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Statement of Basis Approval of No Further Action Volume 15 of 30 January 2000 ER Site 44 Operable Unit 1303 Round 9

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Sandia National Laboratories

**Statement of Basis
Approval of No Further Action
Volume 15 of 30**

January 2000

**ER Site 44
Operable Unit 1303
Round 9**

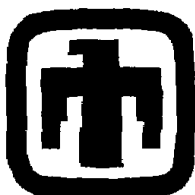
(RCRA Permit No. NM5890110518)

NFA Originally Submitted September 24, 1997
RSI Originally Submitted September 1999

**Environmental
Restoration
Project**



**United States Department of Energy
Albuquerque Operations Office**



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ACRONYMS AND ABBREVIATIONS

Am	americium
amp/m ²	amperes per square meter
CEARP	Comprehensive Environmental Assessment and Response Program
COC	constituent(s) of concern
COPEC	constituent(s) of potential ecological concern
cpm	count(s) per minute
Cs	cesium
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
famsl	ft above mean sea level
fbgl	ft below ground level
fbgs	ft below ground surface
ft	foot (feet)
GM	Geiger-Mueller
MDA	minimum detectable activity
mg/kg	milligram(s) per kilogram
mrem/hr	millirem(s) per hour
NFA	No Further Action
pCi/g	picocurie(s) per gram
Pu	plutonium
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound(s)
TA-II	Technical Area II
U	uranium
UCP	Uranium Calibration Pit
VCM	Voluntary Corrective Measure
VOC	volatile organic compound(s)

1.0 INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based No Further Action (NFA) for Environmental Restoration (ER) Site 44, the Uranium Calibration Pits (UCP) (ER Site 44a) and the Decontamination Area (ER Site 44b), Operable Unit 1303. ER Site 44 has been divided into two separate areas based on historical operations and potential constituents of concern (COC). This proposal provides a description, history, evaluation of relevant evidence, and rationale for the NFA decision for ER Site 44.

1.1 Description of Environmental Restoration Site 44

The UCPs were used to test and calibrate down-hole radiometric logging tools for the National Uranium Resource Evaluation Program. The UCPs were located in the western portion of Technical Area II (TA-II), west of Building 906 (Figure 1-1). The Decontamination Area was used to decontaminate weapons components and related test materials from the Nevada Test Site. The Decontamination Area, less than 0.1 acre in area, is located on the west side of Building 906, near the central portion of TA-II (Figure 1-1).

The regional aquifer in the vicinity of ER Site 44 is within the upper unit of the Santa Fe Group. The depth to the regional aquifer in the nearest monitor well to ER Site 44 (TA2-NW1-595) is approximately 520 feet (ft) below ground surface (fbgs) or 4,889.3 ft above mean sea level (famsl). TA2-NW1-595 has a total depth of 598 fbgs, with screens from 535 to 555 fbgs and 585 to 595 fbgs. A shallow water-bearing zone also exists in the vicinity of ER Site 44. The depth to the shallow zone in the vicinity of ER Site 44 ranges from approximately 267 to 320 fbgs (5,081 to 4,889 famsl). Monitor wells TA2-SW1-325, TA2-NW1-320, WYO-2, TA2-W-19, and TA2-W-01 are located in the vicinity of ER Site 44 and are screened in the shallow water-bearing zone.

The area is essentially flat, with a gentle slope to the west of approximately 4 percent. Tijeras Arroyo, the largest drainage feature at SNL/NM, is located immediately southeast of TA-II. The surface geology at ER Site 44 consists of unconsolidated alluvial and colluvial deposits derived from the Sandia and Manzanita Mountains. These deposits consist of sediments ranging from clay to gravel derived from the granitic rocks of the Sandia Mountains and greenstone, limestone, and quartzite derived from the Manzanita Mountains (SNL/NM 1996).

Surficial deposits are underlain by the upper unit of the Santa Fe Group. Hawley and Haase (1992) estimate that in this area, the piedmont-slope alluvium may be up to 100 ft thick, and the upper Santa Fe unit is approximately 1,200 ft thick.

The piedmont-slope alluvium, which was deposited by the ancestral Tijeras Arroyo, is generally coarse-grained sand and gravel. The upper Santa Fe unit was deposited from 5 to 1 million years ago and consists of coarse- to fine-grained fluvial deposits from the ancestral Rio Grande that intertongue with coarse-grained alluvial-fan/piedmont-veneer facies, which extend westward from the Sandia and Manzanita Mountains. ER Site 44 is near the easternmost limit of the ancestral Rio Grande deposits (Hawley and Haase 1992).

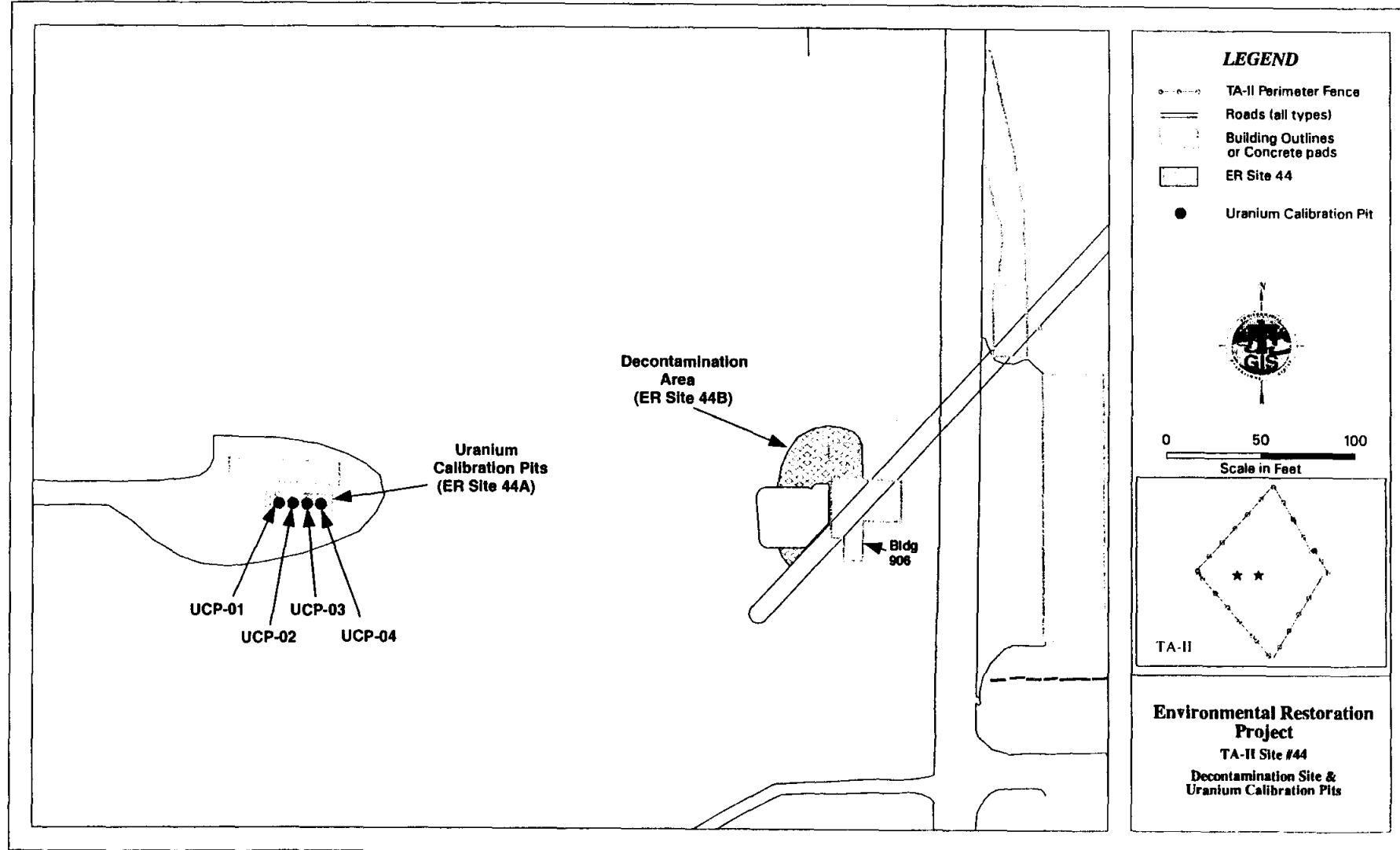


Figure 1-1. ER Sites 44A and 44B Location Map

Several rift-bounding faults are located east of ER Site 44. The nearest is the Sandia fault-zone, characterized by north-trending, west-dipping normal faults. The westernmost fault is located approximately 1.2 miles east of the site (Hawley and Haase 1992). The Sandia fault-zone merges with the Tijeras fault-zone and the Hubbell Springs fault near the southern edge of Kirtland Air Force Base. These faults are discussed in the 1995 Site-Wide Hydrogeologic Characterization Project Annual Report (SNL/NM 1996) as well as in Hawley and Haase (1992).

1.2 No Further Action Basis

Review and analysis of all relevant data for ER Sites 44a and 44b indicate that concentrations of COCs at these site are less than the applicable risk assessment action levels (Section 6.0). Thus, ER Sites 44a and 44b are being proposed for an NFA decision based on confirmatory sampling data demonstrating that COCs that may have been released from this site into the environment pose an acceptable level of risk under current and projected future land use, per NFA Criterion 5 of the ER Document of Understanding (NMED April 1996).

2.0 HISTORY OF ENVIRONMENTAL RESTORATION SITE 44

This section discusses the historical operations, previous audits, inspections, and findings at ER Sites 44a and 44b.

2.1 ER Site 44a

2.1.1 Historical Operations at ER Site 44a

The UCPs consisted of four pits that were constructed in 1978. Very limited information exists about the geophysical testing conducted at the UCPs. Initial information was based on employee interviews (Haines et al. 1991). No testing reports, "As Built," or other engineering drawings are known to exist for the UCPs. Construction details and pit contents discussed below were verified during the Voluntary Corrective Measure (VCM).

Construction Details of the UCPs

From west to east, the four UCPs were numbered sequentially 1 through 4 (Figure 2-1). The distance between the centers of adjacent pits was approximately 6 ft. The four UCPs were constructed by excavating 4-ft diameter pits to 8 fbs. A small borehole (about 4.5 inches in diameter) subsequently was drilled in the center of each pit. Boreholes at UCPs 1, 2, and 3 were drilled to approximately 19, 14, and 18 fbs, respectively. The UCP 4 borehole was drilled to an approximate depth of 206 ft. Four-inch diameter polyvinyl chloride (PVC) pipes were installed into the UCPs 2, 3, and 4 boreholes, and a four-inch diameter steel pipe was installed in the UCP 1 borehole. The pipes were not grouted in place. Four 4-ft diameter by 8-ft long concrete culverts (i.e., hollow concrete pipe) subsequently were lowered by a crane into each of the open pits. After the culverts were in place, a 6-inch thick concrete plug was poured at the bases of UCPs 1, 3, and 4. UCP 2 did not have a concrete plug base. Although the cement plugs were poured in the culverts, it was assumed that leakage could have occurred between the plug and the culvert. A circular steel plate was placed upon, but was not sealed to, the top of each UCP and served as a pit cover.

Historical Use of the Uranium Calibration Pits

Although basic construction details were similar for the four UCPs, the pits were used for different uranium (U) calibration operations. Reported materials and processes used at each pit are described below. No information was revealed during the employee interviews, audits, surveys, or VCM that indicated material had been removed from the UCPs during the period of operation.

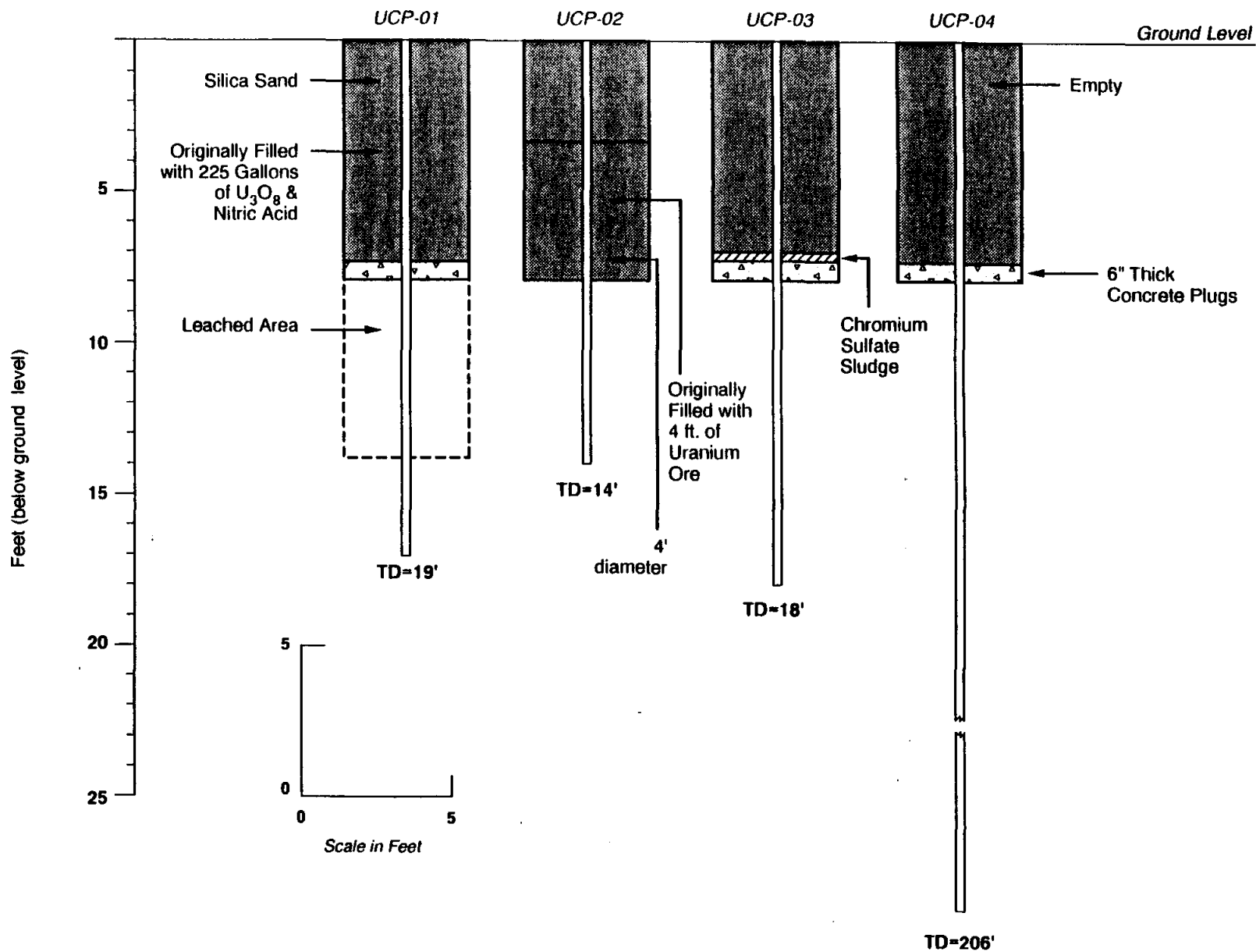


Figure 2-1
Schematic Cross Section of the Four Uranium Calibration Pits (ER Site 44a)

Uranium Calibration Pit 1

UCP 1 (Figure 2-1) was used to simulate a water-saturated, uranium (U)-bearing sand. The pit was filled with silica sand, which then was saturated with a solution of uranyl nitrate. Ten to twenty pounds of U oxide were dissolved with a minimal amount of nitric acid, which subsequently was diluted with distilled water to form the uranyl nitrate solution. The total volume of uranyl nitrate solution was approximately 225 gallons. After the UCP was filled, the solution inadvertently migrated into the soil beneath the pit, where it precipitated in the alkaline soil.

Uranium Calibration Pit 2

UCP 2 (Figure 2-1) had a plastic sheeting bottom and was filled with 4 ft of U ore from the Jackpile mine near Grants, New Mexico. Another plastic sheet was placed on top of the ore and 4 ft of clean fill was placed above the sheeting.

Uranium Calibration Pit 3

UCP 3 (Figure 2-1) was lined with a waterproof neoprene fabric liner with sealed seams that extended to the rim of the concrete culvert. The pit was filled with a solution of chromium sulfate.

Uranium Calibration Pit 4

No solutions or other material were placed into UCP 4 (Figure 2-1). It was used only for background calibrations.

2.1.2 Previous Audits, Inspections, and Findings

In 1987, a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) was performed for the entire SNL/NM installation (EPA 1987). At that time, ER Site 44, the UCPs and the Decontamination Area, were identified as solid waste management unit #130 and were described as having the potential for release of hazardous waste or constituents. A more comprehensive assessment was performed under Phase 1 of the Comprehensive Environmental Assessment and Response Program (CEARP) (DOE 1987), during which the UCPs and Decontamination Area were assessed and, again, were found to require additional investigation. The scope of the Phase 1 assessment included a literature and records search, interviews with current and former employees, and, in some cases, visual site inspections. No samples and only limited background data were collected during both the RFA and CEARP Phase 1 assessment.

2.2 ER Site 44b

2.2.1 Historical Operations at ER Site 44b

The Decontamination Area was used from approximately the late 1960s until the mid-1970s. Weapons components and related test materials from the Nevada Test Site reportedly were decontaminated outside Building 906. These materials may have contained metals and radionuclides. Decontamination (washing off contaminated material with a hose) was conducted on the ground surface.

2.2.2 Previous Audits, Inspections, and Findings

Section 2.1.2 discusses the previous audits, inspections, and findings for ER Site 44b.

3.0 EVALUATION OF RELEVANT EVIDENCE

3.1 ER Site 44a

3.1.1 Unit Characteristics and Operating Practices

The characteristics and best available knowledge concerning the operating practices are described in Section 2.1.1. No activities have occurred at ER Site 44a since those described in Section 2.1.1.

3.1.2 Results of SNL/NM ER Project Sampling/Surveys

Several rounds of sampling have occurred at ER Site 44a, including surveys for gamma contamination and organic vapors. Radiation levels above background were found in UCP 1 and UCP 2. No organic vapors were detected at the site. The results of the surveys are summarized in Table 3-1 and in the sections below.

3.1.2.1 *Prior Investigations of ER Site 44a*

The following sources of information were used to evaluate ER Site 44a:

- Interviews of SNL/NM personnel
- Photographs and field notes collected at the site by SNL/NM ER staff
- Radiation survey of ER Site 44a, December 1991
- Organic vapor survey of UCPs, December 1991
- Radiation survey of UCPs, January 1994
- ER Site 44a VCM, Summer 1994.

3.1.3 Radiological Surveys of ER Site 44a

Two radiation surveys have been performed at ER Site 44a. The results of the surveys are summarized in Table 3-1. On December 5 and 6, 1991, a radiation survey was performed at the UCPs. The survey was performed using a Bicon 2000 gamma detector at waist height, and an ASP-1 survey meter with a HP-260 Geiger-Mueller (GM) pancake probe at ground level for beta-gamma detection. The objectives of the survey were to determine both the general area gamma radiation levels and to try to detect the presence of surface contamination. The

Table 3-1
Summary of ER Project Radiological Surveys at ER Site 44a

Date	Survey/Sample for	Location	Value	Background/ Action Level
12/91	Gamma surface survey	General area	0.02 to 0.03 mrem/hr	Values within background
			80 to 140 cpm	Values within background
	Gamma survey (near surface survey)	UCP 1 pipe	Near 0 activity	Value within background
		UCP 2 pipe	0.5 mrem/hr	Above background
		UCP 3 pipe	0.25 mrem/hr	Above background
		UCP 4 pipe	Near 0 activity	Value within background
1/94	Gamma survey (downhole survey)	UCP 1 pipe	> Background from 8 ft (74,614 cpm) to 14 ft (21,088 cpm)	14,400 cpm (background)
		UCP 2 pipe	> Background from just below ground surface (25,544 cpm) to 11 ft (23,088 cpm)	
		UCP 3 pipe	< Background	
		UCP 4 pipe	< Background	

cpm - Counts per minute.

ft - feet.

mrem/hr - Millirem(s) per hour.

pCi/g - Picocuries per gram.

radiation levels varied from approximately 0.02 to 0.03 millirem per hour (mrem/hr). Surface readings varied from approximately 80 to 140 counts per minute (cpm), well within the range of area background. Several swipe surveys also were performed on the ground, and personnel were monitored for contamination. No elevated readings were indicated.

During the field survey, a hand-held radiation detector was lowered into the pipes at each UCP. Readings up to 0.5 and 0.25 mrem/hr were detected at UCP 2 and 3, respectively, at depths of approximately 3 fbgl. No activities were detected at UCPs 1 and 4.

In January 1994, a second radiation survey was conducted at the four UCPs. The survey was conducted using a downhole PRS-1 sodium iodide gamma probe. Readings were taken approximately every foot in each of the four UCPs. Results of this survey indicate:

- UCP 1 had readings above background (14,400 cpm) from about 8 fbgl (74,614 cpm) to 19 fbgl (21,088 cpm), the total depth of the PVC.
- UCP 2 had elevated readings from 25,544 cpm near the ground surface to 23,088 cpm at 11 fbgl, i.e., 3 ft below the culvert. Total depth of the PVC was approximately 14 fbgl.
- UCP 3 had no elevated readings above background. Total depth of the PVC was approximately 18 fbgl.
- UCP 4 had no elevated readings above background down to the total surveyed depth of 50 fbgl. Total depth of the PVC was approximately 206 fbgl.

3.1.4 Organic Survey of ER Site 44a

On December 5 and 6, 1991, an organic vapor survey was performed at the UCPs. The organic vapor survey was conducted using an HNu photoionization detector, held at waist height, field calibrated to read equivalent benzene concentration. No readings were detected.

3.1.5 VCM Sampling

The UCPs were remediated in June 1994 as a VCM. The following describes the activities performed at each of the four UCPs as part of the VCM. A summary of VCM sampling is included in Table 3-2.

The UCP culverts were removed one at a time, after interior contents were removed, by excavating approximately 8 fbgl with a backhoe and then removing the culvert with a crane. Radiological soil screening was performed in the excavation from 4 fbgl to total depth. After removing each culvert, radiological screening of the soil below the culvert was performed. If radiological levels were at background or below, a confirmatory soil sample was taken. If radiological levels were above background, contaminated soil was removed until background levels were achieved, and then a sample was taken at the bottom of the excavation.

**Table 3-2
Summary of VCM Sampling at ER Site 44a**

Date	Survey/Sample for	Location	MDA (pCi/g)	Value	Background/ Action Level
6/94	Gamma spectrometry and isotopic uranium (following VCM)	UCP 1	0.018	U-238 at 26 pCi/g U-235 at 1.1 pCi/g U-234 at 26 pCi/g	Preliminary risk-based action level 28.6 pci/g
		UCP 2	0.057	U-238 at 2 pCi/g	
		UCP 3	0.022	U-238 at 0.93 pCi/g	
		UCP 4	0.028	U-238 at 0.77 pCi/g	
	Chromium analysis	UCP 3	1.0	Chromium at 3.2 mg/kg	Proposed Subpart S Action Level 400 mg/kg

MDA - Minimum detectable activity.
mg/kg - Milligrams per kilogram.
pCi/g - Picocuries per gram.

The following variations from the above description are noted. At UCP 1, background levels were never obtained in the excavation. Contaminated soil was found for approximately 6 ft beneath the bottom of the concrete plug. Excavation of contaminated soil was ceased when gamma spectrometry results for U were below the preliminary risk-based action level of 28.6 picocuries per gram (pCi/g). Confirmatory soil samples also were taken from the backfill as the excavation was restored to surface grade.

The residual chromate sulfate solution (discussed in Section 2.1.1 above) in UCP 3 was pumped out in May 1994 as the first phase of the VCM. The liner was also removed at this time. Vermiculite was added to the UCP to absorb a minute amount of solution remaining on the bottom of the culvert.

Confirmatory Soil Samples

Confirmatory soil samples were collected and analyzed by gamma spectrometry for isotopic U at the bottom of each UCP culvert after it was removed unless radioactively contaminated soil was present. Radioactively contaminated soil was defined as having activities above background levels determined by field screening. If contaminated soil was present below the culvert, the soil was removed and a confirmatory soil sample was taken at the bottom of the excavation. A confirmatory sample was also taken from the backfill material as the excavation was returned to surface grade. In addition to the radiological analyses, a sample was taken for chromium below UCP 3.

Confirmatory soil samples analyzed by gamma spectroscopy indicate that U-238 was at or below 2 pCi/g in all samples except for the sample collected below UCP 1 (Table 3-2). The

reported concentration in the sample collected from the bottom of the excavation below UCP 1 was 26 pCi/g. The chromium concentration from the sample collected below UCP 3 was 3.2 milligrams per kilogram (mg/kg).

3.1.5.1 *Quality Assurance/Quality Control Summary*

Three sets of quality assurance (QA)/quality control (QC) samples were analyzed as part of the VCM soil sampling program at ER Site 44a. A reagent blank and two laboratory control samples were analyzed with four soil samples sent to an off-site laboratory in June 1994. These QA/QC samples were analyzed for the same constituents (isotopic U) as the soil samples. The reagent blank results were 0.0 pCi/g U-235, 0.086 pCi/g U-233/234, and 0.11 pCi/g U-238. The sample results for these isotopes were significantly higher than the blank results. Results for the spiked laboratory control samples agreed with the known values.

A laboratory control sample and a laboratory control duplicate sample were analyzed in conjunction with a soil sample from ER Site 44a sent to an off-site laboratory in June 1994. These QA/QC samples were analyzed for the same constituents (metals) as the soil sample. The results for the laboratory control sample analyses fell within the required level of precision.

A reagent blank and two laboratory control samples were analyzed with four soil samples sent to an off-site laboratory in July 1994. These QA/QC samples were analyzed for similar radionuclide constituents as the soil samples. The reagent blank results were 0.0 pCi/g U-235, 0.033 pCi/g U-233/234, and 0.014 pCi/g U-238. The sample results for these isotopes were significantly higher than the blank results. Results for the spiked laboratory control samples agreed with the known values.

3.2 ER Site 44b

3.2.1 Unit Characteristics and Operating Practices

The characteristics and operating practices are described in Section 2.2.1. No activities have occurred at ER Site 44b since those described in Section 2.2.1.

3.2.2 Results of SNL/NM ER Project Sampling/Surveys

Several rounds of sampling have occurred in the area, including analyses for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), metals, and radionuclides. No VOCs or SVOCs were detected during an organic vapor survey or a soil vapor investigation. Metals were detected below U.S. Environmental Protection Agency (EPA) action levels and/or below sitewide background soil levels. Radionuclides, with the exception of cesium (Cs)-137, all were detected below sitewide background soil levels or were nondetectable. The results of the surveys are summarized in Tables 3-3 and 3-4 and in the sections below.

Table 3-3
ER Project Radiological Sampling/Surveys at ER Site 44b

Date	Survey/Sampled for	Location	Value	Background
12/91	Gamma surface contamination	General area	20 to 30 μ rem/hr	Values within background
			80 to 140 cpm	Values within background
3/94	Gamma contamination	Vicinity of Building 906. (Values from three areas that exceeded background are given.)	13 to 36 μ rem/hr 130 to 550 cpm	12 μ rem/hr 120 cpm
			13 to 15 μ rem/hr 130 to 160 cpm	
			20 μ rem/hr 250 cpm	

cpm - Counts per minute.
 μ rem/hr - Microrems per hour.

Table 3-4
ER Project Organic Vapor Surveys at ER Site 44b

Date	Survey/Sampled for	Location	Value
12/91	Organic vapors	General area	No VOCs or SVOCs detected
11/93	Organic vapors	Passive soil vapor survey of area	No VOCs or SVOCs detected

SVOC - Semivolatile organic compounds.
VOC - Volatile organic compounds.

3.2.2.1 *Prior Investigations of ER Site 44b*

The following sources of information, presented in chronological order, were used to evaluate ER Site 44b:

- Interviews of SNL/NM personnel
- Photographs and field notes collected at the site by SNL/NM ER staff
- Radiation surveys of ER Site 44b, December 1991 and March 1994

- Organic vapor survey of ER Site 44b, December 1991
- Passive soil vapor survey at ER Site 44b, November 1993
- Geophysical surveys (SNL/NM 1994a, SNL/NM 1994b)
- VCM sampling, November 1996.

3.2.3 Radiological Surveys

Two radiation surveys have been performed at ER Site 44b. The results of the surveys are summarized in Table 3-3. On December 5 and 6, 1991, a radiation survey was performed at the Decontamination Area. The radiation survey was performed using a Bicron 2000 gamma detector held at waist height, and an ASP-1 survey meter with a HP-260 GM pancake probe held at ground level for beta-gamma detection. The objectives of the survey were to determine both the general area gamma radiation levels and to try to detect the presence of surface contamination. The radiation levels varied from approximately 20 to 30 microrem per hour ($\mu\text{rem/hr}$) and surface readings varied from approximately 80 to 140 cpm. Both results were within the range of area background. Several swipe surveys also were performed on the ground, and personnel were monitored for contamination. No elevated readings were indicated.

On March 20, 1994, a surface radiation survey was performed at the Decontamination Area in the immediate vicinity of Building 906 (Figure 1-1). The radiation survey was performed using a gamma scintillometer and a pressurized ionization chamber. A detailed summary of the survey may be found in Section 5.2.1 of "Final Report, Survey and Removal of Radioactive Surface Contamination at Environmental Restoration Sites, Sandia National Laboratories/New Mexico (Draft)" (SNL/NM 1997). Background activities were measured at 120 cpm with the gamma scintillometer and at 12 $\mu\text{rem/hr}$ with the pressurized ionization chamber. Activities above background were measured at three locations within the Decontamination Area. A 60-ft² area near Building 906 had activities between 130 and 550 cpm and at 13 to 36 $\mu\text{rem/hr}$. Activities at a 24-ft² area west of Building 906 ranged between 130 and 160 cpm and 13 to 15 $\mu\text{rem/hr}$. A 2-ft radius circle located about 5 ft south-southeast of the 24-ft² area had activities of 250 cpm and 20 $\mu\text{rem/hr}$. No other activities were measured above background levels in the vicinity of the Decontamination Area.

3.2.4 Organic Vapor Surveys

Two organic surveys were performed at the Decontamination Area. The results are summarized in Table 3-4. An organic vapor survey was performed December 5 and 6, 1991, using a HNu photoionization detector held at waist height, field calibrated to read equivalent benzene concentrations. No VOCs were detected. Between November 11 and December 2, 1993, a passive soil vapor survey investigation was conducted in the vicinity of the Decontamination Area. No VOCs or SVOCs were detected.

3.2.5 Surface Soil Sampling

As summarized in Table 3-5, soil samples were collected on two occasions in 1994. On February 4 and 11, 1994, surface soil grab samples were collected near the northwest corner of Building 906 (Figure 1-1). Four soil samples were collected on February 4, and an additional four soil samples were collected on February 11. The eight soil samples were analyzed for radioisotopes by gamma spectroscopy, for gross alpha/gross beta radiation, and tritium by liquid scintillation. Tritium was below method detection limits in all of the samples; in addition, no elevated gross alpha or gross beta activities were identified. Cs-137 was the only radioisotope detected significantly above background levels. Cs-137 was detected in three surface soil samples, with activities ranging from 8.97 to 87.7 pCi/g. Background for Cs-137 in soil at the surface is 0.84 pCi/g, based on the 95th percentile. Background for Cs-137 in soil in the subsurface is inferred to be less than the cited detection limit for the analyses (0.084 pCi/g) (IT Corporation 1994).

During April 1994, six surface and six subsurface (2 fbg) soil samples were collected in areas previously identified as anomalous based on the surface radiation survey and previous surface soil sample results. The 12 soil samples were analyzed for radioisotopes and metals.

All metals detected were below EPA action-level guidelines except for beryllium. Beryllium concentrations ranged from 0.33 to 0.59 mg/kg, compared to an EPA action level of 0.2 mg/kg. However, sitewide background concentrations show an upper tolerance level of 0.80 mg/kg at a 95 percent confidence level. Therefore, beryllium concentrations are presumed to represent background levels and are not indicative of contamination.

Radionuclides, with the exception of Cs-137, all were detected below background levels when the 2 standard deviation error was considered. Cs-137 concentrations ranged from less than 0.057 to 43 pCi/g, with an approximate mean of 6 pCi/g.

3.2.6 Geophysical Surveys

A STOLS™ survey was performed over the Decontamination Area in December 1993 (SNL/NM 1994a). Two large (>10 amperes per square meter [amp/m^2]), two medium (6 to $10 \text{ amp}/\text{m}^2$), and three small (0 to $5 \text{ amp}/\text{m}^2$) magnetic anomalies along with 19 point locations were identified in the Decontamination Area. The anomalies have been attributed to buried utilities or fencelines (SNL/NM 1994a). One pipe is associated with the sanitary septic line of Building 907. The point locations are products of ferromagnetic surface trash and concentrations of ferromagnetic soil and rock.

An electromagnetic survey was performed during the period of December 6, 1993, through February 24, 1994. The Decontamination Area was surveyed as part of the Phase II Survey Design using the EM-31 survey instrument (SNL/NM 1994b). The survey identified the seepage pit west of Building 906. Various buried utility lines also were identified.

**Table 3-5
ER Project Surface Soil Sampling at ER Site 44b**

Date	Survey/Sampled for	Location	Value	Background
2/94	Soils analyzed for radioisotopes, gross alpha/beta, and tritium	Vicinity of Building 906	Cs-137 ^a at 8.97 to 87.7 pCi/g	0.836 pCi/g
			No elevated gross/alpha values	Values within background
			Tritium < detection limit	NA
4/94	Soils analyzed for radioisotopes and metals	Areas of previous "hits"	Cs-137 ^a at >0.057 to 43 pCi/g	Values above background
			Beryllium ^b 0.33 to 0.59 mg/kg	Background is 0.80 mg/kg EPA action level is 0.2 mg/kg

^aOnly radioisotope detected significantly above background levels.

^bOnly metal detected above EPA action level.

cpm - Counts per minute.

NA - Nondetect.

mg/kg - Milligrams per kilogram.

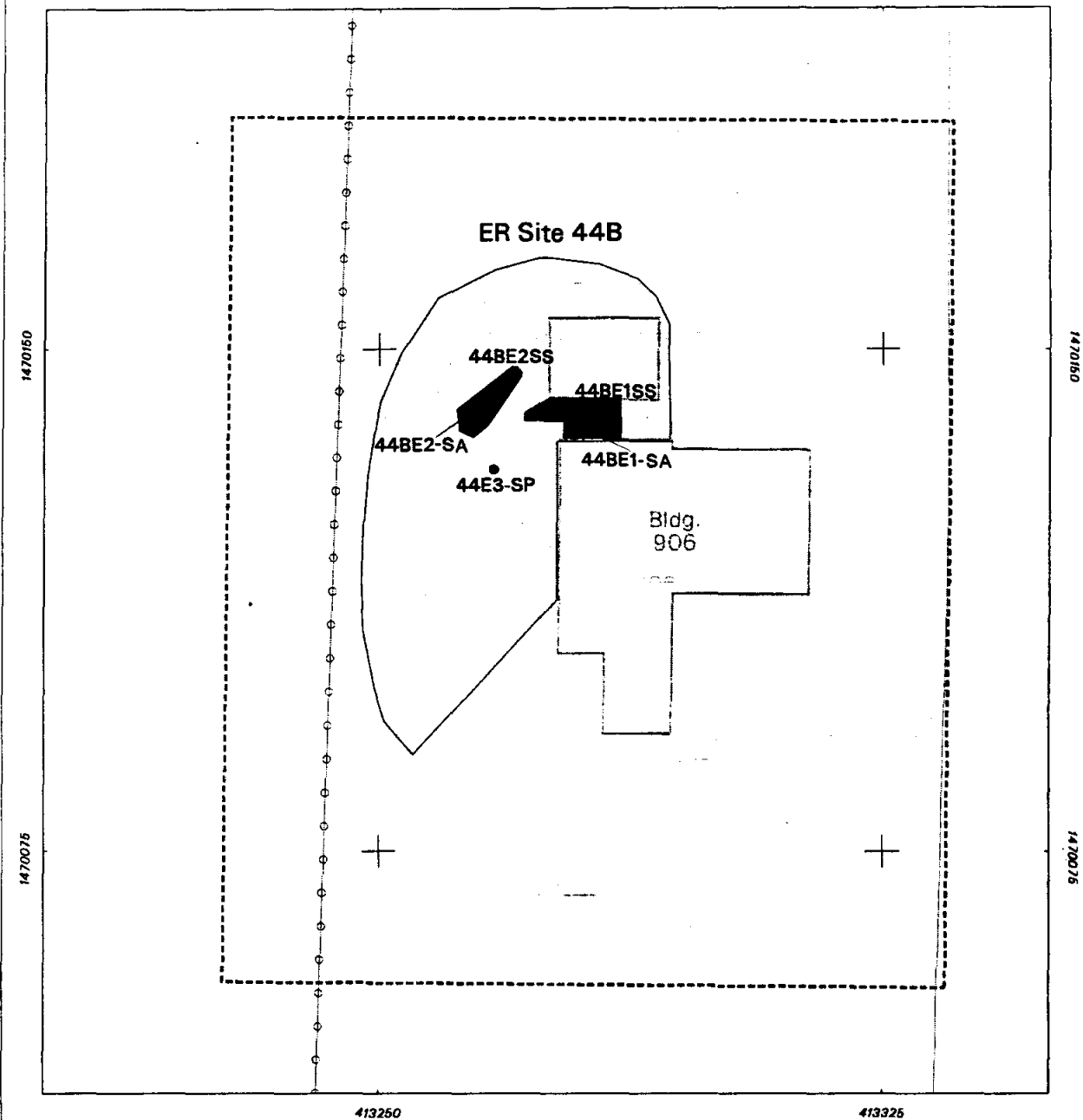
pCi/g - Picocuries per gram.

3.2.7 VCM Sampling at ER Site 44b

VCM activities were conducted at ER Site 44b during November 1996. Cleanup activities included radiation scanning to verify anomalies identified in 1994, removal of fragments and/or soil until readings were less than 1.3 times site-specific background levels, and post-cleanup (verification) soil sampling for gamma spectroscopy analysis. After the removal of radiologically contaminated soils, three surface samples were collected from areas exhibiting the highest residual radioactivity remaining in the soil based on field measurements. The location of radiation survey anomalies and soil sampling locations are shown on Figure 3-1. The maximum levels for Cs-134 and Cs-137 were as follows: Cs-134 not detected and Cs-137 detected at 0.77 pCi/g.

3.2.7.1 Quality Assurance/Quality Control Summary

The surface soil samples were analyzed by gamma spectroscopy by the SNL/NM Radiation Protection Measurements Department in accordance with laboratory and quality assurance procedures. The procedures are listed in Section 3.2.2 of "Final Report, Survey and Removal of Radioactive Surface Contamination at Environmental Restoration Sites, Sandia National



Legend

- Point Source Gamma Radiation Anomaly (Elevated relative to site specific background, SP = Soil Point)
- ▲ Post-cleanup (Verification) Soil Sample Location (SS = Soil Sample)
- Road
- Building
- Fence
- Rad Survey Boundary



ER Site 44
Uranium Calibration Pits



Area Source Gamma Radiation Anomaly (Elevated relative to site specific background) (SA = Soil Area Source)

0 12.5 25
Scale in Feet

0 3 6
Scale in Meters

1:360

1 in = 30'



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Figure 3-1 Phase I Survey Radiation Anomalies and VCM Surface Soil Sampling Locations at ER Site 44B

Laboratories/New Mexico (Draft)* (SNL/NM 1997). Copies of the procedures are provided in Appendix D of the document.

3.3 Gaps in Information

Information about the geophysical testing at ER Site 44a was largely gathered by employee interviews. Construction details and pit contents at ER Site 44a were revealed during the VCM. Information obtained during the various survey and sampling events at ER Sites 44a and 44b were used, along with other available information, to help identify the most likely COCs that might be found at the sites. Analytical data from soil samples collected at the sites (Sections 3.1.5 and 3.2.6) and subsequent risk assessment (Section 3.4) are sufficient to determine whether significant releases of COCs occurred at the site.

3.4 Risk Evaluation for ER Sites 44a and 44b

Human Health and Ecological Risk Assessment Reports were prepared for ER Sites 44a and 44b and are included in Sections 6.1 and 6.2, respectively.

3.4.1 Human Health Risk Assessment

ER Sites 44a and 44b have been recommended for industrial land-use (DOE and USAF 1995). A complete discussion of the risk assessment process, results, and uncertainties is provided in Sections 6.1 and 6.2. Due to the presence of several metals and radionuclides in concentrations and activities greater than background levels, it was necessary to perform a human health risk assessment analysis for the site. Besides metals, any radionuclide compounds either detected above background levels and/or minimum detectable activities were included in this assessment. The risk assessment process provides a quantitative evaluation of the potential adverse human health effects caused by constituents in the site's soil. The Risk Assessment Report presents calculations of the Hazard Index and excess cancer risk for both an industrial land-use and residential land-use setting. The excess cancer risk from nonradioactive COCs and the radioactive COCs is not additive (EPA 1989). The results of the ER Sites 44a and 44b risk assessments are summarized below.

The only nonradiological COC at ER Site 44a was chromium. The maximum chromium concentration was less than the proposed Subpart S action level, and therefore chromium was eliminated from further consideration in the risk assessment during this screening phase. The incremental total effective dose equivalent for radionuclides for an industrial land-use setting at ER Site 44a is 0.06 mrem/yr, which is well below the standard dose limit of 15 mrem/yr (40CFR196 1994). The incremental excess cancer risk for radionuclides is 2×10^{-6} for the industrial land-use scenario, which is much less than risk values calculated due to naturally occurring radiation and from intakes considered background concentration values.

The Hazard Index calculated for ER Site 44b nonradiological COCs is 0.0 for an industrial land-use setting, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). Incremental risk is determined by subtracting risk associated with background from potential nonradiological COC risk. The incremental Hazard Index is 0.0. The

excess cancer risk for ER Site 44b nonradiological COCs is 1×10^{-6} for an industrial land-use setting, which is at the low end of the suggested range of acceptable risk of 10^{-4} to 10^{-6} (EPA 1989). The incremental excess cancer risk for ER Site 44b is 3×10^{-6} . A radiological risk assessment was not performed because no radioactive COCs existed in excess of background concentrations.

The residential land-use scenarios for these sites are provided only for comparison in the Risk Assessment Reports (Sections 6.1 and 6.2). The reports conclude that ER Sites 44a and 44b do not have significant potential to affect human health under an industrial land-use scenario.

3.4.2 Ecological Risk Assessment

No ecological receptors are predicted for ER Site 44a due to the depth of COCs in the subsurface soil (>5 fbg).

Potential risks were indicated for two of the three ecological receptors at ER Site 44b; however, the use of the maximum measured soil concentration or one-half the maximum detection limit to evaluate risk provided a conservative exposure scenario for the risk assessment and may not reflect actual site conditions. Detection limits, at half value, were used to evaluate risk for silver. Maximum measured soil concentrations for chromium (total), mercury, and zinc exceeded their respective plant benchmark concentrations. Although risk was predicted to plants exposed to chromium at this site, the maximum total chromium concentration is actually less than the background value of 12.8 mg/kg. No potential risk was predicted for the deer mouse from nonradioactive constituents of potential ecological concern (COPEC). Mercury was the only COPEC concentration that resulted in an HQ greater than 1.0 for the burrowing owl. Because the home range of the owl is more than 20 times the size of the site, the true risk for the burrowing owl due to mercury from Site 44b is insignificant. Based on these results, silver and chromium can be justified for elimination as COPECs at ER Site 44b; The incremental risk resulted from zinc, subtracting the background, would produce an HQ of 0.2. However, it is very likely that the other risk results are driven by conservatism in data analysis. HQs based on 95 percent upper confidence limits of the mean will likely be lower and still be a conservative estimate of site conditions. Overall ecological risks associated with ER Site 44b are expected to be low.

4.0 RATIONALE FOR NO FURTHER ACTION DECISION

Based on field investigation data and the human health risk assessment analysis, an NFA is recommended for ER Site 44a for the reasons given below.

- VCM sampling results
 - Reported chromium concentration from the sample collected from below UCP 3 is far below the proposed Subpart S Action Level
 - All U concentrations at the UCPs, both soil collected from below the removed culverts and in the backfill soil, also were below risk-based action levels.
- No VOCs were detected during the field screening program or were reportedly used at the site.
- No COCs (particularly metals or radionuclides) were present in concentrations considered hazardous to human health for an industrial land-use scenario.

An NFA for ER Site 44b is recommended for the following reasons:

- After the VCM, which removed point sources with elevated Cs-137, all radionuclide samples were reported at concentrations below background levels.
- All metals were reported below site-specific background concentrations.
- No VOCs or SVOCs were detected during the field screening program.
- No COCs (particularly metals and radionuclides) were present in concentrations considered hazardous to human health for an industrial land-use scenario.

Based on the evidence provided above, ER Sites 44a and 44b are proposed for an NFA based on Criterion 5 of the Document of Understanding (NMED April 1996).

5.0 REFERENCES

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6.0 ANNEXES

6.1 ER Site 44a: Risk Assessment Report

6.2 ER Site 44b: Risk Assessment Report

Section 6.1
ER Site 44a: Risk Assessment Report

ER SITE 44a: RISK ASSESSMENT ANALYSIS

I. Site Description and History

The Uranium Calibration Pits (UCP), Environmental Restoration (ER) Site 44a at Sandia National Laboratories/New Mexico (SNL/NM), were active between 1978 and 1984. The UCPs were located in the western portion of Technical Area (TA)-II west of Building 906. The site consisted of four pits that were managed by the U.S. Department of Energy (DOE). The UCPs were used to test and calibrate down-hole radiometric logging tools for the National Uranium Resource Evaluation Program. The pits were constructed in 1978 and were used until 1984. The site has been inactive since 1984.

From west to east, the four UCPs were numbered sequentially 1 through 4. UCP 1 was used to simulate a water-saturated, uranium-bearing sand. The pit was filled with silica sand, which then was saturated with a solution of uranyl nitrate. UCP 2 contained uranium ore with an estimated grade of 0.1 percent uranium oxide or "yellowcake." UCP 3 was filled with a solution of chromium sulfate. UCP 4 was used only for background calibrations and never contained any anthropogenic materials. Therefore, constituents of concern (COC) included uranium and chromium.

II. Human Health Risk Assessment Analysis

Risk assessment of this site includes a number of steps, which culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at the site. The steps to be discussed include:

Step 1.	Site data are described that provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways by which a representative population might be exposed to the COCs are identified.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The tiered approach includes screening steps, followed by potential intake calculations and a discussion or evaluation of the uncertainty in those calculations. Potential intake calculations are also applied to background screening data.
Step 4.	Data are described on the potential toxicity and cancer effects from exposure to the COCs and associated background constituents and subsequent intake.
Step 5.	Potential toxicity effects (specified as a Hazard Index) and cancer risks are calculated for nonradiological COCs and background. For radiological COCs, the incremental total effective dose equivalent (TEDE) and incremental estimated cancer risk are calculated by subtracting applicable background concentrations directly from maximum on-site contaminant values. This background subtraction only occurs when a radiological COC occurs as contamination and exists as a natural background radionuclide.
Step 6.	These values are compared with guidelines established by the U.S. Environmental Protection Agency (EPA) and the DOE to determine whether further evaluation, and potential site clean-up, is required. Nonradiological COC risk values are also compared to background risk so that an incremental risk may be calculated.
Step 7.	Uncertainties in the previous steps are discussed.

II.1 Step 1. Site Data

Site history and characterization activities are used to identify potential COCs. The identification of COCs and the sampling to determine the concentration levels of those COCs across the site are described in the ER Site 44a No Further Action Proposal. In order to provide conservatism in this risk assessment, the calculation uses only the maximum concentration value of each COC determined for the entire site. Chemicals that are essential nutrients, such as iron, magnesium, calcium, potassium, and sodium, were not included in this risk assessment (EPA 1989). Both radioactive and nonradioactive COCs are evaluated. The only nonradioactive COC is chromium; the only radioactive COC is uranium.

II.2 Step 2. Pathway Identification

ER Site 44a has been designated with a future land-use scenario of industrial (DOE and U.S. Air Force [USAF] 1996) (see Appendix 1 for default exposure pathways and parameters). Because of the location and the characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for chemical COCs and radon inhalation and soil ingestion is included for exposure from radiological contaminants. The inhalation pathway for chemicals and radionuclides is included because of the potential to inhale dust and volatiles. No contamination at depth was suspected, and therefore no water pathways to the groundwater are considered. Depth to groundwater at Site 44a is approximately 320 feet below ground surface. Because of the lack of surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered not to be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate for the industrial land-use scenario. However, plant uptake is considered for the residential land-use scenario.

PATHWAY IDENTIFICATION

Chemical Constituents	Radionuclide Constituents
Soil ingestion	Soil ingestion
Inhalation (dust)	Inhalation (dust and volatiles)
Plant uptake (residential only)	Plant uptake (residential only)
	Direct gamma

II.3 Steps 3-5. Calculation of Hazard Indices and Cancer Risks

Steps 3 through 5 are discussed in this section. These steps include the discussion of the tiered approach in eliminating potential COCs from further consideration in the risk assessment process and the calculation of intakes from all identified exposure pathways, the discussion of the toxicity information, and the calculation of the hazard indices and cancer risks.

The risks from the COCs at ER Site 44a were evaluated using a tiered approach. First, the maximum concentrations of COCs were compared to the SNL/NM background screening level for this area (IT Corporation 1996), as modified during verbal discussion with representatives of New Mexico Environment Department (NMED).

The maximum concentration of each COC was used in order to provide a conservative estimate of the associated risk. If any nonradiological COC was above the SNL/NM background screening levels, all nonradiological COCs were considered in further risk assessment analyses.

For radiological COCs that exceeded the SNL/NM background screening levels, background values were subtracted from the individual maximum radionuclide concentrations. Those that did not exceed these background levels were not carried any further in the risk assessment. This approach is consistent with DOE orders. Radioactive COCs that did not have a background value and were detected above the analytical minimum detectable activity were carried through the risk assessment at their maximum levels. This step is performed (rather than carry the below-background radioactive COCs through the risk assessment and then perform a background risk assessment to determine incremental TEDE and estimated cancer risk) to prevent the "masking" of radiological contamination that may occur if on-site background radiological COCs exist in concentrations far enough below the assigned background level. When this "masking" occurs, the final incremental TEDE and estimated cancer risk are reduced and, therefore, provide a nonconservative estimate of the potential impact on an on-site receptor. This approach is also consistent with the regulatory approach (40 CFR Part 196 1994), which sets a TEDE limit to the on-site receptor in excess of background. The resultant radioactive COCs remaining after this step are referred to as background-adjusted radioactive COCs.

Second, if any nonradiological COC failed the initial screening step, the maximum concentration for each nonradiological COC was compared with pertinent action level calculated using methods and equations promulgated in the proposed Resource Conservation and Recovery Act Subpart S (40 CFR Part 264 1990) and Risk Assessment Guidance for Superfund (RAGS) (EPA 1989) documentation. If there are ten or fewer COCs and each has a maximum concentration less than one-tenth of its action level, then the site would be judged to pose no significant health hazard to humans. If there are more than ten COCs, the Subpart S screening procedure was skipped.

Third, hazard indices and risk due to carcinogenic effects were calculated using reasonable maximum exposure (RME) methods and equations promulgated in RAGS (EPA 1989). The combined effects of all nonradiological COCs in the soils were calculated. The combined effects of the nonradiological COCs at their respective upper tolerance limit (UTL) or 95th percentile background concentrations in the soil were also calculated. For toxic compounds, the combined effects were calculated by summing the individual hazard quotients for each compound into a total Hazard Index. This Hazard Index is compared to the recommended standard of 1. For potentially carcinogenic compounds, the individual risks were summed. The total risk was compared to the recommended acceptable risk range of 10^{-4} to 10^{-6} . For the radioactive COCs, the incremental TEDE was calculated and the corresponding incremental cancer risk estimated using DOE's RESRAD computer code.

II.3.1 Comparison to Background and Action Levels

The only nonradioactive ER Site 44a COC is listed in Table 1, and radioactive COCs are listed in Table 2. Both tables show the associated 95th percentile or UTL background levels (IT Corporation 1996), as modified during verbal discussions with representatives of NMED. The SNL/NM background levels have not yet been approved by the EPA or the NMED but are the result of a comprehensive study of joint SNL/NM and USAF data from the Kirtland Air Force Base (KAFB). The values shown in Tables 1 and 2 supersede the background values described in an interim background study report (IT Corporation 1994).

Table 1 is limited to the sole nonradiological COC, chromium. The chromium concentration was considered to be chromium VI (most conservative). Because there was no SNL/NM background 95th percentile or UTL for chromium VI, the site fails the background screening criteria, and the proposed Subpart S action level screening procedure was performed.

Table 3 shows chromium compared to the proposed Subpart S action level for soil. The table compares the maximum concentration value to the proposed Subpart S action level. This methodology was guidance given to SNL/NM from the EPA (EPA 1996a). This is the second screening process in the tiered risk assessment approach. Chromium was less than the proposed Subpart S action level. Thus, the site passes the proposed Subpart S screening criteria, and a Hazard Index value and cancer risk value does not have to be calculated for chromium.

Table 1
Chromium concentration at ER Site 44a and Comparison to the
Background Screening Value

COC name	Maximum concentration (mg/kg)	SNL/NM 95th % or UTL Level (mg/kg)	Is maximum COC concentration less than or equal to the applicable SNL/NM background screening value?
Chromium, total*	3.2	NC	No

NC - not calculated

*total chromium assumed to be chromium VI (most conservative)

Table 2
Radioactive COCs at ER Site 44a and Comparison to the Background Screening Values

COC name	Maximum concentration (pCi/g)	SNL/NM 95th % or UTL Level (pCi/g)	Is maximum COC concentration less than or equal to the applicable SNL/NM background screening value?
U-238	26	1.3	No
U-235	1.1	0.18	No
U-233/234	26	1.6	No

Table 3
Comparison of ER Site 44a Nonradioactive COC Concentrations to
Proposed Subpart S Action Levels

COC name	Maximum concentration (mg/kg)	Proposed Subpart S Action Level (mg/kg)	Is individual contaminant less than the Action Level?
Chromium, total*	3.2	400	Yes

* total chromium assumed to be chromium VI (most conservative)

Radioactive contamination does not have predetermined action levels analogous to proposed Subpart S, and therefore this step in the screening process is not performed for radionuclides.

II.3.2 Identification of Toxicological Parameters

Table 4 shows the radiological COCs that have been retained in the risk assessment and the values for the toxicological information available for those COCs. Dose conversion factors (DCF) used in determining the incremental TEDE values for the individual pathways were the default values provided in the RESRAD computer code as developed in the following:

- For ingestion and inhalation, DCFs are taken from Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion* (EPA 1988).
- The DCFs for surface contamination (contamination on the surface of the site) were taken from DOE/EH-0070, *External Dose-Rate Conversion Factors for Calculation of Dose to the Public* (DOE 1988).
- The DCFs for volume contamination (exposure to contamination deeper than the immediate surface of the site) were calculated using the methods discussed in, *Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil* (Health Physics 28:193-205) (Kocher 1983), and ANL/EAIS-8, *Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil* (Yu et al. 1993a).

II.3.3 Exposure Assessment and Risk Characterization

Section II.3.3.1 describes the exposure assessment for this risk assessment. Section II.3.3.2 provides the risk characterization, including the incremental TEDE and incremental estimated cancer risk, for the background-adjusted radiological COCs for industrial and residential land uses.

Table 4
Radiological Toxicological Parameter Values for ER Site 44a COCs

COC name	SF _{ev} (g/pCi-yr)	SF _o (1/pCi)	SF _{inh} (1/pCi)	Cancer Class [^]
U-238	5.7×10^{-8}	6.2×10^{-11}	1.2×10^{-8}	A
U-235	2.7×10^{-7}	4.7×10^{-11}	1.3×10^{-8}	A
U-233/234	2.1×10^{-11}	4.4×10^{-11}	1.4×10^{-8}	A

SF_{ev} - external volume exposure slope factor (risk/yr per pCi/g)

SF_o - oral (ingestion) slope factor (risk/pCi)

SF_{inh} - inhalation slope factor (risk/pCi)

[^] EPA weight-of-evidence classification system for carcinogenicity:

A - human carcinogen

B1 - probable human carcinogen. Limited human data are available

B2 - probable human carcinogen. Indicates sufficient evidence in animals and inadequate or no evidence in humans.

C - possible human carcinogen

D - not classifiable as to human carcinogenicity

E - evidence of noncarcinogenicity for humans

II.3.3.1 Exposure Assessment

For radionuclides, the coded equations provided in the RESRAD computer code were used to estimate the excess dose and cancer risk for the individual exposure pathways. Further discussion of this process is provided in Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0 (Yu et al. 1993b).

Although the designated land-use scenario is industrial for this site, the risk and TEDE values for a residential land-use scenario are also presented. These residential risk and TEDE values are presented only to provide perspective on the potential for risk to human health under the more restrictive land-use scenario.

II.3.3.2 Risk Characterization

For the radioactive COCs, contribution from the direct gamma exposure pathway is included, as well as inhalation and soil ingestion. For residential land use, the plant ingestion pathway is included. The incremental TEDE for industrial land-use is 0.06 millirems per year (mrem/yr), and the estimated excess cancer risk is 2×10^{-6} . For residential land-use, the incremental TEDE is 0.22 mrem/yr, and the estimated excess cancer risk is 3×10^{-6} .

II.4 Step 6. Comparison of Risk Values to Numerical Guidelines.

The risk assessment analyses considered the evaluation of the potential for adverse health effects for both an industrial land-use scenario, which is the designated land-use scenario for this site, and a residential land-use scenario.

For the industrial land-use scenario, the calculated incremental TEDE is 0.06 mrem/yr. In accordance with proposed EPA guidance, the standard being utilized is an incremental TEDE of 15 mrem/yr (40 CFR Part 196 1994) for the probable land-use scenario (industrial in this case); the calculated dose value for ER Site 44a for an industrial land-use is well below this standard. The estimated excess cancer risk is 2×10^{-6} .

For the residential land-use scenario, the incremental TEDE is 0.22 mrem/yr. In accordance with proposed EPA guidance, the standard being utilized is an incremental TEDE of 75 mrem/yr (40 CFR Part 196 1994) for a complete loss of institutional controls (residential land-use in this case); the calculated dose values for ER Site 44a for the residential land-use scenario is well below this standard. It should also be noted that, consistent with the proposed guidance (40 CFR Part 196 1994), ER Site 44a should be eligible for unrestricted radiological release, as the residential scenario resulted in an incremental TEDE to the on-site receptor of less than 15 mrem/yr. The associated estimated excess cancer risk is 3×10^{-6} .

II.5 Step 7 Uncertainty Discussion

The voluntary corrective measures (VCM) at ER Site 44a involved the removal of four concrete culverts. After removing each culvert, radiological screening of the soil below the culvert was performed. If radiological levels were at background or below, a confirmatory soil sample was taken. If radiological levels were above background, contaminated soil was removed until background levels were achieved, and then a sample was taken at the bottom of the excavation. The sampling method was defined in the VCM Plan and was deemed sufficient to characterize the site. The contaminants of concern were chromium and isotopic uranium. The chromium was analyzed by EPA Method 6010, and the isotopic uranium was analyzed by alpha spectroscopy.

Three sets of quality assurance/quality control (QA/QC) samples were analyzed as part of the VCM soil sampling program at Site 44a. A reagent blank and two laboratory control samples were included with four soil samples sent to an off-site laboratory in June 1994. These QA/QC samples were analyzed for the same constituents (isotopic uranium) as the soil samples. The reagent blank results were 0.0 picocuries per gram (pCi/g) for uranium (U)-235, 0.086 pCi/g for U-233/234, and 0.11 pCi/g for U-238. The sample results for these isotopes were significantly higher than the blank results. The spiked laboratory control samples agreed with the known values.

Laboratory duplicate control and single control samples were analyzed in conjunction with a soil sample from Site 44a sent to an off-site laboratory in June 1994. These QA/QC samples were analyzed for the same constituents (metals) as the soil sample. The results of the laboratory control sample analyses fell within the required level of precision.

A reagent blank and two laboratory control samples were included with four soil samples sent to an off-site laboratory in July 1994. These QA/QC samples were analyzed for similar radionuclide constituents as the soil samples. The reagent blank results were 0.0 pCi/g for U-235, 0.033 pCi/g for U-233/234, and 0.014 pCi/g for U-238. The sample results for these isotopes were significantly higher than the blank results. The spiked laboratory control samples agreed with the known values.

All soil samples were sent off site to a Contract Laboratory Program (CLP) laboratory for analysis. The data provided by the CLP laboratory are considered definitive data suitable for use in a risk assessment analysis.

The conclusion from the risk assessment analysis is that the potential effects caused by the nonradiological COC (chromium) on human health are within the proposed Subpart S screening criteria and therefore are not considered to pose significant risk to human health. Risk calculations were not performed for chromium since it was eliminated during the proposed Subpart S screening procedure.

For the radiological COCs, the conclusion from the risk assessment is that the potential effects on human health, for the industrial and residential land-use scenarios, are well within the proposed standard (40 CFR Part 196 1994) and are a small fraction of the estimated 290 mrem/yr received due to natural background (NCRP 1989).

Because of the location, history of the site, and the future land-use (DOE and USAF 1995), there is low uncertainty in the land-use scenario and the potentially affected populations that were considered in making the risk assessment analysis. Because the COCs are found in subsurface soils and because of the location and physical characteristics of the site, there is little uncertainty in the exposure pathways relevant to the analysis.

An RME approach was used to calculate the risk assessment values, which means that the parameter values used in the calculations were conservative and that the calculated intakes are likely overestimates. Maximum measured values of the concentrations of the COCs were used to provide conservative results.

The radiological incremental TEDE is a very small fraction of estimated background TEDE for both the industrial and residential land-use scenarios, and both are well within proposed guidelines (40 CFR Part 196 1994). The overall uncertainty in all of the steps in the risk assessment process is considered insignificant with respect to the conclusion reached.

II.6 Summary

ER Site 44a, the UCPs, had relatively minor contamination (after remediation) consisting of chromium and radioactive compounds. Because of the location of the site on KAFB, the designated industrial land-use scenario (DOE and USAF 1995), and the nature of the contamination, the potential exposure pathways identified for this site included soil ingestion and dust inhalation for chemical constituents and soil ingestion, dust and volatile inhalation, and direct gamma exposure for radionuclides. Plant uptake was included as an exposure pathway

for the residential land-use scenario. This site is designated for industrial land-use (DOE and USAF 1995); the residential land-use scenario is provided for perspective only.

The maximum chromium concentration was less than the proposed Subpart S action level and therefore was eliminated from further consideration in the risk assessment during this screening phase.

The incremental TEDE and corresponding estimated cancer risk from the radioactive components are much less than EPA guidance values; the estimated incremental TEDE is 0.06 mrem/yr for the industrial land-use scenario. This value is much less than the numerical guidance of 15 mrem/yr in draft EPA guidance. The corresponding estimated excess cancer risk value is 2×10^{-6} for the industrial land-use scenario.

The uncertainties associated with the calculations are considered small relative to the conservativeness of the risk assessment analysis. It is therefore concluded that this site does not have significant potential to affect human health under an industrial land-use scenario.

III. Ecological Risk Assessment

III.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPEC) at SNL/NM ER Site 44a. The ecological risk assessment process performed for this site is a screening level assessment that follows the methodology presented in IT Corporation (1997) and SNL/NM (1997). The methodology was based on screening level guidance presented by the EPA (EPA 1992, 1996b, 1997) and by Wentzel et al. (1996) and is consistent with a phased approach. This assessment utilizes conservatism in the estimation of ecological risks; however, ecological relevance and professional judgment are also incorporated as recommended by EPA (1996b) and Wentzel et al. (1996) to ensure that the predicted exposures of selected ecological receptors reasonably reflect those expected to occur at the site.

III.2 Ecological Pathways

ER Site 44a is part of Operable Unit 1303 and is located in TA-II. In general, the land within TA-II has been developed in its entirety (IT Corporation 1995). Essentially no suitable habitat (i.e., biological resources) remain in this area to sustain a viable ecological pathway between COPECs in surface and subsurface soil and plants and wildlife.

Chemical contamination of soils at this site has been assessed at soil depths greater than 5 feet. As stated in the protocol for performing ecological risk assessments for the SNL/NM ER Program (IT Corporation 1997), COCs in soil are considered to be bioavailable to a depth of 5 feet. This judgment is based on low rainfall of this habitat. Based on information on root depths and burrowing depths of species common to the grassland habitat at SNL/NM (e.g., Davis 1966, Reynolds and Wakkenen 1987, Reynolds and Fraley 1989), rooting and burrowing in this habitat is expected to be concentrated in the first few feet of the soil profile. If

the receptors cannot be exposed to a contaminant, the exposure pathway for that contaminant can be characterized as incomplete (EPA 1996b, Wentzel et al. 1996). Chemical contaminants at ER Site 44a are not accessible to ecological receptors, and therefore, complete ecological pathways do not exist at this site.

III.3 Constituents of Potential Ecological Concern

Because no complete ecological pathways exist at this site, none of the COCs are considered COPECs.

III.4 Risk Characterization

Due to the depth of the COCs in the subsurface soils, no complete ecological pathways exist at this site. The consequent lack of a cause-and-effect relationship leads to the conclusion no ecological risks are associated with the COCs at this site (Wentzel et al. 1996).

III.5 Uncertainties

The identification of 5 feet as the probable limit of rooting and burrowing depth at SNL/NM is founded on professional judgment based on the observed habitat conditions and information on rooting and burrowing depths from similar habitats and species. Although the possibility of contact with COCs at this depth cannot be completely ruled out, the rarity of such an event, coupled with the small size and disturbed nature of the site, will make it inconsequential to the health and integrity of the ecosystem at large.

III.6 Summary

No ecological receptors are predicted for ER Site 44a due to the depth of COCs in the subsurface soil (>5 ft below ground).

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APPENDIX 1.

Sandia National Laboratories Environmental Restoration Program

EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

BACKGROUND

Sandia National Laboratories (SNL) proposes that a default set of exposure routes and associated default parameter values be developed for each future land-use designation being considered for SNL/NM Environmental Restoration (ER) project sites. This default set of exposure scenarios and parameter values would be invoked for risk assessments unless site-specific information suggested other parameter values. Because many SNL/NM ER sites have similar types of contamination and physical settings, SNL believes that the risk assessment analyses at these sites can be similar. A default set of exposure scenarios and parameter values will facilitate the risk assessments and subsequent review.

The default exposure routes and parameter values suggested are those that SNL views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the USEPA Region VI and NMED, SNL proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all Environmental Restoration sites exist within the boundaries of the Kirtland AFB. Approximately 157 potential waste and release sites have been identified where hazardous, radiological, or mixed materials may have been released to the environment. Evaluation and characterization activities have occurred at all of these sites to varying degrees. Among other documents, the SNL/ER draft Environmental Assessment (DOE 1996) presents a summary of the hydrogeology of the sites, the biological resources present and proposed land use scenarios for the SNL/NM ER sites. At this time, all SNL/NM ER sites have been tentatively designated for either industrial or recreational future land use. The NMED has also requested that risk calculations be performed based on a residential land use scenario. All three land use scenarios will be addressed in this document.

The SNL/NM ER project has screened the potential exposure routes and identified default parameter values to be used for calculating potential intake and subsequent hazard index, risk and dose values. EPA (EPA 1989a) provides a summary of exposure routes that could potentially be of significance at a specific waste site. These potential exposure routes consist of:

- Ingestion of contaminated drinking water;
- Ingestion of contaminated soil;
- Ingestion of contaminated fish and shell fish;
- Ingestion of contaminated fruits and vegetables;
- Ingestion of contaminated meat, eggs, and dairy products;
- Ingestion of contaminated surface water while swimming;
- Dermal contact with chemicals in water;
- Dermal contact with chemicals in soil;
- Inhalation of airborne compounds (vapor phase or particulate), and;

- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

Based on the location of the SNL ER sites and the characteristics of the surface and subsurface at the sites, we have evaluated these potential exposure routes for different land use scenarios to determine which should be considered in risk assessment analyses (the last exposure route is pertinent to radionuclides only). At SNL/NM ER sites, there does not presently occur any consumption of fish, shell fish, fruits, vegetables, meat, eggs, or dairy products that originate on-site. Additionally, no potential for swimming in surface water is present due to the high-desert environmental conditions. As documented in the RESRAD computer code manual (ANL 1993), risks resulting from immersion in contaminated air or water are not significant compared to risks from other radiation exposure routes.

For the industrial and recreational land use scenarios, SNL/NM ER has therefore excluded the following four potential exposure routes from further risk assessment evaluations at any SNL/NM ER site:

- Ingestion of contaminated fish and shell fish;
- Ingestion of contaminated fruits and vegetables;
- Ingestion of contaminated meat, eggs, and dairy products; and
- Ingestion of contaminated surface water while swimming.

That part of the exposure pathway for radionuclides related to immersion in contaminated air or water is also eliminated.

For the residential land-use scenario, we will include ingestion of contaminated fruits and vegetables because of the potential for residential gardening.

Based on this evaluation, for future risk assessments, the exposure routes that will be considered are shown in Table 1. Dermal contact is included as a potential exposure pathway in all land use scenarios. However, the potential for dermal exposure to inorganics is not considered significant and will not be included. In general, the dermal exposure pathway is generally considered to not be significant relative to water ingestion and soil ingestion pathways but will be considered for organic components. Because of the lack of toxicological parameter values for this pathway, the inclusion of this exposure pathway into risk assessment calculations may not be possible and may be part of the uncertainty analysis for a site where dermal contact is potentially applicable.

EQUATIONS AND DEFAULT PARAMETER VALUES FOR IDENTIFIED EXPOSURE ROUTES

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation may also be significant for radionuclides. All of the above routes will, however, be considered for their appropriate land use scenarios. The general equations for calculating potential intakes via

Table 1. Exposure Pathways Considered for Various Land Use Scenarios

Industrial	Recreational	Residential
Ingestion of contaminated drinking water	Ingestion of contaminated drinking water	Ingestion of contaminated drinking water
Ingestion of contaminated soil	Ingestion of contaminated soil	Ingestion of contaminated soil
Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)
Dermal contact	Dermal contact	Dermal contact
External exposure to penetrating radiation from ground surfaces	External exposure to penetrating radiation from ground surfaces	Ingestion of fruits and vegetables
		External exposure to penetrating radiation from ground surfaces

these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund (RAGS): Volume 1 (EPA 1989a and 1991). These general equations also apply to calculating potential intakes for radionuclides. A more in-depth discussion of the equations used in performing radiological pathway analyses with the RESRAD code may be found in the RESRAD Manual (ANL 1993). Also shown are the default values SNL/NM ER suggests for use in Reasonable Maximum Exposure (RME) risk assessment calculations for industrial, recreational, and residential scenarios, based on EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants. RESRAD input parameters that are left as the default values provided with the code are not discussed. Further information relating to these parameters may be found in the RESRAD Manual (ANL 1993).

Generic Equation for Calculation of Risk Parameter Values

The equation used to calculate the risk parameter values (i.e., Hazard Quotient/Index, excess cancer risk, or radiation total effective dose equivalent [dose]) is similar for all exposure pathways and is given by:

Risk (or Dose) = Intake x Toxicity Effect (either carcinogenic, noncarcinogenic, or radiological)

$$= C \times (CR \times EFD/BW/AT) \times \text{Toxicity Effect} \quad (1)$$

where

- C = contaminant concentration (site specific);
- CR = contact rate for the exposure pathway;
- EFD = exposure frequency and duration;
- BW = body weight of average exposure individual;
- AT = time over which exposure is averaged.

The total risk/dose (either cancer risk or hazard index) is the sum of the risks/doses for all of the site-specific exposure pathways and contaminants.

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk range of 10^{-4} to 10^{-6} . The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the Hazard Index) for the toxicity resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of this quantitative estimate with the EPA standard Hazard Index of unity (1). The evaluation of the health hazard due to radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site.

The specific equations used for the individual exposure pathways can be found in RAGS (EPA 1989a) and the RESRAD Manual (ANL 1993). Table 2 shows the default parameter values suggested for use by SNL at ER sites, based on the selected land use scenario. References are given at the end of the table indicating the source for the chosen parameter values. The intention of SNL is to use default values that are consistent with regulatory guidance and consistent with the RME approach. Therefore, the values chosen will, in general, provide a conservative estimate of the actual risk parameter. These parameter values are suggested for use for the various exposure pathways based on the assumption that a particular site has no unusual characteristics that contradict the default assumptions. For sites for which the assumptions are not valid, the parameter values will be modified and documented.

Summary

SNL proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial, recreational or residential future land-use scenario. There are no current residential land-use designations at SNL ER sites, but this scenario has been requested to be considered by the NMED. For sites designated as industrial or recreational land-use, SNL will provide risk parameter values based on a residential land-use scenario to indicate the effects of data uncertainty on risk value calculations or in order to potentially mitigate the need for institutional controls or restrictions on Sandia ER sites. The parameter values are based on EPA guidance and supplemented by information from other government sources. The values are generally consistent with those proposed by Los Alamos National Laboratory, with a few minor variations. If these exposure routes and parameters are acceptable, SNL will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

Table 2. Default Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency (d/y)	***	***	***
Exposure duration (y)	30 ^{a,b}	30 ^{a,b}	30 ^{a,b}
Body weight (kg)	70 ^{a,b}	56 ^{a,b}	70 adult ^{a,b} 15 child
Averaging Time (days) for carcinogenic compounds (=70 y x 365 d/y)	25550 ^a	25550 ^a	25550 ^a
for noncarcinogenic compounds (=ED x 365 d/y)	10950	10950	10950
Soil Ingestion Pathway			
Ingestion rate	100 mg/d ^c	6.24 g/y ^d	114 mg-y/kg-d ^a
Inhalation Pathway			
Inhalation rate (m ³ /yr)	5000 ^{a,b}	146 ^d	5475 ^{a,b,d}
Volatilization factor (m ³ /kg)	chemical specific	chemical specific	chemical specific
Particulate emission factor (m ³ /kg)	1.32E9 ^a	1.32E9 ^a	1.32E9 ^a
Water Ingestion Pathway			
Ingestion rate (L/d)	2 ^{a,b}	2 ^{a,b}	2 ^{a,b}
Food Ingestion Pathway			
Ingestion rate (kg/yr)	NA	NA	138 ^{b,d}
Fraction ingested	NA	NA	0.25 ^{b,d}
Dermal Pathway			
Surface area in water (m ²)	2 ^{b,e}	2 ^{b,e}	2 ^{b,e}
Surface area in soil (m ²)	0.53 ^{b,e}	0.53 ^{b,e}	0.53 ^{b,e}
Permeability coefficient	chemical specific	chemical specific	chemical specific

*** The exposure frequencies for the land use scenarios are often integrated into the overall contact rate for specific exposure pathways. When not included, the exposure frequency for the industrial land use scenario is 8 h/d for 250 d/y; for the recreational land use, a value of 2 hr/wk for 52 wk/y is used (EPA 1989b); for a residential land use, all contact rates are given per day for 350 d/y.

^a RAGS, Vol 1, Part B (EPA 1991).

^b Exposure Factors Handbook (EPA 1989b)

^c EPA Region VI guidance.

^d For radionuclides, RESRAD (ANL 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.

^e Dermal Exposure Assessment (EPA 1992).

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Section 6.2
ER Site 44b: Risk Assessment Report

ER SITE 44b: RISK ASSESSMENT ANALYSIS

I. Site Description and History

The Decontamination Area, Environmental Restoration (ER) Site 44b at Sandia National Laboratories/New Mexico (SNL/NM), was used for a number of years until the mid-1970s. The area was used to decontaminate materials shipped from the Nevada Test Site (NTS). The Decontamination Area is located on the west side of Building 906, near the central portion of Technical Area (TA)-II.

Weapons components and related test materials from the NTS reportedly were decontaminated outside Building 906. These materials may have contained metals and radionuclides. Decontamination (washing off contaminated material with a hose) probably was conducted on the ground surface. No other information has been found regarding past activities conducted at the Decontamination Area. Contaminants of concern (COC) include metals and radionuclides.

II. Human Health Risk Assessment Analysis

Risk assessment of this site includes a number of steps, which culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at the site. The steps to be discussed include:

Step 1.	Site data are described that provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways by which a representative population might be exposed to the COCs are identified.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The tiered approach includes screening steps, followed by potential intake calculations and a discussion or evaluation of the uncertainty in those calculations. Potential intake calculations are also applied to background screening data.
Step 4.	Data are described on the potential toxicity and cancer effects from exposure to the COCs and associated background constituents and subsequent intake.
Step 5.	Potential toxicity effects (specified as a Hazard Index) and cancer risks are calculated for nonradiological COCs and background. For radiological COCs, the incremental total effective dose equivalent (TEDE) and incremental estimated cancer risk are calculated by subtracting applicable background concentrations directly from maximum on-site contaminant values. This background subtraction only occurs when a radiological COC occurs as contamination and exists as a natural background radionuclide.
Step 6.	These values are compared with guidelines established by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) to determine whether further evaluation, and potential site clean-up, is required. Nonradiological COC risk values are also compared to background risk so that an incremental risk may be calculated.
Step 7.	Uncertainties in the previous steps are discussed.

II.1 Step 1. Site Data

Site history and characterization activities are used to identify potential COCs. The identification of COCs and the sampling to determine the concentration levels of those COCs across the site are described in the ER Site 44b No Further Action Proposal. In order to provide conservatism in this risk assessment, the calculation uses only the maximum concentration value of each COC determined for the entire site. Maximum concentrations of nonradiological COCs reported from subsurface and surface samples were combined into a single table to provide conservative risk calculations. All radiological COCs were found to be on the surface so only surface background was used. Minimum upper tolerance limits (UTL) or 95th percentiles, as appropriate, were selected to provide the background screen in Table 1 and to be used to calculate risk attributable to background for Table 6. Chemicals that are essential nutrients, such as iron, magnesium, calcium, potassium, and sodium, were not included in this risk assessment (EPA 1989). Both radioactive and nonradioactive COCs are evaluated. The nonradioactive COCs evaluated are metals.

II.2 Step 2. Pathway Identification

ER Site 44b has been designated with a future land-use scenario of industrial (DOE and USAF 1995) (see Appendix 1 for default exposure pathways and parameters). Because of the location and the characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for chemical COCs and direct gamma exposure for radiological contaminants. The inhalation pathway for both chemicals is included because of the potential to inhale dust and volatiles. Soil ingestion is included for radiological COCs. No contamination at depth was suspected, and therefore no water pathways to the groundwater are considered. Depth to groundwater at Site 44b is approximately 320 feet below ground surface. Because of the lack of surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered not to be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate for the industrial land-use scenario. However, plant uptake is considered for the residential land-use scenario.

PATHWAY IDENTIFICATION

Chemical Constituents	Radionuclide Constituents
Soil ingestion	Soil ingestion
Inhalation (dust)	Inhalation (dust and volatiles)
Plant uptake (Residential only)	Plant uptake (residential only)
	Direct gamma

II.3 Steps 3-5. Calculation of Hazard Indices and Cancer Risks

Steps 3 through 5 are discussed in this section. These steps include the discussion of the tiered approach in eliminating potential COCs from further consideration in the risk assessment process and the calculation of intakes from all identified exposure pathways, the discussion of the toxicity information, and the calculation of the hazard indices and cancer risks.

Table 1
Nonradioactive COCs at ER Site 44b and Comparison to the
Background Screening Values

COC name	Maximum concentration (mg/kg)	SNL/NM 95th % or UTL Level (mg/kg)	Is maximum COC concentration less than or equal to the applicable SNL/NM background screening value?
Barium	122	200	Yes
Beryllium	0.59	0.80	Yes
Cadmium	0.7	<1^	NA
Chromium, total*	9.3	NC	NA
Lead	25.7	11.2	No
Mercury	0.33	<0.1^	No
Nickel	11.4	25.4	Yes
Silver	0.5**	<1^	NA
Zinc	84.1	76	No

NC - not calculated

NA - not applicable

*total chromium assumed to be chromium VI (most conservative)

^ uncertainty due to detection limits

** concentrations are assumed to be one-half of the detection limit

The risks from the COCs at ER Site 44b were evaluated using a tiered approach. First, the maximum concentrations of COCs were compared to the SNL/NM background screening levels for this area (IT Corporation 1996), as modified during verbal discussion with representatives of New Mexico Environment Department (NMED). If a SNL/NM-specific screening level was not available for a constituent, then a background value was obtained, when possible, from the U.S. Geological Survey (USGS) National Uranium Resource Evaluation program (USGS 1994).

The maximum concentration of each COC was used in order to provide a conservative estimate of the associated risk. If any nonradiological COCs were above either the SNL/NM background screening levels or the USGS background value, all nonradiological COCs were considered in further risk assessment analyses.

For radiological COCs that exceeded the SNL/NM background screening levels, background values were subtracted from the individual maximum radionuclide concentrations. Those that did not exceed these background levels were not carried any further in the risk assessment. This approach is consistent with DOE orders. Radioactive COCs that did not have a background value and were detected above the analytical minimum detectable activity were carried through the risk assessment at their maximum levels. This step is performed (rather than carry the below-background radioactive COCs through the risk assessment and then perform a background risk assessment to determine incremental TEDE and estimated cancer risk) to prevent the "masking" of radiological contamination that may occur if on-site background radiological COCs exist in concentrations far enough below the assigned background level. When this "masking" occurs, the final incremental TEDE and estimated cancer risk are reduced

and, therefore, provide a non-conservative estimate of the potential impact on an on-site receptor. This approach is also consistent with the regulatory approach (40 CFR Part 196 1994), which sets a TEDE limit to the on-site receptor in excess of background. The resultant radioactive COCs remaining after this step are referred to as background-adjusted radioactive COCs.

Second, if any nonradiological COC failed the initial screening step, the maximum concentration for each nonradiological COC was compared with the pertinent action level calculated using methods and equations promulgated in the proposed Resource Conservation and Recovery Act (RCRA) Subpart S (40 CFR Part 264 1990) and Risk Assessment Guidance for Superfund (RAGS) (EPA 1989) documentation. If there are ten or fewer COCs and each has a maximum concentration less than one-tenth of its action level, then the site would be judged to pose no significant health hazard to humans. If there are more than ten COCs, the Subpart S screening procedure was skipped.

Third, hazard indices and risk due to carcinogenic effects were calculated using reasonable maximum exposure (RME) methods and equations promulgated in RAGS (EPA 1989). The combined effects of all nonradiological COCs in the soils were calculated. The combined effects of the nonradiological COCs at their respective UTL or 95th percentile background concentrations in the soil were also calculated. For toxic compounds, the combined effects were calculated by summing the individual hazard quotients for each compound into a total Hazard Index. This Hazard Index is compared to the recommended guideline of 1. For potentially carcinogenic compounds, the individual risks were summed. The total risk was compared to the recommended acceptable risk range of 10^{-4} to 10^{-6} . For the radioactive COCs, the incremental TEDE was calculated and the corresponding incremental cancer risk estimated using DOE's RESRAD computer code.

II.3.1 Comparison to Background and Action Levels

Nonradioactive ER Site 44b COCs are listed in Table 1, and radioactive COCs are listed in Table 2. Both tables show the associated 95th percentile or UTL background levels (IT Corporation 1996), as modified during verbal discussion with representatives of NMED.

The SNL/NM background levels have not yet been approved by the EPA or the NMED but are the result of a comprehensive study of joint SNL/NM and U.S. Air Force data from the Kirtland Air Force Base (KAFB). The values shown in Tables 1 and 2 supersede the background values described in an interim background study report (IT Corporation 1994).

Several compounds have maximum measured values greater than background screening levels. Therefore, all nonradiological COCs were retained for further analysis with the exception of lead. The maximum concentration value for lead is 25.7 milligrams per kilogram (mg/kg). The EPA intentionally does not provide any toxicological data on lead, and therefore no risk parameter values can be calculated. However, EPA guidance for the screening value for lead for an industrial land-use scenario is 2,000 mg/kg (EPA 1996a); for a residential land-use scenario, the EPA screening guidance value is 400 mg/kg (EPA 1994). The maximum concentration value for lead at this site is less than both of those screening values, and therefore lead is eliminated from further consideration in this risk assessment. For the

Table 2
Radioactive COCs at ER Site 44b and Comparison to the Background Screening Values

COC name	Maximum concentration (pCi/g)	SNL/NM 95th % or UTL Level (pCi/g)	Is maximum COC concentration less than or equal to the applicable SNL/NM background screening value?
U-238	1.1	1.3	Yes
U-235	ND	0.18	Yes
U-234	ND	1.6	Yes
Th-232	1.0	1.54	Yes
Ra-228	1.0	1.33	Yes
Cs-137	0.77	0.84	Yes

NC - Not calculated.

ND - Not detected.

radiological COCs no maximum measured value exceeded the background screening levels and, therefore, radionuclides were carried no further in the risk assessment.

Because several nonradiological COCs had concentrations greater than their respective SNL/NM background 95th percentiles or UTLs, the site fails the background screening criterion, and all nonradiological COCs proceed to the proposed Subpart S action level screening procedure.

Table 3 shows the nonradioactive COCs compared to the proposed Subpart S action level for soils. The table compares the maximum concentration values to 1/10 of the proposed Subpart S action level. This methodology was guidance given to SNL/NM from the EPA (EPA 1996b). This is the second screening process in the tiered risk assessment approach. Beryllium had a concentration greater than 1/10 of the proposed Subpart S action level. Because of beryllium, the site fails the proposed Subpart S screening criteria, and a Hazard Index value and cancer risk value must be calculated for all of the nonradioactive COCs.

II.3.2 Identification of Toxicological Parameters

Table 4 shows the COCs that have been retained in the risk assessment and the values for the toxicological information available for those COCs.

II.3.3 Exposure Assessment and Risk Characterization

Section II.3.3.1 describes the exposure assessment for this risk assessment. Section II.3.3.2 provides the risk characterization, including the Hazard Index value and the excess cancer risk, for both the potential nonradiological COCs and associated background for industrial and residential land-uses.

Table 3
Comparison of ER Site 44b Nonradioactive COC Concentrations to
Proposed Subpart S Action Levels

COC name	Maximum concentration (mg/kg)	Proposed Subpart S Action Level (mg/kg)	Is individual contaminant less than 1/10 the Action Level?
Barium	122	6,000	Yes
Beryllium	0.59	0.2	No
Cadmium	0.7	80	Yes
Chromium, total*	9.3	400	Yes
Mercury	0.33	20	Yes
Nickel	11.4	2,000	Yes
Silver	0.5**	400	Yes
Zinc	84.1	20,000	Yes

* total chromium assumed to be chromium VI (most conservative)

** concentrations are assumed to be one-half of the detection limit

Table 4
Nonradioactive Toxicological Parameter Values for ER Site 44b COCs

COC name	RfD_o (mg/kg/d)	RfD_{inh} (mg/kg/d)	Confidence	SF_o (kg-d/mg)	SF_{inh} (kg-d/mg)	Cancer Class ^
Barium	0.07	0.000143	M	--	--	D
Beryllium	0.005	--	L	4.3	8.4	B2
Cadmium	0.0005	0.0000571	H	--	6.3	B1
Chromium, total*	0.005	--	L	--	42	A
Mercury	0.0003	0.0000857	M	--	--	D
Nickel	0.02	--	--	--	--	D
Silver	0.005	--	L	--	--	D
Zinc	0.3	--	M	--	--	D

* total chromium assumed to be chromium VI (most conservative)

RfD_o - oral chronic reference dose in mg/kg-day

RfD_{inh} - inhalation chronic reference dose in mg/kg-day

Confidence - L = low, M = medium, H = high

Heast - Heast Table from EPA 1996c

SF_o - oral slope factor in (mg/kg-day)⁻¹

SF_{inh} - inhalation slope factor in (mg/kg-day)⁻¹

^ EPA weight-of-evidence classification system for carcinogenicity:

A - human carcinogen

B1 - probable human carcinogen. Limited human data are available

B2 - probable human carcinogen. Indicates sufficient evidence in animals and inadequate or no evidence in humans.

C - possible human carcinogen

D - not classifiable as to human carcinogenicity

E - evidence of noncarcinogenicity for humans

-- information not available

II.3.3.1 Exposure Assessment

Appendix 1 shows the equations and parameter values used in the calculation of intake values and the subsequent Hazard Index and excess cancer risk values for the individual exposure pathways. The appendix shows the parameters for both industrial and residential land-use scenarios. The equations are based on RAGS (EPA 1989). The parameters are based on information from RAGS (EPA 1989), as well as other EPA guidance documents, and reflect the RME approach advocated by RAGS (EPA 1989).

II.3.3.2 Risk Characterization

Table 5 shows that for the ER Site 44b nonradioactive COCs, the Hazard Index value is 0.00, and the excess cancer risk is 1×10^{-6} for the designated industrial land-use scenario. The numbers presented included exposure from soil ingestion and dust inhalation for the nonradioactive COCs. Table 6 shows that assuming the maximum background concentrations of the ER Site 44b associated nonradiological background constituents, the Hazard Index is 0.00, and the excess cancer risk is 1×10^{-6} for the designated industrial land-use scenario.

For the residential land-use scenario, the Hazard Index value increases to 1, and the excess cancer risk is 5×10^{-6} . The numbers presented included exposure from soil ingestion, dust and volatile inhalation, and plant uptake. Although EPA (1991) generally recommends that inhalation not be included in a residential land-use scenario, this pathway is included because of the potential for soil in Albuquerque, New Mexico, to be eroded and, subsequently, for dust to be present even in predominantly residential areas. Because of the nature of the local soil, other exposure pathways are not considered (see Appendix 1). Table 6 also shows that for the ER Site 44b associated nonradiological background constituents, the Hazard Index increases to 0.2, and the excess cancer risk is 6×10^{-6} .

II.4 Step 6. Comparison of Risk Values to Numerical Guidelines.

The risk assessment analyses considered the evaluation of the potential for adverse health effects for both an industrial land-use scenario, which is the designated land-use scenario for this site, and a residential land-use scenario.

For the industrial land-use scenario, the Hazard Index calculated for the nonradioactive COCs is 0.00; this is much less than the numerical guideline of 1 suggested in RAGS (EPA 1989). The excess cancer risk is estimated at 1×10^{-6} . In RAGS, the EPA suggests that a range of values (10^{-6} to 10^{-4}) be used as the numerical guideline; the value calculated for this site is at the low end of the suggested acceptable risk range. This risk assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the industrial and residential land-use scenarios. For the industrial land-use scenario, the Hazard Index is 0.00. The excess cancer risk is estimated at 1×10^{-6} . Incremental risk is determined by subtracting risk associated with background from potential nonradiological COC risk. These numbers are not rounded before the difference is determined and therefore may appear to be inconsistent with numbers presented in tables and discussed within the text. The incremental

Table 5
Nonradioactive Risk Assessment Values for ER Site 44b COCs

COC Name	Maximum concentration (mg/kg)	Industrial Land-Use Scenario		Residential Land-Use Scenario	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Barium	122	0.00	--	0.02	--
Beryllium	0.59	0.00	1E-6	0.00	5E-6
Cadmium	0.7	0.00	3E-10	0.57	4E-10
Chromium, total*	9.3	0.00	3E-8	0.01	4E-8
Mercury	0.33	0.00	--	0.57	--
Nickel	11.4	0.00	--	0.00	--
Silver	0.5**	0.00	--	0.02	--
Zinc	84.1	0.00	--	0.15	--
TOTAL		0.00	1E-6	1	5E-6

* total chromium assumed to be chromium VI (most conservative)

** concentrations are assumed to be one-half of the detection limit

-- information not available

Table 6
Nonradioactive Risk Assessment Values for ER Site 44b Background Constituents

Constituent Name	Background concentration (mg/kg)	Industrial Land-Use Scenario		Residential Land-Use Scenario	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Barium	200	0.00	--	0.03	--
Beryllium	0.80	0.00	1E-6	0.00	6E-6
Cadmium	<1	--	--	--	--
Chromium, total*	NC	--	--	--	--
Mercury	<0.1	--	--	--	--
Nickel	25.4	0.00	--	0.00	--
Silver	<1	--	--	--	--
Zinc	76	0.00	--	0.14	--
TOTAL		0.00	1E-6	0.2	6E-6

-- information not available

* total chromium assumed to be chromium VI (consistent with Table 5)

Hazard Index is zero and the incremental cancer risk is 3×10^{-8} for the industrial land-use scenario. These incremental risk calculations indicate insignificant risk to human health from the COCs considering an industrial land-use scenario.

For the residential land-use scenario, the calculated Hazard Index for the nonradioactive COCs is 1, which is equal to the numerical guidance. The excess cancer risk is estimated at 5×10^{-6} ; this value is within the suggested acceptable risk range. The Hazard Index for associated background for the residential land-use scenario is 0.2. The excess cancer risk is estimated at 6×10^{-6} . For the residential land-use scenario, the incremental Hazard Index is 1.17, and there is no incremental cancer risk. These incremental risk calculations indicate significant contribution to the Hazard Index from the COCs considering a residential land-use scenario.

II.5 Step 7 Uncertainty Discussion

Voluntary corrective measures activities at Site 44b included radiation scanning to verify anomalies identified in 1994, removal of fragments and/or soil until readings were less than 1.3 times site-specific background levels, and post-cleanup (verification) soil sampling for gamma spectroscopy analysis. After the removal of radiologically contaminated soils, three samples were collected from areas exhibiting the highest residual radioactivity remaining in the soil. The sampling method was deemed sufficient to characterize the site. The nonradiological COCs were barium, beryllium, cadmium, chromium, lead, mercury, nickel, silver, and zinc. The radiological COCs were isotopic uranium, thorium (Th)-232, radium (Ra)-228, cesium (Cs)-137, and Cs-134. The nonradiological COCs were analyzed by EPA Methods 6010 and 7470. Isotopic uranium and Th-232 were analyzed by gamma spectroscopy. Ra-228, Cs-137, and Cs-134 were analyzed by gamma spectroscopy. The data provided by the laboratory are considered definitive data suitable for use in a risk assessment analysis.

The conclusion from the risk assessment analysis is that the potential effects on human health caused by nonradiological COCs are within the acceptable range compared to established numerical guidelines for the industrial land-use scenario. Calculated incremental risk between potential nonradiological COCs and associated background indicate small contribution of risk from nonradiological COCs when considering the industrial land-use scenario.

Since no radioactive COCs existed in excess of background concentrations a radiological risk assessment was not performed.

The potential effects on human health for the nonradiological COCs are greater when considering the residential land-use scenario. Incremental risk between potential nonradiological COCs and associated background also indicates a slightly increased contribution of risk from the nonradiological COCs. The increased effects on human health are primarily the result of including the plant uptake exposure pathway. Constituents that posed little to no risk considering an industrial land-use scenario (some of which are below background screening levels) contribute a significant portion of the risk associated with the residential land-use scenario. These constituents bioaccumulate in plants. Because Site 44b is designated as an industrial land-use area (DOE and USAF 1995), the likelihood of significant plant uptake in this area is highly unlikely. The uncertainty in this conclusion is considered to be small.

Because of the location, history of the site, and the future land-use (DOE and USAF 1995), there is low uncertainty in the land-use scenario and the potentially affected populations that were considered in making the risk assessment analysis. Because the COCs are found in surface and near-surface soils and because of the location and physical characteristics of the site, there is little uncertainty in the exposure pathways relevant to the analysis.

An RME approach was used to calculate the risk assessment values, which means that the parameter values used in the calculations were conservative and that the calculated intakes are likely overestimates. Maximum measured values of the concentrations of the COCs and minimum value of the 95th UTL or percentile background concentration value, as applicable, of background concentrations associated with the COCs were used to provide conservative results.

Table 4 shows the uncertainties (confidence) in the nonradiological toxicological parameter values. There is a mixture of estimated values and values from the Health Effects Assessment Summary Tables (HEAST) (EPA 1996c) and Integrated Risk Information System (IRIS) (EPA 1988, 1997a) databases. Where values are not provided, information is not available from HEAST, IRIS, or EPA regions. Because of the conservative nature of the RME approach, the uncertainties in the toxicological values are not expected to be of high enough concern to change the conclusion from the risk assessment analysis.

The nonradiological risk assessment values are within the acceptable range for the industrial land-use scenario compared to the established numerical guidelines. Though the residential land-use Hazard Index is at the numerical guideline, it has been determined that future land-use at this locality will not be residential (DOE and USAF 1995). The overall uncertainty in all of the steps in the risk assessment process is considered insignificant with respect to the conclusion reached.

II.6 Summary

ER Site 44b, the Decontamination Area, had relatively minor contamination consisting of some inorganic nonradioactive compounds. Because of the location of the site on KAFB, the designated industrial land-use scenario (DOE and USAF 1995), and the nature of the contamination, the potential exposure pathways identified for this site included soil ingestion and dust and volatile inhalation. Plant uptake was included as an exposure pathway for the residential land-use scenario. This site is designated for industrial land-use (DOE and USAF 1995); the residential land-use scenario is provided for perspective only.

Using conservative assumptions and employing an RME approach to the risk assessment, the calculations for the nonradiological COCs show that for the industrial land-use scenario, the Hazard Index (0.00) is significantly less than the accepted numerical guidance from the EPA. The estimated cancer risk (1×10^{-6}) is in the low end of the suggested acceptable risk range. The incremental Hazard Index is 0.00, and the incremental cancer risk is 3×10^{-8} for the industrial land-use scenario. Incremental risk calculations indicate insignificant risk to human health from the nonradiological COCs considering an industrial land-use scenario.

The main contributor to the nonradiological industrial land-use scenario risk assessment was beryllium. The maximum beryllium concentration (0.59 mg/kg) is below the background screening concentration of 0.80 mg/kg and therefore is not indicative of contamination.

The uncertainties associated with the calculations are considered small relative to the conservativeness of the risk assessment analysis. It is therefore concluded that this site does not have significant potential to affect human health under an industrial land-use scenario.

III. Ecological Risk Assessment

III.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPEC) in soils from SNL/NM ER Site 44b. The ecological risk assessment process performed for this site is a screening level assessment that follows the methodology presented in IT Corporation (1997) and SNL/NM (1997). The methodology was based on screening level guidance presented by EPA (EPA, 1992; 1996d; 1997b) and by Wentzel et al. (1996) and is consistent with a phased approach. This assessment utilizes conservatism in the estimation of ecological risks; however, ecological relevance and professional judgment are also incorporated as recommended by EPA (1996d) and Wentzel et al. (1996) to ensure that the predicted exposures of selected ecological receptors reasonably reflect those expected to occur at the site.

III.2 Ecological Pathways

The Decontamination Area (ER Site 44b) is part of Operable Unit 1303 and is located in TA-II. In general, the land within TA-II has been developed to its entirety (IT Corporation 1995). Essentially only limited suitable habitat (i.e., biological resources) remains in this area to sustain a viable ecological pathway between COPECs in surface and subsurface soil and plants and wildlife. Because some potential for exposure does exist, ecological risk predictions will be made.

III.3 Constituents of Potential Ecological Concern

The potential COCs at this site include some RCRA metals, beryllium, nickel, and several radionuclides. Following the screening process used for the selection of potential COCs for the human health risk assessment, the inorganic COCs were screened against background UTLs. Six inorganic analytes were identified as COPECs at Site 44b: cadmium, chromium (total), lead, mercury, silver, and zinc. Chemicals that are essential nutrients, such as iron, magnesium, calcium, potassium, and sodium, were not included in this risk assessment per EPA guidance (EPA 1989). No detected radionuclides exceeded background concentrations.

III.4 Receptors and Exposure Modeling

A nonspecific perennial plant was used as the receptor to represent plant species at the site. Two wildlife receptors (deer mouse and burrowing owl) were used to represent wildlife use of the site. Exposure modeling for the wildlife receptors was limited to the food ingestion pathway. Inhalation and dermal contact were considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Drinking water was also considered an insignificant pathway because of the lack of surface water at this site. The deer mouse was modeled as an omnivore (50 percent of the diet as plants and 50 percent as soil invertebrates), and the burrowing owl was modeled as a strict predator on small mammals (100 percent of the diet as deer mice). Both were modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 7 presents the species-specific factors used in modeling exposures in the wildlife receptors. Although home range is also included in this table, exposures for this screening-level assessment were modeled using an area use factor of 1, implying that all food items and soil ingested are from the site being investigated.

The maximum measured COPEC concentrations from both surface and subsurface soil samples were used to conservatively estimate potential exposures and risks to plants and wildlife at this site. One-half the detection limit was used for silver from the on-site laboratory, which was not otherwise detected but was retained due to the high detection limit.

Table 8 presents the transfer factors used in modeling the concentrations of the nonradioactive COPECs through the food chain. Table 9 presents the maximum concentrations of the nonradioactive COPECs in soil, the derived concentrations in the various food-chain elements, and the modeled dietary exposures for each of wildlife receptor species.

III.5 Toxicity Benchmarks

Benchmark toxicity values for the plant and wildlife receptors are presented in Table 10. For plants, the benchmark soil concentrations are based on the lowest-observed-adverse-effect level (LOAEL). For wildlife, the toxicity benchmarks are based on the no-observed-adverse-effect level (NOAEL) for chronic oral exposure in a taxonomically similar test species. Total chromium was assumed to be entirely chromium-VI. Insufficient toxicity information was found to estimate the NOAELs for birds exposed to silver.

III.6 Risk Characterization

The maximum soil concentrations and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. The results of these nonradiological comparisons are presented in Table 11. Hazard quotients (HQ) are used to quantify the comparison with the benchmarks for wildlife exposure. Maximum soil concentrations for chromium (total), mercury, and zinc exceeded their respective plant benchmark concentrations. No potential risk was predicted for the deer mouse. For the burrowing owl, only the HQ for mercury (HQ = 4.70) exceeded unity.

Table 7
Exposure Factors for Ecological Receptors at
Environmental Restoration Site 44b,
Sandia National Laboratories, New Mexico

Receptor Species	Class/ Order	Trophic level	Body weight (kg) ^a	Food intake rate (kg/d) ^b	Dietary Composition ^c	Home range (acres)
Deer Mouse (<i>Peromyscus maniculatus</i>)	Mammalia/ Rodentia	Omnivore	0.0239 ^d	0.00372	Plants: 50% Invertebrates: 50% (+ Soil at 2% of intake)	0.27 ^e
Burrowing owl (<i>Speotyto cunicularia</i>)	Aves/ Strigiformes	Carnivore	0.155 ^f	0.0173	Rodents: 100% (+ Soil at 2% of intake)	34.6 ^g

^aBody weights are in kilograms wet weight.

^bFood intake rates are estimated from the allometric equations presented in Nagy (1987). Units are kilograms dry weight per day.

^cDietary compositions are generalized for modeling purposes. Default soil intake value of 2 percent of food intake.

^dFrom Silva and Downing (1995).

^eFrom EPA (1993), based on the average home range measured in semi-arid shrubland in Idaho.

^fFrom Dunning (1993).

^gFrom Haug et al. (1993).

Table 8
Transfer Factors Used in Exposure Models for
Constituents of Potential Ecological Concern at
Environmental Restoration Site 44b,
Sandia National Laboratories, New Mexico

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Cadmium	5.50×10^{-1}	6.00×10^{-1}	5.50×10^{-4}
Chromium (Total)	4.00×10^{-2a}	1.30×10^{-1b}	3.00×10^{-2a}
Mercury	1.00×10^{0c}	1.00×10^{0d}	2.50×10^{-1d}
Lead	9.00×10^{-2}	4.00×10^{-2}	8.00×10^{-4}
Silver	1.00×10^{0c}	2.50×10^{-1e}	5.00×10^{-3a}
Zinc	1.50×10^{0d}	3.00×10^{-1e}	1.00×10^{-1c}

^aFrom Baes et al. (1984).

^bFrom Stafford et al. (1991).

^cDefault value.

^dFrom NCRP (1989).

^eFrom Ma (1982).

Table 9
Media Concentrations (mg/kg)^a for
Constituents of Potential Ecological Concern at
Environmental Restoration Site 44b,
Sandia National Laboratories, New Mexico

Constituent of Potential Ecological Concern	Soil (maximum)	Plant Foliage ^b	Soil •Invertebrate ^b	Deer Mouse Tissues ^c
Cadmium	7.00×10^{-1}	3.85×10^{-1}	4.20×10^{-1}	7.16×10^{-4}
Chromium (Total)	9.30×10^0	3.72×10^{-1}	1.21×10^0	9.15×10^{-2}
Lead	$2.57 \times 10^{+1}$	2.31×10^0	1.03×10^0	5.46×10^{-3}
Mercury	3.30×10^{-1}	3.30×10^{-1}	3.30×10^{-1}	2.63×10^{-1}
Silver	5.00×10^{-1}	5.00×10^{-1}	1.25×10^{-1}	5.04×10^{-3}
Zinc	8.41×10^1	1.26×10^2	2.52×10^1	2.42×10^1

^aMilligrams per kilogram. All are based on dry weight of the media.

^bProduct of the soil concentration and the corresponding transfer factor.

^cProduct of the average concentration in food times the food-to-muscle transfer factor times the wet weight-dry weight conversion factor of 3.125 (from EPA 1993).

Table 10
Toxicity Benchmarks for Ecological Receptors at
Environmental Restoration Site 44b,
Sandia National Laboratories, New Mexico

Constituent of Potential Ecological Concern ^a	Plant Benchmark ^a	Mammalian NOAELs			Avian NOAELs		
		Mammalian Test Species ^b	Test Species NOAEL ^c	Deer Mouse NOAEL ^d	Avian Test Species ^e	Test Species NOAEL ^e	Burrowing Owl NOAEL ^f
Cadmium	3	Lab rat	1	1.89	Mallard	1.45	1.45
Chromium (Total)	1	Lab rat	2737	5354	Black Duck	1.0	1.0
Lead	50	Lab rat	8	15.65	Am. Kestrel	3.85	3.85
Mercury	0.3	Lab rat	0.032	0.0626	Mallard	0.0064	0.0064
Silver	2	Lab rat ^g	17.8	34.8	---	---	---
Zinc	50	Lab rat	160	313	Chicken	14.5	14.5

^aFrom Will and Suter (1995).

^bFrom Sample et al. (1996), except where noted. Body weights (in kilograms) for NOAEL conversion are: lab mouse, 0.030; lab rat, 0.350 (except where noted); and mink, 1.0.

^cFrom Sample et al. (1996), except where noted.

^dBased on NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.239 kilograms and a mammalian scaling factor of 0.25.

^eFrom Sample et al. (1996).

^fBased on NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.

^gFrom EPA (1997b).

^h--- designates insufficient toxicity data.

Table 11
Comparisons to Toxicity Benchmarks for
Ecological Receptors at
Environmental Restoration Site 44b,
Sandia National Laboratories, New Mexico

Constituent of Potential Ecological Concern	Plant Hazard Quotient ^a	Deer Mouse Hazard Quotient	Burrowing Owl Hazard Quotient
Cadmium	2.33×10^{-1}	3.44×10^{-2}	1.13×10^{-3}
Chromium (Total)	9.30×10^0	2.84×10^{-5}	3.09×10^{-2}
Lead	5.14×10^{-1}	2.17×10^{-2}	1.50×10^{-2}
Mercury	1.10×10^0	8.37×10^{-1}	4.70×10^0
Silver	2.50×10^{-1}	1.44×10^{-3}	--- ^b
Zinc	1.68×10^0	3.85×10^{-2}	1.99×10^{-1}

^a**Bold text** indicates hazard quotient greater than unity.

^b--- designates insufficient toxicity data available for risk estimation purposes.

III.7 Uncertainties

Many uncertainties are associated with the characterization of ecological risks at ER Site 44b. These uncertainties result in the use of assumptions in estimating risk that may lead to an overestimation or underestimation of the true risk presented at a site. For this screening level risk assessment, assumptions are made that are more likely to overestimate risk rather than to underestimate it. These conservative assumptions are used to be more protective of the ecological resources potentially affected by the site. Conservatisms incorporated into this risk assessment include the use of the maximum measured soil concentration or detection limits (an amount equal to one-half of the detection limit) to evaluate risk, the use of wildlife toxicity benchmarks based on NOAEL values, the use of earthworm-based transfer factors or a default factor of 1.0 for modeling COPECs into soil invertebrates in the absence of insect data, and the use of 1.0 as the area use factor for wildlife receptors regardless of seasonal use or home range size.

III.8 Summary

Potential risks were indicated for two of the three ecological receptors at ER Site 44b; however, the use of the maximum measured soil concentration or one-half the maximum detection limit to evaluate risk provided a conservative exposure scenario for the risk assessment and may not reflect actual site conditions. Detection limits, at half value, were used to evaluate risk for silver. Maximum measured soil concentrations for chromium (total), mercury, and zinc exceeded their respective plant benchmark concentrations. Although risk was predicted to plants exposed to

chromium at this site, the maximum total chromium concentration is actually less than the background value of 12.8 mg/kg. No potential risk was predicted for the deer mouse from nonradioactive COPECs. Mercury was the only COPEC concentration that resulted in an HQ greater than 1.0 for the burrowing owl. Because of the home range of the owl is more than 20 times the size of the site, the true risk for the burrowing owl due to mercury from Site 44b is insignificant. Based on these results, silver and chromium can be justified for elimination as a COPECs at ER Site 44b; The incremental risk resulted from zinc, subtracting the background, would produce an HQ of 0.2. However, it is very likely that the other risk results are driven by conservatisms in data analysis. HQs based on 95 percent upper confidence limits of the mean will likely be lower and still be a conservative estimate of site conditions. Overall ecological risks associated with ER Site 44b are expected to be low.

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APPENDIX 1.

Sandia National Laboratories Environmental Restoration Program

EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

BACKGROUND

Sandia National Laboratories (SNL) proposes that a default set of exposure routes and associated default parameter values be developed for each future land-use designation being considered for SNL/NM Environmental Restoration (ER) project sites. This default set of exposure scenarios and parameter values would be invoked for risk assessments unless site-specific information suggested other parameter values. Because many SNL/NM ER sites have similar types of contamination and physical settings, SNL believes that the risk assessment analyses at these sites can be similar. A default set of exposure scenarios and parameter values will facilitate the risk assessments and subsequent review.

The default exposure routes and parameter values suggested are those that SNL views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the USEPA Region VI and NMED, SNL proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all Environmental Restoration sites exist within the boundaries of the Kirtland AFB. Approximately 157 potential waste and release sites have been identified where hazardous, radiological, or mixed materials may have been released to the environment. Evaluation and characterization activities have occurred at all of these sites to varying degrees. Among other documents, the SNL/ER draft Environmental Assessment (DOE 1996) presents a summary of the hydrogeology of the sites, the biological resources present and proposed land use scenarios for the SNL/NM ER sites. At this time, all SNL/NM ER sites have been tentatively designated for either industrial or recreational future land use. The NMED has also requested that risk calculations be performed based on a residential land use scenario. All three land use scenarios will be addressed in this document.

The SNL/NM ER project has screened the potential exposure routes and identified default parameter values to be used for calculating potential intake and subsequent hazard index, risk and dose values. EPA (EPA 1989a) provides a summary of exposure routes that could potentially be of significance at a specific waste site. These potential exposure routes consist of:

- Ingestion of contaminated drinking water;
- Ingestion of contaminated soil;
- Ingestion of contaminated fish and shell fish;
- Ingestion of contaminated fruits and vegetables;
- Ingestion of contaminated meat, eggs, and dairy products;
- Ingestion of contaminated surface water while swimming;
- Dermal contact with chemicals in water;
- Dermal contact with chemicals in soil;
- Inhalation of airborne compounds (vapor phase or particulate), and;

- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

Based on the location of the SNL ER sites and the characteristics of the surface and subsurface at the sites, we have evaluated these potential exposure routes for different land use scenarios to determine which should be considered in risk assessment analyses (the last exposure route is pertinent to radionuclides only). At SNL/NM ER sites, there does not presently occur any consumption of fish, shell fish, fruits, vegetables, meat, eggs, or dairy products that originate on-site. Additionally, no potential for swimming in surface water is present due to the high-desert environmental conditions. As documented in the RESRAD computer code manual (ANL 1993), risks resulting from immersion in contaminated air or water are not significant compared to risks from other radiation exposure routes.

For the industrial and recreational land use scenarios, SNL/NM ER has therefore excluded the following four potential exposure routes from further risk assessment evaluations at any SNL/NM ER site:

- Ingestion of contaminated fish and shell fish;
- Ingestion of contaminated fruits and vegetables;
- Ingestion of contaminated meat, eggs, and dairy products; and
- Ingestion of contaminated surface water while swimming.

That part of the exposure pathway for radionuclides related to immersion in contaminated air or water is also eliminated.

For the residential land-use scenario, we will include ingestion of contaminated fruits and vegetables because of the potential for residential gardening.

Based on this evaluation, for future risk assessments, the exposure routes that will be considered are shown in Table 1. Dermal contact is included as a potential exposure pathway in all land use scenarios. However, the potential for dermal exposure to inorganics is not considered significant and will not be included. In general, the dermal exposure pathway is generally considered to not be significant relative to water ingestion and soil ingestion pathways but will be considered for organic components. Because of the lack of toxicological parameter values for this pathway, the inclusion of this exposure pathway into risk assessment calculations may not be possible and may be part of the uncertainty analysis for a site where dermal contact is potentially applicable.

EQUATIONS AND DEFAULT PARAMETER VALUES FOR IDENTIFIED EXPOSURE ROUTES

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation may also be significant for radionuclides. All of the above routes will, however, be considered for their appropriate land use scenarios. The general equations for calculating potential intakes via

Table 1. Exposure Pathways Considered for Various Land Use Scenarios

Industrial	Recreational	Residential
Ingestion of contaminated drinking water	Ingestion of contaminated drinking water	Ingestion of contaminated drinking water
Ingestion of contaminated soil	Ingestion of contaminated soil	Ingestion of contaminated soil
Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)
Dermal contact	Dermal contact	Dermal contact
External exposure to penetrating radiation from ground surfaces	External exposure to penetrating radiation from ground surfaces	Ingestion of fruits and vegetables
		External exposure to penetrating radiation from ground surfaces

these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund (RAGS): Volume 1 (EPA 1989a and 1991). These general equations also apply to calculating potential intakes for radionuclides. A more in-depth discussion of the equations used in performing radiological pathway analyses with the RESRAD code may be found in the RESRAD Manual (ANL 1993). Also shown are the default values SNL/NM ER suggests for use in Reasonable Maximum Exposure (RME) risk assessment calculations for industrial, recreational, and residential scenarios, based on EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants. RESRAD input parameters that are left as the default values provided with the code are not discussed. Further information relating to these parameters may be found in the RESRAD Manual (ANL 1993).

Generic Equation for Calculation of Risk Parameter Values

The equation used to calculate the risk parameter values (i.e., Hazard Quotient/Index, excess cancer risk, or radiation total effective dose equivalent [dose]) is similar for all exposure pathways and is given by:

Risk (or Dose) = Intake x Toxicity Effect (either carcinogenic, noncarcinogenic, or radiological)

$$= C \times (CR \times EFD/BW/AT) \times \text{Toxicity Effect} \quad (1)$$

where

- C = contaminant concentration (site specific);
- CR = contact rate for the exposure pathway;
- EFD = exposure frequency and duration;
- BW = body weight of average exposure individual;
- AT = time over which exposure is averaged.

The total risk/dose (either cancer risk or hazard index) is the sum of the risks/doses for all of the site-specific exposure pathways and contaminants.

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk range of 10^{-4} to 10^{-6} . The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the Hazard Index) for the toxicity resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of this quantitative estimate with the EPA standard Hazard Index of unity (1). The evaluation of the health hazard due to radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site.

The specific equations used for the individual exposure pathways can be found in RAGS (EPA 1989a) and the RESRAD Manual (ANL 1993). Table 2 shows the default parameter values suggested for use by SNL at ER sites, based on the selected land use scenario. References are given at the end of the table indicating the source for the chosen parameter values. The intention of SNL is to use default values that are consistent with regulatory guidance and consistent with the RME approach. Therefore, the values chosen will, in general, provide a conservative estimate of the actual risk parameter. These parameter values are suggested for use for the various exposure pathways based on the assumption that a particular site has no unusual characteristics that contradict the default assumptions. For sites for which the assumptions are not valid, the parameter values will be modified and documented.

Summary

SNL proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial, recreational or residential future land-use scenario. There are no current residential land-use designations at SNL ER sites, but this scenario has been requested to be considered by the NMED. For sites designated as industrial or recreational land-use, SNL will provide risk parameter values based on a residential land-use scenario to indicate the effects of data uncertainty on risk value calculations or in order to potentially mitigate the need for institutional controls or restrictions on Sandia ER sites. The parameter values are based on EPA guidance and supplemented by information from other government sources. The values are generally consistent with those proposed by Los Alamos National Laboratory, with a few minor variations. If these exposure routes and parameters are acceptable, SNL will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

Table 2. Default Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency (d/y)	***	***	***
Exposure duration (y)	30 ^{a,b}	30 ^{a,b}	30 ^{a,b}
Body weight (kg)	70 ^{a,b}	56 ^{a,b}	70 adult ^{a,b} 15 child
Averaging Time (days) for carcinogenic compounds (=70 y x 365 d/y)	25550 ^a	25550 ^a	25550 ^a
for noncarcinogenic compounds (=ED x 365 d/y)	10950	10950	10950
Soil Ingestion Pathway			
Ingestion rate	100 mg/d ^c	6.24 g/y ^d	114 mg-y/kg-d ^a
Inhalation Pathway			
Inhalation rate (m ³ /yr)	5000 ^{a,b}	146 ^d	5475 ^{a,b,d}
Volatilization factor (m ³ /kg)	chemical specific	chemical specific	chemical specific
Particulate emission factor (m ³ /kg)	1.32E9 ^a	1.32E9 ^a	1.32E9 ^a
Water Ingestion Pathway			
Ingestion rate (L/d)	2 ^{a,b}	2 ^{a,b}	2 ^{a,b}
Food Ingestion Pathway			
Ingestion rate (kg/yr)	NA	NA	138 ^{b,d}
Fraction ingested	NA	NA	0.25 ^{b,d}
Dermal Pathway			
Surface area in water (m ²)	2 ^{b,e}	2 ^{b,e}	2 ^{b,e}
Surface area in soil (m ²)	0.53 ^{b,e}	0.53 ^{b,e}	0.53 ^{b,e}
Permeability coefficient	chemical specific	chemical specific	chemical specific

*** The exposure frequencies for the land use scenarios are often integrated into the overall contact rate for specific exposure pathways. When not included, the exposure frequency for the industrial land use scenario is 8 h/d for 250 d/y; for the recreational land use, a value of 2 hr/wk for 52 wk/y is used (EPA 1989b); for a residential land use, all contact rates are given per day for 350 d/y.

^a RAGS, Vol 1, Part B (EPA 1991).

^b Exposure Factors Handbook (EPA 1989b)

^c EPA Region VI guidance.

^d For radionuclides, RESRAD (ANL 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.

^e Dermal Exposure Assessment (EPA 1992).

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RSI

**Statement of Basis
Approval of No Further Action**

January 2000

**ER Site 44
Operable Unit 1303
Round 9**

RSI Originally Submitted September 1999

Site-Specific Comments

ER Site 44, Uranium Calibration Pits and Decontamination Area

ER Site 44 may be appropriate for NFA petition, pending review and approval of the information requested below:

Response: Based on General Comments 1 through 6, Tables 3-2 and 3-5 from the original ER Site 44 NFA Proposal have been revised and updated. Table 3-2 summarizing the laboratory results for soil sampling activities at ER Site 44A has been replaced with Tables 3-2A, 3-2B, and 3-2C, which are presented in Attachment G. Table 3-2A summarizes gamma spectroscopy results, Table 3-2B summarizes isotopic uranium results, and Table 3-2C summarizes metals results (metals analyses were only conducted on the sample from beneath Uranium Calibration Pit 3).

Table 3-5 summarizing the laboratory results for soil sampling activities at ER Site 44B has been replaced with Tables 3-5A, 3-5B, 3-5C, and 3-5D, which are presented in Attachment H. Table 3-5A summarizes gamma spectroscopy results, Table 3-5B summarizes gross alpha and gross beta results, Table 3-5C summarizes tritium results, and Table 3-5D summarizes metals results.

1. **DOE/SNL must provide the depths of the confirmatory soil samples collected in each pit.**

Response: The depths of confirmatory soil samples from the uranium calibration pits at ER Site 44A, are identified in the analytical data summary tables presented in Attachment G. Following removal of the concrete culverts at Uranium Calibration Pits 2, 3, and 4, confirmatory samples were collected within an approximate 6-inch interval beginning at 8 feet below ground surface. However, following removal of the concrete culvert at Uranium Calibration Pit 1, additional excavation was required to meet remediation goals and the confirmatory sample was collected within an approximate 6-inch interval beginning at 14 feet below ground surface.

2. **DOE/SNL must provide the gamma spectroscopy results for the samples from all four pits.**

Response: Gamma spectroscopy results for the confirmatory soil samples collected from beneath each uranium calibration pit are summarized in Table 3-2A of Attachment G. Table 3-2A also summarizes gamma spectroscopy results for the confirmatory soil samples from the clean backfill used to restore each uranium calibration pit excavation to surface grade.

Gamma spectroscopy laboratory results for the confirmatory soil samples from each uranium calibration pit, including the clean backfill, are presented in Attachment I. The Environmental Programs Sample Collection Log and Analysis Request/Chain of Custody Record forms are provided in Attachment I to distinguish the sample locations associated with sample numbers identified on the laboratory results. Samples listed on the forms

Site-Specific Comments

that are not confirmatory samples for ER Site 44A have been marked out and those laboratory results not included.

3. **Section 3.2.5—DOE/SNL must provide a map showing the soil-sample locations that were established to characterize the Decontamination Area.**

Response: A sample location map (Figure 1) for the Decontamination Area, ER Site 44B, is presented in Attachment J.

4. **Section 3.2.5—DOE/SNL must summarize the characterization data for radionuclides and metals in tables (results of the February and April 1994 sampling events). See general comments 2-4.**

Response: Analytical results for the soil samples collected at the Decontamination Area, ER Site 44B, in February and April 1994 are summarized in Tables 3-5A through 3-5D of Attachment H.

Section 3.2.5 of the original ER Site 44B NFA Proposal (SNL/NM September 1997) refers to gross alpha/beta and tritium analyses performed on the eight soil samples taken in February 1994. The analyses were actually performed on four water samples taken on February 3, 1994, following an incident at Building 906, which is located directly east of ER Site 44B (see Figure 1, Attachment J). The incident involved a failure of the heating system in Building 906 that caused the fire suppression sprinkler system to freeze and rupture. Before the problem was identified and the fire suppression water supply valve could be turned off, water from the ruptured line had begun to flow from all the exterior doors onto the ground surface surrounding Building 906. Appropriate notifications were made and an Occurrence Report was prepared (SNL/NM July 1994).

To determine whether any release of radioactive materials from Building 906 had occurred, a total of eight soil and four water samples were collected. On February 3, 1994, four water samples were collected from areas of ponding water. Four soil samples were also collected at the same time. An additional four soil samples were collected on February 11, 1994. All eight soil samples were analyzed using gamma spectroscopy (Table 3-5A, Attachment H). The water samples were analyzed for gross alpha/beta and tritium. Analytical results for the water samples collected on February 3, 1994, are summarized in Tables 3-5B and 3-5C, of Attachment H. Figure 1 in Attachment J identifies the soil and water sample locations associated with the February 1994 sampling events.

5. **Section 3.2.7—DOE/SNL must summarize the verification data for radionuclides in tables and provide the gamma spectroscopy results. See general comments 2-4.**

Response: Gamma spectroscopy results for the post-voluntary corrective measure verification soil samples from the Decontamination Area, ER Site 44B, are summarized

Site-Specific Comments

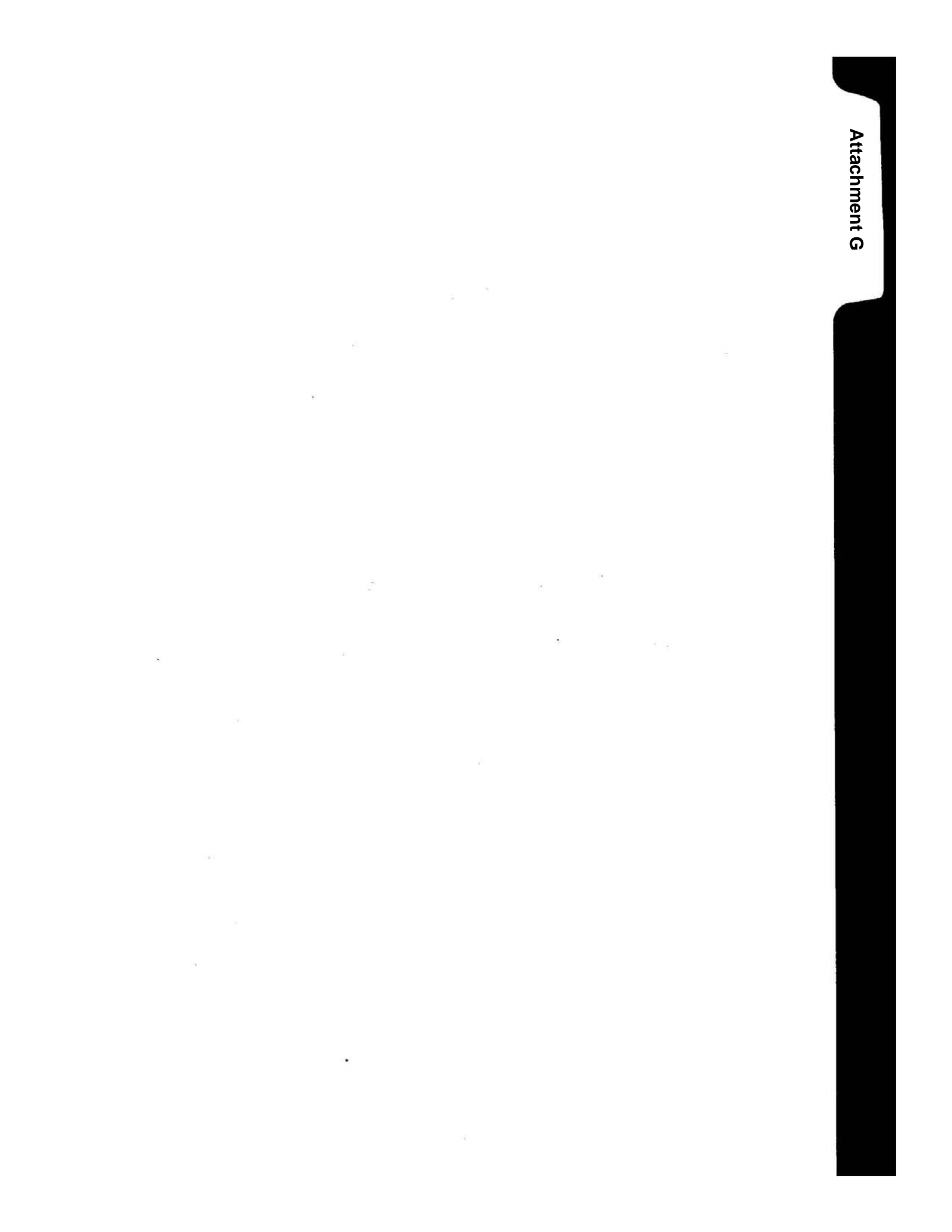
in Table 3-6 in Attachment K. In addition, the gamma spectroscopy laboratory results for the post-voluntary corrective measure verification soil samples from the Decontamination Area, ER Site 44B, are presented in Attachment K.

ER Site 44 References:

Sandia National Laboratories/New Mexico (SNL/NM), September 1997. "Proposal for Risk-Based No Further Action Environmental Restoration Site 44 Uranium Calibration Pits and Decontamination Area Operable Unit 1303," Environmental Restoration Project, U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico.

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Attachment G



ATTACHMENT G

**ER SITE 44A
SUPPLEMENTAL TABLES 3-2A, 3-2B, AND 3-2C**

Table 3-2A
Summary of ER Site 44A Confirmatory Sampling Gamma Spectroscopy Analysis, May, June and July 1994

Sample Attributes				Activity (pCi/g) ^a							
Record Number ^b	ER Sample ID	Date Sampled	Sample Depth (ft)	Uranium-238		Thorium-232		Uranium-235		Cesium-137	
				Result	Error ^c	Result	Error ^c	Result	Error ^c	Result	Error ^c
Confirmatory Soil Samples Collected at Base of Culvert											
508246	UCP 1	6-30-94	14	16.1	0.943	0.620	0.154	0.897	0.0918	ND (0.0260)	--
508246	UCP 2	6-20-94	8	1.45	0.627	0.878	0.168	ND (0.0518)	--	ND (0.0245)	--
00085	UCP 3	5-31-94	8	0.767	0.292	0.969	0.144	ND (0.0361)	--	ND (0.0222)	--
00085	UCP 4	5-31-94	8	1.36	0.439	0.800	0.138	ND (0.0354)	--	ND (0.0187)	--
Backfill Soil Samples											
508246	UCP 1	7-1-94	6	ND (0.524)	--	0.868	0.198	ND (0.0515)	--	ND (0.0304)	--
508244	UCP 1 (off-site laboratory)	7-1-94	6	NR	NR	1.4	0.51	NR	NR	ND (0.091)	--
508246	UCP 2	6-21-94	6	1.22	0.721	0.812	0.212	ND (0.0554)	--	ND (0.0361)	--
00085	UCP 3	5-31-94	6	0.984	0.337	0.905	0.134	ND (0.0364)	--	ND (0.0235)	--
00085	UCP 4	5-31-94	6	1.44	0.490	0.917	0.143	ND (0.0351)	--	ND (0.0181)	--
Background Soil Activities—North Area Subsurface ^d				1.3	NA	1.54	NA	0.18	NA	0.084	NA

Note: Values in bold exceed background.

^a Scientific notation of results provided as reported by laboratory.

^b Analysis request/chain of custody record.

^c Two standard deviations about the mean detected activity.

^d Dinwiddie, September 1997.

ER = Environmental restoration.

ft = Foot (feet).

ID = Identification.

NA = Not applicable.

ND () = Not detected at or above the minimum detectable activity, shown in parentheses.

NR = Not reported in off-site analysis results.

pCi/g = Picocurie(s) per gram.

UCP = Uranium Calibration Pit.

-- = Error not calculated for nondetectable results.

Table 3-2B
Summary of ER Site 44A Confirmatory Sampling Isotopic Uranium Analysis, May, June and July 1994
(Off-Site Laboratory)

Sample Attributes				Activity (pCi/g) ^a					
Record Number ^b	ER Sample ID	Date Sampled	Sample Depth (ft)	Uranium-233/234		Uranium-235		Uranium-238	
				Result	Error ^c	Result	Error ^c	Result	Error ^c
Confirmatory Soil Samples Collected at Base of Culvert									
508244	UCP 1	6-30-94	14	26 B	2.4	1.1	0.16	26	2.4
508244	UCP 2	6-20-94	8	1.9 B	0.23	0.072	0.034	2.0	0.24
00086	UCP 3	5-31-94	8	0.89 B	0.14	0.044	0.026	0.93 B	0.14
00086	UCP 4	5-31-94	8	0.74 B	0.13	0.029	0.022	0.77 B	0.13
Backfill Soil Samples									
508244	UCP 1	7-1-94	6	0.64 B	0.11	0.031	0.020	0.63	0.11
508244	UCP 2	6-21-94	6	0.56 B	0.092	0.014	0.012	0.53	0.090
00086	UCP 3	5-31-94	6	1.2 B	0.19	0.048	0.030	0.99 B	0.16
00086	UCP 4	5-31-94	6	1.7 B	0.23	0.049	0.030	1.4 B	0.20
Background Soil Activities—North Area Subsurface ^d				1.6 ^e	NA	0.18	NA	1.3	NA

Note: Values in **bold** exceed background.

^a Scientific notation of results provided as reported by laboratory.

^b Analysis request/chain of custody record.

^c Two standard deviations about the mean detected activity.

^d Dinwiddle, September 1997.

^e Background soil activity represented by uranium-234.

B = Analyte detected in associated blank.

ER = Environmental restoration.

ft = Foot (feet).

ID = Identification.

NA = Not applicable.

pCi/g = Picocurie(s) per gram.

UCP = Uranium Calibration Pit.

Table 3-2C
Summary of ER Site 44A Confirmatory Sampling Metals Analytical Results, May 1994
(Off-Site Laboratory)

Sample Attributes				Metals (EPA 6010/7000 ^a) (mg/kg)								
Record ^b Number	ER Sample ID	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Confirmatory Soil Sample Collected at Base of Culvert												
00087	UCP 3	5-31-94	8	ND (1.0)	43.1	0.42	ND (0.50)	3.2	3.2	ND (0.10)	ND (0.70)	ND (1.0)
Background Soil Concentrations—North Area Subsurface ^c				4.4	200	0.80	0.9	12.8	11.2	<0.1	<1	<1

^a EPA November 1986.

^b Analysis request/chain of custody record.

^c Dinwiddie, September 1997.

EPA = U.S. Environmental Protection Agency.

ER = Environmental restoration.

ft = Foot (feet).

ID = Identification.

mg/kg = Milligram(s) per kilogram.

ND () = Not detected above the reporting limit, shown in parentheses.

UCP = Uranium Calibration Pit.

Site-Specific Comments

ATTACHMENT H

**ER SITE 44B
SUPPLEMENTAL TABLES 3-5A THROUGH 3-5D**

Table 3-5A
Summary of ER Site 44B Sampling Gamma Spectroscopy Analysis, February and April 1994

Sample Attributes				Activity (pCi/g) ^a							
Record Number ^b	ER Sample ID ^c	Date Sampled	Sample Depth (ft)	Uranium-238		Thorium-232		Uranium-235		Cesium-137	
				Result	Error ^d	Result	Error ^d	Result	Error ^d	Result	Error ^d
February 1994 Sampling											
940053	906-1	2-3-94	0-0.5	ND (3.51E-01)	--	8.51E-01	1.07E-01	ND (3.38E-02)	--	5.00E-01	3.67E-02
940053	906-2	2-3-94	0-0.5	1.62E+00	4.22E-01	9.02E-01	1.20E-01	ND (3.08E-02)	--	1.74E-01	3.07E-02
940053	906-3	2-3-94	0-0.5	ND (2.72E-01)	--	8.46E-01	9.19E-02	ND (2.56E-02)	--	8.75E-01	3.47E-02
940053	906-4	2-3-94	0-0.5	6.68E-01	3.45E-01	8.14E-01	1.01E-01	ND (3.48E-02)	--	9.69E+00	1.01E-01
940061	#1	2-11-94	0-0.5	ND (7.08E-01)	--	6.79E-01	1.05E-01	ND (8.34E-02)	--	8.77E+01	3.34 E-01
940061	#2	2-11-94	0-0.5	ND (3.13E-01)	--	7.44E-01	7.61E-02	ND (3.18E-02)	--	8.97E+00	9.01E-02
940061	#3	2-11-94	0-0.5	ND (5.18E-01)	--	1.50E+00	1.86E-01	ND (4.54E-02)	--	4.88E-01	4.42E-02
940061	#4	2-11-94	0-0.5	ND (2.40E-01)	--	7.54E-01	9.23E-02	ND (2.17E-02)	--	7.94E-01	3.03E-02
April 1994 Sampling											
508879	TA2-906-SS-01-0.0	4-28-94	0.0-0.5	ND (0.354)	--	0.788	0.116	ND (0.0278)	--	0.709	0.0440
508878	TA2-906-SS-01-0.0 (off-site laboratory)	4-28-94	0.0-0.5	NR	NR	0.97	0.32	NR	NR	1.2	0.13
508879	TA2-906-BH-01-2.0	4-28-94	2.0-3.0	ND (0.403)	--	0.815	0.161	ND (0.0330)	--	0.108	0.0357
508878	TA2-906-BH-01-2.0 (off-site laboratory)	4-28-94	2.0-3.0	NR	NR	0.84	0.29	NR	NR	ND (0.057)	--
508879	TA2-906-SS-02-0.0	4-28-94	0.0-0.5	ND (0.351)	--	0.693	0.111	ND (0.0280)	--	0.667	0.0463
508878	TA2-906-SS-02-0.0 (off-site laboratory)	4-28-94	0.0-0.5	NR	NR	0.64	0.33	NR	NR	0.63	0.11
508879	TA2-906-BH-02-2.0	4-28-94	2.0-3.0	ND (0.486)	--	0.808	0.103	ND (0.0429)	--	17.7	0.169
508878	TA2-906-BH-02-2.0 (off-site laboratory)	4-28-94	2.0-3.0	NR	NR	0.80	0.23	NR	NR	15	0.99
508879	TA2-906-SS-03-0.0	4-28-94	0.0-0.5	ND (0.443)	--	0.791	0.105	ND (0.0388)	--	13.4	0.149
508878	TA2-906-SS-03-0.0 (off-site laboratory)	4-28-94	0.0-0.5	NR	NR	0.64	0.31	NR	NR	13	0.88
508879	TA2-906-SS-03D-0.0	4-28-94	0.0-0.5	ND (0.414)	--	0.853	0.152	ND (0.0362)	--	5.95	0.102
508878	TA2-906-SS-03D-0.0 (off-site laboratory)	4-28-94	0.0-0.5	NR	NR	1.0	0.27	NR	NR	5.3	0.35

Refer to footnotes at end of table.

Table 3-5A (Continued)
Summary of ER Site 44B Sampling Gamma Spectroscopy Analysis, February and April 1994

Sample Attributes				Activity (pCi/g) ^a							
Record Number ^b	ER Sample ID ^c	Date Sampled	Sample Depth (ft)	Uranium-238		Thorium-232		Uranium-235		Cesium-137	
				Result	Error ^d	Result	Error ^d	Result	Error ^d	Result	Error ^d
April 1994 Sampling											
508879	TA2-906-BH-03-2.0	4-28-94	2.0-3.0	ND (0.384)	--	0.777	0.121	ND (0.0288)	--	0.0700	0.0239
508878	TA2-906-BH-03-2.0 (off-site laboratory)	4-28-94	2.0-3.0	NR	NR	0.84	0.30	NR	NR	0.15	0.062
508879	TA2-906-SS-04-0.0	4-28-94	0.0-0.5	ND (0.442)	--	0.971	0.154	ND (0.0359)	--	6.78	0.114
508878	TA2-906-SS-04-0.0 (off-site laboratory)	4-28-94	0.0-0.5	NR	NR	1.0	0.26	NR	NR	6.4	0.41
508879	TA2-906-BH-04-2.0	4-28-94	2.0-3.0	0.895	0.414	0.699	0.136	ND (0.0294)	--	0.0461	0.0293
508878	TA2-906-BH-04-2.0 (off-site laboratory)	4-28-94	2.0-3.0	NR	NR	0.77	0.28	NR	NR	0.20	0.083
508879	TA2-906-SS-05-0.0	4-28-94	0.0-0.5	ND (0.683)	--	0.985	0.125	ND (0.0644)	--	32.8	0.274
508878	TA2-906-SS-05-0.0 (off-site laboratory)	4-28-94	0.0-0.5	NR	NR	1.0	0.27	NR	NR	43	2.6
508879	TA2-906-BH-05-2.0	4-28-94	2.0-3.0	1.09	0.510	0.695	0.106	ND (0.0269)	--	0.290	0.0326
508878	TA2-906-BH-05-2.0 (off-site laboratory)	4-28-94	2.0-3.0	NR	NR	1.1	0.32	NR	NR	0.18	0.076
508879	TA2-906-SS-06-0.0	4-28-94	0.0-0.5	ND (0.354)	--	0.953	0.122	ND (0.0282)	--	0.150	0.0317
508878	TA2-906-SS-06-0.0 (off-site laboratory)	4-28-94	0.0-0.5	NR	NR	0.96	0.28	NR	NR	0.17	0.060
508879	TA2-906-BH-06-2.0	4-28-94	2.0-3.0	ND (0.339)	--	0.592	0.119	ND (0.0255)	--	ND (0.0162)	--
508878	TA2-906-BH-06-2.0 (off-site laboratory)	4-28-94	2.0-3.0	NR	NR	0.96	0.31	NR	NR	ND (0.057)	--
Background Soil Activities—North Area ^e				1.3	NA	1.54	NA	0.18	NA	0.084	NA
Quality Assurance/Quality Control Samples (all in pCi/mL)											
508879	TA2-ER44b (equipment blank)	4-28-94	NA	ND (0.165)	--	ND (0.0533)	--	ND (0.0149)	--	ND (0.00986)	--
508878	TA2-ER44b (equipment blank) (off-site laboratory)	4-28-94	NA	NR	NR	NR	NR	NR	NR	ND (0.020)	--

Refer to footnotes at end of table.

Table 3-5A (Concluded)
Summary of ER Site 44B Sampling Gamma Spectroscopy Analysis, February and April 1994

Note: Values in **bold** exceed background.

^a Scientific notation of results provided as reported by laboratory.

^b Analysis request/chain of custody record.

^c **Bold** portion of ER Sample ID corresponds to the sample location in Figure 1.

^d Two standard deviations about the mean detected activity.

^e Dinwiddie, September 1997. The more conservative, lower background value between the surface and subsurface is used for consistency with current risk assessment methodology.

^f Analytical results were reported in picocurie(s) per liter and converted to picocurie(s) per milliliter.

BH = Borehole sample.

D = Duplicate sample.

ER = Environmental restoration.

ft = Foot (feet).

ID = Identification.

NA = Not applicable.

ND () = Not detected at or above the minimum detectable activity, shown in parentheses.

NR = Not reported in off-site laboratory analysis results.

pCi/g = Picocurie(s) per gram.

pCi/mL = Picocurie(s) per milliliter.

SS = Surface soil sample.

TA = Technical Area.

- = Error not calculated for nondetectable results.

Site-Specific Comments

Table 3-5B
Summary of ER Site 44B Gross Alpha and Beta Analytical Results, February 1994
(On-Site Laboratory)

Sample Attributes				Activity (pCi/L)			
Record Number ^a	ER Sample ID ^b	Date Sampled	Sample Depth (ft)	Gross Alpha		Gross Beta	
				Result	Error ^c	Result	Error ^c
940272	Water-1	2-3-94	NA	ND (4.35E+02)	--	ND (1.64E+03)	--
940272	Water-2	2-3-94	NA	ND (4.35E+02)	--	ND (1.64E+03)	--
940272	Water-3	2-3-94	NA	ND (4.35E+02)	--	ND (1.64E+03)	--
940272	Water-4	2-3-94	NA	ND (4.35E+02)	--	ND (1.64E+03)	--

^a Analysis request/chain of custody record.

^b **Bold** portion of ER Sample ID corresponds to the sample location in Figure 1.

^c Two standard deviations about the mean detected activity.

ER = Environmental restoration.

ft = Foot (feet).

ID = Identification.

NA = Not applicable.

ND () = Not detected at or above the minimum detectable activity, shown in parentheses.

pCi/L = Picocurie(s) per liter.

-- = Error not calculated for nondetectable results.

Site-Specific Comments

Table 3-5C
Summary of ER Site 44B Sampling Tritium Analytical Results
February 1994
(On-Site Laboratory)

Sample Attributes				Activity (pCi/L)	
Record Number ^a	ER Sample ID ^b	Date Sampled	Sample Depth (ft)	Result	Error ^c
940272	Water-1	2-3-94	NA	ND (1.69E+03)	--
940272	Water-2	2-3-94	NA	ND (1.69E+03)	--
940272	Water-3	2-3-94	NA	ND (1.69E+03)	--
940272	Water-4	2-3-94	NA	ND (1.69E+03)	--

^a Analysis request/chain of custody record.

^b **Bold** portion of the ER Sample ID corresponds to the sample location in Figure 1.

^c Two standard deviations about the mean detected activity.

ER = Environmental restoration.

ID = Identification.

ft = Foot (feet).

NA = Not applicable.

ND () = Not detected at or above the minimum detectable activity, shown in parentheses.

pCi/L = Picocurie(s) per liter.

-- = Error not calculated for nondetectable results.

Table 3-5D
Summary of ER Site 44B Sampling TAL Metals Analytical Results, April 1994
(Off-Site Laboratory)

Sample Attributes				Metals (EPA 6010/7000 ^a) (mg/kg)									
Record Number ^b	ER Sample ID ^c	Date Sampled	Sample Depth (ft)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
April 1994 Sampling													
508877	TA2-906-SS-01-0.0	4-28-94	0.0-0.5	4,190	3.4 J (6.0)	3.0	91.5	0.39	0.59	6.0	3.8	8.8	25.7
508877	TA2-906-BH-01-2.0	4-28-94	2.0-3.0	6,670	ND (6.0)	4.7	164	0.58	0.60	6.6	4.8	10.7	9.0
508877	TA2-906-SS-02-0.0	4-28-94	0.0-0.5	4,800	2.7 J (6.0)	2.9	97.3	0.39	ND (0.50)	4.0	3.4	5.8	4.1
508877	TA2-906-BH-02-2.0	4-28-94	2.0-3.0	5,270	2.8 J (6.0)	2.2	78.7	0.49	ND (0.50)	6.4	5.0	10.0	7.8
508877	TA2-906-SS-03-0.0	4-28-94	0.0-0.5	6,150	2.8 J (6.0)	2.5	90.5	0.59	0.60	7.2	4.5	9.2	9.9
508877	TA2-906-SS-03D-0.0	4-28-94	0.0-0.5	6,800	ND (6.0)	2.7	99.1	0.59	ND (0.50)	7.7	4.5	9.2	11.9
508877	TA2-906-BH-03-2.0	4-28-94	2.0-3.0	5,060	ND (6.0)	2.8	75.4	0.39	ND (0.50)	4.3	3.8	7.4	5.3
508877	TA2-906-SS-04-0.0	4-28-94	0.0-0.5	6,220	ND (6.0)	2.2	87.4	0.59	ND (0.50)	7.4	4.6	9.1	13.0
508877	TA2-906-BH-04-2.0	4-28-94	2.0-3.0	6,030	ND (6.0)	2.8	133	0.58	ND (0.50)	5.7	3.3	7.4	4.5
508877	TA2-906-SS-05-0.0	4-28-94	0.0-0.5	7,630	ND (6.0)	3.2	122	0.59	0.70	9.3	5.5	17.3	22.3
508877	TA2-906-BH-05-2.0	4-28-94	2.0-3.0	7,280	ND (6.0)	3.2	103	0.58	ND (0.50)	7.3	4.6	9.0	6.3
508877	TA2-906-SS-06-0.0	4-28-94	0.0-0.5	5,920	7.2	2.4	89.2	0.59	ND (0.50)	7.4	5.2	8.4	8.7
508877	TA2-906-BH-06-2.0	4-28-94	2.0-3.0	4,180	3.5 J (5.0)	3.6	160	0.33	ND (0.50)	2.9	3.3	5.9	3.7
Background Soil Concentration—North Area ^d				NE	3.9	4.4	200	0.80	0.9	12.8	7.1	17	11.2
Quality Assurance/Quality Control Samples (all in mg/L)													
508877	TA2-ER44b (equipment blank)	4-28-94	NA	ND (0.10)	0.028	ND (0.0050)	ND (0.010)	ND (0.0020)	ND (0.0050)	ND (0.010)	ND (0.010)	ND (0.020)	ND (0.0050)

Refer to footnotes at end of table.

Table 3-5D (Continued)
Summary of ER Site 44B Sampling TAL Metals Analytical Results, April 1994
(Off-Site Laboratory)

Sample Attributes				Metals (EPA 6010/7000) ^a (mg/kg)							
Record Number ^b	ER Sample ID ^c	Date Sampled	Sample Depth (ft)	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
April 1994 Sampling											
508877	TA2-906-SS-01-0.0	4-28-94	0.0-0.5	183	0.16	5.2	ND (0.50)	ND (1.0)	ND (0.50)	14.5	33.8
508877	TA2-906-BH-01-2.0	4-28-94	2.0-3.0	163	0.058 J (0.10)	8.4	ND (0.50)	ND (1.0)	ND (0.50)	24.2	24.0
508877	TA2-906-SS-02-0.0	4-28-94	0.0-0.5	133	0.053 J (0.10)	5.3	ND (0.50)	ND (1.0)	ND (0.50)	16.5	19.5
508877	TA2-906-BH-02-2.0	4-28-94	2.0-3.0	227	0.12	7.0	ND (0.50)	ND (1.0)	ND (0.50)	17.3	32.1
508877	TA2-906-SS-03-0.0	4-28-94	0.0-0.5	269	0.22	7.0	ND (0.50)	ND (1.0)	ND (0.50)	15.7	32.6
508877	TA2-906-SS-03D-0.0	4-28-94	0.0-0.5	211	0.16	8.0	ND (0.50)	ND (1.0)	ND (0.50)	20.9	42.8
508877	TA2-906-BH-03-2.0	4-28-94	2.0-3.0	153	0.053 J (0.10)	5.4	ND (0.50)	ND (1.0)	ND (0.50)	16.1	21.1
508877	TA2-906-SS-04-0.0	4-28-94	0.0-0.5	233	0.16	7.2	ND (0.50)	ND (1.0)	ND (0.50)	17.1	39.1
508877	TA2-906-BH-04-2.0	4-28-94	2.0-3.0	155	ND (0.10)	6.3	ND (0.50)	ND (1.0)	ND (0.50)	20.3	21.0
508877	TA2-906-SS-05-0.0	4-28-94	0.0-0.5	267	0.33	11.4	ND (0.50)	ND (1.0)	ND (0.50)	16.4	84.1
508877	TA2-906-BH-05-2.0	4-28-94	2.0-3.0	179	0.34	7.2	ND (0.50)	ND (1.0)	ND (0.50)	20.9	28.0
508877	TA2-906-SS-06-0.0	4-28-94	0.0-0.5	269	0.12	7.5	ND (0.50)	ND (1.0)	ND (0.50)	15.6	31.5
508877	TA2-906-BH-06-2.0	4-28-94	2.0-3.0	117	0.082 J (0.10)	5.4	ND (0.50)	ND (1.0)	ND (0.50)	18.3	17.6
Background Soil Concentration—North Area ^d				NE	<0.1	25.4	<1	<1	<1.1	33.0	76
Quality Assurance/Quality Control Samples (all in mg/L)											
508877	TA2-ER44b (equipment blank)	4-28-94	NA	ND (0.010)	0.00011 J (0.00020)	ND (0.040)	ND (0.0050)	ND (0.010)	ND (0.0050)	ND (0.010)	0.0067

Refer to footnotes at end of table.

Table 3-5D (Concluded)
Summary of ER Site 44B Sampling TAL Metals Analytical Results, April 1994
(Off-Site Laboratory)

Note: Values in **bold** exceed background.

^a EPA November 1986.

^b Analysis request/chain of custody record.

^c **Bold** portion of ER Sample ID corresponds to the sample location in Figure 1.

^d Dinwiddie, September 1997. The more conservative, lower background value between the surface and subsurface is used as a benchmark for consistency with current risk assessment methodology.

BH = Borehole sample.

D = Duplicate sample.

EPA = U.S. Environmental Protection Agency.

ER = Environmental restoration.

ft = Foot (feet).

J () = The reported value is less than the reporting limit, shown in parentheses.

ID = Identification.

mg/kg = Milligram(s) per kilogram.

mg/L = Milligram(s) per liter.

NA = Not applicable.

ND () = Not detected above the reporting limit, shown in parentheses.

NE = Background not established for North Area.

SS = Surface soil sample.

TAL = Target analyte list.

TA = Technical Area.

Attachment I

ATTACHMENT I

**ER SITE 44A
SUPPLEMENTAL GAMMA SPECTROSCOPY DATA**



Sandia
National
Laboratories

SF 2001-COC (12-93)

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

440290

AR/COC- 00085

PAGE 1 OF 1

Department No.: <u>7582</u> Project/Task Manager: <u>Rarilee Conway</u> Project Name: <u>TA-11 VLM</u> Sample Team Members: <u>Rarilee Conway</u> <u>Tommy Tharp</u> SCL or Logbook Ref. No.: <u>SCL-00370/368</u>	Date Samples Shipped: <u>5/31/94</u> Carrier/Waybill No.: <u>440290</u> Lab Destination: <u>Albuquerque, NM</u> Lab Contact: <u>Finando Macera</u> SMO Contact/Phone: <u>505-242-2404</u> Send Report to SMO: <u>Albuquerque, NM</u> SMO Reference No.: <u>440290</u>	Bill to: Sandia National Laboratories Supplier Services Department P.O. Box 5800 MS 0154 Albuquerque, NM 87185-0154 Contract No.: <u>N/A</u> Case No.: <u>3615200</u> SMO Authorization: <u>D. Macera</u>
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Sample Number - Fraction	Sample Matrix	Date/Time Collected	Container Type	Sample Volume	Preservative	Required Analytical Testing	Lab Sample Number	Condition on Receipt
✓ 016208 - 1	Soil	5/31/94	Marinelli	500ml	N/A	Gamma Spec	440290-1	Good
✓ 016209 - 1	Soil	5/31/94	Marinelli	500ml	N/A	Gamma Spec	440290-2	Good
✓ 016210 - 1	Soil	5/31/94	Marinelli	500ml	N/A	Gamma Spec	440290-3	Good
✓ 016211 - 1	Soil	5/31/94	Marinelli	500ml	N/A	Gamma Spec	440290-4	Good

Possible Hazard Identification <input checked="" type="checkbox"/> Non-hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Radiological		*Reference attached radiological screening for specific contact readings.	
Turnaround Time <input checked="" type="checkbox"/> Normal <input type="checkbox"/> Rush Required Report Date: _____		Special Instructions/QC Requirements Please send copy of Results along with sample to Lab & to Rarilee Conway 440290.	
Sample Disposal <input type="checkbox"/> Return to Client <input checked="" type="checkbox"/> Disposal by Lab Archive Until: _____			
1. Relinquished by <u>Rarilee Conway</u>	Org. <u>7582</u> Date <u>5/31/94</u> Time <u>1:58</u>	4. Relinquished by	Org. Date Time
1. Received by <u>Finando Macera</u>	Org. <u>7582</u> Date <u>5/31/94</u> Time <u>1:58</u>	4. Received by	Org. Date Time
2. Relinquished by <u>Finando Macera</u>	Org. <u>SMO 7582</u> Date <u>5/31/94</u> Time <u>16:26</u>	5. Relinquished by	Org. Date Time
2. Received by <u>Finando Macera</u>	Org. <u>SMO 7715</u> Date <u>5/31/94</u> Time <u>16:26</u>	5. Received by	Org. Date Time
3. Relinquished by <u>Finando Macera</u>	Org. <u>SMO 7715</u> Date <u>6/6/94</u> Time <u>11:55</u>	6. Relinquished by	Org. Date Time
3. Received by <u>D. Macera</u>	Org. <u>SMO 7576</u> Date <u>6/6/94</u> Time <u>11:55</u>	6. Received by	Org. Date Time

WHITE - To Accompany Samples, Laboratory Copy

BLUE- To Accompany Samples, Return to SMO

YELLOW- SMO Suspense Copy

PINK- Field Copy



Sar.
Nat.
Lab

SNL/NM 016208 SNL/NM 016210

SNL/NM 016209 SNL/NM 016211

MENTAL PROGRAMS E COLLECTION LOG

SCL- 00370

AR/COC No.: AR/COC 00085/86/8

PAGE 1 OF 2

SF 2001-SCL (12-89)

GENERAL INFORMATION		DATE: 5/31/94		WEATHER: overcast, Breezy + warm		SAMPLING INFORMATION		ON-SITE CONTACT: Karilee Conway		ORG: 7582		PHONE: 848-0383	
		SAMPLING PROCEDURE REFERENCE:				AREA: SNL/NM		LOCATION: Technical Area II					
		PURPOSE OF SAMPLING: VCM											
SAMPLE DESCRIPTION		MATRIX: <input type="checkbox"/> GAS <input type="checkbox"/> LIQUID <input type="checkbox"/> SLUDGE <input type="checkbox"/> SOLID <input type="checkbox"/> WATER <input type="checkbox"/> OIL <input checked="" type="checkbox"/> SOIL <input type="checkbox"/> HAZ WASTE <input type="checkbox"/> OTHER										ANALYSES	
		COLLECTED FROM: <input type="checkbox"/> DRUM <input type="checkbox"/> TANK <input type="checkbox"/> SURFACE WATER <input checked="" type="checkbox"/> SOIL <input type="checkbox"/> WASTE WATER <input type="checkbox"/> GROUND WATER <input type="checkbox"/> OTHER											
Sample Number - Fraction	Time	LOCATION	COMMENTS	Sample Type Grab/Comp	CC Sample (NM)	Barium Spec	ISC	TAL Metals	XRF Chromium				
✓ 016208 - 1	10:45	UCP #4 (soil)	Base of culvert - beneath	6	N	X							
016208 - 2	10:45	UCP #4 (soil)	Base of culvert - beneath				X						
✓ 016209 - 1	10:50	UCP #3	"			X							
016209 - 2	10:50	UCP #3	"				X						
016209 - 3	10:50	UCP #3	"					X					
016209 - 4	10:50	UCP #3	"						X				
✓ 016210 - 1	12:00	UCP #4 cleanfill	6' depth backfill			X							
✓ 016211 - 1	12:00	UCP #3 cleanfill	6' depth backfill			X							
PROJECT		PROJECT NAME: TA-II VCM		CASE NUMBER: 3615.2.000		PROJECT CONTACT: Karilee Conway		ORG: 7582		PHONE: 848-0383			
*ADDITIONAL INFORMATION: (Log Book Ref. #)													
SAMPLE TEAM MEMBERS		NAME		SIGNATURE		INIT		COMPANY/ORGANIZATION					
		1. Karilee Conway				RC		SNL/NM 7582					
		2. Tommy Tharp				TET		WESTON / 7582					
3.													
SAMPLE TRACKING		SAMPLE DISTRIBUTION: Amic / TMA / Easect		TRANSPORTED BY: TMA A44142		SPECIAL HANDLING:							
		DATE SHIPPED (MM-DD-YY): 6/7/94		DATA ENTERED (MM-DD-YY): 6/7/94		BY:							

*NOTE: Any additional sampling information must be recorded in an SNL-Issued Log Book or SCL Continuation Form with a Reference No. entered in this space.

WHITE - To Sample Management Office

PINK- Originator

☐ TO BE COMPLETED BY SMO

 * SNL Radiation Sample Diagnostic Program (7715)/881 01-JUN-94 12:19:15 *

 R.CONWAY/E.RANKIN (7582/IT) SNL/NM 016208-1 JCP # 4

Operator: Springer/Cole 6/2/94 Reviewed by JMM 6/3/94

Data File : 94029001.DAT * Sample Quantity: 798.000 GRAM
 Acquire Date: 01-JUN-94 10:56:26 * Efficiency File: SMAR2.EFF
 Sample Date: 31-MAY-94 10:45:00 * Library File: RSDP.LIB
 Sample Type: SOLID *

 *
 Preset Live Time: 3600.0 sec * FWHM at 1332 KeV : 2.4 KeV
 Elapsed Live Time: 3600.0 sec * Peak Search Sensitivity: 4.0
 Elapsed Real Time: 3601.0 sec * Gaussian Assymetry : 10.0 %

*
 Detector : DET2 * Fit Iterations : 20.
 Calib Date : 20-APR-94 16:41:18 * Energy Tolerance: 1.5 KeV
 KeV/Channel: .36617 * Half Life Ratio : 8.0
 Offset : .00135 * Abundance Limit : 50.00 %

[Summary Report -- SNL (7715) -- version 1.2]

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
U-238	1.36E+00	4.39E-01	-----
TH-234	1.37E+00	4.40E-01	-----
U-234	Not Detected	-----	5.69E+00
RA-226	1.82E+00	5.47E-01	-----
PB-214	6.63E-01	7.71E-02	-----
BI-214	5.58E-01	6.46E-02	-----
PB-210	7.42E-01	6.16E-01	-----
TH-232	8.00E-01	1.38E-01	-----
RA-228	8.00E-01	1.38E-01	-----
AC-228	7.22E-01	1.25E-01	-----
TH-228	7.51E-01	4.76E-02	-----
RA-224	Not Significant	-----	-----
PB-212	7.54E-01	4.78E-02	-----
BI-212	3.30E-01	1.93E-01	-----
TL-208	2.28E-01	3.54E-02	-----
U-235	Not Detected	-----	3.54E-02
TH-231	Not Detected	-----	2.22E-01
PA-231	Not Detected	-----	7.27E-01
AC-227	Not Detected	-----	9.95E-01
TH-227	Not Detected	-----	1.31E-01
AM-241	Not Detected	-----	5.06E-02
NP-237	Not Detected	-----	1.39E-01
PA-233	Not Detected	-----	3.45E-02
TH-229	Not Detected	-----	7.10E-02

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Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
AG-110	Not Detected	-----	1.63E-02
BE-7	Not Detected	-----	1.50E-01
AR-41	Short Half-Life	-----	-----
BA-133	Not Detected	-----	2.15E-02
BA-140	Not Detected	-----	6.25E-02
BI-207	Not Detected	-----	1.57E-02
CD-109	Not Detected	-----	5.18E-01
CE-139	Not Detected	-----	1.70E-02
CE-144	Not Detected	-----	1.32E-01
CO-56	Not Detected	-----	1.97E-02
CO-57	Not Detected	-----	1.58E-02
CO-58	Not Detected	-----	1.60E-02
CO-60	Not Detected	-----	3.03E-02
CR-51	Not Detected	-----	1.47E-01
CS-134	Not Detected	-----	1.56E-02
CS-137	Not Detected	-----	1.87E-02
CU-64	Not Detected	-----	2.42E+01
EU-152	Not Detected	-----	4.69E-02
EU-154	Not Detected	-----	9.46E-02
EU-155	Not Detected	-----	7.06E-02
FE-59	Not Detected	-----	4.45E-02
GD-153	Not Detected	-----	4.27E-02
HG-203	Not Detected	-----	1.79E-02
I-125	Not Detected	-----	0.00E+00
I-129	Not Detected	-----	0.00E+00
I-131	Not Detected	-----	1.74E-02
IN-115M	Not Detected	-----	1.81E+00
IR-192	Not Detected	-----	1.66E-02
K-40	1.61E+01	7.34E-01	-----
LA-140	Not Detected	-----	2.65E-02
MN-54	Not Detected	-----	1.70E-02
MN-56	Short Half-Life	-----	-----
NA-22	Not Detected	-----	2.81E-02
NA-24	Not Detected	-----	6.43E-02
NB-95	Not Detected	-----	6.94E-02
RU-103	Not Detected	-----	1.63E-02
RU-106	Not Detected	-----	1.68E-01
SB-124	Not Detected	-----	1.62E-02
SB-125	Not Detected	-----	4.69E-02
SB-126	Not Detected	-----	1.99E-02
SC-46	Not Detected	-----	1.87E-02
SN-113	Not Detected	-----	1.97E-02
SR-85	Not Detected	-----	1.75E-02
TA-182	Not Detected	-----	1.85E-01
TL-201	Not Detected	-----	1.66E-01
XE-133	Not Detected	-----	4.92E-02
Y-88	Not Detected	-----	1.91E-02
ZN-65	Not Detected	-----	4.99E-02
ZR-95	Not Detected	-----	3.27E-02

 * SNL Radiation Sample Diagnostic Program (7715)/881 01-JUN-94 12:21:38 *

 R.CONWAY/E.RANKIN (7582/ET) SNL/NM016209-1 UCP #3

Operator: Spencer Cole 6/2/94 Reviewed by John 6/3/94

Data File : 94029002.DAT * Sample Quantity: 802.000 GRAM
 Acquire Date: 01-JUN-94 12:19:19 * Efficiency File: SMAR2.EFF
 Sample Date: 31-MAY-94 10:50:00 * Library File: RSDP.LIB
 Sample Type: SOLID *

Preset Live Time: 3600.0 sec * FWHM at 1332 KeV : 2.4 KeV
 Elapsed Live Time: 3600.0 sec * Peak Search Sensitivity: 4.0
 Elapsed Real Time: 3602.0 sec * Gaussian Assymetry : 10.0 %

Detector : DET2 * Fit Iterations : 20.
 Calib Date : 20-APR-94 16:41:18 * Energy Tolerance: 1.5 KeV
 KeV/Channel: .36617 * Half Life Ratio : 8.0
 Offset : .00135 * Abundance Limit : 50.00 %

[Summary Report -- SNL (7715) -- version 1.2]

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
U-238	7.67E-01	2.92E-01	-----
TH-234	7.68E-01	2.93E-01	-----
U-234	Not Detected	-----	6.24E+00
RA-226	1.61E+00	5.75E-01	-----
PB-214	6.43E-01	7.74E-02	-----
BI-214	6.22E-01	8.32E-02	-----
PB-210	4.85E-01	5.75E-01	-----
TH-232	9.69E-01	1.44E-01	-----
RA-228	9.69E-01	1.44E-01	-----
AC-228	8.74E-01	1.30E-01	-----
TH-228	8.26E-01	5.50E-02	-----
RA-224	8.68E-01	4.88E-01	-----
PB-212	8.29E-01	5.53E-02	-----
BI-212	5.93E-01	1.84E-01	-----
TL-208	2.58E-01	3.26E-02	-----
U-235	Not Detected	-----	3.61E-02
TH-231	Not Detected	-----	2.35E-01
PA-231	Not Detected	-----	8.04E-01
AC-227	Not Detected	-----	1.05E+00
TH-227	Not Detected	-----	1.50E-01
AM-241	Not Detected	-----	5.27E-02
NP-237	Not Detected	-----	1.40E-01
PA-233	Not Detected	-----	3.86E-02
TH-229	Not Detected	-----	7.70E-02

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
AG-110	Not Detected	-----	1.82E-02
BE-7	Not Detected	-----	1.56E-01
AR-41	Short Half-Life	-----	-----
BA-133	Not Detected	-----	2.39E-02
BA-140	Not Detected	-----	6.85E-02
BI-207	Not Detected	-----	1.75E-02
CD-109	Not Detected	-----	5.35E-01
CE-139	Not Detected	-----	1.75E-02
CE-144	Not Detected	-----	1.32E-01
CO-56	Not Detected	-----	2.13E-02
CO-57	Not Detected	-----	1.68E-02
CO-58	Not Detected	-----	1.59E-02
CO-60	Not Detected	-----	3.01E-02
CR-51	Not Detected	-----	1.47E-01
CS-134	Not Detected	-----	1.70E-02
CS-137	Not Detected	-----	2.22E-02
CU-64	Not Detected	-----	3.27E+01
EU-152	Not Detected	-----	5.06E-02
EU-154	Not Detected	-----	7.54E-02
EU-155	Not Detected	-----	7.11E-02
FE-59	Not Detected	-----	4.28E-02
GD-153	Not Detected	-----	4.39E-02
HG-203	1.74E-02	1.98E-02	not Detected
I-125	Not Detected	-----	0.00E+00
I-129	Not Detected	-----	0.00E+00
I-131	Not Detected	-----	2.02E-02
IN-115M	Not Detected	-----	2.33E+00
IR-192	Not Detected	-----	1.58E-02
K-40	2.01E+01	7.94E-01	-----
LA-140	Not Detected	-----	2.70E-02
MN-54	Not Detected	-----	1.92E-02
MN-56	Short Half-Life	-----	-----
NA-22	Not Detected	-----	2.82E-02
NA-24	Not Detected	-----	6.58E-02
NB-95	Not Detected	-----	8.10E-02
RU-103	Not Detected	-----	1.64E-02
RU-106	Not Detected	-----	1.76E-01
SB-124	Not Detected	-----	1.67E-02
SB-125	Not Detected	-----	4.79E-02
SB-126	Not Detected	-----	2.12E-02
SC-46	Not Detected	-----	2.07E-02
SN-113	Not Detected	-----	2.20E-02
SR-85	Not Detected	-----	1.78E-02
TA-182	Not Detected	-----	1.81E-01
TL-201	Not Detected	-----	1.77E-01
XE-133	Not Detected	-----	5.17E-02
Y-88	Not Detected	-----	2.13E-02
ZN-65	Not Detected	-----	4.86E-02
ZR-95	Not Detected	-----	3.41E-02

not Detected TL208~
6/2/99

 * SNL Radiation Sample Diagnostic Program (7715)/881 01-JUN-94 14:33:30 *

 R.CONWAY/E.RANKIN (7582/IT) SNL/NM 016210-1 VCP # 4 Charfil

Operator: George Cole 6/2/94 Reviewed by ARM 6/3/94

 *
 Data File : 94029003.DAT * Sample Quantity: 742.000 GRAM
 Acquire Date: 01-JUN-94 13:24:29 * Efficiency File: SMAR2.EFF
 Sample Date: 31-MAY-94 12:00:00 * Library File: RSDP.LIB
 Sample Type: SOLID *

 *
 Preset Live Time: 3600.0 sec * FWHM at 1332 KeV : 2.4 KeV
 Elapsed Live Time: 3600.0 sec * Peak Search Sensitivity: 4.0
 Elapsed Real Time: 3601.0 sec * Gaussian Assymetry : 10.0 %

 *
 Detector : DET2 * Fit Iterations : 20.
 Calib Date : 20-APR-94 16:41:18 * Energy Tolerance: 1.5 KeV
 KeV/Channel: .36617 * Half Life Ratio : 8.0
 Offset : .00135 * Abundance Limit : 50.00 %

[Summary Report -- SNL (7715) -- version 1.2]

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
U-238	1.44E+00	4.90E-01	-----
TH-234	1.44E+00	4.90E-01	-----
U-234	Not Detected	-----	6.32E+00
RA-226	1.19E+00	4.58E-01	-----
PB-214	6.71E-01	7.31E-02	-----
BI-214	6.14E-01	6.57E-02	-----
PB-210	6.00E-01	6.14E-01	-----
TH-232	9.17E-01	1.43E-01	-----
RA-228	9.17E-01	1.43E-01	-----
AC-228	8.28E-01	1.29E-01	-----
TH-228	8.10E-01	5.51E-02	-----
RA-224	6.49E-01	4.91E-01	-----
PB-212	8.13E-01	5.53E-02	-----
BI-212	6.50E-01	2.10E-01	-----
TL-208	2.39E-01	4.39E-02	-----
U-235	Not Detected	-----	3.51E-02
TH-231	Not Detected	-----	2.25E-01
PA-231	Not Detected	-----	7.59E-01
AC-227	Not Detected	-----	1.02E+00
TH-227	Not Detected	-----	1.45E-01
AM-241	Not Detected	-----	5.34E-02
NP-237	Not Detected	-----	1.42E-01
PA-233	Not Detected	-----	3.78E-02
TH-229	Not Detected	-----	7.70E-02

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
AG-110	Not Detected	-----	1.85E-02
BE-7	Not Detected	-----	1.57E-01
AR-41	Short Half-Life	-----	-----
BA-133	Not Detected	-----	2.35E-02
BA-140	Not Detected	-----	6.64E-02
BI-207	Not Detected	-----	1.70E-02
CD-109	Not Detected	-----	5.41E-01
CE-139	Not Detected	-----	1.82E-02
CE-144	Not Detected	-----	1.34E-01
CO-56	Not Detected	-----	2.17E-02
CO-57	Not Detected	-----	1.70E-02
CO-58	Not Detected	-----	1.71E-02
CO-60	Not Detected	-----	2.84E-02
CR-51	Not Detected	-----	1.43E-01
CS-134	Not Detected	-----	1.87E-02
CS-137	Not Detected	-----	1.81E-02
CU-64	Not Detected	-----	2.59E+01
EU-152	Not Detected	-----	5.13E-02
EU-154	Not Detected	-----	9.36E-02
EU-155	Not Detected	-----	7.29E-02
FE-59	Not Detected	-----	4.52E-02
GD-153	Not Detected	-----	4.35E-02
HG-203	Not Detected	-----	2.05E-02
I-125	Not Detected	-----	0.00E+00
I-129	Not Detected	-----	0.00E+00
I-131	Not Detected	-----	1.89E-02
IN-115M	Not Detected	-----	2.17E+00
IR-192	Not Detected	-----	1.75E-02
K-40	1.64E+01	7.65E-01	-----
LA-140	Not Detected	-----	3.46E-02
MN-54	Not Detected	-----	1.85E-02
MN-56	Short Half-Life	-----	-----
NA-22	Not Detected	-----	2.82E-02
NA-24	Not Detected	-----	7.42E-02
NB-95	Not Detected	-----	7.83E-02
RU-103	Not Detected	-----	1.69E-02
RU-106	Not Detected	-----	1.60E-01
SB-124	Not Detected	-----	1.87E-02
SB-125	Not Detected	-----	5.03E-02
SB-126	Not Detected	-----	1.98E-02
SC-46	Not Detected	-----	1.95E-02
SN-113	Not Detected	-----	2.13E-02
SR-85	Not Detected	-----	1.92E-02
TA-182	Not Detected	-----	2.13E-01
TL-201	Not Detected	-----	1.87E-01
XE-133	Not Detected	-----	5.26E-02
Y-88	Not Detected	-----	2.18E-02
ZN-65	Not Detected	-----	5.33E-02
ZR-95	Not Detected	-----	3.52E-02

 * SNL Radiation Sample Diagnostic Program (7715)/S81 01-JUN-94 15:37:58 *

 R.CONWAY/E.RANKIN (7582/IT) SNL/NM 016211-1 UCP # 3 Cleanfill

Operator: Spencer Cole 6/2/94 Reviewed by ANN 6/3/94

 *
 Data File : 94029004.DAT * Sample Quantity: 739.000 GRAM
 Acquire Date: 01-JUN-94 14:35:15 * Efficiency File: SMAR2.EFF
 Sample Date: 31-MAY-94 12:00:00 * Library File: RSDP.LIB
 Sample Type: SOLID *

 *
 Preset Live Time: 3600.0 sec * FWHM at 1332 KeV : 2.4 KeV
 Elapsed Live Time: 3600.0 sec * Peak Search Sensitivity: 4.0
 Elapsed Real Time: 3601.0 sec * Gaussian Assymetry : 10.0 %

 *
 Detector : DET2 * Fit Iterations : 20.
 Calib Date : 20-APR-94 16:41:18 * Energy Tolerance: 1.5 KeV
 KeV/Channel: .36617 * Half Life Ratio : 8.0
 Offset : .00135 * Abundance Limit : 50.00 %

[Summary Report -- SNL (7715) -- version 1.2]

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
U-238	9.84E-01	3.37E-01	-----
TH-234	9.86E-01	3.38E-01	-----
U-234	Not Detected	-----	6.07E+00
RA-226	2.01E+00	6.90E-01	-----
PB-214	6.17E-01	6.51E-02	-----
BI-214	5.87E-01	7.09E-02	-----
PB-210	8.01E-01	5.63E-01	-----
TH-232	9.05E-01	1.34E-01	-----
RA-228	9.05E-01	1.34E-01	-----
AC-228	8.17E-01	1.21E-01	-----
TH-228	7.81E-01	5.18E-02	-----
RA-224	Not Significant	-----	-----
PB-212	7.84E-01	5.20E-02	-----
BI-212	5.58E-01	2.25E-01	-----
TL-208	2.31E-01	3.32E-02	-----
U-235	Not Detected	-----	3.64E-02
TH-231	Not Detected	-----	2.24E-01
PA-231	Not Detected	-----	7.74E-01
AC-227	Not Detected	-----	1.07E+00
TH-227	Not Detected	-----	1.46E-01
AM-241	Not Detected	-----	5.31E-02
NP-237	Not Detected	-----	1.39E-01
PA-233	Not Detected	-----	3.75E-02
TH-229	Not Detected	-----	7.59E-02

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SNL/SMO

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
AG-110	Not Detected	-----	1.95E-02
BE-7	Not Detected	-----	1.50E-01
AR-41	Short Half-Life	-----	-----
BA-133	Not Detected	-----	2.45E-02
BA-140	Not Detected	-----	6.57E-02
BI-207	Not Detected	-----	1.72E-02
CD-109	Not Detected	-----	5.41E-01
CE-139	Not Detected	-----	1.78E-02
CE-144	Not Detected	-----	1.39E-01
CO-56	Not Detected	-----	2.05E-02
CO-57	Not Detected	-----	1.65E-02
CO-58	Not Detected	-----	1.87E-02
CO-60	Not Detected	-----	2.68E-02
CR-51	Not Detected	-----	1.57E-01
CS-134	Not Detected	-----	1.86E-02
CS-137	Not Detected	-----	2.35E-02
CU-64	Not Detected	-----	3.03E+01
EU-152	Not Detected	-----	4.90E-02
EU-154	Not Detected	-----	9.73E-02
EU-155	Not Detected	-----	6.97E-02
FE-59	Not Detected	-----	4.91E-02
GD-153	Not Detected	-----	4.64E-02
HG-203	Not Detected	-----	2.11E-02
I-125	Not Detected	-----	0.00E+00
I-129	Not Detected	-----	0.00E+00
I-131	Not Detected	-----	1.80E-02
IN-115M	Not Detected	-----	2.77E+00
IR-192	Not Detected	-----	1.75E-02
K-40	1.60E+01	7.53E-01	-----
LA-140	Not Detected	-----	2.40E-02
MN-54	Not Detected	-----	1.71E-02
MN-56	Short Half-Life	-----	-----
NA-22	Not Detected	-----	2.76E-02
NA-24	Not Detected	-----	7.98E-02
NB-95	Not Detected	-----	8.08E-02
RU-103	Not Detected	-----	1.79E-02
RU-106	Not Detected	-----	1.75E-01
SB-124	Not Detected	-----	1.88E-02
SB-125	Not Detected	-----	4.54E-02
SB-126	Not Detected	-----	2.11E-02
SC-46	Not Detected	-----	1.88E-02
SN-113	Not Detected	-----	2.25E-02
SR-85	Not Detected	-----	1.98E-02
TA-182	Not Detected	-----	1.75E-01
TL-201	Not Detected	-----	1.89E-01
XE-133	Not Detected	-----	5.20E-02
Y-88	Not Detected	-----	2.22E-02
ZN-65	Not Detected	-----	5.09E-02
ZR-95	Not Detected	-----	3.04E-02

CHAIN OF CUSTODY RECORD

No: **508244**

Page **1** of **1**

Department No: 7582 Project/Task Manager: Randall Conway Project Name: UCF-UCM Sample Team Members: Tom Thorp Randall Conway	Date Samples Shipped: 7/15/94 Carrier/Waybill No: A44157 Lab Destination: TMA Lab Contact: Mike Gonzalez SMO Contact/Phone: 848-12404 Send Report to SMO: Debra Gustaf SMO Reference No:	Bill to: Sandia National Laboratories Supplier Services Department 0154 P.O. Box 5800 Albuquerque, NM 87185 Contract No: 12-0841R Case No: 3615-200 SMO Authorization: Debra Gustaf
---	--	--

Sample Number	Sample Type	Date/Time Collected	Container Type	Sample Volume	Preservative	Requested Testing Program	QC	Lab Sample Number	Condition on Receipt
016969-2	SOIL	7/15/94	Glass	0.001	NONE	Isotopic Uranium	NO		
016970-2	SOIL	7/15/94	Glass	0.001	NONE	Isotopic Uranium	NO		
016969-2	WATER	7/15/94	plastic	1L	NONE	Isotopic Uranium	NO		
016968-2	SOIL	7/15/94	Glass	0.02	NONE	Isotopic Uranium	NO		
016970-2	SOIL	7/15/94	Glass	0.02	NONE	Isotopic Uranium	NO		
016970-2	SOIL	7/15/94	Glass	2.02	NONE	Gamma Spec & Isotopic Ur	NO		

Possible Hazard Identification
 Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Other ☒ **RADIOACTIVE**

Turnaround Time
 Normal ☐ Rush ☐ Required Report Date

Sample Disposal
 Return to Client ☒ Disposal by Lab ☐ Archive Until

Special Instructions/QC Requirements

INFORMATION ONLY

1. Relinquished by Tom Thorp	Org 7582	Date 6/30/94 Time 1341	4. Relinquished by	Org	Date	Time
1. Received by Randall Conway	Org 7582	Date 6/30/94 Time 1341	4. Received by	Org	Date	Time
2. Relinquished by Randall Conway	Org 7582	Date 7/15/94 Time 2:45	5. Relinquished by	Org	Date	Time
2. Received by	Org 7582	Date 7/15/94 Time 1415	5. Received by	Org	Date	Time
3. Relinquished by	Org 7582	Date 7/15/94 Time 1415	6. Relinquished by	Org	Date	Time
3. Received by	Org 7582	Date 7/15/94 Time 1415	6. Received by	Org	Date	Time



SNL/NM 016983
National
Laboratories

SF 2001-SCC (4-94)

ENVIRONMENTAL PROGRAMS SAMPLE COLLECTION LOG

(Continuation)

SCL- 00371

AR/COC No.: ⁵⁰⁸²⁴⁶ AR/COC- 508244

PAGE 3 OF 3

ANALYSES

Sample Number - Fraction	Time	LOCATION	COMMENTS	Sample Type Grab/Comp.	OC Sample (Y/N)	Gamma Spec	LE Spec												
016983	9/30/94	UCP#1	Soil Beneath UCP#1 (NMIR WL 508246)	X	N	X													
016970-1	9:00	UCP#1 6'	Backfill	C	N	X													
016970-2	9:00	UCP#1 6'	Backfill (TMA WL 508244)	C	N		X												

WHITE - To Sample Management Office

PINK - Originator

TMA / EBERLINE
SANDIA NATIONAL LABS, 9407120

9407120-04

016970-2

DATA SHEET

SDG <u>9407120</u>	Client/Case no <u>Sandia National Labs 3615-200</u>
Contact <u>Chandra Bales</u>	Case no <u>12-0841B</u>
Lab sample id <u>9407120-04</u>	Client sample id <u>016970-2</u>
Dept sample id _____	Location/Matrix _____ <u>SOIL</u>
Received <u>07/15/94</u>	Collected/Amount <u>07/01/94</u> <u>330 GM</u>
	Chain of custody id <u>508244</u>

ANALYTE	CAS NO	RESULT pCi/g	2 σ ERR (TOTAL)	MDA pCi/g	FDL pCi/g	QUALI- FIERS	TEST
Uranium 233/234	13966-29-5	0.64	0.11	0.019		B	U
Uranium 235	15117-96-1	0.031	0.020	0.008			U
Uranium 238	7440-60-1	0.63	0.11	0.019			U
Cobalt 60	Gamma 10198-40-0			0.11		U	GM1
Cesium 137	Gamma 10045-97-3			0.091		U	GM1
Potassium 40	Gamma 13966-00-2	20	2.7	1.1			GM1
Radium 226	Gamma 13982-63-3	0.68	0.22	0.27			GM1
Radium 228	Gamma 15262-20-1	1.4	0.51	0.53			GM1
Lead 212	Gamma	0.94	0.14	0.15			GM1
Lead 214	Gamma	0.75	0.19	0.24			GM1
Thorium 228	Gamma	0.91	0.38	0.50			GM1
Thorium 232	Gamma	1.4	0.51	0.53			GM1
Thallium 208	Gamma	0.85	0.36	0.46			GM1
77 keV		0.15	0.069				GM1
92 keV		0.050	0.044			B	GM1
336 keV		0.094	0.074				GM1



Sandia National Laboratories

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

BATCH #940355

No: 508246

Page 1 of 1

Department No: <u>7582</u> Project/Task Manager: <u>Ranlee Conway</u> Project Name: <u>UCP-UCM</u> Sample Team Members: <u>Tom Tharp</u> <u>x Ranlee Conway</u>	Date Samples Shipped: <u>7/5/94</u> Carrier/Waybill No: <u>HC</u> Lab Destination: <u>AMIR</u> Lab Contact: <u>Mike Gonzalez</u> SMO Contact/Phone: <u>848-0404</u> Send Report to SMO: <u>Debra Constantine</u> SMO Reference No:	Bill to: <u>Sandia National Laboratories</u> <u>Supplier Services Department 0154</u> <u>P.O. Box 5800</u> <u>Albuquerque, NM 87185</u> Contract No: Case No: <u>3615-200</u> SMO Authorization: <u>Chris Alfari</u>
---	--	--

Sample Number	Sample Type	Date/Time Collected	Container Type	Sample Volume	Preservative	Requested Testing Program	QC	Lab Sample Number	Condition on Receipt
016960 - 1	SOIL	6/20/94 1500	plastic	500ml	None	Gamma Spec	No		
016961	SOIL	6/20/94 1500	plastic	500ml	None	Gamma Spec	No		
016962 - 1	SOIL	6/21/94 815	plastic	500 ml	None	Gamma Spec	No		
016963	SOIL	6/21/94 1010	plastic	500ml	None	Gamma Spec	No		
016964	SOIL	6/21/94 1010	plastic	500ml	None	Gamma Spec	No		
016965	SOIL	6/21/94 1020	plastic	500ml	None	Gamma Spec	No		
016966	SOIL	6/21/94 1020	plastic	500ml	None	Gamma Spec	No		
016967	SOIL	6/21/94 1020	plastic	500ml	None	Gamma Spec	No		
016968 - 1	SOIL	6/21/94 1330	plastic	500ml	None	Gamma Spec	No		
016969	1 WATER	6/21/94 1330	plastic	500ml	None	Gamma Spec	No		
016969	2 WATER		plastic	1L	None	Isotopes	11		

Possible Hazard Identification Non-hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Other <input checked="" type="checkbox"/> <u>RAD</u>	Special Instructions/QC Requirements
Turnaround Time Normal <input checked="" type="checkbox"/> Rush <input type="checkbox"/> Required Report Date _____	
Sample Disposal Return to Client <input checked="" type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive Until _____	
1. Relinquished by <u>Tom Tharp</u> Org <u>7582</u> Date <u>6/30/94</u> Time <u>1341</u>	4. Relinquished by <u>Chris Alfari</u> Org <u>512 7715</u> Date <u>7/8/94</u> Time <u>1412</u>
1. Received by <u>Ranlee Conway</u> Org <u>7582</u> Date <u>7/1/94</u> Time <u>1341</u>	4. Received by <u>Chris Alfari</u> Org <u>7582</u> Date <u>7-8-94</u> Time <u>1412</u>
2. Relinquished by <u>Ranlee Conway</u> Org <u>7582</u> Date <u>7/5/94</u> Time <u>2145</u>	5. Relinquished by _____ Org _____ Date _____ Time _____
2. Received by <u>Emile Raza</u> Org <u>7576</u> Date <u>7/5/94</u> Time <u>1445</u>	5. Received by _____ Org _____ Date _____ Time _____
3. Relinquished by <u>Emile Raza</u> Org <u>7576</u> Date <u>7/5/94</u> Time <u>1541</u>	6. Relinquished by _____ Org _____ Date _____ Time _____
3. Received by _____ Org <u>512 7715</u> Date <u>7/5/94</u> Time <u>1541</u>	6. Received by _____ Org _____ Date _____ Time _____

White-To Accompany Samples,
Laboratory Copy

Blue-To Accompany Samples,
Return to SMO

Pink-Field/Purchasing Copy

Rev 0 10 92



India
National
Laboratories

SF 2001-COD (12-93)

ANALYSIS REQUEST AND
CHAIN OF CUSTODY RECORD
(continuation)

BATCH # 940355

AR/COC- 508246

PAGE 2 OF 2

Project Name: UCP-VCM

Project/Task Manager: Parlee Conway

Case No.: 3615.200

Sample Number	- Fraction	Sample Matrix	Date/Time Collected	Container Type	Sample Volume	Preservative	Required Analytical Testing	Lab Sample Number	Condition Receipt
016970-1	SOIL	SOIL	6/29/94	plastic	500ml	None	Gamma Spec		
016971	SOIL	SOIL	6/29/94	plastic	500ml	None	Gamma Spec		
016972	SOIL	SOIL	6/29/94	plastic	500ml	None	Gamma Spec		
016973	SOIL	SOIL	6/29/94	plastic	500ml	None	Gamma Spec		
016974	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016975	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016976	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016977	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016978	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016979	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016980	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016981	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016982	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016983	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016984	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016985	SOIL	SOIL	6/30/94	plastic	500ml	NONE	Gamma Spec		
016970-1	Soil	SOIL	7/1/94	plastic	500ml	None	Gamma Spec		

WHITE - To Accompany Samples, Laboratory Copy

BLUE- To Accompany Samples, Return to SMO

YELLOW- SMO Suspense Copy

PINK- Field Copy



Sandia : SNL/NM 016960
National : SNL/NM 016961
Laboratory : SNL/NM 016961

SNL/NM 016962
SNL/NM 016963
SNL/NM 016964

SNL/NM 016965
AL PROGRAMS
LECTION LOG

SCL-00371

AR/COC No.: AR/COC-508246
PAGE 1 OF 3X#508245

SF 2001-SCL (12-93)

GENERAL INFORMATION		DATE: 6/20/94		WEATHER: PARTLY CLOUDY		SAMPLING INFORMATION		ON-SITE CONTACT		ORG		PHONE		
		SAMPLING PROCEDURE REFERENCE:						R. CONWAY		7582		848-0383		
		PURPOSE OF SAMPLING: Assess CONTAMINATION. BELOW UCPs												
SAMPLE DESCRIPTION		MATRIX: <input type="checkbox"/> GAS <input type="checkbox"/> LIQUID <input type="checkbox"/> SLUDGE <input type="checkbox"/> SOLID <input type="checkbox"/> WATER <input type="checkbox"/> OIL <input checked="" type="checkbox"/> SOIL <input type="checkbox"/> HAZ WASTE <input type="checkbox"/> OTHER										ANALYSES		
		COLLECTED FROM: <input type="checkbox"/> DRUM <input type="checkbox"/> TANK <input type="checkbox"/> SURFACE WATER <input checked="" type="checkbox"/> SOIL <input type="checkbox"/> WASTE WATER <input type="checkbox"/> GROUND WATER <input type="checkbox"/> OTHER												
Sample Number	- Fraction	Time	LOCATION	COMMENTS	Sample Type	Grab/Comp	OC Sample	(Y/N)	Gamma Spec	ISOTOPIC	URANIUM			
016960-1		6/20/94	UCP#2 BOTTOM	SOIL BENEATH UCP #2 (AMIRWL 30046)	GN				X					
016960-2		6/20/94	UCP#2 BOTTOM	Soil BENEATH UCP #2 (AMIRWL 30046)	GN				X					
016961		6/20/94	UCP#2 BOTTOM	Soil BENEATH UCP #2 (AMIRWL 30046)	GN				X					
016962-1		6/21/94	UCP#2 BACKFILL	BACKFILL FOR UCP#2	GN				X					
016962-2		6/21/94	UCP#2 BACKFILL	BACKFILL FOR UCP#2	GN				X					
016963		6/21/94	Soil BENEATH UCP#1	Soil BENEATH UCP#1 (AMIRWL 30046)	GN				X					
016964		6/21/94	Soil BENEATH UCP#1	Soil BENEATH UCP#1	GN				X					
016965		6/21/94	Soil BENEATH UCP#1	Soil BENEATH UCP#1	GN				X					
PROJECT	PROJECT NAME		CASE NUMBER		PROJECT CONTACT		ORG		PHONE					
	UCP-VCM		3615.200		R. CONWAY		7582		848-0383					
*ADDITIONAL INFORMATION: (Log Book Ref. #)														
SAMPLE TEAM MEMBERS	NAME		SIGNATURE		INIT		COMPANY/ORGANIZATION							
	1. Tom Tharp		Tom Tharp		TT		WESTON / 7582							
	2. [Signature]		[Signature]		[Signature]		IT Corp.							
	3. Rarilee Conway		Rarilee Conway		RC		SNL / 7582							
SAMPLE TRACKING	SAMPLE DISTRIBUTION		TRANSPORTED BY		SPECIAL HANDLING									
	DATE SHIPPED (MM-DD-YY)		DATE ENTERED (MM-DD-YY)		BY:									
		7/19/94		4/4/50				1A 7/19/94						

*NOTE: Any additional sampling information must be recorded in an SNL-Issued Log Book or SCL Continuation Form with a Reference No. entered in this space.

WHITE - To Sample Management Office

PINK- Originator

☐ TO BE COMPLETED BY SMO



SF 2001-SCC (4-94)

India SNL/NM 016966 SNL/NM 016971 NL/NM 016977
Nator SNL/NM 016967 SNL/NM 016972 NL SNL/NM 016978
Laborz OL SNL/NM 016979
SNL/NM 016968 SNL/NM 016973 ntin
SNL/NM 016969 SNL/NM 016974 SNL/NM 016980
SNL/NM 016970 SNL/NM 016975 SNL/NM 016981
SNL/NM 016976 SNL/NM 016982

SCL- 00371

AR/COC No.: AR/COC- 508246
PAGE 2 OF 3Sample
Number - Fraction

Time

LOCA

Sample Type
Grab/Comp.
OC Sample
(N)Gravim. Spec
ISO Uranium

ANALYSES

016966	6/28/94	UCP #1	Soil Beneath UCP1 (AMTR LOC 508246)	G	N	X													
016967	6/28/94	UCP #1	Soil Beneath UCP1	G	N	X													
016968-1	6/28/94	UCP #1	Soil Beneath UCP1 (Background)	G	N	X													
016969-1	6/28/94	UCP #1	Soil Beneath UCP1 Water (PIPE)	G	N	X													TT
016969-2	6/28/94	UCP #1	UCP1 Water (PIPE)	G	N	X													TT
016968-2	6/28/94	UCP #1	Soil Beneath UCP1 (Background) TMA	G	N	X													
016970-1	6/28/94	UCP #1	Soil at bottom of pipe	G	N	X													TT
016970-2	6/28/94	UCP #1	Soil at bottom of pipe	G	N	X													TT
016971-1	6/29/94	UCP #1	Soil Beneath UCP #1 (AMTR LOC 508246)	G	N	X													
016972	6/29/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016973	6/29/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016974	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016975	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016976	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016977	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016978	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016979	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016980	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016981	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													
016982	6/30/94	UCP #1	Soil Beneath UCP #1	G	N	X													

WHITE - To Sample Management Office

PINK - Originator



SNL/NM 016983
National
Laboratories

ENVIRONMENTAL PROGRAMS

SAMPLE COLLECTION LOG

(Continuation)

SCL- 00371

AP/COC No.: AP/COC-508244 ⁵⁰⁸²⁴⁶

PAGE 3 OF 3

ANALYSES

Sample Number	Fraction	Time	LOCATION	COMMENTS	Sample Type	Grav/Comp.	OC Sample	(N/N)	Gamma Spec	Leptopic
016973	4/30/74	UCP#1	Soil Beneath UCP#1	(TMA 10/500211)	G	N	N	X	X	X
016970-1	9:00	UCP#1 6'	Backfill	" 500211)	G	N	N	X	X	X
016970-2	9:00	UCP#1 6'	Backfill	(TMA 10/500211)	G	N	N	X	X	X

WHITE - To Sample Management Office

PINK - Originator

6/20 UCP #2 Bottom Sil Bene

 * SNL Radiation Sample Diagnostic Program (7715)/881 07-JUL-94 15:31:17 *

 R.CONWAY/E.ROSS (7582) SNL 016960-1

UCP #2

Operator: JK 7/7/94 Reviewed by JMM 7/8/94

 *
 Data File : 94035501.DAT * Sample Quantity: 974.000 GRAM
 Acquire Date: 07-JUL-94 14:59:25 * Efficiency File: SMAR2.EFF
 Sample Date: 20-JUN-94 15:00:00 * Library File: RSDP.LIB
 Sample Type: SOLID *

 *
 Preset Live Time: 1800.0 sec * FWHM at 1332 KeV : 2.4 KeV
 Elapsed Live Time: 1800.0 sec * Peak Search Sensitivity: 4.0
 Elapsed Real Time: 1801.0 sec * Gaussian Assymetry : 10.0 %

 *
 Detector : DET2 * Fit Iterations : 20.
 Calib Date : 20-APR-94 16:41:18 * Energy Tolerance: 1.5 KeV
 KeV/Channel: .36617 * Half Life Ratio : 8.0
 Offset : .00135 * Abundance Limit : 50.00 %

[Summary Report -- SNL (7715) -- version 1.2]

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
U-238	1.45E+00	6.27E-01	-----
TH-234	1.45E+00	6.29E-01	-----
U-234	Not Detected	-----	3.51E+00
RA-226	2.41E+00	6.98E-01	-----
PB-214	9.72E-01	1.14E-01	-----
BI-214	8.45E-01	1.10E-01	-----
PB-210	4.64E+00	1.09E+00	-----
TH-232	8.78E-01	1.68E-01	-----
RA-228	8.78E-01	1.68E-01	-----
AC-228	7.92E-01	1.52E-01	-----
TH-228	7.21E-01	6.78E-02	-----
RA-224	Not Significant	-----	-----
PB-212	7.24E-01	6.81E-02	-----
BI-212	7.15E-01	2.84E-01	-----
TL-208	2.23E-01	4.46E-02	-----
U-235	Not Detected	-----	5.18E-02
TH-231	Not Detected	-----	3.00E-01
PA-231	Not Detected	-----	9.47E-01
AC-227	Not Detected	-----	1.34E+00
TH-227	Not Detected	-----	1.95E-01
AM-241	Not Detected	-----	6.94E-02
NP-237	Not Detected	-----	1.86E-01
PA-233	Not Detected	-----	7.58E-02
TH-229	Not Detected	-----	9.82E-02

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
AG-110	Not Detected	-----	2.35E-02
BE-7	Not Detected	-----	2.07E-01
AR-41	Short Half-Life	-----	-----
BA-133	Not Detected	-----	2.96E-02
BA-140	Not Detected	-----	2.08E-01
BI-207	Not Detected	-----	2.25E-02
CD-109	Not Detected	-----	7.51E-01
CE-139	Not Detected	-----	2.60E-02
CE-144	Not Detected	-----	1.84E-01
CO-56	Not Detected	-----	2.86E-02
CO-57	Not Detected	-----	2.36E-02
CO-58	Not Detected	-----	2.75E-02
CO-60	Not Detected	-----	3.96E-02
CR-51	Not Detected	-----	2.76E-01
CS-134	Not Detected	-----	2.46E-02
CS-137	Not Detected	-----	2.45E-02
CU-64	Short Half-Life	-----	-----
EU-152	Not Detected	-----	6.80E-02
EU-154	Not Detected	-----	9.81E-02
EU-155	Not Detected	-----	9.40E-02
FE-59	Not Detected	-----	7.59E-02
GD-153	Not Detected	-----	6.19E-02
HG-203	Not Detected	-----	3.23E-02
I-125	Not Detected	-----	0.00E+00
I-129	Not Detected	-----	0.00E+00
I-131	Not Detected	-----	8.87E-02
IN-115M	Short Half-Life	-----	-----
IR-192	Not Detected	-----	2.36E-02
K-40	1.76E+01	9.50E-01	-----
LA-140	Short Half-Life	-----	-----
MN-54	Not Detected	-----	2.51E-02
MN-56	Short Half-Life	-----	-----
NA-22	Not Detected	-----	3.64E-02
NA-24	Short Half-Life	-----	-----
NB-95	Not Detected	-----	2.27E+00
RU-103	Not Detected	-----	2.74E-02
RU-106	Not Detected	-----	2.20E-01
SB-124	Not Detected	-----	2.65E-02
SB-125	Not Detected	-----	6.52E-02
SB-126	Not Detected	-----	6.32E-02
SC-46	Not Detected	-----	2.98E-02
SN-113	Not Detected	-----	3.21E-02
SR-85	Not Detected	-----	2.63E-02
TA-182	Not Detected	-----	2.74E-01
TL-201	Not Detected	-----	8.81E+00
XE-133	Not Detected	-----	5.90E-01
Y-88	Not Detected	-----	2.87E-02
ZN-65	Not Detected	-----	7.36E-02
ZR-95	Not Detected	-----	4.75E-02

6/21 UCP#2 Backfill

 * SNL Radiation Sample Diagnostic Program (7715)/881 07-JUL-94 14:26:05 *

 R.CONWAY/E.ROSS (7582) SNL 016962-1

Operator: JP 7/7/94Reviewed by AM 7/8/94

 *
 Data File : 94035503.DAT * Sample Quantity: 627.000 GRAM
 Acquire Date: 07-JUL-94 13:44:28 * Efficiency File: SMAR2.EFF
 Sample Date: 21-JUN-94 08:15:00 * Library File: RSDP.LIB
 Sample Type: SOLID *

 *
 Preset Live Time: 1800.0 sec * FWHM at 1332 KeV : 2.4 KeV
 Elapsed Live Time: 1800.0 sec * Peak Search Sensitivity: 4.0
 Elapsed Real Time: 1800.0 sec * Gaussian Assymetry : 10.0 %

 *
 Detector : DET2 * Fit Iterations : 20.
 Calib Date : 20-APR-94 16:41:18 * Energy Tolerance: 1.5 KeV
 KeV/Channel: .36617 * Half Life Ratio : 8.0
 Offset : .00135 * Abundance Limit : 50.00 %

[Summary Report -- SNL (7715) -- version 1.2]

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
U-238	1.22E+00	7.21E-01	-----
TH-234	1.22E+00	7.22E-01	-----
U-234	Not Detected	-----	3.73E+00
RA-226	1.41E+00	6.50E-01	-----
PB-214	6.25E-01	1.29E-01	-----
BI-214	4.92E-01	1.12E-01	-----
PB-210	Not Significant	-----	-----
TH-232	8.12E-01	2.12E-01	-----
RA-228	8.12E-01	2.12E-01	-----
AC-228	7.33E-01	1.91E-01	-----
TH-228	8.04E-01	8.62E-02	-----
RA-224	7.74E-01	8.23E-01	-----
PB-212	8.07E-01	8.66E-02	-----
BI-212	Not Detected	-----	3.60E-01
TL-208	Not Detected	-----	8.00E-02
U-235	Not Detected	-----	5.54E-02
TH-231	Not Detected	-----	3.51E-01
PA-231	Not Detected	-----	1.20E+00
AC-227	Not Detected	-----	1.46E+00
TH-227	Not Detected	-----	2.28E-01
AM-241	Not Detected	-----	7.73E-02
NP-237	Not Detected	-----	2.17E-01
PA-233	Not Detected	-----	8.27E-02
TH-229	Not Detected	-----	1.12E-01

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
AG-110	Not Detected	-----	3.10E-02
BE-7	Not Detected	-----	2.64E-01
AR-41	Short Half-Life	-----	-----
BA-133	Not Detected	-----	4.10E-02
BA-140	Not Detected	-----	2.53E-01
BI-207	Not Detected	-----	2.64E-02
CD-109	Not Detected	-----	8.65E-01
CE-139	Not Detected	-----	2.80E-02
CE-144	Not Detected	-----	2.02E-01
CO-56	Not Detected	-----	3.84E-02
CO-57	Not Detected	-----	2.47E-02
CO-58	Not Detected	-----	2.80E-02
CO-60	Not Detected	-----	4.84E-02
CR-51	Not Detected	-----	3.67E-01
CS-134	Not Detected	-----	3.33E-02
CS-137	Not Detected	-----	3.61E-02
CU-64	Short Half-Life	-----	-----
EU-152	Not Detected	-----	7.00E-02
EU-154	Not Detected	-----	1.31E-01
EU-155	Not Detected	-----	1.10E-01
FE-59	Not Detected	-----	7.70E-02
GD-153	Not Detected	-----	6.61E-02
HG-203	Not Detected	-----	4.32E-02
I-125	Not Detected	-----	0.00E+00
I-129	Not Detected	-----	0.00E+00
I-131	Not Detected	-----	1.06E-01
IN-115M	Short Half-Life	-----	-----
IR-192	Not Detected	-----	3.20E-02
K-40	1.56E+01	1.12E+00	-----
LA-140	Short Half-Life	-----	-----
MN-54	Not Detected	-----	2.97E-02
MN-56	Short Half-Life	-----	-----
NA-22	Not Detected	-----	3.99E-02
NA-24	Short Half-Life	-----	-----
NB-95	Not Detected	-----	2.23E+00
RU-103	Not Detected	-----	3.65E-02
RU-106	Not Detected	-----	2.84E-01
SB-124	Not Detected	-----	4.25E-02
SB-125	Not Detected	-----	6.89E-02
SB-126	Not Detected	-----	6.75E-02
SC-46	Not Detected	-----	3.15E-02
SN-113	Not Detected	-----	3.77E-02
SR-85	Not Detected	-----	3.52E-02
TA-182	Not Detected	-----	3.07E-01
TL-201	Not Detected	-----	8.37E+00
XE-133	Not Detected	-----	5.91E-01
Y-88	Not Detected	-----	3.82E-02
ZN-65	Not Detected	-----	9.94E-02
ZR-95	Not Detected	-----	5.67E-02

6/30 UCP#1 Soil Beneath (Bksd)

* SNL Radiation Sample Diagnostic Program (7715)/881 07-JUL-94 09:34:55 *

R.CONWAY/E.ROSS (7582) SNL 016968-1

Operator: JD 7/7/94 Reviewed by JAM 7/18/94

*
Data File : 94035509.DAT * Sample Quantity: 668.000 GRAM
Acquire Date: 07-JUL-94 08:43:19 * Efficiency File: SMAR2.EFF
Sample Date: 30-JUN-94 13:30:00 * Library File: RSDP.LIB
Sample Type: SOLID *

*
Preset Live Time: 1800.0 sec * FWHM at 1332 KeV : 2.4 KeV
Elapsed Live Time: 1800.0 sec * Peak Search Sensitivity: 4.0
Elapsed Real Time: 1801.0 sec * Gaussian Assymetry : 10.0 %

*
Detector : DET2 * Fit Iterations : 20.
Calib Date : 20-APR-94 16:41:18 * Energy Tolerance: 1.5 KeV
KeV/Channel: .36617 * Half Life Ratio : 8.0
Offset : .00135 * Abundance Limit : 50.00 %

[Summary Report -- SNL (7715) -- version 1.2]

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
U-238	1.61E+01	9.43E-01	-----
TH-234	1.61E+01	9.45E-01	-----
U-234	Not Detected	-----	1.08E+01
RA-226	Not Significant	-----	-----
PB-214	5.61E-01	9.52E-02	-----
BI-214	5.03E-01	9.78E-02	-----
PB-210	Not Detected	-----	0.00E+00
TH-232	6.20E-01	1.54E-01	-----
RA-228	6.20E-01	1.54E-01	-----
AC-228	5.60E-01	1.39E-01	-----
TH-228	6.19E-01	8.03E-02	-----
RA-224	Not Significant	-----	-----
PB-212	6.22E-01	8.06E-02	-----
BI-212	4.73E-01	3.19E-01	-----
TL-208	2.24E-01	5.34E-02	-----
U-235	8.97E-01	9.18E-02	-----
TH-231	Not Detected	-----	5.07E-01
PA-231	Not Detected	-----	1.06E+00
AC-227	Not Detected	-----	1.62E+00
TH-227	Not Detected	-----	2.08E-01
AM-241	Not Detected	-----	1.09E-01
NP-237	Not Detected	-----	2.60E-01
PA-233	Not Detected	-----	5.71E-02
TH-229	Not Detected	-----	1.21E-01

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
AG-110	Not Detected	-----	2.64E-02
BE-7	Not Detected	-----	2.08E-01
AR-41	Short Half-Life	-----	-----
BA-133	Not Detected	-----	3.61E-02
BA-140	Not Detected	-----	1.34E-01
BI-207	Not Detected	-----	2.67E-02
CD-109	Not Detected	-----	1.02E+00
CE-139	Not Detected	-----	3.25E-02
CE-144	Not Detected	-----	2.25E-01
CO-56	Not Detected	-----	2.77E-02
CO-57	Not Detected	-----	2.99E-02
CO-58	Not Detected	-----	2.73E-02
CO-60	Not Detected	-----	3.62E-02
CR-51	Not Detected	-----	2.60E-01
CS-134	Not Detected	-----	2.85E-02
CS-137	Not Detected	-----	2.60E-02
CU-64	Short Half-Life	-----	-----
EU-152	Not Detected	-----	8.74E-02
EU-154	Not Detected	-----	1.17E-01
EU-155	Not Detected	-----	1.22E-01
FE-59	Not Detected	-----	7.34E-02
GD-153	Not Detected	-----	9.33E-02
HG-203	Not Detected	-----	3.24E-02
I-125	Not Detected	-----	0.00E+00
I-129	Not Detected	-----	0.00E+00
I-131	Not Detected	-----	4.97E-02
IN-115M	Short Half-Life	-----	-----
IR-192	Not Detected	-----	2.91E-02
K-40	1.21E+01	9.75E-01	-----
LA-140	Not Detected	-----	3.76E-01
MN-54	Not Detected	-----	2.73E-02
MN-56	Short Half-Life	-----	-----
NA-22	Not Detected	-----	3.45E-02
NA-24	Short Half-Life	-----	-----
NB-95	Not Detected	-----	3.30E-01
RU-103	Not Detected	-----	2.40E-02
RU-106	Not Detected	-----	2.51E-01
SB-124	Not Detected	-----	3.05E-02
SB-125	Not Detected	-----	6.78E-02
SB-126	Not Detected	-----	4.76E-02
SC-46	Not Detected	-----	2.91E-02
SN-113	Not Detected	-----	3.20E-02
SR-85	Not Detected	-----	2.85E-02
TA-182	Not Detected	-----	2.34E-01
TL-201	Not Detected	-----	1.11E+00
XE-133	Not Detected	-----	2.36E-01
Y-88	Not Detected	-----	3.58E-02
ZN-65	Not Detected	-----	7.51E-02
ZR-95	Not Detected	-----	5.31E-02

S M O

VLP #1 6' backfil

 * SNL Radiation Sample Diagnostic Program (7715)/881 06-JUL-94 08:52:41 *

 R.CONWAY/E.ROSS (7582) SNL 016970-1

Operator:

7/6/94

Reviewed by

7/8/94

 *
 Data File : 94035523.DAT * Sample Quantity: 690.000 GRAM
 Acquire Date: 06-JUL-94 08:09:35 * Efficiency File: SMAR2.EFF
 Sample Date: 01-JUL-94 09:00:00 * Library File: RSDP.LIB
 Sample Type: SOLID *

*
 Preset Live Time: 1800.0 sec * FWHM at 1332 KeV : 2.4 KeV
 Elapsed Live Time: 1800.0 sec * Peak Search Sensitivity: 4.0
 Elapsed Real Time: 1801.0 sec * Gaussian Assymetry : 10.0 %

*
 Detector : DET2 * Fit Iterations : 20.
 Calib Date : 20-APR-94 16:41:18 * Energy Tolerance: 1.5 KeV
 KeV/Channel: .36617 * Half Life Ratio : 8.0
 Offset : .00135 * Abundance Limit : 50.00 %

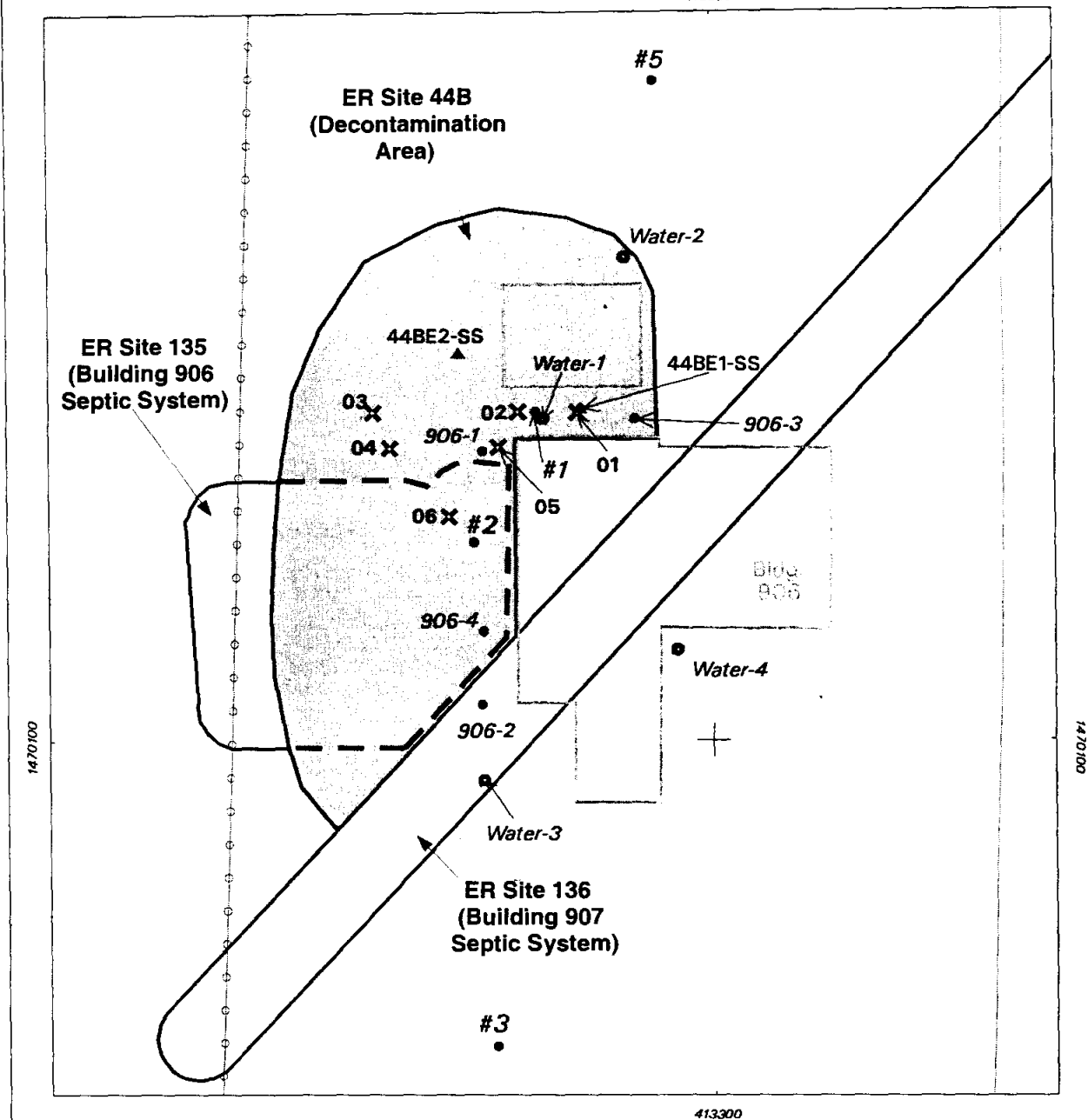
[Summary Report -- SNL (7715) -- version 1.2]

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
U-238	Not Detected	-----	5.24E-01
TH-234	Not Detected	-----	5.25E-01
U-234	Not Detected	-----	8.98E+00
RA-226	1.44E+00	7.06E-01	-----
PB-214	6.31E-01	9.55E-02	-----
BI-214	6.51E-01	1.00E-01	-----
PB-210	1.50E+00	8.19E-01	-----
TH-232	8.68E-01	1.98E-01	-----
RA-228	8.68E-01	1.98E-01	-----
AC-228	7.84E-01	1.79E-01	-----
TH-228	8.01E-01	8.41E-02	-----
RA-224	7.32E-01	7.25E-01	-----
PB-212	8.04E-01	8.45E-02	-----
BI-212	5.38E-01	3.02E-01	-----
TL-208	2.49E-01	5.69E-02	-----
U-235	Not Detected	-----	5.15E-02
TH-231	Not Detected	-----	3.26E-01
PA-231	Not Detected	-----	1.11E+00
AC-227	Not Detected	-----	1.44E+00
TH-227	Not Detected	-----	2.27E-01
AM-241	Not Detected	-----	7.26E-02
NP-237	Not Detected	-----	1.98E-01
PA-233	Not Detected	-----	6.00E-02
TH-229	Not Detected	-----	1.10E-01

Nuclide	Activity (PCI /GRAM)	2-sigma Error	MDA (PCI /GRAM)
AG-110	Not Detected	-----	3.01E-02
BE-7	Not Detected	-----	2.21E-01
AR-41	Short Half-Life	-----	-----
BA-133	Not Detected	-----	3.67E-02
BA-140	Not Detected	-----	1.11E-01
BI-207	Not Detected	-----	2.33E-02
CD-109	Not Detected	-----	7.68E-01
CE-139	Not Detected	-----	2.50E-02
CE-144	Not Detected	-----	1.81E-01
CO-56	Not Detected	-----	3.36E-02
CO-57	Not Detected	-----	2.38E-02
CO-58	Not Detected	-----	2.28E-02
CO-60	Not Detected	-----	4.56E-02
CR-51	Not Detected	-----	2.15E-01
CS-134	Not Detected	-----	2.75E-02
CS-137	Not Detected	-----	3.04E-02
CU-64	Short Half-Life	-----	-----
EU-152	Not Detected	-----	7.18E-02
EU-154	Not Detected	-----	1.13E-01
EU-155	Not Detected	-----	9.68E-02
FE-59	Not Detected	-----	5.87E-02
GD-153	Not Detected	-----	6.15E-02
HG-203	Not Detected	-----	3.14E-02
I-125	Not Detected	-----	0.00E+00
I-129	Not Detected	-----	0.00E+00
I-131	Not Detected	-----	3.79E-02
IN-115M	Short Half-Life	-----	-----
IR-192	Not Detected	-----	2.46E-02
K-40	1.59E+01	1.07E+00	-----
LA-140	Not Detected	-----	2.53E-01
MN-54	Not Detected	-----	2.86E-02
MN-56	Short Half-Life	-----	-----
NA-22	Not Detected	-----	3.60E-02
NA-24	Not Detected	-----	7.36E+00
NB-95	Not Detected	-----	2.52E-01
RU-103	Not Detected	-----	2.92E-02
RU-106	Not Detected	-----	2.53E-01
SB-124	Not Detected	-----	2.98E-02
SB-125	Not Detected	-----	6.55E-02
SB-126	Not Detected	-----	3.67E-02
SC-46	Not Detected	-----	3.06E-02
SN-113	Not Detected	-----	3.36E-02
SR-85	Not Detected	-----	2.58E-02
TA-182	Not Detected	-----	2.81E-01
TL-201	Not Detected	-----	5.75E-01
XE-133	Not Detected	-----	1.23E-01
Y-88	Not Detected	-----	3.74E-02
ZN-65	Not Detected	-----	8.75E-02
ZR-95	Not Detected	-----	5.19E-02

Attachment J

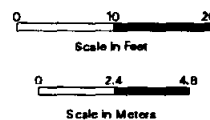
ATTACHMENT J
ER SITE 44B
SUPPLEMENTAL FIGURE 1



Legend

- 906-1 • February 1994 Soil Sample Location
- Water-1 • February 1994 Water Sample Location
- 03 X April 1994 Soil Sample Location
- 44BE1-SS ▲ Post-VCN (Verification) Soil Sample Location
- Road
- Building
- Fence
- Subsurface Extent of ER Site 135 Boundary
- ER Site 44B Decontamination Area
- Other ER Sites

Figure 1
Approximate Soil Sampling Locations at ER Site 44B



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

ATTACHMENT K

**ER SITE 44B
SUPPLEMENTAL TABLE 3-6 AND GAMMA SPECTROSCOPY DATA**

Table 3-6
Summary of ER Site 44B Post-VCM Verification Sampling Gamma Spectroscopy Analysis, November 1996
(On-Site Laboratory)

Sample Attributes				Activity (pCi/g)							
Record Number ^a	ER Sample ID ^b	Date Sampled	Sample Depth (ft)	Uranium-238		Thorium-232		Uranium-235		Cesium-137	
				Result	Error ^c	Result	Error ^c	Result	Error ^c	Result	Error ^c
06053	44BE1-SS	11-19-96	0.0-0.25	ND (0.935)	--	0.545	0.279	ND (0.149)	--	0.653	0.103
06053	44BE1-SD	11-19-96	0.0-0.25	ND (2.26)	--	0.704	0.336	ND (0.281)	--	0.771	0.217
06053	44BE2-SS	11-19-96	0.0-0.25	ND (2.24)	--	0.758	0.392	0.269	0.281	0.618	0.109
Background Soil Activities – North Area ^d				1.3	NA	1.54	NA	0.18	NA	0.084	NA

Note: Values in **bold** exceed background.

^a Analysis request/chain of custody record.

^b **Bold** portion of ER Sample ID corresponds to the sample location in Figure 1.

^c Two standard deviations about the mean detected activity.

^d Dinwiddie, September 1997. The more conservative, lower background value between the surface and subsurface is used as a benchmark for consistency with current risk assessment methodology.

ER = Environmental restoration.

ft = Foot (feet).

ID = Identification.

NA = Not applicable.

ND () = Not detected at or above the minimum detectable activity, shown in parentheses.

pCi/g = Picocurie(s) per gram.

SD = Sample duplicate.

SS = Surface soil sample.

VCM = Voluntary Corrective Measure.

-- = Error not calculated for nondetectable results.

ANALYSIS REQUEST AND CHAIN OF CUSTODY

PAGE 1 OF 1

Internal Lab

Batch No. 630264

AR/COC-06053

Dept. No./Mail Stop: 7585/1148
 Project/Task Manager: R. Conway / K. Lambert
 Project Name: Surface Rad VCM
 Record Center Code: ER/BR/VCA/1303/448/AN
 Logbook Ref No: NA
 Service Order No.: NA

SMO USE

Contract No: NA

Case No: 8245, 2nd

SMO Authorization: [Signature]

Bill to: Send a National Laboratories
 Supplier Services Department
 P.O. Box 5800 MS 0154
 Albuquerque, NM 87185-0154

Lab Contact: Amir M.
 Lab Destination: 7715 Lab
 SMO Contact/Phone: Pam Buisson / 848-0402
 Send Report to SMO: K. Lambert / MS448

Parameter & Method Requested

Location Tech Area 2

Building NA Room NA

Sample No. - Fraction ER Sample ID or Sample Location Detail

Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO)				
			Sample Matrix	Type	Volume	Preservative	Sample Collection Method
0'-3"	44B	11/12/00	S	P	500ml	NO	G SA
0'-3"	44B	11/14/00	↓	↓	↓	↓	↓
0'-3"	44B	11/17/00	↓	↓	↓	↓	↓

Post-It* Fax Note 7671

Date 3/15/99 # of pages 1
 To DOUG VETTER From KATHIE CHAVEZ
 Co/Dept IT Co. SNL
 Phone # 262-8744 Phone # 844-7086
 Fax # 262-8055 Fax # 844-5977

RMMA ☒ Yes ☐ No Ref. No. ER 515 44BSample Disposal ☒ Return to Client ☐ Disposal by labTurnaround Time ☒ Normal ☐ Rush Required Report Date

Sample Team Members	Name	Signature	Init	Company/Organization/Phone
	Ernest Collings	[Signature]	EC	PRCTEC/970-744-6448
	Mike Salazar	[Signature]	MS	601 Barry/602-435-2628
	Ken Sotelo	[Signature]	KS	Western/884-5050

Special Instructions/QC Requirements

RPO - notify K. Lambert at
 my 8244-3456 when gamma spec.
 done.

complete. Further analysis to be
 performed @ Chem Lab upon completion
 of gamma spec. screen

1. Relinquished by [Signature]	Org. RFW	Date 11/25/96	Time 16:05	4. Relinquished by	Org.	Date	Time
1. Received by [Signature]	Org. 7524	Date 11/25/96	Time 16:05	4. Received by	Org.	Date	Time
2. Relinquished by [Signature]	Org. 7524	Date 11/26/96	Time 10:00	5. Relinquished by	Org.	Date	Time
2. Received by [Signature]	Org. 7578	Date 11/26/96	Time 10:00	5. Received by	Org.	Date	Time
3. Relinquished by [Signature]	Org. 7578	Date 12/11/96	Time 14:50	6. Relinquished by	Org.	Date	Time
3. Received by [Signature]	Org. 7524	Date 12/11/96	Time 11:50	6. Received by	Org.	Date	Time

WHITE - To Accompany Samples, Laboratory Copy

BLUE - To Accompany Samples, Return to SMO

YELLOW - SMO Suspense Copy

PINK - Field Copy

MAR 15 '99 11:04 No.001 P.01

ID:5058441388

7578

Survey #:

 * Sandia National Laboratories *
 * Radiation Protection Sample Diagnostics Program [TA5 Laboratory] *
 * 12-02-96 10:59:44 AM *

* Analyzed by: *MDS 12/5/96*Reviewed by: *[Signature] 12/5/96*

 Customer : K.BABILON (7524)
 Customer Sample ID : 44BE1SS
 Lab Sample ID : 63026401

Sample Description : MARINELLI OF SOIL
 Sample Quantity : 7.91E+02 gram
 Sample Date/Time : 11-19-96 8:05:00 AM
 Acquire Start Date/Time : 12-02-96 9:15:36 AM
 Detector Name : LAB2
 Elapsed Live/Real Time : 6000 / 6004 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	-----	9.35E-01
TH-234	9.17E-01	2.68E-01	3.20E-01
RA-226	1.14E+00	5.00E-01	3.95E-01
PB-214	5.31E-01	1.36E-01	3.72E-02
BI-214	5.06E-01	3.65E-01	7.48E-02
TH-232	5.45E-01	2.79E-01	1.06E-01
RA-228	7.41E-01	2.02E-01	1.13E-01
AC-228	6.84E-01	2.04E-01	7.75E-02
TH-228	3.61E-01	2.34E-01	2.90E-01
RA-224	5.98E-01	6.46E-01	7.32E-02
PB-212	6.39E-01	1.63E-01	2.58E-02
BI-212	7.44E-01	4.00E-01	2.76E-01
TL-208	6.24E-01	1.29E-01	5.56E-02
U-235	Not Detected	-----	1.49E-01
TH-231	Not Detected	-----	1.32E+00
PA-231	Not Detected	-----	9.92E-01
TH-227	Not Detected	-----	2.60E-01
RA-223	Not Detected	-----	1.97E-01
RN-219	Not Detected	-----	2.91E-01
PB-211	Not Detected	-----	6.66E-01
TL-207	Not Detected	-----	1.17E+01
AM-241	Not Detected	-----	1.28E-01
PU-239	Not Detected	-----	2.75E+02
NP-237	Not Detected	-----	1.52E-01
PA-233	Not Detected	-----	4.15E-02
TH-229	Not Detected	-----	1.57E-01

[Summary Report] - Sample ID: : 63026401

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected		6.49E-02
AU-198	Not Detected		5.83E-01
BA-133	Not Detected		2.83E-02
BE-7	Not Detected		2.38E-01
CD-109	Not Detected		7.01E-01
CD-115	Not Detected		2.74E+00
CE-139	Not Detected		1.95E-02
CE-141	Not Detected		4.41E-02
CE-144	Not Detected		1.48E-01
CO-56	Not Detected		2.20E-02
CO-57	Not Detected		2.04E-02
CO-58	Not Detected		2.89E-02
CO-60	Not Detected		3.07E-02
CR-51	Not Detected		2.17E-01
CS-134	Not Detected		4.14E-02
CS-137	6.53E-01	1.03E-01	2.13E-02
EU-152	Not Detected		1.89E-01
EU-154	Not Detected		1.43E-01
EU-155	Not Detected		8.11E-02
FE-59	Not Detected		7.15E-02
GD-153	Not Detected		6.22E-02
HG-203	Not Detected		2.40E-02
I-133	Not Detected		7.64E+02
I-131	Not Detected		6.30E-02
I-132	Not Detected		1.00E+26
IR-192	Not Detected		2.16E-02
K-40	1.38E+01	2.18E+00	2.43E-01
MN-54	Not Detected		2.87E-02
MN-56	Not Detected		1.00E+26
MO-99	Not Detected		5.30E+00
NA-22	Not Detected		3.56E-02
NA-24	Not Detected		5.15E+04
NB-95	Not Detected		1.47E+00
ND-147	Not Detected		3.43E-01
NI-57	Not Detected		1.87E+01
RU-103	Not Detected		2.75E-02
RU-106	Not Detected		2.36E-01
SB-122	Not Detected		9.22E-01
SB-124	Not Detected		2.83E-02
SB-125	Not Detected		6.60E-02
SR-85	Not Detected		3.27E-02
TA-182	Not Detected		1.44E-01
TA-183	Not Detected		6.45E-01
TC-99m	Not Detected		9.09E+13
TL-201	Not Detected		1.11E+00
W-187	Not Detected		7.58E+02
XE-133	Not Detected		3.68E+00
Y-88	Not Detected		2.33E-02
ZN-65	Not Detected		8.93E-02
ZR-95	Not Detected		5.17E-02

Survey #:

 * Sandia National Laboratories *
 * Radiation Protection Sample Diagnostics Program [TAS Laboratory] *
 * 11-26-96 4:19:48 PM *

* Analyzed by: *MOJ 12/6/96* Reviewed by: *[Signature] 12/6/96* *

Customer : K.RABIIION (7524)
 Customer Sample ID : 44BE1SD
 Lab Sample ID : 63026402

Sample Description : MARINELLI OF SOIL
 Sample Quantity : 7.66E+02 gram
 Sample Date/Time : 11-19-96 8:05:00 AM
 Acquire Start Date/Time : 11-26-96 2:26:16 PM
 Detector Name : LAB1
 Elapsed Live/Real Time : 6000 / 6001 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	-----	2.26E+00
TH-234	8.23E-01	6.24E-01	5.96E-01
RA-226	1.24E+00	6.32E-01	6.27E-01
PB-214	5.86E-01	1.30E-01	6.23E-02
BI-214	5.55E-01	1.32E-01	6.96E-02
TH-232	7.04E-01	3.36E-01	1.90E-01
RA-228	6.82E-01	3.64E-01	3.49E-01
AC-228	6.68E-01	2.05E-01	1.47E-01
TH-228	5.71E-01	2.77E-01	6.18E-01
RA-224	7.58E-01	5.04E-01	1.35E-01
PB-212	6.46E-01	1.28E-01	4.96E-02
BI-212	9.80E-01	6.41E-01	4.55E-01
TL-208	6.20E-01	2.15E-01	9.74E-02
U-235	Not Detected	-----	2.81E-01
TH-231	Not Detected	-----	2.88E+00
PA-231	Not Detected	-----	2.13E+00
TH-227	Not Detected	-----	4.20E-01
RA-223	Not Detected	-----	2.77E-01
RN-219	Not Detected	-----	6.31E-01
PB-211	Not Detected	-----	1.41E+00
TL-207	Not Detected	-----	2.64E+01
AM-241	Not Detected	-----	3.27E-01
PU-239	Not Detected	-----	4.97E+02
NP-237	Not Detected	-----	2.13E-01
PA-233	Not Detected	-----	8.83E-02
TH-229	Not Detected	-----	2.85E-01

[Summary Report] - Sample ID: : 63026402

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	-----	9.47E-02
AU-198	Not Detected	-----	2.78E-01
BA-133	Not Detected	-----	7.60E-02
BE-7	Not Detected	-----	4.67E-01
CD-109	Not Detected	-----	7.39E-01
CD-115	Not Detected	-----	8.83E-01
CE-139	Not Detected	-----	3.79E-02
CE-141	Not Detected	-----	7.41E-02
CE-144	Not Detected	-----	2.82E-01
CO-56	Not Detected	-----	6.11E-02
CO-57	Not Detected	-----	3.49E-02
CO-58	Not Detected	-----	5.61E-02
CO-60	Not Detected	-----	6.09E-02
CR-51	Not Detected	-----	4.13E-01
CS-134	Not Detected	-----	6.60E-02
CS-137	7.71E-01	2.17E-01	4.10E-02
FU-152	Not Detected	-----	3.81E-01
EU-154	Not Detected	-----	2.65E-01
EU-155	Not Detected	-----	1.48E-01
FE-59	Not Detected	-----	1.26E-01
GD-153	Not Detected	-----	1.19E-01
HG-203	Not Detected	-----	4.69E-02
I-133	Not Detected	-----	1.64E+01
I-131	Not Detected	-----	8.30E-02
I-132	Not Detected	-----	1.00E+26
IR-192	Not Detected	-----	4.39E-02
K-40	1.42E+01	2.33E+00	9.11E-01
MN-54	Not Detected	-----	5.54E-02
MN-56	Not Detected	-----	1.00E+26
MO-99	Not Detected	-----	2.62E+00
NA-22	Not Detected	-----	6.95E-02
NA-24	Not Detected	-----	1.86E+02
NB-95	Not Detected	-----	7.87E-01
ND-147	Not Detected	-----	5.17E-01
NI-57	Not Detected	-----	2.16E+00
RU-103	Not Detected	-----	5.28E-02
RU-106	Not Detected	-----	5.26E-01
SB-122	Not Detected	-----	4.31E-01
SB-124	Not Detected	-----	7.06E-02
SB-125	Not Detected	-----	1.40E-01
SR-85	Not Detected	-----	5.73E-02
TA-182	Not Detected	-----	2.34E-01
TA-183	Not Detected	-----	7.54E-01
TC-99m	Not Detected	-----	1.88E+07
TL-201	Not Detected	-----	6.67E-01
W-187	Not Detected	-----	2.91E+01
XE-133	Not Detected	-----	1.35E+00
Y-88	Not Detected	-----	5.26E-02
ZN-65	Not Detected	-----	1.48E-01
ZR-95	Not Detected	-----	1.06E-01

Survey #:

 * Sandia National Laboratories *
 * Radiation Protection Sample Diagnostics Program [TA5 Laboratory] *
 * 11-27-96 11:02:05 AM *

* Analyzed by: MDS 12/5/96

Reviewed by: *[Signature]* 12/5/96

 Customer : K.BABILON (7524)
 Customer Sample ID : 44BE2SS
 Lab Sample ID : 63026403

Sample Description : MARINELLI OF SOIL
 Sample Quantity : 7.39E+02 gram
 Sample Date/Time : 11-19-96 8:08:00 AM
 Acquire Start Date/Time : 11-27-96 9:17:42 AM
 Detector Name : LAB1
 Elapsed Live/Real Time : 6000 / 6001 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	-----	2.24E+00
TH-234	1.07E+00	6.70E-01	5.54E-01
RA-226	Not Detected	-----	5.95E-01
PB-214	5.44E-01	1.04E-01	6.21E-02
BJ-214	5.65E-01	1.33E-01	7.03E-02
TH-232	7.58E-01	3.92E-01	1.88E-01
RA-228	8.95E-01	7.66E-01	3.82E-01
AC-228	7.14E-01	2.08E-01	1.41E-01
TH-228	7.74E-01	3.13E-01	5.98E-01
RA-224	7.63E-01	4.06E-01	1.37E-01
PB-212	7.52E-01	1.61E-01	5.00E-02
BI-212	7.64E-01	4.72E-01	4.37E-01
TL-208	7.58E-01	1.99E-01	9.58E-02
U-235	2.69E-01	2.81E-01	2.86E-01
TH-231	Not Detected	-----	2.97E+00
PA-231	Not Detected	-----	2.12E+00
TH-227	Not Detected	-----	4.26E-01
RA-223	Not Detected	-----	2.97E-01
RN-219	4.83E-01	5.47E-01	6.23E-01
PB-211	Not Detected	-----	1.39E+00
TL-207	Not Detected	-----	2.67E+01
AM-241	Not Detected	-----	3.26E-01
PU-239	Not Detected	-----	4.88E+02
NP-237	Not Detected	-----	2.40E-01
PA-233	Not Detected	-----	8.87E-02
TH-229	Not Detected	-----	2.87E-01

Not Detected 12/5/96

[Summary Report] - Sample ID: : 63026403

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	-----	8.85E-02
AU-198	Not Detected	-----	1.64E-01
BA-133	Not Detected	-----	7.60E-02
BE-7	Not Detected	-----	4.70E-01
CD-109	Not Detected	-----	8.35E-01
CD-115	Not Detected	-----	1.10E+00
CE-139	Not Detected	-----	3.79E-02
CE-141	Not Detected	-----	7.65E-02
CE-144	Not Detected	-----	2.78E-01
CO-56	Not Detected	-----	5.99E-02
CO-57	6.87E-03	7.96E-03	1.86E-02
CO-58	Not Detected	-----	5.70E-02
CO-60	Not Detected	-----	6.10E-02
CR-51	Not Detected	-----	4.28E-01
CS-134	Not Detected	-----	6.74E-02
CS-137	6.18E-01	1.09E-01	3.81E-02
EU-152	Not Detected	-----	3.85E-01
EU-154	Not Detected	-----	2.65E-01
EU-155	Not Detected	-----	1.49E-01
FE-59	Not Detected	-----	1.34E-01
GD-153	Not Detected	-----	1.22E-01
HG-203	Not Detected	-----	4.79E-02
I-133	Not Detected	-----	3.13E+01
I-131	Not Detected	-----	9.12E-02
I-132	Not Detected	-----	1.00E+26
IR-192	Not Detected	-----	4.47E-02
K-40	1.19E+01	2.06E+00	9.51E-01
MN-54	Not Detected	-----	5.65E-02
MN-56	Not Detected	-----	1.00E+26
MO-99	Not Detected	-----	3.27E+00
NA-22	Not Detected	-----	7.08E-02
NA-24	Not Detected	-----	4.37E+02
NB-95	Not Detected	-----	9.27E-01
ND-147	Not Detected	-----	5.51E-01
NI-57	Not Detected	-----	3.12E+00
RU-103	Not Detected	-----	5.40E-02
RU-106	Not Detected	-----	5.49E-01
SB-122	Not Detected	-----	5.12E-01
SB-124	Not Detected	-----	7.30E-02
SB-125	Not Detected	-----	1.39E-01
SR-85	Not Detected	-----	5.77E-02
TA-182	Not Detected	-----	2.41E-01
TA-183	Not Detected	-----	8.34E-01
TC-99m	Not Detected	-----	1.66E+08
TL-201	Not Detected	-----	8.07E-01
W-187	Not Detected	-----	4.98E+01
XE-133	Not Detected	-----	1.78E+00
Y-88	Not Detected	-----	5.23E-02
ZN-65	Not Detected	-----	1.58E-01
ZR-95	Not Detected	-----	1.05E-01

Not
Detected
12/15/14