



# Westinghouse

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-20-69

Subject: SNM-1107/70-1151  
NRC Semi-Annual Discharge Report  
January – June 2020

August 25, 2020

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 January 1, 2020, through June 30, 2020, 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 ( $\mu\text{Ci}$ )	Parameter	Total 6-month Measured Concentration	Regulatory Concentration Limit
Gaseous	182.8	Uranium (analyzed as gross alpha)	$7 \times 10^{-15} \mu\text{Ci/mL}$ *	$5 \times 10^{-14} \mu\text{Ci/mL}$
Liquid Effluent#	1,683	U-234	$3 \times 10^{-8} \mu\text{Ci/mL}$	$3 \times 10^{-7} \mu\text{Ci/mL}$
	76	U-235		
	297	U-238		
	2,935	Tc-99	$4 \times 10^{-8} \mu\text{Ci/mL}$	$6 \times 10^{-5} \mu\text{Ci/mL}$

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

#Sum of fractions (SOF) equates to less than 1.0.

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 (85.25% U-234, 3.28% U-235, and 11.48% 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 first half of 2020 was  $7.31 \times 10^{10}$  milliliters (mL).

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-20-60, "2020 Semi-Annual Assessment of Public Dose due to Liquid and Gaseous Effluents" is attached.

Sincerely,

  
Jeff Ferguson  
Manager, Environment, Health and Safety

Attachment:

LTR-EHS-20-60, "2020 Semi-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: August 17, 2020

cc: Jeff Ferguson, Elise Malek, Patrick Donnelly, Nancy Parr,  
Anna Pearson,

From: David Wagoner  
Ext: 1919  
Fax: 803.695.4158

Your ref:  
Our ref: LTR-EHS-20-60

Subject: **2020 Semi-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 potential 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, Doses from Liquid Effluent Pathways (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."

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 six 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 the 1<sup>st</sup> half of calendar year 2020:

- 182.8 µCi of Uranium in gaseous effluent
- 2,056 µCi of Uranium in liquid effluent
- 2,935 µCi 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 1<sup>st</sup> half of 2020 resulted in a potential whole body dose of 0.08 mrem, 0.66 mrem to the lung, and 0.003 mrem to the bone for an individual present at the nearest site boundary. The estimated whole body dose is well below the 12.5 mrem annual dose limit (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.

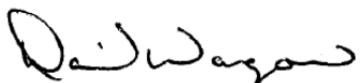
**Table 1.** 2020 Semi-Annual Dose to the Public from Liquid and Gaseous Effluents

	<b>Whole Body Dose (mrem/6 months)</b>	<b>Organ Dose - Bone (mrem/6 months)</b>	<b>Organ Dose - Lung (mrem/6 months)</b>
<b>Gaseous Effluents</b>			
Direct inhalation*	0.08	2.51E-03	0.66
<b>Liquid Effluents</b>			
Potable Water	2.47E-05	3.61E-04	-
Aquatic Food (Fish)	1.49E-06	2.08E-05	-
Shoreline Deposition	9.16E-10	-	-
<i>Total (mrem/6 months)</i>	<i>0.08</i>	<i>2.89E-03</i>	<i>0.66</i>

\* Assumes 80 % residence time

There were no changes in source material and no release points were added or removed during the 1<sup>st</sup> half of 2020. 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.

- Attachment 1: 1<sup>st</sup> Half 2020 Gaseous Effluent Discharges
- Attachment 2: Lung/Bone Organ Dose due to Gaseous Effluent
- Attachment 3: 1<sup>st</sup> Half 2020 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: 2020 Isotopic Fractions
- Attachment 10: Comply Results



David Wagoner, CHP  
Radiation Safety Engineer  
EH&S Operations



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

## Attachment 1

### 1st Half 2020 Gaseous Effluent Discharges

Sampling Station	Location Description	Stack Height (m)	Flow Rate (m <sup>3</sup> /s)	Gross Alpha Concentration* (uCi/ml)	U234	U235	U238	1st Half (Jan-Jun) uCi Uranium Released
1207	MET LAB EXHAUST	10	0.56	1.92E-13	9.05E-14	3.48E-15	1.22E-14	1.67
1229	MAIN WELD EX	11	0.94	1.67E-13	1.34E-13	5.15E-15	1.80E-14	2.47
1243	AC-8	11	3.78	8.01E-14	2.56E-13	3.45E-14	4.73	
1222	CALC COMB GAS LIN 1	12	0.16	2.03E-13	2.22E-14	1.08E-15	3.80E-15	0.52
1223	CALC COMB GAS LIN 2	12	0.16	1.58E-13	2.22E-14	8.55E-16	2.99E-15	0.41
1224	CALC COMB GAS LIN 3	12	0.16	1.41E-13	1.95E-14	7.51E-16	2.63E-15	0.36
1225	CALC COMB GAS LIN 4	12	0.16	9.85E-14	1.36E-14	5.21E-16	1.83E-15	0.25
1226	CALC COMB GAS LIN 5	12	0.16	2.02E-13	2.82E-14	1.08E-15	3.80E-15	0.52
1228	CHEM LAB EX #3	12	0.64	1.33E-13	2.11E-14	8.13E-16	2.85E-15	0.39
1237	ABF HOOD TORIT EX	12	1.42	8.58E-14	1.03E-13	3.96E-15	1.39E-14	1.90
1241	PELLET LINE 6	12	2.78	8.10E-14	1.91E-13	7.34E-15	2.57E-14	3.52
1247	HOT OIL RM EX	12	3.89	1.50E-13	4.94E-13	1.90E-14	6.65E-14	9.11
1201	FURNACE EX LINE 1	13	2.78	8.11E-14	1.91E-13	7.34E-15	2.57E-14	3.52
1202	FURNACE EX LINE 2	13	2.78	8.03E-14	1.89E-13	7.28E-15	2.55E-14	3.49
1203	FURNACE EX LINE 3	13	2.78	9.64E-14	2.27E-13	8.74E-15	3.06E-14	4.19
1204	FURNACE EX LINE 4	13	2.78	8.00E-14	1.89E-13	7.26E-15	2.54E-14	3.48
1205	FURNACE EX LINE 5	13	2.78	8.01E-14	1.89E-13	7.26E-15	2.54E-14	3.48
1206	NEW DECON ROOM	13	1.64	9.16E-14	1.27E-13	4.90E-15	1.72E-14	2.35
1208	INCINERATOR EX	13	1.89	2.75E-13	4.41E-13	1.70E-14	5.94E-14	8.13
1209	SUPPL INCIN EX	13	0.94	1.19E-13	9.54E-14	3.67E-15	1.28E-14	1.76
1217	CONV ENCL EX 4-C	13	3.89	1.62E-13	5.33E-13	2.05E-14	7.18E-14	9.83
1218	CONV ENCL EX 4-D	13	3.89	1.42E-13	0.00E+00	0.00E+00	0.00E+00	0.00
1219	CONV EMERG EX 4E	13	3.89	2.16E-13	3.36E-14	1.29E-15	4.53E-15	0.62
1221	DECON ROOM EX	13	1.42	3.25E-13	3.90E-13	1.50E-14	5.25E-14	7.19
1230	DEV LAB EX #1	13	0.94	1.57E-13	1.26E-13	4.84E-15	1.69E-14	2.32
1231	DEV LAB EX #2	13	0.94	2.23E-13	1.78E-13	6.86E-15	2.40E-14	3.29
1232	PELLET COMBINED EX	13	4.72	8.25E-14	3.30E-13	1.27E-14	4.45E-14	6.09
1229	HP LAB EX	15	0.58	8.81E-14	4.34E-14	1.67E-15	5.84E-15	0.80
1236	MAP COMBINED	15	2.78	2.45E-13	0.00E+00	0.00E+00	0.00E+00	0.00
1240	AC-3	15	3.78	8.29E-14	2.66E-13	1.02E-14	3.58E-14	4.90
1246	AC-4	15	3.89	8.20E-14	2.70E-13	1.04E-14	3.64E-14	4.98
1251	WATERGLASS SCR S1190	15	2.36	1.55E-13	3.05E-13	1.17E-14	4.11E-14	5.63
1210	CONV 1-A EX	16	4.17	1.03E-13	3.65E-13	1.40E-14	4.91E-14	6.73
1211	CONV 1-B EX	16	4.17	1.72E-13	0.00E+00	0.00E+00	0.00E+00	0.00
1212	S1030 A	16	7.56	1.80E-13	1.10E-12	4.22E-14	1.48E-13	20.21
1213	S1030 B	16	7.56	2.06E-13	6.29E-14	2.42E-15	8.47E-15	
1227	CHEM LAB EX #2	16	0.58	6.44E-13	3.19E-13	1.23E-14	4.29E-14	5.88
1229	SOLVENT EXT NEX	16	3.33	8.13E-14	1.97E-13	7.57E-15	2.65E-14	3.63
1234	SOLVENT EXT S EX	16	3.33	2.10E-13	8.46E-14	3.25E-15	1.14E-14	1.56
1220	CHEM LAB FILT EX	17	5.56	8.55E-14	4.03E-13	1.55E-14	5.43E-14	7.44
1242	AC-5	17	3.78	8.06E-14	2.59E-13	9.97E-15	3.49E-14	4.78
1244	AMMON FUME SCR 1008A	17	1.89	8.82E-14	1.41E-13	5.44E-15	1.91E-14	2.61
1245	AMMON FUME SCR 1008B	17	1.89	1.76E-13	0.00E+00	0.00E+00	0.00E+00	0.00
1238	IFBA EXHAUST	18	4.72	8.31E-14	3.33E-13	1.28E-14	4.48E-14	6.14
1248	ERBIA FURNACE EX	18	8.17	9.80E-14	6.79E-13	2.61E-14	9.14E-14	12.52
1249	ERBIA SCRUBBER EX	18	4.33	8.09E-14	2.97E-13	1.14E-14	4.00E-14	5.48
1250	ERBIA CHANGE ROOM	18	1.9	9.39E-14	1.51E-13	5.82E-15	2.04E-14	2.79
<b>Total</b>				<b>9.91E-12</b>	<b>3.81E-13</b>	<b>9.91E-12</b>	<b>1.33E-12</b>	<b>182.83</b>

\*Concentration LLD is 8E-14 uCi/ml

## Lung/Bone Organ Dose due to Gaseous Effluents

**2020**

**Attachment 3 - 1st HALF 2020 LIQUID EFFLUENT RADIOACTIVITY DISCHARGES**

Liquid Effluent Discharges			Isotopic Uranium Measured Concentrations			Tc-99 Measured Concentrations			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 pCi/L	Total U & Tc-99 pCi/L	U234 pCi/L	U-235 pCi/L	U-238 pCi/L	Tc-99 pCi/L	U235 pCi/L	U238 pCi/L	Tc-99 pCi/L	U-235 (uCi)	U-238 (uCi)	Tc-99 (uCi)		
January	3667.702	3,667.702	20.2	1.15	3.34	24.7	0.00	24.7	280.421	15.965	46.367	0.000	1.70	0.469	0.697	25.4	23.600	6.511	9.676	352.609
February	3511.279	3,511.279	24.2	0.888	4.61	29.7	6.89	36.6	321.623	11.802	61.268	91.59	1.89	0.416	0.830	20.6	25.118	5.529	11.031	273.778
March	3273.403	3,273.403	21.3	0.935	4.01	26.2	23.5	49.7	263.903	11.584	49.683	291.161	1.78	0.426	0.777	22.6	22.054	5.278	9.627	280.010
April	2800.576	2,800.576	23.9	0.953	4.10	29.0	71.3	100.3	253.344	10.102	43.461	755.793	1.15	0.257	0.476	3.76	12.190	2.724	5.046	39.857
May	2999.495	2,999.495	22.5	1.05	3.59	27.1	63.2	90.3	255.444	11.921	40.758	717.515	1.61	0.399	0.649	4.96	18.278	4.530	7.368	56.311
June	3050.455	3,050.455	26.7	1.31	4.82	32.8	93.5	126.3	308.277	15.125	55.652	1079.548	1.76	0.441	0.754	4.18	20.321	5.092	8.706	48.262
Total (Jan-Jun)	19302.910	19,302.910							1683.014	76.499	297.188	2935.587					122	30	51	1051
Liters (L)			7.31E+07						2056.7											
Milliliters (ml)			7.31E+10																	

FIRST HALF LIQUID DISCHARGES	
Radionuclide	LLD (uCi/ml)
U234	6.00E-10
U235	6.00E-10
U238	6.00E-10
Total U	2056.7
Tc-99	6.00E-10
Total (Jan-Jun)	4992.3

FIRST HALF LIQUID DISCHARGES		Quantity Released (uCi)		Error		Average Concentration Released (uCi/ml)	
Radionuclide	LLD (uCi/ml)	Quantity Released (uCi)	Error	Quantity Released (uCi)	Error	Average Concentration Released (uCi/ml)	Error
U234	6.00E-10	1683.0	+/-	122		2.30E-08	
U235	6.00E-10	76.5	+/-	30		1.05E-09	
U238	6.00E-10	297.2	+/-	51		4.07E-09	
Total U		2056.7				2.82E-08	
Tc-99	6.00E-10	2935.6	+/-	1051		4.02E-08	
Total (Jan-Jun)		4992.3				9.65E-08	

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

Whole Body-Ingestion									
365 liters									Usage by adult 6 m <u>U</u>
10CFR20									$7.3 \times 10^5 \text{ (ml)}$ which is the annual water intake of "Reference Man."
31293 mixing - dilution									Dilution at diffuser M
0.3 cubic ft/sec									Average discharge F
2.83E-04 U-234									Congaree Flow
2.66E-04 U-235									Effluent Flow
2.55E-04 U-238									9388 cubic feet/sec
1.46E-06 Tc-99									3.00E-01 cubic feet/sec
12 hrs									transit time t <sub>p</sub>
3.23557E-10 U-234									reg guide 1.09 table E-15
1.12404E-13 U-235									λ
1.771058E-14 U-238									T(1/2) yr. T(1/2) hr
3.714077E-10 Tc-99									λ
0.999999961 U-234									Nuclide
1.000000000 U-235									URANIUM234
1.000000000 U-238									URANIUM235
0.999999956 Tc-99									URANIUM238
Activity Released									exp(-λt <sub>p</sub> )
1.663E-03 U-234 release fraction									exp(-λt <sub>p</sub> )
7.650E-05 U-235 release fraction									exp(-λt <sub>p</sub> )
2.972E-04 U-238 release fraction									exp(-λt <sub>p</sub> )
2.936E-03 Tc-99 release fraction									exp(-λt <sub>p</sub> )
check U sum									0.00206
4.77E-07 U-234									release fraction dose factor exp(-λt <sub>p</sub> )
2.04E-08 U-235									release fraction dose factor exp(-λt <sub>p</sub> )
7.57E-08 U-238									release fraction dose factor exp(-λt <sub>p</sub> )
4.29E-09 Tc-99									release fraction dose factor exp(-λt <sub>p</sub> )
5.77E-07 all nuclides									sum of nuclides
42.76736 usage									11000 "usage" dilution flow
<b>2.47E-05 m<u>Ram</u></b>									see regulatory guide 1.09 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**

<b>Bone Surface-Ingestion</b>									
365 liters	Usage by adult/6 mU	100CFR20	$7.3 \times 10^5$ (ml)	which is the annual water intake of "Reference Man."					
31293 mixing - dilution	Dilution at diffuser M	Congaree Flow	938E-01 cubic feet/sec						
0.3 cubic ft/sec	Average discharge F	Effluent Flow	3.00E-01 cubic feet/sec						
4.18E-03 U-234	mRem/vCi	D-bone	EPA Limiting Values of Radioanuclide Intake.....						
3.88E-03 U-235	mRem/vCi	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/vCi	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	6.38E-08 1.01E-06	2.55E-04 3.74E-03			
12 hrs	transit time t-p			Tc-99	3.95E-10 6.04E-11	1.46E-06 2.23E-07			
		reg guide 1table E-15							
3.23557E-10 U-234	decay const	A							
1.12404E-13 U-235	decay const	A	Nuclide	T(1/2) yr	$\lambda$				
1.77058E-14 U-238	decay const	A	URANIUM234	2.45E+05	3.24E-10				
3.71407E-10 Tc-99	decay const	A	URANIUM235	7.04E+08	6.17E+12				
			URANIUM238	4.47E+09	3.91E+13				
0.9999999961 U-234	exp(-At-p)		TC-99	2.13E+05	1.87E+09	3.71E-10			
1.0000000000 U-235	exp(-At-p)						U-234	3.00E-07 7.30E+05	2.19E+01 50
1.0000000000 U-238	exp(-At-p)						U-235	3.00E-07 7.30E+05	2.19E+01 50
0.9999999955 Tc-99	exp(-At-p)						U-238	3.00E-07 7.30E+05	2.19E+01 50
							Tc-99	6.00E-05 7.30E+05	4.38E+01 50
Activity Released								ICRP 69 Comparison	
								Sv/Bq	
1.683E-03 U-234 release fraction	Ci							Rem/Bq	
7.650E-05 U-235 release fraction	Ci							mRem/pCi	
2.972E-04 U-238 release fraction	Ci								
2.936E-03 Tc-99 release fraction	Ci								
check U sum	0.00206								
7.04E-06 U-234	release fraction "dose factor"exp(- $\lambda$ *tD)								
2.97E-07 U-235	release fraction "dose factor"exp(- $\lambda$ *tD)								
1.11E-06 U-238	release fraction "dose factor"exp(- $\lambda$ *tD)								
6.56E-10 Tc-99	release fraction "dose factor"exp(- $\lambda$ *tD)								
8.45E-06 all nuclides	sum of nuclides								
42.6736 usage	1100*(usage dilution)/flow								
<b>3.61E-04 nRem</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**

Whole Body							
see regulatory guide 1.109 page 1.109-40 table E-5. Recommended values for U <sub>ap</sub> )							
10.5 Kg	Usage by adult 6 mU	Congaree Flow	9398 cubic feet/sec	see NUREG-1118 Environmental Assessment for renovation ...SNM-1107 May 1995			
31293 mixing - dilution	Dilution at diffuser M						
0.3 cubic f/sec	Average discharge F		3.00E-01 cubic feet/sec				
2.83E-04 U-234	mRem/pCi D	EPA Limiting Values of Radioisotope Inhalation.....					
2.66E-04 U-235	mRem/pCi D	FRG no 11 [1988]	U-234 7.66E-08	1.13E-08	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	
24 hrs	Transit time t-p		Tc-99 3.95E-10	6.04E-11	1.46E-06	2.23E-07	
reg guide 1 table E-15							
3.23557E-10 U-234	decay const λ	Nuclide	T(112) yr	T(112) hr	λ		
1.12404E-13 U-235	decay const λ	URANIUM234	2.48E+05	2.14E+09	3.24E-10		
1.77058E-14 U-238	decay const λ	URANIUM235	7.04E+05	6.17E+12	1.15E-13		
3.71407E-10 Tc-99	decay const λ	URANIUM238	4.41E+09	3.31E+13	1.77E-14		
		TC-99	2.13E+05	1.87E+09	3.77E-10		
0.9999999223 U-234	exp(-λt-p)						
1.0000000000 U-235	exp(-λt-p)						
1.0000000000 U-238	exp(-λt-p)						
0.99999998109 Tc-99	exp(-λt-p)						
Activity Released							
1.683E-03 U-234 release fraction Ci							
7.650E-05 U-235 release fraction Ci							
2.972E-04 U-238 release fraction Ci							
2.936E-03 Tc-99 release fraction Ci							
check U sum							
0.00206							
bioaccumulation factor BNWL-2075							
9.54E-07 U-234	release fraction *biaccumulation factor*dose factor*exp(-λt-p)		2	UC-11			
4.07E-08 U-235	release fraction *biaccumulation factor*dose factor*exp(-λt-p)		2	Methodology for Calculation of Radiation Doses			
1.51E-07 U-238	release fraction *biaccumulation factor*dose factor*exp(-λt-p)		2	in the Environments from Nuclear Fuel Cycle Facilities			
6.44E-08 Tc-99	sum of nuclides 11000 usage		15				
1.21E-06 all nuclides	usage						
1.23029	see concentration nuclide 1.1000 usage 1.1000 2 and 1.1000 3 for formula and definition of terms						
1.10E-05 nDm							

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

Bone Surface							
10.5 kg	Usage by adult/6 mU	Dilution at diffuser M	Congaree Flow	9388 cubic feet/sec	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985		
3/1293 mixing - dilution	Average discharge F	Effluent Flow	3.00E-01 cubic feet/sec	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
0.3 cubic ft/sec	mRem/pcI	FRG no 11	1988	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
4.18E-03 U-234	mRem/pcI	Exposure-to-dose conversion factors for ingestion	.....	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
3.88E-03 U-235	mRem/pcI	U-234	1.05E-06	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
2.23E-01 U-238	mRem/pcI	U-235	2.66E-04	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
2.23E-01 Tc-99	mRem/pcI	U-238	3.88E-03	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
24 hrs	transit time	T-p	6.88E-08	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
3.2357E-10 U-234	decay const	reg Guide 1.109	3.74E-03	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.1294E-13 U-235	decay const	lambda	2.14E+09	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.7705E-14 U-238	decay const	URANIUM234	3.24E+10	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
3.7140E-10 Tc-99	decay const	URANIUM235	7.04E+08	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
0.999999999232 U-234	exp(kt/p)	URANIUM238	1.12E+12	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.000000000000 U-235	exp(kt/p)	Tc-99	4.47E+09	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.000000000000 U-238	exp(kt/p)		3.91E+13	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
0.999999999232 Tc-99	exp(kt/p)		1.77E-14	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.000000000000 Tc-99	exp(kt/p)		3.71E-10	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
Activity Released				see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.683E-03 U-234 release frICi	1.683E-03 U-234 release frICi	lambda	2.45E+05	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
7.650E-05 U-235 release frICi	7.650E-05 U-235 release frICi		7.04E+08	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
2.937E-04 U-238 release frICi	2.937E-04 U-238 release frICi		1.12E+12	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
2.936E-03 Tc-99 release frICi	2.936E-03 Tc-99 release frICi		4.47E+09	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
check U sum	0.0206			see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.41E-05 U-234	release fraction * bioaccumulation factor*dose factor*exp(-kt/p)		2	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
5.94E-07 U-235	release fraction * bioaccumulation factor*dose factor*exp(-kt/p)		2	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
2.937E-04 U-238	release fraction * bioaccumulation factor*dose factor*exp(-kt/p)		15	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
9.84E-09 Tc-99	release fraction * bioaccumulation factor*dose factor*exp(-kt/p)		15	see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.60E-05 all nuclides	sum of nuclides			see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
1.23028 usage	1/100*(usage/dilution)/flow			see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			
2.08E-05 mRem	see regulatory guide 1.109 page 1.109-2 and 1.109-3 for formula and definition of terms.			see Nursrq-1118 Environmental Assessment for renewram ....SNM-1107 May 1985			

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

## **Attachment 9**

### **2020 Isotopic Fractions**

Based on the plant nominal enrichment for 2020

<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	85.25
<b>U-235</b>	4.25	2.160E-06	9.180E-08	3.28
<b>U-238</b>	95.70	3.360E-07	3.216E-07	11.48
<b>Total</b>	100.0		2.802E-06	100.00

## Attachment 10 - Comply Results

COMPLY: V1.6.

8/13/2020 4:43

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 CO.  
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

2020 SEMI-ANNUAL DOSE TO THE PUBLIC DUE TO GASEOUS EFFLUENT

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SCREENING LEVEL 2  
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DATA ENTERED:  
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RELEASE RATES FOR STACK 1.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	9.050E-14
U-235	Y	3.480E-15
U-238	Y	1.220E-14

RELEASE RATES FOR STACK 2.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	3.900E-13
U-235	Y	1.500E-14
U-238	Y	5.260E-14

RELEASE RATES FOR STACK 3.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	9.210E-13
U-235	Y	3.540E-14
U-238	Y	1.240E-13

RELEASE RATES FOR STACK 4.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	3.240E-12
U-235	Y	1.250E-13
U-238	Y	4.360E-13

RELEASE RATES FOR STACK 5.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	8.840E-13
U-235	Y	3.400E-14
U-238	Y	1.190E-13

RELEASE RATES FOR STACK 6.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	2.120E-12
U-235	Y	8.170E-14
U-238	Y	2.860E-13

RELEASE RATES FOR STACK 7.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	8.040E-13
U-235	Y	3.090E-14
U-238	Y	1.080E-13

RELEASE RATES FOR STACK 8.

Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.460E-12
U-235	Y	5.620E-14
U-238	Y	1.970E-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:

-----

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.

8/13/2020 4:33

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 CO.  
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

S1030A

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

DATA ENTERED:  
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Nuclide		Release Rate (curies/SECOND)
U-234	Y	1.100E-12
U-235	Y	4.220E-14
U-238	Y	1.480E-13

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: 2.2E-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 \*\*\*\*\*