Westinghouse Electric Company LLC
Nuclear Fuel
Columbia Fuel Site
5801 Bluff Road
Hopkins, South Carolina 29061
USA

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

Direct tel: 803-647-1000

Our ref: LTR-RAC-18-57

August 30, 2018

Subject: SNM-1107/70-1151
NRC Semi-Annual Discharge Report
January – June 2018

Dear Sir:
The following report fulfills regulatory requirements as listed in 10 CFR 40.65 and 10 CFR 70.59 "Effluent Monitoring Reporting Requirements." For the six-month period January 1, 2018, through June 30, 2018, the following quantities of radionuclides were released to the unrestricted area by the Westinghouse Electric Company's Columbia, South Carolina Nuclear Fuel Plant:

Discharge	Total 6-month emissions (uCi)	Parameter	Measured Concentration	Regulatory Concentration Limit
Gaseous	162.42	Uranium (analyzed as gross alpha)	6.6 E^{-15} uCi/mL*	5 E^{-14} uCi/mL
Liquid Effluent	1470.8	U-234	2.8 E^{-8} uCi/mL	3 E^{-7} uCi/mL
	81.5	U-235		
	261.3	U-238		
	494.6	Tc-99	8.0 E^{-9} uCi/mL	6 E^{-5} uCi/mL

*Includes a dispersion factor of 1000 to account for dilution between the release point and the nearest site boundary

As shown above, the effluent releases are within the NRC's regulatory limits designed to protect the public health and safety.

Gaseous effluent results were obtained from point source gross alpha analysis of stack gas effluent, and the individual radionuclide activity composition is inferred from the calculated average enrichment (85.04% U-234, 3.38% U-235, and 11.43% U-238). Tc-99 is not reported for gaseous effluents, as significant quantities of Tc-99 were not detected during benchmark testing of gaseous emissions.

Liquid effluent values were obtained by analysis of composite proportional samples prior to discharge to the Congaree River and basing the activity on the calculated average enrichment. All liquid discharges are pumped through a single discharge line to the Congaree River. Liquid effluent composites were analyzed by alpha spectroscopy, and significant quantities of U-236 were not detected using this method. The total liquid effluent volume released to the Congaree River during the first half of 2018 was 6.45E+07 liters.

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Calculated values have been reported for all results, due to variability of minimum detection concentrations (MDC). Negative values are reported as zero.

To meet the requested dosage information outlined in Regulatory Guide 4.16, section 6.1, the internal Westinghouse letter LTR-EHS-18-47 entitled "2018 Semi-Annual Assessment of Public Dose from Liquid and Gaseous Effluents" is attached.

Sincerely,

John Howell, Manager, Environment, Health and Safety

cc: USNRC, Region II
245 Peachtree Center Ave, NE, Suite 1200
Atlanta, Georgia 30303-1257

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Nuclear Fuel
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Your ref:
Our ref: LTR-EHS-18-47

Cc: John Howell, Nancy Parr, Anna Pearson,
Diana Joyner, Sherrie Culler

August 16, 2018

2018 Semi-Annual Assessment of Public Dose from Liquid and Gaseous Effluents

Effluents released from plant operations are monitored to determine the quantities of radionuclides discharged into the environment. The cumulative radioactivity released is summarized semi-annually and annually and input into dose models developed by the NRC and EPA to estimate the dose to the public.

The whole body and organ dose via the following pathways is determined in this assessment:

- Dose due to Gaseous Effluents by Direct Inhalation
  - The whole body dose was estimated using EPA's COMPLY Code at level 2 complexity. The organ dose was estimated by calculating the X/Q factor using the results of the COMPLY analysis for stack #1212 (S1030A), the measured release quantity, and the dose conversion factors from Federal Guidance Report No 11, "Limiting Values of Radionuclide Intake and Air concentration Factors for Inhalation, Submersion, and Ingestion" (FGR 11).
- Dose due to Liquid Effluents by Ingestion of Potable Water
  - Estimated using equations and recommended values in Regulatory Guide 1.109 (RG 1.109). Dose conversion factors are referenced from FGR 11.
- Dose due to Liquid Effluents by Ingestion of Fish
  - Estimated using equations and recommended values in RG 1.109. Dose conversion factors are referenced from FGR 11.
- Dose due to Liquid Effluents by Irradiation from Shoreline Deposition
  - Estimated using equations and recommended values in RG 1.109. Dose conversion factors are referenced from Federal Guidance report No 12, "External Exposure to Radionuclides in Air, Water, and Soil."

The inhalation dose is determined at the nearest site boundary at a distance of 595 meters. The ingestion dose from liquid effluent and external dose from sediment deposition is determined at the point at which the liquid effluent leaves the diffuser in the Congaree River.

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The release rates for gaseous effluent are determined by gross alpha measurements performed on daily air samples, one per stack for 47 stacks (Attachment 1). The release rates for liquid effluent are determined by isotopic analysis of liquid effluent samples taken monthly (Attachment 3). Based on these results, the following quantities were released in the 1st half of calendar year 2018:

- 162.42 μCi of Uranium in gaseous effluent
- 1.81 mCi of Uranium in liquid effluent
- 0.49 mCi of Technetium in liquid effluent

Using these results and the methods previously mentioned the whole body dose, dose to the bone, and dose to the lung were determined for an individual present at the nearest site boundary. Table 1 provides a summary of the results for each pathway. The gaseous and liquid effluents released during the 1st half of 2018 resulted in a potential whole body dose of 0.08 mrem and lung dose of 0.58 mrem to an individual present at the nearest site boundary. The dose to the bone is negligible. The estimated whole body dose is well below the 12.5 mrem (1/2 of the 25 mrem annual dose limit) and the 0.5 mrem ALARA goal (1/2 of 1 mrem annual ALARA goal) for a member of the public.

Table 1. 2018 Semi-Annual Dose to the Public from Liquid and Gaseous Effluents

	Whole Body Dose (mrem/6 months)	**Organ Dose - Bone (mrem/6 months)**	**Organ Dose - Lung (mrem/6 months)**
Gaseous Effluents			
Direct inhalation*	0.08	2.19E-03	0.58
Liquid Effluents			
Potable Water	2.17E-05	3.20E-04	-
Aquatic Food (Fish)	1.26E-06	1.84E-05	-
Shoreline Deposition	7.33E-10	-	-
Total (mrem/6 months)	*0.08*	*2.53E-03*	*0.58*

* Assumes 80 % residence time

There were no changes in source material and no release points were added or removed during the 1st half of 2018. The attachments below illustrate the method used to calculate each result listed in Table 1. The annual dose calculation will be completed when the data is available for the entire calendar year.

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Attachment 1: 1st Half 2018 Gaseous Effluent Discharges
Attachment 2: Lung/Bone Organ Dose due to Gaseous Effluent
Attachment 3: 1st Half 2018 Liquid Effluent Discharges
Attachment 4: Whole Body Dose from Liquid Effluent Pathways - Potable Water
Attachment 5: Dose to the Bone Surface from Liquid Effluent Pathways - Potable Water
Attachment 6: Whole Body Dose from Liquid Effluent Pathways - Aquatic Foods
Attachment 7: Dose to the Bone Surface from Liquid Effluent Pathways - Aquatic Foods
Attachment 8: Whole Body Dose from Liquid Effluent Pathways – Shoreline Deposits
Attachment 9: 2018 Isotopic Fractions
Attachment 10: Comply Results

David Wagoner, CHP
Radiation Safety Engineer
EH&S Operations

Review by: Anna Pearson
Manager, RSO
EH&S Operations

Attachment 1
1st Half 2018 Gaseous Effluent Discharges

Sampling Station	Location Description	Stack Height (m)	Flow Rate (m/s)	Gross Alpha Concentration* (uCi/mL)	Release Rate (Ci/s) U234	U235	U238	1st Half (Jan-Jun) uCi Uranium Released
1207	MET LAB EXHAUST	10	0.56	1.96E-13	9.14E-14	3.63E-15	1.23E-14	1.69
1238	IFBA EXHAUST	10	4.72	8.13E-14	3.23E-13	1.29E-14	4.35E-14	5.98
1239	MAINT WELD EX	11	0.94	1.76E-13	1.40E-13	5.57E-15	1.88E-14	2.59
1243	AC-8	11	3.78	8.01E-14	2.54E-13	1.01E-14	3.42E-14	4.70
1222	CALC COMB GAS LN 1	12	0.16	3.06E-13	4.16E-14	1.66E-15	5.60E-15	0.77
1223	CALC COMB GAS LN 2	12	0.16	5.08E-13	7.03E-14	2.79E-15	9.45E-15	1.30
1224	CALC COMB GAS LN 3	12	0.16	1.28E-13	1.78E-14	7.09E-16	2.40E-15	0.33
1225	CALC COMB GAS LN 4	12	0.16	1.13E-13	1.57E-14	6.23E-16	2.11E-15	0.29
1226	CALC COMB GAS LN 5	12	0.16	1.26E-13	1.73E-14	6.88E-16	2.33E-15	0.32
1228	CHEM LAB EX #3	12	0.64	8.68E-14	2.33E-14	9.24E-16	3.13E-15	0.43
1231	DEV LAB EX #2	12	0.94	1.99E-13	1.58E-13	6.30E-15	2.13E-14	2.93
1237	ABF HOOD TORIT EX	12	1.42	8.64E-14	1.03E-13	4.11E-15	1.39E-14	1.91
1241	PELLET LINE 6	12	2.78	8.12E-14	1.90E-13	7.54E-15	2.55E-14	3.51
1247	HOT OIL RM EX	12	3.89	1.65E-13	5.40E-13	2.15E-14	7.26E-14	9.99
1201	FURNACE EX LINE 1	13	2.78	8.44E-14	1.97E-13	7.85E-15	2.65E-14	3.65
1202	FURNACE EX LINE 2	13	2.78	8.09E-14	1.89E-13	7.50E-15	2.54E-14	3.49
1203	FURNACE EX LINE 3	13	2.78	8.00E-14	1.87E-13	7.42E-15	2.51E-14	3.45
1204	FURNACE EX LINE 4	13	2.78	8.01E-14	1.87E-13	7.44E-15	2.51E-14	3.46
1205	FURNACE EX LINE 5	13	2.78	8.34E-14	1.95E-13	7.74E-15	2.62E-14	3.60
1206	NEW DECON ROOM	13	1.64	9.21E-14	1.27E-13	5.05E-15	1.71E-14	2.35
1208	INCINERATOR EX	13	1.89	1.36E-13	2.16E-13	8.60E-15	2.91E-14	4.00
1209	SUPPL INCIN EX	13	0.94	3.16E-13	2.51E-13	1.00E-14	3.38E-14	4.65
1217	CONV ENCL EX 4-C	13	3.89	1.01E-13	3.29E-13	1.31E-14	4.43E-14	6.09
1218	CONV ENCL EX 4-D	13	3.89	2.00E-13	0.00E+00	0.00E+00	0.00E+00	0.00
1219	CONV EMERG EX 4E	13	3.89	2.20E-13	3.46E-14	1.38E-15	4.65E-15	0.64
1221	DECON ROOM EX	13	1.42	2.90E-13	3.46E-13	1.37E-14	4.64E-14	6.39
1230	DEV LAB EX #1	13	0.94	2.04E-13	1.62E-13	6.45E-15	2.18E-14	3.00
1232	PELLET COMBINED EX	13	4.72	8.14E-14	3.23E-13	1.29E-14	4.35E-14	5.98
1233	SOLVENT EXT N EX	13	3.33	8.49E-14	2.04E-13	8.10E-15	2.74E-14	3.77
1234	SOLVENT EXT S EX	13	3.33	2.06E-13	8.27E-14	3.29E-15	1.11E-14	1.53
1229	HP LAB EX	15	0.58	8.22E-14	4.00E-14	1.59E-15	5.38E-15	0.74
1236	MAP COMBINED	15	2.78	1.07E-13	0.00E+00	0.00E+00	0.00E+00	0.00
1240	AC-3	15	3.78	8.06E-14	2.56E-13	1.02E-14	3.45E-14	4.74
1246	AC-4	15	3.89	8.34E-14	2.73E-13	1.09E-14	3.67E-14	5.05
1251	WATERGLASS SCR S1190	15	2.36	8.14E-14	1.62E-13	6.43E-15	2.17E-14	2.99
1210	CONV 1-A EX	16	4.17	9.92E-14	3.47E-13	1.38E-14	4.67E-14	6.42
1211	CONV 1-B EX	16	4.17	1.97E-13	0.00E+00	0.00E+00	0.00E+00	0.00
1212	S1030 A	16	7.56	1.09E-13	6.58E-13	2.61E-14	8.84E-14	12.16
1213	S1030 B	16	7.56	2.24E-13	6.76E-14	2.69E-15	9.09E-15	1.25
1227	CHEM LAB EX #2	16	0.58	2.49E-13	1.22E-13	4.86E-15	1.64E-14	2.26
1220	CHEM LAB FILT EX	17	5.56	8.71E-14	4.07E-13	1.62E-14	5.47E-14	7.53
1242	AC-5	17	3.78	8.24E-14	2.62E-13	1.04E-14	3.52E-14	4.84
1244	AMMON FUME SCR 1008A	17	1.89	8.89E-14	1.41E-13	5.61E-15	1.90E-14	2.61
1245	AMMON FUME SCR 1008B	17	1.89	1.38E-13	0.00E+00	0.00E+00	0.00E+00	0.00
1248	ERBIA FURNACE EX	18	8.17	8.51E-14	5.85E-13	2.32E-14	7.86E-14	10.81
1249	ERBIA SCRUBBER EX	18	4.33	8.46E-14	3.08E-13	1.23E-14	4.14E-14	5.70
1250	ERBIA CHANGE ROOM	18	1.9	8.56E-14	1.37E-13	5.44E-15	1.84E-14	2.53
	Total				***8.78E-12***	***3.49E-13***	***1.18E-12***	***162.42***

*Concentration LLD is 8E-14 uCi/mL

Attachment 2

Lung/Bone Organ Dose due to Gaseous Effluents

		1st half (Jan-Jun)	**2nd half (Jul-Dec)**	**Total**	**EPA**				
	STACK IDENTIFICATION	**uCi Uranium**	**uCi Uranium**	**uCi released**	**Comply Run Results**				
	S1030 A	**12.16**	**N/A**	**12.16**	**Dose (mrem/yr)**	**1.30E-02**			
	use highest release to calculate X/Q used by COMPLY				Stack height (m)	16			
					Release Rate (Ci/s)	U-234	U-235	U-238	
	Dose from comply	0.00650	mrem/6 mo			6.58E-13	2.61E-14	8.84E-14	
	release quantity	12.16	uCi						
		1.22E-05	Ci						
	App E table E-5	4000.00	m3/6 mo						
	Effective Dose conversion								
	EPA FGR 11 p150-151								
	U-234	3.58E-05	Sv/Bq	85.04%					
	U-235	3.32E-05	Sv/Bq	3.38%					
	U-238	3.20E-05	Sv/Bq	11.43%					
	weighted dose conversion	3.52E-05	Sv/Bq						
	conversion factor	3700.00	mrem/pCi= factor* Sv/Bq						
	weighted dose conversion	0.1303	mrem/pCi						
				equations					
	Dose (mrem) = R(a)*3.17e4*Q*(X/Q)*effective Dose conversion			see RG1.109-25					
	Dose (mrem)/(R(a)*3.17e4*Q*effective Dose conversion)=(X/Q)								
		3.23E-05	X/Q						
	Estimate Lung Dose using X/Q and semi-annual releases for 2018				Estimate Bone Dose using X/Q and semi-annual releases for 2018				
	App E table E-5								
	Lung Organ Dose conversion								
	EPA FGR 11 p150-151								
	U-234	2.98E-04	Sv/Bq	85.04%	1.13E-06	Sv/Bq			
	U-235	2.76E-04	Sv/Bq	3.38%	1.05E-06	Sv/Bq			
	U-238	2.66E-04	Sv/Bq	11.43%	1.01E-06	Sv/Bq			
	weighted dose conversion	2.93E-04	Sv/Bq		1.11E-06	Sv/Bq			
	conversion factor	3700.00	mrem/pCi= factor* Sv/Bq		3700.00	mrem/pCi= factor* Sv/Bq			
	weighted dose conversion	1.0847	mrem/pCi		4.11E-03	mrem/pCi			
	release quantity	162.42	uCi/6 mo		162.42	uCi/6 mo			
		1.62E-04	Ci/6 mo		1.62E-04	Ci/6 mo			
	Lung *	**0.58**	**mrem/6 mo**	**Bone ***	**2.19E-03**	**mrem/6 mo**			
		assume 80% residence							

2018

Attachment 3 - 1st Half 2018 Liquid Effluent Discharges

	Liquid Effluent Discharges			Isotopic Uranium Measured Concentrations				Tc-99 Measured Concentrations	Sum U & Tc-99	Total uCi/month Released (based on monthly GEL discharge samples)				Measurement Uncertainty / Error				Uncertainty / Error			
Month	Average kgal/day	Actual kgal/month	Actual gal/month	**U234** pCi/L	**U235** pCi/L	**U238** pCi/L	**Total U** pCi/L	**Tc-99** piC/L	**Total U & Tc-99** pCi/L	**U234**	**U-235**	**U-238**	**Tc-99**	**U234** piC/L	**U235** piC/L	**U238** piC/L	**Tc-99** piC/L	**U234** (uCi)	**U-235** (uCi)	**U-238** (uCi)	**Tc-99** (uCi)
JAN	93.639	2902.795	2,902,795	20.8	2.04	4.34	27.180	4.73	31.910	228.531	22.414	47.684	51.969	2.13	0.814	1.00	19.5	23.402	8.943	10.987	214.248
FEB	87.617	2453.288	2,453,288	15.1	0.857	2.63	18.587	4.62	23.207	140.214	7.958	24.421	42.900	1.16	0.315	0.490	20.5	10.771	2.925	4.550	190.357
MAR	89.909	2787.174	2,787,174	18.4	1.22	3.19	22.810	3.08	25.890	194.110	12.870	33.653	32.492	1.48	0.432	0.623	26.9	15.613	4.557	6.572	283.780
APR	86.267	2588.010	2,588,010	31.0	1.65	5.51	38.160	9.33	47.490	303.664	16.163	53.974	91.393	2.48	0.646	1.05	26.0	24.293	6.328	10.285	254.686
MAY	92.394	2864.223	2,864,223	36.1	1.13	6.21	43.440	12.8	56.240	391.363	12.250	67.323	138.766	3.02	0.614	1.27	26.6	32.740	6.656	13.768	288.373
JUNE	115.012	3450.345	3,450,345	16.3	0.755	2.62	19.675	10.5	30.175	212.871	9.860	34.216	137.125	1.05	0.264	0.438	25.0	13.713	3.448	5.720	326.489
Total (Jan-June)		17045.835	17,045,835							1470.753	81.515	261.271	494.645					121	33	52	1558
Liters (L)			**6.45E+07**							**1813.5** **uCi Uranium** for 6-month period (all types)											
Milliliters (ml)			6.45E+10							**2308.2** **uCi Uranium & Tc-99** for 6-month period											

FIRST HALF LIQUID DISCHARGES

Radionuclide	LLD (uCi/ml)	Quantity Released (uCi)	Error		Average Concentration Released (uCi/ml)
U234	6.00E-10	1470.8	+/-	121	2.28E-08
U235	6.00E-10	81.5	+/-	33	1.26E-09
U238	6.00E-10	261.3	+/-	52	4.05E-09
Total U		*1813.5*			*2.81E-08*
Tc-99	6.00E-10	494.6	+/-	1558	7.67E-09
Total (Jan-June)		2308.2			6.39E-08

Attachment 4
Whole Body Dose from Liquid Effluent Pathways - Potable Water

		Whole Body-Ingestion																		
365	liters	Usage by adult/6 m	U	10CFR20	7.3 x 10^5 (ml) which is the annual water intake of "Reference Man."															
31293	mixing - dilution	Dilution at difuser	M																	
				Congaree Flow		9388	cubic feet/sec		see Nureg-1118 Environmental Assessment for renewam ...SNM-1107 May 1985											
0.3	cubic ft/sec	Average discharge	F	Effluent Flow		3.00E-01	cubic feet/sec													
									effective	bone	effective	bone								
2.83E-04	U-234	mRem/pCi	D	EPA Limiting Values of Radioanuclide Intake.....					Sv/Bq	Sv/Bq	mRem/pCi	mRem/pCi								
2.66E-04	U-235	mRem/pCi	D	FRG no 11	1988			U-234	7.66E-08	1.13E-06	2.83E-04	4.18E-03								
2.69E-04	U-236	mRem/pCi	D	Exposure-to-dose conversion factors for ingestion				U-235	7.19E-08	1.05E-06	2.66E-04	3.88E-03								
2.55E-04	U-238	mRem/pCi	D					U-236	7.26E-08	1.07E-06	2.69E-04	3.96E-03								
1.46E-06	Tc-99	mRem/pCi	D					U-238	6.88E-08	1.01E-06	2.55E-04	3.74E-03								
								Tc-99	3.95E-10	6.04E-11	1.46E-06	2.23E-07								
12	hrs	transit time	t-p	reg guide 1.109	table E-15															
3.23557E-10	U-234	decay const	λ	Nuclide		T(1/2) yr	T(1/2) hr	λ												
1.12404E-13	U-235	decay const	λ	URANIUM234		2.45E+05	2.14E+09	3.24E-10												
3.38075E-12	U-236	decay const	λ	URANIUM235		7.04E+08	6.17E+12	1.12E-13												
1.77058E-14	U-238	decay const	λ	URANIUM236		2.34E+07	2.05E+11	3.38E-12			for comaprison only									
3.71407E-10	Tc-99	decay const	λ	URANIUM238		4.47E+09	3.91E+13	1.77E-14												
				TC-99		2.13E+05	1.87E+09	3.71E-10			Part 20 table 2		soluble forms							
0.9999999961	U-234	exp(-λt-p)									Dose Conversion									
1.0000000000	U-235	exp(-λt-p)										uCi/ml	milliters	uCi	pCi	mRem	mRem/pCi			
1.0000000000	U-236	exp(-λt-p)									U-234	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04			
1.0000000000	U-238	exp(-λt-p)									U-235	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04			
0.9999999955	Tc-99	exp(-λt-p)									U-236	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04			
											U-238	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04			
Activity Released											Tc-99	6.00E-05	7.30E+05	4.38E+01	4.38E+07	50	1.14E-06			
1.814E-03	**total uranium(Ci)**	**Q**	summation of liquid effluent alpha activity																	
			% of activity based on current nominal uranium isotopic **(see U activity tab)**								ICRP 69	Comparison								
1.542E-03	U-234 release fraction	Ci	URANIUM234	85.04%																
6.130E-05	U-235 release fraction	Ci	URANIUM235	3.38%								Sv/Bq	Rem/Bq	mRem/pCi						
2.720E-06	U-236 release fraction	Ci	URANIUM236	0.15%																
2.073E-04	U-238 release fraction	Ci	URANIUM238	11.43%							adult	5.00E-08	0.005	1.85E-04						
4.946E-04	Tc-99 release fraction	Ci	TC-99								infant	3.70E-07	0.037	1.37E-03						
											bone-adult	7.90E-07	0.079	2.92E-03						
check U sum	0.00181																			
4.37E-07	U-234	release fraction *dose factor*exp(-λ*tp)																		
1.63E-08	U-235	release fraction *dose factor*exp(-λ*tp)																		
7.31E-10	U-236	release fraction *dose factor*exp(-λ*tp)																		
5.28E-08	U-238	release fraction *dose factor*exp(-λ*tp)																		
7.23E-10	Tc-99	release fraction *dose factor*exp(-λ*tp)																		
5.08E-07	all nuclides	sum of nuclides																		
42.76736	usage	1100*(usage*dilution)/flow																		
2.17E-05	**mRem**	see regulatory guide 1.109 page 1.109-2 and 1.109-3 for formula and definition of terms.																		

Attachment 5
Dose to the Bone Surface from Liquid Effluent Pathways - Potable Water

		Bone Surface-Ingestion															
365	liters	Usage by adult/6 m	U	10CFR20	7.3 x 10^5 (ml) which is the annual water intake of "Reference Man."												
31293	mixing - dilution	Dilution at difuser	M														
				Congaree Flow		9388	cubic feet/sec		see Nureg-1118 Environmental Assessment for renewam …SNM-1107 May 1985								
0.3	cubic ft/sec	Average discharge	F	Effluent Flow		3.00E-01	cubic feet/sec										
									effective	bone	effective	bone					
4.18E-03	U-234	mRem/pCi	D-bone	EPA Limiting Values of Radioanuclide Intake……					Sv/Bq	Sv/Bq	mRem/pCi	mRem/pCi					
3.88E-03	U-235	mRem/pCi	D-bone	FRG no 11	1988			U-234	7.66E-08	1.13E-06	2.83E-04	4.18E-03					
3.96E-03	U-236	mRem/pCi	D-bone	Exposure-to-dose conversion factors for ingestion				U-235	7.19E-08	1.05E-06	2.66E-04	3.88E-03					
3.74E-03	U-238	mRem/pCi	D-bone					U-236	7.26E-08	1.07E-06	2.69E-04	3.96E-03					
2.23E-07	Tc-99	mRem/pCi	D-bone					U-238	6.88E-08	1.01E-06	2.55E-04	3.74E-03					
								Tc-99	3.95E-10	6.04E-11	1.46E-06	2.23E-07					
12	hrs	transit time	t-p	reg guide	table E-15												
3.23557E-10	U-234	decay const	λ	Nuclide		T(1/2) yr	T(1/2) hr	λ									
1.12404E-13	U-235	decay const	λ	URANIUM234		2.45E+05	2.14E+09	3.24E-10									
3.38075E-12	U-236	decay const	λ	URANIUM235		7.04E+08	6.17E+12	1.12E-13			Part 20 table 2		soluble forms				
1.77058E-14	U-238	decay const	λ	URANIUM236		2.34E+07	2.05E+11	3.38E-12			Dose Conversion						
3.71407E-10	Tc-99	decay const	λ	URANIUM238		4.47E+09	3.91E+13	1.77E-14				uCi/ml	milliters	uCi	pCi	mRem	mRem/pCi
				TC-99		2.13E+05	1.87E+09	3.71E-10			U-234	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
0.9999999961	U-234	exp(-λt-p)									U-235	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
1.0000000000	U-235	exp(-λt-p)									U-236	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
1.0000000000	U-236	exp(-λt-p)									U-238	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
1.0000000000	U-238	exp(-λt-p)									Tc-99	6.00E-05	7.30E+05	4.38E+01	4.38E+07	50	1.14E-06
0.9999999955	Tc-99	exp(-λt-p)															
											ICRP 69	Comparison					
Activity Released																	
1.814E-03	**total uranium(Ci)**	**Q**	summation of liquid effluent alpha activity									Sv/Bq	Rem/Bq	mRem/pCi			
			% of activity based on current nominal uranium isotopic **(see U activity tab)**														
1.5422E-03	U-234 release fraction	Ci	URANIUM234	85.04%							adult	5.00E-08	0.005	1.85E-04			
6.1296E-05	U-235 release fraction	Ci	URANIUM235	3.38%							infant	3.70E-07	0.037	1.37E-03			
2.7203E-06	U-236 release fraction	Ci	URANIUM236	0.15%							bone-adult	7.90E-07	0.079	2.92E-03			
2.0728E-04	U-238 release fraction	Ci	URANIUM238	11.43%													
4.946E-04	Tc-99 release fraction	Ci	TC-99														
check U sum	0.00181																
6.45E-06	U-234	release fraction *dose factor*exp(-λ*tp)															
2.38E-07	U-235	release fraction *dose factor*exp(-λ*tp)															
1.08E-08	U-236	release fraction *dose factor*exp(-λ*tp)															
7.75E-07	U-238	release fraction *dose factor*exp(-λ*tp)															
1.11E-10	Tc-99	release fraction *dose factor*exp(-λ*tp)															
7.47E-06	all nuclides	sum of nuclides															
42.76736	usage	1100*(usage*dilution)/flow															
3.20E-04	**mRem**	see regulatory guide 1.109 page 1.109-2 and 1.109-3 for formula and definition of terms.															

Attachment 6
Whole Body Dose from Liquid Effluent Pathways - Aquatic Foods

		Whole Body																
10.5	Kg	Usage by adult/6 m	U	see regulatory guide 1.109 page 1.109-40 table E-5, Recommended Values for U(ap)														
31293	mixing - dilution	Dilution at difuser	M	Congaree Flow		9388	cubic feet/sec		see Nureg-1118 Environmental Assessment for renewam …SNM-1107 May 1985									
0.3	cubic ft/sec	Average discharge	F	Effluent Flow		3.00E-01	cubic feet/sec											
									effective	bone	effective	bone						
2.83E-04	U-234	mRem/pCi	D	EPA Limiting Values of Radioanuclide Intake……					Sv/Bq	Sv/Bq	mRem/pCi	mRem/pCi						
2.66E-04	U-235	mRem/pCi	D	FRG no 11	1988			U-234	7.66E-08	1.13E-06	2.83E-04	4.18E-03						
2.69E-04	U-236	mRem/pCi	D	Exposure-to-dose conversion factors for ingestion				U-235	7.19E-08	1.05E-06	2.66E-04	3.88E-03						
2.55E-04	U-238	mRem/pCi	D					U-236	7.26E-08	1.07E-06	2.69E-04	3.96E-03						
1.46E-06	Tc-99	mRem/pCi	D					U-238	6.88E-08	1.01E-06	2.55E-04	3.74E-03						
								Tc-99	3.95E-10	6.04E-11	1.46E-06	2.23E-07						
24	hrs	transit time	t-p	reg guide 1	table E-15													
3.23557E-10	U-234	decay const	λ	Nuclide		T(1/2) yr	T(1/2) hr	λ										
1.12404E-13	U-235	decay const	λ	URANIUM234		2.45E+05	2.14E+09	3.24E-10				for comaprison only						
3.38075E-12	U-236	decay const	λ	URANIUM235		7.04E+08	6.17E+12	1.12E-13										
1.77058E-14	U-238	decay const	λ	URANIUM236		2.34E+07	2.05E+11	3.38E-12				Part 20 table 2		soluble forms				
3.71407E-10	Tc-99	decay const	λ	URANIUM238		4.47E+09	3.91E+13	1.77E-14				Dose Conversion						
				TC-99		2.13E+05	1.87E+09	3.71E-10					uCi/ml	milliters	uCi	pCi	mRem	mRem/pCi
0.99999999223	U-234	exp(-λt-p)										U-234	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
1.00000000000	U-235	exp(-λt-p)										U-235	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
0.99999999992	U-236	exp(-λt-p)										U-236	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
1.00000000000	U-238	exp(-λt-p)										U-238	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
0.99999999109	Tc-99	exp(-λt-p)										Tc-99	6.00E-05	7.30E+05	4.38E+01	4.38E+07	50	1.14E-06
Activity Released												ICRP 69	Comparison					
1.814E-03	**total uranium(Ci)**	**Q**	summation of liquid effluent alpha activity															
			% of activity based on current nominal uranium isotopic		**(see U activity tab)**								Sv/Bq	Rem/Bq	mRem/pCi			
1.5422E-03	U-234 release fraction	Ci	URANIUM234	85.04%														
6.1296E-05	U-235 release fraction	Ci	URANIUM235	3.38%								adult	5.00E-08	0.005	1.85E-04			
2.7203E-06	U-236 release fraction	Ci	URANIUM236	0.15%								infant	3.70E-07	0.037	1.37E-03			
2.0728E-04	U-238 release fraction	Ci	URANIUM238	11.43%								bone-adult	7.90E-07	0.079	2.92E-03			
4.946E-04	Tc-99 release fraction	Ci	TC-99															
check U sum	0.00181																	
							bioaccumulation factor			BNWL-2075								
8.74E-07	U-234	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2			UC-11								
3.26E-08	U-235	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2			Methodology for Calculation of Radiation Doses								
1.46E-09	U-236	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2			in the Environs from Nuclear Fuel								
1.06E-07	U-238	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2			Cycle Facilities								
1.08E-08	Tc-99	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					15											
1.02E-06	all nuclides	sum of nuclides																
1.23029	usage	1100*(usage*dilution)/flow																
1.26E-06	**mRem**	see regulatory guide 1.109 page 1.109-2 and 1.109-3 for formula and definition of terms.																

Attachment 7
Dose to the Bone Surface from Liquid Effluent Pathways - Aquatic Foods

	Bone Surface																		
10.5	Kg	Usage by adult/6 m	U	see regulatory guide 1.109 page 1.109-40 table E-5, Recommended Values for U(ap)															
31293	mixing - dilution	Dilution at difuser	M	Congaree Flow		9388	cubic feet/sec		see Nureg-1118 Environmental Assessment for renewam …SNM-1107 May 1985										
0.3	cubic ft/sec	Average discharge	F	Effluent Flow		3.00E-01	cubic feet/sec												
									effective	bone	effective	bone							
4.18E-03	U-234	mRem/pCi	D	EPA Limiting Values of Radioanuclide Intake……					Sv/Bq	Sv/Bq	mRem/pCi	mRem/pCi							
3.88E-03	U-235	mRem/pCi	D	FRG no 11	1988			U-234	7.66E-08	1.13E-06	2.83E-04	4.18E-03							
3.96E-03	U-236	mRem/pCi	D	Exposure-to-dose conversion factors for ingestion				U-235	7.19E-08	1.05E-06	2.66E-04	3.88E-03							
3.74E-03	U-238	mRem/pCi	D					U-236	7.26E-08	1.07E-06	2.69E-04	3.96E-03							
2.23E-07	Tc-99	mRem/pCi	D					U-238	6.88E-08	1.01E-06	2.55E-04	3.74E-03							
								Tc-99	3.95E-10	6.04E-11	1.46E-06	2.23E-07							
24	hrs	transit time	t-p	reg guide 1.109	table E-15														
3.23557E-10	U-234	decay const	λ	Nuclide		T(1/2) yr	T(1/2) hr	λ				for comaprison only							
1.12404E-13	U-235	decay const	λ	URANIUM234		2.45E+05	2.14E+09	3.24E-10											
3.38075E-12	U-236	decay const	λ	URANIUM235		7.04E+08	6.17E+12	1.12E-13				Part 20 table 2		soluble forms					
1.77058E-14	U-238	decay const	λ	URANIUM236		2.34E+07	2.05E+11	3.38E-12				Dose Conversion							
3.71407E-10	Tc-99	decay const	λ	URANIUM238		4.47E+09	3.91E+13	1.77E-14					uCi/ml	milliters	uCi	pCi	mRem	mRem/pCi	
				TC-99		2.13E+05	1.87E+09	3.71E-10				U-234	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04	
0.99999999223	U-234	exp(-λt-p)										U-235	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04	
1.00000000000	U-235	exp(-λt-p)										U-236	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04	
0.99999999992	U-236	exp(-λt-p)										U-238	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04	
1.00000000000	U-238	exp(-λt-p)										Tc-99	6.00E-05	7.30E+05	4.38E+01	4.38E+07	50	1.14E-06	
0.99999999109	Tc-99	exp(-λt-p)																	
												ICRP 69	Comparison						
Activity Released																			
1.814E-03	**total uranium(Ci**	**Q**		summation of liquid effluent alpha activity									Sv/Bq	Rem/Bq	mRem/pCi				
				% of activity based on current nominal uranium isotopic **(see U activity tab)**															
1.5422E-03	U-234 release fra	Ci		URANIUM234	85.04%							adult	5.00E-08	0.005	1.85E-04				
6.1296E-05	U-235 release fra	Ci		URANIUM235	3.38%							infant	3.70E-07	0.037	1.37E-03				
2.7203E-06	U-236 release fra	Ci		URANIUM236	0.15%							bone-adult	7.90E-07	0.079	2.92E-03				
2.0728E-04	U-238 release fra	Ci		URANIUM238	11.43%														
4.946E-04	Tc-99 release fra	Ci		TC-99															
check U sum	0.00181																		
							bioaccumulation factor		BNWL-2075										
1.29E-05	U-234	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		UC-11										
4.76E-07	U-235	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		Methodology for Calculation of Radiation Doses										
2.15E-08	U-236	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		in the Environs from Nuclear Fuel										
1.55E-06	U-238	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		Cycle Facilities										
1.66E-09	Tc-99	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					15												
1.49E-05	all nuclides	sum of nuclides																	
1.23029	usage	1100*(usage*dilution)/flow																	
1.84E-05	**mRem**	see regulatory guide 1.109 page 1.109-2 and 1.109-3 for formula and definition of terms.																	

Attachment 8
Whole Body Dose from Liquid Effluent Pathways - Shoreline Deposits

		Whole Body													
6	hr	Usage by adult/6 mo	U	see regulatory guide 1.109 page 1.109-40 table E-5, Recommended Values for U(ap)											
31293	mixing - dilution	Dilution at difuser	M												
				Congaree Flow		9388	cubic feet/sec		see Nureg-1118 Environmental Assessment for renewam …SNM-1107 May						
0.3	cubic ft/sec	Average discharge	F	Effluent Flow		3.00E-01	cubic feet/sec								
					Sv/s:Bq/m^2	mrem/hr:pCi/m^2									
9.86E-12	U-234	mRem*m^2/pCi*hr	D	U-234	7.40E-19	9.86E-12	EPA FRG 12		Dose Coeff for exposure to contaminated ground surface						
1.97E-09	U-235	mRem*m^2/pCi*hr	D	U-235	1.48E-16	1.97E-09									
8.66E-12	U-236	mRem*m^2/pCi*hr	D	U-236	6.50E-19	8.66E-12									
7.34E-12	U-238	mRem*m^2/pCi*hr	D	U-238	5.51E-19	7.34E-12									
1.04E-12	Tc-99	mRem*m^2/pCi*hr	D	Tc-99	7.80E-20	1.04E-12									
12	hrs	transit time	t-p	see regulatory guide 1.109 page 1.109-69 table E-15, Recommended Values …								t-i			
131040	hrs	xposure time of sedime	t-b	page 1.109-68			Nuclide		T(1/2) yr	T(1/2) hr	λ	T(1/2) day			
3.23557E-10	U-234	decay const	λ				URANIUM234		2.45E+05	2.14E+09	3.24E-10	8.90E+07			
1.12404E-13	U-235	decay const	λ				URANIUM235		7.04E+08	6.17E+12	1.12E-13	2.56E+11			
3.38075E-12	U-236	decay const	λ				URANIUM236		2.34E+07	2.05E+11	3.38E-12	8.52E+09			
1.77058E-14	U-238	decay const	λ				URANIUM238		4.47E+09	3.91E+13	1.77E-14	1.63E+12			
3.71407E-10	Tc-99	decay const	λ				TC-99		2.13E+05	1.87E+09	3.71E-10	7.75E+07			
0.0000423980	U-234	exp(-λt-p)*[1-exp(-λt-b)]													
0.0000000147	U-235	exp(-λt-p)*[1-exp(-λt-b)]													
0.0000004430	U-236	exp(-λt-p)*[1-exp(-λt-b)]													
0.0000000023	U-238	exp(-λt-p)*[1-exp(-λt-b)]													
0.0000486679	Tc-99	exp(-λt-p)*[1-exp(-λt-b)]													
Activity Released															
1.814E-03	**total uranium(Ci)**	**Q**	summation of liquid effluent alpha activity												
			% of activity based on current nominal uranium isotopic **(see U activity tab)**												
1.5422E-03	U-234 release fraction	Ci	URANIUM234	85.04%											
6.1296E-05	U-235 release fraction	Ci	URANIUM235	3.38%											
2.7203E-06	U-236 release fraction	Ci	URANIUM236	0.15%											
2.0728E-04	U-238 release fraction	Ci	URANIUM238	11.43%											
4.946E-04	Tc-99 release fraction	Ci	TC-99												
check U sum	0.00181														
5.74E-11	U-234	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
4.56E-10	U-235	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
8.89E-14	U-236	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
5.74E-12	U-238	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
1.94E-12	Tc-99	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
5.21E-10	all nuclides	sum of nuclides													
1.406050	usage	11000*(usage*dilution*shore width factor)/flow		see regulatory guide 1.109 page 1.109-40 table A-2,Shore width..											
7.33E-10	**mRem**	see regulatory guide 1.109 page 1.109-2 and 1.109-3 for formula and definition of terms.													

Attachment 9
2018 Isotopic Fractions

Based on the plant nominal enrichment for 2018

Nuclide	Average wt%	Specific Activity Ci/g	Weighted Activity	% Activity
U-234	0.04	6.220E-03	2.388E-06	85.04
U-235	4.40	2.160E-06	9.504E-08	3.38
U-236	0.01	6.470E-05	4.076E-09	0.15
U-238	95.57	3.360E-07	3.211E-07	11.43
Total	100.0		2.809E-06	100.00

Attachment 10 - Comply Results

COMPLY: V1.6. 8/16/2018 10:29

40 CFR Part 61
National Emission Standards
for Hazardous Air Pollutants

REPORT ON COMPLIANCE WITH

THE CLEAN AIR ACT LIMITS FOR RADIONUCLIDE EMISSIONS

FROM THE COMPLY CODE - V1.6.

Prepared by:

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Prepared for:

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Washington, DC 20460

2018 SEMI-ANNUAL DOSE TO THE PUBLIC DUE TO GASEOUS EFFLUENT

SCREENING LEVEL 2

DATA ENTERED:

RELEASE RATES FOR STACK 1.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	4.150E-13
U-235	Y	1.650E-14
U-238	Y	5.580E-14

RELEASE RATES FOR STACK 2.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	3.940E-13
U-235	Y	1.570E-14
U-238	Y	5.300E-14

RELEASE RATES FOR STACK 3.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.180E-12
U-235	Y	4.680E-14
U-238	Y	1.580E-13

RELEASE RATES FOR STACK 4.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	3.030E-12
U-235	Y	1.200E-13
U-238	Y	4.070E-13

RELEASE RATES FOR STACK 5.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	7.310E-13
U-235	Y	2.910E-14
U-238	Y	9.830E-14

RELEASE RATES FOR STACK 6.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.190E-12
U-235	Y	4.750E-14
U-238	Y	1.610E-13

RELEASE RATES FOR STACK 7.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	8.100E-13
U-235	Y	3.220E-14
U-238	Y	1.090E-13

RELEASE RATES FOR STACK 8.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.030E-12
U-235	Y	4.090E-14
U-238	Y	1.380E-13

SITE DATA FOR STACK 1.

Release height 10 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

SITE DATA FOR STACK 2.

Release height 11 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

SITE DATA FOR STACK 3.

Release height 12 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

SITE DATA FOR STACK 4.

Release height 13 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

SITE DATA FOR STACK 5.

Release height 15 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

SITE DATA FOR STACK 6.

Release height 16 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

SITE DATA FOR STACK 7.

Release height 17 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

SITE DATA FOR STACK 8.

Release height 18 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

Default mean wind speed used (2.0 m/sec).

NOTES:

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    Input parameters outside the "normal" range:

        Building (width) is unusually WIDE.
        Receptor is unusually FAR.

RESULTS:
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    Effective dose equivalent:        0.2 mrem/yr.

    *** Comply at level 2.

    This facility is in COMPLIANCE.

    It may or may not be EXEMPT from reporting to the EPA.

    You may contact your regional EPA office for more information.

********** END OF COMPLIANCE REPORT **********
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40 CFR Part 61
National Emission Standards
for Hazardous Air Pollutants

REPORT ON COMPLIANCE WITH

THE CLEAN AIR ACT LIMITS FOR RADIONUCLIDE EMISSIONS

FROM THE COMPLY CODE - V1.6.

Prepared by:

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Prepared for:

U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Washington, DC 20460

S1030 A

SCREENING LEVEL 2

DATA ENTERED:

Nuclide		Release Rate (curies/SECOND)
U-234	Y	6.580E-13
U-235	Y	2.610E-14
U-238	Y	8.840E-14

Release height 16 meters.

Building height 9 meters.

The source and receptor are not on the same building.

Distance from the source to the receptor is 595 meters.

Building width 137 meters.

Default mean wind speed used (2.0 m/sec).

NOTES:

Input parameters outside the "normal" range:

Building (width) is unusually WIDE.
Receptor is unusually FAR.

RESULTS:

Effective dose equivalent: 1.3E-02 mrem/yr.

*** Comply at level 2.

This facility is in COMPLIANCE.

It may or may not be EXEMPT from reporting to the EPA.

You may contact your regional EPA office for more information.

********** END OF COMPLIANCE REPORT **********