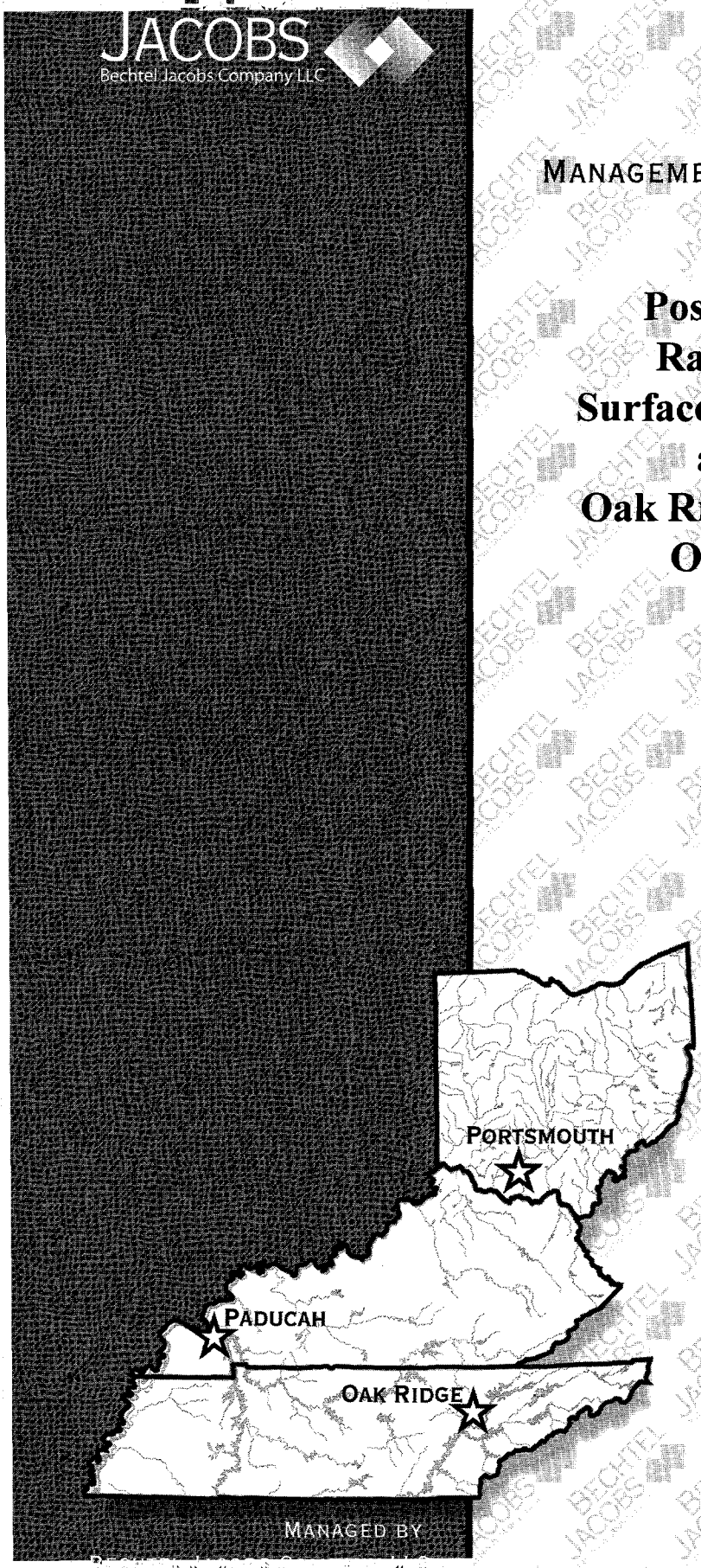
BJC/OR-195

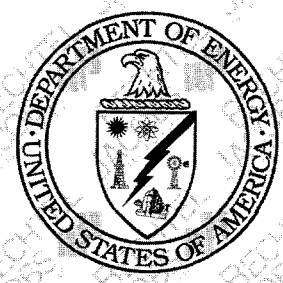
ENVIRONMENTAL MANAGEMENT

& ENRICHMENT FACILITIES

MANAGEMENT AND I[illegible]NTRACT

Post-Remediation Action Radiological Report for Surface Impoundments C (3539) and D (3540) at the Oak Ridge National Laboratory Oak Ridge, Tennessee





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BJC/OR-195

Post-Remediation Action Radiological Report for Surface Impoundments C (3539) and D (3540) at the Oak Ridge National Laboratory Oak Ridge, Tennessee

Date Issued-December 1998

Prepared for the
U.S. Department of Energy
Office of Environmental Management

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Oak Ridge Y-12 Plant Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-98OR22700
for the
U.S. DEPARTMENT OF ENERGY

DISCLAIMER

CONTENTS

TABLES

ACRONYMS

COC	chain-of-custody
cpm	counts per minute
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
NaI	sodium iodide
ORNL	Oak Ridge National Laboratory
QA	quality assurance
QC	quality control
ROD	Record of Decision
SMO	Sample Management Office

EXECUTIVE SUMMARY

During August and September 1998, Bechtel Jacobs Company LLC performed a remedial action within Impoundments 3539 and 3540 (Impoundments C and D, respectively) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act Record of Decision (ROD) for the Surface Impoundments Operable Unit. The remedial action included removal of sediments and 0.1 ft of subimpoundment soil. A post-remedial action radiological survey was conducted to provide data to support the Bethel Valley ROD. Data was obtained from (1) a walkover survey for residual gamma radiation on the base of the impoundments, (2) smear surveys for transferable contamination on remainingriprap, and (3) representative sampling of subimpoundment soils. Walkover surveys identified no locations outside the impoundments with gamma exposure levels greater than three times background levels. Smear surveys detected no removable contamination above release limits as specified in 10 CFR 835, Appendix D. Subimpoundment soil samples quantified low levels of residual contamination.

1. PURPOSE

This report describes the procedures followed to obtain a post-remedial action radiological data screening and the subsequent results in Surface Impoundments C and D.

2. BACKGROUND

Remedial action in accordance with the Record of Decision for Surface Impoundments Operable Unit, (DOE, September 1997) began August 11, 1998, with mobilization and ended with demobilization on September 22, 1998. Sediment and 0.1 ft of subimpoundment soil were removed from both impoundments.

The Remedial Action Work Plan/Remedial Design Report (DOE 1998) stated that the U.S. Department of Energy (DOE) or its representative would perform a walkover radiation survey and collect archival samples to support the Bethel Valley watershed decision-making process. Sample collection and a walkover survey occurred on September 2, 1998. The Sampling and Analysis Plan was reviewed and approved by the U.S. Environmental Protection Agency (EPA), TDEC, and DOE before collecting samples.

3. EVALUATION METHODOLOGY

3.1 WALKOVER SURVEY

The purpose of the walkover survey was to locate areas on the impoundment bottom containing contamination higher than expected. A number of low-level contaminants were identified in Impoundments C and D (ORNL, March 1998). The survey process selected ^{137}Cs as a marker contaminant because gamma rays emitted by ^{137}Cs are more readily and uniformly detected than the alpha and beta radiation associated with the other contaminants in the impoundments. Sediments and subimpoundment soil were physically removed from the impoundments; therefore, variations in physical or chemical properties (e.g., solubility) in the contaminants have no effect on removal. The presence or absence of a suitable marker may be used to infer the presence or absence of the other contaminants.

The walkover survey of the exposed surface used a 2× 2 in. sodium iodide (NaI) probe and a combination scaler/rate meter taking measurements in the rate meter mode. Additional fixed-point measurements were taken from 12 equally divided areas in each impoundment. Measurement results were evaluated in counts per minute (cpm). Because the survey screened for areas of contamination above surrounding background, conversion from cpm into radiological units such as picocuries per gram was not necessary. Results are summarized in Sect. 4.1 and are provided in full in Appendix A.

3.2 TRANSFERABLE CONTAMINATION SURVEY

Smear surveys of the surfaces of the riprap left in place in the impoundments performed on August 18 and 19 and on September 2 and 4, 1998, provided information on transferable contamination required for occupational radiation protection controls. The results of those surveys are provided in Appendix B.

The survey process entailed wiping the surface of theriprap and counting the wipe samples for alpha and beta contamination. The wipe samples followed standard procedures of applying moderate pressure and covering an area of 100 cm^2 each. Survey results were compared with the surface contamination release limits for mixed fission products (1000 dpm) and transuranics (20 dpm) per 100 cm^2.

3.3 SAMPLING AND ANALYSIS

The Sampling and Analysis Plan (Appendix C) was designed to obtain representative samples from the bottom of the remediated surface impoundments. The samples analyzed and archived provide data on the conditions at the impoundments before backfilling.

Composite samples are acceptable where a minimum degree of variability is anticipated and where soil types are amenable to adequate mixing (EPA, May 1996).

Due to the homogeneous nature of the clay liner remaining in theimpoundments and the uniformity of the radiation survey readings, two nine-point surface soil composite samples were collected; one from Impoundment C and one from Impoundment D. Nine aliquots per composite represent the grid cell and prevent significant dilution. Each sample was collected in an identical manner andcomposited from individual, equal aliquots.

Each impoundment is approximately 29 ft× 59 ft to the corners of theriprap base. The impoundments were divided into nine equal sections (approximately 10 ft × 20 ft). Pin flags placed in the approximate center of each section marked the sample aliquot location. A 0- to 2-in. deep soil aliquot was collected at each location, using a stainless steel spoon, and placed into a250 ml pre-cleaned sample jar, ensuring that equal amounts were collected per aliquot from each location. The jar was emptied into a stainless steel bowl/pan large enough to hold nine aliquots. Rinsate was not used between sample aliquot locations. The entire composite sample was thoroughly mixed after collecting the ninth sample aliquot. The composite sample media was added to the sample container for laboratory analysis.

A separate set of decontaminated sampling equipment (spoon, jar, or bowl/pan) was used for each surface impoundment, preventing cross-contamination and eliminating the need forrinsate blanks. The following sample information was logged for chain-of-custody (COC) and sample container labels:

- Sample ID
- Date and Time of Collection
- Type of Sample
- Required Analyses
- Signatures of all Custodians (only required on COCs)

The ORNL sampling team provided sampling equipment,COCs, container labels, and sample containers.

3.4 LABORATORY AND CERTIFICATION

DOE and the Sample Management Office (SMO) certified Core Laboratory through a rigorous audit, ensuring compliance with the SMO Analytical Master Specifications and regulatory guidance. The laboratory performed the analyses in accordance with approved radiological methods and procedures, including

laboratory quality assurance (QA)/quality control (QC) requirements (Appendix D). The data has undergone a 100% level D radiological validation by the SMO.

3.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL

A duplicate sample from Impoundment C verified the homogeneity of the composite sample matrix. The duplicate sample was collected immediately after the first sample from the composite bowl/pan without additional stirring. Field blanks were not collected since equipment cleaning was not required.

The qualifications of the personnel who performed the sample collection activities and the laboratory performing the analysis are provided in Appendix E.

4. RESULTS

4.1 WALKOVER

The results of the walkover survey are summarized as follows.

- Background radiation within the impoundments was 750cpm, higher than the background of 450 cpm measured outside the impoundments.
- The gross fixed-point readings in Impoundment C ranged from 500 to 824cpm with an average gross reading of 668 cpm. The maximum gross reading was approximately 10% above the background reading
- The gross fixed-point readings in Impoundment D ranged from 640 to 904cpm. The average gross reading was 661 cpm. The maximum gross reading was approximately 21% above the background reading.
- Walkover rate meter surveys identified no areas with readings greater than 21% above background.

The results of the transferable contamination survey are summarized as follows:

- A total of 52 smear surveys taken along theriprap of Impoundment C identified no mixed fission product contamination above release limits.
- One survey location had transferable alpha contamination of20 dpm/100 cm^2, which is equal to the transuranic release limit. The average levels of transferable contamination were229 dpm/100 cm^2 for ission products and 3.2 dpm/100 cm^2 for transuranics.
- A total of 52 smear surveys taken along theriprap of Impoundment D identified no mixed fission products or transuranics above release limits. The average levels of transferable contamination were46 dpm/100 cm^2 for fission products and 3.8 dpm/100 cm^2 for transuranics.

4.2 SAMPLING AND ANALYSIS RESULTS

The following table shows the results of the analyses performed on the two composite samples and the field duplicate.

Table of Results
ORNL Surface Impoundments C and D (3539 and 3540) as Remediated

Sample ID & Analyte	Results	TPU	MDA	Units	Val. Qual
SIOU C Duplicate					
Actinium-228	13.1	2.4	1.8	PCI/G	
Cesium-134	0.9	0.4	1.2	PCI/G	
Cesium-137	55.1	2.2	0.3	PCI/G	
Cobalt-57	1.3	0.2	0.1	PCI/G	
Cobalt-60	1.5	0.5	0.2	PCI/G	
Europium-152	3.7	0.5	0.4	PCI/G	
Europium-154	1.0	0.4	0.04	PCI/G	
Europium-155	1.2	0.4	0.4	PCI/G	
Gross Alpha	120	6.2	3.5	PCI/G	J
Gross Beta	371	5.9	3.7	PCI/G	
Lead-212	10.8	0.7	0.3	PCI/G	
Lead-214	2.3	1.0	2.1	PCI/G	
Potassium-40	31.2	4.2	0.5	PCI/G	
Strontium-90	36.6	1.8	1.3	PCI/G	
Thallium-208	4.4	0.9	2.3	PCI/G	
SIOU C Sample					
Actinium-228	11.4	1.6	2.9	PCI/G	
Cesium-137	47.2	2.0	0.2	PCI/G	
Cobalt-57	0.9	0.2	0.2	PCI/G	
Europium-152	4.2	0.5	0.4	PCI/G	
Europium-154	1.1	0.3	0.8	PCI/G	
Gross Alpha	106	5.9	3.5	PCI/G	J
Gross Beta	261	5.1	3.7	PCI/G	
Lead-212	9.1	0.6	0.3	PCI/G	
Potassium-40	24.7	4.2	0.7	PCI/G	
Radium-224	9.9	4.0	3.7	PCI/G	
Strontium-90	33.1	1.7	1.3	PCI/G	
SIOU D Sample					
Actinium-228	6.9	1.9	4.0	PCI/G	
Bismuth-214	1.6	0.6	0.5	PCI/G	
Cesium-137	14	0.9	0.2	PCI/G	
Cobalt-57	0.6	0.1	0.1	PCI/G	
Europium-152	1.7	0.3	0.2	PCI/G	
Gross Alpha	49.7	4.3	3.5	PCI/G	J
Gross Beta	152	4.1	3.7	PCI/G	
Lead-212	4.9	0.4	0.2	PCI/G	
Lead-214	2.7	1.0	1.5	PCI/G	
Potassium-40	30.7	4.3	0.6	PCI/G	
Strontium-90	25.9	1.5	1.3	PCI/G	
Thallium-208	2.0	0.3	0.2	PCI/G	
Thorium-228	14.8	6.8	6.5	PCI/G	

Notes:

1. All values on a dry-weight basis.
2. Non-detects are not included.
3. TPU = Total Propagated Uncertainty
4. MDA = Minimum Detectable Activity
5. Val. Qual. =Validation Qualifier

4.3 ARCHIVED SAMPLES

Eighteen archived samples (duplicates of the individual nine samples) reside in a locked location and may be accessed for future evaluation.

5. CONCLUSIONS

Based on the walkover survey there were no remaining areas of contamination with higher-than-expected concentrations. The analytical data confirmed low concentrations of radionuclides remaining after remediation.

REFERENCES

DOE, September 1997. *Record of Decision for the Surface Impoundments Operable Unit, Oak Ridge, Tennessee*, DOE/OR/02-1630&D2.

DOE, April 1998. *Remedial Action Work Plan/Remedial Design Report for the Surface Impoundments Operable Unit Stage 1 at the Oak Ridge National Laboratory, Oak Ridge, Tennessee,* DOE/OR/0-1726&D1.

EPA, May 1996. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.*

ORNL, March 1998. *Results of the Radiological and Chemical Characterization of Surface Impoundments 3539 and 3540 at Oak Ridge National Laboratory, Oak Ridge, Tennessee*, ORNL/RASA-98/4.

APPENDIX A

WALKOVER SURVEY RESULTS

RADIATION / CONTAMINATION SURVEY MAP

FACILITY X-10 Pond's #3539 + #3540 ROOM N/A DATE 9/2/98 TIME 1000

PURPOSE Survey of Pond BGD with Sodium Iodide Detector RWP # 98-0414

INSTRUMENTS USED:

ALPHA SN N/A BETA SN N/A

N/A DPM/100cm² LLD N/A DPM/100cm²

N/A DPM/100cm² Lc N/A DPM/100cm²

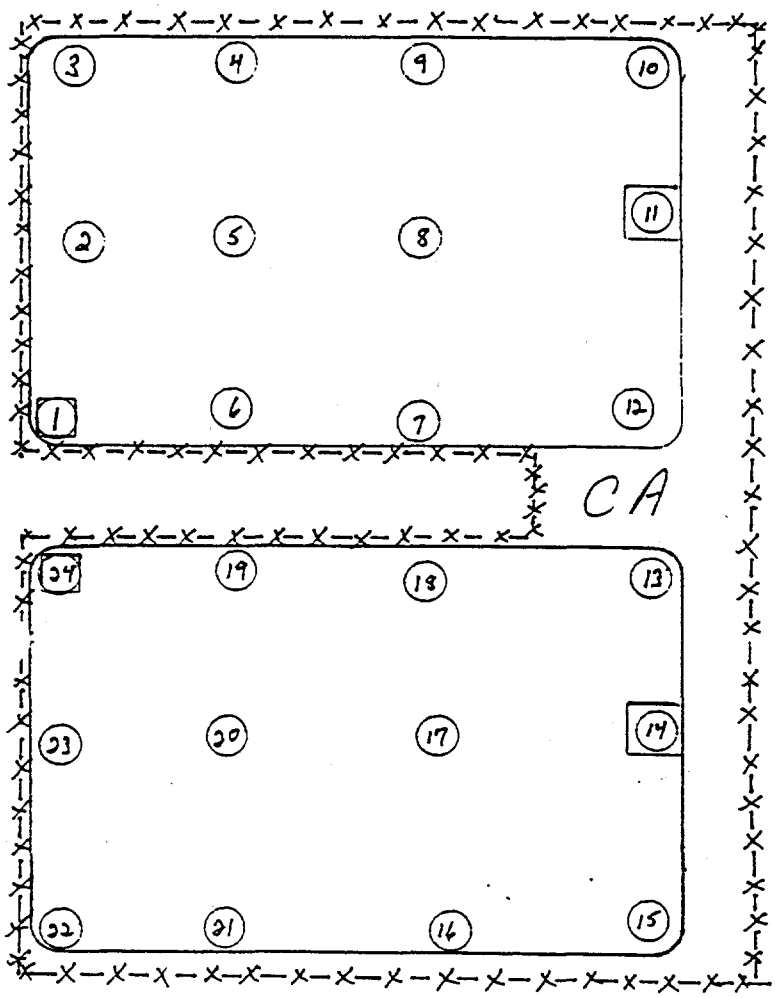
DOSE RATE INST/SN N/A

TECHNICIAN (NAME, SIGNATURE, BADGE #)

W. Swiney

W. Sweeney

N/A



BKG:
SURFACE - 450 CPM
IN POND - 750 CPM

SMEAR/ LOCAT. #	SURFACE ~~DPM/100cm²~~ CPM α	SURFACE ~~DPM/100cm²~~ CPM βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	DOSE RATE mRad/hr β plus γ
1	N/A	594	N/A	N/A	N/A
2		622			
3		726			
4		627			
5		650			
6		824			
7		721			
8		773			
9		719			
10		699			
11		1064			
12		554			
13		687			
14		1030			
15	↓	678	↓	↓	↓
Large Area Wipes					
N/A	N/A	N/A			
	N/A	N/A			
	N/A	N/A		N/A	
	N/A	N/A			
	N/A	N/A			
√	N/A	N/A			

REMARKS: ○ - survey location, △-air sample location, # - general area dose rate, -x-x-x-x- radiological boundaries., # @ c - dose rate at contact.

NOTE: UNABLE TO QUANTIFY READINGS BECAUSE OF NO EFFICIENCY ASSIGNED TO SODIUM IODIDE DETECTOR. RESULTS SHOWN ABOVE ARE IN CPM "ONLY". AREA WAS FREE RELEASED BY JORGE GOVELITZ BY (1Cm) BASED ON THIS SURVEY AND PREVIOUS SURVEYS OF AREA POND'S.

q-48 wt

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RADIATION / CONTAMINATION SURVEY CONTINUATION

FACILITY X-10 Pond's #3539 + #3540 ROOM N/A DATE 9/2/98 TIME 1000
PURPOSE SURVEY OF POND BED'S WITH SODIUM IODIDE DETECTOR RWP # 98-0414
TECHNICIAN (NAME, SIGNATURE, BADGE #)
W. Swiney / W. Sellmeyer / N/A

SMEAR/ LOCAT. #	SURFACE DPM/100cm²		TRANSFERRABLE DPM/100cm²		DOSE RATE mRad/h	SMEAR/ LOCAT. #	SURFACE DPM/100cm²		TRANSFERRABLE DPM/100cm²		DOSE RATE mRad/h	SMEAR/ LOCAT. #	SURFACE DPM/100cm²		TRANSFERRABLE DPM/100cm²	
	α	βγ	α	βγ	β plus γ		α	βγ	α	βγ	β plus γ		α	βγ	α	βγ
16	N/A	679	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17		640														
18		672														
19		904														
20		806														
21		776														
22		735														
23		662														
24		726														
N/A		N/A														
↓	↓	↓														

Large Area Wipes						Large Area Wipes						Large Area Wipes					
N/A	N/A	N/A					N/A	N/A					N/A	N/A			
	N/A	N/A					N/A	N/A					N/A	N/A			
	N/A	N/A			N/A		N/A	N/A			N/A		N/A	N/A			N/A
	N/A	N/A					N/A	N/A					N/A	N/A			
	N/A	N/A					N/A	N/A					N/A	N/A			
↓	N/A	N/A					N/A	N/A					N/A	N/A			

REMARKS: SEE PAGE #1

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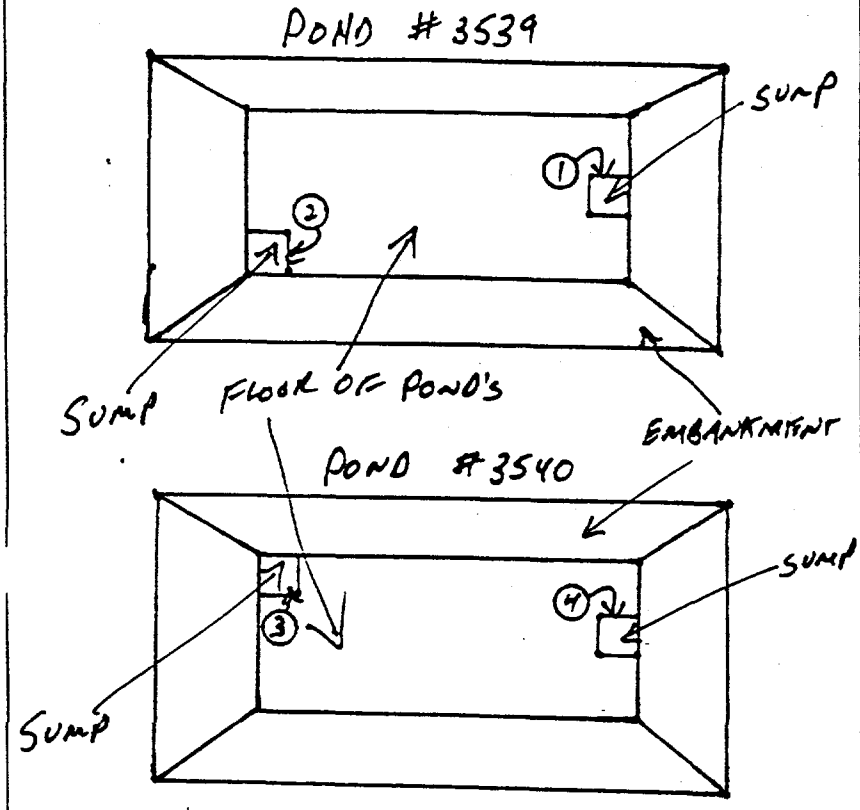
RADIATION / CONTAMINATION SURVEY MAP

FACILITY X-10 POND'S #3539 + #3540 ROOM N/A DATE 9/2/98 TIME 1400
PURPOSE RESURVEY OF SUMP'S AFTER CLEAN-OUT RWP #
INSTRUMENTS USED: TECHNICIAN (NAME, SIGNATURE, BADGE #)
ALPHA SN N/A W. Swiney /
LLD N/A DPM/100cm² BETA SN N/A W. Swiney /
L_c N/A DPM/100cm² LLD N/A DPM/100cm²
DOSE RATE INST/SN L_c N/A DPM/100cm²



NOTE: SODIUM IODIDE SURVEY METER #K30432I USED FOR SURVEY.
CAL. DUE:

SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	DOSE RATE mRad/hr β plus γ
1	N/A	600	N/A	N/A	N/A
2		500			
3		650			
4		750			
N/A	N/A	N/A			
Large Area Wipes					
N/A	N/A	N/A			
	N/A	N/A			
	N/A	N/A			
	N/A	N/A			
	N/A	N/A			
	N/A	N/A			

REMARKS: ○ - survey location, △-air sample location, # - general area dose rate, -x-x-x-x- radiological boundaries., # @ c - dose rate at contact.

NOTE: READING WERE TAKEN "AFTER" SUMP'S WERE CLEANED OUT. USED A SODIUM IODIDE DETECTOR FOR SURVEY. SODIUM IODIDE DETECTORS WILL DETECT GAMMA RAYS "ONLY". ABOVE READINGS ARE IN CPM BECAUSE OF NO CORRECTION FACTOR ON SODIUM IODIDE DETECTOR FOR QUANTIFYING.

WA 9/2/98 (Continued Page 2)

REVIEWED BY: DATE:

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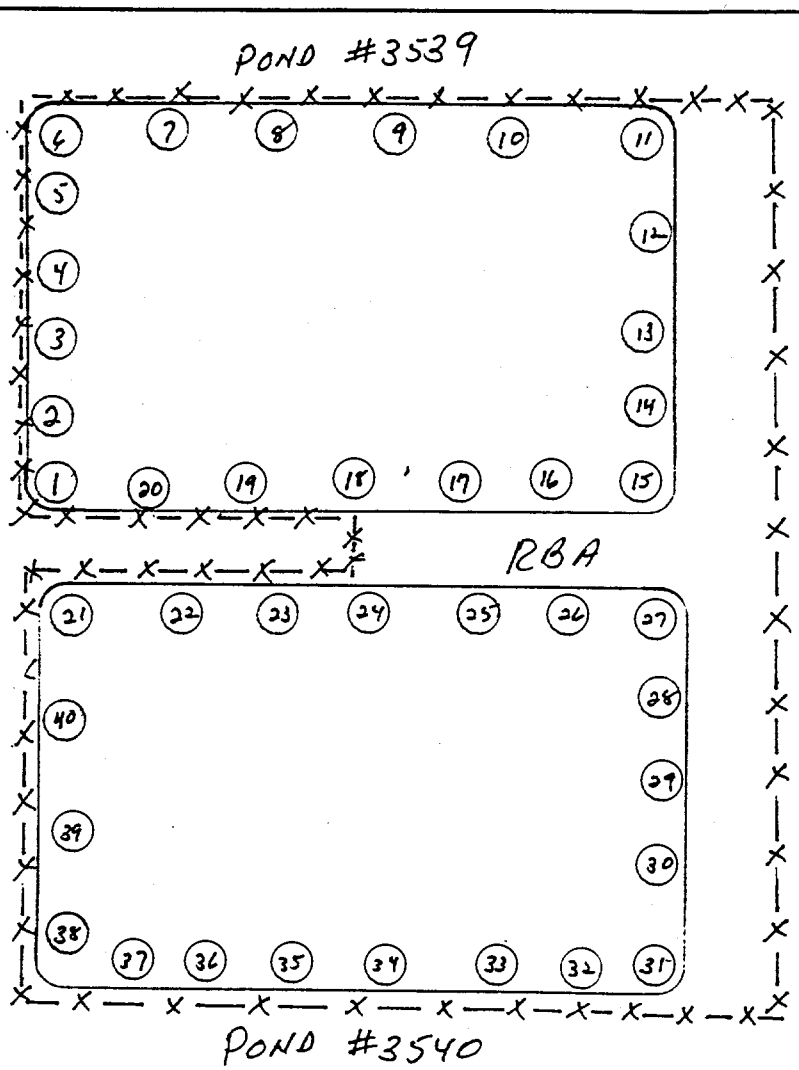
APPENDIX B

RADIATION/CONTAMINATION SURVEY MAPS OF THE OUTER SURFACE OF THE RIPRAP LEFT IN PLACE

RADIATION / CONTAMINATION SURVEY MAP

FACILITY X-10 POND'S #3539 (C) + #3540 (D) ROOM N/A DATE 8/19/98 TIME 1400
PURPOSE ROUTINE CONTAMINATION SURVEY RWP # 98-0386
INSTRUMENTS USED: TECHNICIAN (NAME, SIGNATURE, BADGE #)
ALPHA SN K302 ~~661~~ 564 BETA SN K30433 WINSTON SWINEY
LLD 40.8 DPM/100cm² LLD 234.1 DPM/100cm² Winston Swiney
L_c 28.9 DPM/100cm² L_c 117.3 DPM/100cm²
DOSE RATE INST/SN N/A



SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	DOSE RATE mRad/hr β plus γ
1	N/A	N/A	0	220	N/A
2			0	187	
3			3	236	
4			3	267	
5			0	210	
6			0	272	
7			6	283	
8			0	302	
9			0	342	
10			3	210	
11			9	288	
12			3	282	
13			3	347	
14			6	368	
15	↓	↓	6	372	↓
Large Area Wipes					
N/A	N/A	N/A			
	N/A	N/A			
	N/A	N/A		N/A	
	N/A	N/A			
	N/A	N/A			
↓	N/A	N/A			

REMARKS: ○ - survey location, △-air sample location, # - general area dose rate, -x-x-x-x- radiological boundaries., # @ c - dose rate at contact.

ROUTINE SURVEY OF POND'S #3539 + #3540 AT X-10 FOR DATA AFTER ~ 1½ FT OF H2O WAS PUMPED OUT. ~ 10% OF ALL SMEARS TAKEN WERE TAKEN ON SLUDGE, MOSS, DEBRI, ETC.

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RADIATION / CONTAMINATION SURVEY CONTINUATION

8/31/98 WL

FACILITY X-10 Pond's #3539 C & #3540 D ROOM N/A DATE 8/19/98 TIME 1400

PURPOSE Routine Contamination Survey RWP # 98-0386

TECHNICIAN (NAME, SIGNATURE, BADGE #)

Swirey / W. Sweeney /

SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	DOSE RATE mRad/hr β plus γ	SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	DOSE RATE mRad/hr β plus γ	SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	D β m² β
16	N/A	N/A	6	336	N/A	33	N/A	N/A	3	274	N/A	N/A	N/A	N/A	N/A	N/A	N
17			3	274		34			3	312							
18			3	319		35			3	336							
19			0	315		36			6	254							
20			0	282		37			6	312							
21			0	302		38			0	252							
22			3	228		39			0	236							
23			6	234		40	↓	↓	6	312							
24			6	312		N/A	N/A	N/A	N/A	N/A							
25			3	315													
26			0	220													
27			3	254													
28			3	315													
29			3	302													
30			6	282													
31			0	319													
32	↓	↓	3	294	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

Large Area Wipes			Large Area Wipes			Large Area Wipes		
N/A	N/A	N/A		N/A	N/A		N/A	N/A
	N/A	N/A		N/A	N/A		N/A	N/A
	N/A	N/A		N/A	N/A		N/A	N/A
	N/A	N/A		N/A	N/A		N/A	N/A
	N/A	N/A		N/A	N/A		N/A	N/A
↓	N/A	N/A		N/A	N/A		N/A	N/A

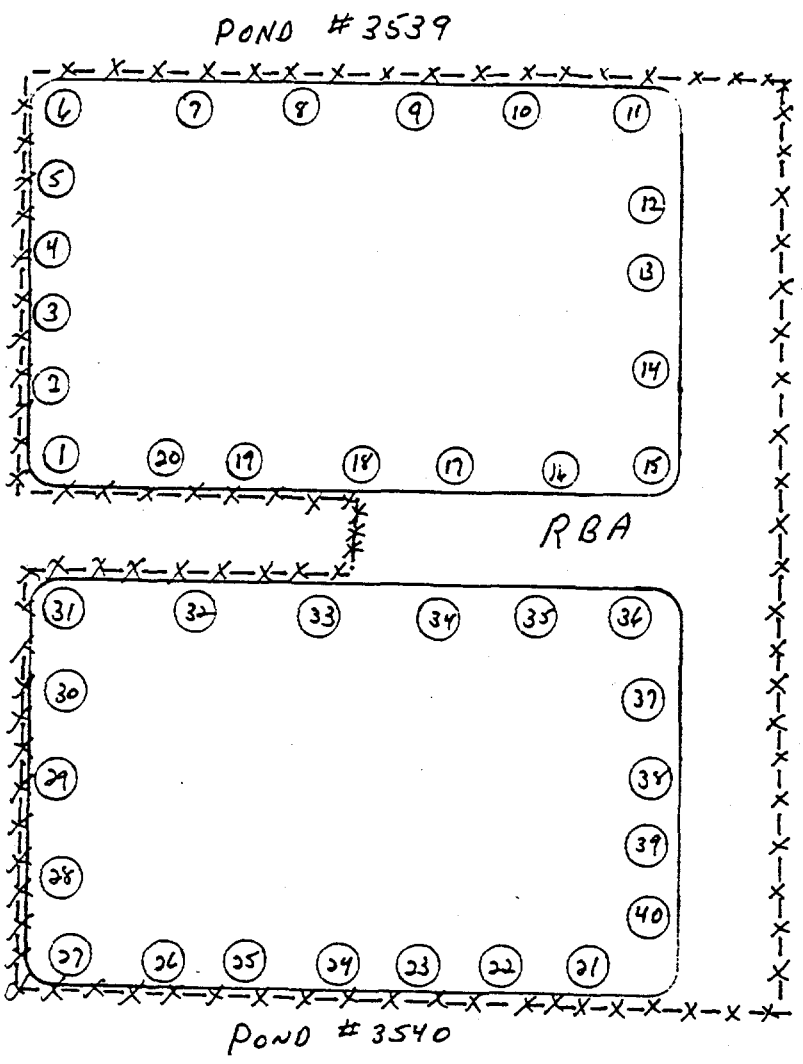
REMARKS: SEE PAGE #1

REVIEWED BY: _____ DATE: _____

HSD-RCO-545

RADIATION / CONTAMINATION SURVEY MAP

FACILITY X-10 POND'S #3539 (C) & #3540 (D) ROOM N/A DATE 8/20/98 TIME 10:00
PURPOSE ROUTINE CONTAMINATION SURVEY RWP # 98-0386
INSTRUMENTS USED: TECHNICIAN (NAME, SIGNATURE, BADGE #)
ALPHA SN K30346F BETA SN K30433F Winston Suiner
LLD 40.8 DPM/100cm² LLD 234.1 DPM/100cm² Winston Suiney
L_c 28.9 DPM/100cm² L_c 117.3 DPM/100cm²
DOSE RATE INST/SN N/A



SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	DOSE RATE mRad/hr β plus γ
1	N/A	N/A	6	288	N/A
2			6	302	
3			20	424	
4			3	184	
5			3	319	
6			0	220	
7			3	302	
8			6	274	
9			3	210	
10			0	319	
11			3	347	
12			9	220	
13			0	306	
14			0	292	
15	↓	↓	0	229	↓
Large Area Wipes					
N/A	N/A	N/A	N/A	N/A	
↓	N/A	N/A	↓	↓	↓
	N/A	N/A			
	N/A	N/A			
	N/A	N/A			
	N/A	N/A			
↓	N/A	N/A	↓	↓	↓

REMARKS: ○ - survey location, △-air sample location, # - general area dose rate, -x-x-x-x- radiological boundaries., # @ c - dose rate at contact.

SURVEY TAKEN AFTER APPROXIMATELY 3 FT. OF H2O WAS PUMPED OUT OF POND'S. ~ 10% OF SMEARS TAKEN WERE TAKEN ON SLUDGE SPOTS, MOSS (ALGAE), DEBRIS ETC.

REVIEWED BY: _____ DATE: _____

Exempt from "10-156"

HSD-RCO-701
Rev. 0
04/23/97

PAGE 2 OF 4

RADIATION / CONTAMINATION SURVEY CONTINUATION

FACILITY X-10 Pond's #3539 (C) & #3540 (D) ROOM N/A DATE 8/20/98 TIME 10:00
PURPOSE Routine Contamination Survey RWP # 98-0386
TECHNICIAN (NAME, SIGNATURE, BADGE #)
J. Swiney / W. Sweeney /

SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	DOSE RATE mRad/h γ β plus γ	SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ	DOSE RATE mRad/h γ β plus γ	SMEAR/ LOCAT. #	SURFACE DPM/100cm² α	SURFACE DPM/100cm² βγ	TRANSFERRABLE DPM/100cm² α	TRANSFERRABLE DPM/100cm² βγ
16	N/A	N/A	0	302	N/A	33	N/A	N/A	3	319	N/A	N/A	N/A	N/A	N/A	N/A
17	"	"	3	319	"	34	"	"	6	347	"	"	"	"	"	"
18	"	"	0	220	"	35	"	"	9	302	"	"	"	"	"	"
19	"	"	3	218	"	36	"	"	6	344	"	"	"	"	"	"
20	"	"	3	302	"	37	"	"	0	220	"	"	"	"	"	"
21	"	"	6	677	"	38	"	"	3	306	"	"	"	"	"	"
22	"	"	6	292	"	39	"	"	0	271	"	"	"	"	"	"
23	"	"	3	319	"	40	↓	↓	0	274	"	"	"	"	"	"
24	"	"	3	229	"	N/A	N/A	N/A	N/A	N/A	"	"	"	"	"	"
25	"	"	0	319	"						"	"	"	"	"	"
26	"	"	0	306	"						"	"	"	"	"	"
27	"	"	3	326	"						"	"	"	"	"	"
28	"	"	3	545	"						"	"	"	"	"	"
29	"	"	6	316	"						"	"	"	"	"	"
30	"	"	6	375	"						"	"	"	"	"	"
31	"	"	0	306	"						"	"	"	"	"	"
32	↓	↓	3	292	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

Large Area Wipes			Large Area Wipes			Large Area Wipes			Large Area Wipes			Large Area Wipes			Large Area Wipes	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
"	N/A	N/A	"	"	"	"	N/A	N/A	"	"	"	"	N/A	N/A	"	"
"	N/A	N/A	"	"	"	"	N/A	N/A	"	"	"	"	N/A	N/A	"	"
"	N/A	N/A	"	"	"	"	N/A	N/A	"	"	"	"	N/A	N/A	"	"
"	N/A	N/A	"	"	"	"	N/A	N/A	"	"	"	"	N/A	N/A	"	"
↓	N/A	N/A	↓	↓	↓	↓	N/A	N/A	↓	↓	↓	↓	N/A	N/A	↓	↓

REMARKS: SEE PAGE #1.

REVIEWED BY: _____ DATE: _____

HSD-RCO-345

APPENDIX C

SAMPLING AND ANALYSIS PLAN

Bethel Valley Watershed

Surface Impoundments C & D Sampling Event

Sampling & Analysis Plan

Purpose

Surface Impoundments C & D have been remediated according to the Record of Decision for Surface Impoundments Operable Unit, (DOE/OR/02-1630&D2, September 24, 1997). The sediment has been removed in addition to 0.1 foot of sub-impoundment soil. As indicated in he Remedial Action Work Plan/Remedial Design Report samples will be collected from the remediated surface impoundments in order to provide data on the conditions present at the impoundments prior to final backfill of clean material.

Definitive data will be generated using rigorous analytical methods. Tangible raw data (e.g., chromatographs, spectra or digital values) will be produced with method specific QA/QC requirements fulfilled. No further excavation will occur due to the results of the sampling event.

Scope

Sample Collection

According to USEPA Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (May 1996), composite samples are most appropriate where a minimum degree of variability is anticipated, and where soil types are amenable to adequate mixing. Due to the homogeneous nature of the clay liner remaining in the impoundments, two 9-point surface soil composite samples will be collected; one from surface impoundment C and one from surface impoundment D. As specified in the USEPA Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, nine aliquots per composite was selected in order to truly represent the grid cell and prevent significant dilution. Each sample will be collected in an identical manner and composited from individual, equal aliquots.

Each impoundment is approximately 29ft x 59ft to the corners of the rip-rap base. The impoundments will be measured to verify the dimensions. The impoundments will be split into nine equal sections (approximately 10ft x 20ft) and pin flags will be placed in the approximate center of each section to mark the sample aliquot location. A 0- to 2-inch depth of soil aliquot will be collected at each location with a stainless steel spoon and placed into a 250ml pre-cleaned sample jar to ensure an equal amount of aliquot is collected for each location. The jar will then be emptied into a stainless steel bowl/pan large enough to hold nine aliquots. No rinsate is required between each sample aliquot location. Upon collection of the ninth sample aliquot, the entire composite sample will then be thoroughly mixed. The composited sample media will then be added to the sample container for laboratory analysis.

A separate set of decontaminated sampling equipment (spoon, jar, bowl/pan) shall be used for each surface impoundment in order to prevent the collection of rinsate blanks. The following sample information will be logged on a chain-of-custody (COC) and sample container labels:

1. Sample ID
2. Date and Time of Collection
3. Type of Sample
4. Required Analyses
5. Signatures of all custodians (only required on COCs)

The sampling equipment, COCs, container labels, and sample containers will be provided by the ORNL sampling team.

Analyses

The following analyses, shown in Table 1, will be performed on the 2 composite samples and the field duplicate. The laboratory will perform the analyses according to approved radiological methods and procedures, which includes the proper laboratory QA/QC requirements. The data will undergo 100% level D radiological validation that will be completed by the Sample Management Office.

Table 1: Required samples and analyses.

Number of Samples	Type of Sample	Required Analyses
2 plus a duplicate	Composite	Gross Alpha/Beta Gamma Spec – full speciation Gas Flow Proportional (Sr-90)

Field QA/QC

A duplicate sample will be required from one of the impoundments in order to verify the homogeneity of the composite sample matrix. The duplicate sample will be collected immediately after the first sample from the composite bowl/pan – no additional stirring. No field blanks will be collected since no equipment will require cleaning and the site conditions do not present the need.

Health Physics/Safety & Health Support

Bechtel Jacobs, LLC, will provide health Physics and Safety & Health Support. The personal protective equipment (PPE) will be determined by the HP and S&H officers and will be provided by the sampling team. Based upon the present conditions, the anticipated PPE will be knee high rubber boots and gloves.

Reference

USEPA Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, USEPA Region 4, May 1996.

APPENDIX D

RADIOCHEMISTRY DATA VALIDATION REPORT

RADIOCHEMISTRY DATA VALIDATION REPORT

by

Bechtel Jacobs LLC Sample and Data Management Office Validation Group

DATA VALIDATION FOR: Gamma Speciation, Gross Alpha, Gross Beta, Strontium-90

SDG NUMBER: SP-1594

SITE: Surface Impoundments

PROJECT: BLBV0900

CONTRACT LAB: Core, Casper, WY

PRIMARY REVIEWER: J. Steven Short

DATE REVIEW COMPLETED: October 23, 1998

PEER REVIEWER: Bryan Johnson

DATE REVIEW COMPLETED:

DATA COMPLETENESS: 100%

Matrix: Sludge

Sample ID	LAB ID
SIC-S	985738-1
SIC-D	985738-2
SID-S	985738-3

Data package was reviewed against the data validation manual *LMES ERWM Programs Intersite Procedures Manual Number ERWM/ER-P2209, Radiochemical Data Verification and Validation, Rev. 0* and *Lockheed Martin Energy Systems, Inc., Analytical Master Specifications for Radiochemical Analysis, Attachment J-VI.*

I. DATA DELIVERABLES

Minimum Detectable Activity (MDA), Total Propagated Uncertainty (TPU), and standard certificates for Gamma Spectroscopy and Strontium-90 were not included in this data package as required by the Analytical Support Agreement.

II. TECHNICAL HOLDING TIMES AND ANALYSIS

Criteria:

Preservation: pH< 2 (liquids only)
Holding Times: 180 days (Gross Alpha/Beta); Not Applicable (all Others)

Samples were collected September 02, 1998. The laboratory received the samples on July 16, 1998. Samples were prepared and analyzed September 17, 26, 29 and October 01, 1998. The chain of custody, case narrative, sample preparation and analysis logs were reviewed. The following preservation and/or holding time exceedances were noted.

Table 1: Technical Holding Time Exceedances

Analyte	Criteria Failed	Affected Samples	Qualifiers for Detects	Qualifiers for Nondetects
None	Holding Time	None	None Required	None Required
None	Preservation	None	J	UJ

III. CALIBRATION AND BACKGROUNDS

Criteria:

Frequency: Initial calibration (IC) and calibration verification (CV) vary for each method
QC Criteria: Calibration and standard traceability vary for each method

Results on calibration were examined to ensure that reported results met required quality control criteria. Quality Control Calibration charts and logs document satisfactory performance of all of the instruments over the period of sample analysis and ensure that the instruments are capable of producing acceptable qualitative and quantitative data. The following calibration and standards traceability exceedances were noted.

Table 2: Calibration and Background Exceedances

Analyte	Criteria Failed	Affected Samples	Qualifiers for Detects	Qualifiers for Nondetects
None	IC & CV	None	J	None Required
None	Standards Traceability	None	J	None Required

IV. BLANK RESULTS

Criteria:

Frequency: 1 per 20 samples
QC Criteria: Blank activities < MDC or 2 counting uncertainty
Blank detects with 0 ND < 1.96 qualified as J or R
Blank detects with 1.96 ND < 2.58 qualified as J
Blank detects with 2.58 ND not qualified

Method blanks are taken to monitor the presence of contamination of theanalyte of interest in the sample preparation and analysis process and were performed with the environmental samples. Blanks are evaluated against the specified criteria. Results were examined to ensure that reported results met required quality control criteria. Blanks were taken at the appropriate frequency, one per every twenty samples. The following target analytes were detected in the blanks associated with this SDG.

Table 3: Analytes detected in Blank Samples

Analyte	Activity±TPU pCi/g	MDA pCi/g	Criteria Failed	Affected Samples	Qualifier for Detects	Qualifier for Nondetects
None	NA	NA	Blank Contamination ND	None	J	None Required

The following equation shows how the normalized differences for blank contamination analyses are calculated.

$$ND = \frac{|S - B|}{\sqrt{(TPU_{sample})^2 + (TPU_{blank})^2}}$$

where:

ND = Normalized Difference
S = Sample Result
B = Blank Result
TPU_{sample} = 1s Total Propagated Uncertainty of Sample Result
TPU_{blank} = 1s Total Propagated Uncertainty of Blank Result

V. LABORATORY CONTROL SAMPLES

Criteria:

Frequency: 1 per 20 samples
QC Criteria: $-1.96 \leq ND \leq 1.96$ not qualified
$-2.58 < ND < -1.96$ or $1.96 < ND < 2.58$ qualified as J, UJ, or U
$ND < -2.58$ or $ND > 2.58$ qualified as J, UJ, U, or R

Laboratory Control Samples (LCS) were taken to monitor the preparation and analysis of the analytical samples. The ND could not be calculated due to thelaboratories failure to report TPU. The percent recovery (%R) was evaluated in lieu of the ND with a ±20 percent acceptance criteria. LCSs were taken at the appropriate frequency, one per every twenty samples. The following %R exceedances are noted.

Table 4: LCS Exceedances

Analyte	Criteria Failed	Affected Samples	Qualifier for Detects	Qualifier for Nondetects
None	%R	None	J	UJ (-bias)

The following equation shows how normalized difference (ND) for the LCS is calculated:

$$ND = \frac{LCS_{measured} - LCS_{expected}}{\sqrt{(TPU_{measured})^2 + (TPU_{expected})^2}}$$

where:

ND = Normalized Difference
$LCS_{measured}$ = Measured LCS Result
$LCS_{expected}$ = Expected LCS Result
$TPU_{measured}$ = 1s Total Propagated Uncertainty of Measured Result
$TPU_{expected}$ = 1s Total Propagated Uncertainty of Expected Result

VI. DUPLICATES

Table 5: Duplicate Exceedances

Analyte	Criteria Failed	Affected Sample	Qualifiers for Detects	Qualifiers for Nondetects
Gross Alpha	RPD	All	J	U

The following equation shows how normalized difference for the duplicate is calculated:

$$ND_{ABS} = \frac{|S - D|}{\sqrt{(TPU_{sample})^2 + (TPU_{duplicate})^2}}$$

where:

ND_{ABS} = Absolute Normalized Difference
S = Sample Result
D = Laboratory Duplicate Result
TPU_{sample} = 1s Total Propagated Uncertainty of Sample Result
$TPU_{duplicate}$ = 1s Total Propagated Uncertainty of Duplicate Result

VII. MATRIX SPIKE

Criteria:

Frequency: One per batch of up to twenty samples
QC Criteria: $-1.96 \leq ND \leq 1.96$ not qualified
$-2.58 < ND < -1.96$ or $1.96 < ND < 2.58$ qualified as J, UJ, or U
$ND < -2.58$ or $ND > 2.58$ qualified as J, UJ, U, or R
Note: May not be required for methods where a carrier or tracer is used. May not be feasible for solid and some liquid analyses.

Matrix spikes are taken to measure the effect ofinterferences from the sample matrix that will preclude accurate quantification by the instrumentation. It is a split of analytical sample in which one half of the split is spiked with a known amount ofradionuclide of interest prior to sample preparation. The ND could not be calculated due to the laboratories failure to report TPU. The percent recovery (%R) was evaluated in lieu of the ND with a ±20 percent acceptance criteria. Matrix Spikes were taken at the appropriate frequency, one per every twenty samples. The following %R exceedances are noted.

Table 6: Matrix Spike Exceedances

Analyte	Criteria Failed	Affected Samples	Qualifier for Detects	Qualifier for Nondetects
None	%R	None	J	UJ (-bias) / U (+bias)

The following equation shows how normalized difference for the matrix spikes is calculated:

$$ND = \frac{(SSR - SR) - ER}{\sqrt{(TPU_{SSR})^2 + (TPU_{SR})^2 + (TPU_{ER})^2}}$$

where:

ND = Normalized Difference
SSR = Spiked Sample Result
SR = Sample Result (unspiked)
ER = Expected Result
TPU_{SSR} = 1s Total Propagated Uncertainty of Spiked Sample Result
TPU_{SR} = 1s Total Propagated Uncertainty of Sample Result (unspiked)
TPU_{ER} = 1s Total Propagated Uncertainty of Expected Result

VIII. ELEVATED UNCERTAINTY

Criteria:

Frequency: Not applicable
QC Criteria: TPU < 80% of Sample Result
Elevated Uncertainty applicable only to Detects

The statistical test for the quality control samples tend to qualify data less conservatively at progressively increasing levels of TPU compared to the sample result. At some level of uncertainty, sample result qualification may be needed to alert the data user that the sample result may be too uncertain to use for an intended purpose. The following test qualifies data as a function of TPU (note: although counting uncertainty may be used instead of a TPU) as a percentage of the sample result. The following elevated uncertainty exceedances are noted.

IX. CHEMICAL YIELD - TRACERS AND CARRIERS

Criteria:

Frequency: Not applicable
QC Criteria: $20 \leq$ Chemical yield (CY) ≤ 105
Note: Sample results shall not be qualified based solely on chemical yield

Results were reviewed to ensure that reported results met the specified criteria. The following chemical yield exceedances are noted.

Table 8: Chemical Yield Exceedances

Analyte	Criteria Failed	Affected Samples	Qualifier for Detects	Qualifier for Nondetects
None	CY	None	J	None Required

X. NEGATIVE RESULTS

Criteria:

Frequency: Not applicable
QC Criteria: $|\text{-Result}| \leq 2$ Counting Uncertainty

Results were reviewed to ensure that reported results met the specified criteria. The following negative result exceedances are noted.

Table 9: Negative Result Exceedances

Analyte	Criteria Failed	Affected Samples	Qualifier for Detects	Qualifier for Nondetects
None	-Result	None	None Required	UJ

XI. MULTIPLE QUALITY DEFICIENCIES

Quality-indicator samples are evaluated during analytical data validation to determine the control of the analytical method and matrix-related effects on sample data. Analytical samples should not be rejected based on a singular quality control sample. Effects of other QC sample deficiencies must be considered in order to evaluate whether conditions are such to justify rejection of data. The following rejections of data are noted.

Table 10: Multiple Quality Deficiencies

Analyte	Criteria Failed	Affected Samples	Qualifier for Detects	Qualifier for Nondetects
None	None	None	R	R

XII. SAMPLE RESULT VERIFICATION

Sample results were checked to see that they were correctly reported with the appropriate analytical uncertainties. Raw data was examined for omissions, reductions, and transcription errors. Raw data for SIC-S (985738-1) for Europium 152, 154, and 155 was omitted. Duplicate analysis was performed on this sample, the results from this analysis was used to replace the unsubstantiated data. No other problems were noted.

XIII. RADIONUCLIDE IDENTIFICATION

Raw data was examined to ensure thatradionuclide activity was accurately and appropriately identified. Based on all of the information submitted, the laboratory accurately identified and reported targetanalyte activity.

XIV. RADIONUCLIDE QUANTITATION

Results and Minimum Detectable Concentrations were verified against the information provided in the analytical laboratory statement of work and data provided on the forms. It was determined that reported results and calculations were reported correctly for all samples.

XV. OVERALL ASSESSMENT OF DATA

Further qualification of the data was deemed unnecessary. Completeness (the percent of non- rejected data) of the total data package was determined to be 100%.

APPENDIX E

RESUMES

Richard Allen - B.S. in Geology, Tennessee Technological University, Cookville, TN. Approximately 10 years coal geology/engineering technician (sampling, surveying, etc.). Approximately 5.5 years working Special Projects for the Office of Environmental Protection - sampling solid, hazardous, PCB, radiological, and mixed waste; NESHAPs air sampling; characterization sampling of buildings that are in D&D program; and characterization sampling of UST, Environmental Restoration, TSCA (PCB), and RCRA sites at ORNL. Lead sampling technician for Special Projects. HasEnsys Certification in use of PCB immunoassay kits, has EPA Method 5 sampling training, has EPA Method 9 opacity training, and OJT with Office of Environmental Protection sampling procedures. Has 40 hour SARA/OSHA training and annual updates andRad Worker II training. Specific in-house training records can be provided if necessary.

Mark Carr - B.S. in Environmental Health, East Tennessee State University, Johnson City, TN. Approximately 5 years environmental, health physics, and industrial hygiene sampling experience with commercial client. Approximately 5.5 years working Special Projects for the Office of Environmental Protection - sampling solid, PCB, hazardous, radiological, and mixed waste; characterization sampling of buildings that are in D&D program; and characterization sampling of Environmental Restoration, RCRA, TSCA (PCB), and UST sites at ORNL. Lead sampling technician forNESHAPs stack sampling program. Has Ensys Certification in use of PCB immunoassay kits, has EPA Method 5 sampling training, has EPA Method 9 opacity training, and OJT with Office of Environmental Protection sampling procedures. SARA/OSHA trained (40 hour and annual updates) andRad Worker II trained. Specific in-house training records can be provided if necessary.

Tim Beatty - Approximately 4 years environmental sampling experience with the Office of Environmental Protection. Four years working Special Projects - sampling solid, PCB, hazardous, radiological, and mixed waste; characterization sampling of buildings that are in D&D program; and characterization sampling of Environmental Restoration, RCRA, TSCA (PCB), and UST sites at ORNL. Also lead sampling technician in ambient air, surface water, and groundwater monitoring program within the Office of Environmental Protection. Aids in NESHAPs sampling program. Has Ensys Certification in use of PCB immunoassay kits, EPA Method 5 sampling training, OJT with Office of Environmental Protection sampling procedures. SARA/OSHA trained (40 hour and annual updates) andRad Worker II trained. Specific in-house training records can be provided if necessary.