ENCLOSURE 2

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

EFFLUENT AND WASTE DISPOSAL REPORT

JULY THROUGH DECEMBER 1990

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EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SUMMARY

SECOND HALF 1990

The radioactive effluents for the second half of 1990 were normal for a three unit boiling water reactor plant in its 5th 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 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 10 CFR 20 Appendix B and 10 CFR 50 Appendix I limits during the second half of 1990.

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SUPPLEMENTAL INFORMATION

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I. Regulatory Limits

A. Fission and Activation Gases in Gaseous Effluent:

1. The release of fission and activation gases is regulated by the dose limits of 10 CFR 50 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 eight days in gaseous effluents.

1. The release of iodines and particulates in gaseous effluent is regulated by the dose limits of 10 CFR 50 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 release of radioactive liquid effluents is regulated by the dose limits of 10 CFR 50 Appendix I. The doses or dose commitment 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.

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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 10 CFR 20 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 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 10 CFR 20 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 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 µCi/sec
Q4 = The release rate from the main stack in µCi/sec.

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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 10 CFR 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 µCi/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.

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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 THIRD Quarter	Value FOURTH Quarter	Units
A. Liquid			
1. Number of batches released	33	30	Each
2. Total time period for batch releases	9,054	8,302	Minutes
3. Maximum time period for a batch release	318	300	Minutes
4. Average time period for batch releases	274	277	Minutes
5. Minimum time period for a batch release	135	129	Minutes
6. Average stream flow during period of release of effluent into a flowing stream[1]			
B. Gaseous			
None			

[1] See Radiological Impact Assessment Report.

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LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

		Unit	Third Quarter	Fourth Quarter	% Error
A.	Fission and Activation Products				
	1. Total Releases	Curies	1.35E-01	7.30E-02	9
	2. Average Diluted Concentration During Period	µCi/ml	9.85E-09	5.79E-09	
	3. Percent of Applicable Limit (1.00E-7 µCi/ml)	%	9.85E+00	5.79E+00	
B.	Tritium				
	1. Total Releases	Curies	4.54E-02	4.91E-02	6
	2. Average Diluted Concentration During Period	µCi/ml	3.31E-09	3.90E-09	
	3. Percent of Applicable Limit (3E-03 µCi/ml)	%	1.10E-04	1.30E-04	
C.	Dissolved and Entrained Noble Gases[1]				
	1. Total Releases	Curies	ND	ND	8
	2. Average Diluted Concentration During Period	µCi/ml	ND	ND	
	3. Percent of Applicable Limit (2E-04 µCi/ml)	%	0	0	
D.	Gross Alpha Radioactivity				
	1. Total Releases	Curies	ND	ND	48
	2. Average Diluted Concentration During Period	µCi/ml	ND	ND	
E.	Volume of Waste Release (Before dilution)	Liters	3.47E+06	3.31E+06	3
F.	Volume of Dilution Water for Period	Liters	1.37E+10	1.26E+10	10
G.	Total CCW flow for Six Months - 116 gigagallons				

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

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LIQUID RELEASES FOR SECOND HALF 1990 - BATCH MODE

Isotope (Required by REG Guide 1.21)		Third Quarter Unit Curies	Fourth Quarter Unit Curies
1.	Cr-51	ND	ND
2.	Mn-54	ND	ND
3.	Co-58	ND	ND
4.	Fe-59	ND	ND
5.	Co-60	6.23E-03	6.55E-03
6.	Zn-65	ND	ND
7.	Nb-95	ND	ND
8.	Zr-95	ND	ND
9.	Mo-Tc-99m	ND	ND
10.	I-131	ND	ND
11.	Xe-133	ND	ND
12.	Cs-134	1.60E-02	7.45E-03
13.	Xe-135	ND	ND
14.	Cs-137	1.13E-01	5.88E-02
15.	Ba-140	ND	ND
16.	La-140	ND	ND
17.	Ce-141	ND	ND
18.	Sr-89	ND	ND
19.	Sr-90	2.81E-05	8.86E-05
Isotope Others (Not Required by REG Guide 1.21)			
1.	Fe-55	ND	ND

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GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

Summation of All Releases		Unit	Third Quarter	Fourth Quarter	% Error
A.	Fission and Activation Gases				
1.	Total Releases	Ci	ND	ND	45
2.	Average Release Rate for Period	µCi/sec	ND	ND	
3.	Percent of T.S. limit[2]	%	0	0	
B.	Iodines				
1.	Total Iodine-131	Ci	ND	ND	36
2.	Average Release Rate for Period	µCi/sec	ND	ND	
3.	Percent of T.S. Limit[2]	%	0	0	
C.	Particulates				
1.	Particulates with half-lives >8 days	Ci	1.16E-04	2.82E-05	35
2.	Avg. release rate for period	µCi/sec	1.48E-05	3.59E-06	
3.	Percent of T.S. limit[2]	%	1.87E+00	1.13E+00	
4.	Gross alpha radioactivity	Ci	3.18E-06	1.04E-06	
D.	Tritium				
1.	Total release	Ci	3.21E-01	1.95E-01	21
2.	Average release rate for period	µCi/sec	4.08E-02	2.48E-02	
3.	Percent of T.S. limit[2]	%	1.87E+00	1.13E+00	
4.	Ground level release	Ci	3.21E-01	1.95E-01	
5.	Elevated release	Ci	ND	ND	

[1] Reporting period - 189 days.

[2] The dose rate limit for noble gases shall be < 500 mrem/year to the total body and < 3000 mrem/year to the skin and the dose rate limit for I-131, I-133, H-3, and particulates with ≥ eight day half lives shall be < 1500 mrem/year to any organ.

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GASEOUS EFFLUENTS - ELEVATED RELEASE

		Unit	Third Quarter	Fourth Quarter
1.	Fission Gases			
	Krypton-85m	Ci	ND	ND
	Krypton-85	Ci	ND	ND
	Krypton-87	Ci	ND	ND
	Krypton-88	Ci	ND	ND
	Xenon-133	Ci	ND	ND
	Xenon-135m	Ci	ND	ND
	Xenon-135	Ci	ND	ND
	Xenon-138	Ci	ND	ND
	Total for Period	Ci	ND	ND
2.	Iodines			
	Iodine-131	Ci	ND	ND
	Iodine-133	Ci	ND	ND
	Iodine-135	Ci	ND	ND
	Total for Period	Ci	ND	ND

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GASEOUS EFFLUENTS - ELEVATED RELEASE (Continued)

		Unit	Third Quarter	Fourth Quarter
3.	Particulates			
	Sr-89[1]	Ci	ND	ND
	Sr-90[1]	Ci	ND	ND
	Cs-134	Ci	ND	ND
	Cs-137	Ci	ND	ND
	Ba-140	Ci	ND	ND
	La-140	Ci	ND	ND
	Total for Period	Ci	ND	ND
4.	Tritium	Ci	ND	ND

[1] Predicted estimation of releases.

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GASEOUS EFFLUENTS - GROUND LEVEL RELEASE

		Unit	Third Quarter	Fourth Quarter
1.	Fission Gases			
	Krypton-85m	Ci	ND	ND
	Krypton-85	Ci	ND	ND
	Krypton-87	Ci	ND	ND
	Krypton-88	Ci	ND	ND
	Xenon-133	Ci	ND	ND
	Xenon-135m	Ci	ND	ND
	Xenon-135	Ci	ND	ND
	Xenon-138	Ci	ND	ND
	Total for Period	Ci	ND	ND
2.	Iodines			
	Iodine-131	Ci	ND	ND
	Iodine-133	Ci	ND	ND
	Iodine-135	Ci	ND	ND
	Total for Period	Ci	ND	ND

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GASEOUS EFFLUENTS - GROUND LEVEL RELEASE

		Unit	Third Quarter	Fourth Quarter
3.	Particulates			
	Sr-89[1]	Ci	3.42E-06	8.63E-07
	Sr-90[1]	Ci	7.31E-07	1.84E-07
	Cs-134	Ci	ND	ND
	Cs-137	Ci	1.12E-04	2.72E-05
	Ba-140	Ci	ND	ND
	La-140	Ci	ND	ND
	Total for Period	Ci	1.16E-04	2.82E-05
4.	Tritium	Ci	3.21E-01	1.95E-01

[1] Predicted estimation of releases.

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SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A. Solid Waste Shipped Offsite for Burial or Disposal (Not Irradiated Fuel)

1. Type of waste	Units	Amount	Error %
a. Spent resins, filter sludges, evaporator bottoms, etc.	m3	2.91E+01	
	Ci	6.62E+01	1.50E+01
b. Dry compressible waste contaminated equip., etc.	m3	8.53E+01	
	Ci	9.44E+00	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 composition (by waste type)

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

Nuclide	Unit		Unit	
1. Manganese-54(1)	%	0.00E+00	Ci	0.00E+00
2. Iron-55(2)	%	3.31E+00	Ci	2.19E+00
3. Cobalt-60(1)	%	3.24E+01	Ci	2.14E+01
4. Zinc-65(1)	%	2.94E-01	Ci	1.95E-01
5. Cesium-134(1)	%	5.26E+00	Ci	3.48E+00
6. Cesium-137(1)	%	4.45E+01	Ci	2.94E+01
7. Other Nuclides(2)	%	1.43E+01	Ci	9.43E+00

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

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SOLID WASTE AND IRRADIATED FUEL SHIPMENTS (Continued)

2. Estimate of major nuclide composition (by waste type) (Cont'd)

b. Dry compressible waste, contaminated equipment, etc.

	Nuclide	Unit		Unit	
1.	Manganese-54(2)	%	8.02E-02	Ci	7.57E-03
2.	Iron-55(2)	%	4.33E+01	Ci	4.08E+00
3.	Iron-59(2)	%	5.00E-04	Ci	4.72E-05
4.	Cobalt-60(2)	%	4.69E+01	Ci	4.43E+00
5.	Zinc-65(2)	%	1.92E+00	Ci	1.82E-01
6.	Silver-11m(2)	%	1.60E-03	Ci	1.51E-04
7.	Cesium-134(2)	%	1.11E+00	Ci	1.05E-01
8.	Cesium-137(2)	%	6.01E+00	Ci	5.68E-01
9.	Other Nuclides(2)	%	6.83E-01	Ci	6.45E-02

(1) Measured
(2) Estimated through the use of percent abundance

c. Irradiated components, control rods, etc.

NONE

d. Other

NONE

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SOLID WASTE AND IRRADIATED FUEL SHIPMENTS (Continued)

2. Solid waste disposition

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

B. Irradiated Fuel Disposition

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

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	Type of Container	Number of Containers	Disposal Volume
DEWATERED					
(Resin)					
RX CLEANUP	B-LSA	B-Stable	HIC	0.3	61.7
COND/WASTE	B-LSA	B-Stable	HIC	1.7	349.9
	A-LSA	A-Stable	HIC	3.0	617.4
(Filters)	N/A	N/A	N/A	NONE	NONE
DRY ACTIVE WASTE					
(Compacted)					
DRUM	N/A	N/A	N/A	NONE	NONE
BOX	N/A	N/A	N/A	NONE	NONE
(Uncompacted)					
DRUM	N/A	N/A	N/A	NONE	NONE
BOX	N/A	N/A	N/A	NONE	NONE
(Processed Offsite)					
(TO PROCESSOR)	A-LSA	A-Unstable	STC	N/A	21665.0
(TO DISPOSAL)	A-LSA	A-Unstable	STC	N/A	3010.6
IRRADIATED COMPONENTS	N/A	N/A	N/A	NONE	NONE
SOLIDIFIED	N/A	N/A	N/A	NONE	NONE
ABSORBED	N/A	N/A	N/A	NONE	NONE

Solidification Agent Used: NONE
Absorbent Used: NONE