Attachment X

Final Status Survey Report #26 Documentation

(UNDER SEPARATE COVER)

FSSR #26

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FINAL

COLUMBUS CLOSURE PROJECT CHARACTERIZATION AND FINAL STATUS SURVEY REPORT FOR THE JN-2 SANITATION LINE SECTION A

Revision 1
June 16, 2006

Prepared by

ECC & E2 Closure Services
1425 State Route 142 East
West Jefferson, OH 43162

Contract Number: DE-AC24-04OH20171

FSSR#26

Final Characterization and Final Status Report for the JN-2 Sanitation Line Section A

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Contract Number: DE-AC24-04OH120171

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Contract Number: DE-AC24-04OH20171

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1.0 Introduction

This report contains the final status surveys (FSS) for the JN-2 Sanitation Line Section A, located at the Columbus Closure Project (CCP), 1425 State Route 142 East, West Jefferson, OH 43162. Final status surveys were conducted according to the guidance presented in the *Manual for Conducting Surveys in Support of License Termination*, NUREG/CR-5849 (NUREG/CR-5849) (ORAU, 1992) and the *Radiological Characterization and Final Status Plan for Battelle Columbus Laboratories Decommissioning Project, West Jefferson Site*, DD-97-02 (Final Status Plan) (Battelle, 2000). The final status surveys were conducted in November of 2005 and performed under Work Instruction 2806 (Closure Services, 2004).

The intent of this final status survey report is to provide a complete and unambiguous record of the radiological status of the JN-2 sanitary line section A excavation. Sufficient information and data is provided to enable an independent re-creation and evaluation at some future date of both the survey activities and the reported results for the excavations. Information in this report is also available in referenced technical basis documents, final status survey plans and procedures, and the *Battelle Memorial Institute Columbus Operations, Decommissioning Plan*, DD-93-19 (BMI Decommissioning Plan), and reporting and quality assurance procedures.

To the extent practicable, this final status survey report is presented with minimal information incorporated by reference. This final status survey report has been generated following the comprehensive, annotated outline presented in Chapter 9 of NUREG-5849 (ORAU, 1992).

1.1 Background

On April 16, 1943, BMI, acting through what is now its Battelle Columbus Operations (BCO), entered into Contract No. W-7405-ENG-92 with the Manhattan Engineering District to perform atomic energy research and development (R&D) activities. BCO performed nuclear materials research and development at privately-owned facilities for the Manhattan Engineering District and its successor agencies – the Atomic Energy Commission (AEC), the Energy Research and Development Agency (ERDA), and the Department of Energy (DOE). Research and development continued until 1988 (Battelle, 2003a).

The BCO facilities at the King Avenue Site, Columbus, Ohio, and the West Jefferson North (WJN) and South (WJS) Sites, West Jefferson, Ohio, became partially radiologically contaminated as a result of the R&D activities. Decontamination of the King Avenue and WJS Sites has been completed and activities continue at the WJN site. The DOE, as the successor to the AEC and the Government's earlier work, is the agreed party with predominant liability and responsibility for decontamination and decommissioning (D&D) of the BCO facilities (Battelle, 2003a). The Assistant Secretary for Nuclear Energy of the DOE accepted the decontamination and decommissioning (D&D) of the WJN into the DOE's Surplus Facilities Management Program as a major project (DOE, 1986). The DOE is the

agency funding and managing the cleanup of the WJN (Battelle, 2003a). However, the site is not a DOE-owned facility.

BMI holds U.S. Nuclear Regulatory Commission (NRC) license number SNM-7. BMI has continually operated and conducted D&D activities in full compliance with this NRC license. The BMI Decommissioning Plan for the WJN site does not serve as a declaration to terminate SNM-7, but establish the criteria for performing D&D activities. The end goal of the BMI Decommissioning Plan is to reach unrestricted use conditions for the site (Battelle, 2003a).

The DOE has contracted ECC&E2 Closure Services, LLC (Closure Services) to safely remove DOE radioactive materials and contamination from the WJN site. Removal of radioactive material will be to levels allowing future use of the site without radiological restrictions as described in the BMI Decommissioning Plan. Closure Services has conducted the characterization and the final status surveys of the JN-2 sanitation line section A excavation, demonstrating that the areas is available for unrestricted release.

2.0 Site Description

Created in 1984, the Battelle Columbus Decommissioning Project (BCLDP) is a remediation project that includes nine buildings at the King Avenue site and five at the WJN site. The CCP is the successor of the BCLDP. The WJN site has one permanent structure (Well House). Three former research facilities, JN-1, JN-2, and JN-3 have been demolished as well as JN-6, the guard house. Several outfalls, filter beds, and wells are also located at the site. The JN-2 sanitary line connected buildings JN-2 and JN-3 to the sanitary filter beds. **Figure 1** presents a site map for the CCP.

2.1 Area Description

As shown in **Figure 1**, the JN-2 sanitation line extended from the south side of JN-1 for roughly 20 meters, then veering to the northwest for roughly 40 meters. The sanitation line was then intercepted by a manway. From the manway, the sanitation line extended to the south where it connected outside JN-1C. A second "dog leg" section of this line connected between JN-2 and JN-3. Section A of the JN-2 sanitation line connected to JN-1C. Other sections of the JN-2 sanitation line are presented in a separate Final Status Survey Report. Section A sanitation line piping and associated soils were removed and disposed of as low level waste. See **Figure 2**.

Two classifications of areas are used in NUREG-5849 and are termed **affected** or **unaffected.** These classifications are defined as (NRC, 1992):

> **Affected Areas:** Areas that have potential radioactive contamination (based on plant operating history) or known radioactive contamination (based on past or preliminary radiological surveillance). This would normally include areas where radioactive materials were used and stored, where records indicate spills or other unusual occurrences that could have resulted in spread of contamination, and where radioactive materials were buried. Areas immediately surrounding or adjacent to locations where radioactive materials were used, stored, or buried are included in this classification because of the potential for inadvertent spread of contamination.
>
> **Unaffected Areas:** All areas not classified as affected. These areas are not expected to contain residual radioactivity, based on knowledge of site history and previous information.

The base of the JN-2 sanitation line section A excavation trench is considered to be affected. The excavation trench sidewalls are considered to be unaffected.

3.0 Decommissioning Activities

3.1 Decommissioning Objective

The objective of the final status survey performed on the JN-2 sanitation line section A excavation trench is to statistically demonstrate that the remediation of the area was successful and that the excavations are free from residual radioactive contamination that would not make it suitable for unrestricted release. The excavation is determined to be free of residual radioactive contamination when remaining soil contamination levels are below those presented in DD-93-03, Rev. 0, "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratory Decommissioning Project" (Battelle, 1993A). **Table 1** presents the volumetric release criteria as presented in DD-93-03, Rev. 0.

4.0 Final Status Survey Procedures

Planning and implementation of the final status survey of the excavations adhered to the requirements of the Final Status Plan (Battelle, 2000) and Work Instruction 2806 (CS, 2004)

4.1 Sampling Parameters

Final status samples of the JN-2 sanitation line section A trench were taken by dividing the trench into sections and collecting samples from the overburden, trench side walls, and the trench base in accordance with WI-2806. See **Figure 3**. Analyses of samples by gamma spectroscopy were performed by the on-site Radioanalytical Laboratory (RAL).

4.2 Major Contaminants Identified

The characterization of the JN2 sanitation line excavation identified Cesium (Cs-137) as the primary radiological contaminant of concern (RCOC). Other RCOCs included Cobalt-60 (Co-60), Europium-152 (Eu-152) and Eu-154, Americium-241 (Am-241), Strontium-90 (Sr-90), Plutonium-238 (Pu-238), and Pu-239. Cs-137 is used as a surrogate for the other RCOC present in the soils as it typically accounts for 64 percent of the total isotopic activity. Further, the release criteria set for Cs-137 is considered conservative for the decommissioning activities. The surrogate relationship of Cs-137 to other RCOCs was calculated using data presented in **Table 2**. **Table 2** presents the isotopic quantity and activity concentrations of samples collected from the filter bed area by BMI from March through September 2000. These data are not associated with the excavation of the JN2 sanitation line excavation. Average activities for the multiple samples were calculated for each RCOC prior to setting the ratios against Cs-137.[1] For each RCOC, the average activity concentration was set as a ratio against the average Cs-137 activity concentration as obtained from previous actions at the filter beds. Cs-137 activity ratios for each RCOC utilized to calculate the RCOCs for the JN2 sanitation line are presented at the lower portion of **Table 2**.

4.2.1 Guidelines Established

Table 1 presents the guidelines for residual radioactivity concentrations for soil and solid volumes as applied to the excavation. Criteria for residual radioactivity concentrations in soil are defined in DD-93-03. DOE Order 5400.5, Section IV.a.2 provides generic guidelines for residual concentrations of Radium-226 (Ra-226), Ra-228, Thorium-230 (Th-230), and Th-232. NRC Guidance has been received by the CCP which contains soil radioactivity concentration guidelines for Co-60, Sr-90, Cs-137, Ra-226, and Ra-228. NRC guidance for soil radioactivity concentration guidelines for natural, enriched, and depleted uranium are also utilized. **Table 1** compiles soil residual radioactivity concentration guidelines to be

[1] Battelle, *Radiological Status of Abandoned Filter Bed Presentation*, http://www.ohio.doe.gov/ccp_seb., Posted 7/15/2003. Presentation provided by DOE to the CCP website. Page titled "Radioactive Inventory of the Abandoned North Filter Beds & Limit Fractions" contains sampling data obtained from March through September 2000 from the filter beds. Average Cs-137 ratios were utilized to calculate the activity concentrations of the isotopes of concern.

utilized by the CCP. **Table 1** values have been generated primarily from the various reference technical documents and from soil guidelines generated from computer pathway analyses. Pu-241 is calculated by applying a ratio to sum of Pu-238 and Pu-239 (obtained from ORIGEN 2.1 derived values, Battelle, 2003c), resulting in a Cs-137 to Pu-241 ratio of 2.8. Using the ratios from **Table 2** and the Cs-137 to Pu-241 ratio of 2.8, the sum of ratios of radionuclides will meet unity at Cs-137 concentrations of 11 pCi/g. This provides modified screening criteria, for Cs-137, of 11 pCi/g.

Exposure rates were compared to the 5 μR/hr above mean background limit listed in DD-97-02, Rev. 0. The calculated mean background exposure rate and the 95 percent confidence intervals used for the CCP grounds are 8 ± 2 μR/hr. Data collected from trench-like culverts located on Battelle property unassociated with site operations indicate a geometry effect, increasing the background exposure rates inside the trenches by 3 to 5 μR/hr.

5.0 Equipment and Procedures

5.1 Equipment

Survey instruments sensitive to gamma radiation are used to monitor excavation surfaces for residual radioactive materials. Ludlum Model 44-10 two-inch by two-inch sodium iodide detectors with Eberline ESP-2 meters were used to scan the excavations. Ludlum Model 19 exposure rate meters were used to obtain microRoentgen per hour measurements.

Other instrumentation used in the Onsite Radioanalytical Laboratory (RAL) to support the final status survey includes:

- A VMS based Canberra Procount data acquisition system in conjunction with high purity germanium detectors for gamma spectroscopy of soil samples.
- A Tennelec Model LB5100 Simultaneous Alpha and Beta Gas Proportional Counter to count smear samples

5.2 Scanning Minimum Detectable Activities

Scanning minimum detectable concentrations (MDC_{scan}) is determined to demonstrate that the MDC_{scan} is less than the modified Cs-137 screening criteria. The MDC_{scan} is calculated utilizing the methodology described in NUREG-1507 and the background count rate and a default detector response to Cs-137 (NRC, 1998). The equation during the walkover surveys of the CCP incorporates a d' of 1.38 and a surveyor efficiency of 0.5. The ambient background in the area was 16,000 counts per minute (cpm). This background is determined using an un-shielded probe. The following is the calculation of the MDC_{scan} using an un-shielded probe:

b_i	=	(16,000 cpm) x (1 sec) x (1 min/60 sec)	=	267 counts
MDCR	=	(1.38) x ($\sqrt{267 counts}$) x (60 sec/1 min)	=	1353 cpm
$MDCR_{surveyor}$	=	1353 cpm/$\sqrt{0.5}$	=	1913 cpm
MDER	=	1913 cpm/(900 cpm/μR/hr)	=	2.13 μR/hr
MDC_{scan}	=	$(5 pCi/g) * \frac{2.13 \mu R/hr}{1.307 \mu R/hr} = 8.15 pCi/g$		

5.3 *Procedures*

The Characterization Team was formally trained and qualified to applicable procedures prior to the initiation of the characterization and final status surveys. Documentation of training is maintained by CCP Project Records.

The following plans and procedures were utilized for the surveys:

DD-93-19, Rev. 5	Decommissioning Plan, Battelle Memorial Institute Columbus Operations
DD-97-02, Rev. 0	Radiological Characterization and Final Status Plan for BCLDP West Jefferson Site
SC-OP-002, Rev. 0	Facility Post-Decontamination Final Status Survey for Baseline Areas
SC-SP-004.2, Rev. 3	Manual and Mechanical Collection of Surface and Subsurface Soil Samples in Support of Site Characterization
HP-OP-100, Rev. 4	Operation and Calibration of the Eberline Model ESP-2 Survey Meter
WI-2806	Excavation and Trench Sampling and Surveys

6.0 Survey Findings

6.1 Exposure Rate Surveys

The calculated mean background exposure rate and the 95 percent confidence intervals used for the CCP grounds are 8 ± 2 μR/hr. The exposure rate readings for the excavation are presented in **Table 3**. A map of the of the survey locations is presented as **Figure 3**. The exposure rate readings were individually compared to the mean background value of 8 ± 2 μR/hr in demonstrate compliance with the 5 μR /hr above background release criterion. Grounds exposure rate surveys must be less than or equal to13 μR/hr to be compliant: trenches must be less than or equal to 18 μR/hr. The one meter measurements in the sanitation line trench indicated an average of 10.4 uR/hr. The minimum measurement in the sanitation line trench was 8 uR/hr and the maximum measurement was 11 uR/hr.

6.2 Scanning Measurements

Scanning of the JN-2 sanitation line section A excavation trench was performed using a two inch by two inch sodium iodide detector. Scanning measurements did not exceed the Decision Level Value (DLV) of 18,374 cpm for soil walkover scans. Scanning results for these areas are presented in **Table 3**. A map of the of the survey locations is presented as **Figure 3**.

6.3 Excavation Sampling

The JN-2 sanitation line section A excavation trench was surveyed and sampled in accordance with WI-2806 which included sampling of trench side walls and the trench bottom. CS-137 sample results are provided in **Table 3**.

Cesium-137 is utilized as a surrogate for determining compliance to the cleanup criteria presented in **Table 1**. The CCP has consistently utilized Cs-137 as a surrogate for other radionuclides of concern as it is the predominate radionuclide present throughout the site and the buildings. Additionally, Cs-137 exhibits the lowest cleanup criteria of 15 pCi/g. The calculation of the Cs-137 surrogate value is performed utilizing sample results obtained prior to remediation of the area in question. **Table 2** presents the results of the pre-remediation samples of the filter bed and are not associated with the JN2 sanitation line excavation. This ratio has been used in past technical basis documents which have been reviewed and approved by the NRC and licensee.

Compliance to the cleanup criteria presented in **Table 1** is demonstrated through a "fraction of limit." The total quantity and activity concentrations are calculated using the average isotopic ratios of radionuclides to Cs-137 as obtained for the filter beds, with the exception of Plutonium (Pu)-241 (Battelle, 2003b). Pu-241 is calculated by applying a ratio to sum of Pu-238 and Pu-239 (obtained from ORIGEN 2.1 derived values, Battelle, 2003c), resulting in a Cs-137 to Pu-241 ratio of 2.8. See **Table 2**. Results for cobalt-60, Cs-137, strontium-90, europium-152 and 154, Pu-239, 240 and 241, and americium-241 are compared to the respective release criteria and a "fraction of limit" calculated. The "fraction of limit" is

determined by summing the ratios of each isotopic concentration to the respective release limit. The sum of ratios must be less than one to meet sample release criteria. Utilizing the average ratios from the filter beds, Cs-137 is the predominate radionuclide and is used to quickly evaluate radioanalytical results, with a modified screening criteria of 11 pCi/g.

When soil sample results begin to approach detected Cs-137 levels above 4 pCi/g, CS applies a "fraction of limit" calculation to verify the original assumptions. Additionally, when Cs-137 levels begin to approach the modified clean-up criteria of 11 pCi/g, CS typically conducts further remediation as an administrative conservatism. The "fraction of limit" for the JN-2 sanitation line trench base and sidewalls was not calculated due to the low concentrations of Cs-137 in respect to the modified screening criteria since the maximum soil sample activity for the sanitary line is 0.25 pCi/g. The following is a summary table of the Cs-137 results for this area:

Location	Number of Samples	Cs-137 Average (pCi/g)	Cs-137 Standard Deviation (pCi/g)	Cs-137 Range (pCi/g)	Cs-137 Comparison Value (pCi/g)	Cs-137 Modified Screening Criteria (pCi/g)
Sanitation Line Trench Base Section A	15	0.03	0.07	-0.01 to 0.25	0.06	11
Sanitation Line Trench Sidewalls Section A	5	0.08	0.10	-0.002 to 0.24	0.16	11

Statistical analyses were performed on the sample data in accordance with Section 6.4.3 of DD-97-02, Rev. 0. Statistical analysis was performed according to NUREG/CR-5849, §8.5, wherein the EPA has recommended applying the calculated value of μ_α, relative to a guideline value, at a desired level of confidence. The value of μ_α is compared to the guideline value; if the μ_α is less than the guideline, the area meets the guideline at a 95% confidence level. This in turn means that the probability is less than 5% that the μ_α, will pass the test, when the true mean activity level exceeds the guideline value. The calculated μ_α, for Cs-137 of 0.06 pCi/g, and 0.16 pCi/g, was less than the modified screening criteria of 11 pCi/g. An example of the comparison value is presented as **Table 4**.

6.4 Overburden Sampling

Samples were taken from the excavation overburden in accordance with Section 6.4.3 of DD-97-02, Rev. 0. A summary table of the Cs-137 results in relation to the sample location is presented as **Table 5**. The only man-made radionuclide detected was Cs-137. The following is a summary Table of the Cs-137 results.

Location	Number of Samples	Cs-137 Average (pCi/g)	Cs-137 Standard Deviation (pCi/g)	Cs-137 Range (pCi/g)	Cs-137 Comparison Value (pCi/g)	Cs-137 Modified Screening Criteria (pCi/g)
Overburden	6	0.10	0.19	-0.003 – 0.48	0.26	11

Statistical analyses were performed on the overburden sample data in accordance with in the same manner as Section 6.3 of this document. The calculation of the Cs-137 comparison value. 0.26 pCi/g. was less than the modified screening criteria of 11 pCi/g. The calculation is presented as **Table 6**.

7.0 Conclusions

The characterization and final status survey results demonstrate that the radiological endpoint criteria objectives of the NRC-approved Decommissioning Plan have been met for the excavation addressed by this effort. (Battelle, 2003) Reported analytical results for media samples obtained from the excavation are below the residual radioactivity concentrations for soil and solid volumes as presented in **Table 1**.

Remaining soil contamination levels are below those presented in DD-93-03, Rev. 0, "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratory Decommissioning Project" (Battelle, 1993). The decommissioning objective has been satisfied. The final status survey performed on the JN-2 sanitation line section A statistically demonstrates that the remediation of the area was successful and that the excavations are free from residual radioactive contamination making them suitable for unrestricted release.

8.0 References

Battelle. 2003a. "Decommissioning Plan for the Battelle Memorial Institute Columbus Operations," DD-93-19.

Battelle. 2003b. Radiological Status of Abandoned Filter Bed Presentation. http://www.ohio.doe.gov/ccp_seb/. Posted 7/15/2003. Presentation provided by DOE to the CCP website. Page titled "Radioactive Inventory of the Abandoned North Filter Beds & Limit Fractions" contains sampling data obtained from March through September 2000 from the filter beds. Average Cs-137 ratios were utilized to calculate the activity concentrations of the isotopes of concern.

Battelle. 2003c. Waste Characterization, Classification, and Shipping Support Technical Basis Document. Rev. 5 for BCLDP West Jefferson Facility. November 2003. Isotopic mixture for Pu-241 is calculated using the values obtained from the ORIGEN2.1-derived data values presented in the technical basis document.

Battelle. 2000. "Radiological Characterization and Final Status Survey Plan for Battelle Columbus Laboratory Decommissioning Project West Jefferson Site," DD-97-02.

Battelle, 1993. "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratories Decommissioning Project." DD-93-03.

ECC&E2 Closure Services, LLC (Closure Services, 2004). Work Instruction 2806. Excavation and Trench Sampling and Survey.

U.S. Department of Energy (DOE), 1990. Finding of No Significant Impact. Decontamination and Decommissioning of the Battelle Columbus Laboratories in Columbus and West Jefferson. Ohio.

U.S. Department of Energy (DOE). 1986. May 29. 1986 memorandum. Voight to Vaughan. approved by Vaughan. June 10, 1986.

U.S. Nuclear Regulatory Commission (NRC). 1998. "Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" NUREG-1507.

Oak Ridge Associated Universities (ORAU). 1992. "Manual for Conducting Radiological Surveys in Support of License Termination. Draft Report for Comment" NUREG/CR-5849. ORAU-92/C57. prepared for the Nuclear Regulatory Commission by the Environmental Survey and Assessment Program. Energy/Environmental Systems Division. ORAU. 1992.

Figures

Figure 1
Site Map

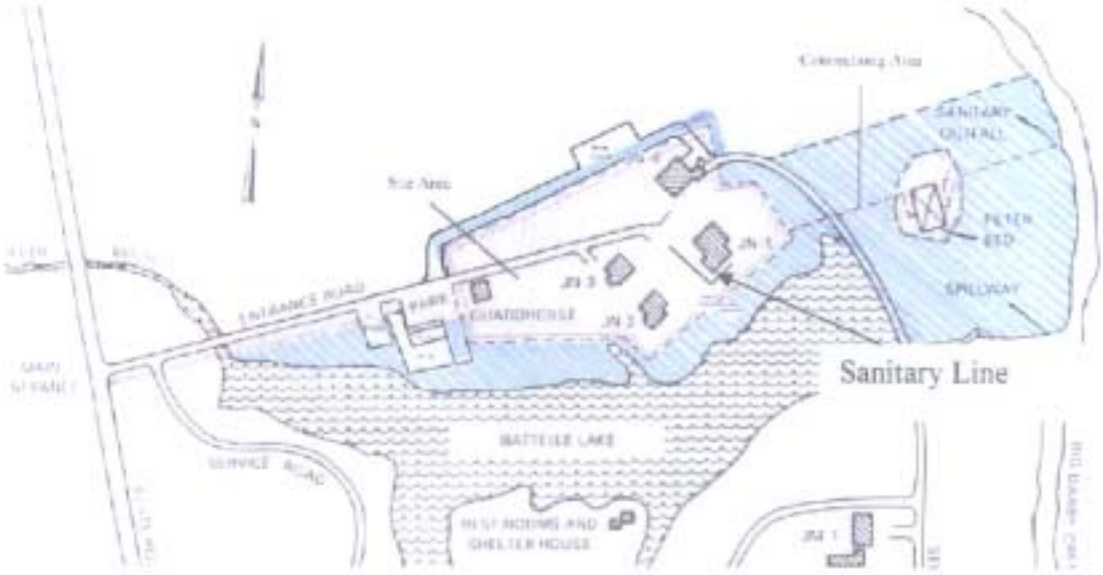
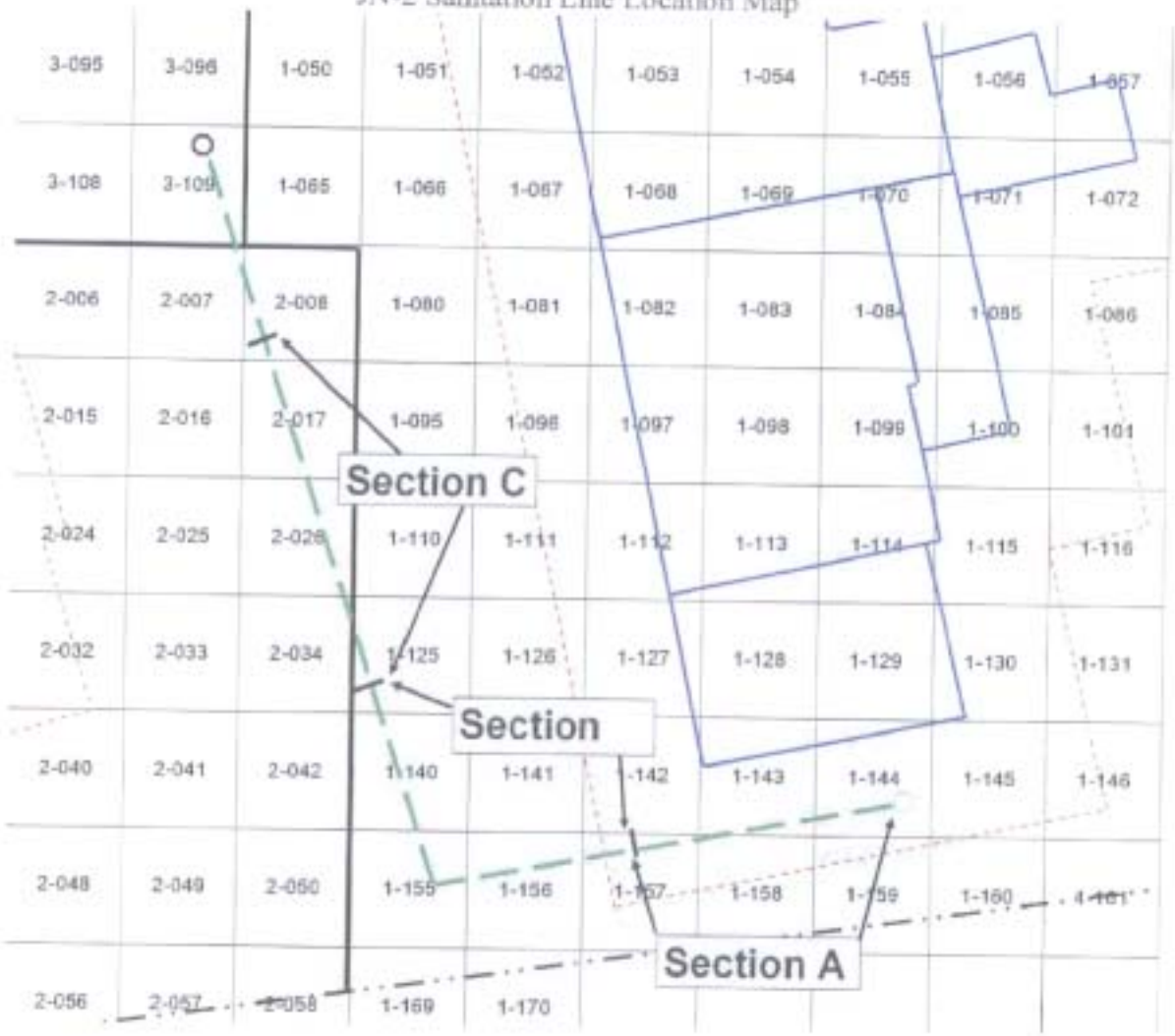


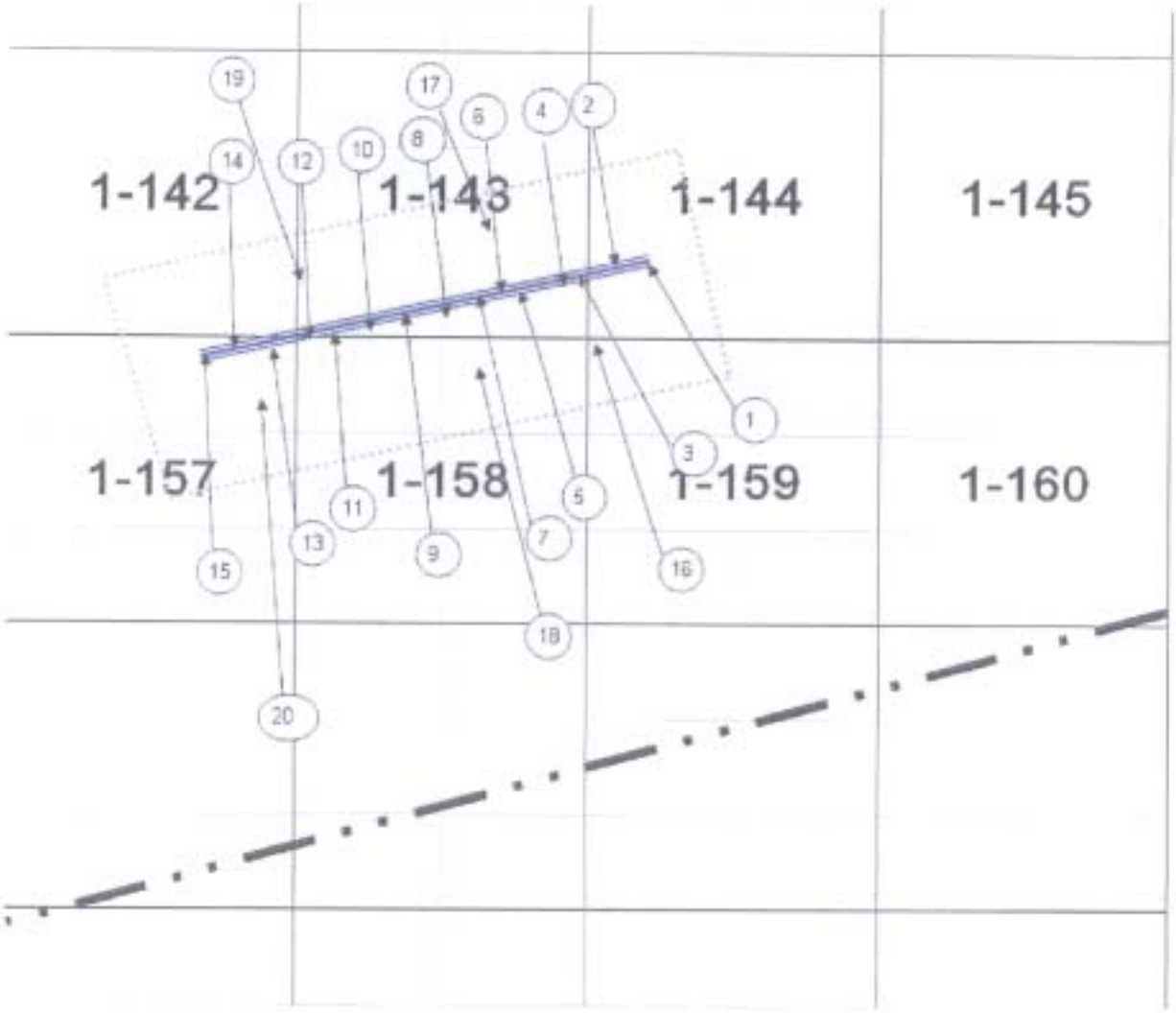
Figure 2

JN-2 Sanitation Line Location Map



Map shown is not to scale

Figure 3
JN-2 Sanitation Line Section A Survey Location Map



Tables

Table 1
BCLDP Guidelines for Residual Radioactivity Concentrations For Soil And Solid Volumes

Radionuclide[a]	King Avenue Concentration (pCi/g)[b]	West Jefferson Concentration (pCi/g)[b]
Natural Uranium	10[1]	na[c]
Enriched Uranium	30[1]	30[1]
Depleted Uranium	35[1]	35[1]
Ac-227	19	19
Am-241	na[c]	30[4]
Am-243	na	30[4]
Ce-144	na	2.100
Cm-243	na	0.79
Cm-244	na	1.0
Co-60	8[2]	8[2]
Cs-134	na	33
Cs-137	15[2]	15[2]
C-14	940	940
Eu-152	na	36
Eu-154	na	32
Eu-155	na	1.800
Fe-55	na	2.7E+07
H-3[d]	41.000	38.000
I-129	na	13
Mn-54	na	61
Ni-59	na	1.3E+07
Ni-63	na	4.9E+06
Np-237	na	0.58
Pa-231	18	18
Pb-210	140	na
Pu-238	na	25[4]
Pu-239	na	25[4]
Pu-240	na	25[4]
Pu-241	na	25[4]
Pu-242	na	25[4]
Ra-226 (0-15 cm of soil)	5[2,3]	na

Radionuclide[a]	King Avenue Concentration (pCi/g)[b]	West Jefferson Concentration (pCi/g)[b]
Ra-226 (>15 cm of soil)	15[2,3]	na
Ra-228	5[2,3]	na
Ru-106	na	180
Sb-125	na	118
Sm-151	na	6,700
Sr-90	5[2]	5[2]
Th-228	29	na
Th-230	5[3]	na
Th-232	5[3]	na

Table 1 Notes and References

Notes:

a. Activity concentrations above natural background concentrations. Where more than one radionuclide is present, the sum of the ratios of the individual radionuclide concentrations to their respective concentration limits shall not exceed 1.

b. Concentrations for which no specific reference is cited have been derived from RESRAD calculations and are the more restrictive values calculated for soil deposition at a depth of 5 meters.

c. Indicates that this radionuclide is not expected to be found at the indicated site.

d. Difference in tritium activity concentrations are due to the difference in depths of the water tables at two sites. The water table depth at King Avenue is deeper than that at West Jefferson.

References:

1. Options 1 and 2 of the Branch Technical Position, "Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations" (46 FR 52061, October 23, 1981).

2. NRC Memorandum, "Acceptable Cleanup Criteria and Practices for Decontamination and Decommissioning (License No. SNM-7)" dated April 17, 1992, to Harley L. Toy, License Coordinator and Manager, Nuclear Sciences, Battelle Memorial Institute from J.W.N. Hickey, Chief, Fuel Cycle Safety Branch, Division of Industrial and Medical Nuclear Safety, Office of Nuclear Material Safety and Safeguards.

3. DOE Order 5400.5, "Radiation Protection of the Public and the Environment".

4. NRC Policy and Guidance Directive FC83-23, "Termination of Byproduct, Source, and Special Nuclear Material Licenses".

Table 2, Cesium-137 Surrogate Analysis Data & Modified Cs-137 Screening Criteria

Sample ID (a,b)	Cs-137 Activity (pCi/g)	Co-60 Activity (pCi/g)	Eu-152 Activity (pCi/g)	Eu-154 Activity (pCi/g)	Am-241 Activity (b) (pCi/g)	Sr-90 Activity (pCi/g)	Pu-238 Activity (pCi/g)	Pu-239 Activity (pCi/g)
16741	40 1	0 05	-0 096	-0 053	1 36 g	-0 172	-0 009	0 053
16746	21 6	0 04	<0 079	-0 051	1 28 a	-0 184	0 026	0 9
16747	26 1	0 06	<0 077	-0 046	0 89 g	-0 175	<0 011	0 110
16751	8	<0 024	<0 068	<0 047	0 93g	<0 151	0 021	0 496
16752	39 1	0 06	<0 086	<0 046	10 74 a	-0 167	0 131	5 822
16607	74 2	0 28	7 26	0 65	1 18 a	0 59	0 0213	0 829
16608	18 7	0 07	4 03	0 26	0 47 a	-0 180	0 016	0 287
16688	41 6	0 08	-0 098	<0 061	2 59 a	NA	0 036	1 846
16686	38 1	0 07	-0 050	-0 031	4 71 a	NA	0 135	3 84
19079	11 7	0 17	8 02	0 64	0 018	4 39	-0 016	0 034
19080	32 4	-0 016	0 562	<0 053	-0 016	0 21	-0 019	-0 017
Average	*31 99*	*0 084*	*1 857*	*0 176*	*2 2*	*0 691*	*0 04*	*1 278*

Calculated Cs-137 Surrogate Ratio (c)	
Cs-137/Co-60	381
Cs-137/Eu-152	17
Cs-137/Eu-154	182
Cs-137Am-241	15
Cs-137/Sr-90	46
Cs-137/Pu-238	800
Cs-137/Pu-239	25
Cs-137/Pu-241 (d)	2 8

Modified Cs-137 Screening Criteria			
Cleanup Criteria (pCi/g)		*Surrogate Activity (pCi/g)*	*Summed Ratio*
Cs-137	15	11	0 73
Co-60	8	0 028884026	0 00
Eu-152	36	0 638543296	0 02
Eu-154	32	0 060518912	0 00
Am-241	30	0 756486402	0 03
Sr-90	5	0 237605502	0 05
Pu-238	25	0 013754298	0 00
Pu-239	25	0 438762113	0 02
Pu-241	25	3 928571429	0 16
		Unity Rule (e)	*1 00*

Notes

(a) Battelle reported analytical results of samples obtained from the filter bed area between March and September 2000

(b) Reported data obtained from gamma spectroscopy analysis

(c) Surrogate ratio calculated by dividing average Cs-137 activity by average activity of isotope of concern

(d) Pu-241 is calculated by applying a ratio to sum of Pu-238 and Pu-239 (obtained from ORIGEN 2 1 derived values Battelle, 2003c)

(e) Unity Rule applied to surrogate isotopic activity resulting in modified Cs-137 screening level of 11 pCi/g

Table 3
JN-2 Sanitation Line Section A Survey and Sampling Results

Sample ID	Number	Location	Collection Date	Walkover Scan (NaI) cpm	Dose Rate µR/hr	Cs-137 Content (Results in pCi/g)
RL05-4058-3867	1	Floor -1st Meter	11/10/2005	12600	10	-0.026
RL05-4059-3868	2	Floor - 2nd Meter	11/10/2005	14700	10	0.004
RL05-4060-3869	3	Floor - 3rd Meter	11/10/2005	14900	11	-0.009
RL05-4061-3870	4	Floor - 4th Meter	11/10/2005	15700	11	0.004
RL05-4062-3871	5	Floor - 5th Meter	11/10/2005	16600	11	-0.003
RL05-4063-3872	6	Floor - 6th Meter	11/10/2005	17300	11	0.014
RL05-4064-3873	7	Floor - 7th Meter	11/10/2005	16200	11	-0.012
RL05-4065-3874	8	Floor - 8th Meter	11/10/2005	15900	11	-0.018
RL05-4066-3875	9	Floor - 9th Meter	11/10/2005	15800	11	-0.002
RL05-4067-3876	10	Floor - 10th Meter	11/10/2005	16200	11	-0.023
RL05-4068-3877	11	Floor - 11th Meter	11/10/2005	16600	11	0.064
RL05-4069-3878	12	Floor - 12th Meter	11/10/2005	16700	11	0.048
RL05-4070-3879	13	Floor - 13th Meter	11/10/2005	15000	11	0.252
RL05-4071-3880	14	Floor - 14th Meter	11/10/2005	14800	11	0.064
RL05-4072-3881	15	Floor - 15th Meter	11/10/2005	16600	10	0.123
RL05-4073-3862	16	Sidewall - 3 Meters	11/10/2005	11800	9	0.063
RL05-4074-3863	17	Sidewall – 6 Meters	11/10/2005	11400	10	0.240
RL05-4075-3864	18	Sidewall - 9 Meters	11/10/2005	11500	8	0.072
RL05-4076-3865	19	Sidewall - 12 Meters	11/10/2005	12200	9	-0.002
RL05-4077-3866	20	Sidewall - 15 Meters	11/10/2005	11500	9	0.009

Table 4

JN-2 Sanitation Line Trench "Sidewall" Comparison Value

Area/Volume ID			Number of Data Points	t95% (n-1) Value from Table B-1 of NUREG/CR-5849
JN-2 Section A Trench	Sidewalls		5	2.015
	Sample Number	Cs-137 Result (pCi/g)		
1	RL05-4073-3862	0.063		
2	RL05-4074-3863	0.240		
3	RL05-4075-3864	0.072		
4	RL05-4076-3865	-0.002		
5	RL05-4077-3866	0.009		

Comparison Value Equation $\mu_{\alpha} = \bar{x} + t_{1-\alpha,df} \frac{S_x}{\sqrt{n}}$

Average	Comparison Value
0.08	0.16
Standard Deviation	Modified Screening Criteria
0.10	11
	Comparison < Criteria
	Yes

Table 5
JN-2 Sanitation Line Section A Overburden Sampling Summary

Sample ID	Collection Date	Cs-137 Content (Results in pCi/g)
RL05-4167-3931	11/14/2005	-3.249E-03
RL05-4168-3932	11/14/2005	1.780E-02
RL05-4169-3933	11/14/2005	6.658E-02
RL05-4170-3934	11/14/2005	4.810E-01
RL05-4171-3935	11/14/2005	-3.426E-03
RL05-4172-3936	11/14/2005	6.870E-02

Table 6

JN-2 Sanitation Line Section A Overburden Comparison Value Calculation

Area/Volume ID		Number of Data Points	t95% (n-1) Value from Table B-1 of NUREG/CR-5849
JN-2 Section A Trench	Overburden	6	2.015

	Sample Number	Cs-137 Result (pCi/g)
1	RL05-4167-3931	-3.249E-03
2	RL05-4168-3932	1.780E-02
3	RL05-4169-3933	6.658E-02
4	RL05-4170-3934	4.810E-01
5	RL05-4171-3935	-3.426E-03
6	RL05-4172-3936	6.870E-02

Comparison Value Equation $\mu_a = \bar{x} + t_{1-\alpha,df} \frac{S_x}{\sqrt{n}}$

Average	Comparison Value
0.1045675	0.26
Standard Deviation	**Modified Screening Criteria**
0.19	11
	Comparison < Criteria
	Yes