ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
SEMIANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
BROWNS FERRY NUCLEAR PLANT

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

JANUARY THROUGH JUNE 1988

ENCLOSURE

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SUMMARY

JANUARY THROUGH JUNE 1988

The radioactive effluents for the first half of 1988 were normal for a three unit boiling water reactor plant in its third year of an extended outage. Because of the extended outage, only radionuclides with a long half-life (longer than a few months) have not decayed away and are being released to the environment. The radioactive decay is particularly significant for gaseous effluents because no fission gases or radioactive iodines are being released. The only radioactive gaseous releases are very small quantities of particulate matter.

The quantity of radionuclides released in liquid effluents during this extended outage is a significant fraction of the quantities released during normal power operation. The radioactivity being released now in liquid effluents is primarily long half-life radionuclides that have been deposited on the surfaces of piping and components. During normal outage work this radioactivity is removed by process water that is purified and released to the river. The water purification process is unable to remove all the radioactivity before it is released to the river.

The release of radioactive material to the environment from Browns Ferry Nuclear Plant has been a small fraction of the 10CFR20 Appendix B and 10CFR50 Appendix I limits during the first half of 1988.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SUPPLEMENTAL INFORMATION

JANUARY THROUGH JUNE 1988

I. Regulatory Limits

A. Fission and Activation Gases in Gaseous Effluent:

1. The average release rate of fission and activation gases is regulated by the dose limits of 10CFR50 Appendix I. The air dose to areas at and beyond the site boundary due to noble gases released in gaseous effluents per unit shall be limited during any calendar quarter to $\leq$ 5 mrad for gamma radiation and $\leq$ 10 mrad for beta radiation; and during any calendar year to $\leq$ 10 mrad for gamma radiation and $\leq$ 20 mrad for beta radiation.

B and C. Iodines and Particulates with Half-Lives Greater Than 8 Days in Gaseous Effluents.

1. The average release rate of iodines and particulates in gaseous effluent is regulated by the dose limits of 10CFR50 Appendix I. The dose to a member of the public from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days in gaseous effluent released per unit to area at and beyond the site boundary shall be limited to any organ during any calendar quarter to $\leq$ 7.5 mrem, and during any calendar year to $\leq$ 15 mrem.

D. Liquid Effluents

1. The average release rate of radioactive liquid effluents is regulated by the dose limits of 10CFR50 Appendix I. The dose to a member of the public from radioactive materials in liquid effluents released from each unit to unrestricted areas shall be limited during any calendar quarter to $\leq$ 1.5 mrem to the total body and $<$ 5 mrem to any organ and, during any calendar year to $<$ 3 mrem to the total body and $<$ 10 mrem to any organ.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SUPPLEMENTAL INFORMATION

JANUARY THROUGH JUNE 1988

II. Maximum Permissible Concentrations

A. Fission and Activation Gases in Gaseous Effluent

1. The instantaneous release rate of fission and activation gases is regulated by the dose rate limit of 10CFR20 Appendix B. The dose rate at any time to areas at and beyond the site boundary due to noble gases released in gaseous effluents from the site shall be limited to < 500 mrem/year to the total body and < 3000 mrem/year to the skin.

2. The BFN Offsite Dose Calculation Manual (ODCM) determines the maximum noble gas release rate based upon the dose rate limits in Section II.A.1. The instantaneous noble gas release rates are limited by the following equation:

$$\frac{Q1}{0.15} + \frac{Q2}{14.4} < 1$$

Q1 = The release rate from the building exhaust vents in Ci/sec.

Q2 = The release rate from the main stack in Ci/sec.

B and C. Iodines and Particulates with Half-Lives Greater than 8 Days in Gaseous Effluents

1. The instantaneous release rate of particulates and iodines is regulated by the dose rate limit of 10CFR20 Appendix B. The dose rate at any time to areas at and beyond the site boundary due to I-131, I-133, H-3 and particulates with greater than eight days half-lives released in gaseous effluents from the site shall be limited to <1500 mrem/yr to any organ.

2. The BFN ODCM determines the maximum particulate and iodine release rate based upon the dose rate limit of Sections II. B and C.1. The instantaneous iodine and particulate release rates are limited by the following equation:

$$\frac{Q3}{2.19} + \frac{Q4}{35.7} < 1$$

Q3 = The release rate from the building exhaust vents in mCi/sec
Q4 = The release rate from the main stack in mCi/sec.

D. Liquid Effluents

1. The concentration of radionuclides in liquid effluents released at any time from the site to unrestricted areas shall be limited to the concentrations specified in 10CFR 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases.

2. For dissolved or entrained noble gases, the concentration shall be limited to 2E-4 mCi/ml total activity.

III. Average Energy - Not applicable

IV. Measurements and Approximations of Total Radioactivity

A. Fission and Activation Gases:

1. Noble gases in the building vent and stack, gaseous effluent are continuously monitored. The flow rate of the stack is continuously monitored and the building vent effluent flow rates are calculated once a shift based on the configuration of operating exhaust fans. The flow rate data is consolidated weekly to determine the volume of airborne effluent released from the plant. The noble gas monitor data is consolidated monthly to determine the total curies of noble gases released during the month.

2. Gas grab samples are taken and analyzed monthly to determine the relative noble gas activity concentrations. This information is used to apportion the total curies of noble gases released between different noble gas radionuclides.

3. The tritium concentration is determined by the analysis of a monthly grab sample for each release point.

B and C. Iodines and Particulates

1. Iodines and particulates are continuously sampled on impregnated charcoal filters and particulate filters, respectively. The charcoal and particulate samples are replaced at least weekly and analyzed to determine specific activity concentrations. The specific activity concentrations and vent flow rate data are used weekly to verify that release rate limits were not exceeded. The specific activity concentrations and total volume of gaseous effluent are used on a monthly basis to determine the total curies of each particulate and iodine released during the month.

IV. Measurements and Approximations of Total Radioactivity (Continued)

2. The gross alpha concentration is determined by analysis of a monthly particulate filter composite sample and Strontium -89 and -90 are determined by analysis of a quarterly particulate filter composite sample for each release point.

D. Liquid Effluents

1. The gamma ray emitting radionuclide concentrations are determined for each batch by gamma ray spectroscopy analysis of a grab sample. The allowable release rate is calculated for each batch based upon the known dilution flow. The flow rate of the liquid effluent is continuously monitored and the total volume released in each batch is determined. The total gamma activity released in each batch is determined by multiplying the radionuclide concentrations by the total volume discharged. The total gamma activity released during the month is then determined by summing the gamma activity content of each batch discharged during the month.

2. The gross alpha and tritium concentrations are measured on a monthly composite sample. The Strontium -89 and -90 and iron -55 are measured on a quarterly composite sample.

V. Batch	Value FIRST Quarter	Value SECOND Quarter	Units
A. Liquid			
1. Number of batches released	98	109	Each
2. Total time period for batch releases	26259	28930	Minutes
3. Maximum time period for a batch release	385	455	Minutes
4. Average time period for batch releases	267	266	Minutes
5. Minimum time period for a batch release	140	5	Minutes
6. Average stream flow during period of release of effluent into a flowing stream	32020	10850	cu.ft./s
B. Gaseous			
None			

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

JANUARY THROUGH JUNE 1988

LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

		Unit	First Quarter	Second Quarter	% Error
A.	Fission and Activation Products				
	1. Total Releases	Curies	3.62E-02	8.25E-02	9
	2. Average Diluted Concentration During Period	mCi/ml	8.92E-10	1.88E-09	
	3. Percent of Applicable Limit (1.00E-7 mCi/ml)	%	8.92E-01	1.88E+00	
B.	Tritium				
	1. Total Releases	Curies	2.94E-01	4.40E-01	6
	2. Average Diluted Concentration During Period	mCi/ml	7.24E-09	1.00E-08	
	3. Percent of Applicable Limit (3E-03 mCi/ml)	%	2.41E-04	3.35E-04	
C.	Dissolved and Entrained Noble Gases[1]				
	1. Total Releases	Curies	1.60E-03	<2.45E-03	8
	2. Average Diluted Concentration During Period	mCi/ml	3.94E-11	<5.59E-11	
	3. Percent of Applicable Limit (2E-04 mCi/ml)	%	1.97E-05	0	
D.	Gross Alpha Radioactivity				
	1. Total Releases	Curies	9.28E-04	2.69E-04	48
	2. Average Diluted Concentration During Period	mCi/ml	2.29E-11	6.14E-12	
E.	Volume of Waste Release (Before dilution)	Liters	1.03E+07	1.15E+07	3
F.	Volume of Dilution Water for Period	Liters	4.06E+10	4.38E+10	10
G.	Total CCW flow for Six Months	117.2 gigagallons			

[1] Includes Xe-133, Xe-135, and others.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

LIQUID RELEASES FOR JANUARY THROUGH JUNE 1988 - BATCH MODE

	Isotope (Required by Reg Guide 1.21)	First Quarter Unit Curies	Second Quarter Unit Curies
1.	Cr-51	<4.62E-03	2.56E-05
2.	Mn-54	2.55E-05	1.40E-04
3.	Co-58	<5.11E-04	<8.64E-04
4.	Fe-59	<9.44E-04	<1.86E-03
5.	Co-60	4.71E-03	1.66E-02
6.	Zn-65	1.80E-03	2.62E-03
7.	Nb-95	<4.61E-04	<7.67E-04
8.	Zr-95	<8.25E-04	<1.37E-03
9.	Mo-Tc-99m	<4.19E-04	<6.39E-04
10.	I-131	<6.03E-04	<9.66E-04
11.	Xe-133	<1.16E-03	<1.93E-03
12.	Cs-134	6.45E-03	1.28E-02
13.	Xe-135	<3.32E-04	<5.21E-04
14.	Cs-137	2.32E-02	5.02E-02
15.	Ba-140	<2.22E-03	<3.67E-03
16.	La-140	<3.04E-04	<3.54E-04
17.	Ce-141	<7.11E-04	<1.14E-03
18.	Sr-89	<3.93E-04	<3.05E-04
19.	Sr-90	<2.10E-04	<1.81E-04

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

LIQUID RELEASES FOR JANUARY THROUGH JUNE 1988 - BATCH MODE

Isotope Others (Not Required by Reg Guide 1.21)		First Quarter Unit Curies	Second Quarter Unit Curies
1.	Sb-125	1.52E-05	1.81E-04
2.	Kr-85	1.60E-03	
3.	Fe-55		<3.16E-03

This section was prepared principally by K. K. Richards

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

JANUARY THROUGH JUNE 1988[1]

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

Summation of All Releases		Unit	First Quarter	Second Quarter	% Error
A.	Fission and Activation Gases				
1.	Total Releases	Ci	<2.55E+02	<2.83E+02	45
2.	Average Release Rate for Period	mCi/sec	<3.24E+01	<3.60E+01	
3.	Percent of T.S. Limit (.15 Ci/sec)	%	0	0	
B.	Iodines				
1.	Total Iodine-131	Ci	<2.54E-04	<1.40E-04	36
2.	Average Release Rate for Period	mCi/sec	<3.23E-05	<1.78E-05	
3.	Percent of T.S. Limit (2.19 mCi/sec)	%	0	0	
C.	Particulates				
1.	Particulates with Half-Lives >8 days	Ci	2.62E-05	1.24E-03	35
2.	Avg. Release Rate for Period	mCi/sec	3.33E-06	1.58E-04	
3.	Percent of T.S. Limit (2.19 mCi/Sec)	%	1.52E-04	7.20E-03	
4.	Gross Alpha Radioactivity	Ci	1.22E-06	1.18E-06	
D.	Tritium				
1.	Total Releases	Ci	9.23E-02	1.58E-01	21
2.	Average Release Rate for Period	mCi/sec	1.17E-02	2.01E-02	
3.	Percent of T.S. Limit (2.19 mCi/sec)	%	5.36E-01	9.18E-01	
4.	Ground Level Release	Ci	9.14E-02	1.58E-01	
5.	Elevated Release	Ci	8.84E-04	1.95E-04	

[1] Reporting period - 182 days.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

JANUARY THROUGH JUNE 1988

GASEOUS EFFLUENTS - ELEVATED RELEASE

		Unit	First Quarter	Second Quarter
1.	Fission Gases			
	Krypton-85m	Ci	<2.80E-01	<2.42E-01
	Krypton-85	Ci	<1.11E+02	<9.33E+01
	Krypton-87	Ci	<5.70E-01	<6.67E-01
	Krypton-88	Ci	<6.73E-01	<9.90E-01
	Xenon-133	Ci	<4.50E-01	<6.58E-01
	Xenon-135m	Ci	<5.06E-01	<3.38E-01
	Xenon-135	Ci	<2.21E-01	<3.03E-01
	Xenon-138	Ci	<1.50E+00	<2.25E+00
	Total for Period	Ci	<1.15E+02	<9.88E+01
2.	Iodines			
	Iodine-131	Ci	<1.01E-05	<5.46E-06
	Iodine-133	Ci	<1.49E-04	<5.47E-05
	Iodine-135	Ci	<1.43E-01	<2.14E-01
	Total for Period	Ci	<1.43E-01	<2.14E-01

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

JANUARY THROUGH JUNE 1988

GASEOUS EFFLUENTS - ELEVATED RELEASE (Continued)

		Unit	First Quarter	Second Quarter
3.	Particulates			
	Sr-89[1]	Ci	<1.06E-06	<8.74E-07
	Sr-90[1]	Ci	<4.21E-07	<3.71E-07
	Cs-134	Ci	<8.10E-06	<5.39E-06
	Cs-137	Ci	<5.76E-06	<1.06E-05
	Ba-140	Ci	<3.10E-05	<2.02E-05
	La-140	Ci	<9.46E-06	<1.47E-06
	Co-60	Ci	2.62E-05	3.13E-05
	Total for Period	Ci	2.62E-05	3.13E-05
4.	Tritium	Ci	8.84E-04	1.95E-04

[1] Predicted estimation of releases.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

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GASEOUS EFFLUENTS - GROUND LEVEL RELEASE

		Unit	First Quarter	Second Quarter
1.	Fission Gases			
	Krypton-85m	Ci	<3.71E-01	<4.14E-01
	Krypton-85	Ci	<1.31E+02	<1.74E+02
	Krypton-87	Ci	<9.36E-01	<1.19E+00
	Krypton-88	Ci	<1.64E+00	<1.36E+00
	Xenon-133	Ci	<1.32E+00	<9.99E-01
	Xenon-135m	Ci	<1.05E+00	<2.01E+00
	Xenon-135	Ci	<4.51E-01	<3.04E-01
	Xenon-138	Ci	<2.98E+00	<4.21E+00
	Total for Period	Ci	<1.40E+02	<1.85E+02
2.	Iodines			
	Iodine-131	Ci	<2.44E-04	<1.34E-04
	Iodine-133	Ci	<8.13E-04	<1.45E-03
	Iodine-135	Ci	<7.60E-01	<1.39E+00
	Total for Period	Ci	<7.61E-01	<1.39E+00

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

JANUARY THROUGH JUNE 1988

GASEOUS EFFLUENTS - GROUND LEVEL RELEASE (Continued)

		Unit	First Quarter	Second Quarter
3.	Particulates			
	Sr-89[1]	Ci	<6.69E-06	<4.81E-05
	Sr-90[1]	Ci	<3.61E-06	<1.15E-05
	Cs-134	Ci	<1.64E-04	2.20E-05
	Cs-137	Ci	<2.67E-04	8.40E-05
	Ba-140	Ci	<7.61E-04	<1.24E-03
	La-140	Ci	<9.04E-05	<1.33E-04
	Co-60	Ci		1.10E-03
	Total for Period	Ci	<1.29E-03	1.21E-03
4.	Tritium	Ci	9.15E-02	1.58E-01

[1] Predicted estimation of releases.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

JANUARY THROUGH JUNE 1988

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A. Solid Waste Shipped Off-Site for Burial or Disposal (Not Irradiated Fuel)

1. Type of Waste	Units	Amount	Error %
a. Spent resins, filter sludges, evaporator bottoms, etc.	m3	1.21E+02	
	Ci	1.68E+02	1.50E+01
b. Dry compressible waste, contaminated equip., etc.	m3	2.58E+02	
	Ci	1.53E+01	1.50E+01
c. Irradiated components, control rods, etc.	m3	0.00E+00	
	Ci	0.00E+00	N/A
d. Other	m3	0.00E+00	
	Ci	0.00E+00	N/A

2. Estimate of major nuclide compositions (by type of waste)

a. Spent resins, filter sludges, evaporator bottoms, etc.

Nuclide	Unit		Unit	
1. Zinc-65 (1)	%	1.09E+01	Ci	1.83E+01
2. Cesium-137 (1)	%	3.82E+01	Ci	6.41E+01
3. Cesium-134 (1)	%	1.08E+01	Ci	1.81E+01
4. Cobalt-60 (1)	%	2.67E+01	Ci	4.48E+01
9. Manganese-54 (1)	%	8.40E-02	Ci	1.41E-01
11. Iron-55 (2)	%	9.11E+00	Ci	1.53E+01
12. Other Nuclides (2)	%	4.15E+00	Ci	6.96E+00

(1) Measured
(2) Estimated through the use of scaling factors

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS (Continued)

2. Estimate of major nuclide compositions (by type of waste) (Continued)

a. Dry compressible waste, contaminated equipment, etc.

	Nuclide	Unit		Unit	
1.	Zinc-65 (2)	%	1.80E+01	Ci	2.75E+00
2.	Cesium-137 (2)	%	8.65E+00	Ci	1.32E+00
3.	Cesium-134 (2)	%	7.11E+00	Ci	1.09E+00
4.	Chromium-51 (2)	%	1.12E+01	Ci	1.70E+00
5.	Cobalt-60 (2)	%	2.06E+01	Ci	3.14E+00
6.	Iron-55 (2)	%	2.48E+01	Ci	3.79E+00
7.	Iron-59 (2)	%	1.79E+00	Ci	2.74E-01
8.	Manganese-54 (2)	%	4.08E+00	Ci	6.24E-01
10.	Silver-110m (2)	%	1.22E+00	Ci	1.87E-01
11.	Niobium-95 (2)	%	2.13E+00	Ci	3.26E-01
12.	Other Nuclides (2)	%	4.92E-01	Ci	7.51E-02

(1) Measured

(2) Estimated through the use of scaling factors

c. Irradiated Components, Control Rods, etc.

NONE

d. Other

NONE

3. Solid waste disposition

Number of Shipments	Mode of Transportation	Destination
36	Sole Use Truck	Barnwell, SC

B. Irradiated Fuel Disposition

Number of Shipments	Mode of Transportation	Destination
NONE	N/A	N/A

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT
JANUARY THROUGH JUNE 1988
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS (Continued)

C. Waste Sources, Burial Class and Type quantity, Container Type, Total Volume in Cubic Feet and Number of Containers Used.

Type of Waste	Type Quantity	Burial Class	Container Type	Number of Containers	Disposal Volume
DEWATERED					
(Resin)					
RX CLEANUP	A-LSA	A-Stable	HIC	1	120.3
	B-LSA	B-Stable	HIC	1	120.3
COND/WASTE	A-LSA	A-Stable	HIC	20	3287.9
	B-LSA	B-Stable	HIC	4	776.4
(Filters)	N/A	N/A	N/A	NONE	NONE
DRY ACTIVE WASTE					
(Compacted)					
DRUM	A-LSA	A-Unstable	STC	241	1807.5
BOX	A-LSA	A-Unstable	STC	45	4185.0
(Uncompacted)					
DRUM	A-LSA	A-Unstable	STC	6	45.0
BOX	A-LSA	A-Unstable	STC	31	3111.8
SOLIDIFIED	N/A	N/A	N/A	NONE	NONE
ABSORBED	N/A	N/A	N/A	NONE	NONE

Solidification agent used: NONE

Absorbents used: NONE