

April 9, 2012

Ms. Laurie Kauffman
U.S. Nuclear Regulatory Commission
Division of Nuclear Materials Safety
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King of Prussia, PA 19406-1415

**SUBJECT: INTERIM REPORT—INDEPENDENT CONFIRMATORY SURVEY
RESULTS FOR THE ARGYLE STREET SEWER SYSTEM, LAYDOWN
AREA, DECON PIT, X-RAY READING ROOM, AND HAUL ROAD AT
THE UNITED NUCLEAR CORPORATION NAVAL PRODUCTS SITE,
NEW HAVEN, CONNECTICUT
DCN: 2040-SR-02-0**

Dear Ms. Kauffman:

The Oak Ridge Institute for Science and Education (ORISE) is pleased to provide the enclosed interim report that details the confirmatory survey procedures and results for the subject areas at the United Nuclear Corporation Naval Products site in New Haven, Connecticut. This interim report will be followed by a consolidated report at the completion of all decommissioning and confirmatory phases. Please contact me via my information below or Erika Bailey at 865.576.6659 if you have any questions.

Sincerely,



Wade C. Adams
Project Manager/Health Physicist
Independent Environmental Assessment
and Verification

WCA:fr

Enclosure

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INTERIM REPORT



Prepared by
Wade C. Adams
Independent Environmental Assessment and Verification

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Prepared for the
U.S. Nuclear Regulatory Commission

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1. INTRODUCTION

United Nuclear Corporation (UNC) Naval Products fabricated fuel elements for the Naval Reactors Program at the New Haven, Connecticut, H-Tract facility (Fig. 1) under U.S. Nuclear Regulatory Commission (NRC) Docket No. 70-371, License No. SNM-368. This license authorized possession and use of enriched uranium (EU) and later, source material, including natural uranium (NU), depleted uranium (DU), and thorium for research and nuclear fuel fabrication. UNC operated the facility from June 8, 1961 to April 22, 1976 (NRC 1996).

In 1974, UNC announced the closing of the H-Tract facility and transferred their inventory of radioactive materials from the New Haven location to the Montville, Connecticut location. Final surveys of the New Haven facility were completed in February 1976 and the NRC performed confirmatory surveys in March 1976. NRC subsequently released the site for unrestricted use in accordance with the existing release criteria (UNC 1976). The SNM-368 license was amended in April 1976 to remove the New Haven facility from the license and the license was terminated on June 8, 1994, following decommissioning at the Montville facility. The NRC's guidance and criteria for release for unrestricted use was the U.S. Atomic Energy Commission (AEC) Regulatory Guide 1.86, dated June 1974 (AEC 1974), and *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material* (NRC 1991).

Around 1994, the NRC had initiated a program to ensure that licenses for facilities, where activities authorized by the AEC and/or NRC were conducted, had been terminated in accordance with the NRC's current release criteria for unrestricted use. As part of this program, the UNC site was identified as a site that required additional review since final radiological survey records were either incomplete or inadequate (NRC 1981 and 1991). In September 1996, the Oak Ridge Institute for Science and Education (ORISE) (an NRC contractor) performed radiological surveys of the

subsurface soils comparing the results to the release criteria in the 1981 Branch Technical Position (BTP) *Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations*, published in the Federal Register on October 23, 1981 (NRC 1981). The ORISE results indicated that residual EU, in certain subsurface/subfloor soil areas inside the building and inside a connected inactive sewer system, had exceeded the release criteria of 30 picocuries per gram (pCi/g) in soil (NRC 1996 and ORISE 1997).

In a letter from UNC General Electric (UNC/GE)—General Electric Corporation is the current site owner—to the NRC, dated June 8, 1998, UNC/GE agreed to proceed with site characterization and to remediate the facility, in accordance with the soil cleanup criteria in Option 1 and delineated in the NRC 1981 BTP (UNC/GE 1998). UNC/GE began sampling activities in 2003 and from 2005 to 2008 issued supplemental documents; e.g., the Radiological Characterization Report (and its associated appendix) and the Final Status Survey Plan (FSSP) (UNC/GE 2005 and 2006). The FSSP was prepared in accordance with the procedures and methods established in NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM), Revision 1 and UNC/GE's Decommissioning Plan (DP) (NRC 2000 and UNC/GE 2005).

UNC/GE's FSSP details the survey and sampling efforts to be performed at the site, with the goal of releasing the property and surrounding area for unrestricted use. UNC/GE has contracted with a remediation contractor, Cabrera Services, Inc. (CSI), and CSI is currently mobilized at the site and is in the process of completing final remediation activities.

The remediated areas of the site that are the subject of this report are: subfloor soils in the Decon Pit and the X-Ray Reading Room, as well as subsurface soils outside the building in the Laydown Area, Haul Road, and the recently backfilled Argyle Street Sewer System (Fig. 2).

The UNC/GE remediation survey activities have included the performance of gamma scans, subfloor soil sampling, and sediment sampling from the associated Argyle Street Sewer System. Surface scans for gamma radiation were performed over accessible floor space in each of the areas of concern. Due to the existence of a water line and a high-pressure line adjacent to the Argyle Street Sewer System excavation, the sewer system was excavated in sections and those sections were backfilled immediately after final status survey (FSS) soil samples were collected. Excavation and backfill activities were performed in conjunction with NRC, State of Connecticut (SoC), and ORISE

observations and sample collection. Confirmatory surveys did not identify any remaining soil contamination after remediation efforts by CSI were completed. The Argyle Street Sewer System excavation has since been backfilled.

2. PROCEDURES

ORISE personnel conducted independent in-process radiation surface scans and soil sampling to evaluate the radiological status of the site excavations for which remediation and FSSs were being performed. These in-process confirmatory survey activities were conducted in accordance with the project-specific plan, the ORISE Survey Procedures Manual, and the Oak Ridge Associated Universities (ORAU) IEAV Quality Program Manual (ORISE 2011a, ORISE 2008, and ORAU 2011). Additionally, the CSI FSSP and preliminary FSS radiological data associated with these excavations were reviewed prior to the in-process radiological surveys.

2.1 REFERENCE SYSTEM

ORISE referenced survey results using CSI's established coordinate system. The reference system used global positioning system (GPS) coordinates X (easting) and Y (northing) in units of feet, based on Connecticut State Plane North American Datum 1983 coordinates.

2.2 SURFACE SCANS

Gamma radiation scans (GRS) of surface and excavation soils were performed using a sodium iodide (NaI) scintillation detector coupled to a ratemeter-scaler with an audible indicator. The NaI detectors were electronically windowed to the low-gamma energies associated with EU; therefore, the higher gamma energies associated with the background contributions from naturally occurring gamma energies were discriminated out of the gamma count rate. GRS coverage for each surveyed area is presented in Table 1.

Table 1. Gamma Radiation Scan Density	
Surveyed Area	Gamma Radiation Scan Density
Argyle Street Sewer System	Medium Density
X-Ray Reading Room	Medium Density
Laydown Area (February 2012)	High Density
Laydown Area (March 2012)	High Density
Decon Pit Area	High Density
Haul Road Area	High Density

For the exterior surfaces (Argyle Street Sewer System, Laydown Area and Haul Road), the detector was also coupled to a GPS system that enabled real-time gamma count rate and geo-referenced data capture; for interior locations (i.e., X-Ray Reading Room and Decon Pit), geo-referenced data capture was not possible. Locations of elevated direct radiation, suggesting the presence of residual contamination, were marked and identified for further investigation.

2.3 SOIL SAMPLING

ORISE collected confirmatory soil samples from locations of elevated gamma radiation as detected by the ORISE personnel during GRS. Soil samples were collected from 21 judgmentally determined locations within the four excavations. In addition, SoC personnel collected 2 soil samples (samples S0020 and S0021) from the X-Ray Reading Room during January and February 2012 site visits and submitted them to the ORISE laboratory for radiological analyses. The number of samples collected from each surveyed area is provided in Table 2.

Table 2. In-Process Judgmental Soil Samples	
Surveyed Area	Number of Judgmental Soil Samples
Argyle Street Sewer System	0 ^a
X-Ray Reading Room	3 ^b
Laydown Area (February 2012)	6
Laydown Area (March 2012)	4
Decon Pit Area	7
Haul Road Area	3

^aConfirmatory soil samples previously collected during the Argyle Street Sewer System excavations. The excavation has since been completed and backfilled; therefore, the GRS survey was conducted over the backfilled soil.

^bThe SoC collected 2 of the 3 soil samples (samples S0020 and S0021) and submitted those to the ORISE laboratory for analysis. ORISE collected sample S0047.

2.4 INTERLABORATORY COMPARISON ANALYSES

ORISE requested that five soil samples, previously collected and analyzed by CSI personnel (S0035 through S0039), be provided to ORISE for interlaboratory comparison analysis.

3. SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples were returned to the ORISE laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses were performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2011b). Soil samples were analyzed by solid-state gamma spectroscopy for EU; samples with ratios of U-238 to U-235 less than 7 were considered enriched uranium and the remaining samples were considered NU. Total NU was calculated by multiplying the U-238 concentration by a factor of 2 and then adding the U-235 concentration. Total EU concentrations were calculated by multiplying the U-235 concentration by a factor of 27 (factor calculated by ORISE and CSI and provided in previous reports [ORISE 1997]) and then adding the U-238 and U-235 concentrations. Analytical results were reported in units of picocuries per gram dry weight basis (pCi/g). The data generated were compared with the approved release criteria.

4. APPLICABLE SITE GUIDELINE

The primary radionuclides of concern (ROCs) for the UNC facility are EU (U-234, U-235 and U-238 are the associated isotopes). The site-specific contamination guideline for processed EU in soil as presented in the FSSP and as established in the NRC BTP *Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations* is less than 30 pCi/g above background, averaged over an area of 100 m² (NRC 1981). This criterion may be modified for “hot spots” or areas that exhibit localized concentrations of uranium over an area smaller than 100 m². The criteria would be limited by using the elevated measurement comparison (EMC) which is calculated as follows:

$$EMC = 30 \text{ pCi/g} * (100/A)^{1/2}$$

where, A is the area of the location with the impacted soil, measured in square meters (m²).

No single value greater than 90 pCi/g will be permitted for unrestricted release.

5. FINDINGS AND RESULTS

The results of the confirmatory in-process surveys are discussed below.

5.1 DOCUMENT REVIEW

The ORISE initial reviews of CSI's preliminary FSS data indicated that the FSSP procedures and methods implemented were appropriate.

5.2 SURFACE SCANS

A summary of the GRS ranges is provided in Table 3. The GRS patterns for each exterior area are provided in Figs. 3 through 5.

Table 3. Gamma Radiation Scan Count Rates		
Surveyed Area	Gamma Radiation Scan Count Rate Range (cpm) ^a	Number of Areas Identified for Further Investigation
Argyle Street Sewer System	1,800 to 3,200	0 ^b
X-Ray Reading Room	2,100 to 7,100	1
Laydown Area (February 2012)	7,300 to 24,000 ^c	6
Laydown Area (March 2012)	1,300 to 7,500	4
Decon Pit Area	400 to 1,400	7
Haul Road Area	1,500 to 3,300	3

^acpm = counts per minute.

^bThe excavation has been completed and backfilled; therefore, the GRS survey was conducted over the backfilled soil. Locations of elevated gamma radiation were not expected.

^cDuring the GRS, the NaI detector window was not set to the ON position. However, elevated gamma radiation locations were detected and marked for further investigations. The February survey activities indicated that further remedial actions were necessary within the Laydown Area.

The CSI remediation activities within the X-Ray Reading Room excavation exposed the building support structure footer. CSI structural engineers indicated that further remediation could possibly affect the stability of the support structure and deemed further remedial actions a safety risk.

Therefore, CSI and ORISE survey activities were limited in this excavation.

5.3 RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

A summary of the total uranium soil sample results is presented in Table 4. Confirmatory soil sample results for each sample, indicating the U-235, U-238 and total uranium concentrations are presented in Table 6. Soil sample locations are presented in Figs. 6 through 9.

Table 4. Summary of Total Uranium Concentrations in Soil Samples		
Surveyed Area	Total Uranium Range (pCi/g)	
	Enriched Uranium	Natural Uranium
X-Ray Reading Room	10 to 240	1.3
Laydown Area (February 2012)	4 to 360	1.5 to 3.2
Laydown Area (March 2012)	19	1.5 to 5.8
Decon Pit Area	4 to 12	1.2 to 2.4
Haul Road Area	32	1.1 to 1.9

5.4 INTERLABORATORY COMPARISON ANALYSIS

The results of the interlaboratory comparison soil samples indicate that the ORISE and CSI radiological soil sample results are in good agreement. The comparison soil sample results are presented in Table 7.

6. COMPARISON OF RESULTS WITH GUIDELINES

Four of the 23 soil samples collected from the various excavations exceeded the 30 pCi/g total uranium release criteria (Table 5).

Table 5. Confirmatory Soil Samples Exceeding the Release Criteria		
Surveyed Area	Soil Samples Exceeding Criteria	Total Uranium (pCi/g)
X-Ray Reading Room	S0047	240
Laydown Area (February 2012)	S0022 and S0024	82 and 360
Laydown Area (March 2012)	NA ^a	NA
Decon Pit Area	NA	NA
Haul Road Area	S0040	32

^aNA = not applicable.

For the Laydown Area and the Haul Road, CSI elected to perform further remediations. The two sample locations from the Laydown Area that exceeded the site release criteria during the February survey activities were remediated; further confirmatory surveys by ORISE within the Laydown Area during the March survey activities indicated that CSI remedial activities were successful. The one sample location from the Haul Road area that exceeded the release criteria had not been remediated while ORISE was on site during the March 2012 survey activities.

For the X-Ray Reading Room, the Sample S0047 result indicates further remediation would be required to meet the current release criteria; however, due to the complexity of maintaining the stability of the footer support structure, remediating the X-Ray Reading Room excavation to meet the current release criteria may not be feasible. CSI, during a conference call on March 25, 2012, indicated they would apply to the NRC and SoC to use dose-based derived concentration guideline levels (DCGLs), which would lead to substantially higher release levels for this portion of the site.

7. SUMMARY

During the periods of February 27 through 29 and March 21 and 22, 2012, at the request of the NRC, ORISE performed radiological confirmatory surveys of the Argyle Street Sewer System, Laydown Area, Decon Pit, Haul Road, and X-Ray Reading Room at the UNC Naval Products site in New Haven, Connecticut. The survey activities included visual inspections, gamma radiation surface scans, gamma direct measurement, and soil sampling activities. Confirmatory survey activities also included interlaboratory comparison analyses of soil samples between the on site CSI count laboratory and the ORISE laboratory.

Surface scans identified multiple areas of elevated direct gamma radiation distinguishable from background that required further remediation activities by CSI. ORISE analyzed 23 confirmatory soil samples with 4 samples exceeding the release criteria and indicating that further remedial actions were required in portions of the excavation. The 2 sample locations (S0022 and S0024) that exceeded the release criteria in the Laydown Area were successfully remediated; the Haul Road sample location (S0040) had not been remediated while ORISE was on site. The sample (S0047) that exceeded the release criteria within the X-Ray Reading Room was not remediated while ORISE was on site. Since further remediation activities surrounding the building support structure would increase the risk of support failure and increase the safety risks within the X-Ray Reading Room, CSI is seeking approval of proposed dose-based DCGLs that are substantially higher than the current site release criteria of 30 pCi/g of total uranium for the X-Ray Reading Room.

The Interlaboratory comparison analyses of the 5 soil samples analyzed by CSI's onsite laboratory indicated good agreement for the sample results and provided confidence in the CSI analytical procedures and FSS soil sample data reporting (Table 7).



Fig. 1. UNC Naval Products Site Location, New Haven, Connecticut



Fig. 2. UNC Naval Plot Plan Indicating Surveyed Areas



Fig. 3. Argyle Street Sewer - Gamma Walkover Scan

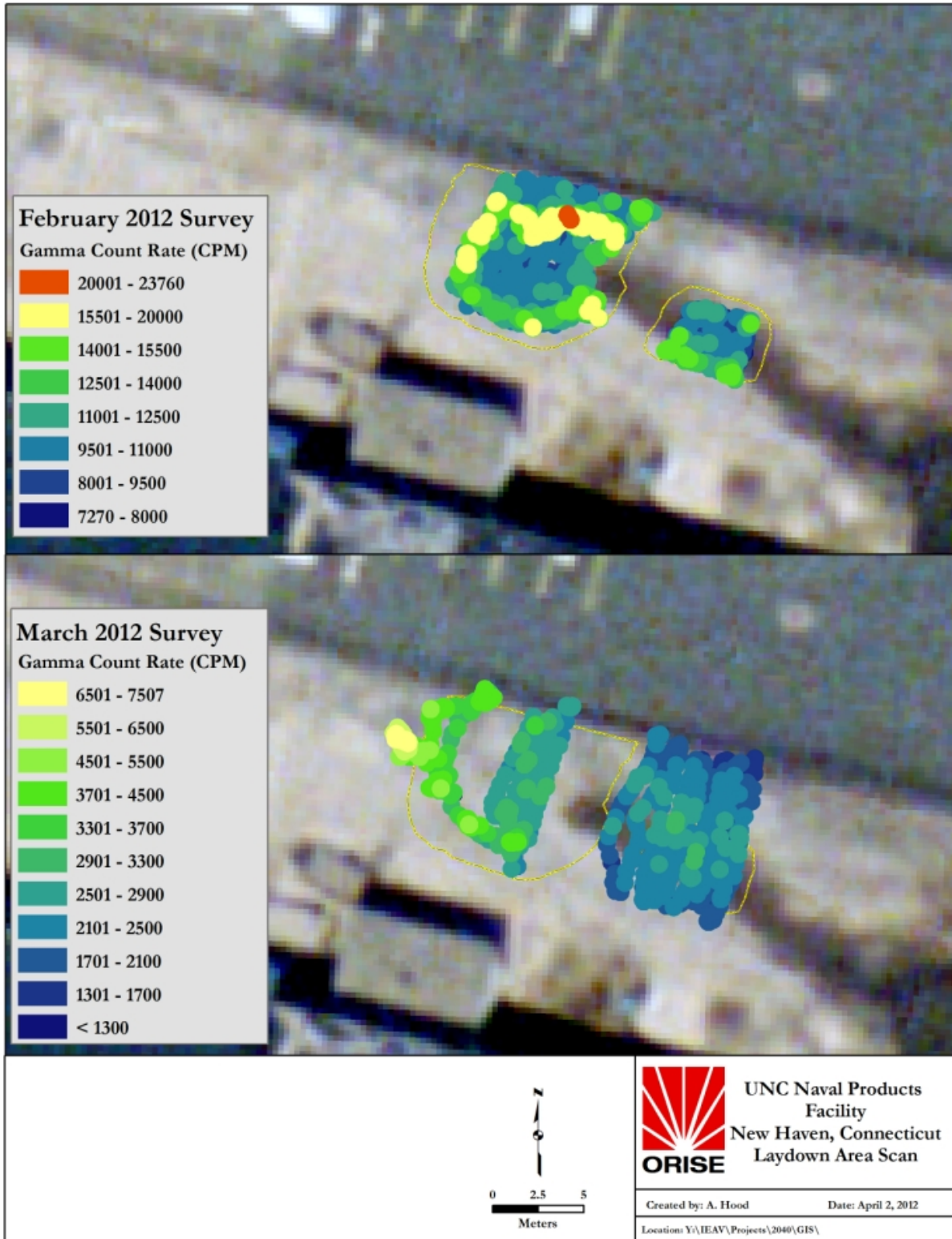


Fig. 4. Laydown Area - Gamma Walkover Scans



Fig. 5. Haul Road Area- Gamma Walkover Scan



Fig. 6. X-Ray ReadingRoom – Soil Sample Location



Fig. 7. Laydown Area – Soil Sample Locations

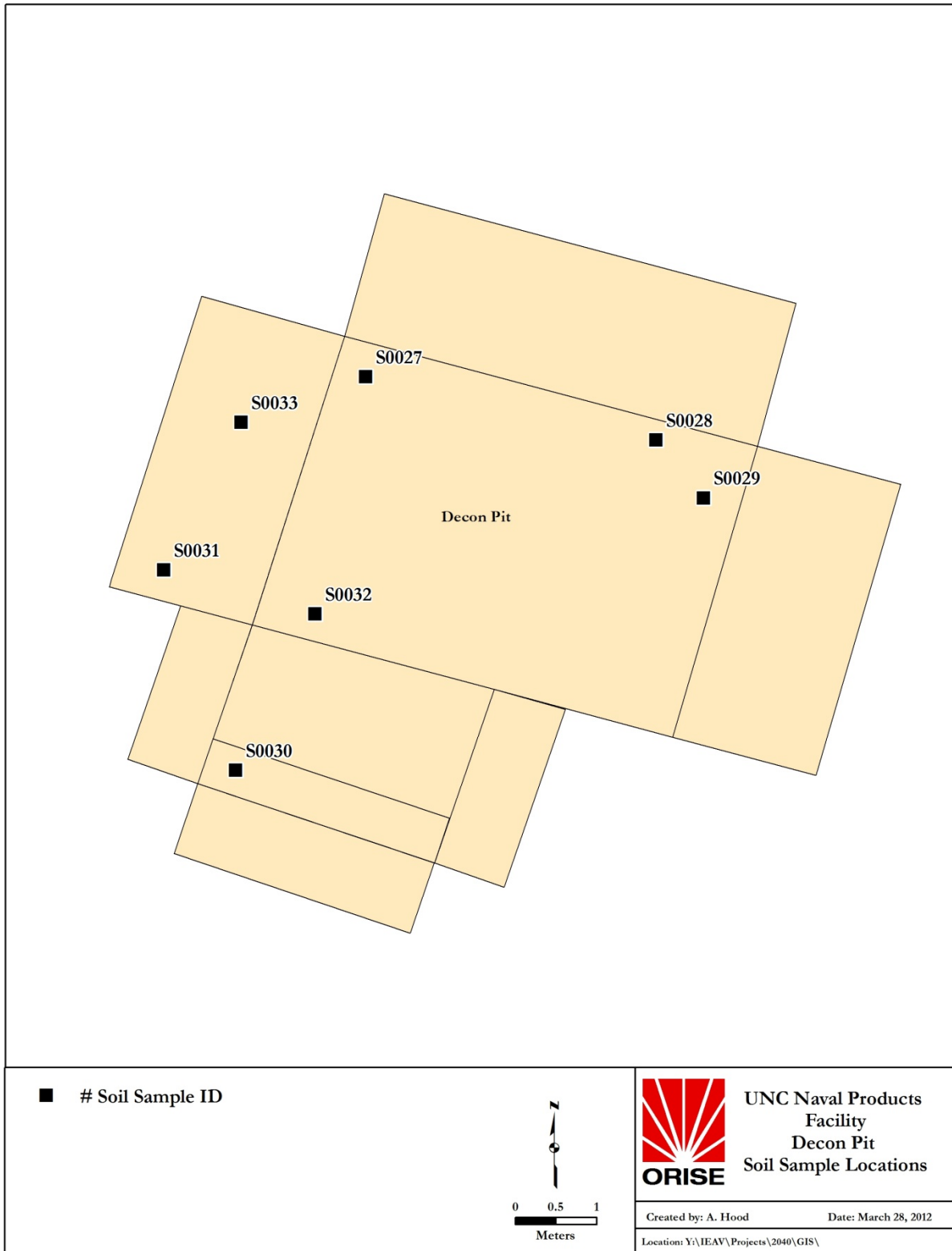


Fig. 8. Decon Pit – Soil Sample Locations



Fig. 9. Haul Road – Soil Sample Locations

Table 6. Total Uranium Concentrations in Soil Samples UNC Naval Products, New Haven, Connecticut												
Sample ID	Collection Date	Gamma Count Rate (cpm)		Total Uranium Concentrations (pCi/g)								
		Pre-sample	Post-sample	U-235		U-238		Total U ^a				
X-Ray Reading Room												
2040S0020	1/5/2012	— ^b	—	0.06	±	0.11 ^c	0.62	±	0.29	1.3	±	0.6
2040S0021	1/20/2012	—	—	0.35	±	0.08	0.63	±	0.30	10	±	2
2040S0047 ^d	3/22/2012	4,525	4,939	8.70	±	0.54	0.30	±	0.53	244	±	15
Laydown Area^e												
2040S0022	2/28/2012	9,786	11,194	2.92	±	0.22	0.51	±	0.34	82	±	6
2040S0023	2/28/2012	9,244	9,774	0.18	±	0.14	1.53	±	0.63	3.2	±	1.3
2040S0024	2/28/2012	7,274	8,430	12.90	±	0.73	0.86	±	0.59	360	±	20
2040S0025	2/28/2012	4,259	4,536	0.37	±	0.11	1.90	±	0.54	12	±	3
2040S0026	2/28/2012	4,250	4,309	-0.02	±	0.12	0.78	±	0.31	1.5	±	0.6
2040S0034	2/28/2012	4,312	4,788	0.13	±	0.07	0.48	±	0.40	4	±	2
2040S0043	3/22/2012	2,585	2,980	0.10	±	0.12	0.69	±	0.39	1.5	±	0.8
2040S0044	3/22/2012	4,240	4,622	0.64	±	0.11	0.93	±	0.41	19	±	3
2040S0045	3/22/2012	4,011	4,121	0.14	±	0.21	1.68	±	0.63	3.5	±	1.3
2040S0046	3/22/2012	6,947	7,910	0.14	±	0.13	2.83	±	0.59	5.8	±	1.2

Table 6. Total Uranium Concentrations in Soil Samples (cont.)												
UNC Naval Products, New Haven, Connecticut												
Sample ID	Collection Date	Gamma Count Rate (cpm)		Total Uranium Concentrations (pCi/g)								
		Pre-sample	Post-sample	U-235		U-238		Total U ^a				
Decon Pit^f												
2040S0027	2/28/2012	1,276	1,356	0.14	±	0.07	0.44	±	0.30	<i>4</i>	±	<i>2</i>
2040S0028	2/28/2012	1,281	1,213	0.00 ^g	±	0.14	0.72	±	0.26	1.4	±	0.5
2040S0029	2/28/2012	1,222	1,159	0.07	±	0.06	0.55	±	0.25	1.2	±	0.5
2040S0030	2/28/2012	1,067	1,068	0.40	±	0.12	0.84	±	0.43	<i>12</i>	±	<i>3</i>
2040S0031	2/28/2012	1,202	1,276	0.10	±	0.09	0.94	±	0.35	2.0	±	0.7
2040S0032	2/28/2012	935	896	0.17	±	0.07	0.20	±	0.24	5	±	2
2040S0033	2/28/2012	1,160	1,312	0.04	±	0.07	1.16	±	0.31	2.4	±	0.6
Haul Road^h												
2040S0040	3/22/2012	—	—	1.11	±	0.15	0.63	±	0.40	32	±	4
2040S0041	3/22/2012	4,344	4,521	0.06	±	0.15	0.91	±	0.37	1.9	±	0.8
2040S0042	3/22/2012	4,222	4,454	-0.12	±	0.16	0.63	±	0.29	1.1	±	0.6

^aTotal U was calculated as U-235 + (2*U-238) for natural U and U-238 + (27*U-235) + U-235 for enriched uranium samples. Italicized Total U results indicate enriched uranium.

^bMeasurement not performed.

^cUncertainties represent the 95% confidence level, based on total propagated uncertainties.

^dRefer to Fig. 6.

^eRefer to Fig. 4.

^fRefer to Fig. 8.

^gZero values are due to rounding.

^hRefer to Fig. 9.

Table 7. Interlaboratory Comparison Analyses UNC Naval Products, New Haven, Connecticut								
ORISE Sample ID	CSI Sample ID ^a	Total Enriched Uranium Concentrations Reported (pCi/g)						
		ORISE			CSI ^b			Relative Error Ratio (RER) ^c
2040S0035	UNC-FSS-LDA-011	10	±	3 ^d	8.32	±	0.12	0.7
2040S0036	UNC-FSS-LDA-015	8	±	2	10.08	±	0.69	1.0
2040S0037	UNC-WCB-XY-018	21	±	3	26.86	±	0.80	2.0
2040S0038	UNC-INV-XY-042	22	±	3	21.45	±	0.52	0.1
2040S0039	UNC-INV-XY-044	22	±	3	18.99	±	0.85	0.8

^aCSI Sample ID provided by CSI.

^bCSI Total Enriched Uranium concentrations are from a CSI-provided data table.

^cRelative Error Ratio (RER) was calculated based on the formula in the DOE’s Quality Systems for Analytical Services and provides a way to determine if analytical results of duplicates (in this case, split samples) are in agreement. A RER < 3 means the samples are in agreement at the 99% confidence level.

^dORISE uncertainties represent the 95% confidence level, based on total propagated uncertainties.

8. REFERENCES

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