

21G-16-0054  
GOV-01-55  
ACF-16-0058

February 26, 2016

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 2015**

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 2015. Attachment 2 reports the Radioactivity in Effluent Air for the period July to December 2015. 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 2015.

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-16-0054) 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 2015*
- 2) *Report of Radioactivity in Effluent Air for the Period of July to December 2015*
- 3) *Report of Gaseous Effluent Dose and Activity Concentrations for the Maximally Exposed Off-Site Individual for the Release Period July to December 2015*

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*Attachment 1*  
*To Letter Dated February 26, 2016*

*Report of Radioactivity in Effluent Liquid for the Period*  
*July to December 2015*

**(2 Pages to Follow)**

**Radioactivity in Effluent Liquid  
July 1, 2015 to December 31, 2015**

21G-16-0054  
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Location	Total Volume (l)	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV <sup>1</sup>
<b>Banner Spring Down</b>							
Pu-238	396,853,757	0.00E+00	6.98E-11	1.61E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	396,853,757	0.00E+00	7.60E-11	1.69E-10	0.00E+00	0.00E+00	0.00E+00
Tc-99	396,853,757	1.36E-08	3.84E-08	6.58E-08	5.40E-03	3.20E-01	2.27E-04
Th-228	396,853,757	4.47E-12	1.36E-10	3.10E-10	1.78E-06	2.17E-09	2.24E-05
Th-230	396,853,757	7.65E-11	1.87E-10	3.50E-10	3.03E-05	1.50E-03	7.65E-04
Th-232	396,853,757	1.89E-12	9.81E-11	1.98E-10	7.50E-07	6.88E+00	6.30E-05
U-233/234	396,853,757	4.93E-10	2.49E-10	1.47E-10	1.96E-04	3.13E-02	1.64E-03
U-235/236	396,853,757	6.72E-11	1.29E-10	1.71E-10	2.67E-05	1.24E+01	2.24E-04
U-238	396,853,757	1.33E-10	1.42E-10	1.40E-10	5.30E-05	1.58E+02	4.45E-04
						<b>Total:</b>	<b>3.39E-03</b>
<b>BLEU Sewer</b>							
Pu-238	887,085	1.30E-11	6.67E-11	1.49E-10	1.15E-08	6.72E-10	6.48E-05
Pu-239/240	887,085	3.49E-12	7.72E-11	1.64E-10	3.09E-09	4.97E-08	1.74E-05
Tc-99	887,085	1.50E-09	3.74E-08	6.50E-08	1.33E-06	7.90E-05	2.51E-06
Th-228	887,085	8.98E-11	2.10E-10	3.58E-10	7.97E-08	9.73E-11	4.49E-05
Th-230	887,085	8.95E-11	2.17E-10	3.83E-10	7.94E-08	3.93E-06	8.95E-05
Th-232	887,085	3.83E-12	1.31E-10	2.70E-10	3.40E-09	3.12E-02	1.28E-05
U-232	887,085	1.15E-11	8.30E-11	1.74E-10	1.02E-08	4.76E-10	1.91E-05
U-233/234	887,085	3.18E-10	1.55E-10	1.31E-10	2.82E-07	4.52E-05	1.06E-04
U-235/236	887,085	1.70E-11	5.81E-11	1.06E-10	1.51E-08	6.99E-03	5.67E-06
U-238	887,085	9.07E-11	8.97E-11	9.23E-11	8.04E-08	2.40E-01	3.02E-05
						<b>Total:</b>	<b>3.93E-04</b>
<b>Sewer</b>							
Pu-238	15,898,679	2.58E-11	1.44E-10	2.76E-10	4.11E-07	2.40E-08	1.29E-04
Pu-239/240	15,898,679	0.00E+00	1.35E-10	2.94E-10	0.00E+00	0.00E+00	0.00E+00
Tc-99	15,898,679	2.02E-08	4.22E-08	7.20E-08	3.21E-04	1.90E-02	3.37E-05
Th-228	15,898,679	3.86E-11	1.93E-10	3.91E-10	6.14E-07	7.50E-10	1.93E-05
Th-230	15,898,679	0.00E+00	1.85E-10	4.21E-10	0.00E+00	0.00E+00	0.00E+00
Th-232	15,898,679	1.45E-11	1.39E-10	2.76E-10	2.30E-07	2.11E+00	4.83E-05
U-232	15,898,679	3.67E-11	7.06E-11	1.28E-10	5.83E-07	2.72E-08	6.11E-05
U-233/234	15,898,679	7.11E-09	7.06E-10	1.33E-10	1.13E-04	1.81E-02	2.37E-03
U-235/236	15,898,679	3.15E-10	1.57E-10	7.16E-11	5.00E-06	2.32E+00	1.05E-04
U-238	15,898,679	1.23E-09	2.94E-10	1.29E-10	1.95E-05	5.82E+01	4.08E-04
						<b>Total:</b>	<b>3.18E-03</b>
<b>West Ditch</b>							
Pu-238	146,498,762	0.00E+00	7.92E-11	1.92E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	146,498,762	1.12E-11	8.24E-11	1.70E-10	1.64E-06	2.64E-05	5.61E-04
Tc-99	146,498,762	1.68E-12	3.44E-08	5.98E-08	2.46E-07	1.46E-05	2.80E-08
Th-228	146,498,762	7.67E-11	1.55E-10	2.00E-10	1.12E-05	1.37E-08	3.84E-04
Th-230	146,498,762	7.49E-11	1.78E-10	3.31E-10	1.10E-05	5.43E-04	7.49E-04

<sup>1</sup> 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, 2015 to December 31, 2015**

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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 <sup>1</sup>
<b>West Ditch</b>							
Th-232	146,498,762	2.68E-11	1.10E-10	1.75E-10	3.93E-06	3.60E+01	8.93E-04
U-233/234	146,498,762	1.47E-08	1.23E-09	1.43E-10	2.15E-03	3.45E-01	4.89E-02
U-235/236	146,498,762	8.40E-10	3.41E-10	1.30E-10	1.23E-04	5.70E+01	2.80E-03
U-238	146,498,762	1.65E-09	4.20E-10	1.46E-10	2.41E-04	7.20E+02	5.49E-03
						<b>Total:</b>	<b>5.98E-02</b>
<b>WWTF</b>							
Am-241	3,430,575	2.89E-11	6.60E-11	1.11E-10	9.90E-08	2.89E-08	1.44E-03
Cs-137	3,430,575	9.31E-10	1.17E-09	1.65E-09	3.19E-06	3.67E-08	9.31E-04
Na-22	3,430,575	1.24E-10	9.04E-10	1.59E-09	4.25E-07	6.81E-11	2.06E-05
Np-237	3,430,575	4.94E-11	1.89E-10	3.58E-10	1.69E-07	2.41E-04	2.47E-03
Pb-212	3,430,575	4.52E-10	3.03E-09	2.94E-09	1.55E-06	1.12E-12	2.26E-04
Pu-238	3,430,575	1.45E-11	4.88E-11	9.84E-11	4.97E-08	2.91E-09	7.24E-04
Pu-239/240	3,430,575	2.48E-11	7.53E-11	1.37E-10	8.52E-08	1.37E-06	1.24E-03
Pu-241	3,430,575	0.00E+00	8.24E-09	1.45E-08	0.00E+00	0.00E+00	0.00E+00
Ra-224	3,430,575	7.04E-09	5.02E-09	9.17E-09	2.41E-05	1.52E-10	3.52E-02
Tc-99	3,430,575	5.11E-08	9.75E-08	1.66E-07	1.75E-04	1.04E-02	8.52E-04
Th-228	3,430,575	2.74E-11	1.35E-10	2.72E-10	9.39E-08	1.15E-10	1.37E-04
Th-230	3,430,575	9.48E-11	1.79E-10	3.09E-10	3.25E-07	1.61E-05	9.48E-04
Th-231	3,430,575	1.06E-08	4.27E-08	4.59E-08	3.64E-05	6.84E-11	2.12E-04
Th-232	3,430,575	4.51E-11	1.16E-10	1.81E-10	1.55E-07	1.42E+00	1.50E-03
U-232	3,430,575	1.49E-11	7.83E-11	1.55E-10	5.13E-08	2.39E-09	2.49E-04
U-233/234	3,430,575	2.20E-08	1.14E-09	1.11E-10	7.55E-05	1.21E-02	7.34E-02
U-235/236	3,430,575	1.03E-09	2.50E-10	8.21E-11	3.54E-06	1.64E+00	3.44E-03
U-238	3,430,575	5.04E-10	1.78E-10	1.04E-10	1.73E-06	5.16E+00	1.68E-03
						<b>Total:</b>	<b>1.25E-01</b>

<sup>1</sup> ECV: Effluent Concentration Value from 10-CFR-20, Appendix B.  
Note: A value of "0" was substituted for negative analytical results.

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*Attachment 2*  
*To Letter Dated February 26, 2016*

*Report of Radioactivity in Effluent Air for the Period*  
*July to December 2015*

**(4 Pages to Follow)**

**Radioactivity in Effluent Air**  
**July 1, 2015 to December 31, 2015**

21G-16-0054  
 GOV-01-55  
 ACF-16-0058

Location	Total Volume (m <sup>3</sup> )	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV <sup>1</sup>
<b>Main Stack 416</b>		<b>1075.37 m<sup>3</sup>/min</b>		<b>17.92 m<sup>3</sup>/sec</b>			
U-234	285,063,029	1.20E-13	2.98E-14	1.91E-14	3.43E-05	5.50E-03	2.41E+00
U-235	285,063,029	4.68E-15	1.16E-15	7.44E-16	1.34E-06	6.18E-01	7.81E-02
U-238	285,063,029	1.52E-15	3.76E-16	2.41E-16	4.33E-07	1.29E+00	2.53E-02
						<b>Total:</b>	<b>2.51E+00</b>
<b>Stack 185 Bldg. 131</b>		<b>110.93 m<sup>3</sup>/min</b>		<b>1.85 m<sup>3</sup>/sec</b>			
Pu-241	29,404,090	0.00E+00	8.09E-16	1.65E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	29,404,090	0.00E+00	2.62E-14	5.35E-14	0.00E+00	0.00E+00	0.00E+00
U-234	29,404,090	5.03E-16	6.83E-15	1.87E-14	1.48E-08	2.37E-06	1.01E-02
U-235	29,404,090	1.56E-17	2.11E-16	5.78E-16	4.58E-10	2.12E-04	2.59E-04
						<b>Total:</b>	<b>1.03E-02</b>
<b>Stack 234 Bldg. 234</b>		<b>309.33 m<sup>3</sup>/min</b>		<b>5.16 m<sup>3</sup>/sec</b>			
Am-241	81,070,063	0.00E+00	1.88E-17	4.19E-17	0.00E+00	0.00E+00	0.00E+00
Pu-238	81,070,063	0.00E+00	2.29E-17	5.12E-17	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	81,070,063	0.00E+00	8.14E-17	1.81E-16	0.00E+00	0.00E+00	0.00E+00
Pu-241	81,070,063	0.00E+00	3.97E-15	7.54E-15	0.00E+00	0.00E+00	0.00E+00
Th-228	81,070,063	0.00E+00	1.25E-17	2.79E-17	0.00E+00	0.00E+00	0.00E+00
Th-230	81,070,063	0.00E+00	1.56E-16	3.49E-16	0.00E+00	0.00E+00	0.00E+00
Th-232	81,070,063	0.00E+00	1.98E-16	4.42E-16	0.00E+00	0.00E+00	0.00E+00
U-234	81,070,063	0.00E+00	4.28E-16	9.54E-16	0.00E+00	0.00E+00	0.00E+00
U-238	81,070,063	0.00E+00	1.25E-16	2.79E-16	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>0.00E+00</b>
<b>Stack 327 Bldg. 330</b>		<b>1075.11 m<sup>3</sup>/min</b>		<b>17.92 m<sup>3</sup>/sec</b>			
Pu-241	284,957,337	1.77E-15	5.13E-16	7.55E-16	5.04E-07	4.89E-09	2.21E-03
Tc-99	284,957,337	5.72E-14	1.66E-14	2.44E-14	1.63E-05	9.64E-04	6.35E-05
U-234	284,957,337	1.17E-13	1.28E-14	9.24E-15	3.32E-05	5.32E-03	2.33E+00
U-235	284,957,337	3.60E-15	3.95E-16	2.86E-16	1.03E-06	4.75E-01	6.01E-02
						<b>Total:</b>	<b>2.39E+00</b>
<b>Stack 421 Bldg. 100</b>		<b>33.33 m<sup>3</sup>/min</b>		<b>0.56 m<sup>3</sup>/sec</b>			
Pu-241	8,815,176	5.10E-15	1.51E-15	2.11E-15	4.50E-08	4.37E-10	6.38E-03
Tc-99	8,815,176	1.65E-13	4.88E-14	6.82E-14	1.45E-06	8.60E-05	1.83E-04
U-234	8,815,176	1.43E-13	2.78E-14	2.21E-14	1.26E-06	2.02E-04	2.86E+00
U-235	8,815,176	4.43E-15	8.59E-16	6.84E-16	3.90E-08	1.81E-02	7.38E-02
						<b>Total:</b>	<b>2.94E+00</b>
<b>Stack 424 Bldg. 100</b>		<b>29.36 m<sup>3</sup>/min</b>		<b>0.49 m<sup>3</sup>/sec</b>			
Pu-241	7,793,200	4.94E-16	9.37E-16	1.65E-15	3.85E-09	3.74E-11	6.17E-04
Tc-99	7,793,200	1.60E-14	3.03E-14	5.33E-14	1.24E-07	7.36E-06	1.77E-05
U-234	7,793,200	1.69E-14	1.21E-14	1.82E-14	1.32E-07	2.11E-05	3.38E-01
U-235	7,793,200	5.23E-16	3.73E-16	5.64E-16	4.08E-09	1.89E-03	8.72E-03
						<b>Total:</b>	<b>3.47E-01</b>

<sup>1</sup> 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, 2015 to December 31, 2015**

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Location	Total Volume (m <sup>3</sup> )	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV <sup>1</sup>
<b>Stack 501 Bldg. 510</b>		<b>54.80 m<sup>3</sup>/min</b>		<b>0.91 m<sup>3</sup>/sec</b>			
Pu-241	14,913,633	0.00E+00	6.90E-15	1.39E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	14,913,633	0.00E+00	2.66E-16	6.49E-16	0.00E+00	0.00E+00	0.00E+00
Th-230	14,913,633	0.00E+00	3.42E-16	8.35E-16	0.00E+00	0.00E+00	0.00E+00
Th-232	14,913,633	0.00E+00	2.28E-16	5.57E-16	0.00E+00	0.00E+00	0.00E+00
U-234	14,913,633	0.00E+00	7.03E-16	1.72E-15	0.00E+00	0.00E+00	0.00E+00
U-235	14,913,633	0.00E+00	1.23E-16	3.02E-16	0.00E+00	0.00E+00	0.00E+00
U-238	14,913,633	0.00E+00	2.47E-16	6.03E-16	0.00E+00	0.00E+00	0.00E+00
<b>Total:</b>						<b>0.00E+00</b>	
<b>Stack 502 OCB</b>		<b>193.26 m<sup>3</sup>/min</b>		<b>3.22 m<sup>3</sup>/sec</b>			
Pu-241	52,605,744	0.00E+00	7.21E-15	1.38E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	52,605,744	4.21E-17	2.99E-16	6.49E-16	2.22E-09	2.71E-12	2.11E-03
Th-230	52,605,744	5.42E-17	3.84E-16	8.35E-16	2.85E-09	1.41E-07	2.71E-03
Th-232	52,605,744	3.61E-17	2.56E-16	5.56E-16	1.90E-09	1.74E-02	9.03E-03
U-234	52,605,744	1.11E-16	7.90E-16	1.72E-15	5.86E-09	9.39E-07	2.23E-03
U-235	52,605,744	1.96E-17	1.39E-16	3.01E-16	1.03E-09	4.76E-04	3.26E-04
U-238	52,605,744	3.91E-17	2.78E-16	6.03E-16	2.06E-09	6.14E-03	6.52E-04
<b>Total:</b>						<b>1.70E-02</b>	
<b>Stack 573 Bldg. 306-W</b>		<b>89.12 m<sup>3</sup>/min</b>		<b>1.49 m<sup>3</sup>/sec</b>			
Pu-241	23,636,859	0.00E+00	7.61E-16	1.54E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	23,636,859	0.00E+00	2.46E-14	4.99E-14	0.00E+00	0.00E+00	0.00E+00
U-234	23,636,859	0.00E+00	6.47E-15	1.81E-14	0.00E+00	0.00E+00	0.00E+00
U-235	23,636,859	0.00E+00	2.00E-16	5.60E-16	0.00E+00	0.00E+00	0.00E+00
<b>Total:</b>						<b>0.00E+00</b>	
<b>Stack 600 Bldg. 110</b>		<b>339.63 m<sup>3</sup>/min</b>		<b>5.66 m<sup>3</sup>/sec</b>			
Pu-241	90,044,307	1.96E-14	9.46E-16	1.00E-15	1.76E-06	1.71E-08	2.45E-02
Tc-99	90,044,307	6.34E-13	3.06E-14	3.24E-14	5.71E-05	3.38E-03	7.04E-04
U-234	90,044,307	8.84E-14	1.11E-14	1.25E-14	7.96E-06	1.28E-03	1.77E+00
U-235	90,044,307	2.73E-15	3.43E-16	3.86E-16	2.46E-07	1.14E-01	4.56E-02
<b>Total:</b>						<b>1.84E+00</b>	
<b>Stack 615 Bldg. 306-W</b>		<b>33.71 m<sup>3</sup>/min</b>		<b>0.56 m<sup>3</sup>/sec</b>			
Pu-241	8,906,148	0.00E+00	7.78E-16	1.62E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	8,906,148	0.00E+00	2.51E-14	5.23E-14	0.00E+00	0.00E+00	0.00E+00
U-234	8,906,148	0.00E+00	6.07E-15	1.82E-14	0.00E+00	0.00E+00	0.00E+00
U-235	8,906,148	0.00E+00	1.88E-16	5.62E-16	0.00E+00	0.00E+00	0.00E+00
<b>Total:</b>						<b>0.00E+00</b>	
<b>Stack 646 Bldg. 110</b>		<b>30.82 m<sup>3</sup>/min</b>		<b>0.51 m<sup>3</sup>/sec</b>			
Pu-241	8,183,388	0.00E+00	9.31E-16	1.88E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	8,183,388	0.00E+00	3.01E-14	6.08E-14	0.00E+00	0.00E+00	0.00E+00
U-234	8,183,388	0.00E+00	6.85E-15	2.08E-14	0.00E+00	0.00E+00	0.00E+00

<sup>1</sup> 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, 2015 to December 31, 2015**

21G-16-0054  
 GOV-01-55  
 ACF-16-0058

Location	Total Volume (m <sup>3</sup> )	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV <sup>1</sup>
<b>Stack 646 Bldg. 110</b>		<b>30.82 m<sup>3</sup>/min</b>		<b>0.51 m<sup>3</sup>/sec</b>			
U-235	8,183,388	0.00E+00	2.12E-16	6.43E-16	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>0.00E+00</b>
<b>Stack 701 Bldg. 307</b>		<b>153.16 m<sup>3</sup>/min</b>		<b>2.55 m<sup>3</sup>/sec</b>			
Pu-241	40,581,190	0.00E+00	8.06E-16	1.62E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	40,581,190	0.00E+00	2.60E-14	5.24E-14	0.00E+00	0.00E+00	0.00E+00
U-234	40,581,190	2.62E-15	7.64E-15	1.81E-14	1.06E-07	1.70E-05	5.23E-02
U-235	40,581,190	8.09E-17	2.36E-16	5.59E-16	3.28E-09	1.52E-03	1.35E-03
						<b>Total:</b>	<b>5.37E-02</b>
<b>Stack 702 Bldg. 307</b>		<b>150.11 m<sup>3</sup>/min</b>		<b>2.50 m<sup>3</sup>/sec</b>			
Pu-241	39,101,970	0.00E+00	8.01E-16	1.64E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	39,101,970	0.00E+00	2.59E-14	5.31E-14	0.00E+00	0.00E+00	0.00E+00
U-234	39,101,970	4.93E-15	8.73E-15	1.83E-14	1.93E-07	3.09E-05	9.86E-02
U-235	39,101,970	1.53E-16	2.70E-16	5.67E-16	5.96E-09	2.76E-03	2.54E-03
						<b>Total:</b>	<b>1.01E-01</b>
<b>Stack 703 Exhaust Room Air</b>		<b>815.72 m<sup>3</sup>/min</b>		<b>13.60 m<sup>3</sup>/sec</b>			
Pu-241	216,134,098	0.00E+00	2.35E-14	4.82E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	216,134,098	3.26E-16	7.51E-16	1.66E-15	7.05E-08	8.60E-11	1.63E-02
Th-230	216,134,098	1.88E-16	4.32E-16	9.55E-16	4.06E-08	2.01E-06	9.39E-03
Th-232	216,134,098	2.67E-16	6.14E-16	1.36E-15	5.77E-08	5.29E-01	6.67E-02
U-234	216,134,098	2.04E-15	4.70E-15	1.04E-14	4.41E-07	7.07E-05	4.08E-02
U-235	216,134,098	2.11E-16	4.85E-16	1.07E-15	4.56E-08	2.11E-02	3.51E-03
U-238	216,134,098	2.57E-16	5.92E-16	1.31E-15	5.55E-08	1.66E-01	4.28E-03
						<b>Total:</b>	<b>1.41E-01</b>
<b>Stack 773 Bldg. 440</b>		<b>199.41 m<sup>3</sup>/min</b>		<b>3.32 m<sup>3</sup>/sec</b>			
Pu-241	52,834,947	0.00E+00	3.27E-14	6.84E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	52,834,947	0.00E+00	1.18E-15	3.26E-15	0.00E+00	0.00E+00	0.00E+00
Th-230	52,834,947	0.00E+00	1.51E-15	4.19E-15	0.00E+00	0.00E+00	0.00E+00
Th-232	52,834,947	0.00E+00	1.01E-15	2.79E-15	0.00E+00	0.00E+00	0.00E+00
U-234	52,834,947	0.00E+00	3.11E-15	8.60E-15	0.00E+00	0.00E+00	0.00E+00
U-235	52,834,947	0.00E+00	5.46E-16	1.51E-15	0.00E+00	0.00E+00	0.00E+00
U-238	52,834,947	0.00E+00	1.09E-15	3.02E-15	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>0.00E+00</b>
<b>Stack 774 Bldg. 301</b>		<b>330.89 m<sup>3</sup>/min</b>		<b>5.51 m<sup>3</sup>/sec</b>			
Th-228	87,913,136	1.34E-16	2.14E-16	4.51E-16	1.18E-08	1.44E-11	6.71E-03
Th-230	87,913,136	4.58E-16	7.30E-16	1.54E-15	4.02E-08	1.99E-06	2.29E-02
Th-232	87,913,136	2.71E-16	4.33E-16	9.12E-16	2.39E-08	2.19E-01	6.78E-02
U-234	87,913,136	1.22E-15	1.95E-15	4.11E-15	1.07E-07	1.72E-05	2.44E-02
U-235	87,913,136	7.95E-17	1.27E-16	2.67E-16	6.99E-09	3.23E-03	1.32E-03

<sup>1</sup> 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, 2015 to December 31, 2015**

21G-16-0054  
 GOV-01-55  
 ACF-16-0058

Location	Total Volume (m <sup>3</sup> )	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV <sup>1</sup>
<b>Stack 774 Bldg. 301</b>		<b>330.89 m<sup>3</sup>/min</b>		<b>5.51 m<sup>3</sup>/sec</b>			
U-238	87,913,136	5.76E-16	9.18E-16	1.93E-15	5.06E-08	1.51E-01	9.59E-03
						<b>Total:</b>	<b>1.33E-01</b>
<b>Stack 796 Bldg. 100</b>		<b>23.79 m<sup>3</sup>/min</b>		<b>0.40 m<sup>3</sup>/sec</b>			
Pu-241	6,305,723	0.00E+00	8.49E-16	1.65E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	6,305,723	0.00E+00	2.75E-14	5.34E-14	0.00E+00	0.00E+00	0.00E+00
U-234	6,305,723	0.00E+00	5.97E-15	1.83E-14	0.00E+00	0.00E+00	0.00E+00
U-235	6,305,723	0.00E+00	1.85E-16	5.65E-16	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>0.00E+00</b>

<sup>1</sup> 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.

21G-16-0054  
GOV-01-55  
ACF-16-0058

*Attachment 3*  
*To Letter Dated February 26, 2016*

*Report of Gaseous Effluent Dose and Activity Concentrations*  
*for the Maximally Exposed*  
*Off-Site Individual for the Release Period*  
*July to December 2015*

**(3 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 2015**

**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 2<sup>nd</sup> half of 2015. 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 450 meters North Northeast from the center of the plant site. The TEDE to the MEI was estimated to be 2.9E-03 mrem for gaseous effluents released during the 2<sup>nd</sup> half of 2015. The highest organ committed dose equivalent (CDE) to the MEI was estimated to be 1.1E-03 mrem to the lower large intestine wall and 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**

<b>Organ</b>	<b>Committed Dose Equivalent (mrem per 2<sup>nd</sup> half of 2015)</b>
Adrenals	1.4E-05
Bone Surface	1.7E-04
Breasts	1.4E-05
Stomach Wall	6.3E-04
Upper Large Intestine Wall	4.0E-04
Kidneys	3.5E-05
Lungs	1.1E-03
Ovaries	1.4E-05
Red Bone Marrow	2.1E-05
Spleen	1.4E-05
Thymus	1.4E-05
Uterus	1.4E-05
Bladder Wall	4.9E-05
Brain	1.4E-05
Esophagus	5.0E-04
Small Intestine Wall	5.6E-05
Lower Large Intestine Wall	1.1E-03
Liver	2.9E-05
Muscle	1.4E-05
Pancreas	1.4E-05
Skin	1.4E-05
Testes	1.4E-05
Thyroid	3.0E-04
<b>Total Effective Dose Equivalent</b>	<b>2.9E-03 mrem</b>
Location of MEI:	450 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 3.7E-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**

<b>Maximum Predicted Airborne Concentrations at or Beyond the Site Boundary</b>					
<b>Nuclide</b>	<b>Maximum Concentration (µCi/mL)</b>	<b>Concentration Location</b>		<b>10 CFR 20, App. B, Table 2, Col. 1 Value (µCi/mL)</b>	<b>Ratio of Maximum Concentration to 10 CFR 20 Value</b>
		<b>Sector</b>	<b>Dist. (m)</b>		
<sup>99</sup> Tc	2.7E-17	NNE	400	9.E-10	3.0E-08
<sup>228</sup> Th	2.4E-20	NNE	450	2.E-14	1.2E-06
<sup>230</sup> Th	2.2E-20	NNE	450	2.E-14	1.1E-06
<sup>231</sup> Th	2.1E-21	NNE	450	9.E-09	2.3E-13
<sup>232</sup> Th	2.3E-20	NNE	450	4.E-15	5.7E-06
<sup>234</sup> U	1.8E-17	NNE	450	5.E-14	3.5E-04
<sup>235</sup> U	5.7E-19	NNE	450	6.E-14	9.6E-06
<sup>238</sup> U	7.2E-20	NNE	650	6.E-14	1.2E-06
<sup>241</sup> Pu	8.2E-19	NNE	400	8.E-13	1.0E-06
<b>Sum of Fractions:</b>					<b>3.7E-04</b>

The TEDE to the MEI for gaseous effluents released during 2015 is provided in Table 3. The results for the 1<sup>st</sup> half of 2015 were previously reported in *Biannual Effluent Monitoring Report January through June 2015* (21G-15-0158). 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 2015**

<b>Period Covered</b>	<b>Direction</b>	<b>Distance (m)</b>	<b>TEDE (mrem)</b>
2 <sup>nd</sup> Half	NNE	450	2.9E-03
1 <sup>st</sup> Half	NNE	450	3.5E-03
<b>Annual Total</b>			<b>6.4E-03</b>