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U-602989
1A.120

March 24, 1998

Docket No. 50-461

10CFR50.36a
10CFR50, App I, IV.B.1

Document Control Desk
Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Clinton Power Station
Annual Radioactive Effluent Release Report

Dear Madam or Sir:

Attached is the Annual Radioactive Effluent Release Report for Clinton Power Station (CPS) for the period of January 1, 1997 through December 31, 1997. This submittal is provided in accordance with the requirements of section 5.6.3 of the CPS Technical Specifications.

Sincerely yours,

Joseph V. Sipek
Director - Licensing

GBS/mlh

Attachment

cc: NRC Clinton Licensing Project Manager
NRC Resident Office, V-690
Regional Administrator, Region III, USNRC
Illinois Department of Nuclear Safety

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ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

FOR THE

CLINTON POWER STATION

January 1, 1997 - December 31, 1997

Prepared by

Plant Radiation Protection and Chemistry Department

April 24,1998

January 1, 1997 - December 31, 1997

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SECTION 1
EXECUTIVE SUMMARY

The Annual Radioactive Effluent Release Report is a detailed description of all radioactive releases (both gaseous and liquid) from the Clinton Power Station (CPS) and the resulting radiation doses for the period from January 1, 1997 through December 31, 1997. This report includes a detailed meteorological section which provides the weather history of the area during this period. This information is used to calculate the dose to the public.

The report also includes a summary of the amounts of radioactive material contained in solid waste that is packaged and shipped for offsite disposal at federally-approved burial facilities. In addition, this report notifies the U.S. Nuclear Regulatory Commission (NRC) staff of changes to CPS's Offsite Dose Calculation Manual (ODCM) and exceptions to the CPS effluent monitoring program which must be reported per ODCM Operation Requirements 2.7.1.b and 3.9.2.b.

The NRC requires that nuclear power stations be designed, constructed, and operated in such a way that the amount of radioactive material in effluent releases to unrestricted areas is kept As Low As Reasonably Achievable (ALARA). To assure these criteria are met, the NRC has established limits governing the release of radioactivity in effluents.

CPS was operated in compliance with established limits during this report period. The maximum radiation dose delivered to the inhabitants of the area surrounding CPS, due to radioactivity released from the station, was very small. The radiation dose to people in the vicinity of CPS was calculated for a continuous gaseous release by using the concentration of radioactive material and the weather conditions at the time of the release. This dose was only a small fraction of the limit for the most exposed member of the public and came entirely from gaseous releases from the site. There were no liquid releases in 1997.

SECTION 2
INTRODUCTION

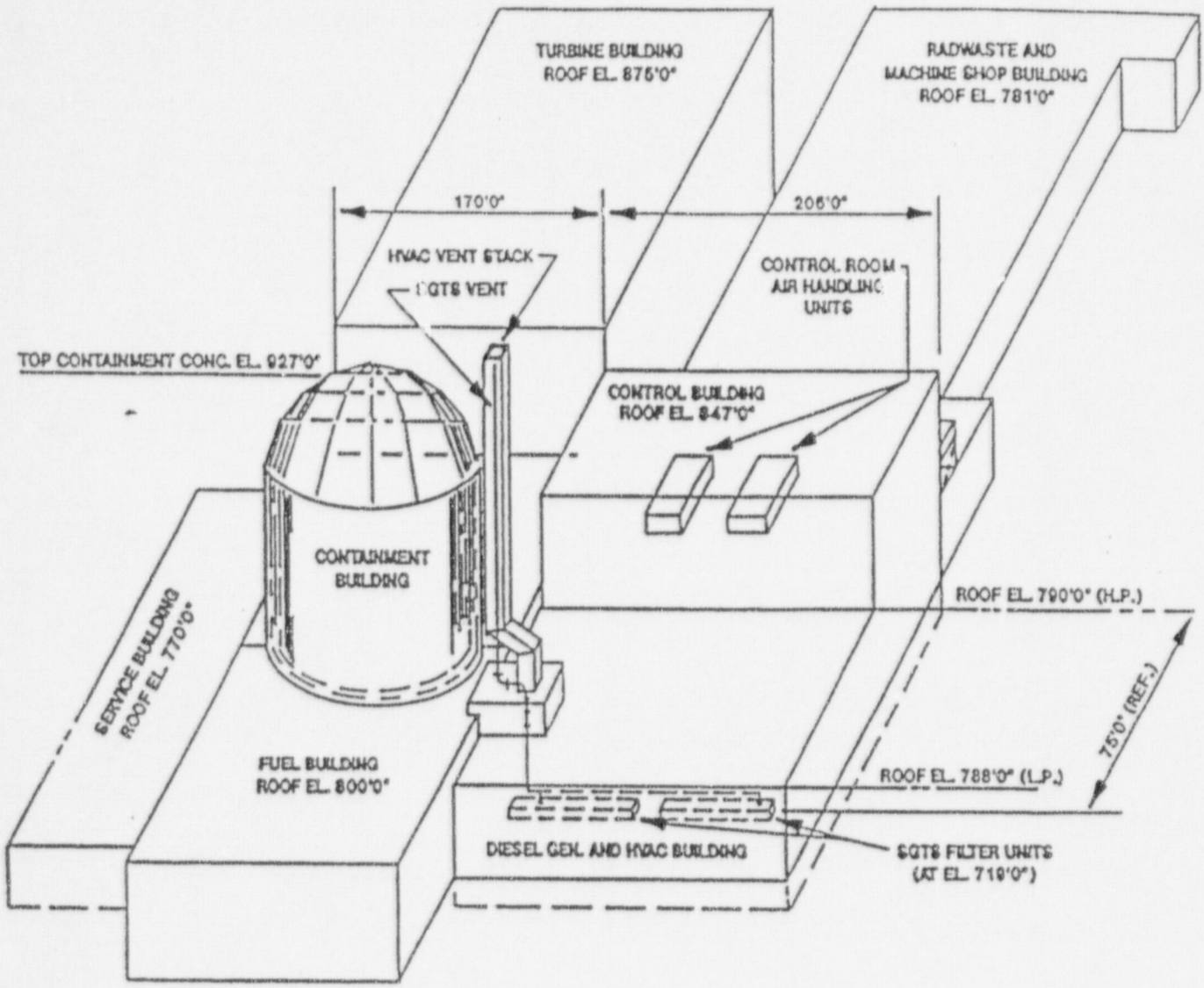
Clinton Power Station is located in Harp Township, DeWitt County approximately six miles east of the city of Clinton in east-central Illinois. Clinton Power Station is a 985 megawatt gross electrical power output boiling water reactor. The reactor and generating units were supplied by General Electric, Sargent and Lundy Engineers served as architect-engineer, and Baldwin Associates was the constructor.

Construction of CPS began in the mid 1970's. Fuel load began in September of 1986 with initial criticality achieved on February 27, 1987. Commercial operation commenced in April 1987 and the reactor reached 100% power for the first time on September 15, 1987.

Airborne effluents are released from CPS via two gaseous effluent release points to the environment: the Common Station Heating, Ventilating, and Air Conditioning (HVAC) Stack and the Standby Gas Treatment System (SGTS) Vent (see Figure 1). Each release point is continuously monitored and a program of periodic sampling and analysis is conducted as specified in the ODCM.

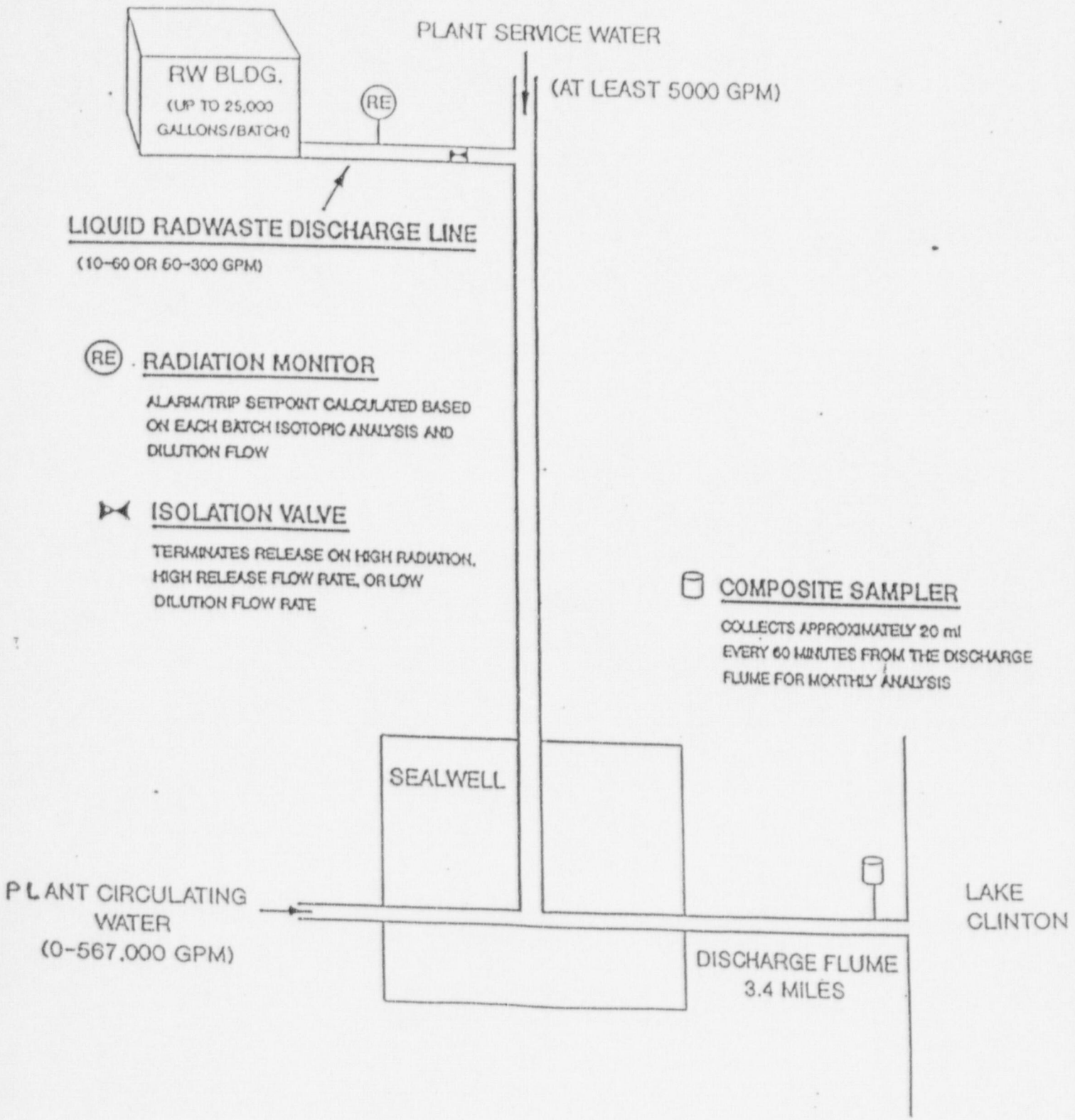
Liquid effluents from CPS are released in batch mode and are sampled and analyzed prior to release. Liquid effluents, (variable from 10-60 gallons per minute (GPM) or 50-300 GPM), combine with Plant Service Water flow (minimum of approximately 5000 GPM) and Plant Circulating Water flow (0-567,000 GPM) in the seal well prior to entering the 3.4 mile discharge flume to Lake Clinton (see Figure 2).

Figure 1
CPS AIRBORNE EFFLUENT RELEASE POINTS



	HVAC Exhaust Stack	SGTS Exhaust Stack
Release Point Height (m)	61	61
Building Height (m)	58	58
Release Point Geometry	Duct	Pipe
Release Point Area (m^2)	11.15	0.15
Release Point Diameter (m)	3.77*	0.44
Annual Average Flow Rate (m^3/sec)	111.71	1.89
Vertical Exit Velocity (m/sec)	10.02	12.49

Figure 2
CPS WATERBORNE EFFLUENTS RELEASE PATHWAY



Regulatory Limits

The NRC requires nuclear power plants to be designed, constructed and operated in such a way that the radioactivity in effluent releases to unrestricted areas is kept ALARA. To assure these criteria are met, each license authorizing nuclear reactor operation includes Offsite Dose Calculation Manual (ODCM) governing the release of radioactive effluents (Code of Federal Regulations, Title 10, Part 50, Appendix I). The ODCM designates the limits for release of effluents, as well as the limits for doses to the general public from the release of radioactive liquids and gases. Keeping releases within these operating limits demonstrates that the ALARA principle is being met.

The dose to a member of the general public from radioactive material in liquid effluents released to unrestricted areas is limited to:

- Less than or equal to 3 mRem per year to the total body.

-and-

- Less than or equal to 10 mRem per year to any organ.

The dose to a member of the general public from the release of noble gases in gaseous effluents is limited to:

- Less than or equal to 10 mrad per year for gamma radiation.

-and-

- Less than or equal to 20 mrad per year for beta radiation.

The dose to a member of the general public from iodine-131, tritium and all particulate radionuclides with a half-life greater than eight days in gaseous effluents is limited to:

- Less than or equal to 15 mRem per year to any organ.

These ALARA limits are a fraction of the dose limits established by the Environmental Protection Agency (EPA). In its Environmental Dose Standard of 40CFR190, the EPA established dose limits for members of the public in the vicinity of a nuclear power plant. These dose limits are:

- Less than or equal to 25 mRem per year to the total body.

- Less than or equal to 75 mRem per year to the thyroid.

-and-

- Less than or equal to 25 mRem per year to any other organ.

See Section 3 for more information on regulatory limits.

Processing and Monitoring

Effluents are strictly controlled at CPS to ensure radioactivity released to the environment is minimal and does not exceed release limits. Effluent controls include the operation of radiation monitoring systems in the plant and offsite environmental sampling and analysis programs. In-plant radiation monitoring systems are used to provide a continuous indication of radioactivity and are also used to collect particulate and radioiodine samples. These samples are analyzed in a laboratory to identify the specific concentration of radionuclides being released. Sampling and analysis provide a more sensitive and precise method of determining effluent composition to complement the information provided by real-time monitoring instruments.

Beyond the plant itself, a radiological environmental monitoring program is maintained in accordance with Federal Regulations. The basic purpose of the program is to assess the radiological impact on the environment due to the operation of the Clinton Power Station. Implicit in this purpose is the regulatory requirement to trend and assess radiation exposure rates and radioactivity concentrations that may contribute to human radiation exposure. The program consists of two phases, pre-operational and operational. During the pre-operational phase of the program, the baseline for the local radiation environment was established. The operational phase of the program includes the objective of making confirmatory measurements to verify that the in-plant controls for the release of radioactive material are functioning as designed. Assessment of the operational impact of CPS on the environment is based on data collected since initial reactor criticality.

Exposure Pathways

Radiological exposure pathways are the means by which people may become exposed to radioactivity released from nuclear facilities. The major pathways of concern are those which could cause the highest calculated radiation dose. These pathways are determined from the type and amount of radioactivity released, the environmental transport mechanism and use of the environment. The environmental transport mechanism includes the meteorological characteristics of the area which will be defined by wind speed and wind direction at the time of the release. This information is used to evaluate how the radionuclides will be distributed in the area. The most important factor in evaluating the exposure pathway is the use of the environment by the people living around CPS. Factors such as location of homes in the area, use of cattle for milk and meat, and the growing of gardens for vegetable consumption are very important considerations in evaluating exposure pathways. Figure 3 illustrates the various effluent exposure pathways considered.

The radioactive gaseous effluent exposure pathways include direct radiation, deposition on plants and soil, and inhalation by animals and humans. The radioactive liquid effluent exposure pathways include fish consumption and direct exposure from the lake.

Dose Assessment

Whole body radiation involves the exposure of all organs in the human body to ionizing radiation. Most background radiation exposures consist of whole body exposure although specific organs can receive radiation exposure from distinct radionuclides. These radionuclides enter the body through inhalation and ingestion and seek different organs depending on the nuclide. For example, radioactive iodine selectively concentrates in the thyroid, radioactive cesium collects in muscle and liver tissue, and radioactive strontium in mineralized bone.

The total dose to organs from a given radionuclide also depends on the amount of activity in the organ and the amount of time that the radionuclide remains in the body. Some radionuclides remain for very short periods of time due to their rapid radioactive decay and/or elimination rate from the body, while others may remain longer.

The radiation dose to people in the area surrounding CPS is calculated for each release using the concentrations of radioactive material and the weather conditions present at the time of the release. The dose is calculated in all sixteen geographical sectors surrounding CPS and takes into account the location of the nearest residents, vegetable gardens producing broad leaf vegetables, dairy and meat animals in all sectors. The calculated dose also uses the concept of a "maximum exposed individual" and "standard man", and the maximum use factors for the environment, such as how much milk an average person drinks and how much air that person breathes in a year.

See Tables 11-18 of Section 6 for more detailed information on dose to the public.

Gaseous Effluents

Gaseous effluent radioactivity released from CPS is classified into two categories, 1) noble gases, and 2) ^{131}I, ^{133}I, ^{3}H and all radionuclides in particulate form with half-lives greater than eight days. Noble gases, such as xenon and krypton, are biologically and chemically nonreactive; these radionuclides cause external radiation exposure. ^{131}I, ^{133}I, ^{3}H and radionuclides in particulate form with half-lives greater than eight days are the major contributors to internal dose.

See Tables 1, 2, and 3 of Section 4 for more detailed information on gaseous effluents.

Liquid Effluents

CPS had no radioactive liquid discharges in 1997.

Solid Waste Shipments

In order to reduce the radiation exposure to personnel and maintain the ALARA concept, the NRC and the Department of Transportation (DOT) have established limits on the types of radioactive waste and the amount of radioactivity that may be packaged and shipped offsite for burial or disposal. To ensure that CPS is complying with these regulations, the types of waste and the radioactivity present are reported to the NRC.

See Table 7 of Section 4 for more detailed information on solid waste shipments.

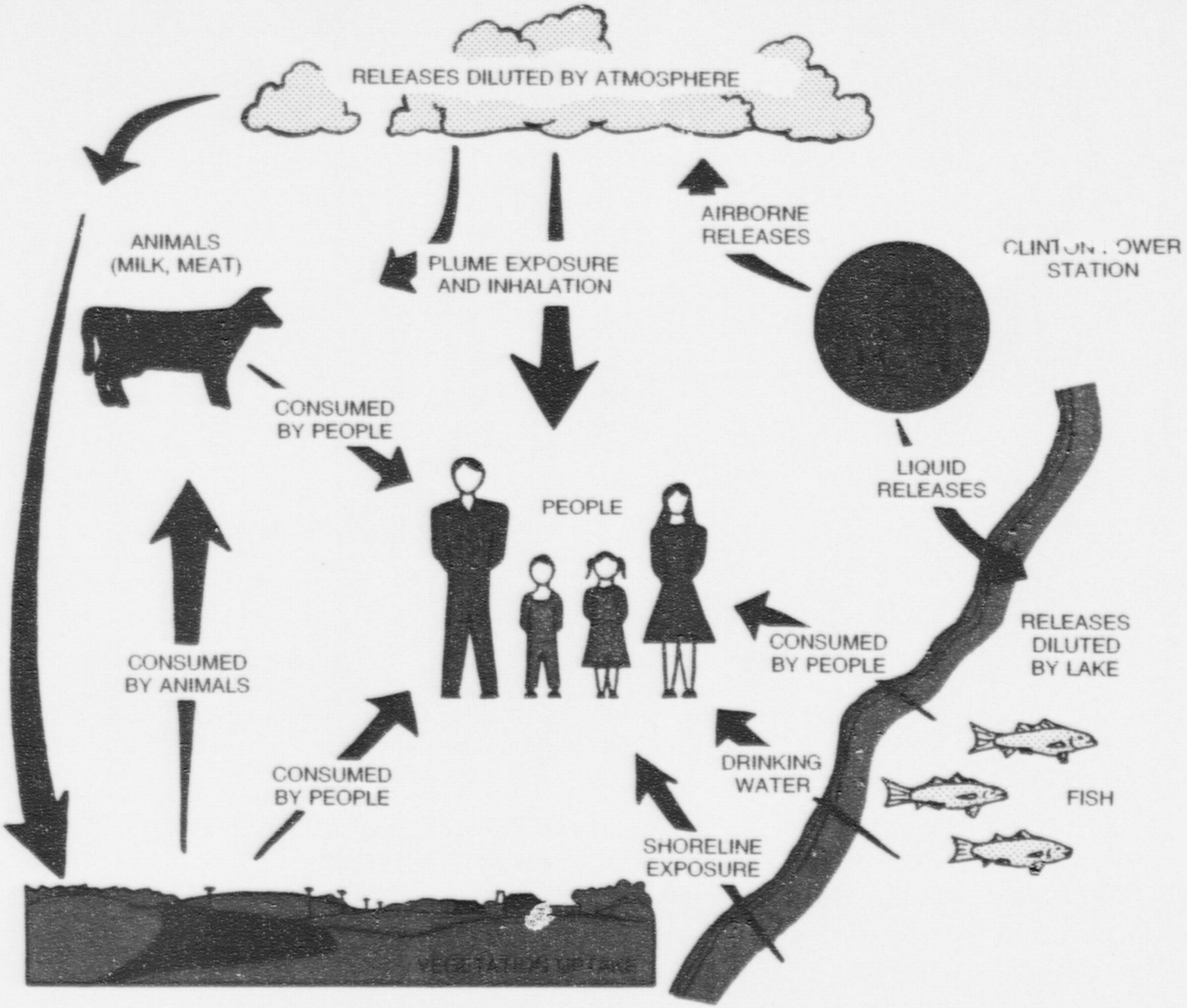


FIGURE 3: POTENTIAL EXPOSURE PATHWAYS OF MAN DUE TO RELEASES OF RADIOACTIVE MATERIAL TO THE ENVIRONMENT

SECTION 3
SUPPLEMENTAL INFORMATION

I. REGULATORY LIMITS

A. Gaseous Effluents

1. In accordance with Title 10 of the Code of Federal Regulations (CFR), Part 20, the maximum permissible concentrations for gaseous effluents shall not exceed the values given in 10CFR20, Appendix B, Table 2, Column 1. To ensure these concentrations are not exceeded, dose rates due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to the following:

   a. Noble gases

      - Less than or equal to 500 mRem/year to the total body.

      - Less than or equal to 3000 mRem/year to the skin.

   b. ^{131}I, ^{133}I, ^{3}H and all radionuclides in particulate form with half-lives greater than eight days:

      - Less than or equal to 1500 mRem/year to any organ.

2. In accordance with Title 10 of the Code of Federal Regulations, Part 50, Appendix I, air dose due to noble gases released in gaseous effluents to areas at and beyond the site boundary shall be limited to the following:

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

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

3. In accordance with 10CFR50, Appendix I, dose to a member of the public (from ^{131}I, ^{133}I, ^{3}H and all radionuclides in particulate form with half-lives greater than eight days) in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

   a. Less than or equal to 7.5 mRem to any organ, during any calendar quarter.

   b. Less than or equal to 15 mRem to any organ, during any calendar year.

B. Liquid Effluents

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

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

   a. Less than or equal to 1.5 mRem to the total body and less than or equal to 5 mRem to any organ during any calendar quarter.

   b. Less than or equal to 3 mRem to the total body and less than or equal to 10 mRem to any organ during any calendar year.

II. AVERAGE ENERGY

The CPS ODCM limits the dose equivalent rates due to the release of fission and activation gases to less than or equal to 500 mRem per year to the total body and less than or equal to 3000 mRem per year to the skin. These limits are based on dose calculations using actual isotopic concentrations in our effluent streams, and are not based upon gross count monitors. Therefore, the average beta and gamma energies (E) for gaseous effluents as described in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants", are not applicable.

III. MEASUREMENT AND APPROXIMATION OF TOTAL RADIOACTIVITY

A. Fission and Activation Gases

1. Gas samples are collected weekly and are counted on a high purity germanium detector (HPGe) for principal gamma emitters. The HVAC and SGTS release points are continuously monitored, and the average release flow rates for each release point are used to calculate the total activity released in a given time period.

2. Tritium is collected by passing a known volume of the sample stream through a gas washer containing a known quantity of demineralized water. The collected samples are distilled and analyzed by liquid scintillation. The tritium released was calculated for each release point from the measured tritium concentration, the volume of the sample, the tritium collection efficiency, and the stack exhaust flow rates.

B. Iodines

Iodine is continuously collected on a charcoal cartridge filter via an isokinetic sampling assembly on each release point. Filters are normally exchanged once per week and analyzed on an HPGe system. The daily average flow rates for each release point are averaged for the duration of the sampling period and these results, along with isotopic concentrations, are used to determine total activity released during the time period in question.

C. Particulates

Particulates are continuously collected on a filter paper via an isokinetic sampling assembly on each release point. Filters are normally exchanged once per week and analyzed on an HPGe system. Flow rates and total activity are determined in the same manner as for iodines.

D. Liquid Effluents

Each tank of liquid radwaste is sampled and analyzed for principal gamma emitters prior to release. Each sample tank is recirculated for a sufficient amount of time prior to sampling to ensure that a representative sample is obtained. Samples are analyzed on an HPGe system and release permits are generated based on the values obtained from the isotopic analysis and the most recent values for ^{3}H, gross alpha, ^{55}Fe, ^{89}Sr and ^{90}Sr. An aliquot based on release volume is saved and added to composite containers. The concentrations of composited isotopes and the volumes of the releases associated with these composites establish the proportional relationships that are then utilized for calculating the total activity released for these isotopes.

IV. BATCH RELEASES

A. Liquid

		1997
1.	Number of batch releases:	0
2.	Total time period for batch releases:	N/A
3.	Maximum time period for batch release:	N/A
4.	Average time period for batch release:	N/A
5.	Minimum time period for batch release:	N/A
6.	Average stream flow during periods of release:	N/A
7.	Total waste volume:	N/A
8.	Total dilution volume:	N/A

B. Gaseous

		1997
1.	Number of batch releases:	0
2.	Total time period for batch releases:	N/A
3.	Maximum time period for batch release:	N/A
4.	Average time period for batch release:	N/A
5.	Minimum time period for batch release:	N/A

V. ABNORMAL RELEASES

CPS had no abnormal release of radioactive liquid during 1997.

A. Liquid

		1997
1.	Number of abnormal releases:	0
2.	Total time period for abnormal releases:	N/A
3.	Maximum time period for abnormal release:	N/A
4.	Average time period for abnormal release:	N/A
5.	Minimum time period for abnormal release:	N/A
6.	Average stream flow during periods of release:	N/A
7.	Total waste volume:	N/A
8.	Total dilution volume:	N/A

VI. DESCRIPTION OF ERROR ESTIMATES

A. Gaseous and Liquid Effluents

Estimates of measurement and analytical error for gaseous and liquid effluents are calculated as follows:

$$E_T = \sqrt{[(E_1)^2 + (E_2)^2 + \ldots(E_n)^2]}$$

where, E_T = total percent error

$E_1 \ldots E_n$ = percent error due to calibration standards, laboratory analysis, instruments, sample flow, etc.

SECTION 4
EFFLUENT AND WASTE DISPOSAL DATA
TABLE 1

AIRBORNE EFFLUENTS - SUMMATION OF ALL RELEASES
Data Period: January 1, 1997 - December 31, 1997
Continuous Mode

	Nuclide Category	Unit		Est. Total[1] Error, %
A.	Fission & Activation Gases			
	1. Total Release	Ci	0.00E+00	30
	2. Average Release Rate for Period	µCi/sec	0.00E+00	
	3. Percent of Applicable Limit	%	0.00E+00	
B.	Iodine-131			
	1. Total Release	Ci	0.00E+00	31
	2. Average Release Rate for Period	µCi/sec	0.00E+00	
C.	Particulates			
	1. Particulates Released released with Half-lives > 8 Days	Ci	6.77E-05	24
	2. Average Release Rate for Period	µCi/sec	2.15E-06	
	3. Gross Alpha Activity Released	Ci	2.54E-06	
	4. Gross Alpha Average Release Rate for Period	µCi/sec	8.06E-08	
	5. Percent of Applicable Limit for Particulates, and Iodine	%	4.83E-02	
D.	Tritium			
	1. Total Release	Ci	3.41E+00	105
	2. Average Release Rate for Period	µCi/sec	1.08E-01	
	3. Percent of Applicable Limit	%	4.16E-03	

[1] It should be noted that the lower the actual sample activity is with respect to background activity, the greater the counting error. Large errors are reported for the various components of CPS gaseous effluents because of consistently low sample activity.

TABLE 2

AIRBORNE EFFLUENTS (Curies)[1]
Data Period: January 1, 1997 - December 31, 1997
Continuous Mode

	Nuclide	Value (Ci)
A.	Gases	
	None Released	0.00E+00
	Total	0.00E+00
B.	Iodines	
	None Released	0.00E+00
	Total	0.00E+00
C.	Particulates w/Half-lives > 8 Days	
	^{54}Mn	8.21E-06
	^{60}Co	3.74E-05
	^{89}Sr	4.61E-06
	Total	5.02E-05

[1] Absence of a nuclide from the above list does not indicate that it was not present. It simply indicates that it's Minimum Detectable Activity (MDA) was below its LLD. See Table 3 for a list of the LLDs of the various nuclides.

TABLE 3

RADIOACTIVE GASEOUS WASTE LLD VALUES

TYPE OF ACTIVITY ANALYSIS	Lower Limit of Detection (LLD)[a] (μCi/ml)
Principal Gamma Emitters[b,c]	$1x10^{-04}$
^{3}H[c]	$1x10^{-06}$
^{131}I[d]	$1x10^{-12}$
^{133}I[d]	$1x10^{-10}$
Principal Gamma Emitters[b,e] (^{131}I, others)	$1x10^{-11}$
Gross Alpha[f]	$1x10^{-11}$
^{89}Sr, ^{90}Sr[g]	$1x10^{-11}$

Table 3 Notations

[a]The LLD is defined, for purposes of these specifications, as an "a priori" determination of 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 and 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:

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

Table 3 Notations (Cont'd)

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 (sec^{-1}) and

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

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.

[b]The principal gamma emitters for which the LLD specification applies include the following radionuclides: ^{87}Kr, ^{88}Kr, ^{133}Xe, ^{133m}Xe, ^{135}Xe, and ^{138}Xe in noble gas releases and ^{54}Mn, ^{59}Fe, ^{58}Co, ^{60}Co, ^{65}Zn, ^{99}Mo, ^{131}I, ^{134}Cs, ^{137}Cs, ^{141}Ce and ^{144}Ce 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 Radioactive Effluent Release Report.

[c]Weekly grab sample and analysis

[d]Continuous charcoal sample analyzed weekly

[e]Continuous particulate sample analyzed weekly

[f]Composite particulate sample analyzed monthly

[g]Composite particulate sample analyzed quarterly

TABLE 4

WATERBORNE EFFLUENTS - SUMMATION OF ALL RELEASES
Data Period: January 1, 1997 - December 31, 1997

	Nuclide Category	Unit	Value	Est. Total Error, %
A.	Fission & Activation Products			
1.	Total Release	Ci	0.00E+00	N/A
2.	Average Diluted Concentration	µCi/ml	0.00E+00	
3.	Percent of Applicable Limit	%	0.00E+00	
B.	Tritium			
1.	Total Release[2]	Ci	0.00E+00	N/A
2.	Average Diluted Concentration	µCi/ml	0.00E+00	
3.	Percent of Applicable Limit	%	0.00E+00	
C.	Dissolved and Entrained Gases			
1.	Total Release[1]	Ci	0.00E+00	N/A
2.	Average Diluted Concentration	µCi/ml	0.00E+00	
3.	Percent of Applicable Limit	%	0.00E+00	
D.	Gross Alpha Radioactivity Released[2]	Ci	0.00E+00	N/A
E.	Volume of Waste Released	gallons	0.00E+00	N/A
		liters	0.00E+00	
F.	Volume of Dilution Water Used	gallons	0.00E+00	N/A
		liters	0.00E+00	

Notation:
[1] An entry of 0.00E+00 does not represent the absence of a radionuclide but indicates that the MDA concentration of the nuclide was below the LLD value listed in Table 6.
[2] A sample was not analyzed for these activities.

TABLE 5

WATERBORNE EFFLUENTS (Curies)
Data Period: January 1, 1997 - December 31, 1997
All Modes

Nuclide Category		Activity
A.	Tritium	N/A
B.	Fission & Activation Products	
	^{51}Cr	N/A
	^{54}Mn	N/A
	^{58}Co	N/A
	^{60}Co	N/A
	^{55}Fe	N/A
	^{59}Fe	N/A
	^{65}Zn	N/A
	^{89}Sr	N/A
	^{90}Sr	N/A
	^{99}Mo	N/A
	^{124}Sb	N/A
	^{131}I	N/A
	^{133}I	N/A
	^{134}Cs	N/A
	^{137}Cs	N/A
	^{140}Ba	N/A
	^{140}La	N/A
	^{141}Ce	N/A
	^{110m}Ag	N/A
	Total	N/A
C.	Dissolved and Entrained Gases	
	^{85}Kr	N/A
	^{85m}Kr	N/A
	^{87}Kr	N/A
	^{88}Kr	N/A
	^{133}Xe	N/A
	^{133m}Xe	N/A
	^{135}Xe	N/A
	^{135m}Xe	N/A
	^{138}Xe	N/A
	Total	N/A

TABLE 6

RADIOACTIVE LIQUID WASTE LLD VALUES

TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD)[a] (μCi/ml)
Principal Gamma Emitters[b]	5×10^{-7}
^{131}I	1×10^{-6}
Dissolved and Entrained Gases(Gamma Emitters)	1×10^{-5}
^{3}H	1×10^{-5}
Gross Alpha	1×10^{-7}
^{89}Sr, ^{90}Sr	5×10^{-8}
^{55}Fe	1×10^{-6}

Table 6 Notations

[a]The LLD is defined, for purposes of these requirements, 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 and only 5% probability of falsely concluding that a blank observation represents a "real" signal.

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

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

Table 6 Notations (Cont'd)

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 (sec^{-1}) and

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

Typical values of E, V, Y, and λt 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, MDA) limit for a particular measurement.

[b]The principal gamma emitters for which the LLD requirement applies include the following radionuclides: ^{54}Mn, ^{59}Fe, ^{58}Co, ^{60}Co, ^{65}Zn, ^{99}Mo, ^{134}Cs, ^{137}Cs, and ^{141}Ce. ^{144}Ce shall also be measured, but with an LLD of 5×10^{-6}. This list does not mean that only these nuclides are to be detected and reported. Other gamma peaks that are measurable, together with those of the above nuclides, shall also be analyzed and reported in the Radioactive Effluent Release Report.

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

During this reporting period there were nineteen (19) radioactive waste shipments and no irradiated fuel shipments from CPS as reported in Table 7. In addition, the CPS ODCM requires reporting of the following information for solid waste shipped offsite during the report period:

Class A:

1. Container volume: 208.4 ft^3, 195.2 ft^3, 195.7 ft^3, 135.8 ft^3, 73.4 ft^3, 669 ft^3*.

2. Total curie quantity: 962 curies as determined by dose-to-curie and sample concentration methodology estimates.

3. Principal radionuclides: See Table 7, A.2 for listing of measured radionuclides.

4. Source of waste and processing employed: Resins, filter sludges and evaporator bottoms dewatered or solidified in cement, and non-compacted dry active waste.

5. Type of container: Type A and Strong Tight Container.

6. Solidification agent or absorbent: None.

* These containers were shipped to a waste processor, not a burial site.

TABLE 7
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
January 1, 1997 - December 31, 1997

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (not irradiated fuel)

1.	TYPE OF WASTE	UNIT	VALUE	EST. TOTAL ERROR, %
a.	Resins, filter sludges, evaporator bottoms, etc.	m^3	7.85E+01	
		Ci	9.62E+02	25
b.	Dry compactible waste, contaminated equipment, etc.	m^3	2.65E+02[1]	
		Ci	3.70E-01	25
c.	Irradiated components, control rods, etc.	m^3	0.00E+00	
		Ci	0.00E+00	0
d.	Other	m^3	0.00E+00	
		Ci	0.00E+00	0

2. LSTIMATE OF MAJOR NUCLIDE COMPOSITION

	NUCLIDE NAME	PERCENT ABUNDANCE	CURIES
a.	Co-60	21.00%	2.02E+02
	Mn-54	8.65%	8.32E+01
	Fe-55	63.84%	6.14E+02
	OTHER	6.51%	6.26E+01
b.	Fe-55	84.65%	3.14E-01
	Co-60	10.05%	3.73E-02
	Mn-54	4.62%	1.71E-02
	OTHER	0.68%	2.52E-03
c.	NONE	N/A	N/A
d.	NONE	N/A	N/A

[1] Actual volume reduced by waste processor.

TABLE 7 (Cont'd)

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
January 1, 1997 - December 31, 1997

3. SOLID WASTE DISPOSITION

NUMBER OF SHIPMENTS	MODE OF TRANSPORTATION	DESTINATION
15	Truck	Barnwell, SC
4	Truck	Oak Ridge, TN

B. IRRADIATED FUEL SHIPMENTS (Disposition)

NUMBER OF SHIPMENTS	MODE OF TRANSPORTATION	DESTINATION
NONE	N/A	N/A

SECTION 5
METEOROLOGICAL DATA AND DISPERSION ESTIMATES

The meteorological monitoring program began at the Clinton Power Station site on April 13, 1972. The meteorological system consists of a tower 199 feet high with two levels of instrumentation, at the 10-meter and 60-meter levels. Wind directions and speeds at the 10-meter and 60-meter levels are measured by a combined cup and vane sensor. The temperature at these levels is sensed by an aspirated dual temperature sensor. One-half of the dual sensor at each elevation is used for ambient temperature while the other half is used to provide a differential temperature between the 10-meter and 60-meter levels. Dew-point is measured at the 10-meter level with an aspirated dew-point sensor.

Meteorological monitoring instruments have been placed on the Clinton Power Station microwave tower at the 10-meter level to act as a backup to the existing meteorological tower.

Clinton Power Station meteorological data is transmitted to the Main Control Room via a dedicated telephone line. There the signals are received and converted to a 4 to 20 milliamp signal and fed individually to a microprocessor and chart recorders. The microprocessor is part of the Clinton Power Station Radiation Monitoring System. Meteorological data is available via the microprocessors in the Main Control Room and the Technical Support Center.

Dispersion modeling for effluents for normal operation of Clinton Power Station is a straight-line, sector-averaged Gaussian plume model designed to estimate average relative concentration at various receptor points. The model was developed in accordance with routine release analysis procedures specified in Regulatory Guide 1.111. For joint frequency input data, periods of calm are distributed in accordance with a directional distribution. For hourly input data, periods of calm are assigned the previous hour's wind direction. Periods of calm are assigned a wind speed value of half the specified instrument threshold value. See Table 10 for more detailed information on meteorology and dispersion data.

TABLE 8

METEOROLOGICAL DATA AVAILABILITY
Data Period: January 1, 1997 - December 31, 1997

Parameter	Percent of Valid Hours During Period (1)
1. Wind Speed	
a. 10-meter Sensor	94%
b. 60-meter Sensor	94%
2. Wind Direction	
a. 10-meter Sensor	94%
b. 60-meter Sensor	94%
3. Temperature	
a. 10-meter	94%
b. 60-Meter	94%
b. Temperature Difference (10m-60m)	94%
4. Percent of hours for which valid 10-meter Wind Speed, Wind Direction, & Delta Temperature were available	94%
5. Percent of hours for which valid 60-meter Wind Speed, Wind Direction, & Delta Temperature were available	94%

(1) There was no invalid data for 1997. The values reported here represent the hours that data was not missed.

TABLE 9

CLASSIFICATION OF ATMOSPHERIC STABILITY

Stability Classification	Pasquill Category	Defining Conditions
Extremely unstable	A	$-0.900<\Delta T\leq -0.019$
Moderately unstable	B	$-0.019<\Delta T\leq -0.017$
Slightly unstable	C	$-0.017<\Delta T\leq -0.015$
Neutral	D	$-0.015<\Delta T\leq -0.005$
Slightly stable	E	$-0.005<\Delta T\leq 0.015$
Moderately stable	F	$0.015<\Delta T\leq 0.040$
Extremely stable	G	$0.040<\Delta T\leq 0.900$
Invalid		$\Delta T\leq -0.900$ or $\Delta T>0.900$

ΔT = temperature difference in Celsius degrees per meter

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

For the Period January 1, 1997 - December 31, 1997

STABILITY CLASS A

60 Meter (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	0.00E+00	9.00E+00	4.80E+01	1.80E+01	0.00E+00	0.00E+00	7.50E+01
NNE	1.00E+00	6.00E+00	2.00E+01	3.00E+01	8.00E+00	0.00E+00	6.50E+01
NE	2.00E+00	1.90E+01	1.40E+01	1.50E+01	7.00E+00	0.00E+00	6.00E+01
ENE	1.00E+00	2.40E+01	2.10E+01	1.70E+01	4.00E+00	3.00E+00	7.00E+01
E	7.00E+00	2.20E+01	3.50E+01	9.00E+00	1.00E+00	1.00E+00	7.50E+01
ESE	7.00E+00	1.60E+01	2.00E+00	0.00E+00	0.00E+00	1.00E+00	2.60E+01
SE	1.70E+01	2.60E+01	1.30E+01	5.00E+00	0.00E+00	3.00E+00	6.40E+01
SSE	6.00E+00	2.30E+01	2.70E+01	7.00E+00	2.00E+00	3.00E+00	6.80E+01
S	7.00E+00	3.60E+01	4.70E+01	2.60E+01	1.20E+01	3.00E+00	1.31E+02
SSW	5.00E+00	5.30E+01	4.60E+01	3.90E+01	1.10E+01	1.00E+00	1.55E+02
SW	2.00E+00	2.10E+01	3.20E+01	3.30E+01	1.00E+01	3.00E+00	1.01E+02
WSW	5.00E+00	2.60E+01	2.90E+01	1.30E+01	2.00E+00	9.00E+00	8.40E+01
W	1.00E+00	1.00E+01	2.10E+01	2.30E+01	2.10E+01	3.00E+00	7.90E+01
WNW	1.00E-02	1.20E+01	2.10E+01	3.70E+01	1.90E+01	7.00E+00	9.60E+01
NW	1.00E+00	1.70E+01	2.50E+01	4.00E+01	9.00E+00	7.00E+00	9.90E+01
NNW	0.00E+00	1.10E+01	2.50E+01	2.80E+01	1.00E+00	0.00E+00	6.50E+01
Total	6.20E+01	3.31E+02	4.26E+02	3.40E+02	1.07E+02	4.70E+01	1.31E+03

Periods of Calm (Hours): 1.00E+00

Hours of Invalid Data: 0.00E+00

10 Meter (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	3.00E+00	1.80E+01	5.80E+01	9.00E+00	0.00E+00	0.00E+00	8.80E+01
NNE	2.00E+00	1.80E+01	3.30E+01	8.00E+00	0.00E+00	0.00E+00	6.10E+01
NE	4.00E+00	3.10E+01	2.10E+01	1.20E+01	0.00E+00	0.00E+00	6.80E+01
ENE	4.00E+00	1.60E+01	8.00E+00	0.00E+00	0.00E+00	0.00E+00	2.80E+01
E	1.40E+01	4.50E+01	1.30E+01	0.00E+00	0.00E+00	0.00E+00	7.20E+01
ESE	8.00E+00	4.40E+01	6.00E+00	0.00E+00	0.00E+00	0.00E+00	5.80E+01
SE	1.10E+01	4.90E+01	2.50E+01	2.00E+00	0.00E+00	0.00E+00	8.70E+01
SSE	9.00E+00	8.00E+01	4.10E+01	3.00E+00	1.00E+00	0.00E+00	1.39E+02
S	8.00E+00	3.90E+01	4.80E+01	1.10E+01	2.00E+00	0.00E+00	1.08E+02
SSW	4.00E+00	2.60E+01	5.80E+01	1.80E+01	2.00E+00	0.00E+00	1.08E+02
SW	1.00E+00	1.80E+01	4.10E+01	2.00E+01	1.00E+00	1.00E+00	8.20E+01
WSW	3.00E+00	2.30E+01	2.30E+01	7.00E+00	1.00E+00	5.00E+00	6.20E+01
W	4.00E+00	2.20E+01	3.10E+01	3.10E+01	5.00E+00	2.00E+00	9.50E+01
WNW	1.00E+00	1.20E+01	3.90E+01	3.10E+01	1.90E+01	0.00E+00	1.02E+02
NW	2.00E+00	2.20E+01	3.40E+01	2.10E+01	1.00E+00	0.00E+00	8.00E+01
NNW	1.00E+00	1.10E+01	4.20E+01	1.80E+01	0.00E+00	0.00E+00	7.20E+01
Total	7.90E+01	4.74E+02	5.21E+02	1.96E+02	3.20E+01	8.00E+00	1.31E+03

Periods of Calm (Hours): 4.00E+00

Hours of Invalid Data: 0.00E+00

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

Data Period: January 1, 1997 - December 31, 1997

STABILITY CLASS B

60 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	1.00E+00	2.00E+00	1.90E+01	7.00E+00	0.00E+00	0.00E+00	2.90E+01
NNE	0.00E+00	4.00E+00	7.00E+00	3.00E+00	3.00E+00	0.00E+00	1.70E+01
NE	0.00E+00	5.00E+00	1.00E+00	4.00E+00	0.00E+00	0.00E+00	1.00E+01
ENE	4.00E+00	1.00E+00	5.00E+00	2.00E+00	1.00E+00	0.00E+00	1.30E+01
E	2.00E+00	3.00E+00	4.00E+00	3.00E+00	2.00E+00	0.00E+00	1.40E+01
ESE	2.00E+00	4.00E+00	0.00E+00	1.00E+00	0.00E+00	0.00E+00	7.00E+00
SE	5.00E+00	3.00E+00	4.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E+01
SSE	2.00E+00	3.00E+00	2.00E+00	0.00E+00	1.00E+00	0.00E+00	8.00E+00
S	6.00E+00	5.00E+00	6.00E+00	4.00E+00	3.00E+00	1.00E+00	2.50E+01
SSW	2.00E+00	2.00E+00	7.00E+00	9.00E+00	5.00E+00	3.00E+00	2.80E+01
SW	1.00E+00	4.00E+00	1.00E+01	9.00E+00	2.00E+00	1.00E+00	2.70E+01
WSW	2.00E+00	2.00E+00	9.00E+00	4.00E+00	4.00E+00	3.00E+00	2.40E+01
W	2.00E+00	7.00E+00	6.00E+00	9.00E+00	5.00E+00	2.00E+00	3.10E+01
WNW	2.00E+00	5.00E+00	9.00E+00	9.00E+00	5.00E+00	4.00E+00	3.40E+01
NW	0.00E+00	7.00E+00	1.20E+01	8.00E+00	4.00E+00	1.00E+00	3.20E+01
NNW	0.00E+00	7.00E+00	9.00E+00	8.00E+00	2.00E+00	0.00E+00	2.60E+01
Total	3.10E+01	6.40E+01	1.10E+02	8.00E+01	3.70E+01	1.50E+01	3.37E+02

Periods of Calm (Hours): 0.00E+00

Hours of Invalid Data: 0.00E+00

10 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	2.00E+00	3.00E+00	2.20E+01	6.00E+00	0.00E+00	0.00E+00	3.30E+01
NNE	1.00E+00	8.00E+00	7.00E+00	0.00E+00	0.00E+00	0.00E+00	1.60E+01
NE	0.00E+00	4.00E+00	3.00E+00	0.00E+00	0.00E+00	0.00E+00	7.00E+00
ENE	4.00E+00	7.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E+01
E	3.00E+00	5.00E+00	4.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E+01
ESE	2.00E+00	5.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00	8.00E+00
SE	3.00E+00	7.00E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	1.20E+01
SSE	5.00E+00	7.00E+00	6.00E+00	1.00E+00	0.00E+00	0.00E+00	1.90E+01
S	3.00E+00	9.00E+00	1.10E+01	2.00E+00	1.00E+00	0.00E+00	2.60E+01
SSW	1.00E+00	5.00E+00	7.00E+00	1.00E+01	3.00E+00	0.00E+00	2.60E+01
SW	4.00E+00	6.00E+00	6.00E+00	4.00E+00	0.00E+00	0.00E+00	2.00E+01
WSW	1.00E+00	7.00E+00	1.30E+01	4.00E+00	0.00E+00	2.00E+00	2.70E+01
W	3.00E+00	4.00E+00	1.60E+01	7.00E+00	2.00E+00	0.00E+00	3.20E+01
WNW	0.00E+00	6.00E+00	1.50E+01	8.00E+00	3.00E+00	4.00E+00	3.60E+01
NW	1.00E+00	1.10E+01	1.20E+01	4.00E+00	1.00E+00	0.00E+00	2.90E+01
NNW	0.00E+00	6.00E+00	1.00E+01	4.00E+00	0.00E+00	0.00E+00	2.00E+01
Total	3.30E+01	1.00E+02	1.35E+02	5.10E+01	1.00E+01	6.00E+00	3.35E+02

Periods of Calm (Hours): 2.00E+00

Hours of Invalid Data: 0.00E+00

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

Data Period: January 1, 1997 - December 31, 1997

STABILITY CLASS C

60 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	0.00E+00	1.10E+01	1.50E+01	9.00E+00	0.00E+00	0.00E+00	3.50E+01
NNE	2.00E+00	4.00E+00	9.00E+00	7.00E+00	2.00E+00	0.00E+00	2.40E+01
NE	5.00E+00	4.00E+00	3.00E+00	4.00E+00	0.00E+00	1.00E+00	1.70E+01
ENE	5.00E+00	6.00E+00	7.00E+00	1.00E+00	0.00E+00	2.00E+00	2.10E+01
E	2.00E+00	3.00E+00	2.00E+00	2.00E+00	1.00E+00	0.00E+00	1.00E+01
ESE	0.00E+00	9.00E+00	8.00E+00	1.00E+00	2.00E+00	0.00E+00	2.00E+01
SE	4.00E+00	4.00E+00	3.00E+00	0.00E+00	2.00E+00	2.00E+00	1.50E+01
SSE	5.00E+00	3.00E+00	4.00E+00	1.00E+00	0.00E+00	0.00E+00	1.30E+01
S	2.00E+00	2.00E+00	6.00E+00	3.00E+00	6.00E+00	3.00E+00	2.20E+01
SSW	0.00E+00	4.00E+00	9.00E+00	1.20E+01	3.00E+00	3.00E+00	3.10E+01
SW	1.00E+00	2.00E+00	6.00E+00	1.20E+01	1.00E+00	0.00E+00	2.20E+01
WSW	1.00E+00	4.00E+00	1.00E+01	7.00E+00	4.00E+00	1.00E+00	2.70E+01
W	2.00E+00	6.00E+00	1.40E+01	1.00E+01	7.00E+00	7.00E+00	4.60E+01
WNW	0.00E+00	2.00E+00	8.00E+00	7.00E+00	5.00E+00	5.00E+00	2.70E+01
NW	2.00E+00	8.00E+00	7.00E+00	4.00E+00	4.00E+00	2.00E+00	2.70E+01
NNW	1.00E+00	7.00E+00	8.00E+00	7.00E+00	0.00E+00	0.00E+00	2.30E+01
Total	3.20E+01	7.90E+01	1.19E+02	8.70E+01	3.70E+01	2.60E+01	3.80E+02

Periods of Calm (Hours): 1.00E+00

Hours of Invalid Data: 0.00E+00

10 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	1.00E+00	8.00E+00	1.90E+01	3.00E+00	0.00E+00	0.00E+00	3.10E+01
NNE	2.00E+00	9.00E+00	9.00E+00	3.00E+00	0.00E+00	0.00E+00	2.30E+01
NE	6.00E+00	7.00E+00	3.00E+00	2.00E+00	0.00E+00	0.00E+00	1.80E+01
ENE	6.00E+00	8.00E+00	3.00E+00	0.00E+00	0.00E+00	0.00E+00	1.70E+01
E	5.00E+00	9.00E+00	3.00E+00	0.00E+00	0.00E+00	0.00E+00	1.70E+01
ESE	1.00E+00	7.00E+00	7.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E+01
SE	3.00E+00	5.00E+00	9.00E+00	1.00E+00	0.00E+00	0.00E+00	1.80E+01
SSE	3.00E+00	4.00E+00	6.00E+00	2.00E+00	0.00E+00	0.00E+00	1.50E+01
S	2.00E+00	1.30E+01	1.20E+01	5.00E+00	1.00E+00	0.00E+00	3.30E+01
SSW	3.00E+00	3.00E+00	1.40E+01	9.00E+00	1.00E+00	0.00E+00	3.00E+01
SW	0.00E+00	4.00E+00	1.10E+01	2.00E+00	0.00E+00	0.00E+00	1.70E+01
WSW	2.00E+00	5.00E+00	9.00E+00	6.00E+00	0.00E+00	0.00E+00	2.20E+01
W	2.00E+00	5.00E+00	2.10E+01	9.00E+00	7.00E+00	1.00E+00	4.50E+01
WNW	0.00E+00	5.00E+00	1.00E+01	6.00E+00	2.00E+00	3.00E+00	2.60E+01
NW	3.00E+00	1.10E+01	1.10E+01	3.00E+00	2.00E+00	0.00E+00	3.00E+01
NNW	3.00E+00	7.00E+00	1.10E+01	2.00E+00	0.00E+00	0.00E+00	2.30E+01
Total	4.20E+01	1.10E+02	1.58E+02	5.30E+01	1.30E+01	4.00E+00	3.80E+02

Periods of Calm (Hours): 1.00E+00

Hours of Invalid Data: 0.00E+00

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

Data Period: January 1, 1997 - December 31, 1997

STABILITY CLASS D

60 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	7.00E+00	3.30E+01	1.05E+02	6.50E+01	1.10E+01	5.00E+00	2.26E+02
NNE	7.00E+00	3.00E+01	5.80E+01	6.00E+01	2.90E+01	2.50E+01	2.09E+02
NE	4.00E+00	2.30E+01	3.40E+01	7.20E+01	5.60E+01	1.90E+01	2.08E+02
ENE	1.40E+01	2.00E+01	3.60E+01	6.40E+01	4.30E+01	3.00E+01	2.07E+02
E	1.00E+01	4.30E+01	5.00E+01	2.40E+01	1.60E+01	1.00E+00	1.44E+02
ESE	9.00E+00	5.40E+01	4.00E+01	5.00E+00	0.00E+00	0.00E+00	1.08E+02
SE	3.00E+00	2.20E+01	1.30E+01	1.50E+01	2.00E+00	3.00E+00	5.80E+01
SSE	4.00E+00	1.80E+01	3.90E+01	3.90E+01	1.90E+01	1.00E+01	1.29E+02
S	3.00E+00	1.10E+01	4.00E+01	6.20E+01	2.60E+01	1.70E+01	1.59E+02
SSW	4.00E+00	2.20E+01	2.80E+01	8.10E+01	2.50E+01	1.20E+01	1.72E+02
SW	6.00E+00	2.80E+01	3.20E+01	2.70E+01	1.30E+01	9.00E+00	1.15E+02
WSW	1.30E+01	2.80E+01	6.40E+01	3.30E+01	2.80E+01	1.40E+01	1.80E+02
W	9.00E+00	1.70E+01	5.50E+01	9.90E+01	5.10E+01	5.70E+01	2.88E+02
WNW	5.00E+00	2.00E+01	6.80E+01	1.05E+02	5.10E+01	2.20E+01	2.71E+02
NW	5.00E+00	3.40E+01	5.40E+01	6.90E+01	4.90E+01	6.00E+00	2.17E+02
NNW	1.10E+01	3.90E+01	5.70E+01	5.60E+01	1.30E+01	1.00E+01	1.86E+02
Total	1.14E+01	4.42E+02	7.73E+02	8.76E+02	4.32E+02	2.40E+02	2.88E+03

Periods of Calm (Hours): 5.00E+00

Hours of Invalid Data: 0.00E+00

10 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	1.50E+01	7.30E+01	1.21E+02	4.30E+01	1.20E+01	0.00E+00	2.64E+02
NNE	1.70E+01	6.10E+01	9.60E+01	3.60E+01	4.00E+00	0.00E+00	2.14E+02
NE	1.40E+01	4.00E+01	6.80E+01	4.20E+01	1.00E+00	0.00E+00	1.65E+02
ENE	2.50E+01	6.40E+01	7.10E+01	1.40E+01	1.00E+00	0.00E+00	1.75E+02
E	2.30E+01	6.70E+01	2.30E+01	0.00E+00	0.00E+00	0.00E+00	1.13E+02
ESE	1.50E+01	8.10E+01	7.00E+00	1.00E+00	0.00E+00	0.00E+00	1.04E+02
SE	5.00E+00	3.50E+01	2.00E+01	1.00E+01	0.00E+00	0.00E+00	7.00E+01
SSE	9.00E+00	7.00E+01	9.20E+01	1.80E+01	1.00E+00	1.00E+00	1.91E+02
S	8.00E+00	4.20E+01	7.10E+01	3.00E+01	7.00E+00	1.00E+00	1.59E+02
SSW	1.00E+01	3.40E+01	6.00E+01	3.40E+01	4.00E+00	0.00E+00	1.42E+02
SW	1.10E+01	3.50E+01	3.80E+01	1.00E+01	2.00E+00	1.00E+00	9.70E+01
WSW	2.30E+01	4.90E+01	7.80E+01	3.60E+01	3.00E+00	4.00E+00	1.93E+02
W	9.00E+00	5.00E+01	1.13E+02	8.90E+01	4.10E+01	1.00E+01	3.12E+02
WNW	7.00E+00	5.30E+01	1.17E+02	1.06E+02	2.40E+01	9.00E+00	3.16E+02
NW	8.00E+00	5.30E+01	5.20E+01	5.70E+01	6.00E+00	0.00E+00	1.76E+02
NNW	1.30E+01	6.20E+01	8.40E+01	2.50E+01	2.00E+00	0.00E+00	1.86E+02
Total	2.12E+02	8.69E+02	1.11E+03	5.51E+02	1.08E+02	2.60E+01	2.88E+03

Periods of Calm (Hours): 5.00E+00

Hours of Invalid Data: 0.00E+00

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

Data Period: January 1, 1997 - December 31, 1997

STABILITY CLASS E

60 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	1.00E+01	1.50E+01	5.40E+01	4.00E+01	1.00E+00	0.00E+00	1.20E+02
NNE	2.00E+00	1.30E+01	2.40E+01	6.00E+01	1.90E+01	1.00E+00	1.19E+02
NE	6.00E+00	1.50E+01	4.60E+01	5.00E+01	4.00E+00	0.00E+00	1.21E+02
ENE	2.00E+00	1.50E+01	2.50E+01	4.20E+01	1.60E+01	0.00E+00	1.00E+02
E	1.20E+01	1.40E+01	2.90E+01	2.60E+01	0.00E+00	0.00E+00	8.10E+01
ESE	1.10E+01	2.90E+01	3.20E+01	1.60E+01	1.00E+00	2.00E+00	9.10E+01
SE	6.00E+00	3.50E+01	3.10E+01	3.00E+01	1.10E+01	4.00E+00	1.17E+02
SSE	3.00E+00	1.90E+01	6.10E+01	6.40E+01	2.00E+01	1.10E+01	1.78E+02
S	4.00E+00	1.40E+01	4.20E+01	1.02E+02	4.90E+01	4.20E+01	2.53E+02
SSW	4.00E+00	1.10E+01	3.50E+01	1.37E+02	6.20E+01	2.90E+01	2.78E+02
SW	4.00E+00	9.00E+00	5.20E+01	7.80E+01	1.70E+01	1.00E+00	1.61E+02
WSW	3.00E+00	1.70E+01	3.40E+01	3.10E+01	1.10E+01	1.00E+00	9.70E+01
W	3.00E+00	1.90E+01	2.10E+01	3.30E+01	2.90E+01	1.70E+01	1.22E+02
WNW	1.00E+00	1.10E+01	3.20E+01	4.40E+01	1.40E+01	3.00E+00	1.05E+02
NW	5.00E+00	2.70E+01	4.50E+01	2.00E+01	1.00E+00	0.00E+00	9.80E+01
NNW	3.00E+00	2.50E+01	4.40E+01	1.20E+01	3.00E+00	2.00E+00	8.90E+01
Total	7.90E+01	2.88E+02	6.07E+02	7.85E+02	2.58E+02	1.13E+02	2.13E+03

Periods of Calm (Hours): 5.00E+00

Hours of Invalid Data: 0.00E+00

10 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	1.60E+01	8.60E+01	4.50E+01	8.00E+00	0.00E+00	0.00E+00	1.55E+02
NNE	1.70E+01	2.10E+01	3.60E+01	0.00E+00	0.00E+00	0.00E+00	7.40E+01
NE	2.40E+01	6.50E+01	1.50E+01	1.00E+00	0.00E+00	0.00E+00	1.05E+02
ENE	2.60E+01	5.60E+01	1.00E+01	0.00E+00	0.00E+00	0.00E+00	9.20E+01
E	2.80E+01	6.50E+01	3.00E+00	0.00E+00	0.00E+00	0.00E+00	9.60E+01
ESE	4.70E+01	6.90E+01	1.00E+01	1.00E+00	0.00E+00	0.00E+00	1.27E+02
SE	2.80E+01	8.70E+01	3.50E+01	6.00E+00	0.00E+00	0.00E+00	1.56E+02
SSE	2.10E+01	1.14E+02	6.90E+01	1.30E+01	0.00E+00	0.00E+00	2.17E+02
S	1.90E+01	5.90E+01	1.02E+02	5.10E+01	3.00E+00	0.00E+00	2.34E+02
SSW	8.00E+00	4.60E+01	1.11E+02	5.40E+01	1.00E+00	0.00E+00	2.20E+02
SW	1.20E+01	7.00E+01	3.40E+01	7.00E+00	0.00E+00	0.00E+00	1.23E+02
WSW	1.40E+01	3.00E+01	4.80E+01	1.20E+01	0.00E+00	0.00E+00	1.04E+02
W	1.60E+01	3.10E+01	3.70E+01	4.10E+01	1.00E+00	0.00E+00	1.26E+02
WNW	1.50E+01	4.30E+01	4.20E+01	7.00E+00	0.00E+00	0.00E+00	1.07E+02
NW	1.80E+01	5.70E+01	1.50E+01	1.00E+00	0.00E+00	0.00E+00	9.10E+01
NNW	1.40E+01	5.90E+01	2.30E+01	2.00E+00	0.00E+00	0.00E+00	9.80E+01
Total	3.23E+02	9.58E+02	6.35E+02	2.04E+02	5.00E+00	0.00E+00	2.13E+03

Periods of Calm (Hours): 1.00E+01

Hours of Invalid Data: 0.00E+00

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

Data Period: January 1, 1997 - December 31, 1997

STABILITY CLASS F

60 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	2.00E+00	1.10E+01	1.10E+01	8.00E+00	0.00E+00	0.00E+00	3.20E+01
NNE	1.00E+00	4.00E+00	1.00E+01	1.60E+01	0.00E+00	0.00E+00	3.10E+01
NE	3.00E+00	0.00E+00	3.20E+01	2.70E+01	2.00E+00	0.00E+00	6.40E+01
ENE	1.00E+00	1.00E+00	2.20E+01	1.10E+01	0.00E+00	0.00E+00	3.50E+01
E	3.00E+00	1.20E+01	1.90E+01	1.80E+01	3.00E+00	0.00E+00	5.50E+01
ESE	4.00E+00	2.40E+01	1.30E+01	5.00E+00	0.00E+00	0.00E+00	4.60E+01
SE	2.00E+00	1.50E+01	1.70E+01	1.00E+01	2.00E+00	0.00E+00	4.60E+01
SSE	0.00E+00	4.00E+00	2.10E+01	1.20E+01	0.00E+00	0.00E+00	3.70E+01
S	0.00E+00	2.00E+00	3.20E+01	4.90E+01	1.00E+00	0.00E+00	8.40E+01
SSW	1.00E+00	9.00E+00	1.60E+01	5.20E+01	7.00E+00	0.00E+00	8.50E+01
SW	1.00E+00	6.00E+00	1.80E+01	4.60E+01	3.00E+00	0.00E+00	7.40E+01
WSW	4.00E+00	5.00E+00	1.40E+01	1.90E+01	9.00E+00	0.00E+00	5.10E+01
W	3.00E+00	7.00E+00	2.10E+01	5.00E+00	0.00E+00	0.00E+00	3.60E+01
WNW	4.00E+00	8.00E+00	1.40E+01	5.00E+00	1.00E+00	0.00E+00	3.20E+01
NW	2.00E+00	8.00E+00	1.40E+01	7.00E+00	0.00E+00	0.00E+00	3.10E+01
NNW	3.00E+00	1.10E+01	1.80E+01	9.00E+00	0.00E+00	0.00E+00	4.10E+01
Total	3.40E+01	1.27E+02	2.92E+02	2.99E+02	2.80E+01	0.00E+00	7.80E+02

Periods of Calm (Hours): 2.00E+00

Hours of Invalid Data: 0.00E+00

10 METER (All tabled values are hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	1.60E+01	2.30E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.90E+01
NNE	1.10E+01	2.30E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.40E+01
NE	3.00E+01	5.20E+01	1.00E+00	0.00E+00	0.00E+00	0.00E+00	8.30E+01
ENE	2.80E+01	1.30E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.10E+01
E	2.10E+01	2.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.60E+01
ESE	2.50E+01	3.70E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E+01
SE	2.70E+01	3.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.90E+01
SSE	1.10E+01	3.60E+01	4.00E+00	0.00E+00	0.00E+00	0.00E+00	5.10E+01
S	1.00E+01	4.20E+01	4.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E+01
SSW	8.00E+00	5.40E+01	1.50E+01	0.00E+00	0.00E+00	0.00E+00	7.70E+01
SW	1.00E+01	3.70E+01	7.00E+00	0.00E+00	0.00E+00	0.00E+00	5.40E+01
WSW	2.30E+01	1.90E+01	1.30E+01	0.00E+00	0.00E+00	0.00E+00	5.50E+01
W	1.20E+01	1.50E+01	1.00E+00	0.00E+00	0.00E+00	0.00E+00	2.80E+01
WNW	1.00E+01	1.30E+01	4.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E+01
NW	7.00E+00	2.60E+01	1.00E+00	0.00E+00	0.00E+00	0.00E+00	3.40E+01
NNW	1.10E+01	1.90E+01	2.00E+00	0.00E+00	0.00E+00	0.00E+00	3.20E+01
Total	2.60E+02	4.66E+02	5.20E+01	0.00E+00	0.00E+00	0.00E+00	7.78E+02

Periods of Calm (Hours): 4.00E+00

Hours of Invalid Data: 0.00E+00

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

Data Period: January 1, 1997 - December 31, 1997

STABILITY CLASS G

60 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	6.00E+00	7.00E+00	4.00E+00	3.00E+00	0.00E+00	0.00E+00	2.00E+01
NNE	4.00E+00	5.00E+00	4.00E+00	3.00E+00	0.00E+00	0.00E+00	1.60E+01
NE	2.00E+00	7.00E+00	1.10E+01	2.00E+01	1.00E+00	0.00E+00	4.10E+01
ENE	2.00E+00	1.10E+01	1.30E+01	8.00E+00	0.00E+00	0.00E+00	3.40E+01
E	0.00E+00	1.00E+01	1.50E+01	6.00E+00	2.00E+00	0.00E+00	3.30E+01
ESE	3.00E+00	2.10E+01	9.00E+00	1.00E+00	0.00E+00	0.00E+00	3.40E+01
SE	2.00E+00	3.00E+00	1.00E+00	5.00E+00	0.00E+00	0.00E+00	1.10E+01
SSE	1.00E+00	6.00E+00	8.00E+00	8.00E+00	0.00E+00	0.00E+00	2.30E+01
S	0.00E+00	3.00E+00	1.10E+01	1.30E+01	0.00E+00	0.00E+00	2.70E+01
SSW	0.00E+00	1.00E+00	1.90E+01	8.00E+00	2.00E+00	0.00E+00	3.00E+01
SW	0.00E+00	1.00E+00	1.10E+01	6.00E+00	1.00E+00	0.00E+00	1.90E+01
WSW	0.00E+00	5.00E+00	7.00E+00	3.00E+00	0.00E+00	0.00E+00	1.50E+01
W	2.00E+00	4.00E+00	7.00E+00	2.00E+00	0.00E+00	0.00E+00	1.50E+01
WNW	1.00E+00	0.00E+00	4.00E+00	0.00E+00	0.00E+00	0.00E+00	5.00E+00
NW	2.00E+00	1.00E+01	6.00E+00	1.00E+00	0.00E+00	0.00E+00	1.90E+01
NNW	4.00E+00	4.00E+00	1.00E+01	4.00E+00	0.00E+00	0.00E+00	2.20E+01
Total	2.90E+01	9.80E+01	1.40E+02	9.10E+01	6.00E+00	0.00E+00	3.64E+02

Periods of Calm (Hours): 3.00E+00

Hours of Invalid Data: 0.00E+00

10 METER (All tabled values are Hours)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	1.70E+01	1.70E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.40E+01
NNE	2.00E+01	1.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E+01
NE	3.10E+01	1.90E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.00E+01
ENE	1.90E+01	4.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E+01
E	1.20E+01	8.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E+01
ESE	1.40E+01	2.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.60E+01
SE	1.40E+01	1.70E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.10E+01
SSE	1.30E+01	2.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.30E+01
S	1.10E+01	9.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E+01
SSW	1.60E+01	7.00E+00	2.00E+00	0.00E+00	0.00E+00	0.00E+00	2.50E+01
SW	8.00E+00	4.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E+01
WSW	5.00E+00	4.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.00E+00
W	7.00E+00	3.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+01
WNW	3.00E+00	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.00E+00
NW	1.40E+01	1.10E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.50E+01
NNW	1.20E+01	5.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.70E+01
Total	2.16E+02	1.45E+02	2.00E+00	0.00E+00	0.00E+00	0.00E+00	3.63E+02

Periods of Calm (Hours): 4.00E+00

Hours of Invalid Data: 0.00E+00

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

Data Period: January 1, 1997 - December 31, 1997

ALL STABILITY CLASSES

60 METER (All tabled values are Percents)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	2.97E-01	1.00E+00	2.92E+00	1.71E+00	1.37E-01	5.71E-02	6.13E+00
NNE	1.94E-01	7.53E-01	1.51E+00	2.04E+00	6.96E-01	2.97E-01	5.49E+00
NE	2.51E-01	8.33E-01	1.61E+00	2.19E+00	7.99E-01	2.63E-01	5.95E+00
ENE	3.31E-01	8.90E-01	1.47E+00	1.66E+00	7.31E-01	4.00E-01	5.48E+00
E	4.11E-01	1.22E+00	1.76E+00	1.00E+00	2.85E-01	2.28E-02	4.70E+00
ESE	4.11E-01	1.79E+00	1.19E+00	3.31E-01	3.42E-02	3.42E-02	3.79E+00
SE	4.45E-01	1.23E+00	9.36E-01	7.42E-01	1.94E-01	1.37E-01	3.69E+00
SSE	2.40E-01	8.68E-01	1.85E+00	1.50E+00	4.79E-01	2.74E-01	5.21E+00
S	2.51E-01	8.33E-01	2.10E+00	2.96E+00	1.11E+00	7.53E-01	8.00E+00
SSW	1.83E-01	1.16E+00	1.83E+00	3.86E+00	1.31E+00	5.48E-01	8.89E+00
SW	1.71E-01	8.11E-01	1.84E+00	2.41E+00	5.37E-01	1.60E-01	5.92E+00
WSW	3.20E-01	9.93E-01	1.91E+00	1.26E+00	6.62E-01	3.20E-01	5.46E+00
W	2.51E-01	7.99E-01	1.66E+00	2.07E+00	1.29E+00	9.82E-01	7.04E+00
WNW	1.49E-01	6.62E-01	1.78E+00	2.36E+00	1.08E+00	4.68E-01	6.51E+00
NW	1.94E-01	1.27E+00	1.86E+00	1.70E+00	7.65E-01	1.83E-01	5.97E+00
NNW	2.51E-01	1.19E+00	1.95E+00	1.42E+00	2.17E-01	1.37E-01	5.16E+00
Total	4.35E+00	1.63E+01	2.82E+01	2.92E+01	1.03E+01	5.03E+00	9.34E+01

Periods of Calm (Hours): 17

Hours of Invalid Data: 0

Hours of Good Data: 8.198E+03 94.2% of Total Hours

10 METER (All tabled values are Percents)

SECTOR	1-3 mph	4-7 mph	8-12 mph	13-18 mph	19-24 mph	>24 mph	TOTAL
N	7.99E-01	2.60E+00	3.03E+00	7.88E-01	1.37E-01	0.00E+00	7.35E+00
NNE	7.99E-01	1.71E+00	2.07E+00	5.37E-01	4.57E-02	0.00E+00	5.16E+00
NE	1.24E+00	2.49E+00	1.27E+00	6.51E-01	1.14E-02	0.00E+00	5.66E+00
ENE	1.28E+00	1.92E+00	1.06E+00	1.60E-01	1.14E-02	0.00E+00	4.43E+00
E	1.21E+00	2.56E+00	5.25E-01	0.00E+00	0.00E+00	0.00E+00	4.29E+00
ESE	1.28E+00	2.80E+00	3.54E-01	2.28E-02	0.00E+00	0.00E+00	4.45E+00
SE	1.04E+00	2.65E+00	1.03E+00	2.28E-01	0.00E+00	0.00E+00	4.94E+00
SSE	8.11E-01	3.78E+00	2.49E+00	4.79E-01	2.28E-02	1.14E-02	7.59E+00
S	6.96E-01	2.43E+00	2.83E+00	1.13E+00	1.60E-01	1.14E-02	7.26E+00
SSW	5.71E-01	2.00E+00	3.05E+00	1.43E+00	1.26E-01	0.00E+00	7.17E+00
SW	5.25E-01	1.99E+00	1.56E+00	4.91E-01	3.42E-02	2.28E-02	4.62E+00
WSW	8.11E-01	1.56E+00	2.10E+00	7.42E-01	4.57E-02	1.26E-01	5.39E+00
W	6.05E-01	1.48E+00	2.50E+00	2.02E+00	6.39E-01	1.48E-01	7.40E+00
WNW	4.11E-01	1.56E+00	2.59E+00	1.80E+00	5.48E-01	1.83E-01	7.10E+00
NW	6.05E-01	2.18E+00	1.43E+00	9.82E-01	1.14E-01	0.00E+00	5.31E+00
NNW	6.16E-01	1.93E+00	1.96E+00	5.82E-01	2.28E-02	0.00E+00	5.11E+00
Total	1.33E+01	3.56E+01	2.98E+01	1.20E+01	1.92E+00	5.02E-01	9.32E+01

Periods of Calm (Hours): 30

Hours of Invalid Data: 0

Hours of Good Data: 8.198E+03 = 94.2% of Total Hours

SECTION 6
DOSE MEASUREMENTS AND ASSESSMENTS

TABLE 11
MAXIMUM* OFFSITE DOSES AND DOSE COMMITMENTS
TO MEMBERS OF THE PUBLIC
Data Period: January 1, 1997 - December 31, 1997

A.	Waterborne Effluents(mRem):		
		Organ	0.00E-00
		Total Body	0.00E-00
B.	Airborne Effluents:		
	1. Iodines and particulates (mRem):		
		Organ	1.18E-03[1]
		Total Body	7.44E-03[1]
	2. Noble Gases (mrad):		
		Gamma	0.00E+00[2]
		Beta	0.00E+00[2]
C.	Direct Radiation (mRem):		
			0.00E+00

THERE ARE NO OTHER URANIUM FUEL CYCLE FACILITIES WITHIN 8 KM OF CPS

* "Maximum" means the largest fraction of the corresponding Appendix I dose design objective.

1 Organ dose is to the Adult Gastrointestinal System via the inhalation, ground plane, meat and vegetation pathways. Total Body dose is to the Child Gastrointestinal System via the inhalation, ground plane, meat and vegetation pathways. Noble gas total body doses also added to organ dose. Calculated at 1.50 km in the North direction using the methodology contained in the CPS ODCM.

2 Dose to total body and skin of all occupants regardless of age. Calculated at 1.50 km in the North direction using the methodology contained in the CPS ODCM.

DOSES TO MEMBERS OF THE PUBLIC WITHIN THE SITE BOUNDARY

CPS Offsite Dose Calculation Manual section 7.2 requires that the Radioactive Effluent Release Report include an assessment of the radiation doses from radioactive liquids and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY. Within the CPS site boundary there are seven areas which are open to members of the public as identified by CPS ODCM Table 3.4-4 (see Figure 4):

- The Department of Natural Resources Recreation Area at 1.287 kilometers (0.8 miles) in the ESE sector
- A road at 0.495 kilometers (0.3 miles) in the SE sector
- A residence at 2.736 kilometers (1.7 miles) in the SSE sector
- A residence at 1.219 kilometers (0.8 miles) in the SW sector
- Agricultural acreage at 1.372 kilometers (0.9 miles) in the SSW sector
- A residence at 2.414 kilometers (1.5 miles) in the WSW sector
- A portion of Clinton Lake at 0.335 kilometers (0.2 miles) in the NW sector

At all of the above locations, the plume, inhalation and ground-plane exposure pathways are used for dose calculations. No other exposure pathways were identified by the 1997 Annual Land Use Census. All dose calculations were performed using the methodology contained in the CPS ODCM.

FIGURE 4

AREAS WITHIN THE CPS SITE BOUNDARY OPEN
TO MEMBERS OF THE PUBLIC

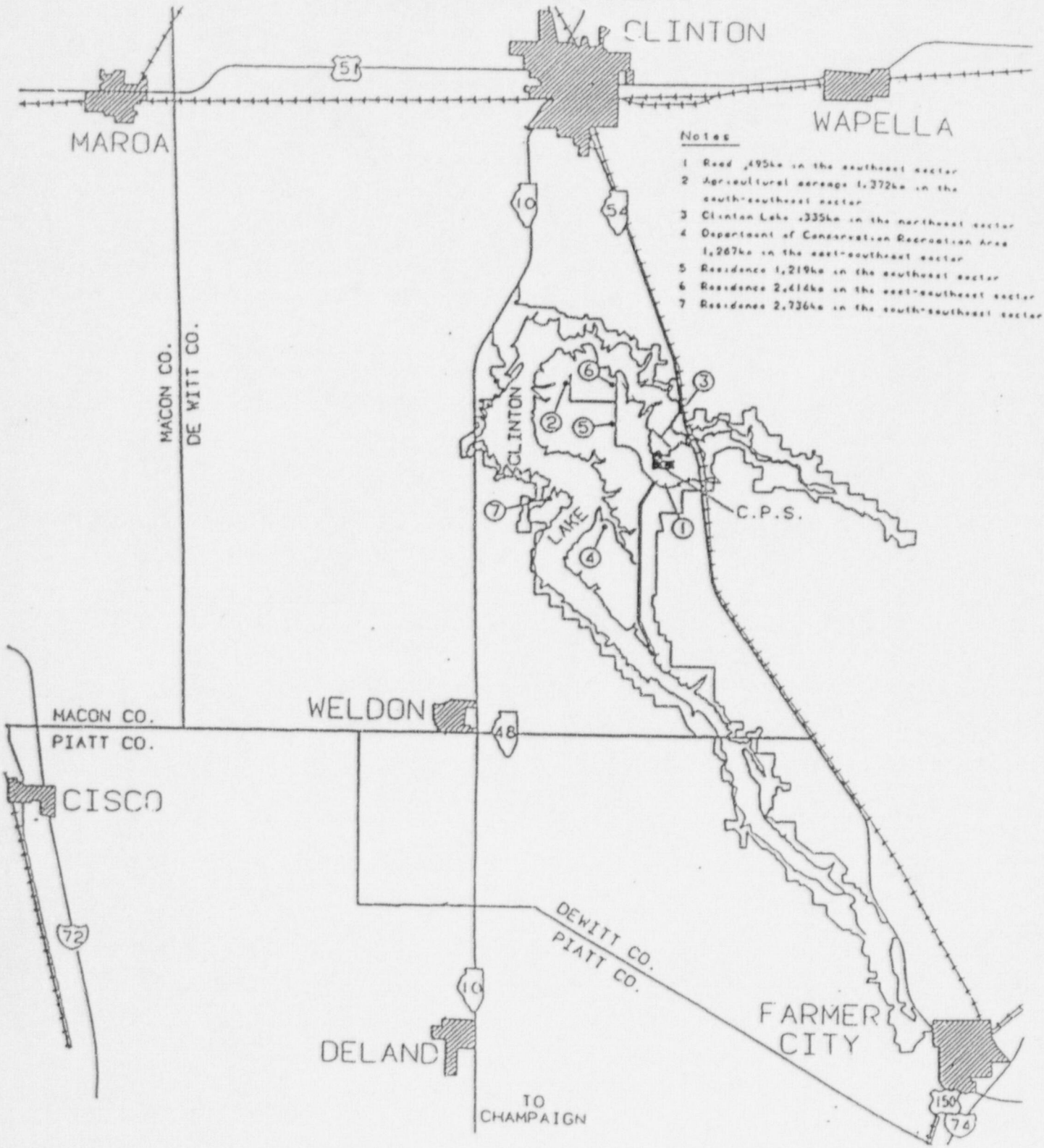


TABLE 12

CALCULATED DOSES TO MEMBERS OF THE PUBLIC
DURING USE OF THE DEPARTMENT OF NATURAL RESOURCES
RECREATION AREA IN THE EAST-SOUTHEAST SECTOR
WITHIN THE CPS SITE BOUNDARY
Data Period: January 1, 1997 - December 31, 1997

Exposure Pathway	Organs	Dose (mRem)
plume*	total body	0.00E+00
	skin	0.00E+00
ground plane*	total body	2.53E-05
	skin	2.98E-05
inhalation; age group highest organ doses:		
	teen lung	7.62E-07
	adult lung	6.71E-06
	child lung	6.09E-06
	infant lung	3.54E-06

* Doses via these pathways are not dependent upon age-group.

TABLE 13

CALCULATED DOSES TO MEMBERS OF THE PUBLIC DURING
USE OF THE ROAD IN THE SOUTHEAST SECTOR
WITHIN THE CPS SITE BOUNDARY
Data Period: January 1, 1997 - December 31, 1997

Exposure Pathway	Organs	Dose (mRem)
plume*	total body	0.00E+00
	skin	0.00E+00
ground plane*	total body	5.10E-06
	skin	6.00E-06
inhalation; age group highest organ doses:		
	teen lung	1.59E-06
	adult lung	1.55E-06
	child lung	1.40E-06
	infant lung	8.10E-07

* Doses via these pathways are not dependent upon age-group.

TABLE 14

CALCULATED DOSES FOR THE RESIDENTS
IN THE SOUTH-SOUTHEAST SECTOR WITHIN
THE CPS SITE BOUNDARY
Data Period: January 1, 1997 - December 31, 1997

Exposure Pathway	Organs	Dose (mRem)
plume*	total body	0.00E+00
	skin	0.00E+00
ground plane*	total body	1.67E-05
	skin	1.97E-05
inhalation; age group highest organ doses: (1)		
	adult lung	8.77E-06
	teen lung	0.00E+00
	child lung	0.00E+00
	infant lung	0.00E+00

* Doses via these pathways are not dependent upon age-group.

(1) A value of 0.00E+00 indicates that no individual of this age group resides at this receptor location.

TABLE 15

CALCULATED DOSES FOR THE RESIDENTS
IN THE SOUTHWEST SECTOR WITHIN
THE CPS SITE BOUNDARY
Data Period: January 1, 1997 - December 31, 1997

Exposure Pathway	Organs	Dose (mRem)
plume*	total body	0.00E+00
	skin	0.00E+00
ground plane*	total body	6.86E-05
	skin	8.07E-05
inhalation; age group highest organ doses: (1)		
	adult lung	4.09E-05
	teen lung	0.00E+00
	child lung	0.00E+00
	infant lung	0.00E+00

* Doses via these pathways are not dependent upon age-group.

(1) A value of 0.00E+00 indicates that no individual of this age group resides at this receptor location.

TABLE 16

CALCULATED DOSES TO MEMBERS OF THE PUBLIC
DURING USE OF THE AGRICULTURAL ACREAGE
IN THE SOUTH-SOUTHWEST SECTOR WITHIN
THE CPS SITE BOUNDARY
Data Period: January 1, 1997 - December 31, 1997

Exposure Pathway	Organs	Dose (mRem)
plume*	total body	0.00E+00
	skin	0.00E+00
ground plane*	total body	6.30E-06
	skin	7.41E-06
inhalation; age group highest organ doses:		
	teen lung	3.03E-06
	adult lung	2.93E-06
	child lung	2.67E-06
	infant lung	1.55E-06

* Doses via these pathways are not dependent upon age-group.

TABLE 17

CALCULATED DOSES FOR THE RESIDENTS
IN THE WEST-SOUTHWEST SECTOR WITHIN
THE CPS SITE BOUNDARY
Data Period: January 1, 1997 - December 31, 1997

Exposure Pathway	Organs	Dose (mRem)
plume*	total body	0.00E+00
	skin	0.00E+00
ground plane*	total body	1.98E-05
	skin	2.33E-05
inhalation; age group highest organ doses (1):		
	adult lung	1.14E-05
	teen lung	0.00E+00
	child lung	0.00E+00
	infant lung	0.00E+00

* Doses via these pathways are not dependent upon age-group.

(1) A value of 0.00E+00 indicates that no individual of this age group resides at this receptor location.

TABLE 18

CALCULATED DOSES TO MEMBERS OF THE PUBLIC
DURING USE OF CLINTON LAKE IN THE
NORTHWEST SECTOR WITHIN THE CPS
SITE BOUNDARY
Data Period: January 1, 1997 - December 31, 1997

Exposure Pathway	Organs	Dose (mRem)
plume*	total body	0.00E+00
	skin	0.00E+00
ground plane*	total body	5.55E-05
	skin	6.53E-05
inhalation; age group highest organ doses:		
	teen lung	7.11E-05
	adult lung	6.89E-05
	child lung	6.26E-05
	infant lung	3.63E-05

* Doses via these pathways are not dependent upon age-group.

SECTION 7
CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL

Changes to the Offsite Dose Calculation Manual are included as separate attachments.

SECTION 8
ODCM OPERATIONAL REQUIREMENT REPORTS

In accordance with ODCM sections 2.7.1 and 3.9.2 inoperable radioactive liquid and gaseous effluent monitoring instrumentation channels remaining in an inoperable condition for greater than 30 days shall be reported in the Radioactive Effluent Release Report.

During 1997, there were 2 instances of radioactive liquid effluent instrumentation channels being inoperable for more than 30 days. These instances are documented on the following pages.

1RIX-PR037 Component Cooling Water

1RIX-PR037 Component Cooling Water (CCW) Process Radiation Monitor was inoperable from 8/18/97 at 0005 to 9/17/97 at 2100. Below is a description of the related events, the root cause and the corrective actions to prevent recurrence.

Chronology

- On August 6, 1997 revision 15 of the ODCM is made effective. This revision places 1RIX-PR037 CCW Process Radiation Monitor into the ODCM as part of the corrective action to Condition Report (CR) 1-96-10-260.

- On August 17, 1997 1RIX-PR037 is calibrated by C&I under Preventative Maintenance Task PCIPRM237 in accordance with CPS No. 8640.06. However, since 1RIX-PR037 is now an ODCM-required monitor, the calibration should have been performed in accordance with CPS No. 9437.62 which is used to calibrate ODCM liquid effluent radiation monitors. CPS No. 9437.62 does not currently address 1RIX-PR037 and requires revision to incorporate it. An additional MWR (D73927) exists for a chattering relay. The System Manager asks if the C&I crew fixed the relay at the same time the calibrated the monitor. They did not. The monitor is maintained inoperable.

- CR 1-97-08-156 is written identifying procedures (CPS Nos. 9911.24, 9911.11, and 8640.06) which are not revised to support the ODCM change. The immediate action for this CR was to declare 1RIX-PR037 inoperable. ODCM Operational requirement (OOR) 97-048 is entered on August 18, 1997 at 0005 in accordance with CPS No. 1909.22

- On August 19, 1997, MWR D73927 to replace chattering relay is approved for work.

- The chattering relay is replaced under MWR D73927 on September 2, 1997.

- An Engineering Evaluation is written by the System Engineer describing the above situation and concludes that the calibration data obtained under CPS No. 8640.06 should be transferred to CPS No. 9437.62 "Liquid Process Radiation Monitor 1RIX-PR004 (5, 36, 38, 39) Calibration" and 1RIX-PR037 declared operable. The logic used was that the calibration methodology and the acceptance criteria for both procedures are exactly the same. This argument is rejected by the Shift Supervisor, The Assistant Plant Manager-Operations, and the Assistant Director-Operations.

- The System Engineer submits a "scope add" request to re-perform the calibration using the revised CPS No. 9437.62 procedure.

- The scope add request is disapproved by the Outage Scope Committee meeting on September 9, 1997.

- The System Engineer speaks directly to the Director-Planning and Scheduling and the work is added to the outage scope.

- On September 10, 1997, a revision to CPS No. 9437.62 is approved which allows calibration of 1RIX-PR037 under the appropriate procedure.

- CR 1-97-09-181 is written identifying the failure to restore 1RIX-PR037 to operable status within 30 days.

- The calibration of 1RIX-PR037 is re-performed under CPS No. 9437.62 and the monitor declared operable on September 17, 1997 at 2100. OOR 97-048 is exited.

- 1RIX-PR037 is inoperable for 740.92 hours (30.87 days).

Root Cause

The root cause of this event is inadequate implementation of the ODCM revision. ODCM, revision 15 was implemented before supporting procedures were ready. The ODCM revision was not made known to affected departments which caused delays in getting the affected procedures revised to support the change. These delays caused the monitor to be inoperable for greater than 30 days. A potential contributing factor was the failure to get the calibration of 1RIX-PR037 added to the outage scope work in a timely manner.

Corrective Actions

The corrective action to prevent recurrence of this condition was to revise CPS No. 1800.00 "Revising the ODCM", to add instructions to notify department heads of pending ODCM changes. This action has been completed and tested successfully with the implementation of ODCM revision 16.

1RIX-PR036 Plant Service Water

1RIX-PR036, Plant Service Water (WS) Process Radiation Monitor was inoperable from 11/16/97 to 01/03/98. Below is a listing of the troubleshooting steps followed to repair the monitor as well as the root cause and corrective actions to prevent recurrence.

- 1RIX-PR036 began experiencing problems in communicating with the Central Control Terminal (CCT) in the Main Control Room). Maintenance Work Request D81531 was issued to correct the problem.

- Control and Instrumentation (C&I) personnel obtained historical information on Communication Line B and on the monitors using Communication Line B. It was determined that more than one monitor had experienced similar problems as 1RIX-PR036 over the last 12 months. Subsequently, the maintenance history of all components and parts that had been replaced was reviewed.

- C&I began troubleshooting the repeater for Communication Line B. All data points were verified correct. Then, all monitor inputs were removed and the testing repeated, identifying several inaccuracies.

- C&I attempted to repair the repeater. Failing this, a new repeater was installed after first verifying the new repeater worked on the bench. A known operable portable radiation monitor was connected to the Communication Line and operation observed for a period of time.

- The other monitors serviced by Communication Line B were reworked and made operable. In addition, the correct operation of the repeater was verified after each monitor was returned to the Communication Line.

- The old repeater was returned to the Vendor for determination of the problem and repair.

- 1RIX-PR036 was returned to the Communication Line and its' proper operation verified for 5 days.

Root Cause

The repeated failure of 1RIX-PR036 was the failure of C&I to correctly troubleshoot both the true cause of the problem as well as the extent of the problem.

Corrective Actions

Specific information and lessons learned concerning this problem was provided to the C&I Technicians through briefing from the Supervisor C&I and the technician involved in the troubleshooting effort. In addition, requalification training will be provided to C&I technicians on the AR/PR system later this year.

SECTION 9
MAJOR CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

In accordance with the CPS ODCM section 7.2, licensee-initiated major changes to the liquid, gaseous or solid radioactive waste treatment systems shall be reported in the Radioactive Effluent Release Report. No major changes to the Waste Treatment Systems were reviewed and approved during this reporting period.

SECTION 10
NEW LOCATIONS FOR DOSE CALCULATION AND/OR ENVIRONMENTAL MONITORING

In accordance with the CPS ODCM, new locations for dose calculations and/or environmental monitoring identified by the Annual Land Use Census shall be reported in the Radioactive Effluent Release Report.

The following is a summary of the 1997 Annual Land Use Census.

1.0 Nearest Residence

The nearest resident identified in each of the 16 sectors are shown below:

SECTOR	1996 RESIDENT	AGE GROUP	1997 RESIDENT	AGE GROUP
N	DAUGHERTY	C T A	DAUGHERTY	C T A
NNE	BROWN	A	BROWN	A
NE	BARTIMUS	C A	BARTIMUS	C A
ENE	DEFEBAUGH	A	DEFEBAUGH	A
E	NIEDERER	A	NIEDERER	A
ESE	EDWARDS	I C A	EDWARDS	C A
SE	TWIST	A	TWIST	T A
SSE	JACOBS	A	JACOBS	A
S	DISNEY	A	DISNEY	A
SSW	EHALT	A	EHALT	A
SW	REYNOLDS	A	REYNOLDS	A
WSW	LYNN	A	LYNN	A
W	SANDERS	T A	SANDERS	T A
WNW	LORD	C T A	HUSTED	T A
NW	ENOS	T A	ENOS	T A
NNW	CRABTREE	A	CRABTREE	A

(I)nfant (C)hild (T)een (A)dult

2.0 Broadleaf Garden Census

Over 100 gardens within 5 miles were located in the 16 sectors surrounding CPS. Specifically broad leaf vegetation was identified for this report. Other crops grown in this area were identified but will not be addressed in this report.

The nearest garden identified in each of the 16 sectors are shown below:

SECTOR	1996 GARDENS	AGE GROUPS	1997 GARDENS	AGE GROUPS
N	DAUGHERTY	C T A	KOHLER	A
NNE	BURTON	A	THRASHER	A
NE	SPENCER	C T A	LARRY	A
ENE	DEFEBAUGH	A	DEFEBAUGH	A
E	BRATCHER	A	BRATCHER	A
ESE	EDWARDS	I C A	HOLTZSCHER	C A
SE	NONE	N/A	NONE	N/A
SSE	WOOD	C T A	WEST	A
S	MARTIN	A	MARTIN	A
SSW	WILLIAMS	A	WILLIAMS	T A
SW	PARKER	A	PARKER	C A
WSW	BURTON	A	THOMASON	A
W	LANUM	I A	LANUM	C A
WNW	STAPLETON	A	HUSTED	T A
NW	RODRICK	T A	SHEAHAN	A
NNW	COPE	C A	LORD	A

(I)nfant (C)hild (T)een (A)dult

3.0 Milking Animal Census

Milking animals within 5 miles were located in 10 of the 16 sectors surrounding CPS. The cattle were used for nursing (nursing of calves) and were being used for meat production (both own use and to be sold). There were no residents that milked their animals for human consumption.

Milking animals were specifically identified for this report. Other livestock raised in this area were identified but will not be addressed in this report.

The nearest milking animals identified in each of the 16 sectors are shown below:

SECTOR	1996 MILKING ANIMALS	AGE GROUPS	1997 MILKING ANIMALS	AGE GROUPS
N	MARX	A	DAUGHERTY	C T A
NNE	LARRY	A	LARRY	A
NE	NONE	N/A	SPENCER	T A
ENE	DAWSON	A	DAWSON	A
E	NONE	N/A	NONE	N/A
ESE	NONE	N/A	NONE	N/A
SE	NONE	N/A	NONE	N/A
SSE	MOODY	A	MOODY	A
S	MARTIN	A	MARTIN	A
SSW	WANTLAND	A	R. WANTLAND	T A
SW	WANTLAND	A	ISSAC	T A
WSW	BEST	A	BEST	A
W	MOODY	C T A	MOODY	C T A
WNW	NONE	N/A	NONE	N/A
NW	NONE	N/A	BASTING	A
NNW	WILSON	A	WILSON	A

(I)nfant (C)hild (T)een (A)dult

SECTION 11
CORRECTIONS TO DATA REPORTED IN PREVIOUS REPORTS

There are no corrections to data included in previous reports.

CLINTON POWER STATION

OFFSITE DOSE CALCULATION MANUAL

REVISION 15

Issued: JULY 30, 1997

26.290

CPS NO. 1005.06F002

16

SAFETY EVALUATION FORM

(8.3.1.1.a) LOG 97 - 154 REV. ____

(8.3.1.1.b) DOCUMENT EVALUATED: Offsite Dose Calculation Manual (ODCM) REVISION: 15

(8.3.1.1.c) TITLE: Offsite Dose Calculation Manual (ODCM) Change

(8.3.1.1.d) DESCRIPTION AND IMPACT OF CHANGE ON LICENSING DOCUMENTS:

This revision to the ODCM incorporates both editorial and technical changes.

The editorial changes correct obvious typographical errors introduced by previous revisions to the ODCM. These changes include:

1) Revising Table 2.3-1, Table Notation "a" definition for "Delta T" to match the algorithm used by the controlled software.
2) Revised SR 3.4.1.1 and SR 3.4.1.2 to cross-reference the correct section numbers in the ODCM.
3) Revised Table 3.4-1 to remove erroneous footnotes which were introduced when the table was reformatted by a previous revision to the ODCM.
4) Revised Table 3.4-1, Table Notation "a" definition for "Delta T" to match the algorithm used by the controlled software.
5) Revised Table 3.4-1, Table Notation "4" to add a clarifying statement regarding monitor applicability.
6) Revised Table 3.9.1-2 to fix mis-aligned table headings.

(continued)

(8.3.1.1.d) REFERENCES:

Offsite Dose Calculation Manual (ODCM): Table 1.1-1, 1.2.2.8.3, 2.1, 2.3.1, Table 2.3-1, 2.3.5, 2.3.6, Table 2.7-1, Table 2.7-2, 3.1, SR 3.4.1.1, SR 3.4.1.2, Table 3.4-1, 3.4.2, 3.4.3, Table 3.9.1-2, Table 3.9.2-1, 5.1, Table 5.1-1, 5.2, 9.2.6.1, 9.2.9.1, 9.2.9.2, 9.2.11, 9.2.11.1

USAR Sections: 1.8, 11.5, Table 11.5-1, Table 11.5-2, Table 15.2.4-3a
Technical Specifications: 5.5.1, 5.5.4, 5.5.4.b, 5.6.2, 5.6.3
Operational Requirements Manual (ORM): 6.8.4.c
(continued)

(8.3.1.1.h)	Prepared by:	W. Lones Name	W Lones Signature	Date: 7/22/97
(8.3.2.2)	Reviewed by:	W. Scott Klein ~~W. Scott~~ mc 7-22-97 Name	W. Scott Klein Signature	Date: 7-22-97
(8.3.3)	Approved by:	J.F. Withrow for D.R. Morris Name	[signature] Signature	Date: 7/22/97
(8.3.4)	FRG:	Philip Thompson Name	P M Thompson Signature	Date: 7/25/97

155-98-014

Rev. No. 1

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: _____

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

References (continued):

Regulatory Guides: 1.21, 1.109, 1.111
NUREG-0133, NUREG-0473
Code of Federal Regulations (CFR): 10CFR20.1302; 10CFR20, Appendix B, Table 2, Column 2; 10CFR50.36a; 10CFR50 Appendix A; 10CFR50 Appendix I; 40CFR190
CR 1-96-10-260
SER Amendment No. 95
General Design Criteria (GDC) 60 and 64
CPS No. 3212.01

Description and Impact (continued):

7) Revised Section 5.1, Remedial Requirement "c" to reference the correct report title in accordance with the associated Technical Specifications section.
8) Revised Table 5.1-1,Table Notation "a" to reference the correct report title in accordance with the associated Technical Specifications section.
9) Revised Section 5.2, Remedial Requirement "a" to reference the correct report title in accordance with the associated Technical Specifications section.
10) Revised Section 9.2.6.1 to add a description for variable "X" for consistency with the other variables in the equation.
11) Revised Sections 9.2.9.1 and 9.2.9.2 to add the word "meters" to the variable column heading.
12) Revised Section 9.2.11.1 to specify "elevated level" in accordance with Section 9.2.11 heading.

The editorial changes incorporated by this revision do not change the intent of the ODCM and are consistent with the regulatory requirements of 10CFR20.1302, 10CFR50.36a, 10CFR50 Appendix I, 40CFR190, and Technical Specifications. These changes maintain the levels of radioactive effluent control required by these regulations and do not adversely impact the reliability of effluent, dose, or setpoint calculations.

This revision to the ODCM contains the following technical changes:

1) Revised Table 1.1-1 to add a clarifying footnote for composite samples.
2) Revised Section 2.3.1 to change the limit for liquid radioactive material released to unrestricted areas to match Technical Specification Licensing Amendment 95, section 5.5.4.b.
3) Revised Section 2.3.5 to require sampling Component Cooling Water (CCW) prior to placing the Fuel Pool Heat Exchanger in the Shutdown Service Water (SX) cooling mode. Deleted the word "batch" from the description of the release type to remove an incorrect description of the type of release.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual (ODCM)

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Description and Impact (continued):

4) Added new Section 2.3.6 to include CCW PRM setpoints in the ODCM based on Condition Report (CR) 1-96-10-260 corrective actions.
5) Revised Table 2.7-1 to include CCW PRM monitoring instrumentation in accordance with CR 1-96-10-260 and new ODCM Section 2.3.6.
6) Revised Table 2.7-1 Remedial Requirement "2" to add the requirement for the "communication link" to be operable for considering the radioactive liquid effluent monitoring instrumentation as operable.
7) Revised Table 2.7-2 to include CCW PRM surveillance requirements in accordance with CR 1-96-10-260 and new ODCM Section 2.3.6.
8) Revised Table 3.9.2-1 to reformat the table for clarity and to add approved alternate flow measuring devices for indicating SGTS flow rate.

The technical changes incorporated by this revision align the ODCM with Technical Specification 5.5.4.b liquid release limits, eliminate unnecessary sampling for the CCW when shutdown service water (SX) is not supplying cooling water to the fuel pool heat exchangers, add CCW PRMs to the monitoring program, specify that the communication links are included in PRM channel check operability, and add alternate flow rate measuring devices for the SGTS gaseous effluent monitoring instruments. These technical changes are consistent with the requirements of 10CFR20, 10CFR50 Appendix A, 10CFR50 Appendix I, 40CFR190, and Technical Specifications. Calculations for dose and alarm setpoints are not modified by these technical changes.

There are no reductions in commitment associated with these editorial and technical changes.

Justification:

Part I:

The editorial and technical changes incorporated by this revision to the ODCM are not pertinent to malfunctions of equipment important to safety (IS) which were evaluated as the design bases. The technical changes incorporated by this revision do not relate to operation of plant equipment, only to surveillance and monitoring of radioactive effluents and calculations of dose to the public.

No safety-related or special scope equipment are affected by these changes. The probability of a malfunction of equipment IS and an increase in the consequences of a malfunction (specifically dose to unrestricted areas) are not applicable to these ODCM changes.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual (ODCM)

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

Part II:

The Clinton Power Station OFFSITE DOSE CALCULATION MANUAL (CPS-ODCM) provides the methodologies and parameters used by Illinois Power Company (IP) to assure compliance with the radioactive effluent dose limitations stated in 10CFR20, 10CFR50 Appendix A (General Design Criteria 60 and 64), 10CFR50 Appendix I, and 40CFR190.

The CPS-ODCM was prepared based on guidance provided in NUREG-0133, PREPARATION OF RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS FOR NUCLEAR POWER PLANTS (October 1978), and NUREG-0473, RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS FOR BOILING WATER REACTORS (Draft 7, to Revision 3). This manual along with station procedures are used by CPS personnel to demonstrate compliance with the above referenced Federal Regulations.

Based on a review of the SAR, there are no evaluated accidents associated with calculations for radioactive effluent dose. The ODCM is not used to operate equipment necessary to mitigate accidents. The ODCM provides calculations and methodologies to determine the extent of dose to unrestricted areas as a result of plant operation. Since the ODCM does not affect accidents previously evaluated in the SAR, these changes will not increase the probability of these evaluated accidents.

The consequences of accidents evaluated in the SAR are associated with ~~to~~ dose to unrestricted areas as a result of radioactive effluents. The ODCM provides the monitoring and calculation requirements to assess and report dose to unrestricted areas and the general public. Since the ODCM is used to determine the dose related to radioactive effluents from both normal plant operation and during postulated accidents, the ODCM in itself is not capable of increasing accident consequences.

Part III:

There are no credible accidents or equipment IS failure modes associated with these changes to the ODCM. The editorial and technical changes incorporated by this revision are being made to ensure that dose resulting from radioactive effluents is accurately determined. Calculations and reporting requirements of the ODCM do not create the possibility of an accident, therefore creating an accident of a different type is also not possible. Equipment operation is not affected by the ODCM, therefore malfunctions of equipment IS of a different type than previously evaluated in the SAR are not possible.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual (ODCM)

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

Part IV:

The changes incorporated by this revision to the ODCM bring the ODCM into full compliance with the requirements of the Technical Specifications for reporting dose to unrestricted areas as a result of liquid and gaseous effluents. These changes will not reduce the margin of safety defined in the basis for any Technical Specification.

Liquid radwaste effluents released from CPS will meet 10CFR20 concentration limits at the point of discharge to the unrestricted area. This design and operation objective will be achieved at all times. Actual discharges of liquid radwaste effluents will normally occur on a batch basis and the average concentration at the point of discharge will be only a small percentage of the allowed limits. USAR Section 11.5 provides a description of radiation monitoring, sampling and effluent control systems. Cumulative quarterly dose contributions due to radioactive effluents released to the unrestricted area will be determined once every 31 days.

Gaseous effluents from CPS are released on both a batch and continuous basis. Gaseous effluents are normally discharged on a long term basis. High volume Continuous Containment Purge and mechanical vacuum pump discharge may be considered short term releases.

There are two gaseous effluent release points to the environment: the Common Station HVAC Stack and the Standby Gas Treatment System (SGTS) Stack. The SGTS is an Engineered Safety Feature filter system utilized following an accident to reduce iodine and particulate activity in gases leaking from the primary containment and which are potentially present in the secondary containment. The Common Station HVAC Stack ("HVAC Stack") receives process and ventilation exhaust inputs.

SAFETY EVALUATION SCREENING FORM

(8.2.2.a) DOCUMENT EVALUATED: Offsite Dose Calculation Manual, Revision 15

(8.2.2.b) DESCRIPTION OF CHANGE:

Revised Table 1.1-1. Added a footnote to clarify "frequency" as it applies to composite samples.

Revised Section 2.3.1. The Operational Requirement limitation was revised to match Technical Specification Amendment No. 95, Section 5.5.4.b.

Revised Table 2.3-1, Table Notation "a." Revised the definition for "delta T" to clarify that the elapsed time for plant effluents is the time between the midpoint of sample collection and the "midpoint of the counting interval" in seconds.

Revised Section 2.3.5. The Component Cooling Water (CCW) sampling requirement now applies only when the Fuel Pool Heat Exchanger is being supplied by the Shutdown Service Water (SX) System.

(continued)

(8.2.2.c) AFFECTED SYSTEM(S)/COMPONENT(S)/FUNCTIONS; None

10CRF50.59 APPLICABILITY DETERMINATION (8.2.2.1)

(Refer to Appendix A for guidance for the following questions)

Yes ___ No ✓ Is this a change to the facility as described in the SAR? *[That is, is the design, function, or method of performing the function of a structure, system or component described by text or drawing in the SAR being changed?]*

Yes ✓ No ___ Is this a change to a procedure as described in the SAR? *[That is, is a procedure that is outlined, summarized or that is completely described in the SAR being changed?)*

Yes ___ No ✓ Is this a test or experiment not described in the SAR? *[That is, is a test or experiment being conducted which might affect safe operation of the plant which was not anticipated in the SAR?]*

Yes ___ No ✓ Does this change require a change to the CPS Tech Specs? *If yes, process the change in accordance with CPS No. 1038.01.*

ORM Impact (8.2.2.2)

(Refer to Appendix B for guidance for the following question)

Yes ___ No ✓ Is this a change(other than an editorial change) to the Operational Requirements Manual? *If yes, **complete a safety evaluation and** process the change in accordance with CPS No. 1038.03.*

IMPACT ON OTHER LICENSING BASIS DOCUMENTS (8.2.2.3)

(Refer to Appendix B for guidance for the following question)

Yes ✓ No ___ Does this change directly affect any of the following programs:

Technical Specification Bases
Physical Security Plan
Emergency Plan
QA Program Description
Licensed Operator Requalification Program
Offsite Dose Calculation Manual
Process Control Program
Fire Protection Plan
Enviromental Protection Plan

DOCUMENT EVALUATED: Offsite Dose Calculation Manual, Revision 15

JUSTIFICATION FOR "YES/NO" ANSWERS:
(8.2.2.1.2, 8.2.2.3)

Description (continued):

Added new Section 2.3.6. This section incorporates corrective action CR 1-96-10-260.
Revised Table 2.7-1. Added new item 2.d for the CCW PRM. This change is being made as a result of corrective action CR 1-96-10-260.
Revised Table 2.7-1, Remedial Requirement 2.a. Added a clarifying statement to specify which equipment is required to be operable.
Revised Table 2.7-2. Added new item 2.d for the CCW PRM. This change is being made as a result of corrective action CR 1-96-10-260.
Revised Surveillance Requirement (SR) 3.4.1.1. This SR cross-references the wrong ODCM Section. Noble gas dose rate calculations are performed in accordance with Section 3.4.2, not Section 3.4.3. This was a typographical error introduced by a previous ODCM revision.
Revised Surveillance Requirement (SR) 3.4.1.2. This SR cross-references the wrong ODCM Section. Radioiodines, particulates and tritium dose rate calculations are performed in accordance with Section 3.4.3, not Section 3.4.4. Section 3.4.4 no longer exists. This was a typographical error introduced by a previous ODCM revision.
Revised Table 3.4-1. Deleted Table Notation "2" from Items A.2 and A.3 "Sampling Frequency" and Item B.1 "Analysis Frequency." These were typographical errors introduced when the table was reformatted by a previous ODCM revision.
Revised Table 3.4-1, Table Notation "a." Revised the definition for "delta T" to clarify that the elapsed time for plant effluents is the time between the midpoint of sample collection and the "midpoint of the counting interval" in seconds.
(continued)

REFERENCES:
(8.2.2.1.2)

Offsite Dose Calculation Manual (ODCM): Table 1.1-1, 1.2.2.8.3, 2.3.1, Table 2.3-1, 2.3.5, 2.3.6, Table 2.7-1, Table 2.7-2, SR 3.4.1.1, SR 3.4.1.2, Table 3.4-1, 3.4.2, 3.4.3, Table 3.9.1-2, Table 3.9.2-1, 5.1, Table 5.1-1, 5.2, 9.2.6.1, 9.2.9.1, 9.2.9.2, 9.2.11, 9.2.11.1

USAR Sections: 1.8, Table 11.5-1, Table 11.5-2, Table 15.2.4-3a
Technical Specifications: 5.5.1, 5.5.4, 5.5.4.b, 5.6.2, 5.6.3
Operational Requirements Manual (ORM): 6.8.4.c
Regulatory Guides: 1.21, 1.109, 1.111
Code of Federal Regulations (CFR): 10CFR20.1302; 10CFR20, Appendix B, Table 2, Column 2; 10CFR50.36a; 10CFR50 Appendix A; 10CFR50 Appendix I; 40CFR190
CR 1-96-10-260; SER Amendment No. 95; CPS No. 3212.01

Prepared by: (8.2.3)	W. Lowes Printed Name	W Lowes Signature	Date: 7/25/97
Reviewed by: (8.2.4)	W. Scott Klein Printed Name	W Scott Klein Signature	Date: 7.25.97

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision 15

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Description (continued):

Revised Table 3.4-1, Table Notation 4. Added "on the applicable PRM (HVAC or SGTS)." This notation only applies to HVAC and SGTS noble gas monitors, not to the Off-Gas noble gas monitor.
Revised Table 3.9.1-2 headings.
Revised Table 3.9.2-1. This change moves the Effluent System Flow Rate Measuring Devices from HVAC and SGTS PRMs to new Table Steps 3 and 4. Added alternate flow rate measuring devices 0FIVG004 and 0FIVG104 to SGTS, Table Step 4.
Revised Table 3.9.2-1, Remedial Requirement 8.a. Added a clarifying statement to specify which equipment is required to be operable.
Revised Section 5.1, Remedial Requirement "c." The correct report associated with Technical Specification 5.6.2 is the "Radiological Environmental Operating Report."
Revised Table 5.1-1, Table Notation "a." The correct report associated with Technical Specification 5.6.2 is the "Radiological Environmental Operating Report."
Revised Section 5.2, Remedial Requirement "a." The correct report associated with Technical Specification 5.6.2 is the "Radiological Environmental Operating Report."
Revised Section 9.2.6.1. Added a description for the "X" variable for this equation.
Revised Sections 9.2.9.1 and 9.2.9.2. Added "meters" to the "X" variable column heading.
Revised Section 9.2.11.1. This step contained an error associated with the plume elevation. In accordance with the section heading 9.2.11, this equation applies to "elevated" level, not ground level.

Justification:

This revision to the ODCM contains the following EDITORIAL changes:

1) Revised Table 2.3-1, Table Notation "a" to clarify the definition for elapsed time (delta T) for the radioactive decay factor used in the LLD calculation. For plant effluents, the elapsed time is the time between the midpoint of sample collection and the midpoint of the counting interval, in seconds. This change removes the ambiguity from the previous version of the definition and aligns the definition with the controlled computer software used for calculating the LLD.

2) Revised Surveillance Requirements (SR) 3.4.1.1 and 3.4.1.2. These SRs cross-referenced the wrong dose rate calculation sections. SR 3.4.1.1 should reference Section 3.4.2 and SR 3.4.1.2 should reference Section 3.4.3. These errors were introduced by a previous revision to the ODCM.

3) Revised Table 3.4-1. Deleted Table Notation "2" from Items A.2 and A.3 "Sampling Frequency" and Item B.1 "Analysis Frequency." These were typographical errors introduced when the table was reformatted by a previous ODCM revision. These changes are consistent with the sampling and analysis requirements found in USAR Section 1.8.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision 15

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

4) Revised Table 3.4-1, Table Notation "a" to clarify the definition for elapsed time (delta T) for the radioactive decay factor used in the LLD calculation. For plant effluents, the elapsed time is the time between the midpoint of sample collection and the midpoint of the counting interval, in seconds. This change removes the ambiguity from the previous version of the definition and aligns the definition with the controlled computer software used for calculating the LLD.

5) Revised Table 3.4-1, Table Notation "4" to clarify which noble gas monitors apply to this note. Added a statement "on the applicable PRM (HVAC or SGTS)" to prevent confusing this requirement with the Offgas noble gas monitors. This revision clarifies the applicability for the noble gas monitors. In accordance with Table 3.4-1, the listed gaseous release types are the Station HVAC Exhaust and the Standby Gas Treatment System Exhaust (when flow exists).

6) Revised Table 3.9.1-2 table headings. These headings were misaligned by a previous revision. This is a typographical error.

7) Revised Section 5.1, Remedial Requirement "c." The correct report associated with Technical Specification 5.6.2 is the "Radiological Environmental Operating Report." This is an editorial change to align the ODCM with Technical Specifications.

8) Revised Table 5.1-1, Table Notation "a." The correct report associated with Technical Specification 5.6.2 is the "Radiological Environmental Operating Report." This is an editorial change to align the ODCM with Technical Specifications.

9) Revised Section 5.2, Remedial Requirement "a." The correct report associated with Technical Specification 5.6.2 is the "Radiological Environmental Operating Report." This is an editorial change to align the ODCM with Technical Specifications.

10) Revised Section 9.2.6.1. Added a description for the "X" variable for this equation. The calculation has not been revised, therefore this is an editorial change.

11) Revised Sections 9.2.9.1 and 9.2.9.2. Added "meters" to the "X" variable column heading. This is an editorial change.

12) Revised Section 9.2.11.1. This step contained a typographical error associated with the plume elevation. In accordance with the section heading 9.2. [illegible]his equation applies to "elevated" level, not ground level.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision 15

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

The editorial changes incorporated by this revision do not change the intent of the ODCM and are consistent with the regulatory requirements of 10CFR20.1302, 10CFR50.36a, 10CFR50 Appendix I, 40CFR190. These changes maintain the levels of radioactive effluent control required by these regulations and do not adversely impact the reliability of effluent, dose, or setpoint calculations.

This revision to the ODCM contains the following TECHNICAL changes:

1) Revised Table 1.1-1 to add a clarifying footnote for composite samples. The composite sampling frequency applies to the time period over which the sample is composited (duration of the composite).

To be representative of the average quantities and concentrations of radioactive materials released in liquid and in particulate form in gaseous effluents, samples for compositing are collected in proportion to the rate of flow of the effluent stream or in proportion to the volume of each batch of effluent releases. Prior to analysis of liquid samples, the composite is thoroughly mixed so that the sample is representative of the average effluent release.

Periods of collection for composites should be as short as practicable to preclude the loss of radioactive material by deposition on walls of the sample container or volatilization of potentially volatile material.

This revision does not change the basis for composite samples. Composite samples are either grab samples collected at different times from the same sample point or are continuous samples. The composite samples are collected over a finite period of time, not instantaneously. This methodology ensures that the effects of variable or irregular discharges and operations are monitored during the entire period during which discharges occur.

2) Revised Section 2.3.1 to change the limit for liquid radioactive material released to unrestricted areas in accordance with Technical Specification Licensing Amendment No. 95, Section 5.5.4.b. The current Technical Specifications allow the concentration of radioactive materials released in liquid effluents to UNRESTRICTED AREAS to be limited to "ten times" the concentrations specified in 10CFR20, Appendix B, Table 2, Column 2 for nuclides other than dissolved or entrained noble gases. This revision to the ODCM aligns Section 2.3.1 to the current Technical Specifications and does not change the current Technical Specifications or 10CFR20, Appendix B, Table 2, Column 2.

In accordance with Technical Specification 5.5.4, the Radioactive Effluent Controls Program "conforms to 10CFR50.36a for the control of radioactive effluents and for maintaining the doses to members of the public from radioactive effluents as low as reasonably achievable. The program shall be contained in the ODCM, shall be implemented by procedures, and shall include remedial actions to be taken whenever the

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision 15

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

program limits are exceeded. The program shall include 'Limitations on the concentrations of radioactive material released in liquid effluents to unrestricted areas, conforming to ten times the concentration values in 10CFR20, Appendix B, Table 2, Column 2.'"

This revision aligns the ODCM with Technical Specifications 5.5.4.b.

3) Revised Section 2.3.5 to eliminate unnecessary weekly sampling of the CCW system while still providing assurances that radioactive materials are not being released to the Ultimate Heat Sink (UHS) via CCW. This change will require CCW to be sampled prior to placing the Fuel Pool Heat Exchanger in the Shutdown Service Water (SX) cooling mode, then weekly thereafter while in this mode. This change also corrects a misnomer which described the potential release of CCW radioactivity to the UHS as a "batch" release.

The fuel pool cooling and cleanup (FPC&C) system maintains the water temperature, purity, and radiation level in the spent fuel and upper containment pools within acceptable limits. This system has two 100%-capacity processing trains with each consisting of a transfer pump, filter demineralizer unit, and heat exchanger. Each heat exchanger is designed to provide the required cooling capacity to accommodate expected long term spent fuel storage. Both processing trains may be operated in parallel for cooling larger than expected heat loads. The RHR system is connected to the FPC&C system to provide supplemental cooling during shutdown, if necessary. A filter-demineralizer unit is employed to maintain water purity and control radioactive exposure.

The CCW system, (which is the normal source of FPC&C heat exchanger cooling) is a closed loop so that continued radioactive leakage will increase the CCW system radioactivity concentration but no discharge to the environment will occur. Radiation monitors are provided downstream of each fuel pool heat exchanger and on the service water effluent. A process radiation monitoring channel monitors for leakage into each cooling water header downstream of the RHR heat exchangers and on the common header downstream of the RWCU non-regenerative heat exchangers. Each channel will alarm on high radiation conditions indicating process leakage into the cooling water. No isolation trip functions are performed by these monitors.

If the fuel pool water temperature rises above 120°F, the FPC&C heat exchanger cooling media may be transferred by the operator from the component cooling water (CCW) system to the shutdown service water (SX) system. The design inlet water temperature of the CCW system is 105°F, while the SX design inlet temperature is 95°F. This change in cooling media increases the heat dissipation capability of the one FPC&C train. If necessary, the Shutdown Service Water (SX) System can also provide cooling of the FPC&C heat exchangers and pump motors under loss of offsite power conditions.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision 15

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

Transfer of secondary cooling water is by operator action. In the event of leakage across the heat exchangers, the potential exists for radioactive materials to be present in the CCW system. The two potential paths for radioactive inleakage to the SX are the RHR heat exchangers and the fuel pool cooling and cleanup (FPC&C) heat exchangers. The SX operates at a higher pressure than the FPC&C, therefore, the probability of radioactive material leakage from the FPC&C system is minimized. Radiation monitors are located in the service water discharge from the RHR and FPC&C heat exchangers. If a high radiation alarm from the heat exchangers occurs, the operator can isolate the heat exchanger by closing motor-operated isolation valves in the service water inlet and discharge. If this action is deemed necessary, the second RHR or FPC&C heat exchanger can then be placed into operation. The process radiation monitoring system, of which these monitors are part, will help to assure that any radioactivity released to the Ultimate Heat Sink (UHS) will not exceed allowable limits. If the SX system is providing the FPC&C heat exchanger service water and leakage occurs, the radioactivity will be diluted by the SX system and discharged to the UHS. Operator action would be required to correct the condition.

Current ODCM sampling and analysis requirements for the CCW system specify a weekly surveillance. The intent of this sampling requirement is to ensure that potential releases to the Ultimate Heat Sink via the SX system are monitored. This revision provides adequate controls to obtain CCW samples prior to entering the SX cooling mode.

4) Added new Section 2.3.6 to include the CCW PRM setpoints in the ODCM due to the CCW system operating at a higher pressure than the Plant Service Water (WS) system at the heat exchangers. This operating condition provides a potential pathway for radioactive materials to enter the WS system. This change assures that a potentially unmonitored release path does not exist.

This change implements a corrective action from Condition Report (CR) 1-96-10-260. CR 1-96-10-260 has identified a discrepancy regarding Plant Service Water (WS) system pressure and CCW system pressure. Depending on WS load and number of WS pumps operating, CCW pressure could possibly be higher than WS pressure. A Safety Evaluation (Log 97-062) determined that this was not an unreviewed safety question.

This revision incorporates the CCW PRM setpoint surveillance requirements into the liquid effluent monitoring program to ensure compliance with 10CFR20 release rate limits.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision 15

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

5) Revised Table 2.7-1 to include the CCW PRM monitoring instrumentati e ODCM due to the CCW system operating at a higher pressure than the Plant Service Water (WS ? the heat exchangers. This operating condition provides a potential pathway for radioactive mate nter the WS system. This change assures that a potentially unmonitored release path does not exist.

This change implements a corrective action from Condition Report (CR) 1-96-10-260. CR 1-96-10-260 has identified a discrepancy regarding Plant Service Water (WS) system pressure and CCW system pressure. Depending on WS load and number of WS pumps operating, CCW pressure could possibly be higher than WS pressure. A Safety Evaluation (Log 97-062) determined that this was not an unreviewed safety question.

This revision incorporates the CCW PRM monitoring instrumentation requirements into the liquid effluent program to ensure compliance with 10CFR20 release rate limits. The minimum channels operable and remedial requirements for the CCW PRM are included in this table.

6) Revised Table 2.7-1 Remedial Requirement 2 to add a clarifying statement for instrument availability. In order to be considered operable, both the communication link and MCR-CCT are required to be operable. This change is consistent with Table 2.7-1 Table Notation "(a)" and Table 2.7-2, Table Notation "5."

This revision ensures that the liquid effluent monitoring instrumentation provides the capability of the MCR Central Control Terminal (MCR-CCT) to provide the alarm status of the applicable radiation monitor channels.

7) Revised Table 2.7-2 to include CCW PRM surveillance requirements in the ODCM due to the CCW system operating at a higher pressure than the Plant Service Water (WS) system at the heat exchangers. This operating condition provides a potential pathway for radioactive materials to enter the WS system. This change assures that a potentially unmonitored release path does not exist.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision 15

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

This change implements a corrective action from Condition Report (CR) 1-96-10-260. CR 1-96-10-260 has identified a discrepancy regarding Plant Service Water (WS) system pressure and CCW system pressure. Depending on WS load and number of WS pumps operating, CCW pressure could possibly be higher than WS pressure. A Safety Evaluation (Log 97-062) determined that this was not an unreviewed safety question.

This revision incorporates the CCW PRM monitoring instrumentation surveillance requirements into the liquid effluent program to ensure compliance with 10CFR20 release rate limits. The channel check, source check, channel calibration, and channel functional test requirements for the CCW PRM are included in this table.

8) Revised Table 3.9.2-1. The Effluent System Flow-Rate Measuring devices listed in Table Steps 1.f and 2.f are not a part of the associated HVAC or SGTS PRMs as indicated. These devices are being moved to their own separate instrument sections 3 and 4 (respectively) to avoid confusion. This is an editorial change since all related minimum channels operable, applicability, and remedial requirement information still applies and is not being changed. This revision adds two alternate SGTS flow-rate measuring devices, OFIVG004 and OFIVG104, to the SGTS Effluent System Flow-Rate Measuring Device "Instrument" section. These alternate devices also meet the minimum channels operable, applicability, and remedial requirements for this instrument.

Revised Table 3.9.2-1 Remedial Requirement "8a" to add a clarifying statement for instrument availability. In order to be considered operable, both the communication link and MCR-CCT are required to be operable. This change is consistent with Table 2.7-1 Table Notation "(a)" and Table 3.9.1-2, Table Notation "3." This revision ensures that the offgas radiation monitoring instrumentation provides the capability of the MCR Central Control Terminal (MCR-CCT) to provide the alarm status of the applicable radiation monitor channels.

The purpose of the Offsite Dose Calculation Manual (ODCM) is to provide the methodologies and parameters used for assuring compliance with the radiological effluent dose limitations provided by 10CFR20, 10CFR50 Appendix A, 10CFR50 Appendix I, and 40CFR190. The ODCM contains information necessary to calculate offsite doses resulting from radioactive liquid and gaseous effluents, calculations for gaseous and liquid effluent monitoring alarm and trip setpoints, and the elements needed to conduct the radiological environmental monitoring program. The radioactive effluent controls program and the radiological environmental monitoring program are described.

(continued)

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision 15

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

The editorial changes incorporated by this revision to the ODCM do not modify calculations for dose or alarm setpoints. The editorial changes incorporated by this revision align the ODCM with Technical Specification reporting requirements, clarify notes, clarify and reorganize tables, add descriptions for calculation variables, and correct obvious typographical errors.

The technical changes incorporated by this revision align the ODCM with Technical Specification 5.5.4.b liquid release limits, eliminate unnecessary sampling for the CCW when shutdown service water (SX) is not supplying cooling water to the fuel pool heat exchangers, add CCW PRMs to the monitoring program, specify that the communication links are included in PRM channel check operability, and add alternate flow rate measuring devices for the SGTS gaseous effluent monitoring instruments. These technical changes are consistent with the requirements of 10CFR20, 10CFR50 Appendix A, 10CFR50 Appendix I, and 40CFR190. Calculations for dose and alarm setpoints are not modified by these technical changes.

This revision to the ODCM does not affect structures, systems or components. The changes being incorporated by this revision are administrative in nature. These changes will ensure that dose from radioactive effluents is monitored and reported in accordance with the requirements of Technical Specifications, 10CFR20, 10CFR50, and 40CFR190. Since the design, function, or method of performing the function of SSC is not changed by this revision, this is not a change to the facility as described in the SAR.

The ODCM implements the requirements of Technical Specifications, 10CFR20, 10CFR50, and 40CFR190. Since ODCM activities are included by reference and description in the Technical Specifications, this revision is considered a change to procedures as described in the SAR.

Performing radioactive effluent surveillances and dose calculations are routine parts of the overall effluent monitoring program. The ODCM incorporates the programs and procedures necessary to ensure that surveillances are performed when required and that their completion is adequately documented. Actions to notify plant management are also provided when surveillances do not meet the specified acceptance criteria. This change does not affect the operation of plant equipment or the ability to monitor radioactive effluents and their associated dose, therefore this revision does not constitute a test or experiment not described in the SAR.

Because these changes affect only monitoring and surveillance activities associated with the ODCM, there are no changes needed to Technical Specifications, Tech Spec Bases, or the ORM.

The ODCM changes are not contrary to Technical Specifications, Tech Spec Bases, ORM, Environmental Plan, Security Plan, Emergency Plan, QA Program Description, Seismic Qualification, Licensed Operator Requalification Program, Radiological Controls, Process Control Program, Accident Analysis, or Fire Protection Program. No changes are required to these programs as a result of the ODCM program revision.

(8.3.1.1.a) LOG ____ - ____ REV. ____

DOCUMENT EVALUATED: Offsite Dose Calculation Manual (ODCM) REVISION: 15

TITLE: Offsite Dose Calculation Manual (ODCM) Change

UNREVIEWED SAFETY QUESTION DETERMINATION
(8.3.1.1.e)
(Attach justification for following questions on CPS No. 1005.06F003)

Part I -- Impact on equipment malfunctions evaluated as the design bases

Yes ___ No ✓ 1. Will change increase the probability of a malfunction of equipment important to safety evaluated previously in the SAR?

Yes ___ No ✓ 2. Will change increase the consequences of a malfunction of equipment important to safety evaluated previously in the SAR?

Part II -- Impact on accidents evaluated as the design bases

Yes ___ No ✓ 3. Will change increase the probability of an accident previously evaluated in the SAR?

Yes ___ No ✓ 4. Will change increase the consequences of an accident previously evaluated in the SAR?

Part III -- Potential for creating a new type of accident or equipment malfunction

Yes ___ No ✓ 5. Will change create the possibility of an accident of a different type than any evaluated previously in the SAR?

Yes ___ No ✓ 6. Will change create the possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the SAR?

Part IV -- Impact on the Margin of Safety

Yes ___ No ✓ 7. Will change reduce the Margin of Safety as defined in the basis for any technical specification?

SUMMARY
(8.3.1.1.f, 8.3.1.1.g)

✓ Change is safe, no USQ exists, and requires no change to technical specifications. The change may be implemented upon FRG review.

___ Change is safe, however there is an USQ, or requires a change to technical specifications. The change requires NRC approval prior to implementation.

26.290

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ILLINOIS POWER COMPANY

CLINTON POWER STATION

UNIT 1

OFFSITE DOSE CALCULATION MANUAL

Docket No. 50-461

FRG _____ Date 7-25-97

Manager-Clinton Power Station _____ Date 7/30/97

155-98-010

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1.0 GENERAL INFORMATION

PREFACE

The Clinton Power Station OFFSITE DOSE CALCULATION MANUAL (CPS-ODCM) provides the methodologies and parameters to be used by Illinois Power Company (IPC) to assure compliance with the radioactive effluent dose limitations stated in 10CFR20, 10CFR50 Appendix A (General Design Criteria 60 and 64), 10CFR50 Appendix I, and 40CFR190.

The CPS-ODCM was prepared based on guidance provided in NUREG-0133, PREPARATION OF RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS FOR NUCLEAR POWER PLANTS (October 1978), and NUREG-0473, RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS FOR BOILING WATER REACTORS (Draft 7, to Revision 3). This manual along with station procedures will be used by CPS personnel to demonstrate compliance with the above referenced Federal Regulations.

Changes to the CPS-ODCM shall be provided in the RADIOACTIVE EFFLUENT RELEASE REPORT.

1.1 Definitions

The following terms are defined so that uniform interpretation of requirements of this manual may be achieved. The defined terms appear in capitalized type and shall be applicable throughout this manual.

CHANNEL CALIBRATION

1.1.1 A 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 that the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including the required sensor, alarm, display, and trip functions, and shall include the CHANNEL FUNCTIONAL TEST. Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an in place qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping or total channel steps so that the entire channel is calibrated.

CHANNEL CHECK

1.1.2 A CHANNEL CHECK shall be the qualitative assessment of channel behavior during operating 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.

CHANNEL FUNCTIONAL TEST

1.1.3 A CHANNEL FUNCTIONAL TEST shall be the injection of a simulated, or actual, signal into the channel as close to the sensor as practicable to verify OPERABILITY, including required alarm, interlock, display, and trip functions, and channel failure trips. The CHANNEL FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping or total channel steps so that the entire channel is tested.

FREQUENCY NOTATION

1.1.4 The FREQUENCY NOTATION specified for the performance of surveillance requirements shall correspond to the intervals defined in Table 1.1-1.

GASEOUS RADWASTE TREATMENT SYSTEM

1.1.5 A GASEOUS RADWASTE TREATMENT SYSTEM is any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the main condenser evacuation system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

MEMBER(S) OF THE PUBLIC

1.1.6 An individual in a controlled or unrestricted area. However, an individual is not a member of the public during any period in which the individual receives an occupational dose.

1.1.6a MODE

A MODE shall correspond to any one inclusive combination of mode switch position, average reactor coolant temperature, and reactor vessel head bolt tensioning specified in Technical Specification Table 1.1-1 with fuel in the reactor vessel.

OPERABLE - OPERABILITY

1.1.7 A system, subsystem, division, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, division, component or device to perform its specified safety function(s) are also capable of performing their related support function(s).

REMEDIAL REQUIREMENT

1.1.8 REMEDIAL REQUIREMENT shall be that part of a requirement which prescribes remedial measures required under designated conditions.

SITE BOUNDARY

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

SOURCE CHECK

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

UNRESTRICTED AREA

1.1.11 An UNRESTRICTED AREA means an area, access to which is neither limited nor controlled by the licensee.

VENTILATION EXHAUST TREATMENT SYSTEM

1.1.12 A VENTILATION EXHAUST TREATMENT SYSTEM is 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.

The following systems are designated VENTILATION EXHAUST TREATMENT SYSTEMS:

1) Machine Shop HVAC (VJ)

2) Laboratory HVAC (VL)

3) Drywell Purge (VQ)

4. Radwaste Bldg HVAC (VW)

1.2 General Operation Requirements

1.2.1 Operation Requirements shall be met during the conditions specified therein; except as provided in Operation Requirement 1.2.2.

1.2.2 Upon discovery of a failure to meet an Operation Requirement, the REMEDIAL REQUIREMENT(s) shall be met, except as provided in 1.2.3.

If the Operation Requirement is met or is no longer applicable prior to expiration of the REMEDIAL REQUIREMENT(s), completion of the REMEDIAL REQUIREMENT(s) is not required, unless otherwise stated.

1.2.3 Equipment removed from service or declared inoperable to comply with REMEDIAL REQUIREMENT(s) may be returned to service under administrative control solely to perform testing required to demonstrate OPERABILITY or the OPERABILITY of other equipment. This is an exception to OPERATION REQUIREMENT 1.2.2 for the system returned to service under administrative control to perform the testing required to demonstrate OPERABILITY.

1.3 General Surveillance Requirements

1.3.1 Surveillance Requirements shall be met during the applicable conditions specified in and for the associated Operation Requirement, unless otherwise stated in the Surveillance Requirement. Failure to meet a Surveillance, whether such failure is experienced during the performance of the surveillance, or between performances of the Surveillance, shall be failure to meet the Operation Requirement.

1.3.2 The specified surveillance interval for each Surveillance Requirement is met if the Surveillance is performed within 1.25 times the specified surveillance interval, as measured from the previous performance or as measured from the time a specified condition of the Surveillance Requirement is met.

For surveillance intervals specified as "once", the above interval extension does not apply.

If a REMEDIAL REQUIREMENT requires periodic performance on a "once per ..." basis, the above surveillance interval extension applies to each performance after the initial performance.

Exceptions to this Surveillance Requirement are stated in the individual Surveillance Requirements.

Failure to perform a surveillance within the specified time interval shall be a failure to meet the Operation Requirement except as provided in Surveillance Requirement 1.3.3. Surveillances do not have to be performed on inoperable equipment or variables outside specified limits.

1.3.3 If it is discovered that a surveillance was not performed within its specified surveillance interval, then compliance with the requirement to declare the Operational Requirement not met may be delayed, from the time of discovery, up to 24 hours or up to the limit of the specified interval, which ever is less. This delay period is to allow performance of the surveillance.

If the surveillance is not performed within the delay period, the Operational Requirement must immediately be declared not met, and the applicable REMEDIAL REQUIREMENTS must be met.

1.3.4 Entry into a condition specified in and for an Operation Requirement shall not be made unless the Surveillance Requirement(s) associated with the Operation Requirement have been performed within the applicable surveillance interval or as otherwise specified.

This provision shall not prevent entry into conditions specified for an Operation Requirement that is required to comply with REMEDIAL REQUIREMENT(s) or that are part of a shutdown of the unit.

Surveillance Requirement 1.3.4 is only applicable for entry into a condition specified for an Operation Requirement in MODES 1, 2, and 3.

1.4 Effluent Concentration Limit (lim) Calculation Requirements

1.4.1 The values found in 10CFR20 Appendix B, Table 2, Column 2 shall be used for all lim calculations in the ODCM.

TABLE 1.1-1

SURVEILLANCE FREQUENCY NOTATION

NOTATION	FREQUENCY
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.
Q	At least once per 92 days.
SA	At least once per 184 days.
A	At least once per 366 days.
R	At least once per 18 months (550 days)
P	Prior to each release.
S/U	Prior to each reactor startup.
NA	Not applicable.

Note: A frequency notation for a composite sample describes the time period over which the sample is to be composited.

rev. 15

2.0 LIQUID EFFLUENTS

2.1 Introduction

Liquid radwaste effluent released from CPS will meet 10CFR20 concentration limits at the point of discharge to the unrestricted area shown in Figure 2.1-1. This design and operation objective will be achieved at all times. Actual discharges of liquid radwaste effluent will normally occur on a batch basis and the average concentration at the point of discharge will be only a small percentage of the allowed limits. Refer to Clinton USAR Section 11.5 for a description of radiation monitoring, sampling and effluent control systems.

Cumulative quarterly dose contributions due to radioactive effluents released to the unrestricted area will be determined once every 31 days using NUREG-0133 and Regulatory Guide 1.109 methodology and parameters.

2.2 Liquid Radwaste Discharge Process Radiation Monitoring (PRM) System

This monitoring subsystem measures liquid radwaste effluent radioactivity prior to the effluent joining plant service water and circulating water dilution streams. A high radioactivity signal from this gamma scintillation detector automatically terminates the liquid radwaste effluent release. The liquid radwaste effluent flow, variable from 10-60 GPM or 50-300 GPM, combines with Plant Service Water flow (minimum flow approximately 2000 GPM during plant shutdown periods depending on system loads) and Plant Circulating Water flow (0-567,000 GPM) in the Seal Well prior to entering the 3.4-mile discharge flume to Lake Clinton (see Figure 2.5-1).

2.3 10CFR20 Release Rate Limits

The Operation and Surveillance Requirements pertaining to discharge of liquid radwaste effluent to the unrestricted area are specified in Section 2.3.1 as follows.

2.3.1 Liquid Effluent Concentration - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The concentration of radioactive material released in liquid effluent to UNRESTRICTED AREAS (see Figure 2.1-1) shall be limited to ten times the concentrations specified in 10CFR Part 20, Appendix B, Table 2, 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} microcuries/ml total activity. This requirement applies during all releases via this pathway.

REMEDIAL REQUIREMENT:

With the concentration of radioactive material released in liquid effluents to UNRFSTRICTED AREAS exceeding the above limits, immediately restore the concentration to within the above limits.

SURVEILLANCE REQUIREMENTS

2.3.1.1 Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 2.3-1.

2.3.1.2 The results of the radioactivity analyses shall be used in accordance with the methodology and parameters of Section 2.3.2 to assure that the concentrations at the point of release are maintained within the limits of the above Operation Requirement.

To comply with the above requirements, setpoints will be calculated to assure that Seal Well concentrations do not exceed 10CFR20, Appendix B, Table 2, Column 2 values at any time.

TABLE 2.3-1

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)
Batch Waste Release Tanks[b]	P Each Batch	P Each Batch	Principal Gamma Emitters[c]	5x10-7
			I-131	1x10-6
	P One Batch/M	M	Dissolved and Entrained Gases[e] (Gamma Emitters)	1x10-5
	P Each Batch	Q Composite[d]	H-3	1x10-5
			Gross Alpha	1x10-7
	P Each Batch	Q Composite[d]	Sr-89, Sr-90	5x10-8
			Fe-55	1x10-6

TABLE 2.3-1 (Continued)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATIONS

[a]The LLD is defined, for purposes of these requirements, 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 measurements system, which may include radiochemical separation:

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

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 (sec^{-1}) and

Δt for plant effluents is the elapsed time between the midpoint of sample collection and the midpoint of the counting interval (sec). | rev. 15

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

TABLE 2.3-1 (Continued)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATIONS (Continued)

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.

[b] A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, the tank is isolated from all inputs and recirculated a minimum of two tank volumes at which time a sample is obtained for isotopic analysis.

[c] The principal gamma emitters are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with an LLD of 5 x 10-6 µCi/ml. All identified radionuclides shall be reported in the Radioactive Effluent Release Report pursuant to Technical Specification 5.6.3 in a format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

[d] A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen that is representative of the liquids released.

[e] Dissolved and Entrained gases are: Xe-133, Xe-135, Xe-138, Kr-85m, Kr-87, and Kr-88.

2.3.2 Liquid Radwaste Discharge PRM Setpoints

To comply with the Operation Requirements of Section 2.3.1 and Section 2.7.1, the alarm/trip setpoints for liquid effluent monitors and flow measurement devices are set to assure that the following equation is satisfied:

$$cf/(F + f) \leq C_{lim} \quad (1)$$

C_{lim} = the effluent concentration limit (Section 2.3.1) implementing 10CFR20 for the site, corresponding to the specific mix of radionuclides in the effluent stream being considered, in µCi/ml

c = the setpoint, in µCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint is inversely proportional to the volumetric flow of the effluent line and proportional to the volumetric flow of the dilution stream(s) plus the effluent stream.

F = the dilution water flow setpoints as determined at the Seal Well, in volume per unit time

f = the liquid radwaste discharge flow setpoint as determined at the liquid radwaste discharge PRM location, in volume per unit time (same units as F)

The available dilution water flow (F) should be constant for a given release, and the liquid radwaste tank discharge flow (f) and monitor setpoint (c) are set to meet the condition of equation (1) for a given effluent concentration (C_{lim}). The method by which this is accomplished is illustrated in sections 2.3.2.1 through 2.3.2.5.

2.3.2.1 The isotopic concentration for a liquid radwaste tank to be discharged is obtained from the sum of the measured concentrations as determined by the analyses required in Table 2.3-1:

$$\Sigma_i C_i = \Sigma_g C_g + \Sigma_a C_a + \Sigma_s C_s + C_T + C_{Fe}, \ \mu Ci/ml \qquad (2)$$

where

$\Sigma_g C_g$ = The sum of concentrations C_g of each measured gamma emitter g (including I-131) observed by gamma spectroscopy of the waste sample, µCi/ml.

$\Sigma_a C_a$ = The sum of concentrations C_a of alpha emitters (a) in liquid radwaste as measured in the most current QUARTERLY composite discharge tank sample, µCi/ml.

$\Sigma_s C_s$ = The sum of concentrations C_s of Sr-89/Sr-90 in liquid radwaste as observed in the most current QUARTERLY composite discharge tank sample, µCi/ml.

C_T = The measured concentration of H-3 in liquid radwaste as determined from analysis of the most current QUARTERLY composite discharge tank sample, µCi/ml.

C_{Fe} = The measured concentration of Fe-55 in liquid radwaste as observed in the most current QUARTERLY composite discharge tank sample, µCi/ml.

2.3.2.2 The measured radionuclide concentrations are used to calculate a DILUTION FACTOR (DF) which is equivalent to the ratio of total dilution flow rate to liquid radwaste tank effluent flow rate required to assure that the limiting concentrations of 10CFR20, Appendix B, Table 2, Column 2 are met at the point of discharge to the unrestricted area.

$$DF = SF[\Sigma_i \ (C_i/lim_i)], \text{ dimensionless} \qquad (3)$$

$$= SF\{\Sigma_g (C_g/lim_g) + \Sigma_a (C_a/lim_a) + \Sigma_s (C_s/lim_s) + (C_T/lim_T) + C_{Fe}/lim_{Fe})]$$

where

$\Sigma_i C_i$ = The measured concentrations C_g, C_a, C_s, C_T, C_{Fe} as defined in equation (2), µCi/ml.

lim_i = The limiting concentration of the corresponding radionuclide from 10CFR20, Appendix B, Table 2, Column 2, µCi/ml. For dissolved or entrained noble gases, the concentration shall be limited to 2E-04 µCi/ml total activity.

SF = The conservative SAFETY FACTOR normally applied to compensate for statistical fluctuations and measurement errors, dimensionless.

2.3.2.3 The maximum permissible liquid radwaste tank effluent flow rate, F_{tank}, is calculated by the following equation:

$$F_{tank} = 0.9(F_{dil}+f_{tank})/DF, \text{ volume/time} \quad (4)$$

where

F_{dil} = Minimum expected dilution water flow rate (Circulating and/or Service Water systems), volume/time

f_{tank} = Maximum expected liquid radwaste tank effluent flow rate, volume/time

0.9 = Flow rate correction factor to provide a 10% margin for variations in flow rates, dimensionless

DF = The DILUTION FACTOR calculated by equation (3), dimensionless

Equation (4) is valid only for $DF \geq 1$; for $DF < 1$, the liquid radwaste tank effluent concentration meets the limits of 10CFR20 without dilution and therefore F_{tank} may assume any value not to exceed discharge pump capacity.

2.3.2.4 The liquid radwaste discharge PRM setpoint may now be specified based on the values of $\Sigma_i C_i$ (Eq.2) and F_{tank} (Eq.4) which were determined to provide compliance with the concentration limits of 10CFR20, Appendix B, Table 2, Column 2. The monitor response is primarily a gamma response and the actual setpoint is therefore based on $\Sigma_g C_g$ (Eq.2). The monitor setpoint, in counts per minute (cpm), which corresponds to the particular setpoint concentration, C_M, is determined based on monitor calibration data or operational data which correlates monitor response to sample analyses associated with the actual liquid radwaste discharged. The second method is considered valid only if the integrity of laboratory methods of determination are proven more accurate than the monitor data.

The set point concentration, C_M, is obtained by the following equation:

$$C_M = [F_{tank}/f_{act}]\Sigma_g C_g, \ \mu Ci/ml \qquad (5)$$

where

f_{act} = The actual liquid radwaste effluent flow rate, volume/time

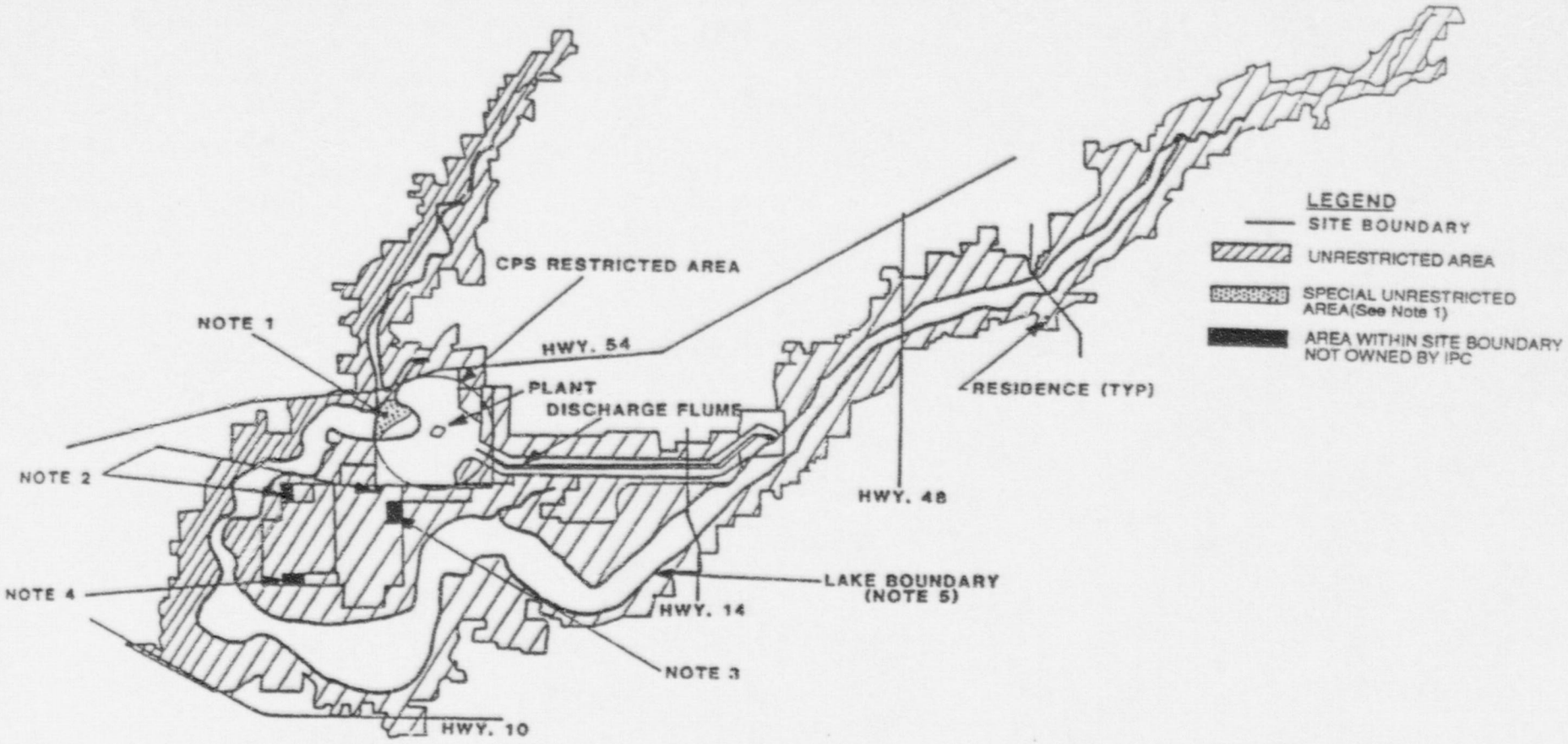
If $(F_{tank}/f_{act}) \geq 1$, the value obtained for C_M is used to determine the monitor setpoint above background, ccpm, from either of the two methods described above. In the case where $(F_{tank}/f_{act}) < 1$, no release may be made using the existing discharge parameter values (DF, F_{tank}, f_{act}).

The setpoint concentration is conservative, even if F_{tank} is attainable, since the calculated flow rate contains the SAFETY FACTOR, dilution flow rate and liquid radwaste tank effluent flow rate margins.

2.3.2.5 To prevent spurious alarms, revise the Plant Service Water Effluent PRM setpoint to coincide with the setpoint concentration, C_M, calculated by equation (5). This setpoint is valid only during periods of actual liquid radwaste discharges.

FIGURE 2.1-1

UNRESTRICTED AREA BOUNDARY FOR LIQUID EFFLUENTS



NOTES

1. THE AREA IN THE LAKE BETWEEN THE BUOYS AND THE EXCLUSION AREA BOUNDARY IS UNRESTRICTED AT THIS TIME. BUT WILL BE CONTROLLED IF PLANT EFFLUENT CONDITIONS WARRANT CLOSURE.
2. LAND PARCEL NOT OWNED BY ILLINOIS POWER, INCLUDES RESIDENCES.
3. LAND PARCEL NOT OWNED BY ILLINOIS POWER, OIL COMPANY PIPELINE PUMPING STATION.
4. LAND PARCEL NOT OWNED BY ILLINOIS POWER, AGRICULTURAL USE.
5. THE LAKE SHORELINE IS APPROXIMATELY 690 FT. MSL ELEVATION LINE.

2.3.3 Plant Service Water Effluent PRM Setpoints

Plant service water effluent continuously releases to the Seal Well where it mixes with circulating water effluent (if present) prior to entering Lake Clinton via the 3.4 mile discharge flume. The plant service water effluent is not considered a radioactive discharge pathway unless liquid radwaste discharges are in progress or any service water cooling load heat exchanger has been detected as failed. To ensure that Plant Service Water intersystem leakage has not occurred, weekly Service Water effluent grab samples will be obtained (when in service) and analyzed to determine the identity and quantity of principal gamma-emitting radionuclides. In addition, a quarterly composite of positive grab samples will be analyzed to determine the quantity of H-3, Sr-89, Sr-90, Fe-55 and gross alpha species released. The analytical Lower Limit of Detection (LLD) for these analyses are specified in Table 2.3-1.

The Plant Service Water effluent PRM setpoint should be established as close to background as practical to prevent spurious alarms, and yet assure an alarm should an inadvertent release occur.

If the weekly grab sample analysis indicates the presence of contamination above background, PRM setpoints will be established following section 2.3.2 methodology as follows:

2.3.3.1 Perform section 2.3.2.2, solving equation (3) for DF using the appropriate values in the concentration term from the grab sample analysis.

2.3.3.2 A modified dilution factor, DF_m, must be determined so that available dilution flows may be apportioned among simultaneous discharge pathways. The modified dilution factor is defined as:

$$DF_m = DF/F_A \qquad (6)$$

where F_A is an administrative allocation factor which may be assigned any value between 0 and 1 under the condition that

$$\Sigma_n \ (F_A)_n \leq 1 \qquad (7)$$

and where n = the number of liquid discharge pathways for which DF $\geq$1 and which are planned for simultaneous release. For simplicity, F_A may be assigned the value 1/n. Calculate F_{tank} in equation (4) by substituting the value of DF_m for DF and perform the calculation specified in section 2.3.2.4 to determine flow rate and PRM setpoints.

2.3.4 Shutdown Service Water (SX) Effluent PRM Setpoints

Shutdown Service Water, when initiated, is a potential continuous radioactive discharge pathway to the Ultimate Heat Sink (UHS) (see Figure 2.5-2). The SX effluent is not considered a radioactive discharge pathway unless any SX cooling load heat exchanger has been detected as failed. SX effluent sampling, analysis and setpoint establishment will be performed as discussed for the Plant Service Water system in Section 2.3.3.

2.3.5 Fuel Pool Heat Exchanger Service Water Effluent PRM Setpoints

The Fuel Pool Heat Exchanger Service Water is normally supplied by the Component Cooling Water (CCW) system (a closed loop system). The CCW system rejects heat loads to the Plant Service Water system where intersystem leakage would be detected as described in section 2.3.3. The Fuel Pool Heat Exchanger Service Water effluent is considered a potential radioactive discharge pathway when SX replaces CCW as the heat sink for the fuel pool heat exchangers. To account for a potential release of CCW radioactivity to the Ultimate Heat Sink via SX, CCW will be sampled prior to placing the Fuel Pool Heat Exchanger in the SX cooling mode and analyzed as discussed in section 2.3.3. The analysis results will then be used to establish Fuel Pool Heat Exchanger Service Water PRM and flow rate setpoints following Section 2.3.3.1 and 2.3.3.2 methodology. rev

Any releases of radioactivity to the environment from the Plant Service Water (except during liquid radwaste discharges), Shutdown Service Water or Fuel Pool Heat Exchanger Service Water Systems are considered abnormal events. Such events will be accounted for as unplanned releases in the RADIOACTIVE EFFLUENT RELEASE REPORT.

2.3.6 Component Cooling Water PRM Setpoints

The Component Cooling water system is a potential continuous radioactive discharge pathway to the Service Water system due to the Component Cooling water system generally operating at a higher pressure. Component Cooling provides cooling to components and heat exchangers that carry radioactive fluids or are in areas that could result in radioactive contamination if the components are damaged. Except for the sampling requirement described in 2.3.5, sampling on this system is done on an as needed basis. The PRM setpoints are established using the methodology in Section 2.3.3. rev.

2.4 10CFR50, Appendix I Release Rate Limits

The Operation and Surveillance Requirements concerning 10CFR50, Appendix I Release Limits are specified in section 2.4.1. Dose calculations for ensuring compliance with these limits are discussed in section 2.4.2.

2.4.1 10CFR50, Appendix I Release Rate Limits - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to UNRESTRICTED AREAS (see Figure 2.1-1) 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.

This requirement applies at all times.

REMEDIAL REQUIREMENT:

With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days 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

2.4.1.1 Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters described in Section 2.4.2 at least once per 31 days.

2.4.2 Discussion

2.4.2.1 The dose contribution to the maximum exposed individual from all radionuclides identified in liquid effluents released to the unrestricted area is calculated as follows:

$$D_j = \Sigma_i [A_{ij} \sum_{\ell=1}^{m} \Delta T_\ell \, C_{i\ell} F_\ell], \text{ mrem} \quad (8)$$

where

D_j = The cumulative calendar quarter or yearly dose to any organ j from liquid effluent for the total release period, mrem

ΔT_ℓ = The length of the ℓth release time period over which $C_{i\ell}$ and F_ℓ are averaged for liquid releases, hours

= Liquid Radwaste Tank Volume/Liquid Radwaste Discharge Flow Rate

$C_{i\ell}$ = The average concentration of nuclide i in undiluted liquid effluent during release period Δt_ℓ for any liquid release, µCi/ml

F_ℓ = The near field average dilution factor for $C_{i\ell}$ during any liquid effluent release, dimensionless. Defined as the ratio of the average undiluted liquid radwaste flow during the release, to the product of the average flow from the discharge structure (during the reporting period, i.e., quarter or year) to the unrestricted receiving water and Z

$$= \frac{\text{Average Undiluted Liquid Waste Flow}}{(\text{Average Discharge Structure Flow})Z} \quad (9)$$

Z = The applicable dilution factor for Lake Clinton, dimensionless

= 1.0

A_{ij} = The composite ingestion dose commitment factor for the total body or critical organ of an ADULT for radionuclide i, mrem/hr per µCi/ml

$$= K_o[(U_w/D_w) + (U_f BF_i)]DF_i \quad (10)$$

where

K_O = A units conversion factor, 1.14E+05 pCi-ml-yr/μCi-liter-hr

= (1.0E+06 pCi/μCi)(1.0E+03 ml/liter)/8760 hr/yr

U_w = Annual water consumption by the maximum adult, 0 liter/yr

D_w = Dilution factor from the near field area to the nearest potable water intake, 1.0

U_f = Adult fish consumption rate, 21 kg/yr (Table E-5 of Regulatory Guide 1.109)

BF_i = Bioaccumulation factor for radionuclide i in fish, pCi/kg per pCi/liter (Table 2.4-2 taken from Table A-1 of Regulatory Guide 1.109)

DF_i = Adult ingestion dose conversion factor for radionuclide i, total body or critical organ, mrem/pCi (Table 2.4-3 taken from Table E-11 of Regulatory Guide 1.109)

Table 2.4-1 contains values for A_{ij} as calculated by equation (10).

The quarterly limits specified in the OPERATION REQUIREMENT at the beginning of this section represent one-half of the annual design objective of Section II.A of 10CFR50, Appendix I.

TABLE 2.4-1

ADULT INGESTION DOSE COMMITMENT FACTORS - A_{ij}
(mrem/hr per µCi/ml)

ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01
C-14	3.12E+04*	6.24E+03	6.24E+03	6.24E+03	6.24E+03	6.24E+03	6.24E+03
NA-24	4.06E+02	4.06E+02	4.06E+02	4.06E+02	4.06E+02	4.06E+02	4.06E+02
P-32	1.39E+06	8.62E+04	5.36E+04	NO DATA	NO DATA	NO DATA	1.56E+05
CR-51	NO DATA	NO DATA	1.27E+00	7.60E-01	2.80E-01	1.68E+00	3.20E+02
MN-54	NO DATA	4.37E+03	8.34E+02	NO DATA	1.30E+03	NO DATA	1.34E+04
MN-56	NO DATA	1.10E+02	1.95E+01	NO DATA	1.40E+02	NO DATA	3.51E+03
FE-55	6.57E+02	4.54E+02	1.06E+02	NO DATA	NO DATA	2.53E+02	2.60E+02
FE-59	1.04E+03	2.44E+03	9.34E+02	NO DATA	NO DATA	6.81E+02	8.13E+03
CO-58	NO DATA	8.90E+01	2.00E+02	NO DATA	NO DATA	NO DATA	1.80E+03
CO-60	NO DATA	2.56E+02	5.64E+02	NO DATA	NO DATA	NO DATA	4.80E+03
NI-63	3.11E+04	2.15E+03	1.04E+03	NO DATA	NO DATA	NO DATA	4.49E+02
NI-65	1.26E+02	1.64E+01	7.48E+00	NO DATA	NO DATA	NO DATA	4.16E+02
CU-64	NO DATA	9.97E+00	4.67E+00	NO DATA	2.51E+01	NO DATA	8.48E+02
ZN-65	2.31E+04	7.36E+04	3.33E+04	NO DATA	4.92E+04	NO DATA	4.64E+04
ZN-69	4.92E+01	9.42E+01	6.55E+00	NO DATA	6.12E+01	NO DATA	1.41E+01
BR-83	NO DATA	NO DATA	4.03E+01	NO DATA	NO DATA	NO DATA	5.81E+01
BR-84	NO DATA	NO DATA	5.23E+01	NO DATA	NO DATA	NO DATA	4.10E-04
BR-85	NO DATA	NO DATA	2.15E+00	NO DATA	NO DATA	NO DATA	LT E-15**
RB-86	NO DATA	1.01E+05	4.70E+04	NO DATA	NO DATA	NO DATA	1.99E+04
RB-88	NO DATA	2.89E+02	1.53E+02	NO DATA	NO DATA	NO DATA	4.00E-09
RB-89	NO DATA	1.92E+02	1.35E+02	NO DATA	NO DATA	NO DATA	1.11E-11
SR-89	2.21E+04	NO DATA	6.34E+02	NO DATA	NO DATA	NO DATA	3.54E+03
SR-90	5.43E+05	NO DATA	1.33E+05	NO DATA	NO DATA	NO DATA	1.57E+04
SR-91	4.06E+02	NO DATA	1.64E+01	NO DATA	NO DATA	NO DATA	1.94E+03
SR-92	1.54E+02	NO DATA	6.67E+00	NO DATA	NO DATA	NO DATA	3.05E+03
Y-90	5.75E-01	NO DATA	1.54E-02	NO DATA	NO DATA	NO DATA	6.10E+03
Y-91m	5.43E-03	NO DATA	2.10E-04	NO DATA	NO DATA	NO DATA	1.60E-02
Y-91	8.42E+00	NO DATA	2.25E-01	NO DATA	NO DATA	NO DATA	4.64E+03
Y-92	5.05E-02	NO DATA	1.48E-03	NO DATA	NO DATA	NO DATA	8.84E+02
Y-93	1.60E-01	NO DATA	4.42E-03	NO DATA	NO DATA	NO DATA	5.08E+03
ZR-95	2.40E-01	7.69E-02	5.20E-02	NO DATA	1.21E-01	NO DATA	2.44E+02
ZR-97	1.32E-02	2.67E-03	1.22E-03	NO DATA	4.04E-03	NO DATA	8.28E+02
NB-95	4.46E+02	2.48E+02	1.33E+02	NO DATA	2.45E+02	NO DATA	1.51E+06
MO-99	NO DATA	1.03E+02	1.96E+01	NO DATA	2.33E+02	NO DATA	2.39E+02
TC-99m	8.86E-03	2.50E-02	3.19E-01	NO DATA	3.80E-01	1.23E-02	1.48E+01
TC-101	9.11E-03	1.31E-02	1.29E-01	NO DATA	2.36E-01	6.70E-03	3.94E-14
RU-103	4.42E+00	NO DATA	1.90E+00	NO DATA	1.69E+01	NO DATA	5.16E+02
RU-105	3.68E-01	NO DATA	1.45E-01	NO DATA	4.76E+00	NO DATA	2.25E+02
RU-106	6.57E+01	NO DATA	8.32E+00	NO DATA	1.27E+02	NO DATA	4.25E+03
AG-110m	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
TE-125m	2.57E+03	9.28E+02	3.43E+02	7.70E+02	1.04E+04	NO DATA	1.02E+04
TE-127m	6.47E+03	2.31E+03	7.89E+02	1.65E+03	2.63E+04	NO DATA	2.17E+04
TE-127	1.05E+02	3.77E+01	2.28E+01	7.79E+01	4.28E+02	NO DATA	8.30E+03
TE-129m	1.10E+04	4.10E+03	1.74E+03	3.78E+03	4.59E+04	NO DATA	5.54E+04
TE-129	3.00E+01	1.13E+01	7.31E+00	2.30E+01	1.26E+02	NO DATA	2.26E+01
TE-131m	1.65E+03	8.09E+02	6.74E+02	1.28E+03	8.19E+03	NO DATA	8.03E+04
TE-131	1.88E+01	7.87E+00	5.95E+00	1.55E+01	8.25E+01	NO DATA	2.67E+00

TABLE 2.4-1 (cont'd)

ADULT INGESTION DOSE COMMITMENT FACTORS - A_{ij}
(mrem/hr per μCi/ml)

ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.41E+03	1.56E+03	1.46E+03	1.72E+03	1.50E+04	NO DATA	7.37E+0[illegible]
I-130	2.71E+01	7.99E+01	3.15E+01	6.78F+03	1.25E+02	NO DATA	6.88E+0[illegible]
I-131	1.49E+02	2.13E+02	1.22E+02	6.99E+04	3.66E+02	NO DATA	5.63E+0[illegible]
I-132	7.28E+00	1.95E+01	6.81E+00	6.81E+02	3.10E+01	NO DATA	3.66E+00
I-133	5.09E+01	8.85E+01	2.70E+01	1.30E+04	1.54E+02	NO DATA	7.96E+01
I-134	3.80E+00	1.03E+01	3.69E+00	1.79E+02	1.64E+01	NO DATA	9.00E-03
I-135	1.59E+01	4.16E+01	1.53E+01	2.74E+03	6.67E+01	NO DATA	4.70E+01
CS-134	2.97E+05	7.07E+05	5.78E+05	NO DATA	2.29E+05	7.60E+04	1.24E+04
CS-136	3.11E+04	1.23E+05	8.84E+04	NO DATA	6.84E+04	9.37E+03	1.40E+04
CS-137	3.81E+05	5.21E+05	3.41E+05	NO DATA	1.77E+05	5.88E+04	1.01E+04
CS-138	2.64E+02	5.21E+02	2.58E+02	NO DATA	3.83E+02	3.78E+01	2.22E-03
BA-139	9.29E-01	6.60E-04	2.72E-02	NO DATA	6.18E-04	3.75E-04	1.65E+00
BA-140	1.94E+02	2.44E-01	1.27E+01	NO DATA	8.29E-02	1.40E-01	4.00E+02
BA-141	4.50E-01	3.40E-04	1.52E-02	NO DATA	3.16E-04	1.93E-04	2.12E-10
BA-142	2.04E-01	2.09E-04	1.28E-02	NO DATA	1.77E-04	1.18E-04	2.89E-19
LA-140	1.49E-01	7.53E-02	1.99E-02	NO DATA	NO DATA	NO DATA	5.53E+03
LA-142	7.65E-03	3.48E-03	8.66E-04	NO DATA	NO DATA	NO DATA	2.54E+01
CE-141	2.24E-02	1.51E-02	1.72E-03	NO DATA	7.03E-03	NO DATA	5.78E+01
CE-143	3.94E-03	2.92E+00	3.23E-04	NO DATA	1.28E-03	NO DATA	1.09E+02
CE-144	1.17E+00	4.88E-01	6.26E-02	NO DATA	2.89E-01	NO DATA	3.94E+02
PR-143	5.50E-01	2.20E-01	2.72E-02	NO DATA	1.27E-01	NO DATA	2.41E+03
PR-144	1.80E-03	7.47E-04	9.14E-05	NO DATA	4.21E-04	NO DATA	2.59E-10
ND-147	3.76E-01	4.34E-01	2.60E-02	NO DATA	2.54E-01	NO DATA	2.08E+03
W-187	2.95E+02	2.47E+02	8.63E+01	NO DATA	NO DATA	NO DATA	8.09E+04
NP-239	2.84E-02	2.80E-03	1.54E-03	NO DATA	8.72E-03	NO DATA	5.74E+02

*3.12×10^{4}
**Less than 10^{-15}

TABLE 2.4-2

BIOACCUMULATION FACTORS -BF_i
(pCi/kg per pCi/liter)

ELEMENT	FRESHWATER FISH
H	9.0E-01
C	4.6E+03
Na	1.0E+02
P	1.0E+05
Cr	2.0E+02
Mn	4.0E+02
Fe	1.0E+02
Co	5.0E+01
Ni	1.0E+02
Cu	5.0E+01
Zn	2.0E+03
Br	4.2E+02
Rb	2.0E+03
Sr	3.0E+01
Y	2.5E+01
Zr	3.3E+00
Nb	3.0E+04
Mo	1.0E+01
Tc	1.5E+01
Ru	1.0E+01
Rh	1.0E+01
Te	4.0E+02
I	1.5E+01
Cs	2.0E+03
Ba	4.0E+00
La	2.5E+01
Ce	1.0E+00
Pr	2.5E+01
Nd	2.5E+01
W	1.2E+03
Np	1.0E+01

TABLE 2.4-3

ADULT INGESTION DOSE FACTORS -DFi
(mrem/pCi ingested)

ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C-14	2.84E-06*	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA-24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P-32	1.[illegible]E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR-51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN-56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE-55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI-63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI-65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU-64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN-69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR-83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR-84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR-85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24**
RB-86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB-88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB-89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR-89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR-90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR-91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR-92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y-90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y-91m	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y-91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y-92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y-93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR-97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO-99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC-99m	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
TC-101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU-103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU-105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU-106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG-110m	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE-125m	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE-127m	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE-127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE-129m	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE-129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE-131m	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE-131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09

TABLE 2.4-3 (cont'd)

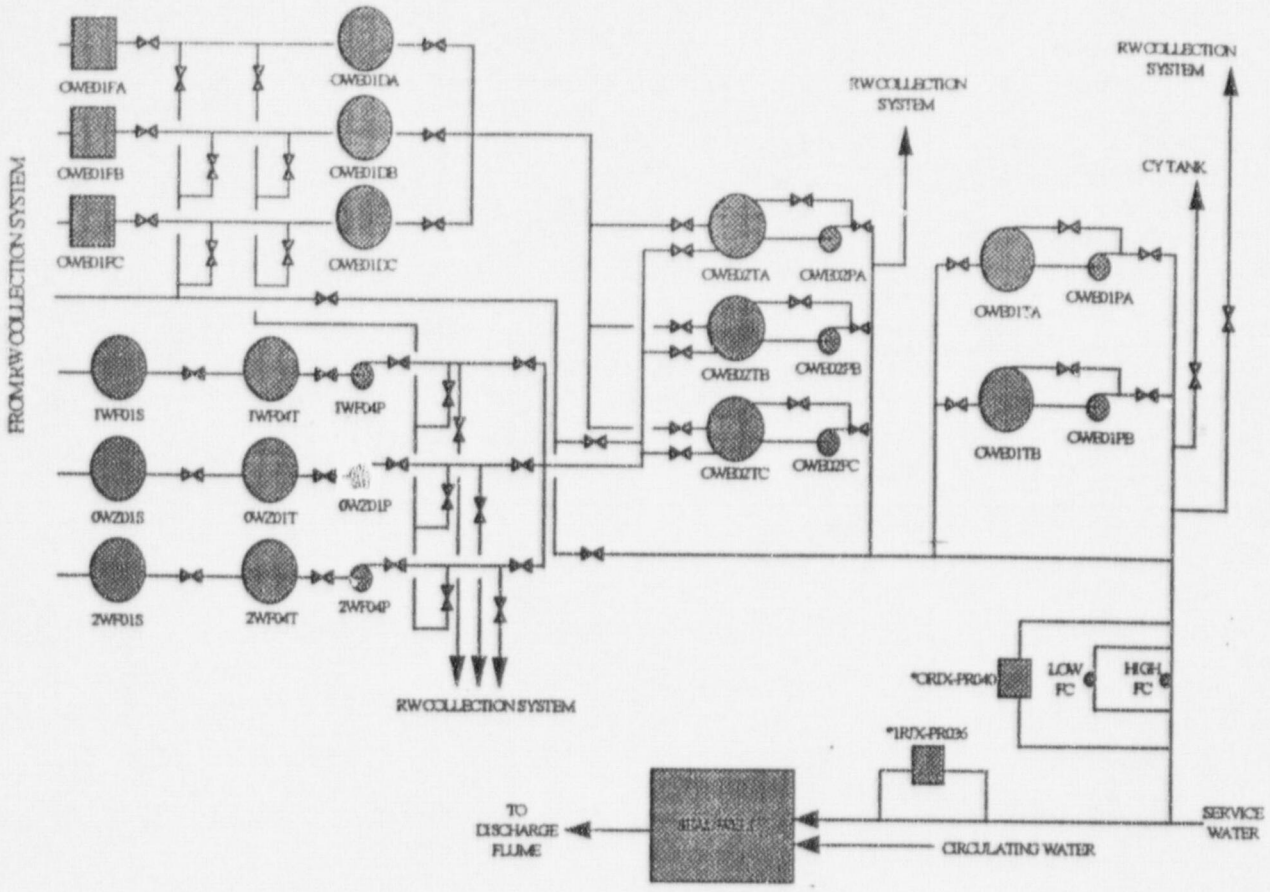
ADULT INGESTION DOSE FACTORS - DF_i
(mrem/pCi ingested)

ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I-130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I-133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I-135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS-136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS-138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA-139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA-141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA-142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA-140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA-142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE-141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE-143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE-144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR-143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR-144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND-147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W-187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP-239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

*2.84×10^{-06}
**Less than 10^{-24}

FIGURE 2.5-1

LIQUID RADWASTE TREATMENT SYSTEM

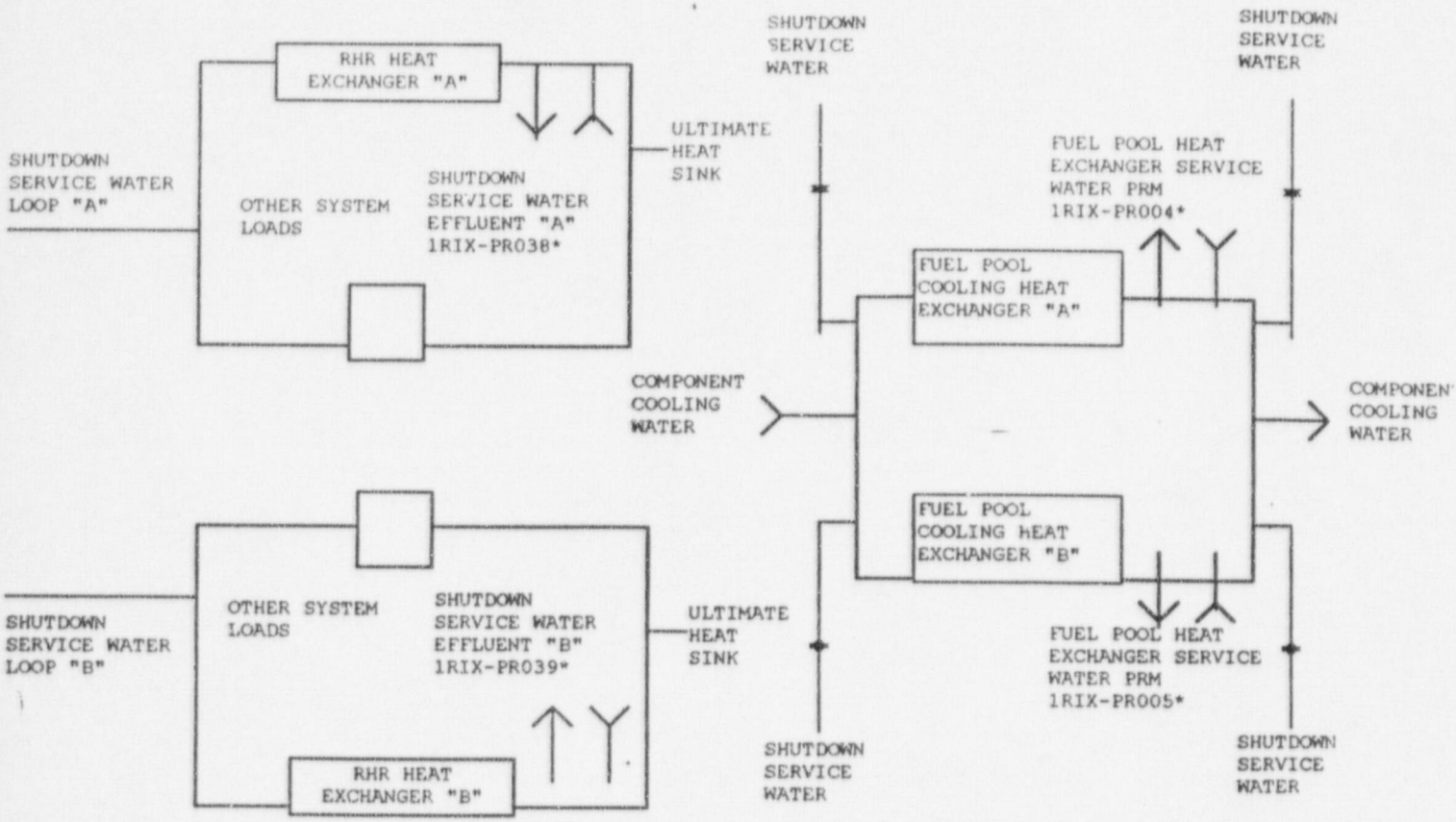


*Monitors required by Section 2.7

WF01S Floor Drain Evaporator	0WZ01P Chem. Wst. Evap. Tank Pump	2WF04T Floor Drain Evaporator Tank	0WE02PA,B, and C Waste Samp. Tk Pumps
WF01S Floor Drain Evaporator	0WE01FA,B, and C Waste Filters	0WZ01T Chem. Waste Evaporator Tank	0WE01TA and B Excess Water Tanks
0WZ01S Chemical Waste Evaporator	0WE01DA,B, and C Waste Demins	1WF04P Flr. Drn. Evap. Tank Pump	0WE01PA and B Excess Water Tank Pumps
WF04T Floor Drain Evaporator Tank	0WE02TA,B, and C Waste Sample Tks.	2WF04P Flr. Drn. Evap. Tank Pump	1PR036 Service Water PRM
			0PR040 Liquid RW Discharge PRM

FIGURE 2.5-2

SHUTDOWN AND FUEL POOL HEAT EXCHANGER SERVICE WATER
EFFLUENT MONITORS



NORMAL COOLING SUPPLY - COMPONENT COOLING WATER
EMERGENCY COOLING SUPPLY - SHUTDOWN SERVICE WATER

*Monitors required by Section 2.7

1RIX-PR038 Shutdown Service Water Effluent "A"

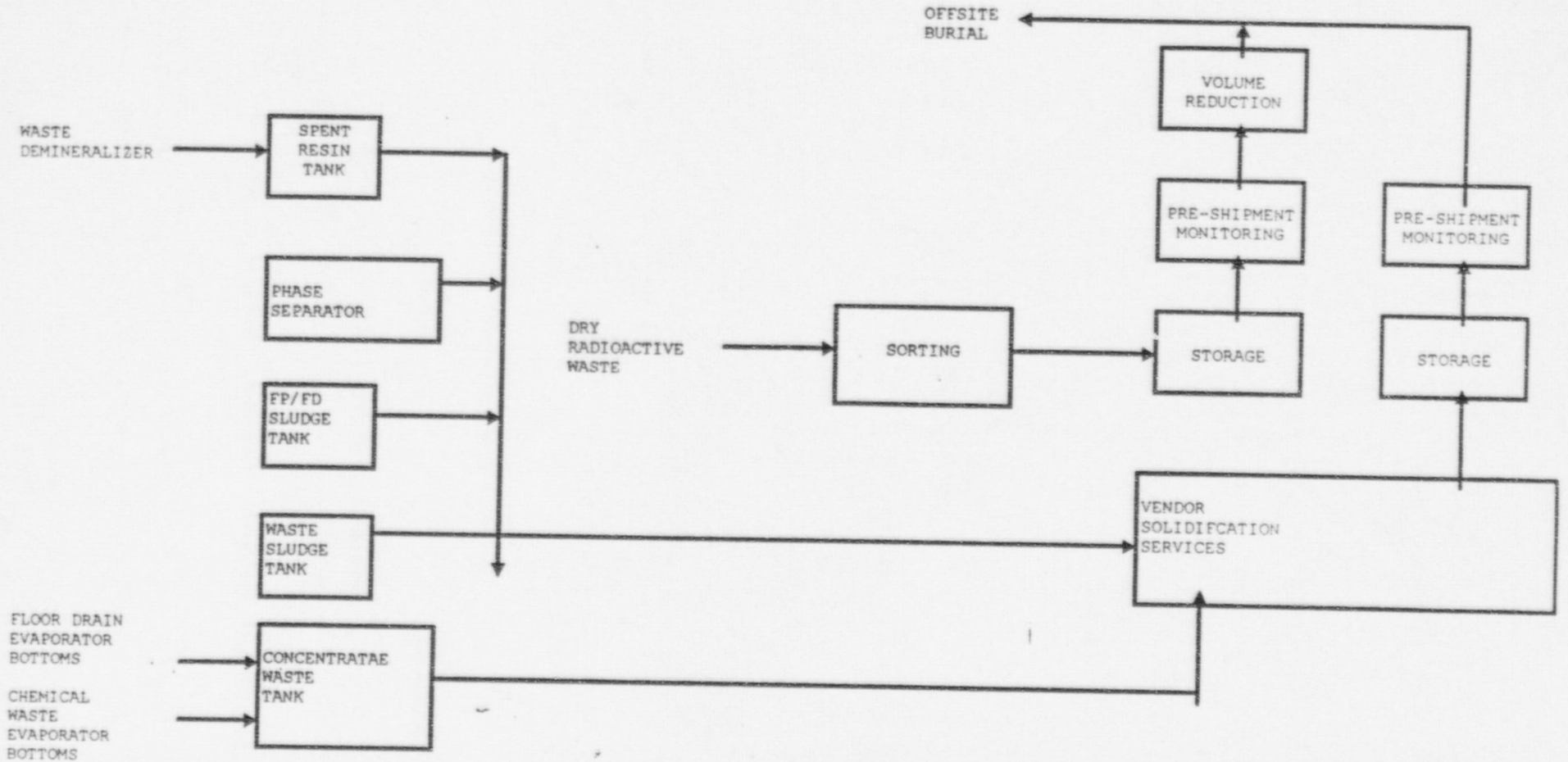
1RIX-PR039 Shutdown Service Water Effluent "B"

1RIX-PR005 Fuel Pool Heat Exchanger Service Water PRM

1RIX-PR004 Fuel Pool Heat Exchanger Service Water PRM

FIGURE 2.5-3

SOLID RADWASTE SYSTEM
SIMPLIFIED FLOW DIAGRAM



2.5 Liquid Radwaste Treatment System

2.5.1 Liquid Radwaste Treatment System - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The liquid radwaste treatment system shall be OPERABLE. The appropriate portions of the system (Figure 2.5-1) shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the projected doses due to the liquid effluent to UNRESTRICTED AREAS (see Figure 2.1-1) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31-day period. This requirement applies at all times.

REMEDIAL REQUIREMENT:

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 Regional Administrator of the Regional Office of the NRC within 30 days 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.

SURVEILLANCE REQUIREMENTS

2.5.1.1 Doses due to liquid releases to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters described in Section 2.4.2.

2.5.1.2 The liquid radwaste treatment shall be demonstrated OPERABLE by meeting the Operation Requirements of Section 2.3.1 and 2.4.1.

2.5.2 Temporary Liquid Radwaste Hold-Up Tanks

The use of temporary liquid radwaste hold-up tanks may occur at CPS. To comply with Operational Requirements Manual (ORM) 2.4.4, the curie limit for liquid radwaste stored in such tanks may be calculated using the methodology presented in Appendix B of NUREG-0133 (BWR-RATAFR code), but limited to less than or equal to 10 curies, excluding tritium and dissolved or entrained noble gases.

2.6 Doses From Other Significant Liquid Effluent Pathways

Section 2.4 of this manual is based upon the aquatic food and potable water exposure pathways only. Other exposure pathways, namely shoreline deposits and irrigated crops, may arise at Clinton Power Station and will be included in the section 2.4 dose contribution if they are likely to provide a significant contribution to the total dose. A pathway is considered significant if a conservative evaluation yields an additional dose increment greater than or equal to 10 percent of the total from all other existing pathways. Methods for calculating doses from other potentially significant liquid effluent pathways are presented in Appendix A to Regulatory Guide 1.109.

When it is determined that other liquid effluent pathways do exist, the Regulatory Guide 1.109 Appendix A equations and parameters will be used in lieu of site-specific data to determine a pathway's significance.

2.7 Radioactive Liquid Effluent Monitoring Instrumentation

2.7.1 Radioactive Liquid Effluent Monitoring Instrumentation Operation and Surveillance Requirements

OPERATION REQUIREMENT

The radioactive liquid effluent monitoring instrumentation channels shown in Table 2.7-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Section 2.3.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters described in Sections 2.3.2 through 2.3.5. This requirement applies during releases via the associated pathway.

REMEDIAL REQUIREMENT:

a. With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above requirement, without delay suspend the release of radioactive liquid 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 liquid effluent monitoring instrumentation channels OPERABLE, comply with the REMEDIAL REQUIREMENT shown in Table 2.7-1. Restore the inoperable instruments to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

SURVEILLANCE REQUIREMENTS

2.7.1.1 Each radioactive liquid effluent monitoring instrumentation control shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST at the frequencies shown in Table 2.7-2.

TABLE 2.7-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

	MINIMUM CHANNELS OPERABLE	REMEDIAL REQUIREMENT
1. RADIOACTIVE MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
a. Liquid Radwaste Discharge Process Radiation Monitor	1(a)	1
2. RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE		
a. Plant Service Water Effluent Process Radiation Monitor	1(a)	2
b. Shutdown Service Water Effluent Process Radiation Monitor	1/Division*(a)	2
c. Fuel Pool Heat Exchanger Service Water Radiation Monitor	1(a)	2
d. Component Cooling Water Process Radiation Monitor	1(a)	2
3. FLOW RATE MEASUREMENT DEVICES		
a. Liquid Radwaste Effluent Line	1	3
b. Plant Service Water Effluent Line	1	3
c. Plant Circulation Water Line	1	3
4. TANK LEVEL INDICATING DEVICES		
a. Cycled Condensate Storage	1	4
b. Reactor Core Isolation Cooling Storage	1	4

*Division I and Division II only.

TABLE 2.7-1 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

TABLE NOTATION

(a) Channel OPERABILITY shall include the capability of the Main Control Room Central Control Terminal (MCR-CCT) to provide the alarm status of the applicable radiation monitor channel(s).

REMEDIAL REQUIREMENT

REMEDIAL REQUIREMENT 1

With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue via this pathway provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with Section 2.3.1.1, and

b. At least two technically qualified members independently verify the release rate calculations and discharge line valving:

Otherwise, suspend release of radioactive effluents via this pathway.

REMEDIAL REQUIREMENT 2

a. With the communication link or the MCR-CCT inoperable perform CHANNEL CHECK using local monitor indication within 8 hours and at least once per 8 hours thereafter.

b. With the monitor otherwise inoperable, effluent releases via this pathway may continue provided that at least once per 12 hours, grab samples are collected and analyzed for radioactivity at a Lower Limit of Detection of 5.0×10^{-7} µCi/cc for the Principal Gamma Emitters. The Principal Gamma Emitters are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall be measured with an LLD of 5.0×10^{-6} µCi/cc. Dissolved and Entrained Gases (gamma emitters only) shall be measured with an LLD of 1.0×10^{-5} µCi/cc. These Dissolved and Entrained Gases are: Xe-133, Xe-135, Xe-138, Kr-85m, Kr-87, and Kr-88.

TABLE 2.7-1 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

TABLE NOTATION

REMEDIAL REQUIREMENT 3	With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided 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. All flows diverted from Plant Service Water must be taken into account when estimating dilution flow when Plant Service Water is the only dilution source.
REMEDIAL REQUIREMENT 4	With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, liquid additions to this tank may continue provided the tank liquid level is estimated during all liquid additions to the tank.

TABLE 2.7-2

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1. RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE				
a. Liquid Radwaste Discharge Process Radiation Monitor Effluent Line	D(4,5)	P	R(3)	Q(1)
2. RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE				
a. Plant Service Water Effluent Process Radiation Monitor	D(5)	M	R(3)	Q(2)
b. Shutdown Service Water Effluent Process Radiation Monitor	D(5)	M	R(3)	Q(2)
c. Fuel Pool Heat Exchanger Service Water Radiation Monitor	D(5)	M	R(3)	Q(2)
d. Component Cooling Water Process Radiation Monitor	D(5)	M	R(3)	Q(2)

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TABLE 2.7-2 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
3. FLOW RATE MEASUREMENT DEVICES				
a. Liquid Radwaste Effluent Line	D(4)	NA	R	Q
b. Plant Service Water Effluent Line	D(4)	NA	R	Q
c. Plant Circulation Water Line	D(4)	NA	R	NA
4. TANK LEVEL INDICATING DEVICES				
a. Cycled Condensate Storage	D*	NA	R	NA
b. Reactor Core Isolation Cooling	D*	NA	R	NA

*During liquid additions to the tank.

TABLE 2.7-2 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

TABLE NOTATIONS

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway occurs and that the MCR-CCT provides annunciation and event display in response to each of the following conditions:

1. Instrument indicates measured levels above the alarm/trip (HIGH) setpoint.

2. Detector failure (LOW FAIL, HI FAIL).

3. Sample flow failure (EXTERNAL FAIL).

4. Instrument not set in normal operate mode (UNINITIALIZED, CALIBRATE, MAINTENANCE, or STANDBY.)*

(2) The CHANNEL FUNCTIONAL TEST shall also demonstrate that the MCR-CCT responds with annunciation and event display to each of the following conditions:

1. Instrument indicates measured levels above the alarm (HIGH) setpoint.

2. Detector failure (LOW FAIL, HI FAIL).

3. Sample flow failure (EXTERNAL FAIL).

4. Instrument not set in normal operate mode (UNINITIALIZED, CALIBRATE, MAINTENANCE, or STANDBY.)*

*A demonstration of automatic isolation of the release pathway is not applicable to this condition.

TABLE 2.7-2 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

TABLE NOTATIONS

(3) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. 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.

(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 which continuous, periodic, or batch releases are made.

(5) Determine that channel communication is established to the MCR-CCT.

3.0 GASEOUS EFFLUENTS

3.1 Introduction

Gaseous effluents from CPS are released on both a batch and continuous basis. Gaseous effluents are normally discharged on a long term basis. High volume Continuous Containment Purge and mechanical vacuum pump discharge may be considered short term releases.

There are two gaseous effluent release points to the environment: the Common Station HVAC Stack and the Standby Gas Treatment System (SGTS) Stack. The height of these stacks is such that all gaseous effluents are treated as mixed-mode releases (reference Table 9.2-1). The SGTS is an Engineered Safety Feature filter system utilized following an accident to reduce iodine and particulate activity in gases leaking from the primary containment and which are potentially present in the secondary containment. The Common Station HVAC Stack ("HVAC Stack") receives process and ventilation exhaust from the following inputs:

1) Continuous Containment Purge (CCP)
2) Containment Building Ventilation
3) Turbine Building Ventilation
4) Radwaste Building Ventilation
5) Auxiliary Building Ventilation
6) Fuel Building Ventilation
7) Auxiliary Building Refrigerant Purge
8) Laboratory Ventilation System
9) Counting/Equipment Decon Rooms Ventilation
10) Steam Packing Exhauster
11) Mechanical Vacuum Pump
12) Drywell Purge

The effluent exiting the SGTS stack is monitored at the SGTS stack and the combined inputs to the HVAC stack are monitored at the HVAC stack. All inputs to the HVAC Stack, with the exception of input numbers 7 through 10, can be monitored prior to entering the stack.

Figure 3.1-1 delineates the CPS site boundary for implementation of gaseous effluent 10CFR20 and 10CFR50, Appendix I Release Rate Limits.

3.2 Gaseous Effluent Release Point Monitoring

3.2.1 HVAC Stack Process Radiation Monitoring (PRM) System

The HVAC Stack inputs are monitored for radioactivity prior to discharge to the environment by the HVAC Stack PRM. The PRM detector configuration provides effluent monitoring using nine (9) channels as follows:

1) Beta scintillator for particulates

2) Alpha surface barrier detector to account for the radon/thoron contribution to the beta particulate measurement

3) Gamma scintillator for iodine

4) Iodine background subtraction

5) Beta scintillator for low range noble gas

6) Energy-compensated Geiger-Mueller (G-M) detector for high range noble gas

7) Energy-compensated G-M detector for gamma area subtraction

8) Sample pressure indication at the HVAC PRM

9) Sample flow rate indication at the HVAC PRM

This monitor has no control function but annunciates in the Main Control Room where proper response actions will be initiated in accordance with CPS procedures.

3.2.2 SGTS Stack Process Radiation Monitoring (PRM) System

As discussed in section 3.1, the SGTS is used to reduce post-accident concentrations of radioactivity in the primary and secondary containment via filter trains. The SGTS Stack PRM monitors the gaseous effluent of the filter trains at the SGTS Stack prior to release to the environment. The PRM detector configuration utilizes nine (9) channels as follows:

1) Beta scintillator for particulates

2) Gamma scintillator for iodine

3) Iodine background subtraction

4) Beta scintillator for low range noble gas

5) Energy-compensated G-M detector for intermediate range noble gas

6) Energy-compensated G-M detector for gamma area subtraction

7) Alpha surface barrier detector to account for the radon/thoron contribution to the beta particulate measurement

8) Sample pressure indication at the SGTS PRM

9) Sample flow-rate indication at the SGTS PRM

This monitor has no control function but annunciates in the Main Control Room where proper response actions will be initiated in accordance with CPS procedures.

3.3 Main Condenser Off-Gas Monitoring System

3.3.1 Pre-Treatment Air Ejector Off-Gas Process Radiation Monitor (PRM)

The Pre-Treatment Off-Gas PRM monitors hydrogen recombiner effluent for gross noble gas radioactivity. This effluent is then routed to the charcoal adsorbers for eventual release to the environment via the station HVAC Stack (see Figure 3.3-1). The PRM detector configuration consists of a single energy-compensated G-M detector mounted in a gas volume.

The monitor has no control function but annunciates in the Main Control Room where proper response actions will be initiated in accordance with CPS procedures.

3.3.2 Post-Treatment Air Ejector Off-Gas Process Radiation Monitor (PRM)

The Post-Treatment Off-Gas PRM monitors the gaseous radioactivity at upstream, intermediate or downstream sections of the charcoal adsorber beds prior to the effluent entering the station HVAC Stack for release to the environment (see Figure 3.3-1). The PRM detector configuration is as described for the HVAC Stack PRM (Section 3.2.1).

The monitor has two control functions. Upon detection of noble gas activity in excess of the ALERT setpoint, the charcoal adsorber bypass valves shut (if in the charcoal bypass mode) and the off-gas is routed through the adsorbers.

Should noble gas activity exceed the HIGH setpoint, or upon PRM failure, the off-gas system is automatically isolated from the HVAC Stack and a reactor scram may occur if loss of condenser vacuum occurs.

The Main Condenser Off-Gas Treatment System is shown in Figure 3.3-1.

3.4 10CFR20 Release Rate Limits

The Operation and Surveillance Requirements concerning 10CFR20 Release Rate Limits are specified in Section 3.4.1. Dose Rate calculations for ensuring compliance with these limits are discussed in Sections 3.4.2 and 3.4.3.

3.4.1 10CFR20 Release Rate Limits - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY (see Figure 3.1-1) 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, for 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.

This requirement applies at all times.

REMEDIAL REQUIREMENT:

With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the above limit(s).

SURVEILLANCE REQUIREMENTS

3.4.1.1 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 3.4.2 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 3.4-1. | rev. 15

3.4.1.2 The dose rate due to iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in Section 3.4.3 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 3.4-1. | rev. 15

TABLE 3.4-1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection LLD (μCi/cc)
A. Station HVAC Exhaust				
1. Noble Gas and Tritium Release	W[2] Grab	W[2]	Principal Gamma Emitters[1] H-3	1.0×10^{-04} 1.0×10^{-06}
2. Iodines Release	Continuous[3]	W[4]	I-131 I-133	1.0×10^{-12} 1.0×10^{-10}
3. Particulates Release	Continuous[3]	W[4]	Principal Gamma Emitters[1]	1.0×10^{-11}
		M Composite	Gross Alpha Activity	1.0×10^{-11}
		Q Composite	Sr-89, Sr-90 Activity	1.0×10^{-11}
B. Standby Gas Treatment System Exhaust, when flow exists				
1. Noble Gas and Tritium Release	W Grab	W	Principal Gamma Emitters[1] H-3	1.0×10^{-04} 1.0×10^{-06}
2. Iodines Release	Continuous[3]	W[4]	I-131 I-133	1.0×10^{-12} 1.0×10^{-10}
3. Particulates Release	Continuous[3]	W[4]	Principal Gamma Emitters[1]	1.0×10^{-11}
		M Composite	Gross Alpha Activity	1.0×10^{-11}
		Q Composite	Sr-89, Sr-90 Activity	1.0×10^{-11}

TABLE 3.4-1 (Continued)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATIONS

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

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

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

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, $s_b = \sqrt{\frac{R_{bkg}}{t}}$

where R_{bkg} = background counts
t=the background count time

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 (sec^{-1}) and

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

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

TABLE 3.4-1 (Continued)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATIONS (Continued)

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.

[1]The principal gamma emitters are: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 in noble gas releases and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, Ce-141 and Ce-144 in iodine and particulate releases. Other gamma peaks that are identifiable, together with those of the above nuclides, shall be analyzed and reported in the Radioactive Effluent Release Report pursuant to Technical Specification 5.6.3 in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

[2]Sampling and analysis shall also be performed following shutdown, startup, or a THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period.

[3]The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Sections 3.4.1, 3.5.1 and 3.5.2.

[4]Samples shall be changed at least once per 7 days and analysis 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 period and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours or less are analyzed, the corresponding LLDs may be increased by a factor of 10. Twenty-four (24) hour sampling requirements do apply if: (1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has increased more than a factor of 3, and (2) the noble gas monitor on the applicable PRM (HVAC or SGTS) shows that effluent activity has increased more than a factor of 3.

3.4.2 Dose Rate Due to Noble Gases

In order to comply with Section 3.4.1.(a), the dose rate at or beyond the site boundary due to noble gases shall be calculated as follows:

$$D_t = \Sigma_i K_i \left[\overline{(X/Q)}_m Q_{im}\right] \quad (1)$$

D_t = total body dose rate at time of release, mrem/year

$$D_s = \Sigma_i (L_i + 1.1 M_i) \left[\overline{(X/Q)}_m Q_{im}\right] \quad (2)$$

D_s = skin dose rate at time of release, mrem/year

The terms in the above equations are defined in section 3.4.3.

3.4.3 Dose Rate Due to Radioiodines, Particulates and Tritium

In order to comply with Section 3.4.1(b), organ dose rates due to radioiodines (I-131, I-133), particulates with half-lives > 8 days and tritium shall be calculated as follows:

$$D_o = \Sigma_i P_{ij} \left[\overline{(X/Q)}_m Q_{im}\right] \quad (3)$$

D_o = organ dose rate at time of release, mrem/yr

The terms used in equations (1) through (3) are defined as follows:

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide i, mrem/yr per $\mu Ci/m^3$

L_i = The skin dose factor due to beta emissions for each identified noble gas radionuclide i, mrem/yr per $\mu Ci/m^3$

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide i, mrad/yr per $\mu Ci/m^3$ (1.1 mrem/mrad converts air dose to skin dose)

P_{ij} = The dose factor for non-noble gas radionuclide i and organ j which includes pathway transport parameters, receptor usage factors and the dosimetry of the exposure. The dose factors for the inhalation, mrem/yr per $\mu Ci/m^3$, pathway are listed in Table 3.4-3 (CHILD). Dose factors are based on NUREG-0133, Section 5.2.1.1 assumptions unless otherwise stated.

Q_{im} = The release rate of noble gas radionuclide i in gaseous effluent from mixed-mode release points, µCi/sec

Q_{im} = The release rate of non-noble gas radionuclide i in gaseous effluent from mixed-mode release points, µCi/sec

$\overline{(X/Q)}_m$ = The highest calculated average relative concentration for any area at or beyond the site boundary from mixed-mode releases, sec/m^3

D_o is calculated for each of six organs and the total body; the maximum D_o value is then used to determine compliance with Section 3.4.1(b).

The factors K_i, L_i, and M_i relate the radionuclide airborne concentrations to various dose rates assuming a semi-infinite cloud. These factors are listed in Table 3.4-2 and were obtained from Table B-1 of Regulatory Guide 1.109 after multiplying the values by the conversion 10^6 pCi/µCi.

10CFR20 organ dose rate calculations are limited to the inhalation pathway only. Section 3.4.1(a) is applicable to the unrestricted area location characterized by the $(X/Q)_m$ value which results in the maximum total body or skin dose commitment. Should the total body and skin locations differ, the selected location shall be that which minimizes allowable release rates.

There are unrestricted areas within the CPS site boundary which are utilized by members of the public for residences, farming, recreation and camping. These areas are identified in Table 3.4-4. Table 3.4-4 will be revised to remain consistent with the most recent land use census.

TABLE 3.4-2

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS*

Radionuclide	Total Body Dose Factor K_i	Skin Dose Factor L_i	Gamma Air Dose Factor M_i	Beta Air Dose Factor N_i
	(mrem/yr per $\mu Ci/m^3$)	(mrem/yr per $\mu Ci/m^3$)	(mrad/yr per $\mu Ci/m^3$)	(mrad/yr per $\mu Ci/m^3$)
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

*The listed dose factors are for radionuclides that may be detected in gaseous effluents.

TABLE 3.4-3

INHALATION PATHWAY DOSE RATE FACTORS (CHILD) - P_{ij}
(mrem/yr per $\mu Ci/m^3$)

ORGAN / ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	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	NO DATA	NO DATA	NO DATA	4.22E+04
CR-51	NO DATA	NO DATA	1.54E+02	8.55E+01	2.43+01	1.70E+04	1.08E+03
MN-54	NO DATA	4.29E+04	9.51E+03	NO DATA	1.00E+04	1.58E+06	2.29E+04
MN-56	NO DATA	1.66E+00	3.12E-01	NO DATA	1.67E+00	1.31E+04	1.23E+05
FE-55	4.74E+04	2.52E+04	7.77E+03	NO DATA	NO DATA	1.11E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	NO DATA	NO DATA	1.27E+06	7.07E+04
CO-58	NO DATA	1.77E+03	3.16E+03	NO DATA	NO DATA	1.11E+06	3.44E+04
CO-60	NO DATA	1.31E+04	2.26E+04	NO DATA	NO DATA	7.07E+06	9.62E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	NO DATA	NO DATA	2.75E+05	6.33E+03
NI-65	2.99E+00	2.96E-01	1.64E-01	NO DATA	NO DATA	8.18E+03	8.40E+04
CU-64	NO DATA	1.99E+00	1.07E+00	NO DATA	6.03E+00	9.58E+03	3.67E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	NO DATA	7.14E+04	9.95E+05	1.63E+04
ZN-69	6.70E-02	9.66E-02	8.92E-03	NO DATA	5.85E-02	1.42E+03	1.02E+04
BR-83	NO DATA	NO DATA	4.74E+02	NO DATA	NO DATA	NO DATA	LT 3.70E-15**
BR-84	NO DATA	NO DATA	5.48E+02	NO DATA	NO DATA	NO DATA	LT 3.70E-15
BR-85	NO DATA	NO DATA	2.53E+01	NO DATA	NO DATA	NO DATA	LT 3.70E-15
RB-86	NO DATA	1.98E+05	1.14E+05	NO DATA	NO DATA	NO DATA	7.99E+03
RB-88	NO DATA	5.62E+02	3.66E+02	NO DATA	NO DATA	NO DATA	1.72E+01
RB-89	NO DATA	3.45E+02	2.90E+02	NO DATA	NO DATA	NO DATA	1.89E+00
SR-89	5.99E+05	NO DATA	1.72E+04	NO DATA	NO DATA	2.16E+06	1.67E+05
SR-90	1.01E+08	NO DATA	6.49E+06	NO DATA	NO DATA	1.48E+07	3.43E+05
SR-91	1.21E+02	NO DATA	4.59E+00	NO DATA	NO DATA	5.33E+04	1.74E+05
SR-92	1.31E+01	NO DATA	5.25E-01	NO DATA	NO DATA	2.40E+04	2.42E+05
Y-90	4.11E+03	NO DATA	1.11E+02	NO DATA	NO DATA	2.62E+05	2.68E+05
Y-91m	5.07E-01	NO DATA	1.84E-02	NO DATA	NO DATA	2.81E+03	1.72+03
Y-91	9.14E+05	NO DATA	2.44E+04	NO DATA	NO DATA	2.63+06	1.84E+05
Y-92	2.04E+01	NO DATA	5.81E-01	NO DATA	NO DATA	2.39E+04	2.39E+05
Y-93	1.87E+02	NO DATA	5.11E+00	NO DATA	NO DATA	7.44E+04	3.89E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	NO DATA	5.96E+04	2.23E+06	6.11E+04
ZR-97	1.88E+02	2.72E+01	1.60E+01	NO DATA	3.89E+01	1.13E+05	3.51E+05
NB-95	2.35E+04	9.18E+03	6.55E+03	NO DATA	8.62E+03	6.14E+05	3.70E+04
MO-99	NO DATA	1.72E+02	4.26E+01	NO DATA	3.92E+02	1.35E+05	1.27E+05
TC-99m	1.78E-03	3.48E-03	5.77E-02	NO DATA	5.07E-02	9.51E+02	4.81E+03
TC-101	8.10E-05	8.51E-05	1.08E-03	NO DATA	1.45E-03	5.82E+02	1.63E+01
RU-103	2.79E+03	NO DATA	1.07E+03	NO DATA	7.03E+03	6.62E+05	4.48E+04
RU-105	1.53E+00	NO DATA	5.55E-01	NO DATA	1.34E+00	1.59E+04	9.95E+04
RU-106	1.36E+05	NO DATA	1.69E+04	NO DATA	1.84E+05	1.43E+07	4.29E+05
AG-110m	1.69E+04	1.14E+04	9.14E+03	NO DATA	2.12E+04	5.48E+06	1.00E+05
TE-125m	6.73E+04	2.33E+03	9.14E+02	1.92E+03	NO DATA	4.77E+05	3.38E+04
TE-127m	2.49E+04	8.56E+03	3.03E+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-03	5.88E-02	2.05E+03	1.33E+03

TABLE 3.4-3 (cont'd)

INHALATION PATHWAY DOSE RATE FACTORS (CHILD) - P_{ij}
(mrem/yr per $\mu Ci/m^3$)

ORGAN ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	4.81E+02	2.72E+02	2.63E+02	3.18E+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	NO DATA	5.11E+03
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	NO DATA	2.84E+03
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	NO DATA	3.20E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	NO DATA	5.48E+03
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	NO DATA	9.55E+02
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	NO DATA	4.44E+03
CS-134	6.51E+05	1.01E+06	2.25E+05	NO DATA	3.30E+05	1.21E+05	3.84E+03
CS-136	6.51E+04	1.71E+05	1.16E+05	NO DATA	9.55E+04	1.45E+04	4.18E+03
CS-137	9.07E+05	8.25E+05	1.28E+05	NO DATA	2.82E+05	1.04E+05	3.62E+03
CS-138	6.33E+02	8.40E+02	5.55E+02	NO DATA	6.21E+02	6.81E+01	2.70E+02
BA-139	1.84E+00	9.84E-04	5.37E-02	NO DATA	8.62E-04	5.77E+03	5.77E+04
BA-140	7.40E+04	6.48E+01	4.33E+03	NO DATA	2.11E+01	1.74E+06	1.02E+05
BA-141	1.96E-01	1.09E-04	6.36E-03	NO DATA	9.47E-05	2.92E+03	2.75E+02
BA-142	5.00E-02	3.60E-05	2.79E-03	NO DATA	2.91E-05	1.64E+03	2.74E+00
LA-140	6.44E+02	2.25E+02	7.55E+01	NO DATA	NO DATA	1.83E+05	2.26E+05
LA-142	1.30E+00	4.11E-01	1.29E-01	NO DATA	NO DATA	8.70E+03	7.59E+04
CE-141	3.92E+04	1.95E+04	2.90E+03	NO DATA	8.55E+03	5.44E+05	5.66E+04
CE-143	3.66E+02	1.99E+02	2.88E+01	NO DATA	8.36E+01	1.15E+05	1.27E+05
CE-144	6.77E+06	2.12E+06	3.62E+05	NO DATA	1.17E+06	1.20E+07	3.89E+05
PR-143	1.85E+04	5.55E+03	9.14E+02	NO DATA	3.00E+03	4.33E+05	9.73E+04
PR-144	5.96E-02	1.85E-02	3.00E-03	NO DATA	9.77E-03	1.57E+03	1.97E+02
ND-147	1.08E+04	8.73E+03	6.81E+02	NO DATA	4.81E+03	3.28E+05	8.21E+04
W-187	1.63E+01	9.66E+00	4.33E+00	NO DATA	NO DATA	4.11E+04	9.10E+04
NP-239	4.66E+02	3.35E+01	2.35E+01	NO DATA	9.73E+01	5.81E+04	6.40E+04

*1.12×10^{3}
**Less than 3.70×10^{-15}

TABLE 3.4-4

LOCATION OF MEMBERS OF THE PUBLIC WITHIN THE CPS SITE BOUNDARY AND THEIR ASSOCIATED OCCUPANCY FACTORS*

Location	Distance (mile/meter)	Sector	Occupancy (hrs/yr)
Road	0.3/495	SE	243(1)
Agricultural Acreage(2)	0.9/1372	SSW	966(3)
Clinton Lake	0.2/335	NW	2208(4)
Department of Conservation Recreation Area	0.8/1287	ESE	2208(5)
Residence	0.8/1219	SW	8760
Residence	1.5/2414	WSW	8760
Residence	1.7/2736	SSE	8760

(1) Assumes travel on road for forty minutes per day.

(2) Maximum farm acreage (276) within site boundary.

(3) Assumes 3.5 hours in field per acre farmed.

(4) Assumes continuous occupation on Clinton Lake for the months of June, July, and August.

(5) Assumes continuous occupation on Department of Conservation camping areas for the months of June, July, and August.

*Doses for such MEMBERS OF THE PUBLIC are provided in the Radioactive Effluent Release Report as given in Section 6.3.2.

3.5 10CFR50, APPENDIX I RELEASE RATE LIMITS

The Operation and Surveillance Requirements concerning 10CFR50 (Appendix I) Release Rate Limits are specified in Sections 3.5.1 and 3.5.2. Dose calculations for ensuring compliance with these limits are discussed in Sections 3.5.3 and 3.5.4.

3.5.1 Noble Gas Dose - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The air dose due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the SITE BOUNDARY (see Figure 3.1-1) 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.

This requirement applies at all times.

REMEDIAL REQUIREMENT:

a. With the calculated air dose from radioactive nobles gases in gaseous effluents exceeding any of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days 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

3.5.1.1 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 described in Section 3.5.3 at least once per 31 days.

3.5.2 Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The dose to a 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 Figure 3.1-1) 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.

This requirement applies at all times.

REMEDIAL REQUIREMENT:

a. 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 Regional Administrator of the Regional Office of the NRC within 30 days 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.

SURVEILLANCE REQUIREMENTS

3.5.2.1 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 described in Section 3.5.4 at least once per 31 days.

3.5.3 Noble Gas Air Dose Equations

The air dose at or beyond the site boundary due to noble gases released in gaseous effluent will be determined using the following equations.

3.5.3.1 During any calendar quarter or calendar year, for gamma radiation:

$$D_\gamma = 3.17 \times 10^{-8} \Sigma_i M_i [\overline{(X/Q)}_m Q_{im}] \quad (4)$$

3.5.3.2 During any calendar quarter or calendar year, for beta radiation:

$$D_\beta = 3.17 \times 10^{-8} \Sigma_i N_i [\overline{(X/Q)}_m Q_{im}] \quad (5)$$

where

M_i = The gamma air dose factor for each identified noble gas radionuclide i, mrad/year per $\mu Ci/m^3$ (M_i values are listed in Table 3.4-2).

N_i = The beta air dose factor for each identified noble gas radionuclide i, mrad/year per $\mu Ci/m^3$ (N_i values are listed in Table 3.4-2).

$\overline{(X/Q)}_m$ = The highest calculated average relative concentration from mixed-mode release points for areas at or beyond the site boundary, sec/m^3.

Q_{im} = The total release of noble gas radionuclide i for long-term releases from mixed-mode release points, μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

3.17×10^{-8} = The inverse of the number of seconds in a year.

Section 3.5.1 noble gas dose calculations are evaluated at the site boundary location where maximum air doses prevail. Should the beta and gamma locations differ, the selected location shall be that which minimizes allowable release rates due to the gamma component.

3.5.4 Radioiodines, Particulates and Tritium Dose Equations

The dose to an individual at or beyond the site boundary due to radioiodines (I-131, I-133), tritium and particulates with half-lives > 8 days, will be determined suing the follow equation:

for any calendar quarter or calendar year,

$$D_P = 3.17 \times 10^{-8} \Sigma_i R_{aij} W_m Q_{im} \quad (6)$$

where

Q_{im} = The releases of radionuclide i (I-131, I-133, tritium and particulates) for releases from mixed-mode release points, μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

$(D/Q)_m$ = The relative deposition from mixed-mode release points for areas at or beyond the site boundary, m^{-2}.

W_m = The dispersion parameter for estimating the dose to an individual at a controlling location for mixed-mode releases.

= $\overline{(X/Q)}_m$, sec/m^3, for the inhalation pathway at the location of the critical receptor.

= $\overline{(D/Q)}_m$, m^{-2}, for the food and ground plane pathways at the location of the critical receptor.

3.17 x 10-8 = The inverse of the number of seconds in a year.

R_{aij} = The dose factor for each identified radionuclide i, age group (a) and organ j, m^2-mrem/year per µCi/sec or mrem/year per $\mu Ci/m^3$.

Section 3.5.2 is applicable to the location at or beyond the site boundary where the combination of existing pathways and receptor age groups indicates the maximum potential exposure. The inhalation and ground plane exposure pathways exist at all locations; other pathways exist as determined by the most current land use census.

3.5.4.1 Dose Factor For Radionuclide i (R_{aij})

The R_{aij} values used to calculate D_p in equation (6) are determined separately for each of the potential exposure pathways, namely:

- Inhalation (I)
- Ground Plane Contamination (G)
- Grass-Cow/Goat-Milk (C)
- Grass-Cow-Meat (M)
- Vegetation (V)

The R_{aij} parameter is independent of the duration of gaseous releases and is calculated using the methodology discussed in the remainder of this section.

3.5.4.1.1 Calculation of the Inhalation Pathway Factor, R^I_{aij}

$$R^I_{aij} = K'(BR)_a(DFA_i)_a, \text{ mrem/year per } \mu Ci/m^3 \quad (7)$$

where

K' = A units conversion constant, 10^6 pCi/µCi

$(BR)_a$ = The breathing rate of the receptor age group (a), m^3/year

= 1400 (infant)
= 3700 (child)
= 8000 (teen and adult)

Values for $(BR)_a$ are obtained from NUREG-0133, pg. 32

$(DFA_i)_a$ = The organ inhalation dose factor for receptor of age group (a) for radionuclide i, mrem/pCi. Values for $(DFA_i)_a$ were obtained from Tables E-7 through E-10 of Regulatory Guide 1.109 and are presented in Tables 3.5-1 through 3.5-4 of this manual.

3.5.4.1.2 Calculation of the Ground Plane Pathway Factor, R^G_i

$$R^G_i = K'K''(SF)(DFG_i)[(1-e^{-\lambda_i t})/\lambda_i], \quad (8)$$

m^2-mrem/year per µCi/sec

where

K' = A units conversion constant, 10^6 pCi/µCi

K" = A units conversion constant, 8760 hour/year

SF = The shielding factor, dimensionless

= 0.7 as suggested in Table E-15 of Regulatory Guide 1.109

DFG_i = The ground plane dose conversion factor for radionuclide i, mrem/hour per pCi/m^2. Values for DFG_i were obtained from Table E-6 of Regulatory Guide 1.109 and are presented in Table 3.5-5 of this manual.

λ_i = The decay constant for radionuclide i, sec^{-1}

t = The exposure time, sec

= 6.31E+08 sec (20 years)

3.5.4.1.3 Calculation of the Grass-Cow/Goat-Milk Pathway Factor, R^C_{aij}

$$R^C_{aij} = K'[Q_F(U_{ap})/(\lambda_i + \lambda_w)]\, F_m(r)(DFL_i)_a \quad (9)$$

$$[f_p f_s/Y_p + (1-f_p f_s)e^{-\lambda_i t_h}/Y_s]e^{-\lambda_i t_f},$$

m^2-mrem/yr per µCi/sec

where

K' = A units conversion constant, 10^6 pCi/µCi

Q_F = The cow/goat feed consumption rate, kg(wet)/day

U_{ap} = The receptor's milk consumption rate for age group (a), liters/year

Y_p = The agricultural productivity by unit area of pasture feed grass, kg/m^2

Y_s = The agricultural productivity by unit area of stored feed, kg/m^2

F_m = The stable element transfer coefficient for milk, days/liter

r = Fraction of deposited activity retained on feed grass, dimensionless

$(DFL_i)_a$ = The organ ingestion dose factor for radionuclide i and the receptor in age group (a), mrem/pCi. Values for $(DFL_i)_a$ were obtained from Tables E-11 through E-14 of Regulatory Guide 1.109 and are presented in Table 3.5-6 through 3.5-9 of this manual.

λ_i = The decay constant for radionuclide i, sec^{-1}

λ_w = The decay constant for removal of activity on leaf and plant surfaces by weathering, sec^{-1}

= 5.73×10^{-7} sec^{-1} (corresponding to a 14-day half-life)

t_f = The transport time from pasture to animal, to milk, to receptor, sec

t_h = The transport time from pasture to harvest, to animal, to receptor, sec

f_p = Fraction of the year that the cow/goat is on pasture, dimensionless

f_s = Fraction of the cow/goat feed that is pasture grass while the cow/goat is on pasture, dimensionless

The input parameters for calculating R^C_{aij} are listed in Table 3.5-10.

Tritium

The concentration of tritium in milk is based on its airborne concentration rather than the deposition.

$$R^{C}_{T} = K'K''F_{m}Q_{f}U_{ap}(DFL_{i})_{a} 0.75(0.5/H), \text{ mrem/yr per } \mu Ci/m^{3} \quad (10)$$

where

K" = A units conversion constant, 10^{3} gm/kg

H = The absolute atmospheric humidity

= 8 gm/m^{3} (NUREG-0133, p. 34)

0.75 = The fraction of total feed that is water, dimensionless

0.5 = The ratio of the specific activity of the feed grass water to the atmospheric water, dimensionless

The other parameters are as defined in the calculation of R^{C}_{aij}

Carbon - 14

Following the development of equation C-8 on page 1.109-26 of Regulatory Guide 1.109, carbon-14 is assumed to be released as an oxide, either $C^{14}O$ or $C^{14}O_{2}$. The concentration of carbon-14 in milk is therefore based upon its airborne concentration assuming that the vegetation C^{14}/C ratio is the same as the local atmospheric C^{14}/C ratio.

$$R^{C}_{14} = K'K''F_{m}Q_{f}U_{ap}(DFL_{i})_{a}\, p(0.11/0.16), \text{ mrem/yr per } \mu Ci/m^{3} \quad (11)$$

where

p = Fractional equilibrium ratio, dimensionless

= Ratio of the total annual C-14 atmospheric release time to the total annual photosynthesis time (4400 hours) not to exceed unity

= 1.0

0.11 = Natural carbon fraction of total plant mass, dimensionless

0.16 = Atmospheric natural carbon concentration, gm/m^3

The other parameters are as defined in the calculation of R^C_T

3.5.4.1.4 Calculation of the Grass-Cow-Meat Pathway Factor, R^M_{aij}

$$R^M_{aij} = [K'Q_F(U_{ap})/(\lambda_i + \lambda_w)]F_f(r)(DFL_i)_a [f_p f_s/Y_p + [(1-f_p f_s)/Y_s]e^{-\lambda_i t_h}]e^{-\lambda_i t_s}, \quad m^2\text{-mrem/yr per } \mu Ci/sec \qquad (12)$$

where

K' = A units conversion constant, 10^6 pCi/μCi

U_{ap} = The receptor's meat consumption rate for age group (a), kg/year

F_f = The stable element transfer coefficient, days/kg

t_s = The transport time from slaughter of meat animal to receptor, seconds

t_h = The transport time from crop field to receptor, seconds

$(DFL_i)_a$ = The organ ingestion dose factor for radionuclide i and the receptor in age group (a), mrem per pCi. Values are tabulated in Table 3.5-6 through 3.5-9 of this manual.

The input parameters necessary for calculating R^M_{aij} are listed in Table 3.5-11. All other terms are as defined for equations (9) and (10).

Tritium

The concentration of tritium in meat is based on its airborne concentration rather than the deposition.

$$R^M_T = K'K''F_f Q_F U_{ap}(DFL_i)_a [0.75(0.5/H)], \quad mrem/yr \text{ per } \mu Ci/m^3 \qquad (13)$$

The terms in equation (13) are as defined in equations (10) and (12).

Carbon - 14

Following the development of equation C-8 on page 1.109-26 of Regulatory Guide 1.109, carbon-14 is assumed to be released as an oxide, either $C^{14}O$ or $C^{14}O_2$. The concentration of carbon-14 in meat is therefore based upon its airborne concentration assuming that the vegetation C^{14}/C ratio is the same as the local atmospheric C^{14}/C ratio.

$$R^{M}_{14} = K'K''F_f Q_f U_{ap} (DFL_i)_a \, p(0.11/0.16), \text{ mrem/yr per } \mu Ci/m^3 \quad (14)$$

The terms in equation (14) are as defined in equations (11) and (13).

3.5.4.1.5 Calculation of the Vegetation Pathway Factor, R^{V}_{aij}

$$R^{V}_{aij} = K'[(r)/[Y_v(\lambda_i + \lambda_w)]](DFL_i)_a [U^{L}_{a} f_L e^{-\lambda_i t_L} + U^{S}_{a} f_g e^{-\lambda_i t_h}], \text{ m}^2\text{-mrem/yr per } \mu Ci/sec \quad (15)$$

where

K' = A units conversion constant, 10^6 pCi/μCi

U^{L}_{a} = The consumption rate of fresh leafy vegetation by the receptor in age group (a), kg/year

U^{S}_{a} = The consumption rate of stored vegetation by the receptor in age group (a), kg/yr

f_L = The fraction of the annual intake of fresh leafy vegetation grown locally, dimensionless

f_g = The fraction of the annual intake of stored vegetation grown locally, dimensionless

t_L = The average time between harvest of leafy vegetation and its consumption, seconds

t_h = The average time between harvest of stored vegetation and its consumption, seconds

Y_v = the vegetation area density, kg/m^2

$(DFL_i)_a$ = The organ ingestion dose factor for radionuclide i and the receptor in age group (a), mrem per pCi. Values are tabulated in Table 3.5-6 through 3.5-9 of this manual.

The input parameters necessary for calculating R^V_{aij} are listed in Table 3.5-12. All other terms are as defined for equations (9) and (14).

Tritium

The concentration of tritium in vegetation is based on its airborne concentration rather than the deposition.

$$R^V_T = K'K''(U^L_a f_L + U^S_a f_g)(DFL_i)_a\ [0.75(0.5/H)], \quad \text{mrem/yr per } \mu Ci/m^3 \qquad (16)$$

The terms in equation (16) are as defined in equations (10) and (15).

Carbon - 14

Following the development of equation C-8 on page 1.109-26 of Regulatory Guide 1.109, carbon-14 is assumed to be released as an oxide, either $C^{14}O$ or $C^{14}O_2$. The concentration of carbon-14 in vegetation is therefore based upon its airborne concentration assuming that the vegetation C^{14}/C ratio is the same as the local atmospheric C^{14}/C ratio.

$$R^V_{14} = K'K''(U^L_a f_L + U^S_a f_g)(DFL_i)_a\, p(0.11/0.16), \quad \text{mrem/yr per } \mu Ci/m^3 \qquad (17)$$

The terms in equation (17) are as defined in equations (11) and (15).

The pathway dose rate factors (R^I_{aij}, R^C_{aij}, R^V_{aij}, R^M_{aij}, R^G_i), by age group are listed in Table 3.5-13 through 3.5-31.

3.6 Gaseous Radwaste (Offgas Treatment)

3.6.1 Gaseous Radwaste (Offgas Treatment) System - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The GASEOUS RADWASTE (OFFGAS) TREATMENT SYSTEM shall be in operation. This requirement applies whenever the main condenser steam jet air ejector system is in operation.

REMEDIAL REQUIREMENT:

a. With gaseous radwaste from the main condenser air ejector system being discharged without treatment for more than 7 days, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days a Special Report that includes the following information:

1. 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.

SURVEILLANCE REQUIREMENT

3.6.1.1 The GASEOUS RADWASTE (OFFGAS) TREATMENT SYSTEM shall be verified to be in operation once every 12 hours when the main condenser air ejector is in use to ensure that the main condenser offgas treatment system is functioning.

NOTE

When placing the Offgas Treatment System in the charcoal bypass mode, the alarm setpoints for the Station HVAC Exhaust and the Post-Treatment Offgas radiation monitors may be calculated to account for the increased fractions of short-lived noble gases. The noble gas release fractions shall be based either on actual measured values or on design basis noble gas concentration fractions (30-minute delay) in the primary coolant offgas.

3.7 Ventilation Exhaust Treatment

3.7.1 Ventilation Exhaust Treatment System - Operation and Surveillance Requirement

OPERATION REQUIREMENT

The VENTILATION EXHAUST TREATMENT SYSTEM (VETS) shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected doses due to gaseous effluent releases to areas at and beyond the SITE BOUNDARY (see Figure 3.1-1) would exceed 0.3 mrem to any organ in a 31-day period. This requirement applies at all times other than when the VETS is undergoing routine maintenance.

REMEDIAL REQUIREMENT:

a. With gaseous waste being discharged without treatment and in excess of the above limit, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days a Special Report that includes the following information:

   1. Explanation of why gaseous 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.

SURVEILLANCE REQUIREMENTS

3.7.1.1 Doses due to gaseous releases from the site shall be projected at least once per 31 days in accordance with this manual when the ventilation exhaust treatment system is not in use.*

*The projected doses resulting from such releases will be calculated using Section 3.5.4 methodology. If the dose impact resulting from the projected 31-day release exceeds 0.3 mrem and the VETS is capable of reducing the projected impact to less than 0.3 mrem, the VETS shall be used.

3.7.1.2 The installed VENTILATION EXHAUST TREATMENT SYSTEM shall be considered OPERABLE by meeting the Operation Requirements of Sections 3.4, 3.5.1, and 3.5.2.

3.8 Effluent Monitor Setpoint Calculations

Gaseous effluent Process Radiation Monitor (PRM) alarm setpoints shall be calculated to ensure that the instantaneous dose rate in unrestricted areas due to noble gases released do not exceed 500 mrem/year to the total body and 3000 mrem/year to the skin. The initial setpoints were calculated using the BWR/GALE code radionuclide mix obtained for CPS; when the actual radionuclide mix can be determined, it will be used for setpoint calculations. The PRM setpoints are based on the instantaneous noble gas dose rates and are applied at the point of which the effluent enters an unrestricted area.

Due to PRM limitations, non-noble gas setpoints will not be implemented to demonstrate compliance with Section 3.4.1(b). Compliance with the organ dose rate limitation is demonstrated during performance of sampling and analysis activities required by Table 3.4-1.

Both total body and skin dose setpoints will be calculated and the more restrictive limit applied to the respective PRM. The actual setpoint used may be lower than the restrictive limit since the two release points will be partitioned such that their sum does not exceed 100 percent of the restrictive limit. The percentages used to partition the release points could vary at plant discretion to accommodate plant operational conditions. In no case will the combined releases due to variations in the PRM setpoints result in effluent limits being exceeded.

3.8.1 Total Body Dose Rate Setpoint

The fraction of the total gaseous radioactivity in each gaseous effluent release path j for each noble gas radionuclide i shall be determined using the following relationship:

$$f_{ij} = C_{ij}/(\Sigma_i C_{ij}), \text{ dimensionless} \qquad (18)$$

where

C_{ij} = The measured concentration of identified noble gas radionuclide i in gaseous effluent release path j, μCi/cc

The maximum acceptable release rate of all noble gases in release path j to comply with Section 3.4.1 is calculated by using the equation:

$$Q_{Tj} = 500\ F_j / [\overline{(X/Q)}_j \Sigma_i (K_i F_{ij})], \ \mu Ci/sec \qquad (19)$$

where

Q_{Tj} = The maximum acceptable release rate of all noble gases in release path j, μCi/sec

F_j = Total dose rate allocation factor assigned to release path j (varying between 0.0 and 1.0), dimensionless

500 = Total body dose rate limit specified in Section 3.4.1(a), mrem/year

$\overline{(X/Q)}_j$ = The highest calculated average relative concentration of release path j at the site boundary

K_i = The total body dose factor due to gamma emissions of noble gas radionuclide i as listed in Table B-1 of Regulatory Guide 1.109 and Table 3.4-2 of this manual, mrem/yr per $\mu Ci/m^3$

f_{ij} = The fraction as defined by equation (18), dimensionless

The total maximum acceptable concentration setpoint of noble gas radionuclides in release path j is calculated using the following equation:

$$C_{Tj} = {}^{Q}T_j / R_j, \ \mu Ci/cc \qquad (20)$$

where

C_{Tj} = The total maximum acceptable concentration setpoint of all noble gases in release path j, μCi/cc

Q_{Tj} = The maximum acceptable release rate of all noble gases in release path j determined from equation (19), µCi/sec

R_j = The effluent release rate of release point j, cc/sec

3.8.2 Skin Dose Rate Setpoint

To ensure compliance with the section 3.4.1(a) skin dose rate limit, PRM setpoints shall be calculated using the methodology presented in Section 3.8.1 and by substituting the following equation for equation (19):

$$Q_{sj} = 3000F_j / [\overline{(X/Q)}_j \Sigma_i (L_i + 1.1M_i a_{ij})], \text{ µCi/sec} \quad (21)$$

where

Q_{sj} = The maximum acceptable release rate of all noble gases in release path j, µCi/sec

F_j = Total dose rate allocation factor assigned to release path j (varying between 0.0 and 1.0), dimensionless

3000 = Skin dose rate limit specified in Section 3.4.1(a), mrem/year

$\overline{(X/Q)}_j$ = The highest calculated average relative concentration of release path j at the site boundary

L_i = The skin dose factor due to gamma emissions for each identified noble gas radionuclide i, mrem/yr per µCi/m^3, as listed in Table 3.4-2 of this manual.

1.1 = An air dose to skin dose equivalent conversion factor, mrem/mrad

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide i, mrad/yr per µCi/m^3, as listed in Table 3.4-2 of this manual

f_{ij} = The fraction defined by equation (18)

The calculated total body and skin maximum acceptable concentration setpoints are compared and the more restrictive setpoint used. A safety factor may also be applied to the concentration setpoint calculated by equation (20) to compensate for statistical fluctuations and measurement errors.

3.9 Radioactive Gaseous Monitoring Instrumentation

3.9.1 Offgas Radiation Monitoring Instrumentation - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The offgas radiation monitoring instrumentation channels shown in Table 3.9.1-1 shall be OPERABLE, with their alarm/trip setpoints within the specified limits. This requirement applies during operation of the main condenser air ejector(s).

REMEDIAL REQUIREMENT:

a. With a radiation monitoring instrumentation channel alarm/trip setpoint exceeding the value shown in Table 3.9.1-1, adjust the setpoint to within the limit within 4 hours or declare the channel inoperable.

b. With one or more radiation monitoring channels inoperable, comply with the REMEDIAL REQUIREMENT specified by Table 3.9.1-1.

SURVEILLANCE REQUIREMENTS

3.9.1.1 Each of the above required radiation monitoring instrumentation channels shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION at the frequencies shown in Table 3.9.1-2.

TABLE 3.9.1-1

OFFGAS RADIATION MONITORING INSTRUMENTATION

INSTRUMENTATION	MINIMUM CHANNELS OPERABLE[b]	ALARM/TRIP SETPOINT	REMEDIAL REQUIREMENT
1. Pre-treatment Off-gas PRM - Noble Gas Activity Monitor	1 [e]	$\leq$ 50 µCi/cc[a,c]	5
2. Post-treatment Off-gas PRM			
a. High-Range Noble Gas Activity Monitor Providing Alarm and Automatic Termination of Release	1 [e]	$\leq$ 7.05 µCi/cc[d]	6
b. Effluent System Flow Rate Measuring Device	1	NA	7
c. Sample Flow Rate Measuring Device	1	NA	7

TABLE 3.9.1-1 (Continued)

OFFGAS RADIATION MONITORING INSTRUMENTATION

TABLE NOTATIONS

a Alarm only.

b A channel may be placed in an inoperable status for up to 1 hour for the purpose of performing surveillances.

c Radioactivity concentration expected at the monitor location is a noble gas mix with a 2.9-minute decay.

d Radioactivity concentration expected at the monitor location is a noble gas mix released from the off-gas treatment system.

e Channel OPERABILITY shall include the capability of the Main Control Room Central Control Terminal (MCR-CCT) to provide the alarm status of the applicable radiation monitor channel(s).

REMEDIAL REQUIREMENT

REMEDIAL REQUIREMENT 5

a. With the MCR-CCT inoperable,

1. Perform a CHANNEL CHECK using local monitor indication within 8 hours and at least once per 8 hours thereafter, and

2. Restore the MCR-CCT to OPERABLE status for the applicable channel(s) within the next 30 days, and if unsuccessful, prepare and submit to the Regional Administrator of the Regional Office of the NRC within the next 10 days a Special Report outlining the cause of the CCT failure or malfunction and the action taken to restore the inoperable equipment to OPERABLE status.

TABLE 3.9.1-1 (Continued)

OFFGAS RADIATION MONITORING INSTRUMENTATION

TABLE NOTATIONS

b. With the Pre-treatment Off-gas PRM - Noble Gas Activity Monitor otherwise inoperable, gases from the main condenser off-gas treatment system may be released to the environment provided:

1. The off-gas treatment system is not bypassed, and

2. The post-treatment air ejector off-gas PRM high range noble gas activity monitor is OPERABLE, or the provisions of REMEDIAL REQUIREMENT 6-b are in effect.

REMEDIAL REQUIREMENT 6

a. With the MCR-CCT inoperable,

1. Perform a CHANNEL CHECK using local monitor indication within 8 hours and at least once per 8 hours thereafter, and

2. Restore the MCR-CCT to OPERABLE status for the applicable channel(s) within the next 30 days, and if unsuccessful, prepare and submit to the Regional Administrator of the Regional Office of the NRC within the next 10 days a Special Report outlining the cause of the CCT failure or malfunction and the action taken to restore the inoperable equipment to OPERABLE status.

TABLE 3.9.1-1 (Continued)

OFFGAS RADIATION MONITORING INSTRUMENTATION

TABLE NOTATIONS

b. With the Post-treatment Off-gas PRM High Range Noble Gas Activity Monitor otherwise inoperable, effluent releases via this pathway may continue provided grab samples are taken at least once per 8 hours, and a noble gas gamma isotopic analysis performed within 24 hours.

REMEDIAL REQUIREMENT 7

With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 8 hours.

TABLE 3.9.1-2

OFFGAS RADIATION MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENTATION	CHANNEL CHECK	SOURCE CHECK	CHANNEL FUNCTIONAL TEST	CHANNEL CALIBRATION
1. Pre-Treatment Off-gas PRM-Noble Gas Activity Monitor	D(3)	M	Q(1)	R(2)
2. Post-Treatment Off-gas PRM				
a. High Range Noble Gas Activity Monitor Providing Alarm and Automatic Termination of Release	D(3)	D	Q(1)	R(2)[a]
b. Effluent System Flow-Rate Measuring Device	D	NA	Q	R
c. Sample Flow-Rate Measuring Device	D	NA	Q	R

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TABLE 3.9.1-2 (Continued)

OFFGAS RADIATION MONITORING
INSTRUMENTATION SURVEILLANCE REQUIREMENTS

TABLE NOTATION

a Automatic isolation of valve 1N66-F060 shall be demonstrated during the CHANNEL CALIBRATION.

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that the MCR-CCT responds with annunciation and event display to each of the following conditions:

1. Instrument indicates measured levels above the alarm/trip (HIGH) setpoint.

2. Detector failure (LOW FAIL, HI FAIL).

3. Sample flow failure (EXTERNAL FAIL).

4. Instrument not set in normal operate mode (UNINITIALIZED, CALIBRATE, MAINTENANCE, or STANDBY).

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended energy range and measurement range. Subsequent CHANNEL CALIBRATION shall be performed using the initial radioactive standards or other standards of equivalent quality or radioactive sources that have been related to the initial calibration.

(3) The CHANNEL CHECK shall also determine that channel communication is established to the MCR-CCT.

3.9.2 Radioactive Gaseous Effluent Monitoring Instrumentation - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.9.2-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Section 3.4.1 and Technical Specification 3.7.5 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in this manual. This requirement applies as shown in Table 3.9.2-1.

REMEDIAL REQUIREMENT:

a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above requirement, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, comply with the REMEDIAL REQUIREMENT specified in Table 3.9.2-1. Restore the inoperable instrumentation to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report pursuant to Technical Specification 5.6.3 why this inoperability was not corrected in a timely manner.

SURVEILLANCE REQUIREMENTS

3.9.2.1 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 3.9.2-2.

TABLE 3.9.2-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE[c]	APPLICABILITY	REMEDIAL REQUIREMENT
1. Station HVAC Exhaust PRM			
a. High-Range Noble Gas Activity Monitor	1[d]	a	8
b. Low-Range Noble Gas Activity Monitor	1[d]	a	8
c. Iodine Sampler[(e)]	1	a	9
d. Particulate Sampler[(e)]	1	a	9
e. Sample Flow-Rate Measuring Device	1	a	10
2. Standby Gas Treatment System Exhaust PRM			
a. High-Range Noble Gas Activity Monitor	1[d]	b	8
b. Low-Range Noble Gas Activity Monitor	1[d]	b	8
c. Iodine Sampler[e]	1	b	9
d. Particulate Sampler[e]	1	b	9
e. Sample Flow-Rate Measuring Device	1	b	10
3. Station HVAC Effluent System Flow-Rate Measuring Device (10PR051-6)	1	a	10
4. SGTS Effluent System Flow-Rate Measuring Device (10PR051-1), 0FIVG004, or 0FIVG104	1	b	10

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TABLE 3.9.2-1 (Continued)
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
TABLE NOTATIONS

a At all times.

b During standby gas treatment system operation.

c A channel may be placed in an inoperable status for up to 1 hour for the purpose of performing surveillances.

d Channel OPERABILITY shall include the capability of the Main Control Room Central Control Terminal (MCR-CCT) to provide the alarm status of the applicable radiation monitor channel(s).

e Filter media (particulate collection patch for particulates and charcoal cartridge for iodines) in place with an operating sample pump constitutes an iodine/particulate sampler.

REMEDIAL REQUIREMENT

REMEDIAL REQUIREMENT 8

a. With the communication link OR the MCR-CCT inoperable, perform a CHANNEL CHECK using local monitor indication within 8 hours and at least once per 8 hours thereafter. Rev. 15

b. With the noble gas activity monitor channel(s) otherwise inoperable, effluent releases via this pathway may continue provided grab samples are taken at least once per 8 hours and analyzed for gross noble gas activity within 24 hours.

REMEDIAL REQUIREMENT 9

With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via this pathway may continue provided that, within 4 hours after the channel has been declared inoperable, samples required by Table 3.4-1 are continuously collected with auxiliary sampling equipment.

REMEDIAL REQUIREMENT 10

With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours.

TABLE 3.9.2-2

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	APPLICABILITY
1. Station HVAC Exhaust PRM					
a. High-Range Noble Gas Activity Monitor	D[3]	M	R(2)	Q(1)	a
b. Low-Range Noble Gas Activity Monitor	D[3]	M	R(2)	Q(1)	a
c. Iodine Sampler	W	NA	NA	NA	a
d. Particulate Sampler	W	NA	NA	NA	a
e. Sample Flow Rate Measuring Device	D	NA	R	Q	a
f. Effluent System Flow Rate Measuring Device	D	NA	R	Q	a
2. Standby Gas Treatment System Exhaust PRM					
a. High-Range Noble Gas Activity Monitor	D[3]	NA	R(2)	Q(1)	b
b. Low-Range Noble Gas Activity Monitor	D[3]	M	R(2)	Q(1)	b
c. Iodine Sampler	W	NA	NA	NA	b
d. Particulate Sampler	W	NA	NA	NA	b
e. Sample Flow Rate Measuring Device	D	NA	R	Q	b
f. Effluent System Flow Rate Measuring Device	D	NA	R	Q	b

TABLE 3.9.2-2 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

TABLE NOTATIONS

a At all times.

b During operation of the standby gas treatment system.

❶(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that the MCR-CCT responds with annunciation and event display to each of the following conditions:

1. Instrument indicates measured levels above the alarm (HIGH) setpoint.

2. Detector failure (LOW FAIL, HI FAIL).

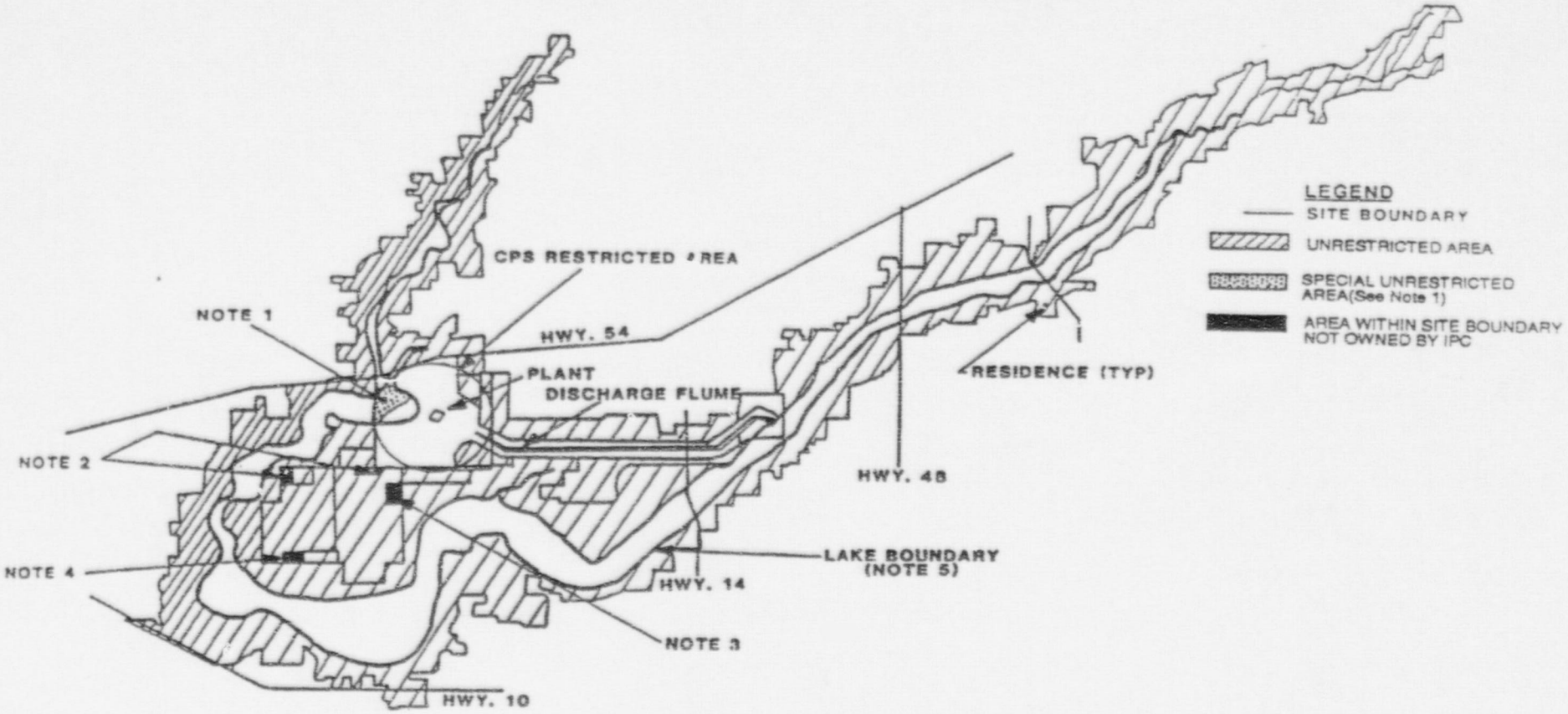
3. Sample flow failure (EXTERNAL FAIL).

4. Instrument not set in normal operate mode (UNINITIALIZED, CALIBRATE, MAINTENANCE, or STANDBY).

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. Subsequent CHANNEL CALIBRATION shall be performed using the initial radioactive standards or other standards of equivalent quality or radioactive sources that have been related to the initial calibration.

❶(3) The CHANNEL CHECK shall also determine that channel communication is established to the MCR-CCT.

FIGURE 3.1-1
CPS SITE BOUNDARY FOR GASEOUS EFFLUENTS

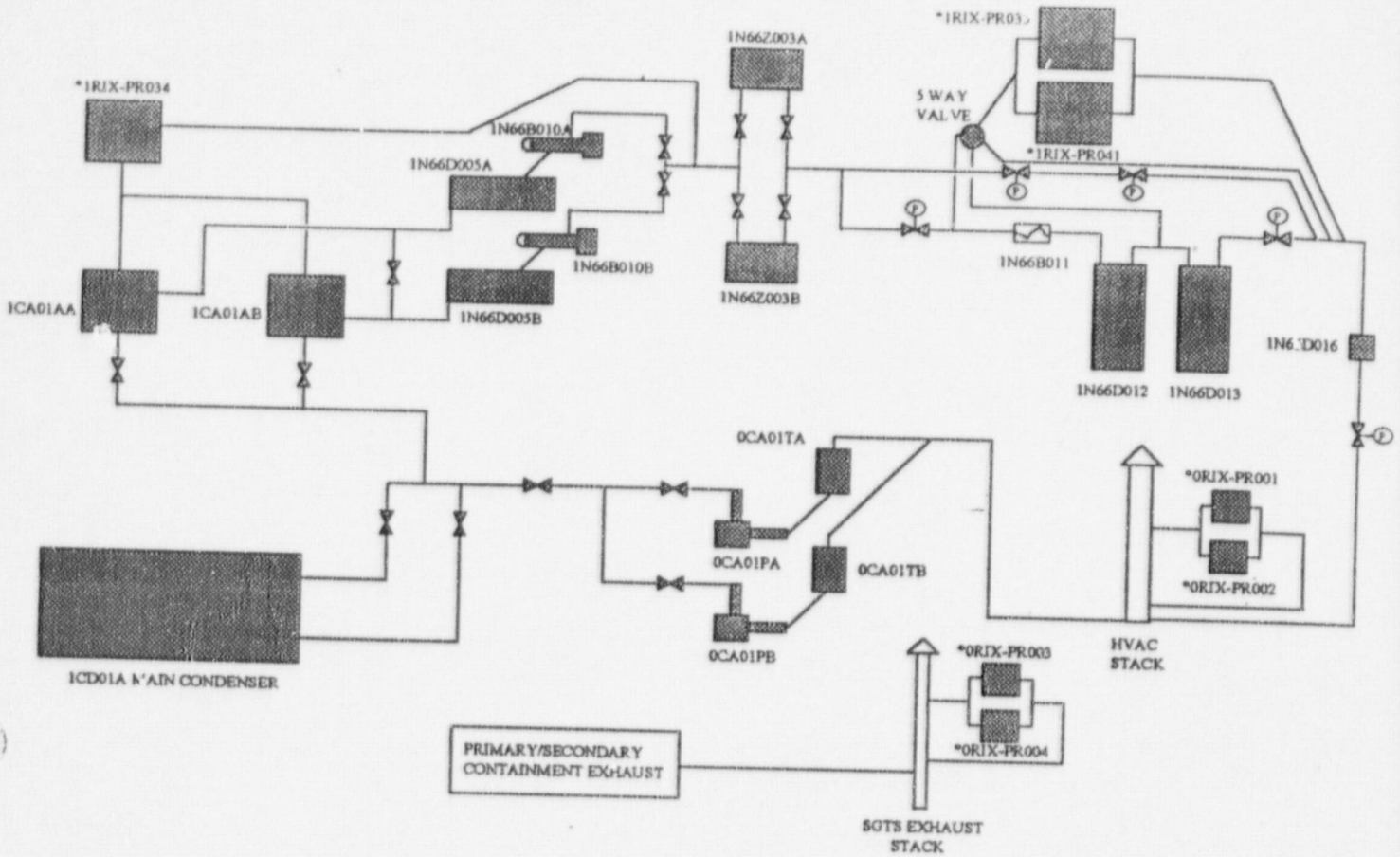


NOTES

1. The area in the lake between the buoys and the exclusion area boundary is unrestricted at this time. But will be controlled if plant effluent conditions warrant closure.
2. Land parcel not owned by Illinois Power, includes residences.
3. Land parcel not owned by Illinois Power, oil company pipeline pumping station.
4. Land parcel not owned by Illinois Power, agricultural use.
5. The lake shoreline is approximately 690 ft. MSL elevation line.

FIGURE 3.3-1

MAIN CONDENSER OFF-GAS TREATMENT SYSTEM



*Monitors required by Sections 3.9.1 and 3.9.2

1CD01A Main Condenser	0CA01TA CV Separator Tank A	1N66B010B Cooler Condenser B	1N66D013 Charcoal Adsorber	1RIX-PR035 Off-Gas Post Treatment PRM
1CA01AA Steam Jet Air Ejector A	0CA01TB CV Separator Tank B	1N66Z003A Dessicant Dryer A	1N66D016 HEPA Filter	1RIX-PR041 Off-Gas Post Treatment PRM
1CA01AB Steam Jet Air Ejector B	1N66D005A Recombiner A	1N66Z003B Dessicant Dryer B	0RIX-PR001 HVAC Stack PRM #1	0RIX-PR003 Standby Gas Treatment PRM
0CA01PA Condenser Vacuum (CV) Pump A	1N66D005B Recombiner B	1N66B011 Gas Cooler	0RIX-PR002 HVAC Stack PRM #2	0RIX-PR004 Standby Gas Treatment PRM
0CA01PB CV Pump B	1N66B010A Cooler Condenser A	1N66D012 Charcoal Adsorber	1RIX-PR034 Off-Gas Pretreatment PRM	

TABLE 3.5-1

INHALATION DOSE FACTORS FOR INFANT - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C-14	1.89E-05*	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA-24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P-32	1.45E-03	8.03E-05	5.53E-05	NO DATA	NO DATA	NO DATA	1.15E-05
CR-51	NO DATA	NO DATA	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN-54	NO DATA	1.81E-05	3.56E-06	NO DATA	3.56E-06	7.14E-04	5.04E-06
MN-56	NO DATA	1.10E-09	1.58E-10	NO DATA	7.86E-10	8.95E-06	5.12E-05
FE-55	1.41E-05	8.39E-06	2.38E-06	NO DATA	NO DATA	6.21E-05	7.82E-07
FE-59	9.69E-06	1.68E-05	6.77E-06	NO DATA	NO DATA	7.25E-04	1.77E-05
CO-58	NO DATA	8.71E-07	1.30E-06	NO DATA	NO DATA	5.55E-04	7.95E-06
CO-60	NO DATA	5.73E-06	8.41E-06	NO DATA	NO DATA	3.22E-03	2.28E-05
NI-63	2.42E-04	1.46E-05	8.29E-06	NO DATA	NO DATA	1.49E-04	1.73E-06
NI-65	1.71E-09	2.03E-10	8.79E-11	NO DATA	NO DATA	5.80E-06	3.58E-05
CU-64	NO DATA	1.34E-09	5.53E-10	NO DATA	2.84E-09	6.64E-06	1.07E-05
ZN-65	1.38E-05	4.47E-05	2.22E-05	NO DATA	2.32E-05	4.62E-04	3.67E-05
ZN-69	3.85E-11	6.91E-11	5.13E-12	NO DATA	2.87E-11	1.05E-06	9.44E-06
BR-83	NO DATA	NO DATA	2.72E-07	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	2.86E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	1.46E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	1.36E-04	6.30E-05	NO DATA	NO DATA	NO DATA	2.17E-06
RB-88	NO DATA	3.98E-07	2.05E-07	NO DATA	NO DATA	NO DATA	2.42E-07
RB-89	NO DATA	2.29E-07	1.47E-07	NO DATA	NO DATA	NO DATA	4.87E-08
SR-89	2.84E-04	NO DATA	8.15E-06	NO DATA	NO DATA	1.45E-03	4.57E-05
SR-90	2.92E-02	NO DATA	1.85E-03	NO DATA	NO DATA	8.03E-03	9.36E-05
SR-91	6.83E-08	NO DATA	2.47E-09	NO DATA	NO DATA	3.76E-05	5.24E-05
SR-92	7.50E-09	NO DATA	2.79E-10	NO DATA	NO DATA	1.70E-05	1.00E-04
Y-90	2.35E-06	NO DATA	6.30E-08	NO DATA	NO DATA	1.92E-04	7.43E-05
Y-91m	2.91E-10	NO DATA	9.90E-12	NO DATA	NO DATA	1.99E-06	1.68E-06
Y-91	4.20E-04	NO DATA	1.12E-05	NO DATA	NO DATA	1.75E-03	5.02E-05
Y-92	1.17E-08	NO DATA	3.29E-10	NO DATA	NO DATA	1.75E-05	9.04E-05
Y-93	1.07E-07	NO DATA	2.91E-09	NO DATA	NO DATA	5.46E-05	1.19E-04
ZR-95	8.24E-05	1.99E-05	1.45E-05	NO DATA	2.22E-05	1.25E-03	1.55E-05
ZR-97	1.07E-07	1.83E-08	8.36E-09	NO DATA	1.85E-08	7.88E-05	1.00E-04
NB-95	1.12E-05	4.59E-06	2.70E-06	NO DATA	3.37E-06	3.42E-04	9.05E-06
MO-99	NO DATA	1.18E-07	2.31E-08	NO DATA	1.89E-07	9.63E-05	3.48E-05
TC-99m	9.98E-13	2.06E-12	2.66E-11	NO DATA	2.22E-11	5.79E-07	1.45E-06
TC-101	4.65E-14	5.88E-14	5.80E-13	NO DATA	6.99E-13	4.17E-07	6.03E-07
RU-103	1.44E-06	NO DATA	4.85E-07	NO DATA	3.03E-06	3.94E-04	1.15E-05
RU-105	8.74E-10	NO DATA	2.93E-10	NO DATA	6.42E-10	1.12E-05	3.46E-05
RU-106	6.20E-05	NO DATA	7.7E-06	NO DATA	7.61E-05	8.26E-03	1.17E-04
AG-110m	7.13E-06	5.16E-06	3.57E-06	NO DATA	7.80E-06	2.62E-03	2.36E-05
TE-125m	3.40E-06	1.42E-06	4.70E-07	1.16E-06	NO DATA	3.19E-04	9.22E-06
TE-127m	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE-127	1.59E-09	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE-129m	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE-129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE-131m	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE-131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06

TABLE 3.5-1 (continued)

INHALATION DOSE FACTORS FOR INFANT - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I-130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	NO DATA	1.42E-06
I-131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	NO DATA	7.56E-07
I-132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	NO DATA	1.36E-06
I-133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	NO DATA	1.54E-06
I-134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	NO DATA	9.21E-07
I-135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	NO DATA	1.31E-06
CS-134	2.83E-04	5.02E-04	5.32E-05	NO DATA	1.36E-04	5.69E-05	9.53E-07
CS-136	3.45E-05	9.61E-05	3.78E-05	NO DATA	4.03E-05	8.40E-06	1.02E-06
CS-137	3.92E-04	4.37E-04	3.25E-05	NO DATA	1.23E-04	5.09E-05	9.53E-07
CS-138	3.61E-07	5.58E-07	2.84E-07	NO DATA	2.93E-07	4.67E-08	6.26E-07
BA-139	1.06E-09	7.03E-13	3.07E-11	NO DATA	4.23E-13	4.25E-06	3.64E-05
BA-140	4.00E-05	4.00E-08	2.07E-06	NO DATA	9.59E-09	1.14E-03	2.74E-05
BA-141	1.12E-10	7.70E-14	3.55E-12	NO DATA	4.64E-14	2.12E-06	3.39E-06
BA-142	2.84E-11	2.36E-14	1.40E-12	NO DATA	1.36E-14	1.11E-06	4.95E-07
LA-140	3.61E-07	1.43E-07	3.68E-08	NO DATA	NO DATA	1.20E-04	6.06E-05
LA-142	7.36E-10	2.69E-10	6.46E-11	NO DATA	NO DATA	5.87E-06	4.25E-05
CE-141	1.98E-05	1.19E-05	1.42E-06	NO DATA	3.75E-06	3.69E-04	1.54E-05
CE-143	2.09E-07	1.38E-07	1.58E-08	NO DATA	4.03E-08	8.30E-05	3.55E-05
CE-144	2.28E-03	8.65E-04	1.26E-04	NO DATA	3.84E-04	7.03E-03	1.06E-04
PR-143	1.00E-05	3.74E-06	4.99E-07	NO DATA	1.41E-06	3.09E-04	2.66E-05
PR-144	3.42E-11	1.32E-11	1.72E-12	NO DATA	4.80E-12	1.15E-06	3.06E-06
ND-147	5.67E-06	5.81E-06	3.57E-07	NO DATA	2.25E-06	2.30E-04	2.23E-05
W-187	9.26E-09	6.44E-09	2.23E-09	NO DATA	NO DATA	2.83E-05	2.54E-05
NP-239	2.65E-07	2.37E-08	1.34E-08	NO DATA	4.73E-08	4.25E-05	1.78E-05

*1.89×10^{-05}
**Less than 10^{-24}

TABLE 3.5-2

INHALATION DOSE FACTORS FOR CHILD - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C-14	9.07E-06*	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA-24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P-32	7.04E-04	3.09E-05	2.67E-05	NO DATA	NO DATA	NO DATA	1.14E-05
CR-51	NO DATA	NO DATA	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN-54	NO DATA	1.16E-05	2.57E-06	NO DATA	2.71E-06	4.26E-04	6.19E-06
MN-56	NO DATA	4.48E-10	8.43E-11	NO DATA	4.52E-10	3.55E-06	3.33E-05
FE-55	1.28E-05	6.80E-06	2.10E-06	NO DATA	NO DATA	3.00E-05	7.75E-07
FE-59	5.59E-06	9.04E-06	4.51E-06	NO DATA	NO DATA	3.43E-04	1.91E-05
CO-58	NO DATA	4.79E-07	8.55E-07	NO DATA	NO DATA	2.99E-04	9.29E-06
CO-60	NO DATA	3.55E-06	6.12E-06	NO DATA	NO DATA	1.91E-03	2.60E-05
NI-63	2.22E-04	1.25E-05	7.56E-06	NO DATA	NO DATA	7.43E-05	1.71E-06
NI-65	8.08E-10	7.99E-11	4.44E-11	NO DATA	NO DATA	2.21E-06	2.27E-05
CU-64	NO DATA	5.39E-10	2.90E-10	NO DATA	1.63E-09	2.59E-06	9.92E-06
ZN-65	1.15E-05	3.06E-05	1.90E-05	NO DATA	1.93E-05	2.69E-04	4.41E-06
ZN-69	1.81E-11	2.61E-11	2.41E-12	NO DATA	1.58E-11	3.84E-07	2.75E-06
BR-83	NO DATA	NO DATA	1.28E-07	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	1.48E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	6.84E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	5.36E-05	3.09E-05	NO DATA	NO DATA	NO DATA	2.16E-06
RB-88	NO DATA	1.52E-07	9.90E-08	NO DATA	NO DATA	NO DATA	4.66E-09
RB-89	NO DATA	9.33E-08	7.83E-08	NO DATA	NO DATA	NO DATA	5.11E-10
SR-89	1.62E-04	NO DATA	4.66E-06	NO DATA	NO DATA	5.83E-04	4.52E-05
SR-90	2.73E-02	NO DATA	1.74E-03	NO DATA	NO DATA	3.99E-03	9.28E-05
SR-91	3.28E-08	NO DATA	1.24E-09	NO DATA	NO DATA	1.44E-05	4.70E-05
SR-92	3.54E-09	NO DATA	1.42E-10	NO DATA	NO DATA	6.49E-06	6.55E-05
Y-90	1.11E-06	NO DATA	2.99E-08	NO DATA	NO DATA	7.07E-05	7.24E-05
Y-91m	1.37E-10	NO DATA	4.98E-12	NO DATA	NO DATA	7.60E-07	4.64E-07
Y-91	2.47E-04	NO DATA	6.59E-06	NO DATA	NO DATA	7.10E-04	4.97E-05
Y-92	5.50E-09	NO DATA	1.57E-10	NO DATA	NO DATA	6.46E-06	6.46E-05
Y-93	5.04E-08	NO DATA	1.38E-09	NO DATA	NO DATA	2.01E-05	1.05E-04
ZR-95	5.13E-05	1.13E-05	1.00E-05	NO DATA	1.61E-05	6.03E-04	1.65E-05
ZR-97	5.07E-08	7.34E-09	4.32E-09	NO DATA	1.05E-08	3.06E-05	9.49E-05
NB-95	6.35E-06	2.48E-06	1.77E-06	NO DATA	2.33E-06	1.66E-04	1.00E-05
MO-99	NO DATA	4.66E-08	1.15E-08	NO DATA	1.06E-07	3.66E-05	3.42E-05
TC-99m	4.81E-13	9.41E-13	1.56E-11	NO DATA	1.37E-11	2.57E-07	1.30E-06
TC-101	2.19E-14	2.30E-14	2.91E-13	NO DATA	3.92E-13	1.58E-07	4.41E-09
RU-103	7.55E-07	NO DATA	2.90E-07	NO DATA	1.90E-06	1.79E-04	1.21E-05
RU-105	4.13E-10	NO DATA	1.50E-10	NO DATA	3.63E-10	4.30E-06	2.69E-05
RU-106	3.68E-05	NO DATA	4.57E-06	NO DATA	4.97E-05	3.87E-03	1.16E-04
AG-110m	4.56E-06	3.08E-06	2.47E-06	NO DATA	5.74E-06	1.48E-03	2.71E-05
TE-125m	1.82E-06	6.29E-07	2.47E-07	5.20E-07	NO DATA	1.29E-04	9.13E-06
TE-127m	6.72E-06	2.31E-06	8.18E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE-127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE-129m	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE-129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE-131m	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE-131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07

TABLE 3.5-2 (continued)

INHALATION DOSE FACTORS FOR CHILD - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I-130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	NO DATA	1.38E-06
I-131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	NO DATA	7.68E-07
I-132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	NO DATA	8.65E-07
I-133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	NO DATA	1.48E-06
I-134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	NO DATA	2.58E-07
I-135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	NO DATA	1.20E-06
CS-134	1.76E-04	2.74E-04	6.07E-05	NO DATA	8.93E-05	3.27E-05	1.04E-06
CS-136	1.76E-05	4.62E-05	3.14E-05	NO DATA	2.58E-05	3.93E-06	1.13E-06
CS-137	2.45E-04	2.23E-04	3.47E-05	NO DATA	7.63E-05	2.81E-05	9.78E-07
CS-138	1.71E-07	2.27E-07	1.50E-07	NO DATA	1.68E-07	1.84E-08	7.29E-08
BA-139	4.98E-10	2.66E-13	1.45E-11	NO DATA	2.33E-13	1.56E-06	1.56E-05
BA-140	2.00E-05	1.75E-08	1.17E-06	NO DATA	5.71E-09	4.71E-04	2.75E-05
BA-141	5.29E-11	2.95E-14	1.72E-12	NO DATA	2.56E-14	7.89E-07	7.44E-08
BA-142	1.35E-11	9.73E-15	7.54E-13	NO DATA	7.87E-15	4.44E-07	7.41E-10
LA-140	1.74E-07	6.08E-08	2.04E-08	NO DATA	NO DATA	4.94E-05	6.10E-05
LA-142	3.50E-10	1.11E-10	3.49E-11	NO DATA	NO DATA	2.35E-06	2.05E-05
CE-141	1.06E-05	5.28E-06	7.83E-07	NO DATA	2.31E-06	1.47E-04	1.53E-05
CE-143	9.89E-08	5.37E-08	7.77E-09	NO DATA	2.26E-08	3.12E-05	3.44E-05
CE-144	1.83E-03	5.72E-04	9.77E-05	NO DATA	3.17E-04	3.23E-03	1.05E-04
PR-143	4.99E-06	1.50E-06	2.47E-07	NO DATA	8.11E-07	1.17E-04	2.63E-05
PR-144	1.61E-11	4.99E-12	8.10E-13	NO DATA	2.64E-12	4.23E-07	5.32E-08
ND-147	2.92E-06	2.36E-06	1.84E-07	NO DATA	1.30E-06	8.87E-05	2.22E-05
W-187	4.41E-09	2.61E-09	1.17E-09	NO DATA	NO DATA	1.11E-05	2.46E-05
P-239	1.26E-07	9.04E-09	6.35E-09	NO DATA	2.63E-08	1.57E-05	1.73E-05

*9.70×10^{-06}
**Less than 10^{-24}

TABLE 3.5-3

INHALATION DOSE FACTORS FOR TEEN - $(DFA_1)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C-14	3.25E-06*	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA-24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P-32	2.36E-04	1.37E-05	8.95E-06	NO DATA	NO DATA	NO DATA	1.16E-05
CR-51	NO DATA	NO DATA	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN-54	NO DATA	6.39E-06	1.05E-06	NO DATA	1.59E-06	2.48E-04	8.35E-06
MN-56	NO DATA	2.12E-10	3.15E-11	NO DATA	2.24E-10	1.90E-06	7.18E-06
FE-55	4.18E-06	2.98E-06	6.93E-07	NO DATA	NO DATA	1.55E-05	7.99E-07
FE-59	1.99E-06	4.62E-06	1.79E-06	NO DATA	NO DATA	1.91E-04	2.23E-05
CO-58	NO DATA	2.59E-07	3.47E-07	NO DATA	NO DATA	1.68E-04	1.19E-05
CO-60	NO DATA	1.89E-06	2.48E-06	NO DATA	NO DATA	1.09E-03	3.24E-05
NI-63	7.25E-05	5.43E-06	2.47E-06	NO DATA	NO DATA	3.84E-05	1.77E-06
NI-65	2.73E-10	3.66E-11	1.59E-11	NO DATA	NO DATA	1.17E-06	4.59E-06
CU-64	NO DATA	2.54E-10	1.06E-10	NO DATA	8.01E-10	1.39E-06	7.68E-06
ZN-65	4.82E-06	1.67E-05	7.80E-06	NO DATA	1.08E-05	1.55E-04	5.83E-06
ZN-69	6.04E-12	1.15E-11	8.07E-13	NO DATA	7.53E-12	1.96E-07	3.56E-08
BR-83	NO DATA	NO DATA	4.30E-08	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	5.41E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	2.29E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	2.38E-05	1.05E-05	NO DATA	NO DATA	NO DATA	2.21E-06
RB-88	NO DATA	6.82E-08	3.40E-08	NO DATA	NO DATA	NO DATA	3.65E-15
RB-89	NO DATA	4.40E-08	2.91E-08	NO DATA	NO DATA	NO DATA	4.22E-17
SR-89	5.43E-05	NO DATA	1.56E-06	NO DATA	NO DATA	3.02E-04	4.64E-05
SR-90	1.35E-02	NO DATA	8.35E-04	NO DATA	NO DATA	2.06E-03	9.56E-05
SR-91	1.10E-08	NO DATA	4.39E-10	NO DATA	NO DATA	7.59E-06	3.24E-05
SR-92	1.19E-09	NO DATA	5.08E-11	NO DATA	NO DATA	3.43E-06	1.49E-05
Y-90	3.73E-07	NO DATA	1.00E-08	NO DATA	NO DATA	3.66E-05	6.99E-05
Y-91m	4.63E-11	NO DATA	1.77E-12	NO DATA	NO DATA	4.00E-07	3.77E-09
Y-91	8.26E-05	NO DATA	2.21E-06	NO DATA	NO DATA	3.67E-04	5.11E-05
Y-92	1.84E-09	NO DATA	5.36E-11	NO DATA	NO DATA	3.35E-06	2.06E-05
Y-93	1.69E-08	NO DATA	4.65E-10	NO DATA	NO DATA	1.04E-05	7.24E-05
ZR-95	1.82E-05	5.73E-06	3.94E-06	NO DATA	8.42E-06	3.36E-04	1.86E-05
ZR-97	1.72E-08	3.40E-09	1.57E-09	NO DATA	5.15E-09	1.62E-05	7.88E-05
NB-95	2.32E-06	1.29E-06	7.08E-07	NO DATA	1.25E-06	9.39E-05	1.21E-05
MO-99	NO DATA	2.11E-08	4.03E-09	NO DATA	5.14E-08	1.92E-05	3.36E-05
TC-99m	1.73E-13	4.83E-13	6.24E-12	NO DATA	7.20E-12	1.44E-07	7.66E-07
TC-101	7.40E-15	1.05E-14	1.03E-13	NO DATA	1.90E-13	8.34E-08	1.09E-16
RU-103	2.63E-07	NO DATA	1.12E-07	NO DATA	9.29E-07	9.73E-05	1.36E-05
RU-105	1.40E-10	NO DATA	5.42E-11	NO DATA	1.76E-10	2.27E-06	1.13E-05
RU-106	1.23E-05	NO DATA	1.55E-06	NO DATA	2.38E-05	2.01E-03	1.20E-04
AG-110m	1.73E-06	1.64E-06	9.99E-07	NO DATA	3.13E-06	8.44E-04	3.41E-05
TE-125m	6.10E-07	2.80E-07	8.34E-08	1.75E-07	NO DATA	6.70E-05	9.38E-06
TE-127m	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE-127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE-129m	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE-129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE-131m	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE-131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09

TABLE 3.5-3 (continued)

INHALATION DOSE FACTORS FOR TEEN - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I-130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	NO DATA	1.14E-06
I-131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	NO DATA	8.11E-07
I-132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	NO DATA	1.59E-07
I-133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	NO DATA	1.29E-06
I-134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	NO DATA	2.55E-09
I-135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	NO DATA	8.69E-07
CS-134	6.28E-05	1.41E-04	6.86E-05	NO DATA	4.69E-05	1.83E-05	1.22E-06
CS-136	6.44E-06	2.42E-05	1.71E-05	NO DATA	1.38E-05	2.22E-06	1.36E-06
CS-137	8.38E-05	1.06E-04	3.89E-05	NO DATA	3.80E-05	1.51E-05	1.06E-06
CS-138	5.82E-08	1.07E-07	5.58E-08	NO DATA	8.28E-08	9.84E-09	3.38E-11
BA-139	1.67E-10	1.18E-13	4.87E-12	NO DATA	1.11E-13	8.08E-07	8.06E-07
BA-140	6.84E-06	8.38E-09	4.40E-07	NO DATA	2.85E-09	2.54E-04	2.86E-05
BA-141	1.78E-11	1.32E-14	5.93E-13	NO DATA	1.23E-14	4.11E-07	9.33E-14
BA-142	4.62E-12	4.63E-15	2.84E-13	NO DATA	3.92E-15	2.39E-07	5.99E-20
LA-140	5.99E-08	2.95E-08	7.82E-09	NO DATA	NO DATA	2.68E-05	6.09E-05
LA-142	1.20E-10	5.31E-11	1.32E-11	NO DATA	NO DATA	1.27E-06	1.50E-06
CE-141	3.55E-06	2.37E-06	2.71E-07	NO DATA	1.11E-06	7.67E-05	1.58E-05
CE-143	3.32E-08	2.42E-08	2.70E-09	NO DATA	1.08E-08	1.63E-05	3.19E-05
CE-144	6.11E-04	2.53E-04	3.28E-05	NO DATA	1.51E-04	1.67E-03	1.08E-04
PR-143	1.67E-06	6.64E-07	8.28E-08	NO DATA	3.86E-07	6.04E-05	2.67E-05
PR-144	5.37E-12	2.20E-12	2.72E-13	NO DATA	1.26E-12	2.19E-07	2.94E-14
ND-147	9.83E-07	1.07E-06	6.41E-08	NO DATA	6.28E-07	4.65E-05	2.28E-05
W-187	1.50E-09	1.22E-09	4.29E-10	NO DATA	NO DATA	5.92E-06	2.21E-05
P-239	4.23E-08	3.99E-09	2.21E-09	NO DATA	1.25E-08	8.11E-06	1.65E-05

*3.52×10^{-06}
**Less than 10^{-24}

TABLE 3.5-4

INHALATION DOSE FACTORS FOR ADULT - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C-14	2.27E-06*	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA-24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P-32	1.65E-04	9.64E-06	6.26E-06	NO DATA	NO DATA	NO DATA	1.08E-05
CR-51	NO DATA	NO DATA	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN-54	NO DATA	4.95E-06	7.87E-07	NO DATA	1.23E-06	1.75E-04	9.67E-06
MN-56	NO DATA	1.55E-10	2.29E-11	NO DATA	1.63E-10	1.18E-06	2.53E-06
FE-55	3.07E-06	2.12E-06	4.93E-07	NO DATA	NO DATA	9.01E-06	7.54E-07
FE-59	1.47E-06	3.47E-06	1.32E-06	NO DATA	NO DATA	1.27E-04	2.35E-05
CO-58	NO DATA	1.98E-07	2.59E-07	NO DATA	NO DATA	1.16E-04	1.33E-05
CO-60	NO DATA	1.44E-06	1.85E-06	NO DATA	NO DATA	7.46E-04	3.56E-05
NI-63	5.40E-05	3.93E-06	1.81E-06	NO DATA	NO DATA	2.23E-05	1.67E-06
NI-65	1.92E-10	2.62E-11	1.14E-11	NO DATA	NO DATA	7.00E-07	1.54E-06
CU-64	NO DATA	1.83E-10	7.69E-11	NO DATA	5.78E-10	8.48E-07	6.12E-06
ZN-65	4.05E-06	1.29E-05	5.82E-06	NO DATA	8.62E-06	1.08E-04	6.68E-06
ZN-69	4.23E-12	8.14E-12	5.65E-13	NO DATA	5.27E-12	1.15E-07	2.04E09
BR-83	NO DATA	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	2.90E-08
BR-84	NO DATA	NO DATA	3.91E-08	NO DATA	NO DATA	NO DATA	2.05E-13
BR-85	NO DATA	NO DATA	1.60E-09	NO DATA	NO DATA	NO DATA	LT E-24**
RB-86	NO DATA	1.69E-05	7.37E-06	NO DATA	NO DATA	NO DATA	2.08E-06
RB-88	NO DATA	4.84E-08	2.41E-08	NO DATA	NO DATA	NO DATA	4.18E-19
RB-89	NO DATA	3.20E-08	2.12E-08	NO DATA	NO DATA	NO DATA	1.16E-21
SR-89	3.80E-05	NO DATA	1.09E-06	NO DATA	NO DATA	1.75E-04	4.37E-05
SR-90	1.24E-02	NO DATA	7.62E-04	NO DATA	NO DATA	1.20E-03	9.02E-05
SR-91	7.74E-09	NO DATA	3.13E-10	NO DATA	NO DATA	4.56E-06	2.39E-05
SR-92	8.43E-10	NO DATA	3.64E-11	NO DATA	NO DATA	2.06E-06	5.38E-06
Y-90	2.61E-07	NO DATA	7.01E-09	NO DATA	NO DATA	2.12E-05	6.32E-05
Y-91m	3.26E-11	NO DATA	1.27E-12	NO DATA	NO DATA	2.40E-07	1.66E-10
Y-91	5.78E-05	NO DATA	1.55E-06	NO DATA	NO DATA	2.13E-04	4.81E-05
Y-92	1.29E-09	NO DATA	3.77E-11	NO DATA	NO DATA	1.96E-06	9.19E-06
Y-93	1.18E-08	NO DATA	3.26E-10	NO DATA	NO DATA	6.06E-06	5.27E-05
ZR-95	1.34E-05	4.30E-06	2.91E-06	NO DATA	6.77E-06	2.21E-04	1.88E-05
ZR-97	1.21E-08	2.45E-09	1.13E-09	NO DATA	3.71E-09	9.84E-06	6.54E-05
NB-95	1.76E-06	9.77E-07	5.26E-07	NO DATA	9.67E-07	6.31E-05	1.30E-05
MO-99	NO DATA	1.51E-08	2.87E-09	NO DATA	3.64E-08	1.14E-05	3.10E-05
TC-99m	1.29E-13	3.64E-13	4.63E-12	NO DATA	5.52E-12	9.55E-08	5.20E-07
TC-101	5.22E-15	7.52E-15	7.38E-14	NO DATA	1.35E-13	4.99E-08	1.36E-21
RU-103	1.91E-07	NO DATA	8.23E-08	NO DATA	7.29E-07	6.31E-05	1.38E-05
RU-105	9.88E-11	NO DATA	3.89E-11	NO DATA	1.27E-10	1.37E-06	6.02E-06
RU-106	8.64E-06	NO DATA	1.09E-06	NO DATA	1.67E-05	1.17E-03	1.14E-04
AG-110m	1.35E-06	1.25E-06	7.43E-07	NO DATA	2.46E-06	5.79E-04	3.78E-05
TE-125m	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE-127m	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE-127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE-129m	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE-129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE-131m	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE-131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09

TABLE 3.5-4 (continued)

INHALATION DOSE FACTORS FOR ADULT - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I-130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	NO DATA	9.61E-07
I-131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	NO DATA	7.85E-07
I-132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	NO DATA	5.08E-08
I-133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	NO DATA	1.11E-06
I-134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	NO DATA	1.26E-10
I-135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	NO DATA	6.56E-07
CS-134	4.66E-05	1.06E-04	9.10E-05	NO DATA	3.59E-05	1.22E-05	1.30E-06
CS-136	4.88E-06	1.83E-05	1.38E-05	NO DATA	1.07E-05	1.50E-06	1.46E-06
CS-137	5.98E-05	7.76E-05	5.35E-05	NO DATA	2.78E-05	9.40E-06	1.05E-06
CS-138	4.14E-08	7.76E-08	4.05E-08	NO DATA	6.00E-08	6.07E-09	2.33E-13
BA-139	1.17E-10	8.32E-14	3.42E-12	NO DATA	7.78E-14	4.70E-07	1.12E-07
BA-140	4.88E-06	6.13E-09	3.21E-07	NO DATA	2.09E-09	1.59E-04	2.73E-05
BA-141	1.25E-11	9.41E-15	4.20E-13	NO DATA	8.75E-15	2.42E-07	1.45E-17
BA-142	3.29E-12	3.38E-15	2.07E-13	NO DATA	2.86E-15	1.49E-07	1.96E-26
LA-140	4.30E-08	2.17E-08	5.73E-09	NO DATA	NO DATA	1.70E-05	5.73E-05
LA-142	8.54E-11	3.88E-11	9.65E-12	NO DATA	NO DATA	7.91E-07	2.64E-07
CE-141	2.49E-06	1.69E-06	1.91E-07	NO DATA	7.83E-07	4.52E-05	1.50E-05
CE-143	2.33E-08	1.72E-08	1.91E-09	NO DATA	7.60E-09	9.97E-06	2.83E-05
CE-144	4.29E-04	1.79E-04	2.30E-05	NO DATA	1.06E-04	9.72E-04	1.02E-04
PR-143	1.17E-06	4.69E-07	5.80E-08	NO DATA	2.70E-07	3.51E-05	2.50E-05
PR-144	3.76E-12	1.56E-12	1.91E-13	NO DATA	8.81E-13	1.27E-07	2.69E-18
ND-147	6.59E-07	7.62E-07	4.56E-08	NO DATA	4.45E-07	2.76E-05	2.16E-05
W-187	1.06E-09	8.85E-10	3.10E-10	NO DATA	NO DATA	3.63E-06	1.94E-05
NP-239	2.87E-08	2.82E-09	1.55E-09	NO DATA	8.75E-09	4.70E-06	1.49E-05

*2.27×10^{-06}
**Less than 10^{-24}

TABLE 3.5-5

GROUND PLANE DOSE FACTORS - DFG_i
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
Na-24	2.50E-08*	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Ni-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91m	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99m	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110m	1.80E-08	2.10E-08

TABLE 3.5-5 (Continued)

GROUND PLANE DOSE FACTORS - DFG_i
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
Te-125m	3.50E-11	4.80E-11
Te-127m	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129m	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131m	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-08
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

*2.50×10^{-08}

TABLE 3.5-6

INGESTION DOSE FACTORS FOR INFANT - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C-14	2.37E-05*	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA-24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P-32	1.70E-03	1.00E-04	6.59E-05	NO DATA	NO DATA	NO DATA	2.30E-05
CR-51	NO DATA	NO DATA	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN-54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06
MN-56	NO DATA	8.18E-07	1.41E-07	NO DATA	7.03-07	NO DATA	7.43E-05
FE-55	1.39E-05	8.98E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE-59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO-58	NO DATA	3.60E-06	8.98E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO-60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI-63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI-65	4.70E-06	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU-64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN-65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05
ZN-69	9.33E-08	1.68E-07	1.25E-08	NO DATA	6.98E-08	NO DATA	1.37E-05
BR-83	NO DATA	NO DATA	3.63E-07	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	3.82E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	1.94E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	1.70E-04	8.40E-05	NO DATA	NO DATA	NO DATA	4.34E-06
RB-88	NO DATA	4.98E-07	2.73E-07	NO DATA	NO DATA	NO DATA	4.85E-07
RB-89	NO DATA	2.86E-07	1.97E-07	NO DATA	NO DATA	NO DATA	9.74E-08
SR-89	2.51E-03	NO DATA	7.20E-05	NO DATA	NO DATA	NO DATA	5.16E-05
SR-90	1.85E-02	NO DATA	4.71E-03	NO DATA	NO DATA	NO DATA	2.31E-04
SR-91	5.00E-05	NO DATA	1.81E-06	NO DATA	NO DATA	NO DATA	5.92E-05
SR-92	1.92E-05	NO DATA	7.13E-07	NO DATA	NO DATA	NO DATA	2.07E-04
Y-90	8.69E-08	NO DATA	2.33E-09	NO DATA	NO DATA	NO DATA	1.20E-04
Y-91m	8.10E-10	NO DATA	2.76E-11	NO DATA	NO DATA	NO DATA	2.70E-06
Y-91	1.13E-06	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	8.10E-05
Y-92	7.65E-09	NO DATA	2.15E-10	NO DATA	NO DATA	NO DATA	1.46E-04
Y-93	2.43E-08	NO DATA	6.62E-10	NO DATA	NO DATA	NO DATA	1.92E-04
ZR-95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05
ZR-97	1.48E-08	2.54E-09	1.16E-09	NO DATA	2.56E-09	NO DATA	1.62E-04
NB-95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05
MO-99	NO DATA	3.40E-05	6.63E-06	NO DATA	5.08E-05	NO DATA	1.12E-05
TC-99m	1.92E-09	3.96E-09	5.10E-08	NO DATA	4.26E-08	2.07E-09	1.15E-06
TC-101	2.27E-09	2.86E-09	2.83E-08	NO DATA	3.40E-08	1.56E-09	4.86E-07
RU-103	1.48E-06	NO DATA	4.95E-07	NO DATA	3.08E-06	NO DATA	1.80E-05
RU-105	1.36E-07	NO DATA	4.58E-08	NO DATA	1.00E-06	NO DATA	5.41E-05
RU-106	2.41E-05	NO DATA	3.01E-06	NO DATA	2.85E-05	NO DATA	1.83E-04
AG-110m	9.96E-07	7.27E-07	4.81E-07	NO DATA	1.04E-06	NO DATA	3.77E-05
TE-125m	2.33E-05	7.79E-06	3.15E-06	7.84E-06	NO DATA	NO DATA	1.11E-05
TE-127m	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	NO DATA	2.36E-05
TE-127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	NO DATA	2.10E-05
TE-129m	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	NO DATA	5.97E-05
TE-129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	NO DATA	2.27E-05
TE-131m	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	NO DATA	1.03E-04
TE-131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	NO DATA	7.11E-06

TABLE 3.5-6 (continued)

INGESTION DOSE FACTORS FOR INFANT - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	NO DATA	3.81E-05
I-130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	NO DATA	2.83E-06
I-131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-06
I-132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	NO DATA	2.73E-06
I-133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	NO DATA	3.08E-06
I-134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	NO DATA	1.84E-06
I-135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	NO DATA	2.62E-06
CS-134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06
CS-136	4.59E-05	1.35E-04	5.04E-05	NO DATA	5.38E-05	1.10E-05	2.05E-06
CS-137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06
CS-138	4.81E-07	7.82E-07	3.79E-07	NO DATA	3.90E-07	6.09E-08	1.25E-06
BA-139	8.81E-07	5.84E-10	2.55E-08	NO DATA	3.51E-10	3.54E-10	5.58E-05
BA-140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-05
BA-141	4.25E-07	2.91E-10	1.34E-08	NO DATA	1.75E-10	1.77E-10	5.19E-06
BA-142	1.84E-07	1.53E-10	9.06E-09	NO DATA	8.81E-11	9.26E-11	7.59E-07
LA-140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA-142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.86E-05
CE-141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE-143	1.48E-08	9.82E-06	1.12E-09	NO DATA	2.86E-09	NO DATA	5.73E-05
CE-144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-07	NO DATA	1.71E-04
PR-143	8.13E-08	3.04E-08	4.03E-09	NO DATA	1.13E-08	NO DATA	4.29E-05
PR-144	2.74E-10	1.06E-10	1.38E-11	NO DATA	3.84E-11	NO DATA	4.93E-06
ND-147	5.53E-08	5.68E-08	3.48E-09	NO DATA	2.19E-08	NO DATA	3.60E-05
W-187	9.03E-07	6.28E-07	2.17E-07	NO DATA	NO DATA	NO DATA	3.69E-05
NP-239	1.11E-08	9.93E-10	5.61E-10	NO DATA	1.98E-09	NO DATA	2.87E-05

*2.37×10^{-05}
**Less than 10^{-24}

TABLE 3.5-7

INGESTION DOSE FACTORS FOR CHILD - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C-14	1.21E-05*	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA-24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P-32	8.25E-04	3.86E-05	3.18E-05	NO DATA	NO DATA	NO DATA	2.28E-05
CR-51	NO DATA	NO DATA	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06
MN-56	NO DATA	3.34E-07	7.54E-08	NO DATA	4.04E-07	NO DATA	4.84E-05
FE-55	1.15E-05	6.10E-06	1.89E-06	NO DATA	NO DATA	3.45E-06	1.13E-06
FE-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05
CO-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05
CO-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05
NI-63	5.38E-04	2.88E-05	1.83E-05	NO DATA	NO DATA	NO DATA	1.94E-06
NI-65	2.22E-06	2.09E-07	1.22E-07	NO DATA	NO DATA	NO DATA	2.56E-05
CU-64	NO DATA	2.45E-07	1.48E-07	NO DATA	5.92E-07	NO DATA	1.15E-05
ZN-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06
ZN-69	4.38E-08	6.33E-08	5.85E-09	NO DATA	3.84E-08	NO DATA	3.99E-06
BR-83	NO DATA	NO DATA	1.71E-07	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	1.98E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	9.12E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	6.70E-05	4.12E-05	NO DATA	NO DATA	NO DATA	4.31E-06
RB-88	NO DATA	1.90E-07	1.32E-07	NO DATA	NO DATA	NO DATA	9.32E-09
RB-89	NO DATA	1.17E-07	1.04E-07	NO DATA	NO DATA	NO DATA	1.02E-09
SR-89	1.32E-03	NO DATA	3.77E-05	NO DATA	NO DATA	NO DATA	5.11E-05
SR-90	1.70E-02	NO DATA	4.31E-03	NO DATA	NO DATA	NO DATA	2.29E-04
SR-91	2.40E-05	NO DATA	9.06E-07	NO DATA	NO DATA	NO DATA	5.30E-05
SR-92	9.03E-06	NO DATA	3.62E-07	NO DATA	NO DATA	NO DATA	1.71E-04
Y-90	4.11E-08	NO DATA	1.10E-09	NO DATA	NO DATA	NO DATA	1.17E-04
Y-91m	3.82E-10	NO DATA	1.39E-11	NO DATA	NO DATA	NO DATA	7.48E-07
Y-91	6.02E-07	NO DATA	1.61E-08	NO DATA	NO DATA	NO DATA	8.02E-05
Y-92	3.60E-09	NO DATA	1.03E-10	NO DATA	NO DATA	NO DATA	1.04E-04
Y-93	1.14E-08	NO DATA	3.13E-10	NO DATA	NO DATA	NO DATA	1.70E-04
ZR-95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05
ZR-97	6.99E-09	1.01E-09	5.96E-10	NO DATA	1.45E-09	NO DATA	1.53E-04
NB-95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05
MO-99	NO DATA	1.33E-05	3.29E-06	NO DATA	2.84E-05	NO DATA	1.10E-05
TC-99m	9.23E-10	1.81E-09	3.00E-08	NO DATA	2.63E-08	9.19E-10	1.03E-06
TC-101	1.07E-09	1.12E-09	1.42E-08	NO DATA	1.91E-08	5.92E-10	3.56E-09
RU-103	7.31E-07	NO DATA	2.81E-07	NO DATA	1.84E-06	NO DATA	1.89E-05
RU-105	6.45E-08	NO DATA	2.34E-08	NO DATA	5.67E-07	NO DATA	4.21E-05
RU-106	1.17E-05	NO DATA	1.46E-06	NO DATA	1.58E-05	NO DATA	1.82E-04
AG-110m	5.39E-07	3.64E-07	2.91E-07	NO DATA	6.78E-07	NO DATA	4.33E-05
TE-125m	1.14E-05	3.09E-06	1.52E-06	3.20E-06	NO DATA	NO DATA	1.10E-05
TE-127m	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	NO DATA	2.34E-05
TE-127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	NO DATA	1.84E-05
TE-129m	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	NO DATA	5.94E-05
TE-129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	NO DATA	8.34E-06
TE-131m	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	NO DATA	1.01E-04
TE-131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	NO DATA	4.36E-07

TABLE 3.5-7 (continued)

INGESTION DOSE FACTORS FOR CHILD - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	NO DATA	4.50E-05
I-130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	NO DATA	2.76E-06
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06
I-132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	NO DATA	1.73E-06
I-133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	NO DATA	2.95E-06
I-134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	NO DATA	5.16E-07
I-135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	NO DATA	2.40E-06
CS-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06
CS-136	2.35E-05	6.46E-05	4.18E-05	NO DATA	3.44E-05	5.13E-06	2.27E-06
CS-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06
CS-138	2.28E-07	3.17E-07	2.01E-07	NO DATA	2.23E-07	2.40E-08	1.46E-07
BA-139	4.14E-07	2.21E-10	1.20E-08	NO DATA	1.93E-10	1.30E-10	2.39E-05
BA-140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05
BA-141	2.00E-07	1.12E-10	6.51E-09	NO DATA	9.69E-11	6.58E-10	1.14E-07
BA-142	8.74E-08	6.29E-11	4.88E-09	NO DATA	5.09E-11	3.70E-11	1.14E-09
LA-140	1.01E-08	3.53E-09	1.10E-09	NO DATA	NO DATA	NO DATA	9.84E-05
LA-142	5.24E-10	1.67E-10	5.23E-11	NO DATA	NO DATA	NO DATA	3.31E-05
CE-141	8.97E-08	1.98E-08	2.94E-09	NO DATA	8.68E-09	NO DATA	2.47E-05
CE-143	6.99E-09	3.79E-06	5.49E-10	NO DATA	1.59E-09	NO DATA	5.55E-05
CE-144	2.08E-06	6.52E-07	1.11E-07	NO DATA	3.61E-07	NO DATA	1.70E-04
PR-143	3.93E-08	1.18E-08	1.95E-09	NO DATA	6.39E-09	NO DATA	4.24E-05
PR-144	1.29E-10	3.99E-11	6.49E-12	NO DATA	2.11E-11	NO DATA	8.59E-08
ND-147	2.79E-08	2.26E-08	1.75E-09	NO DATA	1.24E-08	NO DATA	3.58E-05
W-187	4.29E-07	2.54E-07	1.14E-07	NO DATA	NO DATA	NO DATA	3.57E-05
NP-239	5.25E-09	3.77E-10	2.65E-10	NO DATA	1.09E-09	NO DATA	2.79E-05

*1.21×10^{-05}
**Less than 10^{-24}

TABLE 3.5-8

INGESTION DOSE FACTORS FOR TEEN - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C-14	4.06E-06*	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA-24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P-32	2.76E-04	1.71E-05	1.07E-05	NO DATA	NO DATA	NO DATA	2.32E-05
CR-51	NO DATA	NO DATA	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05
MN-56	NO DATA	1.58E-07	2.81E-08	NO DATA	2.00E-07	NO DATA	1.04E-05
FE-55	3.78E-06	2.68E-06	6.25E-07	NO DATA	NO DATA	1.70E-06	1.16E-06
FE-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05
CO-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05
CO-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05
NI-63	1.77E-04	1.25E-05	6.00E-06	NO DATA	NO DATA	NO DATA	1.99E-06
NI-65	7.49E-07	9.57E-08	4.36E-08	NO DATA	NO DATA	NO DATA	5.19E-06
CU-64	NO DATA	1.15E-07	5.41E-08	NO DATA	2.91E-07	NO DATA	8.92E-06
ZN-65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06
ZN-69	1.47E-08	2.80E-08	1.96E-09	NO DATA	1.83E-08	NO DATA	5.16E-08
BR-83	NO DATA	NO DATA	5.74E-08	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	7.22E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	3.05E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	2.98E-05	1.40E-05	NO DATA	NO DATA	NO DATA	4.41E-06
RB-88	NO DATA	8.52E-08	4.54E-08	NO DATA	NO DATA	NO DATA	7.30E-15
RB-89	NO DATA	5.50E-08	3.89E-08	NO DATA	NO DATA	NO DATA	8.43E-17
SR-89	4.40E-04	NO DATA	1.26E-05	NO DATA	NO DATA	NO DATA	5.24E-05
SR-90	8.30E-03	NO DATA	2.05E-03	NO DATA	NO DATA	NO DATA	2.33E-04
SR-91	8.07E-06	NO DATA	3.21E-07	NO DATA	NO DATA	NO DATA	3.66E-05
SR-92	3.05E-06	NO DATA	1.30E-07	NO DATA	NO DATA	NO DATA	7.77E-05
Y-90	1.37E-08	NO DATA	3.69E-10	NO DATA	NO DATA	NO DATA	1.13E-04
Y-91m	1.29E-10	NO DATA	4.93E-12	NO DATA	NO DATA	NO DATA	6.09E-09
Y-91	2.01E-07	NO DATA	5.39E-09	NO DATA	NO DATA	NO DATA	8.24E-05
Y-92	1.21E-09	NO DATA	3.50E-11	NO DATA	NO DATA	NO DATA	3.32E-05
Y-93	3.83E-09	NO DATA	1.05E-10	NO DATA	NO DATA	NO DATA	1.17E-04
ZR-95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05
ZR-97	2.37E-09	4.69E-10	2.16E-10	NO DATA	7.11E-10	NO DATA	1.27E-04
NB-95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05
MO-99	NO DATA	6.03E-06	1.15E-06	NO DATA	1.38E-05	NO DATA	1.08E-05
TC-99m	3.32E-10	9.26E-10	1.20E-08	NO DATA	1.38E-08	5.14E-10	6.08E-07
TC-101	3.60E-10	5.12E-10	5.03E-09	NO DATA	9.26E-09	3.12E-10	8.75E-17
RU-103	2.55E-07	NO DATA	1.09E-07	NO DATA	8.99E-07	NO DATA	2.13E-05
RU-105	2.18E-08	NO DATA	8.46E-09	NO DATA	2.75E-07	NO DATA	1.76E-05
RU-106	3.92E-06	NO DATA	4.94E-07	NO DATA	7.56E-06	NO DATA	1.88E-04
AG-110m	2.05E-07	1.94E-07	1.18E-07	NO DATA	3.70E-07	NO DATA	5.45E-05
TE-125m	3.83E-06	1.38E-06	5.12E-07	1.07E-06	NO DATA	NO DATA	1.13E-05
TE-127m	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	NO DATA	2.41E-05
TE-127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	NO DATA	1.22E-05
TE-129m	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	NO DATA	6.12E-05
TE-129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	NO DATA	2.45E-07
TE-131m	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	NO DATA	9.39E-05
TE-131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	NO DATA	2.29E-09

TABLE 3.5-8 (continued)

INGESTION DOSE FACTORS FOR TEEN - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	NO DATA	7.00E-05
I-130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	NO DATA	2.29E-06
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06
I-132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	NO DATA	3.18E-07
I-133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	NO DATA	2.58E-06
I-134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	NO DATA	5.10E-09
I-135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	NO DATA	1.74E-06
CS-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06
CS-136	8.59E-06	3.38E-05	2.27E-05	NO DATA	1.84E-05	2.90E-06	2.72E-06
CS-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06
CS-138	7.76E-08	1.49E-07	7.45E-08	NO DATA	1.10E-07	1.28E-08	6.76E-11
BA-139	1.39E-07	9.78E-11	4.05E-09	NO DATA	9.22E-11	6.74E-11	1.24E-06
BA-140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05
BA-141	6.71E-08	5.01E-11	2.24E-09	NO DATA	4.65E-11	3.43E-11	1.43E-13
BA-142	2.99E-08	2.99E-11	1.84E-09	NO DATA	2.53E-11	1.99E-11	9.18E-20
LA-140	3.48E-09	1.71E-09	4.55E-10	NO DATA	NO DATA	NO DATA	9.82E-05
LA-142	1.79E-10	7.95E-11	1.98E-11	NO DATA	NO DATA	NO DATA	2.42E-06
CE-141	1.33E-08	8.88E-09	1.02E-09	NO DATA	4.18E-09	NO DATA	2.54E-05
CE-143	2.35E-09	1.71E-06	1.91E-10	NO DATA	7.67E-10	NO DATA	5.14E-05
CE-144	6.96E-07	2.88E-07	3.74E-08	NO DATA	1.72E-07	NO DATA	1.75E-04
PR-143	1.31E-08	5.23E-09	6.52E-10	NO DATA	3.04E-09	NO DATA	4.31E-05
PR-144	4.30E-11	1.76E-11	2.18E-12	NO DATA	1.01E-11	NO DATA	4.74E-14
ND-147	9.38E-09	1.02E-08	6.11E-10	NO DATA	5.99E-09	NO DATA	3.68E-05
W-187	1.46E-07	1.19E-07	4.17E-08	NO DATA	NO DATA	NO DATA	3.22E-05
NP-239	1.76E-09	1.66E-10	9.22E-11	NO DATA	5.21E-10	NO DATA	2.67E-05

*4.06×10^{-06}
**Less than 10^{-24}

TABLE 3.5-9

INGESTION DOSE FACTORS FOR ADULT - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C-14	2.84E-06*	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA-24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P-32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR-51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN-56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE-55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI-63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI-65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU-64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN-69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR-83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR-84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR-85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24**
RB-86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB-88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB-89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR-89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR-90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR-91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR-92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y-90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y-91m	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y-91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y-92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y-93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR-97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO-99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC-99m	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
TC-101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU-103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU-105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU-106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG-110m	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE-125m	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE-127m	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE-127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE-129m	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE-129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE-131m	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE-131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09

TABLE 3.5-9 (continued)

INGESTION DOSE FACTORS FOR ADULT - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I-130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I-133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I-135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS-136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS-138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA-139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA-141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA-142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA-140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA-142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE-141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE-143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE-144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR-143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR-144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND-147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W-187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP-239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

*2.84×10^{-06}
**Less than 10^{-24}

TABLE 3.5-10

INPUT PARAMETERS FOR CALCULATING R^{C}_{ajl}

Parameter		Value	Table*
Q_F(kg/day)		50 for cow 6 for goat	E-3
U_{ap}(liters/yr)	- Infant	330	E-5
	- Child	330	E-5
	- Teen	400	E-5
	- Adult	310	E-5
Y_p(kg/m^2)		0.7	E-15
Y_s(kg/m^2)		2.0	E-15
F_m(days/liter)		Each stable element for cow Each stable element for goat	E-1 E-2
r(dimensionless)		1.0 for radioiodine 0.2 for particulates	E-15 E-15
t_f(seconds)		1.73×10^5(2 days)	E-15
t_h(seconds)		7.78×10^6(90 days)	E-15
f_s(dimensionless)		1.0 for cow 1.0 for goat	NUREG - 0133 Section 5.3.1.3
f_p(dimensionless)		1.0 for cow 1.0 for goat	NUREG - 0133 Section 5.3.1.3

*of Regulatory Guide 1.109 unless otherwise stated

TABLE 3.5-11

INPUT PARAMETERS FOR CALCULATING R^{M}_{aij}

Parameter		Value	Table*
U_{ap}(liters/yr)	- Infant	0	E-5
	- Child	41	E-5
	- Teen	65	E-5
	- Adult	110	E-5
F_f(days/kg)		Each stable element	E-1
t_s(seconds)		1.73E+06 (20 days)	E-15
t_h(seconds)		7.78E+06 (90 days)	E-15
Y_p(kg/m^2)		0.7	E-15
Y_s(kg/m^2)		2.0	E-15
r(dimensionless)		1.0 for radioiodine	E-15
		0.2 for particulates	E-15
Q_f(kg/day)		50	E-3

*of Regulatory Guide 1.109

TABLE 3.5-12

INPUT PARAMETERS FOR CALCULATING R^{V}_{aij}

Parameter	Value	Table*
U^{L}_{a} (kg/yr) - Infant	0	E-5
- Child	26	E-5
- Teen	42	E-5
- Adult	64	E-5
U^{S}_{a} (kg/yr) - Infant	0	E-5
- Child	520	E-5
- Teen	630	E-5
- Adult	520	E-5
f_L (dimensionless)	1.0	E-15
f_g (dimensionless)	0.76	E-15
t_L (seconds)	8.6×10^4 (1 day)	E-15
t_h (seconds)	5.18×10^6 (60 days)	E-15
Y_v (kg/m^2)	2.0	E-15

*of Regulatory Guide 1.109

TABLE 3.5-13

INHALATION PATHWAY FACTORS - R^{I}_{aij} (INFANT)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	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	5.32E+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	NO DATA	NO DATA	NO DATA	1.61E+04
CR-51	NO DATA	NO DATA	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	NO DATA	2.53E+04	4.98E+03	NO DATA	4.98E+03	1.00E+06	7.06E+03
MN-56	NO DATA	1.54E+00	2.21E-01	NO DATA	1.10E+00	1.25E+04	7.17E+04
FE-55	1.97E+04	1.17E+04	3.33E+03	NO DATA	NO DATA	8.69E+04	1.09E+03
FE-59	1.36E+04	2.35E+04	9.48E+03	NO DATA	NO DATA	1.02E+06	2.48E+04
CO-58	NO DATA	1.22E+03	1.82E+03	NO DATA	NO DATA	7.77E+05	1.11E+04
CO-60	NO DATA	8.02E+03	1.18E+04	NO DATA	NO DATA	4.51E+06	3.19E+04
NI-63	3.39E+05	2.04E+04	1.16E+04	NO DATA	NO DATA	2.09E+05	2.42E+03
NI-65	2.39E+00	2.84E-01	1.23E-01	NO DATA	NO DATA	8.12E+03	5.01E+04
CU-64	NO DATA	1.88E+00	7.74E-01	NO DATA	3.98E+00	9.30E+03	1.50E+04
ZN-65	1.93E+04	6.26E+04	3.11E+04	NO DATA	3.25E+04	6.47E+05	5.14E+04
ZN-69	5.39E-02	9.67E-02	7.18E-03	NO DATA	4.02E-02	1.47E+03	1.32E+04
BR-83	NO DATA	NO DATA	3.81E+02	NO DATA	NO DATA	NO DATA	LT1.4E-15**
BR-84	NO DATA	NO DATA	4.00E+02	NO DATA	NO DATA	NO DATA	LT1.4E-15
BR-85	NO DATA	NO DATA	2.04E+01	NO DATA	NO DATA	NO DATA	LT1.4E-15
RB-86	NO DATA	1.90E+05	8.82E+04	NO DATA	NO DATA	NO DATA	3.04E+03
RB-88	NO DATA	5.57E+02	2.87E+02	NO DATA	NO DATA	NO DATA	3.39E+02
RB-89	NO DATA	3.21E+02	2.06E+02	NO DATA	NO DATA	NO DATA	6.82E+01
SR-89	3.98E+05	NO DATA	1.14E+04	NO DATA	NO DATA	2.03E+06	6.40E+04
SR-90	4.09E+07	NO DATA	2.59E+06	NO DATA	NO DATA	1.12E+07	1.31E+05
SR-91	9.56E+01	NO DATA	3.46E+00	NO DATA	NO DATA	5.26E+04	7.34E+04
SR-92	1.05E+01	NO DATA	3.91E-01	NO DATA	NO DATA	2.38E+04	1.40E+05
Y-90	3.29E+03	NO DATA	8.82E+01	NO DATA	NO DATA	2.69E+05	1.04E+05
Y-91m	4.07E-01	NO DATA	1.39E-02	NO DATA	NO DATA	2.79E+03	2.35E+03
Y-91	5.88E+05	NO DATA	1.57E+04	NO DATA	NO DATA	2.45E+06	7.03E+04
Y-92	1.64E+01	NO DATA	4.61E-01	NO DATA	NO DATA	2.45E+04	1.27E+05
Y-93	1.50E+02	NO DATA	4.07E+00	NO DATA	NO DATA	7.64E+04	1.67E+05
ZR-95	1.15E+05	2.79E+04	2.03E+04	NO DATA	3.11E+04	1.75E+06	2.17E+04
ZR-97	1.50E+02	2.56E+01	1.17E+01	NO DATA	2.59E+01	1.10E+05	1.40E+05
NB-95	1.57E+04	6.43E+03	3.78E+03	NO DATA	4.72E+03	4.79E+05	1.27E+04
MO-99	NO DATA	1.65E+02	3.23E+01	NO DATA	2.65E+02	1.35E+05	4.87E+04
TC-99m	1.40E-03	2.88E-03	3.72E-02	NO DATA	3.11E-02	8.11E+02	2.03E+03
TC-101	6.51E-05	8.23E-05	8.12E-04	NO DATA	9.79E-04	5.84E+02	8.44E+02
RU-103	2.02E+03	NO DATA	6.79E+02	NO DATA	4.24E+03	5.52E+05	1.61E+04
RU-105	1.22E+00	NO DATA	4.10E-01	NO DATA	8.99E-01	1.57E+04	4.84E+04
RU-106	8.68E+04	NO DATA	1.09E+04	NO DATA	1.07E+05	1.16E+07	1.64E+05
AG-110m	9.98E+03	7.22E+03	5.00E+03	NO DATA	1.09E+04	3.67E+06	3.30E+04
TE-125m	4.76E+03	1.99E+03	6.58E+02	1.62E+03	NO DATA	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

TABLE 3.5-13 (continued)

INHALATION PATHWAY FACTORS - R^{I}_{ai} (INFANT)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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	6.39E+03	1.39E+04	5.57E+03	1.60E+06	1.53E+04	NO DATA	1.99E+03
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	NO DATA	1.06E+03
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	NO DATA	1.90E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	NO DATA	2.16E+03
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.09E+03	NO DATA	1.29E+03
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	NO DATA	1.83E+03
CS-134	3.96E+05	7.03E+05	7.45E+04	NO DATA	1.90E+05	7.97E+04	1.33E+03
CS-136	4.83E+04	1.35E+05	5.29E+04	NO DATA	5.64E+04	1.18E+04	1.43E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	NO DATA	1.72E+05	7.13E+04	1.33E+03
CS-138	5.05E+02	7.81E+02	3.98E+02	NO DATA	4.10E+02	6.54E+01	8.76E+02
BA-139	1.48E+00	9.84E-04	4.30E-02	NO DATA	5.92E-04	5.95E+03	5.10E+04
BA-140	5.60E+04	5.60E+01	2.90E+03	NO DATA	1.34E+01	1.60E+06	3.84E+04
BA-141	1.57E-01	1.08E-04	4.97E-03	NO DATA	6.50E-05	2.97E+03	4.75E+03
BA-142	3.98E-02	3.30E-05	1.96E-03	NO DATA	1.90E-05	1.55E+03	6.93E+02
LA-140	5.05E+02	2.00E+02	5.15E+01	NO DATA	NO DATA	1.68E+05	8.48E+04
LA-142	1.03E+00	3.77E-01	9.04E-02	NO DATA	NO DATA	8.22E+03	5.95E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	NO DATA	5.25E+03	5.17E+05	2.16E+04
CE-143	2.93E+02	1.93E+02	2.21E+01	NO DATA	5.64E+01	1.16E+05	4.97E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	NO DATA	5.38E+05	9.84E+06	1.48E+05
PR-143	1.40E+04	5.24E+03	6.99E+02	NO DATA	1.97E+03	4.33E+05	3.72E+04
PR-144	4.79E-02	1.85E-02	2.41E-03	NO DATA	6.72E-03	1.61E+03	4.28E+03
ND-147	7.94E+03	8.13E+03	5.00E+02	NO DATA	3.15E+03	3.22E+05	3.12E+04
W-187	1.30E+01	9.02E+00	3.12E+00	NO DATA	NO DATA	3.96E+04	3.56E+04
NP-239	3.71E+02	3.32E+01	1.88E+01	NO DATA	6.62E+01	5.95E+04	2.49E+04

*6.47×10^{2}
**Less than 1.40×10^{-15}

TABLE 3.5-14

INHALATION PATHWAY FACTORS - R^{I}_{ai} (CHILD)

(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.12E+03*	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
C-14	3.58E+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	9.87E+04	NO DATA	NO DATA	NO DATA	4.21E+04
CR-51	NO DATA	NO DATA	1.54E+02	8.54E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	NO DATA	4.29E+04	9.51E+03	NO DATA	1.00E+04	1.58E+06	2.29E+04
MN-56	NO DATA	1.66E+00	3.12E-01	NO DATA	1.67E+00	1.31E+04	1.23E+05
FE-55	4.74E+04	2.52E+04	7.77E+03	NO DATA	NO DATA	1.11E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	NO DATA	NO DATA	1.27E+06	7.07E+04
CO-58	NO DATA	1.77E+03	3.16E+03	NO DATA	NO DATA	1.11E+06	3.44E+04
CO-60	NO DATA	1.31E+04	2.26E+04	NO DATA	NO DATA	7.07E+06	9.62E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	NO DATA	NO DATA	2.73E+05	6.33E+03
NI-65	2.99E+00	2.96E-01	1.64E-01	NO DATA	NO DATA	8.18E+03	8.40E+04
CU-64	NO DATA	1.99E+00	1.07E+00	NO DATA	6.03E+00	9.58E+03	3.67E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	NO DATA	7.14E+04	9.95E+05	1.63E+04
ZN-69	6.70E-02	9.66E-02	8.92E-03	NO DATA	5.85E-02	1.42E+03	1.02E+04
BR-83	NO DATA	NO DATA	4.74E+02	NO DATA	NO DATA	NO DATA	LT3.70E-15**
BR-84	NO DATA	NO DATA	5.48E+02	NO DATA	NO DATA	NO DATA	LT3.70E-15
BR-85	NO DATA	NO DATA	2.53E+01	NO DATA	NO DATA	NO DATA	LT3.70E-15
RB-86	NO DATA	1.[illegible]8E+05	1.14E+05	NO DATA	NO DATA	NO DATA	7.99E+03
RB-88	NO DATA	5.62E+02	3.66E+02	NO DATA	NO DATA	NO DATA	1.72E+01
RB-89	NO DATA	3.45E+02	2.89E+02	NO DATA	NO DATA	NO DATA	1.89E+00
SR-89	5.99E+05	NO DATA	1.72E+04	NO DATA	NO DATA	2.16E+06	1.67E+05
SR-90	1.01E+08	NO DATA	6.44E+06	NO DATA	NO DATA	1.48E+07	3.43E+05
SR-91	1.21E+02	NO DATA	4.59E+00	NO DATA	NO DATA	5.33E+04	1.74E+05
SR-92	1.31E+01	NO DATA	5.25E-01	NO DATA	NO DATA	2.40E+04	2.42E+05
Y-90	4.11E+03	NO DATA	1.11E+02	NO DATA	NO DATA	2.62E+05	2.66E+05
Y-91m	5.07E-01	NO DATA	1.84E-02	NO DATA	NO DATA	2.81E+03	1.72E+03
Y-91	9.14E+05	NO DATA	2.44E+04	NO DATA	NO DATA	2.63E+06	1.84E+05
Y-92	2.04E+01	NO DATA	5.81E-01	NO DATA	NO DATA	2.39E+04	2.39E+05
Y-93	1.86E+02	NO DATA	5.11E+00	NO DATA	NO DATA	7.44E+04	3.89E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	NO DATA	5.96E+04	2.23E+06	6.11E+04
ZR-97	1.88E+02	2.72E+01	1.60E+01	NO DATA	3.89E+01	1.13E+05	3.51E+05
NB-95	2.35E+04	9.18E+03	6.55E+03	NO DATA	8.62E+03	6.14E+05	3.70E+04
MO-99	NO DATA	1.72E+02	4.26E+01	NO DATA	3.92E+02	1.35E+05	1.27E+05
TC-99m	1.78E-03	3.48E-03	5.77E-02	NO DATA	5.07E-02	9.51E+02	4.81E+03
TC-101	8.10E-05	8.51E-05	1.08E-03	NO DATA	1.45E-03	5.84E+02	1.63E+01
RU-103	2.79E+03	NO DATA	1.07E+03	NO DATA	7.03E+03	6.62E+05	4.48E+04
RU-105	1.53E+00	NO DATA	5.55E-01	NO DATA	1.34E+00	1.59E+04	9.95E+04
RU-106	1.36E+05	NO DATA	1.69E+04	NO DATA	1.84E+05	1.43E+07	4.29E+05
AG-110m	1.69E+04	1.14E+04	9.14E+03	NO DATA	2.12E+04	5.48E+06	1.00E+05
TE-125m	6.73E+03	2.33E+03	9.14E+02	1.92E+03	NO DATA	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

TABLE 3.5-14 (continued)

INHALATION PATHWAY FACTORS - R^{I}_{aij} (CHILD)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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	NO DATA	5.11E+03
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	NO DATA	2.84E+03
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	NO DATA	3.20E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	NO DATA	5.48E+03
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	NO DATA	9.54E+02
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	NO DATA	4.44E+03
CS-134	6.51E+05	1.01E+06	2.25E+05	NO DATA	3.30E+05	1.21E+05	3.85E+03
CS-136	6.51E+04	1.71E+05	1.16E+05	NO DATA	9.55E+04	1.45E+04	4.18E+03
CS-137	9.70E+05	8.25E+05	1.28E+05	NO DATA	2.82E+05	1.04E+05	3.62E+03
CS-138	6.33E+02	8.40E+02	5.55E+02	NO DATA	6.22E+02	6.81E+01	2.70E+02
BA-139	1.84E+00	9.84E-04	5.37E-02	NO DATA	8.62E-04	5.77E+03	5.77E+04
BA-140	7.40E+04	6.48E+01	4.33E+03	NO DATA	2.11E+01	1.74E+06	1.02E+05
BA-141	1.96E-01	1.09E-04	6.36E-03	NO DATA	9.47E-05	2.92E+03	2.75E+02
BA-142	5.00E-02	3.60E-05	2.79E-03	NO DATA	2.91E-05	1.64E+03	2.74E+00
LA-140	6.44E+02	2.25E+02	7.55E+01	NO DATA	NO DATA	1.83E+05	2.26E+05
LA-142	1.30E+00	4.11E-01	1.29E-01	NO DATA	NO DATA	8.70E+03	7.59E+04
CE-141	3.92E+04	1.95E+05	2.90E+03	NO DATA	8.55E+03	5.44E+05	5.66E+04
CE-143	3.66E+02	1.99E+02	2.87E+01	NO DATA	8.36E+01	1.15E+05	1.27E+05
CE-144	6.77E+06	2.12E+06	3.61E+05	NO DATA	1.17E+06	1.20E+07	3.89E+05
PR-143	1.85E+04	5.55E+03	9.14E+02	NO DATA	3.00E+03	4.33E+05	9.73E+04
PR-144	5.96E-02	1.85E-02	3.00E-03	NO DATA	9.77E-03	1.57E+03	1.97E+02
ND-147	1.08E+04	8.73E+03	6.81E+02	NO DATA	4.81E+03	3.28E+05	8.21E+04
W-187	1.63E+01	9.66E+00	4.33E+00	NO DATA	NO DATA	4.11E+04	9.10E+04
NP-239	4.66E+02	3.34E+01	2.35E+01	NO DATA	9.73E+01	5.81E+04	6.40E+04

*1.12×10^{3}
**Less than 3.70×10^{-15}

TABLE 3.5-15

INHALATION PATHWAY FACTORS - R^{I}_{ai} (TEEN)
(mrem/yr per μCi/m³)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	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
P-32	1.89E+06	1.10E+05	7.16E+04	NO DATA	NO DATA	NO DATA	9.28E+04
CR-51	NO DATA	NO DATA	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
MN-54	NO DATA	5.11E+04	8.40E+03	NO DATA	1.27E+04	1.98E+06	6.68E+04
MN-56	NO DATA	1.70E+00	2.52E-01	NO DATA	1.79E+00	1.52E+04	5.74E+04
FE-55	3.34E+04	2.38E+04	5.54E+03	NO DATA	NO DATA	1.24E+05	6.39E+03
FE-59	1.59E+04	3.70E+04	1.43E+04	NO DATA	NO DATA	1.53E+06	1.78E+05
CO-58	NO DATA	2.07E+03	2.78E+03	NO DATA	NO DATA	1.34E+06	9.52E+04
CO-60	NO DATA	1.51E+04	1.98E+04	NO DATA	NO DATA	8.72E+06	2.59E+05
NI-63	5.80E+05	4.34E+04	1.98E+04	NO DATA	NO DATA	3.07E+05	1.42E+04
NI-65	2.18E+00	2.93E-01	1.27E-01	NO DATA	NO DATA	9.36E+03	3.67E+04
CU-64	NO DATA	2.03E+00	8.48E-01	NO DATA	6.41E+00	1.11E+04	6.14E+04
ZN-65	3.86E+04	1.34E+05	6.24E+04	NO DATA	8.64E+04	1.24E+06	4.66E+04
ZN-69	4.83E-02	9.20E-02	6.46E-03	NO DATA	6.02E-02	1.58E+03	2.85E+02
BR-83	NO DATA	NO DATA	3.44E+02	NO DATA	NO DATA	NO DATA	LT8E-15**
BR-84	NO DATA	NO DATA	4.33E+02	NO DATA	NO DATA	NO DATA	LT8E-15
BR-85	NO DATA	NO DATA	1.83E+01	NO DATA	NO DATA	NO DATA	LT8E-15
RB-86	NO DATA	1.90E+05	8.40E+04	NO DATA	NO DATA	NO DATA	1.77E+04
RB-88	NO DATA	5.46E+02	2.72E+02	NO DATA	NO DATA	NO DATA	2.92E-05
RB-89	NO DATA	3.52E+02	2.33E+02	NO DATA	NO DATA	NO DATA	3.38E-07
SR-89	4.34E+05	NO DATA	1.25E+04	NO DATA	NO DATA	2.42E+06	3.71E+05
SR-90	1.08E+08	NO DATA	6.68E+06	NO DATA	NO DATA	1.65E+07	7.65E+05
SR-91	8.80E+01	NO DATA	3.51E+00	NO DATA	NO DATA	6.07E+04	2.59E+05
SR-92	9.52E+00	NO DATA	4.06E-01	NO DATA	NO DATA	2.74E+04	1.19E+05
Y-90	2.98E+03	NO DATA	8.00E+01	NO DATA	NO DATA	2.93E+05	5.59E+05
Y-91m	3.70E-01	NO DATA	1.42E-02	NO DATA	NO DATA	3.20E+03	3.02E+01
Y-91	6.61E+05	NO DATA	1.77E+04	NO DATA	NO DATA	2.94E+06	4.09E+05
Y-92	1.47E+01	NO DATA	4.29E-01	NO DATA	NO DATA	2.68E+04	1.65E+05
Y-93	1.35E+02	NO DATA	3.72E+00	NO DATA	NO DATA	8.32E+04	5.79E+05
ZR-95	1.46E+05	4.58E+04	3.15E+04	NO DATA	6.74E+04	2.69E+06	1.49E+05
ZR-97	1.38E+02	2.72E+01	1.26E+01	NO DATA	4.12E+01	1.30E+05	6.30E+05
NB-95	1.86E+04	1.03E+04	5.66E+03	NO DATA	1.00E+04	7.51E+05	9.68E+04
MO-99	NO DATA	1.69E+02	3.22E+01	NO DATA	4.11E+02	1.54E+05	2.69E+05
TC-99m	1.38E-03	3.86E-03	4.99E-02	NO DATA	5.76E-02	1.15E+03	6.13E+03
TC-101	5.92E-05	8.40E-05	8.24E-04	NO DATA	1.52E-03	6.67E+02	8.72E-07
RU-103	2.10E+03	NO DATA	8.96E+02	NO DATA	7.43E+03	7.83E+05	1.09E+05
RU-105	1.12E+00	NO DATA	4.34E-01	NO DATA	1.41E+00	1.82E+04	9.04E+04
RU-106	9.84E+04	NO DATA	1.24E+04	NO DATA	1.90E+05	1.61E+07	9.60E+05
AG-110m	1.38E+04	1.31E+04	7.99E+03	NO DATA	2.50E+04	6.75E+06	2.73E+05
TE-125m	4.88E+03	2.24E+03	6.67E+02	1.40E+03	NO DATA	5.36E+05	7.50E+04
TE-127m	1.80E+04	8.16E+03	2.18E+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
TE-131	1.58E-02	8.32E-03	5.04E-03	1.24E-02	6.18E-02	2.34E+03	1.51E+01

TABLE 3.5-15 (continued)

INHALATION PATHWAY FACTORS - R^{I}_{aij} (TEEN)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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	1.78E+04	7.17E+03	1.49E+06	2.75E+04	NO DATA	9.12E+03
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	NO DATA	6.49E+03
I-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	NO DATA	1.27E+03
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	NO DATA	1.03E+04
I-134	8.88E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	NO DATA	2.04E+01
I-135	3.70E+03	9.44E+03	3.49E+03	6.21E+05	1.49E+04	NO DATA	6.95E+03
CS-134	5.02E+05	1.12E+06	5.49E+05	NO DATA	3.75E+05	1.46E+05	9.76E+03
CS-136	5.15E+04	1.94E+05	1.37E+05	NO DATA	1.10E+05	1.78E+04	1.09E+04
CS-137	6.70E+05	8.48E+05	3.11E+05	NO DATA	3.04E+05	1.21E+05	8.48E+03
CS-138	4.66E+02	8.56E+02	4.46E+02	NO DATA	6.62E+02	7.87E+01	2.70E-01
BA-139	1.34E+00	9.44E-04	3.90E-02	NO DATA	8.88E-04	6.46E+03	6.45E+03
BA-140	5.47E+04	6.70E+01	3.52E+03	NO DATA	2.28E+01	2.03E+06	2.29E+05
BA-141	1.42E-01	1.06E-04	4.74E-03	NO DATA	9.84E-05	3.29E+03	7.46E-04
BA-142	3.70E-02	3.70E-05	2.27E-03	NO DATA	3.14E-05	1.91E+03	4.79E-10
LA-140	4.79E+02	2.36E+02	6.26E+01	NO DATA	NO DATA	2.14E+05	4.87E+05
LA-142	9.60E-01	4.25E-01	1.06E-01	NO DATA	NO DATA	1.02E+04	1.20E+04
CE-141	2.84E+04	1.90E+04	2.17E+03	NO DATA	8.88E+03	6.14E+05	1.26E+05
CE-143	2.66E+02	1.94E+02	2.16E+01	NO DATA	8.64E+01	1.30E+05	2.55E+05
CE-144	4.89E+06	2.02E+06	2.62E+05	NO DATA	1.21E+06	1.34E+07	8.64E+05
PR-143	1.34E+04	5.31E+03	6.62E+02	NO DATA	3.09E+03	4.83E+05	2.14E+05
PR-144	4.30E-02	1.76E-02	2.18E-03	NO DATA	1.01E-02	1.75E+03	2.35E-04
ND-147	7.86E+03	8.56E+03	5.13E+02	NO DATA	5.02E+03	3.72E+05	1.82E+05
W-187	1.20E+01	9.76E+00	3.43E+00	NO DATA	NO DATA	4.74E+04	1.77E+05
NP-239	3.38E+02	3.19E+01	1.77E+01	NO DATA	1.00E+02	6.49E+04	1.32E+05

*1.27×10^{3}

**Less than 8.00×10^{-15}

TABLE 3.5-16

INHALATION PATHWAY FACTORS - R^{I}_{aij} (ADULT)
(mrem/yr per μCi/m³)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	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	NO DATA	NO DATA	NO DATA	8.64E+04
CR-51	NO DATA	NO DATA	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
MN-54	NO DATA	3.96E+04	6.30E+03	NO DATA	9.84E+03	1.40E+06	7.74E+04
MN-56	NO DATA	1.24E+00	1.83E-01	NO DATA	1.30E+00	9.44E+03	2.02E+04
FE-55	2.46E+04	1.70E+04	3.94E+03	NO DATA	NO DATA	7.21E+04	6.03E+03
FE-59	1.18E+04	2.78E+04	1.06E+04	NO DATA	NO DATA	1.02E+06	1.88E+05
CO-58	NO DATA	1.58E+03	2.07E+03	NO DATA	NO DATA	9.28E+05	1.06E+05
CO-60	NO DATA	1.15E+04	1.48E+04	NO DATA	NO DATA	5.97E+06	2.85E+05
NI-63	4.32E+05	3.14E+04	1.45E+04	NO DATA	NO DATA	1.78E+05	1.34E+04
NI-65	1.54E+00	2.10E-01	9.12E-02	NO DATA	NO DATA	5.60E+03	1.23E+04
CU-64	NO DATA	1.46E+00	6.15E-01	NO DATA	4.62E+00	6.78E+03	4.90E+04
ZN-65	3.24E+04	1.03E+05	4.66E+04	NO DATA	6.90E+04	8.64E+05	5.34E+04
ZN-69	3.38E-02	6.51E-02	4.52E-03	NO DATA	4.22E-02	9.20E+02	1.63E+01
BR-83	NO DATA	NO DATA	2.41E+02	NO DATA	NO DATA	NO DATA	2.32E+02
BR-84	NO DATA	NO DATA	3.13E+02	NO DATA	NO DATA	NO DATA	1.64E-03
BR-85	NO DATA	NO DATA	1.28E+01	NO DATA	NO DATA	NO DATA	LT8E-15**
RB-86	NO DATA	1.35E+05	5.90E+04	NO DATA	NO DATA	NO DATA	1.66E+04
RB-88	NO DATA	3.87E+02	1.93E+02	NO DATA	NO DATA	NO DATA	3.34E-09
RB-89	NO DATA	2.56E+02	1.70E+02	NO DATA	NO DATA	NO DATA	9.28E-12
SR-89	3.04E+05	NO DATA	8.72E+03	NO DATA	NO DATA	1.40E+06	3.50E+05
SR-90	9.92E+07	NO DATA	6.10E+06	NO DATA	NO DATA	9.60E+06	7.22E+05
SR-91	6.19E+01	NO DATA	2.50E+00	NO DATA	NO DATA	3.65E+04	1.91E+05
SR-92	6.74E+00	NO DATA	2.91E-01	NO DATA	NO DATA	1.65E+04	4.30E+04
Y-90	2.09E+03	NO DATA	5.61E+01	NO DATA	NO DATA	1.70E+05	5.06E+05
Y-91m	2.61E-01	NO DATA	1.02E-02	NO DATA	NO DATA	1.92E+03	1.33E+00
Y-91	4.62E+05	NO DATA	1.24E+04	NO DATA	NO DATA	1.70E+06	3.85E+05
Y-92	1.03E+01	NO DATA	3.02E-01	NO DATA	NO DATA	1.57E+04	7.35E+04
Y-93	9.44E+01	NO DATA	2.61E+00	NO DATA	NO DATA	4.85E+04	4.22E+05
ZR-95	1.07E+05	3.44E+04	2.33E+04	NO DATA	5.42E+04	1.77E+06	1.50E+05
ZR-97	9.68E+01	1.96E+01	9.04E+00	NO DATA	2.97E+01	7.87E+04	5.23E+05
NB-95	1.41E+04	7.82E+03	4.21E+03	NO DATA	7.74E+03	5.05E+05	1.04E+05
MO-99	NO DATA	1.21E+02	2.30E+01	NO DATA	2.91E+02	9.12E+04	2.48E+05
TC-99m	1.03E-03	2.91E-03	3.70E-02	NO DATA	4.42E-02	7.64E+02	4.16E+03
TC-101	4.18E-05	6.02E-05	5.90E-04	NO DATA	1.08E-03	3.99E+02	1.09E-11
RU-103	1.53E+03	NO DATA	6.58E+02	NO DATA	5.83E+03	5.05E+05	1.10E+05
RU-105	7.90E-01	NO DATA	3.11E-01	NO DATA	1.02E+00	1.10E+04	4.82E+04
RU-106	6.91E+04	NO DATA	8.72E+03	NO DATA	1.34E+05	9.36E+06	9.12E+05
AG-110m	1.08E+04	1.00E+04	5.94E+03	NO DATA	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
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
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	5.95E-03	3.59E-03	9.36E-03	4.37E-02	1.39E+03	1.84E+01

TABLE 3.5-16 (continued)

INHALATION PATHWAY FACTORS - R^{I}_{aij} (ADULT)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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+04	NO DATA	7.69E+03
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	NO DATA	6.28E+03
I-132	1.16E+03	3.26E+03	1.16E+03	1.14E+05	5.18E+03	NO DATA	4.06E+02
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	NO DATA	8.88E+03
I-134	6.44E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	NO DATA	1.01E+00
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	NO DATA	5.25E+03
CS-134	3.73E+05	8.48E+05	7.28E+05	NO DATA	2.87E+05	9.76E+04	1.04E+04
CS-136	3.90E+04	1.46E+05	1.10E+05	NO DATA	8.56E+04	1.20E+04	1.17E+04
CS-137	4.78E+05	6.21E+05	4.28E+05	NO DATA	2.22E+05	7.52E+04	8.40E+03
CS-138	3.31E+02	6.21E+02	3.24E+02	NO DATA	4.80E+02	4.86E+01	1.86E-03
BA-139	9.36E-01	6.66E-04	2.74E-02	NO DATA	6.22E-04	3.76E+03	8.96E+02
BA-140	3.90E+04	4.90E+01	2.57E+03	NO DATA	1.67E+01	1.27E+06	2.18E+05
BA-141	1.00E-01	7.53E-05	3.36E-03	NO DATA	7.00E-05	1.94E+03	1.16E-07
BA-142	2.63E-02	2.70E-05	1.66E-03	NO DATA	2.29E-05	1.19E+03	1.57E-16
LA-140	3.44E+02	1.74E+02	4.58E+01	NO DATA	NO DATA	1.36E+05	4.58E+05
LA-142	6.83E-01	3.10E-01	7.72E-02	NO DATA	NO DATA	6.33E+03	2.11E+03
CE-141	1.99E+04	1.35E+04	1.53E+03	NO DATA	6.26E+03	3.62E+05	1.20E+05
CE-143	1.86E+02	1.38E+02	1.53E+01	NO DATA	6.08E+01	7.98E+04	2.26E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	NO DATA	8.48E+05	7.78E+06	8.16E+05
PR-143	9.36E+03	3.75E+03	4.64E+02	NO DATA	2.16E+03	2.81E+05	2.00E+05
PR-144	3.01E-02	1.25E-02	1.53E-03	NO DATA	7.05E-03	1.02E+03	2.15E-08
ND-147	5.27E+03	6.10E+03	3.65E+02	NO DATA	3.56E+03	2.21E+05	1.73E+05
W-187	8.48E+00	7.08E+00	2.48E+00	NO DATA	NO DATA	2.90E+04	1.55E+05
NP-239	2.30E+02	2.26E+01	1.24E+01	NO DATA	7.00E+01	3.76E+04	1.19E+05

*1.26×10^{3}
**Less than 8.00×10^{-15}

TABLE 3.5-17

COW MILK PATHWAY FACTORS - R^{C}_{aij} (INFANT)
(m^2rem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.38E+03*	2.38E+03*	2.38E+03*	2.38E+03*	2.38E+03*	2.38E+03*
C-14	3.23E+06*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*
NA-24	1.55E+07**	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07
P-32	1.60E+11	9.41E+09	6.20E+09	NO DATA	NO DATA	NO DATA	2.16E+09
CR-51	NO DATA	NO DATA	1.61E+05	1.05E+05	2.29E+04	2.04E+05	4.69E+06
MN-54	NO DATA	3.90E+07	8.84E+06	NO DATA	8.64E+06	NO DATA	1.43E+07
MN-56	NO DATA	3.12E-02	5.39E-03	NO DATA	2.69E-02	NO DATA	2.84E+00
FE-55	1.35E+08	8.72E+07	2.33E+07	NO DATA	NO DATA	4.26E+07	1.11E+07
FE-59	2.25E+08	3.92E+08	1.55E+08	NO DATA	NO DATA	1.16E+08	1.87E+08
CO-58	NO DATA	2.43E+07	6.06E+07	NO DATA	NO DATA	NO DATA	6.05E+07
CO-60	NO DATA	8.82E+07	2.08E+08	NO DATA	NO DATA	NO DATA	2.10E+08
NI-63	3.50E+10	2.16E+09	1.21E+09	NO DATA	NO DATA	NO DATA	1.08E+08
NI-65	3.52E+00	3.98E-01	1.81E-01	NO DATA	NO DATA	NO DATA	3.03E+01
CU-64	NO DATA	1.84E+05	8.52E+04	NO DATA	3.11E+05	NO DATA	3.78E+06
ZN-65	5.55E+09	1.91E+10	8.78E+09	NO DATA	9.23E+09	NO DATA	1.61E+10
ZN-69	1.94E-11	3.49E-11	2.60E-12	NO DATA	1.45E-11	NO DATA	2.85E-09
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.23E+10	1.10E+10	NO DATA	NO DATA	NO DATA	5.70E+08
RB-88	NO DATA	1.88E-44	1.03E-44	NO DATA	NO DATA	NO DATA	1.83E-44
RB-89	NO DATA	3.43E-52	2.36E-52	NO DATA	NO DATA	NO DATA	1.17E-52
SR-89	1.26E+10	NO DATA	3.61E+08	NO DATA	NO DATA	NO DATA	2.59E+08
SR-90	1.22E+11	NO DATA	3.10E+10	NO DATA	NO DATA	NO DATA	1.52E+09
SR-91	2.71E+05	NO DATA	9.76E+03	NO DATA	NO DATA	NO DATA	3.20E+05
SR-92	4.68E+00	NO DATA	1.74E-01	NO DATA	NO DATA	NO DATA	5.05E+01
Y-90	6.83E+02	NO DATA	1.83E+01	NO DATA	NO DATA	NO DATA	9.43E+05
Y-91m	6.09E-19	NO DATA	2.08E-20	NO DATA	NO DATA	NO DATA	2.03E-15
Y-91	7.33E+04	NO DATA	1.95E+03	NO DATA	NO DATA	NO DATA	5.26E+06
Y-92	5.35E-04	NO DATA	1.50E-05	NO DATA	NO DATA	NO DATA	1.02E+01
Y-93	2.14E+00	NO DATA	5.83E-02	NO DATA	NO DATA	NO DATA	1.69E+04
ZR-95	6.82E+03	1.66E+03	1.18E+03	NO DATA	1.79E+03	NO DATA	8.28E+05
ZR-97	4.03E+00	6.96E-01	3.16E-01	NO DATA	7.01E-01	NO DATA	4.41E+04
NB-95	5.93E+05	2.44E+05	1.41E+05	NO DATA	1.75E+05	NO DATA	2.06E+08
MO-99	NO DATA	2.07E+08	4.04E+07	NO DATA	3.10E+08	NO DATA	6.83E+07
TC-99m	2.75E+01	5.66E+01	7.29E+02	NO DATA	6.09E+02	2.96E+01	1.64E+04
TC-101	2.72E-59	3.42E-59	3.39E-58	NO DATA	4.07E-58	1.87E-59	5.81E-57
RU-103	8.67E+03	NO DATA	2.92E+03	NO DATA	1.81E+04	NO DATA	1.06E+05
RU-105	8.00E-03	NO DATA	2.70E-03	NO DATA	5.88E-02	NO DATA	3.18E+00
RU-106	1.91E+05	NO DATA	2.38E+04	NO DATA	2.26E+05	NO DATA	1.45E+06
AG-110m	3.85E+08	2.81E+08	1.86E+08	NO DATA	4.02E+08	NO DATA	1.46E+10
TE-125m	1.51E+08	5.05E+07	2.04E+07	5.08E+07	NO DATA	NO DATA	7.19E+07
TE-127m	4.22E+08	1.40E+08	5.10E+07	1.22E+08	1.04E+09	NO DATA	1.70E+08
TE-127	6.31E+03	2.11E+03	1.39E+03	5.13E+03	1.58E+04	NO DATA	1.36E+05
TE-129m	5.56E+08	1.91E+08	8.56E+07	2.14E+08	1.39E+09	NO DATA	3.32E+08
TE-129	2.71E-09	9.34E-10	6.33E-10	2.27E-09	6.75E-09	NO DATA	2.17E-07
TE-131m	3.37E+06	1.36E+06	1.12E+06	2.75E+06	9.35E+06	NO DATA	2.29E+07
TE-131	3.48E-32	1.29E-32	9.78E-33	3.11E-32	8.91E-32	NO DATA	1.41E-30

TABLE 3.5-17 (continued)

COW MILK PATHWAY FACTORS - R^{C}_{aij} (INFANT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.12E+07	1.05E+07	9.80E+06	1.55E+07	6.57E+07	NO DATA	3.89E+07
I-130	3.53E+06	7.76E+06	3.12E+06	8.70E+08	8.53E+06	NO DATA	1.66E+06
I-131	2.71E+09	3.19E+09	1.40E+09	1.05E+12	3.73E+09	NO DATA	1.14E+08
I-132	1.43E+00	2.90E+00	1.03E+00	1.36E+02	3.24E+00	NO DATA	2.35E+00
I-133	3.63E+07	5.28E+07	1.55E+07	9.60E+09	6.21E+07	NO DATA	8.93E+06
I-134	1.64E-11	3.36E-11	1.20E-11	7.86E-10	3.76E-11	NO DATA	3.48E-11
I-135	1.13E+05	2.24E+05	8.18E+04	2.01E+07	2.50E+05	NO DATA	8.12E+04
CS-134	3.65E+10	6.81E+10	6.88E+09	NO DATA	1.75E+10	7.19E+09	1.85E+08
CS-136	1.97E+09	5.81E+09	2.17E+09	NO DATA	2.31E+09	4.73E+08	8.82E+07
CS-137	5.15E+10	6.03E+10	4.27E+09	NO DATA	1.62E+10	6.44E+09	1.89E+08
CS-138	8.06E-23	1.31E-22	6.35E-23	NO DATA	6.53E-23	1.02E-22	2.09E-22
BA-139	4.29E-07	2.84E-10	1.24E-08	NO DATA	1.71E-10	1.72E-10	2.72E-05
BA-140	2.45E+08	2.45E+05	1.26E+07	NO DATA	5.72E+04	1.50E+05	5.92E+07
BA-141	4.16E-45	2.85E-48	1.31E-46	NO DATA	1.71E-48	1.73E-48	5.08E-44
BA-142	2.32E-79	1.93E-82	1.14E-80	NO DATA	1.11E-82	1.17E-82	9.56E-79
LA-140	4.05E+01	1.60E+01	4.11E+00	NO DATA	NO DATA	NO DATA	1.88E+05
LA-142	1.73E-10	6.34E-11	1.52E-11	NO DATA	NO DATA	NO DATA	1.08E-05
CE-141	4.34E+04	2.65E+04	3.12E+03	NO DATA	8.17E+03	NO DATA	1.37E+07
CE-143	3.98E+02	2.64E+05	3.01E+01	NO DATA	7.69E+01	NO DATA	1.54E+06
CE-144	2.34E+06	9.56E+05	1.31E+05	NO DATA	3.87E+05	NO DATA	1.34E+08
PR-143	1.49E+03	5.56E+02	7.37E+01	NO DATA	2.07E+02	NO DATA	7.85E+05
PR-144	6.27E-53	2.43E-53	3.16E-54	NO DATA	8.79E-54	NO DATA	1.13E-48
ND-147	8.79E+02	9.03E+02	5.53E+01	NO DATA	3.48E+02	NO DATA	5.72E+05
W-187	6.10E+04	4.24E+04	1.46E+04	NO DATA	NO DATA	NO DATA	2.49E+06
NP-239	3.64E+01	3.26E+00	1.84E+00	NO DATA	6.49E+00	NO DATA	9.41E+04

*mrem/yr per µCi/m^3
**1.55×10^7

TABLE 3.5-18

COW MILK PATHWAY FACTORS - R^{C}_{ai} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.57E+03*	1.57E+03*	1.57E+03*	1.57E+03*	1.57E+03*	1.57E+03*
C-14	1.65E+06*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*
NA-24	8.93E+06**	8.93E+06	8.93E+06	8.93E+06	8.93E+06	8.93E+06	8.93E+06
P-32	7.79E+10	3.64E+09	3.00E+09	NO DATA	NO DATA	NO DATA	2.15E+09
CR-51	NO DATA	NO DATA	1.01E+05	5.63E+04	1.54E+04	1.03E+05	5.38E+06
MN-54	NO DATA	2.10E+07	5.59E+06	NO DATA	5.88E+06	NO DATA	1.76E+07
MN-56	NO DATA	1.28E-02	2.88E-03	NO DATA	1.54E-02	NO DATA	1.85E+00
FE-55	1.12E+08	5.94E+07	1.84E+07	NO DATA	NO DATA	3.36E+07	1.10E+07
FE-59	1.20E+08	1.95E+08	9.71E+07	NO DATA	NO DATA	5.65E+07	2.03E+08
CO-58	NO DATA	1.21E+07	3.71E+07	NO DATA	NO DATA	NO DATA	7.08E+07
CO-60	NO DATA	4.32E+07	1.27E+08	NO DATA	NO DATA	NO DATA	2.39E+08
NI-63	2.97E+10	1.59E+09	1.01E+09	NO DATA	NO DATA	NO DATA	1.07E+08
NI-65	1.65E+00	1.56E-01	9.10E-02	NO DATA	NO DATA	NO DATA	1.91E+01
CU-64	NO DATA	7.40E+04	4.47E+04	NO DATA	1.79E+05	NO DATA	3.47E+06
ZN-65	4.13E+09	1.10E+10	6.83E+09	NO DATA	6.92E+09	NO DATA	1.93E+09
ZN-69	9.11E-12	1.32E-11	1.22E-12	NO DATA	7.99E-12	NO DATA	8.30E-10
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	8.78E+09	5.40E+09	NO DATA	NO DATA	NO DATA	5.65E+08
RB-88	NO DATA	7.16E-45	4.98E-45	NO DATA	NO DATA	NO DATA	3.51E-46
RB-89	NO DATA	1.40E-52	1.25E-52	NO DATA	NO DATA	NO DATA	1.22E-54
SR-89	6.63E+09	NO DATA	1.89E+08	NO DATA	NO DATA	NO DATA	2.57E+08
SR-90	1.12E+11	NO DATA	2.84E+10	NO DATA	NO DATA	NO DATA	1.51E+09
SR-91	1.30E+05	NO DATA	4.89E+03	NO DATA	NO DATA	NO DATA	2.86E+05
SR-92	2.20E+00	NO DATA	8.83E-02	NO DATA	NO DATA	NO DATA	4.17E+01
Y-90	3.23E+02	NO DATA	8.65E+00	NO DATA	NO DATA	NO DATA	9.20E+05
Y-91m	2.88E-19	NO DATA	1.05E-20	NO DATA	NO DATA	NO DATA	5.63E-16
Y-91	3.90E+04	NO DATA	1.04E+03	NO DATA	NO DATA	NO DATA	5.20E+06
Y-92	2.53E-04	NO DATA	7.23E-06	NO DATA	NO DATA	NO DATA	7.30E+00
Y-93	1.01E+00	NO DATA	2.76E-02	NO DATA	NO DATA	NO DATA	1.50E+04
ZR-95	3.84E+03	8.44E+02	7.51E+02	NO DATA	1.21E+03	NO DATA	8.80E+05
ZR-97	1.92E+00	2.78E-01	1.64E-01	NO DATA	3.99E-01	NO DATA	4.21E+04
NB-95	3.18E+05	1.24E+05	8.84E+04	NO DATA	1.16E+05	NO DATA	2.29E+08
MO-99	NO DATA	8.15E+07	2.02E+07	NO DATA	1.74E+08	NO DATA	6.74E+07
TC-99m	1.32E+01	2.58E+01	4.28E+02	NO DATA	3.75E+02	1.31E+01	1.47E+04
TC-101	1.28E-59	1.34E-59	1.70E-58	NO DATA	2.29E-58	7.08E-60	4.26E-59
RU-103	4.29E+03	NO DATA	1.65E+03	NO DATA	1.08E+04	NO DATA	1.11E+05
RU-105	3.80E-03	NO DATA	1.38E-03	NO DATA	3.34E-02	NO DATA	2.48E+00
RU-106	9.25E+04	NO DATA	1.15E+04	NO DATA	1.25E+05	NO DATA	1.44E+06
AG-110m	2.09E+08	1.41E+08	1.13E+08	NO DATA	2.63E+08	NO DATA	1.68E+10
TE-125m	7.39E+07	2.00E+07	9.85E+07	2.07E+07	NO DATA	NO DATA	7.13E+07
TE-127m	2.08E+08	5.61E+07	2.47E+07	4.98E+07	5.94E+08	NO DATA	1.69E+08
TE-127	2.97E+03	8.01E+02	6.37E+02	2.06E+03	8.45E+03	NO DATA	1.16E+05
TE-129m	2.71E+08	7.58E+07	4.21E+07	8.74E+07	7.97E+08	NO DATA	3.31E+08
TE-129	1.28E-09	3.57E-10	3.04E-10	9.12E-10	3.74E-09	NO DATA	7.96E-08
TE-131m	1.60E+06	5.53E+05	5.88E+05	1.14E+06	5.35E+06	NO DATA	2.24E+07
TE-131	1.64E-32	5.01E-33	4.89E-33	1.26E-32	4.97E-32	NO DATA	8.63E-32

TABLE 3.5-18 (continued)

COW MILK PATHWAY FACTORS - R^{C}_{aij} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.03E+07	4.56E+06	5.51E+06	6.64E+06	4.23E+07	NO DATA	4.59E+07
I-130	1.72E+06	3.47E+06	1.79E+06	3.82E+08	5.19E+06	NO DATA	1.62E+06
I-131	1.30E+09	1.31E+09	7.44E+08	4.33E+11	2.15E+09	NO DATA	1.17E+08
I-132	6.91E-01	1.27E+00	5.84E-01	5.89E+01	1.94E+00	NO DATA	1.49E+00
I-133	1.72E+07	2.12E+07	8.03E+06	3.94E+09	3.54E+07	NO DATA	8.56E+06
I-134	7.92E-12	1.47E-11	6.77E-12	3.38E-10	2.25E-11	NO DATA	9.75E-12
I-135	5.43E+04	9.77E+04	4.62E+04	8.56E+06	1.50E+05	NO DATA	7.44E+04
CS-134	2.27E+10	3.72E+10	7.85E+09	NO DATA	1.15E+10	4.14E+09	2.01E+08
CS-136	1.01E+09	2.78E+09	1.80E+09	NO DATA	1.48E+09	2.21E+08	9.76E+07
CS-137	3.23E+10	3.09E+10	4.56E+09	NO DATA	1.01E+10	3.63E+09	1.94E+08
CS-138	3.82E-23	5.31E-23	3.37E-23	NO DATA	3.74E-23	4.02E-24	2.45E-23
BA-139	2.01E-07	1.08E-10	5.84E-09	NO DATA	9.39E-11	6.33E-11	1.16E-05
BA-140	1.18E+08	1.03E+05	6.84E+06	NO DATA	3.37E+04	6.12E+04	5.94E+07
BA-141	1.96E-45	1.10E-48	6.38E-47	NO DATA	9.50E-49	6.45E-48	1.12E-45
BA-142	1.10E-79	7.93E-83	6.15E-81	NO DATA	6.41E-83	4.66E-83	1.44E-81
LA-140	1.94E+01	6.78E+00	2.11E+00	NO DATA	NO DATA	NO DATA	1.89E+05
LA-142	8.23E-11	2.62E-11	8.21E-12	NO DATA	NO DATA	NO DATA	5.20E-06
CE-141	2.19E+04	1.09E+04	1.62E+03	NO DATA	4.78E+03	NO DATA	1.36E+07
CE-143	1.87E+02	1.02E+05	1.47E+01	NO DATA	4.26E+01	NO DATA	1.49E+06
CE-144	1.63E+06	5.10E+05	8.68E+04	NO DATA	2.82E+05	NO DATA	1.33E+08
PR-143	7.19E+02	2.16E+02	3.57E+01	NO DATA	1.17E+02	NO DATA	7.76E+05
PR-144	2.94E-53	9.10E-54	1.48E-54	NO DATA	4.81E-54	NO DATA	1.96E-50
ND-147	4.44E+02	3.59E+02	2.78E+01	NO DATA	1.97E+02	NO DATA	5.69E+05
W-187	2.88E+04	1.71E+04	7.66E+03	NO DATA	NO DATA	NO DATA	2.40E+06
NP-239	1.72E+01	1.24E+00	8.69E-01	NO DATA	3.58E+00	NO DATA	9.15E+04

*mrem/yr per µCi/m^3
**8.93 x 10^6

TABLE 3.5-19

COW MILK PATHWAY FACTORS - R^{C}_{aij} (TEEN)
(m^2mrem/yr per µCi)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	9.92E+02*	9.92E+02*	9.92E+02*	9.92E+02*	9.92E+02*	9.92E+02*
C-14	6.70E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*
NA-24	4.29E+06*	4.29E+06	4.29E+06	4.29E+06	4.29E+06	4.29E+06	4.29E+06
P-32	3.15E+10	1.95E+09	1.22E+09	NO DATA	NO DATA	NO DATA	2.64E+09
CR-51	NO DATA	NO DATA	5.00E+04	2.78E+04	1.10E+04	7.14E+04	8.41E+06
MN-54	NO DATA	1.40E+07	2.78E+06	NO DATA	4.19E+06	NO DATA	2.88E+07
MN-56	NO DATA	7.32E-03	1.30E-03	NO DATA	9.26E-03	NO DATA	4.82E-01
FE-55	4.46E+07	3.16E+07	7.38E+06	NO DATA	NO DATA	2.01E+07	1.37E+07
FE-59	5.18E+07	1.21E+08	4.67E+07	NO DATA	NO DATA	3.81E+07	2.68E+08
CO-58	NO DATA	7.98E+06	1.84E+07	NO DATA	NO DATA	NO DATA	1.10E+08
CO-60	NO DATA	2.78E+07	6.26E+07	NO DATA	NO DATA	NO DATA	3.62E+08
NI-63	1.18E+10	8.34E+08	4.00E+08	NO DATA	NO DATA	NO DATA	1.33E+08
NI-65	6.79E-01	8.67E-02	3.95E-02	NO DATA	NO DATA	NO DATA	4.70E+00
CU-64	NO DATA	4.20E+04	1.97E+04	NO DATA	1.06E+05	NO DATA	3.26E+06
ZN-65	2.11E+09	7.32E+09	3.41E+09	NO DATA	4.68E+09	NO DATA	3.10E+09
ZN-69	3.70E-12	7.06E-12	4.94E-13	NO DATA	4.61E-12	NO DATA	1.30E-11
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	4.74E+09	2.23E+09	NO DATA	NO DATA	NO DATA	7.01E+08
RB-88	NO DATA	3.90E-45	2.08E-45	NO DATA	NO DATA	NO DATA	3.34E-52
RB-89	NO DATA	7.98E-53	5.64E-53	NO DATA	NO DATA	NO DATA	1.22E-61
SR-89	2.68E+09	NO DATA	7.67E+07	NO DATA	NO DATA	NO DATA	3.19E+08
SR-90	6.62E+10	NO DATA	1.64E+10	NO DATA	NO DATA	NO DATA	1.86E+09
SR-91	5.27E+04	NO DATA	2.10E+03	NO DATA	NO DATA	NO DATA	2.39E+05
SR-92	9.03E-01	NO DATA	3.85E-02	NO DATA	NO DATA	NO DATA	2.30E+01
Y-90	1.31E+02	NO DATA	3.53E+00	NO DATA	NO DATA	NO DATA	1.08E+06
Y-91m	1.18E-19	NO DATA	4.49E-21	NO DATA	NO DATA	NO DATA	5.55E-18
Y-91	1.58E+04	NO DATA	4.24E+02	NO DATA	NO DATA	NO DATA	6.48E+06
Y-92	1.03E-04	NO DATA	2.97E-06	NO DATA	NO DATA	NO DATA	2.82E+00
Y-93	4.10E-01	NO DATA	1.12E-02	NO DATA	NO DATA	NO DATA	1.25E+04
ZR-95	1.65E+03	5.20E+02	3.58E+02	NO DATA	7.65E+02	NO DATA	1.20E+06
ZR-97	7.87E-01	1.56E-01	7.17E-02	NO DATA	2.36E-01	NO DATA	4.22E+04
NB-95	1.41E+05	7.81E+04	4.30E+04	NO DATA	7.57E+04	NO DATA	3.34E+08
MO-99	NO DATA	4.46E+07	8.50E+06	NO DATA	1.02E+08	NO DATA	7.98E+07
TC-99m	5.74E+00	1.60E+01	2.08E+02	NO DATA	2.39E+02	8.89E+00	1.05E+04
TC-101	5.22E-60	7.42E-60	7.29E-59	NO DATA	1.34E-58	4.52E-60	1.27E-66
RU-103	1.81E+03	NO DATA	7.73E+02	NO DATA	6.37E+03	NO DATA	1.51E+05
RU-105	1.56E-03	NO DATA	6.06E-04	NO DATA	1.97E-02	NO DATA	1.26E+00
RU-106	3.75E+04	NO DATA	4.73E+03	NO DATA	7.23E+04	NO DATA	1.80E+06
AG-110m	9.64E+07	9.12E+07	5.55E+07	NO DATA	1.74E+08	NO DATA	2.56E+10
TE-125m	3.01E+07	1.08E+07	4.02E+06	8.41E+06	NO DATA	NO DATA	8.88E+07
TE-127m	8.43E+07	2.99E+07	1.00E+07	2.01E+07	3.42E+08	NO DATA	2.10E+08
TE-127	1.21E+03	4.28E+02	2.60E+02	8.33E+02	4.89E+03	NO DATA	9.33E+04
TE-129m	1.10E+08	4.09E+07	1.74E+07	3.56E+07	4.61E+08	NO DATA	4.14E+08
TE-129	5.18E-10	1.93E-10	1.26E-10	3.70E-10	2.17E-09	NO DATA	2.83E-09
TE-131m	6.56E+05	3.15E+05	2.63E+05	4.73E+05	3.28E+06	NO DATA	2.53E+07
TE-131	6.70E-33	2.76E-33	2.09E-33	5.16E-33	2.92E-32	NO DATA	5.50E-34

TABLE 3.5-19 (continued)

COW MILK PATHWAY FACTORS - R^{C}_{aij} (TEEN)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	4.29E+06	2.72E+06	2.56E+06	2.87E+06	2.61E+07	NO DATA	8.61E+07
I-130	7.33E+05	2.12E+06	8.47E+05	1.73E+08	3.27E+06	NO DATA	1.63E+06
I-131	5.36E+08	7.50E+08	4.03E+08	2.19E+11	1.29E+09	NO DATA	1.48E+08
I-132	2.90E-01	7.59E-01	2.72E-01	2.56E+01	1.20E+00	NO DATA	3.31E-01
I-133	7.06E+06	1.20E+07	3.65E+06	1.67E+09	2.10E+07	NO DATA	9.06E+06
I-134	3.34E-12	8.86E-12	3.18E-12	1.48E-10	1.40E-11	NO DATA	1.17E-13
I-135	2.29E+04	5.90E+04	2.19E+04	3.80E+06	9.32E+04	NO DATA	6.54E+04
CS-134	9.79E+09	2.30E+10	1.07E+10	NO DATA	7.32E+09	2.80E+09	2.87E+08
CS-136	4.48E+08	1.76E+09	1.18E+09	NO DATA	9.59E+08	1.51E+08	1.42E+08
CS-137	1.33E+10	1.77E+10	6.18E+09	NO DATA	6.03E+09	2.34E+09	2.52E+08
CS-138	1.58E-23	3.03E-23	1.51E-23	NO DATA	2.23E-23	2.60E-24	1.37E-26
BA-139	8.20E-08	5.77E-11	2.39E-09	NO DATA	5.44E-11	3.98E-11	7.31E-07
BA-140	4.85E+07	5.95E+04	3.13E+06	NO DATA	2.02E+04	4.00E+04	7.49E+07
BA-141	7.98E-46	5.96E-49	2.67E-47	NO DATA	5.53E-49	4.08E-49	1.70E-51
BA-142	4.54E-80	4.54E-83	2.80E-81	NO DATA	3.85E-83	3.02E-83	1.40E-91
LA-140	8.11E+00	3.98E+00	1.06E+00	NO DATA	NO DATA	NO DATA	2.29E+05
LA-142	3.42E-11	1.52E-11	3.78E-12	NO DATA	NO DATA	NO DATA	4.62E-07
CE-141	8.88E+03	5.93E+03	6.81E+02	NO DATA	2.79E+03	NO DATA	1.70E+07
CE-143	7.64E+01	5.55E+04	6.21E+00	NO DATA	2.49E+01	NO DATA	1.67E+06
CE-144	6.61E+05	2.73E+05	3.55E+04	NO DATA	1.63E+05	NO DATA	1.66E+08
PR-143	2.91E+02	1.16E+02	1.45E+01	NO DATA	6.75E+01	NO DATA	9.57E+05
PR-144	1.19E-53	4.88E-54	6.04E-55	NO DATA	2.80E-54	NO DATA	1.31E-56
ND-147	1.81E+02	1.97E+02	1.18E+01	NO DATA	1.16E+02	NO DATA	7.10E+05
)-187	1.19E+04	9.72E+03	3.41E+03	NO DATA	NO DATA	NO DATA	2.63E+06
NP-239	6.99E+00	6.59E-01	3.66E-01	NO DATA	2.07E+00	NO DATA	1.06E+05

*mrem/yr per µCi/m^3
**4.29 x 10^6

TABLE 3.5-20

COW MILK PATHWAY FACTORS - R^{C}_{ai} (ADULT)

(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	7.62E+02*	7.62E+02*	7.62E+02*	7.62E+02*	7.62E+02*	7.62E+02*
C-14	3.63E+05*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*
NA-24	2.46E+06**	2.46E+06	2.46E+06	2.46E+06	2.46E+06	2.46E+06	2.46E+06
P-32	1.71E+10	1.06E+09	6.61E+08	NO DATA	NO DATA	NO DATA	1.92E+09
CR-51	NO DATA	NO DATA	2.85E+04	1.70E+04	6.27E+03	3.78E+04	7.16E+06
MN-54	NO DATA	8.41E+06	1.60E+06	NO DATA	2.50E+06	NO DATA	2.58E+07
MN-56	NO DATA	4.14E-03	7.34E-04	NO DATA	5.26E-03	NO DATA	1.32E-01
FE-55	2.51E+07	1.73E+07	4.04E+06	NO DATA	NO DATA	9.68E+06	9.95E+06
FE-59	2.97E+07	6.99E+07	2.68E+07	NO DATA	NO DATA	1.95E+07	2.33E+08
CO-58	NO DATA	4.72E+06	1.06E+07	NO DATA	NO DATA	NO DATA	9.57E+07
CO-60	NO DATA	1.64E+07	3.62E+07	NO DATA	NO DATA	NO DATA	3.08E+08
NI-63	6.73E+09	4.67E+08	2.26E+08	NO DATA	NO DATA	NO DATA	9.74E+07
NI-65	3.70E-01	4.81E-02	2.19E-02	NO DATA	NO DATA	NO DATA	1.22E+00
CU-64	NO DATA	2.36E+04	1.11E+04	NO DATA	5.94E+04	NO DATA	2.01E+06
ZN-65	1.37E+09	4.37E+09	1.98E+09	NO DATA	2.93E+09	NO DATA	2.75E+09
ZN-69	2.01E-12	3.84E-12	2.67E-13	NO DATA	2.50E-12	NO DATA	5.77E-13
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.60E+09	1.21E+09	NO DATA	NO DATA	NO DATA	5.12E+08
RB-88	NO DATA	2.15E-45	1.14E-45	NO DATA	NO DATA	NO DATA	2.97E-56
RB-89	NO DATA	4.49E-53	3.16E-53	NO DATA	NO DATA	NO DATA	2.61E-66
SR-89	1.45E+09	NO DATA	4.16E+07	NO DATA	NO DATA	NO DATA	2.33E+08
SR-90	4.68E+10	NO DATA	1.15E+10	NO DATA	NO DATA	NO DATA	1.35E+09
SR-91	2.87E+04	NO DATA	1.16E+03	NO DATA	NO DATA	NO DATA	1.37E+05
SR-92	4.92E-01	NO DATA	2.13E-02	NO DATA	NO DATA	NO DATA	9.76E+00
Y-90	7.10E+01	NO DATA	1.90E+00	NO DATA	NO DATA	NO DATA	7.53E+05
Y-91m	6.42E-20	NO DATA	2.49E-21	NO DATA	NO DATA	NO DATA	1.89E-19
Y-91	8.60E+03	NO DATA	2.30E+02	NO DATA	NO DATA	NO DATA	4.73E+06
Y-92	5.57E-05	NO DATA	1.63E-06	NO DATA	NO DATA	NO DATA	9.75E-01
Y-93	2.22E-01	NO DATA	6.12E-03	NO DATA	NO DATA	NO DATA	7.03E+03
ZR-95	9.45E+02	3.03E+02	2.05E+02	NO DATA	4.76E+02	NO DATA	9.61E+05
ZR-97	4.32E-01	8.71E-02	3.98E-02	NO DATA	1.32E-01	NO DATA	2.70E+04
NB-95	8.25E+04	4.59E+04	2.47E+04	NO DATA	4.54E+04	NO DATA	2.79E+08
MO-99	NO DATA	2.48E+07	4.72E+06	NO DATA	5.61E+07	NO DATA	5.74E+07
TC-99m	3.31E+00	9.35E+00	1.19E+02	NO DATA	1.42E+02	4.58E+00	5.53E+03
TC-101	2.85E-60	4.11E-60	4.03E-59	NO DATA	7.41E-59	2.10E-60	1.24E-71
RU-103	1.02E+03	NO DATA	4.39E+02	NO DATA	3.89E+03	NO DATA	1.19E+05
RU-105	8.52E-04	NO DATA	3.36E-04	NO DATA	1.10E-02	NO DATA	5.21E-01
RU-106	2.04E+04	NO DATA	2.58E+03	NO DATA	3.94E+04	NO DATA	1.32E+06
AG-110m	5.82E+07	5.39E+07	3.20E+07	NO DATA	1.06E+08	NO DATA	2.20E+10
TE-125m	1.63E+07	5.91E+06	2.19E+06	4.91E+06	6.64E+07	NO DATA	6.52E+07
TE-127m	4.58E+07	1.64E+07	5.58E+06	1.17E+07	1.86E+08	NO DATA	1.53E+08
TE-127	6.52E+02	2.34E+02	1.41E+02	4.83E+02	2.65E+03	NO DATA	5.14E+04
TE-129m	6.01E+07	2.24E+07	9.52E+06	2.07E+07	2.51E+08	NO DATA	3.03E+08
TE-129	2.82E-10	1.06E-10	6.86E-11	2.16E-10	1.18E-09	NO DATA	2.12E-10
TE-131m	3.60E+05	1.76E+05	1.47E+05	2.79E+05	1.78E+06	NO DATA	1.75E+07
TE-131	3.68E-33	1.54E-33	1.16E-33	3.03E-33	1.61E-32	NO DATA	5.22E-34

TABLE 3.5-20 (continued)

COW MILK PATHWAY FACTORS - R^{C}_{ai} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.41E+06	1.56E+06	1.46E+06	1.72E+06	1.50E+07	NO DATA	7.36E+07
I-130	4.16E+05	1.23E+06	4.84E+05	1.04E+08	1.91E+06	NO DATA	1.06E+06
I-131	2.97E+08	4.24E+08	2.43E+08	1.39E+11	7.27E+08	NO DATA	1.12E+08
I-132	1.65E-01	4.40E-01	1.54E-01	1.54E+01	7.02E-01	NO DATA	8.27E-02
I-133	3.86E+06	6.72E+06	2.05E+06	9.87E+08	1.17E+07	NO DATA	6.04E+06
I-134	1.89E-12	5.13E-12	1.83E-12	8.88E-11	8.15E-12	NO DATA	4.47E-15
I-135	1.29E+04	3.39E+04	1.25E+04	2.23E+06	5.43E+04	NO DATA	3.83E+04
CS-134	5.67E+09	1.35E+10	1.10E+10	NO DATA	4.37E+09	1.45E+09	2.36E+08
CS-136	2.64E+08	1.04E+09	7.49E+08	NO DATA	5.79E+08	7.94E+07	1.18E+08
CS-137	7.39E+09	1.01E+10	6.62E+09	NO DATA	3.43E+09	1.14E+09	1.96E+08
CS-138	8.69E-24	1.72E-23	8.50E-24	NO DATA	1.26E-23	1.24E-24	7.32E-29
BA-139	4.43E-08	3.16E-11	1.30E-09	NO DATA	2.95E-11	1.79E-11	7.86E-08
BA-140	2.72E+07	3.42E+04	1.78E-06	NO DATA	1.16E+04	1.96E+04	5.60E+07
BA-141	4.33E-46	3.27E-49	1.46E-47	NO DATA	3.04E-49	1.86E-49	2.04E-55
BA-142	2.51E-80	2.58E-83	1.58E-81	NO DATA	2.18E-83	1.46E-83	3.54E-98
LA-140	4.53E+00	2.28E+00	6.03E-01	NO DATA	NO DATA	NO DATA	1.67E+05
LA-142	1.89E-11	8.61E-12	2.15E-12	NO DATA	NO DATA	NO DATA	6.29E-08
CE-141	4.84E+03	3.27E+03	3.71E+02	NO DATA	1.52E+03	NO DATA	1.25E+07
CE-143	4.16E+01	3.07E+04	3.40E+00	NO DATA	1.35E+01	NO DATA	1.15E+06
CE-144	3.58E+05	1.50E+05	1.92E+04	NO DATA	8.87E+04	NO DATA	1.21E+08
PR-143	1.58E+02	6.35E+01	7.84E+00	NO DATA	3.66E+01	NO DATA	6.93E+05
PR-144	6.47E-54	2.69E-54	3.29E-55	NO DATA	1.52E-54	NO DATA	9.31E-61
ND-147	9.44E+01	1.09E+02	6.53E+00	NO DATA	6.38E+01	NO DATA	5.24E+05
W-187	6.50E+03	5.43E+03	1.90E+03	NO DATA	NO DATA	NO DATA	1.78E+06
NP-239	3.67E+00	3.60E-01	1.99E-01	NO DATA	1.12E+00	NO DATA	7.39E+04

*mrem/yr per µCi/m^3
**2.46 x 10^6

TABLE 3.5-21

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (INFANT)
(m^2rem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	4.86E+03*	4.86E+03*	4.86E+03*	4.86E+03*	4.86E+03*	4.86E+03*
C-14	3.23E+06*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*
NA-24	1.87E+06**	1.87E+06	1.87E+06	1.87E+06	1.87E+06	1.87E+06	1.87E+06
P-32	1.90E+11	1.12E+10	7.46E+09	NO DATA	NO DATA	NO DATA	2.58E+09
CR-51	NO DATA	NO DATA	1.93E+04	1.26E+04	2.75E+03	2.45E+04	5.63E+05
MN-54	NO DATA	4.68E+06	1.06E+06	NO DATA	1.04E+06	NO DATA	1.72E+06
MN-56	NO DATA	3.75E-03	6.46E-04	NO DATA	3.22E-03	NO DATA	3.40E-01
FE-55	1.75E+06	1.13E+06	3.02E+05	NO DATA	NO DATA	5.53E+05	1.44E+05
FE-59	2.91E+06	5.08E+06	2.00E+06	NO DATA	NO DATA	1.50E+06	2.43E+06
CO-58	NO DATA	2.90E+06	7.24E+06	NO DATA	NO DATA	NO DATA	7.23E+06
CO-60	NO DATA	1.06E+07	2.49E+07	NO DATA	NO DATA	NO DATA	2.51E+07
NI-63	4.19E+09	2.59E+08	1.45E+08	NO DATA	NO DATA	NO DATA	1.29E+07
NI-65	4.20E-01	4.76E-02	2.16E-02	NO DATA	NO DATA	NO DATA	3.62E+00
CU-64	NO DATA	2.04E+04	9.45E+03	NO DATA	3.45E+04	NO DATA	4.19E+05
ZN-65	6.64E+08	2.28E+09	1.05E+09	NO DATA	1.10E+09	NO DATA	1.92E+09
ZN-69	2.32E-12	4.18E-12	3.11E-13	NO DATA	1.74E-12	NO DATA	3.41E-10
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.65E+09	1.31E+09	NO DATA	NO DATA	NO DATA	6.79E+07
RB-88	NO DATA	2.25E-45	1.23E-45	NO DATA	NO DATA	NO DATA	2.19E-45
RB-89	NO DATA	4.09E-53	2.82E-53	NO DATA	NO DATA	NO DATA	1.39E-53
SR-89	2.64E+10	NO DATA	7.56E+08	NO DATA	NO DATA	NO DATA	5.42E+08
SR-90	2.55E+11	NO DATA	6.50E+10	NO DATA	NO DATA	NO DATA	3.19E+09
SR-91	5.65E+05	NO DATA	2.05E+04	NO DATA	NO DATA	NO DATA	6.69E+05
SR-92	9.83E+00	NO DATA	3.65E-01	NO DATA	NO DATA	NO DATA	1.06E+02
Y-90	8.19E+01	NO DATA	2.19E+00	NO DATA	NO DATA	NO DATA	1.13E+05
Y-91m	7.29E-20	NO DATA	2.48E-21	NO DATA	NO DATA	NO DATA	2.43E-16
Y-91	8.78E+03	NO DATA	2.34E+02	NO DATA	NO DATA	NO DATA	6.29E+05
Y-92	6.40E-05	NO DATA	1.80E-06	NO DATA	NO DATA	NO DATA	1.22E+00
Y-93	2.55E-01	NO DATA	6.95E-03	NO DATA	NO DATA	NO DATA	2.02E+03
ZR-95	8.16E+02	1.99E+02	1.41E+02	NO DATA	2.14E+02	NO DATA	9.90E+04
ZR-97	4.85E-01	8.33E-02	3.80E-02	NO DATA	8.40E-02	NO DATA	5.31E+03
NB-95	7.12E+04	2.93E+04	1.69E+04	NO DATA	2.10E+04	NO DATA	2.47E+07
MO-99	NO DATA	2.48E+07	4.84E+06	NO DATA	3.71E+07	NO DATA	8.18E+06
TC-99m	3.26E+00	6.73E+00	8.67E+01	NO DATA	7.24E+01	3.52E+00	1.96E+03
TC-101	3.26E-60	4.11E-60	4.06E-59	NO DATA	4.88E-59	2.24E-60	6.98E-58
RU-103	1.04E+03	NO DATA	3.47E+02	NO DATA	2.16E+03	NO DATA	1.26E+04
RU-105	9.60E-04	NO DATA	3.23E-04	NO DATA	7.06E-03	NO DATA	3.82E-01
RU-106	2.28E+04	NO DATA	2.84E+03	NO DATA	2.69E+04	NO DATA	1.73E+05
AG-110m	4.62E+07	3.37E+07	2.23E+07	NO DATA	4.83E+07	NO DATA	1.75E+09
TE-125m	1.80E+07	6.02E+06	2.43E+06	6.06E+06	NO DATA	NO DATA	8.58E+06
TE-127m	5.04E+07	1.67E+07	6.10E+06	1.46E+07	1.24E+08	NO DATA	2.03E+07
TE-127	7.57E+02	2.54E+02	1.63E+02	6.16E+02	1.85E+03	NO DATA	1.59E+04
TE-129m	6.68E+07	2.29E+07	1.03E+07	2.57E+07	1.67E+08	NO DATA	3.99E+07
TE-129	3.25E-10	1.12E-10	7.59E-11	2.73E-10	8.10E-10	NO DATA	2.60E-08
TE-131m	4.04E+05	1.63E+05	1.34E+05	3.30E+05	1.12E+06	NO DATA	2.74E+06
TE-131	4.19E-33	1.55E-33	1.18E-33	3.74E-33	1.07E-32	NO DATA	1.69E-31

TABLE 3.5-21 (continued)

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (INFANT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.54E+06	1.26E+06	1.17E+06	1.85E+06	7.86E+06	NO DATA	4.65E+06
I-130	4.22E+06	9.28E+06	3.73E+06	1.04E+09	1.02E+07	NO DATA	1.99E+06
I-131	3.25E+09	3.83E+09	1.69E+09	1.26E+12	4.48E+09	NO DATA	1.37E+08
I-132	1.73E+00	3.50E+00	1.25E+00	1.64E+02	3.91E+00	NO DATA	2.84E+00
I-133	4.34E+07	6.32E+07	1.85E+07	1.15E+10	7.43E+07	NO DATA	1.07E+07
I-134	1.97E-11	4.04E-11	1.44E-11	9.42E-10	4.52E-11	NO DATA	4.18E-11
I-135	1.36E+05	2.70E+05	9.85E+04	2.42E+07	3.01E+05	NO DATA	9.77E+04
CS-134	1.09E+11	2.04E+11	2.06E+10	NO DATA	5.25E+10	2.15E+10	5.54E+08
CS-136	5.92E+09	1.74E+10	6.50E+09	NO DATA	6.94E+09	1.42E+09	2.64E+08
CS-137	1.54E+11	1.80E+11	1.28E+10	NO DATA	4.84E+10	1.96E+10	5.63E+08
CS-138	2.42E-22	3.93E-22	1.90E-22	NO DATA	1.96E-22	3.06E-23	6.28E-22
BA-139	5.14E-08	3.41E-11	1.49E-09	NO DATA	2.05E-11	2.07E-11	3.26E-06
BA-140	2.87E+07	2.87E+04	1.48E+06	NO DATA	6.82E+03	1.76E+04	7.06E+06
BA-141	4.97E-46	3.40E-49	1.57E-47	NO DATA	2.05E-49	2.07E-49	6.07E-45
BA-142	2.76E-80	2.30E-83	1.36E-81	NO DATA	1.32E-83	1.39E-83	1.14E-79
LA-140	4.83E+00	1.91E+00	4.90E-01	NO DATA	NO DATA	NO DATA	2.24E+04
LA-142	2.07E-11	7.60E-12	1.82E-12	NO DATA	NO DATA	NO DATA	1.29E-06
CE-141	5.20E+03	3.17E+03	3.73E+02	NO DATA	9.78E+02	NO DATA	1.64E+06
CE-143	4.75E+01	3.15E+04	3.60E+00	NO DATA	9.18E+00	NO DATA	1.84E+05
CE-144	2.79E+05	1.14E+05	1.56E+04	NO DATA	4.61E+04	NO DATA	1.60E+07
PR-143	1.78E+02	6.66E+01	8.83E+00	NO DATA	2.47E+01	NO DATA	9.40E+04
PR-144	7.51E-54	2.90E-54	3.78E-55	NO DATA	1.05E-54	NO DATA	1.35E-49
ND-147	1.06E+02	1.08E+02	6.65E+00	NO DATA	4.18E+01	NO DATA	6.88E+04
W-187	7.27E+03	5.06E+03	1.75E+03	NO DATA	NO DATA	NO DATA	2.97E+05
NP-239	4.37E+00	3.91E-01	2.21E-01	NO DATA	7.80E-01	NO DATA	1.13E+04

*mrem/yr per µCi/m^3
**1.87 x 10^6

TABLE 3.5-22

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (CHILD)
(m^2mrem/yr per μCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	3.20E+03*	3.20E+03*	3.20E+03*	3.20E+03*	3.20E+03*	3.20E+03*
C-14	1.65E+06*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*
NA-24	1.07E+06**	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06
P-32	9.32E+10	4.36E+09	3.59E+09	NO DATA	NO DATA	NO DATA	2.58E+09
CR-51	NO DATA	NO DATA	1.22E+04	6.77E+03	1.85E+03	1.24E+04	6.47E+05
MN-54	NO DATA	2.51E+06	6.70E+05	NO DATA	7.05E+05	NO DATA	2.11E+06
MN-56	NO DATA	1.53E-03	3.45E-04	NO DATA	1.85E-03	NO DATA	1.21E-01
FE-55	1.45E+06	7.65E+05	2.38E+05	NO DATA	NO DATA	4.35E+05	1.42E+05
FE-59	1.55E+06	2.52E+06	1.25E+06	NO DATA	NO DATA	7.29E+05	2.62E+06
CO-58	NO DATA	1.46E+06	4.46E+06	NO DATA	NO DATA	NO DATA	8.49E+06
CO-60	NO DATA	5.16E+06	1.52E+07	NO DATA	NO DATA	NO DATA	2.86E+07
NI-63	3.55E+09	1.90E+08	1.21E+08	NO DATA	NO DATA	NO DATA	1.28E+07
NI-65	1.99E-01	1.87E-02	1.09E-02	NO DATA	NO DATA	NO DATA	2.29E+00
CU-64	NO DATA	8.23E+03	4.97E+03	NO DATA	1.99E+04	NO DATA	3.86E+05
ZN-65	4.96E+08	1.32E+09	8.22E+08	NO DATA	8.33E+08	NO DATA	2.32E+08
ZN-69	1.09E-12	1.58E-12	1.46E-13	NO DATA	9.56E-13	NO DATA	9.94E-11
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	1.05E+09	6.47E+08	NO DATA	NO DATA	NO DATA	6.77E+07
RB-88	NO DATA	8.59E-46	5.97E-46	NO DATA	NO DATA	NO DATA	4.21E-47
RB-89	NO DATA	1.67E-53	1.49E-53	NO DATA	NO DATA	NO DATA	1.46E-55
SR-89	1.39E+10	NO DATA	3.96E+08	NO DATA	NO DATA	NO DATA	5.37E+08
SR-90	2.35E+11	NO DATA	5.95E+10	NO DATA	NO DATA	NO DATA	3.16E+09
SR-91	2.71E+05	NO DATA	1.02E+04	NO DATA	NO DATA	NO DATA	5.99E+05
SR-92	4.61E+00	NO DATA	1.85E-01	NO DATA	NO DATA	NO DATA	8.74E+01
Y-90	3.86E+01	NO DATA	1.03E+00	NO DATA	NO DATA	NO DATA	1.10E+05
Y-91m	3.44E-20	NO DATA	1.25E-21	NO DATA	NO DATA	NO DATA	6.73E-17
Y-91	4.67E+03	NO DATA	1.25E+02	NO DATA	NO DATA	NO DATA	6.22E+05
Y-92	3.02E-05	NO DATA	8.64E-07	NO DATA	NO DATA	NO DATA	8.73E-01
Y-93	1.20E-01	NO DATA	3.29E-03	NO DATA	NO DATA	NO DATA	1.79E+03
ZR-95	4.58E+02	1.01E+02	8.97E+01	NO DATA	1.44E+02	NO DATA	1.05E+05
ZR-97	2.29E-01	3.31E-02	1.95E-02	NO DATA	4.76E-02	NO DATA	5.02E+03
NB-95	3.81E+04	1.48E+04	1.06E+04	NO DATA	1.39E+04	NO DATA	2.75E+07
MO-99	NO DATA	9.74E+06	2.41E+06	NO DATA	2.08E+07	NO DATA	8.05E+06
TC-99m	1.58E+00	3.10E+00	5.13E+01	NO DATA	4.50E+01	1.57E+00	1.76E+03
TC-101	1.54E-60	1.61E-60	2.04E-59	NO DATA	2.74E-59	8.50E-61	5.11E-60
RU-103	5.10E+02	NO DATA	1.96E+02	NO DATA	1.28E+03	NO DATA	1.32E+04
RU-105	4.53E-04	NO DATA	1.65E-04	NO DATA	3.99E-03	NO DATA	2.96E-01
RU-106	1.11E+04	NO DATA	1.38E+03	NO DATA	1.49E+04	NO DATA	1.72E+05
AG-110m	2.50E+07	1.69E+07	1.35E+07	NO DATA	3.15E+07	NO DATA	2.01E+09
TE-125m	8.84E+06	2.39E+06	1.18E+06	2.48E+06	NO DATA	NO DATA	8.53E+06
TE-127m	2.49E+07	6.71E+06	2.96E+06	5.96E+06	7.10E+07	NO DATA	2.02E+07
TE-127	3.57E+02	9.61E+01	7.65E+01	2.47E+02	1.01E+03	NO DATA	1.39E+04
TE-129m	3.24E+07	9.06E+06	5.03E+06	1.05E+07	9.52E+07	NO DATA	3.96E+07
TE-129	1.53E-10	4.28E-11	3.64E-11	1.09E-10	4.49E-10	NO DATA	9.55E-09
TE-131m	1.91E+05	6.60E+04	7.02E+04	1.36E+05	6.39E+05	NO DATA	2.68E+06
TE-131	1.96E-33	5.97E-34	5.83E-34	1.50E-33	5.92E-33	NO DATA	1.03E-32

TABLE 3.5-22 (continued)

GOAT MILK PATHWAY FACTORS - R^{C}_{ai} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.23E+06	5.45E+05	6.59E+05	7.94E+05	5.06E+06	NO DATA	5.49E+06
-130	2.06E+06	4.17E+06	2.15E+06	4.59E+08	6.23E+06	NO DATA	1.95E+06
I-131	1.56E+09	1.57E+09	8.94E+08	5.20E+11	2.58E+09	NO DATA	1.40E+08
I-132	8.32E-01	1.52E+00	7.03E-01	7.09E+01	2.34E+00	NO DATA	1.80E+00
I-133	2.06E+07	2.55E+07	9.64E+06	4.73E+09	4.25E+07	NO DATA	1.03E+07
I-134	9.51E-12	1.77E-11	8.13E-12	4.06E-10	2.70E-11	NO DATA	1.17E-11
I-135	6.53E+04	1.17E+05	5.56E+04	1.04E+07	1.80E+05	NO DATA	8.95E+04
CS-134	6.76E+10	1.11E+11	2.34E+10	NO DATA	3.44E+10	1.23E+10	5.98E+08
CS-136	3.03E+09	8.33E+09	5.39E+09	NO DATA	4.44E+09	6.62E+08	2.93E+08
CS-137	9.65E+10	9.23E+10	1.36E+10	NO DATA	3.01E+10	1.08E+10	5.78E+08
CS-138	1.15E-22	1.59E-22	1.10E-22	NO DATA	1.12E-22	1.21E-23	7.34E-23
BA-139	2.42E-08	1.29E-11	7.01E-10	NO DATA	1.13E-11	7.59E-12	1.40E-06
BA-140	1.40E+07	1.22E+04	8.15E+05	NO DATA	3.98E+03	7.29E+03	7.07E+06
BA-141	2.34E-46	1.31E-49	7.62E-48	NO DATA	1.13E-49	7.70E-49	1.33E-46
BA-142	1.31E-80	9.44E-84	7.32E-82	NO DATA	7.64E-84	5.55E-84	1.71E-82
LA-140	2.32E+00	8.12E-01	2.53E-01	NO DATA	NO DATA	NO DATA	2.26E+04
LA-142	9.85E-12	3.14E-12	9.83E-13	NO DATA	NO DATA	NO DATA	6.22E-07
CE-141	2.62E+03	1.31E+03	1.94E+02	NO DATA	5.73E+02	NO DATA	1.63E+06
CE-143	2.24E+01	1.22E+04	1.76E+00	NO DATA	5.10E+00	NO DATA	1.78E+05
CE-144	1.94E+05	6.10E+04	1.04E+04	NO DATA	3.38E+04	NO DATA	1.59E+07
PR-143	8.61E+01	2.58E+01	4.27E+00	NO DATA	1.40E+01	NO DATA	9.29E+04
PR-144	3.53E-54	1.09E-54	1.78E-55	NO DATA	5.78E-55	NO DATA	2.35E-51
ND-147	5.33E+01	4.32E+01	3.34E+00	NO DATA	2.37E+01	NO DATA	6.84E+04
-187	3.46E+03	2.05E+03	9.20E+02	NO DATA	NO DATA	NO DATA	2.88E+05
NP-239	2.07E+00	1.49E-01	1.04E-01	NO DATA	4.29E-01	NO DATA	1.10E+04

*mrem/yr per µCi/m^3
**1.07 x 10^6

TABLE 3.5-23

GOAT MILK PATHWAY FACTORS - R^{C}_{ai} (TEEN)

(m^2mrem/yr per µCi)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.02E+03*	2.02E+03*	2.02E+03*	2.02E+03*	2.02E+03*	2.02E+03*
C-14	6.70E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*
NA-24	5.15E+05**	5.15E+05	5.15E+05	5.15E+05	5.15E+05	5.15E+05	5.15E+05
P-32	3.78E+10	2.34E+09	1.47E+09	NO DATA	NO DATA	NO DATA	3.18E+09
CR-51	NO DATA	NO DATA	5.94E+03	3.30E+03	1.30E+03	8.48E+03	9.98E+05
MN-54	NO DATA	1.68E+06	3.32E+05	NO DATA	5.00E+05	NO DATA	3.44E+06
MN-56	NO DATA	8.77E-04	1.56E-04	NO DATA	1.11E-03	NO DATA	5.77E-02
FE-55	5.79E+05	4.11E+05	9.57E+04	NO DATA	NO DATA	2.60E+05	1.78E+05
FE-59	6.75E+05	1.58E+06	6.08E+05	NO DATA	NO DATA	4.97E+05	3.73E+06
CO-58	NO DATA	9.51E+05	2.19E+06	NO DATA	NO DATA	NO DATA	1.31E+07
CO-60	NO DATA	3.32E+06	7.47E+06	NO DATA	NO DATA	NO DATA	4.32E+07
NI-63	1.42E+09	1.00E+08	4.81E+07	NO DATA	NO DATA	NO DATA	1.60E+07
NI-65	8.09E-02	1.03E-02	4.71E-03	NO DATA	NO DATA	NO DATA	5.61E-01
CU-64	NO DATA	4.68E+03	2.20E+03	NO DATA	1.18E+04	NO DATA	3.63E+05
ZN-65	2.52E+08	8.76E+08	4.09E+08	NO DATA	5.61E+08	NO DATA	3.71E+08
ZN-69	4.44E-13	8.46E-13	5.92E-14	NO DATA	5.53E-13	NO DATA	1.56E-12
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	5.66E+08	2.66E+08	NO DATA	NO DATA	NO DATA	8.38E+07
RB-88	NO DATA	4.66E-46	2.48E-46	NO DATA	NO DATA	NO DATA	3.99E-53
RB-89	NO DATA	9.52E-54	6.73E-54	NO DATA	NO DATA	NO DATA	1.46E-62
SR-89	5.59E+09	NO DATA	1.60E+08	NO DATA	NO DATA	NO DATA	6.65E+08
SR-90	1.38E+11	NO DATA	3.40E+10	NO DATA	NO DATA	NO DATA	3.87E+09
SR-91	1.11E+05	NO DATA	4.40E+03	NO DATA	NO DATA	NO DATA	5.01E+05
SR-92	1.89E+00	NO DATA	8.05E-02	NO DATA	NO DATA	NO DATA	4.81E+01
Y-90	1.56E+01	NO DATA	4.21E-01	NO DATA	NO DATA	NO DATA	1.29E+05
Y-91m	1.41E-20	NO DATA	5.37E-22	NO DATA	NO DATA	NO DATA	6.64E-19
Y-91	1.89E+03	NO DATA	5.07E+01	NO DATA	NO DATA	NO DATA	7.75E+05
Y-92	1.23E-05	NO DATA	3.57E-07	NO DATA	NO DATA	NO DATA	3.39E-01
Y-93	4.86E-02	NO DATA	1.33E-03	NO DATA	NO DATA	NO DATA	1.49E+03
ZR-95	1.98E+02	6.24E+01	4.29E+01	NO DATA	9.17E+01	NO DATA	1.44E+05
ZR-97	9.43E-02	1.87E-02	8.60E-03	NO DATA	2.83E-02	NO DATA	5.05E+03
NB-95	1.69E+04	9.37E+03	5.16E+03	NO DATA	9.08E+03	NO DATA	4.01E+07
MO-99	NO DATA	5.33E+06	1.02E+06	NO DATA	1.22E+07	NO DATA	9.55E+06
TC-99m	6.87E-01	1.92E+00	2.48E+01	NO DATA	2.86E+01	1.06E+00	1.26E+03
TC-101	6.26E-61	8.91E-61	8.75E-60	NO DATA	1.61E-59	5.43E-61	1.52E-67
RU-103	2.17E+02	NO DATA	9.27E+01	NO DATA	7.64E+02	NO DATA	1.81E+04
RU-105	1.86E-04	NO DATA	7.21E-05	NO DATA	2.35E-03	NO DATA	1.50E-01
RU-106	4.47E+03	NO DATA	5.63E+02	NO DATA	8.62E+03	NO DATA	2.14E+05
AG-110m	1.15E+07	1.09E+07	6.62E+06	NO DATA	2.08E+07	NO DATA	3.06E+09
TE-125m	3.59E+06	1.29E+06	4.80E+05	1.00E+06	NO DATA	NO DATA	1.06E+07
TE-127m	1.01E+07	3.57E+06	1.20E+06	2.39E+06	4.08E+07	NO DATA	2.51E+07
TE-127	1.48E+02	5.14E+01	3.18E+01	1.02E+02	5.87E+02	NO DATA	1.14E+04
TE-129m	1.32E+07	4.89E+06	2.08E+06	4.25E+06	5.51E+07	NO DATA	4.94E+07
TE-129	6.22E-11	2.32E-11	1.51E-11	4.44E-11	2.61E-10	NO DATA	3.40E-10
TE-131m	7.86E+04	3.77E+04	3.14E+04	5.67E+04	3.93E+05	NO DATA	3.02E+06
TE-131	8.04E-34	3.31E-34	2.51E-34	6.19E-34	3.51E-33	NO DATA	6.60E-35

TABLE 3.5-23 (continued)

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (TEEN)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	5.13E+05	3.25E+05	3.06E+05	3.43E+05	3.12E+06	NO DATA	1.03E+07
I-130	8.82E+05	2.55E+06	1.02E+06	2.08E+08	3.93E+06	NO DATA	1.96E+06
I-131	6.44E+08	9.01E+08	4.84E+08	2.63E+11	1.55E+09	NO DATA	1.78E+08
I-132	3.52E-01	9.20E-01	3.30E-01	3.10E+01	1.45E+00	NO DATA	4.01E-01
I-133	8.48E+06	1.44E+07	4.39E+06	2.01E+09	2.52E+07	NO DATA	1.09E+07
I-134	4.03E-12	1.07E-11	3.84E-12	1.78E-10	1.68E-11	NO DATA	1.41E-13
I-135	2.75E+04	7.08E+04	2.62E+04	4.56E+06	1.12E+05	NO DATA	7.85E+04
CS-134	2.94E+10	6.91E+10	3.21E+10	NO DATA	2.20E+10	8.39E+09	8.60E+08
CS-136	1.34E+09	5.27E+09	3.54E+09	NO DATA	2.87E+09	4.52E+08	4.24E+08
CS-137	4.01E+10	5.33E+10	1.86E+10	NO DATA	1.82E+10	7.05E+09	7.59E+08
CS-138	4.73E-23	9.08E-23	4.54E-23	NO DATA	6.70E-23	7.80E-24	4.12E-26
BA-139	9.84E-09	6.92E-12	2.87E-10	NO DATA	6.53E-12	4.77E-12	8.78E-08
BA-140	5.82E+06	7.13E+03	3.75E+05	NO DATA	2.42E+03	4.80E+03	8.98E+06
BA-141	9.53E-47	7.11E-50	3.18E-48	NO DATA	6.60E-50	4.87E-50	2.03E-52
BA-142	5.44E-81	5.44E-84	3.35E-82	NO DATA	4.60E-84	3.62E-84	1.67E-92
LA-140	9.67E-01	4.75E-01	1.26E-01	NO DATA	NO DATA	NO DATA	2.73E+04
LA-142	4.08E-12	1.81E-12	4.51E-13	NO DATA	NO DATA	NO DATA	5.52E-08
CE-141	1.07E+03	7.12E+02	8.17E+01	NO DATA	3.35E+02	NO DATA	2.04E+06
CE-143	9.14E+00	6.65E+03	7.43E-01	NO DATA	2.98E+00	NO DATA	2.00E+05
CE-144	7.86E+04	3.25E+04	4.23E+03	NO DATA	1.94E+04	NO DATA	1.98E+07
PR-143	3.47E+01	1.39E+01	1.73E+00	NO DATA	8.06E+00	NO DATA	1.14E+05
PR-144	1.42E-54	5.81E-55	7.19E-56	NO DATA	3.33E-55	NO DATA	1.56E-57
ND-147	2.17E+01	2.36E+01	1.41E+00	NO DATA	1.38E+01	NO DATA	8.50E+04
W-187	1.43E+03	1.16E+03	4.08E+02	NO DATA	NO DATA	NO DATA	3.15E+05
NP-239	8.38E-01	7.90E-02	4.39E-02	NO DATA	2.48E-01	NO DATA	1.27E+04

*mrem/yr per µCi/m^3
**5.15×10^5

TABLE 3.5-24

GOAT MILK PATHWAY FACTORS - R^{C}_{ail} (ADULT)

(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.55E+03*	1.55E+03*	1.55E+03*	1.55E+03*	1.55E+03*	1.55E+03*
C-14	3.63E+05*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*
NA-24	2.95E+05**	2.95E+05	2.95E+05	2.95E+05	2.95E+05	2.95E+05	2.95E+05
P-32	2.05E+10	1.27E+09	7.91E+08	NO DATA	NO DATA	NO DATA	2.30E+09
CR-51	NO DATA	NO DATA	3.43E+03	2.05E+03	7.56E+02	4.55E+03	8.63E+05
MN-54	NO DATA	1.01E+06	1.92E+05	NO DATA	2.99E+05	NO DATA	3.08E+06
MN-56	NO DATA	4.96E-04	8.79E-05	NO DATA	6.29E-04	NO DATA	1.58E-02
FE-55	3.27E+05	2.26E+05	5.27E+04	NO DATA	NO DATA	1.26E+05	1.30E+05
FE-59	3.85E+05	9.06E+05	3.47E+05	NO DATA	NO DATA	2.53E+05	3.02E+06
CO-58	NO DATA	5.62E+05	1.26E+06	NO DATA	NO DATA	NO DATA	1.14E+07
CO-60	NO DATA	1.96E+06	4.33E+06	NO DATA	NO DATA	NO DATA	3.69E+07
NI-63	8.05E+08	5.58E+07	2.70E+07	NO DATA	NO DATA	NO DATA	1.16E+07
NI-65	4.43E-02	5.76E-03	2.63E-03	NO DATA	NO DATA	NO DATA	1.46E-01
CU-64	NO DATA	2.62E+03	1.23E+03	NO DATA	6.62E+03	NO DATA	2.24E+05
ZN-65	1.64E+08	5.22E+08	2.36E+08	NO DATA	3.49E+08	NO DATA	3.29E+08
ZN-69	2.41E-13	4.61E-13	3.21E-14	NO DATA	3.00E-13	NO DATA	6.93E-14
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	3.10E+08	1.45E+08	NO DATA	NO DATA	NO DATA	6.12E+07
RB-88	NO DATA	2.57E-46	1.36E-46	NO DATA	NO DATA	NO DATA	3.55E-57
RB-89	NO DATA	5.37E-54	3.78E-54	NO DATA	NO DATA	NO DATA	3.12E-67
SR-89	3.04E+09	NO DATA	8.73E+07	NO DATA	NO DATA	NO DATA	4.88E+08
SR-90	9.78E+10	NO DATA	2.40E+10	NO DATA	NO DATA	NO DATA	2.83E+09
SR-91	6.01E+04	NO DATA	2.43E+03	NO DATA	NO DATA	NO DATA	2.86E+05
SR-92	1.03E+00	NO DATA	4.45E-02	NO DATA	NO DATA	NO DATA	2.04E+01
Y-90	8.48E+00	NO DATA	2.28E-01	NO DATA	NO DATA	NO DATA	9.00E+04
Y-91m	7.69E-21	NO DATA	2.98E-22	NO DATA	NO DATA	NO DATA	2.26E-20
Y-91	1.03E+03	NO DATA	2.75E+01	NO DATA	NO DATA	NO DATA	5.66E+05
Y-92	6.68E-06	NO DATA	1.95E-07	NO DATA	NO DATA	NO DATA	1.17E-01
Y-93	2.65E-02	NO DATA	7.32E-04	NO DATA	NO DATA	NO DATA	8.41E+02
ZR-95	1.13E+02	3.63E+01	2.46E+01	NO DATA	5.69E+01	NO DATA	1.15E+05
ZR-97	5.17E-02	1.04E-02	4.77E-03	NO DATA	1.58E-02	NO DATA	3.23E+03
NB-95	9.90E+03	5.51E+03	2.96E+03	NO DATA	5.45E+03	NO DATA	3.34E+07
MO-99	NO DATA	2.96E+06	5.63E+05	NO DATA	6.71E+06	NO DATA	6.86E+06
TC-99m	3.95E-01	1.12E+00	1.42E+01	NO DATA	1.70E+01	5.47E-01	6.61E+02
TC-101	3.43E-61	4.94E-61	4.84E-60	NO DATA	8.89E-60	2.52E-61	1.48E-72
RU-103	1.22E+02	NO DATA	5.24E+01	NO DATA	4.64E+02	NO DATA	1.42E+04
RU-105	1.02E-04	NO DATA	4.02E-05	NO DATA	1.32E-03	NO DATA	6.23E-02
RU-106	2.44E+03	NO DATA	3.09E+02	NO DATA	4.72E+03	NO DATA	1.58E+05
AG-110m	6.96E+06	6.44E+06	3.82E+06	NO DATA	1.27E+07	NO DATA	2.63E+09
TE-125m	1.95E+06	7.07E+05	2.61E+05	5.87E+05	7.94E+06	NO DATA	7.79E+06
TE-127m	5.46E+06	1.95E+06	6.66E+05	1.40E+06	2.22E+07	NO DATA	2.83E+07
TE-127	7.82E+01	2.81E+01	1.69E+01	5.80E+01	3.19E+02	NO DATA	6.17E+03
TE-129m	7.21E+06	2.69E+06	1.14E+06	2.48E+06	3.01E+07	NO DATA	3.63E+07
TE-129	3.83E-11	1.27E-11	8.23E-12	2.59E-11	1.42E-10	NO DATA	2.55E-11
TE-131m	4.33E+04	2.12E+04	1.76E+04	3.35E+04	2.14E+05	NO DATA	2.10E+06
TE-131	4.37E-34	1.83E-34	1.38E-34	3.60E-34	1.92E-33	NO DATA	6.19E-35

TABLE 3.5-24 (continued)

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.87E+05	1.86E+05	1.74E+05	2.05E+05	1.79E+06	NO DATA	8.79E+06
I-130	5.00E+05	1.47E+06	5.82E+05	1.25E+08	2.30E+06	NO DATA	1.27E+06
I-131	3.54E+08	5.06E+08	2.90E+08	1.66E+11	8.68E+08	NO DATA	1.34E+08
I-132	1.98E-01	5.29E-01	1.85E-01	1.85E+01	8.43E-01	NO DATA	9.93E-02
I-133	4.62E+06	8.03E+06	2.45E+06	1.18E+09	1.40E+07	NO DATA	7.22E+06
I-134	2.27E+12	6.16E-12	2.20E-12	1.07E-10	9.80E-12	NO DATA	5.37E-15
I-135	1.55E+04	4.06E+04	1.50E+04	2.68E+06	6.51E+04	NO DATA	4.59E+04
CS-134	1.69E+10	4.03E+10	3.29E+10	NO DATA	1.30E+10	4.32E+09	7.04E+08
CS-136	7.88E+08	3.11E+09	2.24E+09	NO DATA	1.73E+09	2.37E+08	3.53E+08
CS-137	2.21E+10	3.03E+10	1.98E+10	NO DATA	1.02E+10	3.41E+09	5.84E+08
CS-138	2.61E-23	5.15E-23	2.55E-23	NO DATA	3.78E-23	3.73E-24	2.20E-28
BA-139	5.32E-09	3.79E-12	1.56E-10	NO DATA	3.54E-12	2.15E-12	9.44E-09
BA-140	3.23E+06	4.05E+03	2.11E+05	NO DATA	1.38E+03	2.32E+03	6.65E+06
BA-141	5.18E-47	3.92E-50	1.75E-48	NO DATA	3.64E-50	2.22E-50	2.44E-56
BA-142	3.00E-81	3.09E-84	1.89E-82	NO DATA	2.61E-84	1.75E-84	4.23E-99
LA-140	5.40E-01	2.72E-01	7.19E-02	NO DATA	NO DATA	NO DATA	2.00E+04
LA-142	2.27E-12	1.03E-12	2.57E-13	NO DATA	NO DATA	NO DATA	7.52E-09
CE-141	5.80E+02	3.92E+02	4.45E+01	NO DATA	1.82E+02	NO DATA	1.50E+06
CE-143	5.00E+00	3.70E+03	4.09E-01	NO DATA	1.63E+00	NO DATA	1.38E+05
CE-144	4.29E+04	1.79E+04	2.30E+03	NO DATA	1.06E+04	NO DATA	1.45E+07
PR-143	1.89E+01	7.56E+00	9.35E-01	NO DATA	4.37E+00	NO DATA	8.26E+04
PR-144	7.71E-55	3.20E-55	3.92E-56	NO DATA	1.80E-55	NO DATA	1.11E-61
ND-147	1.13E+01	1.30E+01	7.79E-01	NO DATA	7.64E+00	NO DATA	6.25E+04
W-187	7.78E+02	6.50E+02	2.27E+02	NO DATA	NO DATA	NO DATA	2.13E+05
NP-239	4.39E-01	4.32E-02	2.38E-02	NO DATA	1.35E-01	NO DATA	8.86E+03

*mrem/yr per µCi/m^3
**2.95×10^5

TABLE 3.5-25

MEAT PATHWAY FACTORS - R^{M}_{aij} (CHILD)

(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.33E+02*	2.33E+02*	2.33E+02*	2.33E+02*	2.33E+02*	2.33E+02*
C-14	5.29E+05*	1.06E+05*	1.06E+05*	1.06E+05*	1.06E+05*	1.06E+05*	1.06E+05*
NA-24	1.84E-03**	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03
P-32	7.43E+09	3.47E+08	2.86E+08	NO DATA	NO DATA	NO DATA	2.05E+08
CR-51	NO DATA	NO DATA	8.78E+03	4.88E+03	1.33E+03	8.90E+03	4.66E+05
MN-54	NO DATA	8.03E+06	2.14E+06	NO DATA	2.25E+06	NO DATA	6.74E+06
MN-56	NO DATA	1.56E-53	3.52E-54	NO DATA	1.89E-53	NO DATA	2.26E-51
FE-55	4.58E+08	2.43E+08	7.52E+07	NO DATA	NO DATA	1.37E+08	4.50E+07
FE-59	3.76E+08	6.09E+08	3.03E+08	NO DATA	NO DATA	1.76E+08	6.34E+08
CO-58	NO DATA	1.64E+07	5.03E+07	NO DATA	NO DATA	NO DATA	9.58E+07
CO-60	NO DATA	6.93E+07	2.04E+08	NO DATA	NO DATA	NO DATA	3.84E+08
NI-63	2.91E+10	1.56E+09	9.90E+08	NO DATA	NO DATA	NO DATA	1.05E+08
NI-65	3.55E-52	3.34E-53	1.92E-53	NO DATA	NO DATA	NO DATA	4.10E-51
CU-64	NO DATA	2.77E-07	1.67E-07	NO DATA	6.69E-07	NO DATA	1.30E-05
ZN-65	3.75E+08	1.00E+09	6.22E+08	NO DATA	6.30E+08	NO DATA	1.76E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	5.76E+08	3.54E+08	NO DATA	NO DATA	NO DATA	3.71E+07
RB-88	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
RB-89	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
[illegible]-89	4.80E+08	NO DATA	1.37E+07	NO DATA	NO DATA	NO DATA	1.86E+07
[illegible]-90	1.04E+10	NO DATA	2.64E+09	NO DATA	NO DATA	NO DATA	1.40E+08
SR-91	2.26E-10	NO DATA	8.53E-12	NO DATA	NO DATA	NO DATA	4.99E-10
SR-92	2.00E-49	NO DATA	8.04E-51	NO DATA	NO DATA	NO DATA	3.80E-48
Y-90	1.73E+02	NO DATA	4.62E+00	NO DATA	NO DATA	NO DATA	4.91E+05
Y-91m	0.00E+00	NO DATA	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
Y-91	1.80E+06	NO DATA	4.81E+04	NO DATA	NO DATA	NO DATA	2.40E+08
Y-92	2.37E-39	NO DATA	6.78E-41	NO DATA	NO DATA	NO DATA	6.84E-35
Y-93	6.98E-12	NO DATA	1.92E-13	NO DATA	NO DATA	NO DATA	1.04E-07
ZR-95	2.67E+06	5.87E+05	5.22E+05	NO DATA	8.40E+05	NO DATA	6.12E+08
ZR-97	3.16E-05	4.57E-06	2.69E-06	NO DATA	6.55E-06	NO DATA	6.92E-01
NB-95	3.10E+06	1.21E+06	8.61E+05	NO DATA	1.13E+06	NO DATA	2.23E+09
MO-99	NO DATA	1.[illegible]4E+05	2.83E+04	NO DATA	2.44E+05	NO DATA	9.45E+04
TC-99m	6.01E-21	1.[illegible]8E-20	1.95E-19	NO DATA	1.71E-19	5.98E-21	6.71E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
RU-103	1.55E+08	NO DATA	5.96E+07	NO DATA	3.90E+08	NO DATA	4.01E+09
RU-105	8.48E-28	NO DATA	3.08E-28	NO DATA	7.45E-27	NO DATA	5.54E-25
RU-106	4.43E+09	NO DATA	5.53E+08	NO DATA	5.99E+09	NO DATA	6.90E+10
AG-110m	8.41E+06	5.68E+06	4.54E+06	NO DATA	1.06E+07	NO DATA	6.75E+08
TE-125m	5.69E+08	1.54E+08	7.58E+07	1.60E+08	NO DATA	NO DATA	5.49E+08
TE-127m	1.77E+09	4.78E+08	2.11E+08	4.24E+08	5.06E+09	NO DATA	1.44E+09
TE-127	3.34E-10	9.01E-11	7.17E-11	2.31E-10	9.51E-10	NO DATA	1.31E-08
TE-129m	1.79E+09	4.99E+08	2.77E+08	5.76E+08	5.25E+09	NO DATA	2.18E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
TE-131m	6.97E+02	2.41E+02	2.57E+02	4.96E+02	2.33E+03	NO DATA	9.78E+03
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00

TABLE 3.5-25 (continued)

MEAT PATHWAY FACTORS - R^{M}_{aij} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.13E+06	9.43E+05	1.14E+06	1.37E+06	8.76E+06	NO DATA	9.50E+06
I-130	2.91E-06	5.89E-06	3.03E-06	6.49E-04	8.80E-06	NO DATA	2.75E-06
I-131	1.65E+07	1.66E+07	9.46E+06	5.50E+09	2.73E+07	NO DATA	1.48E+06
I-132	1.05E-58	1.93E-58	8.86E-59	8.93E-57	2.95E-58	NO DATA	2.27E-58
I-133	5.75E-01	7.10E-01	2.69E-01	1.32E+02	1.18E+00	NO DATA	2.86E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
I-135	6.86E-17	1.23E-16	5.83E-17	1.09E-14	1.89E-16	NO DATA	9.38E-17
CS-134	9.20E+08	1.51E+09	3.18E+08	NO DATA	4.68E+08	1.68E+08	8.14E+06
CS-136	1.62E+07	4.45E+07	2.88E+07	NO DATA	2.37E+07	3.53E+06	1.56E+06
CS-137	1.33E+09	1.27E+09	1.88E+08	NO DATA	4.15E+08	1.49E+08	7.98E+06
CS-138	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-140	4.38E+07	3.84E+04	2.56E+06	NO DATA	1.25E+04	2.29E+04	2.22E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
LA-140	5.56E-02	1.94E-02	6.05E-03	NO DATA	NO DATA	NO DATA	5.41E+02
LA-142	6.18E-92	1.97E-92	6.17E-93	NO DATA	NO DATA	NO DATA	3.91E-87
CE-141	2.22E+04	1.11E+04	1.64E+03	NO DATA	4.85E+03	NO DATA	1.38E+07
CE-143	3.20E-02	1.74E+01	2.51E-03	NO DATA	7.28E-03	NO DATA	2.54E+02
CE-144	2.31E+06	7.24E+05	1.23E+05	NO DATA	4.01E+05	NO DATA	1.89E+08
PR-143	3.34E+04	1.00E+04	1.66E+03	NO DATA	5.43E+03	NO DATA	3.60E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
ND-147	1.17E+04	9.47E+03	7.33E+02	NO DATA	5.20E+03	NO DATA	1.50E+07
W-187	3.21E-02	1.90E-02	8.53E-03	NO DATA	NO DATA	NO DATA	2.67E+00
NP-239	4.23E-01	3.04E-02	2.14E-02	NO DATA	8.79E-02	NO DATA	2.25E+03

*mrem/yr per µCi/m^3
**1.84×10^{-3}

TABLE 3.5-26

MEAT PATHWAY FACTORS - R^{M}_{ail} (TEEN)
(m^2mrem/yr per µCi)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.93E+02*	1.93E+02*	1.93E+02*	1.93E+02*	1.93E+02*	1.93E+02*
C-14	2.81E+05*	5.62E+04*	5.62E+04*	5.62E+04*	5.62E+04*	5.62E+04*	5.62E+04*
NA-24	1.16E-03**	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03
P-32	3.95E+09	2.45E+08	1.53E+08	NO DATA	NO DATA	NO DATA	3.32E+08
CR-51	NO DATA	NO DATA	5.65E+03	3.14E+03	1.24E+03	8.07E+03	9.50E+05
MN-54	NO DATA	7.02E+06	1.39E+06	NO DATA	2.09E+06	NO DATA	1.44E+07
MN-56	NO DATA	1.17E-53	2.09E-54	NO DATA	1.48E-53	NO DATA	7.72E-52
FE-55	2.38E+08	1.69E+08	3.94E+07	NO DATA	NO DATA	1.07E+08	7.31E+07
FE-59	2.12E+08	4.95E+08	1.91E+08	NO DATA	NO DATA	1.56E+08	1.17E+09
CO-58	NO DATA	1.41E+07	3.25E+07	NO DATA	NO DATA	NO DATA	1.94E+08
CO-60	NO DATA	5.84E+07	1.32E+08	NO DATA	NO DATA	NO DATA	7.61E+08
NI-63	1.52E+10	1.07E+09	5.15E+08	NO DATA	NO DATA	NO DATA	1.71E+08
NI-65	1.90E-52	2.43E-53	1.11E-53	NO DATA	NO DATA	NO DATA	1.32E-51
CU-64	NO DATA	2.06E-07	9.68E-08	NO DATA	5.21E-07	NO DATA	1.60E-05
ZN-65	2.50E+08	8.69E+08	4.05E+08	NO DATA	5.56E+08	NO DATA	3.68E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	4.05E+08	1.90E+08	NO DATA	NO DATA	NO DATA	6.00E+07
RB-88	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
RB-89	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
[illegible]-89	2.54E+08	NO DATA	7.27E+06	NO DATA	NO DATA	NO DATA	3.02E+07
[illegible]-90	8.04E+09	NO DATA	1.99E+09	NO DATA	NO DATA	NO DATA	2.26E+08
SR-91	1.20E-10	NO DATA	4.78E-12	NO DATA	NO DATA	NO DATA	5.45E-10
SR-92	1.08E-49	NO DATA	4.59E-51	NO DATA	NO DATA	NO DATA	2.74E-48
Y-90	9.11E+01	NO DATA	2.45E+00	NO DATA	NO DATA	NO DATA	7.51E+05
Y-91m	0.00E+00	NO DATA	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
Y-91	9.55E+05	NO DATA	2.56E+04	NO DATA	NO DATA	NO DATA	3.91E+08
Y-92	1.26E-39	NO DATA	3.64E-41	NO DATA	NO DATA	NO DATA	3.45E-35
Y-93	3.70E-12	NO DATA	1.01E-13	NO DATA	NO DATA	NO DATA	1.13E-07
ZR-95	1.50E+06	4.74E+05	3.25E+05	NO DATA	6.93E+05	NO DATA	1.09E+09
ZR-97	1.70E-05	3.36E-06	1.55E-06	NO DATA	5.10E-06	NO DATA	9.11E-01
NB-95	1.79E+06	9.94E+05	5.47E+05	NO DATA	9.64E+05	NO DATA	4.25E+09
MO-99	NO DATA	8.20E+04	1.56E+04	NO DATA	1.88E+05	NO DATA	1.47E+05
TC-99m	3.42E-21	9.54E-21	1.24E-19	NO DATA	1.42E-19	5.29E-21	6.26E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
RU-103	8.57E+07	NO DATA	3.66E+07	NO DATA	3.02E+08	NO DATA	7.16E+09
RU-105	4.56E-28	NO DATA	1.77E-28	NO DATA	5.75E-27	NO DATA	3.68E-25
RU-106	2.36E+09	NO DATA	2.97E+08	NO DATA	4.54E+09	NO DATA	1.13E+11
AG-110m	5.04E+06	4.77E+06	2.90E+06	NO DATA	9.10E+06	NO DATA	1.34E+09
TE-125m	3.03E+08	1.09E+08	4.06E+07	8.47E+07	NO DATA	NO DATA	8.95E+08
TE-127m	9.40E+08	3.33E+08	1.12E+08	2.24E+08	3.81E+09	NO DATA	2.34E+09
TE-127	1.78E-10	6.30E-11	3.82E-11	1.23E-10	7.20E-10	NO DATA	1.37E-08
TE-129m	9.49E+08	3.52E+08	1.50E+08	3.06E+08	3.97E+09	NO DATA	3.56E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
TE-131m	3.73E+02	1.79E+02	1.49E+02	2.69E+02	1.87E+03	NO DATA	1.44E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00

TABLE 3.5-26 (continued)

MEAT PATHWAY FACTORS - R^{M}_{aij} (TEEN)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.17E+06	7.38E+05	6.95E+05	7.78E+05	7.08E+06	NO DATA	2.34E+07
I-130	1.63E-06	4.71E-06	1.88E-06	3.84E-04	7.25E-06	NO DATA	3.62E-06
I-131	8.89E+06	1.24E+07	6.69E+06	3.63E+09	2.14E+07	NO DATA	2.46E+06
I-132	5.78E-59	1.51E-58	5.42E-59	5.09E-57	2.38E-58	NO DATA	6.58E-59
I-133	3.09E-01	5.25E-01	1.60E-01	7.32E+01	9.20E+01	NO DATA	3.97E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
I-135	3.79E-17	9.75E-17	3.61E-17	6.27E-15	1.54E-16	NO DATA	1.08E-16
CS-134	5.22E+08	1.23E+09	5.70E+08	NO DATA	3.91E+08	1.49E+08	1.53E+07
CS-136	9.36E+06	3.68E+07	2.47E+07	NO DATA	2.01E+07	3.16E+06	2.96E+06
CS-137	7.24E+08	9.63E+08	3.35E+08	NO DATA	3.28E+08	1.27E+08	1.37E+07
CS-138	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-140	2.37E+07	2.91E+04	1.53E+06	NO DATA	9.86E+03	1.96E+04	3.66E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
LA-140	3.03E-02	1.49E-02	3.97E-03	NO DATA	NO DATA	NO DATA	8.56E+02
LA-142	3.37E-92	1.49E-92	3.72E-93	NO DATA	NO DATA	NO DATA	4.55E-88
CE-141	1.17E+04	7.83E+03	9.00E+02	NO DATA	3.69E+03	NO DATA	2.24E+07
CE-143	1.70E-02	1.24E+01	1.38E-03	NO DATA	5.55E-03	NO DATA	3.72E+02
CE-144	1.23E+06	5.10E+05	6.62E+04	NO DATA	3.04E+05	NO DATA	3.10E+08
PR-143	1.77E+04	7.06E+03	8.80E+02	NO DATA	4.10E+03	NO DATA	5.82E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
ND-147	6.22E+03	6.76E+03	4.05E+02	NO DATA	3.97E+03	NO DATA	2.44E+07
W-187	1.74E-02	1.42E-02	4.96E-03	NO DATA	NO DATA	NO DATA	3.83E+00
NP-239	2.25E-01	2.12E-02	1.18E-02	NO DATA	6.67E-02	NO DATA	3.42E+03

*mrem/yr per µCi/m^3
**1.16×10^{-3}

TABLE 3.5-27

MEAT PATHWAY FACTORS - R^{M}_{aij} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	3.24E+02*	3.24E+02*	3.24E+02*	3.24E+02*	3.24E+02*	3.24E+02*
C-14	3.33E+05*	6.66E+04*	6.66E+04*	6.66E+04*	6.66E+04*	6.66E+04*	6.66E+04*
NA-24	1.45E-03**	1.45E-03	1.45E-03	1.45E-03	1.45E-03	1.45E-03	1.45E-03
P-32	4.65E+09	2.89E+08	1.80E+08	NO DATA	NO DATA	NO DATA	5.23E+08
CR-51	NO DATA	NO DATA	7.05E+03	4.21E+03	1.55E+03	9.35E+03	1.77E+06
MN-54	NO DATA	9.19E+06	1.75E+06	NO DATA	2.73E+06	NO DATA	2.81E+07
MN-56	NO DATA	1.45E-53	2.57E-54	NO DATA	1.84E-53	NO DATA	4.62E-52
FE-55	2.94E+08	2.03E+08	4.74E+07	NO DATA	NO DATA	1.13E+08	1.17E+08
FE-59	2.66E+08	6.24E+08	2.39E+08	NO DATA	NO DATA	1.74E+08	2.08E+09
CO-58	NO DATA	1.83E+07	4.09E+07	NO DATA	NO DATA	NO DATA	3.70E+08
CO-60	NO DATA	7.51E+07	1.66E+08	NO DATA	NO DATA	NO DATA	1.41E+09
NI-63	1.89E+10	1.31E+09	6.32E+08	NO DATA	NO DATA	NO DATA	2.73E+08
NI-65	2.27E-52	2.94E-53	1.34E-53	NO DATA	NO DATA	NO DATA	7.46E-52
CU-64	NO DATA	2.52E-07	1.18E-07	NO DATA	6.36E-07	NO DATA	2.15E-05
ZN-65	3.56E+08	1.13E+09	5.12E+08	NO DATA	7.57E+08	NO DATA	7.13E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	4.87E+08	2.27E+08	NO DATA	NO DATA	NO DATA	9.61E+07
RB-88	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
RB-89	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
?-89	3.01E+08	NO DATA	8.64E+06	NO DATA	NO DATA	NO DATA	4.83E+07
.-90	1.24E+10	NO DATA	3.05E+09	NO DATA	NO DATA	NO DATA	3.59E+08
SR-91	1.43E-10	NO DATA	5.79E-12	NO DATA	NO DATA	NO DATA	6.83E-10
SR-92	1.28E-49	NO DATA	5.54E-51	NO DATA	NO DATA	NO DATA	2.54E-48
Y-90	1.09E+02	NO DATA	2.92E+00	NO DATA	NO DATA	NO DATA	1.15E+06
Y-91m	0.00E+00	NO DATA	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
Y-91	1.13E+06	NO DATA	3.03E+04	NO DATA	NO DATA	NO DATA	6.23E+08
Y-92	1.49E-39	NO DATA	4.36E-41	NO DATA	NO DATA	NO DATA	2.61E-35
Y-93	4.40E-12	NO DATA	1.21E-13	NO DATA	NO DATA	NO DATA	1.39E-07
ZR-95	1.87E+06	6.00E+05	4.06E+05	NO DATA	9.41E+05	NO DATA	1.90E+09
ZR-97	2.03E-05	4.10E-06	1.88E-06	NO DATA	6.17E-06	NO DATA	1.27E+00
NB-95	2.30E+06	1.28E+06	6.86E+05	NO DATA	1.26E+06	NO DATA	7.75E+09
MO-99	NO DATA	9.91E+04	1.89E+04	NO DATA	2.24E+05	NO DATA	2.30E+05
TC-99m	4.32E-21	1.22E-20	1.56E-19	NO DATA	1.86E-19	5.99E-21	7.23E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
RU-103	1.05E+08	NO DATA	4.53E+07	NO DATA	4.02E+08	NO DATA	1.23E+10
RU-105	5.42E-28	NO DATA	2.14E-28	NO DATA	7.00E-27	NO DATA	3.32E-25
RU-106	2.81E+09	NO DATA	3.55E+08	NO DATA	5.42E+09	NO DATA	1.82E+11
AG-110m	6.67E+06	6.17E+06	3.67E+06	NO DATA	1.21E+07	NO DATA	2.52E+09
TE-125m	3.59E+08	1.30E+08	4.81E+07	1.08E+08	1.46E+09	NO DATA	1.43E+09
TE-127m	1.12E+09	3.99E+08	1.36E+08	2.85E+08	4.54E+09	NO DATA	3.75E+09
TE-127	2.09E-10	7.52E-11	4.53E-11	1.55E-10	8.53E-10	NO DATA	1.65E-08
TE-129m	1.13E+09	4.22E+08	1.79E+08	3.89E+08	4.73E+09	NO DATA	5.70E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
TE-131m	4.50E+02	2.20E+02	1.83E+02	3.48E+02	2.23E+03	NO DATA	2.18E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00

TABLE 3.5-27 (continued)

MEAT PATHWAY FACTORS - R^{M}_{aij} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.42E+06	9.21E+05	8.64E+05	1.02E+06	8.87E+06	NO DATA	4.36E+07
I-130	2.03E-06	5.98E-06	2.36E-06	5.07E-04	9.33E-06	NO DATA	5.15E-06
I-131	1.07E+07	1.54E+07	8.80E+06	5.03E+09	2.63E+07	NO DATA	4.05E+06
I-132	7.13E-59	1.91E-58	6.67E-59	6.67E-57	3.04E-58	NO DATA	3.58E-59
I-133	3.70E-01	6.43E-01	1.96E-01	9.45E+01	1.12E+00	NO DATA	5.78E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
I-135	4.65E-17	1.22E-16	4.49E-17	8.03E-15	1.95E-16	NO DATA	1.38E-16
CS-134	6.53E+08	1.55E+09	1.27E+09	NO DATA	5.03E+08	1.67E+08	2.72E+07
CS-136	1.20E+07	4.75E+07	3.42E+07	NO DATA	2.65E+07	3.63E+06	5.40E+06
CS-137	8.69E+08	1.19E+09	7.78E+08	NO DATA	4.03E+08	1.34E+08	2.30E+07
CS-138	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-140	2.88E+07	3.62E+04	1.89E+06	NO DATA	1.23E+04	2.07E+04	5.94E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
LA-140	3.68E-02	1.85E-02	4.90E-13	NO DATA	NO DATA	NO DATA	1.36E+03
LA-142	4.07E-92	1.85E-92	4.61E-93	NO DATA	NO DATA	NO DATA	1.35E-88
CE-141	1.39E+04	9.43E+03	1.07E+03	NO DATA	4.38E+03	NO DATA	3.61E+07
CE-143	2.03E-02	1.50E+01	1.66E-03	NO DATA	6.61E-03	NO DATA	5.61E+02
CE-144	1.46E+06	6.10E+05	7.83E+04	NO DATA	3.62E+05	NO DATA	4.93E+08
PR-143	2.09E+04	8.40E+03	1.04E+03	NO DATA	4.85E+03	NO DATA	9.17E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
ND-147	7.04E+03	8.14E+03	4.87E+02	NO DATA	4.76E+03	NO DATA	3.91E+07
W-187	2.06E-02	1.72E-02	6.02E-03	NO DATA	NO DATA	NO DATA	5.64E+00
NP-239	2.57E-01	2.53E-02	1.39E-02	NO DATA	7.88E-02	NO DATA	5.18E+03

*mrem/yr per µCi/m^3
**1.45×10^{-3}

TABLE 3.5-28

VEGETATION PATHWAY FACTORS - R^{V}_{ai} (CHILD)

(m^2mrem/yr per μCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	4.01E+03*	4.01E+03*	4.01E+03*	4.01E+03*	4.01E+03*	4.01E+03*
C-14	3.51E+06*	7.01E+05*	7.01E+05*	7.01E+05*	7.01E+05*	7.01E+05*	7.01E+05*
NA-24	3.75E+05**	3.75E+05	3.75E+05	3.75E+05	3.75E+05	3.75E+05	3.75E+05
P-32	3.37E+09	1.57E+08	1.30E+08	NO DATA	NO DATA	NO DATA	9.30E+07
CR-51	NO DATA	NO DATA	1.17E+05	6.49E+04	1.77E+04	1.18E+05	6.20E+06
MN-54	NO DATA	6.64E+08	1.77E+08	NO DATA	1.86E+08	NO DATA	5.58E+08
MN-56	NO DATA	1.87E+01	4.22E+00	NO DATA	2.26E+01	NO DATA	2.71E+03
FE-55	8.02E+08	4.25E+08	1.32E+08	NO DATA	NO DATA	2.40E+08	7.88E+07
FE-59	3.98E+08	6.43E+08	3.21E+08	NO DATA	NO DATA	1.87E+08	6.70E+08
CO-58	NO DATA	6.44E+07	1.97E+08	NO DATA	NO DATA	NO DATA	3.76E+08
CO-60	NO DATA	3.79E+08	1.12E+09	NO DATA	NO DATA	NO DATA	2.10E+09
NI-63	3.95E+10	2.11E+09	1.34E+09	NO DATA	NO DATA	NO DATA	1.42E+08
NI-65	1.05E+02	9.89E+00	5.77E+00	NO DATA	NO DATA	NO DATA	1.21E+03
CU-64	NO DATA	1.09E+04	6.59E+03	NO DATA	2.64E+04	NO DATA	5.12E+05
ZN-65	8.11E+08	2.16E+09	1.34E+09	NO DATA	1.36E+09	NO DATA	3.79E+08
ZN-69	9.29E-06	1.34E-05	1.24E-06	NO DATA	8.14E-06	NO DATA	8.46E-04
BR-83	NO DATA	NO DATA	5.40E+00	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	3.92E-11	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	4.53E+08	2.79E+08	NO DATA	NO DATA	NO DATA	2.91E+07
RB-88	NO DATA	4.38E-22	3.04E-22	NO DATA	NO DATA	NO DATA	2.15E-23
RB-89	NO DATA	4.69E-26	4.17E-26	NO DATA	NO DATA	NO DATA	4.09E-28
[illegible]-89	3.59E+10	NO DATA	1.03E+09	NO DATA	NO DATA	NO DATA	1.39E+09
[illegible]-90	1.24E+12	NO DATA	3.14E+11	NO DATA	NO DATA	NO DATA	1.67E+10
SR-91	5.21E+05	NO DATA	1.97E+04	NO DATA	NO DATA	NO DATA	1.15E+06
SR-92	7.29E+02	NO DATA	2.92E+01	NO DATA	NO DATA	NO DATA	1.38E+04
Y-90	2.31E+04	NO DATA	6.18E+02	NO DATA	NO DATA	NO DATA	6.58E+07
Y-91m	9.24E-09	NO DATA	3.36E-10	NO DATA	NO DATA	NO DATA	1.81E-05
Y-91	1.86E+07	NO DATA	4.97E+05	NO DATA	NO DATA	NO DATA	2.48E+09
Y-92	1.58E+00	NO DATA	4.52E-02	NO DATA	NO DATA	NO DATA	4.57E+04
Y-93	2.92E+02	NO DATA	8.01E+00	NO DATA	NO DATA	NO DATA	4.35E+06
ZR-95	3.86E+06	8.49E+05	7.56E+05	NO DATA	1.22E+06	NO DATA	8.86E+08
ZR-97	5.66E+02	8.18E+01	4.83E+01	NO DATA	1.17E+02	NO DATA	1.24E+07
NB-95	4.10E+05	1.60E+05	1.14E+05	NO DATA	1.50E+05	NO DATA	2.95E+08
MO-99	NO DATA	7.67E+06	1.90E+06	NO DATA	1.64E+07	NO DATA	6.35E+06
TC-99m	4.70E+00	9.21E+00	1.53E+02	NO DATA	1.34E+02	4.68E+00	5.24E+03
TC-101	1.48E-30	1.54E-30	1.96E-29	NO DATA	2.63E-29	8.16E-31	4.91E-30
RU-103	1.54E+07	NO DATA	5.90E+06	NO DATA	3.86E+07	NO DATA	3.97E+08
RU-105	9.16E+01	NO DATA	3.32E+01	NO DATA	8.05E+02	NO DATA	5.98E+04
RU-106	7.45E+08	NO DATA	9.30E+07	NO DATA	1.01E+09	NO DATA	1.16E+10
AG-110m	3.21E+07	2.17E+07	1.73E+07	NO DATA	4.04E+07	NO DATA	2.58E+09
TE-125m	3.51E+08	9.52E+07	4.68E+07	9.86E+07	NO DATA	NO DATA	3.39E+08
TE-127m	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	NO DATA	1.07E+09
TE-127	9.84E+03	2.65E+03	2.11E+03	6.81E+03	2.80E+04	NO DATA	3.84E+05
TE-129m	8.43E+08	2.35E+08	1.31E+08	2.72E+08	2.47E+09	NO DATA	1.03E+09
TE-129	1.32E-03	3.68E-04	3.13E-04	9.42E-04	3.86E-03	NO DATA	8.21E-02
TE-131m	1.54E+06	5.33E+05	5.67E+05	1.10E+06	5.16E+06	NO DATA	2.16E+07
TE-131	2.59E-15	7.89E-16	7.71E-16	1.98E-15	7.83E-15	NO DATA	1.36E-14

TABLE 3.5-28 (continued)

VEGETATION PATHWAY FACTORS - R^{V}_{ai} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	7.00E+06	3.10E+06	3.74E+06	4.51E+06	2.88E+07	NO DATA	3.12E+07
I-130	6.10E+05	1.23E+06	6.35E+05	1.36E+08	1.84E+06	NO DATA	5.77E+05
I-131	1.43E+08	1.44E+08	8.16E+07	4.75E+10	2.36E+08	NO DATA	1.28E+07
I-132	9.20E+01	1.69E+02	7.77E+01	7.84E+03	2.59E+02	NO DATA	1.99E+02
I-133	3.53E+06	4.36E+06	1.65E+06	8.11E+08	7.27E+06	NO DATA	1.76E+06
I-134	1.50E-04	2.79E-04	1.28E-04	6.41E-03	4.26E-04	NO DATA	1.85E-04
I-135	6.28E+04	1.13E+05	5.34E+04	1.00E+07	1.73E+05	NO DATA	8.61E+04
CS-134	1.60E+10	2.63E+10	5.55E+09	NO DATA	8.15E+09	2.92E+09	1.42E+08
CS-136	8.23E+07	2.26E+08	1.46E+08	NO DATA	1.20E+08	1.80E+07	7.95E+06
CS-137	2.39E+10	2.29E+10	3.38E+09	NO DATA	7.46E+09	2.68E+09	1.43E+08
CS-138	6.44E-11	8.95E-11	5.68E-11	NO DATA	6.30E-11	6.78E-12	4.12E-11
BA-139	4.97E-02	2.65E-05	1.44E-03	NO DATA	2.32E-05	1.56E-05	2.87E+00
BA-140	2.77E+08	2.42E+05	1.62E+07	NO DATA	7.89E+04	1.45E+05	1.40E+08
BA-141	2.40E-21	1.14E-24	6.64E-23	NO DATA	9.88E-25	6.71E-24	1.16E-21
BA-142	9.70E-39	6.98E-42	5.42E-40	NO DATA	5.65E-42	4.11E-42	1.27E-40
LA-140	3.24E+03	1.13E+03	3.53E+02	NO DATA	NO DATA	NO DATA	3.16E+07
LA-142	3.39E-04	1.08E-04	3.38E-05	NO DATA	NO DATA	NO DATA	2.14E+01
CE-141	6.56E+05	3.27E+05	4.85E+04	NO DATA	1.43E+05	NO DATA	4.08E+08
CE-143	1.71E+03	9.29E+05	1.35E+02	NO DATA	3.90E+02	NO DATA	1.36E+07
CE-144	1.27E+08	3.99E+07	6.79E+06	NO DATA	2.21E+07	NO DATA	1.04E+10
PR-143	1.45E+05	4.37E+04	7.22E+03	NO DATA	2.36E+04	NO DATA	1.57E+08
PR-144	5.64E-26	1.74E-26	2.84E-27	NO DATA	9.22E-27	NO DATA	3.75E-23
ND-147	7.16E+04	5.80E+04	4.49E+03	NO DATA	3.18E+04	NO DATA	9.18E+07
W-187	6.44E+04	3.81E+04	1.71E+04	NO DATA	NO DATA	NO DATA	5.36E+06
NP-239	2.56E+03	1.84E+02	1.29E+02	NO DATA	5.31E+02	NO DATA	1.36E+07

*mrem/yr per µCi/m^3
**3.75 x 10^5

TABLE 3.5-29

VEGETATION PATHWAY FACTORS - R^{V}_{ai} (TEEN)
(m^2mrem/yr per µCi)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.59E+03*	2.59E+03*	2.59E+03*	2.59E+03*	2.59E+03*	2.59E+03*
C-14	1.45E+06*	2.91E+05*	2.91E+05*	2.91E+05*	2.91E+05*	2.91E+05*	2.91E+05*
NA-24	2.40E+05**	2.40E+05	2.40E+05	2.40E+05	2.40E+05	2.40E+05	2.40E+05
P-32	1.61E+09	9.97E+07	6.24E+07	NO DATA	NO DATA	NO DATA	1.35E+08
CR-51	NO DATA	NO DATA	6.12E+04	3.40E+04	1.34E+04	8.74E+04	1.03E+07
MN-54	NO DATA	4.54E+08	9.01E+07	NO DATA	1.36E+08	NO DATA	9.32E+08
MN-56	NO DATA	1.43E+01	2.54E+00	NO DATA	1.81E+01	NO DATA	9.41E+02
FE-55	3.26E+08	2.31E+08	5.39E+07	NO DATA	NO DATA	1.46E+08	1.00E+08
FE-59	1.79E+08	4.18E+08	1.61E+08	NO DATA	NO DATA	1.32E+08	9.88E+08
CO-58	NO DATA	4.36E+07	1.01E+08	NO DATA	NO DATA	NO DATA	6.02E+08
CO-60	NO DATA	2.49E+08	5.60E+08	NO DATA	NO DATA	NO DATA	3.24E+09
NI-63	1.61E+10	1.14E+09	5.46E+08	NO DATA	NO DATA	NO DATA	1.81E+08
NI-65	5.73E+01	7.32E+00	3.34E+00	NO DATA	NO DATA	NO DATA	3.97E+02
CU-64	NO DATA	8.28E+03	3.90E+03	NO DATA	2.10E+04	NO DATA	6.42E+05
ZN-65	4.23E+08	1.47E+09	6.86E+08	NO DATA	9.41E+08	NO DATA	6.23E+08
ZN-69	5.04E-06	9.60E-06	6.72E-07	NO DATA	6.28E-06	NO DATA	1.77E-05
BR-83	NO DATA	NO DATA	2.93E+00	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	2.31E-11	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.72E+08	1.28E+08	NO DATA	NO DATA	NO DATA	4.02E+07
RB-88	NO DATA	3.17E-22	1.69E-22	NO DATA	NO DATA	NO DATA	2.72E-29
RB-89	NO DATA	3.56E-26	2.52E-26	NO DATA	NO DATA	NO DATA	5.45E-35
[illegible]-89	1.51E+10	NO DATA	4.32E+08	NO DATA	NO DATA	NO DATA	1.80E+09
[illegible]-90	7.50E+11	NO DATA	1.85E+11	NO DATA	NO DATA	NO DATA	2.11E+10
SR-91	2.82E+05	NO DATA	1.12E+04	NO DATA	NO DATA	NO DATA	1.28E+06
SR-92	4.00E+02	NO DATA	1.70E+01	NO DATA	NO DATA	NO DATA	1.02E+04
Y-90	1.25E+04	NO DATA	3.37E+02	NO DATA	NO DATA	NO DATA	1.03E+08
Y-91m	5.04E-09	NO DATA	1.93E-10	NO DATA	NO DATA	NO DATA	2.38E-07
Y-91	7.84E+06	NO DATA	2.10E+05	NO DATA	NO DATA	NO DATA	3.21E+09
Y-92	8.60E-01	NO DATA	2.49E-02	NO DATA	NO DATA	NO DATA	2.36E+04
Y-93	1.58E+02	NO DATA	4.34E+00	NO DATA	NO DATA	NO DATA	4.83E+06
ZR-95	1.73E+06	5.46E+05	3.75E+05	NO DATA	8.02E+05	NO DATA	1.26E+09
ZR-97	3.10E+02	6.14E+01	2.83E+01	NO DATA	9.31E+01	NO DATA	1.66E+07
NB-95	1.92E+05	1.07E+05	5.86E+04	NO DATA	1.03E+05	NO DATA	4.56E+08
MO-99	NO DATA	5.64E+06	1.08E+06	NO DATA	1.29E+07	NO DATA	1.01E+07
TC-99m	2.73E+00	7.61E+00	9.86E+01	NO DATA	1.13E+02	4.23E+00	5.00E+03
TC-101	8.02E-31	1.14E-30	1.12E-29	NO DATA	2.06E-29	6.95E-31	1.95E-37
RU-103	6.81E+06	NO DATA	2.91E+06	NO DATA	2.40E+07	NO DATA	5.69E+08
RU-105	4.97E+01	NO DATA	1.93E+01	NO DATA	6.27E+02	NO DATA	4.01E+04
RU-106	3.09E+08	NO DATA	3.89E+07	NO DATA	5.95E+08	NO DATA	1.48E+10
AG-110m	1.51E+07	1.43E+07	8.72E+06	NO DATA	2.72E+07	NO DATA	4.03E+09
TE-125m	1.49E+08	5.35E+07	1.99E+07	4.15E+07	NO DATA	NO DATA	4.38E+08
TE-127m	5.52E+08	1.96E+08	6.57E+07	1.31E+08	2.24E+09	NO DATA	1.38E+09
TE-127	5.40E+03	1.92E+03	1.16E+03	3.73E+03	2.19E+04	NO DATA	4.17E+05
TE-129m	3.60E+08	1.34E+08	5.70E+07	1.16E+08	1.51E+09	NO DATA	1.35E+09
TE-129	7.13E-04	2.66E-04	1.73E-04	5.09E-04	2.99E-03	NO DATA	3.90E-03
TE-131m	8.44E+05	4.05E+05	3.38E+05	6.09E+05	4.22E+06	NO DATA	3.25E+07
TE-131	1.41E-15	5.80E-16	4.39E-16	1.08E-15	6.15E-15	NO DATA	1.15E-16

TABLE 3.5-29 (continued)

VEGETATION PATHWAY FACTORS - R^{V}_{aij} (TEEN)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	3.91E+06	2.48E+06	2.33E+06	2.61E+06	2.37E+07	NO DATA	7.84E+07
I-130	3.50E+05	1.01E+06	4.05E+05	8.26E+07	1.56E+06	NO DATA	7.79E+05
I-131	7.66E+07	1.07E+08	5.76E+07	3.13E+10	1.85E+08	NO DATA	2.12E+07
I-132	5.19E+01	1.36E+02	4.87E+01	4.58E+03	2.14E+02	NO DATA	5.91E+01
I-133	1.93E+06	3.28E+06	1.00E+06	4.58E+08	5.75E+06	NO DATA	2.48E+06
I-134	8.44E-05	2.24E-04	8.03E-05	3.73E-03	3.53E-04	NO DATA	2.95E-06
I-135	3.53E+04	9.09E+04	3.37E+04	5.85E+06	1.44E+05	NO DATA	1.01E+05
CS-134	7.10E+09	1.67E+10	7.75E+09	NO DATA	5.31E+09	2.03E+09	2.08E+08
CS-136	4.37E+07	1.72E+08	1.16E+08	NO DATA	9.37E+07	1.48E+07	1.38E+07
CS-137	1.01E+10	1.35E+10	4.70E+09	NO DATA	4.59E+09	1.78E+09	1.92E+08
CS-138	3.54E-11	6.80E-11	3.40E-11	NO DATA	5.02E-11	5.84E-12	3.08E-14
BA-139	2.70E-02	1.90E-05	7.86E-04	NO DATA	1.79E-05	1.31E-05	2.41E-01
BA-140	1.38E+08	1.69E+05	8.89E+06	NO DATA	5.73E+04	1.14E+05	2.13E+08
BA-141	1.11E-21	8.27E-25	3.70E-23	NO DATA	7.67E-25	5.66E-25	2.36E-27
BA-142	5.35E-39	5.35E-42	3.29E-40	NO DATA	4.53E-42	3.56E-42	1.64E-50
LA-140	1.80E+03	8.86E+02	2.36E+02	NO DATA	NO DATA	NO DATA	5.09E+07
LA-142	1.88E-04	8.35E-05	2.08E-05	NO DATA	NO DATA	NO DATA	2.54E+00
CE-141	2.83E+05	1.89E+05	2.17E+04	NO DATA	8.90E+04	NO DATA	5.41E+08
CE-143	9.33E+02	6.79E+05	7.58E+01	NO DATA	3.04E+02	NO DATA	2.04E+07
CE-144	5.29E+07	2.19E+07	2.84E+06	NO DATA	1.31E+07	NO DATA	1.33E+10
PR-143	7.00E+04	2.79E+04	3.48E+03	NO DATA	1.62E+04	NO DATA	2.30E+08
PR-144	3.04E-26	1.24E-26	1.54E-27	NO DATA	7.14E-27	NO DATA	3.35E-29
ND-147	3.62E+04	3.94E+04	2.36E+03	NO DATA	2.31E+04	NO DATA	1.42E+08
W-187	3.53E+04	2.88E+04	1.01E+04	NO DATA	NO DATA	NO DATA	7.79E+06
NP-239	1.39E+03	1.31E+02	7.26E+01	NO DATA	4.10E+02	NO DATA	2.10E+07

*mrem/yr per µCi/m^3
**2.40×10^5

TABLE 3.5-30

VEGETATION PATHWAY FACTORS - R^{V}_{ai} (ADULT)

(m^2mrem/yr per μCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.26E+03*	2.26E+03*	2.26E+03*	2.26E+03*	2.26E+03*	2.26E+03*
C-14	8.97E+05*	1.79E+05*	1.79E+05*	1.79E+05*	1.79E+05*	1.79E+05*	1.79E+05*
NA-24	2.71E+05**	2.71E+05	2.71E+05	2.71E+05	2.71E+05	2.71E+05	2.71E+05
P-32	1.40E+09	8.70E+07	5.41E+07	NO DATA	NO DATA	NO DATA	1.57E+08
CR-51	NO DATA	NO DATA	4.60E+04	2.75E+04	1.01E+04	6.11E+04	1.16E+07
MN-54	NO DATA	3.13E+08	5.96E+07	NO DATA	9.30E+07	NO DATA	9.58E+08
MN-56	NO DATA	1.59E+01	2.82E+00	NO DATA	2.01E+01	NO DATA	5.06E+02
FE-55	2.10E+08	1.45E+08	3.38E+07	NO DATA	NO DATA	8.10E+07	8.33E+07
FE-59	1.26E+08	2.96E+08	1.13E+08	NO DATA	NO DATA	8.27E+07	9.86E+08
CO-58	NO DATA	3.08E+07	6.90E+07	NO DATA	NO DATA	NO DATA	6.24E+08
CO-60	NO DATA	1.67E+08	3.69E+08	NO DATA	NO DATA	NO DATA	3.14E+09
NI-63	1.04E+10	7.21E+08	3.49E+08	NO DATA	NO DATA	NO DATA	1.50E+08
NI-65	6.18E+01	8.03E+00	3.66E+00	NO DATA	NO DATA	NO DATA	2.04E+02
CU-64	NO DATA	9.16E+03	4.30E+03	NO DATA	2.31E+04	NO DATA	7.81E+05
ZN-65	3.18E+08	1.01E+09	4.57E+08	NO DATA	6.76E+08	NO DATA	6.36E+08
ZN-69	5.39E-06	1.03E-05	7.17E-07	NO DATA	6.69E-06	NO DATA	1.55E-06
BR-83	NO DATA	NO DATA	3.13E+00	NO DATA	NO DATA	NO DATA	4.50E+00
BR-84	NO DATA	NO DATA	2.54E-11	NO DATA	NO DATA	NO DATA	1.99E-16
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.19E+08	1.02E+08	NO DATA	NO DATA	NO DATA	4.33E+07
RB-88	NO DATA	3.43E-22	1.82E-22	NO DATA	NO DATA	NO DATA	4.74E-33
RB-89	NO DATA	3.96E-26	2.79E-26	NO DATA	NO DATA	NO DATA	2.30E-39
[illegible]-89	9.95E+09	NO DATA	2.86E+08	NO DATA	NO DATA	NO DATA	1.60E+09
[illegible]-90	6.04E+11	NO DATA	1.48E+11	NO DATA	NO DATA	NO DATA	1.75E+10
SR-91	3.02E+05	NO DATA	1.22E+04	NO DATA	NO DATA	NO DATA	1.44E+06
SR-92	4.28E+02	NO DATA	1.85E+01	NO DATA	NO DATA	NO DATA	8.48E+03
Y-90	1.33E+04	NO DATA	3.56E+02	NO DATA	NO DATA	NO DATA	1.41E+08
Y-91m	5.42E-09	NO DATA	2.10E-10	NO DATA	NO DATA	NO DATA	1.59E-08
Y-91	5.12E+06	NO DATA	1.37E+05	NO DATA	NO DATA	NO DATA	2.82E+09
Y-92	9.13E-01	NO DATA	2.67E-02	NO DATA	NO DATA	NO DATA	1.60E+04
Y-93	1.69E+02	NO DATA	4.65E+00	NO DATA	NO DATA	NO DATA	5.35E+06
ZR-95	1.18E+06	3.79E+05	2.56E+05	NO DATA	5.94E+05	NO DATA	1.20E+09
ZR-97	3.36E+02	6.78E+01	3.10E+01	NO DATA	1.02E+02	NO DATA	2.10E+07
NB-95	1.42E+05	7.91E+04	4.25E+04	NO DATA	7.82E+04	NO DATA	4.80E+08
MO-99	NO DATA	6.12E+06	1.16E+06	NO DATA	1.39E+07	NO DATA	1.42E+07
TC-99m	3.09E+00	8.73E+00	1.11E+02	NO DATA	1.33E+02	4.28E+00	5.16E+03
TC-101	8.62E-31	1.24E-30	1.22E-29	NO DATA	2.24E-29	6.35E-31	3.73E-42
RU-103	4.77E+06	NO DATA	2.06E+06	NO DATA	1.82E+07	NO DATA	5.57E+08
RU-105	5.36E+01	NO DATA	2.12E+01	NO DATA	6.93E+02	NO DATA	3.28E+04
RU-106	1.93E+08	NO DATA	2.44E+07	NO DATA	3.73E+08	NO DATA	1.25E+10
AG-110m	1.05E+07	9.75E+06	5.79E+06	NO DATA	1.92E+07	NO DATA	3.98E+09
TE-125m	9.67E+07	3.51E+07	1.30E+07	2.91E+07	3.93E+08	NO DATA	3.86E+08
TE-127m	3.49E+08	1.25E+08	4.26E+07	8.93E+07	1.42E+09	NO DATA	1.17E+09
TE-127	5.65E+03	2.03E+03	1.22E+03	4.19E+03	2.30E+04	NO DATA	4.46E+05
TE-129m	2.51E+08	9.35E+07	3.97E+07	8.61E+07	1.05E+09	NO DATA	1.26E+09
TE-129	7.61E-04	2.86E-04	1.85E-04	5.84E-04	3.20E-03	NO DATA	5.75E-04
TE-131m	9.12E+05	4.46E+05	3.72E+05	7.06E+05	4.52E+06	NO DATA	4.43E+07
TE-131	1.51E-15	6.32E-16	4.78E-16	1.24E-15	6.63E-15	NO DATA	2.14E-16

TABLE 3.5-30 (continued)

VEGETATION PATHWAY FACTORS - R^{V}_{aij} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	4.31E+06	2.79E+06	2.62E+06	3.08E+06	2.68E+07	NO DATA	1.32E+08
I-130	3.91E+05	1.15E+06	4.55E+05	9.77E+07	1.80E+06	NO DATA	9.93E+05
I-131	8.07E+07	1.15E+08	6.62E+07	3.78E+10	1.98E+08	NO DATA	3.05E+07
I-132	5.77E+01	1.54E+02	5.40E+01	5.40E+03	2.46E+02	NO DATA	2.90E+01
I-133	2.09E+06	3.63E+06	1.11E+06	5.34E+08	6.34E+06	NO DATA	3.26E+06
I-134	9.33E-05	2.53E-04	9.06E-05	4.39E-03	4.03E-04	NO DATA	2.12E-07
I-135	3.91E+04	1.02E+05	3.77E+04	6.75E+06	1.64E+05	NO DATA	1.16E+05
CS-134	4.67E+09	1.11E+10	9.08E+09	NO DATA	3.59E+09	1.19E+09	1.94E+08
CS-136	4.26E+07	1.68E+08	1.21E+08	NO DATA	9.35E+07	1.28E+07	1.91E+07
CS-137	6.36E+09	8.70E+09	5.70E+09	NO DATA	2.95E+09	9.82E+08	1.68E+08
CS-138	3.84E-11	7.58E-11	3.75E-11	NO DATA	5.57E-11	5.50E-12	3.23E-16
BA-139	2.86E-02	2.04E-05	8.38E-04	NO DATA	1.91E-05	1.16E-05	5.07E-02
BA-140	1.29E+08	1.62E+05	8.43E+06	NO DATA	5.50E+04	9.26E+04	2.65E+08
BA-141	1.18E-21	8.90E-25	3.98E-23	NO DATA	8.28E-25	5.05E-25	5.55E-31
BA-142	5.79E-39	5.96E-42	3.64E-40	NO DATA	5.03E-42	3.37E-42	8.16E-57
LA-140	1.98E+03	9.95E+02	2.63E+02	NO DATA	NO DATA	NO DATA	7.31E+07
LA-142	2.04E-04	9.25E-05	2.31E-05	NO DATA	NO DATA	NO DATA	6.76E-01
CE-141	1.97E+05	1.33E+05	1.51E+04	NO DATA	6.19E+04	NO DATA	5.09E+08
CE-143	9.98E+02	7.38E+05	8.17E+01	NO DATA	3.25E+02	NO DATA	2.76E+07
CE-144	3.28E+07	1.37E+07	1.76E+06	NO DATA	8.14E+06	NO DATA	1.11E+10
PR-143	6.26E+04	2.51E+04	3.10E+03	NO DATA	1.45E+04	NO DATA	2.74E+08
PR-144	3.25E-26	1.35E-26	1.65E-27	NO DATA	7.61E-27	NO DATA	4.68E-33
ND-147	3.33E+04	3.85E+04	2.31E+03	NO DATA	2.25E+04	NO DATA	1.85E+08
W-187	3.80E+04	3.18E+04	1.11E+04	NO DATA	NO DATA	NO DATA	1.40E+07
NP-239	1.43E+03	1.40E+02	7.74E+01	NO DATA	4.38E+02	NO DATA	2.88E+07

*mrem/yr per µCi/m^3
**2.71×10^5

TABLE 3.5-31

GROUND PLANE PATHWAY FACTORS - R^G_i
(m^2mrem/yr per µCi/sec)

ISOTOPE	TOTAL BODY	SKIN	ISOTOPE	TOTAL BODY	SKIN	ISOTOPE	TOTAL BODY	SKIN
H-3	0.00E+00	0.00E+00	Y-91	1.07E+06	1.21E+06	CS-136	1.51E+08	1.71E+08
C-14	0.00E+00	0.00E+00	Y-92	1.80E+05	2.14E+05	CS-137	1.30E+10	1.52E+10
NA-24	1.20E+07*	1.39E+07	Y-93	1.83E+05	2.50E+05	CS-138	3.59E+05	4.10E+05
P-32	0.00E+00	0.00E+00	ZR-95	2.45E+08	2.85E+08	BA-139	1.06E+05	1.19E+05
CR-51	4.65E+06	5.50E+06	ZR-97	2.96E+06	3.44E+06	BA-140	2.05E+07	2.35E+07
MN-54	1.38E+09	1.62E+09	NB-95	1.37E+08	1.61E+08	BA-141	4.17E+04	4.75E+04
MN-56	9.03E+05	1.07E+06	MO-99	3.99E+06	4.62E+06	BA-142	4.49E+04	5.11E+04
FE-55	0.00E+00	0.00E+00	TC-99m	1.84E+05	2.11E+05	LA-140	1.92E+07	2.18E+07
FE-59	2.73E+08	3.20E+08	TC-101	2.03E+04	2.26E+04	LA-142	7.60E+05	9.12E+05
CO-58	3.80E+08	4.45E+08	RU-103	1.08E+08	1.26E+08	CE-141	1.37E+07	1.54E+07
CO-60	2.32E+10	2.73E+10	RU-105	6.36E+05	7.21E+05	CE-143	2.31E+06	2.63E+06
NI-63	0.00E+00	0.00E+00	RU-106	4.22E+08	5.06E+08	CE-144	6.96E+07	8.05E+07
NI-65	2.97E+05	3.45E+05	AG-110m	3.44E+09	4.01E+09	PR-143	0.00E+00	0.00E+00
CU-64	6.05E+05	6.86E+05	TE-125m	1.56E+06	2.13E+06	PR-144	1.84E+03	2.11E+03
ZN-65	7.48E+08	8.60E+08	TE-127m	9.16E+04	1.08E+05	ND-147	8.39E+06	1.01E+07
ZN-69	0.00E+00	0.00E+00	TE-127	2.99E+03	3.29E+03	W-187	2.35E+06	2.73E+06
BR-83	4.87E+03	7.07E+03	TE-129m	1.98E+07	2.31E+07	NP-239	1.71E+06	1.98E+06
BR-84	2.03E+05	2.36E+05	TE-129	2.64E+04	3.12E+04			
BR-85	0.00E+00	0.00E+00	TE-131m	8.02E+06	9.46E+06			
RB-86	8.98E+06	1.03E+07	TE-131	2.92E+04	3.45E+04			
RB-88	3.31E+04	3.78E+04	TE-132	4.24E+06	4.99E+06			
RB-89	1.23E+05	1.48E+05	I-130	5.50E+06	6.68E+06			
[illegible]-89	2.16E+04	2.50E+04	I-131	1.72E+07	2.09E+07			
[illegible]-90	NO DATA	NO DATA	I-132	1.25E+06	1.47E+06			
SR-91	2.14E+06	2.51E+06	I-133	2.45E+06	2.98E+06			
SR-92	7.77E+05	8.64E+05	I-134	4.46E+05	5.30E+05			
Y-90	4.50E+03	5.31E+03	I-135	2.53E+06	2.95E+06			
Y-91m	1.00E+05	1.16E+05	CS-134	6.87E+09	8.01E+09			

*1.20 x 10^7

4.0 COMPLIANCE WITH 40CFR190

4.1 Total Dose - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. This requirement is applicable at all times.

REMEDIAL REQUIREMENT:

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Sections 2.4.1(a), 2.4.1(b), 3.5.1(a), 3.5.1(b), 3.5.2(a), and 3.5.2(b), calculations shall be made including direct radiation contributions from the reactor unit and from outside storage tanks to determine whether the above limits of Section 4.1 have been exceeded. If such is the case, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days 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 10CFR20 Part 2203(4), shall include the following information:

   1. A determination of which uranium fuel cycle facilities or operations, in addition to CPS, contribute to the annual dose to the maximum exposed individual. Fuel cycle facilities located beyond the 5-mile radius from CPS need not be considered in this determination.

   2. A determination of the maximum exposed individual.

3. A determination of the total annual dose to the maximum exposed individual from all existing pathways and sources of radioactivity and radiation (including direct radiation from N-16, the plant and storage facilities) using methodologies described in this manual. The direct radiation dose may be either calculated using NUREG-0133 methodology or measured.#

4. It shall describe the levels of radiation and concentrations 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 40CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40CFR 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

4.1.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Sections 2.4.1.1, 3.5.1.1, and 3.5.2.1, and in accordance with the methodology and parameters described or specified in this manual.

4.1.2 Cumulative dose contributions from direct radiation from the reactor and from radwaste storage tanks shall be determined in accordance with the methodology and parameters described or specified in this manual. This requirement is applicable only under conditions set forth in the Remedial Requirement specified above (Section 4.1).

#The total body and organ doses resulting from liquid effluents will be summed with the doses resulting from gaseous effluents (including non-noble gases) and the doses to the maximum exposed individual from other operations of the uranium fuel cycle. The effluent doses will be based upon releases from CPS during the previous three quarters and from the quarter in which the Section 4.1 OPERATION REQUIREMENT was exceeded.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The primary requirements for the Clinton Power Station Radiological Environmental Monitoring Program (REMP) are set forth in Table 5.1-1 and shown by location in Figures 5.0-1, 5.0-2, 5.0-3 and 5.0-4.

In addition to the required sampling program, CPS will perform supplemental periodic and long term sampling and analyses in order to better monitor environmental exposure pathways. These samples will not be listed in this manual, however, full sample descriptions and results will be included in the Annual Radiological Environmental Operating Report.

Surface and drinking water samples are composited by collecting aliquots of fixed volume at fixed time intervals. This method of sampling is considered consistent with note (g) in Table 5.1-1.

5.1 Monitoring Program - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The Radiological Environmental Monitoring Program shall be conducted as specified in Table 5.1-1. This requirement applies at all times.

REMEDIAL REQUIREMENT:

a. With the radiological environmental monitoring program not being conducted as specified in Table 5.1-1 prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Technical Specification 5.6.2, 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 report levels of Table 5.1-2 when averaged over any calendar quarter prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days 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 Section 2.4.1, 3.5.1, and 3.5.2. When more than one of the radionuclides in Table 5.1-2 are detected in the sampling medium, this report shall be submitted if:

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

When radionuclides other than those in Table 5.1-2 are detected and 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 Section 2.4.1, 3.5.1, and 3.5.2. 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 vegetation samples unavailable from one or more of the sample locations required by Table 5.1-1, 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 5.6.2, identify the cause of the

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

unavailability of samples and identify the new location(s) for obtaining replacement samples in the next annual Radiological Environmental Operating Report and also include in the report a revised figure(s) and table for this manual reflecting the new location(s).

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SURVEILLANCE REQUIREMENTS

5.1.1 The radiological environmental monitoring samples shall be collected pursuant to Table 5.1-1 from the specific locations given in Table 5.1-1 and Figures 5.0-1, 5.0-2, 5.0-3, and 5.0-4 and shall be analyzed pursuant to the requirements of Table 5.1-1 and the detection capabilities required by Table 5.1-3.

TABLE 5.1-1

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]	40 routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: (1) an inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY;	Quarterly	Gamma dose quarterly

SECTOR	CODE	DISTANCE from station (miles)
N	CL-36	0.6
NNE	CL-5	0.7
NE	CL-22	0.6
ENE	CL-23	0.5
E	CL-24	0.5
ESE	CL-42	2.8
SE	CL-43	2.8
SSE	CL-44	2.3
S	CL-45	2.8
SSW	CL-46	2.8
SW	CL-47	3.3
WSW	CL-48	2.3
W	CL-1	1.8
WNW	CL-34	0.8
NW	CL-35	0.7
NNW	CL-63	1.3

TABLE 5.1-1 (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
1. DIRECT RADIATION[b] (continued)	(2) an outer ring of stations, one in each meteorological sector in the 6 to 8 km (3.7 miles to 5.0 miles) range from the site;		

SECTOR	CODE	DISTANCE from station (miles)
N	CL-76	4.6
NNE	CL-77	4.5
NE	CL-78	4.8
ENE	CL-79	4.5
E	CL-53	4.3
ESE	CL-54	4.6
SE	CL-55	4.1
SSE	CL-56	4.1
S	CL-57	4.6
SSW	CL-58	4.3
SW	CL-60	4.5
WSW	CL-61	4.5
W	CL-80	4.1
WNW	CL-81	4.5
NW	CL-51	4.4
NNW	CL-52	4.3

TABLE 5.1-1 (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
1. DIRECT RADIATION[b] (continued)	(3) 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.		

SECTOR	CODE	DISTANCE from station (miles)
N	CL-37	3.4
N	CL-75	0.9
ENE	CL-65	2.6
E	CL-41	2.4
S(control)	CL-11	16
W	CL-49	3.5
W	CL-74	1.9
WNW	CL-64	2.1

TABLE 5.1-1 (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	Samples from 5 locations: a. 3 samples from close to the 3 SITE BOUNDARY locations in different sectors of the highest calculated annual average ground-level D/Q.	Continuous sampler operations with sample collection weekly, or more frequently if required by dust loading.	Radioiodine Canister: I-131 analysis weekly. Particulate Sampler: Gross beta radioactivity analysis following filter change[d]; Gamma isotopic analysis[e] of composite (by location) quarterly.

SECTOR	CODE	DISTANCE from station (miles)
NNE	CL-2	0.7
NE	CL-3	0.7
N	CL-15	0.9

b. 1 sample from the vicinity of a community having the highest calculated annual average ground-level D/Q.

SECTOR	CODE	DISTANCE from station (miles)
E	CL-8	2.2

TABLE 5.1-1 (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 (continued)	c. 1 sample from a control location, as for example 15-30 km (9.3 miles to 18.6 miles) distant and in the least prevalent wind direction[c].		
	SECTOR: S (control) — CODE: CL-11 — DISTANCE from station (miles): 16		
3. WATERBORNE			
a. Surface[f]	1 sample upstream 1 sample downstream	Composite sample over 1 month period[g]	Gamma isotopic analysis[e] monthly. Composite for tritium analysis quarterly.
	SECTOR: ENE (upstream) — CODE: CL-91 — DISTANCE from station (miles): 6.1		
	SECTOR: SE (downstream) — CODE: CL-90 — DISTANCE from station (miles): 0.4		

TABLE 5.1-1 (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
3. WATERBORNE (continued)			
b. Ground	Samples from 1 or 2 sources, only if likely to be affected[h].	Quarterly	Gamma isotopic[e] and tritium analysis quarterly.
	SECTOR: E — CODE: CL-12 — DISTANCE from station (miles): 1.6*		
	SECTOR: ESE — CODE: CL-7D — DISTANCE from station (miles): 2.3		
	*Sample location is in pump station distant from well. Well located 1.0 mile S of plant on the edge of the lake.		
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[g] 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.[i] Composite for gross beta and gamma isotopic analyses[e] monthly. Composite for tritium analysis quarterly.
	SECTOR: WNW — CODE: CL-14 — DISTANCE from station (miles): within Service Building		
	*No municipal or public drinking water supplies are taken from Clinton Lake or downstream for 200 miles. Drinking water for Clinton Power Station is supplied by Clinton Lake.		
	1 sample from a control location**		
	**No control location necessary		

TABLE 5.1-1 (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
3. WATERBORNE (continued)			
d. Sediment from shoreline	1 sample from downstream area with existing or potential recreational value.	Semiannually	Gamma isotopic analysis[e] semiannually.
	SECTOR: SE	CODE: CL-7B	DISTANCE from station (miles): 2.1
4. INGESTION			
a. Milk	Samples from milking animals in 3 locations within 5-km distance having the highest dose potential. If there are none, 1 sample from milking animals in each of 3 areas between 5 to 8 km distant where doses are calculated to be in greater than 1 mrem per year.[k]*	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.

*This sample requirement is checked annually as part of the annual land use survey.

TABLE 5.1-1 (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
4. INGESTION (continued)			
a. Milk (continued)	1 sample from milking animals at a control location, 15-30 km (9.3 miles to 18.6 miles) distant and in the least prevalent wind direction. SECTOR: WSW (control) — CODE: CL-116 — DISTANCE from station (miles): 14		
b. Fish and Invertebrates	1 sample each of 3 important species (such as bass, crappie, carp, or bluegill) in vicinity of plant discharge area. SECTOR: E — CODE: CL-19 — DISTANCE from station (miles): 3.4	Sample in season, or semiannually if they are not seasonal	Gamma isotopic analysis[e] on edible portions.
	1 sample of same species in areas not influenced by plant discharge. SECTOR: S (control) — CODE: CL-105 — DISTANCE from station (miles): 50		

TABLE 5.1-1 (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
4. INGESTION (continued)			
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 been discharged.*	At time of harvest[j]	Gamma isotopic analysis[e] on edible portion.
	*No known usage of Salt Creek water for irrigation in DeWitt, Logan, Menard, or Cass Counties. This information is checked annually as part of the land use survey.		
	Samples of 3 different kinds of broad leaf vegetation (such as lettuce, cabbage, and swiss chard) grown nearest each of two different offsite locations of highest predicted annual average ground-level D/Q if milk sampling is not performed.	Monthly during growing season	Gamma isotopic[e] and I-131 analysis.

SECTOR	CODE	DISTANCE from station (miles)
NE	CL-115	0.7
N	CL-117	0.9
NNE	CL-118	0.9

TABLE 5.1-1 (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
4. INGESTION (continued)			
c. Food Products (continued)	1 sample of each of the similar broad leaf vegetation grown 15-30 km (9.3 miles to 18.6 miles) distant in the least prevalent wind direction if milk sampling is not performed.	Monthly during growing season	Gamma isotopic[e] and I-131

SECTOR	CODE	DISTANCE from station (miles)
SSE (Control)	CL-114	12.5

TABLE 5.1-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TABLE NOTATIONS

[a]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, 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 pursuant to Technical Specification 5.6.2. 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 Technical Specification 5.6.2, identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining replacement samples in the next annual Radiological Environmental Operating Report and also include in the report a revised figure(s) and table for the ODCM 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 40 stations is not an absolute number. The number of direct radiation monitoring stations may be reduced according to geographical limitations; e.g., at an ocean site, some sectors will be over water so that the number of dosimeters may be reduced accordingly. 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.

TABLE 5.1-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TABLE NOTATIONS (Continued)

[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 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 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.

[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 (or time) 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 Section 2.4.2.

TABLE 5.1-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TABLE NOTATIONS (Continued)

[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.

[k]The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in Section 3.5.4.

TABLE 5.1-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

ANALYSIS	WATER (pCi/1)	AIRBORNE PARTICULATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/1)	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	

*For drinking water samples. This is 40CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used.

**If no drinking water pathway exists, a value of 20 pCi/l may be used.

***Total for parent and daughter.

TABLE 5.1-3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[a,b]

LOWER LIMIT OF DETECTION (LLD)[c]

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GAS (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-95	30					
Nb-95	15					
I-131	1**	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

*If no drinking water pathway exists, a value of 3000 pCi/l may be used.
**If no drinking water pathway exists, a value of 15 pCi/l may be used.

TABLE 5.1-3 (Continued)

DETECTION FOR ENVIRONMENTAL SAMPLE ANALYSIS[a,b]

TABLE NOTATIONS

[a]This list does not mean that only these nuclides are to be considered. Other peaks 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 5.6.2.

[b]Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13, Rev. 1, July 1977.

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

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

$$LLD = \frac{4.66 s_b}{[E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda \Delta t)]}$$

Where:

LLD is the "a priori' lower limit of detection as defined above, as picocuries 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 if the counting efficiency, as counts per disintegration,

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

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield, when applicable,

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

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

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. 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 5.6.2.

5.2 Land Use Census - Operation and Surveillance Requirements

OPERATION REQUIREMENT

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. For evaluated or mixed-mode releases as defined in Regulatory Guide 1.111, Revision 1, July 1977, the land use census shall also identify within a distance of 5 km (3 miles) the location in each of the 16 meteorological sectors of all milk animals and all gardens of greater than 50 m2 producing broad leaf vegetation. This requirement applies at all times.

REMEDIAL REQUIREMENT:

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 Section 3.5.2.1, identify the new location(s) in the next annual Radiological Environmental Operating Report, pursuant to Technical Specification 5.6.2. | rev. 15

b. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with Section 5.1, 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

*Broad leaf vegetation sampling of at least three 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 5.1-1.4c shall be followed, including analysis of control samples.

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 5.6.3, identify the new location(s) in the next Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for this manual reflecting the new location(s).

SURVEILLANCE REQUIREMENTS

5.2.1 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 5.6.2.

5.3 Interlaboratory Comparison Program

All analyses for CPS Radiological Environmental Monitoring Program are performed by Teledyne Isotopes Midwest Laboratories (TIML) located in Northbrook, Illinois.

Teledyne Isotopes Midwest Laboratory has participated in interlaboratory comparison (cross-check) programs since the formulation of its quality control program in December 1971. These programs have been operated by agencies which supply environmental-type samples (e.g., milk or water) containing concentrations of radionuclides known to the issuing agency but not to the participant laboratories. The purpose of such a program is to provide an independent check on the laboratory's analytical procedures and to alert it to any possible problems.

Participant laboratories measure the concentrations of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies the range the results should fall within. Results consistently higher or lower than the known values and results outside the specific ranges indicate a need to check the instruments or procedures used.

If the results of a determination in the EPA cross-check program are outside the control limits specified by the EPA, CPS will require TIML to investigate the cause of the problem and take steps to correct it. The results of this investigation and corrective action shall be included in the Annual Radiological Environmental Operating Report.

Operation and Surveillance Requirements for the Interlaboratory Comparison Program are prescribed in Section 5.3.1 (which follows).

5.3.1 Interlaboratory Comparison Program - Operation and Surveillance Requirements

OPERATION REQUIREMENT

Analyses shall be performed on all radioactive materials, supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission, that correspond to samples required by Table 5.1-1. This requirement applies at all times.

REMEDIAL REQUIREMENT:

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 5.6.2.

SURVEILLANCE REQUIREMENTS

5.3.1.1 The Interlaboratory Comparison Program is described in Section 5.3. 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 5.6.2.

FIGURE 5.0-1

REMP LOCATIONS WITHIN 1 MILE OF CPS

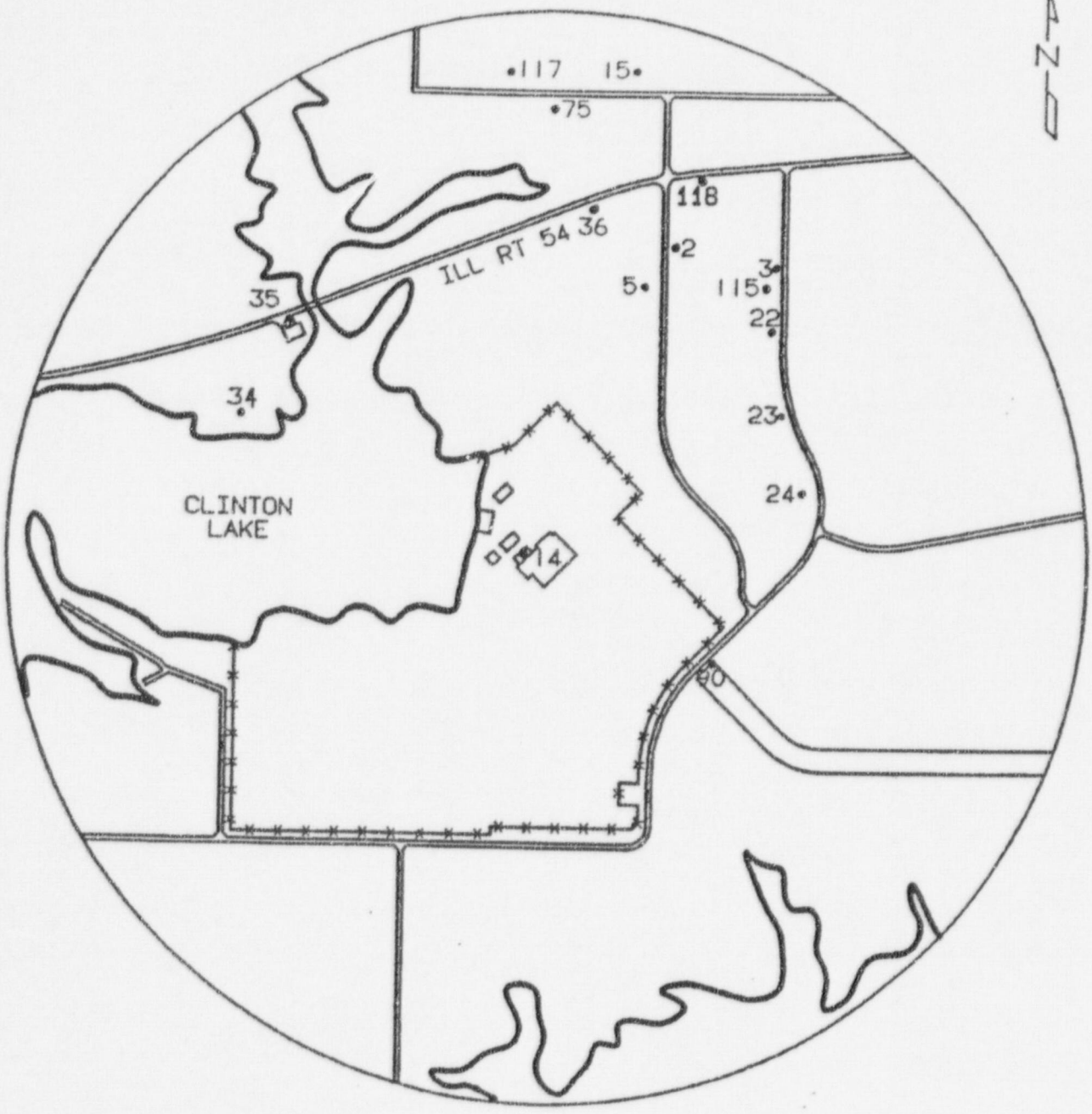


FIGURE 5.0-2

REMP LOCATIONS 1-2 MILES FROM CPS

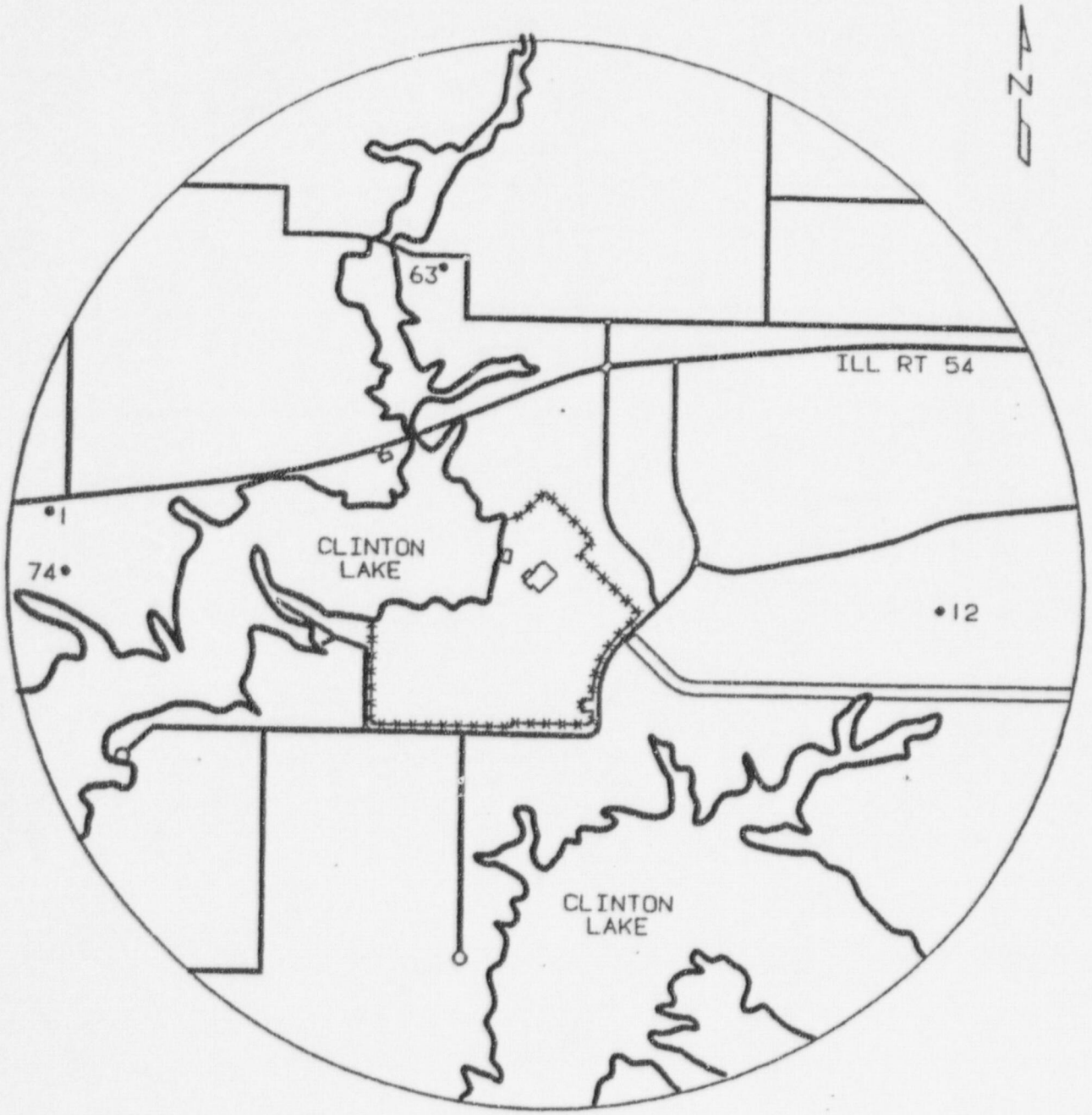


FIGURE 5.0-3
REMP LOCATIONS 2-5 MILES FROM CPS

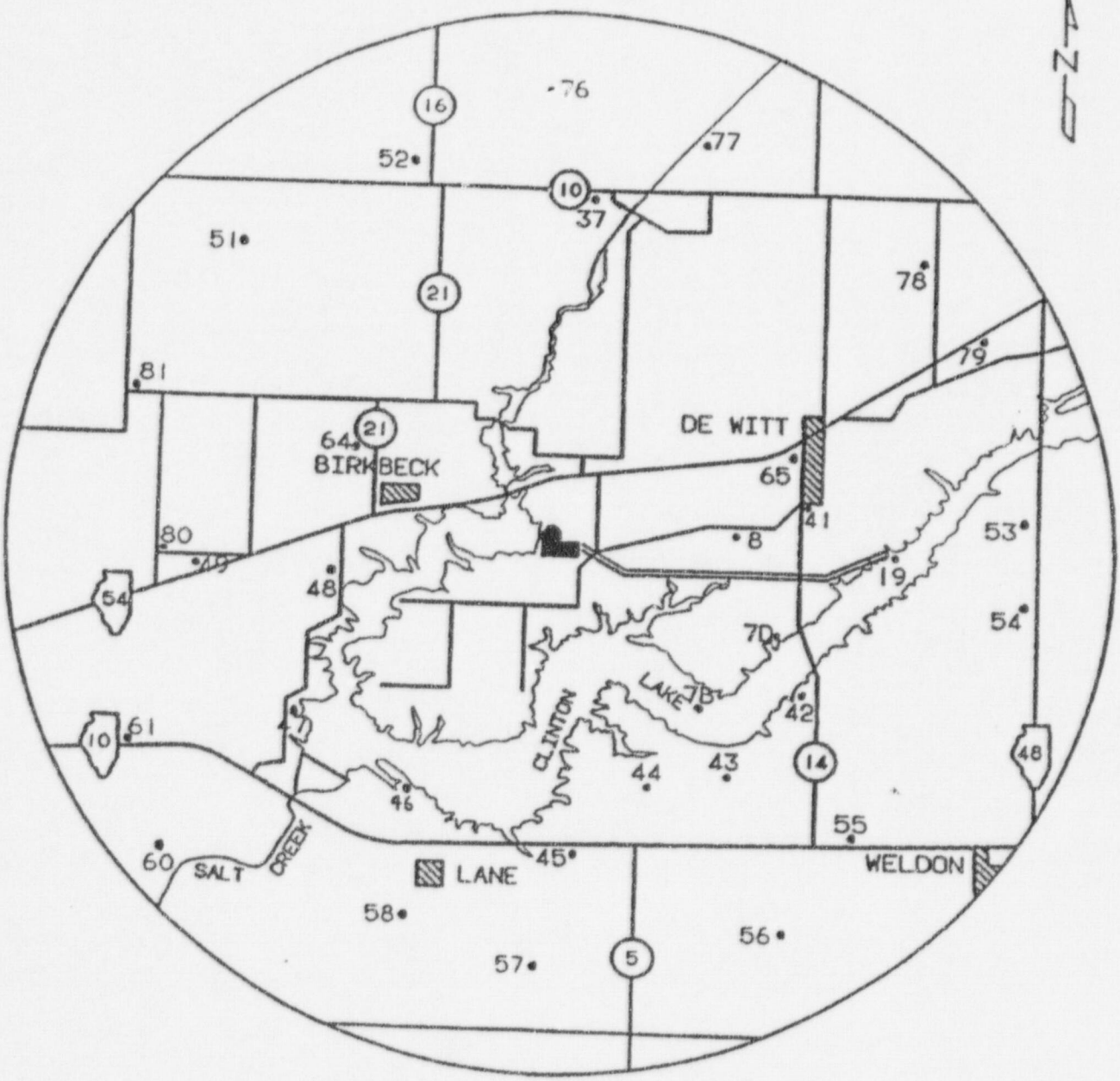
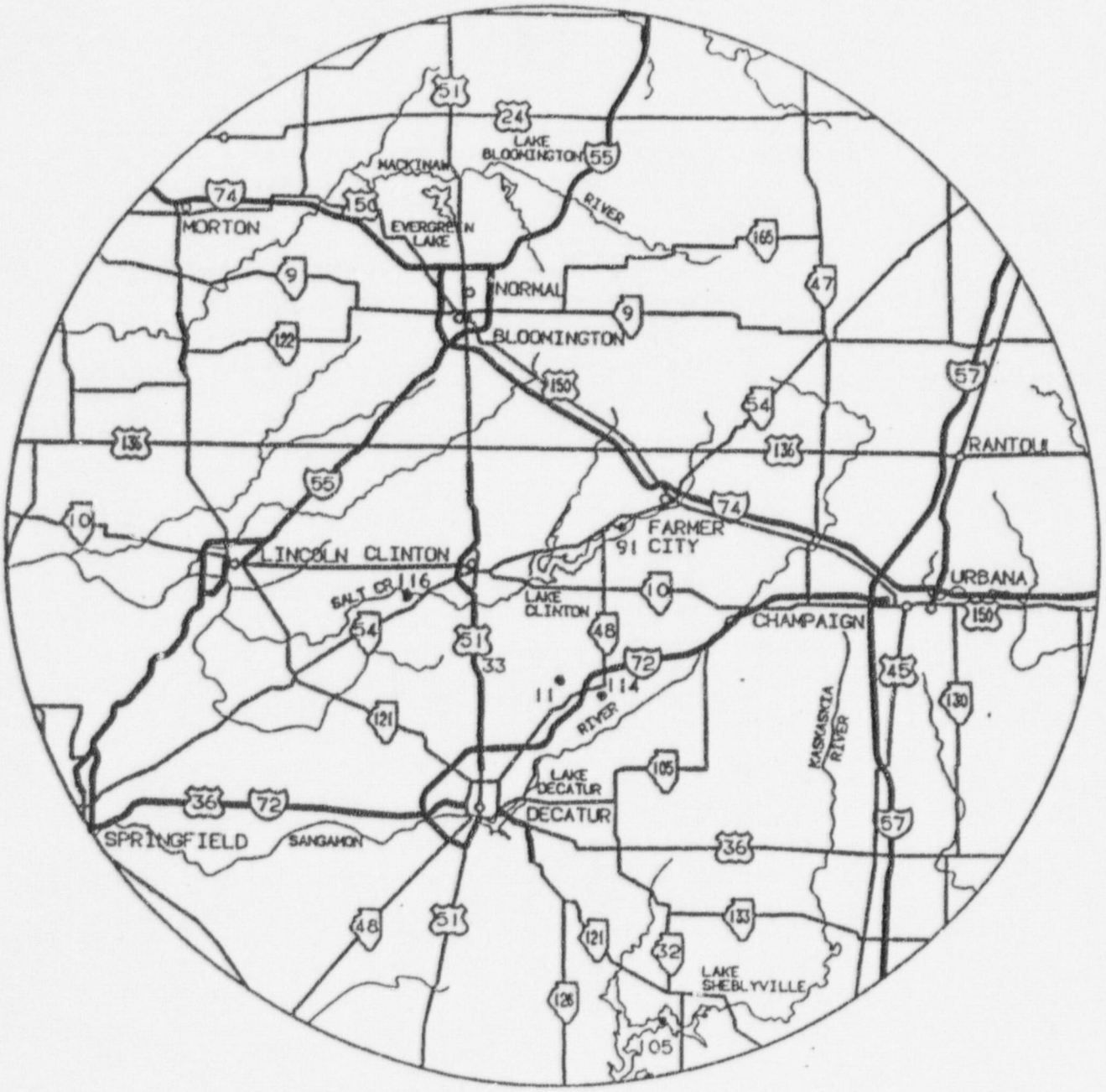


FIGURE 5.0-4

REMP LOCATIONS GREATER THAN 5 MILES FROM CPS



6.0 BASES FOR OPERATION AND SURVEILLANCE REQUIREMENTS

6.1 General Operation and Surveillance Requirements

The requirements of Sections 1.2 and 1.3 provide general requirements applicable to each of the Operation Requirements and Surveillance Requirements specified within Sections 2.0 through 5.0.

1.2.1 This requirement is provided to emphasize when each Operation Requirement is applicable and when the associated REMEDIAL REQUIREMENT should be met.

1.2.2 This requirement defines those conditions necessary to constitute compliance with the terms of an individual Operation Requirement and associated REMEDIAL REQUIREMENT.

1.3.1 This requirement provides that surveillance activities, necessary to ensure the Operation Requirements are met, will be performed during the conditions for which the Operation Requirements are applicable. Some surveillance activities may be required to be performed without regard to the applicable conditions specified in the associated Operation Requirement.

1.3.2 The provisions of this requirement provide allowable tolerances for performing surveillance activities beyond those specified in the nominal surveillance interval. These tolerances are necessary to provide operational flexibility because of scheduling and performance considerations. The phrase "at least" associated with a surveillance frequency does not negate this allowable tolerance; instead, it permits the more frequent performance of surveillance activities.

The tolerance values, taken either individually or consecutively over three test intervals, are sufficiently restrictive to ensure that the reliability associated with the surveillance activity is not significantly degraded beyond that obtained from the nominal specified interval.

1.3.3 The provisions of this requirement set forth the criteria for determination of compliance with the OPERABILITY requirements of the Operation Requirements. Under these criteria, equipment, systems, or components are assumed to be OPERABLE if the associated surveillance activities have been satisfactorily performed within the specified time interval. Nothing in this provision is to be construed as defining equipment, systems or components OPERABLE, when such items are found or known to be inoperable although still meeting the Surveillance Requirements.

1.3.4 This requirement ensures that surveillance activities associated with a Operation Requirement have been performed within the specified time interval prior to entry into a specified system operating mode. The intent of this provision is to ensure that surveillance activities have been satisfactorily demonstrated on a current basis as required to meet the OPERABILITY requirements of the Operation Requirement.

Under the terms of this requirement, for example, during initial plant startup or following extended plant outage, the applicable surveillance activities must be performed within the stated surveillance interval prior to placing or returning the system or equipment into OPERABLE status.

6.2 Monitoring Instrumentation

Section 2.7: Radioactive Liquid Effluent Monitoring Instrumentation

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 this manual to ensure that the alarm/trip will occur prior to exceeding the limits of 10CFR 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 10CFR Part 50.

Section 3.9.1: Offgas Radiation Monitoring Instrumentation

The OPERABILITY of the radiation monitoring instrumentation ensures that; (1) the radiation levels are continually measured in the areas served by the individual channels; (2) the alarm or automatic action is initiated when the radiation level trip setpoint is exceeded; and (3) sufficient information is available on selected plant parameters to monitor and assess these variables following an accident. This capability is consistent with 10CFR Part 50, Appendix A, General Design Criteria 19, 60, 61, 63 and 64.

Section 3.9.2: Radioactive Gaseous Effluent Monitoring Instrumentation

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the release 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 this manual to ensure that the alarm/trip will occur prior to exceeding the limits of 10CFR 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 10CFR Part 50. The sensitivity of any noble gas activity monitors used to show compliance with the gaseous effluent release requirements of Section 3.5.1 shall be such that concentrations as low as 1×10^{-6} µCi/ml are measurable.

6.3 Radioactive Effluents

6.3.1 Liquid Effluents

Section 2.3.1: Liquid Effluent Concentration

This requirement 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 10CFR Part 20, Appendix B, Table 2, 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, 10CFR Part 50, to a MEMBER OF

THE PUBLIC and (2) the limits of 10CFR Part 20.1301 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 lim in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

This requirement applies to the release of radioactive materials in liquid effluents from the site.

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 Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

Section 2.4.1: 10CFR50, Appendix I Release Rate Limits

This requirement is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10CFR 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 40CFR Part 141. The dose calculation methodology and parameters in this manual 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 equations specified in this manual 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 10CFR 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.

This requirement applies to the release of radioactive materials in liquid effluents from the one reactor unit on the site.

Section 2.5.1: Liquid Radwaste Treatment System

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 requirements 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 to 10CFR Part 50 and the design objective given in Section II.D of appendix I to 10CFR 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, 10CFR Part 50, for liquid effluents.

This requirement applies to the release of radioactive materials in liquid effluents from the one reactor unit on the site.

6.3.2 Gaseous Effluents

Section 3.4.1: 10CFR20 Release Rate Limits

This requirement 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 10CFR Part 20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentrations of 10CFR Part 20, Appendix B, Table 2, 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 an UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Appendix B, Table 2 of 10CFR Part 20. 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 such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, shall be given in this manual. Doses for such MEMBERS OF THE PUBLIC are provided in the Radioactive Effluent Release Report. 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 whole body or to less than or equal to 3000 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.

This requirement applies to the release of radioactive materials in gaseous effluents from the one reactor unit on the site.

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 Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

Section 3.5.1: Noble Gas Dose

This requirement is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10CFR Part 50. The Limiting Condition for Operation 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 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 calculation methodology and parameters established in this manual for calculating the doses due to the actual release rates for 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 10CFR 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. The equations in this manual for determining the air doses at and beyond the SITE BOUNDARY are based upon real time atmospheric conditions.

This requirement applies to the release of radioactive materials in gaseous effluents from the site.

Section 3.5.2: Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form

This requirement is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10CFR Part 50. The Limiting Conditions for Operation 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 material 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 10CFR 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 real time atmospheric conditions. The release rate specifications for iodine-131, 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.

This requirement applies to the release of radioactive materials in gaseous effluents from one reactor unit on the site.

Sections 3.6 and 3.7: Gaseous Radwaste (Offgas) Treatment and Ventilation Exhaust Treatment System

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 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 reasonably achievable." This requirement implements the requirements of 10CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10CFR Part 50 and the design objectives given in Section II.D of Appendix I to 10CFR 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, 10CFR Part 50, for gaseous effluents.

This requirement applies to the release of radioactive materials in gaseous effluents from the one reactor unit on the site.

6.3.3 Total Dose

Section 4.1: Total Dose

This requirement is provided to meet the dose limitations of 40CFR Part 190 that have been incorporated into 10CFR Part 20 by 46 FR 18525. The requirement 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 4 reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40CFR 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 40CFR 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 cycles 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 40CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40CFR Part 190 have not already been corrected), in accordance with the provisions of 40CFR Part 190.11 and 10CFR Part 20.2203, is considered to be a timely request and fulfills the requirements of 40CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10CFR Part 20, as addressed in Sections 2.3 and 3.4. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

6.4 Radiological Environmental Monitoring

Section 5.1: Monitoring Program

The radiological environmental monitoring program required by this requirement provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 5.1-3 are considered optimum for routine environmental measurements in industrial laboratories. 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.

Detailed discussion of the LLD, and other detection limits, can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

Section 5.2: Land Use Census

This requirement 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 land use census shall be performed using the best information available (e.g., a door-to-door survey, from aerial surveys, questionnaire, or from consulting with local agricultural authorities). This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR Part 50. Restricting the census to gardens of greater than 50 m^2 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/year) 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/m^2.

Section 5.3.1: Interlaboratory Comparison Program

The requirement for participation in an approved Interlaboratory 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 10CFR Part 50.

7.0 REPORTING REQUIREMENTS

7.1 Annual Radiological Environmental Operating Report

Routine Radiological Environmental Operating Reports covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year pursuant to Technical Specification 5.6.2.

The Annual Radiological Environmental Operating Reports shall include the following information:

1. Summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, with operational controls as appropriate, and with previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment.

2. The results of land use censuses required by Section 5.2.

3. Results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in the Tables and Figures in this manual, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

4. A summary description of the radiological environmental monitoring program.

5. At least two legible maps* covering all sample locations keyed to a table giving distances and directions from the HVAC stack.

*One map shall cover stations near the site boundary and a second map shall include the more distant stations.

6. The results of licensee participation in the Interlaboratory Comparison Program, required by Section 5.3.1.

7. Discussion of all deviations from the sampling schedule of Table 5.1-1.

8. Discussion of all analysis in which the LLD required by Table 5.1-3 was not achievable.

7.2 Radioactive Effluent Release Report

Routine Radioactive Effluent Release Reports covering the operation of the unit during the previous 12 months of operation shall be submitted by May 1 of each year pursuant to Technical Specification 5.6.3.

The Radioactive Effluent Release Report shall include the following information:

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

2. The following information for each class of solid waste (as defined by 10CFR Part 61) shipped offsite during the report period:

   a. Total container volume,

   b. Total curie quantity (specify whether determined by measurement or estimate),

   c. Principal radionuclides (specify whether determined by measurement or estimate),

d. Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms).

3. A list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

4. A listing of new locations for dose calculations and/or environmental monitoring identified by the land use census pursuant to Section 5.2.

5. Changes to the ODCM pursuant to Technical Specification 5.5.1.

6. Major changes to radioactive liquid, gaseous, and solid waste treatment systems*. The discussion of each change shall contain:**

   a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10CFR Part 50.59.

   b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

   c. A detailed description of the equipment, components and processes involved and the interfaces with other plant systems;

   d. An evaluation of the change, which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto;

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*Licensees may choose to submit the information called for in this requirement as part of its annual USAR update.

**Changes described by this requirement shall become effective upon review by the FRG.

e. An evaluation of the change, which shows the expected minimum exposures to a MEMBER OF THE PUBLIC in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid waste, to the actual releases for the period prior to when the changes are to be made;

g. An estimate of the exposure to plant operating personnel as a result of the change; and

h. Documentation of the fact that the change was reviewed and found acceptable by the FRG.

The Radioactive Effluent Release Report shall also include the following information:

1. An annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability.

2. An assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year.

3. An assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY (Figures 2.1-1 and 3.1-1) during the report period.

All assumptions used in making these assessments, i.e., specific activity, exposure time and location, shall be included in these reports. Annual average meteorological conditions or meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents, as determined by sampling frequency and measurements, may be used for determining the gaseous

pathway doses. The assessment of radiation doses shall be performed in accordance with the methodology and parameters in this manual.

4. An assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources, including doses from primary effluent pathways and direct radiation, for the previous calendar year to show conformance with 40CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation.

Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev. 1, October 1977.

8.0 ADJUSTMENT OF THE CPS ODCM METHODOLOGY

Consistent with the NRC Commissioners' opinion on 10CFR50 Appendix I dated April 30, 1975, CPS will use environmental monitoring data to improve dose calculational models and to request CPS ODCM changes on the basis of such operating experience data. Such adjustments are recognized as being especially important for the radioiodine-milk pathway where conservative regulatory guide assumptions have been made. By using environmental monitoring data, uncertainties associated with plume behavior, radioiodine chemical form, deposition and retention of forages, and milk consumption patterns may be circumvented or reduced.

9.0 ATMOSPHERIC TRANSPORT AND DISPERSION MODEL

9.1 Introduction

The atmospheric transport and dispersion model used by Illinois Power Company is a straight-line, sector-averaged Gaussian model designed to estimate average relative concentrations at various receptor points. The model was developed in accordance with routine release analysis procedures specified by Regulatory Guide 1.111 (Revision 1 July 1977), Section C.1.c "Constant Mean Wind Direction Models".

All meteorological and dose calculations prescribed in this manual are based on meteorological data concurrent with the time of release or the annual average values. Near-real time meteorological data processing is prescribed in Section 9.2.

9.2 Concurrent Meteorological Data Processing

Meteorological data is acquired and processed through a model which utilizes bi-level hourly meteorological tower data or single level joint frequency data to perform the required analysis. Three distinct release modes are treated: elevated, ground and mixed. A set of five output arrays are generated for each dose receptor location as follows:

- Relative undecayed, undepleted plume concentration (X/Q)
- Relative decayed and depleted radioiodine and particulate concentration (D2DPXQ)
- Relative decayed noble gas concentration (D1XQ)
- Relative particulate and radioiodine deposition (D/Q)
- Standard deviations of the undecayed, undepleted plume concentrations

Since the Regulatory Guide 1.111 depletion and deposition curves are defined only within the range encompassing 100 to 200,000 meters, analysis results are not considered valid outside this range. The following sections describe the calculations performed by the transport and dispersion model for a one hour time interval.

9.2.1 Determination of Pasquill Stability Class

The Pasquill Stability Class is determined by categorizing the temperature gradient, ΔT, into one of several ranges between -0.900 and 0.900 °C/meter according to the following equation:

$$\Delta T = (T_U - T_L)/(H_U - H_L), \text{ °C/meter} \quad (1)$$

where

T_U = Meteorological (met) tower upper level temperature, °C

T_L = Meteorological tower lower level temperature, °C

H_U = Meteorological tower upper level instrumentation height
= 60 meters

H_L = Meteorological tower level instrumentation height
= 10 meters

ΔT is then classified according to the following scheme:

Pasquill Stability	Defining Condition
A (Extremely Unstable)	$-0.900 < \Delta T \leq -0.019$
B	$-0.019 < \Delta T \leq -0.017$
C	$-0.017 < \Delta T \leq -0.015$
D (Neutral)	$-0.015 < \Delta T \leq -0.005$
E	$-0.005 < \Delta T \leq 0.015$
F	$0.015 < \Delta T \leq 0.040$
G (Extremely Stable)	$0.040 < \Delta T \leq 0.900$
Invalid	$\Delta T \leq -0.900$ or $\Delta T > 0.900$

9.2.2 Calculation of Stack Height Wind Speed

The wind speed at the release point (HVAC Exhaust Stack or Standby Gas Treatment System Exhaust Stack) height, STACWS, is calculated using the expressions:

$$STACWS = WSP_U \ (STACKH/H_U)^P, \text{ meter/sec} \quad (2)$$

$$P = [\log(WSP_L/WSP_U)]/[\log(H_L/H_U)], \text{ dimensionless} \quad (3)$$

where

WSP_U = Upper met tower level wind speed, meter/sec

WSP_L = Lower met tower level wind speed, meter/sec

STACKH = Physical release point stack height

P = Wind power law exponent, dimensionless

All other parameters are as defined for equation (1).

9.2.3 Determination of Release Mode and the Entrainment Coefficient

The mode of release can be elevated, ground or mixed; the latter being a combination of the first two. The mode of release, as well as an entrainment coefficient, TCORR, are determined from the stack height, STACH, building height, BLDGHT, stack exit velocity, EXITV, and wind speed at the stack height, STACWS.

For effluents exhausted from release points that are higher than twice the height of adjacent solid structures,

$$STACKH > 2 \ (BLDGHT), \ TCORR = 0.0 \quad (4)$$

the release is considered completely elevated and the entrainment coefficient is zero. For effluents released from points less than the height of adjacent solid structures, a ground-level release is assumed

$$STACKH < BLDGHT, \ TCORR = 1.0 \quad (5)$$

and the entrainment coefficient is unity. For effluents released from points or vents at the level of, or above, adjacent solid structures, but lower than elevated release points,

$$2(BLDGHT) > STACKH > BLDGHT \quad (6)$$

the release is treated as elevated, ground or mixed according to the following relationships:

ELEVATED: $TCORR = 0.00$ if $EXITV > 5(STACWS)$ (7)

GROUND: $TCORR = 1.0$ if $EXITV < STACWS$ (8)

MIXED: $TCORR = 0.30-0.06(EXITV/STACWS)$ if $5(STACWS) \geq EXITV > 1.5\ (STACWS)$ (9)

$TCORR = 2.58-1.58(EXITV/STACWS)$ if $1.5(STACWS) \geq EXITV \geq (STACWS)$ (10)

In the mixed mode, the release is considered to occur as an elevated release 100 (1-TCORR) percent of the time and as a ground release 100 (TCORR) percent of the time. Each of these cases are then evaluated separately and the concentration X/Q calculated according to the fraction of the time each release occurs.

9.2.4 Calculation of Vertical Standard Deviation

The vertical plume spread (vertical standard deviation), r_z is a function of the distance from the release point to the reception point for a given Pasquill stability class. The numerical value of r_z if obtained by a polynominal fitting equation which simulates Figure 1 of Regulatory Guide 1.111:

$$r_z = 10^{[A + B \log (X) + C (\log(X))^2]}, \text{ meter} \quad (11)$$

where

X = Distance to a specific receptor, kilometer

A,B,C = Empirical factors which vary by stability class, determined by fitting polynominal equations to the Regulatory Guide 1.111 Figure 1 curves, dimensionless

Empirical Factors Used in Equation (11)

Pasquill Class	A	B	C
A	2.79166	2.69043	1.07483
B	2.11394	1.47930	0.40676
C	1.81954	0.88317	-0.06101
D	1.51851	0.74130	-0.08699
E	1.36173	0.68570	-0.11956
F	1.14613	0.66066	-0.12363
G	1.14613	0.66066	-0.12363

Additionally, an optional value called the "mixing height lid" may be specified which limits the value of r_z to be no greater than this value.

9.2.5 Calculation of the Building Wake Correction

For ground-based and mixed-mode releases, an adjustment is made in the calculation of X/Q that takes into consideration initial mixing of the effluent plume within the building wake. This adjustment is an additional factor added in quadrature to the vertical plume spread equation (11):

$$\Sigma_z = [\sigma_z^2 + 0.5\ (BLDGHT)^2/\pi]^{\frac{1}{2}} \qquad (12)$$

with the requirement that Σ^z is restricted to values

$$\Sigma_z \leq (3)^{\frac{1}{2}}\ (\sigma_z).$$

9.2.6 Calculation of Momentum Plume Rise

For elevated or mixed-mode releases only, the amount of plume rise due to the initial vertical momentum of the exhausted effluent, ΔH, is calculated. For Pasquill stability classes A,B,C and D, ΔH is calculated per section 9.2.6.1; for classes E,F and G, section 9.2.6.2 is used.

9.2.6.1 ΔH For Pasquill Class A,B,C and D

ΔH is calculated using both equations (13) and (14) and the minimum value is selected for use. In addition, when the vertical exit velocity, EXITV, is less than 1.5 times the horizontal windspeed, STACWS, a downwash correction is subtracted from equation (13) per equation (15).

$$\Delta H_1 = 1.44(STACD)(EXITV/STACWS)^{2/3} \quad (13)$$

$$(X/STACD)^{1/3} - DOWNWASH, \text{ meter}$$

$$\Delta H_2 = 3.0(STACD)(EXITV/STACWS), \text{ meter} \quad (14)$$

$$DOWNWASH = 3.0(STACD)(1.5 - EXITV/STACWS), \text{ meter} \quad (15)$$

where

STACD = Internal release point stack diameter
= 3.77 meters (HVAC Exhaust Stack)
= 0.44 meters (SGTS Exhaust Stack)

EXITV = Stack exit velocity, meter/second
X = Distance to specified receptor, meter

All other parameters are as defined previously.

9.2.6.2 ΔH For Pasquill Class E, F and G

ΔH is determined by selecting the minimum value calculated by equations (13) and (14) above and equations (16) and (17) below:

$$\Delta H_3 = 4.0[(0.5(EXITV)(STACD))^2/S]^{1/4}, \text{ meter} \quad (16)$$

$$\Delta H_4 = 1.5[(0.5(EXITV)(STACD))^2/STACWS]^{1/3}(S)^{-1/6}, \text{ meter} \quad (17)$$

where

S = Restoring acceleration per unit vertical displacement for adiabatic motion, sec^{-2}
= 8.70E-04 (E stability)
= 1.75E-03 (F stability)
= 2.45E-03 (G stability)

All other parameters are as defined in section 9.2.6.1.

9.2.7 Calculation of the Effective Plume Height

The effective plume height, H, is determined using section 9.2.6 results for the momentum plume rise, ΔH, and the terrain height, TERAIN:

$$H = STACKH + \Delta H - TERAIN, \text{ meter} \quad (18)$$

where

TERAIN = Difference between the plant base height above mean sea level (MSL) and the receptor point height above MSL, meter ≥ 0.0.

9.2.8 Determination of Affected Sectors

The wind direction for the hour determined which sector will be affected. Sectors are 22.5° arcs and are classified according to the following scheme:

Sector Number	Compass Direction	Wind Direction (WD)
1	N	$0.0° \leq WD < 11.25°$ or $348.75° \leq WD \leq 360.00°$
2	NNE	$11.25° \leq WD < 33.75°$
3	NE	$33.75° \leq WD < 56.25°$
4	ENE	$56.25° \leq WD < 78.75°$
5	E	$78.75° \leq WD < 101.25°$
6	ESE	$101.25° \leq WD < 123.75°$
7	SE	$123.75° \leq WD < 146.25°$
8	SSE	$146.25° \leq WD < 168.75°$
9	S	$168.75° \leq WD < 191.25°$
10	SSW	$191.25° \leq WD < 213.75°$
11	SW	$213.75° \leq WD < 236.25°$
12	WSW	$236.25° \leq WD < 258.75°$
13	W	$258.75° \leq WD < 281.25°$
14	WNW	$281.25° \leq WD < 303.75°$
15	NW	$303.75° \leq WD < 326.25°$
16	NNW	$326.25° \leq WD < 348.75°$

For elevated releases, the wind direction at the upper met tower level is used; ground releases follow the direction of the wind at the lower met tower level. For mixed-mode releases, two X/Q calculations are performed: one for each of the two met tower levels. If the wind direction is the same at both levels, the resulting X/Q will be summed into the same sector; otherwise, the X/Q will be summed into the appropriate sectors. During periods of calm wind, the wind speed is set at one-half the anemometer threshold value and assigned the direction of the previous hour.

9.2.9 Calculation of Depletion and Deposition Factors

The depletion, DPF, and deposition, DPSF, factors are calculated using the curves provided by Regulatory Guide 1.111. Actual values are calculated using polynominal equations developed to simulate the Regulatory Guide curves. Both the DPF and DPSF calculations depend on the effective plume height, H, the stability class, S, and the distance, X, to the receptor.

The Regulatory Guide 1.111 curves represent plumes that are 100, 60, 30, and 0 (ground-level) meters above the ground. For plumes between 0 and 15 meters above the ground, the model uses the ground-level release graphs; for those between 15 and 45 meters, it uses the 30 meter curves; between 45 and 80 meters above the ground, it uses the 60 meter curves; and for those greater than 80 meters above the ground, it uses the 100 meter curves. The model assumes that, after full plume rise is achieved, the plume cannot get higher from the ground. The derivation of these curves assumed no change in terrain height with downwind distance. Since topography does change with distance, and likewise the vertical distance between the plume centerline and the ground, it is necessary to read from more than one depletion or deposition curve of Regulatory Guide 1.111 as the plume travels with distance.

9.2.9.1 DPF Calculation

The effective plume height, H is categorized into one of four J-ranges according to the following scheme:

Plume Height (meters)	J Value
$0 \leq H \leq 15$	5
$15 < H \leq 45$	6
$45 < H \leq 80$	7
$H > 80$	8

Similarly, the stability class is categorized into one of three S-ranges as follows:

Stability Class	S. Value
A, B, C	1
D	2
E, F, G	3

The (SJ) product is then calculated and an (A) value determined at the receptor location X according to the following scheme (where no A value is given, DPF=1.0):

S*J Value	X (meters)	A	DPF
5	$X < 100$		1.0
	$X \geq 100$	A = 1	calculated
6	$X < 200$		1.0
	$X \geq 200$	A = 5	calculated
7	$X < 300$		1.0
	$X \geq 300$	A = 17	calculated
8	$X < 600$		1.0
	$X \geq 600$	A = 29	calculated
10	all X		1.0
12	$X < 400$		1.0
	$X \geq 400$	A = 9	calculated
14	$X < 1000$		1.0
	$X \geq 1000$	A = 21	calculated
15	all X		1.0
16	$X < 1700$		1.0
	$X \geq 1700$	A = 33	calculated
18	$X < 6000$		1.0
	$X \geq 6000$	A = 13	calculated
21	$X < 60,000$		1.0
	$X \geq 60,000$	A = 25	calculated
24	all X		1.0

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DPF is calculated using the value for A and equations (19) and (20):

$$DPF = B(A) + B(A + 1)d + B(A + 2)d^2 + B(A + 3)d^3 \quad (19)$$

$$d = \log (X) \quad (20)$$

The corresponding values for the B(A), B(A + 1), B(A + 2) and B(A + 3) terms are as follows:

B(1)	=	.788234	B(19)	=	.426473
B(2)	=	.207198	B(20)	=	-0.0471767
B(3)	=	-.0563034	B(21)	=	.615442
B(4)	=	.0	B(22)	=	.317258
B(5)	=	2.59508	B(23)	=	-.0631839
B(6)	=	-1.43610	B(24)	=	.0
B(7)	=	.433300	B(25)	=	-6.89581
B(8)	=	-.0466221	B(26)	=	3.37961
B(9)	=	1.507264	B(27)	=	-.361582
B(10)	=	-.2745668	B(28)	=	.0
B(11)	=	.0556577	B(29)	=	3.58532
B(12)	=	-.007670194	B(30)	=	-2.21101
B(13)	=	-18.01858857	B(31)	=	.642613
B(14)	=	12.755137	B(32)	=	-.0651465
B(15)	=	-2.7658938	B(33)	=	.234274
B(16)	=	.19103896	B(34)	=	.512656
B(17)	=	2.47756	B(35)	=	-.0857995
B(18)	=	1.36010	B(36)	=	.0

9.2.9.2 DPSF Calculations

Using the same (SJ) and X values determined in section 9.2.9.1, a corresponding C value is defined according to the following scheme (where no C value is given, DPSF = 0):

S*J Value	X (meters)	C	DPSF
5	X < 100		0
	X ≥ 100	C = 1	calculated
6	X < 100		0
	X ≥ 100	C = 8	calculated
7	X < 100		0
	X ≥ 100	C = 29	calculated
8	X < 100		0
	X ≥ 100	C = 50	calculated
10	all X		0
12	X < 100		0
	X ≥ 100	C = 15	calculated
14	X < 120		0
	X ≥ 120	C = 36	calculated
15	all X		0
16	X < 210		0
	X ≥ 210	C = 57	calculated
18	X < 2900		0
	X ≥ 2900	C = 22	calculated

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21	X < 26,000		0
	X ≥ 26,000	C = 43	calculated
24	all X		0

DPSF is calculated using the value for C and equations (20), (21), and (22):

$$DPSF = 10^{Y}/(0.392699X) \quad (21)$$

$$Y = A(C) + A(C+1)d + A(C+2)d^2 + A(C+3)d^3 \quad (22)$$
$$+ A(C+4)d^4 + A)(C+5)d^5 + A(C+6)d^6$$

The corresponding values for the A(C), A(C+1), A(C+2), A(C+3), A(C+4), A(C+5) and A(C+6) terms are as follows:

A(1)	=	-3.17821	A(33)	=	7.552876
A(2)	=	-.153463	A(34)	=	-.82569984
A(3)	=	-.0759066	A(35)	=	.036134823
A(4)	=	0.	A(36)	=	-53.7335
A(5)	=	0.	A(37)	=	45.3671
A(6)	=	0.	A(38)	=	-15.3282
A(7)	=	0.	A(39)	=	2.24735
A(8)	=	-25.7331	A(40)	=	-.122674
A(9)	=	26.2738	A(41)	=	0.
A(10)	=	-11.3014	A(42)	=	0.
A(11)	=	2.04278	A(43)	=	-674.351
A(12)	=	-.134412	A(44)	=	384.531
A(13)	=	0.	A(45)	=	-73.7766
A(14)	=	0.	A(46)	=	4.72041
A(15)	=	-47.5827	A(47)	=	0.
A(16)	=	43.8050	A(48)	=	0.
A(17)	=	-16.0781	A(49)	=	0.
A(18)	=	2.53726	A(50)	=	-55.5622
A(19)	=	-.148044	A(51)	=	53.6534
A(20)	=	0.	A(52)	=	-20.6300
A(21)	=	0.	A(53)	=	3.44177
A(22)	=	-128.5278	A(54)	=	-.212314
A(23)	=	77.28943	A(55)	=	0.
A(24)	=	-15.90284	A(56)	=	0.
A(25)	=	1.071885	A(57)	=	436.987302
A(26)	=	0.	A(58)	=	-755.860224
A(27)	=	0.	A(59)	=	515.64145
A(28)	=	0.	A(60)	=	-181.713295
A(29)	=	41.824767	A(61)	=	35.153579
A(30)	=	-103.969677	A(62)	=	-3.558356
A(31)	=	86.215344	A(63)	=	.14774
A(32)	=	-35.1021096			

9.2.10 Ground Level X/Q, D2DPXQ, D1XQ, D/Q Analysis

9.2.10.1 Undecayed, Undepleted Plume Relative Concentration, X/Q

The atmospheric concentration of effluent at ground level, normalized by the source term Q, is given by the following equation:

$$X/Q = 2.032(TCORR)/WSP_L(X)A_{min}, \text{ sec/m}^3 \quad (23)$$

where

A_{min} = The lesser of the two values obtained by equations (24) and (25), meter

$$A_1 = (\sigma^2_z + \Sigma_z)^{1/2}, \text{ meter} \quad (24)$$

$$A_2 = (3)^{1/2}\sigma_z, \text{ Meter} \quad (25)$$

2.032 = The constant $(2/\pi)^{1/2}$ divided by the width in radians of a 22.5° sector (i.e., $\pi/8$, dimensionless

X = Distance between release point to receptor, meter

9.2.10.2 Decayed, Depleted Radioiodine and Particulate Relative Concentration, D2DPXQ

The decayed, depleted radioiodine concentration, D2DPXQ, is calculated in accordance with the following equation:

$$D2DPXQ = DPF(DC2)X/Q, \text{ sec/m}^3 \quad (26)$$

where

DPF = The depletion factor calculated per section 9.2.9, dimensionless

DC2 = The radioiodine decay factor, dimensionless

= $\exp[-0.693(X)/t_{1/2}(WSP_L)]$

= $\exp[-0.693(X)/(8 \text{ day})(24 \text{ hr/day})(3600 \text{ sec/hr})(WSP_L)]$

$= \exp[-1.00E\text{-}06(X/WSP_L)]$

9.2.10.3 Decayed Noble Gas Plume Relative Concentration, D1XQ

The decayed noble gas plume relative concentration, D1XQ, is calculated in accordance with the following equation:

$$D1XQ = DC1\ (X/Q),\ sec/m^3 \qquad (27)$$

where

DC1 = The noble gas decay factor, dimensionless

$= \exp[-0.693(X)/t_{½}(WSP_L)]$

$= \exp[-0.693(X)/(2.26\ day)(24\ hr/day)(3600\ sec/hr)(WSP_L)]$

$= \exp[-3.55E\text{-}06\ (X/WSP_L)]$

9.2.10.4 Radioiodine and Particulate Relative Deposition, D/Q

The relative deposition for radioiodines and particulates, D/Q is calculated in accordance with the following equation:

$$D/Q = [DPSF(DC2)(TCORR)]/[(2\pi/16)X],\ m^{-2} \qquad (28)$$

where

DPSF = The deposition factor calculated per section 9.2.9, m^{-1}

9.2.11 Elevated X/Q, D2DPXQ, D1XQ, D/Q Analysis

9.2.11.1 Undecayed, Undepleted Plume Relative Concentration, X/Q

Rev. 15

The atmospheric concentration of effluent at elevated level, normalized by the source term Q, is given by the following equation:

$$X/Q = [2.032(1-TCORR)\exp[-0.5(H/\sigma_z)^2]]/[STACWS(X)\ \sigma_z],\ sec/m^3 \qquad (29)$$

where all parameters are as previously defined.

9.2.11.2 Decayed, Depleted Radioiodine and Particulate Relative Concentration, D2DPXQ

The calculation of D2DPXQ for elevated releases follows section 9.2.10.2 methodology with the exception that the WSP_L value used in the calculation of DC2 in equation (26) is replaced by the STACWS value and the equation (29) X/Q is used.

9.2.11.3 Decayed Noble Gas Plume Relative Concentration, D1XQ

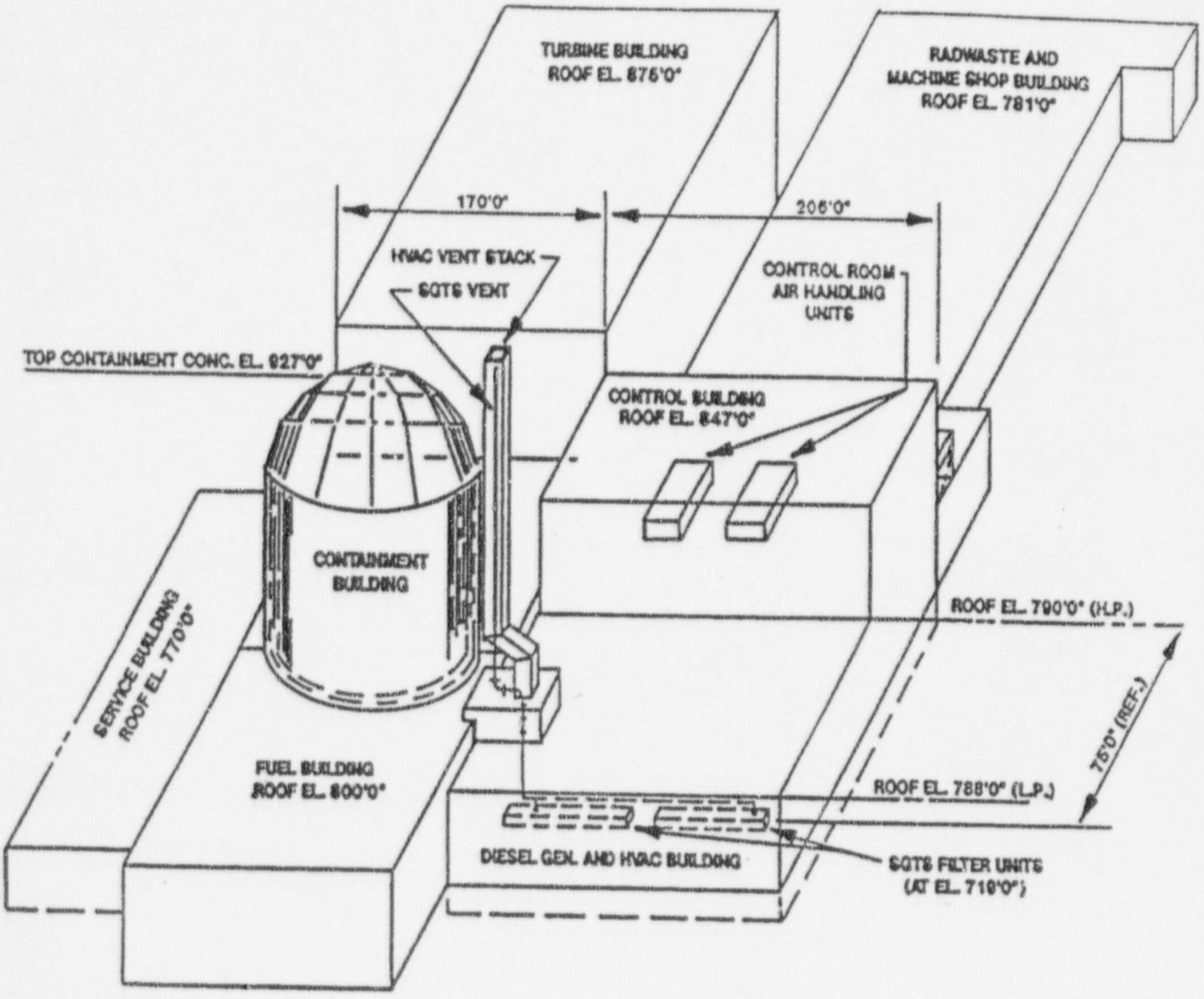
The calculation of D1XQ for elevated releases follows section 9.2.10.3 methodology by substituting the equation (29) X/Q value into equation (27) and STACWS for WSP_L in the calculation of DC1.

9.2.11.4 Radioiodine and Particulate Relative Deposition, D/Q

The calculation of D/Q for elevated releases follows section 9.2.10.4 methodology by substituting (1-TCORR) for the TCORR term in equation (28) and STACWS for WSP_L in the calculation of DC2.

Table 9.2-1

GASEOUS EFFLUENT RELEASE POINT CHARACTERISTICS



	HVAC Exhaust Stack	SGTS Exhaust Stack
Release Point Height (m)	61	61
Building Height (m)	58	58
Release Point Geometry	Duct	Pipe
Release Point Area (m^2)	11.15	0.15
Release Point Diameter (m)	3.77*	0.44
Annual Average Flow Rate (m^3/sec)	111.71	1.89
Vertical Exit Velocity (m/sec)	10.02	12.49

*Effective $2(A/\pi)^{1/2}$ diameter

CLINTON POWER STATION

OFFSITE DOSE CALCULATION MANUAL

REVISION 16

Issued: DECEMBER 13, 1997

26.290

CPS No. 1005.06F001

SAFETY EVALUATION SCREENING FORM

(7)

(8.2.2.a) DOCUMENT EVALUATED: Offsite Dose Calculation Manual, Revision ~~15~~ 16

(8.2.2.b) DESCRIPTION OF CHANGE:

JMW 4-17-98

Revised Table 3.9.2-2. Added Item 3 for Inservice Calibrations on Station HVAC Exhaust and Standby Gas Treatment System Exhaust PRMs. Added annual channel calibration requirement and new applicability Table Notations "c" and "d".

Added new Table Notations explanations "c" and "d" for Table 3.9.2-2.

(8.2.2.c) AFFECTED SYSTEM(S)/COMPONENT(S)/FUNCTIONS; None

10CRF50.59 APPLICABILITY DETERMINATION (8.2.2.1)

(Refer to Appendix A for guidance for the following questions)

Yes ___ No ✓ Is this a change to the facility as described in the SAR? *[That is, is the design, function, or method of performing the function of a structure, system or component described by text or drawing in the SAR being changed?]*

Yes ✓ No ___ Is this a change to a procedure as described in the SAR? *[That is, is a procedure that is outlined, summarized or that is completely described in the SAR being changed?)*

Yes ___ No ✓ Is this a test or experiment not described in the SAR? *[That is, is a test or experiment being conducted which might affect safe operation of the plant which was not anticipated in the SAR?]*

Yes ___ No ✓ Does this change require a change to the CPS Tech Specs? *If yes, process the change in accordance with CPS No. 1038.01.*

ORM Impact (8.2.2.2)

(Refer to Appendix B for guidance for the following question)

Yes ___ No ✓ Is this a change (other than an editorial change) to the Operational Requirements Manual? *If yes, complete a safety evaluation and process the change in accordance with CPS No. 1038.03.*

IMPACT ON OTHER LICENSING BASIS DOCUMENTS (8.2.2.3)

(Refer to Appendix B for guidance for the following question)

Yes ✓ No ___ Does this change directly affect any of the following programs:

Technical Specification Bases
Physical Security Plan
Emergency Plan
QA Program Description
Licensed Operator Requalification Program
Offsite Dose Calculation Manual
Process Control Program
Fire Protection Plan
Enviromental Protection Plan

155-98-014

DOCUMENT EVALUATED: Offsite Dose Calculation Manual, Revision ~~15~~ 16 JMW 4-17-98

JUSTIFICATION FOR "YES/NO" ANSWERS:
(8.2.2.1.2, 8.2.2.3)

Justification:

This change implements Regulatory Guide 1.21, Section C.5 requirements for calibrating continuous monitors using comparisons against analysis of specific radionuclides. Analytical measurements are made to quantify specific radionuclides in continuous releases by analysis of grab samples at scheduled frequencies. The comparison is the basis for calibrating continuous monitors to establish relationships between monitor readings and concentrations of release rates of radionuclides in continuous effluent releases. An annual inservice calibration is specified in the revision. Table Notation "c" and "d" add the applicable conditions for the comparison.

The purpose of the Offsite Dose Calculation Manual (ODCM) is to provide the methodologies and parameters used for assuring compliance with the radiological effluent dose limitations provided by 10CFR20, 10CFR50 Appendix A, 10CFR50 Appendix I, and 40CFR190. The ODCM contains information necessary to calculate offsite doses resulting from radioactive liquid and gaseous effluents, calculations for gaseous and liquid effluent monitoring alarm and trip setpoints, and the elements needed to conduct the radiological environmental monitoring program. The radioactive effluent controls program and the radiological environmental monitoring program are described.

REFERENCES:
(8.2.2.1.2)

Offsite Dose Calculation Manual (ODCM): Table 3.9.2-2, Table 3.9.2-2 Table Notations
USAR Section: 1.8, Table 11.5-1, Table 15.2.4-3a
Technical Specifications: 5.5.1, 5.5.4
Operation Requirements Manual (ORM): 6.8.1
Regulatory Guides: 1.21
Code of Federal Regulations (CFR): 10CFR20.1302, 10 CFR 20, Appendix B, Table 2, Column 2, 10CFR50.36a, 10CFR50, Appendix I, 40 CFR190,

Prepared by: (8.2.3)	Tony Jones Printed Name	W Jones WJL Signature	Date: 11/24/97 12/12
Reviewed by: (8.2.4)	W. Scott Klein Printed Name	W Scott Klein WSK Signature	Date: 12-1-97 12-12-

CLASS CODE: SNNN1
CPS No. 1005.06F003
(Rev. 0)

LOG ___ - ___ REV. ___
Page 1 of 1

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual, Revision ~~15~~ 16 JMW 4-17-98

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

The changes incorporated by this revision to the ODCM do not modify calculations for dose or alarm setpoints. The changes incorporated by this revision align the ODCM with Regulatory Guide 1.21 requirements. These changes are consistent with the requirements of 10CFR20, 10CFR50 Appendix A, 10CFR50 Appendix I, and 40CFR190. Calculations for dose and alarm setpoints are not modified by these changes.

This revision to the ODCM does not affect structures, systems or components. The changes being incorporated by this revision are administrative in nature. These changes will ensure that dose from radioactive effluents is monitored and reported in accordance with the requirements of Technical Specifications, 10CFR20, 10CFR50, and 40CFR190. Since the design, function, or method of performing the function of SSC is not changed by this revision, this is not a change to the facility as described in the SAR.

The ODCM implements the requirements of Technical Specifications, 10CFR20, 10CFR50, and 40CFR190. ~~Since~~ ODCM activities are included by reference and description in the Technical Specifications. This revision is considered a change to procedures as described in the SAR, because the ODCM is referenced in the SAR.

Performing radioactive effluent surveillances and dose calculations are routine parts of the overall effluent monitoring program. The ODCM incorporates the programs and procedures necessary to ensure that surveillances are performed when required and that their completion is adequately documented. This change does not affect the operation of plant equipment or the ability to monitor radioactive effluents and their associated dose, therefore this revision does not constitute a test or experiment not described in the SAR.

Because these changes affect only monitoring and surveillance activities associated with the ODCM, there are no changes needed to Technical Specifications, Tech Spec Bases, or the ORM.

The ODCM changes are not contrary to Technical Specifications, Tech Spec Bases, ORM, Environmental Plan, Security Plan, Emergency Plan, QA Program Description, Seismic Qualification, Licensed Operator Requalification Program, Radiological Controls, Process Control Program, Accident Analysis, or Fire Protection Program. No changes are required to these programs as a result of the ODCM program revision.

CPS NO. 1005.06F002

SAFETY EVALUATION FORM

(8.3.1.1.a) LOG 97 - 226 REV. 0

(8.3.1.1.b) DOCUMENT EVALUATED: Offsite Dose Calculation Manual (ODCM) REVISION: ~~15~~ 16

(8.3.1.1.c) TITLE: Offsite Dose Calculation Manual (ODCM) Change JMW 4-17-98

(8.3.1.1.d) DESCRIPTION AND IMPACT OF CHANGE ON LICENSING DOCUMENTS:

This revision to the ODCM revised Table 3.9.2-2 and Table 3.9.2-2 Table Notations. Item 3 was added to the table for Inservice Calibrations on Station HVAC Exhaust and Standby Gas Treatment System Exhaust PRMs. An annual channel calibration requirement and new applicability Table Notations "c" and "d" were added.

The changes implement Regulatory Guide 1.21, Section C.5 requirements for calibrating continuous monitors using comparisons against analysis of specific radionuclides. The changes do not change the intent of the ODCM and are consistent with the regulatory requirements of 10CFR20.1302, 10CFR50.36a, 10CFR50 Appendix I, 40CFR190, and Technical Specifications. These changes maintain the levels of radioactive effluent control required by these regulations and do not adversely impact the reliability of effluent, dose, or setpoint calculations.

(8.3.1.1.d) REFERENCES:

Offsite Dose Calculation Manual (ODCM): Table 3.9.2-2, Table 3.9.2-2 Table Notations
USAR Sections: 1.8, Table 11.5-1, Table 15.2.4-3a
Technical Specifications: 5.5.1, 5.5.4
Operation Requirements Manual (ORM): 6.8.1
Regulatory Guide: 1.21
Code of Federal Regulations (CFR): 10CFR20.1302, 10 CFR20, Appendix B, Table 2, Column 2, 10CFR50.36a, 10CFR50 Appendix I, 40CFR190

(8.3.1.1.h) Prepared by: W. Lowes (Name) W Lowes (Signature) Date: 11/25/97

(8.3.2.2) Reviewed by: W. Scott Klein (Name) W. Scott Klein (Signature) Date: 12-1-97

Jeffrey J. Place (Name) Jeffrey J. Place (Signature) 12/3/97

(8.3.3) Approved by: Jeffrey J. Place (Name) Jeffrey J. Place (Signature) Date: 12/3/97

(8.3.4) FRG: J R Langley (Name) J R Langley (Signature) Date: 12/12/97

(8.3.1.1.a) LOG 97 - 226 REV. 0

DOCUMENT EVALUATED: Offsite Dose Calculation Manual (ODCM) REVISION: 16,15

TITLE: Offsite Dose Calculation Manual (ODCM) Change JAW 4-17-98

UNREVIEWED SAFETY QUESTION DETERMINATION
(8.3.1.1.e)
(Attach justification for following questions on CPS No. 1005.06F003)

Part I -- Impact on equipment malfunctions evaluated as the design bases

Yes ___ No ✓ 1. Will change increase the probability of a malfunction of equipment important to safety evaluated previously in the SAR?

Yes ___ No ✓ 2. Will change increase the consequences of a malfunction of equipment important to safety evaluated previously in the SAR?

Part II -- Impact on accidents evaluated as the design bases

Yes ___ No ✓ 3. Will change increase the probability of an accident previously evaluated in the SAR?

Yes ___ No ✓ 4. Will change increase the consequences of an accident previously evaluated in the SAR?

Part III -- Potential for creating a new type of accident or equipment malfunction

Yes ___ No ✓ 5. Will change create the possibility of an accident of a different type than any evaluated previously in the SAR?

Yes ___ No ✓ 6. Will change create the possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the SAR?

Part IV -- Impact on the Margin of Safety

Yes ___ No ✓ 7. Will change reduce the Margin of Safety as defined in the basis for any technical specification?

SUMMARY
(8.3.1.1.f, 8.3.1.1.g)

✓ Change is safe, no USQ exists, and requires no change to technical specifications. The change may be implemented upon FRG review.

___ Change is safe, however there is an USQ, or requires a change to technical specifications. The change requires NRC approval prior to implementation.

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual (ODCM)

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification:

Part I:

The changes incorporated by this revision to the ODCM are not pertinent to malfunctions of equipment important to safety which were evaluated as the design basis. The changes incorporated by this revision do not relate to operation of plant equipment, only to surveillance and monitoring of radioactive effluents and calculations of dose to the public.

No safety-related or special scope equipment are affected by these changes. The probability of a malfunction of equipment important to safety and an increase in the consequences of a malfunction (specifically dose to unrestricted areas) are not applicable to these ODCM changes.

Part II:

The Clinton Power Station OFFSITE DOSE CALCULATION MANUAL (CPS-ODCM) provides the methodologies and parameters used by Illinois Power Company (IP) to assure compliance with the radioactive effluent dose limitations stated in 10CFR20, 10CFR50 Appendix A (General Design Criteria 60 and 64), 10CFR50 Appendix I, 40CFR190.

The CPS-ODCM was prepared based on guidance provided in NUREG-0133, PREPARATION OF RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS FOR NUCLEAR POWER PLANTS (October 1978), and NUREG-0473, RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS FOR BOILING WATER REACTORS (Draft 7, to Revision 3). This manual along with station procedures are used by CPS personnel to demonstrate compliance with the above referenced Federal Regulations.

Based on a review of the SAR, there are no evaluated accidents associated with radioactive effluent monitor comparisons. The ODCM is not used to operate equipment necessary to mitigate accidents. The ODCM provides calculations and methodologies to determine the extent of dose to unrestricted areas as a result of plant operations. Since the ODCM does not affect accidents previously evaluated in the SAR, these changes will not increase the probability of these evaluated accidents.

The consequences of accidents evaluated in the SAR are associated with dose to unrestricted areas as a result of radioactive effluents. This revision will improve dose determinations from radioactive gaseous effluents by ensuring the PRMs are calibrated with grab samples. The ODCM provides the monitoring and calculations requirements to assess and report dose to unrestricted areas and the general public. Since the ODCM is used to determine the dose related to radioactive effluents from both normal plant operation and during accident postulated accidents, the ODCM in itself is not capable of increasing accident consequences.

SAFETY EVALUATION CONTINUATION SHEET

Document Evaluated: Offsite Dose Calculation Manual (ODCM)

Provide the justification/references/explanation for all answers on cover sheet as follows (attach additional sheets, as necessary):

Justification (continued):

Part III:

There are no credible accidents or equipment important to safety failure modes associated with these changes to the ODCM. The changes incorporated by this revision are being made to ensure that inservice calibrations on Station HVAC and Standby Gas Treatment System exhaust PRMs are performed annually to comply with Regulatory Guide 1.21 requirements. Equipment operation is not affected by the ODCM, therefore malfunctions of equipment important to safety of a different type than previously evaluated in the SAR is not possible.

Part IV:

These changes incorporated by this revision to the ODCM bring the ODCM in compliance with Regulatory Guide 1.21 requirements and Technical Specifications. These changes will not reduce the margin of safety defined in the basis for any Technical Specification.

Gaseous effluents from CPS are released on both a batch and continuous basis. Gaseous effluents are normally discharged on a long term basis. The changes implement Regulatory Guide 1.21, Section C.5 requirements for calibrating continuous monitors using comparisons against analysis of specific radionuclides.

There are two gaseous effluent release points to the environment: the Common Stack HVAC Stack and the Standby Gas Treatment System (SGTS) Stack. The SGTS is an Engineered Safety Feature filter system utilized following an accident to reduce iodine and particulate activity in gases leaking from the primary containment and which are potentially present in the secondary containment. The Common Station HVAC Stack ("HVAC Stack") receives process and ventilation exhaust inputs.

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UNIT 1

OFFSITE DOSE CALCULATION MANUAL

Docket No. 50-461

JR Langley, JP Stanley 12/12/97
FRG Date

WD Roby 12-13-97
Manager-Clinton Power Station Date

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1.0 GENERAL INFORMATION

PREFACE

The Clinton Power Station OFFSITE DOSE CALCULATION MANUAL (CPS-ODCM) provides the methodologies and parameters to be used by Illinois Power Company (IPC) to assure compliance with the radioactive effluent dose limitations stated in 10CFR20, 10CFR50 Appendix A (General Design Criteria 60 and 64), 10CFR50 Appendix I, and 40CFR190.

The CPS-ODCM was prepared based on guidance provided in NUREG-0133, PREPARATION OF RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS FOR NUCLEAR POWER PLANTS (October 1978), and NUREG-0473, RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS FOR BOILING WATER REACTORS (Draft 7, to Revision 3). This manual along with station procedures will be used by CPS personnel to demonstrate compliance with the above referenced Federal Regulations.

Changes to the CPS-ODCM shall be provided in the RADIOACTIVE EFFLUENT RELEASE REPORT.

1.1 Definitions

The following terms are defined so that uniform interpretation of requirements of this manual may be achieved. The defined terms appear in capitalized type and shall be applicable throughout this manual.

CHANNEL CALIBRATION

1.1.1 A 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 that the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including the required sensor, alarm, display, and trip functions, and shall include the CHANNEL FUNCTIONAL TEST. Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an in place qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping or total channel steps so that the entire channel is calibrated.

CHANNEL CHECK

1.1.2 A CHANNEL CHECK shall be the qualitative assessment of channel behavior during operating 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.

CHANNEL FUNCTIONAL TEST

1.1.3 A CHANNEL FUNCTIONAL TEST shall be the injection of a simulated, or actual, signal into the channel as close to the sensor as practicable to verify OPERABILITY, including required alarm, interlock, display, and trip functions, and channel failure trips. The CHANNEL FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping or total channel steps so that the entire channel is tested.

FREQUENCY NOTATION

1.1.4 The FREQUENCY NOTATION specified for the performance of surveillance requirements shall correspond to the intervals defined in Table 1.1-1.

GASEOUS RADWASTE TREATMENT SYSTEM

1.1.5 A GASEOUS RADWASTE TREATMENT SYSTEM is any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the main condenser evacuation system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

MEMBER(S) OF THE PUBLIC

1.1.6 An individual in a controlled or unrestricted area. However, an individual is not a member of the public during any period in which the individual receives an occupational dose.

1.1.6a MODE

A MODE shall correspond to any one inclusive combination of mode switch position, average reactor coolant temperature, and reactor vessel head bolt tensioning specified in Technical Specification Table 1.1-1 with fuel in the reactor vessel.

OPERABLE - OPERABILITY

1.1.7 A system, subsystem, division, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, division, component or device to perform its specified safety function(s) are also capable of performing their related support function(s).

REMEDIAL REQUIREMENT

1.1.8 REMEDIAL REQUIREMENT shall be that part of a requirement which prescribes remedial measures required under designated conditions.

SITE BOUNDARY

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

SOURCE CHECK

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

UNRESTRICTED AREA

1.1.11 An UNRESTRICTED AREA means an area, access to which is neither limited nor controlled by the licensee.

VENTILATION EXHAUST TREATMENT SYSTEM

1.1.12 A VENTILATION EXHAUST TREATMENT SYSTEM is 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.

The following systems are designated VENTILATION EXHAUST TREATMENT SYSTEMS:

1) Machine Shop HVAC (VJ)

2) Laboratory HVAC (VL)

3) Drywell Purge (VQ)

4) Radwaste Bldg HVAC (VW)

1.2 General Operation Requirements

1.2.1 Operation Requirements shall be met during the conditions specified therein; except as provided in Operation Requirement 1.2.2.

1.2.2 Upon discovery of a failure to meet an Operation Requirement, the REMEDIAL REQUIREMENT(s) shall be met, except as provided in 1.2.3.

If the Operation Requirement is met or is no longer applicable prior to expiration of the REMEDIAL REQUIREMENT(s), completion of the REMEDIAL REQUIREMENT(s) is not required, unless otherwise stated.

1.2.3 Equipment removed from service or declared inoperable to comply with REMEDIAL REQUIREMENT(s) may be returned to service under administrative control solely to perform testing required to demonstrate OPERABILITY or the OPERABILITY of other equipment. This is an exception to OPERATION REQUIREMENT 1.2.2 for the system returned to service under administrative control to perform the testing required to demonstrate OPERABILITY.

1.3 General Surveillance Requirements

1.3.1 Surveillance Requirements shall be met during the applicable conditions specified in and for the associated Operation Requirement, unless otherwise stated in the Surveillance Requirement. Failure to meet a Surveillance, whether such failure is experienced during the performance of the surveillance, or between performances of the Surveillance, shall be failure to meet the Operation Requirement.

1.3.2 The specified surveillance interval for each Surveillance Requirement is met if the Surveillance is performed within 1.25 times the specified surveillance interval, as measured from the previous performance or as measured from the time a specified condition of the Surveillance Requirement is met.

For surveillance intervals specified as "once", the above interval extension does not apply.

If a REMEDIAL REQUIREMENT requires periodic performance on a "once per ..." basis, the above surveillance interval extension applies to each performance after the initial performance.

Exceptions to this Surveillance Requirement are stated in the individual Surveillance Requirements.

Failure to perform a surveillance within the specified time interval shall be a failure to meet the Operation Requirement except as provided in Surveillance Requirement 1.3.3. Surveillances do not have to be performed on inoperable equipment or variables outside specified limits.

1.3.3 If it is discovered that a surveillance was not performed within its specified surveillance interval, then compliance with the requirement to declare the Operational Requirement not met may be delayed, from the time of discovery, up to 24 hours or up to the limit of the specified interval, which ever is less. This delay period is to allow performance of the surveillance.

If the surveillance is not performed within the delay period, the Operational Requirement must immediately be declared not met, and the applicable REMEDIAL REQUIREMENTS must be met.

1.3.4 Entry into a condition specified in and for an Operation Requirement shall not be made unless the Surveillance Requirement(s) associated with the Operation Requirement have been performed within the applicable surveillance interval or as otherwise specified.

This provision shall not prevent entry into conditions specified for an Operation Requirement that is required to comply with REMEDIAL REQUIREMENT(s) or that are part of a shutdown of the unit.

Surveillance Requirement 1.3.4 is only applicable for entry into a condition specified for an Operation Requirement in MODES 1, 2, and 3.

1.4 Effluent Concentration Limit (lim) Calculation Requirements

1.4.1 The values found in 10CFR20 Appendix B, Table 2, Column 2 shall be used for all lim calculations in the ODCM.

TABLE 1.1-1

SURVEILLANCE FREQUENCY NOTATION

NOTATION	FREQUENCY
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.
Q	At least once per 92 days.
SA	At least once per 184 days.
A	At least once per 366 days.
R	At least once per 18 months (550 days)
P	Prior to each release.
S/U	Prior to each reactor startup.
NA	Not applicable.

Note: A frequency notation for a composite sample describes the time period over which the sample is to be composited.

2.0 LIQUID EFFLUENTS

2.1 Introduction

Liquid radwaste effluent released from CPS will meet 10CFR20 concentration limits at the point of discharge to the unrestricted area shown in Figure 2.1-1. This design and operation objective will be achieved at all times. Actual discharges of liquid radwaste effluent will normally occur on a batch basis and the average concentration at the point of discharge will be only a small percentage of the allowed limits. Refer to Clinton USAR Section 11.5 for a description of radiation monitoring, sampling and effluent control systems.

Cumulative quarterly dose contributions due to radioactive effluents released to the unrestricted area will be determined once every 31 days using NUREG-0133 and Regulatory Guide 1.109 methodology and parameters.

2.2 Liquid Radwaste Discharge Process Radiation Monitoring (PRM) System

This monitoring subsystem measures liquid radwaste effluent radioactivity prior to the effluent joining plant service water and circulating water dilution streams. A high radioactivity signal from this gamma scintillation detector automatically terminates the liquid radwaste effluent release. The liquid radwaste effluent flow, variable from 10-60 GPM or 50-300 GPM, combines with Plant Service Water flow (minimum flow approximately 2000 GPM during plant shutdown periods depending on system loads) and Plant Circulating Water flow (0-567,000 GPM) in the Seal Well prior to entering the 3.4-mile discharge flume to Lake Clinton (see Figure 2.5-1).

2.3 10CFR20 Release Rate Limits

The Operation and Surveillance Requirements pertaining to discharge of liquid radwaste effluent to the unrestricted area are specified in Section 2.3.1 as follows.

2.3.1 Liquid Effluent Concentration - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The concentration of radioactive material released in liquid effluent to UNRESTRICTED AREAS (see Figure 2.1-1) shall be limited to ten times the concentrations specified in 10CFR Part 20, Appendix B, Table 2, 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} microcuries/ml total activity. This requirement applies during all releases via this pathway.

REMEDIAL REQUIREMENT:

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.

SURVEILLANCE REQUIREMENTS

2.3.1.1 Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 2.3-1.

2.3.1.2 The results of the radioactivity analyses shall be used in accordance with the methodology and parameters of Section 2.3.2 to assure that the concentrations at the point of release are maintained within the limits of the above Operation Requirement.

To comply with the above requirements, setpoints will be calculated to assure that Seal Well concentrations do not exceed 10CFR20, Appendix B, Table 2, Column 2 values at any time.

TABLE 2.3-1

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)
Batch Waste Release Tanks[b]	P Each Batch	P Each Batch	Principal Gamma Emitters[c]	5x10-7
			I-131	1x10-6
	P One Batch/M	M	Dissolved and Entrained Gases[e] (Gamma Emitters)	1x10-5
	P Each Batch	Q Composite[d]	H-3	1x10-5
			Gross Alpha	1x10-7
	P Each Batch	Q Composite[d]	Sr-89, Sr-90	5x10-8
			Fe-55	1x10-6

TABLE 2.3-1 (Continued)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATIONS

[a]The LLD is defined, for purposes of these requirements, 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 measurements system, which may include radiochemical separation:

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

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 (sec^{-1}) and

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

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

TABLE 2.3-1 (Continued)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATIONS (Continued)

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.

[b] A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, the tank is isolated from all inputs and recirculated a minimum of two tank volumes at which time a sample is obtained for isotopic analysis.

[c] The principal gamma emitters are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with an LLD of 5 x 10-6 µCi/ml. All identified radionuclides shall be reported in the Radioactive Effluent Release Report pursuant to Technical Specification 5.6.3 in a format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

[d] A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen that is representative of the liquids released.

[e] Dissolved and Entrained gases are: Xe-133, Xe-135, Xe-138, Kr-85m, Kr-87, and Kr-88.

2.3.2 Liquid Radwaste Discharge PRM Setpoints

To comply with the Operation Requirements of Section 2.3.1 and Section 2.7.1, the alarm/trip setpoints for liquid effluent monitors and flow measurement devices are set to assure that the following equation is satisfied:

$$cf/(F + f) \leq C_{lim} \quad (1)$$

C_{lim} = the effluent concentration limit (Section 2.3.1) implementing 10CFR20 for the site, corresponding to the specific mix of radionuclides in the effluent stream being considered, in µCi/ml

c = the setpoint, in µCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint is inversely proportional to the volumetric flow of the effluent line and proportional to the volumetric flow of the dilution stream(s) plus the effluent stream.

F = the dilution water flow setpoints as determined at the Seal Well, in volume per unit time

f = the liquid radwaste discharge flow setpoint as determined at the liquid radwaste discharge PRM location, in volume per unit time (same units as F)

The available dilution water flow (F) should be constant for a given release, and the liquid radwaste tank discharge flow (f) and monitor setpoint (c) are set to meet the condition of equation (1) for a given effluent concentration (C_{lim}). The method by which this is accomplished is illustrated in sections 2.3.2.1 through 2.3.2.5.

2.3.2.1 The isotopic concentration for a liquid radwaste tank to be discharged is obtained from the sum of the measured concentrations as determined by the analyses required in Table 2.3-1:

$$\Sigma_i C_i = \Sigma_g C_g + \Sigma_a C_a + \Sigma_s C_s + C_T + C_{Fe}, \ \mu Ci/ml \qquad (2)$$

where

$\Sigma_g C_g$ = The sum of concentrations C_g of each measured gamma emitter g (including I-131) observed by gamma spectroscopy of the waste sample, µCi/ml.

$\Sigma_a C_a$ = The sum of concentrations C_a of alpha emitters (a) in liquid radwaste as measured in the most current QUARTERLY composite discharge tank sample, µCi/ml.

$\Sigma_s C_s$ = The sum of concentrations C_s of Sr-89/Sr-90 in liquid radwaste as observed in the most current QUARTERLY composite discharge tank sample, µCi/ml.

C_T = The measured concentration of H-3 in liquid radwaste as determined from analysis of the most current QUARTERLY composite discharge tank sample, µCi/ml.

C_{Fe} = The measured concentration of Fe-55 in liquid radwaste as observed in the most current QUARTERLY composite discharge tank sample, µCi/ml.

2.3.2.2 The measured radionuclide concentrations are used to calculate a DILUTION FACTOR (DF) which is equivalent to the ratio of total dilution flow rate to liquid radwaste tank effluent flow rate required to assure that the limiting concentrations of 10CFR20, Appendix B, Table 2, Column 2 are met at the point of discharge to the unrestricted area.

$$DF = SF[\Sigma_i \ (C_i/lim_i)], \text{ dimensionless} \qquad (3)$$

$$= SF\{\Sigma_g (C_g/lim_g) + \Sigma_a (C_a/lim_a) + \Sigma_s (C_s/lim_s) + (C_T/lim_T) + C_{Fe}/lim_{Fe})\}$$

where

$\Sigma_i C_i$ = The measured concentrations C_g, C_a, C_s, C_T, C_{Fe} as defined in equation (2), µCi/ml.

lim_i = The limiting concentration of the corresponding radionuclide from 10CFR20, Appendix B, Table 2, Column 2, µCi/ml. For dissolved or entrained noble gases, the concentration shall be limited to 2E-04 µCi/ml total activity.

SF = The conservative SAFETY FACTOR normally applied to compensate for statistical fluctuations and measurement errors, dimensionless.

2.3.2.3 The maximum permissible liquid radwaste tank effluent flow rate, F_{tank}, is calculated by the following equation:

$$F_{tank} = 0.9(F_{dil}+f_{tank})/DF, \text{ volume/time} \quad (4)$$

where

F_{dil} = Minimum expected dilution water flow rate (Circulating and/or Service Water systems), volume/time

f_{tank} = Maximum expected liquid radwaste tank effluent flow rate, volume/time

0.9 = Flow rate correction factor to provide a 10% margin for variations in flow rates, dimensionless

DF = The DILUTION FACTOR calculated by equation (3), dimensionless

Equation (4) is valid only for $DF \geq 1$; for $DF < 1$, the liquid radwaste tank effluent concentration meets the limits of 10CFR20 <u>without dilution</u> and therefore F_{tank} may assume any value not to exceed discharge pump capacity.

2.3.2.4 The liquid radwaste discharge PRM setpoint may now be specified based on the values of $\Sigma_i C_i$ (Eq.2) and F_{tank} (Eq.4) which were determined to provide compliance with the concentration limits of 10CFR20, Appendix B, Table 2, Column 2. The monitor response is primarily a gamma response and the actual setpoint is therefore based on $\Sigma_g C_g$ (Eq.2). The monitor setpoint, in counts per minute (cpm), which corresponds to the particular setpoint concentration, C_M, is determined based on monitor calibration data or operational data which correlates monitor response to sample analyses associated with the actual liquid radwaste discharged. The second method is considered valid only if the integrity of laboratory methods of determination are proven more accurate than the monitor data.

The set point concentration, C_M, is obtained by the following equation:

$$C_M = [F_{tank}/f_{act}]\Sigma_g C_g, \ \mu Ci/ml \qquad (5)$$

where

f_{act} = The actual liquid radwaste effluent flow rate, volume/time

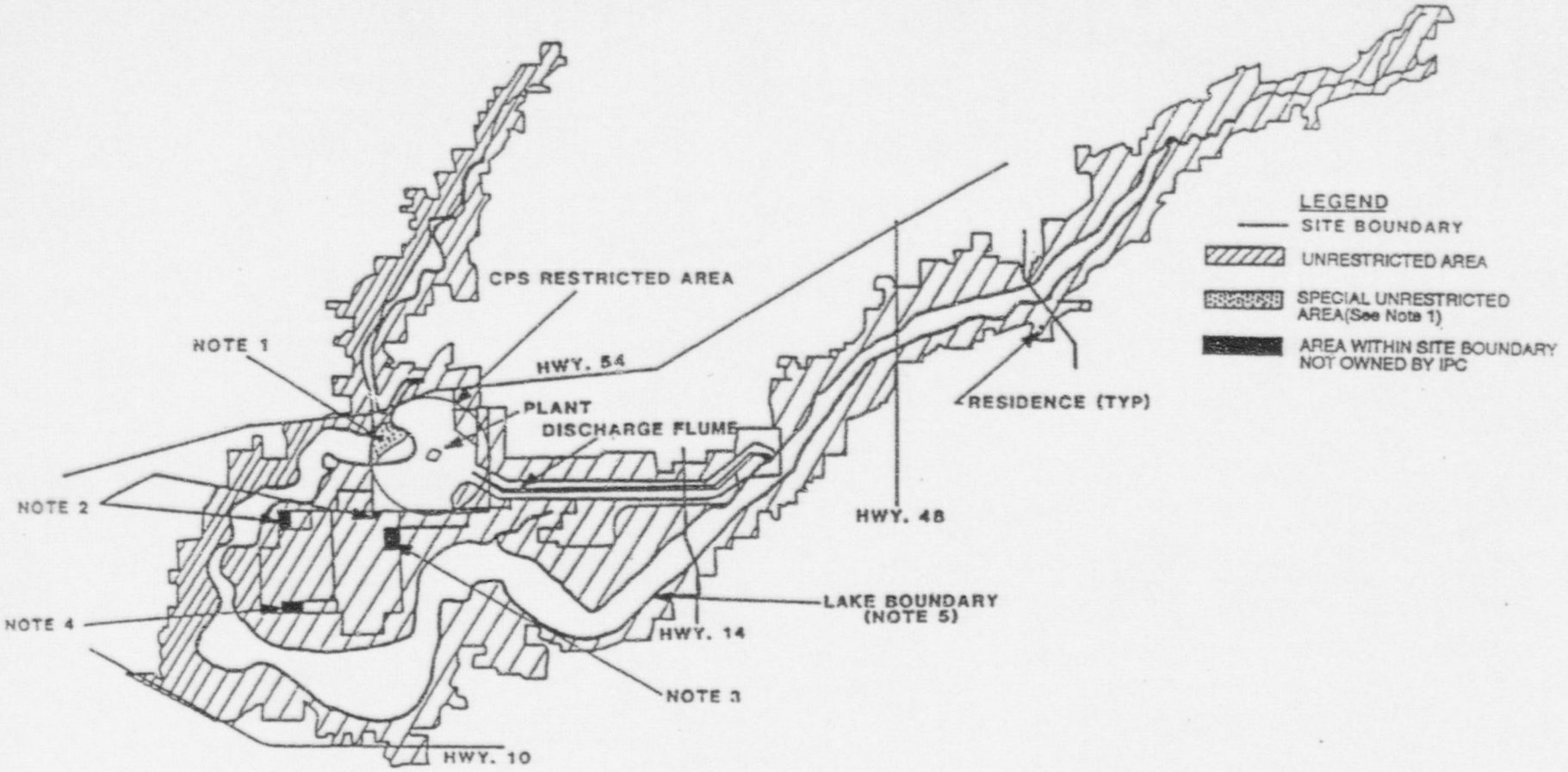
If $(F_{tank}/f_{act}) \geq 1$, the value obtained for C_M is used to determine the monitor setpoint above background, ccpm, from either of the two methods described above. In the case where $(F_{tank}/f_{act}) < 1$, no release may be made using the existing discharge parameter values (DF, F_{tank}, f_{act}).

The setpoint concentration is conservative, even if F_{tank} is attainable, since the calculated flow rate contains the SAFETY FACTOR, dilution flow rate and liquid radwaste tank effluent flow rate margins.

2.3.2.5 To prevent spurious alarms, revise the Plant Service Water Effluent PRM setpoint to coincide with the setpoint concentration, C_M, calculated by equation (5). This setpoint is valid only during periods of actual liquid radwaste discharges.

FIGURE 2.1-1

UNRESTRICTED AREA BOUNDARY FOR LIQUID EFFLUENTS



NOTES

1. THE AREA IN THE LAKE BETWEEN THE BUOYS AND THE EXCLUSION AREA BOUNDARY IS UNRESTRICTED AT THIS TIME. BUT WILL BE CONTROLLED IF PLANT EFFLUENT CONDITIONS WARRANT CLOSURE.
2. LAND PARCEL NOT OWNED BY ILLINOIS POWER, INCLUDES RESIDENCES.
3. LAND PARCEL NOT OWNED BY ILLINOIS POWER, OIL COMPANY PIPELINE PUMPING STATION.
4. LAND PARCEL NOT OWNED BY ILLINOIS POWER, AGRICULTURAL USE.
5. THE LAKE SHORELINE IS APPROXIMATELY 690 FT. MSL ELEVATION LINE.

2.3.3 Plant Service Water Effluent PRM Setpoints

Plant service water effluent continuously releases to the Seal Well where it mixes with circulating water effluent (if present) prior to entering Lake Clinton via the 3.4 mile discharge flume. The plant service water effluent is not considered a radioactive discharge pathway unless liquid radwaste discharges are in progress or any service water cooling load heat exchanger has been detected as failed. To ensure that Plant Service Water intersystem leakage has not occurred, weekly Service Water effluent grab samples will be obtained (when in service) and analyzed to determine the identity and quantity of principal gamma-emitting radionuclides. In addition, a quarterly composite of positive grab samples will be analyzed to determine the quantity of H-3, Sr-89, Sr-90, Fe-55 and gross alpha species released. The analytical Lower Limit of Detection (LLD) for these analyses are specified in Table 2.3-1.

The Plant Service Water effluent PRM setpoint should be established as close to background as practical to prevent spurious alarms, and yet assure an alarm should an inadvertent release occur.

If the weekly grab sample analysis indicates the presence of contamination above background, PRM setpoints will be established following section 2.3.2 methodology as follows:

2.3.3.1 Perform section 2.3.2.2, solving equation (3) for DF using the appropriate values in the concentration term from the grab sample analysis.

2.3.3.2 A modified dilution factor, DF_m, must be determined so that available dilution flows may be apportioned among simultaneous discharge pathways. The modified dilution factor is defined as:

$$DF_m = DF/F_A \qquad (6)$$

where F_A is an administrative allocation factor which may be assigned any value between 0 and 1 under the condition that

$$\Sigma_n (F_A)_n \leq 1 \qquad (7)$$

and where n = the number of liquid discharge pathways for which DF $\geq$1 and which are planned for simultaneous release. For simplicity, F_A may be assigned the value 1/n. Calculate F_{tank} in equation (4) by substituting the value of DF_m for DF and perform the calculation specified in section 2.3.2.4 to determine flow rate and PRM setpoints.

2.3.4 Shutdown Service Water (SX) Effluent PRM Setpoints

Shutdown Service Water, when initiated, is a potential continuous radioactive discharge pathway to the Ultimate Heat Sink (UHS) (see Figure 2.5-2). The SX effluent is not considered a radioactive discharge pathway unless any SX cooling load heat exchanger has been detected as failed. SX effluent sampling, analysis and setpoint establishment will be performed as discussed for the Plant Service Water system in Section 2.3.3.

2.3.5 Fuel Pool Heat Exchanger Service Water Effluent PRM Setpoints

The Fuel Pool Heat Exchanger Service Water is normally supplied by the Component Cooling Water (CCW) system (a closed loop system). The CCW system rejects heat loads to the Plant Service Water system where intersystem leakage would be detected as described in section 2.3.3. The Fuel Pool Heat Exchanger Service Water effluent is considered a potential radioactive discharge pathway when SX replaces CCW as the heat sink for the fuel pool heat exchangers. To account for a potential release of CCW radioactivity to the Ultimate Heat Sink via SX, CCW will be sampled prior to placing the Fuel Pool Heat Exchanger in the SX cooling mode and analyzed as discussed in section 2.3.3. The analysis results will then be used to establish Fuel Pool Heat Exchanger Service Water PRM and flow rate setpoints following Section 2.3.3.1 and 2.3.3.2 methodology.

Any releases of radioactivity to the environment from the Plant Service Water (except during liquid radwaste discharges), Shutdown Service Water or Fuel Pool Heat Exchanger Service Water Systems are considered abnormal events. Such events will be accounted for as unplanned releases in the RADIOACTIVE EFFLUENT RELEASE REPORT.

2.3.6 Component Cooling Water PRM Setpoints

The Component Cooling water system is a potential continuous radioactive discharge pathway to the Service Water system due to the Component Cooling water system generally operating at a higher pressure. Component Cooling provides cooling to components and heat exchangers that carry radioactive fluids or are in areas that could result in radioactive contamination if the components are damaged. Except for the sampling requirement described in 2.3.5, sampling on this system is done on an as needed basis. The PRM setpoints are established using the methodology in Section 2.3.3.

2.4 10CFR50, Appendix I Release Rate Limits

The Operation and Surveillance Requirements concerning 10CFR50, Appendix I Release Limits are specified in section 2.4.1. Dose calculations for ensuring compliance with these limits are discussed in section 2.4.2.

2.4.1 10CFR50, Appendix I Release Rate Limits - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to UNRESTRICTED AREAS (see Figure 2.1-1) 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.

This requirement applies at all times.

REMEDIAL REQUIREMENT:

With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days 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

2.4.1.1 Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters described in Section 2.4.2 at least once per 31 days.

2.4.2 Discussion

2.4.2.1 The dose contribution to the maximum exposed individual from all radionuclides identified in liquid effluents released to the unrestricted area is calculated as follows:

$$D_j = \Sigma_i [A_{ij} \sum_{\ell=1}^{m} \Delta T_\ell \, C_{i\ell} F_\ell], \text{ mrem} \quad (8)$$

where

D_j = The cumulative calendar quarter or yearly dose to any organ j from liquid effluent for the total release period, mrem

ΔT_ℓ = The length of the ℓth release time period over which $C_{i\ell}$ and F_ℓ are averaged for liquid releases, hours

= Liquid Radwaste Tank Volume/Liquid Radwaste Discharge Flow Rate

$C_{i\ell}$ = The average concentration of nuclide i in undiluted liquid effluent during release period Δt_ℓ for any liquid release, µCi/ml

F_ℓ = The near field average dilution factor for $C_{i\ell}$ during any liquid effluent release, dimensionless. Defined as the ratio of the average undiluted liquid radwaste flow during the release, to the product of the average flow from the discharge structure (during the reporting period, i.e., quarter or year) to the unrestricted receiving water and Z

$$= \frac{\text{Average Undiluted Liquid Waste Flow}}{(\text{Average Discharge Structure Flow})Z} \quad (9)$$

Z = The applicable dilution factor for Lake Clinton, dimensionless

= 1.0

A_{ij} = The composite ingestion dose commitment factor for the total body or critical organ of an ADULT for radionuclide i, mrem/hr per µCi/ml

$$= K_o[(U_w/D_w) + (U_f B F_i)]DF_i \quad (10)$$

where

K_O = A units conversion factor, 1.14E+05 pCi-ml-yr/μCi-liter-hr

= (1.0E+06 pCi/μCi)(1.0E+03 ml/liter)/8760 hr/yr

U_w = Annual water consumption by the maximum adult, 0 liter/yr

D_w = Dilution factor from the near field area to the nearest potable water intake, 1.0

U_f = Adult fish consumption rate, 21 kg/yr (Table E-5 of Regulatory Guide 1.109)

BF_i = Bioaccumulation factor for radionuclide i in fish, pCi/kg per pCi/liter (Table 2.4-2 taken from Table A-1 of Regulatory Guide 1.109)

DF_i = Adult ingestion dose conversion factor for radionuclide i, total body or critical organ, mrem/pCi (Table 2.4-3 taken from Table E-11 of Regulatory Guide 1.109)

Table 2.4-1 contains values for A_{ij} as calculated by equation (10).

The quarterly limits specified in the OPERATION REQUIREMENT at the beginning of this section represent one-half of the annual design objective of Section II.A of 10CFR50, Appendix I.

TABLE 2.4-1

ADULT INGESTION DOSE COMMITMENT FACTORS - A_{ij}
(mrem/hr per µCi/ml)

ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01
C-14	3.12E+04*	6.24E+03	6.24E+03	6.24E+03	6.24E+03	6.24E+03	6.24E+03
NA-24	4.06E+02	4.06E+02	4.06E+02	4.06E+02	4.06E+02	4.06E+02	4.06E+02
P-32	1.39E+06	8.62E+04	5.36E+04	NO DATA	NO DATA	NO DATA	1.56E+05
CR-51	NO DATA	NO DATA	1.27E+00	7.60E-01	2.80E-01	1.68E+00	3.20E+02
MN-54	NO DATA	4.37E+03	8.34E+02	NO DATA	1.30E+03	NO DATA	1.34E+04
MN-56	NO DATA	1.10E+02	1.95E+01	NO DATA	1.40E+02	NO DATA	3.51E+03
FE-55	6.57E+02	4.54E+02	1.06E+02	NO DATA	NO DATA	2.53E+02	2.60E+02
FE-59	1.04E+03	2.44E+03	9.34E+02	NO DATA	NO DATA	6.81E+02	8.13E+03
CO-58	NO DATA	8.90E+01	2.00E+02	NO DATA	NO DATA	NO DATA	1.80E+03
CO-60	NO DATA	2.56E+02	5.64E+02	NO DATA	NO DATA	NO DATA	4.80E+03
NI-63	3.11E+04	2.15E+03	1.04E+03	NO DATA	NO DATA	NO DATA	4.49E+02
NI-65	1.26E+02	1.64E+01	7.48E+00	NO DATA	NO DATA	NO DATA	4.16E+02
CU-64	NO DATA	9.97E+00	4.67E+00	NO DATA	2.51E+01	NO DATA	8.48E+02
ZN-65	2.31E+04	7.36E+04	3.33E+04	NO DATA	4.92E+04	NO DATA	4.64E+04
ZN-69	4.92E+01	9.42E+01	6.55E+00	NO DATA	6.12E+01	NO DATA	1.41E+01
BR-83	NO DATA	NO DATA	4.03E+01	NO DATA	NO DATA	NO DATA	5.81E+01
BR-84	NO DATA	NO DATA	5.23E+01	NO DATA	NO DATA	NO DATA	4.10E-04
BR-85	NO DATA	NO DATA	2.15E+00	NO DATA	NO DATA	NO DATA	LT E-15**
RB-86	NO DATA	1.01E+05	4.70E+04	NO DATA	NO DATA	NO DATA	1.99E+04
RB-88	NO DATA	2.89E+02	1.53E+02	NO DATA	NO DATA	NO DATA	4.00E-09
RB-89	NO DATA	1.92E+02	1.35E+02	NO DATA	NO DATA	NO DATA	1.11E-11
SR-89	2.21E+04	NO DATA	6.34E+02	NO DATA	NO DATA	NO DATA	3.54E+03
SR-90	5.43E+05	NO DATA	1.33E+05	NO DATA	NO DATA	NO DATA	1.57E+04
SR-91	4.06E+02	NO DATA	1.64E+01	NO DATA	NO DATA	NO DATA	1.94E+03
SR-92	1.54E+02	NO DATA	6.67E+00	NO DATA	NO DATA	NO DATA	3.05E+03
Y-90	5.75E-01	NO DATA	1.54E-02	NO DATA	NO DATA	NO DATA	6.10E+03
Y-91m	5.43E-03	NO DATA	2.10E-04	NO DATA	NO DATA	NO DATA	1.60E-02
Y-91	8.42E+00	NO DATA	2.25E-01	NO DATA	NO DATA	NO DATA	4.64E+03
Y-92	5.05E-02	NO DATA	1.48E-03	NO DATA	NO DATA	NO DATA	8.84E+02
Y-93	1.60E-01	NO DATA	4.42E-03	NO DATA	NO DATA	NO DATA	5.08E+03
ZR-95	2.40E-01	7.69E-02	5.20E-02	NO DATA	1.21E-01	NO DATA	2.44E+02
ZR-97	1.32E-02	2.67E-03	1.22E-03	NO DATA	4.04E-03	NO DATA	8.28E+02
NB-95	4.46E+02	2.48E+02	1.33E+02	NO DATA	2.45E+02	NO DATA	1.51E+06
MO-99	NO DATA	1.03E+02	1.96E+01	NO DATA	2.33E+02	NO DATA	2.39E+02
TC-99m	8.86E-03	2.50E-02	3.19E-01	NO DATA	3.80E-01	1.23E-02	1.48E+01
TC-101	9.11E-03	1.31E-02	1.29E-01	NO DATA	2.36E-01	6.70E-03	3.94E-14
RU-103	4.42E+00	NO DATA	1.90E+00	NO DATA	1.69E+01	NO DATA	5.16E+02
RU-105	3.68E-01	NO DATA	1.45E-01	NO DATA	4.76E+00	NO DATA	2.25E+02
RU-106	6.57E+01	NO DATA	8.32E+00	NO DATA	1.27E+02	NO DATA	4.25E+03
AG-110m	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
TE-125m	2.57E+03	9.28E+02	3.43E+02	7.70E+02	1.04E+04	NO DATA	1.02E+04
TE-127m	6.47E+03	2.31E+03	7.89E+02	1.65E+03	2.63E+04	NO DATA	2.17E+04
TE-127	1.05E+02	3.77E+01	2.28E+01	7.79E+01	4.28E+02	NO DATA	8.30E+03
TE-129m	1.10E+04	4.10E+03	1.74E+03	3.78E+03	4.59E+04	NO DATA	5.54E+04
TE-129	3.00E+01	1.13E+01	7.31E+00	2.30E+01	1.26E+02	NO DATA	2.26E+01
TE-131m	1.65E+03	8.09E+02	6.74E+02	1.28E+03	8.19E+03	NO DATA	8.03E+04
TE-131	1.88E+01	7.87E+00	5.95E+00	1.55E+01	8.25E+01	NO DATA	2.67E+00

TABLE 2.4-1 (cont'd)

ADULT INGESTION DOSE COMMITMENT FACTORS - A_{ij}
(mrem/hr per μCi/ml)

ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.41E+03	1.56E+03	1.46E+03	1.72E+03	1.50E+04	NO DATA	7.37E+04
I-130	2.71E+01	7.99E+01	3.15E+01	6.78E+03	1.25E+02	NO DATA	6.88E+01
I-131	1.49E+02	2.13E+02	1.22E+02	6.99E+04	3.66E+02	NO DATA	5.63E+01
I-132	7.28E+00	1.95E+01	6.81E+00	6.81E+02	3.10E+01	NO DATA	3.66E+00
I-133	5.09E+01	8.85E+01	2.70E+01	1.30E+04	1.54E+02	NO DATA	7.96E+01
I-134	3.80E+00	1.03E+01	3.69E+00	1.79E+02	1.64E+01	NO DATA	9.00E-03
I-135	1.59E+01	4.16E+01	1.53E+01	2.74E+03	6.67E+01	NO DATA	4.70E+01
CS-134	2.97E+05	7.07E+05	5.78E+05	NO DATA	2.29E+05	7.60E+04	1.24E+04
CS-136	3.11E+04	1.23E+05	8.84E+04	NO DATA	6.84E+04	9.37E+03	1.40E+04
CS-137	3.81E+05	5.21E+05	3.41E+05	NO DATA	1.77E+05	5.88E+04	1.01E+04
CS-138	2.64E+02	5.21E+02	2.58E+02	NO DATA	3.83E+02	3.78E+01	2.22E-03
BA-139	9.29E-01	6.60E-04	2.72E-02	NO DATA	6.18E-04	3.75E-04	1.65E+00
BA-140	1.94E+02	2.44E-01	1.27E+01	NO DATA	8.29E-02	1.40E-01	4.00E+02
BA-141	4.50E-01	3.40E-04	1.52E-02	NO DATA	3.16E-04	1.93E-04	2.12E-10
BA-142	2.04E-01	2.09E-04	1.28E-02	NO DATA	1.77E-04	1.18E-04	2.89E-19
LA-140	1.49E-01	7.53E-02	1.99E-02	NO DATA	NO DATA	NO DATA	5.53E+03
LA-142	7.65E-03	3.48E-03	8.66E-04	NO DATA	NO DATA	NO DATA	2.54E+01
CE-141	2.24E-02	1.51E-02	1.72E-03	NO DATA	7.03E-03	NO DATA	5.78E+01
CE-143	3.94E-03	2.92E+00	3.23E-04	NO DATA	1.28E-03	NO DATA	1.09E+02
CE-144	1.17E+00	4.88E-01	6.26E-02	NO DATA	2.89E-01	NO DATA	3.91E+02
PR-143	5.50E-01	2.20E-01	2.72E-02	NO DATA	1.27E-01	NO DATA	2.41E+03
PR-144	1.80E-03	7.47E-04	9.14E-05	NO DATA	4.21E-04	NO DATA	2.59E-10
ND-147	3.76E-01	4.34E-01	2.60E-02	NO DATA	2.54E-01	NO DATA	2.08E+03
W-187	2.95E+02	2.47E+02	8.63E+01	NO DATA	NO DATA	NO DATA	8.09E+04
NP-239	2.84E-02	2.80E-03	1.54E-03	NO DATA	8.72E-03	NO DATA	5.74E+02

*3.12×10^{4}
**Less than 10^{-15}

TABLE 2.4-2

BIOACCUMULATION FACTORS -BF_i
(pCi/kg per pCi/liter)

ELEMENT	FRESHWATER FISH
H	9.0E-01
C	4.6E+03
Na	1.0E+02
P	1.0E+05
Cr	2.0E+02
Mn	4.0E+02
Fe	1.0E+02
Co	5.0E+01
Ni	1.0E+02
Cu	5.0E+01
Zn	2.0E+03
Br	4.2E+02
Rb	2.0E+03
Sr	3.0E+01
Y	2.5E+01
Zr	3.3E+00
Nb	3.0E+04
Mo	1.0E+01
Tc	1.5E+01
Ru	1.0E+01
Rh	1.0E+01
Te	4.0E+02
I	1.5E+01
Cs	2.0E+03
Ba	4.0E+00
La	2.5E+01
Ce	1.0E+00
Pr	2.5E+01
Nd	2.5E+01
W	1.2E+03
Np	1.0E+01

TABLE 2.4-3

ADULT INGESTION DOSE FACTORS -DF_i
(mrem/pCi ingested)

ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C-14	2.84E-06*	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA-24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P-32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR-51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN-56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE-55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI-63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI-65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU-64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN-69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR-83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR-84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR-85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24**
RB-86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB-88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB-89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR-89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR-90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR-91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR-92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y-90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y-91m	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y-91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y-92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y-93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR-97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO-99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC-99m	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
TC-101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU-103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU-105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU-106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG-110m	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE-125m	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE-127m	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE-127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE-129m	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE-129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE-131m	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	3.40E-05
TE-131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09

TABLE 2.4-3 (cont'd)

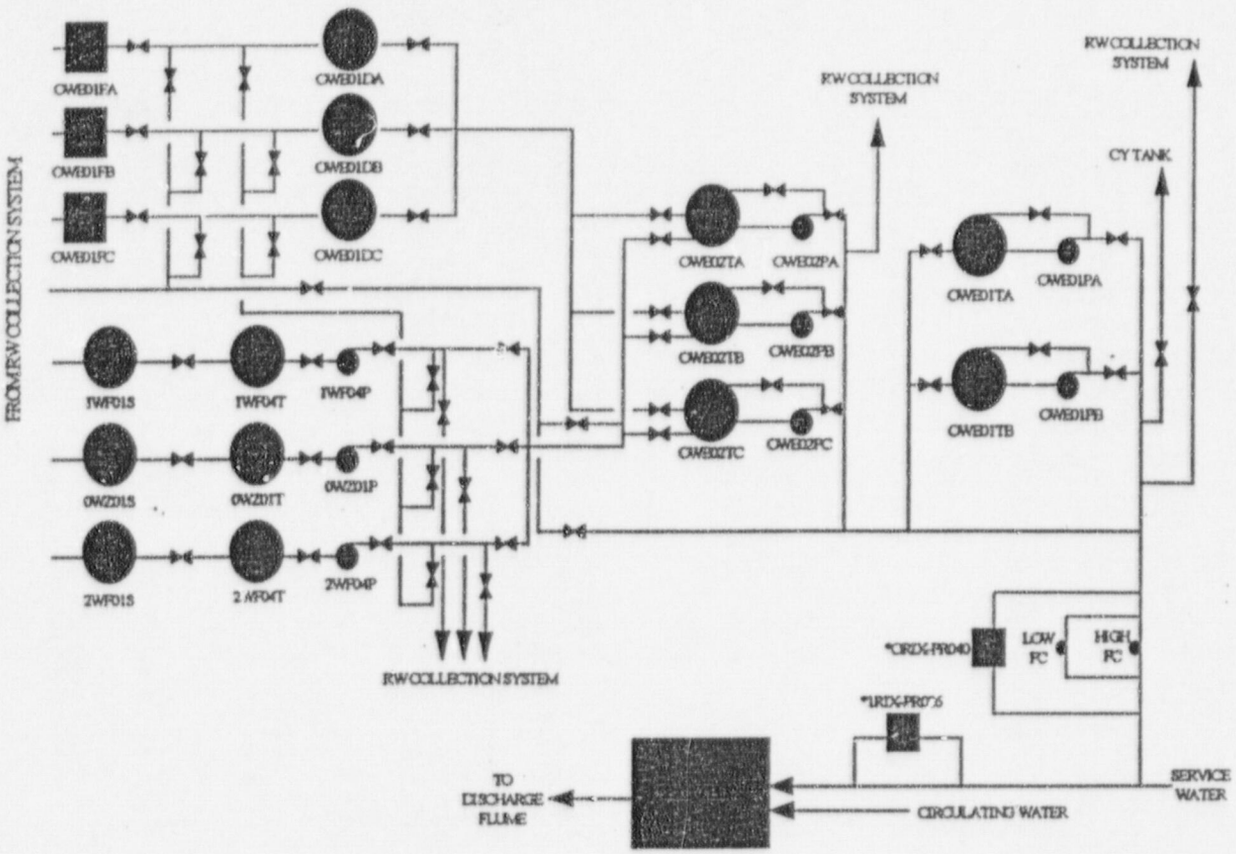
ADULT INGESTION DOSE FACTORS - DF_i
(mrem/pCi ingested)

ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I-130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I-133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I-135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS-136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.25E-05	2.11E-06
CS-138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA-139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA-141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA-142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA-140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA-142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE-141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE-143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE-144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR-143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR-144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND-147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W-187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP-239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

*2.84×10^{-06}
**Less than 10^{-24}

FIGURE 2.5-1

LIQUID RADWASTE TREATMENT SYSTEM

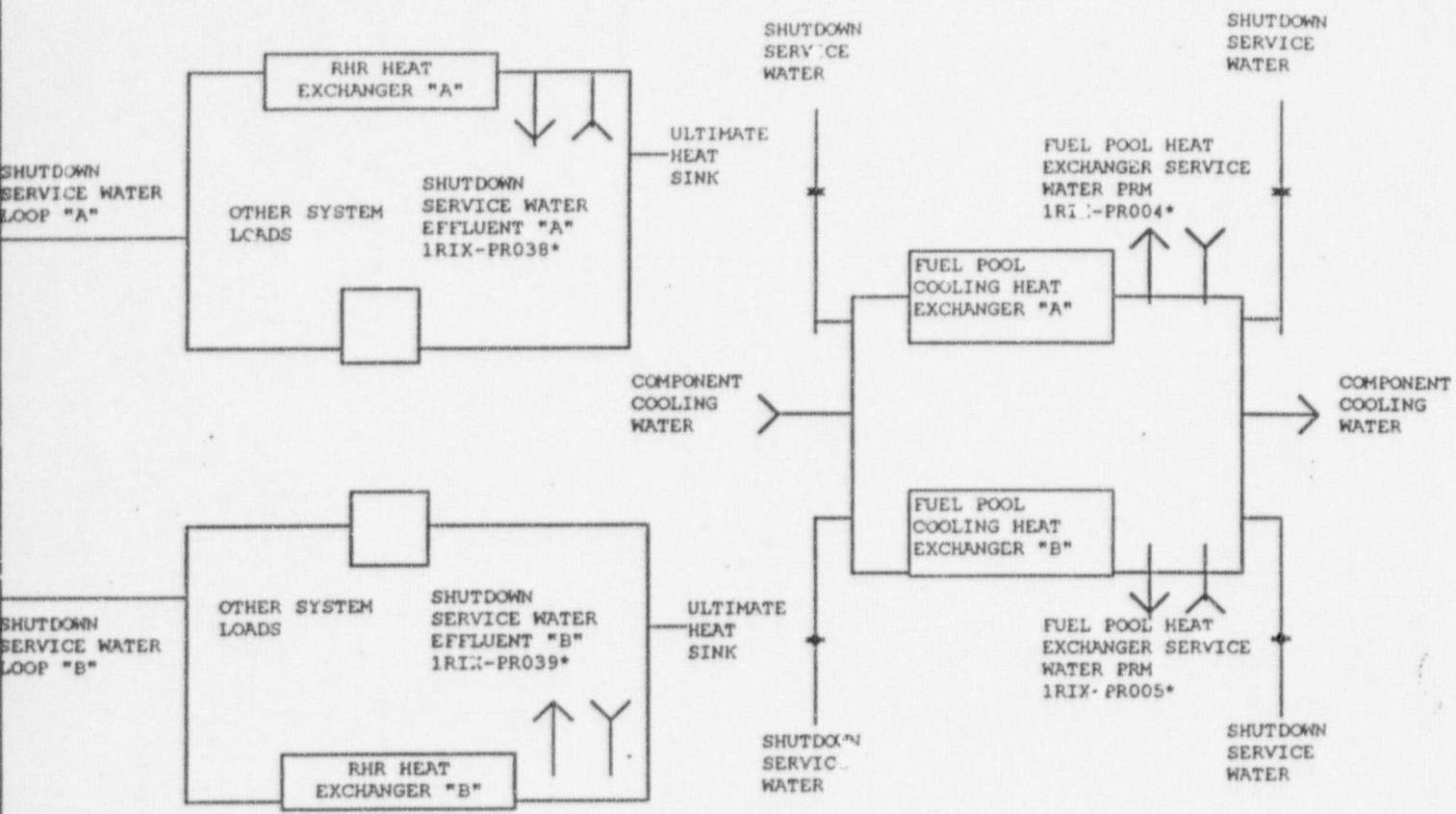


*Monitors required by Section 2.7

WF01S Floor Drain Evaporator	0WZ01P Chem. Wst. Evap. Tank Pump	2WF04T Floor Drain Evaporator Tank	0WE02PA,B, and C Waste Samp. Tk Pumps
WF01S Floor Drain Evaporator	0WE01FA,B, and C Waste Filters	0WZ01T Chem. Waste Evaporator Tank	0WE01TA and B Excess Water Tanks
0WZ01S Chemical Waste Evaporator	0WE01DA,B, and C Waste Demins	1WF04P Flr. Drn. Evap. Tank Pump	0WE01PA and B Excess Water Tank Pumps
WF04T Floor Drain Evaporator Tank	0WE02TA,B, and C Waste Sample Tks	2WF04P Flr. Drn. Evap. Tank Pump	1PR036 Service Water PRM
			0PR040 Liquid RW Discharge PRM

FIGURE 2.5-2

SHUTDOWN AND FUEL POOL HEAT EXCHANGER SERVICE WATER
EFFLUENT MONITORS



NORMAL COOLING SUPPLY - COMPONENT COOLING WATER
EMERGENCY COOLING SUPPLY - SHUTDOWN SERVICE WATER

*Monitors required by Section 2.7

1RIX-PR038 Shutdown Service Water Effluent "A"

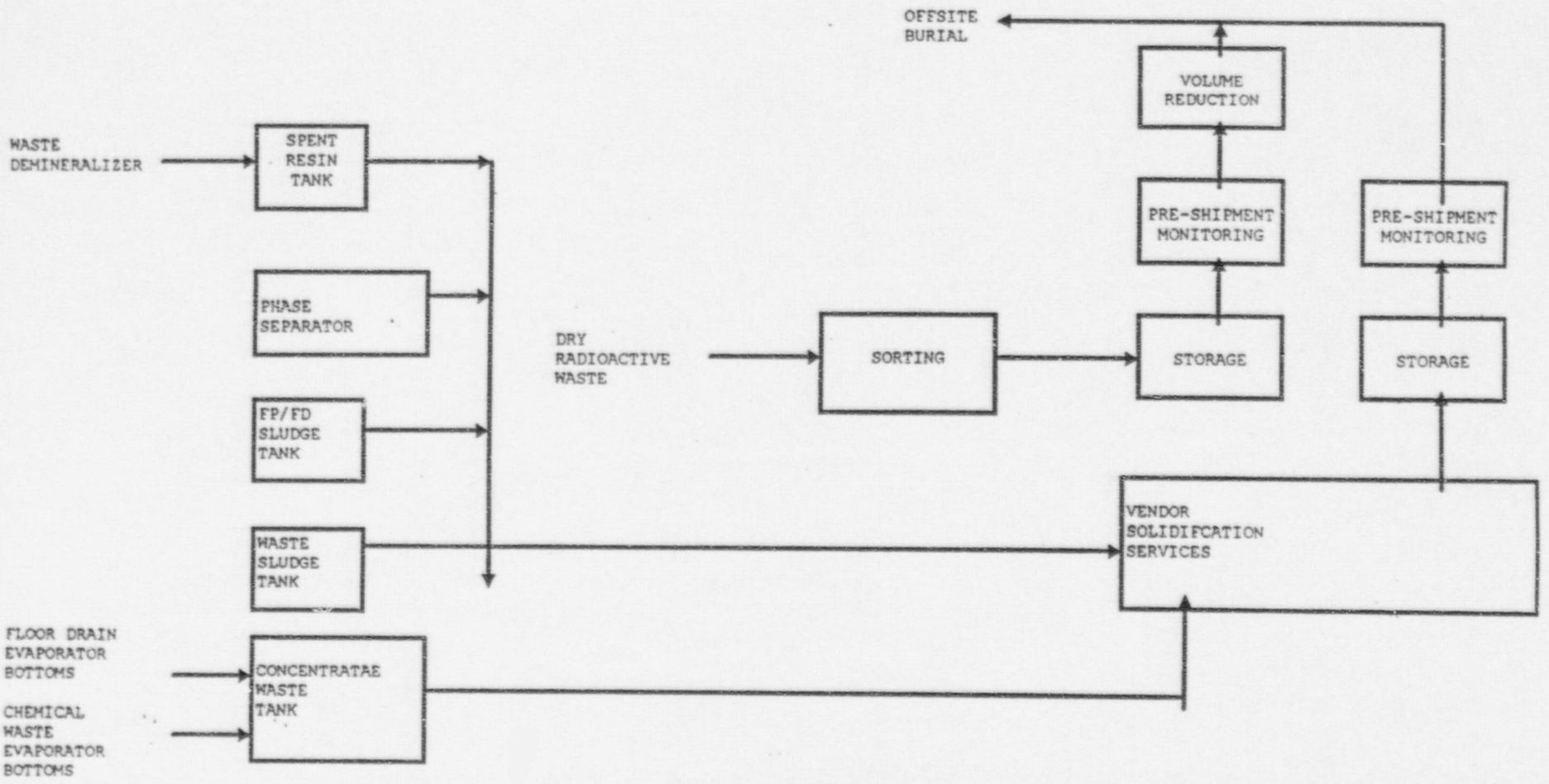
1RIX-PR039 Shutdown Service Water Effluent "B"

1RIX-PR005 Fuel Pool Heat Exchanger Service Water PRM

1RIX-PR004 Fuel Pool Heat Exchanger Service Water PRM

FIGURE 2.5-3

SOLID RADWASTE SYSTEM
SIMPLIFIED FLOW DIAGRAM



2.5 Liquid Radwaste Treatment System

2.5.1 Liquid Radwaste Treatment System - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The liquid radwaste treatment system shall be OPERABLE. The appropriate portions of the system (Figure 2.5-1) shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the projected doses due to the liquid effluent to UNRESTRICTED AREAS (see Figure 2.1-1) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31-day period. This requirement applies at all times.

REMEDIAL REQUIREMENT:

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 Regional Administrator of the Regional Office of the NRC within 30 days 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.

SURVEILLANCE REQUIREMENTS

2.5.1.1 Doses due to liquid releases to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters described in Section 2.4.2.

2.5.1.2 The liquid radwaste treatment shall be demonstrated OPERABLE by meeting the Operation Requirements of Section 2.3.1 and 2.4.1.

2.5.2 Temporary Liquid Radwaste Hold-Up Tanks

The use of temporary liquid radwaste hold-up tanks may occur at CPS. To comply with Operational Requirements Manual (ORM) 2.4.4, the curie limit for liquid radwaste stored in such tanks may be calculated using the methodology presented in Appendix B of NUREG-0133 (BWR-RATAFR code), but limited to less than or equal to 10 curies, excluding tritium and dissolved or entrained noble gases.

2.6 Doses From Other Significant Liquid Effluent Pathways

Section 2.4 of this manual is based upon the aquatic food and potable water exposure pathways only. Other exposure pathways, namely shoreline deposits and irrigated crops, may arise at Clinton Power Station and will be included in the section 2.4 dose contribution if they are likely to provide a significant contribution to the total dose. A pathway is considered significant if a conservative evaluation yields an additional dose increment greater than or equal to 10 percent of the total from all other existing pathways. Methods for calculating doses from other potentially significant liquid effluent pathways are presented in Appendix A to Regulatory Guide 1.109.

When it is determined that other liquid effluent pathways do exist, the Regulatory Guide 1.109 Appendix A equations and parameters will be used in lieu of site-specific data to determine a pathway's significance.

2.7 Radioactive Liquid Effluent Monitoring Instrumentation

2.7.1 Radioactive Liquid Effluent Monitoring Instrumentation Operation and Surveillance Requirements

OPERATION REQUIREMENT

The radioactive liquid effluent monitoring instrumentation channels shown in Table 2.7-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Section 2.3.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters described in Sections 2.3.2 through 2.3.5. This requirement applies during releases via the associated pathway.

REMEDIAL REQUIREMENT:

a. With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above requirement, without delay suspend the release of radioactive liquid 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 liquid effluent monitoring instrumentation channels OPERABLE, comply with the REMEDIAL REQUIREMENT shown in Table 2.7-1. Restore the inoperable instruments to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

SURVEILLANCE REQUIREMENTS

2.7.1.1 Each radioactive liquid effluent monitoring instrumentation control shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST at the frequencies shown in Table 2.7-2.

TABLE 2.7-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

		MINIMUM CHANNELS OPERABLE	REMEDIAL REQUIREMENT
1.	RADIOACTIVE MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
	a. Liquid Radwaste Discharge Process Radiation Monitor	1(a)	1
2.	RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE		
	a. Plant Service Water Effluent Process Radiation Monitor	1(a)	2
	b. Shutdown Service Water Effluent Process Radiation Monitor	1/Division*(a)	2
	c. Fuel Pool Heat Exchanger Service Water Radiation Monitor	1(a)	2
	d. Component Cooling Water Process Radiation Monitor	1(a)	2
3.	FLOW RATE MEASUREMENT DEVICES		
	a. Liquid Radwaste Effluent Line	1	3
	b. Plant Service Water Effluent Line	1	3
	c. Plant Circulation Water Line	1	3
4.	TANK LEVEL INDICATING DEVICES		
	a. Cycled Condensate Storage	1	4
	b. Reactor Core Isolation Cooling Storage	1	4

*Division I and Division II only.

TABLE 2.7-1 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

TABLE NOTATION

(a) Channel OPERABILITY shall include the capability of the Main Control Room Central Control Terminal (MCR-CCT) to provide the alarm status of the applicable radiation monitor channel(s).

REMEDIAL REQUIREMENT

REMEDIAL REQUIREMENT 1

With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue via this pathway provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with Section 2.3.1.1, and

b. At least two technically qualified members independently verify the release rate calculations and discharge line valving:

Otherwise, suspend release of radioactive effluents via this pathway.

REMEDIAL REQUIREMENT 2

a. With the communication link or the MCR-CCT inoperable perform CHANNEL CHECK using local monitor indication within 8 hours and at least once per 8 hours thereafter.

b. With the monitor otherwise inoperable, effluent releases via this pathway may continue provided that at least once per 12 hours, grab samples are collected and analyzed for radioactivity at a Lower Limit of Detection of 5.0×10^{-7} µCi/cc for the Principal Gamma Emitters. The Principal Gamma Emitters are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall be measured with an LLD of 5.0×10^{-6} µCi/cc. Dissolved and Entrained Gases (gamma emitters only) shall be measured with an LLD of 1.0×10^{-5} µCi/cc. These Dissolved and Entrained Gases are: Xe-133, Xe-135, Xe-138, Kr-85m, Kr-87, and Kr-88.

TABLE 2.7-1 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

TABLE NOTATION

REMEDIAL REQUIREMENT 3	With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided 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. All flows diverted from Plant Service Water must be taken into account when estimating dilution flow when Plant Service Water is the only dilution source.
REMEDIAL REQUIREMENT 4	With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, liquid additions to this tank may continue provided the tank liquid level is estimated during all liquid additions to the tank.

TABLE 2.7-2

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1. RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE				
a. Liquid Radwaste Discharge Process Radiation Monitor Effluent Line	D(4,5)	P	R(3)	Q(1)
2. RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE				
a. Plant Service Water Effluent Process Radiation Monitor	D(5)	M	R(3)	Q(2)
b. Shutdown Service Water Effluent Process Radiation Monitor	D(5)	M	R(3)	Q(2)
c. Fuel Pool Heat Exchanger Service Water Radiation Monitor	D(5)	M	R(3)	Q(2)
d. Component Cooling Water Process Radiation Monitor	D(5)	M	R(3)	Q(2)

TABLE 2.7-2 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
3. FLOW RATE MEASUREMENT DEVICES				
a. Liquid Radwaste Effluent Line	D(4)	NA	R	Q
b. Plant Service Water Effluent Line	D(4)	NA	R	Q
c. Plant Circulation Water Line	D(4)	NA	R	NA
4. TANK LEVEL INDICATING DEVICES				
a. Cycled Condensate Storage	D*	NA	R	NA
b. Reactor Core Isolation Cooling	D*	NA	R	NA

*During liquid additions to the tank.

TABLE 2.7-2 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

TABLE NOTATIONS

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway occurs and that the MCR-CCT provides annunciation and event display in response to each of the following conditions:

1. Instrument indicates measured levels above the alarm/trip (HIGH) setpoint.

2. Detector failure (LOW FAIL, HI FAIL).

3. Sample flow failure (EXTERNAL FAIL).

4. Instrument not set in normal operate mode (UNINITIALIZED, CALIBRATE, MAINTENANCE, or STANDBY.)*

(2) The CHANNEL FUNCTIONAL TEST shall also demonstrate that the MCR-CCT responds with annunciation and event display to each of the following conditions:

1. Instrument indicates measured levels above the alarm (HIGH) setpoint.

2. Detector failure (LOW FAIL, HI FAIL).

3. Sample flow failure (EXTERNAL FAIL).

4. Instrument not set in normal operate mode (UNINITIALIZED, CALIBRATE, MAINTENANCE, or STANDBY.)*

*A demonstration of automatic isolation of the release pathway is not applicable to this condition.

TABLE 2.7-2 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

TABLE NOTATIONS

(3) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. 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.

(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 which continuous, periodic, or batch releases are made.

(5) Determine that channel communication is established to the MCR-CCT.

3.0 GASEOUS EFFLUENTS

3.1 Introduction

Gaseous effluents from CPS are released on both a batch and continuous basis. Gaseous effluents are normally discharged on a long term basis. High volume Continuous Containment Purge and mechanical vacuum pump discharge may be considered short term releases.

There are two gaseous effluent release points to the environment: the Common Station HVAC Stack and the Standby Gas Treatment System (SGTS) Stack. The height of these stacks is such that all gaseous effluents are treated as mixed-mode releases (reference Table 9.2-1). The SGTS is an Engineered Safety Feature filter system utilized following an accident to reduce iodine and particulate activity in gases leaking from the primary containment and which are potentially present in the secondary containment. The Common Station HVAC Stack ("HVAC Stack") receives process and ventilation exhaust from the following inputs:

1) Continuous Containment Purge (CCP)
2) Containment Building Ventilation
3) Turbine Building Ventilation
4) Radwaste Building Ventilation
5) Auxiliary Building Ventilation
6) Fuel Building Ventilation
7) Auxiliary Building Refrigerant Purge
8) Laboratory Ventilation System
9) Counting/Equipment Decon Rooms Ventilation
10) Steam Packing Exhauster
11) Mechanical Vacuum Pump
12) Drywell Purge

The effluent exiting the SGTS stack is monitored at the SGTS stack and the combined inputs to the HVAC stack are monitored at the HVAC stack. All inputs to the HVAC Stack, with the exception of input numbers 7 through 10, can be monitored prior to entering the stack.

Figure 3.1-1 delineates the CPS site boundary for implementation of gaseous effluent 10CFR20 and 10CFR50, Appendix I Release Rate Limits.

3.2 Gaseous Effluent Release Point Monitoring

3.2.1 HVAC Stack Process Radiation Monitoring (PRM) System

The HVAC Stack inputs are monitored for radioactivity prior to discharge to the environment by the HVAC Stack PRM. The PRM detector configuration provides effluent monitoring using nine (9) channels as follows:

1) Beta scintillator for particulates

2) Alpha surface barrier detector to account for the radon/thoron contribution to the beta particulate measurement

3) Gamma scintillator for iodine

4) Iodine background subtraction

5) Beta scintillator for low range noble gas

6) Energy-compensated Geiger-Mueller (G-M) detector for high range noble gas

7) Energy-compensated G-M detector for gamma area subtraction

8) Sample pressure indication at the HVAC PRM

9) Sample flow rate indication at the HVAC PRM

This monitor has no control function but annunciates in the Main Control Room where proper response actions will be initiated in accordance with CPS procedures.

3.2.2 SGTS Stack Process Radiation Monitoring (PRM) System

As discussed in section 3.1, the SGTS is used to reduce post-accident concentrations of radioactivity in the primary and secondary containment via filter trains. The SGTS Stack PRM monitors the gaseous effluent of the filter trains at the SGTS Stack prior to release to the environment. The PRM detector configuration utilizes nine (9) channels as follows:

1) Beta scintillator for particulates

2) Gamma scintillator for iodine

3) Iodine background subtraction

4) Beta scintillator for low range noble gas

5) Energy-compensated G-M detector for intermediate range noble gas

6) Energy-compensated G-M detector for gamma area subtraction

7) Alpha surface barrier detector to account for the radon/thoron contribution to the beta particulate measurement

8) Sample pressure indication at the SGTS PRM

9) Sample flow-rate indication at the SGTS PRM

This monitor has no control function but annunciates in the Main Control Room where proper response actions will be initiated in accordance with CPS procedures.

3.3 Main Condenser Off-Gas Monitoring System

3.3.1 Pre-Treatment Air Ejector Off-Gas Process Radiation Monitor (PRM)

The Pre-Treatment Off-Gas PRM monitors hydrogen recombiner effluent for gross noble gas radioactivity. This effluent is then routed to the charcoal adsorbers for eventual release to the environment via the station HVAC Stack (see Figure 3.3-1). The PRM detector configuration consists of a single energy-compensated G-M detector mounted in a gas volume.

The monitor has no control function but annunciates in the Main Control Room where proper response actions will be initiated in accordance with CPS procedures.

3.3.2 Post-Treatment Air Ejector Off-Gas Process Radiation Monitor (PRM)

The Post-Treatment Off-Gas PRM monitors the gaseous radioactivity at upstream, intermediate or downstream sections of the charcoal adsorber beds prior to the effluent entering the station HVAC Stack for release to the environment (see Figure 3.3-1). The PRM detector configuration is as described for the HVAC Stack PRM (Section 3.2.1).

The monitor has two control functions. Upon detection of noble gas activity in excess of the ALERT setpoint, the charcoal adsorber bypass valves shut (if in the charcoal bypass mode) and the off-gas is routed through the adsorbers.

Should noble gas activity exceed the HIGH setpoint, or upon PRM failure, the off-gas system is automatically isolated from the HVAC Stack and a reactor scram may occur if loss of condenser vacuum occurs.

The Main Condenser Off-Gas Treatment System is shown in Figure 3.3-1.

3.4 10CFR20 Release Rate Limits

The Operation and Surveillance Requirements concerning 10CFR20 Release Rate Limits are specified in Section 3.4.1. Dose Rate calculations for ensuring compliance with these limits are discussed in Sections 3.4.2 and 3.4.3.

3.4.1 10CFR20 Release Rate Limits - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY (see Figure 3.1-1) 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, for 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.

This requirement applies at all times.

REMEDIAL REQUIREMENT:

With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the above limit(s).

SURVEILLANCE REQUIREMENTS

3.4.1.1 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 3.4.2 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 3.4-1.

3.4.1.2 The dose rate due to iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in Section 3.4.3 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 3.4-1.

TABLE 3.4-1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection LLD (μCi/cc)
A. Station HVAC Exhaust				
1. Noble Gas and Tritium Release	W[2] Grab	W[2]	Principal Gamma Emitters[1]	1.0×10^{-04}
			H-3	1.0×10^{-06}
2. Iodines Release	Continuous[3]	W[4]	I-131	1.0×10^{-12}
			I-133	1.0×10^{-10}
3. Particulates Release	Continuous[3]	W[4]	Principal Gamma Emitters[1]	1.0×10^{-11}
		M Composite		1.0×10^{-11}
			Gross Alpha Activity	
		Q Composite	Sr-89, Sr-90 Activity	1.0×10^{-11}
B. Standby Gas Treatment System Exhaust, when flow exists				
1. Noble Gas and Tritium Release	W Grab	W	Principal Gamma Emitters[1]	1.0×10^{-04}
			H-3	1.0×10^{-06}
2. Iodines Release	Continuous[3]	W[4]	I-131	1.0×10^{-12}
			I-133	1.0×10^{-10}
3. Particulates Release	Continuous[3]	W[4]	Principal Gamma Emitters[1]	1.0×10^{-11}
		M Composite		1.0×10^{-11}
			Gross Alpha Activity	
		Q Composite	Sr-89, Sr-90 Activity	1.0×10^{-11}

TABLE 3.4-1 (Continued)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATIONS

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

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

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

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, $s_b = \sqrt{\frac{R_{bkg}}{t}}$

where R_{bkg} = background counts
t=the background count time

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 (sec^{-1}) and

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

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

TABLE 3.4-1 (Continued)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATIONS (Continued)

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.

[1]The principal gamma emitters are: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 in noble gas releases and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, Ce-141 and Ce-144 in iodine and particulate releases. Other gamma peaks that are identifiable, together with those of the above nuclides, shall be analyzed and reported in the Radioactive Effluent Release Report pursuant to Technical Specification 5.6.3 in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

[2]Sampling and analysis shall also be performed following shutdown, startup, or a THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period.

[3]The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Sections 3.4.1, 3.5.1 and 3.5.2.

[4]Samples shall be changed at least once per 7 days and analysis 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 period and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours or less are analyzed, the corresponding LLDs may be increased by a factor of 10. Twenty-four (24) hour sampling requirements do apply if: (1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has increased more than a factor of 3, and (2) the noble gas monitor on the applicable PRM (HVAC or SGTS) shows that effluent activity has increased more than a factor of 3.

3.4.2 Dose Rate Due to Noble Gases

In order to comply with Section 3.4.1.(a), the dose rate at or beyond the site boundary due to noble gases shall be calculated as follows:

$$D_t = \Sigma_i K_i \left[\overline{(X/Q)}_m Q_{im}\right] \quad (1)$$

D_t = total body dose rate at time of release, mrem/year

$$D_s = \Sigma_i (L_i + 1.1 M_i) \left[\overline{(X/Q)}_m Q_{im}\right] \quad (2)$$

D_s = skin dose rate at time of release, mrem/year

The terms in the above equations are defined in section 3.4.3.

3.4.3 Dose Rate Due to Radioiodines, Particulates and Tritium

In order to comply with Section 3.4.1(b), organ dose rates due to radioiodines (I-131, I-133), particulates with half-lives > 8 days and tritium shall be calculated as follows:

$$D_o = \Sigma_i P_{ij} \left[\overline{(X/Q)}_m Q_{im}\right] \quad (3)$$

D_o = organ dose rate at time of release, mrem/yr

The terms used in equations (1) through (3) are defined as follows:

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide i, mrem/yr per $\mu Ci/m^3$

L_i = The skin dose factor due to beta emissions for each identified noble gas radionuclide i, mrem/yr per $\mu Ci/m^3$

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide i, mrad/yr per $\mu Ci/m^3$ (1.1 mrem/mrad converts air dose to skin dose)

P_{ij} = The dose factor for non-noble gas radionuclide i and organ j which includes pathway transport parameters, receptor usage factors and the dosimetry of the exposure. The dose factors for the inhalation, mrem/yr per $\mu Ci/m^3$, pathway are listed in Table 3.4-3 (CHILD). Dose factors are based on NUREG-0133, Section 5.2.1.1 assumptions unless otherwise stated.

Q_{im} = The release rate of noble gas radionuclide i in gaseous effluent from mixed-mode release points, µCi/sec

Q_{im} = The release rate of non-noble gas radionuclide i in gaseous effluent from mixed-mode release points, µCi/sec

$\overline{(X/Q)}_m$ = The highest calculated average relative concentration for any area at or beyond the site boundary from mixed-mode releases, sec/m^3

D_o is calculated for each of six organs and the total body; the maximum D_o value is then used to determine compliance with Section 3.4.1(b).

The factors K_i, L_i, and M_i relate the radionuclide airborne concentrations to various dose rates assuming a semi-infinite cloud. These factors are listed in Table 3.4-2 and were obtained from Table B-1 of Regulatory Guide 1.109 after multiplying the values by the conversion 10^6 pCi/µCi.

10CFR20 organ dose rate calculations are limited to the inhalation pathway only. Section 3.4.1(a) is applicable to the unrestricted area location characterized by the $(X/Q)_m$ value which results in the maximum total body or skin dose commitment. Should the total body and skin locations differ, the selected location shall be that which minimizes allowable release rates.

There are unrestricted areas within the CPS site boundary which are utilized by members of the public for residences, farming, recreation and camping. These areas are identified in Table 3.4-4. Table 3.4-4 will be revised to remain consistent with the most recent land use census.

TABLE 3.4-2

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS*

Radionuclide	Total Body Dose Factor K_i	Skin Dose Factor L_i	Gamma Air Dose Factor M_i	Beta Air Dose Factor N_i
	(mrem/yr per $\mu Ci/m^3$)	(mrem/yr per $\mu Ci/m^3$)	(mrad/yr per $\mu Ci/m^3$)	(mrad/yr per $\mu Ci/m^3$)
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

*The listed dose factors are for radionuclides that may be detected in gaseous effluents.

TABLE 3.4-3

INHALATION PATHWAY DOSE RATE FACTORS (CHILD) - P_{ij}
(mrem/yr per $\mu Ci/m^3$)

ORGAN / ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	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	NO DATA	NO DATA	NO DATA	4.22E+04
CR-51	NO DATA	NO DATA	1.54E+02	8.55E+01	2.43+01	1.70E+04	1.08E+03
MN-54	NO DATA	4.29E+04	9.51E+03	NO DATA	1.00E+04	1.58E+06	2.29E+04
MN-56	NO DATA	1.66E+00	3.12E-01	NO DATA	1.67E+00	1.31E+04	1.23E+05
FE-55	4.74E+04	2.52E+04	7.77E+03	NO DATA	NO DATA	1.11E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	NO DATA	NO DATA	1.27E+06	7.07E+04
CO-58	NO DATA	1.77E+03	3.16E+03	NO DATA	NO DATA	1.11E+06	3.44E+04
CO-60	NO DATA	1.31E+04	2.26E+04	NO DATA	NO DATA	7.07E+06	9.62E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	NO DATA	NO DATA	2.75E+05	6.33E+03
NI-65	2.99E+00	2.96E-01	1.64E-01	NO DATA	NO DATA	8.18E+03	8.40E+04
CU-64	NO DATA	1.99E+00	1.07E+00	NO DATA	6.03E+00	9.58E+03	3.67E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	NO DATA	7.14E+04	9.95E+05	1.63E+04
ZN-69	6.70E-02	9.66E-02	8.92E-03	NO DATA	5.85E-02	1.42E+03	1.02E+04
BR-83	NO DATA	NO DATA	4.74E+02	NO DATA	NO DATA	NO DATA	LT 3.70E-15**
BR-84	NO DATA	NO DATA	5.48E+02	NO DATA	NO DATA	NO DATA	LT 3.70E-15
BR-85	NO DATA	NO DATA	2.53E+01	NO DATA	NO DATA	NO DATA	LT 3.70E-15
RB-86	NO DATA	1.98E+05	1.14E+05	NO DATA	NO DATA	NO DATA	7.99E+03
RB-88	NO DATA	5.62E+02	3.66E+02	NO DATA	NO DATA	NO DATA	1.72E+01
RB-89	NO DATA	3.45E+02	2.90E+02	NO DATA	NO DATA	NO DATA	1.89E+00
SR-89	5.99E+05	NO DATA	1.72E+04	NO DATA	NO DATA	2.16E+06	1.67E+05
SR-90	1.01E+08	NO DATA	6.49E+06	NO DATA	NO DATA	1.48E+07	3.43E+05
SR-91	1.21E+02	NO DATA	4.59E+00	NO DATA	NO DATA	5.33E+04	1.74E+05
SR-92	1.31E+01	NO DATA	5.25E-01	NO DATA	NO DATA	2.40E+04	2.42E+05
Y-90	4.11E+03	NO DATA	1.11E+02	NO DATA	NO DATA	2.62E+05	2.68E+05
Y-91m	5.07E-01	NO DATA	1.84E-02	NO DATA	NO DATA	2.81E+03	1.72+03
Y-91	9.14E+05	NO DATA	2.44E+04	NO DATA	NO DATA	2.63+06	1.84E+05
Y-92	2.04E+01	NO DATA	5.81E-01	NO DATA	NO DATA	2.39E+04	2.39E+05
Y-93	1.87E+02	NO DATA	5.11E+00	NO DATA	NO DATA	7.44E+04	3.89E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	NO DATA	5.96E+04	2.23E+06	6.11E+04
ZR-97	1.88E+02	2.72E+01	1.60E+01	NO DATA	3.89E+01	1.13E+05	3.51E+05
NB-95	2.35E+04	9.18E+03	6.55E+03	NO DATA	8.62E+03	6.14E+05	3.70E+04
MO-99	NO DATA	1.72E+02	4.26E+01	NO DATA	3.92E+02	1.35E+05	1.27E+05
TC-99m	1.78E-03	3.48E-03	5.77E-02	NO DATA	5.07E-02	9.51E+02	4.81E+03
TC-101	8.10E-05	8.51E-05	1.08E-03	NO DATA	1.45E-03	5.82E+02	1.63E+01
RU-103	2.79E+03	NO DATA	1.07E+03	NO DATA	7.03E+03	6.62E+05	4.48E+04
RU-105	1.53E+00	NO DATA	5.55E-01	NO DATA	1.34E+00	1.59E+04	9.95E+04
RU-106	1.36E+05	NO DATA	1.69E+04	NO DATA	1.84E+05	1.43E+07	4.29E+05
AG-110m	1.69E+04	1.14E+04	9.14E+03	NO DATA	2.12E+04	5.48E+06	1.00E+05
TE-125m	6.73E+04	2.33E+03	9.14E+02	1.92E+03	NO DATA	4.77E+05	3.38E+04
TE-127m	2.49E+04	8.56E+03	3.03E+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-03	5.88E-02	2.05E+03	1.33E+03

TABLE 3.4-3 (cont'd)

INHALATION PATHWAY DOSE RATE FACTORS (CHILD) - P_{ij}
(mrem/yr per $\mu Ci/m^3$)

AN TOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
132	4.81E+02	2.72E+02	2.63E+02	3.18E+02	1.77E+03	3.77E+05	1.38E+05
0	8.18E+03	1.64E+04	8.44E+03	1.85E+06	2.45E+04	NO DATA	5.11E+03
1	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	NO DATA	2.84E+03
2	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	NO DATA	3.20E+03
3	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	NO DATA	5.48E+03
4	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	NO DATA	9.55E+02
5	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	NO DATA	4.44E+03
134	6.51E+05	1.01E+06	2.25E+05	NO DATA	3.30E+05	1.21E+05	3.84E+03
136	6.51E+04	1.71E+05	1.16E+05	NO DATA	9.55E+04	1.45E+04	4.18E+03
137	9.07E+05	8.25E+05	1.28E+05	NO DATA	2.82E+05	1.04E+05	3.62E+03
138	6.33E+02	8.40E+02	5.55E+02	NO DATA	6.21E+02	6.81E+01	2.70E+02
139	1.84E+00	9.84E-04	5.37E-02	NO DATA	8.62E-04	5.77E+03	5.77E+04
140	7.40E+04	6.48E+01	4.33E+03	NO DATA	2.11E+01	1.74E+06	1.02E+05
141	1.96E-01	1.09E-04	6.36E-03	NO DATA	9.47E-05	2.92E+03	2.75E+02
142	5.00E-02	3.60E-05	2.79E-03	NO DATA	2.91E-05	1.64E+03	2.74E+00
140	6.44E+02	2.25E+02	7.55E+01	NO DATA	NO DATA	1.83E+05	2.26E+05
142	1.30E+00	4.11E-01	1.29E-01	NO DATA	NO DATA	8.70E+03	7.59E+04
141	3.92E+04	1.95E+04	2.90E+03	NO DATA	8.55E+03	5.44E+05	5.66E+04
143	3.66E+02	1.99E+02	2.88E+01	NO DATA	8.36E+01	1.15E+05	1.27E+05
144	6.77E+06	2.12E+06	3.62E+05	NO DATA	1.17E+06	1.20E+07	3.89E+05
143	1.85E+04	5.55E+03	9.14E+02	NO DATA	3.00E+03	4.33E+05	9.73E+04
144	5.96E-02	1.85E-02	3.00E-03	NO DATA	9.77E-03	1.57E+03	1.97E+02
147	1.08E+04	8.73E+03	6.81E+02	NO DATA	4.81E+03	3.28E+05	8.21E+04
7	1.63E+01	9.66E+00	4.33E+00	NO DATA	NO DATA	4.11E+04	9.10E+04
139	4.66E+02	3.35E+01	2.35E+01	NO DATA	9.73E+01	5.81E+04	6.40E+04

12 x 10^3

ess than 3.70 x 10^{-15}

TABLE 3.4-4

LOCATION OF MEMBERS OF THE PUBLIC WITHIN THE CPS SITE BOUNDARY AND THEIR ASSOCIATED OCCUPANCY FACTORS*

Location	Distance (mile/meter)	Sector	Occupancy (hrs/yr)
Road	0.3/495	SE	243(1)
Agricultural Acreage(2)	0.9/1372	SSW	966(3)
Clinton Lake	0.2/335	NW	2208(4)
Department of Conservation Recreation Area	0.8/1287	ESE	2208(5)
Residence	0.8/1219	SW	8760
Residence	1.5/2414	WSW	8760
Residence	1.7/2736	SSE	8760

(1) Assumes travel on road for forty minutes per day.

(2) Maximum farm acreage (276) within site boundary.

(3) Assumes 3.5 hours in field per acre farmed.

(4) Assumes continuous occupation on Clinton Lake for the months of June, July, and August.

(5) Assumes continuous occupation on Department of Conservation camping areas for the months of June, July, and August.

*Doses for such MEMBERS OF THE PUBLIC are provided in the Radioactive Effluent Release Report as given in Section 6.3.2.

3.5 10CFR50, APPENDIX I RELEASE RATE LIMITS

The Operation and Surveillance Requirements concerning 10CFR50 (Appendix I) Release Rate Limits are specified in Sections 3.5.1 and 3.5.2. Dose calculations for ensuring compliance with these limits are discussed in Sections 3.5.3 and 3.5.4.

3.5.1 Noble Gas Dose - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The air dose due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the SITE BOUNDARY (see Figure 3.1-1) 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.

This requirement applies at all times.

REMEDIAL REQUIREMENT:

a. With the calculated air dose from radioactive nobles gases in gaseous effluents exceeding any of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days 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

3.5.1.1 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 described in Section 3.5.3 at least once per 31 days.

3.5.2 Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The dose to a 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 Figure 3.1-1) 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.

This requirement applies at all times.

REMEDIAL REQUIREMENT:

a. 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 Regional Administrator of the Regional Office of the NRC within 30 days 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.

SURVEILLANCE REQUIREMENTS

3.5.2.1 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 described in Section 3.5.4 at least once per 31 days.

3.5.3 Noble Gas Air Dose Equations

The air dose at or beyond the site boundary due to noble gases released in gaseous effluent will be determined using the following equations.

3.5.3.1 During any calendar quarter or calendar year, for gamma radiation:

$$D_\gamma = 3.17 \times 10^{-8} \Sigma_i M_i [\overline{(X/Q)}_m Q_{im}] \quad (4)$$

3.5.3.2 During any calendar quarter or calendar year, for beta radiation:

$$D_\beta = 3.17 \times 10^{-8} \Sigma_i N_i [\overline{(X/Q)}_m Q_{im}] \quad (5)$$

where

M_i = The gamma air dose factor for each identified noble gas radionuclide i, mrad/year per $\mu Ci/m^3$ (M_i values are listed in Table 3.4-2).

N_i = The beta air dose factor for each identified noble gas radionuclide i, mrad/year per $\mu Ci/m^3$ (N_i values are listed in Table 3.4-2).

$\overline{(X/Q)}_m$ = The highest calculated average relative concentration from mixed-mode release points for areas at or beyond the site boundary, sec/m^3.

Q_{im} = The total release of noble gas radionuclide i for long-term releases from mixed-mode release points, μCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

3.17×10^{-8} = The inverse of the number of seconds in a year.

Section 3.5.1 noble gas dose calculations are evaluated at the site boundary location where maximum air doses prevail. Should the beta and gamma locations differ, the selected location shall be that which minimizes allowable release rates due to the gamma compcnent.

3.5.4 Radioiodines, Particulates and Tritium Dose Equations

The dose to an individual at or beyond the site boundary due to radioiodines (I-131, I-133), tritium and particulates with half-lives > 8 days, will be determined suing the follow equation:

for any calendar quarter or calendar year,

$$D_p = 3.17 \times 10^{-8} \Sigma_i R_{aij} W_m Q_{im} \qquad (6)$$

where

Q_{im} = The releases of radionuclide i (I-131, I-133, tritium and particulates) for releases from mixed-mode release points, µCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

$(D/Q)_m$ = The relative deposition from mixed-mode release points for areas at or beyond the site boundary, m^{-2}.

W_m = The dispersion parameter for estimating the dose to an individual at a controlling location for mixed-mode releases.

= $\overline{(X/Q)}_m$, sec/m^3, for the inhalation pathway at the location of the critical receptor.

= $\overline{(D/Q)}_m$, m^{-2}, for the food and ground plane pathways at the location of the critical receptor.

3.17 x 10-8 = The inverse of the number of seconds in a year.

R_{aij} = The dose factor for each identified radionuclide i, age group (a) and organ j, m^2-mrem/year per µCi/sec or mrem/year per $\mu Ci/m^3$.

Section 3.5.2 is applicable to the location at or beyond the site boundary where the combination of existing pathways and receptor age groups indicates the maximum potential exposure. The inhalation and ground plane exposure pathways exist at all locations; other pathways exist as determined by the most current land use census.

3.5.4.1 Dose Factor For Radionuclide i (R_{aij})

The R_{aij} values used to calculate D_p in equation (6) are determined separately for each of the potential exposure pathways, namely:

- Inhalation (I)
- Ground Plane Contamination (G)
- Grass-Cow/Goat-Milk (C)
- Grass-Cow-Meat (M)
- Vegetation (V)

The R_{aij} parameter is independent of the duration of gaseous releases and is calculated using the methodology discussed in the remainder of this section.

3.5.4.1.1 Calculation of the Inhalation Pathway Factor, R^I_{aij}

$$R^I_{aij} = K'(BR)_a(DFA_i)_a, \text{ mrem/year per } \mu Ci/m^3 \quad (7)$$

where

K' = A units conversion constant, 10^6 pCi/µCi

$(BR)_a$ = The breathing rate of the receptor age group (a), m^3/year

= 1400 (infant)
= 3700 (child)
= 8000 (teen and adult)

Values for $(BR)_a$ are obtained from NUREG-0133, pg. 32

$(DFA_i)_a$ = The organ inhalation dose factor for receptor of age group (a) for radionuclide i, mrem/pCi. Values for $(DFA_i)_a$ were obtained from Tables E-7 through E-10 of Regulatory Guide 1.109 and are presented in Tables 3.5-1 through 3.5-4 of this manual.

3.5.4.1.2 Calculation of the Ground Plane Pathway Factor, R^G_i

$$R^G_i = K'K''(SF)(DFG_i)[(1-e^{-\lambda_i t})/\lambda_i], \quad (8)$$

m^2-mrem/year per µCi/sec

where

K' = A units conversion constant, 10^6 pCi/µCi

K" = A units conversion constant, 8760 hour/year

SF = The shielding factor, dimensionless

= 0.7 as suggested in Table E-15 of Regulatory Guide 1.109

DFG_i = The ground plane dose conversion factor for radionuclide i, mrem/hour per pCi/m^2. Values for DFG_i were obtained from Table E-6 of Regulatory Guide 1.109 and are presented in Table 3.5-5 of this manual.

λ_i = The decay constant for radionuclide i, sec^{-1}

t = The exposure time, sec

= 6.31E+08 sec (20 years)

3.5.4.1.3 Calculation of the Grass-Cow/Goat-Milk Pathway Factor, R^C_{aij}

$$R^C_{aij} = K'[Q_F(U_{ap})/(\lambda_i + \lambda_w)]\, F_m(r)(DFL_i)_a \quad (9)$$

$$[f_p f_s/Y_p + (1-f_p f_s)e^{-\lambda_i t_h}/Y_s]e^{-\lambda_i t_f},$$

m^2-mrem/yr per µCi/sec

where

K' = A units conversion constant, 10^6 pCi/µCi

Q_f = The cow/goat feed consumption rate, kg(wet)/day

U_{ap} = The receptor's milk consumption rate for age group (a), liters/year

Y_p = The agricultural productivity by unit area of pasture feed grass, kg/m^2

Y_s = The agricultural productivity by unit area of stored feed, kg/m^2

F_m = The stable element transfer coefficient for milk, days/liter

r = Fraction of deposited activity retained on feed grass, dimensionless

$(DFL_i)_a$ = The organ ingestion dose factor for radionuclide i and the receptor in age group (a), mrem/pCi. Values for $(DFL_i)_a$ were obtained from Tables E-11 through E-14 of Regulatory Guide 1.109 and are presented in Table 3.5-6 through 3.5-9 of this manual.

λ_i = The decay constant for radionuclide i, sec^{-1}

λ_w = The decay constant for removal of activity on leaf and plant surfaces by weathering, sec^{-1}

= 5.73×10^{-7} sec^{-1} (corresponding to a 14-day half-life)

t_f = The transport time from pasture to animal, to milk, to receptor, sec

t_h = The transport time from pasture to harvest, to animal, to receptor, sec

f_p = Fraction of the year that the cow/goat is on pasture, dimensionless

f_s = Fraction of the cow/goat feed that is pasture grass while the cow/goat is on pasture, dimensionless

The input parameters for calculating R^C_{ajl} are listed in Table 3.5-10.

Tritium

The concentration of tritium in milk is based on its airborne concentration rather than the deposition.

$$R^c_T = K'K''F_m Q_f U_{ap} (DFL_i)_a \; 0.75(0.5/H), \text{ mrem/yr per } \mu Ci/m^3 \quad (10)$$

where

K'' = A units conversion constant, 10^3 gm/kg

H = The absolute atmospheric humidity

= 8 gm/m^3 (NUREG-0133, p. 34)

0.75 = The fraction of total feed that is water, dimensionless

0.5 = The ratio of the specific activity of the feed grass water to the atmospheric water, dimensionless

The other parameters are as defined in the calculation of R^c_{aij}

Carbon - 14

Following the development of equation C-8 on page 1.109-26 of Regulatory Guide 1.109, carbon-14 is assumed to be released as an oxide, either $C^{14}O$ or $C^{14}O_2$. The concentration of carbon-14 in milk is therefore based upon its airborne concentration assuming that the vegetation C^{14}/C ratio is the same as the local atmospheric C^{14}/C ratio.

$$R^c_{14} = K'K''F_m Q_f U_{ap} (DFL_i)_a \, p(0.11/0.16), \text{ mrem/yr per } \mu Ci/m^3 \quad (11)$$

where

p = Fractional equilibrium ratio, dimensionless

= Ratio of the total annual C-14 atmospheric release time to the total annual photosynthesis time (4400 hours) not to exceed unity

= 1.0

0.11 = Natural carbon fraction of total plant mass, dimensionless

0.16 = Atmospheric natural carbon concentration, gm/m^3

The other parameters are as defined in the calculation of R^C_T

3.5.4.1.4 Calculation of the Grass-Cow-Meat Pathway Factor, R^M_{aij}

$$R^M_{aij} = [K'Q_F(U_{ap})/(\lambda_i + \lambda_w)]F_f(r)(DFL_i)_a [f_p f_s/Y_p + [(1-f_p f_s)/Y_s]e^{-\lambda_i t_h}]e^{-\lambda_i t_s}, \quad m^2\text{-mrem/yr per } \mu Ci/sec \qquad (12)$$

where

K' = A units conversion constant, 10^6 pCi/μCi

U_{ap} = The receptor's meat consumption rate for age group (a), kg/year

F_f = The stable element transfer coefficient, days/kg

t_s = The transport time from slaughter of meat animal to receptor, seconds

t_h = The transport time from crop field to receptor, seconds

$(DFL_i)_a$ = The organ ingestion dose factor for radionuclide i and the receptor in age group (a), mrem per pCi. Values are tabulated in Table 3.5-6 through 3.5-9 of this manual.

The input parameters necessary for calculating R^M_{aij} are listed in Table 3.5-11. All other terms are as defined for equations (9) and (10).

Tritium

The concentration of tritium in meat is based on its airborne concentration rather than the deposition.

$$R^M_T = K'K''F_f Q_F U_{ap}(DFL_i)_a [0.75(0.5/H)], \quad mrem/yr \text{ per } \mu Ci/m^3 \qquad (13)$$

The terms in equation (13) are as defined in equations (10) and (12).

Carbon - 14

Following the development of equation C-8 on page 1.109-26 of Regulatory Guide 1.109, carbon-14 is assumed to be released as an oxide, either $C^{14}O$ or $C^{14}O_2$. The concentration of carbon-14 in meat is therefore based upon its airborne concentration assuming that the vegetation C^{14}/C ratio is the same as the local atmospheric C^{14}/C ratio.

$$R^{M}_{14} = K'K''F_f Q_f U_{ap} (DFL_i)_a \, p(0.11/0.16), \quad \text{mrem/yr per } \mu Ci/m^3 \qquad (14)$$

The terms in equation (14) are as defined in equations (11) and (13).

3.5.4.1.5 Calculation of the Vegetation Pathway Factor, R^{V}_{aij}

$$R^{V}_{aij} = K'[(r)/[Y_v(\lambda_i + \lambda_w)]](DFL_i)_a \, [U^{L}_{a} f_L e^{-\lambda_i t_L} + U^{S}_{a} f_g e^{-\lambda_i t_h}], \quad m^2\text{-mrem/yr per } \mu Ci/sec \qquad (15)$$

where

K' = A units conversion constant, 10^6 pCi/μCi

U^{L}_{a} = The consumption rate of fresh leafy vegetation by the receptor in age group (a), kg/year

U^{S}_{a} = The consumption rate of stored vegetation by the receptor in age group (a), kg/yr

f_L = The fraction of the annual intake of fresh leafy vegetation grown locally, dimensionless

f_g = The fraction of the annual intake of stored vegetation grown locally, dimensionless

t_L = The average time between harvest of leafy vegetation and its consumption, seconds

t_h = The average time between harvest of stored vegetation and its consumption, seconds

Y_v = the vegetation area density, kg/m^2

$(DFL_i)_a$ = The organ ingestion dose factor for radionuclide i and the receptor in age group (a), mrem per pCi. Values are tabulated in Table 3.5-6 through 3.5-9 of this manual.

The input parameters necessary for calculating R^V_{aij} are listed in Table 3.5-12. All other terms are as defined for equations (9) and (14).

Tritium

The concentration of tritium in vegetation is based on its airborne concentration rather than the deposition.

$$R^V_T = K'K''(U^L_a f_L + U^S_a f_g)(DFL_i)_a\ [0.75(0.5/H)], \text{ mrem/yr per } \mu Ci/m^3 \quad (16)$$

The terms in equation (16) are as defined in equations (10) and (15).

Carbon - 14

Following the development of equation C-8 on page 1.109-26 of Regulatory Guide 1.109, carbon-14 is assumed to be released as an oxide, either $C^{14}O$ or $C^{14}O_2$. The concentration of carbon-14 in vegetation is therefore based upon its airborne concentration assuming that the vegetation C^{14}/C ratio is the same as the local atmospheric C^{14}/C ratio.

$$R^V_{14} = K'K''(U^L_a f_L + U^S_a f_g)(DFL_i)_a\ p(0.11/0.16), \text{ mrem/yr per } \mu Ci/m^3 \quad (17)$$

The terms in equation (17) are as defined in equations (11) and (15).

The pathway dose rate factors (R^I_{aij}, R^C_{aij}, R^V_{aij}, R^M_{aij}, R^G_i), by age group are listed in Table 3.5-13 through 3.5-31.

3.6 Gaseous Radwaste (Offgas Treatment)

3.6.1 Gaseous Radwaste (Offgas Treatment) System - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The GASEOUS RADWASTE (OFFGAS) TREATMENT SYSTEM shall be in operation. This requirement applies whenever the main condenser steam jet air ejector system is in operation.

REMEDIAL REQUIREMENT:

a. With gaseous radwaste from the main condenser air ejector system being discharged without treatment for more than 7 days, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days a Special Report that includes the following information:

1. 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.

SURVEILLANCE REQUIREMENT

3.6.1.1 The GASEOUS RADWASTE (OFFGAS) TREATMENT SYSTEM shall be verified to be in operation once every 12 hours when the main condenser air ejector is in use to ensure that the main condenser offgas treatment system is functioning.

NOTE

When placing the Offgas Treatment System in the charcoal bypass mode, the alarm setpoints for the Station HVAC Exhaust and the Post-Treatment Offgas radiation monitors may be calculated to account for the increased fractions of short-lived noble gases. The noble gas release fractions shall be based either on actual measured values or on design basis noble gas concentration fractions (30-minute delay) in the primary coolant offgas.

3.7 Ventilation Exhaust Treatment

3.7.1 Ventilation Exhaust Treatment System - Operation and Surveillance Requirement

OPERATION REQUIREMENT

The VENTILATION EXHAUST TREATMENT SYSTEM (VETS) shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected doses due to gaseous effluent releases to areas at and beyond the SITE BOUNDARY (see Figure 3.1-1) would exceed 0.3 mrem to any organ in a 31-day period. This requirement applies at all times other than when the VETS is undergoing routine maintenance.

REMEDIAL REQUIREMENT:

a. With gaseous waste being discharged without treatment and in excess of the above limit, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days a Special Report that includes the following information:

   1. Explanation of why gaseous 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.

SURVEILLANCE REQUIREMENTS

3.7.1.1 Doses due to gaseous releases from the site shall be projected at least once per 31 days in accordance with this manual when the ventilation exhaust treatment system is not in use.*

*The projected doses resulting from such releases will be calculated using Section 3.5.4 methodology. If the dose impact resulting from the projected 31-day release exceeds 0.3 mrem and the VETS is capable of reducing the projected impact to less than 0.3 mrem, the VETS shall be used.

3.7.1.2 The installed VENTILATION EXHAUST TREATMENT SYSTEM shall be considered OPERABLE by meeting the Operation Requirements of Sections 3.4, 3.5.1, and 3.5.2.

3.8 Effluent Monitor Setpoint Calculations

Gaseous effluent Process Radiation Monitor (PRM) alarm setpoints shall be calculated to ensure that the instantaneous dose rate in unrestricted areas due to noble gases released do not exceed 500 mrem/year to the total body and 3000 mrem/year to the skin. The initial setpoints were calculated using the BWR/GALE code radionuclide mix obtained for CPS; when the actual radionuclide mix can be determined, it will be used for setpoint calculations. The PRM setpoints are based on the instantaneous noble gas dose rates and are applied at the point of which the effluent enters an unrestricted area.

Due to PRM limitations, non-noble gas setpoints will not be implemented to demonstrate compliance with Section 3.4.1(b). Compliance with the organ dose rate limitation is demonstrated during performance of sampling and analysis activities required by Table 3.4-1.

Both total body and skin dose setpoints will be calculated and the more restrictive limit applied to the respective PRM. The actual setpoint used may be lower than the restrictive limit since the two release points will be partitioned such that their sum does not exceed 100 percent of the restrictive limit. The percentages used to partition the release points could vary at plant discretion to accommodate plant operational conditions. In no case will the combined releases due to variations in the PRM setpoints result in effluent limits being exceeded.

3.8.1 Total Body Dose Rate Setpoint

The fraction of the total gaseous radioactivity in each gaseous effluent release path j for each noble gas radionuclide i shall be determined using the following relationship:

$$f_{ij} = C_{ij}/(\Sigma_i C_{ij}),\ \text{dimensionless} \qquad (18)$$

where

C_{ij} = The measured concentration of identified noble gas radionuclide i in gaseous effluent release path j, μCi/cc

The maximum acceptable release rate of all noble gases in release path j to comply with Section 3.4.1 is calculated by using the equation:

$$Q_{Tj} = 500\ F_j / [\ \overline{(X/Q)}_j \Sigma_i (K_i F_{ij})\ ],\ \mu Ci/sec \qquad (19)$$

where

Q_{Tj} = The maximum acceptable release rate of all noble gases in release path j, μCi/sec

F_j = Total dose rate allocation factor assigned to release path j (varying between 0.0 and 1.0), dimensionless

500 = Total body dose rate limit specified in Section 3.4.1(a), mrem/year

$\overline{(X/Q)}_j$ = The highest calculated average relative concentration of release path j at the site boundary

K_i = The total body dose factor due to gamma emissions of noble gas radionuclide i as listed in Table B-1 of Regulatory Guide 1.109 and Table 3.4-2 of this manual, mrem/yr per $\mu Ci/m^3$

f_{ij} = The fraction as defined by equation (18), dimensionless

The total maximum acceptable concentration setpoint of noble gas radionuclides in release path j is calculated using the following equation:

$$C_{Tj} = {}^{Q}T_j / R_j,\ \mu Ci/cc \qquad (20)$$

where

C_{Tj} = The total maximum acceptable concentration setpoint of all noble gases in release path j, μCi/cc

Q_{Tj} = The maximum acceptable release rate of all noble gases in release path j determined from equation (19), μCi/sec

R_j = The effluent release rate of release point j, cc/sec

3.8.2 Skin Dose Rate Setpoint

To ensure compliance with the section 3.4.1(a) skin dose rate limit, PRM setpoints shall be calculated using the methodology presented in Section 3.8.1 and by substituting the following equation for equation (19):

$$Q_{sj} = 3000F_j / [\overline{(X/Q)}_j \Sigma_i (L_i + 1.1M_i a_{ij})], \ \mu Ci/sec \qquad (21)$$

where

Q_{sj} = The maximum acceptable release rate of all noble gases in release path j, μCi/sec

F_j = Total dose rate allocation factor assigned to release path j (varying between 0.0 and 1.0), dimensionless

3000 = Skin dose rate limit specified in Section 3.4.1(a), mrem/year

$\overline{(X/Q)}_j$ = The highest calculated average relative concentration of release path j at the site boundary

L_i = The skin dose factor due to gamma emissions for each identified noble gas radionuclide i, mrem/yr per μCi/m^3, as listed in Table 3.4-2 of this manual.

1.1 = An air dose to skin dose equivalent conversion factor, mrem/mrad

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide i, mrad/yr per μCi/m^3, as listed in Table 3.4-2 of this manual

f_{ij} = The fraction defined by equation (18)

The calculated total body and skin maximum acceptable concentration setpoints are compared and the more restrictive setpoint used. A safety factor may also be applied to the concentration setpoint calculated by equation (20) to compensate for statistical fluctuations and measurement errors.

3.9 Radioactive Gaseous Monitoring Instrumentation

3.9.1 Offgas Radiation Monitoring Instrumentation - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The offgas radiation monitoring instrumentation channels shown in Table 3.9.1-1 shall be OPERABLE, with their alarm/trip setpoints within the specified limits. This requirement applies during operation of the main condenser air ejector(s).

REMEDIAL REQUIREMENT:

a. With a radiation monitoring instrumentation channel alarm/trip setpoint exceeding the value shown in Table 3.9.1-1, adjust the setpoint to within the limit within 4 hours or declare the channel inoperable.

b. With one or more radiation monitoring channels inoperable, comply with the REMEDIAL REQUIREMENT specified by Table 3.9.1-1.

SURVEILLANCE REQUIREMENTS

3.9.1.1 Each of the above required radiation monitoring instrumentation channels shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION at the frequencies shown in Table 3.9.1-2.

TABLE 3.9.1-1

OFFGAS RADIATION MONITORING INSTRUMENTATION

INSTRUMENTATION	MINIMUM CHANNELS OPERABLE[b]	ALARM/TRIP SETPOINT	REMEDIAL REQUIREMENT
1. Pre-treatment Off-gas PRM - Noble Gas Activity Monitor	1 [e]	$\leq$ 50 µCi/cc[a,c]	5
2. Post-treatment Off-gas PRM			
a. High-Range Noble Gas Activity Monitor Providing Alarm and Automatic Termination of Release	1 [e]	$\leq$ 7.06 µCi/cc[d]	6
b. Effluent System Flow Rate Measuring Device	1	NA	7
c. Sample Flow Rate Measuring Device	1	NA	7

TABLE 3.9.1-1 (Continued)

OFFGAS RADIATION MONITORING INSTRUMENTATION

TABLE NOTATIONS

a Alarm only.

b A channel may be placed in an inoperable status for up to 1 hour for the purpose of performing surveillances.

c Radioactivity concentration expected at the monitor location is a noble gas mix with a 2.9-minute decay.

d Radioactivity concentration expected at the monitor location is a noble gas mix released from the off-gas treatment system.

e Channel OPERABILITY shall include the capability of the Main Control Room Central Control Terminal (MCR-CCT) to provide the alarm status of the applicable radiation monitor channel(s).

REMEDIAL REQUIREMENT

REMEDIAL REQUIREMENT 5

a. With the MCR-CCT inoperable,

1. Perform a CHANNEL CHECK using local monitor indication within 8 hours and at least once per 8 hours thereafter, and

2. Restore the MCR-CCT to OPERABLE status for the applicable channel(s) within the next 30 days, and if unsuccessful, prepare and submit to the Regional Administrator of the Regional Office of the NRC within the next 10 days a Special Report outlining the cause of the CCT failure or malfunction and the action taken to restore the inoperable equipment to OPERABLE status.

TABLE 3.9.1-1 (Continued)

OFFGAS RADIATION MONITORING INSTRUMENTATION

TABLE NOTATIONS

b. With the Pre-treatment Off-gas PRM - Noble Gas Activity Monitor otherwise inoperable, gases from the main condenser off-gas treatment system may be released to the environment provided:

1. The off-gas treatment system is not bypassed, and

2. The post-treatment air ejector off-gas PRM high range noble gas activity monitor is OPERABLE, or the provisions of REMEDIAL REQUIREMENT 6-b are in effect.

REMEDIAL REQUIREMENT 6

a. With the MCR-CCT inoperable,

1. Perform a CHANNEL CHECK using local monitor indication within 8 hours and at least once per 8 hours thereafter, and

2. Restore the MCR-CCT to OPERABLE status for the applicable channel(s) within the next 30 days, and if unsuccessful, prepare and submit to the Regional Administrator of the Regional Office of the NRC within the next 10 days a Special Report outlining the cause of the CCT failure or malfunction and the action taken to restore the inoperable equipment to OPERABLE status.

TABLE 3.9.1-1 (Continued)

OFFGAS RADIATION MONITORING INSTRUMENTATION

TABLE NOTATIONS

b. With the Post-treatment Off-gas PRM High Range Noble Gas Activity Monitor otherwise inoperable, effluent releases via this pathway may continue provided grab samples are taken at least once per 8 hours, and a noble gas gamma isotopic analysis performed within 24 hours.

REMEDIAL REQUIREMENT

7 With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 8 hours.

TABLE 3.9.1-2

OFFGAS RADIATION MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENTATION	CHANNEL CHECK	SOURCE CHECK	CHANNEL FUNCTIONAL TEST	CHANNEL CALIBRATION
1. Pre-Treatment Off-gas PRM-Noble Gas Activity Monitor	D(3)	M	Q(1)	R(2)
2. Post-Treatment Off-gas PRM				
a. High Range Noble Gas Activity Monitor Providing Alarm and Automatic Termination of Release	D(3)	D	Q(1)	R(2)*
b. Effluent System Flow-Rate Measuring Device	D	NA	Q	R
c. Sample Flow-Rate Measuring Device	D	NA	Q	R

TABLE 3.9.1-2 (Continued)

OFFGAS RADIATION MONITORING
INSTRUMENTATION SURVEILLANCE REQUIREMENTS

TABLE NOTATION

a Automatic isolation of valve 1N66-F060 shall be demonstrated during the CHANNEL CALIBRATION.

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that the MCR-CCT responds with annunciation and event display to each of the following conditions:

1. Instrument indicates measured levels above the alarm/trip (HIGH) setpoint.

2. Detector failure (LOW FAIL, HI FAIL).

3. Sample flow failure (EXTERNAL FAIL).

4. Instrument not set in normal operate mode (UNINITIALIZED, CALIBRATE, MAINTENANCE, or STANDBY).

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended energy range and measurement range. Subsequent CHANNEL CALIBRATION shall be performed using the initial radioactive standards or other standards of equivalent quality or radioactive sources that have been related to the initial calibration.

(3) The CHANNEL CHECK shall also determine that channel communication is established to the MCR-CCT.

3.9.2 Radioactive Gaseous Effluent Monitoring Instrumentation - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.9.2-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Section 3.4.1 and Technical Specification 3.7.5 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in this manual. This requirement applies as shown in Table 3.9.2-1.

REMEDIAL REQUIREMENT:

a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above requirement, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, comply with the REMEDIAL REQUIREMENT specified in Table 3.9.2-1. Restore the inoperable instrumentation to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report pursuant to Technical Specification 5.6.3 why this inoperability was not corrected in a timely manner.

SURVEILLANCE REQUIREMENTS

3.9.2.1 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 3.9.2-2.

TABLE 3.9.2-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE[c]	APPLICABILITY	REMEDIAL REQUIREMENT
1. Station HVAC Exhaust PRM			
a. High-Range Noble Gas Activity Monitor	1[d]	a	8
b. Low-Range Noble Gas Activity Monitor	1[d]	a	8
c. Iodine Sampler[(e)]	1	a	9
d. Particulate Sampler[(e)]	1	a	9
e. Sample Flow-Rate Measuring Device	1	a	10
2. Standby Gas Treatment System Exhaust PRM			
a. High-Range Noble Gas Activity Monitor	1[d]	b	8
b. Low-Range Noble Gas Activity Monitor	1[d]	b	8
c. Iodine Sampler[e]	1	b	9
d. Particulate Sampler[e]	1	b	9
e. Sample Flow-Rate Measuring Device	1	b	10
3. Station HVAC Effluent System Flow-Rate Measuring Device (10PR051-6)	1	a	10
4. SGTS Effluent System Flow-Rate Measuring Device (10PR051-1), 0FIVG004, or 0FIVG104	1	b	10

TABLE 3.9.2-1 (Continued)
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
TABLE NOTATIONS

a At all times.

b During standby gas treatment system operation.

c A channel may be placed in an inoperable status for up to 1 hour for the purpose of performing surveillances.

d Channel OPERABILITY shall include the capability of the Main Control Room Central Control Terminal (MCR-CCT) to provide the alarm status of the applicable radiation monitor channel(s).

e Filter media (particulate collection patch for particulates and charcoal cartridge for iodines) in place with an operating sample pump constitutes an iodine/particulate sampler.

REMEDIAL REQUIREMENT

REMEDIAL REQUIREMENT 8	a. With the communication link OR the MCR-CCT inoperable, perform a CHANNEL CHECK using local monitor indication within 8 hours and at least once per 8 hours thereafter. b. With the noble gas activity monitor channel(s) otherwise inoperable, effluent releases via this pathway may continue provided grab samples are taken at least once per 8 hours and analyzed for gross noble gas activity within 24 hours.
REMEDIAL REQUIREMENT 9	With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via this pathway may continue provided that, within 4 hours after the channel has been declared inoperable, samples required by Table 3.4-1 are continuously collected with auxiliary sampling equipment.
REMEDIAL REQUIREMENT 10	With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours.

TABLE 3.9.2-2

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	APPLICABILITY
1. Station HVAC Exhaust PRM					
a. High-Range Noble Gas Activity Monitor	D(3)	M	R(2)	Q(1)	a
b. Low-Range Noble Gas Activity Monitor	D(3)	M	R(2)	Q(1)	a
c. Iodine Sampler	W	NA	NA	NA	a
d. Particulate Sampler	W	NA	NA	NA	a
e. Sample Flow Rate Measuring Device	D	NA	R	Q	a
f. Effluent System Flow Rate Measuring Device	D	NA	R	Q	a
2. Standby Gas Treatment System Exhaust PRM					
a. High-Range Noble Gas Activity Monitor	D(3)	NA	R(2)	Q(1)	b
b. Low-Range Noble Gas Activity Monitor	D(3)	M	R(2)	Q(1)	b
c. Iodine Sampler	W	NA	NA	NA	b
d. Particulate Sampler	W	NA	NA	NA	b
e. Sample Flow Rate Measuring Device	D	NA	R	Q	b
f. Effluent System Flow Rate Measuring Device	D	NA	R	Q	b
3. Inservice Calibrations on Station HVAC Exhaust and Standby Gas Treatment System Exhaust PRMs	NA	NA	A	NA	c,d

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TABLE 3.9.2-2 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

TABLE NOTATIONS

a At all times.

b During operation of the standby gas treatment system.

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that the MCR-CCT responds with annunciation and event display to each of the following conditions:

1. Instrument indicates measured levels above the alarm (HIGH) setpoint.

2. Detector failure (LOW FAIL, HI FAIL).

3. Sample flow failure (EXTERNAL FAIL).

4. Instrument not set in normal operate mode (UNINITIALIZED, CALIBRATE, MAINTENANCE, or STANDBY).

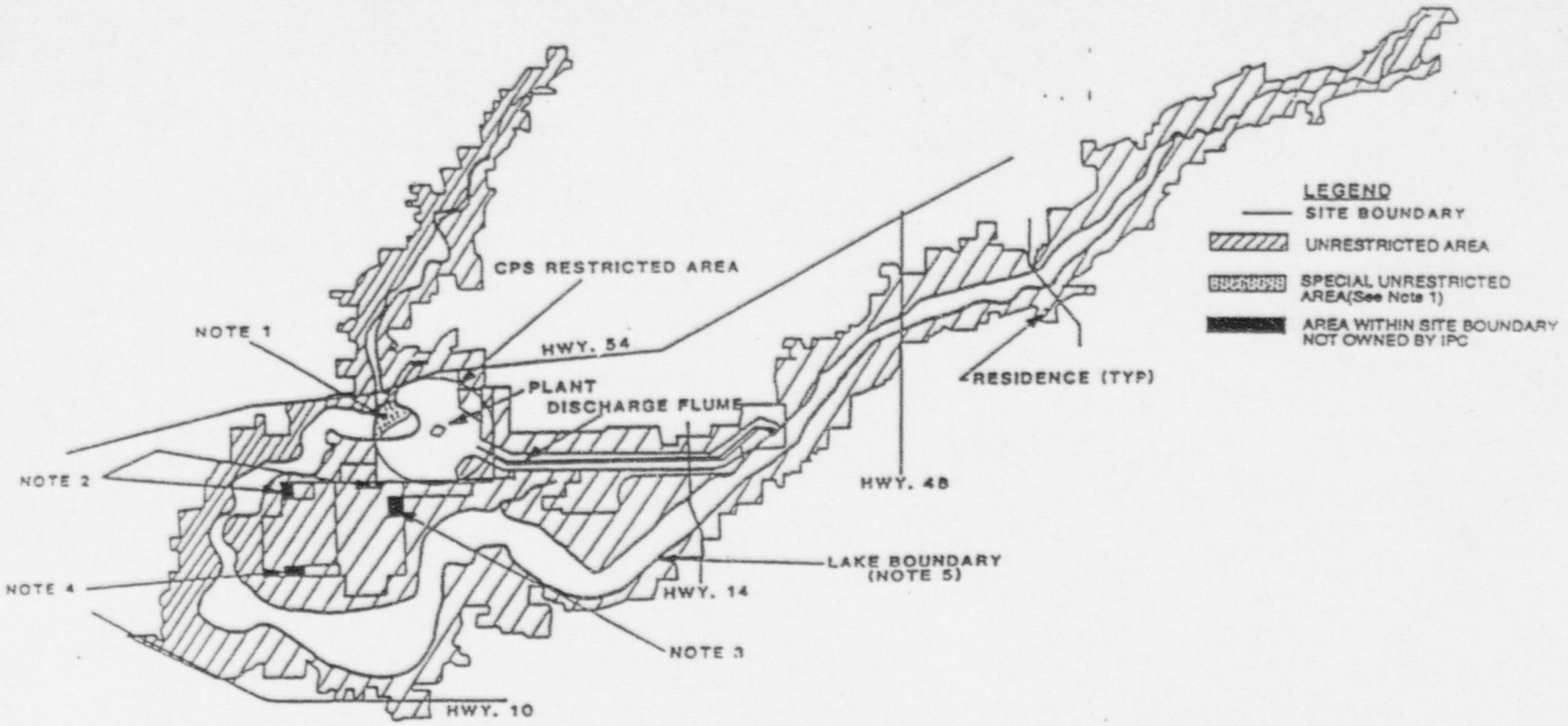
(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. Subsequent CHANNEL CALIBRATION shall be performed using the initial radioactive standards or other standards of equivalent quality or radioactive sources that have been related to the initial calibration.

(3) The CHANNEL CHECK shall also determine that channel communication is established to the MCR-CCT.

c Per Regulatory Guide 1.21, compare the PRM readings with grab sample results for the noble gas and particulate/iodine channels. Modify the channel calibrations as necessary to ensure monitor readings are related to the concentration or release rates of nuclides in the monitored path.

d Not applicable if the activity in the sample stream is not high enough to provide a statistically relevant comparison.

FIGURE 3.1-1
CPS SITE BOUNDARY FOR GASEOUS EFFLUENTS

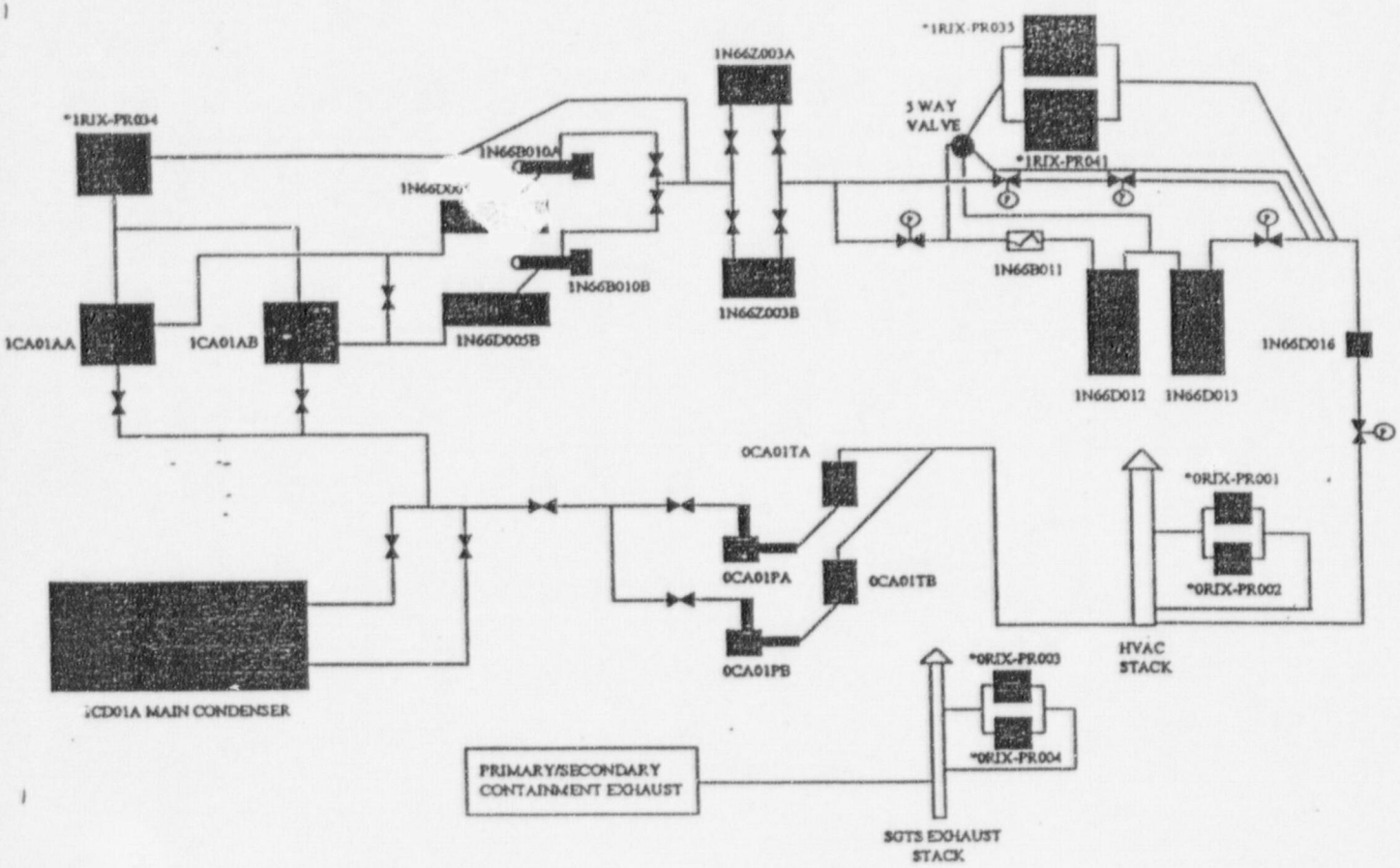


NOTES

1. The area in the lake between the buoys and the exclusion area boundary is unrestricted at this time. But will be controlled if plant effluent conditions warrant closure.
2. Land parcel not owned by Illinois Power, includes residences.
3. Land parcel not owned by Illinois Power, oil company pipeline pumping station.
4. Land parcel not owned by Illinois Power, agricultural use.
5. The lake shoreline is approximately 690 ft. MSL elevation line.

FIGURE 3.3-1

MAIN CONDENSER OFF-GAS TREATMENT SYSTEM



*Monitors required by Sections 3.9.1 and 3.9.2

1CD01A Main Condenser	0CA01TA CV Separator Tank A	1N66B010B Cooler Condenser B	1N66D013 Charcoal Adsorber	1RIX-PR035 Off-Gas Post Treatment PRM
1CA01AA Steam Jet Air Ejector A	0CA01TB CV Separator Tank B	1N66Z003A Dessicant Dryer A	1N66D016 HEPA Filter	1RIX-PR041 Off-Gas Post Treatment PRM
1CA01AB Steam Jet Air Ejector B	1N66D005A Recombiner A	1N66Z003B Dessicant Dryer B	0RIX-PR001 HVAC Stack PRM #1	0RIX-PR003 Standby Gas Treatment PRM
0CA01PA Condenser Vacuum (CV) Pump A	1N66D005B Recombiner B	1N66B011 Gas Cooler	0RIX-PR002 HVAC Stack PRM #2	0RIX-PR004 Standby Gas Treatment PRM
0CA01PB CV Pump B	1N66B010A Cooler Condenser A	1N66D012 Charcoal Adsorber	1RIX-PR034 Off-Gas Pretreatment PRM	

TABLE 3.5-1

INHALATION DOSE FACTORS FOR INFANT - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C-14	1.89E-05*	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA-24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P-32	1.45E-03	8.03E-05	5.53E-05	NO DATA	NO DATA	NO DATA	1.15E-05
CR-51	NO DATA	NO DATA	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN-54	NO DATA	1.81E-05	3.56E-06	NO DATA	3.56E-06	7.14E-04	5.04E-06
MN-56	NO DATA	1.10E-09	1.58E-10	NO DATA	7.86E-10	8.95E-06	5.12E-05
FE-55	1.41E-05	8.39E-06	2.38E-06	NO DATA	NO DATA	6.21E-05	7.82E-07
FE-59	9.69E-06	1.68E-05	6.77E-06	NO DATA	NO DATA	7.25E-04	1.77E-05
CO-58	NO DATA	8.71E-07	1.30E-06	NO DATA	NO DATA	5.55E-04	7.95E-06
CO-60	NO DATA	5.73E-06	8.41E-06	NO DATA	NO DATA	3.22E-03	2.28E-05
NI-63	2.42E-04	1.46E-05	8.29E-06	NO DATA	NO DATA	1.49E-04	1.73E-06
NI-65	1.71E-09	2.03E-10	8.79E-11	NO DATA	NO DATA	5.80E-06	3.58E-05
CU-64	NO DATA	1.34E-09	5.53E-10	NO DATA	2.84E-09	6.64E-06	1.07E-05
ZN-65	1.38E-05	4.47E-05	2.22E-05	NO DATA	2.32E-05	4.62E-04	3.67E-05
ZN-69	3.85E-11	6.91E-11	5.13E-12	NO DATA	2.87E-11	1.05E-06	9.44E-06
BR-83	NO DATA	NO DATA	2.72E-07	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	2.86E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	1.46E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	1.36E-04	6.30E-05	NO DATA	NO DATA	NO DATA	2.17E-06
RB-88	NO DATA	3.98E-07	2.05E-07	NO DATA	NO DATA	NO DATA	2.42E-07
RB-89	NO DATA	2.29E-07	1.47E-07	NO DATA	NO DATA	NO DATA	4.87E-08
SR-89	2.84E-04	NO DATA	8.15E-06	NO DATA	NO DATA	1.45E-03	4.57E-05
SR-90	2.92E-02	NO DATA	1.85E-03	NO DATA	NO DATA	8.03E-03	9.36E-05
SR-91	6.83E-08	NO DATA	2.47E-09	NO DATA	NO DATA	3.76E-05	5.24E-05
SR-92	7.50E-09	NO DATA	2.79E-10	NO DATA	NO DATA	1.70E-05	1.00E-04
Y-90	2.35E-06	NO DATA	6.30E-08	NO DATA	NO DATA	1.92E-04	7.43E-05
Y-91m	2.91E-10	NO DATA	9.90E-12	NO DATA	NO DATA	1.99E-06	1.68E-06
Y-91	4.20E-04	NO DATA	1.12E-05	NO DATA	NO DATA	1.75E-03	5.02E-05
Y-92	1.17E-08	NO DATA	3.29E-10	NO DATA	NO DATA	1.75E-05	9.04E-05
Y-93	1.07E-07	NO DATA	2.91E-09	NO DATA	NO DATA	5.46E-05	1.19E-04
ZR-95	8.24E-05	1.99E-05	1.45E-05	NO DATA	2.22E-05	1.25E-03	1.55E-05
ZR-97	1.07E-07	1.83E-08	8.36E-09	NO DATA	1.85E-08	7.88E-05	1.00E-04
NB-95	1.12E-05	4.59E-06	2.70E-06	NO DATA	3.37E-06	3.42E-04	9.05E-06
MO-99	NO DATA	1.18E-07	2.31E-08	NO DATA	1.89E-07	9.63E-05	3.48E-05
TC-99m	9.98E-13	2.06E-12	2.66E-11	NO DATA	2.22E-11	5.79E-07	1.45E-06
TC-101	4.65E-14	5.88E-14	5.80E-13	NO DATA	6.99E-13	4.17E-07	6.03E-07
RU-103	1.44E-06	NO DATA	4.85E-07	NO DATA	3.03E-06	3.94E-04	1.15E-05
RU-105	8.74E-10	NO DATA	2.93E-10	NO DATA	6.42E-10	1.12E-05	3.46E-05
RU-106	6.20E-05	NO DATA	7.7E-06	NO DATA	7.61E-05	8.26E-03	1.17E-04
AG-110m	7.13E-06	5.16E-06	3.57E-06	NO DATA	7.80E-06	2.62E-03	2.36E-05
TE-125m	3.40E-06	1.42E-06	4.70E-07	1.16E-06	NO DATA	3.19E-04	9.22E-06
TE-127m	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE-127	1.59E-09	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE-129m	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE-129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE-131m	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE-131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06

TABLE 3.5-1 (continued)

INHALATION DOSE FACTORS FOR INFANT - $(DFA_1)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I-130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	NO DATA	1.42E-06
I-131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	NO DATA	7.56E-07
I-132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	NO DATA	1.36E-06
I-133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	NO DATA	1.54E-06
I-134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	NO DATA	9.21E-07
I-135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	NO DATA	1.31E-06
CS-134	2.83E-04	5.02E-04	5.32E-05	NO DATA	1.36E-04	5.69E-05	9.53E-07
CS-136	3.45E-05	9.61E-05	3.78E-05	NO DATA	4.03E-05	8.40E-06	1.02E-06
CS-137	3.92E-04	4.37E-04	3.25E-05	NO DATA	1.23E-04	5.09E-05	9.53E-07
CS-138	3.61E-07	5.58E-07	2.84E-07	NO DATA	2.93E-07	4.67E-08	6.26E-07
BA-139	1.06E-09	7.03E-13	3.07E-11	NO DATA	4.23E-13	4.25E-06	3.64E-05
BA-140	4.00E-05	4.00E-08	2.07E-06	NO DATA	9.59E-09	1.14E-03	2.74E-05
BA-141	1.12E-10	7.70E-14	3.55E-12	NO DATA	4.64E-14	2.12E-06	3.39E-06
BA-142	2.84E-11	2.36E-14	1.40E-12	NO DATA	1.36E-14	1.11E-06	4.95E-07
LA-140	3.61E-07	1.43E-07	3.68E-08	NO DATA	NO DATA	1.20E-04	6.06E-05
LA-142	7.36E-10	2.69E-10	6.46E-11	NO DATA	NO DATA	5.87E-06	4.25E-05
CE-141	1.98E-05	1.19E-05	1.42E-06	NO DATA	3.75E-06	3.69E-04	1.54E-05
CE-143	2.09E-07	1.38E-07	1.58E-08	NO DATA	4.03E-08	8.30E-05	3.55E-05
CE-144	2.28E-03	8.65E-04	1.26E-04	NO DATA	3.84E-04	7.03E-03	1.06E-04
PR-143	1.00E-05	3.74E-06	4.99E-07	NO DATA	1.41E-06	3.09E-04	2.66E-05
PR-144	3.42E-11	1.32E-11	1.72E-12	NO DATA	4.80E-12	1.15E-06	3.06E-06
ND-147	5.67E-06	5.81E-06	3.57E-07	NO DATA	2.25E-06	2.30E-04	2.23E-05
W-187	9.26E-09	6.44E-09	2.23E-09	NO DATA	NO DATA	2.83E-05	2.54E-05
NP-239	2.65E-07	2.37E-08	1.34E-08	NO DATA	4.73E-08	4.25E-05	1.78E-05

*1.89×10^{-05}
**Less than 10^{-24}

TABLE 3.5-2

INHALATION DOSE FACTORS FOR CHILD - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C-14	9.07E-06*	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA-24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P-32	7.04E-04	3.09E-05	2.67E-05	NO DATA	NO DATA	NO DATA	1.14E-05
CR-51	NO DATA	NO DATA	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN-54	NO DATA	1.16E-05	2.57E-06	NO DATA	2.71E-06	4.26E-04	6.19E-06
MN-56	NO DATA	4.48E-10	8.43E-11	NO DATA	4.52E-10	3.55E-06	3.33E-05
FE-55	1.28E-05	6.80E-06	2.10E-06	NO DATA	NO DATA	3.00E-05	7.75E-07
FE-59	5.59E-06	9.04E-06	4.51E-06	NO DATA	NO DATA	3.43E-04	1.91E-05
CO-58	NO DATA	4.79E-07	8.55E-07	NO DATA	NO DATA	2.99E-04	9.29E-06
CO-60	NO DATA	3.55E-06	6.12E-06	NO DATA	NO DATA	1.91E-03	2.60E-05
NI-63	2.22E-04	1.25E-05	7.56E-06	NO DATA	NO DATA	7.43E-05	1.71E-06
NI-65	8.08E-10	7.99E-11	4.44E-11	NO DATA	NO DATA	2.21E-06	2.27E-05
CU-64	NO DATA	5.39E-10	2.90E-10	NO DATA	1.63E-09	2.59E-06	9.92E-06
ZN-65	1.15E-05	3.06E-05	1.90E-05	NO DATA	1.93E-05	2.69E-04	4.41E-06
ZN-69	1.81E-11	2.61E-11	2.41E-12	NO DATA	1.58E-11	3.84E-07	2.75E-06
BR-83	NO DATA	NO DATA	1.28E-07	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	1.48E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	6.84E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	5.36E-05	3.09E-05	NO DATA	NO DATA	NO DATA	2.16E-06
RB-88	NO DATA	1.52E-07	9.90E-08	NO DATA	NO DATA	NO DATA	4.66E-09
RB-89	NO DATA	9.33E-08	7.83E-08	NO DATA	NO DATA	NO DATA	5.11E-10
SR-89	1.62E-04	NO DATA	4.66E-06	NO DATA	NO DATA	5.83E-04	4.52E-05
SR-90	2.73E-02	NO DATA	1.74E-03	NO DATA	NO DATA	3.99E-03	9.28E-05
SR-91	3.28E-08	NO DATA	1.24E-09	NO DATA	NO DATA	1.44E-05	4.70E-05
SR-92	3.54E-09	NO DATA	1.42E-10	NO DATA	NO DATA	6.49E-06	6.55E-05
Y-90	1.11E-06	NO DATA	2.99E-08	NO DATA	NO DATA	7.07E-05	7.24E-05
Y-91m	1.37E-10	NO DATA	4.98E-12	NO DATA	NO DATA	7.60E-07	4.64E-07
Y-91	2.47E-04	NO DATA	6.59E-06	NO DATA	NO DATA	7.10E-04	4.97E-05
Y-92	5.50E-09	NO DATA	1.57E-10	NO DATA	NO DATA	6.46E-06	6.46E-05
Y-93	5.04E-08	NO DATA	1.38E-09	NO DATA	NO DATA	2.01E-05	1.05E-04
ZR-95	5.13E-05	1.13E-05	1.00E-05	NO DATA	1.61E-05	6.03E-04	1.65E-05
ZR-97	5.07E-08	7.34E-09	4.32E-09	NO DATA	1.05E-08	3.06E-05	9.49E-05
NB-95	6.35E-06	2.48E-06	1.77E-06	NO DATA	2.33E-06	1.66E-04	1.00E-05
MO-99	NO DATA	4.66E-08	1.15E-08	NO DATA	1.06E-07	3.66E-05	3.42E-05
TC-99m	4.81E-13	9.41E-13	1.56E-11	NO DATA	1.37E-11	2.57E-07	1.30E-06
TC-101	2.19E-14	2.30E-14	2.91E-13	NO DATA	3.92E-13	1.58E-07	4.41E-09
RU-103	7.55E-07	NO DATA	2.90E-07	NO DATA	1.90E-06	1.79E-04	1.21E-05
RU-105	4.13E-10	NO DATA	1.50E-10	NO DATA	3.63E-10	4.30E-06	2.69E-05
RU-106	3.68E-05	NO DATA	4.57E-06	NO DATA	4.97E-05	3.87E-03	1.16E-04
AG-110m	4.56E-06	3.08E-06	2.47E-06	NO DATA	5.74E-06	1.48E-03	2.71E-05
TE-125m	1.82E-06	6.29E-07	2.47E-07	5.20E-07	NO DATA	1.29E-04	9.13E-06
TE-127m	6.72E-06	2.31E-06	8.18E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE-127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE-129m	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE-129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE-131m	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE-131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07

TABLE 3.5-2 (continued)

INHALATION DOSE FACTORS FOR CHILD - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I-130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	NO DATA	1.38E-06
I-131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	NO DATA	7.68E-07
I-132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	NO DATA	8.65E-07
I-133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	NO DATA	1.48E-06
I-134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	NO DATA	2.58E-07
I-135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	NO DATA	1.20E-06
CS-134	1.76E-04	2.74E-04	6.07E-05	NO DATA	8.93E-05	3.27E-05	1.04E-06
CS-136	1.76E-05	4.62E-05	3.14E-05	NO DATA	2.58E-05	3.93E-06	1.13E-06
CS-137	2.45E-04	2.23E-04	3.47E-05	NO DATA	7.63E-05	2.81E-05	9.78E-07
CS-138	1.71E-07	2.27E-07	1.50E-07	NO DATA	1.68E-07	1.84E-08	7.29E-08
BA-139	4.98E-10	2.66E-13	1.45E-11	NO DATA	2.33E-13	1.56E-06	1.56E-05
BA-140	2.00E-05	1.75E-08	1.17E-06	NO DATA	5.71E-09	4.71E-04	2.75E-05
BA-141	5.29E-11	2.95E-14	1.72E-12	NO DATA	2.56E-14	7.89E-07	7.44E-08
BA-142	1.35E-11	9.73E-15	7.54E-13	NO DATA	7.87E-15	4.44E-07	7.41E-10
LA-140	1.74E-07	6.08E-08	2.04E-08	NO DATA	NO DATA	4.94E-05	6.10E-05
LA-142	3.50E-10	1.11E-10	3.49E-11	NO DATA	NO DATA	2.35E-06	2.05E-05
CE-141	1.06E-05	5.28E-06	7.83E-07	NO DATA	2.31E-06	1.47E-04	1.53E-05
CE-143	9.89E-08	5.37E-08	7.77E-09	NO DATA	2.26E-08	3.12E-05	3.44E-05
CE-144	1.83E-03	5.72E-04	9.77E-05	NO DATA	3.17E-04	3.23E-03	1.05E-04
PR-143	4.99E-06	1.50E-06	2.47E-07	NO DATA	8.11E-07	1.17E-04	2.63E-05
PR-144	1.61E-11	4.99E-12	8.10E-13	NO DATA	2.64E-12	4.23E-07	5.32E-08
ND-147	2.92E-06	2.36E-06	1.84E-07	NO DATA	1.30E-06	8.87E-05	2.22E-05
W-187	4.41E-09	2.61E-09	1.17E-09	NO DATA	NO DATA	1.11E-05	2.46E-05
NP-239	1.26E-07	9.04E-09	6.35E-09	NO DATA	2.63E-08	1.57E-05	1.73E-05

*9.70×10^{-06}
**Less than 10^{-24}

TABLE 3.5-3

INHALATION DOSE FACTORS FOR TEEN - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C-14	3.25E-06*	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA-24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P-32	2.36E-04	1.37E-05	8.95E-06	NO DATA	NO DATA	NO DATA	1.16E-05
CR-51	NO DATA	NO DATA	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN-54	NO DATA	6.39E-06	1.05E-06	NO DATA	1.59E-06	2.48E-04	8.35E-06
MN-56	NO DATA	2.12E-10	3.15E-11	NO DATA	2.24E-10	1.90E-06	7.18E-06
FE-55	4.18E-06	2.98E-06	6.93E-07	NO DATA	NO DATA	1.55E-05	7.99E-07
FE-59	1.99E-06	4.62E-06	1.79E-06	NO DATA	NO DATA	1.91E-04	2.23E-05
CO-58	NO DATA	2.59E-07	3.47E-07	NO DATA	NO DATA	1.68E-04	1.19E-05
CO-60	NO DATA	1.89E-06	2.48E-06	NO DATA	NO DATA	1.09E-03	3.24E-05
NI-63	7.25E-05	5.43E-06	2.47E-06	NO DATA	NO DATA	3.84E-05	1.77E-06
NI-65	2.73E-10	3.66E-11	1.59E-11	NO DATA	NO DATA	1.17E-06	4.59E-06
CU-64	NO DATA	2.54E-10	1.06E-10	NO DATA	8.01E-10	1.39E-06	7.68E-06
ZN-65	4.82E-06	1.67E-05	7.80E-06	NO DATA	1.08E-05	1.55E-04	5.83E-06
ZN-69	6.04E-12	1.15E-11	8.07E-13	NO DATA	7.53E-12	1.98E-07	3.56E-08
BR-83	NO DATA	NO DATA	4.30E-08	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	5.41E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	2.29E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	2.38E-05	1.05E-05	NO DATA	NO DATA	NO DATA	2.21E-06
RB-88	NO DATA	6.82E-08	3.40E-08	NO DATA	NO DATA	NO DATA	3.65E-15
RB-89	NO DATA	4.40E-08	2.91E-08	NO DATA	NO DATA	NO DATA	4.22E-17
SR-89	5.43E-05	NO DATA	1.56E-06	NO DATA	NO DATA	3.02E-04	4.64E-05
SR-90	1.35E-02	NO DATA	8.35E-04	NO DATA	NO DATA	2.06E-03	9.56E-05
SR-91	1.10E-08	NO DATA	4.39E-10	NO DATA	NO DATA	7.59E-06	3.24E-05
SR-92	1.19E-09	NO DATA	5.08E-11	NO DATA	NO DATA	3.43E-06	1.49E-05
Y-90	3.73E-07	NO DATA	1.00E-08	NO DATA	NO DATA	3.66E-05	6.99E-05
Y-91m	4.63E-11	NO DATA	1.77E-12	NO DATA	NO DATA	4.00E-07	3.77E-09
Y-91	8.26E-05	NO DATA	2.21E-06	NO DATA	NO DATA	3.67E-04	5.11E-05
Y-92	1.84E-09	NO DATA	5.36E-11	NO DATA	NO DATA	3.35E-06	2.06E-05
Y-93	1.69E-08	NO DATA	4.65E-10	NO DATA	NO DATA	1.04E-05	7.24E-05
ZR-95	1.82E-05	5.73E-06	3.94E-06	NO DATA	8.42E-06	3.36E-04	1.86E-05
ZR-97	1.72E-08	3.40E-09	1.57E-09	NO DATA	5.15E-09	1.62E-05	7.88E-05
NB-95	2.32E-06	1.29E-06	7.08E-07	NO DATA	1.25E-06	9.39E-05	1.21E-05
MO-99	NO DATA	2.11E-08	4.03E-09	NO DATA	5.14E-08	1.92E-05	3.36E-05
TC-99m	1.73E-13	4.83E-13	6.24E-12	NO DATA	7.20E-12	1.44E-07	7.66E-07
TC-101	7.40E-15	1.05E-14	1.03E-13	NO DATA	1.90E-13	8.34E-08	1.09E-16
RU-103	2.63E-07	NO DATA	1.12E-07	NO DATA	9.29E-07	9.79E-05	1.36E-05
RU-105	1.40E-10	NO DATA	5.42E-11	NO DATA	1.76E-10	2.27E-06	1.13E-05
RU-106	1.23E-05	NO DATA	1.55E-06	NO DATA	2.38E-05	2.01E-03	1.20E-04
AG-110m	1.73E-06	1.64E-06	9.99E-07	NO DATA	3.13E-06	8.44E-04	3.41E-05
TE-125m	6.10E-07	2.80E-07	8.34E-08	1.75E-07	NO DATA	6.70E-05	9.38E-06
TE-127m	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE-127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE-129m	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE-129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE-131m	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE-131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09

TABLE 3.5-3 (continued)

INHALATION DOSE FACTORS FOR TEEN - (DFA_1).
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I-130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	NO DATA	1.14E-06
I-131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	NO DATA	8.11E-07
I-132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	NO DATA	1.59E-07
I-133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	NO DATA	1.29E-06
I-134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	NO DATA	2.55E-09
I-135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	NO DATA	8.69E-07
CS-134	6.28E-05	1.41E-04	6.86E-05	NO DATA	4.69E-05	1.83E-05	1.22E-06
CS-136	6.44E-06	2.42E-05	1.71E-05	NO DATA	1.38E-05	2.22E-06	1.36E-06
CS-137	8.38E-05	1.06E-04	3.89E-05	NO DATA	3.80E-05	1.51E-05	1.06E-06
CS-138	5.82E-08	1.07E-07	5.58E-08	NO DATA	8.28E-08	9.84E-09	3.38E-11
BA-139	1.67E-10	1.18E-13	4.87E-12	NO DATA	1.11E-13	8.08E-07	8.06E-07
BA-140	6.84E-06	8.38E-09	4.40E-07	NO DATA	2.85E-09	2.54E-04	2.86E-05
BA-141	1.78E-11	1.32E-14	5.93E-13	NO DATA	1.23E-14	4.11E-07	9.33E-14
BA-142	4.62E-12	4.63E-15	2.84E-13	NO DATA	3.92E-15	2.39E-07	5.99E-20
LA-140	5.99E-08	2.95E-08	7.82E-09	NO DATA	NO DATA	2.68E-05	6.09E-05
LA-142	1.20E-10	5.31E-11	1.32E-11	NO DATA	NO DATA	1.27E-06	1.50E-06
CE-141	3.55E-06	2.37E-06	2.71E-07	NO DATA	1.11E-06	7.67E-05	1.58E-05
CE-143	3.32E-08	2.42E-08	2.70E-09	NO DATA	1.08E-08	1.63E-05	3.19E-05
CE-144	6.11E-04	2.53E-04	3.28E-05	NO DATA	1.51E-04	1.67E-03	1.08E-04
PR-143	1.67E-06	6.64E-07	8.28E-08	NO DATA	3.86E-07	6.04E-05	2.67E-05
PR-144	5.37E-12	2.20E-12	2.72E-13	NO DATA	1.26E-12	2.19E-07	2.94E-14
ND-147	9.83E-07	1.07E-06	6.41E-08	NO DATA	6.28E-07	4.65E-05	2.28E-05
W-187	1.50E-09	1.22E-09	4.29E-10	NO DATA	NO DATA	5.92E-06	2.21E-05
NP-239	4.23E-08	3.99E-09	2.21E-09	NO DATA	1.25E-08	8.11E-06	1.65E-05

*3.52×10^{-06}
**Less than 10^{-24}

TABLE 3.5-4

INHALATION DOSE FACTORS FOR ADULT - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C-14	2.27E-06*	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA-24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P-32	1.65E-04	9.64E-06	6.26E-06	NO DATA	NO DATA	NO DATA	1.08E-05
CR-51	NO DATA	NO DATA	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN-54	NO DATA	4.95E-06	7.87E-07	NO DATA	1.23E-06	1.75E-04	9.67E-06
MN-56	NO DATA	1.55E-10	2.29E-11	NO DATA	1.63E-10	1.18E-06	2.53E-06
FE-55	3.07E-06	2.12E-06	4.93E-07	NO DATA	NO DATA	9.01E-06	7.54E-07
FE-59	1.47E-06	3.47E-06	1.32E-06	NO DATA	NO DATA	1.27E-04	2.35E-05
CO-58	NO DATA	1.98E-07	2.59E-07	NO DATA	NO DATA	1.16E-04	1.33E-05
CO-60	NO DATA	1.44E-06	1.85E-06	NO DATA	NO DATA	7.46E-04	3.56E-05
NI-63	5.40E-05	3.93E-06	1.81E-06	NO DATA	NO DATA	2.23E-05	1.67E-06
NI-65	1.92E-10	2.62E-11	1.14E-11	NO DATA	NO DATA	7.00E-07	1.54E-06
CU-64	NO DATA	1.83E-10	7.69E-11	NO DATA	5.78E-10	8.48E-07	6.12E-06
ZN-65	4.05E-06	1.29E-05	5.82E-06	NO DATA	8.62E-06	1.08E-04	6.60E-06
ZN-69	4.23E-12	8.14E-12	5.65E-13	NO DATA	5.27E-12	1.15E-07	2.04E09
BR-83	NO DATA	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	2.90E-08
BR-84	NO DATA	NO DATA	3.91E-08	NO DATA	NO DATA	NO DATA	2.05E-13
BR-85	NO DATA	NO DATA	1.60E-09	NO DATA	NO DATA	NO DATA	LT E-24**
RB-86	NO DATA	1.69E-05	7.37E-06	NO DATA	NO DATA	NO DATA	2.08E-06
RB-88	NO DATA	4.84E-08	2.41E-08	NO DATA	NO DATA	NO DATA	4.18E-19
RB-89	NO DATA	3.20E-08	2.12E-08	NO DATA	NO DATA	NO DATA	1.16E-21
SR-89	3.80E-05	NO DATA	1.09E-06	NO DATA	NO DATA	1.75E-04	4.37E-05
SR-90	1.24E-02	NO DATA	7.62E-04	NO DATA	NO DATA	1.20E-03	9.02E-05
SR-91	7.74E-09	NO DATA	3.13E-10	NO DATA	NO DATA	4.56E-06	2.39E-05
SR-92	8.43E-10	NO DATA	3.64E-11	NO DATA	NO DATA	2.06E-06	5.38E-06
Y-90	2.61E-07	NO DATA	7.01E-09	NO DATA	NO DATA	2.12E-05	6.32E-05
Y-91m	3.26E-11	NO DATA	1.27E-12	NO DATA	NO DATA	2.40E-07	1.66E-10
Y-91	5.78E-05	NO DATA	1.55E-06	NO DATA	NO DATA	2.13E-04	4.81E-05
Y-92	1.29E-09	NO DATA	3.77E-11	NO DATA	NO DATA	1.96E-06	9.19E-06
Y-93	1.18E-08	NO DATA	3.26E-10	NO DATA	NO DATA	6.06E-06	5.27E-05
ZR-95	1.34E-05	4.30E-06	2.91E-06	NO DATA	6.77E-06	2.21E-04	1.88E-05
ZR-97	1.21E-08	2.45E-09	1.13E-09	NO DATA	3.71E-09	9.84E-06	6.54E-05
NB-95	1.76E-06	9.77E-07	5.26E-07	NO DATA	9.67E-07	6.31E-05	1.30E-05
MO-99	NO DATA	1.51E-08	2.87E-09	NO DATA	3.64E-08	1.14E-05	3.10E-05
TC-99m	1.29E-13	3.64E-13	4.63E-12	NO DATA	5.52E-12	9.55E-08	5.20E-07
TC-101	5.22E-15	7.52E-15	7.38E-14	NO DATA	1.35E-13	4.99E-08	1.36E-21
RU-103	1.91E-07	NO DATA	8.23E-08	NO DATA	7.29E-07	6.31E-05	1.38E-05
RU-105	9.88E-11	NO DATA	3.89E-11	NO DATA	1.27E-10	1.37E-06	6.02E-06
RU-106	8.64E-06	NO DATA	1.09E-06	NO DATA	1.67E-05	1.17E-03	1.14E-04
AG-110m	1.35E-06	1.25E-06	7.43E-07	NO DATA	2.46E-06	5.79E-04	3.78E-05
TE-125m	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE-127m	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE-127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE-129m	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE-129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE-131m	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE-131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09

TABLE 3.5-4 (continued)

INHALATION DOSE FACTORS FOR ADULT - $(DFA_i)_a$
(mrem per pCi inhaled)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I-130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	NO DATA	9.61E-07
I-131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	NO DATA	7.85E-07
I-132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	NO DATA	5.08E-08
I-133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	NO DATA	1.11E-06
I-134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	NO DATA	1.26E-10
I-135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	NO DATA	6.56E-07
CS-134	4.66E-05	1.06E-04	9.10E-05	NO DATA	3.59E-05	1.22E-05	1.30E-06
CS-136	4.88E-06	1.83E-05	1.38E-05	NO DATA	1.07E-05	1.50E-06	1.46E-06
CS-137	5.98E-05	7.76E-05	5.35E-05	NO DATA	2.78E-05	9.40E-06	1.05E-06
CS-138	4.14E-08	7.76E-08	4.05E-08	NO DATA	6.00E-08	6.07E-09	2.33E-13
BA-139	1.17E-10	8.32E-14	3.42E-12	NO DATA	7.78E-14	4.70E-07	1.12E-07
BA-140	4.88E-06	6.13E-09	3.21E-07	NO DATA	2.09E-09	1.59E-04	2.73E-05
BA-141	1.25E-11	9.41E-15	4.20E-13	NO DATA	8.75E-15	2.42E-07	1.45E-17
BA-142	3.29E-12	3.38E-15	2.07E-13	NO DATA	2.86E-15	1.49E-07	1.96E-26
LA-140	4.30E-08	2.17E-08	5.73E-09	NO DATA	NO DATA	1.70E-05	5.73E-05
LA-142	8.54E-11	3.88E-11	9.65E-12	NO DATA	NO DATA	7.91E-07	2.64E-07
CE-141	2.49E-06	1.69E-06	1.91E-07	NO DATA	7.83E-07	4.52E-05	1.50E-05
CE-143	2.33E-08	1.72E-08	1.91E-09	NO DATA	7.60E-09	9.97E-06	2.83E-05
CE-144	4.29E-04	1.79E-04	2.30E-05	NO DATA	1.06E-04	9.72E-04	1.02E-04
PR-143	1.17E-06	4.69E-07	5.80E-08	NO DATA	2.70E-07	3.51E-05	2.50E-05
PR-144	3.76E-12	1.56E-12	1.91E-13	NO DATA	8.81E-13	1.27E-07	2.69E-18
ND-147	6.59E-07	7.62E-07	4.56E-08	NO DATA	4.[illegible]-07	2.76E-05	2.16E-05
W-187	1.06E-09	8.85E-10	3.10E-10	NO DATA	NO DATA	3.63E-06	1.94E-05
NP-239	2.87E-08	2.82E-09	1.55E-09	NO DATA	8.75E-09	4.70E-06	1.49E-05

*2.27×10^{-06}
**Less than 10^{-24}

TABLE 3.5-5

GROUND PLANE DOSE FACTORS - DFG_i
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
Na-24	2.50E-08*	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Ni-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
b-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91m	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99m	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110m	1.80E-08	2.10E-08

TABLE 3.5-5 (Continued)

GROUND PLANE DOSE FACTORS - DFG_i
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
Te-125m	3.50E-11	4.80E-11
Te-127m	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129m	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131m	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-08
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

*2.50×10^{-08}

TABLE 3.5-6

INGESTION DOSE FACTORS FOR INFANT - $(DFL_1)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C-14	2.37E-05*	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA-24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P-32	1.70E-03	1.00E-04	6.59E-05	NO DATA	NO DATA	NO DATA	2.30E-05
CR-51	NO DATA	NO DATA	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN-54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06
MN-56	NO DATA	8.18E-07	1.41E-07	NO DATA	7.03-07	NO DATA	7.43E-05
FE-55	1.39E-05	8.98E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE-59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO-58	NO DATA	3.60E-06	8.98E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO-60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI-63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI-65	4.70E-06	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU-64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN-65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05
ZN-69	9.33E-08	1.68E-07	1.25E-08	NO DATA	6.98E-08	NO DATA	1.37E-05
BR-83	NO DATA	NO DATA	3.63E-07	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	3.82E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	1.94E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	1.70E-04	8.40E-05	NO DATA	NO DATA	NO DATA	4.34E-06
RB-88	NO DATA	4.98E-07	2.73E-07	NO DATA	NO DATA	NO DATA	4.85E-07
RB-89	NO DATA	2.86E-07	1.97E-07	NO DATA	NO DATA	NO DATA	9.74E-08
SR-89	2.51E-03	NO DATA	7.20E-05	NO DATA	NO DATA	NO DATA	5.16E-05
SR-90	1.85E-02	NO DATA	4.71E-03	NO DATA	NO DATA	NO DATA	2.31E-04
SR-91	5.00E-05	NO DATA	1.81E-06	NO DATA	NO DATA	NO DATA	5.92E-05
SR-92	1.92E-05	NO DATA	7.13E-07	NO DATA	NO DATA	NO DATA	2.07E-04
Y-90	8.69E-08	NO DATA	2.33E-09	NO DATA	NO DATA	NO DATA	1.20E-04
Y-91m	8.10E-10	NO DATA	2.76E-11	NO DATA	NO DATA	NO DATA	2.70E-06
Y-91	1.13E-06	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	8.10E-05
Y-92	7.65E-09	NO DATA	2.15E-10	NO DATA	NO DATA	NO DATA	1.46E-04
Y-93	2.43E-08	NO DATA	6.62E-10	NO DATA	NO DATA	NO DATA	1.92E-04
ZR-95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05
ZR-97	1.48E-08	2.54E-09	1.16E-09	NO DATA	2.56E-09	NO DATA	1.62E-04
NB-95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05
MO-99	NO DATA	3.40E-05	6.63E-06	NO DATA	5.08E-05	NO DATA	1.12E-05
TC-99m	1.92E-09	3.96E-09	5.10E-08	NO DATA	4.26E-08	2.07E-09	1.15E-06
TC-101	2.27E-09	2.86E-09	2.83E-08	NO DATA	3.40E-08	1.56E-09	4.86E-07
RU-103	1.48E-06	NO DATA	4.95E-07	NO DATA	3.08E-06	NO DATA	1.80E-05
RU-105	1.36E-07	NO DATA	4.58E-08	NO DATA	1.00E-06	NO DATA	5.41E-05
RU-106	2.41E-05	NO DATA	3.01E-06	NO DATA	2.85E-05	NO DATA	1.83E-04
AG-110m	9.96E-07	7.[illegible]	4.81E-07	NO DATA	1.04E-06	NO DATA	3.77E-05
TE-125m	2.33E-05	7.[illegible]	3.15E-06	7.84E-06	NO DATA	NO DATA	1.11E-05
TE-127m	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	NO DATA	2.36E-05
TE-127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	NO DATA	2.10E-05
TE-129m	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	NO DATA	5.97E-05
TE-129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	NO DATA	2.27E-05
TE-131m	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	NO DATA	1.03E-04
TE-131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	NO DATA	7.11E-06

TABLE 3.5-6 (continued)

INGESTION DOSE FACTORS FOR INFANT - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	NO DATA	3.81E-05
I-130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	NO DATA	2.83E-06
I-131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-06
I-132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	NO DATA	2.73E-06
I-133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	NO DATA	3.08E-06
I-134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	NO DATA	1.84E-06
I-135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	NO DATA	2.62E-06
CS-134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06
CS-136	4.59E-05	1.35E-04	5.04E-05	NO DATA	5.38E-05	1.10E-05	2.05E-06
CS-137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06
CS-138	4.81E-07	7.82E-07	3.79E-07	NO DATA	3.90E-07	6.09E-08	1.25E-06
BA-139	8.81E-07	5.84E-10	2.55E-08	NO DATA	3.51E-10	3.54E-10	5.58E-05
BA-140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-05
BA-141	4.25E-07	2.91E-10	1.34E-08	NO DATA	1.75E-10	1.77E-10	5.19E-06
BA-142	1.84E-07	1.53E-10	9.06E-09	NO DATA	8.81E-11	9.26E-11	7.59E-07
LA-140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA-142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.86E-05
CE-141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE-143	1.48E-08	9.82E-06	1.12E-09	NO DATA	2.86E-09	NO DATA	5.73E-05
CE-144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-07	NO DATA	1.71E-04
PR-143	8.13E-08	3.04E-08	4.03E-09	NO DATA	1.13E-08	NO DATA	4.29E-05
PR-144	2.74E-10	1.06E-10	1.38E-11	NO DATA	3.84E-11	NO DATA	4.93E-06
ND-147	5.53E-08	5.68E-08	3.48E-09	NO DATA	2.19E-08	NO DATA	3.60E-05
W-187	9.03E-07	6.28E-07	2.17E-07	NO DATA	NO DATA	NO DATA	3.69E-05
NP-239	1.11E-08	9.93E-10	5.61E-10	NO DATA	1.98E-09	NO DATA	2.87E-05

*2.37×10^{-05}

**Less than 10^{-24}

TABLE 3.5-7

INGESTION DOSE FACTORS FOR CHILD - $(DFL_i)_a$
(mrem per pCi ingested)

UCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
-14	1.21E-05*	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
A-24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
-32	8.25E-04	3.86E-05	3.18E-05	NO DATA	NO DATA	NO DATA	2.28E-05
R-51	NO DATA	NO DATA	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
N-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06
N-56	NO DATA	3.24E-07	7.54E-08	NO DATA	4.04E-07	NO DATA	4.84E-05
E-55	1.15E-05	6.10E-06	1.89E-06	NO DATA	NO DATA	3.45E-06	1.13E-06
E-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05
O-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05
O-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05
I-63	5.38E-04	2.88E-05	1.83E-05	NO DATA	NO DATA	NO DATA	1.94E-06
I-65	2.22E-06	2.09E-07	1.22E-07	NO DATA	NO DATA	NO DATA	2.56E-05
U-64	NO DATA	2.45E-07	1.48E-07	NO DATA	5.92E-07	NO DATA	1.15E-05
N-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06
N-69	4.38E-08	6.33E-08	5.85E-09	NO DATA	3.84E-08	NO DATA	3.99E-06
R-83	NO DATA	NO DATA	1.71E-07	NO DATA	NO DATA	NO DATA	LT E-24**
R-84	NO DATA	NO DATA	1.98E-07	NO DATA	NO DATA	NO DATA	LT E-24
R-85	NO DATA	NO DATA	9.12E-09	NO DATA	NO DATA	NO DATA	LT E-24
B-86	NO DATA	6.70E-05	4.12E-05	NO DATA	NO DATA	NO DATA	4.31E-06
B-88	NO DATA	1.90E-07	1.32E-07	NO DATA	NO DATA	NO DATA	9.32E-09
B-89	NO DATA	1.17E-07	1.04E-07	NO DATA	NO DATA	NO DATA	1.02E-09
R-89	1.32E-03	NO DATA	3.77E-05	NO DATA	NO DATA	NO DATA	5.11E-05
R-90	1.70E-02	NO DATA	4.31E-03	NO DATA	NO DATA	NO DATA	2.29E-04
R-91	2.40E-05	NO DATA	9.06E-07	NO DATA	NO DATA	NO DATA	5.30E-05
R-92	9.03E-06	NO DATA	3.62E-07	NO DATA	NO DATA	NO DATA	1.71E-04
-90	4.11E-08	NO DATA	1.10E-09	NO DATA	NO DATA	NO DATA	1.17E-04
-91m	3.82E-10	NO DATA	1.39E-11	NO DATA	NO DATA	NO DATA	7.48E-07
-91	6.02E-07	NO DATA	1.61E-08	NO DATA	NO DATA	NO DATA	8.02E-05
-92	3.60E-09	NO DATA	1.03E-10	NO DATA	NO DATA	NO DATA	1.04E-04
-93	1.14E-08	NO DATA	3.13E-10	NO DATA	NO DATA	NO DATA	1.70E-04
R-95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05
R-97	6.99E-09	1.01E-09	5.96E-10	NO DATA	1.45E-09	NO DATA	1.53E-04
B-95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05
O-99	NO DATA	1.33E-05	3.29E-06	NO DATA	2.84E-05	NO DATA	1.10E-05
C-99m	9.23E-10	1.81E-09	3.00E-08	NO DATA	2.63E-08	9.19E-10	1.03E-06
C-101	1.07E-09	1.12E-09	1.42E-08	NO DATA	1.91E-08	5.92E-10	3.56E-09
U-103	7.31E-07	NO DATA	2.81E-07	NO DATA	1.84E-06	NO DATA	1.89E-05
U-105	6.45E-08	NO DATA	2.34E-08	NO DATA	5.67E-07	NO DATA	4.21E-05
U-106	1.17E-05	NO DATA	1.46E-06	NO DATA	1.58E-05	NO DATA	1.82E-04
G-110m	5.39E-07	3.64E-07	2.91E-07	NO DATA	6.78E-07	NO DATA	4.33E-05
E-125m	1.14E-05	3.09E-06	1.52E-06	3.20E-06	NO DATA	NO DATA	1.10E-05
E-127m	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	NO DATA	2.34E-05
E-127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	NO DATA	1.84E-05
E-129m	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	NO DATA	5.94E-05
E-129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	NO DATA	8.34E-06
E-131m	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	NO DATA	1.01E-04
E-131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	NO DATA	4.36E-07

TABLE 3.5-7 (continued)

INGESTION DOSE FACTORS FOR CHILD - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	NO DATA	4.50E-05
I-130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	NO DATA	2.76E-06
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06
I-132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	NO DATA	1.73E-06
I-133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	NO DATA	2.95E-06
I-134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	NO DATA	5.16E-07
I-135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	NO DATA	2.40E-06
CS-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06
CS-136	2.35E-05	6.46E-05	4.18E-05	NO DATA	3.44E-05	5.13E-06	2.27E-06
CS-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06
CS-138	2.28E-07	3.17E-07	2.01E-07	NO DATA	2.23E-07	2.40E-08	1.46E-07
BA-139	4.14E-07	2.21E-10	1.20E-08	NO DATA	1.93E-10	1.30E-10	2.39E-05
BA-140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05
BA-141	2.00E-07	1.12E-10	6.51E-09	NO DATA	9.69E-11	6.58E-10	1.14E-07
BA-142	8.74E-08	6.29E-11	4.88E-09	NO DATA	5.09E-11	3.70E-11	1.14E-09
LA-140	1.01E-08	3.53E-09	1.10E-09	NO DATA	NO DATA	NO DATA	9.84E-05
LA-142	5.24E-10	1.67E-10	5.23E-11	NO DATA	NO DATA	NO DATA	3.31E-05
CE-141	8.97E-08	1.98E-08	2.94E-09	NO DATA	8.68E-09	NO DATA	2.47E-05
CE-143	6.99E-09	3.79E-06	5.49E-10	NO DATA	1.59E-09	NO DATA	5.55E-05
CE-144	2.08E-06	6.52E-07	1.11E-07	NO DATA	3.61E-07	NO DATA	1.70E-04
PR-143	3.93E-08	1.18E-08	1.95E-09	NO DATA	6.39E-09	NO DATA	4.24E-05
PR-144	1.29E-10	3.99E-11	6.49E-12	NO DATA	2.11E-11	NO DATA	8.59E-08
ND-147	2.79E-08	2.26E-08	1.75E-09	NO DATA	1.24E-08	NO DATA	3.58E-05
W-187	4.29E-07	2.54E-07	1.14E-07	NO DATA	NO DATA	NO DATA	3.57E-05
NP-239	5.25E-09	3.77E-10	2.65E-10	NO DATA	1.09E-09	NO DATA	2.79E-05

*1.21×10^{-05}

**Less than 10^{-24}

TABLE 3.5-8

INGESTION DOSE FACTORS FOR TEEN - $(DFL_i)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C-14	4.06E-06*	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA-24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P-32	2.76E-04	1.71E-05	1.07E-05	NO DATA	NO DATA	NO DATA	2.32E-05
CR-51	NO DATA	NO DATA	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05
MN-56	NO DATA	1.58E-07	2.81E-08	NO DATA	2.00E-07	NO DATA	1.04E-05
FE-55	3.78E-06	2.68E-06	6.25E-07	NO DATA	NO DATA	1.70E-06	1.16E-06
FE-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05
CO-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05
CO-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05
NI-63	1.77E-04	1.25E-05	6.00E-06	NO DATA	NO DATA	NO DATA	1.99E-06
NI-65	7.49E-07	9.57E-08	4.36E-08	NO DATA	NO DATA	NO DATA	5.19E-06
CU-64	NO DATA	1.15E-07	5.41E-08	NO DATA	2.91E-07	NO DATA	8.92E-06
ZN-65	5.76E+06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06
ZN-69	1.47E-08	2.80E-08	1.96E-09	NO DATA	1.83E-08	NO DATA	5.16E-08
BR-83	NO DATA	NO DATA	5.74E-08	NO DATA	NO DATA	NO DATA	LT E-24**
BR-84	NO DATA	NO DATA	7.22E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR-85	NO DATA	NO DATA	3.05E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB-86	NO DATA	2.98E-05	1.40E-05	NO DATA	NO DATA	NO DATA	4.41E-06
RB-88	NO DATA	8.52E-08	4.54E-08	NO DATA	NO DATA	NO DATA	7.30E-15
RB-89	NO DATA	5.50E-08	3.89E-08	NO DATA	NO DATA	NO DATA	8.43E-17
SR-89	4.40E-04	NO DATA	1.26E-05	NO DATA	NO DATA	NO DATA	5.24E-05
SR-90	8.30E-03	NO DATA	2.05E-03	NO DATA	NO DATA	NO DATA	2.33E-04
SR-91	8.07E-06	NO DATA	3.21E-07	NO DATA	NO DATA	NO DATA	3.66E-05
SR-92	3.05E-06	NO DATA	1.30E-07	NO DATA	NO DATA	NO DATA	7.77E-05
Y-90	1.37E-08	NO DATA	3.69E-10	NO DATA	NO DATA	NO DATA	1.13E-04
Y-91m	1.29E-10	NO DATA	4.93E-12	NO DATA	NO DATA	NO DATA	6.09E-09
Y-91	2.01E-07	NO DATA	5.39E-09	NO DATA	NO DATA	NO DATA	8.24E-05
Y-92	1.21E-09	NO DATA	3.50E-11	NO DATA	NO DATA	NO DATA	3.32E-05
Y-93	3.83E-09	NO DATA	1.05E-10	NO DATA	NO DATA	NO DATA	1.17E-04
ZR-95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05
ZR-97	2.37E-09	4.69E-10	2.16E-10	NO DATA	7.11E-10	NO DATA	1.27E-04
NB-95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05
MO-99	NO DATA	6.03E-06	1.15E-06	NO DATA	1.38E-05	NO DATA	1.08E-05
TC-99m	3.32E-10	9.26E-10	1.20E-08	NO DATA	1.38E-08	5.14E-10	6.08E-07
TC-101	3.60E-10	5.12E-10	5.03E-09	NO DATA	9.26E-09	3.12E-10	8.75E-17
RU-103	2.55E-07	NO DATA	1.09E-07	NO DATA	8.99E-07	NO DATA	2.13E-05
RU-105	2.18E-08	NO DATA	8.46E-09	NO DATA	2.75E-07	NO DATA	1.76E-05
RU-106	3.92E-06	NO DATA	4.94E-07	NO DATA	7.56E-06	NO DATA	1.88E-04
AG-110m	2.05E-07	1.94E-07	1.18E-07	NO DATA	3.70E-07	NO DATA	5.45E-05
TE-125m	3.83E-06	1.38E-06	5.12E-07	1.07E-06	NO DATA	NO DATA	1.13E-05
TE-127m	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	NO DATA	2.41E-05
TE-127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	NO DATA	1.22E-05
TE-129m	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	NO DATA	6.12E-05
TE-129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	NO DATA	2.45E-07
TE-131m	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	NO DATA	9.39E-05
TE-131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	NO DATA	2.29E-09

TABLE 3.5-8 (continued)

INGESTION DOSE FACTORS FOR TEEN - $(DFL_1)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	NO DATA	7.00E-05
I-130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	NO DATA	2.29E-06
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06
I-132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	NO DATA	3.18E-07
I-133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	NO DATA	2.58E-06
I-134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	NO DATA	5.10E-09
I-135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	NO DATA	1.74E-06
CS-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06
CS-136	8.59E-06	3.38E-05	2.27E-05	NO DATA	1.84E-05	2.90E-06	2.72E-06
CS-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06
CS-138	7.76E-08	1.49E-07	7.45E-08	NO DATA	1.10E-07	1.28E-08	6.76E-11
BA-139	1.39E-07	9.78E-11	4.05E-09	NO DATA	9.22E-11	6.74E-11	1.24E-06
BA-140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05
BA-141	6.71E-08	5.01E-11	2.24E-09	NO DATA	4.65E-11	3.43E-11	1.43E-13
BA-142	2.99E-08	2.99E-11	1.84E-09	NO DATA	2.53E-11	1.99E-11	9.18E-20
LA-140	3.48E-09	1.71E-09	4.55E-10	NO DATA	NO DATA	NO DATA	9.82E-05
LA-142	1.79E-10	7.95E-11	1.98E-11	NO DATA	NO DATA	NO DATA	2.42E-06
CE-141	1.33E-08	8.88E-09	1.02E-09	NO DATA	4.18E-09	NO DATA	2.54E-05
CE-143	2.35E-09	1.71E-06	1.91E-10	NO DATA	7.67E-10	NO DATA	5.14E-05
CE-144	6.96E-07	2.88E-07	3.74E-08	NO DATA	1.72E-07	NO DATA	1.75E-04
PR-143	1.31E-08	5.23E-09	6.52E-10	NO DATA	3.04E-09	NO DATA	4.31E-05
PR-144	4.30E-11	1.76E-11	2.18E-12	NO DATA	1.01E-11	NO DATA	4.74E-14
ND-147	9.38E-09	1.02E-08	6.11E-10	NO DATA	5.99E-09	NO DATA	3.68E-05
W-187	1.46E-07	1.19E-07	4.17E-08	NO DATA	NO DATA	NO DATA	3.22E-05
NP-239	1.76E-09	1.66E-10	9.22E-11	NO DATA	5.21E-10	NO DATA	2.67E-05

*4.06×10^{-06}
**Less than 10^{-24}

TABLE 3.5-9

INGESTION DOSE FACTORS FOR ADULT - $(DFL_i)_a$
(mrem per pCi ingested)

UCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
-14	2.84E-06*	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
A-24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
-32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
R-51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
N-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
N-56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
E-55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
E-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
O-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
O-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
I-63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
I-65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
U-64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
N-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
N-69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
R-83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
R-84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
R-85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24**
B-86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
B-88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
B-89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
R-89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
R-90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
R-91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
R-92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
-90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
-91m	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
-91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
-92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
-93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
R-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
R-97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
B-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
O-99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
C-99m	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
C-101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
U-103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
U-105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
U-106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
G-110m	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
E-125m	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
E-127m	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
E-127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
E-129m	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
E-129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
E-131m	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
E-131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09

TABLE 3.5-9 (continued)

INGESTION DOSE FACTORS FOR ADULT - $(DFL_1)_a$
(mrem per pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I-130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I-133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I-135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS-136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS-138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA-139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA-141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA-142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.0CE-26
LA-140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA-142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE-141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE-143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE-144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR-143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR-144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND-147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W-187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP-239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

*2.84×10^{-06}
**Less than 10^{-24}

TABLE 3.5-10

INPUT PARAMETERS FOR CALCULATING R^{C}_{ajl}

Parameter		Value	Table*
Q_F(kg/day)		50 for cow 6 for goat	E-3
U_{ap}(liters/yr)	- Infant	330	E-5
	- Child	330	E-5
	- Teen	400	E-5
	- Adult	310	E-5
Y_p(kg/m^2)		0.7	E-15
Y_s(kg/m^2)		2.0	E-15
F_m(days/liter)		Each stable element for cow Each stable element for goat	E-1 E-2
r(dimensionless)		1.0 for radioiodine 0.2 for particulates	E-15 E-15
t_f(seconds)		1.73×10^5(2 days)	E-15
t_h(seconds)		7.78×10^6(90 days)	E-15
f_s(dimensionless)		1.0 for cow 1.0 for goat	NUREG - 0133 Section 5.3.1.3
f_p(dimensionless)		1.0 for cow 1.0 for goat	NUREG - 0133 Section 5.3.1.3

*of Regulatory Guide 1.109 unless otherwise stated

TABLE 3.5-11

INPUT PARAMETERS FOR CALCULATING R^{M}_{aij}

Parameter		Value	Table*
U_{ap}(liters/yr)	- Infant	0	E-5
	- Child	41	E-5
	- Teen	65	E-5
	- Adult	110	E-5
F_f(days/kg)		Each stable element	E-1
t_s(seconds)		1.73E+06 (20 days)	E-15
t_h(seconds)		7.78E+06 (90 days)	E-15
Y_p(kg/m^2)		0.7	E-15
Y_s(kg/m^2)		2.0	E-15
r(dimensionless)		1.0 for radioiodine	E-15
		0.2 for particulates	E-15
Q_f(kg/day)		50	E-3

*of Regulatory Guide 1.109

TABLE 3.5-12

INPUT PARAMETERS FOR CALCULATING R^{V}_{aij}

rameter		Value	Table*
(kg/yr)	- Infant	0	E-5
	- Child	26	E-5
	- Teen	42	E-5
	- Adult	64	E-5
(kg/yr)	- Infant	0	E-5
	- Child	520	E-5
	- Teen	630	E-5
	- Adult	520	E-5
(dimensionless)		1.0	E-15
(dimensionless)		0.76	E-15
(seconds)		8.6×10^{4} (1 day)	E-15
(seconds)		5.18×10^{6} (60 days)	E-15
(kg/m^2)		2.0	E-15

f Regulatory Guide 1.109

TABLE 3.5-13

INHALATION PATHWAY FACTORS - R^{I}_{ai} (INFANT)

(mrem/yr per µCi/m^3)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	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	5.32E+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	NO DATA	NO DATA	NO DATA	1.61E+04
CR-51	NO DATA	NO DATA	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	NO DATA	2.53E+04	4.98E+03	NO DATA	4.98E+03	1.00E+06	7.06E+03
MN-56	NO DATA	1.54E+00	2.21E-01	NO DATA	1.10E+00	1.25E+04	7.17E+04
FE-55	1.97E+04	1.17E+04	3.33E+03	NO DATA	NO DATA	8.69E+04	1.09E+03
FE-59	1.36E+04	2.35E+04	9.48E+03	NO DATA	NO DATA	1.02E+06	2.48E+04
CO-58	NO DATA	1.22E+03	1.82E+03	NO DATA	NO DATA	7.77E+05	1.11E+04
CO-60	NO DATA	8.02E+03	1.18E+04	NO DATA	NO DATA	4.51E+06	3.19E+04
NI-63	3.39E+05	2.04E+04	1.16E+04	NO DATA	NO DATA	2.09E+05	2.42E+03
NI-65	2.39E+00	2.84E-01	1.23E-01	NO DATA	NO DATA	8.12E+03	5.01E+04
CU-64	NO DATA	1.88E+00	7.74E-01	NO DATA	3.98E+00	9.30E+03	1.50E+04
ZN-65	1.93E+04	6.26E+04	3.11E+04	NO DATA	3.25E+04	6.47E+05	5.14E+04
ZN-69	5.39E-02	9.67E-02	7.18E-03	NO DATA	4.02E-02	1.47E+03	1.32E+04
BR-83	NO DATA	NO DATA	3.81E+02	NO DATA	NO DATA	NO DATA	LT1.4E-15**
BR-84	NO DATA	NO DATA	4.00E+02	NO DATA	NO DATA	NO DATA	LT1.4E-15
BR-85	NO DATA	NO DATA	2.04E+01	NO DATA	NO DATA	NO DATA	LT1.4E-15
RB-86	NO DATA	1.90E+05	8.82E+04	NO DATA	NO DATA	NO DATA	3.04E+03
RB-88	NO DATA	5.57E+02	2.87E+02	NO DATA	NO DATA	NO DATA	3.39E+02
RB-89	NO DATA	3.21E+02	2.06E+02	NO DATA	NO DATA	NO DATA	6.82E+01
SR-89	3.98E+05	NO DATA	1.14E+04	NO DATA	NO DATA	2.03E+06	6.40E+04
SR-90	4.09E+07	NO DATA	2.59E+06	NO DATA	NO DATA	1.12E+07	1.31E+05
SR-91	9.56E+01	NO DATA	3.46E+00	NO DATA	NO DATA	5.26E+04	7.34E+04
SR-92	1.05E+01	NO DATA	3.91E-01	NO DATA	NO DATA	2.38E+04	1.40E+05
Y-90	3.29E+03	NO DATA	8.82E+01	NO DATA	NO DATA	2.69E+05	1.04E+05
Y-91m	4.07E-01	NO DATA	1.39E-02	NO DATA	NO DATA	2.79E+03	2.35E+03
Y-91	5.88E+05	NO DATA	1.57E+04	NO DATA	NO DATA	2.45E+06	7.03E+04
Y-92	1.64E+01	NO DATA	4.61E-01	NO DATA	NO DATA	2.45E+04	1.27E+05
Y-93	1.50E+02	NO DATA	4.07E+00	NO DATA	NO DATA	7.64E+04	1.67E+05
ZR-95	1.15E+05	2.79E+04	2.03E+04	NO DATA	3.11E+04	1.75E+06	2.17E+04
ZR-97	1.50E+02	2.56E+01	1.17E+01	NO DATA	2.59E+01	1.10E+05	1.40E+05
NB-95	1.57E+04	6.43E+03	3.78E+03	NO DATA	4.72E+03	4.79E+05	1.27E+04
MO-99	NO DATA	1.65E+02	3.23E+01	NO DATA	2.65E+02	1.35E+05	4.87E+04
TC-99m	1.40E-03	2.88E-03	3.72E-02	NO DATA	3.11E-02	8.11E+02	2.03E+03
TC-101	6.51E-05	8.23E-05	8.12E-04	NO DATA	9.79E-04	5.84E+02	8.44E+02
RU-103	2.02E+03	NO DATA	6.79E+02	NO DATA	4.24E+03	5.52E+05	1.61E+04
RU-105	1.22E+00	NO DATA	4.10E-01	NO DATA	8.99E-01	1.57E+04	4.84E+04
RU-106	8.68E+04	NO DATA	1.09E+04	NO DATA	1.07E+05	1.16E+07	1.64E+05
AG-110m	9.98E+03	7.22E+03	5.00E+03	NO DATA	1.09E+04	3.67E+06	3.30E+04
TE-125m	4.76E+03	1.99E+03	6.58E+02	1.62E+03	NO DATA	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

TABLE 3.5-13 (continued)

INHALATION PATHWAY FACTORS - R^{I}_{ai} (INFANT)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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	6.39E+03	1.39E+04	5.57E+03	1.60E+06	1.53E+04	NO DATA	1.99E+03
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	NO DATA	1.06E+03
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	NO DATA	1.90E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	NO DATA	2.16E+03
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.09E+03	NO DATA	1.29E+03
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	NO DATA	1.83E+03
CS-134	3.96E+05	7.03E+05	7.45E+04	NO DATA	1.90E+05	7.97E+04	1.33E+03
CS-136	4.83E+04	1.35E+05	5.29E+04	NO DATA	5.64E+04	1.18E+04	1.43E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	NO DATA	1.72E+05	7.13E+04	1.33E+03
CS-138	5.05E+02	7.81E+02	3.98E+02	NO DATA	4.10E+02	6.54E+01	8.76E+02
BA-139	1.48E+00	9.84E-04	4.30E-02	NO DATA	5.92E-04	5.95E+03	5.10E+04
BA-140	5.60E+04	5.60E+01	2.90E+03	NO DATA	1.34E+01	1.60E+06	3.84E+04
BA-141	1.57E-01	1.08E-04	4.97E-03	NO DATA	6.50E-05	2.97E+03	4.75E+03
BA-142	3.98E-02	3.30E-05	1.96E-03	NO DATA	1.90E-05	1.55E+03	6.93E+02
LA-140	5.05E+02	2.00E+02	5.15E+01	NO DATA	NO DATA	1.68E+05	8.48E+04
LA-142	1.03E+00	3.77E-01	9.04E-02	NO DATA	NO DATA	8.22E+03	5.95E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	NO DATA	5.25E+03	5.17E+05	2.16E+04
CE-143	2.93E+02	1.93E+02	2.21E+01	NO DATA	5.64E+01	1.16E+05	4.97E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	NO DATA	5.38E+05	9.84E+06	1.48E+05
PR-143	1.40E+04	5.24E+03	6.99E+02	NO DATA	1.97E+03	4.33E+05	3.72E+04
PR-144	4.79E-02	1.85E-02	2.41E-03	NO DATA	6.72E-03	1.61E+03	4.28E+03
ND-147	7.94E+03	8.13E+03	5.00E+02	NO DATA	3.15E+03	3.22E+05	3.12E+04
W-187	1.30E+01	9.02E+00	3.12E+00	NO DATA	NO DATA	3.96E+04	3.56E+04
NP-239	3.71E+02	3.32E+01	1.88E+01	NO DATA	6.62E+01	5.95E+04	2.49E+04

*6.47×10^{2}

**Less than 1.40×10^{-15}

TABLE 3.5-14

INHALATION PATHWAY FACTORS - R^{I}_{ai} (CHILD)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.12E+03*	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
C-14	3.58E+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	9.87E+04	NO DATA	NO DATA	NO DATA	4.21E+04
CR-51	NO DATA	NO DATA	1.54E+02	8.54E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	NO DATA	4.29E+04	9.51E+03	NO DATA	1.00E+04	1.58E+06	2.29E+04
MN-56	NO DATA	1.66E+00	3.12E-01	NO DATA	1.67E+00	1.31E+04	1.23E+05
FE-55	4.74E+04	2.52E+04	7.77E+03	NO DATA	NO DATA	1.11E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	NO DATA	NO DATA	1.27E+06	7.07E+04
CO-58	NO DATA	1.77E+03	3.16E+03	NO DATA	NO DATA	1.11E+06	3.44E+04
CO-60	NO DATA	1.31E+04	2.26E+04	NO DATA	NO DATA	7.07E+06	9.62E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	NO DATA	NO DATA	2.73E+05	6.33E+03
NI-65	2.99E+00	2.96E-01	1.64E-01	NO DATA	NO DATA	8.18E+03	8.40E+04
CU-64	NO DATA	1.99E+00	1.07E+00	NO DATA	6.03E+00	9.58E+03	3.67E+04
ZN-65	4.26E+04	1.13E+05	7.03E+04	NO DATA	7.14E+04	9.95E+05	1.63E+04
ZN-69	6.70E-02	9.66E-02	8.92E-03	NO DATA	5.85E-02	1.42E+03	1.02E+04
BR-83	NO DATA	NO DATA	4.74E+02	NO DATA	NO DATA	NO DATA	LT3.70E-15**
BR-84	NO DATA	NO DATA	5.48E+02	NO DATA	NO DATA	NO DATA	LT3.70E-15
BR-85	NO DATA	NO DATA	2.53E+01	NO DATA	NO DATA	NO DATA	LT3.70E-15
RB-86	NO DATA	1.98E+05	1.14E+05	NO DATA	NO DATA	NO DATA	7.99E+03
RB-88	NO DATA	5.62E+02	3.66E+02	NO DATA	NO DATA	NO DATA	1.72E+01
RB-89	NO DATA	3.45E+02	2.89E+02	NO DATA	NO DATA	NO DATA	1.89E+00
SR-89	5.99E+05	NO DATA	1.72E+04	NO DATA	NO DATA	2.16E+06	1.67E+05
SR-90	1.01E+08	NO DATA	6.44E+06	NO DATA	NO DATA	1.48E+07	3.43E+05
SR-91	1.21E+02	NO DATA	4.59E+00	NO DATA	NO DATA	5.33E+04	1.74E+05
SR-92	1.31E+01	NO DATA	5.25E-01	NO DATA	NO DATA	2.40E+04	2.42E+05
Y-90	4.11E+03	NO DATA	1.11E+02	NO DATA	NO DATA	2.62E+05	2.66E+05
Y-91m	5.07E-01	NO DATA	1.84E-02	NO DATA	NO DATA	2.81E+03	1.72E+03
Y-91	9.14E+05	NO DATA	2.44E+04	NO DATA	NO DATA	2.63E+06	1.84E+05
Y-92	2.04E+01	NO DATA	5.81E-01	NO DATA	NO DATA	2.39E+04	2.39E+05
Y-93	1.86E+02	NO DATA	5.11E+00	NO DATA	NO DATA	7.44E+04	3.89E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	NO DATA	5.96E+04	2.23E+06	6.11E+04
ZR-97	1.88E+02	2.72E+01	1.60E+01	NO DATA	3.89E+01	1.13E+05	3.51E+05
NB-95	2.35E+04	9.18E+03	6.55E+03	NO DATA	8.62E+03	6.14E+05	3.70E+04
MO-99	NO DATA	1.72E+02	4.26E+01	NO DATA	3.92E+02	1.35E+05	1.27E+05
TC-99m	1.78E-03	3.48E-03	5.77E-02	NO DATA	5.07E-02	9.51E+02	4.81E+03
TC-101	8.10E-05	8.51E-05	1.08E-03	NO DATA	1.45E-03	5.84E+02	1.63E+01
RU-103	2.79E+03	NO DATA	1.07E+03	NO DATA	7.03E+03	6.62E+05	4.48E+04
RU-105	1.53E+00	NO DATA	5.55E-01	NO DATA	1.34E+00	1.59E+04	9.95E+04
RU-106	1.36E+05	NO DATA	1.69E+04	NO DATA	1.84E+05	1.43E+07	4.29E+05
AG-110m	1.69E+04	1.14E+04	9.14E+03	NO DATA	2.12E+04	5.48E+06	1.00E+05
TE-125m	6.73E+03	2.33E+03	9.14E+02	1.92E+03	NO DATA	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

TABLE 3.5-14 (continued)

INHALATION PATHWAY FACTORS - R^{I}_{ai} (CHILD)
(mrem/yr per $\mu Ci/m^3$)

RGAN: SOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
E-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05
-130	8.18E+03	1.64E+04	8.44E+03	1.85E+06	2.45E+04	NO DATA	5.11E+03
-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	NO DATA	2.84E+03
-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	NO DATA	3.20E+03
-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	NO DATA	5.48E+03
-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	NO DATA	9.54E+02
-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	NO DATA	4.44E+03
S-134	6.51E+05	1.01E+06	2.25E+05	NO DATA	3.30E+05	1.21E+05	3.85E+03
S-136	6.51E+04	1.71E+05	1.16E+05	NO DATA	9.55E+04	1.45E+04	4.18E+03
S-137	9.70E+05	8.25E+05	1.28E+05	NO DATA	2.82E+05	1.04E+05	3.62E+03
S-138	6.33E+02	8.40E+02	5.55E+02	NO DATA	6.22E+02	6.81E+01	2.70E+02
A-139	1.84E+00	9.84E-04	5.37E-02	NO DATA	8.62E-04	5.77E+03	5.77E+04
A-140	7.40E+04	6.48E+01	4.33E+03	NO DATA	2.11E+01	1.74E+06	1.02E+05
A-141	1.96E-01	1.09E-04	6.36E-03	NO DATA	9.47E-05	2.92E+03	2.75E+02
A-142	5.00E-02	3.60E-05	2.79E-03	NO DATA	2.91E-05	1.64E+03	2.74E+00
A-140	6.44E+02	2.25E+02	7.55E+01	NO DATA	NO DATA	1.83E+05	2.26E+05
A-142	1.30E+00	4.11E-01	1.29E-01	NO DATA	NO DATA	8.70E+03	7.59E+04
E-141	3.92E+04	1.95E+05	2.90E+03	NO DATA	8.55E+03	5.44E+05	5.66E+04
E-143	3.66E+02	1.99E+02	2.87E+01	NO DATA	8.36E+01	1.15E+05	1.27E+05
E-144	6.77E+06	2.12E+06	3.61E+05	NO DATA	1.17E+06	1.20E+07	3.89E+05
R-143	1.85E+04	5.55E+03	9.14E+02	NO DATA	3.00E+03	4.33E+05	9.73E+04
R-144	5.96E-02	1.85E-02	3.00E-03	NO DATA	9.77E-03	1.57E+03	1.97E+02
D-147	1.08E+04	8.73E+03	6.81E+02	NO DATA	4.81E+03	3.28E+05	8.21E+04
-187	1.63E+01	9.66E+00	4.33E+00	NO DATA	NO DATA	4.11E+04	9.10E+04
P-239	4.66E+02	3.34E+01	2.35E+01	NO DATA	9.73E+01	5.81E+04	6.40E+04

1.12×10^{3}

*Less than 3.70×10^{-15}

TABLE 3.5-15

INHALATION PATHWAY FACTORS - R^{I}_{ai} (TEEN)

(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	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
P-32	1.89E+06	1.10E+05	7.16E+04	NO DATA	NO DATA	NO DATA	9.28E+04
CR-51	NO DATA	NO DATA	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
MN-54	NO DATA	5.11E+04	8.40E+03	NO DATA	1.27E+04	1.98E+06	6.68E+04
MN-56	NO DATA	1.70E+00	2.52E-01	NO DATA	1.79E+00	1.52E+04	5.74E+04
FE-55	3.34E+04	2.38E+04	5.54E+03	NO DATA	NO DATA	1.24E+05	6.39E+03
FE-59	1.59E+04	3.70E+04	1.43E+04	NO DATA	NO DATA	1.53E+06	1.78E+05
CO-58	NO DATA	2.07E+03	2.78E+03	NO DATA	NO DATA	1.34E+06	9.52E+04
CO-60	NO DATA	1.51E+04	1.98E+04	NO DATA	NO DATA	8.72E+06	2.59E+05
NI-63	5.80E+05	4.34E+04	1.98E+04	NO DATA	NO DATA	3.07E+05	1.42E+04
NI-65	2.18E+00	2.93E-01	1.27E-01	NO DATA	NO DATA	9.36E+03	3.67E+04
CU-64	NO DATA	2.03E+00	8.48E-01	NO DATA	6.41E+00	1.11E+04	6.14E+04
ZN-65	3.86E+04	1.34E+05	6.24E+04	NO DATA	8.64E+04	1.24E+06	4.66E+04
ZN-69	4.83E-02	9.20E-02	6.46E-03	NO DATA	6.02E-02	1.58E+03	2.85E+02
BR-83	NO DATA	NO DATA	3.44E+02	NO DATA	NO DATA	NO DATA	LT8E-15**
BR-84	NO DATA	NO DATA	4.33E+02	NO DATA	NO DATA	NO DATA	LT8E-15
BR-85	NO DATA	NO DATA	1.83E+01	NO DATA	NO DATA	NO DATA	LT8E-15
RB-86	NO DATA	1.90E+05	8.40E+04	NO DATA	NO DATA	NO DATA	1.77E+04
RB-88	NO DATA	5.46E+02	2.72E+02	NO DATA	NO DATA	NO DATA	2.92E-05
RB-89	NO DATA	3.52E+02	2.33E+02	NO DATA	NO DATA	NO DATA	3.38E-07
SR-89	4.34E+05	NO DATA	1.25E+04	NO DATA	NO DATA	2.42E+06	3.71E+05
SR-90	1.08E+08	NO DATA	6.68E+06	NO DATA	NO DATA	1.65E+07	7.65E+05
SR-91	8.80E+01	NO DATA	3.51E+00	NO DATA	NO DATA	6.07E+04	2.59E+05
SR-92	9.52E+00	NO DATA	4.06E-01	NO DATA	NO DATA	2.74E+04	1.19E+05
Y-90	2.98E+03	NO DATA	8.00E+01	NO DATA	NO DATA	2.93E+05	5.59E+05
Y-91m	3.70E-01	NO DATA	1.42E-02	NO DATA	NO DATA	3.20E+03	3.02E+01
Y-91	6.61E+05	NO DATA	1.77E+04	NO DATA	NO DATA	2.94E+06	4.09E+05
Y-92	1.47E+01	NO DATA	4.29E-01	NO DATA	NO DATA	2.68E+04	1.65E+05
Y-93	1.35E+02	NO DATA	3.72E+00	NO DATA	NO DATA	8.32E+04	5.79E+05
ZR-95	1.46E+05	4.58E+04	3.15E+04	NO DATA	6.74E+04	2.69E+06	1.49E+05
ZR-97	1.38E+02	2.72E+01	1.26E+01	NO DATA	4.12E+01	1.30E+05	6.30E+05
NB-95	1.86E+04	1.03E+04	5.66E+03	NO DATA	1.00E+04	7.51E+05	9.68E+04
MO-99	NO DATA	1.69E+02	3.22E+01	NO DATA	4.11E+02	1.54E+05	2.69E+05
TC-99m	1.38E-03	3.86E-03	4.99E-02	NO DATA	5.76E-02	1.15E+03	6.13E+03
TC-101	5.92E-05	8.40E-05	8.24E-04	NO DATA	1.52E-03	6.67E+02	8.72E-07
RU-103	2.10E+03	NO DATA	8.96E+02	NO DATA	7.43E+03	7.83E+05	1.09E+05
RU-105	1.12E+00	NO DATA	4.34E-01	NO DATA	1.41E+00	1.82E+04	9.04E+04
RU-106	9.84E+04	NO DATA	1.24E+04	NO DATA	1.90E+05	1.61E+07	9.60E+05
AG-110m	1.38E+04	1.31E+04	7.99E+03	NO DATA	2.50E+04	6.75E+06	2.73E+05
TE-125m	4.88E+03	2.24E+03	6.67E+02	1.40E+03	NO DATA	5.36E+05	7.50E+04
TE-127m	1.80E+04	8.16E+03	2.18E+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
TE-131	1.58E-02	8.32E-03	5.04E-03	1.24E-02	6.18E-02	2.34E+03	1.51E+01

TABLE 3.5-15 (continued)

INHALATION PATHWAY FACTORS - R^{1}_{ail} (TEEN)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
E-132	3.60E+02	2.90E+02	2.19E+02	2.46E+02	1.95E+03	4.49E+05	4.63E+05
-130	6.24E+03	1.78E+04	7.17E+03	1.49E+06	2.75E+04	NO DATA	9.12E+03
-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	NO DATA	6.49E+03
-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	NO DATA	1.27E+03
-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	NO DATA	1.03E+04
-134	8.88E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	NO DATA	2.04E+01
-135	3.70E+03	9.44E+03	3.49E+03	6.21E+05	1.49E+04	NO DATA	6.95E+03
S-134	5.02E+05	1.12E+06	5.49E+05	NO DATA	3.75E+05	1.46E+05	9.76E+03
S-136	5.15E+04	1.94E+05	1.37E+05	NO DATA	1.10E+05	1.78E+04	1.09E+04
S-137	6.70E+05	8.48E+05	3.11E+05	NO DATA	3.04E+05	1.21E+05	8.48E+03
S-138	4.66E+02	8.56E+02	4.46E+02	NO DATA	6.62E+02	7.87E+01	2.70E-01
A-139	1.34E+00	9.44E-04	3.90E-02	NO DATA	8.88E-04	6.46E+03	6.45E+03
A-140	5.47E+04	6.70E+01	3.52E+03	NO DATA	2.28E+01	2.03E+06	2.29E+05
A-141	1.42E-01	1.06E-04	4.74E-03	NO DATA	9.84E-05	3.29E+03	7.46E-04
A-142	3.70E-02	3.70E-05	2.27E-03	NO DATA	3.14E-05	1.91E+03	4.79E-10
A-140	4.79E+02	2.36E+02	6.26E+01	NO DATA	NO DATA	2.14E+05	4.87E+05
A-142	9.60E-01	4.25E-01	1.06E-01	NO DATA	NO DATA	1.02E+04	1.20E+04
E-141	2.84E+04	1.90E+04	2.17E+03	NO DATA	8.88E+03	6.14E+05	1.26E+05
E-143	2.66E+02	1.94E+02	2.16E+01	NO DATA	8.64E+01	1.30E+05	2.55E+05
E-144	4.89E+06	2.02E+06	2.62E+05	NO DATA	1.21E+06	1.34E+07	8.64E+05
R-143	1.34E+04	5.31E+03	6.62E+02	NO DATA	3.09E+03	4.83E+05	2.14E+05
R-144	4.30E-02	1.76E-02	2.18E-03	NO DATA	1.01E-02	1.75E+03	2.35E-04
D-147	7.86E+03	8.56E+03	5.13E+02	NO DATA	5.02E+03	3.72E+05	1.82E+05
-187	1.20E+01	9.76E+00	3.43E+00	NO DATA	NO DATA	4.74E+04	1.77E+05
P-239	3.38E+02	3.19E+01	1.77E+01	NO DATA	1.00E+02	6.49E+04	1.32E+05

1.27×10^{3}

*Less than 8.00×10^{-15}

TABLE 3.5-16

INHALATION PATHWAY FACTORS - R^{I}_{a1} (ADULT)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	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	NO DATA	NO DATA	NO DATA	8.64E+04
CR-51	NO DATA	NO DATA	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
MN-54	NO DATA	3.96E+04	6.30E+03	NO DATA	9.84E+03	1.40E+06	7.74E+04
MN-56	NO DATA	1.24E+00	1.83E-01	NO DATA	1.30E+00	9.44E+03	2.02E+04
FE-55	2.46E+04	1.70E+04	3.94E+03	NO DATA	NO DATA	7.21E+04	6.03E+03
FE-59	1.18E+04	2.78E+04	1.06E+04	NO DATA	NO DATA	1.02E+06	1.88E+05
CO-58	NO DATA	1.58E+03	2.07E+03	NO DATA	NO DATA	9.28E+05	1.06E+05
CO-60	NO DATA	1.15E+04	1.48E+04	NO DATA	NO DATA	5.97E+06	2.85E+05
NI-63	4.32E+05	3.14E+04	1.45E+04	NO DATA	NO DATA	1.78E+05	1.34E+04
NI-65	1.54E+00	2.10E-01	9.12E-02	NO DATA	NO DATA	5.60E+03	1.23E+04
CU-64	NO DATA	1.46E+00	6.15E-01	NO DATA	4.62E+00	6.78E+03	4.90E+04
ZN-65	3.24E+04	1.03E+05	4.66E+04	NO DATA	6.90E+04	8.64E+05	5.34E+04
ZN-69	3.38E-02	6.51E-02	4.52E-03	NO DATA	4.22E-02	9.20E+02	1.63E+01
BR-83	NO DATA	NO DATA	2.41E+02	NO DATA	NO DATA	NO DATA	2.32E+02
BR-84	NO DATA	NO DATA	3.13E+02	NO DATA	NO DATA	NO DATA	1.64E-03
BR-85	NO DATA	NO DATA	1.28E+01	NO DATA	NO DATA	NO DATA	LT8E-15**
RB-86	NO DATA	1.35E+05	5.90E+04	NO DATA	NO DATA	NO DATA	1.66E+04
RB-88	NO DATA	3.87E+02	1.93E+02	NO DATA	NO DATA	NO DATA	3.34E-09
RB-89	NO DATA	2.56E+02	1.70E+02	NO DATA	NO DATA	NO DATA	9.28E-12
SR-89	3.04E+05	NO DATA	8.72E+03	NO DATA	NO DATA	1.40E+06	3.50E+05
SR-90	9.92E+07	NO DATA	6.10E+06	NO DATA	NO DATA	9.60E+06	7.22E+05
SR-91	6.19E+01	NO DATA	2.50E+00	NO DATA	NO DATA	3.65E+04	1.91E+05
SR-92	6.74E+00	NO DATA	2.91E-01	NO DATA	NO DATA	1.65E+04	4.30E+04
Y-90	2.09E+03	NO DATA	5.61E+01	NO DATA	NO DATA	1.70E+05	5.06E+05
Y-91m	2.61E-01	NO DATA	1.02E-02	NO DATA	NO DATA	1.92E+03	1.33E+00
Y-91	4.62E+05	NO DATA	1.24E+04	NO DATA	NO DATA	1.70E+06	3.85E+05
Y-92	1.03E+01	NO DATA	3.02E-01	NO DATA	NO DATA	1.57E+04	7.35E+04
Y-93	9.44E+01	NO DATA	2.61E+00	NO DATA	NO DATA	4.85E+04	4.22E+05
ZR-95	1.07E+05	3.44E+04	2.33E+04	NO DATA	5.42E+04	1.77E+06	1.50E+05
ZR-97	9.68E+01	1.96E+01	9.04E+00	NO DATA	2.97E+01	7.87E+04	5.23E+05
NB-95	1.41E+04	7.82E+03	4.21E+03	NO DATA	7.74E+03	5.05E+05	1.04E+05
MO-99	NO DATA	1.21E+02	2.30E+01	NO DATA	2.91E+02	9.12E+04	2.48E+05
TC-99m	1.03E-03	2.91E-03	3.70E-02	NO DATA	4.42E-02	7.64E+02	4.16E+03
TC-101	4.18E-05	6.02E-05	5.90E-04	NO DATA	1.08E-03	3.99E+02	1.09E-11
RU-103	1.53E+03	NO DATA	6.58E+02	NO DATA	5.83E+03	5.05E+05	1.10E+05
RU-105	7.90E-01	NO DATA	3.11E-01	NO DATA	1.02E+00	1.10E+04	4.82E+04
RU-106	6.91E+04	NO DATA	8.72E+03	NO DATA	1.34E+05	9.36E+06	9.12E+05
AG-110m	1.08E+04	1.00E+04	5.94E+03	NO DATA	1.97E+04	4.63E+05	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
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
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	5.95E-03	3.59E-03	9.36E-03	4.37E-02	1.39E+03	1.84E+01

TABLE 3.5-16 (continued)

INHALATION PATHWAY FACTORS - R^{I}_{aij} (ADULT)
(mrem/yr per $\mu Ci/m^3$)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
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+04	NO DATA	7.69E+03
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	NO DATA	6.28E+03
I-132	1.16E+03	3.26E+03	1.16E+03	1.14E+05	5.18E+03	NO DATA	4.06E+02
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	NO DATA	8.88E+03
I-134	6.44E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	NO DATA	1.01E+00
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	NO DATA	5.25E+03
CS-134	3.73E+05	8.48E+05	7.28E+05	NO DATA	2.87E+05	9.76E+04	1.04E+04
CS-136	3.90E+04	1.46E+05	1.10E+05	NO DATA	8.56E+04	1.20E+04	1.17E+04
CS-137	4.78E+05	6.21E+05	4.28E+05	NO DATA	2.22E+05	7.52E+04	8.40E+03
CS-138	3.31E+02	6.21E+02	3.24E+02	NO DATA	4.80E+02	4.86E+01	1.86E-03
BA-139	9.36E-01	6.66E-04	2.74E-02	NO DATA	6.22E-04	3.76E+03	8.96E+02
BA-140	3.90E+04	4.90E+01	2.57E+03	NO DATA	1.67E+01	1.27E+06	2.18E+05
BA-141	1.00E-01	7.53E-05	3.36E-03	NO DATA	7.00E-05	1.94E+03	1.16E-07
BA-142	2.63E-02	2.70E-05	1.66E-03	NO DATA	2.29E-05	1.19E+03	1.57E-16
LA-140	3.44E+02	1.74E+02	4.58E+01	NO DATA	NO DATA	1.36E+05	4.58E+05
LA-142	6.83E-01	3.10E-01	7.72E-02	NO DATA	NO DATA	6.33E+03	2.11E+03
CE-141	1.99E+04	1.35E+04	1.53E+03	NO DATA	6.26E+03	3.62E+05	1.20E+05
CE-143	1.86E+02	1.38E+02	1.53E+[illegible]	NO DATA	6.08E+01	7.98E+04	2.26E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	NO DATA	8.48E+05	7.78E+06	8.16E+05
PR-143	9.36E+03	3.75E+03	4.64E+02	NO DATA	2.16E+03	2.81E+05	2.00E+05
PR-144	3.01E-02	1.25E-02	1.53E-03	NO DATA	7.05E-03	1.02E+03	2.15E-08
ND-147	5.27E+03	6.10E+03	3.65E+02	NO DATA	3.56E+03	2.21E+05	1.73E+05
W-187	8.48E+00	7.08E+00	2.48E+00	NO DATA	NO DATA	2.90E+04	1.55E+05
NP-239	2.30E+02	2.26E+01	1.24E+01	NO DATA	7.00E+01	3.76E+04	1.19E+05

*1.26×10^{3}

**Less than 8.00×10^{-15}

TABLE 3.5-17

COW MILK PATHWAY FACTORS - R^{C}_{ai} (INFANT)
(m^2rem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.38E+03*	2.38E+03*	2.38E+03*	2.38E+03*	2.38E+03*	2.38E+03*
C-14	3.23E+06*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*
NA-24	1.55E+07**	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07
P-32	1.60E+11	9.41E+09	6.20E+09	NO DATA	NO DATA	NO DATA	2.16E+09
CR-51	NO DATA	NO DATA	1.61E+05	1.05E+05	2.29E+04	2.04E+05	4.69E+06
MN-54	NO DATA	3.90E+07	8.84E+06	NO DATA	8.64E+06	NO DATA	1.43E+07
MN-56	NO DATA	3.12E-02	5.39E-03	NO DATA	2.69E-02	NO DATA	2.84E+00
FE-55	1.35E+08	8.72E+07	2.33E+07	NO DATA	NO DATA	4.26E+07	1.11E+07
FE-59	2.25E+08	3.92E+08	1.55E+08	NO DATA	NO DATA	1.16E+08	1.87E+08
CO-58	NO DATA	2.43E+07	6.06E+07	NO DATA	NO DATA	NO DATA	6.05E+07
CO-60	NO DATA	8.82E+07	2.08E+08	NO DATA	NO DATA	NO DATA	2.10E+08
NI-63	3.50E+10	2.16E+09	1.21E+09	NO DATA	NO DATA	NO DATA	1.08E+08
NI-65	3.52E+00	3.98E-01	1.81E-01	NO DATA	NO DATA	NO DATA	3.03E+01
CU-64	NO DATA	1.84E+05	8.52E+04	NO DATA	3.11E+05	NO DATA	3.78E+06
ZN-65	5.55E+09	1.91E+10	8.78E+09	NO DATA	9.23E+09	NO DATA	1.61E+10
ZN-69	1.94E-11	3.49E-11	2.60E-12	NO DATA	1.45E-11	NO DATA	2.85E-09
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.23E+10	1.10E+10	NO DATA	NO DATA	NO DATA	5.70E+08
RB-88	NO DATA	1.88E-44	1.03E-44	NO DATA	NO DATA	NO DATA	1.83E-44
RB-89	NO DATA	3.43E-52	2.36E-52	NO DATA	NO DATA	NO DATA	1.17E-52
SR-89	1.26E+10	NO DATA	3.61E+08	NO DATA	NO DATA	NO DATA	2.59E+08
SR-90	1.22E+11	NO DATA	3.10E+10	NO DATA	NO DATA	NO DATA	1.52E+09
SR-91	2.71E+05	NO DATA	9.76E+03	NO DATA	NO DATA	NO DATA	3.20E+05
SR-92	4.68E+00	NO DATA	1.74E-01	NO DATA	NO DATA	NO DATA	5.05E+01
Y-90	6.83E+02	NO DATA	1.83E+01	NO DATA	NO DATA	NO DATA	9.43E+05
Y-91m	6.09E-19	NO DATA	2.08E-20	NO DATA	NO DATA	NO DATA	2.03E-15
Y-91	7.33E+04	NO DATA	1.95E+03	NO DATA	NO DATA	NO DATA	5.26E+06
Y-92	5.35E-04	NO DATA	1.50E-05	NO DATA	NO DATA	NO DATA	1.02E+01
Y-93	2.14E+00	NO DATA	5.83E-02	NO DATA	NO DATA	NO DATA	1.69E+04
ZR-95	6.82E+03	1.66E+03	1.18E+03	NO DATA	1.79E+03	NO DATA	8.28E+05
ZR-97	4.03E+00	6.96E-01	3.16E-01	NO DATA	7.01E-01	NO DATA	4.41E+04
NB-95	5.93E+05	2.44E+05	1.41E+05	NO DATA	1.75E+05	NO DATA	2.06E+08
MO-99	NO DATA	2.07E+08	4.04E+07	NO DATA	3.10E+08	NO DATA	6.83E+07
TC-99m	2.75E+01	5.66E+01	7.29E+02	NO DATA	6.09E+02	2.96E+01	1.64E+04
TC-101	2.72E-59	3.42E-59	3.39E-58	NO DATA	4.07E-58	1.87E-59	5.81E-57
RU-103	8.67E+03	NO DATA	2.92E+03	NO DATA	1.81E+04	NO DATA	1.06E+05
RU-105	8.00E-03	NO DATA	2.70E-03	NO DATA	5.88E-02	NO DATA	3.18E+00
RU-106	1.91E+05	NO DATA	2.38E+04	NO DATA	2.26E+05	NO DATA	1.45E+06
AG-110m	3.85E+08	2.81E+08	1.86E+08	NO DATA	4.02E+08	NO DATA	1.46E+10
TE-125m	1.51E+08	5.05E+07	2.04E+07	5.08E+07	NO DATA	NO DATA	7.19E+07
TE-127m	4.22E+08	1.40E+08	5.10E+07	1.22E+08	1.04E+09	NO DATA	1.70E+08
TE-127	6.31E+03	2.11E+03	1.39E+03	5.13E+03	1.58E+04	NO DATA	1.36E+05
TE-129m	5.56E+08	1.91E+08	8.56E+07	2.14E+08	1.39E+09	NO DATA	3.32E+08
TE-129	2.71E-09	9.34E-10	6.33E-10	2.27E-09	6.75E-09	NO DATA	2.17E-07
TE-131m	3.37E+06	1.36E+06	1.12E+06	2.75E+06	9.35E+06	NO DATA	2.29E+07
TE-131	3.48E-32	1.29E-32	9.78E-33	3.11E-32	8.91E-32	NO DATA	1.41E-30

TABLE 3.5-17 (continued)

COW MILK PATHWAY FACTORS - R^{C}_{ai} (INFANT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.12E+07	1.05E+07	9.80E+06	1.55E+07	6.57E+07	NO DATA	3.89E+07
I-130	3.53E+06	7.76E+06	3.12E+06	8.70E+08	8.53E+06	NO DATA	1.66E+06
I-131	2.71E+09	3.19E+09	1.40E+09	1.05E+12	3.73E+09	NO DATA	1.14E+08
I-132	1.43E+00	2.90E+00	1.03E+00	1.36E+02	3.24E+00	NO DATA	2.35E+00
I-133	3.63E+07	5.28E+07	1.55E+07	9.60E+09	6.21E+07	NO DATA	8.93E+06
I-134	1.64E-11	3.36E-11	1.20E-11	7.86E-10	3.76E-11	NO DATA	3.48E-11
I-135	1.13E+05	2.24E+05	8.18E+04	2.01E+07	2.50E+05	NO DATA	8.12E+04
CS-134	3.65E+10	6.81E+10	6.88E+09	NO DATA	1.75E+10	7.19E+09	1.85E+08
CS-136	1.97E+09	5.81E+09	2.17E+09	NO DATA	2.31E+09	4.73E+08	8.82E+07
CS-137	5.15E+10	6.03E+10	4.27E+09	NO DATA	1.62E+10	6.44E+09	1.89E+08
CS-138	8.06E-23	1.31E-22	6.35E-23	NO DATA	6.53E-23	1.02E-22	2.09E-22
BA-139	4.29E-07	2.84E-10	1.24E-08	NO DATA	1.71E-10	1.72E-10	2.72E-05
BA-140	2.45E+08	2.45E+05	1.26E+07	NO DATA	5.72E+04	1.50E+05	5.92E+07
BA-141	4.16E-45	2.85E-48	1.31E-46	NO DATA	1.71E-48	1.73E-48	5.08E-44
BA-142	2.32E-79	1.93E-82	1.14E-80	NO DATA	1.11E-82	1.17E-82	9.56E-79
LA-140	4.05E+01	1.60E+01	4.11E+00	NO DATA	NO DATA	NO DATA	1.88E+05
LA-142	1.73E-10	6.34E-11	1.52E-11	NO DATA	NO DATA	NO DATA	1.08E-05
CE-141	4.34E+04	2.65E+04	3.12E+03	NO DATA	8.17E+03	NO DATA	1.37E+07
CE-143	3.98E+02	2.64E+05	3.01E+01	NO DATA	7.69E+01	NO DATA	1.54E+06
CE-144	2.34E+06	9.56E+05	1.31E+05	NO DATA	3.87E+05	NO DATA	1.34E+06
PR-143	1.49E+03	5.56E+02	7.37E+01	NO DATA	2.07E+02	NO DATA	7.85E+05
PR-144	6.27E-53	2.43E-53	3.16E-54	NO DATA	8.79E-54	NO DATA	1.13E-48
ND-147	8.79E+02	9.03E+02	5.53E+01	NO DATA	3.48E+02	NO DATA	5.72E+05
W-187	6.10E+04	4.24E+04	1.46E+04	NO DATA	NO DATA	NO DATA	2.49E+06
NP-239	3.64E+01	3.26E+00	1.84E+00	NO DATA	6.49E+00	NO DATA	9.41E+04

mrem/yr per µCi/m^3
*1.55 x 10^7

TABLE 3.5-18

COW MILK PATHWAY FACTORS - R^{C}_{ail} (CHILD)

(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.57E+03*	1.57E+03*	1.57E+03*	1.57E+03*	1.57E+03*	1.57E+03*
C-14	1.65E+06*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*
NA-24	8.93E+06**	8.93E+06	8.93E+06	8.93E+06	8.93E+06	8.93E+06	8.93E+06
P-32	7.79E+10	3.64E+09	3.00E+09	NO DATA	NO DATA	NO DATA	2.15E+09
CR-51	NO DATA	NO DATA	1.01E+05	5.63E+04	1.54E+04	1.03E+05	5.38E+06
MN-54	NO DATA	2.10E+07	5.59E+06	NO DATA	5.88E+06	NO DATA	1.76E+07
MN-56	NO DATA	1.28E-02	2.88E-03	NO DATA	1.54E-02	NO DATA	1.85E+00
FE-55	1.12E+08	5.94E+07	1.84E+07	NO DATA	NO DATA	3.36E+07	1.10E+07
FE-59	1.20E+08	1.95E+08	9.71E+07	NO DATA	NO DATA	5.65E+07	2.03E+08
CO-58	NO DATA	1.21E+07	3.71E+07	NO DATA	NO DATA	NO DATA	7.08E+07
CO-60	NO DATA	4.32E+07	1.27E+08	NO DATA	NO DATA	NO DATA	2.39E+08
NI-63	2.97E+10	1.59E+09	1.01E+09	NO DATA	NO DATA	NO DATA	1.07E+08
NI-65	1.65E+00	1.56E-01	9.10E-02	NO DATA	NO DATA	NO DATA	1.91E+01
CU-64	NO DATA	7.40E+04	4.47E+04	NO DATA	1.79E+05	NO DATA	3.47E+06
ZN-65	4.13E+09	1.10E+10	6.83E+09	NO DATA	6.92E+09	NO DATA	1.93E+09
ZN-69	9.11E-12	1.32E-11	1.22E-12	NO DATA	7.99E-12	NO DATA	8.30E-10
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	8.78E+09	5.40E+09	NO DATA	NO DATA	NO DATA	5.65E+08
RB-88	NO DATA	7.16E-45	4.98E-45	NO DATA	NO DATA	NO DATA	3.51E-46
RB-89	NO DATA	1.40E-52	1.25E-52	NO DATA	NO DATA	NO DATA	1.22E-54
SR-89	6.63E+09	NO DATA	1.89E+08	NO DATA	NO DATA	NO DATA	2.57E+08
SR-90	1.12E+11	NO DATA	2.84E+10	NO DATA	NO DATA	NO DATA	1.51E+09
SR-91	1.30E+05	NO DATA	4.89E+03	NO DATA	NO DATA	NO DATA	2.86E+05
SR-92	2.20E+00	NO DATA	8.83E-02	NO DATA	NO DATA	NO DATA	4.17E+01
Y-90	3.23E+02	NO DATA	8.65E+00	NO DATA	NO DATA	NO DATA	9.20E+05
Y-91m	2.88E-19	NO DATA	1.05E-20	NO DATA	NO DATA	NO DATA	5.63E-16
Y-91	3.90E+04	NO DATA	1.04E+03	NO DATA	NO DATA	NO DATA	5.20E+06
Y-92	2.53E-04	NO DATA	7.23E-06	NO DATA	NO DATA	NO DATA	7.30E+00
Y-93	1.01E+00	NO DATA	2.76E-02	NO DATA	NO DATA	NO DATA	1.50E+04
ZR-95	3.84E+03	8.44E+02	7.51E+02	NO DATA	1.21E+03	NO DATA	8.80E+05
ZR-97	1.92E+00	2.78E-01	1.64E-01	NO DATA	3.99E-01	NO DATA	4.21E+04
NB-95	3.18E+05	1.24E+05	8.84E+04	NO DATA	1.16E+05	NO DATA	2.29E+08
MO-99	NO DATA	8.15E+07	2.02E+07	NO DATA	1.74E+08	NO DATA	6.74E+07
TC-99m	1.32E+01	2.58E+01	4.28E+02	NO DATA	3.75E+02	1.31E+01	1.47E+04
TC-101	1.28E-59	1.34E-59	1.70E-58	NO DATA	2.29E-58	7.08E-60	4.26E-59
RU-103	4.29E+03	NO DATA	1.65E+03	NO DATA	1.08E+04	NO DATA	1.11E+05
RU-105	3.80E-03	NO DATA	1.38E-03	NO DATA	3.34E-02	NO DATA	2.48E+00
RU-106	9.25E+04	NO DATA	1.15E+04	NO DATA	1.25E+05	NO DATA	1.44E+06
AG-110m	2.09E+08	1.41E+08	1.13E+08	NO DATA	2.63E+08	NO DATA	1.68E+10
TE-125m	7.39E+07	2.00E+07	9.85E+07	2.07E+07	NO DATA	NO DATA	7.13E+07
TE-127m	2.08E+08	5.61E+07	2.47E+07	4.98E+07	5.94E+08	NO DATA	1.69E+08
TE-127	2.97E+03	8.01E+02	6.37E+02	2.06E+03	8.45E+03	NO DATA	1.16E+05
TE-129m	2.71E+08	7.58E+07	4.21E+07	8.74E+07	7.97E+08	NO DATA	3.31E+08
TE-129	1.28E-09	3.57E-10	3.04E-10	9.12E-10	3.74E-09	NO DATA	7.96E-08
TE-131m	1.60E+06	5.53E+05	5.88E+05	1.14E+06	5.35E+06	NO DATA	2.24E+07
TE-131	1.64E-32	5.01E-33	4.89E-33	1.26E-32	4.97E-32	NO DATA	8.63E-32

TABLE 3.5-18 (continued)

COW MILK PATHWAY FACTORS - R^{C}_{ail} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.03E+07	4.56E+06	5.51E+06	6.64E+06	4.23E+07	NO DATA	4.59E+07
I-130	1.72E+06	3.47E+06	1.79E+06	3.82E+08	5.19E+06	NO DATA	1.62E+06
I-131	1.30E+09	1.31E+09	7.44E+08	4.33E+11	2.15E+09	NO DATA	1.17E+08
I-132	6.91E-01	1.27E+00	5.84E-01	5.89E+01	1.94E+00	NO DATA	1.49E+00
I-133	1.72E+07	2.12E+07	8.03E+06	3.94E+09	3.54E+07	NO DATA	8.56E+06
I-134	7.92E-12	1.47E-11	6.77E-12	3.38E-10	2.25E-11	NO DATA	9.75E-12
I-135	5.43E+04	9.77E+04	4.62E+04	8.56E+06	1.50E+05	NO DATA	7.44E+04
CS-134	2.27E+10	3.72E+10	7.85E+09	NO DATA	1.15E+10	4.14E+09	2.01E+08
CS-136	1.01E+09	2.78E+09	1.80E+09	NO DATA	1.48E+09	2.21E+08	9.76E+07
CS-137	3.23E+10	3.09E+10	4.56E+09	NO DATA	1.01E+10	3.63E+09	1.94E+08
CS-138	3.82E-23	5.31E-23	3.37E-23	NO DATA	3.74E-23	4.02E-24	2.45E-23
BA-139	2.01E-07	1.08E-10	5.84E-09	NO DATA	9.39E-11	6.33E-11	1.16E-05
BA-140	1.18E+08	1.03E+05	6.84E+06	NO DATA	3.37E+04	6.12E+04	5.94E+07
BA-141	1.96E-45	1.10E-48	6.38E-47	NO DATA	9.50E-49	6.45E-48	1.12E-45
BA-142	1.10E-79	7.93E-83	6.15E-81	NO DATA	6.41E-83	4.66E-83	1.44E-81
LA-140	1.94E+01	6.78E+00	2.11E+00	NO DATA	NO DATA	NO DATA	1.89E+05
LA-142	8.23E-11	2.62E-11	8.21E-12	NO DATA	NO DATA	NO DATA	5.20E-06
CE-141	2.19E+04	1.09E+04	1.62E+03	NO DATA	4.78E+03	NO DATA	1.36E+07
CE-143	1.87E+02	1.02E+05	1.47E+01	NO DATA	4.26E+01	NO DATA	1.49E+06
CE-144	1.63E+06	5.10E+05	8.68E+04	NO DATA	2.82E+05	NO DATA	1.33E+08
PR-143	7.19E+02	2.16E+02	3.57E+01	NO DATA	1.17E+02	NO DATA	7.76E+05
PR-144	2.94E-53	9.10E-54	1.48E-54	NO DATA	4.81E-54	NO DATA	1.96E-50
ND-147	4.44E+02	3.59E+02	2.78E+01	NO DATA	1.97E+02	NO DATA	5.69E+05
W-187	2.88E+04	1.71E+04	7.66E+03	NO DATA	NO DATA	NO DATA	2.40E+06
NP-239	1.72E+01	1.24E+00	8.69E-01	NO DATA	3.58E+00	NO DATA	9.15E+04

*mrem/yr per µCi/m^3
**8.93×10^6

TABLE 3.5-19

COW MILK PATHWAY FACTORS - R^{C}_{ai} (TEEN)

(m^2mrem/yr per μCi)

ORGAN: ISOTOPE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	9.92E+02*	9.92E+02*	9.92E+02*	9.92E+02*	9.92E+02*	9.92E+02*
C-14	6.70E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*
NA-24	4.29E+06*	4.29E+06	4.29E+06	4.29E+06	4.29E+06	4.29E+06	4.29E+06
P-32	3.15E+10	1.95E+09	1.22E+09	NO DATA	NO DATA	NO DATA	2.64E+09
CR-51	NO DATA	NO DATA	5.00E+04	2.78E+04	1.10E+04	7.14E+04	8.41E+06
MN-54	NO DATA	1.40E+07	2.78E+06	NO DATA	4.19E+06	NO DATA	2.88E+07
MN-56	NO DATA	7.32E-03	1.30E-03	NO DATA	9.26E-03	NO DATA	4.82E-01
FE-55	4.46E+07	3.16E+07	7.38E+06	NO DATA	NO DATA	2.01E+07	1.37E+07
FE-59	5.18E+07	1.21E+08	4.67E+07	NO DATA	NO DATA	3.81E+07	2.68E+08
CO-58	NO DATA	7.98E+06	1.84E+07	NO DATA	NO DATA	NO DATA	1.10E+08
CO-60	NO DATA	2.78E+07	6.26E+07	NO DATA	NO DATA	NO DATA	3.62E+08
NI-63	1.18E+10	8.34E+08	4.00E+08	NO DATA	NO DATA	NO DATA	1.33E+08
NI-65	6.79E-01	8.67E-02	3.95E-02	NO DATA	NO DATA	NO DATA	4.70E+00
CU-64	NO DATA	4.20E+04	1.97E+04	NO DATA	1.06E+05	NO DATA	3.26E+06
ZN-65	2.11E+09	7.32E+09	3.41E+09	NO DATA	4.68E+09	NO DATA	3.10E+09
ZN-69	3.70E-12	7.06E-12	4.94E-13	NO DATA	4.61E-12	NO DATA	1.30E-11
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	4.74E+09	2.23E+09	NO DATA	NO DATA	NO DATA	7.01E+08
RB-88	NO DATA	3.90E-45	2.08E-45	NO DATA	NO DATA	NO DATA	3.34E-52
RB-89	NO DATA	7.98E-53	5.64E-53	NO DATA	NO DATA	NO DATA	1.22E-61
SR-89	2.68E+09	NO DATA	7.67E+07	NO DATA	NO DATA	NO DATA	3.19E+08
SR-90	6.62E+10	NO DATA	1.64E+10	NO DATA	NO DATA	NO DATA	1.86E+09
SR-91	5.27E+04	NO DATA	2.10E+03	NO DATA	NO DATA	NO DATA	2.39E+05
SR-92	9.03E-01	NO DATA	3.85E-02	NO DATA	NO DATA	NO DATA	2.30E+01
Y-90	1.31E+02	NO DATA	3.53E+00	NO DATA	NO DATA	NO DATA	1.08E+06
Y-91m	1.18E-19	NO DATA	4.49E-21	NO DATA	NO DATA	NO DATA	5.55E-18
Y-91	1.58E+04	NO DATA	4.24E+02	NO DATA	NO DATA	NO DATA	6.48E+06
Y-92	1.03E-04	NO DATA	2.97E-06	NO DATA	NO DATA	NO DATA	2.82E+00
Y-93	4.10E-01	NO DATA	1.12E-02	NO DATA	NO DATA	NO DATA	1.25E+04
ZR-95	1.65E+03	5.20E+02	3.58E+02	NO DATA	7.65E+02	NO DATA	1.20E+06
ZR-97	7.87E-01	1.56E-01	7.17E-02	NO DATA	2.36E-01	NO DATA	4.22E+04
NB-95	1.41E+05	7.81E+04	4.30E+04	NO DATA	7.57E+04	NO DATA	3.34E+08
MO-99	NO DATA	4.46E+07	8.50E+06	NO DATA	1.02E+08	NO DATA	7.98E+07
TC-99m	5.74E+00	1.60E+01	2.08E+02	NO DATA	2.39E+02	8.89E+00	1.05E+04
TC-101	5.22E-60	7.42E-60	7.29E-59	NO DATA	1.34E-58	4.52E-60	1.27E-66
RU-103	1.81E+03	NO DATA	7.73E+02	NO DATA	6.37E+03	NO DATA	1.51E+05
RU-105	1.56E-03	NO DATA	6.06E-04	NO DATA	1.97E-02	NO DATA	1.26E+00
RU-106	3.75E+04	NO DATA	4.73E+03	NO DATA	7.23E+04	NO DATA	1.80E+06
AG-110m	9.64E+07	9.12E+07	5.55E+07	NO DATA	1.74E+08	NO DATA	2.56E+10
TE-125m	3.01E+07	1.08E+07	4.02E+06	8.41E+06	NO DATA	NO DATA	8.88E+07
TE-127m	8.43E+07	2.99E+07	1.00E+07	2.01E+07	3.42E+08	NO DATA	2.10E+08
TE-127	1.21E+03	4.28E+02	2.60E+02	8.33E+02	4.89E+03	NO DATA	9.33E+04
TE-129m	1.10E+08	4.09E+07	1.74E+07	3.56E+07	4.61E+08	NO DATA	4.14E+08
TE-129	5.18E-10	1.93E-10	1.26E-10	3.70E-10	2.17E-09	NO DATA	2.83E-09
TE-131m	6.56E+05	3.15E+05	2.63E+05	4.73E+05	3.28E+06	NO DATA	2.53E+07
TE-131	6.70E-33	2.76E-33	2.09E-33	5.16E-33	2.92E-32	NO DATA	5.50E-34

TABLE 3.5-19 (continued)

COW MILK PATHWAY FACTORS - R^{C}_{aij} (TEEN)
(m^2mrem/yr per μCi/sec)

RGAN: SOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
E-132	4.29E+06	2.72E+06	2.56E+06	2.87E+06	2.61E+07	NO DATA	8.61E+07
-130	7.33E+05	2.12E+06	8.47E+05	1.73E+08	3.27E+06	NO DATA	1.63E+06
-131	5.36E+08	7.50E+08	4.03E+08	2.19E+11	1.29E+09	NO DATA	1.48E+08
-132	2.90E-01	7.59E-01	2.72E-01	2.56E+01	1.20E+00	NO DATA	3.31E-01
-133	7.06E+06	1.20E+07	3.65E+06	1.67E+09	2.10E+07	NO DATA	9.06E+06
-134	3.34E-12	8.86E-12	3.18E-12	1.48E-10	1.40E-11	NO DATA	1.17E-13
-135	2.29E+04	5.90E+04	2.19E+04	3.80E+06	9.32E+04	NO DATA	6.54E+04
S-134	5.79E+09	2.30E+10	1.07E+10	NO DATA	7.32E+09	2.80E+09	2.87E+08
S-136	4.48E+08	1.76E+09	1.18E+09	NO DATA	9.59E+08	1.51E+08	1.42E+08
S-137	1.33E+10	1.77E+10	6.18E+09	NO DATA	6.03E+09	2.34E+09	2.52E+08
S-138	1.58E-23	3.03E-23	1.51E-23	NO DATA	2.23E-23	2.60E-24	1.37E-26
A-139	8.20E-08	5.77E-11	2.39E-09	NO DATA	5.44E-11	3.98E-11	7.31E-07
A-140	4.85E+07	5.95E+04	3.13E+06	NO DATA	2.02E+04	4.00E+04	7.49E+07
A-141	7.98E-46	5.96E-49	2.67E-47	NO DATA	5.53E-49	4.08E-49	1.70E-51
A-142	4.54E-80	4.54E-83	2.80E-81	NO DATA	3.85E-83	3.02E-83	1.40E-91
A-140	8.11E+00	3.98E+00	1.06E+00	NO DATA	NO DATA	NO DATA	2.29E+05
A-142	3.42E-11	1.52E-11	3.78E-12	NO DATA	NO DATA	NO DATA	4.62E-07
E-141	8.88E+03	5.93E+03	6.81E+02	NO DATA	2.79E+03	NO DATA	1.70E+07
E-143	7.64E+01	5.55E+04	6.21E+00	NO DATA	2.49E+01	NO DATA	1.67E+06
E-144	6.61E+05	2.73E+05	3.55E+04	NO DATA	1.63E+05	NO DATA	1.66E+08
R-143	2.91E+02	1.16E+02	1.45E+01	NO DATA	6.75E+01	NO DATA	9.57E+05
R-144	1.19E-53	4.88E-54	6.04E-55	NO DATA	2.80E-54	NO DATA	1.31E-56
D-147	1.81E+02	1.97E+02	1.18E+01	NO DATA	1.16E+02	NO DATA	7.10E+05
r187	1.19E+04	9.72E+03	3.41E+03	NO DATA	NO DATA	NO DATA	2.63E+06
P-239	6.99E+00	6.59E-01	3.66E-01	NO DATA	2.07E+00	NO DATA	1.06E+05

mrem/yr per μCi/m^3
*4.29 x 10^6

TABLE 3.5-20

COW MILK PATHWAY FACTORS - R^{C}_{ai} (ADULT)

(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	7.62E+02*	7.62E+02*	7.62E+02*	7.62E+02*	7.62E+02*	7.62E+02*
C-14	3.63E+05*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*
NA-24	2.46E+06**	2.46E+06	2.46E+06	2.46E+06	2.46E+06	2.46E+06	2.46E+06
P-32	1.71E+10	1.06E+09	6.61E+08	NO DATA	NO DATA	NO DATA	1.92E+09
CR-51	NO DATA	NO DATA	2.85E+04	1.70E+04	6.27E+03	3.78E+04	7.16E+06
MN-54	NO DATA	8.41E+06	1.60E+06	NO DATA	2.50E+06	NO DATA	2.58E+07
MN-56	NO DATA	4.14E-03	7.34E-04	NO DATA	5.26E-03	NO DATA	1.32E-01
FE-55	2.51E+07	1.73E+07	4.04E+06	NO DATA	NO DATA	9.68E+06	9.95E+06
FE-59	2.97E+07	6.99E+07	2.68E+07	NO DATA	NO DATA	1.95E+07	2.33E+08
CO-58	NO DATA	4.72E+06	1.06E+07	NO DATA	NO DATA	NO DATA	9.57E+07
CO-60	NO DATA	1.64E+07	3.62E+07	NO DATA	NO DATA	NO DATA	3.08E+08
NI-63	6.73E+09	4.67E+08	2.26E+08	NO DATA	NO DATA	NO DATA	9.74E+07
NI-65	3.70E-01	4.81E-02	2.19E-02	NO DATA	NO DATA	NO DATA	1.22E+00
CU-64	NO DATA	2.36E+04	1.11E+04	NO DATA	5.94E+04	NO DATA	2.01E+06
ZN-65	1.37E+09	4.37E+09	1.98E+09	NO DATA	2.93E+09	NO DATA	2.75E+09
ZN-69	2.01E-12	3.84E-12	2.67E-13	NO DATA	2.50E-12	NO DATA	5.77E-13
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.60E+09	1.21E+09	NO DATA	NO DATA	NO DATA	5.12E+08
RB-88	NO DATA	2.15E-45	1.14E-45	NO DATA	NO DATA	NO DATA	2.97E-56
RB-89	NO DATA	4.49E-53	3.16E-53	NO DATA	NO DATA	NO DATA	2.61E-66
SR-89	1.45E+09	NO DATA	4.16E+07	NO DATA	NO DATA	NO DATA	2.33E+08
SR-90	4.68E+10	NO DATA	1.15E+10	NO DATA	NO DATA	NO DATA	1.35E+09
SR-91	2.87E+04	NO DATA	1.16E+03	NO DATA	NO DATA	NO DATA	1.37E+05
SR-92	4.92E-01	NO DATA	2.13E-02	NO DATA	NO DATA	NO DATA	9.76E+00
Y-90	7.10E+01	NO DATA	1.90E+00	NO DATA	NO DATA	NO DATA	7.53E+05
Y-91m	6.42E-20	NO DATA	2.49E-21	NO DATA	NO DATA	NO DATA	1.89E-19
Y-91	8.60E+03	NO DATA	2.30E+02	NO DATA	NO DATA	NO DATA	4.73E+06
Y-92	5.57E-05	NO DATA	1.63E-06	NO DATA	NO DATA	NO DATA	9.75E-01
Y-93	2.22E-01	NO DATA	6.12E-03	NO DATA	NO DATA	NO DATA	7.03E+03
ZR-95	9.45E+02	3.03E+02	2.05E+02	NO DATA	4.76E+02	NO DATA	9.61E+05
ZR-97	4.32E-01	8.71E-02	3.98E-02	NO DATA	1.32E-01	NO DATA	2.70E+04
NB-95	8.25E+04	4.59E+04	2.47E+04	NO DATA	4.54E+04	NO DATA	2.79E+08
MO-99	NO DATA	2.48E+07	4.72E+06	NO DATA	5.61E+07	NO DATA	5.74E+07
TC-99m	3.31E+00	9.35E+00	1.19E+02	NO DATA	1.42E+02	4.58E+00	5.53E+03
TC-101	2.85E-60	4.11E-60	4.03E-59	NO DATA	7.41E-59	2.10E-60	1.24E-71
RU-103	1.02E+03	NO DATA	4.39E+02	NO DATA	3.89E+03	NO DATA	1.19E+05
RU-105	8.52E-04	NO DATA	3.36E-04	NO DATA	1.10E-02	NO DATA	5.21E-01
RU-106	2.04E+04	NO DATA	2.58E+03	NO DATA	3.94E+04	NO DATA	1.32E+06
AG-110m	5.82E+07	5.39E+07	3.20E+07	NO DATA	1.06E+08	NO DATA	2.20E+10
TE-125m	1.63E+07	5.91E+06	2.19E+06	4.91E+06	6.64E+07	NO DATA	6.52E+07
TE-127m	4.58E+07	1.64E+07	5.58E+06	1.17E+07	1.86E+08	NO DATA	1.53E+08
TE-127	6.52E+02	2.34E+02	1.41E+02	4.83E+02	2.65E+03	NO DATA	5.14E+04
TE-129m	6.01E+07	2.24E+07	9.52E+06	2.07E+07	2.51E+08	NO DATA	3.03E+08
TE-129	2.82E-10	1.06E-10	6.86E-11	2.16E-10	1.18E-09	NO DATA	2.12E-10
TE-131m	3.60E+05	1.76E+05	1.47E+05	2.79E+05	1.78E+06	NO DATA	1.75E+07
TE-131	3.68E-33	1.54E-33	1.16E-33	3.03E-33	1.61E-32	NO DATA	5.22E-34

TABLE 3.5-20 (continued)

COW MILK PATHWAY FACTORS - R^{C}_{ailj} (ADULT)
(m^2mrem/yr per µCi/sec)

RGAN: SOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
-132	2.41E+06	1.56E+06	1.46E+06	1.72E+06	1.50E+07	NO DATA	7.36E+07
-130	4.16E+05	1.23E+06	4.84E+05	1.04E+08	1.91E+06	NO DATA	1.06E+06
-131	2.97E+08	4.24E+08	2.43E+08	1.39E+11	7.27E+08	NO DATA	1.12E+08
-132	1.65E-01	4.40E-01	1.54E-01	1.54E+01	7.02E-01	NO DATA	8.27E-02
-133	3.86E+06	6.72E+06	2.05E+06	9.87E+08	1.17E+07	NO DATA	6.04E+06
-134	1.89E-12	5.13E-12	1.83E-12	8.88E-11	8.15E-12	NO DATA	4.47E-15
-135	1.29E+04	3.39E+04	1.25E+04	2.23E+06	5.43E+04	NO DATA	3.83E+04
-134	5.67E+09	1.35E+10	1.10E+10	NO DATA	4.37E+09	1.45E+09	2.36E+08
-136	2.64E+08	1.04E+09	7.49E+08	NO DATA	5.79E+08	7.94E+07	1.18E+08
-137	7.39E+09	1.01E+10	6.62E+09	NO DATA	3.43E+09	1.14E+09	1.96E+08
-138	8.69E-24	1.72E-23	8.50E-24	NO DATA	1.26E-23	1.24E-24	7.32E-29
-139	4.43E-08	3.16E-11	1.30E-09	NO DATA	2.95E-11	1.79E-11	7.86E-08
-140	2.72E+07	3.42E+04	1.78E-06	NO DATA	1.16E+04	1.96E+04	5.60E+07
-141	4.33E-46	3.27E-49	1.46E-47	NO DATA	3.04E-49	1.86E-49	2.04E-55
-142	2.51E-80	2.58E-83	1.58E-81	NO DATA	2.18E-83	1.46E-83	3.54E-98
-140	4.53E+00	2.28E+00	6.03E-01	NO DATA	NO DATA	NO DATA	1.67E+05
-142	1.89E-11	8.61E-12	2.15E-12	NO DATA	NO DATA	NO DATA	6.29E-08
-141	4.84E+03	3.27E+03	3.71E+02	NO DATA	1.52E+03	NO DATA	1.25E+07
-143	4.16E+01	3.07E+04	3.40E+00	NO DATA	1.35E+01	NO DATA	1.15E+06
-144	3.58E+05	1.50E+05	1.92E+04	NO DATA	8.87E+04	NO DATA	1.21E+08
-143	1.58E+02	6.35E+01	7.84E+00	NO DATA	3.66E+01	NO DATA	6.93E+05
-144	6.47E-54	2.69E-54	3.29E-55	NO DATA	1.52E-54	NO DATA	9.31E-61
-147	9.44E+01	1.09E+02	6.53E+00	NO DATA	6.38E+01	NO DATA	5.24E+05
-187	6.50E+03	5.43E+03	1.90E+03	NO DATA	NO DATA	NO DATA	1.78E+06
-239	3.67E+00	3.60E-01	1.99E-01	NO DATA	1.12E+00	NO DATA	7.39E+04

mrem/yr per µCi/m^3
*2.46 x 10^6

TABLE 3.5-21

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (INFANT)
(m^2rem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	4.86E+03*	4.86E+03*	4.86E+03*	4.86E+03*	4.86E+03*	4.86E+03*
C-14	3.23E+06*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*	6.89E+05*
NA-24	1.87E+06**	1.87E+06	1.87E+06	1.87E+06	1.87E+06	1.87E+06	1.87E+06
P-32	1.90E+11	1.12E+10	7.46E+09	NO DATA	NO DATA	NO DATA	2.58E+09
CR-51	NO DATA	NO DATA	1.93E+04	1.26E+04	2.75E+03	2.45E+04	5.63E+05
MN-54	NO DATA	4.68E+06	1.06E+06	NO DATA	1.04E+06	NO DATA	1.72E+06
MN-56	NO DATA	3.75E-03	6.46E-04	NO DATA	3.22E-03	NO DATA	3.40E-01
FE-55	1.75E+06	1.13E+06	3.02E+05	NO DATA	NO DATA	5.53E+05	1.44E+05
FE-59	2.91E+06	5.08E+06	2.00E+06	NO DATA	NO DATA	1.50E+06	2.43E+06
CO-58	NO DATA	2.90E+06	7.24E+06	NO DATA	NO DATA	NO DATA	7.23E+06
CO-60	NO DATA	1.06E+07	2.49E+07	NO DATA	NO DATA	NO DATA	2.51E+07
NI-63	4.19E+09	2.59E+08	1.45E+08	NO DATA	NO DATA	NO DATA	1.29E+07
NI-65	4.20E-01	4.76E-02	2.16E-02	NO DATA	NO DATA	NO DATA	3.62E+00
CU-64	NO DATA	2.04E+04	9.45E+03	NO DATA	3.45E+04	NO DATA	4.19E+05
ZN-65	6.64E+08	2.28E+09	1.05E+09	NO DATA	1.10E+09	NO DATA	1.92E+09
ZN-69	2.32E-12	4.18E-12	3.11E-13	NO DATA	1.74E-12	NO DATA	3.41E-10
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.65E+09	1.31E+09	NO DATA	NO DATA	NO DATA	6.79E+07
RB-88	NO DATA	2.25E-45	1.23E-45	NO DATA	NO DATA	NO DATA	2.19E-45
RB-89	NO DATA	4.09E-53	2.82E-53	NO DATA	NO DATA	NO DATA	1.39E-53
SR-89	2.64E+10	NO DATA	7.56E+08	NO DATA	NO DATA	NO DATA	5.42E+08
SR-90	2.55E+11	NO DATA	6.50E+10	NO DATA	NO DATA	NO DATA	3.19E+09
SR-91	5.65E+05	NO DATA	2.05E+04	NO DATA	NO DATA	NO DATA	6.69E+05
SR-92	9.83E+00	NO DATA	3.65E-01	NO DATA	NO DATA	NO DATA	1.06E+02
Y-90	8.19E+01	NO DATA	2.19E+00	NO DATA	NO DATA	NO DATA	1.13E+05
Y-91m	7.29E-20	NO DATA	2.48E-21	NO DATA	NO DATA	NO DATA	2.43E-16
Y-91	8.78E+03	NO DATA	2.34E+02	NO DATA	NO DATA	NO DATA	6.29E+05
Y-92	6.40E-05	NO DATA	1.80E-06	NO DATA	NO DATA	NO DATA	1.22E+00
Y-93	2.55E-01	NO DATA	6.95E-03	NO DATA	NO DATA	NO DATA	2.02E+03
ZR-95	8.16E+02	1.99E+02	1.41E+02	NO DATA	2.14E+02	NO DATA	9.90E+04
ZR-97	4.85E-01	8.33E-02	3.80E-02	NO DATA	8.40E-02	NO DATA	5.31E+03
NB-95	7.12E+04	2.93E+04	1.69E+04	NO DATA	2.10E+04	NO DATA	2.47E+07
MO-99	NO DATA	2.48E+07	4.84E+06	NO DATA	3.71E+07	NO DATA	8.18E+06
TC-99m	3.26E+00	6.73E+00	8.67E+01	NO DATA	7.24E+01	3.52E+00	1.96E+03
TC-101	3.26E-60	4.11E-60	4.06E-59	NO DATA	4.88E-59	2.24E-60	6.08E-58
RU-103	1.04E+03	NO DATA	3.47E+02	NO DATA	2.16E+03	NO DATA	1.26E+04
RU-105	9.60E-04	NO DATA	3.23E-04	NO DATA	7.06E-03	NO DATA	3.82E-01
RU-106	2.28E+04	NO DATA	2.84E+03	NO DATA	2.69E+04	NO DATA	1.73E+05
AG-110m	4.62E+07	3.37E+07	2.23E+07	NO DATA	4.83E+07	NO DATA	1.75E+09
TE-125m	1.80E+07	6.02E+06	2.43E+06	6.06E+06	NO DATA	NO DATA	8.58E+06
TE-127m	5.04E+07	1.67E+07	6.10E+06	1.46E+07	1.24E+08	NO DATA	2.03E+07
TE-127	7.57E+02	2.54E+02	1.63E+02	6.16E+02	1.85E+03	NO DATA	1.59E+04
TE-129m	6.68E+07	2.29E+07	1.03E+07	2.57E+07	1.67E+08	NO DATA	3.99E+07
TE-129	3.25E-10	1.12E-10	7.59E-11	2.73E-10	8.10E-10	NO DATA	2.60E-08
TE-131m	4.04E+05	1.63E+05	1.34E+05	3.30E+05	1.12E+06	NO DATA	2.74E+06
TE-131	4.19E-33	1.55E-33	1.18E-33	3.74E-33	1.07E-32	NO DATA	1.69E-31

TABLE 3.5-21 (continued)

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (INFANT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.54E+06	1.26E+06	1.17E+06	1.85E+06	7.86E+06	NO DATA	4.65E+06
I-130	4.22E+06	9.28E+06	3.73E+06	1.04E+09	1.02E+07	NO DATA	1.99E+06
I-131	3.25E+09	3.83E+09	1.69E+09	1.26E+12	4.48E+09	NO DATA	1.37E+08
I-132	1.73E+00	3.50E+00	1.25E+00	1.64E+02	3.91E+00	NO DATA	2.84E+00
I-133	4.34E+07	6.32E+07	1.85E+07	1.15E+10	7.43E+07	NO DATA	1.07E+07
I-134	1.97E-11	4.04E-11	1.44E-11	9.42E-10	4.52E-11	NO DATA	4.18E-11
I-135	1.36E+05	2.70E+05	9.85E+04	2.42E+07	3.01E+05	NO DATA	9.77E+04
CS-134	1.09E+11	2.04E+11	2.06E+10	NO DATA	5.25E+10	2.15E+10	5.54E+08
CS-136	5.92E+09	1.74E+10	6.50E+09	NO DATA	6.94E+09	1.42E+09	2.64E+08
CS-137	1.54E+11	1.80E+11	1.28E+10	NO DATA	4.84E+10	1.96E+10	5.63E+08
CS-138	2.42E-22	3.93E-22	1.90E-22	NO DATA	1.96E-22	3.06E-23	6.28E-22
BA-139	5.14E-08	3.41E-11	1.49E-09	NO DATA	2.05E-11	2.07E-11	3.26E-06
BA-140	2.87E+07	2.87E+04	1.48E+06	NO DATA	6.82E+03	1.76E+04	7.06E+06
BA-141	4.97E-46	3.40E-49	1.57E-47	NO DATA	2.05E-49	2.07E-49	6.07E-45
BA-142	2.76E-80	2.30E-83	1.36E-81	NO DATA	1.32E-83	1.39E-83	1.14E-79
LA-140	4.83E+00	1.91E+00	4.90E-01	NO DATA	NO DATA	NO DATA	2.24E+04
LA-142	2.07E-11	7.60E-12	1.82E-12	NO DATA	NO DATA	NO DATA	1.29E-06
CE-141	5.20E+03	3.17E+03	3.73E+02	NO DATA	9.78E+02	NO DATA	1.64E+06
CE-143	4.75E+01	3.15E+04	3.60E+00	NO DATA	9.18E+00	NO DATA	1.84E+05
CE-144	2.79E+05	1.14E+05	1.56E+04	NO DATA	4.61E+04	NO DATA	1.60E+07
PR-143	1.78E+02	6.66E+01	8.83E+00	NO DATA	2.47E+01	NO DATA	9.40E+04
PR-144	7.51E-54	2.90E-54	3.78E-55	NO DATA	1.05E-54	NO DATA	1.35E-49
ND-147	1.06E+02	1.08E+02	6.65E+00	NO DATA	4.18E+01	NO DATA	6.88E+04
W-187	7.27E+03	5.06E+03	1.75E+03	NO DATA	NO DATA	NO DATA	2.97E+05
NP-239	4.37E+00	3.91E-01	2.21E-01	NO DATA	7.80E-01	NO DATA	1.13E+04

*mrem/yr per µCi/m^3
**1.87 x 10^6

TABLE 3.5-22

GOAT MILK PATHWAY FACTORS - R^{C}_{ail} (CHILD)

(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	3.20E+03*	3.20E+03*	3.20E+03*	3.20E+03*	3.20E+03*	3.20E+03*
C-14	1.65E+06*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*	3.29E+05*
NA-24	1.07E+06**	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06
P-32	9.32E+10	4.36E+09	3.59E+09	NO DATA	NO DATA	NO DATA	2.58E+09
CR-51	NO DATA	NO DATA	1.22E+04	6.77E+03	1.85E+03	1.24E+04	6.47E+05
MN-54	NO DATA	2.51E+06	6.70E+05	NO DATA	7.05E+05	NO DATA	2.11E+06
MN-56	NO DATA	1.53E-03	3.45E-04	NO DATA	1.85E-03	NO DATA	1.21E-01
FE-55	1.45E+06	7.65E+05	2.38E+05	NO DATA	NO DATA	4.35E+05	1.42E+05
FE-59	1.55E+06	2.52E+06	1.25E+06	NO DATA	NO DATA	7.29E+05	2.62E+06
CO-58	NO DATA	1.46E+06	4.46E+06	NO DATA	NO DATA	NO DATA	8.49E+06
CO-60	NO DATA	5.16E+06	1.52E+07	NO DATA	NO DATA	NO DATA	2.86E+07
NI-63	3.55E+09	1.90E+08	1.21E+08	NO DATA	NO DATA	NO DATA	1.28E+07
NI-65	1.99E-01	1.87E-02	1.09E-02	NO DATA	NO DATA	NO DATA	2.29E+00
CU-64	NO DATA	8.23E+03	4.97E+03	NO DATA	1.99E+04	NO DATA	3.86E+05
ZN-65	4.96E+08	1.32E+09	8.22E+08	NO DATA	8.33E+08	NO DATA	2.32E+08
ZN-69	1.09E-12	1.58E-12	1.46E-13	NO DATA	9.56E-13	NO DATA	9.94E-11
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	1.05E+09	6.47E+08	NO DATA	NO DATA	NO DATA	6.77E+07
RB-88	NO DATA	8.59E-46	5.97E-46	NO DATA	NO DATA	NO DATA	4.21E-47
RB-89	NO DATA	1.67E-53	1.49E-53	NO DATA	NO DATA	NO DATA	1.46E-55
SR-89	1.39E+10	NO DATA	3.96E+08	NO DATA	NO DATA	NO DATA	5.37E+08
SR-90	2.35E+11	NO DATA	5.95E+10	NO DATA	NO DATA	NO DATA	3.16E+09
SR-91	2.71E+05	NO DATA	1.02E+04	NO DATA	NO DATA	NO DATA	5.99E+05
SR-92	4.61E+00	NO DATA	1.85E-01	NO DATA	NO DATA	NO DATA	8.74E+01
Y-90	3.86E+01	NO DATA	1.03E+00	NO DATA	NO DATA	NO DATA	1.10E+05
Y-91m	3.44E-20	NO DATA	1.25E-21	NO DATA	NO DATA	NO DATA	6.73E-17
Y-91	4.67E+03	NO DATA	1.25E+02	NO DATA	NO DATA	NO DATA	6.22E+05
Y-92	3.02E-05	NO DATA	8.64E-07	NO DATA	NO DATA	NO DATA	8.73E-01
Y-93	1.20E-01	NO DATA	3.29E-03	NO DATA	NO DATA	NO DATA	1.79E+03
ZR-95	4.58E+02	1.01E+02	8.97E+01	NO DATA	1.44E+02	NO DATA	1.05E+05
ZR-97	2.29E-01	3.31E-02	1.95E-02	NO DATA	4.76E-02	NO DATA	5.02E+03
NB-95	3.81E+04	1.48E+04	1.06E+04	NO DATA	1.39E+04	NO DATA	2.75E+07
MO-99	NO DATA	9.74E+06	2.41E+06	NO DATA	2.08E+07	NO DATA	8.05E+06
TC-99m	1.58E+00	3.10E+00	5.13E+01	NO DATA	4.50E+01	1.57E+00	1.76E+03
TC-101	1.54E-60	1.61E-60	2.04E-59	NO DATA	2.74E-59	8.50E-61	5.11E-60
RU-103	5.10E+02	NO DATA	1.96E+02	NO DATA	1.28E+03	NO DATA	1.32E+04
RU-105	4.53E-04	NO DATA	1.65E-04	NO DATA	3.99E-03	NO DATA	2.96E-01
RU-106	1.11E+04	NO DATA	1.38E+03	NO DATA	1.49E+04	NO DATA	1.72E+05
AG-110m	2.50E+07	1.69E+07	1.35E+07	NO DATA	3.15E+07	NO DATA	2.01E+09
TE-125m	8.84E+06	2.39E+06	1.18E+06	2.48E+06	NO DATA	NO DATA	8.53E+06
TE-127m	2.49E+07	6.71E+06	2.96E+06	5.96E+06	7.10E+07	NO DATA	2.02E+07
TE-127	3.57E+02	9.61E+01	7.65E+01	2.47E+02	1.01E+03	NO DATA	1.39E+04
TE-129m	3.24E+07	9.06E+06	5.03E+06	1.05E+07	9.52E+07	NO DATA	3.96E+07
TE-129	1.53E-10	4.28E-11	3.64E-11	1.09E-10	4.49E-10	NO DATA	9.55E-09
TE-131m	1.91E+05	6.60E+04	7.02E+04	1.36E+05	6.39E+05	NO DATA	2.68E+06
TE-131	1.96E-33	5.97E-34	5.83E-34	1.50E-33	5.92E-33	NO DATA	1.03E-32

TABLE 3.5-22 (continued)

GOAT MILK PATHWAY FACTORS - R^{C}_{ai} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.23E+06	5.45E+05	6.59E+05	7.94E+05	5.06E+06	NO DATA	5.49E+06
I-130	2.06E+06	4.17E+06	2.15E+06	4.59E+08	6.23E+06	NO DATA	1.95E+06
I-131	1.56E+09	1.57E+09	8.94E+08	5.20E+11	2.58E+09	NO DATA	1.40E+08
I-132	6.32E-01	1.52E+00	7.03E-01	7.09E+01	2.34E+00	NO DATA	1.80E+00
I-133	2.06E+07	2.55E+07	9.64E+06	4.73E+09	4.25E+07	NO DATA	1.03E+07
I-134	9.51E-12	1.77E-11	8.13E-12	4.06E-10	2.70E-11	NO DATA	1.17E-11
I-135	6.53E+04	1.17E+05	5.56E+04	1.04E+07	1.80E+05	NO DATA	8.95E+04
CS-134	6.76E+1	11E+11	2.34E+10	NO DATA	3.44E+10	1.23E+10	5.98E+08
CS-136	3.03E+0	33E+09	5.39E+09	NO DATA	4.44E+09	6.62E+08	2.93E+08
CS-137	9.65E	3E+10	1.36E+10	NO DATA	3.01E+10	1.08E+10	5.78E+08
CS-138	1.15E-	9E-22	1.10E-22	NO DATA	1.12E-22	1.21E-23	7.34E-23
BA-139	2.42E-0	9E-11	7.01E-10	NO DATA	1.13E-11	7.59E-12	1.40E-06
BA-140	1.40E+07	1.22E+04	8.15E+05	NO DATA	3.98E+03	7.29E+03	7.07E+06
BA-141	2.34E-46	1.31E-49	7.62E-48	NO DATA	1.13E-49	7.70E-49	1.33E-46
BA-142	1.31E-80	9.44E-84	7.32E-82	NO DATA	7.64E-84	5.55E-84	1.71E-82
LA-140	2.32E+00	8.12E-01	2.53E-01	NO DATA	NO DATA	NO DATA	2.26E+04
LA-142	9.85E-12	3.14E-12	9.83E-13	NO DATA	NO DATA	NO DATA	6.22E-07
CE-141	2.62E+03	1.31E+03	1.94E+02	NO DATA	5.73E+02	NO DATA	1.63E+06
CE-143	2.24E+01	1.22E+04	1.76E+00	NO DATA	5.10E+00	NO DATA	1.78E+05
CE-144	1.94E+05	6.10E+04	1.04E+04	NO DATA	3.38E+04	NO DATA	1.59E+07
PR-143	8.61E+01	2.58E+01	4.27E+00	NO DATA	1.40E+01	NO DATA	9.29E+04
PR-144	3.53E-54	1.09E-54	1.78E-55	NO DATA	5.78E-55	NO DATA	2.35E-51
ND-147	5.33E+01	4.32E+01	3.34E+00	NO DATA	2.37E+01	NO DATA	6.84E+04
[187	3.46E+03	2.05E+03	9.20E+02	NO DATA	NO DATA	NO DATA	2.88E+05
P-239	2.07E+00	1.49E-01	1.04E-01	NO DATA	4.29E-01	NO DATA	1.10E+04

*mrem/yr per µCi/m^3
**1.07 x 10^6

TABLE 3.5-23

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (TEEN)

(m^2mrem/yr per μCi)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.02E+03*	2.02E+03*	2.02E+03*	2.02E+03*	2.02E+03*	2.02E+03*
C-14	6.70E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*	1.34E+05*
NA-24	5.15E+05**	5.15E+05	5.15E+05	5.15E+05	5.15E+05	5.15E+05	5.15E+05
P-32	3.78E+10	2.34E+09	1.47E+09	NO DATA	NO DATA	NO DATA	3.18E+09
CR-51	NO DATA	NO DATA	5.94E+03	3.30E+03	1.30E+03	8.48E+03	9.98E+05
MN-54	NO DATA	1.68E+06	3.32E+05	NO DATA	5.00E+05	NO DATA	3.44E+06
MN-56	NO DATA	8.77E-04	1.56E-04	NO DATA	1.11E-03	NO DATA	5.77E-02
FE-55	5.79E+05	4.11E+05	9.57E+04	NO DATA	NO DATA	2.60E+05	1.78E+05
FE-59	6.75E+05	1.58E+06	6.08E+05	NO DATA	NO DATA	4.97E+05	3.73E+06
CO-58	NO DATA	9.51E+05	2.19E+06	NO DATA	NO DATA	NO DATA	1.31E+07
CO-60	NO DATA	3.32E+06	7.47E+06	NO DATA	NO DATA	NO DATA	4.32E+07
NI-63	1.42E+09	1.00E+08	4.81E+07	NO DATA	NO DATA	NO DATA	1.60E+07
NI-65	8.09E+02	1.03E-02	4.71E-03	NO DATA	NO DATA	NO DATA	5.61E-01
CU-64	NO DATA	4.68E+03	2.20E+03	NO DATA	1.18E+04	NO DATA	3.63E+05
ZN-65	2.52E+08	8.76E+08	4.09E+08	NO DATA	5.61E+08	NO DATA	3.71E+08
ZN-69	4.44E-13	8.46E-13	5.92E-14	NO DATA	5.53E-13	NO DATA	1.56E-12
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	5.66E+08	2.66E+08	NO DATA	NO DATA	NO DATA	8.38E+07
RB-88	NO DATA	4.66E-46	2.48E-46	NO DATA	NO DATA	NO DATA	3.99E-53
RB-89	NO DATA	9.52E-54	6.73E-54	NO DATA	NO DATA	NO DATA	1.46E-62
SR-89	5.59E+09	NO DATA	1.60E+08	NO DATA	NO DATA	NO DATA	6.65E+08
SR-90	1.38E+11	NO DATA	3.40E+10	NO DATA	NO DATA	NO DATA	3.87E+09
SR-91	1.11E+05	NO DATA	4.40E+03	NO DATA	NO DATA	NO DATA	5.01E+05
SR-92	1.89E+00	NO DATA	8.05E-02	NO DATA	NO DATA	NO DATA	4.81E+01
Y-90	1.56E+01	NO DATA	4.21E-01	NO DATA	NO DATA	NO DATA	1.29E+05
Y-91m	1.41E-20	NO DATA	5.37E-22	NO DATA	NO DATA	NO DATA	6.64E-19
Y-91	1.89E+03	NO DATA	5.07E+01	NO DATA	NO DATA	NO DATA	7.75E+05
Y-92	1.23E-05	NO DATA	3.57E-07	NO DATA	NO DATA	NO DATA	3.39E-01
Y-93	4.86E-02	NO DATA	1.33E-03	NO DATA	NO DATA	NO DATA	1.49E+03
ZR-95	1.98E+02	6.24E+01	4.29E+01	NO DATA	9.17E+01	NO DATA	1.44E+05
ZR-97	9.43E-02	1.87E-02	8.60E-03	NO DATA	2.83E-02	NO DATA	5.05E+03
NB-95	1.69E+04	9.37E+03	5.16E+03	NO DATA	9.08E+03	NO DATA	4.01E+07
MO-99	NO DATA	5.33E+06	1.02E+06	NO DATA	1.22E+07	NO DATA	9.55E+06
TC-99m	6.87E-01	1.92E+00	2.48E+01	NO DATA	2.86E+01	1.06E+00	1.26E+03
TC-101	6.26E-61	8.91E-61	8.75E-60	NO DATA	1.61E-59	5.43E-61	1.52E-67
RU-103	2.17E+02	NO DATA	9.27E+01	NO DATA	7.64E+02	NO DATA	1.81E+04
RU-105	1.86E-04	NO DATA	7.21E-05	NO DATA	2.35E-03	NO DATA	1.50E-01
RU-106	4.47E+03	NO DATA	5.63E+02	NO DATA	8.62E+03	NO DATA	2.14E+05
AG-110m	1.15E+07	1.09E+07	6.62E+06	NO DATA	2.08E+07	NO DATA	3.06E+09
TE-125m	3.59E+06	1.29E+06	4.80E+05	1.00E+06	NO DATA	NO DATA	1.06E+07
TE-127m	1.01E+07	3.57E+06	1.20E+06	2.39E+06	4.08E+07	NO DATA	2.51E+07
TE-127	1.48E+02	5.14E+01	3.18E+01	1.02E+02	5.87E+02	NO DATA	1.14E+04
TE-129m	1.32E+07	4.89E+06	2.08E+06	4.25E+06	5.51E+07	NO DATA	4.94E+07
TE-129	6.22E-11	2.32E-11	1.51E-11	4.44E-11	2.61E-10	NO DATA	3.40E-10
TE-131m	7.86E+04	3.77E+04	3.14E+04	5.67E+04	3.93E+05	NO DATA	3.02E+06
TE-131	8.04E-34	3.31E-34	2.51E-34	6.19E-34	3.51E-33	NO DATA	6.60E-35

TABLE 3.5-23 (continued)

GOAT MILK PATHWAY FACTORS - R^{C}_{aij} (TEEN)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	5.13E+05	3.25E+05	3.06E+05	3.43E+05	3.12E+06	NO DATA	1.03E+07
I-130	8.82E+05	2.55E+06	1.02E+06	2.08E+08	3.93E+06	NO DATA	1.96E+06
I-131	6.44E+08	9.01E+08	4.84E+08	2.63E+11	1.55E+09	NO DATA	1.78E+08
I-132	3.52E-01	9.20E-01	3.30E-01	3.10E+01	1.45E+00	NO DATA	4.01E-01
I-133	8.48E+06	1.44E+07	4.39E+06	2.01E+09	2.52E+07	NO DATA	1.09E+07
I-134	4.03E-12	1.07E-11	3.84E-12	1.78E-10	1.68E-11	NO DATA	1.41E-13
I-135	2.75E+04	7.08E+04	2.62E+04	4.56E+06	1.12E+05	NO DATA	7.85E+04
CS-134	2.94E+10	6.91E+10	3.21E+10	NO DATA	2.20E+10	8.39E+09	8.60E+08
CS-136	1.34E+09	5.27E+09	3.54E+09	NO DATA	2.87E+09	4.52E+08	4.24E+08
CS-137	4.01E+10	5.33E+10	1.86E+10	NO DATA	1.82E+10	7.05E+09	7.59E+08
CS-138	4.73E-23	9.08E-23	4.54E-23	NO DATA	6.70E-23	7.80E-24	4.12E-26
BA-139	9.84E-09	6.92E-12	2.87E-10	NO DATA	6.53E-12	4.77E-12	8.78E-08
BA-140	5.82E+06	7.13E+03	3.75E+05	NO DATA	2.42E+03	4.80E+03	8.98E+06
BA-141	9.53E-47	7.11E-50	3.18E-48	NO DATA	6.60E-50	4.87E-50	2.03E-52
BA-142	5.44E-81	5.44E-84	3.35E-82	NO DATA	4.60E-84	3.62E-84	1.67E-92
LA-140	9.67E-01	4.75E-01	1.26E-01	NO DATA	NO DATA	NO DATA	2.73E+04
LA-142	4.08E-12	1.81E-12	4.51E-13	NO DATA	NO DATA	NO DATA	5.52E-08
CE-141	1.07E+03	7.12E+02	8.17E+01	NO DATA	3.35E+02	NO DATA	2.04E+06
CE-143	9.14E+00	6.65E+03	7.43E-01	NO DATA	2.98E+00	NO DATA	2.00E+05
CE-144	7.86E+04	3.25E+04	4.23E+03	NO DATA	1.94E+04	NO DATA	1.98E+07
PR-143	3.47E+01	1.39E+01	1.73E+00	NO DATA	8.06E+00	NO DATA	1.14E+05
PR-144	1.42E-54	5.81E-55	7.19E-56	NO DATA	3.33E-55	NO DATA	1.56E-57
ND-147	2.17E+01	2.36E+01	1.41E+00	NO DATA	1.38E+01	NO DATA	8.50E+04
W-187	1.43E+03	1.16E+03	4.08E+02	NO DATA	NO DATA	NO DATA	3.15E+05
NP-239	8.38E-01	7.90E-02	4.39E-02	NO DATA	2.48E-01	NO DATA	1.27E+04

*mrem/yr per µCi/m^3
**5.15×10^5

TABLE 3.5-24

GOAT MILK PATHWAY FACTORS - R^{C}_{ail} (ADULT)

(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.55E+03*	1.55E+03*	1.55E+03*	1.55E+03*	1.55E+03*	1.55E+03*
C-14	3.63E+05*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*	7.26E+04*
NA-24	2.95E+05**	2.95E+05	2.95E+05	2.95E+05	2.95E+05	2.95E+05	2.95E+05
P-32	2.05E+10	1.27E+09	7.91E+08	NO DATA	NO DATA	NO DATA	2.30E+09
CR-51	NO DATA	NO DATA	3.43E+03	2.05E+03	7.56E+02	4.55E+03	8.63E+05
MN-54	NO DATA	1.01E+06	1.92E+05	NO DATA	2.99E+05	NO DATA	3.08E+06
MN-56	NO DATA	4.96E-04	8.79E-05	NO DATA	6.29E-04	NO DATA	1.58E-02
FE-55	3.27E+05	2.26E+05	5.27E+04	NO DATA	NO DATA	1.26E+05	1.30E+05
FE-59	3.85E+05	9.06E+05	3.47E+05	NO DATA	NO DATA	2.53E+05	3.02E+06
CO-58	NO DATA	5.62E+05	1.26E+06	NO DATA	NO DATA	NO DATA	1.14E+07
CO-60	NO DATA	1.96E+06	4.33E+06	NO DATA	NO DATA	NO DATA	3.69E+07
NI-63	8.05E+08	5.58E+07	2.70E+07	NO DATA	NO DATA	NO DATA	1.16E+07
NI-65	4.43E-02	5.76E-03	2.63E-03	NO DATA	NO DATA	NO DATA	1.46E-01
CU-64	NO DATA	2.62E+03	1.23E+03	NO DATA	6.62E+03	NO DATA	2.24E+05
ZN-65	1.64E+08	5.22E+08	2.36E+08	NO DATA	3.49E+08	NO DATA	3.29E+08
ZN-69	2.41E-13	4.61E-13	3.21E-14	NO DATA	3.00E-13	NO DATA	6.93E-14
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	3.10E+08	1.45E+08	NO DATA	NO DATA	NO DATA	6.12E+07
RB-88	NO DATA	2.57E-46	1.36E-46	NO DATA	NO DATA	NO DATA	3.55E-57
RB-89	NO DATA	5.37E-54	3.78E-54	NO DATA	NO DATA	NO DATA	3.12E-67
SR-89	3.04E+09	NO DATA	8.73E+07	NO DATA	NO DATA	NO DATA	4.88E+08
SR-90	9.78E+10	NO DATA	2.40E+10	NO DATA	NO DATA	NO DATA	2.83E+09
SR-91	6.01E+04	NO DATA	2.43E+03	NO DATA	NO DATA	NO DATA	2.86E+05
SR-92	1.03E+00	NO DATA	4.45E-02	NO DATA	NO DATA	NO DATA	2.04E+01
Y-90	8.48E+00	NO DATA	2.28E-01	NO DATA	NO DATA	NO DATA	9.00E+04
Y-91m	7.69E-21	NO DATA	2.98E-22	NO DATA	NO DATA	NO DATA	2.26E-20
Y-91	1.03E+03	NO DATA	2.75E+01	NO DATA	NO DATA	NO DATA	5.66E+05
Y-92	6.68E-06	NO DATA	1.95E-07	NO DATA	NO DATA	NO DATA	1.17E-01
Y-93	2.65E-02	NO DATA	7.32E-04	NO DATA	NO DATA	NO DATA	8.41E+02
ZR-95	1.13E+02	3.63E+01	2.46E+01	NO DATA	5.69E+01	NO DATA	1.15E+05
ZR-97	5.17E-02	1.04E-02	4.77E-03	NO DATA	1.58E-02	NO DATA	3.23E+03
NB-95	9.90E+03	5.51E+03	2.96E+03	NO DATA	5.45E+03	NO DATA	3.34E+07
MO-99	NO DATA	2.96E+06	5.63E+05	NO DATA	6.71E+06	NO DATA	6.86E+06
TC-99m	3.95E-01	1.12E+00	1.42E+01	NO DATA	1.70E+01	5.47E-01	6.61E+02
TC-101	3.43E-61	4.94E-61	4.84E-60	NO DATA	8.89E-60	2.52E-61	1.48E-72
RU-103	1.22E+02	NO DATA	5.24E+01	NO DATA	4.64E+02	NO DATA	1.42E+04
RU-105	1.02E-04	NO DATA	4.02E-05	NO DATA	1.32E-03	NO DATA	6.23E-02
RU-106	2.44E+03	NO DATA	3.09E+02	NO DATA	4.72E+03	NO DATA	1.58E+05
AG-110m	6.96E+06	6.44E+06	3.82E+06	NO DATA	1.27E+07	NO DATA	2.63E+09
TE-125m	1.95E+06	7.07E+05	2.61E+05	5.87E+05	7.94E+06	NO DATA	7.79E+06
TE-127m	5.46E+06	1.95E+06	6.66E+05	1.40E+06	2.22E+07	NO DATA	2.83E+07
TE-127	7.82E+01	2.81E+01	1.69E+01	5.80E+01	3.19E+02	NO DATA	6.17E+03
TE-129m	7.21E+06	2.69E+06	1.14E+06	2.48E+06	3.01E+07	NO DATA	3.63E+07
TE-129	3.83E-11	1.27E-11	8.23E-12	2.59E-11	1.42E-10	NO DATA	2.55E-11
TE-131m	4.33E+04	2.12E+04	1.76E+04	3.35E+04	2.14E+05	NO DATA	2.10E+06
TE-131	4.37E-34	1.83E-34	1.38E-34	3.60E-34	1.92E-33	NO DATA	6.19E-35

TABLE 3.5-24 (continued)

GOAT MILK PATHWAY FACTORS - R^{C}_{ai} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.87E+05	1.86E+05	1.74E+05	2.05E+05	1.79E+06	NO DATA	8.79E+06
I-130	5.00E+05	1.47E+06	5.82E+05	1.25E+08	2.30E+06	NO DATA	1.27E+06
I-131	3.54E+08	5.06E+08	2.90E+08	1.66E+11	8.68E+08	NO DATA	1.34E+08
I-132	1.98E-01	5.29E-01	1.85E-01	1.85E+01	8.43E-01	NO DATA	9.93E-02
I-133	4.62E+06	8.03E+06	2.45E+06	1.18E+09	1.40E+07	NO DATA	7.22E+06
I-134	2.27E+12	6.16E-12	2.20E-12	1.07E-10	9.80E-12	NO DATA	5.37E-15
I-135	1.55E+04	4.06E+04	1.50E+04	2.68E+06	6.51E+04	NO DATA	4.59E+04
CS-134	1.69E+10	4.03E+10	3.29E+10	NO DATA	1.30E+10	4.32E+09	7.04E+08
CS-136	7.88E+08	3.11E+09	2.24E+09	NO DATA	1.73E+09	2.37E+08	3.53E+08
CS-137	2.21E+10	3.03E+10	1.98E+10	NO DATA	1.02E+10	3.41E+09	5.84E+08
CS-138	2.61E-23	5.15E-23	2.55E-23	NO DATA	3.78E-23	3.73E-24	2.20E-28
BA-139	5.32E-09	3.79E-12	1.56E-10	NO DATA	3.54E-12	2.15E-12	9.44E-09
BA-140	3.23E+06	4.05E+03	2.11E+05	NO DATA	1.38E+03	2.32E+03	6.65E+06
BA-141	5.18E-47	3.92E-50	1.75E-48	NO DATA	3.64E-50	2.22E-50	2.44E-56
BA-142	3.00E-81	3.09E-84	1.89E-82	NO DATA	2.61E-84	1.75E-84	4.23E-99
LA-140	5.40E-01	2.72E-01	7.19E-02	NO DATA	NO DATA	NO DATA	2.00E+04
LA-142	2.27E-12	1.03E-12	2.57E-13	NO DATA	NO DATA	NO DATA	7.52E-09
CE-141	5.80E+02	3.92E+02	4.45E+01	NO DATA	1.82E+02	NO DATA	1.50E+06
CE-143	5.00E+00	3.70E+03	4.09E-01	NO DATA	1.63E+00	NO DATA	1.38E+05
CE-144	4.29E+04	1.79E+04	2.30E+03	NO DATA	1.06E+04	NO DATA	1.45E+07
PR-143	1.89E+01	7.56E+00	9.35E-01	NO DATA	4.37E+00	NO DATA	8.26E+04
PR-144	7.71E-55	3.20E-55	3.92E-56	NO DATA	1.80E-55	NO DATA	1.11E-61
ND-147	1.13E+01	1.30E+01	7.79E-01	NO DATA	7.64E+00	NO DATA	6.25E+04
W-187	7.78E+02	6.50E+02	2.27E+02	NO DATA	NO DATA	NO DATA	2.13E+05
NP-239	4.39E-01	4.32E-02	2.38E-02	NO DATA	1.35E-01	NO DATA	8.86E+03

*mrem/yr per µCi/m^3
**2.95×10^5

TABLE 3.5-25

MEAT PATHWAY FACTORS - R^{M}_{ail} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.33E+02*	2.33E+02*	2.33E+02*	2.33E+02*	2.33E+02*	2.33E+02*
C-14	5.29E+05*	1.06E+05*	1.06E+05*	1.06E+05*	1.06E+05*	1.06E+05*	1.06E+05*
NA-24	1.84E-03**	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03
P-32	7.43E+09	3.47E+08	2.86E+08	NO DATA	NO DATA	NO DATA	2.05E+08
CR-51	NO DATA	NO DATA	8.78E+03	4.88E+03	1.33E+03	8.90E+03	4.66E+05
MN-54	NO DATA	8.03E+06	2.14E+06	NO DATA	2.25E+06	NO DATA	6.74E+06
MN-56	NO DATA	1.56E-53	3.52E-54	NO DATA	1.89E-53	NO DATA	2.26E-51
FE-55	4.58E+08	2.43E+08	7.52E+07	NO DATA	NO DATA	1.37E+08	4.50E+07
FE-59	3.76E+08	6.09E+08	3.03E+08	NO DATA	NO DATA	1.76E+08	6.34E+08
CO-58	NO DATA	1.64E+07	5.03E+07	NO DATA	NO DATA	NO DATA	9.58E+07
CO-60	NO DATA	6.93E+07	2.04E+08	NO DATA	NO DATA	NO DATA	3.84E+08
NI-63	2.91E+10	1.56E+09	9.90E+08	NO DATA	NO DATA	NO DATA	1.05E+08
NI-65	3.55E-52	3.34E-53	1.92E-53	NO DATA	NO DATA	NO DATA	4.10E-51
CU-64	NO DATA	2.77E-07	1.67E-07	NO DATA	6.69E-07	NO DATA	1.30E-05
ZN-65	3.75E+08	1.00E+09	6.22E+08	NO DATA	6.30E+08	NO DATA	1.76E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	5.76E+08	3.54E+08	NO DATA	NO DATA	NO DATA	3.71E+07
RB-88	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
RB-89	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
SR-89	4.80E+08	NO DATA	1.37E+07	NO DATA	NO DATA	NO DATA	1.86E+07
-90	1.04E+10	NO DATA	2.64E+09	NO DATA	NO DATA	NO DATA	1.40E+08
-91	2.26E-10	NO DATA	8.53E-12	NO DATA	NO DATA	NO DATA	4.99E-10
SR-92	2.00E-49	NO DATA	8.04E-51	NO DATA	NO DATA	NO DATA	3.80E-48
Y-90	1.73E+02	NO DATA	4.62E+00	NO DATA	NO DATA	NO DATA	4.91E+05
Y-91m	0.00E+00	NO DATA	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
Y-91	1.80E+06	NO DATA	4.81E+04	NO DATA	NO DATA	NO DATA	2.40E+08
Y-92	2.37E-39	NO DATA	6.78E-41	NO DATA	NO DATA	NO DATA	6.84E-35
Y-93	6.98E-12	NO DATA	1.92E-13	NO DATA	NO DATA	NO DATA	1.04E-07
ZR-95	2.67E+06	5.87E+05	5.22E+05	NO DATA	8.40E+05	NO DATA	6.12E+08
ZR-97	3.16E-05	4.57E-06	2.69E-06	NO DATA	6.55E-06	NO DATA	6.92E-01
NB-95	3.10E+06	1.21E+06	8.61E+05	NO DATA	1.13E+06	NO DATA	2.23E+09
MO-99	NO DATA	1.14E+05	2.83E+04	NO DATA	2.44E+05	NO DATA	9.45E+04
TC-99m	6.01E-21	1.18E-20	1.95E-19	NO DATA	1.71E-19	5.98E-21	6.71E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
RU-103	1.55E+08	NO DATA	5.96E+07	NO DATA	3.90E+08	NO DATA	4.01E+09
RU-105	8.48E-28	NO DATA	3.08E-28	NO DATA	7.45E-27	NO DATA	5.54E-25
RU-106	4.43E+09	NO DATA	5.53E+08	NO DATA	5.99E+09	NO DATA	6.90E+10
AG-110m	8.41E+06	5.68E+06	4.54E+06	NO DATA	1.06E+07	NO DATA	6.75E+08
TE-125m	5.69E+08	1.54E+08	7.58E+07	1.60E+08	NO DATA	NO DATA	5.49E+08
TE-127m	1.77E+09	4.78E+08	2.11E+08	4.24E+08	5.06E+09	NO DATA	1.44E+09
TE-127	3.34E-10	9.01E-11	7.17E-11	2.31E-10	9.51E-10	NO DATA	1.31E-08
TE-129m	1.79E+09	4.99E+08	2.77E+08	5.76E+08	5.25E+09	NO DATA	2.18E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
TE-131m	6.97E+02	2.41E+02	2.57E+02	4.96E+02	2.33E+03	NO DATA	9.78E+03
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00

TABLE 3.5-25 (continued)

MEAT PATHWAY FACTORS - R^{M}_{ail} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	2.13E+06	9.43E+05	1.14E+06	1.37E+06	8.76E+06	NO DATA	9.50E+06
I-130	2.91E-06	5.89E-06	3.03E-06	6.49E-04	8.80E-06	NO DATA	2.75E-06
I-131	1.65E+07	1.66E+07	9.46E+06	5.50E+09	2.73E+07	NO DATA	1.48E+06
I-132	1.05E-58	1.93E-58	8.86E-59	8.93E-57	2.95E-58	NO DATA	2.27E-58
I-133	5.75E-01	7.10E-01	2.69E-01	1.32E+02	1.18E+00	NO DATA	2.86E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
I-135	6.86E-17	1.23E-16	5.83E-17	1.09E-14	1.89E-16	NO DATA	9.38E-17
CS-134	9.20E+08	1.51E+09	3.18E+08	NO DATA	4.68E+08	1.68E+08	8.14E+06
CS-136	1.62E+07	4.45E+07	2.88E+07	NO DATA	2.37E+07	3.53E+06	1.56E+06
CS-137	1.33E+09	1.27E+09	1.88E+08	NO DATA	4.15E+08	1.49E+08	7.98E+06
CS-138	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-140	4.38E+07	3.84E+04	2.56E+06	NO DATA	1.25E+04	2.29E+04	2.22E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
LA-140	5.56E-02	1.94E-02	6.05E-03	NO DATA	NO DATA	NO DATA	5.41E+02
LA-142	6.18E-92	1.97E-92	6.17E-93	NO DATA	NO DATA	NO DATA	3.91E-87
CE-141	2.22E+04	1.11E+04	1.64E+03	NO DATA	4.85E+03	NO DATA	1.38E+07
CE-143	3.20E-02	1.74E+01	2.51E-03	NO DATA	7.28E-03	NO DATA	2.54E+02
CE-144	2.31E+06	7.24E+05	1.23E+05	NO DATA	4.01E+05	NO DATA	1.89E+08
PR-143	3.34E+04	1.00E+04	1.66E+03	NO DATA	5.43E+03	NO DATA	3.60E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
ND-147	1.17E+04	9.47E+03	7.33E+02	NO DATA	5.20E+03	NO DATA	1.50E+07
W-187	3.21E-02	1.90E-02	8.53E-03	NO DATA	NO DATA	NO DATA	2.67E+00
NP-239	4.23E-01	3.04E-02	2.14E-02	NO DATA	8.79E-02	NO DATA	2.25E+03

*mrem/yr per µCi/m^3
**1.84×10^{-3}

TABLE 3.5-26

MEAT PATHWAY FACTORS - R^{M}_{ail} (TEEN)
(m^2mrem/yr per μCi)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.93E+02*	1.93E+02*	1.93E+02*	1.93E+02*	1.93E+02*	1.93E+02*
C-14	2.81E+05*	5.62E+04*	5.62E+04*	5.62E+04*	5.62E+04*	5.62E+04*	5.62E+04*
NA-24	1.16E-03**	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03
P-32	3.95E+09	2.45E+08	1.53E+08	NO DATA	NO DATA	NO DATA	3.32E+08
CR-51	NO DATA	NO DATA	5.65E+03	3.14E+03	1.24E+03	8.07E+03	9.50E+05
MN-54	NO DATA	7.02E+06	1.39E+06	NO DATA	2.09E+06	NO DATA	1.44E+07
MN-56	NO DATA	1.17E-53	2.09E-54	NO DATA	1.48E-53	NO DATA	7.72E-52
FE-55	2.38E+08	1.69E+08	3.94E+07	NO DATA	NO DATA	1.07E+08	7.31E+07
FE-59	2.12E+08	4.95E+08	1.91E+08	NO DATA	NO DATA	1.56E+08	1.17E+09
CO-58	NO DATA	1.41E+07	3.25E+07	NO DATA	NO DATA	NO DATA	1.94E+08
CO-60	NO DATA	5.84E+07	1.32E+08	NO DATA	NO DATA	NO DATA	7.61E+08
NI-63	1.52E+10	1.07E+09	5.15E+08	NO DATA	NO DATA	NO DATA	1.71E+08
NI-65	1.90E-52	2.43E-53	1.11E-53	NO DATA	NO DATA	NO DATA	1.32E-51
CU-64	NO DATA	2.06E-07	9.68E-08	NO DATA	5.21E-07	NO DATA	1.60E-05
ZN-65	2.50E+08	8.69E+08	4.05E+08	NO DATA	5.56E+08	NO DATA	3.68E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	4.05E+08	1.90E+08	NO DATA	NO DATA	NO DATA	6.00E+07
RB-88	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
RB-89	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
SR-89	2.54E+08	NO DATA	7.27E+06	NO DATA	NO DATA	NO DATA	3.02E+07
SR-90	3.04E+09	NO DATA	1.99E+09	NO DATA	NO DATA	NO DATA	2.26E+08
SR-91	1.20E-10	NO DATA	4.78E-12	NO DATA	NO DATA	NO DATA	5.45E-10
SR-92	1.08E-49	NO DATA	4.59E-51	NO DATA	NO DATA	NO DATA	2.74E-48
Y-90	9.11E+01	NO DATA	2.45E+00	NO DATA	NO DATA	NO DATA	7.51E+05
Y-91m	0.00E+00	NO DATA	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
Y-91	9.55E+05	NO DATA	2.56E+04	NO DATA	NO DATA	NO DATA	3.91E+08
Y-92	1.26E-39	NO DATA	3.64E-41	NO DATA	NO DATA	NO DATA	3.45E-35
Y-93	3.70E-12	NO DATA	1.01E-13	NO DATA	NO DATA	NO DATA	1.13E-07
ZR-95	1.50E+06	4.74E+05	3.25E+05	NO DATA	6.93E+05	NO DATA	1.09E+09
ZR-97	1.70E-05	3.36E-06	1.55E-06	NO DATA	5.10E-06	NO DATA	9.11E-01
NB-95	1.79E+06	9.94E+05	5.47E+05	NO DATA	9.64E+05	NO DATA	4.25E+09
MO-99	NO DATA	8.20E+04	1.56E+04	NO DATA	1.88E+05	NO DATA	1.47E+05
TC-99m	3.42E-21	9.54E-21	1.24E-19	NO DATA	1.42E-19	5.29E-21	6.26E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
RU-103	8.57E+07	NO DATA	3.66E+07	NO DATA	3.02E+08	NO DATA	7.16E+09
RU-105	4.56E-28	NO DATA	1.77E-28	NO DATA	5.75E-27	NO DATA	3.68E-25
RU-106	2.36E+09	NO DATA	2.97E+08	NO DATA	4.54E+09	NO DATA	1.13E+11
AG-110m	5.04E+06	4.77E+06	2.90E+06	NO DATA	9.10E+06	NO DATA	1.34E+09
TE-125m	3.03E+08	1.09E+08	4.06E+07	8.47E+07	NO DATA	NO DATA	8.95E+08
TE-127m	9.40E+08	3.33E+08	1.12E+08	2.24E+08	3.81E+09	NO DATA	2.34E+09
TE-127	1.78E-10	6.30E-11	3.82E-11	1.23E-10	7.20E-10	NO DATA	1.37E-08
TE-129m	9.49E+08	3.52E+08	1.50E+08	3.06E+08	3.97E+09	NO DATA	3.56E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
TE-131m	3.73E+02	1.79E+02	1.49E+02	2.69E+02	1.87E+03	NO DATA	1.44E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00

TABLE 3.5-26 (continued)

MEAT PATHWAY FACTORS - R^{M}_{aij} (TEEN)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.17E+06	7.38E+05	6.95E+05	7.78E+05	7.08E+06	NO DATA	2.34E+07
I-130	1.63E-06	4.71E-06	1.88E-06	3.84E-04	7.25E-06	NO DATA	3.62E-06
I-131	8.89E+06	1.24E+07	6.69E+06	3.63E+09	2.14E+07	NO DATA	2.46E+06
I-132	5.78E-59	1.51E-58	5.42E-59	5.09E-57	2.38E-58	NO DATA	6.58E-59
I-133	3.09E-01	5.25E-01	1.60E-01	7.32E+01	9.20E+01	NO DATA	3.97E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
I-135	3.79E-17	9.75E-17	3.61E-17	6.27E-15	1.54E-16	NO DATA	1.08E-16
CS-134	5.22E+08	1.23E+09	5.70E+08	NO DATA	3.91E+08	1.49E+08	1.53E+07
CS-136	9.36E+06	3.68E+07	2.47E+07	NO DATA	2.01E+07	3.16E+06	2.96E+06
CS-137	7.24E+08	9.63E+08	3.35E+08	NO DATA	3.28E+08	1.27E+08	1.37E+07
CS-138	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-140	2.37E+07	2.91E+04	1.53E+06	NO DATA	9.86E+03	1.96E+04	3.66E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
LA-140	3.03E-02	1.49E-02	3.97E-03	NO DATA	NO DATA	NO DATA	8.56E+02
LA-142	3.37E-92	1.49E-92	3.72E-93	NO DATA	NO DATA	NO DATA	4.55E-88
CE-141	1.17E+04	7.83E+03	9.00E+02	NO DATA	3.69E+03	NO DATA	2.24E+07
CE-143	1.70E-02	1.24E+01	1.38E-03	NO DATA	5.55E-03	NO DATA	3.72E+02
CE-144	1.23E+06	5.10E+05	6.62E+04	NO DATA	3.04E+05	NO DATA	3.10E+08
PR-143	1.77E+04	7.06E+03	0.80E+02	NO DATA	4.10E+03	NO DATA	5.82E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
ND-147	6.22E+03	6.76E+03	4.05E+02	NO DATA	3.97E+03	NO DATA	2.44E+07
W-187	1.74E-02	1.42E-02	4.96E-03	NO DATA	NO DATA	NO DATA	3.83E+00
NP-239	2.25E-01	2.12E-02	1.18E-02	NO DATA	6.67E-02	NO DATA	3.42E+03

*mrem/yr per µCi/m^3
**1.16×10^{-3}

TABLE 3.5-27

MEAT PATHWAY FACTORS - R^{M}_{aij} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	3.24E+02*	3.24E+02*	3.24E+02*	3.24E+02*	3.24E+02*	3.24E+02*
C-14	3.33E+05*	6.66E+04*	6.66E+04*	6.66E+04*	6.66E+04*	6.66E+04*	6.66E+04*
NA-24	1.45E-03**	1.45E-03	1.45E-03	1.45E-03	1.45E-03	1.45E-03	1.45E-03
P-32	4.65E+09	2.89E+08	1.80E+08	NO DATA	NO DATA	NO DATA	5.23E+08
CR-51	NO DATA	NO DATA	7.05E+03	4.21E+03	1.55E+03	9.35E+03	1.77E+06
MN-54	NO DATA	9.19E+06	1.75E+06	NO DATA	2.73E+06	NO DATA	2.81E+07
MN-56	NO DATA	1.45E-53	2.57E-54	NO DATA	1.84E-53	NO DATA	4.62E-52
FE-55	2.94E+08	2.03E+08	4.74E+07	NO DATA	NO DATA	1.13E+08	1.17E+08
FE-59	2.66E+08	6.24E+08	2.39E+08	NO DATA	NO DATA	1.74E+08	2.08E+09
CO-58	NO DATA	1.83E+07	4.09E+07	NO DATA	NO DATA	NO DATA	3.70E+08
CO-60	NO DATA	7.51E+07	1.66E+08	NO DATA	NO DATA	NO DATA	1.41E+09
NI-63	1.89E+10	1.31E+09	6.32E+08	NO DATA	NO DATA	NO DATA	2.73E+08
NI-65	2.27E-52	2.94E-53	1.34E-53	NO DATA	NO DATA	NO DATA	7.46E-52
CU-64	NO DATA	2.52E-07	1.18E-07	NO DATA	6.36E-07	NO DATA	2.15E-05
ZN-65	3.56E+08	1.13E+09	5.12E+08	NO DATA	7.57E+08	NO DATA	7.13E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
BR-83	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	4.87E+08	2.27E+08	NO DATA	NO DATA	NO DATA	9.61E+07
RB-88	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
RB-89	NO DATA	0.00E+00	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
SR-89	3.01E+08	NO DATA	8.64E+06	NO DATA	NO DATA	NO DATA	4.83E+07
SR-90	1.24E+10	NO DATA	3.05E+09	NO DATA	NO DATA	NO DATA	3.59E+08
SR-91	1.43E-10	NO DATA	5.79E-12	NO DATA	NO DATA	NO DATA	6.83E-10
SR-92	1.28E-49	NO DATA	5.54E-51	NO DATA	NO DATA	NO DATA	2.54E-48
Y-90	1.09E+02	NO DATA	2.92E+00	NO DATA	NO DATA	NO DATA	1.15E+06
Y-91m	0.00E+00	NO DATA	0.00E+00	NO DATA	NO DATA	NO DATA	0.00E+00
Y-91	1.13E+06	NO DATA	3.03E+04	NO DATA	NO DATA	NO DATA	6.23E+08
Y-92	1.49E-39	NO DATA	4.36E-41	NO DATA	NO DATA	NO DATA	2.61E-35
Y-93	4.40E-12	NO DATA	1.21E-13	NO DATA	NO DATA	NO DATA	1.39E-07
ZR-95	1.87E+06	6.00E+05	4.06E+05	NO DATA	9.41E+05	NO DATA	1.90E+09
ZR-97	2.03E-05	4.10E-06	1.88E-06	NO DATA	6.17E-06	NO DATA	1.27E+00
NB-95	2.30E+06	1.28E+06	6.86E+05	NO DATA	1.26E+06	NO DATA	7.75E+09
MO-99	NO DATA	9.91E+04	1.89E+04	NO DATA	2.24E+05	NO DATA	2.30E+05
TC-99m	4.32E-21	1.22E-20	1.56E-19	NO DATA	1.86E-19	5.99E-21	7.23E-18
TC-101	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
RU-103	1.05E+08	NO DATA	4.53E+07	NO DATA	4.02E+08	NO DATA	1.23E+10
RU-105	5.42E-28	NO DATA	2.14E-28	NO DATA	7.00E-27	NO DATA	3.32E-25
RU-106	2.81E+09	NO DATA	3.55E+08	NO DATA	5.42E+09	NO DATA	1.82E+11
AG-110m	6.67E+06	6.17E+06	3.67E+06	NO DATA	1.21E+07	NO DATA	2.52E+09
TE-125m	3.59E+08	1.30E+08	4.81E+07	1.08E+08	1.46E+09	NO DATA	1.43E+09
TE-127m	1.12E+09	3.99E+08	1.36E+08	2.85E+08	4.54E+09	NO DATA	3.75E+09
TE-127	2.09E-10	7.52E-11	4.53E-11	1.55E-10	8.53E-10	NO DATA	1.65E-08
TE-129m	1.13E+09	4.22E+08	1.79E+08	3.89E+08	4.73E+09	NO DATA	5.70E+09
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
TE-131m	4.50E+02	2.20E+02	1.83E+02	3.48E+02	2.23E+03	NO DATA	2.18E+04
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00

TABLE 3.5-27 (continued)

MEAT PATHWAY FACTORS - R^{M}_{ai} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	1.42E+06	9.21E+05	8.64E+05	1.02E+06	8.87E+06	NO DATA	4.36E+07
I-130	2.03E-06	5.98E-06	2.36E-06	5.07E-04	9.33E-06	NO DATA	5.15E-06
I-131	1.07E+07	1.54E+07	8.80E+06	5.03E+09	2.63E+07	NO DATA	4.05E+06
I-132	7.13E-59	1.91E-58	6.67E-57	6.67E-57	3.04E-58	NO DATA	3.58E-59
I-133	3.70E-01	6.43E-01	1.96E-01	9.45E+01	1.12E+00	NO DATA	5.78E-01
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00
I-135	4.65E-17	1.22E-16	4.49E-17	8.03E-15	1.95E-16	NO DATA	1.38E-16
CS-134	6.53E+08	1.55E+09	1.27E+09	NO DATA	5.03E+08	1.67E+08	2.72E+07
CS-136	1.20E+07	4.75E+07	3.42E+07	NO DATA	2.65E+07	3.63E+06	5.40E+06
CS-137	8.69E+08	1.19E+09	7.78E+08	NO DATA	4.03E+08	1.34E+08	2.30E+07
CS-138	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-140	2.88E+07	3.62E+04	1.89E+06	NO DATA	1.23E+04	2.07E+04	5.94E+07
BA-141	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	0.00E+00	0.00E+00
LA-140	3.68E-02	1.85E-02	4.90E-13	NO DATA	NO DATA	NO DATA	1.36E+03
LA-142	4.07E-92	1.85E-92	4.61E-93	NO DATA	NO DATA	NO DATA	1.35E-88
CE-141	1.39E+04	9.43E+03	1.07E+03	NO DATA	4.38E+03	NO DATA	3.61E+07
CE-143	2.03E-02	1.50E+01	1.66E-03	NO DATA	6.61E-03	NO DATA	5.61E+02
CE-144	1.46E+06	6.10E+05	7.83E+04	NO DATA	3.62E+05	NO DATA	4.93E+08
PR-143	2.09E+04	8.40E+03	1.04E+03	NO DATA	4.85E+03	NO DATA	9.17E+07
PR-144	0.00E+00	0.00E+00	0.00E+00	NO DATA	0.00E+00	NO DATA	0.00E+00
ND-147	7.04E+03	8.14E+03	4.87E+02	NO DATA	4.76E+03	NO DATA	3.91E+07
W-187	2.06E-02	1.72E-02	6.02E-03	NO DATA	NO DATA	NO DATA	5.64E+00
NP-239	2.57E-01	2.53E-02	1.39E-02	NO DATA	7.88E-02	NO DATA	5.18E+03

*mrem/yr per µCi/m^3
**1.45×10^{-3}

TABLE 3.5-28

VEGETATION PATHWAY FACTORS - R^{V}_{aij} (CHILD)
(m^2mrem/yr per μCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	4.01E+03*	4.01E+03*	4.01E+03*	4.01E+03*	4.01E+03*	4.01E+03*
C-14	3.51E+06*	7.01E+05*	7.01E+05*	7.01E+05*	7.01E+05*	7.01E+05*	7.01E+05*
NA-24	3.75E+05**	3.75E+05	3.75E+05	3.75E+05	3.75E+05	3.75E+05	3.75E+05
P-32	3.37E+09	1.57E+08	1.30E+08	NO DATA	NO DATA	NO DATA	9.30E+07
CR-51	NO DATA	NO DATA	1.17E+05	6.49E+04	1.77E+04	1.18E+05	6.20E+06
MN-54	NO DATA	6.64E+08	1.77E+08	NO DATA	1.86E+08	NO DATA	5.58E+08
MN-56	NO DATA	1.87E+01	4.22E+00	NO DATA	2.26E+01	NO DATA	2.71E+03
FE-55	8.02E+08	4.25E+08	1.32E+08	NO DATA	NO DATA	2.40E+08	7.88E+07
FE-59	3.98E+08	6.43E+08	3.21E+08	NO DATA	NO DATA	1.87E+08	6.70E+08
CO-58	NO DATA	6.44E+07	1.97E+08	NO DATA	NO DATA	NO DATA	3.76E+08
CO-60	NO DATA	3.79E+08	1.12E+09	NO DATA	NO DATA	NO DATA	2.10E+09
NI-63	3.95E+10	2.11E+09	1.34E+09	NO DATA	NO DATA	NO DATA	1.42E+08
NI-65	1.05E+02	9.89E+00	5.77E+00	NO DATA	NO DATA	NO DATA	1.21E+03
CU-64	NO DATA	1.09E+04	6.59E+03	NO DATA	2.64E+04	NO DATA	5.12E+05
ZN-65	8.11E+08	2.16E+09	1.34E+09	NO DATA	1.36E+09	NO DATA	3.79E+08
ZN-69	9.29E-06	1.34E-05	1.24E-06	NO DATA	8.14E-06	NO DATA	8.46E-04
BR-83	NO DATA	NO DATA	5.40E+00	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	3.92E-11	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	4.53E+08	2.79E+08	NO DATA	NO DATA	NO DATA	2.91E+07
RB-88	NO DATA	4.38E-22	3.04E-22	NO DATA	NO DATA	NO DATA	2.15E-23
RB-89	NO DATA	4.69E-26	4.17E-26	NO DATA	NO DATA	NO DATA	4.09E-28
SR-89	3.59E+10	NO DATA	1.03E+09	NO DATA	NO DATA	NO DATA	1.39E+09
SR-90	1.24E+12	NO DATA	3.14E+11	NO DATA	NO DATA	NO DATA	1.67E+10
SR-91	5.21E+05	NO DATA	1.97E+04	NO DATA	NO DATA	NO DATA	1.15E+06
SR-92	7.29E+02	NO DATA	2.92E+01	NO DATA	NO DATA	NO DATA	1.38E+04
Y-90	2.31E+04	NO DATA	6.18E+02	NO DATA	NO DATA	NO DATA	6.58E+07
Y-91m	9.24E-09	NO DATA	3.36E-10	NO DATA	NO DATA	NO DATA	1.81E-05
Y-91	1.86E+07	NO DATA	4.97E+05	NO DATA	NO DATA	NO DATA	2.48E+09
Y-92	1.58E+00	NO DATA	4.52E-02	NO DATA	NO DATA	NO DATA	4.57E+04
Y-93	2.92E+02	NO DATA	8.01E+00	NO DATA	NO DATA	NO DATA	4.35E+06
ZR-95	3.86E+06	8.49E+05	7.56E+05	NO DATA	1.22E+06	NO DATA	8.86E+08
ZR-97	5.66E+02	8.18E+01	4.83E+01	NO DATA	1.17E+02	NO DATA	1.24E+07
NB-95	4.10E+05	1.60E+05	1.14E+05	NO DATA	1.50E+05	NO DATA	2.95E+08
MO-99	NO DATA	7.67E+06	1.90E+06	NO DATA	1.64E+07	NO DATA	6.35E+06
TC-99m	4.70E+00	9.21E+00	1.53E+02	NO DATA	1.34E+02	4.68E+00	5.24E+03
TC-101	1.48E-30	1.54E-30	1.96E-29	NO DATA	2.63E-29	8.16E-31	4.91E-30
RU-103	1.54E+07	NO DATA	5.90E+06	NO DATA	3.86E+07	NO DATA	3.97E+08
RU-105	9.16E+01	NO DATA	3.32E+01	NO DATA	8.05E+02	NO DATA	5.98E+04
RU-106	7.45E+08	NO DATA	9.30E+07	NO DATA	1.01E+09	NO DATA	1.16E+10
AG-110m	3.21E+07	2.17E+07	1.73E+07	NO DATA	4.04E+07	NO DATA	2.58E+09
TE-125m	3.51E+08	9.52E+07	4.68E+07	9.86E+07	NO DATA	NO DATA	3.39E+08
TE-127m	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	NO DATA	1.07E+09
TE-127	9.84E+03	2.65E+03	2.11E+03	6.81E+03	2.80E+04	NO DATA	3.84E+05
TE-129m	8.43E+08	2.35E+08	1.31E+08	2.72E+08	2.47E+09	NO DATA	1.03E+09
TE-129	1.32E-03	3.68E-04	3.13E-04	9.42E-04	3.86E-03	NO DATA	8.21E-02
TE-131m	1.54E+06	5.33E+05	5.67E+05	1.10E+06	5.16E+06	NO DATA	2.16E+07
TE-131	2.59E-15	7.89E-16	7.71E-16	1.98E-15	7.83E-15	NO DATA	1.36E-14

TABLE 3.5-28 (continued)

VEGETATION PATHWAY FACTORS - R^{V}_{ajj} (CHILD)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	7.00E+06	3.10E+06	3.74E+06	4.51E+06	2.88E+07	NO DATA	3.12E+07
I-130	6.10E+05	1.23E+06	6.35E+05	1.36E+08	1.84E+06	NO DATA	5.77E+05
I-131	1.43E+08	1.44E+08	8.16E+07	4.75E+10	2.36E+08	NO DATA	1.28E+07
I-132	9.20E+01	1.69E+02	7.77E+01	7.84E+03	2.59E+02	NO DATA	1.99E+02
I-133	3.53E+06	4.36E+06	1.65E+06	8.11E+08	7.27E+06	NO DATA	1.76E+06
I-134	1.50E-04	2.79E-04	1.28E-04	6.41E-03	4.26E-04	NO DATA	1.85E-04
I-135	6.28E+04	1.13E+05	5.34E+04	1.00E+07	1.73E+05	NO DATA	8.61E+04
CS-134	1.60E+10	2.63E+10	5.55E+09	NO DATA	8.15E+09	2.92E+09	1.42E+08
CS-136	8.23E+07	2.26E+08	1.46E+08	NO DATA	1.20E+08	1.80E+07	7.95E+06
CS-137	2.39E+10	2.29E+10	3.38E+09	NO DATA	7.46E+09	2.68E+09	1.43E+08
CS-138	6.44E-11	8.95E-11	5.68E-11	NO DATA	6.30E-11	6.78E-12	4.12E-11
BA-139	4.97E-02	2.65E-05	1.44E-03	NO DATA	2.32E-05	1.56E-05	2.87E+00
BA-140	2.77E+08	2.42E+05	1.62E+07	NO DATA	7.89E+04	1.45E+05	1.40E+08
BA-141	2.40E-21	1.14E-24	6.64E-23	NO DATA	9.88E-25	6.71E-24	1.16E-21
BA-142	9.70E-39	6.98E-42	5.42E-40	NO DATA	5.65E-42	4.11E-42	1.27E-40
LA-140	3.24E+03	1.13E+03	3.53E+02	NO DATA	NO DATA	NO DATA	3.16E+07
LA-142	3.39E-04	1.08E-04	3.38E-05	NO DATA	NO DATA	NO DATA	2.11E+01
CE-141	6.56E+05	3.27E+05	4.85E+04	NO DATA	1.43E+05	NO DATA	4.08E+08
CE-143	1.71E+03	9.29E+05	1.35E+02	NO DATA	3.90E+02	NO DATA	1.36E+07
CE-144	1.27E+08	3.99E+07	6.79E+06	NO DATA	2.21E+07	NO DATA	1.04E+10
PR-143	1.45E+05	4.37E+04	7.22E+03	NO DATA	2.36E+04	NO DATA	1.57E+08
PR-144	5.64E-26	1.74E-26	2.84E-27	NO DATA	9.22E-27	NO DATA	3.75E-23
ND-147	7.16E+04	5.80E+04	4.49E+03	NO DATA	3.18E+04	NO DATA	9.18E+07
W-187	6.44E+04	3.81E+04	1.71E+04	NO DATA	NO DATA	NO DATA	5.36E+06
NP-239	2.56E+03	1.84E+02	1.29E+02	NO DATA	5.31E+02	NO DATA	1.36E+07

*mrem/yr per µCi/m^3
**3.75×10^5

TABLE 3.5-29

VEGETATION PATHWAY FACTORS - R^{V}_{aij} (TEEN)
(m^2mrem/yr per µCi)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.59E+03*	2.59E+03*	2.59E+03*	2.59E+03*	2.59E+03*	2.59E+03*
C-14	1.45E+06*	2.91E+05*	2.91E+05*	2.91E+05*	2.91E+05*	2.91E+05*	2.91E+05*
NA-24	2.40E+05**	2.40E+05	2.40E+05	2.40E+05	2.40E+05	2.40E+05	2.40E+05
P-32	1.61E+09	9.97E+07	6.24E+07	NO DATA	NO DATA	NO DATA	1.35E+08
CR-51	NO DATA	NO DATA	6.12E+04	3.40E+04	1.34E+04	8.74E+04	1.03E+07
MN-54	NO DATA	4.54E+08	9.01E+07	NO DATA	1.36E+08	NO DATA	9.32E+08
MN-56	NO DATA	1.43E+01	2.54E+00	NO DATA	1.81E+01	NO DATA	9.41E+02
FE-55	3.26E+08	2.31E+08	5.39E+07	NO DATA	NO DATA	1.46E+08	1.00E+08
FE-59	1.79E+08	4.18E+08	1.61E+08	NO DATA	NO DATA	1.32E+08	9.88E+08
CO-58	NO DATA	4.36E+07	1.01E+08	NO DATA	NO DATA	NO DATA	6.02E+08
CO-60	NO DATA	2.49E+08	5.60E+08	NO DATA	NO DATA	NO DATA	3.24E+09
NI-63	1.61E+10	1.14E+09	5.46E+08	NO DATA	NO DATA	NO DATA	1.81E+08
NI-65	5.73E+01	7.32E+00	3.34E+00	NO DATA	NO DATA	NO DATA	3.97E+02
CU-64	NO DATA	8.28E+03	3.90E+03	NO DATA	2.10E+04	NO DATA	6.42E+05
ZN-65	4.23E+08	1.47E+09	6.86E+08	NO DATA	9.41E+08	NO DATA	6.23E+08
ZN-69	5.04E-06	9.60E-06	6.72E-07	NO DATA	6.28E-06	NO DATA	1.77E-05
BR-83	NO DATA	NO DATA	2.93E+00	NO DATA	NO DATA	NO DATA	NO DATA
BR-84	NO DATA	NO DATA	2.31E-11	NO DATA	NO DATA	NO DATA	NO DATA
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.72E+08	1.28E+08	NO DATA	NO DATA	NO DATA	4.02E+07
RB-88	NO DATA	3.17E-22	1.69E-22	NO DATA	NO DATA	NO DATA	2.72E-29
RB-89	NO DATA	3.56E-26	2.52E-26	NO DATA	NO DATA	NO DATA	5.45E-35
SR-89	1.51E+10	NO DATA	4.32E+08	NO DATA	NO DATA	NO DATA	1.80E+09
SR-90	7.50E+11	NO DATA	1.85E+11	NO DATA	NO DATA	NO DATA	2.11E+10
SR-91	2.82E+05	NO DATA	1.12E+04	NO DATA	NO DATA	NO DATA	1.28E+06
SR-92	4.00E+02	NO DATA	1.70E+01	NO DATA	NO DATA	NO DATA	1.02E+04
Y-90	1.25E+04	NO DATA	3.37E+02	NO DATA	NO DATA	NO DATA	1.03E+08
Y-91m	5.04E-09	NO DATA	1.93E-10	NO DATA	NO DATA	NO DATA	2.38E-07
Y-91	7.84E+06	NO DATA	2.10E+05	NO DATA	NO DATA	NO DATA	3.21E+09
Y-92	8.60E-01	NO DATA	2.49E-02	NO DATA	NO DATA	NO DATA	2.36E+04
Y-93	1.58E+02	NO DATA	4.34E+00	NO DATA	NO DATA	NO DATA	4.83E+06
ZR-95	1.73E+06	5.46E+05	3.75E+05	NO DATA	8.02E+05	NO DATA	1.26E+09
ZR-97	3.10E+02	6.14E+01	2.83E+01	NO DATA	9.31E+01	NO DATA	1.66E+07
NB-95	1.92E+05	1.07E+05	5.86E+04	NO DATA	1.03E+05	NO DATA	4.56E+08
MO-99	NO DATA	5.64E+06	1.08E+06	NO DATA	1.29E+07	NO DATA	1.01E+07
TC-99m	2.73E+00	7.61E+00	9.86E+01	NO DATA	1.13E+02	4.23E+00	5.00E+03
TC-101	8.02E-31	1.14E-30	1.12E-29	NO DATA	2.06E-29	6.95E-31	1.95E-37
RU-103	6.81E+06	NO DATA	2.91E+06	NO DATA	2.40E+07	NO DATA	5.69E+08
RU-105	4.97E+01	NO DATA	1.93E+01	NO DATA	6.27E+02	NO DATA	4.01E+04
RU-106	3.09E+08	NO DATA	3.89E+07	NO DATA	5.95E+08	NO DATA	1.48E+10
AG-110m	1.51E+07	1.43E+07	8.72E+06	NO DATA	2.72E+07	NO DATA	4.03E+09
TE-125m	1.49E+08	5.35E+07	1.99E+07	4.15E+07	NO DATA	NO DATA	4.38E+08
TE-127m	5.52E+08	1.96E+08	6.57E+07	1.31E+08	2.24E+09	NO DATA	1.38E+09
TE-127	5.10E+03	1.92E+03	1.16E+03	3.73E+03	2.19E+04	NO DATA	4.17E+05
TE-129m	3.60E+08	1.34E+08	5.70E+07	1.16E+08	1.51E+09	NO DATA	1.35E+09
TE-129	7.13E-04	2.66E-04	1.73E-04	5.09E-04	2.99E-03	NO DATA	3.90E-03
TE-131m	8.44E+05	4.05E+05	3.38E+05	6.09E+05	4.22E+06	NO DATA	3.25E+07
TE-131	1.41E-15	5.80E-16	4.39E-16	1.08E-15	6.15E-15	NO DATA	1.15E-16

TABLE 3.5-29 (continued)

VEGETATION PATHWAY FACTORS - R^{V}_{alj} (TEEN)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	3.91E+06	2.48E+06	2.33E+06	2.61E+06	2.37E+07	NO DATA	7.84E+07
I-130	3.50E+05	1.01E+06	4.05E+05	8.26E+07	1.56E+06	NO DATA	7.79E+05
I-131	7.66E+07	1.07E+08	5.76E+07	3.13E+10	1.85E+08	NO DATA	2.12E+07
I-132	5.19E+01	1.36E+02	4.87E+01	4.58E+03	2.14E+02	NO DATA	5.91E+01
I-133	1.93E+06	3.28E+06	1.00E+06	4.58E+08	5.75E+06	NO DATA	2.48E+06
I-134	8.44E-05	2.24E-04	8.03E-05	3.73E-03	3.53E-04	NO DATA	2.95E-06
I-135	3.53E+04	9.09E+04	3.37E+04	5.85E+06	1.44E+05	NO DATA	1.01E+05
CS-134	7.10E+09	1.67E+10	7.75E+09	NO DATA	5.31E+09	2.03E+09	2.08E+08
CS-136	4.37E+07	1.72E+08	1.16E+08	NO DATA	9.37E+07	1.48E+07	1.38E+07
CS-137	1.01E+10	1.35E+10	4.70E+09	NO DATA	4.59E+09	1.78E+09	1.92E+08
CS-138	3.54E-11	6.80E-11	3.40E-11	NO DATA	5.02E-11	5.84E-12	3.08E-14
BA-139	2.70E-02	1.90E-05	7.86E-04	NO DATA	1.79E-05	1.31E-05	2.41E-01
BA-140	1.38E+08	1.69E+05	8.89E+06	NO DATA	5.73E+04	1.14E+05	2.13E+08
BA-141	1.11E-21	8.27E-25	3.70E-23	NO DATA	7.67E-25	5.66E-25	2.36E-27
BA-142	5.35E-39	5.35E-42	3.29E-40	NO DATA	4.53E-42	3.56E-42	1.64E-50
LA-140	1.80E+03	8.86E+02	2.36E+02	NO DATA	NO DATA	NO DATA	5.09E+07
LA-142	1.88E-04	8.35E-05	2.08E-05	NO DATA	NO DATA	NO DATA	2.54E+00
CE-141	2.83E+05	1.89E+05	2.17E+04	NO DATA	8.90E+04	NO DATA	5.41E+08
CE-143	9.33E+02	6.79E+05	7.58E+01	NO DATA	3.04E+02	NO DATA	2.04E+07
CE-144	5.29E+07	2.19E+07	2.84E+06	NO DATA	1.31E+07	NO DATA	1.33E+10
PR-143	7.00E+04	2.79E+04	3.48E+03	NO DATA	1.62E+04	NO DATA	2.30E+08
PR-144	3.04E-26	1.24E-26	1.54E-27	NO DATA	7.14E-27	NO DATA	3.35E-29
ND-147	3.62E+04	3.94E+04	2.36E+03	NO DATA	2.31E+04	NO DATA	1.42E+08
W-187	3.53E+04	2.88E+04	1.01E+04	NO DATA	NO DATA	NO DATA	7.79E+06
NP-239	1.39E+03	1.31E+02	7.26E+01	NO DATA	4.10E+02	NO DATA	2.10E+07

*mrem/yr per µCi/m^3
**2.40×10^5

TABLE 3.5-30

VEGETATION PATHWAY FACTORS - R^{V}_{aij} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	2.26E+03*	2.26E+03*	2.26E+03*	2.26E+03*	2.26E+03*	2.26E+03*
C-14	8.97E+05*	1.79E+05*	1.79E+05*	1.79E+05*	1.79E+05*	1.79E+05*	1.79E+05*
NA-24	2.71E+05**	2.71E+05	2.71E+05	2.71E+05	2.71E+05	2.71E+05	2.71E+05
P-32	1.40E+09	8.70E+07	5.41E+07	NO DATA	NO DATA	NO DATA	1.57E+08
CR-51	NO DATA	NO DATA	4.60E+04	2.75E+04	1.01E+04	6.11E+04	1.16E+07
MN-54	NO DATA	3.13E+08	5.96E+07	NO DATA	9.30E+07	NO DATA	9.58E+08
MN-56	NO DATA	1.59E+01	2.82E+00	NO DATA	2.01E+01	NO DATA	5.06E+02
FE-55	2.10E+08	1.45E+08	3.38E+07	NO DATA	NO DATA	8.10E+07	8.33E+07
FE-59	1.26E+08	2.96E+08	1.13E+08	NO DATA	NO DATA	8.27E+07	9.86E+08
CO-58	NO DATA	3.08E+07	6.90E+07	NO DATA	NO DATA	NO DATA	6.24E+08
CO-60	NO DATA	1.67E+08	3.69E+08	NO DATA	NO DATA	NO DATA	3.14E+09
NI-63	1.04E+10	7.21E+08	3.49E+08	NO DATA	NO DATA	NO DATA	1.50E+08
NI-65	6.18E+01	8.03E+00	3.66E+00	NO DATA	NO DATA	NO DATA	2.04E+02
CU-64	NO DATA	9.16E+03	4.30E+03	NO DATA	2.31E+04	NO DATA	7.81E+05
ZN-65	3.18E+08	1.01E+09	4.57E+08	NO DATA	6.76E+08	NO DATA	6.36E+08
ZN-69	5.39E-06	1.03E-05	7.17E-07	NO DATA	6.69E-06	NO DATA	1.55E-06
BR-83	NO DATA	NO DATA	3.13E+00	NO DATA	NO DATA	NO DATA	4.50E+00
BR-84	NO DATA	NO DATA	2.54E-11	NO DATA	NO DATA	NO DATA	1.99E-16
BR-85	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
RB-86	NO DATA	2.19E+08	1.02E+08	NO DATA	NO DATA	NO DATA	4.33E+07
RB-88	NO DATA	3.43E-22	1.82E-22	NO DATA	NO DATA	NO DATA	4.74E-33
RB-89	NO DATA	3.96E-26	2.79E-26	NO DATA	NO DATA	NO DATA	2.30E-39
SR-89	9.95E+09	NO DATA	2.86E+08	NO DATA	NO DATA	NO DATA	1.60E+09
SR-90	6.04E+11	NO DATA	1.48E+11	NO DATA	NO DATA	NO DATA	1.75E+10
SR-91	3.02E+05	NO DATA	1.22E+04	NO DATA	NO DATA	NO DATA	1.44E+06
SR-92	4.28E+02	NO DATA	1.85E+01	NO DATA	NO DATA	NO DATA	8.48E+03
Y-90	1.33E+04	NO DATA	3.56E+02	NO DATA	NO DATA	NO DATA	1.41E+08
Y-91m	5.42E-09	NO DATA	2.10E-10	NO DATA	NO DATA	NO DATA	1.59E-08
Y-91	5.12E+06	NO DATA	1.37E+05	NO DATA	NO DATA	NO DATA	2.82E+09
Y-92	9.13E-01	NO DATA	2.67E-02	NO DATA	NO DATA	NO DATA	1.60E+04
Y-93	1.69E+02	NO DATA	4.65E+00	NO DATA	NO DATA	NO DATA	5.35E+06
ZR-95	1.18E+06	3.79E+05	2.56E+05	NO DATA	5.94E+05	NO DATA	1.20E+09
ZR-97	3.36E+02	6.78E+01	3.10E+01	NO DATA	1.02E+02	NO DATA	2.10E+07
NB-95	1.42E+05	7.91E+04	4.25E+04	NO DATA	7.82E+04	NO DATA	4.80E+08
MO-99	NO DATA	6.12E+06	1.16E+06	NO DATA	1.39E+07	NO DATA	1.42E+07
TC-99m	3.09E+00	8.73E+00	1.11E+02	NO DATA	1.33E+02	4.28E+00	5.16E+03
TC-101	8.62E-31	1.24E-30	1.22E-29	NO DATA	2.24E-29	6.35E-31	3.73E-42
RU-103	4.77E+06	NO DATA	2.06E+06	NO DATA	1.82E+07	NO DATA	5.57E+08
RU-105	5.36E+01	NO DATA	2.12E+01	NO DATA	6.93E+02	NO DATA	3.28E+04
RU-106	1.93E+08	NO DATA	2.44E+07	NO DATA	3.73E+08	NO DATA	1.25E+10
AG-110m	1.05E+07	9.75E+06	5.79E+06	NO DATA	1.92E+07	NO DATA	3.98E+09
TE-125m	9.67E+07	3.51E+07	1.30E+07	2.91E+07	3.93E+08	NO DATA	3.86E+08
TE-127m	3.49E+08	1.25E+08	4.26E+07	8.93E+07	1.42E+09	NO DATA	1.17E+09
TE-127	5.65E+03	2.03E+03	1.22E+03	4.19E+03	2.30E+04	NO DATA	4.46E+05
TE-129m	2.51E+08	9.35E+07	3.97E+07	8.61E+07	1.05E+09	NO DATA	1.26E+09
TE-129	7.61E-04	2.86E-04	1.85E-04	5.84E-04	3.20E-03	NO DATA	5.75E-04
TE-131m	9.12E+05	4.46E+05	3.72E+05	7.06E+05	4.52E+06	NO DATA	4.43E+07
TE-131	1.51E-15	6.32E-16	4.78E-16	1.24E-15	6.63E-15	NO DATA	2.14E-16

TABLE 3.5-30 (continued)

VEGETATION PATHWAY FACTORS - R^{V}_{ail} (ADULT)
(m^2mrem/yr per µCi/sec)

ORGAN: ISOTOPE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-132	4.31E+06	2.79E+06	2.62E+06	3.08E+06	2.68E+07	NO DATA	1.32E+08
I-130	3.91E+05	1.15E+06	4.55E+05	9.77E+07	1.80E+06	NO DATA	9.93E+05
I-131	8.07E+07	1.15E+08	6.62E+07	3.78E+10	1.98E+08	NO DATA	3.05E+07
I-132	5.77E+01	1.54E+02	5.40E+01	5.40E+03	2.46E+02	NO DATA	2.90E+01
I-133	2.09E+06	3.63E+06	1.11E+06	5.34E+08	6.34E+06	NO DATA	3.26E+06
I-134	9.33E-05	2.53E-04	9.06E-05	4.39E-03	4.03E-04	NO DATA	2.12E-07
I-135	3.91E+04	1.02E+05	3.77E+04	6.75E+06	1.64E+05	NO DATA	1.16E+05
CS-134	4.67E+09	1.11E+10	9.08E+09	NO DATA	3.59E+09	1.19E+09	1.94E+08
CS-136	4.26E+07	1.68E+08	1.21E+08	NO DATA	9.35E+07	1.28E+07	1.91E+07
CS-137	6.36E+09	8.70E+09	5.70E+09	NO DATA	2.95E+09	9.82E+08	1.68E+08
CS-138	3.84E-11	7.58E-11	3.75E-11	NO DATA	5.57E-11	5.50E-12	3.23E-16
BA-139	2.86E-02	2.04E-05	8.38E-04	NO DATA	1.91E-05	1.16E-05	5.07E-02
BA-140	1.29E+08	1.62E+05	8.43E+06	NO DATA	5.50E+04	9.26E+04	2.65E+08
BA-141	1.18E-21	8.90E-25	3.98E-23	NO DATA	8.28E-25	5.05E-25	5.55E-31
BA-142	5.79E-39	5.96E-42	3.64E-40	NO DATA	5.03E-42	3.37E-42	8.16E-57
LA-140	1.98E+03	9.95E+02	2.63E+02	NO DATA	NO DATA	NO DATA	7.31E+07
LA-142	2.04E-04	9.25E-05	2.31E-05	NO DATA	NO DATA	NO DATA	6.76E-01
CE-141	1.97E+05	1.33E+05	1.51E+04	NO DATA	6.19E+04	NO DATA	5.09E+08
CE-143	9.98E+02	7.38E+05	8.17E+01	NO DATA	3.25E+02	NO DATA	2.76E+07
CE-144	3.28E+07	1.37E+07	1.76E+06	NO DATA	8.14E+06	NO DATA	1.11E+10
PR-143	6.26E+04	2.51E+04	3.10E+03	NO DATA	1.45E+04	NO DATA	2.74E+08
PR-144	3.25E-26	1.35E-26	1.65E-27	NO DATA	7.61E-27	NO DATA	4.68E-33
ND-147	3.33E+04	3.85E+04	2.31E+03	NO DATA	2.25E+04	NO DATA	1.85E+08
W-187	3.80E+04	3.18E+04	1.11E+04	NO DATA	NO DATA	NO DATA	1.40E+07
NP-239	1.43E+03	1.40E+02	7.74E+01	NO DATA	4.38E+02	NO DATA	2.88E+07

*mrem/yr per µCi/m^3
**2.71×10^5

TABLE 3.5-31

GROUND PLANE PATHWAY FACTORS - R^G_i

(m^2mrem/yr per μCi/sec)

ISOTOPE	TOTAL BODY	SKIN	ISOTOPE	TOTAL BODY	SKIN	ISOTOPE	TOTAL BODY	SKIN
H-3	0.00E+00	0.00E+00	Y-91	1.07E+06	1.21E+06	CS-136	1.51E+08	1.71E+08
C-14	0.00E+00	0.00E+00	Y-92	1.80E+05	2.14E+05	CS-137	1.30E+10	1.52E+10
NA-24	1.20E+07*	1.39E+07	Y-93	1.83E+05	2.50E+05	CS-138	3.59E+05	4.10E+05
P-32	0.00E+00	0.00E+00	ZR-95	2.45E+08	2.85E+08	BA-139	1.06E+05	1.19E+05
CR-51	4.65E+06	5.50E+06	ZR-97	2.96E+06	3.44E+06	BA-140	2.05E+07	2.35E+07
MN-54	1.38E+09	1.62E+09	NB-95	1.37E+08	1.61E+08	BA-141	4.17E+04	4.75E+04
MN-56	9.03E+05	1.07E+06	MO-99	3.99E+06	4.62E+06	BA-142	4.49E+04	5.11E+04
FE-55	0.00E+00	0.00E+00	TC-99m	1.84E+05	2.11E+05	LA-140	1.92E+07	2.18E+07
FE-59	2.73E+08	3.20E+08	TC-101	2.03E+04	2.26E+04	LA-142	7.60E+05	9.12E+05
CO-58	3.80E+08	4.45E+08	RU-103	1.08E+08	1.26E+08	CE-141	1.37E+07	1.54E+07
CO-60	2.32E+10	2.73E+10	RU-105	6.36E+05	7.21E+05	CE-143	2.31E+06	2.63E+06
NI-63	0.00E+00	0.00E+00	RU-106	4.22E+08	5.06E+08	CE-144	6.96E+07	8.05E+07
NI-65	2.97E+05	3.45E+05	AG-110m	3.44E+09	4.01E+09	PR-143	0.00E+00	0.00E+00
CU-64	6.05E+05	6.86E+05	TE-125m	1.56E+06	2.13E+06	PR-144	1.84E+03	2.11E+03
ZN-65	7.48E+08	8.60E+08	TE-127m	9.16E+04	1.08E+05	ND-147	8.39E+06	1.01E+07
ZN-69	0.00E+00	0.00E+00	TE-127	2.99E+03	3.29E+03	W-187	2.35E+06	2.73E+06
BR-83	4.87E+03	7.07E+03	TE-129m	1.98E+07	2.31E+07	NP-239	1.71E+06	1.98E+06
BR-84	2.03E+05	2.36E+05	TE-129	2.64E+04	3.12E+04			
BR-85	0.00E+00	0.00E+00	TE-131m	8.02E+06	9.46E+06			
RB-86	8.98E+06	1.03E+07	TE-131	2.92E+04	3.45E+04			
RB-88	3.31E+04	3.78E+04	TE-132	4.24E+06	4.99E+06			
RB-89	1.23E+05	1.48E+05	I-130	5.50E+06	6.68E+06			
SR-89	2.16E+04	2.50E+04	I-131	1.72E+07	2.09E+07			
SR-90	NO DATA	NO DATA	I-132	1.25E+06	1.47E+06			
SR-91	2.14E+06	2.51E+06	I-133	2.45E+06	2.98E+06			
SR-92	7.77E+05	8.64E+05	I-134	4.46E+05	5.30E+05			
Y-90	4.50E+03	5.31E+03	I-135	2.53E+06	2.95E+06			
Y-91m	1.00E+05	1.16E+05	CS-134	6.87E+09	8.01E+09			

*1.20 x 10^7

4.0 COMPLIANCE WITH 40CFR190

4.1 Total Dose - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. This requirement is applicable at all times.

REMEDIAL REQUIREMENT:

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Sections 2.4.1(a), 2.4.1(b), 3.5.1(a), 3.5.1(b), 3.5.2(a), and 3.5.2(b), calculations shall be made including direct radiation contributions from the reactor unit and from outside storage tanks to determine whether the above limits of Section 4.1 have been exceeded. If such is the case, prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days 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 10CFR20 Part 2203(4), shall include the following information:

   1. A determination of which uranium fuel cycle facilities or operations, in addition to CPS, contribute to the annual dose to the maximum exposed individual. Fuel cycle facilities located beyond the 5-mile radius from CPS need not be considered in this determination.

   2. A determination of the maximum exposed individual.

3. A determination of the total annual dose to the maximum exposed individual from all existing pathways and sources of radioactivity and radiation (including direct radiation from N-16, the plant and storage facilities) using methodologies described in this manual. The direct radiation dose may be either calculated using NUREG-0133 methodology or measured.#

4. It shall describe the levels of radiation and concentrations 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 40CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40CFR 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

4.1.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Sections 2.4.1.1, 3.5.1.1, and 3.5.2.1, and in accordance with the methodology and parameters described or specified in this manual.

4.1.2 Cumulative dose contributions from direct radiation from the reactor and from radwaste storage tanks shall be determined in accordance with the methodology and parameters described or specified in this manual. This requirement is applicable only under conditions set forth in the Remedial Requirement specified above (Section 4.1).

#The total body and organ doses resulting from liquid effluents will be summed with the doses resulting from gaseous effluents (including non-noble gases) and the doses to the maximum exposed individual from other operations of the uranium fuel cycle. The effluent doses will be based upon releases from CPS during the previous three quarters and from the quarter in which the Section 4.1 OPERATION REQUIREMENT was exceeded.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The primary requirements for the Clinton Power Station Radiological Environmental Monitoring Program (REMP) are set forth in Table 5.1-1 and shown by location in Figures 5.0-1, 5.0-2, 5.0-3 and 5.0-4.

In addition to the required sampling program, CPS will perform supplemental periodic and long term sampling and analyses in order to better monitor environmental exposure pathways. These samples will not be listed in this manual, however, full sample descriptions and results will be included in the Annual Radiological Environmental Operating Report.

Surface and drinking water samples are composited by collecting aliquots of fixed volume at fixed time intervals. This method of sampling is considered consistent with note (g) in Table 5.1-1.

5.1 Monitoring Program - Operation and Surveillance Requirements

OPERATION REQUIREMENT

The Radiological Environmental Monitoring Program shall be conducted as specified in Table 5.1-1. This requirement applies at all times.

REMEDIAL REQUIREMENT:

a. With the radiological environmental monitoring program not being conducted as specified in Table 5.1-1 prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Technical Specification 5.6.2, 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 report levels of Table 5.1-2 when averaged over any calendar quarter prepare and submit to the Regional Administrator of the Regional Office of the NRC within 30 days 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 Section 2.4.1, 3.5.1, and 3.5.2. When more than one of the radionuclides in Table 5.1-2 are detected in the sampling medium, this report shall be submitted if:

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

When radionuclides other than those in Table 5.1-2 are detected and 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 Section 2.4.1, 3.5.1, and 3.5.2. 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 vegetation samples unavailable from one or more of the sample locations required by Table 5.1-1, 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 5.6.2, identify the cause of the

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

unavailability of samples and identify the new location(s) for obtaining replacement samples in the next annual Radiological Environmental Operating Report and also include in the report a revised figure(s) and table for this manual reflecting the new location(s).

SURVEILLANCE REQUIREMENTS

5.1.1 The radiological environmental monitoring samples shall be collected pursuant to Table 5.1-1 from the specific locations given in Table 5.1-1 and Figures 5.0-1, 5.0-2, 5.0-3, and 5.0-4 and shall be analyzed pursuant to the requirements of Table 5.1-1 and the detection capabilities required by Table 5.1-3.

TABLE 5.1-1

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]	40 routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: (1) an inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY;	Quarterly	Gamma dose quarterly

SECTOR	CODE	DISTANCE from station (miles)
N	CL-36	0.6
NNE	CL-5	0.7
NE	CL-22	0.6
ENE	CL-23	0.5
E	CL-24	0.5
ESE	CL-42	2.8
SE	CL-43	2.8
SSE	CL-44	2.3
S	CL-45	2.8
SSW	CL-46	2.8
SW	CL-47	3.3
WSW	CL-48	2.3
W	CL-1	1.8
WNW	CL-34	0.8
NW	CL-35	0.7
NNW	CL-63	1.3

TABLE 5.1-1 (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
1. DIRECT RADIATION[b] (continued)	(2) an outer ring of stations, one in each meteorological sector in the 6 to 8 km (3.7 miles to 5.0 miles) range from the site;		

SECTOR	CODE	DISTANCE from station (miles)
N	CL-76	4.6
NNE	CL-77	4.5
NE	CL-78	4.8
ENE	CL-79	4.5
E	CL-53	4.3
ESE	CL-54	4.6
SE	CL-55	4.1
SSE	CL-56	4.1
S	CL-57	4.6
SSW	CL-58	4.3
SW	CL-60	4.5
WSW	CL-61	4.5
W	CL-80	4.1
WNW	CL-81	4.5
NW	CL-51	4.4
NNW	CL-52	4.3

TABLE 5.1-1 (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
1. DIRECT RADIATION[b] (continued)	(3) 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.		

SECTOR	CODE	DISTANCE from station (miles)
N	CL-37	3.4
N	CL-75	0.9
ENE	CL-65	2.6
E	CL-41	2.4
S(control)	CL-11	16
W	CL-49	3.5
W	CL-74	1.9
WNW	CL-64	2.1

TABLE 5.1-1 (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	Samples from 5 locations: a. 3 samples from close to the 3 SITE BOUNDARY locations in different sectors of the highest calculated annual average ground-level D/Q.	Continuous sampler operations with sample collection weekly, or more frequently if required by dust loading.	Radioiodine Canister: I-131 analysis weekly. Particulate Sampler: Gross beta radioactivity analysis following filter change[d]; Gamma isotopic analysis[e] of composite (by location) quarterly.

SECTOR	CODE	DISTANCE from station (miles)
NNE	CL-2	0.7
NE	CL-3	0.7
N	CL-15	0.9

b. 1 sample from the vicinity of a community having the highest calculated annual average ground-level D/Q.

SECTOR	CODE	DISTANCE from station (miles)
E	CL-8	2.2

TABLE 5.1-1 (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 (continued)	c. 1 sample from a control location, as for example 15-30 km (9.3 miles to 18.6 miles) distant and in the least prevalent wind direction[c].		
	SECTOR: S (control) — CODE: CL-11 — DISTANCE from station (miles): 16		
3. WATERBORNE			
a. Surface[f]	1 sample upstream 1 sample downstream	Composite sample over 1 month period[g]	Gamma isotopic analysis[e] monthly. Composite for tritium analysis quarterly.
	SECTOR: ENE (upstream) — CODE: CL-91 — DISTANCE from station (miles): 6.1		
	SECTOR: SE (downstream) — CODE: CL-90 — DISTANCE from station (miles): 0.4		

TABLE 5.1-1 (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
3. WATERBORNE (continued)			
b. Ground	Samples from 1 or 2 sources, only if likely to be affected[h].	Quarterly	Gamma isotopic[e] and tritium analysis quarterly.

SECTOR	CODE	DISTANCE from station (miles)
E	CL-12	1.6*
ESE	CL-7D	2.3

*Sample location is in pump station distant from well. Well located 1.0 mile S of plant on the edge of the lake.

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[g] 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.[i] Composite for gross beta and gamma isotopic analyses[e] monthly. Composite for tritium analysis quarterly.

SECTOR	CODE	DISTANCE from station (miles)
WNW	CL-14	within Service Building

*No municipal or public drinking water supplies are taken from Clinton Lake or downstream for 200 miles. Drinking water for Clinton Power Station is supplied by Clinton Lake.

1 sample from a control location**

**No control location necessary

TABLE 5.1-1 (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
3. WATERBORNE (continued)			
d. Sediment from shoreline	1 sample from downstream area with existing or potential recreational value.	Semiannually	Gamma isotopic analysis[e] semiannually.
	SECTOR: SE; CODE: CL-7B; DISTANCE from station (miles): 2.1		
4. INGESTION			
a. Milk	Samples from milking animals in 3 locations within 5-km distance having the highest dose potential. If there are none, 1 sample from milking animals in each of 3 areas between 5 to 8 km distant where doses are calculated to be in greater than 1 mrem per year.[k]*	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.

*This sample requirement is checked annually as part of the annual land use survey.

TABLE 5.1-1 (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
4. INGESTION (continued)			
a. Milk (continued)	1 sample from milking animals at a control location, 15-30 km (9.3 miles to 18.6 miles) distant and in the least prevalent wind direction. SECTOR: WSW (control) CODE: CL-116 DISTANCE from station (miles): 14		
b. Fish and Invertebrates	1 sample each of 3 important species (such as bass, crappie, carp, or bluegill) in vicinity of plant discharge area. SECTOR: E CODE: CL-19 DISTANCE from station (miles): 3.4 1 sample of same species in areas not influenced by plant discharge. SECTOR: S (control) CODE: CL-105 DISTANCE from station (miles): 50	Sample in season, or semiannually if they are not seasonal	Gamma isotopic analysis[e] on edible portions.

TABLE 5.1-1 (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
4. INGESTION (continued)			
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 been discharged.*	At time of harvest[j]	Gamma isotopic analysis[e] on edible portion.
	*No known usage of Salt Creek water for irrigation in DeWitt, Logan, Menard, or Cass Counties. This information is checked annually as part of the land use survey.		
	Samples of 3 different kinds of broad leaf vegetation (such as lettuce, cabbage, and swiss chard) grown nearest each of two different offsite locations of highest predicted annual average ground-level D/Q if milk sampling is not performed.	Monthly during growing season	Gamma isotopic[e] and I-131 analysis.

SECTOR	CODE	DISTANCE from station (miles)
NE	CL-115	0.7
N	CL-117	0.9
NNE	CL-118	0.9

TABLE 5.1-1 (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
4. INGESTION (continued)			
c. Food Products (continued)	1 sample of each of the similar broad leaf vegetation grown 15-30 km (9.3 miles to 18.6 miles) distant in the least prevalent wind direction if milk sampling is not performed.	Monthly during growing season	Gamma isotopic[e] and I-131
	SECTOR / CODE / DISTANCE from station (miles)		
	SSE (Control) / CL-114 / 12.5		

TABLE 5.1-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TABLE NOTATIONS

[a]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, 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 pursuant to Technical Specification 5.6.2. 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 Technical Specification 5.6.2, identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining replacement samples in the next annual Radiological Environmental Operating Report and also include in the report a revised figure(s) and table for the ODCM 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 40 stations is not an absolute number. The number of direct radiation monitoring stations may be reduced according to geographical limitations; e.g., at an ocean site, some sectors will be over water so that the number of dosimeters may be reduced accordingly. 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.

TABLE 5.1-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TABLE NOTATIONS (Continued)

[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 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 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.

[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 (or time) 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 Section 2.4.2.

TABLE 5.1-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TABLE NOTATIONS (Continued)

[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.

[k]The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in Section 3.5.4.

TABLE 5.1-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

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	

*For drinking water samples. This is 40CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used.

**If no drinking water pathway exists, a value of 20 pCi/l may be used.

***Total for parent and daughter.

TABLE 5.1-3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[a,b]

LOWER LIMIT OF DETECTION (LLD)[c]

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GAS (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-95	30					
Nb-95	15					
I-131	1**	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

*If no drinking water pathway exists, a value of 3000 pCi/l may be used.
**If no drinking water pathway exists, a value of 15 pCi/l may be used.

TABLE 5.1-3 (Continued)

DETECTION FOR ENVIRONMENTAL SAMPLE ANALYSIS[a,b]

TABLE NOTATIONS

[a]This list does not mean that only these nuclides are to be considered. Other peaks 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 5.6.2.

[b]Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13, Rev. 1, July 1977.

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

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

$$LLD = \frac{4.66 s_b}{[E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda \Delta t)]}$$

Where:

LLD is the "a priori' lower limit of detection as defined above, as picocuries 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 if the counting efficiency, as counts per disintegration,

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

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield, when applicable,

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

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

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. 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 5.6.2.

5.2 Land Use Census - Operation and Surveillance Requirements

OPERATION REQUIREMENT

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. For evaluated or mixed-mode releases as defined in Regulatory Guide 1.111, Revision 1, July 1977, the land use census shall also identify within a distance of 5 km (3 miles) the location in each of the 16 meteorological sectors of all milk animals and all gardens of greater than 50 m2 producing broad leaf vegetation. This requirement applies at all times.

REMEDIAL REQUIREMENT:

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 Section 3.5.2.1, identify the new location(s) in the next annual Radiological Environmental Operating Report, pursuant to Technical Specification 5.6.2.

b. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with Section 5.1, 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

*Broad leaf vegetation sampling of at least three 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 5.1-1.4c shall be followed, including analysis of control samples.

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 5.6.3, identify the new location(s) in the next Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for this manual reflecting the new location(s).

SURVEILLANCE REQUIREMENTS

5.2.1 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 5.6.2.

5.3 Interlaboratory Comparison Program

All analyses for CPS Radiological Environmental Monitoring Program are performed by Teledyne Isotopes Midwest Laboratories (TIML) located in Northbrook, Illinois.

Teledyne Isotopes Midwest Laboratory has participated in interlaboratory comparison (cross-check) programs since the formulation of its quality control program in December 1971. These programs have been operated by agencies which supply environmental-type samples (e.g., milk or water) containing concentrations of radionuclides known to the issuing agency but not to the participant laboratories. The purpose of such a program is to provide an independent check on the laboratory's analytical procedures and to alert it to any possible problems.

Participant laboratories measure the concentrations of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies the range the results should fall within. Results consistently higher or lower than the known values and results outside the specific ranges indicate a need to check the instruments or procedures used.

If the results of a determination in the EPA cross-check program are outside the control limits specified by the EPA, CPS will require TIML to investigate the cause of the problem and take steps to correct it. The results of this investigation and corrective action shall be included in the Annual Radiological Environmental Operating Report.

Operation and Surveillance Requirements for the Interlaboratory Comparison Program are prescribed in Section 5.3.1 (which follows).

5.3.1 Interlaboratory Comparison Program - Operation and Surveillance Requirements

OPERATION REQUIREMENT

Analyses shall be performed on all radioactive materials, supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission, that correspond to samples required by Table 5.1-1. This requirement applies at all times.

REMEDIAL REQUIREMENT:

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 5.6.2.

SURVEILLANCE REQUIREMENTS

5.3.1.1 The Interlaboratory Comparison Program is described in Section 5.3. 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 5.6.2.

FIGURE 5.0-1

REMP LOCATIONS WITHIN 1 MILE OF CPS

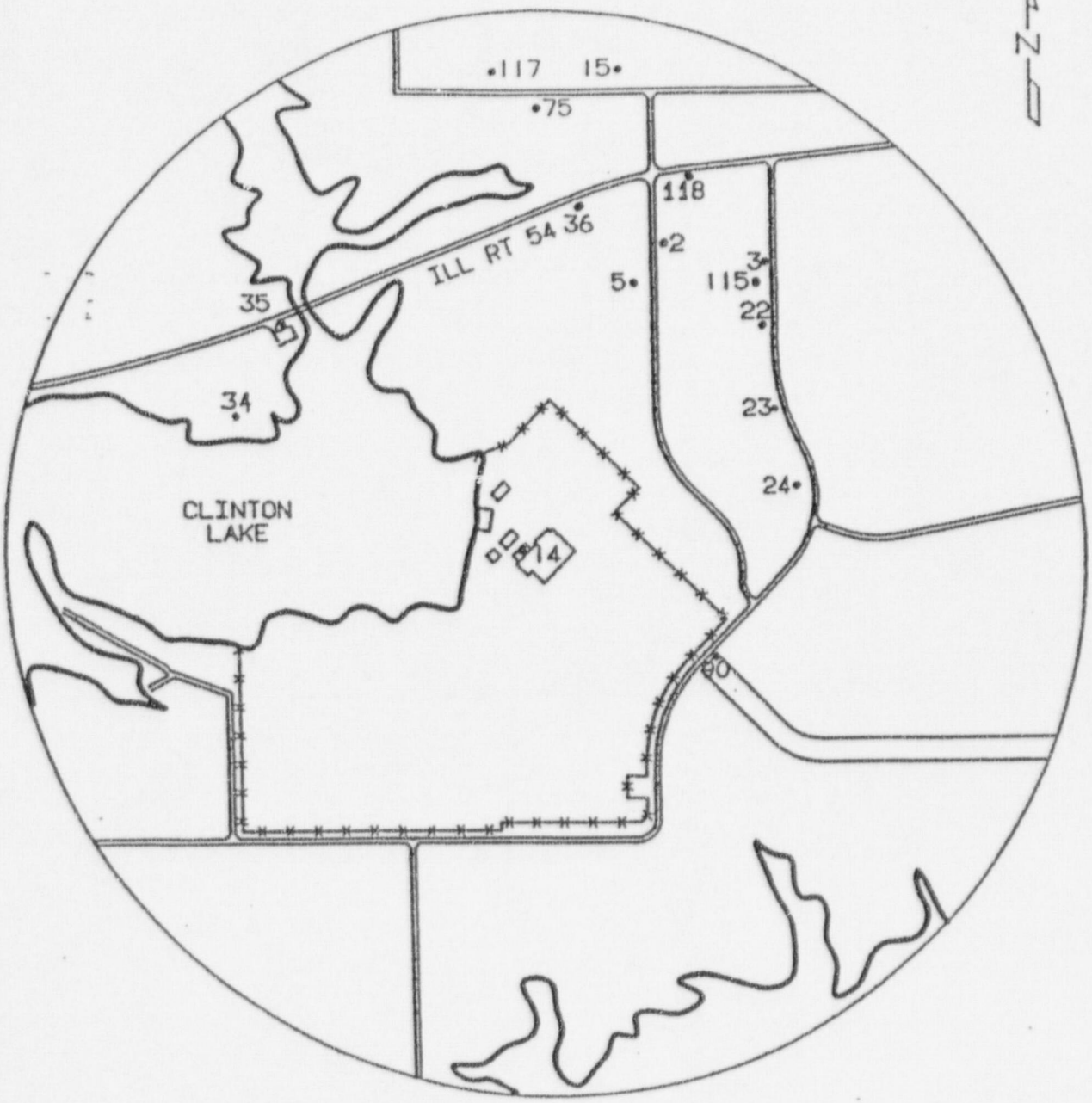


FIGURE 5.0-2

REMP LOCATIONS 1-2 MILES FROM CPS

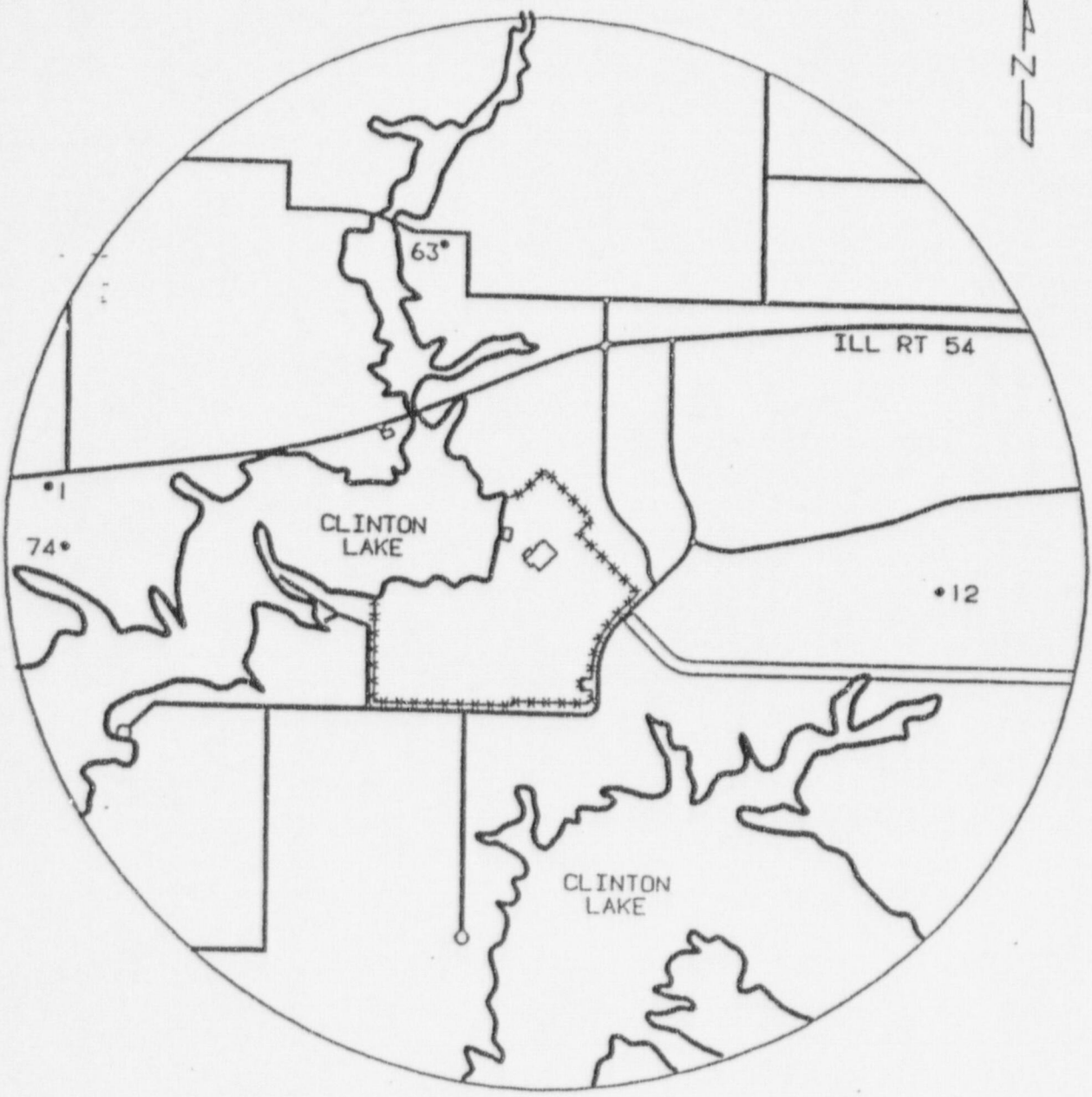


FIGURE 5.0-3
REMP LOCATIONS 2-5 MILES FROM CPS

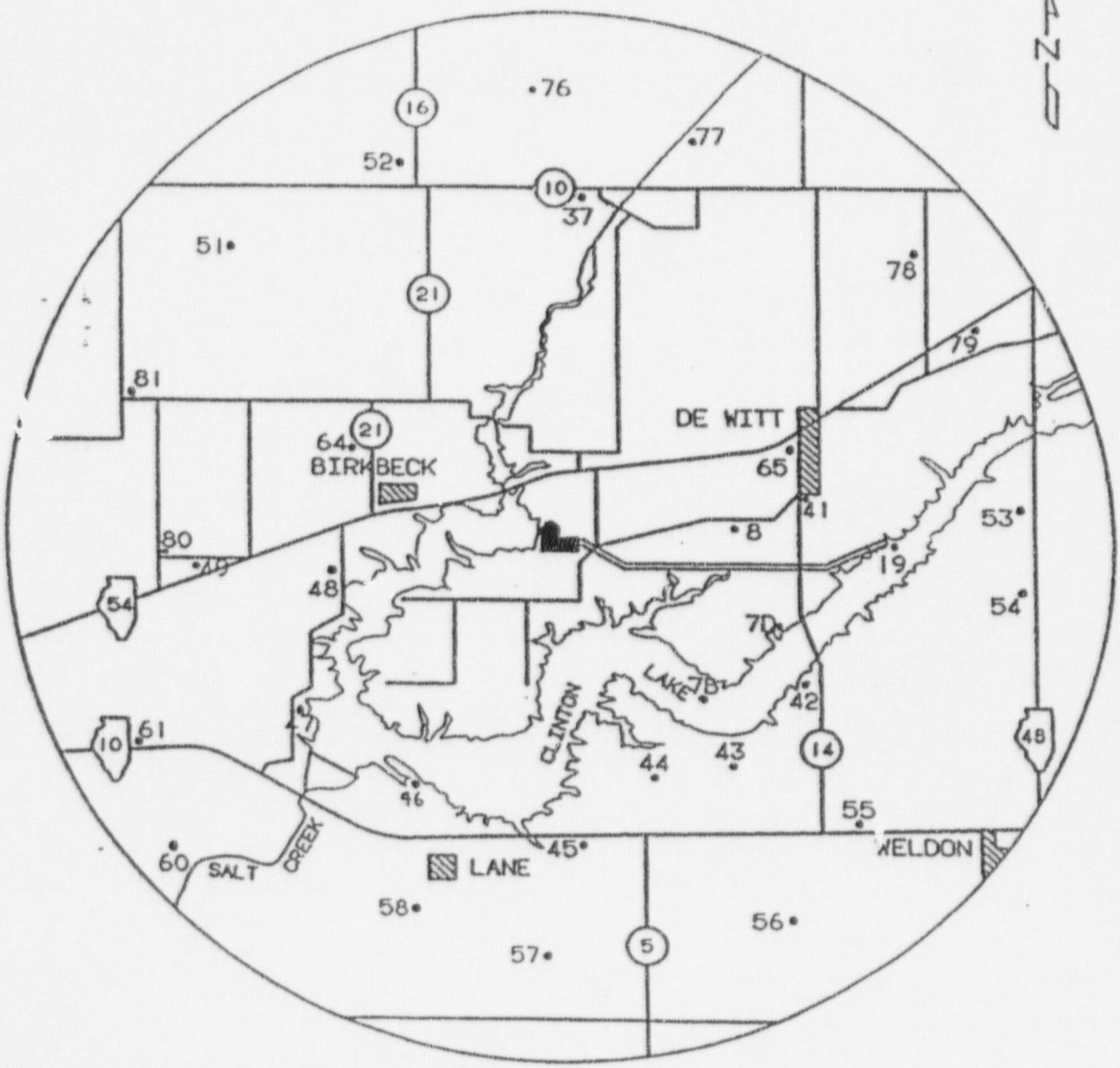
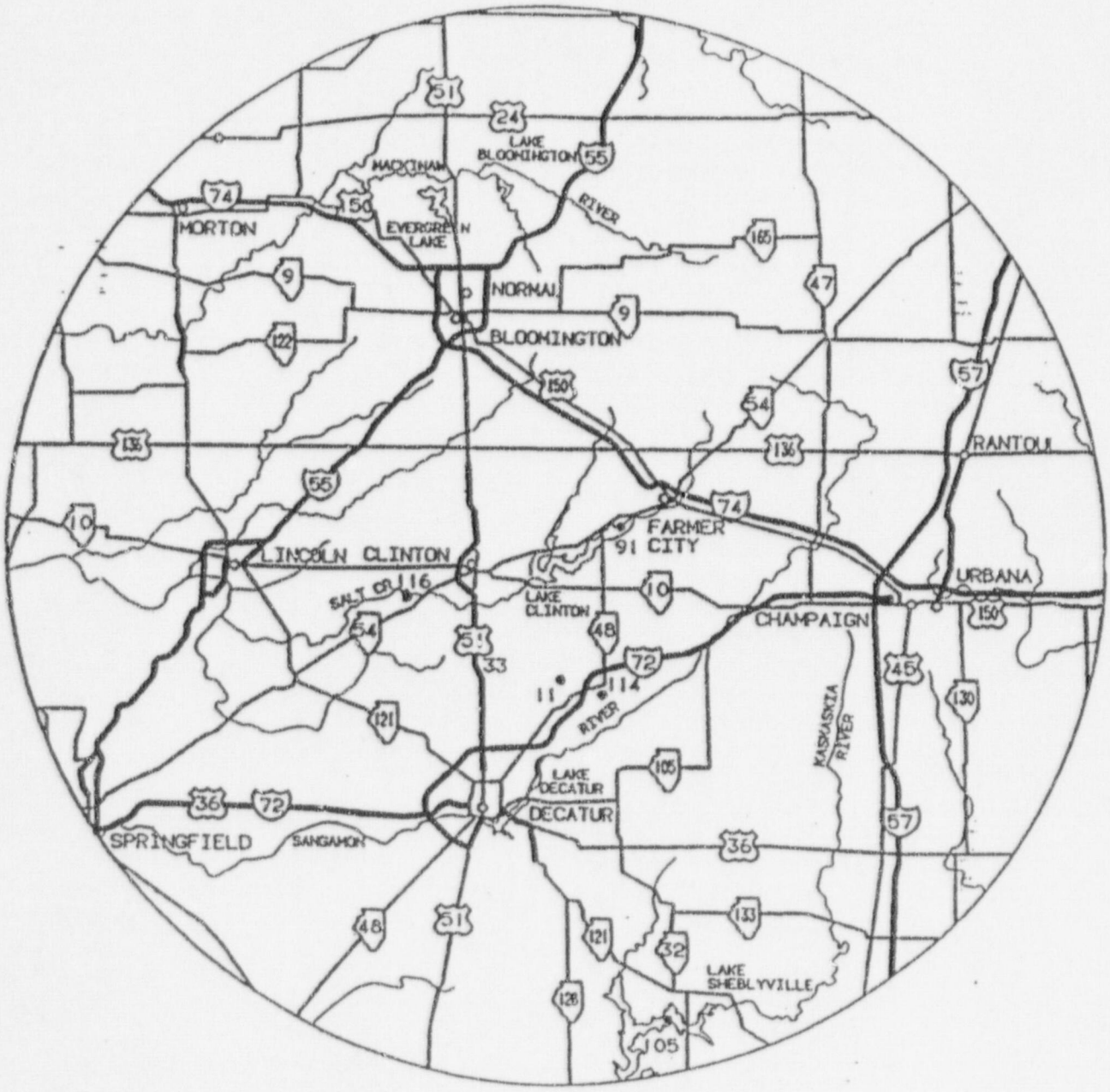


FIGURE 5.0-4

REMP LOCATIONS GREATER THAN 5 MILES FROM CPS



6.0 BASES FOR OPERATION AND SURVEILLANCE REQUIREMENTS

6.1 General Operation and Surveillance Requirements

The requirements of Sections 1.2 and 1.3 provide general requirements applicable to each of the Operation Requirements and Surveillance Requirements specified within Sections 2.0 through 5.0.

1.2.1 This requirement is provided to emphasize when each Operation Requirement is applicable and when the associated REMEDIAL REQUIREMENT should be met.

1.2.2 This requirement defines those conditions necessary to constitute compliance with the terms of an individual Operation Requirement and associated REMEDIAL REQUIREMENT.

1.3.1 This requirement provides that surveillance activities, necessary to ensure the Operation Requirements are met, will be performed during the conditions for which the Operation Requirements are applicable. Some surveillance activities may be required to be performed without regard to the applicable conditions specified in the associated Operation Requirement.

1.3.2 The provisions of this requirement provide allowable tolerances for performing surveillance activities beyond those specified in the nominal surveillance interval. These tolerances are necessary to provide operational flexibility because of scheduling and performance considerations. The phrase "at least" associated with a surveillance frequency does not negate this allowable tolerance; instead, it permits the more frequent performance of surveillance activities.

The tolerance values, taken either individually or consecutively over three test intervals, are sufficiently restrictive to ensure that the reliability associated with the surveillance activity is not significantly degraded beyond that obtained from the nominal specified interval.

1.3.3 The provisions of this requirement set forth the criteria for determination of compliance with the OPERABILITY requirements of the Operation Requirements. Under these criteria, equipment, systems, or components are assumed to be OPERABLE if the associated surveillance activities have been satisfactorily performed within the specified time interval. Nothing in this provision is to be construed as defining equipment, systems or components OPERABLE, when such items are found or known to be inoperable although still meeting the Surveillance Requirements.

1.3.4 This requirement ensures that surveillance activities associated with a Operation Requirement have been performed within the specified time interval prior to entry into a specified system operating mode. The intent of this provision is to ensure that surveillance activities have been satisfactorily demonstrated on a current basis as required to meet the OPERABILITY requirements of the Operation Requirement.

Under the terms of this requirement, for example, during initial plant startup or following extended plant outage, the applicable surveillance activities must be performed within the stated surveillance interval prior to placing or returning the system or equipment into OPERABLE status.

6.2 Monitoring Instrumentation

Section 2.7: Radioactive Liquid Effluent Monitoring Instrumentation

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 this manual to ensure that the alarm/trip will occur prior to exceeding the limits of 10CFR 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 10CFR Part 50.

Section 3.9.1: Offgas Radiation Monitoring Instrumentation

The OPERABILITY of the radiation monitoring instrumentation ensures that; (1) the radiation levels are continually measured in the areas served by the individual channels; (2) the alarm or automatic action is initiated when the radiation level trip setpoint is exceeded; and (3) sufficient information is available on selected plant parameters to monitor and assess these variables following an accident. This capability is consistent with 10CFR Part 50, Appendix A, General Design Criteria 19, 60, 61, 63 and 64.

Section 3.9.2: Radioactive Gaseous Effluent Monitoring Instrumentation

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the release 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 this manual to ensure that the alarm/trip will occur prior to exceeding the limits of 10CFR 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 10CFR Part 50. The sensitivity of any noble gas activity monitors used to show compliance with the gaseous effluent release requirements of Section 3.5.1 shall be such that concentrations as low as 1×10^{-6} µCi/ml are measurable.

6.3 Radioactive Effluents

6.3.1 Liquid Effluents

Section 2.3.1: Liquid Effluent Concentration

This requirement 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 10CFR Part 20, Appendix B, Table 2, 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, 10CFR Part 50, to a MEMBER OF

THE PUBLIC and (2) the limits of 10CFR Part 20.1301 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 lim in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

This requirement applies to the release of radioactive materials in liquid effluents from the site.

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 Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

Section 2.4.1: 10CFR50, Appendix I Release Rate Limits

This requirement is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10CFR 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 40CFR Part 141. The dose calculation methodology and parameters in this manual 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 equations specified in this manual 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 10CFR 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.

This requirement applies to the release of radioactive materials in liquid effluents from the one reactor unit on the site.

Section 2.5.1: Liquid Radwaste Treatment System

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 requirements 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 to 10CFR Part 50 and the design objective given in Section II.D of appendix I to 10CFR 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, 10CFR Part 50, for liquid effluents.

This requirement applies to the release of radioactive materials in liquid effluents from the one reactor unit on the site.

6.3.2 Gaseous Effluents

Section 3.4.1: 10CFR20 Release Rate Limits

This requirement 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 10CFR Part 20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentrations of 10CFR Part 20, Appendix B, Table 2, 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 an UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Appendix B, Table 2 of 10CFR Part 20. 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 such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, shall be given in this manual. Doses for such MEMBERS OF THE PUBLIC are provided in the Radioactive Effluent Release Report. 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 whole body or to less than or equal to 3000 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.

This requirement applies to the release of radioactive materials in gaseous effluents from the one reactor unit on the site.

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 Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

Section 3.5.1: Noble Gas Dose

This requirement is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10CFR Part 50. The Limiting Condition for Operation 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 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 calculation methodology and parameters established in this manual for calculating the doses due to the actual release rates for 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 10CFR 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. The equations in this manual for determining the air doses at and beyond the SITE BOUNDARY are based upon real time atmospheric conditions.

This requirement applies to the release of radioactive materials in gaseous effluents from the site.

Section 3.5.2: Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form

This requirement is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10CFR Part 50. The Limiting Conditions for Operation 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 material 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 10CFR 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 real time atmospheric conditions. The release rate specifications for iodine-131, 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.

This requirement applies to the release of radioactive materials in gaseous effluents from one reactor unit on the site.

Sections 3.6 and 3.7: Gaseous Radwaste (Offgas) Treatment and Ventilation Exhaust Treatment System

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 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 reasonably achievable." This requirement implements the requirements of 10CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10CFR Part 50 and the design objectives given in Section II.D of Appendix I to 10CFR 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, 10CFR Part 50, for gaseous effluents.

This requirement applies to the release of radioactive materials in gaseous effluents from the one reactor unit on the site.

6.3.3 Total Dose

Section 4.1: Total Dose

This requirement is provided to meet the dose limitations of 40CFR Part 190 that have been incorporated into 10CFR Part 20 by 46 FR 18525. The requirement 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 4 reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40CFR 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 40CFR 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 cycles 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 40CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40CFR Part 190 have not already been corrected), in accordance with the provisions of 40CFR Part 190.11 and 10CFR Part 20.2203, is considered to be a timely request and fulfills the requirements of 40CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10CFR Part 20, as addressed in Sections 2.3 and 3.4. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

6.4 Radiological Environmental Monitoring

Section 5.1: Monitoring Program

The radiological environmental monitoring program required by this requirement provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that tne measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 5.1-3 are considered optimum for routine environmental measurements in industrial laboratories. 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.

Detailed discussion of the LLD, and other detection limits, can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

Section 5.2: Land Use Census

This requirement 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 land use census shall be performed using the best information available (e.g., a door-to-door survey, from aerial surveys, questionnaire, or from consulting with local agricultural authorities). This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR Part 50. Restricting the census to gardens of greater than 50 m^2 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/year) 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/m^2.

Section 5.3.1: Interlaboratory Comparison Program

The requirement for participation in an approved Interlaboratory 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 10CFR Part 50.

7.0 REPORTING REQUIREMENTS

7.1 Annual Radiological Environmental Operating Report

Routine Radiological Environmental Operating Reports covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year pursuant to Technical Specification 5.6.2.

The Annual Radiological Environmental Operating Reports shall include the following information:

1. Summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, with operational controls as appropriate, and with previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment.

2. The results of land use censuses required by Section 5.2.

3. Results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in the Tables and Figures in this manual, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

4. A summary description of the radiological environmental monitoring program.

5. At least two legible maps* covering all sample locations keyed to a table giving distances and directions from the HVAC stack.

*One map shall cover stations near the site boundary and a second map shall include the more distant stations.

6. The results of licensee participation in the Interlaboratory Comparison Program, required by Section 5.3.1.

7. Discussion of all deviations from the sampling schedule of Table 5.1-1.

8. Discussion of all analysis in which the LLD required by Table 5.1-3 was not achievable.

7.2 Radioactive Effluent Release Report

Routine Radioactive Effluent Release Reports covering the operation of the unit during the previous 12 months of operation shall be submitted by May 1 of each year pursuant to Technical Specification 5.6.3.

The Radioactive Effluent Release Report shall include the following information:

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

2. The following information for each class of solid waste (as defined by 10CFR Part 61) shipped offsite during the report period:

   a. Total container volume,

   b. Total curie quantity (specify whether determined by measurement or estimate),

   c. Principal radionuclides (specify whether determined by measurement or estimate),

d. Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms).

3. A list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

4. A listing of new locations for dose calculations and/or environmental monitoring identified by the land use census pursuant to Section 5.2.

5. Changes to the ODCM pursuant to Technical Specification 5.5.1.

6. Major changes to radioactive liquid, gaseous, and solid waste treatment systems*. The discussion of each change shall contain:**

   a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10CFR Part 50.59.

   b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

   c. A detailed description of the equipment, components and processes involved and the interfaces with other plant systems;

   d. An evaluation of the change, which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto;

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*Licensees may choose to submit the information called for in this requirement as part of its annual USAR update.

**Changes described by this requirement shall become effective upon review by the FRG.

e. An evaluation of the change, which shows the expected minimum exposures to a MEMBER OF THE PUBLIC in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid waste, to the actual releases for the period prior to when the changes are to be made;

g. An estimate of the exposure to plant operating personnel as a result of the change; and

h. Documentation of the fact that the change was reviewed and found acceptable by the FRG.

The Radioactive Effluent Release Report shall also include the following information:

1. An annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability.

2. An assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year.

3. An assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY (Figures 2.1-1 and 3.1-1) during the report period.

All assumptions used in making these assessments, i.e., specific activity, exposure time and location, shall be included in these reports. Annual average meteorological conditions or meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents, as determined by sampling frequency and measurements, may be used for determining the gaseous

pathway doses. The assessment of radiation doses shall be performed in accordance with the methodology and parameters in this manual.

4. An assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources, including doses from primary effluent pathways and direct radiation, for the previous calendar year to show conformance with 40CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation.

Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev. 1, October 1977.

8.0 ADJUSTMENT OF THE CPS ODCM METHODOLOGY

Consistent with the NRC Commissioners' opinion on 10CFR50 Appendix I dated April 30, 1975, CPS will use environmental monitoring data to improve dose calculational models and to request CPS ODCM changes on the basis of such operating experience data. Such adjustments are recognized as being especially important for the radioiodine-milk pathway where conservative regulatory guide assumptions have been made. By using environmental monitoring data, uncertainties associated with plume behavior, radioiodine chemical form, deposition and retention of forages, and milk consumption patterns may be circumvented or reduced.

9.0 ATMOSPHERIC TRANSPORT AND DISPERSION MODEL

9.1 Introduction

The atmospheric transport and dispersion model used by Illinois Power Company is a straight-line, sector-averaged Gaussian model designed to estimate average relative concentrations at various receptor points. The model was developed in accordance with routine release analysis procedures specified by Regulatory Guide 1.111 (Revision 1 July 1977), Section C.1.c "Constant Mean Wind Direction Models".

All meteorological and dose calculations prescribed in this manual are based on meteorological data concurrent with the time of release or the annual average values. Near-real time meteorological data processing is prescribed in Section 9.2.

9.2 Concurrent Meteorological Data Processing

Meteorological data is acquired and processed through a model which utilizes bi-level hourly meteorological tower data or single level joint frequency data to perform the required analysis. Three distinct release modes are treated: elevated, ground and mixed. A set of five output arrays are generated for each dose receptor location as follows:

- Relative undecayed, undepleted plume concentration (X/Q)
- Relative decayed and depleted radioiodine and particulate concentration (D2DPXQ)
- Relative decayed noble gas concentration (D1XQ)
- Relative particulate and radioiodine deposition (D/Q)
- Standard deviations of the undecayed, undepleted plume concentrations

Since the Regulatory Guide 1.111 depletion and deposition curves are defined only within the range encompassing 100 to 200,000 meters, analysis results are not considered valid outside this range. The following sections describe the calculations performed by the transport and dispersion model for a one hour time interval.

9.2.1 Determination of Pasquill Stability Class

The Pasquill Stability Class is determined by categorizing the temperature gradient, ΔT, into one of several ranges between -0.900 and 0.900 °C/meter according to the following equation:

$$\Delta T = (T_U - T_L)/(H_U - H_L), \ ^\circ C/meter \qquad (1)$$

where

T_U = Meteorological (met) tower upper level temperature, °C

T_L = Meteorological tower lower level temperature, °C

H_U = Meteorological tower upper level instrumentation height
= 60 meters

H_L = Meteorological tower level instrumentation height
= 10 meters

ΔT is then classified according to the following scheme:

Pasquill Stability	Defining Condition
A (Extremely Unstable)	$-0.900 < \Delta T \leq -0.019$
B	$-0.019 < \Delta T \leq -0.017$
C	$-0.017 < \Delta T \leq -0.015$
D (Neutral)	$-0.015 < \Delta T \leq -0.005$
E	$-0.005 < \Delta T \leq 0.015$
F	$0.015 < \Delta T \leq 0.040$
G (Extremely Stable)	$0.040 < \Delta T \leq 0.900$
Invalid	$\Delta T \leq -0.900$ or $\Delta T > 0.900$

9.2.2 Calculation of Stack Height Wind Speed

The wind speed at the release point (HVAC Exhaust Stack or Standby Gas Treatment System Exhaust Stack) height, STACWS, is calculated using the expressions:

$$STACWS = WSP_U \ (STACKH/H_U)^P, \text{ meter/sec} \quad (2)$$

$$P = [\log(WSP_L/WSP_U)]/[\log(H_L/H_U)], \text{ dimensionless} \quad (3)$$

where:

WSP_U = Upper met tower level wind speed, meter/sec

WSP_L = Lower met tower level wind speed, meter/sec

STACKH = Physical release point stack height

P = Wind power law exponent, dimensionless

All other parameters are as defined for equation (1).

9.2.3 Determination of Release Mode and the Entrainment Coefficient

The mode of release can be elevated, ground or mixed; the latter being a combination of the first two. The mode of release, as well as an entrainment coefficient, TCORR, are determined from the stack height, STACH, building height, BLDGHT, stack exit velocity, EXITV, and wind speed at the stack height, STACWS.

For effluents exhausted from release points that are higher than twice the height of adjacent solid structures,

$$STACKH > 2 \ (BLDGHT), \ TCORR = 0.0 \quad (4)$$

the release is considered completely elevated and the entrainment coefficient is zero. For effluents released from points less than the height of adjacent solid structures, a ground-level release is assumed

$$STACKH < BLDGHT, \ TCORR = 1.0 \quad (5)$$

and the entrainment coefficient is unity. For effluents released from points or vents at the level of, or above, adjacent solid structures, but lower than elevated release points,

$$2(BLDGHT) > STACKH > BLDGHT \quad (6)$$

the release is treated as elevated, ground or mixed according to the following relationships:

ELEVATED: TCORR = 0.00 if EXITV >5(STACWS) (7)

GROUND: TCORR = 1.0 if EXITV < STACWS (8)

MIXED: TCORR = 0.30-0.06(EXITV/STACWS) if 5(STACWS) $\geq$ EXITV > 1.5 (STACWS) (9)

TCORR = 2.58-1.58(EXITV/STACWS) if 1.5(STACWS) $\geq$ EXITV $\geq$ (STACWS) (10)

In the mixed mode, the release is considered to occur as an elevated release 100 (1-TCORR) percent of the time and as a ground release 100 (TCORR) percent of the time. Each of these cases are then evaluated separately and the concentration X/Q calculated according to the fraction of the time each release occurs.

9.2.4 Calculation of Vertical Standard Deviation

The vertical plume spread (vertical standard deviation), r_z is a function of the distance from the release point to the reception point for a given Pasquill stability class. The numerical value of r_z if obtained by a polynominal fitting equation which simulates Figure 1 of Regulatory Guide 1.111:

$$r_z = 10^{[A + B \log (X) + C (\log(X))^2]}, \text{ meter} \quad (11)$$

where

X = Distance to a specific receptor, kilometer

A,B,C = Empirical factors which vary by stability class, determined by fitting polynominal equations to the Regulatory Guide 1.111 Figure 1 curves, dimensionless

Empirical Factors Used in Equation (11)

Pasquill Class	A	B	C
A	2.79166	2.69043	1.07483
B	2.11394	1.47930	0.40676
C	1.81954	0.88317	-0.06101
D	1.51851	0.74130	-0.08699
E	1.36173	0.68570	-0.11956
F	1.14613	0.66066	-0.12363
G	1.14613	0.66066	-0.12363

Additionally, an optional value called the "mixing height lid" may be specified which limits the value of r_z to be no greater than this value.

9.2.5 Calculation of the Building Wake Correction

For ground-based and mixed-mode releases, an adjustment is made in the calculation of X/Q that takes into consideration initial mixing of the effluent plume within the building wake. This adjustment is an additional factor added in quadrature to the vertical plume spread equation (11):

$$\Sigma_z = [\sigma_z^2 + 0.5\ (BLDGHT)^2/\pi]^{1/2} \qquad (12)$$

with the requirement that Σ^z is restricted to values

$$\Sigma_z \leq (3)^{1/2}\ (\sigma_z).$$

9.2.6 Calculation of Momentum Plume Rise

For elevated or mixed-mode releases only, the amount of plume rise due to the initial vertical momentum of the exhausted effluent, ΔH, is calculated. For Pasquill stability classes A,B,C and D, ΔH is calculated per section 9.2.6.1; for classes E,F and G, section 9.2.6.2 is used.

9.2.6.1 ΔH For Pasquill Class A,B,C and D

ΔH is calculated using both equations (13) and (14) and the minimum value is selected for use. In addition, when the vertical exit velocity, EXITV, is less than 1.5 times the horizontal windspeed, STACWS, a downwash correction is subtracted from equation (13) per equation (15).

$$\Delta H_1 = 1.44(STACD)(EXITV/STACWS)^{2/3} \quad (13)$$

$$(X/STACD)^{1/3} - DOWNWASH, \text{ meter}$$

$$\Delta H_2 = 3.0(STACD)(EXITV/STACWS), \text{ meter} \quad (14)$$

$$DOWNWASH = 3.0(STACD)(1.5-EXITV/STACWS), \text{ meter} \quad (15)$$

where

STACD = Internal release point stack diameter
= 3.77 meters (HVAC Exhaust Stack)
= 0.44 meters (SGTS Exhaust Stack)

EXITV = Stack exit velocity, meter/second
X = Distance to specified receptor, meter

All other parameters are as defined previously.

9.2.6.2 ΔH For Pasquill Class E,F and G

ΔH is determined by selecting the minimum value calculated by equations (13) and (14) above and equations (16) and (17) below:

$$\Delta H_3 = 4.0[(0.5(EXITV)(STACD))^2/S]^{1/4}, \text{ meter} \quad (16)$$

$$\Delta H_4 = 1.5[(0.5(EXITV)(STACD))^2/STACWS]^{1/3}(S)^{-1/6}, \text{ meter} \quad (17)$$

where

S = Restoring acceleration per unit vertical displacement for adiabatic motion, sec^{-2}
= 8.70E-04 (E stability)
= 1.75E-03 (F stability)
= 2.45E-03 (G stability)

All other parameters are as defined in section 9.2.6.1.

9.2.7 Calculation of the Effective Plume Height

The effective plume height, H, is determined using section 9.2.6 results for the momentum plume rise, ΔH, and the terrain height, TERAIN:

$$H = STACKH + \Delta H - TERAIN, \text{ meter} \quad (18)$$

where

TERAIN = Difference between the plant base height above mean sea level (MSL) and the receptor point height above MSL, meter $\geq$0.0.

9.2.8 Determination of Affected Sectors

The wind direction for the hour determined which sector will be affected. Sectors are 22.5° arcs and are classified according to the following scheme:

Sector Number	Compass Direction	Wind Direction (WD)
1	N	0.0° $\leq$ WD < 11.25° or 348.75° $\leq$ WD $\leq$ 360.00°
2	NNE	11.25° $\leq$ WD $\leq$ 33.75°
3	NE	33.75° $\leq$ WD < 56.25°
4	ENE	56.25° $\leq$ WD < 78.75°
5	E	78.75° $\leq$ WD < 101.25°
6	ESE	101.25° $\leq$ WD < 123.75°
7	SE	123.75° $\leq$ WD < 146.25°
8	SSE	146.25° $\leq$ WD < 168.75°
9	S	168.75° $\leq$ WD < 191.25°
10	SSW	191.25° $\leq$ WD < 213.75°
11	SW	213.75° $\leq$ WD < 236.25°
12	WSW	236.25° $\leq$ WD < 258.75°
13	W	258.75° $\leq$ WD < 281.25°
14	WNW	281.25° $\leq$ WD < 303.75°
15	NW	303.75° $\leq$ WD < 326.25°
16	NNW	326.25° $\leq$ WD < 348.75°

For elevated releases, the wind direction at the upper met tower level is used; ground releases follow the direction of the wind at the lower met tower level. For mixed-mode releases, two X/Q calculations are performed: one for each of the two met tower levels. If the wind direction is the same at both levels, the resulting X/Q will be summed into the same sector; otherwise, the X/Q will be summed into the appropriate sectors. During periods of calm wind, the wind speed is set at one-half the anemometer threshold value and assigned the direction of the previous hour.

9.2.9 Calculation of Depletion and Deposition Factors

The depletion, DPF, and deposition, DPSF, factors are calculated using the curves provided by Regulatory Guide 1.111. Actual values are calculated using polynominal equations developed to simulate the Regulatory Guide curves. Both the DPF and DPSF calculations depend on the effective plume height, H, the stability class, S, and the distance, X, to the receptor.

The Regulatory Guide 1.111 curves represent plumes that are 100, 60, 30, and 0 (ground-level) meters above the ground. For plumes between 0 and 15 meters above the ground, the model uses the ground-level release graphs; for those between 15 and 45 meters, it uses the 30 meter curves; between 45 and 80 meters above the ground, it uses the 60 meter curves; and for those greater than 80 meters above the ground, it uses the 100 meter curves. The model assumes that, after full plume rise is achieved, the plume cannot get higher from the ground. The derivation of these curves assumed no change in terrain height with downwind distance. Since topography does change with distance, and likewise the vertical distance between the plume centerline and the ground, it is necessary to read from more than one depletion or deposition curve of Regulatory Guide 1.111 as the plume travels with distance.

9.2.9.1 DPF Calculation

The effective plume height, H is categorized into one of four J-ranges according to the following scheme:

Plume Height (meters)	J Value
$0 \leq H \leq 15$	5
$15 < H \leq 45$	6
$45 < H \leq 80$	7
$H > 80$	8

Similarly, the stability class is categorized into one of three S-ranges as follows:

Stability Class	S. Value
A, B, C	1
D	2
E, F, G	3

The (SJ) product is then calculated and an (A) value determined at the receptor location X according to the following scheme (where no A value is given, DPF=1.0):

S*J Value	X (meters)	A	DPF
5	$X < 100$		1.0
	$X \geq 100$	A = 1	calculated
6	$X \leq 200$		1.0
	$X \geq 200$	A = 5	calculated
7	$X \leq 300$		1.0
	$X \geq 300$	A = 17	calculated
8	$X \leq 600$		1.0
	$X \geq 600$	A = 29	calculated
10	all X		1.0
12	$X < 400$		1.0
	$X \geq 400$	A = 9	calculated
14	$X \leq 1000$		1.0
	$X \geq 1000$	A = 21	calculated
15	all X		1.0
16	$X < 1700$		1.0
	$X \geq 1700$	A = 33	calculated
18	$X \leq 6000$		1.0
	$X \geq 6000$	A = 13	calculated
21	$X \leq 60,000$		1.0
	$X \geq 60,000$	A = 25	calculated
24	all X		1.0

DPF is calculated using the value for A and equations (19) and (20):

$$DPF = B(A) + B(A + 1)d + B(A + 2)d^2 + B(A + 3)d^3 \quad (19)$$

$$d = \log (X) \quad (20)$$

The corresponding values for the B(A), B(A + 1), B(A + 2) and B(A + 3) terms are as follows:

B(1)	=	.788234	B(19)	=	.426473
B(2)	=	.207198	B(20)	=	-0.0471767
B(3)	=	-.0563034	B(21)	=	.615442
B(4)	=	.0	B(22)	=	.317258
B(5)	=	2.59508	B(23)	=	-.0631839
B(6)	=	-1.43610	B(24)	=	.0
B(7)	=	.433300	B(25)	=	-6.89581
B(8)	=	-.0466221	B(26)	=	3.37961
B(9)	=	1.507264	B(27)	=	-.361582
B(10)	=	-.2745668	B(28)	=	.0
B(11)	=	.0556577	B(29)	=	3.58532
B(12)	=	-.007670194	B(30)	=	-2.21101
B(13)	=	-18.01858857	B(31)	=	.642613
B(14)	=	12.755137	B(32)	=	-.0651465
B(15)	=	-2.7658938	B(33)	=	.234274
B(16)	=	.19103896	B(34)	=	.512656
B(17)	=	2.47756	B(35)	=	-.0857995
B(18)	=	1.36010	B(36)	=	.0

9.2.9.2 DPSF Calculations

Using the same (SJ) and X values determined in section 9.2.9.1, a corresponding C value is defined according to the following scheme (where no C value is given, DPSF = 0):

S*J Value	X (meters)	C	DPSF
5	$X < 100$		0
	$X \geq 100$	C = 1	calculated
6	$X < 100$		0
	$X \geq 100$	C = 8	calculated
7	$X < 100$		0
	$X \geq 100$	C = 29	calculated
8	$X < 100$		0
	$X \geq 100$	C = 50	calculated
10	all X		0
12	$X < 100$		0
	$X \geq 100$	C = 15	calculated
14	$X < 120$		0
	$X \geq 120$	C = 36	calculated
15	all X		0
16	$X < 210$		0
	$X \geq 210$	C = 57	calculated
18	$X < 2900$		0
	$X \geq 2900$	C = 22	calculated

21	X < 26,000		0
	X ≥ 26,000	C = 43	calculated
24	all X		0

DPSF is calculated using the value for C and equations (20), (21), and (22):

$$DPSF = 10^{Y}/(0.392699X) \quad (21)$$

$$Y = A(C) + A(C+1)d + A(C+2)d^2 + A(C+3)d^3 + A(C+4)d^4 + A)(C+5)d^5 + A(C+6)d^6 \quad (22)$$

The corresponding values for the A(C), A(C+1), A(C+2), A(C+3), A(C+4), A(C+5) and A(C+6) terms are as follows:

A(1)	=	-3.17821	A(33)	=	7.552876
A(2)	=	-.153463	A(34)	=	-.82569984
A(3)	=	-.0759066	A(35)	=	.036134823
A(4)	=	0.	A(36)	=	-53.7335
A(5)	=	0.	A(37)	=	45.3671
A(6)	=	0.	A(38)	=	-15.3282
A(7)	=	0.	A(39)	=	2.24735
A(8)	=	-25.7331	A(40)	=	-.122674
A(9)	=	26.2738	A(41)	=	0.
A(10)	=	-11.3014	A(42)	=	0.
A(11)	=	2.04278	A(43)	=	-674.351
A(12)	=	-.134412	A(44)	=	384.531
A(13)	=	0.	A(45)	=	-73.7766
A(14)	=	0.	A(46)	=	4.72041
A(15)	=	-47.5827	A(47)	=	0.
A(16)	=	43.8050	A(48)	=	0.
A(17)	=	-16.0781	A(49)	=	0.
A(18)	=	2.53726	A(50)	=	-55.5622
A(19)	=	-.148044	A(51)	=	53.6534
A(20)	=	0.	A(52)	=	-20.6300
A(21)	=	0.	A(53)	=	3.44177
A(22)	=	-128.5278	A(54)	=	-.212314
A(23)	=	77.28943	A(55)	=	0.
A(24)	=	-15.90284	A(56)	=	0.
A(25)	=	1.071885	A(57)	=	436.987302
A(26)	=	0.	A(58)	=	-755.860224
A(27)	=	0.	A(59)	=	515.64145
A(28)	=	0.	A(60)	=	-181.713295
A(29)	=	41.824767	A(61)	=	35.153579
A(30)	=	-103.969677	A(62)	=	-3.558356
A(31)	=	86.215344	A(63)	=	.14774
A(32)	=	-35.1021096			

9.2.10 Ground Level X/Q, D2DPXQ, D1XQ, D/Q Analysis

9.2.10.1 Undecayed, Undepleted Plume Relative Concentration, X/Q

The atmospheric concentration of effluent at ground level, normalized by the source term, Q, is given by the following equation:

$$X/Q = 2.032(TCORR)/WSP_L(X)A_{min}, \text{ sec/m}^3 \quad (23)$$

where

A_{min} = The lesser of the two values obtained by equations (24) and (25), meter

$$A_1 = (\sigma^2_z + \Sigma_z)^{1/2}, \text{ meter} \quad (24)$$

$$A_2 = (3)^{1/2}\,\sigma_z, \text{ Meter} \quad (25)$$

2.032 = The constant $(2/\pi)^{1/2}$ divided by the width in radians of a 22.5° sector (i.e., $\pi/8$, dimensionless

X = Distance between release point to receptor, meter

9.2.10.2 Decayed, Depleted Radioiodine and Particulate Relative Concentration, D2DPXQ

The decayed, depleted radioiodine concentration, D2DPXQ, is calculated in accordance with the following equation:

$$D2DPXQ = DPF(DC2)X/Q, \text{ sec/m}^3 \quad (26)$$

where

DPF = The depletion factor calculated per section 9.2.9, dimensionless

DC2 = The radioiodine decay factor, dimensionless

$$= \exp[-0.693(X)/t_{1/2}(WSP_L)]$$

$$= \exp[-0.693(X)/(8 \text{ day})(24 \text{ hr/day})(3600 \text{ sec/hr})(WSP_L)]$$

$$= \exp[-1.00E\text{-}06(X/WSP_L)]$$

9.2.10.3 Decayed Noble Gas Plume Relative Concentration, D1XQ

The decayed noble gas plume relative concentration, D1XQ, is calculated in accordance with the following equation:

$$D1XQ = DC1\ (X/Q),\ sec/m^3 \qquad (27)$$

where

DC1 = The noble gas decay factor, dimensionless

$$= \exp\ [-0.693(X)/t_{½}(WSP_L)]$$

$$= \exp\ [-0.693(X)/(2.26\ day)(24\ hr/day)(3600\ sec/hr)(WSP_L)]$$

$$= \exp\ [-3.55E\text{-}06\ (X/WSP_L)]$$

9.2.10.4 Radioiodine and Particulate Relative Deposition, D/Q

The relative deposition for radioiodines and particulates, D/Q is calculated in accordance with the following equation:

$$D/Q = [DPSF(DC2)(TCORR)]/[(2\pi/16)X],\ m^{-2} \qquad (28)$$

where

DPSF = The deposition factor calculated per section 9.2.9, m^{-1}

9.2.11 Elevated X/Q, D2DPXQ, D1XQ, D/Q Analysis

9.2.11.1 Undecayed, Undepleted Plume Relative Concentration, X/Q

The atmospheric concentration of effluent at elevated level, normalized by the source term Q, is given by the following equation:

$$X/Q = [2.032(1-TCORR)\exp[-0.5(H/\sigma_z)^2]]/[STACWS(X)\ \sigma_z],\ sec/m^3 \qquad (29)$$

where all parameters are as previously defined.

9.2.11.2 Decayed, Depleted Radioiodine and Particulate Relative Concentration, D2DPXQ

The calculation of D2DPXQ for elevated releases follows section 9.2.10.2 methodology with the exception that the WSP_L value used in the calculation of DC2 in equation (26) is replaced by the STACWS value and the equation (29) X/Q is used.

9.2.11.3 Decayed Noble Gas Plume Relative Concentration, D1XQ

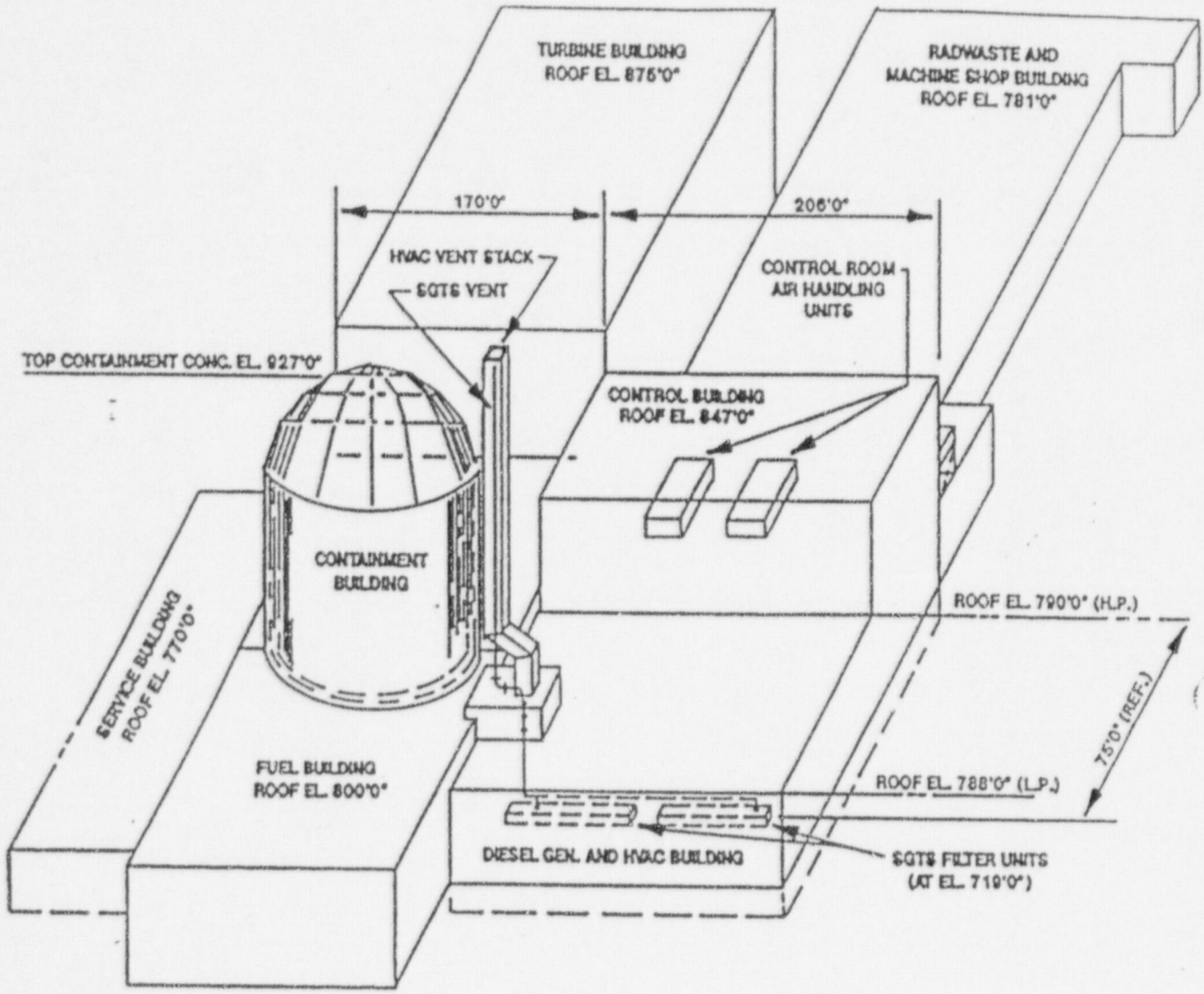
The calculation of D1XQ for elevated releases follows section 9.2.10.3 methodology by substituting the equation (29) X/Q value into equation (27) and STACWS for WSP_L in the calculation of DC1.

9.2.11.4 Radioiodine and Particulate Relative Deposition, D/Q

The calculation of D/Q for elevated releases follows section 9.2.10.4 methodology by substituting (1-TCORR) for the TCORR term in equation (28) and STACWS for WSP_L in the calculation of DC2.

Table 9.2-1

GASEOUS EFFLUENT RELEASE POINT CHARACTERISTICS



	HVAC Exhaust Stack	SGTS Exhaust Stack
Release Point Height (m)	61	61
Building Height (m)	58	58
Release Point Geometry	Duct	Pipe
Release Point Area (m^2)	11.15	0.15
Release Point Diameter (m)	3.77*	0.44
Annual Average Flow Rate (m^3/sec)	111.71	1.89
Vertical Exit Velocity (m/sec)	10.02	12.49

*Effective $2(A/\pi)^{1/2}$ diameter