



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

Subject: SNM-1107/70-1151  
 NRC Semi-Annual Discharge Report  
 July – December 2018

Our ref: LTR-RAC-19-15

February 27, 2019

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 July 1, 2018, through December 31, 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	Total 6-month Measured Concentration	Regulatory Concentration Limit
<b>Gaseous</b>	204.5	Uranium (analyzed as gross alpha)	7.4 E-15 uCi/mL*	5 E-14 uCi/mL
<b>Liquid Effluent</b>	1,342.2	U-234	2.1 E-8 uCi/mL	3 E-7 uCi/mL
	47.4	U-235		
	222.1	U-238		
	629.6	Tc-99		

\*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.

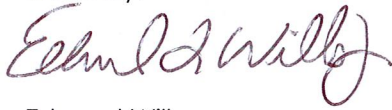
Gaseous effluent results were obtained from point source gross alpha analysis of stack gas effluent, and the individual radionuclide activity composition is inferred from the calculated average enrichment (85.04% U-234, 3.38% U-235, and 11.43% U-238). Tc-99 is not reported for gaseous effluents, as significant 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 second half of 2018 was 7.84E+07 liters.

Calculated values have been reported for all results, due to variability of minimum detection

To meet the requested dosage information outlined in Regulatory Guide 4.16, section 6.1, the internal Westinghouse letter LTR-EHS-19-17 entitled "Annual Assessment of Public Dose due to Liquid and Gaseous Effluents" is attached.

Sincerely,

A handwritten signature in dark ink, appearing to read "Edward Wills". The signature is fluid and cursive, with the first name "Edward" being more prominent than the last name "Wills".

Edward Wills  
Manager, Environment, Health and Safety

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



To: Cynthia Logsdon, Diana Joyner

Date: February 22, 2019

cc: Ed Wills, Nancy Parr, Anna Pearson, Ed Byrd

From: David Wagoner  
Ext: 1919  
Fax: 803.695.4158

Your ref:  
Our ref: LTR-EHS-19-17

Subject: **Annual Assessment of Public Dose due to 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 were determined in this assessment:

- Dose due to Gaseous Effluents by Direct Inhalation
  - The whole body dose was estimated using the EPA's COMPLY Code at level 2 complexity. The organ dose was estimated using the calculated X/Q factor for stack number 1210 (Conv. 1-A Ex.), 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, Doses from Liquid Effluent Pathways (RG1.109). Dose conversion factors were taken 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 were taken 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 were taken 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 where the liquid effluent leaves the diffuser in the Congaree River.

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 composite liquid effluent samples taken monthly (Attachment 3). Based on these results, the following quantities were released in calendar year 2018:

- 366.92  $\mu\text{Ci}$  of Uranium in gaseous effluent
- 3.43 mCi of Uranium in liquid effluent
- 1.12 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 2018 resulted in a potential whole body dose of 0.16 mrem to an individual present at the nearest site boundary. This dose is significantly less than the 25 mrem annual whole body dose limit for a member of the public.

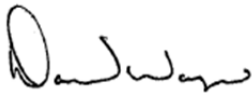
**Table 1.** 2018 Annual Dose to the Public from Liquid and Gaseous Effluents

	<b>Whole Body Dose (mrem/yr)</b>	<b>Organ Dose - Bone (mrem/yr)</b>	<b>Organ Dose - Lung (mrem/yr)</b>
<b>Gaseous Effluents</b>			
Direct inhalation*	0.16	4.9E-03	1.3
<b>Liquid Effluents</b>			
Potable Water	8.2E-05	1.2E-03	-
Aquatic Food (Fish)	4.8E-06	6.9E-05	-
Shoreline Deposition	3.0E-08	-	-
<i>Total (mrem)</i>	<i>0.16</i>	<i>6.2E-03</i>	<i>1.3</i>

\* Assumes 80 % residence time

No effluent release points were added or removed from the effluent monitoring program in 2018. The attachments below illustrate the method used to calculate each result listed in Table 1.

- Attachment 1: 2018 Gaseous Effluent Discharges
- Attachment 2: Lung/Bone Organ Dose due to Gaseous Effluent
- Attachment 3: 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



Anna Pearson  
Manager, RSO  
EH&S Operations

# Attachment 1 2018 Gaseous Effluent Discharges

Sampling Station	Location Description	Stack Height (m)	Gross Alpha Concentration*		2nd Half Uranium Released	Total uCi Released	Release Rate (Ci/s)		
			1st Half (uCi/mL)	2nd Half (uCi/mL)			U234	U235	U238
1207	MET LAB EXHAUST	10	1.96E-13	1.69	1.70	3.39	9.18E-14	3.65E-15	1.23E-14
1238	IFBA EXHAUST	10	8.13E-14	5.98	7.11	13.09	3.54E-13	1.41E-14	4.77E-14
1239	MAINT WELD EX	11	1.76E-13	2.59	2.31	4.90	1.33E-13	5.28E-15	1.78E-14
1243	AC-8	11	8.01E-14	4.70	4.83	9.53	2.58E-13	1.03E-14	3.47E-14
1222	CALC COMB GAS LN 1	12	3.06E-13	0.77	0.30	1.07	2.90E-14	1.15E-15	3.90E-15
1223	CALC COMB GAS LN 2	12	5.08E-13	1.30	0.42	1.72	4.66E-14	1.85E-15	6.26E-15
1224	CALC COMB GAS LN 3	12	1.28E-13	0.33	0.36	0.69	1.87E-14	7.44E-16	2.51E-15
1225	CALC COMB GAS LN 4	12	1.13E-13	0.29	0.34	0.63	1.71E-14	6.79E-16	2.29E-15
1226	CALC COMB GAS LN 5	12	1.26E-13	0.32	0.24	0.56	1.52E-14	6.04E-16	2.04E-15
1228	CHEM LAB EX #3	12	8.68E-14	0.43	0.45	0.88	2.38E-14	9.49E-16	3.20E-15
1231	DEV LAB EX #2	12	1.99E-13	2.93	3.00	5.93	1.61E-13	6.39E-15	2.16E-14
1237	ABF HOOD TORIT EX	12	8.64E-14	1.91	2.02	3.93	1.06E-13	4.24E-15	1.43E-14
1241	PELLET LINE 6	12	8.12E-14	3.51	3.57	7.08	1.92E-13	7.63E-15	2.58E-14
1247	HOT OIL RM EX	12	1.65E-13	9.99	16.24	26.23	7.10E-13	2.83E-14	9.55E-14
1201	FURNACE EX LINE 1	13	8.44E-14	3.65	3.60	7.25	1.96E-13	7.81E-15	2.64E-14
1202	FURNACE EX LINE 2	13	8.09E-14	3.49	3.56	7.05	1.91E-13	7.60E-15	2.57E-14
1203	FURNACE EX LINE 3	13	8.00E-14	3.45	3.54	6.99	1.89E-13	7.53E-15	2.54E-14
1204	FURNACE EX LINE 4	13	8.01E-14	3.46	3.58	7.04	1.91E-13	7.59E-15	2.56E-14
1205	FURNACE EX LINE 5	13	8.34E-14	3.60	3.50	7.10	1.92E-13	7.65E-15	2.58E-14
1206	NEW DECON ROOM	13	9.21E-14	2.35	10.19	12.54	3.40E-13	1.35E-14	4.57E-14
1208	INCINERATOR EX	13	1.36E-13	4.00	15.24	19.24	5.21E-13	2.07E-14	7.00E-14
1209	SUPPL INCIN EX	13	3.16E-13	4.65	3.51	8.16	2.21E-13	8.80E-15	2.97E-14
1217	CONV ENCL EX 4-C	13	1.01E-13	6.09	7.92	14.01	3.79E-13	1.51E-14	5.10E-14
1218	CONV ENCL EX 4-D	13	2.00E-13	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
1219	CONV EMERG EX 4E	13	2.20E-13	0.64	0.78	1.42	3.85E-14	1.53E-15	5.17E-15
1221	DECON ROOM EX	13	2.90E-13	6.39	7.09	13.48	3.65E-13	1.45E-14	4.91E-14
1230	DEV LAB EX #1	13	2.04E-13	3.00	2.76	5.76	1.56E-13	6.21E-15	2.10E-14
1232	PELLET COMBINED EX	13	8.14E-14	5.98	6.22	12.20	3.30E-13	1.32E-14	4.44E-14
1233	SOLVENT EXT N EX	13	8.49E-14	3.77	3.95	7.72	2.09E-13	8.32E-15	2.81E-14
1234	SOLVENT EXT S EX	13	2.06E-13	1.53	1.70	3.23	8.75E-14	3.48E-15	1.18E-14
1229	HP LAB EX	15	8.22E-14	0.74	0.83	1.57	4.25E-14	1.69E-15	5.72E-15
1236	MAP COMBINED	15	1.07E-13	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
1240	AC-3	15	8.06E-14	4.74	4.94	9.68	2.62E-13	1.04E-14	3.52E-14
1246	AC-4	15	8.34E-14	5.05	5.06	10.11	2.74E-13	1.09E-14	3.68E-14
1251	WATERGLASS SCR S1190	15	8.14E-14	2.99	3.05	6.04	1.64E-13	6.51E-15	2.20E-14
1210	CONV 1-A EX	16	9.92E-14	6.42	20.19	26.61	7.21E-13	2.87E-14	9.69E-14
1211	CONV 1-B EX	16	1.97E-13	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
1212	S1030 A	16	1.09E-13	12.16	11.15	23.31	6.31E-13	2.51E-14	8.49E-14
1213	S1030 B	16	2.24E-13	1.25	1.68	2.93	7.93E-14	3.16E-15	1.07E-14
1227	CHEM LAB EX #2	16	2.49E-13	2.26	2.60	4.86	1.32E-13	5.24E-15	1.77E-14
1220	CHEM LAB FILT EX	17	8.71E-14	7.53	8.35	15.88	4.30E-13	1.71E-14	5.78E-14
1242	AC-5	17	8.24E-14	4.84	5.21	10.05	2.72E-13	1.08E-14	3.66E-14
1244	AMMON FUME SCR 1008A	17	8.89E-14	2.61	2.92	5.53	1.50E-13	5.96E-15	2.01E-14
1245	AMMON FUME SCR 1008B	17	1.38E-13	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
1248	ERBIA FURNACE EX	18	8.51E-14	10.81	10.27	21.08	5.71E-13	2.27E-14	7.67E-14
1249	ERBIA SCRUBBER EX	18	8.46E-14	5.70	5.69	11.39	3.08E-13	1.23E-14	4.15E-14
1250	ERBIA CHANGE ROOM	18	8.56E-14	2.53	2.53	5.06	1.37E-13	5.45E-15	1.84E-14
<b>Total</b>			<b>162.42</b>	<b>204.50</b>	<b>204.50</b>	<b>366.92</b>	<b>9.94E-12</b>	<b>3.96E-13</b>	<b>1.34E-12</b>

\*Minimum Detectable Concentration is 8E-14 uCi/ml

Total offsite dose calculated by Comply (mrem/y) =

0.2

Assume 80% residence time =

0.16

Attachment 2  
Lung/Bone Organ Dose due to Gaseous Effluents

	1st half (Jan-Jun) uCi Uranium 6.42	2nd half (Jul-Dec) uCi Uranium 20.19	Total uCi released 26.61	EPA Comply Run Results Dose (mrem/yr) Stack height (m) Release Rate (Ci/s)			
<b>STACK IDENTIFICATION</b>							
Conv 1-A Ex use highest release to calculate X/Q used by COMPLY				1.40E-02 16 U-234 7.21E-13	U-235 2.87E-14 U-238 9.69E-14		
Dose from comply release quantity	0.01400 26.61 2.66E-05	mrem/yr uCi Ci					
App E table E-5 Effective Dose conversion	8000.00	m3/yr					
EPA FGR 11 p150-151							
U-234	3.58E-05	Sv/Bq	85.16%				
U-235	3.32E-05	Sv/Bq	3.39%				
U-238	3.20E-05	Sv/Bq	11.45%				
weighted dose conversion	3.53E-05	Sv/Bq					
conversion factor	3700.00	mrem/pCi= factor* Sv/Bq					
weighted dose conversion	0.1305	mrem/pCi					
			equations see RG1.109-25				
Dose (mrem) = R(a)*3.17e4*Q*(X/Q)*effective Dose conversion							
Dose (mrem)/(R(a)*3.17e4*Q*effective Dose conversion)=(X/Q)							
	1.59E-05	X/Q					
Estimate Lung Dose using X/Q and annual releases for 2018				Estimate Bone Dose using X/Q and 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	85.16%	1.13E-06	Sv/Bq		
U-235	2.76E-04	Sv/Bq	3.39%	1.05E-06	Sv/Bq		
U-238	2.66E-04	Sv/Bq	11.45%	1.07E-06	Sv/Bq		
weighted dose conversion	2.94E-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	1.0863	mrem/pCi		4.12E-03	mrem/pCi		
release quantity	366.92 3.67E-04	uCi/yr Ci/yr		366.92 3.67E-04	uCi/yr Ci/yr		
<b>Lung *</b> *assume 80% residence	1.29	mrem/yr	<b>Bone *</b>	4.87E-03	mrem/yr		

2018

Attachment 3 - 2018 Liquid Effluent Discharges

Month	Liquid Effluent Discharges		Isotopic Uranium Measured Concentrations				Tc-99 Measured Concentrations	Sum U & Tc-99 pCi/L	Total uCi/month Released (based on monthly GEL discharge samples)				Measurement Uncertainty / Error				Uncertainty / Error				
	Average kgal/day	Actual kgal/month	Actual gal/month	U234 pCi/L	U235 pCi/L	U238 pCi/L			Total U pCi/L	U234 pCi/L	U-235	U-238	Tc-99	U234 pCi/L	U235 pCi/L	U238 pCi/L	Tc-99 pCi/L	U234 (uCi)	U-235 (uCi)	U-238 (uCi)	Tc-99 (uCi)
January	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
February	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
March	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
April	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
July	123.373	3824.560	3,824.560	14.3	0.522	2.19	17.0	0.0	17.0	207.006	7.556	31.702	0.000	1.94	0.467	0.784	24.9	28.083	6.760	11.349	360.451
August	117.849	3535.467	3,535.467	11.9	0.378	1.91	14.2	10.8	25.0	159.243	5.058	25.559	144.523	1.28	0.269	0.519	23.0	17.129	3.600	6.945	307.780
September	117.801	3534.026	3,534.026	14.7	0.517	2.42	17.6	14.2	31.8	196.631	6.916	32.371	189.943	1.42	0.312	0.584	21.0	18.994	4.173	7.812	280.902
October	116.834	3388.172	3,388.172	17.1	0.528	2.85	20.5	0.247	20.7	219.294	6.771	36.549	3.168	1.53	0.325	0.635	20.0	19.621	4.168	8.143	256.485
November	120.969	3024.228	3,024.228	21.1	0.867	3.42	25.4	13.0	38.4	241.525	9.924	39.148	148.807	1.79	0.412	0.736	23.7	20.490	4.716	8.425	271.287
December	121.681	3407.058	3,407.058	24.7	0.888	4.40	30.0	11.1	41.1	318.524	11.193	56.741	143.142	1.83	0.401	0.775	20.8	23.599	5.171	9.994	268.231
<b>Total</b>		37759.346	37,759.346							2812.978	128.934	483.341	1124.229					248	61	105	3303
<b>Liters (L)</b>			<b>1.43E+08</b>							<b>3425.3</b>											
<b>Milliliters (ml)</b>			1.43E+11							<b>uCi Uranium (all types)</b>											
										<b>4549.5</b>											
										<b>uCi Uranium &amp; Tc-99</b>											

LIQUID DISCHARGES

Radionuclide	LLD (uCi/ml)	Quantity Released (uCi)	Error	Average Concentration Released (uCi/ml)
U234	6.00E-10	2813.0	+/- 248	1.97E-08
U235	6.00E-10	128.9	+/- 61	9.02E-10
U238	6.00E-10	483.3	+/- 105	3.38E-09
<b>Total U</b>		<b>3425.3</b>		<b>2.40E-08</b>
Tc-99	6.00E-10	1124.2	+/- 3303	7.87E-09
<b>Total</b>		<b>4549.5</b>		<b>3.18E-08</b>





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

Bone Surface-Ingestion																					
730 liters									10CFR20	$7.3 \times 10^7$ (ml)											
		Usage by adult/yr	U																		
	31293 mixing - dilution	Dilution at diffuser	M																		
	0.3 cubic ft/sec	Average discharge	F					9388 cubic feet/sec 3.00E-01 cubic feet/sec													
	4.18E-03 U-234	mRem/pCi																			
	3.88E-03 U-235	mRem/pCi																			
	3.74E-03 U-238	mRem/pCi																			
	2.23E-07 Tc-99	mRem/pCi																			
	12 hrs	transit time	t-p																		
	3.23557E-10 U-234	decay const	$\lambda$																		
	1.12404E-13 U-235	decay const	$\lambda$																		
	1.77059E-14 U-238	decay const	$\lambda$																		
	3.71407E-10 Tc-99	decay const	$\lambda$																		
	0.9999999996 U-234	$\exp(-\lambda t-p)$																			
	1.0000000000 U-235	$\exp(-\lambda t-p)$																			
	1.0000000000 U-238	$\exp(-\lambda t-p)$																			
	0.9999999995 Tc-99	$\exp(-\lambda t-p)$																			
Activity Released																					
	3.426E-03 total uranium(Ci)	Q																			
	2.813E-03 U-234 release fraction	Ci																			
	1.289E-04 U-235 release fraction	Ci																			
	4.833E-04 U-238 release fraction	Ci																			
	1.124E-03 Tc-99 release fraction	Ci																			
check U sum																					
	1.18E-05 U-234	release fraction *dose factor*exp(- $\lambda^*t$ )*p)																			
	5.07E-07 U-235	release fraction *dose factor*exp(- $\lambda^*t$ )*p)																			
	1.87E-06 U-238	release fraction *dose factor*exp(- $\lambda^*t$ )*p)																			
	2.51E-10 Tc-99	release fraction *dose factor*exp(- $\lambda^*t$ )*p)																			
	1.41E-05 all nuclides	sum of nuclides																			
	85.53473 usage	1100*(usage*dilution)/flow																			
	<b>1.20E-03 mRem</b>	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

21 Kg																				
Whole Body																				
Usage by adult/yr	U	see regulatory guide 1.109 page 1.109-40 table E-5, Recommended Values for U(ap)																		
Dilution at diffuser	M	Congaree Flow	9388	cubic feet/sec																
Average discharge	F	Effluent Flow		3.00E-01	cubic feet/sec															
2.83E-04 U-234	D	EPA Limiting Values of Radionuclide Intake																		
2.86E-04 U-235	D	FRG no 11	1988																	
2.55E-04 U-238	D	Exposure-to-dose conversion factors for ingestion																		
1.46E-06 Tc-99	D																			
24 hrs	t-p	reg guide	table E-15																	
3.23557E-10 U-234	A	decay const																		
1.12404E-13 U-235	A	decay const																		
1.77056E-14 U-238	A	decay const																		
3.71407E-10 Tc-99	A	decay const																		
0.99999999223 U-234	exp(-lambda*p)																			
1.00000000000 U-235	exp(-lambda*p)																			
1.00000000000 U-238	exp(-lambda*p)																			
0.99999999109 Tc-99	exp(-lambda*p)																			
Activity Released																				
3.425E-03	total uranium(Ci)																			
2.813E-03	U-234 release fraction																			
1.269E-04	U-235 release fraction																			
4.833E-04	U-238 release fraction																			
1.124E-03	Tc-99 release fraction																			
check U sum		0.00343																		
1.59E-06 U-234	release fraction *bioaccumulation factor*exp(-lambda*p)																			
6.86E-08 U-235	release fraction *bioaccumulation factor*exp(-lambda*p)																			
2.46E-07 U-238	release fraction *bioaccumulation factor*exp(-lambda*p)																			
2.46E-08 Tc-99	release fraction *bioaccumulation factor*exp(-lambda*p)																			
1.93E-06 all nuclides	sum of nuclides																			
2.46059	usage	1100*(usage dilution)/flow																		
4.76E-06 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

12 hr	Whole Body	Usage by adult/yr	U	see regulatory guide 1.109 page 1.109-40 table E-5, Recommended Values for U(pp)																									
31293 mixing - dilution	Dilution at diffuser	M																											
0.3 cubic ft/sec	Average discharge	F		Congaree Flow Effluent Flow	9388 cubic feet/sec 3.00E-01 cubic feet/sec																						see Nureg-1118 Environmental Assessment for renewam ... SNM-1107 May		
9.86E-12 U-234	mRem*m^2/pCi*hr	D		U-234	7.40E-19	9.86E-12	EPA FRG 12																						
1.97E-09 U-235	mRem*m^2/pCi*hr	D		U-235	1.48E-16	1.97E-09																							
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 ...																									
131040 hrs	exposure time of sediment	t-b		page 1.109-68																									
3.24E-10 U-234	decay const	λ																											
1.12404E-13 U-235	decay const	λ																											
1.77058E-14 U-238	decay const	λ																											
3.71407E-10 Tc-99	decay const	λ																											
0.0000423980 U-234	exp(-λt-p)*[1-exp(-λt-b)]																												
0.000000147 U-235	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																													
3.425E-03	total uranium(Ci)	Q																											
2.813E-03	U-234 release fraction	Ci																											
1.289E-04	U-235 release fraction	Ci																											
4.833E-04	U-238 release fraction	Ci																											
1.124E-03	Tc-99 release fraction	Ci																											
check U sum																													
1.05E-10 U-234	release fraction	"dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i																											
9.59E-10 U-235	release fraction	"dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i																											
1.34E-11 U-238	release fraction	"dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i																											
4.41E-12 Tc-99	release fraction	"dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i																											
1.08E-09	all nuclides	sum of nuclides																											
28.121006	usage	110000*(usage*dilution*shore width factor)/flow																											
3.04E-08	mRem	see regulatory guide 1.109 page 1.109-2 and 1.109-3 for formula and definition of terms.																											
		see regulatory guide 1.109 page 1.109-15 table A-2, Shore width...																											

## Attachment 9 2018 Isotopic Fractions

Based on the plant nominal enrichment for 2018

<b>Nuclide</b>	<b>Average wt%</b>	<b>Specific Activity Ci/g</b>	<b>Weighted Activity</b>	<b>% Activity</b>
<b>U-234</b>	0.04	6.220E-03	2.388E-06	85.16
<b>U-235</b>	4.40	2.160E-06	9.504E-08	3.39
<b>U-238</b>	95.57	3.360E-07	3.211E-07	11.45
<b>Total</b>	100.0		2.805E-06	100.00

Attachment 10 - Comply Results

COMPLY: V1.6.

2/22/2019 1:35

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:

Westinghouse Electric Company  
Columbia Fuel Fabrication Facility  
5801 Bluff Rd. Hopkins, SC 29061

David Wagoner  
803.647.1919

Prepared for:

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

## 2018 Annual Dose to the Public Due to Gaseous Effluents

### ----- SCREENING LEVEL 2 -----

#### DATA ENTERED: -----

#### RELEASE RATES FOR STACK 1.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	4.460E-13
U-235	Y	1.780E-14
U-238	Y	6.000E-14

#### RELEASE RATES FOR STACK 2.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	3.910E-13
U-235	Y	1.560E-14
U-238	Y	5.250E-14

#### RELEASE RATES FOR STACK 3.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.320E-12
U-235	Y	5.250E-14
U-238	Y	1.770E-13

#### RELEASE RATES FOR STACK 4.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	3.610E-12
U-235	Y	1.440E-13
U-238	Y	4.850E-13

#### RELEASE RATES FOR STACK 5.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	7.420E-13
U-235	Y	2.950E-14
U-238	Y	9.980E-14

#### RELEASE RATES FOR STACK 6.

Release Rate



Nuclide		(curies/SECOND)
U-234	Y	1.560E-12
U-235	Y	6.220E-14
U-238	Y	2.100E-13

RELEASE RATES FOR STACK 7.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	8.520E-13
U-235	Y	3.390E-14
U-238	Y	1.150E-13

RELEASE RATES FOR STACK 8.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.020E-12
U-235	Y	4.050E-14
U-238	Y	1.370E-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:

-----

Input parameters outside the "normal" range:

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

RESULTS:  
-----

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 \*\*\*\*\*

COMPLY: V1.6.

2/22/2019 1:49

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:

Westinghouse Electric Company  
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5801 Bluff Rd. Hopkins, SC 29061

David Wagoner  
803.647.1919

Prepared for:

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

Conv 1-A EX

-----  
SCREENING LEVEL 2  
-----

DATA ENTERED:  
-----

Nuclide		Release Rate (curies/SECOND)
U-234	Y	7.210E-13
U-235	Y	2.870E-14
U-238	Y	9.690E-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: 1.4E-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 \*\*\*\*\*