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APPROVED	DATE
	Aug 9, 2019

Executive Summary

The U.S. Department of Energy (DOE) published the Portsmouth Gaseous Diffusion 2017 Annual Site Environmental Report in January 2019, which reported that 0.00015 picocuries per cubic meter of the radionuclide Neptunium-237 was identified at an air sampler near the Zahn's Corner Middle School (Zahn's Corner) in Piketon, Ohio. A radiological dose of 0.08 millirem per year was calculated based on the amount.

During the spring of 2019, an independent study performed by members of the public with assistance of Northern Arizona University (NAU) reported the presence of enriched uranium around the community and inside Zahn's Corner.

Based on the NAU report finding, DOE performed radiological sampling at Zahn's Corner Middle School on May 25th and 26th, 2019, to investigate the reported enriched uranium. DOE asked the Ohio Department of Health (ODH) and the Pike County General Health District (PCGHD) to observe the collection of a triplicate set of 44 surface contamination samples and a duplicate set of seven air samples. The surface contamination samples were divided between DOE, ODH, and PCGHD; the air samples were divided between DOE and ODH only. The plan was to have the three organizations independently analyze their set of samples, using similar methodologies, but at different analytical laboratories. For ODH: Eberline Analytical Corporation Laboratory performed gross alpha/beta analysis on 39 wipes and alpha spectroscopy on 7 air samples; and Lawrence Livermore National Laboratory performed inductively coupled plasma mass spectrometry (ICP-MS) on eight wipes. For DOE: Savannah River National Laboratory (SRNL) performed gross alpha/beta; alpha spectrometry, and ICP-MS on their samples. For PCGHD: Northern Arizona University (NAU) performed ICP-MS only. The three groups agreed to share and compare the independent results.

Based upon review of laboratory results from the samples collected and analyzed, ODH does not see evidence of a public health or safety risk due to radiation. There is no radioactive material at the site that is present in quantities that necessitates a regulatory action such as licensing and there are no radioactive material quantities that require a state request to DOE to take any mitigating actions.

1. Background

The U.S. Department of Energy (DOE) published the 2017 Annual Site Environmental Report (ASER) for DOE's Portsmouth Gaseous Diffusion Plant (PORTS) in January of 2019. The annual ASER report summarizes the results of the environmental monitoring performed on and around the PORTS site to identify the impact the plant

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operations has on public health and the environment. The environmental monitoring consisted of sampling:

- Ambient air;
- External radiation;
- Discharges to surface water;
- Local surface water;
- Sediment;
- Soil;
- Biota (vegetation, deer, fish, crops, milk, and eggs); and
- Groundwater.

The PORTS radionuclides of concern that the site environmental monitoring addresses include:

- Technetium-99;
- Uranium-233;
- Uranium-234;
- Uranium-235;
- Uranium-236;
- Uranium-238;
- Neptunium-237;
- Plutonium-238;
- Plutonium-239;
- Plutonium-240; and
- Americium-241.

In the executive summary, the 2017 ASER report stated that the "*maximum activities of detected radionuclides were located at stations A41A (Zahn’s Corner) and A36 (on site near the X-611 Water Treatment Plant)*" The report identified the radionuclide as Neptunium-237, measured at 0.00015 picocuries per cubic meter (pCi/m³). A

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radiological dose of approximately 0.08 millirem per year (mrem/yr) was calculated based on that concentration.

During the spring of 2019, an independent study looking at whether radionuclides from the site had been released offsite was performed by members of the public with assistance from Northern Arizona University (NAU). The NAU Report identified that multiple locations in the areas around PORTS contained enriched uranium, believed to be from the PORTS site. One of the sites identified was the Zahn’s Corner Middle School.

2. DOE ZAHN’S CORNER SAMPLING PROJECT

DOE decided to perform radiological sampling at Zahn’s Corner on the weekend of May 25th and 26th, 2019, to investigate the reported finding in the NAU Report that enriched uranium from the PORTS site was found in the school.

The Ohio Department of Health (ODH) and the Pike County General Health District (PCGHD) participated in the DOE-Zahn’s Corner sampling project as independent observers of the DOE teams collecting three sets of identical samples.

At the end of the sampling, ODH and PCGHD would take one set each of the triplicate samples, have the samples independently analyzed, and then report back to compare the sample results. A few days after the sampling DOE provided their recommended protocols for conducting the analysis.

3. DOE SAMPLING METHOD

DOE used the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) process to develop a sampling plan to investigate the potential presence of enriched uranium in the building. Thirty-nine random locations were determined using the Visual Sampling Plan (VSP) software. Three sets of surface area wipes were taken from undisturbed surfaces (above ceiling tiles) at each of the 39 specified VSP locations inside the school. Each wipe covered a surface area of 100 square centimeters (cm²). The three wipes were taken as close to each other as possible without overlapping the same area.

Note: As identified in U.S. Nuclear Regulatory Commission’s 1974 NRC Regulatory Guide 1.86, the amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. See also ANSI Standard 13.12, January 2013.

Additionally, three sets of surface area wipes were collected at five Special locations that were identified by the school staff and the PCGHD Health Commissioner. These Special locations were associated with samples collected during the earlier,

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independent study. The Special wipes were taken using the same technique as the previous 39 wipes.

In addition to surface area wipe samples, two sets of air samples (one set for DOE and one set for ODH) were collected, both inside the school and outside at the front door and on the playground. These consisted of:

- Two sets of four low-volume (low-vol) air samples pulling air through the filters at about one cubic foot per minute (cfm) for six hours;
- Two sets of three high-volume (hi-vol) air samples with two pulling air through the filter at about four cfm and the third hi-vol pulling air at 24 cfm for six hours.

After all samples were collected, the three sets of 39 surface area wipes and five special surface area wipes were divided between DOE, ODH, and the PCGHD for independent laboratory analysis. The two sets of air samples were divided between DOE and ODH for independent laboratory analysis.

Three sets of Blanks were also distributed to DOE, ODH, and the PCGHD for laboratory analysis purposes. These Blanks consisted of one set for hi-vol samples (unused four-inch diameter filters), one set for low-vol air samples (unused 47 mm diameter filters), and one set for surface area wipes (additional unused 47 mm diameter filters).

Blanks are used by an analytical lab to determine the contribution of any naturally occurring radioactive material (NORM) that is present in the unused filter media itself. This background value is subtracted from the gross radiation count of the sample to calculate the net count of the material that has collected on the filter.

4. ANALYSIS

The Zahn’s Corner sample set received by ODH were sent to Eberline Analytical Corporation in Oak Ridge, Tennessee (Eberline) and to Lawrence Livermore National Laboratory (LLNL) in Livermore, California for analysis.

39 Surface Area Wipes

The 39 surface area wipe samples were analyzed for gross alpha and gross beta activity by Eberline using a gas-flow proportional counter. The sample count time was 15 minutes.

A positive detection was defined as greater than the Minimum Detectable Activity (MDA) plus twice the measurement uncertainty. Samples with a positive detection would be considered for follow-up radiochemical separation and alpha spectroscopy analysis (alpha spec). A radiological dose would be calculated for any alpha spec result.

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Note: *The Minimum Detectable Activity represents the smallest quantity of a radionuclide that can be detected with 95% confidence in a radiological counting system.*

Seven Air Samples

The seven hi-vol and low-vol air samples were analyzed by Eberline using alpha spec. Each sample was counted for 335 minutes. Radionuclides that were analyzed included:

- Thorium-228;
- Thorium-230;
- Thorium-232;
- Uranium-234;
- Uranium-235;
- Uranium-238;
- Neptunium-237;
- Plutonium-238;
- Plutonium-239; and
- Americium-241.

A positive detection was defined as greater than the MDA plus twice the measurement uncertainty. A radiological dose would be calculated for any alpha spec result with a positive detection.

Five Special Surface Area Wipes

Eight surface area wipe samples (all five of the Special samples plus three of the 39 surface area wipes) were sent to the Lawrence Livermore National Laboratory in Livermore, California (LLNL), for analysis using an inductively coupled plasma mass spectrometer (ICP-MS). A radiological dose would be calculated for any positive detection ICP-MS result.

These samples include:

- SCF 00011 - AH4 Ductwork (special)
- SCF-00012 – Top of Block Wall AH4 Room (special)

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- SCF 00013 - AH4 Beam (special)
- SCF-00014 – AH4 Truss A (special)
- SCF-00513 – Room 123 Ceiling (special)
- SCF-00522 - VSP-19
- SCF-00525 - VSP-30
- SCF-00515 - VSP-40

5. CONCLUSIONS

39 Surface Area Wipes

Eberline Laboratory analysis included using a gross alpha/beta calibrated instrument. This instrument is commonly used by both industry and state & federal regulators for measuring radioactive material for the purposes of assessing potential impact to human health and the environment.

The Radiological Health and Safety Section reviewed laboratory data. There was no detectable radioactive material for the 39 surface wipe samples that were screened for gross alpha and gross beta activity. No samples had gross alpha detections and all samples for gross beta were at or near minimum detectable activity (MDA). Based on these results, none of the 39 wipes required alpha spectroscopy.

See Attachment A for a complete summary of the 39-surface area wipe sample analysis results.

Air Samples

Eberline Laboratory analysis included using an alpha spectroscopy calibrated instrument. This instrument is commonly used by both industry and state & federal regulators for measuring radioactive material for the purposes of assessing potential impact to human health and the environment.

The Radiological Health and Safety Section reviewed laboratory data. There was no detectable radioactive material for the seven air samples that were analyzed using alpha spectroscopy. For both the low and high-volume air samples collected, each of the 10 radionuclides were below the laboratory’s MDA or within the uncertainty level of the MDA.

See Attachment B for a complete summary of the air sample analysis results.

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Special Samples

Lawrence Livermore National Laboratories used an ICP-MS (a mass spectrometer). ICP-MS is not commonly used in industry or by state & federal regulators. It is extremely sensitive and can measure extremely low levels of radioactive material. There are a limited number of laboratories who have this type of analysis capability and it is very expensive to use.

The Radiological Health and Safety Section staff reviewed laboratory data. Very low levels of radioactive material were detected in seven of the eight samples analyzed using inductively coupled plasma mass spectrometry (ICP-MS). The highest wipe measurement was less than one disintegration per minute (DPM) which is very low.

See Attachment C for a complete summary of the eight surface area wipes (including all five of the Special wipes) analyzed using an inductively coupled plasma mass spectrometer (ICP-MS). It includes a calculated radiological dose (in a year) for any positive detection ICP-MS result.

Relative Exposures

In the executive summary, the 2017 ASER report stated that the "*maximum activities of detected radionuclides were located at stations A41A (Zahn's Corner) and A36 (on site near the X-611 Water Treatment Plant)*" The report identified the radionuclide as Neptunium-237, measured at 0.00015 picocuries per cubic meter (pCi/m³).

A radiological dose of approximately 0.08 millirem per year **0.08 mrem/yr** was calculated based on that concentration.

For comparison see the following:

- Releases from all sources of radiation from the site are limited to **100 mrem/yr.** (This is a state and federal requirement)
- Radiation exposure from natural background (cosmic, terrestrial, internal), Americans receive on average a radiation dose of approximately **312 mrem/yr.**
- From a Medical chest x-ray, patients receive a radiation dose of **~10 mrem.**
- An example from one of the sample results in this report #SCF-00011 for U-234 shows 1.54E-08 dpm (disintegrations per minute) which equals ~1.92E-5 urem which is ~0.0000192 urem. Compared to the three categories above this sample would result in a dose of **0.000000192 mrem.**

6. REFERENCES

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Attachment A

Results of the Zahn's Corner Middle School 39 Surface Area Wipes Analyzed for Gross Alpha and Gross Beta Activity

Sample Location	Analysis	Result (dpm/100 cm ²)	Minimum Detectable Activity (dpm /100 cm ²)	Comments
VSP-01	Gross Alpha	-1.58E+00±8.64E-01	1.70E+00	Less than the Minimum Detectable Activity
	Gross Beta	6.13E-01±2.16E+00	2.43E+00	Less than the Minimum Detectable Activity
VSP-01 Duplicate	Gross Alpha	-1.58E+00±8.64E-01	1.70E+00	Less than the Minimum Detectable Activity
	Gross Beta	1.03E+00±2.21E+00	2.43E+00	Less than the Minimum Detectable Activity
VSP-02	Gross Alpha	-1.31E+00±1.29E+00	2.15E+00	Less than the Minimum Detectable Activity
	Gross Beta	4.83E+00±2.87E+00	2.92E+00	Less than the Minimum Detectable Activity plus 2σ
VSP-03	Gross Alpha	-2.25E+00±9.02E-01	2.16E+00	Less than the Minimum Detectable Activity
	Gross Beta	-2.97E-02±2.31E+00	2.83E+00	Less than the Minimum Detectable Activity
VSP-04	Gross Alpha	-1.95E+00±9.75E-01	2.07E+00	Less than the Minimum Detectable Activity
	Gross Beta	1.38E+00±2.29E+00	2.52E+00	Less than the Minimum Detectable Activity
VSP-05	Gross Alpha	-1.43E+00±6.89E-01	1.13E+00	Less than the Minimum Detectable Activity
	Gross Beta	2.43E+00±2.44E+00	2.55E+00	Less than the Minimum Detectable Activity
VSP-06	Gross Alpha	-1.55E+00±9.97E-01	1.84E+00	Less than the Minimum Detectable Activity
	Gross Beta	4.96E-01±2.37E+00	2.82E+00	Less than the Minimum Detectable Activity
VSP-07	Gross Alpha	-1.37E+00±9.08E-01	1.55E+00	Less than the Minimum Detectable Activity
	Gross Beta	1.59E+00±2.53E+00	2.91E+00	Less than the Minimum Detectable Activity
VSP-08	Gross Alpha	-1.40E+00±1.23E+00	2.14E+00	Less than the Minimum Detectable Activity
	Gross Beta	1.31E+00±2.35E+00	2.62E+00	Less than the Minimum Detectable Activity
VSP-09	Gross Alpha	-1.06E+00±1.27E+00	1.95E+00	Less than the Minimum Detectable Activity
	Gross Beta	-1.18E+00±2.05E+00	2.61E+00	Less than the Minimum Detectable Activity
VSP-10	Gross Alpha	-1.38E+00±1.10E+00	1.88E+00	Less than the Minimum Detectable Activity
	Gross Beta	-7.25E-02±2.10E+00	2.49E+00	Less than the Minimum Detectable Activity

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Sample Location	Analysis	Result (dpm/100 cm ²)	Minimum Detectable Activity (dpm/100 cm ²)	Comments
VSP-11	Gross Alpha	-1.13E+00±1.11E+00	1.72E+00	Less than the Minimum Detectable Activity
	Gross Beta	3.59E-01±2.51E+00	3.02E+00	Less than the Minimum Detectable Activity
VSP-12	Gross Alpha	-1.01E+00±9.83E-01	1.32E+00	Less than the Minimum Detectable Activity
	Gross Beta	2.63E+00±2.49E+00	2.64E+00	Less than the Minimum Detectable Activity
VSP-13	Gross Alpha	-3.97E-01±1.33E+00	1.60E+00	Less than the Minimum Detectable Activity
	Gross Beta	4.62E-01±2.10E+00	2.30E+00	Less than the Minimum Detectable Activity
VSP-14	Gross Alpha	-1.49E+00±9.50E-01	1.71E+00	Less than the Minimum Detectable Activity
	Gross Beta	7.10E-01±2.21E+00	2.51E+00	Less than the Minimum Detectable Activity
VSP-15	Gross Alpha	-1.49E+00±7.14E-01	1.29E+00	Less than the Minimum Detectable Activity
	Gross Beta	3.66E+00±2.43E+00	2.27E+00	Less than the Minimum Detectable Activity plus 2σ
VSP-16	Gross Alpha	-1.61E+00±1.01E+00	1.88E+00	Less than the Minimum Detectable Activity
	Gross Beta	2.00E+00±2.56E+00	2.89E+00	Less than the Minimum Detectable Activity
VSP-17	Gross Alpha	5.71E-01±1.05E+00	1.71E+00	Less than the Minimum Detectable Activity
	Gross Beta	2.72E+00±2.36E+00	2.51E+00	Less than the Minimum Detectable Activity plus 2σ
VSP-17 Duplicate	Gross Alpha	-1.14E-01±7.08E-01	1.71E+00	Less than the Minimum Detectable Activity
	Gross Beta	1.11E+00±2.17E+00	2.51E+00	Less than the Minimum Detectable Activity
VSP-18	Gross Alpha	5.76E-01±8.44E-01	1.29E+00	Less than the Minimum Detectable Activity
	Gross Beta	3.36E+00±2.32E+00	2.27E+00	Less than the Minimum Detectable Activity plus 2σ
VSP-19	Gross Alpha	4.16E-01±6.99E-01	1.15E+00	Less than the Minimum Detectable Activity
	Gross Beta	5.33E+00±2.63E+00	2.46E+00	Less than the Minimum Detectable Activity plus 2σ
VSP-20	Gross Alpha	8.66E-01±1.30E+00	1.97E+00	Less than the Minimum Detectable Activity

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Attachment A (Continued)

Results of the Zahn's Corner Middle School 39 Surface Area Wipes
Analyzed for Gross Alpha and Gross Beta Activity

Sample Location	Analysis	Result (dpm/100 cm ²)	Minimum Detectable Activity (dpm/100 cm ²)	Comments
	Gross Beta	9.05E-01±2.42E+00	2.92E+00	Less than the Minimum Detectable Activity
VSP-21	Gross Alpha	3.05E-01±7.92E-01	1.51E+00	Less than the Minimum Detectable Activity
	Gross Beta	2.81E-01±2.07E+00	2.49E+00	Less than the Minimum Detectable Activity
VSP-22	Gross Alpha	-1.84E-01±7.96E-01	1.93E+00	Less than the Minimum Detectable Activity
	Gross Beta	-5.75E-01±2.11E+00	2.74E+00	Less than the Minimum Detectable Activity
VSP-23	Gross Alpha	8.28E-01±9.83E-01	1.32E+00	Less than the Minimum Detectable Activity
	Gross Beta	3.43E+00±2.51E+00	2.64E+00	Less than the Minimum Detectable Activity plus 2σ
VSP-24	Gross Alpha	4.80E-01±9.41E-01	1.60E+00	Less than the Minimum Detectable Activity
	Gross Beta	1.65E+00±2.13E+00	2.30E+00	Less than the Minimum Detectable Activity
VSP-25	Gross Alpha	1.73E+00±1.32E+00	1.29E+00	Less than the Minimum Detectable Activity plus 2σ
	Gross Beta	8.90E-01±2.06E+00	2.27E+00	Less than the Minimum Detectable Activity
VSP-27	Gross Alpha	2.32E+00±1.49E+00	1.15E+00	Less than the Minimum Detectable Activity plus 2σ
	Gross Beta	3.86E+00±2.51E+00	2.46E+00	Less than the Minimum Detectable Activity plus 2σ
VSP-29	Gross Alpha	-5.78E-02±9.33E-01	1.97E+00	Less than the Minimum Detectable Activity
	Gross Beta	-2.42E-03±2.29E+00	2.92E+00	Less than the Minimum Detectable Activity
VSP-30	Gross Alpha	5.48E-01±9.25E-01	1.51E+00	Less than the Minimum Detectable Activity
	Gross Beta	2.69E+00±2.37E+00	2.49E+00	Less than the Minimum Detectable Activity plus 2σ
VSP-31	Gross Alpha	3.06E-01±1.05E+00	1.93E+00	Less than the Minimum Detectable Activity
	Gross Beta	1.80E+00±2.39E+00	2.74E+00	Less than the Minimum Detectable Activity
VSP-32	Gross Alpha	9.68E-01±9.98E-01	1.70E+00	Less than the Minimum Detectable Activity
	Gross Beta	-1.26E+01±2.47E+00	2.43E+00	Less than the Minimum Detectable Activity

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Analyzed for Gross Alpha and Gross Beta Activity

Sample Location	Analysis	Result (dpm/100 cm ²)	Minimum Detectable Activity (dpm/100 cm ²)	Comments
VSP-32 Duplicate	Gross Alpha	9.68E-01±9.98E-01	1.70E+00	Less than the Minimum Detectable Activity
	Gross Beta	-1.21E+01±2.41E+00	2.43E+00	Less than the Minimum Detectable Activity
VSP-33	Gross Alpha	7.55E-01±1.20E+00	2.15E+00	Less than the Minimum Detectable Activity
	Gross Beta	-1.17E+01±2.62E+00	2.92E+00	Less than the Minimum Detectable Activity
VSP-34	Gross Alpha	5.19E-01±1.12E+00	2.16E+00	Less than the Minimum Detectable Activity
	Gross Beta	-8.63E+00±2.23E+00	2.83E+00	Less than the Minimum Detectable Activity
VSP-35	Gross Alpha	1.05E+00±1.26E+00	2.07E+00	Less than the Minimum Detectable Activity
	Gross Beta	-1.04E+01±2.28E+00	2.52E+00	Less than the Minimum Detectable Activity
VSP-36	Gross Alpha	8.69E-01±6.89E-01	1.13E+00	Less than the Minimum Detectable Activity
	Gross Beta	-1.17E+01±2.42E+00	2.55E+00	Less than the Minimum Detectable Activity
VSP-37	Gross Alpha	7.51E-01±9.97E-01	1.84E+00	Less than the Minimum Detectable Activity
	Gross Beta	-1.13E+01±2.54E+00	2.82E+00	Less than the Minimum Detectable Activity
VSP-38	Gross Alpha	4.59E-01±6.42E-01	1.55E+00	Less than the Minimum Detectable Activity
	Gross Beta	-9.85E+00±2.42E+00	2.91E+00	Less than the Minimum Detectable Activity
VSP-39	Gross Alpha	1.65E+00±1.50E+00	2.14E+00	Less than the Minimum Detectable Activity
	Gross Beta	-1.09E+01±2.40E+00	2.62E+00	Less than the Minimum Detectable Activity
VSP-40	Gross Alpha	4.34E+00±2.06E+00	1.95E+00	Less than the Minimum Detectable Activity plus 2σ
	Gross Beta	-1.57E+01±2.87E+00	2.61E+00	Less than the Minimum Detectable Activity
VSP-41	Gross Alpha	9.17E-01±1.10E+00	1.88E+00	Less than the Minimum Detectable Activity
	Gross Beta	-9.70E+00±2.15E+00	2.49E+00	Less than the Minimum Detectable Activity

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Attachment B

Results of the Zahn's Corner Air Samples Using Alpha Spectroscopy

Sample Location	Analysis	Result (μCi/mL)	Minimum Detectable Activity (μCi/mL)	Comments
VSP-14 Room 141 Low-Vol Air Sample	Thorium-228	-5.27E-15 ± 3.83E-14	5.89E-14	Less than the Minimum Detectable Activity
	Thorium-230	-2.44E-14 ± 4.64E-14	4.15E-14	Less than the Minimum Detectable Activity
	Thorium-232	-3.00E-15 ± 2.90E-14	3.80E-14	Less than the Minimum Detectable Activity
	Uranium-234	-1.25E-14 ± 4.61E-14	4.15E-14	Less than the Minimum Detectable Activity
	Uranium-235	6.84E-15 ± 3.57E-14	3.23E-14	Less than the Minimum Detectable Activity
	Uranium-238	-2.09E-14 ± 4.24E-14	2.60E-14	Less than the Minimum Detectable Activity
	Neptunium-237	-1.98E-14 ± 1.82E-14	4.20E-14	Less than the Minimum Detectable Activity
	Plutonium-238	-9.13E-15 ± 1.84E-14	3.98E-14	Less than the Minimum Detectable Activity
	Plutonium-239/240	-9.21E-14 ± 1.84E-14	3.98E-14	Less than the Minimum Detectable Activity
	Americium-241	-2.21E-14 ± 2.25E-14	3.58 E-14	Less than the Minimum Detectable Activity
VSP-14 Room 141 (Duplicate) Low-Vol Air Sample	Americium-241	-2.41E-14 ± 1.98E-14	3.15E-14	Less than the Minimum Detectable Activity
VSP-33 Foyer Low-Vol Air Sample	Thorium-228	4.06E-14 ± 8.08E-14	1.10E-13	Less than the Minimum Detectable Activity
	Thorium-230	-1.23E-13 ± 5.66E-14	1.32E-13	Less than the Minimum Detectable Activity
	Thorium-232	-8.22E-14 ± 4.86E-14	1.45E-13	Less than the Minimum Detectable Activity
	Uranium-234	5.04E-14 ± 6.82E-14	2.90E-14	Within uncertainty level of MDA
	Uranium-235	1.28E-14 ± 4.76E-14	4.36E-14	Less than the Minimum Detectable Activity
	Uranium-238	-2.17E-14 ± 5.51E-14	3.42E-14	Less than the Minimum Detectable Activity
	Neptunium-237	1.09E-14 ± 3.05E-14	5.80E-14	Less than the Minimum Detectable Activity
	Plutonium-238	-3.69E-15 ± 3.92E-14	4.16E-14	Less than the Minimum Detectable Activity
	Plutonium-239/240	-2.64E-14 ± 5.75E-14	4.28E-14	Less than the Minimum Detectable Activity
	Americium-241	-6.13E-15 ± 3.67E-14	4.54E-14	Less than the Minimum Detectable Activity
VSP-33 Foyer (Duplicate) Low-Vol Air Sample	Neptunium-237	-1.72E-14 ± 2.69E-14	3.52E-14	Less than the Minimum Detectable Activity
	Plutonium-238	1.34E-14 ± 2.88E-14	8.76E-14	Less than the Minimum Detectable Activity
	Plutonium-239/240	-8.36E-14 ± 2.80E-14	5.04E-14	Less than the Minimum Detectable Activity

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Attachment B (Continued)

Results of the Zahn's Corner Air Samples Using Alpha Spectroscopy

Sample Location	Analysis	Result (μCi/mL)	Minimum Detectable Activity (μCi/mL)	Comments
VSP-34 Gym Low-Vol Air Sample	Thorium-228	-1.26E-14 ± 2.64E-14	8.42E-14	Less than the Minimum Detectable Activity
	Thorium-230	9.77E-15 ± 5.42E-14	4.48E-14	Less than the Minimum Detectable Activity
	Thorium-232	-1.26E-14 ± 2.64E-14	6.69E-14	Less than the Minimum Detectable Activity
	Uranium-234	-6.59E-14 ± 4.49E-14	5.26E-14	Less than the Minimum Detectable Activity
	Uranium-235	-2.73E-14 ± 3.17E-14	4.48E-14	Less than the Minimum Detectable Activity
	Uranium-238	8.54E-15 ± 6.66E-14	5.62E-14	Less than the Minimum Detectable Activity
	Neptunium-237	-1.92E-14 ± 1.16E-14	3.11E-14	Less than the Minimum Detectable Activity
	Plutonium-238	1.17E-14 ± 3.23E-14	5.60E-14	Less than the Minimum Detectable Activity
	Plutonium-239/240	-4.45E-14 ± 4.24E-14	5.89E-14	Less than the Minimum Detectable Activity
	Americium-241	-2.08E-14 ± 1.71E-14	2.24E-14	Less than the Minimum Detectable Activity
VSP-34 Gym (Duplicate) Low-Vol Air Sample	Thorium-228	2.15E-14 ± 6.01E-14	3.88E-14	Less than the Minimum Detectable Activity
	Thorium-230	2.15E-14 ± 6.01E-14	4.05E-14	Less than the Minimum Detectable Activity
	Thorium-232	1.03E-14 ± 4.40E-14	4.34E-14	Less than the Minimum Detectable Activity
VSP-35 Library Low-Vol Air Sample	Thorium-228	1.08E-13 ± 8.83E-14	8.51E-14	Within uncertainty level of MDA
	Thorium-230	5.20E-14 ± 8.43E-14	5.86E-14	Less than the Minimum Detectable Activity
	Thorium-232	1.19E-13 ± 8.42E-14	6.55E-14	Within uncertainty level of MDA
	Uranium-234	8.49E-14 ± 6.67E-14	4.18E-14	Within uncertainty level of MDA
	Uranium-235	8.49E-14 ± 6.67E-14	3.52E-14	Within uncertainty level of MDA
	Uranium-238	9.20E-14 ± 6.80E-14	4.36E-14	Within uncertainty level of MDA
	Neptunium-237	-1.94E-15 ± 2.38E-14	3.69E-14	Less than the Minimum Detectable Activity
	Plutonium-238	-1.94E-15 ± 2.38E-14	4.05E-14	Less than the Minimum Detectable Activity
	Plutonium-239/240	-7.05E-14 ± 2.27E-14	3.26E-14	Less than the Minimum Detectable Activity
	Americium-241	-3.24E-14 ± 2.09E-14	4.50E-14	Less than the Minimum Detectable Activity
VSP-35 Library (Duplicate) Low-Vol Air Sample	Uranium-234	7.17E-14 ± 6.45E-14	2.99E-14	Within uncertainty level of MDA
	Uranium-235	1.08E-14 ± 4.00E-14	3.11E-14	Less than the Minimum Detectable Activity
	Uranium-238	-3.03E-15 ± 5.23E-14	2.51E-14	Less than the Minimum Detectable Activity

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Attachment B (Continued)

Results of the Zahn's Corner Air Samples Using Alpha Spectroscopy

Sample Location	Analysis	Result (μCi/mL)	Minimum Detectable Activity (μCi/mL)	Comments
Main Entrance Hi-Vol Air Sample	Thorium-228	-3.12E-14 ± 2.53E-14	2.92E-14	Less than the Minimum Detectable Activity
	Thorium-230	-5.73E-14 ± 2.17E-14	2.49E-14	Less than the Minimum Detectable Activity
	Thorium-232	-3.35E-14 ± 2.16E-14	2.31E-14	Less than the Minimum Detectable Activity
	Uranium-234	-7.55E-14 ± 1.80E-14	1.51E-14	Less than the Minimum Detectable Activity
	Uranium-235	-1.69E-14 ± 8.30E-15	1.65E-14	Less than the Minimum Detectable Activity
	Uranium-238	-6.08E-14 ± 1.47E-14	1.02E-14	Less than the Minimum Detectable Activity
	Neptunium-237	-1.28E-17 ± 5.21E-15	1.10E-14	Less than the Minimum Detectable Activity
	Plutonium-238	1.29E-15 ± 6.91E-15	1.34E-14	Less than the Minimum Detectable Activity
	Plutonium-239/240	2.33E-15 ± 8.35E-15	1.22E-14	Less than the Minimum Detectable Activity
	Americium-241	6.96E-15 ± 6.74E-15	8.34E-15	Less than the Minimum Detectable Activity
Playground Hi-Vol Air Sample	Thorium-228	-1.51E-14 ± 3.44E-15	5.02E-15	Less than the Minimum Detectable Activity
	Thorium-230	-1.27E-14 ± 5.09E-15	3.46E-15	Less than the Minimum Detectable Activity
	Thorium-232	-1.31E-14 ± 3.40E-15	3.87E-15	Less than the Minimum Detectable Activity
	Uranium-234	-1.31E-14 ± 5.48E-15	2.06E-15	Less than the Minimum Detectable Activity
	Uranium-235	3.72E-15 ± 4.27E-15	1.76E-15	Within uncertainty level of MDA
	Uranium-238	-1.41E-14 ± 4.06E-15	1.88E-15	Less than the Minimum Detectable Activity
	Neptunium-237	1.90E-16 ± 1.43E-15	2.78E-15	Less than the Minimum Detectable Activity
	Plutonium-238	-1.73E-16 ± 1.51E-15	3.03E-15	Less than the Minimum Detectable Activity
	Plutonium-239/240	-3.27E-16 ± 1.57E-15	3.63E-15	Less than the Minimum Detectable Activity
	Americium-241	1.30E-15 ± 1.39E-15	2.43E-15	Less than the Minimum Detectable Activity
Playground (Duplicate) Hi-Vol Air Sample	Thorium-228	-1.52E-14 ± 3.41E-15	5.23E-15	Less than the Minimum Detectable Activity
	Thorium-230	-1.25E-14 ± 5.28E-15	5.16E-15	Less than the Minimum Detectable Activity
	Thorium-232	-1.13E-14 ± 4.05E-15	4.55E-15	Less than the Minimum Detectable Activity
	Uranium-234	-2.23E-14 ± 3.14E-15	3.38E-15	Less than the Minimum Detectable Activity
	Uranium-235	-1.26E-15 ± 2.35E-15	3.18E-15	Less than the Minimum Detectable Activity
	Uranium-238	-1.58E-14 ± 3.07E-15	3.19E-15	Less than the Minimum Detectable Activity
	Neptunium-237	-6.01E-16 ± 1.01E-15	2.86E-15	Less than the Minimum Detectable Activity
	Plutonium-238	1.17E-15 ± 1.95E-15	3.29E-15	Less than the Minimum Detectable Activity
	Plutonium-239/240	-1.61E-15 ± 1.39E-15	2.60E-15	Less than the Minimum Detectable Activity
	Americium-241	5.68E-16 ± 1.25E-15	1.98E-15	Less than the Minimum Detectable Activity

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Results of the Zahn's Corner Air Samples Using Alpha Spectroscopy

Sample Location	Analysis	Result (μCi/mL)	Minimum Detectable Activity (μCi/mL)	Comments
VSP-11 Center of Building Hi-Vol Air Sample	Thorium-228	-1.92E-14 ± 1.96E-14	2.01E-14	Less than the Minimum Detectable Activity
	Thorium-230	-1.57E-14 ± 2.42E-14	2.21E-14	Less than the Minimum Detectable Activity
	Thorium-232	-1.11E-14 ± 2.02E-14	1.69E-14	Less than the Minimum Detectable Activity
	Uranium-234	-1.56E-14 ± 1.64E-14	6.18E-15	Less than the Minimum Detectable Activity
	Uranium-235	2.06E-15 ± 8.74E-15	6.81E-15	Less than the Minimum Detectable Activity
	Uranium-238	-3.34E-14 ± 1.08E-14	5.50E-15	Less than the Minimum Detectable Activity
	Neptunium-237	2.73E-15 ± 4.10E-15	6.22E-15	Less than the Minimum Detectable Activity
	Plutonium-238	5.11E-16 ± 6.96E-15	1.48E-14	Less than the Minimum Detectable Activity
	Plutonium-239/240	-4.97E-15 ± 5.29E-15	1.42E-14	Less than the Minimum Detectable Activity
	Americium-241	-2.96E-15 ± 3.13E-15	9.43E-15	Less than the Minimum Detectable Activity

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Attachment C

Results of the Five Special Samples and Three of the 39 Surface Area Wipes Analyzed Using Inductively Coupled Plasma Mass Spectrometry

Sample Location	Radionuclide	Result (μCi)	2σ	Detection Limit (L _c)	Comment
SCF-00011 AH4 Ductwork (Special)	Uranium-233	-8.7E-10	1.2E-09	9.3E-10	Negative Results
	Uranium-234	1.5E-08	4.5E-10	6.2E-10	8.33E-04 mrem/year
	Uranium-235	5.8E-10	2.4E-12	2.8E-13	3.22E-05 mrem/year
	Uranium-236	1.7E-12	5.9E-12	9.1E-12	Negative Results
	Uranium-238	1.2E-08	3.7E-11	5.0E-12	6.66E-04 mrem/year
	Protactinium-231	9.3E-09	9.4E-09	3.9E-09	Negative Results
	Plutonium-239	-1.3E-08	4.8E-08	2.0E-08	Negative Results
	Plutonium-240	2.3E-08	1.0E-07	5.9E-08	Negative Results
	Plutonium / Americium-241	Not Applicable	Not Applicable		Not Applicable
	Americium-243	-2.1E-09	1.3E-07	1.5E-08	Negative Results
	Neptunium-237	-9.3E-11	2.0E-11	6.3E-11	Negative Results
SCF-00012 Top of Block Wall AH4 Room (Special)	Uranium-233	-4.3E-10	7.0E-10	9.3E-10	Negative Results
	Uranium-234	-9.7E-10	5.8E-11	6.2E-10	Negative Results
	Uranium-235	-4.9E-11	3.2E-13	2.8E-13	Negative Results
	Uranium-236	1.2E-13	5.5E-13	9.1E-12	Negative Results
	Uranium-238	-1.7E-09	3.1E-12	5.0E-12	Negative Results
	Protactinium-231	-1.1E-08	2.1E-08	3.9E-09	Negative Results
	Plutonium-239	4.1E-08	5.9E-08	2.0E-08	Negative Results
	Plutonium-240	1.2E-08	2.9E-08	5.9E-08	Negative Results
	Plutonium / Americium-241	Not Applicable	Not Applicable		Not Applicable
	Americium-243	-1.9E-08	2.4E-07	1.5E-08	Negative Results
	Neptunium-237	-6.5E-11	1.1E-11	6.3E-11	Negative Results

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Attachment C (Continued)

Results of the Five Special Samples and Three of the 39 Surface Area Wipes
Analyzed Using Inductively Coupled Plasma Mass Spectrometry

Sample Location	Radionuclide	Result (μCi)	2σ	Detection Limit (L _c)	Comment
SCF-00013 AH4 Beam (Special)	Uranium-233	-7.7E-10	1.2E-09	9.3E-10	Negative Results
	Uranium-234	-6.5E-10	3.4E-11	6.2E-10	Negative Results
	Uranium-235	-1.5E-11	8.6E-14	2.8E-13	Negative Results
	Uranium-236	2.8E-12	4.9E-12	9.1E-12	Negative Results
	Uranium-238	-6.2E-10	1.9E-12	5.0E-12	Negative Results
	Protactinium-231	4.3E-09	2.3E-09	3.9E-09	2.39E-04 mrem/year
	Plutonium-239	-2.7E-08	2.5E-07	2.0E-08	Negative Results
	Plutonium-240	3.0E-08	1.3E-07	5.9E-08	Negative Results
	Plutonium / Americium-241	Not Applicable	Not Applicable		Not Applicable
	Americium-243	8.5E-09	1.6E-07	1.5E-08	Negative Results
SCF-00014 AH4 Truss A (Special)	Neptunium-237	-8.2E-12	9.6E-13	6.3E-11	Negative Results
	Uranium-233	-1.3E-09	1.3E-09	9.3E-10	Negative Results
	Uranium-234	4.8E-09	3.0E-10	6.2E-10	2.66E-04 mrem/year
	Uranium-235	2.2E-10	1.3E-12	2.8E-13	1.22E-05 mrem/year
	Uranium-236	3.2E-12	5.9E-12	9.1E-12	Negative Results
	Uranium-238	3.8E-09	1.6E-11	5.0E-12	2.11E-04 mrem/year
	Protactinium-231	6.0E-09	3.0E-09	3.9E-09	3.33E-04 mrem/year
	Plutonium-239	-1.8E-08	1.1E-07	2.0E-08	Negative Results
	Plutonium-240	-2.1E-08	5.4E-08	5.9E-08	Negative Results
	Plutonium / Americium-241	Not Applicable	Not Applicable		Not Applicable
	Americium-243	-1.1E-08	7.2E-08	1.5E-08	Negative Results
	Neptunium-237	8.8E-12	3.3E-12	6.3E-11	4.88E-07 mrem/year

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Results of the Five Special Samples and Three of the 39 Surface Area Wipes
Analyzed Using Inductively Coupled Plasma Mass Spectrometry

Sample Location	Radionuclide	Result (μCi)	2σ	Detection Limit (L _c)	Comment
SCF-00513 Room 123 Ceiling (Special)	Uranium-233	-9.6E-10	2.2E-09	9.3E-10	Negative Results
	Uranium-234	8.2E-09	1.8E-10	6.2E-10	4.55E-04 mrem/year
	Uranium-235	4.2E-10	2.4E-12	2.8E-13	2.33E-05 mrem/year
	Uranium-236	5.2E-12	7.1E-12	9.1E-12	Negative Results
	Uranium-238	7.6E-09	1.9E-11	5.0E-12	4.22E-04 mrem/year
	Protactinium-231	1.9E-08	1.4E-08	3.9E-09	1.05E-03 mrem/year
	Plutonium-239	2.1E-08	4.4E-08	2.0E-08	Negative Results
	Plutonium-240	3.5E-08	7.2E-08	5.9E-08	Negative Results
	Plutonium / Americium-241	Not Applicable	Not Applicable		Not Applicable
	Americium-243	2.6E-08	1.1E-07	1.5E-08	Negative Results
	Neptunium-237	9.3E-11	2.2E-11	6.3E-11	5.16E-06 mrem/year
SCF-00515 (VSP-40) Library	Uranium-233	5.4E-10	6.6E-10	9.3E-10	Negative Results
	Uranium-234	3.4E-08	2.2E-09	6.2E-10	1.89E-03 mrem/year
	Uranium-235	1.6E-09	5.4E-12	2.8E-13	8.88E-05 mrem/year
	Uranium-236	8.4E-12	1.3E-11	9.1E-12	Negative Results
	Uranium-238	3.4E-08	8.7E-11	5.0E-12	1.89E-03 mrem/year
	Protactinium-231	3.5E-08	2.4E-08	3.9E-09	1.94E-03 mrem/year
	Plutonium-239	8.6E-08	7.9E-08	2.0E-08	4.77E-03 mrem/year
	Plutonium-240	-6.2E-08	2.9E-07	5.9E-08	Negative Results
	Plutonium / Americium-241	Not Applicable	Not Applicable		Not Applicable
	Americium-243	2.0E-08	2.0E-07	1.5E-08	Negative Results
	Neptunium-237	-3.7E-11	5.9E-12	6.3E-11	Negative Results

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Results of the Five Special Samples and Three of the 39 Surface Area Wipes
Analyzed Using Inductively Coupled Plasma Mass Spectrometry

Sample Location	Radionuclide	Result (μCi)	2σ	Detection Limit (L _c)	Comment
SCF-00522 (VSP-19) Room 132	Uranium-233	8.5E-10	9.0E-10	9.3E-10	Negative Results
	Uranium-234	1.8E-08	2.4E-10	6.2E-10	9.99E-04 mrem/year
	Uranium-235	7.8E-10	4.3E-12	2.8E-13	4.33E-05 mrem/year
	Uranium-236	5.8E-12	8.4E-12	9.1E-12	Negative Results
	Uranium-238	1.4E-08	5.0E-11	5.0E-12	7.77E-04 mrem/year
	Protactinium-231	3.4E-09	9.5E-09	3.9E-09	Negative Results
	Plutonium-239	-6.2E-09	4.5E-07	2.0E-08	Negative Results
	Plutonium-240	-1.4E-08	2.0E-07	5.9E-08	Negative Results
	Plutonium / Americium-241	Not Applicable	Not Applicable		Not Applicable
	Americium-243	-1.8E-08	1.1E-07	1.5E-08	Negative Results
	Neptunium-237	-8.2E-11	1.7E-11	6.3E-11	Negative Results
SCF-00525 (VSP-30) Outside Room 130	Uranium-233	3.8E-10	6.0E-10	9.3E-10	Negative Results
	Uranium-234	1.5E-08	7.5E-10	6.2E-10	8.33E-04 mrem/year
	Uranium-235	6.6E-10	2.6E-12	2.8E-13	3.66E-05 mrem/year
	Uranium-236	8.4E-12	8.4E-12	9.1E-12	Negative Results
	Uranium-238	1.2E-08	1.6E-11	5.0E-12	6.66E-04 mrem/year
	Protactinium-231	2.2E-08	3.5E-08	3.9E-09	Negative Results
	Plutonium-239	2.2E-08	9.3E-08	2.0E-08	Negative Results
	Plutonium-240	-2.7E-08	9.0E-07	5.9E-08	Negative Results
	Plutonium / Americium-241	Not Applicable	Not Applicable		Not Applicable
	Americium-243	2.4E-08	9.0E-08	1.5E-08	Negative Results
	Neptunium-237	-2.9E-12	5.5E-13	6.3E-11	Negative Results