0059031

CVP-2001-00005
Rev. 0

Cleanup Verification Package for the 116-F-2, 107-F Liquid Waste Disposal Trench

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 documents completion of remedial action for the 116-F-2, 107-F Liquid Waste Disposal Trench (also referred to as the 116-F-2 site). The 116-F-2 site is located within the 100-FR-1 Operable Unit, in the 100 Areas of the Hanford Site in southeastern Washington State. The site is located approximately 670 m (2,200 ft) east of the 105-F Reactor Building. The 116-F-2 site was an open liquid disposal trench that operated from 1950 to 1965. The site was fed by two emergency bypass ditches. One ditch was fed by a valve on the 100-F-19 pipeline, which originated at the 105-F Reactor then ran to the south end of the 116-F-14 Retention Basin. The second ditch connected the 116-F-2 Trench to another valve on the 107-cm 105-F effluent pipeline (100-F-19).

Remedial action objectives and goals for the 116-F-2 site were established by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy, Richland Operations Office (DOE-RL), in concurrence with the Washington State Department of Ecology.. These goals and objectives are documented in the *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (ROD) (EPA 1997) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2002).

The selected remedial action for the 116-F-2 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). Waste site

COCs identified through process knowledge were listed in the *100* [illegible] *Action Sampling and Analysis Plan* (DOE-RL 2001). The COCs fo[illegible] the following:

- Carbon-14
- Cesium-137
- Cobalt-60
- Europium-152
- Europium-154
- Hexavalent chromium.

E2.0 RESULTS

Site excavation and waste disposal are complete, and the exposed [illegible] have been sampled and analyzed to verify attainment of the RAGs. At the comp[illegible] of the remedial action, the total excavation was approximately 15,352 m^2 (50,367 ft^2) in area with a depth greater than 4.6 m (15 ft). Approximately 113,007 metric tons (1[illegible] of materia[illegible] from the site were disposed of at the Environmental Restoration Di[illegible] Facility.

Results of the sampling, laboratory analyses, and data evaluations [illegible] the 116-F-2 site indicate that all remedial action objectives and goals for direct exp[illegible], protection of groundwater, and protection of the Columbia River have been met [illegible] Table [illegible]S-1). The following sections discuss these results.

Table ES-1. Summary of Cleanup Verification Results for the 116-F-2, 107-F Liquid Waste Disposal Trench.

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 rate calculated by RESRAD is 3.54 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 quotient of <1 for noncarcinogens.	2. Cumulative hazard quotient is 6.27×10^{-3}.		b
	3. Excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	3. Excess cancer risk for individual carcinogens are all less than 1×10^{-6}.		b
	4. Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	4. Total excess cancer risk is 1.19×10^{-6}, which is below 1×10^{-5}.		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 rate to target receptor/organs.	2. All organ-specific dose rates are below the 4 mrem/yr dose rate limit.		c
	3. Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5.	3. There are no alpha-emitting COCs for this site.		c
	4. Meet total uranium standard of 21.2 pCi/L.	4. Uranium is not a COC for this site.		
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
Other supporting Information	1. Sample variance calculation (Appendix C).			d
	2. Sample location design (Appendix C).			e

[a] *116-F-2 Trench Cleanup Verification RESRAD Calculation*, 0100F-CA-V0124, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[b] *116-F-2 Trench Cleanup Verification 95% UCL Calculation*, 0100F-CA-V0123, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[c] *116-F-2 Trench Comparison to Drinking Water Standards*, 0100F-CA-V0125, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[d] *116-F-2 107-F Liquid Waste Disposal Trench Variance Calculation*, 0100F-CA-V0147, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
[e] *116-F-2 Shallow and Deep Zone Sampling Locations*, 0100F-CA-V0116, Rev. 0, Bechtel Hanford, Inc., Richland, Washington, and *116-F-2 Overburden Sampling Design*, 0100F-CA-V0117, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

E2.1 DIRECT EXPOSURE SOIL CLEANUP STANDARDS

E2.1.1 Radionuclides

The ROD (EPA 1997), developed in compliance with the "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP) (40 *Code of Federal Regulations* [CFR] 300), expresses the RAG for direct exposure to radionuclides in terms of an allowable radiation dose rate above background (i.e., 15 mrem/yr). The total dose rate above background, considering all radionuclide COCs and pathways, was predicted from the RESidual RADioactivity (RESRAD) dose assessment model (ANL 2002). The results indicate that the maximum dose rates above background from the site and overburden are 3.54 mrem/yr and 4.65×10^{-01} mrem/yr, respectively, and would occur at present (year 2002); this dose rate decreases to 7.78×10^{-10} mrem/yr and 5.07×10^{-17} mrem/yr, respectively, in 1,000 years. The majority of the maximum dose rate is due to cesium-137. The estimated total dose rate in the year 2018 is 1.56 mrem/yr and 1.22×10^{-01} mrem/yr in the overburden. 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.

Although the RAG for radionuclides is expressed in terms of radiation dose, the cleanup verification package also includes radionuclide excess lifetime cancer risk estimates as additional information. The NCP (40 CFR 300) presents a target range for residual risk of 10^{-4} to 10^{-6}. The RESRAD model calculated the total excess cancer risk for radionuclides using the EPA's Health Effects Assessment Summary Tables (HEAST) (update dated April 16, 2001, "Update of Radionuclide Carcinogenicity Slope Factors," available on the Internet at www.epa.gov/radiation/heast). Because of radioactive decay, the risk associated with radionuclides decreases over time. Based on RESRAD results, the excess lifetime cancer risk is largest, 4.21×10^{-05} from the site and 4.02×10^{-06} in the overburden, both at present (year 2002), and decreases to 1.24×10^{-14} from the site and 3.44×10^{-22} in the overburden in 1,000 years. The estimated excess cancer

risk due to radionuclides in the year 2018 is 2.11×10^{-05} from the site and 1.19×10^{-06} in the overburden.

E2.1.2 Nonradionuclides

The nonradionuclide COC is hexavalent chromium. The hexavalent chromium concentration is below the RAG for direct exposure.

Hexavalent chromium is associated with both noncarcinogenic and carcinogenic health effects. With respect to noncarcinogenic risk, the hazard quotient for hexavalent chromium is below the corresponding RAG (a hazard quotient of 1.0). With respect to carcinogenic risk, the excess lifetime cancer risk estimate in the shallow zone (0 to 4.6 m [15 ft]) due to residual hexavalent chromium is below the risk limit for individual COCs of 1×10^{-6}, and also below the excess lifetime total cancer risk estimate limit of 1×10^{-5}.

E2.2 PROTECTION OF GROUNDWATER AND THE RIVER

E2.2.1 Radionuclides

The estimated radionuclide dose rate via the groundwater and river pathways is below the RAG of 4 mrem/yr for beta and gamma emitters. There are no alpha-emitting COCs for this site; therefore, groundwater and river protectiveness standards for alpha emitters 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, cleanup verification results indicate that the residual concentration of hexavalent chromium, the only nonradionuclide COC for this site, is protective of groundwater and the river.

E3.0 WASTE SITE RECLASSIFICATION

The site meets cleanup standards and has been reclassified as "interim 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 1998). A copy of the waste site reclassification form is included as Attachment ES-1.

Attachment ES-1

Waste Site Reclassification Form

Date Submitted: 03/05/03 **Originator:** R. A. Carlson **Phone:** 372-9632	**Operable Unit(s):** 100-FR-1 **Waste Site ID:** 116-F-2, 107-F Liquid Waste Disposal Trench **Type of Reclassification Action:** Rejected ☐ Closed Out ☐ Interim Closed Out ☒ No Action ☐	**Control Number:** 2002-057 **Lead Agency:** EPA

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 (NPL) 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 (EPA) and the U.S. Department of Energy, Richland Operations Office (DOE-RL), in concurrence with the Washington State Department of Ecology. 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 116-F-2, 107-F Liquid Waste Disposal Trench has been remediated to meet the cleanup standards specified in the *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units*, 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 116-F-2, 107-F Liquid Waste Disposal Trench* (CVP-2001-00005), 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.

R. Chris Smith DOE Project Manager	Signature	3/7/03 Date
NA Ecology Project Manager	Signature	Date
DENNIS Faulk EPA Project Manager	Signature	3-11-03 Date

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ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
COC	contaminant of concern
CVP	cleanup verification package
DQA	data quality assessment
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
MCL	maximum contaminant level
MDA	minimum detectable activity
MS	matrix spike
NaI	sodium iodide
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PQL	practical quantitation limit
QA/QC	quality assurance/quality control
RAG	remedial action goal
RAO	remedial action objective
RDR/RAWP	Remedial Design Report/Remedial Action Work Plan
RESRAD	RESidual RADioactivity dose assessment model
ROD	Record of Decision
RPD	relative percent difference
SAP	sampling and analysis plan
SDG	sample delivery group
TDL	target detection limit
UCL	upper confidence limit
WAC	Washington Administrative Code

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this cleanup verification package (CVP) is to document that the 116-F-2, 107-F Liquid Waste Disposal Trench site (herein referred to as the 116-F-2 site) was remediated in accordance with the *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (ROD) (EPA 1997). The ROD provides the U.S. Department of Energy, Richland Operations Office the authority, guidance, and objectives to conduct this remedial action. The preferred remedy specified in the ROD (EPA 1997) and conducted for the 116-F-2 site was excavation and disposal of contaminated materials at the Environmental Restoration Disposal Facility (ERDF).

1.2 DOCUMENT ORGANIZATION

The cleanup verification evaluation is presented in the following sections:

- Section 2.0 Site Description and Supporting Information
- Section 3.0 Summary of Remedial Action Objectives and Goals
- Section 4.0 Remedial Action Field Activities
- Section 5.0 Cleanup Verification Data Evaluation
- Section 6.0 Evaluation of Remedial Action Goal Attainment
- Section 7.0 Radionuclide Risk Information
- Section 8.0 Statement of Protectiveness
- Section 9.0 References
- Section 10.0 Bibliography

The main text is supported by the following appendices:

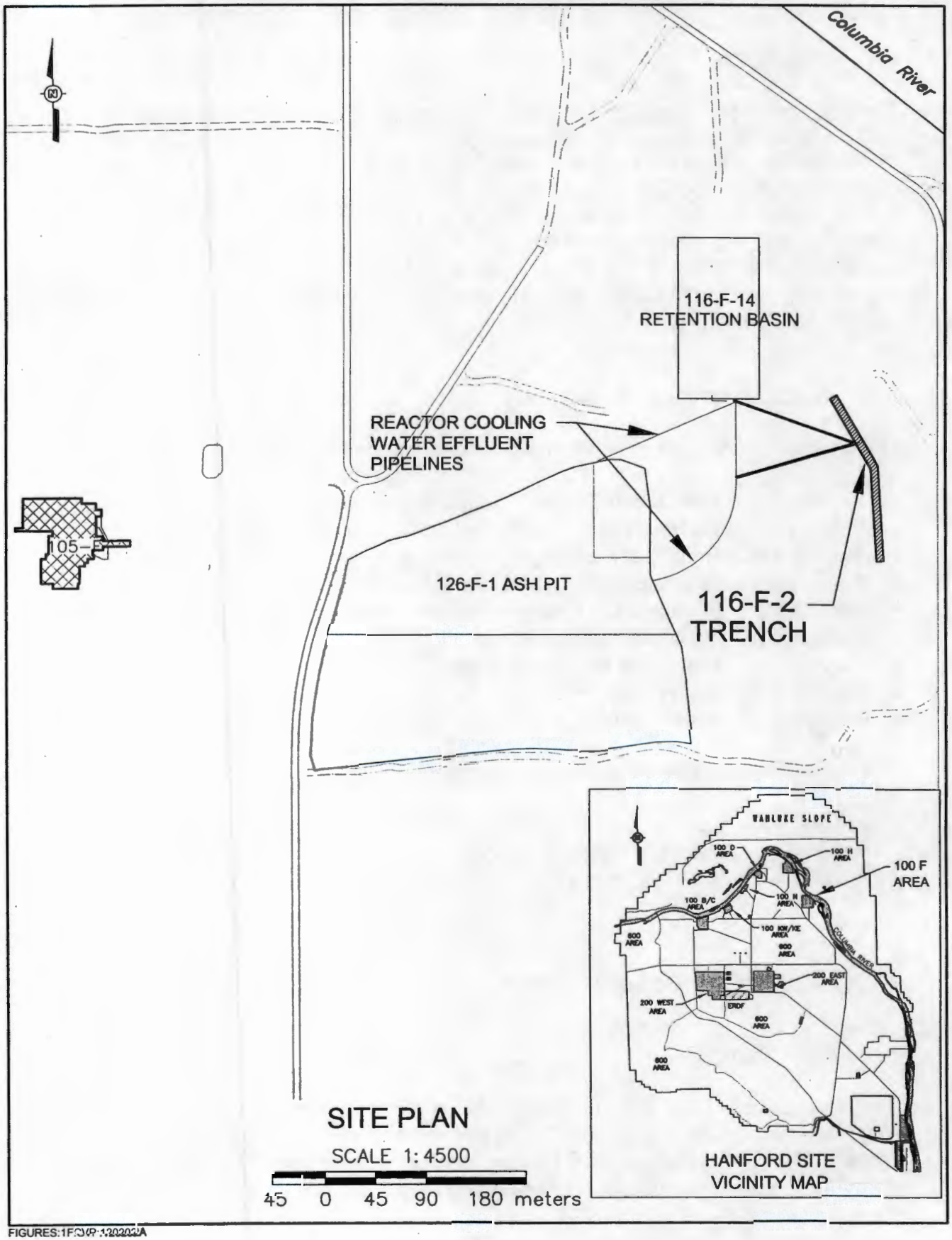
- Appendix A Summary of Verification Soil Sampling and Analytical Results
- Appendix B Data Quality Assessment
- Appendix C RESRAD Input Parameters and Calculation Brief Excerpts.

2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION

2.1 SITE HISTORY

The 116-F-2 site is located in the 100-F Area and is approximately 120 m (394 ft) from the Columbia River (Figure 1). The site received cooling water effluent from the 116-F-14 Retention Basin during reactor outages due to ruptures of fuel elements. It is located approximately 670 m (2,200 ft) east of the 105-F Reactor Building.

Figure 1. Hanford Site Map and 116-F-2 Site Plan.



FIGURES:1F0VP-1202002A

The site was an open liquid trench that operated from 1950 to 1965. The site was fed by two emergency bypass ditches. One ditch was fed by a valve on the 100-F-19 pipeline, which originated at the 105-F Reactor then ran to the south end of the 116-F-14 Retention Basin. The second ditch connected the 116-F-2 Trench to another valve on the 107-cm 105-F effluent pipeline (100-F-19). During deactivation of the 105-F Reactor, the 116-F-2 Trench received overflow water from the 105-F Fuel Storage Basin via the 116-F-14 Retention Basin.

2.2 SUBSURFACE CONDITIONS

The soil column 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 12.2 to 18.3 m (40 to 60 ft) below the surface grade level. The long-term groundwater level beneath the site is estimated at El. 114 m (374 ft) for analysis purposes, based on historical and current information from adjacent groundwater wells. The depth to groundwater is estimated to be 7.4 m (24.3 ft) beneath the floor of the excavation and 12 m (39.4 ft) beneath surface grade level. Groundwater elevations in adjacent wells are influenced by the nearby Columbia River and other factors such as atmospheric pressure.

2.3 CONTAMINANTS OF CONCERN

Waste site contaminants of concern (COCs) identified through process knowledge are listed in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2001). The COCs for this site consist of the following:

- Carbon-14
- Cesium-137
- Cobalt-60
- Europium-152
- Europium-154
- Hexavalent chromium.

3.0 SUMMARY OF REMEDIAL ACTION OBJECTIVES AND GOALS

3.1 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) for the 116-F-2 site were established in the Amendment to the Interim Action ROD (EPA 1997). The RAOs are qualitative statements defining the extent to which waste sites require cleanup to protect human

health and the environment. For a detailed discussion of the RAOs, see the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2002) and the ROD (EPA 1997).

3.2 REMEDIAL ACTION GOALS

Remedial action goals (RAGs) are the specific numeric goals against which the cleanup verification data are evaluated in order to demonstrate attainment of the RAOs. The RAGs were 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 the soil column 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 2002).

The contaminant-specific RAGs applicable to the 116-F-2 site are listed in Table 1.

3.2.1 Direct Exposure RAGs

Under the rural-residential scenario, direct exposure RAGs are applicable to soils that are less than 4.6 m (15 ft) below ground surface (shallow zone soils). Direct exposure RAGs are listed in Table 1 and summarized below.

- **Radionuclide COCs:** 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).

Table 1. Summary of Remedial Action Goals.

COCs	Direct Exposure RAG	Groundwater Protection RAG (pCi/L)	Columbia River Protection RAG (pCi/L)
Radionuclides			
Carbon-14	15 mrem/yr (cumulative)[a]	4 mrem/yr (cumulative)[b]	4 mrem/yr (cumulative)[b]
Cesium-137			
Cobalt-60			
Europium-152			
Europium-154			
Nonradionuclides			
COCs	**Direct Exposure RAGs (mg/kg)**	**Soil RAG for Groundwater Protection (mg/kg)**	**Soil RAG for Columbia River Protection (mg/kg)**
Hexavalent chromium	400[c] 2.1[d,e]	8[f]	2[g]

[a]Lookup values that correspond to the 15 mrem/yr dose rate are based on a generic site model and are presented in the RDR/RAWP (DOE-RL 2002).
[b]Lookup values based on individual radionuclide 4 mrem/yr dose rate equivalent for beta and gamma emitters per National Drinking Water Standards as presented in the RDR/RAWP (DOE-RL 2002).
[c]*Washington Administrative Code* (WAC) 173-340 Method B noncarcinogenic cleanup limit.
[d]WAC 173-340 Method B carcinogenic cleanup limit.
[e]*Calculation of Hexavalent Chromium Carcinogenic Risk*, 0100X-CA-V0031 (BHI 2000).
[f]Soil RAG based on "100 times groundwater cleanup" rule as presented in the RDR/RAWP (DOE-RL 2002).
[g]Soil RAG based on 100 times dilution attenuation factor times surface water quality standard as presented in the RDR/RAWP (DOE-RL 2002).

- **Nonradionuclide COCs:**
  - Hazard quotient of less than 1.0 for noncarcinogenic contaminants.
  - Excess cancer risk of less than 1×10^{-6} for individual carcinogenic contaminants.
  - Cumulative excess cancer risk of less than 1×10^{-5}.
  - Cleanup verification sample results pass the *Washington Administrative Code* (WAC) 173-340 (*Model Toxics Control Act Cleanup Regulation)* three-part test.

3.2.2 Groundwater and River Protection

Groundwater and river protection RAGs are applicable to all vadose zone soils (shallow and deep zone soils). For this CVP, river protection and surface water protection are synonymous, since the Columbia River is the only surface water in proximity to the Hanford Site. The term river protection is used throughout this CVP. The groundwater and river protection RAGs are listed in Table 1 and summarized below.

- **Beta- and gamma-emitting radionuclide COCs:** Meet "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* [CFR] 141.66) dose rate standards (4 mrem/yr total body or organ dose rate) for a period of 1,000 years starting from site cleanup. Meet individual COC RAGs as applicable.

- **Alpha-emitting radionuclide COCs:** Meet drinking water standards for alpha-emitting radionuclides based on the more stringent of 15 pCi/L or 1/25th of the derived concentration guide per DOE Order 5400.5. The maximum contaminant level for uranium is 30 μg/L as promulgated by the U.S. Environmental Protection Agency (EPA) on December 7, 2000 (65 *Federal Register* 76708). For the 116-F-2 site there were no alpha-emitting COCs, including uranium.

- **Nonradionuclide COCs:** Meet the individual RAGs listed in Table 1 with cleanup verification sample results passing the WAC 173-340 three-part test, or demonstrate by site-specific modeling that residual 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 protection RAGs). The nonradionuclide groundwater and river protection RAGs listed in Table 1 were calculated using the WAC 173-340 "100 times rule," as established in the ROD (EPA 1997).

4.0 REMEDIAL ACTION FIELD ACTIVITIES

4.1 EXCAVATION AND DISPOSAL

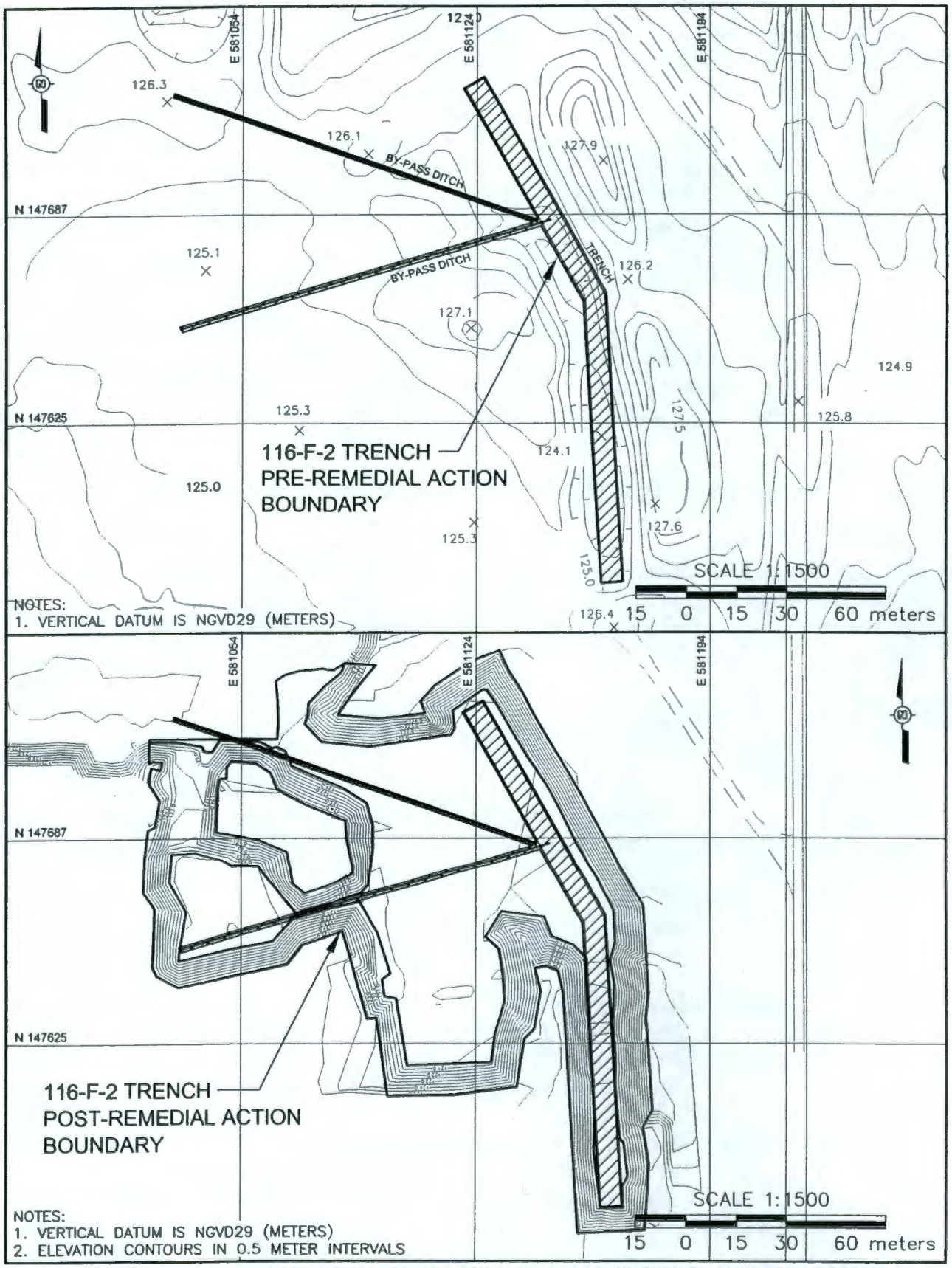
Remedial action at the 116-F-2 site began on November 22, 2000. Excavation of the site involved removing the overburden materials and underlying contaminated soil. Contaminated materials were disposed of at the ERDF.

On April 17, 2002, the excavation was completed. Pre- and post-remediation topographic maps are shown in Figure 2. The elevation of the bottom of the excavation was at 121.4 m (413.4 ft) upon completion. The excavation was approximately 15,352 m^2 (50,367 ft^2) in area with a depth of approximately 4.6 m (15 ft). Approximately 113,007 metric tons (124,534 tons) of material from the site were disposed of at the ERDF.

4.2 FIELD SCREENING

Field screening was conducted during the site remedial action as specified in the SAP (DOE-RL 2001). Field screening was used to guide the excavation to quickly assess for the presence and level of contamination. Field screening for the 116-F-2 site included using a radiological data mapping system survey, hand-held sodium iodide (NaI) detectors, and gamma energy analyses. The radiological mapping survey is performed over more than 50% of the site excavation surface area. The hand-held NaI detector is used to screen excavated waste material and to screen for potential excavation wall and floor hot spots. Gamma energy analyses were used to support waste characterization and to corroborate the radiological mapping survey and hand-held NaI detector data.

Figure 2. Pre- and Post-Remediation Topographic Plans.



FIGURES\1F\CVP\120202B

NOTE: NORTHINGS AND EASTINGS ARE NAD83 WASHINGTON STATE PLANE COORDINATES.

4.3 VARIANCE SAMPLING AND ANALYSIS

Variance analysis was performed following field screening. The variance analysis quantifies the variability of residual contamination. This information was used to determine the site-specific number of final cleanup verification samples to be collected.

Variance sampling and testing was performed in May 2002. As specified in the SAP and the instruction guide (DOE-RL 2001, BHI 2001), variance analysis was performed for the shallow zone and overburden decision units. A total of 48 variance samples were collected from the shallow zone, and a total of 48 variance samples were collected from the overburden of the 116-F-2 site. Variance samples were collected in the locations shown on the sample design calculation brief (Appendix C).

The results of the variance analysis indicated that the number of verification samples to be taken was less than the default number of four; therefore, four final verification samples were collected from the shallow zone decision subunit and the overburden decision subunit.

4.4 CLEANUP VERIFICATION SAMPLING AND ANALYSIS

Final cleanup verification samples were collected following variance sampling, analysis, and data evaluation. Cleanup verification sampling began on May 21, 2002, and was finished on May 29, 2002. The final verification samples were submitted to offsite laboratories for analysis using approved EPA analytical methods, as required per the SAP (DOE-RL 2001). Each verification sample was a composite formed by combining soil collected at four randomly selected nodes within each sampling area. The sample design methodology and sample location figures are presented in the calculation briefs for variance analysis and sample design in Appendix C.

The division of the site excavation into decision units (e.g., shallow zone and deep zone) as shown on the sample design figures is a function of the applicable RAGs (Section 3.2, "Remedial Action Goals"). The direct exposure, groundwater protection, and river protection RAGs are applicable to soils within 4.6 m (15 ft) of the ground surface. This soil zone is referred to as the shallow zone. The groundwater protection and river protection RAGs are applicable to soils greater than 4.6 m (15 ft) below the ground surface. This soil zone is referred to as the deep zone.

The 116-F-2 site consisted of shallow zone, deep zone, and overburden decision units. The site was excavated to a depth greater than 4.6 m (15 ft) with the shallow zone consisting of the excavation sidewalls and the deep zone consisting of the floor of the excavation. All deep zone samples were collected below 4.6 m (15 ft).

The shallow zone decision unit contained two decision subunits, which were divided into eight sampling areas (SA1-SA4, SB5-SB8). The deep zone decision unit also contained two decision subunits, which were divided into six sampling areas (DA1-DA4, DB5-DB6). In addition, an overburden decision unit, containing two decision subunits,

was included with this site, and was divided into eight sampling areas (OA1-OA4, OB5-OB8). One composite cleanup verification sample was collected from each sample area. The sample design for this site is documented in the sample area and location calculation brief included in Appendix C.

As described in Section 4.3, the required number of composite samples for each decision subunit in the shallow zone was less than the default number of four composite samples specified in the SAP (DOE-RL 2001). Therefore, the default number of four samples were collected from each shallow zone decision subunit (excluding the quality assurance/quality control samples). This was also the case for the overburden decision unit. As specified in the SAP (DOE-RL 2001), three composite samples were collected from each of the deep zone (i.e., below 4.6 m [15 ft]) decision subunits in addition to quality assurance/quality control samples.

5.0 CLEANUP VERIFICATION DATA EVALUATION

This section presents the evaluation and modeling of the 116-F-2 cleanup verification data for comparison with the data quality criteria and RAGs.

5.1 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment 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 data quality assessment for the 116-F-2 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. The cleanup verification sample analytical data are stored in the Hanford Environmental Information System and are summarized in Appendix A. The detailed data quality assessment is presented in Appendix B.

5.2 CONTAMINANTS OF CONCERN 95% UPPER CONFIDENCE LIMIT

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 2001). This process is summarized below.

Verification sampling summary statistics (95% UCL values) are listed in Table 2. Individual sample cleanup verification results are presented in Appendix A.

- **Radionuclides:** The laboratory reported value is used in the calculation of the 95% UCL. In cases where the laboratory does not report a value for data qualified with a "U" (i.e., less than the detection limit), half of the minimum detectable activity is 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 Washington State Department of Ecology regulations (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 116-F-2 cleanup verification 95% UCL calculation brief (Appendix C). The columns on the left side of Table 2 are the 95% statistical values before subtraction of background, if appropriate. The columns on the right side of the table present statistical values adjusted for background, when background values exist. Typically, in the shallow and deep zone decision units, Hanford Site background concentration values are only subtracted for isotopic uranium. Isotopic uranium is not a COC for the 116-F-2 site. In overburden soil, all COCs are adjusted for background, when background values exist. Table 2 summarizes the cleanup verification data set used for RESRAD modeling.

5.3 SITE-SPECIFIC CLEANUP VERIFICATION MODEL

The statistical values summarized above (Table 2) were evaluated and used to develop a site-specific cleanup verification model. For the 116-F-2 site, the site-specific cleanup verification model assumes the worst case described in the RDR/RAWP (DOE-RL 2002), where the excavation statistical concentrations continue for the deep zone at the same concentrations to groundwater. A schematic cross section of this site-specific cleanup verification model is included in the RESRAD calculation in Appendix C.

Table 2. Cleanup Verification Data.

COCs	95% UCL Statistical Values			Hanford Site Background[a]	Cleanup Verification Data Set[b]		
	Shallow Zone	Deep Zone	Overburden		Shallow Zone	Deep Zone	Overburden
Radionuclides (pCi/g)[d]							
Carbon-14	-0.911[e]	3.87	-0.930[e]	NA[c]	-0.911[e]	3.87	-0.930[e]
Cesium-137	0.262	20.0	0.0715	1.1	0.262	20.0	0(<BG)
Cobalt-60	0.0459	1.30	0.0270	0.008	0.0459	1.30	0.0190
Europium-152	0.413	41.6	0.0638	0.0330	0.413	41.6	0.0308
Europium-154	0.131	4.21	0.0835	0.054	0.131	4.21	0.0295
Nonradionuclides (mg/kg)[d]							
Hexavalent chromium	1.6	0.91	0.42	NA[c]	1.6	0.91	0.42

[a]Represents the 90th percentile of the lognormal distribution (DOE-RL 1995).
[b]The statistical value above background is used as the input value for RESRAD. For overburden, background is subtracted from all radionuclides, when background values are available. Refer to Appendix C for additional details on determination of statistical values. Because the RESRAD program does not accept negative values, zero is entered when the cleanup verification result is negative.
[c]A background value for this analyte has not been established.
[d]Laboratory data including the minimum detectable activity or practical quantitation limit for the individual cleanup verification samples are included in Appendix A and the 95% UCL calculation brief.
[e]RESRAD does not accept negative values. When results are negative, zero is used as the input value.
BG = Background
NA = Not applicable

5.4 RESRAD MODELING

The individual radionuclide cleanup verification statistical values (Table 2) were entered into the RESRAD computer code, Version 6.21 (ANL 2002), to estimate the dose rate and to estimate the impact on groundwater and the river from residual COC concentrations. The direct radiation exposure dose rate to the resident living in his or her basement (rural-residential scenario) 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 RESRAD modeling methodologies, results, input values, and the site-specific cleanup verification model are included in the RESRAD calculation brief (Appendix C). The drinking water dose rate calculations based on the RESRAD estimated groundwater radionuclide concentrations are shown in the comparison to drinking water standards calculation brief (Appendix C). Specific results from the calculations are discussed in the RAG evaluation section (Section 6.0).

6.0 EVALUATION OF REMEDIAL ACTION GOAL ATTAINMENT

This section demonstrates that remedial actions at the 116-F-2 site have achieved the applicable RAGs. Sections 6.1, 6.2, and 6.3 address attainment of direct exposure RAGs, groundwater protection RAGs, and Columbia River protection RAGs, respectively. Section 6.4 documents application of the WAC 173-340 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.

6.1 DIRECT EXPOSURE SOIL REMEDIAL ACTION GOALS ATTAINED

6.1.1 Radionuclides

The results of the RESRAD dose rate estimates for the site (shallow and deep zone combined), all-pathways scenarios are presented in Figure 3. The results of the RESRAD dose rate estimates for the overburden soil are presented in Figure 4. This dose rate represents the dose contributions from soils at relevant time periods. The dose rate is largest at present (year 2002), 3.54 mrem/yr, and decreases to 7.78×10^{-10} mrem/yr in 1,000 years for the shallow zone and deep zone. The dose rate for the overburden at present (year 2002) is 4.65×10^{-01} mrem/yr, and decreases to 5.07×10^{-17} mrem/yr in 1,000 years. The estimated dose rate in the year 2018 is 1.56 mrem/yr for the shallow and deep zone, and 1.22×10^{-01} mrem/yr for the overburden in year 2018. The 2018 date corresponds to the 30-year site cleanup schedule of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1998). All dose rate estimates are less than the 15 mrem/yr RAG. The RESRAD computations are presented in detail in the referenced calculation briefs summarized in Appendix C.

Figure 3. RESRAD Analysis – All-Radionuclides, All-Pathways Dose Rate Estimate for Shallow Zone and Deep Zone.

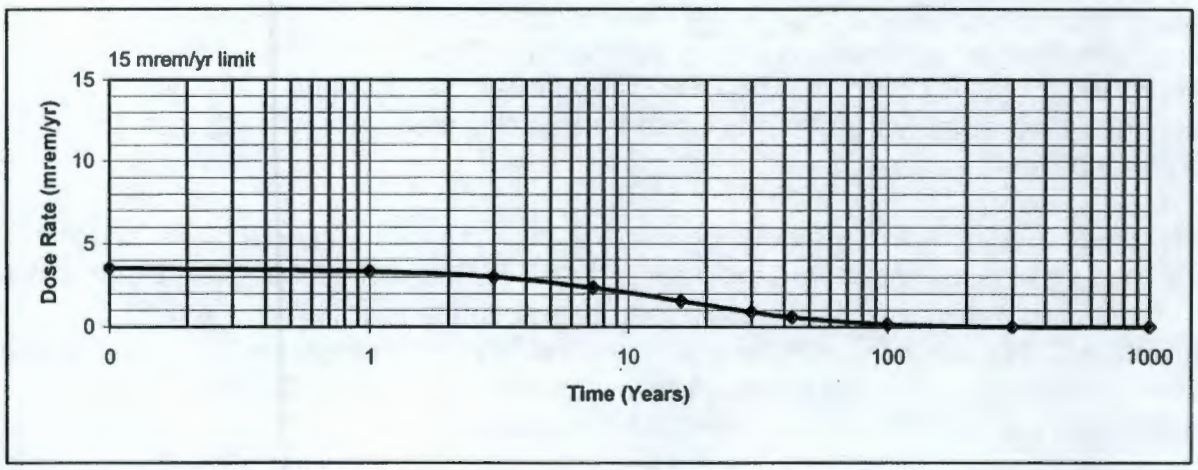
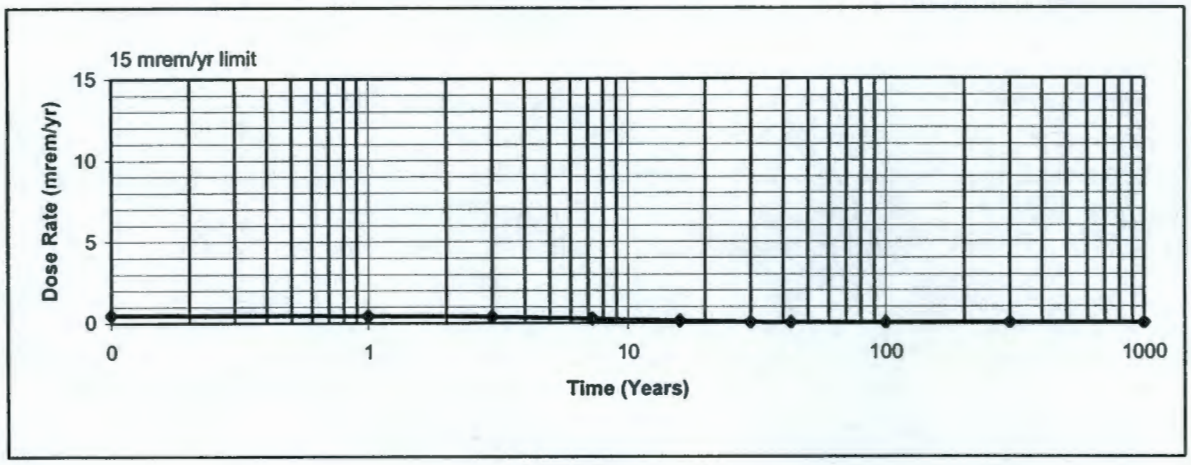


Figure 4. RESRAD Analysis – All-Radionuclides, All-Pathways Dose Rate Estimate for Overburden.



6.1.2 Nonradionuclides

6.1.2.1 Direct Comparison to RAGs. Table 3 compares the cleanup verification statistical values presented in Table 2 to the direct exposure RAGs presented in Table 1.

Table 3. Attainment of Nonradionuclide Direct Exposure Standards.

Nonradionuclides	Direct Exposure RAG (mg/kg)	Statistical Value (mg/kg)	Direct Exposure RAGs Attained?[a]
Hexavalent chromium	2.1[b]	1.6	Yes

[a]Criterion is comparison to the cleanup criteria (RAG).
[b]BHI, 2000, *Calculation of Hexavalent Chromium Carcinogenic Risk*, Calc. No. 0100X-CA-V0031, Bechtel Hanford, Inc., Richland, Washington.

6.1.2.2 Noncarcinogenic Hazard Quotient RAG Attained. For noncarcinogenic COCs, WAC 173-340 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 ROD (EPA 1997), a comparable conservative approach is used to demonstrate attainment of the noncarcinogenic risk requirements.

Hexavalent chromium, the only nonradionuclide COC for this site, has noncarcinogenic health effects. Hexavalent chromium is also associated with carcinogenic risk, which is discussed in Section 6.1.2.3. The hexavalent chromium hazard quotient for the shallow zone soils is 4.00×10^{-3}, which is below the limit of 1.0. Therefore, the noncarcinogenic risk requirements have been attained. Calculation of the hazard quotient is presented in the 95% UCL calculation brief (Appendix C).

6.1.2.3 Carcinogenic Risk RAG Attained. For individual nonradionuclide carcinogenic COCs, the WAC 173-340 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. 1998).

The only nonradionuclide carcinogenic COC at this site is hexavalent chromium. For the shallow zone, the value for hexavalent chromium cancer risk is 7.62×10^{-7}. This value is below the individual and total risk limits; therefore, the carcinogenic risk standards have been attained for both individual and total excess cancer risk. This calculation is documented in the 95% UCL calculation brief (Appendix C).

6.2 GROUNDWATER REMEDIAL ACTION GOALS ATTAINED

6.2.1 Radionuclides

The estimated groundwater concentrations for all of the radionuclide COCs contributed by the site soils are shown in the RESRAD calculation brief (Appendix C). 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.

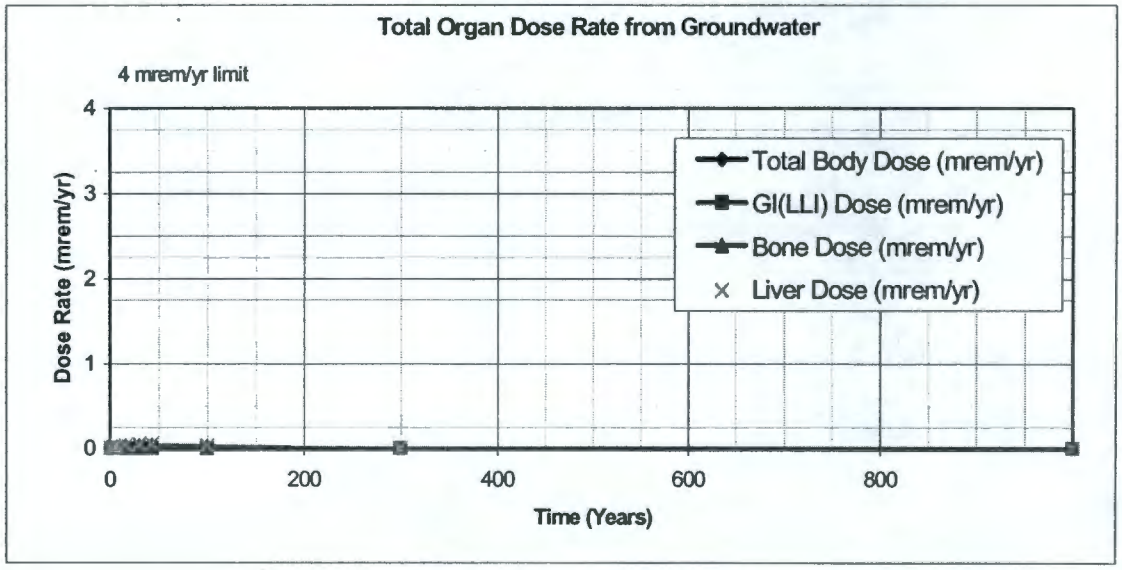
Table 4. Estimated Peak Radionuclide Groundwater Concentrations (Summing Shallow and Deep Zone Impacts) Compared to RAGs.

Radionuclide	Peak Concentration (pCi/L)	RAG (pCi/L)	RAGS Attained? (Yes/No)
Carbon-14	[a]	2,000[b]	Yes
Cesium-137	0.819	60[b]	Yes
Cobalt-60	0.00934	100[b]	Yes
Europium-152	[a]	200[b]	Yes
Europium-154	[a]	60[b]	Yes
Overburden			
Carbon-14	[a]	2,000[b]	Yes
Cesium-137	[a]	60[b]	Yes
Cobalt-60	[a]	100[b]	Yes
Europium-152	[a]	200[b]	Yes
Europium-154	[a]	60[b]	Yes

[a]These radionuclides do not reach groundwater in 1,000 years.
[b]Lookup value corresponding to a dose rate of 4 mrem/yr.

Figure 5 shows the individual organ dose rates for beta- and gamma-emitting radionuclides predicted over 1,000 years, as shown in the comparison to drinking water standards calculation brief (Appendix C). None of the organ dose rates are predicted to exceed the 4 mrem/yr standard over 1,000 years. There are no alpha emitters identified at this site; therefore, the drinking water standard for nonuranium alpha emitters and the uranium standard of 30 µg/L have been met. Results of the RESRAD calculations are shown in Appendix C.

Figure 5. Dose Rates to Organs from Groundwater.



6.2.2 Nonradionuclides

Table 5 illustrates the comparison of cleanup verification statistical values to the groundwater protection RAGs. The table shows that the residual concentration (statistical value) of hexavalent chromium for the site is less than the listed groundwater protection soil RAG. The results of meeting the RAGs listed in Table 5 demonstrates that the groundwater protection RAGs have been attained for this site.

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 Data 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						
Hexavalent chromium	8.0	2.0	1.6	No	NA	Yes
Deep Zone						
Hexavalent chromium	8.0	2.0	0.91	No	NA	Yes
Overburden						
Hexavalent chromium	8.0	2.0	0.42	No	NA	Yes

NA = Not applicable. RESRAD modeling was not performed because residual concentrations meet the groundwater and river protection RAGs.

6.3 COLUMBIA RIVER REMEDIAL ACTION GOALS ATTAINED

6.3.1 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.

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.

6.3.2 Nonradionuclides

Table 5 illustrates the comparison of cleanup verification statistical values to the Columbia River protection RAGs. The table shows that the residual concentration (statistical value) of hexavalent chromium for the site is less than the listed river protection soil RAG. The results of meeting the RAGs listed in Table 5 demonstrates that the Columbia River protection RAGs have been attained for this site.

6.4 WAC 173-340 THREE-PART TEST FOR NONRADIONUCLIDES

Sections 6.1, 6.2, and 6.3 looked separately at compliance with direct exposure RAGs, groundwater protection RAGs, and Columbia River protection RAGs. Section 6.4 documents application of the WAC 173-340 three-part test for nonradionuclides using the most restrictive RAGs applicable to each decision unit (i.e., shallow zone,

overburden, and deep zone). The most restrictive RAG is defined as the lowest of the direct exposure, groundwater protection, and river protection RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to the shallow zone and overburden. Groundwater and river protection RAGs are applicable to the deep zone. The WAC 173-340 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%.

Table 6 summarizes the results of the WAC 173-340 three-part test (WAC 173-340-740(7)) for the shallow zone, overburden, and deep zone sample data sets. For hexavalent chromium, the only nonradionuclide COC for the 116-F-2 site, the table lists the most restrictive applicable RAG (selected from the RAGs in Table 1), the maximum detected value, the total number of samples collected, and the number of samples exceeding the most restrictive RAG. The final column of the table describes the result of applying the three WAC 173-340 criteria using the values listed in the preceding columns. Table 6 shows that hexavalent chromium passes the WAC 173-340 three-part test for both the shallow and deep zones.

Table 6. Application of the MTCA Three-Part Test.

Nonradionuclides	Most Stringent Applicable 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						
Hexavalent chromium	2.0	1.6	1.6	9	0	Yes
Deep Zone						
Hexavalent chromium	2.0	0.91	1.4	7	0	Yes
Overburden						
Hexavalent chromium	2.0	0.42	0.42	9	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%.

7.0 RADIONUCLIDE RISK INFORMATION

The radionuclide RAG for direct exposure is derived from the ROD (EPA 1997) and is expressed in terms of an allowable radiation dose rate above background (i.e., 15 mrem/yr). The RAG evaluation (Section 5.0) involved using the RESRAD model to estimate total annual radiation dose rates 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 dose rates using the EPA's Health Effects Assessment Summary Tables (HEAST) (update dated April 16, 2001, "Update of Radionuclide Carcinogenicity Slope Factors," available on the Internet at www.epa.gov/radiation/heast). The "National Oil and Hazardous Substances Pollution Contingency Plan "(40 CFR 300) presents a target range for residual risk of 10^{-4} to 10^{-6}. Figure 6 illustrates excess lifetime cancer risk for the shallow zone and deep zone as estimated using the RESRAD model. Figure 7 illustrates this for the overburden. Because of radioactive decay, the risk decreases over time. For the shallow and deep zones the estimated risk is largest, 4.21×10^{-05}, at present (year 2002), and decreases to 1.24×10^{-14} in 1,000 years. The estimated risk in the year 2018 is 2.11×10^{-05}. Figure 8 plots the radiation dose rate above background for the shallow zone and deep zone, similar to Figure 3, and shows the corresponding radionuclide risk at present and in the year 2018. Figure 9 plots this information for the overburden.

Figure 6. RESRAD Analysis – Radionuclide Risk, All Pathways Shallow Zone and Deep Zone.

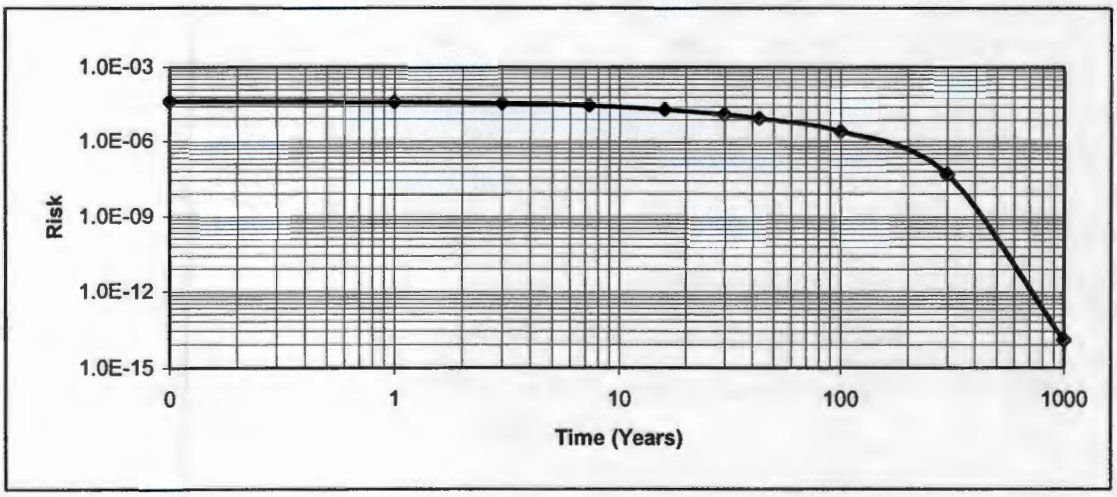


Figure 7. RESRAD Analysis – Radionuclide Risk, All Pathways Overburden.

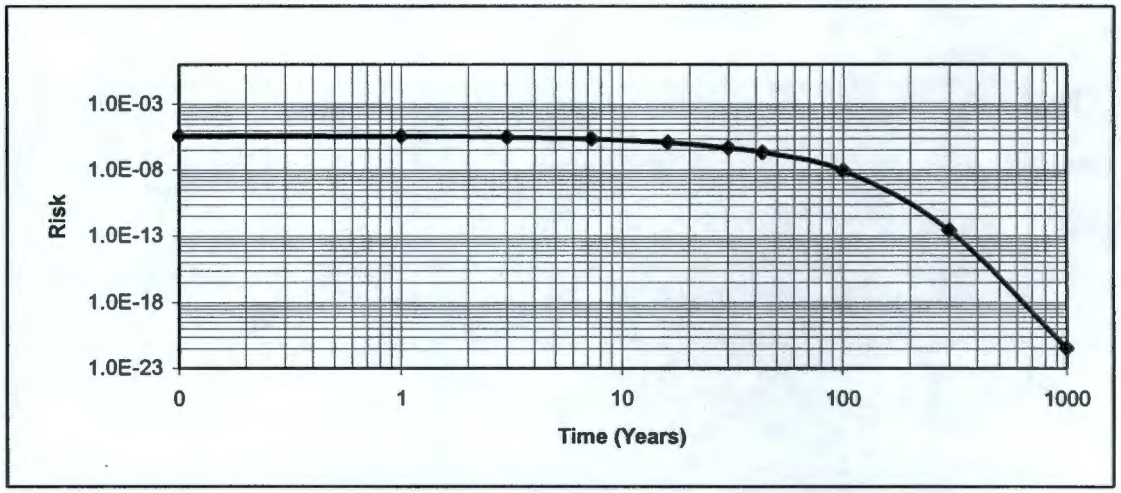


Figure 8. RESRAD Analysis – Radionuclide Dose Rate, All Pathways, With Corresponding Risk Values for Shallow Zone and Deep Zone.

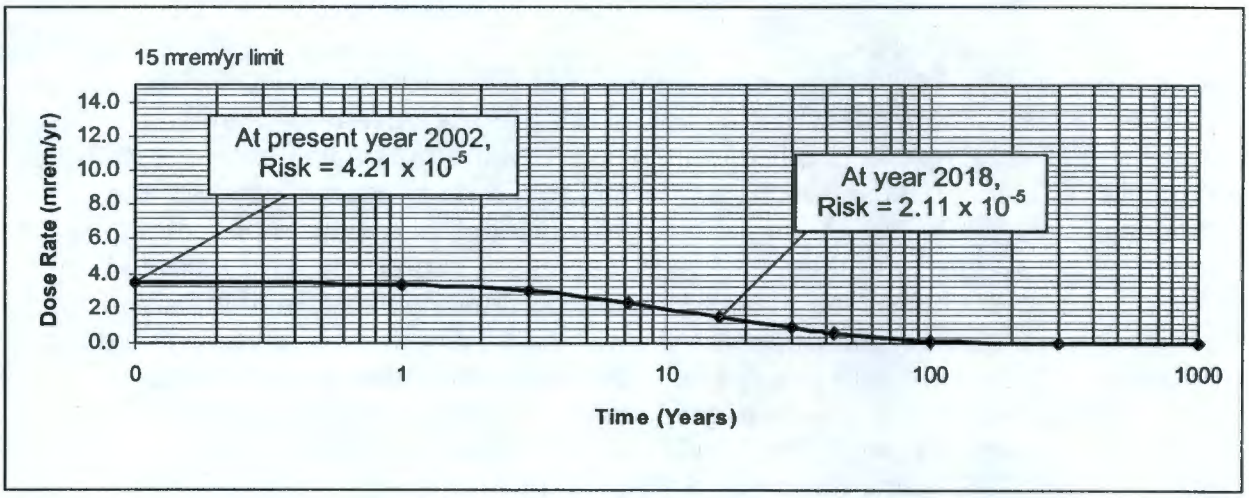
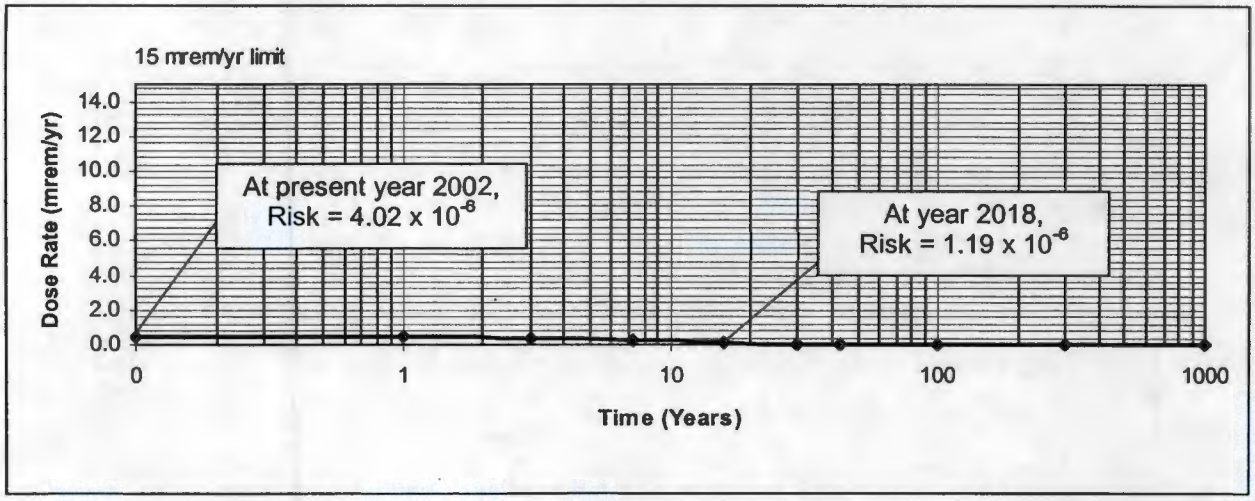


Figure 9. RESRAD Analysis – Radionuclide Dose Rate, All Pathways, With Corresponding Risk Values for Overburden.



8.0 STATEMENT OF PROTECTIVENESS

This CVP demonstrates that remedial action at the 116-F-2 site has achieved the RAOs and corresponding RAGs established in the ROD (EPA 1997) and RDR/RAWP (DOE-RL 2002). The remaining soils at the 116-F-2 site have been sampled, analyzed, and modeled. The results of this effort indicate that the materials from the 116-F-2 site containing COCs at concentrations exceeding RAGs have been excavated and disposed of at the ERDF. These results also indicate that 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 concentrations throughout the site pose no 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 116-F-2 site is verified to be remediated in accordance with the ROD (EPA 1997) 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 (5/28/2002).

Sampling Area	HEIS Number	Sample Date	C-14			Cs-137			Co-60			Eu-152			Eu-154			Cr^{+6}		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL
SA1	B14RJ1	5/28/2002	5.60E-02	U	3.60E+00	3.18E-01		5.10E-02	5.40E-02	U	5.40E-02	1.10E-01	U	1.10E-01	1.80E-01	U	1.80E-01	4.2E-01	U	4.2E-01
Duplicate of B14RJ1	B14RJ9	5/28/2002	-1.47E+00	U	3.20E+00	3.60E-01		3.60E-02	3.50E-02	U	3.50E-02	2.00E-01	U	2.00E-01	1.00E-01	U	1.00E-01	4.1E-01	U	4.1E-01
Split of B14RJ1	B14RK1	5/28/2002	8.50E-02	U	3.24E-01	9.71E-02		2.29E-02	9.63E-03	U	2.59E-02	4.58E-02	U	6.49E-02	-3.01E-02	U	7.81E-02	3.5E-01	U	3.5E-01
SA2	B14RJ2	5/28/2002	-2.48E+00	U	3.30E+00	4.19E-01		4.10E-02	3.00E-02	U	3.00E-02	2.30E-01	U	2.30E-01	2.60E-01	U	2.60E-01	7.5E-01		4.3E-01
SA3	B14RJ3	5/28/2002	-2.08E+00	U	3.30E+00	6.80E-02	U	6.80E-02	5.10E-02	U	5.10E-02	2.60E-01	U	2.60E-01	1.90E-01	U	1.90E-01	4.3E-01	U	4.3E-01
SA4	R14RJ4	5/28/2002	-2.50E+00	U	3.70E+00	7.60E-02	[a]	3.40E-02	3.40E-02	U	3.40E-02	1.60E-01	U	1.60E-01	1.00E-01	U	1.00E-01	4.2E-01	U	4.2E-01
SB5	B14RJ5	5/28/2002	-1.86E-01	U	4.00E+00	2.60E-01		7.90E-02	7.30E-02	U	7.30E-02	2.20E-01	U	2.20E-01	2.90E-01	U	2.90E-01	1.6E+00		4.3E-01
SB6	B14RJ6	5/28/2002	-1.33E-01	U	3.00E+00	6.10E-02	U	6.10E-02	2.70E-02	U	2.70E-02	1.81E-01		5.30E-02	9.20E-02	U	9.20E-02	4.2E-01	U	4.2E-01
SB7	B14RJ7	5/28/2002	-1.55E+00	U	3.20E+00	1.56E-01		5.30E-02	6.20E-02	U	6.20E-02	8.40E-02		9.50E-02	1.40E-01	U	1.40E-01	4.2E-01	U	4.2E-01
SB8	B14RJ8	5/28/2002	-2.43E+00	U	3.30E+00	2.00E-01	U	2.00E-01	1.80E-01	U	1.80E-01	1.02E+00		2.40E-01	3.90E-01	U	3.90E-01	4.2E-01	U	4.2E-01

[a] Because of laboratory reporting conventions, these data were given a nonrelevant "J" qualifier that appears in the Hanford Environmental Information System (HEIS) database and in analytical data. The data quality assessment (Appendix B) further discusses the "J" qualifiers applied during validation.
U = Analyte is below detection limits of the method and instruments used (not detected).
In some cases, the laboratory reports no value but provides a minimum detectable activity (MDA). In these cases, the MDA has been used as the sample result.

Table A-2. Deep Zone Cleanup Verification Data (5/21/2002).

Sampling Area	HEIS Number	Sample Date	C-14			Cs-137			Co-60			Eu-152			Eu-154			Cr^{+6}		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL
DA1	B14LJ4	5/21/2002	1.21E+00	U	3.40E+00	4.47E+01		3.40E-01	2.07E+00		1.50E-01	8.57E+01		8.20E-01	8.90E+00		6.40E-01	4.0E-01	U	4.0E-01
Duplicate of B14LJ4	B14LK0	5/21/2002	1.54E-01	U	3.70E+00	2.42E+01		2.20E-01	1.04E+00		8.80E-02	4.89E+01		5.50E-01	4.51E+00		3.50E-01	9.0E-01		4.0E-01
Split of B14LJ4	B14LK2	5/21/2002	2.48E-01	U	3.22E-01	2.98E+01		1.07E-01	3.21E-01		1.09E-01	5.97E+01		2.78E-01	6.26E+00		1.75E-01	3.2E-01		8.0E-02
DA2	B14LJ5	5/21/2002	6.62E+00	J	3.90E+00	1.16E+01		1.90E-01	8.66E-01		8.80E-02	3.41E+01		4.30E-01	3.85E+00		3.60E-01	4.0E-01	U	4.0E-01
DA3	B14LJ6	5/21/2002	1.95E+00	U	3.90E+00	1.32E+00		9.90E-02	7.50E-02	U	7.50E-02	4.34E+00		1.50E-01	2.64E-01		1.80E-01	4.0E-01	U	4.0E-01
DA4	B14LJ7	5/21/2002	2.16E+00	U	3.80E+00	1.54E+01		1.50E-01	1.77E+00		7.60E-02	3.18E+01		3.80E-01	2.89E+00		2.50E-01	1.4E+00		4.0E-01
DB5	B14LJ8	5/21/2002	1.80E+00	U	3.70E+00	3.39E+00		7.70E-02	3.46E-01		4.80E-02	6.00E+00		1.30E-01	7.33E-01		1.90E-01	4.0E-01	U	4.0E-01
DB6	B14LJ9	5/21/2002	1.58E+00	U	3.80E+00	3.44E+00		5.20E-01	4.04E-01		3.90E-02	7.32E+00		9.70E-02	8.27E-01		1.30E-01	9.1E-01		4.0E-01

[a] Because of laboratory reporting conventions, these data were given a nonrelevant "J" qualifier that appears in the Hanford Environmental Information System (HEIS) database and in analytical data. The data quality assessment (Appendix B) further discusses the "J" qualifiers applied during validation.
U = Analyte is below detection limits of the method and instruments used (not detected).
In some cases, the laboratory reports no value but provides a minimum detectable activity (MDA). In these cases, the MDA has been used as the sample result.

Table A-3. Overburden Cleanup Verification Data (5/29/2002).

Sampling Area	HEIS Number	Sample Date	C-14			Cs-137			Co-60			Eu-152			Eu-154			Cr^{+6}		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL
OA1	B14RK2	5/29/2002	1.77E+00	U	5.90E-02	4.50E-02	U	4.50E-02	5.80E-02	U	5.80E-02	1.00E-01	U	1.00E-01	1.70E-01	U	1.70E-01	4.1E-01	U	4.1E-01
Duplicate of B14RK2	B14RL0	5/29/2002	-1.58E+00	U	4.40E+00	4.10E-02	U	4.10E-02	4.50E-02	U	4.50E-02	9.50E-02	U	9.50E-02	1.50E-01	U	1.50E-01	4.1E-01	U	4.1E-01
Split of B14RK2	B14RL2	5/29/2002	1.50E-02	U	3.15E-01	-9.01E-05	U	1.85E-02	3.09E-03	U	1.88E-02	1.06E-02	U	4.56E-02	-2.94E-02	U	5.53E-02	3.5E-01	U	3.5E-01
OA2	B14RK3	5/29/2002	-1.37E+00	U	3.90E+00	4.10E-02	U	4.10E-02	3.30E-02	U	3.30E-02	7.60E-02	U	7.60E-02	1.00E-01	U	1.00E-01	4.1E-01	U	4.1E-01
OA3	B14RK4	5/29/2002	-5.40E-02	U	4.10E+00	5.70E-02	U	5.70E-02	5.60E-02	U	5.60E-02	1.20E-01	U	1.20E-01	1.90E-01	U	1.90E-01	4.1E-01	U	4.1E-01
OA4	B14RK5	5/29/2002	-2.26E+00	U	4.30E+00	3.40E-02	U	3.40E-02	3.80E-02	U	3.80E-02	1.00E-01	U	1.00E-01	1.30E-01	U	1.30E-01	4.1E-01	U	4.1E-01
OB5	B14RK6	5/29/2002	-3.19E+00	U	4.50E+00	4.20E-02	U	4.20E-02	4.40E-02	U	4.40E-02	9.60E-02	U	9.60E-02	1.30E-01	U	1.30E-01	4.1E-01	U	4.1E-01
OB6	B14RK7	5/29/2002	-1.70E+00	U	4.60E+00	2.70E-02	U	2.70E-02	2.50E-02	U	2.50E-02	7.50E-02	U	7.50E-02	9.10E-02	U	9.10E-02	4.2E-01	U	4.2E-01
OB7	B14RK8	5/29/2002	-1.93E+00	U	4.50E+00	1.23E-01		8.00E-02	7.60E-02	U	7.60E-02	1.90E-01	U	1.90E-01	2.20E-01	U	2.20E-01	4.2E-01	U	4.2E-01
OB8	B14RK9	5/29/2002	-2.25E+00	U	4.90E+00	1.14E-01		2.50E-02	3.20E-02	U	3.20E-02	9.50E-02	U	9.50E-02	9.90E-02	U	9.90E-02	4.2E-01	U	4.2E-01

[a] Because of laboratory reporting conventions, these data were given a nonrelevant "J" qualifier that appears in the Hanford Environmental Information System (HEIS) database and in analytical data. The data quality assessment (Appendix B) further discusses the "J" qualifiers applied during validation.
U = Analyte is below detection limits of the method and instruments used (not detected).
In some cases, the laboratory reports no value but provides a minimum detectable activity (MDA). In these cases, the MDA has been used as the sample result.

APPENDIX B

DATA QUALITY ASSESSMENT

B1.0 DATA QUALITY ASSESSMENT FOR THE 116-F-2 SITE

B1.1 OVERVIEW

This data quality assessment (DQA) was 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 the data to determine if they are of the right type, quality, and quantity to support their intended use (i.e., closeout decisions [EPA 2000]). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process.

This DQA was performed in accordance with BHI-EE-01, *Environmental Investigations Procedures.* Specific data quality objectives for the site are found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2001). The DQA is based on the guidelines presented in *Guidance for Data Quality Assessment* (EPA 2000). Statistical tests used in this DQA were performed as specified in the SAP (DOE-RL 2001) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2002).

Prior to performing statistical tests, all of the analytical data are evaluated and a portion are validated for compliance with quality assurance project plan requirements (DOE-RL 2001). Data evaluation is performed to determine if the laboratory carried out all steps required by the SAP and the laboratory contract governing the conduct of analysis and reporting of the data. This evaluation also examines the available laboratory data to determine if an analyte is present or absent in a sample and the degree of overall uncertainty associated with that determination. Data validation is done in accordance with validation procedures (BHI 2000a, 2000b) as part of data evaluation. After data evaluation and validation, the appropriate statistical test is performed on the adjusted raw analytical data (see calculation briefs in Appendix C), 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 116-F-2 site determined that the data are of the right type, quality, and quantity to support site cleanup 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 results for the 116-F-2 site, including formal data validation, supplementary data evaluation, and field quality assurance (QA)/quality control (QC) program results. The statistical evaluation of the data is provided in the calculation brief excerpts included in Appendix C.

B1.2 DATA VALIDATION

B1.2.1 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:

- Laboratory Contamination. Each analytical batch contains a laboratory (method) blank (material of similar composition as the samples with known/minimal contamination of the analytes of interest) carried through the complete analytical process. The method blank is used to evaluate false-positive results in samples due to contamination during handling at the laboratory.

- Analytical Accuracy. For most analyses, a known quantity of representative analytes of interest (matrix spike [MS]) is added to a separate aliquot of a sample from the analytical batch. The recovery percentage of the added MS is used to evaluate analytical accuracy. For analyses not amenable to MS techniques (e.g., gamma energy analysis) or where analytical recovery is corrected via internal standards (e.g., alpha spectral analyses), accuracy is evaluated from recovery of the QC reference sample (e.g., laboratory control spike [LCS] or blank spike sample).

- Analytical Precision. Separate aliquots removed from the same sample container (replicate samples) are analyzed for each analytical batch. The replicate sample results (evaluated as relative percent differences [RPDs]) are used to assess 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 provide an independent check on analytical technique and methodology.

Verification sample laboratories are also subject to periodic and random assessments of the laboratory performance, systems, 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.

B1.2.2 Data Validation Results

After sampling was completed, all of the fixed-base laboratory data from one SDG, H1789, 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 Procedure for Radiochemical Analysis* (BHI 2000a) and *Data Validation Procedure for Chemical Analysis* (BHI 2000b). Validation was performed by Tech Law, Inc. (Tech Law 2001a, 2001b).

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/matrix spike duplicate (MSD) results
- Sample replicates
- Associated batch laboratory control sample results
- Data package completeness
- Achievement of target (or contractual) detection limits (TDLs)

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 for precision, accuracy, completeness, and target detection limits pursuant to the SAP (DOE-RL 2001). The organization performing the data validation reported that, of the data given formal validation, the laboratory met the standards for performance for precision (±30%), accuracy (±30%), and completeness (>90%). Comparison of the TDL with the respective MDA or PQL is discussed in Section B1.3.

A summary of deficiencies noted during validation of SDG H1789 follows.

Radionuclides. The DQA noted no major deficiencies. Minor deficiencies noted during validation include the following:

- Reported analytical detection levels for undetected analytes are compared against the SAP TDLs to ensure that laboratory detection levels meet the required criteria. Sixteen analytes were reported above their TDL. Of the 16 missed TDLs nondetects, none exceeded the TDL by more than a factor of 2. All missed TDL nondetects in shallow zone samples were less than one-tenth of their associated remedial action goals (RAGs). All other reported results met the analyte-specific TDL.

Nonradionuclides. No major deficiencies were noted for nonradionuclides. Minor deficiencies noted during validation include the following:

Matrix spike (MS) analyses are used to assess the analytical accuracy of the reported data and the effect of the matrix on the ability to accurately quantify sample concentrations. Matrix spike recoveries must fall within the range of 70% to 130%. Samples with a spike recovery greater than 130% or less than 70% and a sample result greater than the instrument detection limit (IDL) are qualified as estimates and flagged "J." Finally, for samples with a spike recovery greater than 130% and a sample result less than the IDL, no qualification is required.

Due to a matrix spike recovery of 133% (insoluble chromium VI), all chromium VI results were qualified as estimates and flagged "J." As stated previously, data flagged "J" indicate that the associated concentration is an estimate, but under the Bechtel Hanford, Inc. statement of work, that data may be usable for decision-making purposes. All other validated results are considered accurate within the standard error associated with the methods.

B1.3 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 data evaluation of all SDGs.

To ensure adequate data quality, DQA investigators reviewed the study objectives in the SAP (DOE-RL 2001) to determine the context for assessing the data. The context for assessing the data includes evaluating the sample data using the statistical methodology of the SAP (included in the calculation brief excerpts in Appendix C) and a comparison of analytical results to the PARCC parameters as specified in the SAP (DOE-RL 2001). This section summarizes the results of the PARCC parameter comparison and presents an evaluation of the affected data.

TDL Comparison: Reported analytical detection levels for nondetected analytes were compared to the TDLs specified in the SAP (DOE-RL 2001). When detected results are obtained, evaluation of detection limits is not performed. The data validation and supplemental data evaluation noted any analyses in which the detection limit (MDA or PQL) was above the SAP TDLs for nondetected analytes.

The reported MDA was above the TDL for the following contaminants of concern (COCs):

- Cesium-137: 1 of 10 nondetect results
- Cobalt-60: 8 of 19 nondetect results

- Europium-152: 8 of 15 nondetect results
- Europium-154: 12 of 18 nondetect results

Of the 29 missed TDL nondetects, 8 exceeded the TDL by more than a factor of 2. All missed TDL nondetects in verification samples were less than one-tenth of their associated RAGs, with two exceptions. All missed TDL nondetect values in the deep zone meet RAGs applicable to deep zone soils (groundwater and Columbia River protection) as demonstrated in the calculation briefs (Appendix C) and discussed in the cleanup verification package. Because the reported values are sufficiently less than the RAGs, the associated data are of sufficient quality for decision-making purposes (DOE-RL 2002). All other nondetected analyses had detection limits below the TDL.

All other parameters meet acceptance criteria.

Precision and Accuracy Evaluation: 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 respect to accuracy and precision.

All RPDs for laboratory duplicates were within acceptable limits.

B1.4 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. Field QA/QC samples included one equipment blank (B14LK1), three field duplicate samples (sample B14RJ9, which was a duplicate of shallow zone sample B14RJ1; sample B14LK0, which was a duplicate of deep zone sample B14LJ4; and sample B14RL0, which was a duplicate of overburden sample B14RK2), and three field split samples (sample B14RK1, which was a split of shallow zone sample B14RJ1; sample B14LK2, which was a split of deep zone sample B14LJ4; and sample B14RL2, which was a split of overburden sample B14RK2). All main and QA/QC sample results are presented in Appendix A.

B1.4.1 Equipment Blank Samples

One equipment blank sample (B14LK1) was collected as part of the QA/QC measures. The blank sample results for this site were less than detection for all COCs.

B1.4.2 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.

Based on these criteria, calculation of the RPD was required for deep zone field duplicate sample B14LJ4 for cesium-137, cobalt-60, europium-152, and europium-154. These RPDs were greater than the control limit of 30%. Difficulty in producing truly homogeneous mixtures of soils is well known, and the lack of homogenous samples often times results in high RPDs. It is likely that more essentially inert material (e.g., larger size rocks or cobble) was present in one sample. As all values were below the RAGs by a larger amount than the potential inhomogeneity in the samples, the usability of the data is not affected. Calculation of the RPDs was not required for COCs in the shallow zone or overburden.

B1.4.3 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 TDLs or contract required detection limit for both the main and split sample were compared.

Based on these criteria, calculation of the RPD was required for deep zone field duplicate sample B14LJ4 for cesium-137, cobalt-60, europium-152, and europium-154. These RPDs were greater than the control limit of 30%. Field QA/QC sample results tend to suggest a limited degree of heterogeneity. Variance analysis (Appendix C) 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. As all values were below the RAGs by a larger amount than the potential nonhomogeneity in the samples, the usability of the data is not affected. As was the case for the field duplicates, calculation of the RDPs were not required for COCs in the shallow zone or overburden.

B1.4.4 Regulator Split Samples

In addition to the field split samples described above, EPA split samples were collected for the 116-F-2 site.

The 116-F-2 site had EPA splits for B14RJ1, B14RJ3, B14RJ5, and, B14RJ7. They were EPA02-1, EPA02-2, EPA02-3, and, EPA02-4, respectively.

The 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. Three criteria are described in these guidelines:

1. If **both** main and split results are below detection, no further analysis is required.

2. If **both** main and split results are greater than five times the TDL, the RPD was computed. This RPD is compared to +/-35%.

3. If **either** the main or split result is greater than five times the TDL, then the difference is computed. This difference is compared to two times the TDL.

Based on the criteria above, calculation of the RPDs for the regulator splits was not required.

B1.5 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.

B2.0 REFERENCES

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APPENDIX C

RESRAD INPUT PARAMETERS AND CALCULATION BRIEF EXCERPTS

RESRAD INPUT PARAMETERS FOR THE SHALLOW ZONE

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Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14	2.090E-06	2.090E-06	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)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	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-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
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	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	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)
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	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-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)
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)
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)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
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				
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				
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)

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Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.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)	1.535E+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	2.500E+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)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.300E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.600E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	3.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	4.300E+01	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Co-60	4.590E-02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.620E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Eu-152	4.130E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-154	1.310E-01	0.000E+00	---	S1(6)
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)
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
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

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Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	7.400E+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 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)
R016	Distribution coefficients for daughter C-14				
R016	Contaminated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)

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Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.RAD

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 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)
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)
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)	1.970E+01	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)	7.300E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI

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Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	0.768E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.768E+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)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	---	FLOOR1
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	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	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	active

Contaminated Zone Dimensions

Area:	15352.00 square meters
Thickness:	4.60 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Co-60	4.590E-02
Cs-137	2.620E-01
Eu-152	4.130E-01
Eu-154	1.310E-01

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.542E+00	3.332E+00	2.956E+00	2.313E+00	1.468E+00	7.707E-01	4.545E-01	7.337E-02	5.959E-04	4.843E-11
M(t):	2.362E-01	2.221E-01	1.971E-01	1.542E-01	9.785E-02	5.138E-02	3.030E-02	4.891E-03	3.973E-05	3.229E-12

0Maximum TDOSE(t): 3.542E+00 mrem/yr   at t = 0.000E+00 years

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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
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.
Co-60	4.478E-01	0.1264	3.975E-07	0.0000	0.000E+00	0.0000	5.215E-03	0.0015	3.798E-03	0.0011	8.703E-04	0.0002	6.756E-05	0.0000
Cs-137	5.649E-01	0.1595	3.487E-07	0.0000	0.000E+00	0.0000	2.919E-02	0.0082	3.457E-02	0.0098	2.147E-02	0.0061	7.562E-04	0.0002
Eu-152	1.811E+00	0.5111	3.754E-06	0.0000	0.000E+00	0.0000	3.675E-04	0.0001	9.660E-05	0.0000	2.553E-06	0.0000	1.523E-04	0.0000
Eu-154	6.222E-01	0.1756	1.521E-06	0.0000	0.000E+00	0.0000	1.695E-04	0.0000	4.456E-05	0.0000	1.178E-06	0.0000	7.026E-05	0.0000
Total	3.446E+00	0.9727	6.021E-06	0.0000	0.000E+00	0.0000	3.494E-02	0.0099	3.851E-02	0.0109	2.234E-02	0.0063	1.046E-03	0.0003

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-														
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	4.577E-01	0.1292
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	6.509E-01	0.1837
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	1.811E+00	0.5113
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	6.225E-01	0.1757
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	3.542E+00	1.0000

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	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.
•Co-60	3.925E-01	0.1178	3.485E-07	0.0000	0.000E+00	0.0000	4.572E-03	0.0014	3.329E-03	0.0010	7.629E-04	0.0002	5.922E-05	0.0000
Cs-137	5.519E-01	0.1656	3.406E-07	0.0000	0.000E+00	0.0000	2.851E-02	0.0086	3.377E-02	0.0101	2.098E-02	0.0063	7.388E-04	0.0002
Eu-152	1.719E+00	0.5159	3.563E-06	0.0000	0.000E+00	0.0000	3.488E-04	0.0001	9.170E-05	0.0000	2.424E-06	0.0000	1.446E-04	0.0000
Eu-154	5.751E-01	0.1726	1.405E-06	0.0000	0.000E+00	0.0000	1.567E-04	0.0000	4.119E-05	0.0000	1.088E-06	0.0000	6.493E-05	0.0000
÷Total	3.238E+00	0.9719	5.658E-06	0.0000	0.000E+00	0.0000	3.359E-02	0.0101	3.723E-02	0.0112	2.174E-02	0.0065	1.007E-03	0.0003

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	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.
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	4.012E-01	0.1204
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	6.359E-01	0.1909
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	1.719E+00	0.5160
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	5.753E-01	0.1727
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	3.332E+00	1.0000

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 = 3.000E+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	fract.
Co-60	3.016E-01	0.1020	2.678E-07	0.0000	0.000E+00	0.0000	3.513E-03	0.0012	2.558E-03	0.0009	5.862E-04	0.0002	4.551E-05	0.0000
Cs-137	5.268E-01	0.1782	3.251E-07	0.0000	0.000E+00	0.0000	2.721E-02	0.0092	3.223E-02	0.0109	2.002E-02	0.0068	7.051E-04	0.0002
Eu-152	1.549E+00	0.5240	3.211E-06	0.0000	0.000E+00	0.0000	3.144E-04	0.0001	8.263E-05	0.0000	2.184E-06	0.0000	1.303E-04	0.0000
Eu-154	4.912E-01	0.1662	1.200E-06	0.0000	0.000E+00	0.0000	1.338E-04	0.0000	3.518E-05	0.0000	9.297E-07	0.0000	5.546E-05	0.0000
Total	2.868E+00	0.9704	5.004E-06	0.0000	0.000E+00	0.0000	3.118E-02	0.0105	3.491E-02	0.0118	2.061E-02	0.0070	9.363E-04	0.0003

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+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	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	3.083E-01	0.1043
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	6.069E-01	0.2053
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	1.549E+00	0.5241
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	4.914E-01	0.1662
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	2.956E+00	1.0000

*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 = 7.300E+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	fract.
Co-60	1.712E-01	0.0740	1.520E-07	0.0000	0.000E+00	0.0000	1.994E-03	0.0009	1.452E-03	0.0006	3.327E-04	0.0001	2.583E-05	0.0000
Cs-137	4.765E-01	0.2060	2.941E-07	0.0000	0.000E+00	0.0000	2.462E-02	0.0106	2.916E-02	0.0126	1.811E-02	0.0078	6.378E-04	0.0003
Eu-152	1.238E+00	0.5354	2.567E-06	0.0000	0.000E+00	0.0000	2.513E-04	0.0001	6.606E-05	0.0000	1.746E-06	0.0000	1.041E-04	0.0000
Eu-154	3.500E-01	0.1513	8.553E-07	0.0000	0.000E+00	0.0000	9.536E-05	0.0000	2.507E-05	0.0000	6.625E-07	0.0000	3.952E-05	0.0000
Total	2.236E+00	0.9667	3.868E-06	0.0000	0.000E+00	0.0000	2.696E-02	0.0117	3.070E-02	0.0133	1.844E-02	0.0080	8.073E-04	0.0003

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.300E+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	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	1.750E-01	0.0757
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	5.490E-01	0.2374
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	1.239E+00	0.5356
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	3.501E-01	0.1514
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	2.313E+00	1.0000

*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 = 1.600E+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	fract.
Co-60	5.442E-02	0.0371	4.831E-08	0.0000	0.000E+00	0.0000	6.339E-04	0.0004	4.616E-04	0.0003	1.058E-04	0.0001	8.211E-06	0.0009
Cs-137	3.890E-01	0.2650	2.401E-07	0.0000	0.000E+00	0.0000	2.010E-02	0.0137	2.380E-02	0.0162	1.478E-02	0.0101	5.207E-04	0.0004
Eu-152	7.873E-01	0.5364	1.632E-06	0.0000	0.000E+00	0.0000	1.598E-04	0.0001	4.200E-05	0.0000	1.110E-06	0.0000	6.622E-05	0.0000
Eu-154	1.763E-01	0.1201	4.308E-07	0.0000	0.000E+00	0.0000	4.803E-05	0.0000	1.263E-05	0.0000	3.337E-07	0.0000	1.991E-05	0.0000
Total	1.407E+00	0.9586	2.351E-06	0.0000	0.000E+00	0.0000	2.094E-02	0.0143	2.432E-02	0.0166	1.489E-02	0.0101	6.150E-04	0.0004

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 = 1.600E+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	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	5.563E-02	0.0379
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	4.482E-01	0.3054
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	7.876E-01	0.5366
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	1.764E-01	0.1202
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	1.468E+00	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/28/2002 10:18 Page 15
Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.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+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	fract.
*Co-60	8.609E-03	0.0112	7.642E-09	0.0000	0.000E+00	0.0000	1.003E-04	0.0001	7.302E-05	0.0001	1.673E-05	0.0000	1.299E-06	0.0000
Cs-137	2.806E-01	0.3641	1.732E-07	0.0000	0.000E+00	0.0000	1.450E-02	0.0188	1.717E-02	0.0223	1.067E-02	0.0138	3.756E-04	0.0005
Eu-152	3.799E-01	0.4929	7.875E-07	0.0000	0.000E+00	0.0000	7.710E-05	0.0001	2.027E-05	0.0000	5.356E-07	0.0000	3.195E-05	0.0000
Eu-154	5.848E-02	0.0759	1.429E-07	0.0000	0.000E+00	0.0000	1.593E-05	0.0000	4.188E-06	0.0000	1.107E-07	0.0000	6.603E-06	0.0000
*Total	7.276E-01	0.9441	1.111E-06	0.0000	0.000E+00	0.0000	1.469E-02	0.0191	1.727E-02	0.0224	1.068E-02	0.0139	4.155E-04	0.0005

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+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	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	8.800E-03	0.0114
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	3.233E-01	0.4196
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	3.800E-01	0.4931
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	5.851E-02	0.0759
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	7.707E-01	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/28/2002 10:18 Page 16
Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.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 = 4.300E+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	fract.
Co-60	1.553E-03	0.0034	1.379E-09	0.0000	0.000E+00	0.0000	1.809E-05	0.0000	1.318E-05	0.0000	3.019E-06	0.0000	2.344E-07	0.0000
Cs-137	2.072E-01	0.4559	1.279E-07	0.0000	0.000E+00	0.0000	1.071E-02	0.0236	1.268E-02	0.0279	7.876E-03	0.0173	2.774E-04	0.0006
Eu-152	1.931E-01	0.4248	4.003E-07	0.0000	0.000E+00	0.0000	3.919E-05	0.0001	1.030E-05	0.0000	2.723E-07	0.0000	1.624E-05	0.0000
Eu-154	2.099E-02	0.0462	5.129E-08	0.0000	0.000E+00	0.0000	5.719E-06	0.0000	1.503E-06	0.0000	3.973E-08	0.0000	2.370E-06	0.0000
Total	4.229E-01	0.9304	5.809E-07	0.0000	0.000E+00	0.0000	1.077E-02	0.0237	1.271E-02	0.0280	7.880E-03	0.0173	2.962E-04	0.0007

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 = 4.300E+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	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	1.588E-03	0.0035
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	2.388E-01	0.5253
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	1.932E-01	0.4250
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	2.100E-02	0.0462
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	4.545E-01	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T* Limit = 0.5 year 10/28/2002 10:18 Page 17
Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.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+02 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.
*Co-60	8.523E-07	0.0000	7.566E-13	0.0000	0.000E+00	0.0000	9.927E-09	0.0000	7.229E-09	0.0000	1.657E-09	0.0000	1.286E-10	0.0000
Cs-137	5.485E-02	0.7475	3.385E-08	0.0000	0.000E+00	0.0000	2.834E-03	0.0386	3.356E-03	0.0457	2.085E-03	0.0284	7.342E-05	0.0010
Eu-152	9.936E-03	0.1354	2.060E-08	0.0000	0.000E+00	0.0000	2.016E-06	0.0000	5.301E-07	0.0000	1.401E-08	0.0000	8.357E-07	0.0000
Eu-154	2.348E-04	0.0032	5.739E-10	0.0000	0.000E+00	0.0000	6.399E-08	0.0000	1.682E-08	0.0000	4.445E-10	0.0000	2.652E-08	0.0000
*Total	6.502E-02	0.8862	5.502E-08	0.0000	0.000E+00	0.0000	2.836E-03	0.0386	3.357E-03	0.0458	2.085E-03	0.0284	7.428E-05	0.0010

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+02 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.
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	8.713E-07	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	6.319E-02	0.8613
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	9.939E-03	0.1355
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	2.350E-04	0.0032
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	7.337E-02	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/28/2002 10:18 Page 18
Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.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-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	3.088E-18	0.0000	2.741E-24	0.0000	0.000E+00	0.0000	3.596E-20	0.0000	2.619E-20	0.0000	6.001E-21	0.0000	4.659E-22	0.0000
Cs-137	5.170E-04	0.8675	3.191E-10	0.0000	0.000E+00	0.0000	2.671E-05	0.0448	3.163E-05	0.0531	1.965E-05	0.0330	6.920E-07	0.0012
Eu-152	2.992E-07	0.0005	6.203E-13	0.0000	0.000E+00	0.0000	6.072E-11	0.0000	1.596E-11	0.0000	4.218E-13	0.0000	2.516E-11	0.0000
Eu-154	3.346E-11	0.0000	8.176E-17	0.0000	0.000E+00	0.0000	9.116E-15	0.0000	2.396E-15	0.0000	6.333E-17	0.0000	3.778E-15	0.0000
Total	5.173E-04	0.8680	3.197E-10	0.0000	0.000E+00	0.0000	2.671E-05	0.0448	3.163E-05	0.0531	1.965E-05	0.0330	6.920E-07	0.0012

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-														
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	3.157E-18	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	5.957E-04	0.9995
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	2.993E-07	0.0005
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	3.347E-11	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	5.959E-04	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/28/2002 10:18 Page 19
Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.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- 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	0.000E+00	0.0000
Cs-137	4.203E-11	0.8679	2.594E-17	0.0000	0.000E+00	0.0000	2.171E-12	0.0448	2.572E-12	0.0531	1.597E-12	0.0330	5.626E-14	0.0012
Eu-152	4.481E-23	0.0000	1.439E-16	0.0000	0.000E+00	0.0000	3.184E-16	0.0000	8.370E-17	0.0000	2.212E-18	0.0000	1.320E-16	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
*******	*********	******	*********	******	*********	******	*********	******	*********	******	*********	******	*********	******
*Total	4.203E-11	0.8679	1.699E-16	0.0000	0.000E+00	0.0000	2.172E-12	0.0448	2.572E-12	0.0531	1.597E-12	0.0330	5.639E-14	0.0012

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- 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	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	4.843E-11	1.0000
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	6.802E-16	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
*******	*********	******	*********	******	*********	******	*********	******	*********	******	*********	******	*********	******
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	4.843E-11	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T∝ Limit = 0.5 year 10/28/2002 10:18 Page 20
Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.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	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
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Co-60	Co-60	1.000E+00	9.973E+00	8.742E+00	6.717E+00	3.813E+00	1.212E+00	1.917E-01	3.459E-02	1.898E-05	6.877E-17	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.484E+00	2.427E+00	2.316E+00	2.095E+00	1.711E+00	1.234E+00	9.114E-01	2.412E-01	2.273E-03	1.848E-10
0Eu-152	Eu-152	7.208E-01	3.161E+00	3.001E+00	2.704E+00	2.162E+00	1.375E+00	6.632E-01	3.371E-01	1.735E-02	5.223E-07	7.823E-23
0Eu-152	Eu-152	2.792E-01	1.224E+00	1.162E+00	1.047E+00	8.374E-01	5.324E-01	2.569E-01	1.306E-01	6.719E-03	2.023E-07	3.030E-23
Eu-152	Gd-152	2.792E-01	4.268E-17	1.251E-16	2.777E-16	5.566E-16	9.615E-16	1.327E-15	1.495E-15	1.658E-15	1.662E-15	1.647E-15
Eu-152	äDSR(j)		1.224E+00	1.162E+00	1.047E+00	8.374E-01	5.324E-01	2.569E-01	1.306E-01	6.719E-03	2.023E-07	1.647E-15
0Eu-154	Eu-154	1.000E+00	4.752E+00	4.392E+00	3.751E+00	2.673E+00	1.346E+00	4.466E-01	1.603E-01	1.794E-03	2.555E-10	2.788E-34
ffffffff	ffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff

*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.
0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Co-60	1.504E+00	1.716E+00	2.233E+00	3.934E+00	1.238E+01	7.824E+01	4.336E+02	7.902E+05	*1.131E+15	*1.131E+15
Cs-137	6.038E+00	6.180E+00	6.475E+00	7.158E+00	8.769E+00	1.215E+01	1.646E+01	6.219E+01	6.598E+03	8.115E+10
Eu-152	3.420E+00	3.603E+00	3.998E+00	5.001E+00	7.866E+00	1.630E+01	3.207E+01	6.233E+02	2.070E+07	*1.765E+14
Eu-154	3.157E+00	3.415E+00	3.999E+00	5.612E+00	1.114E+01	3.359E+01	9.358E+01	8.363E+03	5.871E+10	*2.639E+14
ffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff

*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 = 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)
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Co-60	4.590E-02	0.000E+00	9.973E+00	1.504E+00	9.973E+00	1.504E+00
Cs-137	2.620E-01	0.000E+00	2.484E+00	6.038E+00	2.484E+00	6.038E+00
Eu-152	4.130E-01	0.000E+00	4.386E+00	3.420E+00	4.386E+00	3.420E+00
Eu-154	1.310E-01	0.000E+00	4.752E+00	3.157E+00	4.752E+00	3.157E+00
ffffffff	ffffffffff	ffffffffffffffffff	ffffffffff	ffffffffff	ffffffffff	ffffffffff

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Summary : 116-F-2 Trench Shallow Zone File: 116-F-2 Trench Shallow Zone.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated
DOSE(j,t), mrem/yr

0Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	4.577E-01	4.012E-01	3.083E-01	1.750E-01	5.563E-02	8.800E-03	1.588E-03	8.713E-07	3.157E-18	0.000E+00
0Cs-137	Cs-137	1.000E+00	6.509E-01	6.359E-01	6.069E-01	5.490E-01	4.482E-01	3.233E-01	2.388E-01	6.319E-02	5.957E-04	4.843E-11
0Eu-152	Eu-152	7.208E-01	1.306E+00	1.239E+00	1.117E+00	8.928E-01	5.677E-01	2.739E-01	1.392E-01	7.164E-03	2.157E-07	3.231E-23
Eu-152	Eu-152	2.792E-01	5.057E-01	4.801E-01	4.326E-01	3.458E-01	2.199E-01	1.061E-01	5.393E-02	2.775E-03	8.355E-08	1.252E-23
Eu-152	ÄDOSE(j)		1.811E+00	1.719E+00	1.549E+00	1.239E+00	7.876E-01	3.800E-01	1.932E-01	9.939E-03	2.993E-07	4.483E-23
0Gd-152	Eu-152	2.792E-01	1.763E-17	5.168E-17	1.147E-16	2.299E-16	3.971E-16	5.481E-16	6.172E-16	6.847E-16	6.865E-16	6.802E-16
0Eu-154	Eu-154	1.000E+00	6.225E-01	5.753E-01	4.914E-01	3.501E-01	1.764E-01	5.851E-02	2.100E-02	2.350E-04	3.347E-11	0.000E+00

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

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated
S(j,t), pCi/g

0Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	4.590E-02	4.024E-02	3.092E-02	1.755E-02	5.579E-03	8.824E-04	1.592E-04	8.737E-08	3.165E-19	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.620E-01	2.560E-01	2.443E-01	2.210E-01	1.804E-01	1.302E-01	9.611E-02	2.544E-02	2.398E-04	1.949E-11
0Eu-152	Eu-152	7.208E-01	2.977E-01	2.826E-01	2.547E-01	2.036E-01	1.294E-01	6.246E-02	3.175E-02	1.633E-03	4.918E-08	7.367E-24
Eu-152	Eu-152	2.792E-01	1.153E-01	1.095E-01	9.864E-02	7.886E-02	5.014E-02	2.419E-02	1.230E-02	6.327E-04	1.905E-08	2.854E-24
Eu-152	äS(j):		4.130E-01	3.921E-01	3.533E-01	2.824E-01	1.796E-01	8.665E-02	4.404E-02	2.266E-03	6.824E-08	1.022E-23
0Gd-152	Eu-152	2.792E-01	0.000E+00	7.211E-16	2.055E-15	4.494E-15	8.035E-15	1.123E-14	1.270E-14	1.412E-14	1.416E-14	1.403E-14
0Eu-154	Eu-154	1.000E+00	1.310E-01	1.211E-01	1.034E-01	7.369E-02	3.712E-02	1.231E-02	4.419E-03	4.944E-05	7.044E-12	7.687E-36

BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 1.24 seconds

RESRAD INPUT PARAMETERS FOR OVERBURDEN

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-60	2.190E-04	2.190E-04	DCF2(1)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(2)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(4)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(5)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(2)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(4)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(5)
D-34	Food transfer factors:			
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(2,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(2,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(2,3)
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(4,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(4,3)
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(2,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(5,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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)	1.535E+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	2.500E+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)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.300E+00	1.000E+01	---	T(4)
•R011	Times for calculations (yr)	1.600E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	3.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	4.300E+01	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Co-60	1.900E-02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Eu-152	3.080E-02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Eu-154	2.950E-02	0.000E+00	---	S1(4)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(4)
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
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

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	7.400E+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 Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.166E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Eu-154				
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 daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.316E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
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

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.RAD

Site-Specific Parameter Summary (continued)

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)	1.970E+01	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)	7.300E+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	0.768E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.768E+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

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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
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
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
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	---	FLOOR1
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

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	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	active

Contaminated Zone Dimensions
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Area:	15352.00 square meters
Thickness:	4.60 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g
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Co-60	1.900E-02
Eu-152	3.080E-02
Eu-154	2.950E-02

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
ÄÄÄ

t (years):	0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.647E-01	4.239E-01	3.538E-01	2.437E-01	1.215E-01	4.516E-02	1.979E-02	7.945E-04	2.233E-08	5.073E-17
M(t):	3.098E-02	2.826E-02	2.359E-02	1.624E-02	8.099E-03	3.010E-03	1.319E-03	5.297E-05	1.488E-09	3.382E-18

0Maximum TDOSE(t): 4.647E-01 mrem/yr at t = 0.000E+00 years

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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
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.
Co-60	1.854E-01	0.3988	1.645E-07	0.0000	0.000E+00	0.0000	2.159E-03	0.0046	1.572E-03	0.0034	3.603E-04	0.0008	2.797E-05	0.0001
Eu-152	1.350E-01	0.2906	2.799E-07	0.0000	0.000E+00	0.0000	2.741E-05	0.0001	7.204E-06	0.0000	1.904E-07	0.0000	1.136E-05	0.0000
Eu-154	1.401E-01	0.3015	3.424E-07	0.0000	0.000E+00	0.0000	3.818E-05	0.0001	1.004E-05	0.0000	2.652E-07	0.0000	1.582E-05	0.0000
Total	4.605E-01	0.9909	7.869E-07	0.0000	0.000E+00	0.0000	2.224E-03	0.0048	1.589E-03	0.0034	3.607E-04	0.0008	5.514E-05	0.0001

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- 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	1.895E-01	0.4077
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	1.351E-01	0.2907
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	1.402E-01	0.3016
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	4.647E-01	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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	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.
Co-60	1.625E-01	0.3833	1.442E-07	0.0000	0.000E+00	0.0000	1.892E-03	0.0045	1.378E-03	0.0033	3.158E-04	0.0007	2.451E-05	0.0001
Eu-152	1.282E-01	0.3024	2.657E-07	0.0000	0.000E+00	0.0000	2.602E-05	0.0001	6.839E-06	0.0000	1.807E-07	0.0000	1.078E-05	0.0000
Eu-154	1.295E-01	0.3055	3.165E-07	0.0000	0.000E+00	0.0000	3.528E-05	0.0001	9.275E-06	0.0000	2.451E-07	0.0000	1.462E-05	0.0000
Total	4.202E-01	0.9912	7.265E-07	0.0000	0.000E+00	0.0000	1.954E-03	0.0046	1.394E-03	0.0033	3.162E-04	0.0007	4.992E-05	0.0001

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	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.
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	1.661E-01	0.3918
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-01	0.3025
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	1.296E-01	0.3056
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	4.239E-01	1.0000

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 = 3.000E+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.
Co-60	1.249E-01	0.3529	1.108E-07	0.0000	0.000E+00	0.0000	1.454E-03	0.0041	1.059E-03	0.0030	2.427E-04	0.0007	1.884E-05	0.0001
Eu-152	1.155E-01	0.3264	2.395E-07	0.0000	0.000E+00	0.0000	2.344E-05	0.0001	6.163E-06	0.0000	1.629E-07	0.0000	9.715E-06	0.0000
Eu-154	1.106E-01	0.3126	2.703E-07	0.0000	0.000E+00	0.0000	3.014E-05	0.0001	7.922E-06	0.0000	2.094E-07	0.0000	1.249E-05	0.0000
Total	3.510E-01	0.9919	6.206E-07	0.0000	0.000E+00	0.0000	1.508E-03	0.0043	1.073E-03	0.0030	2.430E-04	0.0007	4.104E-05	0.0001

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+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.
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	1.276E-01	0.3607
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	1.155E-01	0.3266
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	1.107E-01	0.3127
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	3.538E-01	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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 = 7.300E+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.
Co-60	7.086E-02	0.2908	6.291E-08	0.0000	0.000E+00	0.0000	8.253E-04	0.0034	6.011E-04	0.0025	1.377E-04	0.0006	1.069E-05	0.0000
Eu-152	9.234E-02	0.3790	1.914E-07	0.0000	0.000E+00	0.0000	1.874E-05	0.0001	4.927E-06	0.0000	1.302E-07	0.0000	7.767E-06	0.0000
Eu-154	7.881E-02	0.3235	1.926E-07	0.0000	0.000E+00	0.0000	2.147E-05	0.0001	5.645E-06	0.0000	1.492E-07	0.0000	8.899E-06	0.0000
Total	2.420E-01	0.9933	4.470E-07	0.0000	0.000E+00	0.0000	8.655E-04	0.0036	6.116E-04	0.0025	1.380E-04	0.0006	2.736E-05	0.0001

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 = 7.300E+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.
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	7.244E-02	0.2973
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	9.238E-02	0.3791
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	7.885E-02	0.3236
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	2.437E-01	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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 = 1.600E+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	fract.
‹Co-60	2.253E-02	0.1855	2.000E-08	0.0000	0.000E+00	0.0000	2.624E-04	0.0022	1.911E-04	0.0016	4.379E-05	0.0004	3.399E-06	0.0000
Eu-152	5.871E-02	0.4833	1.217E-07	0.0000	0.000E+00	0.0000	1.192E-05	0.0001	3.132E-06	0.0000	8.279E-08	0.0000	4.938E-06	0.0000
Eu-154	3.970E-02	0.3268	9.702E-08	0.0000	0.000E+00	0.0000	1.082E-05	0.0001	2.843E-06	0.0000	7.515E-08	0.0000	4.483E-06	0.0000
Total	1.209E-01	0.9956	2.387E-07	0.0000	0.000E+00	0.0000	2.851E-04	0.0023	1.971E-04	0.0016	4.394E-05	0.0004	1.282E-05	0.0001

Q

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.600E+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	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	2.303E-02	0.1896
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	5.873E-02	0.4835
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	3.972E-02	0.3269
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	1.215E-01	1.0000

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 = 3.000E+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	fract.
Co-60	3.563E-03	0.0789	3.163E-09	0.0000	0.000E+00	0.0000	4.150E-05	0.0009	3.022E-05	0.0007	6.926E-06	0.0002	5.376E-07	0.0000
Eu-152	2.833E-02	0.6274	5.873E-08	0.0000	0.000E+00	0.0000	5.750E-06	0.0001	1.511E-06	0.0000	3.995E-08	0.0000	2.383E-06	0.0001
Eu-154	1.317E-02	0.2916	3.218E-08	0.0000	0.000E+00	0.0000	3.588E-06	0.0001	9.432E-07	0.0000	2.493E-08	0.0000	1.487E-06	0.0000
Total	4.506E-02	0.9979	9.408E-08	0.0000	0.000E+00	0.0000	5.084E-05	0.0011	3.268E-05	0.0007	6.991E-06	0.0002	4.407E-06	0.0001

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+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	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	3.643E-03	0.0807
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	2.834E-02	0.6276
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	1.317E-02	0.2918
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	4.516E-02	1.0000

*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 = 4.300E+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	fract.
Co-60	6.430E-04	0.0325	5.708E-10	0.0000	0.000E+00	0.0000	7.489E-06	0.0004	5.454E-06	0.0003	1.250E-06	0.0001	9.701E-08	0.0000
Eu-152	1.440E-02	0.7276	2.985E-08	0.0000	0.000E+00	0.0000	2.923E-06	0.0001	7.683E-07	0.0000	2.030E-08	0.0000	1.211E-06	0.0001
Eu-154	4.726E-03	0.2388	1.155E-08	0.0000	0.000E+00	0.0000	1.288E-06	0.0001	3.385E-07	0.0000	8.947E-09	0.0000	5.337E-07	0.0000
Total	1.977E-02	0.9989	4.197E-08	0.0000	0.000E+00	0.0000	1.170E-05	0.0006	6.561E-06	0.0003	1.279E-06	0.0001	1.842E-06	0.0001

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.300E+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	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	6.573E-04	0.0332
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	1.440E-02	0.7279
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	4.729E-03	0.2389
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	1.979E-02	1.0000

*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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+02 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.
Co-60	3.528E-07	0.0004	3.132E-13	0.0000	0.000E+00	0.0000	4.109E-09	0.0000	2.993E-09	0.0000	6.857E-10	0.0000	5.323E-11	0.0000
Eu-152	7.410E-04	0.9326	1.536E-09	0.0000	0.000E+00	0.0000	1.504E-07	0.0002	3.953E-08	0.0000	1.045E-09	0.0000	6.232E-08	0.0001
Eu-154	5.289E-05	0.0666	1.292E-10	0.0000	0.000E+00	0.0000	1.441E-08	0.0000	3.788E-09	0.0000	1.001E-10	0.0000	5.971E-09	0.0000
Total	7.942E-04	0.9996	1.666E-09	0.0000	0.000E+00	0.0000	1.689E-07	0.0002	4.631E-08	0.0001	1.831E-09	0.0000	6.835E-08	0.0001

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+02 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.
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	3.607E-07	0.0005
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	7.412E-04	0.9329
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	5.291E-05	0.0666
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	7.945E-04	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
*Co-60	1.278E-18	0.0000	1.135E-24	0.0000	0.000E+00	0.0000	1.489E-20	0.0000	1.084E-20	0.0000	2.484E-21	0.0000	1.929E-22	0.0000
Eu-152	2.231E-08	0.9993	4.626E-14	0.0000	0.000E+00	0.0000	4.528E-12	0.0002	1.190E-12	0.0001	3.146E-14	0.0000	1.876E-12	0.0001
Eu-154	7.534E-12	0.0003	1.841E-17	0.0000	0.000E+00	0.0000	2.053E-15	0.0000	5.396E-16	0.0000	1.426E-17	0.0000	8.507E-16	0.0000
Total	2.232E-08	0.9997	4.628E-14	0.0000	0.000E+00	0.0000	4.530E-12	0.0002	1.191E-12	0.0001	3.147E-14	0.0000	1.877E-12	0.0001

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-														
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	1.307E-18	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	2.232E-08	0.9997
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	7.538E-12	0.0003
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	2.233E-08	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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	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	0.000E+00	0.0000
Eu-152	3.342E-24	0.0000	1.073E-17	0.2116	0.000E+00	0.0000	2.375E-17	0.4681	6.242E-18	0.1230	1.650E-19	0.0033	9.841E-18	0.1940
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
Total	3.342E-24	0.0000	1.073E-17	0.2116	0.000E+00	0.0000	2.375E-17	0.4681	6.242E-18	0.1230	1.650E-19	0.0033	9.841E-18	0.1940

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	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	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	5.073E-17	1.0000
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
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	5.073E-17	1.0000

*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,t) (mrem/yr)/(pCi/g)									
Co-60	Co-60	1.000E+00	9.973E+00	8.742E+00	6.717E+00	3.813E+00	1.212E+00	1.917E-01	3.459E-02	1.898E-05	6.877E-17	0.000E+00
0Eu-152	Eu-152	7.208E-01	3.161E+00	3.001E+00	2.704E+00	2.162E+00	1.375E+00	6.632E-01	3.371E-01	1.735E-02	5.223E-07	7.823E-23
0Eu-152	Eu-152	2.792E-01	1.224E+00	1.162E+00	1.047E+00	8.374E-01	5.324E-01	2.569E-01	1.306E-01	6.719E-03	2.023E-07	3.030E-23
Eu-152	Gd-152	2.792E-01	4.268E-17	1.251E-16	2.777E-16	5.566E-16	9.615E-16	1.327E-15	1.495E-15	1.658E-15	1.662E-15	1.647E-15
Eu-152	ãDSR(j)		1.224E+00	1.162E+00	1.047E+00	8.374E-01	5.324E-01	2.569E-01	1.306E-01	6.719E-03	2.023E-07	1.647E-15
0Eu-154	Eu-154	1.000E+00	4.752E+00	4.392E+00	3.751E+00	2.673E+00	1.346E+00	4.466E-01	1.603E-01	1.794E-03	2.555E-10	2.788E-34

*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.
0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	1.504E+00	1.716E+00	2.233E+00	3.934E+00	1.238E+01	7.824E+01	4.336E+02	7.902E+05	*1.131E+15	*1.131E+15
Eu-152	3.420E+00	3.603E+00	3.998E+00	5.001E+00	7.866E+00	1.630E+01	3.207E+01	6.233E+02	2.070E+07	*1.765E+14
Eu-154	3.157E+00	3.415E+00	3.999E+00	5.612E+00	1.114E+01	3.359E+01	9.358E+01	8.363E+03	5.871E+10	*2.639E+14

*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 = 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	1.900E-02	0.000E+00	9.973E+00	1.504E+00	9.973E+00	1.504E+00
Eu-152	3.080E-02	0.000E+00	4.386E+00	3.420E+00	4.386E+00	3.420E+00
Eu-154	2.950E-02	0.000E+00	4.752E+00	3.157E+00	4.752E+00	3.157E+00

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Summary : 116-F-2 Trench Overburden File: 116-F-2 Trench Overburden.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	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.895E-01	1.661E-01	1.276E-01	7.244E-02	2.303E-02	3.643E-03	6.573E-04	3.607E-07	1.307E-18	0.000E+00
0Eu-152	Eu-152	7.208E-01	9.736E-02	9.243E-02	8.329E-02	6.658E-02	4.233E-02	2.043E-02	1.038E-02	5.343E-04	1.609E-08	2.410E-24
Eu-152	Eu-152	2.792E-01	3.771E-02	3.580E-02	3.226E-02	2.579E-02	1.640E-02	7.912E-03	4.022E-03	2.069E-04	6.231E-09	9.333E-25
Eu-152	äDOSE(j)		1.351E-01	1.282E-01	1.155E-01	9.238E-02	5.873E-02	2.834E-02	1.440E-02	7.412E-04	2.232E-08	3.343E-24
0Gd-152	Eu-152	2.792E-01	1.315E-18	3.854E-18	8.554E-18	1.714E-17	2.961E-17	4.087E-17	4.603E-17	5.106E-17	5.120E-17	5.073E-17
0Eu-154	Eu-154	1.000E+00	1.402E-01	1.296E-01	1.107E-01	7.885E-02	3.972E-02	1.317E-02	4.729E-03	5.291E-05	7.538E-12	0.000E+00

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	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.900E-02	1.666E-02	1.280E-02	7.264E-03	2.309E-03	3.653E-04	6.591E-05	3.616E-08	1.310E-19	0.000E+00
0Eu-152	Eu-152	7.208E-01	2.220E-02	2.107E-02	1.899E-02	1.518E-02	9.653E-03	4.658E-03	2.367E-03	1.218E-04	3.668E-09	5.494E-25
Eu-152	Eu-152	2.792E-01	8.599E-03	8.163E-03	7.356E-03	5.881E-03	3.739E-03	1.804E-03	9.170E-04	4.719E-05	1.421E-09	2.128E-25
Eu-152	äS(j):		3.080E-02	2.924E-02	2.635E-02	2.106E-02	1.339E-02	6.462E-03	3.285E-03	1.690E-04	5.089E-09	7.622E-25
0Gd-152	Eu-152	2.792E-01	0.000E+00	5.378E-17	1.533E-16	3.352E-16	5.992E-16	8.376E-16	9.468E-16	1.053E-15	1.056E-15	1.047E-15
0Eu-154	Eu-154	1.000E+00	2.950E-02	2.726E-02	2.329E-02	1.659E-02	8.358E-03	2.773E-03	9.951E-04	1.113E-05	1.586E-12	1.731E-36

BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 1.18 seconds

RESRAD INPUT PARAMETERS FOR THE DEEP ZONE

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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14	2.090E-06	2.090E-06	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)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	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-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
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	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	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)
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	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-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)
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)
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)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
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				
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				
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)

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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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)	1.535E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	7.400E+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	2.500E+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)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.300E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.600E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	3.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	4.300E+01	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	3.870E+00	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Co-60	1.300E+00	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.000E+01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Eu-152	4.160E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-154	4.210E+00	0.000E+00	---	S1(6)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(1)
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)
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

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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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 C-14				
R016	Contaminated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCC(1)
R016	Saturated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.373E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(2)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.347E-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	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.347E-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	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.373E-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	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.373E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
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	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	8.182E-06	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)
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)	1.970E+01	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	0.768E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.768E+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

Site-Specific Parameter Summary (continued)

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)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	8.894E+01	---	CO2F
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	---	FLOOR1
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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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.RAD

Site-Specific Parameter Summary (continued)

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	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	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	active

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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.RAD

Contaminated Zone Dimensions
Area: 15352.00 square meters
Thickness: 7.40 meters
Cover Depth: 4.60 meters

Initial Soil Concentrations, pCi/g

C-14	3.870E+00
Co-60	1.300E+00
Cs-137	2.000E+01
Eu-152	4.160E+01
Eu-154	4.210E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 4.000E+00 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.338E-03	1.107E-02	2.581E-02	5.288E-02	9.184E-02	1.230E-01	1.299E-01	8.043E-02	2.357E-03	7.299E-10
M(t):	8.344E-04	2.767E-03	6.453E-03	1.322E-02	2.296E-02	3.074E-02	3.248E-02	2.011E-02	5.893E-04	1.825E-10

0Maximum TDOSE(t): 1.299E-01 mrem/yr at t = 42.82 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 = 4.282E+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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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 = 4.282E+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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	9.546E-06	0.0001	3.240E-06	0.0000	0.000E+00	0.0000	1.078E-06	0.0000	3.718E-06	0.0000	1.078E-06	0.0000	1.866E-05	0.0001
Cs-137	2.988E-02	0.2300	6.576E-02	0.5061	0.000E+00	0.0000	3.334E-03	0.0257	1.744E-02	0.1342	1.349E-02	0.1038	1.299E-01	0.9999
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
Total	2.989E-02	0.2301	6.577E-02	0.5062	0.000E+00	0.0000	3.336E-03	0.0257	1.745E-02	0.1343	1.349E-02	0.1038	1.299E-01	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	2.973E-05	0.0089	9.307E-06	0.0028	0.000E+00	0.0000	2.812E-06	0.0008	3.871E-06	0.0012	2.059E-06	0.0006	4.778E-05	0.0143
Cs-137	9.135E-04	0.2737	1.857E-03	0.5563	0.000E+00	0.0000	8.560E-05	0.0256	1.800E-04	0.0539	2.542E-04	0.0762	3.290E-03	0.9857
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
Total	9.432E-04	0.2826	1.866E-03	0.5590	0.000E+00	0.0000	8.841E-05	0.0265	1.839E-04	0.0551	2.562E-04	0.0768	3.338E-03	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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)

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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	8.000E-05	0.0072	2.637E-05	0.0024	0.000E+00	0.0000	8.485E-06	0.0008	2.203E-05	0.0020	7.616E-06	0.0007	1.445E-04	0.0131
Cs-137	2.706E-03	0.2445	5.785E-03	0.5226	0.000E+00	0.0000	2.838E-04	0.0256	1.119E-03	0.1011	1.031E-03	0.0931	1.093E-02	0.9869
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
Total	2.786E-03	0.2517	5.811E-03	0.5250	0.000E+00	0.0000	2.922E-04	0.0264	1.141E-03	0.1031	1.038E-03	0.0938	1.107E-02	1.0000

*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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+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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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+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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	1.445E-04	0.0056	4.847E-05	0.0019	0.000E+00	0.0000	1.592E-05	0.0006	4.960E-05	0.0019	1.528E-05	0.0006	2.738E-04	0.0106
Cs-137	6.050E-03	0.2344	1.316E-02	0.5098	0.000E+00	0.0000	6.585E-04	0.0255	3.113E-03	0.1206	2.558E-03	0.0991	2.554E-02	0.9894
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
Total	6.195E-03	0.2400	1.321E-02	0.5117	0.000E+00	0.0000	6.745E-04	0.0261	3.162E-03	0.1225	2.573E-03	0.0997	2.581E-02	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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 = 7.300E+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.
*C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
*ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff
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 = 7.300E+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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	1.835E-04	0.0035	6.197E-05	0.0012	0.000E+00	0.0000	2.051E-05	0.0004	6.807E-05	0.0013	2.019E-05	0.0004	3.542E-04	0.0067
Cs-137	1.222E-02	0.2312	2.678E-02	0.5064	0.000E+00	0.0000	1.351E-03	0.0255	6.797E-03	0.1285	5.378E-03	0.1017	5.253E-02	0.9933
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
ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff	ffffffff	ffffff
Total	1.241E-02	0.2346	2.684E-02	0.5075	0.000E+00	0.0000	1.371E-03	0.0259	6.865E-03	0.1298	5.398E-03	0.1021	5.288E-02	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/30/2002 08:55 Page 14
Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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 = 1.600E+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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 = 1.600E+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	1.237E-04	0.0013	4.192E-05	0.0005	0.000E+00	0.0000	1.392E-05	0.0002	4.738E-05	0.0005	1.385E-05	0.0002	2.408E-04	0.0026
Cs-137	2.116E-02	0.2304	4.649E-02	0.5061	0.000E+00	0.0000	2.353E-03	0.0256	1.214E-02	0.1322	9.464E-03	0.1030	9.160E-02	0.9974
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
Total	2.128E-02	0.2317	4.653E-02	0.5066	0.000E+00	0.0000	2.367E-03	0.0258	1.219E-02	0.1327	9.478E-03	0.1032	9.184E-02	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T* Limit = 0.5 year 10/30/2002 08:55 Page 15
Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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 = 3.000E+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	3.630E-05	0.0003	1.231E-05	0.0001	0.000E+00	0.0000	4.095E-06	0.0000	1.408E-05	0.0001	4.089E-06	0.0000	7.087E-05	0.0006
Cs-137	2.830E-02	0.2302	6.225E-02	0.5062	0.000E+00	0.0000	3.155E-03	0.0257	1.645E-02	0.1337	1.274E-02	0.1036	1.229E-01	0.9994
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
Total	2.834E-02	0.2304	6.226E-02	0.5063	0.000E+00	0.0000	3.159E-03	0.0257	1.646E-02	0.1339	1.275E-02	0.1037	1.230E-01	1.0000

*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/30/2002 08:55 Page 16
Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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 = 4.300E+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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 = 4.300E+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	9.366E-06	0.0001	3.178E-06	0.0000	0.000E+00	0.0000	1.058E-06	0.0000	3.648E-06	0.0000	1.058E-06	0.0000	1.831E-05	0.0001
Cs-137	2.988E-02	0.2300	6.576E-02	0.5061	0.000E+00	0.0000	3.334E-03	0.0257	1.744E-02	0.1342	1.349E-02	0.1038	1.299E-01	0.9999
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
Total	2.989E-02	0.2301	6.577E-02	0.5062	0.000E+00	0.0000	3.335E-03	0.0257	1.745E-02	0.1343	1.349E-02	0.1038	1.299E-01	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T½ Limit = 0.5 year 10/30/2002 08:55 Page 17
Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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+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	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	1.201E-08	0.0000	4.077E-09	0.0000	0.000E+00	0.0000	1.357E-09	0.0000	4.704E-09	0.0000	1.360E-09	0.0000	2.350E-08	0.0000
Cs-137	1.848E-02	0.2297	4.068E-02	0.5058	0.000E+00	0.0000	2.064E-03	0.0257	1.085E-02	0.1349	8.366E-03	0.1040	8.043E-02	1.0000
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
Total	1.848E-02	0.2297	4.068E-02	0.5058	0.000E+00	0.0000	2.064E-03	0.0257	1.085E-02	0.1349	8.366E-03	0.1040	8.043E-02	1.0000

*Sum of all water independent and dependent pathways.

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- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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	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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	1.352E-19	0.0000	4.591E-20	0.0000	0.000E+00	0.0000	1.529E-20	0.0000	5.311E-20	0.0000	1.534E-20	0.0000	2.648E-19	0.0000
Cs-137	5.411E-04	0.2295	1.192E-03	0.5056	0.000E+00	0.0000	6.048E-05	0.0257	3.186E-04	0.1352	2.454E-04	0.1041	2.357E-03	1.0000
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
Total	5.411E-04	0.2295	1.192E-03	0.5056	0.000E+00	0.0000	6.048E-05	0.0257	3.186E-04	0.1352	2.454E-04	0.1041	2.357E-03	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/30/2002 08:55 Page 19
Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
+C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
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+03 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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	1.675E-10	0.2295	3.689E-10	0.5055	0.000E+00	0.0000	1.873E-11	0.0257	9.873E-11	0.1353	7.600E-11	0.1041	7.299E-10	1.0000
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
Total	1.675E-10	0.2295	3.689E-10	0.5055	0.000E+00	0.0000	1.873E-11	0.0257	9.873E-11	0.1353	7.600E-11	0.1041	7.299E-10	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/30/2002 08:55 Page 20
Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.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	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
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C-14	C-14	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	0.000E+00
0Co-60	Co-60	1.000E+00	3.675E-05	1.111E-04	2.106E-04	2.725E-04	1.852E-04	5.451E-05	1.408E-05	1.808E-08	2.037E-19	0.000E+00
0Cs-137	Cs-137	1.000E+00	1.645E-04	5.463E-04	1.277E-03	2.626E-03	4.580E-03	6.145E-03	6.496E-03	4.022E-03	1.179E-04	3.650E-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	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	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	0.000E+00
Eu-152	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	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	0.000E+00
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*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.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 4.000E+00 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
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C-14	*4.454E+12	*4.454E+12	*4.454E+12	*4.454E+12	*4.454E+12	*4.454E+12	*4.454E+12	*4.454E+12	*4.454E+12	*4.454E+12
Co-60	1.088E+05	3.599E+04	1.899E+04	1.468E+04	2.159E+04	7.338E+04	2.840E+05	2.212E+08	*1.131E+15	*1.131E+15
Cs-137	2.432E+04	7.323E+03	3.132E+03	1.523E+03	8.733E+02	6.509E+02	6.158E+02	9.946E+02	3.394E+04	1.096E+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	*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	*2.639E+14
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*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 = 42.82 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)
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄ
C-14	3.870E+00	0.000E+00	0.000E+00	*4.454E+12	0.000E+00	*4.454E+12
Co-60	1.300E+00	7.24 ñ 0.01	2.725E-04	1.468E+04	1.435E-05	2.787E+05
Cs-137	2.000E+01	42.85 ñ 0.09	6.496E-03	6.158E+02	6.496E-03	6.158E+02
Eu-152	4.160E+01	0.000E+00	0.000E+00	*1.765E+14	0.000E+00	*1.765E+14
Eu-154	4.210E+00	0.000E+00	0.000E+00	*2.639E+14	0.000E+00	*2.639E+14
ïïïïïïï	ïïïïïïïïï	ïïïïïïïïïïïïïïïïï	ïïïïïïïïï	ïïïïïïïïï	ïïïïïïïïï	ïïïïïïïïï

*At specific activity limit

1RESRAD, Version 6.21 T« Limit = 0.5 year 10/30/2002 08:55 Page 21
Summary : 116-F-2 Trench Deep Zone File: 116-F-2 Trench Deep Zone.RAD

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

DOSE(j,t), mrem/yr

0Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	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	0.000E+00
0Co-60	Co-60	1.000E+00	4.778E-05	1.445E-04	2.738E-04	3.542E-04	2.408E-04	7.087E-05	1.831E-05	2.350E-08	2.648E-19	0.000E+00
0Cs-137	Cs-137	1.000E+00	3.290E-03	1.093E-02	2.554E-02	5.253E-02	9.160E-02	1.229E-01	1.299E-01	8.043E-02	2.357E-03	7.299E-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	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	0.000E+00
Eu-152	äDOSE(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	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	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	0.000E+00

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

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

S(j,t), pCi/g

0Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	7.300E+00	1.600E+01	3.000E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	3.870E+00	3.869E+00	3.868E+00	3.866E+00	3.860E+00	3.852E+00	3.844E+00	3.811E+00	3.694E+00	3.315E+00
0Co-60	Co-60	1.000E+00	1.300E+00	1.140E+00	8.759E-01	4.973E-01	1.582E-01	2.505E-02	4.526E-03	2.495E-06	9.188E-18	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.000E+01	1.954E+01	1.865E+01	1.688E+01	1.379E+01	9.960E+00	7.363E+00	1.958E+00	1.876E-02	1.615E-09
0Eu-152	Eu-152	7.208E-01	2.999E+01	2.846E+01	2.565E+01	2.051E+01	1.304E+01	6.295E+00	3.200E+00	1.649E-01	4.985E-06	7.575E-22
Eu-152	Eu-152	2.792E-01	1.161E+01	1.103E+01	9.936E+00	7.944E+00	5.052E+00	2.438E+00	1.240E+00	6.386E-02	1.931E-06	2.934E-22
Eu-152	äS(j):		4.160E+01	3.949E+01	3.559E+01	2.845E+01	1.809E+01	8.733E+00	4.440E+00	2.287E-01	6.916E-06	1.051E-21
0Gd-152	Eu-152	2.792E-01	0.000E+00	7.264E-14	2.070E-13	4.527E-13	8.094E-13	1.132E-12	1.279E-12	1.424E-12	1.429E-12	1.421E-12
0Eu-154	Eu-154	1.000E+00	4.210E+00	3.891E+00	3.324E+00	2.368E+00	1.193E+00	3.959E-01	1.421E-01	1.592E-03	2.278E-10	2.522E-34

BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 1.12 seconds

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.

116-F-2 107-F Liquid Waste Disposal Trench Variance Calculation, Calculation No. 0100F-CA-V0147, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

116-F-2 Shallow and Deep Zone Sampling Design, Calculation No. 0100F-CA-V0116, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

116-F-2 Overburden Sampling Design, Calculation No. 0100F-CA-V0117, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

116-F-2 Trench Cleanup Verification 95% UCL Calculation, Calculation No. 0100F-CA-V0123, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

116-F-2 Trench Cleanup Verification RESRAD Calculation, Calculation No. 0100F-CA-V0124, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

116-F-2 Trench Comparison to Drinking Water Standards, Calculation No. 0100F-CA-V0125, 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.

CALCULATION COVER SHEET

Project Title:	100-F Group 4 Remedial Action	**Job No.**	**22192**
Area	100-F Remedial Action		
Discipline	Environmental	***Calc. No.**	0100F-CA-V0147
Subject	116-F-2 107-F Liquid Waste Disposal Trench Variance Calculation		
Computer Program	Excel	**Program No.**	Excel 97

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

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover - 1 Calculations - 7 Total - 8	September 27, 2002 M. T. Stankovich	9/27/02 D. W. Shea	10/2/02 J. E. Thomson	10/8/02 M. A. Buckmaster	10/8/02

SUMMARY OF REVISIONS

Scanned	Rev.	Date	Bar Code No.

* Obtain Calc. No. from DIS.

Cover

CALCULATION SHEET

	Bechtel Hanford Inc.						
Originator	M. T. Stankovich	Date	9/27/2002	Calc. No.	0100F-CA-V0147	Rev. No.	0
Project	100F Group 4 Remedial Action	Job No.	22192	Checked		Date	9/27/02
Subject	116-F-2 107-F Liquid Waste Disposal Trench Variance Calculation					Sheet No.	1 of 7

Conclusion:
The required number of samples calculated (1 sample) for each decision sub-unit is less than the default number (4 samples) specified in the DOE/RL-96-22, Rev 3. Therefore, the default number of samples will be collected from each decision sub-unit.

Problem:
Calculate the number of verification samples required for 116-F-2 107-F Liquid Waste Disposal Trench Decision Unit as required in "100 Area Remedial Action Sampling and Analysis Plan" (DOE/RL-96-22, Rev 3) and "Instruction Guide for the Remediation of 100 Areas Waste Sites" (0100X-IG-G0001, Rev 3).

Given:
1) Sample locations for the 116-F-2 107-F Liquid Waste Disposal Trench Decision Unit are identified on the 116-F-2 Shallow and Deep Zone Sample Design, Calculation number 0100F-CA-V00116 and 116-F-2 Overburden Sample Design, Calculation number 0100F-CA-V00117
2) Lookup values from DOE/RL-96-22, Rev 3.
3) Sample Design requirements from DOE/RL-96-22, Rev 3 and 0100X-IG-G0001, Rev 3.

Solution:
Calculation methodology is described in Appendix A of DOE/RL-96-22, Rev 3. Data from attached worksheets are used to calculate the required number of closeout samples. Variance calculation is based on the same three isotopes used to develop the statistical approach in DOE/RL-96-22, Rev 3. 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.

Sheet No.	Contents	Topic
1	Calc. Summary	Summary of Calc Brief
2	Shallow Zone	Required Number of Samples Calculation
3	Overburden Zone	Required Number of Samples Calculation
4	Shallow Zone Formulas	Formulas
5	Overburden Zone Formulas	Formulas
6	Shallow Zone Data	Raw Data from Sample Management
7	Overburden Zone Data	Raw Data from Sample Management

SHALLOW ZONE CALCULATION SHEET

	Bechtel Hanford Inc.						
Originator	M. T. Stankovich	Date	9/27/2002	Calc. No.	0100F-CA-V0147	Rev. No.	0
Project	100F Group 4 Remedial Action	Job No.	22192	Checked		Date	9/27/02
Subject	116-F-2 107-F Liquid Waste Disposal Trench Variance Calculation					Sheet No.	2 of 7

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 analyte evaluated.
The highest value of the three evaluations is used to determine the required number of samples as compared against the default of four.
Sample locations are from Calculation 0100F-CA-V0116.
Mean, Standard Deviation, t, and Number of Samples formulas are from DOE/RL-96-22, Appendix A.

Decision Unit: Shallow Zone
Samples values from GEA analysis
Sample Areas A & B

Sample #	Sample Date	Location	Constituent Cobalt-60 pCi/g	Q	Cesium-137 pCi/g	Q	Europium-152 pCi/g	Q
Look-up Value (HT) ==========>			1.4		6.2		3.3	
B14KD0	14-May-2002	SA1-2	0.09	U	0.079	U	0.17	U
B14KD1	14-May-2002	SA1-3	0.075	U	0.071	U	0.142	U
B14KD2	14-May-2002	SA1-4	0.093	U	0.089	U	0.22	U
B14KD3	14-May-2002	SA1-10	0.056	U	1.32		0.17	U
B14KD4	14-May-2002	SA1-13	0.039	U	0.044	U	0.11	U
B14KD5	14-May-2002	SA1-16	0.1	U	0.1	U	0.34	U
B14KD6	14-May-2002	SA2-3	0.058	U	0.059	U	0.212	
B14KD7	14-May-2002	SA2-6	0.076	U	0.143		0.17	U
B14KD8	14-May-2002	SA2-7	0.093	U	0.092	U	0.21	U
B14KD9	14-May-2002	SA2-10	0.068	U	0.076	U	0.16	U
B14KF0	14-May-2002	SA2-14	0.088	U	0.077	U	0.18	U
B14KF1	14-May-2002	SA2-15	0.078	U	0.075	U	0.17	U
B14KF2	14-May-2002	SA3-1	0.074	U	0.13	U	0.21	U
B14KF3	14-May-2002	SA3-2	0.046	U	0.039	J	0.12	U
B14KF4	14-May-2002	SA3-4	0.081	U	0.087	U	0.16	U
B14KF5	14-May-2002	SA3-5	0.13	U	0.38		0.321	
B14KF6	14-May-2002	SA3-9	0.326		0.857		6.47	
B14KF7	14-May-2002	SA3-11	0.068	U	0.075	U	0.474	
B14KF8	14-May-2002	SA4-3	0.072	U	0.11	U	0.18	U
B14KF9	14-May-2002	SA4-4	0.061	U	0.094	J	0.299	
B14KH0	14-May-2002	SA4-7	0.084	U	0.075	U	0.16	U
B14KH1	14-May-2002	SA4-9	0.13	U	0.13	U	0.29	U
B14KH2	14-May-2002	SA4-12	0.069	U	0.088	U	0.14	U
B14KH3	14-May-2002	SA4-13	0.062	U	0.058	U	0.2	U
B14KH4	15-May-2002	SB5-1	0.081	U	0.077	U	0.16	U
B14KH5	15-May-2002	SB5-2	0.053	U	0.04	U	0.11	U
B14KH6	15-May-2002	SB5-5	0.13	U	0.13	U	0.23	U
B14KH7	15-May-2002	SB5-7	0.077	U	0.07	U	0.14	U
B14KH8	15-May-2002	SB5-13	0.054	U	0.389		0.15	U
B14KH9	15-May-2002	SB5-15	0.12	U	0.068	U	0.2	U
B14KJ0	15-May-2002	SB6-1	0.053	U	0.078	U	0.14	U
B14KJ1	15-May-2002	SB6-10	0.068	U	0.12	U	0.22	U
B14KJ2	15-May-2002	SB6-12	0.081	U	0.11	U	0.24	U
B14KJ3	15-May-2002	SB6-13	0.044	U	0.048	U	0.12	U
B14KJ4	15-May-2002	SB6-15	0.094	U	0.081	U	0.17	U
B14KJ5	15-May-2002	SB6-16	0.048	U	0.178		0.216	
B14KJ6	15-May-2002	SB7-1	0.12	U	0.22	U	0.352	
B14KJ7	15-May-2002	SB7-3	0.064	U	0.058	U	0.16	U
B14KJ8	15-May-2002	SB7-4	0.355		2.33		3.75	
B14KJ9	15-May-2002	SB7-5	0.21	U	0.157		1.73	
B14KK0	15-May-2002	SB7-8	0.059	U	0.096	U	0.208	
B14KK1	15-May-2002	SB7-11	0.081	U	0.608		0.21	U
B14KK2	15-May-2002	SB8-2	0.07	U	0.07	U	0.19	U
B14KK3	15-May-2002	SB8-3	0.061	U	0.05	U	0.14	U
B14KK4	15-May-2002	SB8-4	0.097	U	0.095	U	0.2	U
B14KK5	15-May-2002	SB8-8	0.066	U	0.055	U	0.145	
B14KK6	15-May-2002	SB8-12	0.12	U	0.12	U	0.517	
B14KK7	15-May-2002	SB8-13	0.15	U	0.334		2.3	
Mean (LV) ==========>			0.09		0.21		0.48	
Standard Deviation (S) ==========>			0.06		0.39		1.08	
α (5%) ==========>			1.645		1.645		1.645	
β (20%) ==========>			0.842		0.842		0.842	
Number of Samples ==========>			1		1		1	

Shallow Zone

OVERBURDEN ZONE CALCULATION SHEET

	Bechtel Hanford Inc.						
Originator	M. T. Stankovich	Date	9/27/2002	Calc. No.	0100F-CA-V0147	Rev. No.	0
Project	100F Group 4 Remedial Action	Job No.	22192	Checked		Date	9/27/02
Subject	116-F-2 107-F Liquid Waste Disposal Trench Variance Calculation					Sheet No.	3 of 7

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 analyte evaluated.
The highest value of the three evaluations is used to determine the required number of samples as compared against the default of four.
Sample locations are from Calculation 0100F-CA-V0117.
Mean, Standard Deviation, t, and Number of Samples formulas are from DOE/RL-96-22, Appendix A.

Decision Unit: Shallow Zone
Samples values from GEA analysis
Sample Areas A & B

Sample #	Sample Date	Location	Constituent Cobalt-60 pCi/g	Q	Cesium-137 pCi/g	Q	Europium-152 pCi/g	Q
Look-up Value (HT) ==========>			1.4		6.2		3.3	
B14KK8	5/16/02	OA1-2	0.13	U	0.14	U	0.28	U
B14KK9	5/16/02	OA1-3	0.062	U	0.045	U	0.12	U
B14KL0	5/16/02	OA1-4	0.13	U	0.11	U	0.25	U
B14KL1	5/16/02	OA1-10	0.1	U	0.082	U	0.2	U
B14KL2	5/16/02	OA1-13	0.068	U	0.065	U	0.16	U
B14KL3	5/16/02	OA1-14	0.11	U	0.083	U	0.21	U
B14KL4	5/16/02	OA2-3	0.062	U	0.054	U	0.15	U
B14KL5	5/16/02	OA2-6	0.084	U	0.088	U	0.21	U
B14KL6	5/16/02	OA2-7	0.12	U	0.084	U	0.21	U
B14KL7	5/16/02	OA2-10	0.083	U	0.065	U	0.17	U
B14KL8	5/16/02	OA2-14	0.12	U	0.1	U	0.23	U
B14KL9	5/16/02	OA2-15	0.057	U	0.053	U	0.14	U
B14KM0	5/16/02	OA3-1	0.056	U	0.095	U	0.21	U
B14KM1	5/16/02	OA3-2	0.091	U	0.1	U	0.18	U
B14KM2	5/16/02	OA3-4	0.083	U	0.074	U	0.16	U
B14KM3	5/16/02	OA3-5	0.051	U	0.044	U	0.1	U
B14KM4	5/16/02	OA3-9	0.064	U	0.069	U	0.15	U
B14KM5	5/16/02	OA3-11	0.12	U	0.1	U	0.22	U
B14KM6	5/16/02	OA4-3	0.13	U	0.1	U	0.25	U
B14KM7	5/16/02	OA4-4	0.066	U	0.058	U	0.14	U
B14KM8	5/16/02	OA4-7	0.067	U	0.064	U	0.14	U
B14KM9	5/16/02	OA4-9	0.058	U	0.07	J	0.19	U
B14KN0	5/16/02	OA4-12	0.083	U	0.077	U	0.17	U
B14KN1	5/16/02	OA4-13	0.076	U	0.055	U	0.14	U
B14KN2	5/20/02	OB5-1	0.12	U	0.11	U	0.23	U
B14KN3	5/20/02	OB5-2	0.055	U	0.046	U	0.12	U
B14KN4	5/20/02	OB5-5	0.095	U	0.093	U	0.2	U
B14KN5	5/20/02	OB5-7	0.061	U	0.057	U	0.14	U
B14KN6	5/20/02	OB5-13	0.056	U	0.045	U	0.11	U
B14KN7	5/20/02	OB5-15	0.064	U	0.06	U	0.13	U
B14KN8	5/20/02	OB6-1	0.041	U	0.038	U	0.089	U
B14KN9	5/20/02	OB6-10	0.072	U	0.06	U	0.15	U
B14KP0	5/20/02	OB6-12	0.11	U	0.14	U	0.19	U
B14KP1	5/20/02	OB6-13	0.065	U	0.062	U	0.14	U
B14KP2	5/20/02	OB6-15	0.11	U	0.11	U	0.21	U
B14KP3	5/20/02	OB6-16	0.047	U	0.04	U	0.1	U
B14KP4	5/20/02	OB7-1	0.093	U	0.082	U	0.17	U
B14KP5	5/20/02	OB7-3	0.074	U	0.069	U	0.14	U
B14KP6	5/20/02	OB7-4	0.063	U	0.083	J	0.14	U
B14KP7	5/20/02	OB7-5	0.05	U	0.035	U	0.097	U
B14KP8	5/20/02	OB7-8	0.053	U	0.045	U	0.13	U
B14KP9	5/20/02	OB7-11	0.087	U	0.086	U	0.19	U
B14KR0	5/20/02	OB8-2	0.083	U	0.088	U	0.21	U
B14KR1	5/20/02	OB8-3	0.087	U	0.086	U	0.21	U
B14KR2	5/20/02	OB8-4	0.12	U	0.094	U	0.22	U
B14KR3	5/20/02	OB8-8	0.055	U	0.052	U	0.12	U
B14KR4	5/20/02	OB8-12	0.11	U	0.086	U	0.22	U
B14KR5	5/20/02	OB8-13	0.072	U	0.055	U	0.14	U
Mean (LV) ==========>			0.08		0.07		0.17	
Standard Deviation (S) ==========>			0.03		0.02		0.05	
α (5%) ==========>			1.645		1.645		1.645	
β (20%) ==========>			0.842		0.842		0.842	
Number of Samples ==========>			1		1		1	

Overburden Zone

CALCULATION COVER SHEET

Project Title	**116-F-2 Shallow & Deep Zone Sample Design**	**Job No.**	**22192**
Area	**100 F Area**		
Discipline	**Environmental Engineering**	***Calc. No**	**0100F-CA-V0116**
Subject	**116-F-2 Shallow & Deep Zone Sampling Design**		
Computer Program	**Excel**	**Program No.**	**Office 97 Version**

Committed Calculation ☑ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheet Calc = 2 Sheets Attach1 = 1 Sheet Attach2 = 1 Sheet Attach3 = 2 Sheets Total = 7 Sheets	G.Cruz 5/23/02	C.A. Bentz 5/24/02	M.T Stankovich 5-30-02	~~E.M. Corpuz~~ M. Buckmaster 5/30/02	5/30/02

SUMMARY OF REVISIONS

* Obtain Calc. No. from DIS

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator	Gerardo Cruz	**Date**	5/23/2002	**Calc. No.**	0100F-CA-V0116	**Rev. No.**	0
Project	116-F-2 Shallow & Deep Zone Sample Design	**Job No.**	22192	**Checked**	CAB	**Date**	5/24/02
Subject	116-F-2 Shallow & Deep Zone Sampling Design					**Sheet No.**	

Problem: Calculate and display required sampling nodes in concurrence with 100 Area
SAP DOE/RL-96-22 Rev. 3 for verification and closure.

Given: -SAP (DOE/RL-96-22 Rev. 3) and IG (0100X-IG-G0001 Rev. 3) requirements
-Shallow Sampling Area (Surface area of each zone determined from CAD program,
Attachment 3, Sht 1 of 2 , CAD file 1F:052302B, 116-F-2 Shallow Zone Sampling Plan)
-Deep Zone Sampling Area (Surface area of each zone determined from CAD program,
Attachment 3, Sht 2 of 2, CAD file 1F:052302C, 116-F-2 Deep Zone Sampling Plan)

SAP and IG Requirements:
-Develop a 16 node sampling grid for the sampling area
Shallow Zone -Use appendix A of the IG to determine which six of the sixteen will be sampled
to collect HPGe and 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:	6521.43	m^2
Area of Decision Subunits (total area 2 subunit)	3260.71	m^2
Decision Subunit divided into 4 Sampling Areas:	815.17	m^2
Sampling Areas divided into a 16 node grid (node numbers 1-16):	50.94	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, 116-F-2 Shallow Zone Sampling Plan,
for Sample Location Table

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator Gerardo Cruz **Date** 5/23/2002 **Calc. No.** 0100F-CA-V0116 **Rev. No.** 0
Project 116-F-2 Shallow & Deep Zone Sample Design **Job No.** 22192 **Checked** GB **Date** 5/24/02
Subject 116-F-2 Shallow & Deep Zone Sampling Design **Sheet No.**

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:	6998.14	m^2
Area of Decision Subunits (total area 2 subunits)	3499.07	m^2
Decision Subunits divided into 3 Sampling Areas:	1166.35	m^2
Sampling Areas divided into a 16 node grid (node numbers 1-16):	72.89	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, 116-F-2 Deep Zone Sampling Plan,
for Sample Location Table

Bechtel Hanford, Inc.

Originator	Gerardo Cruz	Date	5/23/2002	Calc. No.	0100F-CA-V0116	Rev. No.	0
Project	116-F-2 Shallow & Deep Zone Sample Design			Job No.	22192	Checked	Date 5/24/02
Subject	116-F-2 Shallow & Deep Zone Sampling Design					Sheet No	

ATTACHMENT 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	8	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 Fig. 5-1 of this IG

Bechtel Hanford, Inc.

Originator Gerardo Cruz Date 5/23/2002 Calc. No. 0100F-CA-V0116 Rev. No. 0
Project 116-F-2 Shallow & Deep Zone Sample Design Job No. 22192 Checked Date 5/24/02
Subject 116-F-2 Shallow & Deep Zone Sampling Design Sheet No.

ATTACHMENT 2

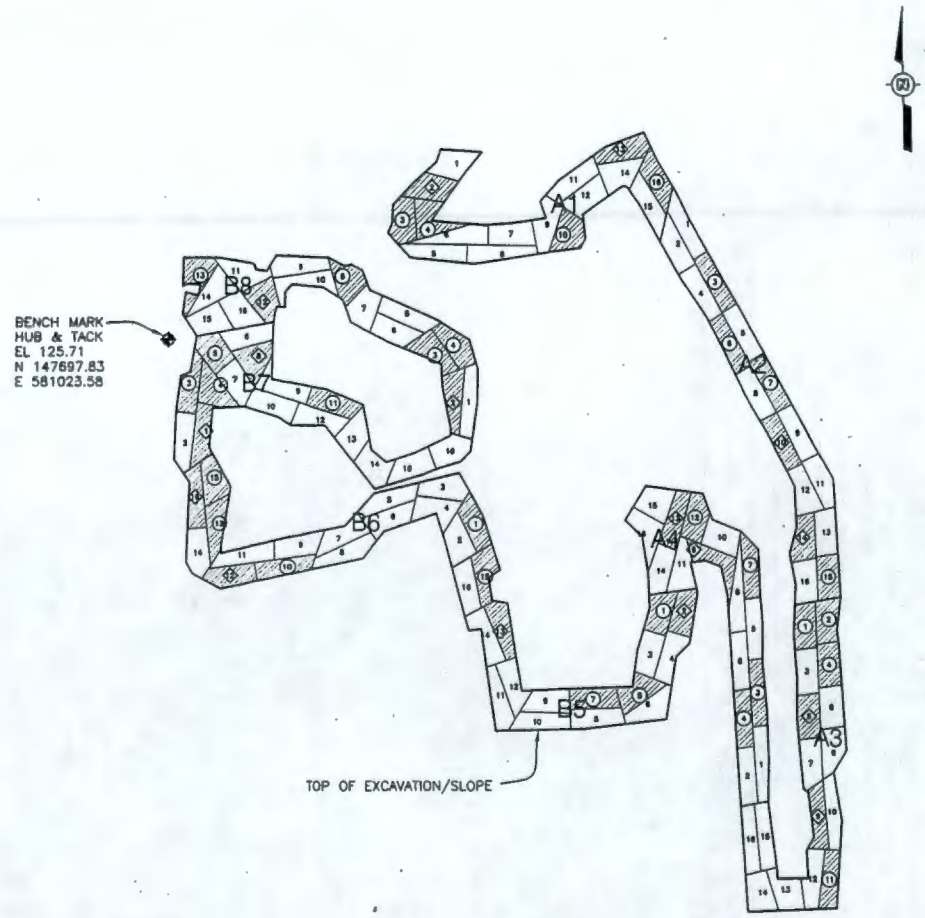
Number of Decision Subunits Based on Area.

Area of Primary Decision Unit (m2)	Number of Subunits
<1,394	1
>1,394 to <2,326	2
>2,326 to <3,256	3
>3,256 to <4,186	4
>4,186 to <9,303	2
>9,303 to <13,024	3
>13,024 to <16,745	4
>16,745 to <20,466	5
>20,466	ROUNDa (Area/3,720)
a ROUND is an integer rounding function.	

1F:0523028

E 580950

N 147650



NOTES

1. SHALLOW ZONE NODE AREAS ARE APPROXIMATELY 50.94 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE SHALLOW ZONE CONSISTS OF SAMPLING AREAS A1, A2, A3 & A4 WITHIN DECISION SUBUNIT 1. SAMPLING AREAS B5, B6, B7, & B8 WITHIN DECISION SUBUNIT 2.
3. REFERENCE ELEVATION POINTS ARE NGVD29, CONVERSION TO NAVD88 +1.031 (METERS)

LEGEND

GAMMA ENERGY ANALYSIS & CLOSEOUT VERIFICATION SAMPLING NODE

GAMMA ENERGY ANALYSIS SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	S-A1-2	147731.61	581083.57
		S-A1-3	147724.41	581076.95
		S-A1-4	147722.32	581082.66
		S-A1-10	147721.20	581113.32
		S-A1-13	147739.99	581128.32
		S-A1-16	147732.81	581134.45
	A2	S-A2-3	147710.87	581147.92
		S-A2-6	147697.08	581151.37
		S-A2-7	147688.25	581160.76
		S-A2-10	147674.98	581163.32
		S-A2-14	147653.52	581166.12
		S-A2-15	147644.67	581173.87
	A3	S-A3-1	147633.41	581168.64
		S-A3-2	147635.07	581174.06
		S-A3-4	147624.76	581174.17
		S-A3-5	147613.02	581169.54
		S-A3-9	147590.61	581171.47
		S-A3-11	147576.49	581173.93
	A4	S-A4-3	147618.35	581158.01
		S-A4-4	147612.47	581154.77
		S-A4-7	147647.37	581156.25
		S-A4-8	147650.76	581143.31
		S-A4-12	147658.03	581143.61
		S-A4-13	147657.82	581139.19
2	B5	S-B5-1	147638.90	581136.36
		S-B5-2	147638.91	581141.11
		S-B5-6	147617.68	581131.00
		S-B5-7	147616.79	581120.53
		S-B5-13	147632.20	581099.50
		S-B5-15	147644.50	581096.09
	B6	S-B6-1	147656.49	581093.86
		S-B6-10	147646.81	581051.05
		S-B6-12	147644.92	581037.97
		S-B6-13	147656.66	581035.42
		S-B6-15	147668.91	581034.24
		S-B6-18	147662.62	581029.82
	B7	S-B7-1	147677.36	581032.17
		S-B7-3	147686.09	581028.21
		S-B7-4	147687.86	581035.50
		S-B7-5	147694.75	581034.19
		S-B7-8	147694.18	581044.24
		S-B7-11	147683.66	581061.42
	B8	S-B8-2	147683.69	581088.71
		S-B8-3	147694.30	581084.31
		S-B8-4	147694.33	581088.67
		S-B8-8	147712.04	581083.42
		S-B8-12	147706.31	581045.04
		S-B8-13	147712.24	581030.73

ATTACHMENT 3

Attachment 3 Sheet No. 1 of 2
Originator G.Cerny Date 5/23/02
Chkd By CAB Date 5/24/02
Chk. No 0100E-CA-V00116 Rev. No. 0

SCALE 1:1000

10 0 10 20 40 meters

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

100 F AREA
100 AREA REMEDIAL DESIGN
116-F-2 SHALLOW ZONE
SAMPLING PLAN

1F:052302C

E 580950

N 147650

BENCH MARK
HUB & TACK
EL 125.71
N 147697.83
E 581023.58

NOTES

1. DEEP ZONE NODE AREAS ARE APPROXIMATELY 72.89 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE DEEP ZONE CONSISTS OF SAMPLING AREAS A1, A2, & A3 WITHIN DECISION SUBUNIT 1. SAMPLING AREAS B4, B5, & B6 WITHIN DECISION SUBUNIT 2.
3. REFERENCE ELEVATION POINTS ARE NGVD29, CONVERSION TO NAVD88 +1.031 (METERS)

LEGEND

GAMMA ENERGY ANALYSIS & CLOSEOUT VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	D-A1-3	147720.02	581121.71
		D-A1-4	147713.44	581114.79
		D-A1-10	147698.16	581124.77
		D-A1-16	147686.81	581148.52
	A2	D-A2-3	147683.53	581136.13
		D-A2-6	147676.32	581138.94
		D-A2-7	147667.98	581130.89
		D-A2-15	147628.36	581124.20
	A3	D-A3-1	147664.18	581148.83
		D-A3-2	147666.80	581152.31
		D-A3-4	147675.41	581157.03
		D-A3-11	147622.86	581161.44
2	B4	D-B4-3	147658.42	581114.85
		D-B4-4	147656.75	581112.89
		D-B4-7	147652.83	581110.56
		D-B4-12	147664.87	581102.56
	B5	D-B5-1	147662.01	581108.84
		D-B5-5	147667.02	581061.73
		D-B5-7	147661.23	581059.38
		D-B5-15	147642.58	581040.83
	B6	D-B6-1	147712.11	581106.97
		D-B6-10	147753.32	581066.16
		D-B6-13	147716.30	581037.40
		D-B6-15	147733.61	581073.99

ATTACHMENT 3

Attachment 3 — Sheet No. 2 of 2
Prepared by G. CRUZ — Date 5/23/02
Field By CAB — Date 5/24/02
Dwg No. 0100F-CA-V0116 — Rev. No. 0

SCALE 1:1000
10 0 10 20 40 meters

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

100 F AREA
100 AREA REMEDIAL DESIGN
116-F-2 DEEP ZONE
SAMPLING PLAN

CH_LZERO.DWG

CALCULATION COVER SHEET

Project Title 116-F-2 Overburden Sample Design **Job No.** 22192

Area 100 F Area

Discipline Environmental Engineering ***Calc. No** 0100F-CA-V0117

Subject 116-F-2 Overburden Sampling Design

Computer Program Excel **Program No.** Office 97 Version

Committed Calculation ☑ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheet Calc = 1 Sheets Attach1 = 1 Sheet Attach2 = 1 Sheet Attach3 = 1 Sheets Total = 5 Sheets	G.CRUZ G.Cruz 5/23/02	CAB C.A. Bentz 5/24/02	MTS M.T Stankovich 5-30-02	~~F.M.Corpuz~~ M. Buckmaster 5/30/02	5/30/02

SUMMARY OF REVISIONS

* Obtain Calc. No. from DIS

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator	Gerardo Cruz	**Date**	5/23/2002	**Calc. No.**	0100F-CA-V0117	**Rev. No.**	0
Project	116-F-2 Overburden Sample Design			**Job No.**	22192	**Checked**	**Date** 5/24/02
Subject	116-F-2 Overburden Sampling Design					**Sheet No.**	

Problem: Calculate and display required sampling nodes in concurrence with 100 Area
SAP DOE/RL-96-22 Rev. 3 for verification and closure.

Given: -SAP (DOE/RL-96-22 Rev. 3) and IG (0100X-IG-G0001 Rev. 3) requirements
-Overburden Sampling Area (Surface area of each zone determined from CAD program,
Attachment 3, Sht 1 , CAD file 1F:052302A, 116-F-2 Overburden Sampling Plan)

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

Determination of Overburden Sampling Grid:

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

Total Area:	1832.60	m^2
Area of Decision Subunits (total area 2 subunit)	916.30	m^2
Decision Subunit divided into 4 Sampling Areas:	229.07	m^2
Sampling Areas divided into a 16 node grid (node numbers 1-16):	14.31	m^2

Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)
See Attachment 3, Sht 1 , 116-F-2 Overburden Sampling Plan,
for Sample Location Table

Bechtel Hanford, Inc.

Originator	Gerardo Cruz	Date	5/23/2002	Calc. No.	0100F-CA-V0117	Rev. No.	0
Project	116-F-2 Overburden Sample Design			Job No.	22192	Checked	Date 5/24/02
Subject	116-F-2 Overburden Sampling Design					Sheet No	

ATTACHMENT 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 Fig. 5-1 of this IG

Bechtel Hanford, Inc.

Originator Gerardo Cruz Date 5/23/2002 Calc. No. 0100F-CA-V0117 Rev. No. 0
Project 116-F-2 Overburden Sample Design Job No. 22192 Checked GB Date 5/24/02
Subject 116-F-2 Overburden Sampling Design Sheet No.

ATTACHMENT 2

Number of Decision Subunits Based on Area.

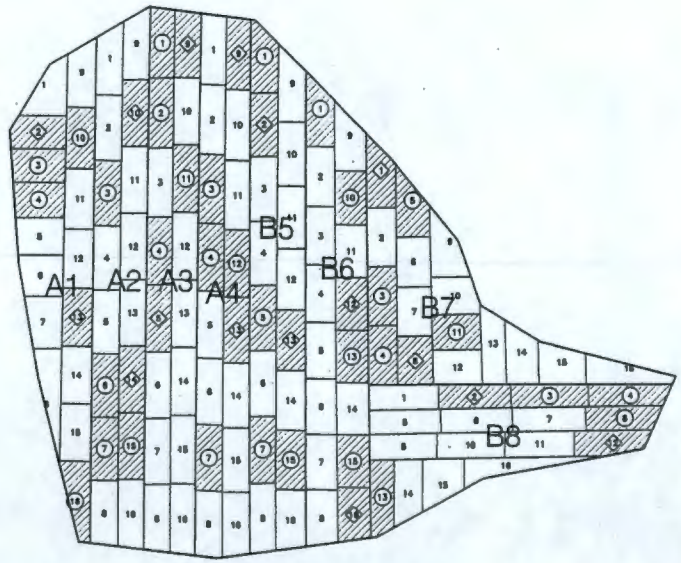
Area of Primary Decision Unit (m2)	Number of Subunits
<1,394	1
>1,394 to <2,326	2
>2,326 to <3,256	3
>3,256 to <4,186	4
>4,186 to <9,303	2
>9,303 to <13,024	3
>13,024 to <16,745	4
>16,745 to <20,466	5
>20,466	ROUNDa (Area/3,720)

a ROUND is an integer rounding function.

1F:052302A

E 580950

N 147650



NOTES

1. OVERBURDEN NODE AREAS ARE APPROXIMATELY 14.31 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE OVERBURDEN CONSISTS OF SAMPLING AREAS A1, A2, A3 & A4 WITHIN DECISION SUBUNIT 1. SAMPLING AREAS B5, B6, B7, & B8 WITHIN DECISION SUBUNIT 2.

LEGEND

GAMMA ENERGY ANALYSIS & CLOSEOUT VERIFICATION SAMPLING NODE

GAMMA ENERGY ANALYSIS SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	O-A1-2	147654.77	580676.33
		O-A1-3	147651.79	580676.33
		O-A1-4	147648.71	580676.43
		O-A1-10	147634.24	580680.12
		O-A1-13	147636.08	580679.98
		O-A1-16	147621.38	580679.86
	A2	O-A2-3	147648.30	580682.64
		O-A2-6	147631.86	580682.55
		O-A2-7	147628.10	580682.52
		O-A2-10	147636.48	580685.10
		O-A2-14	147632.43	580684.86
		O-A2-15	147629.35	580684.95
	A3	O-A3-1	147662.80	580687.48
		O-A3-2	147656.50	580687.44
		O-A3-4	147644.11	580687.36
		O-A3-5	147638.00	580687.38
		O-A3-9	147662.72	580689.81
		O-A3-11	147650.63	580689.77
	A4	O-A4-3	147649.68	580692.11
		O-A4-4	147643.51	580692.08
		O-A4-7	147625.31	580692.00
		O-A4-9	147661.86	580694.41
		O-A4-12	147642.97	580694.42
		O-A4-13	147636.92	580694.42
2	B5	O-B5-1	147661.63	580696.78
		O-B5-2	147655.49	580696.80
		O-B5-5	147638.08	580696.82
		O-B5-7	147628.08	580696.83
		O-B5-13	147636.02	580699.32
		O-B5-15	147625.15	580699.34
	B6	O-B6-1	147656.91	581001.86
		O-B6-10	147646.96	581004.73
		O-B6-12	147639.34	581004.85
		O-B6-13	147634.56	581004.92
		O-B6-15	147625.05	581005.04
		O-B6-16	147620.22	581005.10
	B7	O-B7-1	147651.41	581007.81
		O-B7-3	147640.04	581007.88
		O-B7-4	147634.65	581007.74
		O-B7-5	147646.71	581010.44
		O-B7-8	147634.17	581010.71
		O-B7-11	147636.76	581014.46
	B8	O-B8-2	147630.88	581016.12
		O-B8-3	147630.93	581022.86
		O-B8-4	147631.00	581030.13
		O-B8-8	147628.94	581029.80
		O-B8-12	147628.86	581028.37
		O-B8-13	147621.82	581007.71

ATTACHMENT 3

Attachment 3
Originator G. Carr
Chk'd By
Calc. No. 0100F-CA-V0117

Sheet No. 1 of 1
Date 5/23/02
Date 7/24/02
Rev. No. 0

SCALE 1:400

4 0 4 8 16 meters

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

100 F AREA
100 AREA REMEDIAL DESIGN
116-F-2 OVERBURDEN
SAMPLING PLAN

CH_17ERC.DWG

CALCULATION COVER SHEET

Project Title:	116-F-2 Site Closeout	**Job No.**	22192
Area	100-F		
Discipline	Environmental	***Calc. No.**	0100F-CA-V0123
Subject	116-F-2 Trench Cleanup Verification 95% UCL Calculation		
Computer Program	Excel	**Program No.**	Excel 97

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

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 7 Total = 8	N. N. Smith-Jackson 10/15/02 N. N. Smith-Jackson	J.E. Thomson 10/15/02 J.E. Thomson T.B. Miley 10/15/02 T.B. Miley	K.E. Cook 10/15/02 K.E. Cook	M.A. Buckmaster 10/21/02 M.A. Buckmaster	10/21/02

SUMMARY OF REVISIONS

* Obtain calc no. from DIS

Nov-98

DE01-437.03

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator	N. N. Smith-Jackson NNSJ	Date	10/15/02	Calc. No.	0100F-CA-V0123	Rev. No.	0
Project	116-F-2 Site Closeout	Job No.	22192	Checked	J.E. Thomson JET	Date	10/15/02
					T.B. Miley JBM		10/15/02
Subject	116-F-2 Trench Cleanup Verification 95% UCL Calculation					Sheet No.	1 of 7

Purpose:

Calculate the 95% UCL to evaluate compliance with cleanup standards for the 116-F-2 Trench. Also, calculate the carcinogenic risk for applicable nonradionuclide analytes (shallow zone only), WAC 173-340 (Model Toxics Control Act (MTCA)) 3-part test, if required (all nonradionuclide analytes), and the relative percent difference (RPD) for each contaminant of concern (COC).

Table of Contents:

Page 1 of 7: Calculation Sheet Summary (Page 1)
Page 2 of 7: Calculation Sheet Summary (Page 2)
Page 3 of 7: Shallow Zone Data
Page 4 of 7: Overburden Data
Page 5 of 7: Deep Zone Data
Page 6 of 7: Split -Dup Analysis
Page 7 of 7: Regulator Splits

Given/References:

1) Sample Results
2) Lookup values from Remedial Design Report/Remedial Action Work Plan (RDR/RAWP) (DOE-RL 2001). All lookup values and RAGs are taken from RDR/RAWP unless otherwise specified.
3) DOE-RL, 2001, 100 Area Remedial Action Sampling and Analysis Plan (SAP), DOE/RL-96-22, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2001, Remedial Design Report/Remedial Action Work Plan for the 100 Area, DOE/RL-96-17, Rev. 3, 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. 3, 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, WSEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013.
9) Ecology, 1996 Model Toxic Control Act Cleanup Levels and Risk Calculations (CLARC II) Update, Publication #940145, Washington State Department of Ecology, Olympia, Washington.

Solution:

Calculation methodology is described in Ecology Pub. #92-54 and below. Use data from attached worksheets to calculate the 95% upper confidence limit (UCL) for each analyte and carcinogenic risk and to perform the WAC 173-340 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 site 116-F-2 Trench. 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 Verfication 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 (e.g., metals) data reported as being below detection limits 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. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation.

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.

For nonradionuclides the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data, and the 95% UCL calculated on the appropriate distribution. For nonradionuclide small data sets (n < 10) and all radionuclide data sets, the calculations are performed assuming nonparametric distribution, and no test for distribution is performed. For nonradionuclide large data sets (n >= 10), a distribution test is conducted on the data set using Ecology MTCAStat software.

The estimated hazard quotient (for applicable nonradionuclide COCs) is determined by dividing the statistical value (derived in this calculation) by the WAC 173-340 B non-carcinogenic cleanup limit. The nonradionuclide carcinogenic risk, above background, is determined by dividing the statistical value by the WAC 173-340 B carcinogenic cleanup limit and then multiplying by 10^{-6}. For data sets where all values are below detection, neither of these calculations are required. For noncarcinogenic nonradionuclide COCs, only the estimated fraction of risk computation must be performed.

The WAC 173-340 3-part test determines if:
1) the statistical value exceeds the most stringent cleanup limit for each non-radionuclide COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each non-radionuclide COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each non-radionuclide COC.

The 3-part test is performed for nonradionuclide analytes found in overburden, the shallow zone, and the deep zone (as necessary).

The RPD is performed when both the main value and, either the duplicate, split, or regulator split values are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method. These detection limit requirements are located in Table II-2 of the SAP, DOE/RL-96-22, where they are referred to as the RDL. The RPD calculations use the following formula: RPD =[|M-S|/((M+S)/2)]*100

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

CALCULATION COVER SHEET

Project Title 116-F-2 Site Closeout **Job No.** 22192
Area 100-F Area
Discipline Environmental **Calc. No.** 0100F-CA-V0124
Subject 116-F-2 Trench Cleanup Verification RESRAD Calculation
Computer Program RESRAD **Program No.** Version 6.21

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

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Summary– 5 pgs Attn. 1 - 1 pg Attn. 2 - 21 pgs Attn. 3 - 22 pgs Attn. 4 - 11 pgs Attn. 5 - 20 pgs Attn. 6 - 22 pgs Attn. 7 - 11 pgs Attn. 8 - 21 pgs Attn. 9 - 22 pgs Attn. 10 – 11 pgs Total– 168 pages	N. N. Smith-Jackson N. Smith-Jackson 11/01/02	S. W. Clark S. W. Clark 11/01/02	K. E. Cook KEC 11/1/02	M. A. Buckmaster 11/6/02	11/6/02

SUMMARY OF REVISION

*Obtain Calc. No. from DIS

November 1998

DE01-437.03

Bechtel Hanford, Inc.

116-F-2 TRENCH RESRAD CALCULATION SUMMARY

Originator:	N.N. Smith-Jackson NNSJ	Date:	11/01/02	Calc. No.:	0100F-CA-V0124	Rev.:	0
Project:	116-F-2 TSD Site Closeout	Job No:	22192	Checked:	S. W. Clark SWC	Date:	11/01/02
Subject:	116-F-2 Trench Cleanup Verification RESRAD Calculation					Sheet No. 1 of 5	

PROBLEM STATEMENT:

Calculate the soil and groundwater concentrations, dose, and risk contributions from remaining radionuclide contaminants in the vadose zone soil at the 116-F-2 Trench Remediation site over a period of 1,000 years.

REFERENCES:

1) Cleanup verification data from *116-F-2 Trench 95% UCL Calculations for Compliance with Cleanup Standards (Shallow Zone and Deep Zone)*, Calculation No. 0100F-CA-V0124, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
2) *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
3) Radioactive and nonradioactive contaminants of concern from the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP), DOE/RL-96-22, Rev. 3, U.S. Department of Energy. Richland Operations Office, Richland, Washington. For the purpose of these RESRAD calculations, the radioactive contaminants of concern (COCs) are carbon-14, cobalt-60, cesium-137, europium-152, and europium-154. Hexavalent chromium is the only nonradionuclide COC.
4) RESidual RADioactivity (RESRAD) computer code, version 6.21, 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.

SOLUTION:

1) Separate RESRAD runs were performed for the relevant vadose zone soil horizons (shallow zone, deep zone, and overburden). Table 1 shows the elevations (NAVD88) and dimensions of each soil horizon. The shallow zone was chosen as the sidewalls of the excavation to 4.6 m deep (from the backfill reference elevation of 126.0 m to an elevation of 121.4 m). The deep zone is the remaining portion of the vadose zone from 4.6 m below ground surface to groundwater (elevation 114.0 m). The total-plan view area of the excavation was used to conservatively estimate the site area input parameter for each soil horizon. Attachment 1 shows the dimensions of each soil horizon and the contaminant pathways considered for dose, risk, and groundwater protection.

   A separate RESRAD run was performed using the verification samples collected from the overburden soils. Because overburden soil was used to backfill the site excavation, the contaminated zone thickness model assumes that the contamination is equal to the depth of the remedial site excavation.

Bechtel Hanford, Inc.

116-F-2 TRENCH RESRAD CALCULATION SUMMARY

Originator:	N.N. Smith-Jackson NSJ	Date:	11/01/02	Calc. No.:	0100F-CA-V0124	Rev.:	0
Project:	116-F-2 TSD Site Closeout	Job No:	22192	Checked:	S. W. Clark SWC	Date:	11/01/02
Subject:	116-F-2 Trench Cleanup Verification RESRAD Calculation					Sheet No. 2 of 5	

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.

Table 1. Dimensions and Elevations of 116-F-2 Soil Horizons

RESRAD Run #	Vadose Zone Horizon	Upper Elevation (m)	Lower Elevation (m)	Thickness (m)
1-Radionuclides	Shallow Zone	126.0	121.4	4.6
2-Radionuclides	Overburden	126.0	121.4	4.6
3-Radionuclides	Deep Zone	121.4	114.0	7.4

2) The year where the peak dose (or concentration) occurs from each individual COC and layer is determined by a preliminary run. This year is then added for all horizons for the final RESRAD runs. For the direct exposure pathways (i.e., soil ingestion and inhalation and external radiation), the peak year occurred at year 0 (the present, year 2002). For the water dependent pathways (i.e., drinking water and food ingestion) the peak years were 7.3 for cobalt-60 and 43 for cesium-137. The 7.3 and 43-year time periods were included in all of the RESRAD runs.

METHODOLOGY:

1) Runs of RESRAD Version 6.21 were completed for the vadose zone using the radionuclide concentrations shown in Table 2. RESRAD numerical output reports for dose, risk, and concentration for the shallow and deep zones are presented in the Attachments to this Calculation Summary.

Table 2. Cleanup Verification Data Set

Radionuclide COCs	Shallow Zone[a]	Overburden[a]	Deep Zone[a]
	Radionuclide Activity, pCi/g		
C-14	-9.11E-01 (U)[b]	-9.30E-01 (U)[b]	3.87E+00
Cs-137	2.62E-01	0 (<BG)	2.00E+01
Co-60	4.59E-02 (U)	1.90E-02 (U)	1.30E+00
Eu-152	4.13E-01	3.08E-02	4.16E+01
Eu-154	1.31E-01 (U)	2.95E-02 (U)	4.21E+00
Nonradionuclide COCs	**Nonradionuclide Concentration, mg/kg**		
Cr (VI)	1.60E+00[c]	4.20E-01 (U)[c]	9.08E-01[c]

[a] The Shallow Zone and Deep Zone concentrations are from the *116-F-2 Cleanup Verification 95% UCL Calculation*, Calculation No. 0100F-CA-V0123, Rev. 0.
[b] RESRAD does not accept negative values. When results are negative, zero is used as the input value.
[c] Value was not input into RESRAD because the concentration is below RAGs, below Hanford Site background, below Washington State background, or because the analyte was not detected in cleanup verification samples at the indicated PQLs.
U = All analytical results for the data set were below laboratory detection limits.

Bechtel Hanford, Inc.

116-F-2 TRENCH RESRAD CALCULATION SUMMARY

Originator:	N.N. Smith-Jackson NNJ	Date:	11/01/02	Calc. No.:	0100F-CA-V0124	Rev.:	0
Project:	116-F-2 TSD Site Closeout	Job No:	22192	Checked:	S. W. Clark SWC	Date:	11/01/02
Subject:	116-F-2 Trench Cleanup Verification RESRAD Calculation					Sheet No. 3 of 5	

RESULTS:

1) **Radionuclide "All Pathways" Dose Rate:** The "all pathways" (maximum) dose rates are shown in Table 3. The maximum dose rate of 3.54 mrem/yr is from the shallow zone and occurs at year 0 (the present).

The maximum dose rate for the 116-F-2 overburden soil is 4.65×10^{-1} mrem/yr and occurs at year 0 (i.e., present).

Table 3. 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	3	7.3	16	30	43	100	300	1000
1	Shallow Zone	3.54E+00	3.33E+00	2.96E+00	2.31E+00	1.47E+00	7.71E-01	4.55E-01	7.34E-02	5.96E-04	4.84E-11
3	Deep Zone	3.34E-03	1.11E-02	2.58E-02	5.29E-02	9.18E-02	1.23E-01	1.30E-01	8.04E-02	2.36E-03	7.30E-10
Total All Pathways Dose Rate (mrem/yr)		3.54E+00	3.34E+00	2.99E+00	2.36E+00	1.56E+00	8.94E-01	5.85E-01	1.54E-01	2.96E-03	7.78E-10
2	Overburden[a]	4.65E-01	4.24E-01	3.54E-01	2.44E-01	1.22E-01	4.52E-02	1.98E-02	7.95E-04	2.23E-08	5.07E-17

[a] Dose rates attributed to the overburden are not included in the total dose.

2) **Radionuclide Excess Cancer Risk**

The radionuclide excess cancer risk results are shown on Table 4. The maximum risk (4.04×10^{-5}) occurs at year 0 and is primarily from shallow zone soils.

The maximum risk (4.02×10^{-6}) occurs at year 0 for overburden soils.

Table 4. Radionuclide Excess Cancer Risk

RESRAD Run #	Vadose Zone Horizons	Excess Cancer Risk at Each Time Slice (yr)									
		0	1	3	7.3	16	30	43	100	300	1000
1	Shallow Zone	4.04E-05	3.83E-05	3.45E-05	2.78E-05	1.85E-05	1.03E-05	6.38E-06	1.15E-06	9.73E-09	7.91E-16
3	Deep Zone	1.67E-06	1.76E-06	1.92E-06	2.20E-06	2.56E-06	2.74E-06	2.64E-06	1.42E-06	3.85E-08	1.16E-14
Total Excess Cancer Risk		4.21E-05	4.01E-05	3.64E-05	3.00E-05	2.11E-05	1.30E-05	9.02E-06	2.57E-06	4.82E-08	1.24E-14
2	Overburden[a]	4.02E-06	3.70E-06	3.15E-06	2.25E-06	1.19E-06	4.76E-07	2.17E-07	9.22E-09	2.63E-13	3.44E-22

[a] Excess cancer risk attributed to the overburden are not included in the total excess cancer risk.

Bechtel Hanford, Inc.

116-F-2 TRENCH RESRAD CALCULATION SUMMARY

Originator:	N.N. Smith-Jackson NNJ	Date:	11/01/02	Calc. No.:	0100F-CA-V0124	Rev.:	0
Project:	116-F-2 TSD Site Closeout	Job No:	22192	Checked:	S. W. Clark SWC	Date:	11/01/02
Subject:	116-F-2 Trench Cleanup Verification RESRAD Calculation					Sheet No. 4 of 5	

3) Radionuclide Groundwater Protection

The radionuclide concentrations in groundwater calculated by the RESRAD model are summarized in Table 5. Only concentrations are presented here. Cobalt-60, and cesium-137 were calculated to reach groundwater in the 1,000 years of the RESRAD model run for the vadose zone. These radionuclide contaminants reach groundwater at concentrations significantly below the RAGs.

Table 5. RESRAD Estimated Groundwater (Well Water/Drinking) Concentrations.

Radio-nuclide	Vadose Zone Horizon	Groundwater Concentration in pCi/L at Each Time Slice (yr)										RAG from RDR pCi/L
		0	1	3	7.3	16	30	43	100	300	1000	
C-14	SZ	0	0	0	0	0	0	0	0	0	0	2,000
	DZ	0	0	0	0	0	0	0	0	0	0	
	Total	0	0	0	0	0	0	0	0	0	0	
	Overburden [a]	0	0	0	0	0	0	0	0	0	0	
Cs-137	SZ	0	0	0	0	0	0	0	0	0	0	60
	DZ	0	4.99E-02	1.44E-01	3.17E-01	5.69E-01	7.72E-01	8.19E-01	5.10E-01	1.50E-02	4.64E-09	
	Total	0	4.99E-02	1.44E-01	3.17E-01	5.69E-01	7.72E-01	8.19E-01	5.10E-01	1.50E-02	4.64E-09	
	Overburden [a]	0	0	0	0	0	0	0	0	0	0	
Co-60	SZ	0	0	0	0	0	0	0	0	0	0	100
	DZ	0	2.91E-03	6.75E-03	9.34E-03	6.53E-03	1.94E-03	5.03E-04	6.49E-07	7.33E-18	0	
	Total	0	2.91E-03	6.75E-03	9.34E-03	6.53E-03	1.94E-03	5.03E-04	6.49E-07	7.33E-18	0	
	Overburden [a]	0	0	0	0	0	0	0	0	0	0	
Eu-152	SZ	0	0	0	0	0	0	0	0	0	0	200
	DZ	0	0	0	0	0	0	0	0	0	0	
	Total	0	0	0	0	0	0	0	0	0	0	
	Overburden [a]	0	0	0	0	0	0	0	0	0	0	
Eu-154	SZ	0	0	0	0	0	0	0	0	0	0	60
	DZ	0	0	0	0	0	0	0	0	0	0	
	Total	0	0	0	0	0	0	0	0	0	0	
	Overburden [a]	0	0	0	0	0	0	0	0	0	0	

[a] Groundwater concentrations attributed to the overburden are not included in the total estimated groundwater concentration amount.

CONCLUSIONS:

- The maximum dose rate for the 116-F-2 Trench site is 3.54 mrem/yr and occurs at year zero (year 2002).
- The dominant pathway for the dose rate at the year of maximum dose is direct external exposure.
- The primary radionuclide contributing to the dose rate at the year of maximum dose is cesium-137.

Bechtel Hanford, Inc.

116-F-2 TRENCH RESRAD CALCULATION SUMMARY

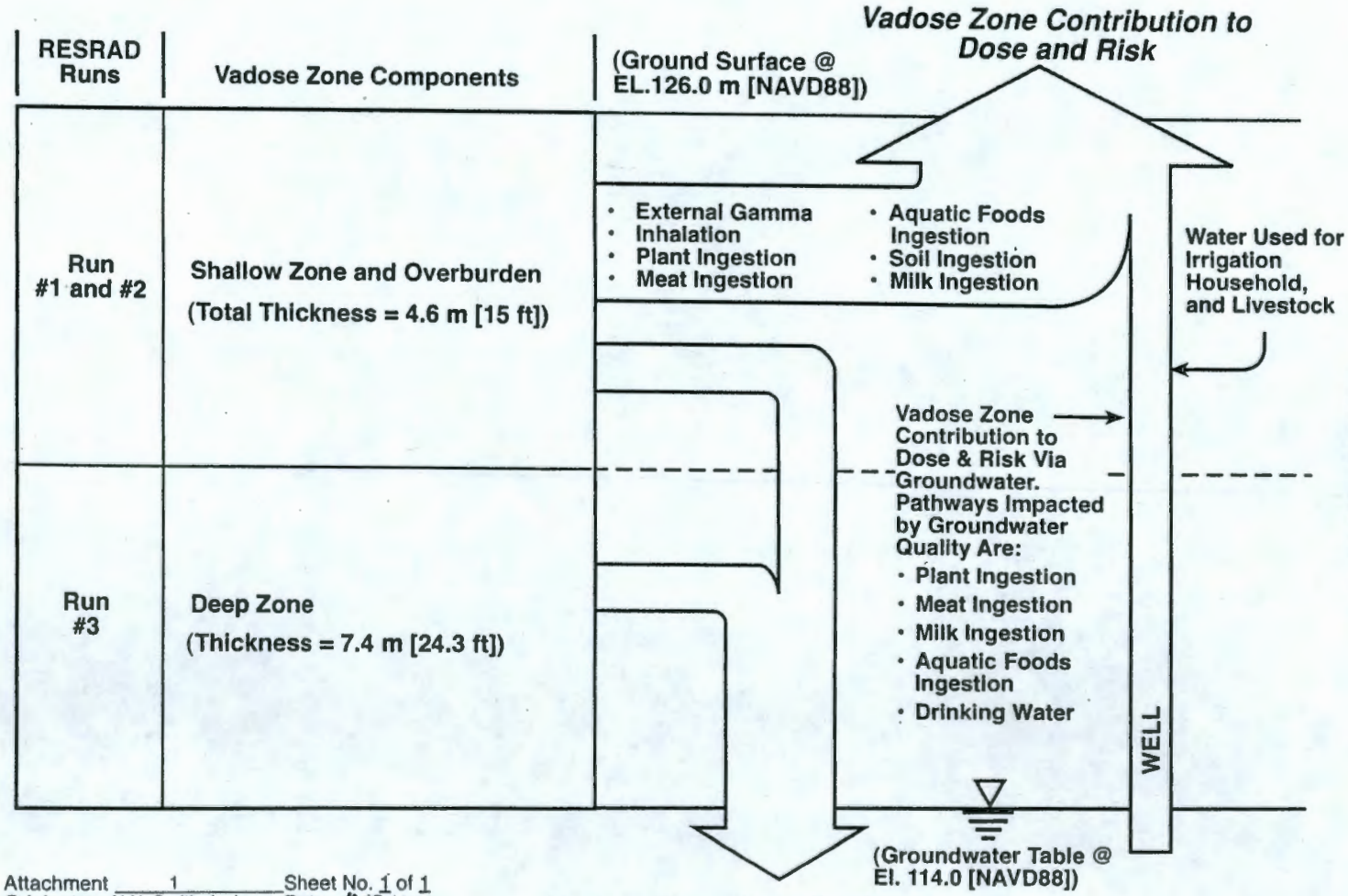
Originator:	N.N. Smith-Jackson NNJ	Date:	11/01/02	Calc. No.:	0100F-CA-V0124	Rev.:	0
Project:	116-F-2 TSD Site Closeout	Job No:	22192	Checked:	S. W. Clark SWC	Date:	11/01/02
Subject:	116-F-2 Trench Cleanup Verification RESRAD Calculation					Sheet No. 5 of 5	

- None of the 116-F-2 site COCs are projected to exceed remedial action goals (RAGs) within the 1,000 years of the RESRAD evaluation.
- Maximum excess lifetime cancer risk (4.04×10^{-5}) occurs at year zero and is primarily contributed from the shallow zone.
- Of the contaminants of concern, cobalt-60 and cesium-137 are calculated to reach groundwater within the 1,000 years of the RESRAD model run. These radionuclides reach groundwater at concentrations significantly below the RAGs.

ATTACHMENTS:

1. Graphic showing 116-F-2 Cleanup Verification Model (1 page)
2. RESRAD Output: 116-F-2 – Shallow Zone (Run #1), Part I: Mixture Sums and Single Radionuclide Guidelines (21 pages)
3. RESRAD Output: 116-F-2 – Shallow Zone (Run #1), Part III: Intake Quantities and Health Risk Factors (22 pages)
4. RESRAD Output: 116-F-2 – Shallow Zone (Run #1), Part IV: Concentration of Radionuclides (11 pages)
5. RESRAD Output: 116-F-2 – Overburden (Run #2), Part I: Mixture Sums and Single Radionuclide Guidelines (20 pages)
6. RESRAD Output: 116-F-2 – Overburden (Run #2), Part III: Intake Quantities and Health Risk Factors (22 pages)
7. RESRAD Output: 116-F-2 – Overburden (Run #2), Part IV: Concentration of Radionuclides (11 pages)
8. RESRAD Output: 116-F-2 – Deep Zone (Run #3), Part I: Mixture Sums and Single Radionuclide Guidelines (21 pages)
9. RESRAD Output: 116-F-2 – Deep Zone (Run #3), Part III: Intake Quantities and Health Risk Factors (22 pages)
10. RESRAD Output: 116-F-2 – Deep Zone (Run #3), Part IV: Concentration of Radionuclides (11 pages)

Attachment 1



Attachment	1	Sheet No.	1 of 1
Originator	N.N. Smith-Jackson	Date	10/31/02
Chk'd By	S. W. Clark	Date	11/01/02
Calc. No.	0100F-CA-V0124	Rev. No.	0

CALCULATION COVER SHEET

Project Title:	116-F-2 Site Closeout	**Job No.**	22192
Area	100-F Area		
Discipline	Environmental	***Calc. No.**	0100F-CA-V0125
Subject	116-F-2 Trench Comparison to 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 - 3 Total - 4	N. N. Smith-Jackson N. Smith-Jackson 10/31/02	S. W. Clark S. W. Clark 11/01/02	K. E. Cook KEC 11/1/02	M. A. Buckmaster 11/6/02	11/6/02

SUMMARY OF REVISIONS

*Obtain Calc. No. from DIS

November 1998

DE01437.03

Bechtel Hanford, Inc. CALCULATION SHEET

Originator	N. N. Smith-Jackson	Date	10/31/02	Calc. No.	0100F-CA-V0125	Rev. No.	0
Project	116-F-2 Site Closeout	Job No.	22192	Checked	S. W. Clark	Date	11/01/02
Subject	116-F-2 Trench Comparison to Drinking Water Standards					Sheet No.	1 of 3

Purpose:
Compare RESRAD derived groundwater radionuclide concentrations to MCLs . Compare beta/gamma emitter dose contribution to the maximum allowable dose of 4 mrem/yr (National Primary Drinking Water Regulations, 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.

Table of Contents:
1. Calculation Summary
2. Comparison to MCLs
3. Cumulative Dose Comparison

Given/References:
1) RESRAD derived groundwater radionuclide concentrations from Calculation 0100F-CA-V0124.

2) Radionuclide concentrations in water corresponding to 4 mrem/year (C4 mrem/yr) from Calculation 0100X-CA-V0025 or as determined from references in item 5.

3) MCLs summarized in Table 2-3 of: DOE, 2001, Remedial Design Report/Remedial Action Work Plan for the 100 Area (RDR/RAWP), DOE/RL-96-17, Rev. 3, 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 caclulation methodology from: NBS 1963, *Maximum Permissible Body Burdens and Maximum Permissible Concetrations of Radionuclides in Air or Water for Occupational Exposure*, NBS Handbook 69, as amended, U.S. Department of Commerce, Washington D.C., and *National Interim Primary Drinking Water Regulations*, EPA-570/9-76-003, 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 cumulative dose for each organ for all beta and gamma emitting COCs (C-14, Co-60, Cs-137, Eu-152, Eu-154, and Eu-155) at time t is calculated separately using the corresponding to 4 mRem/year dose (C4) 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.

Doseorgan x (t) = [ConcA(t)/C4A(x) + ConcB(t)/C4B(x) + ...] x (4 mrem/yr)

where:
Doseorgan 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
C4A(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 < 4 mrem/yr, then the standard is met.

Conclusions:
The summed concentrations for each radionuclide are less than the GW MCL given in the Soil Screening Guidance for Radionuclides: User's Guide.

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).

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator	N. N. Smith-Jackson	**Date** 10/31/02	**Calc. No.** 0100F-CA-V0125	**Rev. No.** 0
Project	116-F-2 Site Closeout	**Job** 22192	**Checked** S. W. Clark	**Date** 11/01/02
Subject	116-F-2 Trench Comparison to Drinking Water Standards			**Sheet No.** 2 of 3

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

Radionuclide	Time (years) 0	1	3	7.3	16	30	43	100	300	1000	MCL	Exceeds MCL?	Peak Conc.	Year of Peak Conc.
C-14	0	0	0	0	0	0	0	0	0	0	2,000	No	0	0
Cs-137	0	4.99E-02	1.44E-01	3.17E-01	5.69E-01	7.72E-01	8.19E-01	5.10E-01	1.50E-02	4.64E-09	60	No	8.19E-01	43
Co-60	0	2.91E-03	6.75E-03	9.34E-03	6.53E-03	1.94E-03	5.03E-04	6.49E-07	7.33E-18	0	100	No	9.34E-03	7.3
Eu-152	0	0	0	0	0	0	0	0	0	0	200	No	0	0
Eu-154	0	0	0	0	0	0	0	0	0	0	60	No	0	0

Bechtel Hanford, Inc.

CALCULATION SHEET

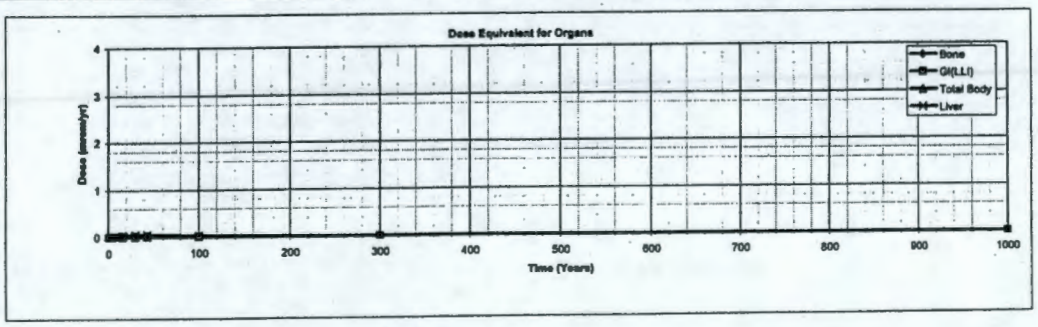
Originator	N. N. Smith-Jackson NSJ	Date 10/31/02	Calc. No. 0100F-CA-V0125		Rev. No. 0
Project	116-F-2 Site Closeout	Job 22192	Checked S. W. Clark SWC		Date 11/01/02
Subject	116-F-2 Trench Comparison to Drinking Water Standards				Sheet No. 13 of 13

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

Radionuclide	Time (years) 0	1	3	7.3	16	30	43	100	300	1000	Organ	C_4	Exceeds 4 mrem/yr?	Peak Conc.	Year of Peak Conc.
C-14	0	0	0	0	0	0	0	0	0	0	Total Body	9,000	No	0	0
											Bone	2,000	No		
											Fat	2,000	No		
Cs-137	0	4.99E-02	1.44E-01	3.17E-01	5.69E-01	7.72E-01	8.19E-01	5.10E-01	1.50E-02	4.64E-09	Bone	80	No	8.19E-01	43
											GI(LLI)	2,000	No		
											Total Body	200	No		
											Liver	60	No		
Co-60	0	2.91E-03	6.75E-03	9.34E-03	6.53E-03	1.94E-03	5.03E-04	6.49E-07	7.33E-18	0	GI(LLI)	100	No	9.34E-03	7.3
											Total Body	900	No		
											Liver	3,000	No		
Eu-152	0	0	0	0	0	0	0	0	0	0	Bone	30,000	No	0	0
											GI(LLI)	200	No		
											Total Body	200,000	No		
											Liver	100,000	No		
Eu-154	0	0	0	0	0	0	0	0	0	0	Bone	5,000	No	0	0
											GI(LLI)	60	No		
											Total Body	70,000	No		
											Liver	60,000	No		

Cumulative dose for each organ (with time)

Organ	Time (years) 0	1	3	7.3	16	30	43	100	300	1000	Exceeds 4 mrem/yr?	Peak Conc.	Year of Peak Conc.
Bone	0.00E+00	2.51E-03	7.23E-03	1.59E-02	2.85E-02	3.86E-02	4.10E-02	2.55E-02	7.50E-04	2.32E-10	No	4.10E-02	43
GI(LLI)	0.00E+00	2.16E-04	5.58E-04	1.01E-03	1.40E-03	1.62E-03	1.66E-03	1.02E-03	3.00E-05	9.28E-12	No	1.66E-03	43
Total Body	0.00E+00	1.01E-03	2.91E-03	6.38E-03	1.14E-02	1.54E-02	1.64E-02	1.02E-02	3.00E-04	9.28E-11	No	1.64E-02	43
Liver	0.00E+00	3.33E-03	9.61E-03	2.11E-02	3.79E-02	5.15E-02	5.46E-02	3.40E-02	1.00E-03	3.09E-10	No	5.46E-02	43



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Cumulative Dose Comparison

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