

21G-16-0159  
GOV-01-55  
ACF-16-0235  
August 24, 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 January to June 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 January to June 2016. The Sanitary Sewer sample collected at the BLEU Complex was discontinued in February. At that time, all connections to the Sanitary Sewer, from the former process area, were isolated. Attachment 2 reports the Radioactivity in Effluent Air for the period January to June 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 January to June 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-16-0159) 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 January to June 2016
- 2) Report of Radioactivity in Effluent Air for the Period of January to June 2016
- 3) Report of Gaseous Effluent Dose and Activity Concentrations for the Maximally Exposed Off-Site Individual for the Release Period January to June 2016

IE48  
NMSS20  
NMSS

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**Attachment 1  
To Letter Dated August 24, 2016**

**Report of Radioactivity in Effluent Liquid for the Period  
January to June 2016**

**(2 Pages to Follow)**

**Radioactivity in Effluent Liquid  
 January 1, 2016 to June 30, 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 <sup>1</sup>
<b>Banner Spring Down</b>							
Pu-238	448,388,190	0.00E+00	5.90E-11	1.62E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	448,388,190	0.00E+00	6.55E-11	1.64E-10	0.00E+00	0.00E+00	0.00E+00
Tc-99	448,388,190	2.96E-09	4.27E-08	7.40E-08	1.33E-03	7.87E-02	4.94E-05
Th-228	448,388,190	0.00E+00	1.51E-10	3.54E-10	0.00E+00	0.00E+00	0.00E+00
Th-230	448,388,190	1.83E-10	2.56E-10	4.05E-10	8.19E-05	4.06E-03	1.83E-03
Th-232	448,388,190	8.05E-11	1.65E-10	2.55E-10	3.61E-05	3.31E+02	2.68E-03
U-233/234	448,388,190	6.38E-10	2.25E-10	1.43E-10	2.86E-04	4.59E-02	2.13E-03
U-235/236	448,388,190	7.24E-11	9.99E-11	1.26E-10	3.25E-05	1.50E+01	2.41E-04
U-238	448,388,190	8.56E-11	9.92E-11	1.44E-10	3.84E-05	1.15E+02	2.85E-04
						<b>Total:</b>	<b>7.21E-03</b>
<b>BLEU Sewer</b>							
Pu-238	137,751	1.10E-11	1.25E-10	2.60E-10	1.52E-09	8.90E-11	5.52E-05
Pu-239/240	137,751	0.00E+00	1.23E-10	3.10E-10	0.00E+00	0.00E+00	0.00E+00
Tc-99	137,751	1.04E-08	3.98E-08	6.80E-08	1.44E-06	8.51E-05	1.74E-05
Th-228	137,751	8.53E-11	2.06E-10	3.54E-10	1.17E-08	1.43E-11	4.26E-05
Th-230	137,751	9.35E-11	2.02E-10	3.59E-10	1.29E-08	6.38E-07	9.35E-05
Th-232	137,751	2.14E-12	1.15E-10	2.49E-10	2.95E-10	2.71E-03	7.14E-06
U-232	137,751	0.00E+00	8.42E-11	2.12E-10	0.00E+00	0.00E+00	0.00E+00
U-233/234	137,751	4.28E-10	2.16E-10	1.60E-10	5.90E-08	9.45E-06	1.43E-04
U-235/236	137,751	7.47E-11	1.08E-10	1.68E-10	1.03E-08	4.77E-03	2.49E-05
U-238	137,751	2.00E-10	1.53E-10	1.39E-10	2.75E-08	8.22E-02	6.67E-05
						<b>Total:</b>	<b>4.50E-04</b>
<b>Sewer</b>							
Pu-238	11,720,858	0.00E+00	1.34E-10	3.04E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	11,720,858	1.43E-11	1.65E-10	3.54E-10	1.68E-07	2.70E-06	7.15E-05
Tc-99	11,720,858	1.85E-09	4.07E-08	7.06E-08	2.17E-05	1.28E-03	3.08E-06
Th-228	11,720,858	8.42E-11	2.21E-10	3.76E-10	9.87E-07	1.21E-09	4.21E-05
Th-230	11,720,858	3.07E-10	3.34E-10	4.76E-10	3.60E-06	1.78E-04	3.07E-04
Th-232	11,720,858	1.02E-10	1.91E-10	3.04E-10	1.20E-06	1.10E+01	3.40E-04
U-232	11,720,858	2.59E-11	1.61E-10	3.26E-10	3.03E-07	1.42E-08	4.31E-05
U-233/234	11,720,858	1.08E-08	1.25E-09	2.15E-10	1.27E-04	2.04E-02	3.61E-03
U-235/236	11,720,858	5.94E-10	3.09E-10	2.68E-10	6.96E-06	3.22E+00	1.98E-04
U-238	11,720,858	1.81E-09	5.00E-10	2.04E-10	2.12E-05	6.32E+01	6.02E-04
						<b>Total:</b>	<b>5.22E-03</b>
<b>West Ditch</b>							
Pu-238	150,428,006	0.00E+00	4.69E-11	1.27E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	150,428,006	0.00E+00	5.06E-11	1.44E-10	0.00E+00	0.00E+00	0.00E+00
Tc-99	150,428,006	0.00E+00	4.00E-08	7.05E-08	0.00E+00	0.00E+00	0.00E+00
Th-228	150,428,006	3.91E-11	1.58E-10	3.14E-10	5.88E-06	7.18E-09	1.95E-04
Th-230	150,428,006	7.48E-11	1.83E-10	3.32E-10	1.13E-05	5.57E-04	7.48E-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  
 January 1, 2016 to June 30, 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 <sup>1</sup>
<b>West Ditch</b>							
Th-232	150,428,006	3.78E-11	1.12E-10	1.91E-10	5.69E-06	5.22E+01	1.26E-03
U-233/234	150,428,006	1.78E-08	1.19E-09	1.41E-10	2.68E-03	4.29E-01	5.93E-02
U-235/236	150,428,006	9.88E-10	3.13E-10	1.22E-10	1.49E-04	6.88E+01	3.29E-03
U-238	150,428,006	2.32E-09	4.30E-10	1.28E-10	3.49E-04	1.04E+03	7.74E-03
						<b>Total:</b>	<b>7.26E-02</b>
<b>WWTF</b>							
Am-241	3,634,210	2.14E-11	8.15E-11	1.34E-10	7.79E-08	2.27E-08	1.07E-03
Cs-137	3,634,210	2.85E-10	1.11E-09	1.72E-09	1.04E-06	1.19E-08	2.85E-04
Na-22	3,634,210	0.00E+00	9.10E-10	1.59E-09	0.00E+00	0.00E+00	0.00E+00
Np-237	3,634,210	0.00E+00	1.44E-10	3.77E-10	0.00E+00	0.00E+00	0.00E+00
Pb-212	3,634,210	8.41E-10	3.46E-09	3.38E-09	3.06E-06	2.21E-12	4.20E-04
Pu-238	3,634,210	1.47E-11	9.39E-11	1.87E-10	5.35E-08	3.13E-09	7.36E-04
Pu-239/240	3,634,210	9.89E-12	8.71E-11	1.77E-10	3.59E-08	5.78E-07	4.95E-04
Pu-241	3,634,210	0.00E+00	9.54E-09	1.67E-08	0.00E+00	0.00E+00	0.00E+00
Ra-224	3,634,210	7.97E-09	3.14E-09	5.75E-09	2.90E-05	1.82E-10	3.99E-02
Tc-99	3,634,210	0.00E+00	1.12E-07	1.97E-07	0.00E+00	0.00E+00	0.00E+00
Th-228	3,634,210	1.25E-11	1.60E-10	3.27E-10	4.55E-08	5.56E-11	6.27E-05
Th-230	3,634,210	7.41E-11	1.92E-10	3.78E-10	2.69E-07	1.33E-05	7.41E-04
Th-231	3,634,210	1.05E-08	4.11E-08	4.62E-08	3.80E-05	7.15E-11	2.09E-04
Th-232	3,634,210	4.08E-11	1.31E-10	2.06E-10	1.48E-07	1.36E+00	1.36E-03
U-232	3,634,210	1.74E-11	9.73E-11	2.00E-10	6.33E-08	2.96E-09	2.90E-04
U-233/234	3,634,210	6.38E-09	6.62E-10	1.43E-10	2.32E-05	3.72E-03	2.13E-02
U-235/236	3,634,210	3.30E-10	1.65E-10	1.04E-10	1.20E-06	5.55E-01	1.10E-03
U-238	3,634,210	1.79E-10	1.27E-10	1.14E-10	6.52E-07	1.94E+00	5.98E-04
						<b>Total:</b>	<b>6.85E-02</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.

**Attachment 2  
To Letter Dated August 24, 2016**

**Report of Radioactivity in Effluent Air for the Period  
January to June 2016**

**(4 Pages to Follow)**

## Radioactivity in Effluent Air January 1, 2016 to June 30, 2016

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>1062.28 m<sup>3</sup>/min</b>		<b>17.70 m<sup>3</sup>/sec</b>			
Th-230	276,872,219	2.80E-16	7.87E-17	6.14E-17	7.76E-08	3.84E-06	1.40E-02
U-234	276,872,219	8.64E-14	2.43E-14	1.89E-14	2.39E-05	3.83E-03	1.73E+00
U-235	276,872,219	4.20E-15	1.18E-15	9.21E-16	1.16E-06	5.39E-01	7.01E-02
U-238	276,872,219	2.52E-15	7.09E-16	5.53E-16	6.98E-07	2.08E+00	4.20E-02
						<b>Total:</b>	<b>1.85E+00</b>
<b>Stack 185 Bldg. 131</b>		<b>110.55 m<sup>3</sup>/min</b>		<b>1.84 m<sup>3</sup>/sec</b>			
Pu-241	28,813,487	0.00E+00	8.61E-16	1.80E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	28,813,487	0.00E+00	2.78E-14	5.82E-14	0.00E+00	0.00E+00	0.00E+00
U-234	28,813,487	0.00E+00	6.88E-15	1.97E-14	0.00E+00	0.00E+00	0.00E+00
U-235	28,813,487	0.00E+00	2.13E-16	6.09E-16	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>0.00E+00</b>
<b>Stack 234 Bldg. 234</b>		<b>315.93 m<sup>3</sup>/min</b>		<b>5.27 m<sup>3</sup>/sec</b>			
Am-241	82,666,209	4.28E-17	2.55E-17	4.43E-17	3.54E-09	1.03E-09	2.14E-03
Pu-238	82,666,209	5.24E-17	3.12E-17	5.42E-17	4.33E-09	2.53E-10	2.62E-03
Pu-239/240	82,666,209	1.86E-16	1.11E-16	1.92E-16	1.53E-08	2.47E-07	9.28E-03
Pu-241	82,666,209	0.00E+00	4.21E-15	7.94E-15	0.00E+00	0.00E+00	0.00E+00
Th-228	82,666,209	2.86E-17	1.70E-17	2.96E-17	2.36E-09	2.88E-12	1.43E-03
Th-230	82,666,209	3.57E-16	2.13E-16	3.69E-16	2.95E-08	1.46E-06	1.79E-02
Th-232	82,666,209	4.52E-16	2.70E-16	4.68E-16	3.74E-08	3.43E-01	1.13E-01
U-234	82,666,209	9.76E-16	5.82E-16	1.01E-15	8.07E-08	1.29E-05	1.95E-02
U-238	82,666,209	2.86E-16	1.70E-16	2.96E-16	2.36E-08	7.05E-02	4.76E-03
						<b>Total:</b>	<b>1.71E-01</b>
<b>Stack 327 Bldg. 330</b>		<b>1096.37 m<sup>3</sup>/min</b>		<b>18.27 m<sup>3</sup>/sec</b>			
Pu-241	285,758,346	3.41E-15	6.20E-16	7.71E-16	9.75E-07	9.46E-09	4.26E-03
Tc-99	285,758,346	1.10E-13	2.00E-14	2.49E-14	3.15E-05	1.86E-03	1.23E-04
U-234	285,758,346	1.54E-13	1.47E-14	8.68E-15	4.39E-05	7.04E-03	3.08E+00
U-235	285,758,346	4.76E-15	4.53E-16	2.68E-16	1.36E-06	6.29E-01	7.93E-02
						<b>Total:</b>	<b>3.16E+00</b>
<b>Stack 421 Bldg. 100</b>		<b>34.15 m<sup>3</sup>/min</b>		<b>0.57 m<sup>3</sup>/sec</b>			
Pu-241	8,900,888	3.29E-15	1.45E-15	2.25E-15	2.93E-08	2.84E-10	4.11E-03
Tc-99	8,900,888	1.06E-13	4.69E-14	7.28E-14	9.46E-07	5.60E-05	1.18E-04
U-234	8,900,888	9.19E-14	2.28E-14	2.27E-14	8.18E-07	1.31E-04	1.84E+00
U-235	8,900,888	2.84E-15	7.06E-16	7.02E-16	2.53E-08	1.17E-02	4.74E-02
						<b>Total:</b>	<b>1.89E+00</b>
<b>Stack 424 Bldg. 100</b>		<b>27.86 m<sup>3</sup>/min</b>		<b>0.46 m<sup>3</sup>/sec</b>			
Pu-241	7,262,416	1.43E-16	9.48E-16	1.79E-15	1.04E-09	1.01E-11	1.78E-04
Tc-99	7,262,416	4.61E-15	3.07E-14	5.78E-14	3.35E-08	1.98E-06	5.13E-06
U-234	7,262,416	8.04E-15	1.13E-14	1.96E-14	5.84E-08	9.36E-06	1.61E-01

<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  
 January 1, 2016 to June 30, 2016**

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 424 Bldg. 100</b>		<b>27.86 m<sup>3</sup>/min</b>		<b>0.46 m<sup>3</sup>/sec</b>			
U-235	7,262,416	2.49E-16	3.48E-16	6.05E-16	1.81E-09	8.36E-04	4.15E-03
						<b>Total:</b>	<b>1.65E-01</b>
<b>Stack 501 Bldg. 510</b>		<b>54.74 m<sup>3</sup>/min</b>		<b>0.91 m<sup>3</sup>/sec</b>			
Pu-241	14,345,334	0.00E+00	6.92E-15	1.34E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	14,345,334	0.00E+00	2.44E-16	6.12E-16	0.00E+00	0.00E+00	0.00E+00
Th-230	14,345,334	0.00E+00	3.14E-16	7.86E-16	0.00E+00	0.00E+00	0.00E+00
Th-232	14,345,334	0.00E+00	2.09E-16	5.24E-16	0.00E+00	0.00E+00	0.00E+00
U-234	14,345,334	0.00E+00	6.45E-16	1.62E-15	0.00E+00	0.00E+00	0.00E+00
U-235	14,345,334	0.00E+00	1.13E-16	2.84E-16	0.00E+00	0.00E+00	0.00E+00
U-238	14,345,334	0.00E+00	2.27E-16	5.68E-16	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>0.00E+00</b>
<b>Stack 502 OCB</b>		<b>192.58 m<sup>3</sup>/min</b>		<b>3.21 m<sup>3</sup>/sec</b>			
Pu-241	50,472,126	7.54E-15	8.68E-15	1.45E-14	3.80E-07	3.69E-09	9.42E-03
Th-228	50,472,126	2.94E-16	3.90E-16	6.63E-16	1.48E-08	1.81E-11	1.47E-02
Th-230	50,472,126	3.77E-16	5.02E-16	8.52E-16	1.91E-08	9.43E-07	1.89E-02
Th-232	50,472,126	2.52E-16	3.34E-16	5.68E-16	1.27E-08	1.17E-01	6.29E-02
U-234	50,472,126	7.76E-16	1.03E-15	1.75E-15	3.92E-08	6.28E-06	1.55E-02
U-235	50,472,126	1.36E-16	1.81E-16	3.08E-16	6.88E-09	3.19E-03	2.27E-03
U-238	50,472,126	2.73E-16	3.62E-16	6.16E-16	1.38E-08	4.11E-02	4.54E-03
						<b>Total:</b>	<b>1.28E-01</b>
<b>Stack 573 Bldg 306-W</b>		<b>85.80 m<sup>3</sup>/min</b>		<b>1.43 m<sup>3</sup>/sec</b>			
Pu-241	22,345,766	0.00E+00	8.50E-16	1.65E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	22,345,766	0.00E+00	2.75E-14	5.32E-14	0.00E+00	0.00E+00	0.00E+00
U-234	22,345,766	3.58E-15	7.52E-15	1.81E-14	8.00E-08	1.28E-05	7.16E-02
U-235	22,345,766	1.11E-16	2.33E-16	5.60E-16	2.48E-09	1.15E-03	1.85E-03
						<b>Total:</b>	<b>7.35E-02</b>
<b>Stack 600 Bldg. 110</b>		<b>349.77 m<sup>3</sup>/min</b>		<b>5.83 m<sup>3</sup>/sec</b>			
Pu-241	91,163,983	3.46E-15	7.63E-16	1.04E-15	3.15E-07	3.06E-09	4.32E-03
Tc-99	91,163,983	1.12E-13	2.47E-14	3.38E-14	1.02E-05	6.03E-04	1.24E-04
U-234	91,163,983	8.49E-14	1.22E-14	1.21E-14	7.74E-06	1.24E-03	1.70E+00
U-235	91,163,983	2.63E-15	3.76E-16	3.74E-16	2.39E-07	1.11E-01	4.38E-02
						<b>Total:</b>	<b>1.75E+00</b>
<b>Stack 615 Bldg. 306-W</b>		<b>34.94 m<sup>3</sup>/min</b>		<b>0.58 m<sup>3</sup>/sec</b>			
Pu-241	9,107,542	0.00E+00	8.70E-16	1.77E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	9,107,542	0.00E+00	2.81E-14	5.73E-14	0.00E+00	0.00E+00	0.00E+00
U-234	9,107,542	0.00E+00	6.81E-15	1.94E-14	0.00E+00	0.00E+00	0.00E+00
U-235	9,107,542	0.00E+00	2.11E-16	6.00E-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.



## Radioactivity in Effluent Air January 1, 2016 to June 30, 2016

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>29.02 m<sup>3</sup>/min</b>		<b>0.48 m<sup>3</sup>/sec</b>			
Pu-241	7,565,016	0.00E+00	9.65E-16	2.03E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	7,565,016	0.00E+00	3.12E-14	6.55E-14	0.00E+00	0.00E+00	0.00E+00
U-234	7,565,016	0.00E+00	6.92E-15	2.22E-14	0.00E+00	0.00E+00	0.00E+00
U-235	7,565,016	0.00E+00	2.14E-16	6.86E-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>153.19 m<sup>3</sup>/min</b>		<b>2.55 m<sup>3</sup>/sec</b>			
Pu-241	39,928,525	0.00E+00	8.54E-16	1.79E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	39,928,525	0.00E+00	2.76E-14	5.78E-14	0.00E+00	0.00E+00	0.00E+00
U-234	39,928,525	0.00E+00	7.05E-15	1.95E-14	0.00E+00	0.00E+00	0.00E+00
U-235	39,928,525	0.00E+00	2.18E-16	6.05E-16	0.00E+00	0.00E+00	0.00E+00
<b>Total:</b>						<b>0.00E+00</b>	
<b>Stack 702 Bldg. 307</b>		<b>148.55 m<sup>3</sup>/min</b>		<b>2.48 m<sup>3</sup>/sec</b>			
Pu-241	38,718,123	0.00E+00	9.12E-16	1.77E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	38,718,123	0.00E+00	2.95E-14	5.73E-14	0.00E+00	0.00E+00	0.00E+00
U-234	38,718,123	6.50E-15	1.01E-14	1.94E-14	2.52E-07	4.03E-05	1.30E-01
U-235	38,718,123	2.01E-16	3.12E-16	6.00E-16	7.78E-09	3.60E-03	3.35E-03
<b>Total:</b>						<b>1.33E-01</b>	
<b>Stack 703 Exhaust Room Air</b>		<b>815.70 m<sup>3</sup>/min</b>		<b>13.60 m<sup>3</sup>/sec</b>			
Pu-241	212,605,198	0.00E+00	2.44E-14	5.25E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	212,605,198	0.00E+00	6.60E-16	1.76E-15	0.00E+00	0.00E+00	0.00E+00
Th-230	212,605,198	0.00E+00	3.80E-16	1.01E-15	0.00E+00	0.00E+00	0.00E+00
Th-232	212,605,198	0.00E+00	5.40E-16	1.44E-15	0.00E+00	0.00E+00	0.00E+00
U-234	212,605,198	0.00E+00	4.14E-15	1.10E-14	0.00E+00	0.00E+00	0.00E+00
U-235	212,605,198	0.00E+00	4.27E-16	1.14E-15	0.00E+00	0.00E+00	0.00E+00
U-238	212,605,198	0.00E+00	5.20E-16	1.39E-15	0.00E+00	0.00E+00	0.00E+00
<b>Total:</b>						<b>0.00E+00</b>	
<b>Stack 773 Bldg. 440</b>		<b>193.24 m<sup>3</sup>/min</b>		<b>3.22 m<sup>3</sup>/sec</b>			
Pu-241	50,504,094	0.00E+00	3.47E-14	6.93E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	50,504,094	0.00E+00	1.21E-15	3.31E-15	0.00E+00	0.00E+00	0.00E+00
Th-230	50,504,094	0.00E+00	1.55E-15	4.26E-15	0.00E+00	0.00E+00	0.00E+00
Th-232	50,504,094	0.00E+00	1.03E-15	2.84E-15	0.00E+00	0.00E+00	0.00E+00
U-234	50,504,094	0.00E+00	3.19E-15	8.75E-15	0.00E+00	0.00E+00	0.00E+00
U-235	50,504,094	0.00E+00	5.60E-16	1.54E-15	0.00E+00	0.00E+00	0.00E+00
U-238	50,504,094	0.00E+00	1.12E-15	3.07E-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>306.64 m<sup>3</sup>/min</b>		<b>5.11 m<sup>3</sup>/sec</b>			
Th-228	79,923,475	1.70E-15	3.78E-16	4.18E-16	1.36E-07	1.66E-10	8.48E-02
Th-230	79,923,475	5.78E-15	1.29E-15	1.43E-15	4.62E-07	2.29E-05	2.89E-01
Th-232	79,923,475	3.43E-15	7.65E-16	8.45E-16	2.74E-07	2.51E+00	8.57E-01

<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**  
**January 1, 2016 to June 30, 2016**

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>306.64 m<sup>3</sup>/min</b>		<b>5.11 m<sup>3</sup>/sec</b>			
U-234	79,923,475	1.54E-14	3.44E-15	3.81E-15	1.23E-06	1.98E-04	3.09E-01
U-235	79,923,475	1.00E-15	2.24E-16	2.48E-16	8.02E-08	3.71E-02	1.67E-02
U-238	79,923,475	7.27E-15	1.62E-15	1.79E-15	5.81E-07	1.73E+00	1.21E-01
						<b>Total:</b>	<b>1.68E+00</b>
<b>Stack 796 Bldg. 100</b>		<b>23.47 m<sup>3</sup>/min</b>		<b>0.39 m<sup>3</sup>/sec</b>			
Pu-241	6,118,438	0.00E+00	8.89E-16	1.77E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	6,118,438	0.00E+00	2.88E-14	5.73E-14	0.00E+00	0.00E+00	0.00E+00
U-234	6,118,438	0.00E+00	5.91E-15	1.94E-14	0.00E+00	0.00E+00	0.00E+00
U-235	6,118,438	0.00E+00	1.83E-16	6.00E-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.

**Attachment 3  
To Letter Dated August 24, 2016**

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

**(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: January to June 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 1<sup>st</sup> 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 3.2E-03 mrem for gaseous effluents released during the 1<sup>st</sup> 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**

<b>Organ</b>	<b>Committed Dose Equivalent (mrem per 1<sup>st</sup> half of 2016)</b>
Adrenals	9.8E-06
Bone Surface	4.8E-04
Breasts	9.8E-06
Stomach Wall	3.7E-04
Upper Large Intestine Wall	2.3E-04
Kidneys	3.8E-05
Lungs	1.2E-03
Ovaries	1.3E-05
Red Bone Marrow	2.9E-05
Spleen	9.8E-06
Thymus	9.8E-06
Uterus	9.8E-06
Bladder Wall	3.0E-05
Brain	9.8E-06
Esophagus	5.6E-04
Small Intestine Wall	3.4E-05
Lower Large Intestine Wall	6.7E-04
Liver	3.0E-05
Muscle	9.8E-06
Pancreas	9.8E-06
Skin	1.2E-05
Testes	1.3E-05
Thyroid	1.7E-04
<b>Total Effective Dose Equivalent</b>	<b>3.2E-03 mrem</b>
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 4.4E-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 ( $\mu\text{Ci/mL}$ )	Concentration Location		10 CFR 20, App. B, Table 2, Col. 1 Value ( $\mu\text{Ci/mL}$ )	Ratio of Maximum Concentration to 10 CFR 20 Value
		Sector	Dist. (m)		
<sup>99</sup> Tc	1.5E-17	NNE	400	9.E-10	1.6E-08
<sup>228</sup> Th	3.7E-20	NNE	500	2.E-14	1.8E-06
<sup>230</sup> Th	1.3E-19	NNE	450	2.E-14	6.6E-06
<sup>231</sup> Th	2.4E-21	NNE	450	9.E-09	2.6E-13
<sup>232</sup> Th	8.7E-20	NNE	450	4.E-15	2.2E-05
<sup>234</sup> U	2.0E-17	NNE	450	5.E-14	4.0E-04
<sup>235</sup> U	6.5E-19	NNE	450	6.E-14	1.1E-05
<sup>238</sup> U	2.2E-19	NNE	550	6.E-14	3.6E-06
<sup>238</sup> Pu	4.4E-21	NNE	200	2.E-14	2.2E-07
<sup>239</sup> Pu	1.6E-20	NNE	200	2.E-14	7.8E-07
<sup>241</sup> Pu	5.8E-19	NNE	400	8.E-13	7.2E-07
<sup>241</sup> Am	3.6E-21	NNE	200	2.E-14	1.8E-07
<b>Sum of Fractions:</b>					<b>4.4E-04</b>