FINAL

CLOSEOUT REPORT

REMEDIAL ACTION

AREA OF CONCERN 6 BUILDING 650 RECLAMATION FACILITY SUMP AND SUMP OUTFALL

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AOC 6 BUILDING 650 RECLAMATION FACILITY
SUMP AND SUMP OUTFALL
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1.0 Introduction

1.1 Purpose

The purpose of this closeout report is to document the characterization, excavation, closeout surveys, sampling results, and disposal of contaminated soil and debris from Brookhaven National Laboratory's Area of Concern (AOC) 6, as required in the *Operable Unit (OU) I Record of Decision* (ROD) (DOE, August 1999). The remedial actions specified in the *OU I ROD* (DOE, August 1999) include the excavation and disposal of radiologically contaminated soils to meet prescribed cleanup goals and the removal, segmentation, and disposal of approximately 987 feet of underground storm pipe, concrete, and asphalt from the Area of Concern 6 Reclamation Facility and Sump Outfall at Brookhaven National Laboratory (BNL).

The scope of remedial work is outlined in detail in the *Final Remedial Action Work Plan AOC 6 Building 650 Reclamation Facility Sump and Sump Outfall* (BNL, August 2001) and in the *Final Remedial Action Field Sampling Plan AOC 6 Reclamation Facility Sump and Sump Outfall* (BNL, August 2001).

1.2 Regulatory Framework

On December 21, 1989, the BNL site was included on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priority List (NPL). In May 1992, the Department of Energy (DOE) entered into an Interagency Agreement (IAG) with the United States Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) under CERCLA, Section 120. The IAG established the framework and schedule for characterizing, assessing and remediating the site in accordance with the requirements of CERCLA, and the Resource Conservation and Recovery Act (RCRA). BNL originally grouped the AOCs into seven OUs (BNL Response Strategy Document, SAIC, 1992) that have subsequently been combined into six OUs.

The nature and extent of the radiologically-contaminated soil in AOC 6 have been addressed in the *Final Operable Unit IV Remedial Investigation Report* (CDM, December 1994) and the *AOC 6 Building 650 Reclamation Facility and Sump Outfall Basin: Soil/Groundwater Geoprobe Round III Sampling Report* (BNL, February 1999). An evaluation and recommendation of remedial alternatives for AOC 6 was presented in the *Final Feasibility Study Report, Operable Unit I and Radiologically-Contaminated Soils* (CDM Federal, March 1999). The remedial design for the AOC 6 remedial action activities was provided in the *Remedial Design and General and Supplemental Specifications for Remedial Action Operable Unit I Contaminated Soil and Debris* (URS, October 2000). The *OU I Record of Decision* (DOE, August 1999) selected excavation and offsite disposal as the remedial alternative for the radiologically-contaminated soil, concrete, asphalt and storm pipe in AOC 6.

1.3 Site Cleanup Criteria

The goals for controlling or remediating radioactive contaminants must comply with the following criteria and guidance values that limit the radiological risks from exposure :

(a) The CERCLA range for excess cancer risk of 0.0001 to 0.000001 (1.0E-04 to 1.0E-06) due to exposures from all potential pathways and through all media, as identified in EPA Directive *OSWER-9200.4-18*. [*NOTE: Historically, EPA indicated that a dose limit of 15 millrem per year effective dose equivalent was considered consistent with this excess cancer risk range. Recent EPA guidance has reiterated the primacy of the risk range criterion over the dose-based criterion. Although not a presumptive cleanup goal, the 15 mrem per year criterion is addressed herein for consistency with previous BNL risk assessments*.]

(b) The *National Primary Drinking Water Regulations* in Title 40 CFR Part 141, including

- total effective dose equivalent of no more than 4 mrem/yr above background from all beta/gamma emitting radionuclides contaminating the site through groundwater exposure pathways,
- a maximum contaminant level of 5 pCi/L for combined Ra-226 and Ra-228,
- a maximum contaminant level of 15 pCi/L for gross alpha activity,
- a maximum contaminant level of 8 pCi/L limit for Sr-90, and
- a maximum contaminant level of 20,000 pCi/L for Tritium (H-3).

(c) The NYSDEC guideline in *TAGM 4003* that specifies an as As Low As Reasonably Achievable (ALARA) objective limiting the total effective dose equivalent to no more than 10 mrem/yr above background from all radionuclides contaminating the site through all exposure pathways.

Cleanup levels for specific radionuclides corresponding to the dose criteria were calculated using the DOE Residual Radioactive Material Guidelines computer code, *RESRAD*, based on BNL site-specific conditions and a residential land use scenario following 50 years of institutional control of the site. Cleanup criteria reported in the *OU I Feasibility Study* (CDM, 1999) for radionuclides that have been detected in AOC 6 are identified in Table 1.

1.4 Historical Description

The Former Building 650 Reclamation Facility, known as Building 650, was constructed for the decontamination of radioactive contaminated clothing and heavy equipment. The facility was designed to perform decontamination operations both inside and outside the building. These operations date back to at least 1959, with the construction of two (2000) gallon underground storage tanks (USTs) 650-1 and 650-2 in 1962, and two (3000) gallon USTs 650-3 and 650-4 in 1972. The structural integrity of the USTs had never been tested. At present, Building 650 is not used as a decontamination facility or a radioactive contaminated clothing laundry.

In the past, all soiled laundry from BNL was delivered to Building 650, where potentially radioactively contaminated laundry was segregated from routine laundry. The radioactively contaminated laundry was cleaned with dedicated equipment and the residual wash water was transferred to and contained in the 650-1 and 650-2 USTs, until the activity could be determined. These USTs were located on the north side of the building. The contents of the tanks were designated as D-waste, defined by BNL as waste with a gross beta activity greater than 90 pico curies/milliliter (pCi/ml). The liquid waste was emptied from the USTs about three times a year and taken to the Waste Concentration Facility (WCF) by a tanker truck. Approximately six drums of sludge were removed from the USTs in 1983.

Table 1: Summary of Radionuclides Detected Above Background and their Remediation Goals

Radionuclide	Maximum (pCi/g)	Minimum (pCi/g)[3]	Representative Site Value[1] (pCi/g)	Remediation Goal (pCi/g)[2]
Americium-241	26	0.05	6.5	39
Bismuth-214	16	0.49	4.5	n/a
Cobalt-60	150	0.66	38	1160
Cesium-137	1800	0.63	450	23
Europium-152	580	0.1	145	49
Europium-154	350	0.59	88	170
Europium-155	68	0.19	17	150,000
Lead-214	14	0.56	3.5	n/a
Plutonium-239/240	170	0.02	42	40
Potassium-40	7.9	0.1	2.0	n/a
Radium-226	63	0.1	16	5
Strontium-90	140	0.1	35	15
Technetium-99	3.5	0.5	0.9	n/a
Thorium-234	22	0.1	5.6	n/a
Uranium-234	31	0.2	7.8	13
Uranium-238	51	0.3	13	11

[1] Representative site values were determined as follows: 25% percentile of the difference between the maximum and minimum value chosen to represent the site value given that the data is log normally distributed.
[2] Remediation goals developed from RESRAD analyses reported in the OU I FS Report (CDM, 1999)
[3] Minimum value found above detection limit
n/a Not applicable

Building 650 also served as a decontamination facility for radioactively contaminated equipment. The radioactively contaminated equipment was steam cleaned on a 30 foot by 30 foot concrete pad on the north side of the building. The decontamination pad was in use by 1959, however, the date of its initial operation is not known.

The radioactively contaminated water from the steam cleaning operation collected in a drain in the middle of the sloping concrete pad, known as the Building 650 Sump. It was presumed by operation

personnel that the effluent was piped into the sanitary sewer system or into the USTs. The radioactive contaminated water that was deemed to be excessively contaminated was planned to be routed to 650-1 and 650-2 USTs, designated for D-waste. Typically, however, the water was deemed clean enough to be routed to USTs (650-3 and 650-4), designated for F-waste. Brookhaven National Laboratory defines F-waste as waste with a gross beta activity less than 90 pCi/ml.

The contents of these USTs were emptied approximately twice a year and discharged to the BNL Sewage Treatment Plant (STP). The laundry facility and the decontamination pad area are the only known sources of D and F waste delivered to the four USTs at Building 650. The USTs were included under AOC 12 and were removed under Removal Action (RA) II, the UST RA, during the summer of 1994.

In late 1969, approximately five curies of tritium were released into the Building 650 Sump and presumably into the sanitary sewer system. However, this tritium was not detected at the BNL STP. An investigation revealed that the drainage pipe from the outdoor pad behind Building 650 led to a natural depression in a wooded area about 800 feet northeast of Building 650, rather than to either the sanitary sewer system or to a UST, as had been assumed by operation personnel. The practice of decontaminating radioactively contaminated equipment on the concrete pad was discontinued after the 1969 incident. The natural wooded depression is referred to as the Building 650 Sump Outfall Area as shown in Figure 1A.

2.0 Remediation Activities

The removal of overburden and the clearing of trees and vegetation commenced October 11, 2001. Approximately 10,000 cubic yards of clean overburden from the area above the pipeline and the Sump Outfall were excavated. Characterization of the trees in the Sump Outfall and along the pipeline was conducted to determine whether this material was suitable for use as backfill. Details on the material that was suitable for use as backfill are provided in section 4.2.

Excavation began in March 2002 and was completed in June 2002. Soils and debris were excavated from the areas shown in Figure 1A. In addition to soil excavation at the Building 650 Sump Outfall, approximately 987 feet of storm pipe leading from the Building 650 Sump to the Sump Outfall and the 30’ by 30’ concrete decontamination pad (and associated soils) behind Building 650 were excavated for disposal at Envirocare. The work included the removal and disposal of 8” and 15” diameter storm pipe, two manholes, and contaminated soil around the pipeline and manholes.

Approximately 1854 cubic yards of soil, debris (concrete, brick, clay tile pipe), and vegetation were excavated as waste for shipment to Envirocare of Utah, Inc (Envirocare). Table 2 provides a summary of the current estimated waste volumes following excavation. See Sections 2.4 and 3.0 regarding management of these wastes. Details of the excavations including depths are discussed in following sections. Details on the radiological walkover survey results prior to, during, and following excavation activities are provided in Sections 2.5 and 2.6 of this report.

Radiological surveys were performed prior to excavation for all areas are provided in Figures 2A,

2B, 2C, and 2D. Interim radiological surveys performed during excavation for all areas are provided in Figures 3A, 3B, 3C, and 3D. Following remediation of an area, a final radiological status survey was performed to demonstrate that residual radioactivity in each area satisfies the clean-up criteria identified by the OU I ROD. The final walkover survey consisted of a 100% surface scan of the remediated Class 1 areas and a minimum 25% surface scan of the adjacent Class 2 areas. The final status surveys for all areas are provided in Figures 4A, 4B, 4C, and 4D. Figure 4D provides composite survey results for the Sump Outfall.

Statistical tests were performed, based on the MARSSIM process for final status surveys, to demonstrate that the excavated site meets the clean-up criteria. Based on this analysis each survey area meets the release criterion.

A post closure risk assessment was performed to verify that risks and doses from residual contaminants on site were within the acceptable risk and dose criteria defined in the OU I ROD. An assessment of radiation risk and dose using the RESRAD program was performed for residually contaminated soils following remediation efforts. A present and future industrial/ commercial use scenario and a future resident scenario fifty years in the future were evaluated and compared to the OU I ROD requirements. The consequences for each of the modeled scenarios as estimated by the RESRAD code are discussed in Section 4.4 and summarized in Table 19 of this report. . The maximum future resident dose of 0.81 mrem/year is well below the 15 mrem/year given in the ROD.

For the current and future site worker, their activities do not present an external or direct exposure hazard to the individual, and the surface activity is only a minor exposure. The dose and risk are essentially zero.

The risk for the future resident occurs from potential migration of radionuclides into the drinking water supply approximately 60 years (for Sr-90) to 400 years (for U-234/U-238) following the remediation. Radionuclides might be detectable in the well water of the future resident, but their concentrations are well below the Maximum Contaminant Level established by the US EPA in the National Primary Drinking Water Regulations, Title 40, CFR Part 141. A maximum dose of 0.81mrem is estimated for Uranium in the ground water at year 440 in the future.

Table 2: Building 650 Estimated Excavated Soil and Debris Waste Volumes

Description of Area	Excavated Volume* (cyd)
30' by 30' Concrete Decontamination Pad and soils behind Building 650	64 (concrete/asphalt) 250 (soil)
Soils/vegetation from Building 650 Sump Outfall	1260
Storm Line leading from Building 650 to the Sump Outfall	60 (concrete pipe) 130 (soil and clay tile pipe)
Western and Eastern Manholes	10 (Brick) 80 (Soil)
Waste Volume Total:	1854

*Estimated +/- 10%. Does not include 13 cyd of PPE and other secondary wastes.

2.1 Concrete Decontamination Pad and Soils Behind Building 650

Approximately 64 cubic yards of concrete/asphalt and 250 cubic yards of associated soils were excavated from the former decontamination pad area behind Building 650 as shown in Picture 1. Depths of excavation ranged from one feet to three feet. Radiological walkover surveys of the area (as described in sections 2.5 and 2.6) just prior to, during and after complete excavation are provided in Figures 2A, 3A, and 4A, respectively. The entire area of excavation is shown in Figure 4A (650 Pad Class 1 Final Status Survey).

Picture 1: Concrete Pad Excavation Area Behind Building 650

2.2 Building 650 Sump Outfall Soils

Approximately 1260 cubic yards of soil were excavated from the Building 650 Sump Outfall. Excavation depths ranged from two feet to as deep as ten feet in small isolated areas. Radiological walkover surveys of the area (as described in sections 2.5 and 2.6) just prior to, during and after excavation are provided in Figures 2C, Figures 3B, 3C, 3D and Figures 4C, 4D respectively.

2.3 Building 650 Storm Line and Manhole Removal

Approximately 837 feet of concrete storm pipe (sections 2 and 3 as shown in Figure 1A) and 150 feet of clay tile storm pipe (section 1 as shown in Figure 1A) leading from the Building 650 Sump to the Building 650 Sump Outfall and associated contaminated soils along the pipeline were removed using the hydraulic excavator. Each 5 1/2-foot segment of concrete pipe was loaded into a lined roll-off container on plastic wrapped dunnage by a crane as shown below. The depths of the entire pipeline ranged from 6 feet to 13 feet below grade (soil above pipe was removed as clean overburden). In addition to the pipeline, the western and eastern manholes as shown in Figure 1A were also removed.

Picture 2: Building 650 Sump Outfall Excavation Site

Radiological walkover surveys just prior to and after excavation for the areas along the pipeline are provided in Figures 2B and 4B, respectively. Excavation volumes associated with the pipeline removal are provided in Tables 2 and 3.

Picture 3: Loading of Concrete Pipe Segment at Building 650 Sump Outfall

2.4 Waste Volume Summary

A total of approximately 1854 cubic yards of debris and soil and approximately 13 cubic yards of PPE and miscellaneous secondary wastes were generated for shipment to Envirocare, Utah (see Table 2 above and Table 3 below). A summary of the waste generated, associated Radiological Waste Control Form numbers, estimated weights, volumes, and temporary storage areas are summarized in Table 3. All wastes associated with the Building 650 project were shipped by rail to Envirocare by September 12, 2002. See Section 3.0 below regarding management of these wastes

2.5 Field Screening Methods Prior to and During Excavation

Gamma walkover surveys with a 2x2 NaI detector were performed prior to and during remediation activities to identify localized as well as distributed sources of contamination. During the as-found surveys, the in-situ response of the sodium iodide (NaI) detector was found not to correlate linearly with biased soil sample results from the ISOCS due to excessive background levels found in the Outfall area. As an alternative, data imaging techniques were used to graphically plot the results of the walkover surveys on AOC6 CAD drawings (see figures 2). This enabled remediation efforts to be focused on the areas with the greatest surface contamination. Once the surrounding gamma background levels were reduced, the walkover surveys were compared directly to biased soil sample results from the ISOCS to ascertain the relative response of the NaI to a projected Cs-137 contamination level. Any areas found exceeding 4,000 counts per minute (cpm) above background were evaluated for sampling and analysis for radionuclide identification and/or excavation. The basis for the investigation level (4,000 cpm above background) and a derivation of the use of the Cs-137 gamma-emission as an indicator or surrogate for other radionuclides (i.e. Sr-90 and Pu-239), are given in the *Final Status Survey Plan* (BNL, 2002) and *Field Sampling Plan* (BNL, August 2001).

Table 3
Building 650 Project Detailed Waste Summary

Waste Type	Storage Area	Package	Weight (lbs)	Volume (cu. Yd.)	Contents	RWCF #	Container ID
Debris / Soil	Section 1 – 650 Yard Area	Supersacks (8 total)	96,000	64	Concrete, Soil, Asphalt, Branches, Protective Clothing, Wood	43205-43212	650-SSRVL-01 through 08
PPE	Section 2-Bldg. 650 Fence Room Area	Plastic Bags	450	12	Tyvek, Gloves, Booties	43215	NA
Geotextile	Section 2-Bldg. 650 Fence Room Area	Plastic Bags	25	<1	Geotextile	43215	NA
Herculite	Section 2-Bldg. 650 Fence Room Area	Plastic Bags	50	1	Herculite	43215	NA
Soil	Section 2-Bldg. 650 Fence Room Area	Plastic Bags	110	<1	Soil	43213	NA
Liquid	Section 2-Bldg. 650 Fence Room Area	55 gallon drum	672	<1	Liquid	NA	650-SSW-001
Concrete Pipe	Section 3-Glassholes RR Staging Area	Stockpile	130,900	60	Concrete Pipe	42011	NA
Brick Manholes	Section 3-Glassholes RR Staging Area	NA	2,450	10	Concrete Manhole	NA	650-SSM-001
Concrete Slab	Section 3-Glassholes RR Staging Area	NA	300	<1	Concrete Slab	NA	650-SSM-002
Wood (trees)	Section 3-Glassholes RR Staging Area	Stockpile	30,000	26	Tree Trunks, Roots and Branches	42010	650-SO-10
Soil	Section 3-Glassholes RR Staging Area	Stockpile	3,950,100	1,694	Soil	43217	NA
Total			**4,211,057**	**1,867**			

The *Operable Unit I Contaminated Soils and Debris Remedial Design Drawings and Specifications* (URS, October 2000) was used to define and map the primary areas (Class 1) and secondary areas (Class 2). The primary areas (Class 1) designated for excavation indicated concentrations of radionuclides above the remediation goal as identified in the *Final Feasibility Study Report, Operable Unit I and Radiological-Contaminated Soils.* Secondary areas (Class 2) contained concentrations of radionuclides at or above background levels but below the cleanup level. The remediation goals are provided in Table 1 and the Class 1 and Class 2 areas and the final status sampling locations for AOC 6 are shown in Figure 1A.

2.6 Post Excavation Final Status Surveys

Following remediation, a final radiological status survey was performed to demonstrate that residual radioactivity in each area satisfies the clean-up criteria identified by the ROD. The final walkover survey consisted of a 100% surface scan of the Class 1 areas and a 25% surface scan of Class 2 areas using a Ludlum Model 2221 Ratemeter with 2" x 2" sodium iodide (NaI) detector. In addition, the Oak Ridge Institute for Science and Education (ORISE) and the NYSDEC performed independent verification to support that clean-up goals were achieved. Preliminary results of the independent verification are provided in Attachment 1 and Attachment 2. Final status surveys for the Sump Outfall, the pad and soils behind Building 650, and along the pipeline are provided in Figures 4A,4B,4C, and 4D.

2.6.1 Final Radiological Status Survey Design

The design of the final status survey was based on guidance provided in the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM). Details of the survey design are provided in the *Final Building 650 Field Sampling Plan* (BNL, August 2001) and *Final Status Survey Plan Area of Concern Building 650 Reclamation Facility Sump and Sump Outfall* (BNL, 2002). The survey was an integrated design, combining:

- A surface scanning meter survey (walkover survey) to identify localized areas of elevated activity (100% of Class 1 and 25% of Class 2 areas);
- Analysis of soil samples from systematic positions on a triangular grid to determine the average concentration of activity distributions in relatively large areas (Class 1, Class 2 and Reference areas); and
- Analysis of soil samples to confirm instrument readings (100% of high readings) or to verify on-site analysis (10% of samples analyzed on site will be sent to Severn Trent Labs (STL)). All samples analyzed for Uranium and Plutonium were sent to STL for isotopic analysis by alpha spectroscopy.

Decision criteria and survey components are discussed further in the following sections.

a. <u>Classifying survey units</u>

Areas within the AOCs were categorized using MARSSIM methods to define the survey design. Class 1 areas were those areas with contamination levels greater than the clean-up goals. Class 2 areas were those which had been found to be contaminated, but at levels below the clean-up goals. Three areas of irregular shape were identified as Class 1 and three as Class2. The areas are described in Table 4.

Table 4: Description of Survey Units

Description	Area Class	Planned			Actual		
		Area (m^2)	# of samples	Separation Distance (m)	Area (m^2)	# of samples	Separation Distance (m)
6-1a (Pad and Soils behind 650)	1	335	3	11	315	4	10
6-1b (Pipeline)	1	370	3	80[a]	370	5	80
6-1c (Sump Outfall)	1	1,140	10	12	1,000	10	6
6-2a(Pad and Soils behind 650)	2	2,000	4	24	2,000	3	25
6-2b (Pipeline)	2	3,600	5	48[b]	3,600	6	50
6-2c (Sump Outfall)	2	3,450	7	24	3,450	10	25

[a] The spacing for the pipeline is based on 1/3 of 240 m length.
[b] The spacing for the pipeline is based on 1/5 of 240 m length.

b. Determining sampling grid size and number of samples

Using the methods recommended in MARSSIM, Chapter 5, a calculation of number and spacing for a systematic sampling grid pattern was performed. This number of systematic samples, and the corresponding grid spacing between the samples, assures a statistically sufficient database for determining whether the average radioactivity concentration in each of the survey units meets or exceeds the cleanup goal. The number and spacing of the samples planned before excavation and those performed for the actual excavated areas are listed in Table 4. The calculation of the grid separation distance and of the number of sample points is detailed in *Final Status Survey Plan, Area of Concern 6 Building 650 Reclamation Facility Sump and Sump Outfall* (BNL, 2002).

c. Evaluation of Multiple Radionuclides

When multiple radionuclides are the contaminants of concern the MARSSIM recommends a statistical analysis based on the Wilcoxon Rank Sum (WRS) Test. Each radionuclide's Wilcoxon Test Cleanup Goal (CGw) corresponds to the site release criterion that results in the regulatory limit dose or risk. However, in the presence of multiple radionuclides, the total of the CGw for all radionuclides could result in an annual radiation dose that exceeds the release criterion. In this case, the individual CGw need to be adjusted to account for the presence of multiple radionuclides contributing to the total dose.

The MARSSIM suggests the use of the unity rule as one method to adjust the evaluation for the presence of multiple radionuclides. For the situation of the AOC 6 remediation, where there are multiple radionuclide contaminants present, the unity rule takes the form:

$$\sum_i \frac{C_i}{CGw_i} \leq 1$$

where

CG_{Wi} ≡ the remediation goal for radionuclide i

C_i ≡ measured concentration for radionuclide i in elevated area

The unity rule, represented in the expression above, is satisfied when radionuclide mixtures yield a combined fractional concentration limit that is less than or equal to one (in MARSSIM notation, the unity rule cleanup goal is 1, $CG_{WU} = 1$).

d. <u>NaI detector surveys</u>

A walkover survey of each excavated area was performed using a Ludlum Model 2221 Ratemeter with 2" x 2" Sodium Iodide detector. The 2221 has an RS-232 output that feeds data into the Trimble Pathfinder Pro Global Positioning System (GPS) unit every second. The data stream contains GPS northing/easting coordinates and the gross counts per minute (CPM) value for that location.

The detection of potential “hotspots” during the walkover survey was accomplished by means of continuous data logging and post processing of the collected data. Logs of the detector response were interpreted into posting plots using color graphics overlying the graphically displayed survey areas.

(a) Two investigation levels were used in evaluating the walkover survey data.

- *Trend Level Location*. Areas of elevated gamma response between 2,000 and 4,000 cpm above background were reviewed for trends in higher instrument response not necessarily apparent from the tabulated readings themselves. A "trend' is a localized grouping of responses that are high, as opposed to individual isolated high readings that would be interpreted as fluctuations about the norm.

- *Elevated Rate Position*. Individual locations of elevated gamma response more than 4,000 cpm above background.

(b) When the posting plot indicated a trend level location or an elevated rate position, the area was evaluated for further sampling and excavation if it indicated an instrument response greater than 4,000 CPM above background.

e. Sample Analysis

The MARSSIM survey design established the number of and location for finite samples to be obtained for contaminant quantification. In this final status survey, on site gamma spectroscopy and Sr-90 sample analysis were performed in accordance with the Standard Operating Procedures provided in Appendix B *Final Remedial Action Field Sampling Plan* (BNL, August 2001). In addition, the collection and analysis of samples for submission to an off-site analytical laboratory was performed. The analysis type, location and quality control samples are summarized in Table 5.

Table 5: Sample Laboratory, Analysis and Location

Analysis	Where Performed	QC Repeats/Splits
Gamma Spectroscopy	On Site ISOCS	25% repeated on site 10% sent off site to Severn Trent Labs
Sr-90 isotopic	On Site BetaScint	25% repeated on site 10% sent off site to Severn Trent Labs
Alpha Spectroscopy (U, Pu)	Severn Trent Labs, Inc	10% split

2.6.2 Final Status Survey Results

A summary of the radiological surveys conducted and the survey dates are given in Table 6. The results of the final walkover surveys (net CPM) as shown in Figures 4A, 4B, 4C and 4D and the analysis of discrete surface soil samples were used with the MARSSIM statistical methods to demonstrate that clean-up criteria have been achieved successfully in each survey unit.

a. Final Radiological Walkover Survey

During remediation walkover surveys were performed following excavation to identify any localized areas of activity above the cleanup goal remaining in the soil. The locally elevated areas were re-excavated and another walkover survey of the re-excavated areas was performed to verify final compliance with the cleanup goal. (See Figures 3A, 3B, 3C, and 3D for interim survey results and Table 6 for the survey descriptions and dates.) In a few instances where single readings were near the screening levels for cleanup, readings were averaged with adjacent locations. In all cases, these average values were below the screening criteria.

Table 6: Summary of Building 650 Project Radiological Surveys

Figure Number	Description	Survey Date(s)
2A	Radiological Survey Prior to Excavation at the Building 650 Pad	03/28/02
2B	Radiological Survey Prior to Excavation at the Pipeline Sections 2 & 3	04/05/02, 04/08/02
2C	Radiological Surveys Prior to Excavation at the Sump Outfall	04/15/02
3A	Interim Radiological Survey at the Building 650 Pad	05/29/02
3B	Interim Radiological Survey (after 1st remediation) at the Sump Outfall	05/15/02
3C	Interim Radiological Survey (after 2nd remediation) at the Sump Outfall	05/21/02
3D	Interim Radiological Survey (after 3rd remediation) at the Sump Outfall	05/23/02
4A	Final Radiological Status Survey for the 650 Pad Class 1 Areas	06/12/02
4B	Final Radiological Status Survey for the 650 Pipeline Class 1 and Class 2 Areas	06/11/02, 06/12/02
4C	Final Radiological Status Survey for the Sump Outfall Class 2 Areas	06/13/03
4D	Final Radiological Status Survey for the Sump Outfall Class 1 Areas	06/10/02, 06/19/02, 06/27/02

The final walkover survey consisted of a 100% surface scan of the Class 1 areas and a minimum 25% surface scan of the Class 2 areas using a Ludlum Model 2221 Ratemeter with 2" x 2" NaI detector. The 2221 has an RS-232 output that feeds data into the Trimble Pathfinder Pro Global Positioning System (GPS) unit every second. The data stream contains GPS northing/easting coordinates and the gross CPM value for that location. The survey results were recorded and downloaded into a file.

(*Note: Despite the fact that the GPS unit used during the AOC6 project was differentially corrected, the data recorded during the gamma walkover surveys are still subject to reporting errors. Therefore, data points plotted on the BNL CAD maps may appear to be geographically misplaced with respect to permanently installed equipment or physical landmarks. The Trimble Pathfinder Pro DGPS system used by Cabrera typically has a positional accuracy of better than ± 1 meter. However, recorded accuracies will vary depending on weather, local obstructions, and time of day. An example of this geographical error is shown in Figure 4C, the Final Radiological Status Survey for the Sump Outfall Class 2 Areas. The path of the surveyor, which was actually along the northern ledge of the excavated pipeline, is actually reported by the GPS as being directly on top of the pipeline.)

The final status surveys for all three excavated areas are provided in Figures 4A, 4B, 4C, and 4D. Figure 4D provides composite survey results for the Sump Outfall. Following the survey on June 10, 2002, several areas were noted that required additional excavation. Survey data are provided in Figure 4D.

The excavation boundary depicted in Figures 4C and 4D represent the 'total' excavation boundary for the outfall area of the project. [That is, excavation that was performed in the outfall beyond what was necessary to achieve appropriate radiological cleanup criteria (ie: to accommodate equipment movement within the outfall and/or safety benching to ensure proper sloping angles for excavations)]. This explanation is necessary to better explain the significance of the excavation boundary versus the definition provided in the *AOC6 Final Status Survey (FSS) Plan* (April, 2002).

b. Sample Analysis

Final status survey surface soil samples were obtained at positions in accordance with MARSSIM guidelines provided in Figure 1A. The samples were submitted for analysis on-site (for ISOCS [gamma spectroscopy] and beta scintillation [Sr-90]) and at Severn Trent Laboratories, St. Louis, Missouri [for Uranium and Plutonium isotopic analyses].

c. Data Usability

Differences in reporting by the two analytical services were reconciled before the data was used for site evaluation.

- In reporting the on-site analytical results, the ISOCS and BetaScint instruments incorporate a non-detect algorithm, so that when the upper bound of the 95% confidence interval for the sample result is below the minimum detectable concentration (MDC), the sample result is reported as "Non Detect".

- The Severn Trent Laboratories however, reported a numerical concentration value for all sample analyses, including when the results were below the MDC and even reporting negative values, which can be expected due to the statistical nature of decay events at these very low concentrations.

Therefore, for the Severn Trent results, to provide comparable data for use in site evaluation, if the upper bound of the 95% confidence interval for the sample result was below the MDC, the sample result was coded ND for non-detect.

d. Analysis Results

The analytical results of the surface soil samples are provided in Tables 7 through 9 for the Class 1, Class 2 and Reference areas, respectively. The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

The results of the analyses are summarized below:

- For the Class 1 Area, eight radionuclides were detected. Thirteen out of 19 samples collected had detectable amounts of Co-60 with an average concentration of 0.42 ± 0.06 pCi/g. Cesium-137 was detected in 16 samples with a mean value of 1.1 ± 1.1 pCi/g. Plutonium-

238, Pu-239/240, and U-235 were detected in 1, 15, and 10 samples, respectively. The average values of these radionuclides were 0.04 ± 0.04, 0.28 ± 0.44, and 0.08 ± 0.09 pCi/g, respectively. Strontium-90, U-234, and U-238 were detected in all 19 Class 1 samples. The average values were 2.4 ± 1.4, 0.75 ± 1.3, 0.81 ± 1.4 pCi/g, respectively.

- Eight radionuclides were also detected in the Class 2 samples. Cesium-137 was detected in 13 samples with a mean concentration of 0.50 ± 0.43 pCi/g. Radium-226, Pu-238, Pu-239/240, and U-235 were detected in one, two, six, and four samples with mean concentrations of 1.7 ± 1.0, .02 ± 0.01,0.15 ± 0.16, and 0.06 ± 0.03 pCi/g, respectively. Strontium-90, U-234, and U-238 were detected in all 19 samples and the mean concentrations were calculated as 1.9 ± 0.7, 0.47 ± 0.38, 0.42 ± 0.23 pCi/g, respectively.
- Five radionuclides were detected in the reference area samples. Cesium-137, U-234 and U-238 were identified in all 16 samples with a mean of 0.34 ± .06, 0.92 ± 0.19 and 0.89 ± 0.15 pCi/g, respectively. Radium-226 and U-235 were detected in 10 and 7 samples. The average concentrations of these radionuclides are 1.4 ± 0.44 and 0.05 ± 0.02 pCi/g, respectively. For the reference area, Pu-238, Pu-239/240 and Sr-90 were not analyzed for and were assigned "0" concentration, since these radionuclides were not found in background soils.

e. Areas of Elevated Activity Identified Following Remediation

Following the initial excavation and remediation activities, ORISE (on June 11 and 12) and NYSDEC (on June 12) surveyed the site to evaluate the attainment of remediation goals. Through sampling and walkover surveys, both agencies identified areas in the outfall zone requiring further investigation and/or remediation. Upon review of the preliminary NYSDEC and ORISE findings, additional excavations, sampling and evaluations were performed by BNL.

After these subsequent remedial activities, NYSDEC (on June 27) and ORISE (on July 1) returned to BNL for additional surveys. BNL identified two locations where total excavation of the radioactive contaminant could not be accomplished. Each agency also identified positions in the remediation site found to contain localized areas of radioactivity elevated above the average exposure readings of the remediated site. The survey reports of both NYSDEC and ORISE are provided in Attachments 1 and 2 of this report, and these locations are described below. A radiological survey of the Sump Outfall was conducted by BNL's Radiological Controls Division on July 31 and on October 18. These surveys were intended to verify the final status of the remediation and to identify any institutional control issues related to the area for deposting. The results of these surveys are given in Attachment 6.

(1) Elevated areas identified by ORISE

On the initial survey, ORISE identified soil in excess of the cleanup goals remaining in the drainage pipe trench and several locations in the sump outfall. After the BNL remediation of these areas, and following the second survey, ORISE concluded that the BNL remediation activities:

...appeared to have reduced residual contamination levels so that the soils in the sump, drainage

pipe trench, and the sump outfall meet established guidelines with the following exceptions: Sample location 35 [in the sump outfall area] *exceeded the U-238 criteria and ESSAP recommends additional investigation. Additionally, the soil underneath the electrical conduit does not meet the guidelines for release for unrestricted use and, if left in place, should be addressed by a hazard assessment....* [ORISE, *Letter Report, Area of Concern 6, BNL*, Sept 9, 2002 (see Attachment 2)]

The description and investigation of these two areas are provided below.

Table 7: Post Remediation Soil Radiological Concentrations (pCi/gm) for the AOC 6 Class 1 Areas

Sample ID	Co-60			Cs-137			Eu-152			Eu-154			Eu-155		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-Cert	MDC	Conc.	Un-cert	MDC
AOC6-1-01	0.5	0.04	0.06	ND		0.08	ND		0.1	ND		0.09	ND		0.1
AOC6-1-02	0.4	0.04	0.06	0.07	0.04	0.06	ND		0.1	ND		0.09	ND		0.1
AOC6-1-03	0.4	0.04	0.07	0.04	0.03	0.04	ND		0.1	ND		0.09	ND		0.1
AOC6-1-04	0.3	0.04	0.07	0.2	0.04	0.05	ND		0.1	ND		0.08	ND		0.1
AOC6-1-05	ND		0.03	0.6	0.07	0.07	ND		0.07	ND		0.05	ND		0.08
AOC6-1-06	ND		0.04	ND		0.04	ND		0.07	ND		0.04	ND		0.08
AOC6-1-07	ND		0.03	0.03	0.04	0.06	ND		0.06	ND		0.05	ND		0.07
AOC6-1-08	ND		0.2	ND		0.2	ND		0.2	ND		0.2	ND		0.2
AOC6-1-09	ND		0.3	1.1	0.3	0.2	ND		0.3	ND		0.2	ND		0.3
AOC6-1-10	ND		0.2	2.5	0.4	0.3	ND		0.4	ND		0.3	ND		0.4
AOC6-1-11	0.5	0.05	0.08	3.5	0.3	0.1	ND		0.2	ND		0.1	ND		0.2
AOC6-1-12	0.4	0.05	0.07	0.5	0.07	0.08	ND		0.1	ND		0.1	ND		0.1
AOC6-1-13	0.5	0.04	0.06	0.6	0.08	0.07	ND		0.1	ND		0.1	ND		0.1
AOC6-1-14	0.4	0.04	0.07	1.9	0.2	0.09	ND		0.1	ND		0.1	ND		0.1
AOC6-1-15	0.4	0.04	0.06	2.6	0.2	0.08	ND		0.1	ND		0.1	ND		0.1
AOC6-1-16	0.5	0.05	0.07	2.4	0.2	0.09	ND		0.2	ND		0.1	ND		0.1
AOC6-1-17	0.4	0.04	0.07	0.2	0.05	0.06	ND		0.1	ND		0.08	ND		0.1
AOC6-1-18	0.4	0.05	0.06	0.08	0.04	0.06	ND		0.1	ND		0.09	ND		0.1
AOC6-1-19	0.4	0.04	0.06	0.7	0.09	0.09	ND		0.1	ND		0.09	ND		0.1

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

Table 7: (continued) Post Remediation Soil Radiological Concentrations (pCi/gm) for the AOC 6 Class 1 Areas

Sample ID	Ra-226			Am-241			Sr-90			Pu- 238		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC
AOC6-1-01	ND		1.3	ND		0.09	5.1	0.51	0.72	ND		0.04
AOC6-1-02	ND		1	ND		0.09	2.6	0.48	0.72	ND		0.1
AOC6-1-03	ND		1.1	ND		0.09	0.5	0.45	0.72	ND		0.081
AOC6-1-04	ND		1.1	ND		0.08	4.3	0.50	0.72	ND		0.04
AOC6-1-05	ND		0.9	ND		0.05	3	0.48	0.72	ND		0.075
AOC6-1-06	ND		0.7	ND		0.05	3.3	0.48	0.72	ND		0.044
AOC6-1-07	ND		0.7	ND		0.05	1.3	0.46	0.72	ND		0.071
AOC6-1-08	ND		2.3	ND		0.2	0.7	0.45	0.72	ND		0.078
AOC6-1-09	ND		3.3	ND		0.2	2.2	0.47	0.72	ND		0.046
AOC6-1-10	ND		5.4	ND		0.3	4	0.51	0.75	ND		0.091
AOC6-1-11	ND		1.7	ND		0.1	3	0.48	0.72	0.036	0.035	0.056
AOC6-1-12	ND		1.4	ND		0.1	2.7	0.48	0.72	ND		0.04
AOC6-1-13	ND		1	ND		0.1	0.7	0.45	0.72	ND		0.084
AOC6-1-14	ND		1.1	ND		0.1	4.2	0.49	0.72	ND		0.084
AOC6-1-15	ND		1.3	ND		0.1	1.1	0.46	0.72	ND		0.064
AOC6-1-16	ND		1.8	ND		0.1	3.2	0.48	0.72	ND		0.03
AOC6-1-17	ND		1.2	ND		0.08	1.5	0.46	0.72	ND		0.11
AOC6-1-18	ND		1.3	ND		0.09	0.8	0.45	0.72	ND		0.066
AOC6-1-19	ND		1.3	ND		0.09	1.1	0.46	0.72	ND		0.059

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

Table 7: (continued) Post Remediation Soil Radiological Concentrations (pCi/gm) for the AOC 6 Class 1 Areas

Sample ID	Pu-239/240			U-234			U-235			U-238		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC
AOC6-1-01	0.014	0.028	0.037	0.39	0.19	0.05	ND		0.06	0.31	0.16	0.09
AOC6-1-02	ND		0.083	0.36	0.18	0.16	ND		0.18	0.51	0.22	0.14
AOC6-1-03	ND		0.098	0.17	0.11	0.09	0.02	0.04	0.054	0.15	0.11	0.09
AOC6-1-04	0.038	0.048	0.065	0.38	0.19	0.12	0.023	0.046	0.062	0.33	0.17	0.05
AOC6-1-05	0.047	0.048	0.032	0.29	0.15	0.07	ND		0.092	0.38	0.17	0.07
AOC6-1-06	0.009	0.019	0.025	0.23	0.13	0.09	0.021	0.041	0.056	0.34	0.17	0.09
AOC6-1-07	ND		0.1	0.35	0.18	0.06	ND		0.14	0.28	0.16	0.1
AOC6-1-08	ND		0.06	0.25	0.13	0.11	ND		0.09	0.111	0.081	0.073
AOC6-1-09	0.038	0.038	0.046	0.42	0.18	0.07	ND		0.083	0.3	0.14	0.1
AOC6-1-10	0.26	0.22	0.08	5.5	1.3	0.05	0.26	0.17	0.07	5.8	1.4	0.09
AOC6-1-11	0.59	0.2	0.03	0.79	0.27	0.11	0.083	0.083	0.1	0.41	0.18	0.1
AOC6-1-12	0.15	0.1	0.04	0.3	0.16	0.13	0.056	0.077	0.12	0.44	0.2	0.05
AOC6-1-13	0.19	0.12	0.07	0.096	0.088	0.052	0.024	0.048	0.064	0.15	0.11	0.09
AOC6-1-14	0.4	0.16	0.07	2.83	0.73	0.1	0.25	0.16	0.1	3.73	0.91	0.11
AOC6-1-15	0.36	0.14	0.07	0.58	0.26	0.19	ND		0.2	0.61	0.26	0.17
AOC6-1-16	0.28	0.12	0.05	0.51	0.23	0.12	0.051	0.073	0.069	0.49	0.23	0.12
AOC6-1-17	0.034	0.048	0.046	0.12	0.11	0.12	ND		0.07	0.39	0.2	0.06
AOC6-1-18	0.012	0.023	0.032	0.36	0.19	0.1	ND		0.14	0.24	0.15	0.1
AOC6-1-19	1.73	0.46	0.08	0.34	0.18	0.11	0.024	0.048	0.065	0.34	0.18	0.11

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

Table 8: Post Remediation Soil Radiological Concentrations (pCi/gm) for the AOC 6 Class 2 Areas

Sample ID	Co-60			Cs-137			Eu-152			Eu-154			Eu-155		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC
AOC6-2-01	ND		0.07	0.2	0.05	0.08	ND		0.1	ND		0.08	ND		0.1
AOC6-2-02	ND		0.09	0.9	0.1	0.09	ND		0.1	ND		0.1	ND		0.1
AOC6-2-03	ND		0.04	0.4	0.2	0.2	ND		0.2	ND		0.2	ND		0.3
AOC6-2-04	ND		0.1	ND		0.2	ND		0.2	ND		0.2	ND		0.4
AOC6-2-05	ND		0.1	ND		0.2	ND		0.3	ND		0.2	ND		0.3
AOC6-2-06	ND		0.1	ND		0.2	ND		0.2	ND		0.2	ND		0.2
AOC6-2-07	ND		0.1	ND		0.2	ND		0.2	ND		0.2	ND		0.2
AOC6-2-08	ND		0.2	ND		0.1	ND		0.2	ND		0.2	ND		0.3
AOC6-2-09	ND		0.2	ND		0.2	ND		0.2	ND		0.2	ND		0.3
AOC6-2-10	ND		0.07	0.2	0.07	0.1	ND		0.1	ND		0.08	ND		0.1
AOC6-2-11	ND		0.1	0.5	0.08	0.09	ND		0.2	ND		0.1	ND		0.2
AOC6-2-12	ND		0.08	0.3	0.06	0.07	ND		0.1	ND		0.09	ND		0.1
AOC6-2-13	ND		0.06	0.3	0.06	0.08	ND		0.1	ND		0.08	ND		0.1
AOC6-2-14	ND		0.07	0.7	0.08	0.07	ND		0.1	ND		0.09	ND		0.1
AOC6-2-15	ND		0.05	0.06	0.03	0.05	ND		0.09	ND		0.07	ND		0.08
AOC6-2-16	ND		0.04	0.2	0.05	0.06	ND		0.08	ND		0.05	ND		0.1
AOC6-2-17	ND		0.05	0.9	0.1	0.09	ND		0.08	ND		0.06	ND		0.1
AOC6-2-18	ND		0.04	1.6	0.1	0.08	ND		0.09	ND		0.06	ND		0.1
AOC6-2-19	ND		0.03	0.2	0.03	0.05	ND		0.06	ND		0.05	ND		0.08

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

Table 8: (continued) Post Remediation Soil Radiological Concentrations (pCi/gm) for the AOC 6 Class 2 Areas

Sample ID	Ra-226			Am-241			Sr-90			Pu- 238		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC
AOC6-2-01	ND		1.2	ND		0.09	0.4	0.45	0.72	ND		0.047
AOC6-2-02	ND		1.5	ND		0.1	3.2	0.48	0.72	ND		0.075
AOC6-2-03	ND		2.9	ND		0.2	2.1	0.47	0.72	ND		0.07
AOC6-2-04	ND		3.8	ND		0.3	2.5	0.47	0.72	ND		0.063
AOC6-2-05	ND		3.2	ND		0.2	2.6	0.48	0.72	ND		0.053
AOC6-2-06	ND		2.5	ND		0.2	2.2	0.47	0.72	ND		0.04
AOC6-2-07	ND		2.1	ND		0.2	1.1	0.46	0.72	ND		0.072
AOC6-2-08	ND		2.4	ND		0.2	2.1	0.47	0.72	ND		0.098
AOC6-2-09	ND		2.7	ND		0.2	2.1	0.47	0.72	0.028	0.04	0.038
AOC6-2-10	ND		1.5	ND		0.1	1.7	0.46	0.72	ND		0.07
AOC6-2-11	ND		1.8	ND		0.1	2.2	0.47	0.72	ND		0.084
AOC6-2-12	ND		1.4	ND		0.1	1.9	0.47	0.72	ND		0.087
AOC6-2-13	ND		1.1	ND		0.09	1.9	0.47	0.72	0.013	0.025	0.034
AOC6-2-14	ND		1.3	ND		0.1	2.1	0.47	0.72	ND		0.1
AOC6-2-15	ND		0.9	ND		0.07	0.4	0.45	0.72	ND		0.04
AOC6-2-16	ND		1.4	ND		0.06	1.8	0.47	0.72	ND		0.05
AOC6-2-17	ND		0.9	ND		0.06	1.8	0.47	0.72	ND		0.064
AOC6-2-18	ND		1.2	ND		0.06	2.2	0.47	0.72	ND		0.079
AOC6-2-19	1.7	1	1.5	ND		0.05	2	0.47	0.72	ND		0.06

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

Table 8: (continued) Post Remediation Soil Radiological Concentrations (pCi/gm) for the AOC 6 Class 2 Areas

Sample ID	Pu-239/240			U-234			U-235			U-238		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC
AOC6-2-01	0.03	0.035	0.027	0.145	0.092	0.036	ND		0.092	0.21	0.11	0.06
AOC6-2-02	ND		0.058	0.3	0.16	0.09	ND		0.11	0.22	0.14	0.11
AOC6-2-03	ND		0.07	0.42	0.19	0.04	ND		0.096	0.45	0.19	0.1
AOC6-2-04	0.063	0.06	0.063	1.83	0.49	0.14	ND		0.16	1.07	0.33	0.12
AOC6-2-05	ND		0.03	0.25	0.13	0.08	ND		0.05	0.19	0.11	0.08
AOC6-2-06	ND		0.04	0.68	0.28	0.12	0.026	0.052	0.07	0.79	0.3	0.06
AOC6-2-07	ND		0.061	0.71	0.27	0.09	ND		0.11	0.65	0.26	0.09
AOC6-2-08	ND		0.08	0.31	0.15	0.1	0.058	0.068	0.053	0.37	0.17	0.08
AOC6-2-09	ND		0.04	0.58	0.21	0.04	ND		0.09	0.42	0.17	0.06
AOC6-2-10	ND		0.059	0.24	0.13	0.11	ND		0.095	0.24	0.13	0.08
AOC6-2-11	ND		0.069	0.41	0.17	0.07	ND		0.082	0.34	0.15	0.09
AOC6-2-12	ND		0.095	0.37	0.16	0.1	ND		0.094	0.3	0.14	0.09
AOC6-2-13	ND		0.03	0.28	0.16	0.13	ND		0.12	0.38	0.18	0.05
AOC6-2-14	0.15	0.1	0.04	0.75	0.29	0.06	0.1	0.11	0.07	0.56	0.24	0.06
AOC6-2-15	ND		0.04	0.15	0.11	0.05	ND		0.1	0.15	0.11	0.1
AOC6-2-16	0.011	0.021	0.028	0.34	0.17	0.16	ND		0.17	0.41	0.19	0.14
AOC6-2-17	0.2	0.11	0.08	0.26	0.14	0.09	ND		0.06	0.23	0.13	0.09
AOC6-2-18	0.43	0.16	0.05	0.51	0.22	0.11	0.066	0.078	0.06	0.57	0.23	0.05
AOC6-2-19	ND		0.06	0.36	0.19	0.1	ND		0.15	0.49	0.23	0.1

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

Table 9: Soil Radiological Concentrations (pCi/gm) for the AOC 6 Reference Area

Sample ID*	Co-60			Cs-137			Eu-152			Eu-154			Eu-155		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC
H1	ND		0.07	0.3	0.07	0.09	ND		0.1	ND		0.08	ND		0.1
H2	ND		0.07	0.3	0.05	0.07	ND		0.1	ND		0.09	ND		0.1
H3	ND		0.07	0.3	0.05	0.06	ND		0.1	ND		0.09	ND		0.1
H4	ND		0.08	0.4	0.07	0.08	ND		0.1	ND		0.09	ND		0.1
H5	ND		0.04	0.4	0.08	0.1	ND		0.1	ND		0.07	ND		0.1
H6	ND		0.05	0.4	0.08	0.1	ND		0.1	ND		0.07	ND		0.1
H7	ND		0.05	0.4	0.07	0.09	ND		0.09	ND		0.07	ND		0.1
H8	ND		0.05	0.3	0.07	0.08	ND		0.09	ND		0.07	ND		0.1
H9	ND		0.04	0.3	0.05	0.05	ND		0.07	ND		0.05	ND		0.1
H10	ND		0.05	0.4	0.07	0.09	ND		0.09	ND		0.06	ND		0.1
H11	ND		0.04	0.2	0.05	0.06	ND		0.08	ND		0.05	ND		0.1
H12	ND		0.05	0.4	0.08	0.1	ND		0.09	ND		0.06	ND		0.1
H13	ND		0.04	0.3	0.08	0.1	ND		0.1	ND		0.07	ND		0.1
H14	ND		0.04	0.3	0.06	0.08	ND		0.09	ND		0.07	ND		0.1
H15	ND		0.04	0.4	0.07	0.08	ND		0.09	ND		0.07	ND		0.1
H16	ND		0.04	0.3	0.06	0.08	ND		0.09	ND		0.07	ND		0.1

a. For the reference area, Pu-238, Pu-239/240 and Sr-90 were not analyzed for and are assigned "0" concentration, since these radionuclides are not found in background soils.

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

*Sample locations are provided in Figure 1B.

Table 9: (continued) Soil Radiological Concentrations (pCi/gm) for the AOC 6 Reference Area

Sample ID*	Ra-226			Am-241			Sr-90 [a]			Pu- 238 [a]		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC
H1	1.1	0.8	1.2	ND		0.10	0			0		
H2	1.1	0.7	1.1	ND		0.10	0			0		
H3	1.6	0.7	1.1	ND		0.10	0			0		
H4	ND		1.4	ND		0.10	0			0		
H5	ND		1.9	ND		0.07	0			0		
H6	1.8	1.1	1.8	ND		0.07	0			0		
H7	1.9	0.9	1.4	ND		0.08	0			0		
H8	ND		1	ND		0.07	0			0		
H9	1.6	0.9	1.4	ND		0.06	0			0		
H10	1.1	1	1.6	ND		0.07	0			0		
H11	1.1	0.7	1.2	ND		0.06	0			0		
H12	ND		1	ND		0.06	0			0		
H13	ND		1.9	ND		0.08	0			0		
H14	2.2	1.3	2.1	ND		0.07	0			0		
H15	ND		0.09	ND		0.07	0			0		
H16	0.9	1	1.7	ND		0.07	0			0		

a. For the reference area, Pu-238, Pu-239/240 and Sr-90 were not analyzed for and are assigned "0" concentration, since these radionuclides are not found in background soils.

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

*Sample locations are provided in Figure 1B.

Table 9: (continued) Soil Radiological Concentrations (pCi/gm) for the AOC 6 Reference Area

Sample ID*	Pu-239/240 [a]			U-234			U-235			U-238		
	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC	Conc.	Un-cert	MDC
H1	0			0.81	0.31	0.1	ND		0.13	0.7	0.29	0.06
H2	0			0.51	0.23	0.12	ND		0.07	0.86	0.32	0.12
H3	0			0.67	0.25	0.12	ND		0.092	1.02	0.33	0.13
H4	0			1.03	0.32	0.11	0.053	0.067	0.09	0.99	0.31	0.07
H5	0			1.01	0.36	0.12	ND		0.13	0.83	0.32	0.14
H6	0			0.89	0.31	0.08	0.054	0.074	0.12	0.88	0.3	0.05
H7	0			0.74	0.3	0.12	0.054	0.078	0.073	0.99	0.36	0.14
H8	0			0.86	0.29	0.08	0.04	0.057	0.054	0.87	0.3	0.09
H9	0			0.97	0.37	0.18	ND		0.28	0.78	0.33	0.25
H10	0			1.14	0.4	0.11	0.028	0.057	0.076	0.61	0.27	0.11
H11	0			1.01	0.33	0.08	0.07	0.08	0.11	0.99	0.32	0.04
H12	0			0.95	0.35	0.21	ND		0.19	0.81	0.31	0.12
H13	0			1.1	0.36	0.09	ND		0.11	1.19	0.38	0.05
H14	0			0.71	0.28	0.1	ND		0.12	0.73	0.29	0.06
H15	0			1.14	0.4	0.11	ND		0.14	0.91	0.34	0.04
H16	0			1.17	0.41	0.13	0.083	0.097	0.075	1.08	0.38	0.13

a. For the reference area, Pu-238, Pu-239/240 and Sr-90 were not analyzed for and are assigned "0" concentration, since these radionuclides are not found in background soils.

The tables provide values in pCi/g for concentration (Conc.), for the statistical counting uncertainty (Uncert), and for the minimum detectable concentration (MDC).

*Sample locations are provided in Figure 1B.

ORISE located several discrete spots of residual contamination that were not identified in advance by BNL. The "swinging" detector method used by ORISE appears to be more effective for finding discrete spots than the "walkover" method used by BNL's contractor.

(a) Sample result exceeding the U-238 criteria

ORISE found this sample location to contain 174 pCi/gm U-238. This location represents an area adjacent to and associated with a monitoring well that was excavated as deep as practical. No further excavation of this location is planned. The pit will be filled to grade and covered with topsoil.

This area was sampled by BNL following the identification by ORISE. Results of the BNL and ORISE analyses are provided in Table 10.

Table 10. Area of Elevated U-238 activity

Organization	BNL		ORISE
Sample ID	AOC6-PL67		35
Radionuclide	Activity	MDC	Activity
Co-60 [a]	ND	0.2	0.14 ± 0.03
Cs-137 [a]	16 ± 0.2	0.2	23.4 ± 0.98
Eu-152 [a]	ND	0.2	0.48 ± 0.15
Eu-154 [a]	ND	0.2	NR
Eu-155 [a]	ND	0.2	NR
Ra-226 [a]	1.1 ± 0.57	2.5	NR
Am-241 [a]	ND	0.2	0.74 ± 0.18
U-234 [c]	23.3± 4.9	0.1	NR
U-235 [c]	1.1± 0.4	0.2	NR
U-238 [c]	24.7± 5.2	0.1	174 ± 11
Pu239/240 [c]	1.99± 0.5	0.08	---
Sr-90 [d]	2.6± 0.8	0.9	---

Notes:
- a gamma spectroscopy analysis
- c alpha spectroscopy
- d wet chemistry separation
- MDC minimum detectable concentration
- ND not detected at 95% confidence level
- NR not reported
- --- analysis not performed

ORISE results from *Letter Report, Area of Concern 6, BNL, Sept 9, 2002* (see Attachment 2)

Of the 19 Class 1 area samples taken by BNL, only two samples exhibited U-238 greater than 1.0 pCi/g, and none exceeded 5.8 pCi/gm of U-238 (see Table 7). Of the 19 Class 2 area samples taken by BNL, only two samples exhibited U-238 greater than 0.65 pCi/g, with the highest observed

concentration of 1.07 pCi/g U-238 (see Table 8). Of the other four post cleanup biased sample analyses performed by ORISE, the highest U-238 concentration was 2.7 pCi/gm. Of the eight samples taken by NYSDEC, the highest U-238 concentration observed was 9.5 pCi/gm. A review for Pa-234m (a decay progeny of U-238) in BNL samples taken prior to final cleanup indicates only low levels of potential U-238 even when other contaminants were elevated. The maximum concentration of U-238 found in the area prior to remediation was 51 pCi/g (see Table 1). The above data suggest that the isolated finding of 174 pCi/gm U-238 was an anomaly, not representative of activity in the outfall area. It is likely that sampling the spot removed the majority of the elevated activity, as is evidenced by the reduced concentration and survey meter counts observed in the results of the subsequent BNL sample. An earlier radiological survey showed 28.8 Kcpm and a recent survey following resampling of that location resulted in 18.8 Kcpm (see Attachment 6). It should be noted that this discrete site represents a small area less than a square meter. A dose assessment of this sample location is provided in Section 4, below.

(b) Section of storm line pipe not removed

Approximately 25 feet of storm line (five, 5-ft sections of pipe) at a depth of 12-14 feet below grade were left in place. The pipe could not be excavated and removed without adversely impacting the integrity of an overlying conduit containing an active high voltage supply line for the laboratory. Visual inspection of the pipe interior revealed there was not enough material volume inside the pipe to sample. Both BNL and ORISE obtained samples of soil adjacent to each end of the pipe for analysis, with the results indicated in Table 11. Positioning a survey meter with a NaI detector at locations along the pipe interior for static one-minute analyses revealed the count rates indicated in Table 12. Activity in the soil appeared to be associated with residues released from the pipe joint when separating the concrete sections.

Accessible soil contamination was removed to the extent practical. The ends of the pipe were sealed with concrete. After backfilling with clean overburden, the pipe and remaining soil were 14 feet below grade. The risk associated with leaving this contaminated pipe in place is assessed in Section 4, below.

(2) Elevated areas identified by NYSDEC

On the initial survey, NYSDEC identified soil in excess of the cleanup goals remaining in the drainage pipe trench and at two locations in the sump outfall vicinity. On the return survey, following additional remediation efforts by BNL, NYSDEC evaluated the two previous locations and identified two additional areas above the cleanup goals. NYSDEC concluded:

> *...the areas exhibiting the high concentration shown in samples 061201, 061202, and 062701 were remediated following our investigations. The residual concentrations shown by sample 062702 was not further remediated....* [NYSDEC, *Radiation Survey Report*, BNL, report dated August 16, 2002 (see Attachment 1)]

NYSDEC also identified the location of contaminated soil under the active electrical service line that was described previously.

Table 11. Soil Radioactivity (pCi/g) in soil adjacent to un-excavated pipe

Location	East end of pipe			West end of pipe		
Organization	BNL		ORISE	BNL		ORISE
Sample ID	AOC6-PL64		ESSAP 24	AOC6-PL65		ESSAP 25
Radionuclide	Activity	MDC	Activity	Activity	MDC	Activity
Co-60 [a]	0.7 ± 0.1	0.10	0.0 ± 0.02	1.0 ± 0.1	0.14	0.19 ± 0.05
Cs-137 [a]	0.56 ± 0.12	0.10	0.45 ± 0.05	37.9 ± 3.4	0.25	25.6 ± 1.10
Eu-152 [a]	ND	0.20	-0.01 ± 0.03	2.0 ± 0.2	0.29	1.38 ± 0.27
Eu-154 [a]	ND	0.14	NR	1.1 ± 0.1	0.21	NR
Eu-155 [a]	ND	0.16	NR	ND	0.28	NR
Ra-226 [a]	ND	0.16	NR	ND	0.35	NR
Am-241 [a]	ND	0.14	0.02 ± 0.02	0.5 ± 0.15	0.25	0.33 ± 0.06
Sr-90 [b]	0.4 ± 0.5	0.79	---	15.8 ± 0.7	0.79	---
U-234 [c]	0.39 ± 0.18	0.11	NR	2.7 ± 0.8	0.29	NR
U-238 [c]	0.34 ± 0.17	0.09	0.71 ± 0.41	2.6 ± 0.8	0.25	2.3 ± 1.0
Pu239/240 [c]	0.16 ± 0.10	0.08	0.22 ± 0.05	5.0 ± 1.1	0.06	4.1 ± 0.4
Sr-90 [d]	1.13 ± 0.52	0.72	1.29 ± 0.47	11.2 ± 2.4	0.8	3.63 ± 0.60

Notes: a gamma spectroscopy analysis; b BetaScint; c alpha spectroscopy; d wet chemistry separation
MDC minimum detectable concentration; NR not reported
ND not detected at 95% confidence level; --- analysis not performed
ORISE results from *Letter Report, Area of Concern 6, BNL, Sept 9, 2002* (see Attachment 2)

Table 12. Counts in one minute at locations on interior of un-excavated pipe

Location	Background	Opening	1 foot	2 feet	3 feet
East end of pipe	5,578	26,160	19,127	16,252	18,082
West end of pipe	6,600	17,822	8,397	9,247	12,811

(a) Activity at depth not removed

In the outfall area several monitoring wells had been installed in order to detect any potential groundwater impact of the radionuclides that had been released at the site. During the remediation of the site, small pockets of elevated activity were found below the layer of soil meeting the cleanup goals. The area near NYSDEC sample location 062702 corresponded to an old monitoring well. Radioactivity observed in the sample analysis is provided in Table 13.

It was surmised that rain events since the installation of the monitoring wells led to the mobilization of radionuclides in the soil that preferentially drained down the outside of a well, contributing to the observed deep sub-surface contamination. The area adjacent to the well was excavated as deep as

practical without adversely impacting well integrity and within the capabilities of the available equipment. The risk associated with leaving this contaminated soil in place is assessed in Section 4, below.

(b) Section of storm line pipe not removed

The description of the radioactivity and conditions of this area were previously addressed in the discussion of ORISE findings. The risk associated with leaving this contaminated pipe in place is assessed in Section 4 below.

Table 13. Soil Radioactivity (pCi/g) in soil at depth

Organization	BNL		NYSDEC	
Sample ID	AOC 6 - PL66		062702	
Radionuclide	Activity	MDC	Activity	MDC
Co-60 [a]	0.56 ± 0.06	0.11	ND	0.07
Cs-137 [a]	16.6 ± 2.3	0.09	20.3 ± 2.2	0.11
Eu-152 [a]	ND	0.23	NR	NR
Eu-154 [a]	ND	0.16	NR	NR
Eu-155 [a]	ND	0.17	NR	NR
Ra-226 [a]	ND	0.21	0.45 ± 0.16	0.21
Am-241 [a]	ND	0.16	NR	NR
Sr-90 [b]	1.2 ± 0.5	0.8	---	---
U-238 [a]	0.56 ± 0.26	0.13	ND	1.69
Pu-238 [b]	ND	0.03	ND	0.12
Pu239/240 [b]	ND	0.028	ND	0.09
Sr-90 [c]	1.14± 0.58	0.82	1.57 ± 0.02	0.66

Notes: a gamma spectroscopy analysis b BetaScint
c alpha spectroscopy c wet chemistry separation
MDC minimum detectable concentration NR not reported
ND not detected at 95% confidence level --- Analysis not performed
NYSDEC results from *Radiation Survey Report, BNL, Aug 16, 2002* (see Attachment 1)

2.6.3 Final Status Survey Conclusions

The Wilcoxon Rank Sum (WRS) test was performed to demonstrate that the excavated site meets the clean-up criteria. In the WRS Test null hypothesis, one assumes that the survey unit is still contaminated above the cleanup goal and uses the test on survey unit and reference area characteristic statistics to support or reject this assumption.

As described in Section 2.6.1, the weighted sums were computed for each measurement location in both the reference area and the two survey units. For radionuclides that were not detected, the MDC was greater than the sum of the concentration and the uncertainty (two standard deviations), the MDC values were used in place of an actual concentration. For the samples in the reference area, a value of zero was used for Sr-90 and Pu-239/240. The WRS test was then performed on the weighted sum. The calculations for the statistical test are shown in Tables 14 and 15 for the Class 1 and Class 2 areas, respectively. The CG_W (i.e., 1.0, when using the unity rule for multiple radionuclides) was added to the weighted sum for each location in the reference area. The ranks of the combined survey unit and adjusted reference area weighted sums were then computed. The concentrations of Pu-238 and U-235 were not included in the results since there was no clean-up level for these radionuclides.

A critical value test statistic of 338 was obtained from MARSSIM Table I.4 for 16 reference samples, 19 survey samples and a Type I error of 0.05. The sum of the ranks of the adjusted reference area weighted sums was then compared to the critical value. In Tables 9 and 10, the sums of the ranks of the adjusted reference area weighted sums are 423 for the Class 1 area and 439 for the Class 2 area. Since the test statistic value exceeds the critical value in each case, the null hypothesis is rejected in each survey unit. Each survey unit meets the release criterion.

2.6.4 Independent Verification

The Oak Ridge Institute for Science and Education (ORISE) served as an independent authority to verify that remediation efforts and analysis procedures were sufficient to support the conclusion that clean-up goals were achieved. Additional excavation near monitoring wells and the former location of the headwall were also verified by ORISE. ORISE, under contract to DOE, prepared a separate survey plan, reviewed project surveys and analysis results, and performed an independent field verification sampling and walkover survey to evaluate the final status after remediation. In addition, the NYSDEC also performed an independent verification to support that clean up goals were achieved. The preliminary independent verification findings are provided in the Attachment 1.

Table 14: WRS Test Results for Class 1 Areas

Nuclide	Co-60	Cs-137	Eu-152	Eu-154	Eu-155	Ra-226	Am-241	Sr-90	Pu-239/240	U-234	U-238	Sum	Rank	
Clean up Goal$_i$	1160	23	49	170	150000	5	39	15	40	13	11		Ref.	Survey
H1	0.07	0.3	0.1	0.08	0.1	1.1	0.1	0	0	0.81	0.7	1.30	24	0
H2	0.07	0.3	0.1	0.09	0.1	1.1	0.1	0	0	0.51	0.86	1.28	20	0
H3	0.07	0.3	0.1	0.09	0.1	1.6	0.1	0	0	0.67	1.02	1.39	28	0
H4	0.08	0.4	0.1	0.09	0.1	1.4	0.1	0	0	1.03	0.99	1.38	27	0
H5	0.04	0.4	0.1	0.07	0.1	1.9	0.07	0	0	1.01	0.83	1.48	32	0
H6	0.05	0.4	0.1	0.07	0.1	1.8	0.07	0	0	0.89	0.88	1.45	30	0
H7	0.05	0.4	0.09	0.07	0.1	1.9	0.08	0	0	0.74	0.99	1.46	31	0
H8	0.05	0.3	0.09	0.07	0.1	1	0.07	0	0	0.86	0.87	1.28	21	0
H9	0.04	0.3	0.07	0.05	0.1	1.6	0.06	0	0	0.97	0.78	1.41	29	0
H10	0.05	0.4	0.09	0.06	0.1	1.1	0.07	0	0	1.14	0.61	1.33	26	0
H11	0.04	0.2	0.08	0.05	0.1	1.1	0.06	0	0	1.01	0.99	1.31	25	0
H12	0.05	0.4	0.09	0.06	0.1	1	0.06	0	0	0.95	0.81	1.29	23	0
H13	0.04	0.3	0.1	0.07	0.1	1.9	0.08	0	0	1.1	1.19	1.48	33	0
H14	0.04	0.3	0.09	0.07	0.1	2.2	0.07	0	0	0.71	0.73	1.51	34	0
H15	0.04	0.4	0.09	0.07	0.1	0.09	0.07	0	0	1.14	0.91	1.13	18	0
H16	0.04	0.3	0.09	0.07	0.1	0.9	0.07	0	0	1.17	1.08	1.29	22	0
AOC6-1-01	0.5	0.08	0.1	0.09	0.1	1.3	0.09	5.1	0.014	0.39	0.31	0.67	0	14
AOC6-1-02	0.4	0.07	0.1	0.09	0.1	1	0.09	2.6	0.083	0.36	0.51	0.46	0	7
AOC6-1-03	0.4	0.04	0.1	0.09	0.1	1.1	0.09	0.5	0.098	0.17	0.15	0.29	0	2
AOC6-1-04	0.3	0.2	0.1	0.08	0.1	1.1	0.08	4.3	0.038	0.38	0.33	0.58	0	13
AOC6-1-05	0.03	0.6	0.07	0.05	0.08	0.9	0.05	3	0.047	0.29	0.38	0.47	0	8
AOC6-1-06	0.04	0.04	0.07	0.04	0.08	0.7	0.05	3.3	0.009	0.23	0.34	0.41	0	6
AOC6-1-07	0.03	0.03	0.06	0.05	0.07	0.7	0.05	1.3	0.1	0.35	0.28	0.29	0	1
AOC6-1-08	0.2	0.2	0.2	0.2	0.2	2.3	0.2	0.7	0.06	0.25	0.111	0.56	0	11
AOC6-1-09	0.3	1.1	0.3	0.2	0.3	3.3	0.2	2.2	0.038	0.42	0.3	0.93	0	17
AOC6-1-10	0.2	2.5	0.4	0.3	0.4	5.4	0.3	4	0.26	5.5	5.8	2.43	0	35
AOC6-1-11	0.5	3.5	0.2	0.1	0.2	1.7	0.1	3	0.59	0.79	0.41	0.81	0	16
AOC6-1-12	0.4	0.5	0.1	0.1	0.1	1.4	0.1	2.7	0.15	0.3	0.44	0.55	0	10
AOC6-1-13	0.5	0.6	0.1	0.1	0.1	1	0.1	0.7	0.19	0.096	0.15	0.30	0	3
AOC6-1-14	0.4	1.9	0.1	0.1	0.1	1.1	0.1	4.2	0.4	2.83	3.73	1.15	0	19
AOC6-1-15	0.4	2.6	0.1	0.1	0.1	1.3	0.1	1.1	0.36	0.58	0.61	0.56	0	12
AOC6-1-16	0.5	2.4	0.2	0.1	0.1	1.8	0.1	3.2	0.28	0.51	0.49	0.78	0	15
AOC6-1-17	0.4	0.2	0.1	0.08	0.1	1.2	0.08	1.5	0.034	0.12	0.39	0.40	0	5
AOC6-1-18	0.4	0.08	0.1	0.09	0.1	1.3	0.09	0.8	0.012	0.36	0.24	0.37	0	4
AOC6-1-19	0.4	0.7	0.1	0.09	0.1	1.3	0.09	1.1	1.73	0.34	0.34	0.47	0	9
Critical Value = 338							**Adjusted Sum**						**423**	207

Table 15: WRS Test Results for Class 2 Areas

Nuclide	Co-60	Cs-137	Eu-152	Eu-154	Eu-155	Ra-226	Am-241	Sr-90	Pu-239/240	U-234	U-238	Sum	Rank	
CG_i	1160	23	49	170	150,000	5	39	15	40	13	11		Ref.	Survey
H1	0.07	0.3	0.1	0.08	0.1	1.1	0.1	0	0	0.81	0.7	1.30	25	0
H2	0.07	0.3	0.1	0.09	0.1	1.1	0.1	0	0	0.51	0.86	1.28	21	0
H3	0.07	0.3	0.1	0.09	0.1	1.6	0.1	0	0	0.67	1.02	1.39	29	0
H4	0.08	0.4	0.1	0.09	0.1	1.4	0.1	0	0	1.03	0.99	1.38	28	0
H5	0.04	0.4	0.1	0.07	0.1	1.9	0.07	0	0	1.01	0.83	1.48	33	0
H6	0.05	0.4	0.1	0.07	0.1	1.8	0.07	0	0	0.89	0.88	1.45	31	0
H7	0.05	0.4	0.09	0.07	0.1	1.9	0.08	0	0	0.74	0.99	1.46	32	0
H8	0.05	0.3	0.09	0.07	0.1	1	0.07	0	0	0.86	0.87	1.28	22	0
H9	0.04	0.3	0.07	0.05	0.1	1.6	0.06	0	0	0.97	0.78	1.41	30	0
H10	0.05	0.4	0.09	0.06	0.1	1.1	0.07	0	0	1.14	0.61	1.33	27	0
H11	0.04	0.2	0.08	0.05	0.1	1.1	0.06	0	0	1.01	0.99	1.31	26	0
H12	0.05	0.4	0.09	0.06	0.1	1	0.06	0	0	0.95	0.81	1.29	24	0
H13	0.04	0.3	0.1	0.07	0.1	1.9	0.08	0	0	1.1	1.19	1.48	34	0
H14	0.04	0.3	0.09	0.07	0.1	2.2	0.07	0	0	0.71	0.73	1.51	35	0
H15	0.04	0.4	0.09	0.07	0.1	0.09	0.07	0	0	1.14	0.91	1.13	19	0
H16	0.04	0.3	0.09	0.07	0.1	0.9	0.07	0	0	1.17	1.08	1.29	23	0
AOC6-2-01	0.07	0.2	0.1	0.08	0.1	1.2	0.09	0.4	0.03	0.145	0.21	0.31	0	2
AOC6-2-02	0.09	0.9	0.1	0.1	0.1	1.5	0.1	3.2	0.058	0.3	0.22	0.60	0	12
AOC6-2-03	0.04	0.4	0.2	0.2	0.3	2.9	0.2	2.1	0.07	0.42	0.45	0.82	0	17
AOC6-2-04	0.1	0.2	0.2	0.2	0.4	3.8	0.3	2.5	0.063	1.83	1.07	1.19	0	20
AOC6-2-05	0.1	0.2	0.3	0.2	0.3	3.2	0.2	2.6	0.03	0.25	0.19	0.87	0	18
AOC6-2-06	0.1	0.2	0.2	0.2	0.2	2.5	0.2	2.2	0.04	0.68	0.79	0.79	0	16
AOC6-2-07	0.1	0.2	0.2	0.2	0.2	2.1	0.2	1.1	0.061	0.71	0.65	0.63	0	13
AOC6-2-08	0.2	0.1	0.2	0.2	0.3	2.4	0.2	2.1	0.08	0.31	0.37	0.69	0	14
AOC6-2-09	0.2	0.2	0.2	0.2	0.3	2.7	0.2	2.1	0.04	0.58	0.42	0.78	0	15
AOC6-2-10	0.07	0.2	0.1	0.08	0.1	1.5	0.1	1.7	0.059	0.24	0.24	0.47	0	5
AOC6-2-11	0.1	0.5	0.2	0.1	0.2	1.8	0.1	2.2	0.069	0.41	0.34	0.60	0	11
AOC6-2-12	0.08	0.3	0.1	0.09	0.1	1.4	0.1	1.9	0.095	0.37	0.3	0.48	0	7
AOC6-2-13	0.06	0.3	0.1	0.08	0.1	1.1	0.09	1.9	0.03	0.28	0.38	0.42	0	4
AOC6-2-14	0.07	0.7	0.1	0.09	0.1	1.3	0.1	2.1	0.15	0.75	0.56	0.55	0	8
AOC6-2-15	0.05	0.06	0.09	0.07	0.08	0.9	0.07	0.4	0.04	0.15	0.15	0.24	0	1
AOC6-2-16	0.04	0.2	0.08	0.05	0.1	1.4	0.06	1.8	0.011	0.34	0.41	0.48	0	6
AOC6-2-17	0.05	0.9	0.08	0.06	0.1	0.9	0.06	1.8	0.2	0.26	0.23	0.39	0	3
AOC6-2-18	0.04	1.6	0.09	0.06	0.1	1.2	0.06	2.2	0.43	0.51	0.57	0.56	0	10
AOC6-2-19	0.03	0.2	0.06	0.05	0.08	1.7	0.05	2	0.06	0.36	0.49	0.56	0	9
Critical Value = 338							**Adjusted Sum**						**439**	191

3.0 Waste Management

3.1 Waste Characterization and Handling

The waste management strategy, waste characterization, packaging, handling, and storage were in accordance with the *Building 650 Reclamation Facility Sump and Sump Outfall Waste Management Plan* (BNL, 2002) and the *BNL Standard Based Management System* (SBMS). The waste was designated as low-level radioactive waste (LLW) and was temporarily staged at the Former Chemical/Animal Holes, where the soil and debris were stockpiled for loading into railcars for transport to Envirocare of Utah.

Characterization of the waste stream was completed in accordance with the Final Bulk Waste Characterization for Off-site Disposal Sampling Guidance (BNL, August 2000). The Final Bulk Waste Characterization for Off-site Disposal Sampling Guidance (BNL, August 2000) provides information on requirements for the handling and characterization of bulk waste streams. Based on this guidance, sampling was conducted for TCLP metals and results confirmed that the soil was not hazardous in the areas identified for excavation (see Waste Management Plan).

3.2 Waste Shipment and Disposal

Transport to Envirocare occurred by placing the contaminated soil and debris onto rail cars for transportation via rail. Waste loading and shipping were completed on September 12, 2002. The types and volume of wastes excavated were discussed in Section 2.4 and listed in Table 3.

A LLW Exemption Request to DOE Order 435.1 was prepared to obtain permission from DOE to dispose of LLW at a non-DOE commercial disposal facility prior to the transport and disposal of the waste. The LLW Exemption Request showed that there are cost benefits to transport and disposal of the waste at Envirocare of Utah utilizing the DOE Ohio contract.

3.3 Pollution Prevention and Waste Minimization Opportunities

The overall objectives of the BNL Pollution Prevention and Waste Minimization Program include the following:

- Reduction of environmental impacts as low as reasonably achievable
- Elimination or reduction of wastes, effluents and emissions
- Reduction of waste management costs
- Conservation of natural resources and reuse of materials
- Recycling and procurement of environmentally preferable products.

The pollution prevention and waste minimization opportunities that resulted in cost avoidances during the Building 650 project include the following:

- The use of radiological walkover surveys for the removal of clean overburden to minimize the co-mingling of clean and contaminated soils thereby reducing the volume of waste generated.

- Controlling runoff by maintaining an earthen dome over the pipe and over a temporary roadbed to shed storm water away from the pipe during the remediation activities.

- Excavation of test pits along the pipeline by removing and separating soil in 6 inch lifts for characterization. This effort will provide a vertical profile of the contamination area to minimize soil removed.

- Using excavation methods that minimize quantities of excavated soil (i.e., hand and small equipment excavation), which are above treatment standards.

- Ensuring that the required radiological surveys are performed to prevent accidental spread of contamination.

4.0 Post Closure Dose Assessment

A post closure risk assessment was performed to verify that risks and doses from residual contaminants on site were within the risk and dose criteria described in section 1.3.

4.1 Risk Assessment Methods

An assessment of radiation risk and dose using the RESRAD code was performed for residually contaminated soils following the remediation efforts. RESRAD is a computer code developed by Argonne National Laboratory that calculates radiation dose from residual radioactivity in the ground (ANL, 2001). While the RESRAD model allows the inclusion of site-specific characteristics and exposure pathway assumptions, it remains conservative and protective of human health. The version of the RESRAD code used in this risk assessment is *RESRAD 6.1*, issued in July 2001.

The RESRAD code calculates radiation doses, soil guidelines, and media concentrations over user-specified time intervals. The radiation source is adjusted by the code over the time interval to account for radioactive decay and in-growth, leaching, erosion, and mixing. Assumptions on use and occupancy of the site in the future are used to quantify exposures to individuals through multiple environmental pathways and land use scenarios. RESRAD uses a one-dimensional groundwater model that accounts for differential transport of parent and progeny radionuclides with different distribution coefficients. In this risk assessment, doses estimated through RESRAD are compared to the risk for all pathways and to the dose limit for drinking water pathway.

4.2 Summary of Site Conditions.

Following the final status survey and verification that cleanup goals had been attained, the excavation will be backfilled to approximate the pre-excavation surface contours. In addition to the

site soils meeting the cleanup goals, there are three areas of slightly elevated activity that need to be addressed in the post remediation risk assessment. Concentration of measured contaminants in the remediation zone is provided in Table 15.

4.2.1 Backfill Materials

Backfill material will consist of:

- clean soil (volume sufficient to restore surface contour).
- excavated roots, soils, limbs and pieces from trees (biomass) that had been growing in the outfall area, with contaminant concentrations below the cleanup goals (approximately 30 cubic yards).

The branches and trunks of trees within Class 1 areas were treated as waste for disposal at Envirocare. Any remaining oversized root piles were sampled, and those piles meeting the cleanup criteria for soil were used as backfill material. Radiological surveys of the trees outside contaminated (Class 2 areas) and along the pipeline were conducted. The surveys indicated no elevated readings. These trees were then randomly sampled and the wood samples were sent for off-site analysis for gamma spec, gross beta, Sr-90, and alpha isotopic analysis. Results indicated that the trees in the class 2 areas did not need to be removed and treated as waste. The approved sampling strategy used to allow excavated material to be used as backfill is provided in the *Final Bulk Waste Characterization Sampling Guidance* (BNL, August 2000). The guidance provides information on the requirements for handling and characterization of bulk waste streams. In addition to field screening data, analytical data is available for the backfill material and is provided in Table 16.

The average depth of excavation at the Sump Outfall was approximately 5 ft. The volume of replaced biomass will create a 6-inch (0.15-cm) layer with an area of 1,600 ft^2 (150 m^2) covering approximately 15% of the outfall excavation hole. This backfill zone will then be covered with approximately 4.5 ft (1.4 m) of clean soil. Other portions of the excavation were filled/covered with an average of 5 feet (1.6 m) of clean soil. In the vicinity of the outfall, the average depth to the water table is 20 feet from the excavation bottom.

4.2.2 Section of storm line pipe not removed

Approximately 25 feet of storm line (five, 5-ft sections of pipe) at a depth of 12-14 feet below grade were left in place. The pipe could not be excavated and removed without adversely impacting the integrity of an overlying conduit containing an active high voltage supply line for the laboratory. Accessible soil contamination was removed to the extent practical. The ends of the pipe were sealed with concrete. After backfilling with clean overburden, the pipe and remaining soil were 14 feet below grade. The activity associated with this pipe and soil was described in Section 2.6.2, above. The approximate volume of the potential source is estimated at 0.5 m^3 (25 ft long X 1.5 ft wide by 0.5 ft deep).

4.2.3 Activity at depth not removed

Associated with monitoring wells in the outfall area were small pockets of elevated activity at greater depth than the surrounding contaminated layers. It was surmised that rain events since the installation of the monitoring wells led to the mobilization of radionuclides in the soils that preferentially drained down the outside of a well, contributing to the observed sub-surface contamination. The area adjacent to each well was excavated as deep as practical without adversely impacting well integrity and within the capabilities of the available equipment. The activity associated with this deep soil was described in Section 2.6.2, above. The approximate volume of the aggregate potential source from the wells is estimated at 17 m^3 (10 ft long X 10 ft wide X 3 ft deep X 2 wells).

Table 16: Contamination Concentration Summary

Radio-nuclide	Cleanup Goal (pCi/g)	Activity Concentration (pCi/g)					
		Reference Area	Class 1	Class 2	Backfill Biomass	Un-excavated Pipeline Soil	Soil at Depth
Co-60	1,160	ND [0.05 ± 0.01]	0.43 ± 0.06	ND [0.08 ± 0.04]	NR [0.3]	1.0 ± 0.1	ND
Cs-137	23	0.34 ± 0.06	1.06 ± 1.13	0.50 ± 0.43	0.17 ± 0.14	37.9 ± 3.4	20.3± 2.2
Eu-152	49	ND [0.09 ± 0.01]	ND [0.14 ± 0.09]	ND [0.14 ± 0.06]	NR [4.8]	2.0 ± 0.2	ND
Eu-154	170	ND [0.07 ± 0.01]	ND [0.10 ± 0.06]	ND [0.12 ± 0.06]	NR [17]	1.1 ± 0.1	ND
Eu-155	150,000	ND [0.15 ± 0.00]	ND [0.13 ± 0.08]	ND [0.17 ± 0.10]	NR [0.3]	ND	ND
Ra-226	5	1.4 ± 0.4	ND [1.6 ± 1.1]	ND [1.8 ± 0.8]	NR [0.5]	ND	0.5± 0.5
Am-241	39	ND [0.08 ± 0.01]	ND [0.11 ± 0.06]	ND [0.13 ± 0.07]	NR [4.0]	0.5 ± 0.15	0.7± 0.2
Sr-90	15	NM	2.4 ± 1.4	1.9 ± 0.7	1.3 ± 1.1	15.8 ± 0.7	2.6± 0.8
Pu-239/240	40	NM	0.28 ± 0.44	0.15 ± 0.16	0.004 ± 0.013	5.0 ± 1.1	2.0± 0.5
U-234	11	0.92 ± 0.19	0.75 ± 1.3	0.47 ± 0.38	0.07 ± 0.04	2.7 ± 0.8	23.2± 4.9
U-238	13	0.89 ± 0.15	0.81 ± 1.4	0.42 ± 0.23	0.04 ± 0.04	2.6 ± 0.8	24.7± 5.2
Number of samples		16	19	19	14	1 of 4 [a]	1 of 2 [a]

Notes:
- a : the concentrations are from the single, highest analysis of the four samples
- NM = not measured
- ND = not detected; minimum detectable concentration in [ ]
- NR = results not reported by laboratory when less than the contract specified value in [ ]
- 1.4 ± 0.4 = mean and standard deviation of multiple measurements

4.3 Post Remediation Exposure Assessment

In applying the RESRAD code to radiological risk analysis at BNL, certain assumptions are necessary, and consistent site parameters are developed to describe the site characteristics that influence potential radiological doses to individuals on the site. These assumptions are based on those given in the 1999 OU I Record of Decision (ROD).

4.3.1 Future Land Use

In developing the risk assessment, future land use was considered. BNL has evaluated future land use Plan alternatives for the facility. The OU I ROD assumes that BNL will continue to operate as a Federal Government research facility for an indeterminate time, after which it will be released for public use. The primary remedation goals for BNL based on the ROD include an industrial/residential land use scenario which is defined as:

(1) A 50-year period of continued federal operation and institutional control of BNL as an industrial site was assumed in developing the risk assessment. It is believed that the federal government will maintain use of the facilities at BNL for the foreseeable future.

(2) After 50 years, federal control of the facility is also a reasonable assumption. Even if a federal presence on site is not maintained, institutional controls such as deed restrictions and access controls could be used to ensure that unanticipated changes in land use do not occur that could result in unacceptalbe exposures to remaining contamination. Maintenance of existing fencing and signs could be performed as necessary.

(3) Despite the reasonable assumption of continued federal control, this risk evaluation was performed based on a residential land use scenario following a 50-year period of site operation. This proposed land use allows maximum flexibility in future governmental decisions and provides an extra safety conservatism in the risk analysis.

In this post remediation exposure assessment, two exposure scenarios were evaluated. The first was an industrial/commercial use scenario where present day workers were exposed to radiation from residual soil contamination within AOC6. The second scenario was a future resident scenario where exposure occurs at least fifty years in the future to an individual who constructs and lives in a home over the affected areas. The soil cleanup levels of 23 pCi/gm Cs-137 in the OU I ROD were base on this latter scenario.

4.3.2 Exposure Pathways

Given the land use scenario, there are exposure pathways in the RESRAD model that are inappropriate or must be modified, due to site specific characteristics that make it improbable that the pathway applies fully.

(a) Plant ingestion. The RESRAD code defines a bounding and credible scenario for a diet sustained by a residential garden as a garden providing half the family's diet if the area available

for gardens and orchards in 1,000 m^2 or more. It is assumed that half the diet would be food purchased from a market or alternate source, even if sufficient land were available for a larger garden.

(b) Meat and milk ingestion. The area required for livestock, including summer pasture and forage for winter use, to provide sufficient meat and milk for a family of four is estimated to be approximately 20,000 m^2. The total area of the Class 1 and Class 2 areas in AOC 6 is approximately 10,000 to 11,000 m^2 (see Table 4). Allowing for living areas, yard and drives, garden space, barns, and support buildings, the area available for grazing/forage would be considerably less than that necessary to support milk and meat production.

Although the AOC6 site is too small to provide a base for raising of meat or dairy foods on site for a self-sufficient diet, these pathways are evaluated in the model through shared pasture with adjacent areas. In this case, the residential land use scenario would imply that at some point in the future, the AOC6 area would be part of a much larger pasture, and dairy cattle would forage across the residually contaminated site and the non-impacted areas adjacent to AOC6. The RESRAD code scales the ingestion exposure pathway with the available area, the fraction of the meat and milk that is contaminated is assumed to decrease linearly from 1 to 0 as the area decreases from 20,000 to 0 m^2.

(c) Aquatic foods. The site does not support a surface water pond for raising aquatic foods. Assumptions on surface reconfiguration in the future to allow a pond would conflict with and disrupt the existing surface soil contamination, so that ponding assumptions rather than the site contaminants would dominate the risk evaluation.

The following Table 17 indicates the pathways that are active in the RESRAD analysis of the indicated land use scenario.

Table 17: Summary of Pathway Selections for Risk Assessment

Pathway	Residential Scenario	Industrial Scenario	Comment
external gamma	active	active	Time on site differs between scenarios
inhalation (w/o radon)	active	active	Time on site differs between scenarios
plant ingestion	active	suppressed	On site garden to supplement diet for resident
meat ingestion	active	suppressed	Small site proportioned to required area
milk ingestion	active	suppressed	Small site proportioned to required area
aquatic foods	suppressed	suppressed	Site inappropriate to support production
drinking water	active	suppressed	Alternate water source available for industrial use
soil ingestion	active	active	Incidental through ground contact
radon	suppressed	suppressed	No source on site

4.3.3 Detail of Model Parameters

The RESRAD code uses over 200 parameters to describe the site exposure scenario in the mathematical model. Default and BNL site-specific parameter values are provided in RESRAD reports in the appendix. Specific parameter values of interest are described here. The demographic and hydrogeological parameters used for modeling the exposures were the same as those used in previous analysis done for OU I. The differences consisted of the size of the areas of exposure, the levels of radioactivity within each of the areas and use of a soil cover for the excavated and backfilled area.

During 1 year the current/future on-site worker spends 1,500 hours (17%) outdoors at the site, 500 hours (6%) indoors at the site, and 6,760 hours (77%) away from the site. The future resident spends 4,380 hours (50%) indoors, 2,190 hours (25%) outdoors in the decontaminated area, and 2,190 hours (25%) away from the site. While indoors, the walls, floors, and foundation of the house or office building will reduce external direct gamma exposure by 20%.

The indoor dust level in the house or office building is 40% of the outdoor dust level. The annual intake of soil is 36.5 g/yr for future on-site worker and for the future resident. For the future resident scenario, an individual's annual intake of leafy vegetables and other produce is 14 and 160 kg/yr, respectively. Of the plant food diet consumed by the resident, 20% is grown in the remediated area. The future on-site worker does not consume these plants.

The precipitation and irrigation rates are 120 cm/yr and 20 cm/yr, respectively. Approximately 20% of the precipitation is lost by runoff and 46% of the remainder is lost by evapo-transpiration.

The sandy soils in the remediation area have a density of 1.66 g/cm^3 and a total and effective porosity of 0.33 and 0.24, respectively. The vertical hydraulic conductivity in the unsaturated zone is 5,000 m/yr. The hydraulic conductivity and hydraulic gradient in the saturated zone are 20,000

m/yr and 0.001, respectively. The “b” parameter used by RESRAD to calculate the saturation ratio in the unsaturated zones is 4.9.

The distribution coefficient (Kd) is used to calculate radionuclide leaching and transport in groundwater. The Kd value is specific to the chemical species of the radionuclide as well as the site-specific characteristics of the media.

- Site-specific distribution coefficients have been measured in BNL soil for several contaminants of concern (BNL, Furhmann, 1999). These values were substituted for RESRAD default values. The strontium-90 distribution coefficient of 7 ml/g was used instead of the default value of 15, and the cesium value of 190 was used instead of the default value of 1000. The smaller values indicate that more radionuclide is in the water phase, and mobilizes more readily.
- While the biomass backfill material may have dissimilar properties from soil, it was treated as soil in the model.

(Note: The property that most influences the risk assessment is the distribution coefficient, K_d, which measures the "strength" of the material to bind up the radionuclide. The lower the K_d value, the more rapidly the radioactive material releases from the solid matrix and enters the interstitial water phase. A distribution coefficient value is not available for Sr-90 in plant root tissue, so the value for soil was used. The site-specific value of 7 ml/g for BNL soil was used instead of the RESRAD default value of 30 ml/g. The biomass matrix is contaminated because, when alive, it extracted and bound the Sr-90 from the water phase and from the soil itself. It is likely that the Sr-90 is bound to the biomass at least as tightly as to the soil, so the assumption of the K_d for biomass being equal to that of soil is probably conservative.)

The future resident drinks 700 L/yr (2 L/d for 350 d/yr) of water drawn from an on-site well. For the future on-site worker it was assumed that an uncontaminated, potable water supply was available for consumption.

The soil radioactivity measurements and other principal parameters used in the model are summarized in Table 18. Cesium-137, Sr-90 and U-238 were the major contaminant of concern. The contributions of other radionuclides to any current or future exposures are negligible. For the future industrial scenario, radionuclide concentrations at year "0" are adjusted to account for decay during the 50-year period of institutional control.

Table 18: Parameter Values Used in the RESRAD Code

Parameter of Interest	Units	Class 1 Sub-surface	Class 2 Surface	Sub-surface Backfill	Un-excavated Pipeline Soil	Soil at Depth
Radionuclide activity at year "0"						
Co-60	pCi/g	0.4	0	0	1.0	0.1
Cs-137	pCi/g	0.7	0.16	0.2	38	20
Sr-90	pCi/g	2.5	2	1.3	15.8	2
U-238/234	pCi/g	0	0	0	2.6	20
Pu-239	pCi/g	0.3	0.15	0	5.0	1
Am-241	pCi/g	0	0	0	0.5	0.7
Area	m^2	1,850	9,100	150	3.5	17
Layer Thickness	m	0.15	0.15	0.15	0.15	0.9
Depth to ground water	m	6.1	7.6	6.25	6.1	4.0
Cover thickness	m	1.4	1.4	1.4	4.0	6.0
Length Parallel to Aquifer	m	50	100	15	7.5	3

The RESRAD code can evaluate only one contaminated area of uniform contamination for a single scenario. To evaluate the post-remediation AOC 6 areas, ten RESRAD runs were performed (the two scenarios in each of the five contamination zones). Printouts of each RESRAD analysis are provided in Attachment 5. The contributions of each source zone were combined to develop a risk estimate and dose for each of the land use scenarios.

4.4 Results

Following remediation residual contaminated soil and biomass are present at the levels and distributions indicated in Table 16. The consequences for each of the modeled scenarios as estimated by the RESRAD code are listed in Table 19.

(a) For the current site worker, the activity at depth does not present an external or direct exposure hazard to the individual, and the surface activity is only a minor exposure. The dose and risk are essentially zero. The future site worker is exposed to even less, due to decay of the surface activity during the 50-year period of institutional presence and control. [In the extreme future, beyond 1,000 years, the prediction of increasing dose and risk is beyond the credible projection of the model assumptions].

(b) The dose and risk for the future resident occurs from potential migration of radionuclides into the drinking water supply approximately 60 years (for Sr-90) to 400 years (for U-234/U-238) following the remediation. This would be approximately 10 years after the assumed period of institutional control. The analysis indicates that the maximum dose and excess risk

occur to a future resident at approximately Year 440, due to potential migration of Uranium into the groundwater used as an untreated drinking water source. Radionuclides might be detectable in the well water of the future resident, but their concentrations are well below the Maximum Contaminant Level established by the US EPA in the *National Primary Drinking Water Regulations*, Title 40, CFR Part 141.

Graphs of estimated radionuclide concentration, total dose, and excess risk from remaining contaminated materials are shown in Attachment 4.

Table 19. Consequences of Residual Radioactive Materials in AOC6

Consequence	Current Worker (1)	Future Worker (1)	Future Resident
Maximum Excess Risk	1.5E-13 in initial year	2.0E-15 in year 51	3.9E-06 in year 438 (2)
Maximum Total Dose	3.3E-08 mrem in initial year	2.2E-10 mrem in year 51	0.81 mrem in year 438
Maximum Dose through Groundwater Pathways	0 mrem Water from on site is not consumed	0 mrem Water from on site is not consumed (3)	0.81 mrem in year 438
Maximum Concentration of Sr-90 in Drinking Water	0.63 pCi/L in year 96	Maximum Contaminant Limit 8 pCi/L	
Maximum Concentration of Total Uranium in Drinking Water	4.0 pCi/L [4.4 µg/L] (4) in year 438	Maximum Contaminant Limit 27 pCi/L [30 µg/L]	
Maximum Concentration of Am-241 in Drinking Water	0.1 pCi/l in year 180	Maximum Contaminant Limit 15 pCi/L gross alpha	

Note (1) Although the code calculates a finite value for the dose and risk for the worker scenario, the extremely small values are essentially zero (0).

(2) Time of occurrence of the consequence is measured from the end of remediation. Thus Year 438 is 438 years after remediation or 388 years following the end of a 50-year institutional control period.

(3) If the future worker consumed water from on site, consequences would be less than those from the future resident, since less than 100% of the water diet is consumed from the site during working hours.

(4) Using EPA mid-range conversion factor of 0.9 picoCurie per microgram (pCi/µg) for Uranium, from *National Primary Drinking Water Regulations, Final Rule,* **Federal Register**, Dec 7, 2000.

4.5 Conclusions

The post-remediation risk assessment has quantified the estimated dose and excess risk associated with each land use alternative.

- The remediated site is protective of the future site resident under the dose criterion of 15 mrem/yr total effective dose equivalent through all exposure pathways. The dose is also less than the 10 mrem/yr NYSDEC guidance and proposed As Low As Reasonably Achievable (ALARA) goal.
- The remediated site is protective of the future site resident under the dose criterion of 4 mrem/yr total effective dose equivalent through the drinking water exposure pathway.
- The remediated site is protective of the drinking water supply. The only radionuclides that reach the groundwater are Sr-90, Am-241 and U-234/U-238. The maximum concentration in drinking water for the radionuclides remains well below the current regulatory limits.
- The remediated site is protective of the future site resident under the excess risk criterion of 1E-04 to 1E-06 through all exposure pathways.
- The remediated site is protective of the current site worker under dose criteria of Title 10 CFR Part 835.

5.0 Lessons Learned

The following is a summary of the lessons learned from this project and the corrective actions for future projects:

1. All remediation should be totally completed and survey/analytical data evaluated before scheduling the independent verification contractor and regulators to perform the final status verification sampling.
   ***Corrective Action*:** BNL shall forward the results of the final status survey sampling verifying that remediation has been completed to the independent verification contractors for review prior to scheduling the independent verification contractors. The Operating Procedure for conducting gamma surveys will be modified to incorporated this requirement.

2. The planning phase of this project should be evaluated to take a look at the compression of the schedule toward the end of the project that resulted in more overtime than originally estimated.
   Corrective Action: Weekly meetings will be held during the planning phases of future projects to assess potential schedule and cost overruns. Project schedules will be modified to correct this problem.

3. Adequate characterization of vegetation and trees should be conducted prior to excavation to minimize waste volume and cost.
   Corrective Action: A Vegetation Sampling and Analysis Plan will be prepared and approved prior to any work activities for future projects.

4. Manpower estimates need to be better correlated with work needs throughout the duration of the project.
   Corrective Action: Manpower and work needs will be assessed during planning activities. Weekly meetings will be held to assess these needs throughout the duration of the project.

5. Deep contamination was found associated with monitoring and water level wells in the Building 650 Sump Outfall. Rain events since the installation of the monitoring wells may have led to the mobilization of radionuclides that preferentially drained down the outsides of these wells. This appears to have contributed to the significant sub-surface contamination observed.
   ***Corrective Action**:* Soils in the vicinity of wells in contaminated areas shall be evaluated and sampled if necessary using the geoprobe to identify pockets of deep contamination.

6. Small Isolated pockets of contamination covered by clean overburden soils were clearly detectable using survey instruments, which resulted in additional excavation. Additional geoprobes at the Sump Outfall to determine depth of contamination would have been useful. Using gamma walkover surveys and surface soil samples alone proved to be problematic since clean overburden soils were shown to mask underlying pockets of contaminated soils. Soil samples collected as part of the Final Status Survey indicated that cleanup goals for this project had been met.
   Corrective Action: An adequate number of geoprobe/vertical profile borings shall be installed to identify isolated pockets of deep contamination covered by clean overburden soils. In addition, inconsistencies between surface survey meter readings and soil sample results must be resolved prior to declaring a remediation to be complete.

7. New installation of electrical duct banks and other utilities over older contaminated utilities require the installation of adequate reinforcing steel to allow for the duct bank and/or utility to free stand during the removal of contaminated materials.
   Corrective Action: Utilities above older contaminated utilities shall be appropriately supported to allow the utilities to free stand during excavation.

8. During excavation of the pipeline, it was discovered that an installation of a transecting steam system was installed directly below a section of the pipeline to be removed. The soil disturbance as a result of this installation caused failure of the section of reinforced concrete pipe and subsequent contamination of the steam system exterior as well as soil contamination locally to a greater depth at the area than was encountered along the pipe trench. This condition was caused by inadequate compaction of the bearing soils surrounding the steam line.
   Corrective Action: Excavation should proceed carefully in areas of recent utility installations and if necessary, proper support should be provided to utilities above the areas of soil disturbance.

9. Preferential pooling of soils occurred following heavy rain. These soils collected in localized low areas resulting in elevated surface activity concentrations at those locations.
   Corrective Action: Storm water run-off controls shall be placed around excavated areas to avoid preferential pooling of soils.

10. Although the Final Status Survey maps identified most locations of discrete elevated residual contamination, these locations were not noted, characterized and evaluated prior to the independent validator's surveys. A survey should be conducted in addition to direct systematic

measurements of surface radioactivity in order to selectively identify such elevated areas or anomalies for further evaluation or remediation prior to final validation of the survey.
Corrective Action: A survey procedure, which is consistent with the MARSSIM method, will be prepared using scanning techniques in order to identify and mark locations for further investigation and evaluation.

A formal documented review of these lessons learned and an evaluation of their root causes will be conducted. Recommendations will be prepare and distributed and findings posted on the ERD web page for future reference. Each of these corrective actions will be documented in the Standards Based Management System (SBMS) subject area "Lessons Learned" through the EMD Lessons Learned Coordinator. In addition, Operations Procedures will be prepare or modified to incorporate these corrective actions where applicable.

6.0 References

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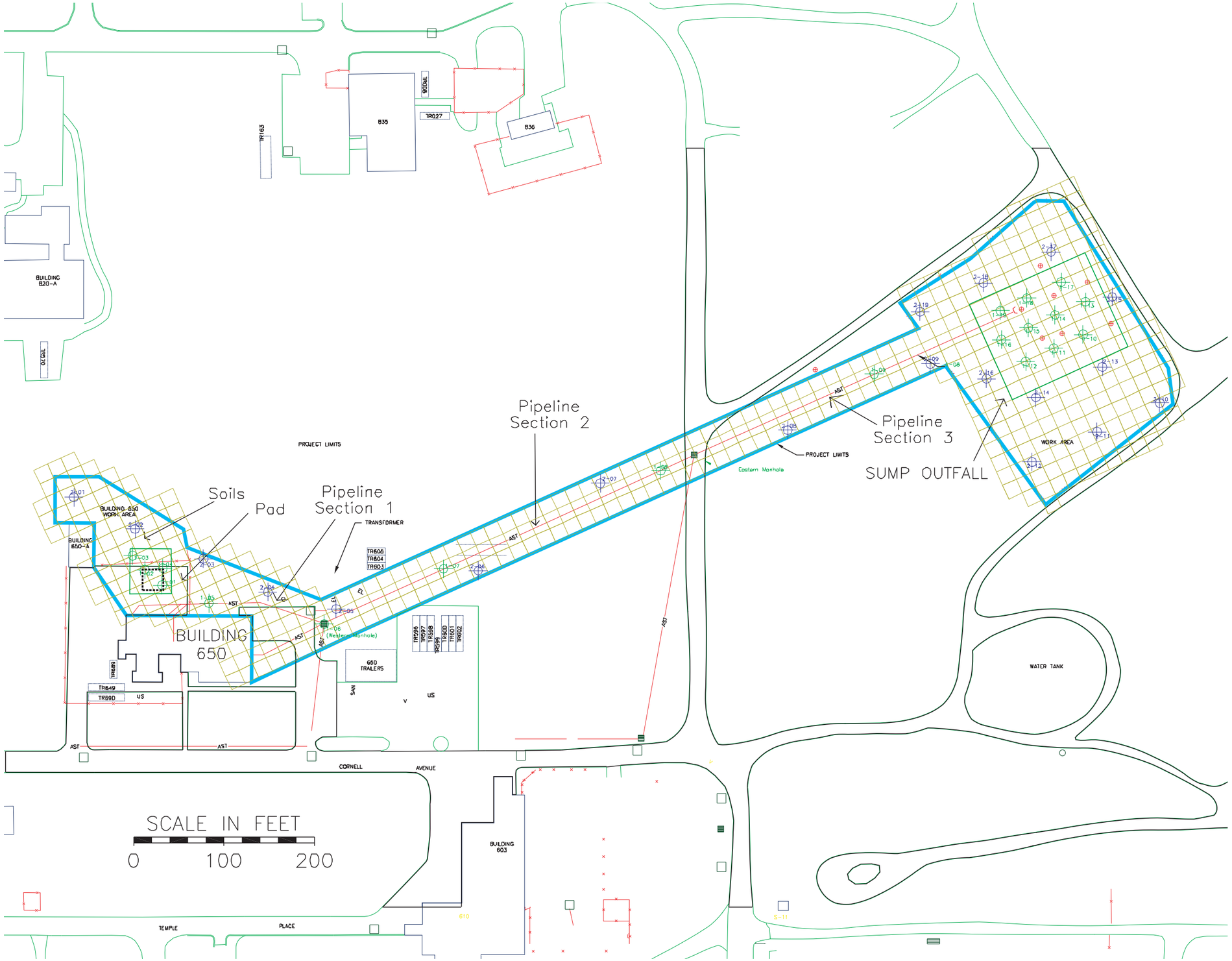

BROOKHAVEN NATIONAL LABORATORY

Environmental Information Management System

Environmental Management Directorate

Operable Unit 1

AOC 6

Figure 1 A

Building 650 and Sump Outfall
Close-Out Grid
Survey Sample Locations

Legend

- Class 1 Sample Locations
- Class 2 Sample Locations
- 5 Meter Grid
- Class 1 Areas
- AOC 6 Boundary
- Pipeline

N

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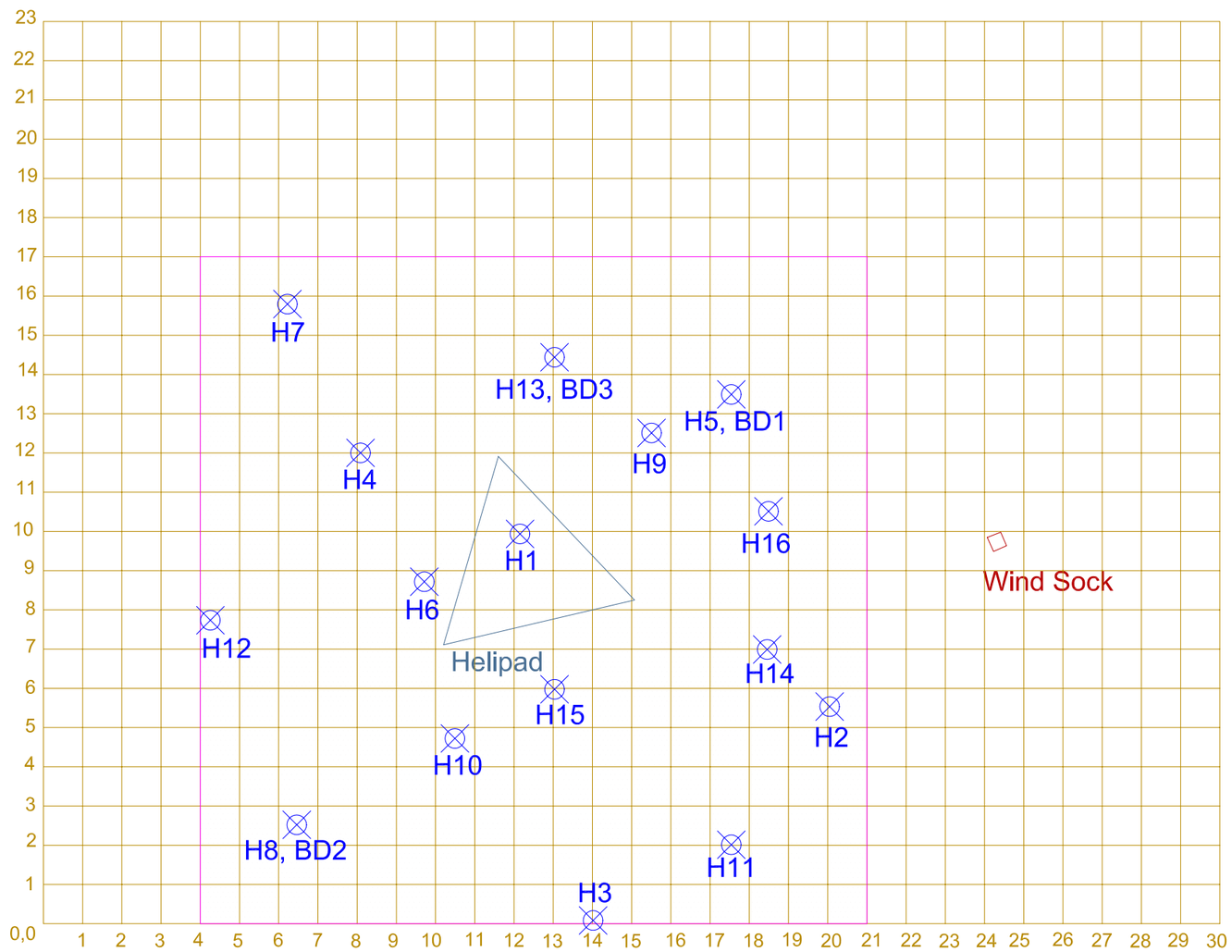

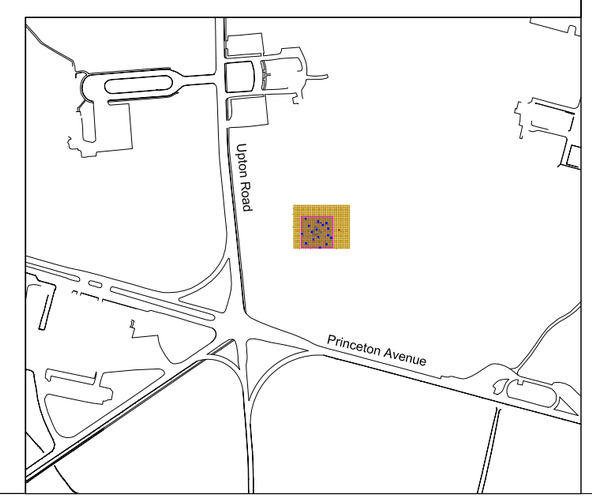

BROOKHAVEN NATIONAL LABORATORY

Environmental Information Management System

Environmental Management Directorate

Operable Unit 1

AOC 6

Figure 1 B

Sampling Locations
Reference Area

Background Sampling at
Field South of Building 50

Legend

2 Meter Radiological Survey Grid

Confirmatory Sample Location

Class 2 Area

N

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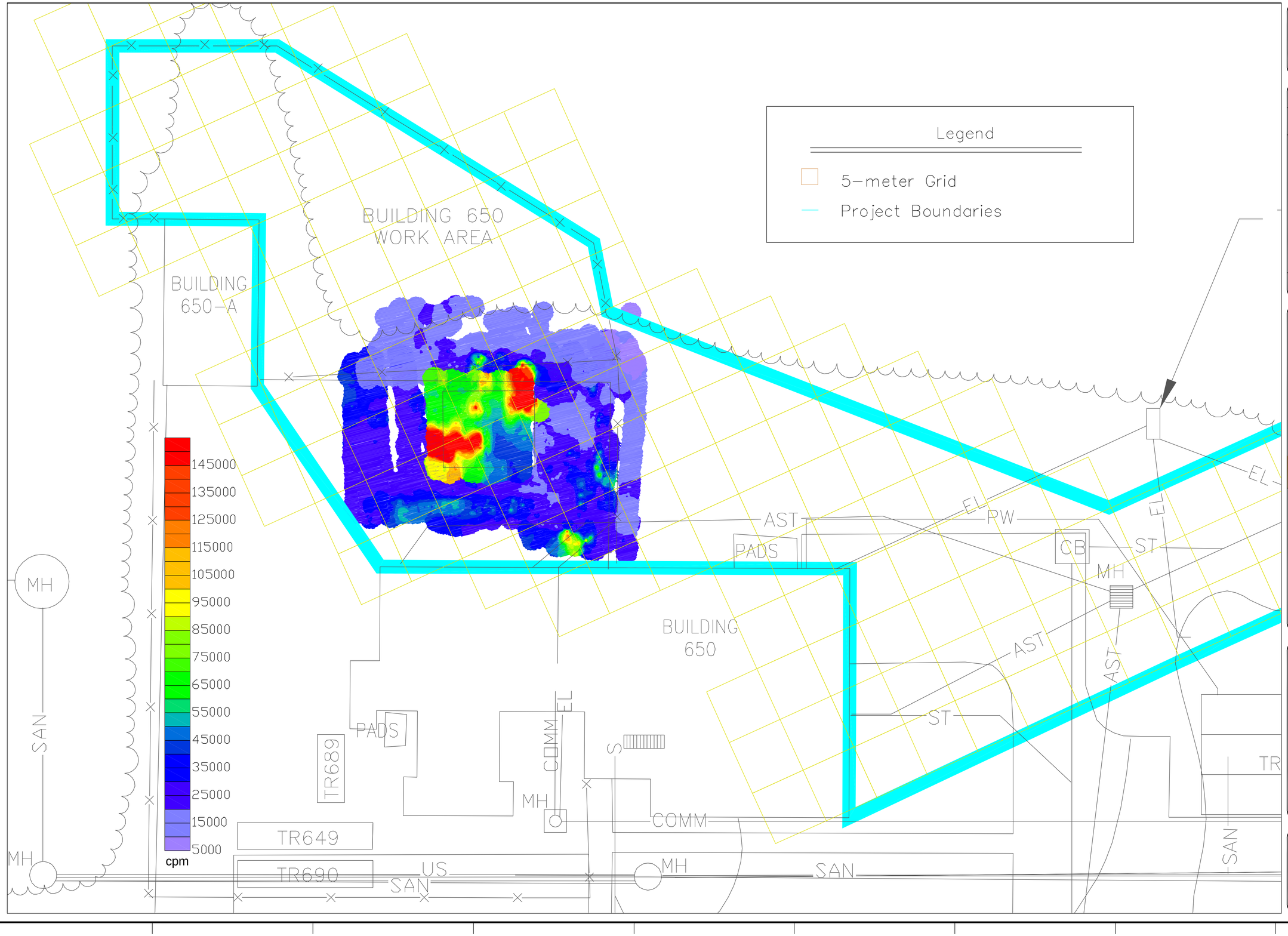

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Surveyed by: C Hales Date: 3/28/02
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BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Radiological Surveys
Prior to Excavation at the
Building 650 Pad

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 2A

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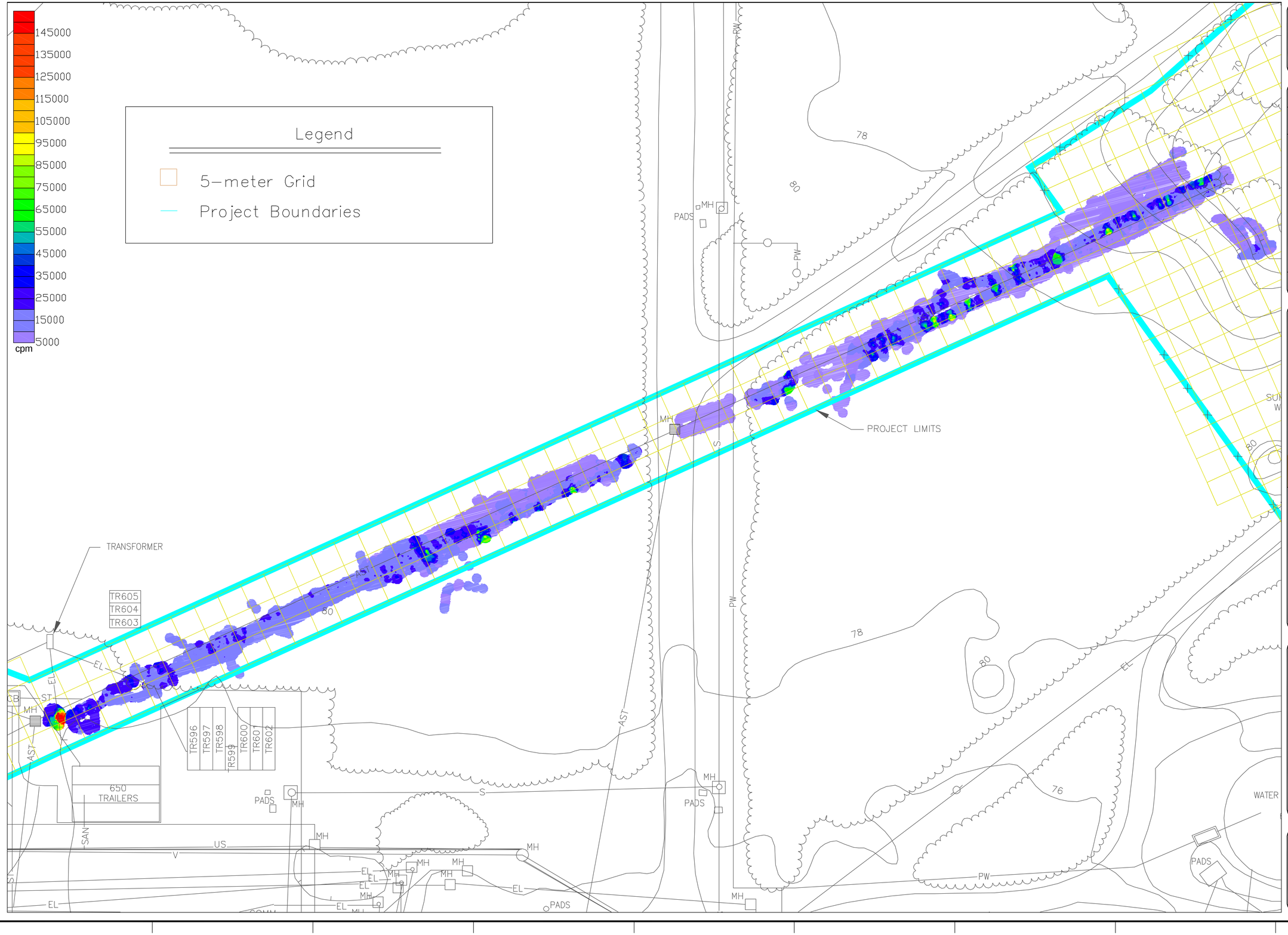

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BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Radiological Surveys
Prior to Excavation at the Pipeline
Sections 2 & 3

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 2B

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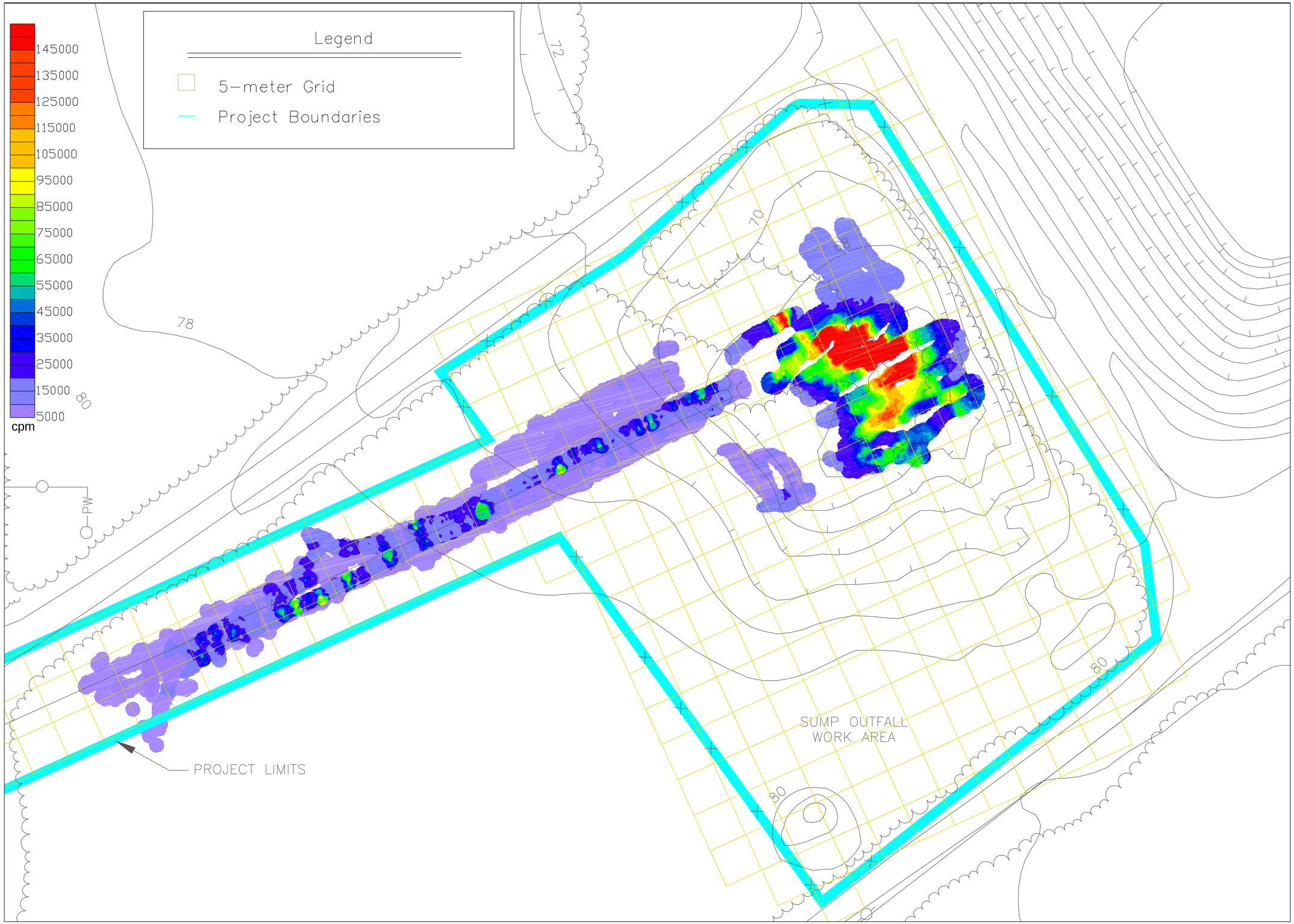

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C Hales 4/15/02
File Name:

BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Radiological Surveys
Prior to Excavation at the
Sump Outfall

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 2C

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Surveyed by: C Hales Date: 5/29/02
File Name:

BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Interim Radiological Survey
at the
650 Pad Class 1 Areas

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 3A

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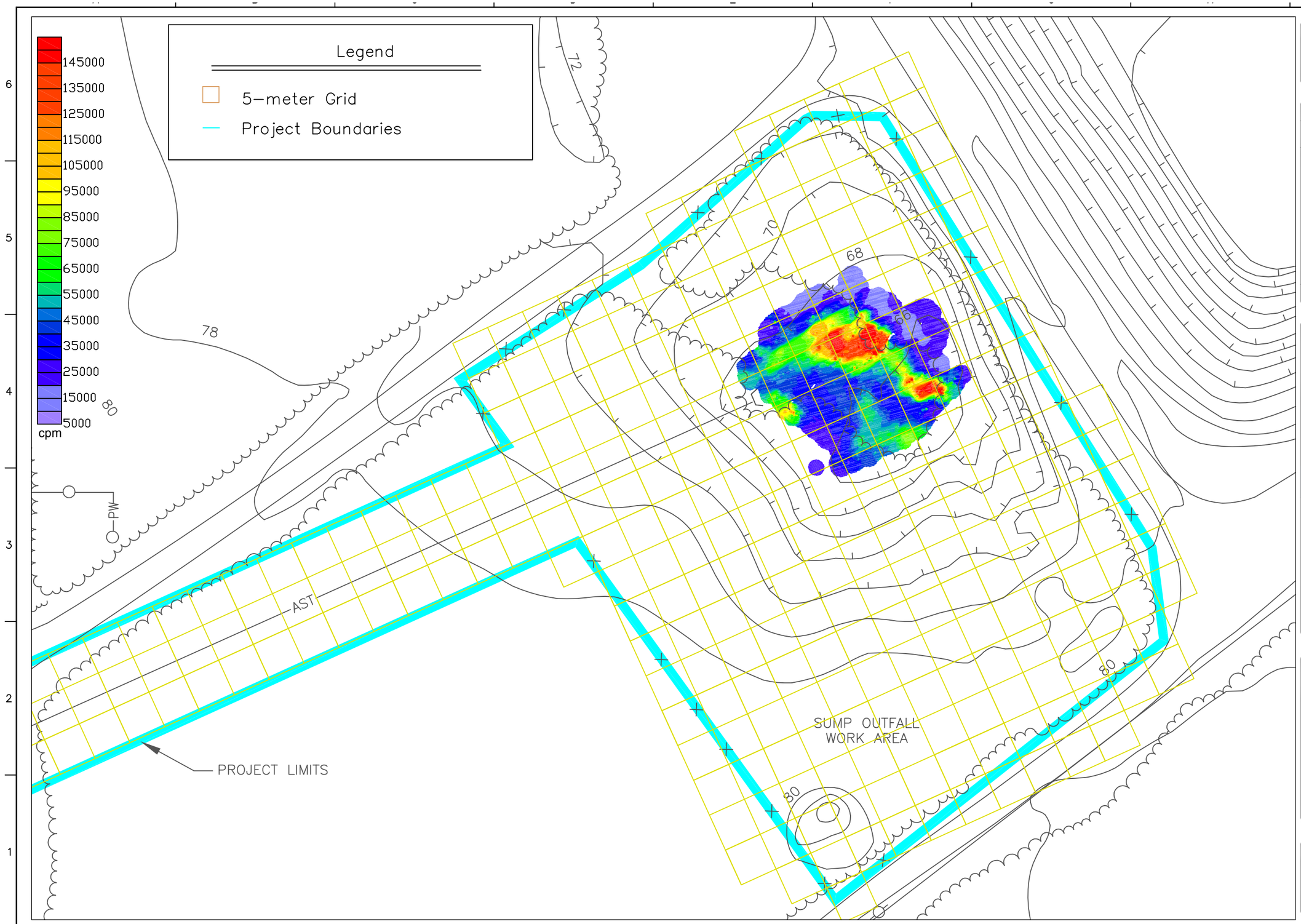

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BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Interim Radiological Survey
(after 1st remediation)
at the Sump Outfall

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 3B

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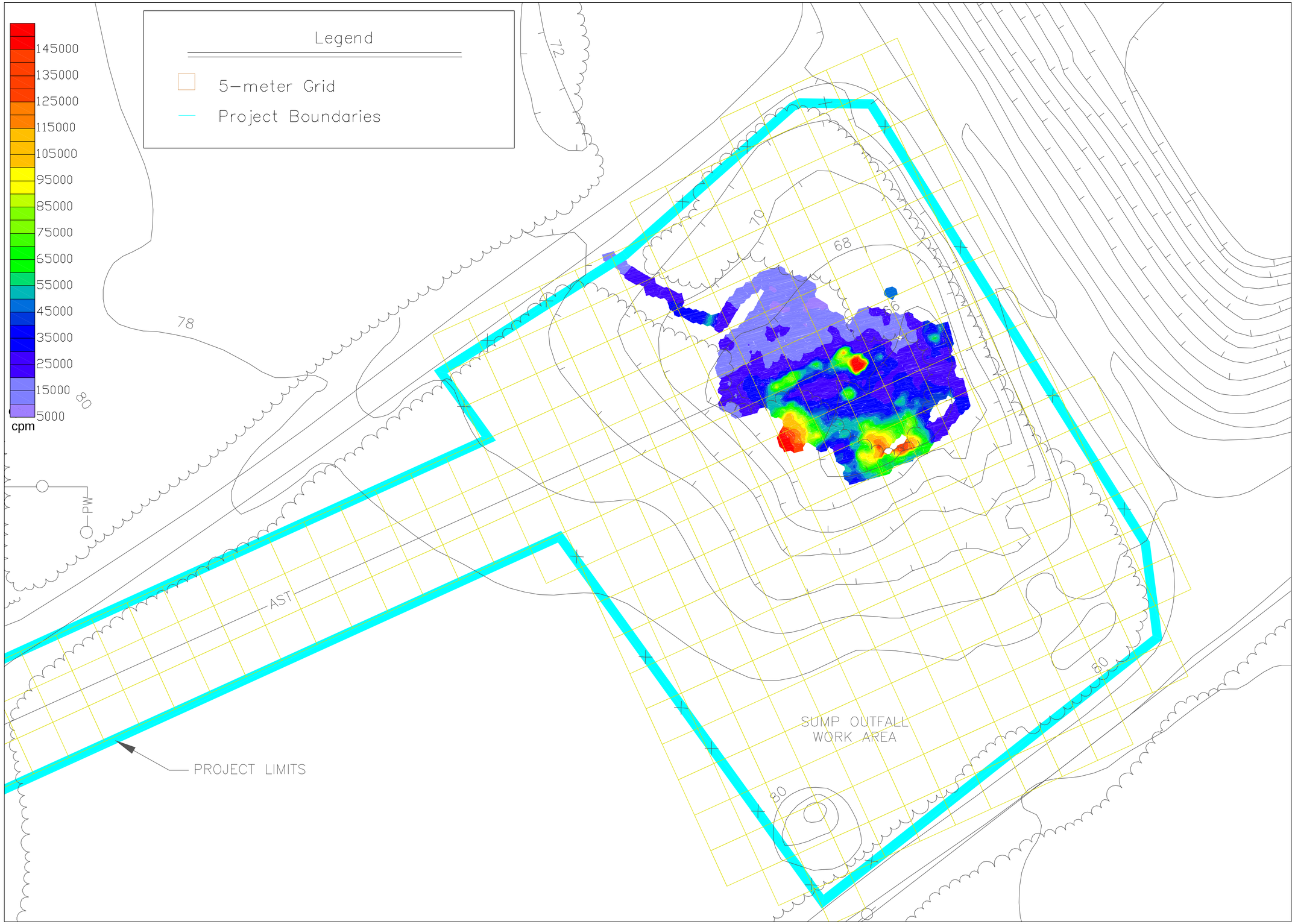

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C Hales 5/21/02
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BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Interim Radiological Survey
(after 2nd remediation)
at the Sump Outfall

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 3C

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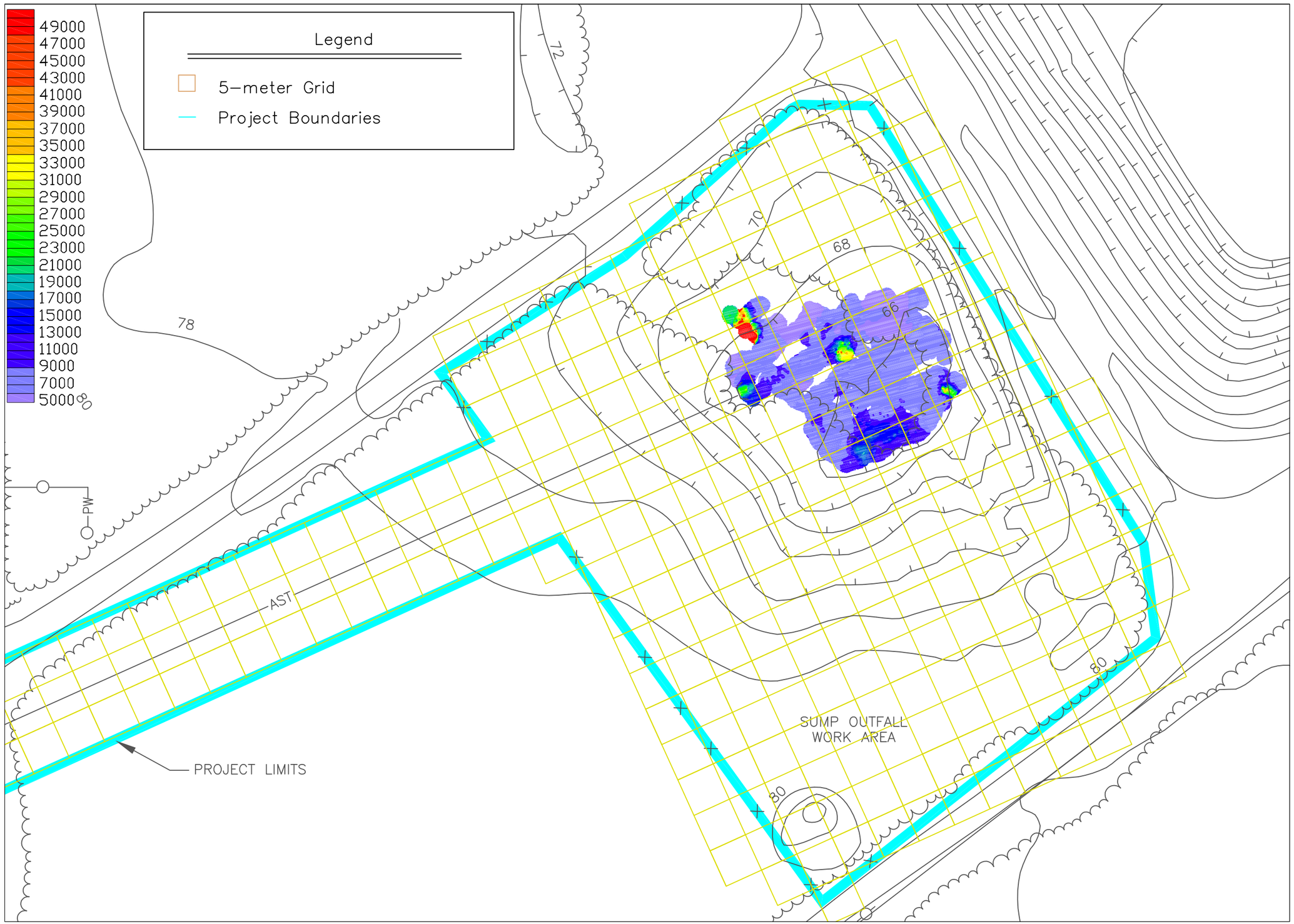

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Interim Radiogoloical Survey
(after 3rd remediation)
at the Sump Outfall

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
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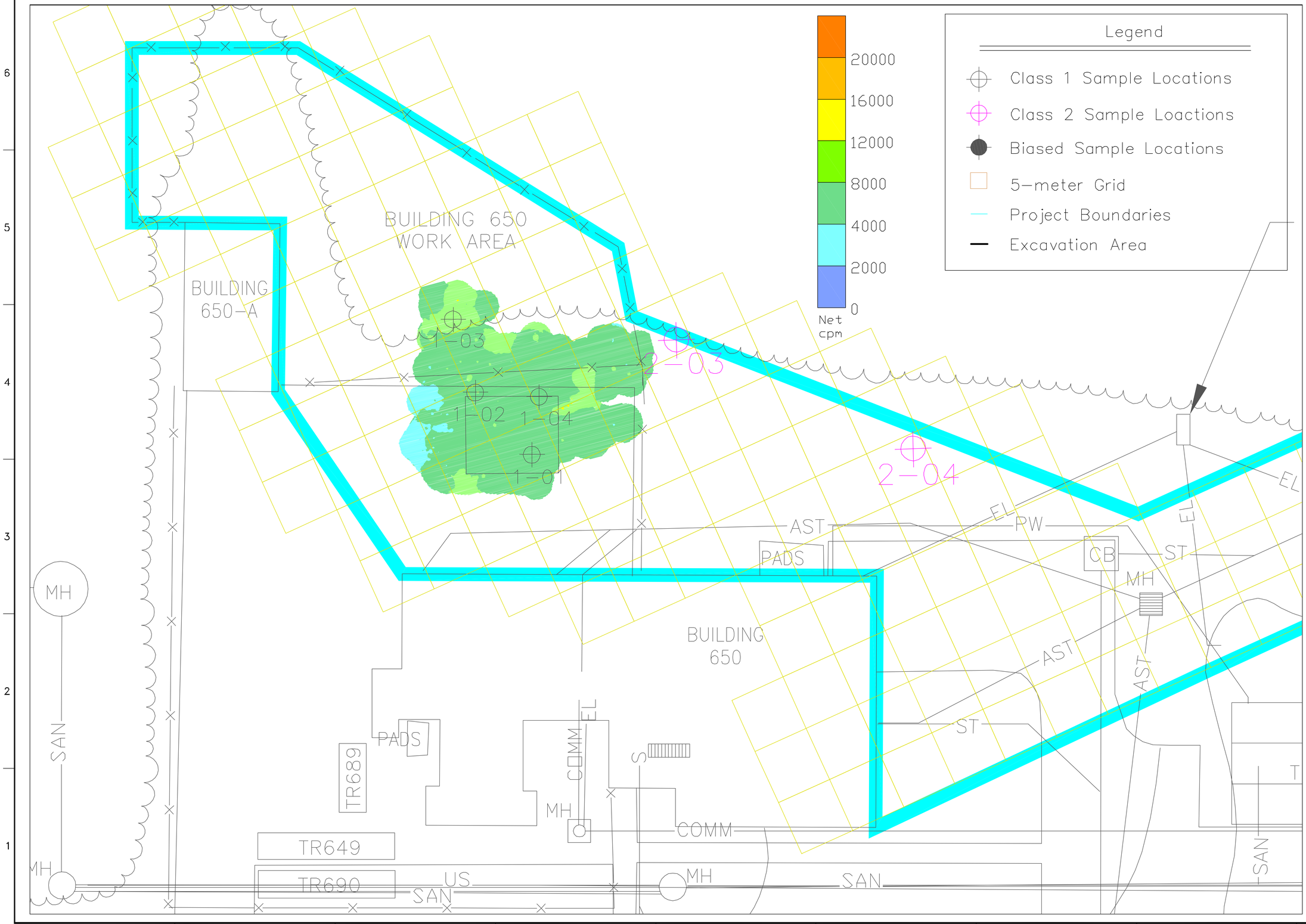

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BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Final Radiological Status Survey
for the
650 Pad Class 1 Areas

Contract Number: 97751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 4A

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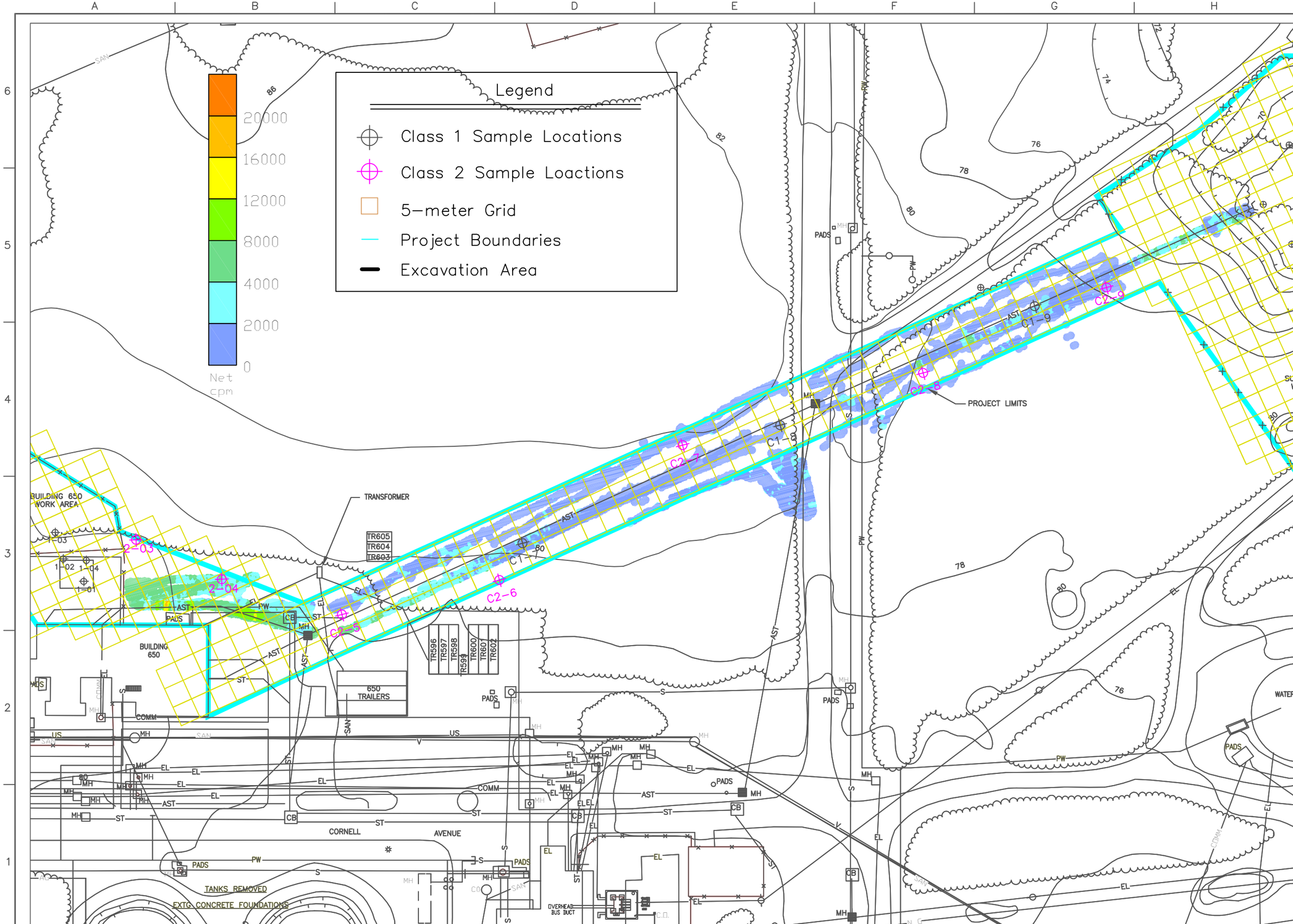

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BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Final Radiological Status Survey
for the 650 Pipeline
Class 1 & Class 2 Areas

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 4B

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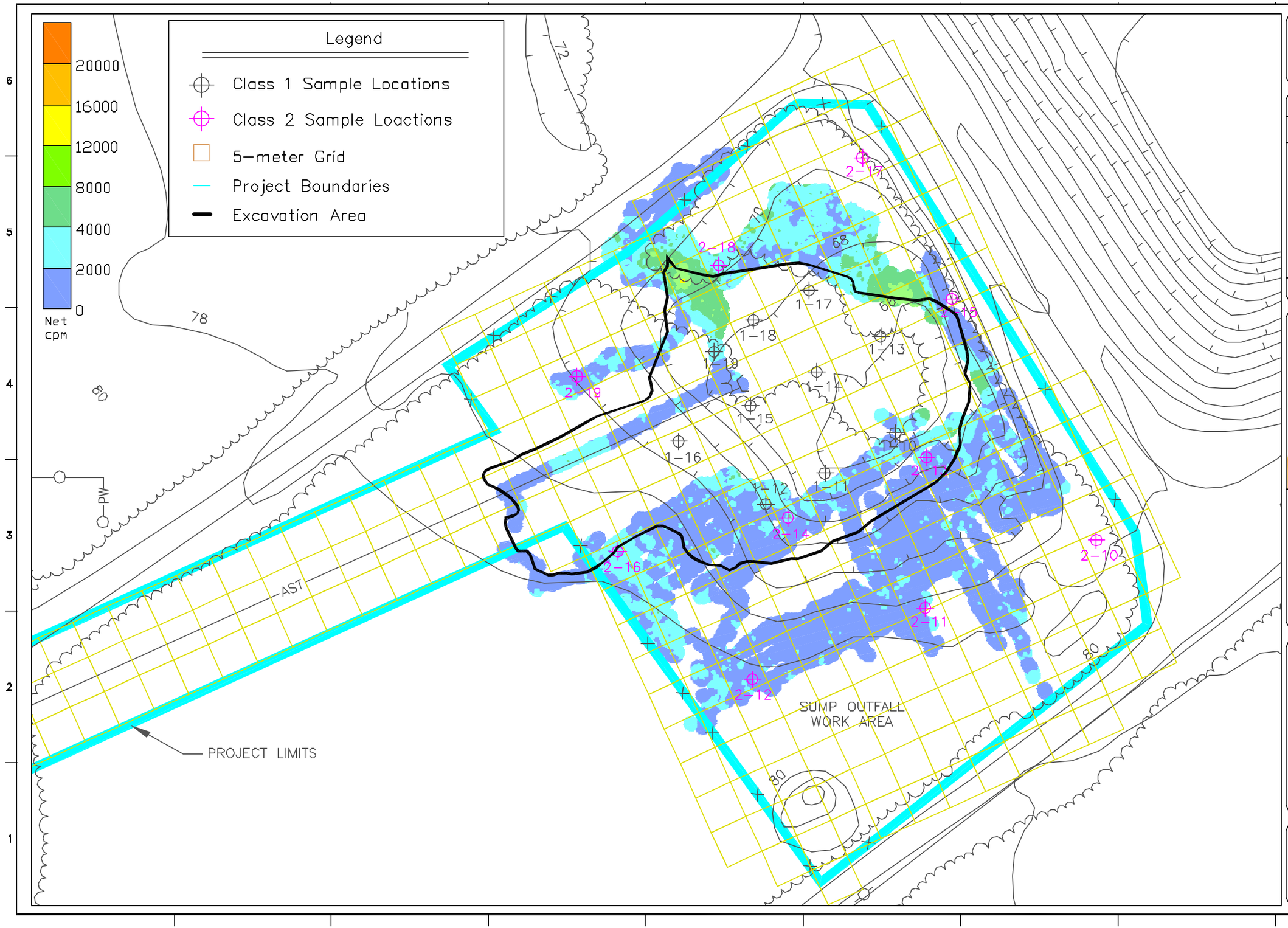

Brookhaven National Laboratory
Upton, New York

Final Radiological Status Survey
for the
Sump Outfall Class 2 Areas

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 4C

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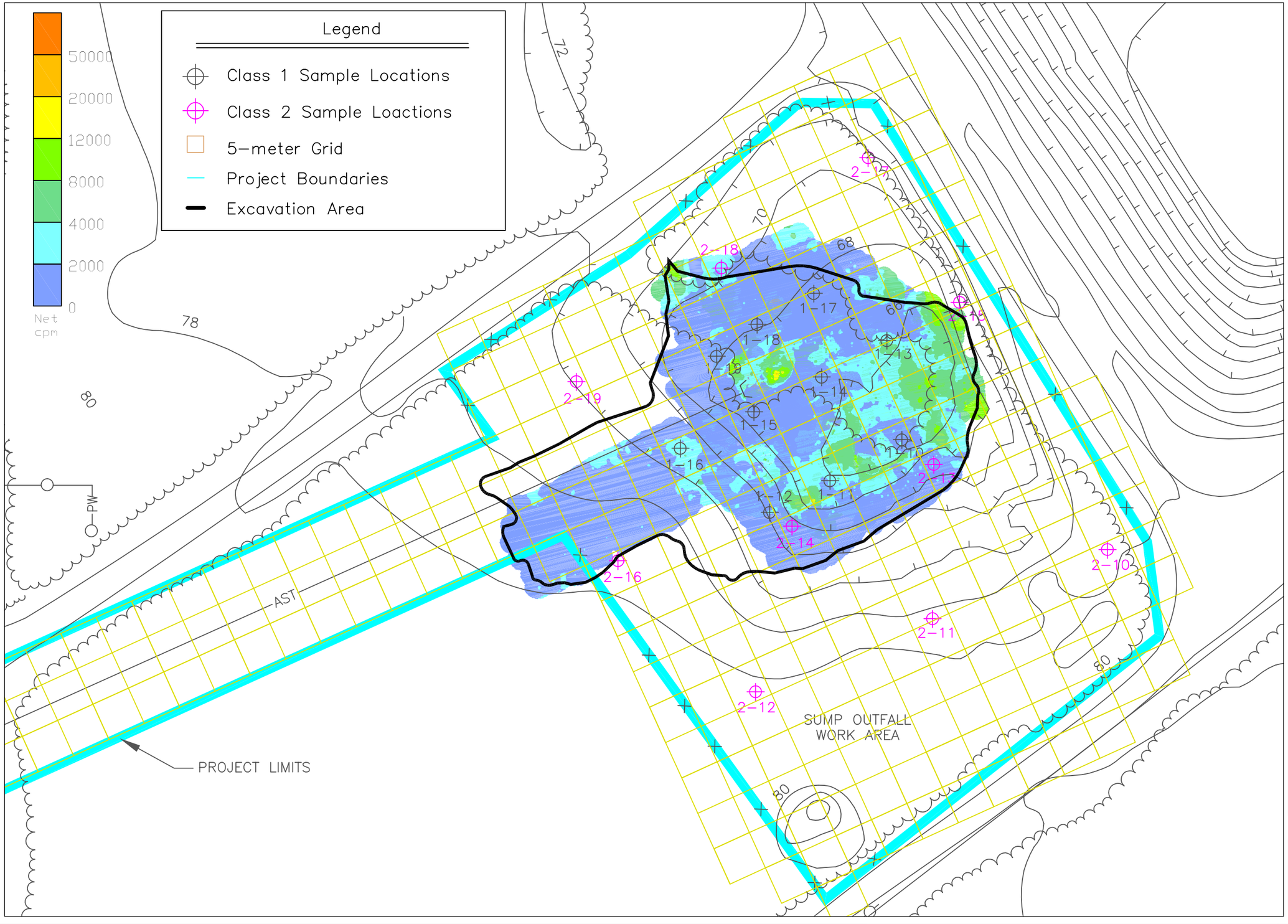

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C Hales 6/19/02
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BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
Upton, New York

Final Radiological Status Survey
for the
Sump Outfall Class 1 Areas

Contract Number: 9751
Delivery Order Number: 11
Project Number: 01-3001.11
Drawing Number: 4D

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ATTACHMENT 1

New York State Department of Environmental Conservation

Radiation Survey Report

Post-Remediation Confirmation Survey

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SOLID & HAZARDOUS MATERIALS
BUREAU OF RADIATION

Radiation Survey Report

DATES OF SURVEYS: **June 12 & June 27, 2002**

NAME: **Brookhaven National Laboratory (BNL)**
ADDRESS: **P.O. Box 5000**
Upton, NY 11973

COUNTY: **Suffolk** DEC REGION: **1**

CONTACT PERSON: **Jim Brower, BSA**
TELEPHONE NUMBER: **(631) 344-7513**
FAX NUMBER: **(631) 344-7776**
EMAIL ADDRESS: **brower@bnl.gov**

TYPE OF SURVEY: **Post-remediation confirmation survey**

REPORTING STAFF MEMBER: **Robert Rommel**

_____ _____
Signature Date of Report

SURVEY STAFF (6/12/02): **Jerry Riggi & Tom Papura**

REVIEWED BY: _____ DATE_____

SUMMARY

On June 12, 2002, in order to confirm that radionuclide soil concentrations met established cleanup goals, the Building 650 outfall (AOC 6 of OU IV) was surveyed and sampled following remediation by staff from the DEC and the Oak Ridge Institute for Science and Education (ORISE). Survey meter readings clearly indicated that remediation was incomplete, and two soil samples were obtained for laboratory analysis. After further cleanup efforts, BNL again contacted DEC staff to confirm the 650 outfall area. On June 27, more surveying was performed by DEC staff. Lower radiation levels were observed than reported during the initial survey, and six soil samples were collected. Small areas still required remediation following our second radiation survey.

INTRODUCTION

Building 650, the former Reclamation Facility at BNL, served as a decontamination facility from approximately 1959 to 1969. Steam cleaning of contaminated equipment was performed on a 30' x 30' concrete pad behind the north side of the building. Wastewater generated by cleaning operations collected in a sump in the middle of a sloping pad, which was presumed to be connected to the site sanitary sewer system. An investigation in 1969 determined that this sump was not connected to the sewer system, but was instead directed through a drainage pipe to a natural depression 800 feet northeast of Building 650. After the identification of this Building 650 Sump Outfall Area, decontamination operations ceased using the Building 650 concrete pad. Building 650 was designated as AOC 6 under the interagency agreement, and is shown in Figure 1.

As part of the AOC 6 Final Status Survey, staff from the DEC's Bureau of Radiation performed radiation surveys and obtained confirmatory samples for radionuclide analysis after this area was remediated. This sampling occurred on two separate occasions, since it was apparent during the initial survey that cleanup goals had not yet been met by BNL.

MATERIALS AND METHODS

Gamma radiation-detecting survey instruments were used to survey the excavated areas (Class 1 impacted areas in MARSSIM terminology) on both dates. Details of the instruments are provided below. Background on 6/27/02 was 7230 counts per minute (CPM) on the Ludlum unit, and 5 µrem/hr on the Bicron at the control point at the entrance to the area. All survey instruments were satisfactorily checked in Albany prior to leaving for BNL, and again upon our return. No abnormalities were noted in instrument performance.

SURVEY INSTRUMENTS: June 12, 2002

Meter: Ludlum Model 2221 Portable SCA, S/N 132864
Calibrated On: March 6, 2002

Probe: Ludlum Model 44-10 Scintillation Detector,
S/N PR135862, 2"×2" NaI(Tl) scintillator

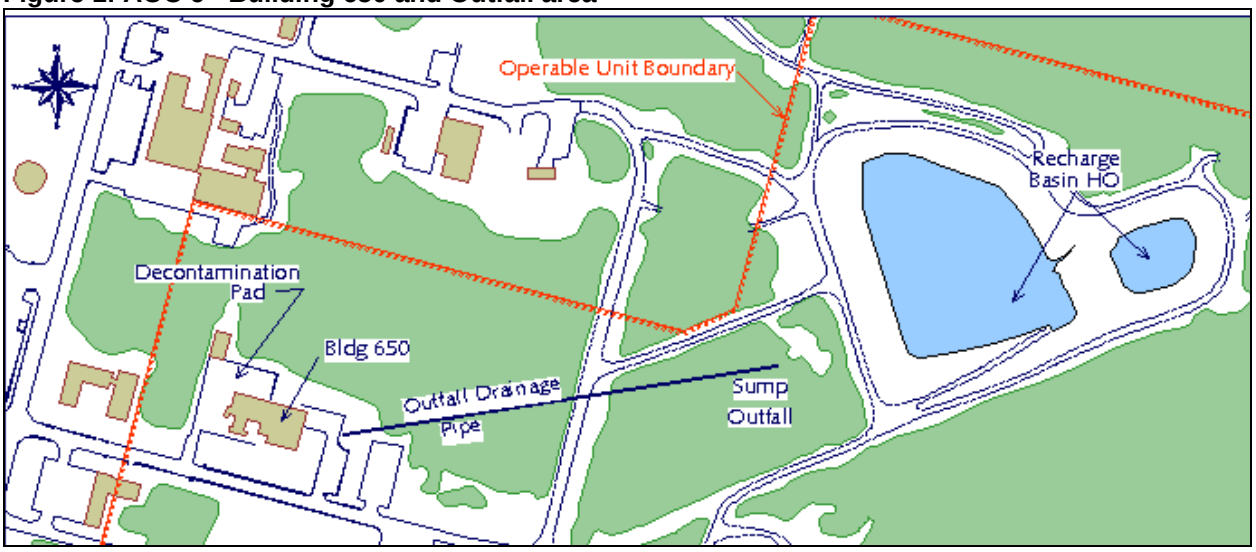
June 27, 2002

Meter: Ludlum Model 2221 Portable SCA, S/N 71244
Calibrated On: August 17, 2001

Probe: Ludlum Model 44-10 Scintillation Detector,
S/N PR114338, 2"×2" NaI(Tl) scintillator

Meter: Bicron microRem, S/N B169G
Calibrated On: December 13, 2001

Figure 1: AOC 6 - Building 650 and Outfall area



On June 12, 100% walkover surveys were performed of all Class 1 areas near Building 650, at the outfall area, and along the drainage pipe path using a portable SCA and a 2x2" NaI(Tl) detector (Ludlum 2221/44-10). Significantly elevated survey meter readings were noted in the vicinity of the outfall, one of which (061201) was in a Class 2 area. BNL soil samples indicated that the surface concentrations met the cleanup goals, but the elevated nature of the readings and the fact that radiation levels increased as soil was removed indicated that significant contamination existed below the surface. Only two soil samples were taken from within the outfall area on June 12, due to the obvious need for additional remediation. These samples were obtained from deeper soils (6-8" and 18-24") near monitoring well 066-10 (061201) and at the outfall area (061202). A general survey map of radiation readings seen on June 12 is shown in Figure 2.

During the second investigation on June 27, a 50% walkover survey of the entire outfall area was performed using the same type of detector. Six soil samples were taken based on walkover survey results. The first sample (062701) was obtained by an undisturbed area close to the entry point that exhibited elevated radioactivity. This area was later recognized as having been identified by ORISE on 6/11/02, but had not been remediated as of June 27. The other five were from areas previously identified by ORISE and DEC that required additional excavation after June 12, and were reported as being completed by BNL staff. The area near the end of the discharge pipe in which two samples (062702 & -03) were taken still exhibited elevated radioactivity. Likewise, an excavated area immediately east of the discharge pipe excavation still exhibited higher radiation levels where a sample was obtained (062704). The other two samples (062705 & -06) were from further remediated areas that showed background radiation levels. Approximate sample locations for both sampling dates are shown on Figure 4.

In addition to the Ludlum 2221/44-10 survey, an additional walkover survey of the outfall area using a tissue-equivalent dose-rate meter (Bicron microRem) was performed on June 27. With the meter held at approximately 1 meter above the ground, all readings were at or below background levels.

Figure 2: Outfall area radiation levels on June 12, 2002.

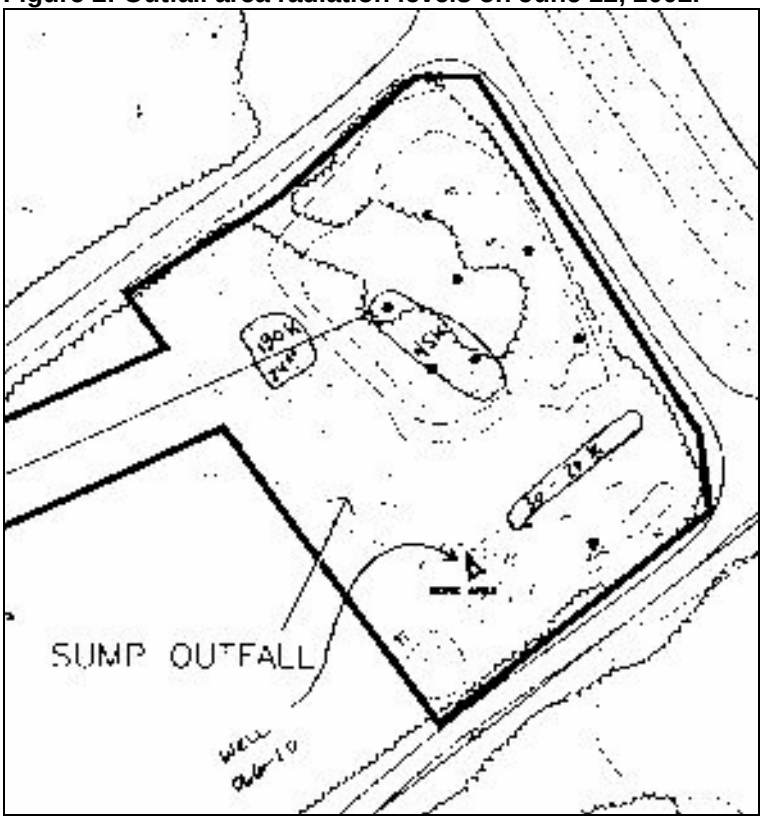


Figure 3: Building 650 and pipeline survey areas.

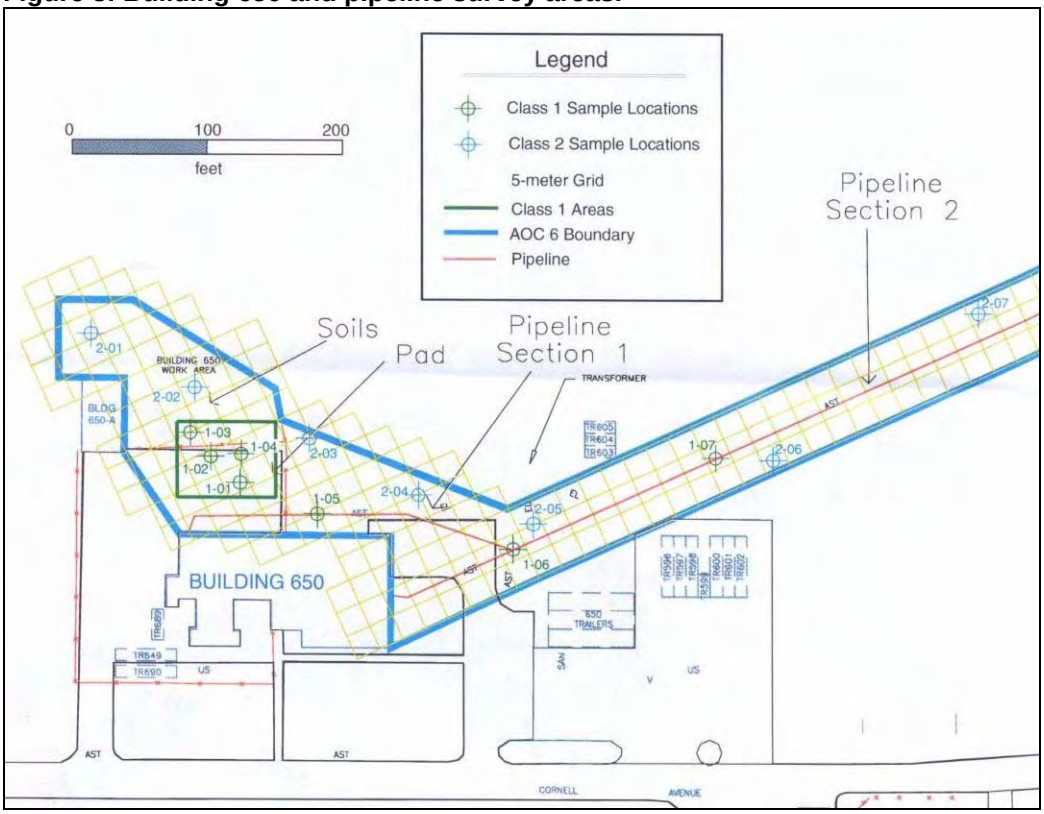
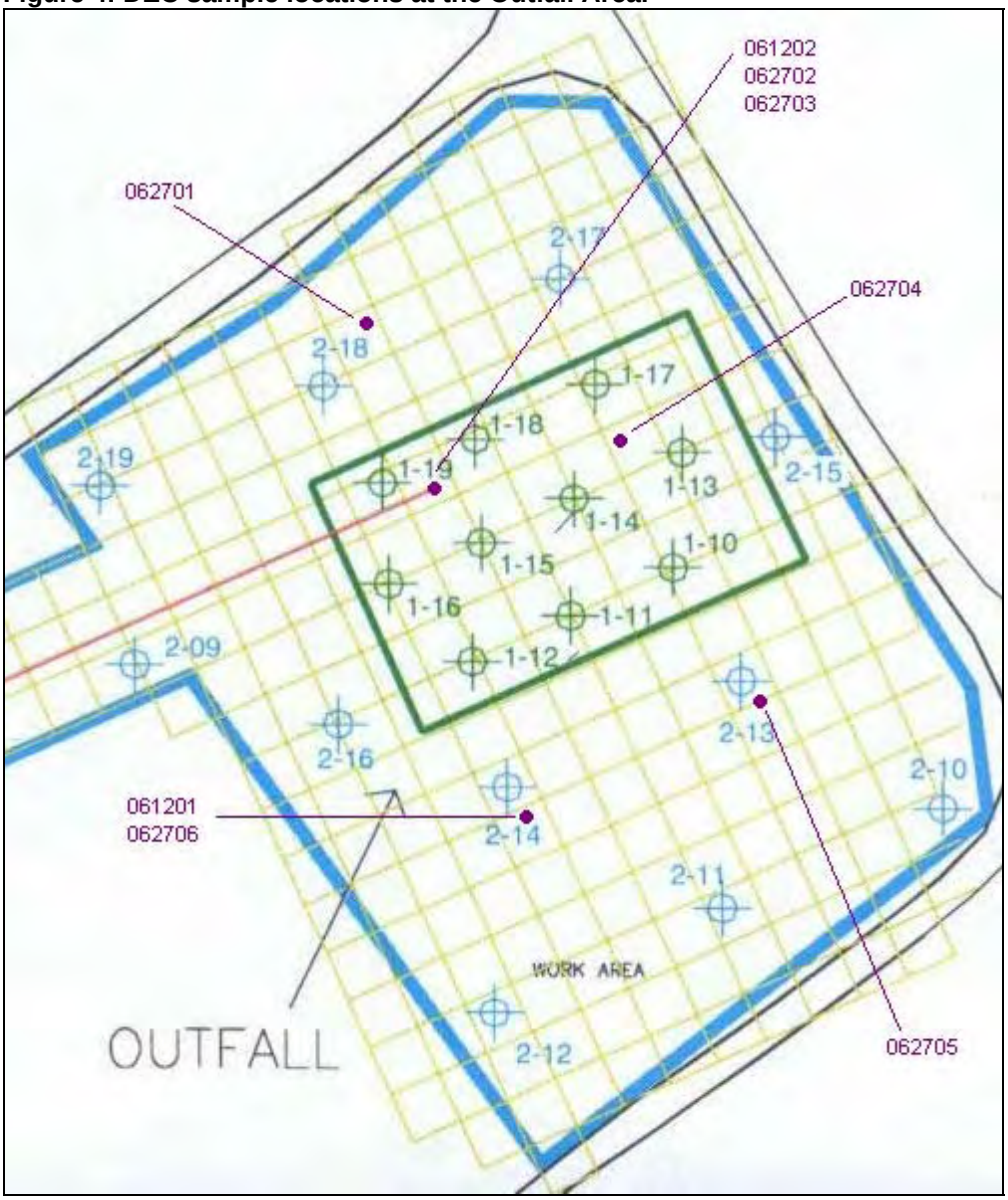


Figure 4: DEC sample locations at the Outfall Area.



RESULTS

The summary below reports the highest results reported from either of the duplicates for samples 061202, 0627001, and 062702, which duplicate analyses performed. Included in the appendix to this report are the laboratory analysis results for these samples. Survey meter readings are provided for each sample location, and are discussed in the "conclusions" section of this report. All survey meter readings are presented "as read," meaning without background subtraction.

Sample Number: NR002 0603S **061201**
Location: Near Monitoring Well 066-10, 6-8" in depth
Surface Reading: 37,000 CPM

γ Spec:	Cs-137:	56.14 ± 5.99 pCi/g	[MDA = 0.18 pCi/g]
	Co-60:	0.26 ± 0.08 pCi/g	[MDA = 0.10 pCi/g]
	Ra-226:	0.87 ± 0.27 pCi/g	[MDA = 0.38 pCi/g]
	K-40:	4.56 ± 1.26 pCi/g	[MDA = 0.77 pCi/g]
	U-238:	9.54 ± 2.29 pCi/g	[MDA = 3.02 pCi/g]
Strontium-90:		1.30 ± 0.10 pCi/g	[MDA = 0.72 pCi/g]
Plutonium-238:		Not Detected	[MDA = 0.04 pCi/g]
Plutonium-239/240:		2.63 ± 0.60 pCi/g	[MDA = 0.08 pCi/g]

Sample Number: NR002 0603S **061202**
Location: Outfall area, 18-24" in depth
Surface Reading: 130,000 CPM

γ Spec:	Cs-137:	51.17 ± 5.38 pCi/g	[MDA = 0.12 pCi/g]
	Co-60:	0.18 ± 0.05 pCi/g	[MDA = 0.06 pCi/g]
	Ra-226:	Not Detected	[MDA = 0.30 pCi/g]
	K-40:	2.14 ± 0.68 pCi/g	[MDA = 0.46 pCi/g]
	U-238:	Not Detected	[MDA = 2.45 pCi/g]
Strontium-90:		16.09 ± 0.32 pCi/g	[MDA = 0.69 pCi/g]
Plutonium-238:		Not Detected	[MDA = 0.04 pCi/g]
Plutonium-239/240:		0.80 ± 0.27 pCi/g	[MDA = 0.04 pCi/g]

Sample Number: NR002 0605S **062701**
Location: Area by entry and excavator
Surface Reading: 34,174 CPM

γ Spec:	Cs-137:	57.04 ± 6.08 pCi/g	[MDA = 0.11 pCi/g]	
	Co-60:	0.53 ± 0.08 pCi/g	[MDA = 0.08 pCi/g]	
	Ra-226:	0.66 ± 0.19 pCi/g	[MDA = 0.24 pCi/g]	**Note D**
	K-40:	4.96 ± 1.01 pCi/g	[MDA = 0.41 pCi/g]	
	U-238:	Not Detected	[MDA = 2.10 pCi/g]	
Strontium-90:		1.64 ± 0.07 pCi/g	[MDA = 0.73 pCi/g]	
Plutonium-238:		Not Detected	[MDA = 0.25 pCi/g]	
Plutonium-239/240:		1.92 ± 0.72 pCi/g	[MDA = 0.25 pCi/g]	

Sample Number: NR002 0605S **062702**
Location: Outfall excavation, by end of former outfall pipe (0-6")
Surface Reading: 31,233 CPM

γ Spec:	Cs-137:	20.27 ± 2.19 pCi/g	[MDA = 0.11 pCi/g]
	Co-60:	Not Detected	[MDA = 0.07 pCi/g]
	Ra-226:	0.45 ± 0.16 pCi/g	[MDA = 0.21 pCi/g]
	K-40:	2.76 ± 0.86 pCi/g	[MDA = 0.62 pCi/g]
	U-238:	Not Detected	[MDA = 1.69 pCi/g]
Strontium-90:		1.57 ± 0.02 pCi/g	[MDA = 0.66 pCi/g]
Plutonium-238:		Not Detected	[MDA = 0.12 pCi/g]
Plutonium-239/240:		Not Detected	[MDA = 0.09 pCi/g]

Sample Number: NR002 0605S **062703**
Location: Outfall excavation, by end of former outfall pipe (6-12")
Surface Reading: 44,482 CPM

γ Spec:	Cs-137:	11.62 ± 1.26 pCi/g	[MDA = 0.06 pCi/g]
	Co-60:	Not Detected	[MDA = 0.04 pCi/g]
	Ra-226:	0.25 ± 0.09 pCi/g	[MDA = 0.11 pCi/g]
	K-40:	1.72 ± 0.51 pCi/g	[MDA = 0.32 pCi/g]
	U-238:	Not Detected	[MDA = 0.96 pCi/g]
Strontium-90:		Not Detected	[MDA = 0.80 pCi/g]
Plutonium-238:		Not Detected	[MDA = 0.10 pCi/g]
Plutonium-239/240:		Not Detected	[MDA = 0.12 pCi/g]

Sample Number: NR002 0605S **062704**
Location: Area #2 by well
Surface Reading: 13,633 CPM

γ Spec:	Cs-137:	3.12 ± 0.37 pCi/g	[MDA = 0.05 pCi/g]	
	Co-60:	0.05 ± 0.03 pCi/g	[MDA = 0.05 pCi/g]	**Notes 1 & 2**
	Ra-226:	0.43 ± 0.09 pCi/g	[MDA = 0.09 pCi/g]	
	K-40:	2.79 ± 0.66 pCi/g	[MDA = 0.35 pCi/g]	
	U-238:	Not Detected	[MDA = 1.04 pCi/g]	
Strontium-90:		Not Detected	[MDA = 0.79 pCi/g]	
Plutonium-238:		Not Detected	[MDA = 0.19 pCi/g]	
Plutonium-239/240:		0.13 ± 0.12 pCi/g	[MDA = 0.12 pCi/g]	**Note 1**

Sample Number: NR002 0605S **062705**
Location: Area # 3 by well
Surface Reading: 12,898 CPM

γ Spec:	Cs-137:	3.10 ± 0.36 pCi/g	[MDA = 0.05 pCi/g]
	Co-60:	Not Detected	[MDA = 0.07 pCi/g]
	Ra-226:	0.29 ± 0.10 pCi/g	[MDA = 0.12 pCi/g]
	K-40:	2.68 ± 0.80 pCi/g	[MDA = 0.42 pCi/g]
	U-238:	3.74 ± 0.93 pCi/g	[MDA = 1.17 pCi/g]
Strontium-90:		0.66 ± 0.02 pCi/g	[MDA = 0.63 pCi/g]
Plutonium-238:		Not Detected	[MDA = 0.18 pCi/g]
Plutonium-239/240:		0.33 ± 0.20 pCi/g	[MDA = 0.15 pCi/g] **Note 1**

Sample Number: NR002 0605S **062706**
Location: Area # 4
Surface Reading: 11,283 CPM

γ Spec:	Cs-137:	0.97 ± 0.16 pCi/g	[MDA = 0.09 pCi/g]
	Co-60:	Not Detected	[MDA = 0.09 pCi/g]
	Ra-226:	0.51 ± 0.17 pCi/g	[MDA = 0.17 pCi/g]
	K-40:	6.43 ± 1.39 pCi/g	[MDA = 0.92 pCi/g]
	U-238:	Not Detected	[MDA = 1.36 pCi/g]
Strontium-90:		Not Detected	[MDA = 0.88 pCi/g]
Plutonium-238:		Not Detected	[MDA = 0.21 pCi/g]
Plutonium-239/240:		Not Detected	[MDA = 0.11 pCi/g]

Notes on Sample Results

If the analysis result was less than the minimum detectable activity for the analysis, the nuclide is listed as "Not Detected." In the case of duplicate samples, "Not Detected" means that neither sample showed detectable activity for the nuclide in question.

Note 1 - The reported error is at least 50% of the reported activity.
Note 2 - The reported activity is at the detection limit (MDA) of the analytical procedure.
Note D - This nuclide was not detected in the duplicate sample.

INTERPRETATION OF RESULTS

Several of the samples analyzed exceeded the 23 pCi/g primary remediation goal for cesium-137, especially both samples obtained on June 12. Determination of whether a site meets remediation goals is more than a matter of ensuring that the primary radionuclide contaminant is below guidelines. It further entails checking that (a) each radionuclide contributing to the dose is below its respective guideline and (b) that the resultant total contribution from all involved nuclides does not exceed the applicable dose limit. Radionuclide concentrations are compared to the cleanup goals developed for radiologically contaminated soils on-site, based on a 15 mrem/year dose limit, specified in the *Record of Decision, Operable Unit I and Radiologically Contaminated Soils* (OU I ROD), dated August 25, 1999. The goals specified in the OU I ROD are 23 pCi/g of cesium-137, 15 pCi/g of strontium-90, and 5 pCi/g of radium-226. For additional radionuclides, the concentration goals are those developed for the Landscaping Soils.

In order to determine if any of the samples exceed the 15 mrem/year dose limit, a "sum of ratios" was calculated which divides each detected radionuclide concentration by its cleanup goal and then summing all these ratios together. A sum less than one indicates that the combined effect of a large area contaminated with that radionuclide concentration would result in a dose less than 15 mrem/year, and a sum greater than one would result in a dose exceeding 15 mrem/year and therefore would exceed the remediation goal. Sums of ratios (SOR) were calculated using the following equation (in which [Cs-137] means "concentration of cesium-137 in pCi/g"):

$$SOR = \frac{[Cs-137]}{23} + \frac{[Sr-90]}{15} + \frac{[Ra-226]}{5} + \frac{[Co-60]}{1160} + \frac{[Pu-238]}{66} + \frac{[Pu-239/240]}{40}$$

The sums of ratios for each sample are provided in Table 1, below. Radium-226 results, even though a natural radionuclide whose concentration was detected at expected background levels, is included in Table 1 because a cleanup goal for it is specified in the OU I ROD.

Table 1: Calculated Sums of Ratios

Sample Number	Identified Isotopes	Sum of Ratios (SOR)
061201	Cs-137, Ra-226, Co-60, Sr-90, Pu-239/240	**2.8**
061202	Cs-137, Co-60, Sr-90, Pu-239/240	**3.3**
062701	Cs-137, Ra-226, Co-60, Sr-90, Pu-239/240	**2.8**
062702	Cs-137, Ra-226	**1.1**
062703	Cs-137, Ra-226	0.6
062704	Cs-137, Ra-226, Co-60, Pu-239/240	0.2
062705	Cs-137, Ra-226, Sr-90, Pu-239/240	0.2
062706	Cs-137, Ra-226	0.1

All samples contained cesium-137, and most contained low concentrations of radium-226. All samples obtained on June 12th in the immediate vicinity of the outfall showed detectable concentrations of cobalt-60, strontium-90, and plutonium-239/240. Sums of Ratios exceeded unity in four samples, both samples taken on June 12, and two surface samples taken on June 27. In all cases, these areas were identified to BNL personnel. Based on BNL reports (draft Closeout Report for AOC 6), the areas exhibiting the high concentrations shown in samples 061201, 061202, and 062701 were remediated following our investigations. The residual concentrations shown by sample 062702 was not further remediated due to the limitations of BNL's excavation capability.

BNL staff also indicated on June 27th an area where they intended to leave subsurface contamination. It is located slightly off the right edge of Figure 3, and is shown in Picture 4. An electrical conduit passes perpendicularly over the Building 650 discharge pipe. Although the pipe has been removed and some removal of soil has occurred under the conduit, BNL cannot remove additional soils without potentially collapsing this in-service conduit. Therefore, BNL proposes to leave the soils below this conduit in their current condition, and backfill over the conduit.

PHOTOGRAPHS

Picture 1: DEC staff obtaining Sample 061201 near Well 066-10 (facing SSW).

Picture 2: Outfall area on 6/27/02, showing additional excavations, and Building 650 in the background with the excavation path of the discharge pipe (facing SW).

Picture 3: Arrow indicates area of contamination by Sample 062701 (facing SE).

Picture 4: Electrical conduit with remaining subsurface contamination (facing S).

CONCLUSIONS

Contamination was detected above cleanup goals during both investigations at the outfall area. Significant subsurface contamination was identified near the outlet of the discharge pipe by surface radiation readings, and verified by sampling. Two areas with unacceptable soil contamination (located around samples 061201 and 062701) were located outside of Class 1 areas, and had not been identified by BNL personnel or contractors. Further remediation was required following both confirmation surveys. Survey results will serve to focus the reviews of BNL's closeout report for this AOC.

APPENDIX

Sample Results

EBERLINE SERVICES

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Phone (865) 481-0683
Fax (865) 483-4621

EBS-OR-17401

July 18, 2002

Ms. Judy Stone
Lionville Laboratory, Inc.
208 Welsh Pool Road
Lionville, PA 19341-1313

NYSDEC
0207L114

CASE NARRATIVE
Work Order # 02-07021-OR

SAMPLE RECEIPT

This work order contains six soil samples received 07/05/02. All samples were analyzed for Isotopic Plutonium, Strontium-90 and by Gamma Spectroscopy.

CLIENT ID	LAB ID
NR0020605S062701	02-07021-04
NR0020605S062702	02-07021-05
NR0020605S062703	02-07021-06
NR0020605S062704	02-07021-07
NR0020605S062705	02-07021-08
NR0020605S062706	02-07021-09

ANALYTICAL METHODS

Isotopic Plutonium was analyzed using Method EML Pu-02 modified. Strontium-90 was analyzed using EIChroM Method SRW01 modified. Gamma Spectroscopy was performed using Method LANL ER-130 modified.

ANALYTICAL RESULTS

ISOTOPIC PLUTONIUM

Sample results demonstrated non-detect equivalent Plutonium-238 activity and non-detect equivalent to slightly positive Plutonium-239/240 activity. Chemical recovery was acceptable for all samples. The blank results demonstrated non-detect equivalent Plutonium-238 activity and statistically equivalent Plutonium-239/240 activity. Replicate results demonstrated high relative percent differences for Plutonium-238 and Plutonium-239/240. Both Plutonium-238 and Plutonium-239 replicate results demonstrated acceptable normalized differences. Results for the laboratory control sample demonstrated a slightly high percent recovery for Plutonium-238 and an acceptable percent recovery for Plutonium-239/240. Both Plutonium-238 and Plutonium-239/240 results demonstrated acceptable normalized differences for the laboratory control sample.

ANALYTICAL RESULTS CONTINUED

STRONTIUM-90 BY SEQUENTIAL COUNTS

Sample results demonstrated non-detect equivalent to slightly positive Strontium-90 activity. Chemical recovery was acceptable for all samples. The blank result demonstrated non-detect equivalent Strontium-90 activity. The replicate result demonstrated a high relative percent difference and an acceptable normalized difference. Results for the laboratory control sample demonstrated an acceptable percent recovery and normalized difference for Strontium-90.

GAMMA SPECTRAL ANALYSIS

Sample results demonstrated non-detect equivalent to slightly positive Thorium-232, Radium-226, Cobalt-60, Lead-214, Thorium-228, Uranium-238 and Thallium-208 activity. Slightly positive Cesium-137, Potassium-40 and Lead-212 activity was demonstrated. The blank results demonstrated non-detect equivalent Thorium-232, Radium-226, Cobalt-60, Cesium-137, Potassium-40, Lead-212, Lead-214, Thorium-228, Uranium-238 and Thallium-208 activity. Replicate results demonstrated acceptable relative percent differences and normalized differences for Cesium-137 and Potassium-40. Results for the laboratory control sample demonstrated acceptable percent recoveries and normalized differences for Cobalt-60 and Cesium-137.

CERTIFICATION OF ACCURACY

I certify that this data report is in compliance with the terms and conditions of the PurchaseOrder, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the cognizant project manager or his/her designee to be accurate as verified by the following signature.

M.R. McDougall
Laboratory Manager

Date: 7/18/2002

Judy Stone
Lionville Laboratory, Inc.
208 Welsh Pool Road
Lionville, PA 19341-1313

SDG: 0207021
MATRIX: Soil

Lab ID	Client ID	Sample Date	Receipt Date	Analysis Date	Report Date	Batch ID	Analyte	Method	Result	Error	MDA	Units
02-07021-01	K KNOWN	07/05/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	4.94	0.14		pCi/g
02-07021-01	S SPIKE	07/05/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	5.97	1.41	0.15	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	0.05	0.07	0.10	pCi/g
02-07021-03	D NR0020605S062702	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	0.05	0.07	0.12	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	0.08	0.13	0.25	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	0.01	0.05	0.13	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	0.00	0.01	0.10	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	-0.01	0.05	0.19	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	0.02	0.07	0.18	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-238	EML Pu-02 Modified	0.01	0.08	0.21	pCi/g
02-07021-01	K KNOWN	07/05/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	5.96	0.18		pCi/g
02-07021-01	S SPIKE	07/05/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	5.97	1.41	0.05	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	0.17	0.12	0.05	pCi/g
02-07021-03	D NR0020605S062702	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	0.04	0.06	0.09	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	1.92	0.72	0.25	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	0.10	0.10	0.13	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	0.01	0.04	0.12	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	0.13	0.12	0.12	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	0.33	0.20	0.15	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/15/02	07/18/02	0207021	Plutonium-239/240	EML Pu-02 Modified	0.10	0.09	0.11	pCi/g
02-07021-01	K KNOWN	07/05/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	21.32	0.45		pCi/g
02-07021-01	S SPIKE	07/05/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	18.63	0.34	0.72	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	0.16	0.01	0.76	pCi/g
02-07021-03	D NR0020605S062702	06/27/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	1.57	0.02	0.66	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	1.64	0.07	0.73	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	1.20	0.21	0.99	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	0.18	0.04	0.80	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	0.20	0.10	0.79	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	0.66	0.02	0.63	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/16/02	07/18/02	0207021	Strontium-90	EIChroM SRW01 Modified	-1.02	0.00	0.88	pCi/g

K=Known,S=Spike,B=Blank,D=Duplicate,MS=Matrix Spike

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SDG: 0207021
MATRIX: Soil

Lab ID	Client ID	Sample Date	Receipt Date	Analysis Date	Report Date	Batch ID	Analyte	Method	Result	Error	MDA	Units
02-07021-01	K KNOWN	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	256.65	11.68		pCi/g
02-07021-01	K KNOWN	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	153.47	7.21		pCi/g
02-07021-01	S SPIKE	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	260.10	18.55	1.16	pCi/g
02-07021-01	S SPIKE	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	159.80	17.08	1.03	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	0.00	0.02	0.04	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	0.01	0.02	0.04	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Potassium-40	LANL ER-130 Modified	0.10	0.37	0.22	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Lead-212	LANL ER-130 Modified	0.05	0.05	0.05	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Lead-214	LANL ER-130 Modified	-0.02	0.06	0.07	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Radium-226	LANL ER-130 Modified	0.03	0.04	0.08	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-228	LANL ER-130 Modified	-0.03	0.07	0.12	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-232	LANL ER-130 Modified	-0.03	0.07	0.12	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Thallium-208	LANL ER-130 Modified	0.13	0.06	0.08	pCi/g
02-07021-02	B BLANK	07/05/02	07/05/02	07/08/02	07/18/02	0207021	Uranium-238	LANL ER-130 Modified	-4.11	2.21	0.64	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	0.50	0.07	0.06	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	56.86	6.07	0.11	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Potassium-40	LANL ER-130 Modified	4.89	0.92	0.44	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-212	LANL ER-130 Modified	1.04	0.26	0.27	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-214	LANL ER-130 Modified	0.76	0.28	0.37	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Radium-226	LANL ER-130 Modified	0.66	0.19	0.24	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-228	LANL ER-130 Modified	0.76	0.22	0.27	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-232	LANL ER-130 Modified	0.76	0.22	0.27	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thallium-208	LANL ER-130 Modified	0.70	0.34	0.45	pCi/g
02-07021-03	D NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Uranium-238	LANL ER-130 Modified	1.40	1.69	2.16	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	0.53	0.08	0.08	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	57.04	6.08	0.11	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Potassium-40	LANL ER-130 Modified	4.96	1.01	0.50	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-212	LANL ER-130 Modified	0.54	0.20	0.26	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-214	LANL ER-130 Modified	0.59	0.26	0.38	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Radium-226	LANL ER-130 Modified	0.44	0.22	0.30	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-228	LANL ER-130 Modified	0.66	0.22	0.26	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-232	LANL ER-130 Modified	0.66	0.22	0.26	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thallium-208	LANL ER-130 Modified	0.73	0.18	0.37	pCi/g
02-07021-04	NR0020605S062701	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Uranium-238	LANL ER-130 Modified	1.65	1.47	2.10	pCi/g

K=Known,S=Spike,B=Blank,D=Duplicate,MS=Matrix Spike

Judy Stone
Lionville Laboratory, Inc.
208 Welsh Pool Road
Lionville, PA 19341-1313

SDG: 0207021
MATRIX: Soil

Lab ID	Client ID	Sample Date	Receipt Date	Analysis Date	Report Date	Batch ID	Analyte	Method	Result	Error	MDA	Units
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	0.01	0.03	0.07	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	20.27	2.19	0.11	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Potassium-40	LANL ER-130 Modified	2.76	0.86	0.62	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-212	LANL ER-130 Modified	1.31	0.29	0.21	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-214	LANL ER-130 Modified	0.62	0.22	0.32	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Radium-226	LANL ER-130 Modified	0.45	0.16	0.21	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-228	LANL ER-130 Modified	0.59	0.24	0.44	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-232	LANL ER-130 Modified	0.59	0.24	0.44	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thallium-208	LANL ER-130 Modified	0.62	0.20	0.37	pCi/g
02-07021-05	NR0020605S062702	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Uranium-238	LANL ER-130 Modified	1.60	1.25	1.69	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	0.01	0.02	0.04	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	11.62	1.26	0.06	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Potassium-40	LANL ER-130 Modified	1.72	0.51	0.32	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-212	LANL ER-130 Modified	0.20	0.08	0.10	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-214	LANL ER-130 Modified	0.21	0.11	0.17	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Radium-226	LANL ER-130 Modified	0.25	0.09	0.11	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-228	LANL ER-130 Modified	0.14	0.08	0.12	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-232	LANL ER-130 Modified	0.14	0.08	0.12	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thallium-208	LANL ER-130 Modified	0.22	0.08	0.16	pCi/g
02-07021-06	NR0020605S062703	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Uranium-238	LANL ER-130 Modified	-2.33	1.66	0.96	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	0.05	0.03	0.05	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	3.12	0.37	0.05	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Potassium-40	LANL ER-130 Modified	2.79	0.66	0.35	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-212	LANL ER-130 Modified	0.30	0.08	0.09	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-214	LANL ER-130 Modified	0.51	0.11	0.11	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Radium-226	LANL ER-130 Modified	0.43	0.09	0.09	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-228	LANL ER-130 Modified	0.30	0.14	0.15	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-232	LANL ER-130 Modified	0.30	0.14	0.15	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thallium-208	LANL ER-130 Modified	0.20	0.09	0.14	pCi/g
02-07021-07	NR0020605S062704	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Uranium-238	LANL ER-130 Modified	0.41	0.89	1.04	pCi/g

K=Known,S=Spike,B=Blank,D=Duplicate,MS=Matrix Spike

Judy Stone
Lionville Laboratory, Inc.
208 Welsh Pool Road
Lionville, PA 19341-1313

SDG: 0207021
MATRIX: Soil

Lab ID	Client ID	Sample Date	Receipt Date	Analysis Date	Report Date	Batch ID	Analyte	Method	Result	Error	MDA	Units
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	0.01	0.03	0.07	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	3.10	0.36	0.05	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Potassium-40	LANL ER-130 Modified	2.68	0.80	0.42	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-212	LANL ER-130 Modified	0.28	0.12	0.10	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-214	LANL ER-130 Modified	0.14	0.11	0.12	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Radium-226	LANL ER-130 Modified	0.29	0.10	0.12	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-228	LANL ER-130 Modified	0.33	0.14	0.17	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-232	LANL ER-130 Modified	0.33	0.14	0.17	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thallium-208	LANL ER-130 Modified	0.22	0.09	0.17	pCi/g
02-07021-08	NR0020605S062705	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Uranium-238	LANL ER-130 Modified	3.74	0.93	1.17	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cobalt-60	LANL ER-130 Modified	0.02	0.05	0.10	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Cesium-137	LANL ER-130 Modified	0.97	0.16	0.09	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Potassium-40	LANL ER-130 Modified	6.43	1.39	0.92	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-212	LANL ER-130 Modified	0.74	0.14	0.13	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Lead-214	LANL ER-130 Modified	0.48	0.13	0.19	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Radium-226	LANL ER-130 Modified	0.51	0.17	0.17	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-228	LANL ER-130 Modified	0.60	0.24	0.33	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thorium-232	LANL ER-130 Modified	0.60	0.24	0.33	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Thallium-208	LANL ER-130 Modified	0.58	0.18	0.22	pCi/g
02-07021-09	NR0020605S062706	06/27/02	07/05/02	07/08/02	07/18/02	0207021	Uranium-238	LANL ER-130 Modified	0.19	1.31	1.36	pCi/g

K=Known,S=Spike,B=Blank,D=Duplicate,MS=Matrix Spike

02 07 021

74-15-1 (9/97)—q

SEND THIS SHEET WITH SAMPLE TO CONTACT LAB

-4

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Print Legibly

Part 3

CAUTION (check if applicable)

☐ Lab personnel are expected to use caution when handling DEC samples, however, please use special caution when handling this sample since it is believed to contain significant concentrations of hazardous and/or toxic materials(s)

CHECK THE BOX PRECEDING THE REQUESTED ANALYSIS

PRIORITY POLLUTANTS (Water Part 136)—SPDES

☐ 2. 13PP Metals
☐ 3. Volatiles—(USEPA 624 GC/MS)
☐ 6. Pesticides/PCBs (USEPA 608-GC)
☐ 4. Acids Base/Neutrals (USEPA 624 GC/MS)
☐ 5. Cyanide
☐ 9. BOD
☐ 7. Halogenated Volatiles (USEPA 601 GC)
☐ 8. Aromatic Volatiles USEPA 602 GC)
☐ 12. TSS
☐ 10. pH
☐ 11. COD
☐ 15. Ammonia
☐ 13. Settleable Solids
☐ 14. TKN
☐ 18. Reactive Phosphorus
☐ 16. Nitrate/Nitrite
☐ 17. Total Phosphorus
☐ 21. Total Phenols
☐ 19. Oil/Grease)
☐ 20. TOC
☐ 60. PCBs congener method (ASP 91-11)
☐ 22. Other _____
☐ 59. PCBs at 0.065 ug/l
☐ 64. Total Solids
☐ 62. CBOD
☐ 65. Volatiles (USEPA 524.2 GC/MS)

CONTRACT LABORATORY PROTOCOLS

☐ 23 (ALL)—Water—Includes 24-28
☐ 29. (ALL)—Soil/Sediments—Includes 30-34
☐ 24 Base/Neutral/Acid (B/N/A)—Water—GC/MS (ASP #95-2)
☐ 30. (B/N/A)—Soil/Sediments—GC/MS (ASP #95-2)
☐ 25 Volatile Organic Analysis VOA—Water—GC/MS (ASP #95-1)
☐ 31. VOA—Soil/Sediments—GC/MS (ASP #95-1)
☐ 26 Pesticides/PCBs—Water—GC/MS (ASP #95-3)
☐ 32. Pesticides/PCBs—Soil/Sediments—GC (ASP #95-3)
☐ 27 Metals—23 in Water
☐ 33. Metals—23 in Soil/Sediments)
☐ 28 Cyanide—Water
☐ 34. Cyanide—Soil/Sediments)
☐ 66 Dioxin-Water (ASP #91-7)
☐ 67. Dioxin-Soil/Sediments (ASP #91-7)
☐ 35 Other _____

RECEIVED
JUL - 5 2002
TMA/ Eberline
OAK RIDGE LAB

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

☐ 36. EP Toxicity
☐ 37. EP Toxicity (Metals Only)
☐ 38. Ignitability
☐ 39. Corrosivity
☐ 40. VOA—(USEPA 8260 GC/MS)
☐ 41. BNA—(USEPA 8270 GC/MS)
☐ 42. Pesticides/PCBs (USEPA 8081)
☐ 43. TCLP
☐ 44. TCLP (Metals Only)
☐ 45. Reactivity
☐ 46. Dioxin (USEPA 8280)
☐ 47. Appendix IX
☒ 48. Other See Attached Letter
☐ 63 Percent Solids
☐ 68. Metals—17 Hazardous

MUNICIPAL SLUDGE

☐ 56. RS-01 ☐ 57. RS-02 ☐ 58. Other _____

COLLECTED BY:	TELEPHONE NUMBER:	REGION NO.:
Robert Rommel	518 402-8580	~~10~~ 1

CONTRACT LABORATORY:	COUNTY:	SAMPLING DATE:	MILITARY TIME:
Eberline Services	Suffolk	06/27/02	1046

SAMPLE MATRIX:

☐ Air ☒ Soil/Sediment ☐ Groundwater ☐ Surface Water ☐ Wastewater ☐ Other _____

CASE NO.	SDG NO.	SAMPLE NO.	CHECK FOR MS/MD	TYPE OF SAMPLE
NR002	06058	062701	☐ This sample	☒ Grab ☐ Composite ☐ Term _____ hours

☐ Check if there will be more samples with this SDG sent in this calendar week.

SAMPLING POINT:
Rec'd 7/5/02 0930 K Shaulis

Report via Category B, unless checked ☐
Check if field duplicate ☐ Outfall Number
Check if sampling is part of inspection ☐
FLOW: _____ GPD _____ MGD
SPDES NUMBER/REGISTRY NUMBER

74-15-1 (9/97)—q

SEND THIS SHEET WITH SAMPLE TO CONTACT LAB

-5

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Print Legibly

Part 3

CAUTION (check if applicable)

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☐ 4. Acids Base/Neutrals (USEPA 624 GC/MS)
☐ 5. Cyanide
☐ 9. BOD
☐ 7. Halogenated Volatiles (USEPA 601 GC)
☐ 8. Aromatic Volatiles USEPA 602 GC)
☐ 12. TSS
☐ 10. pH
☐ 11. COD
☐ 15. Ammonia
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☐ 14. TKN
☐ 18. Reactive Phosphorus
☐ 16. Nitrate/Nitrite
☐ 17. Total Phosphorus
☐ 21. Total Phenols
☐ 19. Oil/Grease)
☐ 20. TOC
☐ 60. PCBs congener method (ASP 91-11)
☐ 22. Other _____
☐ 59. PCBs at 0.065 ug/l
☐ 64. Total Solids
☐ 62. CBOD
☐ 65. Volatiles (USEPA 524.2 GC/MS)

CONTRACT LABORATORY PROTOCOLS

☐ 23 (ALL)—Water—Includes 24-28
☐ 29. (ALL)—Soil/Sediments—Includes 30-34
☐ 24 Base/Neutral/Acid (B/N/A)—Water—GC/MS (ASP #95-2)
☐ 30. (B/N/A)—Soil/Sediments—GC/MS (ASP #95-2)
☐ 25 Volatile Organic Analysis VOA—Water—GC/MS (ASP #95-1)
☐ 31. VOA—Soil/Sediments—GC/MS (ASP #95-1)
☐ 26 Pesticides/PCBs—Water—GC/MS (ASP #95-3)
☐ 32. Pesticides/PCBs—Soil/Sediments—GC (ASP #95-3)
☐ 27 Metals—23 in Water
☐ 33. Metals—23 in Soil/Sediments)
☐ 28 Cyanide—Water
☐ 34. Cyanide—Soil/Sediments)
☐ 66 Dioxin-Water (ASP #91-7)
☐ 67. Dioxin-Soil/Sediments (ASP #91-7)
☐ 35 Other _____

RECEIVED
JUL - 5 2002
TMA/ Shoreline
OAK RIDGE LAB

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

☐ 36. EP Toxicity
☐ 37. EP Toxicity (Metals Only)
☐ 38. Ignitability
☐ 39. Corrosivity
☐ 40. VOA—(USEPA 8260 GC/MS)
☐ 41. BNA—(USEPA 8270 GC/MS)
☐ 42. Pesticides/PCBs (USEPA 8081)
☐ 43. TCLP
☐ 44. TCLP (Metals Only)
☐ 45. Reactivity
☐ 46. Dioxin (USEPA 8280)
☐ 47. Appendix IX
☒ 48. Other See Attached List
☐ 63 Percent Solids
☐ 68. Metals—17 Hazardous

MUNICIPAL SLUDGE

☐ 56. RS-01 ☐ 57. RS-02 ☐ 58. Other _____

COLLECTED BY:	TELEPHONE NUMBER:	REGION NO.:
Robert Romano	518-402-8550	1

CONTRACT LABORATORY:	COUNTY:	SAMPLING DATE:	MILITARY TIME:
Shoreline Services	Suffolk	06/27/02	1055

SAMPLE MATRIX:

☐ Air ☒ Soil/Sediment ☐ Groundwater ☐ Surface Water ☐ Wastewater ☐ Other _____

CASE NO.	SDG NO.	SAMPLE NO.	CHECK FOR MS/MD	TYPE OF SAMPLE
N/A 0002	6P5N	0C2790	☐ This sample	☒ Grab ☐ Composite ☐ Term _____ hours

☐ Check if there will be more samples with this SDG sent in this calendar week.

SAMPLING POINT:
Rec'd 7/5/02 0930 K Skoulis

Report via Category B, unless checked ☐
Check if field duplicate ☐ Outfall Number
Check if sampling is part of inspection ☐
FLOW: _____ GPD _____ MGD
SPDES NUMBER/REGISTRY NUMBER

02 07 021
-6

74-15-1 (9/97)—q

SEND THIS SHEET WITH SAMPLE TO CONTACT LAB

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Print Legibly

Part 3

CAUTION (check if applicable)

☐ Lab personnel are expected to use caution when handling DEC samples, however, please use special caution when handling this sample since it is believed to contain significant concentrations of hazardous and/or toxic materials(s)

CHECK THE BOX PRECEDING THE REQUESTED ANALYSIS

PRIORITY POLLUTANTS (Water Part 136)—SPDES

☐ 2. 13PP Metals
☐ 3. Volatiles—(USEPA 624 GC/MS)
☐ 6. Pesticides/PCBs (USEPA 608-GC)
☐ 4. Acids Base/Neutrals (USEPA 624 GC/MS)
☐ 5. Cyanide
☐ 9. BOD
☐ 7. Halogenated Volatiles (USEPA 601 GC)
☐ 8. Aromatic Volatiles USEPA 602 GC)
☐ 12. TSS
☐ 10. pH
☐ 11. COD
☐ 15. Ammonia
☐ 13. Settleable Solids
☐ 14. TKN
☐ 18. Reactive Phosphorus
☐ 16. Nitrate/Nitrite
☐ 17. Total Phosphorus
☐ 21. Total Phenols
☐ 19. Oil/Grease)
☐ 20. TOC
☐ 60. PCBs congener method (ASP 91-11)
☐ 22. Other _____
☐ 59. PCBs at 0.065 ug/l
☐ 64. Total Solids
☐ 62. CBOD
☐ 65. Volatiles (USEPA 524.2 GC/MS)

CONTRACT LABORATORY PROTOCOLS

☐ 23 (ALL)—Water—Includes 24-28
☐ 29. (ALL)—Soil/Sediments—Includes 30-34
☐ 24 Base/Neutral/Acid (B/N/A)—Water—GC/MS (ASP #95-2)
☐ 30. (B/N/A)—Soil/Sediments—GC/MS (ASP #95-2)
☐ 25 Volatile Organic Analysis VOA—Water—GC/MS (ASP #95-1)
☐ 31. VOA—Soil/Sediments—GC/MS (ASP #95-1)
☐ 26 Pesticides/PCBs—Water—GC/MS (ASP #95-3)
☐ 32. Pesticides/PCBs—Soil/Sediments—GC (ASP #95-3)
☐ 27 Metals—23 in Water
☐ 33. Metals—23 in Soil/Sediments)
☐ 28 Cyanide—Water
☐ 34. Cyanide—Soil/Sediments)
☐ 66 Dioxin-Water (ASP #91-7)
☐ 67. Dioxin-Soil/Sediments (ASP #91-7)
☐ 35 Other _____

RECEIVED
JUL - 5 2002
TMS, SHIRLEY
OAK RIDGE LAB

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

☐ 36. EP Toxicity
☐ 37. EP Toxicity (Metals Only)
☐ 38. Ignitability
☐ 39. Corrosivity
☐ 40. VOA—(USEPA 8260 GC/MS)
☐ 41. BNA—(USEPA 8270 GC/MS)
☐ 42. Pesticides/PCBs (USEPA 8081)
☐ 43. TCLP
☐ 44. TCLP (Metals Only)
☐ 45. Reactivity
☐ 46. Dioxin (USEPA 8280)
☐ 47. Appendix IX
☒ 48. Other See attached list
☐ 63 Percent Solids
☐ 68. Metals—17 Hazardous

MUNICIPAL SLUDGE

☐ 56. RS-01 ☐ 57. RS-02 ☐ 58. Other _____

COLLECTED BY:	TELEPHONE NUMBER:	REGION NO.:
Robert Rummel	518-402-8230	1

CONTRACT LABORATORY:	COUNTY:	SAMPLING DATE:	MILITARY TIME:
[illegible] Services	Suffolk	07/17/02	1100

SAMPLE MATRIX:

☐ Air ☒ Soil/Sediment ☐ Groundwater ☐ Surface Water ☐ Wastewater ☐ Other _____

CASE NO.	SDG NO.	SAMPLE NO.	CHECK FOR MS/MD	TYPE OF SAMPLE
NR02	0CP53	0C2713	☐ This sample	☒ Grab ☐ Composite ☐ Term _____ hours

☐ Check if there will be more samples with this SDG sent in this calendar week.

SAMPLING POINT:

Rcvd 7/5/02 0930 K Shaulis

Report via Category B, unless checked ☐

Check if field duplicate ☐ Outfall Number

Check if sampling is part of inspection ☐

FLOW: _____ GPD _____ MGD

SPDES NUMBER/REGISTRY NUMBER

| | | | | | |

74-15-1 (9/97)—q

SEND THIS SHEET WITH SAMPLE TO CONTACT LAB

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Print Legibly

Part 3

CAUTION (check if applicable)

☐ Lab personnel are expected to use caution when handling DEC samples, however, please use special caution when handling this sample since it is believed to contain significant concentrations of hazardous and/or toxic materials(s)

CHECK THE BOX PRECEDING THE REQUESTED ANALYSIS

PRIORITY POLLUTANTS (Water Part 136)—SPDES

☐ 2. 13PP Metals
☐ 3. Volatiles—(USEPA 624 GC/MS)
☐ 6. Pesticides/PCBs (USEPA 608-GC)
☐ 4. Acids Base/Neutrals (USEPA 624 GC/MS)
☐ 5. Cyanide
☐ 9. BOD
☐ 7. Halogenated Volatiles (USEPA 601 GC)
☐ 8. Aromatic Volatiles USEPA 602 GC)
☐ 12. TSS
☐ 10. pH
☐ 11. COD
☐ 15. Ammonia
☐ 13. Settleable Solids
☐ 14. TKN
☐ 18. Reactive Phosphorus
☐ 16. Nitrate/Nitrite
☐ 17. Total Phosphorus
☐ 21. Total Phenols
☐ 19. Oil/Grease)
☐ 20. TOC
☐ 60. PCBs congener method (ASP 91-11)
☐ 22. Other _____
☐ 59. PCBs at 0.065 ug/l
☐ 64. Total Solids
☐ 62. CBOD
☐ 65. Volatiles (USEPA 524.2 GC/MS)

CONTRACT LABORATORY PROTOCOLS

☐ 23 (ALL)—Water—Includes 24-28
☐ 29. (ALL)—Soil/Sediments—Includes 30-34
☐ 24 Base/Neutral/Acid (B/N/A)—Water—GC/MS (ASP #95-2)
☐ 30. (B/N/A)—Soil/Sediments—GC/MS (ASP #95-2)
☐ 25 Volatile Organic Analysis VOA—Water—GC/MS (ASP #95-1)
☐ 31. VOA—Soil/Sediments—GC/MS (ASP #95-1)
☐ 26 Pesticides/PCBs—Water—GC/MS (ASP #95-3)
☐ 32. Pesticides/PCBs—Soil/Sediments—GC (ASP #95-3)
☐ 27 Metals—23 in Water
☐ 33. Metals—23 in Soil/Sediments)
☐ 28 Cyanide—Water
☐ 34. Cyanide—Soil/Sediments)
☐ 66 Dioxin-Water (ASP #91-7)
☐ 67. Dioxin-Soil/Sediments (ASP #91-7)
☐ 35 Other _____

RECEIVED JUL - 5 2002 OAK RIDGE LAB

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

☐ 36. EP Toxicity
☐ 37. EP Toxicity (Metals Only)
☐ 38. Ignitability
☐ 39. Corrosivity
☐ 40. VOA—(USEPA 8260 GC/MS)
☐ 41. BNA—(USEPA 8270 GC/MS)
☐ 42. Pesticides/PCBs (USEPA 8081)
☐ 43. TCLP
☐ 44. TCLP (Metals Only)
☐ 45. Reactivity
☐ 46. Dioxin (USEPA 8280)
☐ 47. Appendix IX
☒ 48. Other See Analytical Order
☐ 63 Percent Solids
☐ 68. Metals—17 Hazardous

MUNICIPAL SLUDGE

☐ 56. RS-01 ☐ 57. RS-02 ☐ 58. Other _____

COLLECTED BY:	TELEPHONE NUMBER:	REGION NO.:
Robert Rowan	518-402-9580	1

CONTRACT LABORATORY:	COUNTY:	SAMPLING DATE:	MILITARY TIME:
Laboratory Services	Suffolk	7/09/02	1107

SAMPLE MATRIX:

☐ Air ☒ Soil/Sediment ☐ Groundwater ☐ Surface Water ☐ Wastewater ☐ Other _____

CASE NO.	SDG NO.	SAMPLE NO.	CHECK FOR MS/MD	TYPE OF SAMPLE
NR1012	06055	01709H	☐ This sample	☒ Grab ☐ Composite ☐ Term _____ hours

☐ Check if there will be more samples with this SDG sent in this calendar week.

SAMPLING POINT:

Recd 7/5/02 0930 K Shaulis

Report via Category B, unless checked ☐

Check if field duplicate ☐ Outfall Number

Check if sampling is part of inspection ☐

FLOW: _____ GPD _____ MGD

SPDES NUMBER/REGISTRY NUMBER

02 07 021
-8

74-15-1 (9/97)—q

SEND THIS SHEET WITH SAMPLE TO CONTACT LAB

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Print Legibly

Part 3

CAUTION (check if applicable)

☐ Lab personnel are expected to use caution when handling DEC samples, however, please use special caution when handling this sample since it is believed to contain significant concentrations of hazardous and/or toxic materials(s)

CHECK THE BOX PRECEDING THE REQUESTED ANALYSIS

PRIORITY POLLUTANTS (Water Part 136)—SPDES

☐ 2. 13PP Metals
☐ 3. Volatiles—(USEPA 624 GC/MS)
☐ 6. Pesticides/PCBs (USEPA 608-GC)
☐ 4. Acids Base/Neutrals (USEPA 624 GC/MS)
☐ 5. Cyanide
☐ 9. BOD
☐ 7. Halogenated Volatiles (USEPA 601 GC)
☐ 8. Aromatic Volatiles USEPA 602 GC)
☐ 12. TSS
☐ 10. pH
☐ 11. COD
☐ 15. Ammonia
☐ 13. Settleable Solids
☐ 14. TKN
☐ 18. Reactive Phosphorus
☐ 16. Nitrate/Nitrite
☐ 17. Total Phosphorus
☐ 21. Total Phenols
☐ 19. Oil/Grease)
☐ 20. TOC
☐ 60. PCBs congener method (ASP 91-11)
☐ 22. Other _____
☐ 59. PCBs at 0.065 ug/l
☐ 64. Total Solids
☐ 62. CBOD
☐ 65. Volatiles (USEPA 524.2 GC/MS)

CONTRACT LABORATORY PROTOCOLS

☐ 23 (ALL)—Water—Includes 24-28
☐ 29. (ALL)—Soil/Sediments—Includes 30-34
☐ 24 Base/Neutral/Acid (B/N/A)—Water—GC/MS (ASP #95-2)
☐ 30. (B/N/A)—Soil/Sediments—GC/MS (ASP #95-2)
☐ 25 Volatile Organic Analysis VOA—Water—GC/MS (ASP #95-1)
☐ 31. VOA—Soil/Sediments—GC/MS (ASP #95-1)
☐ 26 Pesticides/PCBs—Water—GC/MS (ASP #95-3)
☐ 32. Pesticides/PCBs—Soil/Sediments—GC (ASP #95-3)
☐ 27 Metals—23 in Water
☐ 33. Metals—23 in Soil/Sediments)
☐ 28 Cyanide—Water
☐ 34. Cyanide—Soil/Sediments)
☐ 66 Dioxin-Water (ASP #91-7)
☐ 67. Dioxin-Soil/Sediments (ASP #91-7)
☐ 35 Other _____

RECEIVED
JUL - 5 2002
TMA/ Sherline
OAK RIDGE LAB

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

☐ 36. EP Toxicity
☐ 37. EP Toxicity (Metals Only)
☐ 38. Ignitability
☐ 39. Corrosivity
☐ 40. VOA—(USEPA 8260 GC/MS)
☐ 41. BNA—(USEPA 8270 GC/MS)
☐ 42. Pesticides/PCBs (USEPA 8081)
☐ 43. TCLP
☐ 44. TCLP (Metals Only)
☐ 45. Reactivity
☐ 46. Dioxin (USEPA 8280)
☐ 47. Appendix IX
☒ 48. Other Sr Attenuation Test
☐ 63 Percent Solids
☐ 68. Metals—17 Hazardous

MUNICIPAL SLUDGE

☐ 56. RS-01 ☐ 57. RS-02 ☐ 58. Other _____

COLLECTED BY:	TELEPHONE NUMBER:	REGION NO.:
Robert Romano	518-402-8530	1

CONTRACT LABORATORY:	COUNTY:	SAMPLING DATE:	MILITARY TIME:
[illegible]	Suffolk	06/27/02	1117

SAMPLE MATRIX:

☐ Air ☒ Soil/Sediment ☐ Groundwater ☐ Surface Water ☐ Wastewater ☐ Other _____

CASE NO.	SDG NO.	SAMPLE NO.	CHECK FOR MS/MD	TYPE OF SAMPLE
N R H 0 2	V 6 0 5 5	0 0 0 7 0 5	☐ This sample	☒ Grab ☐ Composite ☐ Term _____ hours

☐ Check if there will be more samples with this SDG sent in this calendar week.

SAMPLING POINT:

Rec'd 7/5/02 0930 K Shaulo

Report via Category B, unless checked ☐

Check if field duplicate ☐ Outfall Number

Check if sampling is part of inspection ☐

FLOW: _____ GPD _____ MGD

SPDES NUMBER/REGISTRY NUMBER

02 07 021

74-15-1 (9/97)—q

SEND THIS SHEET WITH SAMPLE TO CONTACT LAB

-9

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Print Legibly

Part 3

CAUTION (check if applicable)

☐ Lab personnel are expected to use caution when handling DEC samples, however, please use special caution when handling this sample since it is believed to contain significant concentrations of hazardous and/or toxic materials(s)

CHECK THE BOX PRECEDING THE REQUESTED ANALYSIS

PRIORITY POLLUTANTS (Water Part 136)—SPDES

☐ 2. 13PP Metals
☐ 3. Volatiles—(USEPA 624 GC/MS)
☐ 6. Pesticides/PCBs (USEPA 608-GC)
☐ 4. Acids Base/Neutrals (USEPA 624 GC/MS)
☐ 5. Cyanide
☐ 9. BOD
☐ 7. Halogenated Volatiles (USEPA 601 GC)
☐ 8. Aromatic Volatiles USEPA 602 GC)
☐ 12. TSS
☐ 10. pH
☐ 11. COD
☐ 15. Ammonia
☐ 13. Settleable Solids
☐ 14. TKN
☐ 18. Reactive Phosphorus
☐ 16. Nitrate/Nitrite
☐ 17. Total Phosphorus
☐ 21. Total Phenols
☐ 19. Oil/Grease)
☐ 20. TOC
☐ 60. PCBs congener method (ASP 91-11)
☐ 22. Other _____
☐ 59. PCBs at 0.065 ug/l
☐ 64. Total Solids
☐ 62. CBOD
☐ 65. Volatiles (USEPA 524.2 GC/MS)

CONTRACT LABORATORY PROTOCOLS

☐ 23 (ALL)—Water—Includes 24-28
☐ 29. (ALL)—Soil/Sediments—Includes 30-34
☐ 24 Base/Neutral/Acid (B/N/A)—Water—GC/MS (ASP #95-2)
☐ 30. (B/N/A)—Soil/Sediments—GC/MS (ASP #95-2)
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☐ 31. VOA—Soil/Sediments—GC/MS (ASP #95-1)
☐ 26 Pesticides/PCBs—Water—GC/MS (ASP #95-3)
☐ 32. Pesticides/PCBs—Soil/Sediments—GC (ASP #95-3)
☐ 27 Metals—23 in Water
☐ 33. Metals—23 in Soil/Sediments)
☐ 28 Cyanide—Water
☐ 34. Cyanide—Soil/Sediments)
☐ 66 Dioxin-Water (ASP #91-7)
☐ 67. Dioxin-Soil/Sediments (ASP #91-7)
☐ 35 Other _____

RECEIVED
JUL - 5 2002
TMA/ Sherline
OAK RIDGE LAB

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

☐ 36. EP Toxicity
☐ 37. EP Toxicity (Metals Only)
☐ 38. Ignitability
☐ 39. Corrosivity
☐ 40. VOA—(USEPA 8260 GC/MS)
☐ 41. BNA—(USEPA 8270 GC/MS)
☐ 42. Pesticides/PCBs (USEPA 8081)
☐ 43. TCLP
☐ 44. TCLP (Metals Only)
☐ 45. Reactivity
☐ 46. Dioxin (USEPA 8280)
☐ 47. Appendix IX
☒ 48. Other See Attached Cover
☐ 63 Percent Solids
☐ 68. Metals—17 Hazardous

MUNICIPAL SLUDGE

☐ 56. RS-01 ☐ 57. RS-02 ☐ 58. Other _____

COLLECTED BY:	TELEPHONE NUMBER:	REGION NO.:
Robert Rennel	518-402 5550	1

CONTRACT LABORATORY:	COUNTY:	SAMPLING DATE:	MILITARY TIME:
Eli Lilly Services	Sullivan	06/27/02	1021

SAMPLE MATRIX:

☐ Air ☒ Soil/Sediment ☐ Groundwater ☐ Surface Water ☐ Wastewater ☐ Other _____

CASE NO.	SDG NO.	SAMPLE NO.	CHECK FOR MS/MD	TYPE OF SAMPLE
A1812	1515	6123	☐ This sample	☒ Grab ☐ Composite ☐ Term _____ hours

☐ Check if there will be more samples with this SDG sent in this calendar week.

SAMPLING POINT:

Recd 7/5/02 0930 K Shaulis

Report via Category B, unless checked ☐

Check if field duplicate ☐ Outfall Number

Check if sampling is part of inspection ☐

FLOW: _____ GPD _____ MGD

SPDES NUMBER/REGISTRY NUMBER

NYS Department of Environmental Conservation
Bureau of Radiation
625 Broadway
Albany, NY 12233

Sample Collection Chain-of-Custody Form

Page 1 of 1 Side A

Site: BNL, 650 OUTFALL REMEDIATION PROJECT

Security Seal No.	Collection Date	Collection Time	Sample Type	Location	Coll. by
262 326	6/27/02	1046	SOIL	NR002 0605 S 062701 Area by entry & excavator	[illegible]
262 327	6/27/02	1055	SOIL	062702 BOTTOM OF LARGEST EXCAVATION 0-6"	[illegible]
262 328	6/27/02	1100	SOIL	062703 BOTTOM OF LARGEST EXCAVATION 6-12"	[illegible]
262 329	6/27/02	1107	SOIL	062704 EXCAVATION #2, EAST OF LARGE EXC.	[illegible]
262 330	6/27/02	1117	SOIL	062705 EXCAVATION #3, SOUTH OF 2ND ONE	[illegible]
262 331	6/27/02	1121	SOIL	062706 EXCAVATION #4, SOUTH OF LARGE EXC.	[illegible]

RECEIVED
JUL - 5 2002
[illegible] Eberline
OAK RIDGE LAB

See Side B (reverse) for Chain-of-Custody

Relinquished By	Received By
Print ROBERT ROMMEL Date 7/3/02	Print Kathy Shaulis Date 7/5/02
Signature [illegible] Time 8:30 A.M.	Signature Kathy B Shaulis Time 0930
Purpose of Transfer: SHIPMENT FOR SAMPLE ANALYSIS.	

Relinquished By	Received By
Print Date	Print Date
Signature Time	Signature Time
Purpose of Transfer:	

Relinquished By	Received By
Print Date	Print Date
Signature Time	Signature Time
Purpose of Transfer:	

Relinquished By	Received By
Print Date	Print Date
Signature Time	Signature Time
Purpose of Transfer:	

EBERLINE SERVICES

Oak Ridge Laboratory
601 Scarboro Road
Oak Ridge, TN 37830
Phone (865) 481-0683
Fax (865) 483-4621

EBS-OR-17449

July 29, 2002

Ms. Judy Stone
Lionville Laboratory, Inc.
208 Welsh Pool Road
Lionville, PA 19341-1313

Nysdec
02071190

CASE NARRATIVE
Work Order # 02-07081-OR

SAMPLE RECEIPT

This work order contains two soil samples received 07/15/02. Both samples were analyzed for Isotopic Plutonium, Strontium-90 and by Gamma Spectroscopy.

CLIENT ID	LAB ID
NR0020603S061201	02-07081-04
NR0020603S061202	02-07081-05

ANALYTICAL METHODS

Isotopic Plutonium was analyzed using Method EML Pu-02 modified. Strontium-90 was analyzed using EIChroM Method SRW01 modified. Gamma Spectroscopy was performed using Method LANL ER-130 modified.

ANALYTICAL RESULTS

ISOTOPIC PLUTONIUM

Sample results demonstrated non-detect equivalent Plutonium-238 activity, and slightly positive Plutonium-239/240 activity. Both samples demonstrated an acceptable chemical recovery. The blank results demonstrated non-detect equivalent Plutonium-238 and Plutonium-239/240 activity. Replicate results demonstrated high relative percent differences and acceptable normalized differences for Plutonium-238 and Plutonium-239/240. Results for the laboratory control sample demonstrated acceptable percent recoveries and normalized differences for Plutonium-238 and Plutonium-239/240.

STRONTIUM-90 BY SEQUENTIAL COUNTS

Sample results demonstrated slightly positive Strontium-90 activity. Chemical recovery was acceptable for both samples. The blank result demonstrated non-detect equivalent Strontium-90 activity. The replicate result demonstrated a slightly high relative percent difference and normalized difference for Strontium-90. Results for the laboratory control sample demonstrated an acceptable percent recovery and normalized difference for Strontium-90.

ANALYTICAL RESULTS CONTINUED

GAMMA SPECTRAL ANALYSIS

Sample results demonstrated non-detect equivalent Thorium-232, Lead-212, Lead-214, Thorium-228 and Thallium-208 activity, non-detect equivalent to slightly positive Radium-226 and Uranium-238 activity, and slightly positive Cobalt-60, Cesium-137 and Potassium-40 activity. The blank results demonstrated non-detect equivalent Thorium-232, Radium-226, Cobalt-60, Cesium-137, Potassium-40, Lead-212, Lead-214, Thorium-228, Uranium-238 and Thallium-208 activity. Replicate results demonstrated acceptable relative percent differences and normalized differences for Cesium-137 and Uranium-238. Results for the laboratory control sample demonstrated acceptable percent recoveries and normalized differences for Cobalt-60 and Cesium-137.

CERTIFICATION OF ACCURACY

I certify that this data report is in compliance with the terms and conditions of the Purchase Order, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the cognizant project manager or his/her designee to be accurate as verified by the following signature.

M.R. McDougall
Laboratory Manager

Date: 7/29/2002

Judy Stone
Lionville Laboratory, Inc.
208 Welsh Pool Road
Lionville, PA 19341-1313

SDG: 0207081
Matrix: Soil

Lab ID	Client ID	Sample Date	Receipt Date	Analysis Date	Report Date	Batch ID	Analyte	Method	Result	Error	MDA	Units
02-07081-01	K KNOWN	07/15/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-238	EML Pu-02 Modified	4.90	0.14		pCi/g
02-07081-01	S SPIKE	07/15/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-238	EML Pu-02 Modified	4.33	0.88	0.08	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-238	EML Pu-02 Modified	0.01	0.03	0.04	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-238	EML Pu-02 Modified	0.03	0.04	0.04	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-238	EML Pu-02 Modified	0.04	0.05	0.07	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-238	EML Pu-02 Modified	0.02	0.03	0.04	pCi/g
02-07081-01	K KNOWN	07/15/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-239/240	EML Pu-02 Modified	5.95	0.18		pCi/g
02-07081-01	S SPIKE	07/15/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-239/240	EML Pu-02 Modified	5.30	1.05	0.04	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-239/240	EML Pu-02 Modified	0.05	0.05	0.04	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-239/240	EML Pu-02 Modified	1.68	0.43	0.04	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-239/240	EML Pu-02 Modified	2.63	0.60	0.08	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/19/02	07/29/02	0207081	Plutonium-239/240	EML Pu-02 Modified	0.80	0.27	0.04	pCi/g
02-07081-01	K KNOWN	07/15/02	07/15/02	07/26/02	07/29/02	0207081	Strontium-90	EIChroM SRW01 Modified	21.51	0.45		pCi/g
02-07081-01	S SPIKE	07/15/02	07/15/02	07/26/02	07/29/02	0207081	Strontium-90	EIChroM SRW01 Modified	22.83	0.59	0.79	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/26/02	07/29/02	0207081	Strontium-90	EIChroM SRW01 Modified	0.55	0.14	1.31	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/26/02	07/29/02	0207081	Strontium-90	EIChroM SRW01 Modified	1.30	0.10	0.72	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/26/02	07/29/02	0207081	Strontium-90	EIChroM SRW01 Modified	0.96	0.02	0.72	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/26/02	07/29/02	0207081	Strontium-90	EIChroM SRW01 Modified	16.09	0.32	0.69	pCi/g
02-07081-01	K KNOWN	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Cobalt-60	LANL ER-130 Modified	256.65	11.68		pCi/g
02-07081-01	K KNOWN	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Cesium-137	LANL ER-130 Modified	153.47	7.21		pCi/g
02-07081-01	S SPIKE	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Cobalt-60	LANL ER-130 Modified	255.20	18.15	1.18	pCi/g
02-07081-01	S SPIKE	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Cesium-137	LANL ER-130 Modified	158.30	16.67	1.20	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Cobalt-60	LANL ER-130 Modified	0.00	0.03	0.06	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Cesium-137	LANL ER-130 Modified	0.01	0.03	0.07	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Potassium-40	LANL ER-130 Modified	-0.05	0.31	0.75	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Lead-212	LANL ER-130 Modified	-0.02	0.05	0.09	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Lead-214	LANL ER-130 Modified	0.01	0.06	0.12	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Radium-226	LANL ER-130 Modified	-0.02	0.07	0.12	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Thorium-228	LANL ER-130 Modified	-0.07	0.12	0.21	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Thorium-232	LANL ER-130 Modified	-0.07	0.12	0.21	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Thallium-208	LANL ER-130 Modified	-0.04	0.11	0.20	pCi/g
02-07081-02	B BLANK	07/15/02	07/15/02	07/17/02	07/29/02	0207081	Uranium-238	LANL ER-130 Modified	0.07	0.67	0.64	pCi/g

K=Known,S=Spike,B=Blank,D=Duplicate,MS=Matrix Spike

Judy Stone
Lionville Laboratory, Inc.
208 Welsh Pool Road
Lionville, PA 19341-1313

SDG: 0207081
Matrix: Soil

Lab ID	Client ID	Sample Date	Receipt Date	Analysis Date	Report Date	Batch ID	Analyte	Method	Result	Error	MDA	Units
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Cobalt-60	LANL ER-130 Modified	0.26	0.08	0.10	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Cesium-137	LANL ER-130 Modified	56.12	5.99	0.19	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Potassium-40	LANL ER-130 Modified	4.07	1.18	0.14	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Lead-212	LANL ER-130 Modified	0.65	0.33	0.39	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Lead-214	LANL ER-130 Modified	0.89	0.41	0.57	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Radium-226	LANL ER-130 Modified	0.72	0.22	0.40	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thorium-228	LANL ER-130 Modified	0.66	0.24	0.31	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thorium-232	LANL ER-130 Modified	0.66	0.24	0.31	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thallium-208	LANL ER-130 Modified	0.72	0.27	0.62	pCi/g
02-07081-03	D NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Uranium-238	LANL ER-130 Modified	9.01	1.99	2.95	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Cobalt-60	LANL ER-130 Modified	0.19	0.08	0.09	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Cesium-137	LANL ER-130 Modified	56.14	5.99	0.18	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Potassium-40	LANL ER-130 Modified	4.56	1.26	0.77	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Lead-212	LANL ER-130 Modified	0.59	0.30	0.39	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Lead-214	LANL ER-130 Modified	0.82	0.40	0.58	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Radium-226	LANL ER-130 Modified	0.87	0.27	0.38	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thorium-228	LANL ER-130 Modified	0.52	0.25	0.39	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thorium-232	LANL ER-130 Modified	0.52	0.25	0.39	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thallium-208	LANL ER-130 Modified	0.66	0.27	0.59	pCi/g
02-07081-04	NR0020603S061201	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Uranium-238	LANL ER-130 Modified	9.54	2.29	3.02	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Cobalt-60	LANL ER-130 Modified	0.18	0.05	0.06	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Cesium-137	LANL ER-130 Modified	51.17	5.38	0.12	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Potassium-40	LANL ER-130 Modified	2.14	0.68	0.46	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Lead-212	LANL ER-130 Modified	0.32	0.25	0.27	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Lead-214	LANL ER-130 Modified	0.52	0.28	0.39	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Radium-226	LANL ER-130 Modified	0.24	0.16	0.30	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thorium-228	LANL ER-130 Modified	0.27	0.15	0.24	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thorium-232	LANL ER-130 Modified	0.27	0.15	0.24	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Thallium-208	LANL ER-130 Modified	0.16	0.10	0.40	pCi/g
02-07081-05	NR0020603S061202	06/12/02	07/15/02	07/17/02	07/29/02	0207081	Uranium-238	LANL ER-130 Modified	-1.36	1.48	2.45	pCi/g

K=Known,S=Spike,B=Blank,D=Duplicate,MS=Matrix Spike

02 07 081

NYS Department of Environmental Conservation
Bureau of Radiation
625 Broadway
Albany, NY 12233

Sample Collection Chain-of-Custody Form

Page 1 of 1 Side A

Site: BNL, 650 OUTFALL AREA

	Security Seal No.	Collection Date	Collection Time	Sample Type	Location	Coll. by
4	275560	6/12/02	1453	Soil	Adjacent to Well # 066-10, 6"-8"	
5	275561	6/12/02	1500	Soil	End of Pipe Trench / @ Outfall, 18"-24"	

RECEIVED
JUL 15 2002
TMA, Eberline
OAK RIDGE LAB

See Side B (reverse) for Chain-of-Custody

Relinquished By		Received By	
Print Robert Renner	Date 7/12/02	Print K Bannister	Date 7-15-02
Signature [illegible]	Time 10:20	Signature K Bannister	Time 0930
Purpose of Transfer: Shipment for Sample Analysis			

Relinquished By		Received By	
Print	Date	Print	Date
Signature	Time	Signature	Time
Purpose of Transfer:			

Relinquished By		Received By	
Print	Date	Print	Date
Signature	Time	Signature	Time
Purpose of Transfer:			

Relinquished By		Received By	
Print	Date	Print	Date
Signature	Time	Signature	Time
Purpose of Transfer:			

ATTACHMENT 2

ORISE Verification Survey of Area of Concern 6

Building 650 Reclamation Facility

Sump and Sump Outfall

ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

September 9, 2002

Ms. Gail Penny
Brookhaven Group
U.S. Department of Energy
Building 464
P.O. Box 5000
Upton, NY 11973-5000

SUBJECT: DOE CONTRACT NO. DE-AC05-00OR22750
LETTER REPORT—VERIFICATION SURVEY OF AREA OF CONCERN 6, BUILDING 650 RECLAMATION FACILITY SUMP AND SUMP OUTFALL, BROOKHAVEN NATIONAL LABORATORY, UPTON, NEW YORK

Dear Ms. Penny:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) has completed verification activities at the Brookhaven National Laboratory's Area of Concern (AOC) 6, Building 650 Reclamation Facility Sump and Sump Outfall. Verification activities were conducted on June 11 and 12, 2002 and again on July 1, 2002. Enclosed is the letter report describing the survey procedures and results.

Please contact me at (865) 576-5321 or Timothy J. Vitkus at (865) 576-5073 should you have any questions or require additional information.

Sincerely,

Phyllis C. Weaver
Project Leader/Health Physicist
Environmental Survey and
Site Assessment Program

PCW:ar

Attachment

cc: J. Brower, DOE/Brookhaven Group
T. Kneitel, DOE/Brookhaven Group
W. Beck, ORISE/ESSAP
E. Abelquist, ORISE/ESSAP
T. Vitkus, ORISE/ESSAP
File/0947

LETTER REPORT
VERIFICATION SURVEY OF
AREA OF CONCERN 6
BUILDING 650 RECLAMATION FACILITY SUMP AND SUMP OUTFALL
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK

INTRODUCTION AND SITE HISTORY

The Brookhaven National Laboratory (BNL) was established in 1947 and has since operated a variety of research facilities for the scientific community. During the periods of World Wars I and II, BNL was operated by the U.S. Army as Camp Upton, and between the wars, by the Civilian Conservation Corps. In 1947, the site was transferred to the Atomic Energy Commission (AEC) and to the Energy Research and Development Administration (ERDA) in 1975, and to the U.S. Department of Energy (DOE) in 1977.

With operations dating back to 1959, the former Reclamation Facility Building 650 served as a decontamination facility for radioactively contaminated clothing and equipment. Decontamination activities were conducted both inside and outside the facility in designated areas. Contaminated clothing was cleaned in dedicated equipment and the residual wash-water was stored in two-2,000 gallon underground storage tanks, located on the north side of the building, until the water could be sampled and assayed. Contaminated equipment was steam cleaned outside Building 650 on a 30 foot by 30 foot concrete pad that was also located on the north side of building. Effluent from this operation was collected into a drum located in the center of a sloping pad, known as the Building 650 Sump, and from there was pumped to the sanitary sewer system or building holding tanks. However, in 1969, it was discovered that the drainage pipe from the concrete pad area led to a natural depression in the wooded area about 800 feet northeast of the building and not into the sanitary sewer system. This discovery resulted in discontinuing decontamination of equipment on the outdoor pad (BNL 2001a). The natural wooded area to which the sump drained, became known as the Building 650 Sump Outfall. The Building 650 Sump and the Sump Outfall have been designated as Area of Concern 6 by BNL.

BNL recently remediated the AOC 6 areas by excavating and removing radiologically-contaminated soil, concrete, and the drain line pipe (BNL 2001b). The two-2,000 gallon underground storage tanks were removed prior to this decontamination effort, possibly shortly after outdoor decontamination activities were discontinued in 1969. Excavated soil from AOC 6 that exceeded the Cs-137 derived concentration guideline (DCGL) of 23 pCi/g, were removed to an off-site disposal facility (BNL 2002a). Soils that were determined to be below the Cs-137 DCGL were used to backfill the excavated area. Final status measurements and sampling by BNL were determined using *in situ* gamma spectroscopy and gamma radiation measurements. BNL designated 31,600 square feet (ft^2) of AOC 6 as Class 1 and approximately 99,500 ft^2 as Class 2 survey areas in accordance with the definitions contained in the Multi-Agency Radiation Survey and Site Investigation Manual (NRC 1997).

SITE DESCRIPTION

BNL is located on Long Island approximately 60 miles from New York City in Upton, New York within Suffolk County (Figure 1). The BNL site contains 5,265 acres of gently rolling terrain at elevations between 44 and 120 feet above main sea level. The AOC 6 area is located in the northeast quadrant of the site towards the center of the BNL property, adjacent to the former Reclamation Facility Building 650 (Figure 2). AOC 6 consists of the Building 650 sump, the 8 and 15 inch diameter concrete drainage pipeline, which extends 987 feet east of the Building 650 sump (BNL 2002b) at depths of approximately 3 to 15 feet below grade, and the sump outfall area, which is approximately 150 ft by 150 ft and is enclosed by a secured cyclone fence (BNL 2002a) (Figure 3).

OBJECTIVES

The objectives of the verification survey were to confirm that remedial actions had been effective in meeting established release criteria and that documentation accurately and adequately described the final radiological conditions of the land areas associated with the AOC 6 remedial action.

DOCUMENT REVIEW

ESSAP reviewed planning documentation provided by BNL as part of the verification process to determine the adequacy and appropriateness of the procedures and processes implemented by BNL to meet final status survey requirements.

SURVEY PROCEDURES

ESSAP performed independent measurements and sampling at the site on June 11 and 12, 2002 and additional survey activities were conducted at the site on July 1, 2002. Survey activities were conducted in accordance with the site-specific survey plan, approved by the DOE (ORISE 2002a), and the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals (ORISE 2000 and 2002b). Survey activities included gamma surface scans and soil sampling.

REFERENCE SYSTEM

ESSAP did not attempt to re-establish the BNL grid to reference measurement and sampling locations. Sample and measurement locations were referenced to prominent site features.

SURFACE SCANS

Gamma scans were conducted over 100 percent of the excavated AOC 6 Class 1 soil areas, and up to 75 percent of surface soil in Class 2 areas. Gamma radiation scans were performed using NaI scintillation detectors connected to ratemeters with audible indicators. Locations of elevated gamma activity were marked for further investigation.

SOIL SAMPLING

Twenty-two soil samples from random-start systematic locations and 10 judgmental soil samples (Figure 3) from locations of elevated gamma activity identified by ESSAP, were collected for analysis during the initial verification survey site visit. ESSAP returned to BNL to perform follow-

up verification surveys of areas in AOC 6 that required additional remediation by BNL. Five additional judgmental surface soil samples were collected from the drainage pipe area and from the sump outfall in locations where elevated activity had been previously identified (Figure 4). BNL provided ESSAP with two samples, collected from the east and west side of the electrical conduit that crosses the outfall drainage trench for the purpose of performing confirmatory analysis.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Soil samples were returned to ESSAP's Oak Ridge, Tennessee laboratory for analysis and interpretation. Sample analyses were performed in accordance with the ORISE/ESSAP Laboratory Procedures Manual (ORISE 2002c). Soil samples were analyzed by gamma spectroscopy for the radionuclide of interest, Cs-137. Spectra were also reviewed for any other identifiable photopeaks. Specific analyses for Sr-90 and alpha spectroscopy for Am-241 and Pu-239/240 were performed on selected soil samples that were representative of the Building 650 Outfall and Sump area. The two samples provided by BNL were also analyzed for Sr-90 and Am-241 and Pu-239/240 isotopes. Analytical results were reported in units of pCi/g.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP reviewed the licensee's sampling plan documentation for the AOC 6 project. The review indicated that there were basic issues concerning radiological survey procedures. These concerns included:

- accounting for multiple radionuclides for the final status survey
- selection of the instrumentation and detector combination
- modification of the DCGL to account for multiple radionuclides

BNL revised the sampling plan and addressed the issues identified by ESSAP. A modified Cs-137 DCGL (16 pCi/g) for the site clean-up goal was developed to account for Sr-90 and Pu-239/240. The unity rule was also applied to address other radionuclides at the site.

SURFACE SCANS

Soil surface scans identified several areas of elevated gamma radiation activity both in the drainage pipe trench and the sump outfall. Two small isolated locations were remediated at the time of the survey with the resulting soil disposed of by BNL. In the sump outfall, significant elevated activity was identified in and around the area where the drainage pipe terminated into the sump. Based upon the number of locations identified by ESSAP, BNL conducted additional remediation of the sump outfall.

During the excavation of the drain pipe, a 15 kilovolt electrical conduit that lies above and perpendicular to the drainage pipe, prevented the removal of that section of pipe. Elevated activity was detected in the soil around the openings at each end of the pipe. At the time of ESSAP's survey, it was ESSAP's understanding that BNL may attempt additional remediation such that the electrical conduit would not be impacted or the area would otherwise be addressed through supplemental guidelines.

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

The primary gamma-emitting radionuclide of concern was Cs-137. Tables 1 and 2 contain analytical results for soil samples. The gamma spectroscopy results for samples collected during the first visit (locations 1 -32), showed concentrations for Cs-137 that ranged from 0.00 to 6.72 pCi/g for the random-start systematic soil samples and from 4.92 to 318 pCi/g for judgmental samples. The concentrations of other radionuclides that were identified during the analysis process were as follows: Co-60 ranged from -0.01 to 0.24 pCi/g for systematic soil samples and 0.05 to 6.51 pCi/g for judgmental soil samples. The concentration of Eu-152 in systematic soil samples ranged from -0.03 to 0.13 and from -0.10 to 10.67 pCi/g for judgmental soil samples. Am-241 concentrations in systematic soils ranged from -0.01 to 0.10 pCi/g and 0.10 to 3.45 pCi/g for judgmental samples.

U-238 concentrations ranged from 0.13 to 1.12 pCi/g and -1.4 to 5.4 pCi/g for systematic and judgmental soil samples, respectively. Cs-137 concentrations in the samples collected from either side of the electrical conduit, were 69.5 pCi/g and 318 pCi/g.

Samples at locations 33 to 37, were collected by ESSAP during a second site survey after BNL had performed additional extensive excavation of the drainage pipe trench and sump outfall. Radionuclide concentrations in these samples ranged from 7.59 to 30.0 pCi/g for Cs-137, Co-60 ranged from 0.00 to 2.53 pCi/g, Am-241 ranged from 0.04 to 0.74 pCi/g, U-238 ranged from 0.22 to 174 pCi/g, and Eu-152 ranged from -0.05 to 2.20 pCi/g.

Five samples were randomly selected for Sr-90 analysis and alpha spectroscopy for Am-241 and Pu-239/240. These samples were from locations 20, 28, 32, 34, and 37. Sr-90 concentrations ranged from 0.48 to 18.5 pCi/g; Am-241 activity ranged from 0.04 to 2.55 pCi/g and Pu-239/240 concentrations ranged from 0.54 to 23.9 pCi/g. The positive result (18.5 pCi/g) on the Sr-90 from location 28 prompted the analysis of three additional samples, 26, 27, and 33, that had been collected in or near the same area. The Sr-90 results for these samples ranged from 0.66 to 4.19 pCi/g.

BNL provided ESSAP with two samples to conduct comparison analysis. Samples PL 64 and PL 65 (ESSAP sample location 24 and 25) were collected from the east and west side, respectively, of the electrical conduit that remains in place across the outfall drainage pipe trench. These samples were collected by BNL after additional soil had been removed as a result of the initial ESSAP visit. ESSAP analyzed these samples by gamma spectroscopy and wet chemistry for Sr-90, Am-241, and Pu-239/240. The results of the comparison analyses are provided in Table 3. A review of both data sets showed that most results did not agree within the statistical deviations of the procedures with BNL reporting a higher concentration in most cases (BNL 2002c). The cause of the differences has not been determined.

COMPARISON OF RESULTS WITH GUIDELINES

Site release criteria for the multiple radionuclides that have been identified are listed below (BNL 2002a).

Radionuclide	Remediation Goal (pCi/g)
Americium-21	39
Cobalt-60	1,160
Cesium-137	23
Europium-152	49
Europium-154	170
Europium-155	150,000
Plutonium-239/240	40
Radium-226	5
Strontium-90	15
Uranium-234	13
Uranium-238	11

All verification data were compared individually to the respective guideline criteria when the analyses for Sr-90 and Pu-239/240 were performed. Otherwise data were compared to the modified DCGL of 16 pCi/g for Cs-137—which accounts for the presence of Sr-90 and Pu-239/240— when analyses for these radionuclides were not performed. BNL used the 16 pCi/g DCGL to ensure that the remediation goal would be met during the clean-up process (BNL 2002a). These site-specific DCGLs were applicable to the average concentrations that may be uniformly distributed for a survey unit, with allowances ($DCGL_{EMC}$) for small areas of residual contamination to remain. Additionally, when multiple radionuclides are present the unity rule must also be satisfied.

Initial survey results showed that soil in excess of the Cs-137 DCGL remained in the drainage pipe trench and in the sump outfall. BNL further remediated these areas reaching depths of 10 feet or greater. The follow-up verification sampling indicated that the residual contamination levels were decreased or removed and that following the additional remediation, most of the AOC 6 areas satisfied the applicable Cs-137 DCGL, other applicable individual DCGLs, and the unity rule.

Two areas remain where either individual DCGLs or the unity rule were not satisfied. These areas included the soil adjacent to the electrical conduit and the area associated with outfall sample locations 34, 35, 36, and 37. Qualitative field measurements indicated that the outfall locations were about 10 m^2 in size. Using the area factor from the BNL table times the modified guideline for Cs-137, the $DCGL_{EMC}$ limit for an area of 10 m^2 was determined to be 44 pCi/g. Therefore, the concentrations of Cs-137 remaining in these soil locations satisfy the $DCGL_{EMC}$. However, also at sample location 35, the U-238 concentration of 174 pCi/g, exceeded the DCGL of 11 pCi/g. The surrounding samples from the area did not identify any elevated concentrations of U-238. Similarly, the size of this elevated area is approximated to 10 m^2 or less. The corresponding area factor is 2.3 and the respective U-238 $DCGL_{EMC}$ would be 25 pCi/g. This location may not, therefore, satisfy the limit. Lastly, the soil surrounding the electrical conduit associated with BNL sample PL 65 (ESSAP 25) exceeds the Cs-137 DCGL, but as stated previously, it is ESSAP's understanding that supplemental guidelines will be developed.

SUMMARY

During the periods of June 11 and 12, and July 1, 2002, the Environmental Survey and Site Assessment Program of the Oak Ridge Institute for Science and Education, performed verification survey activities at the Area of Concern 6, Building 650 Sump and Sump Outfall project at Brookhaven National Laboratory. Survey activities consisted of gamma scans and soil sampling. In addition to the scan information, 37 soil samples were collected for verifying the BNL remediation activities. Two samples received from BNL were also analyzed for verification of site clean-up. The results of the verification survey identified residual contamination that required further remediation and follow-up surveys. These activities appeared to have reduced residual contamination levels so that the soils in the sump, drainage pipe trench, and the sump outfall, meet established guidelines with the following exceptions: Sample location 35 exceeded the U-238 criteria and ESSAP recommends additional investigation. Additionally, the soil underneath the electrical conduit does not meet the guidelines for release for unrestricted use and, if left in place, should be addressed by a hazard assessment and supplemental criteria. Lastly, the comparative analyses did not agree, although in most cases BNL reported a higher and therefore more conservative result. ESSAP does recommend that the cause for the discrepancy be evaluated in the near future.

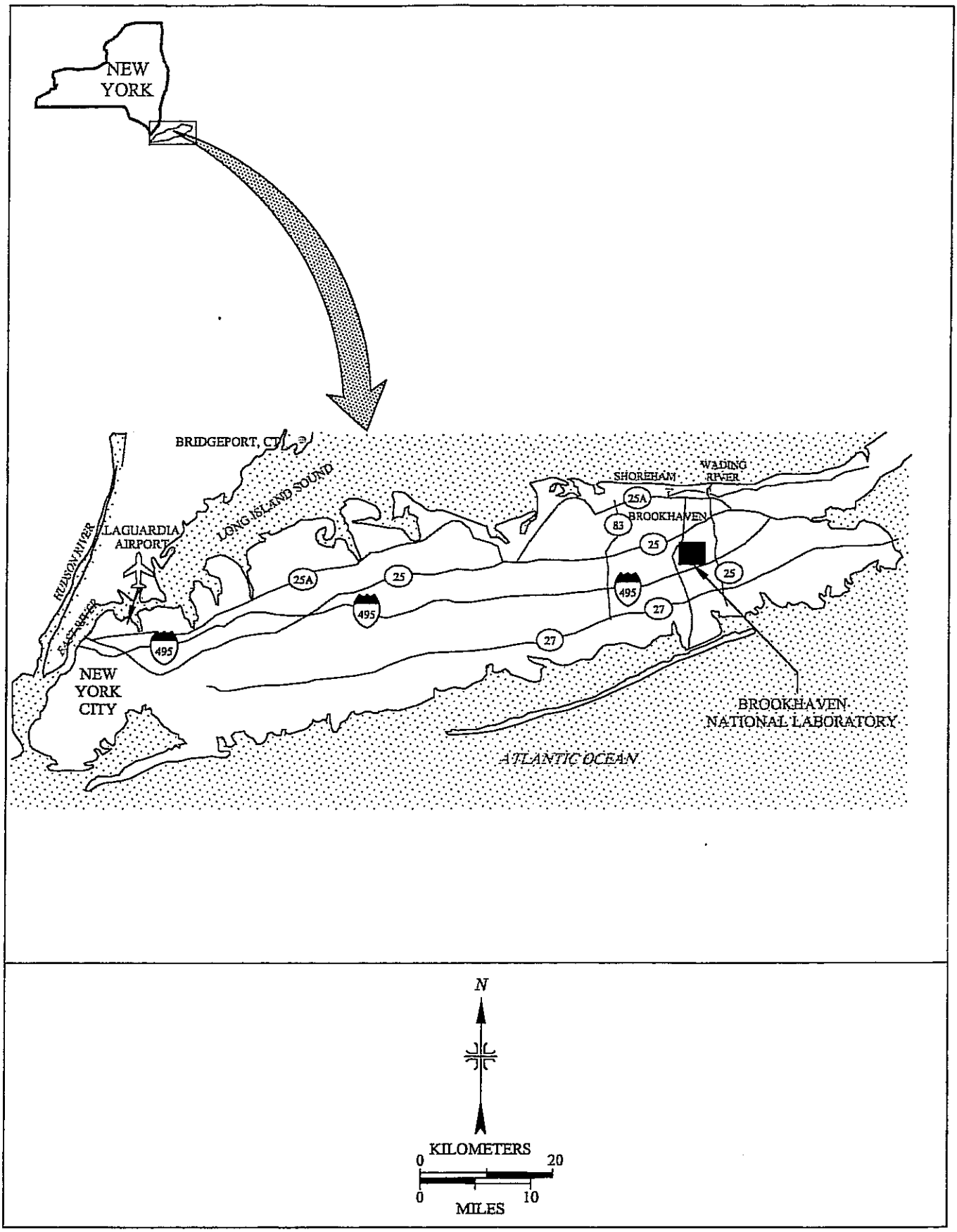

FIGURE 1: Location of Brookhaven National Laboratory, Upton, New York

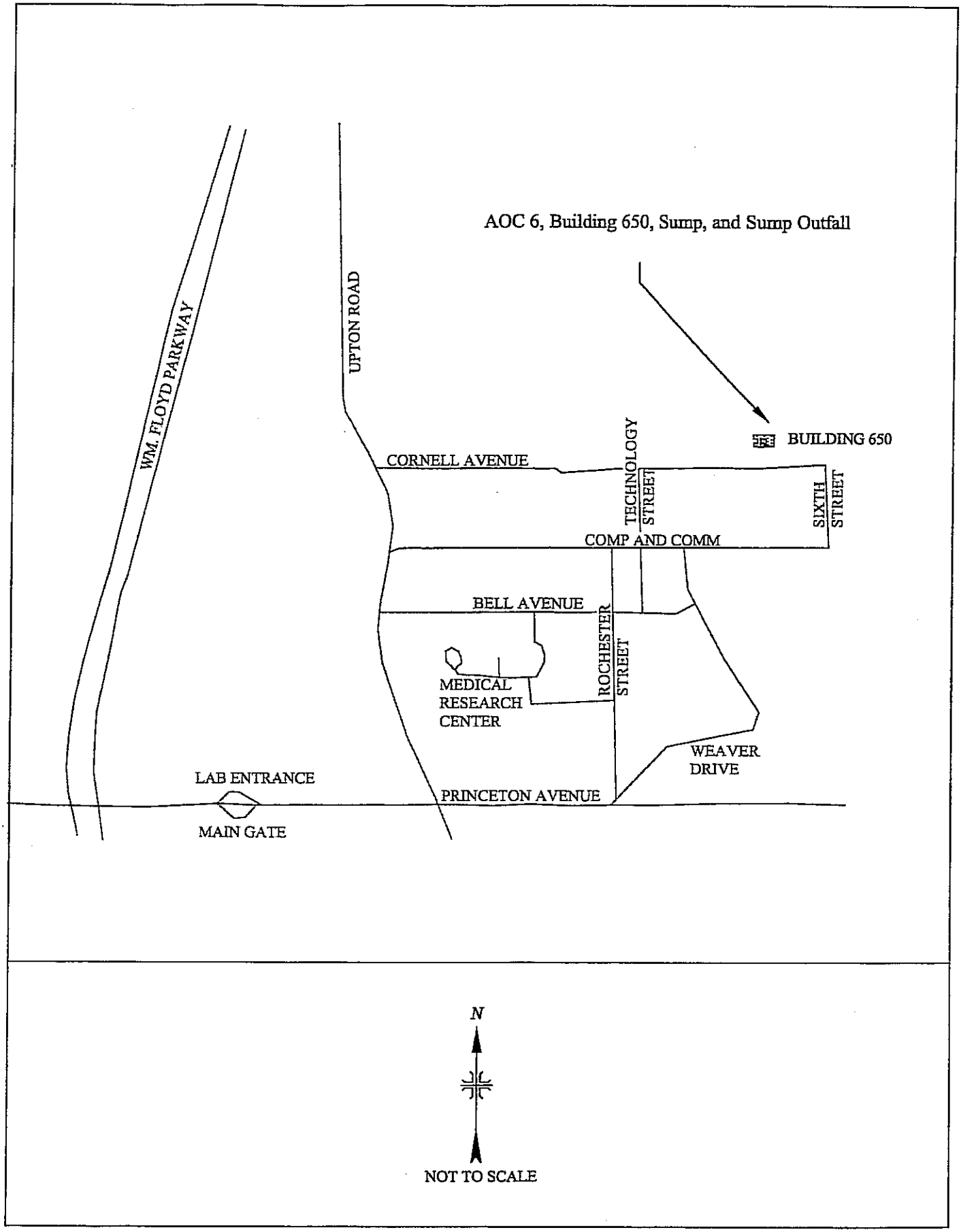

FIGURE 2 : Location of the Brookhaven National Laboratory AOC 6, Building 650 Sump and Sump Outfall

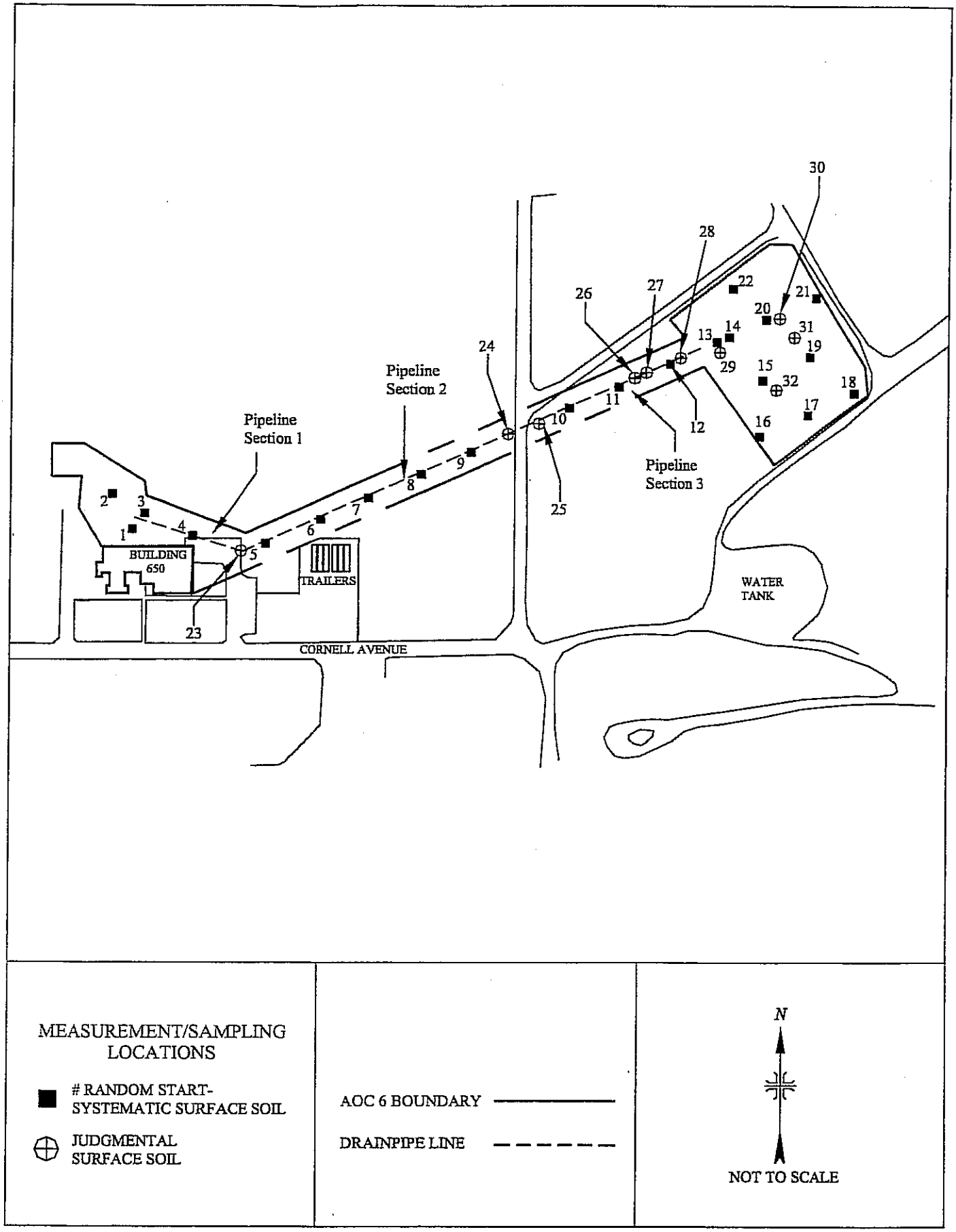

FIGURE 3: AOC 6, Building 650 Sump and Sump Outfall - Measurement and Sampling Locations

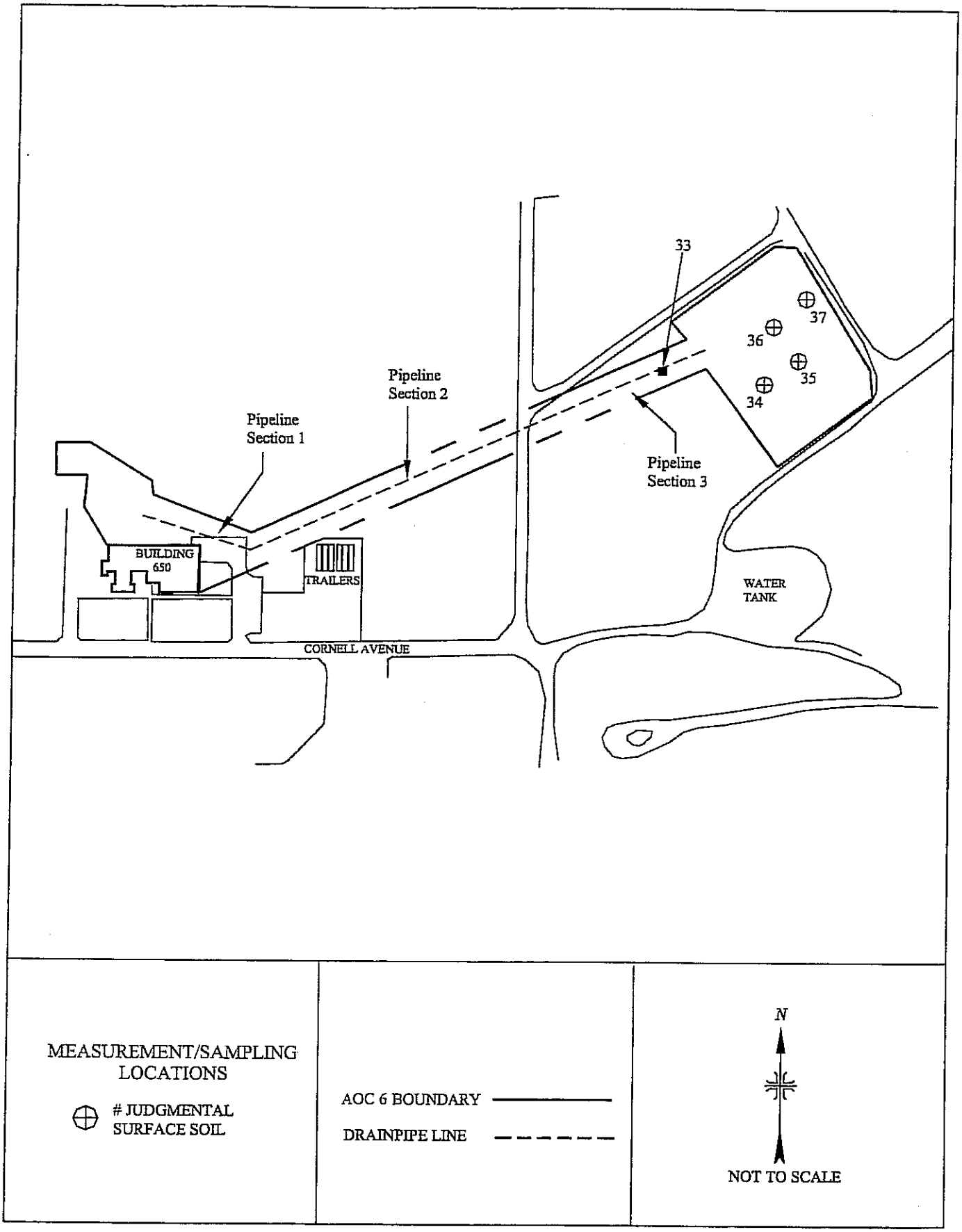

FIGURE 4: AOC 6, Building 650 Sump and Sump Outfall - Follow-up Judgmental Sampling Locations

ORISE TABLE 1

SYSTEMATIC SOIL SAMPLES
AREA OF CONCERN 6
BUILDING 650 SUMP AND SUMP OUTFALL
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK

Location[a]	Radionuclide Concentration (pCi/g)						
	Cs-137	Co-60	U-238	Am-241	Eu-152	Pu-239/240[c]	Sr-90[e]
1	1.06 ± 0.07[b]	0.01 ± 0.02	0.92 ± 0.46	0.00 ± 0.04	0.02 ± 0.04	---[d]	---
2	6.72 ± 0.32	0.24 ± 0.05	0.62 ± 0.71	0.10 ± 0.06	0.08 ± 0.09	---	---
3	0.05 ± 0.02	0.00 ± 0.01[f]	0.53 ± 0.30	0.01 ± 0.02	0.01 ± 0.03	---	---
4	0.78 ± 0.06	0.01 ± 0.02	0.77 ± 0.52	0.05 ± 0.04	-0.01 ± 0.04	---	---
5	0.69 ± 0.06	0.01 ± 0.02	0.73 ± 0.56	0.03 ± 0.04	0.00 ± 0.05	---	---
6	0.82 ± 0.05	0.01 ± 0.02	0.62 ± 0.40	0.03 ± 0.03	0.00 ± 0.04	---	---
7	0.00 ± 0.01	0.01 ± 0.01	0.45 ± 0.34	0.02 ± 0.03	0.00 ± 0.03	---	---
8	0.08 ± 0.02	0.00 ± 0.02	0.50 ± 0.39	0.02 ± 0.03	0.01 ± 0.03	---	---
9	0.05 ± 0.02	-0.01 ± 0.01	0.13 ± 0.17	0.00 ± 0.02	-0.01 ± 0.03	---	---
10	0.77 ± 0.06	0.01 ± 0.01	0.41 ± 0.32	0.01 ± 0.03	0.00 ± 0.03	---	---
11	0.05 ± 0.02	0.00 ± 0.01	0.69 ± 0.44	0.00 ± 0.03	0.02 ± 0.03	---	---
12	0.23 ± 0.03	0.05 ± 0.02	0.35 ± 0.38	-0.01 ± 0.03	-0.03 ± 0.03	---	---
13	2.09 ± 0.12	0.01 ± 0.01	0.33 ± 0.34	0.03 ± 0.03	0.00 ± 0.05	---	---
14	1.33 ± 0.09	0.02 ± 0.02	0.27 ± 0.40	0.00 ± 0.03	0.00 ± 0.05	---	---

ORISE TABLE 1 (continued)

SYSTEMATIC SOIL SAMPLES
AREA OF CONCERN 6
BUILDING 650 SUMP AND SUMP OUTFALL
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK

Location[a]	Radionuclide Concentration (pCi/g)						
	Cs-137	Co-60	U-238	Am-241	Eu-152	Pu-239/240[c]	Sr-90[e]
15	1.93 ± 0.11[b]	0.01 ± 0.02	0.77 ± 0.44	0.02 ± 0.03	0.13 ± 0.07	---[d]	---
16	0.47 ± 0.05	0.00 ± 0.02[f]	0.42 ± 0.50	0.02 ± 0.04	-0.01 ± 0.05	---	---
17	0.38 ± 0.04	0.01 ± 0.02	0.85 ± 0.44	0.00 ± 0.03	-0.03 ± 0.04	---	---
18	0.24 ± 0.05	0.00 ± 0.02	0.98 ± 0.48	0.04 ± 0.04	-0.02 ± 0.05	---	---
19	0.57 ± 0.05	0.00 ± 0.02	0.46 ± 0.49	0.00 ± 0.03	0.02 ± 0.04	---	---
20	1.58 ± 0.09	0.01 ± 0.01	0.47 ± 0.38	0.04 ± 0.03[c]	0.04 ± 0.05	0.54 ± 0.08	0.48 ± 0.24
21	0.39 ± 0.04	0.01 ± 0.01	0.75 ± 0.36	0.03 ± 0.02	0.01 ± 0.03	---	---
22	4.19 ± 0.21	0.02 ± 0.02	1.12 ± 0.59	0.08 ± 0.05	0.10 ± 0.08	---	---

[a]Refer to Figure 3.
[b]Uncertainties represent the 95% confidence level, based on total propagated uncertainty.
[c]Analysis by alpha spectroscopy.
[d]--- Analyses were not performed.
[e]Sr-90 analysis by wet chemistry.
[f]Zero due to rounding.

ORISE TABLE 2

JUDGMENTAL SOIL SAMPLES
AREA OF CONCERN 6
BUILDING 650 SUMP AND SUMP OUTFALL
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK

Location[a,b]	Radionuclide Concentration (pCi/g)						
	Cs -137	Co-60	U-238	Am-241	Eu-152	Pu-239/240[c]	Sr-90[d]
23	9.10 ± 0.42[e]	0.05 ± 0.03	1.58 ± 0.93	0.14 ± 0.06	-0.10 ± 0.10	---[f]	---
24	318 ± 13	2.87 ± 0.14	4.1 ± 1.5	3.45 ± 0.28	2.04 ± 0.45	---	---
25	69.5 ± 3.0	0.15 ± 0.10	-1.4 ± 1.9	0.13 ± 0.21	0.20 ± 0.46	---	---
26	4.92 ± 0.27	0.66 ± 0.09	1.25 ± 0.78	0.02 ± 0.06	0.07 ± 0.09	---	1.90 ± 0.52
27	86.9 ± 3.7	1.87 ± 0.12	1.1 ± 1.2	0.44 ± 0.15	0.08 ± 0.23	---	4.19 ± 0.64
28	128.7 ± 5.3	6.51 ± 0.27	1.9 ± 1.2	2.55 ± 0.24[e]	0.94 ± 0.38	23.9 ± 2.0	18.5 ± 1.0
29	13.15 ± 0.56	0.14 ± 0.03	0.51 ± 0.39	0.10 ± 0.06	-0.04 ± 0.07	---	---
30	77.2 ± 3.3	0.06 ± 0.04	1.6 ± 1.1	0.53 ± 0.14	0.56 ± 0.27	---	---
31	174.6 ± 7.1	2.25 ± 0.12	5.4 ± 1.5	1.71 ± 0.20	10.67 ± 0.86	---	---
32	93.9 ± 3.9	0.73 ± 0.10	0.8 ± 1.1	1.23 ± 0.15[e]	8.73 ± 0.78	13.6 ± 1.2	11.37 ± 0.75
33	7.59 ± 0.34	2.53 ± 0.14	0.22 ± 0.40	0.04 ± 0.04	0.27 ± 0.12	---	0.66 ± 0.42
34	20.35 ± 0.88	0.12 ± 0.04	1.14 ± 0.77	0.32 ± 0.06[e]	2.20 ± 0.27	3.58 ± 0.34	6.51 ± 0.54
35	23.41 ± 0.98	0.14 ± 0.03	174 ± 11	0.74 ± 0.18	0.48 ± 0.15	---	---

ORISE TABLE 2 (continued)

JUDGMENTAL SOIL SAMPLES
AREA OF CONCERN 6
BUILDING 650 SUMP AND SUMP OUTFALL
BROOKHAVEN NATIONAL LABORATORY
UPTON, NEW YORK

Location[a,b]	Radionuclide Concentration (pCi/g)						
	Cs-137	Co-60	U-238	Am-241	Eu-152	Pu-239/240[c]	Sr-90[d]
36	19.94 ± 0.85[e]	0.00 ± 0.02	1.79 ± 0.80	0.04 ± 0.05	-0.05 ± 0.10	---[f]	---
37	30.0 ± 1.3	0.20 ± 0.06	2.71 ± 0.99	0.62 ± 0.09[e]	1.66 ± 0.32	4.90 ± 0.45	9.58 ± 0.68

[a]Refer to Figures 3 and 4.
[b]Samples 33-37 collected July 1, 2002.
[c]Analysis by alpha spectroscopy.
[d]Sr-90 analysis by wet chemistry.
[e]Uncertainties represent the 95% confidence level, based on total propagated uncertainty.
[f]--- Analyses were not performed.

TABLE 3

ESSAP AND BNL RESULTS FOR COMPARISON SOIL SAMPLES AREA OF CONCERN 6 BUILDING 650 SUMP AND SUMP OUTFALL BROOKHAVEN NATIONAL LABORATORY UPTON, NEW YORK

Location[a]	Radionuclide Concentration (pCi/g)						
	Cs-137	Co-60	U-238	Am-241	Eu-152	Pu-239/240	Sr-90[b]
24/PL 64							
ESSAP	0.45 ± 0.05[c]	0.00 ± 0.02	0.71 ± 0.41	0.02 ± 0.02[d]	-0.01 ± 0.03	0.22 ± 0.05	1.29 ± 0.47
BNL	0.50 ± 0.09	0.70 ± 0.08	---[e]	---	---	---	0.4 ± 0.5
25/PL 65							
ESSAP	25.6 ± 1.10	0.19 ± 0.05	2.3 ± 1.0	0.33 ± 0.06	1.38 ± 0.27	4.08 ± 0.38	3.63 ± 0.60
BNL	37.9 ± 3.40	1.03 ± 0.10	---	0.51 ± 0.15	2.03 ± 0.17	---	15.8 ± 0.7

[a]Refer to Figure 3.
[b]ESSAP Sr-90 analysis by wet chemistry.
[c]Uncertainties represent the 95% confidence level, based on total propagated uncertainty.
[d]ESSAP Am-241 and Pu-239/240 analysis by alpha spectroscopy.
[e]--- results not provided by BNL

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ATTACHMENT 3

Minimum Detectable Concentration (MDC) Calculations for Gamma Walkover Scan Surveys

Minimum Detectable Concentration (MDC) Calculations for Gamma Walkover Scan Surveys Using a Ludlum 2221 Ratemeter with a 2-inch by 2-inch Sodium Iodide Scintillation Detector

Prepared for:

Environmental Management Directorate (EMD)
Brookhaven National Laboratory
Upton, NY 11973

In Support of:

Radiological Surveys of Contaminated Soils
Operable Unit 1
Area of Concern 6
Building 650 Sump and Outfall

Prepared by:

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Verified By:	D. Quinn	Date:	4/12/02

1. Introduction

This document provides calculated estimates of scan minimum detectable concentrations (MDC) for the 2-inch by 2-inch Sodium Iodide (2x2 NaI) scintillation detector to be used for Final Status Survey (FSS) purposes at the 650 Reclamation Facility Sump and Sump Outfall Project. This area is designated by BNL as Area of Concern 6 (AOC 6).

This calculation utilizes the methodology and approach documented in Table 6.7 of Section 6.7.2.2 of NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, for a 2x2 NaI scintillation detector (NRC 2000). MARSSIM calculations for the 2x2 NaI detectors are based on NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (NRC 1997). Factors included in this analysis are the surveyor scan efficiency, index of sensitivity, the natural background of the surveyed area, scan rate, detector to source geometry, areal extent of the potential hot spot(s), and energy and yield of gamma emissions.

2. Description of Method

The computer code Microshield Ver. 5.05 was used to model the presence of a normalized concentration of 1 pCi/g for each AOC 6 radionuclide of concern in soil with the assumption that the activity was uniformly distributed to a depth of 15 cm and spread over a disk shaped area with a diameter of 56 cm. This is consistent with the NUREG-1507 methodology and provides for a count rate-to-exposure rate ratio (CPM/μR/hr) to be calculated. Microshield does not provide "soil" as a standard material, so a "concrete" material was selected and a material density of 1.6 g/cm^3 was input to be representative of the soil density in the area of the 650 outfall. Activity concentrations must be entered into Microshield in units of μCi/cm^3. The normalized radionuclide concentrations were converted to inputs acceptable to Microshield as follows:

$$1 \text{ pCi/g} \times 1\text{E-6 } \mu\text{Ci/pCi} \times 1.6 \text{ g/cm}^3 = 1.6\text{E-6 } \mu\text{Ci/cm}^3$$

Therefore, activity concentrations for each ROC were entered into Microshield as 1.6E-6 μCi/cm^3.

For the sake of demonstrating the NUREG-1507 method, a complete scan MDC calculation for Cs-137 is provided in the sections to follow. A summary of all calculated scan MDCs for the AOC 6 ROCs are shown in Table 1.

2.1. Fluence Rate to Exposure Rate (FRER)

The fluence rate to exposure rate (FRER) may be approximated by:

$$FRER \approx \frac{1\mu R/hr}{(E_\gamma)(\mu_{en}/\rho)_{air}}$$

Where:

E_γ	=	energy of the gamma photon of concern, keV
(μ_{en}/ρ)	=	the mass energy absorption coefficient for air, cm^2/g

This can be represented in tabular form, as in Appendix A, Table 1.

2.2 Probability of Interaction (P) Through Detector End for a Given Energy

The probability, P, of a gamma ray interaction in the NaI scintillation crystal entering through the end of the crystal is given by:

$$Probability(P) = 1 - e^{-(\mu/\rho)_{NaI}(X)(\rho_{NaI})}$$

Where:

$(\mu/\rho)_{NaI}$	=	the mass attenuation coefficient for NaI
X	=	the thickness through the end of the 2x2 NaI crystal, 5.1 cm
(ρ_{NaI})	=	the density of the NaI crystal, 3.67 g/cm^3

This can be represented in tabular form, as in Appendix A, Table 2.

2.3 Relative Detector Response (RDR)

The Relative Detector Response (RDR) as a function of photon energy is determined by multiplying the relative fluence rate to exposure rate (FRER) by the probability (P) of an interaction and is given by:

$$RDR = (FRER)(P)$$

This can be represented in tabular form, as in Appendix A, Table 3.

2.4 Determination of CPM per μR/hr as a Function of Energy

The equivalent FRER, P, and finally RDR may be calculated for the NaI scintillation detector at the Cesium-137 (Cs-137) energy of 662 keV. Manufacturers of this equipment typically provide an instrument response in terms of CPM and μR/hr at the Cs-137 energy. This point allows one to determine the CPM per μR/hr and, ultimately, activity concentration and minimum detection sensitivity level in terms of pCi/g for a specific instrument.

Based on a manufacturer's 2x2 NaI response specification (Ludlum 44-10) of 900 CPM/μR/hr, the FRER, P, and RDR for Cs-137 are calculated. The mass energy absorption coefficient for air and the mass attenuation coefficient for a NaI are interpolated from tables in the Radiological Health Handbook, Revised Edition January 1970, pages 139, and 140.

FRER	$Energy_{\gamma}$, keV	$(\mu_{en}/\rho)_{air}$, cm^2/g
0.0514	662	0.0294

$(\mu_{en}/\rho)_{NaI}$, cm^2/g	P
0.0780	0.77

Therefore, the Cs-137 RDR (662 keV) = 0.0456. Nominal single energy response factors for a 2x2 NaI detector are presented in tabular form in Appendix A, Table 4. Gamma energy weighted response factors for each ROC have also been calculated and are provided in Appendix A, Table 5.

2.5 Minimum Detectable Count Rate

The minimum detectable count rate (MDCR) is calculated using the NUREG-1507 methodology where:

The average number of background counts in a one second interval, b_i = CPM/60. The average background count rate for a 2x2 NaI is 8,000 CPM, based on measurements taken at BNL. Therefore B_i can be calculated as:

$$B_i = (8{,}000\ \text{CPM})^* (1\ \text{sec}) * (1\ \text{min}/60\text{sec}) = 133\ \text{counts}$$

The MDCR is therefore calculated as:

$$\text{MDCR} = (d')(B_i)^{0.5}(60\text{sec}/1\text{min})$$

Where d' is from Table 6.1 of NUREG-1507 and represents the rate of detections at 95% and a false positive rate of 60%, and b_i is the background counts, giving:

$$\text{MDCR} = (1.38)(133)^{0.5}(60) = 955\ \text{CPM}$$

The MDCR for the surveyor is given as:

$$\text{MDCR}_{surveyor} = \text{MDCR} / (P)^{0.5}$$

Where P is the surveyor efficiency equal to 0.5 to 0.75 as given by NUREG-1507. A surveyor efficiency value of 0.75 was selected for these surveys since Cabrera utilizes an automated data logger to collect all of the scan survey data.

$$MDCR_{surveyor} = 955 / (0.75)^{0.5} = 1102 \text{ CPM above background.}$$

2.6 Estimate of Scan MDC for Cs-137

Microshield 5.05 was run to determine the expected exposure rate (in μR/hr) for a normalized 1 pCi/g concentration of Cs-137 in soil. This was done to provide a nominal multiplication factor for the derived $MDCR_{surveyor}$ value. All Microshield exposure rate outputs are included as an attachment to this calculation.

The minimum detectable exposure rate from each radionuclide is obtained by dividing the $MDCR_{surveyor}$ value by the vendor's specified count rate-to-exposure rate value of 900 CPM/μR/hr for the Ludlum 44-10 2x2 NaI(Tl) probe.

$$1102 \text{ CPM} / 900 \text{ CPM} / \mu\text{R/hr} = 1.22 \ \mu\text{R/hr}$$

The scan MDC is then equal to the ratio of the Minimum Detectable Exposure Rate in the field to the exposure rate determined from the normalized 1 pCi/g Microshield run.

$$ScanMDC = \frac{(Normalized\_Cs_{conc})(ExposureRate_{surveyor})}{(ExposureRate_{normalized\_Cs\_conc})}$$

Scan MDC = (1 pCi/g)(1.22 μR/hr)/(0.226 μR/hr) = **5.39 pCi/g**

2.7 Scan MDCs for ROCs.

Scan MDC calculations for all remaining ROCs were performed using the same methodology used above for Cs-137. The results are presented in Table 1 below and in Appendix A.

Table 1 - Scan MDCs for AOC6 ROCs

Radionuclide of Concern	Scan MDC (pCi/g)	BNL Remediation Goal (pCi/g)
Cs-137	5.39	23
Co-60	2.94	1160
Eu-152	2.83	49
Eu-154	3.07	170
Eu-155	9.34	150,000
Ra-226	2.17	5
U-234	6,159 / 2.19	13
U-238	2.19	11
Pu-239/240	10,045	40
Am-241	26.73	39

2.7.1 Notes and Assumptions

1. The scan MDC for U-234 was calculated for the following cases: (a) in equilibrium with U-238 (U-nat), and (b) in separated form without the contributions from U-238's decay progeny.
2. U-238 was decayed for 600,000 years in Microshield to achieve approximate secular equilibrium with U-234.
3. The Scan MDC value for Pu-239 presented in Table 1 was selected to represent the combination of Pu-239/Pu-240.
4. Ra-226 was decayed for 25 years to allow in-growth of decay progeny. No credit is taken for the presence of Ra-226 in U-238's decay chain.

Table 1
Fluence Rate to Exposure Rate

Gamma Energy (keV)	Mass Energy Absorbtion Coefficient - Air (cm^2/g)	FRER
40	0.0640	0.3906
50	0.0384	0.5208
60	0.0292	0.5708
80	0.0236	0.5297
100	0.0231	0.4329
150	0.0251	0.2656
200	0.0268	0.1866
300	0.0288	0.1157
400	0.0296	0.0845
500	0.0297	0.0673
600	0.0296	0.0563
800	0.0289	0.0433
1000	0.0280	0.0357
1500	0.0255	0.0261
2000	0.0234	0.0214
3000	0.0205	0.0163

Table 2
Probability (P) of Interaction Through Detector End

Gamma Energy (keV)	Mass Attenuation Coefficient - NaI (cm^2/g)	P
40	19.3000	1.00
50	10.7000	1.00
60	6.6200	1.00
80	3.1200	1.00
100	1.7200	1.00
150	0.6250	1.00
200	0.3340	1.00
300	0.1670	0.96
400	0.1170	0.89
500	0.0955	0.83
600	0.0826	0.79
800	0.0676	0.72
1000	0.0586	0.67
1500	0.0469	0.58
2000	0.0413	0.54
3000	0.0366	0.50

Table 3

Relative Detector Response (RDR)

Gamma Energy (keV)	FRER	P	RDR
40	0.3906	1.00	0.3906
50	0.5208	1.00	0.5208
60	0.5708	1.00	0.5708
80	0.5297	1.00	0.5297
100	0.4329	1.00	0.4329
150	0.2656	1.00	0.2656
200	0.1866	1.00	0.1862
300	0.1157	0.96	0.1107
400	0.0845	0.89	0.0750
500	0.0673	0.83	0.0561
600	0.0563	0.79	0.0443
800	0.0433	0.72	0.0310
1000	0.0357	0.67	0.0238
1500	0.0261	0.58	0.0153
2000	0.0214	0.54	0.0115
3000	0.0163	0.50	0.0081

Table 4

2-in x 2-in NaI Detector Response vs. Energy

Gamma Energy (keV)	RDR	CPM per microR/hr
40	0.3906	7710
50	0.5208	10280
60	0.5708	11265
80	0.5297	10454
100	0.4329	8544
150	0.2656	5242
200	0.1862	3675
300	0.1107	2184
400	0.0750	1480
500	0.0561	1107
600	0.0443	874
800	0.0310	613
1000	0.0238	470
1500	0.0153	302
2000	0.0115	227
3000	0.0081	159

Table 5
Weighted CPM per microR/hr vs. Energy for Cs-137
15 cm x 56 cm cylinder
(Page 1 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	6.83E-05	7710	2.327E+00
50	0.00E+00	10280	0.000E+00
60	0.00E+00	11265	0.000E+00
80	0.00E+00	10454	0.000E+00
100	0.00E+00	8544	0.000E+00
150	0.00E+00	5242	0.000E+00
200	0.00E+00	3675	0.000E+00
300	0.00E+00	2184	0.000E+00
400	0.00E+00	1480	0.000E+00
500	0.00E+00	1107	0.000E+00
600	2.26E-01	874	8.742E+02
800	0.00E+00	613	0.000E+00
1000	0.00E+00	470	0.000E+00
1500	0.00E+00	302	0.000E+00
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**2.26E-01**		**8.766E+02**

MDCR (surveyor)	1102	cpm
Microshield Output	2.26E-01	uR/hr per pCi/g
Min Det Exp Rate	1.22	uR/hr
Cs-137 Scan MDC	**5.39**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for Co-60
15 cm x 56 cm cylinder
(Page 2 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	0.00E+00	7710	0.000E+00
50	0.00E+00	10280	0.000E+00
60	4.33E-05	11265	4.850E-01
80	0.00E+00	10454	0.000E+00
100	0.00E+00	8544	0.000E+00
150	0.00E+00	5242	0.000E+00
200	0.00E+00	3675	0.000E+00
300	0.00E+00	2184	0.000E+00
400	0.00E+00	1480	0.000E+00
500	0.00E+00	1107	0.000E+00
600	0.00E+00	874	0.000E+00
800	0.00E+00	613	0.000E+00
1000	4.21E-01	470	1.964E+02
1500	5.85E-01	302	1.753E+02
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**1.01E+00**		**3.723E+02**

MDCR (surveyor)	1102	cpm
Microshield Output	1.01E+00	uR/hr per pCi/g
Min Det Exp Rate	2.96	uR/hr
Co-60 Scan MDC	**2.94**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for Eu-152
15 cm x 56 cm cylinder
(Page 3 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	3.07E-03	7710	5.216E+01
50	1.06E-03	10280	2.391E+01
60	0.00E+00	11265	0.000E+00
80	0.00E+00	10454	0.000E+00
100	7.67E-03	8544	1.444E+02
150	0.00E+00	5242	0.000E+00
200	5.96E-03	3675	4.823E+01
300	3.52E-02	2184	1.693E+02
400	1.12E-02	1480	3.639E+01
500	1.26E-03	1107	3.073E+00
600	1.13E-02	874	2.169E+01
800	6.15E-02	613	8.301E+01
1000	1.80E-01	470	1.863E+02
1500	1.36E-01	302	9.011E+01
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**4.54E-01**		**8.586E+02**

MDCR (surveyor)	1102	cpm
Microshield Output	4.54E-01	uR/hr per pCi/g
Min Det Exp Rate	1.28	uR/hr
Eu-152 Scan MDC	**2.83**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for Eu-154
15 cm x 56 cm cylinder
(Page 4 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	1.06E-03	7710	1.528E+01
50	3.69E-04	10280	7.107E+00
60	0.00E+00	11265	0.000E+00
80	0.00E+00	10454	0.000E+00
100	1.09E-02	8544	1.749E+02
150	0.00E+00	5242	0.000E+00
200	5.43E-03	3675	3.741E+01
300	0.00E+00	2184	0.000E+00
400	1.27E-03	1480	3.516E+00
500	4.84E-04	1107	1.004E+00
600	2.14E-02	874	3.511E+01
800	1.35E-01	613	1.547E+02
1000	1.30E-01	470	1.140E+02
1500	2.28E-01	302	1.290E+02
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**5.33E-01**		**6.721E+02**

MDCR (surveyor)	1102	cpm
Microshield Output	5.33E-01	uR/hr per pCi/g
Min Det Exp Rate	1.64	uR/hr
Eu-154 Scan MDC	**3.07**	**pCi/g**

Samp.Date Weighted CPM per microR/hr vs. Energy for Eu-155 15 cm x 56 cm cylinder (Page 5 of 11)			
Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	9.41E-04	7710	5.782E+02
50	4.21E-04	10280	3.446E+02
60	1.32E-04	11265	1.181E+02
80	5.48E-03	10454	4.563E+03
100	5.58E-03	8544	3.798E+03
150	0.00E+00	5242	0.000E+00
200	0.00E+00	3675	0.000E+00
300	0.00E+00	2184	0.000E+00
400	0.00E+00	1480	0.000E+00
500	0.00E+00	1107	0.000E+00
600	0.00E+00	874	0.000E+00
800	0.00E+00	613	0.000E+00
1000	0.00E+00	470	0.000E+00
1500	0.00E+00	302	0.000E+00
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**1.25E-02**		**9.402E+03**

MDCR (surveyor)	1102	cpm
Microshield Output	1.25E-02	uR/hr per pCi/g
Min Det Exp Rate	0.12	uR/hr
Eu-155 Scan MDC	**9.34**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for Ra-226
15 cm x 56 cm cylinder
(Page 6 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	0.00E+00	7710	0.000E+00
50	2.33E-04	10280	3.408E+00
60	0.00E+00	11265	0.000E+00
80	4.02E-03	10454	5.978E+01
100	3.62E-05	8544	4.401E-01
150	0.00E+00	5242	0.000E+00
200	8.47E-03	3675	4.426E+01
300	2.66E-02	2184	8.247E+01
400	6.72E-02	1480	1.415E+02
500	3.95E-03	1107	6.211E+00
600	1.27E-01	874	1.575E+02
800	3.23E-02	613	2.812E+01
1000	1.30E-01	470	8.704E+01
1500	1.10E-01	302	4.724E+01
2000	1.93E-01	227	6.240E+01
3000	0.00E+00	159	0.000E+00
TOTAL	**7.03E-01**		**7.204E+02**

MDCR (surveyor)	1102	cpm
Microshield Output	7.03E-01	uR/hr per pCi/g
Min Det Exp Rate	1.53	uR/hr
Ra-226 Scan MDC	**2.17**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for U-234
15 cm x 56 cm cylinder
(Page 7 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	0.00E+00	7710	0.000E+00
50	8.42E-06	10280	4.501E+03
60	0.00E+00	11265	0.000E+00
80	0.00E+00	10454	0.000E+00
100	1.08E-05	8544	4.803E+03
150	0.00E+00	5242	0.000E+00
200	0.00E+00	3675	0.000E+00
300	0.00E+00	2184	0.000E+00
400	0.00E+00	1480	0.000E+00
500	0.00E+00	1107	0.000E+00
600	0.00E+00	874	0.000E+00
800	0.00E+00	613	0.000E+00
1000	0.00E+00	470	0.000E+00
1500	0.00E+00	302	0.000E+00
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**1.92E-05**		**9.304E+03**

MDCR (surveyor)	1102	cpm
Microshield Output	1.92E-05	uR/hr per pCi/g
Min Det Exp Rate	0.12	uR/hr
U-234 Scan MDC	**6159.67**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for U-238
15 cm x 56 cm cylinder
(Page 8 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	1.02E-08	7710	1.165E-04
50	3.52E-04	10280	5.372E+00
60	4.32E-04	11265	7.234E+00
80	3.83E-03	10454	5.941E+01
100	1.70E-03	8544	2.159E+01
150	6.09E-05	5242	4.744E-01
200	8.03E-03	3675	4.385E+01
300	2.51E-02	2184	8.150E+01
400	6.36E-02	1480	1.398E+02
500	3.76E-03	1107	6.187E+00
600	1.20E-01	874	1.557E+02
800	3.17E-02	613	2.882E+01
1000	1.28E-01	470	8.906E+01
1500	1.04E-01	302	4.671E+01
2000	1.83E-01	227	6.165E+01
3000	0.00E+00	159	0.000E+00
TOTAL	**6.73E-01**		**7.474E+02**

MDCR (surveyor)	1102	cpm
Microshield Output	6.73E-01	uR/hr per pCi/g
Min Det Exp Rate	1.47	uR/hr
U-238 Scan MDC	**2.19**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for Pu-239
15 cm x 56 cm cylinder
(Page 9 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	0.00E+00	7710	0.000E+00
50	0.00E+00	10280	0.000E+00
60	0.00E+00	11265	0.000E+00
80	0.00E+00	10454	0.000E+00
100	1.28E-05	8544	8.544E+03
150	0.00E+00	5242	0.000E+00
200	0.00E+00	3675	0.000E+00
300	0.00E+00	2184	0.000E+00
400	0.00E+00	1480	0.000E+00
500	0.00E+00	1107	0.000E+00
600	0.00E+00	874	0.000E+00
800	0.00E+00	613	0.000E+00
1000	0.00E+00	470	0.000E+00
1500	0.00E+00	302	0.000E+00
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**1.28E-05**		**8.544E+03**

MDCR (surveyor)	1102	cpm
Microshield Output	1.28E-05	uR/hr per pCi/g
Min Det Exp Rate	0.13	uR/hr
Pu-239 Scan MDC	**10045.02**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for Pu-240
15 cm x 56 cm cylinder
(Page 10 of 11)

Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	0.00E+00	7710	0.000E+00
50	3.74E-06	10280	1.028E+04
60	0.00E+00	11265	0.000E+00
80	0.00E+00	10454	0.000E+00
100	0.00E+00	8544	0.000E+00
150	0.00E+00	5242	0.000E+00
200	0.00E+00	3675	0.000E+00
300	0.00E+00	2184	0.000E+00
400	0.00E+00	1480	0.000E+00
500	0.00E+00	1107	0.000E+00
600	0.00E+00	874	0.000E+00
800	0.00E+00	613	0.000E+00
1000	0.00E+00	470	0.000E+00
1500	0.00E+00	302	0.000E+00
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**3.74E-06**		**1.028E+04**

MDCR (surveyor)	1102	cpm
Microshield Output	3.74E-06	uR/hr per pCi/g
Min Det Exp Rate	0.11	uR/hr
Pu-240 Scan MDC	**28640.81**	**pCi/g**

Table 5
Weighted CPM per microR/hr vs. Energy for Am-241
15 cm x 56 cm cylinder
(Page 11 of 11)

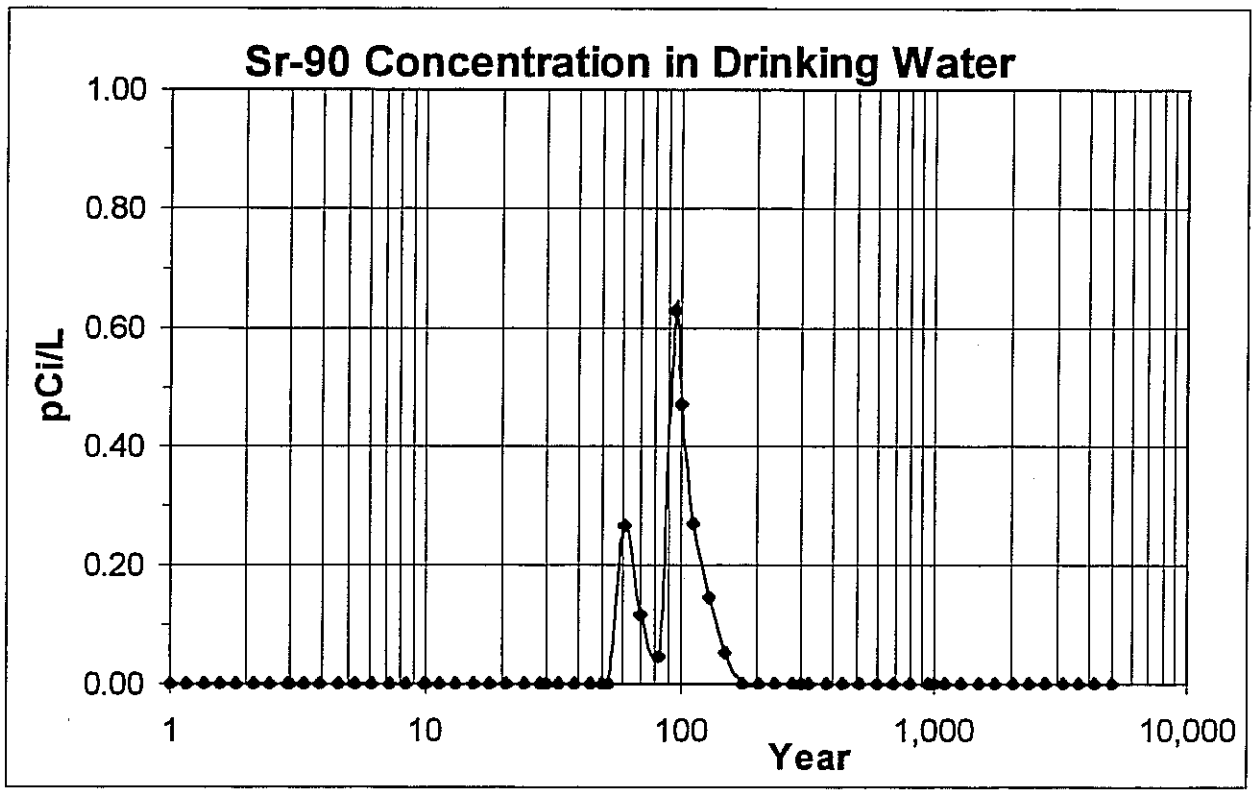
Gamma Energy (keV)	Microshield Exposure Rate for 1pCi/g (microR/hr w/buildup)	2x2 NaI CPM per microR/hr Table 4	2x2 NaI CPM per microR/hr (weighted)
40	0.00E+00	7710	0.000E+00
50	0.00E+00	10280	0.000E+00
60	3.66E-03	11265	1.127E+04
80	0.00E+00	10454	0.000E+00
100	0.00E+00	8544	0.000E+00
150	0.00E+00	5242	0.000E+00
200	0.00E+00	3675	0.000E+00
300	0.00E+00	2184	0.000E+00
400	0.00E+00	1480	0.000E+00
500	0.00E+00	1107	0.000E+00
600	0.00E+00	874	0.000E+00
800	0.00E+00	613	0.000E+00
1000	0.00E+00	470	0.000E+00
1500	0.00E+00	302	0.000E+00
2000	0.00E+00	227	0.000E+00
3000	0.00E+00	159	0.000E+00
TOTAL	**3.66E-03**		**1.127E+04**

MDCR (surveyor)	1102	cpm
Microshield Output	3.66E-03	uR/hr per pCi/g
Min Det Exp Rate	0.10	uR/hr
Am-241 Scan MDC	**26.73**	**pCi/g**

ATTACHMENT 4

Total Estimated Concentrations, Excess Risk and Total Dose from Remaining Radioisotopes

Figure A4-1. Concentration of Radionuclides in Drinking Water



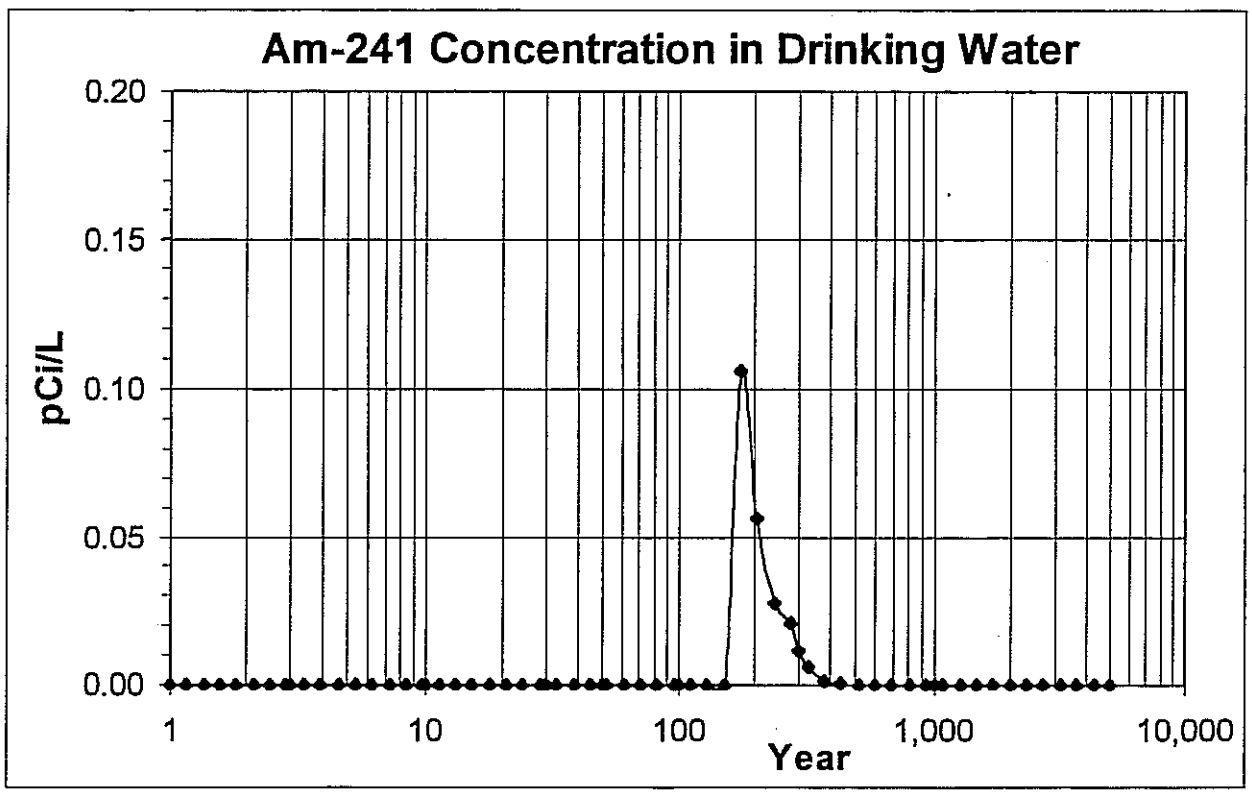


Figure A4-1. (Continued) Concentration of Radionuclides in Drinking Water

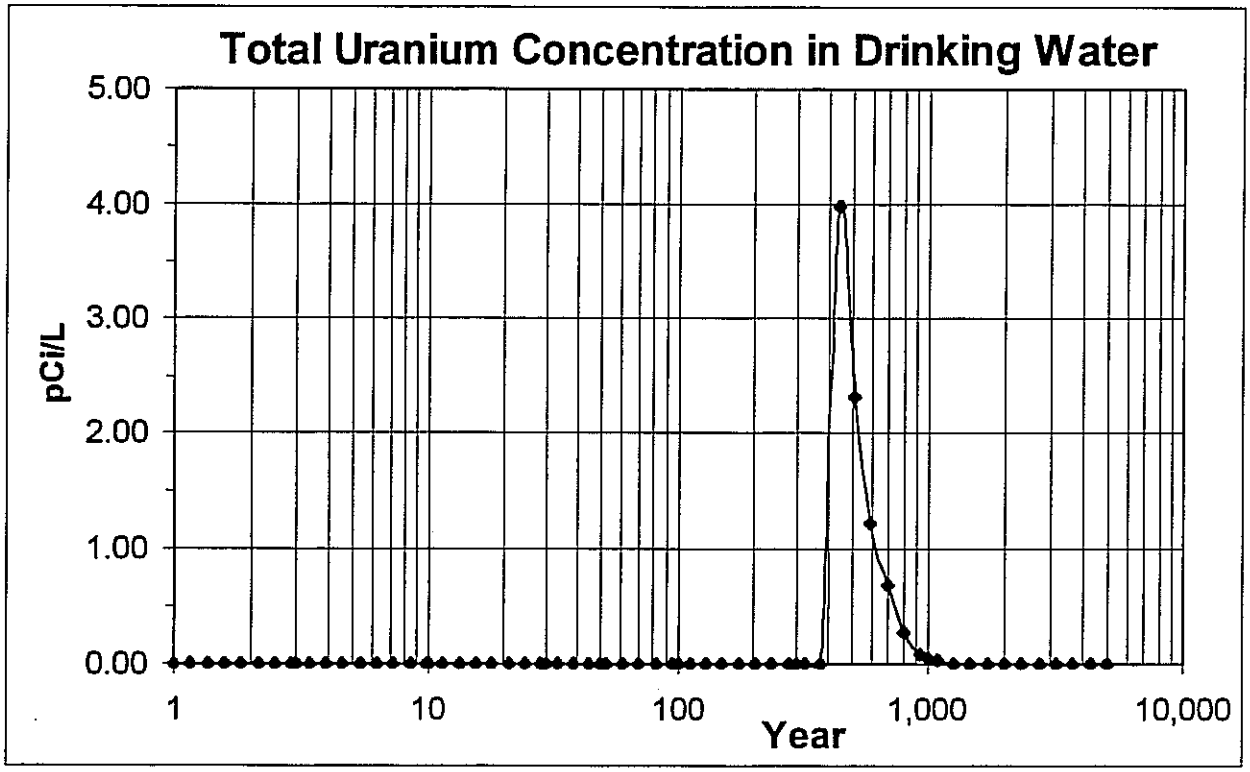
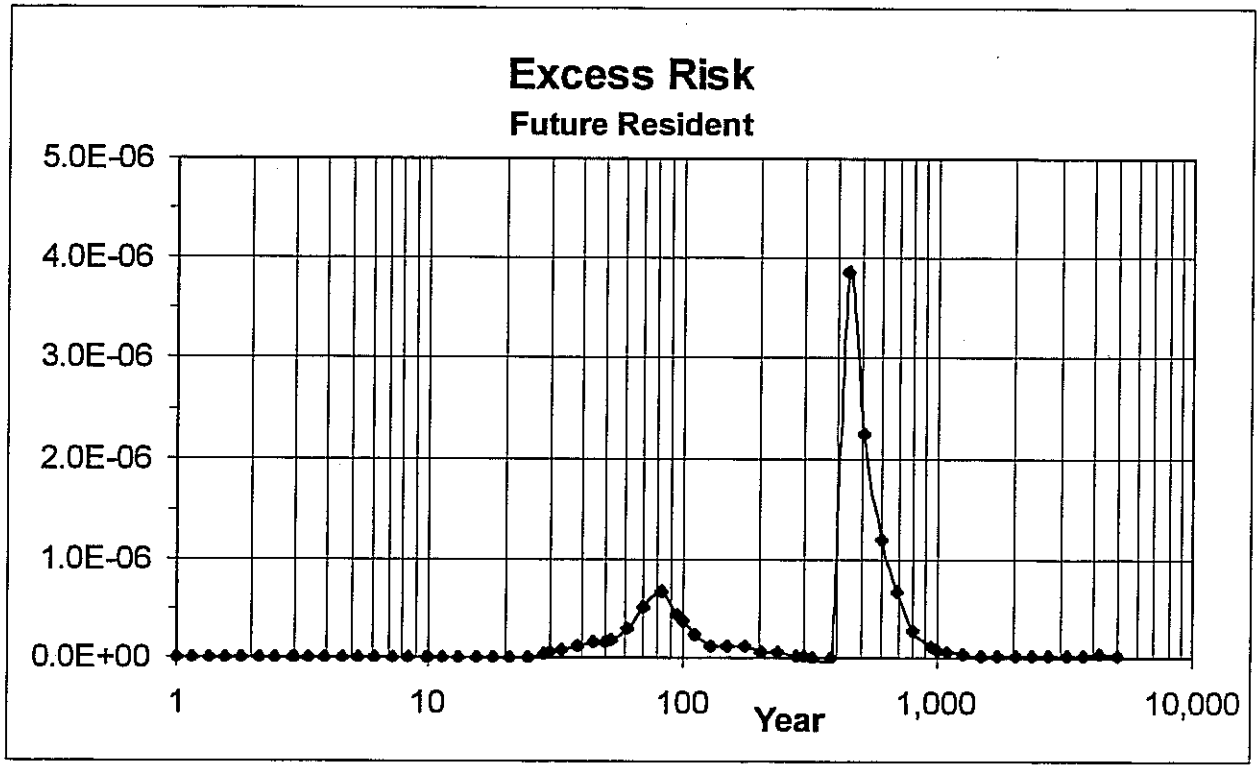


Figure A4-2. Excess Risk and Total Dose for Future Resident Scenario



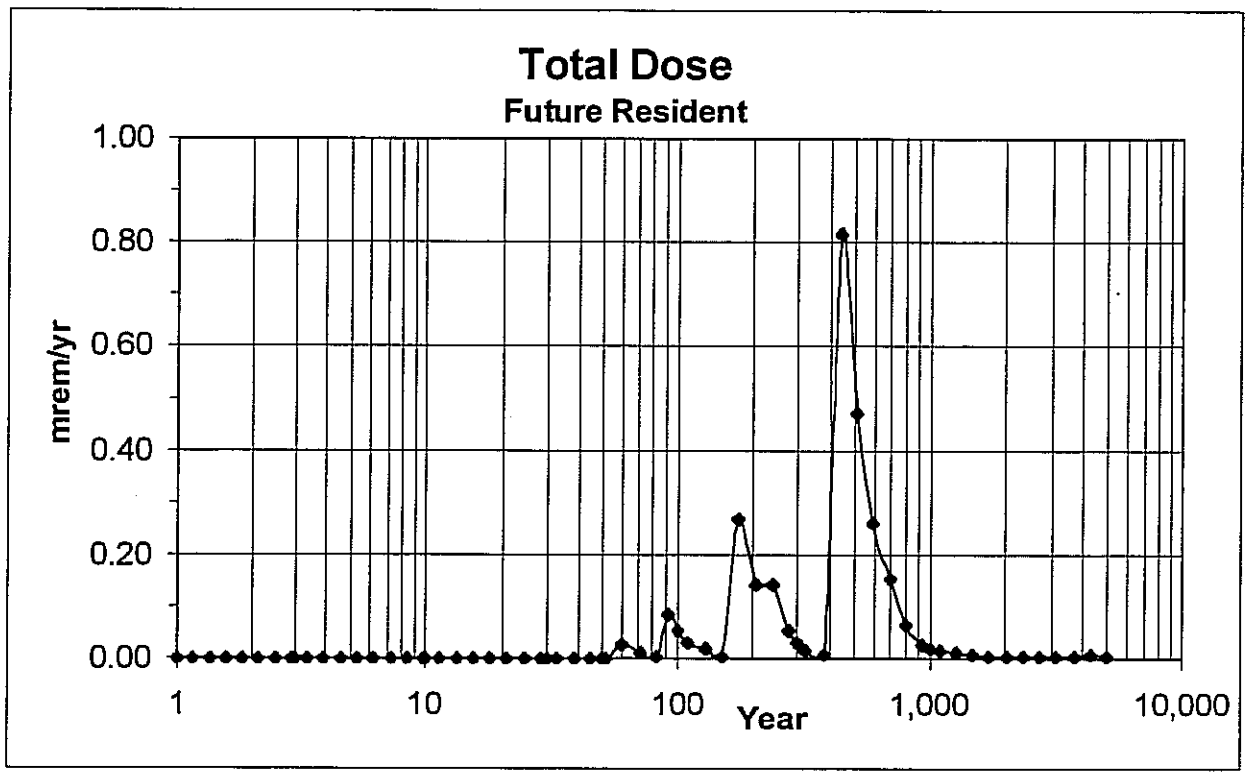
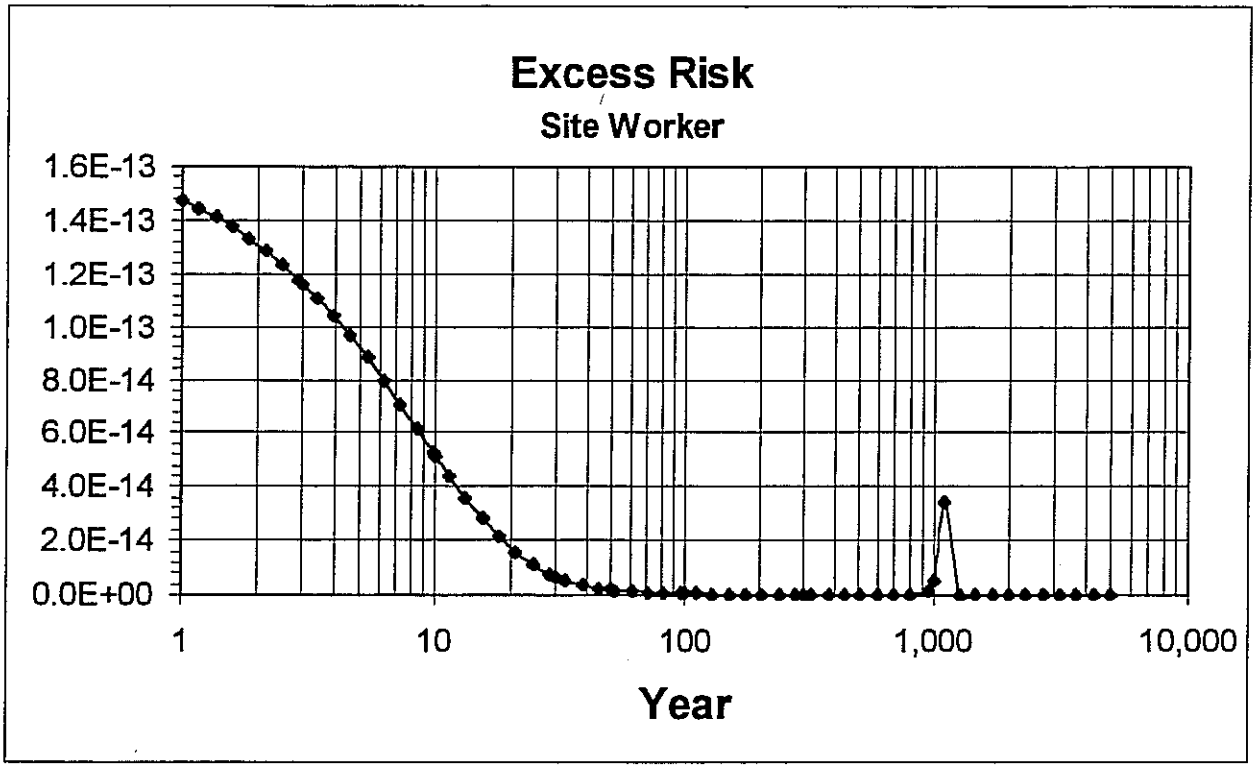
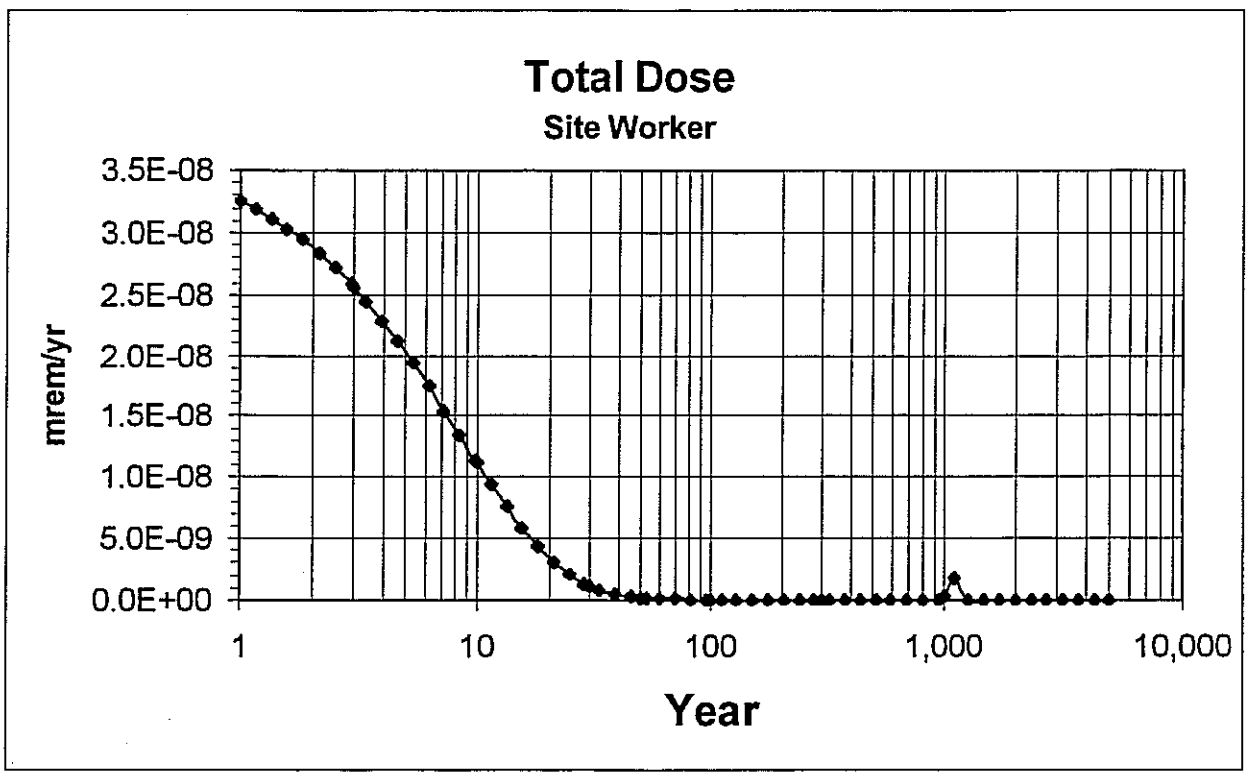


Figure A4-3. Excess Risk and Total Dose for Industrial Use Worker Scenario





ATTACHMENT 5

RESRAD Results

BNL Bldg. 650 Project

Total Dose Contributions for Individual Radionuclides and Exposure Pathways

ATTACHMENT 5a

RESRAD Results

BNL Site Specific 650 Outfall – Industrial Use – Class 1

Summary : BNL Site Specific 650 Outfall -- Industrial Use --Class 1
File : 650iu1_2.rad

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality

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	Cs-137+D	3.190E-05	3.190E-05	DCF2(2)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(3)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(2)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(3)
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	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(2,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,3)
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(3,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
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	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(2,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(3,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.850E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	5.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Co-60	4.000E-01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Cs-137	7.000E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Sr-90	2.500E+00	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	1.400E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.660E+00	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)	1.660E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.400E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	6.230E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	4.600E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.200E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.515E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.323E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.521E-01	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R017	Inhalation rate (m**3/yr)	8.400E+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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

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)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

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)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	64	---	---	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	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : BNL Site Specific 650 Outfall -- Industrial Use --Class 1
File : 650iu1_2.rad

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1850.00 square meters	Co-60	4.000E-01
Thickness:	0.15 meters	Cs-137	7.000E-01
Cover Depth:	1.40 meters	Sr-90	2.500E+00

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
TDOSE(t):	3.661E-08	3.246E-08	2.554E-08	1.107E-08	1.128E-09	1.955E-10	3.954E-11	6.434E-13	3.602E-19	0.000E+00
M(t):	2.440E-09	2.164E-09	1.702E-09	7.382E-10	7.519E-11	1.303E-11	2.636E-12	4.290E-14	2.402E-20	0.000E+00

0Maximum TDOSE(t): 3.661E-08 mrem/yr at t = 0.000E+00 years

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)

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	3.630E-08	0.9916	0.000E+00	0.0000	0.000E+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	3.075E-10	0.0084	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.068E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.661E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 0.000E+00 years
0 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	3.630E-08	0.9916
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	3.075E-10	0.0084
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.068E-14	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	3.661E-08	1.0000

0*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 = 1.000E+00 years
0 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	3.216E-08	0.9907	0.000E+00	0.0000	0.000E+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	3.013E-10	0.0093	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.449E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.246E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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	3.216E-08	0.9907
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	3.013E-10	0.0093
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.449E-14	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	3.246E-08	1.0000

0*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+00 years
0 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	2.525E-08	0.9887	0.000E+00	0.0000	0.000E+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	2.891E-10	0.0113	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.108E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.554E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+00 years
0 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	2.525E-08	0.9887
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	2.891E-10	0.0113
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.108E-15	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	2.554E-08	1.0000

0*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 = 1.000E+01 years
0 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	1.082E-08	0.9774	0.000E+00	0.0000	0.000E+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	2.504E-10	0.0226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.882E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.107E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+01 years
0 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	1.082E-08	0.9774
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	2.504E-10	0.0226
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.882E-16	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	1.107E-08	1.0000

0*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+01 years

0 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	9.619E-10	0.8529	0.000E+00	0.0000	0.000E+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	1.659E-10	0.1471	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.758E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.128E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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

0 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	9.619E-10	0.8529
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	1.659E-10	0.1471
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.758E-19	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	1.128E-09	1.0000

0*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 = 5.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	8.550E-11	0.4374	0.000E+00	0.0000	0.000E+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	1.100E-10	0.5626	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.849E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.955E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 5.000E+01 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	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	8.550E-11	0.4374
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	1.100E-10	0.5626
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.849E-22	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	1.955E-10	1.0000

0*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 = 1.000E+02 years
0 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	2.014E-13	0.0051	0.000E+00	0.0000	0.000E+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	3.934E-11	0.9949	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.163E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.954E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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	2.014E-13	0.0051
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	3.934E-11	0.9949
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.163E-30	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	3.954E-11	1.0000

0*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)

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	6.201E-24	0.0000	0.000E+00	0.0000	0.000E+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	6.434E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.434E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+02 years
0 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	6.201E-24	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	6.434E-13	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.434E-13	1.0000

0*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 = 1.000E+03 years
0 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
Cs-137	3.602E-19	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.602E-19	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 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
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	3.602E-19	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.602E-19	1.0000

0*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 = 5.000E+03 years
0 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
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
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+03 years
0 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
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
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Co-60	Co-60	1.000E+00	9.075E-08	8.040E-08	6.312E-08	2.705E-08	2.405E-09	2.138E-10	5.035E-13	1.550E-23	0.000E+00	0.000E+00
Cs-137	Cs-137	1.000E+00	4.394E-10	4.304E-10	4.131E-10	3.577E-10	2.371E-10	1.571E-10	5.619E-11	9.192E-13	5.146E-19	0.000E+00
Sr-90	Sr-90	1.000E+00	8.272E-15	5.795E-15	2.843E-15	2.353E-16	1.903E-19	1.539E-22	2.865E-30	0.000E+00	0.000E+00	0.000E+00

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

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

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Co-60	1.653E+08	1.866E+08	2.377E+08	5.544E+08	6.237E+09	7.017E+10	2.979E+13	*1.131E+15	*1.131E+15	*1.131E+15
Cs-137	3.414E+10	3.485E+10	3.631E+10	4.194E+10	6.327E+10	9.546E+10	2.669E+11	1.632E+13	*8.701E+13	*8.701E+13
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14

*At specific activity limit

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

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	4.000E-01	0.000E+00	9.075E-08	1.653E+08	9.075E-08	1.653E+08
Cs-137	7.000E-01	0.000E+00	4.394E-10	3.414E+10	4.394E-10	3.414E+10
Sr-90	2.500E+00	0.000E+00	8.272E-15	*1.365E+14	8.272E-15	*1.365E+14

*At specific activity limit

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Co-60	Co-60	1.000E+00	3.630E-08	3.216E-08	2.525E-08	1.082E-08	9.619E-10	8.550E-11	2.014E-13	6.201E-24	0.000E+00	0.000E+00
Cs-137	Cs-137	1.000E+00	3.075E-10	3.013E-10	2.891E-10	2.504E-10	1.659E-10	1.100E-10	3.934E-11	6.434E-13	3.602E-19	0.000E+00
Sr-90	Sr-90	1.000E+00	2.068E-14	1.449E-14	7.108E-15	5.882E-16	4.758E-19	3.849E-22	7.163E-30	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

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Co-60	Co-60	1.000E+00	4.000E-01	3.498E-01	2.676E-01	1.047E-01	7.177E-03	4.919E-04	6.050E-07	1.384E-18	0.000E+00	0.000E+00
Cs-137	Cs-137	1.000E+00	7.000E-01	6.750E-01	6.277E-01	4.867E-01	2.353E-01	1.138E-01	1.850E-02	1.291E-05	1.161E-16	0.000E+00
Sr-90	Sr-90	1.000E+00	2.500E+00	1.717E+00	8.094E-01	5.826E-02	3.164E-05	1.718E-08	1.181E-16	0.000E+00	0.000E+00	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.
RESCALC.EXE execution time = 5.17 seconds

ATTACHMENT 5b

RESRAD Results

BNL Site Specific 650 Outfall – Industrial Use – Class 2

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(2)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(3)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(4)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(5)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(6)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(2)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(3)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(4)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(5)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(6)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(2,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(3,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(4,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(4,3)
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(5,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(5,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,3)
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(6,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(6,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(2,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(3,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(3,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(4,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(5,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(5,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(6,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	9.100E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	5.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.600E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.500E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Sr-90	2.000E+00	0.000E+00	---	S1(5)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(5)
R013	Cover depth (m)	1.400E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.660E+00	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)	1.660E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.400E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	6.230E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	4.600E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.200E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.515E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.521E-01	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.249E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.017E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)

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 U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.017E-02	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R017	Inhalation rate (m**3/yr)	8.400E+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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.000E-02	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.700E-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)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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
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	64	---	---	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	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : BNL Site Specific 650 Outfall -- Industrial Use --Class 2
File : 650iu2_2.rad

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	9100.00 square meters	Cs-137	1.600E-01
Thickness:	0.15 meters	Pu-239	1.500E-01
Cover Depth:	1.40 meters	Sr-90	2.000E+00

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
TDOSE(t):	2.498E-11	2.473E-11	2.425E-11	2.263E-11	1.858E-11	1.526E-11	9.325E-12	1.300E-12	2.587E-10	0.000E+00
M(t):	1.665E-12	1.649E-12	1.616E-12	1.509E-12	1.239E-12	1.017E-12	6.217E-13	8.670E-14	1.725E-11	0.000E+00

0Maximum TDOSE(t): 8.448E-04 mrem/yr at t = 1399 ñ 3 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 = 1.399E+03 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Cs-137	2.736E-17	0.0000	1.418E-23	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.797E-20	0.0000
Pu-239	1.330E-06	0.0016	1.099E-04	0.1301	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.336E-04	0.8684
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.330E-06	0.0016	1.099E-04	0.1301	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.336E-04	0.8684

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 = 1.399E+03 years
0 Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
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	2.738E-17	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.448E-04	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.448E-04	1.0000

0*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 = 0.000E+00 years
0 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.
Cs-137	2.497E-11	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.734E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.846E-15	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.498E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 0.000E+00 years
0 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.
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	2.497E-11	0.9998
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.734E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.846E-15	0.0002
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	2.498E-11	1.0000

0*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 = 1.000E+00 years
0 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.
Cs-137	2.473E-11	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.771E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.095E-15	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.473E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	2.473E-11	0.9998
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.771E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.095E-15	0.0002
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	2.473E-11	1.0000

0*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+00 years
0 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.
Cs-137	2.424E-11	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.847E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.009E-15	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.425E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+00 years
0 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.
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	2.424E-11	0.9999
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.847E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.009E-15	0.0001
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	2.425E-11	1.0000

0*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 = 1.000E+01 years
0 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.
Cs-137	2.263E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	2.142E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.663E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.263E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+01 years
0 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.
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	2.263E-11	1.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.142E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.663E-16	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	2.263E-11	1.0000

0*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+01 years
0 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.
Cs-137	1.858E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	3.268E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.345E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.858E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	1.858E-11	1.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.268E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.345E-19	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	1.858E-11	1.0000

0*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 = 5.000E+01 years
0 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.
Cs-137	1.526E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	4.986E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.088E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.526E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 5.000E+01 years
0 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.
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	1.526E-11	1.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.986E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.088E-22	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	1.526E-11	1.0000

0*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 = 1.000E+02 years
0 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.
Cs-137	9.325E-12	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.434E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.025E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	9.325E-12	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	9.325E-12	1.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.434E-18	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.025E-30	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	9.325E-12	1.0000

0*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)

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.
Cs-137	1.300E-12	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	9.800E-17	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.300E-12	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+02 years
0 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.
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	1.300E-12	0.9999
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.800E-17	0.0001
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.300E-12	1.0000

0*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 = 1.000E+03 years
0 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.
Cs-137	1.317E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	2.587E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.587E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 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.
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	1.317E-15	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.587E-10	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.587E-10	1.0000

0*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 = 5.000E+03 years
0 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.
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
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+03 years
0 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.
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
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
			DSR(j,t) (mrem/yr)/(pCi/g)									
Cs-137	Cs-137	1.000E+00	1.561E-10	1.545E-10	1.515E-10	1.414E-10	1.161E-10	9.537E-11	5.828E-11	8.127E-12	8.231E-15	0.000E+00
0Pu-239	Pu-239	1.000E+00	1.156E-18	1.181E-18	1.232E-18	1.428E-18	2.179E-18	3.324E-18	9.557E-18	6.533E-16	1.725E-09	0.000E+00
Pu-239	U-235	1.000E+00	8.365E-25	2.504E-24	5.815E-24	1.727E-23	5.137E-23	9.352E-23	2.990E-22	2.274E-20	8.510E-14	0.000E+00
Pu-239	Pa-231	1.000E+00	2.394E-28	1.655E-27	8.508E-27	6.920E-26	4.615E-25	1.063E-24	3.536E-24	1.345E-22	3.903E-17	0.000E+00
Pu-239	Ac-227	1.000E+00	1.540E-29	2.225E-28	2.388E-27	4.767E-26	5.932E-25	1.619E-24	6.009E-24	2.400E-22	7.825E-17	0.000E+00
Pu-239	äDSR(j)		1.156E-18	1.181E-18	1.232E-18	1.428E-18	2.179E-18	3.324E-18	9.558E-18	6.533E-16	1.725E-09	0.000E+00
0Sr-90	Sr-90	1.000E+00	2.923E-15	2.047E-15	1.005E-15	8.313E-17	6.725E-20	5.440E-23	1.012E-30	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.
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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Cs-137	9.611E+10	9.706E+10	9.899E+10	1.061E+11	1.292E+11	1.573E+11	2.574E+11	1.846E+12	*8.701E+13	*8.701E+13
Pu-239	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	8.696E+09	*6.212E+10
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+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 = 1399 ñ 3 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.600E-01	0.000E+00	1.561E-10	9.611E+10	1.711E-16	*8.701E+13
Pu-239	1.500E-01	1399 ñ 3	5.632E-03	2.663E+03	5.632E-03	2.663E+03
Sr-90	2.000E+00	0.000E+00	2.923E-15	*1.365E+14	0.000E+00	*1.365E+14

*At specific activity limit

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Cs-137	Cs-137	1.000E+00	2.497E-11	2.473E-11	2.424E-11	2.263E-11	1.858E-11	1.526E-11	9.325E-12	1.300E-12	1.317E-15	0.000E+00
0Pu-239	Pu-239	1.000E+00	1.734E-19	1.771E-19	1.847E-19	2.142E-19	3.268E-19	4.986E-19	1.434E-18	9.799E-17	2.587E-10	0.000E+00
0U-235	Pu-239	1.000E+00	1.255E-25	3.755E-25	8.723E-25	2.591E-24	7.706E-24	1.403E-23	4.485E-23	3.411E-21	1.276E-14	0.000E+00
0Pa-231	Pu-239	1.000E+00	3.590E-29	2.482E-28	1.276E-27	1.038E-26	6.923E-26	1.595E-25	5.304E-25	2.017E-23	5.855E-18	0.000E+00
0Ac-227	Pu-239	1.000E+00	2.310E-30	3.337E-29	3.582E-28	7.150E-27	8.898E-26	2.428E-25	9.014E-25	3.600E-23	1.174E-17	0.000E+00
0Sr-90	Sr-90	1.000E+00	5.846E-15	4.095E-15	2.009E-15	1.663E-16	1.345E-19	1.088E-22	2.025E-30	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

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Cs-137	Cs-137	1.000E+00	1.600E-01	1.560E-01	1.482E-01	1.238E-01	7.419E-02	4.444E-02	1.234E-02	7.347E-05	1.195E-12	0.000E+00
0Pu-239	Pu-239	1.000E+00	1.500E-01	1.498E-01	1.494E-01	1.481E-01	1.443E-01	1.407E-01	1.319E-01	1.020E-01	4.143E-02	2.412E-04
0U-235	Pu-239	1.000E+00	0.000E+00	1.440E-10	4.106E-10	1.154E-09	2.237E-09	2.588E-09	2.637E-09	2.054E-09	8.348E-10	4.860E-12
0Pa-231	Pu-239	1.000E+00	0.000E+00	1.511E-15	1.271E-14	1.121E-13	5.422E-13	8.597E-13	1.099E-12	8.889E-13	3.612E-13	2.103E-15
0Ac-227	Pu-239	1.000E+00	0.000E+00	1.555E-17	3.700E-16	8.966E-15	8.305E-14	1.562E-13	2.214E-13	1.821E-13	7.398E-14	4.307E-16
0Sr-90	Sr-90	1.000E+00	2.000E+00	1.373E+00	6.475E-01	4.661E-02	2.531E-05	1.375E-08	9.450E-17	0.000E+00	0.000E+00	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 14.12 seconds

ATTACHMENT 5c

RESRAD Results

BNL Site Specific 650 Outfall – Resident Farmer - Backfill

Summary : BNL Site Specific 650 Outfall -- Resident Farmer --Backfill
File : 650rfB_4.rad

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(2)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(2)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(2,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(2,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(2,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)

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)	1.500E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.500E+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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	5.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.000E-01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.300E+00	0.000E+00	---	S1(2)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(2)
R013	Cover depth (m)	1.400E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.660E+00	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)	1.660E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.400E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	6.230E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	4.600E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.200E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.660E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.300E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.400E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	2.000E+04	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.000E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.900E+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)	1.800E+01	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	6.250E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.660E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.300E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.400E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.900E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.323E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.521E-01	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.000E+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	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.750E-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.750E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.750E-02	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)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
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
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Number of graphical time points	64	---	---	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	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : BNL Site Specific 650 Outfall -- Resident Farmer --Backfill
File : 650rfB_4.rad

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	150.00 square meters	Cs-137	2.000E-01
Thickness:	0.15 meters	Sr-90	1.300E+00
Cover Depth:	1.40 meters		

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
TDOSE(t):	8.788E-11	8.609E-11	8.262E-11	7.154E-11	4.741E-11	3.143E-11	1.673E-03	1.838E-13	2.585E-19	0.000E+00
M(t):	5.859E-12	5.739E-12	5.508E-12	4.769E-12	3.161E-12	2.095E-12	1.115E-04	1.226E-14	1.723E-20	0.000E+00

0Maximum TDOSE(t): 2.147E-02 mrem/yr at t = 92.5 ñ 0.2 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 = 9.255E+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.
Cs-137	1.310E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.292E-29	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.310E-11	0.0000	0.000E+00	0.0000	0.000E+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 = 9.255E+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.
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	1.310E-11	0.0000
Sr-90	2.125E-02	0.9896	0.000E+00	0.0000	0.000E+00	0.0000	1.918E-04	0.0089	1.987E-05	0.0009	1.089E-05	0.0005	2.147E-02	1.0000
Total	2.125E-02	0.9896	0.000E+00	0.0000	0.000E+00	0.0000	1.918E-04	0.0089	1.987E-05	0.0009	1.089E-05	0.0005	2.147E-02	1.0000

0*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 = 0.000E+00 years
0 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.
Cs-137	8.787E-11	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.075E-14	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.788E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 0.000E+00 years
0 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.
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	8.787E-11	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.075E-14	0.0001
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.788E-11	1.0000

0*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 = 1.000E+00 years
0 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.
Cs-137	8.608E-11	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.533E-15	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.609E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	8.608E-11	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.533E-15	0.0001
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.609E-11	1.0000

0*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+00 years
0 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.
Cs-137	8.261E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.696E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.262E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+00 years
0 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.
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	8.261E-11	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.696E-15	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	8.262E-11	1.0000

0*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 = 1.000E+01 years
0 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.
Cs-137	7.154E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.059E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.154E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+01 years
0 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.
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	7.154E-11	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.059E-16	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	7.154E-11	1.0000

0*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+01 years
0 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.
Cs-137	4.741E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.474E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.741E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	4.741E-11	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.474E-19	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	4.741E-11	1.0000

0*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 = 5.000E+01 years
0 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.
Cs-137	3.143E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.001E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.143E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 5.000E+01 years
0 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.
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	3.143E-11	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.001E-22	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	3.143E-11	1.0000

0*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 = 1.000E+02 years
0 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.
Cs-137	1.124E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.725E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.124E-11	0.0000	0.000E+00	0.0000	0.000E+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
0 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.
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	1.124E-11	0.0000
Sr-90	1.655E-03	0.9895	0.000E+00	0.0000	0.000E+00	0.0000	1.511E-05	0.0090	1.640E-06	0.0010	8.659E-07	0.0005	1.673E-03	1.0000
Total	1.655E-03	0.9895	0.000E+00	0.0000	0.000E+00	0.0000	1.511E-05	0.0090	1.640E-06	0.0010	8.659E-07	0.0005	1.673E-03	1.0000

0*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)

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.
Cs-137	1.838E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.838E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+02 years
0 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.
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	1.838E-13	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.838E-13	1.0000

0*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 = 1.000E+03 years
0 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.
Cs-137	1.029E-19	0.3981	0.000E+00	0.0000	0.000E+00	0.0000	1.418E-19	0.5485	1.049E-20	0.0406	3.303E-21	0.0128	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.029E-19	0.3981	0.000E+00	0.0000	0.000E+00	0.0000	1.418E-19	0.5485	1.049E-20	0.0406	3.303E-21	0.0128	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 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.
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	2.585E-19	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.585E-19	1.0000

0*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 = 5.000E+03 years
0 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.
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
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+03 years
0 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.
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
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Cs-137	Cs-137	1.000E+00	4.394E-10	4.304E-10	4.131E-10	3.577E-10	2.371E-10	1.571E-10	5.619E-11	9.192E-13	1.293E-18	0.000E+00
0Sr-90	Sr-90	1.000E+00	8.272E-15	5.795E-15	2.843E-15	2.353E-16	1.903E-19	1.539E-22	1.287E-03	7.551E-36	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.
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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Cs-137	3.414E+10	3.485E+10	3.631E+10	4.194E+10	6.327E+10	9.546E+10	2.669E+11	1.632E+13	*8.701E+13	*8.701E+13
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	1.166E+04	*1.365E+14	*1.365E+14	*1.365E+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 = 92.5 ñ 0.2 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	2.000E-01	0.000E+00	4.394E-10	3.414E+10	6.550E-11	2.290E+11
Sr-90	1.300E+00	92.5 ñ 0.2	1.652E-02	9.082E+02	1.652E-02	9.082E+02

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Cs-137	Cs-137	1.000E+00	8.787E-11	8.608E-11	8.261E-11	7.154E-11	4.741E-11	3.143E-11	1.124E-11	1.838E-13	2.585E-19	0.000E+00
0Sr-90	Sr-90	1.000E+00	1.075E-14	7.533E-15	3.696E-15	3.059E-16	2.474E-19	2.001E-22	1.673E-03	0.000E+00	0.000E+00	0.000E+00
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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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Cs-137	Cs-137	1.000E+00	2.000E-01	1.929E-01	1.793E-01	1.391E-01	6.724E-02	3.251E-02	5.285E-03	3.690E-06	3.318E-17	0.000E+00
0Sr-90	Sr-90	1.000E+00	1.300E+00	8.927E-01	4.209E-01	3.030E-02	1.645E-05	8.936E-09	6.142E-17	0.000E+00	0.000E+00	0.000E+00
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 7.25 seconds

ATTACHMENT 5d

RESRAD Results

BNL Site Specific 650 Outfall – Industrial Use - Backfill

Summary : BNL Site Specific 650 Outfall -- Industrial Use -- Backfill
File : 650iuB_3.rad

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(2)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(2)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(2,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(2,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(2,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)

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)	1.500E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	5.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.000E-01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.300E+00	0.000E+00	---	S1(2)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(2)
R013	Cover depth (m)	1.400E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.660E+00	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)	1.660E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.400E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	6.230E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	4.600E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.200E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.323E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.521E-01	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.000E-02	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.700E-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)

Site-Specific Parameter Summary (continued)

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

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
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
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)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Number of graphical time points	64	---	---	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	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : BNL Site Specific 650 Outfall -- Industrial Use -- Backfill
File : 650iuB_3.rad

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	150.00 square meters	Cs-137	2.000E-01
Thickness:	0.15 meters	Sr-90	1.300E+00
Cover Depth:	1.40 meters		

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
TDOSE(t):	3.105E-11	3.042E-11	2.919E-11	2.528E-11	1.675E-11	1.110E-11	3.971E-12	6.496E-14	3.637E-20	0.000E+00
M(t):	2.070E-12	2.028E-12	1.946E-12	1.685E-12	1.117E-12	7.402E-13	2.647E-13	4.331E-15	2.424E-21	0.000E+00

0Maximum TDOSE(t): 3.105E-11 mrem/yr at t = 0.000E+00 years

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)

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.
Cs-137	3.105E-11	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.800E-15	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.105E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 0.000E+00 years
0 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.
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	3.105E-11	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.800E-15	0.0001
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	3.105E-11	1.0000

0*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 = 1.000E+00 years
0 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.
Cs-137	3.042E-11	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.662E-15	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.042E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	3.042E-11	0.9999
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.662E-15	0.0001
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	3.042E-11	1.0000

0*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+00 years
0 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.
Cs-137	2.919E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.306E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.919E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+00 years
0 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.
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	2.919E-11	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.306E-15	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	2.919E-11	1.0000

0*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 = 1.000E+01 years
0 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.
Cs-137	2.528E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.081E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.528E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+01 years
0 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.
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	2.528E-11	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.081E-16	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	2.528E-11	1.0000

0*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+01 years
0 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.
Cs-137	1.675E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.742E-20	0.0000	0.000E+00	0.0000	0.000E+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-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	1.675E-11	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.742E-20	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	1.675E-11	1.0000

0*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 = 5.000E+01 years
0 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.
Cs-137	1.110E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.071E-23	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.110E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 5.000E+01 years
0 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.
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	1.110E-11	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.071E-23	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	1.110E-11	1.0000

0*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 = 1.000E+02 years
0 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.
Cs-137	3.971E-12	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.316E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.971E-12	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	3.971E-12	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.316E-30	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	3.971E-12	1.0000

0*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.
Cs-137	6.496E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.496E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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.
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	6.496E-14	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.496E-14	1.0000

0*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 = 1.000E+03 years
0 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.
Cs-137	3.637E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.637E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 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.
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	3.637E-20	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.637E-20	1.0000

0*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 = 5.000E+03 years
0 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.
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
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+03 years
0 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.
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
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
			DSR(j,t) (mrem/yr)/(pCi/g)									
Cs-137	Cs-137	1.000E+00	1.552E-10	1.521E-10	1.460E-10	1.264E-10	8.376E-11	5.552E-11	1.985E-11	3.248E-13	1.818E-19	0.000E+00
0Sr-90	Sr-90	1.000E+00	2.923E-15	2.047E-15	1.005E-15	8.313E-17	6.725E-20	5.440E-23	1.012E-30	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.
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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Cs-137	9.662E+10	9.863E+10	1.028E+11	1.187E+11	1.791E+11	2.702E+11	7.555E+11	4.618E+13	*8.701E+13	*8.701E+13
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+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)
Cs-137	2.000E-01	0.000E+00	1.552E-10	9.662E+10	1.552E-10	9.662E+10
Sr-90	1.300E+00	0.000E+00	2.923E-15	*1.365E+14	2.923E-15	*1.365E+14

*At specific activity limit

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Cs-137	Cs-137	1.000E+00	3.105E-11	3.042E-11	2.919E-11	2.528E-11	1.675E-11	1.110E-11	3.971E-12	6.496E-14	3.637E-20	0.000E+00
0Sr-90	Sr-90	1.000E+00	3.800E-15	2.662E-15	1.306E-15	1.081E-16	8.742E-20	7.071E-23	1.316E-30	0.000E+00	0.000E+00	0.000E+00
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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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Cs-137	Cs-137	1.000E+00	2.000E-01	1.929E-01	1.793E-01	1.391E-01	6.724E-02	3.251E-02	5.285E-03	3.690E-06	3.318E-17	0.000E+00
0Sr-90	Sr-90	1.000E+00	1.300E+00	8.927E-01	4.209E-01	3.030E-02	1.645E-05	8.936E-09	6.142E-17	0.000E+00	0.000E+00	0.000E+00
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BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 4.23 seconds

ATTACHMENT 5e

RESRAD Results

BNL Site Specific 650 Outfall – Resident Farmer – Class 1

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(2)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(4)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(5)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(6)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(7)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(2)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(4)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(5)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(6)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(7)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(2,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(2,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(2,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(4,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(4,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(5,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(6,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(6,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
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				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(4,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(4,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(5,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(6,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(6,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)

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)	1.850E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	5.000E+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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	5.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Co-60	4.000E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	7.000E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Pu-239	3.000E-01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Sr-90	2.500E+00	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): Pu-239	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(6)
R013	Cover depth (m)	1.400E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.660E+00	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)	1.660E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.400E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	6.230E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	4.600E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.200E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.660E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.300E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.400E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	2.000E+04	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.000E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.900E+00	5.300E+00	---	BSZ

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.800E+01	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)	6.100E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.660E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.300E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.400E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.900E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.515E-03	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)	1.900E+02	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.323E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-03	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.521E-01	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.249E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)

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 Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.017E-02	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.017E-02	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R017	Inhalation rate (m**3/yr)	8.400E+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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-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)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.000E+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	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.925E-01	FMEAT
R018	Contamination fraction of milk	-1	-1	0.925E-01	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
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
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	64	---	---	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	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : BNL Site Specific 650 Outfall -- Resident Farmer --Class 1
File : 650rf1_3.rad

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1850.00 square meters	Co-60	4.000E-01
Thickness:	0.15 meters	Cs-137	7.000E-01
Cover Depth:	1.40 meters	Pu-239	3.000E-01
		Sr-90	2.500E+00

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
TDOSE(t):	3.661E-08	3.246E-08	2.554E-08	1.107E-08	1.128E-09	1.955E-10	4.183E-02	6.661E-13	4.253E-03	7.350E-09
M(t):	2.440E-09	2.164E-09	1.702E-09	7.382E-10	7.519E-11	1.303E-11	2.788E-03	4.440E-14	2.835E-04	4.900E-10

0Maximum TDOSE(t): 4.722E-02 mrem/yr at t = 92.3 ñ 0.2 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 = 9.230E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Co-60	5.115E-13	0.0000	0.000E+00	0.0000	0.000E+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	4.609E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	6.897E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.111E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.660E-11	0.0000	0.000E+00	0.0000	0.000E+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 = 9.230E+01 years
0 Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
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	5.115E-13	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	4.609E-11	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.897E-18	0.0000
Sr-90	4.380E-02	0.9275	0.000E+00	0.0000	0.000E+00	0.0000	2.637E-03	0.0559	5.069E-04	0.0107	2.772E-04	0.0059	4.722E-02	1.0000
Total	4.380E-02	0.9275	0.000E+00	0.0000	0.000E+00	0.0000	2.637E-03	0.0559	5.069E-04	0.0107	2.772E-04	0.0059	4.722E-02	1.0000

0*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 = 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	3.630E-08	0.9916	0.000E+00	0.0000	0.000E+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	3.075E-10	0.0084	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	9.815E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	2.068E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.661E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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.
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	3.630E-08	0.9916
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	3.075E-10	0.0084
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.815E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.068E-14	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	3.661E-08	1.0000

0*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 = 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	3.216E-08	0.9907	0.000E+00	0.0000	0.000E+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	3.013E-10	0.0093	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.002E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.449E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.246E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

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

0	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	3.216E-08	0.9907
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	3.013E-10	0.0093
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.002E-18	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.449E-14	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	3.246E-08	1.0000

0*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+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	2.525E-08	0.9887	0.000E+00	0.0000	0.000E+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	2.891E-10	0.0113	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.046E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.108E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.554E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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.
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	2.525E-08	0.9887
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	2.891E-10	0.0113
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.046E-18	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.108E-15	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	2.554E-08	1.0000

0*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 = 1.000E+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	1.082E-08	0.9774	0.000E+00	0.0000	0.000E+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	2.504E-10	0.0226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.212E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.882E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.107E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

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

0	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	1.082E-08	0.9774
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	2.504E-10	0.0226
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.212E-18	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.882E-16	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	1.107E-08	1.0000

0*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+01 years
0 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	9.619E-10	0.8529	0.000E+00	0.0000	0.000E+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	1.659E-10	0.1471	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.850E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.758E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.128E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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	9.619E-10	0.8529
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	1.659E-10	0.1471
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.850E-18	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.758E-19	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	1.128E-09	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 = 5.000E+01 years
0 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	8.550E-11	0.4374	0.000E+00	0.0000	0.000E+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	1.100E-10	0.5626	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	2.822E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.849E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.955E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 5.000E+01 years
0 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	8.550E-11	0.4374
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	1.100E-10	0.5626
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.822E-18	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.849E-22	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	1.955E-10	1.0000

0*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 = 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	2.014E-13	0.0000	0.000E+00	0.0000	0.000E+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	3.934E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	8.115E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.163E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.954E-11	0.0000	0.000E+00	0.0000	0.000E+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+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	2.014E-13	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	3.934E-11	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.115E-18	0.0000
Sr-90	3.879E-02	0.9275	0.000E+00	0.0000	0.000E+00	0.0000	2.337E-03	0.0559	4.505E-04	0.0108	2.458E-04	0.0059	4.183E-02	1.0000
Total	3.879E-02	0.9275	0.000E+00	0.0000	0.000E+00	0.0000	2.337E-03	0.0559	4.505E-04	0.0108	2.458E-04	0.0059	4.183E-02	1.0000

0*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.
Co-60	6.201E-24	0.0000	0.000E+00	0.0000	0.000E+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	6.434E-13	0.9660	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	5.547E-16	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.440E-13	0.9669	0.000E+00	0.0000	0.000E+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.
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	6.201E-24	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	6.434E-13	0.9660
Pu-239	2.089E-14	0.0314	0.000E+00	0.0000	0.000E+00	0.0000	1.168E-15	0.0018	5.944E-19	0.0000	1.313E-18	0.0000	2.262E-14	0.0340
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.089E-14	0.0314	0.000E+00	0.0000	0.000E+00	0.0000	1.168E-15	0.0018	5.944E-19	0.0000	1.313E-18	0.0000	6.661E-13	1.0000

0*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 = 1.000E+03 years
0 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
Cs-137	3.602E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.309E-18	0.0000	4.530E-19	0.0000	1.426E-19	0.0000	0.000E+00	0.0000
Pu-239	1.465E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.251E-03	0.9995	1.937E-06	0.0005	2.287E-08	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.465E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.251E-03	0.9995	1.937E-06	0.0005	2.287E-08	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 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
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	4.265E-18	0.0000
Pu-239	7.099E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.974E-10	0.0000	1.017E-11	0.0000	3.953E-12	0.0000	4.253E-03	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.099E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.974E-10	0.0000	1.017E-11	0.0000	3.953E-12	0.0000	4.253E-03	1.0000

0*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 = 5.000E+03 years
0 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
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
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+03 years
0 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
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
Pu-239	6.948E-09	0.9452	0.000E+00	0.0000	0.000E+00	0.0000	3.894E-10	0.0530	1.025E-11	0.0014	3.075E-12	0.0004	7.350E-09	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.948E-09	0.9452	0.000E+00	0.0000	0.000E+00	0.0000	3.894E-10	0.0530	1.025E-11	0.0014	3.075E-12	0.0004	7.350E-09	1.0000

0*Sum of all water independent and dependent pathways.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Co-60	Co-60	1.000E+00	9.075E-08	8.040E-08	6.312E-08	2.705E-08	2.405E-09	2.138E-10	5.035E-13	1.550E-23	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	4.394E-10	4.304E-10	4.131E-10	3.577E-10	2.371E-10	1.571E-10	5.619E-11	9.192E-13	6.092E-18	0.000E+00
0Pu-239	Pu-239	1.000E+00	3.272E-18	3.342E-18	3.486E-18	4.041E-18	6.166E-18	9.407E-18	2.705E-17	1.849E-15	1.418E-02	0.000E+00
Pu-239	U-235	1.000E+00	2.367E-24	7.086E-24	1.646E-23	4.889E-23	1.454E-22	2.647E-22	8.461E-22	6.437E-20	6.920E-09	5.197E-09
Pu-239	Pa-231	1.000E+00	6.774E-28	4.684E-27	2.408E-26	1.958E-25	1.306E-24	3.009E-24	1.001E-23	3.805E-22	4.463E-09	4.606E-09
Pu-239	Ac-227	1.000E+00	4.359E-29	6.297E-28	6.758E-27	1.349E-25	1.679E-24	4.582E-24	1.701E-23	7.354E-14	1.371E-08	1.470E-08
Pu-239	äDSR(j)		3.272E-18	3.342E-18	3.486E-18	4.041E-18	6.166E-18	9.408E-18	2.705E-17	7.539E-14	1.418E-02	2.450E-08
0Sr-90	Sr-90	1.000E+00	8.272E-15	5.795E-15	2.843E-15	2.353E-16	1.903E-19	1.539E-22	1.673E-02	9.194E-34	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 = 1.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Co-60	1.653E+08	1.866E+08	2.377E+08	5.544E+08	6.237E+09	7.017E+10	2.979E+13	*1.131E+15	*1.131E+15	*1.131E+15
Cs-137	3.414E+10	3.485E+10	3.631E+10	4.194E+10	6.327E+10	9.546E+10	2.669E+11	1.632E+13	*8.701E+13	*8.701E+13
Pu-239	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	1.058E+03	6.122E+08
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	8.966E+02	*1.365E+14	*1.365E+14	*1.365E+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 = 92.3 ñ 0.2 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
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Co-60	4.000E-01	0.000E+00	9.075E-08	1.653E+08	1.279E-12	1.173E+13
Cs-137	7.000E-01	0.000E+00	4.394E-10	3.414E+10	6.584E-11	2.278E+11
Pu-239	3.000E-01	650 ñ 1	2.224E-02	6.744E+02	2.299E-17	*6.212E+10
Sr-90	2.500E+00	92.3 ñ 0.2	1.889E-02	7.942E+02	1.889E-02	7.942E+02
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*At specific activity limit

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Co-60	Co-60	1.000E+00	3.630E-08	3.216E-08	2.525E-08	1.082E-08	9.619E-10	8.550E-11	2.014E-13	6.201E-24	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	3.075E-10	3.013E-10	2.891E-10	2.504E-10	1.659E-10	1.100E-10	3.934E-11	6.434E-13	4.265E-18	0.000E+00
0Pu-239	Pu-239	1.000E+00	9.815E-19	1.002E-18	1.046E-18	1.212E-18	1.850E-18	2.822E-18	8.115E-18	5.547E-16	4.253E-03	0.000E+00
0U-235	Pu-239	1.000E+00	7.102E-25	2.126E-24	4.937E-24	1.467E-23	4.362E-23	7.940E-23	2.538E-22	1.931E-20	2.076E-09	1.559E-09
0Pa-231	Pu-239	1.000E+00	2.032E-28	1.405E-27	7.224E-27	5.875E-26	3.919E-25	9.026E-25	3.002E-24	1.142E-22	1.339E-09	1.382E-09
0Ac-227	Pu-239	1.000E+00	1.308E-29	1.889E-28	2.028E-27	4.047E-26	5.036E-25	1.375E-24	5.102E-24	2.206E-14	4.113E-09	4.409E-09
0Sr-90	Sr-90	1.000E+00	2.068E-14	1.449E-14	7.108E-15	5.882E-16	4.758E-19	3.849E-22	4.183E-02	0.000E+00	0.000E+00	0.000E+00
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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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Co-60	Co-60	1.000E+00	4.000E-01	3.498E-01	2.676E-01	1.047E-01	7.177E-03	4.919E-04	6.050E-07	1.384E-18	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	7.000E-01	6.750E-01	6.277E-01	4.867E-01	2.353E-01	1.138E-01	1.850E-02	1.291E-05	1.161E-16	0.000E+00
0Pu-239	Pu-239	1.000E+00	3.000E-01	2.996E-01	2.988E-01	2.962E-01	2.886E-01	2.813E-01	2.638E-01	2.039E-01	8.287E-02	4.824E-04
0U-235	Pu-239	1.000E+00	0.000E+00	2.880E-10	8.213E-10	2.307E-09	4.474E-09	5.176E-09	5.275E-09	4.109E-09	1.670E-09	9.720E-12
0Pa-231	Pu-239	1.000E+00	0.000E+00	3.022E-15	2.543E-14	2.243E-13	1.084E-12	1.719E-12	2.198E-12	1.778E-12	7.224E-13	4.205E-15
0Ac-227	Pu-239	1.000E+00	0.000E+00	3.110E-17	7.399E-16	1.793E-14	1.661E-13	3.124E-13	4.429E-13	3.641E-13	1.480E-13	8.614E-16
0Sr-90	Sr-90	1.000E+00	2.500E+00	1.717E+00	8.094E-01	5.826E-02	3.164E-05	1.718E-08	1.181E-16	0.000E+00	0.000E+00	0.000E+00
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BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 23.57 seconds

ATTACHMENT 5f

RESRAD Results

BNL Site Specific 650 Outfall – Resident Farmer – Class 2

Summary : BNL Site Specific 650 Outfall -- Resident Farmer --Class 2
File : 650rf2_2.rad

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(2)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(3)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(4)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(5)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(6)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(2)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(3)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(4)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(5)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(6)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(2,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(3,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(4,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(4,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(5,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(5,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(6,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(6,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(2,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(3,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(3,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(4,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(5,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(5,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(6,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	9.100E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	5.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.600E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.500E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Sr-90	2.000E+00	0.000E+00	---	S1(5)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(5)
R013	Cover depth (m)	1.400E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.660E+00	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)	1.660E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.400E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	6.230E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	4.600E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.200E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	1.660E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.300E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.400E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	2.000E+04	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.000E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.900E+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)	1.800E+01	1.000E+01	---	DWIBWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	7.600E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.660E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.300E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.400E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.900E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.515E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.521E-01	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.249E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.017E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)

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 U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.017E-02	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R017	Inhalation rate (m**3/yr)	8.400E+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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-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)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Drinking water intake (L/yr)	7.000E+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	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.455E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.455E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
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

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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
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	64	---	---	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	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : BNL Site Specific 650 Outfall -- Resident Farmer --Class 2
File : 650rf2_2.rad

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	9100.00 square meters	Cs-137	1.600E-01
Thickness:	0.15 meters	Pu-239	1.500E-01
Cover Depth:	1.40 meters	Sr-90	2.000E+00

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
TDOSE(t):	7.069E-11	6.999E-11	6.862E-11	6.404E-11	5.259E-11	4.319E-11	2.639E-11	3.681E-12	2.130E-03	8.763E-09
M(t):	4.713E-12	4.666E-12	4.575E-12	4.270E-12	3.506E-12	2.879E-12	1.759E-12	2.454E-13	1.420E-04	5.842E-10

0Maximum TDOSE(t): 2.448E-02 mrem/yr at t = 113.1 ñ 0.2 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 = 1.131E+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.
Cs-137	2.319E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	5.354E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.319E-11	0.0000	0.000E+00	0.0000	0.000E+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 = 1.131E+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.
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	2.319E-11	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.354E-18	0.0000
Sr-90	2.132E-02	0.8709	0.000E+00	0.0000	0.000E+00	0.0000	1.284E-03	0.0524	1.214E-03	0.0496	6.637E-04	0.0271	2.448E-02	1.0000
Total	2.132E-02	0.8709	0.000E+00	0.0000	0.000E+00	0.0000	1.284E-03	0.0524	1.214E-03	0.0496	6.637E-04	0.0271	2.448E-02	1.0000

0*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 = 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.
Cs-137	7.067E-11	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	4.908E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.654E-14	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.069E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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.
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	7.067E-11	0.9998
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.908E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.654E-14	0.0002
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	7.069E-11	1.0000

0*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 = 1.000E+00 years
0 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.
Cs-137	6.998E-11	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	5.012E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.159E-14	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.999E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	6.998E-11	0.9998
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.012E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.159E-14	0.0002
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.999E-11	1.0000

0*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+00 years
0 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.
Cs-137	6.862E-11	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	5.229E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.686E-15	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.862E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+00 years
0 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.
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	6.862E-11	0.9999
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.229E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.686E-15	0.0001
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.862E-11	1.0000

0*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 = 1.000E+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.
Cs-137	6.404E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	6.062E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.705E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.404E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

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

0	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.
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	6.404E-11	1.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.062E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.705E-16	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	6.404E-11	1.0000

0*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+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.
Cs-137	5.259E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	9.249E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.806E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.259E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+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.
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	5.259E-11	1.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.249E-19	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.806E-19	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	5.259E-11	1.0000

0*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 = 5.000E+01 years
0 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.
Cs-137	4.319E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	1.411E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	3.079E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.319E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 5.000E+01 years
0 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.
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	4.319E-11	1.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.411E-18	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.079E-22	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	4.319E-11	1.0000

0*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 = 1.000E+02 years
0 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.
Cs-137	2.639E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	4.057E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	5.730E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.639E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 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.
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	2.639E-11	1.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.057E-18	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.730E-30	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	2.639E-11	1.0000

0*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)

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.
Cs-137	3.680E-12	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	2.773E-16	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.681E-12	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+02 years
0 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.
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	3.680E-12	0.9999
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.773E-16	0.0001
Sr-90	5.036E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.065E-28	0.0000	3.026E-28	0.0000	1.598E-28	0.0000	5.805E-27	0.0000
Total	5.036E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.065E-28	0.0000	3.026E-28	0.0000	1.598E-28	0.0000	3.681E-12	1.0000

0*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 = 1.000E+03 years
0 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.
Cs-137	3.727E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.422E-14	0.0000	2.301E-14	0.0000	7.246E-15	0.0000	0.000E+00	0.0000
Pu-239	7.323E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.126E-03	0.9977	4.763E-06	0.0022	5.625E-08	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.323E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.126E-03	0.9977	4.763E-06	0.0022	5.625E-08	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

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.
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	6.820E-14	0.0000
Pu-239	4.791E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.685E-10	0.0000	2.912E-11	0.0000	1.002E-11	0.0000	2.130E-03	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.791E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.685E-10	0.0000	2.912E-11	0.0000	1.002E-11	0.0000	2.130E-03	1.0000

0*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 = 5.000E+03 years
0 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.
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
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+03 years
0 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.
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
Pu-239	8.226E-09	0.9387	0.000E+00	0.0000	0.000E+00	0.0000	4.611E-10	0.0526	6.069E-11	0.0069	1.554E-11	0.0018	8.763E-09	1.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.226E-09	0.9387	0.000E+00	0.0000	0.000E+00	0.0000	4.611E-10	0.0526	6.069E-11	0.0069	1.554E-11	0.0018	8.763E-09	1.0000

0*Sum of all water independent and dependent pathways.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Cs-137	Cs-137	1.000E+00	4.417E-10	4.374E-10	4.288E-10	4.003E-10	3.287E-10	2.699E-10	1.649E-10	2.300E-11	4.263E-13	0.000E+00
0Pu-239	Pu-239	1.000E+00	3.272E-18	3.342E-18	3.486E-18	4.041E-18	6.166E-18	9.407E-18	2.705E-17	1.849E-15	1.420E-02	0.000E+00
Pu-239	U-235	1.000E+00	2.367E-24	7.086E-24	1.646E-23	4.889E-23	1.454E-22	2.647E-22	8.461E-22	6.437E-20	6.932E-09	1.055E-08
Pu-239	Pa-231	1.000E+00	6.774E-28	4.684E-27	2.408E-26	1.958E-25	1.306E-24	3.009E-24	1.001E-23	3.805E-22	5.399E-09	1.153E-08
Pu-239	Ac-227	1.000E+00	4.359E-29	6.297E-28	6.758E-27	1.349E-25	1.679E-24	4.582E-24	1.701E-23	6.792E-22	2.172E-08	3.634E-08
Pu-239	äDSR(j)		3.272E-18	3.342E-18	3.486E-18	4.041E-18	6.166E-18	9.408E-18	2.705E-17	1.849E-15	1.420E-02	5.842E-08
0Sr-90	Sr-90	1.000E+00	8.272E-15	5.795E-15	2.843E-15	2.353E-16	1.903E-19	1.539E-22	2.865E-30	2.903E-27	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.
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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Cs-137	3.396E+10	3.429E+10	3.498E+10	3.747E+10	4.563E+10	5.557E+10	9.094E+10	6.521E+11	3.519E+13	*8.701E+13
Pu-239	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	1.056E+03	2.568E+08
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+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 = 113.1 ñ 0.2 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.600E-01	538 ñ 1	1.426E-08	1.052E+09	1.449E-10	1.035E+11
Pu-239	1.500E-01	650 ñ 1	2.228E-02	6.732E+02	3.570E-17	*6.212E+10
Sr-90	2.000E+00	113.1 ñ 0.2	1.224E-02	1.226E+03	1.224E-02	1.226E+03

*At specific activity limit

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Cs-137	Cs-137	1.000E+00	7.067E-11	6.998E-11	6.862E-11	6.404E-11	5.259E-11	4.319E-11	2.639E-11	3.680E-12	6.820E-14	0.000E+00
0Pu-239	Pu-239	1.000E+00	4.908E-19	5.012E-19	5.229E-19	6.062E-19	9.249E-19	1.411E-18	4.057E-18	2.773E-16	2.130E-03	0.000E+00
0U-235	Pu-239	1.000E+00	3.551E-25	1.063E-24	2.469E-24	7.333E-24	2.181E-23	3.970E-23	1.269E-22	9.655E-21	1.040E-09	1.583E-09
0Pa-231	Pu-239	1.000E+00	1.016E-28	7.026E-28	3.612E-27	2.938E-26	1.959E-25	4.513E-25	1.501E-24	5.708E-23	8.098E-10	1.730E-09
0Ac-227	Pu-239	1.000E+00	6.539E-30	9.445E-29	1.014E-27	2.024E-26	2.518E-25	6.873E-25	2.551E-24	1.019E-22	3.258E-09	5.451E-09
0Sr-90	Sr-90	1.000E+00	1.654E-14	1.159E-14	5.686E-15	4.705E-16	3.806E-19	3.079E-22	5.730E-30	5.805E-27	0.000E+00	0.000E+00
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Cs-137	Cs-137	1.000E+00	1.600E-01	1.560E-01	1.482E-01	1.238E-01	7.419E-02	4.444E-02	1.234E-02	7.347E-05	1.195E-12	0.000E+00
0Pu-239	Pu-239	1.000E+00	1.500E-01	1.498E-01	1.494E-01	1.481E-01	1.443E-01	1.407E-01	1.319E-01	1.020E-01	4.143E-02	2.412E-04
0U-235	Pu-239	1.000E+00	0.000E+00	1.440E-10	4.106E-10	1.154E-09	2.237E-09	2.588E-09	2.637E-09	2.054E-09	8.348E-10	4.860E-12
0Pa-231	Pu-239	1.000E+00	0.000E+00	1.511E-15	1.271E-14	1.121E-13	5.422E-13	8.597E-13	1.099E-12	8.889E-13	3.612E-13	2.103E-15
0Ac-227	Pu-239	1.000E+00	0.000E+00	1.555E-17	3.700E-16	8.966E-15	8.305E-14	1.562E-13	2.214E-13	1.821E-13	7.398E-14	4.307E-16
0Sr-90	Sr-90	1.000E+00	2.000E+00	1.373E+00	6.475E-01	4.661E-02	2.531E-05	1.375E-08	9.450E-17	0.000E+00	0.000E+00	0.000E+00
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

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

0RESCALC.EXE execution time = 21.48 seconds

ATTACHMENT 5g

RESRAD Results

BNL Site Specific 650 Outfall – Resident Farmer – Pipeline

Summary : BNL Site Specific 650 Outfall -- Res Farmer --Pipeline
File : 650rfp02.rad

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(5)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(6)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(7)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(8)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(9)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(10)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(11)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(12)
B-1	U-233	1.350E-01	1.350E-01	DCF2(13)
B-1	U-234	1.320E-01	1.320E-01	DCF2(14)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(15)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(16)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(5)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(6)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(7)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(8)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(9)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(10)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(11)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(12)
D-1	U-233	2.890E-04	2.890E-04	DCF3(13)
D-1	U-234	2.830E-04	2.830E-04	DCF3(14)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(15)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(16)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(5,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(6,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(6,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(7,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(7,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(7,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(8,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(9,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(9,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(9,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(10,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(10,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(10,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(11,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(12,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(13,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(13,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(14,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(14,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(14,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(15,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(15,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name

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D-34 ³ U-238+D  , plant/soil concentration ratio, dimensionless    ³ 2.500E-03 ³ 2.500E-03 ³ RTF(16,1)
D-34 ³ U-238+D  , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    ³ 3.400E-04 ³ 3.400E-04 ³ RTF(16,2)
D-34 ³ U-238+D  , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     ³ 6.000E-04 ³ 6.000E-04 ³ RTF(16,3)
     ³                                                             ³           ³           ³
D-5  ³ Bioaccumulation factors, fresh water, L/kg:                 ³           ³           ³
D-5  ³ Ac-227+D , fish                                             ³ 1.500E+01 ³ 1.500E+01 ³ BIOFAC( 1,1)
D-5  ³ Ac-227+D , crustacea and mollusks                           ³ 1.000E+03 ³ 1.000E+03 ³ BIOFAC( 1,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Am-241   , fish                                             ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC( 2,1)
D-5  ³ Am-241   , crustacea and mollusks                           ³ 1.000E+03 ³ 1.000E+03 ³ BIOFAC( 2,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Co-60    , fish                                             ³ 3.000E+02 ³ 3.000E+02 ³ BIOFAC( 3,1)
D-5  ³ Co-60    , crustacea and mollusks                           ³ 2.000E+02 ³ 2.000E+02 ³ BIOFAC( 3,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Cs-137+D , fish                                             ³ 2.000E+03 ³ 2.000E+03 ³ BIOFAC( 4,1)
D-5  ³ Cs-137+D , crustacea and mollusks                           ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC( 4,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Np-237+D , fish                                             ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC( 5,1)
D-5  ³ Np-237+D , crustacea and mollusks                           ³ 4.000E+02 ³ 4.000E+02 ³ BIOFAC( 5,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Pa-231   , fish                                             ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC( 6,1)
D-5  ³ Pa-231   , crustacea and mollusks                           ³ 1.100E+02 ³ 1.100E+02 ³ BIOFAC( 6,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Pb-210+D , fish                                             ³ 3.000E+02 ³ 3.000E+02 ³ BIOFAC( 7,1)
D-5  ³ Pb-210+D , crustacea and mollusks                           ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC( 7,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Pu-239   , fish                                             ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC( 8,1)
D-5  ³ Pu-239   , crustacea and mollusks                           ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC( 8,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Ra-226+D , fish                                             ³ 5.000E+01 ³ 5.000E+01 ³ BIOFAC( 9,1)
D-5  ³ Ra-226+D , crustacea and mollusks                           ³ 2.500E+02 ³ 2.500E+02 ³ BIOFAC( 9,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Sr-90+D  , fish                                             ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(10,1)
D-5  ³ Sr-90+D  , crustacea and mollusks                           ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(10,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Th-229+D , fish                                             ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(11,1)
D-5  ³ Th-229+D , crustacea and mollusks                           ³ 5.000E+02 ³ 5.000E+02 ³ BIOFAC(11,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ Th-230   , fish                                             ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(12,1)
D-5  ³ Th-230   , crustacea and mollusks                           ³ 5.000E+02 ³ 5.000E+02 ³ BIOFAC(12,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ U-233    , fish                                             ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(13,1)
D-5  ³ U-233    , crustacea and mollusks                           ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(13,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ U-234    , fish                                             ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(14,1)
D-5  ³ U-234    , crustacea and mollusks                           ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(14,2)
D-5  ³                                                             ³           ³           ³
D-5  ³ U-235+D  , fish                                             ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(15,1)
D-5  ³ U-235+D  , crustacea and mollusks                           ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(15,2)
D-5  ³                                                             ³           ³           ³
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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)

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)	5.000E+00	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	5.000E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+00	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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	5.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	5.000E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	1.000E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	3.800E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Pu-239	5.000E+00	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.600E+01	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): U-234	2.600E+00	0.000E+00	---	S1(14)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E-01	0.000E+00	---	S1(15)
R012	Initial principal radionuclide (pCi/g): U-238	2.600E+00	0.000E+00	---	S1(16)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(14)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(15)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(16)
R013	Cover depth (m)	4.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.660E+00	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)	1.660E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.400E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	6.230E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	4.600E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.200E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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	Romberg failures occurred	EPS

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Density of saturated zone (g/cm**3)	1.660E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.300E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.400E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	2.000E+04	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.000E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.900E+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)	1.800E+01	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)	6.100E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.660E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.300E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.400E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.900E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.746E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.546E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.969E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.773E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.056E-01	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.505E-02	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.505E-02	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.505E-02	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.746E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.930E-03	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.505E-02	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)

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 Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.536E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.076E-02	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-05	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.505E-02	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R017	Inhalation rate (m**3/yr)	8.400E+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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	3.200E+01	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	2.800E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.000E+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	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.250E-02	FPLANT
R018	Contamination fraction of meat	-1	-1	0.250E-03	FMEAT
R018	Contamination fraction of milk	-1	-1	0.250E-03	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)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
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

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	64	---	---	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	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	5.00 square meters	Am-241	5.000E-01
Thickness:	0.50 meters	Co-60	1.000E+00
Cover Depth:	4.00 meters	Cs-137	3.800E+01
		Pu-239	5.000E+00
		Sr-90	1.600E+01
		U-234	2.600E+00
		U-235	1.000E-01
		U-238	2.600E+00

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
TDOSE(t):	1.487E-22	1.320E-22	1.040E-22	4.515E-23	4.170E-24	3.946E-25	7.677E-03	9.804E-03	3.834E-04	8.481E-05
M(t):	9.917E-24	8.802E-24	6.934E-24	3.010E-24	2.780E-25	2.631E-26	5.118E-04	6.536E-04	2.556E-05	5.654E-06

0Maximum TDOSE(t): 7.107E-02 mrem/yr at t = 247.3 ñ 0.5 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 = 2.473E+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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	1.246E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	6.884E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.172E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.547E-27	0.0000	0.000E+00	0.0000	0.000E+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 = 2.473E+02 years

0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Nuclide														
Am-241	7.107E-02	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	3.976E-06	0.0001	1.367E-08	0.0000	1.208E-09	0.0000	7.107E-02	1.0000
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	1.246E-27	0.0000
Pu-239	7.448E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.968E-23	0.0000	4.477E-26	0.0000	1.176E-25	0.0000	7.448E-19	0.0000
Sr-90	4.988E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.020E-15	0.0000	1.590E-15	0.0000	8.590E-16	0.0000	4.989E-11	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.884E-27	0.0000
U-235	4.133E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.212E-15	0.0000	2.542E-18	0.0000	6.523E-18	0.0000	4.133E-11	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.172E-28	0.0000
Total	7.107E-02	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	3.976E-06	0.0001	1.367E-08	0.0000	1.208E-09	0.0000	7.107E-02	1.0000

0*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 = 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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	1.487E-22	0.9999	0.000E+00	0.0000	0.000E+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	2.039E-26	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.966E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.487E-22	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.487E-22	0.9999
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	2.039E-26	0.0001
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.966E-28	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	1.487E-22	1.0000

0*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 = 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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	1.320E-22	0.9998	0.000E+00	0.0000	0.000E+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	2.016E-26	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.967E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.320E-22	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

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

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.320E-22	0.9998
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	2.016E-26	0.0002
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.967E-28	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	1.320E-22	1.0000

0*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+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	1.040E-22	0.9998	0.000E+00	0.0000	0.000E+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	1.971E-26	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.968E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.040E-22	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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+00 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.040E-22	0.9998
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	1.971E-26	0.0002
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.968E-28	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	1.040E-22	1.0000

0*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 = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	4.513E-23	0.9996	0.000E+00	0.0000	0.000E+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	1.821E-26	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.696E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.974E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.515E-23	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

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

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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	4.513E-23	0.9996
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	1.821E-26	0.0004
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.696E-30	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.974E-28	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	4.515E-23	1.0000

0*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+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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	4.155E-24	0.9964	0.000E+00	0.0000	0.000E+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	1.453E-26	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.524E-29	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.990E-28	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.170E-24	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.155E-24	0.9964
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	1.453E-26	0.0035
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.524E-29	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.990E-28	0.0001
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	4.170E-24	1.0000

0*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 = 5.000E+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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	3.826E-25	0.9694	0.000E+00	0.0000	0.000E+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	1.159E-26	0.0294	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	7.715E-29	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.007E-28	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.946E-25	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	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 = 5.000E+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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.826E-25	0.9694
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	1.159E-26	0.0294
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.715E-29	0.0002
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.007E-28	0.0010
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	3.946E-25	1.0000

0*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 = 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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	9.841E-28	0.0000	0.000E+00	0.0000	0.000E+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	6.584E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	4.088E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.048E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.382E-27	0.0000	0.000E+00	0.0000	0.000E+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
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.841E-28	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	6.584E-27	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	7.676E-03	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	4.647E-07	0.0001	2.447E-07	0.0000	1.322E-07	0.0000	7.677E-03	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.088E-28	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.048E-28	0.0000
Total	7.676E-03	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	4.647E-07	0.0001	2.447E-07	0.0000	1.322E-07	0.0000	7.677E-03	1.0000

0*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 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	6.865E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.543E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.217E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.654E-26	0.0000	0.000E+00	0.0000	0.000E+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+02 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	9.804E-03	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	5.498E-07	0.0001	1.922E-09	0.0000	1.677E-10	0.0000	9.804E-03	1.0000
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	6.865E-28	0.0000
Pu-239	6.678E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.733E-18	0.0000	5.141E-21	0.0000	1.135E-20	0.0000	6.678E-14	0.0000
Sr-90	5.867E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.552E-18	0.0000	1.870E-18	0.0000	1.010E-18	0.0000	5.868E-14	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.543E-26	0.0000
U-235	8.263E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.621E-12	0.0000	6.375E-15	0.0000	1.405E-14	0.0000	8.263E-08	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.217E-28	0.0000
Total	9.804E-03	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	5.498E-07	0.0001	1.922E-09	0.0000	1.677E-10	0.0000	9.804E-03	1.0000

0*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 = 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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.619E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.988E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.619E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	6.778E-08	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	3.816E-12	0.0000	2.642E-13	0.0000	3.315E-15	0.0000	6.778E-08	0.0002
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
Pu-239	6.986E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.916E-13	0.0000	2.891E-14	0.0000	1.161E-14	0.0000	6.986E-09	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.107E-04	0.5496	0.000E+00	0.0000	0.000E+00	0.0000	1.182E-08	0.0000	3.793E-10	0.0000	1.015E-09	0.0000	2.107E-04	0.5496
U-235	1.944E-05	0.0507	0.000E+00	0.0000	0.000E+00	0.0000	1.091E-09	0.0000	1.034E-10	0.0000	3.157E-11	0.0000	1.944E-05	0.0507
U-238	1.531E-04	0.3994	0.000E+00	0.0000	0.000E+00	0.0000	8.586E-09	0.0000	2.035E-10	0.0000	7.848E-10	0.0000	1.531E-04	0.3995
Total	3.833E-04	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	2.150E-08	0.0001	6.865E-10	0.0000	1.832E-09	0.0000	3.834E-04	1.0000

0*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 = 5.000E+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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Am-241	8.789E-08	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	4.948E-12	0.0000	3.429E-13	0.0000	3.890E-15	0.0000	8.789E-08	0.0010
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
Pu-239	8.536E-09	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	4.784E-13	0.0000	3.467E-14	0.0000	1.080E-14	0.0000	8.537E-09	0.0001
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	8.468E-05	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	4.765E-09	0.0001	2.786E-10	0.0000	3.224E-10	0.0000	8.469E-05	0.9986
U-235	1.679E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.679E-28	0.0000
U-238	2.340E-08	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	1.317E-12	0.0000	7.740E-14	0.0000	9.251E-14	0.0000	2.340E-08	0.0003
Total	8.480E-05	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	4.771E-09	0.0001	2.790E-10	0.0000	3.225E-10	0.0000	8.481E-05	1.0000

0*Sum of all water independent and dependent pathways.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Am-241	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.961E-02	7.198E-14	0.000E+00
Am-241	Np-237	1.000E+00	2.522E-43	7.539E-43	1.757E-42	5.280E-42	1.585E-41	2.823E-41	7.856E-41	1.100E-07	1.354E-07	1.757E-07
Am-241	U-233	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.338E-12	1.662E-10	5.466E-11
Am-241	Th-229	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.401E-45	5.605E-45	6.306E-44	2.376E-16	8.184E-14	5.851E-13
Am-241	äDSR(j)		2.522E-43	7.539E-43	1.757E-42	5.280E-42	1.585E-41	2.824E-41	7.862E-41	1.961E-02	1.356E-07	1.758E-07
0Co-60	Co-60	1.000E+00	1.487E-22	1.320E-22	1.040E-22	4.513E-23	4.155E-24	3.826E-25	9.841E-28	4.309E-38	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	5.366E-28	5.306E-28	5.187E-28	4.793E-28	3.823E-28	3.049E-28	1.733E-28	1.807E-29	6.613E-33	0.000E+00
0Pu-239	Pu-239	1.000E+00	1.682E-43	1.710E-43	1.794E-43	2.102E-43	3.251E-43	5.059E-43	1.518E-42	9.373E-41	4.753E-34	0.000E+00
Pu-239	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.803E-45	4.276E-10	3.860E-10
Pu-239	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.401E-45	8.408E-45	7.581E-43	2.639E-10	3.245E-10
Pu-239	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.401E-45	1.682E-44	1.336E-14	7.058E-10	9.968E-10
Pu-239	äDSR(j)		1.682E-43	1.710E-43	1.794E-43	2.102E-43	3.251E-43	5.087E-43	1.543E-42	1.336E-14	1.397E-09	1.707E-09
0Sr-90	Sr-90	1.000E+00	3.152E-37	2.825E-37	2.269E-37	1.054E-37	1.179E-38	1.320E-39	4.798E-04	3.667E-15	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.160E-05	1.462E-28
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.572E-09	6.539E-09
U-234	Ra-226	1.000E+00	2.981E-33	2.096E-32	1.119E-31	1.037E-30	9.708E-30	2.967E-29	1.572E-28	5.934E-27	4.182E-06	6.780E-06
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.525E-05	2.579E-05
U-234	äDSR(j)		2.981E-33	2.096E-32	1.119E-31	1.037E-30	9.708E-30	2.967E-29	1.572E-28	5.934E-27	8.104E-05	3.257E-05
0U-235	U-235	1.000E+00	5.273E-41	5.354E-41	5.501E-41	5.773E-41	6.745E-41	7.947E-41	1.173E-40	5.631E-40	5.829E-05	1.399E-28
U-235	Pa-231	1.000E+00	3.076E-40	9.263E-40	2.179E-39	6.732E-39	2.127E-38	3.829E-38	9.399E-38	6.503E-37	4.847E-05	5.576E-28
U-235	Ac-227	1.000E+00	1.689E-41	1.168E-40	6.019E-40	4.932E-39	3.361E-38	7.822E-38	2.403E-37	8.263E-07	8.769E-05	9.811E-28
U-235	äDSR(j)		3.772E-40	1.097E-39	2.836E-39	1.172E-38	5.494E-38	1.166E-37	3.344E-37	8.263E-07	1.944E-04	1.679E-27
0U-238	U-238	1.000E+00	1.525E-28	1.526E-28	1.526E-28	1.529E-28	1.535E-28	1.541E-28	1.557E-28	1.622E-28	5.872E-05	1.410E-28
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.750E-07	2.087E-30
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.171E-12	1.627E-11
U-238	Ra-226	1.000E+00	2.111E-39	3.175E-38	3.729E-37	1.013E-35	2.664E-34	1.304E-33	1.259E-32	9.610E-31	6.164E-10	2.100E-09
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.192E-09	6.883E-09
U-238	äDSR(j)		1.525E-28	1.526E-28	1.526E-28	1.529E-28	1.535E-28	1.541E-28	1.557E-28	1.632E-28	5.890E-05	8.999E-09

*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.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Am-241	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	7.650E+02	1.106E+08	8.533E+07
Co-60	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15
Cs-137	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13
Pu-239	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	1.074E+10	8.786E+09
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	3.126E+04	*1.365E+14	*1.365E+14	*1.365E+14
U-234	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	1.851E+05	4.605E+05
U-235	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	7.714E+04	*2.160E+06
U-238	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	2.547E+05	*3.360E+05
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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 = 247.3 ñ 0.5 years

0Nuclide

(i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
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Am-241	5.000E-01	247.4 ñ 0.5	1.418E-01	1.058E+02	1.421E-01	1.055E+02
Co-60	1.000E+00	0.000E+00	1.487E-22	*1.131E+15	0.000E+00	*1.131E+15
Cs-137	3.800E+01	0.000E+00	5.366E-28	*8.701E+13	3.278E-29	*8.701E+13
Pu-239	5.000E+00	4004 ñ 8	1.024E-03	1.465E+04	1.490E-19	*6.212E+10
Sr-90	1.600E+01	85.2 ñ 0.2	3.150E-03	4.762E+03	3.118E-12	4.811E+12
U-234	2.600E+00	656 ñ 1	6.627E-03	2.264E+03	2.648E-27	*6.245E+09
U-235	1.000E-01	656 ñ 1	1.594E-02	9.413E+02	4.133E-10	*2.160E+06
U-238	2.600E+00	656 ñ 1	6.323E-03	2.372E+03	1.605E-28	*3.360E+05
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*At specific activity limit

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Am-241	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.804E-03	3.599E-14	0.000E+00
0Np-237	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.502E-08	6.770E-08	8.787E-08
0U-233	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.669E-12	8.309E-11	2.733E-11
0Th-229	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.188E-16	4.092E-14	2.926E-13
0Co-60	Co-60	1.000E+00	1.487E-22	1.320E-22	1.040E-22	4.513E-23	4.155E-24	3.826E-25	9.841E-28	0.000E+00	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.039E-26	2.016E-26	1.971E-26	1.821E-26	1.453E-26	1.159E-26	6.584E-27	6.865E-28	0.000E+00	0.000E+00
0Pu-239	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.138E-09	1.930E-09
U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.829E-06	1.399E-29
U-235	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	5.831E-06	1.930E-09
0Pa-231	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.320E-09	1.623E-09
Pa-231	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.847E-06	5.576E-29
Pa-231	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	4.848E-06	1.623E-09
0Ac-227	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.678E-14	3.529E-09	4.984E-09
Ac-227	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.263E-08	8.769E-06	9.810E-29
Ac-227	äDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.263E-08	8.773E-06	4.984E-09
0Sr-90	Sr-90	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.677E-03	5.868E-14	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.602E-04	3.801E-28
U-234	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.549E-07	5.427E-30
U-234	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	1.606E-04	3.855E-28
0Th-230	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.709E-08	1.700E-08
Th-230	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.384E-11	4.230E-11
Th-230	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	1.711E-08	1.704E-08
0Ra-226	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	2.696E-30	2.524E-29	7.715E-29	4.088E-28	1.543E-26	1.087E-05	1.763E-05
Ra-226	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.603E-09	5.460E-09
Ra-226	äDOSE(j)		0.000E+00	0.000E+00	0.000E+00	2.696E-30	2.524E-29	7.715E-29	4.088E-28	1.543E-26	1.087E-05	1.763E-05
0Pb-210	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.966E-05	6.704E-05
Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.700E-09	1.789E-08
Pb-210	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	3.966E-05	6.706E-05
0U-238	U-238	1.000E+00	3.966E-28	3.967E-28	3.968E-28	3.974E-28	3.990E-28	4.007E-28	4.048E-28	4.217E-28	1.527E-04	3.665E-28

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
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Am-241	Am-241	1.000E+00	5.000E-01	4.808E-01	4.447E-01	3.383E-01	1.549E-01	7.090E-02	1.005E-02	4.063E-06	5.395E-18	0.000E+00
0Np-237	Am-241	1.000E+00	0.000E+00	1.586E-07	4.564E-07	1.320E-06	2.716E-06	3.235E-06	3.253E-06	1.860E-06	2.392E-07	1.941E-12
0U-233	Am-241	1.000E+00	0.000E+00	3.475E-13	3.011E-12	2.936E-11	1.847E-10	3.659E-10	6.824E-10	6.445E-10	8.628E-11	7.003E-16
0Th-229	Am-241	1.000E+00	0.000E+00	1.099E-17	2.884E-16	9.685E-15	2.001E-13	7.207E-13	3.281E-12	1.711E-11	3.366E-11	2.382E-11
0Co-60	Co-60	1.000E+00	1.000E+00	8.761E-01	6.725E-01	2.665E-01	1.892E-02	1.343E-03	1.804E-06	5.868E-18	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	3.800E+01	3.698E+01	3.504E+01	2.899E+01	1.687E+01	9.815E+00	2.535E+00	1.128E-02	6.633E-11	0.000E+00
0Pu-239	Pu-239	1.000E+00	5.000E+00	4.998E+00	4.994E+00	4.980E+00	4.939E+00	4.899E+00	4.801E+00	4.426E+00	3.331E+00	6.563E-01
0U-235	Pu-239	1.000E+00	0.000E+00	4.886E-09	1.444E-08	4.562E-08	1.181E-07	1.711E-07	2.482E-07	2.940E-07	2.240E-07	4.414E-08
U-235	U-235	1.000E+00	1.000E-01	9.851E-02	9.559E-02	8.603E-02	6.367E-02	4.712E-02	2.220E-02	1.094E-03	2.909E-08	2.081E-34
U-235	äS(j):		1.000E-01	9.851E-02	9.559E-02	8.603E-02	6.367E-02	4.712E-02	2.220E-02	1.095E-03	2.531E-07	4.414E-08
0Pa-231	Pu-239	1.000E+00	0.000E+00	5.157E-14	4.548E-13	4.708E-12	3.474E-11	7.951E-11	2.006E-10	4.009E-10	3.232E-10	6.368E-11
Pa-231	U-235	1.000E+00	0.000E+00	2.084E-06	6.067E-06	1.820E-05	4.040E-05	4.982E-05	4.692E-05	6.924E-06	6.089E-10	2.089E-35
Pa-231	äS(j):		0.000E+00	2.084E-06	6.067E-06	1.820E-05	4.040E-05	4.982E-05	4.692E-05	6.924E-06	9.321E-10	6.368E-11
0Ac-227	Pu-239	1.000E+00	0.000E+00	5.392E-16	1.386E-14	4.336E-13	7.474E-12	2.304E-11	7.661E-11	1.825E-10	1.494E-10	2.942E-11
Ac-227	U-235	1.000E+00	0.000E+00	3.258E-08	2.746E-07	2.437E-06	1.200E-05	1.918E-05	2.249E-05	3.814E-06	3.508E-10	1.222E-35
Ac-227	äS(j):		0.000E+00	3.258E-08	2.746E-07	2.437E-06	1.200E-05	1.918E-05	2.249E-05	3.814E-06	5.002E-10	2.942E-11
0Sr-90	Sr-90	1.000E+00	1.600E+01	1.406E+01	1.085E+01	4.385E+00	3.294E-01	2.474E-02	3.827E-05	2.189E-16	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	2.600E+00	2.561E+00	2.485E+00	2.237E+00	1.655E+00	1.225E+00	5.771E-01	2.843E-02	7.541E-07	5.335E-33
U-234	U-238	1.000E+00	0.000E+00	7.261E-06	2.114E-05	6.341E-05	1.408E-04	1.736E-04	1.636E-04	2.419E-05	2.141E-09	7.617E-35
U-234	äS(j):		2.600E+00	2.561E+00	2.485E+00	2.237E+00	1.655E+00	1.225E+00	5.772E-01	2.845E-02	7.562E-07	5.412E-33
0Th-230	U-234	1.000E+00	0.000E+00	2.323E-05	6.865E-05	2.173E-04	5.648E-04	8.218E-04	1.208E-03	1.530E-03	1.524E-03	1.398E-03
Th-230	U-238	1.000E+00	0.000E+00	3.284E-11	2.897E-10	3.003E-09	2.222E-08	5.102E-08	1.299E-07	2.741E-07	2.874E-07	2.637E-07
Th-230	äS(j):		0.000E+00	2.323E-05	6.865E-05	2.173E-04	5.648E-04	8.219E-04	1.208E-03	1.530E-03	1.524E-03	1.398E-03
0Ra-226	U-234	1.000E+00	0.000E+00	5.026E-09	4.445E-08	4.647E-07	3.525E-06	8.287E-06	2.226E-05	5.372E-05	5.909E-05	5.421E-05
Ra-226	U-238	1.000E+00	0.000E+00	4.742E-15	1.254E-13	4.322E-12	9.521E-11	3.608E-10	1.775E-09	8.693E-09	1.115E-08	1.023E-08
Ra-226	äS(j):		0.000E+00	5.026E-09	4.445E-08	4.647E-07	3.525E-06	8.288E-06	2.227E-05	5.373E-05	5.910E-05	5.422E-05
0Pb-210	U-234	1.000E+00	0.000E+00	5.168E-11	1.351E-09	4.475E-08	8.870E-07	3.058E-06	1.240E-05	4.156E-05	4.759E-05	4.365E-05
Pb-210	U-238	1.000E+00	0.000E+00	3.664E-17	2.875E-15	3.177E-13	1.888E-11	1.080E-10	8.496E-10	6.466E-09	8.975E-09	8.235E-09
Pb-210	äS(j):		0.000E+00	5.168E-11	1.351E-09	4.475E-08	8.870E-07	3.058E-06	1.240E-05	4.156E-05	4.759E-05	4.366E-05
0U-238	U-238	1.000E+00	2.600E+00	2.561E+00	2.485E+00	2.237E+00	1.655E+00	1.225E+00	5.772E-01	2.845E-02	7.562E-07	5.412E-33
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 1509.19 seconds
Total water/soil iteration failures = 541.

ATTACHMENT 5h

RESRAD Results

BNL Site Specific 650 Outfall – Resident Farmer – Soil at Depth

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(5)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(6)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(7)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(8)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(9)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(10)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(11)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(12)
B-1	U-233	1.350E-01	1.350E-01	DCF2(13)
B-1	U-234	1.320E-01	1.320E-01	DCF2(14)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(15)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(16)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(5)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(6)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(7)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(8)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(9)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(10)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(11)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(12)
D-1	U-233	2.890E-04	2.890E-04	DCF3(13)
D-1	U-234	2.830E-04	2.830E-04	DCF3(14)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(15)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(16)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(5,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(6,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(6,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(7,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(7,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(7,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(8,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(9,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(9,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(9,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(10,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(10,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(10,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(11,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(12,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(13,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(13,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(14,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(14,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(14,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(15,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(15,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(5,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(6,2)
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(7,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(7,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(8,2)
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(9,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(9,2)
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(10,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(11,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(11,2)
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(12,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(12,2)
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(13,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(13,2)
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(14,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(14,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(15,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(15,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

Menu	Parameter	Current Value	Default	Parameter Name
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.700E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	9.000E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	3.000E+00	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)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	5.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	7.000E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	1.000E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.000E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.000E+00	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Sr-90	2.000E+00	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): U-234	2.000E+01	0.000E+00	---	S1(14)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E+00	0.000E+00	---	S1(15)
R012	Initial principal radionuclide (pCi/g): U-238	2.000E+01	0.000E+00	---	S1(16)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(14)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(15)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(16)
R013	Cover depth (m)	6.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.660E+00	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)	1.660E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.400E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	6.230E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	4.600E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.200E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Density of saturated zone (g/cm**3)	1.660E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.300E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.400E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	2.000E+04	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.000E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.900E+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)	1.800E+01	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)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.660E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.300E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.400E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.900E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	5.000E+03	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.081E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.192E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	1.900E+02	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.205E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.096E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	7.000E+00	3.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.868E-02	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.361E-03	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.361E-03	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.361E-03	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.081E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.628E-03	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.361E-03	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)

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 Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.187E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.977E-03	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.988E-06	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.988E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.361E-03	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R017	Inhalation rate (m**3/yr)	8.400E+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	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

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)	3.200E+01	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	2.800E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.000E+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	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.850E-02	FPLANT
R018	Contamination fraction of meat	-1	-1	0.850E-03	FMEAT
R018	Contamination fraction of milk	-1	-1	0.850E-03	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)	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	64	---	---	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	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions

Area:	17.00 square meters
Thickness:	0.90 meters
Cover Depth:	6.00 meters

Initial Soil Concentrations, pCi/g

Am-241	7.000E-01
Co-60	1.000E-01
Cs-137	2.000E+01
Pu-239	1.000E+00
Sr-90	2.000E+00
U-234	2.000E+01
U-235	1.000E+00
U-238	2.000E+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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
TDOSE(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.110E-03	1.897E-02	1.403E-02	3.106E-03
M(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.402E-05	1.265E-03	9.354E-04	2.071E-04

0Maximum TDOSE(t): 8.143E-01 mrem/yr at t = 437.7 ñ 0.9 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 = 4.377E+02 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.377E+02 years

0 Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	9.354E-04	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	1.783E-07	0.0000	6.288E-10	0.0000	5.440E-11	0.0000	9.355E-04	0.0011
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
Pu-239	8.557E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.627E-13	0.0000	2.836E-15	0.0000	2.061E-15	0.0000	8.559E-10	0.0000
Sr-90	1.160E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.386E-19	0.0000	1.249E-19	0.0000	6.777E-20	0.0000	1.161E-15	0.0000
U-234	3.953E-01	0.4854	0.000E+00	0.0000	0.000E+00	0.0000	7.532E-05	0.0001	1.780E-06	0.0000	6.881E-06	0.0000	3.953E-01	0.4855
U-235	4.127E-02	0.0507	0.000E+00	0.0000	0.000E+00	0.0000	7.867E-06	0.0000	5.425E-07	0.0000	3.351E-07	0.0000	4.128E-02	0.0507
U-238	3.767E-01	0.4626	0.000E+00	0.0000	0.000E+00	0.0000	7.177E-05	0.0001	1.697E-06	0.0000	6.557E-06	0.0000	3.767E-01	0.4627
Total	8.141E-01	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	1.551E-04	0.0002	4.020E-06	0.0000	1.377E-05	0.0000	8.143E-01	1.0000

0*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 = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*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 = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

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

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

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

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*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 = 5.000E+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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*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 = 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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.110E-03	0.9996	0.000E+00	0.0000	0.000E+00	0.0000	2.282E-07	0.0002	1.195E-07	0.0001	6.483E-08	0.0001	1.110E-03	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.110E-03	0.9996	0.000E+00	0.0000	0.000E+00	0.0000	2.282E-07	0.0002	1.195E-07	0.0001	6.483E-08	0.0001	1.110E-03	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
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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+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.
Am-241	1.834E-02	0.9666	0.000E+00	0.0000	0.000E+00	0.0000	3.495E-06	0.0002	1.220E-08	0.0000	1.066E-09	0.0000	1.834E-02	0.9668
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
Pu-239	1.887E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.588E-15	0.0000	4.957E-18	0.0000	1.091E-17	0.0000	1.887E-11	0.0000
Sr-90	8.922E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.834E-14	0.0000	9.604E-15	0.0000	5.211E-15	0.0000	8.925E-11	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	6.301E-04	0.0332	0.000E+00	0.0000	0.000E+00	0.0000	1.199E-07	0.0000	1.657E-10	0.0000	3.646E-10	0.0000	6.302E-04	0.0332
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.897E-02	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	3.615E-06	0.0002	1.237E-08	0.0000	1.430E-09	0.0000	1.897E-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 = 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.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.654E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.082E-10	0.0000	7.434E-12	0.0000	8.985E-14	0.0000	5.655E-07	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
Pu-239	6.705E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.278E-12	0.0000	8.607E-14	0.0000	4.192E-14	0.0000	6.706E-09	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	7.620E-03	0.5431	0.000E+00	0.0000	0.000E+00	0.0000	1.454E-06	0.0001	4.759E-08	0.0000	1.240E-07	0.0000	7.622E-03	0.5432
U-235	1.005E-03	0.0717	0.000E+00	0.0000	0.000E+00	0.0000	1.917E-07	0.0000	1.612E-08	0.0000	4.984E-09	0.0000	1.006E-03	0.0717
U-238	5.402E-03	0.3850	0.000E+00	0.0000	0.000E+00	0.0000	1.030E-06	0.0001	2.441E-08	0.0000	9.407E-08	0.0000	5.403E-03	0.3851
Total	1.403E-02	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	2.675E-06	0.0002	8.813E-08	0.0000	2.231E-07	0.0000	1.403E-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 = 5.000E+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.
Am-241	3.889E-18	0.0000	0.000E+00	0.0000	0.000E+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
Pu-239	8.049E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	8.534E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.720E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	2.899E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.537E-09	0.0000	0.000E+00	0.0000	0.000E+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 = 5.000E+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.
Am-241	2.993E-07	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	5.730E-11	0.0000	3.972E-12	0.0000	4.448E-14	0.0000	2.994E-07	0.0001
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
Pu-239	8.390E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.599E-12	0.0000	1.125E-13	0.0000	3.912E-14	0.0000	8.392E-09	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	3.098E-03	0.9974	0.000E+00	0.0000	0.000E+00	0.0000	5.926E-07	0.0002	3.466E-08	0.0000	4.016E-08	0.0000	3.099E-03	0.9976
U-235	2.954E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.631E-20	0.0000	5.491E-21	0.0000	4.759E-22	0.0000	2.954E-16	0.0000
U-238	7.139E-06	0.0023	0.000E+00	0.0000	0.000E+00	0.0000	1.366E-09	0.0000	7.988E-11	0.0000	9.270E-11	0.0000	7.140E-06	0.0023
Total	3.105E-03	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	5.940E-07	0.0002	3.474E-08	0.0000	4.026E-08	0.0000	3.106E-03	1.0000

*Sum of all water independent and dependent pathways.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Am-241	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.620E-02	7.059E-09	0.000E+00
Am-241	Np-237	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.223E-07	8.001E-07	4.276E-07
Am-241	U-233	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.757E-10	6.808E-10	8.546E-11
Am-241	Th-229	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.051E-14	4.610E-13	2.478E-12
Am-241	äDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.620E-02	8.079E-07	4.277E-07
0Co-60	Co-60	1.000E+00	1.129E-33	1.002E-33	7.900E-34	3.436E-34	3.185E-35	2.953E-36	7.723E-39	0.000E+00	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	1.526E-41	1.511E-41	1.482E-41	1.387E-41	1.146E-41	9.363E-42	5.856E-42	8.674E-43	1.401E-45	0.000E+00
0Pu-239	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.047E-15
Pu-239	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.289E-09	2.075E-09
Pu-239	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.127E-09	1.533E-09
Pu-239	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.887E-11	3.290E-09	4.784E-09
Pu-239	äDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.887E-11	6.706E-09	8.392E-09
0Sr-90	Sr-90	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.552E-04	4.463E-11	6.571E-36	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.823E-04	2.107E-17
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.525E-08	3.461E-08
U-234	Ra-226	1.000E+00	5.605E-45	3.503E-44	1.878E-43	1.789E-42	1.804E-41	5.917E-41	3.692E-40	2.219E-38	2.089E-05	3.242E-05
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.784E-05	1.225E-04
U-234	äDSR(j)		5.605E-45	3.503E-44	1.878E-43	1.789E-42	1.804E-41	5.917E-41	3.692E-40	2.219E-38	3.811E-04	1.549E-04
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.671E-04	2.017E-17
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.221E-04	8.039E-17
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.302E-04	5.164E-04	1.949E-16
U-235	äDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.302E-04	1.006E-03	2.954E-16
0U-238	U-238	1.000E+00	1.242E-41	1.251E-41	1.267E-41	1.330E-41	1.528E-41	1.753E-41	2.475E-41	9.823E-41	2.691E-04	2.032E-17
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.019E-07	3.009E-19
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.186E-11	1.089E-10
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.803E-45	3.223E-44	4.703E-42	4.441E-08	7.508E-08
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.659E-07	2.818E-07
U-238	äDSR(j)		1.242E-41	1.251E-41	1.267E-41	1.330E-41	1.528E-41	1.753E-41	2.478E-41	1.029E-40	2.701E-04	3.570E-07

*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.

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Am-241	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	*3.430E+12	5.725E+02	1.857E+07	3.507E+07
Co-60	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15
Cs-137	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13
Pu-239	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	*6.212E+10	2.237E+09	1.787E+09
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	2.702E+04	3.361E+11	*1.365E+14	*1.365E+14
U-234	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	3.936E+04	9.682E+04
U-235	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	2.380E+04	1.492E+04	*2.160E+06
U-238	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	5.553E+04	*3.360E+05

*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 = 437.7 ñ 0.9 years

0Nuclide

(i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Am-241	7.000E-01	165.1 ñ 0.3	4.830E-01	3.106E+01	1.336E-03	1.122E+04
Co-60	1.000E-01	0.000E+00	0.000E+00	*1.131E+15	0.000E+00	*1.131E+15
Cs-137	2.000E+01	2354 ñ 5	1.672E-27	*8.701E+13	0.000E+00	*8.701E+13
Pu-239	1.000E+00	5.000E+03	8.392E-09	1.787E+09	8.559E-10	1.753E+10
Sr-90	2.000E+00	56.9 ñ 0.1	1.872E-02	8.015E+02	5.803E-16	*1.365E+14
U-234	2.000E+01	437.8 ñ 0.9	1.975E-02	7.594E+02	1.977E-02	7.588E+02
U-235	1.000E+00	437.8 ñ 0.9	4.127E-02	3.634E+02	4.128E-02	3.634E+02
U-238	2.000E+01	437.8 ñ 0.9	1.882E-02	7.969E+02	1.884E-02	7.963E+02

*At specific activity limit

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	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Am-241	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.834E-02	4.941E-09	0.000E+00
0Np-237	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.056E-07	5.601E-07	2.993E-07
0U-233	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.230E-10	4.766E-10	5.982E-11
0Th-229	Am-241	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.358E-15	3.227E-13	1.734E-12
0Co-60	Co-60	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Pu-239	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.047E-15
0U-235	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.289E-09	2.075E-09
U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.671E-04	2.017E-17
U-235	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	2.671E-04	2.075E-09
0Pa-231	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.127E-09	1.533E-09
Pa-231	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.221E-04	8.039E-17
Pa-231	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	2.221E-04	1.533E-09
0Ac-227	Pu-239	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.887E-11	3.290E-09	4.784E-09
Ac-227	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.302E-04	5.164E-04	1.949E-16
Ac-227	äDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.302E-04	5.164E-04	4.784E-09
0Sr-90	Sr-90	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.110E-03	8.925E-11	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.647E-03	4.215E-16
U-234	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.604E-05	6.018E-18
U-234	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	5.663E-03	4.275E-16
0Th-230	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.050E-07	6.921E-07
Th-230	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.437E-09	2.178E-09
Th-230	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	7.065E-07	6.943E-07
0Ra-226	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.177E-04	6.484E-04
Ra-226	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.883E-07	1.502E-06
Ra-226	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	4.186E-04	6.499E-04
0Pb-210	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.557E-03	2.450E-03
Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.317E-06	5.637E-06
Pb-210	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	1.560E-03	2.455E-03
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.383E-03	4.064E-16

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

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03	5.000E+03
Am-241	Am-241	1.000E+00	7.000E-01	6.845E-01	6.545E-01	5.594E-01	3.573E-01	2.282E-01	7.439E-02	8.402E-04	1.287E-10	0.000E+00
0Np-237	Am-241	1.000E+00	0.000E+00	2.240E-07	6.562E-07	2.014E-06	4.820E-06	6.498E-06	8.109E-06	6.679E-06	2.141E-06	3.178E-09
0U-233	Am-241	1.000E+00	0.000E+00	4.904E-13	4.320E-12	4.454E-11	3.254E-10	7.388E-10	1.839E-09	3.496E-09	1.387E-09	2.063E-12
0Th-229	Am-241	1.000E+00	0.000E+00	1.548E-17	4.112E-16	1.440E-14	3.324E-13	1.324E-12	7.438E-12	6.363E-11	2.146E-10	2.001E-10
0Co-60	Co-60	1.000E+00	1.000E-01	8.764E-02	6.732E-02	2.673E-02	1.911E-03	1.366E-04	1.865E-07	6.489E-19	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00	2.000E+01	1.950E+01	1.854E+01	1.553E+01	9.360E+00	5.642E+00	1.592E+00	1.008E-02	2.037E-10	0.000E+00
0Pu-239	Pu-239	1.000E+00	1.000E+00	9.998E-01	9.993E-01	9.976E-01	9.929E-01	9.881E-01	9.764E-01	9.310E-01	7.879E-01	3.036E-01
0U-235	Pu-239	1.000E+00	0.000E+00	9.806E-10	2.917E-09	9.437E-09	2.603E-08	3.999E-08	6.584E-08	1.030E-07	9.550E-08	3.681E-08
U-235	U-235	1.000E+00	1.000E+00	9.917E-01	9.752E-01	9.198E-01	7.781E-01	6.583E-01	4.334E-01	8.140E-02	2.337E-04	6.975E-19
U-235	äS(j):		1.000E+00	9.917E-01	9.752E-01	9.198E-01	7.781E-01	6.583E-01	4.334E-01	8.140E-02	2.338E-04	3.681E-08
0Pa-231	Pu-239	1.000E+00	0.000E+00	1.036E-14	9.219E-14	9.847E-13	7.926E-12	1.972E-11	6.029E-11	2.053E-10	2.475E-10	9.562E-11
Pa-231	U-235	1.000E+00	0.000E+00	2.098E-05	6.190E-05	1.946E-04	4.938E-04	6.961E-04	9.160E-04	5.150E-04	4.893E-06	7.002E-20
Pa-231	äS(j):		0.000E+00	2.098E-05	6.190E-05	1.946E-04	4.938E-04	6.961E-04	9.160E-04	5.150E-04	4.894E-06	9.562E-11
0Ac-227	Pu-239	1.000E+00	0.000E+00	1.087E-16	2.834E-15	9.329E-14	1.835E-12	6.357E-12	2.701E-11	1.183E-10	1.503E-10	5.808E-11
Ac-227	U-235	1.000E+00	0.000E+00	3.291E-07	2.829E-06	2.687E-05	1.586E-04	2.991E-04	5.116E-04	3.424E-04	3.439E-06	5.012E-20
Ac-227	äS(j):		0.000E+00	3.291E-07	2.829E-06	2.687E-05	1.586E-04	2.991E-04	5.116E-04	3.424E-04	3.439E-06	5.808E-11
0Sr-90	Sr-90	1.000E+00	2.000E+00	1.842E+00	1.562E+00	8.766E-01	1.684E-01	3.235E-02	5.232E-04	3.580E-11	2.999E-36	0.000E+00
0U-234	U-234	1.000E+00	2.000E+01	1.983E+01	1.950E+01	1.840E+01	1.556E+01	1.316E+01	8.665E+00	1.627E+00	4.661E-03	1.375E-17
U-234	U-238	1.000E+00	0.000E+00	5.623E-05	1.659E-04	5.215E-04	1.324E-03	1.866E-03	2.457E-03	1.384E-03	1.323E-05	1.963E-19
U-234	äS(j):		2.000E+01	1.983E+01	1.950E+01	1.840E+01	1.556E+01	1.317E+01	8.668E+00	1.628E+00	4.675E-03	1.395E-17
0Th-230	U-234	1.000E+00	0.000E+00	1.793E-04	5.334E-04	1.727E-03	4.776E-03	7.354E-03	1.219E-02	1.971E-02	2.122E-02	1.991E-02
Th-230	U-238	1.000E+00	0.000E+00	2.538E-10	2.259E-09	2.414E-08	1.946E-07	4.850E-07	1.490E-06	5.202E-06	7.194E-06	6.763E-06
Th-230	äS(j):		0.000E+00	1.793E-04	5.334E-04	1.727E-03	4.776E-03	7.354E-03	1.219E-02	1.971E-02	2.123E-02	1.992E-02
0Ra-226	U-234	1.000E+00	0.000E+00	3.881E-08	3.458E-07	3.713E-06	3.032E-05	7.650E-05	2.421E-04	9.306E-04	1.429E-03	1.349E-03
Ra-226	U-238	1.000E+00	0.000E+00	3.664E-14	9.779E-13	3.478E-11	8.373E-10	3.459E-09	2.091E-08	1.970E-07	4.787E-07	4.582E-07
Ra-226	äS(j):		0.000E+00	3.881E-08	3.458E-07	3.713E-06	3.032E-05	7.650E-05	2.421E-04	9.308E-04	1.429E-03	1.349E-03
0Pb-210	U-234	1.000E+00	0.000E+00	3.990E-10	1.051E-08	3.572E-07	7.613E-06	2.818E-05	1.352E-04	7.486E-04	1.258E-03	1.189E-03
Pb-210	U-238	1.000E+00	0.000E+00	2.830E-16	2.240E-14	2.551E-12	1.651E-10	1.027E-09	9.911E-09	1.487E-07	4.204E-07	4.040E-07
Pb-210	äS(j):		0.000E+00	3.990E-10	1.051E-08	3.572E-07	7.613E-06	2.818E-05	1.352E-04	7.488E-04	1.258E-03	1.190E-03
0U-238	U-238	1.000E+00	2.000E+01	1.983E+01	1.950E+01	1.840E+01	1.556E+01	1.317E+01	8.668E+00	1.628E+00	4.675E-03	1.395E-17

BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 90.95 seconds

ATTACHMENT 6

BNL Radiological Controls Division

Post Excavation Walkover Surveys

Bldg. 650 Sump Outfall

October 18, 2002

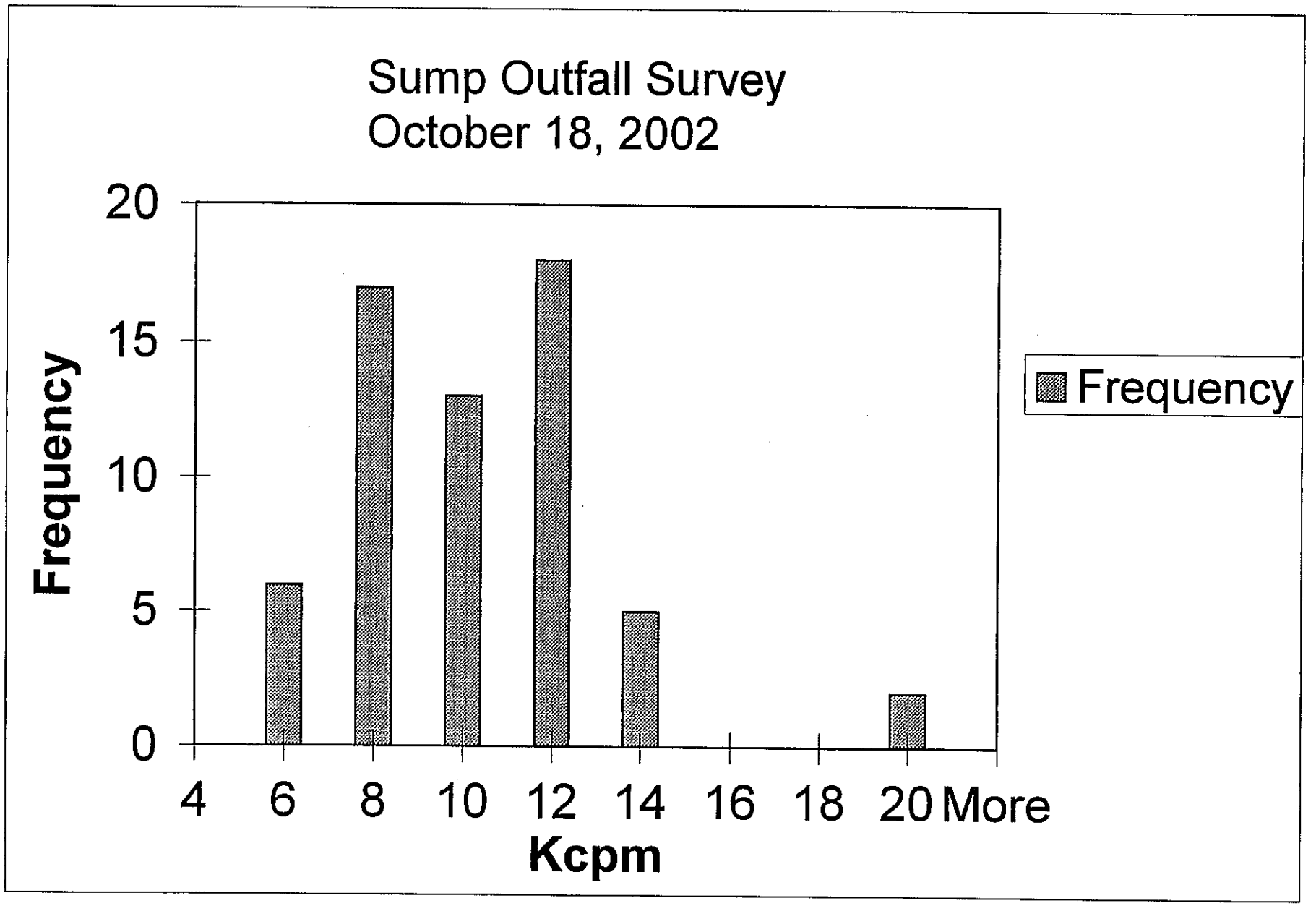
and

July 31, 2002

Bldg. 650 Sump Outfall
Radiologial Survey 10/18/02
Performed by BNL Radiological Controls Division

Summary Statistics in Kcpm

Parameter	*Value*
Mean	9.4
Standard Error	0.4
Median	9.2
Mode	11.9
Standard Deviation	2.9
Sample Variance	8.4
Kurtosis	1.8
Skewness	1.0
Range	14.0
Minimum	4.9
Maximum	18.9
Sum	581.3
Count	62


Sump Outfall Survey
October 18, 2002
Frequency
20
15
10
5
0
4
6
8
10
12
14
16
18
20
More
Kcpm
Frequency

Bldg. 650 Sump Outfall
Radiologial Survey 10/18/02
Performed by BNL Radiological Controls Division

Reading #	Location	Kcpm
1	1-1	5.80
2	1-1	7.10
3	1-2	5.96
4	1-2	6.90
5	2-1	5.90
6	2-2	5.60
7	2-3	7.10
8	2-4	6.96
9	3-1	10.60
10	3-2	6.90
11	3-3	11.20
12	3-4	9.60
13	3-5	6.83
14	3-6	7.40
15	4-1	7.50
16	4-2	8.30
17	4-3	10.60
18	4-4	11.90
19	4-5	9.80
20	4-6	11.60
21	4-7	10.40
22	5-1	11.60
23	5-2	12.30
24	5-3	9.60
25	5-4	7.96
26	5-5	18.80
27	5-6	8.70
28	5-7	11.20
29	6-1	9.10
30	6-2	10.70
31	6-3	10.10

Reading #	Location	Kcpm
32	6-4	9.30
33	6-5	8.60
34	6-7	10.80
35	6-8	11.90
36	7-1	11.90
37	7-2	8.10
38	7-3	11.90
39	7-4	7.60
40	7-5	12.10
41	7-6	8.30
42	7-7	7.60
43	8-1	9.96
44	8-2	11.90
45	8-3	4.90
46	8-4	6.20
47	8-5	10.24
48	9-1	11.90
49	9-2	13.90
50	9-3	11.90
51	9-4	13.50
52	9-5	4.90
53	9-6	6.10
54	9-7	18.90
55	10-1	12.30
56	11-1	6.24
57	11-2	7.31
58	11-3	8.90
59	11-4	9.30
60	11-5	6.00
61	11-6	8.00
62	12-1	6.80

BNL RADIOLOGICAL SURVEY FORM

BLDG.#: 650 LOCATION: Sump Outfall DATE/TIME: 10-18-02 0930 to 1430

☐ ROUTINE
☑ SPECIAL walk over
☐ RWP #
☐ WP#

2x2 Probe

MODEL	E-600	N/A	N/A	N/A	N/A	N/A
SERIAL#	07390					
Cal Due Date	3/7/03					
Source Check OK (Yes or No)	yes					

DOSE RATES (HIGHEST)		AIRBORNE CONTAMINATION		
CONTACT	N/A	TIME	uCi/cc	%DAC
GENERAL AREA		N/A		

LEGEND: O SMEAR SURVEY LOCATION ☐ MASSLINN SURVEY LOCATION

XXX Y / ZZZ — XXX = CONTACT READING, ZZZ = READING @ 30 Cm, Y = RADIATION TYPE — Δ AIR SAMPLE LOCATION

SMEAR SURVEY RESULTS (DPM/100 cm²) ³H B–γ α

☐ All Dose Rates are in mR/Hr and taken at waist level unless otherwise noted.
☐ All masslinn wipes are <1,000 dpm/LAS
☐ Frisked various areas – all were less than 100ccpm
☐ See Attachment for smear survey results

1.		8.		15.		22.	
2.		9.		16.		23.	
3.	N/A	10.	N/A	17.	N/A	24.	N/A
4.		11.		18.		25.	
5.		12.		19.		26.	
6.		13.		20.		27.	
7.		14.		21.		28.	

MASSLINN SURVEY RESULTS (DPM/LAS)

1.		8.	
2.		9.	
3.	N/A	10.	
4.		11.	
5.		12.	
6.		13.	
7.		14.	

This is a cover page for the walk over survey done on 10-18-02 per Chuck Schaeffer. The area was dry or nearly dry before, but is now covered in mud + puddles in wells. Any area where mud was concentrated was not entered due to safety concerns. Photo's attatched have survey results written in kcpm. All results are in kcpm. The only area not identified previously, is inbetween rock pile, marked + noted. Bkgd is 5.9kcpm

Counts are gross

SURVEYED BY: Deborah S. Dondy 10-21-02 / Pamela Bartlett 10-21-02 Signature/date

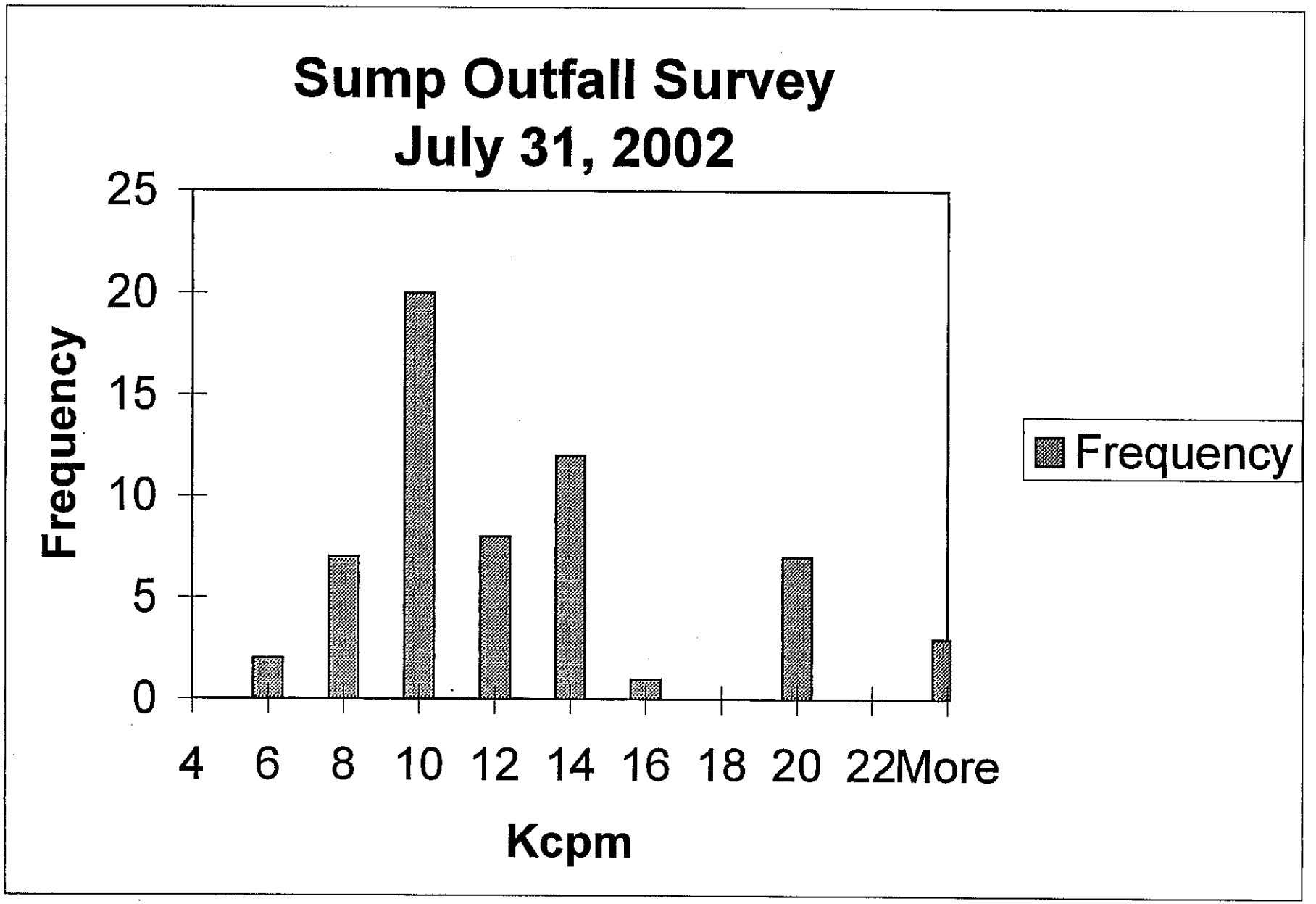
REVIEWED BY: Cheryl Burns 10/23/02 Signature/date

Form FS-1000.1 FS-SOP-1000, rev 3, attch. 8.2, File Code: HP3120

Bldg. 650 Sump Outfall
Radiologial Survey 7/31/02
Performed by BNL Radiological Controls Division

Summary Statistics in Kcpm

Parameter	*Value*
Mean	12.4
Standard Error	0.9
Median	11.0
Mode	12.1
Standard Deviation	7.0
Sample Variance	48.6
Kurtosis	17.0
Skewness	3.5
Range	47.1
Minimum	4.9
Maximum	52
Sum	766.5
Count	62


Sump Outfall Survey
July 31, 2002
Frequency
25
20
15
10
5
0
4
6
8
10
12
14
16
18
20
22More
Kcpm
Frequency

Bldg. 650 Sump Outfall
Radiologial Survey 7/31/02
Performed by BNL Radiological Controls Division

Reading #	Location	Kcpm
1	Sump Outfall	11.3
2	by trench	12.1
3		11.1
4		12.5
5		7.9
6		8.3
7		8.6
8		9.3
9		7.4
10		8.9
11		7.7
12		9.6
13	South Outfall	19.4
14		19.2
15		18.6
16		19.3
17	South Edge	26.7
18	South Edge	30.1
19		19.6
20		20.0
21		13.7
22		12.6
23		12.9
24	SW Outfall	9.2
25		12.1
26		18.1
27	Under Rock	52.0
28		9.2
29		12.1
30		4.9
31		7.2

Reading #	Location	Kcpm
32	Center Outfall	8.5
33		9.8
34		11.3
35		12.1
36	Asphalt	7.1
37		8.3
38	Woods	4.9
39		7.2
40	East Outfall	11.0
41		8.9
42		13.8
43		15.5
44		13.5
45		12.9
46		12.8
47		9.2
48	SE Outfall	8.8
49		8.3
50		9.2
51		8.1
52	NE Outfall	10.6
53		9.6
54		11.7
55		12.0
56	North Gate	6.9
57		9.0
58		9.8
59		10.9
60		9.6
61	Soil/wood Pile	11.3
62		12.3

Radiological Control Division

Upton, NY 11973-5000
Phone 631 344-4601
Fax 631 344-7776
burns@bnl.gov

Managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

Building 51
P.O. Box 5000

Date: *September 9, 2002*

To: *J. Brower*

From: *C. Burns*

Subject: ***Results of Facility Support 650 Project Walkover Survey to Depost***

The memo dated August 14, 2002 had incorrect GPS coordinates, below you will find the correct coordinates/elevations.
A walkover survey was performed using a 2"x2" NaI detector connected to an Eberline E600 ratemeter in the area excavated during the Bldg 650 Sump and Outfall remediation. Three elevated areas were detected. These areas had not been discovered during the Final Status Survey nor during independent verification surveys.

EMD will need to determine if any follow up action is required.

The area locations and corresponding GPS coordinates are tabulated below:

Location	GPS Coordinates	Contamination Level (cpm)
Bldg 650 pad South trench wall at 1-1.5 ft from the asphalt surface	GPS 40° 52' 10N, 072° 52' 20W	60,000
Sump Outfall Elevation 86 ft.	GPS 40° 52' 10N, 072° 52' 06W	30,000
Sump Outfall Elevation 81ft.	GPS 40° 52' 10N, 072° 52' 07W	50,000

The elevated area grid locations that EMD identified should be on your posting chart and in the field logbook as per EM-OPM 4.18.

Feel free to call if you have any further questions.

Respectfully
Cheryl Burns

BNL RADIOLOGICAL SURVEY FORM

☐ ROUTINE
☑ SPECIAL Walkover survey
☐ RWP #
☐ WP#

BLDG.#: 650 LOCATION: Sump Outfall DATE/TIME: 7-31-02

2x2 Probe

MODEL	E-600					
SERIAL#	00739					
Cal Due Date	3-7-03					
Source Check OK (Yes or No)	yes					

DOSE RATES (HIGHEST)		AIRBORNE CONTAMINATION		
		TIME	uCi/cc	%DAC
CONTACT	N		N	
GENERAL AREA	A			A

LEGEND: O SMEAR SURVEY LOCATION ☐ MASSLINN SURVEY LOCATION

XXX Y
ZZZ

XXX = CONTACT READING
ZZZ = READING @ 30 Cm
Y = RADIATION TYPE

Δ AIR SAMPLE LOCATION

☐ All Dose Rates are in mR/Hr and taken at waist level unless otherwise noted.
☐ All masslinn wipes are <1,000 dpm/LAS
☐ Frisked various areas – all were less than 100cpm
☐ See Attachment for smear survey results

SMEAR SURVEY RESULTS (DPM/100 cm²)

	³H	β-γ	α		³H	β-γ	α		³H	β-γ	α		³H	β-γ	α
1.				8.				15.				22.			
2.				9.				16.				23.			
3.	N			10.				17.	N			24.			
4.				11.				18.				25.			
5.				12.				19.				26.			
6.				13.	A			20.				27.	A		
7.				14.				21.				28.			

MASSLINN SURVEY RESULTS (DPM/LAS)

1.				8.			
2.	N			9.			
3.				10.			
4.				11.			
5.				12.			
6.				13.	A		
7.				14.			

Third Survey of the 650 Sump Outfall Area

This Survey was Taken ~~the~~ on 4 days after RAIN

Temperature 90°

Last survey

Results Do VARY

Photo's Following Contain Readings

SURVEYED BY: Deborah S Dandy 8/1/02 Signature/date REVIEWED BY: Cheryl Burns 8/12/02 Signature/date

ATTACHMENT 7

Response to Comments on the Draft Closeout Report

July 29, 2002

EMD Responses to DEC Comments on the Draft Building 650 AOC 6 Reclamation Facility Sump and Sump Outfall Closeout Report September 16, 2002

Comment 1A: Section 2.6.2 on page 13 notes that Figures 4A through 4D depict final walkover survey results, and that Figures 3A through 3D show interim survey results leading to re-excavations of contaminated soils. BNL does not provide the dates these figures represent. Please provide on these figures, or in a table contained in the text, the dates when each survey map was developed.

Response: The following table will be included in section 2.6.2:

Summary of Building 650 Radiological Surveys

Figure Number	Description	Survey Date(s)
2A	Radiological Survey Prior to Excavation at the Building 650 Pad	03/28/02
2B	Radiological Survey Prior to Excavation at the Pipeline	04/05/02, 04/08/02
2C	Radiological Survey Prior to Excavation at the Sump Outfall	04/15/02
3A	Interim Radiological Survey at the Building 650 Pad (after first excavation)	05/29/02
3B	Interim Radiological Survey at the Building 650 Sump Outfall (after first excavation)	05/15/02
3C	Interim Radiological Survey at the Building 650 Sump Outfall (after second excavation)	05/21/02
3D	Interim Radiological Survey at the Building 650 Sump Outfall (after third excavation)	05/23/02
4A	FSS for the Building 650 Pad Class 1 Areas	06/12/02
4B	FSS for the Pipeline Class 1 and Class 2 Areas	06/11/02, 06/12/02
4C	FSS for the Sump Outfall Class 2 Areas	06/13/03
4D	FSS for the Sump Outfall Class 1 Areas	06/10/02, 06/19/02, 06/27/02

Comment 1B: This is going to be helpful to understand the results of the samples taken during the DEC's verification efforts on June 12 and June 27. The radiological conditions apparent to DEC staff on those dates correspond to those documented in Figures 3A through 3D, and not that shown in Figures 4A through 4D. Similar to what occurred in AOC 16 in the year 2000, BNL requested verification of AOC 6 prior to the projects final status survey being complete and defensible. Thus our

efforts helped to direct further remediation, instead of verifying the final radiological status of this project.

Response: Noted. This is included as a lesson learned in section 5.0.

"All remediation should be totally completed and survey/analytical data evaluated before scheduling the independent verification contractor and regulators to perform the final status verification sampling."

Comment 2: During the DEC investigation on June 27, 2002, BNL staff pointed out two areas containing residual contamination that BNL intends to leave in place. One area is below an active concrete electrical conduit, where any further excavation would undermine the conduit and possibly lead to a loss of electrical service. The other area is at the discharge pipe outfall itself, where minor contamination extended to depths inaccessible to BNL's existing excavation capability. These areas are not described in detail within this report, nor is it clear if Table 13 on page 34 includes the contribution from these areas in the calculation of the area average concentrations used in the RESRAD dose model. BNL should clarify if this remaining contamination is included in Table 13, and should describe both of these areas with respect to surface area, approximate volume, and estimated source term in this report.

Response: The two areas containing residual contamination that BNL intends to leave in please are currently not reflected in Table 13.

Both of these areas will be described in detail and a summary of the analytical radiological results will be included in section 2.6.2. In addition, a sum of fractions analysis and RESRAD analysis will be conducted for each of the two areas and included in section 4.3 of the Final Closeout Report. The two areas will be included in the calculation of total dose and excess risk from the contaminated materials provided in Table 14 and will be included in Table 13.

Comment 3: The lessons learned (Section 5) listed on pages 36 to 37 are very brief, and offer no specific plans for action or correction. For example, the first lesson learned notes that, "all remediation should be totally completed and survey/analytical data evaluated before scheduling the independent verification contractor and regulators to perform the final status verification sampling." It does not, however, indicate how this proposed outcome will be guaranteed. Please note that in our December 1, 2000 memorandum concerning AOC 16's final status survey and verification, we recommended that the draft Completion Report be issued prior to inviting an IVC or regulatory for verification. This did not occur during the final verification of AOC 6 or AOC 16, and the verification process followed similar paths for both of these projects.

Please include within this section the actions to be taken to ensure these lessons result in an improvement in the project's management, efficiency, savings, or performance.

Response: For each lesson learned, the corrective action to be taken will be included in section 5.0 as shown below:

1. All remediation should be totally completed and survey/analytical data evaluated before scheduling the independent verification contractor and regulators to perform the final status verification sampling.
   ***Corrective Action*:** BNL shall forward the results of the final status survey sampling verifying that remediation has been completed to the independent verification contractors for review prior to scheduling the independent verification contractors.

2. The planning phase of this project should be evaluated to take a look at the compression of the schedule toward the end of the project that resulted in more overtime than originally estimated.
   Corrective Action: Weekly meetings will be held during the planning phases of future projects to assess potential schedule and cost overruns.

3. Adequate characterization of vegetation and trees should be conducted prior to excavation to minimize waste volume and cost.
   Corrective Action: A Vegetation Sampling and Analysis Plan will be prepared and approved prior to any work activities for future projects.

4. Manpower estimates need to be better correlated with work needs throughout the duration of the project.
   Corrective Action: Weekly meetings will be held to assess manpower and work needs throughout the duration of the project.

5. Deep contamination was found associated with monitoring and water level wells in the Building 650 Sump Outfall. Rain events since the installation of the monitoring wells may have led to the mobilization of radionuclides that preferentially drained down the outsides of these wells. This appears to have contributed to the significant sub-surface contamination observed.
   Corrective Action: Soils in the vicinity of installed monitoring wells in contaminated areas shall be sampled using the geoprobe to identify pockets of deep contamination.

6. Small isolated pockets of contamination covered by clean overburden soils were clearly detectable using survey instruments, which resulted in additional excavation. Additional geoprobes at the Sump Outfall to determine depth of contamination would have been useful. Using gamma walkover surveys and surface soil samples alone proved to be problematic since clean overburden soils were shown to mask underlying pockets of contaminated soils. Soil samples collected as part of the Final Status Survey indicated that cleanup goals for this project had been met.
   Corrective Action: An adequate number of geoprobe/vertical profile borings shall be installed to identify isolated pockets of deep contamination covered by clean overburden soils. In addition, inconsistencies between surface survey meter readings and soil sample results must be resolved prior to declaring a remediation to be complete.

7. New installation of electrical duct banks and other utilities over older contaminated utilities require the installation of adequate reinforcing steel to allow for the duct bank and/or utility to free stand during the removal of contaminated materials.
   Corrective Action: Utilities above older contaminated utilities shall be appropriately supported to allow the utilities to free stand during excavation.

8. During excavation of the pipeline, it was discovered that an installation of a transecting steam system was installed directly below a section of the pipeline to be removed. The soil disturbance as a result of this installation caused failure of the section of reinforced concrete pipe and subsequent contamination of the steam system exterior as well as soil contamination locally to a greater depth at the area than was encountered along the pipe trench. This condition was caused by inadequate compaction of the bearing soils surrounding the steam line.
   Corrective Action: Excavation should proceed carefully in areas of recent utility installations and if necessary, proper support should be provided to utilities above the areas of soil disturbance.

9. Preferential pooling of soils occurred following heavy rain. These soils collected in localized low areas resulting in elevated surface activity concentrations at those locations.
   Corrective Action: Storm water run-off controls shall be placed around excavated areas to avoid preferential pooling of soils.

Comment 4: The fifth lesson learned on page 37 notes that, "installed and abandoned wells must be evaluated prior to excavation to account for isolated pockets of deep contamination." This was one of the most important lessons learned from this project, and should be further detailed in this report. We recommend inclusion of the following points, which details additional lessons learned from this project:

After BNL's excavation of the historical surface contamination, post-excavation surface soil samples indicated that cleanup goals had been met. However, additional contamination was clearly detectable using survey instruments, which required remediation beneath this clean soil horizon. Rain events since the installation of the monitoring wells mentioned on page 37 mobilized radionuclides which preferentially drained down the outsides of these wells, which led to the significant sub-surface contamination observed. The substantial surface contamination encountered in AOC 6 should have been excavated upon its discovery in 1969, and not allowed to be exposed to and mobilized by weather for over 30 years. Also, obvious inconsistencies between survey meter readings and soil sample results must be resolved prior to declaring a remediation to be complete.

Response: The following text will be included in section 5.0 (Lessons Learned):

"Soil samples collected as part of the Final Status Survey indicated that cleanup goals for this project had been met. However, small isolated pockets of contamination

covered by clean overburden soils were clearly detectable using survey instruments, which resulted in additional excavation. Rain events since the installation of the monitoring wells at the Building 650 Sump Outfall led to the mobilization of radionuclides that preferentially drained down the outsides of these wells, which contributed to the significant sub-surface contamination observed.

In addition, inconsistencies between surface survey meter readings and soil sample results must be resolved prior to declaring a remediation to be complete."

Comment 5: The report of the Department's verification efforts for the remediation of AOC 6 is under internal review and will be provided to BNL once this review is complete.

Response: The report was received on September 11, 2002.

Response to findings by ORISE (ESSAP) September,18, 2002 Verification Survey of Area of Concern 6, Building 650 Reclamation Facility Sump and Sump Outfall.

Finding: Sample location 35 exceeded the U-238 criteria and ESSAP recommends additional investigation.

Response: ORISE found this sample location to contain 174 pCi/gm U-238. This location represents an area associated with a well that was excavated as deep as practical. Additional investigation and evaluation has been performed at this location. A biased sample of this location was taken by BNL and the U-238 alpha isotopic analyses performed. Lab analysis for gamma by STS Lab showed Cs-137 was about 16 pCi/gm compared to 23 pCi/gm in the ORISE sample. Pa-234m (a daughter of U-238) was 25 pCi/gm and Thorium 234 was 21 pCi/gm. Isotopic analysis fro U-238 showed 24.7 pCi/gm. Of the 19 Class 2 area samples taken by BNL, none exceeded 3.7 pCi/gm U-238. Of the 4 post cleanup biased sample analyses, the highest U-238 concentration was 2.6 pCi/gm. Of the 8 samples taken by NYSDEC, the highest U-238 concentration was 9.5 pCi/gm. A radiological survey of the location showed the elevated site to be very localized. An evaluation of BNL samples for Pa-234m taken prior to final cleanup indicate only low levels of potential U-238, even when other contaminants were elevated. The above data suggest that the isolated finding of 174 pCi/gm U-238 was an anomaly or a "hot spot" of naturally occurring U-238. A dose assessment and evaluation of this sample location is given in the final Closeout Report. No further excavation of this location is planned. The area will be filled to grade and covered with top soil.

Finding: The soil under the electrical conduit does not meet the guidelines for release of unrestricted use and, if left in place, should be addressed by a hazard assessment and supplemental criteria.

Response: Due to the stressing of the encased electrical conduit, there is a risk of compromising the 15.5KV service to lab facilities. The removal of the storm pipe and soil under the conduit would weaken the supporting soil base for the encasement. We plan to leave 5 sections (25ft.) of the pipe in place and fill the ends of the contaminated pipe with concrete. Accessible soil contamination was removed to the extent practical. After backfilling, the pipe and remaining contaminated soil with be 12-14 ft below grade. This capping of the pipe and backfilling with soil has been completed.

A hazard assessment and recommended institutional controls is included in the final Closeout Report.

Finding: The comparative analyses (of BNL and ORISE data) did not agree, although in most cases BNL reported a higher and therefore more conservative result.

Response: BNL samples PL 64 and PL 65 were analysed using Canberra ISOCS system for the gamma isotopes and the BetaScint system for Sr-90. It is not suprising that different analytical systems will give different results that are outside the range of the

error estimates. For example, Sr-90 analysis by BNL was a dry sample direct measurement compared to ORISE's wet chemical method. Additional analyses from BNL's contract laboratory STL were not available at the time of the ORISE's comparison. Current STL laboratory results show some differences with BNL and ORISE results and are given below. These data can be compared to Table 3 of the ORISE report. BNL does not view these differences which include the STL results as significant or unusual.

Location	Cs-137	Co-60	U-238	Am-241	Eu-152	Pu-239/240	Sr-90
24/PL 64	0.56 +/-0.12	--	0.34 +/-0.17	–	--	0.16 +/-0.1	1.13 +/-0.52
25/PL 65	32.0 +/- 3.7	–	2.6 +/-0.8	–	–	5.0 +/- 1.1	11.2 +/- 2.4

Responses to ORISE Comments on the Draft Closeout Report Area of Concern 6 Building 650 Reclamation Facility Sump and Sump Outfall
October 2, 2002

Comment 1: The Closeout Report does not clearly indicate when BNL conducted final survey activities such as, the walkover survey and sampling. The New York Department of Environmental Conservation (NYDEC) verification activities indicate that in late June, remediation efforts were not complete and in early July ESSAP's verification activities also identified activity above the cleanup goals established by the site. Furthermore, the report does not address the above cleanup goal contamination identified during verification, in the Outfall and underneath the electrical conduit, nor does it provide a statement as to what the current level of residual radioactivity level are in these identified areas. The reviewer suggests the report provide a statement as to how BNL has addressed these areas.

Comment 2: Section 2.6; 3rd sentence: This sentence makes the statement that through various activities, the cleanup goals for the site have been met. However, there are those areas that remain above the cleanup goals that have been confirmed by the NYDEC and ESSAP (See Comment No. 1).

Responses to Comments 1 and 2: The following tables and text will be included in Section 2.6.2 to indicate when BNL conducted survey activities and to address the areas above clean up goals:

Table 6: Summary of Building 650 Project Radiological Surveys

Figure Number	Description	Survey Date(s)
2A	Radiological Survey Prior to Excavation at the Building 650 Pad	03/28/02
2B	Radiological Survey Prior to Excavation at the Pipeline Sections 2 & 3	04/05/02, 04/08/02
2C	Radiological Surveys Prior to Excavation at the Sump Outfall	04/15/02
3A	Interim Radiological Survey at the Building 650 Pad	05/29/02
3B	Interim Radiological Survey (after 1st remediation) at the Sump Outfall	05/15/02
3C	Interim Radiological Survey (after 2nd remediation) at the Sump Outfall	05/21/02
3D	Interim Radiological Survey (after 3rd remediation) at the Sump Outfall	05/23/02
4A	Final Radiological Status Survey for the 650 Pad Class 1 Areas	06/12/02
4B	Final Radiological Status Survey for the 650 Pipeline Class 1 and Class 2 Areas	06/11/02, 06/12/02
4C	Final Radiological Status Survey for the Sump Outfall Class 2 Areas	06/13/03
4D	Final Radiological Status Survey for the Sump Outfall Class 1 Areas	06/10/02, 06/19/02, 06/27/02

e. Areas of Elevated Activity Identified Following Remediation

Following the initial excavation and remediation activities, ORISE (on June 11 and 12) and NYSERDA (on June 12) surveyed the site to evaluate the attainment of remediation goals. Through sampling and walkover surveys, both agencies identified areas in the outfall zone requiring further investigation and/or remediation. Upon review of the preliminary NYSDEC and ORISE findings, additional excavations, sampling and evaluations were performed by BNL.

After these subsequent remedial activities, NYSDEC (on June 27) and ORISE (on July 1) returned to BNL for additional surveys. BNL identified two locations where total excavation of the radioactive contaminant could not be accomplished. Each agency also identified positions in the remediation site found to contain localized areas of radioactivity elevated above the average exposure readings of the remediated site. The survey reports of both NYSERDA and ORISE are provided in Attachment 1 of this report, and these locations are described below. A radiological survey of the Sump Outfall was conducted by BNL's Radiological Controls Division in October. This survey was intended to verify the final status of the remediation and to identify any institutional control issues related to the area. The results of this survey are given in Attachment 5.

(1) Elevated areas identified by ORISE

On the initial survey, ORISE identified soil in excess of the cleanup goals remaining in the drainage pipe trench and several locations in the sump outfall. After the BNL remediation of these areas, and following the second survey, ORISE concluded that the BNL remediation activities:

> *...appeared to have reduced residual contamination levels so that the soils in the sump, drainage pipe trench, and the sump outfall meet established guidelines with the following exceptions: Sample location 35* [in the sump outfall area] *exceeded the U-238 criteria and ESSAP recommends additional investigation. Additionally, the soil underneath the electrical conduit does not meet the guidelines for release for unrestricted use and, if left in place, should be addressed by a hazard assessment....* [ORISE, *Letter Report, Area of Concern 6, BNL*, Sept 9, 2002 (see Attachment 1)]

The description and investigation of these two areas are provided below.

(a) Sample result exceeding the U-238 criteria

ORISE found this sample location to contain 174 pCi/gm U-238. This location represents an area adjacent to and associated with a monitoring well that was excavated as deep as practical. No further excavation of this location is planned. The pit will be filled to grade and covered with topsoil.

This area was sampled by BNL following the identification by ORISE. Results of the BNL and ORISE analyses are provided in Table 10.

Table 10. Area of Elevated U-238 activity

Organization	BNL		ORISE
Sample ID	AOC6-PL67		35
Radionuclide	Activity	MDC	Activity
Co-60 [a]	ND	0.2	0.14 ± 0.03
Cs-137 [a]	16 ± 0.2	0.2	23.4 ± 0.98
Eu-152 [a]	ND	0.2	0.48 ± 0.15
Eu-154 [a]	ND	0.2	NR
Eu-155 [a]	ND	0.2	NR
Ra-226 [a]	1.1 ± 0.57	2.5	NR
Am-241 [a]	ND	0.2	0.74 ± 0.18
U-234 [c]	23.3± 4.9	0.1	NR
U-235 [c]	1.1±0.4	0.2	NR
U-238 [c]	24.7±5.2	0.1	174 ± 11
Pu239/240 [c]	1.99± 0.5	0.08	---
Sr-90 [d]	2.6±0.8	0.9	---

Notes: a gamma spectroscopy analysis
c alpha spectroscopy
d wet chemistry separation
MDC minimum detectable concentration NR not reported
ND not detected at 95% confidence level --- analysis not performed
ORISE results from *Letter Report, Area of Concern 6, BNL, Sept 9, 2002* (see Attachment 2)

Of the 19 Class 1 area samples taken by BNL, only two samples exhibited U-238 greater than 1.0 pCi/g, and none exceeded 5.8 pCi/gm of U-238 (see Table 7). Of the 19 Class 2 area samples taken by BNL, only two samples exhibited U-238 greater than 0.65 pCi/g, with the highest observed concentration of 1.07 pCi/g U-238 (see Table 8). Of the other four post cleanup biased sample analyses performed by ORISE, the highest U-238 concentration was 2.7 pCi/gm. Of the eight samples taken by NYSDEC, the highest U-238 concentration observed was 9.5 pCi/gm. A review for Pa-234m (a decay progeny of U-238) in BNL samples taken prior to final cleanup indicates only low levels of potential U-238 even when other contaminants were elevated. The above data suggest that the isolated finding of 174 pCi/gm U-238 was an anomaly, not representative of activity in the outfall area. It is likely that sampling the spot removed the majority of the elevated activity, as is evidenced by the reduced concentration and survey meter counts observed in the results of the subsequent BNL sample. An earlier radiological survey showed 28.8 Kcpm and a recent survey following resampling of that location resulted in 18.8 Kcpm (see Attachment 4). A dose assessment of this sample location is provided in Section 4, below.

(b) Section of storm line pipe not removed

Approximately 25 feet of storm line (five, 5-ft sections of pipe) at a depth of 12-14 feet below grade were left in place. The pipe could not be excavated and removed without adversely impacting the

integrity of an overlying conduit containing an active high voltage supply line for the laboratory. Visual inspection of the pipe interior revealed there was not enough material volume inside the pipe to sample. Both BNL and ORISE obtained samples of soil adjacent to each end of the pipe for analysis, with the results indicated in Table 11. Positioning a survey meter with a NaI detector at locations along the pipe interior for static one-minute analyses revealed the count rates indicated in Table 12. Activity in the soil appeared to be associated with residues released from the pipe joint when separating the concrete sections.

Table 11. Soil Radioactivity (pCi/g) in soil adjacent to un-excavated pipe

Location	East end of pipe			West end of pipe		
Organization	BNL		ORISE	BNL		ORISE
Sample ID	AOC6-PL64		ESSAP 24	AOC6-PL65		ESSAP 25
Radionuclide	Activity	MDC	Activity	Activity	MDC	Activity
Co-60 [a]	0.7 ± 0.1	0.10	0.0 ± 0.02	1.0 ± 0.1	0.14	0.19 ± 0.05
Cs-137 [a]	0.5 ± 0.1	0.10	0.45 ± 0.05	37.9 ± 3.4	0.25	25.6 ± 1.10
Eu-152 [a]	ND	0.20	-0.01 ± 0.03	2.0 ± 0.2	0.29	1.38 ± 0.27
Eu-154 [a]	ND	0.14	NR	1.1 ± 0.1	0.21	NR
Eu-155 [a]	ND	0.16	NR	ND	0.28	NR
Ra-226 [a]	ND	0.16	NR	ND	0.35	NR
Am-241 [a]	ND	0.14	0.02 ± 0.02	0.5 ± 0.15	0.25	0.33 ± 0.06
Sr-90 [b]	0.4 ± 0.5	0.79	---	15.8 ± 0.7	0.79	---
U-234 [c]	0.39 ± 0.18	0.11	NR	2.7 ± 0.8	0.29	NR
U-238 [c]	0.34 ± 0.17	0.09	0.71 ± 0.41	2.6 ± 0.8	0.25	2.3 ± 1.0
Pu239/240 [c]	0.16 ± 0.10	0.08	0.22 ± 0.05	5.0 ± 1.1	0.06	4.1 ± 0.4
Sr-90 [d]	1.13 ± 0.52	0.72	1.29 ± 0.47	11.2 ± 2.4	0.8	3.63 ± 0.60

Notes: a gamma spectroscopy analysis
b BetaScint
MDC minimum detectable concentration
ND not detected at 95% confidence level
c alpha spectroscopy
d wet chemistry separation
NR not reported
--- analysis not performed
ORISE results from *Letter Report, Area of Concern 6, BNL, Sept 9, 2002* (see Attach 1)

Table 12. Counts in one minute at locations on interior of un-excavated pipe

Location	Background	Opening	1 foot	2 feet	3 feet
East end of pipe	5,578	26,160	19,127	16,252	18,082
West end of pipe	6,600	17,822	8,397	9,247	12,811

Accessible soil contamination was removed to the extent practical. The ends of the pipe were sealed with concrete. After backfilling with clean overburden, the pipe and remaining soil were 14 feet below grade. The risk associated with leaving this contaminated pipe in place is assessed in Section 4, below.

(2) Elevated areas identified by NYSDEC

On the initial survey, NYSDEC identified soil in excess of the cleanup goals remaining in the drainage pipe trench and at two locations in the sump outfall vicinity. On the return survey, following additional remediation efforts by BNL, NYSDEC evaluated the two previous locations and identified two additional areas above the cleanup goals. NYSDEC concluded:

> *...the areas exhibiting the high concentration shown in samples 061201, 061202, and 062701 were remediated following our investigations. The residual concentrations shown by sample 062702 was not further remediated....* [NYSDEC, *Radiation Survey Report,* BNL, report dated August 16, 2002 (see Attachment 1)]

NYSDEC also identified the location of contaminated soil under the active electrical service line that was described previously.

(a) Activity at depth not removed

In the outfall area several monitoring wells had been installed in order to detect any potential groundwater impact of the radionuclides that had been released at the site. During the remediation of the site, small pockets of elevated activity were found below the layer of soil meeting the cleanup goals. The area near NYSDEC sample location 062702 corresponded to an old monitoring well. Radioactivity observed in the sample analysis is provided in Table 13.

It was surmised that rain events since the installation of the monitoring wells led to the mobilization of radionuclides in the soil that preferentially drained down the outside of a well, contributing to the observed deep sub-surface contamination. The area adjacent to the well was excavated as deep as practical without adversely impacting well integrity and within the capabilities of the available equipment. The risk associated with leaving this contaminated soil in place is assessed in Section 4, below.

(b) Section of storm line pipe not removed

The description of the radioactivity and conditions of this area were previously addressed in the discussion of ORISE findings. The risk associated with leaving this contaminated pipe in place is assessed in Section 4 below.

Table 13. Soil Radioactivity (pCi/g) in soil at depth

Organization	BNL		NYSDEC	
Sample ID	AOC 6 - PL66		062702	
Radionuclide	Activity	MDC	Activity	MDC
Co-60 [a]	0.56 ± 0.06	0.11	ND	0.07
Cs-137 [a]	16.6 ± 2.3	0.09	20.3 ± 2.2	0.11
Eu-152 [a]	ND	0.23	NR	NR
Eu-154 [a]	ND	0.16	NR	NR
Eu-155 [a]	ND	0.17	NR	NR
Ra-226 [a]	ND	0.21	0.45 ± 0.16	0.21
Am-241 [a]	ND	0.16	NR	NR
Sr-90 [b]	1.2 ± 0.5	0.8	---	---
U-238 [a]	0.56 ± 0.26	0.13	ND	1.69
Pu-238 [b]	ND	0.03	ND	0.12
Pu239/240 [b]	ND	0.028	ND	0.09
Sr-90 [c]	1.14± 0.58	0.82	1.57 ± 0.02	0.66

Notes: a gamma spectroscopy analysis b BetaScint
c alpha spectroscopy c wet chemistry separation
MDC minimum detectable concentration NR not reported
ND not detected at 95% confidence level --- Analysis not performed
NYSDEC results from *Radiation Survey Report, BNL, Aug 16, 2002* (see Attachment 1)

Comment 3: Were any of the soil samples reported in Tables 6 and 7 collected after NYDEC and ESSAP verification activities? This would assist the reader with validation that additional actions were performed by BNL to address the issue of residual activity above the cleanup goals.

Response to Comment 3:

There were samples collected and are now reported in Tables 10, 11 and 13 subsequent to NYSDEC and ESSAP verification activities. The following text will be included in Section 2.6.2 for clarification:

Upon review of the preliminary NYSDEC and ORISE findings, additional excavations, sampling and evaluations were performed by BNL.

After these subsequent remedial activities, NYSDEC (on June 27) and ORISE (on July 1) returned to BNL for additional surveys. BNL identified two locations where total excavation of the radioactive contaminant could not be accomplished. Each agency also identified positions in the remediation site found to contain localized areas of radioactivity elevated above the average exposure readings of the remediated site. The survey reports of both NYSERDA and ORISE are provided in Attachment 1 of this report, and these locations are described below. A radiological survey of the Sump Outfall was conducted by BNL's Radiological Controls Division on July 31 and on October 18. These surveys were intended to verify the final status of the remediation and to identify any institutional control issues related to the area for deposting. The results of these surveys are given in Attachment 5.

Comment 4: Page 15; first bullet: The wording suggests that elevated Co-60 activity was identified in the samples collected; however, a review of the data indicates activity only slightly above the MDA? The reviewer suggests that including the range or maximum concentrations, in addition to the average activities, would be appropriate when discussing final status survey results.

Response to Comment 4: Text will be revised in Section 2.6.2 d. as follows:

"Thirteen samples indicated elevated levels of Co-60 ranging from 0.3 to 0.5 pCi/g with an average concentration of 0.42 ± 0.06 pCi/g."

Comment 5: Figure 4B: The figure does not indicate that samples were collected from the area of the electrical conduit nor is the activity in those samples provided in the report.

Response to Comment 5: The figure will be revised to indicate the locations of the samples collected from the area of the electrical conduit. The activities of these samples will be reflected in Table 11 (please see response to Comments 1 and 2).