3B

PNL-10061
AD-902

Pacific Northwest Laboratory Facilities Radionuclide Inventory Assessment CY 1992-1993

M. J. Sula
S. J. Jette

September 1994

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

Battelle

PNL-10061

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 Battelle Memorial Institute, nor any of their employees, makes **any warranty, expressed 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, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE MEMORIAL INSTITUTE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RLO 1830

Printed in the United States of America

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; prices available from (615) 576-8401. FTS 626-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.


The contents of this report were printed on recycled paper

3 3679 00054 1427

PNL-10061
AD-902

Pacific Northwest Laboratory Facilities Radionuclide Inventory Assessment CY 1992-1993

M. J. Sula
S. J. Jette

September 1994

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Richland, Washington 99352

Summary

Assessments for evaluating compliance with airborne radionuclide emission monitoring requirements in the National Emission Standards for Hazardous Air Pollutants (NESHAPs - U.S. Code of Federal Regulations, Title 40 Part 61, Subparts H and I) were performed for 33 buildings at the U.S. Department of Energy's (DOE) Pacific Northwest Laboratory on the Hanford Site, and for five buildings owned and operated by Battelle, Pacific Northwest Laboratories in Richland, Washington.

The assessments were performed using building radionuclide inventory data obtained in 1992 and 1993. Results of the assessments are summarized in Table S.1 for DOE-PNL buildings and in Table S.2 for Battelle-owned buildings.

Based on the radionuclide inventory assessments, four DOE-PNL buildings (one with two emission points) require continuous sampling for radionuclides per 40 CFR 61. None of the Battelle-owned buildings require continuous emission sampling.

Table S.1. Radionuclide NESHAP Assessment Summary: DOE-PNL Hanford Buildings

Building Evaluated	Continuous Emission Sampling Required	Building Evaluated	Continuous Emission Sampling Required
231-Z	No	329	No
242-B/BL	No	329-NMF	No
2718-E	No	331/331-A	No
300-N	No	331-C	No
303-C	No	331-G	No
303-J	No	331-H	No
305-B	No	3708	No
306-W	No	3720	Yes
314	No	3730	No
318/318-Tr4	No	3745	No
318-Tr5	No	3745-B	No
320	No	3746-A	No
323	No	622-R	No
324	Yes[(a)]	622-S	No
325	Yes[(a)]	6652 (ALE)	No
326	No	747	No
327	Yes[(a)]		

(a) Based on 1991 and 1992 facility data. These buildings not reevaluated in 1993.

Table S.2. Radionuclide NESHAP Assessment Summary: Battelle-Owned Buildings in Richland

Building Evaluated	Continuous Emission Sampling Required
530	No
ESB	No
LSL-II	No
MRC	No
RTL	No

Contents

Summary iii

1.0 Introduction 1.1

2.0 Assessment Methods 2.1

2.1 Projections of Annual Release Quantities 2.1

2.1.1 Maximum Receptor Unit Dose Calculation 2.4

2.1.2 Potential Emission Dose Assessment 2.5

2.2 Assessment Documentation 2.5

3.0 References 3.1

Appendix A - Unit Dose Factor Calculations—Emission Sampling Assessments A.1

Appendix B - Building Inventory Assessment Worksheet Summaries B.1

Tables

S.1 Radionuclide NESHAP Assessment Summary: DOE-PNL Hanford Buildings iv

S.2 Radionuclide NESHAP Assessment Summary: Battelle-Owned Buildings in Richland iv

2.1 Radioactive Materials 2.3

2.2 Radionuclide Physical Forms and Potential Release Fractions 2.3

2.3 Location Correction Factors 2.4

1.0 Introduction

The Clean Air Act's National Emission Standard for Hazardous Air Pollutants (NESHAPs - U.S. Code of Federal Regulations, Title 40 Part 61, Subparts H and I), issued in 1989, and the U.S. Department of Energy (DOE) Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T), issued in 1991, require sampling for radionuclide emissions from DOE facilities. Emission points capable of causing a dose to an offsite receptor of greater than 0.1 mrem from unmitigated annual releases must be sampled continuously. All other emission points from locations containing potentially releasable radionuclides must be sampled periodically to verify their radionuclide emission status. In addition, DOE 5400.1 General Environmental Protection Program specifies that any facility where continuous emission sampling is required must document its emission sampling program in a Facility Effluent Monitoring Plan (FEMP).

In response to these requirements, the potential unmitigated offsite receptor dose from each of the Pacific Northwest Laboratory (PNL)[a] operated DOE-owned Hanford building containing radionuclides was evaluated. Initial evaluations were performed in 1991 and, based on the assessments, four buildings were identified where unmitigated emissions could potentially result in an annual offsite maximum receptor dose of 0.1 mrem. These facilities are the 324 Building, the 325 Building, the 327 Building, and the 3720 Building. In accordance with the NESHAP and the DOE regulatory guide, qualifying emission points from these buildings are sampled continuously. Also, in accordance with DOE 5400.1, Facility Effluent Monitoring Plans were prepared for these buildings.[b]

In keeping with the DOE 5400.1 requirement that the effluent monitoring status of DOE facilities be reviewed annually, facility radionuclide assessments were updated in 1992 and 1993. In addition, in 1993, assessments were performed for privately owned Battelle, Pacific Northwest Laboratories facilities in Richland.[c]

(a) Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC06-76RLO 1830.

(b) PNL-MA-660, *Facility Effluent Monitoring Plan for the 324 Facility*. Facilities Management, Pacific Northwest Laboratory, Richland, Washington. November 1991.
PNL-MA-661, *Facility Effluent Monitoring Plan for the 325 Facility*. Facilities Management, Pacific Northwest Laboratory, Richland, Washington. November 1991.
PNL-MA-662, *Facility Effluent Monitoring Plan for the 327 Facility*. Facilities Management, Pacific Northwest Laboratory, Richland, Washington. November 1991.
PNL-MA-663, *Facility Effluent Monitoring Plan for the 3720 Facility*. Facilities Management, Pacific Northwest Laboratory, Richland, Washington. November 1991.

(c) Battelle privately owned facilities are not directly subject to DOE orders or 40 CFR 61 Subpart H NESHAP regulations. These facilities are licensed by the State of Washington.

2.0 Assessment Methods

Requirements for facility air emission sampling are promulgated by the DOE in regulatory guide DOE/EH-0173T and by the EPA in 40 CFR 61 Subparts H and I. These regulations require that all emission units with the potential to emit radioactivity be evaluated. They further require that emission units be continuously sampled if there is the potential for unmitigated releases to cause a dose of 0.1 mrem to a maximum offsite receptor.

To determine if an emission point is subject to the NESHAP requirements, it is evaluated with respect to its potential annual radionuclide emissions under the assumption that pollution control equipment for the emission point does not exist (unmitaged releases), but that facility operations are otherwise normal. Using the potential radionuclide emissions, the committed effective dose equivalent to a maximum exposed offsite receptor from potential annual emissions is calculated and compared to the 0.1 mrem criteria.

2.1 Projections of Annual Release Quantities

Neither the DOE nor the EPA has provided specific guidance for assessing the potential radionuclide emissions from an emission point for the purpose of evaluating sampling criteria, possibly because there exist a variety of assessment methods, dependent on the nature of the emission point to be evaluated. The method that has been used by PNL is based on an evaluation of the radionuclide inventory that is potentially available for release from the emission point.[(a)] The use of an inventory-based assessment method, rather than an approach based on historical past releases (operating experience), is justified for research and development facilities where types and quantities of radionuclides can change from year to year and where there is no guarantee that future releases can be predicted from past experiences.

(a) This method of assessing potential releases based on inventory is similar but not identical to the method described in 40 CFR 61, Appendix D. That method projects facility releases by multiplying the quantity of radionuclide in the facility by a potential release fraction that depends on the physical form of the radionuclide. Method D is specified in 40 CFR 61 for evaluating facility modifications and new construction. The PNL method differs from Method D in several respects. First, Method D includes allowances for emission reduction by emission control devices such as High Efficiency Particulate Air (HEPA) filters. NESHAP assessment criteria specify that potential releases may not be adjusted to account for emission controls; that is, projected releases are unmitigated. Also, Appendix D requires that any radionuclide that boils at 100°C or is heated to ≥100°C be assigned a release fraction of 1.0. Experience at PNL shows that this assumption is unreasonably conservative; radionuclides do not behave as gases unless they are in a gaseous form. Materials that may change state during process are assumed to be in the state that would generate the maximum potential emission.

At PNL, radioactive source and material information is maintained using three separate inventory systems:

- **Nuclear Materials Inventory**—This inventory includes the majority of tritium, uranium, and transuranics in PNL facilities. The inventory includes material in process as well as residual contamination from historical operations in the facility. Inventory quantities are expressed in mass units and are organized according to defined "material balance areas" (MBAs), each having an identified nuclear materials custodian. Custodians update the inventory for their assigned MBA on a monthly basis.[(a)] The Nuclear Materials Inventory is referred to as "Type 3 inventory" category.

- **Composite Radioactive Materials Inventory**—This inventory includes DOE and privately owned radionuclides used as calibration, testing, irradiation, or tracer sources. Most of the radionuclides in this inventory are in "sealed source" form. The integrity of sealed sources is checked on a monthly basis, and the inventory is updated quarterly.[(b)] The Composite Radioactive Materials Inventory is referred to as "Type 2 inventory" category.

- **Facilities Management Radioactive Materials Inventory**—This data base was developed specifically to account for all radioactive material not included in either of the above two inventories (i.e., not included in Type 2 or Type 3 inventories). This category consists primarily of fission product radionuclides including radionuclides in process as well as residual contamination (e.g., in hot cells) from historical operations in the facility. This inventory is updated annually in conjunction with the facility radionuclide assessment process. Inventory data are maintained as part of the NESHAP assessment documentation. The Facilities Management Radioactive Material Inventory is referred to as "Type 1 inventory" category.

For each of these inventories, radioactive materials are identified according to radionuclide, physical form, and quantity. Quantities are expressed either in terms of activity (Ci) or mass (grams). Mixtures of radionuclides may be expressed as radioactive "material types" when the isotopic composition of the mixture can be determined from the type specification. Examples of material types include *natural uranium*, *depleted uranium*, *Hanford 6%(^{240}Pu) plutonium*, etc. Mass to activity conversion factors and assumed radionuclide composition for several of these mixtures of materials are listed in Table 2.1. When *fission product* mixtures are listed in inventories, it is assumed that the mixture is composed of 50% ^{137}Cs and 50% ^{90}Sr. If the material is specified in terms of *alpha* or *beta* activity, the material is assumed to be ^{241}Am (alpha) or ^{90}Sr (beta).

Radionuclides meeting any of the following criteria are exempt from inclusion in the inventory:

- radionuclides present in commercially available building/construction materials

- radionuclides that can be purchased or possessed without a special radioactive materials license

---

(a) The nuclear materials accountability system is described in PNL-MA-5, *Nuclear Materials Control and Accountability*.

(b) The composite radioactive materials inventory database is maintained according to PNL Safeguards Administrative Procedure SAP-38.

Table 2.1. Radioactive Materials

Material	Assumed Radionuclide	Specific Activity (Ci/g)
Depleted Uranium	^{238}U	3.64E-07
Natural Uranium	^{238}U	6.87E-07
U-enriched (<20% ^{235}U)	^{235}U	9.36E-06
U-enriched (<90% ^{235}U)	^{235}U	6.21E-05
Pu (6% ^{240}Pu)	^{239}Pu	8.00E-02
Pu (12% ^{240}Pu)	^{239}Pu	9.60E-02
Pu (24% ^{240}Pu)	^{239}Pu	3.48E-01

- <100 pCi/g alpha activity and <400 pCi/g beta activity.

The radionuclide physical form data supplied by the material custodian is used to assign a potential release fraction to the radionuclide material. Releases are assumed to occur as the result of normal operations (including anticipated process upsets); thus, radionuclides present in sealed sources or in sealed Department of Transportation (DOT) shipping containers are considered to be unavailable for release (i.e., potential release fraction = 0). Table 2.2 lists physical form categories with their associated potential release fractions.

Table 2.2. Radionuclide Physical Forms and Potential Release Fractions

Form	Code	Description	Potential Release Fraction
Gas	G	Nuclide will exceed its boiling point when uncontained, except nuclides in gaseous form in commercial gas cylinders that are not opened may be listed as L.	1
Liquid/ Powder	L	Nuclide will exceed its melting point or be present in particulate form (AMD<100 microns) when uncontained, except liquid and powders in unopened containers may be listed as S.	10^{-3}
Solid	S	Nuclides not meeting conditions for the more dispersible classes.	10^{-6}
Contained	C	Sealed sources or material in sealed, DOT containers except those meeting exempt criteria.	0
Exempt	E	Sealed sources engineered to pass the special form testing specified by the DOT in 40 CFR 173.469 or ANSI N43.6, or sealed in Type B DOT shipping containers.	0

Radioactive material custodians are requested to provide reasonably conservative estimates of radionuclide types and quantities when detailed information on the types and quantities is unavailable or when the inventory data would be too complex or cumbersome to permit its convenient use for calculating potential emission quantities. For example, 100 small vials, each containing less than 1 millicurie total of one or more different beta-emitting radionuclides may be reported simply as "less than 100 millicuries of beta activity." This inventory will be conservatively assumed to be 100 millicuries of ^{90}Sr for assessment purposes.

2.1.1 Maximum Receptor Unit Dose Calculation

The maximum offsite receptor is defined as an individual whose residence location, work location, and lifestyle maximize the dose from airborne pathways. The dose factor calculation is performed using the EPA Clean Air Act compliance code CAP88-PC (Parks 1992) with site specific atmospheric dispersion and environmental transport and uptake parameters as described in Appendix A.

To simplify the assessment process, maximum offsite receptor dose factors for evaluating releases from all 300 Area buildings were calculated assuming a single emission point at the 331 Building, in the southeast corner of the 300 Area. The 331 facility is close to the nearest offsite downwind receptor location (1000 meters east of the 331 Building) and dose factors based on 331 Building releases will overestimate the offsite receptor dose resulting from releases at other 300 Area locations.

Dose factors for emission points outside the 300 Area were calculated by multiplying the 331 Building unit dose factors by a location correction factor to account for differences in source-receptor distance and direction. The location correction factor is the ratio of the atmospheric dispersion coefficient (Chi/Q) for the location of interest to the dispersion coefficient for the 331 Building. The dispersion coefficients were calculated using CAP88-PC as described in Appendix A. Location correction factors are shown in Table 2.3.

Table 2.3. Location Correction Factors

Emission Location	Distance To Receptor (m)	Direction To Receptor	Location Correction Factor[(a)]
331	1000	E	1.0
6652(ALE)	2400	SSE	0.44
RTL	200	N	8.2
ESB	200	S	8.4
LSL-II	200	W	4.8
PSL	200	E	5.0

(a) The location factor is used to correct unit dose factors calculated using the 331 Building release point, for different atmospheric dispersion characteristics for release points outside the 300 Area.

2.1.2 Potential Emission Dose Assessment

Doses from projected radionuclide emissions were calculated by multiplying the quantity of each radionuclide present in the facility by its associated potential release fraction, the 331 Building unit dose factor, and the location correction factor. Doses from individual radionuclides were summed to derive the total potential annual emission dose for each facility.

2.2 Assessment Documentation

Radionuclide inventory data was compiled using computerized spreadsheet software. The spreadsheets contain inventory and potential release quantity estimates as well as the calculated potential offsite receptor dose for each building. Assessment summaries are provided in Appendix B of this report. The radionuclides that contribute to 90% or greater of the potential dose are listed in the summaries as "Principal Radionuclides."

3.0 References

Parks, B. S. 1992. *User's Guide for CAP88-PC Version 1.0.* 402-B-92-001, U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas Facility, Las Vegas, Nevada.

Appendix A

Unit Dose Factor Calculations—Emission Sampling Assessments

Appendix A

Unit Dose Factor Calculations—Emission Sampling Assessments

Unit dose factors were calculated for various radionuclides using the EPA compliance code CAP88-PC (Parks 1992). The unit dose factor are multiplied by the radionuclide inventory, the potential release fraction, and the facility location factor and summed over all radionuclides to yield the potential maximum receptor dose.

Unit dose factors were calculated assuming the point of release to be a 10-meter high stack situated at the 331 Building and an offsite receptor 1000 meters east of the release point as described in the attached application report. All environmental transport pathways potentially associated with an airborne radionuclide release were included in the calculation (i.e., air inhalation, air submersion, exposure to deposited radionuclides, uptake of vegetation grown in contaminated soil).

CAP88-PC was also used to calculate Chi/Q dispersion values for emission point locations outside the 300 Area. The ratio of the Chi/Q for the non-300 Area source to the 331 Building Chi/Q established the location modification factor used to correct the 331 unit dose factors for other source-receptor combinations. Since receptors in some of the non-300 Area locations do not consume foodstuffs grown at the receptor location, the use of the 331 Building unit dose factor (which includes foodstuff pathways) may grossly overestimate the dose.

Reference

Parks, B. S. 1992. *User's Guide for CAP88-PC Version 1.0.* 402-B-92-001. U.S. Environmental Protection Agency, Office of Radiation Programs, Las Vegas Facility, Las Vegas, Nevada.

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

Document reviewed (include title or description of calculation, document number, author, and date, as applicable):

CAP88-PC Dose Conversion Factors for 331 Building

Submitted by: Lissa Sawyer Date Submitted: 3/15/93

Scope of Review:

YES	NO*	N/A		
[x]	[ ]	[ ]	1.	A detailed technical review and approval of the environmental transport and dose calculation portion of the analysis has been performed and documented.
[ ]	[ ]	[x]	2.	Detailed technical review(s) and approval(s) of scenario and release determinations have been performed and documented.
[x]	[ ]	[ ]	3.	HEDOP-approved code(s) were used.
[ ]	[ ]	[x]	4.	Receptor locations were selected according to HEDOP recommendations.
[x]	[ ]	[ ]	5.	All applicable environmental pathways and code options were included and are appropriate for the calculations.
[x]	[ ]	[ ]	6.	Hanford site data were used.
[x]	[ ]	[ ]	7.	Model adjustments external to the computer program were justified and performed correctly.
[x]	[ ]	[ ]	8.	The analysis is consistent with HEDOP recommendations.
[ ]		[x]	9.	Supporting notes, calculations, comments, comment resolutions, or other information is attached. (Use the "Page 1 of X" page numbering format and sign and date each added page.)
[x]	[ ]		10.	**Approval is granted on behalf of the Hanford Environmental Dose Overview Panel.**

* All "NO" responses must be explained and use of nonstandard methods justified.

Kathy Rhoads K Rhoads 3/22/93
HEDOP-Approved Reviewer (Printed Name and Signature) Date

COMMENTS (add additional signed and dated pages if necessary):
Not Applicable

APPLICATION REPORT

1) Project title and number CAP88-PC DOSE CONVERSION FACTORS FOR 331 BUILDING M91738 3/11/93

2) Purpose of application package and relationship to other work:

This series of CAP88-PC runs was produced in order to report the 50-year maximally exposed individual (MI) committed effective dose equivalent (EDE) per Ci released for the 331 Building. These values will be used to demonstrate NESHAPs (National Emissions Standards for Hazardous Air Pollutants) compliance. The GENII computer code was run as a comparison with the CAP88-PC code for Hanford Dose Overview Panel review.

3) List original sources of input data, assumptions and derivations used to obtain it, and justification for its use, as appropriate. (If input information has been previously reviewed, reference the documentation of this review.)

One curie of each radionuclide was assumed to be released from the 331 Building 10 m stack. The maximum Chi/Q was chosen from runs performed for several 300 Area buildings to confirm the location of the MI (1000 m East of the 331 Building). Hanford parameters listed in McCormack et al (1984) were used in place of default CAP88-PC default parameters to better model the Hanford environment.

4) Minor changes made in the software that produced the application run (see section 4.1). N/A

5) Describe interrelationships and dependencies of each application run in the application package.

The EDEs for the CAP88-PC radionuclides were adjusted to represent the value with the contribution from progeny which were grown-in after the release from the facility. The adjustment factors were derived from GENII runs where only the parent is released, and the output includes the doses from the progeny. The adjustment factor was taken by dividing the dose from the parent by the total dose from the parent and progeny. The CAP88-PC value was then divided by the factor to represent the total dose. Where CAP88-PC calculated chains (i.e., Cs-137, Ba-140, Th-232 and U-238) the sum of the progeny were added to the parent, and no adjustment was made.

6) Summarize the overall output of the application package in relation of the purpose stated in item 2 above (including tables and graphs, as appropriate):

Parameter changes are listed in Table 1, maximum off-site chi/Q values for each building are listed with their location in Table 2, and Table 3 presents the 50-year EDE Conversion Factors as calculated by CAP88-PC. Table 4 includes the GENII results.

7) Submitted for ITR by:

Preparer _____ Date 3/20/93

8) Approved for reporting results to sponsor by:

Preparer _____ Date 3/24/93

APPLICATION RECORD LOG

1) Project title and number: CAP88-PC Dose Conversion Factors for 331 Building (M91738)

2) Application Record Log Number	3) Date and Time of Run	4) Software Name (title) and Version	5) computer type operating system compilers/libraries	6) Comments	7) Data input Identifier
Filename (a)	see below	CAP88-PC Ver 1.0	IBM/PS-2	see below	see below

FEMP1 331 H-ZN	03-06-93	1:56p
FEMP2 331 GA-ZR	03-06-93	1:58p
FEMP3 331 NB-IN	03-06-93	2:00p
FEMP4 331 SN-I	03-06-93	2:02p
FEMP5 331 XE-PR	03-06-93	2:05p
FEMP6 331 ND-W	03-06-93	2:06p
FEMP7 331 RE-FR	03-06-93	2:08p
FEMP8 331 RA-PA	03-06-93	2:10p
FEMP9 331 U-PU	03-06-93	2:12p
FEMP0 331 AM-CF	03-06-93	2:13p
9y chiQ 10m	12-15-92	3:42p
331 chiQ 10m 9y	02-16-93	5:15p
320 chiq10m 9y	02-16-93	5:19p
326 chiQ 10m 9y	02-16-93	5:17p
325 chiQ 10m 9y	02-16-93	5:18p
324 chiQ 10m 9y	02-16-93	5:18p
femp1 5y h-zn	03-03-93	12:44p
ESB CHIQ 10M 9Y	03-10-93	5:22p
ESB-R CHIQ 10M 9	03-10-93	5:23p

TITLE File	INH	ING	EXT	EDE (Intnl)	ORGAN D	UNIT	ORG	PTH	NUC	RUN DATE	TIME	SLP	ENVIRONMENTAL EXP PATH (near/ac/pop)	TIME (in/rel/com)
H-Y Femp 331 unit :	5.4E-04	4.8E-03	1.7E-04	5.5E-03	1.4E-02	rem	Bon	Ing	SE79	03/09/93	15:36	FFF	TTTTTTTTTTTFFFFFFFFFFFFF	1 150
Zr-Te Femp 331 uni:	1.7E-03	2.0E-03	1.7E-04	3.9E-03	2.5E-02	rem	Kid	Ing	CD113M	03/09/93	15:20	FFF	TTTTTTTTTTTFFFFFFFFFFFFF	1 150
I-Ta Femp 331 unit:	4.2E-02	6.0E-03	2.0E-04	4.9E-02	7.2E-01	rem	Bon	Inh	SM147	03/09/93	15:25	FFF	TTTTTTTTTTTFFFFFFFFFFFFF	1 150
W-Cf Femp 331 unit:	7.5E+00	3.3E-01	1.7E-04	7.8E+00	1.1E+02	rem	Bon	Inh	TH229	03/09/93	15:33	FFF	TTTTTTTTTTTFFFFFFFFFFFFF	1 150
Progeny 1 331 unit:	6.5E-02	1.2E-03	8.6E-05	6.7E-02	5.4E-01	rem	Lun	Inh	U 238	03/10/93	14:08	FFF	TTTTTTTTTTTFFFFFFFFFFFFF	1 150
Progeny 2 Femp 331:	9.1E-03	4.0E-04	8.4E-06	9.5E-03	1.0E-01	rem	Bon	Inh	CM242	03/09/93	13:45	FFF	TTTTTTTTTTTFFFFFFFFFFFFF	1 150
Progeny 3 331 unit:	1.6E-01	2.2E-02	8.8E-06	1.8E-01	1.6E+00	rem	Bon	Inh	PU242	03/10/93	14:13	FFF	TTTTTTTTTTTFFFFFFFFFFFFF	1 150
Progeny 4 331 unit:	1.6E-01	1.5E-04	5.3E-10	1.6E-01	1.5E+00	rem	Bon	Inh	PU238	03/10/93	14:14	FFF	TTTTTTTTTTTFFFFFFFFFFFFF	1 150

8) Prepared by: Signature [signature] Date 3/20/93

UNIT DOSE CALCULATIONS FOR PNL FACILITY EFFLUENT MONITORING PLANS

L. H. Sawyer March 11, 1991

INTRODUCTION

Dose calculations for chronic unit (1 Ci) radionuclide releases were performed in support of efforts by Pacific Northwest Laboratories (PNL) to satisfy requirements of the U.S. Environmental Protection Agency (EPA) National Emmissions Standards for Hazardous Air Pollutants (NESHAPS) and Department of Energy's Facilities Effluent Monitoring Plan (DOE-FEMP) for PNL facilities in the 300 area of the Hanford site. Atmospheric releases from the 331 Building were modeled for 10 m stack releases. The CAP88-PC (Parks 1993) computer code package was used to model atmospheric releases using Hanford specific default parameters.

METHODS

Standard parameters for Hanford dose calculations (Table 1) were included in the calculations where possible (McCormack, et al 1984). Joint frequency meteorology data were collected from the 300 area weather stations and represent the nine-year average of wind data taken between 1983 and 1991. The calculations used the average annual rainfall and temperatures (i.e., 15.88 cm/y and 12 C, respectively). The location of the maximally exposed individual (MI) was based on the site boundary location having the greatest radionuclide air concentration under average atmospheric conditions. Distances to the site boundary were determined using the Threatened Areas Database (TADS). The maximum chi/q was determined by running tritium calculations for each of the PNL facility buildings and choosing that with the greatest value. The chi/Q values were also determined for selected buildings in the 3000 area.

CAP88-PC input:
Doses were calculated as 50-year committed effective dose equivalents for all internal deposition pathways using the EPA model specified in 40 CFR 61. Default solubility classes were used for all radionuclides in these preliminary calculations. These should be appropriate for most facilities evaluated, except where plutonium or uranium are released in soluble form and contribute substantially to the overall dose from a given facility. Default classes for uranium and plutonium assume these radionuclides are released as insoluble compounds; this will result in a lower overall dose than would be the case if they were released in more soluble form.

GENII Calculations:
The GENII code was also run for Handford Dose Overview Panel (HDOP) review and comparison to the CAP88-PC results. Where possible, the same parameters were entered into the GENII input codes. GENII output includes the dose from radionuclides which have been grown-in by the calculation code. The sum of the grown-in radionuclides were reported with the parent resulting in a total dose per parent Ci released. The percent of the dose contributed by the parent was calculated. This percent was divided into the CAP88-PC results to include the contribution to dose from the progeny.

RESULTS

The 331 building had the highest overall chi/Q value in the 1000 m East sector, as expected (Table 2). Results of the evaluation are presented in Tables 3 and 4, and represent the 50-year committed dose equivalent following a chronic annual release of 1 Ci of each radionuclide. CAP88-PC only calculates ingrowth of progeny radionuclide activities for 4 chains, Cs-137/Ba-137m, Ba-140/La140, Th-232, and U-238. CAP88-PC doses reported in Tables 3 and 4 are for the release of the parent nuclide only, except in the case where very short-lived daughters have been included in the parent dose as noted.

The total dose expected from emissions at a given facility can be obtained by multiplying the release quantity in Ci for each radionuclide by the corresponding unit dose factor in the tables, and summing the contributions for all nuclides in the effluent stream. Please note that doses calculated using the CAP88-PC code are reported in mrem to the maximum individual from an annual release, while those from GENII are reported in rem. Values in the tables have been left in the units reported by each code to avoid transcription errors.

REFERENCES

McCormack, W. D., J. V. Ramsdell, and B. A. Napier. 1984. Hanford Dose Overview Program: Standardized Methods and Data for Hanford Environmental Dose Calculations. PNL-3777, Rev. 1, Pacific Northwest Laboratory, Richland, Washington.

Park, B. S. 1992. User's Guide for CAP88-PC, Version 1.0. United States Environmental Protection Agency, Las Vegas, NV

U. S. Environmental Protection Agency. 1989. National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration. 40 CFR Part 61, Federal Register 54 (240):51654-51715.

Table 1. Parameters Changed from CAP88-PC Default Values to Hanford Specific Values.

Parameter Description	Hanford Specific Value	CAP88-PC Default Value
Inhalation rate of man (cm^3/hr)	9.7E+05	9.176E+05
Fraction of radioactivity on vegetable & produce remaining after washing (-)	1.0	0.5
Ingestion rate of meat [beef and poultry] by MI (kg/yr)	98.	85
Ingestion rate of leafy vegetables by MI (kg/yr)	30.	18
Ingestion rate of milk by MI (L/yr)	270.	112
Ingestion rate of produce [fruit, roots and grains] by MI (kg/yr)	630.	176
Fraction year animals graze on pasture (-)	0.75	0.4
Fraction animals daily feed is pasture grass (-)	1.0	0.43
Removal rate constant - Physical loss by weathering (hr^{-1})	3.0E-3	2.9E-3
Effective surface density of soil, dry weight (Assumes 15 cm plow layer) (kg/m^2)	224.	215.
Fallout interception fraction - Pasture	0.25	0.57
Fallout interception fraction - Vegetable	0.25	0.20
Crop/leafy growing period (hr)	2160.	1440.
Stored feed holdup time (hr)	2400.	2160.
Leafy vegetable holdup time (hr)	24.	336.
Produce holdup time (hr)	120.	336.
Meat holdup time (d)	15.	20.
Milk productivity (kg/m^2)	1.5	0.28
Leafy/produce productivity (kg/m^2)	2.0	0.716
Long-term buildup in Soil (yr)	50	100.
Direction of the MI	13 (East)	Not specified
Distance to the MI (m)	1000	Not specified
Ground surface correction factor	1.0	0.5

Table 2. Chi/Q Values to Nearest Potential School, Residence or Office for Tritium Released From Various PNL Facility Buildings

Building	Maximum ^{3}H Chi/Q (s/m^3)	Distance* (m)	Direction
300 Area			
331	1.769E-6	1000	East
320	1.474E-6	1700	South
324	1.402E-6	1200	East
325	1.190E-6	2000	South
326	1.114E-6	2100	South
3000 Area Nearest School/Residential			
RTL	1.050E-6	1500	East
ESB	1.777E-6	1300	South Southeast
LSL II	9.425E-7	2100	South Southeast
PSL	8.842E-7	2200	South Southeast
3000 Area Nearest Office Building**			
RTL	1.444E-5	200	North
ESB	1.485E-5	200	South
LSL II	8.550E-6	200	West
PSL	8.817E-6	200	East
ALE Reserve			
6652H	7.851E-7	2400	South Southeast

* Distances determined by the Threatened Area Database System (TADS)

** Values included for information only. It is not appropriate to use MI dose factors for individuals located at office buildings. The MI dose factors assume year round occupancy and a backyard garden. Clearly these assumptions do not apply to Hanford Site buildings.

Table 3. CAP88-PC Unit Ci Release Dose Factors to the MI (1000 m East) 331 Building, 10 m Stack With Hanford Parameters, 9 Y Meteorologic Data (Page 1 of 2)

Nuclide	Dose Factor (mrem/y)	Nuclide	Dose Factor (mrem/y)	Nuclide	Dose Factor (mrem/y)
H-3	4.23E-04	RB-90	1.26E-04	SN-126	1.20E+00 (76)
BE-7	4.57E-03	RB-90M	2.87E-04	SB-124	2.24E-01
BE-10	*	SR-89	7.73E-02	SB-125	6.32E-01 (87)
C-11	2.16E-04	SR-90***	4.96E+00 (94)	SB-126	9.32E-02
C-14	5.06E-02	SR-91	1.03E-03	SB-126M	3.32E-04
C-15	**	SR-92	8.13E-04	SB-127	1.45E-02
N-13	1.50E-04	Y-90	1.12E-02	TE-125M	3.56E-02
O-15	3.86E-05	Y-90M	2.70E-04	TE-127	2.01E-04
F-18	3.78E-04	Y-91	9.96E-02	TE-127M	9.34E-02 (93)
NA-22	2.49E+00	Y-91M	1.61E-04	TE-129	7.27E-05
NA-24	4.69E-03	Y-92	6.53E-04	TE-129M	8.81E-02
P-32	5.76E-02	Y-93	1.38E-03	TE-131	1.36E-04
S-35	6.35E-03	ZR-93	3.30E-02	TE-131M	5.35E-03
AR-41	3.46E-04	ZR-95	1.28E-01 (76)	TE-132	1.35E-02
K-40	3.32E+00	NB-93M	2.87E-02	TE-133	1.55E-04
CA-41	2.07E-04	NB-94	1.62E+01	TE-133M	6.41E-04
SC-46	2.72E-01	NB-95	6.57E-02	TE-134	2.27E-04
CR-51	2.29E-03	NB-95M	6.29E-03 (75)	I-122	4.44E-05
MN-54	3.50E-01	NB-97	2.64E-04	I-123	1.40E-03
MN-56	9.13E-04	NB-97M	9.74E-06	I-125	3.33E+00
FE-55	7.02E-03	MO-93	5.72E-02	I-129	5.79E+01
FE-59	1.18E-01	MO-99	5.18E-03 ****	I-130	1.56E-02
CO-57	6.18E-02	TC-97	1.37E-01	I-131	1.75E+00
CO-58	1.22E-01	TC-99	6.33E-01	I-132	3.08E-03
CO-60	5.11E+00	TC-99M	9.51E-05	I-133	1.27E-02
NI-59	8.27E-03	TC-101	5.93E-05	I-134	1.43E-03
NI-63	1.05E-02	RU-97	1.66E-03	I-135	5.61E-03
NI-65	3.66E-04	RU-103	5.10E-02	XE-122	1.88E-05
CU-64	3.45E-04	RU-105	6.83E-04	XE-123	1.67E-04
ZN-65	4.42E-01	RU-106	4.83E-01	XE-125	6.92E-05
ZN-69	2.77E-05	RH-103M	3.50E-06	XE-127	7.27E-05
ZN-69M	9.16E-04	RH-105	9.59E-04	XE-131M	2.65E-06
GA-67	1.69E-03	RH-105M	1.95E-07	XE-133	9.75E-06
AS-76	3.13E-03	RH-106	3.85E-07	XE-133M	8.52E-06
SE-79	*	PD-107	8.71E-03	XE-135	6.85E-05
BR-82	6.46E-03	PD-109	7.80E-04	XE-135M	7.58E-05
BR-83	2.80E-06	AG-109M	2.21E-08	XE-137	1.39E-05
BR-84	4.73E-04	AG-110	2.66E-08	XE-138	2.14E-04
BR-85	3.72E-06	AG-110M	9.82E-01	CS-134	2.18E+00
KR-83M	6.22E-08	AG-111	1.98E-02	CS-134M	2.99E-05
KR-85	9.42E-07	CD-113	*	CS-135	1.19E-01
KR-85M	4.38E-05	CD-113M	*	CS-136	9.01E-02
KR-87	2.27E-04	CD-115	5.35E-03	CS-137	5.02E+00 ****
KR-88	6.08E-04	CD-115M	1.47E-01	CS-138	6.41E-04
KR-89	1.22E-04	IN-113M	1.09E-04	CS-139	4.58E-05
KR-90	3.32E-06	IN-115	2.07E+00	BA-133	1.54E+00
RB-86	7.38E-02	IN-115M	1.60E-04	BA-133M	8.80E-04
RB-87	2.69E-01	SN-113	4.70E-02 (87)	BA-137M	2.92E-05
RB-88	1.72E-04	SN-123	1.05E-03	BA-139	9.34E-05
RB-89	4.23E-04	SN-125	5.86E-02	BA-140	8.05E-02 ****

Table 3. CAP88-PC Unit Ci Release Dose Factors to the MI (1000 m East) 331 Building, 10 m Stack With Hanford Parameters, 9 Y Meteorologic Data
(Page 2 of 2)

Nuclide	Dose Factor (mrem/y)	Nuclide	Dose Factor (mrem/y)	Nuclide	Dose Factor (mrem/y)
BA-141	1.77E-04	PB-214	3.92E-04	U-237	1.09E-02
BA-142	1.39E-04	BI-210	1.02E-01	U-238	6.40E+01 ****
LA-140	9.50E-03	BI-211	7.59E-05	U-240	1.19E-03
LA-141	1.91E-05	BI-212	1.41E-02	NP-237	2.71E+02
LA-142	9.68E-04	BI-213	5.31E-04	NP-238	1.79E-02
CE-141	2.78E-02	BI-214	4.55E-04	NP-239	3.46E-03
CE-143	2.86E-03	PO-210	2.12E+01	NP-240	3.98E-04
CE-144	3.81E-01	PO-212	**	NP-240M	4.38E-05
PR-143	2.53E-02	PO-213	**	PU-236	4.55E+01
PR-144	3.17E-05	PO-214	**	PU-238	1.85E+02
PR-144M	1.28E-05 (58)	PO-215	**	PU-239	2.00E+02
ND-147	2.24E-02	PO-216	**	PU-240	2.00E+02
PM-147	2.84E-02	PO-218	5.19E-06	PU-241	3.26E+00
PM-148	3.01E-02	AT-217	**	PU-242	1.90E+02
PM-148M	2.07E-01 (97)	RN-219	4.81E-18	PU-243	1.18E-04
PM-149	3.28E-03	RN-220	6.94E-06	PU-244	1.89E+02
PM-151	6.14E-04	RN-222	*	AM-241	2.94E+02
SM-147	3.65E+01	FR-221	6.42E-04	AM-242	2.87E-02 (97)
SM-151	1.80E-02	FR-223	9.24E-04	AM-242M	2.84E+02
SM-153	2.17E-03	RA-223	6.75E+00	AM-243	2.94E+02
EU-152	4.98E+00	RA-224	2.09E+00	CM-242	9.36E+00
EU-152M	2.36E-04	RA-225	4.84E+00	CM-243	1.97E+02
EU-154	4.06E+00	RA-226	1.75E+01	CM-244	1.55E+02
EU-155	1.71E-01	RA-228	8.09E+00	CM-245	3.04E+02
EU-156	7.59E-02	AC-225	3.20E+00	CM-246	3.01E+02
GD-152	*	AC-227	3.38E+02	CM-247	2.79E+02
TB-160	1.64E-01	AC-228	3.97E-02	CM-248	1.11E+03
HO-166	2.14E-03	TH-227	5.65E+00	CF-252	8.09E+01
HO-166M	1.62E+01	TH-228	1.19E+02		
HF-181	7.15E-02	TH-229	3.34E+02		
W-181	9.69E-03	TH-230	1.21E+02		
W-185	1.52E-02	TH-231	5.60E-04		
W-187	1.14E-03	TH-232	1.98E+02 ****		
RE-187	6.57E-04	TH-234	1.02E-01		
IR-192	1.41E-01	PA-231	2.73E+02		
HG-203	4.51E-02	PA-233	3.58E-02		
TL-207	1.39E-06	PA-234	1.71E-03		
TL-208	2.25E-04	PA-234M	3.17E-07		
TL-209	9.07E-05	U-232	2.51E+02		
PB-209	4.53E-05	U-233	7.27E+01		
PB-210	6.41E+01 ****	U-234	7.19E+01		
PB-211	3.65E-03	U-235	6.85E+01		
PB-212	7.78E-02	U-236	6.80E+01		

* Dose factors not included in CAP88-PC.
** Nuclide half-life too short to produce a dose.
*** Value adjusted to include dose from grown-in progeny. CAP88-PC value divided by percent contribution from the parent derived from GENII.
**** Includes dose from short-lived progeny.

Table 4. GENII Unit Ci Release Effective Dose Equivalent Factors to the MI (1000 m East) from 331 Building, Chronic Release, 9 Y Meteorlogic Data. Values in Parenthesis Indicate the Parent's Contribution to the Total Chain Decay Dose Reported.

Nuclide	Dose Factor (rem/y)	Nuclide	Dose Factor (rem/y)		Nuclide	Dose Factor (rem/y)	
H 3	5.2E-07	SR 87M	1.5E-07		AG 110M	5.2E-04	
BE 7	3.0E-07	RB 87	4.7E-05		AG 111	2.5E-05	
BE 10	2.1E-04	KR 88	8.5E-07		CD 109	1.2E-04	
C 14	1.1E-04	RB 88	3.6E-07		CD 113M	1.7E-03	
N 13	3.3E-07	KR 89	2.9E-07		CD 115M	8.1E-05	
F 18	5.5E-07	RB 89	8.5E-07		CD 115	3.1E-06	
NA 22	4.6E-04	SR 89	2.9E-05		IN 115M	2.4E-07	
NA 24	3.0E-06	KR 90	1.4E-09		IN 111	7.8E-07	
SI 31	1.2E-07	RB 90M	7.0E-07		IN 114M	6.0E-05	
P 32	4.6E-05	RB 90	3.2E-07		SN 113	2.1E-05	(87)
P 33	6.3E-06	SR 90	8.9E-04	(94)	IN 113M	1.2E-07	
S 35	1.1E-05	Y 90	6.8E-06		SN 117M	6.6E-06	
CL 36	2.2E-04	RB 86	4.1E-05		SN 119M	9.8E-06	
K 40	2.4E-04	SR 85	9.8E-06		SN 121M	1.9E-05	(79)
AR 39	1.0E-10	SR 91	8.1E-07		SN 121	3.4E-07	
AR 41	4.9E-07	Y 91M	2.9E-07		SN 123	5.1E-05	
CA 41	1.2E-05	Y 91	4.8E-05		SN 125	2.2E-05	
CA 45	2.6E-05	SR 92	9.5E-07		SB 125	3.1E-05	(87)
SC 46	4.9E-05	Y 92	5.8E-07		TE 125M	1.7E-05	
CR 51	5.5E-07	Y 93	1.3E-06		SN 126	2.1E-04	(76)
MN 54	2.7E-05	MO 93	0.0E+00		SB 126M	5.9E-07	(100)
MN 56	9.5E-07	ZR 93	4.2E-15		SB 126	2.4E-05	
FE 55	4.7E-06	NB 93M	7.2E-18		SB 122	5.0E-06	
FE 59	2.9E-05	MO 93	7.2E-06		SB 124	5.1E-05	
CO 57	1.0E-05	ZR 93	5.0E-05		SB 127	6.6E-06	
CO 58	2.2E-05	NB 93M	1.8E-05		TE 127M	5.6E-05	(93)
CO 60	2.4E-04	ZR 95	2.9E-05	(76)	TE 127	1.8E-07	
NI 59	1.3E-06	NB 95M	2.8E-06	(75)	TE 129M	4.1E-05	(100)
NI 63	3.5E-06	NB 95	1.1E-05		TE 129	6.7E-08	(100)
NI 65	3.7E-07	ZR 97	2.4E-06		TE 123M	3.6E-05	
CU 64	2.1E-07	NB 97M	3.0E-07		TE 131M	4.6E-06	
ZN 65	3.1E-04	NB 97	3.8E-07		TE 131	2.2E-07	
ZN 69M	7.8E-07	NB 94	2.7E-04		I 131	2.1E-05	
ZN 69	2.8E-08	MO 99	2.2E-06		XE 131M	3.3E-12	
GA 72	2.5E-06	TC 99M	9.7E-08		TE 132	7.5E-06	
AS 76	2.6E-06	TC 99	8.9E-05		I 132	9.7E-07	
SE 75	9.1E-04	TC 101	1.4E-07		TE 133M	1.1E-06	
SE 79	1.7E-03	RU 103	1.3E-05	(100)	TE 133	3.8E-07	
BR 82	1.7E-05	PD 103	2.9E-06		I 133	1.8E-07	
BR 83	5.7E-08	RH 103M	2.8E-09		XE 133M	4.9E-12	
KR 83M	1.2E-10	RU 105	6.4E-07		XE 133	1.0E-10	
BR 84	7.9E-07	RH 105	1.0E-06		I 129	2.2E-02	
KR 85M	5.4E-08	RU 106	3.5E-04		I 131	1.3E-03	
KR 85	1.1E-09	PD 107	7.9E-06		XE 131M	3.5E-09	
KR 87	3.8E-07	PD 109	8.3E-07		I 132	1.4E-06	

Table 4. GENII Unit Ci Release Effective Dose Equivalent Factors to the MI (1000 m East) from 331 Building, Chronic Release, 9 Y Meteorlogic Data. Values in Parenthesis Indicate the Parent's Contribution to the Total Chain Decay Dose Reported.

Nuclide	Dose Factor (rem/y)		Nuclide	Dose Factor (rem/y)		Nuclide	Dose Factor (rem/y)	
I 133	2.1E-05		EU 155	2.9E-05		U 237	4.3E-06	
XE 133M	1.3E-08		EU 156	2.2E-05		NP 237	3.7E-01	
XE 133	2.1E-08		GD 153	1.7E-05		PA 233	2.5E-05	
TE 134	4.1E-07		GD 159	4.4E-07		U 233	7.4E-02	
I 134	1.3E-06		TB 160	3.8E-05		TH 229	9.6E-01	
I 125	2.3E-03		TB 161	3.8E-06		RA 225	4.9E-03	
CS 134M	3.4E-08		DY 165	8.4E-08		AC 225	4.9E-03	
CS 134	7.9E-04		HO 166M	4.8E-04		U 238	6.5E-02	(100)
I 130	6.0E-06		HO 166	2.0E-06		TH 234	4.1E-05	(100)
I 135	2.0E-06		ER 169	2.5E-06		PA 234	1.3E-06	
XE 135M	1.8E-07		ER 171	4.8E-07		AM 242M	2.4E-01	
XE 135	1.5E-07		TA 182	5.4E-05		AM 242	3.2E-05	(97)
CS 135	8.1E-05		W 181	2.3E-06		CM 242	9.4E-03	(100)
XE 137	4.5E-08		W 185	9.1E-06		PU 242	1.6E-01	
CS 137	5.8E-04		W 187	6.9E-07		NP 238	2.5E-05	
XE 138	4.2E-07		RE 187	8.6E-08		PU 238	1.6E-01	
CS 138	1.1E-06		OS 185	5.8E-06		CM 244	1.4E-01	
CS 139	1.0E-07		OS 191	1.4E-06		PU 244	1.6E-01	
BA 139	1.1E-07		IR 192	3.6E-05		U 240	2.5E-05	
BA 140	2.6E-05	(50)	HG 203	6.3E-05		PU 240	1.7E-01	
LA 140	3.9E-06		TH 230	1.4E-01		CM 245	2.6E-01	
CS 136	3.6E-05		RA 226	7.9E-03		PU 241	2.7E-03	
BA 141	3.5E-07		RN 222	4.4E-05		AM 241	2.5E-01	
LA 141	3.6E-07		PB 210	2.6E-02		CM 246	2.7E-01	
CE 141	1.0E-05		BI 210	1.4E-04		CM 247	2.4E-01	
BA 142	3.0E-07		PO 210	1.3E-02		CM 243	1.8E-01	
LA 142	1.4E-06		PU 236	7.4E-02		PU 243	1.6E-06	
CE 143	2.3E-06		U 232	3.6E-01		AM 243	2.5E-01	
PR 143	1.0E-05		TH 232	6.5E-01		NP 239	1.6E-05	
CE 144	2.7E-04	(100)	RA 228	5.2E-03		PU 239	1.7E-01	
PR 144M	1.4E-08	(58)	AC 228	1.0E-04		CM 248	9.5E-01	
PR 144	3.6E-08		TH 228	1.9E-01		CF 252	7.9E-02	
PR 142	1.8E-06		RA 224	2.2E-03				
ND 147	8.0E-06		PB 212	3.2E-04				
PM 147	2.6E-05		BI 212	5.9E-05				
SM 147	4.2E-02		U 234	7.3E-02				
PM 148M	3.9E-05	(97)	U 236	6.9E-02				
PM 148	1.2E-05		U 235	6.8E-02				
PM 149	2.2E-06		TH 231	5.0E-06				
PM 151	1.3E-06		PA 231	5.2E-01				
SM 151	1.8E-05		AC 227	7.6E-01				
SM 153	1.4E-06		TH 227	9.1E-03				
EU 152M	6.1E-07		FR 223	4.2E-06				
EU 152	1.7E-04		RA 223	5.3E-03				
EU 154	2.2E-04		PU 237	2.1E-06				

Appendix B

Building Inventory Assessment Worksheet Summaries

Appendix B

Building Inventory Assessment Worksheet Summaries

Contents	Page
PNL-Hanford Buildings	
231-Z	B.2
242-B/BL	B.3
2718-E	B.4
300-N	B.5
303-C	B.6
303-J	B.7
305-B	B.8
306-W	B.9
314	B.10
318 & 318 Tr4	B.11
318 Tr5	B.12
320	B.13
323	B.14
324	B.15
325	B.16
326	B.17
327	B.18
329	B.19
329-NMF	B.20
331 & 331-A	B.21
331-C	B.22
331-G	B.23
331-H	B.24
3708	B.25

Contents	Page
PNL-Hanford Buildings (contd)	
3720	B.26
3730	B.27
3745	B.28
3745-B	B.29
3746-A	B.30
622-R	B.31
622-S	B.32
6652 (ALE)	B.33
747A	B.39
Battelle-Private Buildings	
530	B.34
ESB	B.35
LSL-II	B.36
MRC	B.37
RTL	B.38

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 231-Z
Managing Center: Material & Chemical Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	5.8E-8
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	4.7E-3
Total	4.7E-3

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{241}Am	Solid	2.9 g	2.8E-3	60%	60%
Pu (6% ^{240}Pu)	Solid	70 g	1.1E-3	23%	83%
Pu (12% ^{240}Pu)	Solid	42.5 g	8.2E-4	17%	~100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 242-B/BL
Managing Center: Facilities and Operations
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	<0.1
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	<0.1

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{137}Cs	Solid	<300 Ci	<0.1	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 2718-E
Managing Center: Material & Chemical Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.2E-8
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	1.2E-8

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{239}Pu	Solid	6.0E-5 g	1.2E-8	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 300 North Burial Ground
Managing Center: Earth & Environmental Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	0
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	0

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total

— Sealed Sources Only —

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 303-C
Managing Center: Material & Chemical Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	3.1E-6
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	3.1E-6

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{60}Co	Liquid/ Particulate	6E-4 Ci	3.1E-6	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 303-J
Managing Center: Material & Chemical Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	0
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	0

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total

— Sealed Sources Only —

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 305-B
Managing Center: Facilities & Operations
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	4.8E-7
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	4.8E-7

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{137}Cs	Liquid	5.8E-5 Ci	2.9E-7	60%	60%
^{90}Sr	Liquid	2.7E-5 Ci	1.3E-7	27%	87%
^{129}I	Liquid	1.0E-6 Ci	5.8E-8	10%	97%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 306-W
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.4E-11
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	5.3E-2
Total	5.3E-2

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
U (20% ^{235}U)	Particulate	52 Kg	3.3E-2	62%	62%
^{232}Th	Particulate	813 Kg	1.8E-2	34%	96%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 314
Managing Center: Materials & Chemical Science
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	8.8E-6
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	6.7E-5
Total	7.6E-5

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
U (depleted)	Solid	2900 Kg	6.7E-5	88%	88%
U (natural)	Solid	200 Kg	8.8E-6	12%	~100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 318 & 318 Tr 4
Managing Center: Life Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	2.9E-8
Government and Private Radioactive Source Inventory	2.0E-7
Nuclear Materials Accountability Database	4.2E-5
Total	4.2E-5

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
U (90% ^{235}U)	Liquid	9.6 g	4.1E-5	98%	98%
U (natural)	Solid	26 Kg	1.2E-6	~2%	~100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 318 Tr 5
Managing Center: Life Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	0
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	1.4E-7
Total	1.4E-7

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
U (depleted)	Solid	6 Kg	1.4E-7	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 320
Managing Center: Material & Chemical Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	7.2E-4
Government and Private Radioactive Source Inventory	2.2E-5
Nuclear Materials Accountability Database	5.6E-6
Total	7.5E-4

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{233}U	Liquid	7.7 mCi	5.6E-4	75%	75%
^{238}U	Liquid	0.75 mCi	4.8E-5	6%	81%
^{241}Am	Solid	0.15 Ci	4.4E-5	6%	87%
^{227}Ac	Liquid	7.0E-5 Ci	2.4E-5	3%	90%
^{36}Cl	Liquid	0.1 Ci	2.3E-5	3%	93%
^{125}I	Liquid	5 mCi	1.7E-5	2%	95%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 323
Managing Center: Material & Chemical Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.1E-4
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	1.1E-4

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{60}Co	Solid	10 Ci	5.1E-5	46%	46%
^{181}Hf	Solid	519 Ci	3.7E-5	34%	80%
^{58}Co	Solid	159 Ci	1.9E-5	17%	97%

Pacific Northwest Laboratory
1992 Radionuclide Inventory Assessment

Building: 324
Managing Center: Process Technology
Effective Inventory Date: June 1992

Assessment Summary

Potential Inventory Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	97.7
Government and Private Radioactive Source Inventory	1.9
Nuclear Materials Accountability Database	33.7
Total	133

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{90}Sr	Liquid/ Particulate	4.7E+4 Ci	52.4	39%	39%
^{137}Cs	Liquid/ Particulate	7.3E+4 Ci	35.3	27%	66%
^{238}Pu	Liquid/ Particulate	6.7 g	23.6	18%	84%
Pu (12% ^{240}Pu)	Liquid/ Particulate	277 g	5.9	4%	88%
^{90}Sr	Solid	4.3E+6 Ci	4.7	4%	92%
^{137}Cs	Solid	6.8E+6 Ci	3.2	2%	94%
^{239}Pu	Liquid/ Particulate	9.2 Ci	2.0	2%	96%
Pu (24% ^{240}Pu)	Solid	2.68E+4 g	2.1	2%	98%
^{244}Cm	Solid	72 Ci	1.1	1%	99%

Pacific Northwest Laboratory
1992 Radionuclide Inventory Assessment

Building 325
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: June 1992

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	4.3
Government and Private Radioactive Source Inventory	0.001
Nuclear Materials Accountability Database	125
Total	129

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{238}Pu	Particulate	23.3 g	57.9	45%	45%
^{244}Cm	Particulate	3.0 g	44.1	34%	79%
Pu (6% ^{240}Pu)	Particulate	680 g	12.0	9%	88%
Pu (12% ^{240}Pu)	Particulate	290 g	6.2	5%	93%
^{241}Am	Particulate	1.7 g	1.8	1%	94%
^{90}Sr	Particulate	400 Ci	1.6	1%	95%
^{3}H	Particulate	710 Ci	1.2	1%	96%
Pu (24% Pu)	Particulate	14 g	1.1	1%	97%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 326
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.1E-4
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	1.1E-4

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{90}Sr	Particulate	10 mCi	5.0E-5	45%	45%
^{137}Cs	Particulate	10 mCi	5.0E-5	45%	90%
^{60}Co	Solid	0.7 Ci	3.6E-6	3%	93%
^{54}Mn	Solid	3.7 Ci	1.3E-6	1%	94%

Pacific Northwest Laboratory
1992 Radionuclide Inventory Assessment

Building: 327
Managing Center: Process Technology
Effective Inventory Date: June 1992 (Amended March '94 for Project 21303)

Assessment Summary

Potential Inventory Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	8.4E-1
Government and Private Radioactive Source Inventory	3.3E-11
Nuclear Materials Accountability Database	2.5E+1
Total	2.6E+1

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{238}Pu	Particulate	7.2 g	2.5E+1	92%	92%
^{137}Cs	Solid	1.1E+6 Ci	5.1E-1	2%	94%
^{238}Pu	Solid	65.7 g	2.3E-1	1%	95%
^{227}Ac	Liquid	0.7 Ci	2.4E-1	1%	96%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 329
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: October 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	7.5E-3
Government and Private Radioactive Source Inventory	1.4E-2
Nuclear Materials Accountability Database	6.5E-5
Total	2.2E-2

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{244}Cm	Liquid/ Particulate	0.1 Ci	1.6E-2	73%	73%
^{137}Cs	Liquid/ Particulate	0.96 Ci	4.8E-3	22%	95%
^{230}Th	Liquid/ Particulate	3 mg	3.6E-4	2%	97%
^{90}Sr	Liquid/ Particulate	0.05 Ci	2.5E-4	1%	98%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 329-NMF
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.1E-6
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	1.1E-6

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{244}Cm	Solid	7.09 mCi	1.1E-6	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 331 / 331-A
Managing Center: Life Sciences
Effective Inventory Date: June 1993 (Amended March '94 to correct for transfer of I-125 and I-131 from LSL-II in January 1993)

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	2.5E-6
Government and Private Radioactive Source Inventory	3.5E-2
Nuclear Materials Accountability Database	3.0E-3
Total	3.8E-2

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{170}Tm	Liquid/ Particulate	7 Ci	3.5E-2	92%	92%
^{239}Pu	Liquid/ Particulate	0.23 g	2.9E-3	8%	~100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 331-C
Managing Center: Life Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	9.6E-5
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	9.6E-5

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{239}Pu	Liquid / Particulate	0.3 mg	6.0E-5	63%	63%
^{238}Pu	Liquid / Particulate	0.2 mg	3.6E-5	37%	~100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 331-G
Managing Center: Life Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	6.6E-7
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	6.6E-7

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{210}Pb	Solid	5 mCi	3.2E-7	48%	48%
^{90}Sr	Solid	50 mCi	2.5E-7	38%	86%
^{226}Ra	Solid	5 mCi	8.8E-8	13%	99%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 331-H
Managing Center: Life Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.5E-11
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	1.5E-11

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{210}Po	Solid	7.0E-7 Ci	1.5E-11	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 3708
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	3.4E-5
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	3.4E-5

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{241}Am	Liquid	5.0E-5 Ci	1.5E-5	44%	44%
^{241}Am	Solid	1.9E-2 Ci	5.6E-6	16%	60%
^{137}Cs	Particulate	1 mCi	5.0E-6	14%	74%
^{90}Sr	Particulate	1 mCi	5.0E-6	14%	88%
^{237}Np	Particulate	5 uCi	1.4E-6	4%	92%
^{239}Pu	Particulate	5 uCi	1.0E-6	3%	95%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 3720
Managing Center: Earth & Environmental Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.8E-4
Government and Private Radioactive Source Inventory	3.9E-11
Nuclear Materials Accountability Database	7.7E-1
Total	7.7E-1

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{241}Am	Liquid/ Particulate	0.5 g	0.47	61%	61%
^{238}Pu	Liquid/ Particulate	0.06 g	0.19	25%	86%
^{243}Am	Liquid/ Particulate	1.1 g	0.06	8%	94%
^{239}Pu	Liquid/ Particulate	3.2 g	0.04	5%	99%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 3730
Managing Center: Materials & Chemical Science
Effective Inventory Date: October 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	3.0E-4
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	3.0E-4

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{54}Mn	Solid	420 Ci	1.5E-4	50%	50%
^{60}Co	Solid	16 Ci	8.2E-5	27%	77%
^{181}Hf	Solid	519 Ci	3.7E-5	12%	89%
^{58}Co	Solid	159 Ci	1.9E-5	6%	95%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 3745
Managing Center: Material & Chemical Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.3E-7
Government and Private Radioactive Source Inventory	1.2E-10
Nuclear Materials Accountability Database	1.3E-2
Total	1.3E-2

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{244}Cm	Solid	1.0 g	1.3E-2	~ 100%	~ 100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 3745-B
Managing Center: Life Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	4.2E-8
Government and Private Radioactive Source Inventory	2.9E-11
Nuclear Materials Accountability Database	0
Total	4.2E-8

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{3}H	Solid	100 Ci	4.2E-8	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 3746-A
Managing Center: Life Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	6.8E-6
Government and Private Radioactive Source Inventory	5.9E-10
Nuclear Materials Accountability Database	0
Total	6.8E-6

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{125}I	Liquid	1 mCi	3.3E-6	49%	49%
^{14}C	Liquid	2.6E-3 mCi	2.6E-6	38%	87%
^{32}P	Liquid	15 mCi	8.6E-7	13%	~100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 622-R
Managing Center: Earth & Environmental Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	0
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	0

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total

— Sealed Sources Only —

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 622 - S
Managing Center: Earth & Environmental Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	0
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	0

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total

— Sealed Sources Only —

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 6652 (ALE)
Managing Center: Earth & Environmental Sciences
Effective Inventory Date: June 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.1E-7
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	1.3E-4
Total	1.3E-4

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
U (depleted)	Particulate	12.5 Kg	1.3E-4	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 530
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	1.8E-9
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	1.8E-9

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{85}Kr	Gas Cylinder	236 Ci	1.8E-9	100%	100%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: ESB
Managing Center: Life Sciences
Effective Inventory Date: August 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	3.1E-9
Government and Private Radioactive Source Inventory	2.5E-12
Nuclear Materials Accountability Database	0
Total	3.1E-9

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{238}U	Solid	4.4E-6 Ci	2.3E-9	74%	74%
^{137}Cs	Solid	1.3E-5 Ci	5.3E-10	17%	91%
^{60}Co	Solid	2.5E-6 Ci	1.1E-10	3%	94%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: LSL-II
Managing Center: Life Sciences
Effective Inventory Date: August 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	9.0E-2
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	1.9E-4
Total	9.0E-2

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{226}Ra	Liquid	1.0 g	8.8E-2	98%	98%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: MRC
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	0
Government and Private Radioactive Source Inventory	0
Nuclear Materials Accountability Database	0
Total	0

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total

— Sealed Sources Only —

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: RTL
Managing Center: Materials & Chemical Sciences
Effective Inventory Date: August 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	3.7E-4
Government and Private Radioactive Source Inventory	2.8E-6
Nuclear Materials Accountability Database	2.2E-5
Total	4.0E-4

Principal Radionuclides

Nuclide	Form	Estimated Inventory Quantity	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{137}Cs	Liquid	4.6E-3 Ci	1.9E-4	48%	48%
^{60}Co	Liquid	3.1E-3 Ci	1.3E-4	33%	81%
^{14}C	Liquid	18 mCi	1E-5	3%	84%
^{134}Cs	Liquid	0.36 mCi	6.4E-6	2%	86%

Pacific Northwest Laboratory
1993 Radionuclide Inventory Assessment

Building: 747-A
Managing Center: Life Sciences
Effective Inventory Date: July 1993

Assessment Summary

Potential Inventory	
Inventory Type	Dose (mrem/y)
Effluent Monitoring Program Inventory	3.1E-9
Government and Private Radioactive Source Inventory	1.0E-8
Nuclear Materials Accountability Database	0
Total	1.3E-8

Principal Radionuclides

Nuclide	Form	Estimated Inventory	Potential Emission Dose (mrem)	Percent of Total Dose	Cumulative Percent of Total
^{241}Am	Solid	1.6E-5 Ci	4.6E-9	35%	35%
^{239}Pu	Solid	2.1E-5 Ci	4.1E-9	32%	67%
^{60}Co	Liquid/ Particulate	3.3E-7 Ci	1.7E-9	13%	80%
^{238}Pu	Solid	7.5E-6 Ci	1.4E-9	11%	91%
^{137}Cs	Liquid/ Particulate	12.6E-7 Ci	1.3E-9	10%	~100%

Distribution

No. of Copies

Offsite

12 DOE/Office of Scientific and Technical Information

Onsite

2 **DOE Richland Operations Office**

E. M. Bowers, K8-50
S. D. Stites, A5-15

2 **Westinghouse Hanford Company**

W. E. Davis, H6-20
L. P. Diediker, T1-30

No. of Copies

34 **Pacific Northwest Laboratory**

C. M. Andersen, K7-34
M. Y. Ballinger, P7-68
E. G. Damberg, P7-68
L. R. Eberhardt, P7-68
M. F. Gillis, K1-50
T. M. Graham, P7-79
D. P. Higby, P7-78
G. R. Hoenes, P7-79
A. S. Ikenberry, P7-68
S. J. Jette, P7-68 (5)
H. E. Kjarmo, K2-22
S. K. Loverne, P7-18
R. G. Riley, K6-96
B. D. Robertson, P7-35
M. S. Sula, SEQUI MSLTRL 1/9 (5)
H. T. Tilden, P7-79
J. W. Wald, K2-22
M. A. Williams, P7-60
R. K. Woodruff, P7-68
V. A. Young, P7-79
Publishing Coordination
Technical Report Files (5)