Page 1 of 2
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

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

Our ref: LTR-RAC-20-21-R1

Subject: SNM-1107/70-1151
NRC Semi-Annual Discharge Report
July - December 2019

February 25, 2020
September 8, 2020 R1

This letter was revised to attach Revision 1 of dose report LTR-EHS-20-17 (LTR-EHS-20-17-R1). Per CAP 2020-5991, it was noted that data in the "Gross Alpha Concentration" column of Attachment 1 had not been updated. Note that all dose calculations are correct and unchanged.

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 of July 1, 2019 through December 31, 2019, 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 (µCi)	Parameter	Total 6-month Measured Concentration	Regulatory Concentration Limit
Gaseous	243.52	Uranium (analyzed as gross alpha)	9.4 E^{-15} µCi/mL*	5 E^{-14} µCi/mL
Liquid Effluent	1,256.4	U-234	2.0 E^{-08} µCi/mL	3 E^{-07} µCi/mL
	67.3	U-235		
	224.9	U-238		
	123.2	Tc-99	1.6 E^{-09} µCi/mL	6 E^{-05} µCi/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 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 the quantities of Tc-99 detected during benchmark testing of gaseous emissions were below the thresholds that would necessitate reporting.

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 2019 was 7.71E+07 liters.

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, LTR-EHS-20-17-R1, "Annual Assessment of Public Dose due to Liquid and Gaseous Effluents" is attached.

Sincerely,

Jeff Ferguson
Manager, Environment, Health and Safety

Attachment:
LTR-EHS-20-17-R1, "Annual Assessment of Public Dose due to Liquid and Gaseous Effluents"

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

To: Cynthia Logsdon, Diana Joyner

Date: May 14, 2020

cc: Jeff Ferguson, Nancy Parr, Anna Pearson, Amanda Spalding

From: David Wagoner
Ext: 1919
Fax: 803.695.4158

Your ref:
Our ref: LTR-EHS-20-17 Rev. 1

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 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 1247 (Hot Oil Room 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"

Bounding dose assessments for direct inhalation and for ingestion are performed using conservative assumptions to determine the maximum potential dose to a hypothetical individual member of the public. The inhalation dose is determined for the hypothetical individual standing at the nearest site boundary (595 meters) for twelve months. 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.

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 2019:

- 446.35 μCi of Uranium in gaseous effluent
- 3.83 mCi of Uranium in liquid effluent
- 1.10 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 2019 resulted in a potential whole body dose of 0.16 mrem and lung dose of 1.6 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 25 mrem annual dose limit and the 1 mrem annual ALARA goal for a member of the public.

Table 1. 2019 Annual Dose to the Public from Liquid and Gaseous Effluents

	Whole Body Dose (mrem/yr)	**Organ Dose - Bone (mrem/yr)**	**Organ Dose - Lung (mrem/yr)**
Gaseous Effluents			
Direct inhalation*	0.16	6.1E-03	1.6
Liquid Effluents			
Potable Water	9.1E-05	1.4E-03	-
Aquatic Food (Fish)	5.3E-06	7.7E-05	-
Shoreline Deposition	3.9E-09	-	-
Total (mrem)	*0.16*	*7.6E-03*	*1.6*

* Assumes 80 % residence time

There were no changes in source material and no release points were added or removed during 2019. Based on updated emissions testing in support of the SCDHEC air permit renewal, the orientation and stack height for the S-958 scrubber (samples 1233 and 1234) was modified to optimize atmospheric dispersion for nitrogen oxides (NOx) in 2019. The attachments below illustrate the method used to calculate each result listed in Table 1.

Attachment 1:	2019 Gaseous Effluent Discharges
Attachment 2:	Lung/Bone Organ Dose due to Gaseous Effluent
Attachment 3:	2019 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:	2019 Isotopic Fractions
Attachment 10:	Comply Results

David Wagoner, CHP
Radiation Safety Engineer
EH&S Operations

Anna Pearson
Manager, RSO
EH&S Operations

Attachment 1

2019 Gaseous Effluent Discharges

Sampling Station	Location Description	Stack Height (m)	Gross Alpha Concentration* (uCi/mL)	1st Half (Jan-Jun) uCi Uranium Released	2nd Half (July-Dec) uCi Uranium Released	Total uCi Released	Release Rate (Ci/s) U234	Release Rate (Ci/s) U235	Release Rate (Ci/s) U238
1207	MET LAB EXHAUST	10	1.36E-13	0.97	1.40	2.37	6.39E-14	2.56E-15	8.59E-15
1239	MAINT WELD EX	11	2.61E-13	2.36	5.36	7.72	2.08E-13	8.32E-15	2.80E-14
1243	AC-8	11	8.15E-14	4.77	4.85	9.62	2.59E-13	1.04E-14	3.49E-14
1222	CALC COMB GAS LN 1	12	1.40E-13	0.21	0.50	0.71	1.91E-14	7.65E-16	2.57E-15
1223	CALC COMB GAS LN 2	12	1.64E-13	0.31	0.54	0.85	2.29E-14	9.16E-16	3.08E-15
1224	CALC COMB GAS LN 3	12	1.29E-13	0.24	0.42	0.66	1.78E-14	7.12E-16	2.39E-15
1225	CALC COMB GAS LN 4	12	1.45E-13	0.28	0.46	0.74	2.00E-14	7.98E-16	2.68E-15
1226	CALC COMB GAS LN 5	12	8.42E-14	0.21	0.22	0.43	1.16E-14	4.64E-16	1.56E-15
1228	CHEM LAB EX #3	12	1.51E-13	0.45	1.06	1.51	4.07E-14	1.63E-15	5.47E-15
1231	DEV LAB EX #2	12	3.36E-13	3.52	6.42	9.94	2.68E-13	1.07E-14	3.60E-14
1237	ABF HOOD TORIT EX	12	8.79E-14	1.94	1.96	3.90	1.05E-13	4.20E-15	1.41E-14
1241	PELLET LINE 6	12	8.60E-14	3.77	3.70	7.47	2.01E-13	8.05E-15	2.71E-14
1247	HOT OIL RM EX	12	7.02E-13	43.07	42.33	85.40	2.30E-12	9.21E-14	3.10E-13
1201	FURNACE EX LINE 1	13	8.17E-14	3.53	3.56	7.09	1.91E-13	7.64E-15	2.57E-14
1202	FURNACE EX LINE 2	13	8.91E-14	3.79	3.95	7.74	2.09E-13	8.34E-15	2.81E-14
1203	FURNACE EX LINE 3	13	8.95E-14	3.51	4.26	7.77	2.10E-13	8.38E-15	2.82E-14
1204	FURNACE EX LINE 4	13	8.12E-14	3.49	3.55	7.04	1.90E-13	7.59E-15	2.55E-14
1205	FURNACE EX LINE 5	13	8.05E-14	3.46	3.54	7.00	1.89E-13	7.55E-15	2.54E-14
1206	NEW DECON ROOM	13	8.65E-14	2.19	2.24	4.43	1.19E-13	4.78E-15	1.61E-14
1208	INCINERATOR EX	13	2.41E-13	8.19	6.04	14.23	3.84E-13	1.53E-14	5.16E-14
1209	SUPPL INCIN EX	13	1.16E-13	1.24	2.18	3.42	9.22E-14	3.69E-15	1.24E-14
1217	CONV ENCL EX 4-C	13	1.39E-13	6.72	10.24	16.96	4.57E-13	1.83E-14	6.15E-14
1218	CONV ENCL EX 4-D	13	2.37E-13	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
1219	CONV EMERG EX 4E	13	3.38E-13	0.69	1.27	1.96	5.28E-14	2.11E-15	7.10E-15
1221	DECON ROOM EX	13	4.55E-13	5.55	14.67	20.22	5.45E-13	2.18E-14	7.33E-14
1230	DEV LAB EX #1	13	2.20E-13	2.26	4.24	6.50	1.75E-13	7.01E-15	2.36E-14
1232	PELLET COMBINED EX	13	9.64E-14	6.50	7.74	14.24	3.84E-13	1.54E-14	5.16E-14
1229	HP LAB EX	15	9.22E-14	0.74	0.94	1.68	4.53E-14	1.81E-15	6.09E-15
1233	SOLVENT EXT N EX	15	8.86E-14	3.66	4.26	7.92	2.14E-13	8.54E-15	2.87E-14
1234	SOLVENT EXT S EX	15	2.90E-13	1.60	2.72	4.32	1.16E-13	4.66E-15	1.57E-14
1236	MAP COMBINED	15	2.52E-13	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
1240	AC-3	15	9.35E-14	4.72	6.32	11.04	2.98E-13	1.19E-14	4.00E-14
1246	AC-4	15	8.20E-14	4.93	5.03	9.96	2.69E-13	1.07E-14	3.61E-14
1251	WATERGLASS SCR S1190	15	8.06E-14	2.95	2.99	5.94	1.60E-13	6.40E-15	2.15E-14
1210	CONV 1-A EX	16	1.45E-13	10.45	8.38	18.83	5.08E-13	2.03E-14	6.82E-14
1211	CONV 1-B EX	16	2.49E-13	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
1212	S1030 A	16	1.96E-13	17.29	26.98	44.27	1.19E-12	4.77E-14	1.60E-13
1213	S1030 B	16	3.11E-13	1.12	2.38	3.50	9.44E-14	3.77E-15	1.27E-14
1227	CHEM LAB EX #2	16	4.58E-13	2.87	5.51	8.38	2.26E-13	9.03E-15	3.04E-14
1220	CHEM LAB FILT EX	17	9.23E-14	7.27	8.77	16.04	4.32E-13	1.73E-14	5.81E-14
1242	AC-5	17	8.67E-14	4.88	5.36	10.24	2.76E-13	1.10E-14	3.71E-14
1244	AMMON FUME SCR 1008A	17	1.01E-13	3.16	2.81	5.97	1.61E-13	6.44E-15	2.16E-14
1245	AMMON FUME SCR 1008B	17	1.89E-13	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00
1238	IFBA EXHAUST	18	8.02E-14	5.85	5.97	11.82	3.19E-13	1.27E-14	4.28E-14
1248	ERBIA FURNACE EX	18	8.06E-14	10.16	10.41	20.57	5.55E-13	2.22E-14	7.46E-14
1249	ERBIA SCRUBBER EX	18	8.12E-14	5.51	5.49	11.00	2.97E-13	1.19E-14	3.99E-14
1250	ERBIA CHANGE ROOM	18	8.32E-14	2.45	2.50	4.95	1.33E-13	5.34E-15	1.79E-14
	Total			***202.83***	***243.52***	***446.35***	***1.20E-11***	***4.81E-13***	***1.62E-12***

*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**				
	Hot Oil Room	**43.07**	**42.33**	**85.40**	**Dose (mrem/yr)**	**4.60E-02**			
	use highest release to calculate X/Q used by COMPLY				Stack height (m)	12			
					Release Rate (Ci/s)	U-234	U-235	U-238	
	Dose from comply	0.04600	mrem/yr			2.30E-12	9.21E-14	3.10E-13	
	release quantity	85.40	uCi						
		8.54E-05	Ci						
	App E table E-5	8000.00	m3/yr						
	Effective Dose conversion								
	EPA FGR 11 p150-151								
	U-234	3.58E-05	Sv/Bq	85.03%					
	U-235	3.32E-05	Sv/Bq	3.40%					
	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)								
		1.63E-05	X/Q						
	Estimate Lung Dose using X/Q and annual releases for 2019				Estimate Bone Dose using X/Q and annual releases for 2019				
	App E table E-5								
	Lung Organ Dose conversion								
	EPA FGR 11 p150-151								
	U-234	2.98E-04	Sv/Bq	85.03%	1.13E-06	Sv/Bq			
	U-235	2.76E-04	Sv/Bq	3.40%	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	1.0848	mrem/pCi		4.11E-03	mrem/pCi			
	release quantity	446.35	uCi		446.35	uCi			
		4.46E-04	Ci		4.46E-04	Ci			
	Lung *	**1.60**	**mrem**	**Bone ***	**6.07E-03**	**mrem**			
		assume 80% residence							

Attachment 3 - 2019 Liquid Effluent Discharges

2019

	Liquid Effluent Dischages		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	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)
January	3484.056	3,484,056	16.9	1.57	3.66	22.1	5.89	28.0	222.9	20.7	48.3	77.7	1.7	0.6	0.8	16.8	22.6	7.8	10.5	221.5
February	2906.489	2,906,489	28.2	1.83	5.58	35.6	20.50	56.1	310.2	20.1	61.4	225.5	1.5	0.4	0.7	21.4	16.1	4.7	7.2	235.4
March	3436.647	3,436,647	34.4	1.86	6.88	43.1	14.60	57.7	447.5	24.2	89.5	189.9	1.5	0.4	0.7	26.9	19.0	5.0	8.5	349.9
April	2717.148	2,717,148	26.6	1.03	2.88	30.5	28.10	58.6	273.6	10.6	29.6	289.0	3.5	0.9	1.2	22.0	36.1	9.0	12.8	226.3
May	2927.418	2,927,418	28.4	1.08	4.94	34.4	5.35	39.8	314.7	12.0	54.7	59.3	2.0	0.4	0.8	22.6	21.8	4.8	9.2	250.4
June	3563.415	3,563,415	20.8	1.05	3.64	25.5	10.30	35.8	280.5	14.2	49.1	138.9	1.9	0.5	0.8	21.7	25.0	6.4	10.5	292.7
July	3102.469	3,102,469	16.0	0.89	3.26	20.1	1.52	21.7	187.9	10.4	38.3	17.8	1.7	0.5	0.8	26.3	20.1	5.6	9.2	308.8
August	4029.124	4,029,124	17.1	1.08	2.81	21.0	0.00	21.0	260.8	16.5	42.9	0.0	1.5	0.4	0.6	25.1	23.2	6.6	9.5	382.8
September	3130.477	3,130,477	15.3	0.71	2.57	18.6	0.90	19.5	181.3	8.4	30.5	10.7	1.0	0.2	0.4	23.3	11.8	2.9	5.0	276.1
October	3250.124	3,250,124	15.1	0.68	2.66	18.4	0.48	18.9	185.8	8.4	32.7	5.9	1.3	0.3	0.5	24.2	15.5	4.0	6.6	297.7
November	3195.197	3,195,197	12.9	0.63	2.32	15.9	7.34	23.2	156.0	7.6	28.1	88.8	1.4	0.4	0.6	24.0	17.2	4.4	7.4	290.3
December	3651.177	3,651,177	20.6	1.16	3.80	25.6	0.00	25.6	284.7	16.0	52.5	0.0	0.9	0.3	0.4	25.2	12.4	3.5	5.4	348.3
Total	39393.741	39393741							3105.7	169.1	557.5	1103.5					240.7	64.6	101.8	3480.1
Liters (L)		**1.49E+08**							**3832.3 uCi Uranium**											
Milliliters (ml)		1.49E+11							**4935.8 uCi Uranium & Tc-99**											

LIQUID DISCHARGES

Radionuclide	LLD (uCi/ml)	Quantity Released (uCi)	Error		Average Concentration Released (uCi/ml)
U234	6.00E-10	3105.7	+/-	241	2.08E-08
U235	6.00E-10	169.08	+/-	65	1.13E-09
U238	6.00E-10	557.48	+/-	102	3.74E-09
Total U		*3832.3*			*2.57E-08*
Tc-99	6.00E-10	1103.5	+/-	3480	7.40E-09
Total		4935.8			5.88E-08

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

		Whole Body-Ingestion																		
730	liters	Usage by adult/yr	U	10CFR20	7.3×10^5 (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								
2.55E-04	U-238	mRem/pCi	D	Exposure-to-dose conversion factors for ingestion				U-235	7.19E-08	1.05E-06	2.66E-04	3.88E-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																	
1.12404E-13	U-235	decay const	λ	Nuclide		T(1/2) yr	T(1/2) hr	λ												
1.77058E-14	U-238	decay const	λ	URANIUM234		2.45E+05	2.14E+09	3.24E-10												
3.71407E-10	Tc-99	decay const	λ	URANIUM235		7.04E+08	6.17E+12	1.12E-13			for comaprison only									
				URANIUM238		4.47E+09	3.91E+13	1.77E-14												
0.9999999961	U-234	exp(-λt-p)		TC-99		2.13E+05	1.87E+09	3.71E-10			Part 20 table 2									
1.0000000000	U-235	exp(-λt-p)									Dose Conversion		soluble forms							
1.0000000000	U-238	exp(-λt-p)										uCi/ml	milliters	uCi	pCi	mRem	mRem/pCi			
0.9999999955	Tc-99	exp(-λt-p)									U-234	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04			
											U-235	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04			
Activity Released											U-238	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04			
											Tc-99	6.00E-05	7.30E+05	4.38E+01	4.38E+07	50	1.14E-06			
3.106E-03	U-234 release fraction	Ci									ICRP 69	Comparison								
1.691E-04	U-235 release fraction	Ci																		
5.575E-04	U-238 release fraction	Ci										Sv/Bq	Rem/Bq	mRem/pCi						
1.104E-03	Tc-99 release fraction	Ci																		
											adult	5.00E-08	0.005	1.85E-04						
check U sum	0.00383										infant	3.70E-07	0.037	1.37E-03						
											bone-adult	7.90E-07	0.079	2.92E-03						
8.80E-07	U-234	release fraction *dose factor*exp(-λ*tp)																		
4.50E-08	U-235	release fraction *dose factor*exp(-λ*tp)																		
1.42E-07	U-238	release fraction *dose factor*exp(-λ*tp)																		
1.61E-09	Tc-99	release fraction *dose factor*exp(-λ*tp)																		
1.07E-06	all nuclides	sum of nuclides																		
85.53473	usage	1100*(usage*dilution)/flow																		
9.14E-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															
730	liters	Usage by adult/yr	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					
3.74E-03	U-238	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					
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														
1.12404E-13	U-235	decay const	λ	Nuclide		T(1/2) yr	T(1/2) hr	λ									
1.77058E-14	U-238	decay const	λ	URANIUM234		2.45E+05	2.14E+09	3.24E-10			Part 20 table 2						
3.71407E-10	Tc-99	decay const	λ	URANIUM235		7.04E+08	6.17E+12	1.12E-13			Dose Conversion		soluble forms				
				URANIUM238		4.47E+09	3.91E+13	1.77E-14									
0.9999999961	U-234	exp(-λt-p)		TC-99		2.13E+05	1.87E+09	3.71E-10				uCi/ml	milliters	uCi	pCi	mRem	mRem/pCi
1.0000000000	U-235	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-238	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
											Tc-99	6.00E-05	7.30E+05	4.38E+01	4.38E+07	50	1.14E-06
Activity Released																	
											ICRP 69	Comparison					
3.106E-03	U-234 release fraction	Ci										Sv/Bq	Rem/Bq	mRem/pCi			
1.691E-04	U-235 release fraction	Ci															
5.575E-04	U-238 release fraction	Ci									adult	5.00E-08	0.005	1.85E-04			
1.104E-03	Tc-99 release fraction	Ci									infant	3.70E-07	0.037	1.37E-03			
											bone-adult	7.90E-07	0.079	2.92E-03			
check U sum	0.00383																
1.30E-05	U-234	release fraction *dose factor*exp(-λ*tp)															
6.57E-07	U-235	release fraction *dose factor*exp(-λ*tp)															
2.08E-06	U-238	release fraction *dose factor*exp(-λ*tp)															
2.47E-10	Tc-99	release fraction *dose factor*exp(-λ*tp)															
1.57E-05	all nuclides	sum of nuclides															
85.53473	usage	1100*(usage*dilution)/flow															
1.35E-03	**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																
21	Kg	Usage by adult/yr	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						
2.55E-04	U-238	mRem/pCi	D	Exposure-to-dose conversion factors for ingestion				U-235	7.19E-08	1.05E-06	2.66E-04	3.88E-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															
1.12404E-13	U-235	decay const	λ	Nuclide		T(1/2) yr	T(1/2) hr	λ										
1.77058E-14	U-238	decay const	λ	URANIUM234		2.45E+05	2.14E+09	3.24E-10				for comaprison only						
3.71407E-10	Tc-99	decay const	λ	URANIUM235		7.04E+08	6.17E+12	1.12E-13										
				URANIUM238		4.47E+09	3.91E+13	1.77E-14				Part 20 table 2		soluble forms				
0.99999999223	U-234	exp(-λt-p)		TC-99		2.13E+05	1.87E+09	3.71E-10				Dose Conversion						
1.00000000000	U-235	exp(-λt-p)											uCi/ml	milliters	uCi	pCi	mRem	mRem/pCi
1.00000000000	U-238	exp(-λt-p)										U-234	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04
0.99999999109	Tc-99	exp(-λt-p)										U-235	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
												ICRP 69	Comparison					
3.106E-03	U-234 release fraction	Ci											Sv/Bq	Rem/Bq	mRem/pCi			
1.691E-04	U-235 release fraction	Ci																
5.575E-04	U-238 release fraction	Ci										adult	5.00E-08	0.005	1.85E-04			
1.104E-03	Tc-99 release fraction	Ci										infant	3.70E-07	0.037	1.37E-03			
check U sum	0.00383											bone-adult	7.90E-07	0.079	2.92E-03			
							bioaccumulation factor		BNWL-2075									
1.76E-06	U-234	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		UC-11									
9.00E-08	U-235	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		Methodology for Calculation of Radiation Doses									
2.84E-07	U-238	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		in the Environs from Nuclear Fuel									
2.42E-08	Tc-99	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					15		Cycle Facilities									
2.16E-06	all nuclides	sum of nuclides																
2.46059	usage	1100*(usage*dilution)/flow																
5.31E-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																			
21	Kg	Usage by adult/yr	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								
3.74E-03	U-238	mRem/pCi	D	Exposure-to-dose conversion factors for ingestion				U-235	7.19E-08	1.05E-06	2.66E-04	3.88E-03								
2.23E-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																	
1.12404E-13	U-235	decay const	λ	Nuclide		T(1/2) yr	T(1/2) hr	λ				for comaprison only								
1.77058E-14	U-238	decay const	λ	URANIUM234		2.45E+05	2.14E+09	3.24E-10												
3.71407E-10	Tc-99	decay const	λ	URANIUM235		7.04E+08	6.17E+12	1.12E-13				Part 20 table 2		soluble forms						
				URANIUM238		4.47E+09	3.91E+13	1.77E-14				Dose Conversion								
0.99999999223	U-234	exp(-λt-p)		TC-99		2.13E+05	1.87E+09	3.71E-10					uCi/ml	milliters	uCi	pCi	mRem	mRem/pCi		
1.00000000000	U-235	exp(-λt-p)										U-234	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04		
1.00000000000	U-238	exp(-λt-p)										U-235	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04		
0.99999999109	Tc-99	exp(-λt-p)										U-238	3.00E-07	7.30E+05	2.19E-01	2.19E+05	50	2.28E-04		
												Tc-99	6.00E-05	7.30E+05	4.38E+01	4.38E+07	50	1.14E-06		
Activity Released																				
												ICRP 69	Comparison							
													Sv/Bq	Rem/Bq	mRem/pCi					
3.106E-03	U-234 release fra	Ci																		
1.691E-04	U-235 release fra	Ci																		
5.575E-04	U-238 release fra	Ci										adult	5.00E-08	0.005	1.85E-04					
1.104E-03	Tc-99 release fra	Ci										infant	3.70E-07	0.037	1.37E-03					
												bone-adult	7.90E-07	0.079	2.92E-03					
check U sum	0.00383																			
							bioaccumulation factor		BNWL-2075											
2.60E-05	U-234	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		UC-11											
1.31E-06	U-235	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		Methodology for Calculation of Radiation Doses											
4.17E-06	U-238	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					2		in the Environs from Nuclear Fuel											
3.70E-09	Tc-99	release fraction *bioaccumulation factor*dose factor*exp(-λ*tp)					15		Cycle Facilities											
3.15E-05	all nuclides	sum of nuclides																		
2.46059	usage	1100*(usage*dilution)/flow																		
7.74E-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													
12	hr	Usage by adult/yr	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									
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	xposure time of sedime	t-b	page 1.109-68								t-i			
3.23557E-10	U-234	decay const	λ				Nuclide		T(1/2) yr	T(1/2) hr	λ	T(1/2) day			
1.12404E-13	U-235	decay const	λ				URANIUM234		2.45E+05	2.14E+09	3.24E-10	8.90E+07			
1.77058E-14	U-238	decay const	λ				URANIUM235		7.04E+08	6.17E+12	1.12E-13	2.56E+11			
3.71407E-10	Tc-99	decay const	λ				URANIUM238		4.47E+09	3.91E+13	1.77E-14	1.63E+12			
							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)]													
0.0000000023	U-238	exp(-λt-p)*[1-exp(-λt-b)]													
0.0000486679	Tc-99	exp(-λt-p)*[1-exp(-λt-b)]													
Activity Released															
3.106E-03	U-234 release fraction	Ci													
1.691E-04	U-235 release fraction	Ci													
5.575E-04	U-238 release fraction	Ci													
1.104E-03	Tc-99 release fraction	Ci													
check U sum	0.00383														
1.16E-10	U-234	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
1.26E-09	U-235	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
1.54E-11	U-238	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
4.33E-12	Tc-99	release fraction *dose factor*exp(-λt-p)*1-exp(-λt-b)*t-i													
1.39E-09	all nuclides	sum of nuclides													
2.812101	usage	11000*(usage*dilution*shore width factor)/flow													
3.92E-09	**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 1.109-40 table A-2,Shore width..										

Attachment 9
2019 Isotopic Fractions

Based on the plant nominal enrichment for 2019

Nuclide	Average wt%	Specific Activity Ci/g	Weighted Activity	% Activity
U-234	0.04	6.220E-03	2.388E-06	85.03
U-235	4.42	2.160E-06	9.549E-08	3.40
U-236	0.01	6.470E-05	4.076E-09	0.15
U-238	95.56	3.360E-07	3.211E-07	11.43
Total	100.0		2.809E-06	100.00

COMPLY: V1.6. 2/10/2020 4:40

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

2019 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	6.39OE-14
U-235	Y	2.56OE-15
U-238	Y	8.59OE-15

RELEASE RATES FOR STACK 2.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	4.68OE-13
U-235	Y	1.87OE-14
U-238	Y	6.28OE-14

RELEASE RATES FOR STACK 3.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	3.01OE-12
U-235	Y	1.20OE-13
U-238	Y	4.05OE-13

RELEASE RATES FOR STACK 4.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	3.20OE-12
U-235	Y	1.28OE-13
U-238	Y	4.30OE-13

RELEASE RATES FOR STACK 5.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.10OE-12
U-235	Y	4.41OE-14
U-238	Y	1.48OE-13

RELEASE RATES FOR STACK 6.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	2.02OE-12
U-235	Y	8.08OE-14
U-238	Y	2.72OE-13

RELEASE RATES FOR STACK 7.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	8.70OE-13
U-235	Y	3.48OE-14
U-238	Y	1.17OE-13

RELEASE RATES FOR STACK 8.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.30OE-12
U-235	Y	5.21OE-14
U-238	Y	1.75OE-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 **********

40 CFR Part 61
National Emission Standards
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REPORT ON COMPLIANCE WITH

THE CLEAN AIR ACT LIMITS FOR RADIONUCLIDE EMISSIONS

FROM THE COMPLY CODE - V1.6.

Prepared by:

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803.647.1919

Prepared for:

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

Hot Oil Room

SCREENING LEVEL 2

DATA ENTERED:

Nuclide		Release Rate (curies/SECOND)
U-234	Y	2.300E-12
U-235	Y	9.210E-14
U-238	Y	3.100E-13

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.

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: 4.6E-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 **********