
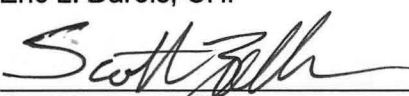





Fort Calhoun Station Potential Radionuclides of Concern

FC-020-007
Revision 0

**Fort Calhoun Station Potential Radionuclides of
Concern**

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1.0 ISSUE STATEMENT

An initial listing of radionuclides is needed to support the decommissioning of Fort Calhoun Station. This listing will be specifically used to identify radionuclides applicable for calculating the derived concentration guideline levels (DCGLs) which are required for the license termination plan (LTP) to ultimately terminate the NRC operating license as delineated in 10 CFR 50.82 [1]. Once the DCGLs are calculated for each of the radionuclides in the initial suite, some may be deselected as Radionuclides of Concern (ROCs) based on a future dose-significance analysis for the implementation of the final status surveys which will also be required by the LTP.

2.0 BACKGROUND STATEMENT

In March 2018, the Fort Calhoun RP technical staff prepared Technical Basis Document (TBD) FC-18-002, "Potential Radionuclides of Concern During the Decommissioning of Fort Calhoun Station" [2]. This TBD evaluated expected radionuclides based on a review of industry guidance and from 14 samples collected within various waste/process streams from 2016 through 2018 analyzed by an offsite laboratory for nuclides typically required by 10CFR61, and decay-corrected to 2/15/2028. The list of radionuclides from FC-18-002 is reproduced in Table 1.

Table 1: List of Radionuclides from FC-18-002

Radionuclide	Half-Life, years
H-3	12.3
Fe-55	2.73
Co-60	5.27
Ni-63	100.1
Sr-90	28.74
Cs-134	2.07
Cs-137	30.04
Pu-238	87.7
Pu-239/240	24110
Pu-241	14.35
Am-241	432.2
Cm-243/244	29.1

The analysis in FC-18-002 appears to have eliminated some of the radionuclides initially considered in the TBD based on fractional abundance and/or short half-lives. Also, the radionuclide fractional abundance listed in Attachment 1 of FC-18-002 appear to be intrinsically weighted by each sample activity whereas other prior LTPs have included fractional abundances using weighted and non-weighted approaches. From the data contained in this attachment, sample No. L71393 for the primary resin appears to dominate the activity from all other samples, therefore, using this data as presented

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would unnecessarily numerically weight the radionuclide mixture by this single sample analysis.

From November 2019 through March 2020, the staff at Fort Calhoun station implemented a comprehensive concrete sampling and characterization plan where 744 discrete concrete samples at multiple depths up to 6 inches were collected throughout plant areas including the containment and the auxiliary buildings. Each of these samples were analyzed using the onsite gamma spectroscopy system and 37 of these were sent for offsite laboratory analysis for a wide range of radionuclide detections including actinides, and other hard-to detect fission and activation radionuclides. The results of these 37 analyses are used in this TBD to evaluate whether additional radionuclides should be added or removed from the list provided in FC-018-002. With this list, DCGLs will be calculated for the applicable media and end-state of the site to be included in the site's LTP.

3.0 METHODOLOGY

Provide the results of the offsite laboratory analysis for all radionuclides and for each of the 37 samples. This should determine those radionuclides that are considered non-detected and further determine the radionuclide fractional abundances for each of the 37 samples.

Analyze the radionuclide fractional results to identify those present in the sampled plant environments and compare this list to the initial listing from FC-018-002 and select the initial list for DCGL development.

4.0 ASSUMPTIONS

The analysis of samples from the offsite laboratory meets the applicable quality standards as delineated by the laboratory.

The presence of radionuclides other than for the requested suite is insignificant or is otherwise added in this analysis.

5.0 CONCLUSIONS

This analysis identifies 23 radionuclides that should be included in this listing of radionuclides as compared to the 12 that were initially identified in [2], as listed below, where the additional radionuclides are shaded. Additionally, it should be noted that the Europium isotopes are isolated to areas exposed to neutrons. For these, the data shows the presence of these isotopes is primarily in the area below the reactor vessel which is currently scheduled for removal and may not be an end-state structure. We also added Np-237 but we anticipate that this radionuclide may likely be removed in a future revision to this TSD following additional sampling and analysis since this was not included in the analysis suite from the recent characterization campaign.

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H-3	Zn-65	Eu-155
C-14	Tc-99	Pu-238
Mn-54	Sr-90	Pu-239/ 240
Fe-55	Sb-125	Pu-241
Co-58	Cs-134	Am-241
Ni-59	Cs-137	Cm-243/ 244
Ni-63	Ce-144	Np-237
Co-60	Eu-152	
	Eu-154	

6.0 CALCULATIONS

6.1 Sample Locations and Designations

Four separate sample plans were developed and implemented using the Tru-Pro concrete sampling techniques in references [3], [4], [5], and [6] representing 744 discrete samples ranging from the surface (to 0.5 inch) to a depth of 6 inches in the following buildings:

- containment building,
- auxiliary building,
- turbine building, and
- radwaste processing building.

From this sample population, 37 samples were sent to GEL for analysis of the following gamma emitting, beta emitting, and alpha emitting radionuclides typically considered during nuclear power plant decommissioning projects.

H-3	Zn-65	Eu-152
C-14	Nb-94	Eu-154
Mn-54	Tc-99	Eu-155
Fe-55	Sr-90	Pu-238
Co-57	Ag-110m	Pu-239/ 240
Co-58	Sb-125	Pu-241
Ni-59	Cs-134	Am-241
Ni-63	Cs-137	Cm-242
Co-60	Ce-144	Cm-243/ 244

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Table 2 provides the sample identification numbers and general locations for all 37 samples. The analysis was performed by GEL Laboratories LLC in Charleston SC in 3 batches of reports in references [7], [8] and [9]. The original reports were prepared and sent from January through March 2020 and then revised in June 2020 to add the "critical level (Lc)" to these reports for the analysis supported in this Technical Basis Document.

6.2 Sample Results

Table 3 shows the average minimum detectable activity (MDA) from all 37 samples analyzed by GEL for each radionuclide. This listing demonstrates that an effective average MDA was achieved by GEL for the analysis.

Attachment 8.1 provides the analysis results for all samples. These results include all results as reported by GEL whether negative or less than any screening value including the minimum detectable activity (MDA).

To determine radionuclide fractions for each sample, the concentration data from Attachment 8.1 was first compared to the result to the reported critical level (for 95% probability of detection). For those samples with results less than this criteria, a blank was substituted for the sample result as shown in Attachment 8.2. This data clearly shows that a large fraction of the samples did not detect some radionuclides above Lc. In fact, 2 radionuclides were only detected in 1 sample above Lc among all samples: Ag-110m and Cm-242 and will not be included for further consideration in this analysis. Four additional radionuclides were detected at levels below twice the Lc values but these will be included at this point in the analysis.

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Table 2: Listing of Sample ID Numbers, Types and Locations

Sample ID Number	Type of Sample	Area Name
1100X-1-CJ-FCV1-005	Concrete, Floor	CB 977' Elevation – Under Vessel Area
1100X-1-CJ-WCV1-004	Concrete, Wall	CB 977' Elevation – Under Vessel Area
1200X-1-CJ-FCV1-001	Concrete, Floor	CB 995'/996' Elevation G/A
1200X-1-CJ-FCV1-002	Concrete, Floor	CB 995'/996' Elevation G/A
1200X-1-CJ-FCV1-003	Concrete, Floor	CB 995'/996' Elevation G/A
1200X-1-CJ-FCV1-010	Concrete, Floor	CB 995'/996' Elevation G/A
1200X-1-CJ-FCV1-018	Concrete, Floor	CB 995'/996' Elevation G/A
1200X-1-CJ-FCV1-023	Concrete, Floor	CB 995'/996' Elevation G/A
1200X-1-CJ-FCV1-025	Concrete, Floor	CB 995'/996' Elevation G/A
1200X-1-CJ-FCV1-027	Concrete, Floor	CB 995'/996' Elevation G/A
1200X-1-CJ-WCV1-005	Concrete, Wall	CB 995'/996' Elevation G/A
1200X-1-CJ-WCV1-009	Concrete, Wall	CB 995'/996' Elevation G/A
1300X-1-CJ-FCV1-003	Concrete, Floor	CB 1013' Elevation G/A
1300X-1-CJ-FCV1-006	Concrete, Floor	CB 1013' Elevation G/A
1300X-1-CJ-FCV1-008	Concrete, Floor	CB 1013' Elevation G/A
1400X-1-CJ-FCV1-002	Concrete, Floor	CB 1045' Elevation G/A
1400X-1-CJ-FCV1-021	Concrete, Floor	CB 1045' Elevation G/A
2100X-1-CJ-FCV1-006	Concrete, Floor	AB 971' Elevation G/A
2100X-1-CJ-FCV1-011	Concrete, Floor	AB 971' Elevation G/A
2100X-1-CJ-FCV1-014	Concrete, Floor	AB 971' Elevation G/A
2200X-1-CJ-FCV1-008	Concrete, Floor	AB 989' Elevation G/A
2200X-1-CJ-FCV1-010	Concrete, Floor	AB 989' Elevation G/A
2200X-1-CJ-FCV1-020	Concrete, Floor	AB 989' Elevation G/A
2200X-1-CJ-FCV1-022	Concrete, Floor	AB 989' Elevation G/A
2200X-1-CJ-FCV1-026	Concrete, Floor	AB 989' Elevation G/A
2200X-1-CJ-FCV1-031	Concrete, Floor	AB 989' Elevation G/A
2200X-1-CJ-FCV1-035	Concrete, Floor	AB 989' Elevation G/A
2200X-1-CJ-WCV1-009	Concrete, Wall	AB 989' Elevation G/A
2300X-1-CJ-FCV1-001	Concrete, Floor	AB 1007' Elevation G/A
2300X-1-CJ-FCV1-002	Concrete, Floor	AB 1007' Elevation G/A
2300X-1-CJ-FCV1-005	Concrete, Floor	AB 1007' Elevation G/A
2300X-1-CJ-FCV1-007	Concrete, Floor	AB 1007' Elevation G/A
2600X-1-CJ-FCV1-002	Concrete, Floor	AB 1025' Elevation G/A
3100X-3-CJ-FCV1-006	Concrete, Floor	TB 990' Elevation G/A
3100X-3-CJ-FCV1-014	Concrete, Floor	TB 990' Elevation G/A
4100X-1-CJ-FCV1-004	Concrete, Floor	Radwaste Processing Building
4100X-1-CJ-FCV1-005	Concrete, Floor	Radwaste Processing Building

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Table 3: Average MDA's from 37 GEL Analysis Results and for Each Radionuclide

Radionuclide	Average MDA, pCi/g
H-3	1.30E+01
C-14	5.51E+00
Mn-54	9.17E-01
Fe-55	1.34E+01
Co-57	1.82E+00
Co-58	1.42E+00
Ni-59	3.83E+00
Ni-63	4.66E+00
Co-60	6.59E-01
Zn-65	2.36E+00
Nb-94	8.02E-01
Tc-99	2.60E+00
Sr-90	1.50E-01
Ag-110m	1.36E+00
Sb-125	7.88E+00
Cs-134	9.77E-01
Cs-137	1.94E+00
Ce-144	8.84E+00
Eu-152	6.36E+00
Eu-154	2.50E+00
Eu-155	4.22E+00
Pu-238	9.23E-02
Pu-239/ 240	1.01E-01
Pu-241	6.95E+00
Am-241	1.12E-01
Cm-242	8.21E-02
Cm-243/ 244	9.73E-02

Attachment 8.4 converts the concentration values from 8.2 into radionuclide fractions for each sample where the blank data (concentrations less than Lc) is not included in the fraction calculations. This information is summarized in Table 4. This summary provides the average, maximum, and 95th percentile of the activity fractions among all sample for each radionuclide not excluded, as discussed above. The second to last column in this Table 4 is the re-normalized 95th percentile values to represent an appropriate fractional value. For this analysis, radionuclides are deselected from the initial list if the renormalized fractional value is less than 0.0001 (0.01%), except for the actinide radionuclides and consistent with [2]. The actinides are excluded from the 0.01% criteria since the relative abundance for these radionuclides is typically lower and we therefore included all actinides that are positively detected above the Lc. The last column in this table identifies whether the radionuclide is included in the final selection process.

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Table 4: Summary of Radionuclide Fractions for all Sample Results >Lc

Radionuclide	Average	Max	95th Percentile	Renormalized 95th	Include ? (>.01%)
H-3	1.20E-01	5.86E-01	3.11E-01	9.44E-02	Y
C-14	2.54E-01	8.50E-01	7.85E-01	2.39E-01	Y
Mn-54	2.79E-03	2.15E-02	1.40E-02	4.26E-03	Y
Fe-55	7.08E-02	3.92E-01	2.88E-01	8.74E-02	Y
Co-57	2.02E-04	3.16E-04	3.07E-04	9.33E-05	N
Co-58	2.94E-04	8.74E-04	7.68E-04	2.33E-04	Y
Ni-59	9.27E-04	2.68E-03	2.52E-03	7.66E-04	Y
Ni-63	1.05E-01	4.34E-01	3.39E-01	1.03E-01	Y
Co-60	1.40E-02	9.46E-02	5.97E-02	1.82E-02	Y
Zn-65	3.37E-04	6.13E-04	5.85E-04	1.78E-04	Y
Nb-94	6.61E-05	1.12E-04	1.07E-04	3.26E-05	N
Tc-99	3.97E-02	1.20E-01	1.08E-01	3.27E-02	Y
Sr-90	6.64E-03	1.50E-01	1.96E-02	5.97E-03	Y
Sb-125	6.71E-04	8.85E-04	8.66E-04	2.63E-04	Y
Cs-134	1.09E-03	6.30E-03	4.84E-03	1.47E-03	Y
Cs-137	5.01E-01	9.89E-01	9.51E-01	2.89E-01	Y
Ce-144	0.00E+00	0.00E+00	1.12E-01	3.41E-02	Y
Eu-152	6.96E-02	2.72E-01	2.52E-01	7.65E-02	Y
Eu-154	1.78E-02	2.98E-02	2.92E-02	8.86E-03	Y
Eu-155	2.09E-03	5.07E-03	4.65E-03	1.41E-03	Y
Pu-238	6.35E-04	5.71E-03	5.27E-03	1.60E-03	Y
Pu-239/ 240	3.72E-05	1.08E-04	9.05E-05	2.75E-05	Y
Pu-241	1.48E-03	4.81E-03	3.86E-03	1.17E-03	Y
Am-241	2.09E-04	2.92E-03	5.27E-04	1.60E-04	Y
Cm-243/ 244	1.54E-05	3.69E-05	3.50E-05	1.06E-05	Y

The selected radionuclides for future considerations are provided below. Those radionuclides that are shaded represent additions to the list developed in reference [2]. Note that Np-237 has been added in this listing and was not included in the initial list for this characterization campaign, however, we recommend that additional characterization be performed to establish the presence or absence of Np-237.

Additionally, the final selection of radionuclides of concern (ROCs) for the purpose of final status surveys will be performed based on the dose significance of these radionuclides and will be a future analysis to support the LTP to include an evaluation of radionuclide surrogate relationships.

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H-3

C-14

Mn-54

Fe-55

Co-58

Ni-59

Ni-63

Co-60

Zn-65

Tc-99

Sr-90

Sb-125

Cs-134

Cs-137

Ce-144

Eu-152

Eu-154

Eu-155

Pu-238

Pu-239/ 240

Pu-241

Am-241

Cm-243/ 244

Np-237

7.0 REFERENCES

- [1] USNRC, Title 10 Code of Federal Regulation Part 50 ("Domestic Licensing of Production and Utilization Facilities") Subpart 82 ("Termination of License"), US Nuclear Regulatory Commission.
- [2] FC-018-002, "Potential Radionuclides of Concern During the Decommissioning of Fort Calhoun Station", Fort Calhoun Station Technical Basis Document, 2018.
- [3] Fort Calhoun Characterization Sample Plan, Survey Area 1000, 2019.
- [4] Fort Calhoun Characterization Sample Plan, Survey Area 2000, 2019.
- [5] Fort Calhoun Characterization Sample Plan, Survey Area 3000, 2019.
- [6] Fort Calhoun Characterization Sample Plan, Survey Area 4000, 2019.
- [7] ENRG078, WO No. 499910, Charleston, NC: GEL Laboratories LLC, 2020.
- [8] ENRG078, WO No. 499244, Charleston, NC: GEL Laboratories LLC, 2020.
- [9] ENRG078, WO No. 505229, Charleston, NC: GEL Laboratories LLC, 2020.

8.0 ATTACHMENTS

- 8.1 GEL Reported Sample Results
- 8.2 GEL Sample Results Screened Against the Critical Level
- 8.3 Fractional Abundances for All Radionuclides and Samples.



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Attachment 8.1: GEL Analytical Sample Results

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Table 5: GEL Analysis Results from All Samples 1st Set of Radionuclides¹

Sample No	H-3	C-14	Mn-54	Fe-55	Co-57	Co-58	Ni-59	Ni-63	Co-60
1100X-1-CJ-FCV1-005	1.79E+03	1.56E+03	9.36E-01	3.77E+03	0.00E+00	0.00E+00	1.12E+01	1.05E+03	1.09E+03
1100X-1-CJ-WCV1-004	2.99E+03	1.06E+03	4.86E+00	3.99E+03	0.00E+00	2.06E+01	3.10E+01	2.36E+03	2.23E+03
1200X-1-CJ-FCV1-001	7.89E+02	1.53E+03	0.00E+00	-2.92E+00	2.07E-02	3.55E-01	7.12E-02	1.30E+02	4.78E+01
1200X-1-CJ-FCV1-002	7.68E+02	2.67E+03	6.89E-01	5.49E+00	1.42E-01	-4.80E-01	0.00E+00	5.43E+02	8.67E+01
1200X-1-CJ-FCV1-003	7.38E+02	1.99E+03	5.61E-01	-1.52E+00	5.06E-02	1.93E-02	2.23E+00	2.03E+02	4.18E+01
1200X-1-CJ-FCV1-010	9.29E+02	1.45E+02	0.00E+00	-2.02E+00	0.00E+00	-2.73E-01	0.00E+00	1.41E+02	1.26E+01
1200X-1-CJ-FCV1-018	8.99E+02	1.59E+03	3.37E-02	6.27E+00	2.50E-02	3.50E-02	-7.59E-01	5.76E+01	1.81E+00
1200X-1-CJ-FCV1-023	2.80E+02	8.09E+01	4.50E-01	-2.19E+00	1.45E+00	2.19E-01	1.09E+01	1.13E+03	7.85E+01
1200X-1-CJ-FCV1-025	6.97E+02	2.70E+03	1.20E-01	-3.79E+00	2.44E-01	-2.54E-02	2.31E-01	1.19E+02	1.21E+01
1200X-1-CJ-FCV1-027	5.38E+02	1.62E+03	3.04E-01	-1.45E+00	4.08E-02	4.15E-01	8.96E-01	1.00E+02	3.18E+01
1200X-1-CJ-WCV1-005	3.36E+02	7.19E+02	2.13E-02	-3.11E+00	0.00E+00	-2.58E-01	4.68E-02	2.17E+01	2.43E+00
1200X-1-CJ-WCV1-009	2.46E+02	2.62E+03	-8.53E-03	-3.64E+00	7.03E-02	2.95E-01	5.12E-01	1.08E+01	9.35E-01
1300X-1-CJ-FCV1-003	4.11E+02	1.41E+03	9.31E-02	-4.12E-01	-1.21E-01	-6.44E-02	-7.01E-02	1.47E+02	1.84E+01
1300X-1-CJ-FCV1-006	1.95E+02	1.72E+02	1.53E-02	5.29E+00	1.22E-01	9.73E-02	-3.40E-01	3.54E+01	2.48E+00
1300X-1-CJ-FCV1-008	8.12E+01	3.03E+02	1.41E-01	2.72E+00	4.60E-01	2.85E-01	1.69E+00	4.21E+01	3.07E+00
1400X-1-CJ-FCV1-002	3.88E+02	8.55E+03	-5.91E-02	-4.61E+00	-6.91E-02	2.06E-02	2.03E+00	4.86E+01	3.47E+00
1400X-1-CJ-FCV1-021	5.08E+02	2.07E+03	4.51E-03	-5.90E+00	1.18E-01	-1.98E-02	1.86E-01	6.37E+00	3.55E+00
2100X-1-CJ-FCV1-006	2.99E+01	2.87E+00	6.03E-02	-5.87E+00	-1.89E-02	1.60E-01	-1.44E-01	3.24E+01	2.73E+00
2100X-1-CJ-FCV1-011	7.05E+00	3.64E+00	1.38E-02	-4.62E+00	-2.17E-02	-8.26E-03	4.02E-01	6.20E+01	4.32E+00
2100X-1-CJ-FCV1-014	1.13E+00	7.85E+00	-3.09E-02	-1.20E+01	2.23E-02	-8.74E-03	-1.96E+00	4.81E+01	9.76E-01
2200X-1-CJ-FCV1-008	9.34E+01	2.38E+01	3.11E-01	-2.17E-01	2.00E-01	2.68E-01	-8.75E-01	9.47E+01	4.74E+01
2200X-1-CJ-FCV1-010	1.85E+01	9.15E+00	9.11E-02	-5.59E+00	-4.24E-02	-3.75E-02	-1.83E-04	1.36E+02	1.00E+01
2200X-1-CJ-FCV1-020	5.84E+01	1.99E+01	2.59E-01	3.76E+00	-2.50E-01	5.69E-01	4.91E+00	1.42E+03	2.34E+01
2200X-1-CJ-FCV1-022	1.61E+01	2.28E+01	-1.93E-02	4.81E-01	2.86E-01	-2.54E-01	6.56E+00	6.42E+02	1.29E+00
2200X-1-CJ-FCV1-026	1.68E+01	1.31E+01	-2.37E-01	6.41E-01	-6.53E-01	2.02E-01	-1.14E-01	1.90E+02	0.00E+00
2200X-1-CJ-FCV1-031	2.40E+02	4.97E+00	4.35E-02	8.58E+00	6.14E-02	7.05E-02	2.37E+00	2.27E+02	7.21E+00

¹ Shaded cells represent negative reported values. All values in pCi/g.

Fort Calhoun Station Potential Radionuclides of Concern

Sample No	H-3	C-14	Mn-54	Fe-55	Co-57	Co-58	Ni-59	Ni-63	Co-60
2200X-1-CJ-FCV1-035	1.27E+01	1.93E+01	8.52E-03	1.23E+01	2.44E-01	1.24E-01	3.21E+00	4.06E+02	1.84E+01
2200X-1-CJ-WCV1-009	6.19E+00	1.88E+01	-4.36E-02	-3.31E+00	-6.25E-04	-6.23E-02	1.08E+00	6.26E+00	4.47E-01
2300X-1-CJ-FCV1-001	2.51E+00	7.99E+01	6.44E-02	1.43E+01	-4.37E-01	-9.57E-02	3.41E+00	3.14E+02	1.01E+00
2300X-1-CJ-FCV1-002	1.40E+01	5.28E+01	4.61E-03	1.37E+00	-4.98E-01	-3.71E-02	6.57E+00	7.73E+02	8.40E+00
2300X-1-CJ-FCV1-005	5.52E+00	3.25E+01	1.33E-01	2.35E+01	8.58E-02	-1.12E-02	4.10E+00	4.14E+02	2.81E+00
2300X-1-CJ-FCV1-007	4.48E+01	5.02E+01	1.01E-01	-2.53E+00	3.00E-01	1.98E-01	-5.29E-01	5.70E+01	7.75E+00
2600X-1-CJ-FCV1-002	1.46E+01	2.42E+01	-1.78E-02	-9.00E+00	-1.31E-01	-3.74E-02	-7.54E-01	1.91E+01	1.93E+00
3100X-3-CJ-FCV1-006	-1.68E+00	3.26E+00	8.23E-02	1.60E+00	-4.30E-03	3.06E-02	-9.29E-01	-3.99E-01	2.52E-02
3100X-3-CJ-FCV1-014	-3.70E+00	1.82E+00	-2.64E-04	1.90E-01	2.99E-02	2.68E-02	-4.19E-01	1.71E+00	5.57E-02
4100X-1-CJ-FCV1-004	-7.58E-01	8.05E+00	-8.85E-02	2.35E+00	6.70E-03	-1.41E-02	7.16E-01	1.86E+00	2.88E-01
4100X-1-CJ-FCV1-005	-5.45E+00	8.47E-01	-4.89E-02	3.41E+00	1.15E-03	1.45E-02	1.65E-04	4.01E-01	6.26E-01

Table 6: GEL Analysis Results from All Samples 2nd Set of Radionuclides²

Sample No	Zn-65	Nb-94	Tc-99	Sr-90	Ag-110m	Sb-125	Cs-134	Cs-137	Ce-144
1100X-1-CJ-FCV1-005	0.00E+00	1.87E-01	4.51E-02	6.20E+00	1.17E+00	-2.03E+00	1.29E+02	4.87E+03	-1.86E+01
1100X-1-CJ-WCV1-004	0.00E+00	2.13E+00	2.56E+00	9.88E+00	4.58E+00	0.00E+00	1.08E+02	5.34E+03	-5.77E+00
1200X-1-CJ-FCV1-001	2.40E-01	9.98E-02	6.85E-01	7.05E-01	4.18E-01	5.76E-01	1.07E-01	1.24E+02	3.03E-01
1200X-1-CJ-FCV1-002	5.17E-01	1.36E-01	4.11E-01	2.19E+00	-3.43E-01	-3.56E+00	4.30E-01	4.68E+02	-9.80E-01
1200X-1-CJ-FCV1-003	3.58E-02	3.32E-01	5.62E-01	4.30E+00	2.40E-01	3.07E-01	1.15E+00	1.07E+03	2.25E-01
1200X-1-CJ-FCV1-010	9.71E-01	-6.87E-02	4.07E-01	5.07E-01	1.53E-01	-5.78E-01	6.39E-02	3.51E+02	7.99E-01
1200X-1-CJ-FCV1-018	-4.21E-02	5.93E-02	8.56E-02	4.51E-01	-3.99E-02	1.22E+00	1.61E-01	2.50E+02	-1.43E+00
1200X-1-CJ-FCV1-023	-4.73E-01	1.06E-01	2.09E-01	1.72E+01	1.17E-01	6.66E+00	3.78E+00	5.90E+03	2.82E+00
1200X-1-CJ-FCV1-025	4.96E-03	-7.76E-02	2.43E-01	2.08E+00	-2.80E-01	3.11E+00	4.01E-01	9.55E+02	1.68E+00
1200X-1-CJ-FCV1-027	-3.36E-01	2.04E-01	-3.73E-01	1.05E+00	-2.53E-01	1.73E+00	3.58E+00	4.47E+03	-2.64E+00
1200X-1-CJ-WCV1-005	1.07E-01	1.96E-02	2.21E-01	1.07E-01	-3.24E-02	3.76E-01	3.54E-02	9.35E+01	8.90E-01
1200X-1-CJ-WCV1-009	-1.87E-03	4.43E-03	6.60E-02	8.16E-02	9.26E-02	-1.13E+00	5.72E-02	2.97E+02	-4.04E-01
1300X-1-CJ-FCV1-003	-5.01E-01	1.76E-01	4.44E-01	5.09E-01	3.16E-01	7.01E-01	3.94E+00	5.35E+03	-2.75E+00

² Shaded cells represent negative reported values. All values in pCi/g.

Fort Calhoun Station Potential Radionuclides of Concern

Sample No	Zn-65	Nb-94	Tc-99	Sr-90	Ag-110m	Sb-125	Cs-134	Cs-137	Ce-144
1300X-1-CJ-FCV1-006	3.60E-02	-3.41E-02	-4.24E-01	2.42E-01	-4.05E-02	3.95E-01	9.01E-01	8.79E+02	9.97E-02
1300X-1-CJ-FCV1-008	-6.70E-02	-7.27E-03	1.01E-01	1.43E+00	-2.23E-01	2.06E-01	5.73E-01	1.26E+03	1.30E+00
1400X-1-CJ-FCV1-002	6.77E-02	-3.81E-02	1.72E-01	1.03E+01	-6.65E-02	4.18E-01	2.35E-01	2.79E+03	2.56E+00
1400X-1-CJ-FCV1-021	-3.13E-03	5.45E-02	1.76E-01	-2.40E-02	9.97E-02	-4.14E-01	-5.69E-02	9.14E+01	-3.27E-01
2100X-1-CJ-FCV1-006	-2.67E-01	-3.28E-02	1.14E-01	4.42E-01	1.95E-01	-4.86E-01	1.26E-01	1.14E+02	1.76E-01
2100X-1-CJ-FCV1-011	0.00E+00	4.43E-02	5.53E+00	1.99E-01	7.20E-02	-1.32E-01	1.45E-01	6.02E+01	-6.41E-01
2100X-1-CJ-FCV1-014	-4.69E-02	4.14E-02	2.60E+01	2.47E-01	3.82E-02	1.18E-01	8.66E-02	1.33E+02	1.03E+00
2200X-1-CJ-FCV1-008	-3.03E-01	-8.25E-02	-1.81E-01	1.73E+00	6.29E-02	1.73E+00	1.46E+00	1.22E+03	9.64E-02
2200X-1-CJ-FCV1-010	-3.52E-01	2.38E-02	-2.30E-01	1.33E+00	-1.04E-01	1.40E+00	0.00E+00	3.35E+02	-4.66E-01
2200X-1-CJ-FCV1-020	2.88E-01	-4.72E-03	1.61E+00	7.69E+00	-6.70E-01	3.62E+00	2.63E+01	1.22E+04	8.33E-01
2200X-1-CJ-FCV1-022	4.19E-03	7.17E-02	-5.06E-02	1.78E+01	-9.35E-02	-4.68E+00	2.61E-01	1.87E+04	-4.59E+00
2200X-1-CJ-FCV1-026	7.41E-02	0.00E+00	-4.62E-01	2.25E+01	-2.06E-01	-1.19E+01	2.25E-01	2.12E+04	4.58E+00
2200X-1-CJ-FCV1-031	2.06E-02	9.88E-02	-1.92E+00	1.18E+00	-1.23E-01	-1.68E-01	2.16E-01	3.93E+02	5.79E-01
2200X-1-CJ-FCV1-035	-1.27E-03	4.60E-02	-5.48E-01	1.77E+00	2.53E-01	5.09E-01	1.86E-01	8.44E+02	1.67E-01
2200X-1-CJ-WCV1-009	-7.15E-02	-5.02E-02	4.35E-01	-3.97E-02	-4.64E-02	-6.37E-02	9.61E-02	3.82E+01	-2.37E-01
2300X-1-CJ-FCV1-001	-2.98E-02	1.08E-01	-5.82E+00	1.81E+01	-4.43E-02	-1.95E+00	-1.57E-01	7.57E+03	4.15E-01
2300X-1-CJ-FCV1-002	-1.89E-02	-2.07E-01	-3.19E+00	2.37E+01	-1.50E-01	7.27E-01	2.08E-01	1.05E+04	-1.86E+00
2300X-1-CJ-FCV1-005	2.50E-01	9.35E-02	1.81E-01	6.47E+00	4.15E-03	-1.77E+00	8.13E-02	3.61E+03	4.12E-01
2300X-1-CJ-FCV1-007	-1.97E-02	1.18E-01	-2.33E-01	3.70E+00	-3.61E-01	1.17E+00	2.32E+00	7.80E+02	2.53E+00
2600X-1-CJ-FCV1-002	1.04E-01	2.89E-02	1.51E-01	5.47E-02	2.09E-02	1.33E-02	1.15E-01	6.77E+01	-2.18E-01
3100X-3-CJ-FCV1-006	-3.21E-03	9.05E-04	-2.82E-01	1.06E-01	-4.74E-02	4.87E-02	-1.88E-03	3.54E-01	1.55E-01
3100X-3-CJ-FCV1-014	-2.77E-01	-1.83E-02	-4.20E-01	6.38E-02	5.65E-02	1.27E-02	1.20E-01	1.54E-01	5.46E-01
4100X-1-CJ-FCV1-004	-8.07E-02	5.86E-02	-1.13E-01	-3.38E-02	-4.67E-02	-4.43E-02	8.95E-02	6.85E+00	-5.13E-02
4100X-1-CJ-FCV1-005	-2.68E-01	-2.35E-02	-6.41E-01	1.31E+00	-5.12E-02	1.51E-01	-9.52E-03	3.36E+00	1.34E-01

Fort Calhoun Station Potential Radionuclides of Concern

Table 7: GEL Analysis Results from All Samples 3rd Set of Radionuclides³

Sample No	Eu-152	Eu-154	Eu-155	Pu-238	Pu-239/ 240	Pu-241	Am-241	Cm-242	Cm-243/ 244
1100X-1-CJ-FCV1-005	5.57E+03	6.11E+02	1.83E+01	3.02E-01	1.23E+00	9.86E+00	3.17E-01	1.12E-02	1.06E-01
1100X-1-CJ-WCV1-004	4.84E+03	5.52E+02	7.20E+00	1.46E+00	1.72E+00	2.42E+01	2.51E+00	2.12E-02	7.43E-01
1200X-1-CJ-FCV1-001	-2.35E-01	4.50E-01	1.96E-01	4.51E-02	0.00E+00	6.68E+00	3.99E-02	0.00E+00	5.43E-03
1200X-1-CJ-FCV1-002	1.68E-01	-7.17E-01	-1.84E-01	2.61E-01	8.37E-02	5.38E+00	4.90E-01	0.00E+00	1.68E-01
1200X-1-CJ-FCV1-003	-7.99E-01	4.91E-01	-6.51E-01	6.04E-02	4.92E-02	4.86E+00	9.72E-02	0.00E+00	3.94E-02
1200X-1-CJ-FCV1-010	2.36E+00	1.70E-02	4.72E-02	1.58E-02	-5.56E-03	2.43E+00	3.55E-02	0.00E+00	1.31E-02
1200X-1-CJ-FCV1-018	1.56E-02	-7.00E-02	-7.53E-01	2.10E-02	-1.00E-02	2.40E+00	9.22E-03	6.81E-03	3.14E-03
1200X-1-CJ-FCV1-023	2.61E-01	1.38E-01	-1.01E+00	7.22E-01	3.98E-01	1.55E+01	9.46E-01	0.00E+00	1.16E-01
1200X-1-CJ-FCV1-025	-1.71E-01	-3.52E-02	-1.34E+00	1.87E-03	1.01E-02	3.79E+00	9.23E-03	8.10E-03	-6.60E-03
1200X-1-CJ-FCV1-027	4.01E-01	-2.00E-01	-1.22E+00	7.86E-03	1.07E-02	5.32E+00	8.05E-03	8.98E-03	1.70E-03
1200X-1-CJ-WCV1-005	0.00E+00	2.78E-01	2.01E-01	8.10E-03	-6.35E-03	5.67E+00	1.30E-02	0.00E+00	-5.30E-03
1200X-1-CJ-WCV1-009	1.34E+00	2.40E-01	-1.93E-01	1.60E-02	-1.51E-02	3.65E+00	3.02E-02	0.00E+00	2.15E-02
1300X-1-CJ-FCV1-003	-4.62E-01	7.25E-02	6.63E-01	2.22E-02	1.13E-02	4.73E+00	3.34E-03	0.00E+00	-3.07E-03
1300X-1-CJ-FCV1-006	-1.73E-01	-6.36E-02	-7.70E-01	6.54E-03	6.53E-04	4.18E+00	-5.00E-03	0.00E+00	6.91E-03
1300X-1-CJ-FCV1-008	1.89E+00	3.43E-01	9.31E-02	2.97E-02	2.31E-02	1.99E+00	5.54E-02	0.00E+00	1.86E-03
1400X-1-CJ-FCV1-002	-1.47E-01	3.15E-01	-1.85E-01	-1.77E-02	-2.10E-02	-1.82E+00	2.44E-02	0.00E+00	0.00E+00
1400X-1-CJ-FCV1-021	5.22E-01	9.85E-02	1.37E-01	1.77E-02	4.34E-02	-6.11E-01	1.42E-02	0.00E+00	-6.74E-03
2100X-1-CJ-FCV1-006	4.23E-01	8.57E-02	9.29E-01	1.59E-02	-2.38E-02	1.73E+00	1.04E-02	-2.95E-03	-2.48E-03
2100X-1-CJ-FCV1-011	-4.27E-01	4.15E-03	-1.56E-01	-1.88E-02	-3.92E-04	9.98E-02	-5.69E-03	0.00E+00	-5.63E-03
2100X-1-CJ-FCV1-014	-7.83E-01	-4.98E-01	1.19E-01	2.39E-02	-1.73E-03	-4.26E-01	-2.03E-02	1.99E-02	6.71E-04
2200X-1-CJ-FCV1-008	-8.64E-01	1.88E-01	-2.36E-01	1.80E-03	1.35E-02	-8.17E-02	1.51E-02	-2.72E-03	-7.06E-03
2200X-1-CJ-FCV1-010	3.35E-01	-1.27E-01	4.87E-01	-3.05E-03	1.25E-02	-4.64E-01	-3.18E-02	1.19E-02	-1.52E-02
2200X-1-CJ-FCV1-020	3.16E+00	5.91E-02	-1.98E+00	8.89E-03	1.40E-02	-3.33E-01	2.04E-02	6.83E-03	-1.30E-02
2200X-1-CJ-FCV1-022	1.61E+00	-2.53E-01	-3.94E+00	-5.53E-03	-1.92E-02	-2.92E+00	-2.27E-02	-2.17E-03	-2.06E-02
2200X-1-CJ-FCV1-026	2.41E+00	-1.90E-02	-1.85E+00	4.16E-03	-1.54E-02	-9.86E-01	-1.66E-03	-4.63E-03	-1.97E-02

³ Shaded cells represent negative reported values. All values in pCi/g.

Fort Calhoun Station Potential Radionuclides of Concern

Sample No	Eu-152	Eu-154	Eu-155	Pu-238	Pu-239/ 240	Pu-241	Am-241	Cm-242	Cm-243/ 244
2200X-1-CJ-FCV1-031	-5.42E-01	7.82E-02	-2.50E-01	-1.04E-02	1.35E-02	-5.84E-01	9.34E-03	-2.03E-03	1.30E-02
2200X-1-CJ-FCV1-035	1.40E-01	6.70E-02	-1.69E-02	4.11E-02	3.19E-02	-1.25E+00	3.78E-02	-1.81E-03	4.90E-03
2200X-1-CJ-WCV1-009	-3.73E-01	-1.26E-01	3.02E-02	-1.29E-03	-9.25E-03	-7.18E-01	-2.04E-02	1.46E-02	-5.78E-03
2300X-1-CJ-FCV1-001	-1.23E+00	6.70E-02	1.67E+00	-1.99E-03	-3.98E-03	-1.39E+00	7.48E-03	4.27E-03	-3.41E-03
2300X-1-CJ-FCV1-002	1.76E+00	7.23E-02	-3.62E-01	5.16E-01	3.29E-01	4.08E+00	8.98E-01	1.99E-03	1.10E-01
2300X-1-CJ-FCV1-005	-1.39E+00	-3.57E-02	-1.22E+00	4.02E-03	-3.40E-03	-8.19E-02	4.79E-02	-3.85E-03	-1.67E-02
2300X-1-CJ-FCV1-007	5.48E-01	2.54E-01	-1.44E+00	2.24E-02	3.24E-04	1.13E+00	2.48E-01	-1.12E-02	-9.22E-03
2600X-1-CJ-FCV1-002	9.12E-01	1.10E-01	9.29E-02	-8.16E-03	1.39E-02	2.51E-01	2.32E-02	-6.61E-03	5.97E-03
3100X-3-CJ-FCV1-006	8.14E-02	-2.91E-01	-5.63E-02	2.19E-02	6.94E-03	-1.45E+00	1.12E-02	6.55E-03	9.32E-03
3100X-3-CJ-FCV1-014	-3.24E-02	3.48E-01	5.88E-02	2.16E-02	-1.71E-03	-7.09E-01	-1.00E-02	-2.01E-03	-1.19E-02
4100X-1-CJ-FCV1-004	7.01E-02	2.14E-01	-5.31E-02	1.15E-02	1.15E-02	-1.49E+00	8.82E-04	6.51E-03	-1.92E-02
4100X-1-CJ-FCV1-005	8.72E-02	1.03E-01	-6.28E-02	-4.75E-03	-9.22E-03	3.96E-01	2.75E-03	-2.41E-03	-6.13E-03



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Attachment 8.2: GEL Sample Results Screened Against the Critical Level, Lc

Fort Calhoun Station Potential Radionuclides of Concern

Table 8: GEL Analysis Results from All Samples Screened Against Lc, 1st Set of Radionuclides⁴

Sample No	H-3	C-14	Mn-54	Fe-55	Co-57	Co-58	Ni-59	Ni-63	Co-60
1100X-1-CJ-FCV1-005	1.79E+03	1.56E+03		3.77E+03			1.12E+01	1.05E+03	1.09E+03
1100X-1-CJ-WCV1-004	2.99E+03	1.06E+03	4.86E+00	3.99E+03		2.06E+01	3.10E+01	2.36E+03	2.23E+03
1200X-1-CJ-FCV1-001	7.89E+02	1.53E+03						1.30E+02	4.78E+01
1200X-1-CJ-FCV1-002	7.68E+02	2.67E+03	6.89E-01	5.49E+00				5.43E+02	8.67E+01
1200X-1-CJ-FCV1-003	7.38E+02	1.99E+03	5.61E-01				2.23E+00	2.03E+02	4.18E+01
1200X-1-CJ-FCV1-010	9.29E+02	1.45E+02						1.41E+02	1.26E+01
1200X-1-CJ-FCV1-018	8.99E+02	1.59E+03		6.27E+00				5.76E+01	1.81E+00
1200X-1-CJ-FCV1-023	2.80E+02	8.09E+01	4.50E-01		1.45E+00		1.09E+01	1.13E+03	7.85E+01
1200X-1-CJ-FCV1-025	6.97E+02	2.70E+03						1.19E+02	1.21E+01
1200X-1-CJ-FCV1-027	5.38E+02	1.62E+03					8.96E-01	1.00E+02	3.18E+01
1200X-1-CJ-WCV1-005	3.36E+02	7.19E+02						2.17E+01	2.43E+00
1200X-1-CJ-WCV1-009	2.46E+02	2.62E+03				2.95E-01		1.08E+01	9.35E-01
1300X-1-CJ-FCV1-003	4.11E+02	1.41E+03						1.47E+02	1.84E+01
1300X-1-CJ-FCV1-006	1.95E+02	1.72E+02		5.29E+00				3.54E+01	2.48E+00
1300X-1-CJ-FCV1-008	8.12E+01	3.03E+02	1.41E-01		4.60E-01	2.85E-01	1.69E+00	4.21E+01	3.07E+00
1400X-1-CJ-FCV1-002	3.88E+02	8.55E+03					2.03E+00	4.86E+01	3.47E+00
1400X-1-CJ-FCV1-021	5.08E+02	2.07E+03			1.18E-01			6.37E+00	3.55E+00
2100X-1-CJ-FCV1-006	2.99E+01	2.87E+00						3.24E+01	2.73E+00
2100X-1-CJ-FCV1-011	7.05E+00	3.64E+00						6.20E+01	4.32E+00
2100X-1-CJ-FCV1-014		7.85E+00						4.81E+01	9.76E-01
2200X-1-CJ-FCV1-008	9.34E+01	2.38E+01	3.11E-01					9.47E+01	4.74E+01
2200X-1-CJ-FCV1-010	1.85E+01	9.15E+00						1.36E+02	1.00E+01
2200X-1-CJ-FCV1-020	5.84E+01	1.99E+01		3.76E+00		5.69E-01	4.91E+00	1.42E+03	2.34E+01
2200X-1-CJ-FCV1-022	1.61E+01	2.28E+01					6.56E+00	6.42E+02	1.29E+00
2200X-1-CJ-FCV1-026	1.68E+01	1.31E+01						1.90E+02	
2200X-1-CJ-FCV1-031	2.40E+02	4.97E+00		8.58E+00			2.37E+00	2.27E+02	7.21E+00

⁴ All values in pCi/g.



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Sample No	H-3	C-14	Mn-54	Fe-55	Co-57	Co-58	Ni-59	Ni-63	Co-60
2200X-1-CJ-FCV1-035	1.27E+01	1.93E+01		1.23E+01	2.44E-01		3.21E+00	4.06E+02	1.84E+01
2200X-1-CJ-WCV1-009	6.19E+00	1.88E+01						6.26E+00	4.47E-01
2300X-1-CJ-FCV1-001		7.99E+01		1.43E+01			3.41E+00	3.14E+02	1.01E+00
2300X-1-CJ-FCV1-002	1.40E+01	5.28E+01					6.57E+00	7.73E+02	8.40E+00
2300X-1-CJ-FCV1-005	5.52E+00	3.25E+01	1.33E-01	2.35E+01			4.10E+00	4.14E+02	2.81E+00
2300X-1-CJ-FCV1-007	4.48E+01	5.02E+01			3.00E-01			5.70E+01	7.75E+00
2600X-1-CJ-FCV1-002	1.46E+01	2.42E+01						1.91E+01	1.93E+00
3100X-3-CJ-FCV1-006		3.26E+00	8.23E-02						
3100X-3-CJ-FCV1-014		1.82E+00						1.71E+00	
4100X-1-CJ-FCV1-004		8.05E+00						1.86E+00	2.88E-01
4100X-1-CJ-FCV1-005				3.41E+00					6.26E-01

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Table 9: GEL Analysis Results from All Samples Screened Against Lc, 2nd Set of Radionuclides⁵

Sample No	Zn-65	Nb-94	Tc-99	Sr-90	Sb-125	Cs-134	Cs-137	Ce-144
1100X-1-CJ-FCV1-005				6.20E+00		1.29E+02	4.87E+03	
1100X-1-CJ-WCV1-004		2.13E+00	2.56E+00	9.88E+00		1.08E+02	5.34E+03	
1200X-1-CJ-FCV1-001				7.05E-01			1.24E+02	
1200X-1-CJ-FCV1-002				2.19E+00			4.68E+02	
1200X-1-CJ-FCV1-003		3.32E-01		4.30E+00		1.15E+00	1.07E+03	
1200X-1-CJ-FCV1-010	9.71E-01			5.07E-01			3.51E+02	
1200X-1-CJ-FCV1-018				4.51E-01	1.22E+00		2.50E+02	
1200X-1-CJ-FCV1-023				1.72E+01	6.66E+00	3.78E+00	5.90E+03	
1200X-1-CJ-FCV1-025				2.08E+00	3.11E+00	4.01E-01	9.55E+02	
1200X-1-CJ-FCV1-027				1.05E+00		3.58E+00	4.47E+03	
1200X-1-CJ-WCV1-005				1.07E-01			9.35E+01	8.90E-01
1200X-1-CJ-WCV1-009				8.16E-02			2.97E+02	
1300X-1-CJ-FCV1-003		1.76E-01		5.09E-01		3.94E+00	5.35E+03	
1300X-1-CJ-FCV1-006				2.42E-01		9.01E-01	8.79E+02	
1300X-1-CJ-FCV1-008				1.43E+00		5.73E-01	1.26E+03	
1400X-1-CJ-FCV1-002				1.03E+01		2.35E-01	2.79E+03	
1400X-1-CJ-FCV1-021							9.14E+01	
2100X-1-CJ-FCV1-006				4.42E-01			1.14E+02	
2100X-1-CJ-FCV1-011			5.53E+00	1.99E-01			6.02E+01	
2100X-1-CJ-FCV1-014			2.60E+01	2.47E-01			1.33E+02	1.03E+00
2200X-1-CJ-FCV1-008				1.73E+00		1.46E+00	1.22E+03	
2200X-1-CJ-FCV1-010				1.33E+00			3.35E+02	
2200X-1-CJ-FCV1-020			1.61E+00	7.69E+00		2.63E+01	1.22E+04	
2200X-1-CJ-FCV1-022				1.78E+01		2.61E-01	1.87E+04	

⁵ All values in pCi/g.



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Sample No	Zn-65	Nb-94	Tc-99	Sr-90	Sb-125	Cs-134	Cs-137	Ce-144
2200X-1-CJ-FCV1-026				2.25E+01		2.25E-01	2.12E+04	
2200X-1-CJ-FCV1-031		9.88E-02		1.18E+00		2.16E-01	3.93E+02	
2200X-1-CJ-FCV1-035				1.77E+00		1.86E-01	8.44E+02	
2200X-1-CJ-WCV1-009							3.82E+01	
2300X-1-CJ-FCV1-001				1.81E+01			7.57E+03	
2300X-1-CJ-FCV1-002				2.37E+01		2.08E-01	1.05E+04	
2300X-1-CJ-FCV1-005	2.50E-01	9.35E-02		6.47E+00			3.61E+03	
2300X-1-CJ-FCV1-007				3.70E+00		2.32E+00	7.80E+02	2.53E+00
2600X-1-CJ-FCV1-002				5.47E-02			6.77E+01	
3100X-3-CJ-FCV1-006				1.06E-01			3.54E-01	
3100X-3-CJ-FCV1-014				6.38E-02				5.46E-01
4100X-1-CJ-FCV1-004							6.85E+00	
4100X-1-CJ-FCV1-005				1.31E+00			3.36E+00	

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Table 10: GEL Analysis Results from All Samples Screened Against Lc, 3rd Set of Radionuclides⁶

Sample No	Eu-152	Eu-154	Eu-155	Pu-238	Pu-239/ 240	Pu-241	Am-241	Cm-243/ 244
1100X-1-CJ-FCV1-005	5.57E+03	6.11E+02	1.83E+01	3.02E-01	1.23E+00	9.86E+00	3.17E-01	1.06E-01
1100X-1-CJ-WCV1-004	4.84E+03	5.52E+02	7.20E+00	1.46E+00	1.72E+00	2.42E+01	2.51E+00	7.43E-01
1200X-1-CJ-FCV1-001				4.51E-02			3.99E-02	
1200X-1-CJ-FCV1-002				2.61E-01	8.37E-02	5.38E+00	4.90E-01	1.68E-01
1200X-1-CJ-FCV1-003		4.91E-01		6.04E-02	4.92E-02	4.86E+00	9.72E-02	3.94E-02
1200X-1-CJ-FCV1-010	2.36E+00			1.58E-02		2.43E+00	3.55E-02	1.31E-02
1200X-1-CJ-FCV1-018				2.10E-02			9.22E-03	
1200X-1-CJ-FCV1-023				7.22E-01	3.98E-01	1.55E+01	9.46E-01	1.16E-01
1200X-1-CJ-FCV1-025					1.01E-02	3.79E+00		
1200X-1-CJ-FCV1-027						5.32E+00		
1200X-1-CJ-WCV1-005						5.67E+00	1.30E-02	
1200X-1-CJ-WCV1-009	1.34E+00			1.60E-02		3.65E+00	3.02E-02	2.15E-02
1300X-1-CJ-FCV1-003				2.22E-02		4.73E+00		
1300X-1-CJ-FCV1-006						4.18E+00		
1300X-1-CJ-FCV1-008	1.89E+00			2.97E-02	2.31E-02		5.54E-02	
1400X-1-CJ-FCV1-002							2.44E-02	
1400X-1-CJ-FCV1-021	5.22E-01			1.77E-02	4.34E-02			
2100X-1-CJ-FCV1-006			9.29E-01					
2100X-1-CJ-FCV1-011								
2100X-1-CJ-FCV1-014				2.39E-02				
2200X-1-CJ-FCV1-008							1.51E-02	
2200X-1-CJ-FCV1-010								
2200X-1-CJ-FCV1-020								
2200X-1-CJ-FCV1-022								
2200X-1-CJ-FCV1-026								

⁶ All values in pCi/g.



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Sample No	Eu-152	Eu-154	Eu-155	Pu-238	Pu-239/ 240	Pu-241	Am-241	Cm-243/ 244
2200X-1-CJ-FCV1-031								
2200X-1-CJ-FCV1-035				4.11E-02	3.19E-02		3.78E-02	
2200X-1-CJ-WCV1-009								
2300X-1-CJ-FCV1-001								
2300X-1-CJ-FCV1-002				5.16E-01	3.29E-01	4.08E+00	8.98E-01	1.10E-01
2300X-1-CJ-FCV1-005							4.79E-02	
2300X-1-CJ-FCV1-007				2.24E-02			2.48E-01	
2600X-1-CJ-FCV1-002	9.12E-01				1.39E-02		2.32E-02	
3100X-3-CJ-FCV1-006				2.19E-02			1.12E-02	
3100X-3-CJ-FCV1-014				2.16E-02				
4100X-1-CJ-FCV1-004								
4100X-1-CJ-FCV1-005								



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Attachment 8.3: Radionuclide Fractions for All Samples

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Table 11: Radionuclide Fractions for Each Sample for 1st Set of Radionuclides

Sample No	H-3	C-14	Mn-54	Fe-55	Co-57	Co-58	Ni-59	Ni-63	Co-60
1100X-1-CJ-FCV1-005	8.74E-02	7.61E-02		1.84E-01			5.47E-04	5.13E-02	5.32E-02
1100X-1-CJ-WCV1-004	1.27E-01	4.50E-02	2.06E-04	1.69E-01		8.74E-04	1.31E-03	1.00E-01	9.46E-02
1200X-1-CJ-FCV1-001	3.01E-01	5.84E-01						4.96E-02	1.82E-02
1200X-1-CJ-FCV1-002	1.69E-01	5.87E-01	1.51E-04	1.21E-03				1.19E-01	1.91E-02
1200X-1-CJ-FCV1-003	1.82E-01	4.91E-01	1.38E-04				5.50E-04	5.00E-02	1.03E-02
1200X-1-CJ-FCV1-010	5.86E-01	9.15E-02						8.90E-02	7.95E-03
1200X-1-CJ-FCV1-018	3.20E-01	5.67E-01		2.23E-03				2.05E-02	6.45E-04
1200X-1-CJ-FCV1-023	3.72E-02	1.07E-02	5.98E-05		1.93E-04		1.45E-03	1.50E-01	1.04E-02
1200X-1-CJ-FCV1-025	1.55E-01	6.01E-01						2.65E-02	2.69E-03
1200X-1-CJ-FCV1-027	7.95E-02	2.39E-01					1.32E-04	1.48E-02	4.70E-03
1200X-1-CJ-WCV1-005	2.85E-01	6.10E-01						1.84E-02	2.06E-03
1200X-1-CJ-WCV1-009	7.74E-02	8.24E-01				9.28E-05		3.40E-03	2.94E-04
1300X-1-CJ-FCV1-003	5.60E-02	1.92E-01						2.00E-02	2.50E-03
1300X-1-CJ-FCV1-006	1.51E-01	1.33E-01		4.09E-03				2.73E-02	1.92E-03
1300X-1-CJ-FCV1-008	4.79E-02	1.79E-01	8.31E-05		2.71E-04	1.68E-04	9.96E-04	2.48E-02	1.81E-03
1400X-1-CJ-FCV1-002	3.29E-02	7.25E-01					1.72E-04	4.12E-03	2.94E-04
1400X-1-CJ-FCV1-021	1.90E-01	7.72E-01			4.40E-05			2.38E-03	1.32E-03
2100X-1-CJ-FCV1-006	1.63E-01	1.57E-02						1.77E-01	1.49E-02
2100X-1-CJ-FCV1-011	4.93E-02	2.55E-02						4.34E-01	3.02E-02
2100X-1-CJ-FCV1-014		3.61E-02						2.21E-01	4.49E-03
2200X-1-CJ-FCV1-008	6.30E-02	1.61E-02	2.10E-04					6.39E-02	3.20E-02
2200X-1-CJ-FCV1-010	3.63E-02	1.79E-02						2.67E-01	1.96E-02
2200X-1-CJ-FCV1-020	4.24E-03	1.45E-03		2.73E-04		4.13E-05	3.57E-04	1.03E-01	1.70E-03
2200X-1-CJ-FCV1-022	8.30E-04	1.17E-03					3.38E-04	3.31E-02	6.65E-05
2200X-1-CJ-FCV1-026	7.83E-04	6.11E-04						8.86E-03	
2200X-1-CJ-FCV1-031	2.71E-01	5.62E-03		9.70E-03			2.68E-03	2.57E-01	8.15E-03
2200X-1-CJ-FCV1-035	9.63E-03	1.46E-02		9.33E-03	1.85E-04		2.43E-03	3.08E-01	1.40E-02
2200X-1-CJ-WCV1-009	8.86E-02	2.69E-01						8.96E-02	6.40E-03

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Sample No	H-3	C-14	Mn-54	Fe-55	Co-57	Co-58	Ni-59	Ni-63	Co-60
2300X-1-CJ-FCV1-001		9.99E-03		1.79E-03			4.26E-04	3.92E-02	1.26E-04
2300X-1-CJ-FCV1-002	1.23E-03	4.64E-03					5.77E-04	6.79E-02	7.38E-04
2300X-1-CJ-FCV1-005	1.35E-03	7.93E-03	3.24E-05	5.73E-03			1.00E-03	1.01E-01	6.85E-04
2300X-1-CJ-FCV1-007	4.72E-02	5.29E-02			3.16E-04			6.01E-02	8.17E-03
2600X-1-CJ-FCV1-002	1.14E-01	1.88E-01						1.49E-01	1.50E-02
3100X-3-CJ-FCV1-006		8.50E-01	2.15E-02						
3100X-3-CJ-FCV1-014		4.37E-01						4.11E-01	
4100X-1-CJ-FCV1-004		4.72E-01						1.09E-01	1.69E-02
4100X-1-CJ-FCV1-005				3.92E-01					7.19E-02

Table 12: Radionuclide Fractions for Each Sample for 2nd Set of Radionuclides

Sample No	Zn-65	Nb-94	Tc-99	Sr-90	Sb-125	Cs-134	Cs-137	Ce-144
1100X-1-CJ-FCV1-005				3.03E-04		6.30E-03	2.38E-01	
1100X-1-CJ-WCV1-004		9.03E-05	1.09E-04	4.19E-04		4.58E-03	2.26E-01	
1200X-1-CJ-FCV1-001				2.69E-04			4.73E-02	
1200X-1-CJ-FCV1-002				4.81E-04			1.03E-01	
1200X-1-CJ-FCV1-003		8.18E-05		1.06E-03		2.83E-04	2.64E-01	
1200X-1-CJ-FCV1-010	6.13E-04			3.20E-04			2.21E-01	
1200X-1-CJ-FCV1-018				1.61E-04	4.35E-04		8.91E-02	
1200X-1-CJ-FCV1-023				2.28E-03	8.85E-04	5.02E-04	7.84E-01	
1200X-1-CJ-FCV1-025				4.63E-04	6.92E-04	8.93E-05	2.13E-01	
1200X-1-CJ-FCV1-027				1.55E-04		5.29E-04	6.60E-01	
1200X-1-CJ-WCV1-005				9.07E-05			7.93E-02	7.55E-04
1200X-1-CJ-WCV1-009				2.57E-05			9.34E-02	
1300X-1-CJ-FCV1-003		2.40E-05		6.93E-05		5.36E-04	7.28E-01	
1300X-1-CJ-FCV1-006				1.87E-04		6.96E-04	6.79E-01	
1300X-1-CJ-FCV1-008				8.43E-04		3.38E-04	7.43E-01	
1400X-1-CJ-FCV1-002				8.73E-04		1.99E-05	2.37E-01	

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Sample No	Zn-65	Nb-94	Tc-99	Sr-90	Sb-125	Cs-134	Cs-137	Ce-144
1400X-1-CJ-FCV1-021							3.41E-02	
2100X-1-CJ-FCV1-006				2.41E-03			6.22E-01	
2100X-1-CJ-FCV1-011			3.87E-02	1.39E-03			4.21E-01	
2100X-1-CJ-FCV1-014			1.20E-01	1.14E-03			6.12E-01	4.74E-03
2200X-1-CJ-FCV1-008				1.17E-03		9.85E-04	8.23E-01	
2200X-1-CJ-FCV1-010				2.61E-03			6.57E-01	
2200X-1-CJ-FCV1-020			1.17E-04	5.59E-04		1.91E-03	8.86E-01	
2200X-1-CJ-FCV1-022				9.17E-04		1.34E-05	9.64E-01	
2200X-1-CJ-FCV1-026				1.05E-03		1.05E-05	9.89E-01	
2200X-1-CJ-FCV1-031		1.12E-04		1.33E-03		2.44E-04	4.44E-01	
2200X-1-CJ-FCV1-035				1.34E-03		1.41E-04	6.40E-01	
2200X-1-CJ-WCV1-009							5.47E-01	
2300X-1-CJ-FCV1-001				2.26E-03			9.46E-01	
2300X-1-CJ-FCV1-002				2.08E-03		1.83E-05	9.22E-01	
2300X-1-CJ-FCV1-005	6.10E-05	2.28E-05		1.58E-03			8.81E-01	
2300X-1-CJ-FCV1-007				3.90E-03		2.45E-03	8.22E-01	2.67E-03
2600X-1-CJ-FCV1-002				4.26E-04			5.27E-01	
3100X-3-CJ-FCV1-006				2.76E-02			9.23E-02	
3100X-3-CJ-FCV1-014				1.53E-02				1.31E-01
4100X-1-CJ-FCV1-004							4.02E-01	
4100X-1-CJ-FCV1-005				1.50E-01			3.86E-01	

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Table 13: Radionuclide Fractions for Each Sample for 3rd Set of Radionuclides

Sample No	Eu-152	Eu-154	Eu-155	Pu-238	Pu-239/ 240	Pu-241	Am-241
1100X-1-CJ-FCV1-005	2.72E-01	2.98E-02	8.93E-04	1.47E-05	6.00E-05	4.81E-04	1.55E-05
1100X-1-CJ-WCV1-004	2.05E-01	2.34E-02	3.05E-04	6.19E-05	7.29E-05	1.03E-03	1.06E-04
1200X-1-CJ-FCV1-001				1.72E-05			1.52E-05
1200X-1-CJ-FCV1-002				5.74E-05	1.84E-05	1.18E-03	1.08E-04
1200X-1-CJ-FCV1-003		1.21E-04		1.49E-05	1.21E-05	1.20E-03	2.40E-05
1200X-1-CJ-FCV1-010	1.49E-03			9.97E-06		1.53E-03	2.24E-05
1200X-1-CJ-FCV1-018				7.48E-06			3.29E-06
1200X-1-CJ-FCV1-023				9.59E-05	5.29E-05	2.06E-03	1.26E-04
1200X-1-CJ-FCV1-025					2.25E-06	8.44E-04	
1200X-1-CJ-FCV1-027						7.86E-04	
1200X-1-CJ-WCV1-005						4.81E-03	1.10E-05
1200X-1-CJ-WCV1-009	4.21E-04			5.03E-06		1.15E-03	9.50E-06
1300X-1-CJ-FCV1-003				3.02E-06		6.44E-04	
1300X-1-CJ-FCV1-006						3.23E-03	
1300X-1-CJ-FCV1-008	1.11E-03			1.75E-05	1.36E-05		3.27E-05
1400X-1-CJ-FCV1-002							2.07E-06
1400X-1-CJ-FCV1-021	1.95E-04			6.60E-06	1.62E-05		
2100X-1-CJ-FCV1-006			5.07E-03				
2100X-1-CJ-FCV1-011							
2100X-1-CJ-FCV1-014				1.10E-04			
2200X-1-CJ-FCV1-008							1.02E-05
2200X-1-CJ-FCV1-010							
2200X-1-CJ-FCV1-020							
2200X-1-CJ-FCV1-022							
2200X-1-CJ-FCV1-026							
2200X-1-CJ-FCV1-031							

Fort Calhoun Station Potential Radionuclides of Concern

Sample No	Eu-152	Eu-154	Eu-155	Pu-238	Pu-239/ 240	Pu-241	Am-241
2200X-1-CJ-FCV1-035				3.12E-05	2.42E-05		2.87E-05
2200X-1-CJ-WCV1-009							
2300X-1-CJ-FCV1-001							
2300X-1-CJ-FCV1-002				4.53E-05	2.89E-05	3.58E-04	7.89E-05
2300X-1-CJ-FCV1-005							1.17E-05
2300X-1-CJ-FCV1-007				2.36E-05			2.61E-04
2600X-1-CJ-FCV1-002	7.10E-03				1.08E-04		1.80E-04
3100X-3-CJ-FCV1-006				5.71E-03			2.92E-03
3100X-3-CJ-FCV1-014				5.19E-03			
4100X-1-CJ-FCV1-004							
4100X-1-CJ-FCV1-005							