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March 8, 2010

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SUBJECT: FINAL INDEPENDENT CONFIRMATORY SURVEY REPORT FOR THE CULVERT AT THE HEMATITE DECOMMISSIONING PROJECT, FESTUS, MISSOURI (DOCKET NO. 070-036; RFTA NO. 10-003)DCN 1768-SR-02-0

Dear Mr. Watson:

Enclosed are the results of the Oak Ridge Institute for Science and Education's (ORISE) confirmatory survey activities of the culvert area of the Hematite Decommissioning Project in Festus, Missouri. The survey activities consisted of gamma soil scans and soil sampling. The report is being issued as a preliminary final pending concurrence from the ORISE laboratory review.

My contact information is listed below. You may also contact Erika Bailey at 865.576.6659 or Tim Vitkus at 865.576.5073 with any questions or comments.

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INDEPENDENT CONFIRMATORY SURVEY REPORT FOR THE CULVERT AT THE HEMATITE DECOMMISSIONING PROJECT FESTUS, MISSOURI

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U.S. Nuclear Regulatory Commission

FINAL REPORT

March 2010

This final report has not been given full review and patent clearance, and the dissemination of its information is only for official use. No release to the public shall be made without the approval of the Communications and Marketing Department, Oak Ridge Institute for Science and Education.

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ABBREVIATIONS AND ACRONYMS

Am	americium
cpm	counts per minute
DCGL	derived concentration guideline level
GPS	global positioning system
HDP	Hematite Decommissioning Project
HEU	highly enriched uranium
IEAV	Independent Environmental Assessment and Verification
ITP	Intercomparison Testing Program
MAPEP	Mixed Analyte Performance Evaluation Program
MDC	minimum detectable concentration
NaI	Sodium iodide
NIST	National Institute of Standards and Technology
Np	neptunium
NRC	Nuclear Regulatory Commission
NRIP	NIST Radiochemistry Intercomparison Program
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
Pu	plutonium
TAP	total absorption peak
Th	thorium
U	uranium
UF_6	uranium hexaflouride
UTM	Universal Transverse Mercator
WEC	Westinghouse Electric Company, LLC

INDEPENDENT CONFIRMATORY SURVEY REPORT FOR THE CULVERT AT THE HEMATITE DECOMMISSIONING PROJECT FESTUS, MISSOURI

INTRODUCTION

The Westinghouse Electric Company, LLC (WEC) former fuel cycle facility near Festus, Missouri operated from 1956 to 2001. The facility produced uranium fuel pellets from natural and enriched uranium. The site ceased operational activities in September 2001 and is now proposing to decommission the facility. The site is now known as the Hematite Decommissioning Project (HDP). From its inception in 1956 through 1974, the facility was used primarily in support of government contracts that required production of highly enriched uranium (HEU) products. From 1974 through the plant closure in 2001, the focus changed from government contracts to commercial fuel production. Specifically, operations included the conversion of uranium hexafluoride (UF_6) gas of various uranium enrichments to uranium oxide, uranium carbide, uranium dioxide pellets, and uranium metal. Secondary operations included research and development and uranium scrap recovery processes. The facility's production buildings, central land area, and the site creek were impacted by the fuel fabrication activities. Currently within permitted licensed activities, WEC has performed equipment decontamination and dismantlement and has shipped various equipment and materials off site. The State of Missouri plans to do work on a culvert that is just outside the HDP property boundary in the spring of 2010; prior to the start of that work, the U.S. Nuclear Regulatory (NRC) requested that the Independent Environmental Assessment and Verification (IEAV) Program at Oak Ridge Institute for Science and Education (ORISE) perform confirmatory surveys and collect soil samples in order to quantify any contamination that may have been released into the culvert from site operations.

The NRC is responsible for oversight of permitted license activities that are currently being conducted at the HDP. The NRC has opted to perform independent (third party) confirmatory activities of various site activities. The purpose of confirmatory activities is to verify that site characterization activities are developed with appropriate technical bases, that any remedial actions have been effective in meeting site-specific guidelines, and that documentation accurately and adequately describes the radiological conditions at the site.

SITE DESCRIPTION

The Hematite facility is located in Jefferson County Missouri less than four miles west of the town of Festus, Missouri and 35 miles south of the city of St. Louis. The site is surrounded by forest, agricultural lands, and low density residential housing. The entire site consists of approximately 228 acres; however, the impacted portion of the site, referred to as the central tract, only includes approximately 19 acres. The central tract of the site is bounded by State Road P to the north, the northeast site creek to the east, Union-Pacific railroad tracks to the south, and the site creek/pond to the west. The culvert runs under State Road P, which can be seen in the upper left corner of Figures A-1 & A-2 included in Appendix A of this report.

OBJECTIVES

The objectives of this survey were to provide independent contractor field data reviews and to generate independent radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's procedures and survey results.

DOCUMENT REVIEW

Prior to onsite activities, ORISE reviewed the applicable sections of the "*Hematite Decommissioning Plan*" (WEC 2005) to obtain site-specific information for confirmatory survey planning as well as other applicable data or relevant documents to meet the survey objectives. The focus of the review included prior activities performed in the process buildings, past characterization and remediation performed, and survey methodology for instrumentation detection capabilities and calibration to determine the adequacy and appropriateness of HDP's approach. These reviews included data interpretation, statistical evaluation, and comparison of results to ensure that the appropriate methodologies were applied and performed correctly. ORISE also reviewed the licensee's adherence to investigation procedures triggered by specified survey results.

PROCEDURES

A survey team from ORISE visited the HDP from November 16 through 19, 2009 to perform visual inspections and measurement and sampling activities. Confirmatory survey activities were conducted in accordance with a site-specific survey plan, the ORISE/IEAV Survey Procedures Manual and the Quality Program Manual (ORISE 2009b, 2008 and ORAU 2009). Figure A-1 shows an aerial photo of the areas involved in the confirmatory activities as discussed below.

REFERENCE SYSTEM

The culvert gamma scan data, in units of counts per minute (cpm), was referenced to Universal Transverse Mercator (UTM). Measurement/sampling locations were documented on a survey map provided by the licensee.

SURFACE SCANS

Medium density scans for gamma radiation were performed in the area around the culvert. Surface scans were performed using sodium iodide (NaI) detectors coupled to ratemeter-scalars with audible indicators and a Trimble GeoXH GPS/datalogger with sensor input. Field personnel relied on the audio output of the ratemeter to identify any locations of elevated direct gamma radiation that might suggest the presence of residual contamination.

SOIL SAMPLING

Six surface soil samples were collected from judgmental locations. Sample locations were selected based on gamma radiation levels detected during surface scans. Figure A-3 shows soil sampling locations.

SAMPLE ANALYSIS AND DATA INTERPRETATION

All data collected on site were brought back to the ORISE facility for interpretation. Samples collected for radiological analysis were delivered to the ORISE radiochemistry laboratory in Oak Ridge, Tennessee for analysis. Sample analyses were performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2009a). Soil samples were analyzed by gamma spectroscopy for gamma-emitting thorium and uranium isotopes and results reported in units of picocuries per gram (pCi/g). The gamma spectra were also reviewed for any other identifiable photopeaks.

APPLICABLE SITE GUIDELINES

Based on past site investigations, the primary contaminants of concern at the HDP are technetium-99 (Tc-99), thorium-232 (Th-232), uranium-234 (U-234), U-235, and U-238. Secondary radiological contaminants include the transuranic radionuclides of americium-241 (Am-241), neptunium-237 (Np-237), and plutonium-239/240 (Pu-239/240). Transuranics are likely to be present only in trace concentrations (WEC 2005). The proposed surface soil derived concentration guideline levels (DCGLs) for the site have not been approved by the NRC so they are not included at this time.

FINDINGS AND RESULTS

SURFACE SCANS

Gamma surface scans conducted of the culvert area yielded a range of 4,200 cpm to 10,700 cpm with isolated areas of elevated gamma radiation. The six judgmental soil samples were collected from these locations. Figure A-2 shows the gamma scan results and Figure A-4 provides a histogram of the gamma count rate distribution.

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

Table B-1 of this report provides the ORISE confirmatory soil sample analytical results. The ranges of radionuclide concentrations are presented in Table 1.

TABLE 1
RANGES OF RADIONUCLIDE CONCENTRATIONS IN SOIL BY GAMMA SPECTROSCOPY
HEMATITE DECOMMISSIONING PROJECT

Radionuclide	Range (pCi/g)		
U-235	0.16 ± 0.07	to	0.61 ± 0.13
U-238	0.95 ± 0.29	to	5.10 ± 0.68
Th-228	0.82 ± 0.08	to	1.00 ± 0.09
Th-232	0.97 ± 0.15	to	1.22 ± 0.21
Total Natural Uranium	2.08 ± 0.58	to	10.8 ± 1.4
Total Enriched Uranium[a]	5.0 ± 1.5	to	18.9 ± 2.9
Total Thorium	1.79 ± 0.17	to	2.19 ± 0.23

[a]Total Enriched U is determined using the following formula: $^{235}U + (^{235}U \times 21.7) + {}^{238}U$

COMPARISON OF RESULTS WITH GUIDELINES

Because there are no approved site-specific DCLGs, the confirmatory radionuclide soil concentration levels can be compared to the HDP-determined background levels for that area. These values were reported in the Hematite Decommissioning Plan in Table 4-7 (WEC 2005). The relevant values from Table 4-7 are as follows: U-235: 0.015 pCi/g, U-238: 0.816 pCi/g, Th-228: 1.039 pCi/g, and Th-232: 0.996 pCi/g. (WEC 2005). Using the ORISE laboratory's calculation for total enriched uranium and the Westinghouse soil background radionuclide concentrations, the total uranium background soil concentration for that area is 1.157 pCi/g.

Based on the comparison of the confirmatory sample concentrations with the background concentration level, all of the uranium values are above background. All Th-232 levels except for sample S0038 were also above background.

SUMMARY

At the request of the NRC, ORISE conducted confirmatory surveys at the HDP during the period of November 16 through 19, 2009. The survey activities included visual inspections and scanning and sampling activities.

The average radiation reading in the culvert was around 7,000 cpm with six isolated hotspots, the highest of which was measured to have a gamma reading of 12,640 cpm, therefore those locations were sampled. The samples were found to have levels of thorium and uranium above background levels.

REFERENCES

Oak Ridge Associated Universities (ORAU). Quality Program for the Independent Environmental Assessment and Verification Program. Oak Ridge, TN; June 30, 2009.

Oak Ridge Associated Universities. ORAU/ORISE Health & Safety Manual. Revision 12. Oak Ridge, TN; April 2, 2008.

Oak Ridge Associated Universities. ORAU/ORISE Radiation Protection Manual. Oak Ridge , TN; September 10, 2005.

Oak Ridge Institute for Science and Education (ORISE). Survey Procedures Manual for the Independent Environmental Assessment and Verification Program. Oak Ridge, TN; May 1, 2008.

Oak Ridge Institute for Science and Education. Laboratory Procedures Manual for the Independent Environmental Assessment and Verification Program. Oak Ridge, TN; June 30, 2009a.

Oak Ridge Institute for Science and Education. Independent Confirmatory Survey Project-Specific Plan for the Hematite Decommissioning Project, Hematite, Missouri 1768-PL-02-0. Oak Ridge, Tennessee; November 10, 2009b.

Westinghouse Electric Company (WEC). Hematite Decommissioning Plan. Document No. DO-04-004, Rev. 2. Hematite, MO; August 2005.

Hematite Decommissioning Project 1768-SR-02-0

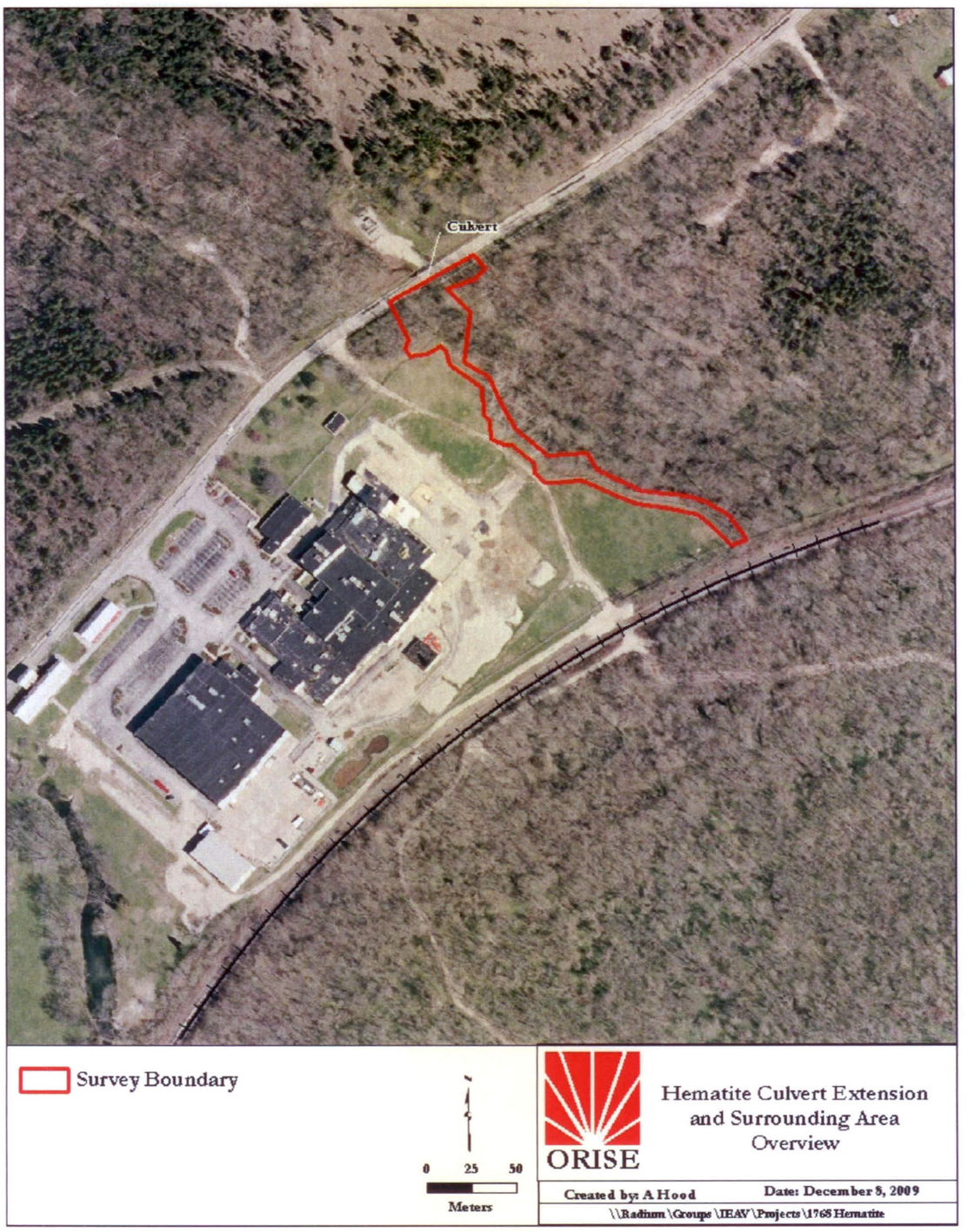

Figure A-1: The Culvert Area

Figure A-2: Scan Data from the Culvert

Figure A-3: Soil Sample Locations in the Culvert

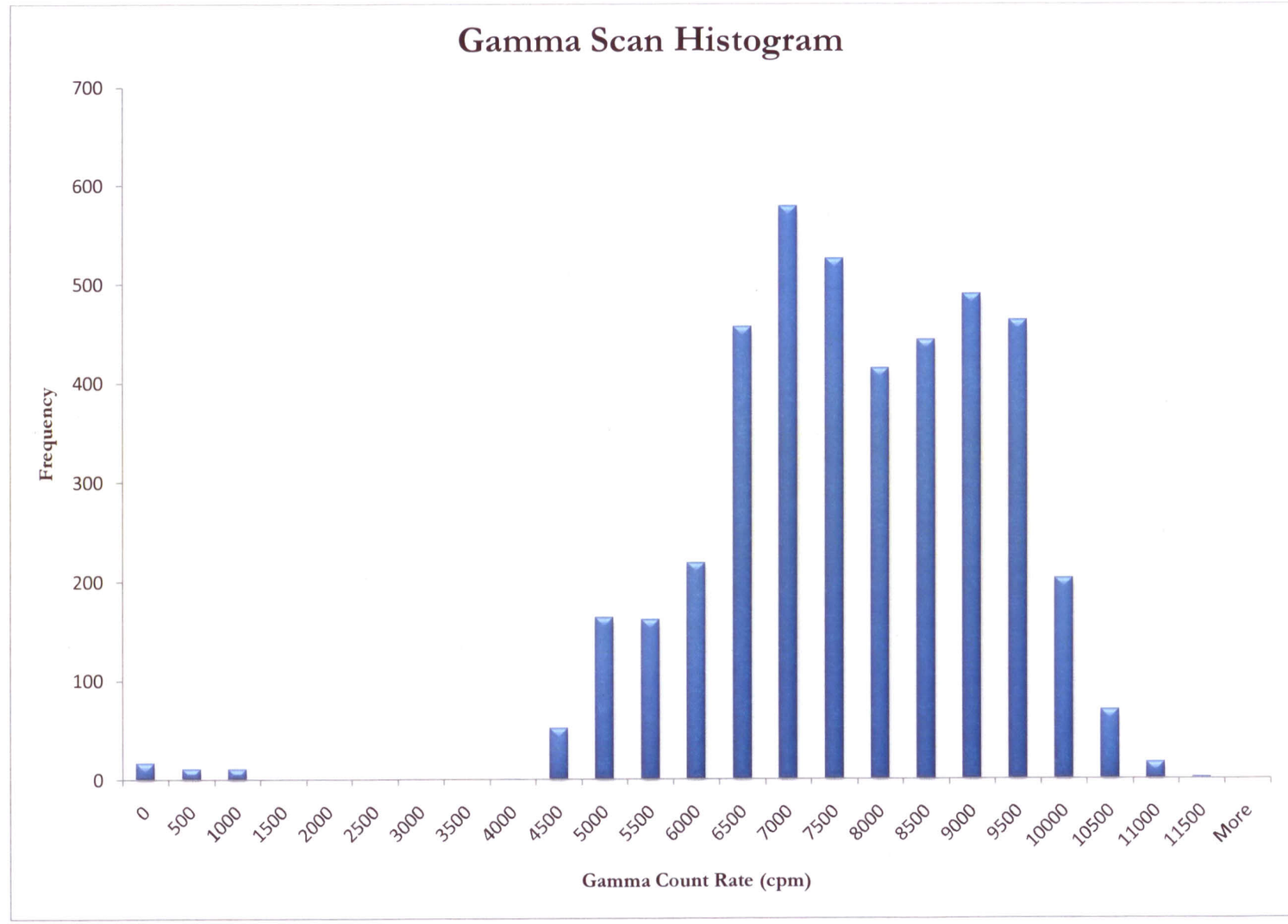

Figure A-4: Gamma Scan Histogram

APPENDIX B
TABLES

TABLE B- 1
RADIONUCLIDE CONCENTRATIONS IN SOIL
BY GAMMA SPECTROSCOPY
HEMATITE DECOMMISSIONING PROJECT

Sample ID	Sample Grid Coordinates Easting, Northing	Sample Date	Radionuclide		Radionuclide Concentrations in Soil Samples (pCi/g)
1768S0035	827336, 865424	11/19/09	Uranium	U-235	0.21 ± 0.09
				U-238	2.26 ± 0.46
			Thorium	Th-228	0.97 ± 0.09
				Th-232	1.11 ± 0.18
			Totals	Natural U[a]	4.73 ± 0.92
				Enriched U[b]	7.0 ± 2.0
				Th	2.08 0.20
1768S0036	827356, 865390	11/19/09	Uranium	U-235	0.30 ± 0.11
				U-238	1.93 ± 0.50
			Thorium	Th-228	0.97 ± 0.10
				Th-232	1.22 ± 0.21
			Totals	Natural U	4.16 ± 1.00
				Enriched U	8.7 ± 2.4
				Th	2.19 ± 0.23
1768S0037	827329, 865453	11/19/09	Uranium	U-235	0.16 ± 0.07
				U-238	1.40 ± 0.30
			Thorium	Th-228	0.89 ± 0.08
				Th-232	1.03 ± 0.15
			Totals	Natural U	2.96 ± 0.60
				Enriched U	5.0 ± 1.5
				Th	1.92 ± 0.17

TABLE B-1 (cont.):
RADIONUCLIDE CONCENTRATIONS IN SOIL
BY GAMMA SPECTROSCOPY
HEMATITE DECOMMISSIONING PROJECT

Sample ID	Sample Grid Coordinates Easting, Northing	Sample Date	Radionuclide		Radionuclide Concentration in Soil Samples (pCi/g)
1768S0038	827268, 865501	11/19/09	Uranium	U-235	0.18 ± 0.07
				U-238	0.95 ± 0.29
			Thorium	Th-228	0.82 ± 0.08
				Th-232	0.97 ± 0.15
			Totals	Natural U	2.08 ± 0.58
				Enriched U	5.0 ± 1.5
				Th	1.79 ± 0.17
1768S0039	827729, 865093	11/19/09	Uranium	U-235	0.26 ± 0.09
				U-238	2.73 ± 0.79
			Thorium	Th-228	1.00 ± 0.09
				Th-232	1.15 ± 0.19
			Totals	Natural U	5.72 ± 1.58
				Enriched U	8.6 ± 2.1
				Th	2.15 ± 0.21
1768S0040	827844, 865066	11/19/09	Uranium	U-235	0.61 ± 0.13
				U-238	5.10 ± 0.68
			Thorium	Th-228	1.00 ± 0.10
				Th-232	1.09 ± 0.19
			Totals	Natural U	10.8 ± 1.4
				Enriched U	18.9 ± 2.9
				Th	2.09 ± 0.22

[a]Total Natural U is determined using the following formula: $^{235}U + (2 \times {}^{238}U)$[c]

[b]Total Enriched U is determined using the following formula: $^{235}U + \left({}^{235}U \times 21.7\right) + {}^{238}U$. [c]

[c]The equations for Total U include U-234, however as it cannot be determined through the gamma spectroscopy it is accounted for using typical ratios in the calculations.

APPENDIX C
MAJOR INSTRUMENTATION

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the author or her employer.

SCANNING INSTRUMENT/DETECTOR COMBINATIONS

Gamma

Ludlum Ratemeter-Scaler Model 2221
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to
Ludlum SPA-3 NaI Scintillation Detector Model 44-10, crystal: 5.1 cm x 5.1 cm
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to
Trimble GeoXH Receiver and Data Logger
(Trimble Navigation Limited, Sunnyvale, CA)

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detector
CANBERRA/Tennelec Model No: ERVDS30-25195
(Canberra, Meriden, CT)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
Dell Workstation
(Canberra, Meriden, CT)

High Purity Extended Range Intrinsic Detector
Model No. GMX-45200-5
(AMETEK/ORTEC, Oak Ridge, TN)
used in conjunction with:
Lead Shield Model SPG-16-K8
(Nuclear Data)
Multichannel Analyzer
Dell Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-30-P4, 30% Eff.
(AMETEK/ORTEC, Oak Ridge, TN)
Used in conjunction with:

LABORATORY ANALYTICAL INSTRUMENTATION (CONTINUED)

Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
Dell Workstation
(Canberra, Meriden, CT)

APPENDIX D
SURVEY AND ANALYTICAL PROCEDURES

SURVEY AND ANALYTICAL PROCEDURES

PROJECT HEALTH AND SAFETY

The proposed survey and sampling procedures were evaluated to ensure that any hazards inherent to the procedures themselves were addressed in current job hazard analyses. Prior to onsite activities, a pre-job integrated safety management checklist was completed and discussed with field personnel. Additionally, upon arrival on site, a walk-down of the site was performed to identify hazards present. All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection procedures (April 2008 and September 2005).

QUALITY ASSURANCE

Analytical and field survey activities were conducted in accordance with procedures from the following documents:

- Survey Procedures Manual (May 1, 2008)
- Laboratory Procedures Manual (June 30, 2009)
- Quality Program Manual (June 30, 2009)

The procedures contained in these manuals were developed to meet the requirements of Department of Energy Order 414.1C and the U.S. Nuclear Regulatory Commission *Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards* and contain measures to assess processes during their performance.

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST. Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in MAPEP, NRIP, and ITP Laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

CALIBRATION PROCEDURES

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to the National Institute of Standards and Technology (NIST), when such standards/sources were available. In cases where they were not available, standards of an industry-recognized organization were used.

SURVEY PROCEDURES

Surface Scans

Scans for elevated gamma radiation were performed by passing the detector slowly over the surface. The distance between the detector and surface was maintained at a nominal distance of about 1 to 5cm. NaI scintillation detectors were coupled to GPS units that enabled real-time recording of position in one-second intervals. The identification of elevated radiation levels that could exceed the site criteria were determined based on an increase in the audible signal from the indicating instrument.

Specific scan MDCs for the NaI scintillation detector were not determined as the instrument was used solely as a qualitative means to identify elevated gamma radiation levels in excess of background.

Soil Sampling

Approximately 0.5 to 1 kg of soil was collected at each sample location. Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ORISE survey procedures.

RADIOLOGICAL ANALYSIS

Gamma Spectroscopy

Samples of soil were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in a 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. All total absorption

peaks (TAP) associated with the radionuclides of concern were reviewed for consistency of activity. TAPs used for determining the activities of radionuclides of concern and the typical associated MDCs for a one-hour count time were:

Radionuclide	TAP (MeV)	MDC (pCi/g)
^{228}Th	0.23863 MeV	0.24
^{232}Th	0.911 MeV	0.14
^{235}U	0.14376 MeV	0.06
^{238}U	0.0633 MeV	0.75

Spectra were also reviewed for other identifiable TAPs. The determination of MDCs was derived from the progeny of Th-232 and U-238 (actinium-228 for Th-232 and thorium-234 for U-238). Soil concentration calculations were based on the assumption that actinium-228 and thorium-234 were in equilibrium with their parent isotopes.

Uncertainties

The uncertainties associated with the analytical data presented in the tables of this report represent the total propagated uncertainties for those data. These uncertainties were calculated based on both the gross sample count levels and the associated background count level.