

21G-17-0054
GOV-01-55
ACF-17-0058
February 20, 2017

Director
Office of Nuclear Material Safety & Safeguards
U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Reference: Docket No. 70-143; SNM License 124

Subject: **Biannual Effluent Monitoring Report July to December 2016**

Dear Sir:

In accordance with the requirements set forth in 10 CFR, Part 70.59, Nuclear Fuel Services, Inc. (NFS) submits the attached reports. Attachment 1 reports the Radioactivity in Effluent Liquid for the period July to December 2016. Attachment 2 reports the Radioactivity in Effluent Air for the period July to December 2016. Attachment 3 summarizes an evaluation of the dose and air activity concentrations for the maximally exposed offsite individual due to gaseous effluents, during the period July to December 2016.

If you or your staff have any questions, require additional information, or wish to discuss this, please contact me, or Mr. R. Jason Faddis, Environmental Safety Unit Manager, at (423) 735-5438. Please reference our unique document identification number (21G-17-0054) in any correspondence concerning this letter.

Sincerely,

NUCLEAR FUEL SERVICES, INC.



Richard J. Freudenberger
Safety & Safeguards Director

CJB/pj

Attachments

- 1) Report of Radioactivity in Effluent Liquid for the Period July to December 2016
- 2) Report of Radioactivity in Effluent Air for the Period July to December 2016
- 3) Report of Gaseous Effluent Dose and Activity Concentrations for the Maximally Exposed Off-Site Individual for the Release Period July to December 2016

Copy:

Mr. Leonard Pitts
Senior Fuel Facility Inspector
U. S. Nuclear Regulatory Commission
Region II
245 Peachtree Center Ave., NE
Suite 1200
Atlanta, GA 30303-1257

Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
245 Peachtree Center Ave., NE
Suite 1200
Atlanta, GA 30303-1257

Mr. Kevin Ramsey
Senior Project Manager
Fuel Manufacturing Branch
Division of Fuel Cycle Safety, Safeguards,
and Environmental Review
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Two White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. Marvin Sykes
Chief, Projects Branch 1
U. S. Nuclear Regulatory Commission
Region II
245 Peachtree Center Ave., NE
Suite 1200
Atlanta, GA 30303-1257

Mr. Larry Harris
Senior Resident Inspector
U. S. Nuclear Regulatory Commission

**Attachment 1
To Letter Dated February 20, 2017**

**Report of Radioactivity in Effluent Liquid for the Period
July to December 2016**

(2 Pages to Follow)

Radioactivity in Effluent Liquid July 1, 2016 to December 31, 2016

Location	Total Volume (l)	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV ¹
Banner Spring Down							
Pu-238	371,207,672	0.00E+00	7.42E-11	1.65E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	371,207,672	0.00E+00	7.22E-11	1.62E-10	0.00E+00	0.00E+00	0.00E+00
Tc-99	371,207,672	0.00E+00	2.83E-08	4.93E-08	0.00E+00	0.00E+00	0.00E+00
Th-228	371,207,672	1.07E-11	1.11E-10	2.25E-10	3.97E-06	4.84E-09	5.34E-05
Th-230	371,207,672	5.40E-11	1.44E-10	2.68E-10	2.00E-05	9.92E-04	5.40E-04
Th-232	371,207,672	0.00E+00	8.20E-11	1.78E-10	0.00E+00	0.00E+00	0.00E+00
U-233/234	371,207,672	3.75E-10	2.11E-10	1.79E-10	1.39E-04	2.23E-02	1.25E-03
U-235/236	371,207,672	5.52E-11	1.05E-10	1.60E-10	2.05E-05	9.49E+00	1.84E-04
U-238	371,207,672	6.90E-11	1.06E-10	1.43E-10	2.56E-05	7.65E+01	2.30E-04
						Total:	2.26E-03
Sewer							
Pu-238	17,034,300	4.73E-12	1.35E-10	3.24E-10	8.06E-08	4.71E-09	2.37E-05
Pu-239/240	17,034,300	7.55E-13	1.47E-10	3.31E-10	1.29E-08	2.07E-07	3.78E-06
Tc-99	17,034,300	1.50E-09	2.92E-08	5.08E-08	2.56E-05	1.51E-03	2.50E-06
Th-228	17,034,300	2.36E-11	2.06E-10	4.13E-10	4.03E-07	4.91E-10	1.18E-05
Th-230	17,034,300	1.60E-10	2.63E-10	4.49E-10	2.72E-06	1.35E-04	1.60E-04
Th-232	17,034,300	0.00E+00	1.41E-10	2.95E-10	0.00E+00	0.00E+00	0.00E+00
U-232	17,034,300	0.00E+00	7.48E-11	1.89E-10	0.00E+00	0.00E+00	0.00E+00
U-233/234	17,034,300	4.72E-09	8.37E-10	2.81E-10	8.04E-05	1.29E-02	1.57E-03
U-235/236	17,034,300	2.79E-10	2.32E-10	2.19E-10	4.75E-06	2.20E+00	9.29E-05
U-238	17,034,300	6.23E-10	3.18E-10	2.41E-10	1.06E-05	3.17E+01	2.08E-04
						Total:	2.08E-03
West Ditch							
Pu-238	110,208,134	0.00E+00	7.38E-11	1.74E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	110,208,134	1.80E-11	6.85E-11	1.34E-10	1.99E-06	3.20E-05	9.02E-04
Tc-99	110,208,134	0.00E+00	2.76E-08	4.81E-08	0.00E+00	0.00E+00	0.00E+00
Th-228	110,208,134	2.85E-11	1.33E-10	2.61E-10	3.14E-06	3.84E-09	1.43E-04
Th-230	110,208,134	7.91E-11	1.74E-10	3.18E-10	8.71E-06	4.31E-04	7.91E-04
Th-232	110,208,134	2.20E-11	1.05E-10	1.83E-10	2.42E-06	2.22E+01	7.33E-04
U-233/234	110,208,134	1.24E-08	1.15E-09	1.74E-10	1.36E-03	2.19E-01	4.13E-02
U-235/236	110,208,134	4.59E-10	2.62E-10	1.57E-10	5.06E-05	2.34E+01	1.53E-03
U-238	110,208,134	1.13E-09	3.57E-10	1.65E-10	1.24E-04	3.71E+02	3.76E-03
						Total:	4.91E-02
WWTF							
Am-241	2,837,713	1.73E-11	6.49E-11	1.18E-10	4.92E-08	1.43E-08	8.66E-04
Cs-137	2,837,713	1.55E-10	9.40E-10	1.50E-09	4.40E-07	5.05E-09	1.55E-04
Na-22	2,837,713	3.40E-10	7.84E-10	1.47E-09	9.64E-07	1.54E-10	5.66E-05
Np-237	2,837,713	2.47E-11	1.66E-10	3.42E-10	7.00E-08	9.95E-05	1.23E-03
Pb-212	2,837,713	6.98E-10	3.44E-09	2.88E-09	1.98E-06	1.43E-12	3.49E-04
Pu-238	2,837,713	0.00E+00	7.15E-11	1.70E-10	0.00E+00	0.00E+00	0.00E+00

¹ ECV: Effluent Concentration Value from 10-CFR-20, Appendix B.

Note: A value of "0" was substituted for negative analytical results.

Radioactivity in Effluent Liquid July 1, 2016 to December 31, 2016

Location	Total Volume (l)	Activity Concentration ($\mu\text{Ci/ml}$)	Error Estimate ($\mu\text{Ci/ml}$)	LLD ($\mu\text{Ci/ml}$)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV ¹
WWTF							
Pu-239/240	2,837,713	9.58E-12	6.87E-11	1.42E-10	2.72E-08	4.37E-07	4.79E-04
Pu-241	2,837,713	0.00E+00	8.72E-09	1.52E-08	0.00E+00	0.00E+00	0.00E+00
Ra-224	2,837,713	9.95E-09	4.30E-09	8.03E-09	2.82E-05	1.78E-10	4.98E-02
Tc-99	2,837,713	0.00E+00	1.11E-07	1.93E-07	0.00E+00	0.00E+00	0.00E+00
Th-228	2,837,713	1.92E-11	1.41E-10	2.87E-10	5.45E-08	6.65E-11	9.60E-05
Th-230	2,837,713	4.84E-11	1.56E-10	3.32E-10	1.37E-07	6.80E-06	4.84E-04
Th-231	2,837,713	4.96E-09	4.93E-08	4.76E-08	1.41E-05	2.65E-11	9.92E-05
Th-232	2,837,713	4.68E-11	1.25E-10	1.98E-10	1.33E-07	1.22E+00	1.56E-03
U-232	2,837,713	0.00E+00	6.56E-11	1.46E-10	0.00E+00	0.00E+00	0.00E+00
U-233/234	2,837,713	3.75E-09	4.94E-10	1.26E-10	1.06E-05	1.71E-03	1.25E-02
U-235/236	2,837,713	2.19E-10	1.27E-10	9.31E-11	6.23E-07	2.88E-01	7.31E-04
U-238	2,837,713	1.30E-10	1.06E-10	1.18E-10	3.69E-07	1.10E+00	4.33E-04
						Total:	6.88E-02

¹ ECV: Effluent Concentration Value from 10-CFR-20, Appendix B.

Note: A value of "0" was substituted for negative analytical results.

**Attachment 2
To Letter Dated February 20, 2017**

**Report of Radioactivity in Effluent Air for the Period
July to December 2016**

(4 Pages to Follow)

Radioactivity in Effluent Air July 1, 2016 to December 31, 2016

Location	Total Volume (m ³)	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV ¹
Main Stack 416		1086.66 m³/min		18.11 m³/sec			
Th-228	286,260,872	2.14E-16	5.60E-17	4.24E-17	6.14E-08	7.50E-11	1.07E-02
Th-230	286,260,872	3.22E-16	8.40E-17	6.37E-17	9.21E-08	4.56E-06	1.61E-02
Th-232	286,260,872	3.22E-16	8.40E-17	6.37E-17	9.21E-08	8.45E-01	8.04E-02
U-234	286,260,872	1.01E-13	2.63E-14	1.99E-14	2.89E-05	4.62E-03	2.02E+00
U-235	286,260,872	3.97E-15	1.04E-15	7.85E-16	1.14E-06	5.26E-01	6.61E-02
U-238	286,260,872	1.61E-15	4.20E-16	3.18E-16	4.60E-07	1.37E+00	2.68E-02
						Total:	2.22E+00
Stack 185 Bldg. 131		106.86 m³/min		1.78 m³/sec			
Pu-241	28,165,960	0.00E+00	8.21E-16	1.70E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	28,165,960	0.00E+00	2.66E-14	5.50E-14	0.00E+00	0.00E+00	0.00E+00
U-234	28,165,960	4.35E-16	7.35E-15	1.95E-14	1.22E-08	1.96E-06	8.70E-03
U-235	28,165,960	1.34E-17	2.27E-16	6.03E-16	3.79E-10	1.75E-04	2.24E-04
						Total:	8.92E-03
Stack 234 Bldg. 234		322.53 m³/min		5.38 m³/sec			
Am-241	84,528,380	0.00E+00	1.97E-17	4.58E-17	0.00E+00	0.00E+00	0.00E+00
Pu-238	84,528,380	0.00E+00	2.41E-17	5.60E-17	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	84,528,380	0.00E+00	8.53E-17	1.99E-16	0.00E+00	0.00E+00	0.00E+00
Pu-241	84,528,380	0.00E+00	4.13E-15	7.94E-15	0.00E+00	0.00E+00	0.00E+00
Th-228	84,528,380	0.00E+00	1.31E-17	3.06E-17	0.00E+00	0.00E+00	0.00E+00
Th-230	84,528,380	0.00E+00	1.64E-16	3.82E-16	0.00E+00	0.00E+00	0.00E+00
Th-232	84,528,380	0.00E+00	2.08E-16	4.84E-16	0.00E+00	0.00E+00	0.00E+00
U-234	84,528,380	0.00E+00	4.48E-16	1.04E-15	0.00E+00	0.00E+00	0.00E+00
U-238	84,528,380	0.00E+00	1.31E-16	3.06E-16	0.00E+00	0.00E+00	0.00E+00
						Total:	0.00E+00
Stack 327 Bldg. 330		1094.83 m³/min		18.25 m³/sec			
Pu-241	288,504,382	4.68E-15	6.88E-16	7.76E-16	1.35E-06	1.31E-08	5.85E-03
Tc-99	288,504,382	1.51E-13	2.22E-14	2.51E-14	4.36E-05	2.58E-03	1.68E-04
U-234	288,504,382	1.25E-13	1.36E-14	8.87E-15	3.60E-05	5.76E-03	2.49E+00
U-235	288,504,382	3.85E-15	4.21E-16	2.74E-16	1.11E-06	5.15E-01	6.42E-02
						Total:	2.56E+00
Stack 421 Bldg. 100		37.13 m³/min		0.62 m³/sec			
Pu-241	9,766,812	3.17E-15	1.48E-15	2.23E-15	3.09E-08	3.00E-10	3.96E-03
Tc-99	9,766,812	1.02E-13	4.78E-14	7.20E-14	1.00E-06	5.92E-05	1.14E-04
U-234	9,766,812	1.28E-13	2.66E-14	2.39E-14	1.25E-06	2.00E-04	2.55E+00
U-235	9,766,812	3.94E-15	8.22E-16	7.40E-16	3.85E-08	1.78E-02	6.57E-02
						Total:	2.62E+00
Stack 424 Bldg. 100		34.93 m³/min		0.58 m³/sec			
Pu-241	9,154,271	9.55E-16	1.02E-15	1.72E-15	8.74E-09	8.48E-11	1.19E-03
Tc-99	9,154,271	3.09E-14	3.30E-14	5.57E-14	2.83E-07	1.67E-05	3.43E-05

¹ ECV: Effluent Concentration Value from 10-CFR-20, Appendix B. Fraction of ECV at the stack is provided for reference only. Concentrations at off-site locations are significantly less than those reported here (at stack) due to the atmospheric dispersion that occurs before the effluent exits the site.

Note: A value of "0" was substituted for negative analytical results.

Radioactivity in Effluent Air July 1, 2016 to December 31, 2016

Location	Total Volume (m ³)	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV ¹
Stack 424 Bldg. 100		34.93 m³/min		0.58 m³/sec			
U-234	9,154,271	5.36E-14	1.47E-14	1.96E-14	4.91E-07	7.87E-05	1.07E+00
U-235	9,154,271	1.66E-15	4.54E-16	6.07E-16	1.52E-08	7.03E-03	2.76E-02
						Total:	1.10E+00
Stack 501 Bldg. 510		55.78 m³/min		0.93 m³/sec			
Pu-241	14,619,922	1.26E-15	9.13E-15	1.62E-14	1.84E-08	1.79E-10	1.58E-03
Th-228	14,619,922	9.63E-16	5.52E-16	7.65E-16	1.41E-08	1.72E-11	4.81E-02
Th-230	14,619,922	1.24E-15	7.09E-16	9.84E-16	1.81E-08	8.96E-07	6.19E-02
Th-232	14,619,922	8.25E-16	4.73E-16	6.56E-16	1.21E-08	1.11E-01	2.06E-01
U-234	14,619,922	2.54E-15	1.46E-15	2.02E-15	3.72E-08	5.96E-06	5.09E-02
U-235	14,619,922	4.47E-16	2.56E-16	3.55E-16	6.54E-09	3.03E-03	7.45E-03
U-238	14,619,922	8.94E-16	5.12E-16	7.11E-16	1.31E-08	3.90E-02	1.49E-02
						Total:	3.91E-01
Stack 502 OCB		137.65 m³/min		2.29 m³/sec			
Pu-241	36,074,842	5.35E-15	9.63E-15	1.61E-14	1.93E-07	1.88E-09	6.69E-03
Th-228	36,074,842	9.61E-16	5.88E-16	7.63E-16	3.47E-08	4.23E-11	4.80E-02
Th-230	36,074,842	1.24E-15	7.56E-16	9.82E-16	4.46E-08	2.21E-06	6.18E-02
Th-232	36,074,842	8.23E-16	5.04E-16	6.54E-16	2.97E-08	2.73E-01	2.06E-01
U-234	36,074,842	2.54E-15	1.55E-15	2.02E-15	9.16E-08	1.47E-05	5.08E-02
U-235	36,074,842	4.46E-16	2.73E-16	3.54E-16	1.61E-08	7.45E-03	7.43E-03
U-238	36,074,842	8.92E-16	5.46E-16	7.09E-16	3.22E-08	9.61E-02	1.49E-02
						Total:	3.95E-01
Stack 573 Bldg 306-W		88.39 m³/min		1.47 m³/sec			
Pu-241	23,310,404	0.00E+00	8.21E-16	1.67E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	23,310,404	0.00E+00	2.65E-14	5.39E-14	0.00E+00	0.00E+00	0.00E+00
U-234	23,310,404	3.92E-16	7.39E-15	1.92E-14	9.13E-09	1.46E-06	7.83E-03
U-235	23,310,404	1.21E-17	2.28E-16	5.93E-16	2.82E-10	1.31E-04	2.02E-04
						Total:	8.04E-03
Stack 600 Bldg. 110		322.13 m³/min		5.37 m³/sec			
Pu-241	84,743,678	5.57E-15	8.29E-16	1.04E-15	4.72E-07	4.58E-09	6.96E-03
Tc-99	84,743,678	1.80E-13	2.68E-14	3.37E-14	1.53E-05	9.03E-04	2.00E-04
U-234	84,743,678	1.13E-13	1.40E-14	1.25E-14	9.54E-06	1.53E-03	2.25E+00
U-235	84,743,678	3.48E-15	4.34E-16	3.87E-16	2.95E-07	1.37E-01	5.80E-02
						Total:	2.32E+00
Stack 615 Bldg. 306-W		40.37 m³/min		0.67 m³/sec			
Pu-241	10,747,155	0.00E+00	8.33E-16	1.75E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	10,747,155	0.00E+00	2.69E-14	5.66E-14	0.00E+00	0.00E+00	0.00E+00
U-234	10,747,155	5.24E-16	7.99E-15	2.00E-14	5.63E-09	9.03E-07	1.05E-02
U-235	10,747,155	1.62E-17	2.47E-16	6.19E-16	1.74E-10	8.07E-05	2.70E-04
						Total:	1.08E-02

¹ ECV: Effluent Concentration Value from 10-CFR-20, Appendix B. Fraction of ECV at the stack is provided for reference only. Concentrations at off-site locations are significantly less than those reported here (at stack) due to the atmospheric dispersion that occurs before the effluent exits the site.

Note: A value of "0" was substituted for negative analytical results.

Radioactivity in Effluent Air July 1, 2016 to December 31, 2016

Location	Total Volume (m ³)	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV ¹
Stack 646 Bldg. 110		35.54 m³/min		0.59 m³/sec			
Pu-241	9,316,071	0.00E+00	9.51E-16	1.94E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	9,316,071	0.00E+00	3.07E-14	6.28E-14	0.00E+00	0.00E+00	0.00E+00
U-234	9,316,071	0.00E+00	7.76E-15	2.23E-14	0.00E+00	0.00E+00	0.00E+00
U-235	9,316,071	0.00E+00	2.40E-16	6.90E-16	0.00E+00	0.00E+00	0.00E+00
						Total:	0.00E+00
Stack 701 Bldg. 307		134.96 m³/min		2.25 m³/sec			
Pu-241	35,594,987	0.00E+00	8.07E-16	1.71E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	35,594,987	0.00E+00	2.61E-14	5.53E-14	0.00E+00	0.00E+00	0.00E+00
U-234	35,594,987	5.51E-16	7.67E-15	1.96E-14	1.96E-08	3.14E-06	1.10E-02
U-235	35,594,987	1.70E-17	2.37E-16	6.07E-16	6.07E-10	2.81E-04	2.84E-04
						Total:	1.13E-02
Stack 702 Bldg. 307		166.39 m³/min		2.77 m³/sec			
Pu-241	43,817,929	0.00E+00	8.41E-16	1.71E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	43,817,929	0.00E+00	2.72E-14	5.53E-14	0.00E+00	0.00E+00	0.00E+00
U-234	43,817,929	1.27E-14	9.75E-15	1.96E-14	5.54E-07	8.88E-05	2.53E-01
U-235	43,817,929	3.91E-16	3.02E-16	6.08E-16	1.71E-08	7.94E-03	6.52E-03
						Total:	2.60E-01
Stack 703 Exhaust Room Air		814.00 m³/min		13.57 m³/sec			
Pu-241	214,504,271	0.00E+00	2.45E-14	5.10E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	214,504,271	2.54E-16	7.46E-16	1.78E-15	5.44E-08	6.65E-11	1.27E-02
Th-230	214,504,271	1.46E-16	4.30E-16	1.03E-15	3.13E-08	1.55E-06	7.31E-03
Th-232	214,504,271	2.08E-16	6.11E-16	1.46E-15	4.45E-08	4.09E-01	5.19E-02
U-234	214,504,271	1.59E-15	4.67E-15	1.12E-14	3.41E-07	5.46E-05	3.18E-02
U-235	214,504,271	1.64E-16	4.83E-16	1.15E-15	3.52E-08	1.63E-02	2.73E-03
U-238	214,504,271	2.00E-16	5.88E-16	1.40E-15	4.29E-08	1.28E-01	3.33E-03
						Total:	1.10E-01
Stack 773 Bldg. 440		186.32 m³/min		3.11 m³/sec			
Pu-241	49,100,331	0.00E+00	3.33E-14	7.27E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	49,100,331	0.00E+00	1.15E-15	3.58E-15	0.00E+00	0.00E+00	0.00E+00
Th-230	49,100,331	0.00E+00	1.48E-15	4.60E-15	0.00E+00	0.00E+00	0.00E+00
Th-232	49,100,331	0.00E+00	9.85E-16	3.06E-15	0.00E+00	0.00E+00	0.00E+00
U-234	49,100,331	0.00E+00	3.04E-15	9.45E-15	0.00E+00	0.00E+00	0.00E+00
U-235	49,100,331	0.00E+00	5.34E-16	1.66E-15	0.00E+00	0.00E+00	0.00E+00
U-238	49,100,331	0.00E+00	1.07E-15	3.32E-15	0.00E+00	0.00E+00	0.00E+00
						Total:	0.00E+00
Stack 774 Bldg. 301		325.60 m³/min		5.43 m³/sec			
Th-228	85,768,834	3.07E-15	4.89E-16	4.48E-16	2.63E-07	3.21E-10	1.53E-01
Th-230	85,768,834	1.05E-14	1.67E-15	1.53E-15	8.97E-07	4.44E-05	5.23E-01
Th-232	85,768,834	6.20E-15	9.87E-16	9.05E-16	5.32E-07	4.88E+00	1.55E+00

¹ ECV: Effluent Concentration Value from 10-CFR-20, Appendix B. Fraction of ECV at the stack is provided for reference only. Concentrations at off-site locations are significantly less than those reported here (at stack) due to the atmospheric dispersion that occurs before the effluent exits the site.

Note: A value of "0" was substituted for negative analytical results.

Radioactivity in Effluent Air July 1, 2016 to December 31, 2016

Location	Total Volume (m ³)	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV ¹
Stack 774 Bldg. 301		325.60 m ³ /min		5.43 m ³ /sec			
U-234	85,768,834	2.79E-14	4.45E-15	4.08E-15	2.40E-06	3.84E-04	5.59E-01
U-235	85,768,834	1.82E-15	2.89E-16	2.65E-16	1.56E-07	7.21E-02	3.03E-02
U-238	85,768,834	1.32E-14	2.09E-15	1.92E-15	1.13E-06	3.37E+00	2.19E-01
						Total:	3.04E+00
Stack 796 Bldg. 100		21.32 m ³ /min		0.36 m ³ /sec			
Pu-241	5,648,491	1.59E-16	9.19E-16	1.73E-15	8.96E-10	8.70E-12	1.98E-04
Tc-99	5,648,491	5.13E-15	2.97E-14	5.58E-14	2.90E-08	1.71E-06	5.70E-06
U-234	5,648,491	2.27E-16	7.29E-15	1.98E-14	1.28E-09	2.06E-07	4.54E-03
U-235	5,648,491	7.02E-18	2.25E-16	6.12E-16	3.97E-11	1.84E-05	1.17E-04
						Total:	4.86E-03

¹ ECV: Effluent Concentration Value from 10-CFR-20, Appendix B. Fraction of ECV at the stack is provided for reference only. Concentrations at off-site locations are significantly less than those reported here (at stack) due to the atmospheric dispersion that occurs before the effluent exits the site.

Note: A value of "0" was substituted for negative analytical results.

**Attachment 3
To Letter Dated February 20, 2017**

**Report of Gaseous Effluent Dose and Activity Concentrations
for the Maximally Exposed
Off-Site Individual for the Release Period
July to December 2016**

(4 Pages to Follow)

Report of Potential Gaseous Effluent Dose to the Maximally Exposed Offsite Individual and on the Maximum Radionuclide Concentrations for the Period: July to December 2016

Introduction

During this biannual period, NRC License SNM-124, Section 9.1.1.3 required NFS to assess the total effective dose equivalent (TEDE) to the maximally exposed offsite receptor and the maximum radioactive air concentrations at the site boundary, attributable to NFS' air effluents. The required biannual assessment has been completed and the details of the assessment are provided in the subsequent sections.

Summary of Methods

In accordance with SNM-124, Section 9.1.1.4 and internal procedure NFS-HS-A-27, the U.S. Department of Energy's CAP88-PC computer program was used to estimate off-site doses and activity concentrations for gaseous effluents. NFS operated eighteen (18) radiological stacks during the 2nd half of 2016. Based on effluent types and stack physical characteristics, releases from these stacks were grouped into effective stacks for modeling purposes. To accommodate the co-location limitation of the model, the effective stacks were taken to be at the approximate center of the plant site. The distance to the site boundary (nearest model receptor distance) was conservatively taken to be 150 meters for all sectors.

Meteorological data were based on five-year average wind speed and direction frequencies as presented in NFS' 1996 Environmental Report. Atmospheric stability class D (neutral atmosphere) was used for all releases (default value recommended by the U.S. Environmental Protection Agency in "User's Guide for COMPLY"). The most conservative inhalation class was assumed for each radionuclide released. A particle size (activity median aerodynamic diameter or AMAD) of 1.0 microns was assumed for modeling purposes since no information on actual particle sizes exists.

Because CAP88-PC models releases over an entire year, the six-month source term (i.e., total curies of each radionuclide released over the period, given in Attachment 2) was annualized (i.e., transformed into a 12-month release) so that airborne activity concentrations would not be under-estimated during the release period.

Summary of Results

Doses are reported in Table 1 below and are derived from the CAP88-PC "Synopsis Report." These doses are at the location of the maximally exposed (off-site) individual (MEI). The results include an adjustment (using the normalization factor mentioned above) to convert the "annualized" doses back to those doses that were actually received in the six-month release period. Activity concentrations reported in Table 2 come directly from the CAP88-PC "Concentration Tables" report; no adjustments are needed for these concentrations. The CAP88-PC output reports are available for review at NFS.

Table 1 summarizes the six-month dose to a hypothetical individual at the MEI location, which was determined to be approximately 400 meters North Northeast from the center of the plant site. The TEDE to the MEI was estimated to be 3.4E-03 mrem for gaseous effluents released during the 2nd half of 2016. The highest organ committed dose equivalent (CDE) to the MEI was estimated to be 1.2E-03 mrem to the lungs. These MEI doses are well below the Environmental Radiological Monitoring Program action levels and applicable regulatory limits/ALARA constraints.

Table 1. Organ Doses and Total Effective Dose Equivalent at the MEI Location

Organ	Committed Dose Equivalent (mrem per 2nd half of 2016)
Adrenals	1.3E-05
Bone Surface	7.4E-04
Breasts	1.3E-05
Stomach Wall	5.4E-04
Upper Large Intestine Wall	3.4E-04
Kidneys	4.5E-05
Lungs	1.2E-03
Ovaries	1.8E-05
Red Bone Marrow	4.1E-05
Spleen	1.3E-05
Thymus	1.3E-05
Uterus	1.3E-05
Bladder Wall	4.3E-05
Brain	1.3E-05
Esophagus	5.7E-04
Small Intestine Wall	5.0E-05
Lower Large Intestine Wall	9.8E-04
Liver	3.5E-05
Muscle	1.3E-05
Pancreas	1.3E-05
Skin	1.7E-05
Testes	1.8E-05
Thyroid	2.5E-04
Total Effective Dose Equivalent	3.4E-03 mrem
Location of MEI:	400 meters North Northeast

Table 2 summarizes the maximum radioactive air concentrations at or beyond the site boundary, as determined by CAP88-PC, for the radionuclides released. The total sum of fractions was estimated to be 4.6E-04 and indicates that exposures to offsite public from gaseous effluents were much less than 1% of the 10 CFR 20, Appendix B, Table 2, Col. 1 values for all offsite receptors including the site boundary. It is noted that the location of the maximum airborne concentration for a given radionuclide does not necessarily correspond to the MEI location. This is due primarily to the fact that the maximum concentrations for individual nuclides can vary due to differences in values input into the dispersion model for each of the effective stacks - such inputs include stack height, stack diameter, flow rate, and total radionuclide activities released per stack. Another reason for the disparity is the fact that the MEI dose includes both inhalation and ingestion pathways.

Table 2. Maximum Predicted Airborne Concentrations at or Beyond the Site Boundary

Maximum Predicted Airborne Concentrations at or Beyond the Site Boundary					
Nuclide	Maximum Concentration (µCi/mL)	Concentration Location		10 CFR 20, App. B, Table 2, Col. 1 Value (µCi/mL)	Ratio of Maximum Concentration to 10 CFR 20 Value
		Sector	Dist. (m)		
⁹⁹ Tc	2.2E-17	NNE	400	9.E-10	2.4E-08
²²⁸ Th	9.7E-20	NNE	450	2.E-14	4.8E-06
²³⁰ Th	2.4E-19	NNE	500	2.E-14	1.2E-05
²³¹ Th	2.4E-21	NNE	450	9.E-09	2.6E-13
²³² Th	1.5E-19	NNE	500	4.E-15	3.8E-05
²³⁴ U	2.0E-17	NNE	400	5.E-14	3.9E-04
²³⁵ U	6.5E-19	NNE	450	6.E-14	1.1E-05
²³⁸ U	3.2E-19	NNE	500	6.E-14	5.3E-06
²⁴¹ Pu	7.6E-19	NNE	400	8.E-13	9.6E-07
Sum of Fractions:					4.6E-04

The TEDE to the MEI for gaseous effluents released during 2016 is provided in Table 3. The results for the 1st half of 2016 were previously reported in *Biannual Effluent Monitoring Report January through June 2016* (21G-16-0159). The annual dose is well below the Environmental Radiological Monitoring Program action levels and applicable regulatory limits/ALARA constraints.

Table 3. Annual Dose to the MEI for Gaseous Effluents Released During 2016

Period Covered	Direction	Distance (m)	TEDE (mrem)
2 nd Half	NNE	400	3.4E-03
1 st Half	NNE	400	3.2E-03
Annual Total			6.6E-03