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Rev. 0

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Cleanup Verification Package for the D and DR Group 2 North Pipelines (100-D-48:1/49:1), 100-D-19 Sludge Trench, and UPR-100-D-4 Unplanned Release Site

Prepared for the U.S. Department of Energy by Bechtel Hanford, Inc.

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EXECUTIVE SUMMARY

E1.0 INTRODUCTION

This cleanup verification package (CVP) documents completion of remedial action for a portion of the 100-D and 100-DR Group 2 Pipelines, the 100-D-19 Sludge Trench, and the UPR-100-D-4 unplanned release site. The 100-D and 100-DR Group 2 Pipeline segments addressed in this CVP include 100-D and 100-DR Reactor cooling water effluent pipelines located to the north of the 116-DR-9 and 116-D-7 Retention Basins. These pipeline segments have Waste Information Data System identifiers 100-D-48:1 (100-D Reactor pipelines) and 100-D-49:1 (100-DR Reactor pipelines). The 100-D-19 Sludge Trench was used for disposal of sludge excavated from the bottom of the 116-D-7 Retention Basin. The UPR-100-D-4 unplanned release site is associated with a leak from the 116-D-7 Retention Basin. The combined sites (pipelines, 100-D-19, and the unplanned release site) are referred to throughout this CVP as the 100-D-48:1/49:1 Pipelines site. The 100-D-48:1/49:1 Pipelines site is located within the 100-DR-1 Operable Unit in the 100 Areas of the Hanford Site in southeastern Washington State.

Remedial action objectives and goals for the 100-D-48:1/49:1 Pipelines site were established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U.S. Department of Energy, Richland Operations Office. These goals and objectives are documented in the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (ROD) (EPA 1995) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 1998b).

The selected remedial action for the 100-D-48:1/49:1 Pipelines site included (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Areas of the Hanford Site, and (3) backfilling the site with clean soil to average adjacent grade elevation. Excavation was driven by remedial action objectives for direct exposure, protection of groundwater, and protection of the

Columbia River. For the respective points of compliance, remedial action goals (RAGs) were established to identify radionuclide and nonradionuclide contaminants of concern (COCs) and contaminants of potential concern (COPCs). Waste site COCs and COPCs identified though process knowledge are listed in the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 1998a). Additional COCs and COPCs specific to 100-D-19 (indicated below) were identified during remedial action based on analogous site information (i.e., other sludge burial sites). The COCs and COPCs identified for these combined sites consist of the following:

COCs

Americium-241 (100-D-19)
Cobalt-60
Cesium-137
Europium-152
Europium-154
Nickel-63 (100-D-19)
Plutonium-239/240
Strontium-90
Uranium-233/234
Uranium-238
Hexavalent chromium (Cr^{+6})
Mercury (100-D-19)

COPCs

Polychlorinated biphenyls (PCBs) (100-D-19)

The COPC PCBs were not detected in the cleanup verification samples from the 100-D-19 Sludge Trench and are therefore not addressed further in this document. Total PCB cleanup verification sample results are included in Table A-3. The PCB analyses met detection limit requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 1998a).

E2.0 RESULTS

Site excavation and waste disposal are complete, and the exposed surfaces have been sampled and analyzed to verify attainment of the RAGs. At the completion of the remedial action, the total excavation was approximately 15,504 m^2 (166,800 ft^2) in area with a maximum depth of approximately 6.0 m (20 ft) below ground surface. Approximately 107,266 metric tons (118,241 tons) of material from the D Area pipelines sites have been disposed of at the Environmental Restoration Disposal Facility through July 2000.

Results of the sampling, laboratory analyses, and data evaluations for the 100-D-48:1/49:1 Pipelines site indicate that all remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met (see Table ES-1). The following sections discuss these results.

E2.1 DIRECT EXPOSURE SOIL CLEANUP STANDARDS

E2.1.1 Radionuclides

The Interim Action ROD (EPA 1995), developed in compliance with the National Contingency Plan, expresses the RAG for direct exposure to radionuclides in terms of an allowable radiation dose (i.e., 15 mrem/yr) above background. The total dose rate above background, considering all radionuclide COCs and pathways, was calculated from the RESidual RADioactivity (RESRAD) dose assessment model (ANL 1999). The results indicate that the maximum dose rate above background for a hypothetical residential user would be 3.71 mrem/yr and would occur at present (year 2000); this dose decreases to 3.86×10^{-2} mrem/yr in 1,000 years. The majority of the maximum dose rate is due to cesium-137, europium-152, and europium-154. The estimated total dose rate in the year 2018 is 1.65 mrem/yr. The 2018 date corresponds to the 30-year site cleanup schedule of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1998). Total dose rate estimates never exceed the direct exposure RAG of 15 mrem/yr above background.

Table ES-1. Summary of Cleanup Verification Results for the 100-D-48:1/49:1 Pipelines.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Direct Exposure – Radionuclides	1. Attain 15 mrem/yr dose rate above background over 1,000 years.	1. Maximum dose calculated by RESRAD is 3.71 mrem/yr (not accounting for clean backfill).	Yes	a
Direct Exposure – Nonradionuclides	1. Attain individual COC RAGs.	1. All individual COC concentrations are below the RAGs.	Yes	b
Meet Nonradionuclide Risk Requirements	1. Hazard quotient of <1 for noncarcinogens.	1. All hazard quotients are below 1.	Yes	b
	2. Cumulative hazard index of <1 for noncarcinogens.	2. Cumulative hazard index is 1 x 10^{-3} for noncarcinogens.		b
	3. Excess cancer risk of <1 x 10^{-6} for individual carcinogens.	3. Excess cancer risk for individual carcinogens are all less than 1 x 10^{-6}.		b
	4. Attain a total excess cancer risk of <1 x 10^{-5} for carcinogens.	4. Total excess cancer risk is less than 1 x 10^{-5} for carcinogens.		b
Groundwater/River Protection – Radionuclides	1. Attain single-COC groundwater and river protection RAGs.	1. All single-COC groundwater and river RAGs have been attained.	Yes	c
	2. Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose to target receptor/organs.	2. All organ-specific doses are below the 4 mrem/yr dose limit.		c
	3. Meet National Primary Drinking Water Standards: 15 pCi/L (alpha activity).	3. The alpha activity is 0 pCi/L for all years.		c
	4. Meet total uranium standard of 21.2 pCi/L[h]	4. Isotopic uranium concentrations are below background.		a
Groundwater/River Protection – Nonradionuclides	1. Attain individual nonradionuclide groundwater and river cleanup requirements.	1. All the groundwater and river RAGs have been attained.	Yes	a,b,g
Other supporting Information	1. Sample variance calculations.			d
	2. Sample location designs.			e
	3. Deep zone model calculation.			f

[a] *100-D-48:1 100-D-49:1 RESRAD*, 0100D-CA-V0168, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[b] *95% UCL Calculations for 100-D-48:1 and 100-D-49:1*, 0100D-CA-V0183, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[c] *100-D-48:1/49:1 MCL Drinking Water Standards*, 0100D-CA-V0131, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[d] *Group 2 – North Pipeline Sample Variance Calculations*, 0100D-CA-V0075, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[e] *100-D-48:1/49:1 Shallow and Deep Zone Sampling Locations*, 0100D-CA-V0080, Rev. 0, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[f] *100-D-19 Deep Zone Cleanup Verification Model*, 0100D-CA-V0180, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[g] Attainment of hexavalent chromium river protection RAG is based on the hexavalent chromium leach study located in Appendix D of the 116-D-7 CVP (BHI 2000b).
[h] The 21.2 pCi/L uranium limit is calculated based on the National Primary Drinking Water Standard maximum contaminant level of 30 μg/L for uranium promulgated by the U.S. Environmental Protection Agency on December 7, 2000 (65 FR 76708). Concentration-to-activity is documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038 (BHI 2001).

Although the RAG for radionuclides is expressed in terms of radiation dose, the CVP also includes radionuclide excess lifetime cancer risk estimates as additional information. The National Contingency Plan presents a target range for residual risk of 10^{-4} to 10^{-6}. The RESRAD model calculated the total excess cancer risk for radionuclides. Because of radioactive decay, the risk associated with radionuclides decreases over time. Based on RESRAD results, the excess lifetime cancer risk is largest, 3.31×10^{-5}, at present (year 2000), and decreases to 1.03×10^{-7} in 1,000 years. The estimated excess cancer risk due to radionuclides in the year 2018 is 1.68×10^{-5}.

E2.1.2 Nonradionuclides

The nonradionuclides COCs are hexavalent chromium and mercury. All nonradionuclide COC concentrations are below the RAGs for direct exposure.

With respect to noncarcinogenic risk, the individual and cumulative hazard quotients for COCs with noncarcinogenic effects are below the corresponding risk limit (a hazard index of 1.0 in both cases). With respect to carcinogenic risk, the only nonradionuclide carcinogenic COC is hexavalent chromium. The excess lifetime cancer risk estimate for hexavalent chromium in the shallow zone (0 to 4.6 m [15 ft]) is below the risk limit of 1×10^{-6}.

E2.2 PROTECTION OF GROUNDWATER AND THE RIVER

E2.2.1 Radionuclides

The estimated radionuclide dose via the groundwater and river pathways is below the RAG of 4 mrem/yr for beta and gamma emitters. The RESRAD model predicts that alpha emitters will not reach groundwater within 1,000 years; therefore, they meet the gross particle activity standard of 15 pCi/L. A new National Primary Drinking Water Standard maximum contaminant level of 30 μg/L for total uranium was promulgated by the U.S. Environmental Protection Agency on December 7, 2000 (65 FR 76708). The 30 μg/L maximum contaminant level corresponds to a total uranium activity of

21.2 pCi/L. The concentration-to-activity calculation is documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001). Concentrations of uranium detected in soil are below background; therefore, groundwater and river protectiveness standards for uranium are met. In summary, all radionuclide RAGs for protection of groundwater and the river have been met.

E2.2.2 Nonradionuclides

Based on comparison with groundwater and river protection RAGs, RESRAD modeling, and the 100-D Area hexavalent chromium leach study reported in Appendix D of the 116-D-7 CVP (BHI 2000b), cleanup verification results indicate that residual concentrations of nonradionuclide COCs (i.e., hexavalent chromium and mercury) are protective of groundwater and the river. Application of the hexavalent chromium leach rate study to the North Pipelines site is based on regulatory agency agreement (Ecology et al. 2000).

E3.0 WASTE SITE RECLASSIFICATION

The site meets cleanup standards and has been reclassified as "closed out" in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1998) and the Waste Site Reclassification Guideline TPA-MP-14 (RL-TPA-90-0001) (DOE-RL 1998c). Copies of the waste site reclassification forms for waste sites 100-D-48:1, 100-D-49:1, 100-D-19, and UPR-100-D-4 are included as Attachments ES-1 through ES-4, respectively.

Attachment ES-1

Waste Site Reclassification Form

Date Submitted: 02/22/01 **Originator:** F. M. Corpuz **Phone:** 531-0625	**Operable Unit(s):** 100-DR-1 **Waste Site ID:** D Group 2 North Pipelines (100-D-48:1) **Type of Reclassification Action:** Rejected ☐ **Closed Out** ☒ No Action ☐	**Control Number:** 2000-126 **Lead Agency:** Ecology

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List of no action or closed-out sites will occur at a future date.

Description of current waste site condition:

Remedial action at this site has been performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U.S. Department of Energy, Richland Operations Office. The selected remedial action involves (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Area of the Hanford Site, and (3) backfilling the site with clean soil to adjacent grade elevations. The excavation and disposal activities have been completed.

Basis for reclassification:

The D Group 2 North Pipelines (100-D-48:1) have been remediated to meet the cleanup standards specified in the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units*, Hanford Site, Benton County, Washington, September 1995, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. Remedial actions were performed so as to allow rural-residential use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep) and to protect groundwater and the Columbia River. The basis for reclassification is described in detail in the *Cleanup Verification Package for the D and DR Group 2 North Pipelines (100-D-48:1/49:1), 100-D-19 Sludge Trench, and UPR-100-D-4 Unplanned Release*, CVP-2000-00003, Bechtel Hanford, Inc., Richland, Washington. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required.

Glenn T. Goldberg DOE Project Manager	Signature	3/14/01 Date
Wayne Soper Ecology Project Manager	Signature	3-19-01 Date
N/A EPA Project Manager	Signature	Date

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Attachment ES-2

Waste Site Reclassification Form

Date Submitted: 02/22/01 **Originator:** F. M. Corpuz **Phone:** 531-0625	**Operable Unit(s):** 100-DR-1 **Waste Site ID:** DR Group 2 North Pipelines (100-D-49:1) **Type of Reclassification Action:** Rejected ☐ **Closed Out** ☒ No Action ☐	**Control Number:** 2000-127 **Lead Agency:** Ecology

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List of no action or closed-out sites will occur at a future date.

Description of current waste site condition:

Remedial action at this site has been performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U.S. Department of Energy, Richland Operations Office. The selected remedial action involves (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Area of the Hanford Site, and (3) backfilling the site with clean soil to adjacent grade elevations. The excavation and disposal activities have been completed.

Basis for reclassification:

The DR Group 2 North Pipelines (100-D-49:1) have been remediated to meet the cleanup standards specified in the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1 and 100-HR-1 Operable Units,* Hanford Site, Benton County, Washington, September 1995, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. Remedial actions were performed so as to allow rural-residential use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep) and to protect groundwater and the Columbia River. The basis for reclassification is described in detail in the *Cleanup Verification Package for the D and DR Group 2 North Pipelines (100-D-48:1/49:1), 100-D-19 Sludge Trench, and UPR-100-D-4 Unplanned Release,* CVP-2000-00003, Bechtel Hanford, Inc., Richland, Washington. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required.

Glenn I. Goldberg DOE Project Manager	Signature	3/14/01 Date
Wayne Sopper Ecology Project Manager	Signature	3-26-01 Date
N/A EPA Project Manager	Signature	Date

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Attachment ES-3

Waste Site Reclassification Form

Date Submitted: 02/22/01 **Originator:** F. M. Corpuz **Phone:** 531-0625	**Operable Unit(s):** 100-DR-1 **Waste Site ID:** 100-D-19 Sludge Trench **Type of Reclassification Action:** Rejected ☐ **Closed Out** ☒ No Action ☐	**Control Number:** 2000-128 **Lead Agency:** Ecology

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List of no action or closed-out sites will occur at a future date.

Description of current waste site condition:

Remedial action at this site has been performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U.S. Department of Energy, Richland Operations Office. The selected remedial action involves (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Area of the Hanford Site, and (3) backfilling the site with clean soil to adjacent grade elevations. The excavation and disposal activities have been completed.

Basis for reclassification:

The 100-D-19 Sludge Trench has been remediated to meet the cleanup standards specified in the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1 and 100-HR-1 Operable Units,* Hanford Site, Benton County, Washington, September 1995, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. Remedial actions were performed so as to allow rural-residential use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep) and to protect groundwater and the Columbia River. The basis for reclassification is described in detail in the *Cleanup Verification Package for the D and DR Group 2 North Pipelines (100-D-48:1/49:1), 100-D-19 Sludge Trench, and the UPR-100-D-4 Unplanned Release,* CVP-2000-00003, Bechtel Hanford, Inc., Richland, Washington. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required.

Glenn I. Goldberg DOE Project Manager	Signature	3/14/01 Date
Wayne Soper Ecology Project Manager	Signature	3-26-01 Date
N/A EPA Project Manager	Signature	Date

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Attachment ES-4

Waste Site Reclassification Form

Date Submitted: 02/22/01 **Originator:** F. M. Corpuz **Phone:** 531-0625	**Operable Unit(s):** 100-DR-1 **Waste Site ID:** Unplanned Release Site UPR-100-D-4 **Type of Reclassification Action:** Rejected ☐ **Closed Out** ☒ No Action ☐	**Control Number:** 2000-034 **Lead Agency:** Ecology

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List of no action or closed-out sites will occur at a future date.

Description of current waste site condition:

Remedial action at this site has been performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U.S. Department of Energy, Richland Operations Office. The selected remedial action involves (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Area of the Hanford Site, and (3) backfilling the site with clean soil to adjacent grade elevations. The excavation and disposal activities have been completed.

Basis for reclassification:

The UPR-100-D-4 Unplanned Release Site has been remediated to meet the cleanup standards specified in the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1 and 100-HR-1 Operable Units,* Hanford Site, Benton County, Washington, September 1995, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. Remedial actions were performed so as to allow rural-residential use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep) and to protect groundwater and the Columbia River. The basis for reclassification is described in detail in the *Cleanup Verification Package for the D and DR Group 2 North Pipelines (100-D-48:1/49:1), 100-D-19 Sludge Trench, and UPR-100-D-4 Unplanned Release*, CVP-2000-00003, Bechtel Hanford, Inc., Richland, Washington. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required.

Glen Goldberg DOE Project Manager	Signature	3/14/01 Date
Wayne Soper Ecology Project Manager	Signature	3/26/01 Date
N/A EPA Project Manager	Signature	Date

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ACRONYMS

CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
CVP	cleanup verification package
DQA	data quality assessment
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
GEA	gamma energy analysis
MCL	maximum contaminant level
MTCA	*Model Toxics Control Act*
NaI	sodium iodide
PCB	polychlorinated biphenyl
QA	quality assurance
QC	quality control
RAG	remedial action goal
RAO	remedial action objective
RCF	Radiological Counting Facility
RDR/RAWP	Remedial Design Report/Remedial Action Work Plan
RESRAD	RESidual RADioactivity dose assessment model
RL	U.S. Department of Energy, Richland Operations Office
ROD	Record of Decision
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	*Washington Administrative Code*

1.0 INTRODUCTION

1.1 PURPOSE

This cleanup verification package (CVP) documents the attainment of the remedial action objectives (RAOs) and corresponding remedial action goals (RAGs) for the D/DR Group 2 North Pipelines (Waste Information Data System identifiers 100-D-48:1, 100-D-49:1), the 100-D-19 Sludge Trench, and the UPR-100-D-4 unplanned release site. The D/DR Group 2 North Pipelines include the D and DR cooling water effluent pipelines located to the north of the 116-DR-9 and 116-D-7 Retention Basins. The 100-D-19 site and the unplanned release site are associated with sludge burial from the 116-D-7 Retention Basin and with leaks from the 116-D-7 Retention Basin, respectively. The 100-D-48:1 and 100-D-49:1 site boundary encompasses the other two sites. The combined sites (pipelines, 100-D-19, and the unplanned release site) are referred throughout this CVP as the 100-D-48:1/49:1 Pipelines site.

RAOs are narrative statements that define the extent to which the waste sites require cleanup to protect human health and the environment. RAGs are contaminant-specific numerical cleanup criteria developed to guide the remedial actions to meet the RAOs. Site-specific data evaluations are presented to demonstrate protection from direct exposure and protection of groundwater and the Columbia River.

As shown in Figure 1, the 100-D-48:1/49:1 Pipelines site is located within the 100-DR-1 Operable Unit in the 100 Areas of the Hanford Site in southeastern Washington State.

1.2 REMEDIATION AUTHORITY

The site remediation was performed in accordance with the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (ROD) (EPA 1995). The Interim Action ROD (EPA 1995) provides the U.S. Department of Energy, Richland Operations Office (RL) the authority and guidelines to conduct this remedial action at the site. The preferred remedy specified in the ROD is excavation and disposal of contaminated materials at the Environmental Restoration Disposal Facility (ERDF). The RAOs were established in the ROD (EPA 1995) and are summarized in Section 5.0 along with the corresponding RAGs. Methods to attain the RAOs are presented in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 1998b) and are discussed in further detail in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 1998a) and in other referenced documents.

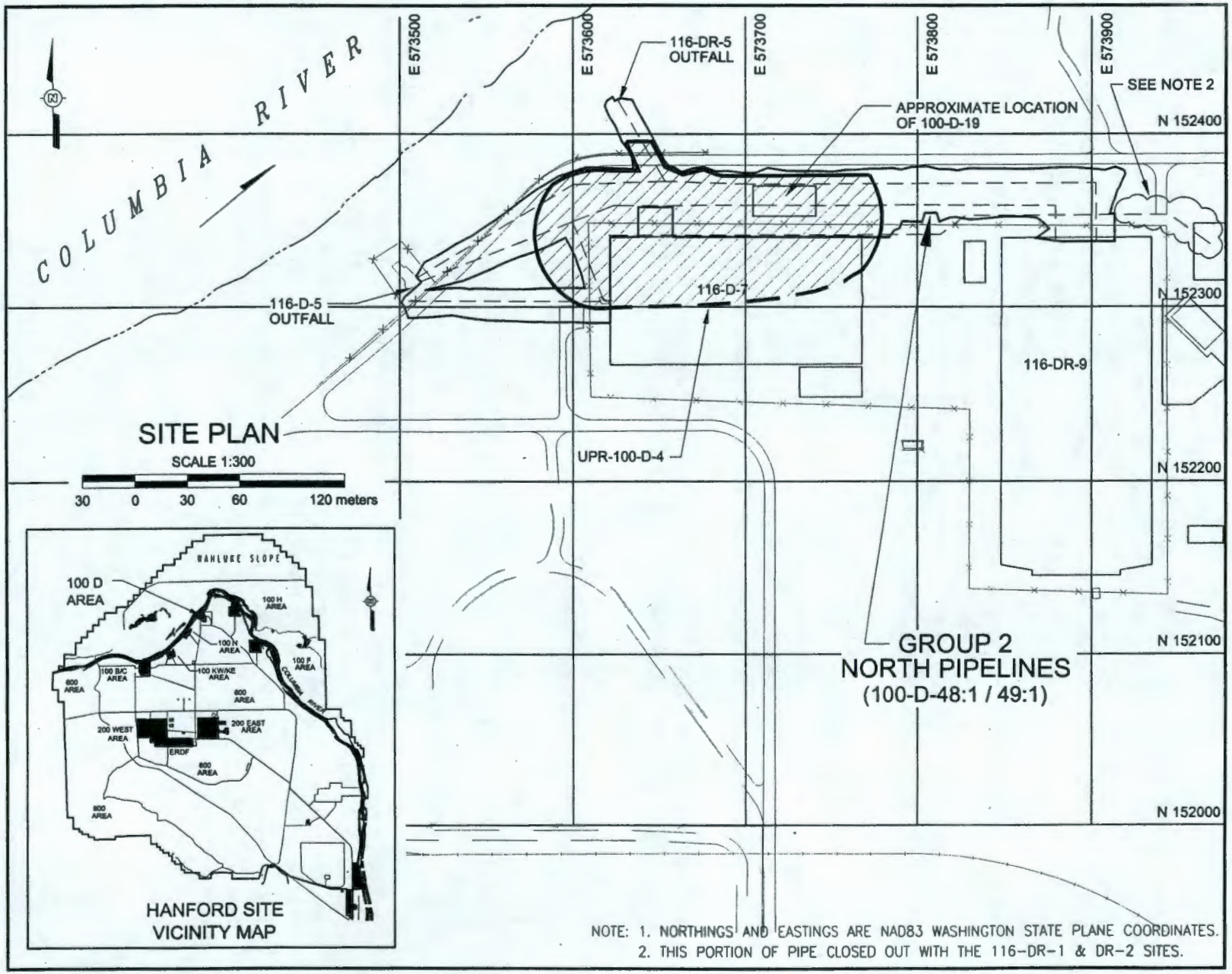

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Figure 1. Hanford Site Map and 100-D-48:1/49:1 Pipelines Site Plan.

1.3 DOCUMENT ORGANIZATION

The cleanup verification evaluation is presented in the following sections:

- Section 2.0 Site Description and Supporting Information
- Section 3.0 Cleanup Verification Sampling, Analysis, and Data Evaluation Methodologies
- Section 4.0 Summary of Remedial Action Objectives and Goals
- Section 5.0 Remedial Action Goal Evaluation
- Section 6.0 Radionuclide Risk Information
- Section 7.0 Statement of Protectiveness
- Section 8.0 References
- Section 9.0 Bibliography.

The main text is supported by the following appendices:

- Appendix A Summary of Verification Soil Sampling and Analytical Results
- Appendix B Attainment of Remedial Action Goals -- Calculational Methodologies
- Appendix C Data Quality Assessment
- Appendix D RESRAD Input Parameters and Calculation Brief Excerpts.

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2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION

2.1 SITE HISTORY

The 100-D-48:1/49:1 Pipelines site includes sections of D and DR Reactor cooling water effluent pipelines, the 100-D-19 Sludge Trench, and one unplanned release site (UPR-100-D-4). The pipelines are the sections of D and DR Reactor cooling water effluent pipelines located to the north of the 116-DR-9 and 116-D-7 Retention Basins. The 100-D-19 Sludge Trench and the UPR-100-D-4 unplanned release site are located to the immediate north of the 116-D-7 Retention Basin. The west end of the former DR Reactor effluent pipeline at the 116-D-5 Outfall is the closest point (approximately 5 m [15 ft]) to the Columbia River (Figure 1).

The 100-D-48:1/49:1 sections of the former D and DR Reactor cooling water effluent pipelines ran from the 116-D-7 and 116-DR-9 Retention Basins to the 116-D-5 and 116-DR-5 Outfalls. The pipelines shown in Figure 1 were constructed of 152-cm (60-in.)-diameter carbon steel. The cooling water effluent pipelines were used from 1944 until 1967 when the D and DR Reactors were shut down.

The 100-D-19 site was a trench used for disposal of sludge from the 116-D-7 Retention Basin. Sludge from the basin was reportedly buried in the trench in 1953. The 100-D-19 Sludge Trench is located to the north of the 116-D-7 Retention Basin.

The unplanned release (UPR-100-D-4) of D Reactor cooling water from the 116-D-7 Retention Basin occurred in 1950 on the north side of the basin, between the basin and the river. The water drained under the road to a section between the road and the perimeter fence. Estimated volumes of water associated with the unplanned releases are not available. The estimated boundary of the release shown in Figure 1 is from the Dorian and Richards study (Dorian and Richards 1978).

2.2 SUBSURFACE CONDITIONS

The soil column (vadose zone) underlying the waste site and extending to groundwater consists of materials belonging to the Hanford and Ringold Formations. The shallower Hanford formation consists predominantly of medium dense to dense sand and gravel, with varying amounts of silt and cobble. The underlying Ringold Formation consists of dense, well-cemented gravels with sand and silt interbeds. The Hanford/Ringold contact is approximately 13.1 to 16.8 m (50 to 55 ft) below the surface grade level. The long-term groundwater level beneath the site is estimated at El. 116.4 m (382 ft) for analysis purposes, based on historical and current information from adjacent groundwater wells. The depth to groundwater is estimated to be 12.0 m (39.0 ft) beneath the floor of the excavation and 18.0 m (59 ft) beneath average surface grade level. The nearby Columbia River and other factors such as atmospheric pressure influence groundwater elevations in adjacent wells.

2.3 CONTAMINANTS OF CONCERN

Waste site contaminants of concern (COCs) and contaminants of potential concern (COPCs) identified through process knowledge are listed in the SAP (DOE-RL 1998a). Additional COCs and COPCs specific to 100-D-19 (indicated below) were identified during remedial action based on analogous site information (i.e., other sludge burial sites). The COCs and COPCs for this site consist of the following:

COPCs	COCs
Polychlorinated biphenyls (PCBs) (100-D-19)	Americium-241 (100-D-19)
	Cobalt-60
	Cesium-137
	Europium-152
	Europium-154
	Nickel-63 (100-D-19)
	Plutonium-239/240
	Strontium-90
	Uranium-233/234
	Uranium-238
	Hexavalent chromium (Cr^{+6})
	Mercury (100-D-19)

PCBs, identified as COPCs, were not detected in cleanup verification samples and are therefore not addressed further in this document. Total PCB cleanup verification sample results are included in Table A-3. The PCB analyses met detection limit requirements of the SAP (DOE-RL 1998a).

2.4 REMEDIAL ACTION DESCRIPTION

Remedial action at the 100-D-48:1/49:1 Pipelines site began on December 28, 1998. Excavation of the site involved removing the overburden materials, the contaminated structure, and underlying contaminated soil. Based on field screening, overburden materials identified as potentially clean were placed in stockpiles for potential use as backfill. Materials that were found to be contaminated were disposed of at ERDF. On July 24, 2000, the excavation reached the design limit. Because remediation of the 100-D-48:1/49:1 Pipelines site required moving an active overhead power line, site remedial action and sampling were conducted in two phases. These separate phases are reflected by the long time period between the start and finish dates for excavation.

The excavation design depth generally corresponded with the invert elevation of the pipelines. At the completion of remedial action and removal of the engineered structure, the excavation was approximately 15,504 m^2 (166,800 ft^2) in area with a maximum depth of approximately 6.0 m (20 ft) below ground surface. Approximately 107,266 metric tons (118,241 tons) of material from the D Area pipelines site have been disposed of at the ERDF through July 2000. Cleanup verification sampling began on April 3, 2000, and was finished on August 8, 2000. The ground surface in the vicinity of the site varies with an average elevation of approximately 134.4 m (441 ft). Pre- and post-remediation topographic maps are shown in Figures 2 and 3, respectively.

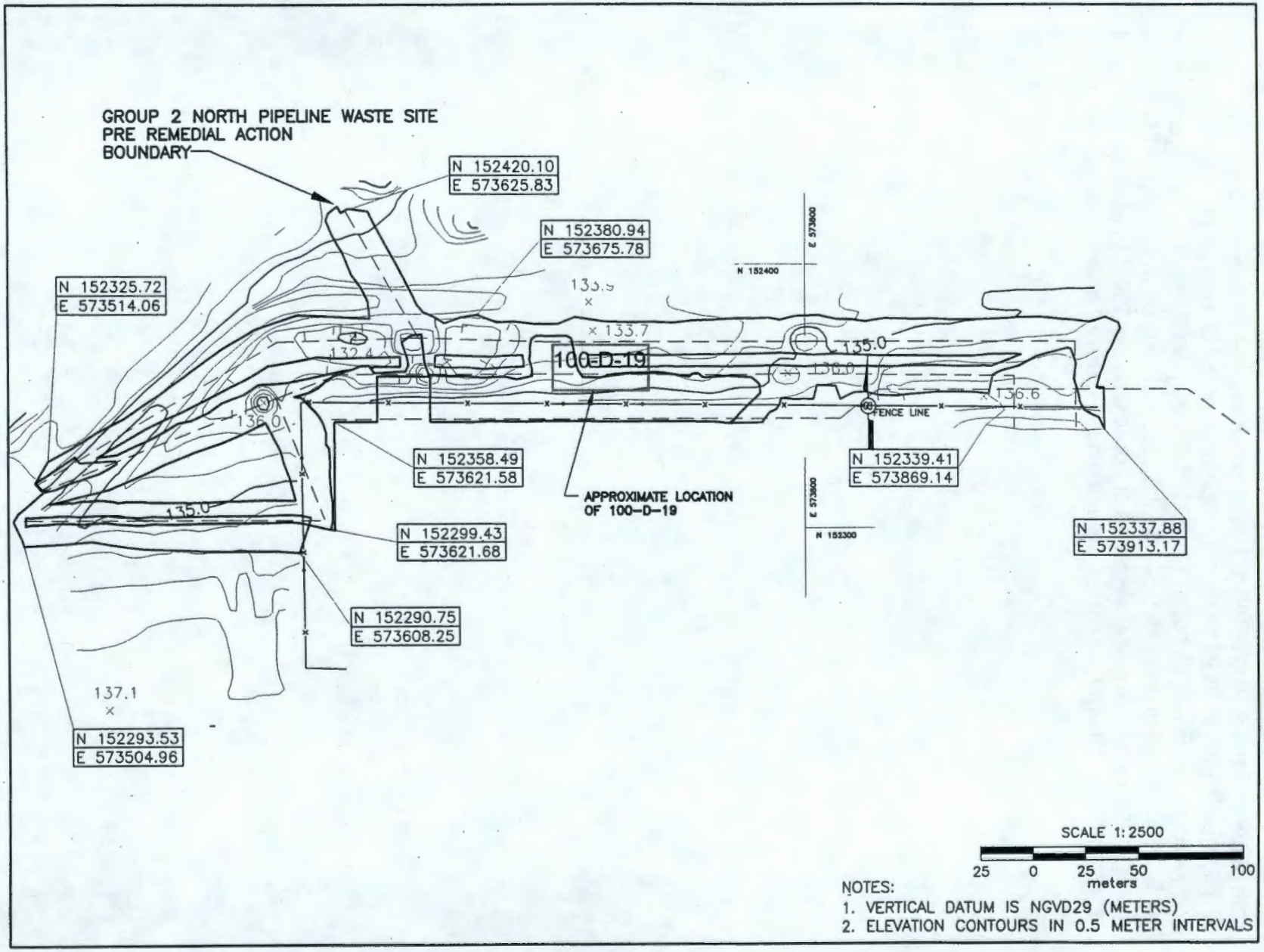

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Figure 2. Pre-Remediation Topographic Plan.

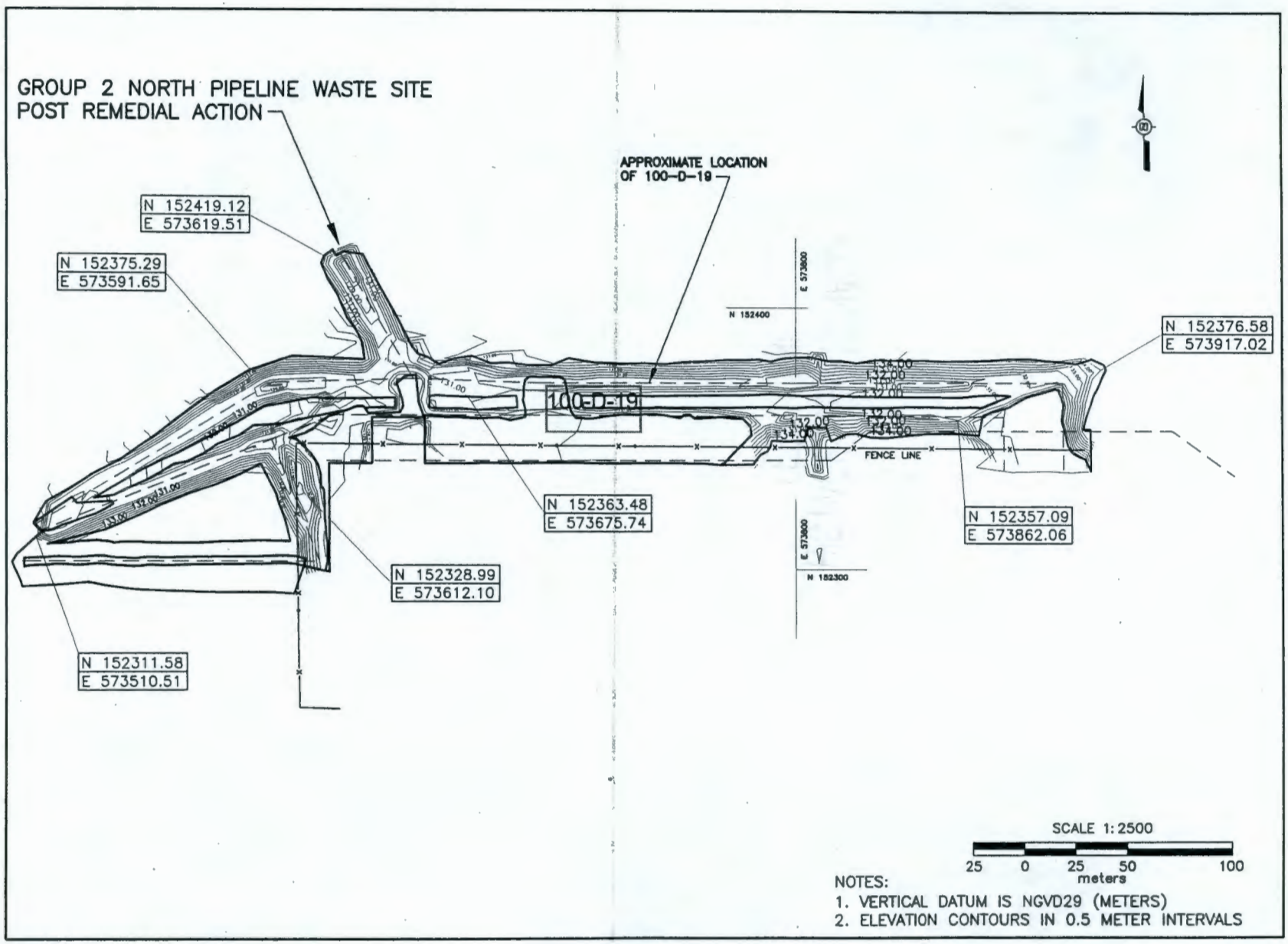

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Figure 3. Post-Remediation Topographic Plan.

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3.0 CLEANUP VERIFICATION SAMPLING, ANALYSIS, AND DATA EVALUATION METHODOLOGIES

The sampling, analysis, and data evaluation process to verify site cleanup involves many steps. This section presents a generalized description of the cleanup verification methodology. A flowchart illustrating the process is presented in Figure 4.

3.1 FIELD SCREENING

Field screening techniques are used during remedial action to guide excavation activities. Such techniques minimize interruptions and lower analytical costs.

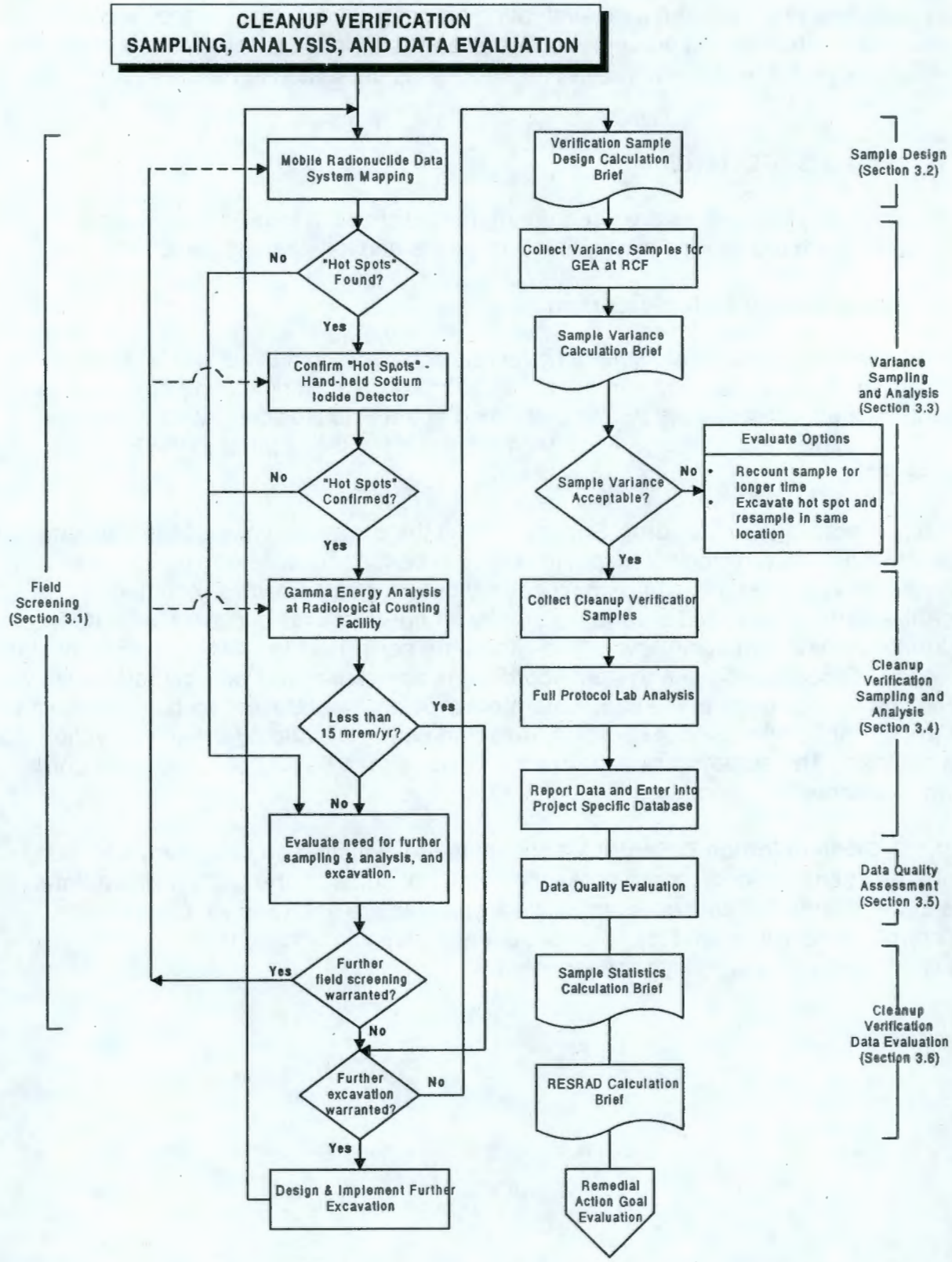
3.1.1 Radiological Field Screening

Three gamma-radiation field screening technologies are employed: (1) an operator-carried radiological mapping survey, (2) hand-held sodium iodide (NaI) detectors, and (3) gamma energy analyses (GEA) performed at the Radiological Counting Facility (RCF) or an offsite laboratory. Each technique is discussed further in the following subsections.

3.1.1.1 Radiological Mapping Survey. When the excavation reaches the subcontract design limits, the radiological mapping survey is performed to determine if further excavation is warranted. NaI gamma energy detector equipment is mounted to a portable cart that is pulled around the site by an operator or is backpack mounted. The operator stops at regular intervals and allows the equipment to count radioactivity at that location. Global positioning system coordinates are transmitted with the radioactivity readings to computers at the site. Operators process the data and maps of radioactivity at the site are plotted. If hot spots are detected during the effort, further excavation may be planned. The surveys are performed over more than 50% of each site in accordance with field screening procedures.

3.1.1.2 Sodium Iodide Detector. If hot spots are identified on the survey site map, analysts attempt to confirm the presence of the hot spots on the ground with a hand-held NaI detector. If hot spots are located, samples are analyzed via GEA for confirmation (Section 3.1.1.3). If a hot spot at a particular location can not be confirmed, the survey results are reevaluated.

Figure 4. Sampling, Analysis, and Data Evaluation Process Diagram.



3.1.1.3 Gamma Energy Analysis. Gamma energy analyses are used to corroborate survey and hand-held NaI detector data, to support waste characterization, and to perform contaminant variance analyses. GEA is performed at the RCF or at an offsite laboratory under controlled conditions. The GEA sampling and analyses activities are documented in the field logbooks and in the project files.

3.1.2 Field Screening for Nonradionuclides

At sites where radiation field screening is not appropriate or sufficient to guide remedial action, samples are collected for quick-turnaround nonradionuclide analyses. Nonradionuclide field screening was not conducted at the 100-D-48:1/49:1 Pipelines site.

3.2 SAMPLE DESIGN

Site cleanup verification sampling is governed by sampling designs developed in accordance with the SAP and the instruction guide (DOE-RL 1998a, BHI 1999). In general terms, the sampling designs specify collection of samples at random locations to assess the variability and levels of any residual contamination. The excavation surface (i.e., sidewalls and floor) is divided into one or more decision units (i.e., shallow zone, deep zone, or overburden). A sampling design is then developed for each decision unit. The shallow zone decision unit is defined as soil from grade level to 4.6 m (15 ft) below the ground surface. In practice, the shallow zone is typically represented by soils from the excavation sidewalls to a depth of 4.6 m (15 ft). The deep zone decision unit is represented by soil from the excavation floor (if at or below 4.6 m [15 ft]) and by any sidewall soils below 4.6 m (15 ft). As needed, decision subunits and associated sampling design are also established for suspect clean overburden stockpiles (i.e., to verify suitability for backfill material). The layout and orientation of the sampling designs are based on the size, shape, and depth of the site.

The sampling designs divide each decision unit into decision subunits that, in turn, are divided into sampling areas. Each sampling area is divided into 16 grid areas. The center of each grid area is designated as a sampling "node." A number of nodes in each sampling area are randomly selected for variance sampling, and each sample is analyzed using GEA or, for nonradionuclides, other appropriate methods. These results are used in the variance analysis.

The 100-D-48:1/49:1 Pipelines site consisted of both a shallow and a deep zone decision unit. The site was excavated to a maximum depth of approximately 6 m (19.7 ft) below ground surface. As described above, separate sample designs were prepared for the shallow zone and the deep zone. The shallow zone decision unit sample design figure is shown on page D-128 and contains three decision subunits (12 sampling areas). The deep zone decision unit design figure is shown on page D-129 and contains two decision subunits (six sampling areas). The sample design for this site is documented in the sample area and location calculation brief included in Appendix D.

3.3 VARIANCE SAMPLING AND ANALYSIS

Variance analysis is performed for decision units where direct exposure is a concern (i.e., shallow zone or overburden). Variance analysis (as described in the SAP, Section A.6 [DOE-RL 1998a]) quantifies the variability of residual contamination and is used to determine the site-specific number of final verification samples. The analysis uses the individual variance sample results and is based on the minimum detectable difference approach presented in U.S. Environmental Protection Agency (EPA) guidance (EPA 1993). The variance data are also used for a preliminary assessment of whether the shallow zone RAGs have been met.

For the 100-D-48:1/49:1 Pipelines site, 72 variance samples were collected from random locations in the shallow zone and were submitted to the RCF for analysis in accordance with the SAP and the instruction guide (DOE-RL 1998a, BHI 1999). Variance sampling and testing began on March 29, 2000 and was completed on July 27, 2000. The variance analysis result was less than the default number of four; therefore, four final verification samples were collected from each decision subunit. Analysis of the variance data indicated that contaminant levels were below the shallow zone RAGs. The variance analysis is documented in the calculation briefs referenced in Appendix D.

3.4 CLEANUP VERIFICATION SAMPLING AND ANALYSIS

Once the variance sampling, analysis, and data evaluation are completed, final cleanup verification samples are collected for each decision unit. Each verification sample is a composite formed by combining samples collected at a minimum of four randomly selected nodes within each sampling area. The final cleanup verification samples for each decision unit comprise the composite samples collected for each of that unit's sampling areas.

As described in Section 3.3, the required number of composite samples for each sampling area in the shallow zone was less than the default number of four samples specified in the SAP (DOE-RL 1998a). Therefore, the default number of samples were collected from each shallow zone decision subunit (excluding the quality assurance/ quality control samples). Three composite samples were also collected from each deep zone decision subunit in addition to quality assurance/quality control samples. Two additional samples were collected from the estimated footprint of the 100-D-19 site to assess for the COCs that are specific to 100-D-19. The COCs specific to 100-D-19 are only applicable to the deep zone, because the location of the 100-D-19 site footprint is entirely within the 100-D-48:1/49:1 site excavation and the adjacent 116-D-7 Retention Basin excavation. That is, the 100-D-19 footprint is located within other excavations in an area of those excavations that is greater than 4.6 m (15 ft) below ground surface. The final verification samples were submitted to offsite laboratories for analysis using approved EPA analytical methods, as required per the SAP (DOE-RL 1998a).

3.5 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment (DQA) is performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA involves the scientific and statistical evaluation of data to determine if the data are of the right type, quality, and quantity to support the intended use (EPA 1996). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process.

The DQA was performed in accordance with BHI-EE-01, *Environmental Investigations Procedures.* Specific data quality objectives are found in the SAP (DOE-RL 1998a). The DQA is based on the guidelines presented in *Guidance for Data Quality Assessment* (EPA 1996). Statistical tests used in this DQA were performed as specified in the SAP (DOE-RL 1998a) and the RDR/RAWP (DOE-RL 1998b).

Analytical data are evaluated for compliance with quality assurance project plan requirements (DOE-RL 1998a), including requirements for precision, accuracy, completeness, and method detection limits. The appropriate statistical test is performed on the adjusted raw analytical data (see Appendix B) to determine statistical values for each contaminant. The number of samples collected for cleanup verification is then evaluated to confirm assumptions concerning contaminant variability. The DQA for the 100-D-48:1/49:1 Pipelines site is included in Appendix C.

3.6 CLEANUP VERIFICATION DATA EVALUATION

Upon completion of the remedial action excavation, cleanup verification samples were collected and analyzed to verify attainment of the established RAOs and corresponding RAGs. The verification sampling, laboratory analyses, subsequent evaluations, and statistical treatment of the data were performed in accordance with the procedures outlined in the RDR/RAWP (DOE-RL 1998b), the SAP (DOE-RL 1998a), the instruction guide (BHI 1999), and EPA/Washington State Department of Ecology (Ecology) meeting minutes (EPA et al. 1997). The cleanup verification sample results are presented in Appendix A. The resulting engineering and environmental analyses are presented in detail in the calculation briefs referenced in Appendix D.

Before the RAOs and corresponding RAGs were evaluated, the following steps were taken to compile and organize the data for the site:

1. Calculated contaminant-specific summary statistics for the excavation site samples

2. Developed a site-specific verification model

3. Prepared a single cleanup verification data set for use in evaluating the attainment of RAGs

4. Performed RESidual RADioactivity (RESRAD) dose assessment modeling.

3.6.1 Statistical Calculation

The primary statistical calculation to support cleanup verification is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each COC are computed for each decision unit (e.g., for the shallow and deep zones, as appropriate). Prior to calculating the 95% UCL, the individual sample results are reviewed and, as appropriate, adjusted per the SAP (DOE-RL 1998a). This process is described in Appendix B and summarized below:

- Radionuclides: For data qualified with a "U" (i.e., less than detection), the minimum detectable activity is substituted for the nondetect value reported by the laboratory and used in the calculation of the 95% UCL.

- Nonradionuclides: For data flagged with a "U" (i.e., less than detection), a value equal to one-half the practical quantitation limit is used in the calculation of the 95% UCL, as required by Ecology regulations (*Washington Administrative Code* [WAC] 173-340-740(7)(g)).

For nonradionuclides, if greater than half of the sample results for a given COC are below detection, then the statistical value is set equal to the maximum concentration detected (i.e., versus computing a 95% UCL).

Statistical calculations are presented in the 95% UCL calculation brief (Appendix D). The method to determine the statistical values is presented in Appendix B and in the calculation brief.

3.6.2 Statistical Values

Verification sampling summary statistics are presented in Table 1. The column(s) on the left side of the table present unadjusted statistical values computed as described in Section 3.6.1. The columns on the right side of the table present statistical values adjusted for background; it is these values that constitute the cleanup verification data set and are used for RESRAD dose modeling. Naturally occurring background is subtracted from the statistical value for isotopic uranium only; this is done for all decision units. Background is not subtracted for any other radionuclides. This process of determining statistical values is presented in Appendix D.

Table 1. Cleanup Verification Data.

COCs	95% UCL Statistical Values[a]		Hanford Site Background[b]	Cleanup Verification Data Set[c]		
	Shallow Zone	Deep Zone		Shallow Zone	Deep Zone – Level 1	Deep Zone – Level 2
Radionuclides (pCi/g)						
Cesium-137	0.251	28.2	1.1	0.251	28.2	
Cobalt-60	0.050	5.29	0.008	0.050	5.29	
Europium-152	0.300	34.2	NA	0.300	34.2	
Europium-154	0.120	4.25	0.033	0.120	4.25	
Plutonium-239/240	0.130	0.449	NA	0.130	0.449	
Strontium-90	0.150	0.607	0.18	0.150	0.607	
Uranium-233/234	0.500	0.570	1.1	0 <(BG)	0 < (BG)	
Uranium-238	0.420	0.554	1.1	0 <(BG)	0 < (BG)	
Americium-241	d	0.464	NA	d	0.464	
Nickel-63	d	1060	NA	d	1060	2.65[e]
Nonradionuclides (mg/kg)						
Cr (VI)	0.64	5.0	NA	0.64	5.0	
Mercury	d	2.0	0.33	d	2.0	0.001[e]

[a]Laboratory data including the minimum detectable activity or practical quantitation limit for individual cleanup verification samples are included in Appendix A and the 95% UCL calculation brief.
[b]Represents the 90th percentile of the lognormal distribution (DOE-RL 1995).
[c]The statistical value above background is used as the input value for RESRAD. In the shallow and deep zones, background is only subtracted for isotopic uranium. Refer to Appendices B and D for additional details on determining statistical values.
[d]COCs specific to 100-D-19 are only applicable to the deep zone because the estimated 100-D-19 footprint is located entirely within an area of the remedial excavation that is greater than 4.6 m (15 ft) below ground surface (see Section 3.4).
[e]Deep Zone – Level 2 values are based on the site-specific cleanup verification model (see Section 3.6.3).
BG = Background.
NA = Not analyzed as part of the Hanford Site-wide background study (DOE-RL 1995).

Statistical values for the COCs specific to 100-D-19 are applicable to the deep zone because the 100-D-19 site footprint is located entirely within an area of the remedial excavation that greater than 4.6 m (15 ft) below ground surface. The COC statistical values specific to 100-D-19 were calculated based on two additional cleanup verification samples collected from the estimated 100-D-19 site footprint.

3.6.3 Site-Specific Cleanup Verification Model

The summary of statistical values described above (Table 1) along with 116-DR-1/116-DR-2 borehole data and other waste site information were evaluated and used to develop a site-specific cleanup verification model for the 100-D-48:1/49:1 Pipelines site. The model is composed of three soil units or horizons: (1) shallow zone, (2) deep zone level 1, and (3) deep zone level 2. A schematic cross section of this site-specific verification model is included in Appendix D. The elements of the 100-D-48:1/49:1 Pipeline site model are described in the following subsections.

3.6.3.1 Shallow Zone. The shallow zone consists of soil up to 4.6 m (15 ft) below the ground surface. The 100-D-48/49:1 excavation extended to a maximum depth of approximately 6 m (20 ft); this is 1.4 m (5 ft) below the bottom of the shallow zone.

3.6.3.2 Deep Zone. The deep zone consists of those soils left in place below 4.6 m (15 ft) deep. Typically, the site-specific model assumes a conservative case described in the RDR/RAWP (DOE-RL 1998b), where the excavation floor concentrations continue for the deep zone at the same levels to groundwater. However, in certain cases, a more detailed model is required to accurately depict the distribution of contamination with depth in a site's deep zone. In these cases, test pit or soil boring sampling results or other waste site information are used to develop a deep zone contaminant profile. The test pit or boring is placed either at the waste site of interest or at a location in the reactor area that is believed to represent worst-case conditions for contaminants at depth. The data from the test pit, boring, or other waste site are combined with the statistical data summarized in Table 1 to develop the site-specific model.

The deep zone for the 116-D-48:1/49:1 Pipelines site was divided into two levels (level 1 and level 2). For all COCs with the exceptions of nickel-63 and mercury, the site-specific model assumes the worst case described in the RDR/RAWP (DOE-RL 1998b), where the deep zone statistical concentrations continue for the deep zone at the same concentrations to groundwater. For nickel-63 and mercury, a more detailed model was needed, so data from the 116-DR-1/DR-2 borehole and the 1607-D2 waste site were used to establish deep zone level 2 specific nickel-63 and mercury concentrations. Computations to develop the deep zone model are presented in Appendix D.

3.6.4 RESRAD Modeling

The RESRAD computer code, Version 5.91 (ANL 1999), was used to model the impact of residual COC concentrations on the vadose zone, groundwater, and the river. The RESRAD model is intended primarily for radionuclide contaminants. However, the software can also be used to evaluate the potential for nonradionuclides to reach groundwater. The RESRAD modeling results, input values, and the site-specific cleanup verification model are included in the RESRAD calculation brief (Appendix D). RESRAD calculation methodologies are described in Appendix B.

4.0 SUMMARY OF REMEDIAL ACTION OBJECTIVES AND GOALS

4.1 REMEDIAL ACTION OBJECTIVES

Remedial action objectives are broad guidelines intended to define and guide the remediation work. The RAOs are presented in the interim action ROD (EPA 1995). A brief summary of the RAOs is presented below. For more detailed information on the RAOs, see the RDR/RAWP (DOE-RL 1998b) and the ROD (EPA 1995).

1. Protection from direct exposure. Protect human and ecological receptors from exposure to contaminants in soils, structures, and debris by dermal exposure, inhalation, or ingestion of radionuclides, inorganics, or organics.

2. Groundwater and river protection. Control the sources of groundwater contamination to minimize the impacts to groundwater resources, protect the Columbia River from further adverse impacts, and reduce the degree of groundwater cleanup that may be required under future actions.

3. Unlimited future land use. To the extent practicable, return soil concentrations to levels that allow for unlimited future use and exposure. Where it is not practicable to remediate to levels that will allow for unrestricted use in all areas, institutional controls and long-term monitoring will be required.

4.2 REMEDIAL ACTION GOALS

RAGs are the specific numeric goals applied to evaluate the attainment of each RAO. The first RAO (i.e., protection from direct exposure) is addressed by attainment of RAGs developed to support a rural-residential exposure scenario. This scenario involves exposures to soils less than 4.6 m (15 ft) deep only. In the rural-residential scenario, an individual is assumed to live for 30 years in a residence built on the waste site and to spend 60% of his or her time indoors, 20% outdoors, and 20% offsite. The scenario assumes a portion of the resident's time is spent in the basement of the home. It further assumes that he or she consumes crops, meat, and milk from plants and animals raised upon the waste site, and consumes fish from a pond downgradient from the waste site. Residual (post-cleanup) contaminant concentrations in the shallow zone (i.e., less than 4.6 m [15 ft]) are assumed for the soils in which crops are raised and on which animals providing meat and milk are raised. Water used by the resident for drinking, showering, watering livestock, and for fish production is assumed to be taken from groundwater derived from surface water that has infiltrated through shallow zone soils at the site. The scenario assumes institutional controls against uncontrolled drilling or digging into deep zone soils (i.e., below 4.6 m [15 ft]). A more detailed description of the rural-residential scenario, and how it is applied, is provided in the RDR/RAWP (DOE-RL 1998b).

The second RAO (i.e., groundwater and river protection) is addressed by evaluating radionuclide COCs with the RESRAD model as described in the RDR/RAWP (DOE-RL 1998b) and by evaluating nonradionuclide COCs for compliance with RAGs based on maximum contaminant levels (MCLs) and other applicable criteria (shown in Table 2).

The third RAO (i.e., unlimited future land use) is addressed via assessment of the first two RAOs and corresponding RAGs, including those RAGs based on the rural-residential exposure scenario. No further RAGs are defined to address the third RAO.

The RAGs and the RAG evaluations presented in this report are consistent with the RDR/RAWP (DOE-RL 1998b), the SAP (DOE-RL 1998a), and subsequent agreements between EPA, Ecology, and RL in December 1997 (EPA et al. 1997). These agreements are included in the Administrative Record and will be included in the next revision of the RDR/RAWP.

4.2.1 Remedial Action Goal Overview

The RAGs that were applicable to this CVP are defined in the RDR/RAWP (DOE-RL 1998b) and are summarized below.

Direct exposure:

- For radionuclide COCs in the shallow zone (all pathways) and in the deep zone (water-dependent pathways), meet a 15 mrem/yr above background total dose rate (this RAG must be met for 1,000 years).

- For nonradionuclide COCs in the shallow zone:

  - Attain a hazard quotient of less than 1.0 for noncarcinogenic contaminants.

  - Attain an excess cancer risk of less than 1×10^{-6} for individual carcinogenic contaminants.

  - Attain a cumulative excess cancer risk of less than 1×10^{-5}.

Protection of groundwater and surface waters (including the Columbia River): Under a rural-residential scenario that includes an irrigation rate of 76 cm/yr (30 in./yr) for 1,000 years, residual COC concentrations in vadose zone soils must achieve the following:

- Beta- and gamma-emitting radionuclide COCs: Meet "National Primary Drinking Water Regulations" dose standards (4 mrem/yr total body or organ dose) for a period of 1,000 years starting from site cleanup. Meet individual COC RAGs as applicable.

Table 2. Summary of Remedial Action Goals.

COCs	Direct Exposure RAG	Groundwater Protection RAG[b] (pCi/L)	Columbia River[b] Protection RAG (pCi/L)
Radionuclides			
Cesium-137	15 mrem/yr (cumulative)[a]	4 mrem/yr (cumulative)[b]	4 mrem/yr (cumulative)[b]
Cobalt-60			
Europium-152			
Europium-154			
Plutonium-239/240		15[b]	15[b]
Strontium-90		8[d]	8[d]
Uranium-233/234		21.2[c]	21.2[c]
Uranium-238			
Americium-241		15[b]	15[b]
Nickel-63		4 mrem/yr (cumulative)[b]	4 mrem/yr (cumulative)[b]

COCs	Direct Exposure RAGs (mg/kg)	Groundwater Protection		Columbia River Protection		
		Action Levels (µg/L)	Soil RAG (mg/kg)	Action Levels (µg/L)	Near-River Action Levels (µg/L)	Soil RAG (mg/kg)
Nonradionuclides						
Cr (VI)	2.1[h,l] 400[i]	80[i]	8[e]	11[j]	22	2.2[f]
Mercury	24[i]	2[i]	0.33[g]	0.012[k]	0.024	0.33[g]

[a]Lookup values based on cumulative groundwater and river protection that correspond to the 15 mrem/yr dose rate and a generic site model are presented in the RDR/RAWP (DOE-RL 1998b).
[b]Lookup values based on "National Primary Drinking Water Regulations" that correspond to the individual radionuclide 4 mrem/yr dose equivalent for beta and gamma emitters are presented in the RDR/RAWP (DOE-RL 1998b). The alpha emitters must meet a gross particle activity standard of 15 pCi/L.
[c]The National Primary Drinking Water Regulation MCL for uranium is 30 µg/L (65 FR 76708), which corresponds to an activity of 21.2 pCi/L. Concentration-to-activity calculation is in the *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038 (BHI 2001).
[d]Promulgated groundwater protection standard. Strontium-90 also contributes to the 4 mrem/yr (cumulative) for groundwater and river protection.
[e]Soil RAG based on "100 times groundwater cleanup" rule.
[f]Soil RAG based on "100 times DAF times surface water protection" rule.
[g]The "100 times groundwater cleanup" and/or "100 times DAF times surface water protection" soil values were less than Hanford Site background concentrations; therefore, background values are used as the soil RAG.
[h]MTCA B carcinogenic cleanup limit
[i]MTCA B noncarcinogenic cleanup limit.
[j]Federal Ambient Water Quality Criteria (40 CFR 131).
[k]Washington State Surface Water Quality Criteria (WAC 173-201A).
[l]*Calculation of Hexavalent Chromium Carcinogenic Risk*, 0100X-CA-V0031 (BHI 2000a).

- Alpha-emitting radionuclide COCs: Meet "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* [CFR] 141.5) (15 pCi/L excluding radon and uranium). The 21.2 pCi/L uranium limit is calculated based on the National Primary Drinking Water Standard MCL of 30 µg/L for uranium promulgated by the EPA on December 7, 2000 (65 FR 76708). The concentration-to-activity calculation is documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater,* 0100X-CA-V0038 (BHI 2001).

- Nonradionuclide COCs: Meet individual COC *Model Toxics Control Act* (MTCA) "100 times rule" soil RAGS for protection of groundwater and the river or demonstrate that residual soil COC levels do not pose an unacceptable threat to groundwater or surface water for 1,000 years (i.e., residual soil levels do not have the potential to exceed groundwater or river RAGs).

4.2.2 Specific Remedial Action Goals

The RAGs are presented in Table 2. Radionuclide and nonradionuclide RAGs are discussed in the following subsections.

4.2.2.1 Radionuclide RAGs. The direct exposure radionuclide RAG is a dose above background of 15 mrem/yr; it is evaluated through RESRAD modeling.

The protection of groundwater and the Columbia River is determined by attainment of radionuclide-specific RAGs and attainment of "National Primary Drinking Water Regulations" criteria for determining the cumulative impact of radionuclides. The RESRAD model calculates the individual COC concentrations in groundwater that would result from the residual soils under a rural-residential scenario that includes an irrigation rate of 76 cm/yr (30 in./yr) for 1,000 years. These individual concentrations are directly compared to the RAGs. The individual concentrations are also used in calculations to determine if the cumulative dose exceeds "National Primary Drinking Water Regulations" standards.

4.2.2.2 Nonradionuclide RAGs. The nonradionuclide direct exposure, protection of groundwater, and protection of river RAGs are summarized in Table 2.

The soil RAGs for protection of groundwater and the river are derived by the "100 times groundwater cleanup" rule and the "100 times DAF times surface water quality" rule. If the RAGs developed by this method are below Hanford Site background values or the practical quantitation limit, the background value or practical quantitation limit (whichever is greatest) is used as the RAG.

If the cleanup verification statistical value (Table 1) is greater than the listed RAGs, groundwater and river protection are evaluated using RESRAD modeling, consideration of travel time to the river, or other demonstrations (e.g., soil leach testing) that show protectiveness of groundwater and the river.

5.0 REMEDIAL ACTION GOAL EVALUATION

This section demonstrates that remedial actions at the 100-D-48:1/49:1 Pipelines site have achieved the applicable RAGs. Sections 5.1, 5.2, and 5.3 address attainment of direct exposure RAGs, groundwater protection RAGs, and Columbia River protection RAGs, respectively. Section 5.4 documents application of the MTCA three-part test to the shallow and deep zones. This test is required for nonradionuclide COCs only and is based on the most restrictive RAG for each zone.

5.1 ATTAINMENT OF DIRECT EXPOSURE SOIL CLEANUP STANDARDS

5.1.1 Attainment of Radionuclide Direct Exposure Standards

The RESRAD computer code (ANL 1999) was used to demonstrate that the direct exposure radionuclide dose limit of 15 mrem/yr above background is not exceeded for the 100-D-48:1/49:1 Pipelines site. The direct radiation exposure dose to the resident living in his or her basement was conservatively estimated by substituting (for analysis purposes) a case where the resident is standing on level ground with the soil containing concentrations representative of residual (i.e., post-cleanup) shallow zone soils. This is conservative because it ignores the potential shielding effects of concrete basement walls and any clean backfill between residual soils and the basement walls.

The individual radionuclide cleanup verification statistical values above background (Table 1) were entered into the RESRAD model for evaluation. The RESRAD model setup and input parameters are provided in Appendix D. The results of the RESRAD dose estimate for the shallow and deep zones (both level 1and level 2) soils at the relevant time slices were totaled (Figure 5). The total dose from the 100-D-48:1/49:1 Pipelines site is largest at present (year 2000), 3.71 mrem/yr, and decreases to 3.86×10^{-2} mrem/yr in 1,000 years. The estimated dose rate in the year 2018 is 1.65 mrem/yr. The 2018 date corresponds to the 30-year site cleanup schedule of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1998). Site dose and risk were calculated for 2018 at the request of the regulatory agencies. The RESRAD computations are presented in detail in the referenced calculation briefs summarized in Appendix D.

5.1.2 Attainment of Nonradionuclide Direct Exposure Standards

5.1.2.1 Attainment of Soil Concentration Remedial Action Goals. Table 3 compares the shallow zone cleanup verification statistical values presented in Table 1 to the direct exposure RAGs presented in Table 2. This comparison demonstrates that the direct exposure RAGs have been attained.

Figure 5. RESRAD Analysis – All Radionuclides, All-Pathways Dose Estimate.

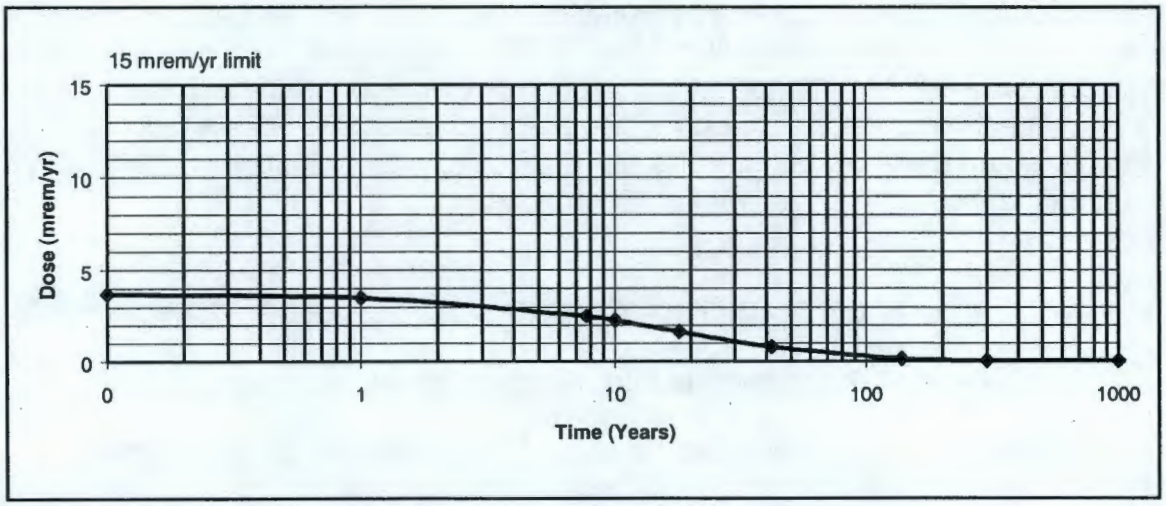


Table 3. Attainment of Nonradionuclide Direct Exposure Standards for Shallow Zone Soil.

Nonradionuclides	Direct Exposure RAG (mg/kg)	Statistical Value (mg/kg)[a]	Direct Exposure RAGs Attained?
Shallow Zone			
Cr (VI)	2.1	0.64	Yes

[a]Criterion is comparison to the cleanup criteria (RAG).
[b]*Calculation of Hexavalent Chromium Carcinogenic Risk*, 0100X-CA-V0031 (BHI 2000a).

5.1.2.2 Attainment of Noncarcinogenic Risk Standards. For noncarcinogenic COCs, MTCA specifies the evaluation of the hazard quotient, which is given as daily intake divided by a reference dose (DOE-RL 1995). For cleanup actions under the interim action ROD (EPA 1995), a comparable conservative approach is used to demonstrate attainment of the noncarcinogenic risk requirements.

The only nonradioactive COC at this site with noncarcinogenic effects is hexavalent chromium. Calculation of the hazard quotient is presented in the 95% UCL calculation brief. The hazard quotient for the shallow zone soils is 1.6×10^{-3}, which is below the limit of 1.0. Therefore, the noncarcinogenic risk requirements have been attained.

5.1.2.3 Attainment of Carcinogenic Risk Standards. For individual nonradionuclide carcinogenic COCs, the MTCA Method B cleanup limits are based on an incremental cancer risk of 1×10^{-6}. For nonradionuclide carcinogenic COCs, the total excess cancer risk must be less than 1×10^{-5} (EPA et al. 1998b). The calculation methodology for deriving nonradionuclide carcinogenic risk is presented in Appendix B.

Hexavalent chromium is the only nonradionuclide carcinogenic COC. For the shallow zone, the individual and total risks are both 3.0×10^{-7}. This value is below the individual and total risk limits; therefore, the carcinogenic risk standards have been attained. This calculation is documented in the 95% UCL calculation brief (Appendix D).

5.2 ATTAINMENT OF GROUNDWATER REMEDIAL ACTION GOALS

5.2.1 Radionuclides

The estimated groundwater concentrations for all the radionuclide COCs contributed by the soils in the shallow and deep zones are shown in the RESRAD calculation brief, summarized in Appendix D. Table 4 shows the total peak concentration predicted for each radionuclide COC and provides the individual RAGs for comparison. No COC is predicted to exceed the RAGs; therefore, the RAGs are attained.

Table 4. Estimated Peak Radionuclide Groundwater Concentrations (Summing Shallow and Deep Zone Impacts) Compared to RAGs.

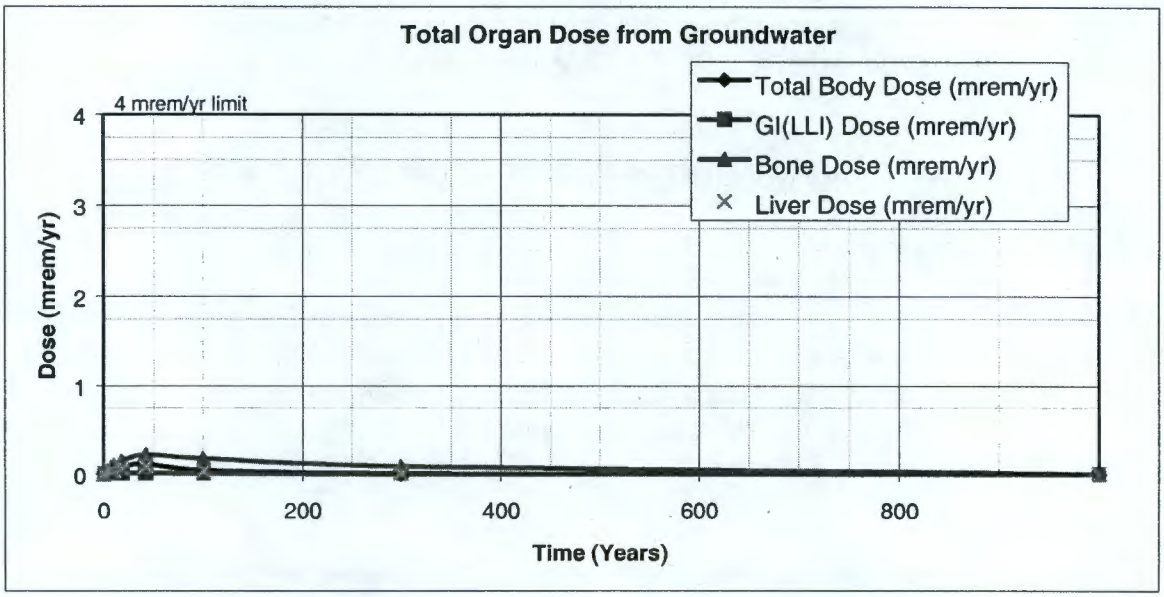
Radionuclide	Peak Concentration (pCi/L)	RAG (pCi/L)	RAGS Attained? (Yes/No)
Cesium-137	1.15×10^{0}	120	Yes
Cobalt-60	3.81×10^{-2}	147	Yes
Europium-152[a]	0	235	Yes
Europium-154[a]	0	59	Yes
Plutonium 239/240[a]	0	1.2	Yes
Strontium-90	1.76×10^{-1}	8	Yes
Americium-241[a]	0	1.2	Yes
Nickel-63	1.59×10^{0}	46	Yes

[a]These analytes do not reach groundwater in 1,000 years.

Figure 6 shows the individual organ doses for beta- and gamma-emitting radionuclides predicted over 1,000 years (40 CFR 141.16), as shown in the comparison to drinking water standards calculation (Appendix D). None of the organ doses is predicted to exceed the 4 mrem/yr standard over 1,000 years.

None of the alpha-emitting COCs are predicted to reach groundwater; therefore, the 15 pCi/L alpha-emitter standard has been met. Because isotopic uranium levels are below background, the need to demonstrate protectiveness under the recently promulgated National Primary Drinking Water Standard MCL of 30 µg/L for total uranium (65 FR 76708) has been met. Methods and results of the RESRAD calculations are shown in Appendices B and D.

Figure 6. Dose to Organs from Groundwater.



5.2.2 Nonradionuclides

The methodology for demonstrating the attainment of groundwater protection RAGs for nonradionuclides is summarized in Appendix B and in EPA/Ecology/RL meeting minutes (EPA et al. 1998a, Ecology 1997). Site-specific calculations are summarized in Appendix D.

Table 5 illustrates the comparison of cleanup verification values to the groundwater protection RAGs. The table shows that residual concentration of the nonradionuclide COCs with the exception of mercury meet the listed RAGs. The listed RAG for mercury is based on Hanford site background. Because the listed background RAG was not met, the mercury depth distribution model was refined (as discussed in Section 3.6.3) and RESRAD modeling was performed to provide a more detailed analysis of the potential impact of residual mercury on groundwater. RESRAD modeling predicts that the residual concentration of mercury will not impact groundwater during the 1,000-year time frame. The results of meeting the listed RAGs as well as RESRAD modeling demonstrates that the RAGs have been attained.

5.3 ATTAINMENT OF COLUMBIA RIVER REMEDIAL ACTION GOALS

5.3.1 Radionuclides

The river protection RAGs for radionuclides are identical to the groundwater protection RAGs. The RESRAD modeling results were compared to the groundwater protection RAGs in Table 4.

Table 5. Attainment of Nonradionuclide Remedial Action Goals for Protection of Groundwater and the Columbia River.

Nonradio-nuclides	Soil RAG for Groundwater Protection (mg/kg)	Soil RAG for Columbia River Protection (mg/kg)	Cleanup Verification Value (mg/kg)	Groundwater and/or River Protection RAGs Exceeded?	Does RESRAD Predict Migration to Groundwater in 1,000 Years?	RAGs Attained? (Yes/No)
Shallow Zone						
Cr (VI)	8.0	2.2	0.64	No	NA	Yes
Deep Zone (Level 1)						
Cr (VI)	8.0	2.2	5.0	Yes[a]	[a]	Yes[a]
Mercury	0.33	0.33	2.01	Yes	No	Yes
Deep Zone (Level 2)						
Cr (VI)	8.0	2.2	5.0	Yes[a]	[a]	Yes[a]
Mercury	0.33	0.33	0.001	No	NA	Yes

NA = Not applicable. RESRAD modeling was not performed because residual concentrations meet the groundwater and river protection.
[a]Groundwater protection RAGs are met. Attainment of River protection RAG is based on 100-D Area hexavalent chromium leachability study (BHI 2000b).

The results indicated that radionuclides are not predicted to reach groundwater (and, by extension, not predicted to reach the Columbia River) at levels above 4 mrem/yr; therefore, the Columbia River protection RAGs have been attained.

5.3.2 Nonradionuclides

The methodology for demonstrating the attainment of the Columbia River RAGs for nonradionuclides is summarized in Appendix B and in EPA/Ecology/RL meeting minutes (EPA et al. 1997, 1998a; Ecology 1997). Site-specific calculations are presented in the calculation briefs found in Appendix D.

Table 5 shows the comparison of cleanup verification values to the Columbia River protection RAGs. The table shows that the cleanup verification value of hexavalent chromium in the shallow zone is less than the listed Columbia River protection RAG. Table 5 also shows that the deep zone hexavalent chromium and mercury exceed the listed RAGs. The listed RAGs are based on Hanford Site background for mercury and the "100 times surface water quality criteria times DAF rule" for hexavalent chromium.

Because the deep zone mercury cleanup verification value is greater than background, the mercury depth distribution model was refined (as discussed in Section 3.6.3) and RESRAD modeling was performed to provide a more detailed analysis of the potential impact of residual mercury on groundwater. RESRAD modeling predicts that the residual concentration of mercury will not impact groundwater and therefore not impact the river during the 1,000-year time frame.

Because of elevated hexavalent chromium at the 100-D Area, a leach rate study was commissioned by the U.S. Department of Energy to evaluate the mobility of hexavalent chromium in soil. The study was performed by Pacific Northwest National Laboratory and is reported in Appendix D of the 116-D-7 CVP (BHI 2000b). Soil samples were collected from potholes or test pits excavated below the floor of the 116-D-7 site. These samples were evaluated to estimate the relative mobility of hexavalent chromium in 100-D Area soils under simulated rural-residential exposure scenario conditions.

The findings of the study indicated that the hexavalent chromium encountered in soil is less mobile than indicated by simple distribution coefficient considerations. The test was set up to simulate rural-residential exposure scenario leaching conditions over 1 year. Only a small fraction of hexavalent chromium in the test was leached from the soil. The concentrations of hexavalent chromium in the leachate were very dilute during the entire experiment. The report concludes that a geochemical condition (yet to be directly identified) within the 100-D Area system causes the hexavalent chromium to have a lower leach rate than originally anticipated. Based on the study findings, the U.S. Department of Energy and Ecology have agreed that the hexavalent chromium remaining in the sediments at the 100-D-48:1/49:1 Pipelines site do not pose an unacceptable risk to the river; therefore, hexavalent chromium concentrations in the site deep zone meet the river protection RAG. Application of the hexavalent chromium leach rate study to the North Pipelines site is based on regulatory agency agreement (Ecology et al. 2000).

5.4 MTCA THREE-PART TEST FOR NONRADIONUCLIDES

Sections 5.1, 5.2, and 5.3 looked separately at compliance with direct exposure RAGs, groundwater protection RAGs, and Columbia River protection RAGs. Section 5.4 documents application of the MTCA three-part test for nonradionuclides, which is performed separately for the shallow and deep zone sample data sets, using the most restrictive RAGs applicable to each zone. (The most restrictive RAG is defined as the lowest of the direct exposure, groundwater protection, and Columbia River RAGs.) The MTCA three-part test consists of the following criteria: (1) the cleanup verification statistical value must be less than the cleanup level, (2) no single detection can exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10%.

5.4.1 Shallow Zone

Table 6 summarizes the results of the MTCA three-part test (WAC 173-340-740(7)) for the shallow zone. For each nonradionuclide COC, the table lists the most restrictive RAG (selected from the RAGs in Table 2), the maximum detected value, the total number of samples collected, and the number of samples exceeding the most restrictive RAG. All of the RAGs (i.e., direct exposure, groundwater protection, and river protection) are applicable to the shallow zone. The final column of the table describes the result of applying the three MTCA criteria using the values listed in the preceding columns. Table 6 shows that the shallow zone passes the MTCA three-part test.

Table 6. Application of the MTCA Three-Part Test to the Shallow Zone.

Nonradionuclides	Most Stringent Shallow Zone RAG (mg/kg)	Statistical Value (mg/kg)[a]	Maximum Detected (mg/kg)[b]	Total Number of Samples[c]	Number Exceeding Criteria[d]	RAGs Attained? (Yes/No)
Shallow Zone						
Cr (VI)	2.1	0.64	0.64	13	0	Yes

[a]Criterion is comparison to the cleanup criteria (RAG).
[b]Criterion is no single detection can exceed two times the cleanup criteria.
[c]The total number of samples includes field duplicate samples, which are included in the evaluation as separate samples.
[d]Criterion is the percentage of samples exceeding the cleanup criteria must be less than 10%.

5.4.2 Deep Zone

Table 7 summarizes the results of the MTCA three-part test (WAC 173-340-740(7)) for the deep zone. For each nonradionuclide COC, the table lists the most restrictive applicable RAG (selected from the RAGs in Table 2), the maximum detected value, the total number of samples collected, and the number of samples exceeding the most restrictive RAG. Groundwater protection and river protection RAGs are applicable to deep zone. The final column of the table describes the result of applying the three MTCA criteria using the values listed in the preceding columns. Table 7 shows that all nonradionuclide COCs pass the MTCA three-part test for the deep zone.

Table 7. Application of the MTCA Three-Part Test to the Deep Zone.

Nonradionuclides	Most Stringent Deep Zone RAG (mg/kg)	Statistical Value (mg/kg)[a]	Maximum Detected (mg/kg)[b]	Total Number of Samples[c]	Number Exceeding Criteria[d]	RAGs Attained? (Yes/No)
Deep Zone						
Cr VI	2.2	5.0	5.0	7	2	Yes[e]
Mercury	0.33	2.01	1.6	2	1	Yes[f]

[a]Criterion is comparison to the cleanup criteria (RAG).
[b]Criterion is no single detection can exceed two times the cleanup criteria.
[c]The total number of samples includes field duplicate samples, which are included in the evaluation as separate samples.
[d]Criterion is the percentage of samples exceeding the cleanup criteria must be less than 10%.
[e]The hexavalent chromium data set meets the three-part criteria when compared to the "100 times" rule groundwater RAG. River protection is demonstrated through the 100-D hexavalent chromium leachability study (see Section 5.3).
[f] Groundwater and river protection are demonstrated through site-specific RESRAD modeling (see Sections 5.2 and 5.3).

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6.0 RADIONUCLIDE RISK INFORMATION

The radionuclide RAG for direct exposure is derived from the interim action ROD (EPA 1995) and is expressed in terms of an allowable radiation dose above background (i.e., 15 mrem/yr). The RAG evaluation (Section 5.0) involved using the RESRAD model to estimate total annual radiation doses for 1,000 years for comparison to the RAG. Radiation presents a carcinogenic risk, and the RESRAD model also calculates the excess lifetime cancer risk associated with the estimated radiation doses. The National Contingency Plan presents a target range for residual risk of 10^{-4} to 10^{-6}. Figure 7 illustrates excess lifetime cancer risk as estimated using the RESRAD model. Because of radioactive decay, the risk decreases over time. The estimated risk is largest, 3.31×10^{-5} mrem/yr, at present (year 2000), and decreases to 1.03×10^{-7} in 1,000 years. The estimated risk in the year 2018 is 1.68×10^{-5} mrem/yr. Figure 8 plots the radiation dose above background, similar to Figure 5, and shows the corresponding radionuclide risk at present and in the year 2018.

Figure 7. RESRAD Analysis – Radionuclide Risk, All Pathways.

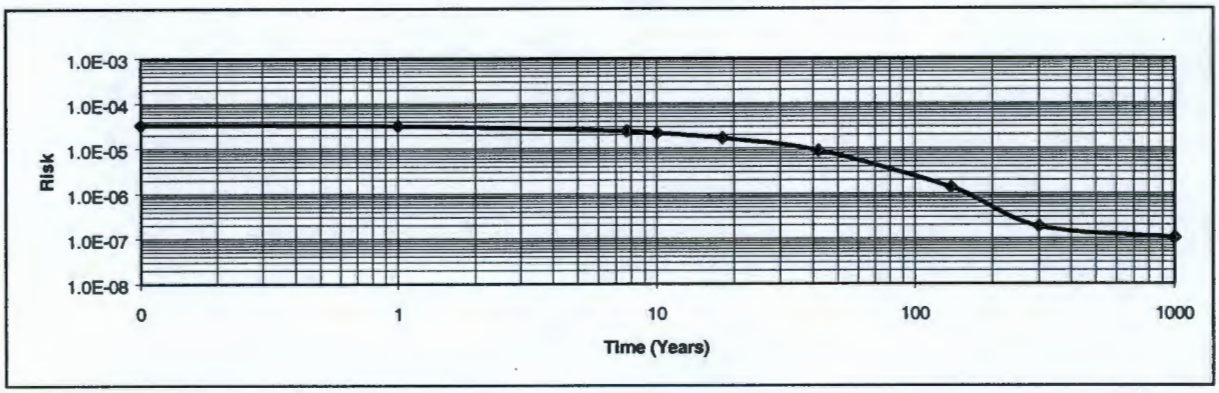
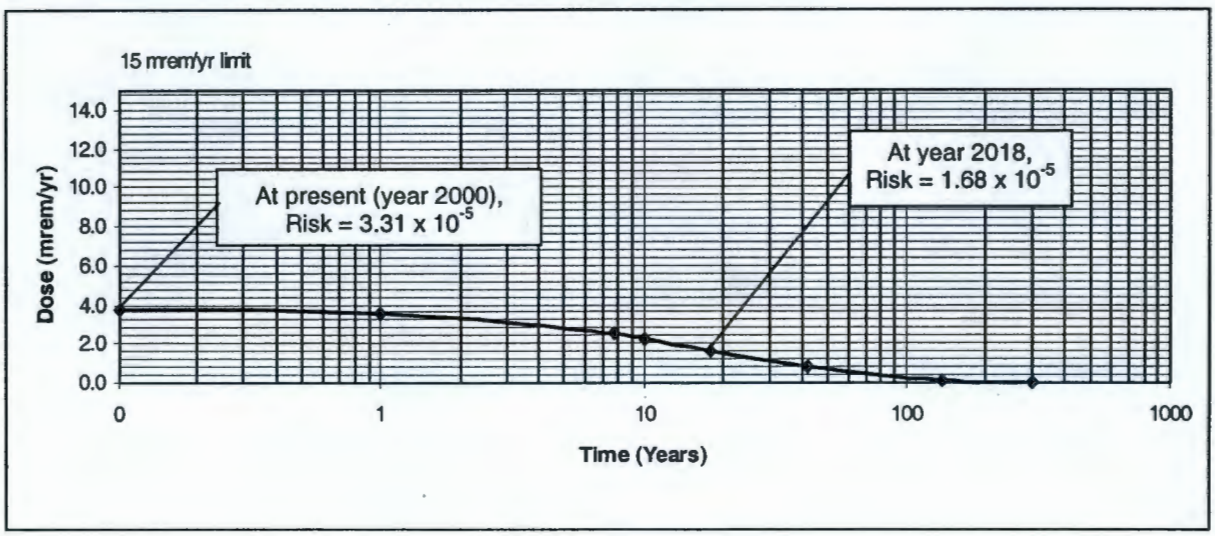


Figure 8. RESRAD Analysis – Radionuclide Dose, All Pathways, With Corresponding Risk Values.



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7.0 STATEMENT OF PROTECTIVENESS

This CVP demonstrates that remedial action at the 100-D-48:1/49:1 Pipelines site has achieved the RAOs and corresponding RAGs established in the approved interim action ROD (EPA 1995) and RDR/RAWP (DOE-RL 1998b). The remaining soils at the 100-D-48:1/49:1 Pipelines site have been sampled, analyzed, and modeled. The results of this effort indicate that the materials from the 100-D-48:1/49:1 Pipelines site containing COCs at concentrations exceeding the RAGs have been excavated and disposed of at the ERDF. Residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario, and that residual COC concentrations throughout the site do not pose an unacceptable threat to groundwater or the Columbia River. The acceptability of unrestricted direct exposure to deep zone soils has not been demonstrated; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]) are required. The 100-D-48:1/49:1 Pipelines site (includes the 100-D-19 and UPR-100-D-4 sites) is verified to be remediated in accordance with the interim action ROD (EPA 1995) and may be backfilled.

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APPENDIX A

SUMMARY OF VERIFICATION SOIL SAMPLING AND ANALYTICAL RESULTS

Table A-1. Shallow Zone Cleanup Verification Data (4/11/00 and 8/8/00). (Page 1 of 2)

Sampling Area	HEIS Number	Cs-137 pCi/g		Co-60 pCi/g		Eu-152 pCi/g		Eu-154 pCi/g		Pu-239/240 pCi/g	
		Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA
E1	B0XXM8	5.80E-02 J	3.10E-02	2.60E-02 U	2.60E-02	7.60E-02 U	7.60E-02	9.60E-02 U	9.60E-02	-1.10E-02 U	6.20E-02
E2	B0XXM9	4.00E-02 J	3.80E-02	3.30E-02 U	3.30E-02	8.50E-02 U	8.50E-02	1.10E-01 U	1.10E-01	5.00E-03 U	5.80E-02
E3	B0XXN2	5.30E-02 J	3.70E-02	3.50E-02 U	3.50E-02	9.20E-02 U	9.20E-02	1.10E-01 U	1.10E-01	4.00E-03 U	5.40E-02
E4	B0XXN3	1.90E-02 U	2.10E-02	4.70E-02 U	4.70E-02	6.90E-02 U	6.90E-02	1.00E-01 U	1.00E-01	-4.00E-03 U	4.00E-02
F5	B0XXN4	2.80E-02 U	2.80E-02	3.10E-02 U	3.10E-02	1.48E-01	5.90E-02	9.50E-02 U	9.50E-02	-3.00E-03 U	2.40E-02
F6	B0XXN5	4.30E-02 U	4.30E-02	5.00E-02 U	5.00E-02	1.10E-01 U	1.10E-01	1.50E-01 U	1.50E-01	-2.00E-03 U	1.90E-02
F7	B0XXN6	3.70E-02 U	3.70E-02	4.30E-02 U	4.30E-02	9.80E-02 U	9.80E-02	1.20E-01 U	1.20E-01	4.00E-03 U	1.80E-02
F8	B0XXN7	3.80E-02 J	3.10E-02	4.60E-02 U	4.60E-02	3.54E-01	5.80E-02	1.00E-01 U	1.00E-01	-5.00E-03 U	5.20E-02
G9	B0XXN8	2.40E-02 J	2.30E-02	2.10E-02 U	2.10E-02	1.52E-01	5.20E-02	7.10E-02 U	7.10E-02	1.10E-02 U	2.00E-02
G10	B0XXN9	4.32E-01	3.20E-02	6.10E-02 U	6.10E-02	3.57E-01	6.50E-02	9.50E-02 U	9.50E-02	1.60E-02 U	2.50E-02
G1	B0XXP0	8.09E-01	4.10E-02	4.70E-02 U	4.70E-02	2.66E-01	1.20E-01	1.30E-01 U	1.30E-01	8.30E-02 U	2.10E-01
G2	B0XXP1	3.20E-02 J	2.70E-02	2.60E-02 U	2.60E-02	4.02E-01	5.80E-02	8.60E-02 U	8.60E-02	2.40E-01 U	2.40E-01
Duplicate of B0XXM9	B0XXN0	9.90E-02 J	3.00E-02	2.90E-02 U	2.90E-02	7.00E-02 U	7.00E-02	9.00E-02 U	9.00E-02	2.30E-02 U	3.70E-02
Split of B0XXM9	B0XXP2	2.18E-02 U	2.25E-02	-3.09E-03 U	1.97E-02	7.79E-03 U	4.93E-02	-3.50E-02 U	6.43E-02	2.18E-02 U	4.58E-02
Equipment Blank	B0XXN1	1.30E-02 U	1.30E-02	1.40E-02 U	1.40E-02	3.40E-02 U	3.40E-02	4.30E-02 U	4.30E-02	-6.00E-03 U	4.00E-02

Table A-1. Shallow Zone Cleanup Verification Data (4/11/00 and 8/8/00). (Page 2 of 2)

Sampling Area	HEIS Number	Sr-90[a] pCi/g		U-233/234 pCi/g		U-238 pCi/g		Cr+6 mg/kg	
		Result	MDA	Result	MDA	Result	MDA	Result	PQL
E1	B0XXM8	-6.00E-03 U	1.40E-01	2.33E-01 J	1.30E-01	5.16E-01 J	1.30E-01	0.41 U	0.41
E2	B0XXM9	-8.00E-02 U	1.90E-01	4.65E-01 J	1.10E-01	4.36E-01 J	1.10E-01	0.40 U	0.40
E3	B0XXN2	1.50E-02 U	1.20E-01	5.32E-01 J	1.20E-01	3.29E-01 J	1.20E-01	0.41 U	0.41
E4	B0XXN3	-9.00E-03 U	1.30E-01	4.00E-01 J	1.10E-01	3.41E-01 J	1.10E-01	0.41 U	0.41
F5	B0XXN4	1.96E-01 J	1.50E-01	5.67E-01 J	1.30E-01	3.67E-01 J	1.30E-01	0.42 U	0.42
F6	B0XXN5	5.70E-02 U	1.30E-01	3.42E-01 J	1.20E-01	3.42E-01 J	1.20E-01	0.42 U	0.42
F7	B0XXN6	-3.40E-02 U	1.20E-01	4.75E-01 J	2.00E-01	3.51E-01 J	2.80E-01	0.42 U	0.42
F8	B0XXN7	-2.00E-03 U	1.20E-01	3.05E-01 J	1.90E-01	2.29E-01 J	1.90E-01	0.41 U	0.41
G9	B0XXN8	-3.60E-02 U	8.90E-02	7.13E-01 J	1.30E-01	4.00E-01 J	1.30E-01	0.41 U	0.41
G10	B0XXN9	9.90E-02 U	1.10E-01	3.94E-01 J	1.50E-01	4.14E-01 J	2.40E-01	0.41 U	0.41
G1	B0XXP0	2.90E-02 U	1.70E-01	3.77E-01 J	1.70E-01	4.22E-01 J	1.70E-01	0.40 U	0.40
G2	B0XXP1	-1.10E-02 U	1.60E-01	3.42E-01 J	2.40E-01	3.42E-01 J	2.40E-01	0.64	0.43
Duplicate of B0XXM9	B0XXN0	-1.00E-02 U	1.20E-01	2.74E-01 J	1.10E-01	4.32E-01 J	1.10E-01	0.41 U	0.41
Split of B0XXM9	B0XXP2	5.31E-02 U	1.59E-01	6.83E-01 J	3.49E-02	6.76E-01 J	2.85E-02	8.0E-02 U	8.0E-02
Equipment Blank	B0XXN1	-3.00E-03 U	1.50E-01	3.89E-01 J	1.10E-01	3.44E-01 J	1.10E-01	0.40 U	0.40

[a]Sr-90 values are total radioactive strontium values.

J = The reported value is an estimate. In most cases for radionuclides, the results reported are near the minimum detectable activity (MDA). Where the MDA is within an order of magnitude of the reported results, there is a greater statistical likelihood for yielding a higher-than or lower-than actual result.

U = Analyte is below the detection limits of the methods and instruments used (undetected).

Table A-2. Summary of 100-D-48:1/49:1 Deep Zone Verification Soil Sample Analytical Data (4/3/00 and 7/27/00). (Page 1 of 2)

Sampling Area	HEIS Number	Cs-137 pCi/g		Co-60 pCi/g		Eu-152 pCi/g		Eu-154 pCi/g		Pu-239/240 pCi/g	
		Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA
C1	B0XXJ7	1.25E+01	6.50E-02	4.81E-01	4.10E-02	4.88E+00	1.50E-01	5.68E-01	1.20E-01	1.13E-01 J	5.00E-02
C2	B0XXJ8	1.91E+01	2.40E-01	7.33E+00	1.10E-01	2.87E+01	6.00E-01	3.61E+00	4.00E-01	5.44E-01 J	4.10E-02
C3	B0XXK0	1.69E+01	8.50E-02	7.90E-02	3.90E-02	1.60E+00	2.20E-01	1.70E-01 U	1.70E-01	6.00E-02 U	7.70E-02
D4	B0XXK1	3.35E+00	5.40E-02	2.56E-01	2.80E-02	3.46E+00	9.10E-02	3.93E-01	1.00E-01	7.30E-02 J	4.00E-02
D5	B0XXK2	3.95E+01	1.30E-01	8.05E+00	8.80E-02	6.42E+01	4.20E-01	8.01E+00	3.40E-01	7.35E-01 J	2.20E-02
D6	B0XXK3	2.71E+01	1.20E-01	3.82E-01	4.30E-02	1.83E+00	3.40E-01	3.43E-01	1.30E-01	5.10E-02 J	3.10E-02
Duplicate of B0XXJ8	B0XXJ9	1.99E+01	1.40E-01	7.10E+00	7.70E-02	2.79E+01	3.20E-01	3.28E+00	2.50E-01	4.35E-01 J	4.30E-02
Split of B0XXJ8	B0XXM1	1.88E+01	7.09E-02	7.32E+00	3.53E-02	2.68E+01	1.70E-01	3.18E+00	1.23E-01	1.31E+00	6.09E-02

Table A-2. Summary of 100-D-48:1/49:1 Deep Zone Verification Soil Sample Analytical Data (4/3/00 and 7/27/00). (Page 2 of 2)

Sampling Area	HEIS Number	Sr-90 pCi/g		U-233/234 pCi/g		U-238 pCi/g		Cr+6 mg/kg	
		Result	MDA	Result	MDA	Result	MDA	Result	PQL
C1	B0XXJ7	1.21E-01 U	1.30E-01	5.42E-01 J	1.40E-01	6.14E-01 J	1.40E-01	5.00E+00	4.00E-01
C2	B0XXJ8	8.68E-01 J	1.20E-01	5.26E-01 J	1.10E-01	5.41E-01 J	1.10E-01	2.39E+00	See note, below
C3	B0XXK0	3.29E-01 J	2.20E-01	4.33E-01 J	1.20E-01	3.69E-01 J	1.20E-01	4.10E-01 U	4.10E-01
D4	B0XXK1	2.27E-01 J	1.70E-01	2.05E-01 J	1.40E-01	3.54E-01 J	1.40E-01	4.10E-01 U	4.10E-01
D5	B0XXK2	5.92E-01 J	1.50E-01	4.49E-01 J	1.20E-01	4.49E-01 J	1.20E-01	4.20E-01 U	4.20E-01
D6	B0XXK3	5.65E-01 J	1.20E-01	3.49E-01 J	1.50E-01	4.46E-01 J	1.50E-01	4.10E-01 U	4.10E-01
Duplicate of B0XXJ8	B0XXJ9	7.12E-01 J	1.20E-01	9.33E-01 J	1.00E-01	7.00E-01 J	1.00E-01	See note, below	
Split of B0XXJ8	B0XXM1	1.14E+00	1.23E-01	8.65E-01 J	4.03E-02	8.73E-01 J	3.35E-02	See note, below	

Note: Because of Cr-6 discrepancies between the main/duplicate laboratory and the split laboratory for sample area C2, an independent third laboratory analyzed four discrete samples (B108M4, B108M5, B108M6, and B108M7) collected from four sample nodes of sample area C2. The Cr-6 value for sample area C2 is a mathematical composite of the results from the third laboratory. Additional discussion is included in the DQA (Appendix C).

J = The reported value is an estimate. In most cases for radionuclides, the results reported are near the minimum detectable activity (MDA). Where the MDA is within an order of magnitude of the reported results, there is a greater statistical likelihood for yielding a higher-than or lower-than actual result.

U = Analyte is below the detection limits of the methods and instruments used (undetected).

Table A-3. Additional Deep Zone Verification Soil Sample Analytical Data for 100-D-19 (6/26/00).

Sampling Area	HEIS Number	Am-241 pCi/g		Ni-63 pCi/g		Mercury mg/kg		PCBs µg/kg	
		Result	MDA	Result	MDA	Result	PQL	Result	PQL
D4	B0YM40	6.20E-02 J	5.90E-02	6.22E+01	2.20E+00	3.2E-01	2.0E-02	ND U	34
D5	B0YM41	3.66E-01 J	5.30E-02	8.17E+02	2.20E+00	1.6E+00	2.0E-02	ND U	34

Note: Statistical computation input data: for radionuclides, the minimum detectable activity used for nondetects. For nonradionuclides, one-half the detection limit used for nondetects.

J = The reported value is an estimate. In most cases for radionuclides, the results reported are near the minimum detectable activity (MDA). Where the MDA is within an order of magnitude of the reported results, there is a greater statistical likelihood for yielding a higher-than or lower-than actual result.

ND = Not detected.

U = Analyte is below the detection limits of the methods and instruments used (undetected).

APPENDIX B

ATTAINMENT OF REMEDIAL ACTION GOALS -- CALCULATION METHODOLOGIES

B1.0 DIRECT EXPOSURE

B1.1 RADIONUCLIDES

The 95% upper confidence limit (UCL) is calculated for each contaminant of concern (COC) for the arithmetic mean of the samples taken. For radionuclide data qualified with a "U" (i.e., less than detection), the minimum detectable activity (MDA) is used in the calculation of the 95% UCL. For data qualified with flags other than a "U," the reported value is used in the data set without adjustment. For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set.

Naturally occurring background for isotopic uranium is subtracted from the statistical value for shallow and deep zone soils. (Naturally occurring and anthropologic background is subtracted from the overburden statistical values for all radionuclides.) The result is the statistical value above background and is used as the input value for RESidual RADioactivity (RESRAD) model dose analysis (ANL 1999).

To determine if the direct exposure remedial action goal (RAG) of 15 mrem/yr cumulative radionuclide dose above background is attained, RESRAD analysis (ANL 1999) is performed for the exposure pathways. The exposure pathways are explained in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 1998). The parameters, both generic and site-specific, for this analysis are listed in Appendix D.

B1.2 NONRADIONUCLIDES

Prior to calculation of the sample statistics, the nonradionuclide data below the detection limit are adjusted to one-half the detection limit value, as required by Washington State Department of Ecology (Ecology) guidance (Ecology 1993, *Washington Administrative Code* [WAC] 173-340). Data qualified with anything but a "U" are included in the data set without adjustment. The 95% UCL for the arithmetic mean is then calculated for each COC.

The statistical value used for cleanup verification is the 95% UCL for the mean, except in the following cases:

- Where more than 50% of the laboratory results are nondetects, the statistical value used is the maximum value of the data set.
- Where 100% of the laboratory results are nondetects, the statistical value used is the practical quantitation limit.

The statistical value for the COC is then compared to the cleanup criteria to evaluate attainment of direct exposure RAGs.

B2.0 GROUNDWATER PROTECTION

A rural-residential scenario that includes an irrigation rate of 76 cm/yr (30 in./yr) for 1,000 years is assumed when evaluating the potential impact of residual COC concentrations in soils to groundwater. The site model also uses the conservative assumption that the levels of COCs detected during verification sampling in the excavation floor extend to groundwater. In addition, COC distribution in the deep zone is based on cleanup verification sampling data.

B2.1 RADIONUCLIDES

The cleanup verification statistical values above background for site-specific parameters are entered into RESRAD for calculation of individual COC groundwater concentrations predicted to result from residual COC concentrations in soil. The results from each run are compared against maximum contaminant levels (MCLs) and "National Primary Drinking Water Regulations" (40 CFR 141) requirements.

The RESRAD model is used to calculate the individual radionuclide concentrations in groundwater that would be predicted to result from the residual COC concentrations. If the site conceptual model breaks the contamination into multiple layers, the groundwater concentrations from the various layers are added to provide the concentration data for the dose calculation. The dose calculation is performed in the RESRAD model included in Appendix D.

If RESRAD shows that concentrations are below the groundwater RAG, then the analysis proceeds to the next step of determining groundwater compliance.

The "National Primary Drinking Water Regulations" (40 CFR 141.5) establish a gross alpha particle standard of 15 pCi/L for alpha-emitting radionuclides (excluding radon and uranium). Additionally, because there is no MCL for isotopic uranium, an activity of 30 pCi/L from the *Uranium Mill Tailings Radiation Control Act of 1992* (40 CFR 192), promulgated by the U.S. Environmental Protection Agency (EPA), is used as the standard for isotopic uranium.

The "National Primary Drinking Water Regulations" establish a 4 mrem/yr dose standard for beta- and gamma-emitting radionuclides in drinking water (40 CFR 141.16). In addition, they specify MCLs for strontium-90 and tritium of 8 pCi/L and 20,000 pCi/L, respectively (40 CFR 141.16). They also specify the method of calculating dose: the individual organ-dose calculational method given in NBS Handbook 69 (NBS 1963). To determine if any organ receives more than a 4 mrem/yr dose, the dose to each organ is calculated for the COC radionuclides.
There is a critical organ for each radionuclide (that is the organ that receives the highest dose from ingestion of that radionuclide). The critical organs for each radionuclide are determined from the maximum permissible concentrations (MPCs) given in Table 1 of NBS Handbook 69. The factor C_4 (that is the concentration that will produce a

4 mrem/yr dose to that organ) for each organ and radionuclide is calculated. The equation for the calculation of C_4 for radionuclide A and organ x is as follows:

$$C_4^A (x) = 4.4 \times 10^6 \text{ (MPC/ORL)}.$$

The term ORL is the occupational radiation limit (in rems) for the organ given in the *National Primary Drinking Water Regulations* (EPA 1976). The ORLs for the individual organs are total body - 5, gonads - 5, thyroid - 30, bone - 29.1, and other organs - 15. The C_4 factors for the COCs are summarized in the drinking water calculation brief (Appendix D).

The cumulative dose for each organ at time *t* needs to be calculated separately and the sum of fractions equation (EPA 1976) calculated as shown below. If a radionuclide does not have an MPC for the organ of interest, the C_4 factor for total body dose is used in the calculation. The calculations performed are documented in the drinking water comparison calculation brief (Appendix D). The organs for which doses need to be computed are total body, bone, and gastrointestinal tract (lower large intestine). The individual organ doses are compared to 4 mrem/yr. With this methodology, one does not sum doses for different organs for the comparison to 4 mrem/yr.

$$\text{Dose}_{\text{organ x}} (t) = [\text{ConcA } (t)/C_4^A(x) + \text{ConcB}(t)/C_4^B(x) + \ldots] \times (4 \text{ mrem/yr})$$

If the dose for organ x is less than 4 mrem/yr, then the standard is met. Organ doses from groundwater are summarized in the drinking water comparison calculation brief included in Appendix D.

B2.2 NONRADIONUCLIDES

If the statistical value of a COC is below the background value, the COC is not considered further in the groundwater protection evaluation, and the groundwater protection RAG is considered to be attained.

To determine the RAG for contaminants in soil that is protective of groundwater, the "100 times groundwater cleanup" rule is applied (as a first test) to the groundwater MCL (or relevant action level) for each COC. Application of the "100 times groundwater cleanup" rule involves a conversion of groundwater action levels (μg/L) to equivalent soil action levels (mg/kg). This calculation is based on a 1 kg/L density conversion factor assumption. The "100 times groundwater cleanup" rule is applied in accordance with WAC 173-340-740(3)a. For example, a RAG of 1 μg/L has a corresponding soil equivalent RAG of 0.1 mg/kg (e.g., 1 μg/L = 0.001 mg/L, 0.001 mg/L ÷ 1 kg/L = 0.001 mg/kg, 100 x 0.001 mg/kg = 0.1 mg/kg). After conversion of the groundwater action level to a soil equivalent value, the COC statistical values can be compared directly to the RAG soil equivalent value. Per WAC 173-340-740(3)a, the COC statistical values that are less than the RAG soil equivalent value are considered protective of the groundwater.

For hexavalent chromium, RAGs of 8 mg/kg and 2.2 mg/kg (soil value) have been set by the EPA and Ecology (EPA et al. 1997, Ecology 1997) as protective of the groundwater and the Columbia River, respectively. The statistical value is compared to these RAGs to demonstrate attainment of groundwater and Columbia River protection for hexavalent chromium.

If the statistical value of a COC is determined to be equal to the analytical method practical quantitation limit (PQL), which is the lowest detectable value, but the PQL is greater than the cleanup RAG, the RAG is considered to have been attained in accordance with WAC 173-340-707. For example, the MCL for polychlorinated biphenyls (PCBs) is 0.2 μg/L (or 0.0002 mg/L) using the current EPA slope factor for drinking water ingestion of PCBs of 0.4 kg-day/mg, which after applying the "100 times groundwater cleanup" rule, provides a soil RAG of 0.02 mg/kg. Direct comparison of the statistical value to this soil RAG is inappropriate because the PQL at which PCBs are detectable is greater than 0.02 mg/kg. Therefore, in this case, the PQL for PCB analysis and the corresponding statistical value is considered protective of the groundwater. In cases where the COC analytical PQL is below the RAG, the statistical value is directly compared to the soil equivalent RAG.

Application of the "100 times groundwater cleanup" rule represents a conservative scenario in that the COC soil concentrations are assumed to extend uniformly from the bottom of the excavation to the groundwater. If attainment of the groundwater RAGs is not met under the "100 times groundwater cleanup" rule, a more detailed site-specific evaluation is performed, using RESRAD modeling. Nonradionuclide COCs are modeled by using an equivalent radionuclide surrogate with a long half-life (>1,000 years) with the distribution coefficient (K_d) set at the actual K_d of the nonradionuclide constituent. K_d values are listed in the RDR/RAWP (DOE-RL 1998). The resulting groundwater concentration calculated by RESRAD is then compared directly to the action level for groundwater.

B3.0 COLUMBIA RIVER PROTECTION

B3.1 RADIONUCLIDES

The cleanup verification statistical values above background for site-specific parameters are entered into RESRAD for analysis of individual COC river concentrations from residual COC concentrations in soil. The results from each run are compared against MCLs and "National Primary Drinking Water Regulations" (40 CFR 141) requirements.

The individual radionuclide Columbia River RAG is equivalent to the groundwater RAG[1]; therefore, if the individual radionuclide groundwater RAG is attained, the individual Columbia River RAG is also attained. Methodology for attainment of the radionuclide

[1]Because there are no ambient water quality criteria for radionuclides, the groundwater action levels apply to river protection.

groundwater RAGs is described in Section B2.1. Where the groundwater RAG is not attained, the surface water protection action levels are multiplied by the dilution attenuation factor (DAF) for each individual radionuclide. This accounts for half-life decay, transport time, and dilution at the groundwater/Columbia River interface. Calculation of the DAF is described in the RDR/RAWP (DOE-RL 1998). If contaminants do not reach the Columbia River in concentrations exceeding the action levels times the DAF, then Columbia River RAGs are attained.

B3.2 NONRADIONUCLIDES

If the statistical value of a COC is below the background value, it is not considered further in Columbia River protection cleanup verification evaluation, and the Columbia River RAG has been attained.

For hexavalent chromium, a RAG of 2.2 mg/kg (soil value in the deep zone) has been set by the EPA and Ecology (EPA et al. 1997, Ecology 1997) that is protective of the groundwater and the Columbia River. The statistical value is compared to the RAG to show attainment of Columbia River protection for hexavalent chromium.

To determine the RAG for other nonradionuclide contaminants in soils that is protective of the river, the "100 times DAF surface water protection" rule was applied (as a first test) to the river protection action level for each COC. Application of the "100 times DAF surface water protection" rule involves a conversion of river protection action levels (μg/L) to equivalent soil action levels (mg/kg). This calculation is based on a 1 kg/L density conversion factor assumption. The "100 times DAF surface water protection" rule is then applied to provide a soil equivalent RAG that is protective of the Columbia River. The statistical value is then directly compared to the soil equivalent RAG for river protection. If the statistical value is lower, the Columbia River RAGs are attained.

If the statistical value of a COC is determined to be equal to the analytical method PQL, but the PQL is greater than the cleanup RAG, the RAG is considered to have been attained in accordance with WAC 173-340-707. For example, the ambient water quality criterion for PCBs is 0.014 μg/L (or 0.000014 mg/L), which after applying the "100 times DAF surface water protection" rule, provides a soil RAG of 0.0028 mg/kg. Direct comparison of the statistical value to this soil RAG is inappropriate because the PQL at which PCBs are detectable is greater than 0.0028 mg/kg. Therefore, in this case, the PQL for PCB analysis and the corresponding statistical value is considered protective of the groundwater. In cases where the COC analytical PQL is below the RAG, the statistical value is directly compared to the soil equivalent RAG.

If the Columbia River RAG is not attained by these methods, then the statistical values are modeled using RESRAD (as described in Section B2.2) to determine if nonradionuclides reach the groundwater within 1,000 years after remediation. If these nonradionuclides do not reach the groundwater, then they do not reach the Columbia River; thus, Columbia River RAGs are attained.

If RESRAD modeling indicates that contaminants do reach the groundwater within 1,000 years, the travel time in the groundwater underlying the site to the Columbia River is estimated. If contaminants do not reach the Columbia River within 1,000 years in concentrations exceeding the RAGs, then Columbia River remedial action objectives are attained.

B4.0 RISK INFORMATION

The *Model Toxics Control Act* (MTCA) requires the evaluation of risk for multiple pathways of exposure and multiple contaminants. The procedures discussed in this section provide the needed risk information for purposes of the report. Upon the completion of the remedial action of individual waste sites within each 100 Area operable unit, a formal baseline risk assessment will be performed for the entire operable unit or reactor area.

B4.1 NONCARCINOGENS

For noncarcinogenic COCs, MTCA specifies the use of the hazard index, which is defined as daily intake divided by a reference dose (DOE-RL 1995). The cumulative hazard index is the sum of the hazard indexes for the individual COCs.

In the 100 Area cleanup verification packages, the hazard index requirement is addressed as follows. The MTCA Method B cleanup limits are set to be compliant with a hazard index of 1.0; therefore, the ratio of the statistical value from the verification samples to the direct exposure RAG (lookup value obtained from the RDR/RAWP [DOE-RL 1998]) provides a conservative approach for addressing the hazard index. The fraction of cleanup level (Fc) is calculated as follows:

$$Fc = S/V$$

where:

Fc = fraction of cleanup level (dimensionless)
S = statistical value of the COCs (in mg/kg)
V = lookup value (MTCA Method B derived, direct exposure RAG in mg/kg).

If the Fc is less than 1 for an individual COC, then the hazard index has been addressed.

For multiple COCs, a sum of the individual COC Fc values are used to address the cumulative hazard index. The Fc values for all noncarcinogenic COCs are summed. If that sum is less than 1, then the hazard index has been addressed.

B4.2 CARCINOGENS

For individual nonradionuclide carcinogenic COCs, the MTCA Method B cleanup limits are based on an incremental cancer risk of 1×10^{-6}. If a linear relationship is assumed between environmental concentration and risk, the ratio (Fc) of the statistical value from the verification samples divided by the MTCA Method B limit, multiplied by 10^{-6}, is an estimate of the risk associated with the statistical value.

For multiple carcinogenic COCs, the risks of the individual COCs (described above) are summed. If no risk associated with a single COC exceeds 1×10^{-6} and if the sum of the individual COC risks does not exceed 1×10^{-5}, then the MTCA Method B risk requirement has been addressed for this remedial action.

B5.0 REFERENCES

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WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, as amended.

APPENDIX C

DATA QUALITY ASSESSMENT

C1.0 DATA QUALITY ASSESSMENT FOR THE 100-D-48:1/49:1 PIPELINES SITE

C1.1 OVERVIEW

The data quality assessment (DQA) for the 100-D-48:1/49:1 Pipelines site determined that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. Additional quality requirements of the quality assurance project plan included data acquisition requirements. The cleanup verification sample analytical data are stored in the Hanford Environmental Information System and are summarized in Appendix A.

The following subsections describe the DQA process and results for the 100-D-48:1/49:1 Pipelines site, including formal data validation, supplementary data evaluation, and field quality assurance (QA)/quality control (QC) program results.

C1.2 DATA VALIDATION

C1.2.1 Laboratory QA/QC Analysis

All verification samples are subject to laboratory-specific QA requirements, including instrument procurement, maintenance, calibration, and operation. Additional laboratory requirements for internal QC checks are performed as appropriate for the analytical method at a rate of 1 per sample delivery group (SDG), or 1 in 20, whichever is more frequent. Laboratory internal QC checks include the following:

- Matrix-spike duplicates (MSDs). Matrix-spiked (MS) samples require the addition of a known quantity of a representative analyte of interest to the sample as a measure of recovery percentage and as a test of analytical precision.

- Replicate samples. Replicate samples are separate aliquots removed from the same sample container in the laboratory. Replicate samples are a measure of analytical precision.

- QC reference samples. A QC reference sample is prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples are required as an independent check on analytical technique and methodology.

Verification sample laboratories are also subject to periodic and random assessments of the laboratory performance, system, and overall program. These assessments are performed by the Bechtel Hanford, Inc. Quality Assurance group to ensure that the laboratories are performing to meet laboratory contract requirements.

C1.2.2 Data Validation Results

After sampling was completed, all of the fixed-base laboratory data from SDG HO806 were validated to Level C per BHI-EE-01, Procedure 2.5, "Data Package Validation Process." Level C validation procedures are specified in *Data Validation Procedures for Radiochemical Analyses* (WHC 1992a) and *Data Validation Procedures for Chemical Analyses* (WHC 1992b). Validation was performed by Tech Law, Inc. (Tech Law 2000a, 2000b).

Under the Level C validation procedure, the following items were reviewed, as appropriate, for each analytical method:

- Sample holding times
- Method blanks
- MS recovery
- Surrogate recovery
- MS/MSD results
- Sample replicates
- Associated batch laboratory control sample results
- Data package completeness.

Data flagged as estimated (i.e., "J") indicate that the associated concentration is an estimate but that the data may be used for decision-making purposes. Data flagged as below detection limits (i.e., "U") indicate the contaminant was analyzed for but not detected and the concentration is below the minimum detectable activity (MDA) for radionuclides or the practical quantitation limit (PQL) (i.e., reporting limit) for nonradionuclides. For nonradionuclides, nondetects are reported as the PQL. For radionuclides, nondetects report the actual value obtained from analysis (positive or negative but less than the MDA) except for limited analyses where no value can be calculated. In these cases, the MDA is reported. This situation is applicable for sample results that are below detection limits. All other validated results are considered to be accurate within the standard errors associated with the methods.

The adequacy of laboratory QA/QC was evaluated as a subset of the PARCC parameters (i.e., precision, accuracy, representativeness, completeness, and comparability) in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 1998). The organization performing the data validation reported that the laboratory met the target detection limits (TDLs), precision (±30%), accuracy (±30%), and completeness (>90%).

The following is a summary of the data evaluation results for SDG H0806-TR:

- TDL Comparison: Reported analytical detection levels were compared to the TDLs specified in the SAP (DOE-RL 1998). The data validation noted any analyses in which the detection limit (MDA or PQL) was above the SAP TDLs. The reported MDA or PQL was above the TDL for europium-154 in sample B0XXK0. For hexavalent chromium, the PQL is greater than the SAP TDL for all undetected sample results. However, because the reported detection limits are below the RAGs, all results qualified as undetected ("U") are also below the RAGs; therefore, the data are suitable for decision-making purposes.

- Evaluation of Method Blanks: The method blank results were less than detection for all contaminants of concern (COCs). All blank results were acceptable.

- MS/MSD Analysis: The percent recoveries and relative percent differences (RPDs) were within acceptable limits for all COCs.

- Completeness: Because of R qualified (rejected) data for non-COC analytes, the completion rate for the validated data package was 98%.

- Summary of deficiencies noted during validation:

  - *Radiochemistry* (Gamma Energy Analysis, Total Radioactive Strontium, Plutonium Isotopic). The DQA noted no major deficiencies for gamma, total radioactive strontium, or plutonium (isotopic) during analyses of the site. Minor deficiencies resulted in some samples being flagged as "J". Additional minor deficiencies included a description of analytes with PQLs greater than their TDLs. These minor deficiencies still allow the data to be used for decision-making purposes.

  - *Nonradionuclides*. No major deficiencies were noted for nonradionuclides. Minor deficiencies included a description of analytes with PQLs greater than their TDLs. These minor deficiencies still allow the data to be used for decision-making purposes.

C1.3 SUPPLEMENTARY DATA EVALUATION

The formal data validation described in the previous section included evaluation of only one SDG; however, DQA is required for all SDGs. Therefore, supplementary data evaluation was performed on the remaining SDGs. The following paragraphs include the results of the supplementary data evaluation of all SDGs.

To ensure adequate data quality, DQA investigators reviewed the study objectives in the SAP (DOE-RL 1998) to determine the context for analyzing the data. The context for analyzing the data includes evaluating the sample data using the statistical

methodology of the SAP and a comparison of analytical results to the PARCC parameters as specified in the SAP (DOE-RL 1998). This section summarizes the results of that comparison and presents an evaluation of the affected data.

- TDL Comparison: Reported analytical detection levels were compared to the TDLs specified in the SAP (DOE-RL 1998). The data validation and supplemental data evaluation noted any analyses in which the detection limit (MDA or PQL) was above the SAP TDLs. The following analytes were reported above their TDL: europium-154 (B0XXK0, B0XXM9, B0XXN2, B0XXN5, B0XXN6, and B0XXP0), europium-152 in sample B0XXN5, plutonium-239/240 in samples B0XXP0 and B0XXP1. For hexavalent chromium, the PQL is greater than the SAP TDL for all undetected sample results except B0XXP2. However, because the reported values are sufficiently less than the RAGs, the associated data are of sufficient quality for decision-making purposes. All other analyses had detection limits or MDAs below the TDL.

- MS/MSD Analysis: Analytical accuracy and precision were evaluated by examination of the percent recovery and RPD between the main and duplicate samples. Only the COCs detected at five times the detection limit (or greater) are used for data analysis with regards to accuracy and precision. Because of an RPD of 44%, all uranium-238 results in all samples were qualified as estimates and flagged as "J."

C1.4 FIELD QA/QC

Field QA/QC measures were used to assess potential sources of error and cross-contamination of soil samples that could bias results. The QA/QC sample results are used to assess analytical precision and accuracy. Field QA/QC samples included one equipment blank (sample B0XXN1), two field duplicate samples (sample B0XXN0, duplicate of shallow zone sample B0XXM9, and sample B0XXJ9, duplicate of deep zone sample B0XXJ8), and two field split samples (sample B0XXP2, split of shallow zone sample B0XXM9, and sample B0XXM1, split of deep zone sample B0XXJ8). All main and QA/QC sample results are presented in Appendix A.

C1.4.1 Field Blank Samples

Field blank samples were collected as part of the QA/QC measures. The blank sample results for this site were less than detection for all COCs.

C1.4.2 Field Duplicate Samples

Duplicate samples were collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the duplicate samples for each COC. Only analytes with values

above five times the detection limits for both the main and duplicate samples are compared.

Two sample duplicate pairs (B0XXN0/B0XXM9 and B0XXJ9/B0XXJ8) were submitted for analysis. The samples were compared using the criteria described above. The radiochemistry field duplicate results for sample pair B0XXJ9/B0XXJ8 indicated the RPD for uranium-233/234 was outside QC limits (56%). All other field duplicate results were acceptable.

Difficulty in producing truly homogeneous soil mixtures containing actinide contamination is well known. Actinides are typically present as alpha-emitting particles that have a natural tendency to accumulate in discrete portions of the matrix. Even distribution of the contaminants throughout the matrix is not likely to occur in nature and is difficult to achieve in prepared standard materials. The possibility of getting an actinide hot spot in a subfraction of a sample is significant, even in prepared standard materials. The RPDs for actinides in the duplicate samples are most likely due to sample heterogeneity. Additional data need to be compared to determine if a true trend exists (which has not been systematically performed to date). Based on guidance from Environmental Restoration Contractor radiochemists, this does not affect the usefulness of the data.

C1.4.3 Field Split Samples

Split samples were collected to provide a relative measure of the degree of variability in the sampling, sample handling, and analytical techniques used by commercial laboratories. The field main and split samples are evaluated by computing the RPD of the split samples for each COC to determine the usability of the verification data. The U.S. Environmental Protection Agency (EPA) Contract Laboratory Program duplicate sample comparison methodology, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994), is used as an initial test of the data from the splits. Only analytes that had values above five times the detection limits for both the main and split sample were compared.

Two field split samples (sample B0XXP2/B0XXM9 and sample B0XXM1/B0XXJ8) were taken.

For radionuclides the RPD results for all splits are within the +/-30% range with the exceptions noted below. The plutonium-239/240, uranium-233/234, and uranium-238 RPDs for B0XXJ8 and split B0XXM1 are 83%, 49% and 47%, respectively. The out-of-limit RPDs are most likely because of sample heterogeneity. As discussed previously, difficulty in producing truly homogeneous soil mixtures containing actinides is a contributing factor for the plutonium-239/240, uranium-233/234, and uranium-238 RPDs.

Field QA/QC sample results tend to suggest a limited degree of heterogeneity with regard to the COCs of interest. Variance analysis (Appendix D) indicates that the number of samples taken is sufficient for site verification. The use of statistical values

described in Section 5.0 is used to compensate for COC variance at the site and ensure that decisions are made within acceptable error tolerance.

For hexavalent chromium the main split B0XXM9/B0XXP2 sample pair were within control limits and the main/split B0XXJ8/B0XXM1 sample pair were outside of control limits. As a result, additional hexavalent analyses were conducted on the B0XXJ8/B0XXM1 sample pair by the main and split laboratories (Thermo-RECRA and Severn Trent) and the regulatory agency laboratory (Paragon). The results of the additional analyses were inconclusive in resolving the discrepancy. The additional analyses results are documented in a December 27, 2000 memorandum (BHI 2000b). The B0XXJ8/B0XXM1 sample pair were collected from deep zone sampling area C2. Based on regulatory agency agreement, additional samples were collected from sampling area C2 and analyzed by another laboratory (Southwest Research Institute). These results were used, in agreement with the regulatory agency, to represent the hexavalent chromium concentration of sampling area C2 (see Appendix A, Table A-2).

C1.5 SUITABILITY OF DATA

The conclusion of the DQA is that the data are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and SDG completeness were analyzed to determine if any analytical results should be rejected as a result of QA/QC deficiencies. All COC analytical data were found to be acceptable for decision-making purposes, and the raw data are acceptable for calculating the required statistical values.

C2.0 REFERENCES

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APPENDIX D

RESRAD INPUT PARAMETERS AND CALCULATION BRIEF EXCERPTS

RESRAD INPUT PARAMETERS

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Dose Conversion Factor (and Related) Parameter Summary
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(2)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(4)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(6)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(7)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(8)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(9)
B-1	Pu-240	4.290E-01	4.290E-01	DCF2(10)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(11)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(12)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(13)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(14)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(15)
B-1	U-236	1.250E-01	1.250E-01	DCF2(16)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(2)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(4)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(6)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(7)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(8)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(9)
D-1	Pu-240	3.540E-03	3.540E-03	DCF3(10)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(11)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(12)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(13)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(14)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(15)
D-1	U-236	2.690E-04	2.690E-04	DCF3(16)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(2,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(2,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(2,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(4,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(4,3)

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(7,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(8,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(8,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(9,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(10,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(11,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(11,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(11,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(12,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(12,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(12,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(13,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(13,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(13,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(14,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(14,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(14,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(15,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(15,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(2,2)

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(6,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(7,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(7,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(8,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(9,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(9,2)
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(11,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(11,2)
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(12,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(13,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(13,2)
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(14,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(14,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(15,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(15,2)
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)

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File : D48&49-1.RAD

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.550E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.600E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	7.500E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	7.700E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.800E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	4.200E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.380E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Co-60	5.000E-02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.510E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Eu-152	3.000E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-154	1.200E-01	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.050E-01	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): Pu-240	2.500E-02	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.500E-01	0.000E+00	---	S1(12)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(12)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.500E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	1.340E+01	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	1.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.166E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.166E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.323E-04	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.397E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.316E-05	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.166E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.085E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.119E-03	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.119E-03	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	8.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.000E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

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Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.100E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	2.700E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	1.000E+02	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	3.600E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.775E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.775E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)

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Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS

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Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

```
1RESRAD, Version 5.91     T« Limit = 0.5 year       08/23/2000  15:43  Page  12
 Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
 File    : D48&49-1.RAD

      Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g
      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ            ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
        Area:  15504.00 square meters                Co-60       5.000E-02
   Thickness:      4.60 meters                       Cs-137      2.510E-01
 Cover Depth:      0.00 meters                       Eu-152      3.000E-01
                                                     Eu-154      1.200E-01
                                                     Pu-239      1.050E-01
                                                     Pu-240      2.500E-02
                                                     Sr-90       1.500E-01
0
                                                  Total Dose TDOSE(t), mrem/yr
                                            Basic Radiation Dose Limit =  15 mrem/yr
                             Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
                             ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    t (years):  0.000E+00  1.000E+00  7.700E+00  1.000E+01  1.800E+01  4.200E+01  1.380E+02  3.000E+02  1.000E+03
     TDOSE(t):  3.708E+00  3.501E+00  2.454E+00  2.195E+00  1.541E+00  6.567E-01  8.795E-02  4.226E-02  3.857E-02
         M(t):  2.472E-01  2.334E-01  1.636E-01  1.464E-01  1.027E-01  4.378E-02  5.864E-03  2.817E-03  2.572E-03
0Maximum TDOSE(t):  3.708E+00 mrem/yr    at t = 0.000E+00 years
```

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/23/2000 15:43 Page 13
Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	5.207E-01	0.1404	4.626E-07	0.0000	0.000E+00	0.0000	6.063E-03	0.0016	4.459E-03	0.0012	1.022E-03	0.0003	3.927E-05
Cs-137	5.476E-01	0.1477	3.383E-07	0.0000	0.000E+00	0.0000	2.829E-02	0.0076	3.384E-02	0.0091	2.102E-02	0.0057	3.665E-04
Eu-152	1.350E+00	0.3641	2.801E-06	0.0000	0.000E+00	0.0000	2.739E-04	0.0001	7.272E-05	0.0000	1.922E-06	0.0000	5.676E-05
Eu-154	5.928E-01	0.1599	1.450E-06	0.0000	0.000E+00	0.0000	1.615E-04	0.0000	4.287E-05	0.0000	1.133E-06	0.0000	3.346E-05
Pu-239	2.030E-05	0.0000	1.903E-03	0.0005	0.000E+00	0.0000	2.096E-02	0.0057	5.895E-04	0.0002	1.600E-05	0.0000	1.085E-02
Pu-240	2.474E-06	0.0000	4.531E-04	0.0001	0.000E+00	0.0000	4.991E-03	0.0013	1.403E-04	0.0000	3.809E-06	0.0000	2.584E-03
Sr-90	2.509E-03	0.0007	8.302E-06	0.0000	0.000E+00	0.0000	3.880E-01	0.1046	1.071E-01	0.0289	6.049E-02	0.0163	6.701E-04
Total	3.014E+00	0.8127	2.370E-03	0.0006	0.000E+00	0.0000	4.487E-01	0.1210	1.462E-01	0.0394	8.255E-02	0.0223	1.460E-02

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.323E-01
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.311E-01
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.350E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.930E-01
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.434E-02
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.175E-03
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.587E-01
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.708E+00

0*Sum of all water independent and dependent pathways.

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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
Co-60	4.564E-01	0.1304	4.055E-07	0.0000	0.000E+00	0.0000	5.315E-03	0.0015	3.909E-03	0.0011	8.957E-04	0.0003	3.443E-05 0.0000
Cs-137	5.350E-01	0.1528	3.305E-07	0.0000	0.000E+00	0.0000	2.764E-02	0.0079	3.306E-02	0.0094	2.053E-02	0.0059	3.580E-04 0.0001
Eu-152	1.281E+00	0.3660	2.659E-06	0.0000	0.000E+00	0.0000	2.601E-04	0.0001	6.904E-05	0.0000	1.825E-06	0.0000	5.389E-05 0.0000
Eu-154	5.479E-01	0.1565	1.340E-06	0.0000	0.000E+00	0.0000	1.493E-04	0.0000	3.962E-05	0.0000	1.047E-06	0.0000	3.093E-05 0.0000
Pu-239	2.030E-05	0.0000	1.903E-03	0.0005	0.000E+00	0.0000	2.096E-02	0.0060	5.894E-04	0.0002	1.600E-05	0.0000	1.085E-02 0.0031
Pu-240	2.474E-06	0.0000	4.531E-04	0.0001	0.000E+00	0.0000	4.990E-03	0.0014	1.403E-04	0.0000	3.808E-06	0.0000	2.584E-03 0.0007
Sr-90	2.449E-03	0.0007	8.103E-06	0.0000	0.000E+00	0.0000	3.787E-01	0.1082	1.045E-01	0.0299	5.904E-02	0.0169	6.541E-04 0.0002
Total	2.823E+00	0.8064	2.369E-03	0.0007	0.000E+00	0.0000	4.380E-01	0.1251	1.423E-01	0.0407	8.049E-02	0.0230	1.457E-02 0.0042

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.666E-01 0.1333
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.166E-01 0.1761
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.282E+00 0.3661
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.481E-01 0.1566
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.434E-02 0.0098
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.174E-03 0.0023
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.454E-01 0.1558
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.501E+00 1.0000

0*Sum of all water independent and dependent pathways.

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File : D48&49-1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.700E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	1.888E-01	0.0769	1.678E-07	0.0000	0.000E+00	0.0000	2.199E-03	0.0009	1.617E-03	0.0007	3.706E-04	0.0002	1.424E-05
Cs-137	4.576E-01	0.1865	2.827E-07	0.0000	0.000E+00	0.0000	2.364E-02	0.0096	2.827E-02	0.0115	1.756E-02	0.0072	3.062E-04
Eu-152	9.042E-01	0.3684	1.876E-06	0.0000	0.000E+00	0.0000	1.835E-04	0.0001	4.871E-05	0.0000	1.287E-06	0.0000	3.802E-05
Eu-154	3.231E-01	0.1316	7.903E-07	0.0000	0.000E+00	0.0000	8.802E-05	0.0000	2.337E-05	0.0000	6.175E-07	0.0000	1.824E-05
Pu-239	2.029E-05	0.0000	1.902E-03	0.0008	0.000E+00	0.0000	2.095E-02	0.0085	5.891E-04	0.0002	1.599E-05	0.0000	1.085E-02
Pu-240	2.471E-06	0.0000	4.526E-04	0.0002	0.000E+00	0.0000	4.985E-03	0.0020	1.402E-04	0.0001	3.804E-06	0.0000	2.581E-03
Sr-90	2.082E-03	0.0008	6.889E-06	0.0000	0.000E+00	0.0000	3.219E-01	0.1312	8.886E-02	0.0362	5.019E-02	0.0205	5.561E-04
Total	1.876E+00	0.7643	2.364E-03	0.0010	0.000E+00	0.0000	3.740E-01	0.1524	1.196E-01	0.0487	6.815E-02	0.0278	1.436E-02

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.700E+00 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.930E-01
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.274E-01
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.044E-01
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.232E-01
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.432E-02
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.165E-03
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.636E-01
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.454E+00

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T* Limit = 0.5 year 08/23/2000 15:43 Page 16
Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	fract.
Co-60	1.395E-01	0.0635	1.239E-07	0.0000	0.000E+00	0.0000	1.624E-03	0.0007	1.195E-03	0.0005	2.737E-04	0.0001	1.052E-05	0.0000
Cs-137	4.337E-01	0.1975	2.679E-07	0.0000	0.000E+00	0.0000	2.240E-02	0.0102	2.680E-02	0.0122	1.664E-02	0.0076	2.902E-04	0.0001
Eu-152	8.021E-01	0.3654	1.664E-06	0.0000	0.000E+00	0.0000	1.628E-04	0.0001	4.321E-05	0.0000	1.142E-06	0.0000	3.373E-05	0.0000
Eu-154	2.695E-01	0.1228	6.593E-07	0.0000	0.000E+00	0.0000	7.342E-05	0.0000	1.949E-05	0.0000	5.152E-07	0.0000	1.521E-05	0.0000
Pu-239	2.029E-05	0.0000	1.902E-03	0.0009	0.000E+00	0.0000	2.094E-02	0.0095	5.890E-04	0.0003	1.598E-05	0.0000	1.084E-02	0.0049
Pu-240	2.471E-06	0.0000	4.524E-04	0.0002	0.000E+00	0.0000	4.983E-03	0.0023	1.401E-04	0.0001	3.803E-06	0.0000	2.580E-03	0.0012
Sr-90	1.969E-03	0.0009	6.515E-06	0.0000	0.000E+00	0.0000	3.045E-01	0.1387	8.405E-02	0.0383	4.747E-02	0.0216	5.259E-04	0.0002
Total	1.647E+00	0.7501	2.363E-03	0.0011	0.000E+00	0.0000	3.547E-01	0.1615	1.128E-01	0.0514	6.441E-02	0.0293	1.430E-02	0.0065

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	fract.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.426E-01	0.0649
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.998E-01	0.2277
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.024E-01	0.3655
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.696E-01	0.1228
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.432E-02	0.0156
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.162E-03	0.0037
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.385E-01	0.1997
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.195E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/23/2000 15:43 Page 17
Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.800E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Co-60	4.863E-02	0.0316	4.321E-08	0.0000	0.000E+00	0.0000	5.663E-04	0.0004	4.165E-04	0.0003	9.543E-05	0.0001	3.668E-06	0.0000
Cs-137	3.599E-01	0.2336	2.223E-07	0.0000	0.000E+00	0.0000	1.859E-02	0.0121	2.224E-02	0.0144	1.381E-02	0.0090	2.408E-04	0.0002
Eu-152	5.289E-01	0.3433	1.098E-06	0.0000	0.000E+00	0.0000	1.073E-04	0.0001	2.850E-05	0.0000	7.531E-07	0.0000	2.224E-05	0.0000
Eu-154	1.435E-01	0.0931	3.509E-07	0.0000	0.000E+00	0.0000	3.908E-05	0.0000	1.038E-05	0.0000	2.742E-07	0.0000	8.098E-06	0.0000
Pu-239	2.027E-05	0.0000	1.900E-03	0.0012	0.000E+00	0.0000	2.093E-02	0.0136	5.886E-04	0.0004	1.597E-05	0.0000	1.084E-02	0.0070
Pu-240	2.467E-06	0.0000	4.518E-04	0.0003	0.000E+00	0.0000	4.977E-03	0.0032	1.399E-04	0.0001	3.798E-06	0.0000	2.577E-03	0.0017
Sr-90	1.622E-03	0.0011	5.367E-06	0.0000	0.000E+00	0.0000	2.508E-01	0.1628	6.923E-02	0.0449	3.911E-02	0.0254	4.332E-04	0.0003
Total	1.083E+00	0.7026	2.359E-03	0.0015	0.000E+00	0.0000	2.960E-01	0.1921	9.265E-02	0.0601	5.303E-02	0.0344	1.412E-02	0.0092

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.800E+01 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.971E-02	0.0323
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.148E-01	0.2692
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.291E-01	0.3434
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.435E-01	0.0931
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.429E-02	0.0223
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.151E-03	0.0053
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.612E-01	0.2344
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.541E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/23/2000 15:43 Page 18
Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.200E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	2.060E-03	0.0031	1.831E-09	0.0000	0.000E+00	0.0000	2.399E-05	0.0000	1.765E-05	0.0000	4.044E-06	0.0000	1.554E-07
Cs-137	2.056E-01	0.3131	1.270E-07	0.0000	0.000E+00	0.0000	1.062E-02	0.0162	1.271E-02	0.0193	7.892E-03	0.0120	1.376E-04
Eu-152	1.517E-01	0.2309	3.147E-07	0.0000	0.000E+00	0.0000	3.077E-05	0.0000	8.170E-06	0.0000	2.159E-07	0.0000	6.377E-06
Eu-154	2.164E-02	0.0329	5.292E-08	0.0000	0.000E+00	0.0000	5.894E-06	0.0000	1.565E-06	0.0000	4.135E-08	0.0000	1.221E-06
Pu-239	2.023E-05	0.0000	1.896E-03	0.0029	0.000E+00	0.0000	2.089E-02	0.0318	5.874E-04	0.0009	1.594E-05	0.0000	1.082E-02
Pu-240	2.458E-06	0.0000	4.501E-04	0.0007	0.000E+00	0.0000	4.957E-03	0.0075	1.394E-04	0.0002	3.784E-06	0.0000	2.567E-03
Sr-90	9.067E-04	0.0014	3.000E-06	0.0000	0.000E+00	0.0000	1.402E-01	0.2135	3.870E-02	0.0589	2.186E-02	0.0333	2.422E-04
Total	3.819E-01	0.5816	2.350E-03	0.0036	0.000E+00	0.0000	1.767E-01	0.2691	5.216E-02	0.0794	2.978E-02	0.0453	1.377E-02

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.200E+01 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.106E-03
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.370E-01
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.517E-01
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.164E-02
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.422E-02
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.120E-03
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.019E-01
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.567E-01

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T< Limit = 0.5 year 08/23/2000 15:43 Page 19
Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.380E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	6.642E-09	0.0000	5.902E-15	0.0000	0.000E+00	0.0000	7.735E-11	0.0000	5.689E-11	0.0000	1.304E-11	0.0000	5.010E-13
Cs-137	2.192E-02	0.2492	1.354E-08	0.0000	0.000E+00	0.0000	1.132E-03	0.0129	1.354E-03	0.0154	8.411E-04	0.0096	1.467E-05
Eu-152	1.025E-03	0.0117	2.126E-09	0.0000	0.000E+00	0.0000	2.080E-07	0.0000	5.521E-08	0.0000	1.459E-09	0.0000	4.309E-08
Eu-154	1.119E-05	0.0001	2.738E-11	0.0000	0.000E+00	0.0000	3.049E-09	0.0000	8.095E-10	0.0000	2.139E-11	0.0000	6.319E-10
Pu-239	2.008E-05	0.0002	1.881E-03	0.0214	0.000E+00	0.0000	2.072E-02	0.2356	5.827E-04	0.0066	1.582E-05	0.0002	1.073E-02
Pu-240	2.420E-06	0.0000	4.432E-04	0.0050	0.000E+00	0.0000	4.882E-03	0.0555	1.373E-04	0.0016	3.726E-06	0.0000	2.528E-03
Sr-90	8.852E-05	0.0010	2.929E-07	0.0000	0.000E+00	0.0000	1.369E-02	0.1556	3.778E-03	0.0430	2.134E-03	0.0243	2.364E-05
Total	2.306E-02	0.2622	2.325E-03	0.0264	0.000E+00	0.0000	4.042E-02	0.4596	5.852E-03	0.0665	2.995E-03	0.0340	1.330E-02

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.380E+02 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.790E-09
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.526E-02
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.025E-03
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.120E-05
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.395E-02
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.996E-03
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.971E-02
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.795E-02

*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/23/2000 15:43 Page 20
Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	3.591E-18	0.0000	3.190E-24	0.0000	0.000E+00	0.0000	4.181E-20	0.0000	3.075E-20	0.0000	7.047E-21	0.0000	2.708E-22
Cs-137	5.011E-04	0.0119	3.096E-10	0.0000	0.000E+00	0.0000	2.589E-05	0.0006	3.096E-05	0.0007	1.923E-05	0.0005	3.354E-07
Eu-152	2.230E-07	0.0000	4.629E-13	0.0000	0.000E+00	0.0000	4.526E-11	0.0000	1.202E-11	0.0000	3.176E-13	0.0000	9.379E-12
Eu-154	3.187E-11	0.0000	7.797E-17	0.0000	0.000E+00	0.0000	8.684E-15	0.0000	2.305E-15	0.0000	6.092E-17	0.0000	1.799E-15
Pu-239	1.981E-05	0.0005	1.856E-03	0.0439	0.000E+00	0.0000	2.045E-02	0.4839	5.750E-04	0.0136	1.560E-05	0.0004	1.059E-02
Pu-240	2.358E-06	0.0001	4.319E-04	0.0102	0.000E+00	0.0000	4.757E-03	0.1126	1.338E-04	0.0032	3.631E-06	0.0001	2.463E-03
Sr-90	1.746E-06	0.0000	5.776E-09	0.0000	0.000E+00	0.0000	2.699E-04	0.0064	7.450E-05	0.0018	4.208E-05	0.0010	4.662E-07
Total	5.253E-04	0.0124	2.288E-03	0.0541	0.000E+00	0.0000	2.550E-02	0.6034	8.142E-04	0.0193	8.055E-05	0.0019	1.305E-02

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.670E-18
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.775E-04
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.231E-07
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.189E-11
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.350E-02
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.791E-03
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.887E-04
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.226E-02

0*Sum of all water independent and dependent pathways.

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Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	4.074E-11	0.0000	2.517E-17	0.0000	0.000E+00	0.0000	2.105E-12	0.0000	2.517E-12	0.0000	1.564E-12	0.0000	2.726E-14
Eu-152	3.341E-23	0.0000	1.047E-16	0.0000	0.000E+00	0.0000	2.313E-16	0.0000	6.140E-17	0.0000	1.623E-18	0.0000	4.793E-17
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	1.869E-05	0.0005	1.751E-03	0.0454	0.000E+00	0.0000	1.929E-02	0.5001	5.425E-04	0.0141	1.472E-05	0.0004	9.989E-03
Pu-240	2.108E-06	0.0001	3.860E-04	0.0100	0.000E+00	0.0000	4.252E-03	0.1102	1.196E-04	0.0031	3.246E-06	0.0001	2.201E-03
Sr-90	7.486E-14	0.0000	2.477E-16	0.0000	0.000E+00	0.0000	1.157E-11	0.0000	3.195E-12	0.0000	1.805E-12	0.0000	1.999E-14
ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ
Total	2.080E-05	0.0005	2.137E-03	0.0554	0.000E+00	0.0000	2.354E-02	0.6103	6.620E-04	0.0172	1.797E-05	0.0005	1.219E-02

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.696E-11
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.469E-16
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	3.118E-07	0.0000	2.722E-09	0.0000	0.000E+00	0.0000	3.448E-08	0.0000	2.467E-09	0.0000	9.992E-09	0.0000	3.161E-02
Pu-240	2.023E-06	0.0001	1.231E-08	0.0000	0.000E+00	0.0000	2.236E-07	0.0000	1.364E-08	0.0000	6.948E-08	0.0000	6.966E-03
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.667E-11
ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ
Total	2.334E-06	0.0001	1.503E-08	0.0000	0.000E+00	0.0000	2.581E-07	0.0000	1.610E-08	0.0000	7.947E-08	0.0000	3.857E-02

0*Sum of all water independent and dependent pathways.

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Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.065E+01	9.331E+00	3.861E+00	2.852E+00	9.942E-01	4.213E-02	1.358E-07	7.341E-17	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.514E+00	2.456E+00	2.101E+00	1.991E+00	1.652E+00	9.442E-01	1.006E-01	2.301E-03	1.871E-10
0Eu-152	Eu-152	7.208E-01	3.244E+00	3.080E+00	2.173E+00	1.928E+00	1.271E+00	3.645E-01	2.463E-03	5.360E-07	8.029E-23
0Eu-152	Eu-152	2.792E-01	1.257E+00	1.193E+00	8.417E-01	7.468E-01	4.924E-01	1.412E-01	9.540E-04	2.076E-07	3.110E-23
Eu-152	Gd-152	2.792E-01	0.000E+00	7.654E-17	4.983E-16	6.123E-16	9.177E-16	1.339E-15	1.506E-15	1.504E-15	1.490E-15
Eu-152	ãDSR(j)		1.257E+00	1.193E+00	8.417E-01	7.468E-01	4.924E-01	1.412E-01	9.540E-04	2.076E-07	1.490E-15
0Eu-154	Eu-154	1.000E+00	4.942E+00	4.567E+00	2.693E+00	2.247E+00	1.196E+00	1.804E-01	9.331E-05	2.657E-10	2.900E-34
0Pu-239	Pu-239	1.000E+00	3.271E-01	3.271E-01	3.269E-01	3.268E-01	3.266E-01	3.259E-01	3.234E-01	3.190E-01	3.010E-01
Pu-239	U-235	1.000E+00	0.000E+00	5.417E-10	4.106E-09	5.301E-09	9.349E-09	2.053E-08	5.351E-08	8.213E-08	3.299E-06
Pu-239	Pa-231	1.000E+00	0.000E+00	7.840E-14	4.947E-12	8.331E-12	2.671E-11	1.397E-10	1.284E-09	4.731E-09	8.196E-08
Pu-239	Ac-227	1.000E+00	0.000E+00	5.591E-16	2.007E-13	4.273E-13	2.293E-12	2.358E-11	4.282E-10	1.983E-09	1.949E-07
Pu-239	ãDSR(j)		3.271E-01	3.271E-01	3.269E-01	3.268E-01	3.266E-01	3.259E-01	3.234E-01	3.190E-01	3.010E-01
0Pu-240	Pu-240	1.000E+00	3.270E-01	3.269E-01	3.266E-01	3.265E-01	3.261E-01	3.248E-01	3.198E-01	3.116E-01	2.786E-01
Pu-240	U-236	1.000E+00	0.000E+00	1.765E-09	1.357E-08	1.752E-08	3.091E-08	6.784E-08	1.761E-07	2.681E-07	9.397E-05
Pu-240	Th-232	1.000E+00	0.000E+00	2.382E-19	1.327E-17	2.225E-17	7.088E-17	3.694E-16	3.398E-15	1.260E-14	3.068E-13
Pu-240	Ra-228	1.000E+00	0.000E+00	2.015E-19	7.986E-17	1.646E-16	7.878E-16	6.210E-15	7.455E-14	2.948E-13	1.831E-12
Pu-240	Th-228	1.000E+00	0.000E+00	1.670E-20	3.220E-17	7.716E-17	4.824E-16	4.740E-15	6.353E-14	2.570E-13	1.454E-12
Pu-240	ãDSR(j)		3.270E-01	3.269E-01	3.266E-01	3.265E-01	3.261E-01	3.248E-01	3.198E-01	3.116E-01	2.787E-01
0Sr-90	Sr-90	1.000E+00	3.725E+00	3.636E+00	3.091E+00	2.923E+00	2.408E+00	1.346E+00	1.314E-01	2.591E-03	1.111E-10

*Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life < 0.5 yr) daughters.
0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
Co-60	1.409E+00	1.607E+00	3.885E+00	5.260E+00	1.509E+01	3.561E+02	1.105E+08	*1.131E+15	*1.131E+15
Cs-137	5.966E+00	6.106E+00	7.139E+00	7.532E+00	9.077E+00	1.589E+01	1.491E+02	6.519E+03	8.018E+10
Eu-152	3.332E+00	3.511E+00	4.975E+00	5.608E+00	8.505E+00	2.966E+01	4.390E+03	2.017E+07	*1.765E+14
Eu-154	3.035E+00	3.284E+00	5.569E+00	6.676E+00	1.254E+01	8.316E+01	1.607E+05	5.645E+10	*2.639E+14
Pu-239	4.586E+01	4.586E+01	4.589E+01	4.590E+01	4.593E+01	4.602E+01	4.639E+01	4.702E+01	4.983E+01
Pu-240	4.587E+01	4.588E+01	4.593E+01	4.595E+01	4.600E+01	4.618E+01	4.690E+01	4.813E+01	5.383E+01
Sr-90	4.027E+00	4.126E+00	4.853E+00	5.131E+00	6.229E+00	1.114E+01	1.141E+02	5.788E+03	1.350E+11

*At specific activity limit

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Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	5.000E-02	0.000E+00	1.065E+01	1.409E+00	1.065E+01	1.409E+00
Cs-137	2.510E-01	0.000E+00	2.514E+00	5.966E+00	2.514E+00	5.966E+00
Eu-152	3.000E-01	0.000E+00	4.501E+00	3.332E+00	4.501E+00	3.332E+00
Eu-154	1.200E-01	0.000E+00	4.942E+00	3.035E+00	4.942E+00	3.035E+00
Pu-239	1.050E-01	0.000E+00	3.271E-01	4.586E+01	3.271E-01	4.586E+01
Pu-240	2.500E-02	0.000E+00	3.270E-01	4.587E+01	3.270E-01	4.587E+01
Sr-90	1.500E-01	0.000E+00	3.725E+00	4.027E+00	3.725E+00	4.027E+00

1RESRAD, Version 5.91 T* Limit = 0.5 year 08/23/2000 15:43 Page 24
Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	5.323E-01	4.666E-01	1.930E-01	1.426E-01	4.971E-02	2.106E-03	6.790E-09	3.670E-18	0.000E+00
0Cs-137	Cs-137	1.000E+00	6.311E-01	6.166E-01	5.274E-01	4.998E-01	4.148E-01	2.370E-01	2.526E-02	5.775E-04	4.696E-11
0Eu-152	Eu-152	7.208E-01	9.733E-01	9.240E-01	6.519E-01	5.784E-01	3.814E-01	1.093E-01	7.389E-04	1.608E-07	2.409E-23
Eu-152	Eu-152	2.792E-01	3.770E-01	3.579E-01	2.525E-01	2.240E-01	1.477E-01	4.235E-02	2.862E-04	6.229E-08	9.330E-24
Eu-152	ãDOSE(j):		1.350E+00	1.282E+00	9.044E-01	8.024E-01	5.291E-01	1.517E-01	1.025E-03	2.231E-07	3.342E-23
0Gd-152	Eu-152	2.792E-01	0.000E+00	2.296E-17	1.495E-16	1.837E-16	2.753E-16	4.017E-16	4.517E-16	4.511E-16	4.469E-16
0Eu-154	Eu-154	1.000E+00	5.930E-01	5.481E-01	3.232E-01	2.696E-01	1.435E-01	2.164E-02	1.120E-05	3.189E-11	0.000E+00
0Pu-239	Pu-239	1.000E+00	3.434E-02	3.434E-02	3.432E-02	3.432E-02	3.429E-02	3.422E-02	3.395E-02	3.350E-02	3.161E-02
0U-235	Pu-239	1.000E+00	0.000E+00	5.688E-11	4.312E-10	5.567E-10	9.817E-10	2.155E-09	5.618E-09	8.623E-09	3.464E-07
0Pa-231	Pu-239	1.000E+00	0.000E+00	8.232E-15	5.195E-13	8.748E-13	2.804E-12	1.467E-11	1.348E-10	4.967E-10	8.606E-09
0Ac-227	Pu-239	1.000E+00	0.000E+00	5.870E-17	2.108E-14	4.486E-14	2.408E-13	2.476E-12	4.496E-11	2.082E-10	2.046E-08
0Pu-240	Pu-240	1.000E+00	8.175E-03	8.174E-03	8.165E-03	8.162E-03	8.151E-03	8.120E-03	7.996E-03	7.791E-03	6.964E-03
0U-236	Pu-240	1.000E+00	0.000E+00	4.412E-11	3.392E-10	4.381E-10	7.729E-10	1.696E-09	4.404E-09	6.703E-09	2.349E-06
0Th-232	Pu-240	1.000E+00	0.000E+00	5.955E-21	3.317E-19	5.562E-19	1.772E-18	9.236E-18	8.496E-17	3.150E-16	7.671E-15
0Ra-228	Pu-240	1.000E+00	0.000E+00	5.036E-21	1.996E-18	4.116E-18	1.970E-17	1.552E-16	1.864E-15	7.369E-15	4.578E-14
0Th-228	Pu-240	1.000E+00	0.000E+00	4.175E-22	8.051E-19	1.929E-18	1.206E-17	1.185E-16	1.588E-15	6.424E-15	3.635E-14
0Sr-90	Sr-90	1.000E+00	5.587E-01	5.454E-01	4.636E-01	4.385E-01	3.612E-01	2.019E-01	1.971E-02	3.887E-04	1.667E-11

BRF(i) is the branch fraction of the parent nuclide.

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Summary : 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1)
File : D48&49-1.RAD

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Co-60	Co-60	1.000E+00	5.000E-02	4.383E-02	1.813E-02	1.339E-02	4.670E-03	1.979E-04	6.379E-10	3.448E-19	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.510E-01	2.452E-01	2.097E-01	1.988E-01	1.650E-01	9.425E-02	1.005E-02	2.297E-04	1.867E-11
0Eu-152	Eu-152	7.208E-01	2.162E-01	2.053E-01	1.448E-01	1.285E-01	8.473E-02	2.429E-02	1.642E-04	3.573E-08	5.351E-24
Eu-152	Eu-152	2.792E-01	8.376E-02	7.951E-02	5.610E-02	4.977E-02	3.282E-02	9.409E-03	6.358E-05	1.384E-08	2.073E-24
Eu-152	äS(j):		3.000E-01	2.848E-01	2.009E-01	1.783E-01	1.175E-01	3.370E-02	2.277E-04	4.957E-08	7.424E-24
0Gd-152	Eu-152	2.792E-01	0.000E+00	5.238E-16	3.410E-15	4.191E-15	6.280E-15	9.164E-15	1.030E-14	1.029E-14	1.019E-14
0Eu-154	Eu-154	1.000E+00	1.200E-01	1.109E-01	6.540E-02	5.456E-02	2.904E-02	4.380E-03	2.266E-06	6.452E-12	7.041E-36
0Pu-239	Pu-239	1.000E+00	1.050E-01	1.050E-01	1.049E-01	1.049E-01	1.048E-01	1.046E-01	1.038E-01	1.024E-01	9.663E-02
0U-235	Pu-239	1.000E+00	0.000E+00	1.031E-10	7.805E-10	1.008E-09	1.777E-09	3.901E-09	1.017E-08	1.561E-08	1.877E-08
0Pa-231	Pu-239	1.000E+00	0.000E+00	1.092E-15	6.397E-14	1.074E-13	3.431E-13	1.790E-12	1.643E-11	6.051E-11	3.008E-10
0Ac-227	Pu-239	1.000E+00	0.000E+00	1.150E-17	4.933E-15	1.058E-14	5.743E-14	5.956E-13	1.086E-11	5.034E-11	2.858E-10
0Pu-240	Pu-240	1.000E+00	2.500E-02	2.500E-02	2.497E-02	2.496E-02	2.493E-02	2.483E-02	2.445E-02	2.383E-02	2.130E-02
0U-236	Pu-240	1.000E+00	0.000E+00	7.381E-10	5.584E-09	7.209E-09	1.271E-08	2.787E-08	7.234E-08	1.101E-07	1.262E-07
0Th-232	Pu-240	1.000E+00	0.000E+00	1.822E-20	1.068E-18	1.793E-18	5.730E-18	2.992E-17	2.755E-16	1.022E-15	5.248E-15
0Ra-228	Pu-240	1.000E+00	0.000E+00	7.110E-22	2.667E-19	5.488E-19	2.619E-18	2.060E-17	2.471E-16	9.767E-16	5.194E-15
0Th-228	Pu-240	1.000E+00	0.000E+00	6.036E-23	1.200E-19	2.879E-19	1.803E-18	1.774E-17	2.378E-16	9.620E-16	5.177E-15
0Sr-90	Sr-90	1.000E+00	1.500E-01	1.464E-01	1.245E-01	1.177E-01	9.697E-02	5.420E-02	5.292E-03	1.044E-04	4.475E-12
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

BRF(i) is the branch fraction of the parent nuclide.
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1RESRAD, Version 5.91 T< Limit = 0.5 year 08/31/2000 07:22 Page 1
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

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File : D48&49-2.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(5)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(7)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(8)
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(9)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(10)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(11)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(12)
B-1	Pu-240	4.290E-01	4.290E-01	DCF2(13)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(14)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(15)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(16)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(17)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(18)
B-1	U-233	1.350E-01	1.350E-01	DCF2(19)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(20)
B-1	U-236	1.250E-01	1.250E-01	DCF2(21)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(5)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(7)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(8)
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(9)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(10)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(11)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(12)
D-1	Pu-240	3.540E-03	3.540E-03	DCF3(13)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(14)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(15)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(16)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(17)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(18)
D-1	U-233	2.890E-04	2.890E-04	DCF3(19)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(20)
D-1	U-236	2.690E-04	2.690E-04	DCF3(21)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(7,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(8,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,3)
D-34				
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(9,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(9,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(9,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(10,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(10,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(10,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(11,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(11,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(11,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(12,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(13,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(13,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(13,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(14,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(14,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(14,3)
D-34				

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(15,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(15,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(15,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(16,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(16,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(16,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(17,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(17,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(17,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(18,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(18,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(18,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(19,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(19,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(19,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(20,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(20,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(20,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(21,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(21,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(21,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(7,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(8,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
D-5				

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File : D48&49-2.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(9,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(9,2)
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(10,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(11,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(12,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(13,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(13,2)
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(14,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(14,2)
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(15,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(15,2)
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(16,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(16,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(17,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(17,2)
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(18,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(18,2)
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(19,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(19,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(20,2)
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(21,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(21,2)

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File : D48&49-2.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.550E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	7.500E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	4.000E+00	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	7.700E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.800E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	4.200E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.380E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	4.640E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	5.290E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.820E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-152	3.420E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Eu-154	4.250E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Ni-63	1.060E+03	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): Pu-239	3.620E-01	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): Pu-240	8.700E-02	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g): Sr-90	6.070E-01	0.000E+00	---	S1(15)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(15)
R013	Cover depth (m)	4.600E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.500E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	9.400E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	1.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.491E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.491E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Ni-63				
R016	Contaminated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.146E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.971E-04	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.206E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.514E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.849E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.491E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.247E-04	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.887E-03	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(20)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(20,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.887E-03	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(21)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(21,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(21)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.887E-03	ALEACH(21)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(21)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	not used	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.100E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	2.700E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	1.000E+02	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	3.600E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.775E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.775E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	suppressed
9 -- radon	suppressed
Find peak pathway doses	suppressed

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     Contaminated Zone Dimensions            Initial Soil Concentrations,'pCi/g
     ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ            ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
       Area:  15504.00 square meters               Am-241      4.640E-01
  Thickness:      4.00 meters                      Co-60       5.290E+00
Cover Depth:      4.60 meters                      Cs-137      2.820E+01
                                                   Eu-152      3.420E+01
                                                   Eu-154      4.250E+00
                                                   Ni-63       1.060E+03
                                                   Pu-239      3.620E-01
                                                   Pu-240      8.700E-02
                                                   Sr-90       6.070E-01
0
                                             Total Dose TDOSE(t), mrem/yr
                                       Basic Radiation Dose Limit =   4 mrem/yr
                        Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
                        ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    t (years):  0.000E+00  1.000E+00  7.700E+00  1.000E+01  1.800E+01  4.200E+01  1.380E+02  3.000E+02  1.000E+03
     TDOSE(t):  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  1.664E-06  1.046E-05
         M(t):  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  4.161E-07  2.615E-06
0Maximum TDOSE(t):  1.046E-05 mrem/yr   at t = 1.000E+03 years
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 File    : D48&49-2.RAD
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 07:22 Page 17
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.700E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.700E+00 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000

0*Sum of all water independent and dependent pathways.

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1RESRAD, Version 5.91     T* Limit = 0.5 year        08/31/2000  07:22  Page  18
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
 File    : D48&49-2.RAD
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 07:22 Page 19
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.800E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.800E+01 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 07:22 Page 20
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.200E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.200E+01 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 07:22 Page 21
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.380E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.380E+02 years
Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T* Limit = 0.5 year 08/31/2000 07:22 Page 22
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
Am-241	5.642E-09	0.0034	3.434E-11	0.0000	0.000E+00	0.0000	6.225E-10	0.0004	3.766E-11	0.0000	1.927E-10	0.0001	6.529E-09 0.0039
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-239	1.734E-07	0.1042	1.060E-09	0.0006	0.000E+00	0.0000	1.915E-08	0.0115	1.174E-09	0.0007	5.933E-09	0.0036	2.007E-07 0.1206
Pu-240	1.259E-06	0.7564	7.655E-09	0.0046	0.000E+00	0.0000	1.390E-07	0.0835	8.445E-09	0.0051	4.312E-08	0.0259	1.457E-06 0.8755
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Total	1.438E-06	0.8639	8.750E-09	0.0053	0.000E+00	0.0000	1.588E-07	0.0954	9.657E-09	0.0058	4.925E-08	0.0296	1.664E-06 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 07:22 Page 23
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	7.530E-07	0.0720	4.755E-09	0.0005	0.000E+00	0.0000	8.324E-08	0.0080	5.060E-09	0.0005	2.574E-08	0.0025	8.718E-07	0.0833
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.119E-06	0.1070	1.032E-08	0.0010	0.000E+00	0.0000	1.237E-07	0.0118	9.066E-09	0.0009	3.538E-08	0.0034	1.297E-06	0.1240
Pu-240	7.162E-06	0.6846	4.357E-08	0.0042	0.000E+00	0.0000	7.918E-07	0.0757	4.829E-08	0.0046	2.460E-07	0.0235	8.292E-06	0.7926
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	9.034E-06	0.8636	5.865E-08	0.0056	0.000E+00	0.0000	9.988E-07	0.0955	6.242E-08	0.0060	3.071E-07	0.0294	1.046E-05	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 07:22 Page 24
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Am-241	Np-237	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Am-241	U-233	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.407E-08	1.870E-06
Am-241	Th-229	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.416E-12	8.815E-09
Am-241	ãDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.407E-08	1.879E-06
0Co-60	Co-60	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-152	Eu-152	7.208E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-152	Eu-152	2.792E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Gd-152	2.792E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	ãDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-154	Eu-154	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ni-63	Ni-63	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Pu-239	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.538E-07	3.286E-06
Pu-239	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.663E-10	7.121E-08
Pu-239	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.633E-10	2.271E-07
Pu-239	ãDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.545E-07	3.584E-06
0Pu-240	Pu-240	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	U-236	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.675E-05	9.531E-05
Pu-240	Th-232	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.561E-15	2.940E-13
Pu-240	Ra-228	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.038E-15	3.211E-13
Pu-240	Th-228	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.316E-16	8.676E-14
Pu-240	ãDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.675E-05	9.531E-05
0Sr-90	Sr-90	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 07:22 Page 25
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 4 mrem/yr

0Nuclide

(i)	t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Am-241	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	2.843E+08	2.129E+06
Co-60	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15
Cs-137	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13
Eu-152	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14
Eu-154	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14
Ni-63	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13
Pu-239	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	7.214E+06	1.116E+06
Pu-240	*2.277E+11	*2.277E+11	*2.277E+11	*2.277E+11	*2.277E+11	*2.277E+11	*2.277E+11	2.388E+05	4.197E+04
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 1.000E+03 years

0Nuclide

(i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Am-241	4.640E-01	1.000E+03	1.879E-06	2.129E+06	1.879E-06	2.129E+06
Co-60	5.290E+00	0.000E+00	0.000E+00	*1.131E+15	0.000E+00	*1.131E+15
Cs-137	2.820E+01	0.000E+00	0.000E+00	*8.701E+13	0.000E+00	*8.701E+13
Eu-152	3.420E+01	0.000E+00	0.000E+00	*1.765E+14	0.000E+00	*1.765E+14
Eu-154	4.250E+00	0.000E+00	0.000E+00	*2.639E+14	0.000E+00	*2.639E+14
Ni-63	1.060E+03	0.000E+00	0.000E+00	*5.916E+13	0.000E+00	*5.916E+13
Pu-239	3.620E-01	1.000E+03	3.584E-06	1.116E+06	3.584E-06	1.116E+06
Pu-240	8.700E-02	1.000E+03	9.531E-05	4.197E+04	9.531E-05	4.197E+04
Sr-90	6.070E-01	0.000E+00	0.000E+00	*1.365E+14	0.000E+00	*1.365E+14
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

*At specific activity limit

1RESRAD, Version 5.91 T½ Limit = 0.5 year 08/31/2000 07:22 Page 26
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Np-237	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-233	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.528E-09	8.677E-07
0Th-229	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.121E-12	4.090E-09
0Co-60	Co-60	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-152	Eu-152	7.208E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Eu-152	2.792E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	ãDOSE(j):		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Gd-152	Eu-152	2.792E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-154	Eu-154	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ni-63	Ni-63	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Pu-239	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.005E-07	1.189E-06
0Pa-231	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.326E-10	2.578E-08
0Ac-227	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.315E-10	8.220E-08
0Pu-240	Pu-240	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-236	Pu-240	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.457E-06	8.292E-06
0Th-232	Pu-240	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.358E-16	2.558E-14
0Ra-228	Pu-240	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.[illegible]E-17	2.754E-14
0Th-228	Pu-240	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.015E-17	7.54[illegible]E-15
0Sr-90	Sr-90	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #2) Rad
File : D48&49-2.RAD

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
ÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ
Am-241	Am-241	1.000E+00	4.640E-01	4.632E-01	4.581E-01	4.563E-01	4.503E-01	4.326E-01	3.687E-01	2.815E-01	8.768E-02
0Np-237	Am-241	1.000E+00	0.000E+00	1.502E-07	1.150E-06	1.490E-06	2.664E-06	6.090E-06	1.846E-05	3.520E-05	7.094E-05
0U-233	Am-241	1.000E+00	0.000E+00	3.278E-13	1.911E-11	3.204E-11	1.017E-10	5.218E-10	4.473E-09	1.475E-08	4.814E-08
0Th-229	Am-241	1.000E+00	0.000E+00	1.032E-17	4.653E-15	1.015E-14	5.827E-14	7.071E-13	2.101E-11	1.635E-10	2.296E-09
0Co-60	Co-60	1.000E+00	5.290E+00	4.637E+00	1.918E+00	1.417E+00	4.938E-01	2.091E-02	6.718E-08	3.613E-17	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.820E+01	2.755E+01	2.356E+01	2.233E+01	1.852E+01	1.057E+01	1.124E+00	2.556E-02	2.031E-09
0Eu-152	Eu-152	7.208E-01	2.465E+01	2.340E+01	1.651E+01	1.465E+01	9.657E+00	2.768E+00	1.869E-02	4.0[illegible]E-06	6.051E-22
Eu-152	Eu-152	2.792E-01	9.549E+00	9.064E+00	6.395E+00	5.673E+00	3.741E+00	1.072E+00	7.240E-03	1.574E-06	2.344E-22
Eu-152	ãS(j):		3.420E+01	3.247E+01	2.290E+01	2.032E+01	1.340E+01	3.841E+00	2.593E-02	5.637E-06	8.395E-22
0Gd-152	Eu-152	2.792E-01	0.000E+00	5.972E-14	3.887E-13	4.777E-13	7.159E-13	1.045E-12	1.174E-12	1.172E-12	1.160E-12
0Eu-154	Eu-154	1.000E+00	4.250E+00	3.928E+00	2.316E+00	1.932E+00	1.028E+00	1.551E-01	8.016E-05	2.280E-10	2.474E-34
0Ni-63	Ni-63	1.000E+00	1.060E+03	1.052E+03	9.995E+02	9.821E+02	9.239E+02	7.692E+02	3.696E+02	1.073E+02	5.123E-01
0Pu-239	Pu-239	1.000E+00	3.620E-01	3.620E-01	3.617E-01	3.617E-01	3.614E-01	3.606E-01	3.575E-01	3.522E-01	3.304E-01
0U-235	Pu-239	1.000E+00	0.000E+00	3.555E-10	2.683E-09	3.461E-09	6.084E-09	1.324E-08	3.344E-08	4.933E-08	5.598E-08
0Pa-231	Pu-239	1.000E+00	0.000E+00	3.764E-15	2.201E-13	3.694E-13	1.177E-12	6.106E-12	5.479E-11	1.958E-10	9.115E-10
0Ac-227	Pu-239	1.000E+00	0.000E+00	3.964E-17	1.698E-14	3.640E-14	1.972E-13	2.034E-12	3.632E-11	1.633E-10	8.654E-10
0Pu-240	Pu-240	1.000E+00	8.700E-02	8.699E-02	8.689E-02	8.685E-02	8.674E-02	8.639E-02	8.500E-02	8.271E-02	7.351E-02
0U-236	Pu-240	1.000E+00	0.000E+00	2.568E-09	1.938E-08	2.499E-08	4.392E-08	9.548E-08	2.401E-07	3.511E-07	3.793E-07
0Th-232	Pu-240	1.000E+00	0.000E+00	6.340E-20	3.708E-18	6.225E-18	1.985E-17	1.030E-16	9.287E-16	3.347E-15	1.623E-14
0Ra-228	Pu-240	1.000E+00	0.000E+00	2.474E-21	9.267E-19	1.906E-18	9.078E-18	7.102E-17	8.340E-16	3.203E-15	1.507E-14
0Th-228	Pu-240	1.000E+00	0.000E+00	2.100E-22	4.171E-19	1.000E-18	6.252E-18	6.118E-17	8.031E-16	3.156E-15	1.602E-14
0Sr-90	Sr-90	1.000E+00	6.070E-01	5.924E-01	5.034E-01	4.761E-01	3.919E-01	2.187E-01	2.122E-02	4.141E-04	1.[illegible]7E-11
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

BRF(i) is the branch fraction of the parent nuclide.
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1RESRAD, Version 5.91 T< Limit = 0.5 year 11/02/2000 12:12 Page 1
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
File : D48&49-3.RAD

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Time = 0.000E+00 11
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1RESRAD, Version 5.91 T< Limit = 0.5 year 11/02/2000 12:12 Page 2
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
File : D48&49-3.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(1)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(2)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(3)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(4)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(5)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(6)
B-1	U-234	1.320E-01	1.320E-01	DCF2(7)
B-1	U-236	1.250E-01	1.250E-01	DCF2(8)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(9)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(1)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(2)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(3)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(4)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(5)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(6)
D-1	U-234	2.830E-04	2.830E-04	DCF3(7)
D-1	U-236	2.690E-04	2.690E-04	DCF3(8)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(9)
D-34	Food transfer factors:			
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(1,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(1,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(1,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(4,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)

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File : D48&49-3.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(2,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(2,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(4,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(4,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)

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File : D48&49-3.RAD

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.550E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	7.500E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	4.000E+00	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	7.700E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.800E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	4.200E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.380E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): U-236	1.466E+03	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-238	8.015E-01	0.000E+00	---	S1(9)
R012	Concentration in groundwater (pCi/L): U-236	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(9)
R013	Cover depth (m)	4.600E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.500E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	9.400E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	1.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat: zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for U-236				
R016	Contaminated zone (cm**3/g)	0.000E+00	5.000E+01	1.360E+01	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	5.000E+01	1.360E+01	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	0.000E+00	5.000E+01	1.360E+01	DCNUCS(8)
R016	Leach rate (/yr)	9.100E-04	0.000E+00	---	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	3.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	3.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.146E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.247E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.247E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.247E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.240E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter U-234				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.887E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	not used	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	not used	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
File : D48&49-3.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
File : D48&49-3.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	suppressed
9 -- radon	suppressed
Find peak pathway doses	suppressed

```
1RESRAD, Version 5.91      T« Limit = 0.5 year        11/02/2000  12:12  Page  10
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File     : D48&49-3.RAD

      Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g
      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ            ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
        Area:  15504.00 square meters                U-236      1.466E+03
   Thickness:      4.00 meters                       U-238      8.015E-01
 Cover Depth:      4.60 meters
0
                                                  Total Dose TDOSE(t), mrem/yr
                                            Basic Radiation Dose Limit =    4 mrem/yr
                           Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
                           ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    t (years):  0.000E+00  1.000E+00  7.700E+00  1.000E+01  1.800E+01  4.200E+01  1.380E+02  3.000E+02  1.000E+03
     TDOSE(t):  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  1.245E-03  7.499E-03
         M(t):  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00  3.112E-04  1.875E-03
0Maximum TDOSE(t):  7.499E-03 mrem/yr   at t = 1.000E+03 years
```

```
1RESRAD, Version 5.91     T« Limit = 0.5 year        11/02/2000  12:12  Page  11
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File    : D48&49-3.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                              As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0                                Water Independent Pathways (Inhalation excludes radon)
0            Ground            Inhalation          Radon              Plant              Meat               Milk               Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
 fract.
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ÄÄÄÄÄÄ
 U-236   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
 0.0000
 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
 0.0000
0
                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                              As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0                                Water Dependent Pathways
0            Water             Fish               Radon              Plant              Meat               Milk               All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
 fract.
 ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄ
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 U-236   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
 0.0000
 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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ßßßßßß
 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
 0.0000
0*Sum of all water independent and dependent pathways.
```

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1RESRAD, Version 5.91     T« Limit = 0.5 year        11/02/2000  12:12  Page  12
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File    : D48&49-3.RAD
```

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ			
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ			
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0*Sum of all water independent and dependent pathways.

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1RESRAD, Version 5.91     T< Limit = 0.5 year        11/02/2000  12:12  Page  13
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File    : D48&49-3.RAD
```

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.700E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.700E+00 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

*Sum of all water independent and dependent pathways.

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1RESRAD, Version 5.91      T« Limit = 0.5 year        11/02/2000  12:12  Page  14
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File    : D48&49-3.RAD
```

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	fract.
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	fract.
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
File : D48&49-3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.800E+01 years
Water Independent Pathways (Inhalation excludes radon)

0

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.800E+01 years
Water Dependent Pathways

0

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0*Sum of all water independent and dependent pathways.

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1RESRAD, Version 5.91     T« Limit = 0.5 year        11/02/2000  12:12  Page  16
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File    : D48&49-3.RAD
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.200E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.200E+01 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T< Limit = 0.5 year 11/02/2000 12:12 Page 17
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
File : D48&49-3.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.380E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	fract.
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.380E+02 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	fract.
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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1RESRAD, Version 5.91     T« Limit = 0.5 year        11/02/2000  12:12  Page  18
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File    : D48&49-3.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                              As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0                               Water Independent Pathways (Inhalation excludes radon)
0            Ground            Inhalation            Radon              Plant              Meat               Milk               Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
fract.
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 U-236   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
0.0000
 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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0

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                              As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0                                             Water Dependent Pathways
0            Water             Fish              Radon              Plant              Meat               Milk               All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
fract.
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 U-236   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
0.0000
 U-238   1.245E-03 1.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.245E-03
1.0000
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 Total   1.245E-03 1.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.245E-03
1.0000
0*Sum of all water independent and dependent pathways.
```

```
1RESRAD, Version 5.91     T< Limit = 0.5 year        11/02/2000  12:12  Page  19
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File    : D48&49-3.RAD
```

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
U-236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	7.499E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.499E-03	1.0000
Total	7.499E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.499E-03	1.0000

0*Sum of all water independent and dependent pathways.

```
1RESRAD, Version 5.91      T« Limit = 0.5 year        11/02/2000  12:12  Page  20
 Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
 File    : D48&49-3.RAD
```

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
U-236	U-236	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-236	Th-232	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-236	Ra-228	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-236	Th-228	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-236	äDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.553E-03	9.352E-03
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.886E-09	9.659E-07
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.170E-10	5.628E-07
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.457E-10	2.776E-06
U-238	äDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.553E-03	9.357E-03

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life 6 0.5 yr) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 4 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
U-236	*6.466E+07	*6.466E+07	*6.466E+07	*6.466E+07	*6.466E+07	*6.466E+07	*6.466E+07	*6.466E+07	*6.466E+07
U-238	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	2.575E+03	4.275E+02

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 1.000E+03 years

0Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
U-236	1.466E+03	0.000E+00	0.000E+00	*6.466E+07	0.000E+00	*6.466E+07
U-238	8.015E-01	1.000E+03	9.357E-03	4.275E+02	9.357E-03	4.275E+02

*At specific activity limit

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-I (RUN #3) Nonrad
File : D48&49-3.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
U-236	U-236	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-232	U-236	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ra-228	U-236	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-228	U-236	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.245E-03	7.496E-03
0Th-230	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.916E-09	7.741E-07
0Ra-226	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.379E-11	4.511E-07
0Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.168E-10	2.225E-06

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
U-236	U-236	1.000E+00	1.466E+03	1.465E+03	1.456E+03	1.453E+03	1.442E+03	1.411E+03	1.293E+03	1.116E+03	5.901E+02
0Th-232	U-236	1.000E+00	0.000E+00	7.229E-08	5.548E-07	7.197E-07	1.291E-06	2.976E-06	9.338E-06	1.880E-05	4.582E-05
0Ra-228	U-236	1.000E+00	0.000E+00	4.188E-09	1.935E-07	3.018E-07	7.648E-07	2.398E-06	8.801E-06	1.833E-05	4.555E-05
0Th-228	U-236	1.000E+00	0.000E+00	4.675E-10	1.063E-07	1.897E-07	6.009E-07	2.206E-06	8.624E-06	1.818E-05	4.547E-05
0U-238	U-238	1.000E+00	8.015E-01	8.012E-01	7.989E-01	7.982E-01	7.955E-01	7.877E-01	7.569E-01	7.078E-01	5.295E-01
0U-234	U-238	1.000E+00	0.000E+00	2.265E-06	1.708E-05	2.202E-05	3.866E-05	8.378E-05	2.078E-04	2.955E-04	2.730E-04
0Th-230	U-238	1.000E+00	0.000E+00	1.021E-11	5.965E-10	1.001E-09	3.190E-09	1.653E-08	1.476E-07	5.236E-07	2.348E-06
0Ra-226	U-238	1.000E+00	0.000E+00	1.474E-15	6.653E-13	1.452E-12	8.350E-12	1.018E-10	3.088E-09	2.486E-08	3.990E-07
0Pb-210	U-238	1.000E+00	0.000E+00	1.138E-17	3.807E-14	1.065E-13	1.054E-12	2.644E-11	1.746E-09	1.898E-08	3.727E-07

BRF(i) is the branch fraction of the parent nuclide.
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Dose Conversion Factor (and Related) Parameter Summary
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(5)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(7)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(8)
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(9)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(10)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(11)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(12)
B-1	Pu-240	4.290E-01	4.290E-01	DCF2(13)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(14)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(15)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(16)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(17)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(18)
B-1	U-233	1.350E-01	1.350E-01	DCF2(19)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(20)
B-1	U-236	1.250E-01	1.250E-01	DCF2(21)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(5)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(7)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(8)
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(9)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(10)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(11)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(12)
D-1	Pu-240	3.540E-03	3.540E-03	DCF3(13)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(14)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(15)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(16)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(17)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(18)
D-1	U-233	2.890E-04	2.890E-04	DCF3(19)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(20)
D-1	U-236	2.690E-04	2.690E-04	DCF3(21)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(7,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(8,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,3)
D-34				
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(9,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(9,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(9,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(10,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(10,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(10,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(11,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(11,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(11,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(12,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(13,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(13,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(13,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(14,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(14,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(14,3)
D-34				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(15,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(15,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(15,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(16,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(16,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(16,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(17,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(17,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(17,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(18,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(18,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(18,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(19,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(19,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(19,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(20,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(20,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(20,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(21,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(21,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(21,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(7,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(8,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
D-5				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

0 Menu	Parameter	Current Value	Default	Parameter Name
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(9,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(9,2)
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(10,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(11,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(12,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(13,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(13,2)
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(14,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(14,2)
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(15,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(15,2)
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(16,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(16,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(17,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(17,2)
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(18,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(18,2)
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(19,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(19,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(20,2)
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(21,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(21,2)

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.550E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	9.400E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	7.500E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	4.000E+00	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	7.700E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.800E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	4.200E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.380E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	4.640E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	5.290E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.820E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-152	3.420E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Eu-154	4.250E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Ni-63	2.650E+00	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): Pu-239	3.620E-01	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): Pu-240	8.700E-02	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g): Sr-90	6.070E-01	0.000E+00	---	S1(15)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(15)
R013	Cover depth (m)	8.600E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.500E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	0	1	---	NS
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCC(2)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.655E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.060E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(4)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.060E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(5)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.655E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(7)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.655E-05	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ni-63				
R016	Contaminated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCC(9)
R016	Saturated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.764E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(12)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.655E-05	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(13)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.655E-05	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCC(15)
R016	Saturated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.115E-04	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.641E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(8)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.441E-06	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(10)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.063E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(11)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.060E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCC(14)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.307E-05	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(16)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.655E-05	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(17)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.655E-05	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(18)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.655E-05	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(19)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.505E-03	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(20)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.505E-03	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(21)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(21)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.505E-03	ALEACH(21)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(21)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	not used	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.100E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	2.700E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	1.000E+02	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	3.600E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.775E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.775E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	suppressed
9 -- radon	suppressed
Find peak pathway doses	suppressed

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 13
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	15504.00 square meters	Am-241	4.640E-01
Thickness:	9.40 meters	Co-60	5.290E+00
Cover Depth:	8.60 meters	Cs-137	2.820E+01
		Eu-152	3.420E+01
		Eu-154	4.250E+00
		Ni-63	2.650E+00
		Pu-239	3.620E-01
		Pu-240	8.700E-02
		Sr-90	6.070E-01

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 4 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
TDOSE(t):	0.000E+00	8.138E-03	5.951E-02	7.322E-02	1.091E-01	1.456E-01	5.260E-02	3.650E-03	3.399E-05
M(t):	0.000E+00	2.034E-03	1.488E-02	1.830E-02	2.726E-02	3.639E-02	1.315E-02	9.125E-04	8.497E-06

0Maximum TDOSE(t): 1.456E-01 mrem/yr at t = 43.22 ñ 0.09 years
0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.322E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 14
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.322E+01 years

0 Water Dependent Pathways

0 Pathways* Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All mrem/yr fract.
Am-241	5.655E-09	0.0000	3.442E-11	0.0000	0.000E+00	0.0000	6.239E-10	0.0000	3.774E-11	0.0000	1.931E-10	0.0000	6.544E-09 0.0000
Co-60	3.929E-05	0.0003	3.980E-06	0.0000	0.000E+00	0.0000	4.437E-06	0.0000	1.546E-05	0.0001	4.481E-06	0.0000	6.765E-05 0.0005
Cs-137	4.215E-02	0.2895	2.583E-02	0.1774	0.000E+00	0.0000	4.703E-03	0.0323	2.484E-02	0.1706	1.921E-02	0.1319	1.167E-01 0.8017
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	4.187E-04	0.0029	1.485E-05	0.0001	0.000E+00	0.0000	4.690E-05	0.0003	4.131E-05	0.0003	4.783E-04	0.0033	1.000E-03 0.0069
Pu-239	1.795E-07	0.0000	1.097E-09	0.0000	0.000E+00	0.0000	1.982E-08	0.0000	1.215E-09	0.0000	6.139E-09	0.0000	2.077E-07 0.0000
Pu-240	1.303E-06	0.0000	7.922E-09	0.0000	0.000E+00	0.0000	1.439E-07	0.0000	8.737E-09	0.0000	4.462E-08	0.0000	1.508E-06 0.0000
Sr-90	1.962E-02	0.1347	4.573E-04	0.0031	0.000E+00	0.0000	2.362E-03	0.0162	3.119E-03	0.0214	2.253E-03	0.0155	2.781E-02 0.1910
Total	6.222E-02	0.4273	2.631E-02	0.1807	0.000E+00	0.0000	7.116E-03	0.0489	2.802E-02	0.1924	2.195E-02	0.1507	1.456E-01 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 15
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 16
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr fract.
Am-241	7.844E-14	0.0000	4.539E-16	0.0000	0.000E+00	0.0000	7.786E-15	0.0000	3.032E-16	0.0000	2.042E-15	0.0000	8.903E-14 0.0000
Co-60	2.327E-04	0.0286	2.255E-05	0.0028	0.000E+00	0.0000	2.387E-05	0.0029	5.103E-05	0.0063	2.025E-05	0.0025	3.504E-04 0.0431
Cs-137	2.570E-03	0.3158	1.507E-03	0.1852	0.000E+00	0.0000	2.605E-04	0.0320	8.444E-04	0.1038	8.938E-04	0.1098	6.076E-03 0.7466
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	1.312E-05	0.0016	4.531E-07	0.0001	0.000E+00	0.0000	1.389E-06	0.0002	9.537E-07	0.0001	1.287E-05	0.0016	2.878E-05 0.0035
Pu-239	1.205E-10	0.0000	7.086E-13	0.0000	0.000E+00	0.0000	1.239E-11	0.0000	5.602E-13	0.0000	3.425E-12	0.0000	1.376E-10 0.0000
Pu-240	8.767E-10	0.0000	5.157E-12	0.0000	0.000E+00	0.0000	9.017E-11	0.0000	4.071E-12	0.0000	2.493E-11	0.0000	1.001E-09 0.0000
Sr-90	1.239E-03	0.1522	2.820E-05	0.0035	0.000E+00	0.0000	1.417E-04	0.0174	1.499E-04	0.0184	1.240E-04	0.0152	1.683E-03 0.2068
Total	4.055E-03	0.4983	1.558E-03	0.1915	0.000E+00	0.0000	4.276E-04	0.0525	1.046E-03	0.1286	1.051E-03	0.1291	8.138E-03 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 17
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.700E+00 years
Water Independent Pathways (Inhalation excludes radon)

0

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
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Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.700E+00 years
Water Dependent Pathways

0

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	3.583E-11	0.0000	2.166E-13	0.0000	0.000E+00	0.0000	3.907E-12	0.0000	2.259E-13	0.0000	1.188E-12	0.0000	4.137E-11
Co-60	7.473E-04	0.0126	7.534E-05	0.0013	0.000E+00	0.0000	8.354E-05	0.0014	2.798E-04	0.0047	8.303E-05	0.0014	1.269E-03
Cs-137	1.706E-02	0.2867	1.041E-02	0.1749	0.000E+00	0.0000	1.885E-03	0.0317	9.572E-03	0.1609	7.576E-03	0.1273	4.650E-02
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	9.655E-05	0.0016	3.415E-06	0.0001	0.000E+00	0.0000	1.075E-05	0.0002	9.254E-06	0.0002	1.086E-04	0.0018	2.286E-04
Pu-239	7.138E-09	0.0000	4.325E-11	0.0000	0.000E+00	0.0000	7.820E-10	0.0000	4.615E-11	0.0000	2.394E-10	0.0000	8.249E-09
Pu-240	5.194E-08	0.0000	3.146E-10	0.0000	0.000E+00	0.0000	5.689E-09	0.0000	3.349E-10	0.0000	1.742E-09	0.0000	6.002E-08
Sr-90	8.158E-03	0.1371	1.897E-04	0.0032	0.000E+00	0.0000	9.770E-04	0.0164	1.263E-03	0.0212	9.239E-04	0.0155	1.151E-02
ïïïïïïï	ïïïïïïïïï	ïïïïïï	ïïïïïïïïï	ïïïïïï	ïïïïïïïïï	ïïïïïï	ïïïïïïïïï	ïïïïïï	ïïïïïïïïï	ïïïïïï	ïïïïïïïïï	ïïïïïï	ïïïïïïïïï
Total	2.606E-02	0.4380	1.067E-02	0.1794	0.000E+00	0.0000	2.956E-03	0.0497	1.112E-02	0.1869	8.692E-03	0.1461	5.951E-02

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T½ Limit = 0.5 year 08/31/2000 08:10 Page 18
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	7.832E-11	0.0000	4.743E-13	0.0000	0.000E+00	0.0000	8.568E-12	0.0000	5.017E-13	0.0000	2.617E-12	0.0000	9.048E-11	0.0000
Co-60	7.173E-04	0.0098	7.241E-05	0.0010	0.000E+00	0.0000	8.042E-05	0.0011	2.724E-04	0.0037	8.029E-05	0.0011	1.223E-03	0.0167
Cs-137	2.101E-02	0.2870	1.283E-02	0.1753	0.000E+00	0.0000	2.328E-03	0.0318	1.196E-02	0.1633	9.400E-03	0.1284	5.753E-02	0.7858
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	1.233E-04	0.0017	4.365E-06	0.0001	0.000E+00	0.0000	1.375E-05	0.0002	1.192E-05	0.0002	1.393E-04	0.0019	2.927E-04	0.0040
Pu-239	1.202E-08	0.0000	7.291E-11	0.0000	0.000E+00	0.0000	1.319E-09	0.0000	7.856E-11	0.0000	4.053E-10	0.0000	1.390E-08	0.0000
Pu-240	8.744E-08	0.0000	5.302E-10	0.0000	0.000E+00	0.0000	9.599E-09	0.0000	5.697E-10	0.0000	2.949E-09	0.0000	1.011E-07	0.0000
Sr-90	1.003E-02	0.1370	2.333E-04	0.0032	0.000E+00	0.0000	1.203E-03	0.0164	1.565E-03	0.0214	1.140E-03	0.0156	1.417E-02	0.1935
Total	3.188E-02	0.4355	1.314E-02	0.1795	0.000E+00	0.0000	3.625E-03	0.0495	1.381E-02	0.1886	1.076E-02	0.1470	7.322E-02	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 19
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.800E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.800E+01 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	4.533E-10	0.0000	2.752E-12	0.0000	0.000E+00	0.0000	4.982E-11	0.0000	2.971E-12	0.0000	1.533E-11	0.0000	5.242E-10	0.0000
Co-60	4.510E-04	0.0041	4.562E-05	0.0004	0.000E+00	0.0000	5.077E-05	0.0005	1.748E-04	0.0016	5.103E-05	0.0005	7.732E-04	0.0071
Cs-137	3.144E-02	0.2883	1.924E-02	0.1764	0.000E+00	0.0000	3.498E-03	0.0321	1.826E-02	0.1675	1.422E-02	0.1304	8.667E-02	0.7947
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	2.095E-04	0.0019	7.424E-06	0.0001	0.000E+00	0.0000	2.342E-05	0.0002	2.049E-05	0.0002	2.382E-04	0.0022	4.990E-04	0.0046
Pu-239	3.871E-08	0.0000	2.353E-10	0.0000	0.000E+00	0.0000	4.262E-09	0.0000	2.572E-10	0.0000	1.316E-09	0.0000	4.478E-08	0.0000
Pu-240	2.815E-07	0.0000	1.709E-09	0.0000	0.000E+00	0.0000	3.100E-08	0.0000	1.862E-09	0.0000	9.571E-09	0.0000	3.256E-07	0.0000
Sr-90	1.492E-02	0.1368	3.474E-04	0.0032	0.000E+00	0.0000	1.793E-03	0.0164	2.353E-03	0.0216	1.706E-03	0.0156	2.112E-02	0.1936
Total	4.702E-02	0.4312	1.964E-02	0.1801	0.000E+00	0.0000	5.365E-03	0.0492	2.081E-02	0.1908	1.622E-02	0.1487	1.091E-01	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 20
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.200E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.200E+01 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr fract.
Am-241	5.246E-09	0.0000	3.193E-11	0.0000	0.000E+00	0.0000	5.787E-10	0.0000	3.500E-11	0.0000	1.791E-10	0.0000	6.071E-09 0.0000
Co-60	4.481E-05	0.0003	4.539E-06	0.0000	0.000E+00	0.0000	5.060E-06	0.0000	1.762E-05	0.0001	5.110E-06	0.0000	7.714E-05 0.0005
Cs-137	4.213E-02	0.2894	2.582E-02	0.1774	0.000E+00	0.0000	4.700E-03	0.0323	2.482E-02	0.1705	1.920E-02	0.1319	1.167E-01 0.8016
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00 0.0000
Ni-63	4.105E-04	0.0028	1.456E-05	0.0001	0.000E+00	0.0000	4.598E-05	0.0003	4.050E-05	0.0003	4.689E-04	0.0032	9.805E-04 0.0067
Pu-239	1.726E-07	0.0000	1.055E-09	0.0000	0.000E+00	0.0000	1.906E-08	0.0000	1.168E-09	0.0000	5.903E-09	0.0000	1.998E-07 0.0000
Pu-240	1.253E-06	0.0000	7.619E-09	0.0000	0.000E+00	0.0000	1.384E-07	0.0000	8.401E-09	0.0000	4.291E-08	0.0000	1.450E-06 0.0000
Sr-90	1.963E-02	0.1348	4.575E-04	0.0031	0.000E+00	0.0000	2.363E-03	0.0162	3.120E-03	0.0214	2.254E-03	0.0155	2.782E-02 0.1911
Total	6.221E-02	0.4274	2.630E-02	0.1807	0.000E+00	0.0000	7.115E-03	0.0489	2.800E-02	0.1924	2.193E-02	0.1507	1.456E-01 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 21
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.380E+02 years
Water Independent Pathways (Inhalation excludes radon)

0

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.380E+02 years
Water Dependent Pathways

0

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	fract.
Am-241	7.961E-08	0.0000	4.867E-10	0.0000	0.000E+00	0.0000	8.797E-09	0.0000	5.352E-10	0.0000	2.729E-09	0.0000	9.216E-08	0.0000
Co-60	4.838E-10	0.0000	4.904E-11	0.0000	0.000E+00	0.0000	5.471E-11	0.0000	1.916E-10	0.0000	5.538E-11	0.0000	8.345E-10	0.0000
Cs-137	1.504E-02	0.2859	9.222E-03	0.1753	0.000E+00	0.0000	1.680E-03	0.0319	8.926E-03	0.1697	6.880E-03	0.1308	4.175E-02	0.7936
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	6.710E-04	0.0128	2.381E-05	0.0005	0.000E+00	0.0000	7.522E-05	0.0014	6.648E-05	0.0013	7.682E-04	0.0146	1.605E-03	0.0305
Pu-239	6.608E-07	0.0000	4.206E-09	0.0000	0.000E+00	0.0000	7.304E-08	0.0000	4.586E-09	0.0000	2.251E-08	0.0000	7.652E-07	0.0000
Pu-240	4.746E-06	0.0001	2.887E-08	0.0000	0.000E+00	0.0000	5.246E-07	0.0000	3.197E-08	0.0000	1.629E-07	0.0000	5.495E-06	0.0001
Sr-90	6.517E-03	0.1239	1.520E-04	0.0029	0.000E+00	0.0000	7.854E-04	0.0149	1.040E-03	0.0198	7.501E-04	0.0143	9.245E-03	0.1758
Total	2.223E-02	0.4226	9.398E-03	0.1787	0.000E+00	0.0000	2.542E-03	0.0483	1.003E-02	0.1907	8.399E-03	0.1597	5.260E-02	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 22
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	3.388E-07	0.0001	2.086E-09	0.0000	0.000E+00	0.0000	3.745E-08	0.0000	2.280E-09	0.0000	1.162E-08	0.0000	3.923E-07	0.0001
Co-60	5.869E-19	0.0000	5.950E-20	0.0000	0.000E+00	0.0000	6.639E-20	0.0000	2.329E-19	0.0000	6.726E-20	0.0000	1.013E-18	0.0000
Cs-137	7.717E-04	0.2114	4.734E-04	0.1297	0.000E+00	0.0000	8.626E-05	0.0236	4.589E-04	0.1257	3.534E-04	0.0968	2.144E-03	0.5873
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ni-63	4.488E-04	0.1230	1.593E-05	0.0044	0.000E+00	0.0000	5.033E-05	0.0138	4.452E-05	0.0122	5.142E-04	0.1409	1.074E-03	0.2942
Pu-239	1.279E-06	0.0004	8.860E-09	0.0000	0.000E+00	0.0000	1.414E-07	0.0000	9.194E-09	0.0000	4.296E-08	0.0000	1.482E-06	0.0004
Pu-240	8.987E-06	0.0025	5.468E-08	0.0000	0.000E+00	0.0000	9.935E-07	0.0003	6.057E-08	0.0000	3.087E-07	0.0001	1.040E-05	0.0029
Sr-90	2.962E-04	0.0811	6.907E-06	0.0019	0.000E+00	0.0000	3.570E-05	0.0098	4.732E-05	0.0130	3.411E-05	0.0093	4.202E-04	0.1151
Total	1.527E-03	0.4185	4.963E-04	0.1360	0.000E+00	0.0000	1.735E-04	0.0475	5.508E-04	0.1509	9.021E-04	0.2472	3.650E-03	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 23
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Am-241	1.767E-06	0.0520	1.127E-08	0.0003	0.000E+00	0.0000	1.953E-07	0.0057	1.186E-08	0.0003	6.032E-08	0.0018	2.045E-06
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Cs-137	2.401E-10	0.0000	1.473E-10	0.0000	0.000E+00	0.0000	2.684E-11	0.0000	1.429E-10	0.0000	1.100E-10	0.0000	6.671E-10
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ni-63	4.713E-06	0.1387	1.673E-07	0.0049	0.000E+00	0.0000	5.286E-07	0.0156	4.680E-07	0.0138	5.402E-06	0.1589	1.128E-05
Pu-239	2.462E-06	0.0724	2.413E-08	0.0007	0.000E+00	0.0000	2.722E-07	0.0080	2.052E-08	0.0006	7.663E-08	0.0023	2.856E-06
Pu-240	1.538E-05	0.4526	9.359E-08	0.0028	0.000E+00	0.0000	1.701E-06	0.0500	1.037E-07	0.0031	5.284E-07	0.0155	1.781E-05
Sr-90	2.082E-11	0.0000	4.856E-13	0.0000	0.000E+00	0.0000	2.510E-12	0.0000	3.330E-12	0.0000	2.399E-12	0.0000	2.955E-11
Total	2.432E-05	0.7156	2.964E-07	0.0087	0.000E+00	0.0000	2.697E-06	0.0793	6.042E-07	0.0178	6.068E-06	0.1785	3.399E-05

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 5.91 T« Limit = 0.5 year 08/31/2000 08:10 Page 24
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	7.700E+00	DSR(j,t) (mrem/yr)/(pCi/g) 1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
ÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ
Am-241	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Am-241	Np-237	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Am-241	U-233	1.000E+00	0.000E+00	1.919E-13	8.915E-11	1.950E-10	1.130E-09	1.308E-08	1.985E-07	8.441E-07	4.381E-06
Am-241	Th-229	1.000E+00	0.000E+00	2.255E-18	3.299E-15	8.869E-15	8.475E-14	2.230E-12	1.291E-10	1.285E-09	2.663E-08
Am-241	ãDSR(j)		0.000E+00	1.919E-13	8.915E-11	1.950E-10	1.130E-09	1.308E-08	1.986E-07	8.454E-07	4.408E-06
0Co-60	Co-60	1.000E+00	0.000E+00	6.625E-05	2.399E-04	2.312E-04	1.462E-04	1.458E-05	1.578E-10	1.915E-19	0.000E+00
0Cs-137	Cs-137	1.000E+00	0.000E+00	2.155E-04	1.649E-03	2.040E-03	3.073E-03	4.137E-03	1.480E-03	7.602E-05	2.366E-11
0Eu-152	Eu-152	7.208E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-152	Eu-152	2.792E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Gd-152	2.792E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	ãDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-154	Eu-154	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ni-63	Ni-63	1.000E+00	0.000E+00	1.086E-05	8.625E-05	1.104E-04	1.883E-04	3.700E-04	6.055E-04	4.052E-04	4.256E-06
0Pu-239	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	U-235	1.000E+00	0.000E+00	3.800E-10	2.278E-08	3.838E-08	1.236E-07	5.511E-07	2.096E-06	3.998E-06	7.113E-06
Pu-239	Pa-231	1.000E+00	0.000E+00	9.013E-15	2.652E-12	5.661E-12	3.161E-11	3.572E-10	5.593E-09	2.544E-08	1.840E-07
Pu-239	Ac-227	1.000E+00	0.000E+00	1.912E-16	4.956E-13	1.384E-12	1.372E-11	3.361E-10	1.194E-08	6.952E-08	5.910E-07
Pu-239	ãDSR(j)		0.000E+00	3.800E-10	2.279E-08	3.839E-08	1.237E-07	5.518E-07	2.114E-06	4.093E-06	7.888E-06
0Pu-240	Pu-240	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	U-236	1.000E+00	0.000E+00	1.151E-08	6.898E-07	1.162E-06	3.743E-06	1.667E-05	6.316E-05	1.196E-04	2.047E-04
Pu-240	Th-232	1.000E+00	0.000E+00	5.757E-20	1.219E-17	2.553E-17	1.383E-16	1.523E-15	2.352E-14	1.065E-13	7.608E-13
Pu-240	Ra-228	1.000E+00	0.000E+00	8.229E-22	2.121E-18	5.735E-18	5.127E-17	9.876E-16	2.245E-14	1.100E-13	8.330E-13
Pu-240	Th-228	1.000E+00	0.000E+00	1.385E-23	2.182E-19	6.979E-19	8.489E-18	2.178E-16	5.802E-15	2.921E-14	2.254E-13
Pu-240	ãDSR(j)		0.000E+00	1.151E-08	6.898E-07	1.162E-06	3.743E-06	1.667E-05	6.316E-05	1.196E-04	2.047E-04
0Sr-90	Sr-90	1.000E+00	0.000E+00	2.772E-03	1.896E-02	2.335E-02	3.479E-02	4.583E-02	1.523E-02	6.923E-04	4.868E-11
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.

1RESRAD, Version 5.91 T< Limit = 0.5 year 08/31/2000 08:10 Page 25
Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 4 mrem/yr

0Nuclide

(i)	t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
ÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ
Am-241	*3.430E+12	*3.430E+12	4.487E+10	2.051E+10	3.541E+09	3.057E+08	2.014E+07	4.732E+06	9.074E+05
Co-60	*1.131E+15	6.038E+04	1.667E+04	1.730E+04	2.737E+04	2.743E+05	2.536E+10	*1.131E+15	*1.131E+15
Cs-137	*8.701E+13	1.857E+04	2.426E+03	1.961E+03	1.301E+03	9.668E+02	2.702E+03	5.262E+04	1.691E+11
Eu-152	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14
Eu-154	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14	*2.639E+14
Ni-63	*5.916E+13	3.683E+05	4.637E+04	3.622E+04	2.124E+04	1.081E+04	6.606E+03	9.871E+03	9.397E+05
Pu-239	*6.212E+10	1.053E+10	1.755E+08	1.042E+08	3.234E+07	7.249E+06	1.892E+06	9.774E+05	5.071E+05
Pu-240	*2.277E+11	3.476E+08	5.798E+06	3.443E+06	1.069E+06	2.400E+05	6.333E+04	3.345E+04	1.954E+04
Sr-90	*1.365E+14	1.443E+03	2.109E+02	1.713E+02	1.150E+02	8.727E+01	2.626E+02	5.778E+03	8.217E+10
ÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 43.22 ñ 0.09 years

0Nuclide

(i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
ÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ
Am-241	4.640E-01	1.000E+03	4.408E-06	9.074E+05	1.410E-08	2.836E+08
Co-60	5.290E+00	7.74 ñ 0.02	2.399E-04	1.667E+04	1.279E-05	3.128E+05
Cs-137	2.820E+01	43.40 ñ 0.09	4.140E-03	9.663E+02	4.140E-03	9.663E+02
Eu-152	3.420E+01	0.000E+00	0.000E+00	*1.765E+14	0.000E+00	*1.765E+14
Eu-154	4.250E+00	0.000E+00	0.000E+00	*2.639E+14	0.000E+00	*2.639E+14
Ni-63	2.650E+00	137.5 ñ 0.3	6.055E-04	6.606E+03	3.774E-04	1.060E+04
Pu-239	3.620E-01	1.000E+03	7.888E-06	5.071E+05	5.738E-07	6.971E+06
Pu-240	8.700E-02	1.000E+03	2.047E-04	1.954E+04	1.733E-05	2.308E+05
Sr-90	6.070E-01	41.96 ñ 0.08	4.583E-02	8.727E+01	4.581E-02	8.731E+01
ÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ	ÎÎÎÎÎÎÎÎÎ

*At specific activity limit

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
ÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ	ÃÃÃÃÃÃÃÃÃ
Am-241	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Np-237	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-233	Am-241	1.000E+00	0.000E+00	8.903E-14	4.136E-11	9.048E-11	5.241E-10	6.070E-09	9.210E-08	3.917E-07	2.033E-06
0Th-229	Am-241	1.000E+00	0.000E+00	1.046E-18	1.531E-15	4.115E-15	3.933E-14	1.035E-12	5.990E-11	5.964E-10	1.236E-08
0Co-60	Co-60	1.000E+00	0.000E+00	3.504E-04	1.269E-03	1.223E-03	7.732E-04	7.714E-05	8.345E-10	1.013E-18	0.000E+00
0Cs-137	Cs-137	1.000E+00	0.000E+00	6.076E-03	4.650E-02	5.753E-02	8.667E-02	1.167E-01	4.175E-02	2.144E-03	6.671E-10
0Eu-152	Eu-152	7.208E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Eu-152	2.792E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	ãDOSE(j):		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Gd-152	Eu-152	2.792E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Eu-154	Eu-154	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ni-63	Ni-63	1.000E+00	0.000E+00	2.878E-05	2.286E-04	2.927E-04	4.990E-04	9.805E-04	1.605E-03	1.074E-03	1.128E-05
0Pu-239	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	Pu-239	1.000E+00	0.000E+00	1.375E-10	8.248E-09	1.389E-08	4.476E-08	1.995E-07	7.588E-07	1.447E-06	2.575E-06
0Pa-231	Pu-239	1.000E+00	0.000E+00	3.263E-15	9.600E-13	2.049E-12	1.144E-11	1.293E-10	2.025E-09	9.210E-09	6.661E-08
0Ac-227	Pu-239	1.000E+00	0.000E+00	6.920E-17	1.794E-13	5.010E-13	4.966E-12	1.217E-10	4.324E-09	2.517E-08	2.139E-07
0Pu-240	Pu-240	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-236	Pu-240	1.000E+00	0.000E+00	1.001E-09	6.002E-08	1.011E-07	3.256E-07	1.450E-06	5.495E-06	1.040E-05	1.781E-05
0Th-232	Pu-240	1.000E+00	0.000E+00	5.008E-21	1.060E-18	2.221E-18	1.203E-17	1.325E-16	2.046E-15	9.263E-15	6.619E-14
0Ra-228	Pu-240	1.000E+00	0.000E+00	7.159E-23	1.845E-19	4.990E-19	4.460E-18	8.593E-17	1.953E-15	9.570E-15	7.247E-14
0Th-228	Pu-240	1.000E+00	0.000E+00	1.205E-24	1.898E-20	6.071E-20	7.385E-19	1.895E-17	5.047E-16	2.542E-15	1.961E-14
0Sr-90	Sr-90	1.000E+00	0.000E+00	1.683E-03	1.151E-02	1.417E-02	2.112E-02	2.782E-02	9.245E-03	4.202E-04	2.955E-11
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

BRF(i) is the branch fraction of the parent nuclide.

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Summary : 100-D-48:1 &49:1 North Pipelines - DZ-II (RUN #4)
File : D48&49-4.RAD

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	7.700E+00	1.000E+01	1.800E+01	4.200E+01	1.380E+02	3.000E+02	1.000E+03
ÄÄÄÄÄÄ	ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Am-241	Am-241	1.000E+00	4.640E-01	4.632E-01	4.582E-01	4.565E-01	4.506E-01	4.333E-01	3.705E-01	2.845E-01	9.088E-02
0Np-237	Am-241	1.000E+00	0.000E+00	1.502E-07	1.150E-06	1.491E-06	2.665E-06	6.098E-06	1.854E-05	3.554E-05	7.316E-05
0U-233	Am-241	1.000E+00	0.000E+00	3.282E-13	1.928E-11	3.241E-11	1.039E-10	5.470E-10	5.181E-09	1.975E-08	9.414E-08
0Th-229	Am-241	1.000E+00	0.000E+00	1.033E-17	4.684E-15	1.023E-14	5.918E-14	7.328E-13	2.350E-11	2.046E-10	3.941E-09
0Co-60	Co-60	1.000E+00	5.290E+00	4.638E+00	1.920E+00	1.419E+00	4.950E-01	2.103E-02	6.852E-08	3.771E-17	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.820E+01	2.755E+01	2.358E+01	2.236E+01	1.857E+01	1.064E+01	1.146E+00	2.668E-02	2.344E-09
0Eu-152	Eu-152	7.208E-01	2.465E+01	2.340E+01	1.651E+01	1.465E+01	9.664E+00	2.773E+00	1.878E-02	4.107E-06	6.272E-22
Eu-152	Eu-152	2.792E-01	9.549E+00	9.065E+00	6.397E+00	5.675E+00	3.743E+00	1.074E+00	7.276E-03	1.591E-06	2.429E-22
Eu-152	åS(j):		3.420E+01	3.247E+01	2.291E+01	2.033E+01	1.341E+01	3.846E+00	2.606E-02	5.698E-06	8.702E-22
0Gd-152	Eu-152	2.792E-01	0.000E+00	5.972E-14	3.888E-13	4.778E-13	7.161E-13	1.045E-12	1.176E-12	1.176E-12	1.171E-12
0Eu-154	Eu-154	1.000E+00	4.250E+00	3.928E+00	2.317E+00	1.933E+00	1.029E+00	1.553E-01	8.056E-05	2.304E-10	2.564E-34
0Ni-63	Ni-63	1.000E+00	2.650E+00	2.630E+00	2.503E+00	2.461E+00	2.320E+00	1.942E+00	9.549E-01	2.881E-01	1.625E-03
0Pu-239	Pu-239	1.000E+00	3.620E-01	3.620E-01	3.618E-01	3.618E-01	3.616E-01	3.612E-01	3.592E-01	3.560E-01	3.425E-01
0U-235	Pu-239	1.000E+00	0.000E+00	3.561E-10	2.718E-09	3.520E-09	6.272E-09	1.420E-08	4.143E-08	7.450E-08	1.258E-07
0Pa-231	Pu-239	1.000E+00	0.000E+00	3.768E-15	2.221E-13	3.738E-13	1.203E-12	6.409E-12	6.367E-11	2.631E-10	1.777E-09
0Ac-227	Pu-239	1.000E+00	0.000E+00	3.968E-17	1.711E-14	3.676E-14	2.008E-13	2.121E-12	4.167E-11	2.168E-10	1.687E-09
0Pu-240	Pu-240	1.000E+00	8.700E-02	8.699E-02	8.691E-02	8.688E-02	8.679E-02	8.652E-02	8.542E-02	8.361E-02	7.620E-02
0U-236	Pu-240	1.000E+00	0.000E+00	2.572E-09	1.963E-08	2.542E-08	4.527E-08	1.024E-07	2.976E-07	5.312E-07	8.620E-07
0Th-232	Pu-240	1.000E+00	0.000E+00	6.347E-20	3.741E-18	6.297E-18	2.026E-17	1.080E-16	1.074E-15	4.443E-15	3.020E-14
0Ra-228	Pu-240	1.000E+00	0.000E+00	2.476E-21	9.332E-19	1.923E-18	9.234E-18	7.403E-17	9.578E-16	4.229E-15	2.984E-14
0Th-228	Pu-240	1.000E+00	0.000E+00	2.102E-22	4.196E-19	1.008E-18	6.348E-18	6.362E-17	9.201E-16	4.158E-15	2.973E-14
0Sr-90	Sr-90	1.000E+00	6.070E-01	5.926E-01	5.045E-01	4.774E-01	3.940E-01	2.214E-01	2.208E-02	4.512E-04	2.258E-11
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

BRF(i) is the branch fraction of the parent nuclide.
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CALCULATION BRIEF EXCERPTS

DISCLAIMER FOR CALCULATIONS

The calculations that are provided in the following appendix are included for reference only. Use of these calculations by persons who do not have access to all of their pertinent factors could lead to incorrect conclusions or assumptions.

Before applying these calculations to work activities or projects outside the context of this report, these calculations must be thoroughly reviewed with appropriate and authorized Hanford Site ERC personnel. Without this review, the ER Project cannot assume any responsibility for the use of these calculations.

CALCULATION BRIEFS

The following calculation briefs have been prepared in accordance with BHI-DE-01, *Design Engineering Procedures Manual*, EDPI-4.37-01, "Project Calculations," Bechtel Hanford, Inc., Richland, Washington.

Group 2 – North Pipeline Sample Variance, Calculation No. 0100D-CA-V0075, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

Group 2 North Pipelines (100-D-48:1 & 100-D-49:1) Cleanup Verification Sampling Locations, Calculation No. 0100D-CA-V0080, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

95% UCL Calculations for 100-D-48:1 and 100-D-49:1, Calculation No. 0100D-CA-V0183, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

100-D-19 Deep Zone Cleanup Verification Model, Calculation No. 0100D-CA-V0180, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

100-D-48:1 100-D-49:1 RESRAD, Calculation No. 0100D-CA-V0168, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

100-D-48:1/49:1 MCL Drinking Water Standards, Calculation No. 0100D-CA-V0131, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

NOTE: The calculation briefs referenced in this appendix are kept in the active Environmental Restoration Contractor project files and are available upon request. When the project is completed, the files will be stored in a U.S. Department of Energy, Richland Operations Office repository. Only excerpts of the calculation briefs are included in this appendix.

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CALCULATION COVER SHEET

Project Title:	100-DR-1 Remedial Action	**Job No.**	22192
Area	100-D		
Discipline	Environmental	***Calc. No.**	0100D-CA-V0075
Subject	Group 2 - North Pipeline Sample Variance		
Computer Program	Excel	**Program No.**	Excel 97

Committed Calculation X **Preliminary** **Superseded**

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Calc. Summary = 1 Attachment A = 2 Attachment B = 3 Attachment C = 2 Attachment D = 2 Total pages = 11	R.B. Kerkow R.B. Kerkow RBK 4-10-00	C Trice CTRICE 4-12-00	J.D. Fumber 3/2000 May 3, 2000	5.9.00 FM Corpus 5-10-00	5-10-00
1	SAME AS REV 0	C Trice CTRICE 8/7/00	M. Buckmaster 8/21/00	M.H. STURGES 9/11/00	FM corpus	9-14-00

SUMMARY OF REVISIONS

1 REV 1 INCLUDES ADDITIONAL VARIANCE SAMPLES THAT WERE DEFERRED FOR A UTILITY RELOCATION. REPLACED PAGES: ATTACHMENT A PG 2 OF 2, ATTACHMENT C PG 2 OF 2, and ATTACHMENT D PG 2 OF 2.

Scanned	Rev.	Date	Bar Code No.

* Obtain Calc. No. from DIS.

Calc. Summary

CALCULATION SHEET

Originator	R. B. Kerkow RBK	Date	4/10/2000	Calc. No.	0100D-CA-V0075	Rev. No.	0
Project	100-DR-1 Remedial Action	Job No.	22192	Checked	C Price	Date:	4-12-00
Subject	Group 2 - North Pipeline Sample Variance					Sheet:	1 of 1

Problem:
Perform a sample variance calculation to determine the number of samples required for Group 2 - North Pipelines Shallow Zone Decision Unit, verification sampling, as required in DOE/RL-96-22, Rev. 1, "100 AREA REMEDIAL ACTION SAMPLING AND ANALYSIS PLAN" (SAP); and Instruction Guide (IG) 0100X-IG-G0001, Rev. 2, "INSTRUCTION GUIDE FOR THE REMEDIATION OF THE 100-BC-1, 100-DR-1, AND 100-HR-1 WASTE SITE.

Given:
1) Sample locations for the Group 2 - North Pipelines Shallow Zone Decision Unit are identified on the Group 2 - North Pipelines (100-D-48:1 & 100-D-49:1) Cleanup Verification Sample Locations, Calculation Number 0100B-CA-V0080, Rev. 0.
2) Results of Gamma Energy Analysis (GEA) provided by Thermo Nutec Analytical (TMA) Laboratory.
3) Lookup values from DOE/RL-96-22, Rev 1.
4) Requirements from DOE/RL-96-22, Rev 1 and 0100X-IG-G0001, Rev 2.

Solution:
Calculation methodology is described in DOE/RL-96-22, Rev 1, Attachment A-1. Variance calculation is based on the same three isotopes used to develop the statistical approach in DOE/RL-96-22, Rev 1. The statistical design is based on the premise that these isotopes are the predominant components of the contamination and are representative of the contamination distribution. Although analytical results are available for other isotopes, this information is not considered applicable or appropriate for the purpose of this calculation.

Attachment	Title	Topic
A	Variance	Variance calculation to compute the number of verification samples required.
B	Formulas	Excel spreadsheet formulas used to perform the variance calculation.
C	Data Summary	Sample ID, sample location, and data for selected analytes.
D	Sample Results	Gamma Energy Analysis results, reported by TMA laboratory.

Calculations and Data sheets are interlinked within the spreadsheet such that a change in the data will affect the calculation. An "=IF" statement is used in column "O" of the "Data Summary" spreadsheet to verify that the sample identification number is correctly assigned to the appropriate analytical result.

Conclusion:
The required number of samples for the Group 2 - North Pipeline Shallow Zone Decision Unit is less than the default number of 4 composite samples per Shallow Zone sub-unit, as specified in DOE/RL-96-22, Rev 1. Therefore, the default number of four composite samples, per sub-unit, will be collected.

Variance

1 **CALCULATION SHEET**

2 **Originator**	R. B. Kerkow RBK	4/10/00	**Calc. No.**	0100D-CA-V0075	**Rev. No.** 0
3 **Project**	100-DR-1 Remedial Action	22192	**Checked**	D Drue	**Date:** 4-12-00
4 **Subject**	Group 2 - North Pipeline Sample Variance				**Attachment:** A

Statistical Evaluation of Analytical Data

The required number of samples resulting from the calculation is highlighted at the bottom of the page.

Each value is reflective of the specific isotope evaluated.

The highest value of the three evaluations is used to determine the required number samples as compared against the default of four.

5 **Decision Unit = Shallow Zone** **Sub-units = "E", "F" & "G"**

Samples values from Gamma Energy Analysis (GEA) in pCi/g.

			Constituent					
	Sample #	Location	Co60		Cs137		Eu152	
6	Look-up Value		1.40E+00		6.20E+00		3.30E+00	
7	B0XX85	E1-2	7.70E-02	U	7.80E-02	U	1.60E-01	U
8	B0XX86	E1-3	7.00E-02	U	6.70E-02	U	1.70E-01	U
9	B0XX87	E1-4	7.80E-02	U	2.24E-01		2.00E-01	U
10	B0XX88	E1-10	5.70E-02	U	6.90E-02	U	1.70E-01	U
11	B0XX89	E1-13	9.50E-02	U	9.90E-02	U	2.00E-01	U
12	B0XX90	E1-16	4.30E-02	U	3.70E-02	U	9.70E-02	U
13	B0XX91	E2-3	1.20E-01	U	6.70E-02	U	2.20E-01	U
14	B0XX92	E2-6	4.60E-02	U	8.40E-02	U	1.40E-01	U
15	B0XX93	E2-7	7.00E-02	U	6.00E-02	U	1.40E-01	U
16	B0XX94	E2-10	8.30E-02	U	7.70E-02	U	1.90E-01	U
17	B0XX95	E2-14	9.30E-02	U	8.80E-02	U	2.20E-01	U
18	B0XX96	E2-15	4.30E-02	U	4.10E-02	U	1.00E-01	U
19	B0XX97	E3-1	7.40E-02	U	7.70E-02	U	4.08E-01	
20	B0XX98	E3-2	4.80E-02	U	4.30E-02	U	1.10E-01	U
21	B0XX99	E3-4	8.50E-02	U	7.50E-02	U	1.80E-01	U
22	B0XXB0	E3-5	9.70E-02	U	8.90E-02	U	2.10E-01	U
23	B0XXB1	E3-9	4.60E-02	U	4.70E-02	U	1.01E-01	
24	B0XXB2	E3-11	1.00E-01	U	8.20E-02	U	2.40E-01	U
25	B0XXB3	E4-3	5.20E-02	U	5.80E-02	U	1.40E-01	U
26	B0XXB4	E4-4	5.50E-02	U	3.00E-02	U	3.42E-01	
27	B0XXB5	E4-7	8.30E-02	U	6.00E-02	U	1.70E-01	U
28	B0XXB6	E4-9	1.00E-01	U	1.30E-01	U	3.17E-01	
29	B0XXB7	E4-12	4.60E-02	U	4.90E-02	U	1.20E-01	U
30	B0XXB8	E4-13	6.70E-02	U	7.50E-02	U	1.70E-01	U
31	B0XXB9	F5-1	1.75E-01		9.10E-02	J	3.04E+00	
32	B0XXC0	F5-2	6.80E-02	U	6.60E-02	U	1.90E-01	U
33	B0XXC1	F5-5	5.90E-02	U	4.60E-02	U	1.20E-01	U
34	B0XXC2	F5-7	1.10E-01	U	8.30E-02	U	2.00E-01	U
35	B0XXC3	F5-13	8.30E-02	U	1.00E-01	U	2.20E-01	U
36	B0XXC4	F5-15	6.00E-02	U	5.80E-02	U	1.34E-01	
37	B0XXC5	F6-1	8.70E-02	U	7.00E-02	U	1.70E-01	U
38	B0XXC6	F6-10	6.10E-02	U	5.70E-02	U	1.30E-01	U
39	B0XXC7	F6-12	6.70E-02	U	6.10E-02	U	1.40E-01	U
40	B0XXC8	F6-13	5.70E-02	U	5.60E-02	U	1.40E-01	U
41	B0XXC9	F6-15	4.10E-02	U	3.50E-02	U	9.30E-02	U
42	B0XXD0	F6-16	4.20E-02	U	3.90E-02	U	1.10E-01	U
43	B0XXD1	F7-1	4.70E-02	U	8.10E-02	U	3.54E-01	
44	B0XXD2	F7-3	9.00E-02	U	8.30E-02	U	2.00E-01	U
45	B0XXD3	F7-4	1.10E-01	U	9.80E-02	U	2.40E-01	U
46	B0XXD4	F7-5	4.80E-02	U	5.00E-02	U	1.30E-01	U
47	B0XXD5	F7-8	5.40E-02	U	7.10E-02	J	1.60E-01	U
48	B0XXD6	F7-11	5.00E-02	U	5.50E-02	U	1.10E-01	U
49	B0XXD7	F8-2	1.80E-01	U	2.63E-01		1.20E+00	
50	B0XXD8	F8-3	8.30E-02	U	8.50E-02	U	2.00E-01	U
51	B0XXD9	F8-4	9.50E-02	U	7.90E-02	J	8.08E-01	
52	B0XXF0	F8-8	7.30E-02	U	7.00E-02	U	1.60E-01	U
53	B0XXF1	F8-12	5.00E-02	U	4.70E-02	U	1.30E-01	U
54	B0XXF2	F8-13	3.80E-02	U	3.70E-02	U	1.00E-01	U
55	B0XXF3	G9-3	1.10E-01	U	7.20E-02	U	2.10E-01	U
56	B0XXF4	G9-4	4.60E-02	U	4.40E-02	U	1.10E-01	U
57	B0XXF5	G9-5	6.50E-02	U	7.10E-02	U	1.70E-01	U

Variance
CALCULATION SHEET

2 **Originator**	C. Trice CT	8/7/00	**Calc. No.**	0100D-CA-V0075	**Rev. No.** 1
3 **Project**	100-DR-1 Remedial Action	22192	**Checked**	[illegible]	**Date:** 8/8/00
4 **Subject**	Group 2 - North Pipelines Sample Variance				**Attachment:** A

Statistical Evaluation of Analytical Data

The required number of samples resulting from the calculation is highlighted at the bottom of the page.

Each value is reflective of the specific isotope evaluated.

The highest value of the three evaluations is used to determine the required number samples as compared against the default of four.

5 **Decision Unit = Shallow Zone** **Sub-units = "E", "F" & "G"**

Samples values from Gamma Energy Analysis (GEA) in pCi/g.

			Constituent						
	Sample #	**Location**	**Co60**		**Cs137**		**Eu152**		
58	B0XXF6	G9-10	5.50E-02	U	4.20E-02	U	1.10E-01	U	
59	B0XXF7	G9-14	5.10E-02	U	9.70E-02	U	2.10E-01	U	
60	B0XXF8	G9-16	6.30E-02	U	7.80E-02	U	1.68E-01		
61	B0XXF9	G10-3	8.10E-02	U	7.80E-02	U	4.18E+00		
62	B0XXH0	G10-4	8.40E-02		2.51E-01		1.07E+00		
63	B0XXH1	G10-8	4.20E-02	U	6.40E-02	J	1.10E-01	U	
64	B0XXH2	G10-10	4.40E-02	U	4.30E-02	U	2.28E-01		
65	B0XXH3	G10-14	7.50E-02	U	1.45E+00		2.40E-01	U	
66	B0XXH4	G10-16	8.10E-02	U	2.25E-01		6.59E-01		
67	B0XXH5	G1-2	8.00E-02	U	8.80E-02	U	1.90E-01	U	
68	B0XXH6	G1-3	3.50E-02	U	4.40E-02	U	1.20E-01	U	
69	B0XXH7	G1-4	6.20E-02	U	6.20E-02	U	1.60E-01	U	
70	B0XXH8	G1-10	5.40E-02	U	4.40E-02	U	1.00E-01	U	
71	B0XXH9	G1-13	7.60E-02	U	7.50E-02	U	1.50E-01	U	
72	B0XXJ0	G1-16	4.80E-02	U	1.26E-01		1.03E+00		
73	B0XXJ1	G2-3	1.00E-01	U	6.61E+00		7.87E-01		
74	B0XXJ2	G2-6	4.00E-02	U	3.60E-02	U	9.60E-02	U	
75	B0XXJ3	G2-7	4.60E-02	U	5.20E-02	U	1.40E-01	U	
76	B0XXJ4	G2-10	3.60E-02	U	3.40E-02	U	9.40E-02	U	
77	B0XXJ5	G2-14	8.20E-02	U	7.30E-02	U	1.80E-01	U	
78	B0XXJ6	G2-15	4.10E-02	U	4.00E-02	U	9.50E-02	U	Based on Lines:
79	Mean=========>		7.02E-02		1.86E-01		3.28E-01		67 THRU 78
80	Standard Deviation=>		2.81E-02		7.86E-01		6.10E-01		67 THRU 78
81	τ ==========>		4.74E+01		7.65E+00		4.87E+00		67 THRU 78
82	**Number of Samples>**		**2.75E-03**		**1.06E-01**		**2.61E-01**		67 THRU 78

CALCULATION COVER SHEET

Project Title Group 2 North Pipelines (100-D-48:1 & 100-D-49:1) Cleanup Verification Sampling Locations- Shallow & Deep Zone Areas

Job No. 22192 **Area** 100-D/DR

Discipline Environmental ***Calc. No.** 0100D-CA-V0080

Subject Group 2 North Pipelines (100-D-48:1 & 100-D-49:1) Cleanup Verification Sampling Locations

Computer Program AutoDesk World 2.0 and AutoCAD Map 3.0 **Program No.** NA

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 sheet Calc = 2 sheets Attach 1 = 1 sheet Attach 2 = 1 sheet Attach 3 = 2 sheets Total = 7 sheets	G. Cruz 7-24-00	D.N. Strom 7-24-00	KEC K.E. Cook 7/24/00	M. H. Sturges 7/26/00	7/27/00

SUMMARY OF REVISION

Scanned:	Rev.	Date	Bar Code No.	Rev.	Date	Bar Code No.

*Obtain Calc. No. from DIS.

CALCULATION SHEET

Originator	G. Cruz	Date	7/22/00	Calc. No.	0100D-CA-V0060	Rev. No.	0
Project	100-D/DR	Job No.	22192	Checked	DNS	Date	7-24-00
Subject	Group 2 North Pipelines (100-D-48:1 & 100-D-49:1) Clean up Verification Sampling Loca					Sheet No.	1 of 2

Problem: Calculate and display required sampling nodes in concurrence with 100 Area SAP DOE/RL-96-22 Rev. 1 for verification and closure.

Given:
-SAP (DOE/RL-96-22 Rev. 0) and IG (0100X-IG-G0001 Rev. 2) requirements
-Shallow Sampling Area Surface area of each zone determined from CAD program,
Attachment 3, Sht 1 of 2, CAD file 1D:041700A,Group 2 North Pipelines (100-D-48:1 & 100-D-49:1)
Shallow Zone Sampling Plan
Attachment 3, Sht 2 of 2, CAD file 1D:041700B,Group 2 North Pipelines (100-D-48:1 & 100-D-49:1)
Deep Zone Sampling Plan
-Deep Sampling Area Surface area of each zone determined from CAD program,

SAP and IG Requirements:

Shallow Zone:
-Develop a 16 node sampling grid for the sampling area
-Use appendix A of the IG to determine which six of the sixteen will be sampled to collect HPGe and clean up verification samples

Deep Zone:
-Develop a 16 node sampling grid for the sampling area
-Use appendix A of the IG to determine which four of the sixteen will be sampled to collect clean up verification samples

Determination of Shallow Zone Sampling Grid:

Shallow Zone Sampling Grid Area determined from Table 5-1, IG Attachment 2, Number of Decision Subunits Based on Area (Converted to Sq Meters)

Total Area:	11128.25	m^2
Area of Decision Subunits (total area divided into 3 subunits)	3709.41	m^2
Decision Subunit divided into 4 Sampling Areas:	927.35	m^2
Sampling Areas divided into a 16 node grid (node numbers 1-16):	57.95	m^2

Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)
See Attachment 3, Sht 1 of 2, Group 2 North Pipelines (100-D-48:1 & 100-D-49:1) Shallow Zone Sampling Plan, for Sample Location Table

CALCULATION SHEET

Originator	G. Cruz	Date	7/22/00	Calc. No.	0100D-CA-V0080	Rev. No.	0
Project	100-D/DR	Job No.	22192	Checked	DNS	Date	7-24-00
Subject	Group 2 North Pipelines (100-D-48:1 & 100-D-49:1) Clean up Verification Sampling Loca					Sheet No.	2 of 2

Determination of Deep Zone Sampling Grid:

Deep Zone Sampling Grid Area determined from Table 5-1, IG
Attachment 2, Number of Decision Subunits Based on Area (Converted to Sq Meters)

Total Area:	4375.95	m^2
Area of Decision Subunits (total area divided into 2 subunits)	2187.97	m^2
Decision Subunits divided into 3 Sampling Areas:	729.32	m^2
Sampling Areas divided into a 16 node grid (node numbers 1-16):	45.58	m^2

Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)

See Attachment 3, Sht 2 of 2, Group 2 North Pipelines (100-D-48:1 & 100-D-49:1) Deep Zone Sampling Plan, for Sample Location Table

ATTACHMENT 2

Table 5-1. Number of Decision Subunits Based on Area.

Area of Primary Decision Unit (m^2)	Number of Subunits
<1,394	1
>1,394 to <2,323	2
>2,323 to <3,252	3
>3,252 to <4,181	4
>4,181 to <9,290	2
>9,290 to <13,006	3
>13,006 to <16,723	4
>16,723 to <20,439	5
>20,439	ROUND[a] (Area/3,716)

[a] ROUND is an integer rounding function.

Attachment 2 Sheet No. 1 of 1
Originator G.CRUZ Date 7-22-00
Chk'd By DMS Date 7-24-00
Calc. No. 01000-CA-V0080 Rev. No. 0

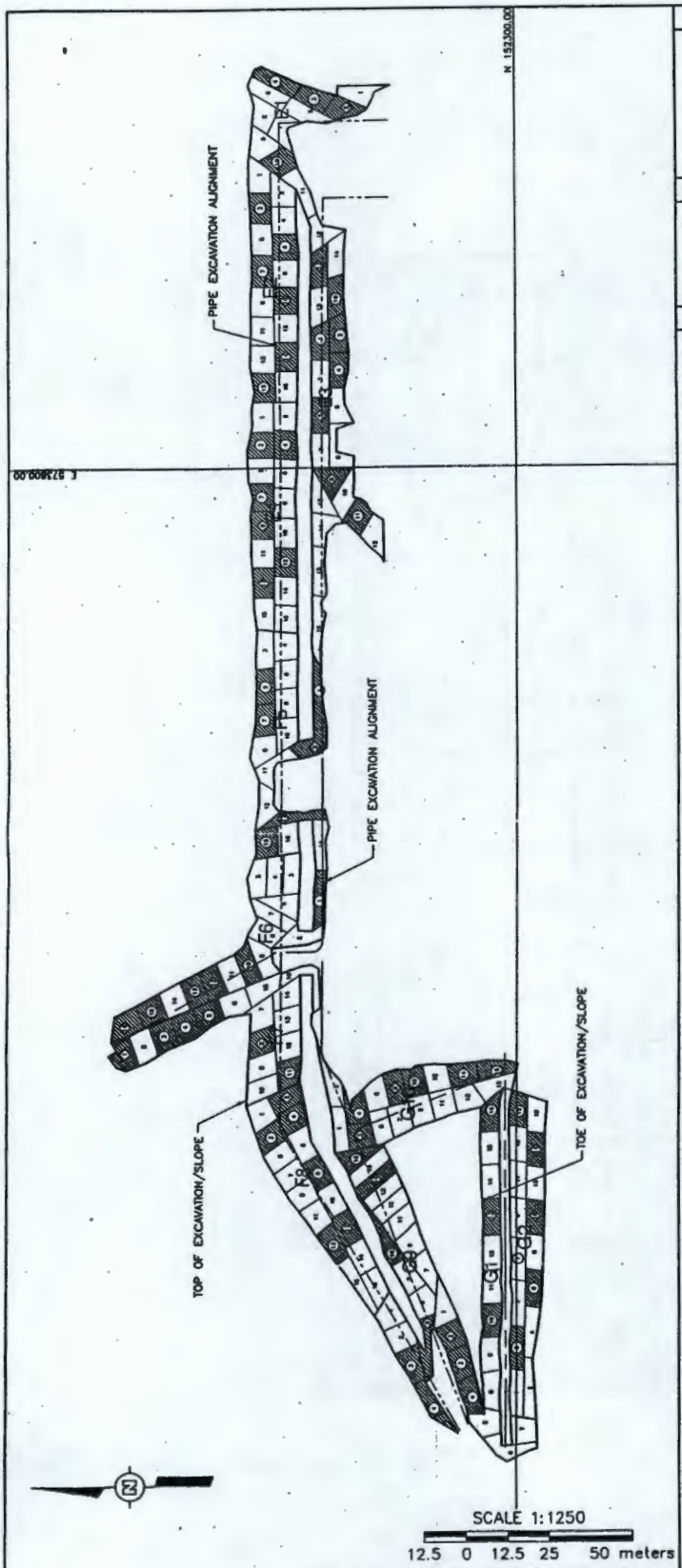
ATTACHMENT 1

Table A-1. Sample Grid Point Lookup Table.

Default Plan	Sampling Area 1	Sampling Area 2	Sampling Area 3	Sampling Area 4	Sampling Area 5	Sampling Area 6	Sampling Area 7	Sampling Area 8	Sampling Area 9	Sampling Area 10
HPGe/Closeout	3	6	1	4	5	1	3	3	4	16
HPGe/Closeout	4	7	11	3	15	15	5	13	10	10
HPGe/Closeout	16	3	2	7	7	10	11	4	3	14
HPGe/Closeout	10	15	4	12	1	13	4	8	16	4
HPGe	2	14	5	9	13	12	8	2	14	8
HPGe	13	10	9	13	2	16	1	12	5	3
Not sampling	6	1	10	8	14	4	16	5	8	6
Not sampling	1	9	13	1	10	5	12	1	1	15
Not sampling	9	12	7	5	6	2	6	7	15	9
Not sampling	15	16	15	14	16	6	2	15	11	1
Not sampling	8	13	8	10	12	11	13	14	2	12
Not sampling	5	2	3	11	4	3	9	10	7	11
Not sampling	7	11	14	15	11	14	14	6	13	2
Not sampling	11	4	6	2	9	7	7	11	9	7
Not sampling	12	8	16	16	3	8	15	9	6	13
Not sampling	14	5	12	6	8	9	10	16	12	5

**NOTE: Grid nodes for each sampling area in each waste site should be numbered consistently, e.g., begin numbering the nodes in the northwesternmost node. Then number consecutively left to right as shown in Figure 5-1 of this IG.

Attachment 1 Sheet No. 1 of 1
Originator G. Cruz Date 7-22-00
Chk'd By DNS Date 7-24-00
Calc. No. 01000-CA-V00080 Rev. No. 0



NOTES

1. SHALLOW ZONE NODE AREAS ARE APPROXIMATELY 57.95 SQUARE METERS.
2. SAMPLES IS TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE SHALLOW ZONE CONSISTS OF SAMPLING AREAS E1, E2, E3 AND E4 WITHIN DECISION SUBUNIT 1, SAMPLING AREAS F5, F6, F7 AND F8 WITHIN DECISION SUBUNIT 2 AND SAMPLING AREAS G9, G10, G1 AND G2 WITHIN DECISION SUBUNIT 3.

LEGEND

CLOSEOUT VERIFICATION SAMPLING NODE

GAMMA ENERGY ANALYSIS SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	E1	E1-2	152351.08	573906.49
		E1-3	152360.86	573909.17
		E1-4	152372.38	573914.54
		E1-10	152371.88	573890.48
		E1-13	152359.45	573859.72
		E1-16	152354.37	573850.06
	E2	E2-3	152376.99	573876.89
		E2-6	152369.63	573865.35
		E2-7	152376.33	573858.31
		E2-10	152369.47	573849.74
		E2-14	152369.30	573833.25
		E2-15	152375.94	573824.28
	E3	E3-1	152359.00	573838.37
		E3-2	152352.97	573839.37
		E3-4	152353.45	573829.16
		E3-5	152359.20	573815.69
		E3-9	152355.83	573796.50
		E3-11	152347.91	573785.09
	E4	E4-3	152376.97	573806.92
		E4-4	152369.61	573806.92
		E4-7	152376.71	573791.15
		E4-9	152376.42	573782.54
		E4-12	152369.61	573771.45
		E4-13	152376.21	573765.19
2	F5	F5-1	152359.51	573732.70
		F5-2	152361.00	573715.95
		F5-5	152375.64	573733.88
		F5-7	152375.95	573723.89
		F5-13	152370.28	573693.80
		F5-15	152375.32	573686.28
	F6	F6-1	152359.33	573668.73
		F6-10	152380.32	573649.80
		F6-12	152390.60	573644.66
		F6-13	152396.20	573642.05
		F6-15	152408.92	573635.95
		F6-16	152416.82	573631.21
	F7	F7-1	152416.71	573623.47
		F7-3	152405.20	573628.72
		F7-4	152398.83	573631.45
		F7-5	152391.81	573634.77
		F7-8	152376.33	573626.48
		F7-11	152367.93	573617.69
	F8	F8-2	152368.73	573610.27
		F8-3	152373.19	573598.00
		F8-4	152366.66	573604.41
		F8-8	152359.30	573587.12
		F8-12	152350.64	573570.28
		F8-13	152354.67	573565.36
3	G9	G9-3	152331.58	573529.02
		G9-4	152324.66	573516.47
		G9-5	152326.82	573541.62
		G9-10	152337.23	573562.82
		G9-14	152342.11	573585.01
		G9-16	152348.00	573591.31
	G10	G10-3	152346.85	573598.49
		G10-4	152347.22	573605.16
		G10-8	152336.57	573612.80
		G10-10	152330.81	573614.61
		G10-14	152316.09	573616.75
		G10-16	152306.19	573617.60
	G1	G1-2	152319.77	573537.63
		G1-3	152316.70	573529.58
		G1-4	152313.17	573519.63
		G1-10	152307.57	573542.24
		G1-13	152307.67	573573.43
		G1-16	152307.66	573605.80
	G2	G2-3	152299.93	573534.09
		G2-6	152294.71	573551.85
		G2-7	152299.60	573561.01
		G2-10	152294.30	573573.42
		G2-14	152293.98	573593.84
		G2-15	152299.22	573605.52

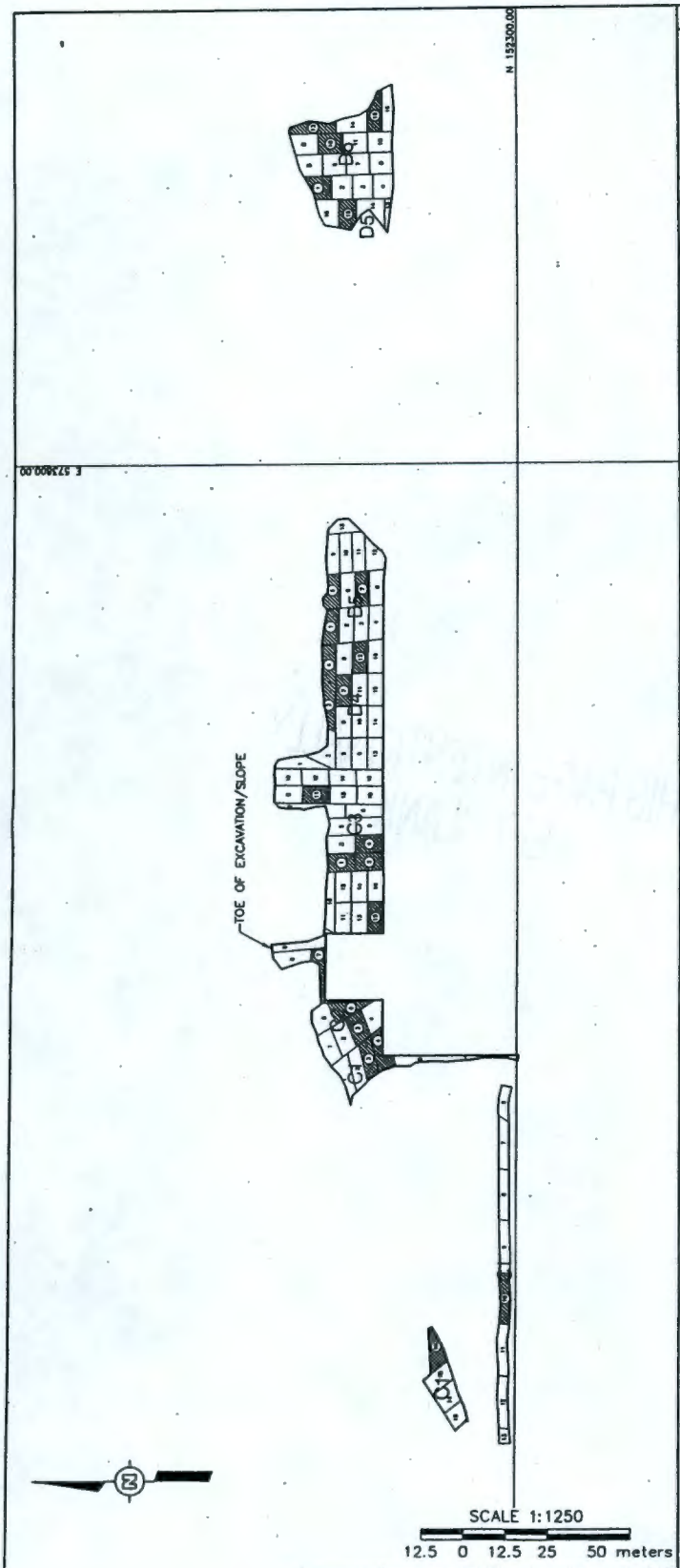
Attachment 3 Sheet No. 1 of 2
Originator G.C. Cruz Date 7-22-00
Chk'd By DNS Date 7-24-00
Calc. No. 0100D-CA-V0028 Rev. No. 0

ATTACHMENT 3

U.S DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
HANFORD ENVIRONMENTAL RESTORATION PROGRAM

100 D AREA
100 AREA REMEDIAL DESIGN
GROUP 2 NORTH PIPELINES
(100-D-48:1 & 100-D-49:1)
SHALLOW ZONE SAMPLING PLAN

1D:041700A



NOTES

1. SHALLOW ZONE NODE AREAS ARE APPROXIMATELY 45.58 SQUARE METERS.
2. SAMPLES IS TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE SHALLOW ZONE CONSISTS OF SAMPLING AREAS C1, C2, C3 WITHIN DECISION SUBUNIT 1, SAMPLING AREAS C4, C5, C6 WITHIN DECISION SUBUNIT 2

LEGEND

CLOSEOUT VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	C1	C1-3	152344.50	573620.64
		C1-4	152341.70	573626.02
		C1-10	152303.18	573548.47
		C1-16	152323.43	573534.11
	C2	C2-3	152347.79	573629.71
		C2-6	152349.96	573635.64
		C2-7	152359.69	573651.48
		C2-15	152342.88	573662.66
	C3	C3-1	152353.26	573679.05
		C3-2	152344.86	573679.32
		C3-4	152344.88	573684.75
		C3-11	152360.75	573700.06
2	D4	D4-3	152357.06	573727.73
		D4-4	152357.04	573739.63
		D4-7	152352.57	573731.95
		D4-12	152347.68	573741.84
	D5	D5-1	152356.61	573750.80
		D5-5	152356.14	573761.61
		D5-7	152347.13	573762.00
		D5-15	152351.43	573874.91
	D6	D6-1	152360.39	573882.62
		D6-10	152356.62	573895.76
		D6-13	152361.79	573900.58
		D6-15	152343.16	573903.95

Attachment 3 Sheet No. 2 of 2
Originator G. CRUZ Date 7-27-00
Chk'd By DJS Date 7-27-00
Calc. No. 0100P-CA-V00 B0 Rev. No. 0

ATTACHMENT 3

U.S DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
HANFORD ENVIRONMENTAL RESTORATION PROGRAM

100 D AREA
100 AREA REMEDIAL DESIGN
GROUP 2 NORTH PIPELINES
(100-D-48:1 & 100-D-49:1)
DEEP ZONE SAMPLING PLAN

10:0417008

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CALCULATION COVER SHEET

Project Title:	North Pipelines Site Closeout	**Job No.**	22192
Area	100-D		
Discipline	Environmental	**Calc. No.**	0100D-CA-V0183
Subject	95% UCL Calculations for 100-D-48:1 and 100-D-49:1		
Computer Program	Excel	**Program No.**	Excel 97

Committed Calculation X **Preliminary** **Superseded**

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 17 Total = 18	SW Callison 11/6/00 S.W. Callison	LE Ivey 11/6/00 L.E. Ivey TB Miley 11/6/00 T.B. Miley	KEC 11/8/00 K.E. Cook	11.9.00 FM Corpuz F.M. Corpuz	11-9-00

SUMMARY OF REVISIONS

This calculation supersedes calculation 0100D-CA-V0121.

D48-1&49-1&D19 UCL DV0183 Rev0.xls/Cover

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator	S.W. Callison SWC	**Date** 11/06/00	**Calc. No.** 0100D-CA-V0183	**Rev. No.**	0
Project	North Pipelines Site Closeout	**Job No.** 22192	**Checked** L.E. Ivey LEI	**Date**	11/06/00
			T.B. Miley TBM	**Date**	11/06/00
Subject	95% UCL Calculations for 100-D-48:1 and 100-D-49:1			**Sheet No.**	1 of 17

Problem:
Calculate the requisite statistics to evaluate compliance with cleanup standards as required by the Instruction Guide (IG) (100-IG-G0001, Rev. 1); these statistical values will also be used to determine compliance with groundwater and river protection criteria. Also, calculate the carcinogenic risk for applicable nonradionuclide analytes (shallow zone only), MTCA 3-part test (all nonradionuclide analytes), and the relative percent difference (RPD) for each contaminant of concern (COC).

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Shallow Zone Cleanup Verification Results and 95% UCL Calculation	3
Shallow Zone Data MTCAStat distribution testing and UCL Calculation	4-11
Deep Zone Cleanup Verification Results and 95% UCL Calculation	12
100-D-19 Specific COC Deep Zone 95% UCL Calculation	13-14
Relative Percent Difference (RPD) Quality Assessment Calculation	15
95% UCL Calculation Formulae	16
RPD Calculation Formulae	17

Given/References:
1) Sample Results
2) Lookup values from Remedial Design Report/Remedial Action Work Plan (RDR/RAWP) (DOE-RL1998b).
3) DOE-RL, 1998a, 100 Area Remedial Action Sampling and Analysis Plan, DOE/RL-96-22, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 1998b, Remedial Design Report/Remedial Action Work Plan for the 100 Area, DOE/RL-96-17, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) BHI, 1999, Instruction Guide for the Remediation of the 100-BC-1, 100-DR-1, and 100-HR-1 Waste Sites, 0100X-IG-G0001, Rev. 2, Bechtel Hanford, Inc., Richland, Washington.
6) Model Toxics Control Act, Washington Administrative Code-173-340, and Statistical Guidance for Ecology Site Managers, Ecology Pub. #92-54, Washington Department of Ecology, Olympia, Washington.
7) Ecology, 1993, Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-Detection Limit or Below-PQL Values (Censored Data Sets).
8) EPA, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013.
9) Calculation of Hexavalent Chromium Carcinogenic Risk (Calc. No. 0100X-CA-00031, Rev. 0)

Solution:
Calculation methodology is described in Ecology Pub. #92-54, below, and in Attachment A-1 of the SAP. Use data from attached worksheets to calculate the 95% upper confidence limit (UCL) for each analyte, carcinogenic risk and perform the MTCA 3-part test for nonradionuclides, and RPD calculations for each COC.

Calculation Description:
The subject calculations were performed on data from soil verification samples from waste sites 100-D-48:1/49:1 (D Group 2 North Pipelines) and 100-D-19. The data were entered into an EXCEL 97 spreadsheet and calculations performed by utilizing the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the Cleanup Verification Package (CVP) for this site.

Methodology:
The statistical value calculated to evaluate the effectiveness of cleanup was the 95% UCL. For nonradioactive analytes with > 50% of the data below detection limits, the maximum value for the sample data was used instead of the 95% UCL. All nonradionuclide (i.e., metals) data reported as being below detection limit were set to ½ the detection limit value for calculation of the statistics (Ecology, 1993).

For radionuclide data, calculation of the statistics was done on the reported value, or using the minimal detectable activity (MDA) for those analytes below detection. When overburden is present the natural background and anthropogenic radiation is subtracted from the statistical value. This value then becomes the RESRAD input value.

For some data, the lab has reported a "U" qualifier even though the reported value was greater than the MDA. This is due to sample results being within the background range, thus, the lab has qualified the data accordingly and the results are considered nondetects. For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

The MTCA statistical guidance suggests that a test for distributional form be performed on the data, and the 95% UCL calculated on the appropriate distribution. For small data sets (n < 10), the calculations are performed assuming a nonparametric distribution. For large data sets a test for distribution is performed using Ecology's MTCAStat 2.1 statistical software.

Because the estimated location of the former 100-D-19 sludge burial site is within the excavated area of the 100-D-48:1/100-D-49:1 (North Pipelines) site, two additional samples were collected from the bottom of the North Pipeline excavation (at a depth greater than 15 feet below ground surface) in the vicinity of the 100-D-19 site and analyzed for the specific COCs associated with 100-D-19. The deep zone 95% UCL values for these 100-D-19 specific COCs were calculated using the sample results of the two additional samples.

The estimated hazard quotient (for applicable nonradionuclide COCs) is determined by dividing the statistical value (derived in this calculation) by the MTCA B noncarcinogenic cleanup limit. The nonradionuclide carcinogenic risk, above background, is determined by dividing the statistical value by the MTCA B carcinogenic cleanup limit and then multiplying by 10^{-6}. For data sets where all values are below detection or below the practical quantitation limit (PQL), neither of these calculations are required. Where the cleanup level is less than the PQL and the associated analyte is detected at a concentration below the PQL, the cleanup level is considered to have been attained (WAC 173-340-707). For noncarcinogenic nonradionuclide COCs, only the estimated fraction of risk computation must be performed.

The MTCA 3-part test determines if:
1) the statistical value exceeds the most stringent cleanup limit for each nonradionuclide COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each nonradionuclide COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each nonradionuclide COC.

The 3-part test is performed for nonradionuclide analytes found in overburden, the shallow zone, and the deep zone, as necessary. Where the data set does not meet the 3-part-test based on conservative "100 times groundwater criteria" rule and "100 times surface water quality times DAF" rule cleanup levels a more detailed analysis (as permitted by MTCA) using RESRAD or alternate techniques will be done. As stated above, in cases where all values are below detection or below the PQL, the cleanup level is considered to have been attained (WAC 173-340-707). The MTCA 3-part-test is not applicable in these cases.

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CALCULATION SHEET

Originator	S.W. Callison SWC	**Date** 11/06/00	**Calc. No.** 0100D-CA-V0183	**Rev. No.**	0
Project	North Pipelines Site Closeout	**Job No.** 22192	**Checked** L.E. Ivey LI	**Date**	11/06/00
			T.B. Miley TBM	**Date**	11/06/00
Subject	95% UCL Calculations for 100-D-48:1 and 100-D-49:1			**Sheet No.**	2 of 17

Methodology (continued):
The RPD is performed when both the main value and, either, the duplicate, split, or regulator split values are greater than 5 times the target detection limit (TDL). These RPD calculations use the following formula: RPD =[|M-S|/((M+S)/2)]*100

where, M = Main Sample Value
D = Split (or duplicate) Sample Value

For QA/QC split and duplicate RPD calculations, a value below +/- 30% indicates the data compare favorably. For regulatory splits, a threshold of +/- 35% is used (EPA 540/R-94/013). If the RPD is greater than +/- 30% (or +/- 35% for regulatory split data), further investigation regarding the usability of the data is performed. Data usability is discussed in the Data Quality Assessment (DQA) section of the site Cleanup Verification Package (CVP).

If regulator splits comparison is required, an additional parameter is evaluated. A control limit of +/- 2 times the TDL shall be used if either the main or regulator split value is less than 5 times the TDL and above detection. In the case where only one result is above the five times the TDL and the other is below, the +/- 2 times the TDL criteria applies. Therefore the following calculation is performed during these two cases involving regulator split data:

difference = main - regulator split

If the difference is greater than +/- 2 times the TDL, then further investigation regarding the useability of the data is performed. Data usability is discussed in the DQA section of the site CVP.

Results:
The results presented in the summary tables that follow are for use in RESRAD dose/risk analysis and the Cleanup Verification Package (CVP)

Result Summary - Shallow Zone

100-D-48:1 &49:1 Group 2 North Pipelines

Cs-137	2.51E-01	pCi/g
Co-60	5.00E-02	pCi/g
Eu-152	3.00E-01	pCi/g
Eu-154	1.20E-01	pCi/g
Pu-239/240	1.30E-01	pCi/g
Sr-90	1.50E-01	pCi/g
U-233/234	0 (< BG)	pCi/g
U-238	0 (< BG)	pCi/g
Cr-6	6.40E-01	mg/kg

Note: Because the 100-D-19 sludge trench site was entirely located within the North Pipeline site excavation, the 100-D-19 specific COCs are only applicable to the deep zone (soil area immediately beneath the former sludge trench). The 100-D-19 specific COC 95% UCL values are based on analyses results from two cleanup verification samples collected in the vicinity of the former sludge trench.

Result Summary - Deep Zone

100-D-48:1 &49:1 Group 2 North Pipelines and 100-D-19 Sludge Trench

Cs-137	2.82E+01		pCi/g
Co-60	5.29E+00		pCi/g
Eu-152	3.42E+01		pCi/g
Eu-154	4.25E+00		pCi/g
Pu-239/240	4.49E-01		pCi/g
Sr-90	6.07E-01		pCi/g
U-233/234	0 (< BG)		pCi/g
U-238	0 (< BG)		pCi/g
Cr-6	5.00E+00	*	mg/kg
100-D-19 Specific			
Am-241	4.64E-01		pCi/g
Ni-63	1.06E+03		pCi/g
Mercury	2.01E+00	*	mg/kg
PCB-Aroclor-101	3.40E-02	U	mg/kg
PCB-Aroclor-122	3.40E-02	U	mg/kg
PCB-Aroclor-123	3.40E-02	U	mg/kg
PCB-Aroclor-124	3.40E-02	U	mg/kg
PCB-Aroclor-124	3.40E-02	U	mg/kg
PCB-Aroclor-125	3.40E-02	U	mg/kg
PCB-Aroclor-126	3.40E-02	U	mg/kg

MTCA Evaluation (Shallow Zone)

MTCA 3-Part Test:

95% UCL > Cleanup Limit?	NO
> 10% above Cleanup Limit?	NO
Any sample > Cleanup Limit?	NO

Risk Estimate:

Nonrad noncarcinogenic sum of quotients:	1.6E-03
Nonrad carcinogenic risk:	3.0E-07

MTCA Evaluation (Deep Zone)

MTCA 3-Part Test:

95% UCL > Cleanup Limit?	YES	*
> 10% above Cleanup Limit?	YES	*
Any sample > Cleanup Limit?	YES	*

* For analytes with "YES" answers to the MTCA 3-part-test, groundwater and/or river protection are demonstrated by leach testing and/or site specific modeling using RESRAD.

Relative Percent Difference (RPD) Results
QA/QC Analysis

Analyte	Duplicate Analysis	Split Analysis
Cs-137		
Co-60		
Eu-152		
Eu-154		
Pu-239/240		
Sr-90		
U-233/234		
U-238		
Cr-6		

Relative Percent Difference (RPD) Results
QA/QC Analysis

Analyte	Duplicate Analysis	Split Analysis
Cs-137	4.10%	1.58%
Co-60	3.19%	0.14%
Eu-152	2.83%	6.85%
Eu-154	9.58%	12.67%
Pu-239/240		82.63%
Sr-90		
U-233/234	55.79%	48.74%
U-238	25.62%	46.96%
Cr-6	NA	NA

Notes: A blank box indicates that the RPD did not need to be calculated.
Discussion regarding the data useability where RPDs are greater than 30% is located in the site Cleanup Verification Package (CVP).

D48-1&49-1&D19 UCL DV0183 Rev0.xls/Summary

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CALCULATION COVER SHEET

Project Title 100-D-48:1 / 100-D-49:1 / 100-D-19 Cleanup Verification **Job No.** 22192
Area 100-D/DR Area
Discipline Environmental **Calc. No.** 0100D-CA-V0180
Subject 100-D-19 Deep Zone Cleanup Verification Model
Computer Program _____ **Program No.** _____

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Sheets – 4 pg Attm. 1 – 1 pg Attm. 2 – 7 pg Attm. 3 - 1 pg Attm. 4 - 1 pg Total – 15 pages	S. W. Callison 11/1/00	S. W. Clark 11/1/00	K. E. Cook 11/8/00	F. M. Corpuz 11-9-00	11-9-00

SUMMARY OF REVISION

Scanned:	Rev.	Date	Bar Code No.	Rev.	Date	Bar Code No.

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator:	S. W. Callison SWC	Date:	11/1/00	Calc. No.	0100D-CA-V0180	Rev. No.	0
Project:	100-D-48:1 / 100-D-49:1 / 100-D-19 Cleanup Verification	Job No.	22192	Checked:	Steven W. Clark SWC	Date: 11/1/00	
Subject:	**100-D-19 Deep Zone Cleanup Verification Model**					Sheet No. 1 of 4	

Problem:

Only excavation floor cleanup verification data are available from the 100-D-48:1 and 49:1 and 100-D-19 (North Pipelines) site. Other available information must be used to estimate the nickel-63, mercury, and hexavalent chromium deep zone contaminant distribution at the North Pipelines site.

Given:

1) North Pipelines excavation floor statistical values from Calc. No. 0100D-CA-V0183 (Attachment 1)
2) 116-DR-1 & DR-2 site characterization borehole results (Attachment 2)
3) 1607-D-2 septic tank tile field mercury in process soil results (Attachment 3)
4) 1607-D-2 cleanup verification sample results (Attachment 4)

Solution:

Use available data to describe the deep zone nickel-63, mercury, and hexavalent chromium soil contamination profile. Combine the data into fewer depth ranges to simplify RESRAD modeling.

Cleanup verification evaluations for the North Pipelines deep zone are based on cleanup verification sample results from the excavation floor, data from the 116-DR-1 and DR-2 test boring, and data from the 1607-D-2 site.

This calculation brief describes how the information was evaluated and combined to represent the deep zone nickel-63, mercury, and hexavalent chromium soil contamination profile at the site.

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator:	S. W. Callison SWC	Date:	11/1/00	Calc. No.	0100D-CA-V0180	Rev. No.	0
Project:	100-D-48:1 / 100-D-49:1 / 100-D-19 Cleanup Verification	Job No.	22192	Checked: Steven W. Clark SWC		Date: 11/1/00	
Subject:	**100-D-19 Deep Zone Cleanup Verification Model**					Sheet No. 2 of 4	

Data Evaluation:

1) North Pipelines excavation floor statistical values from Calc. No. 0100D-CA-V0183 (Attachment 1)

The deep excavation floor statistical values for site represent the deep zone surface. Of the listed COCs in attachment 1 hexavalent chromium, nickel-63, and mercury are at levels needing additional assessment of the deep zone contaminant depth distribution.

2) 116-DR-1 and DR-2 Test Boring Results (Attachment 2)

A test boring was performed at what was considered to be the worst case site (116-DR-1 & DR-2) for contamination. The boring was located in the most contaminated location known within the worst case site. Samples were collected at approximately 1-meter intervals and analyzed for a suite of radionuclide and nonradionuclide contaminants. The concentration/depth profiles and raw data are included as Attachment 2.

For mercury the 116-DR-1/DR-2 borehole mercury depth distribution is not usable because the mercury results are almost all below detection. Where mercury was detected, the levels are near the practical quantitation limit. For this reason, the mercury data in items 3) and 4) is used to establish a mercury depth profile.

For hexavalent chromium the 116-DR-1/DR-2 borehole hexavalent chromium depth distribution is used rather than the 116-D-7 test pit hexavalent chromium depth distribution, because the borehole has data spanning the entire vadose zone (about 13 meters at the borehole), while the 116-D-7 test pits spanned only the top 9 meters of the vadose zone at the 116-D-7 site.

3) 1607-D-2 Septic Tank and Tile Field Mercury in Process Soil Results (Attachment 3)

During excavation of the 1607-D-2 septic tank tile field, in process (waste characterization) samples were collected from fine grained soil material inside and adjacent to the drain field piping. Mercury was detected in all 4 of the in process samples. In process mercury sample results and sample location information are listed in Attachment 3.

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator:	S. W. Callison SWC	Date:	11/1/00	Calc. No.	0100D-CA-V0180	Rev. No.	0
Project:	100-D-48:1 / 100-D-49:1 / 100-D-19 Cleanup Verification	Job No.	22192	Checked: Steven W. Clark SWC		Date: 11/1/00	
Subject:	**100-D-19 Deep Zone Cleanup Verification Model**					Sheet No. 3 of 4	

4) 1607-D-2 Cleanup Verification Sample Results (Attachment 4)

Following excavation of the 1607-D-2 septic tank tile field, cleanup verification soil samples were collected. Mercury was not detected in any of the cleanup verification samples collected from the walls and floor of the septic tank and tile field excavations.

Deep Zone Model:

- ***Depth Horizons.*** The deep zone was divided into two horizons (Level I and Level II).

  Level I, is the horizon where the highest contaminant levels are observed. Based on the results from the data above, Level I will be 4-meters thick (1 meter above and 3 meters below the bottom of the excavation). The excavation is 5.6 meters in depth. The shallow zone is the top 4.6 m. Level I of the deep zone is the remaining 1 meter to the bottom of the excavation plus 3 meters below the bottom of the excavation.

  Level II, represents the remaining vadose zone below Level I where contaminant concentrations are much lower. Level II will be 9.4-meters thick (134.4 m surface elev. – 116.4 m groundwater elev. – 4.6 m shallow zone – 4 m for Level I = 9.4 m).

- ***Contaminant Concentrations.*** In the cases described above, the highest concentrations were observed in the higher elevations; therefore the deep zone nickel-63, mercury, and hexavalent chromium statistical values will be used as a worst case to represent the Level I nickel-63, mercury, and hexavalent chromium contaminant concentrations (i.e., concentrations in the top 4 meters of the deep zone).

  Based on the nickel-63 and hexavalent chromium data from the 116-DR-1 / DR-2 boring and the mercury data from the 1607-D-2 site, the worst case concentrations in the Level II horizon were divided by the worst case concentrations in the Level I horizon (and multiplied by 100) to estimate the worst case percentage of contamination in Level II soils. This percentage was then multiplied by the deep zone nickel-63, mercury, and hexavalent chromium statistical values to produce site specific Level II nickel-63, mercury, and hexavalent chromium concentrations. These calculations are shown in Table 1 using data provided in the attachments.

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator:	S. W. Callison SWC	Date:	11/1/00	Calc. No.	0100D-CA-V0180	Rev. No.	0
Project:	100-D-48:1 / 100-D-49:1 / 100-D-19 Cleanup Verification	Job No.	22192	Checked: Steven W. Clark SWC		Date: 11/1/00	
Subject:	**100-D-19 Deep Zone Cleanup Verification Model**					Sheet No. 4 of 4	

Conclusion: The deep zone model concentrations in Table 1 are conservative estimates of the nickel-63, mercury, and hexavalent chromium concentrations in Level I and Level II of the site. These values will be used in the RAO/RAG evaluations of how the site may impact groundwater and the Columbia River, which includes RESRAD modeling.

Table 1. Deep Zone Cleanup Verification Model Calculations

COC		Nickel-63 *pCi/g*	Mercury *mg/kg*	Hexavalent Chromium *mg/kg*
Data Source	*Description*			
116-DR-1/DR-2 Test Boring Data for Nickel-63 and Hexavalent Chromium and 1607-D-2 Site Data for Mercury	Max. in Level I	129	63.4	2.30
	Max. in Level II	0.322	0.021 U	0.44 U
Calculated	Level II as % of Level I	0.25	0.03	19.1
Deep Zone Cleanup Verification Value	***Level I Conc.***	***1,060***	***2.01***	***5.0***
Calculated	***Level II Conc.***	***2.65***	***0.001***	***0.96***

NOTES:

1. ***Deep zone cleanup verification values are shown in bold italic above.***
2. U – Not detected at the indicated practical quantitation limit.

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CALCULATION COVER SHEET

Project Title 100-D/DR Remedial Action **Job No.** 22192
Area 100-D/DR Area
Discipline Environmental ***Calc. No.** 100D-CA-V0168
Subject 100-D-48:1 100-D-49:1 RESRAD
Computer Program RESRAD Version 5.91 **Program No.**

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover - 1 pg Summary - 8 pg Attm. 1 – 1 pg Attm. 2 – 25 pg Attm. 3 – 39 pg Attm. 4 – 19 pg Attm. 5 – 27 pg Attm. 6 – 39 pg Attm. 7 – 19 pg Attm. 8 – 21 pg Attm. 9 – 10 pg Attm. 10 – 27 pg Attm. 11 – 39 pg Attm. 12 – 19 pg Total – 294 pages	S. W. Callison SW Callison 11/6/00	S. W. Clark S.W. Clark 11/6/00	K. E. Cook KEC 11/8/00	F. M. Corpuz FM Corpuz 11.9.00	11-9-00

SUMMARY OF REVISION

*Obtain Calc. No. from DIS

November 1998

DE01-437.03

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator:	S. W. Callison SWC	Date:	11/6/00	Calc. No.:	0100D-CA-V0168	Rev.:	0
Project:	100-D/DR Remedial Action	Job No:	22192	Checked:	S. W. Clark SWC	Date:	11/6/00
Subject:	100-D-48:1 100-D-49:1 RESRAD					Sheet No.	1 of 8

PROBLEM STATEMENT:

Calculate the soil and groundwater concentrations, dose, and risk contributions from remaining radionuclide contaminants in the upper (shallow) zone, and two lower (deep) zones over a period of 1000 years.

GIVEN:

1) Shallow and deep zone cleanup verification statistical values from *95% UCL Calculations for 100-D-48:1 and 100-D-49:1*, Calculation No. 0100D-CA-V0183, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
2) Deep zone Level I and Level II cleanup verification data set from *100-D-48:1 and 49:1 and 100-D-19 Deep Zone Cleanup Verification Model*, Calculation No. 0100D-CA-V0180, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
3) *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) Calculation of relative individual Pu-239 and Pu-240 activities from the reported Pu-239/249 results per *Ratios of Plutonium Isotopes at 100 Areas Remedial Action Sites*, Calculation No. 0100B-CA-V0013, Bechtel Hanford, Inc., Richland, Washington.
5) For the purpose of these RESRAD calculations, the radioactive contaminants of concern (COCs) for 100-D pipelines from the *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 1, are: cobalt-60, cesium-137, europium-152, europium-154, plutonium-239/240, strontium-90, uranium-233/234, and uranium-238. Uranium-233/234 and uranium-238 are present with activities below the Hanford Site background value of 1.1 pCi/g and are not considered further.
6) The only nonradionuclide COC for 100-D pipelines from the *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 1, is hexavalent chromium. The hexavalent chromium 95% UCL value for the shallow zone is below the most stringent soil remedial action goal (RAG) of 2.1 mg/kg (soil RAG for protection of human health). Sample results are presented in the 100-D-48:1 and 49:1 95% UCL Calculations. Hexavalent chromium in the shallow zone is not considered further. Hexavalent chromium in the deep zone is greater than the value of the Model Toxics Control Act (MTCA) "100 time rule" [WAC 173-340-740(3)(a)(ii)(A)], as presented in the site UCL calculations. Therefore, the potential for hexavalent chromium to migrate to groundwater was evaluated.
7) The 100-D-19 sludge trench is included in the 100-D-48:1 and 49:1 pipelines site. Additional radioactive COCs associated with the sludge trench that are not listed in bullet 5 include americium-241 and nickel-63. The 100-D-19 sludge trench COC list was developed from analogous sludge pit and sludge trench site data included in the *Contaminants of Concern for the 100-D-19 Sludge Disposal Trench ERC Interoffice Memorandum* (CCN 077496) and from development of Revison 2 of the *100 Area Remedial Action Sampling and Analysis Plan.*

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator:	S. W. Callison SWC	Date:	11/6/00	Calc. No.:	0100D-CA-V0168	Rev.:	0
Project:	100-D/DR Remedial Action	Job No:	22192	Checked:	S. W. Clark SWC	Date:	11/6/00
Subject:	100-D-48:1 100-D-49:1 RESRAD					Sheet No.	2 of 8

8) Additional nonradionuclide COCs associated with the 100-D-19 sludge trench that are not listed in bullet 6 include mercury and polychlorinated biphenyls (PCBs). The 100-D-19 sludge trench COC list was developed from analogous sludge pit and trench site data included in the *Contaminants of Concern for the 100-D-19 Sludge Disposal Trench ERC Interoffice Memorandum* (CCN 077496) and from development of Revison 2 of the *100 Area Remedial Action Sampling and Analysis Plan.* PCBs were not detected in the 100-D-19 cleanup verification samples and are therefore not considered further. As shown in Table 3, only mercury in the Deep Zone Level I has a concentration higher than the Hanford site background value of 0.33 mg/kg. Therefore, the potential for mercury in the Deep Zone Level I to migrate to groundwater was evaluated.
9) Memo "From the Desk of" (FDO) S. K. DeMers to R. C. Smith, J. G. April, and S. W. Clark, *Using RESRAD Ver. 5.61 for Chemical Data*, Dated March 5, 1997.
10) RESidual RADioactivity (RESRAD) computer code, version 5.91, to calculate compliance with residual radioactivity guidelines, developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois.
11) Specific activities of surrogate radionuclides from Table J.1 of: *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0*, ANL/EAD/LD-2, 1993, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois
12) Shallow and deep zone sample design data from *Group 2 North Pipelines (100-D-48:1 & 100-D-49:1) Cleanup Verification Sampling,* Calculation No. 0100D-CA-V0080, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

SOLUTION:

1) Separate RESRAD runs were performed for each of the relevant vadose zone soil horizons. Table 1 shows the elevation (NGVD29) and dimensions of each soil horizon. The shallow zone was chosen as the sidewalls of the excavation (from the surface to 4.6 m deep). The deep zone (below 4.6 m) was divided into two levels consistent with the *100-D-19 Deep Zone Cleanup Verification Model*, Calculation No. 0100D-CA-V0180. Attachment 1 shows the dimensions of each soil horizon and the contaminant pathways considered for dose, risk, and groundwater protection. Input factors for each run are shown in the "Summary" section of the RESRAD "Part I: Mixture Sums and Single Radionuclide Guidelines" printouts in the Attachments to this Calculation Summary.

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Table 1. Dimensions and Elevation of Soil Horizons

RESRAD Run #	Vadose Zone Horizon	Upper Elevation (m)	Lower Elevation (m)	Thickness (m)
1	Shallow Zone	134.4	129.8	4.6
2	Deep Zone Level I	129.8	125.8	4.0
3	Deep Zone Level II	125.8	116.4	9.4

2) The year where the peak dose (or concentration) occurs from each individual layer is determined by a preliminary run. This year is then added for all horizons for the final RESRAD run. For the upper (shallow) zone of the site, the peak year is year 0.0 (the present). For the lower (deep) zone Level I, no COC was predicted to reach groundwater in 1,000 years. Therefore, there is no peak year for the deep zone Level I. For the lower (deep) zone Level II the peak years were 7.7 for cobalt-60, 42 for cesium-137 and strontium-90, and 138 for nickel-63. The 7.7, 43, and 138-year time slices were added to the shallow and deep zone radionuclide RESRAD runs.

METHODOLOGY:

1) Pu-239/240 Conversion: The relative individual Pu-239 and Pu-240 activities were calculated from the combined Pu-239/249 results reported. The calculations were performed in accordance with Calculation No. 0100B-CA-V0013. The relative activities for Pu-239 and Pu-240 were calculated by multiplying the cleanup verification value for Pu-239/240 by 0.807 and 0.193, respectively. Table 2 shows the results from this calculation.

Table 2. Conversion of Pu-239/240 Activity to Relative Pu-239 and Pu-240 Activities

RESRAD Run #	Vadose Zone Horizon	Pu-239/240 Activity (pCi/g)	Pu-239, (pCi/g) (0.807 multiplier)	Pu-240, (pCi/g) (0.193 multiplier)
1	Shallow Zone	0.130	0.105	0.025
2	Deep Zone Level I	0.449	0.362	0.087
3	Deep Zone Level II	0.449	0.362	0.087

2) Runs of RESRAD version 5.91 were completed for the upper (shallow) zone and two lower (deep) zones using the radionuclide concentrations shown in Table 3. RESRAD numerical

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output reports for dose, risk, and concentration for the upper and two lower (deep) zones are presented in the Attachments to this Calculation Summary.

Table 3. Cleanup Verification Data Set

Radionuclide COCs	Radionuclide Activity, pCi/g		
	Run #1 (Rad); Shallow Zone	Runs #2 (Rad) and #3 (Nonrad) , Deep Zone Level I	Run #4 (Rad), Deep Zone Level II
Am-241	[a]	0.464	0.464
Co-60	0.050	5.29	5.29
Cs-137	0.251	28.2	28.2
Eu-152	0.300	34.2	34.2
Eu-154	0.120	4.25	4.25
Ni-63	[a]	1,060	2.65
Pu-239	0.105	0.362	0.362
Pu-240	0.025	0.087	0.087
Sr-90	0.150	0.607	0.607
Nonradionuclide COCs	Nonradionuclide Concentrations, mg/kg		
Cr(VI)	0.64[b]	5.0	0.96[b]
Hg	[a]	2.01	0.001[b]

[a] Analyte is only a COC for the 100-D-19 site. The 100-D-19 is located within the 100-D48:1 and 100-D-49:1 pipeline site and therefore does not have a shallow zone.
[b] Value was not input into RESRAD, because the concentration is below RAGs or Hanford site background.

3) Modeling Nonradionuclide COCs with RESRAD: RESRAD is used to model the impact of nonradionuclide contaminants on groundwater quality as discussed in Section C3.1 of the 100 Area RDR/RAWP and in the 1997 FDO by DeMers. Long half-life surrogate radionuclides are selected for nonradionuclide contaminants, nonradionuclide concentrations in Table 3 are converted to radionuclide activities, the surrogates are assigned the distribution coefficients (Kd) of the metals being simulated, and they are entered into the RESRAD program. Table 4 shows the conversions to surrogate radionuclides for hexavalent chromium and mercury for deep zone Level I.

After running the RESRAD software with these inputs, the graphical and numerical outputs are examined. If the concentration of a soil contaminant in drinking water is zero at all times the contaminant is predicted not to reach groundwater. If a contaminant is predicted to reach groundwater, the year of its peak concentration in groundwater is determined and the RESRAD model is re-run with the peak year as one of the calculation times. The peak activity of the surrogate in drinking water is read from the RESRAD concentration report [concent.rep] and the activity is converted to concentration of the nonradionuclide COC.

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For this site, the surrogate radionuclides for hexavalent chromium and mercury are not predicted to reach groundwater in 1,000 years. Therefore, no potential impact of nonradionuclides on groundwater is predicted.

Conversions of nonradionuclide concentration to radionuclide activities are accomplished in an Excel spreadsheet via the following relationships:

- Conversion of Nonrad to Rad
  - Surrogate soil "activity" (pCi/g) = [nonrad soil concentration (mg/kg)] x [surrogate specific activity (pCi/g)] x {[surrogate atomic wt.] / [nonrad atomic wt.]} x [units conversion]
  - Example for mercury: U-238 soil surrogate activity (pCi/g) = [2.01 mg mercury/kg] x [3.36E+05 pCi U-238/g] x {[238.051 g U-238/mole] / [200.59 g mercury/mole]} x [1E-06 kg/mg] = 6.38E-01 pCi U-238/g

Table 4. Nonradionuclide Conversions to Radionuclide Surrogates

Deep Zone Level	Metal	Metals Conc. (mg/kg)	Metals Atomic Wt., (g/mole)	Distrib-ution Coef. (K_d)	Leach Rate, (fraction per year)[a]	Surrogate	Surrogates Atomic Wt., (g/mole)	Surrogate Specific Activity (pCi/g)	Surrogate Activity for input to RESRAD (pCi/g)
I	Cr VI	5.0	51.997	0	0.00091	U-236	236.046	6.46E+07	1.466E+03
	Mercury	2.01	200.59	30	-	U-238	238.051	3.36E+05	8.015E-01

[a] To more accurately estimate the impact of the site Cr VI, the leach rate from the 100-D Hexavalent Chromium Leach Rate Analysis calculation is used in RESRAD. For other analytes the Kd is used in RESRAD.

RESULTS:

1) Radionuclide "All Pathways" Dose Rate

The "all pathways" (maximum) dose rates are shown in Table 5. The maximum dose rate of 3.71 mrem/yr is from the shallow zone and occurs at year 0. The maximum dose rate occurred at year 42 for the Level II deep zone. The maximum radionuclide all pathways dose rate at year 0 is principally due to europium-152 (36.4% of the total dose), while cesium-137 contributes 17.0%, europium-154 contributes 16.0%, strontium contributes 15.1%, and cobalt-60 contributes 14.4% of the total dose. All other radionuclides contribute less than ten percent of the total dose.

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Table 5. All Pathways Dose Rate (mrem/yr)

RESRAD Run #	Vadose Zone Horizons	"All Pathways" Dose Contributions in mrem/yr at Each Time Slice (yr)								
		0	1	7.7	10	18	42	138	300	1000
1	Shallow Zone	3.71E+00	3.50E+00	2.45E+00	2.20E+00	1.54E+00	6.57E-01	8.80E-02	4.23E-02	3.86E-02
2	Deep Zone, Level I	0	0	0	0	0	0	0	1.66E-06	1.05E-05
4	Deep Zone, Level II	0	8.13E-03	5.95E-02	7.32E-02	1.09E-01	1.46E-01	5.26E-02	3.65E-03	3.40E-05
Total All Pathway Dose Rate (mrem/yr)		3.71E+00	3.51E+00	2.51E+00	2.27E+00	1.65E+00	8.03E-01	1.41E-01	4.60E-02	3.86E-02

2) Radionuclide Excess Cancer Risk

The radionuclide excess cancer risk results are shown in Table 6. The maximum risk (3.31×10^{-5}) occurs at year 0 (the present). Like the dose rate, the maximum risk occurred at year 42 for the Level II deep zone.

Table 6. Radionuclide Excess Cancer Risk

RESRAD Run #	Vadose Zone Horizons	Excess Cancer Risk at Each Time Slice (yr)								
		0	1	7.7	10	18	42	138	300	1000
1	Shallow Zone	3.15E-05	3.00E-05	2.20E-05	1.99E-05	1.44E-05	6.37E-06	6.13E-07	1.21E-07	1.03E-07
2	Deep Zone, Level I	0	0	0	0	0	0	0	1.12E-11	4.94E-11
4	Deep Zone, Level II	1.56E-06	1.63E-06	2.05E-06	2.16E-06	2.41E-06	2.45E-06	7.59E-07	6.34E-08	3.97E-10
Total Excess Cancer Risk		3.31E-05	3.16E-05	2.41E-05	2.21E-05	1.68E-05	8.82E-06	1.37E-06	1.84E-07	1.03E-07

3) Radionuclide Groundwater Protection

The radionuclide concentrations in groundwater calculated by the RESRAD model are summarized in Table 7. The organ specific dose via the groundwater (and river) pathway is calculated in a separate calculation brief. Only concentrations are presented here. RESRAD predicts that the radionuclides cobalt-60, cesium-137, nickel-63, and strontium-90 from the Level II Deep Zone will reach the groundwater within 1,000 years.

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Table 7. RESRAD Estimated Groundwater (Well Water/Drinking Water) Concentrations.

Radio-nuclide	Vadose Zone Horizon	Groundwater Concentration in pCi/L at Each Time Slice (yr)									RAGs from RDR
		0	1	7.7	10	18	42	138	300	1000	
Am-241	Total	0	0	0	0	0	0	0	0	0	1.2
Co-60	Shallow	0	0	0	0	0	0	0	0	0	147
	I	0	0	0	0	0	0	0	0	0	147
	II	0	1.19E-02	3.81E-02	3.65E-02	2.30E-02	2.28E-03	2.46E-08	2.99E-17	0	147
	Total	0	1.19E-02	3.81E-02	3.65E-02	2.30E-02	2.28E-03	2.46E-08	2.99E-17	0	147
Cs-137	Shallow	0	0	0	0	0	0	0	0	0	120
	I	0	0	0	0	0	0	0	0	0	120
	II	0	7.04E-02	4.67E-01	5.76E-01	8.62E-01	1.15E+00	4.12E-01	2.11E-02	6.58E-09	120
	Total	0	7.04E-02	4.67E-01	5.76E-01	8.62E-01	1.15E+00	4.12E-01	2.11E-02	6.58E-09	120
Eu-152	Total	0	0	0	0	0	0	0	0	0	235
Eu-154	Total	0	0	0	0	0	0	0	0	0	59
Ni-63	Shallow	0	0	0	0	0	0	0	0	0	46
	I	0	0	0	0	0	0	0	0	0	46
	II	0	3.11E-02	2.29E-01	2.93E-01	4.97E-01	9.75E-01	1.59E+00	1.07E+00	1.12E-02	46
	Total	0	3.11E-02	2.29E-01	2.93E-01	4.97E-01	9.75E-01	1.59E+00	1.07E+00	1.12E-02	46
Pu-239	Total	0	0	0	0	0	0	0	0	0	1.2
Pu-240	Total	0	0	0	0	0	0	0	0	0	1.2
Sr-90	Shallow	0	0	0	0	0	0	0	0	0	8
	I	0	0	0	0	0	0	0	0	0	8
	II	0	1.11E-02	7.30E-02	9.98E-02	1.34E-01	1.76E-01	5.84E-02	2.65E-03	1.86E-10	8
	Total	0	1.11E-02	7.30E-02	9.98E-02	1.34E-01	1.76E-01	5.84E-02	2.65E-03	1.86E-10	8

4) Nonradionuclide Groundwater Protection

Examination of the graphical and numerical outputs from modeling hexavalent chromium and mercury with surrogate radionuclides with RESRAD found that the concentrations of all nonradionuclide soil contaminants in drinking water were predicted to be zero at all times. Therefore, no nonradionuclide soil contaminants are predicted to impact groundwater within 1,000 years.

CONCLUSIONS:

- The maximum dose rate of 3.71 mrem/yr occurs at year 0, and originates only from the shallow (upper) zone.
- The dominant pathway for the shallow zone contribution is direct (ground) exposure.
- The dominant radionuclide driving the direct exposure pathway is europium-152. The next most significant contributors for this pathway are cesium-137 and europium-154.

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- None of the radionuclide or nonradionuclide contaminants are projected to exceed Remedial Action Goals (RAGs), even at 1,000 years.

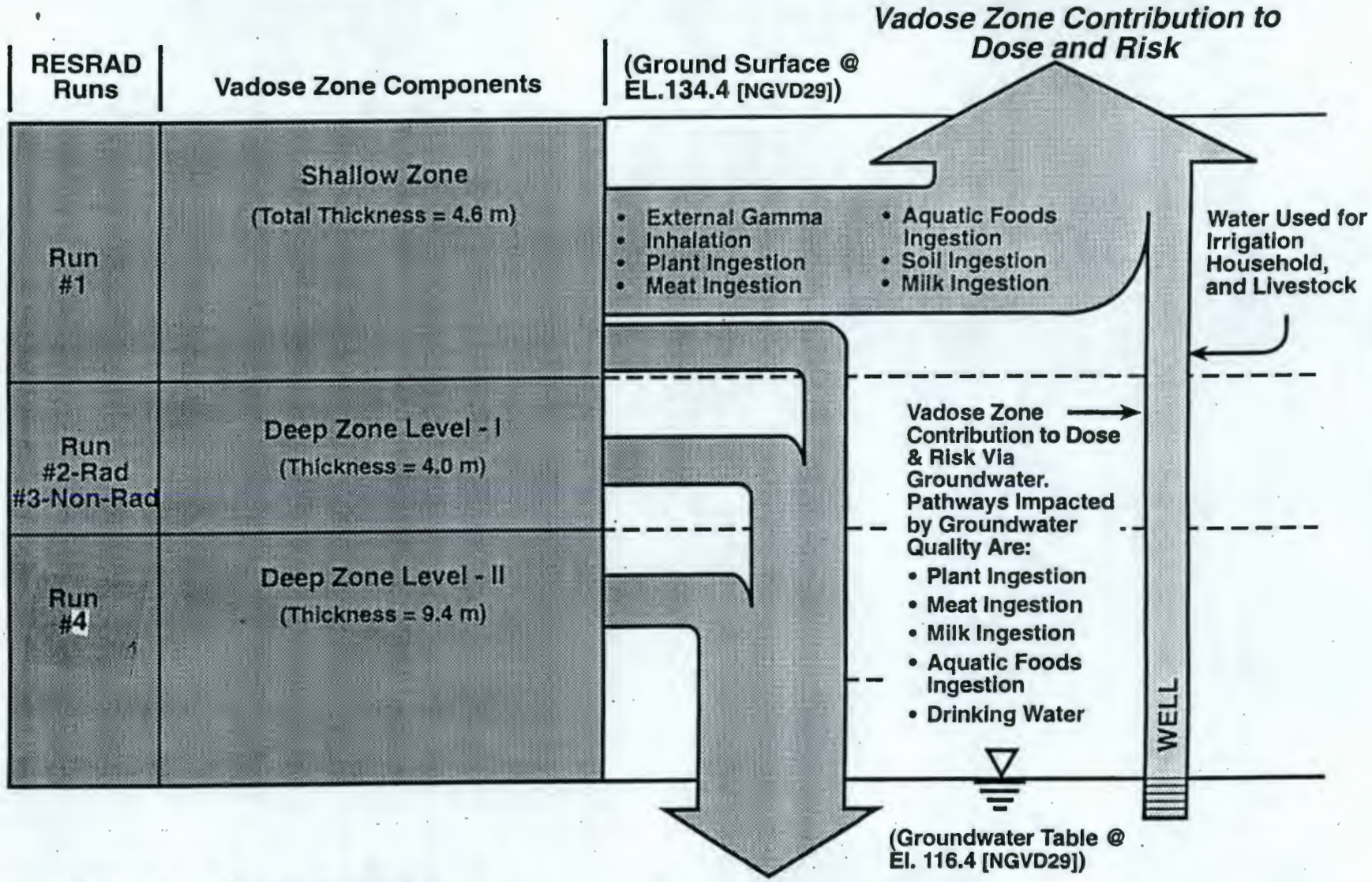
- Excess cancer risk mirrors the dose rate results; that is, the maximum excess cancer risk (3.31×10^{-5}) occurs at year 0, and is virtually exclusively from the shallow zone contribution.

- Of the contaminants of concern, cobalt-60, cesium-137, nickel-63, and strontium-90 were predicted to reach groundwater in the 1,000 years of the RESRAD model run. The four radionuclide contaminants reach groundwater at concentrations far below the RAGs.

ATTACHMENTS:

1. Graphic showing 100-D-48:1 and 49:1 North Pipelines Cleanup Verification Model (1 page)
2. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1), Part I: Mixture Sums and Single Radionuclide Guidelines (25 pages)
3. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines - SHALLOW ZONE (RUN #1), Part III: Intake Quantities and Health Risk Factors (39 pages)
4. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines – SHALLOW ZONE (RUN #1), Part IV: Concentration of Radionuclides (19 pages)
5. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines – DZ-I (RUN #2) Rad., Part I: Mixture Sums and Single Radionuclide Guidelines (27 pages)
6. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines – DZ-I (RUN #2) Rad., Part III: Intake Quantities and Health Risk Factors (39 pages)
7. RESRAD Output: 100-D-48:1 & 49:2 North Pipelines – DZ-I (RUN #2) Rad., Part IV: Concentration of Radionuclides (19 pages)
8. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines – DZ-I (RUN #3) Nonrad, Part I: Mixture Sums and Single Radionuclide Guidelines (21 pages)
9. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines – DZ-I (RUN #3) Nonrad, Part IV: Concentration of Radionuclides (10 pages)
10. RESRAD Output: 100-D-48:1 & 49:2 North Pipelines – DZ-II (RUN #4), Part I: Mixture Sums and Single Radionuclide Guidelines (27 pages)
11. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines – DZ-II (RUN #4), Part III: Intake Quantities and Health Risk Factors (39 pages)
12. RESRAD Output: 100-D-48:1 & 49:1 North Pipelines – DZ-II (RUN #4), Part IV: Concentration of Radionuclides (19 pages)

100-D-48:1 and 49:1 North Pipelines Cleanup Verification Model



Attachment 1 Sheet No. 1 of 1
S.W. Callison Originator ~~L. E. Ivey~~ SWC Date 11/6/00
Chk'd By S. W. Clark SWC Date 11/6/00
Calc. No. 0100D-CA-V0168 Rev. No. 0

Attachment 1

CVP-2000-00003
Rev. 0

CALCULATION COVER SHEET

Project Title:	100-D Remedial Action	**Job No.**	22192
Area	100-D Area		
Discipline	Environmental	**Calc. No.**	0100D-CA-V0131
Subject	100-D-48:1 / 49:1 MCL Drinking Water Standards		
Computer Program	Excel	**Program No.**	Excel 97

Committed Calculation X **Preliminary** **Superseded**

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover - 1 Calculations - 4 Total - 5	SW Callison 11/6/00 S.W. Callison	11/6/00 S. W. Clark	KEC 11/8/00 K.E. Cook	11.9.00 F. M. Corpuz	11-9-00

SUMMARY OF REVISIONS

*Obtain Calc. No. from DIS

November 1998

DE01-437.03

CALCULATION SHEET

Originator	S.W. Callison SWC	**Date**	11/06/2000	**Calc. No.**	0100D-CA-V0131	**Rev. No.**	0
Project	100-D Remedial Action	**Job No.**	22192	**Checked**	S. W. Clark SWC	**Date**	11/06/2000
Subject	100-D-48:1 / 49:1 MCL Drinking Water Standards					**Sheet No.**	1 of 4

Problem:
Compare RESRAD derived groundwater radionuclide concentrations to MCLs (summarized in DOE 1998, the RDR/RAWP, DOE/RL-96-17, Rev. 1, Table 2-3). Compare alpha emitter dose contribution to the maximum allowable gross particle activity of 15 pCi/L (40 CFR Part 141, Subpart B, 141.51). Compare beta/gamma emitter dose contribution to the maximum allowable dose of 4 mrem/yr (40 CFR Part 141, Subpart B, 141.16), as calculated using NBS Handbook 69 individual organ-dose calulation methodology and EPA-570/9-76-003 total organ-dose calulation methodology.

Given/References:
1) RESRAD derived groundwater radionuclide concentrations from Calc. No. 0100D-CA-V0168, Rev. 0, *100-D-48:1 100-D-49:1 RESRAD.*

2) Radionuclide concentrations in water corresponding to 4 mrem/year (C_4 mrem/yr) from Calc. No. 0100X-CA-V0025 or as determined from references in item 5.

3) MCLs summarized in Table 2-3 of: DOE, 1998, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 1, U.S. Department of Energy, Richland Operations office, Richland, WA.

4) Maximum allowable gross particle activity (alpha emitters) and maximum allowable dose (beta/gamma emitters) from: 40 CFR 141, "National Primary Drinking Water Regulation," *Code of Federal Regulations*, as amended.

5) Individual organ-dose calculation methodology from: NBS Handbook 69, *Maximum Permissible Body Burdens end Maximum Permissible Concetrations of Radionuclides in Air or Water for Occupational Exposure*, as amended, U.S. Department of Commerce, Washington D.C., and EPA-570/9-76-003, *National Interim Primary Drinking Water Regulations*, U.S. Environmental Protection Agency, Office of Water Supply, Washington D.C.

Solution:
1. The site data for the calculation are the groundwater concentrations for the COCs (daughter products are not considered) over time from the RESRAD groundwater (GW) concentration file.

2. If the site conceptual model breaks the contamination into multiple layers with differing concentrations, then the GW concentrations from the various model runs are added (for each time interval) to provide the concentration data for comparison to the individual MCLs and the dose calculation for the beta and gamma emitters.

3. Compare the summed concentrations for each radionuclide to the GW MCL given in the RDR/RAWP, Table 2-3.

4. The summed concentrations for the alpha emitters (Am-241, Pu-239, and Pu-240) are added to determine if they meet the 15 pCi/L limit specified in 40 CFR 141.15.

5. The cumulative dose for each organ for all beta and gamma emitting COCs (Co-60, Cs-137, Eu-152, Eu-154, Ni-63, and Sr-90) at time t is calculated separately using the activity corresponding to a 4 mrem/year dose (C_4) and the sum of fractions equation shown below (from EPA 570/9-76-003). The organs for which doses need to be computed are total body, bone, liver and gastrointestinal tract [lower large intestine] (GI(LLI)). The individual organ doses are compared to 4 mrem/yr.

$$Dose_{organ\ x\ (t)} = [ConcA_{(t)}/C_4^{A}{}_{(x)} + ConcB_{(t)}/C_4^{B}{}_{(x)} + ...] \times (4\ mrem/yr)$$

where:
$Dose_{organ\ x\ (t)}$ is the total dose to organ x in mrem/yr
$ConcA_{(t)}$ is the concentration of isotope A at time t in pCi/L
$C_4^{A}{}_{(x)}$ is the 4 mrem/yr dose equivalent concentration for organ x of isotope A at time t in pCi/L
If the dose for organ x $\leq$ 4 mrem/yr, then the standard is met.

Conclusions:

The summed concentrations for each radionuclide are less than the GW MCL given in the RDR/RAWP.

The summed concentrations for the alpha emitting COCs are less than the 15 pCi/l limit specified in 40 CFR 141.15.

The cumulative dose for each total body, bone, liver and gastrointestinal tract for all beta and gamma emitting COCs is less than 4 mrem/yr (using EPA-570/9-76-003 total dose calculation methodology).

CALCULATION SHEET

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Project	100-D Remedial Action	**Job**	22192	**Checked**	S. W. Clark SWC
Subject	100-D-48:1 / 49:1 MCL Drinking Water Standards				

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Comparison of the summed concentrations for each radionuclide to the GW MCL given in the RDR/RAWP
Data derived from RESRAD modelling, units are pCi/L.

Radionuclide	Time (years)									MCL	Exceeds MCL?	Peak Conc.	Year of Peak Conc.
	0	1	7.7	10	18	42	138	300	1000				
Co-60	0	1.19E-02	3.81E-02	3.65E-02	2.30E-02	2.28E-03	2.46E-08	2.99E-17	0.00E+00	147	No	3.81E-02	7.7
Cs-137	0	7.04E-02	4.67E-01	5.76E-01	8.62E-01	1.15E+00	4.12E-01	2.11E-02	6.58E-09	120	No	1.15E+00	42
Eu-152	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	235	No	0.00E+00	0
Eu-154	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	59	No	0.00E+00	0
Ni-63	0	3.11E-02	2.29E-01	2.93E-01	4.97E-01	9.75E-01	1.59E+00	1.07E+00	1.12E-02	46	No	1.59E+00	138
Sr-90	0	1.11E-02	7.30E-02	9.98E-02	1.34E-01	1.76E-01	5.84E-02	2.65E-03	1.86E-10	8	No	1.76E-01	42

CALCULATION SHEET

Originator	S.W. Callison SWC	**Date**	11/06/2000	**Calc. No.**	0100D-CA-V0131
Project	100-D Remedial Action	**Job**	22192	**Checked**	S. W. Clark
Subject	100-D-48:1 / 49:1 MCL Drinking Water Standards				

Rev. No.	0
Date	11/06/2000
Sheet No.	3 of 4

Comparison of the summed concentrations for each alpha emitting radionuclide to the 15 pCi/L limit in 40 CFR 141.15.
Data derived from RESRAD modelling.

Radionuclide	Time (years)									Exceeds 15 pCi/L?	Peak Conc.	Year of Peak Conc.
	0	1	7.7	10	18	42	138	300	1000			
Am-241	0	0	0	0	0	0	0	0	0	No	0	0
Pu-239	0	0	0	0	0	0	0	0	0	No	0	0
Pu-240	0	0	0	0	0	0	0	0	0	No	0	0
Gross Alpha	0	0	0	0	0	0	0	0	0	No	0	0

CALCULATION SHEET

Originator	S.W. Callison SWC	Date	11/06/2000	Calc. No.	0100D-CA-V0131
Project	100-D Remedial Action	Job	22192	Checked	S. W. Clark SWC
Subject	100-D-48:1 / 49:1 MCL Drinking Water Standards				

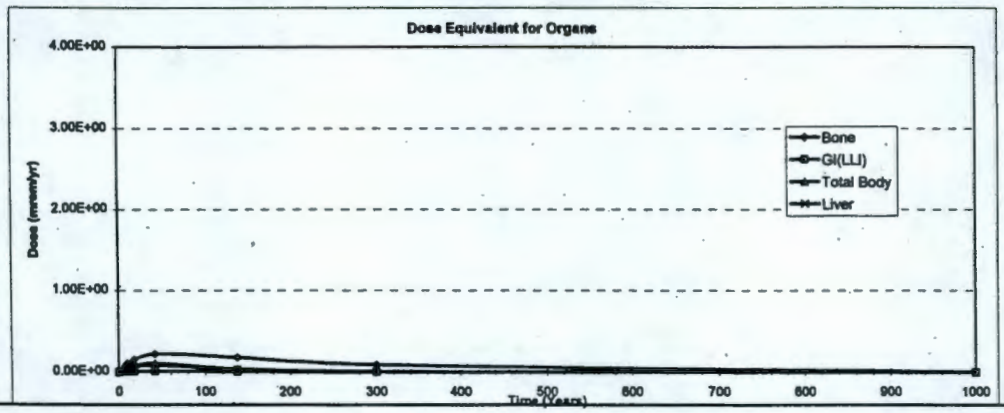
Rev. No. 0
Date 11/06/2000
Sheet No. 4 of 4

Comparison of the summed concentrations for each radionuclide to the GW MCL given in the RDR/RAWP
Data derived from RESRAD modelling, units are pCi/L. C_i values from Calculation 0100X-CA-V0025.

Radionuclide	Time (years) 0	1	7.7	10	18	42	138	300	1000	Organ	C_i	Exceeds 4 mrem/yr?	Peak Conc.	Year of Peak Conc.
Co-60	0	1.19E-02	3.81E-02	3.65E-02	2.30E-02	2.28E-03	2.46E-08	2.99E-17	0.00E+00	GI(LLI)	100	No	3.810E-02	7.7
										Total Body	900	No		
										Liver	3000	No		
Cs-137	0	7.04E-02	4.67E-01	5.76E-01	8.82E-01	1.15E+00	4.12E-01	2.11E-02	6.58E-09	Bone	80	No	1.150E+00	42
										GI(LLI)	2000	No		
										Total Body	200	No		
										Liver	60	No		
Eu-152	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	Bone	1E+07	No	0.000E+00	0
										GI(LLI)	200	No		
										Total Body	2E+06	No		
										Liver	2E+07	No		
Eu-154	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	Bone	5000	No	0.000E+00	0
										GI(LLI)	60	No		
										Total Body	70000	No		
										Liver	60000	No		
Ni-63	0	3.11E-02	2.29E-01	2.93E-01	4.97E-01	9.75E-01	1.59E+00	1.07E+00	1.12E-02	Bone	50	Yes	1.59E+00	138
										GI(LLI)	3000	Yes		
										Total Body	2000	Yes		
										Liver	600	Yes		
Sr-90	0	1.11E-02	7.30E-02	9.98E-02	1.34E-01	1.76E-01	5.84E-02	2.65E-03	1.86E-10	Bone	8	No	1.760E-01	42
										GI(LLI)	100	No		
										Total Body	8	No		

Total dose for each organ (with time)

Organ	Time (years) 0	1	7.7	10	18	42	138	300	1000	Exceeds 4 mrem/yr?	Peak Dose	Year of Peak
Bone	0.00E+00	1.16E-02	7.82E-02	1.02E-01	1.50E-01	2.24E-01	1.77E-01	8.80E-02	8.96E-04	No	2.24E-01	42
GI(LLI)	0.00E+00	1.10E-03	5.68E-03	6.99E-03	8.67E-03	1.07E-02	5.28E-03	1.57E-03	1.49E-05	No	1.07E-02	42
Total Body	0.00E+00	7.07E-03	4.65E-02	6.22E-02	8.53E-02	1.13E-01	4.06E-02	3.89E-03	2.24E-05	No	1.13E-01	42
Liver	0.00E+00	4.92E-03	3.27E-02	4.04E-02	6.08E-02	8.32E-02	3.81E-02	8.54E-03	7.47E-05	No	8.32E-02	42



100-D-48-1&49-1 MCL V0131.xlsCumulative Dose Comparison

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