SEMIANNUAL RADIOACTIVE EFFLUENT

RELEASE REPORT

CALLAWAY NUCLEAR PLANT

UNION ELECTRIC COMPANY

LICENSE NPF - 30

JANUARY - JUNE, 1985

IE29
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1.0 INTRODUCTION

This Semiannual Radioactive Effluent Release Report is for Union Electric Company's Callaway Plant and is submitted in accordance with the requirements of Technical Specification 6.9.1.7. The report covers the period from January 1, 1985 through June 30, 1985.

This report includes a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the plant. The information is presented in accordance with the format outlined in Appendix B of Regulatory Guide 1.21, Revision 1, June 1974.

All liquid and gaseous effluents discharged during this reporting period were in compliance with the limits of the Callaway Plant Technical Specifications.

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

Specified as follows are the technical specification limits applicable to the release of radioactive material in liquid and gaseous effluents.

2.1.1 Fission and Activation Gases (Noble Gases)

The dose rate due to radioactive noble gases released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin.

The air dose due to noble gases released in gaseous effluents, from each unit, to areas at and beyond the site boundary shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation and,

b. During any calendar year: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

2.1.2 Radioiodine, Tritium, and Particulates

The dose rate due to Iodine 131 and 133, tritium and all radionuclides in particulate form with half lives greater than eight (8) days released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to less than or equal to 1500 mrem/yr to any organ.

The dose to a member of the public from Iodine 131 and 133, tritium, and all radionuclides in particulate form with half-lives greater than eight (8) days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrem to any organ and,

b. During any calendar year: Less than or equal to 15 mrem to any organ.

2.1.3 Liquid Effluents

The concentration of radioactive material released in liquid effluents to unrestricted areas shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2.0E-04 microcuries/ml total activity.

The dose or dose commitment to an Individual from radioactive materials in liquid effluents released to unrestricted areas shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrem to the total body and less than or equal to 5 mrem to any organ, and

b. During any calendar year to less than or equal to 3 mrem to the whole body and to less than or equal to 10 mrem to any organ.

2.1.4 Uranium Fuel Cycle Sources

The annual (calendar year) dose or dose commitment to any member of the public due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem.

2.2 Maximum Permissible Concentrations

2.2.1 The maximum permissible concentration values specified in 10CFR20, Appendix B, Table II, Column 2 are used to calculate release rates and permissible concentrations of liquid radioactive effluents at the unrestricted area boundary. A value of 2.0E-4 microcuries/ml is used as the MPC for dissolved and entrained noble gases in liquid effluents. The concentration limit used to calculate the percent of limit for mixed fission and activation products in Table 2A is 3.0E-7 microcuries/cc. A limit of 3.0E-3 microcuries/ml (i.e., H-3 MPC value) is utilized in the calculation of the percent of limit for tritium in Table 2A.

2.2.2 For gaseous effluents, maximum permissible concentrations are not directly used in release rate calculations since the applicable limits are stated in terms of dose rate at the unrestricted area boundary.

2.3 Average Energy

This is not applicable to the Callaway Plant's radiological effluent technical specifications.

2.4 Measurements and Approximations of Total Radioactivity

The quantification of radioactivity in liquid and gaseous effluents was accomplished by performing the sampling and radiological analysis of effluents in accordance with the requirements of Table 4.11-1 and Table 4.11-2 of the Callaway Plant Technical Specifications (See attachments 1 and 2).

Gamma spectroscopy was the primary analysis technique used to determine the radionuclide composition and concentration of liquid and gaseous effluents. For Sr-89, Sr-90, and Fe-55 composite samples were collected and analyses performed by a contract laboratory. For these radionuclides the measured concentrations of the previous composite analyses were used. Tritium and alpha were measured for both liquid and gaseous effluents using liquid scintillation counting and gas flow proportional counting techniques, respectively.

The measured total radioactivity in effluent releases was determined from the measured concentrations of each radionuclide present and the total volume of effluents discharged. Gross beta or gamma radioactivity measurement techniques were not utilized to approximate the total radioactivity in effluents.

2.5 Batch Releases

2.5.1 Liquid

2.5.1.1 Number of batch releases: 453

2.5.1.2 Total time period for batch releases: 55173.0 minutes

2.5.1.3 Maximum time period for a batch release: 395.0 minutes

2.5.1.4 Average time period for batch releases: 121.8 minutes

2.5.1.5 Minimum time period for a batch release: 3.0 minutes

2.5.1.6 Average stream flow during periods of release of effluent into a flowing stream: 69,000 cfs

2.5.2 Gaseous

2.5.2.1 Number of batch releases: 44

2.5.2.2 Total time period for batch releases: 15803.0 minutes

2.5.2.3 Maximum time period for a batch release: 4182.0 minutes

2.5.2.4 Average time period for batch releases: 359.2 minutes

2.5.2.5 Minimum time period for a batch release: 17.0 minutes

2.6 Abnormal Releases

2.6.1 Liquid

2.6.1.1 Number of releases: 1

2.6.1.2 Total Activity released: 3.15E-2 Curies

2.6.2 Gaseous

2.6.2.1 Number of releases: 0

2.6.2.2 Total Activity released: 0

3.0 SUMMARY OF GASEOUS RADIOACTIVE EFFLUENTS

3.1 The quantities of radioactive material released in gaseous effluents are summarized in Table 1A and 1B. Note that for this reporting period no gaseous effluents were considered as elevated releases.

4.0 SUMMARY OF LIQUID RADIOACTIVE EFFLUENTS

4.1 The quantities of radioactive material released in liquid effluents are summarized in Table 2A and 2B.

5.0 SOLID WASTES

5.1 The quantities of radioactive material released in shipments of solid waste and irradiated fuel transported from the site during the reporting period are summarized in Table 3.

6.0 RELATED INFORMATION

6.1 Unplanned Releases

6.1.1 On February 8, 1985, an unplanned release occurred from Secondary Liquid Waste Monitor Tank B (THF04B) which resulted in the discharge of 170 gallons of waste water without an effluent release permit.

Effluent release permit CAL-85-L109 had been generated for the discharge of Liquid Waste Monitor Tank B (THB07B), however, due to personnel error, release of Secondary Liquid Waste Monitor Tank B was initiated instead of Liquid Waste Monitor Tank B. This condition was recognized by personnel in the Control Room and the release was immediately terminated.

Samples had been collected from Secondary Liquid Waste Monitor Tank B prior to the inadvertent release. These samples were analyzed and a radiological assessment of the release was conducted in accordance with the Callaway Plant Offsite Dose Calculation Manual. Results of this evaluation are as follows:

Radioactivity Concentrations present in the tank:	H-3	4.90E-2	uci/ml
	Xe-133	7.80E-6	uci/ml
	Xe-135	5.54E-8	uci/ml
Concentrations at unrestricted area boundary:	H-3	3.97E-4	uci/ml
	Xe-133	6.33E-8	uci/ml
	Xe-135	4.49E-10	uci/ml

Percent of MPC (Total): 13.3%
Activity released: 3.15E-2 Curies
Total body Offsite Dose: 4.52E-8 mrem
Percent of quarterly total body dose limit: 3.0E-6%

No technical specifications or 10CFR20 limits were exceeded as a result of this release. Corrective actions have been taken to prevent recurrence.

6.2 Changes to the Process Control Program

Revision 3, to the Callaway Process Control Program (PCP) was issued March 1, 1985. This revision incorporated revised formulations for the solidification of concentrated wastes (borated), revision to the boric acid binding agent (sodium metasilicate) addition chart, and incorporation of a new solidification formulation chart for non-borated concentrated wastes. Minor text wording changes were required due to these changes. Attachment 5 includes documentation of the fact that the change has been reviewed and found acceptable by the On-site Review Committee (ORC).

6.3 Changes to the Offsite Dose Calculation Manual

Changes incorporated into revision 3 of the Callaway Plant Offsite Dose Calculation Manual include:

1) Cleanup of typographical errors previously identified by an errata transmitted by letter, ULNRC-803, dated April 17, 1984 from Mr. Donald F. Schnell, Vice President Nuclear, Union Electric Company to Mr. Harold R. Denton, Director Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission.

2) Incorporation of changes resulting from the 1984 Land Use Census.

3) Incorporate changes to environmental monitoring station locations previously described in the above referenced letter.

Attachment 3 includes copies of the revised pages of the ODCM, a detailed explanation of the changes and documentation of the review and approval of the changes by the ORC.

6.4 Major Changes to Radwaste Treatment Systems

During this reporting period, a modification to the liquid radwaste treatment system was completed. This modification involved the addition of two 100,000 gallon batch waste release tanks. These tanks were required due to an increase in the volume of secondary liquid waste, specifically waste from condensate demineralizer (polisher) regenerations.

Original design estimates of the volume of secondary liquid wastes from regeneration of the condensate polishers was 17,000 gallons per day. Plant operational data has shown waste volumes averaging 43,000 gallons per day. The addition of the two 100,000 gallon tanks was foreseen as a means of providing adequate storage volume for this increase in wastes from regeneration of the condensate polishers as well as to provide required sampling and analysis time prior to discharge to the environment. On September 11, 1984, this requested modification was approved by the On-site Review Committee.

An application was submitted to NRR on October 3, 1984, requesting a revision to the Technical Specifications to allow the addition of two 100,000 gallon tanks (a copy of this letter is shown as Attachment 4). Based upon NRC approval granted on February 4, 1985, (see Attachment 4), work commenced in implementing the subject modification with final installation and acceptance of the modification occurring during June 1985.

A detailed description of the subject modification is contained in the Safety Evaluation and Significant Hazards Consideration presented in Attachment 4, ULNRC-937. As stated therein, the requested modification "does not involve a significant increase in the probability or consequence of an accident or other adverse condition over previous evaluations; or create the possibility of a new or different kind of accident or condition over previous evaluations; or involve a significant reduction in a margin of safety".

6.5 Land Use Census Changes

6.5.1 New critical receptor locations for dose calculations as determined by the most recent land use census are listed as follows:

	Previous Location	New Location
Nearest Cow	2575 meters W sector	5053 meters NW sector
Nearest Goat	3540 meters NNE sector	5053 meters NW sector
Nearest Vegetable Garden	2736 meters NNW sector	2865 meters NNW sector
Nearest Residence	2736 meters NNW sector	2865 meters NNW sector

6.6 Inoperability of Effluent Monitoring Instrumentation

This section of the report covers the inoperability of the Unit Vent gaseous effluent monitor GT-RE-21B from 5/29/85 to 6/11/85. Details of this incident are covered in Licensee Event Report 85-028-00. A summary of the gaseous radioactive effluents released from the Unit Vent during this time period is provided.

The activity released from the Aux/Fuel Building HVAC System from 5/29/95 to 6/11/85 as determined by performance of the routine gaseous radioactive effluent sampling and analysis program (see Section 2.4) was:

H-3	1.24E-1	Curies
Xe-133	1.52E+1	Curies
Xe-135	5.20E-1	Curies
I-131	6.35E-6	Curies
I-133	1.19E-6	Curies
Gross Alpha	1.64E-7	Curies

During this period three containment purges were conducted. During each purge redundant particulate, radioiodine and gaseous radioactivity monitors, GT-RE-22 and GT-RE-33, were operable and provided continuous monitoring with alarm and isolation capability. The total activity released from these three containment purges is presented as follows:

H-3	4.79E-1	Curies
Kr-85m	4.25E-2	Curies
Kr-85	1.50E 0	Curies
Kr-88	2.19E-2	Curies
Xe-131m	1.78E 0	Curies
Xe-133m	2.43E 0	Curies
Xe-133	2.12E+2	Curies
Xe-135	1.05E 0	Curies
Ar-41	2.10E-1	Curies

The offsite doses resulting from the effluents released from the Unit Vent during this period were only a small fraction of Technical Specification limits.

TABLE 1A

SEMIANNUAL SUMMATION OF GASEOUS RELEASES
ALL AIRBORNE EFFLUENTS
QUARTERS 1 AND 2, 1985

TYPE OF EFFLUENT	UNIT	QUARTER 1	QUARTER 2	EST TOTAL ERROR %
FISSION AND ACTIVATION GASES				
TOTAL RELEASE	CURIES	3.03E 02	5.73E 02	3.50E 01
AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	3.90E 01	7.21E 01	
PERCENT OF TECH SPEC LIMIT	%	2.24E-03	4.14E-03	
RADIOIODINES				
TOTAL IODINE-131	CURIES	5.36E-06	1.86E-05	3.50E 01
AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	6.89E-07	2.34E-06	
PERCENT OF TECH SPEC LIMIT	%	6.56E-07	2.23E-06	
PARTICULATES				
PARTICULATES (HALF-LIVES > 8 DAYS)	CURIES	6.68E-07	1.40E-05	3.50E 01
AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	8.59E-08	1.76E-06	
PERCENT OF TECH SPEC LIMIT	%	5.58E-09	1.14E-07	
GROSS ALPHA RADIOACTIVITY	CURIES	5.21E-07	1.70E-06	
TRITIUM				
TOTAL RELEASE	CURIES	5.59E-01	1.59E 00	2.50E 01
AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	7.19E-02	2.00E-01	
PERCENT OF TECH SPEC LIMIT	%	4.73E-06	1.32E-05	

TABLE 1B

SEMIANNUAL AIRBORNE CONTINUOUS AND BATCH RELEASES
GROUND LEVEL RELEASES
FISSION GASES, IODINES, AND PARTICULATES
QUARTERS 1 AND 2, 1985

		CONTINUOUS RELEASES		BATCH RELEASES	
NUCLIDE	UNIT	QUARTER 1	QUARTER 2	QUARTER 1	QUARTER 2
FISSION GASES					
KR-85M	CURIES	1.35E 00	3.24E-01	2.68E-01	6.67E-02
KR-85	CURIES	0.00E 00	0.00E 00	0.00E 00	1.57E 00
KR-87	CURIES	1.91E-01	0.00E 00	0.00E 00	0.00E 00
KR-88	CURIES	1.37E 00	4.06E-01	1.56E-01	2.63E-02
XE-131M	CURIES	1.73E 00	0.00E 00	8.90E-01	6.97E 00
XE-133M	CURIES	2.81E-01	8.99E-02	2.74E 00	3.42E 00
XE-133	CURIES	7.15E 01	9.75E 01	2.10E 02	4.56E 02
XE-135M	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
XE-135	CURIES	5.60E 00	4.38E 00	5.73E 00	1.59E 00
XE-138	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
AR-41	CURIES	0.00E 00	0.00E 00	7.91E-01	8.67E-01
TOTAL FOR PERIOD	CURIES	8.20E 01	1.03E 02	2.21E 02	4.70E 02
IODINES					
I-131	CURIES	5.09E-06	1.86E-05	2.69E-07	1.53E-08
I-133	CURIES	0.00E 00	1.19E-06	0.00E 00	0.00E 00
I-135	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
TOTAL FOR PERIOD	CURIES	5.09E-06	1.98E-05	2.69E-07	1.53E-08
PARTICULATES					
H-3	CURIES	3.71E-01	8.14E-01	1.88E-01	7.71E-01
NA-24	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
MN-54	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
FE-59	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CO-58	CURIES	0.00E 00	1.23E-05	1.46E-07	0.00E 00
CO-60	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
ZN-65	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
SR-89	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
MO-99	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CS-134	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00

TABLE 1B

SEMIANNUAL AIRBORNE CONTINUOUS AND BATCH RELEASES
GROUND LEVEL RELEASES
FISSION GASES, IODINES, AND PARTICULATES
QUARTERS 1 AND 2, 1985

		CONTINUOUS RELEASES		BATCH RELEASES	
NUCLIDE	UNIT	QUARTER 1	QUARTER 2	QUARTER 1	QUARTER 2
PARTICULATES CONTINUED					
CS-137	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
BA-140	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
LA-140	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CE-141	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CE-144	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
SR-90	CURIES	0.00E 00	0.00E 00	0.00E 00	3.39E-08
G ALPHA	CURIES	5.01E-07	1.68E-06	2.00E-08	2.04E-08
UNIDENTIFIED	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
TOTAL FOR PERIOD	CURIES	3.71E-01	8.15E-01	1.88E-01	7.71E-01

TABLE 2A

SEMIANNUAL SUMMATION OF LIQUID RELEASES
ALL LIQUID EFFLUENTS
QUARTERS 1 AND 2, 1985

TYPE OF EFFLUENT	UNIT	QUARTER 1	QUARTER 2	EST TOTAL ERROR %
FISSION AND ACTIVATION PRODUCTS				
TOTAL RELEASE (NOT INCLUDING TRITIUM, GASES, ALPHA)	CURIES	1.39E-04	9.84E-04	2.50E 01
AVERAGE DILUTED CONCENTRATION DURING PERIOD	UCI/ML	1.56E-10	1.87E-09	
PERCENT OF APPLICABLE LIMIT	%	5.20E-02	6.23E-01	
TRITIUM				
TOTAL RELEASE	CURIES	1.55E 02	1.63E 02	2.50E 01
AVERAGE DILUTED CONCENTRATION DURING PERIOD	UCI/ML	1.74E-04	3.09E-04	
PERCENT OF APPLICABLE LIMIT	%	5.80E 00	1.03E 01	
DISSOLVED AND ENTRAINED GASES				
TOTAL RELEASE	CURIES	1.06E-01	1.17E-01	2.50E 01
AVERAGE DILUTED CONCENTRATION DURING PERIOD	UCI/ML	1.19E-07	2.22E-07	
PERCENT OF APPLICABLE LIMIT	%	5.95E-02	1.11E-01	
GROSS ALPHA RADIOACTIVITY				
TOTAL RELEASE	CURIES	4.79E-04	2.87E-04	2.50E 01
WASTE VOL RELEASED (PRE-DILUTION)	GAL	7.38E 06	5.34E 06	1.00E 01
VOLUME OF DILUTION WATER USED	GAL	2.28E 08	1.34E 08	1.00E 01

TABLE 2B

SEMIANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
TOTALS FOR EACH NUCLIDE RELEASED
QUARTER 1 AND 2, 1985

		CONTINUOUS RELEASES		BATCH RELEASES	
NUCLIDE	UNIT	QUARTER 1	QUARTER 2	QUARTER 1	QUARTER 2
ALL NUCLIDES					
H-3	CURIES	0.00E 00	3.70E-02	1.55E 02	1.63E 02
NA-24	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CR-51	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
MN-54	CURIES	0.00E 00	0.00E 00	0.00E 00	1.48E-06
FE-55	CURIES	0.00E 00	0.00E 00	0.00E 00	4.34E-04
FE-59	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CO-58	CURIES	0.00E 00	9.98E-06	7.74E-05	3.48E-04
CO-60	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
ZN-65	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
SR-89	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
ZN-95	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
NB-95	CURIES	0.00E 00	0.00E 00	1.35E-06	0.00E 00
MO-99	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
TC-99M	CURIES	0.00E 00	0.00E 00	6.29E-06	0.00E 00
I-131	CURIES	0.00E 00	0.00E 00	4.94E-05	1.19E-04
I-133	CURIES	0.00E 00	0.00E 00	3.75E-06	5.19E-05
I-135	CURIES	0.00E 00	0.00E 00	0.00E 00	1.44E-05
CS-134	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CS-137	CURIES	0.00E 00	0.00E 00	0.00E 00	1.57E-06
LA-140	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CE-141	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
CE-144	CURIES	0.00E 00	0.00E 00	0.00E 00	3.86E-06
W-187	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
KR-85M	CURIES	0.00E 00	0.00E 00	2.32E-07	0.00E 00
XE-131M	CURIES	0.00E 00	0.00E 00	9.44E-04	7.43E-04
XE-133	CURIES	0.00E 00	0.00E 00	1.03E-01	1.13E-01
XE-133M	CURIES	0.00E 00	0.00E 00	7.37E-04	1.11E-03
XE-135	CURIES	0.00E 00	0.00E 00	1.18E-03	1.63E-03
Xe-135M	CURIES	0.00E 00	0.00E 00	4.87E-05	1.97E-04
BA-140	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
SR-90	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
G ALPHA	CURIES	0.00E 00	0.00E 00	4.79E-04	2.87E-04
UNIDENTIFIED	CURIES	0.00E 00	0.00E 00	0.00E 00	0.00E 00
TOTAL FOR PERIOD	CURIES	0.00E 00	3.70E-02	1.55E 02	1.63E 02

TABLE 3

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
QUARTERS 1 AND 2, 1985

A. SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL

1.

WASTE TYPE	SOLIDIFICATION AGENT	CUBIC METERS	WASTE CLASS	TYPE OF CONTAINERS	CURIES	% ERROR (CI)
Spent Resins	Cement	12.7	A	LSA	3.6E-02	+/- 25%

2. Estimates Of Major Nuclides By Waste Type

WASTE TYPE	NUCLIDE	ABUNDANCE	CURIES
Spent Resins	H-3	100%	3.6E-02

3. Solid Waste Disposition Summary

NUMBER OF SHIPMENTS	MODE OF TRANSPORTATION	DESTINATION
1	TRUCK	RICHLAND, WA

B. IRRADIATED FUEL SHIPMENTS (DISPOSITION)

NONE

TABLE 4.11-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD)(1) (μCi/ml)
1. Batch Waste Release Tanks(2)	P Each Batch	P Each Batch	Principal Gamma Emitters(3)	$5x10^{-7}$
			I-131	$1x10^{-6}$
a. Waste Monitor Tank	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	$1x10^{-5}$
b. Secondary Liquid Waste Monitor Tank	P Each Batch	M Composite(4)	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
c. Discharge Monitor Tank	P Each Batch	Q Composite(4)	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$
2. Continuous Releases(5) Steam Generator Blowdown	Daily(6) Grab Sample	W Composite(4)	Principal Gamma Emitters(3)	$5x10^{-7}$
			I-131	$1x10^{-6}$
	M Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	$1x10^{-5}$
	Daily(6) Grab Sample	M Composite(4)	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
	Daily(6) Grab Sample	Q Composite(4)	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$

TABLE 4.11-1 (Continued)

TABLE NOTATIONS

(1)The LLD is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

Where:

LLD = the "a priori" lower limit of detection (microCuries per unit mass or volume),

s_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22×10^6 = the number of disintegrations per minute per microCurie,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (s^{-1}), and

Δt = the elapsed time between the midpoint of sample collection and the time of counting (s).

Typical values of E, V, Y, and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

(2)A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated, and then thoroughly mixed by a method described in the ODCM to assure representative sampling.

TABLE 4.11-1 (Continued)

TABLE NOTATIONS (Continued)

(3)The principal gamma emitters for which the LLD specification applies include the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Semiannual Radioactive Effluent Release Report pursuant to Specification 6.9.1.7, in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

(4)A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen that is representative of the liquids released. Prior to analysis, all samples taken for the composite shall be thoroughly mixed in order for the composite samples to be representative of the effluent release.

(5)A continuous release is the discharge of liquid wastes of a nondiscrete volume, e.g., from a volume of a system that has an input flow during the continuous release.

(6)Samples shall be taken at the initiation of effluent flow and at least once per 24 hours thereafter while the release is occurring. To be representative of the liquid effluent, the sample volume shall be proportioned to the effluent stream discharge volume. The ratio of sample volume to effluent discharge volume shall be maintained constant for all samples taken for the composite sample.

TABLE 4.11-2

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

GASEOUS RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD)[1] (μCi/ml)
1. Waste Gas Decay Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters[2]	1×10^{-4}
2. Containment Purge or Vent[3]	P Each PURGE[3] Grab Sample	P Each PURGE[3]	Principal Gamma Emitters[2]	1×10^{-4}
		M	H-3 (oxide)	1×10^{-6}
3. Unit Vent	M[3],[4] Grab Sample	M[3]	Principal Gamma Emitters[2]	1×10^{-4}
		M[4]	H-3 (oxide)	1×10^{-6}
4. Spent Fuel Building Exhaust	M[5] Grab Sample	M	Principal Gamma Emitters[2]	1×10^{-4}
		M[5]	H-3 (oxide)	1×10^{-6}
5. Radwaste Building Vent	M Grab Sample	M	Principal Gamma Emitters[2]	1×10^{-4}
6. All Release Types as listed in 1., 2., 3., 4., and 5. above	Continuous[6] [8]	W[7] Charcoal Sample	I-131	1×10^{-12}
			I-333	1×10^{-10}
	Continuous[6] [8]	W[7] Particulate Sample	Principal Gamma Emitters[2]	1×10^{-11}
	Continuous[6] [8]	M Composite Particulate Sample	Gross Alpha	1×10^{-11}
	Continuous[6] [8]	Q Composite Particulate Sample	Sr-89, Sr-90	1×10^{-11}

TABLE 4.11-2 (Continued)

TABLE NOTATIONS

(1) The LLD is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

Where:

LLD = the "a priori" lower limit of detection (microCuries per unit mass or volume),

s_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22×10^6 = the number of disintegrations per minute per microCurie,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (s^{-1}), and

Δt = the elapsed time between the midpoint of sample collection and the time of counting (s).

Typical values of E, V, Y, and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

ATTACHMENT 2

REVISION 1

TABLE 4.11-2 (Continued)

TABLE NOTATIONS (Continued)

(2)The principal gamma emitters for which the LLD specification applies include the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 in noble gas releases and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, Ce-141, and Ce-144 in iodine and particulate releases. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Semiannual Radioactive Effluent Release Report pursuant to Specification 6.9.1.7, in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

(3)Sampling and analysis shall also be performed following shutdown, startup, or a THERMAL POWER change exceeding 15% of RATED THERMAL POWER within 1 hour period.

(4)Tritium grab samples shall be taken and analyzed at least once per 24 hours when the refueling canal is flooded.

(5)Tritium grab samples shall be taken and analyzed at least once per 7 days from the ventilation exhaust from the spent fuel pool area, whenever spent fuel is in the spent fuel pool. Grab samples need to be taken only when spent fuel is in the spent fuel pool.

(6)The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Specifications 3.11.2.1, 3.11.2.2, and 3.11.2.3.

(7)Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing, or after removal from sampler. For unit vent, sampling shall also be performed at least once per 24 hours for at least 7 days following each shutdown, STARTUP or THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLDs may be increased by a factor of 10. This requirement does not apply if: (1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the reactor coolant has not increased more than a factor of 3, and (2) the noble gas monitor shows that effluent activity has not increased more than a factor of 3.

(8)Continuous sampling of the spent fuel building exhaust needs to be performed only when spent fuel is in the spent fuel pool.

ATTACHMENT 3

OFFSITE DOSE CALCULATION MANUAL CHANGES

This Attachment contains the following:

1. Description of Changes to the ODCM
   page 1 through 3

2. Callaway Plant ORC Meeting Minutes
   page 1 through 2

3. ODCM Procedure Request Form Package
   page 1 through 8

4. ODCM Rev. 3 Page Changes

   Pages: title page, list of effective pages, i, ii, iii, iv, v, vi, vii, viii, 11, 13, 17, 18, 19, 21, 33, 38, 39, 40, 41, 46, 47, 51, 52, 53, 54, 55, 56, 57, 58, 59, 72, 74, 76, 78, 80, 81, 83, Figure 5.1A, Figure 5.1B, Figure 5.3, 90, 91, 92, 93, 95, 96, 97, 98, 99, 100, 101, 102

ATTACHMENT 3

Description of Changes To The ODCM

The following presents justification for the changes to the ODCM. A copy of the revised pages and documentation of ORC approval is included.

Page 11

Minor typographical error.

Page 13

Changes "Individual" to "Member of the Public". Removed the term "from each unit" as the Callaway Plant is a single unit site. This is consistent with the wording of Callaway Plant Technical specifications.

Page 17

The former wording, "nuclides which are below the LLD for the analyses are reported as "less than" the nuclides Minimum Detecable Activity (MDA . . . ," was somewhat confusing and ambiguous. The revised wording provides clarification with respect to the use of the MDA for nuclides that are not detected.

Pages 18 & 19 (Table 1)

Added Ingestion Dose Commitment Factor values for Br-85, Y-93, Tc-101, Ba-141, Ba-142, and La-142.

Page 21

Removed the term "from each unit", as the Callaway Plant is a single unit site.

Page 33

The former definition indicated that Qi was applicable only to radioiodines. The new definition clearly applies to all radionuclides.

Page 38

Removed the term "from each unit".

Pages 39 & 40

Revised "Individual" to "Member of the Public". Removed the term "from each unit".

Page 41

Revised to allow application of D/Q values at or beyond the Site Boundary, as appropriate, in accordance with Tech Spec 3.11.2.3.

Page 46

Typographical error. Revised to read Tc-99m instead of Te-99m.

Page 47

Skin dose factor Te-131 was revised from 3.45E7 to 3.45E4. The original value was miscalculated due to an apparent typographical error in Reg. Guide 1.109.

Pages 51, 52, 53, 54, 55, 56, 57, 58 & 59

Typographical errors as identified by ULNRC-803.

Pages 72

Added description to Station #20. Corrected error in stated location for Station #34. No changes to actual station locations.

Page 74

Added stations B-3 and A-9 to Table 6 as identified in ULNRC-803.

Page 76

Added footnote "g" in accordance with Tech Spec 3.12.1, Table 3.12-1.

Page 78

Replaced stations V-2 and V-4 with new stations V-6 and V-7, as identified by the 1984 Land Use Census.

Pages 80, 81 & 83

Footnotes revised as per Tech Spec 3.12.1, Table 4.12-1, and Table 4.12-2.

Figures 5.1A, 5.1B, and 5.3

Revised as per revised Table 6.

Page 90

"Rev" changed to "Ref". Figure 6.1 was deleted as it was originally intended to be a graphical representation of how the computational procedure works and not intended to be used to determine the site-specific slope factor. The ODCM has been revised to reference the same figure in NUREG/CR-2929. Typographical error "8700 hours" corrected to "8760 hours".

Pages 91, 92, & 93

Corrected typographical errors as identified in ULNRC-803. Changed receptor locations as identified by the 1984 Land Use Census.

Page 95 & 96

Revised to be consistent with Tech Spec 6.9.1.7.

Page 97

Revised to incorporate the results of the evaluation of computer codes utilized to calculate offsite doses.

Pages 98 & 99

Added reference 9.5.5. Corrected reference 9.6.14.

Pages 100, 101, & 102

Page numbers have changed due to addition of reference 9.5.5 on page 98 (above). No changes to references.

P54 01

CALLAWAY PLANT

ORC MEETING MINUTES

QA RECORD

I. Meeting Number 433s Date 6-26-85

II. Attendees

~~Chairman~~/Vice-Chairman A.P. NEUHALFEN

~~Member~~/Alternate B.R. MOSLEMI

~~Member/Alternate~~ CC Chairman

Member/~~Alternate~~ Lance C Kruckert

~~Member~~/Alternate W. J. Stempfield

Member/~~Alternate~~ M. Poole

Member/~~Alternate~~ G. Randolph

Member/Alternate

III. Proposed Items

		Recommended Disposition		
A.	ODCM Rev 5	Approval /X/	Disapproval /__/	Open /__/
B.		Approval /__/	Disapproval /__/	Open /__/
C.		Approval /__/	Disapproval /__/	Open /__/
D.		Approval /__/	Disapproval /__/	Open /__/
E.		Approval /__/	Disapproval /__/	Open /__/
F.		Approval /__/	Disapproval /__/	Open /__/
G.	Attached list of Procedure Request forms and Safety Evaluations	Approval W/O Exception /__/	Approval W/Exceptions /__/	Identify exceptions & reason on attached list & carry as open item.

NOTE: For items A through G, a recommendation for approval signifys that ORC found that the items did not constitute an unreviewed safety question unless otherwise specifically stipulated in the ORC minutes.

NOTE: Open Items must be rescheduled for future meetings. Disapproval and Open categories must have supporting rationale attached in writing. Dissenting opinions require an attached statement of reason. Attached pages shall be uniquely identified by indicating in a prominent manner the meeting number, the date and page number of the attachment to this form.

ORC ~~Chairman~~/Vice-Chairman Andrew P. Neuhalfen

Distribution

ORC File - w/Attachments (QA Record)
NSRB - w/Attachments
ISEG - w/Attachments
Members - w/Attachments
Supt., Training - w/Attachments

CA-A138
02/11/84
APA-ZZ-00030

ORC OPEN ITEMS LIST

1. JTG Punchlist items:

   #351 - At the first refueling outage: Normal exhaust fans, Aux. Bldg, didn't meet Acceptance Criteria 2.3 in slow speed; need CMR 84-0271A prior to work.

2. Physical Security Plan Change Notice #235 held open pending clarification of documentation on security boundaries.

3. IR 85-036 held open (status change) pending PM performance (MPE-ZZ-QS005) indicates no problems found. Action assigned Asst. Manager O&M.

4. APA-ZZ-00748, Rev. 0, held open pending further review of procedure by Industrial Relations. APN has action. Due date July 19, 1985.

5. IR 85-0235 held open pending further Operation and Rad Waste discussion to prevent further occurrance. GLR has action. Due date June 28, 1985.

H52.C6

PROCEDURE REQUEST FORM

Procedure Number N/A Revision Number 2

Procedure Title OFFSITE DOSE CALCULATION MANUAL

☐ New Procedure Request ☐ Removing Deficiencies ☐ Procedure Deletion

☒ Procedure Revision, New Revision Number 3

☐ Temporary Procedure Change, effective until incorporated into next revision. TCN# _____

☐ One Time Temporary Procedure Change, effective from _____ to _____, TCN# _____

New Procedure/Change Summary

5.1 Procedure Page Numbers Affected by Proposed Change
MULTIPLE, AS DESIGNATED BY "REV 3"

5.2 Description of New Procedure/Changes/Deficiencies Removed
INCORPORATES ERRATA AS IDENTIFIED BY ULNRC 803, DESCRIBES CHANGES TO THE EFFLUENTS ACCOUNTABILITY PROGRAM RESULTING FROM RESULTS OF 1984 LAND USE CENSUS & CHANGES TO THE ENVIRONMENTAL MONITORING STATIONS LOCATIONS (ULNRC 803, ATTACHMENTS 1 & 2 ARE ATTACHED TO THIS FORM).
(Use additional pages if required.)

5.3 Reason for New Procedure/Change/Deficiency Removal
CHANGES REQUIRED PURSUANT TO TECHNICAL SPECIFICATION 6.14
(Use additional pages if required.)

Prepared by _____ (Signature) NUCLEAR SCIENTIST (Title) 6/24/85 (Date)

Qualified Review (Check appropriate boxes)

5.a Cross Disciplinary Review Required? NO ☐ YES ☒ (If Yes, complete 5.b below.)

ORC Review Required? NO ☐ YES ☒

Reviewed by _____ (Signature) SUPV HPTS (Title) 6/24/85 (Date)

5.b Cross Disciplinary Review Required (Signature/Date); Date Due _____

☐ Eng. ___/___	☐ P & S ___/___	☒ QA [signature] 6/24/85
☐ H.P. ___/___	☐ Admin-S ___/___	☐ Mat'ls. ___/___
☐ R.W. ___/___	☐ Trng. ___/___	☐ Admin-R ___/___
☐ Chem. ___/___	☐ Sec. ___/___	☐ I & C ___/___
☐ Ops ___/___	☐ Comp. ___/___	☐ ___/___
☐ Maint. ___/___	☐ Outages ___/___	☐ ___/___

Responsible Department Head (Check appropriate box and sign):

5.a ☐ Approved for Issue ___/___

5.b ☒ Approved for ORC Review [signature] for JR Penny / 6/24/85

Temporary Procedure Change Preliminary Approval (Signature/Date)

Member Management Staff ___/___

Senior Reactor Operator ___/___

Manager, Callaway Plant ___/___

Temporary Procedure Change Final Approval (Signature/Date; required within 14 days of Preliminary Approval.)

Responsible Dept. Head ___/___

Manager, Callaway Plant ___/___

Procedure Approval (Signature/Date)

Manager, Callaway Plant [signature] / 7-3-85

QA RECORD

(1) Applicable for new procedures and procedure revisions only.
(2) Applicable for Temporary Procedure changes only; not all signatures are required in these sections. See APA-ZZ-00101 Section 5.1 for approval requirements.

Total 8 pages P.1

CA-#33
05/31/85
APA-ZZ-00101

CALLAWAY PLANT

NUCLEAR SAFETY EVALUATION CHECKLIST

(10 CFR50.59-APPLICABILITY DETERMINATION)

NO. N/A

(1) CHECKLIST APPLICABLE TO: Offsite Dose Calculation Manual REV. 3 TCN _____

(2) 10CFR50.59 APPLICABILITY DETERMINATION

The procedure, procedure revision or change, or modification to which this evaluation is applicable represents:

(2.1) Yes ____ No ✓ A change to the plant as described in the FSAR including the RERP and Security Plan?

(2.2) Yes ____ No ✓ A change to procedures as described in the FSAR including the RERP and Security Plan?

(2.3) Yes ____ No ✓ A test or experiment not described in the FSAR including the RERP and Security Plan?

(2.4) Yes ____ No ✓ A change to the Technical Specifications?

(2.5) Yes ____ No ✓ A change to plant structures, systems, or components.

If any question above is answered "Yes", this Checklist shall be forwarded to the Superintendent, Engineering, for completion of a Nuclear Safety Evaluation (CA-#1041) per APA-ZZ-00140.

(3) For design changes or temporary modifications to permanent plant equipment, provide additional justification below (using CA-#515 as guidelines) as to why the change does not constitute a potential unreviewed safety question. Provide a description of the proposed change(s) or refer to the appropriate design change record which fully describes the change.

(4) Prepared by: [signature] Date 6/24/85

(5) Reviewed by: [signature] Date 6/24/85

(6) Responsible Dept. Head [signature] Date 6/24/85

UNION ELECTRIC COMPANY
1901 GRATIOT STREET
ST. LOUIS, MISSOURI

DONALD F. SCHNELL
VICE PRESIDENT

April 17, 1984

MAILING ADDRESS
P. O. BOX 149
ST. LOUIS, MISSOURI 63166

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton: ULNRC-803

DOCKET NUMBER 50-483
CALLAWAY PLANT, UNIT 1
OFFSITE DOSE CALCULATION MANUAL, REV. 2 ERRATA

Reference: ULNRC-760 dated March 8, 1984

The referenced letter transmitted Revision 2 of the Callaway Offsite Dose Calculation Manual (ODCM). As a result of a phone call between Mr. Ed Branagan (NR) and Mr. D. Shafer (UE) on April 16, 1984, the following additional information is submitted:

1) Errata to Callaway ODCM, Revision 2.

2) Change page 73 and Figure 5.1B indicating monitoring station A-9 is the "community of Reform" and adding station B-3.

3) "Comparison of Callaway Plant Offsite Dose Calculations for Routine Effluents" performed by Bechtel Power Corporation dated 3/22/84.

The corrections and additions from items 1 and 2 will be made in the initial Semi-Annual Radioactive Effluent Release Report.

Very truly yours,

Donald F. Schnell

DS/lw

cc: J. Holonich w/a
E. Branagan w/a

p.3

STATE OF MISSOURI)
) S S
CITY OF ST. LOUIS)

Robert J. Schukai, of lawful age, being first duly sworn upon oath says that he is General Manager-Engineering (Nuclear) for Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By _____
Robert J. Schukai
General Manager-Engineering
Nuclear

SUBSCRIBED and sworn to before me this 17th day of April, 1984.

Barbara J. Pfaff
BARBARA J. PFAFF
NOTARY PUBLIC, STATE OF MISSOURI
MY COMMISSION EXPIRES APRIL 22, 1985
ST. LOUIS COUNTY

cc: Glenn L. Koester
Vice President
Operations
Kansas Gas & Electric
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Errata to Callaway ODCM Revision 2

Page	Column	Line	Change
51	NUCLIDE	6	Change "Mu" to "Mn"
51	NUCLIDE	7	Change "Mu" to "Mn"
51	NUCLIDE	8	Change "fe" to "Fe"
51	NUCLIDE	9	Change "fe" to "Fe"
51	NUCLIDE	16	Change "Zn-60" to "Zn-69"
51	NUCLIDE	17	Change "BR" to "Br"
51	NUCLIDE	18	Change "BR" to "Br"
51	NUCLIDE	22	Change "RB" to "Rb"
51	NUCLIDE	25	Change "SR" to "Sr"
52	NUCLIDE	13	Change "Rn" to "Ru"
52	NUCLIDE	14	Change "Rn" to "Ru"
53	NUCLIDE	7	Change "Cs-134" to "Cs-136"
54	LIVER	4	Change "4.37E10" to "4.37E9"
55	NUCLIDE	13	Change "Rn" to "Ru"
55	NUCLIDE	14	Change "Rn" to "Ru"
56	NUCLIDE	2	Change "I-131" to "I-132"
56	TOTAL BODY	2	Change "6.10E1 to "6.10E-1"
57	GI-LLI	16	Change "9.11E4" to "9.11E-4"
58	TOTAL BODY	25	Change "6.38ES" to "6.38E5"
58	GI-LLI	25	Change "5.79ES" to "5.79E5"
59	KIDNEY	5	Change "1.70ES" to "1.70E5"
91			Change units for columns labeled "X/Q - Decayed/Undepleted" and "X/Q - Decayed/Depleted" from "(m^2/sec)" to "(sec/m^3)".
92			Same change as on page 91.

pla

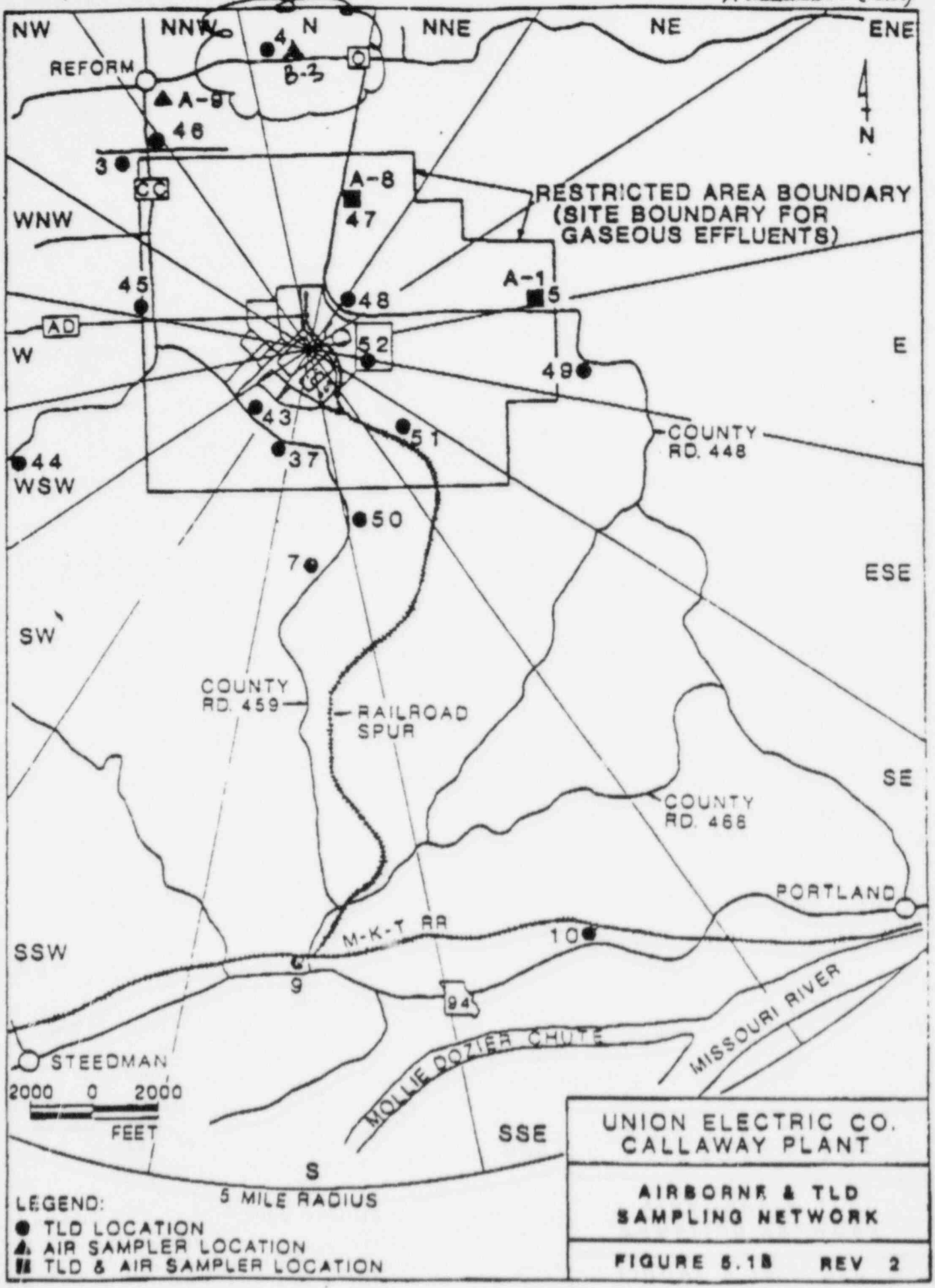
Rev. 2

TABLE 6 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

			isotopic analysis[d] on those samples for which the gross beta activity is > 10 times the yearly mean of control samples. Perform gamma isotopic analysis[d] on composite samples (by location) at least once per 92 days.
Station Code	Sector	Site Description	Location
A-1	D	Primary Meteorological Tower	1.3 mi. @ 76° ENE
A-8	B	County Road 448, 0.9 mi. South of Highway O	.9 mi. @ 20° NNE
B-3	A	0.6 mile east of Highway O and CC Junction	1.9 mi. @ 355° N
		One sample from the community with the highest D/Q	
A-9	R	community of Reform	1.7 mi. @ 336° NNW
		One sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction.	
A-7	Q	C. Bartley Farm	9.5 mi. @ 312° NW

47


NW
NNW
N
NNE
NE
ENE
REFORM
B-3
A-8
46
3
A-8
47
RESTRICTED AREA BOUNDARY
(SITE BOUNDARY FOR
GASEOUS EFFLUENTS)
WNW
45
A-1
5
48
AD
W
52
E
48
43
51
COUNTY
RD. 448
44
WSW
37
50
7
ESE
SW
COUNTY
RD. 459
RAILROAD
SPUR
SE
COUNTY
RD. 466
PORTLAND
M-K-T RR
10
SSW
9
94
MISSOURI RIVER
MOLLIE DOZIER CHUTE
STEEDMAN
2000 0 2000
FEET
SSE
S
5 MILE RADIUS
LEGEND:
TLD LOCATION
AIR SAMPLER LOCATION
TLD & AIR SAMPLER LOCATION
UNION ELECTRIC CO.
CALLAWAY PLANT
AIRBORNE & TLD
SAMPLING NETWORK
FIGURE 5.1B REV 2

Rev. 3

UNION ELECTRIC COMPANY

CALLAWAY PLANT

OFFSITE DOSE CALCULATION MANUAL

Approved: Steven E Miltenberger for HBN
Chairman, ORC

7-3-85
Date

4335 W.o. 1/85
ORC meeting number

Reviewed: James R Peevy
Superintendent, Health Physics

7/2/85
Date

Reviewed: [illegible]
Supervisor, H. P. Tech. Support

7/1/85
Date

Prepared By: [illegible]

7/1/85
Date

This document contains the following:

Pages	1	through	102
Tables	1	through	12
Figures	4.1, 5.1A, 5.1B, 5.2A, 5.2B, 5.3		

Table of Contents

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Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

List of Figures

List of Tables

Record of Revisions

Revision Number	Date	Reason for Revision
Rev. 0	March 1983	
Rev. 1	November 1983	Revised to support the current RETS submittal and to incorporate NRC Staff comments
Rev. 2	March 1984	Revised to incorporate NRC Staff comments
! Rev. 3	June 1985	Revised to incorporate errata identified by ULNRC-803 and changes to the Environmental Monitoring Program. Incorporate results of 1984 Land use Census.

$$c = A \sum_{1} (C_g)_i \quad \frac{\mu Ci}{ml} \qquad \text{(Refer to Note Following)} \qquad (2.9)$$

Where:

A = Adjustment factor which will allow the setpoint to be established in a practical manner for convenience and to prevent spurious alarms.

$$A = \frac{f_{max}}{f_p} \qquad \text{(Refer to Note Following)} \qquad (2.10)$$

If A > 1: Calculate c and determine the maximum value for the actual monitor setpoint (μCi/ml).

If A ≤ 1: No release may be made. This condition must be flagged and the operator instructed to re-evaluate F_{dp} and F_{eff} (i.e., reduce effluent flow rate or return radwaste for reprocessing).

NOTE

If F_d < 1, no further dilution is required and the release may be made without regard to available dilution or to other releases made simultaneously. However, it is necessary to establish a monitor setpoint which will provide alarm should the release concentration inadvertently exceed Radiological Effluent Technical Specification 3.11.1.1 limits. This can be accomplished by establishing the adjustment factor as follows:

$$A = \frac{1}{F_d} \qquad (2.11)$$

Dose contributions from liquids discharged as continuous releases are determined by utilizing the last measured values of samples required in accordance with Radiological Effluent Technical Specifications Table 4.11-1.

2.5 Individual Dose Due to Liquid Effluents

2.5.1 Radiological Effluent Technical Specification 3.11.1.2

! The dose or dose commitment to a MEMBER OF THE PUBLIC
! from radioactive materials in liquid effluents
! released, to UNRESTRICTED AREAS shall be limited:

a. During any calendar quarter to less than or equal
! to 1.5 mrem to the whole body and less than or equal to 5 mrem to any organ, and

b. During any calendar year to less than or equal to
! 3 mrem to the total body and to less than or equal to 10 mrem to any organ.

2.5.2 The Maximum Exposed Individual

The cumulative dose determination considers the dose contributions from the maximum exposed individual's consumption of fish and potable water, as appropriate. Normally, the adult is considered to be the maximum exposed individual. (Ref. 9.8.3, 9.8.4)

The Callaway Plant's liquid effluents are discharged to the Missouri River. As there are no potable water intakes within 50 miles of the discharge point (Ref. 9.7.1, 9.6.6), this pathway does not require routine evaluation. Therefore, the dose contribution from fish consumption is expected to account for more than 95% of the total man-rem dose from discharges to the Missouri River. Dose from recreational activities is expected to contribute the additional 5%, which is considered to be negligible. (Ref. 9.6.7)

Thus, the maximum exposed individual is an adult, receiving 95% of the total dose from eating fish and 5% of the total dose from recreational activities.

2.5.3 ODCM Methodology for Determining Dose Contributions From Liquid Effluents

2.5.3.1 Calculation of Dose Contributions

The dose contributions for the total time period

Inserting the appropriate usage factors from Regulatory Guide 1.109 into Equation (2.14) yields the following expression:

$$A_{i\tau} = 1.14E05\ (21BF_i)DF_i \qquad (2.15)$$

or $$A_{i\tau} = 2.39E06 \times BF_i \times DF_i \qquad (2.16)$$

2.5.4 Summary, Determination of Individual Dose Due to Liquid Effluents

The dose contribution for the total time period

$$\sum_{\ell=1}^{m} \Delta t_\ell$$

is determined by calculation at least once per 31 days and a cumulative summation of the total body and organ doses is maintained for each calendar quarter. The projected dose contribution from batch releases for which radionuclide concentrations are determined by periodic composite and grab sample analysis, as stated in Table 4.11-1 of the Radiological Effluent Technical Specifications, may be approximated by using the last measured value. However, for reporting purposes, the calculated dose contribution from those radionuclides is based on actual composite/grab sample analysis. Dose contributions are determined for all radionuclides identified in liquid effluents released to UNRESTRICTED ! AREAS. Nuclides which are not detected in the analyses are reported as "less than" the nuclide's Minimum Detectable Activity (MDA) and are not reported as being present at the LLD level for that nuclide. The "less than" values are not used in the required dose calculations.

TABLE 1

INGESTION DOSE COMMITMENT FACTOR (A_{it}) FOR ADULT AGE GROUP

(mrem-hr per μci-ml)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
H-3	No Data	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01
C-14	3.13E+04	6.26E+03	6.26E+03	6.26E+03	6.26E+03	6.26E+03	6.26E+03
Na-24	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02
P-32	4.62E+07	2.87E+06	1.78E+06	No Data	No Data	No Data	5.19E+06
Cr-51	No Data	No Data	1.27E+00	7.62E-01	2.81-01	1.69E+00	3.2-E+02
Mn-54	No Data	4.38E+03	8.35E+02	No Data	1.30E+03	No Data	1.34E+04
Mn-56	No Data	1.10E+02	1.95E+01	No Data	1.40E+02	No Data	3.52E+03
Fe-55	6.57E+02	4.54E+02	1.06E+02	No Data	No Data	2.53E+02	2.61E+02
Fe-59	1.04E+03	2.44E+03	9.34E+02	No Data	No Data	6.81E+02	8.13E+03
Co-58	No Data	8.94E+01	2.00E+02	No Data	No Data	No Data	1.81E+03
Co-60	No Data	2.57E+02	5.66E+02	No Data	No Data	No Data	4.82E+03
Ni-63	3.11E+04	2.15E+03	1.04E+03	No Data	No Data	No Data	4.49E+02
Ni-65	1.26E+02	1.64E+01	7.48E+00	No Data	No Data	No Data	4.16E+02
Cu-64	NO Data	1.00E+01	4.69E+00	No Data	2.52E+01	No Data	8.52E+02
Zn-65	2.32E+04	7.38E+04	3.33E+04	No Data	4.93E+04	No Data	4.65E+04
Zn-69	4.93E+01	9.44E+01	6.56E+00	No Data	6.13E+01	No Data	1.42E+01
Br-83	No Data	No Data	4.04E+01	No Data	No Data	No Data	5.81E+01
Br-84	No Data	No Data	5.26E+01	No Data	No Data	No Data	4.13E-04
Br-85	No Data	No Data	2.15E+00	No Data	No Data	No Data	0
Rb-86	No Data	1.01E+05	4.71E+04	No Data	No Data	No Data	1.99E+04
Rb-88	No Data	2.90E+02	1.54E+02	No Data	No Data	No Data	4.00E-09
Rb-89	No Data	1.92E+02	1.35E+02	No Data	No Data	No Data	1.12E-11
Sr-89	2.21E+04	No Data	6.35E+02	No Data	No Data	No Data	3.55E+03
Sr-90	5.44E+05	No Data	1.34E+05	No Data	No Data	No Data	1.57E+04
Sr-91	4.07E+02	No Data	1.64E+01	No Data	No Data	No Data	1.94E+03
Sr-92	1.54E+02	No Data	6.68E+00	No Data	No Data	No Data	3.06E+03
Y-90	5.75E-01	No Data	1.54E-02	No Data	No Data	No Data	6.10E+03
Y-91M	5.44E-03	No Data	2.10E-04	No Data	No Data	No Data	1.60E-02
Y-91	8.43E+00	No Data	2.25E-01	No Data	No Data	No Data	4.64E+03
Y-92	5.05E-02	No Data	1.48E-03	No Data	No Data	No Data	8.85E+02
Y-93	1.60E-01	No Data	4.42E-03	No Data	No Data	No Data	5.08E+03
Zr-95	2.40E-01	7.70E-02	5.21E-02	No Data	1.21E-01	No Data	2.44E+02
Zr-97	1.33E-02	2.68E-03	1.22E-03	No Data	4.04E-03	No Data	8.30E+02
Nb-95	4.47E+02	2.48E+02	1.34E+02	No Data	2.46E+02	No Data	1.51E+06
Mo-99	No Data	1.03E+02	1.96E+01	No Data	2.33E+02	No Data	2.39E+02
Tc-99M	8.87E-03	2.51E-02	3.19E-01	No Data	3.81E-01	1.23E-02	1.48E+02
Tc-101	9.11E-03	1.31E-02	1.29E-01	No Data	2.36E-01	6.70E-03	0
Ru-103	4.42E+00	No Data	1.90E+00	No Data	1.69E+01	No Data	5.17E+02
Ru-105	3.68E-01	No Data	1.45E-01	No Data	4.76E+00	No Data	2.25E+02
Ru-106	6.57E+01	No Data	8.32E+00	No Data	1.27E+02	No Data	4.25E+03

TABLE 1 (Continued)

INGESTION DOSE COMMITMENT FACTOR (A_{it}) FOR ADULT AGE GROUP

(mrem-hr per μci-ml)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Te-125M	2.57E+03	9.30E+02	3.44E+02	7.72E+02	1.04E+04	No Data	1.02E+04
Te-127M	6.47E+03	2.32E+03	7.90E+02	1.66E+03	2.63E+04	No Data	2.17E+04
Te-127	1.05E+02	3.78E+01	2.28E+01	7.80E+01	4.29E+02	No Data	8.30E+03
Te-129M	1.10E+04	4.11E+03	1.74E+03	3.78E+03	4.60E+04	No Data	5.54E+04
Te-129	3.01E+01	1.13E+01	7.33E+00	2.31E+01	1.26E+02	No Data	2.27E+01
Te-131M	1.66E+03	8.09E+02	6.75E+02	1.28E+03	8.21E+03	No Data	8.03E+04
Te-131	1.89E+01	7.88E+00	5.96E+00	1.55E+01	8.25E+01	No Data	2.67E+00
Te-132	2.41E+03	1.56E+03	1.47E+03	1.72E+03	1.50E+04	No Data	7.38E+04
I-130	2.71E+01	8.01E+01	3.16E+01	6.79E+03	1.25E+02	No Data	6.89E+01
I-131	1.49E+02	2.14E+02	1.22E+02	7.00E+04	3.66E+02	No Data	5.64E+01
I-132	7.29E+00	1.95E+01	6.82E+00	6.82E+02	3.11E+01	No Data	3.66E+00
I-133	5.10E+01	8.87E+01	2.70E+01	1.30E+04	1.55E+02	No Data	7.97E+01
I-134	3.81E+00	1.03E+01	3.70E+00	1.79E+02	1.64E+01	No Data	9.01E-03
I-135	1.59E+01	4.16E+01	1.54E+01	2.75E+03	6.68E+01	No Data	4.70E+01
Cs-134	2.98E+05	7.09E+05	5.80E+05	No Data	2.29E+05	7.62E+04	1.24E+04
Cs-136	3.12E+04	1.23E+05	8.86E+04	No Data	6.85E+04	9.39E+03	1.40E+04
Cs-137	3.82E+05	5.22E+05	3.42E+05	No Data	1.77E+05	5.89E+04	1.01E+04
Cs-138	2.64E+02	5.22E+02	2.59E+02	No Data	3.84E+02	3.79E+01	2.23E-03
Ba-139	9.29E-01	6.62E-04	2.72E-02	No Data	6.19E-04	3.76E-04	1.65E+00
Ba-140	1.94E+02	2.44E-01	1.27E+01	No Data	8.31E-02	1.40E-01	4.00E+02
Ba-141	4.50E-01	3.40E-04	1.52E-02	No Data	3.16E-04	1.93E-04	2.12E-10
Ba-142	2.04E-01	2.09E-04	1.28E-02	No Data	1.77E-04	1.19E-04	0
La-140	1.50E-01	7.53E-02	1.99E-02	No Data	No Data	No Data	5.53E+03
La-142	7.65E-03	3.48E-03	8.66E-04	No Data	No Data	No Data	2.54E+02
Ce-141	2.24E-02	1.51E-02	1.72E-03	No Data	7.03E-03	No Data	5.78E+02
Ce-143	3.94E-03	2.92E+00	3.23E-04	No Data	1.28E-03	No Data	1.09E+02
Ce-144	1.17E+00	4.88E-01	6.26E-02	No Data	2.89E-01	No Data	3.94E+02
Pr-143	5.50E-01	2.21E-01	2.73E-02	No Data	1.27E-01	No Data	2.41E+03
Nd-147	3.76E-01	4.35E-01	2.60E-02	No Data	2.54E-01	No Data	2.09E+03
W-187	2.96E+02	2.47E+02	8.64E+01	No Data	No Data	No Data	8.09E+04
Np-239	2.84E-02	2.80E-03	1.54E-03	No Data	8.72E-03	No Data	5.74E+02

2.6 LIQUID RADWASTE TREATMENT SYSTEM

2.6.1 Radiological Effluent Technical Specification 3.11.1.3

The LIQUID RADWASTE TREATMENT SYSTEM Shall be OPERABLE and appropriate portions of the system shall be used to reduce releases of radioactivty when the projected doses due to the liquid effluent, to UNRESTRICTED AREAS, would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31 day period.

2.6.2 Description Of The LIQUID RADWASTE TREATMENT SYSTEM

2.6.3 OPERABILITY Of The LIQUID RADWASTE TREATMENT SYSTEM

The LIQUID RADWASTE TREATMENT SYSTEM is capable of varying treatment, depending on waste type and product desired. It is capable of concentrating, gas stripping, and distillation of liquid wastes through the use of the evaporator system. The demineralization system is capable of removing radioactive ions from solutions to be reused as makeup water. Filtration is performed on certain liquid wastes and it may, in some cases, be the only required treatment prior to release. The system has the ability to absorb halides through the use of charcoal filters prior to their release.

The design and operation requirements of the LIQUID RADWASTE TREATMENT SYSTEM provide assurance that releases of radioactive materials in liquid effluents will be kept "As Low As Reasonably Achievable" (ALARA).

The OPERABILITY of the LIQUID RADWASTE TREATMENT SYSTEM ensures this system will be available for use when liquids require treatment prior to their release to the environment. OPERABILITY is demonstrated through compliance with Radiological Effluent Technical Specifications 3.11.1.1 and 3.11.1.2.

$$D_o = \sum_i P_i[(\overline{X/Q})Q_i] \leq 1500 \text{ mrem/yr} \quad (3.7)$$

Where:

D_o = Dose rate to any critical organ, in (mrem/yr).

P_i = Dose parameter for radionuclides other than noble gases for the inhalation pathway for the child, based on the critical organ, in (mrem/yr) per (μCi/m^3). (Table 4)

! Q_i = The release rate of radionuclide, i, in gaseous effluents, from all vent releases, in (μCi/sec). Q_i is calculated as the product of the ventilation path design flow rate and the measured activity of the effluent stream as determined by grab sampling. Flow rates for the ventilation pathways can be found in references 9.6.21, 9.6.22, 9.6.23, and 9.6.24.

$(\overline{X/Q})$ is as previously defined.

The dose parameter (P_i) includes the internal dosimetry of radionuclide, i, and the receptor's breathing rate, which are functions of the receptor's age. Therefore the child age group has been selected as the limiting age group.

For the child exposure, separate values of P_i are tabulated in Table 4 for the inhalation pathway. These values were calculated according to (Ref. 9.8.9):

$$P_i = K' (BR) DFA_i \quad (3.8)$$

Where:

K' = Units conversion factor: 1μCi = 1E06 pCi.

3.5.2 Individual Dose Due To Gaseous Effluents

3.5.2.1 Radiological Effluent Technical Specification 3.11.2.2

The air dose due to noble gases released in gaseous effluents, to areas at and beyond the SITE BOUNDARY shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation and,

b. During any calendar year: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

3.5.2.1.1 Noble Gases

The air dose at the SITE BOUNDARY due to noble gases released from the site is determined according to the following methodology (Ref. 9.8.10):

During any calendar quarter, for gamma radiation:

$$D_g = 3.17 \quad E\text{-}08 \sum_i [M_i \{(\overline{X/Q})\ Q_i + (X/q)\ q_i\}] \leq 5 \text{ mrad} \qquad (3.9)$$

During any calendar quarter, for beta radiation:

$$D_b = 3.17 \quad E\text{-}08 \sum_i [N_i \{(\overline{X/Q})\ Q_i + (X/q)\ q_i\}] \leq 10 \text{ mrad} \qquad (3.10)$$

During any calendar year, for gamma radiation:

$$D_g = 3.17 \quad E\text{-}08 \sum_i [M_i \{(\overline{X/Q})\ Q_i + (X/q)\ q_i\}] \leq 10 \text{ mrad} \qquad (3.11)$$

During any calendar year, for beta radiation:

$$D_b = 3.17 \quad E\text{-}08 \sum_i [N_i \{(\overline{X/Q})\ Q_i + (X/q)\ q_i\}] \leq 20 \text{ mrad} \qquad (3.12)$$

Where:

D_g = Air dose from gamma radiation due to noble gases released in gaseous effluent.

D_b = Air dose from beta radiation due to noble gases released in gaseous effluents.

(X/q) = The relative concentration for areas at or beyond the SITE BOUNDARY for short-term releases (equal to or less than 500 hrs/year). Refer to Tables 9, 10, 11, and 12.

q_i = The average release of noble gas radionuclides, i, in gaseous effluents from all vent releases for short-term releases (equal to or less than 500 hrs/year), in (μCi). Releases are cumulative over the calendar quarter or year, as appropriate.

N_i = The air dose factor due to beta emissions for each identified noble gas radionuclide, i, in (mrad/yr) per ($\mu Ci/m^3$). (Table 3)

Q_i = The average release of noble gas radionuclides, i, in gaseous effluents from all vent releases for long-term releases (greater than 500 hrs/year), in (μCi). Releases are cumulative over the calendar quarter or year, as appropriate.

$(\overline{X/Q})$ = The highest calculated annual average relative concentration for areas at or beyond the SITE BOUNDARY for long-term releases (greater than 500 hrs/yr). Refer to Tables 9, 10, and 12.

3.17E-08 = The inverse of the number of seconds per year.

M_i is as previously defined. (Refer to Section 3.4.1.2)

3.5.2.2 Radiological Effluent Technical Specification 3.11.2.3

! The dose to a MEMBER OF THE PUBLIC from Iodine-131 and 133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous ef-
! fluents released, to areas at and beyond the SITE BOUNDARY shall be limited to the following (Ref. 9.8.10):

a. During any calendar quarter: Less than or equal to 7.5 mrem to any organ and,

b. During any calendar year: Less than or equal to 15 mrem to any organ.

3.5.2.2.1 Radionuclides Other Than Noble Gases

! The dose to a MEMBER OF THE PUBLIC from Iodine-131 and 133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous ef-
! fluents released, to areas at and beyond the SITE BOUNDARY, is determined according to the following expressions:

During any calendar quarter:

$$D_i = 3.17E\text{-}08 \sum_i R_i \left[W Q_i + w q_i\right] \leq 7.5 \text{ mrem} \qquad (3.13)$$

During any calendar year:

$$D_i = 3.17E\text{-}08 \sum_i R_i \left[W Q_i + w q_i\right] \leq 15 \text{ mrem} \qquad (3.14)$$

Where:

! D_i = Dose to a MEMBER OF THE PUBLIC from radionuclides other than noble gases.

Q_i = The releases of radionuclides, radioactive materials in particulate form, and radionuclides other than noble gases, i, in gaseous effluents, for all vent releases for long-term releases (greater than 500 hrs/yr), in (μCi). Releases are cumulative over the calendar quarter or year as appropriate.

q_i = The releases of radionuclides, radioactive materials in particulate form and radionuclides other than noble gases, i, in gaseous effluents for all vent releases for short-term releases (equal to or less than 500 hrs/yr), in (μCi). Releases are cumulative over the calendar quarter or year as appropriate.

R_i = The dose factor for each identified radionuclide, i, in m^2(mrem/yr) per (μCi/sec) or (mrem/yr) per (μCi/m^3). (Table 5)

W = The dispersion parameter for estimating the dose to an individual at the controlling location for long-term releases (greater than 500 hrs/yr):

W = $(\overline{X/Q})$ for the inhalation and tritium pathways, in(sec/m^3).

W = $(\overline{D/Q})$ for the food and ground plane pathways, in(meters^{-2}). Refer to Tables 9, 10, and 12.

w = The dispersion parameter for estimating the dose to an individual at the controlling location for short-term releases (equal to or less than 500 hrs/yr):

w = (X/q) for the inhalation pathway, in(sec/m^3)

w = (D/q) for the food and ground plane pathway, in (meters^{-2}). Refer to Tables 9, 10, 11, and 12.

3.17 E-08 = The inverse of the number of seconds per year.

$(\overline{D/Q})$ = the average relative deposition of the effluent at or beyond the SITE BOUNDARY, considering depletion of the plume during transport, for long term releases (greater than 500 hrs/yr), in (meters^{-2}).

(D/q) = the relative deposition of the effluent at or beyond the SITE BOUNDARY, considering depletion of the plume during transport, for short term releases (less than or equal to 500 hrs/yr), in (meters^{-2}).

Note: For the direction sectors with existing pathways within 5 miles from the site, the appropriate R_i values are used. If no real pathway exists within 5 miles from the center of the building complex, the cow-milk R_i value is used, and it is assumed that this pathway exists at the 4.5 to 5.0 mile distance in the limiting-case sector. If the R_i for an existing pathway within 5 miles is less than a cow-milk R_i at 4.5 to 5.0 miles, then the value of the cow-milk R_i at 4.5 to 5.0 miles is used. (Rev. 9.8.10.)

Although the annual average relative concentration (X/Q) and the average relative deposition rate (D/Q)

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Ground Plane Pathway

(M^2 mrem/yr) per (μCi/sec)

Nuclide	Total Body	Skin
Na-24	1.19E7	1.39E7
Cr-51	4.65E6	5.51E6
Mn-54	1.39E9	1.63E9
Mn-56	9.03E5	1.07E6
Fe-59	2.72E8	3.20E8
Co-58	3.79E8	4.44E8
Co-60	2.15E10	2.53E10
Ni-65	2.97E5	3.45E5
Cu-64	6.07E5	6.88E5
Zn-65	7.47E8	8.59E8
Br-83	4.87E3	7.08E3
Br-84	2.03E5	2.36E5
Rb-86	8.99E6	1.03E7
Rb-88	3.31E4	3.78E4
Rb-89	1.23E5	1.48E5
Sr-89	2.16E4	2.51E4
Sr-91	2.15E6	2.51E6
Sr-92	7.77E5	8.63E5
Y-90	4.49E3	5.31E3
Y-91m	1.00E5	1.16E5
Y-91	1.07E6	1.21E6
Y-92	1.80E5	2.14E5
Y-93	1.83E5	2.51E5
Zr-95	2.45E8	2.84E8
Zr-97	2.96E6	3.44E6
Nb-95	1.37E8	1.61E8
Mo-99	3.98E6	4.62E6
Tc-99m	1.84E5	2.11E5
Tc-101	2.04E4	2.26E4
Ru-103	1.08E8	1.26E8
Ru-105	6.36E5	7.21E5
Ru-106	4.22E8	5.07E8
Ag-110m	3.44E9	4.01E9
Te-125m	1.55E6	2.13E6
Te-127m	9.16E4	1.08E5

TABLE 5 (Contd.)

Ground Plane Pathway

(M^2 mrem/yr) per (μCi/sec)

Nuclide	Total Body	Skin
Te-127	2.98E3	3.28E3
Te-129m	1.98E7	2.31E7
Te-129	2.62E4	3.10E4
Te-131m	8.03E6	9.46E6
Te-131	2.92E4	3.45E4
Te-132	4.23E6	4.98E6
I-130	5.51E6	6.69E6
I-131	1.72E7	2.09E7
I-132	1.23E6	1.45E6
I-133	2.45E6	2.98E6
I-134	4.47E5	5.30E5
I-135	2.51E6	2.93E6
Cs-134	6.86E9	8.00E9
Cs-136	1.53E8	1.74E8
Cs-137	1.03E10	1.20E10
Cs-138	3.59E5	4.10E5
Ba-139	1.06E5	1.19E5
Ba-140	2.05E7	2.35E7
Ba-141	4.15E4	4.73E4
Ba-142	4.44E4	5.06E4
La-140	1.92E7	2.18E7
La-142	7.40E5	8.89E5
Ce-141	1.37E7	1.54E7
Ce-143	2.31E6	2.63E6
Ce-144	6.96E7	8.04E7
Pr-144	1.84E3	2.11E3
Nd-147	8.41E6	1.01E7
W-187	2.36E6	2.74E6
Np-239	1.71E6	1.98E6

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Grass-Cow-Milk Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
H-3	ND	1.57E3	1.57E3	1.57E3	1.57E3	1.57E3	1.57E3
C-14	1.19E9	2.39E8	2.39E8	2.39E8	2.39E8	2.39E8	2.39E8
Na-24	8.89E6	8.89E6	8.89E6	8.89E6	8.89E6	8.89E6	8.89E6
P-32	7.77E10	3.64E9	3.00E9	ND	ND	ND	2.15E9
Cr-51	ND	ND	1.03E5	5.65E4	1.56E4	1.04E5	5.40E6
Mn-54	ND	2.10E7	5.59E6	ND	5.88E6	ND	1.76E7
Mn-56	ND	1.29E-2	2.90E-3	ND	1.56E-2	ND	1.86E0
Fe-55	1.12E8	5.93E7	1.84E7	ND	ND	3.35E7	1.10E7
Fe-59	1.20E8	1.94E8	9.69E7	ND	ND	5.64E7	2.02E8
Co-58	ND	1.21E7	3.71E7	ND	ND	ND	7.07E7
Co-60	ND	4.32E7	1.27E8	ND	ND	ND	2.39E8
Ni-68	2.69E10	1.59E9	1.01E9	ND	ND	ND	1.07E8
Ni-65	1.66E0	1.56E-1	9.01E-2	ND	ND	ND	1.91E1
Cu-64	ND	7.46E4	4.51E4	ND	1.80E5	ND	3.50E6
Zn-65	4.13E9	1.10E10	6.85E9	ND	6.94E9	ND	1.93E9
Zn-69	0	0	0	ND	0	ND	1.12E-9
Br-83	ND	ND	ND	ND	ND	ND	ND
Br-84	ND	ND	ND	ND	ND	ND	ND
Br-85	ND	ND	ND	ND	ND	ND	ND
Rb-86	ND	8.80E9	5.41E9	ND	ND	ND	5.66E8
Rb-88	ND	0	0	ND	ND	ND	0
Rb-89	ND	0	0	ND	ND	ND	0
Sr-89	6.62E9	ND	1.89E8	ND	ND	ND	2.56E8
Sr-90	1.12E11	ND	2.83E10	ND	ND	ND	1.51E9
Sr-91	1.30E5	ND	4.92E3	ND	ND	ND	2.88E5

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Grass-Cow-Milk Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Sr-92	2.18E0	ND	8.75E-2	ND	ND	ND	4.13E1
Y-90	3.22E2	ND	8.62E0	ND	ND	ND	9.17E5
Y-91m	0	ND	0	ND	ND	ND	0
Y-91	3.90E4	ND	1.04E3	ND	ND	ND	5.20E6
Y-92	2.53E-4	ND	7.24E-6	ND	ND	ND	7.31E0
Y-93	1.05E0	ND	2.90E-2	ND	ND	ND	1.57E4
Zr-95	3.83E3	8.42E2	7.50E2	ND	1.21E3	ND	8.79E5
Zr-97	1.92E0	2.77E-1	1.64E-1	ND	3.98E-1	ND	4.20E4
Nb-95	3.18E5	1.24E5	8.84E4	ND	1.16E5	ND	2.29E8
Mo-99	ND	8.14E7	2.01E7	ND	1.74E8	ND	6.73E7
Tc-99m	1.32E1	2.59E1	4.29E2	ND	3.76E2	1.32E1	1.47E4
Tc-101	0	0	0	ND	0	0	0
Ru-103	4.28E3	ND	1.65E3	ND	1.08E4	ND	1.11E5
Ru-105	3.82E-3	ND	1.39E-3	ND	3.36E-2	ND	2.49E0
Ru-106	9.24E4	ND	1.15E4	ND	1.25E5	ND	1.44E6
Ag-110m	2.09E8	1.41E8	1.13E8	ND	2.63E8	ND	1.68E10
Te-125m	7.38E7	2.00E7	9.84E6	2.07E7	ND	ND	7.12E7
Te-127m	2.08E8	5.60E7	2.47E7	4.97E7	5.93E8	ND	1.68E8
Te-127	3.05E3	8.22E2	6.54E2	2.11E3	8.67E3	ND	1.19E5
Te-129m	2.71E8	7.57E7	4.21E7	8.74E7	7.96E8	ND	3.31E8
Te-129	0	0	0	0	2.90E-9	ND	6.17E-8
Te-131m	1.60E6	5.53E5	5.89E5	1.14E6	5.35E6	ND	2.24E7
Te-131	0	0	0	0	0	ND	0
Te-132	1.02E7	4.52E6	5.46E6	6.58E6	4.20E7	ND	4.55E7
I-130	1.73E6	3.49E6	1.80E6	3.84E8	5.22E6	ND	1.63E6

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Grass-Cow-Milk Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
I-131	1.30E9	1.31E9	7.45E8	4.33E11	2.15E9	ND	1.17E8
I-132	6.02E-1	1.11E0	5.08E-1	5.13E1	1.69E0	ND	1.30E0
I-133	1.74E7	2.15E7	8.13E6	3.99E9	3.58E7	ND	8.66E6
I-134	0	0	0	0	0	ND	0
I-135	5.40E4	9.72E4	4.60E4	8.61E6	1.49E5	ND	7.40E4
Cs-134	2.26E10	3.72E10	7.84E9	ND	1.15E10	4.13E9	2.00E8
Cs-136	1.01E9	2.77E9	1.79E9	ND	1.48E9	2.20E8	9.74E7
Cs-137	3.22E10	3.09E10	4.56E9	ND	1.01E10	3.62E9	1.93E8
Cs-138	0	0	0	ND	0	0	0
Ba-139	1.89E-7	0	5.48E-9	ND	0	0	1.09E-5
Ba-140	1.17E8	1.03E5	6.84E6	ND	3.34E4	6.12E4	5.93E7
Ba-141	0	0	0	ND	0	0	0
Ba-142	0	0	0	ND	0	0	0
La-140	1.95E1	6.80E0	2.29E0	ND	ND	ND	1.90E5
La-142	0	0	0	ND	ND	ND	2.90E-6
Ce-141	2.19E4	1.09E4	1.62E3	ND	4.78E3	ND	1.36E7
Ce-143	1.87E2	1.02E5	1.47E1	ND	4.26E1	ND	1.49E6
Ce-144	1.62E6	5.09E5	8.66E4	ND	2.82E5	ND	1.33E8
Pr-143	7.19E2	2.16E2	3.57E1	ND	1.17E2	ND	7.75E5
Pr-144	0	0	0	ND	0	ND	0
Nd-147	4.45E2	3.61E2	2.79E1	ND	1.98E2	ND	5.71E5
W-187	2.91E4	1.73E4	7.73E3	ND	ND	ND	2.42E6
Np-239	1.72E1	1.23E0	8.68E-1	ND	3.57E0	ND	9.14E4

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Grass-Goat-Milk Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
H-3	ND	3.20E3	3.20E3	3.20E3	3.20E3	3.20E3	3.20E3
C-14	1.19E9	2.39E8	2.39E8	2.39E8	2.39E8	2.39E8	2.39E8
Na-24	1.07E6	1.07E6	1.07E6	1.07E6	1.07E6	1.07E6	1.07E6
P-32	9.33E10	4.37E9	3.60E9	ND	ND	ND	2.58E9
Cr-51	ND	ND	1.23E4	6.78E3	1.87E3	1.25E4	6.48E5
Mn-54	ND	2.52E6	6.70E5	ND	7.06E5	ND	2.11E6
Mn-56	ND	1.54E-3	3.49E-4	ND	1.87E-3	ND	2.24E-1
Fe-55	1.45E6	7.71E5	2.39E5	ND	ND	4.36E5	1.43E5
Fe-59	1.56E6	2.53E6	1.26E6	ND	ND	7.33E5	2.63E6
Co-58	ND	1.45E6	4.45E6	ND	ND	ND	8.49E6
Co-60	ND	5.18E6	1.53E7	ND	ND	ND	2.87E7
Ni-63	3.56E9	1.90E8	1.21E8	ND	ND	ND	1.28E7
Ni-65	1.99E-1	1.87E-2	1.09E-2	ND	ND	ND	2.29E0
Cu-64	ND	8.31E3	5.02E3	ND	2.01E4	ND	3.90E5
Zn-65	4.96E8	1.32E9	8.22E8	ND	8.33E8	ND	2.32E8
Zn-69	0	0	0	ND	0	ND	1.35E-10
Br-83	ND	ND	ND	ND	ND	ND	ND
Br-84	ND	ND	ND	ND	ND	ND	ND
Br-85	ND	ND	ND	ND	ND	ND	ND
Rb-86	ND	1.06E9	6.50E8	ND	ND	ND	6.80E7
Rb-88	ND	0	0	ND	ND	ND	0
Rb-89	ND	0	0	ND	ND	ND	0
Sr-89	1.39E10	ND	3.97E8	ND	ND	ND	5.38E8
Sr-90	2.35E11	ND	5.95E10	ND	ND	ND	3.16E9
Sr-91	2.74E5	ND	1.03E4	ND	ND	ND	6.04E5

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Grass-Goat-Milk Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Sr-92	4.58E0	ND	1.84E-1	ND	ND	ND	8.68E1
Y-90	3.87E1	ND	1.03E0	ND	ND	ND	1.10E5
Y-91m	0	ND	0	ND	ND	ND	0
Y-91	4.68E3	ND	1.25E2	ND	ND	ND	6.24E-5
Y-92	3.04E-5	ND	8.69E-7	ND	ND	ND	8.77E-1
Y-93	1.27E-1	ND	3.48E-3	ND	ND	ND	1.89E3
Zr-95	4.60E2	1.01E2	9.00E1	ND	1.45E2	ND	1.05E5
Zr-97	2.30E-1	3.33E-2	1.96E-2	ND	4.78E-2	ND	5.04E3
Nb-95	3.81E4	1.48E4	1.06E4	ND	1.39E4	ND	2.75E7
Mo-99	ND	9.76E6	2.42E6	ND	2.09E7	ND	8.08E6
Tc-99m	1.59E0	3.11E0	5.15E1	ND	4.52E1	1.58E0	1.77E3
Tc-101	0	0	0	ND	0	0	0
Ru-103	5.14E2	ND	1.98E2	ND	1.29E3	ND	1.33E4
Ru-105	4.58E-4	ND	1.66E-4	ND	4.03E-3	ND	2.99E-1
Ru-106	1.11E4	ND	1.38E3	ND	1.50E4	ND	1.72E5
Ag-110m	2.51E7	1.69E7	1.35E7	ND	3.15E7	ND	2.01E9
Te-125m	8.85E6	2.40E6	1.18E6	2.48E6	ND	ND	8.54E6
Te-127m	2.50E7	6.72E6	2.96E6	5.97E6	7.12E7	ND	2.02E7
Te-127	3.66E2	9.86E1	7.85E1	2.53E2	1.04E3	ND	1.43E4
Te-129m	3.25E7	9.09E6	5.05E6	1.05E7	9.55E7	ND	3.97E7
Te-129	0	0	0	0	0	ND	7.40E-9
Te-131m	1.92E5	6.64E4	7.07E4	1.37E5	6.43E5	ND	2.69E6
Te-131	0	0	0	0	0	ND	0
Te-132	1.23E6	5.42E5	6.55E5	7.90E5	5.04E6	ND	5.46E6
I-130	2.07E6	4.19E6	2.16E6	4.61E8	6.26E6	ND	1.96E6

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Grass-Goat-Milk Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
I-131	1.56E9	1.57E9	8.94E8	5.20E11	2.58E9	ND	1.40E8
I-132	7.22E-1	1.33E0	6.10E-1	6.15E1	2.03E0	ND	1.56E0
I-133	2.09E7	2.58E7	9.76E6	4.79E9	4.30E7	ND	1.04E7
I-134	0	0	0	0	0	ND	0
I-135	6.48E4	1.17E5	5.52E4	1.03E7	1.79E5	ND	8.88E4
Cs-134	6.79E10	1.11E11	2.35E10	ND	3.45E10	1.24E10	6.01E8
Cs-136	3.03E9	8.32E9	5.38E9	ND	4.43E9	6.61E8	2.92E8
Cs-137	9.67E10	9.26E10	1.37E10	ND	3.02E10	1.09E10	5.80E8
Cs-138	0	0	0	ND	0	0	0
Ba-139	2.27E-8	0	0	ND	0	0	1.31E-6
Ba-140	1.41E7	1.23E4	8.20E5	ND	4.01E3	7.34E3	7.12E6
Ba-141	0	0	0	ND	0	0	0
Ba-142	0	0	0	ND	0	0	0
La-140	2.34E0	8.17E-1	2.75E-1	ND	ND	ND	2.28E4
La-142	0	0	0	ND	ND	ND	3.49E-7
Ce-141	2.62E3	1.31E3	1.94E2	ND	5.74E2	ND	1.63E6
Ce-143	2.25E1	1.22E4	1.77E0	ND	5.12E0	ND	1.79E5
Ce-144	1.95E5	6.11E4	1.04E4	ND	3.38E4	ND	1.59E7
Pr-143	8.62E1	2.59E1	4.28E0	ND	1.40E1	ND	9.30E4
Pr-144	0	0	0	ND	0	ND	0
Nd-147	5.34E1	4.33E1	3.35E0	ND	2.37E1	ND	6.85E4
W-187	3.49E3	2.07E3	9.27E2	ND	ND	ND	2.90E5
Np-239	2.06E0	1.48E-1	1.04E-1	ND	4.28E-1	ND	1.10E4

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Vegetation Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
H-3	ND	4.01E3	4.01E3	4.01E3	4.01E3	4.01E3	4.01E3
C-14	8.89E8	1.78E8	1.78E8	1.78E8	1.78E8	1.78E8	1.78E8
Na-24	3.75E5	3.75E5	3.75E5	3.75E5	3.75E5	3.75E5	3.75E5
P-32	3.37E9	1.57E8	1.30E8	ND	ND	ND	9.30E7
Cr-51	ND	ND	1.17E5	6.50E4	1.78E4	1.19E5	6.21E6
Mn-54	ND	6.65E8	1.77E8	ND	1.86E8	ND	5.58E8
Mn-56	ND	1.88E1	4.24E0	ND	2.27E1	ND	2.72E3
Fe-55	8.01E8	4.25E8	1.32E8	ND	ND	2.40E8	7.87E7
Fe-59	3.97E8	6.43E8	3.20E8	ND	ND	1.86E8	6.69E8
Co-58	ND	6.44E7	1.97E8	ND	ND	ND	3.76E8
Co-60	ND	3.78E8	1.12E9	ND	ND	ND	2.10E9
Ni-63	3.95E10	2.11E9	1.34E9	ND	ND	ND	1.42E8
Ni-65	1.05E2	9.89E0	5.77E0	ND	ND	ND	1.21E3
Cu-64	ND	1.10E4	6.64E3	ND	2.66E4	ND	5.16E5
Zn-65	8.12E8	2.16E9	1.35E9	ND	1.36E9	ND	3.80E8
Zn-69	1.09E-5	1.57E-5	1.45E-6	ND	9.52E-6	ND	9.11E-4
Br-83	ND	ND	5.37E0	ND	ND	ND	0
Br-84	ND	ND	0	ND	ND	ND	0
Br-85	ND	ND	0	ND	ND	ND	0
Rb-86	ND	4.58E8	2.82E8	ND	ND	ND	2.94E7
Rb-88	ND	0	0	ND	ND	ND	0
Rb-89	ND	0	0	ND	ND	ND	0
Sr-89	3.59E10	ND	1.03E9	ND	ND	ND	1.39E9
Sr-90	1.24E12	ND	3.15E11	ND	ND	ND	1.67E10
Sr-91	5.24E5	ND	1.98E4	ND	ND	ND	1.16E6

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Vegetation Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Sr-92	7.28E2	ND	2.92E1	ND	ND	ND	1.38E4
Y-90	2.31E4	ND	6.18E2	ND	ND	ND	6.57E7
Y-91m	6.87E-9	ND	3.23E-10	ND	ND	ND	1.74E-5
Y-91	1.86E7	ND	4.99E5	ND	ND	ND	2.48E9
Y-92	1.58E0	ND	4.53E-2	ND	ND	ND	4.58E4
Y-93	3.01E2	ND	8.25E0	ND	ND	ND	4.48E6
Zr-95	3.86E6	6.45E5	7.55E5	ND	1.21E6	ND	8.84E8
Zr-97	5.70E2	8.24E1	4.86E1	ND	1.18E2	ND	1.25E7
Nb-95	4.10E5	1.59E5	1.14E5	ND	1.50E5	ND	2.95E8
Mo-99	ND	7.71E6	1.91E6	ND	1.65E7	ND	6.38E6
Tc-99m	4.71E0	9.24E0	1.53E2	ND	1.34E2	4.69E0	5.26E3
Tc-101	0	0	0	ND	0	0	0
Ru-103	1.54E7	ND	5.90E6	ND	3.87E7	ND	3.97E8
Ru-105	9.16E1	ND	3.32E1	ND	8.05E2	ND	5.98E4
Ru-106	7.45E8	ND	9.30E7	ND	1.01E9	ND	1.16E10
Ag-110m	3.22E7	2.17E7	1.74E7	ND	4.05E7	ND	2.58E9
Te-125m	3.51E8	9.50E7	4.67E7	9.84E7	ND	ND	3.38E8
Te-127m	1.32E9	3.56E8	1.57E8	3.16E8	3.77E9	ND	1.07E9
Te-127	1.00E4	2.69E3	2.14E3	6.91E3	2.84E4	ND	3.90E5
Te-129m	8.38E8	2.34E8	1.30E8	2.70E8	2.46E9	ND	1.02E9
Te-129	1.16E-3	3.23E-4	2.75E-4	8.26E-4	3.39E-3	ND	7.20E-2
Te-131m	1.54E6	5.33E5	5.68E5	1.10E6	5.16E6	ND	2.16E7
Te-131	0	0	0	0	0	ND	0
Te-132	6.98E6	3.09E6	3.73E6	4.50E6	2.87E7	ND	3.11E7
I-130	6.16E5	1.24E6	6.38E5	1.37E8	1.86E6	ND	5.79E5

TABLE 5 (Contd.)

PATHWAY DOSE FACTORS (R_i) FOR RADIONUCLIDES OTHER THAN NOBLE GASES

Vegetation Pathway

(m^2 mrem/yr) per (μCi/sec)

Nuclide	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
I-131	1.43E8	1.44E8	8.17E7	4.75E10	2.36E8	ND	1.28E7
I-132	8.58E1	1.58E2	7.25E1	7.31E3	2.41E2	ND	1.86E2
I-133	3.56E6	4.40E6	1.67E6	8.18E8	7.34E6	ND	1.77E6
I-134	1.55E-4	2.88E-4	1.32E-4	6.62E-3	4.40E-4	ND	1.91E-4
I-135	6.62E4	1.13E5	5.33E4	9.97E6	1.70E5	ND	8.58E4
Cs-134	1.60E10	2.63E10	5.55E9	ND	8.15E9	2.93E9	1.42E8
Cs-136	8.17E7	2.25E8	1.45E8	ND	1.20E8	1.78E7	7.90E6
Cs-137	2.39E10	2.29E10	3.38E9	ND	7.46E9	2.68E9	1.43E8
Cs-138	0	0	0	ND	0	0	0
Ba-139	4.80E-2	2.56E-5	1.39E-3	ND	2.24E-5	1.51E-5	2.77E0
Ba-140	2.77E8	2.42E5	1.62E7	ND	7.89E4	1.45E5	1.40E8
Ba-141	0	0	0	ND	0	0	0
Ba-142	0	0	0	ND	0	0	0
La-140	3.25E3	1.14E3	3.83E2	ND	ND	ND	3.17E7
La-142	2.50E-4	7.98E-5	2.50E-5	ND	ND	ND	1.58E1
Ce-141	6.56E5	3.27E5	4.86E4	ND	1.43E5	ND	4.08E8
Ce-143	1.72E3	9.31E5	1.35E2	ND	3.91E2	ND	1.36E7
Ce-144	1.27E8	3.98E7	6.78E6	ND	2.21E7	ND	1.04E10
Pr-143	1.46E5	4.38E4	7.25E3	ND	2.37E4	ND	1.58E8
Pr-144	0	0	0	ND	0	ND	0
Nd-147	7.17E4	5.81E4	4.50E3	ND	3.19E4	ND	9.20E7
W-187	6.47E4	3.83E4	1.72E4	ND	ND	ND	5.38E6
Np-239	2.55E3	1.83E2	1.29E2	ND	5.30E2	ND	1.36E7

TABLE 6 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Station Code	Sector	Site Description	Location
40	P	Callaway Electric Cooperative Utility Pole No. 18145	4.2 mi. @ 291° WNW
39	Q	Callaway Electric Cooperative Utility Pole No. 17516	5.4 mi. @ 312 ° NW
38	R	Callaway Electric Cooperative Utility Pole No. 34708	4.5 mi. @ 334° NNW
		Eight Stations to be placed in special interest areas such as population centers, nearby residences, schools, and in 1 or 2 areas to serve as control stations.	
33		City of Hams Prairie	7.3 mi. @ 271° W
31		City of Mokane	7.6 mi. @ 218° SW
26		Town of Americus	12.1 mi. @ 82° E
27		Town of Bluffton	9.5 mi. @ 112° ESE
35		City of Toledo	5.8 mi. @ 340° NNW
23		City of Yucatan	6.7 mi. @ 14° NNE
11		City of Portland	5.0 mi. @ 136° SE
20		City of Readsville	4.8 mi. @ 45° NE
34 (P-Control)		2.5 Miles South of O and C Junction	9.5 mi. @ 291° WNW

TABLE 6 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Station Code	Sector	Site Description	Location		
A-8	B	County Road 448, 0.9 mi. South of Highway 0	.9 mi. @ 20° NNE		
B-3	A	0.6 mile east of Highway 0 and CC Junction	1.9 mi. @ 355° NNW		
		One sample from the community with the highest D/Q			
A-9	R	Community of Reform	1.7 mi. @ 336° NNW		
		One sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction.			
A-7	Q	C. Bartley Farm	9.5 mi. @ 312° NW		
3. Waterborne[e] a. Surface		One sample upstream	Composite sample[f] over a period of less than or equal to 31 days.	Gamma isotopic analysis[d] of each sample. Tritium analysis of composite sample at least once per 92 days.	
S01	H	84 feet upstream of discharge, north bank	4.8 mi. @ 144° SE		
		One sample downstream			

TABLE 6 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Station Code	Sector	Site Description	Location		
C	G	1.0 river mile downstream of discharge, north bank	5.1 mi. @ 135° SE		
4. Ingestion					
a. Milk		Samples from milking animals in three location within 5 km distance having the highest dose potential g. If there are none, then one sample from milking animals in each of three areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per year	Semimonthly when animals are on pasture, monthly at other times.	Gamma isotopic [d] and I-131 analysis semimonthly when animals are on pasture; monthly at other times.	
		One sample from milking animals at a control location, 15 to 30 km distant and in the least prevalent wind direction.			

Due to a lack of milk animals which satisfy these requirements, the milk pathway is currently not included as a part of the Callaway Plant Radiological Environmental Monitoring Program. Should the Annual Land Use Census identify the existence of milking animals in locations which satisfy these requirements, then the program will be revised to include this pathway.

TABLE 6 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Station Code	Sector	Site Description	Location	
		Samples of three different kinds of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground-level D/Q if milk sampling is not performed.	Monthly when available	Gamma Isotopic[(d)] and I-131 analysis.
! V-6	R	Becker Farm	1.8 mi. @ 344° NNW	
! V-7	A	Meehan Farm	1.8 mi. @ 356° N	
		One sample of each of the similar broad leaf vegetation grown 15 to 30 km distant in the least prevalent wind direction if milk sampling is not performed.	Monthly when available	Gamma isotopic[(d)] analysis.
V-3	L	Hazlett Farm	15 mi. @ 224° SW	

TABLE 7

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Reporting Levels

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/kg), wet	Milk (pCi/l)	Food Product (pCi/kg, wet)
H-3	20,000 *				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zr-Nb-95	400 **				
I-131	2	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200 **			300**	

* For drinking water samples. For surface water samples a value of 30,000 pCi/l is used.

** Total activity, parent plus daughter activity.

TABLE 8

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD)[a,b,c]

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m³)	Fish (pCi/kg), wet	Milk (pCi/l)	Food Product (pCi/kg, wet)	Sediment (pCi/Kg, dry)
Gross Beta	4	.01				
H-3	2000 *					
Fe-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zr-Nb-95	15 **					
I-131	1(d)	.07		1	60	
Cs-134	15	.05	130	15	60	150
Cs-137	18	.06	150	18	80	180
Ba-La-140	15 **			15**		

* For surface water samples, a value of 3000 pCi/l is used.

** Total activity, parent plus daughter activity.

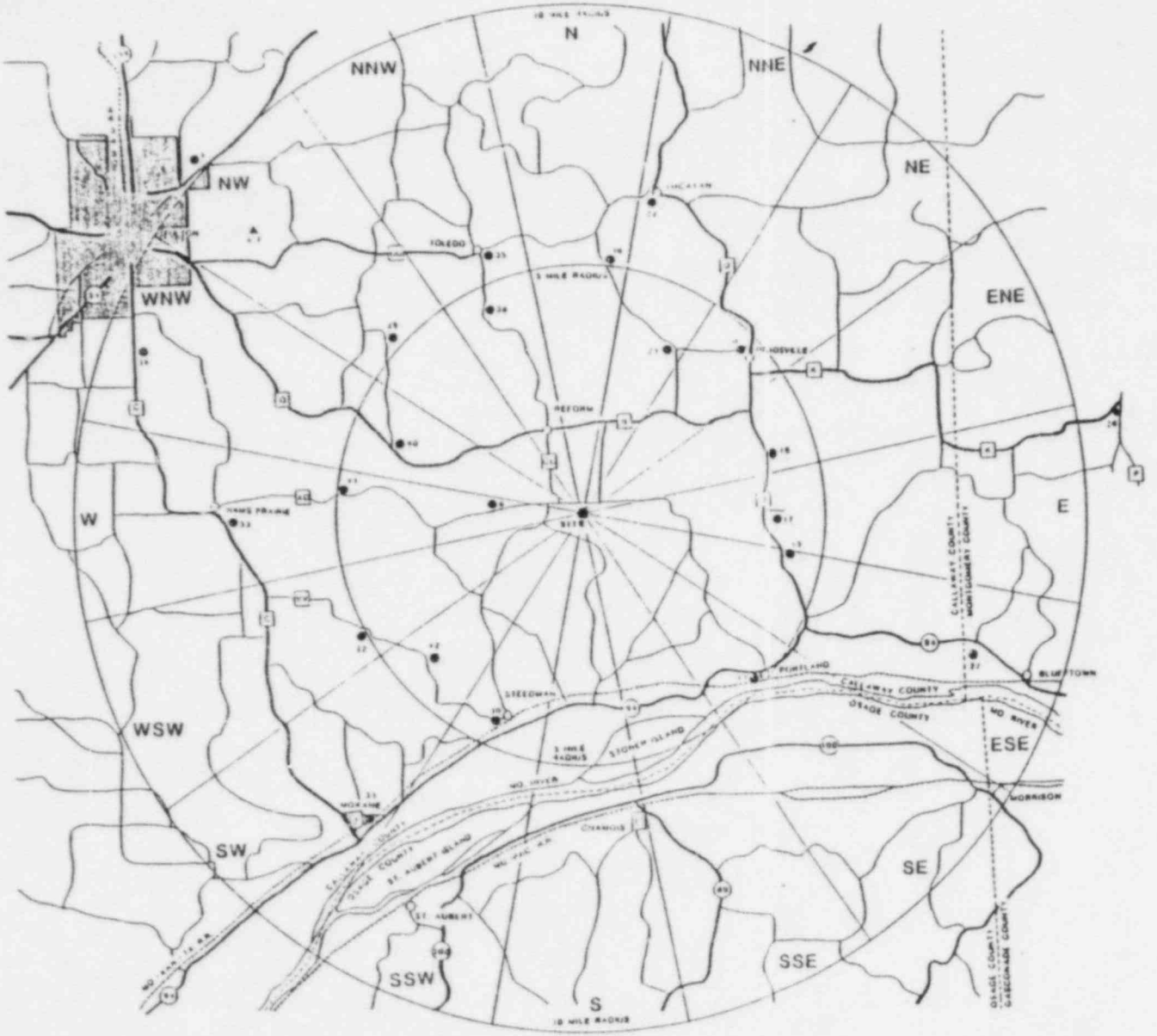
Δt = the elapsed time between sample collection (or end of the smaple collection period) and time of counting (for environmental samples, not plant effluent samples).

Typical values of E, V, Y and Δt shall be used in the calculations.

It should be recognized that the LLD is defined as a a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. Analyses are performed in such a manner that the stated LLDs are achieved under routine conditions. Occassionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report.

! (b) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be anlayzed and reported in the Annual Radiological Environmental Operating Report.

! (c) Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the reccommendations of Regulatory Guide 4.13, Revision 1, July 1977.



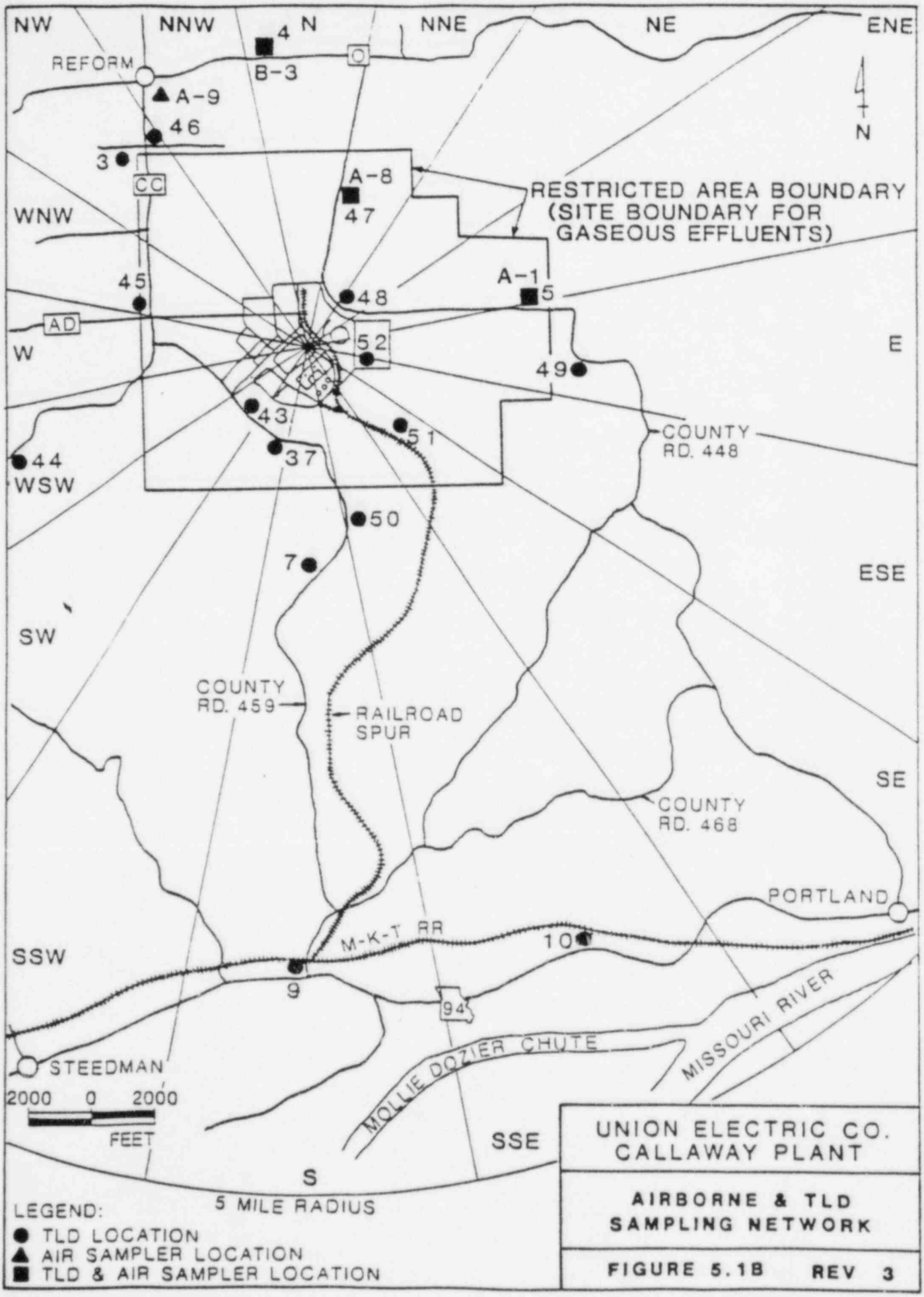
N

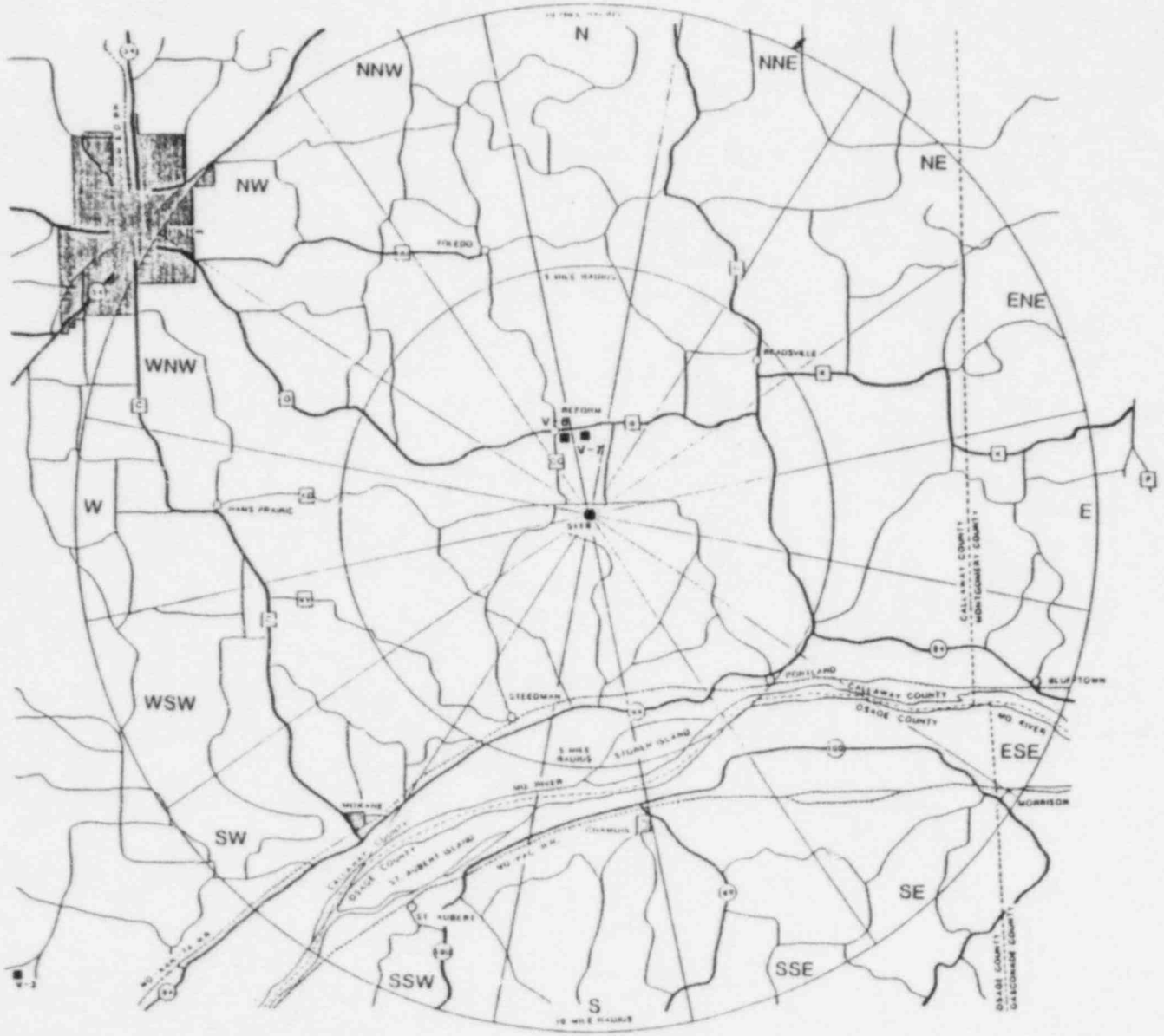
LEGEND:

- INCORPORATED COMMUNITIES
- UNINCORPORATED COMMUNITIES
- AIR SAMPLER LOCATIONS
- TLD LOCATIONS
- TLD & AIR SAMPLER LOCATIONS

REFERENCE:
THIS MAP WAS PREPARED FROM A PORTION OF THE FOLLOWING U.S.G.S. MAP:
ST. LOUIS, MO., 1982.

UNION ELECTRIC CO. CALLAWAY PLANT
AIRBORNE & TLD SAMPLING NETWORK
FIGURE 5.1A REV 3


NW
NNW
N
NNE
NE
ENE
REFORM
4
B-3
Q
A-9
46
3
CC
A-8
47
RESTRICTED AREA BOUNDARY
(SITE BOUNDARY FOR
GASEOUS EFFLUENTS)
WNW
45
A-1
5
48
AD
W
52
E
49
43
51
COUNTY
RD. 448
44
WSW
37
50
7
ESE
SW
COUNTY
RD. 459
RAILROAD
SPUR
SE
COUNTY
RD. 468
PORTLAND
M-K-T RR
10
SSW
9
94
MISSOURI RIVER
MOLLIE DOZIER CHUTE
STEEDMAN
2000 0 2000
FEET
SSE
S
5 MILE RADIUS
LEGEND:
TLD LOCATION
AIR SAMPLER LOCATION
TLD & AIR SAMPLER LOCATION
UNION ELECTRIC CO.
CALLAWAY PLANT
AIRBORNE & TLD
SAMPLING NETWORK
FIGURE 5.1B REV 3



UNION ELECTRIC CO. CALLAWAY PLANT
FOOD PRODUCTS SAMPLING LOCATIONS
FIGURE 5.3 REV 3

Values of the slope factor (S), are presented in TABLE 11.

Short term dispersion estimates are applicable to short term releases which are not sufficiently random in both time of day and duration (e.g., the short term release periods are not dependent solely on atmospheric conditions or time of day) to be represented by the annual average dispersion conditions. (Ref. 9.8.12.)

6.1.2.1 The Determination of the Slope Factor (S).

The general approach employed by subroutine PURGE of XOQDOQ (Ref. 9.17.4) was utilized to produce values of the slope of the (X/Q) curves (Slope Factor (S)) for both the Radwaste Building Vent and the Unit Vent. However, instead of using approximation procedures to produce the 15 precentile (X/Q) values, the 15 percentile (X/Q) value for each release and at each location was determined by ranking all the 1-hour $(X/Q)_1$ values for that release and at the location in descending order. The $(X/Q)_1$ value which corresponded to the 15 percentile of all the calculated (X/Q) values within a sector was extracted for use in the intermittent release (X/Q) calculation.

The intermittent release (X/Q) curve was constructed using the calculated 1-hour 15 percentile $(X/Q)_1$ and its corresponding annual average $(X/Q)_a$. A graphic representation, of how the computational procedure works is illustrated by Figure 4.8 of reference 9.17.4. The straight line connecting these points represents $(X/Q)_i$ values for intermittent releases, ranging in duration from one (1) hour to 8760 hours. The slope (S) of the curve is expressed as:

$$S = \frac{-\log\left((X/Q)_1/(X/Q)_a\right)}{\log\left(Ta/T_1\right)} \qquad (6.8)$$

or

$$S = \frac{-\left(\log (X/Q)_1 - \log (X/Q)_a\right)}{\log Ta - \log T_1} \qquad (6.9)$$

TABLE 9

HIGHEST ANNUAL AVERAGE ATMOSPHERIC DISPERSION PARAMETERS (a)

RADWASTE BUILDING VENT

LOCATION (b)	SECTOR	DISTANCE (METERS)	X/Q (sec/m³)	X/Q Decayed/Undepleted (sec/m³)	X/Q Decayed/Depleted (sec/m³)	D/Q (m^{-2})
SITE BOUNDARY	S	1300	1.3E-6	1.3E-6	1.2E-6	4.4E-9
Nearest Cow (c)	NW	5053	4.3E-7	4.2E-7	3.3E-7	1.1E-9
Nearest Goat (c)	NW	5053	4.3E-7	4.2E-7	3.3E-7	1.1E-9
Nearest Meat Animal	NNW	2736	7.6E-7	7.6E-7	6.4E-8	2.4E-9
Nearest Vegtable (c) Garden	NNW	2865	8.2E-7	8.1E-7	6.8E-7	2.5E-9
Nearest Residence(c)	NNW	2865	8.2E-7	8.1E-7	6.8E-7	2.5E-9
Boundary, Area Closed to Public Use (c)	NW	1154	4.0E-6	4.0E-6	3.5E-6	1.4E-8

(a) Values given are from FSAR, Table 2.3-84, and Table 2.3-86

(b) Data from 1984 Land Use Census

(c) Values derived from FSAR, Table 2.3-81, using the methodology presented in Equation (6.2)

Building Shape Parameter (C) = 0.5 (Ref. 9.5.4)
Vertical Height of Highest Adjacent Building (V) = 19.96 meters (Ref. 9.5.4)

TABLE 10

HIGHEST ANNUAL AVERAGE ATMOSPHERIC DISPERSION PARAMETERS (a)

UNIT VENT

LOCATION (b)	SECTOR	DISTANCE (METERS)	X/Q	X/Q Decayed/Undepleted	X/Q Decayed/Depleted	D/Q
			(sec/m^3)	(sec/m^3)	(sec/m^3)	(m^{-2})
SITE BOUNDARY	S	1300	9.9E-7	9.8E-7	8.8E-7	4.4E-9
Nearest Cow (c)	NW	5053	3.6E-7	3.6E-7	2.8E-7	1.1E-9
Nearest Goat (c)	NW	5053	3.6E-7	3.6E-7	2.8E-7	1.1E-9
Nearest Meat Animal	NNW	2736	5.9E-7	5.9E-7	5.0E-7	2.4E-9
Nearest Vegtable (c) Garden	NNW	2865	6.4E-7	6.3E-7	5.3E-7	2.5E-9
Nearest Residence(c)	NNW	2865	6.4E-7	6.3E-7	5.3E-7	2.5E-9
Boundary, Area Closed to Public Use (c)	NW	1154	2.8E-6	2.8E-6	2.5E-6	1.4E-8

(a) Values given are from FSAR, Table 2.3-82, and Table 2.3-85

(b) Data from 1984 Land Use Census

(c) Values derived from FSAR, Table 2.3-83, using the methodology presented in Equation (6.2)

Building Shape Parameter (C) = 0.5 (Ref. 9.5.4)
Vertical Height of Highest Adjacent Building (V) = 66.45 meters (Ref. 9.5.4)

TABLE 11

SHORT TERM DISPERSION PARAMETERS (a) (c)

Location (b)	Sector	Distance (meters)	Slope Factor(S) Unit Vent	Slope Factor(S) Radwaste Building Vent
Site Boundary	S	1300	-.328	-.320
Nearest Cow	NW	5053	-.263	-.266
Nearest Goat	NW	5053	-.263	-.266
Nearest Meat Animal	NNW	2736	-.262	-.268
Nearest Vegetable Garden	NNW	2865	-.264	-.268
Nearest Residence	NNW	2865	-.264	-.268

(a) Reference 9.5.4
(b) Data from 1984 Land Use Census
(c) Recirculation Factor = 1.0

7.0 SEMI-ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

Routine Radioactive Effluent Release Reports covering the operation of the unit during the previous 6 months of operation are submitted within 60 days after January 1 and July 1 of each year. The period of the first report begins with the date of initial criticality.

The Radioactive Effluent Release Reports include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof. For solid wastes, the format for Table 3 in Appendix B is supplemented with three additional categories: class of solid waste (as defined by 10 CFR ! Part 61), type of container (e.g., LSA, Type A, Type B, ! Large Quantity), and SOLIDIFICATION agent or absorbent ! (e.g., cement, urea formaldehyde).

The Radioactive Effluent Release Report to be submitted within 60 days after January 1 of each year includes an annual summary of hourly meteorological data collected over the previous year which may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation, or in the form of joint frequency distributions of wind speed wind direction, and atmospheric stability.* This same report includes an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year. This same report also includes, the asessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY during the report period. All assumptions used in making these assessments, i.e., specific activity, exposure time and location, is included in ! these reports. Acceptable methods for calculating the ! dose contributions from liquid and gaseous effluents ! are given in Regulatory Guide 1.109, and the ODCM.

The Radioactive Effluent Release Report to be submitted 60 days after January 1 of each year also includes, as required by Technical Specification 3.11.4, an assessment of radition doses to the likely most exposed MEMBER OF THE PUBLIC from Reactor releases and other nearby uranium fuel cycle sources, including doses from primary effluent pathways and direct radiation, for the

previous calender year to show conformance with 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation".

The Radioactive Effluent Release Reports include a list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

The Radioactive Effluent Release Reports include any changes made during the reporting period to the PROCESS CONTROL PROGRAM and to the ODCM, pursuant to Specification 6.13 and 6.14, respectively, as well as any major change to Liquid, Gaseous, or Solid Radwaste Treatment System, pursuant to Specification 6.15. It also includes a listing of new locations for dose calculations and or environmental monitoring identified by the Land Use Census pursuant to Specification 3.12.2.

The Radioactive Effluent Release Reports also include the following information: An explanation as to why the inoperability of liquid or gaseous effluent monitoring instrumentation was not corrected within the time specified in Specification 3.3.3.10 or 3.3.3.11, respectively; and description of the events leading to liquid holdup tanks or gas storage tanks exceeding the limits of Specification 3.11.1.4 or 3.11.2.5, respectively.

*In lieu of submission, the Union Electric Company has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

(Ref.9.4)

8.0 IMPLEMENTATION OF ODCM METHODOLOGY

The ODCM provides the mathematical relationships used to implement the Radiological Effluent Technical Specifications.

For routine effluent release and dose assessment, computer codes are utilized to implement the ODCM
! methodologies. These codes have been evaluated by a
! qualified independent reviewer to ensure that they pro-
! duce results consistent with the methodologies pre-
! sented in the ODCM. (Ref. 9.5.5)

9.0 REFERENCES

9.1 Title 10, "Energy", Chapter 1, Code of Federal Regulations, Part 20; U.S. Government Printing Office, Washington, D.C. 20402.

9.2 Title 10, "Energy", Chapter 1, Code of Federal Regulations, Part 50, Appendix I; U.S. Government Printing Office, Washington, D.C. 20402.

9.3 Title 40, "Protection of Environment", Chapter 1, Code of Federal Regulations, Part 190; U.S. Government Printing Office, Washington, D.C. 20402.

9.4 Callaway Technical Specifications, Section 3.3.3.9, 3.3.3.10, 3/4.11, 3/4.12, and 6.9.1.7 as submitted to the U.S. Nuclear Regulatory Commisssion, August 1983.

9.5 Communications

9.5.1 Letter NEO-54, D.W. Capone to S.E. Miltenberger, dated January 5, 1983; Union Electric Company correspondence.

9.5.2 Letter BLUE 1285, "Callaway Annual Average X/Q and D/Q Values", J. H. Smith (Bechtel Power Corporation), to D. W. Capone (Union Electric Co.), dated February 27, 1984.

9.5.3 Letter BLUE 1159, J. H. Smith (Bechtel Power Corporation) to D. W. Capone (Union Electric Company), dated January 18, 1984.

9.5.4 Letter BLUE 1232, "Callaway Annual Average X/Q Values and "S" Values", J. H. Smith (Bechtel Power Corporation) to D. W. Capone (Union Elecctric Co.), dated February 9, 1984.

! 9.5.5 Letter BLUE 1358, "Comparison of Callaway
! Plant Offsite Dose Calculations for Routine
! Effluents", J.H. Smith (Bechtel Power Corpora-
! tion) to D.W. Capone (Union Electric Company),
! dated March 22, 1984.

9.6 Union Electric Company Callaway Plant, Unit 1, Final Safety Analysis Report.

9.6.1 Section 11.5.2.2.3.1

9.6.2 Section 11.5.2.2.3.4

9.6.3 Section 11.5.2.1.2

9.6.4 Section 11.5.2.2.3.2

9.6.5 Section 11.5.2.2.3.3

9.6.6 Section 11.2.3.3.4

9.6.7 Section 11.2.3.4.3

9.6.8 Section 11.5.2.3.3.1

9.6.9 Section 11.5.2.3.3.2

9.6.10 Section 11.5.2.3.2.3

9.6.11 Section 11.5.2.3.2.2

9.6.12 Section 2.3.5

9.6.13 Section 2.3.5.1

! 9.6.14 Section 2.3.5.2.1.2

9.6.15 (Reference Deleted)

9.6.16 (Reference Deleted)

9.6.17 Section 9.2.6

9.6.18 Section 9.2.7.2.1

9.6.19 Section 6.3.2.2

9.6.20 Table 11.1-6

9.6.21 Table 9.4-6

9.6.22 Table 9.4-8

9.6.23 Table 9.4-11

9.6.24 Table 9.4-12

9.6.25 Table 2.3-66

9.6.26 Table 2.3-68

9.7 Union Electric Company Callaway Plant Environmental Report, Operating License Stage.

9.7.1 Table 2.1-19

9.7.2 Section 2.1.2.3

9.7.3 Section 2.1.3.2.8

9.7.4 Section 2.1.3.3.4

9.7.5 Section 2.1.3.1.3

9.7.6 Section 5.2.4.1

9.7.7 Table 2.1-19

9.8 U.S. Nuclear Regulatory Commission, "Preparation of Radiological Effluent Technical Specification For Nuclear Power Plants", USNRC NUREG-0133, Washington, D.C. 20555, October 1978.

9.8.1 Pages AA-1 through AA-3

9.8.2 Section 5.3.1.3

9.8.3 Section 4.3

9.8.4 Section 4.3.1

9.8.5 Section 5.3.1.5

9.8.6 Section 5.1.1

9.8.7 Section 5.1.2

9.8.8 Section 5.2.1

9.8.9 Section 5.2.1.1

9.8.10 Section 5.3.1

9.8.11 Section 3.8

9.8.12 Section 3.3

9.9 U.S. Nuclear Regulatory Commission, "XOQDOQ, Program For the Meterological Evaluation Of Routine Effluent Releases At Nuclear Power Stations", USNRC NUREG-0324, Washington, D.C. 20555.

9.9.1 Pages 19-20 Subroutine PURGE

9.10 Regulatory Guide 1.111, "Methods For Estimating Atmospheric Transport And Dispersion of Gaseous Effluents In Routine Releases From Light-Water-Cooled Reactors", Revision 1, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, July, 1977.

9.10.1 Section c.1.b

9.10.2 Figures 3 through 6

9.10.3 Figures 7 through 10

9.10.4 (Reference Deleted)

9.10.5 Section c.4

9.11 Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases Of Reactor Effluents For the Purpose Of Evaluating Compliance With 10 CFR Part 50, Appendix I", Revision 1, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, October 1977.

9.11.1 Appendix C, Section 3.a

9.11.2 Appendix E, Table E-15

9.11.3 Appendix C, Section 1

9.12 U.S. Nuclear Regulatory Commission, "Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190)", USNRC NUREG-0543, Washington, D.C. 20555, January 1980.

9.12.1 Section I, Page 2

9.12.2 Section IV, Page 8

9.12.3 Section IV, Page 9

9.12.4 Section III, Page 6

9.13 U.S. Nuclear Regulatory Commission, "Standard Radiological Effluent Technical Specifications for Pressurized Water Reactors", USNRC NUREG-0472, Draft Revision 3, Washington, D.C. 20555, January 1983.

9.13.1 Definition 1.7, Page 1-2

9.14 Management Agreement for the Public Use of Lands, Union Electric Company and the State of Missouri Department of Conservation, December 21, 1982.

9.14.1 Exhibit A

9.15 Wildlife Code of Missouri, Rules of the Conservation Commission, Issued January 1, 1983.

9.16 Miscellaneous References

9.16.1 Drawing Number M-109-0007-06, Revision 5.

9.17 U.S. Nuclear Regulatory Commission, "X0QDOQ: Computer Program for the Meterological Evaluation of Routine Effluent Releases at Nuclear Power Stations", USNRC NUREG/CR-2929, September, 1982, Washington, D.C. 20555.

9.17.1 Section 4.1, "Subroutine ANNUAL", pages 23-25.

9.17.2 Section 4.1, "Subroutine ANNUAL", page 25.

9.17.3 Section 4.2, "Subroutine DEPOS", page 26.

9.17.4 Section 4, "Subroutine PURGE", pages 27 and 28.

ATTACHMENT 4

DESCRIPTION OF RADWASTE TREATMENT SYSTEM CHANGES

This Attachment contains the following:

1. ULNRC-937, Mr. Donald F. Schnell to Mr. Harold R. Denton, dated October 3, 1984.

   page 1 through 10

2. Letter Mr. B. J. Youngblood to Mr. D. F. Schnell, Subject: Callaway Plant, Unit 1 - Amendment No. 2 to License NPF-30.

   page 1 through 9

ATTACHMENT 4

Received

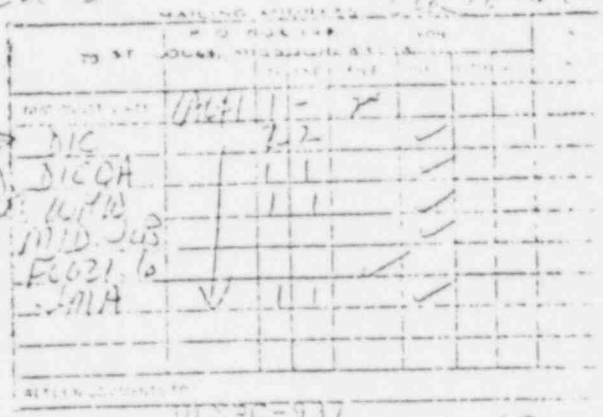
OCT 05 1984

Nuclear Constr.

UNION ELECTRIC COMPANY
1901 GRATIOT STREET
ST. LOUIS, MISSOURI

DONALD F. SCHNELL
VICE PRESIDENT

CUD-17,326



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COPY

October 1, 1984

Mr. Harold R. Denton
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

A11.43
A11.40

DOCKET NUMBER 50-483
CALLAWAY PLANT, UNIT 1
ADDITION TO TECHNICAL SPECIFICATION TABLE 4.11-1

Union Electric Company is transmitting three (3) original and forty (40) conformed copies of an application for Amendment to Facility Operating License No. NPF-25 for the Callaway Plant, Unit 1.

This application requests that Technical Specification Table 4.11-1 be revised to include two additional Batch Waste Release Tanks. Two 100,000 gallon tanks are required for storage and/or discharge due to an increase in the volume of secondary liquid waste, specifically waste from condensate demineralizer regenerations. Originally, the volume of waste from regeneration of the condensate demineralizers was estimated at 17,000 gallons per day. Recent operating experience has shown waste volumes averaging 43,000 gallons per day. Two additional 100,000 gallon tanks should provide adequate capability based on revised estimates.

The proposed changes would become effective for Union Electric implementation upon NRC approval. Attachment 1 to this letter describes all enclosures transmitted herewith.

Enclosed is a check for the $150 application fee requested by 10CFR171.21.

RECEIVED
OCT 0 5 1984
DANIEL DOCUMENT CONTROL
PROJECT 7186

Very truly yours,

Donald F. Schnell

Donald F. Schnell

1 - Petts - 1
1 - Warfel - 1
3 - Berg - 1
35 - Smith - 1

DJM/lw

Attachments

ATTACHMENT 4

STATE OF MISSOURI)
) S S
CITY OF ST. LOUIS)

Donald F. Schnell, of lawful age, being first duly sworn upon oath says that he is Vice President-Nuclear and an officer of Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Donald F. Schnell
Donald F. Schnell
Vice President
Nuclear

SUBSCRIBED and sworn to before me this 3rd day of October, 1984

Barbara J. Peaff

BARBARA J. PEAFF
NOTARY PUBLIC, STATE OF MISSOURI
MY COMMISSION EXPIRES APRIL 22, 1985
ST. LOUIS COUNTY

Attachment 1

Enclosure A	Safety Evaluation
Enclosure B	Significant Hazards Consideration
Enclosure C	Marked Technical Specification Pages
Enclosure D	Environmental Evaluation

ATTACHMENT 4

10/1/84

Safety Evaluation

This amendment request is for revision of Technical Specification Table 4.11-1 to include two additional Batch Waste Release Tanks. These two 100,000 gallon tanks are required for storage and/or discharge due to an increase in the volume of secondary liquid waste; specifically waste from condensate demineralizer regenerations. Originally, the volume of waste from regeneration of the condensate demineralizers was estimated at 17,000 gallons per day. Recent operating experience has shown waste volumes averaging 43,000 gallons per day. Waste water from demineralizers will be neutralized and processed through a filter to remove total suspended solids. No other treatment will be provided unless it is required to meet NPDES limits for discharge or Technical Specification limits. If a primary to secondary leak should occur, this waste stream would be processed through a filter, the secondary liquid waste evaporator, and a demineralizer for discharge or for recycle.

The tanks will be located near the southwest corner of the radwaste building and will be protected by a concrete dike built to contain one tank volume in the event of a tank failure. Tank overflows will be piped directly to the diked area sump. The drain from this sump will be directed to the Dirty Radwaste Equipment and Floor Drain system. High level alarms on the tanks will immediately signal valves to close on the tank fill lines and to trip off the system's transfer pumps which will terminate flow going to the tanks. A radiation monitor located inside the radwaste building will continuously monitor waste water being discharged from the tanks to the discharge line. A valve located downstream of this monitor will be isolated on a high radiation signal which will terminate the discharge.

Quality requirements and design features of the system will comply with Regulatory Guide 1.143.

Water can also be routed to these tanks from liquid radwaste and steam generator blowdown; however, the volume of waste from these waste streams is not expected to increase from the expected flows given in the FSAR Chapter 11. Since the proposed tanks will contain mainly secondary liquid waste, the activity in these tanks is expected to be considerably less than that of the refueling water storage tank. A greater volume of waste water will be discharged than originally estimated; however, because the activity of the secondary liquid waste system is normally negligable, the amount of radioactivity released to the environment will not increase significantly and will not approach the activities for liquid effluents given in Table 11.2-1 of the FSAR. Therefore, the revision to this Technical Specification does not adversely affect or endanger the health or safety of the general public and does not involve an unreviewed safety question.

ATTACHMENT 4

ENCLOSURE 3
NLS-84-037
10/3/84

Significant Hazards Consideration

This amendment request is for revision of Technical Specification Table 4.11-1 to include two additional Batch Waste Release Tanks. These two 100,000 gallon tanks are required for storage and/or discharge due to an increase in the estimated volume of secondary liquid waste, specifically waste from condensate demineralizer regenerations. Originally, the volume of waste from regeneration of the condensate demineralizers was estimated at 17,000 gallons per day. Recent operating experience has shown waste volumes averaging 43,000 gallons per day. The two tanks will be protected by a concrete dike built to contain one tank volume in the event of a tank failure. Tank overflows will be piped directly to the diked area sump. The drain from this sump will be directed to the Dirty Radwaste Equipment and Floor Drain system. The activity in these tanks is expected to be considerably less than the activity in the refueling water storage tank, or in the reactor makeup water storage tank, since the largest portion of water going to these tanks will be secondary liquid waste. Although a greater volume of waste water will be discharged from original estimates, the volume of waste from waste streams is not expected to increase from the flows given in Chapter 11 of the FSAR. In addition the activity of the secondary liquid waste system is normally negligable and the amount of radioactivity released to the environment will not increase significantly. The activities will not approach the activities for liquid effluents given in Table 11.2-1 of the FSAR.

The Commission has provided guidance concerning the application of the standards in 10 CFR 50.92 by providing certain examples (48 FR 14870). One of the examples of actions involving no significant hazards consideration relates to a change that constitutes an additional limitation, restriction, or control not presently in the Technical Specifications. The addition of two 100,000 gallon tanks will provide additional liquid waste system control not presently in the Technical Specifications.

This amendment request does not involve a significant increase in the probability or consequence of an accident or other adverse condition over previous evaluations; or create the possibility of a new or different kind of accident or condition over previous evaluations; or involve a significant reduction in a margin of safety. Based on this information, the requested license amendment does not present a significant hazard.

ATTACHMENT 4

Enclosure C
ULNRC-937
10/3/84

MARKED TECHNICAL SPECIFICATION PAGES

REVISION 0

TABLE 4.11-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD)(1) (uCi/ml)
1. Batch Waste Release Tanks(2)	P Each Batch	P Each Batch	Principal Gamma Emitters(3)	5×10^{-7}
			I-131	1×10^{-6}
a. Waste Monitor Tank	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
b. Secondary Liquid Waste Monitor Tank	P Each Batch	M Composite(4)	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
a. Discharge Monitor Tank	P Each Batch	Q Composite(4)	Sr-89, Sr-90	5×10^{-8}
			Fe-55	1×10^{-6}
Continuous Releases(5)	Daily(6) Grab Sample	W Composite(4)	Principal Gamma Emitters(3)	5×10^{-7}
			I-131	1×10^{-6}
Steam Generator Blowdown	M Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
	Daily(6) Grab Sample	M Composite(4)	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	Daily(6) Grab Sample	Q Composite(4)	Sr-89, Sr-90	5×10^{-8}
			Fe-55	1×10^{-6}

ATTACHMENT 4

[illegible] 0
[illegible]-917
10/3/94

Environmental Evaluation

This amendment request is for revision of Technical Specification Table 4.11-1 to include two additional Batch Waste Release Tanks. The two 100,000 gallon tanks are required for storage and/or discharge due to an increase in the estimated volume of secondary liquid waste; specifically waste from condensate demineralizer regenerations. Although water can also be routed to these tanks from liquid radwaste and steam generator blowdown, the volume of waste from these sources is not expected to significantly increase from that given in the Environmental Report. A greater volume of waste water will be discharged than originally estimated; however, because the activity of the secondary liquid waste system is small, the amount of radioactivity released to the environment will not increase significantly and will not approach the activities for liquid effluents given in the Environmental Report. Therefore, the change does not constitute an unreviewed environmental question.

In addition, the tanks are located in the southwest corner of the radwaste building (outside). During the original construction of the plant, this area underwent significant impact and was determined to contain no cultural resources.

cc: Gerald Charnoff, Esq.
Shaw, Pittman, Potts & Trowbridge
1800 M. Street, N.W.
Washington, D.C. 20036

Nicholas A. Petrick
Executive Director
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Rockville, Maryland 20850

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U.S. Nuclear Regulatory Commission
RR#1
Steedman, Missouri 65077

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Resident Programs, Chief, Section 1A
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RR#1
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Ron Kucera, Deputy Director
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102

ATTACHMENT 4

bcc: 3484-0021.6
Nuclear Date
OFS Chrono
D. F. Schnell
J. F. McLaughlin
J. E. Birk
W. H. Weber
F. D. Field
R. J. Schukai
M. A. Stiller
S. E. Miltenberger
J. J. Beisman
Missouri Public Service Commission
D. W. Capone
A. C. Passwater
T. H. McFarland
R. P. Wendling
D. E. Shafer
D. J. Walker
G56.37 (CA-460)
Compliance (J. E. Davis)
NSRB (Laura Robertson)

Attachment 4

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 4 1985

Docket No.: STN 50-483

Mr. D. F. Schnell
Vice President - Nuclear
Union Electric Company
P. O. Box 149
St. Louis, MO 63166

Dear Mr. Schnell:

Subject: Callaway Plant, Unit 1 - Amendment No. 2 to License NPF-30

The Commission has issued the enclosed Amendment No. 2 to Operating License NPF-30 for the Callaway Plant, Unit 1. The amendment consists of a change to the Technical Specification in response to your application dated October 3, 1984, as supplemented December 6, 1984 and December 27, 1984, which requested the addition of two 100,000 gallon tanks in order to provide sufficient storage time for secondary effluent to allow sample analysis and to show acceptability of the water prior to release to the environment.

The amendment modifies Table 4.11-1 of the Callaway Technical Specifications to include two additional Batch Waste Release Tanks.

A copy of the related Safety Evaluation is enclosed. The notice of issuance will be included in the Commission's next regular monthly Federal Register Notice.

Sincerely,

B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing

Enclosures:
1. Amendment No. 2 to NPF-30
2. Safety Evaluation Report

cc: See next page

RECEIVED
FEB 8 1985
D. F. SCHNELL

CALLAWAY

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Vice President - Nuclear
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St. Louis, Missouri 63166

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Thomas A. Baxter, Esq.
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Mr. John Neisler
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Mr. Donald Bollinger, Member
Missourians for Safe Energy
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Mayor Howard Steffen
Chamois, Missouri 65024

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Mr. Harold Lottman
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Mr. John G. Reed
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Mr. Dan I. Bolef, President
Kay Drey, Representative
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Birch, Horton, Bittner and Moore
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Washington, D. C. 10036

Attachment 4
UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

UNION ELECTRIC COMPANY

DOCKET NO. 50-483

CALLAWAY PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 2
License No. NPF-30

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Union Electric Company (the licensee), dated October 3, 1984, as supplemented December 6, 1984 and December 27, 1984, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public; and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by a change to the Technical Specifications as indicated in the attachment to this license amendment and Paragraph 2.C.(2) of Operating License No. NPF-30 is hereby amended to read as follows:

   (2) Technical Specifications and Environmental Protection Plan

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 2, and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. UE shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing

Attachment:
Change to the Technical
Specifications

Date of Issuance: February 4, 1985

ATTACHMENT TO LICENSE AMENDMENT NO. ?

OPERATING LICENSE NO. NPF-30

DOCKET NO. STN 50-483

Revise Appendix A, as follows:

REMOVE	INSERT
3/4 11-2	3/4 11-2

TABLE 4.11-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD)(1) (μCi/ml)
1. Batch Waste Release Tanks(2)	P Each Batch	P Each Batch	Principal Gamma Emitters(3)	$5x10^{-7}$
			I-131	$1x10^{-6}$
a. Waste Monitor Tank	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	$1x10^{-5}$
b. Secondary Liquid Waste Monitor Tank	P Each Batch	M Composite(4)	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
c. Discharge Monitor Tank	P Each Batch	Q Composite(4)	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$
2. Continuous Releases(5)	Daily(6) Grab Sample	W Composite(4)	Principal Gamma Emitters(3)	$5x10^{-7}$
			I-131	$1x10^{-6}$
Steam Generator Blowdown	M Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	$1x10^{-5}$
	Daily(6) Grab Sample	M Composite(4)	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
	Daily(6) Grab Sample	Q Composite(4)	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 2 TO FACILITY OPERATING LICENSE NO. NPF-30

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. STN 50-483

1.0 INTRODUCTION

By letter dated October 3, 1984, as supplemented December 6, 1984 and December 27, 1984, Union Electric Company (the licensee) requested an amendment to Facility Operating License No. NPF-30 for operation of the Callaway Plant in Callaway County, Missouri.

The amendment would modify Table 4.11-1 of the Callaway Technical Specifications (TS) to include two additional Batch Waste Release Tanks.

2.0 EVALUATION

The licensee requested the addition of two 100,000 gallon tanks for the purpose of storing liquid waste generated from the secondary coolant sluice water. This waste water originates from the condenser hot well and is used as the working fluid to transport resins from the condensate demineralizers into the condensate demineralizer regeneration system, and also to carry acid and caustic into the same system. As this sluice water leaves the condensate demineralizer regeneration system, it contains amounts of dissolved solids and conductivity that is unacceptable for returning to the condenser hot well without additional treatment. The secondary liquid waste system possesses the flexibility to either process this water through an evaporator and/or demineralizer so that it can be returned to the condenser hotwell, or to directly discharge the untreated water to the river.

In a telephone conversation on December 19, 1984, Union Electric stated that if this stream contains radioactivity, as determined by sampling and/or monitoring of the secondary waste discharge, it would be redirected through the secondary waste evaporators and demineralizers at which time it would then be returned to the condenser hot well. However, because there normally is insignificant radioactivity in this stream, Union Electric has chosen, for financial considerations, to by-pass the secondary waste evaporator and demineralizers and discharge the water to the environment while making up the loss of condensate by cheaper methods.

To ensure releases are within technical specification radioactivity and NPDES limits, Union Electric will add storage tanks (two 100,000 gallon tanks) in parallel with the two existing secondary liquid waste monitor tanks (15,000 gallons each) to provide sufficient time for samoling and analyses prior to discharge.

The staff finds the design change to add two 100,000 gallon discharge monitor tanks and the associated Technical Specification change to be acceptable. This conclusion is based on the following facts:

a) Even though the secondary waste evaporator and demineralizers are by-passed, there will only be an insignificant increase in radioactivity release via this stream.

b) All secondary waste is sampled and monitored for radioactivity prior to and during releases.

c) Releases of secondary waste pollutants (such as radioactivity, chemicals and total dissolved solids) is limited by Technical Specification and NPDES limits.

d) Proper tank protection features meeting the requirements of Regulatory Guide 1.143 for radioactive waste treatment systems are provided.

e) All radioactive effluents are limited by Technical Specifications. This amendment does not affect these limits.

3.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant change in the types or significant increase in the amounts of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR Section 51.22(c)(9). An environmental assessment was prepared for this amendment request (49FR50848) in which it was determined that an environmental impact statement was not required for this action.

4.0 CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner; and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Date: February 4, 1985

Principal Contributors:
R. W. Feli, METB
J. A. Stevens, LB#1

ATTACHMENT 5

PROCESS CONTROL PROGRAM CHANGES

This Attachment contains the following:

1. Callaway Plant ORC Meeting Minutes (applicable sections)

   page 1 through 3

2. Process Control Program Procedure Request Form Package

   page 1 through 5

ATTACHMENT 5
CALLAWAY PLANT
ORC MEETING MINUTES

I. Meeting Number 450 (REVISED) Date 8/9/85

II. Attendees

~~Chairman~~ Vice-Chairman A.P. NEUHOFF
Member/~~Alternate~~ James C Chamberlain
~~Member/Alternate~~ H. L. Stuhlman
~~Member/Alternate~~ Albert J White
~~Member/Alternate~~ Morton R Faulkner
Member/~~Alternate~~ D Mooney
Member/~~Alternate~~ J Pierce
Member/~~Alternate~~ B Randolph

III. Proposed Items

		Recommended Disposition					
A.	CMP 84-0357, Rev. A	Approval	X	Disapproval		Open	
B.	CMP 84-1-5-3 Rev. C	Approval	X	Disapproval		Open	
C.	CMP 84-05-13, Rev. A	Approval	X	Disapproval		Open	
D.	CMP 84-1505, Rev. A	Approval	X	Disapproval		Open	
E.	CMP 84-0781 (AMN-02)	Approval	X	Disapproval		Open	
F.	CMP 84-0786, Rev. C	Approval	X	Disapproval		Open	
(2)	Attached list of Procedure Request forms and Safety Evaluations	Approval W/O Exception	X	Approval W/Exceptions		Identify exceptions & reason on attached list & carry as open item.	

NOTE: For items A through G, a recommendation for approval signifys that ORC found that the items did not constitute an unreviewed safety question unless otherwise specifically stipulated in the ORC minutes.

NOTE: Open items must be rescheduled for future meetings. Disapproval and Open categories must have supporting rationale attached in writing. Dissenting opinions require an attached statement of reason. Attached pages shall be uniquely identified by indicating in a prominent manner the meeting number, the date and page number of the attachment to this form.

ORC ~~Chairman~~ Vice-Chairman A.P. Neuhoff

Distribution

ORC File - w/Attachments (QA Record)
NSRB - w/Attachments
ISEG - w/Attachments
Members - w/Attachments
Supt., Training - w Attachments

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CA-#136
02/11/84
APAGEE-00050

This is page 1 of 2 of the minutes for this meeting

page 1 of 3

Total Pg
11 & pages
one 8-12-85

ATTACHMENT 3

CALLAWAY PLANT

ORC MEETING MINUTES

Meeting Number 450 Date 9/2/85

I. Attendees

Chairman/Vice-Chairman _____

~~Member~~/Alternate M. I. EVANS BY TELECON

~~Member~~/Alternate Charles Naslund

~~Member~~/Alternate J. E. Mercich

~~Member~~/Alternate J. M. PRICE BY TELECON

Member/Alternate _____

Member/Alternate _____

~~Member/Alternate~~ D. W. Patterson

II. Proposed Items

		Recommended Disposition		
A.	CNP 84-031C, (FCN-01)	Approval [X]	Disapproval [ ]	Open [ ]
B.	CNP 85-0001, Rel. 1	Approval [X]	Disapproval [ ]	Open [ ]
C.	CNP 85-0149, Rel. 1	Approval [X]	Disapproval [ ]	Open [ ]
D.	CNP 85-0200, Rel. B	Approval [X]	Disapproval [ ]	Open [ ]
E.	CNP 85-0209, Rel. 1	Approval [X]	Disapproval [ ]	Open [ ]
F.	CNP 85-0212, Rel. 1	Approval [X]	Disapproval [ ]	Open [ ]
G.	Attached list of Procedure Request forms and Safety Evaluations	Approval W/O Exception [ ]	Approval W/Exceptions [ ]	Identify exceptions & reason on attached list & carry as open item.

NOTE: For items A through G, a recommendation for approval signifys that ORC found that the items did not constitute an unreviewed safety question unless otherwise specifically stipulated in the ORC minutes.

NOTE: Open Items must be rescheduled for future meetings. Disapproval and Open categories must have supporting rationale attached in writing. Dissenting opinions require an attached statement of reason. Attached pages shall be uniquely identified by indicating in a prominent manner the meeting number, the date and page number of the attachment to this form.

ORC Chairman/Vice-Chairman _____

Distribution

ORC File - w/Attachments (QA Record)
NSRB - w/Attachments
ISEG - w/Attachments
Members - w/Attachments
Supt., Training - w/Attachments

CA-#138
02/11/84
APA-ZZ-00100

This is page 1 of ___ of the minutes for this meeting

page 2 of 3

ATTACHMENT 5

CALLAWAY PLANT

ORC MEETING MINUTES

Meeting Number 450 Date 3/9/85

II. Attendees

Chairman/Vice-Chairman _____

Member/Alternate _____

Member/Alternate _____

Member/Alternate _____

Member/Alternate _____

Member/Alternate _____

Member/Alternate _____

Member/Alternate _____

III. Proposed Items

		Recommended Disposition		
A.	EC 25-2222	Approval [X]	Disapproval [ ]	Open [ ]
B.	PCP REV. 4	Approval [X]	Disapproval [ ]	Open [ ]
C.	CMP 84-03-21 REV. A FCN-01	Approval [X]	Disapproval [ ]	Open [ ]
D.	APA-ZZ-00125 REV. 3	Approval [X]	Disapproval [ ]	Open [ ]
E.	APA-ZZ-00121 REV. 4 5	Approval [X]	Disapproval [ ]	Open [ ]
F.	EIP-ZZ-A0010 REV. 2	Approval [X]	Disapproval [ ]	Open [ ]
G.	Attached list of Procedure Request forms and Safety Evaluations	Approval W/O Exception [ ]	Approval W/Exceptions [ ]	Identify exceptions & reason on attached list & carry as open item.

NOTE: For items A through G, a recommendation for approval signifys that ORC found that the items did not constitute an unreviewed safety question unless otherwise specifically stipulated in the ORC minutes.

NOTE: Open Items must be rescheduled for future meetings. Disapproval and Open categories must have supporting rationale attached in writting. Dissenting opinions require an attached statement of reason. Attached pages shall be uniquely identified by indicating in a prominent manner the meeting number, the date and page number of the attachment to this form.

ORC Chairman/Vice-Chairman _____

Distribution

ORC File - w/Attachments (QA Record)
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CA-#138
02/11/84
APA-ZZ-00050

This is page 1 of ___ of the minutes for this meeting

PAGE 3043

ATTACHMENT 5

PGC.01

PROCEDURE REQUEST FORM

Procedure Number: PCP Revision Number: 3

Procedure Title: Callaway Plant Process Control Program

☐ New Procedure Request ☐ Removing Deficiencies ☐ Procedure Deletion

☑ Procedure Revision, New Revision Number 4

☐ Temporary Procedure Change, effective until incorporated into next revision. TCN#

☐ One Time Temporary Procedure Change, effective from _____ to _____, TCN#

INFORMATION ONLY
UNCONTROLLED
COPY

New Procedure/Change Summary

Procedure Page Numbers Affected by Proposed Change: ~~Attachment~~ 1

Description of New Procedure/Changes/Deficiencies Removed

Revised ~~Attachment~~ 1 (Resin Solidification Formulations) to incorporate formulation for resin slurries having a waste classification of Class A which will be disposed of as "UNSTABLE" waste.

(Use additional pages if required.)

Reason for New Procedure/Change/Deficiency Removal

Based upon in plant testing of both test samples and full scale drums, a solidified product can be obtained having 0.0% free-standing liquids. However, disposal of this waste would have to be done by treating the waste as an UNSTABLE waste form. Provided waste can be shown to be Class A this formulation may be utilized. This change is consistent with applicable ~~shipping and disposal rules~~ (cont.)

(Use additional pages if required.)

Prepared by Jerry S. Hamilton (Signature) | Radwaste Engineer (Title) | 7/30/85 (Date)

Qualified Review (Check appropriate boxes)

Cross Disciplinary Review Required? NO ☐ YES ☑ (If Yes, complete 4.b below.)

ORC Review Required? NO ☐ YES ☑

Reviewed by R. Buschbaum (Signature) | Rad Chem Foreman (Title) | 8-6-85 (Date)

Cross Disciplinary Review Required (Signature/Date); Date Due _____

☐ Eng _____/_____	☐ P & S _____/_____	☑ QA [illegible] Notified	8/6/85
☐ H.P. _____/_____	☐ Admin-S _____/_____	☐ Mat'ls. _____/_____
☐ R.W. _____/_____	☐ Trng. _____/_____	☐ Admin-R _____/_____
☐ Chem. _____/_____	☐ Sec. _____/_____	☐ I & C _____/_____
☐ Ops _____/_____	☑ Comp. Bruce E. Murick	8/6/85	☐ _____/_____
☐ Maint. _____/_____	☐ Outages _____/_____	☐ _____/_____

Responsible Department Head (Check appropriate box and sign):

☐ Approved for Issue _____/_____

☒ Approved for ORC Review [signature] / 8/6/85

Temporary Procedure Change Preliminary Approval (Signature/Date)

Member Management Staff _____/_____

Senior Reactor Operator _____/_____

Manager, Callaway Plant _____/_____

Temporary Procedure Change Final Approval (Signature/Date; required within 14 days of Preliminary Approval.)

Responsible Dept. Head _____/_____

Manager, Callaway Plant _____/_____

Procedure Approval (Signature/Date)

Manager, Callaway Plant [signature] / 8/12/85

(1) Applicable for new procedures and procedure revisions only.
(2) Applicable for Temporary Procedure changes only; not all signatures are required in these sections. See APA-ZZ-00101 Section 5.1 for approval requirements.

Rec 8/21/85 ~~Folio 21 Pages~~

PCP
Rev 4

2.3 Reason for Change (cont.)

shipping and disposal site requirements. The reasoning for requiring wastes solidified using this formulation to be treated as "UNSTABLE" waste is that stability requirements for a "STABLE" waste form have not been tested for (ie., biodegradation, immersion testing, etc.) using this formulation. ~~either by~~

wait 11/20/85

ATTACHMENT 3

CALLAWAY PLANT

NUCLEAR SAFETY EVALUATION CHECKLIST

(10 CFR50.59 APPLICABILITY DETERMINATION)

NO. _____

(1) CHECKLIST APPLICABLE TO: PCP REV. 4 TCN _____

(2) 10CFR50.59 APPLICABILITY DETERMINATION

The procedure, procedure revision or change, or modification to which this evaluation is applicable represents:

(2.1) Yes ____ No ✓ A change to the plant as described in the FSAR including the RERP and Security Plan?

(2.2) Yes ____ No ✓ A change to procedures as described in the FSAR including the RERP and Security Plan?

(2.3) Yes ____ No ✓ A test or experiment not described in the FSAR including the RERP and Security Plan?

(2.4) Yes ____ No ✓ A change to the Technical Specifications?

(2.5) Yes ____ No ✓ A change to plant structures, systems, or components.

If any question above is answered "Yes", this Checklist shall be forwarded to the Superintendent, Engineering, for completion of a Nuclear Safety Evaluation (CA-#1041) per APA-ZZ-00140.

(3) For design changes or temporary modifications to permanent plant equipment, provide additional justification below (using CA-#915 as guidelines) as to why the change does not constitute a potential unreviewed safety question. Provide a description of the proposed change(s) or refer to the appropriate design change record which fully describes the change.

(4) Prepared by: Gerry S. Hamilton Date 7/30/85

(5) Reviewed by: [signature] Date 8-6-85

(6) Responsible Dept. Head [signature] Date 9/6/85

ATTACHMENT 5

PROCEDURE DATA DEPT FORM

Mode

Date: 3|5|Ø|8|Ø|2 Originator GWH

PROCEDURE GAG IAUTI IAQA

REV ØIØ4

REVDTE

DEPT R

REVIEW

REFERENCE

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REFDTE

INTERFACES

NOTIFY

REPLY

DEFICIENCY

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CA-0134
09/01/83
ADP-ZZ-0-0006
APA-ZZ-00101

ATTACHMENT 5
OQR- 1-4-2

: G. W. Hamilton DATE: 3/4/5

OM: S. B. Grawcock

OCEDURE NO.: DCP Process Control Program Rev. NO.: 7

FERENCES: _____

PROCEDURE COMMENT SHEET

ote: For any comment listed, there must be an Action and Approval.

OMMENTS	ACTION TAKEN	ACTION ACCEPTABLE
No Comment	N/A	

: Submitted by: S. B. Grawcock

ATTACH TO PROCEDURE REQUEST FORM

cc: ADSR
AD 17F07 (w/comments) Line _____

UNION ELECTRIC COMPANY
1901 Gratiot Street, St. Louis

Donald F. Schnell
Vice President

August 29, 1985

PRIORITY ROUTING

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Aug +1

Mr. James G. Keppler
Regional Administrator
Office of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

ULNRC-1163

Dear Mr. Keppler:

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
FACILITY OPERATING LICENSE NPF-30
SEMI-ANNUAL RADIOACTIVE EFFLUENT REPORT

The enclosed Semi-Annual Effluent Report for the first half of 1985 is submitted pursuant to section 6.9.1.7 of the Callaway Unit 1 Technical Specifications.

Very truly yours,

Donald F. Schnell

Donald F. Schnell

IE25
1/1

SEP 9 1985

Mailing Address: P.O. Box 149, St. Louis, MO 63166

cc distribution for ULNRC-1163

with enclosures

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Washington, DC 20555

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