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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Semiannual Radioactive Effluent Release Report

Gentlemen:

Attached is the Semiannual Radioactive Effluent Release Report for the period July 1 through December 31, 1991. This report is submitted in accordance with Waterford 3 Technical Specification 6.9.1.8.

If you have any questions, please contact C.J. Thomas at (504) 739-6531.

Very truly yours,

RFB/CJT/ssf
Attachment

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Semiannual Radioactive Effluent Release

Report

July 1, 1991 - December 31, 1991

Waterford 3 SES

Entergy Operations, Inc.

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1.0 SCOPE

This Semiannual Radioactive Effluent Release Report is submitted as required by Waterford 3's Technical Specification 6.9.1.8. It covers the period from July 1, 1991 through December 31, 1991. Information in this report is presented in the format outlined in Appendix B of Regulatory Guide 1.21.

The information contained in this report includes:

- (1) A summary of the quantities of radioactive liquid and gaseous effluents and solid wastes released from the plant during the reporting period;
- (2) A summary of the meteorological data collected during 1991;
- (3) Assessment of radiation doses due to liquid and gaseous radioactive effluents released during 1991;
- (4) Explanation of why certain effluent instrumentation was not restored to operable status within the time specified in the ACTION Statement, as per UNL-005-014, Offsite Dose Calculation Manual (ODCM), Specification 5.6.1 and 5.6.2;
- (5) A summary of the quantities of radioactive gaseous effluents released from identified miscellaneous secondary release pathways for 1991;
- (6) A summary of changes to the Offsite Dose Calculation Manual and the Process Control Program during this reporting period.

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

The Limits applicable to the release of radioactive material in liquid and gaseous effluents are described in the following sections. These limits are addressed in UNT-005-014, Offsite Dose Calculation Manual.

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 the site to areas at or 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 Iodines; Particulates, Half Lives > 8 Days; and Tritium

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 $2.0E-4$ $\mu\text{Ci/ml}$ total activity.

The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released to unrestricted areas shall be limited to the following:

- 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 dose or dose commitment to any member of the public due to releases of radioactivity and 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) over 12 consecutive months.

2.2 Maximum Permissible Concentrations

2.2.1 Fission and Activation Gases; Iodines; and Particulates, Half Lives > 8 Days

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

2.2.2 Liquid Effluents

The maximum permissible concentration (MPC) values specified in 10 CFR Part 20, Appendix B, Table II, Column 2 are used as the permissible concentrations of liquid radioactive effluents at the unrestricted area boundary. A value of $2.0\text{E-}4$ $\mu\text{Ci/ml}$ is used as the MPC for dissolved and entrained noble gases in liquid effluents.

2.3 Average Energy

This is not applicable to Waterford 3's Effluent Specifications. E-Bars are not required to be calculated from effluent release data.

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 Tables 5.3-1 and 5.4-1 of UNT-005-014, Offsite Dose Calculation Manual.

2.4.1 Fission and Activation Gases (Noble Gases)

For continuous releases, a gas grab sample was analyzed monthly for noble gases. Each week a Gas Ratio (GR) was calculated according to the following equation:

$$GR = \frac{\text{Average Weekly Noble Gas Monitor Reading}}{\text{Monitor Reading During Noble Gas Sampling}}$$

The monthly sample analysis and weekly Gas Ratio were then used to determine noble gases discharged continuously for the previous week. For gas decay tank and containment purge batch releases, a gas grab sample was analyzed prior to release to determine noble gas concentrations in the batch. In all cases the total radioactivity in gaseous effluents was determined from measured concentrations of each radionuclide present and the total volume discharged.

2.4.2 Iodines and Particulates

Iodines and particulates discharged were sampled using a continuous sampler which contained a charcoal cartridge and a particulate filter. Each week the charcoal cartridge and particulate filter were analyzed for gamma emitters using gamma spectroscopy. The determined radionuclide concentrations and effluent volume discharged were used to calculate the previous week's activity released.

The particulate samples were composited and analyzed quarterly for Sr-89 and Sr-90 by a contract laboratory (Teledyne Isotopes). Particulate gross alpha activity was measured weekly using alpha scintillation counting techniques. The determined activities were used to estimate effluent concentrations in subsequent releases until the next scheduled analysis was performed.

Grab samples of continuous and batch releases were analyzed monthly for tritium. The determined concentrations were used to estimate tritium activity in subsequent releases until the next scheduled analysis was performed.

2.4.3 Liquid Effluents

For continuous releases, samples were collected weekly and analyzed using gamma spectroscopy. The measured concentrations were used to determine radionuclide concentrations in the previous week's releases. For batch releases, gamma analysis was performed on the sample prior to release.

For both continuous and batch releases, composite samples were analyzed quarterly by a contract laboratory (Teledyne Isotopes) for Sr-89, Sr-90, and Fe-55. Samples were composited and analyzed monthly for tritium and gross alpha using liquid scintillation and gas flow proportional counting techniques, respectively. For radionuclides measured in the composite samples, the measured concentrations in the composite samples from the previous month or quarter were used to estimate released quantities of these isotopes in liquid effluents during the current month or quarter.

The total radioactivity in liquid effluent releases was determined from the measured and estimated concentrations of each radionuclide present and the total volume of the effluent discharged.

2.5 Batch Releases

A summary of information for gaseous and liquid batch releases is included in Table 1.

2.6 Unplanned Abnormal Releases

During this reporting period, there were no instances of Unplanned Abnormal releases.

3.0 GASEOUS EFFLUENTS

The quantities of radioactive material released in gaseous effluents are summarized in Tables 1A, 1B, and 1C. Note that there were no elevated releases, since all Waterford 3 releases are considered to be at ground level. The estimated total error in % is based upon several statistical uncertainties due to sample counting, efficiency, volume, etc. Detailed statistical evaluations of error are not required as per Regulatory Guide 1.21.

4.0 LIQUID EFFLUENTS

The quantities of radioactive material released in liquid effluents are summarized in Tables 2A and 2B. The estimated total error in % is based upon several statistical uncertainties due to sample counting, efficiency, volume, etc. Detailed statistical evaluations of error are not required as per Regulatory Guide 1.21.

5.0 SOLID WASTES

The summary of radioactive solid wastes shipped offsite for disposal is listed in Table 3. For certain waste forms Waterford 3 is now using volume reduction services provided by Scientific Ecology Group, Inc. and Alaron Corp. These waste forms are identified in Table 3 and volumes reported reflect the volume of waste shipped offsite, not final disposal volumes. Final disposal volumes are reported as they become available. The estimated total error in % is based upon several statistical uncertainties due to sample counting, efficiency, volume, etc. Detailed statistical evaluations of error are not required as per Regulatory Guide 1.21.

6.0 METEOROLOGICAL DATA

In Table 4 the hourly meteorological data from January 1, 1991 through December 31, 1991, is presented in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. The Waterford-3 data recovery results by parameter are as follows:

<u>Parameter</u>	<u>January - June</u>	<u>July - December</u>	<u>Entire Year</u>
Delta T	90.5%	94.5%	92.7%
Wind Speed	98.3%	96.5%	97.4%
Wind Direction	98.3%	96.5%	97.4%
Overall*	88.8%	91.4%	90.1%

*Simultaneous occurrence of valid data for all three parameters.

7.0 ASSESSMENT OF DOSES

7.1 Dose Due to Gaseous Effluents

7.1.1 Air Doses at the Site Boundary

Air doses from gaseous effluents were evaluated at the closest offsite location that could be occupied continuously during the term of plant operation and that would result in the highest dose. This location was determined by examining the atmospheric dispersion parameters (χ/Q 's) at the closest offsite locations that could be continuously occupied during plant operation in each of the meteorological sectors surrounding the plant. The location that would have the highest dose would be that location having the most restrictive (largest) χ/Q value. Based on actual meteorological data collected during 1991, this location was determined to be in the NE sector at a distance of 966 meters from the plant. Doses were assessed at this location in accordance with the methodology described in the Waterford 3 Offsite Dose Calculation Manual considering only beta and gamma exposures in air due to noble gas. The results of these assessments for the year 1991 are summarized as follows:

Beta air dose: 0.88 mrad

Gamma air dose: 0.31 mrad

The beta and gamma air doses are 4.4% and 3.1% of the Annual Dose Limits, respectively. The results of the dose calculations by quarter are summarized in Table 5.

7.1.2 Maximum Organ Dose to the Critical Receptor

The maximum organ dose to a MEMBER OF THE PUBLIC from I-131, I-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the site boundary was determined for 1991.

An assessment of the maximum organ dose was performed for the critical receptor. The critical receptor was assumed to be located at the nearest residence to the plant having the most restrictive atmospheric dispersion (χ/Q) and deposition (D/Q) parameters. Furthermore, it was assumed that the receptor living at this residence consumed food products that were either raised or produced at this residence. Using land use census and meteorological data for 1991, the residence with the highest χ/Q and D/Q values was determined to be in the N sector at a distance of 1448 meters. The dose calculation was performed in accordance with the methodology described in the Waterford 3 Offsite Dose Calculation Manual considering the inhalation, ground plane exposure, and ingestion pathways.

The maximum organ dose to the critical receptor was determined to be 1.86 mrem to the infant thyroid. This represents 12.4% of the Annual Dose Limit. Dose calculation results are summarized by quarters in Table 5.

7.2 Doses Due to Liquid Effluents

The annual doses to the maximum exposed individual resulting from exposure to liquid effluents released during 1991 from Waterford 3 were 0.73 mrem total body and 0.99 mrem to the maximum exposed organ (liver). These values are 24.3% and 9.9% respectively, of the Annual Dose Limits. Dose calculation results are summarized by quarters in Table 5. The doses were calculated in accordance with the methodology described in the Waterford 3 Offsite Dose Calculation Manual.

7.3 40 CFR Part 190 Dose Evaluation

In accordance with Waterford 3 Offsite Dose Calculation Manual, Section 5.5.2, dose evaluations to demonstrate compliance with Surveillance Requirements 5.5.1.a and 5.5.1.b of the ODCM, dealing with dose from the uranium fuel cycle, need to be performed only if quarterly doses exceed 3 mrem to the total body (liquid releases), 10 mrem to any organ (liquid releases), 10 mrad gamma air dose, 20 mrad beta air dose, or 15 mrem to any organ from radioiodines and particulates.

At no time during 1991 were any of these limits exceeded; therefore, no evaluations were required.

7.4 Doses to Public Inside the Site Boundary

The Member of the Public inside the site boundary expected to have the maximum exposure due to gaseous effluents would be an employee at Waterford 1 and 2 fossil fuel plants, located in the NW sector, approximately 670 meters from the plant. Based on an assumed occupancy of 25% (40 hour work week) and the fact that all employees are adults, the maximum organ dose would be less than 0.046 mrem to the thyroid. Total body and skin doses were calculated to be 0.05 and 0.13 mrem, respectively. These doses were calculated according to the methodology described in the Waterford 3 Offsite Dose Calculation Manual considering only the inhalation and ground plane exposure pathways.

8.0 RELATED INFORMATION

8.1 Changes to the Process Control Program

There were significant changes to the Process Control Program for the period covered by this report. In accordance with NRC Generic Letter 89-01, the Process Control Program has been removed from the Site Technical Specifications and placed in procedure RW-001-210, Process Control Program. This change received prior NRC approval and was implemented on September 24, 1991. Copies of the changes to the Process Control Program are included in Attachment 10.2.

8.2 Changes to the Offsite Dose Calculation Manual

There were significant changes made to the Waterford 3 Offsite Dose Calculation Manual during the period covered by this report. In accordance with NRC Generic Letter 89-01, Radiological Effluent Technical Specifications have been removed from the Site Technical Specifications and placed in the Offsite Dose Calculation Manual, UNT-005-014. This change received prior NRC approval and was implemented on September 17, 1991. A revision to the Offsite Dose Calculation Manual was done on November 29, 1991 to clarify environmental sampling locations, add two food product sampling locations, include list of references to specific factors used in the calculation of A_1 and R_1 factors, include bioaccumulation factors, correct typographical errors, and change the applicability requirements for the Waste Gas Holdup monitor and the Main Condenser Evacuation and Turbine Gland Seal monitor to reflect that monitor operation is not required while the systems are not being operated. A change to the ODCM, done on December 23, 1991 and effective on January 1, 1992, implemented a new value for the bioaccumulation factor in fish for the element niobium. Affected dose factors were also changed. Copies of the changes to the Offsite Dose Calculation Manual are included in Attachment 10.1.

8.3 Unavailability of REMP Milk Samples

Due to the unavailability of three milk sampling locations within five kilometers of the plant, Broad Leaf sampling is performed in accordance with ODCM Table 5.8-1. Milk is collected, when available, from the control location and two identified sampling locations as indicated in Waterford 3 Offsite Dose Calculation Manual, Attachment 6.14.

8.4 Report of Required Effluent Instrument Inoperability

ODCM Specifications, 5.6.1.b and 5.6.2.b requires reporting in the Semiannual Radioactive Effluent Release Report of why designated inoperable effluent monitoring instrumentation was not restored to operability within the time specified in the ACTION Statement. During the reporting period, there were no cases when instrumentation was not restored to operability within the time specified.

8.5 Activity Released Via Secondary Pathways

The following secondary release paths were continuously monitored for radioactivity: 1) the Hot Machine Shop Exhaust (AH-35), 2) Decontamination Shop Exhaust (AH-34), 3) the RAB H&V Equipment Room Ventilation system Exhaust (E-41A and E-41B); and 4) the Switchgear/Cable Vault Area Ventilation System (AH-25). Continuous sampling for these areas is maintained in order to demonstrate the operability of installed treatment systems and to verify integrity of barriers separating primary and secondary ventilation systems. Sampling for these areas was limited to continuous particulate and iodine sampling and monthly noble gas grab sampling. The activity released via these secondary pathways resulted from routine operations and remained below significant levels. Table 6 contains a summary of activity released during 1991.

8.6 Missed Effluent Samples:

8.6.1 No liquid or gaseous effluent samples were missed during this reporting period.

8.7 Additional Information

The most recent Reactor Coolant System E-Bar calculation was 1.649 MeV/Disintegration from a sample obtained on June 24, 1991. Reactor Coolant System E-Bar is supplied for information only and is not used for effluent dose calculations.

8.8 Corrections to Semiannual Radioactive Release Reports

Corrections to Table 3 of Semi Annual Radioactive Release Report covering the period from January 1, 1991 to June 30, 1991 are presented in attachment 10.3. These changes are due to submittal of actual burial volumes and activities from volume reduction and disposal facilities, which was not available when the last report was submitted to the Nuclear Regulatory Commission.

9.0 TABLES

- 1 Batch Release Summary
- 1A Semiannual Summation of all Releases by Quarter - All Airborne Effluents
- 1B Semiannual Airborne Continuous Elevated and Ground Level Releases
- 1C Semiannual Airborne Batch Elevated and Ground Level Releases
- 2A Semiannual Summation of All Releases by Quarter - All Liquid Effluents
- 2B Semiannual Liquid Continuous and Batch Releases
- 3 Solid Waste Shipped Offsite for Disposal
- 4 Joint Frequency Distribution of Meteorological Data
- 5 Dose Calculation Results for 1991
- 6 Activity Calculations for Secondary Release Pathways for 1991

10.0 ATTACHMENTS

- 10.1 Changes to Offsite Dose Calculation Manual; July 1, 1991 to December 31, 1991. (349 pages)
- 10.2 Changes to Process Control Program; July 1, 1991 to December 31, 1991 (11 pages)
- 10.3 Corrections to Table 3 of Semiannual Radioactive Release Report of January 1, - June 30, 1991 Submittal of burial volumes and activities from volume reduction and disposal facilities. (3 pages)

TABLE 1
(1 of 1)

REPORT CATEGORY : BATCH RELEASE SUMMARY
RELEASE POINT : ALL
TYPE OF RELEASE : BATCH LIQUID AND GASEOUS
PERIOD START TIME : 4344:00 HRS = 12:00AM JULY 1, 1991
PERIOD END TIME : 8759:59 HRS = 11:59PM DECEMBER 31, 1991

LIQUID RELEASES

NUMBER OF RELEASES : 61
TOTAL TIME FOR ALL RELEASES : 15453.0 MINUTES
MAXIMUM TIME FOR A RELEASE : 320.0 MINUTES
AVERAGE TIME FOR A RELEASE : 253.3 MINUTES
MINIMUM TIME FOR A RELEASE : 194.0 MINUTES
AVERAGE STREAM FLOW : 907539.6 GPM

GASEOUS RELEASES

NUMBER OF RELEASES : 0
TOTAL TIME FOR ALL RELEASES : 0.0 MINUTES
MAXIMUM TIME FOR A RELEASE : 0.0 MINUTES
AVERAGE TIME FOR A RELEASE : 0.0 MINUTES
MINIMUM TIME FOR A RELEASE : 0.0 MINUTES

TABLE 1A

(1 of 1)

REPORT CATEGORY : SEMIANNUAL SUMMATION OF ALL RELEASES BY QUARTER
 TYPE OF ACTIVITY : ALL AIRBORNE EFFLUENTS
 REPORTING PERIOD : QUARTER # 3 AND QUARTER # 4
 STATION OR UNIT NUMBER : 1

	UNIT	QUARTER 3	QUARTER 4	EST. TOTAL
TYPE OF EFFLUENT	HOURS	14345-6552	16553-8760	ERROR N

A. FISSION AND ACTIVATION PRODUCTS

1. TOTAL RELEASE	CURIES	6.63E-00	2.61E-00	1.50E-01
2. AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	6.35E-01	5.98E-01	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	

B. RADIODIODINES

1. TOTAL IODINE-131	CURIES	6.92E-06	2.76E-05	1.50E-01
2. AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	8.72E-07	3.47E-06	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	

C. PARTICULATES

1. PARTICULATES (HALF-LIVES > 8 DAYS)	CURIES	1.78E-04	1.09E-04	1.50E-01
2. AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	2.24E-05	1.32E-05	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	
4. GROSS ALPHA RADIOACTIVITY	CURIES	3.34E-06	5.07E-06	

D. TRITIUM

1. TOTAL RELEASE	CURIES	5.34E-01	3.43E-02	1.50E-01
2. AVERAGE RELEASE RATE FOR PERIOD	UCI/SEC	6.72E-00	4.32E-01	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	

TABLE 1B

(1 of 1)

REPORT CATEGORY : SEMIANNUAL AIRBORNE CONTINUOUS ELEVATED AND GROUND
 : LEVEL RELEASES. TOTALS FOR EACH NUCLIDE RELEASED.
 TYPE OF ACTIVITY : FISSION GASES, IODINES, AND PARTICULATES
 REPORTING PERIOD : QUARTER # 3 AND QUARTER # 4
 STATION OR UNIT NUMBER : 1

		ELEVATED RELEASES		GROUND RELEASES	
	UNIT	QUARTER 3	QUARTER 4	QUARTER 3	QUARTER 4
		HOURS	HOURS	HOURS	HOURS
NUCLIDE		14345-6552	16553-8760	14345-6552	16553-8760

FISSION GASES

XE-133M	CURIES	0.00E-01	0.00E-01	0.00E-01	2.61E 00
XE-133	CURIES	0.00E-01	0.00E-01	4.94E 00	0.00E-01
XE-135	CURIES	0.00E-01	0.00E-01	1.69E 00	0.00E-01
TOTAL FOR PERIOD	CURIES	0.00E-01	0.00E-01	6.63E 00	2.61E 00

IODINES

I-131	CURIES	0.00E-01	0.00E-01	6.92E-06	2.76E-05
I-133	CURIES	0.00E-01	0.00E-01	0.00E-01	7.36E-06
TOTAL FOR PERIOD	CURIES	0.00E-01	0.00E-01	6.92E-06	3.49E-05

PARTICULATES

H-3	CURIES	0.00E-01	0.00E-01	5.34E 01	3.43E 02
CS-137	CURIES	0.00E-01	0.00E-01	1.21E-07	0.00E-01
G ALPHA	CURIES	0.00E-01	0.00E-01	3.34E-06	5.07E-06
BR-82	CURIES	0.00E-01	0.00E-01	1.78E-04	1.05E-04
TOTAL FOR PERIOD	CURIES	0.00E-01	0.00E-01	5.34E 01	3.43E 02

TABLE 1C

(1 of 1)

REPORT CATEGORY : SEMIANNUAL AIRBORNE BATCH ELEVATED AND GROUND
 TYPE OF ACTIVITY : LEVEL RELEASES. TOTALS FOR EACH NUCLIDE RELEASED.
 REPORTING PERIOD : FISSION GASES, IODINES, AND PARTICULATES
 STATION OR UNIT NUMBER : QUARTER # 3 AND QUARTER # 4
 : 1

	ELEVATED RELEASES		GROUND RELEASES		
NUCLIDE	UNIT	QUARTER 3 : HOURS :4345-6552	QUARTER 4 : HOURS :6553-8760	QUARTER 3 : HOURS :4345-6552	QUARTER 4 : HOURS :6553-8760

FISSION GASES

NONE

IODINES

NONE

PARTICULATES

NONE

TABLE 2A

(1 of 1)

REPORT CATEGORY : SEMIANNUAL SUMMATION OF ALL RELEASES BY QUARTER
 TYPE OF ACTIVITY : ALL LIQUID EFFLUENTS
 REPORTING PERIOD : QUARTER # 1 AND QUARTER # 4
 STATION OR UNIT NUMBER : 1

	UNIT	QUARTER 3	QUARTER 4	EST. TOTAL
TYPE OF EFFLUENT		HOURS	HOURS	ERROR %
		4345-6552	6553-8760	

A. FISSION AND ACTIVATION PRODUCTS

1. TOTAL RELEASE (NOT INCLUDING TRITIUM, GASES, ALPHA)	CURIES	9.94E-02	7.83E-02	1.50E-01
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	UCI/ML	2.78E-09	4.50E-09	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	

B. TRITIUM

1. TOTAL RELEASE	CURIES	8.01E-01	1.01E-02	1.50E-01
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	UCI/ML	2.24E-06	5.83E-06	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	

C. DISSOLVED AND ENTRAINED GASES

1. TOTAL RELEASE	CURIES	4.64E-02	8.46E-02	1.50E-01
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	UCI/ML	1.35E-09	4.86E-09	
3. PERCENT OF APPLICABLE LIMIT	%	N/A	N/A	

D. GROSS ALPHA RADIOACTIVITY

1. TOTAL RELEASE	CURIES	0.00E-01	0.00E-01	1.50E-01
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E. WASTE VOL RELEASED (PRE-DILUTION)	GAL	4.35E-05	2.95E-05	1.50E-01
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F. VOLUME OF DILUTION WATER USED	GAL	9.43E-09	4.60E-09	1.50E-01
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TABLE 2B

(1 of 2)

REPORT CATEGORY : SEMIANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
 : TOTALS FOR EACH NUCLIDE RELEASED.
 TYPE OF ACTIVITY : ALL RADIONUCLIDES
 REPORTING PERIOD : QUARTER # 3 AND QUARTER # 4
 STATION OR UNIT NUMBER : 1

NUCLIDE	UNIT	CONTINUOUS RELEASES		BATCH RELEASES	
		QUARTER 3	QUARTER 4	QUARTER 3	QUARTER 4
		HOURS	HOURS	HOURS	HOURS
		14345-6552	16553-8760	14345-6552	16553-8760
ALL NUCLIDES					
H-3	CURIES	0.00E-01	1.03E-04	8.01E-01	1.01E-02
NA-24	CURIES	0.00E-01	0.00E-01	1.17E-05	0.00E-01
CR-51	CURIES	0.00E-01	0.00E-01	3.60E-03	0.00E-01
MN-54	CURIES	0.00E-01	0.00E-01	2.46E-03	0.73E-03
FE-55	CURIES	0.00E-01	0.00E-01	1.13E-02	4.42E-03
FE-59	CURIES	0.00E-01	0.00E-01	1.93E-04	0.00E-01
CO-58	CURIES	0.00E-01	7.26E-07	2.46E-02	9.27E-03
CO-60	CURIES	0.00E-01	6.00E-01	1.54E-02	3.16E-02
Zn-65	CURIES	0.00E-01	0.00E-01	0.00E-01	2.18E-04
SR-90	CURIES	0.00E-01	0.00E-01	8.05E-05	8.72E-05
ZR-95	CURIES	0.00E-01	0.00E-01	1.99E-03	1.72E-03
ZR-97	CURIES	0.00E-01	0.00E-01	1.95E-04	2.30E-04
NA-99	CURIES	0.00E-01	0.00E-01	3.91E-03	4.80E-03
RU-103	CURIES	0.00E-01	0.00E-01	7.23E-06	0.00E-01
RU-106	CURIES	0.00E-01	0.00E-01	2.09E-03	3.75E-03
AG-110M	CURIES	0.00E-01	0.00E-01	4.18E-03	4.79E-03
I-131	CURIES	0.00E-01	0.00E-01	4.51E-04	1.65E-04
CS-134	CURIES	0.00E-01	0.00E-01	7.76E-03	1.51E-03
CS-137	CURIES	0.00E-01	0.00E-01	1.04E-02	2.39E-03
BA-139	CURIES	0.00E-01	0.00E-01	0.00E-01	1.72E-05
LA-140	CURIES	0.00E-01	0.00E-01	3.97E-04	2.70E-05
LA-142	CURIES	0.00E-01	0.00E-01	3.18E-05	0.00E-01
W-187	CURIES	0.00E-01	0.00E-01	7.72E-04	7.91E-04
XE-131M	CURIES	0.00E-01	0.00E-01	0.00E-01	6.46E-04
XE-133M	CURIES	0.00E-01	0.00E-01	4.00E-04	8.43E-04
XE-135	CURIES	0.00E-01	0.00E-01	4.55E-07	8.38E-02
XF-135	CURIES	0.00E-01	0.00E-01	4.27E-04	1.50E-04
SR-90	CURIES	0.00E-01	0.00E-01	8.24E-06	0.00E-01

TABLE 2B

(2 of 2)

REPORT CATEGORY : SEMIANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
 : TOTALS FOR EACH NUCLIDE RELEASED.
 TYPE OF ACTIVITY : ALL RADIONUCLIDES
 REPORTING PERIOD : QUARTER # 3 AND QUARTER # 4
 STATION OR UNIT NUMBER : 3

		CONTINUOUS RELEASES		BATCH RELEASES	
	UNIT	QUARTER 3	QUARTER 4	QUARTER 3	QUARTER 4
		HOURS	HOURS	HOURS	HOURS
NUCLIDE		14345-6552	16553-8768	14345-6552	16553-8768

ALL NUCLIDES CONTINUED

CO-57	CURIES	0.00E-01	0.00E-01	1.26E-04	1.82E-04
SB-124	CURIES	0.00E-01	0.00E-01	2.22E-04	3.19E-05
SN-113	CURIES	0.00E-01	0.00E-01	7.72E-04	1.06E-03
XB-92	CURIES	0.00E-01	0.00E-01	8.41E-04	6.58E-05
SB-122	CURIES	0.00E-01	0.00E-01	4.25E-05	6.73E-06
SB-125	CURIES	0.00E-01	0.00E-01	8.62E-03	6.59E-03
TOTAL FOR PERIOD	CURIES	0.00E-01	1.04E-04	8.03E-01	1.02E-02

TABLE 3
(1 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURISC PERIOD 7/1/91 THRU 12/31/91

WASTE TYPE	CONTAINER VOLUME (ft ³)	WASTE VOLUME (m ³)	TOTAL ACTIVITY (Ci)	ERROR
(B) Non Compacted Dry Activity Waste Shipped to Scientific Ecology Group for Volume Reduction *	1040	115.3 29.64 Burial Volume	2.54E+1 *1 1.07E+1 Buried Activity	±25% ±25%
(B) Non Compacted Dry Activity Waste Shipped to Alaron Corp for Volume Reduction *	1040	117.79	1.15E+1 *1	±25%

* Waste volumes shipped for volume reduction do not reflect final burial waste volumes unless otherwise stated.

*1 Activity determined by estimations.

*2 Activity determined by measurements.

TABLE 3
(2 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

WASTE TYPE	CONTAINER VOLUME (ft ³)	WASTE VOLUME (m ³)	TOTAL ACTIVITY (Ci)	ERROR
(A) Resin Waste Management Resin Dewatered in a High Integrity Container (Bead Resin)	170.8	4.8	2.97E+02 *2	±25%
(A) Mechanical Filters Dewatered Shipped in a High Integrity Container	120.3	3.4	1.55E+02 *2	±25%
(A) Liquid Waste Management Resin Dewatered in a Carbon Steel Liner (Bead Resin)	177.5	5.0	3.20E+00 *2	±25%
(D) Waste Oil Shipped to Scientific Ecology Group for Incineration *	7.5	2.97	1.78E-03 *1	±25%

* Waste volumes shipped for volume reduction do not reflect final burial waste volumes unless otherwise stated.

*1 Activity determined by estimations.

*2 Activity determined by measurements.

TABLE 3
(3 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

WASTE TYPE	NUCLIDE NAME	% ABUNDANCE	CURIES
(B) Non-Compacted	Co-58	71.151	4.02E-02
Dry Activity Waste	63	9.009	5.09E-03
Shipped to Scientific	Cs-137	4.460	2.52E-03
Ecology Group for	Cs-137	7.062	3.99E-03
Volume Reduction	Co-60	3.770	2.13E-03
	Fe-55	2.230	1.26E-03
	Mn-54	1.876	1.06E-03
(B) Non-Compacted	Co-58	71.164	1.41E-01
Dry Activity Waste	Ni-63	9.009	1.79E-02
Shipped to Scientific	Cs-137	7.051	1.40E-02
Ecology Group for	Cs-134	4.457	8.83E-03
Volume Reduction	Co-60	3.765	7.46E-03
	Fe-55	2.236	4.43E-03
	Mn-54	1.876	3.72E-03

TABLE 3
(4 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

WASTE TYPE	NUCLIDE NAME	% ABUNDANCE	CURIES
(B) Non Compacted	Co-58	71.177	5.88E-02
Dry Activity Waste	Ni-63	8.993	7.43E-03
Shipped to Alaron	Cs-137	7.064	5.83E-03
Corp for Volume	Cs-134	4.451	3.68E-03
Reduction	Co-60	3.764	3.11E-03
	Fe-55	2.233	1.84E-03
	Mn-54	1.875	1.55E-03
(B) Non Compacted	Co-58	71.164	2.36E-02
Dry Activity Waste	Ni-63	8.994	2.98E-03
Shipped to Alaron	Cs-137	7.068	2.34E-03
Corp for Volume	Cs-134	4.452	1.48E-03
Reduction	Co-60	3.766	1.25E-03
	Fe-55	2.236	7.41E-04
	Mn-54	1.877	6.22E-04

TABLE 3
(5 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

WASTE TYPE	NUCLIDE NAME	% ABUNDANCE	CURIES
(A) Liquid Waste Management	Co-137	36.925	1.18E+00
Resin Dewatered in a	Co-58	30.917	9.88E-01
Carbon Steel Liner	Cs-134	19.276	6.16E-01
(Bead Resin)	Fe-55	4.475	1.43E-01
	Co-60	3.567	1.14E-01
	H-3	1.649	5.27E-02
	Mn-54	1.496	4.78E-02
	Ni-63	1.446	4.62E-02
(A) Resin Waste Management	Co-58	30.755	9.12E+01
Resin Dewatered in a	Cs-137	22.965	6.81E+01
High Integrity Liner	Cs-134	15.748	4.67E+01
(Bead Resin)	Ni-63	11.095	3.29E+01
	Fe-55	10.892	3.23E+01
	Co-60	3.743	1.11E+01
	Mn-54	3.315	9.83E+00

TABLE 3
(6 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

WASTE TYPE	NUCLIDE NAME	% ABUNDANCE	CURIES
(A) Mechanical Filters	Co-58	27.484	4.25E+01
Dewatered in a High	Fe-55	24.509	3.79E+01
Integrity Container	Cr-51	15.391	2.38E+01
	Nb-95	11.446	1.77E+01
	Ni-63	7.372	1.14E+01
	Co-60	5.652	8.74E+01
	Sb-125	3.725	5.76E+00
	Zr-95	1.888	2.92E+00
	Mn-54	1.080	1.67E+00
(D) Waste Oil Sent to	Co-58	71.169	1.26E-03
Scientific Ecology	Ni-63	8.985	1.60E-04
Group for Incineration	Cs-137	7.070	1.26E-04
	Cs-134	4.453	7.97E-05
	Co-60	3.767	6.67E-05
	Fe-55	2.238	3.98E-05
	Mn-54	1.876	3.33E-05

TABLE 3
(7 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

NUMBER OF SHIPMENTS	MODE OF TRANSPORTATION	DESTINATION
8	TRUCK	3-Barnwell, SC 3-Oakridge, TN 2-Wampum, PA

WASTE CLASS	% OF SHIPMENTS	TYPE	TYPE OF CONTAINER	MODE	DESTINATION
A	1	Type A	Liner Carbon Steel	Truck	Barnwell, SC
B	1	Type A	Poly-HIC	Truck	Barnwell, SC
C	1	Type B	Poly-HIC	Truck	Barnwell, SC
A	1	LSA	Strong-Tight	Truck	Oakridge, TN
A	1	LSA	Strong-Tight	Truck	Oakridge, TN
Limited Quantity	1	Limited Quantity	Strong-Tight	Truck	Oakridge, TN
A	1	LSA	Strong-Tight	Truck	Wampum, PA
A	1	LSA	Strong-Tight	Truck	Wampum, PA

TABLE 3
(8 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

SUMMARY BY MAJOR WASTE TYPES

- (A) Spent Resins, Filter Sludges, Evaporator Bottoms, etc.
- (B) Dry Compressible Waste, Contaminated Equipment, etc.
- (C) Irradiated Components, Control Rods, etc.
- (D) Other (Waste Oil)

WASTE TYPE	WASTE VOLUME (M ³)	TOTAL ACTIVITY (Ci)	ERROR
(A)	16.39	4.52E+2	±25%
(B)	29.64* Burial Volume	3.69E-1	±25%
(C)	NONE	N/A	N/A
(D)	2.97	1.78E-3	±25%

* Does not include all Type (B) waste volume.

TABLE 3
(9 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

SUMMARY BY MAJOR WASTE TYPE (Cont'd)

WASTE TYPE	NUCLIDE NAME	% ABUNDANCE	CURIES
(A)	Co-58	30.08	1.35E+02
	Co-60	4.46	2.00E+01
	Cs-134	10.57	4.73E+01
	Cs-137	15.47	6.93E+01
	Fe-55	15.71	7.03E+01
	Mn-54	2.58	1.15E+01
	Ni-63	9.91	4.43E+00
	Nb-95	3.95	1.77E+00
	Zr-95	0.65	2.92E+00
	Cr-51	5.32	2.38E+01
	Sb-125	1.29	5.76E+00
	H-3	0.01	5.27E-02
(B)	Co-58	71.46	2.64E-01
	Co-60	3.78	1.40E-02
	Cs-134	4.48	1.65E-02
	Cs-137	7.09	2.62E-02
	Fe-55	2.24	8.27E-03
	Mn-54	1.88	6.95E-03
	Ni-63	9.06	3.34E-02

TABLE 3
(10 of 10)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 7/1/91 THRU 12/31/91

SUMMARY BY MAJOR WASTE TYPE (Cont'd)

WASTE TYPE	NUCLIDE NAME	% ABUNDANCE	CURIES
(D)	Co-58	71.17	1.26E-03
	Co-60	3.77	6.69E-05
	Cs-134	4.45	7.91E-05
	Cs-137	7.07	1.26E-04
	Fe-55	2.24	3.98E-05
	Mn-54	1.88	3.33E-05
	Ni-63	8.99	1.60E-04

TABLE 4

(1 of 4)

JOINT FREQUENCY DISTRIBUTION OF METEOROLOGICAL DATA

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS

PASQUILL CLASS A

		WIND SPEED (M/S) AT 10-M LEVEL												TOTAL
WIND DIRECTION		35-50	51-75	76-100	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10	10.1-15	15.1-18.0	>18.0	
N	0	0	0	1	5	17	52	13	3	0	0	0	0	71
NNE	0	0	1	1	6	6	12	3	0	0	0	0	0	29
NE	0	0	0	0	6	19	88	15	3	0	0	0	0	131
NNE	0	0	0	0	2	6	18	12	1	0	0	0	0	39
E	0	0	0	0	1	2	5	8	0	0	0	0	0	16
ESE	0	0	0	0	1	0	5	2	0	0	0	0	0	8
SE	0	0	0	0	0	0	8	20	11	4	0	0	0	41
SSE	0	0	0	0	4	6	20	25	4	0	0	0	0	59
S	0	0	0	1	2	14	18	16	3	0	0	0	0	54
SSW	0	0	0	1	3	12	4	3	4	0	0	0	0	27
SW	0	0	1	3	4	13	10	4	1	0	0	0	0	36
WSW	0	0	1	0	2	24	10	0	0	0	0	0	0	37
W	0	0	0	0	8	16	6	3	1	0	0	0	0	34
WNW	0	0	0	0	3	22	7	2	0	0	0	0	0	34
NW	0	0	0	1	1	6	11	5	0	0	0	0	0	24
NNW	0	0	0	0	1	1	11	16	0	0	0	0	0	29
TOTAL		0	0	3	10	40	180	295	138	24	0	0	0	699

NUMBER OF CALMS FOR A STABILITY 0

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS

PASQUILL CLASS B

		WIND SPEED (M/S) AT 10-M LEVEL												TOTAL
WIND DIRECTION		35-50	51-75	76-100	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10	10.1-15	15.1-18.0	>18.0	
N	0	0	0	1	5	6	4	5	1	0	0	0	0	22
NNE	0	0	1	1	2	2	7	2	1	0	0	0	0	16
NE	0	0	0	0	3	18	37	0	1	0	0	0	0	59
NNE	0	0	0	0	1	1	5	0	0	0	0	0	0	12
E	0	0	0	0	0	1	2	0	0	0	0	0	0	3
ESE	0	0	0	0	0	0	7	2	0	0	0	0	0	9
SE	0	0	0	0	1	3	11	4	2	0	0	0	0	21
SSE	0	0	0	1	0	5	6	10	4	0	0	0	0	26
S	0	0	0	1	2	3	7	10	5	0	0	0	0	28
SSW	0	0	0	2	1	3	4	2	2	0	0	0	0	14
SW	0	1	0	0	2	2	3	1	3	0	0	0	0	12
WSW	0	0	0	1	0	1	5	3	1	0	0	0	0	11
W	0	0	0	1	7	4	2	0	0	0	0	0	0	14
WNW	0	0	0	0	1	3	2	0	0	0	0	0	0	6
NW	0	0	0	1	1	2	1	1	2	0	0	0	0	8
NNW	0	0	0	1	2	6	6	5	1	0	0	0	0	19
TOTAL		0	1	1	10	28	60	109	50	23	0	0	0	262

NUMBER OF CALMS FOR B STABILITY 0

TABLE 4

(2 of 4)

JOINT FREQUENCY DISTRIBUTION OF METEOROLOGICAL DATA

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS

PASQUILL CLASS C

		WIND SPEED (M/S) AT 10-M LEVEL												TOTAL
WIND DIRECTION	35-50	51-75	76-100	101-125	126-150	151-175	176-200	201-225	226-250	251-275	276-300	301-325	326-350	
N	0	0	0	1	3	4	11	5	1	0	0	0	0	25
NNE	0	0	0	3	3	4	1	2	1	0	0	0	0	14
NE	0	0	0	1	5	26	32	2	1	0	0	0	0	67
ENE	0	0	0	0	0	6	7	5	0	0	0	0	0	18
E	0	0	0	0	0	4	5	2	0	0	0	0	0	11
ESE	0	0	0	1	1	3	10	1	0	0	0	0	0	16
SE	0	0	0	1	0	3	10	6	2	0	0	0	0	22
SSE	0	0	1	1	1	8	22	20	5	0	0	0	0	58
S	0	0	0	2	2	7	6	6	5	1	0	0	0	29
SSW	0	0	0	0	2	2	0	1	0	3	0	0	0	8
SW	0	0	1	2	3	1	3	2	2	0	0	0	0	14
WSW	0	0	0	2	1	3	6	5	0	0	0	0	0	17
W	0	0	0	0	2	0	8	2	0	0	0	0	0	12
WNW	0	0	0	1	2	4	4	1	1	0	0	0	0	13
NW	0	0	0	0	0	1	5	0	0	0	0	0	0	6
NNW	0	0	1	1	1	3	10	4	1	0	0	0	0	21
TOTAL	0	0	3	16	26	79	140	64	19	4	0	0	0	351

NUMBER OF CALMS FOR C STABILITY

0

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS

PASQUILL CLASS D

		WIND SPEED (M/S) AT 10-M LEVEL												TOTAL
WIND DIRECTION	35-50	51-75	76-100	101-125	126-150	151-175	176-200	201-225	226-250	251-275	276-300	301-325	326-350	
N	1	0	5	12	13	29	148	79	10	0	0	0	0	297
NNE	0	0	3	17	10	29	69	56	8	0	0	0	0	192
NE	0	1	2	10	27	95	150	32	8	0	0	0	0	325
ENE	0	0	0	5	16	35	55	26	1	0	0	0	0	138
E	1	0	1	0	6	24	35	22	4	0	0	0	0	113
ESE	0	0	1	1	2	21	157	43	1	0	0	0	0	226
SE	0	0	1	3	8	32	127	50	6	0	0	0	0	227
SSE	0	0	0	3	13	71	150	74	21	0	0	0	0	332
S	0	2	3	11	11	42	86	54	39	2	0	0	0	252
SSW	0	2	2	7	11	19	26	18	12	0	0	0	0	97
SW	0	0	2	6	11	17	28	13	3	0	0	0	0	80
WSW	1	0	4	10	13	19	18	5	0	0	0	0	0	70
W	1	1	5	12	14	15	13	3	0	0	0	0	0	64
WNW	0	1	6	9	10	17	22	4	1	0	0	0	0	70
NW	0	1	2	16	17	24	35	9	11	0	0	0	0	115
NNW	1	0	1	18	19	46	86	47	6	0	0	0	0	220
TOTAL	5	8	38	156	201	535	1227	535	131	2	0	0	0	2618

NUMBER OF CALMS FOR D STABILITY

2

TABLE 4

(3 of 4)

JOINT FREQUENCY DISTRIBUTION OF METEOROLOGICAL DATA

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS

PASQUILL CLASS E

		WIND SPEED (M/S) AT 10-M LEVEL												TOTAL
WIND DIRECTION		35-50	51-75	76-100	101-125	126-150	151-175	176-200	201-225	226-250	251-275	276-300	301-325	
N	0	3	6	15	18	59	72	5	0	0	0	0	0	178
NNE	0	3	8	10	30	52	56	9	1	0	0	0	0	179
NE	0	3	6	22	41	82	129	19	2	0	0	0	0	304
NNE	1	1	7	12	23	74	71	14	12	0	0	0	0	215
E	1	2	6	10	18	63	66	13	0	0	0	0	0	179
ESE	0	4	3	4	9	46	84	7	0	0	0	0	0	157
SE	1	8	0	13	17	64	54	4	0	0	0	0	0	167
SSE	1	4	16	34	54	87	34	15	1	0	0	0	0	266
S	4	6	16	34	30	32	16	22	2	0	0	0	0	172
SSW	2	6	14	16	18	19	9	6	1	0	0	0	0	91
SW	6	6	16	20	21	16	10	1	0	0	0	0	0	98
WSW	2	8	15	26	36	27	11	0	0	0	0	0	0	125
W	1	1	13	30	11	13	5	0	0	0	0	0	0	74
WNW	0	6	13	27	12	12	6	2	1	0	0	0	0	79
NW	0	2	9	19	21	31	21	6	1	0	0	0	0	110
NNW	0	3	5	14	18	44	40	8	2	0	0	0	0	134
TOTAL		19	68	161	306	585	721	694	131	23	0	0	0	2508

NUMBER OF CALMS FOR E STABILITY

8

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS

PASQUILL CLASS F

		WIND SPEED (M/S) AT 10-M LEVEL												TOTAL
WIND DIRECTION		35-50	51-75	76-100	101-125	126-150	151-175	176-200	201-225	226-250	251-275	276-300	301-325	
N	2	1	4	18	6	10	2	0	0	0	0	0	0	43
NNE	1	0	7	15	3	8	4	0	0	0	0	0	0	38
NE	1	2	7	12	13	40	9	0	0	0	0	0	0	84
NNE	1	3	7	6	14	25	12	3	0	0	0	0	0	69
E	0	1	2	8	7	5	4	0	0	0	0	0	0	27
ESE	1	0	6	6	1	1	2	0	0	0	0	0	0	16
SE	1	2	2	6	5	1	0	0	0	0	0	0	0	17
SSE	1	3	9	12	17	11	0	0	0	0	0	0	0	53
S	4	3	25	44	17	6	0	0	0	0	0	0	0	99
SSW	5	18	27	38	6	1	0	0	0	0	0	0	0	97
SW	4	11	37	40	11	2	1	0	0	0	0	0	0	106
WSW	2	12	22	29	12	1	0	0	0	0	0	0	0	78
W	4	5	21	22	8	0	0	0	0	0	0	0	0	62
WNW	2	6	10	19	4	2	0	0	0	0	0	0	0	43
NW	3	6	8	8	6	11	2	0	0	0	0	0	0	44
NNW	0	1	5	3	5	5	1	0	0	0	0	0	0	22
TOTAL		54	74	198	284	137	128	39	4	0	0	0	0	898

NUMBER OF CALMS FOR F STABILITY

11

TABLE 4

(4 of 4)

JOINT FREQUENCY DISTRIBUTION OF METEOROLOGICAL DATA

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS

FANMILL CLASS G

WIND DIRECTION	WIND SPEED (M/S) AT 10-M LEVEL													TOTAL
	25-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	86-90	
N	2	1	8	7	3	0	0	0	0	0	0	0	0	21
NNE	0	4	3	5	2	1	1	0	0	0	0	0	0	16
NNE	0	3	4	6	4	3	0	0	0	0	0	0	0	20
NNE	1	1	2	6	2	0	0	0	0	0	0	0	0	12
E	1	1	1	0	0	0	0	0	0	0	0	0	0	3
ESE	2	0	2	2	0	0	0	0	0	0	0	0	0	6
SE	1	1	1	0	0	0	0	0	0	0	0	0	0	3
SSE	1	2	1	3	3	0	0	0	0	0	0	0	0	10
S	1	5	6	10	4	0	0	0	0	0	0	0	0	26
SSW	0	2	6	11	4	0	0	0	0	0	0	0	0	23
SW	3	4	9	4	0	0	1	0	0	0	0	0	0	21
WSW	1	2	11	3	3	0	0	0	0	0	0	0	0	20
W	4	5	18	7	0	0	0	0	0	0	0	0	0	34
WNW	4	5	15	5	2	0	0	0	0	0	0	0	0	31
NW	5	8	12	7	2	1	0	0	0	0	0	0	0	35
NNW	1	5	4	7	3	1	0	0	0	0	0	0	0	21
TOTAL	27	44	103	85	32	6	1	0	0	0	0	0	0	305

NUMBER OF CALMS FOR G STABILITY 14

TOTAL VALID HOURS FOR ALL STABILITIES = 7894

TOTAL INVALID HOURS FOR ALL STABILITIES = 866

TABLE 5

(1 of 2)

DOSE CALCULATION RESULTS FOR 1991

(DOSES DUE TO GASEOUS RADIOACTIVE EFFLUENTS)

** UNIT 1 ** QUARTER 1 OF 1991 **

DOSE FROM RADIOIODINES, PARTICULATES, AND TRITIUM
AT CONTROLLING LOCATION:

TOTAL DOSE (MREM) FOR BONE	: 2.9467E-03
TOTAL DOSE (MREM) FOR LIVER	: 1.7324E-02
TOTAL DOSE (MREM) FOR TOTAL BODY	: 1.6352E-02
TOTAL DOSE (MREM) FOR THYROID	: 1.9917E-00
TOTAL DOSE (MREM) FOR KIDNEY	: 1.7749E-02
TOTAL DOSE (MREM) FOR LUNG	: 1.3914E-02
TOTAL DOSE (MREM) FOR GI-LLI	: 1.4015E-02
NOBLE GAS DOSE AT SITE BOUNDARY:	
TOTAL BODY DOSE TOTAL (MREM)	: 2.5149E-01
SKIN DOSE TOTAL (MREM)	: 5.9748E-01
NOBLE GAS AIRDOSE AT SITE BOUNDARY:	
TOTAL GAMMA AIRDOSE (MRAD)	: 2.9978E-01
TOTAL BETA AIRDOSE (MRAD)	: 8.4947E-01

** UNIT 1 ** QUARTER 2 OF 1991 **

DOSE FROM RADIOIODINES, PARTICULATES, AND TRITIUM
AT CONTROLLING LOCATION:

TOTAL DOSE (MREM) FOR BONE	: 1.5214E-03
TOTAL DOSE (MREM) FOR LIVER	: 1.1040E-02
TOTAL DOSE (MREM) FOR TOTAL BODY	: 1.0051E-02
TOTAL DOSE (MREM) FOR THYROID	: 5.1881E-01
TOTAL DOSE (MREM) FOR KIDNEY	: 1.1201E-02
TOTAL DOSE (MREM) FOR LUNG	: 9.3808E-03
TOTAL DOSE (MREM) FOR GI-LLI	: 9.4141E-03
NOBLE GAS DOSE AT SITE BOUNDARY:	
TOTAL BODY DOSE TOTAL (MREM)	: 3.5207E-03
SKIN DOSE TOTAL (MREM)	: 8.2510E-03
NOBLE GAS AIRDOSE AT SITE BOUNDARY:	
TOTAL GAMMA AIRDOSE (MRAD)	: 4.1395E-03
TOTAL BETA AIRDOSE (MRAD)	: 1.1187E-02

** UNIT 1 ** QUARTER 3 OF 1991 **

DOSE FROM RADIOIODINES, PARTICULATES, AND TRITIUM
AT CONTROLLING LOCATION:

TOTAL DOSE (MREM) FOR BONE	: 1.8847E-05
TOTAL DOSE (MREM) FOR LIVER	: 2.9955E-02
TOTAL DOSE (MREM) FOR TOTAL BODY	: 2.9942E-02
TOTAL DOSE (MREM) FOR THYROID	: 3.4804E-02
TOTAL DOSE (MREM) FOR KIDNEY	: 2.9954E-02
TOTAL DOSE (MREM) FOR LUNG	: 2.9936E-02
TOTAL DOSE (MREM) FOR GI-LLI	: 2.9936E-02
NOBLE GAS DOSE AT SITE BOUNDARY:	
TOTAL BODY DOSE TOTAL (MREM)	: 1.7183E-03
SKIN DOSE TOTAL (MREM)	: 3.8821E-03
NOBLE GAS AIRDOSE AT SITE BOUNDARY:	
TOTAL GAMMA AIRDOSE (MRAD)	: 1.9301E-03
TOTAL BETA AIRDOSE (MRAD)	: 3.6575E-03

** UNIT 1 ** QUARTER 4 OF 1991 **

DOSE FROM RADIOIODINES, PARTICULATES, AND TRITIUM
AT CONTROLLING LOCATION:

TOTAL DOSE (MREM) FOR BONE	: 5.0760E-05
TOTAL DOSE (MREM) FOR LIVER	: 1.9271E-01
TOTAL DOSE (MREM) FOR TOTAL BODY	: 1.9268E-01
TOTAL DOSE (MREM) FOR THYROID	: 2.1210E-01
TOTAL DOSE (MREM) FOR KIDNEY	: 1.9272E-01
TOTAL DOSE (MREM) FOR LUNG	: 1.9265E-01
TOTAL DOSE (MREM) FOR GI-LLI	: 1.9266E-01
NOBLE GAS DOSE AT SITE BOUNDARY:	
TOTAL BODY DOSE TOTAL (MREM)	: 2.4916E-04
SKIN DOSE TOTAL (MREM)	: 1.3470E-03
NOBLE GAS AIRDOSE AT SITE BOUNDARY:	
TOTAL GAMMA AIRDOSE (MRAD)	: 3.2468E-04
TOTAL BETA AIRDOSE (MRAD)	: 1.4691E-03

** UNIT 1 ** TOTALS FOR 1991 **

DOSE FROM RADIOIODINES, PARTICULATES, AND TRITIUM
AT CONTROLLING LOCATION:

TOTAL DOSE (MREM) FOR BONE	: 4.5369E-03
TOTAL DOSE (MREM) FOR LIVER	: 2.5104E-01
TOTAL DOSE (MREM) FOR TOTAL BODY	: 2.4893E-01
TOTAL DOSE (MREM) FOR THYROID	: 1.8575E-00
TOTAL DOSE (MREM) FOR KIDNEY	: 2.5165E-01
TOTAL DOSE (MREM) FOR LUNG	: 2.4588E-01
TOTAL DOSE (MREM) FOR GI-LLI	: 2.4602E-01
NOBLE GAS DOSE AT SITE BOUNDARY:	
TOTAL BODY DOSE TOTAL (MREM)	: 2.5498E-01
SKIN DOSE TOTAL (MREM)	: 6.1096E-01
NOBLE GAS AIRDOSE AT SITE BOUNDARY:	
TOTAL GAMMA AIRDOSE (MRAD)	: 3.0615E-01
TOTAL BETA AIRDOSE (MRAD)	: 8.7669E-01

TABLE 5

(2 of 2)

DOSE CALCULATION RESULTS FOR 1991
(DOSES DUE TO LIQUID RADIOACTIVE EFFLUENTS)

```

** UNIT 1 ** QUARTER 1 OF 1991 **
TOTAL DOSE (MREM) FOR BONE           : 4.3941E-02
TOTAL DOSE (MREM) FOR LIVER          : 9.1280E-02
TOTAL DOSE (MREM) FOR TOTAL BODY     : 6.6583E-02
TOTAL DOSE (MREM) FOR THYROID        : 9.4473E-03
TOTAL DOSE (MREM) FOR KIDNEY         : 3.1027E-02
TOTAL DOSE (MREM) FOR LUNG           : 1.0269E-02
TOTAL DOSE (MREM) FOR GI-LLI        : 2.8173E-02

** UNIT 1 ** QUARTER 2 OF 1991 **
TOTAL DOSE (MREM) FOR BONE           : 4.8548E-01
TOTAL DOSE (MREM) FOR LIVER          : 8.3778E-01
TOTAL DOSE (MREM) FOR TOTAL BODY     : 6.1515E-01
TOTAL DOSE (MREM) FOR THYROID        : 1.0326E-02
TOTAL DOSE (MREM) FOR KIDNEY         : 2.7839E-01
TOTAL DOSE (MREM) FOR LUNG           : 9.2316E-02
TOTAL DOSE (MREM) FOR GI-LLI        : 2.9920E-01

** UNIT 1 ** QUARTER 3 OF 1991 **
TOTAL DOSE (MREM) FOR BONE           : 2.7328E-02
TOTAL DOSE (MREM) FOR LIVER          : 4.2658E-02
TOTAL DOSE (MREM) FOR TOTAL BODY     : 3.5153E-02
TOTAL DOSE (MREM) FOR THYROID        : 2.3069E-04
TOTAL DOSE (MREM) FOR KIDNEY         : 1.5845E-02
TOTAL DOSE (MREM) FOR LUNG           : 6.3319E-03
TOTAL DOSE (MREM) FOR GI-LLI        : 2.7536E-02

** UNIT 1 ** QUARTER 4 OF 1991 **
TOTAL DOSE (MREM) FOR BONE           : 2.5136E-03
TOTAL DOSE (MREM) FOR LIVER          : 1.3142E-02
TOTAL DOSE (MREM) FOR TOTAL BODY     : 9.6218E-03
TOTAL DOSE (MREM) FOR THYROID        : 2.4471E-04
TOTAL DOSE (MREM) FOR KIDNEY         : 4.4999E-03
TOTAL DOSE (MREM) FOR LUNG           : 1.5869E-03
TOTAL DOSE (MREM) FOR GI-LLI        : 4.3995E-02

** UNIT 1 ** TOTALS FOR 1991 **
TOTAL DOSE (MREM) FOR BONE           : 6.7424E-01
TOTAL DOSE (MREM) FOR LIVER          : 9.8983E-01
TOTAL DOSE (MREM) FOR TOTAL BODY     : 7.2651E-01
TOTAL DOSE (MREM) FOR THYROID        : 2.0249E-02
TOTAL DOSE (MREM) FOR KIDNEY         : 3.2977E-01
TOTAL DOSE (MREM) FOR LUNG           : 1.8950E-01
TOTAL DOSE (MREM) FOR GI-LLI        : 3.9891E-01

```

TABLE 6
(1 of 1)
ACTIVITY CALCULATIONS FOR SECONDARY
RELEASE PATHWAYS FOR 1991

VENTILATION SYSTEM	TOTAL ACTIVITY RELEASED DURING 1991 (Curies)				
	I-131	I-133	Co-58	Xe-133	Br-82
SWITCHGEAR AREA VENT (AH-25)	2.04E-5	<LLD	<LLD	1.49E-2	<LLD
+46 H&V EQUIPMENT ROOM (E-41A&B)	7.65E-6	<LLD	<LLD	<LLD	<LLD
HOT MACHINE SHOP (AH-35)	3.09E-5	3.21E-7	1.55E-7	<LLD	<LLD
DECONTAMINATION SHOP (AH-34)	4.88E-5	1.05E-6	<LLD	<LLD	1.16E-6
TOTALS	1.08E-4	3.38E-6	1.55E-7	1.49E-2	1.16E-6

ATTACHMENT 10.1

(349 PAGES)

CHANGES TO UNT-005-014,

OFFSITE DOSE CALCULATION MANUAL (ODCM)

July 1, 1991 To December 31, 1991

~~PORC/PORC-86-e~~

UNT-005-014

REVISION 1

EFFECTIVE DATE

SAFETY-RELATED

ADMINISTRATIVE PROCEDURE
OFFSITE DOSE CALCULATION MANUAL


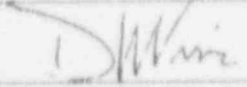
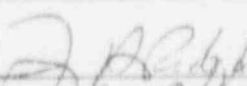
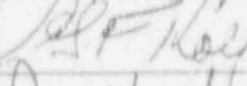
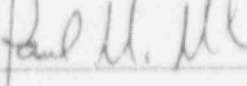
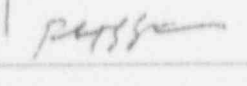
W-3 RECORDS
UNCONTROLLED COPY
DO NOT USE FOR SAFETY-RELATED TESTING,
MAINTENANCE, OR OPERATIONAL ACTIVITY

PORC ANB-PORC---S/C
RFVIEW AND APPROVAL SHEET

REVIEW OF: UNT-005-014 - (Change 1)
Offsite Dose Calculation Manual (Rev. 1)

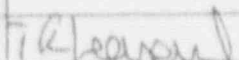
PORC ☒
PORC - S/C ☐

The PORC or PORC S/C has reviewed this item and determined that a Safety/Commitment Review was performed (if applicable), that a Safety Evaluation was performed (if applicable), that an unreviewed safety question does not exist, and that nuclear safety is/was not adversely affected.

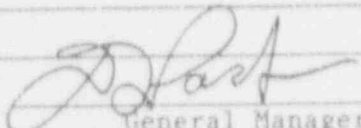
PORC MEMBER	MEMBER SIGNATURE	RECOMMENDED FOR APPROVAL	
		YES	NO
Maintenance Superintendent		<input checked="" type="checkbox"/>	
Operations Superintendent		<input checked="" type="checkbox"/>	
Radiation Protection Superintendent		<input checked="" type="checkbox"/>	
Quality Assurance Member		<input checked="" type="checkbox"/>	
Plant Engineering Superintendent		<input checked="" type="checkbox"/>	
Manager Operations & Maintenance		<input checked="" type="checkbox"/>	
PORC-S/C Member			
PORC-S/C Member			
PORC-S/C Member			

Meeting No. 91-166 Item No. VI-K Date: 12/19/91

This item is recommended for approval? ☒ YES ☐ NO
This item requires SRC/NRC review prior to implementation? ☐ YES ☒ NO
If yes, ensure documentation supporting review is attached.

	SIGNATURE	RECOMMENDED FOR APPROVAL		DATE
		YES	NO	
PORC-S/C Chairman				
PORC Chairman		<input checked="" type="checkbox"/>		<u>12/26/91</u>

Comments: _____

Approved by 
General Manager Plant Operations

Date 12/23/91

PLANT OPERATING MANUAL

Check Block Below

CHANGE/REVISION/DELETION REQUEST

☒ P/RC ☐ P/RC-S/CProcedure No. UNT-005-014 Title CERTE DOSE CALCULATION MANUALEffective Date 1-1-92 (if different from approval date)

Complete A, B, and C

A. Change No. 1 ☒ Permanent ☐ Deviation Expiration Date _____B. Revision No. 1C. Deletion ☐ YES ☒ NO

DESCRIPTION OF CHANGE, REVISION OR DELETION ADDED REFERENCE 2.10; CHANGED
the description of where the Bioaccumulation factors are obtained to
Attachment 2.21 for use in calculating A_i ; Changed A_i for
Wb-95 for both discharge points (page 115+118); Changed B_i
for Niobium from $3.0E+4$ to $3.0E+2$. FOR EASE OF IMPLEMENTING,
this change should be made effective on January 1, 1992.

REASON FOR CHANGE, REVISION OR DELETION Reduction of Bioaccumulation Factor (B_i)
for Niobium in aquatic marine biota. The current B_i is too large and
is much larger than per Reference 2.10. Using the old B_i would overestimate
effluent dose to the population due to Wb-95. Affected dose factors
were recalculated.

ORIGINATOR <u>Ang Hood</u>	DATE <u>12-11-91</u>
SAFETY SCREENING/EVALUATION <u>same as</u>	DATE <u>12-11-91</u>
TECHNICAL REVIEW <u>same as</u>	DATE <u>12-11-91</u>
GROUP HEAD REVIEW <u>Phil J. Phillips</u>	DATE <u>12/17/91</u>
TEMPORARY APPROVAL* (SRO) _____	DATE _____
TEMPORARY APPROVAL* _____	DATE _____

*Refer to paragraphs 3.2.15 and 5.3.1.10c for temporary approval requirements.

PORC ANB-PORC---S/E
REVIEW AND APPROVAL SHEET

REVIEW OF: UNT-005-014 - Offsite Dose
Calculation Manual (Rev. 1)

PORC ☒
PORC - S/C ☐

The PORC or PORC S/C has reviewed this item and determined that a Safety/Commitment Review was performed, (if applicable) that a Safety Evaluation was performed (if applicable), that an unreviewed safety question does not exist and that nuclear safety is/was not adversely affected.

PORC MEMBER	MEMBER SIGNATURE	RECOMMENDED FOR APPROVAL		DATE
		YES	NO	
Maintenance Superintendent	<i>[Signature]</i>	✓		11/27/91
Operations Superintendent	<i>[Signature]</i>	✓		11/27/91
Radiation Protection Superintendent	<i>[Signature]</i>	✓		11/27/91
Operations Quality Assurance Manager				
Plant Engineering Superintendent				
Assistant Plant Manager	<i>[Signature]</i>	✓		11/27/91
PORC-S/C Member				
PORC-S/C Member				
PORC-S/C Member				
PORC-S/C Chairman				
PORC Chairman	<i>[Signature]</i>	✓		11/27/91

Meeting No. 91-159 Item No. VI-E Date: 11/27/91

This item is recommended for approval? ☒ YES ☐ NO
This item requires SRC/NRC review prior to implementation? ☐ YES ☒ NO
If yes, ensure documentation supporting review is attached.

PLANT MANAGER-NUCLEAR APPROVAL

Comments: _____

Approved by *[Signature]*
Plant Manager-Nuclear

Date 11/29/91

WATERFORD 3 SES

PLANT OPERATING MANUAL

Check Block Below

CHANGE/REVISION/DELETION REQUEST

☒ PORC ☐ PORC-S/CProcedure No. UNT-005-014 Title ashite Dose Calculation ManualEffective Date (if different from approval date)

Complete A, B, and C

A. Change No. ☐ Permanent ☐ Deviation Expiration Date B. Revision No. 1C. Deletion ☐ YES ☒ NO

DESCRIPTION OF CHANGE, REVISION OR DELETION

- ① correct typographical errors from Rev. 0
- ② Added Attachment 6.21, Bioaccumulation Factors
- ③ correct some PEMP sampler descriptions and added new two lead products sample locations
- ④ Deleted Milk sample at MKE-4
- ⑤ changed the applicability requirement for waste gas holdup system and Main condenser evacuation system

REASON FOR CHANGE, REVISION OR DELETION

- ① typographical errors
- ② NRC comment on ODCM Revision on Feb. 8, 1991.
- ③ QA observations, Report SA-90-022.1
- ④ Based on land use census and to satisfy commitment A-17593.
- ⑤ The monitor function is only during the discharge of gas during tank. Also, Main condenser evacuation Monitor function is only when it has a vacuum in the condenser.

ORIGINATOR James J. HallDATE 11-8-91SAFETY SCREENING/EVALUATION same asDATE 11/13/91TECHNICAL REVIEW Gregory D. SpenserDATE 11/21/91GROUP HEAD REVIEW [Signature]DATE 11-21-91TEMPORARY APPROVAL* (SRO) DATE TEMPORARY APPROVAL* DATE

*Refer to paragraphs 3.2.15 and 5.3.1.10c for temporary approval requirements.

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- 6.1 Liquid Waste Management System Effluent Sources and Release Pathways and Points
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LIST OF EFFECTIVE PAGES

Title	Revision 1
1-198	Revision 1
2, 4a, 30, 115, 118, 198	Revision 1, change

change
see 11/1/80

1.0 PURPOSE

- 1.1 The offsite Dose Calculation Manual (ODCM) is a supporting document of the Waterford 3 Technical Specifications. This document provides (1) The Radiological Effluent Specifications and Radiological Environmental Monitoring Program required by Technical Specification 6.8.3; (2) the general characteristics of the Waterford 3 site; (3) the detailed Radiological Environmental Monitoring Program (REMP); (4) the description of the Radiological Environmental Monitoring Inter-laboratory Comparison Program; (5) the liquid and gaseous radwaste block flow diagram; (6) the Radioactive Liquid and Gaseous Waste Sampling and Analysis Programs; (7) the general methodology to be used to calculate dose to individuals due to releases of radioactive gaseous and liquid effluents from the Waterford 3 site; (8) the general methodology to be used to calculate effluent monitor setpoints and allowable release rates to ensure compliance with the Radiological Effluent Controls, 10CFR20, and 10CFR50 criteria; (9) the methodology to be used to ensure representative sampling of liquids; and (10) the methodology to be used to comply with 40CFR190 criteria.
- 1.2 The Offsite Dose Calculation Manual (ODCM) follows the general models suggested by NUREG 0133 and Regulatory Guide 1.109. However, alternate calculation methods from those presented may be used provided the overall methodology is acceptable and consistent with regulation or provided the alternate methodology is conservative. In addition, the most up-to-date dose conversion factors and bioaccumulation factors may be substituted in lieu of Regulatory Guide 1.109 values.
- 1.3 Actual step-by-step dose calculation will be performed by in-plant procedures which are consistent with the methodology presented in this document.

2.0 REFERENCES

- 2.1 Waterford 3 SES Technical Specifications, Chapter 16 of Waterford 3 FSAR.
 - 2.1.1 Technical Specification 6.14.1
 - 2.1.2 Technical Specification 6.14.2
- 2.2 USNRC Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Gaseous-Effluents from Light-Water-Cooled Reactors, July 1977.
- 2.3 USNRC Regulatory Guide 1.113, Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, April 1977.
- 2.4 USNRC Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I, Revision 1, October, 1977.
- 2.5 USNRC NUREG 0133, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, October 1978.
- 2.6 Code of Federal Regulations: Title 10, Parts 20, 40, 50 and 100; Title 40, Part 190.
- 2.7 HP-001-215, NRC and EPA Radiological Reporting Requirements
- 2.8 USNRC Generic Letter 89-01, Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program.
- 2.9 UNT-006-010, Event Notification and Reporting

2.0 REFERENCES (cont'd)

- 2.10 International Atomic Energy Agency (IAEA) Safety Series No. 57, *Generic Models and Parameters for Assessing the Environmental Transfer of Radionuclides from Routine Releases, Exposures of Critical Groups.*

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3.0 DEFINITIONS

- 3.1 ACTION shall be that part of a Specification which prescribes remedial measures required under designated conditions.
- 3.2 CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter which the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel including the sensor and alarm and/or trip functions, and shall include the CHANNEL FUNCTIONAL TEST. The CHANNEL CALIBRATION may be performed by any series of sequential, overlapping, and total channel steps such that the entire channel is calibrated.
- 3.3 A CHANNEL CHECK shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.
- 3.4 A CHANNEL FUNCTIONAL TEST shall be:
- a. Analog channels - the injection of a simulated signal into channel as close to the sensor as practicable to verify OPERABILITY including alarm and/or trip functions.
 - b. Bistable channels - the injection of a simulated signal into the sensor to verify OPERABILITY including alarm and/or trip functions.
 - c. Digital computer channels - the exercising of the digital computer hardware using diagnostic programs and the injection of simulated process data into the channel to verify OPERABILITY including alarm and/or trip function.

3.0 DEFINITIONS (cont'd)

3.5 The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the following intervals.

<u>NOTATION</u>	<u>FREQUENCY</u>
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days.
M	At least once per 31 days.
P	Completed prior to each release.
Q	At least once per 92 days.
SA	At least once per 184 days.
R	At least once per 18 months.
S/U	Prior to each reactor startup.
N.A.	Not applicable.

3.6 MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the licensee, its contractors, or vendors. Also excluded from this category are persons who enter the site to service equipment or make deliveries. This category does include persons who use portions of the site for recreational, occupational, or other purposes not associated with the plant.

3.7 A system, subsystem, train, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).

3.0 DEFINITIONS (cont'd)

3.8 An OPERATIONAL MODE (i.e. MODE) shall correspond to any one inclusive combination of core reactivity condition, power level and average reactor coolant temperature as specified.

<u>OPERATIONAL MODE</u>	<u>REACTIVITY CONDITION, K_{eff}</u>	<u>% OF RATED THERMAL POWER*</u>	<u>AVERAGE COOLANT TEMPERATURE</u>
1. POWER OPERATION	≥ 0.99	$> 5\%$	$\geq 350^{\circ}\text{F}$
2. STARTUP	≥ 0.99	$\leq 5\%$	$\geq 350^{\circ}\text{F}$
3. HOT STANDBY	< 0.99	0	$\geq 350^{\circ}\text{F}$
4. HOT SHUTDOWN	< 0.99	0	$350^{\circ}\text{F} > T_{avg} > 200^{\circ}\text{F}$
5. COLD SHUTDOWN	< 0.99	0	$\leq 200^{\circ}\text{F}$
6. REFUELING**	≤ 0.95	0	$\leq 140^{\circ}\text{F}$

*Excluding decay heat.

**Fuel in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

3.9 PURGE or PURGING shall be the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

3.10 The SITE BOUNDARY shall be that line beyond which the land is neither owned, nor leased, nor otherwise controlled by the licensee.

3.11 A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

3.0 DEFINITIONS (cont'd)

- 3.12 An UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY, access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the SITE BOUNDARY used for residential quarters or for industrial, commercial, institutional, and/or recreation purposes.
- 3.13 A VENTILATION EXHAUST TREATMENT SYSTEM shall be any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. Such a system is not considered to have any effect on noble gas effluents. Engineered Safety Feature (ESF) (atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.
- 3.14 VENTING shall be the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.
- 3.15 A WASTE GAS HOLDUP SYSTEM shall be any system designed and installed to reduce radioactive gaseous effluents by collecting coolant system offgases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

4.0 RESPONSIBILITIES

- 4.1 General Manager, Plant Operations has lead responsibility for insuring implementation of the Radiological Effluent Specifications and Radiological Environmental Monitoring Program as required by Technical Specification 6.8.3 and as set forth in this procedure.
- 4.2 The Radiation Protection Superintendent is responsible for ensuring Radiological Effluent Specifications and the Radiological Effluent Monitoring Program are performed as required according to procedures and methodologies established by the document. He is also responsible for insuring the Land Use Census and Semi-Annual Effluent Release Report are performed and issued as required.
- 4.3 Director Operations Support and Assessment is responsible for the issuance and submittal of the Annual Environmental Report as required by this document. He is also responsible for the negotiation and maintenance of vendor contracts to supply Sample Analyses and Reports as required by the Radiological Environmental Monitoring Program.

5.0 PROCEDURE

5.1 SITE CHARACTERISTICS

Waterford 3 SES is located on the west (right descending) bank of the Mississippi River at River Mile 129.6 between Baton Rouge, Louisiana, and New Orleans, Louisiana. The site is in the northwestern section of St. Charles Parish, Louisiana, near the towns of Killona and Taft.

The geographic coordinates for the Waterford 3 reactor are Latitude 29° 59' 42" North, and Longitude 90° 28' 16" West. Based on the UTM (Universal Transverse Mercator) Zone 15, the UTM coordinates are Northing 3,320,743 meters and Easting 743,962 meters.

The Mississippi River is the closest prominent natural feature to Waterford 3, while other important nature features include Lac des Allemands, about 5.5 miles southwest of the site, and Lake Pontchartrain, about 7 miles northeast of the site. The land slopes gently from its high points near the Mississippi (10-15 ft. above mean sea level) to extensive wetlands located 1.5 to 2.5 miles inland from the river.

Most of the man-made features are located on the narrow strip of dry land between the Mississippi River and the wetlands. Near the Waterford 3 site are several large industrial facilities, including Waterford 1 and 2 (0.4 miles northwest of the site), Little Gypsy Steam Electric Station (0.8 miles northeast of the site, across the river from Waterford 3), Agrico, a fertilizer manufacturer (0.6 miles east-southeast), Occidental Chemical Company (0.8 miles east-southeast), and Union Carbide, a chemical manufacturer (1.2 miles east-southeast). Louisiana Power & Light Company (LP&L) owns and operates the above-mentioned steam electric stations.

5.1 SITE CHARACTERISTICS (cont'd)

Attachment 6.1 provides a map of the UNRESTRICTED AREA and SITE BOUNDARY for radioactive effluents. LP&L will have full control of all activities conducted within the exclusion area boundary of the Waterford 3 site. All of the property within the designated exclusion area is owned by LP&L with the exception of the bottom lands below mean low water of the Mississippi River.

LP&L owns, in title, all surface rights within the exclusion area boundary of the plant. There is presently no intention to allow exploration for subsurface minerals from points on the surface of the exclusion area.

The Mississippi River, Louisiana Highway 18, the Missouri Pacific Railroad right-of-way, and the west (right descending) bank levee of the Mississippi River constitute traversals of the site exclusion area as allowed by 10CFR100.3 (a). Refer to the Waterford 3 Emergency Plan Implementing Document for the arrangements which have been made to give LP&L authority and control over these traversals. (Note that Louisiana Highway 3127 does traverse the SITE BOUNDARY but not the exclusion area. However, LP&L does have the authority to control this traversal in accordance with the Waterford 3 Emergency Plan Implementing Document.)

In addition to Waterford 3, there are two fossil-fueled units, Waterford SES Units 1 and 2, which are owned by LP&L and which are within the site exclusion area. The plant staff for these two units consists of about 60 people. Since this includes workers assigned to shifts, it is a conservative estimate of the maximum number of fossil plant personnel that would be within the exclusion area at any given time. Evacuation procedures for Waterford SES Units 1 and 2 are described in the Waterford 3 Emergency Plant Implementing Document.

5.1 SITE CHARACTERISTICS (cont'd)

A portion of the land within the SITE BOUNDARY is utilized for agricultural activities. Farmers presently work the land but can be expected to actually be in the field less than 10 percent of the time.

Fishing in the Mississippi River from the batture is a rare practice in the Waterford area. An estimated maximum of 2 people may be expected to be engaged in this activity for a period less than 10 percent of the time within the exclusion area.

Texaco maintains a gas valve station east-southeast of the Waterford 3 SES island structure just within the radius of the exclusion area. This valve station is automated and requires only periodic monthly maintenance involving, typically, two persons. Evacuation procedures for these maintenance workers are described in the Waterford 3 Emergency Plan Implementing Document.

The Waterford property is shown in Figure 5.1-3 of the Waterford 3 Site Technical Specifications (STS) and includes 3,561.3 acres. The plant area is about 48 acres and is defined as including the fenced area immediately adjacent to Waterford 3. The site area is shown in Figure 5.1-3 of the STS along with principal station structures and nearby features. The site includes only station structures and does not include any residential, recreational, or other industrial structures. There is a visitor center and adjacent recreational area approximately 1.0 mile SSW of the plant.

The SITE BOUNDARIES for establishing effluent release limits along with radioactive effluent release points are given in Attachment 6.1. The nearest distances to the boundary line are shown in Attachment 6.2 of this procedure. The release point elevations for gaseous effluents are provided in Attachment 6.1.

5.1 SITE CHARACTERISTICS (cont'd)

The restricted area, defined for the purpose of controlling ingress into and egress from the site, coincides with the plant area which is enclosed by the plant perimeter fence.

For the purpose of establishing effluent release limits in accordance with 10CFR20 and Appendix I to 10CFR50, the concept of the restricted area, as defined above for the purpose of ingress and egress control, is not applicable. The effluent release limits are established in order to ensure that: (1) the concentrations of the radionuclides in gaseous effluents discharged from the plant stack and exhaust systems do not result in exceeding the limits at the site boundary, with limits set forth in Table II, Column 1 of Appendix B to 10CFR20; (2) the concentration of radionuclides in liquid effluent at the unrestricted area boundary does not exceed the limits set forth in Table II, Column 2 of Appendix B to 10CFR20; and (3) the cumulative liquid and gaseous radionuclide releases do not result in exposures to individuals within the UNRESTRICTED AREA or at the SITE BOUNDARY in excess of the limits set forth in Appendix I to 10CFR50.

1980 population by annular sectors within 5 miles of Waterford 3 can be found in the Environmental Report. Population was estimated for 1977 and projected for 1980. The methodology for estimating and projecting population is described in detail in section 6.1.4.2 of the Environmental Report. The closest town to Waterford 3 is Killona, 0.9 miles west-northwest. Other towns near the plant include Norco 2.5 miles east; Hahnville, 3.7 miles east-southeast; and LaPlace, 4.7 miles north. There are also smaller settlements and homes along both banks of the river, the nearest such place to Waterford 3 being Montz, 1.0 mile northeast.

5.2 SPECIFICATIONS AND SURVEILLANCE REQUIREMENTS

- 5.2.1 Compliance with the SPECIFICATIONS contained in the succeeding sections is required during the OPERATIONAL MODES or other conditions specified therein; except that failure to meet the SPECIFICATIONS requires that the associated ACTION requirements shall be met.
- 5.2.2 Noncompliance with the procedure shall exist when the requirements of the SPECIFICATION and/or associated ACTION requirements are not met within the specified time intervals. If the SPECIFICATION is restored prior to expiration of the specified time intervals, completion of the ACTION requirements is not required.
- 5.2.3 Surveillance Requirements shall be applicable during all OPERATIONAL MODES or other conditions specified for individual systems unless otherwise stated in an individual Surveillance Requirement.
- 5.2.4 Each Surveillance Requirement shall be performed within the specified time interval with:
 - 5.1.4.1 A maximum allowable extension not to exceed 25% of the surveillance interval.

5.2 SPECIFICATIONS AND SURVEILLANCE REQUIREMENTS

5.2.5 Failure to perform a Surveillance Requirement within the specified time interval shall constitute a failure to meet the OPERABILITY requirements for a Specific System for Operation. Exceptions to these requirements are stated in the individual specifications. Surveillance Requirements do not have to be performed on inoperable equipment.

5.2.6 Failure to comply with the compensatory ACTION requirements or failure to complete the surveillance requirements within the specified time shall be documented and evaluated in accordance with Reference 2.9.

5.3 LIQUID EFFLUENTS

5.3.1 Concentration Specification

The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Attachment 6.1) 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 2×10^{-4} microcurie/ml total activity.

APPLICABILITY: At all times

ACTION:

With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, immediately restore the concentration to within the above limits, and describe the events leading to this condition in the next Semiannual Radioactive Effluent Release Report.

SURVEILLANCE REQUIREMENTS

- a. Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 5.3-1.
- b. The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in section 5.3.5 to assure that the concentrations at the point of release are maintained within the limits of Specification 5.3.1.

TABLE 5.3-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (μCi/mL)
A. Batch Waste Release ^{b,f,g,h,i} Tanks	P Each Batch	P Each Batch	Principal Gamma Emitters ^c	5x10 ⁻⁷
			I-131	1x10 ⁻⁶
1. Boric Acid Condensate	P	M	Dissolved and Entrained Gases (Gamma Emitters)	1x10 ⁻⁵
2. Waste Condensate	One Batch/M			
	P Each Batch	M Composite ^d	H-3	1x10 ⁻⁵
3. Laundry Waste			Gross Alpha	1x10 ⁻⁷
4. Turbine Building Industrial Waste Sumps*	P Each Batch	Q Composite ^d	Sr-89, Sr-90	5x10 ⁻⁸
			Fe-55	1x10 ⁻⁶
5. Dry Cooling Tower Sumps #1 and #2*				
6. Regenerative Waste				
7. Filter Flush				
8. Waste				

*When release from this source is batch in nature.

TABLE 5.3-1 (Continued)

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (μCi/mL)
B. Continuous Release ^{e, f}	W	W	Principal Gamma Emitters ^c	5x10 ⁻⁷
1. Turbine Building Industrial Waste Sumps ^{**b}	W	W	I-131	1x10 ⁻⁶
2. Dry Cooling Tower Sump #1 ^{**i}	M	M	Dissolved and Entrained Gases (Gamma Emitters)	1x10 ⁻⁵
3. Dry Cooling Tower Sump #2 ^{**i}	W	M	H-3	1x10 ⁻⁵
	Grab Sample	Composite ^d	Gross Alpha	1x10 ⁻⁷
4. Circulating _i Water Discharge- Steam Generator Blow-down HX	W	Q	Sr-89, Sr-90	5x10 ⁻⁸
	Grab Sample	Composite ^d	Fe-55	1x10 ⁻⁶
5. Auxiliary Component Cooling Water _i Pumps _i				

^{**}When release from this source is continuous in nature.

TABLE 5.3-1 (Continued)

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (μ Ci/mL)
B. Continuous Release ^{e,f}	W Continuous ^k	W Composite ^d	Principal Gama Emitters ^c	5×10^{-7}
6. Steam Generator Blowdown Discharge ^{j,l}			I-131	1×10^{-8}
	M Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
	W Continuous ^k	M Composite ^d	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	W Continuous ^k	Q Composite ^d	Sr-89, Sr-90	5×10^{-8}
			Fe-55	1×10^{-6}

TABLE 5.3-1 (Continued)
TABLE NOTATION

^aThe 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 is the "a priori" lower limit of detection as defined above, as microcuries per unit mass or volume,

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

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fraction radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for plant effluents is the elapsed time between the midpoint of sample collection and the time of counting.

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.

^bA 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 Section 5.3.6 to assure representative sampling.

TABLE 5.3-1 (Continued)
TABLE NOTATIONS

^cThe 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 6.9.1.8.

^dA 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.

^eA 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.

^fPrior to analyses, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.

^gIf the contents of the filter flush tank or the regenerative waste tank contain detectable radioactivity, no discharges from these tanks shall be made to the UNRESTRICTED AREA and the contents of these tanks shall be directed to the liquid radwaste treatment system.

^hTurbine Building Industrial Waste Sump (TBIWS)

The TBIWS shall be required to be sampled and analyzed in accordance with this table if any of the following conditions exist:

- (1) Primary to secondary leakage is occurring; or,
- (2) Activity is present in the secondary system as indicated by either the SGB monitors or secondary sampling and analysis; or,
- (3) Activity was present in the TBIWS during the previous 4 weeks.

If none of the above situations exists, then the sampling and analysis of this stream need not be performed.

ⁱSampling and analysis of the dry cooling tower sumps and the auxiliary component cooling water pump discharge will be required only when detectable activity exists in the CCW.

Sampling and analysis of the circulating water discharge-steam generator blowdown heat exchanger discharge (CWD-SGB) will be required only when detectable activity exists in the secondary system.

TABLE 5.3-1 (Continued)
TABLE NOTATIONS

^jSampling and analysis of the steam generator blowdown will be required only when the blowdown is directed to the circulating water system or Waterford 3 waste pond.

Steam generator blowdown to the Waterford 3 waste pond will be limited to situations requiring secondary chemistry control where the Circulating Water System is not available or the secondary chemistry is outside the requirements for Circulating Water System discharge. Blowdown to the waste pond will be terminate upon direction of sample & activity greater than the LLD levels of Table 5.3-1.

^kTo be representative of the quantities and concentration of radioactive materials in liquid effluents, samples shall be collected continuously in proportion to the rate of flow of the effluent stream.

^lSteam generator blowdown discharge to the waste pond is not available unless radiation monitoring and automatic isolation capabilities are added to the waste pond discharge path.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.2 Dose Specification

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to UNRESTRICTED AREAS (see Attachment 6.1) shall be limited:

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

APPLICABILITY: At all times.

ACTION:

- a. With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identified the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits. This Special Report shall also include (1) the results of radiological analyses of the drinking water source and (2) the radiological impact on finished drinking water supplies with regard to the requirements of 40 CFR Part 141.

5.3 LIQUID EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS:

- a. Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with methodology and parameters in Section 5.3.7 at least once per 31 days.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.3 Liquid Radwaste Treatment System Specification

The liquid radwaste treatment system shall be OPERABLE and appropriate portions of the system shall be used to reduce releases of radioactivity when the projected doses due to the liquid effluent to UNRESTRICTED AREAS (see Attachment 6.1) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31 day period.

APPLICABILITY: At all times.

ACTION:

- a. With radioactive liquid waste being discharged without treatment and in excess of the above limits and any portion of the liquid radwaste treatment system not in operation, prepare and submit to the Commission within 30 days pursuant to Technical Specification 6.9.2 a Special Report that includes the following information.
 1. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,
 2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and
 3. Summary description of action (s) taken to prevent a recurrence.

5.3 LIQUID EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS

- a. Doses due to liquid releases to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters in Section 5.3.7.
- b. The installed Liquid Radwaste Treatment System shall be demonstrated OPERABLE by meeting Specifications 5.3.1 and 5.3.2.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.4 Liquid Effluent Dose Calculation

5.3.4.1 The dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas are calculated for the purpose of implementing Section 5.3.2 using the following expression:

$$D_{t\ell} = \Delta t_{\ell} F_{\ell} \sum_{i=1}^n A_{it} C_{i\ell} \quad (1)$$

$$D_t = \sum_{\ell=1}^m D_{t\ell} \quad (2)$$

Where:

$D_{t\ell}$ = the cumulative dose commitment to the total body or any organ (t) from the liquid effluents for each liquid release in mrem during time period (ℓ);

D_t = the cumulative dose commitment to the total body or any organ (t) from the liquid effluents for all (ℓ) time periods;

Δt_{ℓ} = the length of the ℓ^{th} time period over which the release is made, in hours;

$C_{i\ell}$ = the concentration of radionuclide (i) in undiluted liquid effluent during time period Δt_{ℓ} from any liquid release, in $\mu\text{Ci/ml}$;

5.3 LIQUID EFFLUENTS (cont.'d)

A_{it} = the site-related liquid ingestion dose commitment factor to the total body or any organ (t) for each identified nuclide (i) in mrem-ml/hr- μ Ci (Attachment 6.3), and;

F_L = the near field average dilution factor for C_{il} during any liquid effluent release. Defined as the ratio of the undiluted liquid waste flow during release to the average flow from the site discharge structure to site boundary receiving waters.

F_L = $\frac{\text{liquid radioactive waste flow}}{\text{discharge structure exit flow}}$

The liquid radioactive waste flow is the maximum flow from the effluent release. The discharge structure exit flow is the flow during disposal from the discharge structure release point into the receiving water body. For radionuclides not determined in each batch or weekly composite, the dose contribution to the current calendar quarter cumulative summation may be approximated by using a ratio of concentrations based on the previous monthly or quarterly composite analyses.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.4.2 Equation (1) above for calculating the dose contributions required the use of a dose factor, A_{it} , for each nuclide (i) which embodies the dose factors and dilution factors for the points of pathway origin. The adult total body dose factor and the adult organ dose factor for each radionuclide will be used from Table E-11 of Regulatory Guide 1.109; thus the list contains critical organ dose factors for various organs. The dose factor is written:

$$A_{it} = K_O (U_W/D_W + U_f BF_i) DCF_{it} \quad (3)$$

where:

U_W = 730 l/yr adult water consumption;

D_W = Dilution factor from near field area to potable water intake;

= 220 for discharges from the circulating water discharge into the Mississippi River (based on the ratio of the average Mississippi River flow to the maximum discharge flow);

= 1 for discharges into the 40 Arpent Canal (based on the assumption that dilution from the near field area to a potable water intake is negligible);

A_{it} = Composite dose parameter for the total body or critical organ (t) of an adult for nuclide (i) for all appropriate pathways (mrem-ml/hr- μ Ci);

5.3 LIQUID EFFLUENTS (cont'd)

K_o = Unit conversion factor;

U_f = 21 kg/yr, adult fish consumption;

BF_i = Bioaccumulation factor for nuclide (i) in fish (pCi/kg per pCi/l) from ^{Attachment 6.21} ~~Table A-1 of~~ Regulatory Guide 1.109, and;

DCF_{it} = Dose conversion factor for nuclide (i) and organ (t) for adults (mrem/pCi). Values are from Table E-11 of Regulatory Guide 1.109.

NOTE

For other liquid pathways, the appropriate dose factors will be utilized.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.5 Liquid Effluent Monitor Setpoint Calculation Methodology

Specifications 5.3.1 and 5.6.1 require that the liquid effluent monitoring instrumentation alarm/trip setpoints be set so that the concentration of radioactive material released from the site is limited to 10CFR20, 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 $2E-4$ $\mu\text{Ci/ml}$ total activity). This section presents the method to be used for determining setpoints in accordance with Surveillance Requirements 5.3.1 and 5.6.1.

5.3.5.1 The calculated setpoints for the liquid effluent monitors satisfy the following equation:

$$c = \frac{(SF) (RF) (F + f) \sum_{i=1}^n C_i}{TMPC (f)} \quad (4)$$

where;

$\sum_{i=1}^n C_i$ = the undiluted effluent gamma concentration $\mu\text{Ci/ml}$ for all radionuclides (i). The value will be derived from radioanalysis of liquid effluent to be released. This value will be supplied for each liquid release;

c = the setpoint, in $\mu\text{Ci/ml}$, of the liquid effluent monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release. This setpoint represents a value which, if exceeded would result in concentrations exceeding the limits of 10CFR20, Appendix B, Table II, Column 2, to an UNRESTRICTED AREA;

5.3 LIQUID EFFLUENTS (cont'd)

f = the liquid effluents flow as measured at the liquid effluent monitor location in gpm;

F = the dilution water flow as determined via pump curves or other appropriate measures that determine correct plant operating configuration in gpm;

NOTE

IF F is large compared to f then $F + f \cong F$.

SF = Safety factor to ensure that the effluent limit is not exceeded. Actual value is set by procedure (in the range 0.5 - 0.9);

RF = Release fraction allocated to this release (to be used only in situations of simultaneous or concurrent release);

$$TMPC = \sum_{i=1}^n \frac{C_i}{MPC_i} + \sum_{j=1}^m \frac{C_j}{MPC_j}$$

$\frac{C_j}{MPC_j}$ = the undiluted nongamma MPC_j fraction for all nongamma emitting radionuclides (j);

$\frac{C_i}{MPC_i}$ = undiluted gamma MPC_i fraction for all gamma emitting radionuclides (i);

MPC_j = Maximum Permissible Concentration for the applicable nongamma-emitting isotope (j) from 10CFR20, Appendix B, Table II, Column 2; and

MPC_i = Maximum Permissible Concentration for the applicable gamma-emitting isotope (i) from 10CFR20, Appendix B, Table II, Column 2.

5 - LIQUID EFFLUENTS (cont'd)

5.3.5.2 The values of C_i and C_j will be measured for each release as appropriate and the parameters for f and F will be supplied based on current plant operating configurations. The setpoint will be calculated in terms of $\mu\text{Ci/ml}$ and the liquid effluent monitor will be adjusted as necessary to ensure that liquid releases are secured prior to exceeding limits specified in 10CFR20, Appendix B, Table 11, Column 2 to an UNRESTRICTED AREA.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.6 Representative Liquid Sampling

Prior to grab sampling liquid waste tanks, methods should be used to guarantee representative sampling. Large volumes of liquid waste should be mixed in as short a time as possible and uniformly distributed prior to sampling. To determine the minimum mixing time for tanks from which releases are made, the following tests were performed prior to initial use for release purposes.

- a. The tank was filled to a known volume.
- b. A specific quantity of a selected chemical and/or sediments was added to the tank.
- c. Recirculation was initiated through the normal path.
- d. Periodic samples were taken until equilibrium was reached.
- e. The time observed to completely mix the tank is used as a minimum recirculation time prior to effluent sampling. Records of the test will be maintained.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.7 Dose Projection for Liquid Effluents

Specification 5.3.3 requires that appropriate subsystems of the liquid radwaste treatment system be used to reduce releases of radioactivity when the projected doses due to the liquid effluent from each reactor unit to UNRESTRICTED AREAS would exceed 0.06 mrem total body or 0.2 mrem to any organ in a 31-day period. The following calculational method is provided for performing this dose projection.

At least once every 31 days, the total dose from all liquid releases for the quarter-to-date will be divided by the number of days into the quarter and multiplied by 31. If this projected dose exceeds 0.06 mrem total body or 0.2 mrem any organ, and the Liquid Waste Management System has not been operating, it shall be operated, if operation would reduce the monthly projected doses below 0.06 mrem total body or 0.2 mrem any organ. (This is performed in accordance with the Surveillance Requirements of 5.3.3.)

5.3 LIQUID EFFLUENTS (cont'd)

5.3.8 Liquid Effluent Bases

a. CONCENTRATION (Section 5.3.1)

This specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table 11, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC and (2) the limits of 10 CFR Part 20.106(e) to the population. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

The sampling and analysis of the contents of the regenerative waste tank and the filter flush tank is performed if primary to secondary leakage occurs in a steam generator. The contents of these tanks cannot be discharged to the UNRESTRICTED AREA if any radioactivity is detected in these tanks since the discharge from these tanks is unmonitored. When radioactivity is detected in these tanks, the contents from these tanks must be discharged to the liquid radwaste system where the contents may then be monitored upon discharge.

5.3 LIQUID EFFLUENTS (cont'd)

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Handford Company Report ARH-SA-215 (June 1975).

b. DOSE (Section 5.3.2)

This specification is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." Also, for fresh water sites with drinking water supplies that can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR 141.16.

5.3 LIQUID EFFLUENTS (cont'd)

b. DOSE (Section 5.3.2) (cont'd)

The dose calculation methodology and parameters implement the requirement in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in 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, October 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

c. LIQUID RADWASTE TREATMENT SYSTEM (Section 5.3.3)

The OPERABILITY of the liquid radwaste treatment system ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10CFR Part 50.36a, General Design Criterion 60 of Appendix A 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

5.4 GASEOUS EFFLUENTS

5.4.1 Dose Rate Specification

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY (see Attachment 6.1) shall be limited to the following:

- a. For noble gases: Less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin, and
- b. For iodine-131, iodine-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.

APPLICABILITY: At all times

ACTION:

With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the above limit(s), and describe the events leading to this condition in the next Semiannual Radioactive Effluent Release Report.

5.4 GASEOUS EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS:

- a. The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in Section 5.4.5.
- b. Representative samples and analysis of gaseous effluents shall be obtained in accordance with the sampling and analyses program specified in Table 5.4-1.
- c. Based upon the sampling and analysis performed in Table 5.4-1 the dose rate due to I-131, I-133, H-3, and all other radionuclides in particulate form with half-lives greater than 8 days shall be determined to be within the above limits in accordance with the methodology and parameters in Section 5.4.5.

TABLE 5.4-1
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

GASEOUS RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (μCi/mL)
A. Waste Gas Holdup Tanks	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters ^b	1x10 ⁻⁴
B. Containment PURGE (Plant Stack)	P Each PURGE ^c Grab Sample	P Each PURGE ^c	Principal Gamma Emitters ^b	1x10 ⁻⁴
		M	H-3	1x10 ⁻⁶
C.1 Plant Stack	M ^{c,d,i} Grab Sample	M	Principal ^b Noble Gas Gamma Emitters	1x10 ⁻⁴
			H-3	1x10 ⁻⁶
C.2 Fuel Handling Building Ventilation (Normal) Exhaust	M ^{e,j} Grab Sample	M	Principal ^b Noble Gas Gamma Emitters	1x10 ⁻⁴
			H-3	1x10 ⁻⁶

TABLE 5.4-1 (Continued)
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

GASEOUS RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (pCi/mL)
D.1 All Release Types as listed in B., C.1, and C.2 above	Continuous ^{f,h,j}	W ^g Charcoal Sample	I-131	1x10 ⁻¹²
			I-133	1x10 ⁻¹⁰
D.2 Main Condenser Evacuation and Turbine Gland Sealing System	Continuous ^{f,h,j}	W ^g Particulate Sample	Principal Particulate Gamma Emitters ^b	1x10 ⁻¹¹
	Continuous ^{f,h,j}	M Composite Particulate Sample	Gross Alpha	1x10 ⁻¹¹
	Continuous ^{f,h,j}	Q Composite Particulate Sample	Sr-89, Sr-90	1x10 ⁻¹¹
	Continuous ^{f,h,j}	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1x10 ⁻⁶

5.4-1 (Continued)
TABLE NOTATION

^aThe LLD is defined, for purpose 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 is the "a priori" lower limit of detection as defined above, as microcuries per unit mass or volume,

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

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for plant effluents is the elapsed time between the midpoint of sample collection and the time of counting.

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.

5.4-1 (Continued)

TABLE NOTATIONS

- ^bThe 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, I-133, 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 Technical Specification 6.9.1.8.
- ^cSampling shall also be performed within 24 hours following shutdown, startup, or a THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period. Analysis for principle gamma emitters as defined in (b) above shall be completed within 48 hours of sampling.
- ^dTritium grab samples shall be taken at least once per 24 hours when the refueling canal is flooded.
- ^eTritium grab samples shall be taken 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.
- ^fThe 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 Section 5.4.1, 5.4.2, and 5.4.3.
- ^gSamples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing, or after removal from sampler. 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 in 1 hour 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 primary 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.
- ^hIf no primary to secondary leakage exists, then only the gross beta or gamma noble gases analysis need be performed for the main condenser evacuation and turbine gland sealing system. If a primary to secondary leak exists and the release from the main condenser evacuation and turbine gland sealing system has not been released via the plant stack, then the sampling and analysis must be performed.
- ⁱNote (c) above is not applicable for the plant stack unless the noble gas monitor shows that effluent activity has increased by a factor of 3.
- ^jFuel Handling Building sampling is required whenever irradiated fuel is in the storage pool.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.2 Dose-Noble Gas Specification

The air dose due to noble gases released in gaseous effluents to areas at and beyond the SITE BOUNDARY (see Attachment 6.1) 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.

APPLICABILITY: At all times.

ACTION:

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

SURVEILLANCE REQUIREMENTS:

Cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with the methodology and parameters in Section 5.4.6 at least once per 31 days.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.3 Dose - Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form Specification

The dose to MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the SITE BOUNDARY (see Attachment 6.1) 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.

APPLICABILITY: At all times

ACTION:

With the calculated dose from the release of iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

5.4 GASEOUS EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS:

Cumulative dose contributions for the current calendar quarter and current calendar year for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days shall be determined in accordance with the methodology and parameters in Section 5.4.7 at least once per 31 days.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.4 Gaseous Radwaste Treatment Specification

The VENTILATION EXHAUST TREATMENT SYSTEM and the WASTE GAS HOLDUP SYSTEM shall be OPERABLE and appropriate portions of these systems shall be used to reduce releases of radioactivity when the projected doses in 31 days due to gaseous effluent releases to areas at and beyond the SITE BOUNDARY (see Attachment 6.1) would exceed either:

- a. 0.2 mrad to air from gamma radiation, or
- b. 0.4 mrad to air from beta radiation, or
- c. 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

APPLICABILITY: At all times.

ACTION:

With radioactive gaseous waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that includes the following information:

- a. Identification of any inoperable equipment or subsystems, and the reason for the inoperability,
- b. Action(s) taken to restore the inoperable equipment to OPERABLE status, and
- c. Summary description of action(s) taken to prevent a recurrence.

5.4 GASEOUS EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS:

- a. Doses due to gaseous releases to areas at and beyond the SITE BOUNDARY shall be projected at least once per 31 days in accordance with the methodology and parameters in Section 5.4.9.
- b. The installed Gaseous Radwaste Treatment System shall be demonstrated operable by meeting Specifications 5.4.1, 5.4.2 and 5.4.3.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.5 Calculational Methodology for Gaseous Effluent Dose Rate

This section presents the calculational methods used for calculating gaseous effluent doses in fulfillment of Specification 5.4.1.

5.4.5.1 The dose rate due the radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to the following values and expressions:

Release rate limit for noble gases:

$$K' \overline{(X/Q)}_v \sum_{i=1}^n K_i Q_{iv} \leq 500 \text{ mrem/yr. total body} \quad (5)$$

$$K' \overline{(X/Q)}_v \sum_{i=1}^n (L_i + 1.1M_i) Q_{iv} \leq 3000 \text{ mrem/yr. skin} \quad (6)$$

Release rate limit for Iodine-131, Iodine-133, tritium and for all radionuclides in particulate form with half-lives greater than 8 days:

$$\overline{(X/Q)}_v \sum_{i=1}^n P_{it} Q_{iv} \leq 1500 \text{ mrem/yr any organ} \quad (7)$$

Where:

K' = a constant of unit conversion, $1E6 \text{ pCi}/\mu\text{Ci}$;

K_i = the total body dose factor due to gamma emissions for each identified radionuclide (i) in units of mrem/yr per pCi/m^3 (Attachment 6.4);

5.4 GASEOUS EFFLUENTS (cont'd)

L_i = the skin dose factor due to beta emissions for each identified radionuclide (i) in units of mrad/yr per pCi/m³ (Attachment 6.4);

M_i = the air dose factor due to gamma emissions for each identified radionuclide (i) in units of mrad/yr per pCi/m³ (Attachment 6.4). The constant 1.1 converts air dose to skin dose;

P_{it} = the thyroid dose parameter for Iodine-131, Iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days (i) for the inhalation pathway only, in mrem/yr per μ Ci/m³ (Same as R_i values for the child receptor listed in Attachment 6.5). The dose factor is based on the most restrictive age group (child) and most restrictive organ (thyroid) at the SITE BOUNDARY;

P_{it} = (child breathing rate of 3700 m³/yr)(DFA_i) (K') where DFA_i is the inhalation dose factor for each radionuclide from Table E-9, Reference 2.4;

$\sum_{i=1}^n$ = summation for all identified radionuclides;

5.4 GASEOUS EFFLUENTS (cont'd)

Q_{iv} = the average release rate of radionuclides (i) (either noble gas or Iodine-131, Iodine-133, tritium, and radionuclides in the particulate form with half-lives greater than 8 days, as appropriate) during the time of release from all vent releases (v). Value is averaged over one hour and is in units of $\mu\text{Ci/sec}$; and

$(X/Q)_v$ = $1.1\text{E-}5 \text{ sec/m}^3$ in the ESE sector at 0.6 mile for all vent releases (v) (the highest calculated annual average dispersion factor at the SITE BOUNDARY based on historical data). The actual X/Q for the time of release may be determined and used under certain circumstances.

NOTE

All radioiodines are assumed to be released in elemental form.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.6 Calculational Methodology for Noble Gas Doses

This section presents the calculational methods used for calculating noble gas effluent dose in air in accordance with Surveillance Requirement 5.4.2.

5.4.6.1 The air dose due to noble gases released in gaseous effluents to areas at or beyond the SITE BOUNDARY will be determined by the following expressions:

a. During any calendar quarter, for gamma radiation:

$$D_Y = (1.14E2) \overline{(X/Q)}_v \sum_{i=1}^n (M_i) \sum_{j=1}^m (\Delta t_j) (Q_{ijv}) \quad (8)$$

and for beta radiation:

$$D_\beta = (1.14E2) \overline{(X/Q)}_v \sum_{i=1}^n (N_i) \sum_{j=1}^m (\Delta t_j) (Q_{ijv}) \quad (9)$$

b. During any calendar year, for gamma radiation:

$$D_Y = (1.14E2) \overline{(X/Q)}_v \sum_{i=1}^n (M_i) \sum_{j=1}^m (\Delta t_j) (Q_{ijv}) \quad (10)$$

and for beta radiation:

$$D_\beta = (1.14E2) \overline{(X/Q)}_v \sum_{i=1}^n (N_i) \sum_{j=1}^m (\Delta t_j) (Q_{ijv}) \quad (11)$$

Where:

D_Y = the total gamma (γ) air dose from gaseous effluents for the total time period and not to exceed 5 mrad quarterly and 10 mrad yearly;

5.4 GASEOUS EFFLUENTS (cont'd)

D_{β} = the total beta (β) air dose from gaseous effluents for the total time period and not to exceed 10 mrad quarterly and 20 mrad yearly;

Q_{ijv} = the average release rate of radionuclides (i) in gaseous effluent from all vent releases (v) in $\mu\text{Ci/sec}$ during the time period Δt_j ;

$(X/Q)_v$ = $1.1\text{E-}5 \text{ sec/m}^3$ in the ESE sector at 0.6 mile for all vent releases (v). The actual X/Q for the time of release may be determined and used under certain circumstances;

Δt_j = the length of the j^{th} time period over which Q_{ijv} are accumulated for all gaseous releases in hours; and

M_i and N_i = the gamma and beta air dose factors (respectively) for a uniform semi-infinite cloud of radionuclide (i) in $\text{mrad/yr per pCi/m}^3$ (Attachment 6.4).

$1.14\text{E}2$ = a constant of units conversion

= $(1 \text{ yr}/8760 \text{ hr}) (10^6 \text{ pCi}/\mu\text{Ci})$

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.7 Calculational Methodology for Doses Due to Radioiodines, Tritium, and Radioactive Materials in Particulate Form

This section presents the calculational methods used for calculating doses due to iodine-131, iodine-133, tritium, and radionuclides in particulate form in accordance with Surveillance Requirement.

5.4.7.1 The dose to an individual from iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the SITE BOUNDARY will be determined by the following expressions:

During any calendar quarter:

$$D_{ita} = 1.14E-4 \Delta t \sum_{i=1}^n R_{ita} W_v Q_{iv} \quad (12)$$

During any calendar year:

$$D_{ita} = 1.14E-4 \Delta t \sum_{i=1}^n R_{ita} W_v Q_{iv} \quad (13)$$

5.4 GASEOUS EFFLUENTS (cont'd)

Where:

$1.14\text{E-}4$ = a constant of units conversion

= $\text{1yr}/8760 \text{ hr}$;

D_{ita} = the cumulative dose to an organ (t), age group (a), due to radionuclides (i) in gaseous effluents; not to exceed 7.5 mrem quarterly or 15 mrem yearly;

W_v = the dispersion parameter for estimating the dose to an individual at the controlling location for long term vent releases (v);

W_v = $(\overline{X/Q})_v$ for the inhalation pathway from vent releases (v) in sec/m^3 , from historical data, at the location of the critical receptor (Attachment 6.2);

W_v = $(\overline{D/Q})_v$ for the food and ground plane pathways from vent releases (v) in m^2 , from historical data at the location of the critical receptor (Attachment 6.2);

5.4 GASEOUS EFFLUENTS (cont'd)

R_{ita} = the dose factor from each identified radionuclide (i), for each applicable organ (t), and age group (a), in mrem/yr per $\mu\text{Ci}/\text{m}^3$ for the inhalation pathway (Attachment 6.5) and in mrem/yr per $\mu\text{Ci}/\text{m}^2\text{-sec}$ for the food and ground plane pathways (Attachments 6.6, 6.7, 6.8, 6.9, and 6.10). For sectors with real pathways within 5 miles of the plant, the values of R_i are used based on these real pathways; for sectors with no real pathways within 5 miles from the plant, R_i is used assuming that the cow-grass-milk pathway exists at the 5-mile distance. (R_i 's were calculated using the methodology found in Reference 2.5, pages 31-36.);

Q_{iv} = the average release rate of radionuclides (i) in gaseous effluent from all vent releases (v) in $\mu\text{Ci}/\text{sec}$; and

Δt = the time required for the release in hours for all releases per quarter or per year.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.8 Gaseous Effluent Monitor Setpoint Calculational Methodology

5.4.8.1 Specification 5.6.2 requires that the radioactive gaseous effluent monitoring instrumentation alarm/trip setpoints be set to ensure the limits of Specification 5.4.1 are not exceeded.

5.4.8.2 The calculated high alarm/flow termination setpoint is the maximum value for that particular release. For conservatism, an administrative safety factor (SF) of usually 10% will be utilized in the setpoint calculation. To allow for simultaneous releases from common or different release points a Release Fraction (RF) may be used to allocate percentages of the total allowable release.

5.4.8.3 Since the noble gas dose rates are more limiting than the radioiodine dose rate, gaseous setpoints will be based on noble gas dose rates (less than or equal to 500 mrem/yr total body, and less than or equal to 3000 mrem/yr skin). Specifically, gaseous setpoints will be based on the most limiting of the following equations:

a. Total body (Q_{tb}):

$$Q_{tb} = \frac{(500 \text{ mrem/yr.})(RF)(SF)}{\frac{(\overline{X/Q})_v (1E6 \text{ pCi}/\mu\text{Ci}) \sum_{i=1}^n K_i Q_{iv}}{\sum_{i=1}^n Q_{iv}}} \quad (14)$$

5.4 GASEOUS EFFLUENTS (cont'd)

Where:

$\sum_{i=1}^n$ = summation of all nuclides considered;

Q_{tb} = maximum release rate allowed to give a limiting total body dose rate of 500 mrem/yr in $\mu\text{Ci/sec}$;

K_i = the total body dose factor due to gamma emissions for each identified radionuclide (i) in units of mrem/yr per pCi/m^3 (Attachment 6.4);

Q_{iv} = average release rate of isotope (i) from the release point (v) in $\mu\text{Ci/sec}$;

RF = release fraction allotted to release point in consideration;

$(\overline{X/d})_v$ = $1.1\text{E-}5 \text{ sec/m}^3$ (in the ESE sector at 0.6 mile). The sector with highest value of annual average atmospheric dispersion factor at the site boundary for the release point (v) in question; and

SF = administrative safety factor to account for uncontrollable variables (sampling, monitoring errors, etc.). Usually, the SF takes on a value of 0.9.

5.4 GASEOUS EFFLUENTS (cont'd)

b. For Skin (Q_{skin}):

$$Q_{\text{skin}} = \frac{(3000 \text{ mrem/yr.})(\text{RF})(\text{SF})}{\frac{(\overline{X/Q})_v (1\text{E6 pCi}/\mu\text{Ci})}{\sum_{i=1}^n (L_i + 1.1M_i) Q_{iv}}} \quad (15)$$

where all terms are as defined as above except:

Q_{skin} = maximum release rate allowed to give a limiting skin dose of 3000 mrem/yr in $\mu\text{Ci}/\text{sec}$;

L_i = skin dose factor due to beta emissions for each identified radionuclide (i) in units of mrem/yr per pCi/m^3 (Attachment 6.4);

1.1 = conversion factor to convert from air to skin dose; and

M_i = air dose factor due to gamma emissions for identified noble gas isotope (i) in units of mrad/yr per pCi/m^3 (Attachment 6.4).

5.4.8.4 The monitor setpoint is calculated in the following manner:

$$\text{SN} = \frac{Q}{F_{\text{max}}} \quad (16)$$

5.4 GASEOUS EFFLUENTS (cont'd)

Where:

SN = maximum monitor setpoint in $\mu\text{Ci}/\text{cm}^3$;

F_{max} = maximum effluent flow rate (cm^3/sec); and

Q = Minimum value of Q_{tb} or Q_{skin} .

5.4.8.5 Since Kr-88 is the noble gas with the highest dose rate conversion factors, for conservatism, the preceeding calculations may be computed using Kr-88 only. Total body dose becomes more limiting than skin and the release limit is:

$$Q_{\text{Kr-88}} = \frac{(500 \text{ mrem/yr.})(\text{RF})(\text{SF})}{(\bar{X}/Q)_v (1\text{E6 pCi}/\mu\text{Ci})(K_{\text{Kr-88}})} \quad (17)$$

where:

$Q_{\text{Kr-88}}$ = the maximum release rate, based on Kr-88, allowed to give a limiting total body dose rate of 500 mrem/yr in $\mu\text{Ci}/\text{sec}$; and

$K_{\text{Kr-88}}$ = the total body dose factor due to Kr-88 in units of mrem/yr per pCi/m^3 (Attachment 6.4).

All other terms are as previously defined.

The monitor setpoint can be calculated as:

$$\text{SN} = \frac{Q_{\text{Kr88}}}{F_{\text{max}}} \quad (18)$$

and all terms are previously defined

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.9 Dose Projection due to Gaseous Effluents

5.4.9.1 Specification 5.4.4 requires that appropriate subsystems of the Gaseous Radwaste Treatment System be used to reduce releases of radioactivity when the projected doses due to the gaseous effluent to areas at and beyond the SITE BOUNDARY would exceed, in a 31-day period, any of the following:

- 0.2 mrad to air from gamma radiation; or
- 0.4 mrad to air from beta radiation; or
- 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

5.4.9.2 The following calculational method is provided for performing this dose projection.

At least once every 31 days the gamma air dose, beta air dose and the maximum organ dose for the month-to-quarter will be divided by the number of days into the quarter and multiplied by 31. If these projected doses exceed any of the values listed above and the Gaseous Waste Management System has not been operating, it shall be operated to reduce radioactivity levels prior to release. (This is performed in accordance with the Surveillance Requirements of Specification 5.4.4.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.10 Gaseous Effluent Bases

a. DOSE RATE (Section 5.4.1)

This specification is provided to ensure that the dose at any time at and beyond the SITE BOUNDARY from gaseous effluents from all units on the site will be within the annual dose limits of 10 CFR Part 20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in a UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR Part 20.106(b)). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrem/year.

5.4 GASEOUS EFFLUENTS (cont'd)

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

b. DOSE - NOBLE GASES (Section 5.4.2)

The Specification is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. It implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose

5.4 GASEOUS EFFLUENTS (cont'd)

calculation methodology and parameters established for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in 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, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977.

Sections 5.4.2 and 5.4.3 equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

Grab sampling of effluents from the main condenser evacuation and turbine gland sealing system is not required when this source has been continuously discharging to the plant stack over the past 30 days. If no primary to secondary leakage in the steam generator exists, then there should be no radioactive release from the main condenser evacuation and turbine gland sealing system and the gross beta or gamma monitoring for noble gases will be sufficient to determine if any radioactivity is present in the release. If a primary to secondary leak exists, then the release from the main condenser evacuation and turbine gland sealing systems will be sampled and analyzed in accordance with Table 5.4-1.

5.4 GASEOUS EFFLUENTS (cont'd)

c. IODINE-131, IODINE-133, TRITIUM, AND RADIONUCLIDES
IN PARTICULATE FORM (Section 5.4.3)

This specification is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Specifications are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The calculational methods specified in the Surv. Illance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in 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, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions.

5.4 GASEOUS EFFLUENTS (cont'd)

The release rate specifications for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days are dependent upon the existing radionuclide pathways to man in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: (1) individual inhalation of airborne radionuclides, (2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, (3) deposition onto grassy areas where milk animals and meat-producing animals graze with consumption of the milk and meat by man, and (4) deposition on the ground with subsequent exposure of man.

d. GASEOUS RADWASTE TREATMENT (Section 5.4.4)

The OPERABILITY of the WASTE GAS HOLDUP SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The discharge from the main condenser evacuation and turbine gland sealing system shall be required to be directed to the plant stack when the release rate of I-131 from this source is $\geq 2 \times 10^{-4}$ $\mu\text{Ci/s}$. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Section II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

5.5 TOTAL DOSE

5.5.1 TOTAL DOSE SPECIFICATION

The annual (calander year) dose or dose commitment to any MEMBER OF THE PUBLIC due to release 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.

APPLICABILITY: At all times.

ACTION:

With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specification 5.3.2.a, 5.3.2.b, 5.4.2.a, 5.4.2.b, 5.4.3.a, or 5.4.3.b calculations shall be made including direct radiation contributions from the reactor units and from outside storage tanks to determine whether the above limits of Specification 5.5.1 have been exceeded. This evaluation should be done in accordance with guidance in Section 5.5.2. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR 20.405c, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and

5.5 TOTAL DOSE

5.5.1 TOTAL DOSE SPECIFICATION (cont'd)

concentration of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

SURVEILLANCE REQUIREMENTS:

- a. Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Specification 5.3.2, 5.4.2, and 5.4.3 and in accordance with the methodology and parameters in the ODCM.
- b. Cumulative dose contributions from direct radiation from the reactor units and from radwaste storage tanks shall be determined in accordance with the methodology and parameters in the ODCM. This requirements is applicable only under condition set forth in Specification 5.5.1.

5.5 TOTAL DOSE (cont'd)

5.5.2 40 CFR 90 DOSE EVALUATION

This section demonstrates compliance with Specification 5.5.1 Surveillance Requirements. Specifically, the dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and 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) over 12 consecutive months.

Dose evaluations to demonstrate compliance with the above dose limits need to be performed only if quarterly doses exceed:

- (1) 3 mrem to the total body (liquid releases).
- (2) 10 mrem to any organ (liquid releases).
- (3) 15 mrem to the thyroid or any organ from radioiodines and particulates (gaseous releases).

otherwise no evaluations are required.

For the evaluation of doses to real individuals from liquid releases, the same calculational methods as employed in Section 5.3.4 will be used. However, more encompassing and realistic assumptions will be made concerning the dilution and ingestion of radionuclides by individuals who live and fish in the Waterford 3 area. The results of the Radiological Environmental Monitoring Program will be used in determining the realistic dose based on actual measured radionuclide concentra-

5.5 TOTAL DOSE (cont'd)

tions. For the evaluation of doses to real individuals from gaseous releases, the same calculational methods as employed in sections 5.4.6 and 5.4.7 will be used. The total body dose factor should be substituted for the gamma air dose factor (M_1) to determine the total body dose. Otherwise, the same calculational sequence applies. More realistic assumptions will be made concerning the actual location of real individuals, the meteorological conditions, and the consumption of food. Data obtained from the latest land use census should be used to determine locations for evaluating doses. The results of the Radiological Environmental Monitoring Program will be included in determining more realistic doses based on actual measured radionuclide concentrations.

Cumulative dose contributions from direct radiation, from the reactor unit, and from Radwaste Storage Tanks shall be determined utilizing the results of routine plant perimeter surveys, TLD data, or a combination of both when necessary.

5.5 TOTAL DCSE (cont'd)

5.5.3 Total Dose Bases

The specification is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant generated radioactive effluents and direct radiation exceed 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. For sites containing up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the reactor units and outside storage tanks are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 8 km must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.405c, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed.

5.5 TOTAL DOSE (cont'd)

5.5.3 Total Dose Bases

The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in Specifications 5.3.1 and 5.4.1. An individual is not considered a MEMBER OF THE PUBLIC during in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

5.6 INSTRUMENTATION

5.6.1 Radioactive Liquid Effluent Monitoring Instrumentation Specification.

The radioactive liquid effluent monitoring instrumentation channels shown in Table 5.6-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 5.3.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in Section 5.3.5.

APPLICABILITY: At all times.

ACTION:

- a. With radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above Specification, immediately suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable.
- b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 5.6-1. Restore the inoperable instrumentation to OPERABLE status within 30 days or, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report, pursuant to Technical Specification 6.9.1.8, why this inoperability was not corrected within the time specified. Releases need not be terminated after 30 days provided the specified ACTIONS are continued.

5.6 INSTRUMENTATION (Cont'd)

SURVEILLANCE REQUIREMENT

Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 5.6-2.

TABLE 5.6-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>ACTION</u>
1. RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
a. Boric Acid Condensate Discharge	1	28
b. Waste, Waste Condensate and Laundry Discharge	1	28
c. Dry Cooling Tower Sumps	1/sump	29
d. Turbine Building Industrial Waste Sump	1	29
e. Circulating Water Discharge (Blowdown Heat Exchanger and Auxiliary Component Cooling Water Pumps) #	1	29
2. CONTINUOUS COMPOSITE SAMPLERS		
a. Steam Generator Blowdown Effluent Line	1	29
3. FLOW RATE MEASUREMENT DEVICES		
a. Boric Acid Condensate Discharge	1	30
b. Waste, Waste Condensate and Laundry Discharge	1	30
c. Turbine Building Industrial Waste Sump*	N.A.	N.A.
d. Dry Cooling Tower Sumps*	N.A.	N.A.
e. Circulating Water Discharge* (Blowdown and Blowdown Heat Exchanger and Auxiliary Component Cooling Water Pumps)	N.A.	N.A.

#Automatic termination of blowdown discharge only

TABLE 5.6-1 (Continued)

TABLE NOTATIONS

*Pump performance curves generated in place shall be used to estimate flow.

ACTION STATEMENTS

ACTION 28 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that prior to initiating a release:

- a. At least two independent samples are analysed in accordance with Specification 5.3.1, and
- b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge line valving;

ACTION 29 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that grab samples are analyzed for radioactivity at a lower limit of detection of at least 10⁻⁷ microcurie/ml.

- a. At least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 microcurie/gram DOSE EQUIVALENT I-131, or
- b. At least once per 24 hours when the specific activity of the secondary coolant is less than or equal to 0.01 microcurie/gram DOSE EQUIVALENT I-131.

ACTION 30 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that the flow rate is estimated at least once per 4 hours during actual releases. Pump performance curves generated in place may be used to estimate flow.

TABLE 5.6-2

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

<u>INSTRUMENT</u>	<u>CHANNEL CHECK</u>	<u>CHANNEL SOURCE CHECK</u>	<u>CHANNEL CALIBRATION</u>	<u>FUNCTIONAL TEST</u>
1. RADIOACTIVITY MONITORS PROVIDING ALARMS AND AUTOMATIC TERMINATION OF RELEASE				
a. Boric Acid Condensate Discharge	P	P	R(3)	Q(1)
b. Waste, Waste Condensate and Laundry Discharge	P	P	R(3)	Q(1)
c. Dry Cooling Tower Sumps	D	M	R(3)	Q(5)
d. Turbine Building Industrial Waste Sump	D	M	R(3)	Q(5)
e. Circulating Water Discharge (Blowdown Heat Exchanger Auxiliary Component Cooling Water Pumps) #	D	M	R(3)	Q(5)
2. CONTINUOUS COMPOSITE SAMPLERS				
a. Steam Generator Blowdown Effluent Line	D(6)	N.A.	R	Q
3. FLOW RATE MEASUREMENT DEVICES				
a. Boric Acid Condensate Discharge	D(4)	N.A.	R	Q
b. Waste, Waste Condensate and Laundry Discharge	D(4)	N.A.	R	Q
c. Turbine Building Industrial Waste Sump	N.A.	N.A.	N.A.	N.A.
d. Dry Cooling Tower Sumps	N.A.	N.A.	N.A.	N.A.
e. Circulating Water Discharge (Blowdown and Blowdown Heat Exchangers and Auxiliary Component Cooling Water Pumps)	N.A.	N.A.	N.A.	N.A.

#Automatic termination of Blowdown discharge only

TABLE 5.6-2 (Continued)

TABLE NOTATION

1. The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occur if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm/trip setpoint.
 2. Circuit failure
 3. Instrument indicates a downscale failure.
2. The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm setpoint.
 2. Circuit failure.
3. The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Bureau of Standards or using standards that have been obtained from suppliers that participate in measurement assurance activities with NBS. These standards shall permit calibrating the system for over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used.
4. CHANNEL CHECK shall consist of verifying indication of flow during periods of release. CHANNEL CHECK shall be made at least once per 24 hours on days on which continuous, periodic, or batch releases are made.
5. The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway occurs if the instrument indicates measured levels above the alarm/trip setpoint and that control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm set.
 2. Circuit failure.
 3. Instrument controls not set in operate mode.
6. CHANNEL CHECK shall be made at least once per 24 hours on days on which continuous releases are made to the Circulating Water System or Waterford 3 waste pond.

5.6 INSTRUMENTATION (cont'd)

5.6.2 Radioactive Gaseous Effluent Monitoring Instrumentation Specifications

The radioactive gaseous effluent monitoring instrumentation channels shown in Table 5.6.3 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 5.4.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in Section 5.4.8.

APPLICABILITY: As shown in Table 5.6-3

ACTION:

- a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above Specification, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.
- b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 5.6-3. Restore the inoperable instrumentation to OPERABLE status within 30 days or, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report, pursuant to Technical Specification 6.9.1.8, why this inoperability was not corrected within the time specified. Releases need not be terminated after 30 days provided the specified ACTIONS are continued.

5.6 INSTRUMENTATION (cont'd)

SURVEILLANCE REQUIREMENTS:

Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 5.6-4.

TABLE 5.6-3

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>APPLICABILITY</u>	<u>ACTION</u>
1. WASTE GAS HOLDUP SYSTEM			
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	1	**	35
b. Effluent System Flow Rate Measuring Device	1	**	36
2. MAIN CONDENSER EVACUATION AND TURBINE GLAND SEALING SYSTEM			
a. Noble Gas Activity Monitor	1	****	37
b. Iodine Sampler [#]	1	****	39
c. Particulate Sampler [#]	1	****	39
d. Sampler Flow Rate Monitor	1	****	36

[#]If a primary to secondary leak exists or if the noble gas monitors in the main condenser evacuation and turbine gland sealing system or if the steam generator blowdown monitor indicates the presence of radioactivity in the secondary system, the flow from this release point shall be diverted immediately to the plant stack. These instruments are in the plant stack and sampling for radioiodines and particulates shall occur at the plant vent when this occurs.

TABLE 5.6-3 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>APPLICABILITY</u>	<u>ACTION</u>
4. REACTOR AUXILIARY BUILDING VENTILATION SYSTEM (PLANT STACK)			
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release#	1	*	37
b. Iodine Sampler	1	*	39
c. Particulate Sampler	1	*	39
d. Flow Rate Monitor	1	*	36
e. Sampler Flow Rate Monitor	1	*	36
5. FUEL HANDLING BUILDING VENTILATION SYSTEM (NORMAL)			
a. Noble Gas Activity Monitor	1	***	37
b. Iodine Sampler	1	***	39
c. Particulate Sampler	1	***	39
d. Flow Rate Monitor	1	***	36
e. Sampler Flow Rate Monitor	1	***	36

#Automatic termination of containment purge only.

TABLE 5.6-3 (Continued)

TABLE NOTATIONS

- *At all times.
- **During gas waste decay tank discharge.
- ***With irradiated fuel in the storage pool.
- ****When the main condenser is under a vacuum.

ACTION STATEMENTS

- ACTION 35 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, the contents of the tank(s) may be released to the environment provided best efforts are made to repair the instrument and that prior to initiating the release:
- a. At least two independent samples of the tank's contents are analyzed, and
 - b. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge valve lineup;
- ACTION 36 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that the flow rate is estimated at least once per 4 hours. For the waste gas holdup tank this action item is applicable only during periods of release. For the main condenser evacuation and turbine gland sealing systems, this action item applies only during release via the discharge silencer and only during turbine gland sealing operations and/or vacuum pump operation.
- ACTION 37 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that grab samples are taken at least once per 12 hours and these samples are analyzed for gross activity within 24 hours. However, containment purging of radioactive effluents must be immediately suspended during this condition for the plant stack only.

TABLE 5.6-3 (Continued)
TABLE NOTATIONS

ACTION 39 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via the affected pathway may continue provided best efforts are made to repair the instrument and that samples are continuously collected with auxiliary sampling equipment as required in Table 5.4-1.

TABLE 5.6-4

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

<u>INSTRUMENT</u>	<u>CHANNEL CHECK</u>	<u>SOURCE CHECK</u>	<u>CHANNEL CALIBRATION</u>	<u>CHANNEL FUNCTIONAL TEST</u>	<u>MODES IN WHICH SURVEILLANCE IS REQUIRED</u>
1. WASTE GAS HOLDUP SYSTEM					
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	P	P	R(3)	Q(1)	*
b. Effluent System Flow Rate Measuring Device	P	N.A.	R	Q	*
2. MAIN CONDENSER EVACUATION AND TURBINE GLAND SEALING SYSTEM					
a. Noble Gas Activity Monitor	D	M	R(3)	Q(2)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Sampler Flow Rate Monitor	D	N.A.	R	Q	*

TABLE 5.6-4 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

<u>INSTRUMENT</u>	<u>CHANNEL CHECK</u>	<u>SOURCE CHECK</u>	<u>CHANNEL CALIBRATION</u>	<u>CHANNEL FUNCTIONAL TEST</u>	<u>MODES IN WHICH SURVEILLANCE IS REQUIRED</u>
4. REACTOR AUXILIARY BUILDING VENTILATION SYSTEM (PLANT STACK)					
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	D	M	R(3)	Q(6)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate Monitor	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*
5. FUEL HANDLING BUILDING VENTILATION SYSTEM (NORMAL)					
a. Noble Gas Activity Monitor	D	M	R(3)	Q(2)	***
b. Iodine Sampler	W	N.A.	N.A.	N.A.	***
c. Particulate Sampler	W	N.A.	N.A.	N.A.	***
d. Flow Rate Monitor	D	N.A.	R	Q	***
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	***

#Automatic termination of containment purge only.

TABLE 5.6-4 (Continued)

TABLE NOTATIONS

*At all times.

***When irradiated fuel is in the spent fuel pool.

1. The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm/trip setpoint.
 2. Circuit failure.
 3. Instrument indicates a downscale failure.
2. The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm setpoint.
 2. Circuit failure.
3. The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Bureau of Standards (NBS) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NBS. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used.
6. The CHANNEL FUNCTION TEST shall also demonstrate that automatic isolation of this pathway occurs if the instrument indicates measured levels above the alarm/trip setpoint and that control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm set.
 2. Circuit failure.
 3. Instrument controls not set in operate mode.

5.6 INSTRUMENTATION (Cont'd)

5.6.3 Instrumentation Bases

a. RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION (5.6.1)

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in Section 5.3.5 to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

b. RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION (5.6.3)

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in Section 5.4.8 to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. This instrumentation also include provisions for monitoring (and controlling) the concentrations of potentially explosive gas mixtures in the WASTE GAS HOLDUP SYSTEM. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

5.7 LIQUID AND GASEOUS RADWASTE PROCESSES

The block flow diagrams of the radwaste systems are shown in Attachments 6.11 and 6.12. In order to obtain a more detailed description, see the appropriate sections of the FSAR.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REQUIREMENTS

5.8.1 Radiological Environmental Program Specification

The radiological environmental monitoring program shall be conducted as specified in Table 5.8-1.

APPLICABILITY: At all times.

ACTION:

- a. With the radiological environmental monitoring program not being conducted as specified in Table 5.8-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Technical Specification 6.9.1.7, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.
- b. With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeding the reporting levels of Table 5.8-2 when averaged over any calendar quarter, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose* to a MEMBER OF THE PUBLIC is less than the calendar year limits of Specifications 5.3.2, 5.4.2, and 5.4.3. When more than one of the radionuclides in Table 5.8-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \dots \geq 1.0$$

*The methodology and parameters used to estimate the potential annual dose to A MEMBER OF THE PUBLIC shall be indicated in this report.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REQUIREMENTS (Cont'd)

When radionuclides other than those in Table 5.8-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose to A MEMBER OF THE PUBLIC is equal to or greater than the calendar year limits of Specifications 5.3.2, 5.4.2, and 5.4.3. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.

- c. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 5.8-1, identify locations for obtaining replacement samples and add them to the radiological environmental monitoring program within 30 days.

The specific locations from which samples were unavailable may then be deleted from the monitoring program. Pursuant to Technical Specification 6.9.1.8, identify the cause of the unavailability of samples and identify the new location(s) for obtaining replacement samples in the next Semiannual Radioactive Effluent Release Report and also include in the report revisions of Attachments 6.13, 6.14, 6.16, 6.17 and 6.18 reflecting the new location(s).

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REQUIREMENTS (Cont'd)

SURVEILLANCE REQUIREMENTS:

The radiological environmental monitoring samples shall be collected pursuant to Table 5.8-1 from the specific locations given in Attachments 6.13 and 6.14, and shall be analyzed pursuant to the requirements of Table 5.8-1 and the detection capabilities required by Table 5.8-3.

TABLE 5.8-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM*

<u>EXPOSURE PATHWAY AND/OR SAMPLE</u>	<u>NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS^a</u>	<u>SAMPLING AND COLLECTION FREQUENCY</u>	<u>TYPE AND FREQUENCY OF ANALYSIS</u>
1. DIRECT RADIATION ^b	<p>31 routine monitoring stations either with 2 or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows:</p> <p>an inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY,</p> <p>an outer ring of stations, 1 in 10 of the meteorological sectors in the 6 - to 8-km range from the site;</p> <p>the balance of the 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</p>	Quarterly	Gamma dose quarterly.

*The number, media, frequency, and location of samples may vary from site to site. This table presents an acceptable minimum program for a site at which each entry is applicable. Local site characteristics must be examined to determine if pathways not covered by this table may significantly contribute to an individual's dose and should be included in the sampling program.

TABLE 5.8-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM²

<u>EXPOSURE PATHWAY AND/OR SAMPLE</u>	<u>NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS^a</u>	<u>SAMPLING AND COLLECTION FREQUENCY</u>	<u>TYPE AND FREQUENCY OF ANALYSIS</u>
2. AIRBORNE Radioiodine and Particulates	<p>Samples from 5 locations:</p> <p>3 samples from close to the 3 SITE BOUNDARY locations, in different sectors, of the highest calculated annual average ground-level D/Q.</p> <p>1 sample from the vicinity of a community having the highest calculated annual average ground-level D/Q.</p> <p>1 sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction.^c</p>	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	<p>Radioiodine Canister I-131 analysis weekly.</p> <p>Particulate Sampler: Gross beta radioactivity analysis following filter change; Gamma isotopic analysis^e of composite (by location) quarterly.</p>
3. WATERBORNE			
a. Surface ^f	<p>1 sample upstream 1 sample downstream</p>	Composite sample over 1-month period ^g .	Gamma isotopic analysis ^e monthly. Composite for tritium analysis quarterly.
b. Ground	Samples from 1 or 2 sources only if likely to be affected ^h .	Quarterly	Gamma isotopic ^e and tritium analysis quarterly.

TABLE 5.8-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM²

<u>EXPOSURE PATHWAY AND/OR SAMPLE</u>	<u>NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS^a</u>	<u>SAMPLING AND COLLECTION FREQUENCY</u>	<u>TYPE AND FREQUENCY OF ANALYSIS</u>
c. Drinking	1 sample of each of 1 to 3 of the nearest water supplies that could be affected by its discharge.	Composite sample over 2-week period ⁸ when I-131 analysis is performed, monthly composite otherwise	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year. ¹ Composite for gross beta and gamma isotopic analyses ^e monthly. Composite for tritium analysis quarterly.
d. Sediment from shoreline	1 sample from downstream area with existing or potential recreational value.	Semiannually	Gamma isotopic analysis ^e semiannually.
4. INGESTION			
a. Milk	Samples from milking animals in 3 locations within 5 km distance having the highest dose potential. If there are none, then, 1 sample from milking animals in each of 3 areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per yr. ¹ 1 sample from milking animals at a control location 15-30 km distant and in the least prevalent wind direction. ^c	Semimonthly when animals are on pasture; monthly at other times.	Gamma isotopic ^e and I-131 analysis semimonthly when animals are on pasture; monthly at other times.

TABLE 5.8-1 (Continued)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM*

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS ^a	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
b. Fish and Invertebrates	1 sample of each commercially and recreational important species in vicinity of plant discharge area. 1 sample of same species in areas not influenced by plant discharge.	Sample in season, or semiannually if they are not seasonal	Gamma isotopic analysis ^e on edible portions.
c. Food Products	1 sample of each principal class of food products from any area that is irrigated by water in which liquid plant wastes have discharged. Samples of 1 to 3 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. 1 sample of each of the similar broad leaf vegetation grown 15-30 km distant in the least prevalent wind direction if milk sampling is not performed.	At time of harvest ^j Monthly when available Monthly when available	Gamma isotopic analysis ^e on edible portion. Gamma isotopic ^e and I-131 analysis. Gamma isotopic ^e and I-131 analysis.

TABLE 5.8-1 (Continued)
TABLE NOTATIONS

- ^a Specific parameters of distance and direction sector from the centerline of one reactor, and additional description where pertinent, shall be provided for each and every sample location in Attachments 6.14, 6.16, 6.17 and 6.18. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and to Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, corrective action shall be completed prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.7. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program. Pursuant to Specification 6.9.1.8, identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining replacement samples in the next Semiannual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table reflecting the new location(s).
- ^b One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation. The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minima⁷ fading.
- ^c The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites that provide valid background data may be substituted.
- ^d Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for random and thoron daughter decay. If gross beta activity in air particulate samples is greater than 10 times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.
- ^e Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

TABLE 5.8-1 (Continued)TABLE NOTATIONS

- ^f The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream" sample shall be taken in an area beyond but near the mixing zone. "Upstream" samples in an estuary must be taken far enough upstream to be beyond the plant influence. Salt water shall be sampled only when the receiving water is utilized for recreational activities.
- ^g A composite sample is one in which the quantity (aliquot) of liquid sampled is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow. In this program composite sample aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) in order to assure obtaining a representative sample.
- ^h Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.
- ⁱ The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in this document.
- ^j If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvest occurs continuously, sampling shall be monthly. Attention shall be paid to including samples of tuberous and root food products.

TABLE 5.8-2

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 PRODUCTS (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		
Zn-65	300		20,000		
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	

TABLE 5.8-3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

Lower Limits of Detection (LLD)^{bc}

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m ³)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
gross beta	4	0.01				
H-3	2000					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1 ^d	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

TABLE 5.8-3
TABLE NOTATIONS

- ^aThis 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 analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 6.9.1.7.
- ^bRequired detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.
- ^cThe 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 is the "a priori" lower limit of detection as defined above, as microcuries per unit mass or volume,

^{s_b} is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate, as counts per minute,

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting

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

TABLE 5.8-3 (Continued)
TABLE NOTATIONS

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. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally 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 pursuant to Technical Specification 6.9.1.7.

^d LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.2 Interlaboratory Comparison Program Specification

Analyses shall be performed on all radioactive materials supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission.

APPLICABILITY: At all times.

ACTION:

- a. With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 6.9.1.7.

SURVEILLANCE REQUIREMENTS

The Interlaboratory comparison Program shall be described in Section 5.8.5. A summary of the results obtained as part of the above required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 6.9.1.7.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.3 Land Use Census Specification

A land use census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence, and the nearest garden* of greater than 50 m² (500 ft²) producing broad leaf vegetation.

APPLICABILITY: At all times.

ACTION:

- a. With a land use census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Specification 5.4.3, identify the new location(s) in the next Semiannual Radioactive Effluent Release Report, pursuant to Specification 6.9.1.8.
- b. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained in accordance with Specification 5.7.1, add the new location(s) to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from this monitoring program after October 31 of the year in which this land use census was conducted. Pursuant to Technical Specification 6.9.1.8 identify the new location(s) in the next Semiannual Radioactive Effluent Release Report and also include in the report revision of Attachments 6.13, 6.14, 6.16, 6.17, and 6.18 reflecting the new locations(s).

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

SURVEILLANCE REQUIREMENTS

The land use census shall be conducted during the growing season at least once per 12 months using that information that will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 6.9.1.7.

*Broad leaf vegetation sampling of different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. Specifications for broad leaf vegetation sampling in Table 5.8-1 Part 4.c. shall be followed, including analysis of control samples.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.4 Description of the Radiological Environmental Monitoring Program

The Radiological Environmental Monitoring Program (REMP) is expounded on in Attachment 6.13, and the Sample Location Table, Attachment 6.14. Attachment 6.15 explains the sector and zone designations for the sample locations. Attachments 6.16, 6.17 and 6.18 show the sample locations within the 2,10, and 50 mile radius of Waterford 3.

Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report. It is recognized that, at times, it may not be possible or practical continue to obtain samples of the media of choice at the most desired location or time. In these instances, suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the Radiological Environmental Monitoring Programs.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.5 Description of the Interlaboratory Comparison Program

As described in Section 5.8.2 the quality assurance in radiological environmental sampling will be maintained through participation in the Environmental Protection Agency's Radiological Laboratory Quality Assurance Program. The summary of results will be presented in tabular form and will include the type of analysis, the preparation (collection) date, the date the results are returned, the mean of the analyses (usually triplicate), the standard deviation, the date the values are released for information, the known value, the three standard deviation limit, and a two standard deviation/three standard deviation warning/action flag. If the sample analysis indicates results outside the three standard deviation range, then the corrective actions taken to prevent a recurrence will be documented and submitted along with all results when the Annual Radiological Environmental Operating Report is submitted.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.6 Dispersion Parameters For Critical Locations

As per Requirements 5.8.3, the dispersion parameters for the site boundary and where necessary, as identified by the Annual Land Use Census, are listed in Attachment 6.2. This table will be subject to changes based on the Annual Land Use Census and historical data.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.7 Radiological Environmental Monitoring Bases

a. INTERLABORATORY COMPARISON PROGRAM (Section 5.8.2)

The requirement for participation in an approved Inter-laboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix 1 to 10 CFR Part 50.

b. LAND USE CENSUS (Section 5.8.3)

This specification is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the radiological environmental monitoring program are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey or from consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix 1 to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m² provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/yr) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: (1) 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and (2) vegetation yield of 2 kg/m².

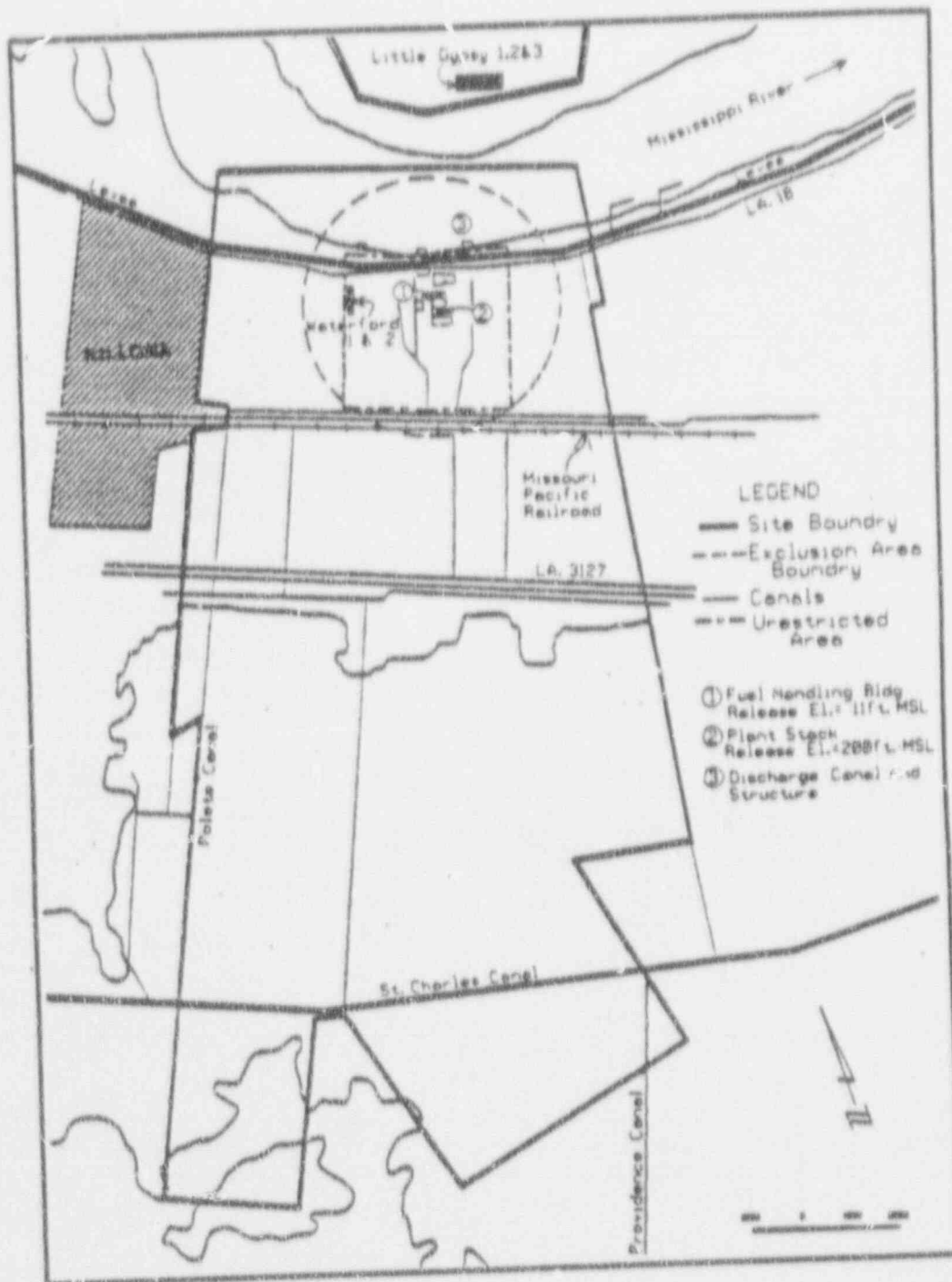
5.9 TECHNICAL SPECIFICATION CROSS-REFERENCES

Changes to the Technical Specifications (TS) recommended by Generic Letter 89-01 (Reference 2.8) resulted in programmatic controls for radiological effluents, radiological environmental monitoring, and effluent radiation monitoring instrumentation being relocated to the Offsite Dose Calculation Manual. All references of the former version of the TS that are contained in current plant operating procedures shall be cross-referenced to specifications contained in the ODCM using Attachment 6.20. Relocated requirements set forth in the ODCM should be incorporated into current plant operating procedures as they undergo routine review and revision.

6.0 ATTACHMENTS

Refer to Table of Contents

SITE BOUNDARY FOR
RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS



HISTORICAL AVERAGE DISPERSION AND DEPOSITION
PARAMETERS FOR AREAS AT OR BEYOND THE
UNRESTRICTED AREA BOUNDARY

ANNUAL AVERAGE ATMOSPHERIC DISPERSION AND DEPOSITION PARAMETERS
BASED ON HISTORICAL METEOROLOGICAL DATA AND CURRENT LAND USE CHANGES

RECEPTOR TYPE OR LOCATION	DIRECTION FROM SITE	SECTOR LOCATION	DISTANCE FROM SITE (Miles) (meters)		K/Q NO DECAY UNDEPLETED (g/m ³)	D/Q (mg/m ²)
SITE BOUNDARY	N(a)	A	0.80	1287	1.0E-05	2.4E-08
	NNE(a)	B	0.60	966	1.6E-05	3.4E-08
	NE(a)	C	0.60	966	1.5E-05	2.8E-08
	ENE(a)	D	0.60	966	1.6E-05	2.5E-08
	E	E	0.80	1287	6.9E-06	1.3E-08
	ESE	F	0.60	966	1.1E-05	2.3E-08
	SE	G	0.60	966	1.1E-05	3.1E-08
	SSE	H	0.80	1287	6.3E-06	2.4E-08
	S	J	1.60	2575	8.9E-07	2.7E-09
	SSW	K	3.10	4989	3.0E-07	7.9E-10
	SW	L	3.40	5472	3.3E-07	9.1E-10
	WSW	M	1.50	2414	1.7E-06	4.9E-09
	W	N	1.00	1609	2.3E-06	7.3E-09
	WNW	P	0.80	1287	7.5E-06	2.7E-08
	NW	Q	0.80	1287	1.0E-05	3.2E-08
	NNW	R	0.90	1448	9.4E-06	2.4E-08
RESIDENCE	N	A	0.90	1448	7.8E-06	1.8E-08
	NNE	B	1.30	2092	3.0E-06	5.8E-09
	NE	C	0.90	1448	6.3E-06	1.2E-08
	ENE	D	0.90	1448	6.8E-06	1.1E-08
	E	E	2.20	3541	7.4E-07	1.0E-09
	ESE	F	3.10	4989	3.7E-07	4.8E-10
	SE	G	4.00	6437	2.3E-07	3.6E-10
	SW	M	1.00	1609	2.3E-06	7.3E-09
	WNW	P	0.90	1448	5.6E-06	2.0E-08
	NW	Q	0.90	1448	7.7E-06	2.3E-08
MILK COW	NW(b)	Q	0.90	1448	7.7E-06	2.3E-08
	NW	Q	4.90	7886	2.6E-07	4.1E-10
MILK GOAT	ENE(b)	D	1.00	1609	5.3E-06	8.2E-09
	E(b)	E	3.30	5311	3.6E-07	3.9E-10
VEGETABLE GARDEN	N	A	1.00	1609	6.1E-06	1.4E-08
	NNE	B	1.30	2092	3.0E-06	5.8E-09
	NE	C	0.90	1448	6.3E-06	1.2E-08
	ENE	D	0.90	1448	6.8E-06	1.1E-08
	E	E	2.20	3541	7.4E-07	1.0E-09
	ESE	F	2.20	3541	7.0E-07	1.1E-09
	SE	G	2.30	3701	6.2E-07	1.3E-09
	WSW	M	1.50	2414	1.7E-06	4.9E-09
	W	N	1.10	1770	1.9E-06	5.7E-09
	WNW	P	0.90	1448	5.6E-06	2.0E-08
	NW	Q	0.90	1448	7.7E-06	2.3E-08
	NNW	R	3.00	4828	7.7E-06	1.3E-09
BEEF COW	E	E	3.20	5150	3.7E-07	4.2E-10
	ESE	F	3.50	5633	3.0E-07	3.6E-10
	SE	G	4.50	7242	1.9E-07	2.8E-10
	WSW	M	1.20	1931	2.7E-06	8.6E-09
	WNW	P	0.90	1448	5.6E-06	2.0E-08
	NW	Q	0.90	1448	7.7E-06	2.3E-08
	NNW	R	2.30	3701	1.3E-06	2.4E-09

a. The site boundary in this sector is located over water. The location cannot be occupied continuously for the life of the plant.

b. The animals at this location do not produce milk for human consumption.

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: CIRCULATING WATER (Int: Mississippi River)

NUCLIDE

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.002+00	2.66E-01	2.66E-01	2.66E-01	2.66E-01	2.66E-01	2.66E-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	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02
P-32	4.62E+07	2.87E+06	1.79E+06	0.00E+00	0.00E+00	0.00E+00	5.19E+06
P-51	0.00E+00	0.00E+00	1.27E+00	7.62E-01	2.81E-01	1.69E+00	3.21E+02
SI-54	0.00E+00	4.38E+03	8.35E+02	0.00E+00	1.30E+03	0.00E+00	1.34E+04
SI-56	0.00E+00	1.10E+02	1.97E+01	0.00E+00	1.43E+02	0.00E+00	3.52E+03
FE-55	6.59E+02	4.56E+02	1.07E+02	0.00E+00	0.00E+00	2.54E+02	2.61E+02
FE-59	1.04E+03	2.45E+03	9.38E+02	0.00E+00	0.00E+00	6.83E+02	8.15E+03
CO-58	0.00E+00	8.95E+01	2.01E+02	0.00E+00	0.00E+00	0.00E+00	1.01E+03
CO-60	0.00E+00	2.57E+02	5.67E+02	0.00E+00	0.00E+00	0.00E+00	4.83E+03
NI-63	3.12E+04	2.16E+03	1.05E+03	0.00E+00	0.00E+00	0.00E+00	4.51E+02
NI-65	1.27E+02	1.64E+01	7.51E+00	0.00E+00	0.00E+00	0.00E+00	4.17E+02
CU-64	0.00E+00	1.00E+01	4.70E+00	0.00E+00	2.52E+01	0.00E+00	8.53E+02
ZN-65	7.56E+04	7.37E+04	3.33E+04	0.00E+00	4.93E+04	0.00E+00	4.64E+04
ZN-69	4.93E+01	9.43E+01	6.56E+00	0.00E+00	4.13E+01	0.00E+00	1.42E+01
BR-83	0.00E+00	0.00E+00	4.04E+01	0.00E+00	0.00E+00	0.00E+00	5.82E+01
BR-84	0.00E+00	0.00E+00	5.24E+01	0.00E+00	0.00E+00	0.00E+00	4.11E+04
BR-85	0.00E+00	0.00E+00	2.15E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	1.01E+05	4.71E+04	0.00E+00	0.00E+00	0.00E+00	1.99E+04
BR-88	0.00E+00	2.90E+02	1.54E+02	0.00E+00	0.00E+00	0.00E+00	4.00E+09
BR-89	0.00E+00	1.92E+02	1.35E+02	0.00E+00	0.00E+00	0.00E+00	1.12E+11
BR-89	2.22E+04	0.00E+00	6.38E+02	0.00E+00	0.00E+00	0.00E+00	3.57E+03
BR-90	5.47E+05	0.00E+00	1.34E+05	0.00E+00	0.00E+00	0.00E+00	1.58E+04
BR-91	4.09E+02	0.00E+00	1.65E+01	0.00E+00	0.00E+00	0.00E+00	1.95E+03
BR-92	1.55E+02	0.00E+00	6.71E+00	0.00E+00	0.00E+00	0.00E+00	3.08E+03
Y-90	5.79E-01	0.00E+00	1.55E-02	0.00E+00	0.00E+00	0.00E+00	6.14E+03
Y-91M	5.47E-03	0.00E+00	2.12E-04	0.00E+00	0.00E+00	0.00E+00	1.61E-02
Y-91	8.49E+00	0.00E+00	2.27E-01	0.00E+00	0.00E+00	0.00E+00	4.67E+03
Y-92	5.09E-02	0.00E+00	1.49E-03	0.00E+00	0.00E+00	0.00E+00	8.91E+02

Conversion factors are in units of mrem/yr per uCi/ml

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: CIRCULATING WATER (100 microliters/kg/day)

NUCLIDE

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.61E-01	0.00E+00	4.42E-02	0.00E+00	0.00E+00	0.00E+00	5.12E+03
Zn-95	2.52E-01	5.07E-03	5.45E-02	0.00E+00	1.27E-01	0.00E+00	2.56E+02
Zn-97	1.39E-01	1.1E-03	1.1E-03	0.00E+00	4.26E-03	0.00E+00	8.69E-02
Mo-99	4.74E-02	2.48E-02	4.54E-02	0.00E+00	2.46E-02	0.00E+00	1.51E+04
Mo-99	0.00E+00	1.01E-02	1.99E-01	0.00E+00	2.37E-02	0.00E+00	2.43E+02
TC-99M	8.96E-03	2.53E-02	3.23E-01	0.00E+00	3.85E-01	1.24E-02	1.50E+01
TC-101	9.22E-03	1.33E-02	1.30E-01	0.00E+00	2.39E-01	6.79E-03	3.99E-14
RU-103	4.50E+00	0.00E+00	1.94E+00	0.00E+10	1.72E+01	0.00E+00	5.25E+02
RU-105	3.75E-01	0.00E+00	1.48E-01	0.00E+00	4.84E+00	0.00E+00	2.29E+02
RU-106	6.69E+01	0.00E+00	8.46E+00	0.00E+00	1.29E+02	0.00E+00	4.33E+03
Ag-110M	8.27E-01	7.65E-01	4.54E-01	0.00E+00	1.50E+00	0.00E+00	3.12E+02
TR-125M	2.97E+03	9.30E+02	3.44E+02	7.72E+02	1.94E+04	0.00E+00	1.03E+04
TE-127	6.49E+03	2.53E+03	7.90E+02	1.66E+03	2.63E+04	0.00E+00	2.17E+04
TE-127	1.05E+02	3.78E+01	2.28E+01	7.81E+01	4.29E+02	0.00E+00	2.32E+03
TE-129M	1.10E+04	4.11E+03	1.76E+03	3.78E+03	4.60E+04	0.00E+00	1.55E+04
TE-129	3.01E+01	1.13E+01	7.33E+00	2.31E+01	1.26E+02	0.00E+00	2.27E+01
TE-131M	1.66E+03	8.10E+02	6.75E+02	1.28E+03	8.21E+03	0.00E+00	8.05E+04
TE-131	1.89E+01	7.60E+00	5.96E+00	1.55E+01	8.27E+01	0.00E+00	2.67E+00
TE-132	2.41E+05	1.54E+03	1.47E+03	1.72E+03	1.50E+04	0.00E+00	7.39E+04
I-130	2.74E+01	8.09E+01	3.19E+01	6.86E+03	1.26E+02	0.00E+00	6.97E+01
I-131	1.51E+02	2.14E+02	1.35E+02	7.08E+04	3.70E+02	0.00E+00	5.70E+01
I-132	7.57E+00	1.07E+01	6.89E+00	6.89E+02	3.14E+01	0.00E+00	3.70E+00
I-133	5.15E+01	8.96E+01	2.73E+01	1.32E+04	1.56E+02	0.00E+00	8.06E+01
I-134	3.85E+00	1.05E+01	3.76E+00	1.81E+02	1.66E+01	0.00E+00	9.11E-03
I-135	1.41E+01	4.21E+01	1.72E+01	2.73E+03	6.75E+01	0.00E+00	4.75E+01
CS-134	2.93E+05	7.89E+05	9.79E+03	0.00E+00	2.29E+05	7.61E+04	1.26E+04
CS-136	3.12E+04	1.23E+05	8.86E+04	0.00E+00	6.85E+04	9.39E+03	1.43E+04
CS-137	3.62E+05	5.22E+05	3.42E+05	0.00E+00	1.77E+05	5.69E+04	1.01E+04
CS-138	2.64E+02	5.22E+02	2.94E+02	0.00E+00	3.94E+02	3.79E+01	2.23E-03
BA-139	9.64E-01	6.88E-04	2.63E-02	0.00E+00	6.43E-04	3.90E-04	1.71E+00

Conversion factors are in units of rem/yr per uCi/dl

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: CIRCULATING WATER (into Mississippi River)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.02E+02	2.54E-01	1.32E+01	0.00E+00	8.63E-02	1.45E-01	4.16E+02
BA-141	4.69E-01	3.54E-04	1.58E-02	0.00E+00	3.29E-04	2.01E-04	2.21E-10
BA-142	2.12E-01	2.18E-04	1.73E-02	0.00E+00	1.84E-04	1.23E-04	2.99E-19
LA-140	1.51E-01	7.59E-02	2.72E-02	0.00E+00	0.00E+00	0.00E+00	5.57E+03
LA-142	7.71E-03	3.51E-03	8.73E-04	0.00E+00	0.00E+00	0.00E+00	2.56E+01
CE-141	2.59E-02	1.75E-02	1.99E-03	0.00E+00	8.15E-03	0.00E+00	6.71E+01
CE-143	4.57E-03	3.38E+00	3.74E-04	0.00E+00	1.49E-03	0.00E+00	1.26E+02
CE-144	1.35E+00	5.22E-01	7.26E-02	0.00E+00	3.35E-01	0.00E+00	4.57E+02
PR-143	5.54E-01	2.22E-01	2.75E-02	0.00E+00	1.28E-01	0.00E+00	2.43E+03
PR-144	1.81E-03	7.53E-04	9.21E-05	0.00E+00	4.25E-04	0.00E+00	2.61E-10
MD-147	3.79E-01	4.38E-01	2.62E-02	0.00E+00	2.56E-01	0.00E+00	2.10E+03
W-187	2.96E-02	2.47E+02	8.65E+01	0.00E+00	0.00E+00	0.00E+00	8.10E+04
WP-239	2.89E-02	2.85E-02	1.57E-03	0.00E+00	8.68E-03	0.00E+00	5.84E+02

Conversion factors are in units of mrem/yr per uCi/ml

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: ALL OTHERS (into 40 Arpent Canal)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
H-3	0.00E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00
C-14	3.15E+04	6.30E+03	6.30E+03	6.30E+03	6.30E+03	6.30E+03	6.30E+03
NA-24	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02
P-32	4.62E+07	2.87E+06	1.77E+06	0.00E+00	0.00E+00	0.00E+00	5.25E+06
CR-51	0.00E+00	0.00E+00	1.41E+00	8.94E-01	3.29E-01	1.98E+00	3.76E+02
KR-54	0.00E+00	4.76E+03	9.04E+02	0.00E+00	1.42E+03	0.00E+00	1.46E+04
WR-56	0.00E+00	1.20E+02	2.12E+01	0.00E+00	1.52E+02	0.00E+00	3.82E+03
FE-55	8.87E+02	6.13E+02	1.43E+02	0.00E+00	0.00E+00	3.42E+02	3.52E+02
FE-59	1.40E+03	3.29E+03	1.26E+03	0.00E+00	0.00E+00	9.19E+02	1.10E+04
CO-58	0.00E+00	1.51E+02	3.39E+02	0.00E+00	0.00E+00	0.00E+00	3.06E+03
CO-60	0.00E+00	4.34E+02	9.58E+02	0.00E+00	0.00E+00	0.00E+00	8.16E+03
NI-63	4.19E+04	2.91E+03	1.41E+03	0.00E+00	0.00E+00	0.00E+00	6.07E+02
NI-65	1.70E+02	2.21E+01	1.01E+01	0.00E+00	0.00E+00	0.00E+00	5.61E+02
CU-64	0.00E+00	1.69E+01	7.93E+00	0.00E+00	4.26E+01	0.00E+00	1.44E+03
ZN-65	2.36E+04	7.50E+04	3.39E+04	0.00E+00	5.02E+04	0.00E+00	6.73E+04
ZN-69	5.02E+01	9.60E+01	6.67E+00	0.00E+00	6.24E+01	0.00E+00	1.44E+01
BR-83	0.00E+00	0.00E+00	4.38E+01	0.00E+00	0.00E+00	0.00E+00	6.30E+01
BR-84	0.00E+00	0.00E+00	5.67E+01	0.00E+00	0.00E+00	0.00E+00	4.45E+04
BR-85	0.00E+00	0.00E+00	2.33E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	1.03E+05	4.79E+04	0.00E+00	0.00E+00	0.00E+00	2.03E+04
BR-88	0.00E+00	2.95E+02	1.56E+02	0.00E+00	0.00E+00	0.00E+00	4.07E+09
BR-89	0.00E+00	1.95E+02	1.37E+02	0.00E+00	0.00E+00	0.00E+00	1.13E+11
BR-89	4.78E+04	0.00E+00	1.37E+03	0.00E+00	0.00E+00	0.00E+00	7.66E+03
BR-90	1.18E+06	0.00E+00	2.88E+05	0.00E+00	0.00E+00	0.00E+00	3.40E+04
BR-91	8.79E+02	0.00E+00	3.55E+01	0.00E+00	0.00E+00	0.00E+00	4.19E+03
BR-92	3.33E+02	0.00E+00	1.44E+01	0.00E+00	0.00E+00	0.00E+00	6.60E+03
Y-90	1.38E+00	0.00E+00	3.69E+02	0.00E+00	0.00E+00	0.00E+00	1.44E+04
Y-91M	1.30E-02	0.00E+00	5.04E-04	0.00E+00	0.00E+00	0.00E+00	3.85E-02
Y-91	2.02E+01	0.00E+00	5.39E+01	0.00E+00	0.00E+00	0.00E+00	1.11E+04
Y-92	1.21E-01	0.00E+00	3.53E+03	0.00E+00	0.00E+00	0.00E+00	2.12E+03

Conversion factors are in units of mrem/yr per uCi/ml

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: ALL OTHERS (into 40 Arpent Canal)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	GONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	3.83E-01	0.00E+00	1.06E-02	0.00E+00	0.00E+00	0.00E+00	1.22E+04
Zr-95	2.77E+00	8.88E-01	6.01E-01	0.00E+00	1.39E+00	0.00E+00	2.82E+03
Zr-97	1.53E-01	3.09E-02	1.41E-02	0.00E+00	4.47E-02	0.00E+00	9.57E+03
Mo-95	4.91E-02	2.47E-03	1.34E-02	0.00E+00	2.48E-02	0.00E+00	1.54E+06
Mo-99	5.00E+00	4.62E+02	8.79E+01	0.00E+00	1.05E+03	0.00E+00	1.07E+03
Tc-99m	2.94E-02	8.32E-02	1.06E+00	0.00E+00	1.26E+00	4.97E-02	4.92E+01
Tc-101	3.03E-02	4.34E-02	4.28E-01	0.00E+00	7.05E-01	2.23E-02	1.31E-13
Ru-103	1.98E+01	0.00E+00	8.54E+00	0.00E+00	7.57E+01	0.00E+00	2.31E+03
Ru-105	1.85E+00	0.00E+00	6.52E-01	0.00E+00	2.13E+01	0.00E+00	1.01E+03
Ru-106	2.95E+02	0.00E+00	3.73E+01	0.00E+00	5.69E+02	0.00E+00	1.91E+04
Au-110m	1.41E+01	1.30E+01	7.74E+00	0.00E+00	2.56E+01	0.00E+00	5.32E+03
Te-125m	2.79E+03	1.01E+03	3.74E+02	8.39E+02	1.13E+04	0.00E+00	1.11E+04
Te-127m	7.05E+03	2.52E+03	8.99E+02	1.80E+03	2.84E+04	0.00E+00	2.54E+04
Te-127	1.16E+02	4.11E+01	2.48E+01	8.41E+01	4.64E+02	0.00E+00	9.03E+03
Te-129m	1.20E+04	4.47E+03	1.89E+03	4.11E+03	5.05E+04	0.00E+00	6.03E+04
Te-129	3.27E+01	1.23E+01	7.94E+00	2.51E+01	1.37E+02	0.00E+00	2.47E+01
Te-131m	1.80E+03	8.81E+02	7.34E+02	1.39E+03	2.92E+03	0.00E+00	8.74E+04
Te-131	2.05E+01	8.57E+00	6.47E+00	1.69E+01	8.98E+01	0.00E+00	2.90E+00
Te-132	2.43E+03	1.70E+03	1.59E+03	1.87E+03	1.63E+04	0.00E+00	8.02E+04
I-130	9.01E+01	2.64E+02	1.05E+03	2.25E+04	4.15E+02	0.00E+00	2.29E+02
I-131	4.96E+02	7.09E+02	4.06E+03	2.52E+05	1.22E+03	0.00E+00	1.87E+02
I-132	2.42E+01	6.47E+01	2.38E+01	2.26E+03	1.03E+02	0.00E+00	1.22E+01
I-133	1.69E+02	2.94E+02	8.97E+01	4.32E+04	5.13E+02	0.00E+00	2.64E+02
I-134	1.26E+01	3.43E+01	1.23E+01	5.94E+02	5.46E+01	0.00E+00	2.99E+02
I-135	5.28E+01	1.38E+03	5.16E+01	9.11E+03	2.22E+02	0.00E+00	1.56E+02
Cs-134	3.03E+05	7.21E+05	5.89E+05	6.00E+00	2.33E+05	7.79E+04	1.26E+04
Cs-136	3.17E+04	1.32E+05	9.01E+04	6.03E+00	6.97E+04	9.55E+03	1.43E+04
Cs-137	11.83E+05	5.31E+05	3.48E+05	8.00E+00	1.80E+05	5.99E+04	1.03E+04
Cs-138	2.89E+02	5.31E+02	2.63E+02	8.00E+00	2.80E+02	3.83E+01	2.27E+03
Ba-139	9.00E+00	6.41E+03	2.64E+01	0.00E+00	5.99E+03	3.64E+03	1.60E+01

Conversion factors are in units of rem/yr per uCi/ml

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: ALL OTHERS (into 40 Arpent Canal)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	1.88E+03	2.37E+00	1.23E+02	0.00E+00	8.05E-01	1.35E+00	3.88E+03
BA-141	4.37E+00	3.30E-03	1.48E-01	0.00E+00	3.07E-03	1.67E-03	2.06E-09
BA-142	1.98E+00	2.03E-03	1.24E-01	0.00E+00	1.72E-03	1.15E-03	2.78E-18
LA-140	3.58E-01	1.80E-01	4.76E-02	0.00E+00	0.00E+00	0.00E+00	1.32E+04
LA-142	1.83E-02	8.33E-03	2.07E-03	0.00E+00	0.00E+00	0.00E+00	6.08E+01
CE-141	8.01E-01	5.42E-01	6.15E-02	0.00E+00	2.52E-01	0.00E+00	2.07E+03
CE-143	1.41E-01	1.04E+02	1.16E-02	0.00E+00	4.60E-02	0.00E+00	3.90E+03
CE-144	4.18E+01	1.75E+01	2.24E+00	0.00E+00	1.04E+01	0.00E+00	1.41E+04
PR-143	1.32E+00	5.28E-01	6.52E-02	0.00E+00	3.05E-01	0.00E+00	5.77E+03
PR-144	4.31E-03	1.79E-03	2.19E-04	0.00E+00	1.01E-03	0.00E+00	6.19E-10
WD-147	9.00E-01	1.04E+00	6.22E-02	0.00E+00	6.08E-01	0.00E+00	4.99E+03
W-187	3.06E+02	2.95E+02	8.90E+01	0.00E+00	0.00E+00	0.00E+00	8.34E+04
MP-239	1.28E+01	1.25E-02	6.91E-03	0.00E+00	3.91E-02	0.00E+00	2.57E+03

Conversion factors are in units of mrem/yr per uCi/ml

DOSE FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES

Nuclide	β -air*(N _i)	β -Skin**(L _i)	γ -Air* (M _i)	γ -Body**(K _i)
Kr-83m	2.88E-04	---	1.93E-05	7.56E-08
Kr-85m	1.97E-03	1.46E-03	1.23E-03	1.17E-03
Kr-85	1.95E-03	1.34E-03	1.72E-05	1.61E-05
Kr-87	1.03E-02	9.73E-03	6.17E-03	5.92E-03
Kr-88	2.93E-03	2.37E-03	1.52E-02	1.47E-02
Kr-89	1.06E-02	1.01E-02	1.73E-02	1.66E-02
Kr-90	7.83E-03	7.29E-03	1.63E-02	1.56E-02
Xe-131m	1.11E-03	4.76E-04	1.56E-04	9.15E-05
Xe-133m	1.48E-03	9.94E-04	3.27E-04	2.51E-04
Xe-133	1.05E-03	3.06E-04	3.53E-04	2.94E-04
Xe-135m	7.39E-04	7.11E-04	3.36E-03	3.12E-03
Xe-135	2.46E-03	1.86E-03	1.92E-03	1.81E-03
Xe-137	1.27E-02	1.22E-02	1.51E-03	1.42E-03
Xe-138	4.75E-03	4.13E-03	9.21E-03	8.83E-03
Ar-41	3.28E-03	2.69E-03	9.30E-03	8.84E-03

* $\frac{\text{mrad-m}^3}{\text{pCi-yr}}$

** $\frac{\text{mrem-m}^3}{\text{pCi-yr}}$

Extracted from Table B-1 of Regulatory Guide 1.109, Revision 1, 1977

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-ILL
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
C-14	1.82E+04	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03
NA-24	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04
P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
RN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
RN-56	0.00E+00	1.24E+00	1.83E-01	0.00E+00	1.30E+00	9.44E+03	2.02E+04
FE-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
CO-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	3.97E+06	2.85E+05
NI-63	4.32E+05	3.14E+04	1.45E+04	0.00E+00	0.00E+00	1.78E+05	1.34E+04
NI-65	1.54E+00	2.10E-01	9.12E-02	0.00E+00	0.00E+00	5.60E+03	1.23E+04
CU-64	0.00E+00	1.44E+00	6.15E-01	0.00E+00	4.62E+00	6.78E+03	4.90E+04
ZN-65	3.26E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
ZN-69	3.46E-02	6.31E-02	4.52E-03	0.00E+00	4.22E-02	9.20E+02	1.63E+01
BR-83	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	0.00E+00	2.32E+02
BR-84	0.00E+00	0.00E+00	3.13E-02	0.00E+00	0.00E+00	0.00E+00	1.64E-03
BR-85	0.00E+00	0.00E+00	1.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04
RB-88	0.00E+00	3.87E+02	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.34E-09
RE-89	0.00E+00	2.56E+02	1.70E+02	0.00E+00	0.00E+00	0.00E+00	9.28E-12
SR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
SR-90	4.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
SR-91	6.19E+01	0.00E+00	2.50E+00	0.00E+00	0.00E+00	3.65E+04	1.91E+05
SR-92	6.74E+00	0.00E+00	2.91E-01	0.00E+00	0.00E+00	1.65E+04	4.30E+04
Y-90	2.09E+03	0.00E+00	5.61E+01	0.00E+00	0.00E+00	1.70E+05	5.06E+05
Y-91M	2.61E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	1.92E+03	1.33E+00
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05
Y-92	1.03E+01	0.00E+00	3.02E-01	0.00E+00	0.00E+00	1.57E+04	7.35E+04

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
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Y-93	9.44E+01	0.00E+00	2.61E+00	0.00E+00	0.00E+00	4.85E+04	4.22E+05
Zr-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
Zr-97	9.58E+01	1.96E+01	9.04E+00	0.00E+00	2.97E+01	7.87E+04	5.23E+05
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Wb-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05
XO-99	0.00E+00	1.21E+02	2.30E+01	0.00E+00	2.91E+02	9.12E+04	2.48E+05
YC-99M	1.03E+03	2.91E+03	3.70E+02	0.00E+00	4.42E+02	7.64E+02	4.16E+03
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TC-101	4.18E+05	6.02E+05	5.90E+04	0.00E+00	1.08E+03	3.99E+02	1.09E+11
RU-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05
RU-105	7.90E+01	0.00E+00	3.11E+01	0.00E+00	1.02E+00	1.10E+04	4.82E+04
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RU-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05
AG-110M	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05
TE-125M	3.42E+03	1.58E+03	4.67E+02	1.05E+03	1.24E+04	3.14E+05	7.06E+04
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TE-127M	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05
TE-127	1.40E+00	6.42E+01	3.10E+01	1.06E+00	5.10E+00	6.51E+03	5.74E+04
TE-129M	9.76E+03	4.67E+03	1.58E+03	3.64E+03	3.66E+04	1.16E+06	3.83E+05
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TE-129	4.98E+02	2.39E+02	1.24E+02	3.90E+02	1.87E+01	1.94E+03	1.57E+02
TE-131M	6.99E+01	4.36E+01	2.90E+01	5.50E+01	3.09E+02	1.46E+05	5.56E+05
TE-131	1.11E+02	3.95E+03	3.59E+03	9.36E+03	4.37E+02	1.39E+03	1.84E+01
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TR-132	2.60E+02	2.15E+02	1.62E+02	1.90E+02	1.46E+03	2.88E+05	5.10E+05
I-130	4.58E+03	1.34E+04	5.26E+03	1.14E+06	2.09E+04	0.00E+00	7.69E+03
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
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I-132	1.16E+03	3.26E+03	1.14E+03	1.14E+05	5.18E+03	0.00E+00	4.04E+02
I-133	8.64E+03	1.48E+04	4.52E+03	2.13E+06	2.58E+04	0.00E+00	8.88E+03
I-134	6.64E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	0.00E+00	1.01E+00
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I-135	2.68E+05	6.98E+03	2.57E+03	4.44E+05	1.11E+04	0.00E+00	5.25E+03
CS-134	3.73E+05	8.43E+05	7.28E+05	0.00E+00	2.80E+05	9.76E+04	1.04E+04
CS-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.70E+04	1.17E+04
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CS-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03
CS-138	3.31E+02	6.21E+02	3.24E+02	0.00E+00	6.80E+02	4.86E+01	1.86E+03
BA-139	9.36E+01	6.66E+04	2.76E+02	0.00E+00	6.22E+04	3.76E+03	8.96E+02

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
BA-141	1.00E-01	7.53E-05	3.36E-03	0.00E+00	7.00E-05	1.94E+03	1.16E-07
BA-142	2.63E-02	2.70E-05	1.66E-03	0.00E+00	2.29E-05	1.19E+03	1.57E-16
LR-140	3.44E+02	1.74E+02	4.58E+01	0.00E+00	0.00E+00	1.36E+05	4.50E+05
LA-142	6.83E-01	3.10E-01	7.72E-02	0.00E+00	0.00E+00	6.33E+03	2.11E+03
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
CS-143	1.84E+02	1.38E+02	1.53E+01	0.00E+00	6.08E+01	7.98E+04	2.26E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05
PR-143	9.36E+03	3.77E+03	4.64E+02	0.00E+00	2.16E+03	2.81E+05	2.00E+05
PR-144	3.01E-02	1.25E-02	1.53E-03	0.00E+00	7.05E-03	1.02E+03	2.15E-08
ND-147	5.27E+03	6.10E+03	3.65E+02	0.00E+00	3.56E+03	2.21E+05	1.73E+05
V-187	8.48E+00	7.08E+00	2.48E+00	0.00E+00	0.00E+00	2.90E+04	1.55E+05
HP-239	2.30E+02	2.26E+01	1.24E+01	0.00E+00	7.00E+01	3.76E+04	1.19E+05

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
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H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
C-14	2.60E+04	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03
NA-24	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04
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P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04
CR-51	0.00E+00	0.00E+00	1.55E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
NI-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.66E+06
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NI-56	0.00E+00	1.77E+00	2.52E+01	0.00E+00	1.79E+00	1.52E+04	5.74E+04
FE-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
FE-59	1.59E+01	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.70E+05
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CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
CO-60	0.00E+00	1.11E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
NI-63	5.80E+05	4.54E+04	1.98E+04	0.00E+00	0.00E+00	3.07E+05	1.42E+04
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RI-65	2.18E+00	2.93E+01	1.27E+01	0.00E+00	0.00E+00	9.36E+03	3.67E+04
CU-64	0.00E+00	2.03E+00	8.48E+01	0.00E+00	6.41E+00	1.11E+04	6.14E+04
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+00	4.66E+04
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ZN-69	4.83E+02	9.20E+02	6.66E+03	0.00E+00	6.03E+02	1.58E+03	2.85E+02
BR-83	0.00E+00	0.00E+00	3.44E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.33E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<hr/>							
BR-85	0.00E+00	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04
RB-88	0.00E+00	5.46E+02	2.73E+02	0.00E+00	0.00E+00	0.00E+00	2.92E+05
<hr/>							
RB-89	0.00E+00	3.52E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	3.38E+07
BR-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
BR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
<hr/>							
BR-91	8.80E+01	0.00E+00	3.51E+00	0.00E+00	0.00E+00	6.07E+04	2.59E+05
BR-92	9.52E+00	0.00E+00	4.06E+01	0.00E+00	0.00E+00	2.74E+04	1.19E+05
Y-90	2.98E+03	0.00E+00	8.00E+01	0.00E+00	0.00E+00	2.93E+05	5.59E+05
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Y-91M	3.70E+01	0.00E+00	1.42E+02	0.00E+00	0.00E+00	3.20E+03	3.02E+01
Y-91	6.81E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05
Y-92	1.47E+01	0.00E+00	4.25E+01	0.00E+00	0.00E+00	2.68E+04	1.65E+05

Conversion factors are in units of arem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, D_i

AGE GROUP: YOUNG (2 of 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.35E+02	6.30E+00	3.72E+00	0.00E+00	0.00E+00	8.32E+04	5.79E+05
ZR-95	1.44E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
ZR-97	1.38E+02	2.72E+01	1.26E+01	0.00E+00	4.12E+01	1.30E+05	6.30E+05
WB-95	1.86E+04	1.03E+04	3.66E+03	0.00E+00	1.00E+04	7.31E+05	9.68E+04
MO-94	0.00E+00	1.69E+02	3.22E+01	0.00E+00	4.11E+02	1.54E+05	7.69E+05
TC-99M	1.38E+03	3.86E+03	4.99E+02	0.00E+00	5.76E+02	1.15E+03	6.13E+03
TC-101	5.92E+05	8.40E+05	8.24E+04	0.00E+00	1.52E+03	6.67E+02	8.72E+07
RU-103	2.12E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05
RU-105	1.12E+00	0.00E+00	4.34E+01	0.00E+00	1.41E+00	1.82E+04	9.04E+04
RU-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.93E+05	1.61E+07	9.60E+05
AG-110M	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05
TE-125M	4.88E+03	2.24E+03	6.67E+02	1.40E+03	0.00E+00	5.56E+05	7.50E+04
TE-127M	1.80E+04	8.16E+03	1.78E+03	4.58E+03	6.54E+04	1.66E+06	1.59E+05
TE-127	2.01E+00	9.12E+01	4.42E+01	1.62E+00	7.28E+00	1.12E+04	8.08E+04
TE-129M	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05
TE-129	7.10E+02	3.38E+02	1.76E+02	5.18E+02	2.66E+01	3.30E+03	1.62E+03
TE-131M	9.84E+01	6.01E+01	4.07E+01	7.25E+01	4.39E+02	2.38E+05	6.21E+05
TE-131	1.58E+02	8.32E+03	5.04E+03	1.24E+02	6.18E+02	2.34E+03	1.51E+01
TE-132	3.60E+02	2.90E+02	2.19E+02	2.66E+02	1.95E+03	4.49E+05	4.63E+05
I-130	6.24E+03	1.79E+04	7.17E+03	1.49E+06	2.75E+04	0.00E+00	9.12E+03
I-131	3.54E+04	4.91E+04	2.64E+04	1.44E+07	8.40E+04	0.00E+00	6.49E+03
I-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	0.00E+00	1.27E+03
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
I-134	8.68E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	0.00E+00	2.04E+01
I-135	3.70E+03	9.44E+03	3.49E+03	4.21E+05	1.49E+04	0.00E+00	6.95E+03
CS-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.14E+05	9.76E+03
CS-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.06E+04	1.09E+04
CS-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
CS-138	4.66E+02	8.56E+02	4.46E+02	0.00E+00	6.62E+02	7.87E+01	2.70E+01
BA-139	1.34E+00	9.44E+04	3.90E+02	0.00E+00	8.88E+04	6.46E+03	6.45E+03

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_i

AGE GROUP: TEEN (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
BA-141	1.42E+01	1.06E+04	4.74E+03	0.00E+00	9.84E+05	3.29E+03	7.46E+04
BA-142	3.70E+02	3.70E+05	2.27E+03	0.00E+00	3.14E+05	1.91E+03	4.79E+10
LA-140	4.79E+02	2.36E+02	6.26E+01	0.00E+00	0.00E+00	2.14E+05	4.87E+05
LA-142	9.60E+01	4.25E+01	1.06E+01	0.00E+00	0.00E+00	1.02E+04	1.20E+04
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
CE-143	2.66E+02	1.94E+02	2.16E+01	0.00E+00	8.64E+01	1.30E+05	2.55E+05
CE-144	4.89E+05	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05
PR-143	1.34E+04	3.1E+03	6.62E+02	0.00E+00	3.09E+03	4.33E+05	2.14E+05
PR-144	4.30E+02	1.76E+02	2.18E+03	0.00E+00	1.01E+02	1.75E+03	2.35E+04
WD-147	7.86E+03	8.56E+03	5.13E+02	0.00E+00	3.02E+03	3.72E+05	1.82E+05
W-187	1.20E+01	9.76E+00	3.43E+00	0.00E+00	0.00E+00	4.74E+04	1.77E+05
WP-230	3.32E+02	3.19E+01	1.77E+01	0.00E+00	1.00E+02	6.49E+04	1.32E+05

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (1 OF 3)

NUCLIDE

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
C-14	3.59E+04	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03
NA-24	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
CR-51	0.00E+00	0.00E+00	1.54E+02	8.53E+01	2.43E+01	1.70E+04	1.08E+03
HR-54	0.07E+02	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
HR-56	0.00E+00	1.66E+00	3.12E-01	0.00E+00	1.67E+00	1.31E+04	1.23E+05
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.67E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03
NI-65	2.99E+00	2.96E-01	1.64E-01	0.00E+00	0.00E+00	0.18E+03	8.40E+04
CU-64	0.00E+00	1.99E+00	1.07E+00	0.00E+00	6.03E+00	0.58E+03	3.67E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
ZN-69	6.70E-02	9.66E-02	8.92E-03	0.00E+00	5.85E-02	1.42E+03	1.02E+04
BR-83	0.00E+00	0.00E+00	4.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	5.48E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	2.53E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RP-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
RS-86	0.00E+00	5.62E+02	3.68E+02	0.00E+00	0.00E+00	0.00E+00	1.72E+01
BR-89	0.00E+00	3.43E+02	2.90E+02	0.00E+00	0.00E+00	0.00E+00	1.89E+00
BR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
BR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
BR-91	1.21E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	5.33E+04	1.74E+05
BR-92	1.31E+01	0.00E+00	5.25E-01	0.00E+00	0.00E+00	2.40E+04	2.42E+05
Y-90	4.11E+03	0.00E+00	1.11E+02	0.00E+00	0.00E+00	2.62E+05	2.68E+05
Y-91M	5.07E-01	0.00E+00	1.84E-02	0.00E+00	0.00E+00	2.81E+03	1.72E+03
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
Y-92	2.04E+01	0.00E+00	5.81E-01	0.00E+00	0.00E+00	2.39E+04	2.39E+05

Conversion factors are in units of area/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.86E+02	0.00E+00	5.11E+00	0.00E+00	0.00E+00	7.44E+04	3.89E+05
Zr-95	1.90E+05	4.18E+14	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
Zr-97	1.83E+02	2.72E+01	1.60E+01	0.00E+00	3.88E+01	1.13E+05	3.51E+05
Mo-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
Mo-99	0.00E+00	1.72E+02	4.26E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05
Tc-99M	1.78E+03	3.48E+03	5.77E+02	0.00E+00	5.07E+02	9.51E+02	4.81E+03
Tc-101	8.10E+05	8.51E+05	1.06E+03	0.00E+00	1.45E+03	5.85E+02	1.63E+01
Ru-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04
Ru-105	1.53E+00	0.00E+00	5.55E+01	0.00E+00	1.34E+00	1.59E+04	9.95E+04
Ru-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
Ag-110M	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
Te-125M	6.73E+03	2.33E+03	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04
Te-127M	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
Te-127	2.77E+03	9.51E+01	6.11E+01	1.96E+00	7.07E+00	1.00E+04	5.62E+04
Te-129M	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
Te-129	9.77E+02	3.50E+02	2.38E+02	7.14E+02	2.57E+01	2.93E+03	2.55E+04
Te-131M	1.34E+02	5.92E+01	5.07E+01	9.77E+01	4.00E+02	2.06E+05	3.08E+05
Te-131	2.17E+02	8.44E+03	6.94E+03	1.70E+02	5.88E+02	2.05E+03	1.33E+03
Te-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05
I-130	8.18E+03	1.64E+04	8.44E+03	1.85E+06	2.45E+04	0.00E+00	5.11E+03
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	0.00E+00	3.20E+03
I-133	1.66E+04	2.03E+04	7.76E+03	3.85E+06	3.94E+04	0.00E+00	5.48E+03
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	0.00E+00	9.55E+02
I-135	4.92E+03	6.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03
Cs-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
Cs-136	6.51E+04	1.71E+05	1.66E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
Cs-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
Cs-138	6.33E+02	8.40E+02	5.55E+02	0.00E+00	6.22E+02	6.81E+01	2.70E+02
Ba-139	1.84E+00	9.84E+04	5.37E+02	0.00E+00	8.62E+04	5.77E+03	5.77E+04

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
BA-141	1.96E+01	1.09E+04	6.36E-03	0.00E+00	9.47E-05	2.92E+03	2.75E+02
BA-142	5.00E-02	3.40E-05	2.79E-03	0.00E+00	2.91E-05	1.64E+03	2.74E+00
LA-140	6.44E+02	2.23E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05
LA-142	1.30E+00	4.11E-01	1.29E-01	0.00E+00	0.00E+00	8.70E+03	7.59E+04
CE-141	3.92E+04	1.95E+04	2.70E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
CE-143	3.66E+02	1.99E+02	2.87E+01	0.00E+00	8.36E+01	1.15E+05	1.27E+05
CE-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05
PR-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	6.33E+05	9.73E+04
PR-144	5.96E-02	1.85E-02	3.00E-03	0.00E+00	9.77E-03	1.57E+03	1.97E+02
MO-147	1.06E+04	8.73E+03	6.81E+02	0.00E+00	4.81E+03	3.54E+05	8.21E+04
W-187	1.63E+01	9.66E+00	4.33E+00	0.00E+00	0.00E+00	4.11E+04	9.10E+04
WP-239	4.66E+02	3.34E+01	2.35E+01	0.00E+00	9.73E+01	5.81E+04	6.40E+04

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: INFANT (1 OF 3)

NUCLIDE

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.L.I
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03
NA-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04
P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
CR-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.94E+03	1.00E+06	7.06E+03
MN-56	0.00E+00	1.54E+00	2.21E-01	0.00E+00	1.10E+00	1.25E+04	7.17E+04
FE-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03
FE-59	1.36E+04	2.35E+04	9.68E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
CO-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
NI-63	3.39E+05	2.04E+04	1.16E+04	0.00E+00	0.00E+00	2.09E+05	2.42E+03
NI-65	2.39E+00	2.84E-01	1.23E-01	0.00E+00	0.00E+00	8.12E+03	5.01E+04
CU-64	0.00E+00	1.88E+00	7.74E-01	0.00E+00	3.98E+00	9.30E+03	1.50E+04
ZN-65	1.03E+04	8.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
ZN-69	5.39E+02	9.67E-02	7.18E-03	0.00E+00	4.02E+02	1.47E+03	1.32E+04
BR-03	0.00E+00	0.00E+00	3.81E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE-84	0.00E+00	0.00E+00	4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-85	0.00E+00	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NR-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03
EB-88	0.00E+00	5.57E+02	2.87E+02	0.00E+00	0.00E+00	0.00E+00	3.39E+02
NR-89	0.00E+00	3.21E+02	2.06E+02	0.00E+00	0.00E+00	0.00E+00	6.82E+01
ER-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
SR-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
SR-91	9.56E+01	0.00E+00	3.46E+00	0.00E+00	0.00E+00	5.26E+04	7.34E+04
ER-92	1.05E+01	0.00E+00	3.91E-01	0.00E+00	0.00E+00	2.38E+04	1.40E+05
Y-90	3.29E+03	0.00E+00	8.62E+01	0.00E+00	0.00E+00	2.69E+05	1.04E+05
Y-91M	4.07E-01	0.00E+00	1.39E-02	0.00E+00	0.00E+00	2.79E+03	2.35E+03
Y-91	5.80E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04
Y-92	1.64E+01	0.00E+00	4.61E-01	0.00E+00	0.00E+00	2.45E+04	1.27E+05

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: INFANT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.50E+02	0.00E+00	4.07E+00	0.00E+00	0.00E+00	7.64E+04	1.67E+05
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
ZR-97	1.50E+02	2.56E+01	1.17E+01	0.00E+00	2.59E+01	1.10E+05	1.40E+05
NR-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04
HO-99	0.00E+00	1.65E+02	3.23E+01	0.00E+00	2.65E+02	1.35E+05	4.87E+04
TC-99M	1.40E-03	2.80E-03	3.72E-02	0.00E+00	3.11E-02	8.11E+02	2.03E+03
TC-101	6.51E-05	8.23E-05	8.12E-04	0.00E+00	9.79E-04	5.84E+02	8.44E+02
RU-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04
RU-105	1.22E+00	0.00E+00	4.10E-01	0.00E+00	8.99E-01	1.57E+04	4.84E+04
RU-106	8.68E+04	9.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05
AG-110M	9.90E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04
TE-125M	4.74E+03	1.99E+03	6.58E+02	1.62E+03	0.00E+00	4.47E+05	1.29E+04
TE-127M	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04
TE-127	2.23E+00	2.53E-01	4.89E-01	1.85E+00	4.86E+00	1.03E+04	2.44E+04
TE-129M	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04
TE-129	7.88E-02	3.47E-02	1.88E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04
TE-131M	1.07E+02	5.50E+01	3.63E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05
TE-131	1.74E-02	8.22E-03	5.00E-03	1.58E-02	3.99E-02	2.06E+03	8.22E+03
TE-132	3.72E+02	2.37E+02	1.76E+02	2.79E+02	1.03E+03	3.40E+05	4.41E+04
I-130	6.34E+03	1.39E+04	5.57E+03	1.60E+06	1.53E+04	0.00E+00	1.99E+03
I-131	3.79E+04	6.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	0.00E+00	1.90E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.09E+03	0.00E+00	1.29E+03
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	0.00E+00	1.83E+03
CS-134	3.94E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
CS-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
CS-138	5.05E+02	7.81E+02	3.98E+02	0.00E+00	4.10E+02	6.54E+01	8.74E+02
BA-139	1.68E+00	9.84E-04	4.30E-02	0.00E+00	5.92E-04	5.95E+03	5.10E+04

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
BA-141	1.57E+01	1.08E+04	4.97E+03	0.00E+00	6.50E+05	2.97E+03	4.75E+03
BA-142	3.98E+02	3.30E+05	1.96E+03	0.00E+00	1.90E+05	1.55E+03	6.93E+02
LA-140	5.05E+02	2.00E+02	5.15E+01	0.00E+00	0.00E+00	1.68E+05	8.48E+04
LA-142	1.03E+00	3.77E+01	9.04E+02	0.00E+00	0.00E+00	8.22E+03	5.95E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
CE-143	2.93E+02	1.93E+02	2.21E+01	0.00E+00	5.64E+01	1.16E+05	4.97E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.30E+05	9.84E+06	1.48E+05
PR-143	1.40E+04	5.24E+03	6.99E+02	0.00E+00	1.97E+03	4.33E+05	3.72E+04
PR-144	4.79E+02	1.85E+02	2.41E+03	0.00E+00	6.72E+03	1.61E+03	4.28E+03
ND-147	7.94E+03	8.13E+03	5.00E+02	0.00E+00	3.15E+03	3.22E+05	3.12E+04
W-187	1.30E+01	9.02E+00	3.12E+00	0.00E+00	0.00E+00	3.96E+04	3.56E+04
W-239	3.71E+32	3.32E+01	1.88E+01	0.00E+00	6.62E+01	5.95E+04	2.49E+04

Conversion factors are in units of mrad/yr per uCi/cubic meter.

GROUND - PLANE DEPOSITION PATHWAY DOSE
FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ALL (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS	
	T. BODY	SKIN

H-3	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00
MA-24	1.19E+07	1.39E+07

P-32	0.00E+00	0.00E+00
CR-51	4.66E+06	5.51E+06
MN-54	1.39E+09	1.63E+09

MN-56	9.03E+05	1.07E+06
FE-55	0.00E+00	0.00E+00
FE-59	2.73E+08	3.21E+08

CO-58	3.79E+08	4.44E+08
CO-60	2.15E+10	2.53E+10
NI-63	0.00E+00	0.00E+00

NI-65	2.97E+05	3.45E+05
CJ-64	6.07E+05	6.88E+05
ZN-65	7.47E+08	8.59E+08

ZN-69	0.00E+00	0.00E+00
BR-83	4.87E+03	7.08E+03
BR-84	2.03E+05	2.36E+05

BR-85	0.00E+00	0.00E+00
RB-86	8.99E+06	1.03E+07
RB-88	3.31E+04	3.78E+04

RB-89	1.23E+05	1.48E+05
RB-89	2.16E+04	2.51E+04
RB-90	0.00E+00	0.00E+00

SR-91	2.15E+05	2.51E+06
SR-92	7.77E+05	8.63E+05
Y-90	4.49E+03	5.31E+03

Y-91M	1.00E+05	1.16E+05
Y-91	1.07E+06	1.21E+06
Y-92	1.80E+05	2.14E+05

Conversion factors are in units of square meter-area/yr per uCi/sec.

GROUND - PLANE DEPOSITION PATHWAY DOSE
FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ALL (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS	
	1. BODY	SKIN

Y-93	1.03E+05	2.51E+05
ZR-95	2.49E+08	2.84E+08
ZR-97	2.96E+06	3.44E+06

RB-95	1.37E+08	1.61E+08
NO-99	3.99E+06	4.63E+06
TC-99M	1.84E+05	2.11E+05

TC-101	2.04E+04	2.26E+04
RU-103	1.08E+08	1.26E+08
RU-105	6.36E+05	7.21E+05

RU-106	4.22E+08	5.07E+08
AG-110M	3.44E+09	4.01E+09
TE-125M	1.55E+06	2.13E+06

TE-127M	9.16E+04	1.08E+05
TE-127	2.98E+03	3.28E+03
TE-129M	1.98E+07	2.31E+07

TE-129	2.62E+04	3.10E+04
TE-131M	8.03E+06	9.46E+06
TE-131	2.92E+04	3.45E+07

TE-132	4.23E+06	4.98E+06
I-130	5.51E+06	6.89E+06
I-131	1.72E+07	2.09E+07

I-132	1.25E+06	1.46E+06
I-133	2.45E+06	2.98E+06
I-134	4.47E+05	5.30E+05

I-135	2.53E+06	2.95E+06
CS-134	6.86E+09	8.00E+09
CS-136	1.51E+08	1.71E+08

CS-137	1.03E+10	1.20E+10
CS-138	3.59E+05	4.10E+05
BA-139	1.06E+05	1.19E+05

Conversion factors are in units of square meter-area/yr per uCi/sec.

GROUND - PLANE DEPOSITION PATHWAY DOSE
FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GRU PP: ALL (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS	
	T. BODY	SKIN
BA-140	2.05E+07	2.35E+07
BA-141	4.17E+04	4.75E+04
BA-142	4.49E+04	5.11E+04
LA-140	1.92E+07	2.18E+07
LA-142	7.60E+05	9.11E+05
CE-141	1.37E+07	1.54E+07
CE-143	2.31E+06	2.63E+06
CE-144	6.95E+07	8.04E+07
PR-143	0.00E+00	0.00E+00
PR-144	1.83E+03	2.11E+03
MD-147	8.39E+06	1.01E+07
M-187	2.33E+06	2.73E+06
HP-239	1.71E+06	1.98E+06

Conversion factors are in units of square meter-gram/yr per uCi/sec.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02
C-14	2.63E+08	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07
NA-24	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06
P-32	1.71E+10	1.06E+09	6.61E+08	0.00E+00	0.00E+00	0.00E+00	1.92E+09
CR-51	0.00E+00	0.00E+00	2.86E+04	1.71E+04	6.30E+03	3.79E+04	7.19E+06
NI-54	0.00E+00	8.41E+04	1.61E+06	0.00E+00	2.50E+06	0.00E+00	2.58E+07
NI-56	0.00E+00	4.15E+03	7.36E+04	0.00E+00	9.27E+03	0.00E+00	1.32E+01
FE-55	2.51E+07	1.74E+07	4.05E+06	0.00E+00	0.00E+00	9.68E+06	9.95E+06
FE-59	2.97E+07	6.98E+07	2.68E+07	0.00E+00	0.00E+00	1.95E+07	2.33E+08
CO-58	0.00E+00	4.71E+06	1.06E+07	0.00E+00	0.00E+00	0.00E+00	9.55E+07
CO-60	0.00E+00	1.64E+07	3.62E+07	0.00E+00	0.00E+00	0.00E+00	3.08E+08
NI-63	6.71E+09	6.66E+08	2.26E+08	0.00E+00	0.00E+00	0.00E+00	9.73E+07
NI-65	3.70E+01	4.81E+02	2.19E+02	0.00E+00	0.00E+00	0.00E+00	1.22E+00
CU-64	0.00E+00	2.38E+04	1.12E+04	0.00E+00	6.01E+04	0.00E+00	2.03E+06
ZN-65	1.37E+09	4.37E+09	1.97E+09	0.00E+00	2.92E+09	0.00E+00	2.75E+09
ZN-69	2.07E+12	4.70E+12	2.78E+13	0.00E+00	2.60E+12	0.00E+00	6.01E+13
BR-83	0.00E+00	0.00E+00	1.17E+02	0.00E+00	0.00E+00	0.00E+00	1.68E+02
BR-84	0.00E+00	0.00E+00	1.93E+24	0.00E+00	0.00E+00	0.00E+00	1.52E+29
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	2.59E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	5.12E+08
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	1.45E+09	0.00E+00	4.16E+07	0.00E+00	0.00E+00	0.00E+00	2.33E+08
SR-90	4.68E+10	0.00E+00	1.15E+10	0.00E+00	0.00E+00	0.00E+00	1.35E+09
SR-91	2.07E+04	0.00E+00	1.17E+03	0.00E+00	0.00E+00	0.00E+00	1.38E+05
SR-92	4.28E+01	0.00E+00	2.11E+02	0.00E+00	0.00E+00	0.00E+00	9.68E+00
Y-90	7.08E+01	0.00E+00	1.90E+00	0.00E+00	0.00E+00	0.00E+00	7.51E+05
Y-91M	5.98E+20	0.00E+00	2.32E+21	0.00E+00	0.00E+00	0.00E+00	1.76E+19
Y-91	8.59E+03	0.00E+00	2.30E+02	0.00E+00	0.00E+00	0.00E+00	4.73E+06
Y-92	5.08E+05	0.00E+00	1.63E+06	0.00E+00	0.00E+00	0.00E+00	9.77E+01

Conversion factors are in units of square meter-mew/yr per uCi/sec for all
nuclides except H-3 which is in units of mew/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G1+LLI
Y-93	2.23E-01	0.00E+00	6.17E-03	0.00E+00	0.00E+00	0.00E+00	7.08E+03
Zr-95	9.43E+02	3.03E+02	2.05E+02	0.00E+00	4.75E+02	0.00E+00	9.59E+05
Zr-97	4.33E-01	8.74E-02	4.00E-02	0.00E+00	1.32E-01	0.00E+00	2.71E+04
Mo-95	8.26E+04	4.59E+04	2.47E+04	0.00E+00	4.54E+04	0.00E+00	2.79E+08
Mo-99	0.00E+00	2.48E+07	4.71E+06	0.00E+00	5.61E+07	0.00E+00	7.4E+07
Tc-99m	3.32E+00	9.38E+00	1.20E+02	0.00E+00	1.63E+02	4.60E+00	5.55E+03
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	1.02E+03	0.00E+00	4.39E+02	0.00E+00	3.89E+03	0.00E+00	1.19E+05
Ru-105	8.57E-04	0.00E+00	3.38E-04	0.00E+00	1.11E-02	0.00E+00	5.24E-01
Ru-106	2.04E+04	0.00E+00	2.58E+03	0.00E+00	3.94E+04	0.00E+00	1.32E+06
Ag-110m	5.82E+07	5.39E+07	3.20E+07	0.00E+00	1.06E+08	0.00E+00	2.20E+10
Te-123m	1.63E+07	5.90E+06	2.18E+06	4.90E+06	6.63E+07	0.00E+00	6.50E+07
Te-127m	4.58E+07	1.64E+07	5.58E+06	1.17E+07	1.86E+08	0.00E+00	1.54E+08
Te-127	6.33E+02	2.34E+02	1.41E+02	4.84E+02	2.66E+03	0.00E+00	5.15E+04
Te-129m	4.02E+07	2.25E+07	9.53E+06	2.07E+07	2.51E+08	0.00E+00	3.03E+08
Te-129	2.82E-10	1.00E-10	6.88E-11	2.17E-10	1.19E-09	0.00E+00	2.13E-10
Te-131m	3.61E+05	1.77E+05	1.47E+05	2.80E+05	1.79E+06	0.00E+00	1.75E+07
Te-131	3.40E-33	1.51E-33	1.14E-33	2.96E-33	1.58E-32	0.00E+00	5.10E-34
Te-132	2.40E+06	1.35E+06	1.46E+06	1.72E+06	1.50E+07	0.00E+00	7.35E+07
I-130	4.20E+05	1.24E+06	4.89E+05	1.05E+06	1.93E+06	0.00E+00	1.07E+06
I-131	2.96E+08	4.23E+08	2.43E+08	1.34E+11	7.26E+08	0.00E+00	1.12E+08
I-132	1.96E-01	4.30E-01	1.54E-01	1.54E+01	7.00E-01	0.00E+00	8.25E-02
I-133	3.67E+06	6.73E+06	2.05E+06	9.89E+06	1.17E+07	0.00E+00	6.05E+06
I-134	2.02E-12	5.48E-12	1.96E-12	9.49E-11	8.71E-12	0.00E+00	4.77E-15
I-135	1.28E+04	3.36E+04	1.24E+04	2.22E+06	5.39E+04	0.00E+00	3.80E+04
Cs-134	5.65E+09	1.35E+10	1.10E+10	0.00E+00	4.35E+09	1.45E+09	2.35E+08
Cs-136	2.63E+09	1.04E+09	7.48E+08	0.00E+00	5.78E+08	7.93E+07	1.18E+08
Cs-137	7.38E+09	1.01E+10	6.61E+09	0.00E+00	3.43E+09	1.14E+09	1.95E+08
Cs-138	9.04E-24	1.79E-23	8.85E-24	0.00E+00	1.31E-23	1.30E-24	7.62E-29
Ba-139	4.42E+08	3.15E+11	1.29E+09	0.00E+00	2.94E+11	1.7E+11	7.84E+08

Conversion factors are in units of square meter-radm/yr per uCi/sec for all
nuclides except R-3 which is in units of arad/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (3 of 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BORE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
<hr/>							
BA-140	2.67E+07	3.38E+04	1.78E+06	0.00E+00	1.15E+04	1.93E+04	5.53E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.10E+00	0.00E+00
<hr/>							
LA-140	4.51E+00	2.27E+00	6.01E-01	0.00E+00	0.00E+00	0.00E+00	1.67E+05
LA-142	1.86E-11	8.45E-12	2.10E-12	0.00E+00	0.00E+00	0.00E+00	6.17E-08
CE-141	4.84E+03	3.28E+03	3.72E+02	0.00E+00	1.52E+03	0.00E+00	1.25E+07
<hr/>							
CE-143	4.16E+01	3.07E+04	3.40E+00	0.00E+00	1.35E+01	0.00E+00	1.15E+06
CE-144	3.58E+05	1.50E+05	1.42E+04	0.00E+00	8.87E+04	0.00E+00	1.21E+08
PR-143	1.58E+02	6.33E+01	7.83E+00	0.00E+00	3.66E+01	0.00E+00	6.92E+05
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PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MD-147	9.42E+01	1.09E+02	6.51E+00	0.00E+00	6.36E+01	0.00E+00	5.22E+05
W-187	6.51E+03	5.45E+03	1.90E+03	0.00E+00	0.00E+00	0.00E+00	1.78E+06
<hr/>							
BP-239	4.60E+01	4.52E+00	2.49E+00	0.00E+00	1.41E+01	0.00E+00	9.27E+05

Conversion factors are in units of square meter-area/yr per uCi/sec for all nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	BODY	THYROID	KIDNEY	LUNG	G.I.T.
H-3	0.00E+00	9.94E+02	9.94E+02	9.94E+02	9.94E+02	9.94E+02	9.94E+02
C-14	4.86E+08	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07
HA-24	4.26E+06	4.26E+06	4.26E+06	4.26E+06	4.26E+06	4.26E+06	4.26E+06
P-32	3.15E+10	1.95E+09	1.22E+09	0.00E+00	0.00E+00	0.00E+00	2.65E+09
CR-51	0.00E+00	0.00E+00	4.99E+04	2.77E+04	1.09E+04	7.13E+04	8.39E+04
HR-54	0.00E+00	1.40E+07	2.78E+06	0.00E+00	4.18E+06	0.00E+00	2.87E+07
NR-56	0.00E+00	7.36E-03	1.31E-03	0.00E+00	9.31E-03	0.00E+00	4.84E-01
FE-55	4.45E+07	3.16E+07	7.36E+06	0.00E+00	0.00E+00	2.00E+07	1.37E+07
FE-59	5.18E+07	1.21E+08	4.67E+07	0.00E+00	0.00E+00	3.81E+07	2.66E+08
CO-58	0.00E+00	7.94E+06	1.63E+07	0.00E+00	0.00E+00	0.00E+00	1.09E+08
CO-60	0.00E+00	2.78E+07	6.26E+07	0.00E+00	0.00E+00	0.00E+00	3.62E+08
NI-63	1.18E+10	8.35E+08	4.01E+08	0.00E+00	0.00E+00	0.00E+00	1.33E+08
NI-65	6.77E-01	8.65E-02	3.94E-02	0.00E+00	0.00E+00	0.00E+00	4.69E+00
CU-64	0.00E+00	4.25E+04	2.00E+04	0.00E+00	1.07E+05	0.00E+00	3.29E+06
ZN-65	2.11E+09	7.32E+09	3.41E+09	0.00E+00	4.68E+09	0.00E+00	3.10E+09
ZN-69	3.85E-12	7.34E-12	5.13E-13	0.00E+00	4.79E-12	0.00E+00	1.35E-11
BR-83	0.00E+00	0.00E+00	2.15E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.45E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	4.73E+09	2.22E+09	0.00E+00	0.00E+00	0.00E+00	7.00E+08
RA-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	2.67E+09	0.00E+00	7.66E+07	0.00E+00	0.00E+00	0.00E+00	3.19E+08
SR-90	6.61E+10	0.00E+00	1.63E+10	0.00E+00	0.00E+00	0.00E+00	1.86E+09
SR-91	5.31E+04	0.00E+00	2.11E+03	0.00E+00	0.00E+00	0.00E+00	2.41E+05
SR-92	8.94E-01	0.00E+00	3.81E-02	0.00E+00	0.00E+00	0.00E+00	2.28E+01
Y-90	1.30E+02	0.00E+00	3.51E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+06
Y-91a	1.10E-19	0.00E+00	4.19E-21	0.00E+00	0.00E+00	0.00E+00	5.17E-18
Y-91	1.58E+04	0.00E+00	4.24E+02	0.00E+00	0.00E+00	0.00E+00	6.48E+06
Y-92	1.03E-04	0.00E+00	2.78E-06	0.00E+00	0.00E+00	0.00E+00	2.03E+00

Conversion factors are in units of square meter-gram/yr per $\mu\text{Ci/sec}$ for all nuclides except H-3 which is in units of gram/yr per $\mu\text{Ci/cubic meter}$.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_i

AGE GROUP: TEEN (2 OF 3)

NUCLID.

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	4.12E-01	0.00E+00	1.13E-02	0.00E+00	0.00E+00	0.00E+00	1.26E+04
Zr-95	1.65E+03	5.20E+02	3.58E+02	0.00E+00	7.65E+02	0.00E+00	1.20E+06
Zr-97	7.88E-01	1.56E-01	7.19E-02	0.00E+00	2.37E-01	0.00E+00	4.22E+04
Mo-95	1.41E+05	7.81E+04	4.30E+04	0.00E+00	7.57E+04	0.00E+00	3.34E+08
Mo-99	0.00E+00	4.47E+07	8.53E+06	0.00E+00	1.02E+08	0.00E+00	8.01E+07
Tc-99m	5.76E+00	1.61E+01	2.08E+02	0.00E+00	2.39E+02	8.92E+00	1.05E+04
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	1.81E+03	0.00E+00	7.74E+02	0.00E+00	6.38E+03	0.00E+00	1.51E+05
Ru-105	1.56E-03	0.00E+00	6.07E-04	0.00E+00	1.97E-02	0.00E+00	1.26E+00
Ru-106	2.89E+04	0.00E+00	4.73E+03	0.00E+00	7.24E+04	0.00E+00	1.80E+06
Ag-110m	9.63E+07	9.11E+07	5.54E+07	0.00E+00	1.74E+08	0.00E+00	2.56E+10
Te-125m	3.00E+07	1.08E+07	4.02E+06	8.39E+06	0.00E+00	0.00E+00	8.86E+07
Te-127m	8.44E+07	2.99E+07	1.00E+07	2.01E+07	3.42E+08	0.00E+00	2.10E+08
Te-127	1.21E+03	4.29E+02	2.60E+02	8.35E+02	4.90E+03	0.00E+00	9.34E+04
Te-129m	1.10E+08	4.09E+07	1.74E+07	3.55E+07	4.61E+08	0.00E+00	4.13E+08
Te-129	5.20E-10	1.94E-10	1.16E-10	3.71E-10	2.18E-09	0.00E+00	2.84E-09
Te-131m	6.57E+05	3.15E+05	2.63E+05	4.74E+05	3.29E+06	0.00E+00	2.53E+07
Te-131	6.58E-33	2.71E-33	2.06E-33	5.07E-33	2.88E-32	0.00E+00	5.40E-34
Te-132	4.29E+06	2.72E+06	2.56E+06	2.87E+06	2.61E+07	0.00E+00	8.61E+07
I-130	7.58E+05	2.14E+06	8.53E+05	1.74E+08	3.29E+06	0.00E+00	1.64E+06
I-131	5.37E+08	7.52E+08	6.04E+08	2.19E+11	1.29E+09	0.00E+00	1.49E+08
I-132	2.91E-01	7.62E-01	2.74E-01	2.57E+01	1.20E+00	0.00E+00	3.32E-01
I-133	7.07E+06	1.20E+07	3.66E+06	1.67E+09	2.10E+07	0.00E+00	9.07E+06
I-134	3.58E-12	9.50E-12	3.41E-12	1.58E-10	1.50E-11	0.00E+00	1.25E-13
I-135	2.28E+04	5.87E+04	2.18E+04	3.78E+06	9.27E+04	0.00E+00	6.51E+04
Cs-134	9.82E+09	2.31E+10	1.07E+10	0.00E+00	7.34E+09	2.80E+09	2.87E+08
Cs-136	4.48E+08	1.16E+09	1.18E+09	0.00E+00	9.40E+08	1.51E+08	1.42E+08
Cs-137	1.34E+10	1.78E+10	6.20E+09	0.00E+00	5.06E+09	2.35E+09	2.53E+08
Cs-138	1.64E-23	3.15E-23	1.57E-23	0.00E+00	2.33E-23	2.71E-24	1.43E-26
Ba-139	8.17E-00	5.75E-11	2.38E-09	0.00E+00	5.42E-11	3.94E-11	7.29E-07

Conversion factors are in units of square meter-mrads/yr per uCi/sec for all nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_j

AGE GROUP: TEEN (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	4.85E+07	5.95E+04	3.13E+06	0.00E+00	2.02E+04	4.00E+00	7.48E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	8.10E+00	3.98E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00	2.29E+05
LA-142	3.35E-11	1.49E-11	3.71E-12	0.00E+00	0.00E+00	0.00E+00	4.53E-07
CE-141	8.88E+03	5.93E+03	6.81E+02	0.00E+00	2.79E+03	0.00E+00	1.70E+07
CE-143	7.64E+01	5.56E+04	6.21E+00	0.00E+00	2.49E+01	0.00E+00	1.67E+06
CE-144	6.58E+05	2.72E+05	3.54E+04	0.00E+00	1.63E+05	0.00E+00	1.66E+08
PR-143	2.90E+02	1.16E+02	1.44E+01	0.00E+00	6.73E+01	0.00E+00	9.54E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MD-147	1.81E+02	1.97E+02	1.18E+01	0.00E+00	1.16E+02	0.00E+00	7.11E+05
W-187	1.19E+04	9.71E+03	3.40E+03	0.00E+00	0.00E+00	0.00E+00	2.63E+06
MP-239	8.78E+01	8.28E+00	4.60E+00	0.00E+00	2.60E+01	0.00E+00	1.33E+06

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (1 OF 3)

NUCLIDES

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03
C-14	1.19E+09	2.39E+09	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08
NA-24	8.85E+06	8.85E+07	8.85E+06	8.85E+06	8.85E+06	8.85E+06	8.85E+06
P-32	7.78E+10	3.64E+09	3.00E+09	0.00E+00	0.00E+00	0.00E+00	2.15E+09
CR-51	0.00E+00	0.00E+00	1.02E+05	5.65E+04	1.54E+04	1.03E+05	5.40E+06
MN-54	0.00E+00	2.10E+07	5.99E+06	0.00E+00	5.88E+06	0.00E+00	1.76E+07
MN-56	0.00E+00	1.28E+02	2.90E+03	0.00E+00	1.55E+02	0.00E+00	1.86E+00
FE-55	1.07E+08	5.93E+07	1.84E+07	0.00E+00	1.00E+00	3.35E+07	1.10E+07
FE-59	1.20E+08	1.95E+08	9.69E+07	0.00E+00	0.00E+00	5.64E+07	2.03E+08
CO-58	0.00E+00	1.21E+07	3.71E+07	0.00E+00	0.00E+00	0.00E+00	7.07E+07
CO-60	0.00E+00	4.32E+07	1.27E+08	0.00E+00	0.00E+00	0.00E+00	2.39E+08
NI-63	2.96E+10	1.59E+09	1.04E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
NI-65	1.66E+00	1.56E+01	9.10E+02	0.00E+00	0.00E+00	0.00E+00	1.91E+01
CJ-64	0.00E+00	7.66E+04	4.51E+04	0.00E+00	1.80E+05	0.00E+00	3.50E+06
ZN-65	4.13E+09	1.10E+10	8.85E+09	0.00E+00	6.94E+09	0.00E+00	1.93E+09
ZN-69	9.47E+12	1.37E+11	1.26E+12	0.00E+00	8.30E+12	0.00E+00	8.62E+10
BR-83	0.00E+00	0.00E+00	5.28E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	7.81E+24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	8.77E+09	5.39E+09	0.00E+00	0.00E+00	0.00E+00	5.64E+08
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	6.62E+09	0.00E+00	1.89E+08	0.00E+00	0.00E+00	0.00E+00	2.56E+08
BR-90	1.12E+11	0.00E+00	2.83E+10	0.00E+00	0.00E+00	0.00E+00	1.51E+09
BR-91	1.30E+05	0.00E+00	4.92E+03	0.00E+00	0.00E+00	0.00E+00	2.88E+05
BR-92	2.18E+00	0.00E+00	8.75E+02	0.00E+00	0.00E+00	0.00E+00	4.13E+01
Y-90	3.22E+02	0.00E+00	8.67E+00	0.00E+00	0.00E+00	0.00E+00	9.17E+05
Y-91M	2.68E+19	0.00E+00	9.74E+21	0.00E+00	0.00E+00	0.00E+00	5.24E+16
Y-91	3.90E+04	0.00E+00	1.04E+03	0.00E+00	0.00E+00	0.00E+00	5.20E+06
Y-92	2.53E+04	0.00E+00	7.24E+06	0.00E+00	0.00E+00	0.00E+00	7.31E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
Y-93	1.01E+00	0.00E+00	2.78E-02	0.00E+00	0.00E+00	0.00E+00	1.51E+04
ZR-95	3.83E+03	8.42E+02	7.50E+02	0.00E+00	1.21E+03	0.00E+00	8.79E+05
ZR-97	1.92E+00	2.77E-01	1.64E-01	0.00E+00	3.98E-01	0.00E+00	4.20E+04
NR-95	3.18E+05	1.24E+05	8.84E+04	0.00E+00	1.16E+05	0.00E+00	2.29E+08
NO-99	0.00E+00	8.14E+07	2.01E+07	0.00E+00	1.74E+08	0.00E+00	6.73E+07
TC-99M	1.32E+01	2.59E+01	4.29E+02	0.00E+00	3.76E+02	1.32E+01	1.47E+04
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	4.28E+03	0.00E+00	1.65E+03	0.00E+00	1.08E+04	0.00E+00	1.11E+05
RU-105	3.82E-03	0.00E+00	1.30E-03	0.00E+00	3.36E-02	0.00E+00	2.49E+00
RU-106	9.24E+04	0.00E+00	1.15E+04	0.00E+00	1.25E+05	0.00E+00	1.44E+06
AG-110M	2.09E+06	1.41E+08	1.13E+08	0.00E+00	2.63E+08	0.00E+00	1.68E+10
TE-125M	7.58E+07	2.00E+07	9.84E+06	2.07E+07	0.00E+00	0.00E+00	7.12E+07
TE-127M	2.00E+08	5.60E+07	2.47E+07	4.97E+07	5.93E+08	0.00E+00	1.68E+08
TE-127	2.98E+03	8.02E+02	6.58E+02	2.06E+03	8.47E+03	0.00E+00	1.16E+05
TE-129M	2.71E+08	7.58E+07	4.21E+07	4.75E+07	7.97E+08	0.00E+00	3.31E+08
TE-129	1.28E-09	3.58E-10	3.04E-10	9.15E-10	3.75E-09	0.00E+00	7.98E-08
TE-131M	1.60E+06	5.53E+05	5.89E+05	1.14E+06	5.35E+06	0.00E+00	2.24E+07
TE-131	1.62E-32	4.95E-33	4.81E-33	1.24E-32	4.89E-32	0.00E+00	8.49E-32
TE-132	1.02E+07	4.53E+06	5.48E+06	6.60E+06	4.21E+07	0.00E+00	4.57E+07
I-130	1.73E+06	3.49E+06	1.80E+06	1.84E+06	5.22E+06	0.00E+00	1.63E+06
I-131	1.30E+09	1.31E+09	7.45E+08	4.33E+11	2.15E+09	0.00E+00	1.17E+08
I-132	6.89E-01	1.27E+00	5.82E-01	5.17E+01	1.94E+00	0.00E+00	1.49E+00
I-133	1.72E+07	2.12E+07	8.03E+06	3.94E+09	3.54E+07	0.00E+00	8.56E+05
I-134	8.48E-12	1.58E-11	7.25E-12	3.62E-10	2.41E-11	0.00E+00	1.04E-11
I-135	5.40E+04	9.72E+04	4.60E+04	8.61E+04	1.49E+05	0.00E+00	7.40E+04
CS-134	2.26E+10	3.72E+10	7.84E+09	0.00E+00	1.15E+10	4.13E+09	2.00E+08
CS-136	1.01E+09	2.86E+09	1.80E+09	0.00E+00	1.68E+09	2.21E+08	9.77E+07
CS-137	3.22E+10	3.09E+10	4.55E+09	0.00E+00	1.01E+10	3.62E+09	1.93E+08
CS-138	3.98E-23	5.53E-23	3.51E-23	0.00E+00	7.89E-23	4.19E-24	2.55E-23
BA-139	2.01E-07	1.07E-10	5.82E-09	0.00E+00	9.34E-11	6.30E-11	1.16E-05

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	1.17E+08	1.03E+05	6.84E+06	0.00E+00	3.34E+04	6.12E+04	5.93E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.94E+01	6.78E+00	2.11E+00	0.00E+00	0.00E+00	0.00E+00	1.89E+05
LA-142	8.10E-11	2.58E-11	8.08E-12	0.00E+00	0.00E+00	0.00E+00	5.11E-06
CE-141	2.19E+04	1.09E+04	1.62E+03	0.00E+00	4.75E+04	0.00E+00	1.36E+07
CE-143	1.87E+02	1.02E+05	1.47E+01	0.00E+00	4.26E+01	0.00E+00	1.49E+06
CE-144	1.52E+06	5.09E+05	8.66E+01	0.00E+00	2.82E+05	0.00E+00	1.33E+08
PR-143	7.18E+02	2.16E+02	3.56E+01	0.00E+00	1.17E+02	0.00E+00	7.75E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-147	4.45E+02	3.60E+02	2.79E+01	0.00E+00	1.98E+02	0.00E+00	5.70E+05
W-187	2.89E+04	1.71E+04	7.68E+03	0.00E+00	0.00E+00	0.00E+00	2.40E+06
MP-239	2.16E+02	1.55E+01	1.09E+01	0.00E+00	4.48E+01	0.00E+00	1.15E+06

Conversion factors are in units of square meter-mm/yr per uCi/mc for all radionuclides except R-3 which is in units of mm/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: INFANT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03
C-14	2.34E+09	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08
NA-24	1.54E+07	1.54E+07	1.54E+07	1.54E+07	1.54E+07	1.54E+07	1.54E+07
P-32	1.60E+11	9.43E+09	6.21E+09	0.00E+00	0.00E+00	0.00E+00	2.17E+09
CR-51	0.00E+00	0.00E+00	1.61E+05	1.05E+05	2.30E+04	2.05E+05	4.70E+06
NI-54	0.00E+00	3.90E+07	8.84E+06	0.00E+00	8.84E+06	0.00E+00	1.43E+07
NI-56	0.00E+00	3.14E+02	5.42E+03	0.00E+00	2.70E+02	0.00E+00	2.85E+00
FE-55	1.35E+08	8.73E+07	2.33E+07	0.00E+00	0.00E+00	4.27E+07	1.11E+07
FE-59	2.24E+08	3.92E+08	1.54E+08	0.00E+00	0.00E+00	1.16E+08	1.87E+08
CO-58	0.00E+00	2.42E+07	6.05E+07	0.00E+00	0.00E+00	0.00E+00	6.04E+07
CO-60	0.00E+00	8.82E+07	2.08E+08	0.00E+00	0.00E+00	0.00E+00	2.10E+08
NI-63	3.49E+10	2.16E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
NI-65	3.50E+00	3.97E+01	1.80E+01	0.00E+00	0.00E+00	0.00E+00	3.02E+01
CU-64	0.00E+00	1.86E+05	8.59E+04	0.00E+00	3.14E+05	0.00E+00	3.81E+06
ZN-65	5.55E+09	1.90E+10	8.78E+09	0.00E+00	9.21E+09	0.00E+00	1.61E+10
ZN-69	2.02E+11	3.63E+11	2.70E+12	0.00E+00	1.51E+11	0.00E+00	2.96E+09
BR-83	0.00E+00	0.00E+00	1.12E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.51E+23	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	2.23E+10	1.10E+10	0.00E+00	0.00E+00	0.00E+00	5.80E+08
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	1.26E+10	0.00E+00	3.61E+08	0.00E+00	0.00E+00	0.00E+00	2.59E+08
BR-90	1.22E+11	0.00E+00	3.10E+10	0.00E+00	0.00E+00	0.00E+00	1.52E+09
BR-91	2.72E+05	0.00E+00	9.83E+03	0.00E+00	0.00E+00	0.00E+00	3.21E+05
BR-92	4.84E+00	0.00E+00	1.72E+01	0.00E+00	0.00E+00	0.00E+00	5.00E+01
Y-90	6.81E+02	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	9.41E+05
Y-91M	5.67E+19	0.00E+00	1.93E+20	0.00E+00	0.00E+00	0.00E+00	1.89E+15
Y-91	7.33E+04	0.00E+00	1.95E+03	0.00E+00	0.00E+00	0.00E+00	5.25E+06
Y-92	5.38E+04	0.00E+00	1.51E+25	0.00E+00	0.00E+00	0.00E+00	1.03E+01

Conversion factors are in units of square meter-arem/yr per uCi/sec for all
radionuclides except H-3 which is in units of arem/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: INFANT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
T-93	2.16E+00	0.00E+00	5.87E-02	0.00E+00	0.00E+00	0.00E+00	1.70E+04
ZR-95	6.80E+03	1.66E+03	1.18E+03	0.00E+00	1.79E+03	0.00E+00	8.26E+05
ZR-97	4.06E+00	6.97E-01	3.18E-01	0.00E+00	7.03E-01	0.00E+00	4.45E+04
NR-95	5.93E+05	2.44E+05	1.41E+05	0.00E+00	1.75E+05	0.00E+00	2.06E+08
MD-99	0.00E+00	2.08E+08	4.06E+07	0.00E+00	3.11E+08	0.00E+00	6.85E+07
TC-99M	2.75E+01	5.87E+01	7.30E+02	0.00E+00	6.10E+02	2.96E+01	1.65E+04
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	5.87E+03	0.00E+00	2.90E+03	0.00E+00	1.80E+04	0.00E+00	1.05E+05
RU-105	8.05E-03	0.00E+00	2.71E-03	0.00E+00	5.92E-02	0.00E+00	3.20E+00
RU-106	1.90E+05	0.00E+00	2.58E+04	0.00E+00	2.25E+05	0.00E+00	1.44E+06
AG-110M	3.86E+08	2.82E+08	1.86E+08	0.00E+00	4.03E+08	0.00E+00	1.46E+10
TE-125M	1.51E+06	5.04E+07	2.04E+07	5.07E+07	0.00E+00	0.00E+00	7.18E+07
TE-127M	4.21E+08	1.40E+08	5.10E+07	1.22E+08	1.04E+09	0.00E+00	1.70E+08
TE-127	6.37E+03	2.12E+03	1.36E+03	5.14E+03	1.54E+04	0.00E+00	1.33E+05
TE-129M	5.57E+08	1.91E+08	8.58E+07	2.14E+08	1.59E+09	0.00E+00	3.33E+08
TE-129	2.72E-09	9.37E-10	6.35E-10	2.28E-09	6.77E-09	0.00E+00	2.17E-07
TE-131M	3.58E+06	1.36E+06	1.12E+06	2.75E+06	9.35E+06	0.00E+00	2.29E+07
TE-131	3.43E-32	1.27E-32	9.62E-33	3.06E-32	8.76E-32	0.00E+00	1.58E-30
TE-132	2.11E+07	1.04E+07	9.75E+06	1.54E+07	6.53E+07	0.00E+00	3.87E+07
I-130	3.55E+06	7.81E+06	3.13E+06	8.75E+06	8.58E+06	0.00E+00	1.67E+06
I-131	2.72E+09	3.20E+09	1.41E+09	1.05E+12	3.74E+09	0.00E+00	1.14E+08
I-132	1.43E+00	2.90E+00	1.03E+00	1.36E+02	3.24E+00	0.00E+00	2.35E+00
I-133	3.63E+07	5.28E+07	1.55E+07	9.60E+09	6.21E+07	0.00E+00	8.93E+06
I-134	1.76E-11	3.60E-11	1.28E-11	8.40E-10	4.03E-11	0.00E+00	3.73E-11
I-135	1.12E+05	2.23E+05	8.14E+04	2.00E+07	2.49E+05	0.00E+00	8.08E+04
CS-134	3.65E+10	6.90E+10	6.87E+09	0.00E+00	1.75E+10	7.18E+09	1.85E+08
CS-136	1.98E+09	5.81E+09	2.17E+09	0.00E+00	2.32E+09	4.74E+08	8.82E+07
CS-137	5.15E+10	6.02E+10	4.27E+09	0.00E+00	1.62E+10	6.55E+09	1.88E+08
CS-138	8.39E-23	1.36E-22	6.61E-23	0.00E+00	6.80E-23	1.06E-23	2.18E-22
BA-139	4.27E-07	2.83E-10	1.24E-08	0.00E+00	1.70E-10	1.72E-10	2.71E-05

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.41E+08	2.41E+05	1.24E+07	0.00E+00	5.72E+04	1.48E+05	5.92E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.05E+01	1.60E+01	4.11E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+05
LA-142	1.72E+10	8.24E+11	1.49E+11	0.00E+00	0.00E+00	0.00E+00	1.06E+05
CE-141	4.34E+04	2.64E+04	3.11E+03	0.00E+00	8.15E+03	0.00E+00	1.37E+07
CE-143	3.97E+02	2.63E+05	3.00E+01	0.00E+00	7.67E+01	0.00E+00	1.54E+06
CE-144	2.33E+06	9.52E+05	1.30E+05	0.00E+00	3.85E+05	0.00E+00	1.33E+08
PR-143	1.49E+03	5.55E+02	7.36E+01	0.00E+00	2.06E+02	0.00E+00	7.84E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HD-147	8.81E+02	9.05E+02	5.55E+01	0.00E+00	3.49E+02	0.00E+00	5.74E+05
M-187	6.08E+04	4.23E+04	1.46E+04	0.00E+00	0.00E+00	0.00E+00	2.48E+06
WP-239	4.57E+02	4.08E+01	2.31E+01	0.00E+00	8.15E+01	0.00E+00	1.18E+06

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	3.25E+02	3.25E+02	3.25E+02	3.25E+02	3.25E+02	3.25E+02
C-14	2.41E+08	4.83E+07	4.83E+07	4.83E+07	4.83E+07	4.83E+07	4.83E+07
NA-24	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03
P-32	4.66E+09	2.90E+08	1.80E+08	0.00E+00	0.00E+00	0.00E+00	5.24E+08
CR-51	0.00E+00	0.00E+00	7.05E+03	4.21E+03	1.55E+03	9.35E+03	1.77E+06
NA-54	0.00E+00	9.18E+06	1.75E+04	0.00E+00	2.73E+06	0.00E+00	2.81E+07
HM-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	2.93E+08	2.03E+08	4.72E+07	0.00E+00	0.00E+00	1.13E+08	1.16E+08
FE-59	2.66E+08	6.24E+08	2.39E+08	0.00E+00	0.00E+00	1.74E+08	2.08E+09
CO-58	0.00E+00	1.82E+07	4.09E+07	0.00E+00	0.00E+00	0.00E+00	3.69E+08
CO-60	0.00E+00	7.52E+07	1.66E+08	0.00E+00	0.00E+00	0.00E+00	1.41E+09
NI-63	1.89E+10	1.31E+09	6.33E+08	0.00E+00	0.00E+00	0.00E+00	2.73E+08
NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	2.71E-07	1.27E-07	0.00E+00	6.84E-07	0.00E+00	2.31E-05
ZN-65	3.56E+08	1.13E+09	5.12E+08	0.00E+00	7.57E+08	0.00E+00	7.13E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	4.87E+08	2.27E+08	0.00E+00	0.00E+00	0.00E+00	9.60E+07
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.30E+00
BR-90	3.02E+08	0.00E+00	8.66E+06	0.00E+00	0.00E+00	0.00E+00	4.84E+07
NR-90	1.24E+10	0.00E+00	3.05E+09	0.00E+00	0.00E+00	0.00E+00	3.59E+08
SR-91	1.52E-10	0.00E+00	6.14E-12	0.00E+00	0.00E+00	0.00E+00	7.23E-10
SR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	1.08E+02	0.00E+00	2.89E+00	0.00E+00	0.00E+00	0.00E+00	1.14E+06
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	1.13E+06	0.00E+00	3.03E+04	0.00E+00	0.00E+00	0.00E+00	6.23E+08
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all radionuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES
OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	G.I. LL
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Y-93	4.69E-12	0.00E+00	1.30E-13	0.00E+00	0.00E+00	0.00E+00	1.49E-07
Zr-95	1.87E+06	6.01E+05	4.07E+05	0.00E+00	9.42E+05	0.00E+00	1.90E+09
Zr-97	2.07E-05	4.17E-06	1.91E-06	0.00E+00	6.30E-06	0.00E+00	1.29E+00
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NB-95	2.30E+06	1.28E+06	6.87E+05	0.00E+00	1.26E+06	0.00E+00	7.76E+09
MO-99	0.00E+00	1.00E+05	1.90E+04	0.00E+00	2.26E+05	0.00E+00	2.32E+05
TC-99M	4.45E-21	1.26E-20	1.60E-19	0.00E+00	1.91E-19	6.16E-21	7.44E-18
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TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.05E+08	0.00E+00	4.53E+07	0.00E+00	4.01E+08	0.00E+00	1.23E+10
RU-105	5.79E-28	0.00E+00	2.28E-28	0.00E+00	7.46E-27	0.00E+00	3.53E-25
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RU-106	2.80E+09	0.00E+00	3.54E+08	0.00E+00	5.40E+09	0.00E+00	1.81E+11
AG-110M	6.68E+06	6.18E+06	3.67E+06	0.00E+00	1.22E+07	0.00E+00	2.52E+09
TE-125M	3.59E+08	1.30E+08	4.81E+07	1.08E+08	1.46E+09	0.00E+00	1.43E+09
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TE-127M	1.12E+09	3.99E+08	1.36E+08	2.85E+08	4.73E+09	0.00E+00	3.74E+09
TE-127	2.12E-10	7.62E-11	4.59E-11	1.57E-10	8.64E-10	0.00E+00	1.67E-08
TE-129M	1.13E+09	4.23E+08	79E+08	3.90E+08	4.73E+09	0.00E+00	5.71E+09
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TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	4.51E+02	2.21E+02	1.64E+02	3.49E+02	2.23E+03	0.00E+00	2.19E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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TE-132	1.42E+06	9.18E+05	8.62E+05	1.01E+06	8.04E+06	0.00E+00	4.34E+07
I-130	2.11E-06	6.22E-06	2.45E-06	5.27E-06	9.71E-06	0.00E+00	5.35E-06
I-131	1.07E+07	1.54E+07	8.80E+06	5.03E+09	2.63E+07	0.00E+00	4.05E+06
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I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	3.65E-01	6.35E-01	1.94E-01	9.34E+01	1.11E+00	0.00E+00	5.71E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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I-135	4.43E-17	1.16E-16	4.22E-17	7.64E-15	1.86E-16	0.00E+00	1.31E-16
CS-134	6.58E+08	1.56E+09	1.28E+09	0.00E+00	5.06E+08	1.68E+08	2.74E+07
CE-136	1.21E+07	4.76E+07	3.43E+07	0.00E+00	2.65E+07	3.63E+06	5.41E+06
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CE-137	8.72E+08	1.19E+09	7.81E+08	0.00E+00	4.05E+08	1.35E+08	2.31E+07
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES
OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.87E+07	6.1E+04	1.88E+06	0.00E+00	1.23E+04	2.07E+04	5.92E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.71E-02	1.87E-02	4.94E-03	0.00E+00	0.00E+00	0.00E+00	1.37E+03
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	1.40E+04	9.50E+03	1.08E+03	0.00E+00	4.41E+03	0.00E+00	3.63E+07
CE-143	2.01E-02	1.48E+01	1.64E-03	0.00E+00	6.53E-03	0.00E+00	5.55E+02
CE-144	1.46E+06	6.09E+05	7.83E+04	0.00E+00	3.61E+05	0.00E+00	4.93E+08
PR-143	2.10E+04	8.41E+03	1.04E+03	0.00E+00	4.85E+03	0.00E+00	9.18E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-147	7.07E+03	6.17E+03	4.89E+02	0.00E+00	4.78E+03	0.00E+00	3.92E+07
M-187	2.07E-02	1.73E-02	6.04E-03	0.00E+00	0.00E+00	0.00E+00	5.66E+00
MP-237	6.53E+02	6.42E+01	3.54E+01	0.00E+00	2.00E+02	0.00E+00	1.32E+07

Conversion factors are in units of square meter-mm²/yr per uCi/sec for all nuclides except H-3 which is in units of mm²/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (1 of 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI

H-3	0.00E+00	1.94E+02	1.94E+02	1.94E+02	1.94E+02	1.94E+02	1.94E+02
C-14	2.04E+08	4.08E+07	4.08E+07	4.08E+07	4.08E+07	4.08E+07	4.08E+07
N-14	1.08E-03	1.08E-03	1.08E-03	1.08E-03	1.08E-03	1.08E-03	1.08E-03

P-32	3.93E+09	2.44E+08	1.53E+08	0.00E+00	0.00E+00	0.00E+00	3.31E+08
CR-51	0.00E+00	0.00E+00	5.64E+03	3.13E+03	1.24E+03	8.05E+03	9.47E+05
MM-54	0.00E+00	7.00E+06	1.39E+06	0.00E+00	2.09E+06	0.00E+00	1.44E+07

MM-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	2.38E+08	1.89E+08	3.94E+07	0.00E+00	0.00E+00	1.07E+08	7.31E+07
FE-59	2.12E+08	4.95E+08	1.91E+08	0.00E+00	0.00E+00	1.56E+08	1.17E+09

CO-58	0.00E+00	1.41E+07	3.24E+07	0.00E+00	0.00E+00	0.00E+00	1.94E+08
CO-60	0.00E+00	5.83E+07	1.31E+08	0.00E+00	0.00E+00	0.00E+00	7.60E+08
SI-63	1.52E+10	3.07E+09	5.15E+08	0.00E+00	0.00E+00	0.00E+00	1.71E+08

NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	2.21E-07	1.04E-07	0.00E+00	5.60E-07	0.00E+00	1.72E-05
ZN-65	2.50E+08	8.49E+08	4.05E+08	0.00E+00	5.56E+08	0.00E+00	3.68E+08

ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

BR-85	0.03E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE-86	0.00E+00	4.07E+08	1.91E+08	0.00E+00	0.00E+00	0.00E+00	6.02E+07
RE-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

RE-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	2.55E+08	0.00E+00	7.17E+06	0.00E+00	0.00E+00	0.00E+00	3.03E+07
BR-90	8.05E+09	0.00E+00	1.99E+09	0.00E+00	0.00E+00	0.00E+00	2.26E+08

BR-91	1.28E-10	0.00E+00	5.08E-12	0.00E+00	0.00E+00	0.00E+00	5.79E-10
BR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	9.04E+01	0.00E+00	2.44E+00	0.00E+00	0.00E+00	0.00E+00	7.47E+05

Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	9.54E+05	0.00E+00	2.56E+04	0.00E+00	0.00E+00	0.00E+00	3.91E+08
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI+LLI
Y-93	3.96E-12	0.00E+00	1.09E-13	0.00E+00	0.00E+00	0.00E+00	1.21E-07
ZR-95	1.50E+06	4.73E+05	3.25E+05	0.00E+00	6.95E+05	0.00E+00	1.09E+09
ZR-97	1.72E-05	3.41E-06	1.57E-06	0.00E+00	5.17E-06	0.00E+00	9.23E-01
NR-95	1.79E+06	9.95E+05	5.48E+05	0.00E+00	9.65E+05	0.00E+00	4.26E+09
MO-99	0.00E+00	8.27E+04	1.58E+04	0.00E+00	1.89E+05	0.00E+00	1.48E+05
YC-99M	3.57E-21	9.66E-21	1.28E-19	0.00E+00	1.47E-19	5.47E-21	6.47E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	8.57E+07	0.00E+00	3.66E+07	0.00E+00	3.02E+08	0.00E+00	7.16E+09
RU-105	4.83E-28	0.00E+00	1.87E-28	0.00E+00	6.09E-27	0.00E+00	3.90E-25
RU-106	1.82E+09	0.00E+00	2.97E+08	0.00E+00	4.55E+09	0.00E+00	1.13E+11
AG-110M	5.06E+06	4.79E+06	2.91E+06	0.00E+00	9.13E+06	0.00E+00	1.34E+09
TE-125M	3.03E+08	1.09E+08	4.05E+07	8.47E+07	0.00E+00	0.00E+00	8.94E+08
TE-127M	9.41E+08	3.34E+08	1.12E+08	2.24E+08	3.02E+09	0.00E+00	2.35E+09
TE-127	1.80E-10	6.38E-11	3.88E-11	1.24E-10	7.29E-10	0.00E+00	1.39E-08
TE-129M	9.50E+08	3.53E+08	1.50E+08	3.07E+08	3.97E+09	0.00E+00	3.57E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	3.76E+02	1.80E+02	1.50E+02	2.71E+02	1.88E+03	0.00E+00	1.45E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	1.16E+06	7.34E+05	6.92E+05	7.76E+05	7.06E+06	0.00E+00	2.33E+07
I-130	1.70E-06	4.91E-06	1.96E-06	4.00E-06	7.56E-06	0.00E+00	3.77E-06
I-131	8.92E+06	1.25E+07	6.71E+06	3.63E+09	2.15E+07	0.00E+00	2.47E+06
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	3.05E-01	3.18E-01	1.58E-01	7.23E-01	9.09E-01	0.00E+00	3.92E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	3.60E-17	9.27E-17	3.44E-17	5.96E-15	1.46E-16	0.00E+00	1.03E-16
CS-134	5.23E+08	1.23E+09	5.71E+08	0.00E+00	3.91E+08	1.49E+08	1.53E+07
CS-136	9.40E+06	3.70E+07	2.48E+07	0.00E+00	2.01E+07	3.17E+06	2.98E+06
CS-137	7.24E+08	9.63E+08	3.36E+08	0.00E+00	3.28E+08	1.27E+08	1.37E+07
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES
OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (3 of 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.36E+07	2.91E+04	1.53E+06	0.00E+00	9.87E+03	1.96E+04	3.66E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.05E-02	9.40E-02	3.99E-03	0.00E+00	0.00E+00	0.00E+00	8.61E+02
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	1.18E+04	7.87E+03	9.04E+02	0.00E+00	3.71E+03	0.00E+00	2.25E+07
CE-143	1.09E-02	1.23E+01	1.37E-03	0.00E+00	5.51E-03	0.00E+00	3.69E+02
CE-144	1.23E+06	5.08E+05	6.60E+04	0.00E+00	3.04E+05	0.00E+00	3.09E+08
PR-143	1.76E+04	7.04E+03	8.78E+02	0.00E+00	4.09E+03	0.00E+00	5.80E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MD-147	6.23E+03	6.77E+03	4.06E+02	0.00E+00	3.96E+03	0.00E+00	2.44E+07
W-187	1.73E-02	1.41E-02	4.95E-03	0.00E+00	0.00E+00	0.00E+00	3.82E+00
HP-239	5.70E+02	5.38E+01	2.99E+01	0.00E+00	1.69E+02	0.00E+00	8.65E+06

Conversion factors are in units of square meter-area/yr per uCi/sec for all nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (1 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
K-3	0.00E+00	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02
C-14	3.83E+08	7.67E+07	7.67E+07	7.67E+07	7.67E+07	7.67E+07	7.67E+07
NA-24	1.72E-03	1.72E-02	1.72E-03	1.72E-03	1.72E-03	1.72E-03	1.72E-03
P-32	7.42E+09	3.47E+08	2.86E+08	0.00E+00	0.00E+00	0.00E+00	2.05E+08
CR-51	0.00E+00	0.00E+00	8.79E+03	4.48E+03	1.53E+03	8.91E-03	4.66E+05
MM-54	0.00E+00	8.01E+06	2.13E+06	0.00E+00	2.25E+06	0.00E+00	6.72E+06
Na-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	4.37E+08	2.42E+08	7.51E+07	0.00E+00	0.00E+00	1.37E+08	4.49E+07
FE-59	3.76E+08	6.09E+08	3.03E+08	0.00E+00	0.00E+00	1.77E+08	6.34E+08
CO-58	0.00E+00	1.64E+07	5.02E+07	0.00E+00	0.00E+00	0.00E+00	9.58E+07
CO-60	0.00E+00	6.93E+07	2.04E+08	0.00E+00	0.00E+00	0.00E+00	3.84E+08
NI-63	2.91E+10	1.50E+09	1.02E+09	0.00E+00	0.00E+00	0.00E+00	1.05E+08
NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	2.97E-07	1.80E-07	0.00E+00	7.19E-07	0.00E+00	1.40E-05
ZN-65	3.75E+08	1.00E+09	6.22E+08	0.00E+00	6.30E+08	0.00E+00	1.76E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	5.77E+08	3.55E+08	0.00E+00	0.00E+00	0.00E+00	3.71E+07
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	4.82E+08	0.00E+00	1.58E+07	0.00E+00	0.00E+00	0.00E+00	1.87E+07
BR-90	1.04E+10	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	1.40E+08
BR-91	2.40E+10	0.00E+00	9.05E+12	0.00E+00	0.00E+00	0.00E+00	5.29E+10
BR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	1.71E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	0.00E+00	4.86E+05
Y-91R	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	1.80E+06	0.00E+00	4.82E+04	0.00E+00	0.00E+00	0.00E+00	2.40E+08
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except K-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
Y-93	7.44E-12	4.00E+00	2.04E-13	0.00E+00	0.00E+00	0.00E+00	1.11E-07
ZR-95	2.64E+06	5.85E+05	5.21E+05	0.00E+00	8.38E+05	0.00E+00	6.11E+08
ZR-97	3.21E-05	4.63E-06	2.73E-06	0.00E+00	6.65E-06	0.00E+00	7.02E-01
NR-99	3.10E+06	1.21E+06	8.62E+05	0.00E+00	1.13E+06	0.00E+00	2.23E+09
NO-99	0.00E+00	1.15E+05	2.84E+04	0.00E+00	2.46E+05	0.00E+00	9.51E+04
TC-99m	6.20E-21	1.22E-20	2.01E-19	0.00E+00	1.77E-19	6.17E-21	5.91E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.55E+08	0.00E+00	5.96E+07	0.00E+00	3.90E+08	0.00E+00	4.01E+09
RU-105	9.02E-28	0.00E+00	3.27E-28	0.00E+00	7.93E-27	0.00E+00	5.84E-25
RU-106	4.44E+09	0.00E+00	5.54E+08	0.00E+00	5.99E+09	0.00E+00	6.40E+10
AG-110m	8.39E+06	5.67E+06	4.53E+06	0.00E+00	1.06E+07	0.00E+00	6.74E+08
TE-123m	5.69E+08	1.54E+08	7.59E+07	1.69E+08	0.00E+00	0.00E+00	5.49E+08
TE-127m	1.77E+09	4.78E+08	2.11E+08	4.24E+08	5.06E+09	0.00E+00	1.44E+09
TE-127	3.39E-10	9.13E-11	7.26E-11	2.34E-10	9.63E-10	0.00E+00	1.32E-08
TE-129m	1.79E+09	5.00E+08	2.78E+08	5.77E+08	5.26E+09	0.00E+00	2.18E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131m	7.00E+02	2.42E+02	2.58E+02	4.98E+02	2.34E+03	0.00E+00	9.82E+03
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	2.12E+06	9.58E+05	1.13E+06	1.37E+06	8.71E+06	0.00E+00	9.45E+06
I-130	3.04E-06	6.13E-06	3.16E-06	6.76E-04	9.17E-06	0.00E+00	2.87E-06
I-131	1.63E+07	1.66E+07	9.46E+06	5.50E+09	2.73E+07	0.00E+00	1.48E+06
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	5.67E-01	7.02E-01	2.66E-01	1.30E+02	1.17E+00	0.00E+00	2.83E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	6.52E-17	1.17E-16	5.55E-17	1.04E-14	1.80E-16	0.00E+00	8.94E-17
CS-134	9.22E+08	1.51E+09	3.19E+08	0.00E+00	4.69E+08	1.68E+08	8.16E+06
CS-136	1.62E+07	4.58E+07	2.98E+07	0.00E+00	2.37E+07	3.54E+06	1.57E+06
CS-137	1.33E+09	1.28E+09	1.88E+08	0.00E+00	4.16E+08	1.50E+08	7.99E+06
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-area/yr per uCi/suc for all nuclides except R-3 which is in units of area/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES
OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (3 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	4.38E+07	3.84E+04	2.56E+06	0.00E+00	1.25E+04	2.29E+04	2.22E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	5.59E-02	1.05E-02	6.08E-03	0.00E+00	0.00E+00	0.00E+00	5.44E+02
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	2.22E+04	1.11E+04	1.64E+03	0.00E+00	4.86E+04	0.00E+00	1.38E+07
CE-143	3.17E-02	1.72E+01	2.69E-03	0.00E+00	7.21E-03	0.00E+00	2.52E+02
CE-144	2.32E+06	7.26E+05	1.24E+05	0.00E+00	4.02E+05	0.00E+00	1.80E+08
PR-143	3.34E+04	1.00E+04	1.66E+03	0.00E+00	5.43E+03	0.00E+00	3.60E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MD-147	1.17E+04	9.47E+03	7.33E+02	0.00E+00	5.19E+03	0.00E+00	1.50E+07
W-187	3.21E-02	1.90E-02	8.53E-03	0.00E+00	0.00E+00	0.00E+00	2.67E+00
WP-239	1.07E+03	7.71E+01	5.42E+01	0.00E+00	2.23E+02	0.00E+00	5.70E+06

Conversion factors are in units of square meter-mm²/yr per μ Ci/sec for all nuclides except H-3 which is in units of mm²/yr per μ Ci/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03
C-14	2.26E+08	4.55E+07	4.55E+07	4.55E+07	4.55E+07	4.55E+07	4.55E+07
NA-24	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05
P-32	1.40E+09	8.72E+07	5.43E+07	0.00E+00	0.00E+00	0.00E+00	1.59E+08
CR-51	0.00E+00	0.00E+00	4.64E+04	2.78E+04	1.02E+04	6.16E+04	1.17E+07
NI-54	0.00E+00	3.13E+06	5.97E+07	0.00E+00	9.31E+07	0.00E+00	9.59E+08
WH-56	0.00E+00	1.59E+01	2.82E+00	0.00E+00	2.02E+01	0.00E+00	5.07E+02
FE-55	2.10E+08	1.45E+08	3.38E+07	0.00E+00	0.00E+00	8.08E+07	8.31E+07
FE-59	1.26E+08	2.96E+08	1.14E+08	0.00E+00	0.00E+00	8.28E+07	9.88E+08
CO-58	0.00E+00	3.07E+07	6.89E+07	0.00E+00	0.00E+00	0.00E+00	6.23E+08
CO-60	0.00E+00	1.67E+08	3.64E+08	0.00E+00	0.00E+00	0.00E+00	3.14E+09
NI-63	1.04E+10	7.21E+08	3.49E+08	0.00E+00	0.00E+00	0.00E+00	1.50E+08
KI-65	6.15E+01	7.99E+00	3.64E+00	0.00E+00	0.00E+00	0.00E+00	2.03E+02
CU-64	0.00E+00	9.20E+03	4.32E+03	0.00E+00	2.32E+04	0.00E+00	7.84E+05
ZN-65	3.17E+08	1.01E+09	4.36E+08	0.00E+00	6.75E+08	0.00E+00	6.36E+08
ZN-69	5.49E+06	1.05E+05	7.31E+07	0.00E+00	6.83E+06	0.00E+00	1.58E+06
BR-83	0.00E+00	0.00E+00	3.11E+00	0.00E+00	0.00E+00	0.00E+00	4.47E+00
BR-84	0.00E+00	0.00E+00	2.48E+11	0.00E+00	0.00E+00	0.00E+00	1.94E+16
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	2.19E+08	1.02E+08	0.00E+00	0.00E+00	0.00E+00	4.33E+07
BR-88	0.00E+00	3.43E+22	1.61E+22	0.00E+00	0.00E+00	0.00E+00	4.74E+33
BR-89	0.00E+00	3.89E+26	2.73E+26	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	9.97E+09	0.00E+00	2.86E+08	0.00E+00	0.00E+00	0.00E+00	1.60E+09
BR-90	6.05E+11	0.00E+00	1.48E+11	0.00E+00	0.00E+00	0.00E+00	1.75E+10
BR-91	3.05E+05	0.00E+00	1.23E+04	0.00E+00	0.00E+00	0.00E+00	1.45E+06
BR-92	4.27E+02	0.00E+00	1.85E+01	0.00E+00	0.00E+00	0.00E+00	8.45E+03
Y-90	1.33E+04	0.00E+00	3.57E+02	0.00E+00	0.00E+00	0.00E+00	1.41E+08
Y-91M	5.22E+09	0.00E+00	2.02E+10	0.00E+00	0.00E+00	0.00E+00	1.53E+08
Y-91	3.11E+04	0.00E+00	1.37E+05	0.00E+00	0.00E+00	0.00E+00	2.81E+09
Y-92	9.15E+01	0.00E+00	2.68E+02	0.00E+00	0.00E+00	0.00E+00	1.60E+04

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.70E+02	0.00E+00	4.68E+00	0.00E+00	0.00E+00	0.00E+00	5.38E+06
Zr-95	1.17E+06	3.77E+05	2.55E+05	0.00E+00	5.91E+05	0.00E+00	1.19E+09
Zr-97	3.37E+02	6.81E+01	3.11E+01	0.00E+00	1.03E+02	0.00E+00	2.11E+07
MB-95	1.42E+05	7.92E+04	4.26E+04	0.00E+00	7.83E+04	0.00E+00	4.81E+08
MO-99	0.00E+00	6.15E+06	1.17E+06	0.00E+00	1.39E+07	0.00E+00	1.43E+07
TC-99M	3.10E+00	8.77E+00	1.12E+02	0.00E+00	1.33E+02	4.30E+00	5.19E+03
TC-101	8.22E-31	1.18E-30	1.16E-29	0.00E+00	2.13E-29	6.05E-31	0.00E+00
RU-103	4.77E+06	0.00E+00	2.06E+06	0.00E+00	1.82E+07	0.00E+00	5.17E+06
RU-105	5.39E+01	0.00E+00	2.13E+01	0.00E+00	6.96E+02	0.00E+00	3.29E+04
RU-106	1.93E+08	0.00E+00	2.44E+07	0.00E+00	3.72E+08	0.00E+00	1.25E+10
AG-110M	1.05E+07	9.75E+06	5.79E+06	0.00E+00	1.92E+07	0.00E+00	3.98E+09
TE-125M	9.66E+07	3.50E+07	1.29E+07	2.90E+07	3.93E+08	0.00E+00	3.86E+08
TE-127M	3.49E+08	1.25E+08	4.26E+07	8.92E+07	1.42E+09	0.00E+00	1.17E+09
TE-127	5.66E+03	2.03E+03	1.22E+03	4.19E+03	2.31E+04	0.00E+00	4.47E+05
TE-129M	2.51E+08	9.38E+07	3.98E+07	8.63E+07	1.05E+09	0.00E+00	1.27E+09
TE-129	7.62E-04	2.87E-04	1.86E-04	5.85E-04	3.20E-03	0.00E+00	5.75E-04
TE-131M	9.12E+05	4.46E+05	3.72E+05	7.06E+05	4.52E+06	0.00E+00	4.43E+07
TE-131	1.50E-15	6.27E-16	4.74E-16	1.23E-15	6.57E-15	0.00E+00	2.13E-16
TE-132	4.30E+06	2.78E+06	2.61E+06	3.07E+06	2.68E+07	0.00E+00	1.32E+08
I-130	3.92E+05	1.16E+06	4.57E+05	9.81E+07	1.81E+06	0.00E+00	9.26E+05
I-131	8.08E+07	1.14E+08	6.62E+07	3.79E+10	1.98E+08	0.00E+00	3.05E+07
I-132	5.76E+01	1.54E+02	5.39E+01	5.39E+03	2.45E+02	0.00E+00	2.89E+01
I-133	2.09E+06	3.63E+06	1.11E+06	5.33E+08	6.33E+06	0.00E+00	3.28E+06
I-134	9.65E-05	2.62E-04	9.36E-05	4.54E-03	4.17E-04	0.00E+00	2.29E-07
I-135	3.90E+04	1.02E+05	3.77E+04	6.73E+06	1.64E+05	0.00E+00	1.15E+05
CS-134	4.67E+09	1.11E+10	9.08E+09	0.00E+00	3.59E+09	1.19E+09	1.94E+08
CS-136	4.27E+07	1.68E+08	1.21E+08	0.00E+00	9.34E+07	1.29E+07	1.91E+07
CS-137	6.36E+09	8.70E+09	5.70E+09	0.00E+00	2.95E+09	9.81E+08	1.68E+08
CS-138	3.91E-11	7.73E-11	3.83E-11	0.00E+00	0.68E-11	5.61E-12	3.30E-16
BA-139	2.86E-02	2.07E-05	8.36E-04	0.00E+00	1.90E-05	1.15E-05	5.07E-02

Conversion factors are in units of square meter-area/yr per uCi/sec for all radionuclides except H-3 which is in units of area/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
BA-140	1.28E+08	1.61E+05	8.42E+06	0.00E+00	5.49E+04	9.24E+04	2.65E+08
BA-141	1.15E-21	8.70E-25	3.89E-23	0.00E+00	8.09E-25	4.94E-25	5.43E-31
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.98E+03	9.97E+02	2.63E+02	0.00E+00	0.00E+00	0.00E+00	7.32E+07
LA-142	2.02E-04	9.19E-05	2.29E-05	0.00E+00	0.00E+00	0.00E+00	6.71E-01
CE-141	1.97E+05	1.33E+05	1.51E+04	0.00E+00	6.19E+04	0.00E+00	5.10E+08
CE-143	9.98E+02	7.38E+05	8.16E+01	0.00E+00	3.25E+02	0.00E+00	2.76E+07
CE-144	3.29E+07	1.58E+07	1.77E+06	0.00E+00	8.16E+06	0.00E+00	1.11E+10
PR-143	6.28E+04	2.51E+04	3.10E+03	0.00E+00	1.45E+04	0.00E+00	2.74E+08
PR-144	3.09E-26	1.28E-26	1.57E-27	0.00E+00	7.23E-27	0.00E+00	4.44E-33
MO-147	3.33E+04	3.85E+04	2.31E+03	0.00E+00	2.25E+04	0.00E+00	1.85E+08
W-187	3.80E+04	3.18E+04	1.11E+04	0.00E+00	0.00E+00	0.00E+00	1.04E+07
NP-239	9.34E+04	9.30E+03	5.17E+03	0.00E+00	2.93E+04	0.00E+00	1.92E+09

Conversion factors are in units of square meter-cm²/yr per uCi/sec for all nuclides except H-3 which is in units of m²-cm²/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (1 OF 3)

NUCLIDE

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03
C-14	3.69E+08	7.38E+07	7.38E+07	7.38E+07	7.38E+07	7.38E+07	7.38E+07
NA-24	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05
P-32	1.61E+09	9.97E+07	6.24E+07	0.00E+00	0.00E+00	0.00E+00	1.35E+08
CR-51	0.00E+00	0.00E+00	6.17E+04	3.43E+04	1.35E+04	8.81E+04	1.04E+07
WM-54	0.00E+00	4.54E+08	9.01E+07	0.00E+00	1.36E+08	0.00E+00	9.32E+08
WM-56	0.00E+00	1.43E+01	2.55E+00	0.00E+00	1.81E+01	0.00E+00	9.44E+02
FE-55	3.26E+08	2.31E+08	5.39E+07	0.00E+00	0.00E+00	1.47E+08	1.00E+08
FE-59	1.79E+08	4.19E+08	1.62E+08	0.00E+00	0.00E+00	1.32E+08	9.90E+08
CO-58	0.00E+00	4.36E+07	1.00E+08	0.00E+00	0.00E+00	0.00E+00	6.01E+08
CO-60	0.00E+00	2.49E+08	5.60E+08	0.00E+00	0.00E+00	0.00E+00	3.24E+09
NI-63	1.61E+10	1.13E+09	5.45E+08	0.00E+00	0.00E+00	0.00E+00	1.81E+08
NI-65	5.72E+01	7.31E+00	3.33E+00	0.00E+00	0.00E+00	0.00E+00	3.97E+02
CU-64	0.00E+00	8.34E+03	3.92E+03	0.00E+00	2.11E+04	0.00E+00	6.47E+05
ZN-65	6.24E+08	1.47E+09	6.87E+08	0.00E+00	9.42E+08	0.00E+00	6.23E+08
ZN-69	5.15E-06	9.80E-06	6.86E-07	0.00E+00	6.41E-06	0.00E+00	1.81E-05
BR-83	0.00E+00	0.00E+00	2.91E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	2.25E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.74E+08	1.29E+08	0.00E+00	0.00E+00	0.00E+00	4.05E+07
RB-88	0.00E+00	3.17E-22	1.69E-22	0.00E+00	0.00E+00	0.00E+00	2.71E-29
RB-89	0.00E+00	3.50E-26	2.47E-26	0.00E+00	0.00E+00	0.00E+00	5.36E-33
SR-90	1.51E+10	0.00E+00	4.34E+08	0.00E+00	0.00E+00	0.00E+00	1.80E+09
SR-90	7.51E+11	0.00E+00	1.85E+11	0.00E+00	0.00E+00	0.00E+00	2.11E+10
SR-91	2.85E+05	0.00E+00	1.13E+04	0.00E+00	0.00E+00	0.00E+00	1.29E+06
SR-92	3.97E+02	0.00E+00	1.69E+01	0.00E+00	1.00E+00	0.00E+00	1.01E+04
Y-90	1.24E+04	0.00E+00	3.35E+02	0.00E+00	0.00E+00	0.00E+00	1.02E+08
Y-91a	4.86E-09	0.00E+00	1.86E-10	0.00E+00	0.00E+00	0.00E+00	2.29E-07
Y-91	7.84E+06	0.00E+00	2.10E+05	0.00E+00	0.00E+00	0.00E+00	3.21E+09
Y-92	8.60E-11	0.00E+00	2.49E-02	0.00E+00	0.00E+00	0.00E+00	2.36E+04

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.59E+02	0.00E+00	4.36E+00	0.00E+00	0.00E+00	0.00E+00	4.86E+00
ZR-95	1.72E+06	5.43E+07	3.73E+05	0.00E+00	7.98E+05	0.00E+00	1.25E+09
ZR-97	3.12E+02	6.18E+01	2.85E+01	0.00E+00	9.37E+01	0.00E+00	1.67E+07
NR-95	1.92E+05	1.07E+05	5.87E+04	0.00E+00	1.03E+05	0.00E+00	4.56E+08
NO-99	0.00E+00	5.65E+06	1.08E+06	0.00E+00	1.25E+07	0.00E+00	1.01E+07
TC-99M	2.74E+00	7.63E+00	9.89E+01	0.00E+00	1.14E+02	4.24E+00	5.01E+03
TC-101	7.64E-31	1.09E-30	1.07E-29	0.00E+00	1.97E-29	6.62E-31	0.00E+00
RU-103	6.82E+06	0.00E+00	2.92E+06	0.00E+00	2.40E+07	0.00E+00	5.70E+08
RU-105	5.00E+01	0.00E+00	1.94E+01	0.00E+00	6.31E+02	0.00E+00	4.04E+04
RU-106	2.38E+08	0.00E+00	3.90E+07	0.00E+00	5.97E+08	0.00E+00	1.48E+10
AG-110M	1.52E+07	1.43E+07	8.72E+06	0.00E+00	2.74E+07	0.00E+00	4.03E+09
TE-125M	1.48E+08	5.34E+07	1.98E+07	4.14E+07	0.00E+00	0.00E+00	4.37E+08
TE-127M	5.51E+08	1.96E+08	6.56E+07	1.31E+08	2.24E+09	0.00E+00	1.37E+09
TE-127	5.34E+03	1.89E+03	1.15E+03	3.68E+03	2.16E+04	0.00E+00	4.12E+05
TE-129M	3.62E+08	1.54E+08	5.73E+07	1.17E+08	1.51E+09	0.00E+00	1.36E+09
TE-129	7.14E-04	2.66E-04	1.59E-04	5.10E-04	3.00E-03	0.00E+00	3.90E-03
TE-131M	8.44E+05	4.05E+05	3.38E+05	6.09E+05	4.22E+06	0.00E+00	3.25E+07
TE-131	1.39E-15	5.75E-16	4.36E-16	1.07E-15	6.10E-15	0.00E+00	1.14E-16
TE-132	3.91E+06	2.47E+06	2.33E+06	2.61E+06	2.37E+07	0.00E+00	7.84E+07
I-130	3.31E+05	1.01E+06	4.05E+05	8.28E+07	1.56E+06	0.00E+00	7.80E+05
I-131	7.69E+07	1.08E+08	5.78E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07
I-132	5.19E+01	1.36E+02	4.88E+01	4.58E+03	2.14E+02	0.00E+00	5.92E+01
I-133	1.94E+06	3.29E+06	1.00E+06	4.59E+08	5.78E+06	0.00E+00	2.49E+06
I-134	8.73E-05	2.31E-04	8.31E-05	3.85E-03	3.65E-04	0.00E+00	3.05E-06
I-135	3.52E+04	9.07E+04	3.36E+04	5.83E+06	1.43E+05	0.00E+00	1.00E+05
CS-134	7.10E+09	1.67E+10	7.75E+09	0.00E+00	5.31E+09	2.03E+09	2.08E+08
CS-136	4.37E+07	1.72E+08	1.16E+08	0.00E+00	9.37E+07	1.48E+07	1.38E+07
CS-137	1.01E+10	1.35E+10	4.69E+09	0.00E+00	4.59E+09	1.78E+09	1.92E+08
CS-138	3.61E-11	6.93E-11	3.47E-11	0.00E+00	5.12E-11	5.96E-12	3.15E-14
BA-139	2.69E-02	1.89E-05	7.83E-04	0.00E+00	1.78E-05	1.30E-05	2.40E-01

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	1.38E+08	1.69E+05	8.90E+06	0.00E+00	5.74E+04	1.14E+05	2.13E+08
BA-141	1.00E-21	8.04E-25	3.59E-23	0.00E+00	7.46E-25	5.50E-25	2.29E-27
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.81E+03	8.88E+02	2.36E+02	0.00E+00	0.00E+00	0.00E+00	5.10E+07
LA-142	1.85E-04	8.23E-05	2.05E-05	0.00E+00	0.00E+00	0.00E+00	2.51E+00
CE-141	2.83E+05	1.89E+05	2.17E+04	0.00E+00	8.89E+04	0.00E+00	5.40E+08
CE-143	9.33E+02	6.79E+05	7.58E+01	0.00E+00	3.04E+02	0.00E+00	2.04E+07
CE-144	5.27E+07	2.18E+07	2.83E+06	0.00E+00	1.30E+07	0.00E+00	1.33E+10
PR-143	7.00E+04	2.80E+04	3.49E+03	0.00E+00	1.63E+04	0.00E+00	2.30E+08
PR-144	2.89E-26	1.10E-26	1.47E-27	0.00E+00	6.80E-27	0.00E+00	3.19E-29
MO-147	3.62E+04	3.94E+04	2.36E+03	0.00E+00	2.31E+04	0.00E+00	1.42E+08
W-187	3.54E+04	2.88E+04	1.01E+04	0.00E+00	0.00E+00	0.00E+00	7.80E+06
WP-239	1.60E+05	1.51E+04	8.38E+03	0.00E+00	4.74E+04	0.00E+00	2.43E+09

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIOISOTOPES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (1 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I. LL1
H-3	0.00E+00	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03
C-14	8.89E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08
NA-24	3.73E+05	3.73E+06	3.73E+05	3.73E+05	3.73E+05	3.73E+05	3.73E+05
P-32	3.37E+09	1.50E+08	1.50E+08	0.00E+00	0.00E+00	0.00E+00	9.31E+07
CR-51	0.00E+00	0.00E+00	1.17E+05	6.50E+04	1.78E+04	1.19E+05	6.21E+06
NH-54	0.00E+00	6.65E+06	1.77E+08	0.00E+00	1.86E+08	0.00E+00	5.58E+08
NH-56	0.00E+00	1.88E+01	4.24E+00	0.00E+00	2.27E+01	0.00E+00	2.72E+03
FE-55	7.66E+08	4.25E+08	1.32E+08	0.00E+00	0.00E+00	2.40E+08	7.87E+07
FE-59	3.98E+08	6.43E+08	3.20E+08	0.00E+00	0.00E+00	1.86E+08	6.70E+08
CO-58	0.00E+00	6.44E+07	1.97E+08	0.00E+00	0.00E+00	0.00E+00	3.76E+08
CO-10	0.00E+00	3.78E+08	1.12E+09	0.00E+00	0.00E+00	0.00E+00	2.10E+09
NI-63	3.95E+10	2.11E+09	1.36E+09	0.00E+00	0.00E+00	0.00E+00	1.42E+08
NI-65	1.05E+02	9.89E+00	5.77E+00	0.00E+00	0.00E+00	0.00E+00	1.21E+03
CU-64	0.00E+00	1.10E+04	6.64E+03	0.00E+00	2.66E+04	0.00E+00	5.16E+05
ZN-65	8.13E+08	2.16E+09	1.35E+09	0.00E+00	1.36E+09	0.00E+00	3.80E+08
ZN-69	9.69E+06	1.37E+05	1.27E+06	0.00E+00	8.32E+06	0.00E+00	8.65E+04
BR-83	0.00E+00	0.00E+00	5.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.82E+11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	4.52E+08	2.78E+08	0.00E+00	0.00E+00	0.00E+00	2.91E+07
BR-88	0.00E+00	4.37E+22	3.04E+22	0.00E+00	0.00E+00	0.00E+00	2.15E+23
BR-89	0.00E+00	4.61E+26	4.10E+26	0.00E+00	0.00E+00	0.00E+00	4.02E+28
BR-90	3.60E+10	0.00E+00	1.03E+09	0.00E+00	0.00E+00	0.00E+00	1.39E+09
BR-90	1.24E+12	0.00E+00	3.15E+11	0.00E+00	0.00E+00	0.00E+00	1.67E+10
SR-91	5.24E+05	0.00E+00	1.98E+04	0.00E+00	0.00E+00	0.00E+00	1.16E+06
SR-92	7.28E+02	0.00E+00	2.92E+01	0.00E+00	0.00E+00	0.00E+00	1.38E+04
Y-90	2.31E+06	0.00E+00	6.18E+02	0.00E+00	0.00E+00	0.00E+00	6.57E+07
Y-91R	8.91E+09	0.00E+00	3.24E+10	0.00E+00	0.00E+00	0.00E+00	1.74E+05
Y-91	1.86E+07	0.00E+00	4.99E+05	0.00E+00	0.00E+00	0.00E+00	2.48E+09
Y-92	1.58E+00	0.00E+00	4.53E+02	0.00E+00	0.00E+00	0.00E+00	4.58E+04

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	2.93E+02	0.00E+00	8.04E+00	0.00E+00	0.00E+00	0.00E+00	4.37E+16
ZR-95	3.86E+06	8.48E+05	7.55E+05	0.00E+00	1.21E+06	0.00E+00	8.85E+03
ZR-97	5.70E+02	8.24E+01	4.86E+01	0.00E+00	1.18E+02	0.00E+00	1.25E+07
NR-99	4.10E+05	1.60E+05	1.14E+05	0.00E+00	1.50E+05	0.00E+00	2.96E+08
NO-99	0.00E+00	7.71E+06	1.91E+06	0.00E+00	1.65E+07	0.00E+00	6.38E+06
TC-99M	4.71E+00	9.24E+00	1.53E+02	0.00E+00	1.34E+02	4.69E+00	5.26E+03
TC-101	1.41E-30	1.47E-30	1.87E-29	0.00E+00	2.51E-29	7.78E-31	4.68E-30
RU-103	1.53E+07	0.00E+00	5.90E+06	0.00E+00	3.86E+07	0.00E+00	3.97E+08
RU-105	9.16E+01	0.00E+00	3.32E+01	0.00E+00	8.05E+02	0.00E+00	5.98E+04
RU-106	7.45E+08	0.00E+00	9.30E+07	0.00E+00	1.01E+09	0.00E+00	1.16E+10
AG-110M	3.21E+07	2.17E+07	1.73E+07	0.00E+00	4.04E+07	0.00E+00	2.58E+09
TE-125M	3.51E+08	9.50E+07	4.67E+07	9.84E+07	0.00E+00	0.00E+00	3.38E+08
TE-127M	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	0.00E+00	1.07E+09
TL-127	9.85E+03	2.65E+03	2.11E+03	6.81E+03	2.80E+04	0.00E+00	3.85E+05
TE-129M	8.41E+08	2.35E+08	1.31E+08	2.71E+08	0.47E+09	0.00E+00	1.03E+09
TE-129	1.32E-03	3.69E-04	3.14E-04	9.43E-04	3.87E-03	0.00E+00	8.23E-02
TE-131M	1.54E+06	5.33E+05	5.68E+05	1.10E+06	5.16E+06	0.00E+00	2.16E+07
TE-131	2.57E-15	7.83E-16	7.64E-16	1.97E-15	7.77E-15	0.00E+00	1.35E-14
TE-132	7.00E+06	3.10E+06	3.74E+06	4.51E+06	2.88E+07	0.00E+00	3.12E+07
I-130	0.16E+05	1.24E+06	6.41E+07	1.37E+08	1.86E+06	0.00E+00	5.82E+05
I-131	1.65E+08	1.44E+08	8.17E+07	4.75E+10	2.36E+08	0.00E+00	1.28E+07
I-132	9.22E+01	1.69E+02	7.79E+01	7.80E+03	2.59E+02	0.00E+00	1.99E+02
I-133	3.53E+06	4.57E+06	1.65E+06	8.11E+08	7.28E+06	0.00E+00	1.76E+06
I-134	1.53E-04	2.88E-04	1.32E-04	6.62E-03	4.40E-04	0.00E+00	1.91E-04
I-135	6.26E+04	1.13E+05	5.33E+04	9.97E+06	1.73E+05	0.00E+00	8.58E+04
CS-134	1.60E+10	2.63E+10	5.55E+09	0.00E+00	8.15E+09	2.93E+09	1.42E+08
CS-136	8.24E+07	2.33E+08	1.47E+08	0.00E+00	1.21E+08	1.80E+07	7.96E+06
CS-137	2.39E+10	2.29E+10	3.38E+09	0.00E+00	7.46E+09	2.68E+09	1.43E+08
CS-138	6.57E-11	9.13E-11	5.79E-11	0.00E+00	6.43E-11	6.91E-12	4.21E-11
BA-139	4.95E-02	2.64E-05	1.44E-03	0.00E+00	2.31E-05	1.56E-05	2.86E+00

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (3 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI

BA-140	2.77E+08	2.42E+05	1.61E+07	0.00E+00	7.89E+04	1.45E+05	1.40E+08
BA-141	1.99E-21	1.11E-24	6.47E-23	0.00E+00	9.62E-25	6.53E-24	1.13E-21
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

LA-140	3.25E+03	1.13E+03	3.53E+02	0.00E+00	0.00E+00	0.00E+00	3.16E+07
LA-142	3.36E-04	1.07E-04	3.35E-05	0.00E+00	0.00E+00	0.00E+00	2.12E+01
CE-141	6.56E+05	3.27E+05	4.86E+04	0.00E+00	1.43E+06	0.00E+00	4.08E+08

CE-143	1.72E+03	9.31E+05	1.35E+02	0.00E+00	3.91E+02	0.00E+00	1.36E+07
CE-144	1.27E+08	3.98E+07	6.78E+06	0.00E+00	2.21E+07	0.00E+00	1.04E+10
PR-143	1.46E+05	4.37E+04	7.23E+03	0.00E+00	2.37E+04	0.00E+00	1.57E+08

PR-144	5.37E-26	1.66E-26	2.70E-27	0.00E+00	8.79E-27	0.00E+00	3.58E-23
ND-147	7.15E+04	5.79E+04	4.48E+03	0.00E+00	3.18E+04	0.00E+00	9.17E+07
W-187	6.43E+04	3.81E+04	1.71E+04	0.00E+00	0.00E+00	0.00E+00	5.35E+06

NP-239	3.86E+05	2.77E+04	1.95E+04	0.00E+00	8.01E+04	0.00E+00	2.05E+09

Conversion factors are in units of square meter-mm/yr per uCi/sec for all nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. ADGY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03
C-14	2.63E+08	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07
NA-24	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05
P-32	2.05E+10	1.28E+09	7.93E+08	0.00E+00	0.00E+00	0.00E+00	2.31E+09
CR-51	0.00E+00	0.00E+00	3.43E+03	2.05E+03	7.55E+02	4.55E+03	8.62E+05
MM-54	0.00E+00	1.01E+06	1.93E+05	0.00E+00	3.00E+05	0.00E+00	3.09E+06
MM-56	0.00E+00	4.98E-04	8.84E-05	0.00E+00	6.32E-04	0.00E+00	1.59E-02
FE-55	3.26E+05	2.26E+05	5.26E+04	0.00E+00	0.00E+00	1.26E+05	1.29E+05
FE-59	3.86E+05	9.07E+05	3.68E+05	0.00E+00	0.00E+00	2.54E+05	3.02E+06
CO-58	0.00E+00	5.66E+05	1.27E+06	0.00E+00	0.00E+00	0.00E+00	1.15E+07
CO-60	0.00E+00	1.97E+06	4.34E+06	0.00E+00	0.00E+00	0.00E+00	3.70E+07
NI-63	8.07E+08	5.60E+07	2.71E+07	0.00E+00	0.00E+00	0.00E+00	1.17E+07
NI-65	4.44E-02	5.77E-03	2.63E-03	0.00E+00	0.00E+00	0.00E+00	1.46E-01
CU-64	0.00E+00	2.66E+03	1.25E+03	0.00E+00	6.70E+03	0.00E+00	2.26E+05
ZN-65	1.65E+08	5.24E+08	2.37E+08	0.00E+00	5.50E+08	0.00E+00	3.30E+08
ZN-69	2.51E-13	4.80E-13	3.34E-14	0.00E+00	3.12E-13	0.00E+00	7.21E-14
BR-83	0.00E+00	0.00E+00	1.40E-03	0.00E+00	0.00E+00	0.00E+00	2.02E-03
BR-84	0.00E+00	0.00E+00	2.32E-25	0.00E+00	0.00E+00	0.00E+00	1.82E-30
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	3.11E+08	1.45E+08	0.00E+00	0.00E+00	0.00E+00	6.14E+07
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	3.05E+09	0.00E+00	8.75E+07	0.00E+00	0.00E+00	0.00E+00	4.89E+08
SR-90	9.83E+10	0.00E+00	2.41E+10	0.00E+00	0.00E+00	0.00E+00	2.64E+09
SR-91	6.07E+04	0.00E+00	2.45E+03	0.00E+00	0.00E+00	0.00E+00	2.89E+05
SR-92	1.03E+00	0.00E+00	4.44E-02	0.00E+00	0.00E+00	0.00E+00	2.03E+01
Y-90	8.50E+00	0.00E+00	2.28E-01	0.00E+00	0.00E+00	0.00E+00	9.01E-04
Y-91M	7.18E-21	0.00E+00	2.78E-22	0.00E+00	0.00E+00	0.00E+00	2.11E-20
Y-91	1.03E+03	0.00E+00	2.76E+01	0.00E+00	0.00E+00	0.00E+00	5.67E+05
Y-92	6.69E-06	0.00E+00	1.96E-07	0.00E+00	0.00E+00	0.00E+00	1.17E-01

Conversion factors are in units of square meter-area/yr per uCi/sec for all nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BOD	THYROID	KIDNEY	LUNG	GI-ILL
Y-93	2.68E-02	0.00E+00	7.40E-04	0.00E+00	0.00E+00	0.00E+00	8.50E+02
Zr-95	1.1E+02	3.63E+01	2.46E+01	0.00E+00	5.70E+01	0.00E+00	1.15E+05
CR-97	5.70E-02	1.05E-02	4.80E-03	0.00E+00	1.58E-02	0.00E+00	3.25E+03
NR-95	9.91E+03	5.51E+03	2.96E-03	0.00E+00	5.45E+03	0.00E+00	3.34E+07
MO-99	0.00E+00	2.97E+06	5.66E+05	0.00E+00	6.73E+06	0.00E+00	6.89E+06
TC-99M	3.98E-01	1.13E+00	1.43E+01	0.00E+00	1.71E+01	5.52E-01	6.66E+02
TC-121	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.22E+02	0.00E+00	5.26E+01	0.00E+00	4.66E+02	0.00E+00	1.43E+04
RU-105	1.03E-04	0.00E+00	4.06E-05	0.00E+00	1.33E-03	0.00E+00	6.29E-02
RU-106	2.45E+03	0.00E+00	3.10E+02	0.00E+00	4.73E+03	0.00E+00	1.58E+05
AG-110M	6.99E-06	6.46E+06	3.84E+06	0.00E+00	1.27E+07	0.00E+00	2.64E+09
TE-125M	1.95E+06	7.08E+05	2.62E+05	5.88E+05	7.95E+06	0.00E+00	7.80E+06
TE-127M	5.49E+06	1.96E+06	6.69E+05	1.45E+06	2.23E+07	0.00E+00	1.84E+07
TE-127	7.83E+01	2.81E+01	1.70E+01	5.80E+01	3.19E+02	0.00E+00	6.18E+03
TE-129M	7.22E+06	2.69E+06	1.14E+06	2.48E+06	3.02E+07	0.00E+00	3.64E+07
TE-129	3.39E-11	1.27E-11	8.25E-12	2.60E-11	1.42E-10	0.00E+00	2.56E-11
TE-131M	4.33E+04	2.12E+04	1.77E+04	3.36E+04	2.15E+05	0.00E+00	2.10E+06
TE-131	4.32E-34	1.81E-34	1.37E-34	3.56E-34	1.89E-33	0.00E+00	6.12E-34
TE-132	2.88E+05	1.86E+05	1.75E+05	2.06E+05	1.80E+06	0.00E+00	8.82E+06
I-130	5.04E+05	1.49E+06	5.87E+05	1.26E+08	2.32E+06	0.00E+00	1.28E+06
I-131	3.55E+08	5.08E+08	2.91E+08	1.67E+11	8.71E+08	0.00E+00	1.34E+08
I-132	1.97E-01	5.27E-01	1.84E-01	1.84E+01	8.40E-01	0.00E+00	9.90E-02
I-133	4.64E+06	8.08E+06	2.46E+06	1.19E+09	1.41E+07	0.00E+00	7.26E+06
I-134	2.42E-12	6.57E-12	2.35E-12	1.14E-10	1.05E-11	0.00E+00	5.73E-15
I-135	1.54E+04	4.03E+04	1.49E+04	2.66E+06	6.47E+04	0.00E+00	4.56E+04
CS-134	1.70E+10	4.04E+10	3.30E+10	0.00E+00	1.31E+10	4.34E+09	7.06E+08
CS-136	7.90E+08	3.12E+09	2.24E+09	0.00E+00	1.73E+09	2.38E+08	3.54E+08
CS-137	2.21E+10	3.03E+10	1.98E+10	0.00E+00	1.03E+10	3.42E+09	5.86E+08
CS-138	2.71E-23	5.34E-23	2.63E-23	0.00E+00	3.94E-23	3.89E-24	2.29E-28
BA-139	5.30E-09	3.78E-12	1.55E-10	0.00E+00	3.53E-12	2.14E-12	9.40E-09

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (3 of 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
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BA-140	3.23E+06	4.05E+03	2.11E+05	0.00E+00	1.36E+03	2.32E+03	6.64E+06
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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LA-140	5.41E-01	2.73E-01	7.21E-02	0.00E+00	0.00E+00	0.00E+00	2.00E+04
LA-142	2.23E-12	1.01E-12	2.53E-13	0.00E+00	0.00E+00	0.00E+00	7.40E-09
CE-141	5.81E+02	5.93E+02	4.66E+01	0.00E+00	1.83E+02	0.00E+00	1.50E+06
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CE-143	4.99E+00	3.69E+03	4.08E-01	0.00E+00	1.62E+00	0.00E+00	1.38E+05
CE-144	4.29E+04	1.79E+04	2.30E+03	0.00E+00	1.06E+04	0.00E+00	1.45E+07
PR-143	1.89E+01	7.60E+00	9.39E-01	0.00E+00	4.39E+00	0.00E+00	8.30E+04
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PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	1.13E+01	1.31E+01	7.81E-01	0.00E+00	7.63E+00	0.00E+00	4.27E+04
W-187	7.82E+02	6.53E+02	2.28E+02	0.00E+00	0.00E+00	0.00E+00	2.14E+05
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WP-239	5.52E+00	5.43E-01	2.99E-01	0.00E+00	1.69E+00	0.00E+00	1.11E+05

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03
C-14	4.86E+08	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07
KA-24	5.11E+05	5.11E+05	5.11E+05	5.11E+05	5.11E+05	5.11E+05	5.11E+05
P-32	3.78E+10	2.34E+09	1.47E+09	0.00E+00	0.00E+00	0.00E+00	3.15E+09
CR-51	0.00E+00	0.00E+00	5.99E+03	3.33E+03	1.31E+03	8.55E+03	1.01E+06
NI-54	0.00E+00	1.68E+06	3.34E+05	0.00E+00	5.02E+05	0.00E+00	3.45E+06
NI-56	0.00E+00	8.83E-04	1.57E-04	0.00E+00	1.12E-03	0.00E+00	5.81E-02
FE-55	5.75E+05	4.11E+05	9.57E+04	0.00E+00	0.00E+00	2.60E+05	1.78E+05
FE-59	6.74E+05	1.57E+06	6.07E+05	0.00E+00	0.00E+00	4.96E+05	3.72E+06
CO-58	0.00E+00	9.52E+05	2.19E+06	0.00E+00	0.00E+00	0.00E+00	1.31E+07
CO-60	0.00E+00	3.34E+06	7.52E+06	0.00E+00	0.00E+00	0.00E+00	4.35E+07
NI-63	1.42E+09	1.00E+08	4.81E+07	0.00E+00	0.00E+00	0.00E+00	1.59E+07
NI-65	8.12E-02	1.04E-02	4.73E-03	0.00E+00	0.00E+00	0.00E+00	5.63E-01
CU-64	0.00E+00	4.73E+03	2.23E+03	0.00E+00	1.20E+04	0.00E+00	3.67E+05
ZN-65	2.53E+08	8.78E+08	4.10E+08	0.00E+00	3.62E+08	0.00E+00	3.72E+08
ZN-69	4.62E-13	8.80E-13	6.16E-14	0.00E+00	5.75E-13	0.00E+00	1.62E-12
BR-83	0.00E+00	0.00E+00	2.58E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.14E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	5.67E+08	2.67E+08	0.00E+00	0.00E+00	0.00E+00	8.40E+07
LB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	5.62E+09	0.00E+00	1.61E+08	0.00E+00	0.00E+00	0.00E+00	6.69E+08
BR-90	1.39E+11	0.00E+00	3.43E+10	0.00E+00	0.00E+00	0.00E+00	3.90E+09
BR-91	1.12E+05	0.00E+00	4.44E+03	0.00E+00	0.00E+00	0.00E+00	5.06E+05
BR-92	1.88E+00	0.00E+00	8.00E-02	0.00E+00	0.00E+00	0.00E+00	4.78E+01
Y-90	1.56E+01	0.00E+00	4.21E-01	0.00E+00	0.00E+00	0.00E+00	1.29E+05
Y-91a	1.31E-20	0.00E+00	5.02E-22	0.00E+00	0.00E+00	0.00E+00	6.21E-19
Y-91	1.90E+03	0.00E+00	5.06E+01	0.00E+00	0.00E+00	0.00E+00	7.77E+05
Y-92	1.24E-05	0.00E+00	3.58E-07	0.00E+00	0.00E+00	0.00E+00	3.39E-01

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	4.94E-02	0.00E+00	1.36E-03	0.00E+00	0.00E+00	0.00E+00	1.51E+03
ZR-95	1.98E+02	6.25E+01	4.30E+01	0.00E+00	9.18E+01	0.00E+00	1.44E+05
ZR-97	9.46E-02	1.87E-02	8.62E-03	0.00E+00	2.84E-02	0.00E+00	5.07E+03
WB-95	1.69E+04	9.37E+03	5.16E+03	0.00E+00	9.08E+03	0.00E+00	4.01E+07
WB-99	0.00E+00	5.37E+06	1.02E+06	0.00E+00	1.23E+07	0.00E+00	9.61E+06
TC-99M	6.91E-01	1.93E+00	2.50E+01	0.00E+00	2.87E+01	1.07E+00	1.27E+03
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	2.17E+02	0.00E+00	9.29E+01	0.00E+00	7.66E+02	0.00E+00	1.81E+04
RU-105	1.88E-04	0.00E+00	7.29E-05	0.00E+00	2.37E-03	0.07E+00	1.52E-01
RU-106	3.47E+03	0.00E+00	5.67E+02	0.00E+00	8.68E+03	0.00E+00	2.16E+05
AS-110M	1.16E+07	1.09E+07	6.65E+06	0.00E+00	2.08E+07	0.00E+00	3.07E+09
TE-125M	3.60E+06	1.37E+06	4.82E+05	1.01E+06	0.00E+00	0.00E+00	1.06E+07
TE-127M	1.01E+07	3.59E+06	1.20E+06	2.41E+06	4.10E+07	0.00E+00	2.52E+07
TE-127	1.45E+02	5.15E+01	3.12E+01	1.00E+02	5.85E+02	0.00E+00	1.12E+04
TE-129M	1.32E+07	4.90E+06	2.09E+06	4.26E+06	5.53E+07	0.00E+00	4.96E+07
TE-129	6.24E-11	2.33E-11	1.39E-11	4.46E-11	2.62E-10	0.00E+00	3.41E-10
TE-131M	7.88E+04	3.78E+04	3.15E+04	5.69E+04	3.94E+05	0.00E+00	3.03E+06
TE-131	7.90E-34	3.26E-34	2.47E-34	6.09E-34	3.45E-33	0.00E+00	6.49E-33
TE-132	5.15E+05	3.26E+05	3.07E+05	3.44E+05	3.13E+06	0.00E+00	1.03E+07
I-130	8.86E+05	2.56E+06	1.02E+06	2.09E+06	3.95E+06	0.00E+00	1.97E+06
I-131	6.45E+08	9.03E+08	4.85E+08	2.63E+11	1.55E+09	0.00E+00	1.79E+08
I-132	3.50E-01	9.15E-01	3.28E-01	3.08E+01	1.44E+00	0.00E+00	3.98E-01
I-133	8.48E+06	1.44E+07	4.39E+06	2.01E+09	2.52E+07	0.00E+00	1.09E+07
I-134	4.30E-12	1.14E-11	4.09E-12	1.90E-10	1.00E-11	0.00E+00	1.50E-13
I-135	2.74E+04	7.06E+04	2.61E+04	4.53E+05	1.11E+05	0.00E+00	7.81E+04
CS-134	2.94E+10	6.93E+10	3.22E+10	0.00E+00	2.20E+10	8.41E+09	8.62E+08
CS-136	1.34E+09	5.29E+09	3.35E+09	0.00E+00	2.88E+09	4.54E+08	4.26E+08
CS-137	4.02E+10	5.34E+10	1.86E+10	0.00E+00	1.82E+10	7.06E+09	7.60E+08
CS-138	4.92E-23	9.45E-23	4.77E-23	0.00E+00	6.98E-23	8.12E-24	4.29E-26
BA-139	9.81E-09	6.90E-12	2.86E-10	0.00E+00	6.50E-12	4.75E-12	8.75E-08

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	5.82E+06	7.13E+03	3.75E+05	0.00E+00	2.42E+03	4.80E+03	8.98E+06
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	9.72E-01	4.78E-01	1.27E-01	0.00E+00	0.00E+00	0.00E+00	2.74E+04
LA-142	4.02E-12	1.79E-12	4.45E-13	0.00E+00	0.00E+00	0.00E+00	5.44E-08
CE-141	1.07E+03	7.12E+02	3.17E+01	0.00E+00	3.75E+02	0.00E+00	2.04E+06
CE-143	9.17E+00	6.67E+03	7.43E-01	0.00E+00	2.99E+00	0.00E+00	1.00E+05
CE-144	7.90E+04	3.27E+04	4.24E+03	0.00E+00	1.95E+04	0.00E+00	1.49E+07
PR-143	3.48E+01	1.39E+01	1.73E+00	0.00E+00	8.08E+00	0.00E+00	1.15E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MD-147	2.17E+01	2.36E+01	1.42E+00	0.00E+00	1.39E+01	0.00E+00	8.53E+04
W-187	1.43E+03	1.17E+03	4.08E+02	0.00E+00	0.00E+00	0.00E+00	3.15E+05
MP-239	1.00E+01	9.93E-01	5.52E-01	0.00E+00	3.12E+00	0.00E+00	1.60E+05

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (1 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03
C-14	1.19E+09	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08
NA-24	1.06E+06	1.06E+07	1.06E+06	1.06E+06	1.06E+06	1.06E+06	1.06E+06
P-32	9.33E+10	4.37E+09	3.60E+09	0.00E+00	0.00E+00	0.00E+00	2.58E+09
CR-51	0.00E+00	0.00E+00	1.22E+04	6.78E+03	1.85E+03	1.24E+04	6.48E+05
MM-54	0.00E+00	2.53E+06	6.70E+05	0.00E+00	7.06E+05	0.00E+00	2.11E+06
MM-56	0.00E+00	1.54E-03	3.48E-04	0.00E+00	1.86E-03	0.00E+00	2.23E-01
FE-55	1.39E+06	7.71E+05	2.39E+05	0.00E+00	0.00E+00	4.36E+05	1.43E+05
FE-59	1.56E+06	2.53E+06	1.26E+06	0.00E+00	0.00E+00	7.33E+05	2.63E+06
CO-58	0.00E+00	1.45E+06	4.45E+06	0.00E+00	0.00E+00	0.00E+00	8.49E+06
CO-60	0.00E+00	5.18E+06	1.53E+07	0.00E+00	0.00E+00	0.00E+00	2.87E+07
NI-63	3.56E+09	1.90E+08	1.24E+08	0.00E+00	0.00E+00	0.00E+00	1.28E+07
NI-65	1.99E-01	1.87E-02	1.09E-02	0.03E+00	0.00E+00	0.00E+00	2.29E+00
CU-64	0.00E+00	8.32E+03	5.02E+03	0.10E+00	2.01E+04	0.00E+00	3.90E+05
ZN-65	4.96E+08	1.32E+09	8.22E+08	0.00E+00	8.33E+08	0.00E+00	2.32E+08
ZR-89	1.14E-12	1.64E-12	1.52E-13	0.00E+00	9.96E-13	0.00E+00	1.03E-10
EC-83	0.00E+00	0.00E+00	6.34E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	9.37E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	1.05E+09	6.47E+08	0.00E+00	0.00E+00	0.00E+00	6.77E+07
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	1.39E+10	0.00E+00	3.97E+08	0.00E+00	0.00E+00	0.00E+00	5.38E+08
SR-90	2.35E+11	0.00E+00	5.95E+10	0.00E+00	0.00E+00	0.00E+00	3.14E+11
SR-91	2.74E+05	0.00E+00	1.03E+04	0.00E+00	0.00E+00	0.00E+00	6.04E+05
SR-92	4.58E+00	0.00E+00	1.84E-01	0.00E+00	0.00E+00	0.00E+00	8.68E-01
Y-90	3.37E+01	0.00E+00	1.03E+00	0.00E+00	0.00E+00	0.00E+00	1.10E+05
Y-91a	3.21E-20	0.00E+00	1.17E-21	0.00E+00	0.00E+00	0.00E+00	6.29E-17
Y-91	4.68E+03	0.00E+00	1.25E+02	0.00E+00	0.00E+00	0.00E+00	6.24E+05
Y-92	3.06E-05	0.00E+00	8.69E-07	0.00E+00	0.00E+00	0.00E+00	8.77E-01

Conversion factors are in units of $\mu\text{rem meter-sq}/\text{yr}$ per $\mu\text{Ci}/\text{sq}$ for all nuclides except H-3 which is in units of mrem/yr per $\mu\text{Ci}/\text{cubic meter}$.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
Y-93	1.21E-01	0.00E+00	3.33E-03	0.00E+00	0.00E+00	0.00E+00	1.81E+03
ZR-95	4.60E+02	1.01E+02	9.00E+01	0.00E+00	1.45E+02	0.00E+00	1.05E+05
ZR-97	2.30E-01	3.33E-02	1.96E-02	0.00E+00	4.78E-02	0.00E+00	5.04E+03
NR-95	3.81E+04	1.49E+04	1.06E+04	0.00E+00	1.40E+04	0.00E+00	2.75E+07
MO-99	0.00E+00	9.76E+06	2.42E+06	0.00E+00	2.09E+07	0.00E+00	8.08E+06
TC-99M	1.59E+00	3.11E+00	5.15E+01	0.00E+00	4.52E+01	1.58E+00	1.77E+03
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	5.14E+02	0.00E+00	1.98E+02	0.00E+00	1.29E+03	0.00E+00	1.33E+04
RU-105	4.58E-04	0.00E+00	1.66E-04	0.00E+00	4.03E-03	0.00E+00	2.99E-01
RU-106	1.11E+04	0.00E+00	1.38E+03	0.00E+00	1.50E+04	0.00E+00	1.72E+05
AG-110M	2.51E+07	1.69E+07	1.35E+07	0.00E+00	3.15E+07	0.00E+00	2.01E+09
TE-125M	8.85E+06	2.40E+06	1.18E+06	2.48E+06	0.00E+00	0.00E+00	8.54E+06
TE-127M	2.50E+07	6.72E+06	2.96E+06	5.97E+06	7.12E+07	0.00E+00	2.02E+07
TE-127	3.57E+02	9.63E+01	7.66E+01	2.47E+02	1.02E+03	0.00E+00	1.40E+04
TE-129M	3.26E+07	9.09E+06	5.06E+06	1.05E+07	9.56E+07	0.00E+00	3.97E+07
TE-129	1.54E-10	4.30E-11	2.65E-11	1.10E-10	4.50E-10	0.00E+00	9.58E-09
TE-131M	1.92E+05	6.64E+04	7.06E+04	1.36E+05	4.42E+05	0.00E+00	2.69E+06
TE-131	1.94E-33	5.91E-34	5.77E-34	1.48E-33	5.86E-33	0.00E+00	1.02E-32
TE-132	1.23E+06	5.44E+05	6.57E+05	7.93E+05	5.05E+06	0.00E+00	5.48E+06
I-130	2.07E+06	4.19E+06	2.18E+06	4.61E+06	6.26E+06	0.00E+00	1.96E+06
I-131	1.56E+09	1.57E+09	8.94E+08	5.20E+11	2.58E+09	0.00E+00	1.40E+05
I-132	8.27E-01	1.57E+00	6.99E-01	7.05E+01	2.33E+00	0.00E+00	1.79E+00
I-133	2.06E+07	2.55E+07	9.64E+06	4.73E+09	4.25E+07	0.00E+00	1.03E+07
I-134	1.02E-11	1.89E-11	8.70E-12	4.33E-10	2.89E-11	0.00E+00	1.25E-11
I-135	6.48E+04	1.17E+05	5.52E+04	1.03E+07	1.79E+05	0.00E+00	8.88E+04
CS-134	6.79E+10	1.11E+11	2.35E+10	0.00E+00	3.45E+10	1.24E+10	6.01E+08
CS-136	3.03E+09	8.58E+09	5.40E+09	0.00E+00	4.44E+09	6.63E+08	2.93E+08
CE-137	9.67E+10	9.26E+10	1.37E+10	0.00E+00	3.02E+10	1.09E+10	5.80E+06
CS-138	1.19E-22	1.66E-22	1.05E-22	0.00E+00	1.17E-22	1.26E-23	7.64E-23
BA-139	2.41E-08	1.29E-11	6.98E-10	0.00E+00	1.12E-11	7.57E-12	1.39E-06

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (3 OF 3)

NUCLIDES	ORGAN DOT: CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GILL
BA-140	1.41E+07	1.23E+04	8.20E+05	0.00E+00	4.01E+03	7.34E+03	7.12E+06
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	2.33E+00	8.14E-01	2.54E-01	0.00E+00	0.00E+00	0.00E+00	2.27E+04
LA-142	9.72E-12	3.10E-12	9.70E-13	0.00E+00	0.00E+00	0.00E+00	6.14E-07
CE-141	2.62E+03	1.31E+03	1.94E+02	0.00E+00	5.74E+03	0.00E+00	1.63E+06
CE-143	2.25E+01	1.22E+04	1.77E+00	0.00E+00	5.12E+00	0.00E+00	1.79E+05
CE-144	1.75E+05	6.11E+04	1.04E+04	0.00E+00	3.38E+04	0.00E+00	1.59E+07
PR-143	8.62E+01	2.59E+01	4.28E+00	0.00E+00	1.40E+01	0.00E+00	9.30E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MD-147	5.33E+01	4.32E+01	3.35E+00	0.00E+00	2.37E+01	0.00E+00	6.85E+04
W-187	3.47E+03	2.05E+03	9.21E+02	0.00E+00	0.00E+00	0.00E+00	2.80E+05
WP-239	2.59E+01	1.86E+00	1.31E+00	0.00E+00	5.38E+00	0.00E+00	1.38E+05

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03
C-14	2.34E+09	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08
NA-24	1.83E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06
P-32	1.92E+11	1.13E+10	7.44E+09	0.00E+00	0.00E+00	0.00E+00	2.60E+09
CR-51	0.00E+00	0.00E+00	1.94E+04	1.26E+04	2.76E+03	2.46E+04	5.64E+05
MN-54	0.00E+00	4.68E+06	1.06E+06	0.00E+00	1.04E+06	0.00E+00	1.72E+06
MN-56	0.00E+00	3.77E-03	4.50E-04	0.00E+00	3.24E-03	0.00E+00	3.43E-01
FE-55	1.76E+04	1.13E+06	3.23E+05	0.00E+00	0.00E+00	5.55E+05	1.44E+05
FE-59	2.92E+06	5.10E+06	2.01E+06	0.00E+00	0.00E+00	1.51E+06	2.43E+06
CO-58	0.00E+00	2.91E+06	7.26E+06	0.00E+00	0.00E+00	0.00E+00	7.25E+06
CO-60	0.00E+00	1.06E+07	2.50E+07	0.00E+00	0.00E+00	0.00E+00	7.52E+07
NI-63	4.19E+09	2.59E+08	1.45E+08	0.00E+00	0.00E+00	0.00E+00	1.29E+07
NI-65	4.21E-01	4.76E-02	2.17E-02	0.00E+00	0.00E+00	0.00E+00	3.62E+00
CU-64	0.00E+00	2.07E+04	9.57E+03	0.00E+00	3.50E+04	0.00E+00	4.74E+05
ZN-65	6.66E+08	2.28E+09	1.05E+09	0.00E+00	1.11E+09	0.00E+00	1.93E+09
ZN-69	2.42E-12	4.36E-12	3.24E-13	0.00E+00	1.81E-12	0.00E+00	3.55E-10
BR-83	0.00E+00	0.00E+00	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.81E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	2.67E+09	1.32E+09	0.00E+00	0.00E+00	0.00E+00	6.83E+07
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-87	2.64E+10	0.00E+00	7.58E+08	0.00E+00	0.00E+00	0.00E+00	5.43E+08
BR-90	2.55E+11	0.00E+00	6.50E+10	0.00E+00	0.00E+00	0.00E+00	3.19E+09
BR-91	5.70E+05	0.00E+00	2.06E+04	0.00E+00	0.00E+00	0.00E+00	6.75E+05
BR-92	9.75E+00	0.00E+00	3.62E-01	0.00E+00	0.00E+00	0.00E+00	1.05E+02
Y-90	8.17E+01	0.00E+00	2.19E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+05
Y-91m	6.81E-20	0.00E+00	2.32E-21	0.00E+00	0.00E+00	0.00E+00	2.27E-16
Y-91	8.79E+03	0.00E+00	2.34E+02	0.00E+00	0.00E+00	0.00E+00	6.30E+05
Y-92	6.45E-05	0.00E+00	1.81E-06	0.00E+00	0.00E+00	0.00E+00	1.23E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	2.59E-01	0.00E+00	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.04E+03
ZR-95	8.17E-02	1.99E-02	1.41E-02	0.00E+00	2.14E-02	0.00E+00	9.91E-04
ZR-97	4.87E-01	8.37E-02	3.82E-02	0.00E+00	8.43E-02	0.00E+00	5.34E+03
KB-95	7.12E-04	2.93E-04	1.70E-04	0.00E+00	2.10E-04	0.00E+00	2.48E+07
MO-99	0.00E+00	2.50E-07	4.87E-06	0.00E+00	3.73E-07	0.00E+00	8.22E-06
TC-99M	3.30E+00	6.69E+00	8.76E+01	0.00E+00	7.32E+01	3.56E+00	1.99E+03
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.04E+03	0.00E+00	3.48E-02	0.00E+00	2.17E+03	0.00E+00	1.27E+04
RU-105	9.66E-04	0.00E+00	3.25E-04	0.00E+00	7.11E-03	0.00E+00	3.84E-01
RU-106	2.28E+04	0.00E+00	2.85E+03	0.00E+00	2.70E+04	0.00E+00	1.73E+05
AL-110M	4.63E-07	3.38E-07	2.24E-07	0.00E+00	4.83E-07	0.00E+00	1.75E+09
TE-125M	1.81E+07	6.05E+06	2.43E+06	6.09E+06	0.00E+00	0.00E+00	8.62E+06
TE-127M	5.05E+07	1.68E+07	6.12E+06	1.46E+07	1.24E+08	0.00E+00	2.04E+07
TE-127	7.58E+02	2.54E+02	1.63E+02	6.17E+02	1.85E+03	0.00E+00	1.59E+04
TE-129M	6.69E+07	2.20E+07	1.03E+07	2.57E+07	1.67E+08	0.00E+00	3.99E+07
TE-129	3.26E-10	1.12E-10	7.62E-11	2.73E-10	8.12E-10	0.00E+00	2.61E-08
TE-131M	4.05E+05	1.63E+05	1.35E+05	3.31E+05	1.12E+06	0.00E+00	2.75E+06
TE-131	4.11E-33	1.52E-33	1.13E-33	3.67E-33	1.05E-32	0.00E+00	1.66E-31
TE-132	2.53E+06	1.25E+06	1.17E+06	1.85E+06	7.84E+06	0.00E+00	4.64E+06
I-130	4.26E+06	9.37E+06	3.76E+06	1.05E+09	1.03E+07	0.00E+00	2.01E+06
I-131	3.26E+09	3.85E+09	1.69E+09	1.36E+12	4.49E+09	0.00E+00	1.37E+08
I-132	1.72E+00	3.48E+00	1.24E+00	1.63E+02	3.89E+00	0.00E+00	2.82E+00
I-133	4.35E+07	6.34E+07	1.86E+07	1.15E+10	7.65E+07	0.00E+00	1.07E+07
I-134	2.11E-11	4.33E-11	1.54E-11	1.01E-09	4.84E-11	0.00E+00	4.47E-11
I-135	1.35E+05	2.68E+05	9.77E+04	2.40E+07	2.99E+05	0.00E+00	9.70E+04
CS-134	1.09E+11	2.04E+11	2.06E+10	0.00E+00	5.25E+10	2.15E+10	5.54E+08
CS-136	5.93E+09	1.74E+10	6.51E+09	0.00E+00	6.95E+09	1.42E+09	2.65E+08
CS-137	1.54E+11	1.81E+11	1.28E+10	0.00E+00	4.85E+10	1.96E+10	5.43E+08
CS-138	2.52E-22	4.09E-22	1.98E-22	0.00E+00	2.04E-22	3.19E-23	6.54E-22
BA-139	5.13E-08	3.40E-11	1.48E-09	0.00E+00	2.04E-11	2.06E-11	3.25E-06

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (3 OF 3)

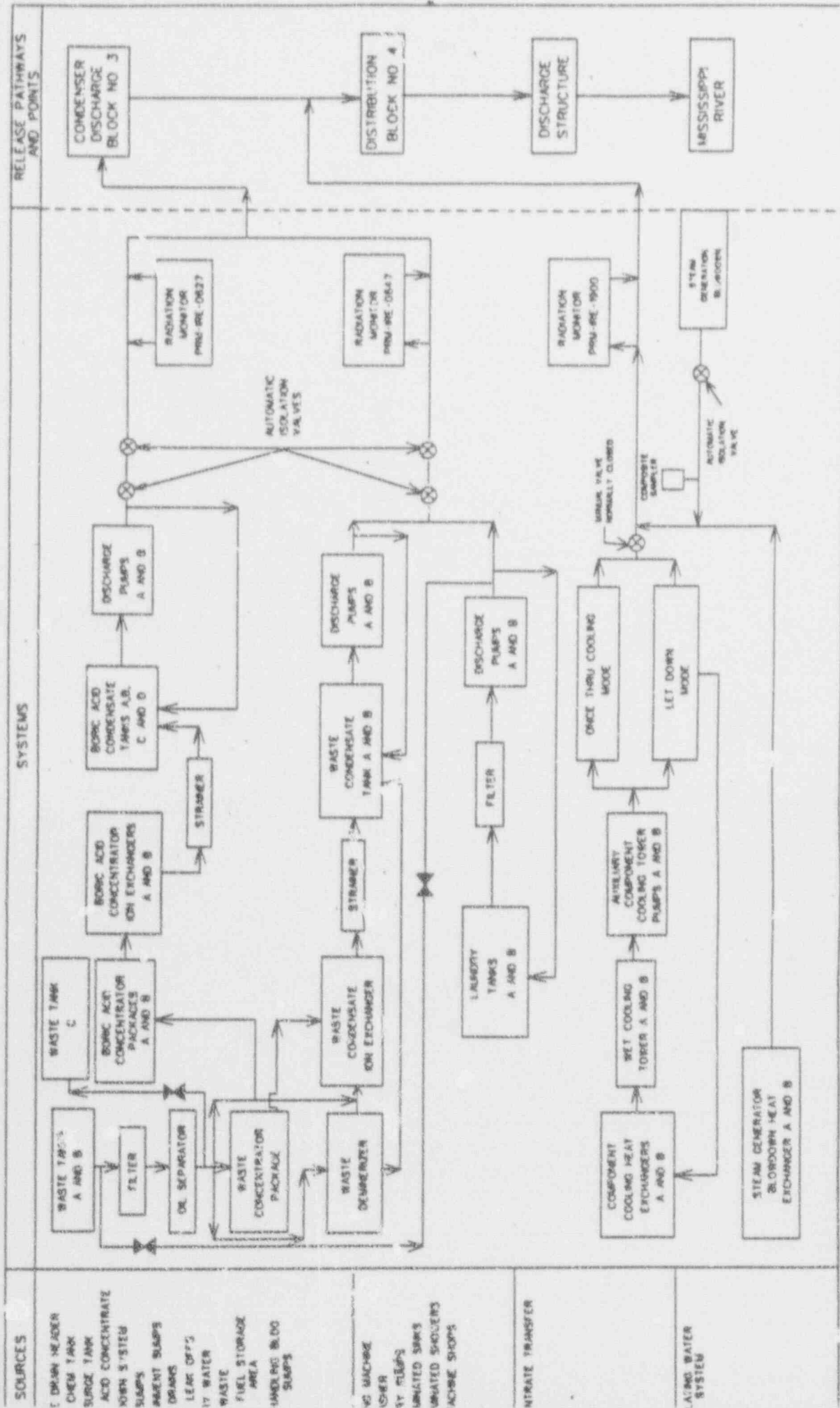
MUCLID

ORGAN DOSE CONVERSION FACTORS

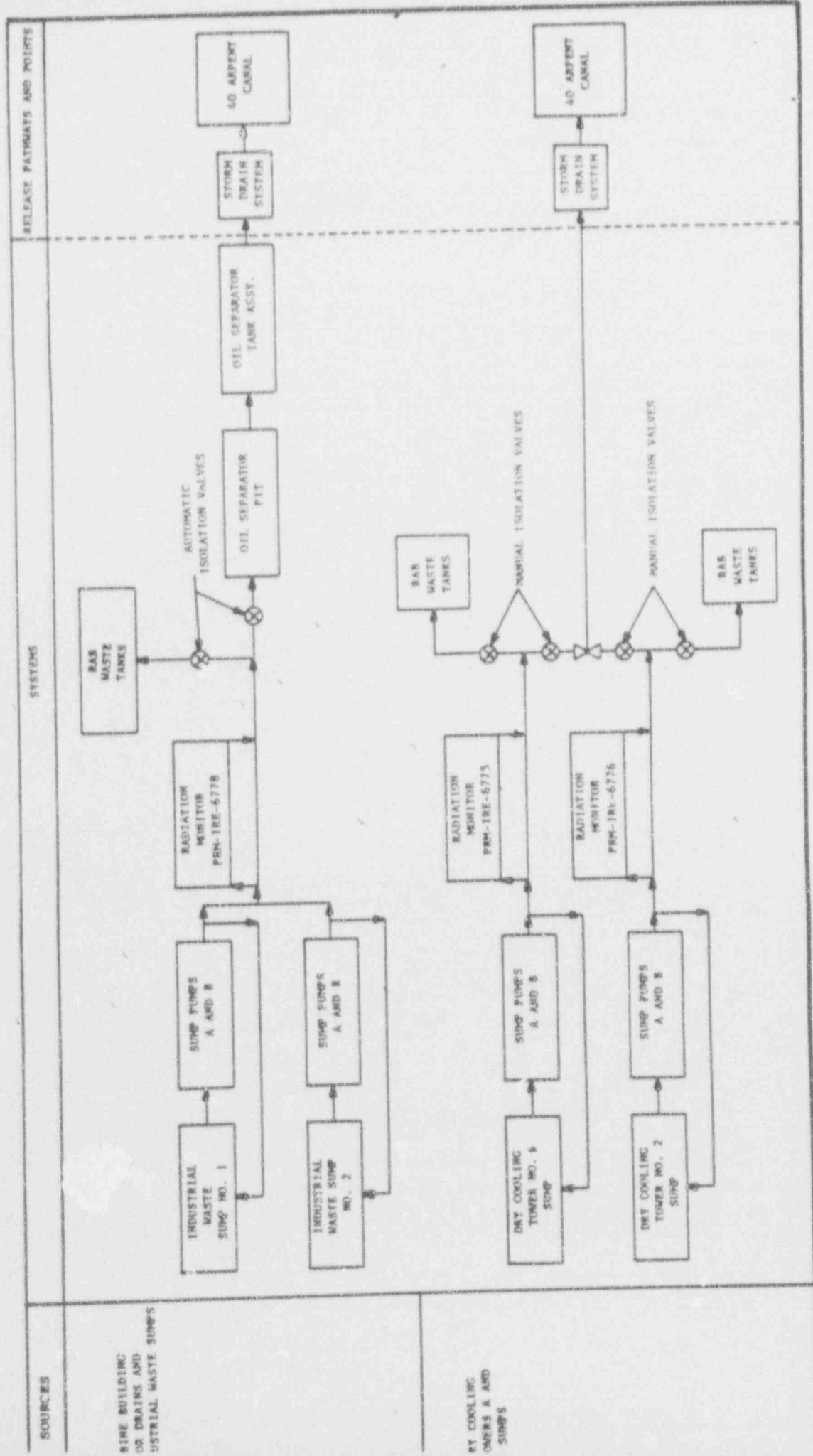
	NONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.89E+07	2.89E+04	1.49E+06	0.00E+00	6.87E+03	1.78E+04	7.10E+06
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.86E+00	1.92E+00	4.93E-01	0.00E+00	0.00E+00	0.00E+00	2.25E+04
LA-142	2.04E-11	7.49E-12	1.79E-12	0.00E+00	0.00E+00	0.00E+00	1.27E-06
CE-141	5.20E+03	3.17E+03	3.74E+02	0.00E+00	9.79E+02	0.00E+00	1.64E+06
CE-143	1.76E+01	3.16E+04	3.60E+00	0.00E+00	9.20E+00	0.00E+00	1.84E+05
CE-144	2.79E+05	1.14E+05	1.56E+04	0.00E+00	4.62E+04	0.00E+00	1.60E+07
PR-143	1.78E+02	6.67E+01	8.84E+00	0.00E+00	2.48E+01	0.00E+00	9.41E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NO-147	1.06E+02	1.09E+02	6.65E+00	0.00E+00	4.19E+01	0.00E+00	6.88E+04
W-187	7.30E+03	5.07E+03	1.75E+03	0.00E+00	0.00E+00	0.00E+00	2.98E+05
BP-239	5.48E+01	4.90E+00	2.77E+00	0.00E+00	9.77E+00	0.00E+00	1.42E+05

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

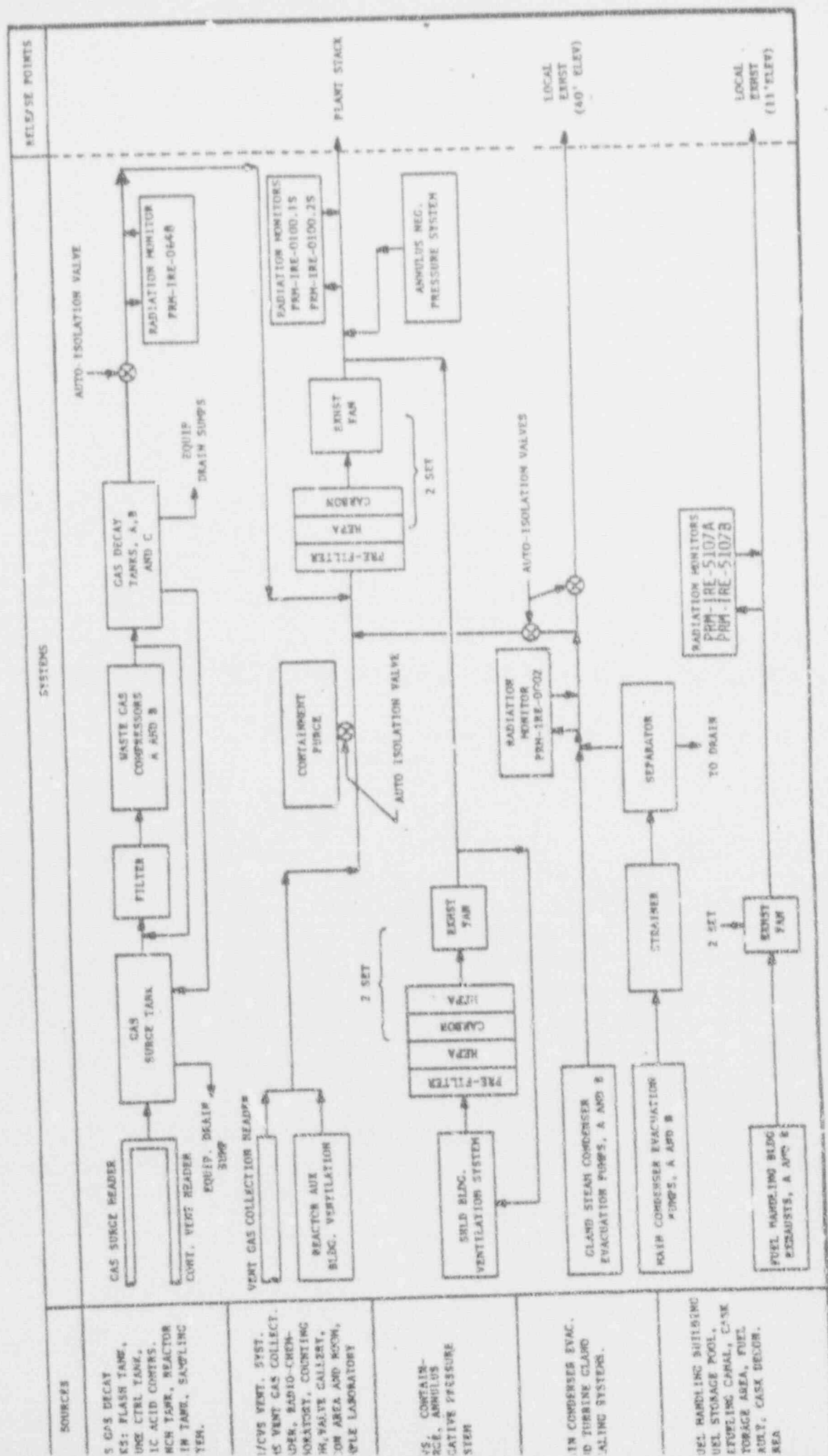
LIQUID WASTE MANAGEMENT SYSTEM EFFLUENT SOURCES AND RELEASE PATHWAYS AND POINTS



LIQUID WASTE MANAGEMENT SYSTEM EFFLUENT SOURCES AND RELEASE PATHWAYS AND POINTS (cont'd)



GASEOUS EFFLUENT SOURCES, GASEOUS WASTE MANAGEMENT SYSTEM EFFLUENT SOURCES AND EXHAUST RELEASE POINTS



RADIOLOGICAL ENVIRONMENT MONITORING PROGRAM

<u>Sample Type</u>	<u>Location</u>	<u>Analysis</u>	<u>Frequency</u>	<u>Volume</u>
TLD	A-2, R-1, C-1, D-2, E-1, F-2, G-2, H-2, J-2, K-1, L-1, M-1, N-1, P-1, Q-1, R-1, A-5, B-4, D-5, E-5 F-4, G-4, H-6, P-6, Q-5 R-6, F-9, G-9, E-15, J-15 E-30	TLD ^a	Quarterly	N/A
Radioiodine and Particulates	APP-1, APQ-1, APG-1, APC-1, APE-30	Gross beta, I-131 γ isotopic ^b	Weekly Quarterly composite	285m ³ /wk 3700 r. ³ /qtr
Ground Water ^f	GWJ-1	γ isotopic, H-3	Quarterly	4 liters
Drinking Water ^c	DWG-2, DWE-5 ^d , LWP-7	H-3 Gross beta, γ isotopic I-131 ^g	Quarterly composite Monthly composite Semi-monthly composite	Homogeneous 4 liters
Surface Water ^c	SWG-2, SWE-5 ^d , SWP-7	H-3 γ isotopic	Quarterly composite Monthly composite	Homogeneous 4 liters
Shoreline Sediment	SHWE-3, SHWJ-1	γ isotopic	Semi-annually	2 kilograms
Milk	MKE-4, MKQ-5, MKQ-45, MKQ-1	γ isotopic, I-131	Semi-monthly/monthly ^h	4 liters
Fish	FH-1, FH-2	γ isotopic	In season or semi-annually ⁱ	500 grams
Food Products	*	γ isotopic	At harvest time ^j	500 grams
Broad Leaf	BLQ-1, BLB-1, BLK-15	γ isotopic, I-131	Monthly When milk samples not collected	500 grams

* Irrigated Food Pathway does not exist. However, food products grown within the site boundary are sampled and analyzed.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

- a. One or more instrument, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. A TLD is considered one phosphor, two or more phosphors in a packet are considered two or more dosimeters. Geographical limitations affect siting of dosimeters.
- b. Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma isotopes analysis shall be performed on the individual samples. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.
- c. Drinking Water and Surface Water samples are identical samples.
- d. The downstream sample is beyond the mixing zone.
- e. A composite sample will contain aliquots of sample taken proportional to the quantity of flowing liquid that results in a specimen representative of the liquid flow.
- f. Ground water samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.
- g. This analysis will be performed when the dose calculated for the consumption of water is greater than 1 mrem per year as calculated for maximum organ and age group.
- h. Milk will be collected semimonthly when animals are on pasture, monthly otherwise. If milk sampling is not performed, broad leafy vegetation will be sampled.
- i. Striped mullet, gizzard shad, freshwater drum, and catfish will be collected. If they are not available, substitute species will be collected and identified in reporting.
- j. One sample of each principal class of food products will be sampled in an area irrigated by water in which plant wastes have been inadvertently discharged. If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvesting occurs continuously, sampling shall be monthly. Tuberous and root products will be sampled when available.

SAMPLE LOCATION TABLE

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
<u>DIRECT RADIATION (TLD)</u>			
A-2	(Eastbank) On fence enclosure surrounding water tower west of Little Gypsy opposite Etienne St. Access from River Road (LA 628). The TLD's are located on the (S) fence opposite the entrance gate to the water tower.	1.1	N
B-1	(Eastbank) On fence enclosing the transmission tower 0.3 miles west (up-river) from Little Gypsy. Access from River Road (LA 628). TLD's are located at SW corner of fence enclosure.	0.8	ENE
C-1	(Eastbank) On fence enclosing the Little Gypsy Cooling Water Intake. Access is from River Road (LA 628) across from Little Gypsy Power Station entrance. TLD's are on the south side (inside) of the Cooling Water Intake fence enclosure, directly opposite the entrance gate.	0.8	NE
D-2	(Eastbank) Located approximately 0.3 miles east of Little Gypsy Power Station. Access from River Road (LA 628) near the west end of the Bonne Carre Spillway. TLD's are on the fence at the West entrance to the spillway (located on levee).	1.1	ENE
E-1	(Westbank) Located on utility pole along River Road (LA 18) approximately 0.3 miles east of Warford 3 plant entrance. Access from LA 18. TLD's are on the third utility pole east of the construction entrance road.	0.2	E
F-2	(Westbank) Located on fence enclosure surrounding the LP&L substation on LA 3142. Access from LA 3142 approximately 0.2 miles south of LA 18. TLD's are on the southeast corner of the fence enclosure.	1.1	ESE

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
G-2	(Westbank) Located on utility pole on East side of LA 3142 near Witco entrance gate (Next to Union Carbide Star Plant Gate 3). Access from LA 3142 approximately 0.2 miles north of railroad overpass.	1.2	SE
H-2	(Westbank) Located on fence enclosure to shell road off of LA 3142. Access from LA 3142 south of railroad overpass on east side of LA 3142. TLD's are on the south side of the gate for shell road. (Just south of Texaco pipeline station).	1.2	SSE
J-2	(Westbank) Located on northeast corner of fence enclosing Texaco valve station south of LA 3127. Access from LA 3127, approximately 0.6 miles west of LA 3127/3142 intersection.	1.3	S
K-1	(Westbank) Located behind "Private Road" SIGN AT Gate 8 entrance off of LA 3127. Access from LA 3127, approximately 1.3 miles west of LA 3127/3142 intersection. (Gate 8 is the access to the Waterford 3 switchyard station and Training Center).	1.0	SSW
L-1	(Westbank) Located behind "Private Road" sign at LP&L Gate 9 entrance off of LA 3127, approximately 1.6 miles west of LA 3127/3142 intersection. (Gate 9 is an access road for Waterford 3).	1.0	SW
M-1	(Westbank) Located on south gate into the Waterford 1 and 2 fuel oil storage tank enclosure. Access is either thru LP&L Gate 8, Gate 9 off of LA 3127, the shell access road from LA 18 between Waterford 3, or thru the Waterford 1 and 2 access road.	0.7	WSW
N-1	(Westbank) Located behind the "No Trespassing" sign off on Short Street, in Killona, just south of the Killona Elementary School.	0.9	W

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
P-1	(Westbank) Located on Short Street, TLD is inside fence at air sample station APP-	0.8	WNW
Q-1	(Westbank) Located on fence enclosing air sample station approximately 0.5 miles west of Waterford 1 and 2 on River Road (LA 18).	0.8	NW
R-1	(Westbank) Located on fence enclosure for Waterford 1 and 2 Cooling Water Intake Structure. Access is from River Road (LA 18) opposite Waterford 1 and 2. TLD's are on the southwest corner of fence.	0.5	NNW
A-5	(Eastbank) Located on utility pole just east of the Shady Nook Trailer Park on Hwy 61 in LaPlace. TLD's are on second utility pole east of trailer park on north side of Hwy 61 (eastern end of LaPlace).	4.5	N
B-4	(Eastbank) Located on utility pole just east of shell access road to South Central Bell transmission tower on south side of Hwy 61. Transmission tower is just east of Weigh Station at St. John/St. Charles Parish line. TLD's are on first utility pole east of access road.	3.8	NNE
D-5	(Eastbank) Located on fence gate on shell access road to Big 3 Chemical Plant. Shell access road is approximately 0.1 miles west of Hwy 61/48 intersection (at black and yellow gate). TLD's are on fence gate 0.1 miles north on shell access road from Hwy 61.	4.2	ENE
E-5	(Eastbank) Located on the Norco Substation fence enclosure. Access from River Road (LA 48) onto Wesco St. (adjacent to Norco Shell Chemical Plant), take Wesco St. to the dead end. TLD's are located on sixth fence post south of the north substation gate.	4.2	E

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
I-4	(Westbank) Located on utility pole behind blonde brick house on Aquarius St. in Hahnville. Access from River Road (LA 18) and turn onto Oak St. Follow Oak St. to Hickory St., turn right on Hickory St. and follow to Aquarius St. and turn left. Blonde brick house is second house on right (west) side of Aquarius St. heading south.	3.5	ESE
G-4	(Westbank) Located on railroad sign northwest side of LA 3160/railroad track intersection. Access from either LA 3127 or River Road (LA 18) onto LA 3160.	3.2	SE
H-6	(Westbank) Located on a road sign on the Northwest side of the second canal bridge east of LA 3160 along LA 3127.	5.7	SSE
P-6	(Westbank) Located on utility pole at southwest corner of LA 640/railroad track intersection. Utility pole is just west of LA 640 and east of radio transmission tower.	5.5	WNW
Q-5	(Westbank) Located on fence post surrounding (green) river marker on levee just east of Edgard. Fence post is located along River Road (LA 18) across from the Webre's house.	5.0	NW
R-6	(Eastbank) Located on fence enclosing LP&L Laydown Yard on LA 3223 in LaPlace. Access from Hwy 61 onto Elm St. (LA 3223), take Elm St. to the northeast corner of LA 3223/railroad intersection. TLD's are located at the entrance of the fence enclosure.	5.3	NNW
F-9	(Eastbank) Located on entrance gate to Destrehan Substation. Access from River Road (LA 48), approximate 1.5 miles east of Luling-Destrehan Bridge, onto Destrehan Road (west of Bunge Corp. Grain Elevator), and proceed to substation gate.	8.2	ESE

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
G-9	(Westbank) Located on back fence of LP&L District Office in Luling. Access via Ellington St. from either River Road (LA 18); or Second or Third S. from Paul Mallard Rd. (LA 52) to Ellington St.	8.1	SE
E-15	(Eastbank) Located on Kenner Substation fence enclosure. Access from either River Road (LA 48) or Hwy 61, turn onto Alliance Ave. TLD's are located at the entrance of the fence enclosure.	11.8	E
J-15	(Westbank) Located on fence enclosure surrounding LP&L switchyard at LA 631/Hwy 90 intersection in Des Allemands. TLD's are on the northwest corner of fence. Access from LA 631 via shell road.	12.0	S
E-30*	(Westbank) Located at LP&L General Office or Delaronde St. in Algiers. TLD's are on a tree in the courtyard at the south entrance to the building.	27.0	E
<u>Airborne</u>			
APP-1	(Westbank) Located in soybean field at northwest corner of Short St. in Killona.	0.8	WN.
APQ-1	(Westbank) Located at northwest corner of soybean field on east side of Killona. Access from River Road (LA 18) approximately 0.6 miles east of LA 18/3141 intersection.	0.8	NW
APG-1	(Westbank) Located at the north side of the Secondary Meterological Tower.	0.5	SE
APC-1	(Eastbank) Located inside the Little Gypsy Cooling Water Intake Structure fence enclosure.	0.8	NE

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
APE-30*	(Westbank) Located on the roof of the LP&L General Office building on Delaronde St. in Algiers.	27.0	E
<u>Food Products</u>			
FPP-1	(Westbank) Located in field on eastern edge of Killona, between air sample stations APP-1 and APQ-1. The crops grown alternate between soybeans and sugar cane.	0.8	WNW
FPG-1	(Westbank) Located in field east of Waterford 3 near the Back-up Meteorological Tower and air sample station AFG-1. The crops grown alternate between soybeans and sugar cane.	0.4	SE
<u>Broad Leaf</u>			
BLQ-1	(Westbank) Located between LA 18 and soybean field on eastern edge Killona, near air sample station APQ-1.	0.8	NW
BLB-1	(Eastbank) Located at wooded area at the southwestern corner of the LP&L Little Gypsy plant along River Road.	0.8	NNE
BLK-15*	(Westbank) Located 3.5 miles SSW of Des Allemands on Hwy. 90.	15.0	SSW
<u>Ingestion</u>			
<u>Milk</u>			
MKQ-5	(Westbank) Located at the Webre's house, just across LA 18 from river marker, at the eastern end of Edgard.	5.0	NW
MKQ-45*	(Eastbank) Located off of I-12 in Denham Springs. Take LA 3002 south of LA 1034 then right to LA 1032. Turn left and go to farm 1 mile on the right.	42	NW
MKQ-1	(Westbank) 1.0 miles west of Waterford 3 at the corner of River Road and Post Street in Killona.	1.0	NW

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
<u>Fish</u>			
FH-1*	Upstream of the plant intake structure.	N/A	N/A
FH-2	Downstream of the plant intake structure.	N/A	N/A
<u>Waterborne</u>			
GWK-1	(Westbank) Located at 40 Arpent Canal south of the plant. Access from LA 3127 through LP&L Gate 8 which is at the Waterford-3 Training Center. The canal is northwest of the shell access road/ railroad track intersection.	0.5	SSW
DWG-2 SWG-2	(Westbank) Located at the Union Carbide drinking water canal. Access from LA 3142 through Gate 28.	2.0	SE
SHWE-3	(Westbank) Located at the Foot Ferry Landing off of LA 18 in Taft.	3.0	E
SHWK-1	(Westbank) Located at 40 arpent canal south of plant. Access thru LP&L gate 8 off of LA 3127.	0.5	SSW
DWE-5 SWE-5	(Eastbank) Located at the St. Charles Parish Waterworks off of River Road (LA 48) near New Sarpy.	4.5	E
DWP-7* SWP-7*	(Westbank) Located at the St. John Parish Waterworks off of LA 18 in Edgard.	6.5	WNW

* DENOTES CONTROL LOCATIONS

N/A - Not Applicable for this sampling location.

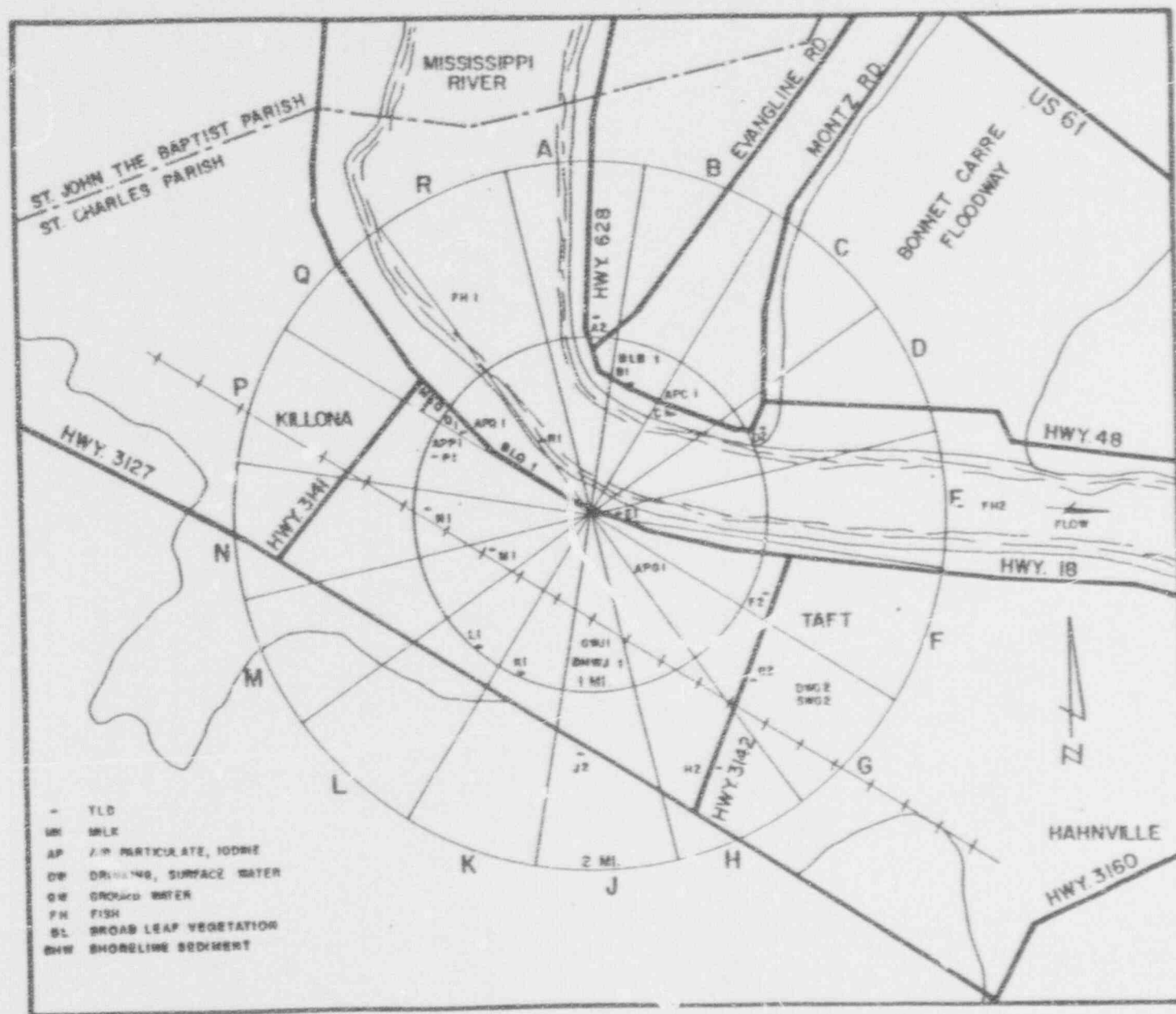
SECTOR AND ZONE DESIGNATORS FOR RADIOLOGICAL SAMPLING
AND MONITORING POINTS

SECTOR NOMENCLATURE		ZONE NOMENCLATURE	
CENTERLINE OF SECTOR IN DEGREES TRUE NORTH FROM FACILITY	22 ½° SECTOR	MILES FROM FACILITY	ZONE
0 & 360	*A N	0-1	1
22½	B NNE	1-2	2
45	C NE	2-3	3
67½	D ENE	3-4	4
90	E E	4-5	5
112½	F ESE	5-6	6
135	G SE	6-7	7
157½	H or SSE	7-8	8
180	J S	8-9	9
202½	K SSW	9-10	10
225	L SW	10-15	15
247½	M WSW	15-20	20
270	N W	20-25	25
292½	P WNW	25-30	30
315	Q NW	30-35	35
337½	R NNW	35-40	40
		40-45	45
		45-50	50

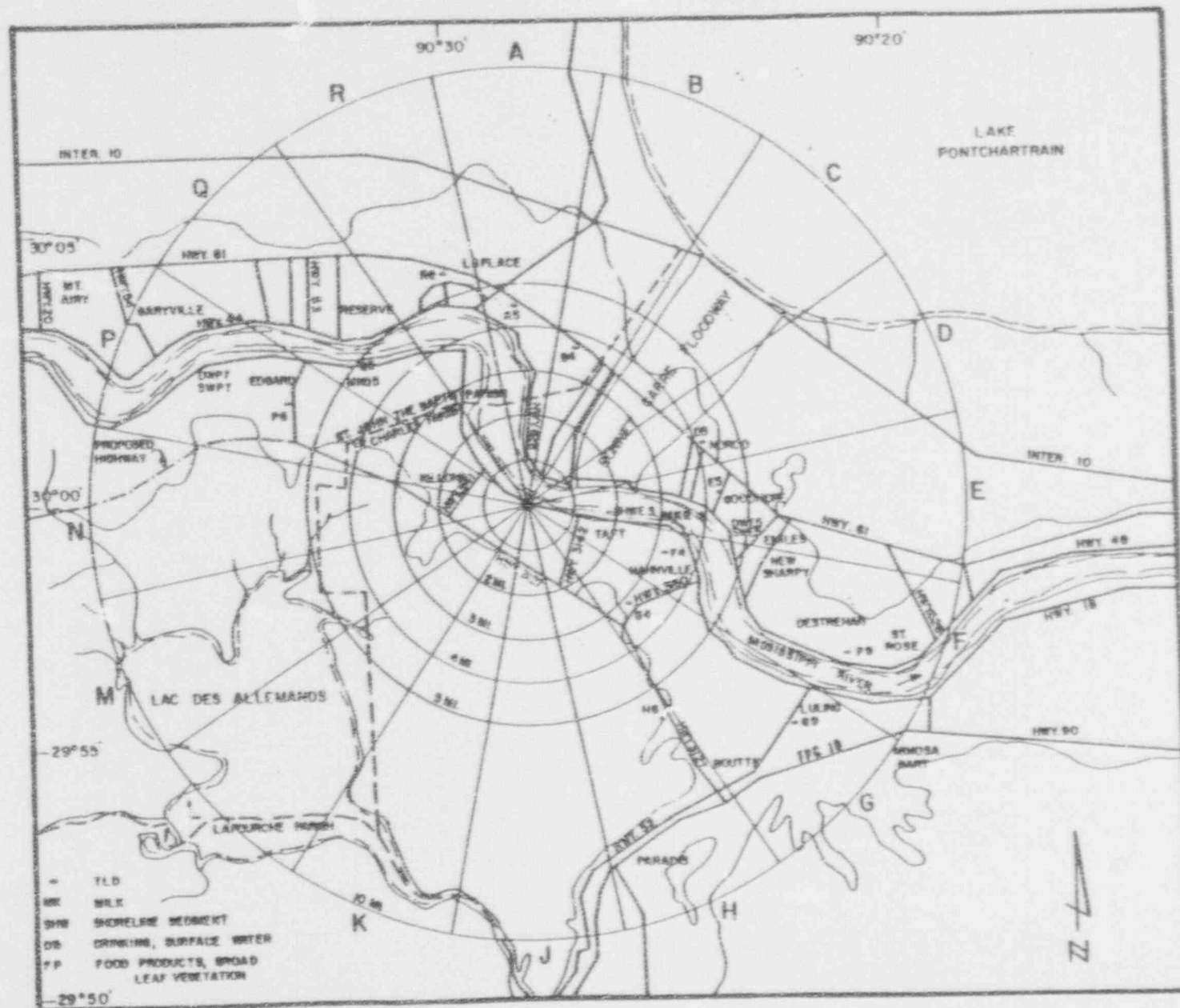
AREA SEGMENT - An area is identified by a Sector and Zone designator. Thus, area N-1 is that area which lies between 348 ¾ and 11½ degrees true north from the facility out to a radius of 1 mile. Area G-4 would be that area between 123 ¾ to 146 ½ degrees and the 3- and 4-mile arcs from the facility. For Airborne, Ingestion (milk), and Food Products pathways, the sector designator will be preceded by acronyms AP, MK, and FP, respectively.

* The letters I and O have been omitted from these sector designators so as to eliminate possible confusion between letters and numbers.

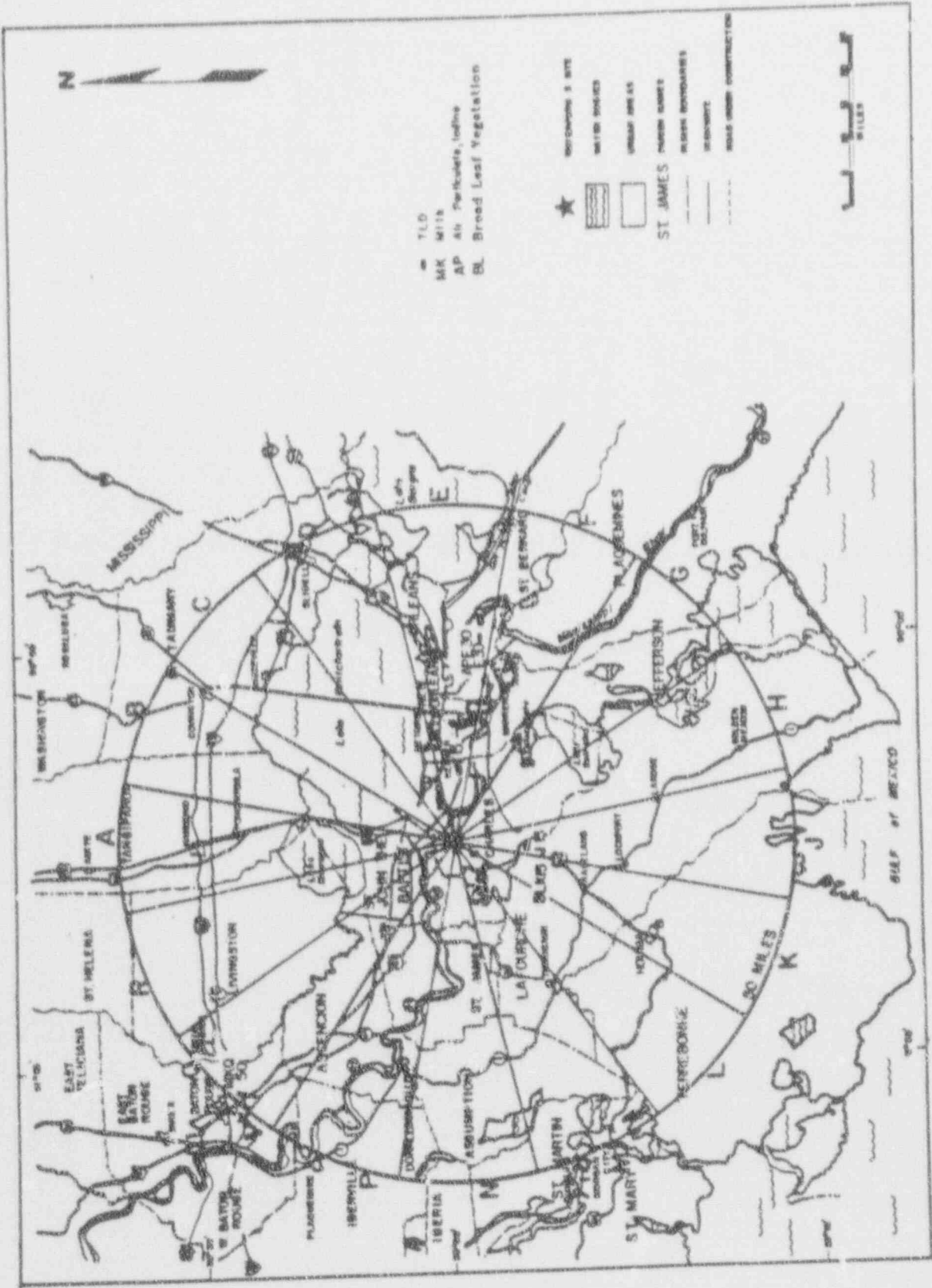
REMP SAMPLING LOCATIONS
WITHIN 2 MILES OF WATERFORD 3



REMP SAMPLING LOCATIONS
WITHIN 10 MILES OF WATERFORD 3



REMP SAMPLING LOCATIONS

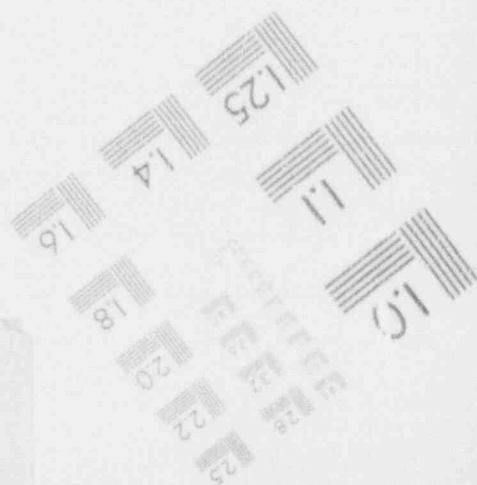
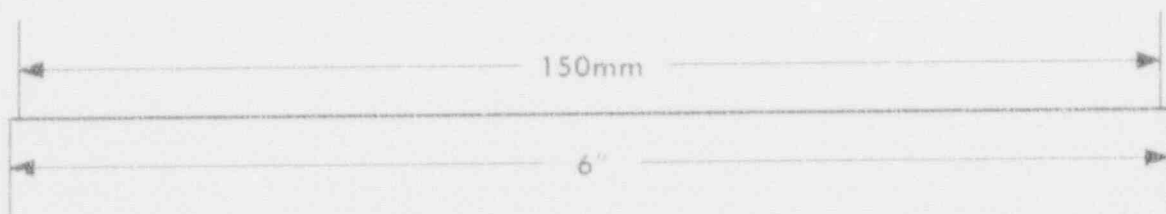
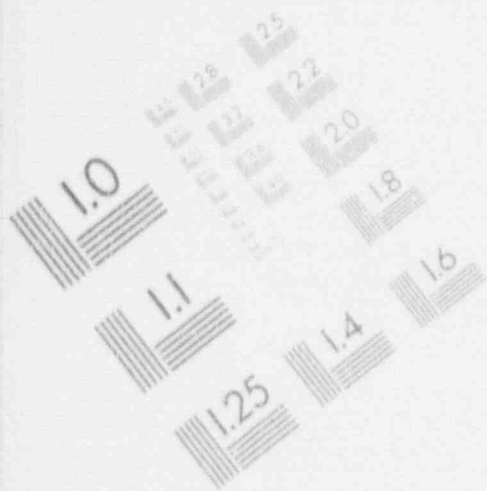


SPECIFICATION CROSS REFERENCE TABLE

Specification <u>Section</u>	<u>Requirement</u>	Methodology <u>Section</u>
5.3.1	Liquid Effluent Concentration	5.3.5 & 5.3.6
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5.8.1	Radiological Environmental Monitoring Program	5.8.4
5.8.2	Interlaboratory Comparison Program	5.8.5
5.8.3	Land Use Census	5.8.3

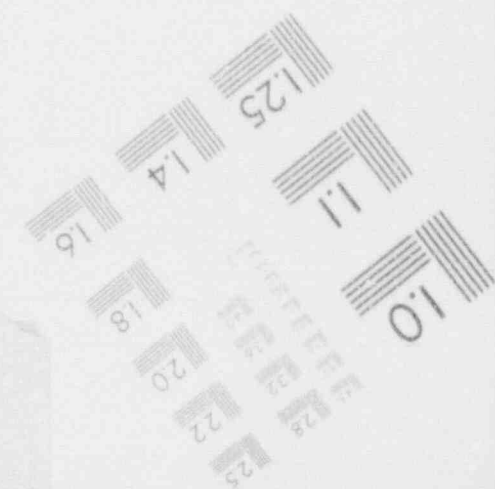
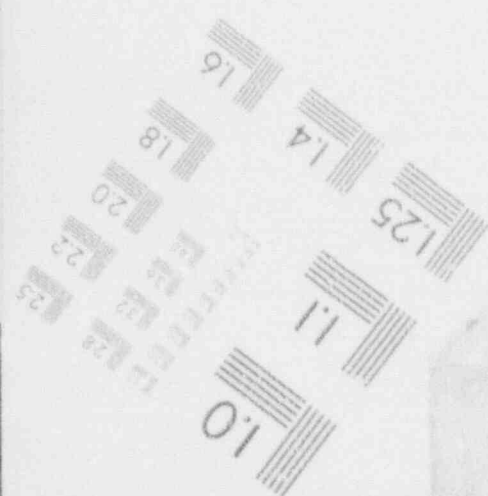
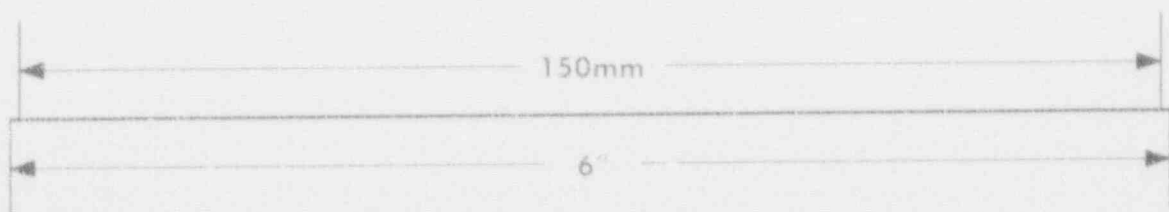
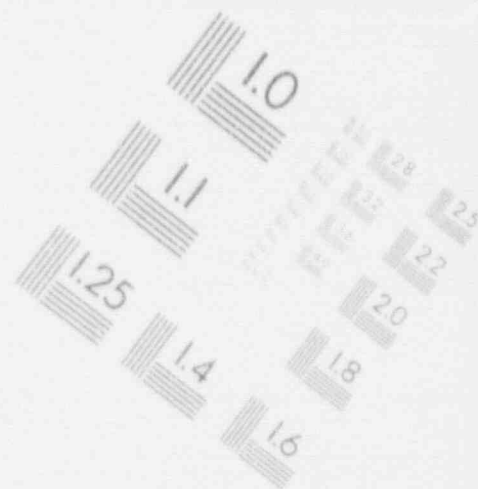
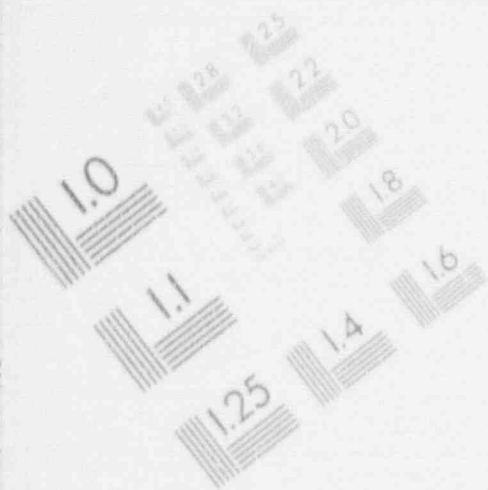
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IMAGE EVALUATION TEST TARGET (MT-3)



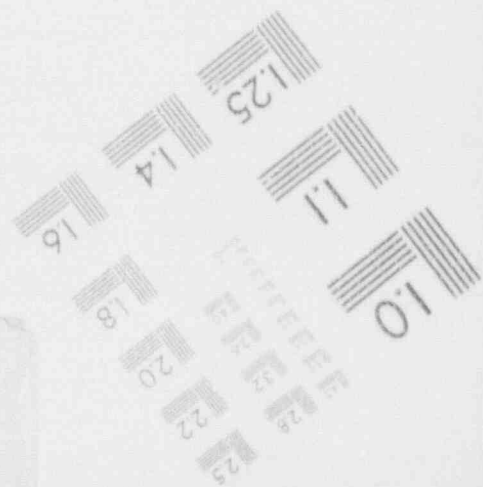
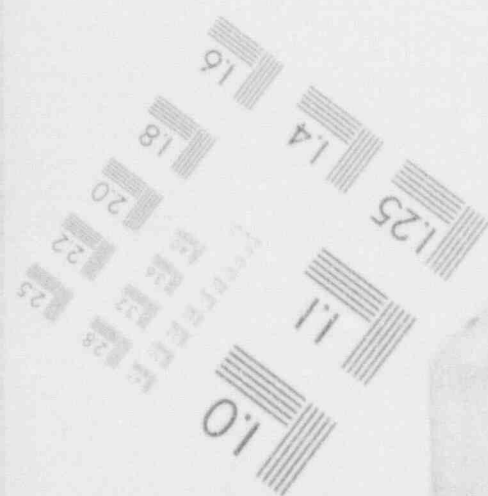
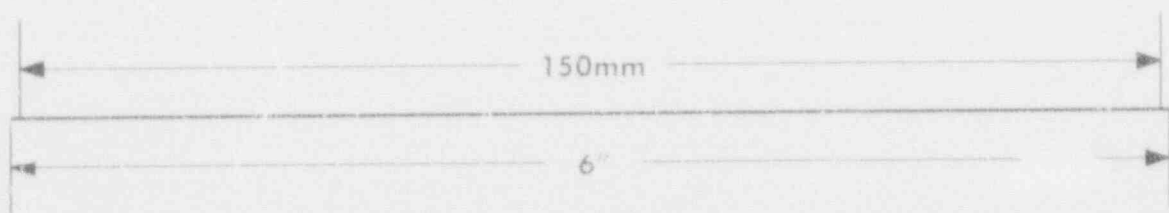
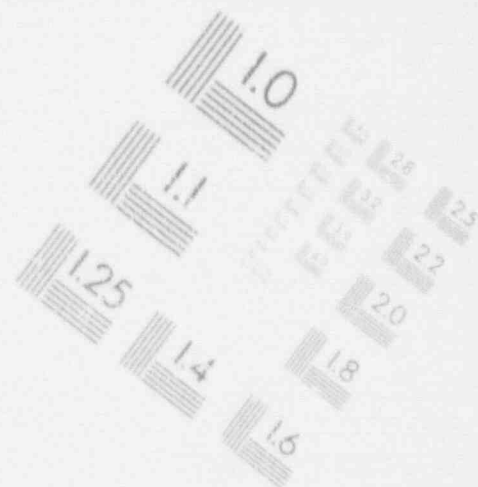
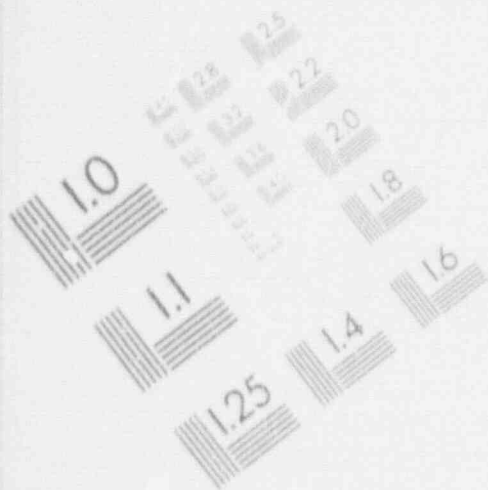
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IMAGE EVALUATION TEST TARGET (MT-3)



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IMAGE EVALUATION
TEST TARGET (MT-3)



TECHNICAL SPECIFICATION CROSS REFERENCE TABLE

Specification <u>Section</u>	<u>Requirement</u>	Technical Specification <u>Section</u>
5.3.1	Liquid Effluent Concentration	3.11.1.1, 4.11.1.1.1, 4.11.1.1.2
5.3.2	Dose due to Liquid Effluents	3.11.1.2 & 4.11.1.2
5.3.3	Dose Projections for Liquid Releases	3.11.1.3, 4.11.1.3.1 & 4.11.1.3.2
5.4.1	Dose Rate Due to Noble Gases	3.11.2.1, 4.11.2.1.1, 4.11.2.1.2 & 4.11.2.1.3
5.4.1	Dose Rate Due to Iodine, Tritium And Particulates with Half Lives Greater than Eight Days	3.11.2.1, 4.11.2.1.1, 4.11.2.1.2 & 4.11.2.1.3
5.4.2	Air Doses due to Noble Gases:	3.11.2.2 & 4.11.2.2
5.4.3	Doses Due to Iodines, Tritium and Particulates with Half-Lives Greater than Eight Days.	3.11.2.3 & 4.11.2.3
5.4.4	Dose Projections for Gaseous Releases	3.11.2.4, 4.11.2.4.1 & 4.11.2.4.2

TECHNICAL SPECIFICATION CROSS REFERENCE TABLE
(cont'd)

<u>Specification Section</u>	<u>Requirement</u>	<u>Technical Specification Section</u>
5.5.1	Total Dose	3.11.4, 4.11.4.1 & 4.11.4.2
5.8.1	Rad:ological Environmental Monitoring Program	3.12.1 & 4.12.1
5.8.2	Interlaboratory Comparison Program	3.12.3 & 4.12.3
5.8.3	Land Use Census	3.12.2 & 4.12.2
5.6.1	Radioactive Liquid Effluent Monitoring Channels Alarm/Trip Setpoints	3.3.3.10 & 4.3.3.10
5.6.2	Radioactive Gaseous Effluent Monitoring Channels Alarm/Trip Setpoints	3.3.3.11 & 4.3.3.11

SPECIFIC FACTORS USED TO DETERMINE A_1 and R_1 VALUES FOR THE
OFFSITE DOSE CALCULATION MANUAL

Values for A_1 and R_1 were calculated as per NUREG-0133. Recommended values for various factors in the calculations were as specified in NUREG-0133. The location of most of the recommended factors are contained in Regulatory Guide 1.109. All factors used in Waterford-3 SES's calculations are for the maximum individual and are not site specific. The various factors are discussed below.

Stable element transfer coefficients for vegetation, cow's milk, and meat were obtained from Regulatory Guide 1.109 Table E-1.

Stable element transfer coefficients for goat's milk were obtained from Regulatory Guide 1.109 Table E-2.

Animal consumption rates were obtained from Regulatory Guide 1.109 Table E-3.

Usage or consumption rates for adult, teen, child, and infant age groups were obtained from Regulatory Guide 1.109 Table E-5. These values are for the maximum exposed individual.

External dose factors for standing on contaminated ground were obtained from Regulatory Guide 1.109 Table E-6.

Inhalation and ingestion dose factors for adult, teen, child, and infant age groups were obtained from Regulatory Guide 1.109 Tables E-7 through E-14.

Other factors used were obtained from Regulatory Guide 1.109 Table E-15 for various parameters.

Bioaccumulation factors for freshwater and saltwater vertebrates and invertebrates are listed on the following page.

BIOACCUMULATION FACTORS FOR VARIOUS ELEMENTS
IN AN AQUATIC ENVIRONMENT

ELEMENT	FRESH-FISH	FRESH-INV	SALT-FISH	SALT-INV
H	9.00e-1	9.00e-1	9.00e-1	9.30e-1
C	4.60e+3	9.10e+3	1.80e+3	1.40e+3
Na	1.00e+2	2.00e+2	6.70e-2	1.90e-1
P	1.00e+5	2.00e+4	2.90e+4	3.00e+4
Cr	2.60e+2	2.00e+3	4.00e+2	2.00e+3
Mn	4.00e+2	9.00e+4	5.50e+2	4.00e+2
Fe	1.00e+2	3.20e+3	3.00e+3	2.00e+4
Co	5.60e+1	2.00e+2	1.00e+2	1.00e+3
Ni	1.00e+2	1.00e+2	1.00e+2	2.50e+2
Cu	5.00e+1	4.00e+2	6.70e+2	1.70e+3
Zn	2.00e+3	1.00e+4	2.00e+3	5.00e+4
Br	4.20e+2	3.30e+2	1.50e-2	3.10e+0
Rb	2.00e+3	1.00e+3	8.30e+0	1.70e+1
Sr	3.00e+1	1.00e+2	2.00e+0	2.00e+1
Y	2.50e+1	1.00e+3	2.50e+1	1.00e+3
Zr	3.30e+0	6.70e+0	2.00e+2	8.00e+1
Nb	3.00e+4	1.00e+2	3.00e+4	1.00e+2
Mo	1.00e+1	1.00e+1	1.00e+1	1.00e+1
Tc	1.50e+1	5.00e+0	1.00e+1	5.00e+1
Ru	1.00e+1	3.00e-2	3.00e+0	1.00e+3
Ag	2.00e+0	8.00e+2	3.00e+3	3.00e+3
Te	4.00e+2	6.10e+3	1.00e+1	1.00e+2
I	1.50e+1	5.00e+0	1.00e+1	5.00e+1
Cs	2.00e+3	1.00e+3	4.00e+1	2.50e+1
Ba	4.00e+0	2.00e+2	1.00e+1	1.00e+2
La	2.50e+1	1.00e+3	2.50e+1	1.00e+3
Ce	1.00e+0	1.00e+3	1.00e+1	6.00e+2
Pr	2.50e+1	1.00e+3	2.50e+1	1.00e+3
Nd	2.50e+1	1.00e+3	2.50e+1	1.00e+3
V	1.20e+3	1.00e+1	3.00e+1	3.00e+1
Np	1.00e+1	4.00e+2	1.00e+1	1.00e+1

Data obtained from Regulatory Guide 1.109 Table A-1 for all elements except Silver(Ag) which is from "Models and Parameters for Environmental Radiological Assessments" (DOE/TIC-11468) and Niobium(Nb) which is from the International Atomic Energy Agency(IAEA) Safety Series No. 57, Generic Models and Parameters for Assessing the Environmental Transfer of Radionuclides from Routine Releases, Exposures of Critical Groups.

PORC/PORC-56 *e*

UNT-005-014

REVISION 0

EFFECTIVE DATE

SAFETY-RELATED

ADMINISTRATIVE PROCEDURE

Offsite Dose Calculation Manual

LP81 W-3
RECORDS MANAGEMENT
CONTROLLED
COPY

NO. 241

PORC AND-PORC---S/E
REVIEW AND APPROVAL SHEET

REVIEW OF: UNT-005-014 - Offsite Dose
Calculation Manual (Rev. 0)

PORC ☒
PORC - S/C ☐

The PORC or PORC S/C has reviewed this item and determined that a Safety/Commitment Review was performed, (if applicable) that a Safety Evaluation was performed (if applicable), that an unreviewed safety question does not exist and that nuclear safety is/was not adversely affected.

PORC MEMBER	MEMBER SIGNATURE	RECOMMENDED FOR APPROVAL		DATE
		YES	NO	
Maintenance Superintendent	<i>T. Klean</i>	✓		8/2/90
Operations Superintendent	<i>R. S. S.</i>	✓		8/2/90
Radiation Protection Superintendent	<i>J. A. S.</i>	✓		8/2/90
Operations Quality Assurance Manager	<i>J. J. S.</i>	✓		8/2/90
Plant Engineering Superintendent				
Assistant Plant Manager				
PORC-S/C Member				
PORC-S/C Member				
PORC-S/C Member				
PORC-S/C Chairman				
PORC Chairman	<i>A. H. S.</i>	✓		8/3/90

Meeting No. 90-067 Item No. VIII-B Date: 8/2/90

This item is recommended for approval? ☒ YES ☐ NO

This item requires SRC/NRC review prior to implementation? ☐ YES ☒ NO

If yes, ensure documentation supporting review is attached.

PLANT MANAGER-NUCLEAR APPROVAL

Comments: _____

Approved by *[Signature]*
Plant Manager-Nuclear

Date 8/3/90

WATERFORD 3 SES
PLANT OPERATING MANUAL
NEW PROCEDURE REQUEST

Check Block Below

☒ PORC ☐ PORC-S/C

PROCEDURE NO. UNT-005-014 REV. NO. 0 PROCEDURE TYPE Administrative

TITLE Offsite Dose Calculation Manual

EFFECTIVE DATE Approval of TSCA #85-07 (IF APPLICABLE)

AUTHOR Bernadette R. Lee

EXPIRATION DATE _____ (IF APPLICABLE)

DESCRIPTION OF PROCEDURE Incorporate Radiological Effluent Tech Specs (RETS) and The Radiological Environmental Monitoring Program (REMP) into existing Offsite Dose Calculation Manual (HP-001-230) and make into an UNT procedure.

REASON FOR PROCEDURE USNRC Generic Letter, dated January 31, 1989, allowed for the RETS and REMP to be incorporated into the Offsite Dose Calculation Manual. Once this procedure is approved by the NRC, these portions of the Tech Specs will be deleted.

AUTHORIZED BY [Signature]

DATE 4/23/90

Plant Manager-Nuclear (POM)

SAFETY SCREENING/EVALUATION [Signature]

Signature, Author

4-23-90

Date

TECHNICAL REVIEW [Signature]

Signature, Technical Reviewer

4-25-90

Date

GROUP HEAD REVIEW [Signature]

Signature, Group Head

4/25/90

Date

Applicable Conditions (Temporary Procedures Only): _____

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- 6.2 Historical Average Dispersion and Deposition Parameters for Areas at or Beyond the Unrestricted Area Boundary
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1-196	Revision 0

1.0 PURPOSE

- 1.1 The offsite Dose Calculation Manual (ODCM) is a supporting document of the Waterford 3 Technical Specifications. This document provides (1) The Radiological Effluent Specifications and Radiological Environmental Monitoring Program required by Technical Specification 6.8.3; (2) the general characteristics of the Waterford 3 site; (3) the detailed Radiological Environmental Monitoring Program (REMP); (4) the description of the Radiological Environmental Monitoring Inter-laboratory Comparison Program; (5) the liquid and gaseous radwaste block flow diagram; (6) the Radioactive Liquid and Gaseous Waste Sampling and Analysis Programs; (7) the general methodology to be used to calculate dose to individuals due to releases of radioactive gaseous and liquid effluents from the Waterford 3 site; (8) the general methodology to be used to calculate effluent monitor setpoints and allowable release rates to ensure compliance with the Radiological Effluent Controls, 10CFR20, and 10CFR50 criteria; (9) the methodology to be used to ensure representative sampling of liquids; and (10) the methodology to be used to comply with 40CFR190 criteria.
- 1.2 The Offsite Dose Calculation Manual (ODCM) follows the general models suggested by NUREG 0133 and Regulatory Guide 1.109. However, alternate calculation methods from those presented may be used provided the overall methodology is acceptable and consistent with regulation or provided the alternate methodology is conservative. In addition, the most up-to-date dose conversion factors and bioaccumulation factors may be substituted in lieu of Regulatory Guide 1.109 values.
- 1.3 Actual step-by-step dose calculation will be performed by in-plant procedures which are consistent with the methodology presented in this document.

2.0 REFERENCES

- 2.1 Waterford 3 SES Technical Specifications, Chapter 16 of Waterford 3 FSAR.
 - 2.1.1 Technical Specification 6.14.1
 - 2.1.2 Technical Specification 6.14.2
- 2.2 USNRC Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases for Gaseous-Effluents from Light-Water-Cooled Reactors, July 1977.
- 2.3 USNRC Regulatory Guide 1.113, Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, April 1977.
- 2.4 USNRC Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I, Revision 1, October, 1977.
- 2.5 USNRC NUREG 0133, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, October 1978.
- 2.6 Code of Federal Regulations: Title 10, Parts 20, 40, 50 and 100, 1987; Title 40, Part 190.
- 2.7 HP-001-215, NRC and EPA Radiological Reporting Requirements
- 2.8 USNRC Generic Letter 89-01, Implementation of Programmatic Controls for Radiological Effluents Technical Specifications in the Administrative Controls Section of the Technical Specification and the Relocation of Procedural Details for RETS to the Offsite Dose Calculation Manual or to the Process Control Program.
- 2.9 UNT-006-010, Event Notification and Reporting

3.0 DEFINITIONS

- 3.1 ACTION shall be that part of a Specification which prescribes remedial measures required under designated conditions.
- 3.2 CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds with the necessary range and accuracy to known values of the parameter which the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel including the sensor and alarm and/or trip functions, and shall include the CHANNEL FUNCTIONAL TEST. The CHANNEL CALIBRATION may be performed by any series of sequential, overlapping, and total channel steps such that the entire channel is calibrated.
- 3.3 A CHANNEL CHECK shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.
- 3.4 A CHANNEL FUNCTIONAL TEST shall be:
- a. Analog channels - the injection of a simulated signal into channel as close to the sensor as practicable to verify OPERABILITY including alarm and/or trip functions.
 - b. Bistable channels - the injection of a simulated signal into the sensor to verify OPERABILITY including alarm and/or trip functions.
 - c. Digital computer channels - the exercising of the digital computer hardware using diagnostic programs and the injection of simulated process data into the channel to verify OPERABILITY including alarm and/or trip function.

3.0 DEFINITIONS (cont'd)

3.5 The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the following intervals.

<u>NOTATION</u>	<u>FREQUENCY</u>
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days.
M	At least once per 31 days.
P	Completed prior to each release.
Q	At least once per 92 days
SA	At least once per 184 days.
R	At least once per 18 months.
S/U	Prior to each reactor startup.
N.A.	Not applicable.

3.6 MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the licensee, its contractors, or vendors. Also excluded from this category are persons who enter the site to service equipment or make deliveries. This category does include persons who use portions of the site for recreational, occupational, or other purposes not associated with the plant.

3.7 A system, subsystem, train, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).

3.0 DEFINITIONS (cont'd)

3.8 An OPERATIONAL MODE (i.e. MODE) shall correspond to any one inclusive combination of core reactivity condition, power level and average reactor coolant temperature as specified.

<u>OPERATIONAL MODE</u>	<u>REACTIVITY</u> <u>CONDITION, K_{eff}</u>	<u>% OF RATED</u> <u>THERMAL POWER*</u>	<u>AVERAGE COOLANT</u> <u>TEMPERATURE</u>
1. POWER OPERATION	≥ 0.99	$> 5\%$	$\geq 350^{\circ}\text{F}$
2. STARTUP	≥ 0.99	$\leq 5\%$	$\geq 350^{\circ}\text{F}$
3. HOT STANDBY	< 0.99	0	$\geq 350^{\circ}\text{F}$
4. HOT SHUTDOWN	< 0.99	0	$350^{\circ}\text{F} > T_{avg} > 200^{\circ}\text{F}$
5. COLD SHUTDOWN	< 0.99	0	$\leq 200^{\circ}\text{F}$
6. REFUELING**	≤ 0.95	0	$\leq 140^{\circ}\text{F}$

*Excluding decay heat.

**Fuel in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

3.9 PURGE or PURGING shall be the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

3.10 The SITE BOUNDARY shall be that line beyond which the land is neither owned, nor leased, nor otherwise controlled by the licensee.

3.11 A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

3.0 DEFINITIONS (cont'd)

- 3.12 An UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the SITE BOUNDARY used for residential quarters or for industrial, commercial, institutional, and/or recreation purposes.
- 3.13 A VENTILATION EXHAUST TREATMENT SYSTEM shall be any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. such a system is not considered to have any effect on noble gas effluents. Engineered Safety Feature (ESF)(atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.
- 3.14 VENTING shall be the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.
- 3.15 A WASTE GAS HOLDUP SYSTEM shall be any system designed and installed to reduce radioactive gaseous effluents by collecting coolant system offgases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

4.0 RESPONSIBILITIES

- 4.1 Nuclear Plant Operations Manager has lead responsibility for insuring implementation of the Radiological Effluent Specifications and Radiological Environmental Monitoring Program as required by Technical Specification 6.8.3 and as set forth in this procedure.
- 4.2 The Radiation Protection Superintendent is responsible for ensuring Radiological Effluent Specifications and the Radiological Effluent Monitoring Program are performed as required according to procedures and methodologies established by the document. He is also responsible for insuring the Land Use Census and Semi-Annual Effluent Release Report are performed and issued as required.
- 4.3 Nuclear Operations Support and Assessment - Manager is responsible for the issuance and submittal of the Annual Environmental Report as required by this document. He is also responsible for the negotiation and maintenance of vendor contracts to supply Sample Analyses and Reports as required by the Radiological Environmental Monitoring Program.

5.0 PROCEDURE

5.1 SITE CHARACTERISTICS

Waterford 3 SES is located on the west (right descending) bank of the Mississippi River at River Mile 129.6 between Baton Rouge, Louisiana, and New Orleans, Louisiana. The site is in the northwestern section of St. Charles Parish, Louisiana, near the towns of Killona and Taft.

The geographic coordinates for the Waterford 3 reactor are Latitude 29° 59' 42" North, and Longitude 90° 28' 16" West. Based on the UTM (Universal Transverse Mercator) Zone 15, the UTM coordinates are Northing 3,320,743 meters and Easting 743,962 meters.

The Mississippi River is the closest prominent natural feature to Waterford 3, while other important nature features include Lac des Allemands, about 5.5 miles southwest of the site, and Lake Pontchartrain, about 7 miles northeast of the site. The land slopes gently from its high points near the Mississippi (10-15 ft. above mean sea level) to extensive wetlands located 1.5 to 2.5 miles inland from the river.

Most of the man-made features are located on the narrow strip of dry land between the Mississippi River and the wetlands. Near the Waterford 3 site are several large industrial facilities, including Waterford 1 and 2 (0.4 miles northwest of the site), Little Gypsy Steam Electric Station (0.8 miles northeast of the site, across the river from Waterford 3), Agrico, a fertilizer manufacturer (0.8 miles east-southeast), Occidental Chemical Company (0.8 miles east-southeast), and Union Carbide, a chemical manufacturer (1.2 miles east-southeast). Louisiana Power & Light Company (LP&L) owns and operates the above-mentioned steam electric stations.

5.1 SITE CHARACTERISTICS (cont'd)

Attachment 6.1 provides a map of the UNRESTRICTED AREA and SITE BOUNDARY for radioactive effluents. LP&L will have full control of all activities conducted within the exclusion area boundary of the Waterford 3 site. All of the property within the designated exclusion area is owned by LP&L with the exception of the bottom lands below mean low water of the Mississippi River.

LP&L owns, in title, all surface rights within the exclusion area boundary of the plant. There is presently no intention to allow exploration for subsurface minerals from points on the surface of the exclusion area.

The Mississippi River, Louisiana Highway 18, the Missouri Pacific Railroad right-of-way, and the west (right descending) bank levee of the Mississippi River constitute traversals of the site exclusion area as allowed by 10CFR100.3 (a). Refer to the Waterford 3 Emergency Plan Implementing Document for the arrangements which have been made to give LP&L authority and control over these traversals. (Note that Louisiana Highway 3127 does traverse the SITE BOUNDARY but not the exclusion area. However, LP&L does have the authority to control this traversal in accordance with the Waterford 3 Emergency Plan Implementing Document.)

In addition to Waterford 3, there are two fossil-fueled units, Waterford SES Units 1 and 2, which are owned by LP&L and which are within the site exclusion area. The plant staff for these two units consists of about 60 people. Since this includes workers assigned to shifts, it is a conservative estimate of the maximum number of fossil plant personnel that would be within the exclusion area at any given time. Evacuation procedures for Waterford SES Units 1 and 2 are described in the Waterford 3 Emergency Plan Implementing Document.

5.1 SITE CHARACTERISTICS (cont'd)

A portion of the land within the SITE BOUNDARY is utilized for agricultural activities. Farmers presently work the land but can be expected to actually be in the field less than 10 percent of the time.

Fishing in the Mississippi River from the batture is a rare practice in the Waterford area. An estimated maximum of 2 people may be expected to be engaged in this activity for a period less than 10 percent of the time within the exclusion area.

Texaco maintains a gas valve station east-southeast of the Waterford 3 SES island structure just within the radius of the exclusion area. This valve station is automated and requires only periodic monthly maintenance involving, typically, two persons. Evacuation procedures for these maintenance workers are described in the Waterford 3 Emergency Plan Implementing Document.

The Waterford property is shown in Figure 5.1-3 of the STS and includes 3,561.3 acres. The plant area is about 48 acres and is defined as including the fenced area immediately adjacent to Waterford 3. The site area is shown in Figure 5.1-3 of the STS along with principal station structures and nearby features. The site includes only station structures and does not include any residential, recreational, or other industrial structures. There is a visitor center and adjacent recreational area approximately 1.0 mile SSW of the plant.

The SITE BOUNDARIES for establishing effluent release limits along with radioactive effluent release points are given in Attachment 6.1. The nearest distances to the boundary line are shown in Attachment 6.2 of this procedure. The release point elevations for gaseous effluents are provided in Attachment 6.1.

5.1 SITE CHARACTERISTICS (cont'd)

The restricted area, defined for the purpose of controlling ingress into and egress from the site, coincide with the plant area which is enclosed by the plant perimeter fence.

For the purpose of establishing effluent release limits in accordance with 10CFR20 and Appendix I to 10CFR50, the concept of the restricted area, as defined above for the purpose of ingress and egress control, is not applicable. The effluent release limits are established in order to ensure that: (1) the concentrations of the radionuclides in gaseous effluents discharged from the plant stack and exhaust systems do not result in exceeding the limits outside the site boundary set forth in Table II, Column 1 of Appendix B to 10CFR20; (2) the concentration of radionuclides in liquid effluent at the unrestricted area boundary does not exceed the limits set forth in Table II, Column 2 of Appendix B to 10CFR20; and (3) the cumulative liquid and gaseous radionuclide releases do not result in exposures to individuals outside the UNRESTRICTED AREA or SITE BOUNDARY in excess of the limits set forth in Appendix I to 10CFR50.

1980 population by annular sectors within 5 miles of Waterford 3 can be found in the Environmental Report. Population was estimated for 1977 and projected for 1980. The methodology for estimating and projecting population is described in detail in section 6.1.4.2 of the Environmental Report. The closest town to Waterford 3 is Killona, 0.9 miles west-northwest. Other towns near the plant include Morco 2.5 miles east; Hahnville, 3.7 miles east-southeast; and LaPlace, 4.7 miles north. There are also smaller settlements and homes along both banks of the river, the nearest such place to Waterford 3 being Montz, 1.0 mile northeast.

5.2 SPECIFICATIONS AND SURVEILLANCE REQUIREMENTS

- 5.2.1 Compliance with the SPECIFICATIONS contained in the succeeding sections is required during the OPERATIONAL MODES or other conditions specified therein; except that failure to meet the SPECIFICATIONS requires that the associated ACTION requirements shall be met.
- 5.2.2 Noncompliance with this procedure shall exist when the requirements of the SPECIFICATION and/or associated ACTION requirements are not met within the specified time intervals. If the SPECIFICATION is restored prior to expiration of the specified time intervals, completion of the ACTION requirements is not required.
- 5.2.3 Surveillance Requirements shall be applicable during all OPERATIONAL MODES or other conditions specified for individual systems unless otherwise stated in an individual Surveillance Requirement.
- 5.2.4 Each Surveillance Requirement shall be performed within the specified time interval with:
 - 5.1.4.1 A maximum allowable extension not to exceed 45% of the surveillance interval.

5.2 SPECIFICATIONS AND SURVEILLANCE REQUIREMENTS

5.2.5 Failure to perform a Surveillance Requirement within the specified time interval shall constitute a failure to meet the OPERABILITY requirements for a Specific System for Operation. Exceptions to these requirements are stated in the individual specifications. Surveillance Requirements do not have to be performed on inoperable equipment.

5.2.6 Failure to comply with the compensatory ACTION requirements or failure to complete the surveillance requirements within the specified time shall be documented and evaluated in accordance with Reference 2.9.

5.3 LIQUID EFFLUENTS

5.3.1 Concentration Specification

The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Attachment 6.1) 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 2×10^{-4} microcurie/ml total activity.

APPLICABILITY: At all times

ACTION:

With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, immediately restore the concentration to within the above limits, and describe the events leading to this condition in the next Semiannual Radioactive Effluent Release Report.

SURVEILLANCE REQUIREMENTS

- a. Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 5.3-1.
- b. The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in section 5.3.5 to assure that the concentrations at the point of release are maintained within the limits of Specification 5.3.1.

TABLE 5.3-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (μCi/mL)
A. Batch Waste Release Tanks ^{b,f,g,h,i}	P Each Batch	P Each Batch	Principal Gamma Emitters ^c	5x10 ⁻⁷
			I-131	1x10 ⁻⁶
1. Boric Acid Condensate	P	M	Dissolved and Entrained Gases (Gamma Emitters)	1x10 ⁻⁵
2. Waste Condensate	One Batch/M			
	P Each Batch	M Composite ^d	H-3	1x10 ⁻⁵
3. Laundry Waste			Gross Alpha	1x10 ⁻⁷
	P	Q	Sr-89, Sr-90	5x10 ⁻⁸
4. Turbine Building Industrial Waste Sumps*	Each Batch	Composite ^d		
			Fe-55	1x10 ⁻⁶
5. Dry Cooling Tower Sumps #1 and #2*				
6. Regenerative Waste				
7. Filter Flush				
8. Waste				

*When release from this source is batch in nature.

TABLE 5.3-1 (Continued)

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (μCi/mL)
B. Continuous Release ^{e, f}	W Grab Sample	W	Principal Gamma Emitters ^c	5x10 ⁻⁷
1. Turbine Building Industrial Waste Sumps ^{g, h}			I-131	1x10 ⁻⁶
2. Dry Cooling Tower Sump #1 ^{g, i}	M Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	1x10 ⁻⁵
3. Dry Cooling Tower Sump #2 ^{g, i}	W Grab Sample	M Composite ^d	H-3	1x10 ⁻⁵
			Gross Alpha	1x10 ⁻⁷
4. Circulating Water Discharge- Steam Generator Blow-down HX	W Grab Sample	Q Composite ^d	Sr-89, Sr-90	5x10 ⁻⁸
			Fe-55	1x10 ⁻⁶
5. Auxiliary Component Cooling Water Pumps ⁱ				

^{g, h, i}When release from this source is continuous in nature.

TABLE 5.3-1 (Continued)

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a ($\mu\text{Ci/mL}$)
B. Continuous Release ^{e, f}	W Continuous ^k	W Composite ^d	Principal Gama Emitters ^c	5×10^{-7}
6. Steam Generator Blowdown Discharge ^{j, l}			I-131	1×10^{-6}
	M Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
	W Continuous ^k	M Composite ^d	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	W Continuous ^k	Q Composite ^d	Sr-89, Sr-90	5×10^{-8}
			Fe-55	1×10^{-6}

TABLE 5.3-1 (Continued)
TABLE NOTATION

^aThe 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 is the "a priori" lower limit of detection as defined above, as microcuries per unit mass or volume,

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

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fraction radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for plant effluents is the elapsed time between the midpoint of sample collection and the time of counting.

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.

^bA 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 Section 5.3.6 to assure representative sampling.

TABLE 5.3-1 (Continued)
TABLE NOTATIONS

^cThe 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 6.9.1.8.

^dA 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.

^eA 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.

^fPrior to analyses, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.

^gIf the contents of the filter flush tank or the regenerative waste tank contain detectable radioactivity, no discharges from these tanks shall be made to the UNRESTRICTED AREA and the contents of these tanks shall be directed to the liquid radwaste treatment system.

^hTurbine Building Industrial Waste Sump (TBIWS)

The TBIWS shall be required to be sampled and analyzed in accordance with this table if any of the following conditions exist:

- (1) Primary to secondary leakage is occurring; or,
- (2) Activity is present in the secondary system as indicated by either the SGB monitors or secondary sampling and analysis; or,
- (3) Activity was present in the TBIWS during the previous 4 weeks.

If none of the above situations exists, then the sampling and analysis of this stream need not be performed.

ⁱSampling and analysis of the dry cooling tower sumps and the auxiliary component cooling water pump discharge will be required only when detectable activity exists in the CCW.

Sampling and analysis of the circulating water discharge-steam generator blowdown heat exchanger discharge (CWD-SGB) will be required only when detectable activity exists in the secondary system.

TABLE 5.3-1 (Continued)
TABLE NOTATIONS

^j Sampling and analysis of the steam generator blowdown will be required only when the blowdown is directed to the circulating water system or Waterford 3 waste pond.

Steam generator blowdown to the Waterford 3 waste pond will be limited to situations requiring secondary chemistry control where the Circulating Water System is not available or the secondary chemistry is outside the requirements for Circulating Water System discharge. Blowdown to the waste pond will be terminate upon direction of sample & activity greater than the LLD levels of Table 5.3-1.

^k To be representative of the quantities and concentration of radioactive materials in liquid effluents, samples shall be collected continuously in proportion to the rate of flow of the effluent stream.

^l Steam generator blowdown discharge to the waste pond is not available unless radiation monitoring and automatic isolation capabilities are added to the waste pond discharge path.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.2 Dose Specification

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to UNRESTRICTED AREAS (see Attachment 6.1) shall be limited:

- a. During any calendar quarter to less than or equal to 1.5 mrems to the total body and to less than or equal to 5 mrems to any organ, and
- b. During any calendar year to less than or equal to 3 mrems to the total body and to less than or equal to 10 mrems to any organ.

APPLICABILITY: At all times.

ACTION:

- a. With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identified the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits. This Special Report shall also include (1) the results of radiological analyses of the drinking water source and (2) the radiological impact on finished drinking water supplies with regard to the requirements of 40 CFR Part 141.

5.3 LIQUID EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS:

- a. Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with methodology and parameters in Section 5.3.7 at least once per 31 days.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.3 Liquid Radwaste Treatment System Specification

The liquid radwaste treatment system shall be OPERABLE and appropriate portions of the system shall be used to reduce releases of radioactivity when the projected doses due to the liquid effluent to UNRESTRICTED AREAS (see Attachment 6.1) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31 day period.

APPLICABILITY: At all times.

ACTION:

- a. With radioactive liquid waste being discharged without treatment and in excess of the above limits and any portion of the liquid radwaste treatment system not in operation, prepare and submit to the Commission within 30 days pursuant to Technical Specification 6.9.2 a Special Report that includes the following information.
 1. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,
 2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and
 3. Summary description of action (s) taken to prevent a recurrence.

5.3 LIQUID EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS

- a. Doses due to liquid releases to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters in Section 5.3.7.
- b. The installed Liquid Radwaste Treatment System shall be demonstrated OPERABLE by meeting Specifications 5.3.1 and 5.3.2.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.4 Liquid Effluent Dose Calculation

5.3.4.1 The dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas are calculated for the purpose of implementing Section 5.3.2 using the following expression:

$$D_{t\ell} = \Delta t_{\ell} F_{\ell} \sum_{i=1}^n A_{it} C_{i\ell} \quad (1)$$

$$D_t = \sum_{\ell=1}^m D_{t\ell} \quad (2)$$

Where:

$D_{t\ell}$ = the cumulative dose commitment to the total body or any organ (t) from the liquid effluents for each liquid release in mrem during time period (ℓ)

D_t = the cumulative dose commitment to the total body or any organ (t) from the liquid effluents for all (ℓ) time periods

Δt_{ℓ} = the length of the ℓ^{th} time period over which the release is made, in hours

$C_{i\ell}$ = the concentration of radionuclide (i) in undiluted liquid effluent during time period Δt_{ℓ} from any liquid release, in $\mu\text{Ci/ml}$

5.3 LIQUID EFFLUENTS (cont'd)

A_{it} = the site-related liquid ingestion dose commitment factor to the total body or any organ (t) for each identified nuclide (i) in mrem-ml/hr- μ Ci (Attachment 6.3)

F_d = the near field average dilution factor for C_{il} during any liquid effluent release. Defined as the ratio of the undiluted liquid waste flow during release to the average flow from the site discharge structure to site boundary receiving waters.

$$F_d = \frac{\text{liquid radioactive waste flow}}{\text{discharge structure exit flow}}$$

The liquid radioactive waste flow is the maximum flow from the effluent release. The discharge structure exit flow is the flow during disposal from the discharge structure release point into the receiving water body. For radionuclides not determined in each batch or weekly composite, the dose contribution to the current calendar quarter cumulative summation may be approximated by using a ratio of concentrations based on the previous monthly or quarterly composite analyses.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.4.2 Equation (1) above for calculating the dose contributions required the use of a dose factor, A_{it} , for each nuclide (i) which embodies the dose factors and dilution factors for the points of pathway origin. The adult total body dose factor and the adult organ dose factor for each radionuclide will be used from Table E-11 of Regulatory Guide 1.109; thus the list contains critical organ dose factors for various organs. The dose factor is written:

$$A_{it} = K_D (U_W/D_W + U_f BF_i) DCF_{it} \quad (3)$$

where:

U_W = 730 l/yr adult water consumption,

D_W = Dilution factor from near field area to potable water intake,

= 220 for discharges from the circulating water discharge into the Mississippi River (based on the ratio of the average Mississippi River flow to the maximum discharge flow),

= 1 for discharges into the 40 Arpent Canal (based on the assumption that dilution from the near field area to a potable water intake is negligible),

A_{it} = Composite dose parameter for the total body or critical organ (t) of an adult for nuclide (i) for all appropriate pathways (mrem-ml/hr- μ Ci),

5.3 LIQUID EFFLUENTS (cont'd)

K_o = Unit conversion factor,

U_f = 21 kg/yr, adult fish consumption,

BF_i = Bioaccumulation factor for nuclide (i) in
fish (pCi/kg per pCi/l) from Table A-1 of
Regulatory Guide 1.109,

DCF_{it} = Dose conversion factor for nuclide (i) and
organ (t) for adults (mrem/pCi). Values are
from Table E-11 of Regulatory Guide 1.109,

NOTE

For other liquid pathways, the appropriate dose factors
will be utilized.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.5 Liquid Effluent Monitor Setpoint Calculation Methodology

Specifications 5.3.1 and 5.6.1 require that the liquid effluent monitoring instrumentation alarm/trip setpoints be set so that the concentration of radioactive material released from the site is limited to 10CFR20, 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 $2E-4$ $\mu\text{Ci/ml}$ total activity). This section presents the method to be used for determining setpoints in accordance with Surveillance Requirements 5.3.1 and 5.6.1.

5.3.5.1 The calculated setpoints for the liquid effluent monitors satisfy the following equation:

$$c = \frac{(SF) (RF) (F + f) \sum_{i=1}^n C_i}{TMPC (f)} \quad (4)$$

where;

$\sum_{i=1}^n C_i$ = the undiluted effluent gamma concentration $\mu\text{Ci/ml}$ for all radionuclides (i). The value will be derived from radioanalysis of liquid effluent to be released. This value will be supplied for each liquid release.

c = the setpoint, in $\mu\text{Ci/ml}$, of the liquid effluent monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release. This setpoint represents a value which, if exceeded would result in concentrations exceeding the limits of 10CFR20, Appendix B, Table II, Column 2, to an UNRESTRICTED AREA.

5.3 LIQUID EFFLUENTS (cont'd)

f = the liquid effluents flow as measured at the liquid effluent monitor location in gpm.

F = the dilution water flow as determined via pump curves or other appropriate measures that determine correct plant operating configuration in gpm.

NOTE

IF F is large compared to f then $F + f \cong F$.

SF = Safety factor to ensure that the effluent limit is not exceeded. Actual value is set by procedure (in the range 0.5 - 0.9).

RF = Release fraction allocated to this release (to be used only in situations of simultaneous or concurrent release).

$$TMPC = \sum_{i=1}^n \frac{C_i}{MPC_i} + \sum_{j=1}^m \frac{C_j}{MPC_j}$$

$\frac{C_j}{MPC_j}$ = the undiluted nongamma MPC_j fraction for all nongamma emitting radionuclides (j)

$\frac{C_i}{MPC_i}$ = undiluted gamma MPC_i fraction for all gamma emitting radionuclides (i)

MPC_j = Maximum Permissible Concentration for the applicable nongamma-emitting isotope (j) from 10CFR20, Appendix B, Table II, Column 2.

MPC_i = Maximum Permissible Concentration for the applicable gamma-emitting isotope (i) from 10CFR20, Appendix B, Table II, Column 2.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.5.2 The values of C_i and C_j will be measured for each release as appropriate and the parameters for f and F will be supplied based on current plant operating configurations. The setpoint will be calculated in terms of $\mu\text{Ci/ml}$ and the liquid effluent monitor will be adjusted as necessary to ensure that liquid releases are secured prior to exceeding limits specified in 10CFR20, Appendix B, Table II, Column 2 to an UNRESTRICTED AREA.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.6 Representative Liquid Sampling

Prior to grab sampling liquid waste tanks, methods should be used to guarantee representative sampling. Large volumes of liquid waste should be mixed in as short a time as possible and uniformly distributed prior to sampling. To determine the minimum mixing time for tanks from which releases are made, the following tests were performed prior to initial use for release purposes.

- a. The tank was filled to a known volume.
- b. A specific quantity of a selected chemical and/or sediments was added to the tank.
- c. Recirculation was initiated through the normal path.
- d. Periodic samples were taken until equilibrium is reached.
- e. The time observed to completely mix the tank is used as a minimum recirculation time prior to effluent sampling. Records of the test will be maintained.

5.3 LIQUID EFFLUENTS (cont'd)

5.3.7 Dose Projection for Liquid Effluents

Specification 5.3.3 requires that appropriate subsystems of the liquid radwaste treatment system be used to reduce releases of radioactivity when the projected doses due to the liquid effluent from each reactor unit to UNRESTRICTED AREAS would exceed 0.06 mrem total body or 0.2 mrem to any organ in a 31-day period. The following calculational method is provided for performing this dose projection.

At least once every 31 days, the total dose from all liquid releases for the quarter-to-date will be divided by the number of days into the quarter and multiplied by 31. If this projected dose exceeds 0.06 mrem total body or 0.2 mrem any organ, and the Liquid Waste Management System has not been operating, it shall be operated, if operation would reduce the monthly projected doses below 0.06 mrem total body or 0.2 mrem any organ. (This is performed in accordance with the Surveillance Requirements of 5.3.3.)

5.3 LIQUID EFFLUENTS (cont'd)

5.3.8 Liquid Effluent Bases

a. CONCENTRATION (Section 5.3.1)

This specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table II, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC and (2) the limits of 10 CFR Part 20.106(e) to the population. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

The sampling and analysis of the contents of the regenerative waste tank and the filter flush tank is performed if primary to secondary leakage occurs in a steam generator. The contents of these tanks cannot be discharged to the UNRESTRICTED AREA if any radioactivity is detected in these tanks since the discharge from these tanks is unmonitored. When radioactivity is detected in these tanks, the contents from these tanks must be discharged to the liquid radwaste system where the contents may then be monitored upon discharge.

5.3 LIQUID EFFLUENTS (cont'd)

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Handford Company Report ARH-SA-215 (June 1975).

b. DOSE (Section 5.3.2)

This specification is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." Also, for fresh water sites with drinking water supplies that can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR Part 141.

5.3 LIQUID EFFLUENTS (cont'd)

b. DOSE (Section 5.3.2) (cont'd)

The dose calculation methodology and parameters implement the requirement in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases or Reactor Effluents for the purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

c. LIQUID RADWASTE TREATMENT SYSTEM (Section 5.3.3)

The OPERABILITY of the liquid radwaste treatment system ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10CFR Part 50.36a, General Design Criterion 60 of Appendix A 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

5.4 GASEOUS EFFLUENTS

5.4.1 Dose Rate Specification

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY (see Attachment 6.1) shall be limited to the following:

- a. For noble gases: Less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin, and
- b. For iodine-131, iodine-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.

APPLICABILITY: At all times

ACTION:

With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the above limit(s), and describe the events leading to this condition in the next Semiannual Radioactive Effluent Release Report.

5.4 GASEOUS EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS:

- a. The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in Section 5.4.5.
- b. Representative samples and analysis of gaseous effluents shall be obtained in accordance with the sampling and analyses program specified in Table 5.4-1.
- c. Based upon the sampling and analysis performed in Table 5.4-1 the dose rate due to I-131, I-133, H-3, and all other radionuclides in particulate form with half-lives greater than 8 days shall be determined to be within the above limits in accordance with the methodology and parameters in Section 5.4.5.

TABLE 5.4-1
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

GASEOUS RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (pCi/mL)
A. Waste Gas Holdup Tanks	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters ^b	1x10 ⁻⁴
B. Containment PURGE (Plant Stack)	P Each PURGE ^c Grab Sample	P Each PURGE ^c	Principal Gamma Emitters ^b	1x10 ⁻⁴
		M	H-3	1x10 ⁻⁵
C.1 Plant Stack	M ^{c,d,i} Grab Sample	M	Principal ^b Noble Gas Gamma Emitters	1x10 ⁻⁴
			H-3	1x10 ⁻⁵
C.2 Fuel Handling Building Ventilation (Normal) Exhaust	M ^{e,j} Grab Sample	M	Principal ^b Noble Gas Gamma Emitters	1x10 ⁻⁴
			H-3	1x10 ⁻⁵

TABLE 5.4-1 (Continued)
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

GASEOUS RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) ^a (pCi/mL)
D.1 All Release Types as listed in B., C.1, and C.2 above	Continuous ^{f,h,j}	W ^g	I-131	1x10 ⁻¹²
		Charcoal Sample	I-133	1x10 ⁻¹⁰
D.2 Main Condenser Evacuation and Turbine Gland Sealing System	Continuous ^{f,h,j}	W ^g Particulate Sample	Principal Particulate Gamma Emitters ^b	1x10 ⁻¹¹
	Continuous ^{f,h,j}	n Composite Particulate Sample	Gross Alpha	1x10 ⁻¹¹
	Continuous ^{f,h,j}	Q Composite Particulate Sample	Sr-89, Sr-90	1x10 ⁻¹¹
	Continuous ^{f,h,j}	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1x10 ⁻⁶

5.4-1 (Continued)
TABLE NOTATION

^aThe LLD is defined, for purpose 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 is the "a priori" lower limit of detection as defined above, as microcuries per unit mass or volume,

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

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for plant effluents is the elapsed time between the midpoint of sample collection and the time of counting.

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.

5.4-1 (Continued)

TABLE NOTATIONS

- ^bThe 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, I-133, Cs-134, Cs-137, C-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 Technical Specification 6.9.1.8.
- ^cSampling shall also be performed within 24 hours following shutdown, startup, or a THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period. Analysis for principle gamma emitters as defined in (b) above shall be completed within 48 hours of sampling.
- ^dTritium grab samples shall be taken at least once per 24 hours when the refueling canal is flooded.
- ^eTritium grab samples shall be taken 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.
- ^fThe 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 Section 5.4.1, 5.4.2, and 5.4.3.
- ^gSamples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing, or after removal from sampler. 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 in 1 hour 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 primary 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.
- ^hIf no primary to secondary leakage exists, then only the gross beta or gamma noble gases analysis need be performed for the main condenser evacuation and turbine gland sealing system. If a primary to secondary leak exists and the release from the main condenser evacuation and turbine gland sealing system has not been released via the plant stack, then the sampling and analysis must be performed.
- ⁱNote (c) above is not applicable for the plant stack unless the noble gas monitor shows that effluent activity has increased by a factor of 3.
- ^jFuel Handling Building sampling is required whenever irradiated fuel is in the storage pool.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.2 Dose-Noble Gas Specification

The air dose due to noble gases released in gaseous effluents to areas at and beyond the SITE BOUNDARY (see Attachment 6.1) 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.

APPLICABILITY: At all times.

ACTION:

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

SURVEILLANCE REQUIREMENTS:

Cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with the methodology and parameters in Section 5.4.6 at least once per 31 days.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.3 Dose - Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form Specification

The dose to MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the SITE BOUNDARY (see Attachment 6.1) 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.

APPLICABILITY: At all times

ACTION:

With the calculated dose from the release of iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

5.4 GASEOUS EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS:

Cumulative dose contributions for the current calendar quarter and current calendar year for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days shall be determined in accordance with the methodology and parameters in Section 5.4.7 at least once per 31 days.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.4 Gaseous Radwaste Treatment Specification

The VENTILATION EXHAUST TREATMENT SYSTEM and the WASTE GAS HOLDUP SYSTEM shall be OPERABLE and appropriate portions of these systems shall be used to reduce releases of radioactivity when the projected doses in 31 days due to gaseous effluent releases to areas at and beyond the SITE BOUNDARY (see Attachment 6.1) would exceed either:

- a. 0.2 mrad to air from gamma radiation, or
- b. 0.4 mrad to air from beta radiation, or
- c. 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

APPLICABILITY: At all times.

ACTION:

With radioactive gaseous waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that includes the following information:

- a. Identification of any inoperable equipment or subsystems, and the reason for the inoperability,
- b. Action(s) taken to restore the inoperable equipment to OPERABLE status, and
- c. Summary description of action(s) taken to prevent a recurrence.

5.4 GASEOUS EFFLUENTS (cont'd)

SURVEILLANCE REQUIREMENTS:

- a. Doses due to gaseous releases to areas at and beyond the SITE BOUNDARY shall be projected at least once per 31 days in accordance with the methodology and parameters in Section 5.4.9.
- b. The installed Gases Radwaste Treatment System shall be demonstrated operable by meeting Specifications 5.4.1, 5.4.2 or 5.4.3.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.5 Calculational Methodology for Gaseous Effluent Dose Rate

This section presents the calculational methods used for calculating gaseous effluent doses in fulfillment of Specification 5.4.1.

5.4.5.1 The dose rate due the radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to the following values and expressions:

Release rate limit for noble gases:

$$K' \overline{(X/Q)}_v \sum_{i=1}^n K_i Q_{iv} \leq 500 \text{ mrem/yr. total body} \quad (5)$$

$$K' \overline{(X/Q)}_v \sum_{i=1}^n (L_i + 1.1M_i) Q_{iv} \leq 3000 \text{ mrem/yr. skin} \quad (6)$$

Release rate limit for Iodine-131, Iodine-133, tritium and for all radionuclides in particulate form with half-lives greater than 8 days:

$$\overline{(X/Q)}_v \sum_{i=1}^n P_{it} Q_{iv} \leq 1500 \text{ mrem/yr any organ} \quad (7)$$

Where:

K' = a constant of unit conversion, $1E6pCi/\mu Ci$.

K_i = the total body dose factor due to gamma emissions for each identified radionuclide (i) in units of mrem/yr per pCi/m^3 (Attachment 6.4).

5.4 GASEOUS EFFLUENTS (cont'd)

L_i = the skin dose factor due to beta emissions for each identified radionuclide (i) in units of mrad/yr per pCi/m³ (Attachment 6.4).

M_i = the air dose factor due to gamma emissions for each identified radionuclide (i) in units of mrad/yr per pCi/m³ (Attachment 6.4). The constant 1.1 converts air dose to skin dose.

P_{it} = the thyroid dose parameter for Iodine-131, Iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days (i) for the inhalation pathway only, in mrem/yr per μ Ci/m³ (Same as R_i values for the child receptor listed in Attachment 6.5). The dose factor is based on the most restrictive age group (child) and most restrictive organ (thyroid) at the SITE BOUNDARY.

P_{it} = (child breathing rate of 3700 m³/yr)(DFA_i) (K') where DFA_i is the inhalation dose factor for each radionuclide from Table E-9, Reference 2.4

$\sum_{i=1}^n$ = summation for all identified radionuclides

5.4 GASEOUS EFFLUENTS (cont'd)

Q_{iv} = the average release rate of radionuclides (i) (either noble gas or Iodine-131, Iodine-133, tritium, and radionuclides in the particulate form with half-lives greater than 8 days, as appropriate) during the time of release from all vent releases (v). Value is averaged over one hour and is in units of $\mu\text{Ci/sec}$.

$(X/Q)_v$ = $1.1\text{E-}5 \text{ sec/m}^3$ in the ESE sector at 0.6 mile for all vent releases (v) (the highest calculated annual average dispersion factor at the SITE BOUNDARY based on historical data). The actual X/Q for the time of release may be determined and used under certain circumstances.

NOTE

All radioiodines are assumed to be released in elemental form.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.6 Calculational Methodology for Noble Gas Doses

This section presents the calculational methods used for calculating noble gas effluent dose in air in accordance with Surveillance Requirement 5.4.2.

5.4.6.1 The air dose due to noble gases released in gaseous effluents to areas at or beyond the SITE BOUNDARY will be determined by the following expressions:

a. During any calendar quarter, for gamma radiation:

$$D_Y = (1.14E2) \overline{(X/Q)}_v \sum_{i=1}^n (M_i) \sum_{j=1}^m (\Delta t_j) (Q_{ijv}) \quad (8)$$

and for beta radiation:

$$D_\beta = (1.14E2) \overline{(X/Q)}_v \sum_{i=1}^n (N_i) \sum_{j=1}^m (\Delta t_j) (Q_{ijv}) \quad (9)$$

b. During any calendar year, for gamma radiation:

$$D_Y = (1.14E2) \overline{(X/Q)}_v \sum_{i=1}^n (M_i) \sum_{j=1}^m (\Delta t_j) (Q_{ijv}) \quad (10)$$

and for beta radiation:

$$D_\beta = (1.14E2) \overline{(X/Q)}_v \sum_{i=1}^n (N_i) \sum_{j=1}^m (\Delta t_j) (Q_{ijv}) \quad (11)$$

Where:

D_Y = the total gamma (γ) air dose from gaseous effluents for the total time period and not to exceed 5 mrad quarterly and 10 mrad yearly.

5.4 GASEOUS EFFLUENTS (cont'd)

D_{β} = the total beta (β) air dose from gaseous effluents for the total time period and not to exceed 10 mrad quarterly and 20 mrad yearly.

Q_{ijv} = the average release rate of radionuclides (i) in gaseous effluent from all vent releases (v) in $\mu\text{Ci/sec}$ during the time period Δt_j .

$\overline{(X/Q)}_v = 1.1\text{E-}5 \text{ sec/m}^3$ in the ESE sector at 0.6 mile for all vent releases (v). The actual X/Q for the time of release may be determined and used under certain circumstances.

Δt_j = the length of the j^{th} time period over which Q_{ijv} are accumulated for all gaseous releases in hours.

M_i and N_i = the gamma and beta air dose factors (respectively) for a uniform semi-infinite cloud of radionuclide (i) in $\text{mrad/yr per } \mu\text{Ci/m}^3$ (Attachment 6.4).

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.7 Calculational Methodology for Doses Due to Radioiodines, Tritium, and Radioactive Materials in Particulate Form

This section presents the calculational methods used for calculating doses due to Iodine-131, Iodine-133, tritium, and radionuclides in particulate form in accordance with Surveillance Requirement.

5.4.7.1 The dose to an individual from Iodine-131, Iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the SITE BOUNDARY will be determined by the following expressions:

During any calendar quarter:

$$D_{ita} = 1.14E-4 \Delta t \sum_{i=1}^n R_{ita} W_v Q_{iv} \quad (12)$$

During any calendar year:

$$D_{ita} = 1.14E-4 \Delta t \sum_{i=1}^n R_{ita} W_v Q_{iv} \quad (13)$$

5.4 GASEOUS EFFLUENTS (cont'd)

Where:

$1.14E-4$ = a constant of units conversion

= $1\text{yr}/8760\text{ hr}$

D_{ita} = the cumulative dose to an organ (t), age group (a), due to radionuclides (i) in gaseous effluents; not to exceed 7.5 mrem quarterly or 15 mrem yearly.

W_v = the dispersion parameter for estimating the dose to an individual at the controlling location for long term vent releases (v).

W_v = $\overline{(X/Q)}_v$ for the inhalation pathway from vent releases (v) in sec/m^3 , from historical data, at the location of the critical receptor (Attachment 6.2).

W_v = $\overline{(D/Q)}_v$ for the food and ground plane pathways from vent releases (v) in m^2 , from historical data at the location of the critical receptor (Attachment 6.2).

5.4 GASEOUS EFFLUENTS (cont'd)

R_{ita} = the dose factor from each identified radionuclide (i), for each applicable organ (t), and age group (a), in mrem/yr per $\mu\text{Ci}/\text{m}^3$ for the inhalation pathway (Attachment 6.5) and in mrem/yr per $\mu\text{Ci}/\text{m}^2\text{-sec}$ for the food and ground plane pathways (Attachments 6.6, 6.7, 6.8, 6.9, and 6.10). For sectors with real pathways within 5 miles of the plant, the values of R_i are used based on these real pathways; for sectors with no real pathways within 5 miles from the plant, R_i is used assuming that the cow-grass-milk pathway exists at the 5-mile distance. (R_i 's were calculated using the methodology found in Reference 2.5, pages 31-36.)

Q_{iv} = the average release rate of radionuclides (i) in gaseous effluent from all vent releases (v) in $\mu\text{Ci}/\text{sec}$.

Δt = the time required for the release in hours for all releases per quarter or per year.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.8 Gaseous Effluent Monitor Setpoint Calculational Methodology

5.4.8.1 Specification 5.6.2 requires that the radioactive gaseous effluent monitoring instrumentation alarm/trip setpoints be set to ensure the limits of Specification 5.4.1 are not exceeded.

5.4.8.2 The calculated high alarm/flow termination setpoint is the maximum value for that particular release. For conservation, an administrative safety factor (SF) of usually 10% will be utilized in the setpoint calculation. To allow for simultaneous releases from common or different release points a Release Fraction (RF) may be used to allocate percentages of the total allowable release.

5.4.8.3 Since the noble gas dose rates are more limiting than the radioiodine dose rate, gaseous setpoints will be based on noble gas dose rates (less than or equal to 500 mrem/yr total body, and less than or equal to 3000 mrem/yr skin). Specifically, gaseous setpoints will be based on the most limiting of the following equations:

a. Total body (Q_{tb}):

$$Q_{tb} = \frac{(500 \text{ mrem/yr.})(RF)(SF)}{\frac{\sum_{i=1}^n K_i Q_{iv}}{\sum_{i=1}^n Q_{iv}}} \quad (14)$$

5.4 GASEOUS EFFLUENTS (cont'd)

Where:

$\sum_{i=1}^n$ = summation of all nuclides considered.

Q_{tb} = maximum release rate allowed to give a limiting total body dose rate of 500 mrem/yr in $\mu\text{Ci/sec}$.

K_i = the total body dose factor due to gamma emissions for each identified radionuclide (i) in units of mrem/yr per pCi/m^3 (Attachment 6.4).

Q_{iv} = average release rate of isotope (i) from the release point (v) in $\mu\text{Ci/sec}$.

RF = release fraction allotted to release point in consideration.

$(\overline{X/Q})_v$ = $1.1\text{E-}5 \text{ sec/m}^3$ (in the ESE sector at 0.6 mile). The sector with highest value of annual average atmospheric dispersion factor at the site boundary for the release point (v) in question.

SF = administrative safety factor to account for uncontrollable variables (sampling, monitoring errors, etc.). Usually, the SF takes on a value of 0.9.

5.4 GASEOUS EFFLUENTS (cont'd)

b. For Skin (Q_{skin}):

$$Q_{\text{skin}} = \frac{(3000 \text{ mrem/yr.})(RF)(SF)}{\overline{(X/Q)}_v (1E6 \text{ pCi/}\mu\text{Ci}) \frac{\sum_{i=1}^n (L_i + 1.1M_i)Q_{iv}}{\sum_{i=1}^n Q_{iv}}} \quad (15)$$

where all terms are as defined above except:

Q_{skin} = maximum release rate allowed to give a limiting skin dose of 3000 mrem/yr in $\mu\text{Ci/sec.}$

L_i = skin dose factor due to beta emissions for each identified radionuclide (i) in units of mrem/yr per pCi/m^3 (Attachment 6.4)

1.1 = conversion factor to convert from air to skin dose.

M_i = air dose factor due to gamma emissions for identified noble gas isotope (i) in units of mrad/yr per pCi/m^3 (Attachment 6.4).

5.4.8.4 The monitor setpoint is calculated in the following manner:

$$SN = \frac{Q}{F_{\text{max}}} \quad (16)$$

5.4 GASEOUS EFFLUENTS (cont'd)

Where:

SN = maximum monitor setpoint in $\mu\text{Ci}/\text{cm}^3$

F_{max} = maximum effluent flow rate (cm^3/sec)

Q = Minimum value of Q_{tb} or Q_{skin}

5.4.8.5 Since Kr-88 is the noble gas with the highest dose rate conversion factors, for conservatism, the preceding calculations may be computed using Kr-88 only. Total body dose becomes more limiting than skin and the release limit is:

$$Q_{\text{Kr-88}} = \frac{(500 \text{ mrem/yr.})(\text{RF})(\text{SF})}{(\text{X/Q})_v (1\text{E6 pCi}/\mu\text{Ci})(K_{\text{Kr-88}})} \quad (17)$$

where:

$Q_{\text{Kr-88}}$ = the maximum release rate, based on Kr-88, allowed to give a limiting total body dose rate of 500 mrem/yr in $\mu\text{Ci}/\text{sec}$.

$K_{\text{Kr-88}}$ = the total body dose factor due to Kr-88 in units of mrem/yr per pCi/m^3 (Attachment 6.4),

All other terms are previously defined.

The monitor setpoint can be calculated as:

$$\text{SN} = \frac{Q_{\text{Kr88}}}{F_{\text{max}}} \quad (18)$$

and all terms are previously defined

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.9 Dose Projection due to Gaseous Effluents

5.4.9.1 Specification 5.4.4 requires that appropriate subsystems of the Gaseous Radwaste Treatment System be used to reduce releases of radioactivity when the projected doses due to the gaseous effluent to areas at and beyond the SITE BOUNDARY would exceed, in a 31-day period, any of the following:

- 0.2 mrad to air from gamma radiation; or
- 0.4 mrad to air from beta radiation; or
- 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

5.4.9.2 The following calculational method is provided for performing this dose projection.

At least once every 31 days the gamma air dose, beta air dose and the maximum organ dose for the month-to-quarter will be divided by the number of days into the quarter and multiplied by 31. If these projected doses exceed any of the values listed above and the Gaseous Waste Management System has not been operating, it shall be operated to reduce radioactivity levels prior to release. (This is performed in accordance with the Surveillance Requirements of Specification 5.4.4.

5.4 GASEOUS EFFLUENTS (cont'd)

5.4.10 Gaseous Effluent Bases

a. DOSE RATE (Section 5.4.1)

This specification is provided to ensure that the dose at any time at and beyond the SITE BOUNDARY from gaseous effluents from all units on the site will be within the annual dose limits of 10 CFR Part 20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in a UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR Part 20.106(b)). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrem/year.

5.4 GASEOUS EFFLUENTS (cont'd)

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

b. DOSE - NOBLE GASES (Section 5.4.2)

The Specification is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. It implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose

5.4 GASEOUS EFFLUENTS (cont'd)

calculation methodology and parameters established for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in 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, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977.

Sections 5.4.2 and 5.4.3 equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

Grab sampling of effluents from the main condenser evacuation and turbine gland sealing system is not required when this source has been continuously discharging to the plant stack over the past 30 days. If no primary to secondary leakage in the steam generator exists, then there should be no radioactive release from the main condenser evacuation and turbine gland sealing system and the gross beta or gamma monitoring for noble gases will be sufficient to determine if any radioactivity is present in the release. If a primary to secondary leak exists, then the release from the main condenser evacuation and turbine gland sealing systems will be sampled and analyzed in accordance with Table 5.4-1.

5.4 GASEOUS EFFLUENTS (cont'd)

c. IODINE-131, IODINE-133, TRITIUM, AND RADIONUCLIDES
IN PARTICULATE FORM (Section 5.4.3)

This specification is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Specifications are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in 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, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions.

5.4 GASEOUS EFFLUENTS (cont'd)

The release rate specifications for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days are dependent upon the existing radionuclide pathways to man in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: (1) individual inhalation of airborne radionuclides, (2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, (3) deposition onto grassy areas where milk animals and meat-producing animals graze with consumption of the milk and meat by man, and (4) deposition on the ground with subsequent exposure of man.

d. GASEOUS RADWASTE TREATMENT (Section 5.4.4)

The OPERABILITY of the WASTE GAS HOLDUP SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The discharge from the main condenser evacuation and turbine gland sealing system shall be required to be directed to the plant stack when the release rate of I-131 from this source is $\geq 2 \times 10^{-4}$ $\mu\text{Ci/s}$. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Section II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

5.5 TOTAL DOSE

5.5.1 TOTAL DOSE SPECIFICATION

The annual (calander year) dose or dose commitment to any MEMBER OF THE PUBLIC due to release of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal tp 75 mrems.

APPLICABILITY: At all times.

ACTION:

With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specification 5.3.2.a, 5.3.2.b, 5.4.2.a, 5.4.2.b, 5.4.3.a, or 5.4.3.b calculations shall be made including direct radiation contributions from the reactor units and from outside storage tanks to determine whether the above limits of Specification 5.5.1 have been exceeded. This evaluation should be done in accordance with guidance in Section 5.5.2. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR 20.405c, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and

5.5 TOTAL DOSE

5.5.1 TOTAL DOSE SPECIFICATION (cont'd)

concentration of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

SURVEILLANCE REQUIREMENTS:

- a. Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Specification 5.3.2, 5.4.2, and 5.4.3 and in accordance with the methodology and parameters in the ODCM.
- b. Cumulative dose contributions from direct radiation from the reactor units and from radwaste storage tanks shall be determined in accordance with the methodology and parameters in the ODCM. This requirements is applicable only under condition set forth in Specification 5.5.1.

5.5 TOTAL DOSE (cont'd)

5.5.2 40 CFR 90 DOSE EVALUATION

This section demonstrates compliance with Specification 5.5.1 Surveillance Requirements. Specifically, the dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and 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) over 12 consecutive months.

Dose evaluations to demonstrate compliance with the above dose limits need to be performed only if quarterly doses exceed:

- (1) 3 mrem to the total body (liquid releases).
- (2) 10 mrem to any organ (liquid releases).
- (3) 15 mrem to the thyroid or any organ from radioiodines and particulates (gaseous releases).

otherwise no evaluations are required.

For the evaluation of doses to real individuals from liquid releases, the same calculational methods as employed in Section 5.3.4 will be used. However, more encompassing and realistic assumptions will be made concerning the dilution and ingestion of radionuclides by individuals who live and fish in the Waterford 3 area. The results of the Radiological Environmental Monitoring Program will be used in determining the realistic dose based on actual measured radionuclide concentra-

5.5 TOTAL DOSE (cont'd)

tions. For the evaluation of doses to real individuals from gaseous releases, the same calculational methods as employed in sections 5.4.6 and 5.4.7 will be used. The total body dose factor should be substituted for the gamma air dose factor (M_i) to determine the total body dose. Otherwise, the same calculational sequence applies. More realistic assumptions will be made concerning the actual location of real individuals, the meteorological conditions, and the consumption of food. Data obtained from the latest land use census should be used to determine locations for evaluating doses. The results of the Radiological Environmental Monitoring Program will be included in determining more realistic doses based on actual measured radionuclide concentrations.

Cumulative dose contributions from direct radiation, from the reactor unit, and from Radwaste Storage Tanks shall be determined utilizing the results of routine plant perimeter surveys, TLD data, or a combination of both when necessary.

5.5 TOTAL DOSE (cont'd)

5.5.3 Total Dose Bases

The specification is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant generated radioactive effluents and direct radiation exceed 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. For sites containing up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the reactor units and outside storage tanks are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that dose contribution from other nuclear fuel cycle facilities at the same site or within a radius of 8 km must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.405c, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed.

5.5 TOTAL DOSE (cont'd)

5.5.3 Total Dose Bases

The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in Specifications 5.3.1 and 5.4.1. An individual is not considered a MEMBER OF THE PUBLIC during in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

5.6 INSTRUMENTATION

5.6.1 Radioactive Liquid Effluent Monitoring Instrumentation Specification

The radioactive liquid effluent monitoring instrumentation channels shown in Table 5.6-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 5.3.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in Section 5.3.5.

APPLICABILITY: At all times.

ACTION:

- a. With radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above Specification, immediately suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable.
- b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 5.6-1. Restore the inoperable instrumentation to OPERABLE status within 30 days or, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report, pursuant to Technical Specification 6.9.1.8, why this inoperability was not corrected within the time specified. Releases need not be terminated after 30 days provided the specified ACTIONS are continued.

5.6 INSTRUMENTATION (Cont'd)

SURVEILLANCE REQUIREMENT

Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 5.6-2.

TABLE 5.6-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>ACTION</u>
1. RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
a. Boric Acid Condensate Discharge	1	28
b. Waste, Waste Condensate and Laundry Discharge	1	28
c. Dry Cooling Tower Sumps	1/sump	29
d. Turbine Building Industrial Waste Sump	1	29
e. Circulating Water Discharge (Blowdown Heat Exchanger and Auxiliary Component Cooling Water Pumps) #	1	29
2. CONTINUOUS COMPOSITE SAMPLERS		
a. Steam Generator Blowdown Effluent Line	1	29
3. FLOW RATE MEASUREMENT DEVICES		
a. Boric Acid Condensate Discharge	1	30
b. Waste, Waste Condensate and Laundry Discharge	1	30
c. Turbine Building Industrial Waste Sump*	N.A.	N.A.
d. Dry Cooling Tower Sumps*	N.A.	N.A.
e. Circulating Water Discharge* (Blowdown and Blowdown Heat Exchanger and Auxiliary Component Cooling Water Pumps)	N.A.	N.A.

#Automatic termination of blowdown discharge only

TABLE 5.6-1 (Continued)

TABLE NOTATIONS

*Pump performance curves generated in place shall be used to estimate flow.

ACTION STATEMENTS

ACTION 28 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that prior to initiating a release:

- a. At least two independent samples are analysed in accordance with Specification 5.3.1, and
- b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge line valving;

ACTION 29 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that grab samples are analyzed for radioactivity at a lower limit of detection of at least 10^{-7} microcurie/ml.

- a. At least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 microcurie/gram DOSE EQUIVALENT I-131, or
- b. At least once per 24 hours when the specific activity of the secondary coolant is less than or equal to 0.01 microcurie/gram DOSE EQUIVALENT I-131.

ACTION 30 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that the flow rate is estimated at least once per 4 hours during actual releases. Pump performance curves generated in place may be used to estimate flow.

TABLE 5.6-2

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

<u>INSTRUMENT</u>	<u>CHANNEL CHECK</u>	<u>CHANNEL SOURCE CHECK</u>	<u>CHANNEL CALIBRATION</u>	<u>FUNCTIONAL TEST</u>
1. RADIOACTIVITY MONITORS PROVIDING ALARMS AND AUTOMATIC TERMINATION OF RELEASE				
a. Boric Acid Condensate Discharge	P	P	R(3)	Q(1)
b. Waste, Waste Condensate and Laundry Discharge	P	P	R(3)	Q(1)
c. Dry Cooling Tower Sumps	D	M	R(3)	Q(5)
d. Turbine Building Industrial Waste Sump	D	M	R(3)	Q(5)
e. Circulating Water Discharge (Blowdown Heat Exchanger Auxiliary Component Cooling Water Pumps) #	D	M	R(3)	Q(5)
2. CONTINUOUS COMPOSITE SAMPLERS				
a. Steam Generator Blowdown Effluent Line	D(6)	N.A.	R	Q
3. FLOW RATE MEASUREMENT DEVICES				
a. Boric Acid Condensate Discharge	D(4)	N.A.	R	Q
b. Waste, Waste Condensate and Laundry Discharge	D(4)	N.A.	R	Q
c. Turbine Building Industrial Waste Sump	N.A.	N.A.	N.A.	N.A.
d. Dry Cooling Tower Sumps	N.A.	N.A.	N.A.	N.A.
e. Circulating Water Discharge (Blowdown and Blowdown Heat Exchangers and Auxiliary Component Cooling Water Pumps)	N.A.	N.A.	N.A.	N.A.

#Automatic termination of Blowdown discharge only

TABLE 5.6-2 (Continued)

TABLE NOTATION

1. The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occur if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm/trip setpoint.
 2. Circuit failure
 3. Instrument indicates a downscale failure.
2. The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm setpoint.
 2. Circuit failure.
3. The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Bureau of Standards or using standards that have been obtained from suppliers that participate in measurement assurance activities with NBS. These standards shall permit calibrating the system for over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used.
4. CHANNEL CHECK shall consist of verifying indication of flow during periods of release. CHANNEL CHECK shall be made at least once per 24 hours on days on which continuous, periodic, or batch releases are made.
5. The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway occurs if the instrument indicates measured levels above the alarm/trip setpoint and that control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm set.
 2. Circuit failure.
 3. Instrument controls not set in operate mode.
6. CHANNEL CHECK shall be made at least once per 24 hours on days on which continuous releases are made to the Circulating Water System or Waterford 3 waste pond.

5.6 INSTRUMENTATION (cont'd)

5.6.2 Radioactive Gaseous Effluent Monitoring Instrumentation Specifications

The radioactive gaseous effluent monitoring instrumentation channels shown in Table 5.6.3 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 5.4.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in Section 4.3.

APPLICABILITY: As shown in Table 5.6-3

ACTION:

- a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above Specification, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.
- b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 5.6-3. Restore the inoperable instrumentation to OPERABLE status within 30 days or, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report, pursuant to Technical Specification 6.9.1.8, why this inoperability was not corrected within the time specified. Releases need not be terminated after 30 days provided the specified ACTIONS are continued.

5.6 INSTRUMENTATION (cont'd)

SURVEILLANCE REQUIREMENTS:

Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 5.6-4.

TABLE 5.6-3

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>APPLICABILITY</u>	<u>ACTION</u>
1. WASTE GAS HOLDUP SYSTEM			
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	1	*	35
b. Effluent System Flow Rate Measuring Device	1	*	36
2. MAIN CONDENSER EVACUATION AND TURBINE GLAND SEALING SYSTEM			
a. Noble Gas Activity Monitor	1	*	37
b. Iodine Sampler [#]	1	*	39
c. Particulate Sampler [#]	1	*	39
d. Sampler Flow Rate Monitor	1	*	36

[#]If a primary to secondary leak exists or if the noble gas monitors in the main condenser evacuation and turbine gland sealing system or if the steam generator blowdown monitor indicates the presence of radioactivity in the secondary system, the flow from this release point shall be diverted immediately to the plant stack. These instruments are in the plant stack and sampling for radioiodines and particulates shall occur at the plant vent when this occurs.

TABLE 5.6-3 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>APPLICABILITY</u>	<u>ACTION</u>
4. REACTOR AUXILIARY BUILDING VENTILATION SYSTEM (PLANT STACK)			
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Releases [#]	1	*	37
b. Iodine Sampler	1	*	39
c. Particulate Sampler	1	*	39
d. Flow Rate Monitor	1	*	36
e. Sampler Flow Rate Monitor	1	*	36
5. FUEL HANDLING BUILDING VENTILATION SYSTEM (NORMAL)			
a. Noble Gas Activity Monitor	1	***	37
b. Iodine Sampler	1	***	39
c. Particulate Sampler	1	***	39
d. Flow Rate Monitor	1	***	36
e. Sampler Flow Rate Monitor	1	***	36

[#]Automatic termination of containment purge only.

TABLE 5.6-3 (Continued)

TABLE NOTATIONS

- *At all times.
- **During WASTE GAS HOLDUP SYSTEM operation.
- ***With irradiated fuel in the storage pool.

ACTION STATEMENTS

- ACTION 35 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, the contents of the tank(s) may be released to the environment provided best efforts are made to repair the instrument and that prior to initiating the release:
- a. At least two independent samples of the tank's contents are analyzed, and
 - b. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge valve lineup;
- ACTION 36 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that the flow rate is estimated at least once per 4 hours. For the waste gas holdup tank this action item is applicable only during periods of release. For the main condenser evacuation and turbine gland sealing systems, this action item applies only during release via the discharge silencer and only during turbine gland sealing operations and/or vacuum pump operation.
- ACTION 37 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided best efforts are made to repair the instrument and that grab samples are taken at least once per 12 hours and these samples are analyzed for gross activity within 24 hours. However, containment purging of radioactive effluents must be immediately suspended during this condition for the plant stack only.

TABLE 5.6-3 (Continued)
TABLE NOTATIONS

ACTION 39 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via the affected pathway may continue provided best efforts are made to repair the instrument and that samples are continuously collected with auxiliary sampling equipment as required in Table 5.4-1.

TABLE 5.6-4

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE IS REQUIRED
1. WASTE GAS HOLDUP SYSTEM					
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	P	P	R(3)	Q(1)	*
b. Effluent System Flow Rate Measuring Device	P	N.A.	R	Q	*
2. MAIN CONDENSER EVACUATION AND TURBINE GLAND SEALING SYSTEM					
a. Noble Gas Activity Monitor	D	M	R(3)	Q(2)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Sampler Flow Rate Monitor	D	N.A.	R	Q	*

TABLE 5.6-4 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

<u>INSTRUMENT</u>	<u>CHANNEL CHECK</u>	<u>SOURCE CHECK</u>	<u>CHANNEL CALIBRATION</u>	<u>CHANNEL FUNCTIONAL TEST</u>	<u>MODES IN WHICH SURVEILLANCE IS REQUIRED</u>
4. REACTOR AUXILIARY BUILDING VENTILATION SYSTEM (PLANT STACK)					
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	D	M	R(3)	Q(6)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate Monitor	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*
5. FUEL HANDLING BUILDING VENTILATION SYSTEM (NORMAL)					
a. Noble Gas Activity Monitor	D	M	R(3)	Q(2)	***
b. Iodine Sampler	W	N.A.	N.A.	N.A.	***
c. Particulate Sampler	W	N.A.	N.A.	N.A.	***
d. Flow Rate Monitor	D	N.A.	R	Q	***
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	***

#Automatic termination of containment purge only.

TABLE 5.6-4 (Continued)

TABLE NOTATIONS

*At all times.

~~When~~ When irradiated fuel is in the spent fuel pool.

1. The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm/trip setpoint.
 2. Circuit failure.
 3. Instrument indicates a downscale failure.
2. The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm setpoint.
 2. Circuit failure.
3. The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Bureau of Standards (NBS) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NBS. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used.
6. The CHANNEL FUNCTION TEST shall also demonstrate that automatic isolation of this pathway occurs if the instrument indicates measured levels above the alarm/trip setpoint and that control room alarm annunciation occurs if any of the following conditions exists:
 1. Instrument indicates measured levels above the alarm set.
 2. Circuit failure.
 3. Instrument controls not set in operate mode.

5.6 INSTRUMENTATION (Cont'd)

5.6.3 Instrumentation Bases

a. RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION (5.6.1)

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in Section 5.3.5 to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

b. RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION (5.6.2)

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in Section 5.4.8 to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. This instrumentation also include provisions for monitoring (and controlling) the concentrations of potentially explosive gas mixtures in the WASTE GAS HOLDUP SYSTEM. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

5.7 LIQUID AND GASEOUS RADWASTE PROCESSES

The block flow diagrams of the radwaste systems are shown in Attachments 6.11 and 6.12. In order to obtain a more detailed description, see the appropriate sections of the FSAR.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REQUIREMENTS

5.8.1 Radiological Environmental Program Specification

The radiological environmental monitoring program shall be conducted as specified in Table 5.8-1.

APPLICABILITY: At all times.

ACTION:

- a. With the radiological environmental monitoring program not being conducted as specified in Table 5.8-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Technical Specification 6.9.1.7, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.
- b. With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeding the reporting level: of Table 5.8-2 when averaged over any calendar quarter, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose* to a MEMBER OF THE PUBLIC is less than the calendar year limits of Specifications 5.3.2, 5.4.2, and 5.4.3. When more than one of the radionuclides in Table 5.8-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \dots \geq 1.0$$

*The methodology and parameters used to estimate the potential annual dose to A MEMBER OF THE PUBLIC shall be indicated in this report.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REQUIREMENTS (Cont'd)

When radionuclides other than those in Table 5.8-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose* to A MEMBER OF THE PUBLIC is equal to or greater than the calendar year limits of Specifications 5.3.2, 5.4.2, and 5.4.3. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.

- c. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 5.8-1, identify locations for obtaining replacement samples and add them to the radiological environmental monitoring program within 30 days.

The specific locations from which samples were unavailable may then be deleted from the monitoring program. Pursuant to Technical Specification 6.9.1.8, identify the cause of the unavailability of samples and identify the new location(s) for obtaining replacement samples in the next Semiannual Radioactive Effluent Release Report and also include in the report revisions of Attachments 6.13, 6.14, 6.16, 6.17 and 6.18 reflecting the new location(s).

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REQUIREMENTS (Cont'd)

SURVEILLANCE REQUIREMENTS:

The radiological environmental monitoring samples shall be collected pursuant to Table 5.8-1 from the specific locations given in Attachments 6.13 and 6.14, and shall be analyzed pursuant to the requirements of Table 5.8-1 and the detection capabilities require y Table 5.8-3.

TABLE 5.8-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM*

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS ^a	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
1. DIRECT RADIATION ^b	<p>31 routine monitoring stations either with 2 or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows:</p> <p>an inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY,</p> <p>an outer ring of stations, 1 in 10 of the meteorological sectors in the 6 - to 8-km range from the site;</p> <p>the balance of the 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</p>	Quarterly	Gamma dose quarterly.

*The number, media, frequency, and location of samples may vary from site to site. This table presents an acceptable minimum program for a site at which each entry is applicable. Local site characteristics must be examined to determine if pathways not covered by this table may significantly contribute to an individual's dose and should be included in the sampling program.

TABLE 5.8-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM*

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS ^a	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
2. AIRBORNE Radioiodine and Particulates	<p>Samples from 5 locations</p> <p>3 samples from close to the 3 SITE BOUNDARY locations, in different sectors, of the highest calculated annual average ground-level D/Q.</p> <p>1 sample from the vicinity of a community having the highest calculated annual average ground-level D/Q.</p> <p>1 sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction. ^c</p>	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	<p>Radioiodine Canister I-131 analysis weekly.</p> <p>Particulate Sampler: Gross beta radioactivity analysis following filter change; Gamma isotopic analysis ^e of composite (by location) quarterly.</p>
3. WATERBORNE			
a. Surface ^f	<p>1 sample upstream</p> <p>1 sample downstream</p>	Composite sample over 1-month period ^g	Gamma isotopic analysis ^e monthly. Composite for tritium analysis quarterly.
b. Ground	Samples from 1 or 2 sources only if likely to be affected ^h	Quarterly	Gamma isotopic ^e and tritium analysis quarterly.

TABLE 5.8-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM²

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS ^a	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
c. Drinking	1 sample of each of 1 to 3 of the nearest water supplies that could be affected by its discharge.	Composite sample over 2-week period ² when I-131 analysis is performed, monthly composite otherwise	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year. ¹ Composite for gross beta and gamma isotopic analyses ^e monthly. Composite for tritium analysis quarterly.
d. Sediment from shoreline	1 sample from downstream area with existing or potential recreational value.	Semiannually	Gamma isotopic analysis ^e semiannually.
4. INGESTION			
a. Milk	<p>Samples from milking animals in 3 locations within 5 km distance having the highest dose potential. If there are none, then, 1 sample from milking animals in each of 3 areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per yr.¹</p> <p>1 sample from milking animals at a control location 15-30 km distant and in the least prevalent wind direction.^c</p>	Semimonthly when animals are on pasture; monthly at other times	Gamma isotopic ^e and I-131 analysis semimonthly when animals are on pasture; monthly at other times.

TABLE 5.8-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM*

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS ^a	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
b. Fish and Inverte- brates	1 sample of each commercially and recreational important species in vicinity of plant discharge area. 1 sample of same species in areas not influenced by plant discharge.	Sample in season, or semiannually if they are not seasonal	Gamma isotopic analysis ^e on edible portions.
c. Food Products	1 sample of each principal class of food products from any area that is irrigated by water in which liquid plant wastes have discharged. Samples of 1 to 3 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. 1 sample of each of the similar broad leaf vegetation grown 15-30 km distant in the least prevalent wind direction if milk sampling is not performed.	At time of harvest ^j Monthly when available Monthly when available	Gamma isotopic analysis ^e on edible portion. Gamma isotopic ^e and I-131 analysis. Gamma isotopic ^e and I-131 analysis.

TABLE 5.8-1 (Continued)
TABLE NOTATIONS

- ^a Specific parameters of distance and direction sector from the centerline of one reactor, and additional description where pertinent, shall be provided for each and every sample location in Attachments 6.14, 6.16, 6.17 and 6.18. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and to Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, corrective action shall be completed prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.7. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program. Pursuant to Specification 6.9.1.8, identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining replacement samples in the next Semiannual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table reflecting the new location(s).
- ^b One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation. The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading.
- ^c The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites that provide valid background data may be substituted.
- ^d Airborne particulate sample filters shall be analyzed for gross beta radioactivity 34 hours or more after sampling to allow for random and thoron daughter decay. If gross beta activity in air particulate samples is greater than 10 times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.
- ^e Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

TABLE 5.8-1 (Continued)

TABLE NOTATIONS

- ^f The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream" sample shall be taken in an area beyond but near the mixing zone. "Upstream" samples in an estuary must be taken far enough upstream to be beyond the plant influence. Salt water shall be sampled only when the receiving water is utilized for recreational activities.
- ^g A composite sample is one in which the quantity (aliquot) of liquid sampled is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow. In this program composite sample aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) in order to assure obtaining a representative sample.
- ^h Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.
- ⁱ The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in this document.
- ^j If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvest occurs continuously, sampling shall be monthly. Attention shall be paid to including samples of tuberous and root food products.

TABLE 5.8-2

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 PRODUCTS (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		
Zn-65	300		20,000		
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	

TABLE 5

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

Lower Limits of Detection (LLD)^{bc}

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m ³)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
gross beta	4	0.01				
H-3	2000					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1 ^d	0.07		1	60	
Cs-134	15	0.05	30	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

TABLE 5.8-3
TABLE NOTATIONS

^aThis 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 analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 6.9.1.7.

^bRequired detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.

^cThe 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 is the "a priori" lower limit of detection as defined above, as microcuries per unit mass or volume,

^{s_b} is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate, as counts per minute,

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting

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

TABLE 5.8-3 (Continued)
TABLE NOTATIONS

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. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally 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 pursuant to Technical Specification 6.9.1.7.

^d LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.2 Interlaboratory Comparison Program Specification

Analyses shall be performed on all radioactive materials supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission.

APPLICABILITY: At all times.

ACTION:

- a. With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 6.9.1.7.

SURVEILLANCE REQUIREMENTS

The Interlaboratory comparison Program shall be described in Section 5.8.5. A summary of the results obtained as part of the above required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 6.9.1.7.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.3 Land Use Census Specification

A land use census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence, and the nearest garden* of greater than 50 m² (5000 ft²) producing broad leaf vegetation.

APPLICABILITY: At all times.

ACTION:

- a. With a land use census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Specification 5.4.3, identify the new location(s) in the next Semiannual Radioactive Effluent Release Report, pursuant to Specification 6.9.1.8.
- b. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained in accordance with Specification 5.7.1, add the new location(s) to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from this monitoring program after October 31 of the year in which this land use census was conducted. Pursuant to Technical Specification 6.9.1.8 identify the new location(s) in the next Semiannual Radioactive Effluent Release Report and also include in the report revision of Attachments 6.13, 6.14, 6.16, 6.17, and 6.18 reflecting the new locations(s).

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

SURVEILLANCE REQUIREMENTS

The land use census shall be conducted during the growing season at least once per 12 months using that information that will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 6.9.1.7.

*Broad leaf vegetation sampling of different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. Specifications for broad leaf vegetation sampling in Table 5.8-1 Part 4.c. shall be followed, including analysis of control samples.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.4 Description of the Radiological Environmental Monitoring Program

The Radiological Environmental Monitoring Program (REMP) is expounded on in Attachment 6.13, and the Sample Location Table, Attachment 6.14. Attachment 6.15 explains the sector and zone designations for the sample locations. Attachments 6.16, 6.17 and 6.18 show the sample locations within the 2, 10, and 50 mile radius of Waterford 3.

Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report. It is recognized that, at times, it may not be possible or practical continue to obtain samples of the media of choice at the most desired location or time. In these instances, suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the Radiological Environmental Monitoring Programs.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.5 Description of the Interlaboratory Comparison Program

As described in Section 5.8.2 the quality assurance in radiological environmental sampling will be maintained through participation in the Environmental Protection Agency's Radiological Laboratory Quality Assurance Program. The summary of results will be presented in tabular form and will include the type of analysis, the preparation (collection) date, the date the results are returned, the mean of the analyses (usually triplicate), the standard deviation, the date the values are released for information, the known value, the three standard deviation limit, and a two standard deviation/three standard deviation warning/action flag. If the sample analysis indicates results outside the three standard deviation range, then the corrective actions taken to prevent a recurrence will be documented and submitted along with all results when the Annual Radiological Environmental Operating Report is submitted.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.6 Dispersion Parameters For Critical Locations

As per Requirements 5.8.3, the dispersion parameters for the site boundary and where necessary, as identified by the Annual Land Use Census, are listed in Attachment 6.2. This table will be subject to changes based on the Annual Land Use Census and historical data.

5.8 RADIOLOGICAL ENVIRONMENTAL MONITORING (Cont'd)

5.8.7 Radiological Environmental Monitoring Bases

a. INTERLABORATORY COMPARISON PROGRAM (Section 5.8.2)

The requirement for participation in an approved Inter-laboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

b. LAND USE CENSUS (Section 5.8.3)

This specification is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the radiological environmental monitoring program are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey or from consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m² provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/yr) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: (1) 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and (2) a vegetation yield of 2 kg/m².

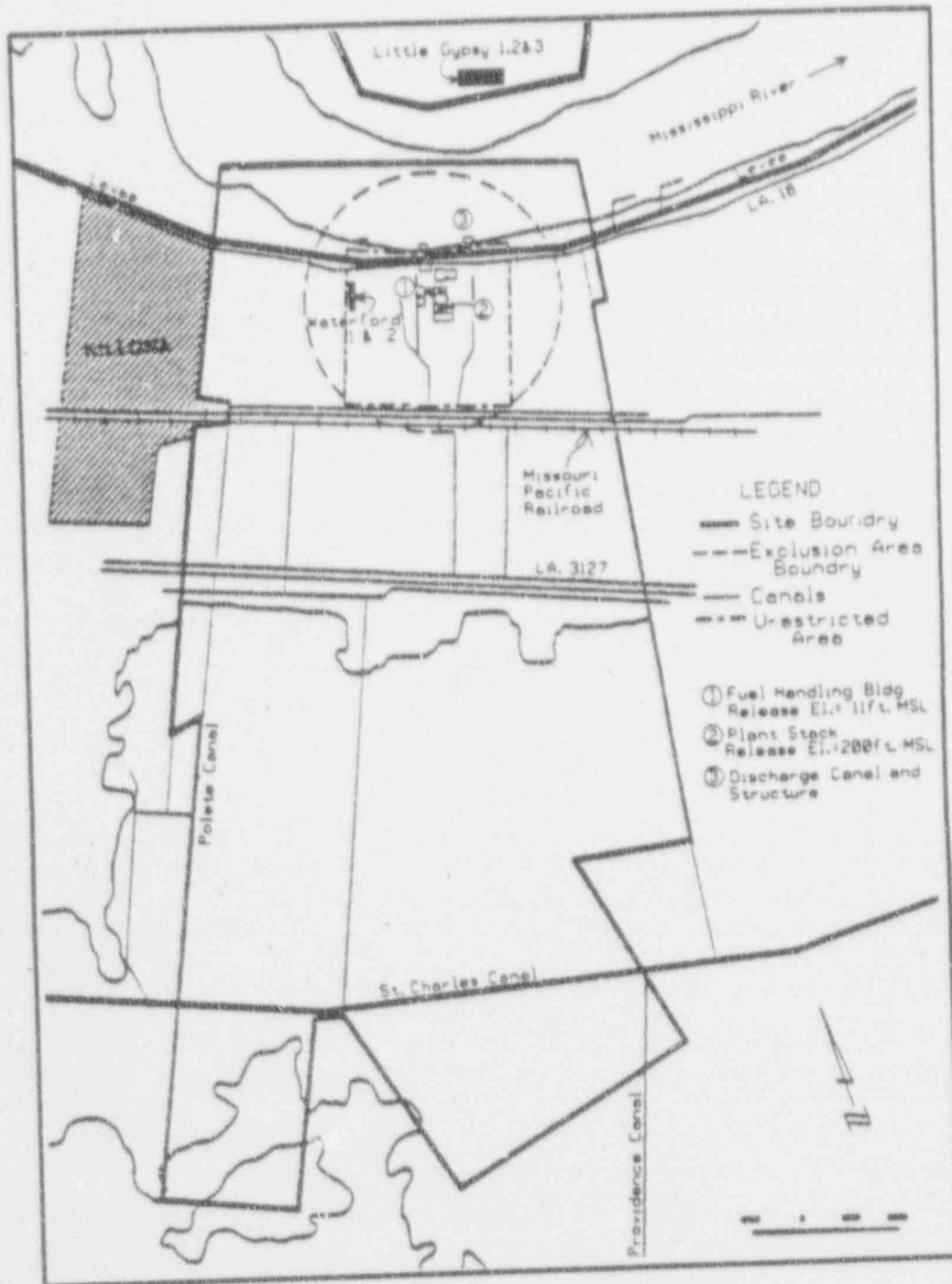
5.9 TECHNICAL SPECIFICATION CROSS-REFERENCES

Changes to the Technical Specifications (TS) recommended by Generic Letter 89-01 (Reference 2.8) resulted in programmatic controls for radiological effluents, radiological environmental monitoring, and effluent radiation monitoring instrumentation being relocated to the Offsite Dose Calculation Manual. All references of the former version of the TS that are contained in current plant operating procedures shall be cross-referenced to specifications contained in the ODCM using Attachment 6.20. Relocated requirements set forth in the ODCM should be incorporated into current plant operating procedures as they undergo routine review and revision.

6.0 ATTACHMENTS

Refer to Table of Contents

SITE BOUNDARY FOR
RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS



HISTORICAL AVERAGE DISPERSION AND DEPOSITION PARAMETERS FOR AREAS AT OR BEYOND THE UNRESTRICTED AREA BOUNDARY

ANNUAL AVERAGE ATMOSPHERIC DISPERSION AND DEPOSITION PARAMETERS
BASED ON HISTORICAL METEOROLOGICAL DATA AND CURRENT LAND USE CENSUS

RECEPTOR TYPE OR LOCATION	DIRECTION FROM SITE	SECTOR LOCATION	DISTANCE FROM SITE (miles) (meters)		X/Q NO DECAY UNDEPLETED (g/m ³)	D/Q (per m ²)
SITE BOUNDARY	N(a)	A	0.80	1287	1.0E-05	2.4E-08
	NNE(a)	B	0.60	966	1.6E-05	3.4E-08
	NE(a)	C	0.60	966	1.5E-05	2.8E-08
	ENE(a)	D	0.60	966	1.6E-05	2.5E-08
	E	E	0.80	1287	6.9E-06	1.3E-08
	ESE	F	0.60	966	1.1E-05	2.3E-08
	SE	G	0.60	966	1.1E-05	3.1E-08
	SSE	H	0.80	1287	6.3E-06	2.4E-08
	S	J	1.60	2575	8.9E-07	2.7E-09
	SSW	K	3.10	4989	3.0E-07	7.9E-10
	SW	L	3.40	5472	3.3E-07	9.1E-10
	WSW	M	1.50	2414	1.7E-06	4.9E-09
	W	N	1.00	1609	2.3E-06	7.3E-09
	WNW	P	0.80	1287	7.5E-06	2.7E-08
	NW	Q	0.80	1287	1.0E-05	3.2E-08
	NNW	R	0.90	1448	9.4E-06	2.4E-08
RESIDENCE	N	A	0.90	1448	7.8E-06	1.8E-08
	NNE	B	1.30	2092	3.0E-06	5.8E-09
	NE	C	0.90	1448	6.3E-06	1.2E-08
	ENE	D	0.90	1448	6.8E-06	1.1E-08
	E	E	2.20	3541	7.4E-07	1.0E-09
	ESE	F	3.10	4989	3.7E-07	4.8E-10
	SE	G	4.00	6437	2.3E-07	3.6E-10
	SW	H	1.00	1609	2.3E-06	7.3E-09
	WNW	P	0.90	1448	5.6E-06	2.0E-08
	NW	Q	0.90	1448	7.7E-06	2.3E-08
MILK COW	NW(b)	Q	0.90	1448	7.7E-06	2.3E-08
	NW	Q	4.90	7886	2.6E-07	4.1E-10
MILK GOAT	ENE(b)	D	1.00	1609	5.3E-06	8.2E-09
	E(b)	E	3.30	5311	3.6E-07	3.9E-10
VEGETABLE GARDEN	N	A	1.00	1609	6.1E-06	1.4E-08
	NNE	B	1.30	2092	3.0E-06	5.8E-09
	NE	C	0.90	1448	6.3E-06	1.2E-08
	ENE	D	0.90	1448	6.8E-06	1.1E-08
	E	E	2.20	3541	7.4E-07	1.0E-09
	ESE	F	2.20	3541	7.0E-07	1.1E-09
	SE	G	2.30	3701	6.2E-07	1.3E-09
	WSW	M	1.50	2414	1.7E-06	4.9E-09
	W	N	1.10	1770	1.9E-06	5.7E-09
	WNW	P	0.90	1448	5.6E-06	2.0E-08
	NW	Q	0.90	1448	7.7E-06	2.3E-08
	NNW	R	3.00	4828	7.7E-06	1.3E-09
BEEF COW	E	E	3.20	5150	3.7E-07	4.2E-10
	ESE	F	3.50	5633	3.0E-07	3.6E-10
	SE	G	4.50	7242	1.9E-07	2.8E-10
	WSW	M	1.20	1931	2.7E-06	8.6E-09
	WNW	P	0.90	1448	5.6E-06	2.0E-08
	NW	Q	0.90	1448	7.7E-06	2.3E-08
	NNW	R	2.30	3701	1.3E-06	2.4E-09

a. The site boundary in this sector is located over water. The location cannot be occupied continuously for the life of the plant.

b. The animals at this location do not produce milk for human consumption.

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: CIRCULATING WATER (into Mississippi River)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.66E-01	2.66E-01	2.66E-01	2.66E-01	2.66E-01	2.66E-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	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02
P-32	4.62E+07	2.87E+06	1.79E+06	0.00E+00	0.00E+00	0.00E+00	5.19E+06
CR-51	0.00E+00	0.00E+00	1.27E+00	7.62E-01	2.81E-01	1.69E+00	3.21E+02
MN-54	0.00E+00	4.32E+03	8.35E+02	0.00E+00	1.30E+03	0.00E+00	1.34E+04
MN-56	0.00E+00	1.10E+02	1.95E+01	0.00E+00	1.40E+02	0.00E+00	3.52E+03
FE-55	6.59E+02	4.56E+02	1.06E+02	0.00E+00	0.00E+00	2.54E+02	2.61E+02
FE-59	1.04E+03	2.45E+03	9.38E+02	0.00E+00	0.00E+00	6.83E+02	8.15E+03
CO-58	0.00E+00	8.95E+01	2.01E+02	0.00E+00	0.00E+00	0.00E+00	1.81E+03
CO-60	0.00E+00	2.57E+02	5.67E+02	0.00E+00	0.00E+00	0.00E+00	4.83E+03
NI-63	3.12E+04	2.16E+03	1.05E+03	0.00E+00	0.00E+00	0.00E+00	4.51E+02
NI-65	1.27E+02	1.64E+01	7.51E+00	0.00E+00	0.00E+00	0.00E+00	4.17E+02
CU-64	0.00E+00	1.70E+01	4.70E+00	0.00E+00	2.52E+01	0.00E+00	8.53E+02
ZN-65	2.32E+04	7.37E+04	3.33E+04	0.00E+00	4.93E+04	0.00E+00	4.64E+04
ZN-69	4.93E+01	9.43E+01	6.56E+00	0.00E+00	6.13E+01	0.00E+00	1.42E+01
SR-83	0.00E+00	0.00E+00	4.04E+01	0.00E+00	0.00E+00	0.00E+00	5.82E+01
SR-84	0.00E+00	0.00E+00	5.24E+01	0.00E+00	0.00E+00	0.00E+00	4.11E+04
SR-85	0.00E+00	0.00E+00	2.15E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-86	0.00E+00	1.01E+05	4.71E+04	0.00E+00	0.00E+00	0.00E+00	1.99E+04
SR-88	0.00E+00	2.90E+02	1.54E+02	0.00E+00	0.00E+00	0.00E+00	4.00E+09
SR-89	0.00E+00	1.92E+02	1.35E+02	0.00E+00	0.00E+00	0.00E+00	1.12E+11
SR-89	2.32E+04	0.00E+00	6.38E+02	0.00E+00	0.00E+00	0.00E+00	3.57E+03
SR-90	5.47E+05	0.00E+00	1.34E+05	0.00E+00	0.00E+00	0.00E+00	1.58E+04
SR-91	4.09E+02	0.00E+00	1.65E+01	0.00E+00	0.00E+00	0.00E+00	1.95E+03
SR-92	1.55E+02	0.00E+00	6.71E+00	0.00E+00	0.00E+00	0.00E+00	3.08E+03
Y-90	5.79E-01	0.00E+00	1.55E-02	0.00E+00	0.00E+00	0.00E+00	6.14E+03
Y-91M	5.47E-03	0.00E+00	2.12E-04	0.00E+00	0.00E+00	0.00E+00	1.61E-02
Y-91	8.49E+00	0.00E+00	2.27E-01	0.00E+00	0.00E+00	0.00E+00	4.67E+03
Y-92	5.09E-02	0.00E+00	1.49E-03	0.00E+00	0.00E+00	0.00E+00	8.91E+02

Conversion factors are in units of mrem/yr per uCi/ml

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: CIRCULATING WATER (in Mississippi River)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.61E-01	0.00E+00	4.46E-03	0.00E+00	0.00E+00	0.00E+00	5.12E+03
ZR-95	2.52E-01	8.07E-02	5.46E-02	0.00E+00	1.27E-01	0.00E+00	2.56E+02
ZY-97	1.39E-02	2.81E-03	1.28E-03	0.00E+00	4.24E-03	0.00E+00	8.69E+02
NR-95	4.47E+02	2.48E+02	1.34E+02	0.00E+00	2.46E+02	0.00E+00	1.51E+06
NO-99	0.00E+00	1.05E+02	1.99E+01	0.00E+00	2.37E+02	0.00E+00	2.43E+02
TC-99M	8.96E-03	2.53E-02	3.23E-01	0.00E+00	3.85E-01	1.24E-02	1.50E+01
TC-101	9.22E-03	1.33E-02	1.30E-01	0.00E+00	2.39E-01	6.79E-03	3.99E-14
RU-103	4.50E+00	0.00E+00	1.94E+00	0.00E+00	1.72E+01	0.00E+00	5.25E+02
RU-105	3.75E-01	0.00E+00	1.48E-01	0.00E+00	4.84E+00	0.00E+00	2.29E+02
RU-106	6.69E+01	0.00E+00	8.46E+00	0.00E+00	1.29E+02	0.00E+00	4.33E+03
AG-110M	8.27E-01	7.65E-01	4.54E-01	0.00E+00	1.50E+00	0.00E+00	3.12E+02
TE-125M	2.57E+03	9.30E+02	3.44E+02	7.72E+02	1.04E+04	0.00E+00	1.03E+04
TE-127M	6.49E+03	2.32E+03	7.90E+02	1.66E+03	2.63E+04	0.00E+00	2.17E+04
TE-127	1.05E+02	3.78E+01	2.28E+01	7.81E+01	4.29E+02	0.00E+00	8.32E+03
TE-129M	1.10E+04	4.11E+03	1.74E+03	3.78E+03	4.60E+04	0.00E+00	5.55E+04
TE-129	3.01E+01	1.13E+01	7.33E+00	2.31E+01	1.26E+02	0.00E+00	2.27E+01
TE-131M	1.66E+03	8.10E+02	6.75E+02	1.28E+03	8.21E+03	0.00E+00	8.05E+04
TE-131	1.89E+01	7.88E+00	5.96E+00	1.55E+01	8.27E+01	0.00E+00	2.67E+00
TE-132	2.41E+03	1.56E+03	1.47E+03	1.72E+03	1.50E+04	0.00E+00	7.39E+04
I-130	2.74E+01	8.09E+01	3.19E+01	6.86E+03	1.26E+02	0.00E+00	6.97E+01
I-131	1.51E+02	2.16E+02	1.24E+02	7.08E+04	3.70E+02	0.00E+00	5.70E+01
I-132	7.37E+00	1.97E+01	6.89E+00	6.89E+02	3.14E+01	0.00E+00	3.70E+00
I-133	5.15E+01	8.96E+01	2.73E+01	1.32E+04	1.56E+02	0.00E+00	8.06E+01
I-134	3.85E+00	1.05E+01	3.71E+00	1.81E+02	1.66E+01	0.00E+00	9.11E+03
I-135	1.61E+01	4.21E+01	1.55E+01	2.78E+03	6.75E+01	0.00E+00	4.75E+01
CS-134	2.98E+05	7.09E+05	5.79E+05	0.00E+00	2.29E+05	7.61E+04	1.24E+04
CS-136	3.12E+04	1.23E+05	8.86E+04	0.00E+00	6.85E+04	9.39E+03	1.40E+04
CS-137	3.82E+05	5.22E+05	3.42E+05	0.00E+00	1.77E+05	5.89E+04	1.01E+04
CS-138	2.64E+02	5.22E+02	2.59E+02	0.00E+00	3.84E+02	3.79E+01	2.23E-03
BA-139	9.66E-01	6.88E-04	2.83E-02	0.00E+00	6.43E-04	3.90E-04	1.71E+00

Conversion factors are in units of mrem/yr per uCi/ml

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: CIRCULATING WATER (into Mississippi River)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.02E+02	2.54E-01	1.32E+01	0.00E+00	8.63E-02	1.45E-01	4.16E+02
BA-141	4.69E-01	3.54E-04	1.58E-02	0.00E+00	3.29E-04	2.01E-04	2.21E-10
BA-142	2.12E-01	2.18E-04	1.33E-02	0.00E+00	1.84E-04	1.23E-04	2.99E-19
LA-140	1.51E-01	7.59E-02	2.01E-02	0.00E+00	0.00E+00	0.00E+00	5.57E+03
LA-142	7.71E-03	3.51E-03	8.73E-04	0.00E+00	0.00E+00	0.00E+00	2.56E+01
CE-141	2.59E-02	1.75E-02	1.99E-03	0.00E+00	8.15E-03	0.00E+00	6.71E+01
CE-143	4.57E-03	3.38E+00	3.74E-04	0.00E+00	1.49E-03	0.00E+00	1.26E+02
CE-144	1.35E+00	5.66E-01	7.26E-02	0.00E+00	3.35E-01	0.00E+00	4.57E+02
PR-143	5.34E-01	2.22E-01	2.75E-02	0.00E+00	1.28E-01	0.00E+00	2.43E+03
PR-144	1.81E-03	7.53E-04	9.21E-05	0.00E+00	4.25E-04	0.00E+00	2.61E-10
ND-147	3.79E-01	4.38E-01	2.62E-02	0.00E+00	2.56E-01	0.00E+00	2.10E+03
W-187	2.96E+02	2.47E+02	8.65E+01	0.00E+00	0.00E+00	0.00E+00	8.10E+04
NP-239	2.89E-02	2.85E-03	1.57E-03	0.00E+00	8.86E-03	0.00E+00	5.84E+02

Conversion factors are in units of mrem/yr per $\mu\text{Ci}/\text{d}$

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: ALL OTHERS (into 40 Arpent Canal)

NUCLIDE

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00
C-14	3.15E+04	6.30E+03	6.30E+03	6.30E+03	6.30E+03	6.30E+03	6.30E+03
NA-24	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02
P-32	4.62E+07	2.87E+06	1.79E+06	0.00E+00	0.00E+00	0.00E+00	5.20E+06
CR-51	0.00E+00	0.00E+00	1.69E+00	8.94E-01	3.29E-01	1.98E+00	3.76E+02
NH-54	0.00E+00	4.76E+03	9.08E+02	0.00E+00	1.42E+03	0.00E+00	1.45E+04
NH-56	0.00E+00	1.20E+02	2.12E+01	0.00E+00	1.52E+02	0.00E+00	3.82E+03
FE-55	8.87E+02	6.13E+02	1.43E+02	0.00E+00	0.00E+00	3.42E+02	3.52E+02
FE-59	1.40E+03	3.29E+03	1.26E+03	0.00E+00	0.00E+00	9.19E+02	1.10E+04
CO-58	0.00E+00	1.51E+02	3.39E+02	0.00E+00	0.00E+00	0.00E+00	3.06E+03
CO-60	0.00E+00	4.34E+02	9.58E+02	0.00E+00	0.00E+00	0.00E+00	8.16E+03
NI-63	4.19E+04	2.91E+03	1.41E+03	0.00E+00	0.00E+00	0.00E+00	6.07E+02
NI-65	1.70E+02	2.21E+01	1.01E+01	0.00E+00	0.00E+00	0.00E+00	5.61E+02
CU-64	0.00E+00	1.69E+01	7.93E+00	0.00E+00	4.26E+01	0.00E+00	1.44E+03
ZN-65	2.36E+04	7.50E+04	3.39E+04	0.00E+00	5.03E+04	0.00E+00	4.73E+04
ZN-69	5.02E+01	9.60E+01	6.67E+00	0.00E+00	6.24E+01	0.00E+00	1.44E+01
BR-83	0.00E+00	0.00E+00	4.38E+01	0.00E+00	0.00E+00	0.00E+00	6.30E+01
BR-84	0.00E+00	0.00E+00	5.67E+01	0.00E+00	0.00E+00	0.00E+00	4.45E+04
BR-85	0.00E+00	0.00E+00	2.33E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	1.03E+05	4.79E+04	0.00E+00	0.00E+00	0.00E+00	2.03E+00
BR-88	0.00E+00	2.95E+02	1.56E+02	0.00E+00	0.00E+00	0.00E+00	4.07E+09
BR-89	0.00E+00	1.95E+02	1.37E+02	0.00E+00	0.00E+00	0.00E+00	1.13E+11
BR-89	4.78E+04	0.00E+00	1.37E+03	0.00E+00	0.00E+00	0.00E+00	7.66E+03
SR-90	1.18E+06	0.00E+00	2.88E+05	0.00E+00	0.00E+00	0.00E+00	3.40E+04
SR-91	8.79E+02	0.00E+00	3.55E+01	0.00E+00	0.00E+00	0.00E+00	4.19E+03
SR-92	3.33E+02	0.00E+00	1.44E+01	0.00E+00	0.00E+00	0.00E+00	6.60E+03
Y-90	1.38E+00	0.00E+00	3.69E+02	0.00E+00	0.00E+00	0.00E+00	1.46E+04
Y-91M	1.30E+02	0.00E+00	5.04E+04	0.00E+00	0.00E+00	0.00E+00	3.82E+02
Y-91	2.02E+01	0.30E+00	5.39E+01	0.00E+00	0.00E+00	0.00E+00	1.11E+04
Y-92	1.21E+01	0.00E+00	3.53E+03	0.00E+00	0.00E+00	0.00E+00	2.12E+03

Conversion factors are in units of mrem/yr per uCi/ml

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT

DISCHARGE POINT: ALL OTHERS (into 40 Arpent Canal)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	3.83E-01	0.00E+00	1.06E-02	0.00E+00	0.00E+00	0.00E+00	1.22E+04
ZR-95	2.77E+00	8.88E-01	6.01E-01	0.00E+00	1.39E+00	0.00E+00	2.82E+03
ZR-97	1.53E-01	3.09E-02	1.41E-02	0.00E+00	4.67E-02	0.00E+00	9.57E+03
NR-95	4.47E+02	2.49E+02	1.34E+02	0.00E+00	2.46E+02	0.00E+00	1.51E+06
NO-99	0.00E+00	4.62E+02	8.79E+01	0.00E+00	1.05E+03	0.00E+00	1.07E+03
TC-99M	2.94E-02	8.32E-02	1.06E+00	0.00E+00	1.26E+00	4.07E-02	4.92E+01
TC-101	3.03E-02	4.36E-02	4.28E-01	0.00E+00	7.85E-01	2.23E-02	1.31E-13
RU-103	1.98E+01	0.00E+00	8.54E+00	0.00E+00	7.57E+01	0.00E+00	2.31E+03
RU-105	1.65E+00	0.00E+00	6.52E-01	0.00E+00	2.13E+01	0.00E+00	1.01E+03
RU-106	2.95E+02	0.00E+00	3.73E+01	0.00E+00	5.69E+02	0.00E+00	1.91E+04
AG-110M	1.41E+01	1.30E+01	7.74E+00	0.00E+00	2.56E+01	0.00E+00	5.32E+03
TE-125M	2.79E+03	1.01E+03	3.74E+02	8.39E+02	1.13E+04	0.00E+00	1.11E+04
TE-127M	7.05E+03	2.52E+03	8.59E+02	1.80E+03	2.86E+04	0.00E+00	2.36E+04
TE-127	1.14E+02	4.11E+01	2.48E+01	8.48E+01	4.66E+02	0.00E+00	9.03E+03
TE-129M	1.20E+04	4.47E+03	1.89E+03	4.11E+03	5.00E+04	0.00E+00	6.03E+04
TE-129	3.27E+01	1.23E+01	7.96E+00	2.51E+01	1.37E+02	0.00E+00	2.47E+01
TE-131M	1.80E+03	8.81E+02	7.34E+02	1.39E+03	8.92E+03	0.00E+00	8.74E+04
TE-131	2.05E+01	8.57E+00	6.47E+00	1.69E+01	8.98E+01	0.00E+00	2.90E+00
TE-132	2.62E+03	1.70E+03	1.59E+03	1.67E+03	1.63E+04	0.00E+00	8.02E+04
I-130	9.01E+01	2.66E+02	1.05E+02	2.25E+04	4.15E+02	0.00E+00	2.29E+02
I-131	4.96E+02	7.09E+02	4.06E+02	2.32E+05	1.22E+03	0.00E+00	1.87E+02
I-132	2.42E+01	6.47E+01	2.26E+01	2.26E+03	1.03E+02	0.00E+00	1.22E+01
I-133	1.69E+02	2.94E+02	8.97E+01	4.32E+04	5.13E+02	0.00E+00	2.64E+02
I-134	1.26E+01	3.43E+01	1.23E+01	5.94E+02	5.46E+01	0.00E+00	2.99E-02
I-135	5.28E+01	1.38E+02	5.10E+01	9.11E+03	2.22E+02	0.00E+00	1.56E+02
CS-134	3.03E+05	7.21E+05	5.89E+05	0.00E+00	2.33E+05	7.75E+04	1.26E+04
CS-136	3.17E+04	1.25E+05	9.01E+04	0.00E+00	6.97E+04	9.55E+03	1.42E+04
CS-137	3.88E+05	5.31E+05	3.48E+05	0.00E+00	1.80E+05	5.99E+04	1.03E+04
CS-138	2.69E+02	5.31E+02	2.63E+02	0.00E+00	3.90E+02	3.85E+01	2.27E-03
BA-139	9.00E+00	6.41E-03	2.64E-01	0.00E+00	5.99E-03	3.64E-03	1.60E+01

Conversion factors are in units of mrem/yr per uCi/ml

SITE RELATED LIQUID INGESTION DOSE COMMITMENT FACTORS (A_1) FOR INDIVIDUAL NUCLIDES

AGE GROUP: ADULT
DISCHARGE POINT: ALL OTHERS (into 40 Argent Canal)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	1.88E+03	2.37E+00	1.23E+02	0.00E+00	8.05E-01	1.35E+00	3.88E+03
BA-141	4.37E+00	3.30E-03	1.48E-01	0.00E+00	3.07E-03	1.87E-03	2.06E-09
BA-142	1.98E+00	2.03E-03	1.24E-01	0.00E+00	1.72E-03	1.15E-03	2.78E-18
LA-140	3.58E-01	1.80E-01	4.76E-02	0.00E+00	0.00E+00	0.00E+00	1.32E+04
LA-142	1.83E-02	8.33E-03	2.07E-03	0.00E+00	0.00E+00	0.00E+00	6.08E+01
CE-141	8.01E-01	5.42E-01	6.15E-02	0.00E+00	2.52E-01	0.00E+00	2.07E+03
CE-143	1.41E-01	1.04E+02	1.16E-02	0.00E+00	4.60E-02	0.00E+00	3.90E+03
CE-144	4.18E+01	1.75E+01	2.24E+00	0.00E+00	1.04E+01	0.00E+00	1.41E+04
PR-143	1.32E+00	5.28E-01	6.52E-02	0.00E+00	3.05E-01	0.00E+00	5.77E+03
PR-144	4.31E-03	1.79E-03	2.19E-04	0.00E+00	1.01E-03	0.00E+00	6.19E-10
MO-147	9.00E-01	1.04E+00	6.22E-02	0.00E+00	6.08E-01	0.00E+00	4.99E+03
W-187	3.04E+02	2.55E+02	8.90E+01	0.00E+00	0.00E+00	0.00E+00	8.34E+04
MP-239	1.28E-01	1.25E-02	6.91E-03	0.00E+00	3.91E-02	0.00E+00	2.57E+03

Conversion factors are in units of mrem/yr per uCi/ml

DOSE FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES

Nuclide	β -air*(N _i)	β -Skin**(L _i)	γ -Air* (M _i)	γ -Body**(K _i)
Kr-83m	2.88E-04	---	1.93E-05	7.56E-08
Kr-85m	1.97E-03	1.46E-03	1.23E-03	1.17E-03
Kr-85	1.95E-03	1.34E-03	1.72E-05	1.61E-05
Kr-87	1.03E-02	9.73E-03	6.17E-03	5.92E-03
Kr-88	2.93E-03	2.37E-03	1.52E-02	1.47E-02
Kr-89	1.06E-02	1.01E-02	1.73E-02	1.66E-02
Kr-90	7.83E-03	7.29E-03	1.63E-02	1.56E-02
Xe-131m	1.11E-03	4.76E-04	1.56E-04	9.15E-05
Xe-133m	1.48E-03	9.94E-04	3.27E-04	2.51E-04
Xe-133	1.05E-03	3.06E-04	3.53E-04	2.94E-04
Xe-135m	7.39E-04	7.11E-04	3.36E-03	3.12E-03
Xe-135	2.46E-03	1.86E-03	1.92E-03	1.81E-03
Xe-137	1.27E-02	1.22E-02	1.51E-03	1.42E-03
Xe-138	4.75E-03	4.13E-03	9.21E-03	8.83E-03
Ar-41	3.28E-03	2.69E-03	9.30E-03	8.84E-03

* $\frac{\text{mrad-m}^3}{\text{pCi-yr}}$

** $\frac{\text{mrem-m}^3}{\text{pCi-yr}}$

Extracted from Table B-1 of Regulatory Guide 1.109, Revision 1, 1977

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
C-14	1.82E+04	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03
NA-24	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04
P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
MN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
MN-56	0.00E+00	1.24E+00	1.83E-01	0.00E+00	1.30E+00	9.44E+03	2.02E+04
FE-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
CO-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.26E+05	1.06E+05
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
NI-63	4.32E+05	3.14E+04	1.45E+04	0.00E+00	0.00E+00	1.78E+05	1.34E+04
NI-65	1.54E+00	2.10E-01	9.12E-02	0.00E+00	0.00E+00	5.60E+03	1.23E+04
CU-64	0.00E+00	1.46E+00	6.15E-01	0.00E+00	4.62E+00	6.78E+03	4.90E+04
ZN-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
ZN-69	3.44E-02	6.51E-02	4.52E-03	0.00E+00	4.22E-02	9.20E+02	1.63E+01
BR-83	0.00E+00	0.00E+00	2.41E+02	0.00E+00	0.00E+00	0.00E+00	2.32E+02
BR-84	0.00E+00	0.00E+00	3.13E+02	0.00E+00	0.00E+00	0.00E+00	1.64E-03
BR-85	0.00E+00	0.00E+00	1.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04
BR-88	0.00E+00	3.87E+02	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.34E-09
BR-89	0.00E+00	2.56E+02	1.70E+02	0.00E+00	0.00E+00	0.00E+00	9.28E-12
BR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
BR-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
SR-91	6.19E+01	0.00E+00	2.50E+00	0.00E+00	0.00E+00	3.65E+04	1.91E+05
SR-92	6.74E+00	0.00E+00	2.91E-01	0.00E+00	0.00E+00	1.65E+04	4.30E+04
Y-90	2.09E+03	0.00E+00	5.61E+01	0.00E+00	0.00E+00	1.70E+05	5.06E+05
Y-91M	2.61E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	1.92E+03	1.33E+00
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05
Y-92	1.03E+01	0.00E+00	3.02E-01	0.00E+00	0.00E+00	1.57E+04	7.35E+04

Conversion factors are in units of $\mu\text{rem/yr}$ per $\mu\text{Ci/cubic meter}$.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
<hr/>							
Y-93	9.44E-01	0.00E+00	2.61E+00	0.00E+00	0.00E+00	4.85E+04	4.22E+05
ZR-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
ZR-97	9.68E+01	1.96E+01	9.04E+00	0.00E+00	2.97E+01	7.87E+04	5.23E+05
<hr/>							
NR-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05
MO-99	0.00E+00	1.21E+02	2.30E+01	0.00E+00	2.91E+02	9.12E+04	2.48E+05
TC-99M	1.03E-03	2.91E-03	3.70E-02	0.00E+00	4.42E-02	7.64E+02	4.16E+03
<hr/>							
TC-101	4.18E-05	6.02E-05	5.90E-04	0.00E+00	1.08E-03	3.99E+02	1.09E-11
RU-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05
RU-105	7.90E-01	0.00E+00	3.11E-01	0.00E+00	1.02E+00	1.10E+04	4.82E+04
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RU-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05
AG-110M	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05
TE-125M	3.42E+03	1.58E+03	4.67E+02	1.05E+03	1.24E+04	3.14E+05	7.06E+04
<hr/>							
TE-127M	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05
TE-127	1.40E+00	6.42E-01	3.10E-01	1.06E+00	5.10E+00	6.51E+03	5.74E+04
TE-129M	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05
<hr/>							
TE-129	4.98E-02	2.39E-02	1.24E-02	3.90E-02	1.87E-01	1.94E+03	1.57E+02
TE-131M	6.99E+01	4.36E+01	2.90E+01	5.50E+01	3.79E+02	1.46E+05	5.56E+05
TE-131	1.11E-02	5.95E-03	3.59E-03	9.36E-03	4.37E-02	1.39E+03	1.84E+01
<hr/>							
TE-132	2.60E+02	2.15E+02	1.62E+02	1.90E+02	1.46E+03	2.88E+05	5.10E+05
I-130	4.58E+03	1.34E+04	5.28E+03	1.14E+06	2.09E+06	0.00E+00	7.69E+03
I-131	2.00E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	9.00E+00	6.28E+03
<hr/>							
I-132	1.16E+03	3.26E+03	1.16E+03	1.14E+05	5.18E+03	0.00E+00	4.06E+02
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03
I-134	6.44E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	0.00E+00	1.01E+00
<hr/>							
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	0.00E+00	5.25E+03
CS-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.80E+05	9.76E+04	1.04E+04
CS-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
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CS-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03
CS-138	3.31E+02	6.21E+02	3.24E+02	0.00E+00	4.80E+02	4.86E+01	1.86E-03
BA-139	9.36E-01	6.66E-04	2.74E-02	0.00E+00	6.22E-04	3.76E+03	8.96E+02

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
BA-141	1.00E-01	7.53E-05	3.36E-03	0.00E+00	7.00E-05	1.94E+03	1.16E-07
BA-142	2.63E-02	2.70E-05	1.66E-03	0.00E+00	2.29E-05	1.19E+03	1.57E-16
LA-140	3.44E+02	1.74E+02	4.58E+01	0.00E+00	0.00E+00	1.36E+05	4.58E+05
LA-142	6.83E-01	3.10E-01	7.72E-02	0.00E+00	0.00E+00	6.33E+03	2.11E+03
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
CE-143	1.86E+02	1.38E+02	1.53E+01	0.00E+00	6.08E+01	7.98E+04	2.26E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05
PR-143	9.36E+03	3.75E+03	4.64E+02	0.00E+00	2.16E+03	2.81E+05	2.00E+05
PR-144	3.01E-02	1.25E-02	1.53E-03	0.00E+00	7.05E-03	1.02E+03	2.15E-08
ND-147	5.27E+03	6.10E+03	3.65E+02	0.00E+00	3.56E+03	2.21E+05	1.73E+05
W-187	8.48E+00	7.08E+00	2.48E+00	0.00E+00	0.00E+00	2.90E+04	1.55E+05
NP-239	2.30E+02	2.26E+01	1.24E+01	0.00E+00	7.00E+01	3.76E+04	1.19E+05

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
C-14	2.60E+04	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03
NA-24	1.38E+04	1.38E+04	1.38E+04	1.73E+04	1.38E+04	1.38E+04	1.38E+04
P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04
CR-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
NH-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
NH-56	0.00E+00	1.70E+00	2.52E-01	0.00E+00	1.79E+00	1.52E+04	5.74E+04
FE-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
FE-59	1.59E+01	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
CO-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
NI-63	5.80E+05	4.34E+04	1.90E+04	0.00E+00	0.00E+00	3.07E+05	1.42E+04
NI-65	2.18E+00	2.93E-01	1.27E-01	0.00E+00	0.00E+00	9.36E+03	3.67E+04
CU-64	0.00E+00	2.03E+00	8.48E-01	0.00E+00	6.41E+00	1.11E+04	6.14E+04
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04
ZN-69	4.83E-02	9.20E-02	6.46E-03	0.00E+00	6.02E-02	1.58E+03	2.85E+02
BR-83	0.00E+00	0.00E+00	3.44E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.33E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04
RB-88	0.00E+00	5.46E+02	2.72E+02	0.00E+00	0.00E+00	0.00E+00	2.92E-05
RB-89	0.00E+00	3.52E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	3.38E-07
SR-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
SR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
SR-91	8.80E+01	0.00E+00	3.51E+00	0.00E+00	0.00E+00	6.07E+04	2.59E+05
SR-92	9.52E+00	0.00E+00	4.06E-01	0.00E+00	0.00E+00	2.74E+04	1.19E+05
Y-90	2.98E+03	0.00E+00	8.00E+01	0.00E+00	0.00E+00	2.93E+05	5.59E+05
Y-91M	3.70E-01	0.00E+00	1.42E-02	0.00E+00	0.00E+00	3.20E+03	3.02E+11
Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05
Y-92	1.47E+01	0.00E+00	4.29E-01	0.00E+00	0.00E+00	2.68E+04	1.65E+05

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (2 OF 3)

NUCLIDE

ORGAN DOSE CONVERSION FACTORS

	BOLE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.35E+02	0.00E+00	3.72E+00	0.00E+00	0.00E+00	8.32E+04	5.79E+05
ZR-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
ZR-97	1.38E+02	2.72E+01	1.26E+01	0.00E+00	4.12E+01	1.30E+05	6.30E+05
NR-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04
MO-99	0.00E+00	1.69E+02	3.22E+01	0.00E+00	4.11E+02	1.54E+05	2.69E+05
TC-99M	1.38E-03	3.86E-03	4.99E-02	0.00E+00	5.76E-02	1.15E+03	6.13E+03
TC-101	5.92E-05	8.40E-05	8.24E-04	0.00E+00	1.52E-03	6.67E+02	8.72E-07
RU-103	2.10E+03	0.00E+0	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05
RU-105	1.12E+00	0.00E+00	4.34E-01	0.00E+00	1.41E+00	1.82E+04	9.04E+04
RU-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05
AG-110M	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05
TE-125M	4.08E+03	2.24E+03	6.67E+02	1.40E+03	0.00E+00	5.36E+05	7.50E+04
TE-127M	1.80E+04	8.16E+03	1.78E+03	4.38E+03	6.54E+04	1.66E+06	1.59E+05
TE-127	2.01E+00	9.12E-01	4.42E-01	1.42E+00	7.28E+00	1.12E+04	8.08E+04
TE-129M	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05
TE-129	7.10E-02	3.38E-02	1.76E-02	5.18E-02	2.66E-01	3.30E+03	1.62E+03
TE-131M	9.84E+01	6.01E+01	4.02E+01	7.25E+01	4.39E+02	2.38E+05	6.21E+05
TC-131	1.58E-02	8.32E-03	5.04E-03	1.24E-02	6.18E-02	2.34E+03	1.51E+01
TE-132	3.60E+02	2.90E+02	2.19E+02	2.46E+02	1.95E+03	4.49E+05	4.63E+05
I-130	6.24E+03	1.79E+04	7.17E+03	1.49E+06	2.75E+04	0.00E+00	9.12E+03
I-131	3.54E+04	4.91E+04	2.66E+04	1.66E+07	8.40E+04	0.00E+00	6.49E+03
I-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	0.00E+00	1.27E+03
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
I-134	8.88E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	0.00E+00	2.04E+01
I-135	3.70E+03	9.44E+03	3.49E+03	6.21E+05	1.49E+04	0.00E+00	6.95E+03
CS-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
CS-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
CS-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
CS-138	4.66E+02	8.56E+02	4.46E+02	0.00E+00	6.62E+02	7.87E+01	2.70E-01
BA-139	1.34E+00	9.44E-04	3.90E-02	0.00E+00	8.88E-04	6.46E+03	6.45E+03

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-I.L.I
BA-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
BA-141	1.42E-01	1.06E-04	4.74E-03	0.00E+00	9.84E-05	3.29E+03	7.46E-04
BA-142	3.70E-02	3.70E-05	2.27E-03	0.00E+00	3.14E-05	1.91E+03	4.79E-10
LA-140	4.79E+02	2.36E+02	6.26E+01	0.00E+00	0.00E+00	2.14E+05	4.87E+05
LA-142	9.60E-01	4.25E-01	1.06E-01	0.00E+00	0.00E+00	1.02E+04	1.20E+04
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
Cl-143	2.66E+02	1.94E+02	2.16E+01	0.00E+00	8.64E+01	1.30E+05	2.55E+05
CE-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05
PR-143	1.34E+04	5.31E+03	6.62E+02	0.00E+00	3.09E+03	4.83E+05	2.14E+05
PR-144	4.30E-02	1.76E-02	2.18E-03	0.00E+00	1.01E-02	1.75E+03	2.35E-04
MD-147	7.86E+03	8.56E+03	5.13E+02	0.00E+00	5.02E+03	3.72E+05	1.82E+05
W-187	1.20E+01	9.76E+00	3.43E+00	0.00E+00	0.00E+00	4.74E+04	1.77E+05
WP-239	3.38E+02	3.19E+01	1.77E+01	0.00E+00	1.00E+02	6.49E+04	1.32E+05

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
C-14	3.59E+04	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03
NA-24	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
MN-56	0.00E+00	1.66E+00	3.12E-01	0.00E+00	1.67E+00	1.31E+04	1.23E+05
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	5.62E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03
NI-65	2.99E+00	2.96E-01	1.64E-01	0.00E+00	0.00E+00	8.18E+03	8.40E+04
CU-64	0.00E+00	1.99E+00	1.07E+00	0.00E+00	6.03E+00	9.58E+03	3.67E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
ZN-69	6.70E-02	9.66E-02	8.92E-03	0.00E+00	5.85E-02	1.42E+03	1.02E+04
BR-83	0.00E+00	0.00E+00	4.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	5.48E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	2.53E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
BR-88	0.00E+00	5.62E+02	3.66E+02	0.00E+00	0.00E+00	0.00E+00	1.72E+01
BR-89	0.00E+00	3.45E+02	2.90E+02	0.00E+00	0.00E+00	0.00E+00	1.89E+00
SR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
SR-91	1.21E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	5.33E+04	1.74E+05
SR-92	1.31E+01	0.00E+00	5.25E-01	0.00E+00	0.00E+00	2.40E+04	2.42E+05
Y-90	4.11E+03	0.00E+00	1.11E+02	0.00E+00	0.00E+00	2.62E+05	2.68E+05
Y-91M	5.07E-01	0.00E+00	1.84E-02	0.00E+00	0.00E+00	2.81E+03	1.72E+03
Y	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
Y-92	2.04E+01	0.00E+00	5.81E-01	0.00E+00	0.00E+00	2.39E+04	2.39E+05

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.86E+02	0.00E+00	5.11E+00	0.00E+00	0.00E+00	7.44E+04	3.89E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
ZR-97	1.88E+02	2.72E+01	1.60E+01	0.00E+00	3.88E+01	1.13E+05	3.51E+05
NR-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
NO-99	0.00E+00	1.72E+02	4.26E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05
TC-99M	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03
TC-101	8.10E-05	8.51E-05	1.08E-03	0.00E+00	1.45E-03	5.85E+02	1.63E+01
RU-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.68E+04
RU-105	1.53E+00	0.00E+00	3.55E-01	0.00E+00	1.34E+00	1.59E+04	9.95E+04
RU-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
AG-110M	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
TE-125M	6.73E+03	2.53E+03	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04
TE-127M	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
TE-127	2.77E+00	9.51E-01	6.11E-01	1.96E+00	7.07E+00	1.00E+04	5.62E+04
TE-129M	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
TE-129	9.77E-02	3.50E-02	2.38E-02	7.14E-02	2.57E-01	2.93E+03	2.55E+04
TE-131M	1.34E+02	5.92E+01	5.07E+01	9.77E+01	4.00E+02	2.06E+05	3.08E+05
TE-131	2.17E-02	8.44E-03	6.59E-03	1.70E-02	5.88E-02	2.05E+03	1.33E+03
TE-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05
I-130	8.18E+03	1.54E+04	8.44E+03	1.85E+04	2.45E+04	0.00E+00	5.11E+03
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	0.00E+00	3.70E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	0.00E+00	9.55E+02
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03
CS-134	6.51E+05	1.61E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
CS-138	6.33E+02	8.40E+02	5.55E+02	0.00E+00	6.22E+02	6.81E+01	2.70E+02
BA-139	1.84E+00	9.84E-04	5.37E-02	0.00E+00	8.62E-04	5.77E+03	5.77E+04

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
BA-141	1.96E-01	1.09E-04	6.36E-03	0.00E+00	9.47E-05	2.92E+03	2.75E+02
BA-142	5.00E-02	3.60E-05	2.79E-03	0.00E+00	2.91E-05	1.64E+C3	2.74E+00
LA-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05
LA-142	1.30E+00	4.11E-01	1.29E-01	0.00E+00	0.00E+00	8.70E+03	7.59E+04
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
CE-143	3.66E+02	1.99E+02	2.87E+01	0.00E+00	8.36E+01	1.15E+05	1.27E+05
CE-144	6.77E+06	2.12E+06	3.81E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05
PR-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	4.13E+05	9.73E+04
PR-144	5.96E-02	1.85E-02	3.00E-03	0.00E+00	9.77E-03	1.57E+03	1.97E+02
MD-147	1.08E+04	8.73E+03	8.81E+02	0.00E+00	4.81E+03	3.28E+05	8.21E+04
W-187	1.63E+01	9.66E+00	4.33E+00	0.00E+00	0.00E+00	4.11E+04	9.11E+04
MP-239	4.66E+02	3.34E+01	2.35E+01	0.00E+00	9.73E+01	5.81E+04	6.70E+04

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03
NA-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04
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P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
CR-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03
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MN-56	0.00E+00	1.54E+00	2.21E-01	0.00E+00	1.10E+00	1.25E+04	7.17E+04
FE-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03
FE-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
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CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
CO-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
NI-63	3.39E+05	2.04E+04	1.16E+04	0.00E+00	0.00E+00	2.09E+05	2.42E+03
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NI-65	2.39E+00	2.84E-01	1.23E-01	0.00E+00	0.00E+00	8.12E+03	5.01E+04
CJ-64	0.00E+00	1.88E+00	7.74E-01	0.00E+00	3.98E+00	9.30E+03	1.50E+04
ZN-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
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ZN-69	5.39E-02	9.67E-02	7.18E-03	0.00E+00	4.02E-02	1.47E+03	1.32E+04
BR-83	0.00E+00	0.00E+00	3.81E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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BR-85	0.00E+00	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03
RB-88	0.00E+00	5.57E+02	2.87E+02	0.00E+00	0.00E+00	0.00E+00	3.39E+02
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RE-89	0.00E+00	3.21E+02	2.06E+02	0.00E+00	0.00E+00	0.00E+00	4.82E+01
SR-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
SR-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
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SR-91	9.56E+01	0.00E+00	3.46E+00	0.00E+00	0.00E+00	5.26E+04	7.34E+04
SR-92	1.05E+01	0.00E+00	3.91E-01	0.00E+00	0.00E+00	2.38E+04	1.40E+05
Y-90	3.29E+03	0.00E+00	8.82E+01	0.00E+00	0.00E+00	2.69E+05	1.04E+05
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Y-91M	4.07E-01	0.00E+00	1.39E-02	0.00E+00	0.00E+00	2.79E+03	2.35E+03
Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04
Y-92	1.64E+01	0.00E+00	4.61E-01	0.00E+00	0.00E+00	2.45E+04	1.27E+05

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.50E+02	0.00E+00	4.07E+00	0.00E+00	0.00E+00	7.64E+04	1.67E+05
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
ZR-97	1.50E+02	2.56E+01	1.17E+01	0.00E+00	2.59E+01	1.10E+05	1.40E+05
NR-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04
NO-99	0.00E+00	1.65E+02	3.23E+01	0.00E+00	2.65E+02	1.35E+05	4.87E+04
TC-99M	1.40E-03	2.88E-03	3.72E-02	0.00E+00	3.11E-02	8.11E+02	2.03E+03
TC-101	6.51E-05	8.23E-05	8.12E-04	0.00E+00	9.79E-04	5.84E+02	8.44E+02
RU-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04
RU-105	1.22E+00	0.00E+00	4.10E-01	0.00E+00	8.99E-01	1.57E+04	4.84E+04
RU-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05
AG-110M	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04
TE-125M	4.76E+03	1.99E+03	6.58E+02	1.62E+03	0.00E+00	4.47E+05	1.29E+04
TE-127M	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04
TE-127	2.23E+00	9.53E-01	4.89E-01	1.85E+00	4.86E+00	1.03E+04	2.44E+04
TE-129M	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04
TE-129	7.88E-02	3.47E-02	1.88E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04
TE-131M	1.07E+02	5.50E+01	3.63E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05
TE-131	1.74E-02	8.22E-03	5.00E-03	1.58E-02	3.99E-02	2.06E+03	8.22E+03
TE-132	3.72E+02	2.37E+02	1.76E+02	2.79E+02	1.03E+03	3.40E+05	4.41E+04
I-130	6.36E+03	1.39E+04	5.57E+03	1.60E+06	1.53E+04	0.00E+00	1.99E+03
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	0.00E+00	1.90E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.09E+03	0.00E+00	1.29E+03
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	0.00E+00	1.83E+03
CS-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
CS-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
CS-138	5.05E+05	7.81E+02	3.98E+02	0.00E+00	4.10E+02	6.54E+01	8.76E+02
BA-139	1.48E+00	9.84E-04	4.30E-02	0.00E+00	5.92E-04	5.95E+03	5.10E+04

Conversion factors are in units of mrem/yr per uCi/cubic meter.

INHALATION PATHWAY DOSES DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BORE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
BA-141	1.57E-01	1.08E-04	4.97E-03	0.00E+00	6.50E-05	2.97E+03	4.75E+03
BA-142	3.98E-02	3.30E-05	1.96E-03	0.00E+00	1.90E-05	1.55E+03	6.93E+02
LA-140	5.05E+02	2.00E+02	5.15E+01	0.00E+00	0.00E+00	1.68E+05	8.48E+04
LA-142	1.03E+00	3.77E-01	9.04E-02	0.00E+00	0.00E+00	8.22E+03	5.95E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
CE-143	2.93E+02	1.93E+02	2.21E+01	0.00E+00	5.64E+01	1.16E+05	4.97E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05
PR-143	1.40E+04	5.24E+03	6.99E+02	0.00E+00	1.97E+03	4.33E+05	3.72E+04
PR-144	4.79E-02	1.85E-02	2.41E-03	0.00E+00	6.72E-03	1.61E+03	4.28E+03
MD-147	7.94E+03	8.13E+03	5.00E+02	0.00E+00	3.15E+03	3.22E+05	3.12E+04
U-187	1.30E+01	9.02E+00	3.12E+00	0.00E+00	0.00E+00	3.96E+04	3.56E+04
WP-239	3.71E+02	3.32E+01	1.88E+01	0.00E+00	6.62E+01	5.95E+04	2.49E+04

Conversion factors are in units of mrem/yr per uCi/cubic meter.

GROUND - PLANE DEPOSITION PATHWAY DOSE
FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ALL (1 OF 3)

NUCLIDS	ORGAN DOSE CONVERSION FACTORS	
	T. BODY	SKIN

H-3	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00
NA-24	1.19E+07	1.39E+07
P-32	0.01E+00	0.00E+00
CR-51	4.66E+06	5.51E+06
MN-54	1.39E+09	1.63E+09
MN-56	9.03E+05	1.07E+06
FE-55	0.00E+00	0.00E+00
FE-59	2.73E+08	3.21E+08
CO-58	3.79E+08	4.44E+08
CO-60	2.15E+10	2.53E+10
NI-63	0.00E+00	0.00E+00
NI-65	2.97E+05	3.45E+05
CU-64	6.07E+05	6.88E+05
ZN-65	7.47E+08	8.59E+08
ZN-69	0.00E+00	0.00E+00
BR-83	4.87E+03	7.08E+03
BR-84	2.03E+05	2.36E+05
BR-85	0.00E+00	0.00E+00
RB-86	8.99E+06	1.03E+07
RB-88	3.31E+04	3.78E+04
RB-89	1.23E+05	1.48E+05
SR-89	2.16E+04	2.51E+04
SR-90	0.00E+00	0.00E+00
SR-91	2.15E+05	2.51E+06
SR-92	7.77E+05	8.63E+05
Y-90	4.49E+03	5.31E+03
Y-91M	1.00E+05	1.16E+05
Y-91	1.07E+06	1.21E+06
Y-92	1.80E+05	2.14E+05

Conversion factors are in units of square meter-area/yr per uCi/sec.

GROUND - PLANE DEPOSITION PATHWAY DOSE
FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ALL (2 OF 3)

NUCLIDE ORGAN DOSE CONVERSION FACTORS

1. BODY SKIN

Y-93	1.83E+05	2.51E+05
Zr-95	2.45E+08	2.64E+08
Zr-97	2.96E+06	3.44E+06
.....		
NB-95	1.37E+08	1.61E+08
MO-99	3.99E+06	4.63E+06
TC-99M	1.84E+05	2.11E+05
.....		
TC-101	2.04E+04	2.26E+04
RU-103	1.08E+08	1.26E+08
RU-105	6.36E+05	7.21E+05
.....		
RU-106	4.22E+08	5.07E+08
AG-110M	3.44E+09	4.01E+09
TE-125M	1.55E+06	2.13E+06
.....		
TE-127M	9.16E+04	1.08E+05
TE-127	2.98E+03	3.28E+03
TE-129M	1.98E+07	2.31E+07
.....		
TE-129	2.62E+04	3.10E+04
TE-131M	8.03E+06	9.46E+06
TE-131	2.92E+04	3.45E+07
.....		
TE-132	4.23E+06	4.98E+06
I-130	5.51E+06	6.69E+06
I-131	1.72E+07	2.09E+07
.....		
I-132	1.25E+06	1.46E+06
I-133	2.45E+06	2.98E+06
I-134	4.47E+05	5.30E+05
.....		
I-135	2.53E+06	2.95E+06
CS-134	6.86E+09	8.00E+09
CS-136	1.51E+08	1.71E+08
.....		
CS-137	1.03E+10	1.20E+10
CS-138	3.59E+05	4.10E+05
BA-139	1.06E+05	1.19E+05

Conversion factors are in units of square meter-mm/yr per uCi/sec.

GROUND - PLANE DEPOSITION PATHWAY DOSE
FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ALL (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS	
	T. BODY	SKIN
BA-140	2.09E+07	2.35E+07
BA-141	4.17E+04	4.75E+04
BA-142	4.49E+04	5.11E+04
.....		
LA-140	1.92E+07	2.18E+07
LA-142	7.60E+05	9.11E+05
CE-141	1.37E+07	1.54E+07
.....		
CE-143	2.31E+06	2.63E+06
CE-144	6.95E+07	8.04E+07
PR-143	0.00E+00	0.00E+00
.....		
PE-144	1.83E+03	2.11E+03
ND-147	8.39E+06	1.01E+07
V-147	2.35E+06	2.73E+06
.....		
HP-239	1.71E+06	1.99E+06

Conversion factors are in units of square meter-gram/yr per uCi/sec.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
H-3	0.00E+00	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02
C-14	2.63E+08	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07
NA-24	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06
P-32	1.71E+10	1.06E+09	6.61E+08	0.00E+00	0.00E+00	0.00E+00	1.92E+09
CR-51	0.00E+00	0.00E+00	2.86E+04	1.71E+04	6.30E+03	3.79E+04	7.19E+06
MM-54	0.00E+00	8.41E+06	1.61E+06	0.00E+00	2.50E+06	0.00E+00	2.58E+07
MM-56	0.00E+00	4.15E+03	7.36E+04	0.00E+00	5.27E+03	0.00E+00	1.32E+01
FE-55	2.51E+07	1.74E+07	4.05E+06	0.00E+00	0.00E+00	9.68E+06	9.95E+06
FE-59	2.97E+07	6.98E+07	2.68E+07	0.00E+00	0.00E+00	1.99E+07	2.33E+08
CO-58	0.00E+00	4.71E+06	1.06E+07	0.00E+00	0.00E+00	0.00E+00	9.55E+07
CO-60	0.00E+00	1.64E+07	3.62E+07	0.00E+00	0.00E+00	0.00E+00	3.08E+08
NI-63	6.73E+09	4.66E+08	2.26E+08	0.00E+00	0.00E+00	0.00E+00	9.73E+07
NI-65	3.70E+01	4.81E+02	2.19E+02	0.00E+00	0.00E+00	0.00E+00	1.22E+00
CU-64	0.00E+00	2.38E+04	1.12E+04	0.00E+00	6.01E+04	0.00E+00	2.03E+06
ZN-65	1.37E+09	4.37E+09	1.97E+09	0.00E+00	2.92E+09	0.00E+00	2.75E+09
ZN-69	2.09E+12	4.00E+12	2.78E+13	0.00E+00	2.60E+12	0.00E+00	6.01E+13
BR-83	0.00E+00	0.00E+00	1.17E+02	0.00E+00	0.00E+00	0.00E+00	1.68E+02
BR-84	0.00E+00	0.00E+00	1.93E+24	0.00E+00	0.00E+00	0.00E+00	1.52E+29
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	2.59E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	5.12E+08
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	1.45E+09	0.00E+00	4.17E+07	0.00E+00	0.00E+00	0.00E+00	2.33E+08
SR-90	4.68E+10	0.00E+00	1.75E+10	0.00E+00	0.00E+00	0.00E+00	1.35E+09
SR-91	2.89E+04	0.00E+00	1.17E+03	0.00E+00	0.00E+00	0.00E+00	1.38E+05
SR-92	4.88E+01	0.00E+00	2.11E+02	0.00E+00	0.00E+00	0.00E+00	9.68E+00
Y-90	7.08E+01	0.00E+00	1.90E+00	0.00E+00	0.00E+00	0.00E+00	7.51E+05
Y-91W	5.98E+20	0.00E+00	2.32E+21	0.00E+00	0.00E+00	0.00E+00	1.76E+19
Y-91	8.59E+03	0.00E+00	2.30E+02	0.00E+00	0.00E+00	0.00E+00	4.73E+06
Y-91'	5.58E+05	0.00E+00	1.63E+06	0.00E+00	0.00E+00	0.00E+00	9.77E+01

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	2.23E-01	0.00E+00	6.17E-03	0.00E+00	0.00E+00	0.00E+00	7.08E+03
ZR-95	9.63E+02	3.03E+02	2.05E+02	0.00E+00	4.75E+02	0.00E+00	9.59E+05
ZR-97	4.33E-01	8.74E-02	4.00E-02	0.00E+00	1.32E-01	0.00E+00	2.71E+04
NR-95	8.26E+04	4.59E+04	2.47E+04	0.00E+00	4.54E+04	0.00E+00	2.79E+08
ND-99	0.00E+00	2.48E+07	4.71E+06	0.00E+00	5.61E+07	0.00E+00	5.74E+07
TC-99M	3.32E+00	9.38E+00	1.20E+02	0.00E+00	1.43E+02	4.60E+00	5.55E+03
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.02E+03	0.00E+00	4.39E+02	0.00E+00	3.89E+03	0.00E+00	1.19E+05
RU-105	8.57E-04	0.00E+00	3.38E-04	0.00E+00	1.11E-02	0.00E+00	5.24E-01
RU-106	2.04E+04	0.00E+00	2.58E+03	0.00E+00	3.94E+04	0.00E+00	1.32E+06
AG-110M	5.82E+07	5.39E+07	3.20E+07	0.00E+00	1.06E+08	0.00E+00	2.20E+10
TE-125M	1.63E+07	5.90E+06	2.18E+06	4.90E+06	6.63E+07	0.00E+00	6.50E+07
TE-127M	4.58E+07	1.64E+07	5.58E+06	1.17E+07	1.86E+08	0.00E+00	1.54E+08
TE-127	6.53E+02	2.34E+02	1.41E+02	4.84E+02	2.66E+03	0.00E+00	5.15E+04
TE-129M	6.02E+07	2.25E+07	9.53E+06	2.07E+07	2.51E+08	0.00E+00	3.03E+08
TE-129	2.82E-10	1.06E-10	6.88E-11	2.17E-10	1.19E-09	0.00E+00	2.13E-10
TE-131M	3.61E+05	1.77E+05	1.47E+05	2.80E+05	1.79E+06	0.00E+00	1.75E+07
TE-131	3.60E-33	1.51E-33	1.14E-33	2.96E-33	1.58E-32	0.00E+00	5.10E-34
TE-132	2.40E+06	1.55E+06	1.46E+06	1.72E+06	1.50E+07	0.00E+00	7.35E+07
I-130	4.20E+05	1.24E+06	4.89E+05	1.05E+08	1.93E+06	0.00E+00	1.07E+06
I-131	2.96E+08	4.23E+08	2.43E+08	1.39E+11	7.26E+08	0.00E+00	1.12E+08
I-132	1.64E-01	4.39E-01	1.54E-01	1.54E+01	7.00E-01	0.00E+00	8.25E-02
I-133	3.87E+06	6.73E+06	2.05E+06	9.89E+08	1.17E+07	0.00E+00	6.05E+06
I-134	2.02E-12	5.48E-12	1.96E-12	9.49E-11	8.71E-12	0.00E+00	4.77E-15
I-135	1.28E+04	3.36E+04	1.24E+04	2.22E+06	5.39E+04	0.00E+00	3.80E+04
CS-134	5.65E+09	1.35E+10	1.10E+10	0.00E+00	4.35E+09	1.45E+09	2.35E+08
CS-136	2.63E+08	1.04E+09	7.48E+08	0.00E+00	5.78E+08	7.93E+07	1.18E+08
CS-137	7.38E+09	1.01E+10	6.61E+09	0.00E+00	3.43E+09	1.14E+09	1.95E+08
CS-138	9.04E-24	1.79E-23	8.85E-24	0.00E+00	1.31E-23	1.30E-24	7.62E-29
BA-139	4.42E-08	3.15E-11	1.29E-09	0.00E+00	2.94E-11	1.79E-11	7.84E-08

Conversion factors are in units of square meter-mm/yr per uCi/sec for all
nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.69E+07	3.38E+04	1.76E+06	0.00E+00	1.15E+04	1.93E+04	5.53E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.51E+00	2.27E+01	1.11E+01	0.00E+00	0.00E+00	0.00E+00	1.67E+05
LA-142	1.86E+11	8.45E+11	2.10E+12	0.00E+00	0.00E+00	0.00E+00	6.17E+08
CE-141	4.84E+03	3.28E+03	1.24E+04	0.00E+00	5.5E+03	0.00E+00	1.25E+07
CE-143	4.16E+01	3.07E+04	3.40E+00	0.00E+00	1.35E+01	0.00E+00	1.15E+06
CE-144	3.58E+05	1.50E+05	1.92E+04	0.00E+00	8.87E+04	0.00E+00	1.21E+08
PR-143	1.58E+02	6.33E+01	7.83E+00	0.00E+00	3.66E+01	0.00E+00	6.92E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	9.42E+01	1.09E+02	6.51E+00	0.00E+00	6.36E+01	0.00E+00	5.22E+05
V-187	6.51E+03	5.45E+03	1.90E+03	0.00E+00	0.00E+00	0.00E+00	1.78E+06
MP-239	4.60E+01	4.52E+00	2.49E+00	0.00E+00	1.41E+01	0.00E+00	9.27E+05

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi, cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GILL
H-3	0.00E+00	9.94E+02	9.94E+02	9.94E+02	9.94E+02	9.94E+02	9.94E+02
C-14	4.86E+08	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07
NA-24	4.26E+06	4.26E+06	4.26E+06	4.26E+06	4.26E+06	4.26E+06	4.26E+06
P-32	3.15E+10	1.95E+09	1.22E+09	0.00E+00	0.00E+00	0.00E+00	2.65E+09
CR-51	0.00E+00	0.00E+00	4.99E+04	2.77E+04	1.09E+04	7.13E+04	8.39E+06
NN-54	0.00E+00	1.40E+07	2.78E+06	0.00E+00	4.18E+06	0.00E+00	2.87E+07
NN-56	0.00E+00	7.36E-03	1.31E-03	0.00E+00	9.31E-03	0.00E+00	4.84E-01
FE-55	4.45E+07	3.16E+07	7.36E+06	0.00E+00	0.00E+00	2.00E+07	1.37E+07
FE-59	5.18E+07	1.21E+08	4.67E+07	0.00E+00	0.00E+00	3.81E+07	2.86E+08
CO-58	0.00E+00	7.94E+06	1.63E+07	0.00E+00	0.00E+00	0.00E+00	1.09E+08
CO-60	0.00E+00	2.78E+07	6.26E+07	0.00E+00	0.00E+00	0.00E+00	3.62E+08
NI-63	1.18E+10	8.35E+08	4.01E+08	0.00E+00	0.00E+00	0.00E+00	1.33E+08
NI-65	6.77E-01	8.65E-02	3.94E-02	0.00E+00	0.00E+00	0.00E+00	4.69E+00
CU-64	0.00E+00	4.25E+04	2.00E+04	0.00E+00	1.07E+05	0.00E+00	3.29E+06
ZN-65	2.11E+09	7.32E+09	3.41E+09	0.00E+00	4.68E+09	0.00E+00	3.10E+09
ZN-69	3.85E-12	7.34E-12	5.13E-13	0.00E+00	4.79E-12	0.00E+00	1.35E-11
BR-83	0.00E+00	0.00E+00	2.15E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.45E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	4.73E+09	2.22E+09	0.00E+00	0.00E+00	0.00E+00	7.00E+08
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	2.67E+09	0.00E+00	7.66E+07	0.00E+00	0.00E+00	0.00E+00	3.19E+08
SR-90	6.61E+10	0.00E+00	1.63E+10	0.00E+00	0.00E+00	0.00E+00	1.86E+09
SR-91	5.31E+04	0.00E+00	2.11E+03	0.00E+00	0.00E+00	0.00E+00	2.41E+05
SR-92	8.94E-01	0.00E+00	3.81E-02	0.00E+00	0.00E+00	0.00E+00	2.28E+01
Y-90	1.30E+02	0.00E+00	3.51E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+06
Y-91M	1.10E-19	0.00E+00	4.19E-21	0.00E+00	0.00E+00	0.00E+00	5.17E-18
Y-91	1.58E+04	0.00E+00	4.24E+02	0.00E+00	0.00E+00	0.00E+00	6.68E+06
Y-92	1.03E-04	0.00E+00	2.98E-06	0.00E+00	0.00E+00	0.00E+00	2.83E+00

Conversion factors are in units of square meter-mm/yr per uCi/sec for all
nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R.

AGE GROUP: TEEN (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	4.12E-01	0.00E+00	1.13E-02	0.00E+00	0.00E+00	0.00E+00	1.26E+04
Zr-95	1.65E+03	5.20E-02	3.58E+02	0.00E+00	7.65E+02	0.00E+00	1.20E+06
Zr-97	7.88E-01	1.56E-01	7.19E-02	0.00E+00	2.37E-01	0.00E+00	4.22E+04
Mo-95	1.41E+05	7.81E+04	4.30E+04	0.00E+00	7.57E+04	0.00E+00	3.34E+08
Mo-99	0.00E+00	4.47E+07	8.53E+06	0.00E+00	1.02E+08	0.00E+00	8.01E+07
Tc-99m	5.76E+00	1.61E+01	2.08E+02	0.00E+00	2.39E+02	8.92E+00	1.05E+04
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	1.81E+03	0.00E+00	7.74E+02	0.00E+00	6.38E+03	0.00E+00	1.51E+05
Ru-105	1.56E-03	0.00E+00	6.07E-04	0.00E+00	1.97E-02	0.00E+00	1.26E+00
Ru-106	2.89E+04	0.00E+00	4.73E+03	0.00E+00	7.24E+04	0.00E+00	1.80E+06
Ag-110m	9.63E+07	9.11E+07	5.54E+07	0.00E+00	1.74E+08	0.00E+00	2.56E+10
Te-125m	3.00E+07	1.08E+07	4.02E+06	8.39E+06	0.00E+00	0.00E+00	8.86E+07
Te-127m	8.44E+07	2.99E+07	1.00E+07	2.01E+07	3.42E+08	0.00E+00	2.10E+08
Te-127	1.21E+03	4.29E+02	2.60E+02	8.35E+02	4.90E+03	0.00E+00	9.34E+04
Te-129m	1.10E+08	4.09E+07	1.74E+07	3.55E+07	4.61E+08	0.00E+00	4.13E+08
Te-129	5.20E-10	1.94E-10	1.16E-10	3.71E-10	2.18E-09	0.00E+00	2.84E-09
Te-131m	6.57E+05	3.15E+05	2.63E+05	4.74E+05	3.29E+06	0.00E+00	2.53E+07
Te-131	6.58E-33	2.71E-33	2.06E-33	5.07E-33	2.88E-32	0.00E+00	5.47E-34
Te-132	4.29E+06	2.72E+06	2.56E+06	2.87E+06	2.61E+07	0.00E+00	8.61E+07
I-130	7.38E+05	2.14E+06	8.53E+05	1.74E+08	3.29E+06	0.00E+00	1.64E+06
I-131	5.37E+08	7.52E+08	4.04E+08	2.19E+11	1.29E+09	0.00E+00	1.49E+08
I-132	2.91E-01	7.62E-01	2.74E-01	2.57E+01	1.20E+00	0.00E+00	3.32E-01
I-133	7.07E+06	1.20E+07	3.66E+06	1.67E+09	2.10E+07	0.00E+00	9.07E+06
I-134	3.58E-12	9.50E-12	3.41E-12	1.58E-10	1.50E-11	0.00E+00	1.25E-13
I-135	2.28E+04	5.87E+04	2.18E+04	3.78E+06	9.27E+07	0.00E+00	6.51E+04
Cs-134	9.82E+09	2.31E+10	1.07E+10	0.00E+00	7.34E+09	2.80E+09	2.87E+08
Cs-136	4.48E+08	1.76E+09	1.18E+09	0.00E+00	9.60E+08	1.51E+08	1.42E+08
Cs-137	1.34E+10	1.78E+10	6.20E+09	0.00E+00	6.06E+09	2.35E+09	2.53E+08
Cs-138	1.64E-23	3.15E-23	1.57E-23	0.00E+00	2.33E-23	2.71E-24	1.43E-26
Ba-139	8.17E-08	5.75E-11	2.38E-09	0.00E+00	5.42E-11	3.96E-11	7.29E-07

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	4.85E+07	5.95E+04	3.13E+06	0.00E+00	2.02E+04	4.00E+04	7.48E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	8.10E+00	3.98E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00	2.29E+05
LA-142	3.35E+11	1.49E+11	3.71E+12	0.00E+00	0.00E+00	0.00E+00	4.53E+07
CE-141	8.88E+03	5.93E+03	6.81E+02	0.00E+00	2.79E+03	0.00E+00	1.70E+07
CE-143	7.64E+01	5.56E+04	6.21E+00	0.00E+00	2.49E+01	0.00E+00	1.67E+06
CE-144	6.58E+05	2.72E+05	3.54E+04	0.00E+00	1.63E+05	0.00E+00	1.66E+08
PR-143	2.90E+02	1.16E+02	1.44E+01	0.00E+00	6.73E+01	0.00E+00	9.54E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MD-147	1.81E+02	1.97E+02	1.18E+01	0.00E+00	1.16E+02	0.00E+00	7.11E+05
W-187	1.19E+04	9.71E+03	3.40E+03	0.00E+00	0.00E+00	0.00E+00	2.63E+06
WP-239	8.78E+01	8.28E+00	4.60E+00	0.00E+00	2.60E+01	0.00E+00	1.33E+06

Conversion factors are in units of square meter-mm/yr per uCi/sec for all nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (1 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03
C-14	1.19E+09	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08
NA-24	8.85E+06	8.85E+07	8.85E+06	8.85E+06	8.85E+06	8.85E+06	8.85E+06
P-32	7.78E+10	3.64E+09	3.00E+09	0.00E+00	0.00E+00	0.00E+00	2.15E+09
CR-51	0.00E+00	0.00E+00	1.02E+05	5.65E+04	1.54E+04	1.03E+05	5.40E+06
MN-54	0.00E+00	2.10E+07	5.59E+06	0.00E+00	5.88E+06	0.00E+00	1.76E+07
MN-56	0.00E+00	1.28E+02	2.90E+03	0.00E+00	1.55E+02	0.00E+00	1.86E+00
FE-55	1.07E+08	5.93E+07	1.84E+07	0.00E+00	0.00E+00	3.35E+07	1.10E+07
FE-59	1.20E+08	1.95E+08	9.69E+07	0.00E+00	0.00E+00	5.64E+07	2.03E+08
CO-58	0.00E+00	1.21E+07	3.71E+07	0.00E+00	0.00E+00	0.00E+00	7.07E+07
CO-60	0.00E+00	4.32E+07	1.27E+08	0.00E+00	0.00E+00	0.00E+00	2.39E+08
NI-63	2.94E+10	1.59E+09	1.04E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
NI-65	1.67E+00	1.56E+01	9.10E+02	0.00E+00	0.00E+00	0.00E+00	1.91E+01
CU-64	0.00E+00	7.46E+04	4.51E+04	0.00E+00	1.80E+05	0.00E+00	3.50E+06
ZN-65	4.13E+09	1.12E+10	6.85E+09	0.00E+00	6.94E+09	0.00E+00	1.93E+09
ZN-69	9.47E+12	1.37E+11	1.26E+12	0.00E+00	5.30E+12	0.00E+00	*.62E+10
BR-83	0.00E+00	0.00E+00	5.28E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	7.81E+24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE-166	0.00E+00	8.77E+09	5.39E+09	0.00E+00	0.00E+00	0.00E+00	5.64E+08
RE-188	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE-189	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	6.62E+09	0.00E+00	1.89E+08	0.00E+00	0.00E+00	0.00E+00	2.56E+08
SR-90	1.12E+11	0.00E+00	2.83E+10	0.00E+00	0.00E+00	0.00E+00	1.51E+09
SR-91	1.30E+05	0.00E+00	4.72E+03	0.00E+00	0.00E+00	0.00E+00	2.88E+05
SR-92	2.18E+00	0.00E+00	8.75E+02	0.00E+00	0.00E+00	0.00E+00	4.13E+01
Y-90	3.22E+02	0.00E+00	6.42E+00	0.00E+00	0.00E+00	0.00E+00	9.17E+05
Y-91M	2.68E+12	0.00E+00	9.74E+21	0.00E+00	0.00E+00	0.00E+00	5.24E+16
Y-91	3.90E+04	0.00E+00	1.04E+03	0.00E+00	0.00E+00	0.00E+00	5.20E+06
Y-92	2.53E+05	0.00E+00	7.24E+06	0.00E+00	0.00E+00	0.00E+00	7.31E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	1.01E+00	0.00E+00	2.78E-02	0.00E+00	0.00E+00	0.00E+00	1.51E+04
Zr-95	5.83E+03	8.42E+02	7.50E+02	0.00E+00	1.21E+03	0.00E+00	8.79E+05
Zr-97	1.92E+00	2.77E-01	1.64E-01	0.00E+00	3.98E-01	0.00E+00	4.20E+04
Mo-95	3.18E+05	1.24E+05	8.84E+04	0.00E+00	1.16E+05	0.00E+00	2.29E+08
Mo-99	0.00E+00	8.14E+07	2.01E+07	0.00E+00	1.74E+08	0.00E+00	6.73E+07
Tc-99m	1.32E+01	2.59E+01	4.29E+02	0.00E+00	3.76E+02	1.32E+01	1.47E+04
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	4.28E+03	0.00E+00	1.65E+03	0.00E+00	1.08E+04	0.00E+00	1.11E+05
Ru-105	3.82E-03	0.00E+00	1.39E-03	0.00E+00	3.36E-02	0.00E+00	2.49E+00
Ru-106	9.24E+04	0.00E+00	1.15E+04	0.00E+00	1.25E+05	0.00E+00	1.44E+06
Ag-110m	2.09E+08	1.41E+08	1.13E+08	0.00E+00	2.63E+08	0.00E+00	1.68E+10
Te-125m	7.38E+07	2.00E+07	9.84E+06	2.07E+07	0.00E+00	0.00E+00	7.12E+07
Te-127m	2.08E+08	5.60E+07	2.47E+07	4.97E+07	5.93E+08	0.00E+00	1.68E+08
Te-127	2.98E+03	8.02E+02	6.38E+02	2.06E+03	8.47E+03	0.00E+00	1.16E+05
Te-129m	2.71E+08	7.58E+07	4.21E+07	8.75E+07	7.97E+08	0.00E+00	3.31E+08
Te-129	1.28E-09	3.58E-10	3.04E-10	9.15E-10	3.75E-09	0.00E+00	7.98E-08
Te-131m	1.60E+06	5.53E+05	5.89E+05	1.14E+06	5.35E+06	0.00E+00	2.24E+07
Te-131	1.62E-32	4.93E-33	4.81E-33	1.24E-32	4.89E-32	0.00E+00	8.49E-32
Te-132	1.02E+07	4.53E+06	5.48E+06	6.60E+06	4.21E+07	0.00E+00	4.57E+07
I-130	1.73E+06	3.49E+06	1.80E+06	3.84E+06	5.22E+06	0.00E+00	1.63E+06
I-131	1.30E+09	1.31E+09	7.45E+08	4.33E+11	2.15E+09	0.00E+00	1.17E+08
I-132	6.89E-01	1.27E+00	5.82E-01	5.87E+01	1.94E+00	0.00E+00	1.49E+00
I-133	1.72E+07	2.12E+07	8.03E+06	3.94E+09	3.54E+07	0.00E+00	8.56E+06
I-134	8.48E-12	1.58E-11	7.25E-12	3.62E-10	2.41E-11	0.00E+00	1.04E-11
I-135	5.40E+04	9.72E+04	4.60E+04	8.61E+06	1.49E+05	0.00E+00	7.40E+04
CS-134	2.26E+10	3.72E+10	7.84E+09	0.00E+00	1.15E+10	4.13E+09	2.00E+08
CS-136	1.01E+09	2.86E+09	1.80E+09	0.00E+00	1.48E+09	2.21E+08	9.77E+07
CS-137	3.22E+10	3.09E+10	4.55E+09	0.00E+00	1.01E+10	3.62E+09	1.93E+08
CS-138	3.98E-23	5.53E-23	3.51E-23	0.00E+00	3.89E-23	4.19E-24	2.55E-23
BA-139	2.01E-07	1.07E-10	5.82E-09	0.00E+00	9.36E-11	6.30E-11	1.16E-05

Conversion factors are in units of square meter-mm/yr per uCi/sec for all
nuclides except R-3 which is in units of mm/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (3 of 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	1.17E+08	1.03E+05	6.84E+06	0.00E+00	3.34E+04	6.12E+04	5.93E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.94E+01	6.78E+00	2.11E+00	0.00E+00	0.00E+00	0.00E+00	1.89E+05
LA-142	8.10E-11	2.58E-11	8.06E-12	0.00E+00	0.00E+00	0.00E+00	5.11E-06
CE-141	2.19E+04	1.09E+04	1.62E+03	0.00E+00	4.78E+04	0.00E+00	1.36E+07
CE-143	1.87E+02	1.02E+05	1.47E+01	0.00E+00	4.26E+01	0.00E+00	1.49E+06
CE-144	1.62E+06	5.09E+05	8.66E+04	0.00E+00	2.82E+05	0.00E+00	1.33E+08
PR-143	7.18E+02	2.16E+02	3.56E+01	0.00E+00	1.17E+02	0.00E+00	7.75E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-147	4.45E+02	3.60E+02	2.79E+01	0.00E+00	1.98E+02	0.00E+00	5.70E+05
W-187	2.89E+04	1.71E+04	7.68E+03	0.00E+00	0.00E+00	0.00E+00	2.40E+06
WP-239	2.16E+02	1.55E+01	1.09E+01	0.00E+00	4.48E+01	0.00E+00	1.15E+06

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except R-3 which is in units of gram/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
H-3	0.00E+00	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03
C-14	2.34E+09	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08
NA-24	1.54E+07	1.54E+07	1.54E+07	1.54E+07	1.54E+07	1.54E+07	1.54E+07
P-32	1.60E+11	9.43E+09	6.21E+09	0.00E+00	0.00E+00	0.00E+00	2.17E+09
CR-51	0.00E+00	0.00E+00	1.61E+05	1.05E+05	2.30E+04	2.05E+05	4.70E+06
MN-54	0.00E+00	3.90E+07	8.64E+06	0.00E+00	8.64E+06	0.00E+00	1.43E+07
MN-56	0.00E+00	3.14E-02	5.42E-03	0.00E+00	2.70E-02	0.00E+00	2.85E+00
FE-55	1.35E+08	8.73E+07	2.33E+07	0.00E+00	0.00E+00	4.27E+07	1.11E+07
FE-59	2.24E+08	3.92E+08	1.54E+08	0.00E+00	0.00E+00	1.16E+08	1.87E+08
CO-58	0.00E+00	2.42E+07	6.05E+07	0.00E+00	0.00E+00	0.00E+00	6.04E+07
CO-60	0.00E+00	8.62E+07	2.08E+08	0.00E+00	0.00E+00	0.00E+00	2.10E+08
NI-63	3.49E+10	2.16E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
NI-65	3.50E+00	3.97E-01	1.80E-01	0.00E+00	0.00E+00	0.00E+00	3.02E+01
CU-64	0.00E+00	1.86E+05	8.59E+04	0.00E+00	3.14E+05	0.00E+00	3.81E+06
ZN-65	5.55E+09	1.90E+10	8.78E+09	0.00E+00	9.23E+09	0.00E+00	1.61E+10
ZN-69	2.02E-11	3.63E-11	2.70E-12	0.00E+00	1.51E-11	0.00E+00	2.96E-09
BR-83	0.00E+00	0.00E+00	1.12E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.51E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	2.23E+10	1.10E+10	0.00E+00	0.00E+00	0.00E+00	5.69E+08
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	1.26E+10	0.00E+00	3.61E+08	0.00E+00	0.00E+00	0.00E+00	2.59E+08
SR-90	1.22E+11	0.00E+00	3.10E+10	0.00E+00	0.00E+00	0.00E+00	1.52E+09
SR-91	2.72E+05	0.00E+00	9.83E+03	0.00E+00	0.00E+00	0.00E+00	3.21E+05
SR-92	4.64E+00	0.00E+00	1.72E-01	0.00E+00	0.00E+00	0.00E+00	5.00E+01
Y-90	5.81E+02	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	9.41E+05
Y-91M	5.67E-19	0.00E+00	1.93E-20	0.00E+00	0.00E+00	0.00E+00	1.89E-15
Y-91	7.33E+04	0.00E+00	1.95E+03	0.00E+00	0.00E+00	0.00E+00	5.25E+06
Y-92	5.38E-04	0.00E+00	1.51E-05	0.00E+00	0.00E+00	0.00E+00	1.03E+01

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: INFANT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	2.16E+00	0.00E+00	5.87E-02	0.00E+00	0.00E+00	0.00E+00	1.70E+04
ZR-95	6.80E+03	1.66E+03	1.18E+03	0.00E+00	1.79E+03	0.00E+00	8.26E+05
ZR-97	4.06E+00	6.97E-01	3.18E-01	0.00E+00	7.03E-01	0.00E+00	4.45E+04
NR-95	5.93E+05	2.44E+05	1.41E+05	0.00E+00	1.75E+05	0.00E+00	2.06E+08
MO-99	0.00E+00	2.08E+08	4.06E+07	0.00E+00	3.11E+08	0.00E+00	6.85E+07
TC-99M	2.75E+01	5.67E+01	7.30E+02	0.00E+00	6.10E+02	2.96E+01	1.65E+04
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	8.67E+03	0.00E+00	2.90E+03	0.00E+00	1.80E+04	0.00E+00	1.05E+05
RU-105	8.05E-03	0.00E+00	2.71E-03	0.00E+00	5.92E-02	0.00E+00	3.20E+00
RU-106	1.90E+05	0.00E+00	2.38E+04	0.00E+00	2.25E+05	0.00E+00	1.44E+06
AG-110M	3.86E+08	2.82E+08	1.86E+08	0.00E+00	4.03E+08	0.00E+00	1.46E+10
TE-125M	1.51E+08	5.04E+07	2.04E+07	5.07E+07	0.00E+00	0.00E+00	7.18E+07
TE-127M	4.21E+08	1.40E+08	5.10E+07	1.22E+08	1.04E+09	0.00E+00	1.70E+08
TE-127	6.32E+03	2.12E+03	1.36E+03	5.14E+03	1.54E+04	0.00E+00	1.33E+05
TE-129M	5.57E+08	1.91E+08	8.58E+07	2.14E+08	1.39E+09	0.00E+00	3.33E+08
TE-129	2.72E-09	9.37E-10	6.35E-10	2.28E-09	6.77E-09	0.00E+00	2.17E-07
TE-131M	3.38E+06	1.36E+06	1.12E+06	2.75E+06	9.35E+06	0.00E+00	2.29E+07
TE-131	3.43E-32	1.27E-32	9.62E-33	3.06E-32	8.76E-32	0.00E+00	1.38E-30
TE-132	2.11E+07	1.04E+07	9.75E+06	1.54E+07	6.53E+07	0.00E+00	3.87E+07
I-130	3.55E+06	7.81E+06	3.13E+06	8.75E+08	8.58E+06	0.00E+00	1.67E+06
I-131	2.72E+09	3.20E+09	1.41E+09	1.05E+12	3.74E+09	0.00E+00	1.14E+08
I-132	1.43E+00	2.90E+00	1.03E+00	1.36E+02	3.24E+00	0.00E+00	2.35E+00
I-133	3.63E+07	5.28E+07	1.55E+07	9.60E+09	6.21E+07	0.00E+00	8.93E+06
I-134	1.76E-11	3.60E-11	1.28E-11	8.40E-10	4.03E-11	0.00E+00	3.73E-11
I-135	1.12E+05	2.36E+05	8.14E+04	2.00E+07	2.49E+05	0.00E+00	8.08E+04
CS-134	3.65E+10	6.40E+10	6.87E+09	0.00E+00	1.75E+10	7.18E+09	1.85E+08
CS-136	1.98E+09	5.81E+09	2.17E+09	0.00E+00	2.32E+09	4.74E+08	8.62E+07
CS-137	5.15E+10	6.02E+10	4.27E+09	0.00E+00	1.62E+10	6.55E+09	1.88E+08
CS-138	8.39E-23	1.36E-22	6.61E-23	0.00E+00	6.80E-23	1.06E-23	2.18E-22
BA-139	4.27E-07	2.83E-10	1.24E-08	0.00E+00	1.70E-10	1.72E-10	2.71E-05

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

COW'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: INFANT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.41E+08	2.41E+05	1.24E+07	0.00E+00	5.72E+04	1.48E+05	5.92E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.05E+01	1.60E+01	4.11E+00	0.00E+00	0.00E+00	0.00E+00	1.86E+05
LA-142	1.70E+10	6.24E+11	1.49E+11	0.00E+00	0.00E+00	0.00E+00	1.06E+05
CE-141	4.34E+04	2.64E+04	3.11E+03	0.00E+00	8.15E+03	0.00E+00	1.37E+07
CE-143	3.97E+02	2.63E+05	3.00E+01	0.00E+00	7.67E+01	0.00E+00	1.54E+06
CE-144	2.33E+06	9.52E+05	1.30E+05	0.00E+00	3.85E+05	0.00E+00	1.33E+08
PR-143	1.49E+03	5.55E+02	7.36E+01	0.00E+00	2.09E+02	0.00E+00	7.84E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E+10	0.00E+00	0.00E+00
ND-147	8.81E+02	9.05E+02	5.55E+01	0.00E+00	3.44E+02	0.00E+00	5.74E+05
V-187	6.08E+04	4.23E+04	1.46E+04	0.00E+00	0.00E+00	0.00E+00	2.48E+06
HP-239	4.57E+02	4.08E+01	2.31E+01	0.00E+00	8.15E+01	0.00E+00	1.18E+06

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (1 of 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
H-3	0.00E+00	3.25E+02	3.25E+02	3.25E+02	3.25E+02	3.25E+02	3.25E+02
C-14	2.41E+08	4.83E+07	4.83E+07	4.83E+07	4.83E+07	4.83E+07	4.83E+07
NA-24	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03
P-32	4.66E+09	2.90E+08	1.80E+08	0.00E+00	0.00E+00	0.00E+00	5.24E+08
CR-51	0.00E+00	0.00E+00	7.05E+03	4.21E+03	1.55E+03	9.35E+03	1.77E+06
MN-54	0.00E+00	9.18E+06	1.75E+06	0.00E+00	2.73E+06	0.00E+00	2.81E+07
MN-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	2.93E+08	2.03E+08	4.72E+07	0.00E+00	0.00E+00	1.13E+08	1.16E+08
FE-59	2.66E+08	6.24E+08	2.39E+08	0.00E+00	0.00E+00	1.74E+08	2.06E+09
CO-58	0.00E+00	8.2E+07	4.09E+07	0.00E+00	0.00E+00	0.00E+00	3.69E+09
CO-60	0.00E+00	7.52E+07	1.66E+08	0.00E+00	0.00E+00	0.00E+00	1.41E+09
NI-63	1.89E+10	1.31E+09	6.33E+08	0.00E+00	0.00E+00	0.00E+00	2.73E+08
NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	2.71E-07	1.27E-07	0.00E+00	6.84E-07	0.00E+00	2.31E-05
ZN-65	3.56E+08	1.13E+09	5.12E+08	0.00E+00	7.57E+08	0.00E+00	7.13E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	4.87E+08	2.27E+08	0.00E+00	0.00E+00	0.00E+00	9.60E+07
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	3.02E+08	0.00E+00	8.66E+06	0.00E+00	0.00E+00	0.00E+00	4.84E+07
BR-90	1.24E+10	0.00E+00	3.05E+09	0.00E+00	0.00E+00	0.00E+00	3.59E+08
BR-91	1.52E-10	0.00E+00	6.14E-12	0.00E+00	0.00E+00	0.00E+00	7.23E-10
BR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	1.08E+02	0.00E+00	2.89E+00	0.00E+00	0.00E+00	0.00E+00	1.14E+06
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	1.13E+06	0.00E+00	3.03E+00	0.00E+00	0.00E+00	0.00E+00	6.23E+08
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of $\mu\text{rem}/\text{hr}/\text{g}/\text{yr}$ per $\mu\text{Ci}/\text{sec}$ for all nuclides except H-3 which is in units of rem/yr per $\mu\text{Ci}/\text{cubic meter}$.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	G.I. LL
Y-93	4.69E-12	0.00E+00	1.30E-13	0.00E+00	0.00E+00	0.00E+00	1.49E-07
ZR-95	1.87E+06	6.01E+05	4.07E+05	0.00E+00	9.42E+05	0.00E+00	1.90E+09
ZR-97	2.07E-05	4.17E-06	1.91E-06	0.00E+00	6.30E-06	0.00E+00	1.29E+00
NR-95	2.30E+06	1.28E+06	6.87E+05	0.00E+00	1.26E+06	0.00E+00	7.76E+09
ND-99	0.00E+00	1.00E+05	1.90E+04	0.00E+00	2.26E+05	0.00E+00	2.32E+05
TC-99M	4.45E-21	1.26E-20	1.60E-19	0.00E+00	1.91E-19	6.16E-21	7.44E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.05E+08	0.00E+00	4.53E+07	0.00E+00	4.01E+08	0.00E+00	1.23E+10
RU-105	5.78E-28	0.00E+00	2.28E-28	0.00E+00	7.46E-27	0.00E+00	3.53E-25
RU-106	2.80E+09	0.00E+00	3.54E+08	0.00E+00	5.40E+09	0.00E+00	1.81E+11
AD-110M	6.68E+06	6.18E+06	3.67E+06	0.00E+00	1.22E+07	0.00E+00	2.52E+09
TE-125M	3.59E+08	1.30E+08	4.81E+07	1.08E+08	1.46E+09	0.00E+00	1.43E+09
TE-127M	1.12E+09	3.99E+08	1.56E+08	2.85E+08	4.53E+09	0.00E+00	3.74E+09
TE-127	2.12E-10	7.62E-11	4.59E-11	1.57E-10	8.64E-10	0.00E+00	1.67E-08
TE-129M	1.13E+09	4.23E+08	1.79E+08	3.90E+08	4.73E+09	0.00E+00	5.71E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	4.51E+02	2.21E+02	1.84E+02	3.49E+02	7.23E+03	0.00E+00	2.19E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	1.42E+06	9.18E+05	8.62E+05	1.01E+06	8.84E+06	0.00E+00	4.34E+07
I-130	2.11E-06	6.22E-06	2.45E-06	5.27E-04	9.71E-06	0.00E+00	5.35E-06
I-131	1.07E+07	1.54E+07	8.80E+06	5.03E+09	2.63E+07	0.00E+00	4.05E+06
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	3.65E-01	6.35E-01	1.94E-01	9.34E+01	1.11E+00	0.00E+00	5.71E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	4.43E-17	1.16E-16	4.28E-17	7.64E-15	1.66E-16	0.00E+00	1.31E-16
CS-134	6.58E+08	1.56E+09	1.28E+09	0.00E+00	5.06E+08	1.68E+08	2.74E+07
CS-136	1.21E+07	4.76E+07	3.43E+07	0.00E+00	2.65E+07	3.63E+06	1.41E+06
CS-137	8.72E+08	1.19E+09	7.81E+08	0.00E+00	4.05E+08	1.35E+08	2.31E+07
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-areu/yr per uCi/sec for all nuclides except H-3 which is in units of areu/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.87E+07	3.61E+04	1.88E+06	0.00E+00	1.23E+04	2.07E+04	5.92E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.71E-02	1.87E-02	4.94E-03	0.00E+00	0.00E+00	0.00E+00	1.37E+03
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	1.40E+04	9.50E+03	1.08E+03	0.00E+00	4.61E+03	0.00E+00	3.63E+07
CE-143	2.01E-02	1.48E+01	1.64E-03	0.00E+00	6.53E-03	0.00E+00	5.55E+02
CE-144	1.75E+06	6.09E+05	7.83E+04	0.00E+00	3.61E+05	0.00E+00	4.93E+08
PR-143	2.10E+04	8.41E+03	1.04E+03	0.00E+00	4.85E+03	0.00E+00	9.18E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SD-147	7.07E+03	8.17E+03	4.89E+02	0.00E+00	4.78E+03	0.00E+00	3.92E+07
W-187	2.07E-02	1.73E-02	6.04E-03	0.00E+00	0.00E+00	0.00E+00	5.66E+00
WP-239	6.53E+02	6.42E+01	3.54E+01	0.00E+00	2.00E+02	0.00E+00	1.52E+07

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	BODY	THYROID	KIDNEY	LUNG	GILL
H-3	0.00E+00	1.94E+02	1.94E+02	1.94E+02	1.94E+02	1.94E+02	1.94E+02
C-14	2.04E+08	4.08E+07	4.08E+07	4.08E+07	4.08E+07	4.08E+07	4.08E+07
NA-24	1.08E-03	1.08E-03	1.08E-03	1.08E-03	1.08E-03	1.08E-03	1.08E-03
P-32	3.93E+09	2.44E+08	1.53E+08	0.00E+00	0.00E+00	0.00E+00	3.31E+08
CR-51	0.00E+00	0.00E+00	5.64E+03	3.13E+03	1.24E+03	8.05E+03	9.47E+05
MM-54	0.00E+00	7.00E+06	1.39E+06	0.00E+00	2.09E+06	0.00E+00	1.44E+07
MM-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	2.38E+08	1.69E+08	3.94E+07	0.00E+00	0.00E+00	1.07E+08	7.31E+07
FE-59	2.12E+08	4.95E+08	1.91E+08	0.00E+00	0.00E+00	1.56E+08	1.17E+09
CO-58	0.00E+00	1.41E+07	3.24E+07	0.00E+00	0.00E+00	0.00E+00	1.94E+08
CO-60	0.00E+00	5.83E+07	1.31E+08	0.00E+00	0.00E+00	0.00E+00	7.60E+08
NI-63	1.52E+10	1.07E+09	5.15E+08	0.00E+00	0.00E+00	0.00E+00	1.71E+08
NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	2.21E+07	1.04E+07	0.00E+00	5.60E+07	0.00E+00	1.72E+05
ZN-65	2.50E+08	8.69E+08	4.05E+08	0.00E+00	5.56E+08	0.00E+00	3.68E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	4.07E+08	1.91E+08	0.00E+00	0.00E+00	0.00E+00	6.02E+07
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	2.55E+08	0.00E+00	7.29E+06	0.00E+00	0.00E+00	0.00E+00	3.03E+07
BR-90	8.05E+09	0.00E+00	1.99E+09	0.00E+00	0.00E+00	0.00E+00	2.26E+08
SR-91	1.28E+10	0.00E+00	5.08E+12	0.00E+00	0.00E+00	0.00E+00	5.79E+10
SR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	9.06E+01	0.00E+00	2.44E+00	0.00E+00	0.00E+00	0.00E+00	7.47E+05
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	9.54E+05	0.00E+00	2.56E+04	0.00E+00	0.00E+00	0.00E+00	3.91E+08
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
Y-93	3.96E-12	0.00E+00	1.09E-13	0.00E+00	0.00E+00	0.00E+00	1.21E-07
ZR-95	1.50E+06	4.73E+05	3.25E+05	0.00E+00	6.95E+05	0.00E+00	1.09E+09
ZR-97	1.72E-05	3.41E-06	1.57E-06	0.00E+00	5.17E-06	0.00E+00	9.23E-01
NR-95	1.79E+06	9.95E+05	5.48E+05	0.00E+00	9.65E+05	0.00E+00	4.26E+09
MO-99	0.00E+00	8.27E+04	1.58E+04	0.00E+00	1.89E+05	0.00E+00	1.48E+05
TC-99M	3.53E-21	9.86E-21	1.28E-19	0.00E+00	1.47E-19	1.47E-21	6.47E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	8.57E+07	0.00E+00	3.66E+07	0.00E+00	3.02E+08	0.00E+00	7.16E+09
RU-105	4.83E-28	0.00E+00	1.87E-28	0.00E+00	6.09E-27	0.00E+00	3.90E-25
RU-106	1.82E+09	0.00E+00	2.97E+08	0.00E+00	4.55E+09	0.00E+00	1.13E+11
AG-110M	5.06E+06	4.79E+06	2.91E+06	0.00E+00	9.13E+06	0.00E+00	1.34E+09
TE-125M	3.03E+08	1.09E+08	4.05E+07	8.47E+07	0.00E+00	0.00E+00	8.94E+08
TE-127M	9.41E+08	3.34E+08	1.12E+08	2.24E+08	3.82E+09	0.00E+00	2.35E+09
TE-127	1.80E-10	6.38E-11	3.88E-11	1.24E-10	7.29E-10	0.00E+00	1.39E-08
TE-129M	9.50E+08	3.53E+08	1.50E+08	3.07E+08	3.97E+09	0.00E+00	3.57E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	3.76E+02	1.80E+02	1.50E+02	2.71E+02	1.88E+03	0.00E+00	1.45E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	1.16E+06	7.56E+05	6.92E+05	7.76E+05	7.06E+06	0.00E+00	2.33E+07
I-130	1.70E-06	4.91E-06	1.96E-06	4.00E-04	7.56E-06	0.00E+00	3.77E-06
I-131	8.92E+06	1.25E+07	6.71E+06	3.65E+09	2.15E+07	0.00E+00	2.47E+06
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	3.05E-01	5.18E-01	1.58E-01	7.23E+01	9.09E-01	0.00E+00	3.92E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	3.60E-17	9.27E-17	3.44E-17	5.96E-15	1.44E-16	0.00E+00	1.03E-16
CS-134	5.23E+08	1.23E+09	5.71E+08	0.00E+00	3.91E+08	1.49E+08	1.53E+07
CS-136	9.40E+06	3.70E+07	2.48E+07	0.00E+00	2.01E+07	3.17E+06	2.98E+06
CS-137	7.24E+08	9.63E+08	3.56E+08	0.00E+00	3.28E+08	1.27E+08	1.37E+07
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES
OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (3 0)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
BA-140	2.38E+07	2.91E+04	1.53E+06	0.00E+00	9.87E+03	1.96E+04	3.66E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.05E-02	1.50E-02	3.99E-03	0.00E+00	0.00E+00	0.00E+00	8.61E+02
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	1.18E+04	7.87E+03	9.04E+02	0.00E+00	3.71E+03	0.00E+00	2.25E+07
CE-143	1.69E-02	1.23E+01	1.37E-03	0.00E+00	5.51E-03	0.00E+00	3.69E+02
CE-144	1.23E+06	5.08E+05	6.60E+04	0.00E+00	3.04E+05	0.00E+00	3.09E+08
PR-143	1.76E+04	7.04E+03	8.78E+02	0.00E+00	4.09E+03	0.00E+00	5.80E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	6.23E+03	6.77E+03	4.06E+02	0.00E+00	3.98E+03	0.00E+00	2.44E+07
W-187	1.73E-02	1.41E-02	4.95E-03	0.00E+00	0.00E+00	0.00E+00	3.82E+00
WP-239	5.70E+02	5.38E+01	2.99E+01	0.00E+00	1.69E+02	0.00E+00	8.65E+06

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (1 OF 3)

NUCLIDES

ORGAN DOSE CONVERSION FACTORS

	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02
C-14	3.83E+06	7.67E+07	7.67E+07	7.67E+07	7.67E+07	7.67E+07	7.67E+07
HA-24	1.72E-03	1.72E-02	1.72E-03	1.72E-03	1.72E-03	1.72E-03	1.72E-03
P-32	7.42E+09	3.47E+08	2.86E+08	0.00E+00	0.00E+00	0.00E+00	2.05E+06
CR-51	0.00E+00	0.00E+00	8.79E+03	4.88E+03	1.33E+03	8.91E+03	4.66E+05
HR-54	0.00E+00	8.01E+06	2.13E+06	0.00E+00	2.25E+06	0.00E+00	6.72E+06
HR-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	4.37E+08	2.42E+08	7.51E+07	0.00E+00	0.00E+00	1.37E+08	4.49E+07
FE-59	3.76E+08	6.09E+08	3.03E+08	0.00E+00	0.00E+00	1.77E+08	6.34E+08
CO-58	0.00E+00	1.64E+07	5.02E+07	0.00E+00	0.00E+00	0.00E+00	9.58E+07
CO-60	0.00E+00	6.93E+07	2.04E+08	0.00E+00	0.00E+00	0.00E+00	3.84E+08
NI-63	2.91E+10	1.56E+09	1.02E+09	0.00E+00	0.00E+00	0.00E+00	1.05E+08
NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	2.97E-07	1.80E-07	0.00E+00	7.19E-07	0.00E+00	1.40E-05
ZN-65	3.75E+08	1.00E+09	6.22E+08	0.00E+00	6.30E+08	0.00E+00	1.76E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	5.77E+08	3.55E+08	0.00E+00	0.00E+00	0.00E+00	3.71E+07
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	4.82E+08	0.00E+00	1.38E+07	0.00E+00	0.00E+00	0.00E+00	1.67E+07
SR-90	1.04E+10	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	1.40E+08
SR-91	2.40E-10	0.00E+00	9.05E-12	0.00E+00	0.00E+00	0.00E+00	5.29E-10
SR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	1.71E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	0.00E+00	4.88E+05
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	1.80E+06	0.00E+00	4.82E+04	0.00E+00	0.00E+00	0.00E+00	2.40E+08
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	7.44E-12	0.00E+00	2.04E-13	0.00E+00	0.00E+00	0.00E+00	1.11E-07
ZR-95	2.66E+06	5.85E+05	5.21E+05	0.00E+00	8.38E+05	0.00E+00	6.11E+08
ZR-97	3.21E-05	4.63E-06	2.73E-06	0.00E+00	6.65E-06	0.00E+00	7.02E-01
NR-95	3.10E+06	1.21E+06	8.62E+05	0.00E+00	1.13E+06	0.00E+00	2.23E+09
NO-99	0.00E+00	1.15E+05	2.84E+04	0.00E+00	2.46E+05	0.00E+00	9.51E+04
TC-99M	6.20E-21	1.22E-20	2.01E-19	0.00E+00	1.77E-19	6.17E-21	6.91E-18
TC-101	0.00E+0	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.55E+08	0.00E+00	5.96E+07	0.00E+00	3.90E+08	0.00E+00	4.01E+09
RU-105	9.02E-28	0.00E+00	3.27E-28	0.00E+00	7.93E-27	0.00E+00	5.88E-25
RU-106	4.64E+09	0.00E+00	5.54E+08	0.00E+00	5.99E+09	0.00E+00	6.90E+10
AG-110M	8.39E+06	5.67E+06	4.53E+06	0.00E+00	1.06E+07	0.00E+00	6.74E+08
TE-125M	5.69E+08	1.54E+08	7.59E+07	1.60E+08	0.00E+00	0.00E+00	5.49E+08
TE-127M	1.77E+09	4.78E+08	2.11E+08	4.24E+08	5.06E+09	0.00E+00	1.44E+09
TE-127	3.39E-10	9.13E-11	7.26E-11	2.34E-10	9.63E-10	0.00E+00	1.32E-08
TE-129M	1.79E+09	5.00E+08	2.78E+08	5.77E+08	5.26E+09	0.00E+00	2.18E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-131M	7.00E+02	2.42E+02	2.58E+02	4.98E+02	2.34E+03	0.00E+00	9.82E+03
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	2.12E+06	9.38E+05	1.13E+06	1.37E+06	8.71E+06	0.00E+00	9.45E+06
I-130	3.04E-06	6.13E-06	3.16E-06	6.76E-04	9.17E-06	0.00E+00	2.87E-06
I-131	1.65E+07	1.66E+07	9.46E+06	5.50E+09	2.73E+07	0.00E+00	1.48E+06
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	5.67E-01	7.02E-01	2.66E-01	1.30E+02	1.17E+00	0.00E+00	2.83E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	6.52E-17	1.17E-16	5.55E-17	1.04E-14	1.80E-16	0.00E+00	8.94E-17
CS-134	9.22E+08	1.51E+09	3.19E+08	0.00E+00	4.69E+08	1.68E+08	8.16E+06
CS-136	1.62E+07	4.58E+07	2.88E+07	0.00E+00	2.37E+07	3.54E+06	1.57E+06
CS-137	1.33E+09	1.28E+09	1.88E+08	0.00E+00	4.16E+08	1.50E+08	7.99E+06
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

MEAT PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES
OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (3 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	4.38E+07	3.84E+04	2.56E+06	0.00E+00	1.25E+04	2.29E+04	2.22E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	5.59E-02	1.95E-02	6.08E-03	0.00E+00	0.00E+00	0.00E+00	5.44E+02
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	2.22E+04	1.11E+04	1.64E+03	0.00E+00	4.86E+04	0.00E+00	1.38E+07
CE-143	3.17E-02	1.72E+01	2.49E-03	0.00E+00	7.21E-03	0.00E+00	2.52E+02
CE-144	2.32E+06	7.26E+05	1.24E+05	0.00E+00	4.02E+05	0.00E+00	1.89E+08
PR-143	3.34E+04	1.00E+04	1.66E+03	0.00E+00	5.43E+03	0.00E+00	3.60E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	1.17E+04	9.47E+03	7.53E+02	0.00E+00	5.19E+03	0.00E+00	1.50E+07
U-187	3.21E-02	1.90E-02	8.53E-03	0.00E+00	0.00E+00	0.00E+00	2.67E+00
NP-239	1.07E+03	7.71E+01	5.42E+01	0.00E+00	2.23E+02	0.00E+00	5.70E+06

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (1 of 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03
C-1	2.28E+08	4.55E+07	4.55E+07	4.55E+07	4.55E+07	4.55E+07	4.55E+07
HA-14	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05
P-32	1.40E+09	8.73E+07	5.43E+07	0.00E+00	0.00E+00	0.00E+00	1.58E+08
CR-51	0.00E+00	0.00E+00	4.64E+04	2.78E+04	1.02E+04	6.16E+04	1.17E+07
MN-54	0.00E+00	3.13E+08	5.97E+07	0.00E+00	9.31E+07	0.00E+00	9.59E+08
MN-56	0.00E+00	1.59E+01	2.82E+00	0.00E+00	2.02E+01	0.00E+00	5.07E+02
FE-55	2.10E+08	1.45E+08	3.38E+07	0.00E+00	0.00E+00	8.08E+07	8.31E+07
FE-59	1.26E+08	2.96E+08	1.14E+08	0.00E+00	0.00E+00	8.28E+07	9.88E+08
CO-58	0.00E+00	3.07E+07	6.89E+07	0.00E+00	0.00E+00	0.00E+00	6.23E+08
CO-60	0.00E+00	1.67E+08	3.69E+08	0.00E+00	0.00E+00	0.00E+00	3.14E+09
NI-63	1.04E+10	7.21E+08	3.49E+08	0.00E+00	0.00E+00	0.00E+00	1.50E+08
NI-65	6.15E+01	7.99E+00	3.64E+00	0.00E+00	0.00E+00	0.00E+00	2.03E+02
CU-64	0.00E+00	9.20E+03	4.32E+03	0.00E+00	2.32E+04	0.00E+00	7.84E+05
ZN-65	3.17E+08	1.01E+09	4.56E+08	0.00E+00	6.75E+08	0.00E+00	6.36E+08
ZN-69	5.49E+06	1.05E+05	7.31E+07	0.00E+00	6.83E+06	0.00E+00	1.58E+06
BR-83	0.00E+00	0.00E+00	3.11E+00	0.00E+00	0.00E+00	0.00E+00	4.47E+00
BR-84	0.00E+00	0.00E+00	2.48E-11	0.00E+00	0.00E+00	0.00E+00	1.94E-16
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	2.19E+08	1.02E+08	0.00E+00	0.00E+00	0.00E+00	4.33E+07
BR-88	0.00E+00	3.43E-22	1.82E-22	0.00E+00	0.00E+00	0.00E+00	4.74E-33
BR-89	0.00E+00	3.89E-26	2.77E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	9.97E+09	0.00E+00	2.86E+08	0.00E+00	0.00E+00	0.00E+00	1.60E+09
SR-90	6.05E+11	0.00E+00	1.48E+11	0.00E+00	0.00E+00	0.00E+00	1.75E+10
SR-91	3.05E+05	0.00E+00	1.23E+04	0.00E+00	0.00E+00	0.00E+00	1.45E+06
SR-92	4.27E+02	0.00E+00	1.85E+01	0.00E+00	0.00E+00	0.00E+00	8.45E+03
Y-90	1.33E+04	0.00E+00	3.57E+02	0.00E+00	0.00E+00	0.00E+00	1.41E+08
Y-91M	5.22E-09	0.00E+00	2.02E-10	0.00E+00	0.00E+00	0.00E+00	1.53E-08
Y-91	5.11E+06	0.00E+00	1.37E+05	0.00E+00	0.00E+00	0.00E+00	2.81E+09
Y-92	9.15E-01	0.00E+00	2.68E-02	0.00E+00	0.00E+00	0.00E+00	1.60E+04

Conversion factors are in units of square meter-mm/yr per uCi/sec for all
nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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93	1.70E+02	0.00E+00	4.68E+00	0.00E+00	0.00E+00	0.00E+00	5.38E+06
ZR-95	1.17E+06	3.77E+05	2.55E+05	0.00E+00	5.91E+05	0.00E+00	1.19E+09
ZR-97	3.37E+02	6.81E+01	3.11E+01	0.00E+00	1.03E+02	0.00E+00	2.11E+07
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NR-95	1.42E+05	7.92E+04	4.26E+04	0.00E+00	7.83E+04	0.00E+00	4.81E+08
NO-99	0.00E+00	6.15E+06	1.17E+06	0.00E+00	1.39E+07	0.00E+00	1.43E+07
TC-99M	3.10E+00	8.77E+00	1.12E+02	0.00E+00	1.33E+02	4.30E+00	5.19E+03
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TC-101	8.22E-31	1.18E-30	1.16E-29	0.00E+00	2.13E-29	6.05E-31	0.00E+00
RU-103	4.77E+06	0.00E+00	2.06E+06	0.00E+00	1.82E+07	0.00E+00	5.57E+08
RU-105	5.39E+01	0.00E+00	2.13E+01	0.00E+00	6.96E+02	0.00E+00	3.29E+04
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RU-106	1.93E+08	0.00E+00	2.44E+07	0.00E+00	3.72E+08	0.00E+00	1.25E+10
AG-110M	1.05E+07	9.75E+06	5.79E+06	0.00E+00	1.92E+07	0.00E+00	3.98E+09
TE-125M	9.66E+07	3.50E+07	1.29E+07	2.90E+07	5.93E+08	0.00E+00	3.86E+08
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TE-127M	3.49E+08	1.25E+08	4.26E+07	8.92E+07	1.42E+09	0.00E+00	1.17E+09
TE-127	5.66E+03	2.03E+03	1.22E+03	4.19E+03	2.31E+04	0.00E+00	4.47E+05
TE-129M	2.51E+08	9.38E+07	3.98E+07	8.63E+07	1.05E+09	0.00E+00	1.27E+09
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TE-129	7.62E-04	2.87E-04	1.86E-04	5.85E-04	3.20E-03	0.00E+00	5.75E-04
TE-131M	9.12E+05	4.46E+05	3.72E+05	7.06E+05	4.52E+06	0.00E+00	4.43E+07
TE-131	1.50E-15	6.27E-16	4.74E-16	1.23E-15	6.57E-15	0.00E+00	2.13E-16
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TE-132	4.30E+06	2.78E+06	2.61E+06	3.07E+06	2.68E+07	0.00E+00	1.32E+08
I-130	3.92E+05	1.16E+06	4.57E+05	9.81E+07	1.81E+06	0.00E+00	9.96E+05
I-131	8.08E+07	1.16E+08	6.62E+07	3.79E+10	1.98E+08	0.00E+00	3.05E+07
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I-132	5.76E+01	1.54E+02	5.39E+01	5.39E+03	2.45E+02	0.00E+00	2.89E+01
I-133	2.09E+06	3.63E+06	1.11E+06	5.33E+08	6.33E+06	0.00E+00	3.26E+06
I-134	9.65E-05	2.62E-04	9.38E-05	4.54E-03	4.17E-04	0.00E+00	2.29E-07
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I-135	3.90E+04	1.02E+05	3.77E+04	6.73E+06	1.64E+05	0.00E+00	1.15E+05
CS-134	4.67E+09	1.11E+10	9.08E+09	0.00E+00	3.59E+09	1.19E+09	1.94E+08
CS-136	4.27E+07	1.68E+08	1.21E+08	0.00E+00	9.38E+07	1.29E+07	1.91E+07
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CS-137	6.36E+09	8.70E+09	5.70E+09	0.00E+00	2.95E+09	9.81E+08	1.68E+08
CS-138	3.91E-11	7.73E-11	3.83E-11	0.00E+00	5.68E-11	5.61E-12	3.30E-16
BA-139	2.86E-02	2.03E-05	8.36E-04	0.00E+00	1.90E-05	1.15E-05	5.07E-02

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	1.28E+08	1.61E+05	8.42E+06	0.00E+00	5.49E+04	9.24E+04	2.65E+08
BA-141	1.15E-21	8.70E-25	3.89E-23	0.00E+00	8.09E-25	4.94E-25	5.43E-31
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.98E+03	9.97E+02	2.63E+02	0.00E+00	0.00E+00	0.00E+00	7.32E+07
LA-142	2.02E-04	9.19E-05	2.29E-05	0.00E+00	0.00E+00	0.00E+00	6.71E-01
CE-141	1.97E+05	1.33E+05	1.51E+04	0.00E+00	6.19E+04	0.00E+00	5.10E+08
CE-143	9.98E+02	7.38E+05	8.16E+01	0.00E+00	3.25E+02	0.00E+00	2.76E+07
CE-144	3.29E+07	1.38E+07	1.77E+06	0.00E+00	8.16E+06	0.00E+00	1.11E+10
PR-143	6.26E+04	2.51E+04	3.10E+03	0.00E+00	1.45E+04	0.00E+00	2.74E+08
PR-144	3.09E-26	1.28E-26	1.57E-27	0.00E+00	7.23E-27	0.00E+00	4.44E-33
ND-147	3.33E+04	3.85E+04	2.31E+03	0.00E+00	2.25E+04	0.00E+00	1.85E+08
W-187	3.80E+04	3.18E+04	1.11E+04	0.00E+00	0.00E+00	0.00E+00	1.04E+07
WP-239	9.54E+04	9.58E+03	5.17E+03	0.00E+00	2.93E+04	0.00E+00	1.92E+09

Conversion factors are in units of square meter-arec/yr per uCi/sec for all nuclides except H-3 which is in units of arec/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03
C-14	3.69E+08	7.38E+07	7.38E+07	7.38E+07	7.38E+07	7.38E+07	7.38E+07
NA-24	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05
P-32	1.61E+09	9.97E+07	6.24E+07	0.00E+00	0.00E+00	0.00E+00	1.35E+08
CR-51	0.00E+00	0.00E+00	6.17E+04	3.43E+04	1.35E+04	8.81E+04	1.04E+07
MN-54	0.00E+00	4.54E+08	9.01E+07	0.00E+00	1.36E+08	0.00E+00	9.32E+08
MN-56	0.00E+00	1.43E+01	2.55E+00	0.00E+00	1.81E+01	0.00E+00	9.44E+02
FE-55	3.26E+08	2.31E+08	5.39E+07	0.00E+00	0.00E+00	1.47E+08	1.00E+08
FS-59	1.79E+08	4.19E+08	1.62E+08	0.00E+00	0.00E+00	1.32E+08	9.90E+08
CO-58	0.00E+00	4.36E+07	1.00E+08	0.00E+00	0.00E+00	0.00E+00	6.01E+08
CO-60	0.00E+00	2.49E+08	5.60E+08	0.00E+00	0.00E+00	0.00E+00	3.24E+09
NI-63	1.61E+10	1.13E+09	5.45E+08	0.00E+00	0.00E+00	0.00E+00	1.81E+08
NI-65	5.72E+01	7.31E+00	3.33E+00	0.00E+00	0.00E+00	0.00E+00	3.97E+02
CU-64	0.00E+00	8.34E+03	3.92E+03	0.00E+00	2.11E+04	0.00E+00	6.47E+05
ZN-65	4.24E+08	1.47E+09	6.87E+08	0.00E+00	9.42E+08	0.00E+00	6.23E+08
ZN-69	5.15E-06	7.80E-06	6.86E-07	0.00E+00	6.41E-06	0.00E+00	1.81E-05
BR-83	0.00E+00	0.00E+00	2.91E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	2.25E-11	0.00E+00	2.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE-86	0.00E+00	2.74E+08	1.29E+08	0.00E+00	0.00E+00	0.00E+00	4.05E+07
RE-88	0.00E+00	3.17E-22	1.69E-22	0.00E+00	0.00E+00	0.00E+00	2.71E-29
RE-89	0.00E+00	3.50E-26	2.47E-26	0.00E+00	0.00E+00	0.00E+00	5.36E-35
SR-89	1.51E+10	0.00E+00	4.34E+08	0.00E+00	0.00E+00	0.00E+00	1.80E+09
SR-90	7.51E+11	0.00E+00	1.85E+11	0.00E+00	0.00E+00	0.00E+00	2.11E+10
SR-91	2.85E+05	0.00E+00	1.13E+04	0.00E+00	0.00E+00	0.00E+00	1.29E+06
SR-92	3.97E+02	0.00E+00	1.69E+01	0.00E+00	0.00E+00	0.00E+00	1.01E+04
Y-90	1.24E+04	0.00E+00	3.35E+02	0.00E+00	0.00E+00	0.00E+00	1.02E+08
Y-91M	4.86E-09	0.00E+00	1.86E-10	0.00E+00	0.00E+00	0.00E+00	2.29E-07
Y-91	7.84E+06	0.00E+00	2.10E+05	0.00E+00	0.00E+00	0.00E+00	3.21E+09
Y-92	8.60E-01	0.00E+00	2.49E-02	0.00E+00	0.00E+00	0.00E+00	2.36E+04

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
Y-93	1.59E+02	0.00E+00	4.36E+00	0.00E+00	0.00E+00	0.00E+00	4.86E+06
ZR-95	1.72E+06	5.43E+05	3.73E+05	0.00E+00	7.98E+05	0.00E+00	1.25E+09
ZR-97	3.12E+02	6.18E+01	2.85E+01	0.00E+00	9.37E+01	0.00E+00	1.67E+07
NR-95	1.92E+05	1.07E+05	5.87E+04	0.00E+00	1.03E+05	0.00E+00	4.56E+08
MO-99	0.00E+00	5.65E+06	1.08E+06	0.00E+00	1.29E+07	0.00E+00	1.01E+07
TC-99M	2.74E+00	7.63E+00	9.89E+01	0.00E+00	1.14E+02	4.24E+00	5.01E+03
TC-101	7.64E-31	1.09E-30	1.07E-29	0.00E+00	1.97E-29	6.62E-31	0.00E+00
RU-103	6.82E+06	0.00E+00	2.92E+06	0.00E+00	2.40E+07	0.00E+00	5.70E+08
RU-105	5.00E+01	0.00E+00	1.94E+01	0.00E+00	6.31E+02	0.00E+00	4.04E+04
RU-106	2.38E+08	0.00E+00	3.90E+07	0.00E+00	5.97E+08	0.00E+00	1.48E+10
AG-110M	1.52E+07	1.43E+07	9.72E+06	0.00E+00	2.74E+07	0.00E+00	4.03E+09
TE-125M	1.48E+08	5.34E+07	1.98E+07	4.14E+07	0.00E+00	0.00E+00	4.37E+08
TE-127M	5.51E+08	1.96E+08	6.56E+07	1.31E+08	2.24E+09	0.00E+00	1.37E+09
TE-127	5.34E+03	1.89E+03	1.15E+03	3.68E+03	2.16E+04	0.00E+00	4.12E+05
TE-129M	3.62E+08	1.34E+08	5.73E+07	1.17E+08	1.51E+09	0.00E+00	1.36E+09
TE-129	7.14E-04	2.66E-04	1.59E-04	5.10E-04	3.00E-03	0.00E+00	3.90E-03
TE-131M	8.44E+05	4.05E+05	3.38E+05	6.09E+05	4.22E+06	0.00E+00	3.25E+07
TE-131	1.39E-15	5.75E-16	4.36E-16	1.07E-15	6.10E-15	0.00E+00	1.14E-16
TE-132	3.91E+06	2.47E+06	2.33E+06	2.61E+06	2.37E+07	0.00E+00	7.84E+07
I-130	3.51E+05	1.01E+06	4.05E+05	8.28E+07	1.56E+06	0.00E+00	7.80E+05
I-131	7.67E+07	1.08E+08	5.78E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07
I-132	5.19E+01	1.36E+02	4.88E+01	4.58E+03	2.14E+02	0.00E+00	5.92E+01
I-133	1.94E+06	3.29E+06	1.00E+06	4.59E+08	5.76E+06	0.00E+00	2.49E+06
I-134	8.73E-05	2.31E-04	8.31E-05	3.85E-03	3.65E-04	0.00E+00	3.05E-06
I-135	3.52E+04	9.07E+04	3.34E+04	5.83E+06	1.43E+05	0.00E+00	1.00E+05
CS-134	7.10E+09	1.67E+10	7.75E+09	0.00E+00	5.31E+09	2.03E+09	2.08E+08
CS-136	4.37E+07	1.72E+08	1.16E+08	0.00E+00	9.37E+07	1.48E+07	1.38E+07
CS-137	1.01E+10	1.35E+10	4.69E+09	0.00E+00	4.59E+09	1.78E+09	1.92E+08
CS-138	3.61E-11	6.93E-11	3.47E-11	0.00E+00	5.12E-11	5.96E-12	3.15E-14
BR-139	2.69E-02	1.89E-05	7.83E-04	0.00E+00	1.78E-05	1.30E-05	2.40E-01

Conversion factors are in units of square meter-mm/yr per uCi/sec for all
nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	1.38E+08	1.69E+05	8.90E+06	0.00E+00	5.74E+04	1.14E+05	2.13E+08
BA-141	1.08E-21	8.04E-25	3.59E-23	0.00E+00	7.46E-25	5.50E-25	2.29E-27
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.81E+03	8.88E+02	2.36E+02	0.00E+00	0.00E+00	0.00E+00	5.10E+07
LA-142	1.85E-04	3.23E-05	2.05E-05	0.00E+00	0.00E+00	0.00E+00	2.51E+00
CE-141	2.83E+05	1.89E+05	2.17E+04	0.00E+00	8.89E+04	0.00E+00	5.40E+08
CE-143	9.33E+02	6.79E+05	7.58E+01	0.00E+00	3.04E+02	0.00E+00	2.04E+07
CE-144	5.27E+07	2.18E+07	2.83E+06	0.00E+00	1.30E+07	0.00E+00	1.33E+10
PR-143	7.00E+04	2.80E+04	3.49E+03	0.00E+00	1.63E+04	0.00E+00	2.30E+08
PR-144	2.89E-26	1.18E-26	1.47E-27	0.00E+00	6.80E-27	0.00E+00	3.19E-29
ND-147	3.62E+04	3.94E+04	2.36E+03	0.00E+00	2.31E+04	0.00E+00	1.42E+08
W-187	3.54E+04	2.88E+04	1.01E+04	0.00E+00	0.00E+00	0.00E+00	7.80E+06
HP-239	1.00E+05	1.51E+04	8.38E+03	0.00E+00	4.74E+04	0.00E+00	2.43E+09

Conversion factors are in units of square meter-rem/yr per uCi/sec for all nuclides except H-3 which is in units of mrem/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (1 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03
C-14	8.89E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08
NA-24	3.73E+05	3.73E+06	3.73E+05	3.73E+05	3.73E+05	3.73E+05	3.73E+05
P-32	3.37E+09	1.58E+08	1.50E+08	0.00E+00	0.00E+00	0.00E+00	9.31E+07
CR-51	0.00E+00	0.00E+00	1.17E+05	6.30E+04	1.78E+04	1.19E+05	6.21E+06
MN-54	0.00E+00	6.65E+08	1.77E+08	0.00E+00	1.86E+08	0.00E+00	5.58E+08
MN-56	0.00E+00	1.88E+01	4.24E+00	0.00E+00	2.27E+01	0.00E+00	2.72E+03
FE-55	7.66E+08	4.25E+08	1.32E+08	0.00E+00	0.00E+00	2.40E+08	7.87E+07
FE-59	3.98E+08	6.43E+08	3.20E+08	0.00E+00	0.00E+00	1.86E+08	6.70E+08
CO-58	0.00E+00	6.44E+07	1.07E+08	0.00E+00	0.00E+00	0.00E+00	3.76E+08
CO-60	0.00E+00	3.78E+08	1.12E+09	0.00E+00	0.00E+00	0.00E+00	2.10E+09
NI-63	3.95E+10	2.11E+09	1.38E+09	0.00E+00	0.00E+00	0.00E+00	1.42E+08
NI-65	1.05E+02	9.89E+00	5.77E+00	0.00E+00	0.00E+00	0.00E+00	1.21E+03
CU-64	0.00E+00	1.10E+04	6.64E+03	0.00E+00	2.66E+04	0.00E+00	5.16E+05
ZN-65	8.13E+08	2.16E+09	1.35E+09	0.00E+00	1.36E+09	0.00E+00	3.80E+08
ZN-69	9.49E-06	1.37E-05	1.27E-06	0.60E+00	8.32E-06	0.00E+00	8.65E-04
BH-83	0.00E+00	0.00E+00	5.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.82E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RS-86	0.00E+00	1.52E+08	2.78E+08	0.00E+00	0.00E+00	0.00E+00	2.91E+07
RH-88	0.00E+00	4.37E-22	3.04E-22	0.00E+00	0.00E+00	0.00E+00	2.15E-23
RS-89	0.00E+00	4.61E-26	4.10E-26	0.00E+00	0.00E+00	0.00E+00	4.02E-28
SR-89	3.60E+10	0.00E+00	1.03E+09	0.00E+00	0.00E+00	0.00E+00	1.39E+09
SR-90	1.24E+12	0.00E+00	3.15E+11	0.00E+00	0.00E+00	0.00E+00	1.67E+10
SR-91	5.24E+05	0.00E+00	1.98E+04	0.00E+00	0.00E+00	0.00E+00	1.16E+06
SR-92	7.28E+02	0.00E+00	2.92E+01	0.00E+00	0.00E+00	0.00E+00	1.38E+04
Y-90	2.31E+04	0.00E+00	6.18E+02	0.00E+00	0.00E+00	0.00E+00	6.57E+07
Y-91M	8.91E-09	0.00E+00	3.24E-10	0.00E+00	0.00E+00	0.00E+00	1.74E-05
Y-91	1.86E+07	0.00E+00	4.99E+05	0.00E+00	0.00E+00	0.00E+00	2.48E+09
Y-91	1.58E+00	0.00E+00	4.53E-02	0.00E+00	0.00E+00	0.00E+00	4.58E+04

Conversion factors are in units of square meter-area/yr per uCi/sec for all nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y-93	2.93E+02	0.00E+00	8.04E+00	0.00E+00	0.00E+00	0.00E+00	4.37E+06
ZR-95	3.86E+06	8.48E+05	7.55E+05	0.00E+00	1.21E+06	0.00E+00	8.85E+08
ZR-97	5.70E+02	8.24E+01	4.86E+01	0.00E+00	1.18E+02	0.00E+00	1.25E+07
NR-95	4.10E+05	1.60E+05	1.14E+05	0.00E+00	1.50E+05	0.00E+00	2.96E+08
MD-99	0.00E+00	7.71E+06	1.91E+06	0.00E+00	1.65E+07	0.00E+00	6.38E+06
TC-99M	4.71E+00	9.24E+00	1.53E+02	0.00E+00	1.34E+02	4.69E+00	5.26E+03
TC-101	1.41E-30	1.47E-30	1.87E-29	0.00E+00	2.51E-29	7.78E-31	4.68E-30
RU-103	1.53E+07	0.00E+00	5.90E+06	0.00E+00	3.86E+07	0.00E+00	3.97E+08
RU-105	9.16E+01	0.00E+00	3.32E+01	0.00E+00	8.05E+02	0.00E+00	5.98E+04
RU-106	7.45E+08	0.00E+00	9.30E+07	0.00E+00	1.01E+09	0.00E+00	1.16E+10
AG-110M	3.21E+07	2.17E+07	1.73E+07	0.00E+00	4.04E+07	0.00E+00	2.58E+09
TE-125M	3.51E+08	9.50E+07	4.67E+07	9.84E+07	0.00E+00	0.00E+00	3.38E+08
TE-127M	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	0.00E+00	1.07E+09
TE-127	9.85E+03	2.65E+03	2.11E+03	6.81E+03	2.80E+04	0.00E+00	3.85E+05
TE-129M	8.41E+08	2.35E+08	1.31E+08	2.71E+08	2.47E+09	0.00E+00	1.03E+09
TE-129	1.32E-03	3.69E-04	3.14E-04	9.43E-04	3.87E-03	0.00E+00	8.23E-02
TE-131M	1.54E+06	5.33E+05	5.68E+05	1.10E+06	5.16E+06	0.00E+00	2.16E+07
TE-131	2.57E-15	7.83E-16	7.64E-16	1.97E-15	7.77E-15	0.00E+00	1.35E-14
TE-132	7.00E+06	3.10E+06	3.74E+06	4.51E+06	2.88E+07	0.00E+00	3.12E+07
I-130	6.16E+05	1.24E+06	6.41E+05	1.37E+08	1.86E+06	0.00E+00	5.82E+05
I-131	1.43E+08	1.44E+08	8.17E+07	4.75E+10	2.36E+08	0.00E+00	1.28E+07
I-132	9.22E+01	1.69E+02	7.79E+01	7.82E+03	2.59E+02	0.00E+00	1.99E+02
I-133	3.53E+06	4.37E+06	1.65E+06	8.11E+08	7.28E+06	0.00E+00	1.76E+06
I-134	1.55E-04	2.88E-04	1.32E-04	6.62E-03	4.40E-04	0.00E+00	1.91E-04
I-135	6.26E+04	1.13E+05	5.33E+04	9.97E+06	1.73E+05	0.00E+00	8.58E+04
CS-134	1.60E+10	2.63E+10	5.55E+09	0.00E+00	8.15E+09	2.93E+09	1.42E+08
CS-136	8.24E+07	2.33E+08	1.47E+08	0.00E+00	1.21E+08	1.80E+07	7.96E+06
CS-137	2.39E+10	2.29E+10	3.38E+09	0.00E+00	7.46E+09	2.68E+09	1.43E+08
CS-138	6.57E-11	9.13E-11	5.79E-11	0.00E+00	6.43E-11	6.91E-12	4.21E-11
BA-139	4.95E-02	2.64E-05	1.44E-03	0.00E+00	2.31E-05	1.56E-05	2.86E+00

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

LEAFY VEGETABLE PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (3 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	2.77E+08	2.42E+05	1.61E+07	0.00E+00	7.89E+04	1.45E+05	1.40E+08
BA-141	1.99E-21	1.11E-24	6.47E-23	0.00E+00	9.62E-25	6.53E-24	1.13E-21
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.25E+03	1.13E+03	3.53E+02	0.00E+00	0.00E+00	0.00E+00	3.16E+07
LA-142	3.36E-04	1.07E-04	3.35E-05	0.00E+00	0.00E+00	0.00E+00	2.12E+01
CE-141	6.56E+05	3.27E+05	4.86E+04	0.00E+00	1.43E+06	0.00E+00	1.08E+08
CE-143	1.72E+03	9.31E+05	1.35E+02	0.00E+00	3.91E+02	0.00E+00	1.36E+07
CE-144	1.27E+08	3.98E+07	6.78E+06	0.00E+00	2.21E+07	0.00E+00	1.04E+10
PR-143	1.46E+05	4.37E+04	7.23E+03	0.00E+00	2.37E+04	0.00E+00	1.57E+08
PR-144	5.37E-26	1.66E-26	2.70E-27	0.00E+00	8.79E-27	0.00E+00	3.58E-23
MD-147	7.15E+04	5.79E+04	4.48E+03	0.00E+00	3.18E+04	0.00E+00	9.17E+07
W-187	6.43E+04	3.81E+04	1.71E+04	0.00E+00	0.00E+00	0.00E+00	5.35E+06
WP-239	3.86E+05	2.77E+04	1.95E+04	0.00E+00	8.01E+04	0.00E+00	2.05E+09

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: ADULT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03
C-14	2.63E+08	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07
NA-24	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05
P-32	2.05E+10	1.28E+09	7.93E+08	0.00E+00	0.00E+00	0.00E+00	2.31E+09
CR-51	0.00E+00	0.00E+00	3.43E+03	2.05E+03	7.55E+02	4.55E+03	8.62E+05
MN-54	0.00E+00	1.01E+06	1.93E+05	0.00E+00	3.00E+05	0.00E+00	3.09E+06
MN-56	0.00E+00	4.98E-04	8.84E-05	0.00E+00	6.32E-04	0.00E+00	1.59E-02
FE-55	3.26E+05	2.26E+05	5.26E+04	0.00E+00	0.00E+00	1.26E+05	1.29E+05
FE-59	3.86E+05	9.07E+05	3.48E+05	0.00E+00	0.00E+00	2.54E+05	3.02E+06
CO-58	0.00E+00	5.66E+05	1.27E+06	0.00E+00	0.00E+00	0.00E+00	1.15E+07
CO-60	0.00E+00	1.97E+06	4.34E+06	0.00E+00	0.00E+00	0.00E+00	3.70E+07
NI-63	8.07E+08	5.60E+07	2.71E+07	0.00E+00	0.00E+00	0.00E+00	1.17E+07
NI-65	4.44E-02	5.77E-03	2.67E-03	0.00E+00	0.00E+00	0.00E+00	1.46E-01
CU-64	0.00E+00	2.66E+03	1.73E+03	0.00E+00	6.70E+03	0.00E+00	2.26E+05
ZN-65	1.65E+08	5.24E+08	2.37E+08	0.00E+00	3.50E+08	0.00E+00	3.30E+08
ZN-69	2.51E-13	4.80E-13	3.34E-14	0.00E+00	3.12E-13	0.00E+00	7.21E-14
BR-83	0.00E+00	0.00E+00	1.40E-03	0.00E+00	0.00E+00	0.00E+00	2.02E-03
BR-84	0.00E+00	0.00E+00	2.32E-25	0.00E+00	0.00E+00	0.00E+00	1.82E-30
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	3.11E+08	1.45E+08	0.00E+00	0.00E+00	0.00E+00	6.14E+07
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	3.05E+09	0.00E+00	8.75E+07	0.00E+00	0.00E+00	0.00E+00	4.89E+08
SR-90	9.83E+10	0.00E+00	2.41E+10	0.00E+00	0.00E+00	0.00E+00	2.84E+09
SR-91	6.07E+04	0.00E+00	2.45E+03	0.00E+00	0.00E+00	0.00E+00	2.89E+05
SR-92	1.03E+00	0.00E+00	4.44E-02	0.00E+00	0.00E+00	0.00E+00	2.03E+01
Y-90	8.50E+00	0.00E+00	2.28E-01	0.00E+00	0.00E+00	0.00E+00	9.01E+04
Y-91M	7.18E-21	0.00E+00	2.78E-22	0.00E+00	0.00E+00	0.00E+00	2.11E-20
Y-91	1.03E+03	0.00E+00	2.76E+01	0.00E+00	0.00E+00	0.00E+00	5.67E+05
Y-92	6.69E-06	0.00E+00	1.96E-07	0.00E+00	0.00E+00	0.00E+00	1.17E-01

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
Y-93	2.68E-02	0.00E+00	7.40E-04	0.00E+00	0.00E+00	0.00E+00	8.50E+02
ZR-95	1.13E+02	3.63E+01	2.46E+01	0.00E+00	5.70E+01	0.00E+00	1.15E+05
ZR-97	5.20E-02	1.05E-02	4.80E-03	0.00E+00	1.58E-02	0.00E+00	3.25E+03
NR-95	9.91E+03	5.51E+03	2.96E+03	0.00E+00	5.45E+03	0.00E+00	3.34E+07
NO-99	0.00E+00	2.97E+06	5.66E+05	0.00E+00	6.73E+06	0.00E+00	6.89E+06
TC-99M	3.98E-01	1.13E+00	1.43E+01	0.00E+00	1.71E+01	5.52E-01	6.66E+02
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.22E+02	0.00E+00	5.26E+01	0.00E+00	4.66E+02	0.00E+00	1.43E+04
RU-105	1.03E-04	0.00E+00	6.06E-05	0.00E+00	1.33E-03	0.00E+00	6.29E-02
RU-106	2.45E+03	0.00E+00	3.10E+02	0.00E+00	4.73E+03	0.00E+00	1.58E+05
AG-110M	6.99E+06	6.46E+06	3.84E+06	0.00E+00	1.27E+07	0.00E+00	2.64E+09
TE-125M	1.95E+06	7.08E+05	2.62E+05	5.88E+05	7.95E+06	0.00E+00	7.80E+06
TE-127M	5.49E+06	1.96E+06	6.89E+05	1.40E+06	2.23E+07	0.00E+00	1.84E+07
TE-127	7.83E+01	2.81E+01	1.70E+01	5.80E+01	3.19E+02	0.00E+00	6.18E+03
TE-129M	7.22E+06	2.69E+06	1.14E+06	2.48E+06	3.02E+07	0.00E+00	3.64E+07
TE-129	3.39E-11	1.27E-11	8.25E-12	2.60E-11	1.42E-10	0.00E+00	2.56E-11
TE-131M	4.33E+04	2.12E+04	1.77E+04	3.36E+04	2.15E+05	0.00E+00	2.10E+06
TE-131	4.32E-34	1.81E-34	1.37E-34	3.56E-34	1.89E-33	0.00E+00	6.12E-35
TE-132	2.88E+05	1.86E+05	1.75E+05	2.06E+05	1.80E+06	0.00E+00	8.82E+06
I-130	5.04E+05	1.49E+06	5.87E+05	1.26E+08	2.32E+06	0.00E+00	1.28E+06
I-131	1.55E+08	5.08E+08	2.91E+08	1.67E+11	8.71E+08	0.00E+00	1.34E+08
I-132	1.97E-01	5.27E-01	1.84E-01	1.84E+01	8.40E-01	0.00E+00	9.90E-02
I-133	4.64E+06	8.38E+06	2.46E+06	1.19E+09	1.41E+07	0.00E+00	7.26E+06
I-134	2.42E-12	6.57E-12	2.35E-12	1.14E-10	1.05E-11	0.00E+00	5.73E-15
I-135	1.54E+04	4.03E+04	1.49E+04	2.66E+06	6.67E+04	0.00E+00	4.56E+04
CS-134	1.70E+10	4.04E+10	3.30E+10	0.00E+00	1.31E+10	4.34E+09	7.06E+08
CS-136	7.90E+08	3.12E+09	2.24E+09	0.00E+00	1.73E+09	2.38E+08	3.54E+08
CS-137	2.21E+10	3.03E+10	1.98E+10	0.00E+00	1.03E+10	3.42E+09	5.86E+08
CS-138	2.71E-23	5.36E-23	2.65E-23	0.00E+00	3.94E-23	3.89E-24	2.29E-28
BA-139	5.33E-09	3.78E-12	1.55E-10	0.00E+00	3.53E-12	2.14E-12	9.40E-09

Conversion factors are in units of square meter-gram/yr per uCi/sec for all nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: ADULT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	1. BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	3.23E+06	4.05E+03	2.11E+05	0.00E+00	1.38E+03	2.32E+03	6.64E+06
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	5.41E-01	2.73E-01	7.21E-02	0.00E+00	0.00E+00	0.00E+00	2.00E+04
LA-142	2.23E-12	1.01E-12	2.53E-13	0.00E+00	0.00E+00	0.00E+00	7.40E-09
CE-141	5.81E+02	3.93E+02	4.46E+01	0.00E+00	1.83E+02	0.00E+00	1.50E+06
CE-143	4.99E+00	3.69E+03	4.08E-01	0.00E+00	1.62E+00	0.00E+00	1.38E+05
CE-144	4.29E+04	1.79E+04	2.30E+03	0.00E+00	1.06E+04	0.00E+00	1.45E+07
PR-143	1.89E+01	7.60E+00	9.39E-01	0.00E+00	4.39E+00	0.00E+00	8.30E+04
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	1.13E+01	1.31E+01	7.81E-01	0.00E+00	7.63E+00	0.00E+00	6.27E+04
W-187	7.82E+02	6.53E+02	2.28E+02	0.00E+00	0.00E+00	0.00E+00	2.14E+05
WP-239	5.52E+00	5.43E-01	2.99E-01	0.00E+00	1.69E+00	0.00E+00	1.11E+05

Conversion factors are in units of square meter-aream/yr per uCi/sec for all nuclides except H-3 which is in units of aream/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: TEEN (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03
C-14	4.86E+08	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07
NA-24	5.11E+05	5.11E+05	5.11E+05	5.11E+05	5.11E+05	5.11E+05	5.11E+05
P-32	3.78E+10	2.34E+09	1.47E+09	0.00E+00	0.00E+00	0.00E+00	3.18E+09
CR-51	0.00E+00	0.00E+00	5.99E+03	3.33E+03	1.31E+03	8.55E+03	1.01E+06
MN-54	0.00E+00	1.68E+06	3.34E+05	0.00E+00	5.02E+05	0.00E+00	3.45E+06
MN-56	0.00E+00	8.83E-04	1.57E-04	0.00E+00	1.12E-03	0.00E+00	5.81E-02
FE-55	5.79E+05	4.11E+05	9.57E+04	0.00E+00	0.00E+00	2.60E+05	1.78E+05
FE-59	6.74E+05	1.57E+06	6.07E+05	0.00E+00	0.00E+00	4.96E+05	3.72E+06
CO-58	0.00E+00	9.52E+05	2.19E+06	0.00E+00	0.00E+00	0.00E+00	1.31E+07
CO-60	0.00E+00	3.34E+06	7.52E+06	0.00E+00	0.00E+00	0.00E+00	4.35E+07
NI-63	1.42E+09	1.00E+08	4.81E+07	0.00E+00	0.00E+00	0.00E+00	1.59E+07
NI-65	8.12E-02	1.04E-02	4.73E-03	0.00E+00	0.00E+00	0.00E+00	5.63E-01
CJ-64	0.00E+00	4.73E+03	2.23E+03	0.00E+00	1.20E+04	0.00E+00	3.67E+05
ZN-65	2.53E+08	8.78E+08	4.10E+08	0.00E+00	5.62E+08	0.00E+00	3.72E+08
ZN-69	4.62E-13	8.80E-13	6.16E-14	0.00E+00	5.75E-13	0.00E+00	1.62E-12
BR-83	0.00E+00	0.00E+00	2.58E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.14E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	5.67E+08	2.67E+08	0.00E+00	0.00E+00	0.00E+00	8.40E+07
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	5.62E+09	0.00E+00	1.61E+08	0.00E+00	0.00E+00	0.00E+00	6.69E+08
SR-90	1.39E+11	0.00E+00	3.43E+10	0.00E+00	0.00E+00	0.00E+00	3.90E+09
SR-91	1.12E+05	0.00E+00	4.44E+03	0.00E+00	0.00E+00	0.00E+00	5.06E+05
SR-92	1.88E+00	0.00E+00	8.00E-02	0.00E+00	0.00E+00	0.00E+00	4.78E+01
Y-90	1.56E+01	0.00E+00	4.21E-01	0.00E+00	0.00E+00	0.00E+00	1.29E+05
Y-91M	1.31E-20	0.00E+00	5.02E-22	0.00E+00	0.00E+00	0.00E+00	6.21E-19
Y-91	1.90E+03	0.00E+00	5.08E+01	0.00E+00	0.00E+00	0.00E+00	7.77E+05
Y-92	1.24E-05	0.00E+00	3.58E-07	0.00E+00	0.00E+00	0.00E+00	3.39E-01

Conversion factors are in units of square meter-mm/yr per uCi/sec for all
nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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Y-93	4.94E-02	0.00E+00	1.36E-03	0.00E+00	0.00E+00	0.00E+00	1.51E+03
ZR-95	1.98E+02	6.25E+01	4.30E+01	0.00E+00	9.18E+01	0.00E+00	1.44E+05
ZR-97	9.46E-02	1.87E-02	8.62E-03	0.00E+00	2.84E-02	0.00E+00	5.07E+03
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NB-95	1.69E+04	9.37E+03	5.16E+03	0.00E+00	9.08E+03	0.00E+00	4.01E+07
MO-99	0.00E+00	5.37E+06	1.02E+06	0.00E+00	1.23E+07	0.00E+00	9.61E+06
TC-99M	6.91E-01	1.93E+00	2.50E+01	0.00E+00	2.87E+01	1.07E+00	1.27E+03
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TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	2.17E+02	0.00E+00	9.29E+01	0.00E+00	7.66E+02	0.00E+00	1.81E+04
RU-105	1.88E-04	0.00E+00	7.29E-05	0.00E+00	2.37E-03	0.00E+00	1.52E-01
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RU-106	3.47E+03	0.00E+00	5.67E+02	0.00E+00	8.68E+03	0.00E+00	2.16E+05
AG-110M	1.16E+07	1.09E+07	6.65E+06	0.00E+00	2.08E+07	0.00E+00	3.07E+09
TE-125N	3.60E+06	1.30E+06	4.82E+05	1.01E+06	0.00E+00	0.00E+00	1.06E+07
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TE-127M	1.01E+07	3.59E+06	1.20E+06	2.41E+06	4.10E+07	0.00E+00	2.52E+07
TE-127	1.45E+02	5.15E+01	3.12E+01	1.00E+02	5.88E+02	0.00E+00	1.12E+04
TE-129M	1.32E+07	4.90E+06	2.05E+06	4.26E+06	5.53E+07	0.00E+00	4.96E+07
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TE-129	6.24E-11	2.33E-11	1.39E-11	4.46E-11	2.62E-10	0.00E+00	3.41E-10
TE-131M	7.88E+04	3.78E+04	3.15E+04	5.69E+04	3.94E+05	0.00E+00	3.03E+06
TE-131	7.90E-34	3.26E-34	2.47E-34	6.09E-34	3.45E-33	0.00E+00	6.49E-35
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TE-132	5.15E+05	3.26E+05	3.07E+05	3.44E+05	3.13E+06	0.00E+00	1.03E+07
I-130	8.86E+05	2.56E+06	1.02E+06	2.09E+08	3.95E+06	0.00E+00	1.97E+06
I-131	6.45E+08	9.03E+08	4.85E+08	2.63E+11	1.55E+09	0.00E+00	1.79E+08
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I-132	3.50E-01	9.15E-01	3.28E-01	3.08E+01	1.44E+00	0.00E+00	3.98E-01
I-133	8.48E+06	1.44E+07	4.39E+06	2.01E+09	2.52E+07	0.00E+00	1.09E+07
I-134	4.50E-12	1.14E-11	4.09E-12	1.90E-10	1.80E-11	0.00E+00	1.50E-13
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I-135	2.74E+04	7.04E+04	2.61E+04	4.53E+06	1.11E+05	0.00E+00	7.81E+04
CS-134	2.94E+10	6.93E+10	3.22E+10	0.00E+00	2.20E+10	8.41E+09	8.62E+08
CS-136	1.34E+09	5.29E+09	3.55E+09	0.00E+00	2.88E+09	4.54E+08	4.26E+08
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CS-137	4.02E+10	5.34E+10	1.86E+10	0.00E+00	1.82E+10	7.06E+09	7.60E+08
CS-138	4.92E-23	9.45E-23	4.72E-23	0.00E+00	6.98E-23	8.12E-24	4.29E-26
BA-139	9.81E-09	6.90E-12	2.86E-10	0.00E+00	6.50E-12	4.75E-12	8.75E-08

Conversion factors are in units of square meter-gram/yr per uCi/aec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: TEEN (3 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA-140	5.82E+06	1.13E+03	3.75E+05	0.00E+00	2.42E+03	4.80E+03	8.98E+06
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	9.72E-01	4.78E-01	1.27E-01	0.00E+00	0.00E+00	0.00E+00	2.74E+04
LA-142	4.02E-12	1.79E-12	4.45E-13	0.00E+00	0.00E+00	0.00E+00	5.44E-08
CE-141	1.07E+03	7.12E+02	8.17E+01	0.00E+00	3.35E+02	0.00E+00	2.04E+06
CE-143	9.17E+00	6.67E+03	7.45E-01	0.00E+00	2.99E+00	0.00E+00	2.00E+05
CE-144	7.90E+04	3.27E+04	4.24E+03	0.00E+00	1.95E+04	0.00E+00	1.99E+07
PR-143	3.48E+01	1.39E+01	1.73E+00	0.00E+00	8.08E+00	0.00E+00	1.15E+05
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	2.17E+01	2.36E+01	1.42E+00	0.00E+00	1.39E+01	0.00E+00	8.53E+04
W-187	1.43E+03	1.17E+03	4.08E+02	0.00E+00	0.00E+00	0.00E+00	3.15E+05
WP-239	1.05E+01	9.93E-01	5.52E-01	0.00E+00	3.12E+00	0.00E+00	1.60E+05

Conversion factors are in units of square meter-gram/yr per uCi/sec for all
nuclides except H-3 which is in units of gram/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (1 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03
C-14	1.19E+09	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08
NA-24	1.06E+06	1.06E+07	1.06E+06	1.06E+06	1.06E+06	1.06E+06	1.06E+06
P-32	9.33E+10	4.37E+09	3.60E+09	0.00E+00	0.00E+00	0.00E+00	2.58E+09
CR-51	0.00E+00	0.00E+00	1.22E+04	6.76E+03	1.85E+03	1.24E+04	6.48E+05
MN-54	0.00E+00	2.52E+06	6.70E+05	0.00E+00	7.06E+05	0.00E+00	2.11E+06
MN-56	0.00E+00	1.54E+03	3.48E+04	0.00E+00	1.86E+03	0.00E+00	2.23E+01
FE-55	1.39E+06	7.71E+05	2.39E+05	0.00E+00	0.00E+00	4.36E+05	1.43E+05
FE-59	1.56E+06	2.53E+06	1.26E+06	0.00E+00	0.00E+00	7.33E+05	2.63E+06
CO-58	0.00E+00	1.45E+06	4.45E+06	0.00E+00	0.00E+00	0.00E+00	8.49E+06
CO-60	0.00E+00	5.18E+06	1.53E+07	0.00E+00	0.00E+00	0.00E+00	2.87E+07
NI-63	3.56E+09	1.90E+08	1.24E+08	0.00E+00	0.00E+00	0.00E+00	1.28E+07
NI-65	1.99E+01	1.87E+02	1.09E+02	0.00E+00	0.00E+00	0.00E+00	2.29E+00
CU-64	0.00E+00	8.32E+03	5.02E+03	0.00E+00	2.01E+04	0.00E+00	3.90E+05
ZN-65	4.96E+08	1.32E+09	8.22E+08	0.00E+00	8.33E+08	0.00E+00	2.32E+08
ZN-69	1.14E+12	1.64E+12	1.52E+13	0.00E+00	9.96E+13	0.00E+00	1.03E+10
BR-83	0.00E+00	0.00E+00	6.34E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	9.37E+25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-86	0.00E+00	1.05E+09	6.47E+08	0.00E+00	0.00E+00	0.00E+00	6.77E+07
BR-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	1.39E+10	0.00E+00	3.97E+08	0.00E+00	0.00E+00	0.00E+00	5.38E+08
SR-90	2.35E+11	0.00E+00	5.95E+10	0.00E+00	0.00E+00	0.00E+00	3.16E+09
SR-91	2.74E+05	0.00E+00	1.03E+04	0.00E+00	0.00E+00	0.00E+00	6.04E+05
SR-92	4.58E+00	0.00E+00	1.84E+01	0.00E+00	0.00E+00	0.00E+00	8.68E+01
Y-90	3.87E+01	0.00E+00	1.03E+00	0.00E+00	0.00E+00	0.00E+00	1.10E+05
Y-91M	3.21E+20	0.00E+00	1.17E+21	0.00E+00	0.00E+00	0.00E+00	6.29E+17
Y-91	4.68E+03	0.00E+00	1.25E+02	0.00E+00	0.00E+00	0.00E+00	6.24E+05
Y-92	3.04E+05	0.00E+00	8.69E+07	0.00E+00	0.00E+00	0.00E+00	8.77E+01

Conversion factors are in units of square meter-mm/yr per uCi/sec for all
nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: CHILD (2 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	G.I. LL1
Y-93	1.21E-01	0.00E+00	3.33E-03	0.00E+00	0.00E+00	0.00E+00	1.81E+03
ZR-95	4.60E+02	1.01E+02	9.00E+01	0.00E+00	1.45E+02	0.00E+00	1.05E+05
ZR-97	2.30E-01	3.33E-02	1.96E-02	0.00E+00	4.78E-02	0.00E+00	5.04E+03
NR-95	3.81E+04	1.49E+04	1.06E+04	0.00E+00	0.00E+00	0.00E+00	2.75E+07
MO-99	0.00E+00	9.76E+06	2.42E+06	0.00E+00	0.00E+00	0.00E+00	8.08E+06
TC-99M	1.59E+00	3.11E+00	5.15E+01	0.00E+00	4.52E+01	1.58E+00	1.77E+03
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	5.14E+02	0.00E+00	1.98E+02	0.00E+00	1.29E+03	0.00E+00	1.33E+04
RU-105	4.58E-04	0.00E+00	1.66E-04	0.00E+00	4.03E-03	0.00E+00	2.99E-01
RU-106	1.11E+04	0.00E+00	1.38E+03	0.00E+00	1.50E+04	0.00E+00	1.72E+05
AG-110M	2.51E+07	1.69E+07	1.35E+07	0.00E+00	3.15E+07	0.00E+00	2.01E+09
TE-125M	8.85E+06	2.40E+06	1.13E+06	2.48E+06	0.00E+00	0.00E+00	8.54E+06
TE-127M	2.50E+07	6.72E+06	2.96E+06	5.97E+06	7.12E+07	0.00E+00	2.02E+07
TE-127	3.57E+02	9.63E+01	7.66E+01	2.47E+02	1.02E+03	0.00E+00	1.40E+04
TE-129M	3.26E+07	9.09E+06	5.06E+06	1.05E+07	9.56E+07	0.00E+00	3.97E+07
TE-129	1.34E-10	4.30E-11	3.65E-11	1.10E-10	4.50E-10	0.00E+00	9.58E-09
TE-131M	1.92E+05	6.64E+04	7.06E+04	1.36E+05	6.42E+05	0.00E+00	2.69E+06
TE-131	1.94E-33	5.91E-34	5.77E-34	1.48E-33	5.86E-33	0.00E+00	1.02E-32
TE-132	1.23E+06	5.44E+05	6.57E+05	7.93E+05	5.05E+06	0.00E+00	5.48E+06
I-130	2.07E+06	4.19E+06	2.16E+06	4.61E+08	6.26E+06	0.00E+00	1.96E+06
I-131	1.56E+09	1.57E+09	8.94E+08	5.20E+11	2.58E+09	0.00E+00	1.40E+08
I-132	8.27E-01	1.52E+00	6.99E-01	7.05E+01	2.33E+00	0.00E+00	1.79E+00
I-133	2.06E+07	2.55E+07	9.64E+06	4.73E+09	4.25E+07	0.00E+00	1.03E+07
I-134	1.02E-11	1.89E-11	8.70E-12	4.35E-10	2.89E-11	0.00E+00	1.25E-11
I-135	6.48E+04	1.17E+05	5.52E+04	1.03E+07	1.79E+05	0.00E+00	8.88E+04
CS-134	6.79E+10	1.11E+11	2.35E+10	0.00E+00	3.45E+10	1.24E+10	6.01E+08
CS-136	3.03E+09	8.58E+09	5.40E+09	0.00E+00	4.44E+09	6.63E+08	2.93E+08
CS-137	9.67E+10	9.26E+10	1.37E+10	0.00E+00	3.02E+10	1.09E+10	5.80E+08
CS-138	1.19E-22	1.66E-22	1.05E-22	0.00E+00	1.17E-22	1.26E-23	7.64E-23
BA-139	2.41E-08	1.29E-11	6.98E-10	0.00E+00	1.12E-11	7.57E-12	1.39E-06

Conversion factors are in units of square meter-grams/yr per uCi/sec for all
nuclides except H-3 which is in units of grams/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R₁

AGE GROUP: CHILD (3 OF 3)

NUCLIDES	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G1-LL1
SA-140	1.41E+07	1.23E+04	8.20E+05	0.00E+00	4.01E+03	7.34E+03	7.12E+06
SA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	2.33E+00	8.14E-01	2.54E-01	0.00E+00	0.00E+00	0.00E+00	2.27E+04
LA-142	9.72E-12	3.10E-12	9.70E-13	0.00E+00	0.00E+00	0.00E+00	6.14E-07
CE-141	2.62E+03	1.31E+03	1.94E+02	0.00E+00	5.74E+03	0.00E+00	1.63E+06
CE-143	2.25E+01	1.22E+04	1.77E+00	0.00E+00	5.12E+00	0.00E+00	1.79E+05
CE-144	1.95E+05	6.11E+04	1.04E+04	0.00E+00	3.38E+04	0.00E+00	1.59E+07
PR-143	8.62E+01	2.59E+01	4.28E+00	0.00E+00	1.40E+01	0.00E+00	9.30E+04
PR-146	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	5.33E+01	4.32E+01	3.35E+00	0.00E+00	2.37E+01	0.00E+00	6.85E+04
W-187	3.47E+03	2.05E+03	9.21E+02	0.00E+00	0.00E+00	0.00E+00	2.88E+05
HP-239	2.59E+01	1.86E+00	1.31E+00	0.00E+00	5.38E+00	0.00E+00	1.38E+05

Conversion factors are in units of square meter-area/yr per uCi/sec for all radionuclides except H-3 which is in units of area/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (1 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
H-3	0.00E+00	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03
C-14	2.34E+09	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08
NA-24	1.85E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06
P-32	1.92E+11	1.13E+10	7.46E+09	0.00E+00	0.00E+00	0.00E+00	2.60E+09
CR-51	0.00E+00	0.00E+00	1.94E+04	1.26E+04	2.76E+03	2.46E+04	5.64E+05
MN-54	0.00E+00	4.68E+06	1.06E+06	0.00E+00	1.04E+06	0.00E+00	1.72E+06
MN-56	0.00E+00	3.77E-03	6.50E-04	0.00E+00	3.24E-03	0.00E+00	3.43E-01
FE-55	1.76E+06	1.13E+06	3.03E+05	0.00E+00	0.00E+00	5.55E+05	1.44E+05
FE-59	2.92E+06	5.10E+06	2.01E+06	0.00E+00	0.00E+00	1.51E+06	2.43E+06
CO-58	0.00E+00	2.91E+06	7.26E+06	0.00E+00	0.00E+00	0.00E+00	7.25E+06
CO-60	0.00E+00	1.06E+07	2.50E+07	0.00E+00	0.00E+00	0.00E+00	2.52E+07
NI-63	4.19E+09	2.59E+08	1.45E+08	0.00E+00	0.00E+00	0.00E+00	1.29E+07
NI-65	4.21E-01	4.76E-02	2.17E-02	0.00E+00	0.00E+00	0.00E+00	3.62E+00
CU-64	0.00E+00	2.07E+04	9.57E+03	0.00E+00	3.50E+04	0.00E+00	4.24E+05
ZN-65	6.66E+08	2.28E+09	1.05E+09	0.00E+00	1.11E+09	0.00E+00	1.93E+09
ZN-69	2.42E-12	4.36E-12	3.24E-13	0.00E+00	1.81E-12	0.00E+00	3.55E-10
BR-83	0.00E+00	0.00E+00	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.81E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.67E+09	1.32E+09	0.00E+00	0.00E+00	0.00E+00	6.83E+07
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.64E+10	0.00E+00	7.58E+08	0.00E+00	0.00E+00	0.00E+00	5.43E+08
SR-90	2.55E+11	0.00E+00	6.50E+10	0.00E+00	0.00E+00	0.00E+00	3.19E+09
SR-91	5.70E+05	0.00E+00	2.06E+04	0.00E+00	0.00E+00	0.00E+00	6.75E+05
SR-92	9.75E+00	0.00E+00	3.62E-01	0.00E+00	0.00E+00	0.00E+00	1.05E+02
Y-90	8.17E+01	0.00E+00	2.19E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+05
Y-91M	6.81E-20	0.00E+00	2.32E-21	0.00E+00	0.00E+00	0.00E+00	2.27E-16
Y-91	8.79E+03	0.00E+00	2.34E+02	0.00E+00	0.00E+00	0.00E+00	6.30E+05
Y-92	6.45E-05	0.00E+00	1.81E-06	0.00E+00	0.00E+00	0.00E+00	1.23E+00

Conversion factors are in units of square meter-area/yr per uCi/sec for all
nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (2 OF 3)

NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
Y-93	2.59E-01	0.00E+00	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.04E+03
ZR-95	8.17E+02	1.99E+02	1.41E+02	0.00E+00	2.14E+02	0.00E+00	9.91E+04
ZR-97	4.87E-01	8.37E-02	3.82E-02	0.00E+00	8.43E-02	0.00E+00	5.34E+03
NR-95	7.12E+04	2.93E+04	1.70E+04	0.00E+00	2.10E+04	0.00E+00	2.48E+07
MO-99	0.00E+00	2.50E+07	4.87E+06	0.00E+00	3.73E+07	0.00E+00	8.22E+06
TC-99M	3.30E+00	6.80E+00	8.76E+01	0.00E+00	7.32E+01	3.56E+00	1.98E+03
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.04E+03	0.00E+00	3.48E+02	0.00E+00	2.17E+03	0.00E+00	1.27E+04
RU-105	9.66E-04	0.00E+00	3.25E-04	0.00E+00	7.11E-03	0.00E+00	3.84E-01
RU-106	2.28E+04	0.00E+00	2.85E+03	0.00E+00	2.70E+04	0.00E+00	1.73E+05
AG-110M	4.63E+07	3.38E+07	2.24E+07	0.00E+00	4.83E+07	0.00E+00	1.75E+09
TE-125M	1.81E+07	6.05E+06	2.45E+06	6.09E+06	0.00E+00	0.00E+00	8.62E+06
TE-127M	5.05E+07	1.68E+07	6.12E+06	1.46E+07	1.24E+08	0.00E+00	2.04E+07
TE-127	7.58E+02	2.54E+02	1.63E+02	6.17E+02	1.85E+03	0.00E+00	1.59E+04
TE-129M	6.69E+07	2.29E+07	1.03E+07	2.57E+07	1.67E+08	0.00E+00	3.09E+07
TE-129	3.26E-10	1.12E-10	7.62E-11	2.73E-10	8.12E-10	0.00E+00	2.61E-08
TE-131M	4.05E+05	1.63E+05	1.35E+05	3.31E+05	1.12E+06	0.00E+00	2.75E+06
TE-131	4.11E-33	1.52E-33	1.15E-33	3.67E-33	1.05E-32	0.00E+00	1.66E-31
TE-132	2.53E+06	1.25E+06	1.17E+06	1.85E+06	7.84E+06	0.00E+00	4.64E+06
I-130	4.26E+06	9.37E+06	3.76E+06	1.05E+09	1.03E+07	0.00E+00	2.01E+06
I-131	3.26E+09	3.85E+09	1.69E+09	1.26E+12	4.49E+09	0.00E+00	1.37E+08
I-132	1.72E+00	3.48E+00	1.24E+00	1.63E+02	3.89E+00	0.00E+00	2.82E+00
I-133	4.35E+07	6.34E+07	1.86E+07	1.15E+10	7.45E+07	0.00E+00	1.07E+07
I-134	2.11E-11	4.33E-11	1.54E-11	1.01E-09	4.84E-11	0.00E+00	4.47E-11
I-135	1.35E+05	2.68E+05	9.77E+04	2.40E+07	2.99E+05	0.00E+00	9.70E+04
CS-134	1.09E+11	2.04E+11	2.06E+10	0.00E+00	5.25E+10	2.15E+10	5.54E+08
CS-136	5.93E+09	1.74E+10	6.51E+09	0.00E+00	6.95E+09	1.42E+09	2.65E+08
CS-137	1.54E+11	1.81E+11	1.28E+10	0.00E+00	4.85E+10	1.96E+10	5.65E+08
CS-138	2.52E-22	4.09E-22	1.98E-22	0.00E+00	2.04E-22	3.19E-23	6.54E-22
BA-139	5.13E-08	3.40E-11	1.48E-09	0.00E+00	2.04E-11	2.06E-11	3.25E-06

Conversion factors are in units of square meter-mm/yr per uCi/sec for all
nuclides except H-3 which is in units of mm/yr per uCi/cubic meter.

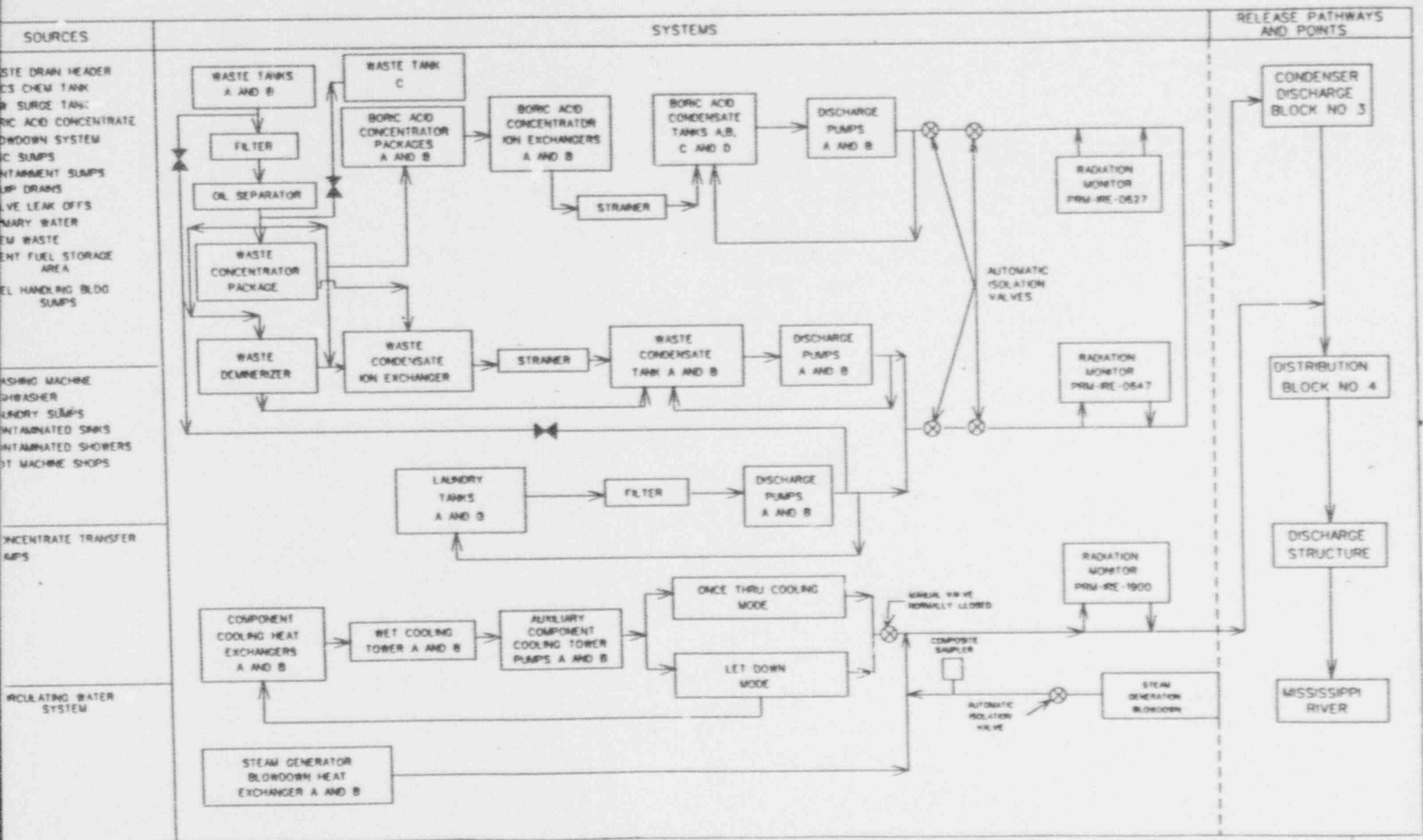
GOAT'S MILK PATHWAY DOSE FACTORS DUE TO
RADIONUCLIDES OTHER THAN NOBLE GASES, R_1

AGE GROUP: INFANT (3 OF 3)

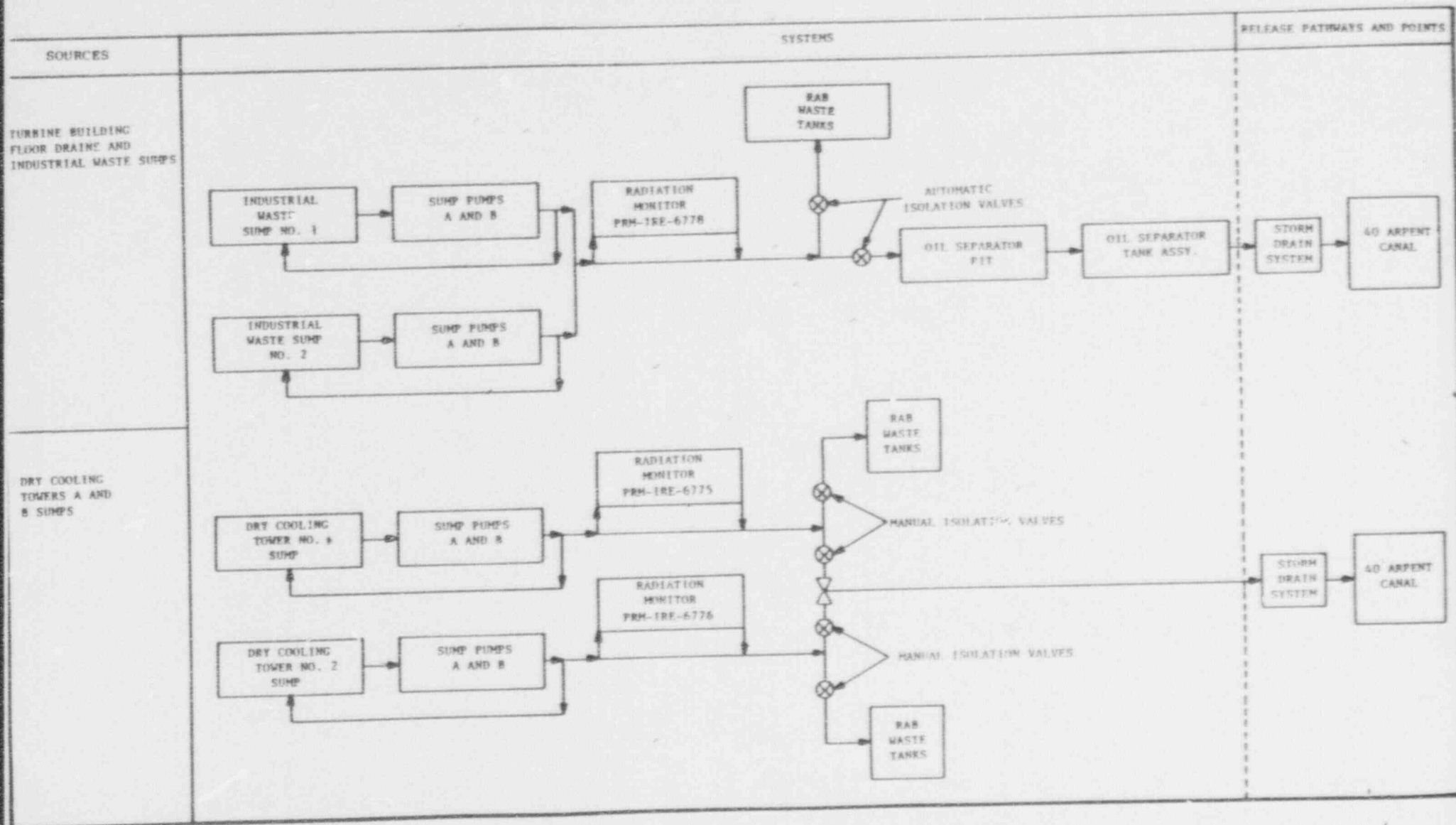
NUCLIDE	ORGAN DOSE CONVERSION FACTORS						
	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	G.I.-LLI
BA-140	2.89E+07	2.89E+04	1.49E+06	0.00E+00	6.87E+03	1.78E+04	7.10E+06
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.86E+00	1.92E+00	4.93E-01	0.00E+00	0.00E+00	0.00E+00	2.25E+04
LA-142	2.04E-11	7.49E-12	1.79E-12	0.00E+00	0.00E+00	0.00E+00	1.27E-06
CE-141	5.20E+03	3.17E+03	3.74E+02	0.00E+00	9.79E+02	0.00E+00	1.64E+06
CE-143	4.76E+01	3.16E+04	3.60E+00	0.00E+00	9.20E+00	0.00E+00	1.84E+05
CE-144	2.79E+05	1.14E+05	1.56E+04	0.00E+00	4.62E+04	0.00E+00	1.60E+07
PR-143	1.78E+02	6.67E+01	8.84E+00	0.00E+00	2.48E+01	0.00E+00	9.41E+04
P-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	1.06E+02	1.09E+02	6.65E+00	0.00E+00	4.19E+01	0.00E+00	6.88E+04
W-187	7.30E+03	5.07E+03	1.75E+03	0.00E+00	0.00E+00	0.00E+00	2.98E+05
WP-239	5.48E+01	4.90E+00	2.77E+00	0.00E+00	9.77E+00	0.00E+00	1.42E+05

Conversion factors are in units of square meter-area/yr per uCi/sec for all nuclides except H-3 which is in units of area/yr per uCi/cubic meter.

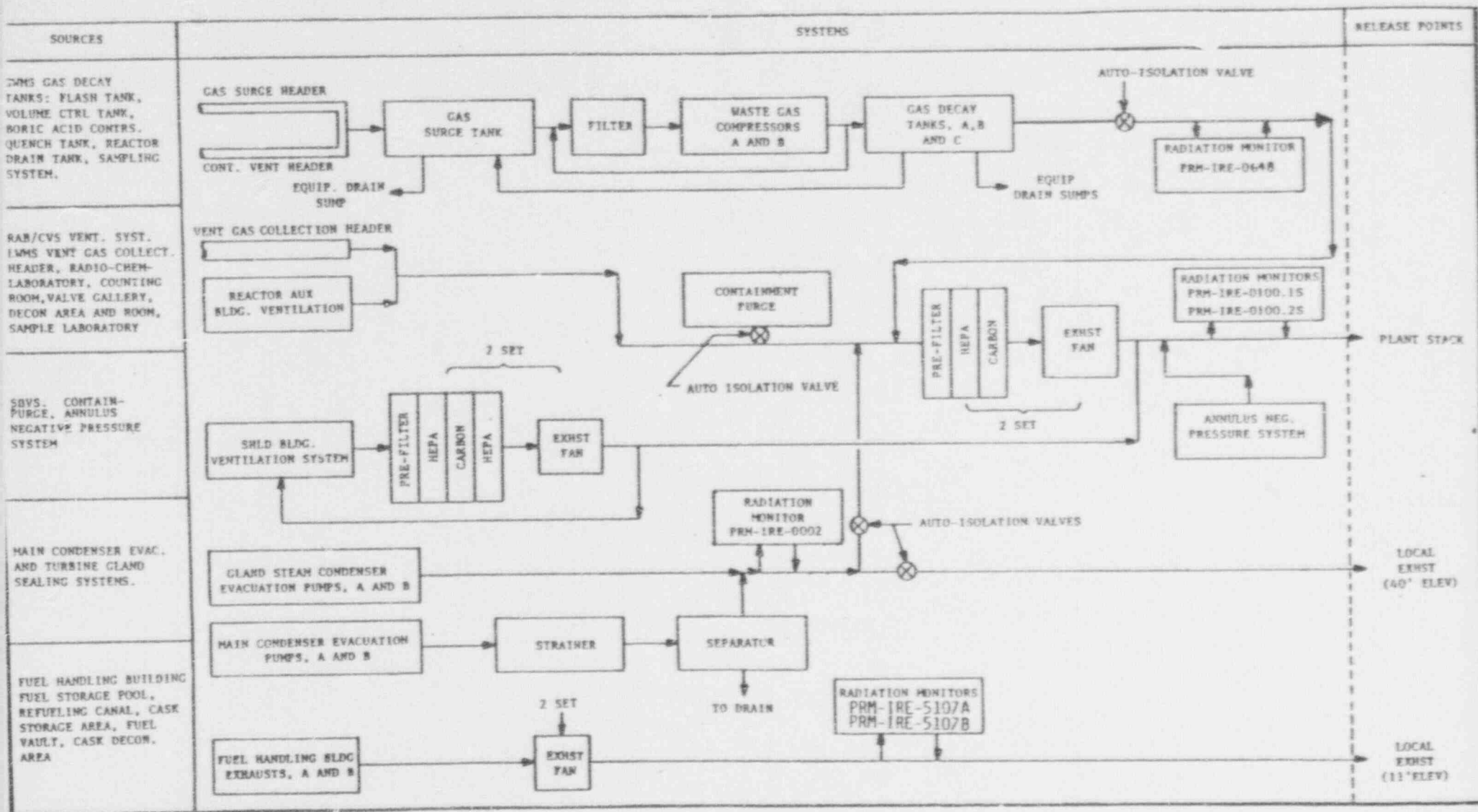
LIQUID WASTE MANAGEMENT SYSTEMS EFFLUENT SOURCES AND RELEASE PATHWAYS AND POINTS



**LIQUID WASTE MANAGEMENT SYSTEM EFFLUENT SOURCES
AND RELEASE PATHWAYS AND POINTS**
(cont'd)



GASEOUS EFFLUENT SOURCES, GASEOUS WASTE MANAGEMENT SYSTEM EFFLUENT SOURCES AND EXHAUST RELEASE POINTS



RADIOLOGICAL ENVIRONMENT MONITORING PROGRAM

<u>Sample Type</u>	<u>Location</u>	<u>Analysis</u>	<u>Frequency</u>	<u>Volume</u>
TLD	A-2, B-1, C-1, D-2, E-1, F-2, G-2, H-2, J-2, K-1, L-1, M-1, N-1, P-1, Q-1, R-1, A-5, B-4, D-5, E-5 F-4, G-4, H-6, P-6, Q-5 R-6, F-9, G-9, E-15, J-15 E-30	TLD ^a	Quarterly	N/A
Radioiodine and	APP-1, APQ-1, APG-1,	Gross beta, I-131	Weekly	285m ³ /wk
Particulates	APC-1, APE-30	γ isotopic ^b	Quarterly composite	3700 m ³ /qtr
Ground Water ^f	GWJ-1	γ isotopic, H-3	Quarterly	4 liters
Drinking Water ^c	DWG-2, DWE-5 ^d , DWP-7	H-3 Gross beta, γ isotopic I-131 ^g	Quarterly composite Monthly composite Semi-monthly composite	Homogeneous 4 liters
Surface Water ^c	SWG-2, SWE-5 ^d , SWP-7	H-3 γ isotopic	Quarterly composite Monthly composite	Homogeneous 4 liters
Shoreline Sediment	SHWE-3, SHWJ-1	γ isotopic	Semi-annually	2 kilograms
Milk	MKE-4, MKQ-5, MKQ-45, MKQ-1	γ isotopic, I-131	Semi-monthly/monthly ^h	4 liters
Fish	FH-1, FH-2	γ isotopic	In season or semi-annually ⁱ	500 grams
Food Products	*	γ isotopic	At harvest time ^j	500 grams
Broad Leaf	BLQ-1, BLB-1, BLK-15	γ isotopic, I-131	Monthly When milk samples not collected	500 grams

* Irrigated Food Pathway does not exist. However, food products grown within the site boundary are sampled and analyzed.

- a. One or more instrument, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. A TLD is considered one phosphor, two or more phosphors in a packet are considered two or more dosimeters. Geographical limitations affect siting of dosimeters.
- b. Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma isotopes analysis shall be performed on the individual samples. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.
- c. Drinking Water and Surface Water samples are identical samples.
- d. The downstream sample is beyond the mixing zone.
- e. A composite sample will contain aliquots of sample taken proportional to the quantity of flowing liquid that results in a specimen representative of the liquid flow.
- f. Ground water samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.
- g. This analysis will be performed when the dose calculated for the consumption of water is greater than 1 mrem per year as calculated for maximum organ and age group.
- h. Milk will be collected semimonthly when animals are on pasture, monthly otherwise. If milk sampling is not performed, broad leafy vegetation will be sampled.
- i. Striped mullet, gizzard shad, freshwater drum, and catfish will be collected. If they are not available, substitute species will be collected and identified in reporting.
- j. One sample of each principal class of food products will be sampled in an area irrigated by water in which plant wastes have been inadvertently discharged. If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvesting occurs continuously, sampling shall be monthly. Tuberous and root products will be sampled when available.

SAMPLE LOCATION TABLE

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
<u>DIRECT RADIATION (TLD)</u>			
A-2	(Eastbank) On fence enclosure surrounding water tower west of Little Gypsy opposite Etienne St. Access from River Road (LA 628). The TLD's are located on the (S) fence opposite the entrance gate to the water tower.	1.1	N
B-1	(Eastbank) On fence enclosing the transmission tower 0.3 miles west (up-river) from Little Gypsy. Access from River Road (LA 628). TLD's are located at SW corner of fence enclosure.	0.8	NNE
C-1	(Eastbank) On fence enclosing the Little Gypsy Cooling Water Intake. Access is from River Road (LA 628) across from Little Gypsy Power Station entrance. TLD's are on the south side (inside) of the Cooling Water Intake fence enclosure, directly opposite the entrance gate.	0.8	NE
D-2	(Eastbank) Located approximately 0.3 miles east of Little Gypsy Power Station. Access from River Road (LA 628) near the west end of the Bonne Carre Spillway. TLD's are on the fence at the West entrance to the spillway (located on levee).	1.1	ENE
E-1	(Westbank) Located on utility pole along River Road (LA 18) approximately 0.3 miles east of Waterford 3 plant entrance. Access from LA 18. TLD's are on the third utility pole east of the construction entrance road.	0.2	E
F-2	(Westbank) Located on fence enclosure surrounding the LP&L substation on LA 3142. Access from LA 3142 approximately 0.2 miles south of LA 18. TLD's are on the southeast corner of the fence enclosure.	1.1	ESE

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
G-2	(Westbank) Located on utility pole on East side of LA 3142 near Witco entrance gate (Next to Union Carbide Star Plant Gate 3). Access from LA 3142 approximately 0.2 miles north of railroad overpass.	1.2	SE
H-2	(Westbank) Located on fence encluse to shell road off of LA 3142. Access from LA 3142 south of railroad overpass on east side of LA 3142. TLD's are on the south side of the gate for shell road. (Just south of Texaco pipeline station).	1.2	SSE
J-2	(Westbank) Located on northeast corner of fence enclosing Texaco valve station south of LA 3127. Access from LA 3127, approximately 0.6 miles west of LA 3127/3142 intersection.	1.3	S
K-1	(Westbank) Located behind "Private Road" SIGN AT Gate 8 entrance off of LA 3127. Access from LA 3127, approximately 1.3 miles west of LA 3127/3142 intersection. (Gate 8 is the access to the Waterford 3 switchyard station).	1.0	SSW
L-1	(Westbank) Located behind "Private Road" sign at LP&L Gate 9 entrance off of LA 3127, approximately 1.6 miles west of LA 3127/3142 intersection. (Gate 9 is an access road for Waterford 3).	1.0	SW
M-1	(Westbank) Located on south gate into the Waterford 1 and 2 fuel oil storage tank enclosure. Access is either thru LP&L Gate 8, Gate 9 off of LA 3127, the shell access road from LA 18 between Waterford 3, or thru the Waterford 1 and 2 access road.	0.7	WSW
N-1	(Westbank) Located behind the "No Trespassing" sign off on Short Street, in Killona, just south of the Killona Elementary School.	0.9	W

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
P-1	(Westbank) Located on Short Street, TLD is on fence at air sample station APP-1.	0.8	WNW
Q-1	(Westbank) Located on fence enclosing air sample station approximately 0.5 miles west of Waterford 1 and 2 on River Road (LA 18).	0.8	NW
R-1	(Westbank) Located on fence enclosure for Waterford 1 and 2 Cooling Water Intake Structure. Access is from River Road (LA 18) opposite Waterford 1 and 2. TLD's are on the southwest corner of fence.	0.5	NNW
A-5	(Eastbank) Located on utility pole just east of the Shady Nook Trailer Park on Hwy 61 in LaPlace. TLD's are on second utility pole east of trailer park on north side of Hwy 61 (eastern end of LaPlace).	4.5	N
B-4	(Eastbank) Located on utility pole just east of shell access road to South Central Bell transmission tower on south side of Hwy 61. Transmission tower is just east of Weigh Station at St. John/St. Charles Parish line. TLD's are on first utility pole east of access road.	3.8	NNE
D-5	(Eastbank) Located on fence gate on shell access road to Big 3 Chemical Plant. Shell access road is approximately 0.1 miles west of Hwy 61/48 intersection (at black and yellow gate). TLD's are on fence gate 0.1 miles north on shell access road from Hwy 61.	4.2	ENE
E-5	(Eastbank) Located on the Norco Substation fence enclosure. Access from River Road (LA 48) onto Wesco St. (adjacent to Norco Shell Chemical Plant), take Wesco St. to the dead end. TLD's are located on sixth fence post south of the north substation gate.	4.2	E

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
F-4	(Westbank) Located on utility pole behind blonde brick house on Aquarius St. in Hahnville. Access from River Road (LA 18) and turn onto Oak St. Follow Oak St. to Hickory St., turn right on Hickory St. and follow to Aquarius St. and turn left. Blonde brick house is second house on right (west) side of Aquarius St. heading south.	3.5	ESE
G-4	(Westbank) Located on railroad sign northwest side of LA 3160/railroad track intersection. Access from either LA 3127 or River Road (LA 18) onto LA 3160.	3.2	SE
H-6	(Westbank) Located on a road sign on the southwest side of the second canal bridge east of LA 3160 along LA 3127.	5.7	SSE
P-6	(Westbank) Located on utility pole at southwest corner of LA 640/railroad track intersection. Utility pole is just west of LA 640 and east of radio transmission tower.	5.5	WNW
Q-5	(Westbank) Located on fence post surrounding (green) river marker on levee just east of Edgard. Fence post is located along River Road (LA 18) across from the Webre's house.	5.0	NW
R-6	(Eastbank) Located on fence enclosing LP&I Laydown Yard on LA 3223 in LaPlace. Access from Hwy 61 onto Elm St. (LA 3223), take Elm St. to the northeast corner of LA 3223/railroad intersection. TLD's are located on the southeast corner of fence enclosure.	5.3	NNW
F-9	(Eastbank) Located on entrance gate to Destrehan Substation. Access from River Road (LA 48), approximate 0.3 miles east of Luling-Destrehan Ferry, onto Destrehan Road (west of Bunge Corp. Grain Elevator), and proceed to substation gate.	8.2	ESE

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
G-9	(Westbank) Located on back fence of LP&L District Office in Luling. Access via Ellington St. from either River Road (LA 18); or Second or Third S. from Paul Mallard Rd. (LA 52) to Ellington St.	8.1	SE
E-15	(Eastbank) Located on Kenner Substation fence enclosure. Access from either River Road (LA 48) or Hwy 61, turn onto Alliance Ave. TLD's are located on the north side of the fence enclosure, near a light pole.	11.8	E
J-15	(Westbank) Located on fence enclosure surrounding LP&L switchyard at LA 631/Hwy 90 intersection in Des Allemands. TLD's are on the northwest corner of fence. Access from LA 631 via shell road.	12.0	S
E-30*	(Westbank) Located on fence at LP&L General Office or Delaronde St. in Algiers. TLD's are on the fence, facing the Mississippi River, in the passageway to the transformer shop.	27.0	E
<u>Airborne</u>			
APP-1	(Westbank) Located in soybean field at northwest corner of Short St. in Killona.	0.8	WNW
APQ-1	(Westbank) Located at northwest corner of soybean field on east side of Killona. Access from River Road (LA 18) approximately 0.6 miles east of LA 18/3141 intersection.	0.8	NW
APG-1	(Westbank) Located at the north side of the Secondary Meterological Tower.	0.5	SE
APC-1	(Eastbank) Located inside the Little Gypsy Cooling Water Intake Structure fence enclosure.	0.8	NE

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
APE-30*	(Westbank) Located on the roof of the LP&L General Office building on Delaronde St. in Algiers.	27.0	E
<u>Broad Leaf</u>			
BLQ-1	(Westbank) Located between LA 18 and soybean field on eastern edge Killona, near air sample station APQ-1.	0.8	NW
BLB-1	(Eastbank) Located at wooded area at the southwestern corner of the LP&L Little Gypsy plant along River Road.	0.8	NNE
BLK-15*	(Westbank) Located 3.5 miles SSW of Des Allemands on Hwy. 90.	15.0	SSW
<u>Ingestion</u>			
<u>Milk</u>			
MKE-4	(Westbank) Located 0.8 miles west of the Time Saver in Hahnville off of River Road.	4.0	E
MKQ-5	(Westbank) Located at the Webre's house, just across LA 18 from river marker, at the eastern end of Edgard.	5.0	NW
MKQ-45*	(Eastbank) Located off of I-12 in Denham Springs. Take LA 3002 south of LA 1034 then right to LA 1032. Turn left and go to farm 1 mile on the right.	52	NW
MKQ-1	(Westbank) 1.0 miles west of Waterford 3 at the corner of River Road and Post Street in Killona.	1.0	NW

SAMPLE LOCATION TABLE (Continued)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
<u>Fish</u>			
FH-1*	Upstream of the plant intake structure.	N/A	N/A
FH-2	Downstream of the plant intake structure.	N/A	N/A
<u>Waterborne</u>			
GWJ-1	(Westbank) Located at 40 Arpent Canal south of the plant. Access from LA 3127 through LP&L Gate 8. The canal is northwest of the shell access road/railroad track intersection.	0.3	S
DWG-2 SWG-2	(Westbank) Located at the Union Carbide drinking water canal. Access from LA 3142 through Gate 28.	2.0	ESE
SHWE-3	(Westbank) Located at the Foot Ferry Landing off of LA 18 in Taft.	3.0	E
SHWJ-1	(Westbank) Located at 40 arpent canal south of plant. Access thru LP&L gate 8 of LA 3127.	1.0	S
DWE-5 SWE-5	(Eastbank) Located at the St. Charles Parish Waterworks off of River Road (LA 48) near New Sarpy.	4.5	E
DWP-7* SWP-7*	(Westbank) Located at the St. John Parish Waterworks off of LA 18 in Edgard.	6.5	WNW

* DENOTES CONTROL LOCATIONS

N/A - Not Applicable for this sampling location.

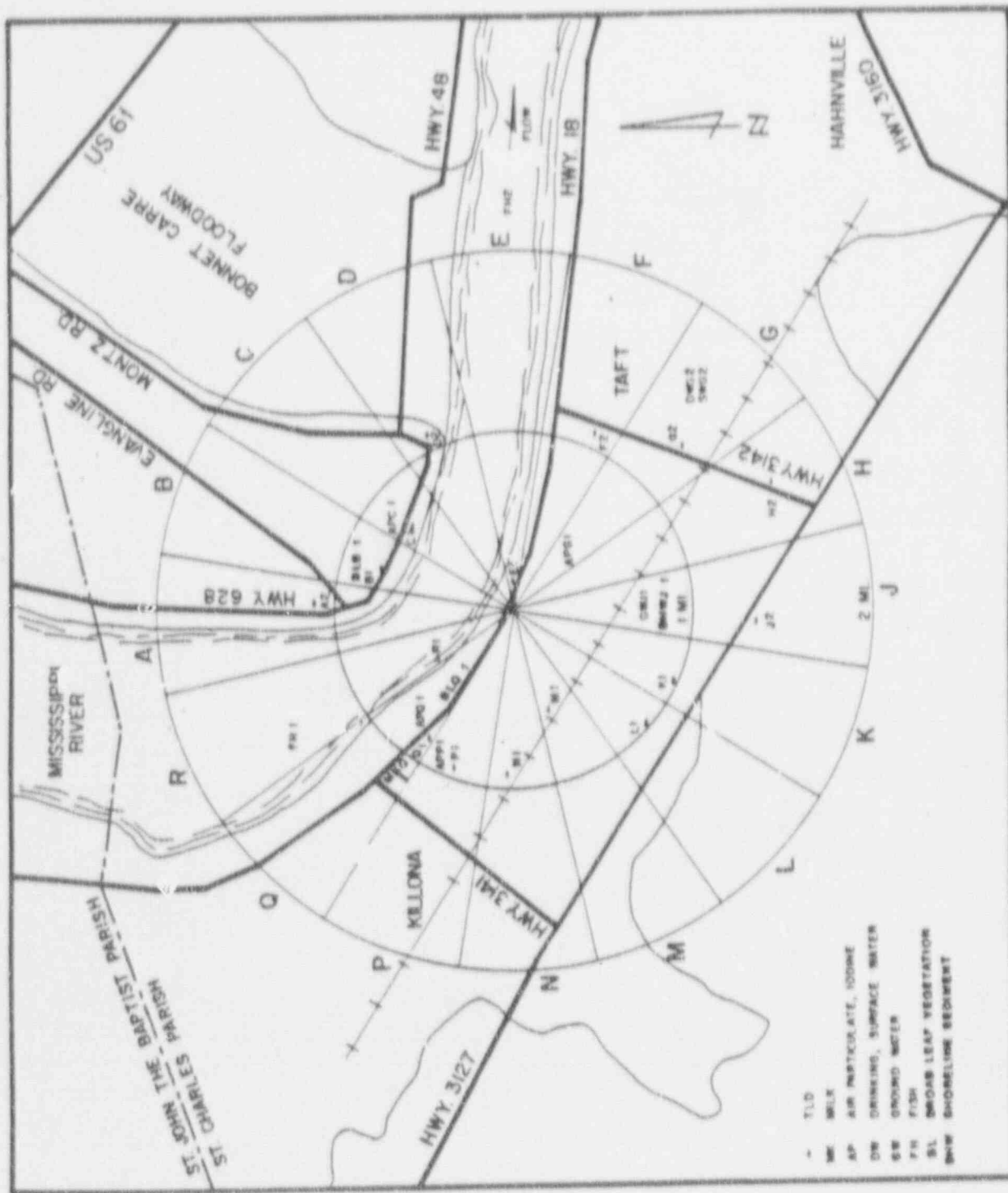
SECTOR AND ZONE DESIGNATORS FOR RADIOLOGICAL SAMPLING AND MONITORING POINTS

SECTOR NOMENCLATURE		ZONE NOMENCLATURE	
CENTERLINE OF SECTOR IN DEGREES TRUE NORTH FROM FACILITY	22 1/2° SECTOR	MILES FROM FACILITY	ZONE
0 & 360	*A N	0-1	1
22 1/2	B NNE	1-2	2
45	C NE	2-3	3
67 1/2	D ENE	3-4	4
90	E E	4-5	5
112 1/2	F ESE	5-6	6
135	G SE	6-7	7
157 1/2	H or SSE	7-8	8
180	J S	8-9	9
202 1/2	K SSW	9-10	10
225	L SW	10-15	15
247 1/2	M WSW	15-20	20
270	N W	20-25	25
292 1/2	P WNW	25-30	30
315	Q NW	30-35	35
337 1/2	R NNW	35-40	40
		40-45	45
		45-50	50

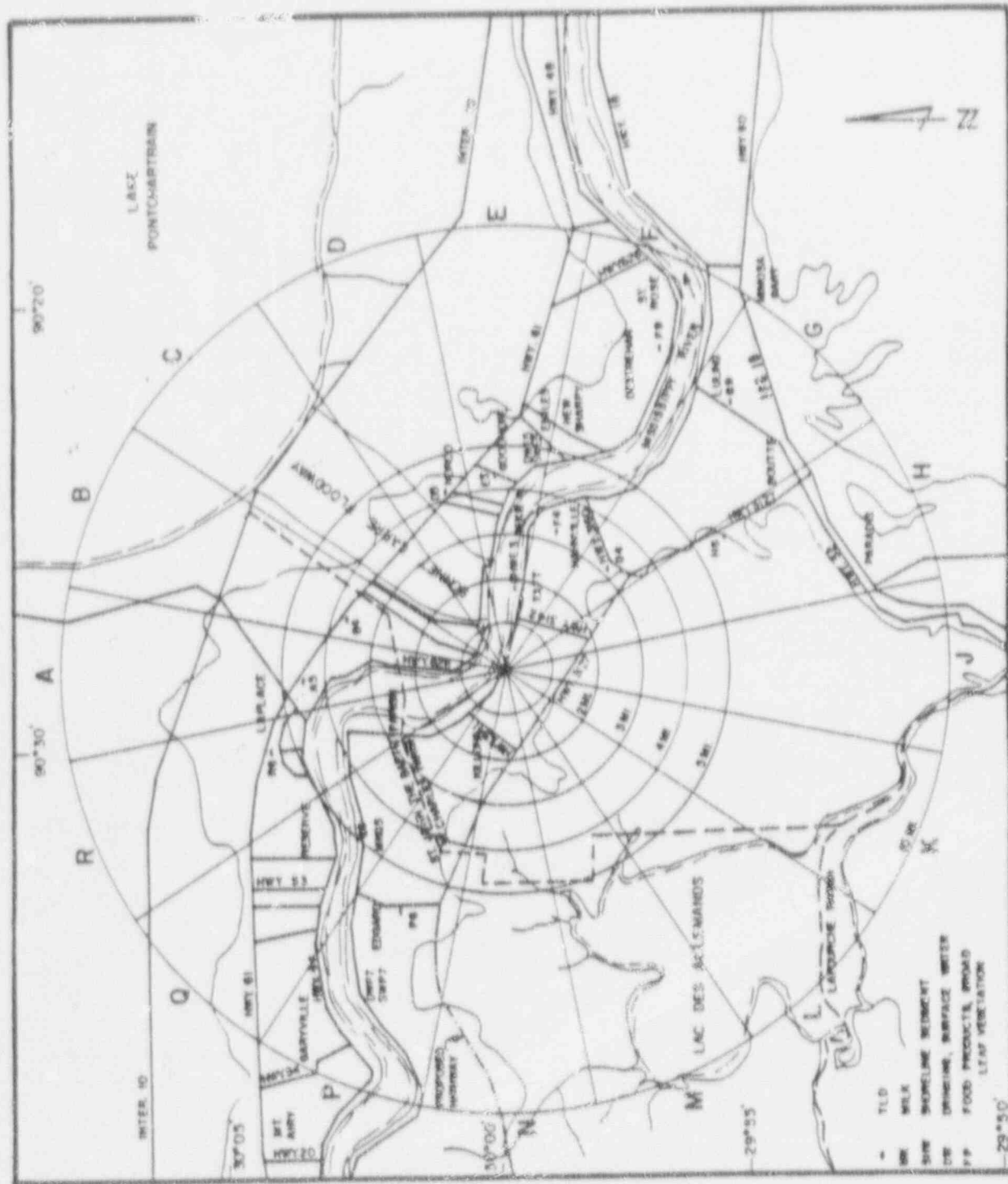
AREA SEGMENT - An area is identified by a Sector and Zone designator. Thus, area N-1 is that area which lies between 348 3/4 and 11 1/2 degrees true north from the facility out to a radius of 1 mile. Area G-4 would be that area between 123 3/4 to 146 1/2 degrees and the 3- and 4-mile arcs from the facility. For Airborne, Ingestion (milk), and Food Products pathways, the sector designator will be preceded by acronyms AP, MK, and FP, respectively.

* The letters I and O have been omitted from these sector designators so as to eliminate possible confusion between letters and numbers.

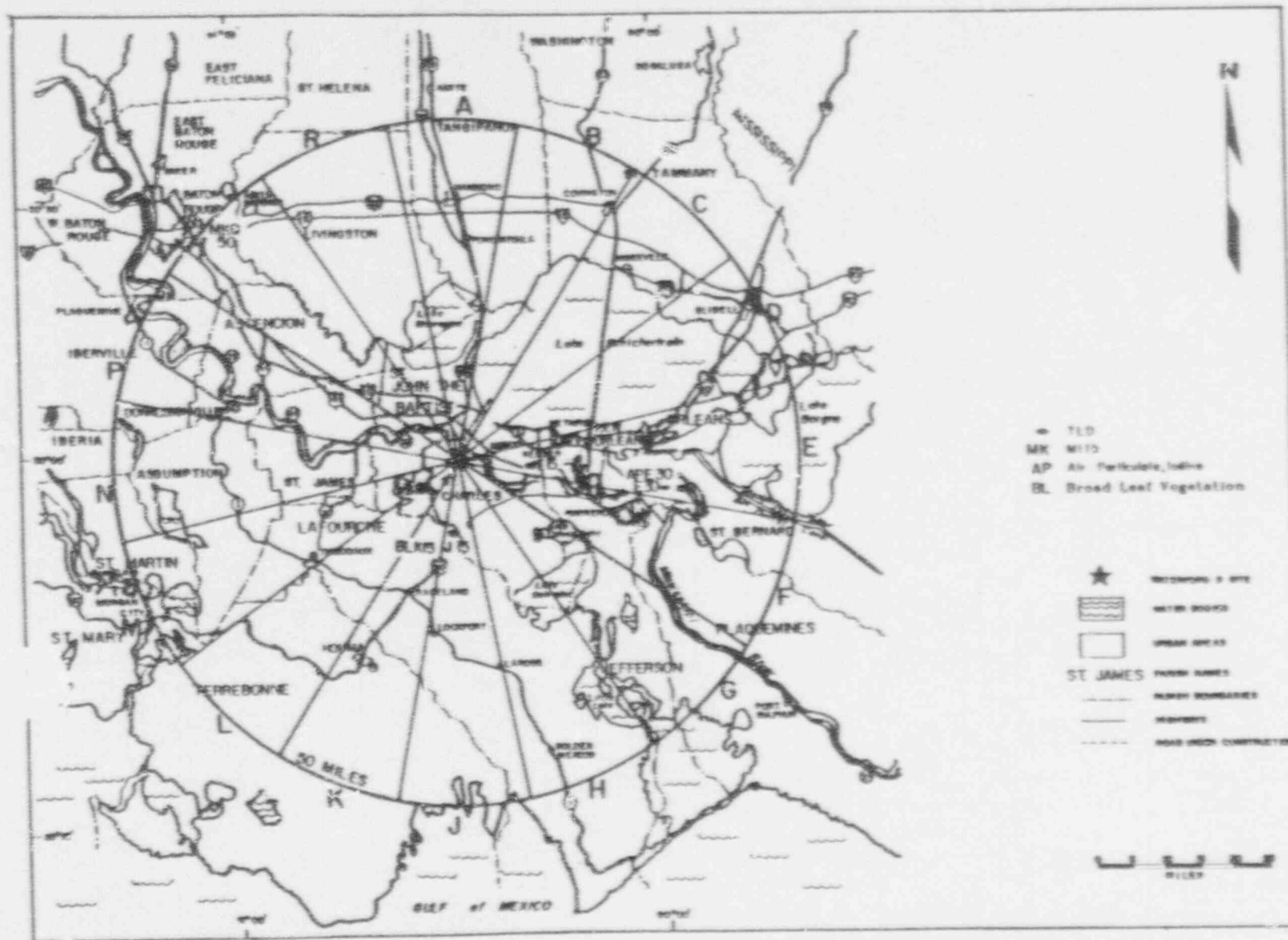
REMP SAMPLING STATIONS WITHIN 2 MILES OF WATERFORD 3



REMP SAMPLING STATIONS WITHIN 10 MILES OF WATERFORD 3



REMP SAMPLING STATIONS WITHIN 50 MILES OF WATERFORD 3



SPECIFICATION CROSS REFERENCE TABLE

<u>Specification Section</u>	<u>Requirement</u>	<u>Methodology Section</u>
5.3.1	Liquid Effluent Concentration	5.3.5 & 5.3.6
5.3.2	Dose due to Liquid Effluents	5.3.4
5.3.3	Dose Projections for Liquid Releases	5.3.7
5.4.1	Dose Rate Due to Noble Gases	5.4.5 & 5.4.8
5.4.1	Dose Rate Due to Iodine, Tritium And Particulates with Half Lives Greater than Eight Days	5.4.5 & 5.4.8
5.4.2	Air Doses due to Noble Gases	5.4.6
5.4.3	Doses Due to Iodines, Tritium and Particulates with Half-Lives Greater than Eight Days.	5.4.7
5.4.4	Dose Projections for Gaseous Releases	5.4.9
5.5.1	Total Dose	5.5.2
5.6.1	Radioactive Liquid Effluent Monitoring Channels Alarm/Trip Setpoints	5.3.5
5.6.2	Radioactive Gaseous Effluent Monitoring Channels Alarm/Trip Setpoints	5.4.8
5.8.1	Radiological Environmental Monitoring Program	5.8.4
5.8.2	Interlaboratory Comparison Program	5.8.5
5.8.3	Land Use Census	5.8.3

TECHNICAL SPECIFICATION CROSS REFERENCE TABLE

Specification <u>Section</u>	<u>Requirement</u>	Technical Specification <u>Section</u>
5.3.1	Liquid Effluent Concentration	3.11.1.1, 4.11.1.1.1, 4.11.1.1.2
5.3.2	Dose due to Liquid Effluents	3.11.1.2 & 4.11.1.2
5.3.3	Dose Projections for Liquid Releases	3.11.1.3, 4.11.1.3.1 & 4.11.1.3.2
5.4.1	Dose Rate Due to Noble Gases	3.11.2.1, 4.11.2.1.1, 4.11.2.1.2 & 4.11.2.1.3
5.4.1	Dose Rate Due to Iodine, Tritium And Particulates with Half Lives Greater than Eight Days	3.11.2.1, 4.11.2.1.1, 4.11.2.1.2 & 4.11.2.1.3
5.4.2	Air Doses due to Noble Gases	3.11.2.2 & 4.11.2.2
5.4.3	Doses Due to Iodines, Tritium and Particulates with Half-Lives Greater than Eight Days.	3.11.2.3 & 4.11.2.3
5.4.4	Dose Projections for Gaseous Releases	3.11.2.4, 4.11.2.4.1 & 4.11.2.4.2

*
TECHNICAL SPECIFICATION CROSS REFERENCE TABLE
(cont'd)

<u>Specification Section</u>	<u>Requirement</u>	<u>Technical Specification Section</u>
5.5.1	Total Dose	3.11.4, 4.11.4.1 & 4.11.4.2
5.8.1	Radiological Environmental Monitoring Program	3.12.1 & 4.12.1
5.8.2	Interlaboratory Comparison Program	3.12.3 & 4.12.3
5.8.3	Land Use Census	3.12.2 & 4.12.2
5.6.1	Radioactive Liquid Effluent Monitoring Channels Alarm/Trip Setpoints	3.3.3.10 & 4.3.3.10
5.6.2	Radioactive Gaseous Effluent Monitoring Channels Alarm/Trip Setpoints	3.3.3.11 & 4.3.3.11

ATTACHMENT 10.2

(11 PAGES)

CHANGES TO RW-001-210,

PROCESS CONTROL PROGRAM (PCP)

July 1, 1991 to December 31, 1991

PORC/PORC-SC-C

RW-001-210

REVISION 4

EFFECTIVE DATE

SAFETY-RELATED

ADMINISTRATIVE PROCEDURE

PROCESS CONTROL PROGRAM

LP&L W-5
RECORDS MANAGEMENT
**CONTROLLED
COPY**
NO. 308



ENTERGY

**Inter-Office
Correspondence**

Date: November 15, 1991
Office: Waterford 3
To: Plant Records
From: L.R. Simon
Subject: Implementation of RW-1-210

Please implement RW-1-210, Rev. 4 immediately, due to TSCR 89-07 being approved on September 24, 1991.

LRS/Gk

PORC AND-PORC---S/C
REVIEW AND APPROVAL SHEET

REVIEW OF: RW-001-210-Process
Control Program (Rev. 4)

PORC ☒
PORC - S/C ☐

The PORC or PORC S/C has reviewed this item and determined that a Safety/Commitment Review was performed, (if applicable) that a Safety Evaluation was performed (if applicable), that an unreviewed safety question does not exist and that nuclear safety is/was not adversely affected.

PORC MEMBER	MEMBER SIGNATURE	RECOMMENDED FOR APPROVAL		DATE
		YES	NO	
Maintenance Superintendent	<i>[Signature]</i>	✓		8/23/90
Operations Superintendent	<i>[Signature]</i>	✓		8/23/90
Radiation Protection Superintendent	<i>[Signature]</i>	✓		8/23/90
Operations Quality Assurance Manager	<i>[Signature]</i>	✓		8/23/90
Plant Engineering Superintendent	<i>[Signature]</i>	✓		8/23/90
Assistant Plant Manager				
PORC-S/C Member				
PORC-S/C Member				
PORC-S/C Member				
PORC-S/C Chairman				
PORC Chairman	<i>[Signature]</i>	✓		8/23/90

Meeting No. 90-074

Item No. VIII - B

Date: 8/23/90

This item is recommended for approval? ☒ YES ☐ NO

This item requires SRC/NRC review prior to implementation? ☐ YES ☒ NO

If yes, ensure documentation supporting review is attached.

PLANT MANAGER-NUCLEAR APPROVAL

Comments: Changes made to the procedure in the responsibilities section
as discussed with General Manager. After, procedure was mutually agreed
on 8/16/90 - [Signature]

Approved by [Signature]
Plant Manager-Nuclear

Date 8/24/90

PLANT OPERATING MANUAL

Check Block Below

CHANGE/REVISION/DELETION REQUEST

☒ PORC ☐ PORC-S/CProcedure No. RW-9-210 Title PROCESS CONTROL PROGRAMEffective Date 7-28-90 (if different from approval date)

Complete A, B, and C

A. Change No. N/A ☐ Permanent ☐ Deviation Expiration Date _____B. Revision No. 4C. Deletion ☐ YES ☒ NODESCRIPTION OF PROCEDURE THE PROCESS CONTROL PROGRAM PROVIDES GUIDANCE TO ASSURE COMPLIANCE WITH THE LICENSING AGENCIES' REQUIREMENTS.

REASON FOR CHANGE, REVISION, OR DELETION INCORPORATING CHANGES REQUESTED BY LICENSING IN PEZR 20071 AS OUTLINED IN NRC GENERIC LETTER 89-01. GENERALLY, THESE CHANGES ARE INTENDED TO ALLOW THE REMOVAL OF THE PCP PCP REQUIREMENTS FROM THE W3SES TECHNICAL SPECIFICATIONS BY INCORPORATING THEM INTO THIS PROCEDURE. THIS CHANGE ALSO ADDRESSES THE NAME CHANGE THAT RESULTED WHEN LN Technologies WAS PURCHASED BY WESTINGHOUSE (W) AND PLACED UNDER THEIR Scientific Ecology Group, Inc. (SEG) BUSINESS UNIT.

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SAFETY SCREENING/EVALUATION	<u>Laurence Bolin</u>	DATE	<u>6-28-90</u>
TECHNICAL REVIEW	<u>Laurence Bolin</u>	DATE	<u>6-28-90</u>
GROUP HEAD REVIEW	<u>John W. Harte</u>	DATE	<u>7/5/90</u>
TEMPORARY APPROVAL* (SRO)	_____	DATE	_____
TEMPORARY APPROVAL*	_____	DATE	_____

*Temporary approval must be followed by Plant Manager - Nuclear approval within 14 days.

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1.0 PURPOSE

1.1 The purpose of Waterford Steam Electric Station - Unit Number 3 (Waterford 3) Process Control Program (PCP) is to describe the program which provides reasonable assurance of the complete stabilization and/or solidification, as applicable of various radioactive "wet wastes" which may include resin slurries and evaporator bottoms are in accordance with applicable Department of Transportation (DOT), Nuclear Regulatory Commission (NRC), State and licensed burial facilities acceptance criteria for packaging and shipment to an approved burial site. Compliance with these criteria will be achieved through implementation of the PCP and related Waterford 3 and vendor supplied procedures. Containers engineered and built to comply with the stability requirement may be used. Waterford 3 SES typically relies on Vendor supplied systems and/or services for stabilization and solidification services.

2.0 REFERENCES

2.1 Waterford 3 Documents

2.1.1 FSAR Chapter 11.4, Solid Waste Management System

2.1.2 FSAR Chapter 13.4, Review and Audit

2.1.3 FSAR Chapter 13.2, Training

2.1.4 FSAR Chapter 13.5, Plant Procedures

2.1.5 Nuclear Operations Management Manual, Section VI, Chapter 5

2.2 Vendor Controlled Documents

- 2.2.1 LN Technologies Corporation, TR002, Topical Report on 10CFR61 Qualified Radioactive Waste Forms, May 1984
- 2.2.2 LN Technologies Corporation FI-013, Process Control Program for Dewatering Liner with LN Technologies Corporation Internals, LN Technologies Corporation
- 2.2.3 Scientific Ecology Group, Inc., OP-4.34, Process Control Program for Dewatering Bead or Powdered Resin with Quick Dry Dewatering System No 8814.
- 2.2.4 Scientific Ecology Group, Inc., OP-4.31, Operating Procedure for SEG Rad Waste Solidification System.
- 2.2.5 Scientific Ecology Group, Inc., OP-4.30, Process Control Program for Rad Waste Solidification Service
- 2.2.6 RW-2-401, Use of Radman Operating Program
- 2.2.7 RW-2-411, Use of Radman Data Base Manager and Recover
- 2.2.8 RW-2-110, Waste Sample Collection and Isotope Evaluation

2.3 Other Documents

- 2.3.1 10CFR61, Licensing Requirements for Land Disposal of Radioactive Waste
- 2.3.2 10CFR20.311, Transfer for disposal and manifests
- 2.3.3 10CFR71.91, Records

3.0 DEFINITIONS

- 3.1 Stability means structural stability as per 10CFR61.2
- 3.2 Solidification means the immobilization of wet radioactive wastes such as evaporator bottoms, spent resins, sludges, and reverse osmosis concentrates as a result of a process of mixing the waste type with a solidification agent(s) to meet the requirements of the licensed disposal site and 10CFR61.

4.0 RESPONSIBILITIES

4.1 Radiation Protection Superintendent

- 4.1.1 The Radiation Protection Superintendent is responsible for the overall effective management of the plant Process Control Program. The Radiation Protection Superintendent ensures that changes are initiated to the Process Control Program procedures when necessary and that appropriate Health Physics support is provided.

4.2 Lead Supervisor-Radwaste

- 4.2.1 The Lead Supervisor-Radwaste who reports to the Radiation Protection Superintendent holds key responsibilities for implementation of the Process Control Program such as:
- 4.2.1.1 The preparation, review and approval of the Process Control Program procedures pertaining to the processing and packaging, of radioactive materials;
- 4.2.1.2 Data collection, trend analysis, long-term planning, and problem solving for the plant Process Control Program;

- 4.2.1.3 Managing radwaste stabilization, dewatering and packaging;
- 4.2.1.4 Preparing procedures for stabilization, dewatering and packaging;
- 4.2.1.5 Interfacing with other groups as necessary to analyze and resolve problems relating to the Process Control program such as the design of Radwaste Systems and Equipment;
- 4.2.1.6 Preparing periodic reports summarizing the Process Control Program;
- 4.2.1.7 Procurement of materials and supplies required for implementation and maintenance of the Process Control Program;
- 4.2.1.8 That personnel receive appropriate training and are qualified for their respective duties;
- 4.2.1.9 Adequate staffing and sufficient resources for efficient and economic operation of the Process Control Program.

4.3 Operations Superintendent

- 4.3.1 The Operations Superintendent is responsible for the effective operations of permanent plant radwaste systems and will coordinate radwaste activities with the radwaste department.

4.4 Plant Chemist

4.4.1 The Plant Chemist is responsible for interfacing with the Radwaste Engineer on items or problems relating to radwaste processes and chemistry controls or chemical reactions and performing chemical and radiochemical analyses of samples of radioactive waste or materials.

4.5 Quality Assurance

4.5.1 Quality Assurance is responsible for:

4.5.1.1 Assessing the implementation and effectiveness of the quality assurance aspects of the Process Control Program through regular audits and selective monitoring of activities.

4.6 Director Operations Support & Assessment

4.6.1 The Director of Operation Support & Assessment is responsible for providing the following services:

4.6.1.1 State-of-the-art technical advise, support, and assistance as required;

4.6.1.2 Licensing and regulatory compliance support; and

4.6.1.3 Appraising the Waterford-3 Process Control Program and recommending improvements.

4.6.2 The Operations Support and Assessment staff interfaces directly with the plant staff in providing these services.

5.0 PROCEDURE

5.1 Program Description

5.1.1 Solidification System Description:

Waterford 3 utilizes vendor supplied portable solidification equipment for radioactive waste solidification. References 2.2.1, 2.2.4 and 2.2.5 provide a general description of respective vendor solidification processes and process control features; Reference 2.2.6 describes the method which will be utilized to classify wastes in accordance with 10CFR61; and Reference 2.1.1 through 2.1.5 are Waterford 3 documents which either implement or describe activities which provide reasonable assurance that wastes are solidified or dewatered in accordance with all applicable regulations and criteria.

5.1.2 Sources of Waterford 3 Stabilization/Solidification Feeds:

The Cement solidification will be used to stabilize resins, evaporator bottoms and boric acid concentrates. During resin stabilization, vendor equipment will be connected to the Resin Waste Management System outlet to allow for the transfer of resin. Vendor equipment will be connected to the Solid waste Management System outlet when evaporator bottoms from the rad-waste evaporator and boric acid concentrates from the Boron Management System evaporator are to be stabilized. Solidification using Aquaset/Petroset media will be used to process resins, oil, water/acid, evaporator bottoms and boric acid concentrates. This process will not be connected to any plant waste systems and will be processed on a batch basis.

5.2 Solidification Process Parameters:

- 5.2.1 Solidification formulas and solidification process parameters are incorporated into the applicable vendor process control program. No exceptions or deviations from vendor supplied procedures or topical reports are anticipated for stabilized waste. The formulas are used to calculate the ratio of waste, cement, water and other reagents required to achieve an acceptable solidified product. Compatibility requirements of the waste stream with respect to the solidification media are described in the vendor process controls program. Waste stream parameters are adjusted as necessary to meet these requirements.
- 5.2.2 Test solidifications are performed on waste stream samples to verify vendor calculated solidification formulas.
- 5.2.3 Radioactive wastes shall be solidified or dewatered in accordance with the process control program to meet shipping and transportation requirements during transit, and disposal site requirements when received at the disposal site.
- 5.2.4 With solidification or dewatering not meeting disposal site and shipping and transportation requirements, suspend shipment of the inadequately processed wastes and correct the process control program, the procedures, and/or the solid waste system as necessary to prevent recurrence.
- 5.2.5 With solidification or dewatering not performed in accordance with the process control program, test the improperly processed waste in each container to ensure that it meets burial ground and shipping requirements and perform appropriate corrective action if required.

- 5.2.6 Solidification of at least one representative test specimen from at least every tenth batch of each type of wet radioactive wastes (e.g., filter sludges, spent resins, evaporator bottoms, boric acid solutions and sodium sulfate solutions) shall be verified in accordance with the vendor's process control program.
- 5.2.7 If the initial test specimen from a batch of waste fails to verify solidification, the process control program shall provide for the collection and testing of representative test specimens from each consecutive batch of the same type of wet waste until at least three consecutive initial test specimens demonstrate solidification. The process control program may be modified if practical to assure solidification of subsequent batches of waste.
- 5.2.8 If any test specimen fails to verify solidification, the solidification of the batch under test shall be suspended until such time as additional test specimens can be obtained, alternative solidification parameters can be determined in accordance with the vendors process control program, and a subsequent test verifies solidification. Solidification of the batch may then be resumed using the alternative solidification parameters determined by the process control program.

5.3 Administrative Controls

5.3.1 Administrative controls utilized to insure compliance with applicable state and federal regulations and burial site criteria are detailed in the radioactive waste solidification surveillance procedure(s). These implementing document(s) for radioactive waste solidification and dewatering describes the requirements which must be met prior to processing radioactive waste, as well as the condition of the solidified or dewatered waste. Test solidifications, full scale calculations and operation of the solidification equipment are performed by vendor personnel. Dewatering operations will be performed by vendor personnel or by qualified Plant staff. Plant staff provides Health Physics and Quality Assurance coverage, operates plant radioactive waste systems, collects waste stream samples and performs isotopic analyses. Copies of all referenced documents are available on site for use by personnel engaged in solidification activities.

5.3.2 Changes to this Process Control Program shall be described in the semi-annual Radioactive Effluent Release Report for the period in which the change is made.

5.4 Waste Characterization and Classification

5.4.1 Waste Classification

5.4.1.1 Solidified wastes are classified in accordance with the requirements of 10CFR61.55, as implemented by reference 2.2.6 and plant waste classification and characterization procedure(s).

5.4.1.2 Annual analysis will be performed on the waste streams to determine the isotopic abundance of gamma emitting isotopes in the streams as described in Reference 2.2.8. Scaling factors for the non-gamma emitting and transuranic constituents will be developed from this annual analysis using References 2.2.6 and 2.2.7. The activity of each radionuclide in the solidified waste will be determined by a core sample or a calculational method employing the percent abundance and scaling factors with a dose to curie conversion factor as described in Reference 2.2.6.

5.4.2 Waste Characteristics

5.4.2.1 Solidified wastes will meet the characteristics of 10CFR61.56(a). Stabilized wastes will meet the characteristics of 10CFR61.56(b). Waste containers will be labelled to identify the waste class.

5.4.2.2 The manifesting requirements of 10CFR20.311 are implemented and records are maintained in accordance with 10CFR71.91.

5.5 Quality Assurance

5.5.1 Quality Assurance related activities for the Radioactive Waste Program are implemented as described in the Nuclear Operations Management Manual (Reference 2.1.5). These activities provide verification that the solidified wastes meet applicable state and federal regulations and burial site criteria.

6.0 ATTACHMENTS

NONE

ATTACHMENT 10.3

(3 PAGES)

CORRECTIONS TO TABLE 3
OF
SEMIANNUAL RADIOACTIVE RELEASE REPORT

January 1, 1991 to June 30, 1991

Submittal of Burial Volumes and Activities from
Volume reduction and disposal facilities.

TABLE 3
(1 of 8)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 1/1/91 THRU 6/30/91

WASTE TYPE	CONTAINER VOLUME (ft ³)	WASTE VOLUME (m ³)	TOTAL ACTIVITY (Ci)	ERROR
*Non Compacted Dry Active Waste Shipped to Scientific Ecology Group for volume reduction	1040	647.89 11.36 Burial Volume	1.32E+0 *1	±25%
*Non Compacted Dry Active Waste Shipped to Allied Technologies Group for Volume Reduction	1040	176.6 16.99 Burial Volume	1.33E-1 *1 1.34E-1 *1 Buried Activity	±25%

* Waste volumes shipped for volume reduction do not reflect final burial waste volumes, unless stated.

*1 Activity determined by estimations.

*2 Activity determined by measurements.

TABLE 3
(3 of 8)

SOLID WASTE SHIPPED OFFSITE FOR DISPOSAL
DURING PERIOD 1/1/91 THRU 6/30/91

WASTE TYPE	CONTAINER VOLUME (ft ³)	WASTE VOLUME (m ³)	TOTAL ACTIVITY (Ci)	ERROR
*Mechanical Filters Dewatered Shipped to Allied Technologies Group	100.1	2.05	8.63E+1 *2	±25%
		3.19 Burial Volume	1.63E+0 *2 Buried Activity	±25%

* Waste volumes shipped for volume reduction do not reflect final burial waste volumes, unless stated.

*1 Activity determined by estimations.

*2 Activity determined by measurements.