Nuclear Fuel Services, Inc.
P.O. Box 337, MS 123
Erwin, TN 37650

(423) 743-9141

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

21G-00-0139
GOV-01-55-03
ACF-00-0205

August 28, 2000

Mr. Luis A. Reyes, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II, Atlanta Federal Center
61 Forsyth Street, SW, Suite 23T85
Atlanta, GA 30303

References: 1) Docket No. 70-143; SNM License 124

Subject: **Bi-Annual Effluent Monitoring Report: January through June 2000**

Dear Mr. Reyes:

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 Radioactivity in Effluent Liquid for the period January 1, 2000 through June 30, 2000. Attachment B reports the Radioactivity in Effluent Air for this same period.

In addition, Attachment C summarizes an evaluation performed to determine radioactivity concentrations in May 2000 discharges of treated liquids from NFS' Wastewater Treatment Facility (WWTF). Due to problems with the monthly composite sample collected for May 2000 WWTF discharges, it was necessary to use an alternative method to determine radioactivity in May 2000 WWTF discharges. Attachment C provides a brief summary of the composite problem (referencing other more detailed reports) as well as a detailed explanation of the method and the best-available data that were used by NFS technical staff to estimate radioactivity in May 2000 WWTF discharges.

Finally, in accordance with SNM-124, Part I, Section 5.1.1.3, Attachment D summarizes an evaluation of the potential dose to the maximally exposed offsite individual and the potential maximum off-site air activity concentrations. The source term for these estimates was radioactivity released in effluent air (reported in Attachment B) during the period January through June 2000. This evaluation indicated that offsite doses and airborne activity concentrations were negligible during the period for air effluents.

If you or your staff have any questions, require additional information, or wish to discuss this information, please contact me or Ms. Janice Greene, Environmental Safety Manager at (423) 743-1730. Please reference our unique document identification number (21G-00-0139) in any correspondence concerning this letter.

Sincerely,

NUCLEAR FUEL SERVICES, INC.

B Marie Moore

B. Marie Moore
Vice President
Safety and Regulatory

TEH/rcy

Attachments (4)

xc:

Mr. William Gloersen, Project Inspector
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Atlanta, GA 30303

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21G-00-0139
GOV-01-55-03
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Attachment A
To Letter Dated August 28, 2000
B. M. Moore to Mr. Luis A. Reyes (NRC)

Report of Radioactivity in Effluent Liquid for the Period
January - June 2000

(One Page to Follow)

Radioactivity in Effluent Liquid
January 1, 2000 to June 30, 2000

Location	Total Volume (l)	Activity Concentration (μCi/ml)	Error Estimate (μCi/ml)	LLD (μCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECL[1]
Banner Spring Down							
Pu-238	296,617,513	1.41E-11	4.10E-11	9.91E-11	4.19E-06	2.45E-07	7.06E-04
Pu-239/240	296,617,513	8.50E-11	7.97E-11	9.10E-11	2.52E-05	4.06E-04	4.25E-03
Tc-99	296,617,513	6.01E-10	7.74E-09	1.89E-08	1.78E-04	1.05E-02	1.00E-05
Th-228	296,617,513	2.81E-11	8.31E-11	1.64E-10	8.33E-06	1.02E-08	1.40E-04
Th-230	296,617,513	4.04E-11	4.15E-11	6.09E-11	1.20E-05	5.93E-04	4.04E-04
Th-232	296,617,513	1.96E-11	2.31E-11	2.82E-11	5.82E-06	5.34E+01	6.54E-04
U-234	296,617,513	1.29E-08	1.83E-09	1.53E-10	3.83E-03	6.13E-01	4.30E-02
U-235/236	296,617,513	6.36E-10	2.46E-10	1.64E-10	1.89E-04	8.74E+01	2.12E-03
U-238	296,617,513	1.88E-09	4.54E-10	1.37E-10	5.57E-04	1.66E+03	6.26E-03
						Total:	**5.76E-02**
Sewer							
Pu-238	24,119,391	6.40E-11	7.51E-11	9.21E-11	1.54E-06	9.03E-08	3.20E-04
Pu-239/240	24,119,391	3.08E-11	3.72E-10	6.80E-11	7.43E-07	1.19E-05	1.54E-04
Tc-99	24,119,391	3.25E-08	1.20E-08	2.31E-08	7.84E-04	4.64E-02	5.42E-05
Th-228	24,119,391	3.12E-11	6.89E-11	1.17E-10	7.52E-07	9.18E-10	1.56E-05
Th-230	24,119,391	5.99E-11	4.68E-11	6.19E-11	1.44E-06	7.15E-05	5.99E-05
Th-232	24,119,391	1.37E-12	3.92E-10	4.61E-11	3.31E-08	3.04E-01	4.58E-06
U-234	24,119,391	1.73E-08	2.37E-09	2.11E-10	4.17E-04	6.69E-02	5.77E-03
U-235/236	24,119,391	6.54E-10	2.53E-10	1.58E-10	1.58E-05	7.30E+00	2.18E-04
U-238	24,119,391	2.00E-09	4.72E-10	1.46E-10	4.82E-05	1.44E+02	6.66E-04
						Total:	**7.26E-03**
WWTF							
Cs-137	3,359,353	4.58E-09	5.22E-09	7.57E-09	1.54E-05	1.77E-07	4.58E-03
Na-22	3,359,353	-3.66E-10	1.99E-09	3.47E-09	-1.23E-06	-1.97E-10	-6.10E-05
Pu-238	3,359,353	3.19E-11	4.71E-10	7.77E-11	1.07E-07	6.26E-09	1.59E-03
Pu-239/240	3,359,353	1.72E-11	4.55E-10	5.24E-11	5.77E-08	9.27E-07	8.58E-04
Ra-224	3,359,353	3.39E-08	7.43E-09	2.01E-08	1.14E-04	7.17E-10	1.70E-01
Tc-99	3,359,353	1.92E-07	6.31E-08	9.74E-08	6.44E-04	3.81E-02	3.19E-03
Th-228	3,359,353	2.64E-10	2.35E-10	4.03E-10	8.88E-07	1.08E-09	1.32E-03
Th-230	3,359,353	4.84E-10	2.27E-10	2.78E-10	1.63E-06	8.05E-05	4.84E-03
Th-232	3,359,353	2.26E-11	4.27E-11	8.74E-11	7.59E-08	6.96E-01	7.53E-04
U-234	3,359,353	1.62E-07	3.76E-08	3.39E-08	5.45E-04	8.74E-02	5.41E-01
U-235/236	3,359,353	1.05E-08	5.40E-09	6.49E-09	3.54E-05	1.64E+01	3.51E-02
U-238	3,359,353	3.14E-09	2.91E-09	4.37E-09	1.05E-05	3.14E+01	1.05E-02
						Total:	**7.73E-01**

[1] ECL: Effluent Concentration Limit from 10-CFR-20, Appendix B.

21G-00-0139
GOV-01-55-03
ACF-00-0205

Attachment B
To Letter Dated August 28, 2000
B. M. Moore to Mr. Luis A. Reyes (NRC)

Report of Radioactivity in Effluent Air for the Period
January - June 2000

(Four Pages to Follow)

Radioactivity in Effluent Air
January 1, 2000 to June 30, 2000

Location	Total Volume (m^3)	Activity Concentration (µCi/ml)	Error Estimate (µCi/ml)	LLD (µCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECL[1]
Main Stack 416	**1239.20 m^3/min**		**20.65 m^3/sec**				
Tc-99	324,770,057	3.08E-12	6.91E-14	3.15E-14	1.00E-03	5.92E-02	3.42E-03
Th-228	324,770,057	4.41E-18	3.72E-19	2.60E-19	1.43E-09	1.75E-12	2.20E-04
U-232	324,770,057	2.20E-17	1.86E-18	1.30E-18	7.15E-09	3.34E-10	2.20E-03
U-234	324,770,057	3.70E-13	3.12E-14	2.18E-14	1.20E-04	1.93E-02	7.40E+00
U-235	324,770,057	7.11E-15	6.00E-16	4.20E-16	2.31E-06	1.07E+00	1.19E-01
U-236	324,770,057	6.32E-14	5.33E-15	3.73E-15	2.05E-05	3.16E-01	1.05E+00
U-238	324,770,057	2.25E-16	1.90E-17	1.33E-17	7.30E-08	2.18E-01	3.74E-03
						Total:	**8.58E+00**
Stack 185 Bldg. 131	**63.71 m^3/min**		**1.06 m^3/sec**				
Tc-99	29,816,787	4.87E-14	2.64E-14	3.44E-14	1.45E-06	8.60E-05	5.42E-05
U-234	29,816,787	1.47E-15	4.60E-15	9.61E-15	4.39E-08	7.04E-06	2.94E-02
U-238	29,816,787	2.86E-15	8.93E-15	1.87E-14	8.52E-08	2.54E-01	4.76E-02
						Total:	**7.71E-02**
Stack 234 Bldg. 234	**302.13 m^3/min**		**5.04 m^3/sec**				
Am-241	12,181,746	1.54E-16	4.30E-16	8.06E-16	1.88E-09	5.49E-10	7.72E-03
Pu-238	12,181,746	3.03E-17	8.43E-17	1.58E-16	3.69E-10	2.16E-11	1.51E-03
Pu-239	12,181,746	3.33E-16	9.29E-16	1.74E-15	4.06E-09	6.53E-08	1.67E-02
Pu-240	12,181,746	1.12E-16	3.13E-16	5.85E-16	1.37E-09	6.00E-09	5.61E-03
Pu-241	12,181,746	-2.32E-16	2.81E-15	5.06E-15	-2.83E-09	-2.74E-11	-2.90E-04
						Total:	**3.12E-02**
Stack 27 Bldg. 234	**90.53 m^3/min**		**1.51 m^3/sec**				
Am-241	23,726,403	2.68E-15	1.39E-15	1.49E-15	6.36E-08	1.86E-08	1.34E-01
Pu-238	23,726,403	5.39E-16	2.79E-16	2.99E-16	1.28E-08	7.48E-10	2.69E-02
Pu-239	23,726,403	5.37E-15	2.78E-15	2.98E-15	1.28E-07	2.05E-06	2.69E-01
Pu-240	23,726,403	1.85E-15	9.56E-16	1.02E-15	4.38E-08	1.92E-07	9.23E-02
Pu-241	23,726,403	2.87E-14	7.00E-15	7.02E-15	6.80E-07	6.61E-09	3.58E-02
						Total:	**5.58E-01**
Stack 28 Bldg. 234	**149.61 m^3/min**		**2.49 m^3/sec**				
Am-241	39,209,477	1.62E-15	1.14E-15	1.46E-15	6.35E-08	1.85E-08	8.10E-02
Pu-238	39,209,477	3.25E-16	2.30E-16	2.94E-16	1.28E-08	7.46E-10	1.63E-02
Pu-239	39,209,477	3.25E-15	2.29E-15	2.93E-15	1.27E-07	2.05E-06	1.62E-01
Pu-240	39,209,477	1.11E-15	7.88E-16	1.01E-15	4.37E-08	1.92E-07	5.57E-02
Pu-241	39,209,477	2.01E-14	6.16E-15	6.94E-15	7.88E-07	7.65E-09	2.51E-02
						Total:	**3.40E-01**
Stack 332 Bldg. 120	**45.97 m^3/min**		**0.77 m^3/sec**				
Tc-99	21,514,372	5.92E-14	2.79E-14	3.44E-14	1.27E-06	7.53E-05	6.58E-05
Th-228	21,514,372	4.26E-16	8.57E-16	1.64E-15	9.16E-09	1.12E-11	2.13E-02
Th-230	21,514,372	1.98E-16	3.99E-16	7.64E-16	4.27E-09	2.11E-07	9.91E-03
Th-232	21,514,372	4.19E-16	8.42E-16	1.61E-15	9.01E-09	8.26E-02	1.05E-01
U-234	21,514,372	3.37E-15	6.78E-15	1.30E-14	7.25E-08	1.16E-05	6.74E-02

[1] ECL: Effluent Concentration Limit from 10-CFR-20, Appendix B. Fraction of ECL 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.

Radioactivity in Effluent Air
January 1, 2000 to June 30, 2000

Location	Total Volume (m^3)	Activity Concentration (µCi/ml)	Error Estimate (µCi/ml)	LLD (µCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECL[1]
Stack 332 Bldg. 120		**45.97 m^3/min**	**0.77 m^3/sec**				
U-235	21,514,372	5.51E-16	1.11E-15	2.12E-15	1.18E-08	5.49E-03	9.18E-03
U-238	21,514,372	2.39E-15	4.80E-15	9.19E-15	5.13E-08	1.53E-01	3.98E-02
						Total:	**2.52E-01**
Stack 376 Bldg. 301		**200.28 m^3/min**	**3.34 m^3/sec**				
Tc-99	92,488,518	4.01E-14	1.63E-14	2.48E-14	3.71E-06	2.19E-04	4.45E-05
U-234	92,488,518	3.68E-15	9.07E-15	2.00E-14	3.40E-07	5.45E-05	7.35E-02
U-235	92,488,518	5.60E-17	1.38E-16	3.05E-16	5.18E-09	2.40E-03	9.33E-04
U-236	92,488,518	1.87E-18	4.61E-18	1.02E-17	1.73E-10	2.66E-06	3.11E-05
U-238	92,488,518	1.12E-18	2.76E-18	6.10E-18	1.04E-10	3.09E-04	1.87E-05
						Total:	**7.46E-02**
Stack 421 Bldg. 100		**23.72 m^3/min**	**0.40 m^3/sec**				
Tc-99	11,099,544	9.55E-14	2.02E-14	2.47E-14	1.06E-06	6.27E-05	1.06E-04
Th-228	11,099,544	7.82E-17	1.65E-17	2.04E-17	8.68E-10	1.06E-12	3.91E-03
U-232	11,099,544	3.52E-16	7.44E-17	9.16E-17	3.91E-09	1.83E-10	3.52E-02
U-234	11,099,544	6.24E-14	1.32E-14	1.62E-14	6.93E-07	1.11E-04	1.25E+00
U-235	11,099,544	8.99E-16	1.90E-16	2.34E-16	9.98E-09	4.62E-03	1.50E-02
U-236	11,099,544	1.44E-14	3.05E-15	3.75E-15	1.60E-07	2.46E-03	2.40E-01
U-238	11,099,544	3.91E-17	8.27E-18	1.02E-17	4.34E-10	1.30E-03	6.52E-04
						Total:	**1.54E+00**
Stack 547 Bldg. 100		**48.51 m^3/min**	**0.81 m^3/sec**				
Tc-99	22,704,305	5.46E-14	2.72E-14	3.42E-14	1.24E-06	7.34E-05	6.07E-05
Th-228	22,704,305	6.46E-18	1.43E-17	2.80E-17	1.47E-10	1.79E-13	3.23E-04
U-232	22,704,305	2.91E-17	6.45E-17	1.26E-16	6.60E-10	3.08E-11	2.91E-03
U-234	22,704,305	5.16E-15	1.14E-14	2.24E-14	1.17E-07	1.88E-05	1.03E-01
U-235	22,704,305	7.43E-17	1.65E-16	3.23E-16	1.69E-09	7.81E-04	1.24E-03
U-236	22,704,305	1.19E-15	2.64E-15	5.17E-15	2.70E-08	4.16E-04	1.98E-02
U-238	22,704,305	3.23E-18	7.16E-18	1.40E-17	7.33E-11	2.19E-04	5.38E-05
						Total:	**1.28E-01**
Stack 573 Bldg 306-W		**94.53 m^3/min**	**1.58 m^3/sec**				
Tc-99	44,067,806	6.48E-14	2.22E-14	3.20E-14	2.85E-06	1.69E-04	7.20E-05
U-234	44,067,806	1.20E-14	1.28E-14	2.59E-14	5.28E-07	8.46E-05	2.40E-01
U-235	44,067,806	1.82E-16	1.95E-16	3.95E-16	8.04E-09	3.72E-03	3.04E-03
U-236	44,067,806	6.08E-18	6.48E-18	1.32E-17	2.68E-10	4.13E-06	1.01E-04
U-238	44,067,806	3.65E-18	3.89E-18	7.90E-18	1.61E-10	4.80E-04	6.08E-05
						Total:	**2.43E-01**
Stack 583 Bldg. 234		**10.99 m^3/min**	**0.18 m^3/sec**				
Am-241	2,879,457	2.58E-15	1.31E-15	1.38E-15	7.43E-09	2.17E-09	1.29E-01
Pu-238	2,879,457	5.18E-16	2.64E-16	2.77E-16	1.49E-09	8.73E-11	2.59E-02
Pu-239	2,879,457	5.17E-15	2.63E-15	2.77E-15	1.49E-08	2.39E-07	2.59E-01
Pu-240	2,879,457	1.78E-15	9.04E-16	9.50E-16	5.11E-09	2.24E-08	8.88E-02

[1] ECL: Effluent Concentration Limit from 10-CFR-20, Appendix B. Fraction of ECL 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.

Radioactivity in Effluent Air
January 1, 2000 to June 30, 2000

Location	Total Volume (m^3)	Activity Concentration (µCi/ml)	Error Estimate (µCi/ml)	LLD (µCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECL[1]
Stack 583 Bldg. 234		**10.99 m^3/min**	**0.18 m^3/sec**				
Pu-241	2,879,457	5.16E-14	8.38E-15	6.57E-15	1.49E-07	1.44E-09	6.45E-02
						Total:	**5.67E-01**
Stack 600 Bldg. 110		**289.93 m^3/min**	**4.83 m^3/sec**				
Tc-99	135,267,264	3.07E-13	3.19E-14	3.25E-14	4.16E-05	2.46E-03	3.41E-04
Th-228	135,267,264	5.19E-17	1.77E-17	2.67E-17	7.02E-09	8.57E-12	2.60E-03
U-232	135,267,264	2.34E-16	7.98E-17	1.20E-16	3.16E-08	1.48E-09	2.34E-02
U-234	135,267,264	4.14E-14	1.42E-14	2.13E-14	5.61E-06	8.98E-04	8.29E-01
U-235	135,267,264	5.97E-16	2.04E-16	3.07E-16	8.08E-08	3.74E-02	9.95E-03
U-236	135,267,264	9.56E-15	3.27E-15	4.92E-15	1.29E-06	1.99E-02	1.59E-01
U-238	135,267,264	2.60E-17	8.87E-18	1.34E-17	3.51E-09	1.05E-02	4.33E-04
						Total:	**1.02E+00**
Stack 615 Bldg. 306-W		**40.97 m^3/min**	**0.68 m^3/sec**				
Tc-99	19,118,196	5.96E-14	2.19E-14	3.21E-14	1.14E-06	6.75E-05	6.63E-05
U-234	19,118,196	6.98E-15	1.22E-14	2.59E-14	1.33E-07	2.14E-05	1.40E-01
U-235	19,118,196	1.06E-16	1.86E-16	3.95E-16	2.03E-09	9.40E-04	1.77E-03
U-236	19,118,196	3.54E-18	6.19E-18	1.32E-17	6.77E-11	1.04E-06	5.90E-05
U-238	19,118,196	2.12E-18	3.71E-18	7.90E-18	4.06E-11	1.21E-04	3.54E-05
						Total:	**1.41E-01**
Stack 646 Bldg. 110		**64.87 m^3/min**	**1.08 m^3/sec**				
Tc-99	30,361,150	4.04E-14	2.51E-14	3.44E-14	1.23E-06	7.26E-05	4.49E-05
Th-228	30,361,150	3.13E-18	1.30E-17	2.82E-17	9.50E-11	1.16E-13	1.56E-04
U-232	30,361,150	1.41E-17	5.87E-17	1.27E-16	4.27E-10	2.00E-11	1.41E-03
U-234	30,361,150	2.50E-15	1.04E-14	2.25E-14	7.58E-08	1.21E-05	4.99E-02
U-235	30,361,150	3.60E-17	1.50E-16	3.24E-16	1.09E-09	5.06E-04	5.99E-04
U-236	30,361,150	5.76E-16	2.40E-15	5.20E-15	1.75E-08	2.70E-04	9.60E-03
U-238	30,361,150	1.56E-18	6.52E-18	1.41E-17	4.75E-11	1.42E-04	2.61E-05
						Total:	**6.18E-02**
Stack 649 Bldg. 330		**21.23 m^3/min**	**0.35 m^3/sec**				
Tc-99	9,774,845	6.39E-14	1.85E-14	2.51E-14	6.24E-07	3.69E-05	7.10E-05
U-234	9,774,845	6.76E-15	8.00E-15	1.59E-14	6.61E-08	1.06E-05	1.35E-01
U-235	9,774,845	2.28E-16	2.71E-16	5.37E-16	2.23E-09	1.03E-03	3.81E-03
U-238	9,774,845	1.80E-15	2.13E-15	4.23E-15	1.76E-08	5.26E-02	3.00E-02
						Total:	**1.69E-01**
Stack 667 Bldg. 410		**1612.42 m^3/min**	**26.87 m^3/sec**				
Am-241	424,817,557	1.89E-15	3.13E-16	3.35E-16	8.01E-07	2.34E-07	9.43E-02
Pu-238	424,817,557	3.37E-16	5.60E-17	5.99E-17	1.43E-07	8.38E-09	1.69E-02
Pu-239	424,817,557	3.87E-15	6.42E-16	6.87E-16	1.64E-06	2.64E-05	1.93E-01
Pu-240	424,817,557	1.30E-15	2.16E-16	2.31E-16	5.53E-07	2.42E-06	6.50E-02
Pu-241	424,817,557	1.68E-13	1.50E-14	1.60E-14	7.13E-05	6.92E-07	2.10E-01
Ra-224	424,817,557	7.09E-15	1.18E-15	1.26E-15	3.01E-06	1.89E-11	3.54E-03

[1] ECL: Effluent Concentration Limit from 10-CFR-20, Appendix B. Fraction of ECL 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.

Radioactivity in Effluent Air
January 1, 2000 to June 30, 2000

Location	Total Volume (m^3)	Activity Concentration (µCi/ml)	Error Estimate (µCi/ml)	LLD (µCi/ml)	Quantity Released (Ci)	Quantity Released (g)	Fraction of ECL[1]
Stack 667 Bldg. 410	**1612.42 m^3/min**		**26.87 m^3/sec**				
Th-228	424,817,557	7.09E-15	1.18E-15	1.26E-15	3.01E-06	3.68E-09	3.54E-01
Th-230	424,817,557	3.61E-15	5.99E-16	6.41E-16	1.53E-06	7.58E-05	1.80E-01
Th-232	424,817,557	7.09E-15	1.18E-15	1.26E-15	3.01E-06	2.76E+01	1.77E+00
U-234	424,817,557	1.77E-14	2.94E-15	3.15E-15	7.53E-06	1.21E-03	3.54E-01
U-235	424,817,557	2.77E-15	4.59E-16	4.92E-16	1.18E-06	5.44E-01	4.61E-02
U-238	424,817,557	1.61E-14	2.67E-15	2.85E-15	6.82E-06	2.04E+01	2.68E-01
						Total:	**3.56E+00**

[1] ECL: Effluent Concentration Limit from 10-CFR-20, Appendix B. Fraction of ECL 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.

21G-00-0139
GOV-01-55-03
ACF-00-0205

Attachment C
To Letter Dated August 28, 2000
B. M. Moore to Mr. Luis A. Reyes (NRC)

Determination of Average Radionuclide Concentrations for May 2000 Discharges from the NFS Waste Water Treatment Facility

(Seven Pages to Follow)

Determination of Average Radionuclide Concentrations for May 2000 Discharges from the NFS Waste Water Treatment Facility

Introduction

On July 24, 2000, the NFS Environmental Safety Manager became aware of a problem with the May 2000 monthly composite sample results for the NFS Waste Water Treatment Facility (WWTF). The results were reported by an off-site contract laboratory and were extremely inconsistent with other data collected for WWTF discharges during the period. An investigation of the analytical results was promptly initiated the same day. On August 3, 2000 the investigative effort was augmented by formal appointment of an NFS TapRoot Investigation Team. As a result of this investigation, this team (with full support from the Health Physicist responsible for the NFS Effluent Control Program) determined that the composite sample was not representative of May 2000 discharges because one of the samples collected for the composite (namely batch ID 00-032) was improperly collected and/or handled. This conclusion is being documented with additional details in an internal TapRoot investigation report (NFS document 21T-00-0656) and in an NRC Inspection Report (Report No. 70-143/00-09). Because the composite sample was not representative of actual releases, radionuclide concentration values for May 2000 (excluding Ra-224, which is discussed below) had to be inferred from other available data. This attachment describes the technique used to estimate values for May 2000 discharges; NFS believes this technique to be the best, most -reasonable approach for these values.

Background Information

During the month of May 2000, fourteen batches of treated wastewater were discharged from the WWTF via a state-permitted outfall (discharge pipe) to the Nolichuckey River. For each batch, a 125-ml discharge sample was collected from each treated batch and analyzed for gross alpha and beta activity. The gross activity data from a batch were then used by safety supervision to determine if the batch could be discharged (from a radiological perspective only). After a batch was determined to be ready for discharge, safety supervision notified WWTF supervision that a 2-liter sample would need to be collected from the batch and transferred to the safety group (i.e., Radiation Technician Supervisor) prior to discharge. This sample was required for use in the monthly composite sample. Upon receipt of the 2-liter sample by the safety group, written approval (regarding radiological release) was issued by safety supervision to WWTF supervision. With the safety approval in hand, the batch was then authorized for discharge by WWTF supervision as long as all other (non-radiological) parameters were within their limits. Soon after the end of the month, all 2-liter samples were used to create a monthly composite sample (per procedure) for May 2000. The aliquot volume taken from each 2-liter container was determined (weighted) based on the volume of the sampled batch as compared to the total monthly discharge volume.

As discussed in the **Introduction**, the monthly composite for May 2000 was sent to an off-site contract laboratory and analyzed for all radionuclides except Ra-224[1]; however, it was determined that the composite sample was not representative of the actual activity in the discharges. Therefore, concentration values would have to be inferred for all radionuclides (except Ra-224) from available data. The next section describes the method used to meet this objective.

Method for Determining Average Radioactivity in May 2000 WWTF Discharges

As a general summary, activity values for May 2000 (except Ra-224) were determined as follows. Activity releases were evaluated for release during the month preceding and following May 2000 to determine the relative percent contribution of each nuclide with respect to gross alpha and gross beta activity (last two columns in Table 1)[2]. This approach for determining radionuclide percents in May 2000 discharges is reasonable because there were no major process changes for influents to the WWTF during these months and the months immediately surrounding May 2000 from a release timing perspective. After the percent contributions were established, the best data available for gross alpha and beta activity for each batch was used to determine (volume-weighted) average alpha and beta concentrations, errors, and minimum detection concentrations (MDCs) in May 2000 discharges (last row in Table 2). These average alpha and beta concentrations were multiplied with the relative nuclide percent contribution to total alpha or beta activity, respectively, to determine concentrations for each radionuclide present in the May 2000 discharges (Table 3).

The following description provides more detailed information regarding data used and calculations performed to determine average radionuclide concentration values (except for Ra-224[1]) for the May 2000 discharges:

1. Total (Ci) radioactivity releases for the months preceding and following May 2000 (i.e., April and June 2000) were used to determine reasonable radionuclide percents with respect to either gross alpha or gross beta activity. These are shown in the last two columns of Table 1.

    a. Nuclide specific data on total activity released for the months preceding and following May 2000 are provided in Columns 2 and 3 of Table 1. The sum of releases for these two months (April and June) is given in Column 4. Data in Columns 2 and 3 was determined using monthly composite concentration values (reported by off-site contract lab for the referenced month) multiplied by total volume discharged in that month (and converting units as appropriate). Ra-224 is not included because it does not need to be estimated for May 2000.

    b. The primary radiation type emitted and intensity of that radiation type is listed in Column 5 of Table 1 for each nuclide. Note that Na-22 decays by both beta+

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[1] Due to decay issues associated with Ra-224, a two-liter volume sample is collected from each batch discharged and analyzed (in-house by gamma spectroscopy) directly for Ra-224 and associated gamma-emitting daughters. The results for May 2000 have been reviewed and validated by a Health Physicist prior to use in this report. No problems were identified for these results.

[2] All tables are located at the end of this attachment.

emission and electron capture; this explains why its beta emission intensity is only ~90%. Values for all radionuclides in this column were determined using ICRP Publication 38.

c. Based on the type of radiation emitted (alpha vs. beta), Columns 6 and 7 of Table 1 simply repeat total activities from Column 5—associating it with the proper radiation type. The last cell in this column is the sum of the alpha and beta activity respectively.

d. The last two columns of Table 1 (Columns 8 and 9) indicate what percents of the total alpha or beta activity is contributed by a particular nuclide. It is determined by dividing line items in Columns 6 and 7 by the "Sum" values for these columns, respectively. With this data, the uranium isotopes account for over 99% of the total alpha activity; technecium-99 and Cs-137 account for over 99% of the beta activity. This is reasonable based on materials that were processed by the facility during April -June 2000.

e. The working assumption is that the relative nuclide percents in Columns 8 and 9 are an accurate reflection of what would be in the May 2000 liquid releases. This is a reasonable assumption since the same influent streams were present during each of the three months involved (April , May, and June) and there were no significant process changes during the period.

2. Average gross alpha and beta activity concentrations were determined for May 2000 discharges. These averages are shown in the last row of Table 2. Individual batch values are shown in the remainder of Table 2.

a. General information on May 2000 discharges is shown in Columns 1 and 2; volumes are batch discharge volumes. Batch volumes are divided by the total volume discharged in the month to determine a weighting factor by which each batch activity value is multiplied to determine "volume-weighted" averages.

b. For gross alpha/beta data, the preference was to use the results from analyses performed on the residual liquid in the 2-liter batch sample originally collected for use in the May composite (described in the **Background Information** section). The 2-liter residual samples were only available/usable for 12 of the 14 batches (namely batches 00-034, 00-035, and 00-037 through 00-046; batch 00-036 was absorbed into other batches--it was never released as an individual batch). For batches 00-032 and 00-033, the alpha/beta results from the routine 125-ml batch discharge samples were used to determine averages. The reasons for using the 125 ml samples on these two batches are as follow. During the TapRoot investigation (referenced the **Introduction** section), it was concluded that the 2-liter sample collected from batch 00-032 (for use in the monthly composite was not representative); the best alpha/beta data available for this batch was that from the 125-ml discharge sample. For batch 00-033, the location of the 2-liter sample container was not known (it was available at the time the monthly composite was mixed, but was not found at the time the investigation was undertaken).

c. There were two primary reasons for placing preference on the results from the residual 2-liter sample liquids. First, the 2-liter sample residual liquids were not counted until about August 3, 2000; this provided ample time for Ra-224 (3.66 day half life) and associated short-lived alpha-emitting progeny (much shorter than 3.66 day half life) to decay to negligible levels in the sample. This decay helped to minimize potential interference associated with Ra-224 (which did not need to be estimated in this effort because actual measured values exist for May 2000). The second reason was that disparities existed between gross alpha and beta results for the 2-liter residual liquids as compared to the 125-ml discharge sample results. Use of the available/usable 2-liter samples increased the volume-weighted gross alpha activity from 122 pCi/L (based on original discharge results) to 215 pCi/L. Average beta concentrations were also slightly increased, albeit a small increase. Ultimately, NFS decided to use the more conservative values to derive radionuclide concentrations. The final alpha/beta concentrations are shown in the last row of Table 2.

3. Radionuclide-specific percents in Columns 8 and 9 of Table 1 were multiplied by the averages in the last row of Table 2 to generate final derived results shown in Table 3. Note that the value for Ra-224 is based on actual measurements and is not derived using the methods described in items 1 and 2 above.

Results

The results of this evaluation are provided in Table 3. In place of the normal monthly composite sample results, the results in Table 3 were used (along with the May 2000 WWTF discharge volume) to represent radioactivity released from the WWTF during May 2000. For other months during the January 1, 2000 to June 30, 2000 period, results from monthly composite samples (analyzed by off-site contract laboratory) were utilized as normal to generate the report included in this transmittal as **Attachment A** "Radioactivity in Effluent Liquid". All calculations and results were independently reviewed by a person knowledgeable of the NFS Effluent Control Program and well-experienced with radioactivity-related calculations.

Evaluation Performed by: Thomas E. Huston 8/24/2000

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Health Physicist III

Peer-Review by: John W. Nagy 8/24/2000

John W. Nagy, C.H.P.
Health Physics Manager

Table 1. Derived Radionuclide Percent Contributions to Total Alpha and Beta Activity for WWTF Discharges (April and June 2000)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
Radionuclide	April 2000 Total Ci Released*	June 2000 Total Ci Released*	April+June Total Ci	Type of Emitter (alpha/beta) and %Intensity**	Alpha Activity (Ci)	Beta Activity (Ci)	% of Alpha Activity	% of Beta Activity
Cs-137	9.40E-07	1.96E-06	2.90E-06	beta- (100%)		2.90E-06		4.92%
Na-22	3.11E-07	1.60E-08	3.27E-07	beta+ (89.9%)		2.94E-07		0.50%
Pu-238	3.55E-08	0.00E+00	3.55E-08	alpha (100%)	3.55E-08		0.02%	
Pu-239/240	1.09E-08	0.00E+00	1.09E-08	alpha (100%)	1.09E-08		0.01%	
Ra-224***								
Tc-99	2.37E-06	5.34E-05	5.58E-05	beta- (100%)		5.58E-05		94.58%
Th-228	1.97E-07	1.61E-07	3.58E-07	alpha (100%)	3.58E-07		0.22%	
Th-230	1.53E-07	5.60E-07	7.13E-07	alpha (100%)	7.13E-07		0.44%	
Th-232	1.64E-08	7.70E-09	2.41E-08	alpha (100%)	2.41E-08		0.01%	
U-234	4.34E-05	1.11E-04	1.54E-04	alpha (100%)	1.54E-04		95.49%	
U-235/236	9.47E-07	3.84E-06	4.79E-06	alpha (100%)	4.79E-06		2.96%	
U-238	4.99E-07	8.67E-07	1.37E-06	alpha (100%)	1.37E-06		0.84%	
				Sum:	1.62E-04	5.90E-05	100.00%	100.00%

Data Sources/Notes:

* Product of monthly discharge volume and nuclide concentrations obtained for WWTF Monthly Composite Sample; analyzed by offsite contract laboratory (GEL, Inc).

** Based on data in ICRP Pub. 38 (Radionuclide Transformations: Energy and Intensity of Emissions)

For beta emissions, conversion electrons and Auger electrons are not included in the percent. For practical reasons, these are assumed to be emitted at the same time as the primary radiation. Gamma and X-ray emitters are not included for the same reason.

*** Ra-224 values are not derived using this method; rather they have been determined from in-house gamma spectroscopy measurements of batches discharged in May 2000. Ra-224 is not included in the percent calculations since the concentration is known for May 2000 discharges.

Table 2. Gross Alpha and Beta Values Used for WWTF Batches Released in May 2000

Batch ID	Volume (L)	Gross Alpha (pCi/L) Result	Error (2σ)	MDC	Gross Beta (pCi/L) Result	Error (2σ)	MDC
00-032	56970	255.05	91.96	137.36	214.81	240.20	402.44
00-033	56970	44	85	155	160	135	239
00-034	56970	256.06	84.29	122.12	-23.46	228.56	391.12
00-035	56970	52.65	72.35	122.12	-12.30	228.80	391.12
00-037	56970	64.61	73.11	122.12	-113.19	226.64	391.12
00-038	56970	98.09	75.19	122.12	17.08	229.42	391.12
00-039	56970	83.77	74.30	122.12	89.50	230.95	391.12
00-040	56970	126.84	76.92	122.12	80.39	230.76	391.12
00-041	56970	52.65	72.35	122.12	85.74	230.87	391.12
00-042	56970	287.18	85.97	122.12	-143.59	225.99	391.12
00-043	56970	150.75	78.34	122.12	-23.46	228.56	391.12
00-044	56970	856.69	112.37	122.12	-206.90	224.62	391.12
00-045	55078	251.21	84.03	122.12	-22.09	228.59	391.12
00-046	56970	435.45	93.56	122.12	-51.58	227.96	391.12
Total Volume:	795688						
	Volume-weighted averages-->	215.27	82.84	125.57	3.70	222.62	381.04

Note: Shaded values are from 125-ml discharge samples (batch 032 run by liquid scintillation; batch 033 run by Gas Flow Proportional Counting technique). All other values are from gross alpha/beta liquid scintillation counting of residual liquids in the 2-liter samples taken for inclusion in the May 2000 composite. The 2-liter sample data was preferred over the 125-ml data due to fact that influences from Ra-224 and daughters are negligible (decay has occurred).

Table 3. Derived Radionuclide Concentrations for May 2000 Composite

Radionuclide	Derived Average Conc. (pCi/L)	Derived Error (pCi/L)	Derived MDC (pCi/L)
Cs-137	1.82E-01	1.09E+01	1.87E+01
Na-22	1.84E-02	1.11E+00	1.90E+00
Pu-238	4.73E-02	1.82E-02	2.76E-02
Pu-239/240	1.45E-02	5.58E-03	8.46E-03
Ra-224*	3.7E+01	4.0E+00	1.7E+01
Tc-99	3.50E+00	2.11E+02	3.60E+02
Th-228	4.77E-01	1.83E-01	2.78E-01
Th-230	9.49E-01	3.65E-01	5.54E-01
Th-232	3.21E-02	1.23E-02	1.87E-02
U-234	2.06E+02	7.91E+01	1.20E+02
U-235/236	6.37E+00	2.45E+00	3.72E+00
U-238	1.82E+00	7.00E-01	1.06E+00

*Note: Ra-224 is not derived; rather it is based on actual measurements of Ra-224 and duaghters by an in-house gamma spectroscopy system.

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ACF-00-0205

Attachment D
To Letter Dated August 28, 2000
B. M. Moore to Mr. Luis A. Reyes (NRC)

Report on Potential Dose to the Maximally Exposed Off-site Individual and on Maximum Radionuclide Concentrations for the Period: January through June 2000 (Effluent Air)

(Two Pages to Follow)

Report on Potential Dose to the Maximally Exposed Offsite Individual and on Maximum Radionuclide Concentrations for the Period: January through June 2000 (Effluent Air)

Introduction

Average radionuclide concentrations in air effluents from stacks 416, 421, 600, and 667 (as measured at the point of release) exceeded concentration values listed in 10 CFR Part 20, Appendix B, Table 2, Column 1 during the release period (i.e., the sum of fractions exceeded 1.0 at the point of release). For this reason, an evaluation was performed in accordance with SNM-124, Part I, Section 5.1.1.3 to estimate the potential dose to the maximally exposed off-site individual (MEI) and the maximum off-site activity concentrations in air. The source term for this evaluation was gaseous effluents released by NFS stacks and vents from January 1, 2000 through June 31, 2000 (provided in Attachment B of this transmittal). Methods used and results of this evaluation are summarized below.

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 (Version 2.0) was used to estimate off-site doses and activity concentrations for gaseous effluents. CAP88-PC accommodates up to six stacks and considers stacks to be co-located (i.e., at the same physical location on the site). NFS operated sixteen (16) radiological stacks during the 1st half of 2000. Based on effluent types and stack physical characteristics, releases from these stacks were grouped into four effective stacks for modeling purposes. To accommodate the co-location limitation of the model, the four 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 taken to be 100 meters for all sectors and is conservative. 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; this size is consistent with assumptions used in EPA Federal Guidance Report 11.

Because CAP88-PC models release 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. To annualize releases the six-month source term was multiplied by a normalization factor, NF, of 2.005 (NF = 365/182).

Summary of Results

Doses are reported in a table 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 given above) to convert the "annualized" doses back to those doses that were actually received in the six-month release period. Activity concentrations reported below come directly from the CAP88-PC "Concentration Tables" report; no adjustments are needed for these concentrations. The CAP88PC 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 300 meters North Northeast from the center of the plant site. The effective dose equivalent (EDE) to the MEI was estimated to be 0.025 mrem for gaseous effluents released during the 1st half of 2000. The highest organ committed dose equivalent (CDE) to the MEI was estimated to be 0.252 mrem to the endosteal tissue (bone surfaces). These MEI doses are well below SNM-124 license action levels and applicable regulatory limits/ALARA constraints.

Table 2 summarizes the maximum off-site air activity concentrations, as determined by CAP88-PC, for radionuclides released. The total sum of fractions based on maximum values indicates that exposures to off-

site public from gaseous effluents were much less than 1% of the 10 CFR 20, Appendix B, Table 2, Col. 1 values for all off-site receptors including the site boundary on out. 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 large 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 1. Organ Dose Equivalents and Effective Dose Equivalent at the MEI Location

Organ	Committed Dose Equivalent (mrem per 1st Half of 2000)
Gonads	2.00E-3
Breast	3.77E-4
Red Bone Marrow	2.01E-2
Lungs	9.63E-2
Thyroid	2.74E-3
Endosteal Tissue (Bone Surfaces)	2.52E-1
Remainder Organs	9.48E-3
Effective Dose Equivalent	**2.49E-2 mrem**
Location of MEI:	300 meters North Northeast

Notes: Dose results are from the CAP88-PC "Synopsis Report" generated for the 1st Half of 2000. CAP88-PC uses organ dose weighting factors equal to those in 10 CFR Part 20.1003 to compute the effective dose equivalent.

Table 2. Maximum Off-site Air Concentrations for Receptors at or Beyond the Site Boundary

Nuclide	Maximum Offsite Airborne Concentration (uCi/ml)	Location of Maximum Offsite Airborne Concentration		Value from 10 CFR Part 20, Appendix B, Table II, Col. 1 (uCi/ml)	Ratio of Maximum Concentration to 10 CFR Part 20 Value
		Sector	Distance (m)		
Tc-99	1.30E-16	NNE	700	9.00E-10	1.44E-07
Th-228	2.00E-18	NNE	250	2.00E-14	1.00E-04
Th-230	1.00E-18	NNE	250	2.00E-14	5.00E-05
Th-232	2.00E-18	NNE	250	4.00E-15	5.00E-04
Ra-224	2.00E-18	NNE	250	9.00E-13	2.22E-06
U-232	2.30E-20	NNE	300	1.00E-14	2.30E-06
U-234	1.80E-17	NNE	550	5.00E-14	3.60E-04
U-235	8.90E-19	NNE	300	6.00E-14	1.48E-05
U-236	2.70E-18	NNE	650	6.00E-14	4.50E-05
U-238	4.60E-18	NNE	250	6.00E-14	7.67E-05
Am-241	6.70E-19	NNE	250	2.00E-14	3.35E-05
Pu-238	1.20E-19	NNE	250	2.00E-14	6.00E-06
Pu-239	1.30E-18	NNE	300	2.00E-14	6.50E-05
Pu-240	4.60E-19	NNE	250	2.00E-14	2.30E-05
Pu-241	4.90E-17	NNE	250	8.00E-13	6.13E-05
				Total Sum of Ratios:	1.34E-03 (0.134%)

Notes: The maximum activity values shown above were extracted from the CAP88-PC "Concentration" output report generated for the 2nd Half of 2000.

Prepared by: Thomas E. Huston 8/24/2000

Peer Reviewed by: John W. Nagy 8/28/200