



NUCLEAR FUEL SERVICES, INC.  
a subsidiary of The Babcock & Wilcox Company

■ 1205 banner hill road ■ erwin, tn 37650 ■ phone 423.743.9141  
■ www.nuclearfuelservices.com

21G-12-0033  
GOV-01-55  
ACF-12-0058

February 16, 2012

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 through December 2011

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 A reports the Radioactivity in Effluent Liquid for the period July through December 2011. Attachment B reports the Radioactivity in Effluent Air for the period July through December 2011. Attachment C summarizes an evaluation of the dose and air activity concentrations for the maximally exposed offsite individual due to gaseous effluents, during the period July through December 2011.

If you or your staff have any questions, require additional information, or wish to discuss this, please contact me or Mr. Robert Holley, Environmental Safety Manager, at (423) 743-1777. Please reference our unique document identification number (21G-12-0033) in any correspondence concerning this letter.

Sincerely,

NUCLEAR FUEL SERVICES, INC.

Mark P. Elliott  
Quality, Safety, & Safeguards  
Director

CJB/rrm

*Attachments*

- A- Report of Radioactivity in Effluent Liquid for the Period July - December 2011
- B- Report of Radioactivity in Effluent Air for the Period of July - December 2011
- C- Report of Gaseous Effluent Dose and Activity Concentrations for the Maximally Exposed Off-Site Individual for the Release Period July - December 2011

nuclear fuel services, inc., a subsidiary of The Babcock & Wilcox Company

NM5501

xc: Ms. Denise Edwards, Project 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  
Atlanta, GA 30303-1257

Mr. Kevin Ramsey, Project Manager  
Fuel Manufacturing Branch  
Division of Fuel Cycle Safety and Safeguards  
Office of Nuclear Material Safety & Safeguards  
U. S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Mr. Galen Smith  
Senior Resident Inspector  
U. S. Nuclear Regulatory Commission

*Attachment A*  
*To Letter Dated February 16, 2012*

*Report of Radioactivity in Effluent Liquid for the Period*  
*July – December 2011*

**(Two Pages to Follow)**

# Radioactivity in Effluent Liquid

## July 1, 2011 to December 31, 2011

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>BLEU Sewer</b>							
Pu-238	1,401,602	0.00E+00	9.14E-11	2.53E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	1,401,602	1.01E-11	7.32E-11	1.82E-10	1.42E-08	2.28E-07	5.06E-05
Tc-99	1,401,602	0.00E+00	4.05E-08	7.06E-08	0.00E+00	0.00E+00	0.00E+00
Th-228	1,401,602	5.08E-11	1.52E-10	2.98E-10	7.11E-08	8.69E-11	2.54E-05
Th-230	1,401,602	1.88E-11	1.36E-10	2.58E-10	2.63E-08	1.30E-06	1.88E-05
Th-232	1,401,602	1.25E-12	1.23E-10	2.14E-10	1.75E-09	1.61E-02	4.17E-06
U-232	1,401,602	1.22E-11	6.35E-11	1.52E-10	1.71E-08	7.99E-10	2.03E-05
U-233/234	1,401,602	8.25E-10	2.66E-10	1.48E-10	1.16E-06	1.85E-04	2.75E-04
U-235/236	1,401,602	1.17E-11	5.37E-11	1.25E-10	1.64E-08	7.59E-03	3.90E-06
U-238	1,401,602	1.40E-10	1.18E-10	1.34E-10	1.96E-07	5.86E-01	4.67E-05
						<b>Total:</b>	<b>4.45E-04</b>
<b>Sewer</b>							
Pu-238	21,918,223	0.00E+00	8.22E-11	2.20E-10	0.00E+00	0.00E+00	0.00E+00
Pu-239/240	21,918,223	3.87E-11	5.89E-11	1.24E-10	8.48E-07	1.36E-05	1.93E-04
Tc-99	21,918,223	0.00E+00	3.81E-08	6.66E-08	0.00E+00	0.00E+00	0.00E+00
Th-228	21,918,223	2.21E-11	1.44E-10	2.80E-10	4.84E-07	5.91E-10	1.10E-05
Th-230	21,918,223	0.00E+00	1.32E-10	3.37E-10	0.00E+00	0.00E+00	0.00E+00
Th-232	21,918,223	2.79E-11	1.33E-10	2.61E-10	6.12E-07	5.62E+00	9.31E-05
U-232	21,918,223	0.00E+00	7.16E-11	2.01E-10	0.00E+00	0.00E+00	0.00E+00
U-233/234	21,918,223	5.66E-09	6.04E-10	1.09E-10	1.24E-04	1.99E-02	1.89E-03
U-235/236	21,918,223	2.86E-10	1.38E-10	1.02E-10	6.27E-06	2.90E+00	9.54E-05
U-238	21,918,223	9.59E-10	2.50E-10	1.03E-10	2.10E-05	6.28E+01	3.20E-04
						<b>Total:</b>	<b>2.60E-03</b>
<b>WWTF</b>							
Am-241	3,023,597	0.00E+00	8.80E-11	2.18E-10	0.00E+00	0.00E+00	0.00E+00
Cs-137	3,023,597	0.00E+00	1.14E-09	1.80E-09	0.00E+00	0.00E+00	0.00E+00
Na-22	3,023,597	0.00E+00	1.09E-09	1.85E-09	0.00E+00	0.00E+00	0.00E+00
Np-237	3,023,597	7.55E-12	1.04E-10	2.64E-10	2.28E-08	3.24E-05	3.77E-04
Pb-212	3,023,597	1.03E-09	3.63E-09	3.98E-09	3.11E-06	2.25E-12	5.14E-04
Pu-238	3,023,597	1.10E-11	5.58E-11	1.33E-10	3.32E-08	1.94E-09	5.50E-04
Pu-239/240	3,023,597	5.85E-12	4.68E-11	1.18E-10	1.77E-08	2.84E-07	2.92E-04
Pu-241	3,023,597	0.00E+00	8.11E-09	1.42E-08	0.00E+00	0.00E+00	0.00E+00
Ra-224	3,023,597	8.51E-09	6.24E-09	1.44E-08	2.57E-05	1.62E-10	4.25E-02
Tc-99	3,023,597	0.00E+00	1.13E-07	1.97E-07	0.00E+00	0.00E+00	0.00E+00
Th-228	3,023,597	2.87E-11	1.14E-10	2.67E-10	8.69E-08	1.06E-10	1.44E-04
Th-230	3,023,597	2.76E-11	1.05E-10	2.11E-10	8.35E-08	4.14E-06	2.76E-04
Th-231	3,023,597	0.00E+00	4.27E-08	5.28E-08	0.00E+00	0.00E+00	0.00E+00
Th-232	3,023,597	2.92E-11	9.91E-11	1.71E-10	8.83E-08	8.10E-01	9.74E-04
U-232	3,023,597	0.00E+00	5.54E-11	1.84E-10	0.00E+00	0.00E+00	0.00E+00
U-233/234	3,023,597	2.60E-08	1.32E-09	1.31E-10	7.86E-05	1.26E-02	8.67E-02

<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, 2011 to December 31, 2011

Location	Total Volume (l)	Activity Concentration ( $\mu\text{Ci}/\text{ml}$ )	Error Estimate ( $\mu\text{Ci}/\text{ml}$ )	LLD ( $\mu\text{Ci}/\text{ml}$ )	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECV <sup>1</sup>
<b>WWTF</b>							
U-235/236	3,023,597	1.39E-09	3.06E-10	1.19E-10	4.19E-06	1.94E+00	4.62E-03
U-238	3,023,597	3.86E-10	1.60E-10	1.09E-10	1.17E-06	3.49E+00	1.29E-03
						<b>Total:</b>	<b>1.38E-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.

***Attachment B***  
***To Letter Dated February 16, 2012***

***Report of Radioactivity in Effluent Air for the Period***  
***July – December 2011***

**(Four Pages to Follow)**

# Radioactivity in Effluent Air

## July 1, 2011 to December 31, 2011

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>1063.98 m<sup>3</sup>/min</b>	<b>17.73 m<sup>3</sup>/sec</b>				
Pu-241	274,250,794	9.19E-13	5.65E-14	5.76E-14	2.52E-04	2.45E-06	1.15E+00
Th-228	274,250,794	4.65E-16	1.19E-16	1.01E-16	1.27E-07	1.56E-10	2.32E-02
Th-230	274,250,794	4.65E-16	1.19E-16	1.01E-16	1.27E-07	6.31E-06	2.32E-02
Th-232	274,250,794	4.65E-16	1.19E-16	1.01E-16	1.27E-07	1.17E+00	1.16E-01
U-234	274,250,794	1.09E-13	2.80E-14	2.38E-14	3.00E-05	4.81E-03	2.19E+00
U-235	274,250,794	4.18E-15	1.07E-15	9.11E-16	1.15E-06	5.31E-01	6.97E-02
U-238	274,250,794	1.16E-15	2.97E-16	2.53E-16	3.19E-07	9.51E-01	1.94E-02
					<b>Total:</b>		<b>3.59E+00</b>
<b>Stack 185 Bldg. 131</b>		<b>110.32 m<sup>3</sup>/min</b>	<b>1.84 m<sup>3</sup>/sec</b>				
Pu-241	28,429,007	5.14E-16	9.37E-16	1.70E-15	1.46E-08	1.42E-10	6.42E-04
Tc-99	28,429,007	1.66E-14	3.03E-14	5.49E-14	4.72E-07	2.79E-05	1.85E-05
U-234	28,429,007	2.46E-14	1.30E-14	2.41E-14	7.00E-07	1.12E-04	4.93E-01
U-235	28,429,007	7.62E-16	4.03E-16	7.44E-16	2.17E-08	1.00E-02	1.27E-02
					<b>Total:</b>		<b>5.06E-01</b>
<b>Stack 234 Bldg. 234</b>		<b>377.12 m<sup>3</sup>/min</b>	<b>6.29 m<sup>3</sup>/sec</b>				
Am-241	98,836,608	5.66E-15	1.29E-15	1.16E-15	5.59E-07	1.63E-07	2.83E-01
Pu-238	98,836,608	1.15E-15	2.62E-16	2.34E-16	1.13E-07	6.63E-09	5.74E-02
Pu-239	98,836,608	9.59E-15	2.19E-15	1.96E-15	9.48E-07	1.52E-05	4.80E-01
Pu-240	98,836,608	3.38E-15	7.73E-16	6.91E-16	3.34E-07	1.47E-06	1.69E-01
Pu-241	98,836,608	7.90E-15	6.60E-15	9.78E-15	7.80E-07	7.58E-09	9.87E-03
					<b>Total:</b>		<b>9.99E-01</b>
<b>Stack 327 Bldg. 330</b>		<b>634.61 m<sup>3</sup>/min</b>	<b>10.58 m<sup>3</sup>/sec</b>				
Pu-241	161,756,738	1.26E-15	7.74E-16	1.23E-15	2.03E-07	1.97E-09	1.57E-03
Tc-99	161,756,738	4.06E-14	2.50E-14	3.97E-14	6.57E-06	3.89E-04	4.51E-05
U-234	161,756,738	3.49E-14	1.30E-14	1.61E-14	5.64E-06	9.04E-04	6.97E-01
U-235	161,756,738	1.08E-15	4.02E-16	4.99E-16	1.74E-07	8.08E-02	1.80E-02
					<b>Total:</b>		<b>7.17E-01</b>
<b>Stack 421 Bldg. 100</b>		<b>18.25 m<sup>3</sup>/min</b>	<b>0.30 m<sup>3</sup>/sec</b>				
Pu-241	4,701,136	5.75E-15	1.79E-15	2.42E-15	2.70E-08	2.63E-10	7.19E-03
Tc-99	4,701,136	1.86E-13	5.80E-14	7.83E-14	8.74E-07	5.17E-05	2.07E-04
U-234	4,701,136	3.81E-13	5.34E-14	3.24E-14	1.79E-06	2.87E-04	7.63E+00
U-235	4,701,136	1.18E-14	1.65E-15	1.00E-15	5.54E-08	2.57E-02	1.97E-01
					<b>Total:</b>		<b>7.83E+00</b>
<b>Stack 424 Bldg. 100</b>		<b>21.22 m<sup>3</sup>/min</b>	<b>0.35 m<sup>3</sup>/sec</b>				
Pu-241	5,415,251	1.83E-15	1.13E-15	1.74E-15	9.91E-09	9.62E-11	2.29E-03
Tc-99	5,415,251	5.92E-14	3.64E-14	5.64E-14	3.21E-07	1.90E-05	6.58E-05
U-234	5,415,251	1.23E-13	2.12E-14	2.51E-14	6.66E-07	1.07E-04	2.46E+00
U-235	5,415,251	3.80E-15	6.55E-16	7.75E-16	2.06E-08	9.54E-03	6.34E-02
					<b>Total:</b>		<b>2.53E+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

## July 1, 2011 to December 31, 2011

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>58.22 m<sup>3</sup>/min</b>		<b>0.97 m<sup>3</sup>/sec</b>			
Pu-241	15,174,438	2.80E-14	1.49E-14	1.90E-14	4.25E-07	4.13E-09	3.50E-02
Th-228	15,174,438	0.00E+00	1.92E-15	4.31E-15	0.00E+00	0.00E+00	0.00E+00
Th-230	15,174,438	0.00E+00	2.47E-15	5.55E-15	0.00E+00	0.00E+00	0.00E+00
Th-232	15,174,438	0.00E+00	1.65E-15	3.70E-15	0.00E+00	0.00E+00	0.00E+00
U-234	15,174,438	0.00E+00	5.08E-15	1.14E-14	0.00E+00	0.00E+00	0.00E+00
U-235	15,174,438	0.00E+00	8.92E-16	2.00E-15	0.00E+00	0.00E+00	0.00E+00
U-238	15,174,438	0.00E+00	1.78E-15	4.00E-15	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>3.50E-02</b>
<b>Stack 502 OCB</b>		<b>200.11 m<sup>3</sup>/min</b>		<b>3.34 m<sup>3</sup>/sec</b>			
Pu-241	52,443,903	6.97E-15	3.25E-15	3.80E-15	3.65E-07	3.55E-09	8.71E-03
Th-228	52,443,903	0.00E+00	3.99E-16	9.18E-16	0.00E+00	0.00E+00	0.00E+00
Th-230	52,443,903	0.00E+00	5.13E-16	1.18E-15	0.00E+00	0.00E+00	0.00E+00
Th-232	52,443,903	0.00E+00	3.42E-16	7.87E-16	0.00E+00	0.00E+00	0.00E+00
U-234	52,443,903	0.00E+00	1.06E-15	2.43E-15	0.00E+00	0.00E+00	0.00E+00
U-235	52,443,903	0.00E+00	1.85E-16	4.26E-16	0.00E+00	0.00E+00	0.00E+00
U-238	52,443,903	0.00E+00	3.71E-16	8.52E-16	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>8.71E-03</b>
<b>Stack 573 Bldg 306-W</b>		<b>54.75 m<sup>3</sup>/min</b>		<b>0.91 m<sup>3</sup>/sec</b>			
Pu-241	14,137,498	0.00E+00	8.69E-16	1.74E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	14,137,498	0.00E+00	2.81E-14	5.62E-14	0.00E+00	0.00E+00	0.00E+00
U-234	14,137,498	0.00E+00	1.01E-14	2.48E-14	0.00E+00	0.00E+00	0.00E+00
U-235	14,137,498	0.00E+00	3.12E-16	7.67E-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>312.95 m<sup>3</sup>/min</b>		<b>5.22 m<sup>3</sup>/sec</b>			
Pu-241	80,773,049	6.53E-14	1.37E-15	1.05E-15	5.28E-06	5.12E-08	8.16E-02
Tc-99	80,773,049	2.11E-12	4.42E-14	3.40E-14	1.71E-04	1.01E-02	2.35E-03
U-234	80,773,049	6.68E-13	2.37E-14	1.57E-14	5.40E-05	8.65E-03	1.34E+01
U-235	80,773,049	2.07E-14	7.33E-16	4.85E-16	1.67E-06	7.73E-01	3.45E-01
						<b>Total:</b>	<b>1.38E+01</b>
<b>Stack 615 Bldg. 306-W</b>		<b>43.92 m<sup>3</sup>/min</b>		<b>0.73 m<sup>3</sup>/sec</b>			
Pu-241	11,222,199	0.00E+00	8.53E-16	1.70E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	11,222,199	0.00E+00	2.76E-14	5.48E-14	0.00E+00	0.00E+00	0.00E+00
U-234	11,222,199	0.00E+00	1.00E-14	2.42E-14	0.00E+00	0.00E+00	0.00E+00
U-235	11,222,199	0.00E+00	3.10E-16	7.49E-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>49.98 m<sup>3</sup>/min</b>		<b>0.83 m<sup>3</sup>/sec</b>			
Pu-241	12,955,802	1.50E-17	8.86E-16	1.67E-15	1.94E-10	1.88E-12	1.87E-05
Tc-99	12,955,802	4.84E-16	2.86E-14	5.41E-14	6.28E-09	3.71E-07	5.38E-07
U-234	12,955,802	6.94E-15	1.14E-14	2.38E-14	9.00E-08	1.44E-05	1.39E-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

## July 1, 2011 to December 31, 2011

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>49.98 m<sup>3</sup>/min</b>		<b>0.83 m<sup>3</sup>/sec</b>			
U-235	12,955,802	2.15E-16	3.53E-16	7.35E-16	2.78E-09	1.29E-03	3.58E-03
						<b>Total:</b>	<b>1.42E-01</b>
<b>Stack 649 Bldg. 330</b>		<b>10.02 m<sup>3</sup>/min</b>		<b>0.17 m<sup>3</sup>/sec</b>			
Pu-241	2,583,829	5.24E-16	5.94E-16	1.05E-15	1.35E-09	1.31E-11	6.55E-04
Tc-99	2,583,829	1.69E-14	1.92E-14	3.41E-14	4.38E-08	2.59E-06	1.88E-05
U-234	2,583,829	0.00E+00	6.87E-15	1.48E-14	0.00E+00	0.00E+00	0.00E+00
U-235	2,583,829	0.00E+00	2.13E-16	4.59E-16	0.00E+00	0.00E+00	0.00E+00
						<b>Total:</b>	<b>6.73E-04</b>
<b>Stack 701 Bldg. 307</b>		<b>136.90 m<sup>3</sup>/min</b>		<b>2.28 m<sup>3</sup>/sec</b>			
Pu-241	35,278,727	1.10E-15	1.05E-15	1.72E-15	3.87E-08	3.76E-10	1.37E-03
Tc-99	35,278,727	3.55E-14	3.41E-14	5.55E-14	1.25E-06	7.41E-05	3.94E-05
U-234	35,278,727	4.17E-14	2.08E-14	2.44E-14	1.47E-06	2.36E-04	8.35E-01
U-235	35,278,727	1.29E-15	6.43E-16	7.55E-16	4.56E-08	2.11E-02	2.15E-02
						<b>Total:</b>	<b>8.58E-01</b>
<b>Stack 702 Bldg. 307</b>		<b>154.00 m<sup>3</sup>/min</b>		<b>2.57 m<sup>3</sup>/sec</b>			
Pu-241	39,648,556	0.00E+00	8.73E-16	1.68E-15	0.00E+00	0.00E+00	0.00E+00
Tc-99	39,648,556	0.00E+00	2.82E-14	5.42E-14	0.00E+00	0.00E+00	0.00E+00
U-234	39,648,556	9.61E-15	1.20E-14	2.39E-14	3.81E-07	6.10E-05	1.92E-01
U-235	39,648,556	2.97E-16	3.70E-16	7.39E-16	1.18E-08	5.45E-03	4.95E-03
						<b>Total:</b>	<b>1.97E-01</b>
<b>Stack 703 Exhaust Room Air</b>		<b>746.15 m<sup>3</sup>/min</b>		<b>12.44 m<sup>3</sup>/sec</b>			
Pu-241	192,327,366	0.00E+00	2.61E-14	5.01E-14	0.00E+00	0.00E+00	0.00E+00
Th-228	192,327,366	1.08E-15	1.10E-15	2.18E-15	2.09E-07	2.55E-10	5.42E-02
Th-230	192,327,366	6.25E-16	6.36E-16	1.26E-15	1.20E-07	5.95E-06	3.12E-02
Th-232	192,327,366	8.88E-16	9.04E-16	1.79E-15	1.71E-07	1.57E+00	2.22E-01
U-234	192,327,366	6.79E-15	6.92E-15	1.37E-14	1.31E-06	2.09E-04	1.36E-01
U-235	192,327,366	7.01E-16	7.14E-16	1.41E-15	1.35E-07	6.24E-02	1.17E-02
U-238	192,327,366	8.55E-16	8.70E-16	1.72E-15	1.64E-07	4.91E-01	1.42E-02
						<b>Total:</b>	<b>4.69E-01</b>
<b>Stack 704 Process Exhaust (H2)</b>		<b>58.16 m<sup>3</sup>/min</b>		<b>0.97 m<sup>3</sup>/sec</b>			
Pu-241	14,960,567	3.82E-15	2.94E-14	5.61E-14	5.71E-08	5.54E-10	4.77E-03
Th-228	14,960,567	6.04E-15	1.46E-15	2.45E-15	9.04E-08	1.10E-10	3.02E-01
Th-230	14,960,567	3.48E-15	8.42E-16	1.41E-15	5.20E-08	2.58E-06	1.74E-01
Th-232	14,960,567	4.94E-15	1.20E-15	2.00E-15	7.40E-08	6.79E-01	1.24E+00
U-234	14,960,567	3.78E-14	9.16E-15	1.53E-14	5.66E-07	9.07E-05	7.57E-01
U-235	14,960,567	3.91E-15	9.46E-16	1.58E-15	5.84E-08	2.71E-02	6.51E-02
U-238	14,960,567	4.76E-15	1.15E-15	1.93E-15	7.12E-08	2.13E-01	7.93E-02
						<b>Total:</b>	<b>2.62E+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

## July 1, 2011 to December 31, 2011

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 773 Bldg. 440</b>		<b>186.95 m<sup>3</sup>/min</b>	<b>3.12 m<sup>3</sup>/sec</b>				
Pu-241	48,187,676	2.18E-12	6.88E-14	6.89E-14	1.05E-04	1.02E-06	2.72E+00
Th-228	48,187,676	8.58E-15	2.44E-15	4.23E-15	4.13E-07	5.05E-10	4.29E-01
Th-230	48,187,676	1.10E-14	3.14E-15	5.44E-15	5.31E-07	2.63E-05	5.51E-01
Th-232	48,187,676	7.35E-15	2.09E-15	3.62E-15	3.54E-07	3.25E+00	1.84E+00
U-234	48,187,676	2.27E-14	6.45E-15	1.12E-14	1.09E-06	1.75E-04	4.53E-01
U-235	48,187,676	3.98E-15	1.13E-15	1.96E-15	1.92E-07	8.88E-02	6.64E-02
U-238	48,187,676	7.96E-15	2.27E-15	3.93E-15	3.84E-07	1.15E+00	1.33E-01
						<b>Total:</b>	<b>6.19E+00</b>
<b>Stack 774 Bldg. 301</b>		<b>339.72 m<sup>3</sup>/min</b>	<b>5.66 m<sup>3</sup>/sec</b>				
Pu-241	86,610,987	2.75E-14	2.02E-14	3.58E-14	2.38E-06	2.31E-08	3.43E-02
Th-228	86,610,987	3.59E-15	4.02E-16	5.96E-16	3.11E-07	3.79E-10	1.79E-01
Th-230	86,610,987	2.83E-15	3.17E-16	4.71E-16	2.45E-07	1.21E-05	1.42E-01
Th-232	86,610,987	3.11E-15	3.49E-16	5.18E-16	2.70E-07	2.47E+00	7.79E-01
U-234	86,610,987	7.77E-14	8.71E-15	1.29E-14	6.73E-06	1.08E-03	1.55E+00
U-235	86,610,987	3.30E-15	3.70E-16	5.49E-16	2.86E-07	1.32E-01	5.50E-02
U-238	86,610,987	3.87E-15	4.34E-16	6.43E-16	3.35E-07	1.00E+00	6.45E-02
						<b>Total:</b>	<b>2.81E+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 C*  
*To Letter Dated February 16, 2012*

*Report of Gaseous Effluent Dose and Activity Concentrations*  
*for the Maximally Exposed*  
*Off-Site Individual for the Release Period*  
*July – December 2011*

**(Three 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 through December 2011**

**Introduction**

During this biannual period, NRC License SNM-124, Part I, Section 5.1.1.3 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 5.1.1.4 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 nineteen (19) radiological stacks during the 2<sup>nd</sup> half of 2011. 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 B) 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 350 meters North Northeast from the center of the plant site. The TEDE to the MEI was estimated to be 7.8E-03 mrem for gaseous effluents released during the 2<sup>nd</sup> half of 2011. The highest organ committed dose equivalent (CDE) to the MEI was estimated to be 4.7E-03 mrem to the bone surface. These MEI doses are well below SNM-124 license 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 2011)</b>
Adrenals	4.2E-05
Bone Surface	4.7E-03
Breasts	4.2E-05
Stomach Wall	1.7E-03
Upper Large Intestine Wall	1.1E-03
Kidneys	9.8E-05
Lungs	2.1E-03
Ovaries	9.1E-05
Red Bone Marrow	2.2E-04
Spleen	4.2E-05
Thymus	4.2E-05
Uterus	4.2E-05
Bladder Wall	1.4E-04
Brain	4.2E-05
Esophagus	9.4E-04
Small Intestine Wall	1.6E-04
Lower Large Intestine Wall	3.1E-03
Liver	6.9E-04
Muscle	4.2E-05
Pancreas	4.2E-05
Skin	4.3E-05
Testes	9.2E-05
Thyroid	8.1E-04
<b>Total Effective Dose Equivalent</b>	<b>7.8E-03 mrem</b>
<b>Location of MEI:</b>	<b>350 meters North Northeast</b>

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 9.3E-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)		
$^{99}\text{Tc}$	7.6E-17	NNE	350	9.E-10	8.4E-08
$^{228}\text{Th}$	3.8E-19	NNE	350	2.E-14	1.9E-05
$^{230}\text{Th}$	3.9E-19	NNE	350	2.E-14	1.9E-05
$^{232}\text{Th}$	3.2E-19	NNE	350	4.E-15	8.1E-05
$^{234}\text{U}$	3.1E-17	NNE	400	5.E-14	6.2E-04
$^{235}\text{U}$	1.1E-18	NNE	400	6.E-14	1.9E-05
$^{238}\text{U}$	3.6E-19	NNE	400	6.E-14	6.0E-06
$^{238}\text{Pu}$	9.9E-20	NNE	250	2.E-14	5.0E-06
$^{239}\text{Pu}$	8.3E-19	NNE	250	2.E-14	4.2E-05
$^{240}\text{Pu}$	2.9E-19	NNE	250	2.E-14	1.5E-05
$^{241}\text{Pu}$	7.1E-17	NNE	450	8.E-13	8.9E-05
$^{241}\text{Am}$	4.9E-19	NNE	250	2.E-14	2.5E-05
Sum of Fractions:					9.3E-04

The TEDE to the MEI for gaseous effluents released during 2011 is provided in Table 3. The results for the 1<sup>st</sup> half of 2011 were previously reported in *Biannual Effluent Monitoring Report January through June 2011 Rev. 1* (21G-12-0032). The annual dose is well below SNM-124 license action levels and applicable regulatory limits/ALARA constraints.

**Table 3. Annual Dose to the MEI for Gaseous Effluents Released During 2011**

Period Covered	Direction	Distance (m)	TEDE (mrem)
2 <sup>nd</sup> Half	NNE	350	7.8E-03
1 <sup>st</sup> Half	NNE	450	2.7E-03
Annual Total			1.1E-02