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May 1, 2014

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Subject: Annual Radioactive Effluent Release Report for 2013  
River Bend Station – Unit 1  
License No. NPF-47  
Docket No. 50-458

Dear Sir or Madam,

Enclosed is the River Bend Station (RBS) Annual Radioactive Effluent Release Report for 2013 for the period January 1, 2013 through December 31, 2013. This report is submitted in accordance with the RBS Technical Specifications, Section 5.6.2

Should you have any questions regarding the enclosed, please contact Mr. Joseph Clark, at (225) 381-4177.

Sincerely,

A handwritten signature in black ink, appearing to read "JAC".

For

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enclosure

TE98  
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# RIVER BEND STATION

## 2013 ANNUAL EFFLUENT RELEASE REPORT

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**ATTACHMENT 1   OFFSITE DOSE CALCULATION MANUAL (ODCM)**

**ATTACHMENT 2   PROCESS APPLICABILITY PROGRAM (PCP)**

## I. INTRODUCTION

This is the annual Radioactive Effluent Release Report for the period of January 1, 2013, through December 31, 2013. This report is submitted in accordance with Technical Specification 5.6.3 of Appendix A to River Bend Station (RBS) License Number NPF-47.

## II. SUPPLEMENTAL INFORMATION

### A. Regulatory Limits

#### 1. 10CFR50, Appendix I Limits

##### a) Fission and Activation Gases

In accordance with Technical Requirement (TR) 3.11.2.2, the air dose due to noble gases released in gaseous effluent to areas at and beyond the SITE BOUNDARY shall be limited to:

$$\begin{aligned}
 D_{\text{Gamma-Air}} &= \text{gamma air dose from radioactive noble gases in millirad (mrad)} \\
 &= 3.17\text{E-}8 \sum_{i=1}^n M_i \overline{(X/Q)} Q_i \leq 5 \text{ mrad/qtr} \\
 &\leq 10 \text{ mrad/yr}
 \end{aligned}$$

$$\begin{aligned}
 D_{\text{Beta-Air}} &= \text{beta air dose from radioactive noble gases in millirad (mrad)} \\
 &= 3.17\text{E-}8 \sum_{i=1}^n N_i \overline{(X/Q)} Q_i \leq 10 \text{ mrad/qtr} \\
 &\leq 20 \text{ mrad/yr}
 \end{aligned}$$

##### b) Radioiodines (I-131 & I-133) and Particulate

In accordance with Technical Requirement 3.11.2.3, the dose to a MEMBER OF THE PUBLIC from radioiodines (I-131 and I-133), tritium (H-3) and all radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluent releases to areas at and beyond the SITE BOUNDARY shall be limited to:

$$\begin{aligned}
 D_{\text{I\&8DP}\tau} &= \text{Dose in mrem to the organ } (\tau) \text{ for the age group of interest from} \\
 &\text{radioiodine (I-131, I-133, tritium, and 8 day particulate via the pathway} \\
 &\text{of interest.)}
 \end{aligned}$$

$$= 3.17E-08 (F_o) \sum_{i=1}^n P_{i\tau} (X/Q) Q_i \quad \text{and}$$

$$= 3.17E-08 (F_o) \sum_{i=1}^n R_{i\tau} (D/Q) Q_i \quad \text{and}$$

$$D_{\tau} = \sum_{z=1}^n D_{I\&8DP\tau} \leq 7.5 \text{ mrem/qtr}$$

$$\leq 15 \text{ mrem/yr}$$

(above terms defined in the RBS ODCM)

c) Liquid Effluent

In accordance with Technical Requirement 3.11.1.2, the dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluent released to UNRESTRICTED AREAS shall be limited to:

$$D_{i\tau} = \frac{A_{i\tau} \Delta t Q_i}{(DF) D_w}$$

and

$$D_{TOTAL\tau} = \sum_{i=1}^n D_{i\tau}$$

$D_{TOTAL\tau}$  = Total dose commitment to the organ ( $\tau$ ) due to all releases during the desired time interval in mrem

and

$$D_{TOTAL} \quad \text{Total Body} \quad \leq 1.5 \text{ mrem/qtr}$$

$$\leq 3 \text{ mrem/yr}$$

$$D_{TOTAL} \quad \text{Any Organ} \quad \leq 5 \text{ mrem/qtr}$$

$$\leq 10 \text{ mrem/yr}$$

(above terms defined in RBS ODCM)



## 2. 40CFR190 Limits

In accordance with Technical Requirement 3.11.4, 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:

≤ 25 mrem to the total body or any organ (except the thyroid)

≤ 75 mrem to the thyroid

## 3. Miscellaneous Limits

### a. Technical Requirement 3.11.2.1 - Fission and Activation Gases

In accordance with Technical Requirement 3.11.2.1, the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be less than or equal to 500 millirems/year (mrem/yr) to the total body and less than or equal to 3000 mrem/yr to the skin:

$DR_{TB}$  = Dose rate to the total body in mrem/yr

$$= \sum_{i=1}^n K_i \overline{(X/Q)} Q_i \leq 500 \text{ mrem/yr and}$$

$DR_{SKIN}$  = Dose rate to the skin in mrem/yr

$$= \sum_{i=1}^n L_i + 1.1M_i \overline{(X/Q)} Q_i \leq 3000 \text{ mrem/yr}$$

(above terms defined in RBS ODCM)

### b. Technical Requirement 3.11.2.1 - Radioiodine (I-131 & I-133) and Particulate

In accordance with Technical Requirement 3.11.2.1, the dose rate due to radioiodines, tritium, and all radionuclides in particulate form with half-lives greater than 8 days released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to less than or equal to 1500 mrem/yr to any organ:

$DR_{I\&8DP\tau}$  = Dose rate to the organ  $\tau$  for the age pathway group of interest from Radioiodines (I-131 & I-133), tritium, and 8 day particulate via the inhalation pathway in mrem/yr.

$$DR_{I\&8DPt} = \sum_{i=1}^n P_i \overline{(X/Q)} \cdot Q_i \leq 1500 \text{ mrem/yr}$$

(above terms defined in RBS ODCM)

c. Technical Requirement 3.11.1.1 - Liquid Effluent

In accordance with Technical Requirement 3.11.1.1, the concentration of radioactive material released in liquid effluent to UNRESTRICTED AREAS shall be limited to ten times the concentrations specified in 10CFR20, 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/milliliter total concentration.

d. Technical Requirement 3.11.2.5 - Ventilation Exhaust Treatment

In accordance with Technical Requirement 3.11.2.5, the VENTILATION EXHAUST TREATMENT SYSTEM 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 and beyond the SITE BOUNDARY would exceed 0.3 mrem to any organ in a 31-day period.

e. Technical Requirement 3.11.1.3 - Liquid Radwaste Treatment System

In accordance with Technical Requirement 3.11.1.3, the liquid radwaste treatment system shall be used to reduce the radioactive materials in liquid waste prior to their discharge when the projected doses, due to the liquid effluent, to UNRESTRICTED AREAS would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31-day period.

## B. Effluent Concentration Limits

### 1. Gaseous Releases

The concentrations of radioactive gaseous releases are based on the dose rate restrictions in RBS Technical Requirements, rather than the Effluent Concentration Limits (ECL) listed in 10CFR20 Appendix B, Table 2, Column 1.

## 2. Liquid Releases

The Effluent Concentration Limits of radioactive materials in liquid effluents are limited to ten times 10CFR20, Appendix B, Table 2, Column 2.

### C. Measurements and Approximations of Total Radioactivity

#### 1. Gaseous Effluent

##### a. Fission and Activation Gases

Periodic grab samples are obtained from the Main Plant Exhaust Duct, Fuel Building Exhaust Vent and Radwaste Building Exhaust Vent. These samples are analyzed using high purity germanium detectors coupled to computerized pulse height analyzers. The sampling and analysis frequencies are described in Table 1F.

Sampling and analysis of these effluent streams provide noble gas radionuclide relative abundance that can then be applied to the noble gas gross activity and gross activity release rate to obtain nuclide specific activities and release rates. The noble gas gross activity released within a specific time period is determined by integrating the stack monitor release rate over the considered time period. If no activity was detected between the stack grab sample and a significant increase in hourly averages was recorded, the nuclide relative abundance of the last sample (or the last similar event), which indicated the presence of activity, was used to obtain nuclide specific activities. Correction factors for the monitors are derived and applied for each sampling period whenever noble gas radionuclides are detected in the effluent stream.

##### b. Particulate and Radioiodine (I-131 & I-133)

Particulates, Iodine-131 and Iodine-133 are continuously sampled from the three release points using a particulate filter and charcoal cartridge in line with a sample pump (stack monitor pump). These filters and charcoal cartridges are removed and analyzed in accordance with the frequencies specified in Table 1F. Analysis is performed to identify and quantify radionuclides using high purity germanium detectors coupled to computerized pulse height analyzers. Given the nuclide specific activity concentrations, process flow rate, and duration of the sample, the nuclide specific activity released to the environment can be obtained. Due to the continuous sampling process, it is assumed that the radioactive material is released to the environment at a constant rate within the sampling period. Strontium-89 and Strontium-90 (Sr-89 and Sr-90)

are quantitatively analyzed by counting by gas flow proportional counting. Gross alpha analysis is performed using a zinc sulfide scintillation counter.

c. Tritium

Tritium grab samples are obtained from the three gaseous release points at the specified frequencies listed in Table 1F using an ice bath condensation collection method. The collected sample is then analyzed using a liquid scintillation counter. Given the tritium concentration, process flow rate, and time period for which the sample is obtained, the tritium activity released to the environment can be determined. Due to the frequency of sampling, it is assumed that the tritium is released to the environment at a constant rate within the time period for which the sample is obtained.

d. Carbon-14 (C-14)

C-14 release details are discussed in Section VI.

e. Nickel-63

No Nickel-63 was quantified in 2013.

2. Liquid Effluent

Representative grab samples are obtained from the appropriate sample recovery tank and analyzed prior to release of the tank in accordance with the frequencies listed in Table 2E. Analysis for gamma emitting nuclides (including dissolved and entrained noble gases) is performed using a high purity germanium detector coupled to a computerized pulse height analyzer. Tritium concentration is determined using a liquid scintillation counter. Strontium-89 and Strontium-90 are quantitatively analyzed by scintillation techniques (Cherenkov counting). Iron-55 is counted with a liquid scintillation counter after digestion of the iron. Gross alpha analysis is performed using a zinc sulfide scintillation counter. The activity of each nuclide released to the environment is determined from the nuclide specific concentration and total tank volume released.

## D. Batch Releases

### 1. Liquid Effluents

Batch releases and receiving stream flow from River Bend Station during the reporting period of January 1, 2013, through December 31, 2013 are shown in Table 2D.

The Mississippi River stream flow is obtained by averaging data from the U. S. Army Corp of Engineers website using flow gauge data at Tarbert Landing.

### 2. Gaseous Effluents

There were no routine batch releases of gaseous effluents from River Bend Station during the reporting period of January 1, 2013, through December 31, 2013.

## E. Abnormal Releases

There were no gaseous abnormal releases in 2013. An abnormal liquid release was reported in the 2012 Annual Radiological Effluent Report. The leak was identified on October 7, 2012 and continued until February 17, 2013. Subsequent investigation has determined the activity will not be detectable past the site boundary and technically does not meet the definition of an abnormal release. However, since this was reported in the 2012 Annual Radiological Effluent Report and the leak continued into 2013, a summary is included below for consistency.

The initial investigation believed that the source of the leak was domestic water. This was based on a pH sample, known buried piping in the area, drawing review and the fact that the waste water treatment plant pumps run intermittently.

The subsequent investigation determined that the reason for the constant flow at the leak location was due to a stuck open check valve (1PBS-V3014) and failed air-relief valve in the greywater discharge line. Check valve 1PBS-V3014 is designed to prevent backflow from the CWS blowdown line into the greywater effluent line. Check valve 1PBS-V3014 had a piece of wood stuck in it preventing the valve from seating correctly. As a result, water from the CWS blowdown line backflowed into the 4-inch greywater effluent line from the WWTP and emerged from the failed, below ground air-relief valve. The water that flowed out of the greywater effluent line appears to have stayed onsite in the plant ditch system and soaked into the ground. There was no evidence of flow to the surface waters (creeks) that would have gone offsite.

Liquid Radwaste System (LWS) discharges flow into the CWS blowdown line and this connection is upstream of the WWTP tie-in. Therefore, during periods of LWS discharging, some of the diluted radioactive water (containing tritium (H-3), cobalt-60 (Co-60) and some noble gases would have been able to leak onto the ground. A mud

sample from beneath the ground surface in the leak area was obtained on March 17, 2013. The sample was counted wet with no specific soil geometry and showed detectable levels of Co-60 ( $2.4E-08$  uCi/gm) (no water was available to perform tritium analysis). This indicated the possibility of CWS water backflowing through the pipe.

The activity of the LWS releases for the time period was reviewed. The dose to the public would be negligible from this event. Even with extremely conservative assumptions, the maximum dose calculated is a small percentage of the 10CFR50 liquid effluent dose objectives.

River Bend Station has a groundwater monitoring program and has wells down gradient of the greywater piping leak location. The site conceptual hydrology model indicates a down-gradient flow generally to the southwest from the greywater piping leak to the Mississippi River. Any potential infiltration will be monitored by the RBS groundwater monitoring program.

The River Bend Station site does not utilize ground water for drinking water use, and the nearest known drinking water user is many miles downstream in the Mississippi River below Baton Rouge, Louisiana. Due to the significant dilution volume of the Mississippi River, it is highly unlikely that any radioactivity that may enter the groundwater from the greywater piping leak will have any meaningful impact offsite.

Private wells south of the River Bend Station property line are not expected to be affected by this situation. The most recent information indicates all neighbors surrounding the station use the parish water supply for their primary source of drinking water. In addition, the direction of groundwater flow is not towards these wells.

River Bend Station made notifications in accordance with NEI 07-07. Since any activity released would have been part of a permitted LWS batch release, the curies released were reported in the Table 2 series.

## F. Estimate of Total Error

### 1. Liquid

The maximum error associated with sample collection, laboratory analysis, and discharge volume is collectively estimated to be:

Fission and Activation Products:  $\pm 14.2\%$

Tritium:  $\pm 14.2\%$

Dissolved and Entrained Noble Gases:  $\pm 14.2\%$

Gross Alpha Radioactivity:  $\pm 14.2\%$

## 2. Gaseous

The maximum error (not including sample line loss) associated with sample flow, process flow, sample collection, monitor accuracy and laboratory analysis are collectively estimated to be:

Noble Gases:  $\pm 37.0\%$   
Iodines :  $\pm 18.6\%$   
Particulate:  $\pm 18.6\%$   
Tritium:  $\pm 18.2\%$

## 3. Determination of Total Error

The total error (i.e., collective error due to sample collection, laboratory analysis, sample flow, process flow, monitor accuracy, etc.) is calculated using the following equation:

$$E_T = \sqrt{((E_1)^2 + (E_2)^2 + \dots(E_n)^2)}$$

where:

$E_T$  = total error

$E_1, E_2 \dots E_n$  = individual errors due to sample collection, laboratory analysis, sample flow, process flow, monitor accuracy, etc.

## III. GASEOUS EFFLUENT SUMMARY INFORMATION

Refer to the Table 1 series for the summation of gaseous releases. It should be noted that an entry of "0.00E+00" Curie (Ci) or microcurie/second (uCi/sec) in this section indicates that the concentration of the particular radionuclide was below the Lower Limit of Detection (LLD) as listed in Table 1F. Also, any nuclide not appearing in the tables was < LLD for all four quarters.

## IV. LIQUID EFFLUENT SUMMARY INFORMATION

Refer to the Table 2 series for the summation of liquid releases. It should be noted that an entry of "0.00E+00" Ci or uCi/ml in this section indicates that the concentration of the particular radionuclide was below the Lower Limit of Detection (LLD) as listed in Table 2E. Also, any nuclide not appearing in the tables was < LLD for all four quarters.

## V. SOLID WASTE

Refer to Table 3, for Solid Waste and Irradiated Fuel Shipments.

## VI. RADIOLOGICAL IMPACT ON MAN (40CFR190)

An assessment (see summary below) was made of radiation doses to the likely most-exposed member of the public from River Bend and other nearby uranium fuel cycle sources (none within five miles). 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.

### Carbon-14 (C-14)

The bounding annual dose from C-14 was calculated using guidance from Regulatory Guide 1.21, Revision 2, NUREG-0016, and the methodology in Regulatory Guide 1.109. The C-14 source term of 11 curies was taken from the site calculation PR(C)-359-3A, Gaseous Releases per NUREG-0016 Revision 1. Carbon-14 does not have dose factors associated with standing on contaminated ground; therefore, no ground plane dose was calculated. There is no milk pathway within five miles of River Bend Station so this pathway is not evaluated. RBS does not take credit for decay in the X/Q. This calculation assumes the inhalation, meat and vegetation pathways are at the site boundary in the sector with the highest X/Q. The dose from liquid effluents is not calculated as the dose contribution from C-14 is considered to be insignificant as indicated in Regulatory Guide 1.21, Revision 2. According to EPRI 1021106, Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents, 95% of the carbon released is in the form of carbon dioxide and this contributes the highest dose to man. The ingestion pathway, specifically vegetation, is the most likely route of intake for man. An assumption has been made for gaseous releases that plants obtain all of their C-14 from carbon dioxide.

Dose not including C-14:

<b>Organ</b>	<b>mrem</b>
Total Body	4.75E-02
Skin	3.18E-02
Thyroid	7.69E-02
Other Organ	4.78E-02



Bounding Dose from C-14 only:

<b>Organ</b>	<b>mrem</b>
Total Body	9.39E-01
Skin	0.00E+00
Thyroid	9.39E-01
Other Organ (Bone)	4.70E+00

In addition, an assessment of doses was made for members of the public due to their activities inside the site boundary. Parameters and assumptions used to make this determination can be found in Table 4. The results of the calculations can be found in Table 5. The maximally exposed member of the public was an employee staying at RBS during the week and is conservatively calculated to have stayed at least four days per week for 50 weeks. It should be noted that liquid effluent pathway dose was not considered since these individuals would not engage in activities that would allow exposure to this pathway.

## **VII. METEOROLOGICAL DATA**

See Tables 6 and 7 for the cumulative joint frequency distributions and annual average data for continuous releases. The meteorological recovery for 2013 was 97 %.

## **VIII. RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION OPERABILITY**

The minimum number of channels required to be OPERABLE as described in Table 3.3.11.2-1 of Technical Requirement 3.3.11.2 were, if inoperable at any time in the period January 1, 2013, through December 31, 2013, restored to operable status within the required time.

## **IX. RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION OPERABILITY**

The minimum number of channels required to be OPERABLE as described in Table 3.3.11.3-1 of Technical Requirement 3.3.11.3 were, if inoperable at any time in the period January 1, 2013, through December 31, 2013, restored to operable status within the required time.

## **X. LIQUID HOLD UP TANKS**

The maximum quantity of radioactive material, excluding tritium and dissolved or entrained noble gases, contained in any unprotected outdoor tank during the period of January 1, 2013, through December 31, 2013 was less than or equal to the 10 curie limit as required by Technical Specification 5.5.8.b.

## **XI. RADIOLOGICAL ENVIRONMENTAL MONITORING**

There were no changes to the Radiological Environmental Monitoring Program during the reporting period January 1, 2013, through December 31, 2013.

## **XII. LAND USE CENSUS**

The Land Use Census was not conducted in 2013. The next scheduled land use census as required by Technical Requirements Manual (TRM) (TR 3.12.2) is in 2014.

## **XIII. OFFSITE DOSE CALCULATION MANUAL (ODCM)**

There were two changes to the ODCM in 2013. One change involved updating the title of the Chemistry Superintendent to Chemistry Manager. The other change revised Step 7.3.3 and Attachment 2 to update the methodology for discharging very low gamma activity tanks in addition to zero gamma activity tanks. A copy of the ODCM is attached to this report.

## **XIV. MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS, AND SOLID WASTE TREATMENT SYSTEMS**

Engineering has performed a review of the Asset Suite database to evaluate non-administrative design changes completed or partially completed during 2013 involving the subject systems (i.e. changes classified as evaluations or nuclear changes). These design changes were then reviewed to determine if there have been any major changes to the subject systems. The review was based on a major change being defined as a modification which affected the method of processing or the effluent from the system. Also, to be a "major change" the change must have affected the Updated Safety Analysis Report (USAR).

The Engineering Changes (EC's) to liquid, solid or gaseous radwaste systems implemented during this time period were:

- EC-48782 TMOD ECN Rev. 0. This EC added a new Cat ID for replacement valves under TMOD EC35300. TMOD EC35300 was reported in the 2012 Annual

Radiological Effluent Report, and it was determined that this change does not constitute a major change to either the liquid, solid or gaseous radwaste treatment systems.

- EC-41004 TMOD Rev. 0. Provides a temporary above-ground path for groundwater discharges from well MW-125 in the Unit 2 hole to the temporary blowdown piping via valve TMOD EC 35300-V6, which discharges to the blowdown pit via 4 inch HDPE (High Density Polyethylene) pipe installed by TMOD EC 35300.
- EC-44465 TMOD ECN Rev.0. ECN to EC41004 to specify a different foot print for store tank spill guard and to address typographical errors in the original EC41004.
- EC-44790 TMOD ECN Rev.0. To address administrative errors to EC-41004 with respect to torque values, to correct a stray mark on the PID-02-01B markup at the jet pump to expansion tank interface, and to add valve numbers to 2 unnamed temporary valves within scope of work.
- EC-45620 TMOD ECN Rev.0. This EC addressed question with respect to the TMOD EC-41004 process applicability determination identified in CR-RBS-2013-04530. Also, this EC addressed several administrative issues with EC-41004, such as added a vendor manuals, addressed typographical errors, and added a check valve to prevent backflow.
- EC-45515 TMOD Rev.0. The purpose of this TMOD is to provide the needed information to cross connect the Reactor Plant Component Cooling Water (RPCCW) system to the Liquid Radioactive Waste (LWS) system. This cross connection will bypass the normally filtration and processing equipment in the LWS system as the water will be processed and filtered before it is sent from the RPCCW system to the LWS system.
- EC-41790 EQC Rev. 0. This EC provides an equivalency evaluation to document the acceptability of and the Engineering instructions for a permanent enclosure for the damaged area of pipeline LWS-004-586-4.
- EC-43216 DC Rev.0. This EC was issued for the replacement of reheater drain bypass valve N64-SOVF010B.
- EC-40118 EVAL Rev.0. This EC evaluates the 400°F setpoint of temperature controllers N64-TCR002A/B, and ensures consistency between design documents and the System Operating Procedure.
- EC-38729 TMOD Rev.0. Temporary program change to temperature recorder N64-TRSR602 to accommodate failure of another recorder. This T-Mod has been removed.

No EC was identified as being completed during this time period that modified any radioactive waste system major component such that the processing method or effluent was changed. Also no changes were identified affecting the method of processing solid, liquid or gaseous waste or the isotopic composition or the quantity of liquid, solid, or gaseous waste as described in the USAR.

In conclusion, no design changes were completed during the specified time period that constituted a major change to either the liquid, solid or gaseous radwaste treatment systems.

## **XV. PROCESS CONTROL PROGRAM (PCP)**

There was a change to the PCP in 2013. The change was editorial in nature, and a copy of that revision is attached to this report.

## **XVI. INDUSTRY GROUND WATER PROTECTION INITIATIVE (GPI) – FINAL GUIDANCE DOCUMENT (NEI 07-07) OBJECTIVE ANNUAL REPORTING**

Ground water samples for gamma radiation and tritium were taken in support of the GPI. These samples are not part of the Radiological Environmental Monitoring Program. The sample results for 2013 are located in Table 8.

River Bend Station made two notifications in accordance with NEI 07-07 in 2013. One was for the leak described in the Abnormal Release, Section II.E of this report. The second notification was in February 2013 when the station identified that CNS-TK2, Condensate Storage Tank (CST) Sump, was overflowing in the CST berm area. The CST berm area had been excavated to support NEI 09-14 inspections of buried piping from the CST. The estimated volume of the overflow was 380 gallons. This leak is not characterized as an abnormal release because the site's contract geologists determined that the water associated with this release will not be detected past the site boundary due to dilution, dispersion, and decay.

The wells with positive activity in Table 8 are associated with the GPI notification made in December 2011. All of the remaining samples taken in support of the GPI meet the Lower Limit of Detection indicated in the Technical Requirement 3.12.1 (Environmental LLDs).

**TABLE 1A**  
**GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES**

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Gases						
1. Total Release	Ci	3.78E+00	1.18E+01	1.93E+00	2.78E-01	1.78E+01
2. Avg. Release Rate	uCi/sec	4.86E-01	1.51E+00	2.43E-01	3.50E-02	5.65E-01
3. % Applicable Limit % (1)		6.27E-02	2.50E-01	7.21E-02	1.54E-02	2.00E-01
Iodine-131						
1. Total Release	Ci	3.75E-04	1.37E-04	1.62E-04	9.07E-05	7.64E-04
2. Avg. Release Rate	uCi/sec	4.82E-05	1.74E-05	2.03E-05	1.14E-05	2.42E-05
3. % Applicable Limit % (1)		1.62E-01	5.82E-02	1.58E-02	3.86E-02	1.64E-01
Particulates Half Life >= 8 days						
1. Total Release	Ci	1.91E-05	3.14E-05	4.20E-06	4.60E-06	5.93E-05
2. Avg. Release Rate	uCi/sec	2.45E-06	3.99E-06	5.29E-07	5.79E-07	1.88E-06
3. % Applicable Limit % (2)		3.40E-02	1.67E-02	7.05E-02	9.42E-03	3.86E-02
Tritium						
1. Total Release	Ci	4.95E+00	5.06E+00	2.81E+00	5.03E+00	1.79E+01
2. Avg. Release Rate	uCi/sec	6.37E-01	6.44E-01	3.54E-01	6.33E-01	5.66E-01
3. % Applicable Limit %		1.02E-01	9.04E-02	6.97E-02	1.04E-01	1.83E-01
Carbon-14						
1. Total Release	Ci	2.73E+00	2.73E+00	2.77E+00	2.77E+00	1.10E+01
2. Avg. Release Rate	uCi/sec	3.50E-01	3.49E-01	3.48E-01	3.48E-01	3.49E-01
3. % Applicable Limit % (2)		1.56E+01	1.56E+01	1.58E+01	1.58E+01	3.13E+01

- 1) Either the gamma air dose limit of 5 mrad/qtr or beta air dose limit of 10 mrad/qtr (T.R. 3.11.2.2.a), which ever is most limiting.
- 2) The % of applicable limit is determined by comparing the dose contribution to the critical organ limits of TRM 3.11.2.3

**TABLE 1B**  
**GASEOUS EFFLUENTS - GROUND RELEASES - CONTINUOUS MODE**

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Gases						
XE-133	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-133M	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-135	Ci	1.32E-01	1.94E-01	2.54E-01	7.23E-02	6.53E-01
XE-135M	Ci	2.31E-01	3.40E-01	4.44E-01	1.26E-01	1.14E+00
Totals for Period...	Ci	3.63E-01	5.34E-01	6.98E-01	1.98E-01	1.79E+00
Iodines						
I-131	Ci	3.13E-06	0.00E+00	0.00E+00	0.00E+00	3.13E-06
I-133	Ci	1.50E-05	0.00E+00	0.00E+00	0.00E+00	1.50E-05
Totals for Period...	Ci	1.81E-05	0.00E+00	0.00E+00	0.00E+00	1.81E-05
Particulates Half Life >= 8 days						
CE-141	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	Ci	8.88E-06	4.21E-06	3.95E-06	2.27E-06	1.93E-05
CR-51	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-59	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN-54	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-95	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-106	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-65	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals for Period...	Ci	8.88E-06	4.21E-06	3.95E-06	2.27E-06	1.93E-05
Tritium						
H-3	Ci	1.24E+00	1.03E+00	8.95E-01	1.26E+00	4.43E+00
Totals for Period...	Ci	1.24E+00	1.03E+00	8.95E-01	1.26E+00	4.43E+00

**TABLE 1C**  
**GASEOUS EFFLUENTS - GROUND RELEASES - BATCH MODE**

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Gases						
XE-133	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-135	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-135M	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals for Period...	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Iodines						
I-131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals for Period...	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Particulates Half Life >= 8 days						
BA-140	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN-54	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-65	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals for Period...	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium						
H-3	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals for Period...	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Carbon-14						
C-14	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**TABLE 1D**  
**GASEOUS EFFLUENTS - MIXED MODE RELEASES - CONTINUOUS MODE**

## Fission and Activation Gases

AR-41	Ci	1.01E+00	0.00E+00	0.00E+00	0.00E+00	1.01E+00
KR-85	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
KR-85M	Ci	2.77E-01	0.00E+00	1.64E-01	0.00E+00	4.42E-01
KR-87	Ci	1.29E-01	0.00E+00	0.00E+00	0.00E+00	1.29E-01
KR-88	Ci	1.36E-01	0.00E+00	0.00E+00	0.00E+00	1.36E-01
XE-131M	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-133	Ci	9.34E-02	2.95E-02	0.00E+00	0.00E+00	1.23E-01
XE-133M	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-135	Ci	1.27E+00	3.36E-01	1.15E-01	7.92E-02	1.80E+00
XE-135M	Ci	5.00E-01	2.36E-01	0.00E+00	0.00E+00	7.35E-01
XE-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
XE-138	Ci	0.00E+00	1.07E+01	9.52E-01	0.00E+00	1.17E+01
		-----	-----	-----	-----	-----
Totals for Period...	Ci	3.42E+00	1.13E+01	1.23E+00	7.92E-02	1.61E+01

## Iodines

I-131	Ci	3.72E-04	1.37E-04	1.62E-04	9.07E-05	7.60E-04
I-132	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	Ci	2.45E-03	1.13E-03	1.37E-03	6.93E-04	5.64E-03
I-135	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		-----	-----	-----	-----	-----
Totals for Period...	Ci	2.82E-03	1.27E-03	1.53E-03	7.84E-04	6.40E-03

## Particulates Half Life &gt;= 8 days

BA-140	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-139	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	Ci	1.79E-06	1.07E-05	0.00E+00	2.33E-06	1.48E-05
CR-51	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-59	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN-54	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	Ci	8.40E-06	1.65E-05	2.50E-07	0.00E+00	2.51E-05
SR-90	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-65	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
		-----	-----	-----	-----	-----
Totals for Period...	Ci	1.02E-05	2.72E-05	2.50E-07	2.33E-06	3.99E-05

## Tritium

H-3	Ci	3.71E+00	4.03E+00	1.92E+00	3.77E+00	1.34E+01
		-----	-----	-----	-----	-----
Totals for Period...	Ci	3.71E+00	4.03E+00	1.92E+00	3.77E+00	1.34E+01
		-----	-----	-----	-----	-----

## Carbon-14

C-14	Ci	2.73E+00	2.73E+00	2.77E+00	2.77E+00	1.10E+01
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**TABLE 1E**  
**SUPPLEMENTAL INFORMATION**  
**GASEOUS EFFLUENTS - BATCH MODE**

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Number of releases		0	0	0	0	0
Total release time	minutes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Maximum release time	minutes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Average release time	minutes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Minimum release time	minutes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**TABLE 1F  
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM**

<b>Gaseous Release Type</b>	<b>Sampling Frequency</b>	<b>Minimum Analysis Frequency</b>	<b>Type of Activity Analysis</b>	<b>Lower Limit of Detection (LLD) uCi/ml</b>
A. Main Plant Exhaust Duct	M Grab Sample	M	Principal Gamma Emitters	1.00E-04
			H-3	1.00E-06
B. Fuel Building Ventilation Exhaust Duct	M Grab Sample	M	Principal Gamma Emitters	1.00E-04
			H-3	1.00E-06
C. Radwaste Building Ventilation Exhaust Duct	M Grab Sample	M	Principal Gamma Emitters	1.00E-04
D. All Release Types as listed in A, B, & C above	Continuous	W Charcoal Sample	I-131	1.00E-12
			I-133	1.00E-10
	Continuous	W Particulate Sample	Principal Gamma Emitters (I-131, Others)	1.00E-11
	Continuous	M Composite Particulate Sample	Gross Alpha	1.00E-11
	Continuous	Q Composite Particulate Sample	Sr-89, Sr-90	1.00E-11
	Continuous	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1.00E-06

W = At least once per 7 days  
M = At least once per 31 days  
Q = At least once per 92 days

**TABLE 1G**  
**GASEOUS ANNUAL DOSE SUMMARY REPORT**

=== I&P DOSE LIMIT ANALYSIS =====

Period-Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Q1 - T.Spec Any Organ	CHILD	THYROID	2.24E-02	7.50E+00	2.99E-01
Q2 - T.Spec Any Organ	CHILD	THYROID	1.24E-02	7.50E+00	1.65E-01
Q3 - T.Spec Any Organ	CHILD	THYROID	1.17E-02	7.50E+00	1.56E-01
Q4 - T.Spec Any Organ	CHILD	THYROID	1.14E-02	7.50E+00	2.03E-01
Yr - T.Spec Any Organ	CHILD	THYROID	5.79E-02	1.50E+01	3.86E-01

Carbon-14 (Bounding calculation)

Q1 - T.Spec Any Organ	CHILD	BONE	1.17E+00	7.50E+00	1.56E+01
Q2 - T.Spec Any Organ	CHILD	BONE	1.17E+00	7.50E+00	1.56E+01
Q3 - T.Spec Any Organ	CHILD	BONE	1.18E+00	7.50E+00	1.58E+01
Q4 - T.Spec Any Organ	CHILD	BONE	1.18E+00	7.50E+00	1.58E+01
Yr - T.Spec Any Organ	CHILD	BONE	4.70E+00	1.50E+01	3.13E+01

=== NG DOSE LIMIT ANALYSIS =====

Period-Limit	Dose (mrad)	Limit (mrad)	% of Limit
Q1 - T.Spec Gamma	3.13E-03	5.00E+00	6.27E-02
Q1 - T.Spec Beta	1.63E-03	1.00E+01	1.63E-02
Q2 - T.Spec Gamma	1.25E-02	5.00E+00	2.50E-01
Q2 - T.Spec Beta	6.42E-03	1.00E+01	6.62E-02
Q3 - T.Spec Gamma	3.61E-03	5.00E+00	7.21E-02
Q3 - T.Spec Beta	1.81E-03	1.00E+01	1.81E-02
Q4 - T.Spec Gamma	7.68E-04	5.00E+00	1.54E-02
Q4 - T.Spec Beta	3.83E-04	1.00E+01	3.83E-03
Yr - T.Spec Gamma	2.00E-02	1.00E+01	2.00E-01
Yr - T.Spec Beta	1.02E-02	2.00E+01	5.12E-02

**TABLE 2A**  
**LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES**

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
<b>Fission and Activation Products</b>						
1. Total Release	Ci	0.00E+00	1.43E-05	3.10E-04	5.63E-04	8.88E-04
2. Avg. Diluted Conc. uCi/ml		0.00E+00	9.79E-12	2.21E-10	4.14E-10	1.74E-10
3. % Applicable Limit % (1)		0.00E+00	1.47E-04	7.28E-02	8.24E-02	5.71E-02
<b>Tritium</b>						
1. Total Release	Ci	1.47E+00	9.97E+00	2.07E+01	8.83E+00	4.10E+01
2. Avg. Diluted Conc. uCi/ml		1.69E-06	6.83E-06	1.48E-05	6.49E-06	8.06E-06
3. % Applicable Limit %		4.57E-04	1.02E-02	6.13E-02	1.65E-02	3.41E-02
<b>Dissolved and Entrained Gases</b>						
1. Total Release	Ci	3.66E-06	6.09E-04	1.31E-03	5.03E-04	2.79E-03
2. Avg. Diluted Conc. uCi/ml		4.20E-10	4.17E-10	9.36E-10	3.70E-10	5.48E-10
3. % Applicable Limit % (2)		2.10E-04	2.09E-04	4.68E-04	1.85E-04	2.74E-04
<b>Gross Alpha Radioactivity</b>						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>Volume of liquid waste liters</b>						
		1.62E+05	9.14E+05	2.50E+06	1.55E+06	5.13E+06
<b>Volume of dil. water liters</b>						
		8.71E+08	1.46E+09	1.40E+09	1.34E+09	5.09E+09

(1) The most limiting dose compared to the total body and critical organ limits of TRM 3.11.1.2.a.

(2) Technical Requirement 3.11.1.1 limit of 2.00E-04 uCi/ml for dissolved and entrained noble gases in liquid effluent.

**TABLE 2B**  
**LIQUID EFFLUENTS - CONTINUOUS MODE**

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
-----						
Fission and Activation Products						
** No Nuclide Activities **		.....	.....	.....	.....	.....
Tritium						
** No Nuclide Activities **		.....	.....	.....	.....	.....
Dissolved and Entrained Gases						
** No Nuclide Activities **		.....	.....	.....	.....	.....
Gross Alpha Radioactivity						
** No Nuclide Activities **		.....	.....	.....	.....	.....

**TABLE 2C**  
**LIQUID EFFLUENTS - BATCH MODE**

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Products						
CO-58	Ci	0.00E+00	0.00E+00	2.63E-06	0.00E+00	2.63E-06
CO-60	Ci	0.00E+00	1.43E-05	2.80E-04	5.02E-04	7.96E-04
MN-54	Ci	0.00E+00	0.00E+00	2.78E-05	4.85E-05	7.63E-05
NA-24	Ci	0.00E+00	0.00E+00	0.00E+00	3.72E-06	3.72E-06
ZN-65	Ci	0.00E+00	0.00E+00	0.00E+00	8.91E-06	8.91E-06
Totals for Period...	Ci	0.00E+00	1.43E-05	3.10E-04	5.63E-04	8.88E-04
Tritium						
H-3	Ci	1.47E+00	9.97E+00	2.07E+01	8.83E+00	4.10E+01
Totals for Period...	Ci	1.47E+00	9.97E+00	2.07E+01	8.83E+00	4.10E+01
Dissolved and Entrained Gases						
XE-133	Ci	9.39E-05	2.06E-04	4.17E-04	2.35E-04	9.52E-04
XE-135	Ci	2.72E-04	4.03E-04	8.74E-04	2.68E-04	1.82E-03
XE-138	Ci	0.00E+00	0.00E+00	1.61E-05	0.00E+00	1.61E-05
Totals for Period...	Ci	3.66E-04	6.09E-04	1.31E-03	5.03E-04	2.79E-03
Gross Alpha Radioactivity						
** No Nuclide Activities **		.....	.....	.....	.....	.....

**TABLE 2D**  
**EFFLUENT AND WASTE DISPOSAL REPORT**  
**SUPPLEMENTAL INFORMATION**  
**LIQUID EFFLUENTS - BATCH MODE**

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Number of releases		3	17	46	27	93
Total release time	minutes	8.69E+02	4.81E+03	1.33E+04	8.16E+03	2.72E+04
Maximum release time	minutes	3.06E+02	3.09E+02	3.41E+02	4.48E+02	4.48E+02
Average release time	minutes	2.90E+02	2.83E+02	2.90E+02	3.02E+02	2.92E+02
Minimum release time	minutes	2.71E+02	2.49E+02	2.11E+02	2.55E+02	2.11E+02

		<u>QTR 1</u>	<u>QTR 2</u>	<u>QTR 3</u>	<u>QTR 4</u>
Average Mississippi River stream flow during periods of release of effluent into a flowing stream.	ft <sup>3</sup> /sec	598,122	801,187	414,978	298,484

**TABLE 2E  
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM**

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) uCi/ml
A. Batch Waste Release (Liquid Radwaste Recovery Sample Tanks)	P Each Batch	P Each Batch	Principal Gamma Emitters: <u>except</u> for Ce-144	5.00E-07
				5.00E-06
			I-131	1.00E-06
	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	1.00E-05
	P Each Batch	M Composite	H-3	1.00E-05
			Gross Alpha	1.00E-07
	P Each Batch	Q Composite	Sr-89, Sr-90	5.00E-08
			Fe-55	1.00E-06

P = Prior to each radioactive release

M = At least once per 31 days

Q = At least once per 92 days



**TABLE 2F**  
**LIQUID ANNUAL DOSE SUMMARY REPORT**

Report for: 2013

Release ID: 10 All Liquid Release Points

Liquid Receptor

=== SITE DOSE LIMIT ANALYSIS =====

Period - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Qtr 1 - T.Spec Any Organ	ADULT	LIVER	6.85E-06	5.00E+00	1.37E-04
Qtr 1 - T.Spec Total Body	ADULT	TBODY	6.85E-06	1.50E+00	4.56E-04
Qtr 2 - T.Spec Any Organ	ADULT	GILLI	1.60E-04	5.00E+00	3.20E-03
Qtr 2 - T.Spec Total Body	ADULT	TBODY	1.54E-04	1.50E+00	1.02E-02
Qtr 3 - T.Spec Any Organ	ADULT	GILLI	4.56E-03	5.00E+00	9.12E-02
Qtr 3 - T.Spec Total Body	ADULT	TBODY	1.17E-03	1.50E+00	7.79E-02
Qtr 4 - T.Spec Any Organ	ADULT	GILLI	4.37E-03	5.00E+00	8.74E-02
Qtr 4 - T.Spec Total Body	ADULT	TBODY	5.91E-04	1.50E+00	3.94E-02
2013 - T.Spec Any Organ	ADULT	GILLI	6.73E-03	1.00E+01	6.73E-02
2013 - T.Spec Total Body	ADULT	TBODY	1.47E-03	3.00E+00	4.89E-02

**TABLE 3**  
**EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT 2013 YEAR**  
**Solid Waste and Irradiated Fuel Shipments**  
**Reporting Period from 01/01/13 to 12/31/13**

**A. SOLID WASTE SHIPPED FOR BURIAL OR DISPOSAL (NOT IRRADIATED FUEL)**

<u>1. Type of Waste</u>	UNITS	12 MONTH PERIOD	WASTE CLASS	ESTIMATED ERROR %
a. Spent resins, filter sludges, evaporator bottoms, etc.	m <sup>3</sup>	5.01E+01	A	± 25%
	Ci	4.54E+01	A	
	m <sup>3</sup>	0.00E+00	B	
	Ci	0.00E+00	B	
	m <sup>3</sup>	0.00E+00	C	
	Ci	0.00E+00	C	
b. Dry Compressible Wastes, Contaminated Equipment, Etc.	m <sup>3</sup>	3.77E+02	A	± 25%
	Ci	4.11E-01	A	
c. Irradiated Components, Control Rods, Etc.	m <sup>3</sup>			
	Ci			
d. Other (Water, EHC, Waste Oil, etc.)	m <sup>3</sup>			± 25%
	Ci			

Note: Volume considered being the total disposal volume of the container.

Radwaste Estimated Error %:

Waste types considered are processed solid waste (i.e. resin, filter media) and non-compactible/compactible dry active waste.

Possible Errors

- Volume
- Representative Sampling
- Instrument/Counting
- Dose to Curie Calculations

**EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT 2013 YEAR**  
**Solid Waste and Irradiated Fuel Shipments**  
**Reporting Period from 01/01/13 to 12/31/13**  
**Table 3 (continued)**

a. Volume Error

Level indication for processed resins can be determined to +/- 0.5 inches. This correlates to approximately 1.0%. Container manufacturer stated design tolerance allows for 1.0% deviation from container dimensions. Volume error is not applicable to dry active waste.

b. Representative Sampling Error

Sampling error for processed resins is based upon obtaining a representative sample from the waste being processed using an iso-lock sampler. Sampling error from dry active waste is based upon obtaining a representative sample from the material being packaged. This error is estimated to be +/- 10% for all waste types, which is consistent with industry standards.

c. Instrument/Counting Error

The error caused by sample geometry, counting time, sample activity and instrument background is estimated to be +/- 10%. The error for radiological survey instrumentation is estimated to be +/- 20%. This error is applicable to all waste types.

d. Dose to Curie Calculations Error

The Dose to Curie method used to calculate activity suffers from analytical accuracy in that certain important parameters are neglected. These parameters are geometry of package, measuring instrument characteristics, build-up, internal attenuation effect, and external media attenuation. An activity correction factor is applied to provide adjustment for these factors. This error is applicable to all waste types.

**2. Estimates of Major Nuclides by Waste Stream**

Resins, Filters, Evaporator Bottoms, Etc. (Min 1%)			Dry Compressible Wastes, Contaminated Equipment, Etc. (Min 1%)			Other Water, EHC, Waste Oil, Etc. (Min 1%)		
Isotope	% Abundance	Curies	Isotope	% Abundance	Curies	Isotope	% Abundance	Curies
MN-54	3.490	1.58E+00	MN-54	1.740	7.15E-03	CR-51	1.173	2.04E-04
FE-55	3.660	1.66E+00	FE-55	55.190	2.27E-01	MN-54	1.962	3.41E-04
CO-60	67.285	3.06E+01	CO-60	33.539	1.39E-01	FE-55	50.310	8.73E-03
NI-63	2.504	1.14E+00	ZR-95	1.617	6.64E-03	CO-60	33.539	5.76E-03
ZN-65	18.173	8.25E+00	NB-95	2.292	9.42E-03	ZR-95	2.636	4.57E-04
CS-137	3.845	1.75E+00	CS-137	1.981	8.14E-03	NB-95	4.352	7.55E-04
						CS-137	1.796	3.12E-04

Determined by Measurement & Correlation.  
 Packaged in Strong, Tight Liners.

No Solidification Agent or Absorbent Used.

**3. Solid Waste Disposition**

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
9	Truck	Energy Solutions (Gallaher) - Oak Ridge, TN
16	Truck	Energy Solutions (Bear Creek) - Oak Ridge, TN
5	Truck	Energy Solutions (BPF) - Barnwell, SC

**B. IRRADIATED FUEL SHIPMENTS DISPOSITION**

No Irradiated Components, Control Rods, Etc. were shipped in 2013

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
0	N/A	N/A

**TABLE 4**  
**DOSES TO A MEMBER OF THE PUBLIC INSIDE SITE BOUNDARY**  
**ASSUMPTIONS/PARAMETERS**

MEMBER OF THE PUBLIC	LOCATION	DISTANCE <sup>(1)</sup> METERS	SECTOR	DURATION (HR/YEAR) <sup>(2)</sup>
People Entering Site Without Consent	Alligator Bayou	2500	SW	40
National Guard	Activity Center	994	WNW	0 <sup>(3)</sup>
Workers staying onsite	Activity Center Trailer City	994	WNW	2400 <sup>(4)</sup>
Deer Hunters	Activity Center	994	WNW	256 <sup>(5)</sup>

- (1) The approximate distances from main plant vent exhaust to location.
- (2) Liquid dose pathway is not considered due to the nature of activities that individuals are engaged in.
- (3) National Guard/State Police are being evaluated, if applicable, for dose while stationed on site as members of the public. The adult age group is the only age group considered in this category. No National Guard in 2013.
- (4) Workers have been permitted to stay long term at the Activity Center Trailer City beginning April 10, 2007. During refueling outages additional workers were on site for about 60 days. The long term individuals will be the receptors for this pathway. For 2013, this conservative estimate is based on 12 hours per day, 4 days per week for 50 weeks, totaling 2400 hours. The adult age group is the only age group considered for this activity.
- (5) Employees are allowed to deer hunt on company property. Since the hunters are spread out all over the site, those workers are conservatively evaluated at the activity center using occupancy information provided by the Bow Club. In 2013, these worker's dose is not greater than Trailer City.

**TABLE 5**  
**DOSES TO MEMBERS OF THE PUBLIC ON SITE**  
**FROM GASEOUS RELEASES 2013**

<b><u>Location</u></b>	<b><u>Critical Organ Dose Annual (mrem)</u></b>	<b><u>Total Body Dose Annual (mrem)</u></b>	<b><u>Skin Dose Annual (mrem)</u></b>	<b><u>Annual Duration Factor</u></b>
<b>Alligator Bayou</b>	2.55E-05	1.05E-05	1.70E-05	4.57E-03
<b>Workers staying onsite</b>	3.40E-03	5.21E-03	8.43E-03	2.74E-01
<b>Deer Hunters</b>	3.62E-04	5.56E-04	8.99E-04	2.92E-02

**TABLE 6**  
**2013 YEAR METEOROLOGICAL DATA - JOINT FREQUENCY TABLES**

RIVER BEND STATION  
 JOINT FREQUENCY TABLE  
 ALL STABILITY CLASSES  
 FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 30 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	107	85	128	183	140	174	68	1	0	0	0	0	886
NNE	85	67	100	198	132	129	10	0	0	0	0	0	721
NE	74	68	76	153	150	94	3	0	0	0	0	0	618
ENE	58	73	57	107	76	60	3	0	0	0	0	0	434
E	55	54	58	102	75	35	0	0	0	0	0	0	379
ESE	24	41	82	135	88	50	2	0	0	0	0	0	422
SE	16	48	114	251	236	195	26	0	0	0	0	0	886
SSE	10	31	65	195	155	220	160	5	0	0	0	0	841
S	8	20	39	109	113	168	86	11	0	0	0	0	554
SSW	9	18	45	88	57	40	32	0	0	0	0	0	289
SW	12	25	39	43	36	30	11	0	0	0	0	0	196
WSW	16	37	30	60	50	50	6	0	0	0	0	0	249
W	26	34	35	59	71	72	12	0	0	0	0	0	309
WNW	46	53	41	57	49	59	20	1	0	0	0	0	326
NW	90	80	42	79	67	115	69	6	0	0	0	0	548
NNW	98	92	63	92	81	168	121	1	0	0	0	0	716
<b>TOTAL</b>	<b>734</b>	<b>826</b>	<b>1014</b>	<b>1911</b>	<b>1576</b>	<b>1659</b>	<b>629</b>	<b>25</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8374</b>

NUMBER OF CALMS: 120

NUMBER OF INVALID HOURS: 266

NUMBER OF VALID HOURS: 8494

TOTAL HOURS FOR THE PERIOD: 8760



RIVER BEND STATION  
JOINT FREQUENCY TABLE

STABILITY CLASS A

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 30 FOOT

WIND SPEED (METERS/SECOND)

WIND DIR	.22- .50	.51- .75	.76- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 5.0	5.1- 7.0	7.1- 10.0	10.1- 13.0	13.1- 18.0	>18	TOT.
N	0	0	1	11	12	32	24	1	0	0	0	0	81
NNE	0	0	1	10	29	40	3	0	0	0	0	0	83
NE	0	0	3	18	43	35	2	0	0	0	0	0	101
ENE	0	0	0	13	23	28	0	0	0	0	0	0	64
E	0	0	2	10	25	20	0	0	0	0	0	0	57
ESE	0	1	0	17	34	17	0	0	0	0	0	0	69
SE	0	0	2	18	48	71	8	0	0	0	0	0	147
SSE	0	0	0	12	24	53	46	1	0	0	0	0	136
S	0	0	0	6	12	44	30	3	0	0	0	0	95
SSW	0	0	1	9	16	9	13	0	0	0	0	0	48
SW	0	0	0	3	10	11	4	0	0	0	0	0	28
WSW	0	0	0	6	17	20	1	0	0	0	0	0	44
W	0	0	0	10	35	49	0	0	0	0	0	0	94
WNW	0	0	0	1	19	29	4	0	0	0	0	0	53
NW	0	0	0	3	13	28	15	4	0	0	0	0	63
NNW	0	0	0	3	19	27	31	1	0	0	0	0	81
<b>TOTAL</b>	<b>0</b>	<b>1</b>	<b>10</b>	<b>150</b>	<b>379</b>	<b>513</b>	<b>181</b>	<b>10</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1244</b>

NUMBER OF CALMS: 1

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 1245

TOTAL HOURS FOR THE PERIOD: 1245

RIVER BEND STATION  
 JOINT FREQUENCY TABLE

STABILITY CLASS B

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 30 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	0	0	0	3	9	10	6	0	0	0	0	0	28
NNE	0	0	1	4	2	4	2	0	0	0	0	0	13
NE	0	0	0	7	8	0	0	0	0	0	0	0	15
ENE	0	1	0	3	2	2	0	0	0	0	0	0	8
E	0	0	2	2	4	0	0	0	0	0	0	0	8
ESE	0	0	1	7	2	0	0	0	0	0	0	0	10
SE	0	0	1	3	12	13	1	0	0	0	0	0	30
SSE	0	0	1	5	3	8	9	0	0	0	0	0	26
S	0	0	0	6	5	9	3	1	0	0	0	0	24
SSW	0	0	1	1	2	2	1	0	0	0	0	0	7
SW	0	0	0	3	9	1	3	0	0	0	0	0	16
WSW	0	0	1	4	11	3	0	0	0	0	0	0	19
W	0	0	0	8	15	1	2	0	0	0	0	0	26
WNW	0	0	1	6	11	3	3	0	0	0	0	0	24
NW	0	0	0	3	7	6	8	0	0	0	0	0	24
NNW	0	0	1	2	5	10	2	0	0	0	0	0	20
TOTAL	0	1	10	67	107	72	40	1	0	0	0	0	298

NUMBER OF CALMS: 0

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 298

TOTAL HOURS FOR THE PERIOD: 298

RIVER BEND STATION  
 JOINT FREQUENCY TABLE  
 STABILITY CLASS C

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 30 FOOT

WIND SPEED (METERS/SECOND)

WIND DIR	.22- .50	.51- .75	.76- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 5.0	5.1- 7.0	7.1- 10.0	10.1- 13.0	13.1- 18.0	>18	TOT.
N	0	0	0	9	15	19	6	0	0	0	0	0	49
NNE	0	0	1	8	9	6	2	0	0	0	0	0	26
NE	0	0	1	10	8	2	0	0	0	0	0	0	21
ENE	0	0	2	6	5	3	0	0	0	0	0	0	16
E	0	1	2	14	3	0	0	0	0	0	0	0	20
ESE	0	0	1	8	1	1	1	0	0	0	0	0	12
SE	0	1	0	12	27	10	4	0	0	0	0	0	54
SSE	0	0	1	10	9	15	18	1	0	0	0	0	54
S	0	0	0	3	12	19	8	2	0	0	0	0	44
SSW	0	0	1	7	7	4	5	0	0	0	0	0	24
SW	0	0	1	10	6	8	1	0	0	0	0	0	26
WSW	0	0	1	16	7	14	1	0	0	0	0	0	39
W	0	0	0	11	10	9	3	0	0	0	0	0	33
WNW	0	0	1	7	3	7	3	0	0	0	0	0	21
NW	0	0	0	13	3	7	16	0	0	0	0	0	39
NNW	0	0	1	6	10	23	15	0	0	0	0	0	55
TOTAL	0	2	13	150	135	147	83	3	0	0	0	0	533

NUMBER OF CALMS: 0

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 533

TOTAL HOURS FOR THE PERIOD: 533

RIVER BEND STATION  
 JOINT FREQUENCY TABLE

STABILITY CLASS D

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 30 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	0	2	17	42	61	98	25	0	0	0	0	0	245
NNE	1	1	8	27	46	44	1	0	0	0	0	0	128
NE	0	4	12	14	26	20	0	0	0	0	0	0	76
ENE	0	2	7	16	5	5	1	0	0	0	0	0	36
E	0	1	5	22	11	5	0	0	0	0	0	0	44
ESE	0	3	7	26	16	6	0	0	0	0	0	0	58
SE	0	3	13	43	50	34	5	0	0	0	0	0	148
SSE	0	1	4	15	16	44	40	1	0	0	0	0	121
S	0	0	4	11	14	45	23	3	0	0	0	0	100
SSW	1	2	2	14	9	12	10	0	0	0	0	0	50
SW	0	0	6	8	4	9	2	0	0	0	0	0	29
WSW	1	1	6	15	11	13	4	0	0	0	0	0	51
W	0	2	13	18	6	8	1	0	0	0	0	0	48
WNW	0	0	7	24	7	9	9	1	0	0	0	0	57
NW	0	2	7	21	28	60	26	2	0	0	0	0	146
NNW	0	1	8	32	29	71	64	0	0	0	0	0	205
TOTAL	3	25	126	348	339	483	211	7	0	0	0	0	1542

NUMBER OF CALMS: 1

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 1543

TOTAL HOURS FOR THE PERIOD: 1543

RIVER BEND STATION  
 JOINT FREQUENCY TABLE

STABILITY CLASS E

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 30 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	5	8	18	65	41	15	7	0	0	0	0	0	159
NNE	7	19	34	102	46	34	2	0	0	0	0	0	244
NE	9	19	24	59	61	36	1	0	0	0	0	0	209
ENE	5	10	26	46	34	21	2	0	0	0	0	0	144
E	9	14	25	44	29	10	0	0	0	0	0	0	131
ESE	5	14	46	65	35	25	1	0	0	0	0	0	191
SE	5	18	59	154	95	67	8	0	0	0	0	0	406
SSE	2	8	25	106	99	100	46	2	0	0	0	0	388
S	2	10	16	70	66	51	22	2	0	0	0	0	239
SSW	4	10	23	46	23	13	3	0	0	0	0	0	122
SW	5	11	18	16	7	1	1	0	0	0	0	0	59
WSW	4	17	13	18	4	0	0	0	0	0	0	0	56
W	1	11	13	11	4	5	6	0	0	0	0	0	51
WNW	5	11	20	16	8	10	1	0	0	0	0	0	71
NW	5	11	17	27	15	14	4	0	0	0	0	0	93
NNW	3	3	16	31	18	36	9	0	0	0	0	0	116
TOTAL	76	194	393	876	585	438	113	4	0	0	0	0	2679

NUMBER OF CALMS: 7

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 2686

TOTAL HOURS FOR THE PERIOD: 2686

RIVER BEND STATION  
JOINT FREQUENCY TABLE

STABILITY CLASS F

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 30 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	12	20	56	33	1	0	0	0	0	0	0	0	122
NNE	13	19	45	42	0	1	0	0	0	0	0	0	120
NE	13	15	22	42	4	1	0	0	0	0	0	0	97
ENE	13	18	11	17	7	1	0	0	0	0	0	0	67
E	25	11	5	7	3	0	0	0	0	0	0	0	51
ESE	10	15	18	9	0	1	0	0	0	0	0	0	53
SE	7	16	32	21	4	0	0	0	0	0	0	0	80
SSE	6	15	31	45	4	0	1	0	0	0	0	0	102
S	4	9	19	12	4	0	0	0	0	0	0	0	48
SSW	4	3	16	10	0	0	0	0	0	0	0	0	33
SW	6	11	11	3	0	0	0	0	0	0	0	0	31
WSW	6	11	4	1	0	0	0	0	0	0	0	0	22
W	16	12	6	1	0	0	0	0	0	0	0	0	35
WNW	17	11	5	3	0	0	0	0	0	0	0	0	36
NW	24	12	10	11	1	0	0	0	0	0	0	0	58
NNW	14	15	11	11	0	1	0	0	0	0	0	0	52
<b>TOTAL</b>	<b>190</b>	<b>213</b>	<b>302</b>	<b>268</b>	<b>28</b>	<b>5</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1007</b>

NUMBER OF CALMS: 30

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 1037

TOTAL HOURS FOR THE PERIOD: 1037

RIVER BEND STATION  
JOINT FREQUENCY TABLE

STABILITY CLASS G

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 30 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	90	55	36	20	1	0	0	0	0	0	0	0	202
NNE	64	28	10	5	0	0	0	0	0	0	0	0	107
NE	52	30	14	3	0	0	0	0	0	0	0	0	99
ENE	40	42	11	6	0	0	0	0	0	0	0	0	99
E	21	27	17	3	0	0	0	0	0	0	0	0	68
ESE	9	8	9	3	0	0	0	0	0	0	0	0	29
SE	4	10	7	0	0	0	0	0	0	0	0	0	21
SSE	2	7	3	2	0	0	0	0	0	0	0	0	14
S	2	1	0	1	0	0	0	0	0	0	0	0	4
SSW	0	3	1	1	0	0	0	0	0	0	0	0	5
SW	1	3	3	0	0	0	0	0	0	0	0	0	7
WSW	5	8	5	0	0	0	0	0	0	0	0	0	18
W	9	9	3	0	1	0	0	0	0	0	0	0	22
WNW	24	31	7	0	1	1	0	0	0	0	0	0	64
NW	61	55	8	1	0	0	0	0	0	0	0	0	125
NNW	81	73	26	7	0	0	0	0	0	0	0	0	187
TOTAL	465	390	160	52	3	1	0	0	0	0	0	0	1071

NUMBER OF CALMS: 81

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 1152

TOTAL HOURS FOR THE PERIOD: 1152

RIVER BEND STATION  
JOINT FREQUENCY TABLE

ALL STABILITY CLASSES

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 150 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	0	2	8	34	45	228	261	30	1	0	0	0	609
NNE	2	4	11	31	77	265	327	13	0	0	0	0	730
NE	1	2	9	28	60	201	407	24	1	0	0	0	733
ENE	1	4	6	41	68	163	273	51	3	0	0	0	610
E	1	6	4	50	97	161	186	68	11	0	0	0	584
ESE	2	6	9	29	37	258	555	103	4	0	0	0	1003
SE	1	4	6	31	35	149	300	47	2	0	0	0	575
SSE	0	6	3	17	35	144	273	114	9	0	0	0	601
S	0	0	4	23	46	167	276	41	18	0	0	0	575
SSW	3	3	6	19	66	154	107	16	1	0	0	0	375
SW	1	5	11	30	39	107	49	4	1	0	0	0	247
WSW	0	3	10	33	78	151	59	0	0	0	0	0	334
W	3	3	4	41	72	173	72	19	1	0	0	0	388
WNW	1	2	8	18	40	115	79	23	7	0	0	0	293
NW	1	2	5	26	41	94	135	35	1	0	0	0	340
NNW	0	1	4	16	45	138	231	58	2	0	0	0	495
TOTAL	17	53	108	467	881	2668	3590	646	62	0	0	0	8492

NUMBER OF CALMS: 2

NUMBER OF INVALID HOURS: 266

NUMBER OF VALID HOURS: 8494

TOTAL HOURS FOR THE PERIOD: 8760



RIVER BEND STATION  
 JOINT FREQUENCY TABLE

STABILITY CLASS A

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 150 FOOT

WIND SPEED (METERS/SECOND)

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOT.
N	0	0	0	2	4	15	30	15	1	0	0	0	67
NNE	0	0	1	4	9	26	25	2	0	0	0	0	67
NE	0	0	0	4	5	45	51	4	0	0	0	0	109
ENE	0	0	1	3	9	19	62	7	0	0	0	0	101
E	0	0	0	7	10	23	55	9	0	0	0	0	104
ESE	0	0	0	1	7	45	73	13	1	0	0	0	140
SE	0	0	0	5	6	34	24	10	0	0	0	0	79
SSE	0	0	0	1	6	13	48	28	3	0	0	0	99
S	0	0	0	4	5	23	47	5	3	0	0	0	87
SSW	0	0	0	2	9	10	12	8	0	0	0	0	41
SW	0	0	1	2	1	12	7	0	0	0	0	0	23
WSW	0	0	0	1	14	26	9	0	0	0	0	0	50
W	0	0	0	3	8	57	35	0	0	0	0	0	103
WNW	0	0	0	2	7	27	12	5	4	0	0	0	57
NW	0	0	0	1	6	18	20	8	0	0	0	0	53
NNW	0	0	0	1	7	21	24	11	1	0	0	0	65
TOTAL	0	0	3	43	113	414	534	125	13	0	0	0	1245

NUMBER OF CALMS: 0

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 1245

TOTAL HOURS FOR THE PERIOD: 1245

RIVER BEND STATION  
JOINT FREQUENCY TABLE

STABILITY CLASS B

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 150 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	0	0	0	1	1	6	11	2	0	0	0	0	21
NNE	0	0	0	1	4	4	6	1	0	0	0	0	16
NE	0	0	0	2	4	5	7	0	0	0	0	0	18
ENE	0	1	0	1	1	6	5	1	0	0	0	0	15
E	0	0	0	0	5	3	1	2	0	0	0	0	11
ESE	0	0	0	1	0	8	7	6	0	0	0	0	22
SE	0	0	1	3	2	5	11	1	0	0	0	0	23
SSE	0	0	0	0	1	1	7	6	0	0	0	0	15
S	0	0	0	2	2	5	12	0	1	0	0	0	22
SSW	0	0	0	1	2	2	1	2	0	0	0	0	8
SW	0	0	0	5	3	4	3	0	0	0	0	0	15
WSW	0	0	0	3	13	9	2	0	0	0	0	0	27
W	0	0	0	3	10	16	3	2	0	0	0	0	34
WNW	0	0	0	1	3	5	5	4	0	0	0	0	18
NW	0	0	1	0	4	6	7	3	0	0	0	0	21
NNW	0	0	0	1	1	6	4	0	0	0	0	0	12
<b>TOTAL</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>25</b>	<b>56</b>	<b>91</b>	<b>92</b>	<b>30</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>298</b>

NUMBER OF CALMS: 0

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 298

TOTAL HOURS FOR THE PERIOD: 298

RIVER BEND STATION  
 JOINT FREQUENCY TABLE

STABILITY CLASS C

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 150 FOOT

WIND SPEED (METERS/SECOND)

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOT.
N	0	0	0	3	8	15	19	2	0	0	0	0	47
NNE	0	0	0	2	4	18	8	1	0	0	0	0	33
NE	0	0	1	1	3	11	6	0	0	0	0	0	22
ENE	0	0	0	2	5	6	8	3	0	0	0	0	24
E	0	0	0	3	2	10	5	0	0	0	0	0	20
ESE	0	1	0	0	2	10	19	6	0	0	0	0	38
SE	0	0	1	3	2	13	13	4	1	0	0	0	37
SSE	0	0	0	0	4	5	17	12	3	0	0	0	41
S	0	0	0	2	4	15	18	7	1	0	0	0	47
SSW	0	0	1	3	8	2	6	1	0	0	0	0	21
SW	0	0	0	6	5	7	6	0	0	0	0	0	24
WSW	0	0	0	5	8	15	15	0	0	0	0	0	43
W	0	0	0	6	7	11	8	3	0	0	0	0	35
WNW	0	0	0	3	6	3	9	4	0	0	0	0	25
NW	0	0	0	6	5	4	11	8	0	0	0	0	34
NNW	0	0	0	5	2	7	21	7	0	0	0	0	42
TOTAL	0	1	3	50	75	152	189	58	5	0	0	0	533

NUMBER OF CALMS: 0

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 533

TOTAL HOURS FOR THE PERIOD: 533

RIVER BEND STATION  
 JOINT FREQUENCY TABLE

STABILITY CLASS D

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 150 FOOT

WIND SPEED (METERS/SECOND)

WIND DIR	.22-.50	.51-.75	.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOT.
N	0	0	4	12	20	74	108	9	0	0	0	0	227
NNE	0	3	2	10	17	54	62	2	0	0	0	0	150
NE	0	0	3	9	9	24	39	3	0	0	0	0	87
ENE	0	0	2	6	6	14	25	7	0	0	0	0	60
E	0	0	0	3	6	19	26	8	0	0	0	0	62
ESE	1	1	0	6	5	37	72	17	0	0	0	0	139
SE	0	1	0	2	4	10	37	7	1	0	0	0	62
SSE	0	0	0	1	3	9	44	30	1	0	0	0	88
S	0	0	0	4	8	19	50	12	6	0	0	0	99
SSW	0	1	4	3	4	18	17	3	0	0	0	0	50
SW	0	0	1	6	7	10	10	3	1	0	0	0	38
WSW	0	0	1	7	10	17	15	0	0	0	0	0	50
W	0	0	1	11	14	18	8	5	1	0	0	0	58
WNW	1	0	3	4	9	19	27	6	2	0	0	0	71
NW	0	0	1	12	11	25	55	15	1	0	0	0	120
NNW	0	0	3	3	19	36	90	30	1	0	0	0	182
<b>TOTAL</b>	<b>2</b>	<b>6</b>	<b>25</b>	<b>99</b>	<b>152</b>	<b>403</b>	<b>685</b>	<b>157</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1543</b>

NUMBER OF CALMS: 0

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 1543

TOTAL HOURS FOR THE PERIOD: 1543

RIVER BEND STATION  
JOINT FREQUENCY TABLE

STABILITY CLASS E

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 150 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	0	1	2	6	5	64	48	2	0	0	0	0	128
NNE	1	0	4	6	12	78	134	7	0	0	0	0	242
NE	1	1	1	4	22	46	149	11	1	0	0	0	236
ENE	0	3	2	11	19	47	104	21	3	0	0	0	210
E	0	3	1	12	23	49	80	46	11	0	0	0	225
ESE	0	0	4	10	14	70	264	57	3	0	0	0	422
SE	1	1	0	6	9	33	127	25	0	0	0	0	202
SSE	0	4	2	3	5	48	140	38	2	0	0	0	242
S	0	0	1	1	7	56	132	17	7	0	0	0	221
SSW	1	2	1	3	13	59	58	2	1	0	0	0	140
SW	0	1	3	2	10	30	19	1	0	0	0	0	66
WSW	0	1	3	4	5	39	12	0	0	0	0	0	64
W	1	2	0	7	12	28	15	9	0	0	0	0	74
WNW	0	0	2	2	7	24	18	2	1	0	0	0	56
NW	0	0	0	1	6	12	26	1	0	0	0	0	46
NNW	0	1	1	1	8	29	62	10	0	0	0	0	112
TOTAL	5	20	27	79	177	712	1388	249	29	0	0	0	2686

NUMBER OF CALMS: 0

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 2686

TOTAL HOURS FOR THE PERIOD: 2686

RIVER BEND STATION  
 JOINT FREQUENCY TABLE

STABILITY CLASS F

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 150 FOOT

WIND SPEED (METERS/SECOND)

WIND	.22-	.51-	.76-	1.1-	1.6-	2.1-	3.1-	5.1-	7.1-	10.1-	13.1-	>18	TOT.
DIR	.50	.75	1.0	1.5	2.0	3.0	5.0	7.0	10.0	13.0	18.0		
N	0	0	0	2	2	26	11	0	0	0	0	0	41
NNE	0	0	1	1	13	45	54	0	0	0	0	0	114
NE	0	0	0	1	5	33	93	4	0	0	0	0	136
ENE	0	0	0	7	16	32	48	12	0	0	0	0	115
E	0	0	2	9	16	22	15	2	0	0	0	0	66
ESE	0	2	1	4	2	42	97	4	0	0	0	0	152
SE	0	0	1	3	3	25	58	0	0	0	0	0	90
SSE	0	1	1	5	5	30	8	0	0	0	0	0	50
S	0	0	1	4	7	28	15	0	0	0	0	0	55
SSW	0	0	0	3	8	26	10	0	0	0	0	0	47
SW	0	0	1	3	9	22	4	0	0	0	0	0	39
WSW	0	2	1	5	12	23	1	0	0	0	0	0	44
W	0	0	0	2	8	13	1	0	0	0	0	0	24
WNW	0	0	0	1	3	9	2	1	0	0	0	0	16
NW	0	1	0	0	2	7	7	0	0	0	0	0	17
NNW	0	0	0	3	2	13	13	0	0	0	0	0	31
<b>TOTAL</b>	<b>0</b>	<b>6</b>	<b>9</b>	<b>53</b>	<b>113</b>	<b>396</b>	<b>437</b>	<b>23</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1037</b>

NUMBER OF CALMS: 0

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 1037

TOTAL HOURS FOR THE PERIOD: 1037

RIVER BEND STATION  
JOINT FREQUENCY TABLE

STABILITY CLASS G

FROM 1/01/13 0:00 TO 12/31/13 23:00

PRIMARY SENSORS - 150 FOOT

WIND SPEED (METERS/SECOND)

WIND DIR	.22- .50	.51- .75	.76- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 5.0	5.1- 7.0	7.1- 10.0	10.1- 13.0	13.1- 18.0	>18	TOT.
N	0	1	2	8	5	28	34	0	0	0	0	0	78
NNE	1	1	3	7	18	40	38	0	0	0	0	0	108
NE	0	1	4	7	12	37	62	2	0	0	0	0	125
ENE	1	0	1	11	12	39	21	0	0	0	0	0	85
E	1	3	1	16	35	35	4	1	0	0	0	0	96
ESE	1	2	4	7	7	46	23	0	0	0	0	0	90
SE	0	2	3	9	9	29	30	0	0	0	0	0	82
SSE	0	1	0	7	11	38	9	0	0	0	0	0	66
S	0	0	2	6	13	21	2	0	0	0	0	0	44
SSW	2	0	0	4	22	37	3	0	0	0	0	0	68
SW	1	4	5	6	4	22	0	0	0	0	0	0	42
WSW	0	0	5	8	16	22	5	0	0	0	0	0	56
W	2	1	3	9	13	30	2	0	0	0	0	0	60
WNW	0	2	3	5	5	28	6	1	0	0	0	0	50
NW	1	1	3	6	7	22	9	0	0	0	0	0	49
NNW	0	0	0	2	6	26	17	0	0	0	0	0	51
TOTAL	10	19	39	118	195	500	265	4	0	0	0	0	1150

NUMBER OF CALMS: 2

NUMBER OF INVALID HOURS: 0

NUMBER OF VALID HOURS: 1152

TOTAL HOURS FOR THE PERIOD: 1152

**TABLE 7  
ATMOSPHERIC DISPERSION AND DEPOSITION RATES FOR  
THE MAXIMUM INDIVIDUAL DOSE CALCULATIONS**

Analysis	Location (meters)	Ground Level Releases	Mixed Mode Releases
Gamma air dose (3) and Beta Air Dose	994 m WNW (Containment)	CHI/Q - 421.0	CHI/Q - 33.1
Maximum Receptor (4)	994 m WNW	CHI/Q - 421.0	CHI/Q - 33.1
Resident		D/Q - 50.3	D/Q - 18.0
Garden			
Meat animal			
Immersion			
Milk animal (5)	7,000 m WNW	CHI/Q - 3.58 D/Q - 0.38	CHI/Q - .870 D/Q - .223
Other on-site Receptors	115 m ENE	CHI/Q - 5977.0 D/Q - 529.7	CHI/Q - 407.5 D/Q - 46.9
	275 m N	CHI/Q - 1644.0 D/Q - 345.6	CHI/Q - 169.1 D/Q - 68.4
	2500 SW	CHI/Q - 34.45 D/Q - 3.35	CHI/Q - 4.65 D/Q - 1.40

Notes:

(1) All CHI/Q =  $10^{-7}$  sec/m<sup>3</sup>

(2) All D/Q =  $10^{-9}$  m<sup>-2</sup>

(3) Maximum offsite location (property boundary) with highest CHI/Q (unoccupied).

(4) Maximum hypothetical occupied offsite location with highest CHI/Q and D/Q.

(5) No milk animal within 5 miles radius, hypothetical location in worst sector.

(6) Other onsite receptors

(7) Revisions to X/Q and D/Q can be performed using NUREG/CR-2919, XOQDOQ, Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations



**TABLE 8**  
**GROUNDWATER MONITORING WELL SAMPLE RESULTS**

**GROUND WATER SAMPLES ( H-3) - RBS**

<b>LAB ID</b>	<b>LOCATION</b>	<b>LLD (pCi/l) DATE</b>	<b>3000 TRITIUM</b>
L53318-1	MW-131	1/16/2013	< 645
L53318-2	MW-151	1/16/2013	< 635
L53318-3	MW-151	1/16/2013	< 630
L53318-4	MW-153	1/16/2013	< 621
L53468-1	PZ-01	1/29/2013	16000
L53468-10	MW-139	1/30/2013	1260
L53468-12	MW-141	1/29/2013	< 565
L53468-14	MW-146	1/30/2013	19600
L53468-15	MW-146	1/30/2013	20400
L53468-17	MW-151	1/29/2013	976
L53468-18	MW-124	1/29/2013	402000
L53468-19	MW-125	1/29/2013	598000
L53468-2	MW-103	1/29/2013	< 670
L53468-20	MW-126	1/29/2013	3520
L53468-3	MW-110	1/29/2013	51700
L53468-4	MW-118	1/29/2013	4770
L53468-5	MW-112	1/29/2013	4820
L53468-6	MW-112	1/29/2013	4950
L53468-7	MW-114	1/29/2013	2470
L53468-8	MW-137	1/29/2013	33300
L53468-9	MW-116	1/29/2013	27800
L53529-1	MW-10	1/30/2013	< 513
L53529-10	MW-13	1/30/2013	< 506
L53529-11	MW-128	1/30/2013	< 510
L53529-12	MW-132	1/30/2013	< 521
L53529-13	MW-134	1/30/2013	< 512
L53529-15	MW-19	1/31/2013	< 517
L53529-16	MW-18	1/31/2013	< 515
L53529-2	MW-06	1/30/2013	< 505
L53529-3	MW-102	1/30/2013	< 509
L53529-4	MW-153	1/30/2013	< 505
L53529-5	MW-08	1/30/2013	< 507
L53529-6	MW-100	1/30/2013	< 501
L53529-7	MW-131	1/30/2013	< 515
L53529-8	MW-131	1/30/2013	< 707
L53544-1	PZ-02	1/31/2013	< 644
L53544-10	MW-120	1/30/2013	< 626
L53544-11	MW-120	1/30/2013	< 632
L53544-12	MW-108	1/30/2013	< 657
L53544-13	MW-104	1/30/2013	< 635
L53544-14	PZ-03	1/29/2013	< 636
L53544-15	MW-148	1/30/2013	< 643
L53544-16	MW-144	1/30/2013	< 624

<b>LAB ID</b>	<b>LOCATION</b>	<b>LLD (pCi/l) DATE</b>	<b>3000 TRITIUM</b>
L53544-17	MW-142	1/30/2013	< 641
L53544-18	SW-101	1/31/2013	< 629
L53544-19	SW-102	1/31/2013	< 635
L53544-20	SW-103	1/31/2013	< 643
L53544-21	SW-104	1/31/2013	< 625
L53544-3	MW-111	1/30/2013	< 643
L53544-4	MW-04	1/30/2013	< 641
L53544-5	MW-122R	1/30/2013	< 641
L53544-6	MW-02	1/30/2013	< 639
L53544-7	MW-106	1/30/2013	< 651
L53544-8	MW-106	1/30/2013	< 632
L53544-9	MW-107	1/30/2013	< 635
L54497-1	MW-114	4/30/2013	2920
L54497-10	MW-141	4/30/2013	< 613
L54497-11	MW-141	4/30/2013	< 621
L54497-12	MW-151	4/30/2013	< 627
L54497-13	MW-126	4/30/2013	2090
L54497-14	MW-124	4/30/2013	121000
L54497-15	MW-125	4/30/2013	585000
L54497-16	MW-146	5/1/2013	22600
L54497-17	MW-110	5/1/2013	57000
L54497-2	MW-112	4/30/2013	5010
L54497-3	MW-137	4/30/2013	33200
L54497-4	MW-137	4/30/2013	30000
L54497-5	MW-116	4/30/2013	26500
L54497-6	MW-139	4/30/2013	1850
L54497-7	MW-118	4/30/2013	5650
L54497-8	PZ-01	4/30/2013	15800
L54497-9	MW-103	4/30/2013	877
L54549-1	MW-128	5/1/2013	< 523
L54549-10	MW-142	5/1/2013	< 541
L54549-11	MW-144	5/1/2013	711
L54549-12	MW-148	5/1/2013	< 527
L54549-13	MW-02	5/2/2013	< 534
L54549-14	MW-104	5/2/2013	< 528
L54549-17	MW-04	5/1/2013	< 532
L54549-18	MW-122R	5/1/2013	< 536
L54549-2	MW-128	5/1/2013	< 523
L54549-3	MW-100	5/1/2013	< 520
L54549-4	MW-131	5/1/2013	< 524
L54549-5	MW-13	5/1/2013	< 529
L54549-6	MW-132	5/1/2013	< 517
L54549-7	MW-134	5/1/2013	< 525
L54575-1	MW-102	5/1/2013	< 534
L54575-3	SW-101	5/1/2013	< 521
L54575-4	SW-102	5/1/2013	< 525

<b>LAB ID</b>	<b>LOCATION</b>	<b>LLD (pCi/l) DATE</b>	<b>3000 TRITIUM</b>
L54575-5	SW-103	5/1/2013	< 533
L54575-6	SW-104	5/1/2013	< 538
L54583-10	MW-06	5/1/2013	< 648
L54583-3	PZ-03	4/30/2013	< 656
L54583-4	PZ-03	4/30/2013	< 640
L54583-5	MW-19	5/1/2013	< 642
L54583-6	MW-18	5/1/2013	< 655
L54583-7	MW-08	5/1/2013	< 650
L54583-8	MW-153	5/1/2013	< 643
L54583-9	MW-10	5/1/2013	< 650
L54584-1	MW-111	5/1/2013	< 642
L54584-2	MW-111	5/1/2013	< 658
L54584-3	MW-120	5/1/2013	< 642
L54584-4	PZ-02	5/1/2013	< 643
L54584-5	MW-108	5/1/2013	< 624
L54584-6	MW-106	5/1/2013	< 637
L54584-7	MW-107	5/1/2013	< 636
L55575-1	PZ-01	7/30/2013	18100
L55575-10	MW-116	7/30/2013	6680
L55575-11	MW-139	7/30/2013	1790
L55575-12	MW-116	7/30/2013	6540
L55575-13	MW-151	7/30/2013	< 656
L55575-15	MW-146	7/31/2013	20300
L55575-16	MW-144	7/31/2013	< 662
L55575-17	MW-124	7/31/2013	60900
L55575-18	MW-125	7/31/2013	502000
L55575-19	MW-126	7/31/2013	1660
L55575-2	MW-103	7/30/2013	< 646
L55575-3	MW-103	7/30/2013	< 658
L55575-4	MW-118	7/30/2013	5650
L55575-5	MW-110	7/30/2013	50700
L55575-6	MW-141	7/30/2013	< 627
L55575-7	MW-114	7/30/2013	1850
L55575-8	MW-112	7/30/2013	11300
L55575-9	MW-137	7/30/2013	24100
L55591-10	SW-103	7/31/2013	< 727
L55591-11	MW-111	7/31/2013	< 732
L55591-12	MW-106	7/31/2013	< 739
L55591-13	MW-107	7/31/2013	< 711
L55591-14	MW-108	7/31/2013	< 720
L55591-15	MW-02	7/31/2013	< 718
L55591-16	MW-02	7/31/2013	< 725
L55591-17	MW-04	7/31/2013	< 726
L55591-18	MW-122R	7/31/2013	< 729
L55591-19	MW-120	7/31/2013	< 741
L55591-2	MW-10	7/31/2013	< 728

LAB ID	LOCATION	LLD (pCi/l) DATE	3000 TRITIUM
L55591-20	PZ-02	7/31/2013	< 721
L55591-21	MW-142	7/31/2013	< 726
L55591-22	MW-148	7/31/2013	< 725
L55591-23	SW-102	8/1/2013	< 725
L55591-24	SW-101	8/1/2013	< 733
L55591-25	MW-104	8/1/2013	< 733
L55591-27	MW-128	8/1/2013	< 718
L55591-28	MW-134	8/1/2013	< 712
L55591-29	PZ-03	8/1/2013	< 733
L55591-3	MW-06	7/31/2013	< 741
L55591-30	MW-100	8/1/2013	< 738
L55591-31	MW-100	8/1/2013	< 736
L55591-32	MW-131	8/1/2013	< 731
L55591-33	MW-131	8/1/2013	< 718
L55591-35	MW-132	8/1/2013	< 715
L55591-36	MW-13	8/1/2013	< 732
L55591-4	MW-102	7/31/2013	< 730
L55591-5	MW-153	7/31/2013	< 725
L55591-6	MW-08	7/31/2013	< 706
L55591-7	MW-18	7/31/2013	< 716
L55591-8	MW-19	7/31/2013	< 730
L56679-1	MW-05	10/23/2013	< 546
L56679-2	MW-20	10/24/2013	< 548
L56679-3	MW-07	10/23/2013	< 544
L56679-4	MW-09	10/23/2013	< 543
L56775-1	MW-21	10/31/2013	< 560
L56806-1	MW-14	11/6/2013	< 543
L56806-2	MW-13	11/6/2013	< 547
L56806-3	MW-12	11/6/2013	< 542
L56806-4	MW-01	11/5/2013	< 538
L56806-5	MW-15	11/5/2013	< 539
L56955-1	MW-126	11/21/2013	< 588
L56955-10	MW-116	11/20/2013	9890
L56955-11	MW-137	11/19/2013	24900
L56955-12	MW-137	11/19/2013	21400
L56955-13	MW-141	11/20/2013	< 593
L56955-14	MW-110	11/20/2013	75000
L56955-15	MW-118	11/20/2013	4470
L56955-16	MW-118	11/20/2013	2970
L56955-17	MW-144	11/20/2013	< 580
L56955-18	MW-146	11/20/2013	99900
L56955-19	MW-147	11/20/2013	28000
L56955-2	MW-151	11/19/2013	< 568
L56955-20	MW-158	11/20/2013	596000
L56955-21	MW-159	11/20/2013	3040
L56955-22	MW-155	11/21/2013	129000

<b>LAB ID</b>	<b>LOCATION</b>	<b>LLD (pCi/l) DATE</b>	<b>3000 TRITIUM</b>
L56955-23	MW-156	11/21/2013	5370
L56955-24	MW-157	11/21/2013	217000
L56955-3	MW-124	11/19/2013	22000
L56955-4	MW-125	11/19/2013	503000
L56955-5	PZ-01	11/19/2013	23500
L56955-6	MW-103	11/19/2013	< 587
L56955-7	MW-112	11/19/2013	13500
L56955-8	MW-139	11/20/2013	2160
L56955-9	MW-114	11/20/2013	2550
L57037-1	MW-18	11/22/2013	< 712
L57037-11	MW-02	11/20/2013	< 569
L57037-12	MW-02	11/20/2013	< 720
L57037-13	MW-06	11/20/2013	< 718
L57037-14	MW-10	11/20/2013	< 703
L57037-15	MW-08	11/20/2013	< 710
L57037-16	MW-108	11/21/2013	< 703
L57037-17	MW-106	11/21/2013	< 715
L57037-18	MW-19	11/21/2013	< 717
L57037-19	MW-13	11/22/2013	< 714
L57037-20	MW-132	11/22/2013	< 554
L57037-21	MW-142	11/20/2013	< 719
L57037-22	MW-148	11/20/2013	< 723
L57037-23	MW-104	11/22/2013	< 715
L57037-24	MW-161	11/22/2013	< 700
L57037-25	MW-120	11/22/2013	< 716
L57037-26	PZ-02	11/22/2013	< 714
L57037-28	MW-111	11/20/2013	< 713
L57037-29	MW-04	11/21/2013	< 727
L57037-3	SW-101	11/22/2013	< 706
L57037-30	MW-04	11/21/2013	< 572
L57037-31	MW-122R	11/21/2013	< 570
L57037-32	MW-107	11/21/2013	< 573
L57037-34	MW-131	11/22/2013	< 572
L57037-36	MW-100	11/21/2013	< 573
L57037-37	MW-100	11/21/2013	< 579
L57037-38	PZ-03	11/21/2013	< 561
L57037-39	PZ-03	11/21/2013	< 568
L57037-4	SW-102	11/22/2013	< 729
L57037-40	MW-134	11/22/2013	< 577
L57037-42	T-14	11/22/2013	< 569
L57037-43	MW-102	11/21/2013	< 557
L57037-44	MW-153	11/21/2013	< 564
L57037-45	MW-03	11/21/2013	< 575
L57037-48	MW-11	11/21/2013	< 575
L57037-5	SW-103	11/22/2013	< 709
L57037-50	MW-17	11/21/2013	< 573

<b>LAB ID</b>	<b>LOCATION</b>	<b>LLD (pCi/l) DATE</b>	<b>3000 TRITIUM</b>
L57037-51	MW-17	11/21/2013	< 562
L57037-53	MW-128	11/21/2013	< 566
L57037-6	SW-104	11/22/2013	< 719
L57037-8	MW-16	11/22/2013	< 710

### GROUND MONITORING WELL SAMPLES (GAMMA) - RBS

Lab ID	LOCATION	DATE	LLD (pCi/l)											
			15 Mn-54	15 Co-58	30 Fe-59	15 Co-60	30 Zn-65	15 Nb-95	30 Zr-95	15 I-131	15 Cs-134	18 Cs-137	60 Ba-140	15 La-140
L53318-1	MW-131	1/16/2013	< 2.84	< 2.73	< 6.03	< 2.88	< 5.64	< 3.15	< 4.54	< 4.95	< 2.79	< 2.93	< 11.80	< 4.74
L53318-2	MW-151	1/16/2013	< 3.82	< 3.79	< 8.23	< 4.02	< 7.57	< 4.09	< 6.31	< 5.99	< 3.61	< 3.46	< 18.80	< 6.45
L53318-3	MW-151	1/16/2013	< 3.20	< 3.21	< 5.98	< 3.04	< 6.20	< 3.47	< 5.65	< 5.15	< 3.17	< 3.47	< 15.40	< 4.96
L53318-4	MW-153	1/16/2013	< 4.43	< 5.23	< 9.97	< 4.70	< 9.17	< 4.68	< 9.27	< 6.91	< 4.41	< 5.11	< 22.00	< 6.26
L53468-1	PZ-01	1/29/2013	< 4.51	< 5.37	< 11.00	< 5.22	< 9.15	< 5.73	< 9.15	< 9.66	< 5.52	< 4.80	< 27.90	< 7.30
L53468-10	MW-139	1/30/2013	< 4.40	< 5.68	< 11.80	< 5.80	< 10.60	< 6.29	< 10.20	< 9.19	< 5.27	< 6.64	< 27.30	< 8.72
L53468-12	MW-141	1/29/2013	< 4.60	< 4.35	< 10.20	< 4.45	< 10.30	< 5.28	< 9.28	< 9.42	< 4.58	< 5.22	< 20.90	< 3.99
L53468-14	MW-146	1/30/2013	< 4.50	< 4.50	< 9.18	< 5.58	< 11.30	< 5.10	< 8.52	< 8.74	< 4.57	< 5.53	< 28.40	< 6.49
L53468-15	MW-146	1/30/2013	< 4.65	< 4.64	< 10.20	< 5.21	< 8.81	< 5.63	< 9.08	< 9.75	< 5.60	< 5.33	< 24.30	< 7.33
L53468-17	MW-151	1/29/2013	< 4.64	< 4.18	< 9.95	< 4.24	< 8.78	< 5.52	< 9.13	< 9.42	< 4.97	< 5.17	< 25.80	< 6.28
L53468-18	MW-124	1/29/2013	< 4.43	< 4.32	< 8.98	< 5.16	< 10.80	< 5.13	< 8.09	< 8.07	< 5.05	< 4.69	< 20.00	< 7.80
L53468-19	MW-125	1/29/2013	< 5.96	< 5.39	< 10.90	< 5.72	< 11.50	< 5.32	< 9.60	< 9.54	< 5.44	< 5.16	< 25.80	< 8.73
L53468-2	MW-103	1/29/2013	< 4.74	< 4.87	< 11.30	< 6.65	< 9.73	< 6.59	< 8.21	< 10.50	< 5.31	< 5.02	< 24.20	< 8.53
L53468-20	MW-126	1/29/2013	< 4.79	< 4.53	< 8.41	< 5.08	< 5.74	< 5.18	< 9.09	< 9.98	< 3.72	< 4.90	< 21.90	< 8.01
L53468-3	MW-110	1/29/2013	< 6.95	< 6.56	< 13.10	< 5.90	< 16.10	< 7.38	< 11.40	< 12.60	< 5.72	< 5.64	< 39.00	< 10.90
L53468-4	MW-118	1/29/2013	< 6.02	< 4.59	< 14.40	< 7.16	< 12.70	< 7.47	< 11.60	< 10.80	< 5.72	< 5.76	< 25.70	< 11.70
L53468-5	MW-112	1/29/2013	< 5.28	< 4.48	< 12.10	< 6.24	< 11.40	< 5.72	< 8.91	< 10.10	< 5.47	< 5.30	< 25.00	< 8.56
L53468-6	MW-112	1/29/2013	< 6.06	< 8.10	< 15.80	< 6.47	< 13.70	< 8.55	< 13.20	< 10.70	< 6.67	< 7.56	< 31.30	< 10.30
L53468-7	MW-114	1/29/2013	< 4.04	< 5.17	< 10.00	< 3.58	< 11.00	< 5.92	< 8.24	< 10.30	< 5.32	< 5.33	< 29.50	< 8.27
L53468-8	MW-137	1/29/2013	< 5.29	< 6.02	< 11.80	< 5.39	< 11.60	< 6.07	< 10.20	< 8.87	< 4.84	< 5.76	< 25.40	< 8.95
L53468-9	MW-116	1/29/2013	< 5.02	< 4.36	< 9.52	< 5.26	< 12.70	< 6.42	< 8.45	< 9.88	< 5.06	< 4.75	< 26.90	< 8.08
L53529-1	MW-10	1/30/2013	< 4.04	< 4.78	< 8.64	< 3.22	< 9.04	< 4.19	< 8.41	< 12.10	< 3.93	< 4.00	< 26.40	< 9.12
L53529-10	MW-13	1/30/2013	< 3.29	< 4.55	< 8.17	< 3.75	< 8.28	< 4.11	< 8.01	< 11.30	< 3.69	< 4.09	< 24.70	< 7.65
L53529-11	MW-128	1/30/2013	< 3.21	< 3.50	< 8.01	< 3.99	< 7.30	< 3.44	< 7.03	< 9.63	< 3.40	< 3.51	< 22.30	< 8.21
L53529-12	MW-132	1/30/2013	< 3.51	< 3.96	< 7.80	< 4.74	< 7.68	< 3.93	< 6.68	< 10.60	< 3.46	< 3.77	< 25.90	< 9.04
L53529-13	MW-134	1/30/2013	< 2.77	< 3.39	< 6.25	< 3.23	< 5.78	< 3.64	< 5.52	< 9.59	< 2.95	< 3.22	< 20.50	< 6.44
L53529-15	MW-19	1/31/2013	< 3.60	< 3.77	< 8.83	< 3.51	< 7.03	< 3.68	< 6.36	< 8.94	< 3.17	< 3.96	< 21.80	< 9.45
L53529-16	MW-18	1/31/2013	< 3.55	< 3.86	< 8.56	< 3.22	< 7.73	< 3.87	< 6.62	< 10.60	< 3.45	< 3.60	< 23.20	< 7.87
L53529-2	MW-06	1/30/2013	< 5.08	< 4.85	< 11.10	< 4.40	< 9.31	< 4.75	< 9.10	< 13.40	< 4.21	< 4.82	< 27.00	< 10.10
L53529-3	MW-102	1/30/2013	< 4.18	< 4.78	< 11.00	< 5.22	< 8.90	< 4.70	< 9.33	< 13.80	< 4.10	< 4.43	< 30.20	< 9.50



Lab ID	LOCATION	LLD (pCi/l) DATE	15 15 30 15 30 15 30 15 30 15 15 18 60 15											
			Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
L53529-4	MW-153	1/30/2013	< 3.84	< 4.60	< 9.32	< 3.63	< 6.78	< 4.44	< 9.26	< 12.20	< 3.74	< 4.26	< 26.20	< 7.57
L53529-5	MW-08	1/30/2013	< 5.48	< 7.20	< 13.40	< 5.20	< 12.80	< 6.26	< 11.40	< 17.50	< 5.42	< 6.68	< 38.40	< 16.80
L53529-6	MW-100	1/30/2013	< 5.05	< 5.36	< 10.00	< 4.14	< 8.24	< 5.10	< 9.97	< 13.60	< 4.54	< 4.91	< 32.20	< 9.96
L53529-7	MW-131	1/30/2013	< 4.34	< 5.21	< 10.20	< 3.98	< 7.41	< 4.70	< 7.89	< 13.40	< 4.34	< 4.68	< 29.20	< 8.73
L53529-8	MW-131	1/30/2013	< 3.04	< 3.14	< 6.89	< 2.41	< 5.74	< 3.23	< 5.90	< 8.93	< 2.77	< 2.95	< 21.20	< 7.18
L53544-1	PZ-02	1/31/2013	< 3.71	< 3.75	< 8.52	< 3.39	< 6.87	< 4.60	< 7.24	< 13.30	< 4.21	< 4.61	< 27.90	< 7.52
L53544-10	MW-120	1/30/2013	< 4.50	< 4.88	< 11.30	< 4.30	< 8.90	< 5.30	< 8.78	< 14.40	< 4.73	< 4.77	< 30.90	< 9.46
L53544-11	MW-120	1/30/2013	< 2.26	< 2.62	< 6.03	< 2.41	< 4.89	< 2.48	< 4.76	< 7.94	< 2.60	< 2.51	< 16.60	< 6.12
L53544-12	MW-108	1/30/2013	< 3.50	< 3.27	< 7.25	< 3.44	< 6.63	< 3.81	< 6.02	< 11.40	< 3.00	< 3.24	< 23.60	< 7.96
L53544-13	MW-104	1/30/2013	< 3.86	< 3.83	< 8.51	< 3.77	< 7.55	< 4.32	< 6.27	< 11.60	< 3.23	< 3.98	< 26.60	< 9.10
L53544-14	PZ-03	1/29/2013	< 2.81	< 3.09	< 7.13	< 3.43	< 5.80	< 3.52	< 5.30	< 10.10	< 2.77	< 3.45	< 21.60	< 7.31
L53544-15	MW-148	1/30/2013	< 3.70	< 3.69	< 8.00	< 3.60	< 6.18	< 3.70	< 5.85	< 10.70	< 3.02	< 3.46	< 27.90	< 7.91
L53544-16	MW-144	1/30/2013	< 3.00	< 3.26	< 7.03	< 2.69	< 5.65	< 3.28	< 5.52	< 10.70	< 2.96	< 3.26	< 22.90	< 6.65
L53544-17	MW-142	1/30/2013	< 4.54	< 4.42	< 11.40	< 3.80	< 9.29	< 4.68	< 8.81	< 13.30	< 3.92	< 4.48	< 29.40	< 12.30
L53544-18	SW-101	1/31/2013	< 2.83	< 3.10	< 6.55	< 2.98	< 5.83	< 2.96	< 5.18	< 9.56	< 2.57	< 3.04	< 20.80	< 5.12
L53544-19	SW-102	1/31/2013	< 2.73	< 3.24	< 6.90	< 3.09	< 6.28	< 3.43	< 6.02	< 9.22	< 2.81	< 3.22	< 19.00	< 6.40
L53544-20	SW-103	1/31/2013	< 2.96	< 3.12	< 6.57	< 3.04	< 6.15	< 3.52	< 6.07	< 10.20	< 3.01	< 3.56	< 22.00	< 7.89
L53544-21	SW-104	1/31/2013	< 3.05	< 3.02	< 5.47	< 2.88	< 5.58	< 3.18	< 6.11	< 9.12	< 2.78	< 2.68	< 21.70	< 7.08
L53544-3	MW-111	1/30/2013	< 3.93	< 4.15	< 9.54	< 3.52	< 7.14	< 4.43	< 7.00	< 11.80	< 3.32	< 3.32	< 26.50	< 9.22
L53544-4	MW-04	1/30/2013	< 4.65	< 5.07	< 12.40	< 4.35	< 8.74	< 4.71	< 9.68	< 14.40	< 4.23	< 4.29	< 32.50	< 11.50
L53544-5	MW-122R	1/30/2013	< 4.29	< 4.48	< 10.50	< 5.17	< 8.67	< 4.53	< 8.36	< 13.10	< 3.94	< 4.32	< 27.30	< 10.60
L53544-6	MW-02	1/30/2013	< 4.27	< 4.80	< 10.30	< 5.41	< 9.07	< 4.63	< 7.70	< 13.30	< 3.94	< 4.08	< 29.70	< 11.60
L53544-7	MW-106	1/30/2013	< 3.85	< 4.48	< 9.17	< 4.00	< 7.67	< 4.37	< 7.76	< 13.80	< 4.07	< 4.56	< 30.70	< 9.48
L53544-8	MW-106	1/30/2013	< 6.21	< 5.86	< 15.70	< 6.41	< 11.80	< 6.75	< 10.80	< 19.00	< 5.20	< 6.05	< 40.70	< 16.50
L53544-9	MW-107	1/30/2013	< 3.42	< 3.48	< 7.33	< 3.49	< 6.29	< 3.67	< 6.02	< 12.10	< 2.99	< 3.54	< 24.90	< 7.49
L54497-1	MW-114	4/30/2013	< 5.10	< 5.77	< 11.40	< 4.85	< 10.60	< 6.44	< 10.60	< 10.80	< 5.05	< 5.79	< 29.80	< 9.66
L54497-10	MW-141	4/30/2013	< 4.94	< 5.26	< 9.86	< 4.72	< 11.00	< 5.62	< 8.30	< 10.60	< 5.35	< 5.85	< 27.60	< 8.06
L54497-11	MW-141	4/30/2013	< 4.67	< 4.76	< 8.90	< 4.44	< 9.51	< 5.29	< 7.93	< 9.88	< 4.40	< 4.86	< 24.90	< 6.87
L54497-12	MW-151	4/30/2013	< 3.70	< 4.12	< 8.46	< 3.42	< 7.70	< 4.57	< 6.94	< 8.20	< 3.76	< 3.83	< 24.50	< 7.71
L54497-13	MW-126	4/30/2013	< 5.28	< 5.17	< 10.60	< 5.70	< 10.90	< 6.42	< 8.49	< 9.89	< 5.26	< 5.46	< 28.30	< 10.30
L54497-14	MW-124	4/30/2013	< 5.67	< 5.45	< 11.10	< 6.82	< 10.20	< 6.22	< 10.40	< 13.80	< 5.37	< 6.61	< 38.20	< 9.56
L54497-15	MW-125	4/30/2013	< 5.63	< 5.86	< 13.00	< 7.78	< 12.50	< 8.21	< 10.50	< 14.80	< 5.72	< 6.84	< 37.20	< 12.50

Lab ID	LOCATION	LLD (pCi/l)	DATE	15	15	30	15	30	15	30	15	15	18	60	15
				Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
L54497-16	MW-146	5/1/2013	< 4.11	< 5.39	< 9.98	< 4.75	< 8.74	< 5.58	< 7.99	< 10.20	< 4.63	< 4.93	< 26.50	< 9.80	
L54497-17	MW-110	5/1/2013	< 7.44	< 7.98	< 16.00	< 5.63	< 11.20	< 7.39	< 13.50	< 14.70	< 7.14	< 7.27	< 39.90	< 10.20	
L54497-2	MW-112	4/30/2013	< 4.62	< 4.18	< 10.10	< 5.08	< 7.20	< 5.37	< 9.80	< 8.46	< 4.10	< 4.71	< 25.10	< 8.76	
L54497-3	MW-137	4/30/2013	< 3.40	< 4.66	< 8.87	< 3.01	< 7.27	< 4.42	< 5.24	< 7.58	< 3.66	< 4.20	< 21.90	< 6.52	
L54497-4	MW-137	4/30/2013	< 5.77	< 6.20	< 12.90	< 6.71	< 14.10	< 6.55	< 10.80	< 12.50	< 4.99	< 5.30	< 31.80	< 10.50	
L54497-5	MW-116	4/30/2013	< 6.84	< 6.25	< 13.10	< 6.12	< 13.50	< 8.38	< 11.50	< 13.90	< 6.16	< 6.77	< 31.90	< 11.30	
L54497-6	MW-139	4/30/2013	< 4.49	< 4.08	< 8.77	< 4.75	< 9.89	< 5.76	< 8.10	< 11.00	< 5.15	< 4.75	< 26.80	< 7.93	
L54497-7	MW-118	4/30/2013	< 6.98	< 6.42	< 13.10	< 5.70	< 14.00	< 6.44	< 11.50	< 10.20	< 5.41	< 5.19	< 30.10	< 13.20	
L54497-8	PZ-01	4/30/2013	< 5.80	< 4.53	< 11.60	< 5.65	< 10.40	< 6.68	< 10.70	< 12.10	< 4.86	< 5.71	< 32.30	< 13.40	
L54497-9	MW-103	4/30/2013	< 4.77	< 5.52	< 9.96	< 5.22	< 8.15	< 5.01	< 8.30	< 9.54	< 4.26	< 5.17	< 24.60	< 8.93	
L54549-1	MW-128	5/1/2013	< 2.88	< 2.74	< 7.79	< 3.23	< 6.35	< 3.38	< 5.63	< 10.10	< 2.88	< 3.52	< 22.30	< 8.77	
L54549-10	MW-142	5/1/2013	< 4.54	< 4.55	< 9.38	< 4.41	< 7.63	< 4.85	< 7.88	< 14.70	< 3.78	< 4.68	< 28.90	< 9.18	
L54549-11	MW-144	5/1/2013	< 3.41	< 3.95	< 8.17	< 3.42	< 7.90	< 4.31	< 7.16	< 13.50	< 3.37	< 4.06	< 27.90	< 8.80	
L54549-12	MW-148	5/1/2013	< 3.77	< 4.30	< 8.74	< 4.33	< 8.75	< 3.76	< 7.21	< 13.40	< 3.46	< 3.71	< 29.70	< 11.10	
L54549-13	MW-02	5/2/2013	< 4.15	< 4.62	< 10.40	< 4.42	< 9.53	< 4.53	< 7.62	< 12.40	< 3.78	< 4.45	< 30.30	< 9.41	
L54549-14	MW-104	5/2/2013	< 3.17	< 3.38	< 5.96	< 3.12	< 7.13	< 3.59	< 5.73	< 9.67	< 3.13	< 3.17	< 24.50	< 7.92	
L54549-17	MW-04	5/1/2013	< 3.19	< 3.29	< 7.32	< 2.89	< 6.23	< 3.69	< 5.83	< 13.50	< 3.30	< 3.72	< 26.40	< 7.54	
L54549-18	MW-122R	5/1/2013	< 3.47	< 3.24	< 7.47	< 3.35	< 6.39	< 3.43	< 5.53	< 12.00	< 2.99	< 3.02	< 25.20	< 9.09	
L54549-2	MW-128	5/1/2013	< 3.53	< 3.92	< 7.74	< 3.23	< 6.94	< 4.03	< 6.59	< 11.90	< 3.53	< 4.05	< 25.90	< 8.62	
L54549-3	MW-100	5/1/2013	< 5.32	< 5.75	< 11.70	< 5.55	< 10.90	< 5.70	< 11.30	< 14.40	< 5.29	< 5.56	< 33.70	< 11.70	
L54549-4	MW-131	5/1/2013	< 4.63	< 4.76	< 9.40	< 5.30	< 9.09	< 4.86	< 7.00	< 13.80	< 4.15	< 4.46	< 34.30	< 10.00	
L54549-5	MW-13	5/1/2013	< 3.81	< 5.57	< 10.30	< 4.51	< 9.10	< 4.94	< 7.71	< 13.90	< 3.58	< 4.31	< 31.60	< 8.68	
L54549-6	MW-132	5/1/2013	< 4.66	< 4.48	< 9.66	< 5.09	< 7.95	< 4.11	< 7.90	< 12.70	< 3.98	< 4.35	< 29.70	< 9.18	
L54549-7	MW-134	5/1/2013	< 4.14	< 4.81	< 9.94	< 4.37	< 8.93	< 4.83	< 8.34	< 14.00	< 4.44	< 4.64	< 34.60	< 7.97	
L54575-1	MW-102	5/1/2013	< 1.43	< 1.78	< 3.89	< 1.46	< 2.79	< 1.80	< 2.93	< 9.34	< 1.40	< 1.48	< 15.60	< 5.40	
L54575-3	SW-101	5/1/2013	< 1.52	< 1.80	< 3.98	< 1.46	< 3.25	< 1.86	< 3.16	< 9.91	< 1.62	< 1.60	< 16.30	< 5.93	
L54575-4	SW-102	5/1/2013	< 2.47	< 2.92	< 6.91	< 2.49	< 4.63	< 2.85	< 4.92	< 13.50	< 2.21	< 2.55	< 25.90	< 8.46	
L54575-5	SW-103	5/1/2013	< 1.59	< 1.85	< 4.26	< 1.56	< 3.46	< 1.91	< 3.31	< 10.50	< 1.54	< 1.67	< 17.90	< 5.63	
L54575-6	SW-104	5/1/2013	< 1.90	< 2.12	< 5.35	< 1.91	< 4.25	< 2.38	< 4.03	< 12.80	< 1.76	< 2.05	< 21.20	< 6.69	
L54583-10	MW-06	5/1/2013	< 1.84	< 2.15	< 5.10	< 1.97	< 4.13	< 2.24	< 3.74	< 12.20	< 1.80	< 1.95	< 19.80	< 7.80	
L54583-3	PZ-03	4/30/2013	< 1.59	< 1.85	< 4.37	< 1.67	< 2.98	< 1.85	< 3.40	< 12.10	< 1.51	< 1.58	< 19.00	< 5.12	
L54583-4	PZ-03	4/30/2013	< 1.98	< 2.35	< 5.75	< 2.16	< 4.07	< 2.55	< 4.35	< 14.10	< 1.85	< 2.23	< 24.10	< 6.99	

Lab ID	LOCATION	LLD (pCi/l) DATE	15		30	15		30	15		30	15	15	18	60	15
			Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140		
L54583-5	MW-19	5/1/2013	< 1.71	< 2.13	< 4.62	< 1.76	< 3.43	< 2.07	< 3.78	< 12.60	< 1.59	< 1.80	< 20.40	< 6.14		
L54583-6	MW-18	5/1/2013	< 1.75	< 2.06	< 4.94	< 2.03	< 3.87	< 2.25	< 3.72	< 12.60	< 1.72	< 2.06	< 21.20	< 6.28		
L54583-7	MW-08	5/1/2013	< 2.10	< 2.34	< 5.17	< 2.31	< 4.59	< 2.36	< 4.48	< 14.20	< 1.95	< 2.18	< 26.10	< 7.33		
L54583-8	MW-153	5/1/2013	< 1.90	< 1.96	< 4.84	< 1.69	< 3.94	< 2.02	< 3.75	< 12.30	< 1.70	< 1.79	< 19.60	< 6.32		
L54583-9	MW-10	5/1/2013	< 2.02	< 2.45	< 5.15	< 1.96	< 3.86	< 2.55	< 4.13	< 14.60	< 1.91	< 2.23	< 24.20	< 6.38		
L54584-1	MW-111	5/1/2013	< 1.96	< 2.18	< 4.87	< 2.13	< 3.98	< 2.38	< 4.07	< 12.40	< 1.88	< 2.05	< 21.40	< 7.41		
L54584-2	MW-111	5/1/2013	< 1.95	< 2.20	< 5.30	< 2.10	< 4.03	< 2.05	< 4.05	< 12.10	< 1.89	< 2.10	< 20.80	< 6.58		
L54584-3	MW-120	5/1/2013	< 1.72	< 2.01	< 4.80	< 1.90	< 3.64	< 2.15	< 3.53	< 10.60	< 1.69	< 1.85	< 18.30	< 5.97		
L54584-4	PZ-02	5/1/2013	< 1.83	< 2.13	< 4.77	< 2.03	< 3.85	< 2.25	< 3.98	< 11.60	< 1.73	< 1.94	< 19.70	< 6.94		
L54584-5	MW-108	5/1/2013	< 1.73	< 1.94	< 4.61	< 1.61	< 3.51	< 2.04	< 3.46	< 10.00	< 1.67	< 1.88	< 18.00	< 5.70		
L54584-6	MW-106	5/1/2013	< 1.66	< 1.96	< 4.25	< 1.72	< 3.50	< 2.09	< 3.77	< 11.60	< 1.73	< 1.89	< 20.10	< 5.21		
L54584-7	MW-107	5/1/2013	< 1.67	< 1.87	< 4.69	< 1.80	< 3.57	< 2.01	< 3.26	< 11.00	< 1.64	< 1.85	< 17.90	< 5.90		
L55575-1	PZ-01	7/30/2013	< 3.16	< 3.50	< 7.46	< 3.52	< 6.19	< 3.82	< 5.67	< 12.40	< 3.14	< 3.22	< 26.40	< 8.00		
L55575-10	MW-116	7/30/2013	< 3.67	< 4.16	< 9.39	< 4.04	< 9.13	< 5.30	< 7.66	< 13.50	< 3.74	< 4.18	< 36.60	< 11.60		
L55575-11	MW-139	7/30/2013	< 3.12	< 3.69	< 7.81	< 2.85	< 6.61	< 4.24	< 6.51	< 13.60	< 3.43	< 4.00	< 27.80	< 10.20		
L55575-12	MW-116	7/30/2013	< 3.82	< 3.96	< 8.80	< 3.55	< 7.10	< 4.18	< 6.23	< 14.00	< 3.43	< 3.46	< 27.40	< 10.30		
L55575-13	MW-151	7/30/2013	< 3.49	< 3.63	< 7.95	< 3.69	< 5.86	< 3.63	< 6.54	< 14.10	< 3.25	< 3.69	< 27.00	< 9.28		
L55575-15	MW-146	7/31/2013	< 3.65	< 4.17	< 10.20	< 4.99	< 7.26	< 4.95	< 8.01	< 14.30	< 3.56	< 4.02	< 27.50	< 9.02		
L55575-16	MW-144	7/31/2013	< 4.74	< 4.23	< 10.90	< 5.10	< 9.53	< 4.41	< 9.77	< 14.90	< 3.80	< 4.86	< 30.40	< 9.24		
L55575-17	MW-124	7/31/2013	< 3.90	< 4.17	< 9.65	< 4.01	< 8.12	< 4.58	< 7.90	< 12.60	< 3.74	< 3.86	< 30.30	< 10.10		
L55575-18	MW-125	7/31/2013	< 3.09	< 3.64	< 7.79	< 3.58	< 6.53	< 4.15	< 6.60	< 13.30	< 3.54	< 3.94	< 29.50	< 9.41		
L55575-19	MW-126	7/31/2013	< 3.75	< 4.28	< 8.59	< 4.29	< 8.27	< 4.85	< 7.76	< 13.60	< 3.77	< 3.96	< 29.40	< 10.80		
L55575-2	MW-103	7/30/2013	< 3.66	< 3.86	< 9.03	< 3.93	< 7.13	< 4.90	< 7.00	< 14.80	< 3.47	< 3.80	< 28.70	< 8.29		
L55575-3	MW-103	7/30/2013	< 3.22	< 3.55	< 7.14	< 3.20	< 6.76	< 3.71	< 7.03	< 14.70	< 3.22	< 3.62	< 26.80	< 7.20		
L55575-4	MW-118	7/30/2013	< 3.48	< 3.82	< 8.79	< 4.19	< 7.78	< 4.10	< 6.39	< 13.20	< 3.51	< 3.78	< 27.30	< 8.29		
L55575-5	MW-110	7/30/2013	< 3.76	< 4.36	< 8.91	< 3.92	< 6.70	< 3.88	< 7.64	< 13.50	< 3.50	< 4.10	< 27.50	< 9.26		
L55575-6	MW-141	7/30/2013	< 4.79	< 4.77	< 11.80	< 4.34	< 10.50	< 5.34	< 9.07	< 13.90	< 4.42	< 4.85	< 35.40	< 11.30		
L55575-7	MW-114	7/30/2013	< 4.65	< 4.08	< 8.67	< 3.76	< 7.95	< 4.71	< 7.31	< 14.80	< 3.38	< 4.36	< 26.70	< 7.80		
L55575-8	MW-112	7/30/2013	< 3.72	< 3.88	< 7.94	< 3.80	< 7.54	< 4.50	< 7.59	< 13.40	< 3.57	< 3.99	< 27.90	< 8.68		
L55575-9	MW-137	7/30/2013	< 3.93	< 4.02	< 8.29	< 3.70	< 8.03	< 4.54	< 7.11	< 13.60	< 3.73	< 3.64	< 31.70	< 7.76		
L55591-10	SW-103	7/31/2013	< 4.80	< 4.76	< 11.20	< 4.86	< 6.99	< 5.54	< 9.11	< 13.50	< 4.65	< 4.55	< 33.40	< 9.77		
L55591-11	MW-111	7/31/2013	< 4.38	< 4.41	< 9.99	< 5.25	< 9.48	< 4.75	< 7.67	< 12.00	< 4.33	< 4.77	< 28.80	< 7.26		

Lab ID	LOCATION	LLD (pCi/l) DATE	15 15 30 15 30 15 30 15 15 18 60 15											
			Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
L55591-12	MW-106	7/31/2013	< 4.86	< 5.42	< 10.00	< 5.00	< 9.67	< 5.40	< 9.72	< 13.70	< 4.73	< 4.86	< 30.40	< 11.90
L55591-13	MW-107	7/31/2013	< 4.45	< 4.93	< 12.00	< 5.06	< 8.88	< 5.44	< 7.92	< 14.30	< 3.73	< 4.03	< 31.00	< 9.20
L55591-14	MW-108	7/31/2013	< 3.85	< 4.13	< 10.00	< 3.95	< 8.60	< 3.78	< 7.33	< 14.30	< 3.88	< 3.91	< 31.60	< 8.44
L55591-15	MW-02	7/31/2013	< 3.73	< 4.04	< 8.86	< 3.88	< 7.96	< 4.28	< 7.12	< 13.50	< 3.03	< 4.04	< 28.00	< 9.61
L55591-16	MW-02	7/31/2013	< 2.82	< 3.37	< 6.70	< 2.64	< 5.88	< 4.06	< 5.85	< 12.00	< 2.94	< 3.24	< 25.50	< 7.31
L55591-17	MW-04	7/31/2013	< 3.25	< 3.93	< 8.26	< 3.28	< 6.44	< 3.47	< 6.57	< 12.70	< 2.94	< 3.24	< 24.30	< 8.66
L55591-18	MW-122R	7/31/2013	< 3.39	< 3.85	< 7.19	< 3.35	< 6.40	< 3.81	< 6.30	< 13.70	< 3.33	< 3.85	< 27.10	< 8.95
L55591-19	MW-120	7/31/2013	< 3.64	< 3.70	< 7.71	< 3.79	< 7.93	< 4.21	< 7.30	< 14.00	< 3.32	< 3.80	< 25.40	< 7.84
L55591-2	MW-10	7/31/2013	< 4.15	< 3.62	< 7.66	< 4.32	< 9.97	< 5.33	< 7.58	< 12.70	< 3.60	< 3.97	< 29.50	< 8.52
L55591-20	PZ-02	7/31/2013	< 3.29	< 3.39	< 7.28	< 3.34	< 6.06	< 3.88	< 6.32	< 12.40	< 3.15	< 3.63	< 26.00	< 8.44
L55591-21	MW-142	7/31/2013	< 3.95	< 4.51	< 11.30	< 4.06	< 7.87	< 4.84	< 8.11	< 14.60	< 3.54	< 4.01	< 32.30	< 10.50
L55591-22	MW-148	7/31/2013	< 3.61	< 4.16	< 8.77	< 3.41	< 6.80	< 4.02	< 6.95	< 14.90	< 3.42	< 3.98	< 28.50	< 9.61
L55591-23	SW-102	8/1/2013	< 4.84	< 4.82	< 10.90	< 5.04	< 10.00	< 5.15	< 8.94	< 7.51	< 4.78	< 5.40	< 23.10	< 8.25
L55591-24	SW-101	8/1/2013	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
L55591-25	MW-104	8/1/2013	< 3.41	< 4.03	< 9.76	< 3.87	< 7.47	< 4.97	< 7.07	< 13.80	< 3.86	< 4.57	< 28.60	< 7.81
L55591-27	MW-128	8/1/2013	< 3.04	< 3.38	< 6.68	< 2.74	< 6.06	< 3.59	< 6.59	< 12.20	< 3.22	< 3.53	< 26.50	< 6.51
L55591-28	MW-134	8/1/2013	< 3.70	< 3.98	< 9.90	< 3.23	< 7.85	< 4.26	< 7.06	< 12.80	< 3.61	< 4.08	< 30.00	< 9.98
L55591-29	PZ-03	8/1/2013	< 2.68	< 3.00	< 7.15	< 2.65	< 6.08	< 3.24	< 5.16	< 13.80	< 2.41	< 2.90	< 24.10	< 8.54
L55591-3	MW-06	7/31/2013	< 3.96	< 4.54	< 10.10	< 4.53	< 8.90	< 4.53	< 7.55	< 12.60	< 4.10	< 4.23	< 25.70	< 7.40
L55591-30	MW-100	8/1/2013	< 3.35	< 3.63	< 7.91	< 3.52	< 6.93	< 4.13	< 6.77	< 14.00	< 3.01	< 3.18	< 28.50	< 9.44
L55591-31	MW-100	8/1/2013	< 2.60	< 3.15	< 7.17	< 2.65	< 5.83	< 3.48	< 5.94	< 14.30	< 2.86	< 3.07	< 28.30	< 6.97
L55591-32	MW-131	8/1/2013	< 3.21	< 3.22	< 7.91	< 3.66	< 6.80	< 3.50	< 5.75	< 14.20	< 2.96	< 3.27	< 27.40	< 9.31
L55591-33	MW-131	8/1/2013	< 3.65	< 4.10	< 9.93	< 3.92	< 8.38	< 4.27	< 7.84	< 14.90	< 3.31	< 3.92	< 30.80	< 9.76
L55591-35	MW-132	8/1/2013	< 3.18	< 3.56	< 7.09	< 2.90	< 6.21	< 3.54	< 5.91	< 14.20	< 3.02	< 3.26	< 25.60	< 8.95
L55591-36	MW-13	8/1/2013	< 3.13	< 3.23	< 8.04	< 3.06	< 6.24	< 3.50	< 6.22	< 13.60	< 2.89	< 3.14	< 25.10	< 8.64
L55591-4	MW-102	7/31/2013	< 4.11	< 4.56	< 8.61	< 3.71	< 7.71	< 4.55	< 8.29	< 13.90	< 4.31	< 4.64	< 29.70	< 9.47
L55591-5	MW-153	7/31/2013	< 4.54	< 4.55	< 9.20	< 4.88	< 7.41	< 4.34	< 5.04	< 10.60	< 3.61	< 4.46	< 25.20	< 12.00
L55591-6	MW-08	7/31/2013	< 5.16	< 4.41	< 10.60	< 4.57	< 9.40	< 5.78	< 9.20	< 12.70	< 4.81	< 5.29	< 38.70	< 10.30
L55591-7	MW-18	7/31/2013	< 5.16	< 5.57	< 11.20	< 5.54	< 10.50	< 5.68	< 10.10	< 13.30	< 5.11	< 5.68	< 35.10	< 9.36
L55591-8	MW-19	7/31/2013	< 4.85	< 5.11	< 11.70	< 4.52	< 10.10	< 5.24	< 8.61	< 14.40	< 4.52	< 5.19	< 33.90	< 10.40
L56679-1	MW-05	10/23/2013	< 1.85	< 2.11	< 4.46	< 2.00	< 3.77	< 2.05	< 3.59	< 10.30	< 1.71	< 1.90	< 17.70	< 6.57
L56679-2	MW-20	10/24/2013	< 1.73	< 1.96	< 4.08	< 1.61	< 3.53	< 2.06	< 3.58	< 10.30	< 1.56	< 1.73	< 17.40	< 4.94

Lab ID	LOCATION	LLD (pCi/l) DATE	15		30	15		30	15		30	15		18	60	15
			Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140		
L56679-3	MW-07	10/23/2013	< 1.94	< 2.06	< 4.61	< 1.79	< 4.05	< 2.18	< 3.91	< 12.40	< 1.77	< 1.98	< 20.40	< 5.87		
L56679-4	MW-09	10/23/2013	< 1.95	< 2.05	< 4.87	< 1.86	< 3.76	< 2.16	< 3.81	< 11.70	< 1.80	< 1.93	< 20.50	< 7.01		
L56775-1	MW-21	10/31/2013	< 6.51	< 5.82	< 12.20	< 6.04	< 12.80	< 6.63	< 11.00	< 14.60	< 5.35	< 5.57	< 37.70	< 11.40		
L56806-1	MW-14	11/6/2013	< 5.32	< 4.90	< 11.40	< 3.53	< 11.70	< 5.73	< 11.00	< 14.80	< 5.03	< 5.88	< 33.20	< 11.90		
L56806-2	MW-13	11/6/2013	< 4.49	< 4.88	< 11.80	< 5.03	< 8.55	< 4.84	< 8.75	< 13.30	< 4.02	< 5.30	< 31.90	< 11.70		
L56806-3	MW-12	11/6/2013	< 3.45	< 3.64	< 8.84	< 3.61	< 7.19	< 4.18	< 6.11	< 11.90	< 3.20	< 3.69	< 25.90	< 7.97		
L56806-4	MW-01	11/5/2013	< 3.48	< 3.73	< 8.77	< 4.04	< 7.49	< 3.82	< 7.14	< 10.90	< 3.63	< 4.01	< 24.60	< 7.94		
L56806-5	MW-15	11/5/2013	< 3.50	< 3.44	< 8.39	< 4.11	< 7.45	< 4.14	< 5.57	< 11.10	< 3.06	< 3.28	< 22.40	< 7.09		
L56955-1	MW-126	11/21/2013	< 3.97	< 4.58	< 11.20	< 4.46	< 9.65	< 5.06	< 7.62	< 12.40	< 4.52	< 4.58	< 31.90	< 9.47		
L56955-10	MW-116	11/20/2013	< 3.26	< 4.65	< 10.70	< 3.99	< 7.97	< 4.52	< 7.95	< 14.40	< 3.80	< 3.98	< 30.70	< 10.60		
L56955-11	MW-137	11/19/2013	< 4.94	< 5.48	< 8.49	< 5.75	< 8.03	< 5.60	< 9.86	< 14.70	< 4.56	< 5.14	< 34.10	< 9.29		
L56955-12	MW-137	11/19/2013	< 3.87	< 5.34	< 11.00	< 4.82	< 10.00	< 5.86	< 8.10	< 14.40	< 4.26	< 5.32	< 32.00	< 9.86		
L56955-13	MW-141	11/20/2013	< 5.39	< 5.78	< 11.40	< 5.32	< 10.40	< 4.96	< 11.40	< 14.60	< 5.28	< 5.20	< 30.80	< 7.42		
L56955-14	MW-110	11/20/2013	< 4.80	< 4.87	< 9.89	< 5.33	< 9.33	< 5.29	< 9.02	< 14.60	< 5.20	< 5.24	< 30.90	< 9.27		
L56955-15	MW-118	11/20/2013	< 4.69	< 6.14	< 10.10	< 5.14	< 11.10	< 5.37	< 10.40	< 14.40	< 5.30	< 5.30	< 32.60	< 6.80		
L56955-16	MW-118	11/20/2013	< 5.16	< 4.46	< 10.80	< 5.32	< 8.38	< 5.29	< 10.40	< 14.50	< 4.38	< 4.97	< 30.70	< 9.17		
L56955-17	MW-144	11/20/2013	< 4.95	< 4.68	< 11.20	< 5.50	< 9.69	< 5.17	< 9.21	< 14.20	< 4.88	< 4.84	< 32.40	< 10.40		
L56955-18	MW-146	11/20/2013	< 5.27	< 4.98	< 11.60	< 6.33	< 9.52	< 5.21	< 8.97	< 14.00	< 4.32	< 5.02	< 27.90	< 8.20		
L56955-19	MW-147	11/20/2013	< 6.23	< 5.58	< 14.60	< 6.08	< 10.70	< 6.33	< 12.00	< 14.90	< 4.83	< 5.81	< 34.10	< 11.00		
L56955-2	MW-151	11/19/2013	< 3.76	< 3.90	< 8.68	< 4.09	< 8.73	< 4.09	< 7.35	< 12.90	< 3.54	< 3.78	< 28.20	< 9.60		
L56955-20	MW-158	11/20/2013	< 4.66	< 4.25	< 11.00	< 5.25	< 8.36	< 5.02	< 8.82	< 14.20	< 3.73	< 4.30	< 29.60	< 7.85		
L56955-21	MW-159	11/20/2013	< 4.48	< 4.68	< 9.89	< 4.64	< 9.71	< 4.98	< 9.44	< 13.40	< 4.39	< 4.83	< 31.00	< 7.68		
L56955-22	MW-155	11/21/2013	< 4.37	< 5.52	< 9.35	< 4.82	< 9.96	< 4.60	< 9.67	< 12.70	< 4.88	< 5.14	< 29.50	< 8.71		
L56955-23	MW-156	11/21/2013	< 5.23	< 4.55	< 12.00	< 3.64	< 9.74	< 5.71	< 8.08	< 12.20	< 4.22	< 5.08	< 27.00	< 11.40		
L56955-24	MW-157	11/21/2013	< 4.36	< 4.26	< 8.42	< 3.48	< 8.11	< 4.49	< 6.84	< 13.50	< 3.69	< 4.37	< 28.70	< 10.80		
L56955-3	MW-124	11/19/2013	< 3.48	< 4.20	< 7.30	< 3.58	< 7.23	< 3.51	< 7.42	< 11.60	< 3.77	< 4.07	< 26.80	< 8.15		
L56955-4	MW-125	11/19/2013	< 3.55	< 4.06	< 8.08	< 3.81	< 8.13	< 4.28	< 7.44	< 12.10	< 3.54	< 3.87	< 27.10	< 7.83		
L56955-5	PZ-01	11/19/2013	< 4.23	< 4.85	< 10.20	< 4.16	< 8.15	< 5.34	< 8.17	< 14.70	< 4.19	< 4.27	< 31.20	< 9.94		
L56955-6	MW-103	11/19/2013	< 4.12	< 4.20	< 9.65	< 4.68	< 9.23	< 4.89	< 8.03	< 12.60	< 3.82	< 4.07	< 29.60	< 10.30		
L56955-7	MW-112	11/19/2013	< 3.60	< 4.33	< 9.18	< 4.07	< 8.38	< 4.90	< 7.44	< 13.60	< 3.74	< 4.39	< 29.30	< 8.17		
L56955-8	MW-139	11/20/2013	< 3.84	< 4.39	< 7.48	< 3.87	< 7.98	< 3.35	< 7.63	< 12.40	< 3.95	< 4.32	< 25.30	< 7.21		
L56955-9	MW-114	11/20/2013	< 3.71	< 4.63	< 9.77	< 4.06	< 8.34	< 5.26	< 8.06	< 14.60	< 4.83	< 4.98	< 31.50	< 9.94		

Lab ID	LOCATION	LLD (pCi/l)	15		30	15		30	15		30	15		18	60	15
			Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140		
L57037-1	MW-18	11/22/2013	< 3.11	< 3.26	< 6.37	< 3.41	< 5.80	< 3.57	< 5.43	< 9.24	< 2.84	< 3.58	< 21.70	< 8.04		
L57037-11	MW-02	11/20/2013	< 4.17	< 4.23	< 9.68	< 4.74	< 7.36	< 4.76	< 8.60	< 14.20	< 4.37	< 4.95	< 30.30	< 9.58		
L57037-12	MW-02	11/20/2013	< 3.84	< 3.63	< 8.60	< 4.40	< 7.77	< 3.90	< 7.34	< 13.30	< 3.54	< 3.37	< 26.40	< 10.90		
L57037-13	MW-06	11/20/2013	< 4.73	< 4.63	< 11.50	< 5.36	< 10.10	< 5.84	< 9.62	< 14.60	< 4.39	< 4.52	< 30.80	< 10.70		
L57037-14	MW-10	11/20/2013	< 4.03	< 4.40	< 8.80	< 3.88	< 8.54	< 4.55	< 8.11	< 14.50	< 3.88	< 3.95	< 32.80	< 10.40		
L57037-15	MW-08	11/20/2013	< 4.22	< 4.34	< 10.00	< 4.06	< 8.72	< 4.74	< 6.52	< 13.50	< 4.03	< 4.33	< 31.90	< 10.40		
L57037-16	MW-108	11/21/2013	< 4.17	< 3.93	< 10.30	< 3.75	< 6.88	< 4.85	< 7.42	< 14.80	< 3.66	< 4.05	< 30.70	< 9.20		
L57037-17	MW-106	11/21/2013	< 3.28	< 3.44	< 8.14	< 3.75	< 7.23	< 3.98	< 7.17	< 14.00	< 3.22	< 3.82	< 27.00	< 8.46		
L57037-18	MW-19	11/21/2013	< 2.80	< 3.13	< 7.54	< 3.47	< 6.30	< 3.50	< 5.17	< 12.60	< 2.76	< 3.00	< 23.40	< 8.49		
L57037-19	MW-13	11/22/2013	< 3.58	< 5.04	< 11.20	< 3.95	< 9.13	< 5.18	< 8.96	< 14.40	< 3.94	< 4.98	< 33.60	< 12.00		
L57037-20	MW-132	11/22/2013	< 2.98	< 2.88	< 6.44	< 2.69	< 4.59	< 3.15	< 5.75	< 9.38	< 2.64	< 2.74	< 20.60	< 6.44		
L57037-21	MW-142	11/20/2013	< 2.64	< 3.43	< 7.28	< 2.79	< 5.83	< 3.44	< 5.80	< 12.70	< 2.82	< 3.15	< 25.50	< 8.13		
L57037-22	MW-148	11/20/2013	< 3.00	< 3.85	< 8.32	< 3.13	< 6.11	< 3.62	< 6.13	< 13.10	< 3.14	< 3.58	< 25.00	< 9.56		
L57037-23	MW-104	11/22/2013	< 2.75	< 3.07	< 6.52	< 3.17	< 6.18	< 3.06	< 5.39	< 10.20	< 2.37	< 2.95	< 22.40	< 7.25		
L57037-24	MW-161	11/22/2013	< 4.19	< 3.97	< 8.78	< 3.87	< 7.05	< 4.83	< 7.55	< 14.80	< 3.35	< 4.23	< 29.40	< 9.06		
L57037-25	MW-120	11/22/2013	< 3.06	< 3.13	< 6.72	< 2.95	< 6.77	< 3.77	< 5.46	< 14.00	< 3.11	< 3.54	< 29.50	< 7.36		
L57037-26	PZ-02	11/22/2013	< 3.38	< 3.70	< 8.37	< 3.34	< 7.12	< 3.89	< 6.46	< 13.00	< 3.32	< 3.45	< 24.10	< 7.57		
L57037-28	MW-111	11/20/2013	< 3.62	< 4.54	< 10.50	< 3.62	< 7.50	< 4.69	< 7.53	< 13.90	< 3.48	< 4.07	< 31.70	< 8.93		
L57037-29	MW-04	11/21/2013	< 2.97	< 2.62	< 6.15	< 2.28	< 5.36	< 2.97	< 6.48	< 13.70	< 2.55	< 2.73	< 26.50	< 7.32		
L57037-3	SW-101	11/22/2013	< 4.58	< 4.52	< 10.50	< 4.01	< 8.46	< 4.27	< 8.74	< 12.10	< 4.12	< 4.31	< 28.40	< 9.39		
L57037-30	MW-04	11/21/2013	< 3.21	< 3.19	< 7.35	< 2.93	< 6.10	< 3.64	< 6.16	< 12.70	< 3.00	< 3.26	< 25.30	< 8.16		
L57037-31	MW-122R	11/21/2013	< 2.99	< 3.08	< 8.02	< 3.46	< 6.59	< 3.69	< 6.42	< 14.40	< 2.86	< 3.17	< 27.60	< 7.62		
L57037-32	MW-107	11/21/2013	< 3.28	< 3.38	< 7.91	< 4.20	< 6.77	< 4.06	< 7.50	< 14.70	< 2.93	< 3.54	< 28.60	< 10.40		
L57037-34	MW-131	11/22/2013	< 3.22	< 3.27	< 7.49	< 3.27	< 5.82	< 3.62	< 5.89	< 13.70	< 2.80	< 3.24	< 24.30	< 8.43		
L57037-36	MW-100	11/21/2013	< 2.72	< 3.01	< 6.41	< 3.06	< 5.83	< 3.41	< 4.87	< 14.70	< 2.67	< 3.26	< 25.30	< 6.13		
L57037-37	MW-100	11/21/2013	< 3.10	< 3.45	< 7.52	< 3.21	< 6.31	< 3.43	< 6.24	< 13.30	< 2.70	< 2.94	< 26.00	< 8.02		
L57037-38	PZ-03	11/21/2013	< 3.88	< 4.09	< 8.75	< 3.66	< 7.06	< 3.99	< 7.03	< 14.90	< 3.22	< 3.63	< 31.30	< 10.40		
L57037-39	PZ-03	11/21/2013	< 3.11	< 3.22	< 8.04	< 2.93	< 7.21	< 3.58	< 6.61	< 13.70	< 2.77	< 3.50	< 28.40	< 8.68		
L57037-4	SW-102	11/22/2013	< 3.43	< 3.26	< 8.02	< 4.01	< 6.37	< 3.77	< 6.99	< 10.10	< 3.39	< 3.81	< 22.20	< 7.77		
L57037-40	MW-134	11/22/2013	< 3.53	< 3.61	< 6.93	< 3.05	< 6.69	< 4.04	< 5.78	< 13.00	< 3.13	< 3.33	< 26.40	< 8.44		
L57037-42	T-14	11/22/2013	< 3.67	< 3.83	< 7.42	< 3.58	< 7.46	< 3.87	< 6.48	< 14.10	< 3.20	< 3.49	< 28.70	< 7.94		
L57037-43	MW-102	11/21/2013	< 2.65	< 3.21	< 7.22	< 2.57	< 6.21	< 3.52	< 5.45	< 13.80	< 2.87	< 3.10	< 23.20	< 7.74		

Lab ID	LOCATION	DATE	LLD (pCi/l)											
			15 Mn-54	15 Co-58	30 Fe-59	15 Co-60	30 Zn-65	15 Nb-95	30 Zr-95	15 I-131	15 Cs-134	18 Cs-137	60 Ba-140	15 La-140
L57037-44	MW-153	11/21/2013	< 2.72	< 3.06	< 6.93	< 2.76	< 5.79	< 3.63	< 5.61	< 14.10	< 2.80	< 2.87	< 27.80	< 8.19
L57037-45	MW-03	11/21/2013	< 2.37	< 2.74	< 5.17	< 2.42	< 4.03	< 2.64	< 4.49	< 14.70	< 2.31	< 2.43	< 22.80	< 3.89
L57037-48	MW-11	11/21/2013	< 3.30	< 3.64	< 8.02	< 2.99	< 7.12	< 3.82	< 6.65	< 14.70	< 2.76	< 3.34	< 33.80	< 8.24
L57037-5	SW-103	11/22/2013	< 4.05	< 4.16	< 7.96	< 3.53	< 7.98	< 4.64	< 6.40	< 11.80	< 3.69	< 3.49	< 25.20	< 9.27
L57037-50	MW-17	11/21/2013	< 2.63	< 3.31	< 6.18	< 2.29	< 5.75	< 2.78	< 5.03	< 14.90	< 2.67	< 2.67	< 24.80	< 6.52
L57037-51	MW-17	11/21/2013	< 2.68	< 2.80	< 6.51	< 2.24	< 4.47	< 2.91	< 4.65	< 12.20	< 2.31	< 2.49	< 24.50	< 6.92
L57037-53	MW-128	11/21/2013	< 2.59	< 2.75	< 6.46	< 2.52	< 4.85	< 2.91	< 5.80	< 13.30	< 2.71	< 2.85	< 25.30	< 6.60
L57037-6	SW-104	11/22/2013	< 3.74	< 4.13	< 7.70	< 3.30	< 8.10	< 4.25	< 6.28	< 10.20	< 3.44	< 3.88	< 24.90	< 7.01
L57037-8	MW-16	11/22/2013	< 3.16	< 3.94	< 7.91	< 3.67	< 6.83	< 3.57	< 5.62	< 10.40	< 3.36	< 3.58	< 22.00	< 7.82

(1) Location SW-101 is a sentinel well with very low recharge rate. It was sampled once and analyzed for H-3.

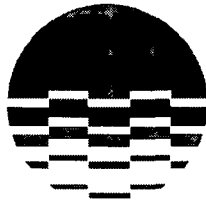
### GROUND MONITORING WELL SAMPLES (Hard-To-Detects) - RBS

Lab ID	LOCATION	DATE	(pCi/l)						
			Sr-89	Sr-90	Fe-55	Ni-63	Cm-242	Cs-243/244	Pu-238
L53468-19	MW-125	1/29/2013	< 4.07E+00	< 1.29E+00	< 9.19E+01	< 3.37E+00	< 1.42E-01	< 1.00E-01	< 8.95E-02

## Attachment 1

# Offsite Dose Calculation Manual





**ENTERGY**

**RIVER BEND STATION  
STATION OPERATING MANUAL  
\*RADIATION SECTION PROCEDURE**

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***\*OFFSITE DOSE CALCULATION MANUAL (ODCM)***

**PROCEDURE NUMBER:** \*RSP-0008  
**REVISION NUMBER:** \*14  
**Effective Date:** \*02/11/2013

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**NOTE : SIGNATURES ARE ON FILE.**

TemRev 2 AddCounter 110 Att Enc DS MSet REGULAR KWN OFF  
INFORMATION USE

\*INDEXING INFORMATION

**TABLE OF CHANGES**

LETTER DESIGNATION TRACKING NUMBER	DETAILED DESCRIPTION OF CHANGES

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1 **PURPOSE/OBJECTIVES**

- 1.1 This manual provides a concise description of the environmental dose models and techniques used to calculate offsite doses resulting from measured or projected releases of radioactive materials from River Bend Nuclear Station. It also provides the methodology for calculating effluent monitoring setpoints and allowable release rates to ensure compliance with the Radiological Effluent Technical Requirements of River Bend Station. This manual also contains a description of the Radiological Environmental Monitoring Program that includes sample point descriptions for both onsite and offsite locations and sampling and analysis frequencies.
- 1.2 The ODCM follows the methodology and models suggested by the "Guidance Manual for Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants" (NUREG-0133, dated October 1978) and "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I" (Regulatory Guide 1.109, Rev. 1, dated October 1977). Alternate calculational methods may be used from those presented as long as the overall methodology does not change or as long as the alternative methods provide results that are more accurate. Also, as available, the most up-to-date revision of Regulatory Guide 1.109 dose conversion factors and site-specific environmental criteria may be used.
- 1.3 The description of information that should be included in the Annual Radiological Environmental Operating Report is located in Section 5.6.2 of the Technical Requirements Manual. The description of information that should be included in the Radioactive Effluent Release Report is located in Section 5.6.3 of the Technical Requirements Manual and states as follows:

Annual Effluent Release Report

Routine Annual Radioactive Effluent Release Report covering the operation of the unit during the previous 12 months of operation shall be submitted as required by Technical Specification 5.6.3

The Annual Radioactive Effluent Release Report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the facility 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 three additional categories: class of solid wastes (as defined by 10 CFR Part 61), type of container (e.g., LSA, Type A, Type B, Large Quantity) and SOLIDIFICATION agent or absorbent (e.g., cement, urea formaldehyde)

## INFORMATION USE

The Annual Radioactive Effluent Release Report shall include a summary of hourly meteorological data collected over the previous year. This summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction and atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. This same report shall include 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. The report shall also include 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 (USAR section 2.1) 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. The assessment of radiation doses shall be performed in accordance with the methodology and parameters of the ODCM.

The Annual Radioactive Effluent Release Report shall also include 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 40 CFR 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 NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," Rev. 0, October 1978.

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

The Annual Radioactive Effluent Release Report shall include any changes made during the reporting period to the PROCESS CONTROL PROGRAM (PCP) and to the ODCM, as well as a listing of new locations for dose calculations and environmental monitoring identified by the land use census pursuant to Requirement 3.12.2.

## 2 REFERENCES

- 2.1 NUREG 0133; Guidance Manual for Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants; October, 1978
- 2.2 REG. GUIDE 1.109, Rev. 1, October, 1977; Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Compliance with 10 CFR Part 50, Appendix I
- 2.3 River Bend Environmental Report, OLS
- 2.4 River Bend Environmental Report, CPS
- 2.5 River Bend Station USAR

## INFORMATION USE

- 2.6 River Bend Technical Specifications
- 2.7 River Bend Technical Requirements Manual (TRM)
- 2.8 River Bend Station Radiological Environmental Operating Report for 1985
- 2.9 REG. GUIDE 1.111; Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water - Cooled Reactors
- 2.10 U.S. Code of Federal Regulations; 10CFR20
- 2.11 U.S. Code Of Federal Regulations, 10CFR50
- 2.12 U.S. Code of Federal Regulations, 40CFR190
- 2.13 NUREG 0543, Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190)
- 2.14 NUREG/CR-2919, XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations
- 2.15 NUREG/CR-3332, ORNL 5968, USNRC Radiological Assessment, A Textbook on Environmental Dose Analysis (1983)

### 3 **DEFINITIONS**

- 3.1 MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the utility, its contractors or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational or other purposes not associated with the plant.
- 3.2 The OFFSITE DOSE CALCULATION MANUAL shall contain the methodology and parameters used in the calculation of offsite doses due to radioactive gaseous and liquid effluents and in the calculation of gaseous and liquid effluent monitoring alarm/trip setpoints. It shall also contain a table and figure defining current radiological environmental monitoring sample locations.
- 3.3 The SITE BOUNDARY shall be that line beyond which the land is not owned, leased, or otherwise controlled by the licensee.



## INFORMATION USE

- 3.4 An UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the site boundary used for residential quarters or for industrial, commercial, institutional, and/or recreational purposes.
- 3.5 A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine and/or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and HEPA filters 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.

## 4 RESPONSIBILITIES

- 4.1 The Radiation Protection Manager or designee is responsible for the development and implementation of the "Offsite Dose Calculation Manual [ODCM] Procedure," which involves review of REMP-related ESPs and program changes, as well as coordination of revisions to the ODCM necessitated by results of the REMP and/or annual Land Use Census. The Radiation Protection Manager or designee, reviews the ODCM and Annual Radiological Environmental Operating Report prior to its submission for approval by the General Manager - Plant Operations. The Radiation Protection Manager or designee, coordinates the preparation of other reports for which the ODCM may provide input (e.g., special reports on excessive doses to members of the public in unrestricted areas attributable to RBS effluents).
- 4.2 The Manager - Operations is responsible for the development and upkeep of the RBS Technical Requirements and Surveillance Test Procedure Cross Reference matrix that includes applicable STP's.
- 4.3 The Director - Nuclear Safety Assurance is responsible for identifying proposed changes to the Technical Requirements and other regulatory documents which would alter the Surveillance Test Program requirements.
- 4.4 The Manager - Planning & Scheduling Outages is responsible for developing, maintaining, and adjusting a station-wide schedule for performance of Surveillance Test Procedures.
- 4.5 The Manager - Chemistry has overall responsibility for the development and implementation of the Radiological Environment Monitoring Program (REMP) to include, as a minimum: developing ODCM related procedures, sampling, report generation, and immediate notification to the Radiation Protection Manager of any REMP result which indicates that a reporting level has been exceeded.

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## INFORMATION USE

- 4.6 The Senior Environmental Specialist has responsibility for supervising the day to day performance and documentation of Surveillance of the ODCM.
- 4.7 The Environmental Specialist has responsibility for the implementation of surveillances and documentation of the ODCM. This responsibility includes timely notification of the Manager - Chemistry of any problem which impacts, or might impact, fulfillment of the Radiological Effluent Technical Requirements and the ODCM.

## 5 PRECAUTIONS AND LIMITATIONS

- 5.1 Licensee-initiated changes to the ODCM shall be made per Reference 2.6 § 5.5.1.
- 5.2 No changes(s) shall be made to the ODCM that will reduce the accuracy or reliability of dose calculations or setpoint determinations.
- 5.3 A change to the ODCM may cause a deviation from methodologies used in the implementing procedures. Any change to RSP-0008 shall have an independent Review from Chemistry, as a minimum, and also requires Chemistry and Radiation Protection to meet and discuss changes to RSP-0008 prior to approval to ensure ODCM methodology compliance.

## 6 PREREQUISITES

- 6.1 None

## 7 LIQUID EFFLUENT METHODOLOGY

### 7.1 River Bend Site Description

The River Bend Station Updated Safety Analysis Report (USAR) contains the official description of the site characteristics. The description that follows is a brief summary for dose calculation purposes:

The River Bend Station (RBS) is on a site in West Feliciana Parish, Louisiana, located approximately 24 miles north-northwest of Baton Rouge, Louisiana. This site is just east of the Mississippi River, which is used as the source of the RBS major water requirements and which receives the RBS liquid effluents.

The reactor is a General Electric boiling water reactor of the BWR-6 or 1972 product line. Containment is of the Mark 3 design, a free-standing cylindrical steel structure surrounded by a reinforced concrete shield building.

7.2 Compliance with 10CFR20 (Liquids)

7.2.1. Requirements

In accordance with Technical Requirements 3.11.1.1, the concentration of radioactive material released in liquid effluents to Unrestricted Areas (Figure 1 shall be limited to ten times the concentrations specified in 10CFR20, 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  $2 \times 10^{-4}$   $\mu\text{Ci/ml}$  total activity. The concentration of radionuclides in liquid waste is determined by sampling and analysis in accordance with Technical Requirements.

7.2.2. Methodology

This section describes the calculational method to be used to determine  $F_L$ , the fraction of 10CFR20 limits of release concentrations of liquid radioactive effluents.

1. General Approach

Liquid effluent releases from River Bend Station are discharged through the cooling tower water blowdown, which is directed to the Mississippi River. Principal sources of radwaste are from floor drains, phase separators/backwash tank subsystem, recovery sample tanks, and reactor water cleanup (as shown in Figure 4). The liquid radwaste system is operated as a batch system. Only one tank of liquid radwaste is released at a time and is considered a batch.

The radioactive content of each batch release will be determined prior to release in accordance with Table 3.11.1.1.-1 of the RBS Technical Requirements. Compliance with TLCO 3.11.1.1 limits will be determined with the following equation:

**NOTE**

*$f_1$  shall be administratively controlled to maintain  $F_L$  to  $\leq 0.3$  for most discharges, as identified. If  $\sum \frac{C_i}{10ECL_i} \leq 0.3$  or if the calculated  $f_1 > 75$  GPM,  $f_1 = 75$  GPM. For  $F_L > 0.3$ , other administrative controls should be implemented to ensure discharges shall not exceed Technical Requirement limits.*

$$F_L = \frac{f_1}{f_1 + f_2} \sum_{i=1}^n \frac{C_i}{(10ECL)_i} \quad 7.2.2.1-1$$

$$\text{Where: } f_1 \leq \frac{660}{\sum \frac{C_i}{(10ECL)_i}} - 0.3$$

$F_L$  = The fraction of Technical Requirement limits resulting from the release source being discharged

$f_1$  = The undiluted release rate at monitor location, in gpm

$f_2$  = The cooling tower blowdown release rate, in gpm

$C_i$  = The undiluted concentration of nuclide (i), in  $\mu\text{Ci/ml}$  from sample assay.

$(10ECL)_i$  = Ten times the Effluent Concentration Limit of nuclide (i) from Attachment 2, in  $\mu\text{Ci/ml}$

As long as  $F_L$  is less than 1.0, the concentration of the tank is within compliance with TLCO 3.11.1.1 limits.

## 2. Simplified Approach

For purposes of simplifying the calculations, the value of  $1 \times 10^{-8} \mu\text{Ci/ml}$  (unidentified 10CFR20 ECL value) could be substituted for  $(ECL)_i$  and the cumulative concentration (C-Total = sum of all identified radionuclide concentrations) or the gross beta-gamma concentration should be substituted for  $C_i$ . As long as the diluted concentration ( $C\text{-Total} \times f_1 / (f_1 + f_2)$ ) is less than  $1 \times 10^{-8} \mu\text{Ci/ml}$ , the nuclide by nuclide calculation is not required to demonstrate compliance with 10CFR20 ECL limits.

## 7.3 Determination of Setpoints for Radioactive Liquid Effluent Monitors

### 7.3.1. Requirements

Technical Requirements 3.3.11.2 requires the radioactive liquid effluent monitor be operable with their high alarm/trip setpoints set to ensure that limits of Technical Requirements 3.11.1.1 are not exceeded. The high alarm/trip setpoints shall be determined and adjusted by the methodology which follows:

The high alarm setpoint for the liquid effluent radiation monitor is derived from ten times the concentration limit provided in 10CFR20, Appendix B, Table 2, Column 2 applied at the restricted area boundary where the discharge flows into the Mississippi River.

Liquid Monitor Setpoints calculated in accordance with the methodology presented in this section will be regarded as upper bounds for the actual high alarm setpoints. That is, a lower high alarm setpoint may be established on the monitor, if desired. Alert level setpoints should be established at an appropriate level to give sufficient warning prior to reaching the high alarm setpoint.

1. Liquid Effluent Monitor

A General Atomics liquid monitor (radwaste effluent RMS-RE107) equipped with a RD-53 detector with sufficient range ( $10^1$  to  $10^7$  cpm) is provided to ensure compliance with Technical Requirements limits for liquid releases. The RD-53 is an offline gamma scintillation (NaI) detector designed for detecting radioactivity in liquids. The monitor consists of a removable sample canister surrounded by Pb shielding. A well inside the canister holds the detector within the sample fluid

7.3.2. Methodology

The high alarm setpoint does not consider dilution, dispersion, or decay of radioactive material beyond the site boundary. That is, the alarm setpoint is based on a concentration limit at the end of the blowdown line.

1. Liquid Radwaste Effluent Monitor (RMS-RE107)

A sample of each batch of liquid radwaste is analyzed for I-131 and other principal gamma emitters as specified in Table 3.11.1.1-1 of Technical Requirements 3.11.1.1, for total activity concentration prior to release. The fraction,  $F_L$ , of the TLCO 3.11.1.1 limits for unrestricted areas is determined in accordance with the preceding section for the activity concentration released.

**NOTE**

*A change to the ODCM may cause a deviation from methodologies used in implementing procedures (i.e., CSP-0110). Any change to RSP-0008 shall have an independent Review from Chemistry, as a minimum, to ensure ODCM methodology compliance.*

The liquid radwaste effluent monitor will terminate a liquid radwaste discharge if activity levels exceed the Technical Requirements limits. The automatic actions associated with a trip of the monitor are:

1. LWS-AOV257 closes
2. LWS-AOV258 opens

An alarm will also be annunciated in the main control room.

## INFORMATION USE

The liquid radwaste effluent line radiation monitor alarm setpoint is determined with the equation:

$$S = \frac{A}{F_L} \times g \times M \quad 7.3.2.1-1$$

Where:

- S = the radiation monitor setpoint (cpm or  $\mu\text{Ci/ml}$ )
- A = the sum of concentrations of gamma-emitting radionuclides in the sample, as measured in the laboratory.
- $F_L$  = the fraction of TLCO 3.11.1.1 limits resulting from the release source being discharged.
- g = "Instrument Correction Factor"; the ratio of effluent radiation monitor counting rate to laboratory counting rate or activity concentration in a given batch of liquid (cpm per cpm/ml, cpm per  $\mu\text{Ci/ml}$ , or  $\mu\text{Ci/ml}$  per  $\mu\text{Ci/ml}$ )
- M = Setpoint Adjustment Factor - error associated with monitor accuracy

### NOTE

*A/ $F_L$  represents the counting rate of a liquid waste stream that would have the same radionuclide distribution as the given batch, but that would produce a concentration of 10 ECL at the point of discharge into the Unrestricted Area.*

### NOTE

*A background determination should be performed prior to each release. Background subtraction may be performed in accordance with the applicable Chemistry procedures.*

### 7.3.3. Zero and Very Low Gamma Activity

1. For batches with no gamma activity, the requirements of TR 3.11.1.1 are automatically met for those isotopes. However, with no gamma activity or very low gamma activity, then the monitor set point is based primarily on beta emitters, which RMS-RE107 does not respond to and the ODCM set point calculation in equation 7.3.2.1-1 will not work.

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2. Whenever gamma activity is zero or too low to calculate the alarm set point with the methodology stated in 7.3.2.1-1, a “dummy isotope” will be used. The “dummy isotope” will be an artificial isotope with a gamma activity assigned to raise the actual measured gamma activity in the batch sufficiently to allow discharge. The value of the “dummy isotope” will be calculated in a manner that limits the alarm set point to a predetermined threshold value. This threshold value will not allow the alarm set point to be higher than needed to perform the discharge of the batch.
3. The “dummy isotope” will be removed in the post release process.

7.4 Determining the Dose for Radioactive Liquid Effluents

7.4.1. Requirements

Technical Requirements 3.11.1.2 requires the dose or dose commitment to a member of the public from radioactive material released in liquid effluents be determined on a cumulative basis at least every 31 days. Dose or dose commitment shall be limited to:

1. Less than or equal to 1.5 mrem to the total body and to less than or equal to 5 mrem to any organ, during any calendar quarter; and
2. 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.

7.4.2. Methodology

This section provides the methodology to calculate dose to all age groups and organs from all radionuclides identified in the liquid effluents.

The method is based on the methodology suggested by Sections 4.3 and 4.3.1 of NUREG-0133, Rev. 1, November 1978. The dose factors  $A_{ir}$  for all viable pathways are listed in Attachment 3.

The following equation provides a dose calculation to the total body or any organ for a given age group based on actual release conditions.

$$D_{ir} = \frac{A_{ir} * \Delta t * Q_i}{DF * D_w} \quad 7.4.2-1$$

$$D_{TOTAL\tau} = \sum_{i=1}^n D_{ir} \quad 7.4.2-2$$

Where:

$D_{TOTAL\tau}$  = The total dose commitment to the organ ( $\tau$ ) due to all releases during the desired time period in mrem.

## INFORMATION USE

- $D_{i\tau}$  = Dose commitment from radionuclide (i) received by organ ( $\tau$ ) of the adult age group during the time period (mrem).
- $A_{i\tau}$  = Site related dose commitment factor to the total body or any organ ( $\tau$ ) for each identified radionuclide (i). The  $A_{i\tau}$  values listed in Attachment 3 are site-related to RBS (mrem/hr per  $\mu\text{Ci/ml}$ ).
- $\Delta t$  = The total time for all batch releases that occurred in the period (hrs).
- $Q_i$  = The total quantity of nuclide (i) released during the interval  $\Delta t$  ( $\mu\text{Ci}$ ).
- $D_w$  = The near field dilution factor. Site specific value is 136.
- $DF$  = The total volume of dilution that occurred during the time period (ml).

The doses associated with each isotope may then be summed to provide the cumulative dose over a desired time period (e.g., sum all doses during a 31 day period, calendar quarter, or a year).

### 7.5 Projecting Dose for Radioactive Liquid Effluents

#### 7.5.1. Requirements

Technical Requirement 3.11.1.3 requires the liquid radwaste treatment system be used to reduce the radioactive materials in liquid wastes prior to their discharge when projected doses due to liquid effluents, to unrestricted areas (Figure 1) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31 day period.

#### 7.5.2. Methodology

The following calculational methodology shall be performed at least once per 31 day period:

$$L_{PD} = \frac{D_{TOTAL\tau}}{X_D} * 31 + D_{PA} \quad 7.5.2-1$$

$D_{TOTAL\tau}$  = The total dose commitment to the organ ( $\tau$ ) due to all releases during the desired time period.

$L_{PD}$  = Projected dose commitment (mrem) to organ ( $\tau$ ) during the 31 day period from liquid effluents.

$X_D$  = Number of days to date in the current quarter



$D_{PA}$  = The anticipated dose contribution to the total body or any organ  $\tau$ , due to planned activities during the next 31 day period, if those activities will result in liquid releases that are in addition to routine liquid effluents. If only routine liquid effluents are anticipated,  $D_{PA} = 0$ .

## 8 GASEOUS EFFLUENT METHODOLOGY

### 8.1 Introduction

River Bend Station discharges gaseous effluents through the Main Plant Exhaust Duct, Fuel Building Exhaust Duct, and Radwaste Building Exhaust Duct. The location of these release points in relation to the River Bend site is found in Figure 3. The gaseous effluent streams, radioactivity monitoring points, and effluent discharge points are shown schematically in Figure 2. All gaseous effluent releases from the Radwaste Building Exhaust Duct and Fuel Building Exhaust Duct are assumed to be ground level releases. The Main Plant Exhaust Duct routine releases are treated as a wake split (conditionally elevated) release.

### 8.2 Data Requirements for Gaseous Effluents

For the purpose of estimating offsite radionuclide concentrations and radiation doses, measured radionuclide concentrations in gaseous effluents and in ventilation air exhausted from the station are used. Table 3.11.2.1-1 in the Technical Requirements identifies the radionuclides in gaseous discharges for which sampling and analysis is done.

Historical annual average meteorological information will be used to calculate off-site dose and monitor set points. Modeling will be performed in accordance with the methodologies described in Reg. Guide 1.111 Rev. 1.

### 8.3 Instantaneous Release Rate and Setpoint Determination

#### 8.3.1 Instantaneous Release Rate Determination

The instantaneous release rate determination is performed to show compliance with the limits set forth in the TRM.

##### 1. Requirements

Technical Requirements 3.11.2.1 states that the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary (see Figure 1) shall be limited to the following:

1. For noble gases: Less than or equal to 500 mrem/year to the total body and less than or equal to 3,000 mrem/year to the skin; and

2. For I-131, I-133, tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: less than or equal to 1,500 mrem/year to any organ.

2. Methodology

1. Total Body and Skin Instantaneous Dose Rate Calculations

To determine the dose rate from noble gases in unrestricted areas, the following formulae are used:

$$DR_{TB} = \sum_{i=1}^n (K_i) (\overline{X/Q}) (\dot{Q}_i) \quad 8.3.1.2.1-1$$

$$DR_{SKIN} = \sum_{i=1}^n (L_i + 1.1M_i) (\overline{X/Q}) (\dot{Q}_i) \quad 8.3.1.2.1-2$$

Where:

$DR_{SKIN}$  = Dose rate to the skin in mrem/year

$DR_{TB}$  = Dose rate to the total body in mrem/year

$K_i$  = The total body dose factor due to gamma emissions for each identified noble gas radionuclide (i) in mrem/yr per  $\mu\text{Ci}/\text{m}^3$  Attachment 4

$L_i$  = Skin dose factor due to beta emissions for each identified noble gas radionuclide (i) in mrem/yr per  $\mu\text{Ci}/\text{m}^3$  Attachment 4

$M_i$  = The air dose factor due to gamma emissions for each identified noble gas radionuclide (i) in mrad/yr per  $\mu\text{Ci}/\text{m}^3$  Attachment 4

$\overline{X/Q}$  = The highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all Sectors ( $\text{sec}/\text{m}^3$ ). Attachment 9

$\dot{Q}_i$  = The release rate of radionuclide (i) in gaseous effluents from all releases in  $\mu\text{Ci}/\text{sec}$

1.1 = Conversion factor for  $M_i$  from mrad to mrem

In order to comply with the limits of the TRM,  $DR_{TB} \leq 500$  mrem/year and  $DR_{skin} \leq 3,000$  mrem/year must be met at the most limiting location, at or beyond the site boundary.

The  $(\overline{X/Q})$  values utilized in equations 8.3.1.2.1-1 and 8.3.1.2.1-2 are based upon maximum long-term annual average  $(\overline{X/Q})$  in the unrestricted area. Attachment 9 lists the maximum  $(\overline{X/Q})$  values for the RBS release points at the appropriate receptor locations.

To select the most limiting location, the highest  $(\overline{X/Q})$  for each release point is used (from Attachment 9):

$$(\overline{X/Q})_{MM} = 3.31 \times 10^{-6} \text{ sec/m}^3$$

$$(\overline{X/Q})_{GRD} = 4.21 \times 10^{-5} \text{ sec/m}^3$$

where:

$$(\overline{X/Q})_{MM} = \text{Chi}/Q \text{ for Main Plant exhaust duct (mixed mode)}$$

$$(\overline{X/Q})_{GRD} = \text{Chi}/Q \text{ for Radwaste Building exhaust duct (ground level) and for Fuel Building exhaust duct (ground level)}$$

(Attachment 9 contains the maximum  $(\overline{X/Q})$  and  $\overline{D/Q}$  values used in calculating individual doses.)

Release rates for all release points must be considered at the same time. If releases are occurring at the same time, the total instantaneous dose for all releases must be less than the limits of Technical Requirements 3.11.2.1. An administrative control limits the release rates for each of the three release points to 1/3 the total Technical Requirements doses.

## 2. Radioiodine, Tritium, and 8-day Particulate Dose Rate Calculations

The following calculational method is provided for determining the dose rate from radioiodine (I-131, I-133), Tritium and particulates with half-lives greater than 8 days and to determine if they are within the limits listed in Section 8.3.1.1.2.

In the calculation to show compliance with the TRM, only the inhalation pathway is considered, since it is the most limiting pathway.

Inhalation Pathway:

$$DR_{I\&8DP\tau} = \sum_{i=1}^i P_i (\overline{X/Q}) (\dot{Q}_i) \quad 8.3.1.2.2-1$$

where:

$DR_{I\&8DP\tau}$  = Dose rate to the organ  $\tau$  for the age group of interest from radioiodines (I-131 and I-133), tritium and 8 day particulates via the inhalation pathway (mrem/yr).

$\dot{Q}_i$  = Release rate of nuclide (i), ( $\mu\text{Ci}/\text{sec}$ ).

$(\overline{X/Q})$  = The highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all sectors ( $\text{sec}/\text{m}^3$ ). Attachment 9.

$P_i$  = The dose factor for applicable environmental pathway (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ ). Attachment 15 through Attachment 18.

Values for  $P_i$  were calculated for all age groups using the inhalation pathway methodology of NUREG-0133.

## 8.3.2. Setpoint Determination

### 1. Requirements

Instrumentation is provided to monitor beta-gamma radiation from radioactive materials released from the River Bend Station in gaseous effluents. Each release point process monitor listed in the TRM includes an alarm (HIGH ALARM) that is set to report when the radioactive noble gas in gaseous effluents (Main Plant exhaust duct, Fuel Building exhaust duct and/or Radwaste Building exhaust duct) is expected to cause a noble gas concentration at ground level offsite resulting in a dose rate equal to or greater than 500 mrem/yr to the total body and/or 3000 mrem/yr to the skin.

The ALERT alarm is set to report when the radioactive noble gas in gaseous effluents (Main Plant exhaust duct, Fuel Building exhaust duct and/or Radwaste Building exhaust duct) is expected to cause a noble gas concentration at ground level offsite that would result in meeting or exceeding either the 5 mrad per quarter gamma air dose or 10 mrad per quarter beta air dose limit (Technical Requirements 3.11.2.2). It is permissible to set the ALERT alarm at twice (2.0) normal (approximately 100 % unit power) detector background if nuisance alarms would result from setpoints based on gamma and beta air dose.

The distribution of radioactive noble gases in a gaseous effluent stream is determined by gamma spectrum analysis of identifiable radionuclides in effluent gas sample(s). Results of one or more previous analyses may be averaged to obtain a representative sample. In the event the distribution is unobtainable from measured data, the distribution of radioactive noble gases based on past data or calculated by the BWR-GALE code may be used.

To allow for multiple sources of releases from the three different release points, the allowable operating setpoints will be administratively controlled to allocate one-third (1/3) of the total allowable release to each of the release sources.

2. Methodology

1. HIGH ALARM Setpoint Determination

This section describes the methodology for determining and adjusting HIGH ALARM setpoints for the three release points:

a Wide Range Gas Monitor (WRGM)

Step 1. Determine  $Q_{TB}$  as follows:

$$Q_{TB} = \frac{(500)}{(\bar{X}/Q) \sum_{i=1}^n (K_i)(f_i)} \quad 8.3.2.2-1$$

where:

$Q_{TB}$  = maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent ( $\mu\text{Ci}/\text{sec}$ ).

$(\overline{X/Q})$  = The highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all Sectors (sec/m<sup>3</sup>). Attachment 9

$K_i$  = The total whole body dose factor due to gamma emissions from noble gas radionuclide (i) mrem/yr per  $\mu\text{Ci}/\text{m}^3$  from Attachment 4.

$f_i$  = Fraction of noble gas radionuclide (i) to total noble gas concentration.

500 = Whole body exposure limits of 500 mrem/year.

Step 2. Determine  $Q_s$  as follows:

$$Q_s = \frac{(3000)}{(\overline{X/Q}) \sum_{i=1}^n [(L_i + 1.1M_i) f_i]} \quad 8.3.2.2-2$$

where:

$Q_s$  = the maximum acceptable release rate of all gas radionuclides in the gaseous effluent [ $\mu\text{Ci}/\text{sec}$ ]

$L_i + 1.1M_i$  = Calculated total skin dose factor due to emission from noble gas radionuclide (i) mrem/yr/ $\mu\text{Ci}/\text{m}^3$  from Attachment 4.

$f_i$  = Fraction of noble gas radionuclide (i) to total noble gas concentration

$(\overline{X/Q})$  = The highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all Sectors (sec/m<sup>3</sup>), Attachment 9.

3000 = Skin exposure limit of 3000 mrem/year

Step 3. Select the lower of the Q values ( $Q_{TB}$  or  $Q_s$ ) obtained in Step 1 and Step 2.

**NOTE**

*Actual alarm setpoint in the data base may be modified to account for loop accuracy.*

Step 4. Multiply the Q value selected in Step 3 by 0.33. By multiplying the Q value by a factor of 0.33, the allowable operating setpoints will be administratively controlled to allocate one-third (1/3) of the total allowable release rate to each of the release points. The resultant product will be the actual ODCM release rate HIGH ALARM setpoint for the appropriate WRGM Monitor.

*b* Particulate and Gas Monitor (P&G) (gas channel only).

Step 1. Perform Steps 1 through 3 of Section 8.3.2.2.1.a above.

Step 2. Determine  $C_m$  (the maximum acceptable total radioactivity concentration of all noble gas radionuclides for all release points in the gaseous effluent [ $\mu\text{Ci/cc}$ ]):

$$C_m = \frac{(2.12 \times 10^{-3}) Q}{F} \qquad 8.3.2.2-3$$

where:

$2.12 \times 10^{-3}$  = Unit conversion factor to convert  $\mu\text{Ci/sec/cfm}$  to  $\mu\text{Ci/cc}$

Q = Lower of the two Q values,  $Q_{TB}$  or  $Q_S$

F = The maximum acceptable effluent flow rate at the point of release based on design flow rates (cfm)

**NOTE**

*Actual alarm setpoint in the database may be modified to account for loop accuracy.*

Step 3. Multiply the  $C_m$  value determined in Step 2 by 0.33. By multiplying the  $C_m$  value by a factor of 0.33, the allowable operating setpoints will be administratively controlled to allocate one-third (1/3) of the total allowable release to each of the release points. The resultant product will be the actual ODCM activity concentration HIGH ALARM setpoint for the appropriate P&G monitor gas channel.

2. ALERT Setpoint Determination (Reference 2.6)

This section describes the methodology for determining and adjusting ALERT setpoints for the three release points.

a Wide Range Gas Monitor (WRGM)

Step 1. Determine  $Q_{G-A}$  utilizing one of the following methods:

$$Q_{G-A} = \frac{(4)(5)}{(\overline{X/Q}) \sum_{i=1}^n M_i f_i} \quad 8.3.2.2-4$$

where:

$Q_{G-A}$  = The maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent [ $\mu\text{Ci}/\text{sec}$ ]

$(\overline{X/Q})$  = The highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all Sectors ( $\text{sec}/\text{m}^3$ ), Attachment 9

5 = 5 mrad/quarter gamma air dose limit at the unrestricted area boundary

$M_i$  = The gamma air dose factor for radioactive noble gas nuclide (i) in  $\text{mrad}\cdot\text{m}^3/\mu\text{Ci}\cdot\text{yr}$ , Attachment 4

$f_i$  = The fractional abundance of noble gas radionuclide i

4 = Number of Quarters Per Year

Step 2. Determine  $Q_{B-A}$  utilizing one of following methods:

$$Q_{B-A} = \frac{(4)(10)}{(\overline{X/Q}) \sum_{i=1}^n N_i f_i} \quad 8.3.2.2-5$$

Where:

$Q_{B-A}$  = maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluents  $\mu\text{Ci}/\text{sec}$



$(\overline{X/Q})$  = The highest calculated annual average relative dispersion factor for an area at or beyond the unrestricted area boundary for all sectors ( $\text{sec}/\text{m}^3$ ), Attachment 9

10 = 10 mrad/quarter (92 days) beta air dose limit at the unrestricted area boundary

$N_i$  = The air dose factor due to beta emissions from each noble gas radionuclide (i) in Attachment 4

$f_i$  = The fractional abundance of noble gas radionuclide i

4 = Number of Quarters Per Year

Step 3. Select the lower of the Q values obtained in Steps 1 and 2, either  $Q_{G-A}$  or  $Q_{B-A}$ .

Step 4. Multiply the Q value selected in Step 3 by 0.33. By multiplying the Q value by this factor, the allowable operating setpoints will be administratively controlled to allocate one-third (1/3) of the total allowable release rate to each of the release points. The resultant product will be the actual ODCM ALERT setpoint to be entered into the applicable WRGMs RM-80.

Step 5. If the actual ODCM ALERT setpoint determined in Step 4 is less than two times (2.0) the detector background, it is permissible to enter an ALERT setpoint equal to two times (2.0) the normal (approximately 100% unit power) detector background to reduce the possibility of nuisance alarms. The twice background setpoint should provide sufficient indication that an offsite dose limit could possibly be exceeded.

*b* Particulate and Gas Monitor (P&G) (gas channel only)

Step 1. Perform Steps 1 through 3 of Section 8.3.2.2.2.a above.

Step 2. Determine  $C_m$  (the maximum acceptable total radioactivity concentration of all noble gas radionuclides for all release points in gaseous effluent [ $\mu\text{Ci}/\text{cc}$ ]):

$$C_m = \frac{(2.12 \times 10^{-3})Q}{F} \quad 8.3.2.2-6$$

Where:

$2.12 \times 10^{-3}$  = Unit conversion factor to convert  $\mu\text{Ci}/\text{sec}/\text{cfm}$  to  $\mu\text{Ci}/\text{cc}$ .

$Q$  = Lower of the two  $Q$  values,  $Q_{G-A}$  or  $Q_{B-A}$

$F$  = The maximum acceptable effluent flow rate at the point of release based on design flow rates (cfm).

Step 3. Multiply the  $C_m$  value determined in Step 2 by 0.33. By multiplying the  $C_m$  value by this factor, the allowable operating setpoints will be administratively controlled to allocate (1/3) of the total allowable release to each of the release points. The resultant product will be the actual ODCM activity concentration ALERT setpoint. This value is the setpoint to be entered into the applicable P&G monitor's RM-80.

Step 4. If the actual ODCM ALERT setpoint determined in Step 3 is less than two times (2.0) the gas detector background, it is permissible to enter an ALERT setpoint equal to two times (2.0) the normal (approximately 100% unit power) gas detector background to reduce the possibility of nuisance alarms. The twice background setpoint should provide sufficient indication that an offsite dose limit could possibly be exceeded.

#### 8.4 Cumulative Dose Determination for Radioactive Gaseous Effluents

##### 8.4.1. Noble Gases

###### 1. Air Dose

###### 1. Requirements

Technical Requirements 3.11.2.2 states that the air dose due to noble gases released in gaseous effluents to areas at and beyond the site boundary (see Attachment 34) shall be limited to the following:

- a* During any calendar quarter: less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation; and
- b* During any calendar year: less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

###### 2. Methodology

This section provides the methodology to calculate the gamma and beta air doses to a maximum receptor location at the site boundary from all noble gas radionuclides identified in the gaseous effluents.

The method is based on the methodology suggested by sections 5.3 and 5.3.1 of NUREG-0133, Rev. 1, November 1978. The dose factors for beta and gamma air dose are listed in Attachment 4 and are obtained from Table B-1 of RG 1.109, Revision 1, October 1977.

The following equations provide for air dose calculations based on actual noble gas releases during a specific time interval for radioactive gaseous release sources at the site boundary:

$$D_{\text{Gamma-Air}} = 3.17E-8 \sum_{i=1}^n (M_i) (\overline{X/Q}) (Q_i) \quad 8.4.1.1.2-1$$

$$D_{\text{Beta-Air}} = 3.17E-8 \sum_{i=1}^n (N_i) (\overline{X/Q}) (Q_i) \quad 8.4.1.1.2-2$$

where:

$D_{\text{Gamma-Air}}$  = The gamma air dose from radioactive noble gases in mrad.

$M_i$  = The gamma air dose factor for radioactive noble gas nuclide (i) in mrad-m<sup>3</sup>/μCi-yr (Attachment 4)

3.17E-8 = Inverse of number of Seconds Per Year in Year/Sec

$(\overline{X/Q})$  = The highest calculated annual average relative dispersion factor for an area at or beyond the unrestricted area boundary for all sectors (sec/m<sup>3</sup>), Attachment 9

$Q_i$  = The quantity of μCi of nuclide (i) released during the period of interest

$D_{\text{Beta-Air}}$  = Beta air dose from radioactive noble gases in mrad

$N_i$  = The beta air dose factor for radioactive noble gas nuclide (i) in mrad-m<sup>3</sup>/μCi-yr (Attachment 4), Table C-1

2. Total Body and Skin Dose

1. Requirements

- a Technical Requirements 3.11.4 states that 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.
- b Technical Specification 5.5.4.j requires the limitations on the annual dose or dose commitment to any member of the public due to releases of radioactivity and to radiation from uranium fuel cycle sources, conforming to 40 CFR 190.

Cumulative doses from liquid effluents and gaseous pathways (radioiodines (I-131, I-133), Tritium and particulates with T 1/2 > 8 days) are determined in accordance with Sections 7.4.2 and 8.4.1.3. Cumulative total body and skin doses from noble gas releases are determined in accordance with Section 8.4.1.2.2.

2. Methodology

This section provides the methodology to calculate the total body and skin doses to the likely most-exposed MEMBER OF THE PUBLIC from all noble gas radionuclides identified in the gaseous effluents.

The method is based on the methodology suggested in section C.2 and Appendix B of NRC Regulatory Guide 1.109, revision 1, October 1977 and is used to calculate the doses in this section. The dose transfer factors required for the calculations are listed in Attachment 4 of this document and are obtained from Table B-1 of RG 1.109, Revision 1, October 1977.

Doses to the total body and to the skin, due to actual noble gas releases during a specific time interval, at the location of the likely most exposed MEMBER OF THE PUBLIC, are calculated as follows:

$$D_{TotalBody} = (S_F)(F_O)(3.17E-8) \sum_{i=1}^n (K_i)(\overline{X/Q})(Q_i) \quad 8.4.1.2.2-1$$

$$D_{Skin} = (F_O)(3.17E-8) \sum_{i=1}^n (L+1.1M(S_F))_i (\overline{X/Q})(Q_i) \quad 8.4.1.2.2-2$$

Where:

INFORMATION USE

$D_{\text{Total Body}}$  = The total body dose from radioactive noble gases in mrem

$K_i$  = The total whole body dose factor due to gamma emissions from noble gas radionuclide (i) (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ ) from Attachment 4, Table C-1

$(\overline{X/Q})$  = The highest calculated annual average relative dispersion factor for an area at or beyond the unrestricted area boundary for all sectors ( $\text{sec}/\text{m}^3$ ) (Attachment 9)

**NOTE**

*When calculating  $D_{\text{Total Body}}$  and  $D_{\text{Skin}}$  for determining 40CFR190 compliance as reported in the Annual Radioactive Effluent Release Report,  $(\overline{X/Q})$  values based on either historical annual-average meteorological data, or on data for the actual period of release, may be used.*

$Q_i$  = The number of  $\mu\text{Ci}$  of noble gas nuclide (i) released during the period of interest

$D_{\text{skin}}$  = The skin dose from radioactive noble gases in mrem

$M_i$  = The gamma air dose factor due to gamma emissions from each noble gas radionuclide (i) released Attachment 4, Table C-1

$F_o$  = Occupancy factor determined for the receptor at the given location (default = 1.0)

**NOTE**

*If a time period is less than one full year, determine the fraction of a year and multiply the fraction by  $3.17\text{E}-8$  for use in equations 8.4.1.2.2-1 and -2.*

$3.17\text{E}-8$  = Inverse of the number of seconds per year in yr/sec

$L_i$  = The skin dose factor due to beta emissions from noble gas radionuclide (i) (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ ) from Attachment 4, Table C-1

1.1 = Average ratio of tissue to air energy absorption coefficients

$S_F$  = 1.0, attenuation factor accounting for shielding provided by residential structures for maximally exposed individual

3. Radioiodine, Tritium, and 8 Day Particulate Dose to Any Organ from Cumulative Releases

1. Requirements

*a* Technical Requirements 3.11.2.3 states that the dose to a Member of the Public from Radioiodines (I-131, I-133), Tritium, and Particulates with  $T_{1/2} > 8$  days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

- i. During any calendar quarter: less than or equal to 7.5 mrem to any organ; and
- ii. During any calendar year: less than or equal to 15 mrem to any organ.

The dose to a member of the Public shall be determined at least once per 31 days for the current calendar quarter and current calendar year.

*b* Technical Requirement 3.11.4 states that the Annual (Calendar year) dose or dose commitment to any Member of the Public, due to releases of radioactivity and to radiation from Uranium Fuel Cycle sources, shall be limited to less than or equal to 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem.

2. Methodology

*a* The following calculational method is provided for determining the organ dose due to releases of radioiodines (I131, I133), tritium and particulates. It is based on Section 5.3.1 of NUREG-0133, Rev. 1, November 1978. The equation can be used for any age group provided that the appropriate dose factors are used and the total dose reflects only those pathways that are applicable to the age group. The total dose to an organ can then be determined by summing the pathways that apply to the receptor. The equations are:

**NOTE**

*When calculating organ doses due to the release of C-14 and/or tritium (H-3),  $(\bar{X}/Q)$  values, not  $(D/Q)$  values, must be used for cow milk, goat milk, meat and vegetation pathway calculations.*

Inhalation Pathways:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) (F_o) \sum_{i=1}^n (P_{i\tau}) (\overline{X/Q}) (Q_i) \quad 8.4.1.3-1$$

Ground Plane Pathway:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) (F_o) \sum_{i=1}^n (R_{i\tau}) (\overline{D/Q}) (Q_i) \quad 8.4.1.3-2$$

Contaminated Forage/Cow/Milk Pathway:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) (F_o) \sum_{i=1}^n (R_{i\tau}) (\overline{D/Q}) (Q_i) \quad 8.4.1.3-3$$

Contaminated Forage/Goat/Milk Pathway:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) (F_o) \sum_{i=1}^n (R_{i\tau}) (\overline{D/Q}) (Q_i) \quad 8.4.1.3-4$$

Contaminated Forage/Meats:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) (F_o) \sum_{i=1}^n (R_{i\tau}) (\overline{D/Q}) (Q_i) \quad 8.4.1.3-5$$

Fresh Fruits and Vegetables:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) (F_o) \sum_{i=1}^n (R_{i\tau}) (\overline{D/Q}) (Q_i) \quad 8.4.1.3-6$$

Total Dose:

$$D_{\tau} = \sum_{z=1}^n D_{I\&8DP\tau} \quad 8.4.1.3-7$$

Where:

$D_{I\&8DP\tau}$  = Dose to the organ ( $\tau$ ) for the age group of interest from radioiodines (I-131, I-133), tritium and 8-day particulates via the pathway of interest

$F_o$  = Occupancy factor defined for the receptor at the given location

$D_{\tau}$  = Total dose in mrem to the organ ( $\tau$ ) of a specified age group summed over all applicable pathways (Z)

$z$  = All the applicable pathways for the age group of interest

$P_{i\tau}$  = Inhalation dose conversion factor mrem/yr per  $\mu\text{Ci}/\text{m}^3$

$Q_i$  = The number of  $\mu\text{Ci}$  of nuclide (i) released during the year of interest

$R_{i\tau}$  = The dose factor for nuclide (i) for pathway (Z) to organ ( $\tau$ ) of the specified age group. For tritium, a site-specific absolute humidity (H) value of  $12.9 \text{ gm}/\text{m}^3$  was used for calculation. (See Attachment 15 through Attachment 33.)  
The units are:

$$\frac{\text{mrem} - \text{m}^3}{\mu\text{Ci} - \text{yr}} \text{ for pathways using } \left(\overline{X/Q}\right)$$

or

$$\frac{\text{mrem} - \text{m}^2 - \text{sec}}{\mu\text{Ci} - \text{yr}} \text{ for pathways using } \left(\overline{D/Q}\right)$$

$\left(\overline{D/Q}\right)$  = A long-term relative deposition value for elevated and ground level releases ( $\text{m}^{-2}$ )

$\left(\overline{X/Q}\right)$  = The highest calculated annual average relative dispersion factor for an area at or beyond the unrestricted area boundary for all sectors ( $\text{sec}/\text{m}^3$ ), Attachment 9.

$3.17 \times 10^{-8}$  = The inverse of the number of seconds per year (years/sec).

## 8.5 Dose Projection - Determination of Need to Operate Ventilation Exhaust Treatment System

### 8.5.1 Requirement

Technical Requirements 3.11.2.5 requires that the ventilation exhaust treatment system be used to reduce radioactive material in waste prior to discharge when the projected dose due to gaseous effluents (radioiodines (I-131, I-133), particulates  $T_{1/2} > 8$  days and H-3) would exceed 0.3 mrem to any organ in a 31 day period.



**NOTE**

*The ventilation exhaust treatment system does not reduce the noble gas concentration in plant effluents (See Definition 3.5).*

8.5.2. Methodology

The following calculation method is provided for determining the projected doses:

$$G_{PD} = \frac{\sum D_{\tau}}{X_D} * 31 + D_{PA} \quad 8.5.2-1$$

Where:

$G_{PD}$  = Projected dose due to radioiodines (I-131, I-133), particulates with T 1/2 > 8 days and H-3 during the current 31 day period (mrem)

$X_D$  = The number of days to date in the current quarter

$D_{\tau}$  = Cumulative total dose due to radioiodines (I-131, I-133), particulates with T 1/2 > 8 days and H-3 during the current quarter (mrem)

$D_{PA}$  = The anticipated dose contribution to the total body or any organ  $\tau$  due to planned activities during the next 31 day period, if those activities will result in gaseous releases that are in addition to routine gaseous effluents. If only routine effluents are anticipated,  $D_{PA} = 0$ . This value may be adjusted to account for any changes in operating conditions that could significantly alter actual releases, such as failed fuel or changes in ventilation flow rate.

A dose projection would be based on the latest results of the monthly calculations of the dose due to radioiodines (I-131, I-133), particulates with T 1/2 > 8 days, and H-3 (Section 8.4.1.3).

9 **RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM**

Attachment 1 contains the sample point description, sampling and collection frequency, analysis, and analysis frequency for various exposure pathways in the vicinity of RBS for the Radiological Environmental Monitoring Program. Attachment 34 and Attachment 38 indicate the locations of the various onsite and offsite sampling points and TLD locations.

## INFORMATION USE

This section describes only those elements of the Radiological Environmental Monitoring Program required by the RBS Technical Requirements Manual. Additional exposure pathways, sample points, analyses, and/or frequencies may be performed as described in Reference 2.3 Section 6.2.

Samples of groundwater are taken from onsite wells located to intercept any potential contamination of the Upland Terrace Aquifer so that any such contamination would be detected before migrating beyond RBS site boundaries.

### 10 **40CFR190 CONSIDERATIONS**

#### 10.1 Compliance with 40CFR190

Compliance with 40CFR190 as prescribed by Technical Requirements 3.11.4 is to be demonstrated only when one or more of Technical Requirement(s) 3.11.1.2.a, 3.11.1.2.b, 3.11.2.2.a, 3.11.2.2.b, 3.11.2.3a, and 3.11.2.3.b, including direct radiation are exceeded by a factor of 2. Once this occurs, EOI has 30 days to submit a report in accordance with Requirement 3.11.4.

#### 10.2 Calculations Evaluating Conformance with 40CFR190

To perform the calculations to evaluate conformance with 40CFR190, an effort is made to develop doses that are realistic by removing assumptions that lead to overestimates of dose to a Member of the Public (i.e., calculations for compliance with 10CFR50 Appendix I). To accomplish this, the following calculational rules are used:

- 10.2.1. Doses to Members of the Public via the liquid release pathway are considered to be < 1 mrem/yr (Ref NUREG-0543).
- 10.2.2. Doses to a member of the Public due to a milk pathway will be evaluated only as can be shown to exist. Otherwise, doses via this pathway will be estimated as < 1 mrem/yr.
- 10.2.3. Environmental sampling data that demonstrate that no pathway exists may be used to delete a pathway to man from a calculation.
- 10.2.4. To sum numbers represented as "less than" (<), use the value of the largest number in the group.  
  
e.g., <5 + <1 + <1 + <3 = <5
- 10.2.5. When doses via direct radiation are added to doses via inhalation pathway, they will be calculated for the same distance in the same sector.
- 10.2.6. The calculational locations for a Member of the Public will only be at residences or places of employment.

**NOTE**

*Additional assumptions may be used to provide situation specific parameters, provided they are documented along with their concomitant bases.*

**NOTE**

*Estimates for each of the calculations below will be made for each of the following exposure pathways to the same location by age class. Only those age classes known to exist at a location are considered.*

10.3 Calculations of Total Body Dose

10.3.1. Direct Radiation (from storage tanks, N-16 sources, etc.)

The component of dose to a Member of the Public due to direct radiation will be determined by thermoluminescent dosimeters (TLDs).

10.3.2. Inhalation Dose

The inhalation dose will be determined at the calculational locations for each age group according to the methods outlined in Section 8 of this manual.

10.3.3. Ingestion Pathway (cow milk, goat milk, meat, vegetation)

The dose via the ingestion pathway will be calculated at the consumer locations for the consumers at risk. If no milk pathway exists in a sector, the dose via this pathway will be treated as < 1 mrem/yr.

10.3.4. Total Body Noble Gas Immersion Dose

This dose will be calculated in accordance with Section 8.4.1.2.2 . for the maximally exposed MEMBER OF THE PUBLIC in the limiting sector.

10.3.5. Ground Plane Deposition

10.3.6. Other Uranium Fuel Cycle Sources

The dose from other fuel sources will be treated as < 1 mrem/yr.

10.4 Thyroid Dose

The dose to the thyroid will be calculated for the limiting sector as the sum of:

10.4.1. Direct Radiation (from storage tanks, N-16 sources, etc.)

## INFORMATION USE

The component of dose to the thyroid due to direct radiation will be determined by thermoluminescent dosimeters (TLDs).

### 10.4.2. Inhalation Dose

The inhalation dose to the thyroid will be determined at the calculational locations for each age group according to the methods outlined in Section 8 of this manual.

### 10.4.3. Ingestion Pathway (cow milk, goat milk, meat, vegetation)

The dose to the thyroid via the ingestion pathway will be calculated at the consumer locations for the consumers at risk. If no milk pathway exists in a sector, the dose via this pathway will be treated as  $< 1$  mrem/yr.

### 10.4.4. Noble Gas Immersion Dose

It is assumed that an external total body dose from noble gases irradiates internal body organs at the same numerical rate (Reference 2.8). This dose for the thyroid will therefore be equal to the dose calculated in Step 10.3.4 above.

### 10.4.5. Ground Plane Deposition

### 10.4.6. Other Uranium Fuel Cycle Sources

The dose from other fuel cycle sources will be treated as  $< 1$  mrem/yr.

## 10.5 Organ Dose (other than thyroid and skin)

The dose to any organ will be calculated for the limiting sector as the sum of:

### 10.5.1. Direct Radiation (from storage tanks, N-16 sources, etc.)

The component of dose to an organ due to direct radiation will be determined by thermoluminescent dosimeters (TLDs).

### 10.5.2. Inhalation Dose

The inhalation dose to an organ will be determined at the calculational locations for each age group according to the methods outlined in Section 8 of this manual.

### 10.5.3. Ingestion Pathway (cow milk, goat milk, meat, vegetation)

The dose to an organ via the ingestion pathway will be calculated at the consumer locations for the consumers at risk. If no milk pathway exists in a sector, the dose via this pathway will be treated as  $< 1$  mrem/yr.

## INFORMATION USE

### 10.5.4. Noble Gas Immersion Dose

It is assumed that an external total body dose from noble gases irradiates internal body organs at the same numerical rate (Reference 2.8). This dose for an organ will therefore be equal to the dose calculated in Step 10.3.4 above.

### 10.5.5. Ground Plane Deposition

### 10.5.6. Other Uranium Fuel Cycle Sources

The dose from other fuel cycle sources will be treated as  $< 1$  mrem/yr.

## 10.6 Skin Dose

The dose to the skin will be calculated for the limiting sector as the sum of:

### 10.6.1. Direct Radiation (from storage tanks, N-16 sources, etc.)

The component of dose to the skin due to direct radiation will be determined by thermoluminescent dosimeters (TLDs).

### 10.6.2. Inhalation Dose

The inhalation dose to the skin (only tritium is considered) will be determined at the calculational locations for each age group according to the methods outlined in Section 8 of this manual.

### 10.6.3. Ingestion Pathway (cow milk, goat milk, meat, vegetation)

The dose to the skin via the ingestion pathway (only tritium and C-14 considered) will be calculated at the consumer locations for the consumers at risk. If no milk pathway exists in a sector, the dose via this pathway will be treated as  $< 1$  mrem/yr.

### 10.6.4. Skin Noble Gas Immersion Dose

This dose will be calculated in accordance with Section 8.4.1.2.2 for the maximally exposed MEMBER OF THE PUBLIC in the limiting sector(s).

### 10.6.5. Ground Plane Deposition

### 10.6.6. Other Uranium Fuel Cycle Sources

This dose from other fuel cycle sources will be treated as  $< 1$  mrem/yr.

11 **INTERLABORATORY COMPARISON STUDIES**

11.1 Requirement

Technical Requirements 3.12.3 states that analyses shall be performed on radioactive materials, that correspond to samples required by Table 3.12.1-1, supplied as part of an Interlaboratory Comparison Program.

11.2 Program

11.2.1. Environmental Sample Analyses Comparison Program

Environmental samples from the River Bend Station are to be analyzed by the River Bend Station Environmental Services Group or by a qualified contracting laboratory. These laboratories will participate in an Environmental Radioactivity Laboratory Intercomparison Studies (Crosscheck) Program. This participation will include all of the determinations (sample-radionuclide combinations) that are included in the licensee's Radiological Environmental Monitoring Program. Results of the Interlaboratory Program will be included in the Annual Radiological Environmental Operating Report.

11.2.2. Effluent Release Analyses Program

RBS Chemistry Group will perform sample analyses for gamma-emitting radionuclides in effluent releases. The radiochemistry laboratory will participate annually in a corporate interlaboratory comparison study or an equivalent study. The results of these studies will be provided to the NRC upon request.

11.2.3. Abnormal Results

The RBS laboratory values and the vendor laboratory "known values" should be compared by some evaluation criteria such as the EPA method, where the acceptable result lies between  $\pm$  three normalized standard deviations from the "known value"; or the NIST traceability method, where the difference between the RBS value and the "known value" should be less than the total propagated uncertainty of the difference. If deviations from such criteria exist, an evaluation will be performed to identify any recommended remedial actions to reduce anomalous errors. Complete documentation on the evaluation will be provided to the NRC upon request.

**TABLE 4.1 - RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM**

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
1. Airborne Particulates and I-131	<p>Samples from 4 locations:</p> <p>AP1. Behind River Bend Station Activity Center; 0.9 km WNW.</p> <p>AQS2. St. Francis Substation on US Hwy. (Bus.) 61 in St. Francisville; 5.8 km NW (Community Location).</p> <p>AGC. Entergy Service Center compound in Zachary; 17 km SE (Control)</p> <p>AN1. RBS site Hwy 965; 0.4 km south of Activity Center; 0.9 km W.</p>	<p>Continuous air sampler with filter collection every two weeks, or as required by dust loading, whichever is more frequent.</p>	<p>Charcoal cartridge: analysis every two weeks for I-131. Particulate sampler: gross beta activity following filter changes every two weeks.</p>
2. Direct Radiation	<p>Measurements from 24 locations:</p> <p>INDICATOR STATIONS</p> <p>TA1. River Bend Training Center; 1.7 km N.</p> <p>TB1. Utility pole near River Bend Station cooling tower yard area; 0.5 km NNE.</p> <p>TC1. Stub pole at Jct. US Hwy. 61 and Old Highway 61; 1.7 km NE.</p> <p>TD1. Stub pole along WF7, 150m S of Jct. WF7 and US Hwy. 61; 1.6 km ENE.</p> <p>TE1. Stub pole along WF7, 1 km S of Jct. WF7 and US Hwy. 61; 1.3 km E.</p> <p>TF1. Stub pole along WF7, 1.6 km S of Jct. WF7 and US Hwy. 61; 1.3 km ESE.</p> <p>TG1. Stub pole along WF7, 2 km S of Jct. WF7 and US Hwy. 61; 1.6 km SE.</p>	<p>Thermoluminescence dosimeters (TLDs); deployment/retrieval quarterly.</p>	<p>mR exposure quarterly.</p>

**TABLE 4.1 - RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM**

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
	TH1. Stub pole at power line crossing of WF7 (near Grants Bayou); 1.7 km SSE.		
	TJ1. Stub pole near River Bend Station Gate #23 on Powell Station Road (LA Hwy. 965); 1.5 km S.		
	TK1. Utility pole on Powell Station Road (LA Hwy. 965), 20 m S of River Bend Station River Access Road; 0.9 km SSW.		
	TL1. First utility pole on Powell Station Road (LA Hwy. 965) S of former Illinois Central Gulf RR crossing; 1.0 km SW.		
	TM1. Third utility pole on Powell Station Road (LA Hwy. 965) N of former Illinois Central Gulf RR crossing; 0.9 km WSW.		
	TNI. Utility pole along Powell Station Road (LA Hwy. 965), near garden and AN1 air sampler location; 0.9 km W.		
	TP1. Behind River Bend Station Activity Center at AP1 air sampler location; 0.9 km WNW.		
	TQ1. Across from MA1 on RBS North Access Road; 0.6 km NW.		
	TR1. River Bend Station North Access Road across from Main Plant entrance; 0.8 km NNW.		
	<b>CONTROL/SPECIAL STATIONS</b>		
	TAC. Utility pole at Jct. of US Hwy. 61 and LA Hwy. 421, 7.9 km north of Bains; 15.8 km N. (Control)		
	TQS1. Utility pole front of Pentecostal church (opposite West Feliciana Parish Hospital) near Jct. US Hwy. 61 and Commerce Street; 4 km NW (Special)		



**TABLE 4.1 - RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM**

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
	TQS2. St. Francis Substation on business US Hwy.61 in St. Francisville; 5.8 km NW (Special).		
	TNS. Utility pole with electrical meter at west bank ferry landing (LA Hwy. 10); 6.0 km W. (Special)		
	TEC. Stub pole at jct. of Hwy. 955 and Greenbrair Road, 4.8 km North of Jct. of Hwys 955 and 964; 16 km E. (Control)		
	TCS. Utility pole at gate to East Louisiana State Hospital in Jackson; 12.3 km NE. (Special)		
	TGS. Entergy Service Center compound in Zachary; 17 km SE (Special).		
	TRS. Stub pole at Jct. of US Hwy. 61 and WF2 near Bains. (West Feliciana High School); 9.2 km NNW. (Special)		
3. Waterborne	SURFACE WATER (1)		
	SWU. Mississippi River about 4 km upstream from the plant liquid discharge outfall, near LA Hwy. 10 ferry crossing. (5km, W)	Quarterly grab.	Quarterly: gamma isotopic analysis; quarterly tritium analysis.
	SWD. Mississippi River about 4 km downstream from plant liquid discharge outfall, near paper mill. (7.75 km, S)		
	GROUNDWATER		
	WU. Upland Terrace Aquifer well upgradient from plant, about 470 m NNE.	Semiannual grab	Gamma isotopic and tritium analysis semiannually.
	WD. Upland Terrace Aquifer well downgradient from plant, about 470 m SW.		

**TABLE 4.1 - RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM**

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
SHORELINE SEDIMENT			
4. Ingestion <sup>(2)</sup>	SEDD. Mississippi River downstream from plant liquid discharge outfall, near paper mill. (7.75 km, S)	Annual grab	Gamma isotopic analysis annually.
	FISH AND INVERTEBRATES		
	FU. One sample of a commercially and/or recreationally important species from upstream area not influenced by plant discharge. (4 km, WSW)	Annually.	Gamma isotopic analysis on edible portions annually.
	FD. One sample of a commercially and/or recreationally important species from downstream area influenced by plant discharge. (7.75 km, S)		
FOOD PRODUCTS			
	GN1. One sample of leafy vegetation from onsite garden near site boundary in sector of highest calculated average ground level D/Q, (0.9 km, W)	Quarterly during growing season.	Gamma isotopic and I-131 analyses quarterly.
	GQC. One sample of similar vegetation from LA State Penitentiary at Angola, 32 km NW (Control).		

**NOTES:**

1. The upstream sample will be taken at a distance beyond significant influence of the plant discharge. The downstream sample will be taken in an area beyond but near the mixing zone.

2. If milk-producing animals become available within a 8-km radius of the plant, sampling will be performed in accordance with Table 3.12.1-1, Section 4.a of the Technical Requirements Manual.

ECL VALUES

EFFLUENT CONCENTRATION LIMIT (µCi/ml)			ECL VALUES		
NUCLIDE	AIR	WATER	NUCLIDE	AIR	WATER
H-3	1E-07	1E-03	SB-126	7E-10	7E-06
BE-7	3E-08	6E-04	SB-127	1E-09	1E-05
C-14	3E-09	3E-05	TE-127M	4E-10	9E-06
NA-24	7E-09	5E-05	TE-127	2E-08	1E-04
P-32	5E-10	9E-06	TE-129M	3E-10	7E-06
CR-51	3E-08	5E-04	TE-129	9E-08	4E-04
MN-54	1E-09	3E-05	TE-131M	1E-09	8E-06
MN-56	2E-08	7E-05	TE-131	2E-08	8E-05
FE-55	3E-09	1E-04	TE-132	9E-10	9E-06
FE-59	5E-10	1E-05	I-130	3E-09	2E-05
CO-56	3E-10	6E-06	I-131	2E-10	1E-06
CO-57	9E-10	6E-05	I-132	2E-08	1E-04
CO-58	1E-09	2E-05	I-133	1E-09	7E-06
CO-60	5E-11	3E-06	I-134	6E-08	4E-04
NI-63	1E-09	1E-04	I-135	6E-09	3E-05
NI-65	2E-08	1E-04	CS-134	2E-10	9E-07
CU-64	3E-08	2E-04	CS-135	2E-09	1E-05
ZN-65	4E-10	5E-06	CS-136	9E-10	6E-06
ZN-69	2E-07	8E-04	CS-137	2E-10	1E-06
ZN-69M	1E-08	6E-05	CS-138	8E-08	4E-04
SE-75	8E-10	7E-06	BA-133	9E-10	2E-05
BR-82	5E-09	4E-05	BA-139	4E-08	2E-04
BR-83	9E-08	9E-04	BA-140	2E-09	8E-06
BR-84	8E-08	4E-04	BA-141	1E-07	3E-04
RB-86	1E-09	7E-06	BA-142	2E-07	7E-04
RB-88	9E-08	4E-04	LA-140	2E-09	9E-06
RB-89	2E-07	9E-04	LA-142	3E-08	1E-04
SR-85	2E-09	4E-05	CE-139	9E-10	7E-05
SR-89	2E-10	8E-06	CE-141	8E-10	3E-05
SR-90	6E-12	5E-07	CE-143	2E-09	2E-05
SR-91	5E-09	2E-05	CE-144	2E-11	3E-06
SR-92	9E-09	4E-05	PR-143	9E-10	2E-05
Y-88	3E-10	1E-05	PR-144	2E-07	6E-04
Y-90	9E-10	7E-06	ND-147	1E-09	2E-05
Y-91M	2E-07	2E-03	EU-152	3E-11	1E-05
Y-91	2E-10	8E-06	W-187	1E-08	3E-05
Y-92	1E-08	4E-05	NP-239	3E-09	2E-05
Y-93	3E-09	2E-05	AR-41	1E-08	0E+00
ZR-95	4E-10	2E-05	KR-83M	5E-05	0E+00
ZR-97	2E-09	9E-06	KR-85M	1E-07	0E+00
NB-94	2E-11	1E-05	KR-85	7E-07	0E+00
NB-95	2E-09	3E-05	KR-87	2E-08	0E+00
NB-97	1E-07	3E-04	KR-88	9E-09	0E+00
MO-90	6E-09	3E-05	KR-89	1E-09	0E+00
MO-99	2E-09	2E-05	KR-90	1E-09	0E+00
TC-99M	2E-07	1E-03	XE-131M	2E-06	0E+00
TC-101	5E-07	2E-03	XE-133M	6E-07	0E+00
RU-103	9E-10	3E-05	XE-133	5E-07	0E+00
RU-105	2E-08	7E-05	XE-135M	4E-08	0E+00
RU-106	2E-11	3E-06	XE-135	7E-08	0E+00
AG-110M	1E-10	6E-06	XE-137	1E-09	0E+00
CD-109	7E-11	6E-06	XE-138	2E-08	0E+00
CD-113M	5E-12	5E-07	G-APLHA	1E-15	2E-09
SN-113	8E-10	3E-05	G-BETA	1E-12	1E-08
SN-117M	2E-09	3E-05	OTHER	0E+00	0E+00
SB-122	2E-09	1E-05	RH-105	8E-09	5E-05
SB-124	3E-10	7E-06	SC-46	3E-10	1E-05
SB-125	7E-10	3E-05	AS-76	2E-09	1E-05

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TABLE B-1: LIQUID ENVIRONMENTAL DOSE TRANSFER FACTORS

A<sub>it</sub> Table B-1  
DOSE FACTOR TABLE: A<sub>it</sub> - Adult, liquid  
Units are mrem/hr per µCi/ml

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	2.81E-01	2.81E-01	2.81E-01	2.81E-01	2.81E-01	2.81E-01	0.00E+00
C-14	4.61E+04	9.22E+03	9.22E+03	9.22E+03	9.22E+03	9.22E+03	9.22E+03	0.00E+00
NA-24	6.02E+02	6.02E+02	6.02E+02	6.02E+02	6.02E+02	6.02E+02	6.02E+02	0.00E+00
P-32	4.85E+07	3.01E+06	1.87E+06	0.00E+00	0.00E+00	0.00E+00	5.45E+06	0.00E+00
CR-51	0.00E+00	0.00E+00	4.31E+00	2.58E+00	9.50E-01	5.72E+00	1.08E+03	0.00E+00
MN-54	0.00E+00	2.39E+05	4.56E+04	0.00E+00	7.12E+04	0.00E+00	7.33E+05	0.00E+00
MN-56	0.00E+00	6.02E+03	1.07E+03	0.00E+00	7.64E+03	0.00E+00	1.92E+05	0.00E+00
FE-55	5.68E+03	3.93E+03	9.16E+02	0.00E+00	0.00E+00	2.19E+03	2.25E+03	0.00E+00
FE-59	8.97E+03	2.11E+04	8.08E+03	0.00E+00	0.00E+00	5.89E+03	7.03E+04	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.74E+02	3.91E+02	0.00E+00	0.00E+00	0.00E+00	3.54E+03	0.00E+00
CO-60	0.00E+00	5.01E+02	1.11E+03	0.00E+00	0.00E+00	0.00E+00	9.41E+03	0.00E+00
NI-63	3.86E+04	2.68E+03	1.29E+03	0.00E+00	0.00E+00	0.00E+00	5.58E+02	0.00E+00
NI-65	1.57E+02	2.04E+01	9.29E+00	0.00E+00	0.00E+00	0.00E+00	5.17E+02	0.00E+00
CU-64	0.00E+00	2.90E+01	1.36E+01	0.00E+00	7.31E+01	0.00E+00	2.47E+03	0.00E+00
ZN-65	5.09E+04	1.62E+05	7.31E+04	0.00E+00	1.08E+05	0.00E+00	1.02E+05	0.00E+00
ZN-69	1.08E+02	2.07E+02	1.44E+01	0.00E+00	1.34E+02	0.00E+00	3.11E+01	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.81E+01	0.00E+00	0.00E+00	0.00E+00	6.92E+01	0.00E+00
BR-84	0.00E+00	0.00E+00	6.23E+01	0.00E+00	0.00E+00	0.00E+00	4.89E-04	0.00E+00
BR-85	0.00E+00	0.00E+00	2.56E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.13E+05	5.28E+04	0.00E+00	0.00E+00	0.00E+00	2.23E+04	0.00E+00
RB-88	0.00E+00	3.25E+02	1.72E+02	0.00E+00	0.00E+00	0.00E+00	4.49E-09	0.00E+00
RB-89	0.00E+00	2.15E+02	1.51E+02	0.00E+00	0.00E+00	0.00E+00	1.25E-11	0.00E+00
SR-89	3.97E+04	0.00E+00	1.14E+03	0.00E+00	0.00E+00	0.00E+00	6.38E+03	0.00E+00
SR-90	9.78E+05	0.00E+00	2.40E+05	0.00E+00	0.00E+00	0.00E+00	2.83E+04	0.00E+00
SR-91	7.32E+02	0.00E+00	2.96E+01	0.00E+00	0.00E+00	0.00E+00	3.48E+03	0.00E+00
SR-92	2.77E+02	0.00E+00	1.20E+01	0.00E+00	0.00E+00	0.00E+00	5.50E+03	0.00E+00
Y-90	6.07E+00	0.00E+00	1.63E-01	0.00E+00	0.00E+00	0.00E+00	6.44E+04	0.00E+00
Y-91M	5.74E-02	0.00E+00	2.22E-03	0.00E+00	0.00E+00	0.00E+00	1.68E-01	0.00E+00
Y-91	8.90E+01	0.00E+00	2.38E+00	0.00E+00	0.00E+00	0.00E+00	4.90E+04	0.00E+00
Y-92	5.33E-01	0.00E+00	1.56E-02	0.00E+00	0.00E+00	0.00E+00	9.34E+03	0.00E+00
Y-93	1.69E+00	0.00E+00	4.67E-02	0.00E+00	0.00E+00	0.00E+00	5.36E+04	0.00E+00
ZR-95	3.57E-01	1.14E-01	7.75E-02	0.00E+00	1.80E-01	0.00E+00	3.63E+02	0.00E+00
ZR-97	1.97E-02	3.98E-03	1.82E-03	0.00E+00	6.01E-03	0.00E+00	1.23E+03	0.00E+00
NB-95	4.48E+02	2.49E+02	1.34E+02	0.00E+00	2.46E+02	0.00E+00	1.51E+06	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	1.28E+02	2.44E+01	0.00E+00	2.90E+02	0.00E+00	2.97E+02	0.00E+00
TC-99M	9.59E-03	2.71E-02	3.45E-01	0.00E+00	4.12E-01	1.33E-02	1.60E+01	0.00E+00
TC-101	9.86E-03	1.42E-02	1.39E-01	0.00E+00	2.56E-01	7.26E-03	4.27E-14	0.00E+00
RU-103	3.61E+01	0.00E+00	1.56E+01	0.00E+00	1.38E+02	0.00E+00	4.22E+03	0.00E+00
RU-105	3.01E+00	0.00E+00	1.19E+00	0.00E+00	3.89E+01	0.00E+00	1.84E+03	0.00E+00
RU-106	5.37E+02	0.00E+00	6.80E+01	0.00E+00	1.04E+03	0.00E+00	3.48E+04	0.00E+00
AG-110M	5.38E-04	4.98E-04	2.95E-04	0.00E+00	9.78E-04	0.00E+00	2.03E-01	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	1.19E+04	4.31E+03	1.59E+03	3.58E+03	4.84E+04	0.00E+00	4.75E+04	0.00E+00
TE-127M	3.01E+04	1.08E+04	3.66E+03	7.69E+03	1.22E+05	0.00E+00	1.01E+05	0.00E+00
TE-127	4.89E+02	1.75E+02	1.06E+02	3.62E+02	1.99E+03	0.00E+00	3.86E+04	0.00E+00

TABLE B-1: LIQUID ENVIRONMENTAL DOSE TRANSFER FACTORS

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-129M	5.11E+04	1.91E+04	8.09E+03	1.75E+04	2.13E+05	0.00E+00	2.57E+05	0.00E+00
TE-129	1.39E+02	5.24E+01	3.40E+01	1.07E+02	5.86E+02	0.00E+00	1.05E+02	0.00E+00
TE131M	7.69E+03	3.76E+03	3.13E+03	5.95E+03	3.81E+04	0.00E+00	3.73E+05	0.00E+00
TE-131	8.75E+01	3.66E+01	2.76E+01	7.20E+01	3.83E+02	0.00E+00	1.24E+01	0.00E+00
TE-132	1.12E+04	7.24E+03	6.80E+03	8.00E+03	6.97E+04	0.00E+00	3.43E+05	0.00E+00
I-130	2.94E+01	8.66E+01	3.42E+01	7.34E+03	1.35E+02	0.00E+00	7.46E+01	0.00E+00
I-131	1.62E+02	2.31E+02	1.32E+02	7.57E+04	3.96E+02	0.00E+00	6.10E+01	0.00E+00
I-132	7.88E+00	2.11E+01	7.38E+00	7.38E+02	3.36E+01	0.00E+00	3.96E+00	0.00E+00
I-133	5.51E+01	9.59E+01	2.92E+01	1.41E+04	1.67E+02	0.00E+00	8.62E+01	0.00E+00
I-134	4.12E+00	1.12E+01	4.00E+00	1.94E+02	1.78E+01	0.00E+00	9.75E-03	0.00E+00
I-135	1.72E+01	4.50E+01	1.66E+01	2.97E+03	7.22E+01	0.00E+00	5.09E+01	0.00E+00
CS-134	3.34E+05	7.94E+05	6.49E+05	0.00E+00	2.57E+05	8.53E+04	1.39E+04	0.00E+00
CS-136	3.49E+04	1.38E+05	9.93E+04	0.00E+00	7.68E+04	1.05E+04	1.57E+04	0.00E+00
CS-137	4.28E+05	5.85E+05	3.83E+05	0.00E+00	1.99E+05	6.60E+04	1.13E+04	0.00E+00
CS-138	2.96E+02	5.85E+02	2.90E+02	0.00E+00	4.30E+02	4.25E+01	2.50E-03	0.00E+00
BA-139	1.20E+01	8.55E-03	3.52E-01	0.00E+00	8.00E-03	4.85E-03	2.13E+01	0.00E+00
BA-140	2.51E+03	3.16E+00	1.65E+02	0.00E+00	1.07E+00	1.81E+00	5.17E+03	0.00E+00
BA-141	5.83E+00	4.41E-03	1.97E-01	0.00E+00	4.10E-03	2.50E-03	2.75E-09	0.00E+00
BA-142	2.64E+00	2.71E-03	1.66E-01	0.00E+00	2.29E-03	1.54E-03	3.71E-18	0.00E+00
LA-140	1.58E+00	7.95E-01	2.10E-01	0.00E+00	0.00E+00	0.00E+00	5.84E+04	0.00E+00
LA-142	8.08E-02	3.67E-02	9.15E-03	0.00E+00	0.00E+00	0.00E+00	2.68E+02	0.00E+00
CE-141	5.37E+00	3.63E+00	4.12E-01	0.00E+00	1.69E+00	0.00E+00	1.39E+04	0.00E+00
CE-143	9.46E-01	7.00E+02	7.74E-02	0.00E+00	3.08E-01	0.00E+00	2.61E+04	0.00E+00
CE-144	2.80E+02	1.17E+02	1.50E+01	0.00E+00	6.94E+01	0.00E+00	9.46E+04	0.00E+00
PR-143	5.80E+00	2.33E+00	2.88E-01	0.00E+00	1.34E+00	0.00E+00	2.54E+04	0.00E+00
PR-144	1.90E-02	7.89E-03	9.65E-04	0.00E+00	4.45E-03	0.00E+00	2.73E-09	0.00E+00
ND-147	3.97E+00	4.59E+00	2.74E-01	0.00E+00	2.68E+00	0.00E+00	2.20E+04	0.00E+00
W-187	2.97E+02	2.48E+02	8.68E+01	0.00E+00	0.00E+00	0.00E+00	8.13E+04	0.00E+00
NP-239	3.00E-01	2.95E-02	1.63E-02	0.00E+00	9.21E-02	0.00E+00	6.06E+03	0.00E+00

TABLE C-1: NOBLE GAS DOSE TRANSFER FACTORS

TABLE C-1

FACTOR FOR EXPOSURE TO A SEMI-INFINITE CLOUD

Nuclide	DOSE TO PEOPLE +			DOSE OF AIR #	
	Gamma-Body K (i)	Beta-Skin L (i)	Skin L(i)+ (1.1)M(i)	Gamma M (i)	Beta N (i)
AR-41	8.840E+03	2.690E+03	1.29E+04	9.300E+03	3.280E+03
KR-83M	7.560E-02	0.000E+00	2.12E+01	1.930E+01	2.880E+02
KR-85	1.610E+01	1.340E+03	1.36E+03	1.720E+01	1.950E+03
KR-85M	1.170E+03	1.460E+03	2.81E+03	1.230E+03	1.970E+03
KR-87	5.920E+03	9.730E+03	1.65E+04	6.170E+03	1.030E+04
KR-88	1.470E+04	2.370E+03	1.91E+04	1.520E+04	2.930E+03
KR-89	1.660E+04	1.010E+04	2.91E+04	1.730E+04	1.060E+04
KR-90	1.560E+04	7.290E+03	2.52E+04	1.630E+04	7.830E+03
XE-131M	9.150E+01	4.760E+02	6.48E+02	1.560E+02	1.110E+03
XE-133	2.940E+02	3.060E+02	6.94E+02	3.530E+02	1.050E+03
XE-133M	2.510E+02	9.940E+02	1.35E+03	3.270E+02	1.480E+03
XE-135	1.810E+03	1.860E+03	3.97E+03	1.920E+03	2.460E+03
XE-135M	3.120E+03	7.110E+02	4.41E+03	3.360E+03	7.390E+02
XE-137	1.420E+03	1.220E+04	1.39E+04	1.510E+03	1.270E+04
XE-138	8.830E+03	4.130E+03	1.43E+04	9.210E+03	4.750E+03

+ -- mrem/yr per  $\mu\text{Ci}/\text{cu.m.}$

# -- mrad/yr per  $\mu\text{Ci}/\text{cu.m.}$

**(RESERVED)**

X/Q AND D/Q VALUES FOR RESTRICTED AREA BOUNDARY

Long Term Diffusion Estimates

E.1 Objective

Annual average CHI/Q and D/Q estimates for continuous and intermittent releases were calculated for each of the sixteen 22.5-degree sectors at receptor locations used to determine the maximum individual and population dose receptors.

The methodology described in Regulatory Guide 1.111, Rev. 1 provided guidance for the aforementioned analysis. The resultant CHI/Q and D/Q values for the maximum individual dose receptors are displayed in Attachment 9.

E.2 Calculation Techniques

Nomenclature

2.032 =	$(2 / \pi)^{1/2} (2\pi/16)^{-1}$	(DIMENSIONLESS)
$\pi$ =	3.14159...	(DIMENSIONLESS)
EXP =	2.71828	(DIMENSIONLESS)
$E_T$ =	ENTRAINMENT COEFFICIENT	(DIMENSIONLESS)
$\Omega_T$ =	TERRAIN RECIRCULATION FACTOR	(DIMENSIONLESS)
X =	DOWNWIND RECEPTOR DISTANCE	(M)
$\frac{\sigma_Z}{u_{30}}$ =	VERTICAL DISPERSION (PLUME SPREAD) COEFFICIENT	(M)
$u_{30}$ =	30-FT AVERAGE WIND SPEED CORRESPONDING TO A GIVEN HOUR OF ONSITE METEOROLOGICAL DATA	(M SEC <sup>-1</sup> )
$u_{150}$ =	150-FT AVERAGE WIND SPEED CORRESPONDING T A GIVEN HOUR OF ON-SITE METEOROLOGICAL DATA	(M SEC <sup>-1</sup> )
(CHI/Q) =	AVERAGE CONCENTRATION NORMAL-IZED BY SOURCE STRENGTH	(SEC M <sup>-3</sup> )
(CHI/Q <sub>D</sub> ) =	DEPLETED CHI/Q	(SEC M <sup>-3</sup> )
$F_M$ =	MOMENTUM FLUX	(M <sup>4</sup> SEC <sup>-3</sup> )
$H_B$ =	MAXIMUM ADJACENT BUILDING HEIGHT	(M)
$H_R$ =	RELEASE HEIGHT	(M)
$H_E$ =	EFFECTIVE RELEASE HEIGHT	(M)
$H_{PR}$ =	NONBUOYANT PLUME RISE	(M)
$H_T$ =	TOPOGRAPHIC HEIGHT OF RECEPTOR ABOVE PLANT GRADE	(M)
D =	STACK OR VENT DIAMETER	(M)
$U_E$ =	EFFLUX VELOCITY	(M SEC <sup>-1</sup> )
N =	TOTAL NUMBER OF VALID HOURS OF ONSITE WIND DATA IN ALL SECTORS FOR APPLICABLE AVERAGING PERIOD	(DIMENSIONLESS)
$\delta/Q$ =	RELATIVE DEPOSITION RATE NORMALIZED BY SOURCE STRENGTH	(M <sup>-1</sup> )
D/Q =	RELATIVE DEPOSITION PER UNIT AREA NORMALIZED BY SOURCE STRENGTH	(M <sup>-2</sup> )
G =	GROUND RELEASE (SUBSCRIPT)	(DIMENSIONLESS)



**X/Q AND D/Q VALUES FOR RESTRICTED AREA BOUNDARY**

I =	INDEX FOR ATMOSPHERIC STABILITY GROUP (CLASSES A THROUGH G)	(DIMENSIONLESS)
J =	INDEX FOR NUMBER OF HOURS	(DIMENSIONLESS)
K =	INDEX FOR A PARTICULAR RECEPTOR DISTANCE	(DIMENSIONLESS)
L =	INDEX FOR A PARTICULAR 22.5-DEGREE SECTOR	(DIMENSIONLESS)
N =	NUMBER OF HOURS ONSITE WIND DATA IN A PARTICULAR 22.5-DEGREE SECTOR	(DIMENSIONLESS)
S =	<u>STABILITY PARAMETER</u>	(SEC <sup>2</sup> )

E.3 CHI/Q Modeling Technique

Annual average values of relative concentration were calculated for continuous gaseous releases of activity from the containment building vent and the radwaste building vent according to the straight-line airflow (Gaussian) model described in Regulatory Guide 1.111, Rev. 1. An adjustment was made to the model to characterize the regional airflow pattern. The equation of this model is as follows:

$$\left(\frac{CHI}{Q}\right)_k = \frac{2.032}{N} \sum_{j=1}^{n*} \left(\frac{\Omega}{x}\right)_k \left[ \frac{E_T}{\bar{u}_{30}(\sigma_{z_k}^2 - ch_b^{2/\pi})^{1/2}} + \frac{(1 - E_T) \exp^{1/2}\left(\frac{h_e}{\sigma_z}\right)}{\bar{u}_{150}\sigma_z} \right] \quad \text{E.3-1}$$

Since the River Bend Station site is located in relatively open terrain, the terrain recirculation factor ( $\Omega_k$ ) (presented in Figure 2 of Regulatory Guide 1.111) was applied.

The entrainment coefficient ( $E_T$ ) is a function of the ratio of efflux velocity ( $u_e$ ) to elevated wind speed ( $u_{150}$ ) for the conditionally elevated release points.

For vent releases occurring below the level of a nearby structure, 100 percent downwash (total entrainment) is conservatively assumed ( $E_T = 1$ ). For vent releases occurring between 1 and 2 times the height of a nearby structure, a conditionally elevated release is assumed, and the entrainment coefficient is defined as follows:

- $E_T = 0.0$  when  $u_e/\bar{u}_{150} \geq 5.0$  (totally elevated)
- $E_T = 0.30-0.06$  when  $1.5 < u_e/\bar{u}_{150} \leq 5.0$  (partially entrained)
- $E_T = 2.58-1.58$  when  $1.0 \leq u_e/\bar{u}_{150} \leq 1.5$  (partially entrained)
- $E_T = 1.0$  when  $u_e/\bar{u}_{150} \leq 1.0$  (totally entrained)

Within 5 km in each downwind sector, Equation E.3-1 was evaluated by sector at the property and restricted area boundaries and nearest resident, vegetable garden, milk cow, and meat animal. There were no goats whose milk is consumed in the area of interest. This evaluation was performed for each continuously emitting release point and the intermittent release from the mechanical vacuum pump with onsite data collected during the period of March 17, 1977 through March 16, 1979.

**X/Q AND D/Q VALUES FOR RESTRICTED AREA BOUNDARY**

The effective release height was computed from the following equation:

$$h_e = (h_r - h_t)_k + h_{pr} \quad \text{E.3-2}$$

Where the downwash correction factor (as defined by Equation (5) in Regulatory Guide 1.111, Rev. 1) is included in the equation for  $h_{pr}$  (see Equation E.3-4).

Values of topographic heights were conservatively assessed as the maximum height within a particular annulus-sector (annsect). An annsect is an area bounded by a 22.5-degree sector and any two radial distances from the release point.

For A-D stability conditions, plume rise for nonbuoyant sources was calculated by the following algorithm:

when:

$$u_e / \bar{u}_{150} > 1.5$$

$$h_{pr} = 1.44(u_e / \bar{u}_{150})^{2/3} (x / d)^{1/3} d \quad \text{E.3-3}$$

when:

$$u_e / \bar{u}_{150} < 1.5$$

$$h_{pr} = 1.44(u_e / \bar{u}_{150})^{2/3} (x / d)^{1/3} (d - 3) [1.5 - (u_e / \bar{u}_{150})d] \quad \text{E.3-4}$$

and,

$$h_{pr} \leq 3(u_e / \bar{u}_{150}) \quad \text{E.3-5}$$

The result from Equation E.3-3 or E.3-4 (whichever condition exists) is then compared to Equation E.3-5 and the smaller value of  $h_{pr}$  is used.

For E-G stability conditions, Equations E.3-3, E.3-4, and E.3-5 are compared with:

$$h_{pr} = 4F_m/s)^{1/4}$$

and

$$h_{pr} = 1.5(F_m / \bar{u}_{150})^{1/3} S^{-1/6}$$

where:

$$F_m = \frac{(u_e)^2 d^2}{4}$$

and the smallest value was chosen.

**X/Q AND D/Q VALUES FOR RESTRICTED AREA BOUNDARY**

In the ground level portion of Equation E.3-1, the vertical dispersion term:

$$(\sigma_{z_{i,k}}^2 + 0.5h_b / \pi)^{1/2}$$

was constrained to be less than or equal to  $1.732\sigma_{z_{i,k}}$

**E.4 (CHI/Q) and D/Q Modeling Techniques**

Annual average depleted relative concentration values were conservatively assumed to be equal to annual average relative concentration values (CHI/Q = (CHI/Q)<sub>D</sub>). Therefore, no credit was taken for attendant plume depletion of radioiodines and particulates.

Annual average relative deposition values were calculated using Regulatory Guide 1.111, Rev. 1 with the following equation:

$$\left(\frac{D}{Q}\right)_k = \left(\frac{\Omega}{X}\right)_k \left(\frac{2-N}{16}\right)^{-1} \left\{ \sum_{j=1}^{n\bullet} \left[ n \bullet \left\{ \left(\frac{\sigma}{Q}\right)_{Gk} E_T + \left(\frac{1}{n} \sum_{n=1}^3 [1 - (E_T)_i] n_i \left(\frac{\delta}{Q}\right)\right) \right\} \right] \right\} \quad \text{E.4-1}$$

For the conditionally elevated release points, Figures 6 through 9 of Regulatory Guide 1.111, Rev. 1 were used to calculate the (δ/Q)<sub>G</sub> and (δ/Q)<sub>i</sub> values, while for the ground level release points, Figure 6 (Attachment 39) was utilized to calculate the (δ/Q)<sub>G</sub> value.

**E.5 Methodology Employed for Intermittent Release**

The methodology employed in the calculation of intermittent release CHI/Qs and D/Qs was as follows:

1. Two-hour sector-averaged CHI/Q values were calculated without terrain recirculation factors.
2. The 15 percent, 1 hour value was plotted at 2 hours on log-log coordinates, while the annual average value was plotted at 8,760 hr. A straight line connecting the two points was drawn.
3. Log-log interpolation based on total ground intermittent release hours versus annual hours yielded a CHI/Q multiplier.
4. The multiplier was applied to annual average CHI/Q and D/Q values to obtain intermittent CHI/Q and D/Q values.

For River Bend Station, a 320 hr/yr intermittent release through the containment building vent from the mechanical vacuum pump was evaluated.

TABLE E-1: ANNUAL AVERAGE CHI/Q VALUES FOR RESTRICTED AREA BOUNDARY

TABLE E-1  
ANNUAL AVERAGE CHI/Q VALUES x 10<sup>-7</sup> (sec/m<sup>3</sup>)  
FOR RESTRICTED AREA BOUNDARY

<u>Sector</u>	Mixed Mode Releases (Continuous)	Ground Level Releases <u>Exhaust (Continuous)</u>
S	11.4	105
SSW	19.7	186
SW	16.4	215
WSW	19.5	326
W	23.6	654
WNW	33.1	421
NW	15.7	262
NNW	14.8	138
N	18.8	180
NNE	24.9	211
NE	16.6	150
ENE	12.2	146
E	9.07	168
ESE	10.4	154
SE	8.19	93.1
SSE	7.69	45.6

TABLE E-2: ANNUAL AVERAGE D/Q VALUES FOR RESTRICTED AREA BOUNDARY

TABLE E-2  
ANNUAL AVERAGE D/Q VALUES x 10<sup>-9</sup> (m<sup>-2</sup>)  
FOR RESTRICTED AREA BOUNDARY

<u>Sector</u>	<u>Mixed Mode Releases (Continuous)</u>	<u>Ground Level Releases (Continuous)</u>
S	7.61	21.4
SSW	11.3	39.6
SW	10.4	36.1
WSW	9.79	38.5
W	13.8	68.8
WNW	18.0	50.3
NW	8.68	40.8
NNW	10.5	24.7
N	11.8	28.6
NNE	11.2	27.1
NE	8.26	22.3
ENE	9.73	22.7
E	7.75	23.0
ESE	7.76	24.6
SE	6.60	17.2
SSE	5.34	11.8

**TABLE F-1: ATMOSPHERIC DISPERSION AND DEPOSITION RATES FOR THE MAXIMUM INDIVIDUAL DOSE CALCULATIONS**

**TABLE F-1  
ATMOSPHERIC DISPERSION AND DEPOSITION RATES FOR  
THE MAXIMUM INDIVIDUAL DOSE CALCULATIONS**

Analysis	Location (meters)	Ground level Releases	Mixed Mode Releases
Gamma air dose (3) and Beta Air Dose	994 m WNW (Containment)	CHI/Q - 421.0	CHI/Q - 33.1
Maximum Receptor (4)	994 m WNW	CHI/Q - 421.0	CHI/Q - 33.1
Resident		D/Q - 50.3	D/Q - 18.1
Garden			
Meat animal			
Immersion			
Milk animal (5)	7,000 m WNW	CHI/Q - 3.58 D/Q - 0.38	CHI/Q - .870 D/Q - .223
Other on-site Receptors (6)	115 m ENE	CHI/Q - 5977.0 D/Q - 529.7	CHI/Q - 407.5 D/Q - 46.9
	275 m N	CHI/Q - 1644.0 D/Q - 345.6	CHI/Q - 169.1 D/Q - 68.4
	500 WNW	CHI/Q - 916.7 D/Q - 148.1	CHI/Q - 105.4 D/Q - 45.6
	2500 SW	CHI/Q - 34.45 D/Q - 3.35	CHI/Q - 4.65 D/Q - 1.40

\* Reference 2.8 and 2.6

Notes:

- (1) All CHI/Q =  $10^{-7}$  sec/m<sup>3</sup>
- (2) All D/Q =  $10^{-9}$  m<sup>-2</sup>
- (3) Maximum offsite location (property boundary) with highest CHI/Q (unoccupied).
- (4) Maximum hypothetical occupied offsite location with highest CHI/Q and D/Q.
- (5) No milk animal within 5 miles radius, hypothetical location in worst sector.
- (6) Other on-site receptors.
- (7) Revisions to CHI/Q and D/Q can be performed using Reference 2.14

TABLE G-1: DOSE FACTOR CALCULATION PARAMETERS

CODE	DESCRIPTION	VALUE	UNITS
csf	Harvest stored feed to cow	7.776E+06	seconds (cfs)
dw	Drinking Water Dilution Factor	2.480E+04	none (dw)
esf	Stored feed exp. to deposition	5.184E+06	seconds (esf)
fg	Fraction Stored Veg. Intake	7.600E-01	none (fg)
fi	Fraction Vegetation Irrigated	1.000E-01	none (fi)
fl	Fraction Leafy Veg. Intake	1.000E+00	none (fi)
fpc	Fraction Year Cow On Pasture	1.000E+00	none (fpc)
fpg	Fraction Year Goat On Pasture	1.000E+00	none (fpg)
fsc	Fraction Cow Feed-Pasture Grass	1.000E+00	none (fsc)
fsg	Fraction Goat Feed-Pasture Grass	1.000E+00	none (fsg)
gsf	Harvest stored feed to goat	7.776E+06	seconds (gsf)
h	Absolute Humidity	1.290E+01	gm/m3 (h)
kc	Water to sediment xfer coeff.	7.220E-02	L/kg hr (kc)
ksf	Liq conv fact pCi*ml*yr/ $\mu$ Ci*1*hr	1.142E+05	(ksf)
lv	Water content of Leafy Veg	9.200E-01	L/kg (lv)
lw	Surface Weather Decay Constant	5.730E-07	1/seconds (lw)
lwr	Iodine Surface Wx Decay Constant	5.730E-07	1/seconds (lwr)
mtv	Mass density of sediment	4.000E+01	kg/m2 (mtv)
p	Effective surface density, soil	2.400E+02	kg/m2 (p)
p14	Fractional equilibrium ratio	1.000E+00	none (p14)
gfc	Cow's Feed Consumption Rate	5.000E+01	kg/day (qfc)
gfg	Goat's Feed Consumption Rate	6.000E+00	kg/day (qfg)
rl	Fraction Deposited Liquid	2.500E-01	none (rl)
rp	Fraction Deposited Particulate	2.000E-01	none (rp)
rr	Fraction Deposited Radioiodine	1.000E+00	none (rr)
sf	Shielding Factor	1.000E+00	none ** (sf)
*tb	Long term sediment exposure	0.000E+00	seconds (tb)
tbl	Long term sediment exp. liquid	4.716E+08	seconds (tbl)
tei	Veg. Exposure in Growing Season	5.184E+06	seconds (tei)
tem	Seasonal forage exposure (milk)	2.592E+06	seconds (tem)
tev	Seasonal crop exposure (veg)	8.000E+06	seconds (tev)
tfh	Fresh Fish Transit Time	0.000E+00	seconds (tfh)
tgm	Time, goat milking to receptor	1.728E+05	seconds (tgm)
thi	Transit Time-Harvest Irrig. Veg	8.640E+04	seconds (thi)
thv	Transit Time-Harvest-Stored Veg	5.184E+06	seconds (thv)
ti	Fresh Non-Fish Transit Time	0.000E+00	seconds (ti)
tl	Transit Time-Harvest-Leafy Veg	8.640E+04	seconds (tl)
tmc	Time, cow miling to receptor	1.728E+05	seconds (tmc)
ts	Time, slaughter to consumer	1.728E+06	seconds (ts)
tw	Drinking Water Transit Time	0.000E+00	seconds (tw)
yiv	Irrigated Veg. Areal Density	2.000E+00	kg/m2 (yiv)
yp	Pasture Grass Areal Density	7.000E-01	kg/m2 (yp)
ys	Stored Feed Areal Density	2.000E+00	kg/m2 (ys)
ysv	Stored Vegetable Areal Density	2.000E+00	kg/m2 (ysv)
yv	Vegetation Areal Density	2.000E+00	kg/m2 (yv)

\* tb-needs to be 4.716E+08 when calculating Ground Plane Dose Factors

\*\* NRC Regulatory Guide 1.109 default = 0.7

TABLE G-2: STABLE ELEMENT TRANSFER FACTORS

Nuclide	Milk Cow	Milk Goat	Meat	Veg./Soil
H-3	1.000E-02	1.700E-01	1.200E-02	4.800E+00
C-14	1.200E-02	1.000E-01	3.100E-02	5.500E+00
NA-24	4.000E-02	4.000E-02	3.000E-02	5.200E-02
P-32	2.500E-02	2.500E-01	4.600E-02	1.100E+00
CR-51	2.200E-03	2.200E-03	2.400E-03	2.500E-04
MN-54	2.500E-04	2.500E-04	8.000E-04	2.900E-02
MN-56	2.500E-04	2.500E-04	8.000E-04	2.900E-02
FE-55	1.200E-03	1.300E-04	4.000E-02	6.600E-04
FE-59	1.200E-03	1.300E-04	4.000E-02	6.600E-04
CO-57	1.000E-03	1.000E-03	1.300E-02	9.400E-03
CO-58	1.000E-03	1.000E-03	1.300E-02	9.400E-03
CO-60	1.000E-03	1.000E-03	1.300E-02	9.400E-03
NI-63	6.700E-03	6.700E-03	5.300E-02	1.900E-02
NI-65	6.700E-03	6.700E-03	5.300E-02	1.900E-02
CU-64	1.400E-02	1.300E-02	8.000E-03	1.200E-01
ZN-65	3.900E-02	3.900E-02	3.000E-02	4.000E-01
ZN-69	3.900E-02	3.900E-02	3.000E-02	4.000E-01
ZN-69M	3.900E-02	3.900E-02	3.000E-02	4.000E-01
BR-82	5.000E-02	5.000E-02	2.600E-02	7.600E-01
BR-83	5.000E-02	5.000E-02	2.600E-02	7.600E-01
BR-84	5.000E-02	5.000E-02	2.600E-02	7.600E-01
BR-85	5.000E-02	5.000E-02	2.600E-02	7.600E-01
RB-86	3.000E-02	3.000E-02	3.100E-02	1.300E-01
RB-88	3.000E-02	3.000E-02	3.100E-02	1.300E-01
RB-89	3.000E-02	3.000E-02	3.100E-02	1.300E-01
SR-89	8.000E-04	1.400E-02	6.000E-04	1.700E-02
SR-90	8.000E-04	1.400E-02	6.000E-04	1.700E-02
SR-91	8.000E-04	1.400E-02	6.000E-04	1.700E-02
SR-92	8.000E-04	1.400E-02	6.000E-04	1.700E-02
Y-90	1.000E-05	1.000E-05	4.600E-03	2.600E-03
Y-91M	1.000E-05	1.000E-05	4.600E-03	2.600E-03
Y-91	1.000E-05	1.000E-05	4.600E-03	2.600E-03
Y-92	1.000E-05	1.000E-05	4.600E-03	2.600E-03
Y-93	1.000E-05	1.000E-05	4.600E-03	2.600E-03
ZR-95	5.000E-06	5.000E-06	3.400E-02	1.700E-04
ZR-97	5.000E-06	5.000E-06	3.400E-02	1.700E-04
NB-95	2.500E-03	2.500E-03	2.800E-01	9.400E-03
NB-97	2.500E-03	2.500E-03	2.800E-01	9.400E-03
MO-99	7.500E-03	7.500E-03	8.000E-03	1.200E-01
TC-99M	2.500E-02	2.500E-02	4.000E-01	2.500E-01
TC-101	2.500E-02	2.500E-02	4.000E-01	2.500E-01
RU-103	1.000E-06	1.000E-06	4.000E-01	5.000E-02
RU-105	1.000E-06	1.000E-06	4.000E-01	5.000E-02
RU-106	1.000E-06	1.000E-06	4.000E-01	5.000E-02
AG-110M	5.000E-02	5.000E-02	1.700E-02	1.500E-01



**TABLE G-2: STABLE ELEMENT TRANSFER FACTORS**

Nuclide	Milk Cow	Milk Goat	Meat	Veg./Soil
SB-124	1.500E-03	1.500E-03	0.000E+00	0.000E+00
SB-125	1.500E-03	1.500E-03	0.000E+00	0.000E+00
TE-125M	1.000E-03	1.000E-03	7.700E-02	1.300E+00
TE-127M	1.000E-03	1.000E-03	7.700E-02	1.300E+00
TE-127	1.000E-03	1.000E-03	7.700E-02	1.300E+00
TE-129M	1.000E-03	1.000E-03	7.700E-02	1.300E+00
TE-129	1.000E-03	1.000E-03	7.700E-02	1.300E+00
TE-131M	1.000E-03	1.000E-03	7.700E-02	1.300E+00
TE-131	1.000E-03	1.000E-03	7.700E-02	1.300E+00
TE-132	1.000E-03	1.000E-03	7.700E-02	1.300E+00
I-130	6.000E-03	6.000E-02	2.900E-03	2.000E-02
I-131	6.000E-03	6.000E-02	2.900E-03	2.000E-02
I-132	6.000E-03	6.000E-02	2.900E-03	2.000E-02
I-133	6.000E-03	6.000E-02	2.900E-03	2.000E-02
I-134	6.000E-03	6.000E-02	2.900E-03	2.000E-02
I-135	6.000E-03	6.000E-02	2.900E-03	2.000E-02
CS-134	1.200E-02	3.000E-01	4.000E-03	1.000E-02
CS-136	1.200E-02	3.000E-01	4.000E-03	1.000E-02
CS-137	1.200E-02	3.000E-01	4.000E-03	1.000E-02
CS-138	1.200E-02	3.000E-01	4.000E-03	1.000E-02
BA-139	4.000E-04	4.000E-04	3.200E-03	5.000E-03
BA-140	4.000E-04	4.000E-04	3.200E-03	5.000E-03
BA-141	4.000E-04	4.000E-04	3.200E-03	5.000E-03
LA-140	5.000E-06	5.000E-06	2.000E-04	2.500E-03
LA-142	5.000E-06	5.000E-06	2.000E-04	2.500E-03
CE-141	1.000E-04	1.000E-04	1.200E-03	2.500E-03
CE-143	1.000E-04	1.000E-04	1.200E-03	2.500E-03
CE-144	1.000E-04	1.000E-04	1.200E-03	2.500E-03
PR-143	5.000E-06	5.000E-06	4.700E-03	2.500E-03
PR-144	5.000E-06	5.000E-06	4.700E-03	2.500E-03
ND-147	5.000E-06	5.000E-06	3.300E-03	2.400E-03
W-187	5.000E-04	5.000E-04	1.300E-03	1.800E-02
NP-239	5.000E-06	5.000E-06	2.000E-04	2.500E-03

Units: Milk - days/liter  
Meat - days/kg  
Soil - unitless

TABLE G-3: BIOACCUMULATION FACTORS

**TABLE G-3**  
**BIOACCUMULATION FACTORS**

Nuclide	Freshwater Fish	Freshwater Non-Fish	Saltwater Fish	Saltwater Non-Fish
H-3	9.000E-01	9.000E-01	9.000E-01	9.300E-01
C-14	4.600E+03	9.100E+03	1.800E+03	1.400E+03
NA-24	1.000E+02	2.000E+02	6.700E-02	1.900E-01
P-32	1.000E+05	2.000E+04	2.900E+04	3.000E+04
CR-51	2.000E+02	2.000E+03	4.000E+02	2.000E+03
MN-54	4.000E+02	9.000E+04	5.500E+02	4.000E+02
MN-56	4.000E+02	9.000E+04	5.500E+02	4.000E+02
FE-55	1.000E+03	3.200E+03	3.000E+03	2.000E+04
FE-59	1.000E+02	3.200E+03	3.000E+03	2.000E+04
CO-57	5.000E+01	2.000E+02	1.000E+02	1.000E+03
CO-58	5.000E+01	2.000E+02	1.000E+02	1.000E+03
CO-60	5.000E+01	2.000E+02	1.000E+02	1.000E+03
NI-63	1.000E+02	1.000E+02	1.000E+02	2.500E+02
NI-65	1.000E+02	1.000E+02	1.000E+02	2.500E+02
CU-64	5.000E+01	4.000E+02	6.700E+02	1.700E+03
ZN-65	2.000E+03	1.000E+04	2.000E+03	5.000E+04
ZN-69	2.000E+03	1.000E+04	2.000E+03	5.000E+04
ZN-69M	2.000E+03	1.000E+04	2.000E+03	5.000E+04
BR-82	4.200E+02	3.300E+02	1.500E-02	3.100E+00
BR-83	4.200E+02	3.300E+02	1.500E-02	3.100E+00
BR-84	4.200E+02	3.300E+02	1.500E-02	3.100E+00
BR-85	4.200E+02	3.300E+02	1.500E-02	3.100E+00
RB-86	2.000E+03	1.000E+03	8.300E+00	1.700E+01
RB-88	2.000E+03	1.000E+03	8.300E+00	1.700E+01
RB-89	2.000E+03	1.000E+03	8.300E+00	1.700E+01
SR-89	3.000E+01	1.000E+02	2.000E+00	2.000E+01
SR-90	3.000E+01	1.000E+02	2.000E+00	2.000E+01
SR-91	3.000E+01	1.000E+02	2.000E+00	2.000E+01
SR-92	3.000E+01	1.000E+02	2.000E+00	2.000E+01
Y-90	2.500E+01	1.000E+03	2.500E+01	1.000E+03
Y-91M	2.500E+01	1.000E+03	2.500E+01	1.000E+03
Y-91	2.500E+01	1.000E+03	2.500E+01	1.000E+03
Y-92	2.500E+01	1.000E+03	2.500E+01	1.000E+03
Y-93	2.500E+01	1.000E+03	2.500E+01	1.000E+03
ZR-95	3.300E+00	6.700E+00	2.000E+02	8.000E+01
ZR-97	3.300E+00	6.700E+00	2.000E+02	8.000E+01
NB-95	3.000E+04	1.000E+02	3.000E+04	1.000E+02
NB-97	3.000E+04	1.000E+02	3.000E+04	1.000E+02
MO-99	1.000E+01	1.000E+01	1.000E+01	1.000E+01
TC-99M	1.500E+01	5.000E+00	1.000E+01	5.000E+01
TC-101	1.500E+01	5.000E+00	1.000E+01	5.000E+01
RU-103	1.000E+01	3.000E+02	3.000E+00	1.000E+03
RU-105	1.000E+01	3.000E+02	3.000E+00	1.000E+03
RU-106	1.000E+01	3.000E+02	3.000E+00	1.000E+03
AG-110M	0.000E+00	0.000E+00	0.000E+00	0.000E+00

**TABLE G-3: BIOACCUMULATION FACTORS**

Nuclide	Freshwater	Freshwater	Saltwater	Saltwater
	Fish	Non-Fish	Fish	Non-Fish
SB-124	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SB-125	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE-125M	4.000E+02	6.100E+03	1.000E+03	1.000E+02
TE-127M	4.000E+02	6.100E+03	1.000E+01	1.000E+02
TE-127	4.000E+02	6.100E+03	1.000E+01	1.000E+02
TE-129M	4.000E+02	6.100E+03	1.000E+01	1.000E+02
TE-129	4.000E+02	6.100E+03	1.000E+01	1.000E+02
TE-131M	4.000E+02	6.100E+03	1.000E+01	1.000E+02
TE-131	4.000E+02	6.100E+03	1.000E+01	1.000E+02
TE-132	4.000E+02	6.100E+03	1.000E+01	1.000E+02
I-130	1.500E+01	5.000E+00	1.000E+01	5.000E+01
I-131	1.500E+01	5.000E+00	1.000E+01	5.000E+01
I-132	1.500E+01	5.000E+00	1.000E+01	5.000E+01
I-133	1.500E+01	5.000E+00	1.000E+01	5.000E+01
I-134	1.500E+01	5.000E+00	1.000E+01	5.000E+01
I-135	1.500E+01	5.000E+00	1.000E+01	5.000E+01
CS-134	2.000E+03	1.000E+03	4.000E+01	2.500E+01
CS-136	2.000E+03	1.000E+03	4.000E+01	2.500E+01
CS-137	2.000E+03	1.000E+03	4.000E+01	2.500E+01
CS-138	2.000E+03	1.000E+03	4.000E+01	2.500E+01
BA-139	4.000E+00	2.000E+02	1.000E+01	1.000E+02
BA-140	4.000E+00	2.000E+02	1.000E+01	1.000E+02
BA-141	4.000E+00	2.000E+02	1.000E+01	1.000E+02
BA-142	4.000E+00	2.000E+02	1.000E+01	1.000E+02
LA-140	2.500E+01	1.000E+03	2.500E+01	1.000E+03
LA-142	2.500E+01	1.000E+03	2.500E+01	1.000E+03
CE-141	1.000E+00	1.000E+03	1.000E+01	6.000E+02
CE-143	1.000E+00	1.000E+03	1.000E+01	6.000E+02
CE-144	1.000E+00	1.000E+03	1.000E+01	6.000E+02
PR-143	2.500E+01	1.000E+03	2.500E+01	1.000E+03
PR-144	2.500E+01	1.000E+03	2.500E+01	1.000E+03
ND-147	2.500E+01	1.000E+03	2.500E+01	1.000E+03
W-187	1.200E+03	1.000E+01	3.000E+01	3.000E+01
NP-239	1.000E+01	4.000E+02	1.000E+01	1.000E+01
RH-105	1.000E+01	3.000E+02	1.000E+01	2.000E+03

Units --> pCi/kg per pCi/liter

TABLE G-4: INDIVIDUAL USAGE FACTORS

TABLE G-4  
INDIVIDUAL USAGE FACTORS

Description	Infant	Child	Teenager	Adult	Units
Fresh Non-fish	0.000E+00	1.700E+00	3.800E+00	5.000E+00	kg/year
Drinking Water	3.300E+02	5.100E+02	5.100E+02	7.300E+02	liters/year
Milk	3.300E+02	3.300E+02	4.000E+02	3.100E+02	liters/year
Shoreline Rec.	0.000E+00	1.400E+01	6.700E+01	1.200E+01	hours/year
Fresh Fish	0.000E+00	6.900E+00	1.600E+01	2.100E+01	kg/year
Fresh Leafy Veg.	0.000E+00	2.600E+01	4.200E+01	6.400E+01	kg/year
Stored Veg.	0.000E+00	5.200E+02	6.300E+02	5.200E+02	kg/year
Irrigated Veg.	0.000E+00	2.600E+01	4.200E+01	6.400E+01	kg/year
Breathing	1.400E+03	3.700E+03	8.000E+03	8.000E+03	m3/year
Meat	0.000E+00	4.100E+01	6.500E+01	1.100E+02	kg/year

**TABLE H-1: ASSUMPTIONS/PARAMETERS FOR DOSES TO A MEMBER OF THE PUBLIC  
INSIDE SITE BOUNDARY**

**TABLE H-1**

**NOTE**

*This table contains default location, distance, sector and duration information. Other locations and variables could be used if they are more limiting and will be documented in the Annual Radiological Effluent Report for the applicable year if needed.*

**ASSUMPTIONS/PARAMETERS FOR DOSES TO A  
MEMBER OF THE PUBLIC INSIDE SITE BOUNDARY**

<b>MEMBER OF THE PUBLIC</b>	<b>LOCATION</b>	<b>DISTANCE (1) METERS</b>	<b>SECTOR</b>	<b>DURATION (HR/YEAR)</b>
Private Driver	North Parking Lot	275	N	125(3)
Employee	Service Building	115(2)	ENE	5
People Entering Site Without Consent	Alligator Bayou	2500	SW	40
Casual Drivers	Main Admin. Building	500	WNW	76(4)

- (1) The approximate distance from main plant vent exhaust to location.
- (2) Midpoint of building.
- (3) An individual is assumed to be on site 0.25/hr in the morning and 0.25/hr in the evening, 5 days per week, 50 weeks per year (0.5 hr/day \* 5 days/week \* 50 weeks/year = 125 hours).
- (4) An individual is assumed to be on site .5 hr/day.
- (5) Liquid pathways dose is not considered due to nature of activities that individuals are engaged in.
- (6) Evaluate the dose, if applicable, to the National Guard/State Police while stationed on site as a member of the public.

TABLE I-1: DOSE FACTOR TABLE: P (I) - ADULT, INHALATION

TABLE I-1  
DOSE FACTOR TABLE: P (i) - Adult, inhalation

Units are mrem/yr per  $\mu\text{Ci}/\text{cu.m.}$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	0.00E+00
C-14	1.82E+04	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03	0.00E+00
NA-24	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	0.00E+00
P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03	0.00E+00
MN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04	0.00E+00
MN-56	0.00E+00	1.24E+00	1.83E-01	0.00E+00	1.30E+00	9.44E+03	2.02E+04	0.00E+00
FE-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03	0.00E+00
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05	0.00E+00
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05	0.00E+00
NI-63	4.32E+05	3.14E+04	1.45E+04	0.00E+00	0.00E+00	1.78E+05	1.34E+04	0.00E+00
NI-65	1.54E+00	2.10E-01	9.12E-02	0.00E+00	0.00E+00	5.60E+03	1.23E+04	0.00E+00
CU-64	0.00E+00	1.46E+00	6.15E-01	0.00E+00	4.62E+00	6.78E+03	4.90E+04	0.00E+00
ZN-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04	0.00E+00
ZN-69	3.38E-02	6.51E-02	4.52E-03	0.00E+00	4.22E-02	9.20E+02	1.63E+01	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	2.41E+02	0.00E+00	0.00E+00	0.00E+00	2.32E+02	0.00E+00
BR-84	0.00E+00	0.00E+00	3.13E+02	0.00E+00	0.00E+00	0.00E+00	1.64E-03	0.00E+00
BR-85	0.00E+00	0.00E+00	1.28E+01	0.00E+00	0.00E+00	0.00E+00	8.00E-15	0.00E+00
RB-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04	0.00E+00
RB-88	0.00E+00	3.87E+02	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.34E-09	0.00E+00
RB-89	0.00E+00	2.56E+02	1.70E+02	0.00E+00	0.00E+00	0.00E+00	9.28E-12	0.00E+00
SR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05	0.00E+00
SR-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05	0.00E+00
SR-91	6.19E+01	0.00E+00	2.50E+00	0.00E+00	0.00E+00	3.65E+04	1.91E+05	0.00E+00
SR-92	6.74E+00	0.00E+00	2.91E-01	0.00E+00	0.00E+00	1.65E+04	4.30E+04	0.00E+00
Y-90	2.09E+03	0.00E+00	5.61E+01	0.00E+00	0.00E+00	1.70E+05	5.06E+05	0.00E+00
Y-91M	2.61E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	1.92E+03	1.33E+00	0.00E+00
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05	0.00E+00
Y-92	1.03E+01	0.00E+00	3.02E-01	0.00E+00	0.00E+00	1.57E+04	7.35E+04	0.00E+00
Y-93	9.44E+01	0.00E+00	2.61E+00	0.00E+00	0.00E+00	4.85E+04	4.22E+05	0.00E+00
ZR-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05	0.00E+00
ZR-97	9.68E+01	1.96E+01	9.04E+00	0.00E+00	2.97E+01	7.87E+04	5.23E+05	0.00E+00
NB-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	1.21E+02	2.30E+01	0.00E+00	2.91E+02	9.12E+04	2.48E+05	0.00E+00
TC-99M	1.03E-03	2.91E-03	3.70E-02	0.00E+00	4.42E-02	7.64E+02	4.16E+03	0.00E+00
TC-101	4.18E-05	6.02E-05	5.90E-04	0.00E+00	1.08E-03	3.99E+02	1.09E-11	0.00E+00
RU-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05	0.00E+00
RU-105	7.90E-01	0.00E+00	3.11E-01	0.00E+00	1.02E+00	1.10E+04	4.82E+04	0.00E+00
RU-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05	0.00E+00
AG-110M	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	3.42E+03	1.58E+03	4.67E+02	1.05E+03	1.24E+04	3.14E+05	7.06E+04	0.00E+00
TE-127M	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05	0.00E+00
TE-127	1.40E+00	6.42E-01	3.10E-01	1.06E+00	5.10E+00	6.15E+03	5.74E+04	0.00E+00
TE-129M	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05	0.00E+00
TE-129	4.98E-02	2.39E-02	1.24E-02	3.90E-02	1.87E-01	1.94E+03	1.57E+02	0.00E+00

TABLE I-1: DOSE FACTOR TABLE: P (I) - ADULT, INHALATION

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	6.99E+01	4.36E+01	2.90E+01	5.50E+01	3.09E+02	1.46E+05	5.56E+05	0.00E+00
TE-131	1.11E-02	5.95E-03	3.59E-03	9.36E-03	4.37E-02	1.39E+03	1.84E+01	0.00E+00
TE-132	2.60E+02	2.15E+02	1.62E+02	1.90E+02	1.46E+03	2.88E+05	5.10E+05	0.00E+00
I-130	4.58E+03	1.34E+04	5.28E+03	1.14E+06	2.09E+04	0.00E+00	7.69E+03	0.00E+00
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03	0.00E+00
I-132	1.16E+03	3.26E+03	1.16E+03	1.14E+05	5.18E+03	0.00E+00	4.06E+02	0.00E+00
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03	0.00E+00
I-134	6.44E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	0.00E+00	1.01E+00	0.00E+00
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	0.00E+00	5.25E+03	0.00E+00
CS-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04	0.00E+00
CS-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04	0.00E+00
CS-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03	0.00E+00
CS-138	3.31E+02	6.21E+02	3.24E+02	0.00E+00	4.80E+02	4.86E+01	1.86E-03	0.00E+00
BA-139	9.36E-01	6.66E-04	2.74E-02	0.00E+00	6.22E-04	3.76E+03	8.96E+02	0.00E+00
BA-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05	0.00E+00
BA-141	1.00E-01	7.53E-05	3.36E-03	0.00E+00	7.00E-05	1.94E+03	1.16E-07	0.00E+00
BA-142	2.63E-02	2.70E-05	1.66E-03	0.00E+00	2.29E-05	1.19E+03	1.57E-16	0.00E+00
LA-140	3.44E+02	1.74E+02	4.58E+01	0.00E+00	0.00E+00	1.36E+05	4.58E+05	0.00E+00
LA-142	6.83E-01	3.10E-01	7.72E-02	0.00E+00	0.00E+00	6.33E+03	2.11E+03	0.00E+00
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05	0.00E+00
CE-143	1.86E+02	1.38E+02	1.53E+01	0.00E+00	6.08E+01	7.98E+04	2.26E+05	0.00E+00
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05	0.00E+00
PR-143	9.36E+03	3.75E+03	4.64E+02	0.00E+00	2.16E+03	2.81E+05	2.00E+05	0.00E+00
PR-144	3.01E-02	1.25E-02	1.53E-03	0.00E+00	7.05E-03	1.02E+03	2.15E-08	0.00E+00
ND-147	5.27E+03	6.10E+03	3.65E+02	0.00E+00	3.56E+03	2.21E+05	1.73E+05	0.00E+00
W-187	8.48E+00	7.08E+00	2.48E+00	0.00E+00	0.00E+00	2.90E+04	1.50E+05	0.00E+00
NP-239	2.30E+02	2.26E+01	1.24E+01	0.00E+00	7.00E+01	3.76E+04	1.19E+05	0.00E+00

TABLE I-2: DOSE FACTOR TABLE: P (I) - TEEN, INHALATION

TABLE I-2  
DOSE FACTOR TABLE: P (i) - Teen, inhalation,  
Units are mrem/yr per  $\mu\text{Ci}/\text{cu.m}$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	0.00E+00
C-14	2.60E+04	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	0.00E+00
NA-24	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	0.00E+00
P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03	0.00E+00
MN-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04	0.00E+00
MN-56	0.00E+00	1.70E+00	2.52E-01	0.00E+00	1.79E+00	1.52E+04	5.74E+04	0.00E+00
FE-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03	0.00E+00
FE-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04	0.00E+00
CO-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05	0.00E+00
NI-63	5.80E+05	4.34E+04	1.98E+04	0.00E+00	0.00E+00	3.07E+05	1.42E+04	0.00E+00
NI-65	2.18E+00	2.93E-01	1.27E-01	0.00E+00	0.00E+00	9.36E+03	3.67E+03	0.00E+00
CU-64	0.00E+00	2.03E+00	8.48E-01	0.00E+00	6.41E+00	1.11E+04	6.14E+04	0.00E+00
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04	0.00E+00
ZN-69	4.83E-02	9.20E-02	6.46E-03	0.00E+00	6.02E-02	1.58E+03	2.85E+02	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	3.44E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.33E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04	0.00E+00
RB-88	0.00E+00	5.46E+02	2.72E+02	0.00E+00	0.00E+00	0.00E+00	2.92E-05	0.00E+00
RB-89	0.00E+00	3.52E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	3.38E-07	0.00E+00
SR-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05	0.00E+00
SR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05	0.00E+00
SR-91	8.80E+01	0.00E+00	3.51E+00	0.00E+00	0.00E+00	6.07E+04	2.59E+05	0.00E+00
SR-92	9.52E+00	0.00E+00	4.06E-01	0.00E+00	0.00E+00	2.74E+04	1.19E+05	0.00E+00
Y-90	2.98E+03	0.00E+00	8.00E+01	0.00E+00	0.00E+00	2.93E+05	5.59E+05	0.00E+00
Y-91M	3.70E-01	0.00E+00	1.42E-02	0.00E+00	0.00E+00	3.20E+03	3.02E+01	0.00E+00
Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05	0.00E+00
Y-92	1.47E+01	0.00E+00	4.29E-01	0.00E+00	0.00E+00	2.68E+04	1.65E+05	0.00E+00
Y-93	1.35E+02	0.00E+00	3.72E+00	0.00E+00	0.00E+00	8.32E+04	5.79E+05	0.00E+00
ZR-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05	0.00E+00
ZR-97	1.38E+02	2.72E+01	1.26E+01	0.00E+00	4.12E+01	1.30E+05	6.30E+05	0.00E+00
NB-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	1.69E+02	3.22E+01	0.00E+00	4.11E+02	1.54E+05	2.69E+05	0.00E+00
TC-99M	1.38E-03	3.86E-03	4.99E-02	0.00E+00	5.76E-02	1.15E+03	6.13E+03	0.00E+00
TC-101	5.92E-05	8.40E-05	8.24E-04	0.00E+00	1.52E-03	6.67E+02	8.72E-07	0.00E+00
RU-103	2.10E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05	0.00E+00
RU-105	1.12E+00	0.00E+00	4.34E-01	0.00E+00	1.41E+00	1.82E+04	9.04E+04	0.00E+00
RU-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05	0.00E+00
AG-110M	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	4.88E+03	2.24E+03	6.67E+02	1.40E+03	0.00E+00	5.36E+05	7.50E+04	0.00E+00
TE-127M	1.80E+04	8.16E+03	2.18E+03	4.38E+03	6.54E+04	1.66E+06	1.59E+05	0.00E+00
TE-127	2.01E+00	9.12E-01	4.42E-01	1.42E+00	7.28E+00	1.12E+04	8.08E+04	0.00E+00
TE-129M	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05	0.00E+00
TE-129	7.10E-02	3.38E-02	1.76E-02	5.18E-02	2.66E-01	3.30E+03	1.62E+03	0.00E+00



TABLE I-2: DOSE FACTOR TABLE: P (I) - TEEN, INHALATION

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	9.84E+01	6.01E+01	4.02E+01	7.25E+01	4.39E+02	2.38E+05	6.21E+05	0.00E+00
TE-131	1.58E-02	8.32E-03	5.04E-03	1.24E-02	6.18E-02	2.34E+03	1.51E+01	0.00E+00
TE-132	3.60E+02	2.90E+02	2.19E+02	2.46E+02	1.95E+03	4.49E+05	4.63E+05	0.00E+00
I-130	6.24E+03	1.79E+04	7.17E+03	1.49E+06	2.75E+04	0.00E+00	9.12E+03	0.00E+00
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03	0.00E+00
I-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	0.00E+00	1.27E+03	0.00E+00
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04	0.00E+00
I-134	8.88E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	0.00E+00	2.04E+01	0.00E+00
I-135	3.70E+03	9.44E+03	3.49E+03	6.21E+05	1.49E+04	0.00E+00	6.95E+03	0.00E+00
CS-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03	0.00E+00
CS-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04	0.00E+00
CS-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03	0.00E+00
CS-138	4.66E+02	8.56E+02	4.46E+02	0.00E+00	6.62E+02	7.87E+01	2.70E-01	0.00E+00
BA-139	1.34E+00	9.44E-04	3.90E-02	0.00E+00	8.88E-04	6.46E+03	6.45E+03	0.00E+00
BA-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05	0.00E+00
BA-141	1.42E-01	1.06E-04	4.74E-03	0.00E+00	9.84E-05	3.29E+03	7.46E-04	0.00E+00
BA-142	3.70E-02	3.70E-05	2.27E-03	0.00E+00	3.14E-05	1.91E+03	4.79E-10	0.00E+00
LA-140	4.79E+02	2.36E+02	6.26E+01	0.00E+00	0.00E+00	2.14E+05	4.87E+05	0.00E+00
LA-142	9.60E-01	4.25E-01	1.06E-01	0.00E+00	0.00E+00	1.02E+04	1.20E+04	0.00E+00
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05	0.00E+00
CE-143	2.66E+02	1.94E+02	2.16E+01	0.00E+00	8.64E+01	1.30E+05	2.55E+05	0.00E+00
CE-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05	0.00E+00
PR-143	1.34E+04	5.31E+03	6.62E+02	0.00E+00	3.09E+03	4.83E+05	2.14E+05	0.00E+00
PR-144	4.30E-02	1.76E-02	2.18E-03	0.00E+00	1.01E-02	1.75E+03	2.35E-04	0.00E+00
ND-147	7.86E+03	8.56E+03	5.13E+02	0.00E+00	5.02E+03	3.72E+05	1.82E+05	0.00E+00
W-187	1.20E+01	9.76E+00	3.43E+00	0.00E+00	0.00E+00	4.74E+04	1.77E+05	0.00E+00
NP-239	3.38E+02	3.19E+01	1.77E+01	0.00E+00	1.00E+02	6.49E+04	1.32E+05	0.00E+00

TABLE I-3: DOSE FACTOR TABLE: P (I) - CHILD, INHALATION

TABLE I-3  
DOSE FACTOR TABLE: P (i) - CHILD, inhalation,  
Units are mrem/yr per  $\mu\text{Ci}/\text{cu.m}$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	0.00E+00
C-14	3.59E+04	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	0.00E+00
NA-24	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	0.00E+00
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03	0.00E+00
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04	0.00E+00
MN-56	0.00E+00	1.66E+00	3.12E-01	0.00E+00	1.67E+00	1.31E+04	1.23E+05	0.00E+00
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03	0.00E+00
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04	0.00E+00
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04	0.00E+00
NI-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03	0.00E+00
NI-65	2.99E+00	2.96E-01	1.64E-01	0.00E+00	0.00E+00	8.18E+03	8.40E+04	0.00E+00
CU-64	0.00E+00	1.99E+00	1.07E+00	0.00E+00	6.03E+00	9.58E+03	3.67E+04	0.00E+00
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04	0.00E+00
ZN-69	6.70E-02	9.66E-02	8.92E-03	0.00E+00	5.85E-02	1.42E+03	1.02E-04	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	5.48E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	2.53E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03	0.00E+00
RB-88	0.00E+00	5.62E+02	3.66E+02	0.00E+00	0.00E+00	0.00E+00	1.72E+01	0.00E+00
RB-89	0.00E+00	3.45E+02	2.90E+02	0.00E+00	0.00E+00	0.00E+00	1.89E+00	0.00E+00
SR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05	0.00E+00
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05	0.00E+00
SR-91	1.21E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	5.33E+04	1.74E+05	0.00E+00
SR-92	1.31E+01	0.00E+00	5.25E-01	0.00E+00	0.00E+00	2.40E+04	2.42E+05	0.00E+00
Y-90	4.11E+03	0.00E+00	1.11E+02	0.00E+00	0.00E+00	2.62E+05	2.68E+05	0.00E+00
Y-91M	5.07E-01	0.00E+00	1.84E-02	0.00E+00	0.00E+00	2.81E+03	1.72E+03	0.00E+00
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05	0.00E+00
Y-92	2.04E+01	0.00E+00	5.81E-01	0.00E+00	0.00E+00	2.39E+04	2.39E+05	0.00E+00
Y-93	1.86E+02	0.00E+00	5.11E+00	0.00E+00	0.00E+00	7.44E+04	3.89E+05	0.00E+00
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04	0.00E+00
ZR-97	1.88E+02	2.72E+01	1.60E+01	0.00E+00	3.88E+01	1.13E+05	3.51E+05	0.00E+00
NB-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	1.72E+02	4.25E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05	0.00E+00
TC-99M	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03	0.00E+00
TC-101	8.10E-05	8.51E-05	1.08E-03	0.00E+00	1.45E-03	5.85E+02	1.63E+01	0.00E+00
RU-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04	0.00E+00
RU-105	1.53E+00	0.00E+00	5.55E-01	0.00E+00	1.34E+00	1.59E+04	9.95E+04	0.00E+00
RU-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05	0.00E+00
AG-110M	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	6.73E+03	2.33E+03	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04	0.00E+00
TE-127M	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04	0.00E+00
TE-127	2.77E+00	9.51E-01	6.10E-01	1.96E+00	7.07E+00	1.00E+04	5.62E+04	0.00E+00
TE-129M	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05	0.00E+00
TE-129	9.77E-02	3.50E-02	2.38E-02	7.14E-02	2.57E-01	2.93E+03	2.55E+04	0.00E+00

TABLE I-3: DOSE FACTOR TABLE: P (I) - CHILD, INHALATION

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	1.34E+02	5.92E+01	5.07E+01	9.77E+01	4.00E+02	2.06E+05	3.08E+05	0.00E+00
TE-131	2.17E-02	8.44E-03	6.59E-03	1.70E-02	5.88E-02	2.05E+03	1.33E+03	0.00E+00
TE-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05	0.00E+00
I-130	8.18E+03	1.64E+04	8.44E+03	1.85E+06	2.45E+04	0.00E+00	5.11E+03	0.00E+00
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03	0.00E+00
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	0.00E+00	3.20E+03	0.00E+00
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03	0.00E+00
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	0.00E+00	9.55E+02	0.00E+00
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03	0.00E+00
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03	0.00E+00
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03	0.00E+00
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03	0.00E+00
CS-138	6.33E+02	8.40E+02	5.55E+02	0.00E+00	6.22E+02	6.81E+01	2.70E+02	0.00E+00
BA-139	1.84E+00	9.84E-04	5.36E-02	0.00E+00	8.62E-04	5.77E+03	5.77E+04	0.00E+00
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05	0.00E+00
BA-141	1.96E-01	1.09E-04	6.36E-03	0.00E+00	9.47E-05	2.92E+03	2.75E+02	0.00E+00
BA-142	4.99E-02	3.60E-05	2.79E-03	0.00E+00	2.91E-05	1.64E+03	2.74E+00	0.00E+00
LA-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05	0.00E+00
LA-142	1.29E+00	4.11E-01	1.29E-01	0.00E+00	0.00E+00	8.70E+03	7.59E+04	0.00E+00
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04	0.00E+00
CE-143	3.66E+02	1.99E+02	2.87E+01	0.00E+00	8.36E+01	1.15E+05	1.27E+05	0.00E+00
CE-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05	0.00E+00
PR-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	4.33E+05	9.73E+04	0.00E+00
PR-144	5.96E-02	1.85E-02	3.00E-03	0.00E+00	9.77E-03	1.57E+03	1.97E+02	0.00E+00
ND-147	1.08E+04	8.73E+03	6.81E+02	0.00E+00	4.81E+03	3.28E+05	8.21E+04	0.00E+00
W-187	1.63E+01	9.66E+00	4.33E+00	0.00E+00	0.00E+00	4.11E+04	9.10E+04	0.00E+00
NP-239	4.66E+02	3.34E+01	2.35E+01	0.00E+00	9.73E+01	5.81E+04	6.40E+04	0.00E+00

TABLE I-4: DOSE FACTOR TABLE: P (I) - INFANT, INHALATION

TABLE I-4  
DOSE FACTOR TABLE: P (i) - Infant, inhalation,  
Units are mrem/yr per  $\mu\text{Ci}/\text{cu.m}$

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	0.00E+00
C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	0.00E+00
NA-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	0.00E+00
P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02	0.00E+00
MN-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03	0.00E+00
MN-56	0.00E+00	1.54E+00	2.21E-01	0.00E+00	1.10E+00	1.25E+04	7.17E+04	0.00E+00
FE-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03	0.00E+00
FE-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04	0.00E+00
CO-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04	0.00E+00
NI-63	3.39E+05	2.04E+04	1.16E+04	0.00E+00	0.00E+00	2.09E+05	2.42E+03	0.00E+00
NI-65	2.39E+00	2.84E-01	1.23E-01	0.00E+00	0.00E+00	8.12E+03	5.01E+04	0.00E+00
CU-64	0.00E+00	1.88E+00	7.74E-01	0.00E+00	3.98E+00	9.30E+03	1.50E+04	0.00E+00
ZN-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04	0.00E+00
ZN-69	5.39E-02	9.67E-02	7.18E-03	0.00E+00	4.02E-02	1.47E+03	1.32E+04	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	3.81E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03	0.00E+00
RB-88	0.00E+00	5.57E+02	2.87E+02	0.00E+00	0.00E+00	0.00E+00	3.39E+02	0.00E+00
RB-89	0.00E+00	3.21E+02	2.06E+02	0.00E+00	0.00E+00	0.00E+00	6.82E+01	0.00E+00
SR-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04	0.00E+00
SR-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05	0.00E+00
SR-91	9.56E+01	0.00E+00	3.46E+00	0.00E+00	0.00E+00	5.26E+04	7.34E+04	0.00E+00
SR-92	1.05E+01	0.00E+00	3.91E-01	0.00E+00	0.00E+00	2.38E+04	1.40E+05	0.00E+00
Y-90	3.29E+03	0.00E+00	8.82E+01	0.00E+00	0.00E+00	2.69E+05	1.04E+05	0.00E+00
Y-91M	4.07E-01	0.00E+00	1.39E-02	0.00E+00	0.00E+00	2.79E+03	2.35E+03	0.00E+00
Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04	0.00E+00
Y-92	1.64E+01	0.00E+00	4.61E-01	0.00E+00	0.00E+00	2.45E+04	1.27E+05	0.00E+00
Y-93	1.50E+02	0.00E+00	4.07E+00	0.00E+00	0.00E+00	7.64E+04	1.67E+05	0.00E+00
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04	0.00E+00
ZR-97	1.50E+02	2.56E+01	1.17E+01	0.00E+00	2.59E+01	1.10E+05	1.40E+05	0.00E+00
NB-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	1.65E+02	3.23E+01	0.00E+00	2.65E+02	1.35E+05	4.87E+04	0.00E+00
TC-99M	1.40E-03	2.88E-03	3.72E-02	0.00E+00	3.11E-02	8.11E+02	2.03E+03	0.00E+00
TC-101	6.51E-05	8.23E-05	8.12E-04	0.00E+00	9.79E-04	5.84E+02	8.44E+02	0.00E+00
RU-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04	0.00E+00
RU-105	1.22E+00	0.00E+00	4.10E-01	0.00E+00	8.99E-01	1.57E+04	4.84E+04	0.00E+00
RU-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05	0.00E+00
AG-110M	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	4.76E+03	1.99E+03	6.58E+02	1.62E+03	0.00E+00	4.47E+05	1.29E+04	0.00E+00
TE-127M	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04	0.00E+00
TE-127	2.23E+00	9.53E-01	4.89E-01	1.85E+00	4.86E+00	1.03E+04	2.44E+04	0.00E+00
TE-129M	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04	0.00E+00
TE-129	7.88E-02	3.47E-02	1.88E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04	0.00E+00

TABLE I-4: DOSE FACTOR TABLE: P (I) - INFANT, INHALATION

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	1.07E+02	5.50E+01	3.63E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05	0.00E+00
TE-131	1.74E-02	8.22E-03	5.00E-03	1.58E-02	3.99E-02	2.06E+03	8.22E+03	0.00E+00
TE-132	3.72E+02	2.37E+02	1.76E+02	2.79E+02	1.03E+03	3.40E+05	4.41E+04	0.00E+00
I-130	6.36E+03	1.39E+04	5.57E+03	1.60E+06	1.53E+04	0.00E+00	1.99E+03	0.00E+00
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03	0.00E+00
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	0.00E+00	1.90E+03	0.00E+00
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03	0.00E+00
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.90E+03	0.00E+00	1.29E+03	0.00E+00
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	0.00E+00	1.83E+03	0.00E+00
CS-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03	0.00E+00
CS-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03	0.00E+00
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03	0.00E+00
CS-138	5.05E+02	7.81E+02	3.98E+02	0.00E+00	4.10E+02	6.54E+01	8.76E+02	0.00E+00
BA-139	1.48E+00	9.84E-04	4.30E-02	0.00E+00	5.92E-04	5.95E+03	5.10E+04	0.00E+00
BA-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04	0.00E+00
BA-141	1.57E-01	1.08E-04	4.97E-03	0.00E+00	6.50E-05	2.97E+03	4.75E+03	0.00E+00
BA-142	3.98E-02	3.30E-05	1.96E-03	0.00E+00	1.90E-05	1.55E+03	6.93E+02	0.00E+00
LA-140	5.05E+02	2.00E+02	5.15E+01	0.00E+00	0.00E+00	1.68E+05	8.48E+04	0.00E+00
LA-142	1.03E+00	3.77E-01	9.04E-02	0.00E+00	0.00E+00	8.22E+03	5.95E+04	0.00E+00
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04	0.00E+00
CE-143	2.93E+02	1.93E+02	2.21E+01	0.00E+00	5.64E+01	1.16E+05	4.97E+04	0.00E+00
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05	0.00E+00
PR-143	1.40E+04	5.24E+03	6.99E+02	0.00E+00	1.97E+03	4.33E+05	3.72E+04	0.00E+00
PR-144	4.79E-02	1.85E-02	2.41E-03	0.00E+00	6.72E-02	1.61E+03	4.28E+03	0.00E+00
ND-147	7.94E+04	8.13E+03	5.00E+02	0.00E+00	3.15E+03	3.22E+05	3.12E+04	0.00E+00
W-187	1.30E+01	9.02E+00	3.12E+00	0.00E+00	0.00E+00	3.96E+04	3.56E+04	0.00E+00
NP-239	3.71E+02	3.32E+01	1.88E+01	0.00E+00	6.62E+01	5.95E+04	2.49E+04	0.00E+00

TABLE I-5: DOSE FACTOR TABLE: R (I) - ALL, GR. PLANE

TABLE I-5  
DOSE FACTOR TABLE: R (i) -All , gr. plane,  
Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA-24	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.39E+07
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR-51	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	5.51E+06
MN-54	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.62E+09
MN-56	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	1.07E+06
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-59	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	3.21E+08
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08	4.44E+08
CO-60	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.53E+10
NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-65	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	3.45E+05
CU-64	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.88E+05
ZN-65	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.48E+08	8.59E+08
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	7.08E+03
BR-84	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.36E+05
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06	1.03E+07
RB-88	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.78E+04
RB-89	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.48E+05
SR-89	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.51E+04
SR-91	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.51E+06
SR-92	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	8.63E+05
Y-90	4.49E+03	4.49E+03	4.49E+03	4.49E+03	4.49E+03	4.49E+03	4.49E+03	5.31E+03
Y-91M	1.00E+05	1.00E+05	1.00E+05	1.00E+05	1.00E+05	1.00E+05	1.00E+05	1.16E+05
Y-91	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.21E+06
Y-92	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	2.14E+05
Y-93	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	2.51E+05
ZR-95	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.84E+08
ZR-97	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	3.44E+06
NB-95	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.61E+08
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	3.99E+06	3.99E+06	3.99E+06	3.99E+06	3.99E+06	3.99E+06	3.99E+06	4.63E+06
TC-99M	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	2.11E+05
TC-101	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.26E+04
RU-103	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.26E+08
RU-105	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	7.21E+05
RU-106	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08	5.07E+08
AG-110M	3.41E+09	3.41E+09	3.41E+09	3.41E+09	3.41E+09	3.41E+09	3.41E+09	5.88E+09
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	1.55E+06	1.55E+06	1.55E+06	1.55E+06	1.55E+06	1.55E+06	1.55E+06	2.13E+06
TE-127M	9.16E+04	9.16E+04	9.16E+04	9.16E+04	9.16E+04	9.16E+04	9.16E+04	1.08E+05
TE-127	2.98E+03	2.98E+03	2.98E+03	2.98E+03	2.98E+03	2.98E+03	2.98E+03	3.28E+03
TE-129M	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	2.31E+07
TE-129	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	3.10E+04

TABLE I-5: DOSE FACTOR TABLE: R (I) - ALL, GR. PLANE

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	9.46E+06
TE-131	2.92E+04	2.92E+04	2.92E+04	2.92E+04	2.92E+04	2.92E+04	2.92E+04	3.45E+07
TE-132	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.98E+06
I-130	5.51E+06	5.51E+06	5.51E+06	5.51E+06	5.51E+06	5.51E+06	5.51E+06	6.69E+06
I-131	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07	2.09E+07
I-132	1.25E+06	1.25E+06	1.25E+06	1.25E+06	1.25E+06	1.25E+06	1.25E+06	1.46E+06
I-133	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.98E+06
I-134	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	5.30E+05
I-135	2.53E+06	2.53E+06	2.53E+06	2.53E+06	2.53E+06	2.53E+06	2.53E+06	2.95E+06
CS-134	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	8.00E+09
CS-136	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.71E+08
CS-137	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.20E+10
CS-138	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	4.10E+05
BA-139	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.19E+05
BA-140	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.35E+07
BA-141	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.75E+04
BA-142	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	5.11E+04
LA-140	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07	2.18E+07
LA-142	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	9.11E+05
CE-141	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.54E+07
CE-143	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.63E+06
CE-144	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	8.04E+07
PR-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PR-144	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	2.11E+03
ND-147	8.39E+06	8.39E+06	8.39E+06	8.39E+06	8.39E+06	8.39E+06	8.39E+06	1.01E+07
W-187	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.73E+06
NP-239	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.98E+06

TABLE I-6: DOSE FACTOR TABLE: R (I) - ADULT, COWS MILK

TABLE I-6  
DOSE FACTOR TABLE: R (i) -Adult, cows' milk  
Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	4.73E+02	4.73E+02	4.73E+02	4.73E+02	4.73E+02	4.73E+02	0.00E+00
C-14	3.63E+05	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04	0.00E+00
NA-24	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	0.00E+00
P-32	1.62E+10	1.01E+09	6.26E+08	0.00E+00	0.00E+00	0.00E+00	1.82E+09	0.00E+00
CR-51	0.00E+00	0.00E+00	2.55E+04	1.53E+04	5.62E+03	3.39E+04	6.42E+06	0.00E+00
MN-54	0.00E+00	6.63E+06	1.27E+06	0.00E+00	1.97E+06	0.00E+00	2.03E+07	0.00E+00
MN-56	0.00E+00	4.21E-03	7.47E-04	0.00E+00	5.34E-03	0.00E+00	1.34E-01	0.00E+00
FE-55	1.95E+07	1.35E+07	3.15E+06	0.00E+00	0.00E+00	7.53E+06	7.75E+06	0.00E+00
FE-59	2.55E+07	5.99E+07	2.30E+07	0.00E+00	0.00E+00	1.67E+07	2.00E+08	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	3.92E+06	8.78E+06	0.00E+00	0.00E+00	0.00E+00	7.94E+07	0.00E+00
CO-60	0.00E+00	1.27E+07	2.81E+07	0.00E+00	0.00E+00	0.00E+00	2.39E+08	0.00E+00
NI-63	5.21E+09	3.61E+08	1.75E+08	0.00E+00	0.00E+00	0.00E+00	7.53E+07	0.00E+00
NI-65	3.76E-01	4.88E-02	2.23E-02	0.00E+00	0.00E+00	0.00E+00	1.24E+00	0.00E+00
CU-64	0.00E+00	2.39E+04	1.12E+04	0.00E+00	6.03E+04	0.00E+00	2.04E+06	0.00E+00
ZN-65	1.09E+09	3.46E+09	1.56E+09	0.00E+00	2.31E+09	0.00E+00	2.18E+09	0.00E+00
ZN-69	2.18E-12	4.17E-12	2.90E-13	0.00E+00	2.71E-12	0.00E+00	6.26E-13	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	9.87E-02	0.00E+00	0.00E+00	0.00E+00	1.42E-01	0.00E+00
BR-84	0.00E+00	0.00E+00	1.73E-23	0.00E+00	0.00E+00	0.00E+00	1.36E-28	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.40E+09	1.12E+09	0.00E+00	0.00E+00	0.00E+00	4.74E+08	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	1.23E+09	0.00E+00	3.54E+07	0.00E+00	0.00E+00	0.00E+00	1.98E+08	0.00E+00
SR-90	3.62E+10	0.00E+00	8.89E+09	0.00E+00	0.00E+00	0.00E+00	1.05E+09	0.00E+00
SR-91	2.90E+04	0.00E+00	1.17E+03	0.00E+00	0.00E+00	0.00E+00	1.38E+05	0.00E+00
SR-92	4.95E-01	0.00E+00	2.14E-02	0.00E+00	0.00E+00	0.00E+00	9.81E+00	0.00E+00
Y-90	7.09E+01	0.00E+00	1.90E+00	0.00E+00	0.00E+00	0.00E+00	7.51E+05	0.00E+00
Y-91M	6.27E-20	0.00E+00	2.43E-21	0.00E+00	0.00E+00	0.00E+00	1.84E-19	0.00E+00
Y-91	7.22E+03	0.00E+00	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.98E+06	0.00E+00
Y-92	5.64E-05	0.00E+00	1.65E-06	0.00E+00	0.00E+00	0.00E+00	9.88E-01	0.00E+00
Y-93	2.24E-01	0.00E+00	6.19E-03	0.00E+00	0.00E+00	0.00E+00	7.11E+03	0.00E+00
ZR-95	7.89E+02	2.53E+02	1.71E+02	0.00E+00	3.97E+02	0.00E+00	8.02E+05	0.00E+00
ZR-97	4.34E-01	8.76E-02	4.01E-02	0.00E+00	1.32E-01	0.00E+00	2.71E+04	0.00E+00
NB-95	7.22E+04	4.02E+04	2.16E+04	0.00E+00	3.97E+04	0.00E+00	2.44E+08	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	2.48E+07	4.71E+06	0.00E+00	5.61E+07	0.00E+00	5.74E+07	0.00E+00
TC-99M	3.34E+00	9.44E+00	1.20E+02	0.00E+00	1.43E+02	4.63E+00	5.59E+03	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	8.82E+02	0.00E+00	3.80E+02	0.00E+00	3.37E+03	0.00E+00	1.03E+05	0.00E+00
RU-105	8.64E-04	0.00E+00	3.41E-04	0.00E+00	1.12E-02	0.00E+00	5.29E-01	0.00E+00
RU-106	1.60E+04	0.00E+00	2.03E+03	0.00E+00	3.10E+04	0.00E+00	1.04E+06	0.00E+00
AG-110M	4.61E+07	4.26E+07	2.53E+07	0.00E+00	8.38E+07	0.00E+00	1.74E+10	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	1.37E+07	4.97E+06	1.84E+06	4.12E+06	5.58E+07	0.00E+00	5.48E+07	0.00E+00
TE-127M	3.72E+07	1.33E+07	4.53E+06	9.51E+06	1.51E+08	0.00E+00	1.25E+08	0.00E+00
TE-127	6.56E+02	2.35E+02	1.42E+02	4.86E+02	2.67E+03	0.00E+00	5.17E+04	0.00E+00
TE-129M	5.29E+07	1.97E+07	8.37E+06	1.82E+07	2.21E+08	0.00E+00	2.66E+08	0.00E+00
TE-129	2.92E-10	1.10E-10	7.11E-11	2.24E-10	1.23E-09	0.00E+00	2.20E-10	0.00E+00



TABLE I-6: DOSE FACTOR TABLE: R (I) - ADULT, COWS MILK

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	3.62E+05	1.77E+05	1.47E+05	2.80E+05	1.79E+06	0.00E+00	1.76E+07	0.00E+00
TE-131	3.95E-33	1.65E-33	1.25E-33	3.25E-33	1.73E-32	0.00E+00	5.60E-34	0.00E+00
TE-132	2.40E+06	1.55E+06	1.46E+06	1.72E+06	1.50E+07	0.00E+00	7.35E+07	0.00E+00
I-130	4.21E+05	1.24E+06	4.90E+05	1.05E+08	1.94E+06	0.00E+00	1.07E+06	0.00E+00
I-131	2.91E+08	4.16E+08	2.38E+08	1.36E+11	7.13E+08	0.00E+00	1.10E+08	0.00E+00
I-132	1.67E-01	4.47E-01	1.56E-01	1.56E+01	7.12E-01	0.00E+00	8.39E-02	0.00E+00
I-133	3.88E+06	6.74E+02	2.06E+06	9.91E+08	1.18E+07	0.00E+00	6.06E+06	0.00E+00
I-134	2.11E-12	5.72E-12	2.05E-12	9.92E-11	9.10E-12	0.00E+00	4.99E-15	0.00E+00
I-135	1.29E+04	3.38E+04	1.25E+04	2.23E+06	5.42E+04	0.00E+00	3.82E+04	0.00E+00
CS-134	4.41E+09	1.05E+10	8.57E+09	0.00E+00	3.39E+09	1.13E+09	1.84E+08	0.00E+00
CS-136	2.51E+08	9.91E+08	7.13E+08	0.00E+00	5.51E+08	7.56E+07	1.13E+08	0.00E+00
CS-137	5.71E+09	7.81E+09	5.12E+09	0.00E+00	2.65E+09	8.82E+08	1.51E+08	0.00E+00
CS-138	9.72E-24	1.92E-23	9.50E-24	0.00E+00	1.41E-23	1.39E-24	8.18E-29	0.00E+00
BA-139	4.54E-08	3.24E-11	1.33E-09	0.00E+00	3.03E-11	1.84E-11	8.06E-08	0.00E+00
BA-140	2.57E+07	3.23E+04	1.68E+06	0.00E+00	1.10E+04	1.85E+04	5.29E+07	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.52E+00	2.28E+00	6.01E-01	0.00E+00	0.00E+00	0.00E+00	1.67E+05	0.00E+00
LA-142	1.90E-11	8.66E-12	2.16E-12	0.00E+00	0.00E+00	0.00E+00	6.32E-08	0.00E+00
CE-141	4.27E+03	2.89E+03	3.27E+02	0.00E+00	1.34E+03	0.00E+00	1.10E+07	0.00E+00
CE-143	4.16E+01	3.08E+04	3.40E+00	0.00E+00	1.35E+00	0.00E+00	1.15E+06	0.00E+00
CE-144	2.82E+05	1.18E+05	1.52E+04	0.00E+00	7.00E+04	0.00E+00	9.55E+07	0.00E+00
PR-143	1.50E+02	6.02E+01	7.44E+00	0.00E+00	3.48E+01	0.00E+00	6.58E+05	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	9.10E+01	1.05E+02	6.29E+00	0.00E+00	6.15E+01	0.00E+00	5.05E+05	0.00E+00
W-187	6.52E+03	5.45E+03	1.90E+03	0.00E+00	0.00E+00	0.00E+00	1.78E+06	0.00E+00
NP-239	3.67E+00	3.61E-01	1.99E-01	0.00E+00	1.13E+00	0.00E+00	7.41E+04	0.00E+00

TABLE I-7: DOSE FACTOR TABLE: R (I) - TEEN, COWS MILK

TABLE I-7  
DOSE FACTOR TABLE: R (i) - Teen, cows' milk

Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	6.16E+02	6.16E+02	6.16E+02	6.16E+02	6.16E+02	6.16E+02	0.00E+00
C-14	6.70E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	0.00E+00
NA-24	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06	0.00E+00
P-32	2.99E+10	1.85E+09	1.16E+09	0.00E+00	0.00E+00	0.00E+00	2.51E+09	0.00E+00
CR-51	0.00E+00	0.00E+00	4.46E+04	2.48E+04	9.77E+03	6.36E+04	7.49E+06	0.00E+00
MN-54	0.00E+00	1.10E+07	2.19E+06	0.00E+00	3.30E+06	0.00E+00	2.27E+07	0.00E+00
MN-56	0.00E+00	7.46E-03	1.33E-03	0.00E+00	9.45E-03	0.00E+00	4.91E-01	0.00E+00
FE-55	3.47E+07	2.46E+07	5.73E+06	0.00E+00	0.00E+00	1.56E+07	1.06E+07	0.00E+00
FE-59	4.45E+07	1.04E+08	4.01E+07	0.00E+00	0.00E+00	3.27E+07	2.45E+08	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	6.60E+06	1.52E+07	0.00E+00	0.00E+00	0.00E+00	9.09E+07	0.00E+00
CO-60	0.00E+00	2.16E+07	4.86E+07	0.00E+00	0.00E+00	0.00E+00	2.81E+08	0.00E+00
NI-63	9.15E+09	6.46E+08	3.10E+08	0.00E+00	0.00E+00	0.00E+00	1.03E+08	0.00E+00
NI-65	6.87E-01	8.78E-02	4.00E-02	0.00E+00	0.00E+00	0.00E+00	4.76E+00	0.00E+00
CU-64	0.00E+00	4.26E+04	2.00E+04	0.00E+00	1.08E+05	0.00E+00	3.30E+06	0.00E+00
ZN-65	1.67E+09	5.79E+09	2.70E+09	0.00E+00	3.71E+09	0.00E+00	2.45E+09	0.00E+00
ZN-69	4.01E-12	7.65E-12	5.35E-13	0.00E+00	5.00E-12	0.00E+00	1.41E-11	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	1.82E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.09E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	4.38E+09	2.06E+09	0.00E+00	0.00E+00	0.00E+00	6.48E+08	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.27E+09	0.00E+00	6.51E+07	0.00E+00	0.00E+00	0.00E+00	2.71E+08	0.00E+00
SR-90	5.12E+10	0.00E+00	1.26E+10	0.00E+00	0.00E+00	0.00E+00	1.44E+09	0.00E+00
SR-91	5.33E+04	0.00E+00	2.12E+03	0.00E+00	0.00E+00	0.00E+00	2.42E+05	0.00E+00
SR-92	9.07E-01	0.00E+00	3.86E-02	0.00E+00	0.00E+00	0.00E+00	2.31E+01	0.00E+00
Y-90	1.30E+02	0.00E+00	3.51E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+06	0.00E+00
Y-91M	1.15E-19	0.00E+00	4.39E-21	0.00E+00	0.00E+00	0.00E+00	5.42E-18	0.00E+00
Y-91	1.33E+04	0.00E+00	3.56E+02	0.00E+00	0.00E+00	0.00E+00	5.45E+06	0.00E+00
Y-92	1.04E-04	0.00E+00	3.01E-06	0.00E+00	0.00E+00	0.00E+00	2.86E+00	0.00E+00
Y-93	4.13E-01	0.00E+00	1.13E-02	0.00E+00	0.00E+00	0.00E+00	1.26E+04	0.00E+00
ZR-95	1.38E+03	4.35E+02	2.99E+02	0.00E+00	6.40E+02	0.00E+00	1.00E+06	0.00E+00
ZR-97	7.90E-01	1.56E-01	7.20E-02	0.00E+00	2.37E-01	0.00E+00	4.23E+04	0.00E+00
NB-95	1.23E+05	6.83E+04	3.76E+04	0.00E+00	6.62E+04	0.00E+00	2.92E+08	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	4.47E+07	8.53E+06	0.00E+00	1.02E+08	0.00E+00	8.01E+07	0.00E+00
TC-99M	5.80E+00	1.62E+01	2.10E+02	0.00E+00	2.41E+02	8.97E+00	1.06E+04	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.57E+03	0.00E+00	6.71E+02	0.00E+00	5.53E+03	0.00E+00	1.31E+05	0.00E+00
RU-105	1.58E-03	0.00E+00	6.13E-04	0.00E+00	1.99E-02	0.00E+00	1.27E+00	0.00E+00
RU-106	2.95E+04	0.00E+00	3.72E+03	0.00E+00	5.69E+04	0.00E+00	1.41E+06	0.00E+00
AG-110M	7.62E+07	7.21E+07	4.39E+07	0.00E+00	1.38E+08	0.00E+00	2.03E+10	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	2.53E+07	9.11E+06	3.38E+06	7.06E+06	0.00E+00	0.00E+00	7.46E+07	0.00E+00
TE-127M	6.86E+07	2.43E+07	8.16E+06	1.63E+07	2.78E+08	0.00E+00	1.71E+08	0.00E+00
TE-127	1.22E+03	4.31E+02	2.61E+02	8.38E+02	4.92E+03	0.00E+00	9.38E+04	0.00E+00
TE-129M	9.67E+07	3.59E+07	1.53E+07	3.12E+07	4.04E+08	0.00E+00	3.63E+08	0.00E+00
TE-129	5.37E-10	2.00E-10	1.31E-10	3.84E-10	2.25E-09	0.00E+00	2.94E-09	0.00E+00

TABLE I-7: DOSE FACTOR TABLE: R (I) - TEEN, COWS MILK

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	6.58E+05	3.15E+05	2.63E+05	4.75E+05	3.29E+06	0.00E+00	2.53E+07	0.00E+00
TE-131	7.22E-33	2.98E-33	2.26E-33	5.57E-33	3.16E-32	0.00E+00	5.93E-34	0.00E+00
TE-132	4.29E+06	2.72E+06	2.56E+06	2.87E+06	2.61E+07	0.00E+00	8.61E+07	0.00E+00
I-130	7.41E+05	2.14E+06	8.56E+05	1.75E+08	3.30E+06	0.00E+00	1.65E+06	0.00E+00
I-131	5.28E+08	7.39E+08	3.97E+08	2.16E+11	1.27E+09	0.00E+00	1.46E+08	0.00E+00
I-132	2.96E-01	7.75E-01	2.78E-01	2.61E+01	1.22E+00	0.00E+00	3.38E-01	0.00E+00
I-133	7.08E+06	1.20E+07	3.66E+06	1.68E+09	2.11E+07	0.00E+00	9.09E+06	0.00E+00
I-134	3.74E-12	9.92E-12	3.56E-12	1.65E-10	1.56E-11	0.00E+00	1.31E-13	0.00E+00
I-135	2.29E+04	5.90E+04	2.19E+04	3.80E+06	9.33E+04	0.00E+00	6.54E+04	0.00E+00
CS-134	7.65E+09	1.80E+10	8.36E+09	0.00E+00	5.72E+09	2.19E+09	2.24E+08	0.00E+00
CS-136	4.27E+08	1.68E+09	1.13E+09	0.00E+00	9.15E+08	1.44E+08	1.35E+08	0.00E+00
CS-137	1.04E+10	1.38E+10	4.80E+09	0.00E+00	4.69E+09	1.82E+09	1.96E+08	0.00E+00
CS-138	1.76E-23	3.38E-23	1.69E-23	0.00E+00	2.50E-23	2.91E-24	1.54E-26	0.00E+00
BA-139	8.40E-08	5.91E-11	2.45E-09	0.00E+00	5.57E-11	4.07E-11	7.50E-07	0.00E+00
BA-140	4.64E+07	5.68E+04	2.99E+06	0.00E+00	1.93E+04	3.82E+04	7.15E+07	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	8.11E+00	3.98E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00	2.29E+05	0.00E+00
LA-142	3.43E-11	1.53E-11	3.80E-12	0.00E+00	0.00E+00	0.00E+00	4.64E-07	0.00E+00
CE-141	7.82E+03	5.22E+03	6.00E+02	0.00E+00	2.46E+03	0.00E+00	1.49E+07	0.00E+00
CE-143	7.65E+01	5.56E+04	6.21E+00	0.00E+00	2.50E+01	0.00E+00	1.67E+06	0.00E+00
CE-144	5.20E+05	2.15E+05	2.79E+04	0.00E+00	1.28E+05	0.00E+00	1.31E+08	0.00E+00
PR-143	2.76E+02	1.10E+02	1.37E+01	0.00E+00	6.40E+01	0.00E+00	9.08E+05	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	1.75E+02	1.90E+02	1.14E+01	0.00E+00	1.12E+02	0.00E+00	6.87E+05	0.00E+00
W-187	1.19E+04	9.71E+03	3.40E+03	0.00E+00	0.00E+00	0.00E+00	2.63E+06	0.00E+00
NP-239	7.01E+00	6.61E-01	3.67E-01	0.00E+00	2.08E+00	0.00E+00	1.06E+05	0.00E+00

TABLE I-8: DOSE FACTOR TABLE R (I) - CHILD, COWS MILK

TABLE I-8  
DOSE FACTOR TABLE: R (i) - Child, cows' milk  
Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	9.73E+02	9.73E+02	9.73E+02	9.73E+02	9.73E+02	9.73E+02	0.00E+00
C-14	1.65E+06	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05	0.00E+00
NA-24	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06	0.00E+00
P-32	7.37E+10	3.45E+09	2.84E+09	0.00E+00	0.00E+00	0.00E+00	2.04E+09	0.00E+00
CR-51	0.00E+00	0.00E+00	9.09E+04	5.05E+04	1.38E+04	9.21E+04	4.82E+06	0.00E+00
MN-54	0.00E+00	1.65E+07	4.40E+06	0.00E+00	4.63E+00	0.00E+00	1.39E+07	0.00E+00
MN-56	0.00E+00	1.30E-02	2.94E-03	0.00E+00	1.57E-02	0.00E+00	1.89E+00	0.00E+00
FE-55	8.70E+07	4.61E+07	1.43E+07	0.00E+00	0.00E+00	2.61E+07	8.55E+06	0.00E+00
FE-59	1.03E+08	1.67E+08	8.31E+07	0.00E+00	0.00E+00	4.84E+07	1.74E+08	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.01E+07	3.08E+07	0.00E+00	0.00E+00	0.00E+00	5.88E+07	0.00E+00
CO-60	0.00E+00	3.35E+07	9.88E+07	0.00E+00	0.00E+00	0.00E+00	1.86E+08	0.00E+00
NI-63	2.29E+10	1.23E+09	7.80E+08	0.00E+00	0.00E+00	0.00E+00	8.27E+07	0.00E+00
NI-65	1.68E+00	1.58E-01	9.24E-02	0.00E+00	0.00E+00	0.00E+00	1.94E+01	0.00E+00
CU-64	0.00E+00	7.48E+04	4.52E+04	0.00E+00	1.81E+05	0.00E+00	3.51E+06	0.00E+00
ZN-65	3.27E+09	8.72E+09	5.43E+09	0.00E+00	5.50E+09	0.00E+00	1.53E+09	0.00E+00
ZN-69	9.87E-12	1.43E-11	1.32E-12	0.00E+00	8.65E-12	0.00E+00	8.99E-10	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.47E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	7.00E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	8.12E+09	4.99E+09	0.00E+00	0.00E+00	0.00E+00	5.22E+08	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	5.63E+09	0.00E+00	1.61E+08	0.00E+00	0.00E+00	0.00E+00	2.18E+08	0.00E+00
SR-90	8.65E+10	0.00E+00	2.19E+10	0.00E+00	0.00E+00	0.00E+00	1.16E+09	0.00E+00
SR-91	1.31E+05	0.00E+00	4.94E+03	0.00E+00	0.00E+00	0.00E+00	2.89E+05	0.00E+00
SR-92	2.21E+00	0.00E+00	8.88E-02	0.00E+00	0.00E+00	0.00E+00	4.19E+01	0.00E+00
Y-90	3.22E+02	0.00E+00	8.63E+00	0.00E+00	0.00E+00	0.00E+00	9.18E+05	0.00E+00
Y-91M	2.80E-19	0.00E+00	1.02E-20	0.00E+00	0.00E+00	0.00E+00	5.49E-16	0.00E+00
Y-91	3.28E+04	0.00E+00	8.78E+02	0.00E+00	0.00E+00	0.00E+00	4.37E+06	0.00E+00
Y-92	2.56E-04	0.00E+00	7.32E-06	0.00E+00	0.00E+00	0.00E+00	7.39E+00	0.00E+00
Y-93	1.02E+00	0.00E+00	2.79E-02	0.00E+00	0.00E+00	0.00E+00	1.51E+04	0.00E+00
ZR-95	3.20E+03	7.04E+02	6.27E+02	0.00E+00	1.01E+03	0.00E+00	7.35E+05	0.00E+00
ZR-97	1.92E+00	2.78E-01	1.64E-01	0.00E+00	3.99E-01	0.00E+00	4.21E+04	0.00E+00
NB-95	2.78E+05	1.08E+05	7.74E+04	0.00E+00	1.02E+05	0.00E+00	2.00E+08	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	8.14E+07	2.01E+07	0.00E+00	1.74E+08	0.00E+00	6.73E+07	0.00E+00
TC-99M	1.33E+01	2.61E+01	4.32E+02	0.00E+00	3.79E+02	1.32E+01	1.48E+04	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	3.71E+03	0.00E+00	1.43E+03	0.00E+00	9.34E+03	0.00E+00	9.59E+04	0.00E+00
RU-105	3.85E-03	0.00E+00	1.40E-03	0.00E+00	3.39E-02	0.00E+00	2.51E+00	0.00E+00
RU-106	7.26E+04	0.00E+00	9.06E+03	0.00E+00	9.81E+04	0.00E+00	1.13E+06	0.00E+00
AG-110M	1.65E+08	1.12E+08	8.92E+07	0.00E+00	2.08E+08	0.00E+00	1.33E+10	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	6.21E+07	1.68E+07	8.28E+06	1.74E+07	0.00E+00	0.00E+00	5.99E+07	0.00E+00
TE-127M	1.69E+08	4.55E+07	2.01E+07	4.04E+07	4.82E+08	0.00E+00	1.37E+08	0.00E+00
TE-127	2.99E+03	8.06E+02	6.41E+02	2.07E+03	8.50E+03	0.00E+00	1.17E+05	0.00E+00
TE-129M	2.38E+08	6.65E+07	3.70E+07	7.68E+07	7.00E+08	0.00E+00	2.91E+08	0.00E+00
TE-129	1.33E-09	3.70E-10	3.15E-10	9.46E-10	3.88E-09	0.00E+00	8.25E-08	0.00E+00

TABLE I-8: DOSE FACTOR TABLE R (I) - CHILD, COWS MILK

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	1.60E+06	5.54E+05	5.89E+05	1.14E+06	5.36E+06	0.00E+00	2.25E+07	0.00E+00
TE-131	1.77E-32	5.40E-33	5.27E-33	1.36E-32	5.36E-32	0.00E+00	9.31E-32	0.00E+00
TE-132	1.02E+07	4.54E+06	5.48E+06	6.61E+06	4.21E+07	0.00E+00	4.57E+07	0.00E+00
I-130	1.73E+06	3.50E+06	1.80E+06	3.86E+08	5.23E+06	0.00E+00	1.64E+06	0.00E+00
I-131	1.28E+09	1.29E+09	7.32E+08	4.26E+11	2.11E+09	0.00E+00	1.15E+08	0.00E+00
I-132	7.01E-01	1.29E+00	5.92E-01	5.97E+01	1.97E+00	0.00E+00	1.52E+00	0.00E+00
I-133	1.72E+07	2.13E+07	8.05E+06	3.95E+09	3.55E+07	0.00E+00	8.57E+06	0.00E+00
I-134	8.87E-12	1.65E-11	7.57E-12	3.79E-10	2.52E-11	0.00E+00	1.09E-11	0.00E+00
I-135	5.43E+04	9.77E+04	4.62E+04	8.66E+06	1.50E+05	0.00E+00	7.45E+04	0.00E+00
CS-134	1.77E+10	2.90E+10	6.11E+09	0.00E+00	8.98E+09	3.22E+09	1.56E+08	0.00E+00
CS-136	9.65E+08	2.65E+09	1.72E+09	0.00E+00	1.41E+09	2.11E+08	9.32E+07	0.00E+00
CS-137	2.50E+10	2.39E+10	3.53E+09	0.00E+00	7.78E+09	2.80E+09	1.50E+08	0.00E+00
CS-138	4.27E-23	5.94E-23	3.77E-23	0.00E+00	4.18E-23	4.50E-24	2.74E-23	0.00E+00
BA-139	2.06E-07	1.10E-10	5.98E-09	0.00E+00	9.62E-11	6.48E-11	1.19E-05	0.00E+00
BA-140	1.12E+08	9.80E+04	6.53E+06	0.00E+00	3.19E+04	5.84E+04	5.67E+07	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.94E+01	6.79E+00	2.29E+00	0.00E+00	0.00E+00	0.00E+00	1.89E+05	0.00E+00
LA-142	8.30E-11	2.64E-11	8.28E-12	0.00E+00	0.00E+00	0.00E+00	5.24E-06	0.00E+00
CE-141	1.93E+04	9.61E+03	1.43E+03	0.00E+00	4.21E+03	0.00E+00	1.20E+07	0.00E+00
CE-143	1.88E+02	1.02E+05	1.47E+01	0.00E+00	4.27E+01	0.00E+00	1.49E+06	0.00E+00
CE-144	1.28E+06	4.02E+05	6.84E+04	0.00E+00	2.22E+05	0.00E+00	1.05E+08	0.00E+00
PR-143	6.83E+02	2.05E+02	3.39E+01	0.00E+00	1.11E+02	0.00E+00	7.37E+05	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	4.29E+02	3.48E+02	2.69E+01	0.00E+00	1.91E+02	0.00E+00	5.51E+05	0.00E+00
W-187	2.89E+04	1.71E+04	7.68E+03	0.00E+00	0.00E+00	0.00E+00	2.40E+06	0.00E+00
NP-239	1.73E+01	1.24E+00	8.71E-01	0.00E+00	3.58E+00	0.00E+00	9.17E+04	0.00E+00

TABLE I-9: DOSE FACTOR TABLE: R (I) - INFANT, COWS MILK

TABLE I-9  
DOSE FACTOR TABLE: R (i) - Infant, cows' milk

Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.48E+03	1.48E+03	1.48E+03	1.48E+03	1.48E+03	1.48E+03	0.00E+00
C-14	3.23E+06	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	0.00E+00
NA-24	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	0.00E+00
P-32	1.52E+11	8.93E+09	5.88E+09	0.00E+00	0.00E+00	0.00E+00	2.05E+09	0.00E+00
CR-51	0.00E+00	0.00E+00	1.44E+05	9.40E+04	2.05E+04	1.83E+05	4.20E+06	0.00E+00
MN-54	0.00E+00	3.07E+07	6.97E+06	0.00E+00	6.81E+06	0.00E+00	1.13E+07	0.00E+00
MN-56	0.00E+00	3.19E-02	5.49E-03	0.00E+00	2.74E-02	0.00E+00	2.90E+00	0.00E+00
FE-55	1.05E+08	6.79E+07	1.82E+07	0.00E+00	0.00E+00	3.32E+07	8.62E+06	0.00E+00
FE-59	1.92E+08	3.36E+08	1.32E+08	0.00E+00	0.00E+00	9.94E+07	1.61E+08	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	2.02E+07	5.03E+07	0.00E+00	0.00E+00	0.00E+00	5.02E+07	0.00E+00
CO-60	0.00E+00	6.84E+07	1.62E+08	0.00E+00	0.00E+00	0.00E+00	1.63E+08	0.00E+00
NI-63	2.70E+10	1.67E+09	9.38E+08	0.00E+00	0.00E+00	0.00E+00	8.31E+07	0.00E+00
NI-65	3.56E+00	4.03E-01	1.83E-01	0.00E+00	0.00E+00	0.00E+00	3.07E+01	0.00E+00
CU-64	0.00E+00	1.86E+05	8.61E+04	0.00E+00	3.15E+05	0.00E+00	3.82E+06	0.00E+00
ZN-65	4.40E+09	1.51E+10	6.95E+09	0.00E+00	7.31E+09	0.00E+00	1.27E+10	0.00E+00
ZN-69	2.10E-11	3.79E-11	2.82E-12	0.00E+00	1.57E-11	0.00E+00	3.09E-09	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	9.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.35E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.06E+10	1.02E+10	0.00E+00	0.00E+00	0.00E+00	5.27E+08	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	1.07E+10	0.00E+00	3.07E+08	0.00E+00	0.00E+00	0.00E+00	2.20E+08	0.00E+00
SR-90	9.41E+10	0.00E+00	2.40E+10	0.00E+00	0.00E+00	0.00E+00	1.18E+09	0.00E+00
SR-91	2.73E+05	0.00E+00	9.87E+03	0.00E+00	0.00E+00	0.00E+00	3.23E+05	0.00E+00
SR-92	4.71E+00	0.00E+00	1.75E-01	0.00E+00	0.00E+00	0.00E+00	5.08E+01	0.00E+00
Y-90	6.82E+02	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	9.41E+05	0.00E+00
Y-91M	5.94E-19	0.00E+00	2.03E-20	0.00E+00	0.00E+00	0.00E+00	1.98E-15	0.00E+00
Y-91	6.16E+04	0.00E+00	1.64E+03	0.00E+00	0.00E+00	0.00E+00	4.42E+06	0.00E+00
Y-92	5.44E-04	0.00E+00	1.53E-05	0.00E+00	0.00E+00	0.00E+00	1.04E+01	0.00E+00
Y-93	2.16E+00	0.00E+00	5.90E-02	0.00E+00	0.00E+00	0.00E+00	1.71E+04	0.00E+00
ZR-95	5.69E+03	1.39E+03	9.83E+02	0.00E+00	1.49E+03	0.00E+00	6.91E+05	0.00E+00
ZR-97	4.07E+00	6.99E-01	3.19E-01	0.00E+00	7.04E-01	0.00E+00	4.46E+04	0.00E+00
NB-95	5.19E+05	2.14E+05	1.24E+05	0.00E+00	1.53E+05	0.00E+00	1.80E+08	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	2.08E+08	4.06E+07	0.00E+00	3.11E+08	0.00E+00	6.85E+07	0.00E+00
TC-99M	2.77E+01	5.70E+01	7.35E+02	0.00E+00	6.14E+02	2.98E+01	1.66E+04	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	7.51E+03	0.00E+00	2.51E+03	0.00E+00	1.56E+04	0.00E+00	9.14E+04	0.00E+00
RU-105	8.12E-03	0.00E+00	2.74E-03	0.00E+00	5.97E-02	0.00E+00	3.23E+00	0.00E+00
RU-106	1.50E+05	0.00E+00	1.87E+04	0.00E+00	1.77E+05	0.00E+00	1.14E+06	0.00E+00
AG-110M	3.05E+08	2.23E+08	1.48E+08	0.00E+00	3.19E+08	0.00E+00	1.16E+10	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	1.27E+08	4.24E+07	1.72E+07	4.27E+07	0.00E+00	0.00E+00	6.05E+07	0.00E+00
TE-127M	3.42E+08	1.14E+08	4.14E+07	9.89E+07	8.43E+08	0.00E+00	1.38E+08	0.00E+00
TE-127	6.34E+03	2.13E+03	1.36E+03	5.16E+03	1.55E+04	0.00E+00	1.33E+05	0.00E+00
TE-129M	4.89E+08	1.68E+08	7.54E+07	1.88E+08	1.22E+09	0.00E+00	2.92E+08	0.00E+00
TE-129	2.81E-09	9.69E-10	6.56E-10	2.36E-09	7.00E-09	0.00E+00	2.25E-07	0.00E+00

TABLE I-9: DOSE FACTOR TABLE: R (I) - INFANT, COWS MILK

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	3.38E+06	1.36E+06	1.12E+06	2.76E+06	9.37E+06	0.00E+00	2.29E+07	0.00E+00
TE-131	3.76E-32	1.39E-32	1.05E-32	3.35E-32	9.61E-32	0.00E+00	1.52E-30	0.00E+00
TE-132	2.11E+07	1.05E+07	9.75E+06	1.54E+07	6.53E+07	0.00E+00	3.87E+07	0.00E+00
I-130	3.56E+06	7.83E+06	3.14E+06	8.78E+08	8.60E+06	0.00E+00	1.68E+06	0.00E+00
I-131	2.67E+09	3.15E+09	1.38E+09	1.03E+12	3.68E+09	0.00E+00	1.12E+08	0.00E+00
I-132	1.45E+00	2.95E+00	1.05E+00	1.38E+02	3.29E+00	0.00E+00	2.39E+00	0.00E+00
I-133	3.63E+07	5.29E+07	1.55E+07	9.62E+09	6.22E+07	0.00E+00	8.95E+06	0.00E+00
I-134	1.84E-11	3.77E-11	1.34E-11	8.78E-10	4.21E-11	0.00E+00	3.89E-11	0.00E+00
I-135	1.13E+05	2.25E+05	8.19E+04	2.01E+07	2.50E+05	0.00E+00	8.13E+04	0.00E+00
CS-134	2.84E+10	5.30E+10	5.36E+09	0.00E+00	1.37E+10	5.60E+09	1.44E+08	0.00E+00
CS-136	1.88E+09	5.54E+09	2.07E+09	0.00E+00	2.21E+09	4.51E+08	8.41E+07	0.00E+00
CS-137	3.98E+10	4.66E+10	3.30E+09	0.00E+00	1.25E+10	5.07E+09	1.46E+08	0.00E+00
CS-138	9.01E-23	1.47E-22	7.10E-23	0.00E+00	7.31E-23	1.14E-23	2.34E-22	0.00E+00
BA-139	4.39E-07	2.91E-10	1.27E-08	0.00E+00	1.75E-10	1.77E-10	2.78E-05	0.00E+00
BA-140	2.30E+08	2.30E+05	1.19E+07	0.00E+00	5.47E+04	1.41E+05	5.66E+07	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.06E+01	1.60E+01	4.11E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+05	0.00E+00
LA-142	1.74E-10	6.40E-11	1.53E-11	0.00E+00	0.00E+00	0.00E+00	1.09E-05	0.00E+00
CE-141	3.82E+04	2.33E+04	2.74E+03	0.00E+00	7.18E+03	0.00E+00	1.20E+07	0.00E+00
CE-143	3.97E+02	2.64E+05	3.01E+01	0.00E+00	7.68E+01	0.00E+00	1.54E+06	0.00E+00
CE-144	1.84E+06	7.52E+05	1.03E+05	0.00E+00	3.04E+05	0.00E+00	1.05E+08	0.00E+00
PR-143	1.41E+03	2.28E+02	7.00E+01	0.00E+00	1.96E+02	0.00E+00	7.45E+05	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	8.51E+02	8.74E+02	5.36E+01	0.00E+00	3.37E+02	0.00E+00	5.54E+05	0.00E+00
W-187	6.08E+04	4.23E+04	1.46E+04	0.00E+00	0.00E+00	0.00E+00	2.49E+06	0.00E+00
NP-239	3.65E+01	3.26E+00	1.84E+00	0.00E+00	6.51E+00	0.00E+00	9.43E+04	0.00E+00

TABLE I-10: DOSE FACTOR TABLE: R (I) - ADULT, GOATS MILK

TABLE I-10  
DOSE FACTOR TABLE: R (i) - Adult, goats' milk

Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	9.65E+02	9.65E+02	9.65E+02	9.65E+02	9.65E+02	9.65E+02	0.00E+00
C-14	3.63E+05	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04	0.00E+00
NA-24	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	0.00E+00
P-32	1.94E+10	1.21E+09	7.51E+08	0.00E+00	0.00E+00	0.00E+00	2.18E+09	0.00E+00
CR-51	0.00E+00	0.00E+00	3.06E+03	1.83E+03	6.75E+02	4.06E+03	7.70E+05	0.00E+00
MN-54	0.00E+00	7.96E+05	1.52E+05	0.00E+00	2.37E+05	0.00E+00	2.44E+06	0.00E+00
MN-56	0.00E+00	5.05E-04	8.96E-05	0.00E+00	6.41E-04	0.00E+00	1.61E-02	0.00E+00
FE-55	2.54E+05	1.76E+05	4.09E+04	0.00E+00	0.00E+00	9.79E+04	1.01E+05	0.00E+00
FE-59	3.31E+05	7.79E+05	2.98E+05	0.00E+00	0.00E+00	2.18E+05	2.60E+06	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	4.70E+05	1.05E+06	0.00E+00	0.00E+00	0.00E+00	9.53E+06	0.00E+00
CO-60	0.00E+00	1.53E+06	3.37E+06	0.00E+00	0.00E+00	0.00E+00	2.87E+07	0.00E+00
NI-63	6.25E+08	4.33E+07	2.10E+07	0.00E+00	0.00E+00	0.00E+00	9.03E+06	0.00E+00
NI-65	4.51E-02	5.86E-03	2.67E-03	0.00E+00	0.00E+00	0.00E+00	1.49E-01	0.00E+00
CU-64	0.00E+00	2.66E+03	1.25E+03	0.00E+00	6.71E+03	0.00E+00	2.27E+05	0.00E+00
ZN-65	1.30E+08	4.15E+08	1.88E+08	0.00E+00	2.78E+08	0.00E+00	2.61E+08	0.00E+00
ZN-69	2.62E-13	5.00E-13	3.48E-14	0.00E+00	3.25E-13	0.00E+00	7.52E-14	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	1.18E-02	0.00E+00	0.00E+00	0.00E+00	1.71E-02	0.00E+00
BR-84	0.00E+00	0.00E+00	2.08E-24	0.00E+00	0.00E+00	0.00E+00	1.63E-29	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.88E+08	1.34E+08	0.00E+00	0.00E+00	0.00E+00	5.68E+07	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.59E+09	0.00E+00	7.43E+07	0.00E+00	0.00E+00	0.00E+00	4.15E+08	0.00E+00
SR-90	7.61E+10	0.00E+00	1.87E+10	0.00E+00	0.00E+00	0.00E+00	2.20E+09	0.00E+00
SR-91	6.10E+04	0.00E+00	2.46E+03	0.00E+00	0.00E+00	0.00E+00	2.90E+05	0.00E+00
SR-92	1.04E+00	0.00E+00	4.50E-02	0.00E+00	0.00E+00	0.00E+00	2.06E+01	0.00E+00
Y-90	8.50E+00	0.00E+00	2.28E-01	0.00E+00	0.00E+00	0.00E+00	9.02E+04	0.00E+00
Y-91M	7.52E-21	0.00E+00	2.91E-22	0.00E+00	0.00E+00	0.00E+00	2.21E-20	0.00E+00
Y-91	8.67E+02	0.00E+00	2.32E+01	0.00E+00	0.00E+00	0.00E+00	4.77E+05	0.00E+00
Y-92	6.77E-06	0.00E+00	1.98E-07	0.00E+00	0.00E+00	0.00E+00	1.19E-01	0.00E+00
Y-93	2.69E-02	0.00E+00	7.43E-04	0.00E+00	0.00E+00	0.00E+00	8.53E+02	0.00E+00
ZR-95	9.47E+01	3.04E+01	2.06E+01	0.00E+00	4.76E+01	0.00E+00	9.62E+04	0.00E+00
ZR-97	5.21E-02	1.05E-02	4.81E-03	0.00E+00	1.59E-02	0.00E+00	3.26E+03	0.00E+00
NB-95	8.67E+03	4.82E+03	2.59E+03	0.00E+00	4.77E+03	0.00E+00	2.93E+07	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	2.97E+06	5.66E+05	0.00E+00	6.73E+06	0.00E+00	6.89E+06	0.00E+00
TC-99M	4.01E-01	1.13E+00	1.44E+01	0.00E+00	1.72E+01	5.55E-01	6.71E+02	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.06E+02	0.00E+00	4.56E+01	0.00E+00	4.04E+02	0.00E+00	1.24E+04	0.00E+00
RU-105	1.04E-04	0.00E+00	4.09E-05	0.00E+00	1.34E-03	0.00E+00	6.34E-02	0.00E+00
RU-106	1.92E+03	0.00E+00	2.43E+02	0.00E+00	3.71E+03	0.00E+00	1.25E+05	0.00E+00
AG-110M	5.53E+06	5.12E+06	3.04E+06	0.00E+00	1.01E+07	0.00E+00	2.09E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	1.65E+06	5.96E+05	2.20E+05	4.95E+05	6.69E+06	0.00E+00	6.57E+06	0.00E+00
TE-127M	4.47E+06	1.60E+06	5.44E+05	1.14E+06	1.81E+07	0.00E+00	1.50E+07	0.00E+00
TE-127	7.87E+01	2.82E+01	1.70E+01	5.83E+01	3.20E+02	0.00E+00	6.21E+03	0.00E+00
TE-129M	6.34E+06	2.37E+06	1.00E+06	2.18E+06	2.65E+07	0.00E+00	3.19E+07	0.00E+00
TE-129	3.50E-11	1.32E-11	8.53E-12	2.69E-11	1.47E-10	0.00E+00	2.64E-11	0.00E+00



**TABLE I-10: DOSE FACTOR TABLE: R (I) - ADULT, GOATS MILK**

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	4.34E+04	2.12E+04	1.77E+04	3.36E+04	2.15E+05	0.00E+00	2.11E+06	0.00E+00
TE-131	4.74E-34	1.98E-34	1.50E-34	3.90E-34	2.08E-33	0.00E+00	6.72E-35	0.00E+00
TE-132	2.88E+05	1.86E+05	1.75E+05	2.06E+05	1.80E+06	0.00E+00	8.82E+06	0.00E+00
I-130	5.06E+05	1.49E+06	5.89E+05	1.26E+08	2.33E+06	0.00E+00	1.28E+06	0.00E+00
I-131	3.49E+08	4.99E+08	2.86E+08	1.64E+11	8.56E+08	0.00E+00	1.32E+08	0.00E+00
I-132	2.00E-01	5.36E-01	1.88E-01	1.88E+01	8.54E-01	0.00E+00	1.01E-01	0.00E+00
I-133	4.65E+06	8.09E+06	2.47E+06	1.19E+09	1.41E+07	0.00E+00	7.27E+06	0.00E+00
I-134	2.53E-12	6.87E-12	2.46E-12	1.19E-10	1.09E-11	0.00E+00	5.99E-15	0.00E+00
I-135	1.55E+04	4.06E+04	1.50E+04	2.68E+06	6.51E+04	0.00E+00	4.58E+04	0.00E+00
CS-134	1.32E+10	3.15E+10	2.57E+10	0.00E+00	1.02E+10	3.38E+09	5.51E+08	0.00E+00
CS-136	7.53E+08	2.97E+09	2.14E+09	0.00E+00	1.65E+09	2.27E+08	3.38E+08	0.00E+00
CS-137	1.71E+10	2.34E+10	1.54E+10	0.00E+00	7.96E+09	2.65E+09	4.54E+08	0.00E+00
CS-138	2.91E-23	5.76E-23	2.85E-23	0.00E+00	4.23E-23	4.18E-24	2.46E-28	0.00E+00
BA-139	5.45E-09	3.88E-12	1.60E-10	0.00E+00	3.63E-12	2.20E-12	9.67E-09	0.00E+00
BA-140	3.08E+06	3.87E+03	2.02E+05	0.00E+00	1.32E+03	2.22E+03	6.35E+06	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	5.42E-01	2.73E-01	7.22E-02	0.00E+00	0.00E+00	0.00E+00	2.00E+04	0.00E+00
LA-142	2.28E-12	1.04E-12	2.59E-13	0.00E+00	0.00E+00	0.00E+00	7.58E-09	0.00E+00
CE-141	5.12E+02	3.46E+02	3.93E+01	0.00E+00	1.61E+02	0.00E+00	1.32E+06	0.00E+00
CE-143	4.99E+00	3.69E+03	4.09E-01	0.00E+00	1.63E+00	0.00E+00	1.38E+05	0.00E+00
CE-144	3.39E+04	1.42E+04	1.82E+03	0.00E+00	8.40E+03	0.00E+00	1.15E+07	0.00E+00
PR-143	1.80E+01	7.23E+00	8.93E-01	0.00E+00	4.17E+00	0.00E+00	7.89E+04	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	1.09E+01	1.26E+01	7.55E-01	0.00E+00	7.37E+00	0.00E+00	6.06E+04	0.00E+00
W-187	7.82E+02	6.54E+02	2.29E+02	0.00E+00	0.00E+00	0.00E+00	2.14E+05	0.00E+00
NP-239	4.41E-01	4.34E-02	2.39E-02	0.00E+00	1.35E-01	0.00E+00	8.89E+03	0.00E+00

TABLE I-11: DOSE FACTOR TABLE: R (I) - TEEN, GOATS MILK

TABLE I-11  
DOSE FACTOR TABLE: R (i) - Teen, goats' milk  
Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	0.00E+00
C-14	6.70E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	0.00E+00
NA-24	5.12E+05	5.12E+05	5.12E+05	5.12E+05	5.12E+05	5.12E+05	5.12E+05	0.00E+00
P-32	3.58E+10	2.22E+09	1.39E+09	0.00E+00	0.00E+00	0.00E+00	3.01E+09	0.00E+00
CR-51	0.00E+00	0.00E+00	5.35E+03	2.97E+03	1.17E+03	7.64E+03	8.99E+05	0.00E+00
MN-54	0.00E+00	1.33E+06	2.63E+05	0.00E+00	3.95E+05	0.00E+00	2.72E+06	0.00E+00
MN-56	0.00E+00	8.95E-04	1.59E-04	0.00E+00	1.13E-03	0.00E+00	5.89E-02	0.00E+00
FE-55	4.51E+05	3.19E+05	7.45E+04	0.00E+00	0.00E+00	2.03E+05	1.38E+05	0.00E+00
FE-59	5.78E+05	1.35E+06	5.21E+05	0.00E+00	0.00E+00	4.25E+05	3.19E+06	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	7.92E+05	1.82E+06	0.00E+00	0.00E+00	0.00E+00	1.09E+07	0.00E+00
CO-60	0.00E+00	2.59E+06	5.83E+06	0.00E+00	0.00E+00	0.00E+00	3.37E+07	0.00E+00
NI-63	1.10E+09	7.75E+07	3.72E+07	0.00E+00	0.00E+00	0.00E+00	1.23E+07	0.00E+00
NI-65	8.25E-02	1.05E-02	4.80E-03	0.00E+00	0.00E+00	0.00E+00	5.72E-01	0.00E+00
CU-64	0.00E+00	4.74E+03	2.23E+03	0.00E+00	1.20E+04	0.00E+00	3.68E+05	0.00E+00
ZN-65	2.00E+08	6.95E+08	3.24E+08	0.00E+00	4.45E+08	0.00E+00	2.94E+08	0.00E+00
ZN-69	4.82E-13	9.18E-13	6.42E-14	0.00E+00	6.00E-13	0.00E+00	1.69E-12	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	2.18E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.71E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	5.25E+08	2.47E+08	0.00E+00	0.00E+00	0.00E+00	7.77E+07	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	4.77E+09	0.00E+00	1.37E+08	0.00E+00	0.00E+00	0.00E+00	5.69E+08	0.00E+00
SR-90	1.07E+11	0.00E+00	2.65E+10	0.00E+00	0.00E+00	0.00E+00	3.02E+09	0.00E+00
SR-91	1.12E+05	0.00E+00	4.46E+03	0.00E+00	0.00E+00	0.00E+00	5.08E+05	0.00E+00
SR-92	1.90E+00	0.00E+00	8.11E-02	0.00E+00	0.00E+00	0.00E+00	4.85E+01	0.00E+00
Y-90	1.56E+01	0.00E+00	4.21E-01	0.00E+00	0.00E+00	0.00E+00	1.29E+05	0.00E+00
Y-91M	1.38E-20	0.00E+00	5.26E-22	0.00E+00	0.00E+00	0.00E+00	6.50E-19	0.00E+00
Y-91	1.59E+03	0.00E+00	4.28E+01	0.00E+00	0.00E+00	0.00E+00	6.54E+05	0.00E+00
Y-92	1.25E-05	0.00E+00	3.62E-07	0.00E+00	0.00E+00	0.00E+00	3.43E-01	0.00E+00
Y-93	4.96E-02	0.00E+00	1.36E-03	0.00E+00	0.00E+00	0.00E+00	1.52E+03	0.00E+00
ZR-95	1.66E+02	5.22E+01	3.59E+01	0.00E+00	7.67E+01	0.00E+00	1.21E+05	0.00E+00
ZR-97	9.48E-02	1.88E-02	8.64E-03	0.00E+00	2.84E-02	0.00E+00	5.08E+03	0.00E+00
NB-95	1.48E+04	8.20E+03	4.51E+03	0.00E+00	7.95E+03	0.00E+00	3.51E+07	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	5.37E+06	1.02E+06	0.00E+00	1.23E+07	0.00E+00	9.61E+06	0.00E+00
TC-99M	6.96E-01	1.94E+00	2.51E+01	0.00E+00	2.89E+01	1.08E+00	1.27E+03	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.88E+02	0.00E+00	8.05E+01	0.00E+00	6.64E+02	0.00E+00	1.57E+04	0.00E+00
RU-105	1.89E-04	0.00E+00	7.35E-05	0.00E+00	2.39E-03	0.00E+00	1.53E-01	0.00E+00
RU-106	3.54E+03	0.00E+00	4.46E+02	0.00E+00	6.82E+03	0.00E+00	1.70E+05	0.00E+00
AG-110M	9.14E+06	8.65E+06	5.26E+06	0.00E+00	1.65E+07	0.00E+00	2.43E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	3.03E+06	1.09E+06	4.06E+05	8.48E+05	0.00E+00	0.00E+00	8.95E+06	0.00E+00
TE-127M	8.23E+06	2.92E+06	9.79E+05	1.96E+06	3.34E+07	0.00E+00	2.05E+07	0.00E+00
TE-127	1.46E+02	5.17E+01	3.14E+01	1.01E+02	5.91E+02	0.00E+00	1.13E+04	0.00E+00
TE-129M	1.16E+07	4.31E+06	1.84E+06	3.74E+06	4.85E+07	0.00E+00	4.36E+07	0.00E+00
TE-129	6.45E-11	2.40E-11	1.57E-11	4.61E-11	2.71E-10	0.00E+00	3.53E-10	0.00E+00

TABLE I-11: DOSE FACTOR TABLE: R (I) - TEEN, GOATS MILK

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	7.89E+04	3.79E+04	3.16E+04	5.69E+04	3.95E+05	0.00E+00	3.04E+06	0.00E+00
TE-131	8.67E-34	3.57E-34	2.71E-34	6.68E-34	3.79E-33	0.00E+00	7.11E-35	0.00E+00
TE-132	5.15E+05	3.26E+05	3.07E+05	3.44E+05	3.13E+06	0.00E+00	1.03E+07	0.00E+00
I-130	8.89E+05	2.57E+06	1.03E+06	2.10E+08	3.96E+06	0.00E+00	1.98E+06	0.00E+00
I-131	6.33E+08	8.87E+08	4.76E+08	2.59E+11	1.53E+09	0.00E+00	1.75E+08	0.00E+00
I-132	3.55E-01	9.30E-01	3.34E-01	3.13E+01	1.47E+00	0.00E+00	4.05E-01	0.00E+00
I-133	8.50E+06	1.44E+07	4.40E+06	2.01E+09	2.53E+07	0.00E+00	1.09E+07	0.00E+00
I-134	4.49E-12	1.19E-11	4.28E-12	1.98E-10	1.88E-11	0.00E+00	1.57E-13	0.00E+00
I-135	2.75E+04	7.09E+04	2.63E+04	4.56E+06	1.12E+05	0.00E+00	7.85E+04	0.00E+00
CS-134	2.30E+10	5.40E+10	2.51E+10	0.00E+00	1.72E+10	6.56E+09	6.72E+08	0.00E+00
CS-136	1.28E+09	5.04E+09	3.39E+09	0.00E+00	2.75E+09	4.33E+08	4.06E+08	0.00E+00
CS-137	3.11E+10	4.13E+10	1.44E+10	0.00E+00	1.41E+10	5.47E+09	5.88E+08	0.00E+00
CS-138	5.29E-23	1.02E-22	5.08E-23	0.00E+00	7.49E-23	8.72E-24	4.61E-26	0.00E+00
BA-139	1.01E-08	7.09E-12	2.94E-10	0.00E+00	6.69E-12	4.89E-12	8.99E-08	0.00E+00
BA-140	5.56E+06	6.82E+03	3.58E+05	0.00E+00	2.31E+03	4.58E+03	8.58E+06	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	9.73E-01	4.78E-01	1.27E-01	0.00E+00	0.00E+00	0.00E+00	2.75E+04	0.00E+00
LA-142	4.12E-12	1.83E-12	4.56E-13	0.00E+00	0.00E+00	0.00E+00	5.57E-08	0.00E+00
CE-141	9.39E+02	6.27E+02	7.20E+01	0.00E+00	2.95E+02	0.00E+00	1.79E+06	0.00E+00
CE-143	9.18E+00	6.68E+03	7.46E-01	0.00E+00	2.99E+00	0.00E+00	2.01E+05	0.00E+00
CE-144	6.24E+04	2.58E+04	3.35E+03	0.00E+00	1.54E+04	0.00E+00	1.57E+07	0.00E+00
PR-143	3.31E+01	1.32E+01	1.65E+00	0.00E+00	7.68E+00	0.00E+00	1.09E+05	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	2.10E+01	2.28E+01	1.37E+00	0.00E+00	1.34E+01	0.00E+00	8.24E+04	0.00E+00
W-187	1.43E+03	1.17E+03	4.08E+02	0.00E+00	0.00E+00	0.00E+00	3.15E+05	0.00E+00
NP-239	8.42E-01	7.94E-02	4.41E-02	0.00E+00	2.49E-01	0.00E+00	1.28E+04	0.00E+00

TABLE I-12: DOSE FACTOR TABLE: R (I) - CHILD, GOATS MILK

TABLE I-12  
DOSE FACTOR TABLE: R (i) - Child, goats' milk

Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.99E+03	1.99E+03	1.99E+03	1.99E+03	1.99E+03	1.99E+03	0.00E+00
C-14	1.65E+06	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05	0.00E+00
NA-24	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	0.00E+00
P-32	8.84E+10	4.14E+09	3.41E+09	0.00E+00	0.00E+00	0.00E+00	2.44E+09	0.00E+00
CR-51	0.00E+00	0.00E+00	1.09E+04	6.05E+03	1.65E+03	1.11E+04	5.79E+05	0.00E+00
MN-54	0.00E+00	1.98E+06	5.28E+05	0.00E+00	5.56E+05	0.00E+00	1.66E+06	0.00E+00
MN-56	0.00E+00	1.56E-03	3.53E-04	0.00E+00	1.89E-03	0.00E+00	2.26E-01	0.00E+00
FE-55	1.13E+06	6.00E+05	1.86E+05	0.00E+00	0.00E+00	3.39E+05	1.11E+05	0.00E+00
FE-59	1.34E+06	2.17E+06	1.08E+06	0.00E+00	0.00E+00	6.29E+05	2.26E+06	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.21E+06	3.70E+06	0.00E+00	0.00E+00	0.00E+00	7.05E+06	0.00E+00
CO-60	0.00E+00	4.02E+06	1.19E+07	0.00E+00	0.00E+00	0.00E+00	2.23E+07	0.00E+00
NI-63	2.75E+09	1.47E+08	9.36E+07	0.00E+00	0.00E+00	0.00E+00	9.92E+06	0.00E+00
NI-65	2.02E-01	1.90E-02	1.11E-02	0.00E+00	0.00E+00	0.00E+00	2.33E+00	0.00E+00
CU-64	0.00E+00	8.34E+03	5.04E+03	0.00E+00	2.02E+04	0.00E+00	3.91E+05	0.00E+00
ZN-65	3.93E+08	1.05E+09	6.51E+08	0.00E+00	6.60E+08	0.00E+00	1.84E+08	0.00E+00
ZN-69	1.18E-12	1.71E-12	1.58E-13	0.00E+00	1.04E-12	0.00E+00	1.08E-10	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	5.36E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	8.40E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	9.74E+08	5.99E+08	0.00E+00	0.00E+00	0.00E+00	6.27E+07	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	1.18E+10	0.00E+00	3.37E+08	0.00E+00	0.00E+00	0.00E+00	4.57E+08	0.00E+00
SR-90	1.82E+11	0.00E+00	4.60E+10	0.00E+00	0.00E+00	0.00E+00	2.45E+09	0.00E+00
SR-91	2.75E+05	0.00E+00	1.04E+04	0.00E+00	0.00E+00	0.00E+00	6.07E+05	0.00E+00
SR-92	4.65E+00	0.00E+00	1.86E-01	0.00E+00	0.00E+00	0.00E+00	8.81E+01	0.00E+00
Y-90	3.87E+01	0.00E+00	1.04E+00	0.00E+00	0.00E+00	0.00E+00	1.10E+05	0.00E+00
Y-91M	3.36E-20	0.00E+00	1.22E-21	0.00E+00	0.00E+00	0.00E+00	6.56E-17	0.00E+00
Y-91	3.94E+03	0.00E+00	1.05E+02	0.00E+00	0.00E+00	0.00E+00	5.25E+05	0.00E+00
Y-92	3.07E-05	0.00E+00	8.78E-07	0.00E+00	0.00E+00	0.00E+00	8.87E-01	0.00E+00
Y-93	1.22E-01	0.00E+00	3.35E-03	0.00E+00	0.00E+00	0.00E+00	1.82E+03	0.00E+00
ZR-95	3.85E+02	8.45E+01	7.53E+01	0.00E+00	1.21E+02	0.00E+00	8.82E+04	0.00E+00
ZR-97	2.31E-01	3.33E-02	1.97E-02	0.00E+00	4.79E-02	0.00E+00	5.05E+03	0.00E+00
NB-95	3.34E+04	1.30E+04	9.29E+03	0.00E+00	1.22E+04	0.00E+00	2.40E+07	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	9.77E+06	2.42E+06	0.00E+00	2.09E+07	0.00E+00	8.08E+06	0.00E+00
TC-99M	1.60E+00	3.13E+00	5.19E+01	0.00E+00	4.55E+01	1.59E+00	1.78E+03	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	4.45E+02	0.00E+00	1.71E+02	0.00E+00	1.12E+03	0.00E+00	1.15E+04	0.00E+00
RU-105	4.62E-04	0.00E+00	1.68E-04	0.00E+00	4.06E-03	0.00E+00	3.02E-01	0.00E+00
RU-106	8.71E+03	0.00E+00	1.09E+03	0.00E+00	1.18E+04	0.00E+00	1.36E+05	0.00E+00
AG-110M	1.98E+07	1.34E+07	1.07E+07	0.00E+00	2.50E+07	0.00E+00	1.59E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	7.45E+06	2.02E+06	9.94E+05	2.09E+06	0.00E+00	0.00E+00	7.19E+06	0.00E+00
TE-127M	2.03E+07	5.46E+06	2.41E+06	4.85E+06	5.79E+07	0.00E+00	1.64E+07	0.00E+00
TE-127	3.59E+02	9.67E+01	7.69E+01	2.48E+02	1.02E+03	0.00E+00	1.40E+04	0.00E+00
TE-129M	2.86E+07	7.99E+06	4.44E+06	9.22E+06	8.40E+07	0.00E+00	3.49E+07	0.00E+00
TE-129	1.59E-10	4.44E-11	3.78E-11	1.14E-10	4.65E-10	0.00E+00	9.90E-09	0.00E+00

TABLE I-12: DOSE FACTOR TABLE: R (I) - CHILD, GOATS MILK

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	1.92E+05	6.65E+04	7.07E+04	1.37E+05	6.43E+05	0.00E+00	2.70E+06	0.00E+00
TE-131	2.13E-33	6.48E-34	6.33E-34	1.63E-33	6.43E-33	0.00E+00	1.12E-32	0.00E+00
TE-132	1.23E+06	5.44E+05	6.57E+05	7.93E+05	5.05E+06	0.00E+00	5.48E+06	0.00E+00
I-130	2.08E+06	4.20E+06	2.16E+06	4.63E+08	6.28E+06	0.00E+00	1.97E+06	0.00E+00
I-131	1.54E+09	1.55E+09	8.78E+08	5.11E+11	2.54E+09	0.00E+00	1.38E+08	0.00E+00
I-132	8.41E-01	1.54E+00	7.10E-01	7.17E+01	2.36E+00	0.00E+00	1.82E+00	0.00E+00
I-133	2.06E+07	2.55E+07	9.66E+06	4.74E+09	4.25E+07	0.00E+00	1.03E+07	0.00E+00
I-134	1.06E-11	1.98E-11	9.09E-12	4.54E-10	3.02E-11	0.00E+00	1.31E-11	0.00E+00
I-135	6.52E+04	1.17E+05	5.55E+04	1.04E+07	1.80E+05	0.00E+00	8.94E+04	0.00E+00
CS-134	5.30E+10	8.69E+10	1.83E+10	0.00E+00	2.69E+10	9.66E+09	4.68E+08	0.00E+00
CS-136	2.89E+09	7.59E+09	5.15E+09	0.00E+00	4.24E+09	6.32E+08	2.80E+08	0.00E+00
CS-137	7.49E+10	7.17E+10	1.06E+10	0.00E+00	2.33E+10	8.40E+09	4.49E+08	0.00E+00
CS-138	1.28E-22	1.78E-22	1.13E-22	0.00E+00	1.25E-22	1.35E-23	8.21E-23	0.00E+00
BA-139	2.48E-08	1.32E-11	7.18E-10	0.00E+00	1.15E-11	7.78E-12	1.43E-06	0.00E+00
BA-140	1.34E+07	1.18E+04	7.84E+05	0.00E+00	3.83E+03	7.01E+03	6.80E+06	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	2.33E+00	8.14E-01	2.75E-01	0.00E+00	0.00E+00	0.00E+00	2.27E+04	0.00E+00
LA-142	9.95E-12	3.17E-12	9.94E-13	0.00E+00	0.00E+00	0.00E+00	6.29E-07	0.00E+00
CE-141	2.31E+03	1.15E+03	1.71E+02	0.00E+00	5.05E+02	0.00E+00	1.44E+06	0.00E+00
CE-143	2.25E+01	1.22E+04	1.77E+00	0.00E+00	5.12E+00	0.00E+00	1.79E+05	0.00E+00
CE-144	1.54E+05	4.82E+04	8.21E+03	0.00E+00	2.67E+04	0.00E+00	1.26E+07	0.00E+00
PR-143	8.19E+01	2.46E+01	4.07E+00	0.00E+00	1.33E+01	0.00E+00	8.84E+04	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	5.15E+01	4.17E+01	3.23E+00	0.00E+00	2.29E+01	0.00E+00	6.61E+04	0.00E+00
W-187	3.47E+03	2.05E+03	9.21E+02	0.00E+00	0.00E+00	0.00E+00	2.89E+05	0.00E+00
NP-239	2.07E+00	1.49E-01	1.05E-01	0.00E+00	4.30E-01	0.00E+00	1.10E+04	0.00E+00

TABLE I-13: DOSE FACTOR TABLE: R (I) - INFANT, GOATS MILK

TABLE I-13  
DOSE FACTOR TABLE: R (i) - Infant, goats' milk

Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	3.01E+03	3.01E+03	3.01E+03	3.01E+03	3.01E+03	3.01E+03	0.00E+00
C-14	3.23E+06	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	0.00E+00
NA-24	1.85E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06	1.85E+06	0.00E+00
P-32	1.82E+11	1.07E+10	7.06E+09	0.00E+00	0.00E+00	0.00E+00	2.46E+09	0.00E+00
CR-51	0.00E+00	0.00E+00	1.71E+04	1.13E+04	2.46E+03	2.19E+04	5.04E+05	0.00E+00
MN-54	0.00E+00	3.69E+06	8.36E+05	0.00E+00	8.17E+05	0.00E+00	1.36E+06	0.00E+00
MN-56	0.00E+00	3.82E-03	6.59E-04	0.00E+00	3.29E-03	0.00E+00	3.47E-01	0.00E+00
FE-55	1.37E+06	8.83E+05	2.36E+05	0.00E+00	0.00E+00	4.32E+05	1.12E+05	0.00E+00
FE-59	2.50E+06	4.37E+06	1.72E+06	0.00E+00	0.00E+00	1.29E+06	2.09E+06	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	2.42E+06	6.03E+06	0.00E+00	0.00E+00	0.00E+00	6.03E+06	0.00E+00
CO-60	0.00E+00	8.21E+06	1.94E+07	0.00E+00	0.00E+00	0.00E+00	1.95E+07	0.00E+00
NI-63	3.24E+09	2.01E+08	1.13E+08	0.00E+00	0.00E+00	0.00E+00	9.98E+06	0.00E+00
NI-65	4.27E-01	4.83E-02	2.20E-02	0.00E+00	0.00E+00	0.00E+00	3.68E+00	0.00E+00
CU-64	0.00E+00	2.07E+04	9.60E+03	0.00E+00	3.51E+04	0.00E+00	4.25E+05	0.00E+00
ZN-65	5.28E+08	1.81E+09	8.35E+08	0.00E+00	8.78E+08	0.00E+00	1.53E+09	0.00E+00
ZN-69	2.52E-12	4.54E-12	3.38E-13	0.00E+00	1.89E-12	0.00E+00	3.70E-10	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	1.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.62E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.47E+09	1.22E+09	0.00E+00	0.00E+00	0.00E+00	6.33E+07	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.25E+10	0.00E+00	6.44E+08	0.00E+00	0.00E+00	0.00E+00	4.62E+08	0.00E+00
SR-90	1.98E+11	0.00E+00	5.03E+10	0.00E+00	0.00E+00	0.00E+00	2.47E+09	0.00E+00
SR-91	5.73E+05	0.00E+00	2.07E+04	0.00E+00	0.00E+00	0.00E+00	6.78E+05	0.00E+00
SR-92	9.89E+00	0.00E+00	3.67E-01	0.00E+00	0.00E+00	0.00E+00	1.07E+02	0.00E+00
Y-90	8.18E+01	0.00E+00	2.19E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+05	0.00E+00
Y-91M	7.13E-20	0.00E+00	2.43E-21	0.00E+00	0.00E+00	0.00E+00	2.38E-16	0.00E+00
Y-91	7.40E+03	0.00E+00	1.97E+02	0.00E+00	0.00E+00	0.00E+00	5.30E+05	0.00E+00
Y-92	6.52E-05	0.00E+00	1.83E-06	0.00E+00	0.00E+00	0.00E+00	1.24E+00	0.00E+00
Y-93	2.60E-01	0.00E+00	7.08E-03	0.00E+00	0.00E+00	0.00E+00	2.05E+03	0.00E+00
ZR-95	6.83E+02	1.66E+02	1.18E+02	0.00E+00	1.79E+02	0.00E+00	8.29E+04	0.00E+00
ZR-97	4.89E-01	8.38E-02	3.83E-02	0.00E+00	8.45E-02	0.00E+00	5.35E+03	0.00E+00
NB-95	6.23E+04	2.57E+04	1.48E+04	0.00E+00	1.84E+04	0.00E+00	2.17E+07	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	2.50E+07	4.87E+06	0.00E+00	3.73E+07	0.00E+00	8.23E+06	0.00E+00
TC-99M	3.32E+00	6.84E+00	8.82E+01	0.00E+00	7.36E+01	3.58E+00	1.99E+03	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	9.02E+02	0.00E+00	3.02E+02	0.00E+00	1.88E+03	0.00E+00	1.10E+04	0.00E+00
RU-105	9.75E-04	0.00E+00	3.28E-04	0.00E+00	7.17E-03	0.00E+00	3.88E-01	0.00E+00
RU-106	1.79E+04	0.00E+00	2.24E+03	0.00E+00	2.12E+04	0.00E+00	1.36E+05	0.00E+00
AG-110M	3.67E+07	2.68E+07	1.77E+07	0.00E+00	3.83E+07	0.00E+00	1.39E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	1.52E+07	5.09E+06	2.06E+06	5.12E+06	0.00E+00	0.00E+00	7.26E+06	0.00E+00
TE-127M	4.11E+07	1.36E+07	4.97E+06	1.19E+07	1.01E+08	0.00E+00	1.66E+07	0.00E+00
TE-127	7.61E+02	2.55E+02	1.64E+02	6.20E+02	1.86E+03	0.00E+00	1.60E+04	0.00E+00
TE-129M	5.87E+07	2.01E+07	9.04E+06	2.25E+07	1.47E+08	0.00E+00	3.51E+07	0.00E+00
TE-129	3.37E-10	1.16E-10	7.87E-11	2.83E-10	8.40E-10	0.00E+00	2.70E-08	0.00E+00

**TABLE I-13: DOSE FACTOR TABLE: R (I) - INFANT, GOATS MILK**

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	4.06E+05	1.63E+05	1.35E+05	3.31E+05	1.12E+06	0.00E+00	2.75E+06	0.00E+00
TE-131	4.51E-33	1.67E-33	1.27E-33	4.02E-33	1.15E-32	0.00E+00	1.82E-31	0.00E+00
TE-132	2.53E+06	1.25E+06	1.17E+06	1.85E+06	7.84E+06	0.00E+00	4.64E+06	0.00E+00
I-130	4.27E+06	9.40E+06	3.77E+06	1.05E+09	1.03E+07	0.00E+00	2.01E+06	0.00E+00
I-131	3.21E+09	3.78E+09	1.66E+09	1.24E+12	4.41E+09	0.00E+00	1.35E+08	0.00E+00
I-132	1.74E+00	3.54E+00	1.26E+00	1.66E+02	3.95E+00	0.00E+00	2.87E+00	0.00E+00
I-133	4.36E+07	6.35E+07	1.86E+07	1.15E+10	7.46E+07	0.00E+00	1.07E+07	0.00E+00
I-134	2.21E-11	4.52E-11	1.61E-11	1.05E-09	5.05E-11	0.00E+00	4.67E-11	0.00E+00
I-135	1.36E+05	2.70E+05	9.83E+04	2.42E+07	3.00E+05	0.00E+00	9.76E+04	0.00E+00
CS-134	8.53E+10	1.59E+11	1.61E+10	0.00E+00	4.10E+10	1.68E+10	4.32E+08	0.00E+00
CS-136	5.65E+09	1.66E+10	6.21E+09	0.00E+00	6.62E+09	1.35E+09	2.52E+08	0.00E+00
CS-137	1.19E+11	1.40E+11	9.91E+09	0.00E+00	3.75E+10	1.52E+10	4.37E+08	0.00E+00
CS-138	2.70E-22	4.40E-22	2.13E-22	0.00E+00	2.19E-22	3.42E-23	7.03E-22	0.00E+00
BA-139	5.27E-08	3.49E-11	1.53E-09	0.00E+00	2.10E-11	2.12E-11	3.34E-06	0.00E+00
BA-140	2.76E+07	2.76E+04	1.42E+06	0.00E+00	6.56E+03	1.70E+04	6.79E+06	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	4.87E+00	1.92E+00	4.94E-01	0.00E+00	0.00E+00	0.00E+00	2.25E+04	0.00E+00
LA-142	2.09E-11	7.67E-12	1.84E-12	0.00E+00	0.00E+00	0.00E+00	1.30E-06	0.00E+00
CE-141	4.58E+03	2.79E+03	3.29E+02	0.00E+00	8.62E+02	0.00E+00	1.44E+06	0.00E+00
CE-143	4.77E+01	3.16E+04	3.61E+00	0.00E+00	9.21E+00	0.00E+00	1.85E+05	0.00E+00
CE-144	2.20E+05	9.02E+04	1.23E+04	0.00E+00	3.64E+04	0.00E+00	1.26E+07	0.00E+00
PR-143	1.70E+02	6.34E+01	8.40E+00	0.00E+00	2.36E+01	0.00E+00	8.95E+04	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	1.02E+02	1.05E+02	6.43E+00	0.00E+00	4.05E+01	0.00E+00	6.65E+04	0.00E+00
W-187	7.30E+03	5.08E+03	1.75E+03	0.00E+00	0.00E+00	0.00E+00	2.98E+05	0.00E+00
NP-239	4.38E+00	3.92E-01	2.21E-01	0.00E+00	7.81E-01	0.00E+00	1.13E+04	0.00E+00

TABLE I-14: DOSE FACTOR TABLE: R (I) - ADULT, MEAT

TABLE I-14  
DOSE FACTOR TABLE: R (i) - Adult, meat  
Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	2.01E+02	2.01E+02	2.01E+02	2.01E+02	2.01E+02	2.01E+02	0.00E+00
C-14	3.33E+05	6.66E+04	6.66E+04	6.66E+04	6.66E+04	6.66E+04	6.66E+04	0.00E+00
NA-24	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	0.00E+00
P-32	4.41E+09	2.74E+08	1.71E+08	0.00E+00	0.00E+00	0.00E+00	4.96E+08	0.00E+00
CR-51	0.00E+00	0.00E+00	6.30E+03	3.76E+03	1.39E+03	8.36E+03	1.58E+06	0.00E+00
MN-54	0.00E+00	7.24E+06	1.38E+06	0.00E+00	2.15E+06	0.00E+00	2.22E+07	0.00E+00
MN-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	2.28E+08	1.58E+08	3.68E+07	0.00E+00	0.00E+00	8.80E+07	9.05E+07	0.00E+00
FE-59	2.28E+08	5.36E+08	2.05E+08	0.00E+00	0.00E+00	1.50E+08	1.79E+09	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.52E+07	3.40E+07	0.00E+00	0.00E+00	0.00E+00	3.07E+08	0.00E+00
CO-60	0.00E+00	5.84E+07	1.29E+08	0.00E+00	0.00E+00	0.00E+00	1.10E+09	0.00E+00
NI-63	1.46E+10	1.01E+09	4.90E+08	0.00E+00	0.00E+00	0.00E+00	2.11E+08	0.00E+00
NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	2.79E-07	1.31E-07	0.00E+00	7.03E-07	0.00E+00	2.38E-05	0.00E+00
ZN-65	2.82E+08	8.97E+08	4.05E+08	0.00E+00	6.00E+08	0.00E+00	5.65E+08	0.00E+00
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	4.51E+08	2.10E+08	0.00E+00	0.00E+00	0.00E+00	8.90E+07	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.56E+08	0.00E+00	7.36E+06	0.00E+00	0.00E+00	0.00E+00	4.11E+07	0.00E+00
SR-90	9.63E+09	0.00E+00	2.36E+09	0.00E+00	0.00E+00	0.00E+00	2.78E+08	0.00E+00
SR-91	1.58E-10	0.00E+00	6.39E-12	0.00E+00	0.00E+00	0.00E+00	7.53E-10	0.00E+00
SR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	1.08E+02	0.00E+00	2.90E+00	0.00E+00	0.00E+00	0.00E+00	1.15E+06	0.00E+00
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	9.53E+05	0.00E+00	2.55E+04	0.00E+00	0.00E+00	0.00E+00	5.24E+08	0.00E+00
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-93	4.87E-12	0.00E+00	1.35E-13	0.00E+00	0.00E+00	0.00E+00	1.55E-07	0.00E+00
ZR-95	1.57E+06	5.02E+05	3.40E+05	0.00E+00	7.88E+05	0.00E+00	1.59E+09	0.00E+00
ZR-97	2.11E-05	4.27E-06	1.95E-06	0.00E+00	6.44E-06	0.00E+00	1.32E+00	0.00E+00
NB-95	2.01E+06	1.12E+06	6.01E+05	0.00E+00	1.11E+06	0.00E+00	6.79E+09	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	1.01E+05	1.91E+04	0.00E+00	2.28E+05	0.00E+00	2.33E+05	0.00E+00
TC-99M	4.74E-21	1.34E-20	1.71E-19	0.00E+00	2.04E-19	6.57E-21	7.93E-18	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	9.12E+07	0.00E+00	3.93E+07	0.00E+00	3.48E+08	0.00E+00	1.06E+10	0.00E+00
RU-105	6.30E-28	0.00E+00	2.49E-28	0.00E+00	8.14E-27	0.00E+00	3.85E-25	0.00E+00
RU-106	2.20E+09	0.00E+00	2.78E+08	0.00E+00	4.25E+09	0.00E+00	1.42E+11	0.00E+00
AG-110M	5.29E+06	4.89E+06	2.91E+06	0.00E+00	9.62E+06	0.00E+00	2.00E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	3.02E+08	1.09E+08	4.05E+07	9.09E+07	1.23E+09	0.00E+00	1.21E+09	0.00E+00
TE-127M	9.07E+08	3.24E+08	1.10E+08	2.32E+08	3.68E+09	0.00E+00	3.04E+09	0.00E+00
TE-127	2.21E-10	7.94E-11	4.78E-11	1.64E-10	9.01E-10	0.00E+00	1.74E-08	0.00E+00
TE-129M	9.96E+08	3.72E+08	1.58E+08	3.42E+08	4.16E+09	0.00E+00	5.02E+09	0.00E+00
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00



TABLE I-14: DOSE FACTOR TABLE: R (I) - ADULT, MEAT

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	4.57E+02	2.23E+02	1.86E+02	3.54E+02	2.26E+03	0.00E+00	2.22E+04	0.00E+00
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	1.43E+06	9.22E+05	8.66E+05	1.02E+06	8.88E+06	0.00E+00	4.36E+07	0.00E+00
I-130	2.18E-06	6.42E-06	2.53E-06	5.44E-04	1.00E-05	0.00E+00	5.52E-06	0.00E+00
I-131	1.06E+07	1.51E+07	8.66E+06	4.95E+09	2.59E+07	0.00E+00	3.99E+06	0.00E+00
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	3.72E-01	6.47E-01	1.97E-01	9.51E+01	1.13E+00	0.00E+00	5.82E-01	0.00E+00
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	4.69E-17	1.23E-16	4.53E-17	8.10E-15	1.97E-16	0.00E+00	1.39E-16	0.00E+00
CS-134	5.13E+08	1.22E+09	9.98E+08	0.00E+00	3.95E+08	1.31E+08	2.14E+07	0.00E+00
CS-136	1.15E+07	4.54E+07	3.27E+07	0.00E+00	2.53E+07	3.46E+06	5.16E+06	0.00E+00
CS-137	6.75E+08	9.23E+08	6.05E+08	0.00E+00	3.13E+08	1.04E+08	1.79E+07	0.00E+00
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	2.75E+07	3.45E+04	1.80E+06	0.00E+00	1.17E+04	1.98E+04	5.66E+07	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.74E-02	1.89E-02	4.98E-03	0.00E+00	0.00E+00	0.00E+00	1.38E+03	0.00E+00
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	1.24E+04	8.37E+03	9.49E+02	0.00E+00	3.89E+03	0.00E+00	3.20E+07	0.00E+00
CE-143	2.03E-02	1.50E+01	1.66E-03	0.00E+00	6.61E-03	0.00E+00	5.61E+02	0.00E+00
CE-144	1.15E+06	4.81E+05	6.18E+04	0.00E+00	2.85E+05	0.00E+00	3.89E+08	0.00E+00
PR-143	2.00E+04	8.00E+03	9.89E+02	0.00E+00	4.62E+03	0.00E+00	8.74E+07	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	6.84E+03	7.90E+03	4.73E+02	0.00E+00	4.62E+03	0.00E+00	3.79E+07	0.00E+00
W-187	2.08E-02	1.74E-02	6.09E-03	0.00E+00	0.00E+00	0.00E+00	5.70E+00	0.00E+00
NP-239	2.61E-01	2.56E-02	1.41E-02	0.00E+00	8.00E+02	0.00E+00	5.26E+03	0.00E+00

TABLE I-15: DOSE FACTOR TABLE: R (I) - TEEN, MEAT

TABLE I-15  
DOSE FACTOR TABLE: R (i) - Teen, meat

Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.20E+02	1.20E+02	1.20E+02	1.20E+02	1.20E+02	1.20E+02	0.00E+00
C-14	2.81E+05	5.62E+04	5.62E+04	5.62E+04	5.62E+04	5.62E+04	5.62E+04	0.00E+00
NA-24	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.11E-03	0.00E+00
P-32	3.73E+09	2.31E+08	1.45E+08	0.00E+00	0.00E+00	0.00E+00	3.13E+08	0.00E+00
CR-51	0.00E+00	0.00E+00	5.04E+03	2.80E+03	1.10E+03	7.19E+03	8.46E+05	0.00E+00
MN-54	0.00E+00	5.52E+06	1.09E+06	0.00E+00	1.65E+06	0.00E+00	1.13E+07	0.00E+00
MN-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	1.85E+08	1.31E+08	3.07E+07	0.00E+00	0.00E+00	8.34E+07	5.69E+07	0.00E+00
FE-59	1.82E+08	4.25E+08	1.64E+08	0.00E+00	0.00E+00	1.34E+08	1.01E+09	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.17E+07	2.69E+07	0.00E+00	0.00E+00	0.00E+00	1.61E+08	0.00E+00
CO-60	0.00E+00	4.53E+07	1.02E+08	0.00E+00	0.00E+00	0.00E+00	5.90E+08	0.00E+00
NI-63	1.18E+10	8.30E+08	3.98E+08	0.00E+00	0.00E+00	0.00E+00	1.32E+08	0.00E+00
NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	2.28E-07	1.07E-07	0.00E+00	5.76E-07	0.00E+00	1.77E-05	0.00E+00
ZN-65	1.98E+08	6.88E+08	3.21E+08	0.00E+00	4.40E+08	0.00E+00	2.91E+08	0.00E+00
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	3.77E+08	1.77E+08	0.00E+00	0.00E+00	0.00E+00	5.57E+07	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	2.16E+08	0.00E+00	6.20E+06	0.00E+00	0.00E+00	0.00E+00	2.58E+07	0.00E+00
SR-90	6.23E+09	0.00E+00	1.54E+09	0.00E+00	0.00E+00	0.00E+00	1.75E+08	0.00E+00
SR-91	1.33E-10	0.00E+00	5.29E-12	0.00E+00	0.00E+00	0.00E+00	6.30E-10	0.00E+00
SR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	9.11E+01	0.00E+00	2.45E+00	0.00E+00	0.00E+00	0.00E+00	7.51E+05	0.00E+00
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	8.03E+05	0.00E+00	2.15E+04	0.00E+00	0.00E+00	0.00E+00	3.29E+08	0.00E+00
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-93	4.11E-12	0.00E+00	1.13E-13	0.00E+00	0.00E+00	0.00E+00	1.26E-07	0.00E+00
ZR-95	1.25E+06	3.96E+05	2.72E+05	0.00E+00	5.82E+05	0.00E+00	9.13E+08	0.00E+00
ZR-97	1.76E-05	3.49E-06	1.61E-06	0.00E+00	5.29E-06	0.00E+00	9.44E-01	0.00E+00
NB-95	1.57E+06	8.71E+05	4.79E+05	0.00E+00	8.44E+05	0.00E+00	3.72E+09	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	8.31E+04	1.58E+04	0.00E+00	1.90E+05	0.00E+00	1.49E+05	0.00E+00
TC-99M	3.77E-21	1.05E-20	1.36E-19	0.00E+00	1.57E-19	5.83E-21	6.90E-18	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	7.43E+07	0.00E+00	3.17E+07	0.00E+00	2.62E+08	0.00E+00	6.20E+09	0.00E+00
RU-105	5.27E-28	0.00E+00	2.04E-28	0.00E+00	6.65E-27	0.00E+00	4.25E-25	0.00E+00
RU-106	1.85E+09	0.00E+00	2.34E+08	0.00E+00	3.57E+09	0.00E+00	8.89E+10	0.00E+00
AG-110M	4.00E+06	3.79E+06	2.31E+06	0.00E+00	7.23E+06	0.00E+00	1.06E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	2.55E+08	9.19E+07	3.41E+07	7.13E+07	0.00E+00	0.00E+00	7.53E+08	0.00E+00
TE-127M	7.65E+08	2.71E+08	9.10E+07	1.82E+08	3.10E+09	0.00E+00	1.91E+09	0.00E+00
TE-127	1.88E-10	6.65E-11	4.04E-11	1.29E-10	7.60E-10	0.00E+00	1.45E-08	0.00E+00
TE-129M	8.34E+08	3.10E+08	1.32E+08	2.69E+08	3.49E+09	0.00E+00	3.13E+09	0.00E+00
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE I-15: DOSE FACTOR TABLE: R (I) - TEEN, MEAT

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	3.81E+02	1.83E+02	1.52E+02	2.75E+02	1.90E+03	0.00E+00	1.47E+04	0.00E+00
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	1.17E+06	7.39E+05	6.95E+05	7.79E+05	7.09E+06	0.00E+00	2.34E+07	0.00E+00
I-130	1.75E-06	5.07E-06	2.02E-06	4.13E-04	7.80E-06	0.00E+00	3.89E-06	0.00E+00
I-131	8.78E+06	1.23E+07	6.60E+06	3.59E+09	2.12E+07	0.00E+00	2.43E+06	0.00E+00
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	3.11E-01	5.28E-01	1.61E-01	7.37E+01	9.26E-01	0.00E+00	3.99E-01	0.00E+00
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	3.82E-17	9.82E-17	3.64E-17	6.32E-15	1.55E-16	0.00E+00	1.09E-16	0.00E+00
CS-134	4.08E+08	9.60E+08	4.45E+08	0.00E+00	3.05E+08	1.16E+08	1.19E+07	0.00E+00
CS-136	8.97E+06	3.53E+07	2.37E+07	0.00E+00	1.92E+07	3.03E+06	2.84E+06	0.00E+00
CS-137	5.60E+08	7.46E+08	2.60E+08	0.00E+00	2.54E+08	9.86E+07	1.06E+07	0.00E+00
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	2.27E+07	2.78E+04	1.46E+06	0.00E+00	9.44E+03	1.87E+04	3.50E+07	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.08E-02	1.51E-02	4.02E-03	0.00E+00	0.00E+00	0.00E+00	8.69E+02	0.00E+00
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	1.04E+04	6.94E+03	7.97E+02	0.00E+00	3.27E+03	0.00E+00	1.98E+07	0.00E+00
CE-143	1.71E-02	1.24E+01	1.39E-03	0.00E+00	5.58E-03	0.00E+00	3.74E+02	0.00E+00
CE-144	9.70E+05	4.01E+05	5.21E+04	0.00E+00	2.40E+05	0.00E+00	2.44E+08	0.00E+00
PR-143	1.68E+04	6.70E+03	8.36E+02	0.00E+00	3.90E+03	0.00E+00	5.52E+07	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	6.02E+03	6.55E+03	3.92E+02	0.00E+00	3.85E+03	0.00E+00	2.36E+07	0.00E+00
W-187	1.74E-02	1.42E-02	4.98E-03	0.00E+00	0.00E+00	0.00E+00	3.85E+00	0.00E+00
NP-239	2.28E-01	2.15E-02	1.19E-02	0.00E+00	6.75E-02	0.00E+00	3.46E+03	0.00E+00

TABLE I-16: DOSE FACTOR TABLE: R (I) - CHILD, MEAT

TABLE I-16  
DOSE FACTOR TABLE: R (i) - Child, meat

Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.45E+02	1.45E+02	1.45E+02	1.45E+02	1.45E+02	1.45E+02	0.00E+00
C-14	5.29E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	0.00E+00
NA-24	1.77E-03	1.77E-03	1.77E-03	1.77E-03	1.77E-03	1.77E-03	1.77E-03	0.00E+00
P-32	7.03E+09	3.29E+08	2.71E+08	0.00E+00	0.00E+00	0.00E+00	1.94E+08	0.00E+00
CR-51	0.00E+00	0.00E+00	7.85E+03	4.36E+03	1.19E+03	7.96E+03	4.16E+05	0.00E+00
MN-54	0.00E+00	6.31E+06	1.68E+06	0.00E+00	1.77E+06	0.00E+00	5.30E+06	0.00E+00
MN-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	3.56E+08	1.89E+08	5.85E+07	0.00E+00	0.00E+00	1.07E+08	3.50E+07	0.00E+00
FE-59	3.23E+08	5.23E+08	2.60E+08	0.00E+00	0.00E+00	1.51E+08	5.44E+08	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	1.36E+07	4.18E+07	0.00E+00	0.00E+00	0.00E+00	7.96E+07	0.00E+00
CO-60	0.00E+00	5.38E+07	1.59E+08	0.00E+00	0.00E+00	0.00E+00	2.98E+08	0.00E+00
NI-63	2.25E+10	1.21E+09	7.66E+08	0.00E+00	0.00E+00	0.00E+00	8.13E+07	0.00E+00
NI-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU-64	0.00E+00	3.06E-07	1.85E-07	0.00E+00	7.39E-07	0.00E+00	1.44E-05	0.00E+00
ZN-65	2.97E+08	7.92E+08	4.93E+08	0.00E+00	4.99E+08	0.00E+00	1.39E+08	0.00E+00
ZN-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	5.34E+08	3.28E+08	0.00E+00	0.00E+00	0.00E+00	3.44E+07	0.00E+00
RB-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	4.10E+08	0.00E+00	1.17E+07	0.00E+00	0.00E+00	0.00E+00	1.59E+07	0.00E+00
SR-90	8.05E+09	0.00E+00	2.04E+09	0.00E+00	0.00E+00	0.00E+00	1.08E+08	0.00E+00
SR-91	2.50E-10	0.00E+00	9.42E-12	0.00E+00	0.00E+00	0.00E+00	5.51E-10	0.00E+00
SR-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	1.72E+02	0.00E+00	4.61E+00	0.00E+00	0.00E+00	0.00E+00	4.91E+05	0.00E+00
Y-91M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	1.52E+06	0.00E+00	4.05E+04	0.00E+00	0.00E+00	0.00E+00	2.02E+08	0.00E+00
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-93	7.73E-12	0.00E+00	2.12E-13	0.00E+00	0.00E+00	0.00E+00	1.15E-07	0.00E+00
ZR-95	2.23E+06	4.90E+05	4.36E+05	0.00E+00	7.01E+05	0.00E+00	5.11E+08	0.00E+00
ZR-97	3.28E-05	4.74E-06	2.80E-06	0.00E+00	6.80E-06	0.00E+00	7.18E-01	0.00E+00
NB-95	2.71E+06	1.06E+06	7.54E+05	0.00E+00	9.92E+05	0.00E+00	1.95E+09	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	1.16E+05	2.86E+04	0.00E+00	2.47E+05	0.00E+00	9.56E+04	0.00E+00
TC-99M	6.61E-21	1.30E-20	2.15E-19	0.00E+00	1.88E-19	6.58E-21	7.37E-18	0.00E+00
TC-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	1.34E+08	0.00E+00	5.16E+07	0.00E+00	3.38E+08	0.00E+00	3.47E+09	0.00E+00
RU-105	9.83E-28	0.00E+00	3.57E-28	0.00E+00	8.64E-27	0.00E+00	6.42E-25	0.00E+00
RU-106	3.49E+09	0.00E+00	4.35E+08	0.00E+00	4.71E+09	0.00E+00	5.43E+10	0.00E+00
AG-110M	6.64E+06	4.49E+06	3.59E+06	0.00E+00	8.36E+06	0.00E+00	5.34E+08	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	4.79E+08	1.30E+08	6.39E+07	1.34E+08	0.00E+00	0.00E+00	4.62E+08	0.00E+00
TE-127M	1.44E+09	3.88E+08	1.71E+08	3.45E+08	4.11E+09	0.00E+00	1.17E+09	0.00E+00
TE-127	3.53E-10	9.51E-11	7.57E-11	2.44E-10	1.00E-09	0.00E+00	1.38E-08	0.00E+00
TE-129M	1.57E+09	4.39E+08	2.44E+08	5.07E+08	4.62E+09	0.00E+00	1.92E+09	0.00E+00
TE-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE I-16: DOSE FACTOR TABLE: R (I) - CHILD, MEAT

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	7.09E+02	2.45E+02	2.61E+02	5.04E+02	2.37E+03	0.00E+00	9.94E+03	0.00E+00
TE-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-132	2.13E+06	9.43E+05	1.14E+06	1.37E+06	8.75E+06	0.00E+00	9.49E+06	0.00E+00
I-130	3.13E-06	6.33E-06	3.26E-06	6.97E-04	9.46E-06	0.00E+00	2.96E-06	0.00E+00
I-131	1.63E+07	1.64E+07	9.30E+06	5.41E+09	2.69E+07	0.00E+00	1.46E+06	0.00E+00
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	5.78E-01	7.15E-01	2.70E-01	1.33E+02	1.19E+00	0.00E+00	2.88E-01	0.00E+00
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	6.91E-17	1.24E-16	5.88E-17	1.10E-14	1.91E-16	0.00E+00	9.47E-17	0.00E+00
CS-134	7.19E+08	1.18E+09	2.49E+08	0.00E+00	3.66E+08	1.31E+08	6.36E+06	0.00E+00
CS-136	1.55E+07	4.25E+07	2.75E+07	0.00E+00	2.27E+07	3.38E+06	1.50E+06	0.00E+00
CS-137	1.03E+09	9.88E+08	1.46E+08	0.00E+00	3.22E+08	1.16E+08	6.19E+06	0.00E+00
CS-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	4.19E+07	3.67E+04	2.45E+06	0.00E+00	1.20E+04	2.19E+04	2.12E+07	0.00E+00
BA-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	5.64E-02	1.97E-02	6.64E-03	0.00E+00	0.00E+00	0.00E+00	5.49E+02	0.00E+00
LA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	1.96E+04	9.76E+03	1.45E+03	0.00E+00	4.28E+03	0.00E+00	1.22E+07	0.00E+00
CE-143	3.21E-02	1.74E+01	2.52E-03	0.00E+00	7.29E-03	0.00E+00	2.55E+02	0.00E+00
CE-144	1.83E+06	5.73E+05	9.76E+04	0.00E+00	3.17E+05	0.00E+00	1.49E+08	0.00E+00
PR-143	3.18E+04	9.54E+03	1.58E+03	0.00E+00	5.17E+03	0.00E+00	3.43E+07	0.00E+00
PR-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	1.13E+04	9.16E+03	7.09E+02	0.00E+00	5.02E+03	0.00E+00	1.45E+07	0.00E+00
W-187	3.23E-02	1.91E-02	8.59E-03	0.00E+00	0.00E+00	0.00E+00	2.69E+00	0.00E+00
NP-239	4.29E-01	3.08E-02	2.16E-02	0.00E+00	8.90E-02	0.00E+00	2.28E+03	0.00E+00

TABLE I-17: DOSE FACTOR TABLE: R (I) - ADULT, VEGETATION

TABLE I-17  
DOSE FACTOR TABLE: R (i)- Adult, vegetation  
Units are m<sup>2</sup>\*mrem/yr per µCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.40E+03	1.40E+03	1.40E+03	1.40E+03	1.40E+03	1.40E+03	0.00E+00
C-14	8.97E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05	0.00E+00
NA-24	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05	0.00E+00
P-32	1.40E+09	8.72E+07	5.42E+07	0.00E+00	0.00E+00	0.00E+00	1.58E+08	0.00E+00
CR-51	0.00E+00	0.00E+00	4.64E+04	2.77E+04	1.02E+04	6.15E+04	1.17E+07	0.00E+00
MN-54	0.00E+00	3.10E+08	5.92E+07	0.00E+00	9.23E+07	0.00E+00	9.50E+08	0.00E+00
MN-56	0.00E+00	1.54E+01	2.74E+00	0.00E+00	1.96E+01	0.00E+00	4.92E+02	0.00E+00
FE-55	2.08E+08	1.43E+08	3.34E+07	0.00E+00	0.00E+00	8.00E+07	8.23E+07	0.00E+00
FE-59	1.26E+08	2.96E+08	1.13E+08	0.00E+00	0.00E+00	8.26E+07	9.85E+08	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	3.06E+07	6.86E+07	0.00E+00	0.00E+00	0.00E+00	6.20E+08	0.00E+00
CO-60	0.00E+00	1.65E+08	3.65E+08	0.00E+00	0.00E+00	0.00E+00	3.11E+09	0.00E+00
NI-63	1.03E+10	7.14E+08	3.45E+08	0.00E+00	0.00E+00	0.00E+00	1.49E+08	0.00E+00
NI-65	5.96E+01	7.75E+00	3.54E+00	0.00E+00	0.00E+00	0.00E+00	1.97E+02	0.00E+00
CU-64	0.00E+00	9.14E+03	4.29E+03	0.00E+00	2.31E+04	0.00E+00	7.79E+05	0.00E+00
ZN-65	3.15E+08	1.00E+09	4.53E+08	0.00E+00	6.70E+08	0.00E+00	6.31E+08	0.00E+00
ZN-69	5.06E-06	9.67E-06	6.72E-07	0.00E+00	6.28E-06	0.00E+00	1.45E-06	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	3.01E+00	0.00E+00	0.00E+00	0.00E+00	4.33E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	2.14E-11	0.00E+00	0.00E+00	0.00E+00	1.68E-16	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.19E+08	1.02E+08	0.00E+00	0.00E+00	0.00E+00	4.32E+07	0.00E+00
RB-88	0.00E+00	2.64E-22	1.40E-22	0.00E+00	0.00E+00	0.00E+00	3.65E-33	0.00E+00
RB-89	0.00E+00	2.88E-26	2.03E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	9.94E+09	0.00E+00	2.85E+08	0.00E+00	0.00E+00	0.00E+00	1.59E+09	0.00E+00
SR-90	5.98E+11	0.00E+00	1.47E+11	0.00E+00	0.00E+00	0.00E+00	1.73E+10	0.00E+00
SR-91	3.02E+05	0.00E+00	1.22E+04	0.00E+00	0.00E+00	0.00E+00	1.44E+06	0.00E+00
SR-92	4.15E+02	0.00E+00	1.79E+01	0.00E+00	0.00E+00	0.00E+00	8.21E+03	0.00E+00
Y-90	1.33E+04	0.00E+00	3.56E+02	0.00E+00	0.00E+00	0.00E+00	1.41E+08	0.00E+00
Y-91M	4.76M-09	0.00E+00	1.84E-10	0.00E+00	0.00E+00	0.00E+00	1.40E-08	0.00E+00
Y-91	5.09E+06	0.00E+00	1.36E+05	0.00E+00	0.00E+00	0.00E+00	2.80E+09	0.00E+00
Y-92	8.96E-01	0.00E+00	2.62E-02	0.00E+00	0.00E+00	0.00E+00	1.57E+04	0.00E+00
Y-93	1.68E+02	0.00E+00	4.65E+00	0.00E+00	0.00E+00	0.00E+00	5.34E+06	0.00E+00
ZR-95	1.17E+06	3.75E+05	2.54E+05	0.00E+00	5.89E+05	0.00E+00	1.19E+09	0.00E+00
ZR-97	3.36E+02	6.78E+01	3.10E+01	0.00E+00	1.02E+02	0.00E+00	2.10E+07	0.00E+00
NB-95	1.42E+05	7.90E+04	4.25E+04	0.00E+00	7.81E+04	0.00E+00	4.80E+08	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	6.14E+06	1.17E+06	0.00E+00	1.39E+07	0.00E+00	1.42E+07	0.00E+00
TC-99M	3.06E+00	8.66E+00	1.10E+02	0.00E+00	1.31E+02	4.24E+00	5.12E+03	0.00E+00
TC-101	5.93E-31	8.55E-31	8.39E-30	0.00E+00	1.54E-29	4.37E-31	0.00E+00	0.00E+00
RU-103	4.76E+06	0.00E+00	2.05E+06	0.00E+00	1.82E+07	0.00E+00	5.56E+08	0.00E+00
RU-105	5.29E+01	0.00E+00	2.09E+01	0.00E+00	6.84E+02	0.00E+00	3.24E+04	0.00E+00
RU-106	1.91E+08	0.00E+00	2.42E+07	0.00E+00	3.69E+08	0.00E+00	1.24E+10	0.00E+00
AG-110M	1.05E+07	9.67E+06	5.74E+06	0.00E+00	1.90E+07	0.00E+00	3.95E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	9.62E+07	3.49E+07	1.29E+07	2.89E+07	3.91E+08	0.00E+00	3.84E+08	0.00E+00
TE-127M	3.47E+08	1.24E+08	4.23E+07	8.87E+07	1.41E+09	0.00E+00	1.16E+09	0.00E+00
TE-127	5.61E+03	2.02E+03	1.21E+03	4.16E+03	2.29E+04	0.00E+00	4.43E+05	0.00E+00
TE-129M	2.51E+08	9.36E+07	3.97E+07	8.61E+07	1.05E+09	0.00E+00	1.26E+09	0.00E+00
TE-129	7.13E-04	2.68E-04	1.74E-04	5.48E-04	3.00E-03	0.00E+00	5.38E-04	0.00E+00

TABLE I-17: DOSE FACTOR TABLE: R (I) - ADULT, VEGETATION

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	9.10E+05	4.45E+05	3.71E+05	7.05E+05	4.51E+06	0.00E+00	4.42E+07	0.00E+00
TE-131	1.25E-15	5.21E-16	3.94E-16	1.03E-15	5.47E-15	0.00E+00	1.77E-16	0.00E+00
TE-132	4.30E+06	2.78E+06	2.61E+06	3.07E+06	2.68E+07	0.00E+00	1.31E+08	0.00E+00
I-130	3.90E+05	1.15E+06	4.54E+05	9.75E+07	1.79E+06	0.00E+00	9.90E+05	0.00E+00
I-131	8.07E+07	1.15E+08	6.61E+07	3.78E+10	1.98E+08	0.00E+00	3.04E+07	0.00E+00
I-132	5.57E+01	1.49E+02	5.21E+01	5.21E+03	2.37E+02	0.00E+00	2.80E+01	0.00E+00
I-133	2.08E+06	3.61E+06	1.10E+06	5.31E+08	6.31E+06	0.00E+00	3.25E+06	0.00E+00
I-134	8.84E-05	2.40E-04	8.59E-05	4.16E-03	3.82E-04	0.00E+00	2.09E-07	0.00E+00
I-135	3.85E+04	1.01E+05	3.72E+04	6.65E+06	1.62E+05	0.00E+00	1.14E+05	0.00E+00
CS-134	4.62E+09	1.10E+10	8.99E+09	0.00E+00	3.56E+09	1.18E+09	1.92E+08	0.00E+00
CS-136	4.26E+07	1.68E+08	1.21E+08	0.00E+00	9.37E+07	1.28E+07	1.91E+07	0.00E+00
CS-137	6.29E+09	8.61E+09	5.64E+09	0.00E+00	2.92E+09	9.71E+08	1.67E+08	0.00E+00
CS-138	3.39E-11	6.70E-11	3.32E-11	0.00E+00	4.92E-11	4.86E-12	2.86E-16	0.00E+00
BA-139	2.70E-02	1.92E-05	7.91E-04	0.00E+00	1.80E-05	1.09E-05	4.79E-02	0.00E+00
BA-140	1.28E+08	1.61E+05	8.41E+06	0.00E+00	5.48E+04	9.23E+04	2.64E+08	0.00E+00
BA-141	8.94E-22	6.76E-25	3.02E-23	0.00E+00	6.28E-25	3.83E-25	4.21E-31	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.97E+03	9.95E+02	2.63E+02	0.00E+00	0.00E+00	0.00E+00	7.30E+07	0.00E+00
LA-142	1.92E-04	8.75E-05	2.18E-05	0.00E+00	0.00E+00	0.00E+00	6.39E-01	0.00E+00
CE-141	1.97E+05	1.33E+05	1.51E+04	0.00E+00	6.18E+04	0.00E+00	5.09E+08	0.00E+00
CE-143	9.95E+02	7.36E+05	8.14E+01	0.00E+00	3.24E+02	0.00E+00	2.75E+07	0.00E+00
CE-144	3.26E+07	1.36E+07	1.75E+06	0.00E+00	8.09E+06	0.00E+00	1.10E+10	0.00E+00
PR-143	6.25E+04	2.51E+04	3.10E+03	0.00E+00	1.45E+04	0.00E+00	2.74E+08	0.00E+00
PR-144	2.36E-26	9.81E-27	1.20E-27	0.00E+00	5.53E-27	0.00E+00	3.40E-33	0.00E+00
ND-147	3.33E+04	3.85E+04	2.30E+03	0.00E+00	2.25E+04	0.00E+00	1.85E+08	0.00E+00
W-187	3.79E+04	3.17E+04	1.11E+04	0.00E+00	0.00E+00	0.00E+00	1.04E+07	0.00E+00
NP-239	1.43E+03	1.40E+02	7.73E+01	0.00E+00	4.37E+02	0.00E+00	2.88E+07	0.00E+00

TABLE I-18: DOSE FACTOR TABLE: R (I) - TEEN, VEGETATION

TABLE I-18  
DOSE FACTOR TABLE: R (i)- Teen, vegetation  
Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	1.60E+03	1.60E+03	1.60E+03	1.60E+03	1.60E+03	1.60E+03	0.00E+00
C-14	1.45E+06	2.91E+05	2.91E+05	2.91E+05	2.91E+05	2.91E+05	2.91E+05	0.00E+00
NA-24	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05	0.00E+00
P-32	1.61E+09	9.95E+07	6.23E+07	0.00E+00	0.00E+00	0.00E+00	1.35E+08	0.00E+00
CR-51	0.00E+00	0.00E+00	6.16E+04	3.42E+04	1.35E+04	8.79E+04	1.03E+07	0.00E+00
MN-54	0.00E+00	4.51E+08	8.94E+07	0.00E+00	1.34E+08	0.00E+00	9.24E+08	0.00E+00
MN-56	0.00E+00	1.39E+01	2.47E+00	0.00E+00	1.76E+01	0.00E+00	9.16E+02	0.00E+00
FE-55	3.23E+08	2.29E+08	5.34E+07	0.00E+00	0.00E+00	1.45E+08	9.90E+07	0.00E+00
FE-59	1.79E+08	4.17E+08	1.61E+08	0.00E+00	0.00E+00	1.32E+08	9.87E+08	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	4.34E+07	1.00E+08	0.00E+00	0.00E+00	0.00E+00	5.98E+08	0.00E+00
CO-60	0.00E+00	2.46E+08	5.54E+08	0.00E+00	0.00E+00	0.00E+00	3.21E+09	0.00E+00
NI-63	1.59E+10	1.12E+09	5.39E+08	0.00E+00	0.00E+00	0.00E+00	1.79E+08	0.00E+00
NI-65	5.55E+01	7.09E+00	3.23E+00	0.00E+00	0.00E+00	0.00E+00	3.85E+02	0.00E+00
CU-64	0.00E+00	8.28E+03	3.90E+03	0.00E+00	2.10E+04	0.00E+00	6.43E+05	0.00E+00
ZN-65	4.20E+08	1.46E+09	6.81E+08	0.00E+00	9.34E+08	0.00E+00	6.18E+08	0.00E+00
ZN-69	4.73E-06	9.02E-06	6.31E-07	0.00E+00	5.89E-06	0.00E+00	1.66E-05	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	2.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.95E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.73E+08	1.28E+08	0.00E+00	0.00E+00	0.00E+00	4.04E+07	0.00E+00
RB-88	0.00E+00	2.44E-22	1.30E-22	0.00E+00	0.00E+00	0.00E+00	2.09E-29	0.00E+00
RB-89	0.00E+00	2.59E-26	1.83E-26	0.00E+00	0.00E+00	0.00E+00	3.98E-05	0.00E+00
SR-89	1.51E+10	0.00E+00	4.32E+08	0.00E+00	0.00E+00	0.00E+00	1.80E+09	0.00E+00
SR-90	7.43E+11	0.00E+00	1.84E+11	0.00E+00	0.00E+00	0.00E+00	2.09E+10	0.00E+00
SR-91	2.82E+05	0.00E+00	1.12E+04	0.00E+00	0.00E+00	0.00E+00	1.28E+06	0.00E+00
SR-92	3.86E+02	0.00E+00	1.65E+01	0.00E+00	0.00E+00	0.00E+00	9.83E+03	0.00E+00
Y-90	1.24E+04	0.00E+00	3.34E+02	0.00E+00	0.00E+00	0.00E+00	1.02E+08	0.00E+00
Y-91M	4.43E-09	0.00E+00	1.69E-10	0.00E+00	0.00E+00	0.00E+00	2.09E-07	0.00E+00
Y-91	7.81E+06	0.00E+00	2.09E+05	0.00E+00	0.00E+00	0.00E+00	3.20E+09	0.00E+00
Y-92	8.42E-01	0.00E+00	2.43E-02	0.00E+00	0.00E+00	0.00E+00	2.31E+04	0.00E+00
Y-93	1.58E+02	0.00E+00	4.33E+00	0.00E+00	0.00E+00	0.00E+00	4.82E+06	0.00E+00
ZR-95	1.71E+06	5.41E+05	3.72E+05	0.00E+00	7.95E+05	0.00E+00	1.25E+09	0.00E+00
ZR-97	3.11E+02	6.15E+01	2.83E+01	0.00E+00	9.33E+01	0.00E+00	1.67E+07	0.00E+00
NB-95	1.92E+05	1.06E+05	5.86E+04	0.00E+00	1.03E+05	0.00E+00	4.55E+08	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	5.64E+06	1.08E+06	0.00E+00	1.29E+07	0.00E+00	1.01E+07	0.00E+00
TC-99M	2.70E+00	7.54E+00	9.77E+01	0.00E+00	1.12E+02	4.18E+00	4.95E+03	0.00E+00
TC-101	5.52E-31	7.85E-31	7.71E-30	0.00E+00	1.42E-29	4.78E-31	1.34E-37	0.00E+00
RU-103	6.80E+06	0.00E+00	2.91E+06	0.00E+00	2.40E+07	0.00E+00	5.68E+08	0.00E+00
RU-105	4.92E+01	0.00E+00	1.91E+01	0.00E+00	6.20E+02	0.00E+00	3.97E+04	0.00E+00
RU-106	3.07E+08	0.00E+00	3.87E+07	0.00E+00	5.92E+08	0.00E+00	1.47E+10	0.00E+00
AG-110M	1.50E+07	1.42E+07	8.65E+06	0.00E+00	2.71E+07	0.00E+00	4.00E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	1.48E+08	5.32E+07	1.97E+07	4.13E+07	0.00E+00	0.00E+00	4.36E+08	0.00E+00
TE-127M	5.48E+08	1.94E+08	6.52E+07	1.30E+08	2.22E+09	0.00E+00	1.37E+09	0.00E+00
TE-127	5.29E+03	1.88E+03	1.14E+03	3.65E+03	2.14E+04	0.00E+00	4.09E+05	0.00E+00
TE-129M	3.61E+08	1.34E+08	5.71E+07	1.16E+08	1.51E+09	0.00E+00	1.35E+09	0.00E+00
TE-129	6.68E-04	2.49E-04	1.63E-04	4.77E-04	2.80E-03	0.00E+00	3.65E-03	0.00E+00



TABLE I-18: DOSE FACTOR TABLE: R (I) - TEEN, VEGETATION

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	8.42E+05	4.04E+05	3.37E+05	6.07E+05	4.21E+06	0.00E+00	3.24E+07	0.00E+00
TE-131	1.16E-15	4.78E-16	3.62E-16	8.93E-16	5.07E-15	0.00E+00	9.52E-17	0.00E+00
TE-132	3.90E+06	2.47E+06	2.33E+06	2.61E+06	2.37E+07	0.00E+00	7.83E+07	0.00E+00
I-130	3.49E+05	1.01E+06	4.03E+05	8.22E+07	1.55E+06	0.00E+00	7.75E+05	0.00E+00
I-131	7.67E+07	1.07E+08	5.77E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07	0.00E+00
I-132	5.02E+01	1.31E+02	4.72E+01	4.43E+03	2.07E+02	0.00E+00	5.72E+01	0.00E+00
I-133	1.93E+06	3.27E+06	9.99E+05	4.57E+08	5.74E+06	0.00E+00	2.48E+06	0.00E+00
I-134	7.99E-05	2.12E-04	7.61E-05	3.53E-03	3.34E-04	0.00E+00	2.79E-06	0.00E+00
I-135	3.48E+04	8.96E+04	3.32E+04	5.76E+06	1.42E+05	0.00E+00	9.93E+04	0.00E+00
CS-134	7.03E+09	1.66E+10	7.68E+09	0.00E+00	5.26E+09	2.01E+09	2.06E+08	0.00E+00
CS-136	4.37E+07	1.72E+08	1.15E+08	0.00E+00	9.36E+07	1.47E+07	1.38E+07	0.00E+00
CS-137	1.00E+10	1.33E+10	4.65E+09	0.00E+00	4.54E+09	1.76E+09	1.90E+08	0.00E+00
CS-138	3.13E-11	6.01E-11	3.00E-11	0.00E+00	4.44E-11	5.16E-12	2.73E-14	0.00E+00
BA-139	2.54E-02	1.79E-05	7.40E-04	0.00E+00	1.69E-05	1.23E-05	2.27E-01	0.00E+00
BA-140	1.38E+08	1.69E+05	8.89E+06	0.00E+00	5.73E+04	1.14E+05	2.13E+08	0.00E+00
BA-141	8.36E-22	6.24E-25	2.79E-23	0.00E+00	5.79E-25	4.27E-25	1.78E-27	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	1.80E+03	8.86E+02	2.36E+02	0.00E+00	0.00E+00	0.00E+00	5.09E+07	0.00E+00
LA-142	1.77E-04	7.84E-05	1.95E-05	0.00E+00	0.00E+00	0.00E+00	2.39E+00	0.00E+00
CE-141	2.82E+05	1.89E+05	2.17E+04	0.00E+00	8.87E+04	0.00E+00	5.39E+08	0.00E+00
CE-143	9.30E+02	6.77E+05	7.56E+01	0.00E+00	3.04E+02	0.00E+00	2.04E+07	0.00E+00
CE-144	5.23E+07	2.16E+07	2.81E+06	0.00E+00	1.29E+07	0.00E+00	1.32E+10	0.00E+00
PR-143	6.99E+04	2.79E+04	3.48E+03	0.00E+00	1.62E+04	0.00E+00	2.30E+08	0.00E+00
PR-144	2.22E-26	9.07E-27	1.12E-27	0.00E+00	5.20E-27	0.00E+00	2.44E-29	0.00E+00
ND-147	3.62E+04	3.93E+04	2.36E+03	0.00E+00	2.31E+04	0.00E+00	1.42E+08	0.00E+00
W-187	3.52E+04	2.87E+04	1.01E+04	0.00E+00	0.00E+00	0.00E+00	7.77E+06	0.00E+00
NP-239	1.38E+03	1.31E+02	7.25E+01	0.00E+00	4.10E+02	0.00E+00	2.10E+07	0.00E+00

TABLE I-19: DOSE FACTOR TABLE: R (I) - CHILD, VEGETATION

TABLE I-19  
DOSE FACTOR TABLE: R (i)- Child, vegetation

Units are m<sup>2</sup>\*mrem/yr per μCi/sec

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
H-3	0.00E+00	2.49E+03	2.49E+03	2.49E+03	2.49E+03	2.49E+03	2.49E+03	0.00E+00
C-14	3.50E+06	7.01E+05	7.01E+05	7.01E+05	7.01E+05	7.01E+05	7.01E+05	0.00E+00
NA-24	3.71E+05	3.71E+05	3.71E+05	3.71E+05	3.71E+05	3.71E+05	3.71E+05	0.00E+00
P-32	3.36E+09	1.57E+08	1.30E+08	0.00E+00	0.00E+00	0.00E+00	9.30E+07	0.00E+00
CR-51	0.00E+00	0.00E+00	1.17E+05	6.49E+04	1.77E+04	1.18E+05	6.20E+06	0.00E+00
MN-54	0.00E+00	6.59E+08	1.76E+08	0.00E+00	1.85E+08	0.00E+00	5.53E+08	0.00E+00
MN-56	0.00E+00	1.82E+01	4.11E+00	0.00E+00	2.20E+01	0.00E+00	2.64E+03	0.00E+00
FE-55	7.94E+08	4.21E+08	1.30E+08	0.00E+00	0.00E+00	2.38E+08	7.80E+07	0.00E+00
FE-59	3.96E+08	6.41E+08	3.19E+08	0.00E+00	0.00E+00	1.86E+08	6.68E+08	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	6.41E+07	1.96E+08	0.00E+00	0.00E+00	0.00E+00	3.74E+08	0.00E+00
CO-60	0.00E+00	3.75E+08	1.10E+09	0.00E+00	0.00E+00	0.00E+00	2.07E+09	0.00E+00
NI-63	3.91E+10	2.09E+09	1.33E+09	0.00E+00	0.00E+00	0.00E+00	1.41E+08	0.00E+00
NI-65	1.02E+02	9.59E+00	5.60E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+03	0.00E+00
CU-64	0.00E+00	1.09E+04	6.60E+03	0.00E+00	2.64E+04	0.00E+00	5.13E+05	0.00E+00
ZN-65	8.06E+08	2.15E+09	1.34E+09	0.00E+00	1.35E+09	0.00E+00	3.77E+08	0.00E+00
ZN-69	8.73E-06	1.26E-05	1.17E-06	0.00E+00	7.66E-06	0.00E+00	7.96E-04	0.00E+00
ZN-69M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	5.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.30E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	4.51E+08	2.78E+08	0.00E+00	0.00E+00	0.00E+00	2.90E+07	0.00E+00
RB-88	0.00E+00	3.77E-22	2.34E-22	0.00E+00	0.00E+00	0.00E+00	1.65E-23	0.00E+00
RB-89	0.00E+00	3.42E-26	3.04E-26	0.00E+00	0.00E+00	0.00E+00	2.98E-28	0.00E+00
SR-89	3.58E+10	0.00E+00	1.02E+09	0.00E+00	0.00E+00	0.00E+00	1.39E+09	0.00E+00
SR-90	1.23E+12	0.00E+00	3.12E+11	0.00E+00	0.00E+00	0.00E+00	1.66E+10	0.00E+00
SR-91	5.20E+05	0.00E+00	1.96E+04	0.00E+00	0.00E+00	0.00E+00	1.15E+06	0.00E+00
SR-92	7.07E+02	0.00E+00	2.84E+01	0.00E+00	0.00E+00	0.00E+00	1.34E+04	0.00E+00
Y-90	2.30E+04	0.00E+00	6.17E+02	0.00E+00	0.00E+00	0.00E+00	6.56E+07	0.00E+00
Y-91M	8.12E-09	0.00E+00	2.95E-10	0.00E+00	0.00E+00	0.00E+00	1.59E-05	0.00E+00
Y-91	1.86E+07	0.00E+00	4.97E+05	0.00E+00	0.00E+00	0.00E+00	2.47E+09	0.00E+00
Y-92	1.55E+00	0.00E+00	4.43E-02	0.00E+00	0.00E+00	0.00E+00	4.48E+04	0.00E+00
Y-93	2.91E+02	0.00E+00	7.98E+00	0.00E+00	0.00E+00	0.00E+00	4.34E+06	0.00E+00
ZR-95	3.84E+06	8.44E+05	7.52E+05	0.00E+00	1.21E+06	0.00E+00	8.81E+08	0.00E+00
ZR-97	5.68E+02	8.20E+01	4.84E+01	0.00E+00	1.18E+02	0.00E+00	1.24E+07	0.00E+00
NB-95	4.09E+05	1.59E+05	1.14E+05	0.00E+00	1.50E+05	0.00E+00	2.95E+08	0.00E+00
NB-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO-99	0.00E+00	7.70E+06	1.91E+06	0.00E+00	1.64E+07	0.00E+00	6.37E+06	0.00E+00
TC-99M	4.65E+00	9.12E+00	1.51E+02	0.00E+00	1.32E+02	4.63E+00	5.19E+03	0.00E+00
TC-101	1.02E-30	1.06E-30	1.35E-29	0.00E+00	1.81E-29	5.62E-31	3.38E-30	0.00E+00
RU-103	1.53E+07	0.00E+00	5.88E+06	0.00E+00	3.85E+07	0.00E+00	3.95E+08	0.00E+00
RU-105	9.01E+01	0.00E+00	3.27E+01	0.00E+00	7.92E+02	0.00E+00	5.88E+04	0.00E+00
RU-106	7.39E+08	0.00E+00	9.22E+07	0.00E+00	9.98E+08	0.00E+00	1.15E+10	0.00E+00
AG-110M	3.19E+07	2.15E+07	1.72E+07	0.00E+00	4.01E+07	0.00E+00	2.56E+09	0.00E+00
SB-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	3.49E+08	9.47E+07	4.66E+07	9.80E+07	0.00E+00	0.00E+00	3.37E+08	0.00E+00
TE-127M	1.31E+09	3.54E+08	1.56E+08	3.14E+08	3.75E+09	0.00E+00	1.06E+09	0.00E+00
TE-127	9.76E+03	2.63E+03	2.09E+03	6.76E+03	2.78E+04	0.00E+00	3.81E+05	0.00E+00
TE-129M	8.39E+08	2.34E+08	1.30E+08	2.71E+08	2.46E+09	0.00E+00	1.02E+09	0.00E+00
TE-129	1.24E-03	3.45E-04	2.94E-04	8.82E-04	3.62E-03	0.00E+00	7.70E-02	0.00E+00

**TABLE I-19: DOSE FACTOR TABLE: R (I) - CHILD, VEGETATION**

Nuclide	Bone	Liver	Tbody	Thyroid	Kidney	Lung	GI Tract	Skin
TE-131M	1.54E+06	5.32E+05	5.66E+05	1.09E+06	5.15E+06	0.00E+00	2.16E+07	0.00E+00
TE-131	2.14E-15	6.51E-16	6.35E-16	1.63E-15	6.46E-15	0.00E+00	1.12E-14	0.00E+00
TE-132	6.99E+06	3.10E+06	3.74E+06	4.51E+06	2.87E+07	0.00E+00	3.12E+07	0.00E+00
I-130	6.12E+05	1.24E+06	6.37E+05	1.36E+08	1.85E+06	0.00E+00	5.78E+05	0.00E+00
I-131	1.43E+08	1.44E+08	8.16E+07	4.75E+10	2.36E+08	0.00E+00	1.28E+07	0.00E+00
I-132	8.91E+01	1.64E+02	7.53E+01	7.60E+03	2.51E+02	0.00E+00	1.93E+02	0.00E+00
I-133	3.52E+06	4.35E+06	1.65E+06	8.08E+08	7.25E+06	0.00E+00	1.75E+06	0.00E+00
I-134	1.42E-04	2.64E-04	1.21E-04	6.07E-03	4.03E-04	0.00E+00	1.75E-04	0.00E+00
I-135	6.18E+04	1.11E+05	5.26E+04	9.86E+06	1.71E+05	0.00E+00	8.48E+04	0.00E+00
CS-134	1.59E+10	2.61E+10	5.50E+09	0.00E+00	8.08E+09	2.90E+09	1.41E+08	0.00E+00
CS-136	8.23E+07	2.26E+08	1.46E+08	0.00E+00	1.20E+08	1.80E+07	7.95E+06	0.00E+00
CS-137	2.37E+10	2.27E+10	3.35E+09	0.00E+00	7.39E+09	2.66E+09	1.42E+08	0.00E+00
CS-138	5.69E-11	7.91E-11	5.02E-11	0.00E+00	5.57E-11	5.99E-12	3.64E-11	0.00E+00
BA-139	4.69E-02	2.50E-05	1.36E-03	0.00E+00	2.18E-05	1.47E-05	2.70E+00	0.00E+00
BA-140	2.76E+08	2.42E+05	1.60E+07	0.00E+00	7.88E+04	1.44E+05	1.40E+08	0.00E+00
BA-141	1.54E-21	8.64E-25	5.02E-23	0.00E+00	7.47E-25	5.07E-24	8.79E-22	0.00E+00
BA-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LA-140	3.24E+03	1.13E+03	3.82E+02	0.00E+00	0.00E+00	0.00E+00	3.16E+07	0.00E+00
LA-142	3.20E-04	1.02E-04	3.19E-05	0.00E+00	0.00E+00	0.00E+00	2.02E+01	0.00E+00
CE-141	6.55E+05	3.26E+05	4.85E+04	0.00E+00	1.43E+05	0.00E+00	4.07E+08	0.00E+00
CE-143	1.71E+03	9.29E+05	1.35E+02	0.00E+00	3.90E+02	0.00E+00	1.36E+07	0.00E+00
CE-144	1.26E+08	3.95E+07	6.73E+06	0.00E+00	2.19E+07	0.00E+00	1.03E+10	0.00E+00
PR-143	1.45E+05	4.36E+04	7.21E+03	0.00E+00	2.36E+04	0.00E+00	1.57E+08	0.00E+00
PR-144	4.11E-26	1.27E-26	2.07E-27	0.00E+00	6.73E-27	0.00E+00	2.74E-23	0.00E+00
ND-147	7.14E+04	5.78E+04	4.48E+03	0.00E+00	2.17E+04	0.00E+00	9.16E+07	0.00E+00
W-187	6.41E+04	3.79E+04	1.70E+04	0.00E+00	0.00E+00	0.00E+00	5.33E+06	0.00E+00
NP-239	2.56E+03	1.83E+02	1.29E+02	0.00E+00	5.31E+02	0.00E+00	1.36E+07	0.00E+00

FIGURE 1: RESTRICTED AREA AND NEAR-FIELD ENVIRONMENTAL MONITORING LOCATIONS

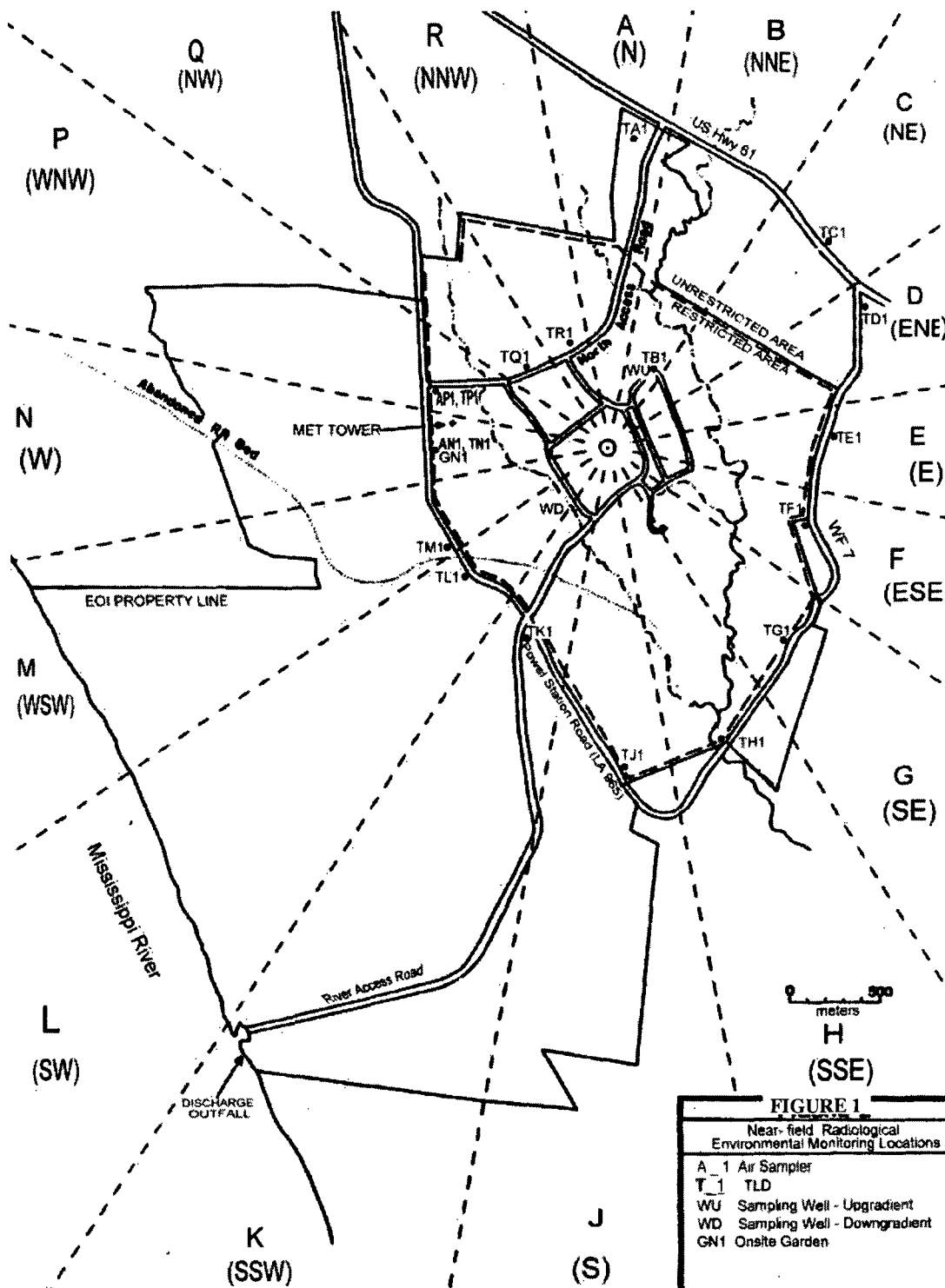


FIGURE 2: SCHEMATIC OF GASEOUS RADWASTE SYSTEM

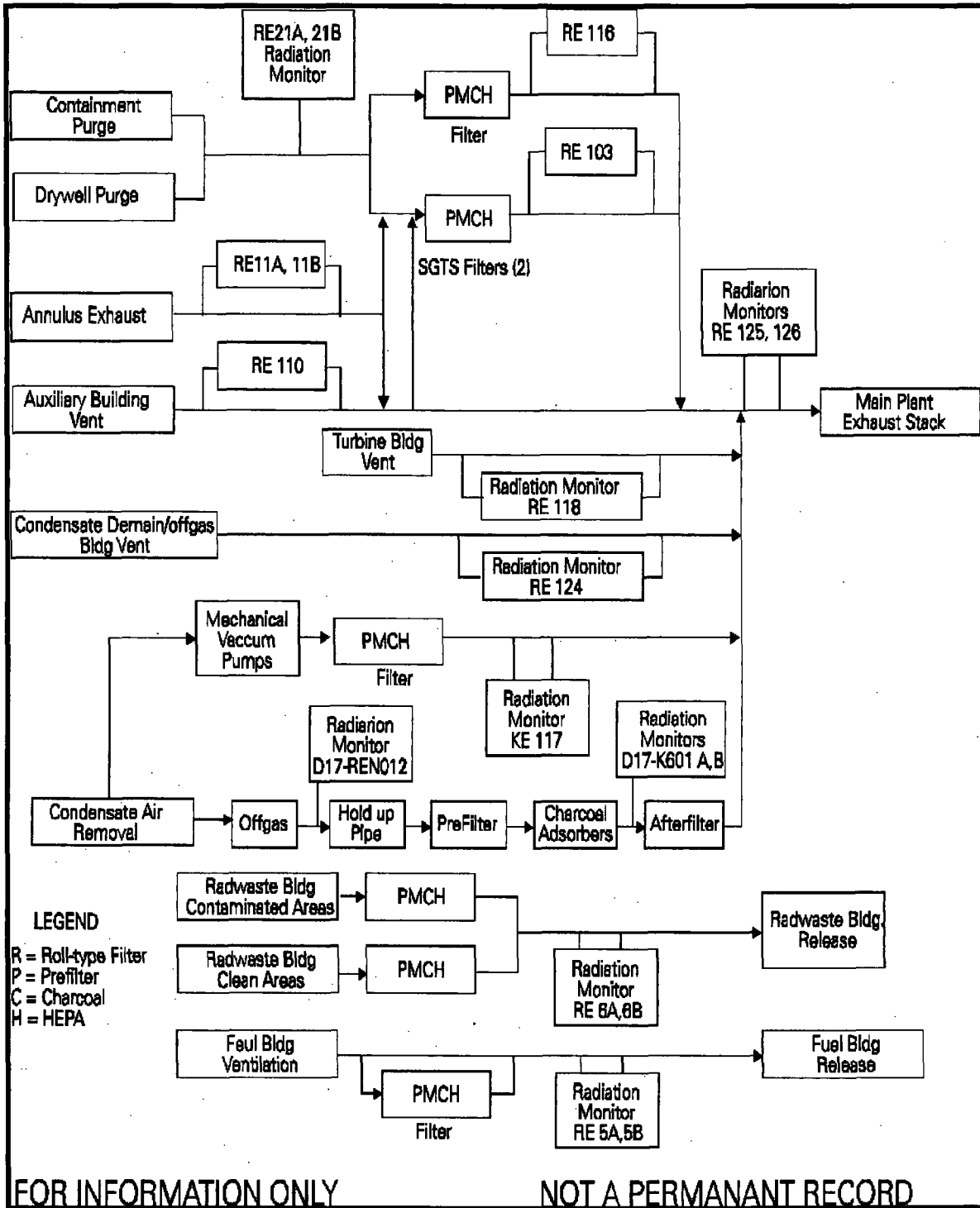


FIGURE 3: EFFLUENT RELEASE POINTS

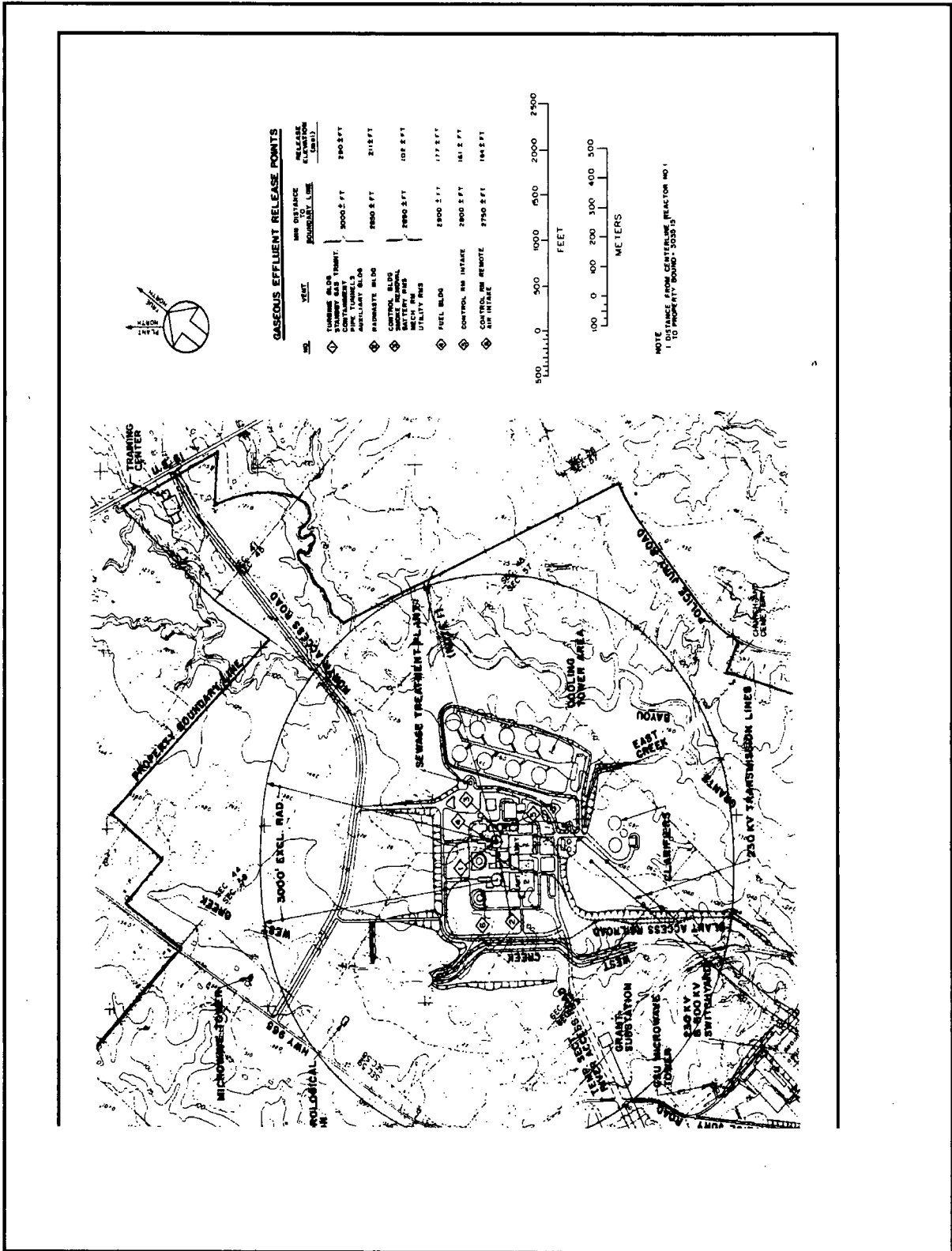


FIGURE 4: SCHEMATIC OF LIQUID RADWASTE SYSTEM

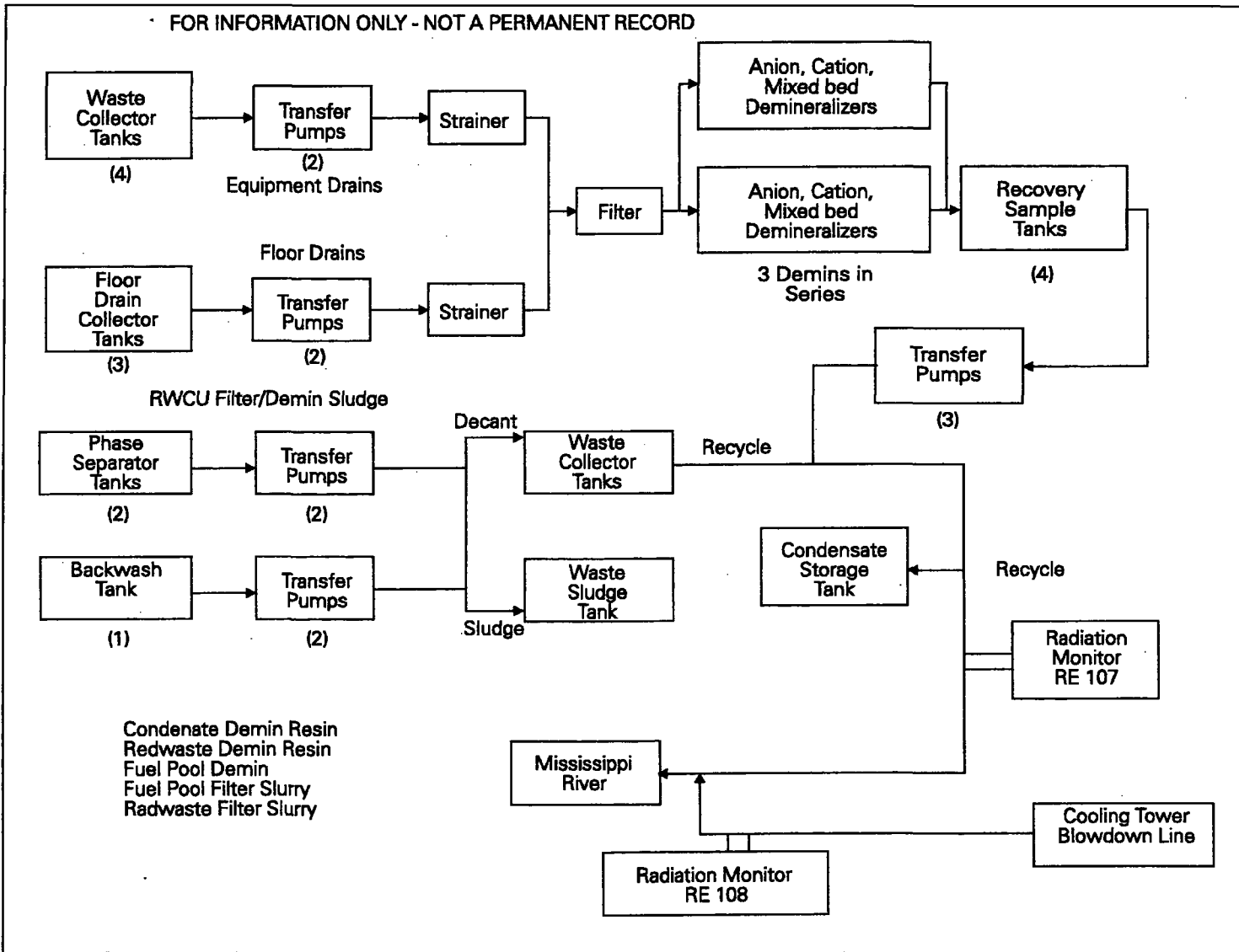


FIGURE 5: FAR-FIELD RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS

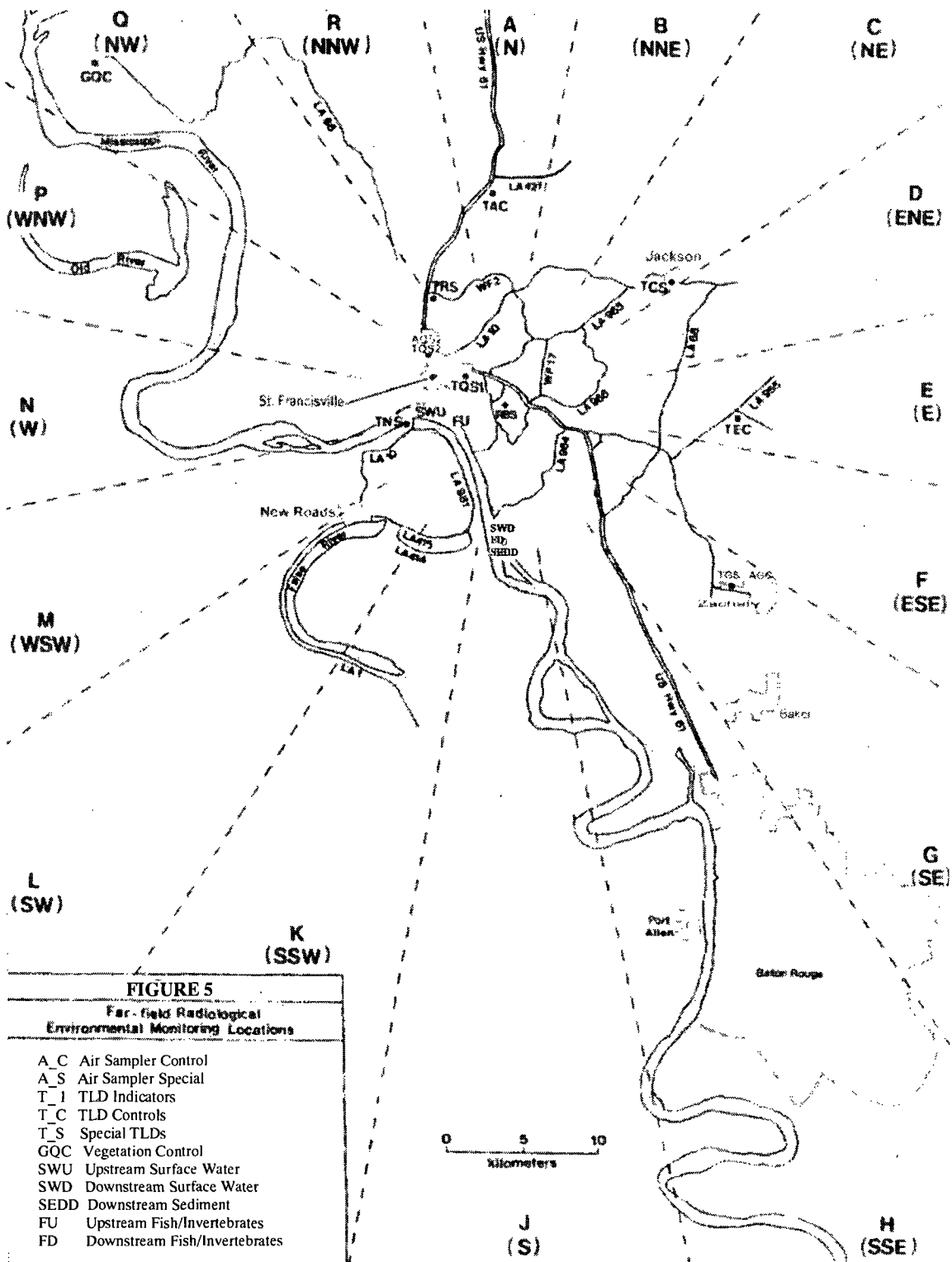
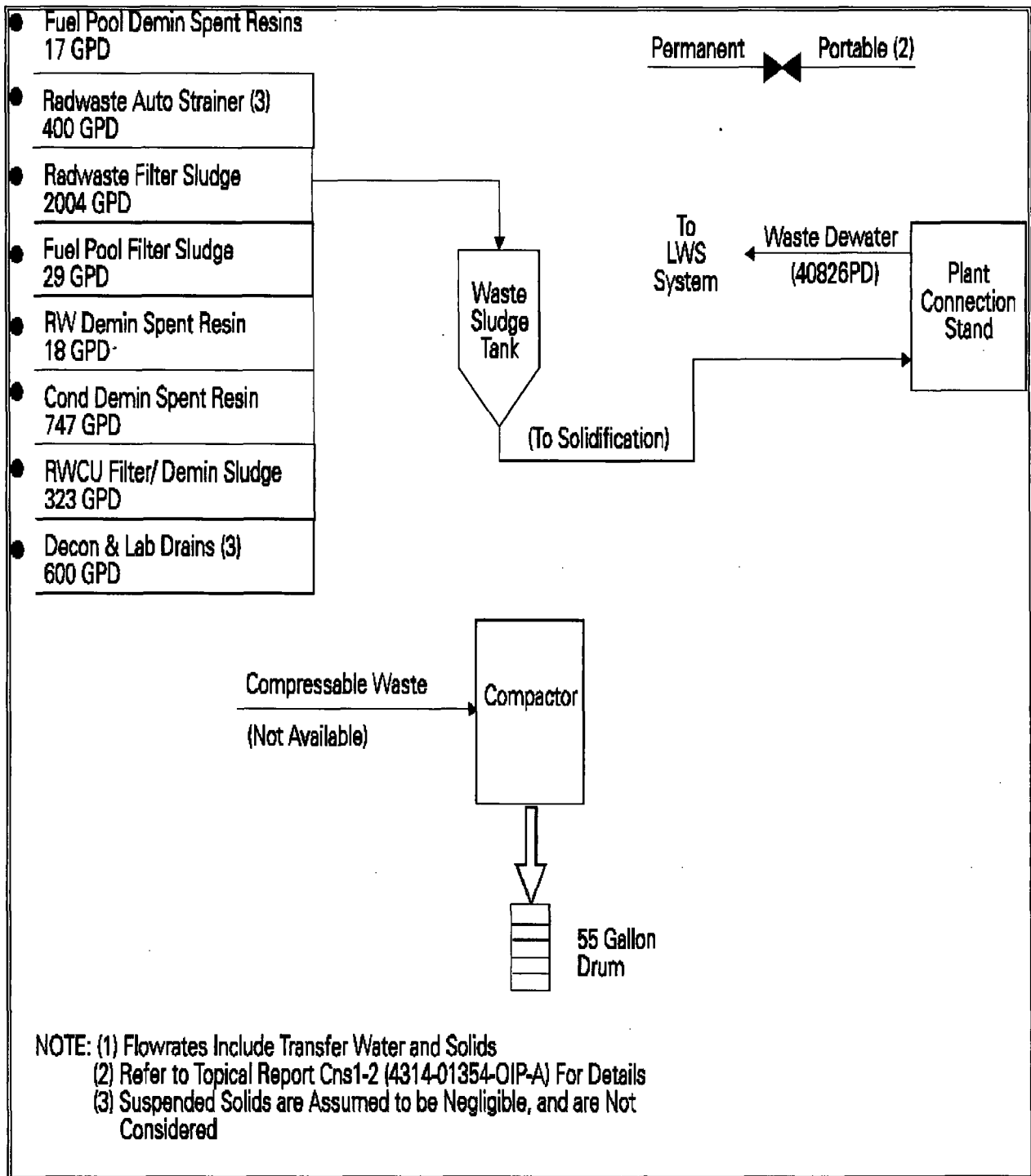




FIGURE 6: SCHEMATIC OF THE SOLID WASTE TREATMENT SYSTEM



**Attachment 2**  
**Process Applicability Program**

**PROCESS CONTROL PROGRAM**

**Procedure Contains NMM ECH eB REFLIB Forms:** YES  NO

<b>HQN Effective Date</b> 3/25/14	<b>Procedure Owner:</b> <b>Title:</b> <b>Site:</b>	Donnie Marvel Manager, RP ANO	<b>Governance Owner:</b> <b>Title:</b> <b>Site:</b>	David Moore Manager, Fleet RP HQN
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Site	Site Procedure Champion	Title
ANO	Donnie Marvel	Manager, RP
BRP	N/A	N/A
CNS	Bob Beilke	Manager, RP
GGNS	Roy Miller	Manager, RP
IPEC	Frank Mitchell	Manager, RP
JAF	Robert Brown	Manager, RP
PLP	Doug Watkins	Manager, RP
PNPS	Steven Brewer	Manager, RP
RBS	Jim Hogan	Manager, RP (acting)
VY	David Tkatch	Manager, RP
W3	Daniel Frey	Manager, RP
HQN	David Moore	Manager, Fleet RP

**For site implementation dates see ECH eB REFLIB using site tree view (Navigation panel).**

**Site and NMM Procedures Canceled or Superseded By This Revision**

None

**Process Applicability Exclusion:** All Sites:


Specific Sites: ANO  BRP  CNS  GGNS  IPEC  JAF  PLP  PNPS  RBS  VY  W3

**Change Statement**

Editorial revision to address the issue identified in CR-HQN-2013-00858, CA-02 (Develop a draft procedure that includes instructions for vendors processing waste still owned by Entergy to comply with the PCP program.)

Reworded Step 5.1[1](b) to improve clarity: inserted text "processed on-site OR off-site by vendors"

**Associated PRHQN #: PR-PRHQN-2014-00048**


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## 1.0 PURPOSE

The Process Control Program (PCP) requires formulas, sampling, analyses, test and determinations to be made to ensure that the processing and packing of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR Parts 20, 61 and 71, State Regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste. The scope of a PCP is to assure that radioactive waste will be handled, shipped, and disposed of in a safe manner in accordance with approved site or vendor procedures, whichever is applicable. **[GGNS UFSAR, Chapter 16B.1 / TRM – 7.6.3.8 paragraph 1]**

- 1.1 The purpose of this document is to provide a description of the solid radioactive waste Process Control Program (PCP) at all the Entergy fleet sites. The PCP describes the methods used for processing, classification and packaging low-level wet radioactive waste into a form acceptable for interim on-site storage, shipping and disposal, in accordance with 10 CFR Part 61 and current disposal site criteria.
- 1.2 To ensure the safe operation of the solid radwaste system, the solid radwaste system will be used in accordance with this Process Control Program to process radioactive wastes to meet interim on-site storage, shipping and burial ground requirements.
- 1.3 This document addresses the process control program in the context of disposal criteria, on-site processing and vendor processing requirements.
- 1.4 The Process Control Program implements the requirements of 10CFR50.36a and General Design Criteria 60 of Appendix A to 10CFR Part 50. The process parameters included in the Process Control Program may include but are not limited to waste type, waste pH, waste/liquid/solidification agent/catalyst ratios, waste oil content, waste principal chemical constituents, and mixing and curing times.
- 1.5 This document does NOT address the requirements for 10CFR Part 61.56 (waste characteristics) for material sent to intermediate processors, because the final treatment and packaging is performed at the vendor facilities.


## 2.0 REFERENCES

- [1] EN-QV-104, "Entergy Quality Assurance Program Manual Control"
- [2] Title 49, Code of Federal Regulations
- [3] Title 10, Code of Federal Regulations, Part 20

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2.0 continued

- [4] Title 10, Code of Federal Regulations, Part 61
- [5] Title 10, Code of Federal Regulations, Part 71, Appendix H **[QAPM, Section A.1.c]**
- [6] Low-Level Waste Licensing Branch Technical Position on Radioactive Waste Classification, 11 May 1983
- [7] Disposal Site Criteria and License
- [8] Waste Processor Acceptance Criteria
- [9] EN-LI-100, "Process Applicability Determination"
- [10] NRC Information and Enforcement Bulletins
  - NRC Information Notice 79-19: Packaging of Low-Level Radioactive Waste for Transport and Burial.
  - NRC Information Notice 80-24: Low-Level Radioactive Waste Burial Criteria.
  - NRC Information Notice 80-32: Clarification of Certain Requirements for Exclusive-Use Shipments of Radioactive Materials.
  - NRC Information Notice 80-32, Rev. 1: Clarification of Certain Requirements for Exclusive-Use Shipments of Radioactive Materials.
  - NRC Information Notice 83-05: Obtaining Approval for Disposing of Very-Low-Level Radioactive Waste - 10CFR Section 20.302.
  - NRC Information Notice 83-10: Clarification of Several Aspects Relating to Use of NRC-Certified Transport Packages.
  - NRC Information Notice 83-33: Non-Representative Sampling of Contaminated Oil.
  - NRC Information Notice 84-50: Clarification of Scope of Quality Assurance Programs for Transport Packages Pursuant to 10CFR 50 Appendix B.
  - NRC Information Notice 84-72: Clarification of Conditions for Waste Shipments Subject to Hydrogen Gas Generation.
  - NRC Information Notice 85-92: Surveys of Wastes Before Disposal from Nuclear Reactor Facilities.
  - NRC Information Notice 86-20: Low-Level Radioactive Waste Scaling Factors, 10CFR 61.
  - NRC Information Notice 86-90: Requests to Dispose of Very Low-Level Radioactive Waste Pursuant 10CFR 20.302

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2.0[10], continued


- NRC Information Notice 87-03: Segregation of Hazardous and Low-Level Radioactive Wastes
  - NRC Information Notice 87-07: Quality Control of On-Site Dewatering/ Solidification Operations by Outside Contractors
- [11] NRC Information and Enforcement Bulletins (continued)
- NRC Information Notice 89-27: Limitations on the Use of Waste Forms and High Integrity Containers for the Disposal of Low-Level Radioactive Waste
  - NRC Information Notice 92-62: Emergency Response Information Requirements for Radioactive Material Shipments
  - NRC Information Notice 92-72: Employee Training and Shipper Registration Requirements for Transporting Radioactive Materials
  - NRC Generic Letter 89-01, "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program".
- [12] Nureg-0800 Standard Review Plan Section 11.4 Revision 2, Solid Waste Management Systems.
- [13] NRC Waste Form Technical Position, Revision 1 Jan 24 1991.
- [14] NRC SECY 94-198 Review of Existing Guidance Concerning the Extended Storage of Low-Level Radioactive Waste.
- [15] EPRI TR-106925 Rev-1, Interim On-Site Storage of Low Level Waste: Guidelines for Extended Storage - October 1996
- [16] NRC Branch Technical Position On Concentration Averaging And Encapsulation Jan 17 1995
- [17] Commitment Documents (U-2 and U-3)
- IPN-99-079, "Supplement to Proposed Changes to Technical Specifications Incorporating Recommendations of Generic Letter 89-01 and the Revised 10 CFR Part 20 and 10 CFR Part 50.36a.
  - Appendix B Technical Specifications, Section 4.5 [IP, RECS ODCM Part 1]

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### 3.0 **DEFINITIONS**


- [1] **Batch** – A quantity of waste to be processed having essentially consistent physical and chemical characteristics as determined through past experience or system operation knowledge by the Radwaste Shipping Specialist. A batch could be a waste tank, several waste tanks grouped together or a designated time period such as between outages as with the DAW waste stream. An isolated quantity of feed waste to be processed having essentially constant physical and chemical characteristics. (The addition or removal of water will not be considered to create a new batch).
- [2] **Certificate of Compliance** - Document issued by the USNRC regulating use of a NRC licensed cask or issued by (SCDHEC) South Carolina Department of Health and Environmental Conservation regulating a High Integrity Container.
- [3] **Chelating Agents** - EDTA, DTPA, hydroxy-carboxylic acids, citric acid, carboic acid and glucinic acid.
- [4] **Compaction** - The process of volume reducing solid waste by applying external pressure.
- [5] **Confirmatory Analysis** - The practice of verifying that gross radioactivity measurements using MCA are reasonably consistent with independent laboratory sample data.
- [6] **Dewatered Waste** - Wet waste that has been processed by means other than solidification, encapsulation, or absorption to meet the free standing liquid requirements of 10CFR Part 61.56 (a)(3) and (b)(2).
- [7] **De-watering** - The removal of water or liquid from a waste form, usually by gravity or pumping.
- [8] **Dilution Factor** - The RADMAN computer code factor to account for the non-radioactive binder added to the waste stream in the final product when waste is solidified.
- [9] **Dry Waste** - Radioactive waste which exist primarily in a non-liquid form and includes such items as dry materials, metals, resins, filter media and sludges.
- [10] **Encapsulation** - Encapsulation is a means of providing stability for certain types of waste by surrounding the waste by an appropriate encapsulation media.
- [11] **Gamma-Spectral-Analysis** - Also known as IG, MCA, Ge/Li and gamma spectroscopy.
- [12] **Gross Radioactivity Measurements** - More commonly known as dose to curie conversion for packaged waste characterization and classification.



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- [13] **Homogeneous** - Of the same kind or nature; essentially alike. Most Volumetric waste streams are considered homogeneous for purposes of waste classification.
- [14] **Incineration** – The process of burning a combustible material to reduce its volume and yield an ash residue.
- [15] **Liquid Waste** - Radioactive waste that exist primarily in a liquid form and is contained in other than installed plant systems, to include such items as oil, EHC fluid, and other liquids. This waste is normally processed off-site.
- [16] **Low-Level Radioactive Waste (LLW)** - Those wastes containing source, special nuclear, or by-product material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste has the same meaning as in the Low-Level Waste Policy Act, that is, radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or by-product material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).
- [17] **Measurement of Specific Radionuclides** - More commonly known as direct sample or container sample using MCA data for packaged waste characterization and classification.
- [18] **Operable** - A system, subsystem, train, component or device SHALL be OPERABLE or have OPERABILITY when it is capable of performing its specified functions(s), and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).
- [19] **Prequalification Program** - The testing program implemented to demonstrate that the proposed method of wet waste processing will result in a waste form acceptable to the land disposal facility and the NRC.
- [20] **Processing** - Changing, modifying, and/or packaging radioactive waste into a form that is acceptable to a disposal facility.
- [21] **Quality Assurance/Quality Control** - As used in this document, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material structure, component, or system to predetermined requirements.

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- [22] **Reportable Quantity Radionuclides (RQ)** - Any radionuclide listed in column (1) of Table 2 of 49CFR Part 172.101 which is present in quantities as listed in column (3) of Table 2 of 49CFR Part 172.101.
- [23] **Sampling Plan** - A program to ensure that representative samples from the feed waste and the final waste form are obtained and tested for conformance with parameters stated in the PCP and waste form acceptance criteria.
- [24] **Scaling Factor** - A dimensionless number which relates the concentration of an easy to measure radionuclide (gamma emitter) to one which is difficult to measure (beta and/or alpha emitters).
- [25] **Significant Quantity** - For purposes of waste classification all the following radionuclide values SHALL be considered significant and must be reported on the disposal manifest.
- Any value (real or LLD) for radionuclides listed in Appendix G to 10CFR20 (H-3, C-14, I-129, Tc-99).
  - Greater than or equal to 1 percent of the concentration limits as listed in 10CFR Part 61.55 Table 1.
  - Greater than or equal to 1 percent of the Class A concentration limits listed in 10CFR Part 61.55 Table 2.
  - Greater than or equal to 1 percent of the total activity.
  - Greater than or equal to 1 percent of the Reportable Quantity limits listed on 49CFR Part 172.101 Table 2.
- [26] **Solidification** - The conversion of wet waste into a free-standing monolith by the addition of an agent so that the waste meets the stability and free-standing liquid requirements of the disposal site.
- [27] **Special Radionuclides** - The RADMAN computer code term for radionuclides listed in Appendix G to 10CFR20 (i.e., H-3, C-14, I-129 & Tc-99)
- [28] **Stability** – Structural stability per 10CFR61.2, Waste Form Technical Position, and Waste Form Technical Position Revision 1. This can be provided by the waste form, or by placing the waste in a disposal container or structure that provides stability after disposal. Stability requires that the waste form maintain its structural integrity under the expected disposal conditions.


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- [29] **Training** - A systematic program that ensures a person has knowledge of hazardous materials and hazardous materials regulations.
- [30] **Type A Package** - Is the packaging together with its radioactive contents limited to A1 or A2 as appropriate that meets the requirements of 49CFR Part 173.410 and Part 173.412, and is designed to retain the integrity of containment and shielding under normal conditions of transport as demonstrated by the tests set forth in 49CFR Part 173.465 or Part 173.466 as appropriate.
- [31] **Type B Package** - Is the packaging together with its radioactive contents that is designed to retain the integrity of containment and shielding when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10CFR Part 71.
- [32] **Volume Reduction** – any process that reduces the volume of waste. This includes but is not limited to, compaction and incineration.
- [33] **Waste Container** - A vessel of any shape, size, and composition used to contain the waste media.
- [34] **Waste Form** - Waste in a waste container acceptable for disposal at a licensed disposal facility.
- [35] **Waste Stream** - A Plant specific and constant source of waste with a distinct radionuclide content and distribution.
- [36] **Waste Type** – A single packaging configuration and waste form tied to a specific waste stream.

#### 4.0 **RESPONSIBILITIES**

- [1] The **Vice President Operations Support (VPOS)** is responsible for the implementation of this procedure.
- [2] Each site **Senior Nuclear Executive (SNE)** is responsible for ensuring that necessary site staff implements this procedure.
- [3] The **Low Level RadWaste (LLRW) Focus Group** is responsible for evaluating and recommending changes and revisions to this procedure.

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- [4] Each site **RP Department – Radwaste Supervisor / Specialist** (title may vary at the site's respectively) has the overall responsibility for implementing the PCP and is responsible for processing and transportation is tasked with the day-to-day responsibilities for the following:
- Implementing the requirements of this document.
  - Ensuring that radioactive waste is characterized and classified in accordance with 10CFR Part 61.55 and Part 61.56.
  - Ensuring that radioactive waste is characterized and classified in accordance with volume reduction facility and disposal site licenses and other requirements.
  - Designating other approved procedures (if required) to be implemented in the packaging of any specific batch of waste.
  - Providing a designated regulatory point of contact between the Plant and the NRC, volume reduction facility or disposal site.
  - Maintaining records of on-site and off-site waste stream sample analysis and Plant evaluations.
  - Suspending shipments of defectively processed or defectively packaged radioactive wastes from the site when the provisions of this process control program are not satisfied.


## 5.0 **DETAILS**

An isotopic analysis SHALL be performed on every batch for each waste stream so that the waste can be classified in accordance with 10CFR61. The isotopic and curie content of each shipping container SHALL be determined in accordance with 49CFR packaging requirements. The total activity in the container may be determined by either isotopic analysis or by dose-rate-to-curie conversion.

### 5.1. **Precautions and Limitations**

#### [1] **Precautions**

- (a) Radioactive materials SHALL be handled in accordance with applicable radiation protection procedures.
- (b) All radioactive waste processed on-site **OR** off-site by vendors must be processed or packaged to meet the minimum requirements listed in 10CFR Part 61.56 (a) (1) through (8).

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- (c) If the provisions of the Process Control Program are not satisfied, suspend shipment of the defectively processed or defectively packaged waste from the site. Shipment may be accomplished when the waste is processed / packaged in accordance with the Process Control Program.
- (d) The generation of combustible gases is dependent on the waste form, radioactive concentration and accumulated dose in the waste. Changes to organic inputs (e.g. oil) to waste stream may change biogas generation rates.


[2] Limitations

- (a) Only qualified personnel will characterize OR package radioactive waste OR radioactive materials for transportation or disposal.
- (b) All site personnel that have any involvement with radioactive waste management computer software **SHALL** be familiar with its functions, operation and maintenance.

**5.2. Waste Management Practices**

[1] Waste processing methods include the following:

- (a) Present and planned practice is NOT to solidify or encapsulate any waste streams.
- (b) Waste being shipped directly for burial in a HIC (High Integrity Container) is dewatered to less than 1 percent by volume prior to shipment.
- (c) Waste being shipped directly for burial in a container other than a HIC is dewatered to less than 0.5 percent by volume prior to shipment.
- (d) IF solidification is required in the future, THEN at least one representative test specimen from at least every 10th batch of each type of radioactive waste will be checked to verify solidification.
  - (1) IF any specimen fails to verify solidification, THEN the solidification of the batch under test **SHALL** be suspended until such time as additional test specimens can be obtained, alternative solidification parameters can be determined, and a subsequent test verifies solidification. If alternative parameters are determined, the subsequent tests shall be verified using the alternative parameters determined.

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- (2) IF the initial test specimen from a batch of waste fails to verify solidification, THEN provide for the collection and testing of representative test specimens from each consecutive batch of the same type of waste until at least 3 consecutive initial test specimens demonstrates solidification. The process SHALL be modified as required to assure solidification of subsequent batches of waste.

[2] Operation and maintenance of dewatering systems and equipment include the following:


- (a) Present and planned practice is to utilize plant personnel supplemented by vendor personnel or contracted vendor personnel, to operate AND maintain dewatering systems and equipment (as needed to meet disposal site requirements).
- (b) All disposal liners are manufactured by and purchased from QA-approved vendors.

[3] ALARA considerations are addressed in all phases of the processes involving handling, packaging AND transfer of any type OR form of radioactive waste (dewatered or dry). Resin, charcoal media, spent filter cartridges AND sludges are typically processed within shields. Sluiceable demineralizers are shielded when in service. Radiation exposure and other health physics requirements are controlled by the issuance of a Radiation Work Permit (RWP) for each task.

### 5.3. Waste Stream Sampling Methods and Frequency

[1] The following general requirements apply to Plant waste stream sampling:

- (a) Treat each waste stream separately for classification purposes.
- (b) Ensure samples are representative of or can be correlated to the final waste form.
- (c) Determine the density for each new waste stream initially or as needed (not applicable for DAW and filters).
- (d) Perform an in-house analysis for gamma-emitting radionuclides for each sample sent to an independent laboratory.
- (e) Periodically perform in-house analysis for gamma emitting radionuclides for comparison to the current data base values for gamma emitters. (The current database is usually based on the most recent independent laboratory results.)
- (f) Resolve any discrepancies between in-house results AND the independent laboratory results for the same or replicate sample as soon as possible.
- (g) Maintain records of on-site and off-site waste stream sample analysis and evaluations.

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- [2] When required, waste stream samples should be analyzed, re-evaluated and if necessary, shipped to a vendor laboratory for additional analysis. The same is true when there is a reason to believe that an equipment or process change has significantly altered the previously determined scaling factors by a factor of 10.

Specific examples include but are not limited to:

- Changes in oxidation reduction methods such as zinc, injection, hydrogen water chemistry,
- Changes in purification methods including media specialization, media distribution, ion/cation ratios,
- Changes in fuel performance criteria including fuel leaks
- Other changes in reactor coolant chemistry.
- Sustained, unexplained, changes in the routinely monitored Beta/Alpha ratios, as determined by Radiation Protection,
- When there is an extended reactor shutdown (> 90 days).
- When there are changes to liquid waste processing, such as bypassing filters, utilizing filters or a change in ion exchange media.
- When there are changes to the waste stream that could change the biogas generation rate.


- [3] The following requirements apply to infrequent or abnormal waste types:
- (a) Infrequent OR abnormal waste types that may be generated must be evaluated on a case-by-case basis.
  - (b) The RP Department Supervisor / Specialist responsible for processing AND shipping will determine if the waste can be correlated to an existing waste stream.
  - (c) IF the radioactive waste cannot be correlated to an existing waste stream, THEN the RP Department Supervisor / Specialist responsible for processing and shipping SHALL determine specific off-site sampling and analysis requirements necessary to properly classify the material.
- [4] Specific sampling methods and data evaluation criteria are detailed in EN-RW-104 for specific waste streams.

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#### 5.4. Waste Classification

- [1] General requirements for scaling factors include the following:
- (a) The Plant has established an inferential measurement program whereby concentrations of radionuclides which cannot be readily measured are estimated through ratio-ing with radionuclides which can be readily measured.
  - (b) Scaling factor relationships are developed on a waste stream-specific basis. These relationships are periodically revised to reflect current independent lab data from direct measurement of samples. The scaling factor relationships currently used by the sites are as follows:
    - Hard to detect ACTIVATION product radionuclides and C-14 are estimated by using scaling factors with measured Co-60 activities.
    - Hard to detect FISSION product radionuclides and H-3, Tc-99 and I-129 are estimated by using scaling factors with measured Cs-137 activities.
    - Hard to detect TRANSURANIC radionuclides are estimated by using scaling factors with measured Ce-144 activities. Where Ce-144 cannot be readily measured, transuranics are estimated by using scaling factors with measured Cs-137 activities. Second order scaling of transuranics is acceptable when Cs-137 and Ce-144 are not readily measurable.
- [2] General requirements for the determination of total activity and radionuclide concentrations include the following:
- (a) The activity for the waste streams is estimated by using either Gross Radioactivity Measurement OR Direct Measurement of Radionuclides. Current specific practices are as follows:
    - DAW - Gross radioactivity measurement in conjunction with the RADMAN computer codes, other approved computer codes or hand calculation.
    - Filters - Gross radioactivity measurement in conjunction with the FILTRK computer code, other approved computer codes or hand calculation.
    - All Other Waste Streams - Direct measurement of radionuclides in conjunction with the RADMAN computer codes, other approved computer codes or hand calculation.
  - (b) Determination of the NRC waste classification is performed by comparing the measured or calculated concentrations of significant radionuclides in the final waste form to those listed in 10CFR Part 61.55.




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### 5.5. Quality Control

- [1] The RADMAN computer code provides a mechanism to assist the Plant in conducting a quality control program in accordance with the waste classification requirements listed in 10CFR Part 61.55. All waste stream sample data changes are written to a computer data file for future review and reference.
- [2] Audits and Management Review includes the following:
- (a) Appendix G to 10CFR20 requires conduct of a QC program which must include management review of audits.
  - (b) Management audits of the Plant Sampling and Classification Program SHALL be periodically performed to verify the adequacy of maintenance sampling and analysis.
  - (c) Audits and assessments are performed and documented by any of the following:
    - Radiation Protection Department
    - Quality Assurance Department
    - Qualified Vendors
  - (d) Certain elements of the Entergy Quality Assurance Program Manual are applied to the Process Control Program. **[QAPM, Section A.1.c]**

### 5.6. Dewatering Operations

- [1] Processing requirements during dewatering operations include the following:
- (a) All dewatering operations are performed per approved Plant or vendor operating procedures and instructions.
  - (b) Dewatering limitations and capabilities are verified by vendor Topical Reports or Operating and Testing Procedures.
- [2] Dewatered resin activity limitations include the following:
- (a) Dewatered resins will not be shipped off-site that have activities which will produce greater than 1.0E+8 rads total accumulated dose over 300 years. This is usually verified by comparing the container specific activity at the time of shipment to the following concentration limits for radionuclides with a half-life greater than five years:
    - 10 Ci (0.37 TBq) per cubic foot.
    - 350 uCi (12.95 MBq) per cubic centimeter


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### 5.7. Waste Packaging

Waste in final form will be packaged in accordance with Title 10 and Title 49 of the Code of federal regulations and in accordance with current burial site criteria as is detailed in EN-RW-102.

### 5.8. Administrative Controls

- [1] Information on solid radioactive waste shipped off-site is reported annually to the Nuclear Regulatory Commission in the Annual Radioactive Effluent Release Report as specified by the Offsite Dose Calculation Manual (ODCM) or Technical Specification. **[ANO1 Technical Specifications - 5.6.3] [ANO2 Technical Specifications – 6.6.3] [WF3 Technical Specifications – 6.9.18] [GGNS ODCM – 5.6.3.c] [JAF Technical Specifications – 5.6.3] [PLP ODCM, Appendix A – IV. A].**
- [2] All changes to the PCP SHALL be documented. All records of reviews performed SHALL be retained as required by the Quality Assurance Program. The documentation of the changes **SHALL [GGNS UFSAR, Chapter 16B.1 / TRM – 7.6.3.8 paragraph 2]:**
  - (a) Contain sufficient information to support the change with appropriate analyses or evaluations justifying the change.
  - (b) Include a determination that the change will maintain the overall conformance of the solidified waste product (if applicable) to existing requirements of Federal, State or other applicable regulations.
- [3] All changes in the Process Control Program and supporting documentation are included in each site's next Annual Radiological Effluent Release Report to the Nuclear Regulatory Commission. **[ANO ODCM - L3.2.1.C] [VTY TRM 6.12]**
- [4] The changes to EN-RW-105 SHALL become effective upon review and acceptance by the site's General Plant Manager (equivalent title at Palisades is Plant Superintendent) except as listed below:
  - (a) For Grand Gulf Nuclear Station, the changes to RW-105 SHALL be accomplished as specified in Grand Gulf Nuclear Station Technical Requirements Manual (TRM) Section 7.6.3.8. The changes SHALL become effective upon review and acceptance by the On-site Safety Review Committee (OSRC) and the approval of the GGNS Plant General Manager. **[GGNS UFSAR, Chapter 16B.1 / TRM – 7.6.3.8 paragraph 2]**


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- (b) For River Bend Nuclear Station, the procedure approval along with changes to RW-105 SHALL be accomplished per the River Bend Nuclear Station Technical Requirements, Section 5.5.14.1. The changes SHALL become effective upon review and acceptance by approval from the River Bend Nuclear Station Plant Manager or Radiation Protection Manager. **[RBS Technical Requirements – 5.5.14.1, 5.5.14.2 & 5.8.2]**
- (c) For Waterford 3, the procedure approval along with changes to RW-105 SHALL be accomplished per Waterford 3 Technical Specifications 6.13.2. The changes SHALL become effective upon review and acceptance by the Waterford 3 General Plant Manager. **[WF3 Technical Specifications – 6.13.2.b]**
- (d) For James A. FitzPatrick Nuclear Station, the procedure approval along with changes to EN-RW-105 SHALL be accomplished per the James A. FitzPatrick Station Technical Specifications, Section 5.6.3. The changes SHALL become effective upon review and acceptance through approval from the James A. FitzPatrick Nuclear Station On-Site Safety Review Committee. **[JAF UFSAR, Chapter 11.3.5]**
- (e) For Vermont Yankee, Changes to the Process Control Program SHALL become effective after review and acceptance by the (OSRC) On-Site Safety Review Committee and the Site VP.
- (f) For IPEC, Changes to the Process Control Program SHALL become effective after final review and acceptance by the On-Site Safety Review Committee (OSRC).

### 5.9. Vendor Requirements

- [1] Vendors performing radwaste services under 10CFR61 and 10CFR71 requirements will be on the Entergy Qualified Supplier's List (QSL). **[QAPM, Section A.1.c]**
- [2] Vendors performing radwaste services on-site are to comply with the following:
  - (a) Dewatering and solidification services SHALL have a NRC-approved Topical Report or other form of certification documenting NRC approval of the processes and associated equipment/containers.
  - (b) All vendor procedures utilized for performing on-site radwaste processing services (to assure compliance with 10 CFR Parts 20, 61 and 71, State Regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste) will be reviewed per the requirements of EN-LI-100, technically by the applicable site's Radiation Protection organization and only be accepted per the approvals specified in Section 5.8 [4].

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- (c) All changes to vendor procedures for ongoing on-site radwaste services will be reviewed technically by the site's Radiation Protection organization and screened per the requirements of EN-LI-100. Significant procedural changes will require the approvals specified in Section 5.8 [4]. During screening, the level of significance for procedural changes on equipment and process parameters may warrant the full 10CFR50.59 documentation and approval process.
- (d) Plant management SHALL review vendor(s) topical reports and test procedures per applicable requirements in Section 5.8.

**NOTE**

The PCP does not have to include the vendor's Topical Report if it has NRC approval, or has been previously submitted to the NRC.

- (e) Plant management review will assure that the vendor's operations and requirements are compatible with the responsibilities and operation of the Plant.
- (f) Training requirements and records listed in Section 5.10 also apply to contracted vendors.

**5.10. Miscellaneous**

[1] Special tools and equipment


- (a) Frequency of Use and Descriptions

Required tools and equipment will vary depending on the specific process and waste container that is used. The various tools and equipment which may be required are detailed in specific procedures developed to govern activities described in this document.

[2] Pre-requisites

- (a) Maintenance of Regulatory Material

Ensure that a current set of DOT, NRC, EPA and applicable State regulations, vendor processing facility and disposal site regulations and requirements are maintained at the site and are readily available for reference. The use of web based regulations is acceptable.

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(b) Representative Radionuclide Sample Data

Ensure that representative radionuclide sample data is on file for each active waste stream. Unless operation conditions or changes in processing methods require increased sample frequency, data is considered to be current if it meets the requirements of EN-RW-104.

(c) Initial and Cyclic Training


- A training program SHALL be developed, implemented and maintained for all personnel involved in processing, packaging, handling and transportation of radioactive waste to ensure radwaste operations are performed within the requirements of NRC Information Bulletin 79-19 and 49CFR Part 172.700 through Part 172.704.
- Training requirements and documentation also apply to contracted on-site vendors.

**NOTE**

Cyclic training is defined as within three years for DOT, and two years for IATA

(d) Specific employee training is required for each person who performs the following job functions [172.702(b)].

- Classifies hazardous materials.
- Packages hazardous materials.
- Fills, loads and/or closes packages.
- Marks and labels packages containing hazardous materials.
- Prepares shipping papers for hazardous materials.
- Offers or accepts hazardous materials for transportation.
- Handles hazardous materials.
- Marks or placards transport vehicles.
- Operates transport vehicles.
- Works in a transportation facility and performs functions in proximity to hazardous materials which are to be transported.
- Inspects or tests packages.

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- (e) Cyclic training is defined as within three years for DOT & within two years for IATA.

Copies of training records are required for as long as a person is employed and 90 days thereafter. The records should include, as a minimum, the following:


- Trainee's name and signature
- Training dates
- Training material or source reference
- Trainer's information

## 6.0 INTERFACES

- [1] EN-LI-100, "Process Applicability Determination"
- [2] EN-RW-104, "Scaling Factors"
- [3] EN-QV-104, "Entergy Quality Assurance Program Manual Control"

## 7.0 RECORDS

- [1] Documentation of pertinent data required to classify waste and verify solidification will be maintained on each batch of processed waste as required by approved procedures.
- [2] Documentation will also be maintained to ensure that containers, shipping casks, and methods of packaging wastes meet applicable Federal regulations and disposal site criteria. The records of reviews performed and documents associated with these reviews will be maintained as QA records.

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## 8.0 SITE SPECIFIC COMMITMENTS

Document	Document Section	NMM Procedure Section	Site Applicability
ANO ODCM	L3.2.1.C	5.8 [3]	ANO
ANO1 Technical Specifications	5.6.3	5.8 [1]	ANO
ANO2 Technical Specifications	6.6.3	5.8 [1]	ANO
RBS Technical Requirements	5.5.14	*	RBS
RBS Technical Requirements	5.5.14.1	5.8 [3] 5.8 [4] (b)	RBS
RBS Technical Requirements	5.5.14.2	5.8 [4] (b)	RBS
RBS Technical Requirements	5.8.2	5.8 [4] (b)	RBS
WF3 Technical Specifications	1.22	*	WF3
WF3 Technical Specifications	6.9.18	5.8 [1]	WF3
WF3 Technical Specifications	6.13.2.b	5.8 [4] (c)	WF3
JAF ODCM	6.2.1	5.8 [1]	JAF
JAF Technical Specifications	5.6.3	5.8 [1], 5.8 [4]	JAF
JAF FSAR	Chapters 7 and 11	5.8 [4]	JAF
11759 – NRC IN 79-19	All	*	WF3
GGNS UFSAR, Chapter 16B.1 / TRM	7.6.3.8 paragraph 1	1.0	GGNS
GGNS ODCM	5.6.3.c	5.8 [1]	GGNS
GGNS FSAR	11.4.5.S2	5.9 [2](a)	GGNS
GGNS FSAR	11.4.2.3AS7	5.9 [2](a)	GGNS
IPN-99-079	All	*	IPEC
Appendix B Technical Specifications	Section 4.5, RECS ODCM Part 1	*	IPEC
PLP Technical Specifications	5.5.15	5.8 [4]	PLP
PLP ODCM	Appendix A – IV. A	5.8 [1]	PLP
NRC Letter 1.98.091	All	*	PNPS
NRC Letter 1.88.078	All	*	PNPS
VY Technical Specifications	6.4.H	*	VY
VY ODCM	10.1	5.8 [1]	VY
VY TRM	6.12	5.8 (3)	VY
QAPM	Section A.1.c	*	All

\* Covered by directive as a whole or by various paragraphs of the directive.

## 9.0 ATTACHMENTS

None

**PROCESS CONTROL PROGRAM**

Procedure Contains NMM REFLIB Forms: YES  NO

Effective Date <b>04/02/2013</b>	Procedure Owner: Title: Site:	Mark L. Carver Manager, Fleet Radwaste HQN	Governance Owner: Title: Site:	Mark L. Carver Manager, Fleet Radwaste HQN
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Exception Date*	Site	Site Procedure Champion	Title
	ANO	S Donnie Marvel	Manager, RP
N/A	BRP	N/A	N/A
N/A	CNS	N/A	N/A
	GGNS	Roy Miller	Manager, RP
	IPEC	Reid Tagliamonte	Manager, RP
	JAF	Eric Wolf	Manager, RP
	PLP	Chuck Sherman	Manager, RP
	PNPS	Steve Brewer	Manager, RP
	RBS	Eric Neal	Manager, RP
	VY	David Tkatch	Manager, RP
	W3	Dan Frey	Manager, RP
N/A	NP	N/A	N/A
N/A	HQN	Mark L. Carver	Manager, Fleet Radwaste

Site and NMM Procedures Canceled or Superseded By This Revision  
None

Process Applicability Exclusion All Sites:


Specific Sites: ANO  BRP  GGNS  IPEC  JAF  PLP  PNPS  RBS  VY  W3  NP

Change Statement

- Editorial Change –
  - Updated step 5.8.4 to allow an equivalency in title for “General Plant Manager and Plant Superintendent” at Palisades

\* No exception dates required for this revision




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## 1.0 PURPOSE

The Process Control Program (PCP) requires formulas, sampling, analyses, test and determinations to be made to ensure that the processing and packing of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR Parts 20, 61 and 71, State Regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste. The scope of a PCP is to assure that radioactive waste will be handled, shipped, and disposed of in a safe manner in accordance with approved site or vendor procedures, whichever is applicable. **[GGNS UFSAR, Chapter 16B.1 / TRM – 7.6.3.8 paragraph 1]**

- 1.1 The purpose of this document is to provide a description of the solid radioactive waste Process Control Program (PCP) at all the Entergy fleet sites. The PCP describes the methods used for processing, classification and packaging low-level wet radioactive waste into a form acceptable for interim on-site storage, shipping and disposal, in accordance with 10 CFR Part 61 and current disposal site criteria.
- 1.2 To ensure the safe operation of the solid radwaste system, the solid radwaste system will be used in accordance with this Process Control Program to process radioactive wastes to meet interim on-site storage, shipping and burial ground requirements.
- 1.3 This document addresses the process control program in the context of disposal criteria, on-site processing and vendor processing requirements.
- 1.4 The Process Control Program implements the requirements of 10CFR50.36a and General Design Criteria 60 of Appendix A to 10CFR Part 50. The process parameters included in the Process Control Program may include but are not limited to waste type, waste pH, waste/liquid/solidification agent/catalyst ratios, waste oil content, waste principal chemical constituents, and mixing and curing times.
- 1.5 This document does NOT address the requirements for 10CFR Part 61.56 (waste characteristics) for material sent to intermediate processors, because the final treatment and packaging is performed at the vendor facilities.


## 2.0 REFERENCES

- [1] EN-QV-104, "Entergy Quality Assurance Program Manual Control"
- [2] Title 49, Code of Federal Regulations
- [3] Title 10, Code of Federal Regulations, Part 20

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- [4] Title 10, Code of Federal Regulations, Part 61
- [5] Title 10, Code of Federal Regulations, Part 71, Appendix H **[QAPM, Section A.1.c]**
- [6] Low-Level Waste Licensing Branch Technical Position on Radioactive Waste Classification, 11 May 1983
- [7] Disposal Site Criteria and License
- [8] Waste Processor Acceptance Criteria
- [9] EN-LI-100, "Process Applicability Determination"
- [10] NRC Information and Enforcement Bulletins
  - NRC Information Notice 79-19: Packaging of Low-Level Radioactive Waste for Transport and Burial.
  - NRC Information Notice 80-24: Low-Level Radioactive Waste Burial Criteria.
  - NRC Information Notice 80-32: Clarification of Certain Requirements for Exclusive-Use Shipments of Radioactive Materials.
  - NRC Information Notice 80-32, Rev. 1: Clarification of Certain Requirements for Exclusive-Use Shipments of Radioactive Materials.
  - NRC Information Notice 83-05: Obtaining Approval for Disposing of Very-Low-Level Radioactive Waste - 10CFR Section 20.302.
  - NRC Information Notice 83-10: Clarification of Several Aspects Relating to Use of NRC-Certified Transport Packages.
  - NRC Information Notice 83-33: Non-Representative Sampling of Contaminated Oil.
  - NRC Information Notice 84-50: Clarification of Scope of Quality Assurance Programs for Transport Packages Pursuant to 10CFR 50 Appendix B.
  - NRC Information Notice 84-72: Clarification of Conditions for Waste Shipments Subject to Hydrogen Gas Generation.
  - NRC Information Notice 85-92: Surveys of Wastes Before Disposal from Nuclear Reactor Facilities.
  - NRC Information Notice 86-20: Low-Level Radioactive Waste Scaling Factors, 10CFR 61.
  - NRC Information Notice 86-90: Requests to Dispose of Very Low-Level Radioactive Waste Pursuant 10CFR 20.302

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- NRC Information Notice 87-03: Segregation of Hazardous and Low-Level Radioactive Wastes
  - NRC Information Notice 87-07: Quality Control of On-Site Dewatering/ Solidification Operations by Outside Contractors
- [11] NRC Information and Enforcement Bulletins (continued)
- NRC Information Notice 89-27: Limitations on the Use of Waste Forms and High Integrity Containers for the Disposal of Low-Level Radioactive Waste
  - NRC Information Notice 92-62: Emergency Response Information Requirements for Radioactive Material Shipments
  - NRC Information Notice 92-72: Employee Training and Shipper Registration Requirements for Transporting Radioactive Materials
  - NRC Generic Letter 89-01, "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program".
- [12] Nureg-0800 Standard Review Plan Section 11.4 Revision 2, Solid Waste Management Systems.
- [13] NRC Waste Form Technical Position, Revision 1 Jan 24 1991.
- [14] NRC SECY 94-198 Review of Existing Guidance Concerning the Extended Storage of Low-Level Radioactive Waste.
- [15] EPRI TR-106925 Rev-1, Interim On-Site Storage of Low Level Waste: Guidelines for Extended Storage - October 1996
- [16] NRC Branch Technical Position On Concentration Averaging And Encapsulation Jan 17 1995
- [17] Commitment Documents (U-2 and U-3)
- IPN-99-079, "Supplement to Proposed Changes to Technical Specifications Incorporating Recommendations of Generic Letter 89-01 and the Revised 10 CFR Part 20 and 10 CFR Part 50.36a.
  - Appendix B Technical Specifications, Section 4.5 [IP, RECS ODCM Part 1]

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### 3.0 DEFINITIONS

- [1] **Batch** – A quantity of waste to be processed having essentially consistent physical and chemical characteristics as determined through past experience or system operation knowledge by the Radwaste Shipping Specialist. A batch could be a waste tank, several waste tanks grouped together or a designated time period such as between outages as with the DAW waste stream. An isolated quantity of feed waste to be processed having essentially constant physical and chemical characteristics. (The addition or removal of water will not be considered to create a new batch).
- [2] **Certificate of Compliance** - Document issued by the USNRC regulating use of a NRC licensed cask or issued by (SCDHEC) South Carolina Department of Health and Environmental Conservation regulating a High Integrity Container.
- [3] **Chelating Agents** - EDTA, DTPA, hydroxy-carboxylic acids, citric acid, carbolic acid and glucinic acid.
- [4] **Compaction** - The process of volume reducing solid waste by applying external pressure.
- [5] **Confirmatory Analysis** - The practice of verifying that gross radioactivity measurements using MCA are reasonably consistent with independent laboratory sample data.
- [6] **Dewatered Waste** - Wet waste that has been processed by means other than solidification, encapsulation, or absorption to meet the free standing liquid requirements of 10CFR Part 61.56 (a)(3) and (b)(2).
- [7] **De-watering** - The removal of water or liquid from a waste form, usually by gravity or pumping.
- [8] **Dilution Factor** - The RADMAN computer code factor to account for the non-radioactive binder added to the waste stream in the final product when waste is solidified.
- [9] **Dry Waste** - Radioactive waste which exist primarily in a non-liquid form and includes such items as dry materials, metals, resins, filter media and sludges.
- [10] **Encapsulation** - Encapsulation is a means of providing stability for certain types of waste by surrounding the waste by an appropriate encapsulation media.
- [11] **Gamma-Spectral-Analysis** - Also known as IG, MCA, Ge/Li and gamma spectroscopy.
- [12] **Gross Radioactivity Measurements** - More commonly known as dose to curie conversion for packaged waste characterization and classification.

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- [13] **Homogeneous** - Of the same kind or nature; essentially alike. Most Volumetric waste streams are considered homogeneous for purposes of waste classification.
- [14] **Incineration** – The process of burning a combustible material to reduce its volume and yield an ash residue.
- [15] **Liquid Waste** - Radioactive waste that exist primarily in a liquid form and is contained in other than installed plant systems, to include such items as oil, EHC fluid, and other liquids. This waste is normally processed off-site.
- [16] **Low-Level Radioactive Waste (LLW)** - Those wastes containing source, special nuclear, or by-product material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste has the same meaning as in the Low-Level Waste Policy Act, that is, radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or by-product material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).
- [17] **Measurement of Specific Radionuclides** - More commonly known as direct sample or container sample using MCA data for packaged waste characterization and classification.
- [18] **Operable** - A system, subsystem, train, component or device SHALL be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).
- [19] **Pregualification Program** - The testing program implemented to demonstrate that the proposed method of wet waste processing will result in a waste form acceptable to the land disposal facility and the NRC.
- [20] **Processing** - Changing, modifying, and/or packaging radioactive waste into a form that is acceptable to a disposal facility.
- [21] **Quality Assurance/Quality Control** - As used in this document, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material structure, component, or system to predetermined requirements.

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- [22] **Reportable Quantity Radionuclides (RQ)** - Any radionuclide listed in column (1) of Table 2 of 49CFR Part 172.101 which is present in quantities as listed in column (3) of Table 2 of 49CFR Part 172.101.
- [23] **Sampling Plan** - A program to ensure that representative samples from the feed waste and the final waste form are obtained and tested for conformance with parameters stated in the PCP and waste form acceptance criteria.
- [24] **Scaling Factor** - A dimensionless number which relates the concentration of an easy to measure radionuclide (gamma emitter) to one which is difficult to measure (beta and/or alpha emitters).
- [25] **Significant Quantity** - For purposes of waste classification all the following radionuclide values SHALL be considered significant and must be reported on the disposal manifest.
- Any value (real or LLD) for radionuclides listed in Appendix G to 10CFR20 (H-3, C-14, I-129, Tc-99).
  - Greater than or equal to 1 percent of the concentration limits as listed in 10CFR Part 61.55 Table 1.
  - Greater than or equal to 1 percent of the Class A concentration limits listed in 10CFR Part 61.55 Table 2.
  - Greater than or equal to 1 percent of the total activity.
  - Greater than or equal to 1 percent of the Reportable Quantity limits listed on 49CFR Part 172.101 Table 2.
- [26] **Solidification** - The conversion of wet waste into a free-standing monolith by the addition of an agent so that the waste meets the stability and free-standing liquid requirements of the disposal site.
- [27] **Special Radionuclides** - The RADMAN computer code term for radionuclides listed in Appendix G to 10CFR20 (i.e., H-3, C-14, I-129 & Tc-99)
- [28] **Stability** – Structural stability per 10CFR61.2, Waste Form Technical Position, and Waste Form Technical Position Revision 1. This can be provided by the waste form, or by placing the waste in a disposal container or structure that provides stability after disposal. Stability requires that the waste form maintain its structural integrity under the expected disposal conditions.

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- [29] **Training** - A systematic program that ensures a person has knowledge of hazardous materials and hazardous materials regulations.
- [30] **Type A Package** - Is the packaging together with its radioactive contents limited to A1 or A2 as appropriate that meets the requirements of 49CFR Part 173.410 and Part 173.412, and is designed to retain the integrity of containment and shielding under normal conditions of transport as demonstrated by the tests set forth in 49CFR Part 173.465 or Part 173.466 as appropriate.
- [31] **Type B Package** - Is the packaging together with its radioactive contents that is designed to retain the integrity of containment and shielding when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10CFR Part 71.
- [32] **Volume Reduction** – any process that reduces the volume of waste. This includes but is not limited to, compaction and incineration.
- [33] **Waste Container** - A vessel of any shape, size, and composition used to contain the waste media.
- [34] **Waste Form** - Waste in a waste container acceptable for disposal at a licensed disposal facility.
- [35] **Waste Stream** - A Plant specific and constant source of waste with a distinct radionuclide content and distribution.
- [36] **Waste Type** – A single packaging configuration and waste form tied to a specific waste stream.

#### 4.0 **RESPONSIBILITIES**

- [1] The **Vice President Operations Support (VPOS)** is responsible for the implementation of this procedure.
- [2] Each site **Senior Nuclear Executive (SNE)** is responsible for ensuring that necessary site staff implements this procedure.
- [3] The **Low Level RadWaste (LLRW) Focus Group** is responsible for evaluating and recommending changes and revisions to this procedure.



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- [4] Each site **RP Department – Radwaste Supervisor / Specialist** (title may vary at the site's respectively) has the overall responsibility for implementing the PCP and is responsible for processing and transportation is tasked with the day-to-day responsibilities for the following:
- Implementing the requirements of this document.
  - Ensuring that radioactive waste is characterized and classified in accordance with 10CFR Part 61.55 and Part 61.56.
  - Ensuring that radioactive waste is characterized and classified in accordance with volume reduction facility and disposal site licenses and other requirements.
  - Designating other approved procedures (if required) to be implemented in the packaging of any specific batch of waste.
  - Providing a designated regulatory point of contact between the Plant and the NRC, volume reduction facility or disposal site.
  - Maintaining records of on-site and off-site waste stream sample analysis and Plant evaluations.
  - Suspending shipments of defectively processed or defectively packaged radioactive wastes from the site when the provisions of this process control program are not satisfied.


## 5.0 **DETAILS**

An isotopic analysis SHALL be performed on every batch for each waste stream so that the waste can be classified in accordance with 10CFR61. The isotopic and curie content of each shipping container SHALL be determined in accordance with 49CFR packaging requirements. The total activity in the container may be determined by either isotopic analysis or by dose-rate-to-curie conversion.

### 5.1. **Precautions and Limitations**

#### [1] **Precautions**

- (a) Radioactive materials SHALL be handled in accordance with applicable radiation protection procedures.
- (b) All radioactive waste must be processed or packaged to meet the minimum requirements listed in 10CFR Part 61.56 (a) (1) through (8).

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- (c) If the provisions of the Process Control Program are not satisfied, suspend shipment of the defectively processed or defectively packaged waste from the site. Shipment may be accomplished when the waste is processed / packaged in accordance with the Process Control Program.
- (d) The generation of combustible gases is dependent on the waste form, radioactive concentration and accumulated dose in the waste. Changes to organic inputs (e.g. oil) to waste stream may change biogas generation rates.


[2] Limitations

- (a) Only qualified personnel will characterize OR package radioactive waste OR radioactive materials for transportation or disposal.
- (b) All site personnel that have any involvement with radioactive waste management computer software **SHALL** be familiar with its functions, operation and maintenance.

**5.2. Waste Management Practices**

[1] Waste processing methods include the following:

- (a) Present and planned practice is NOT to solidify or encapsulate any waste streams.
- (b) Waste being shipped directly for burial in a HIC (High Integrity Container) is dewatered to less than 1 percent by volume prior to shipment.
- (c) Waste being shipped directly for burial in a container other than a HIC is dewatered to less than 0.5 percent by volume prior to shipment.
- (d) IF solidification is required in the future, THEN at least one representative test specimen from at least every 10th batch of each type of radioactive waste will be checked to verify solidification.
  - (1) IF any specimen fails to verify solidification, THEN the solidification of the batch under test **SHALL** be suspended until such time as additional test specimens can be obtained, alternative solidification parameters can be determined, and a subsequent test verifies solidification. If alternative parameters are determined, the subsequent tests shall be verified using the alternative parameters determined.

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- (2) IF the initial test specimen from a batch of waste fails to verify solidification, THEN provide for the collection and testing of representative test specimens from each consecutive batch of the same type of waste until at least 3 consecutive initial test specimens demonstrates solidification. The process **SHALL** be modified as required to assure solidification of subsequent batches of waste.

[2] Operation and maintenance of dewatering systems and equipment include the following:


- (a) Present and planned practice is to utilize plant personnel supplemented by vendor personnel or contracted vendor personnel, to operate AND maintain dewatering systems and equipment (as needed to meet disposal site requirements).
- (b) All disposal liners are manufactured by and purchased from QA-approved vendors.

[3] ALARA considerations are addressed in all phases of the processes involving handling, packaging AND transfer of any type OR form of radioactive waste (dewatered or dry). Resin, charcoal media, spent filter cartridges AND sludges are typically processed within shields. Sluicible demineralizers are shielded when in service. Radiation exposure and other health physics requirements are controlled by the issuance of a Radiation Work Permit (RWP) for each task.

### 5.3. Waste Stream Sampling Methods and Frequency

[1] The following general requirements apply to Plant waste stream sampling:

- (a) Treat each waste stream separately for classification purposes.
- (b) Ensure samples are representative of or can be correlated to the final waste form.
- (c) Determine the density for each new waste stream initially or as needed (not applicable for DAW and filters).
- (d) Perform an in-house analysis for gamma-emitting radionuclides for each sample sent to an independent laboratory.
- (e) Periodically perform in-house analysis for gamma emitting radionuclides for comparison to the current data base values for gamma emitters. (The current database is usually based on the most recent independent laboratory results.)
- (f) Resolve any discrepancies between in-house results AND the independent laboratory results for the same or replicate sample as soon as possible.
- (g) Maintain records of on-site and off-site waste stream sample analysis and evaluations.

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- [2] When required, waste stream samples should be analyzed, re-evaluated and if necessary, shipped to a vendor laboratory for additional analysis. The same is true when there is a reason to believe that an equipment or process change has significantly altered the previously determined scaling factors by a factor of 10.

Specific examples include but are not limited to:


- Changes in oxidation reduction methods such as zinc, injection, hydrogen water chemistry,
- Changes in purification methods including media specialization, media distribution, ion/cation ratios,
- Changes in fuel performance criteria including fuel leaks
- Other changes in reactor coolant chemistry.
- Sustained, unexplained, changes in the routinely monitored Beta/Alpha ratios, as determined by Radiation Protection,
- When there is an extended reactor shutdown (> 90 days).
- When there are changes to liquid waste processing, such as bypassing filters, utilizing filters or a change in ion exchange media.
- When there are changes to the waste stream that could change the biogas generation rate.

- [3] The following requirements apply to infrequent or abnormal waste types:
- (a) Infrequent OR abnormal waste types that may be generated must be evaluated on a case-by-case basis.
  - (b) The RP Department Supervisor / Specialist responsible for processing AND shipping will determine if the waste can be correlated to an existing waste stream.
  - (c) IF the radioactive waste cannot be correlated to an existing waste stream, THEN the RP Department Supervisor / Specialist responsible for processing and shipping SHALL determine specific off-site sampling and analysis requirements necessary to properly classify the material.
- [4] Specific sampling methods and data evaluation criteria are detailed in EN-RW-104 for specific waste streams.

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#### 5.4. Waste Classification

- [1] General requirements for scaling factors include the following:
- (a) The Plant has established an inferential measurement program whereby concentrations of radionuclides which cannot be readily measured are estimated through ratio-ing with radionuclides which can be readily measured.
  - (b) Scaling factor relationships are developed on a waste stream-specific basis. These relationships are periodically revised to reflect current independent lab data from direct measurement of samples. The scaling factor relationships currently used by the sites are as follows:
    - Hard to detect ACTIVATION product radionuclides and C-14 are estimated by using scaling factors with measured Co-60 activities.
    - Hard to detect FISSION product radionuclides and H-3, Tc-99 and I-129 are estimated by using scaling factors with measured Cs-137 activities.
    - Hard to detect TRANSURANIC radionuclides are estimated by using scaling factors with measured Ce-144 activities. Where Ce-144 cannot be readily measured, transuranics are estimated by using scaling factors with measured Cs-137 activities. Second order scaling of transuranics is acceptable when Cs-137 and Ce-144 are not readily measurable.
- [2] General requirements for the determination of total activity and radionuclide concentrations include the following:
- (a) The activity for the waste streams is estimated by using either Gross Radioactivity Measurement OR Direct Measurement of Radionuclides. Current specific practices are as follows:
    - DAW - Gross radioactivity measurement in conjunction with the RADMAN computer codes, other approved computer codes or hand calculation.
    - Filters - Gross radioactivity measurement in conjunction with the FILTRK computer code, other approved computer codes or hand calculation.
    - All Other Waste Streams - Direct measurement of radionuclides in conjunction with the RADMAN computer codes, other approved computer codes or hand calculation.
  - (b) Determination of the NRC waste classification is performed by comparing the measured or calculated concentrations of significant radionuclides in the final waste form to those listed in 10CFR Part 61.55.


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### 5.5. Quality Control

- [1] The RADMAN computer code provides a mechanism to assist the Plant in conducting a quality control program in accordance with the waste classification requirements listed in 10CFR Part 61.55. All waste stream sample data changes are written to a computer data file for future review and reference.
- [2] Audits and Management Review includes the following:
- (a) Appendix G to 10CFR20 requires conduct of a QC program which must include management review of audits.
  - (b) Management audits of the Plant Sampling and Classification Program SHALL be periodically performed to verify the adequacy of maintenance sampling and analysis.
  - (c) Audits and assessments are performed and documented by any of the following:
    - Radiation Protection Department
    - Quality Assurance Department
    - Qualified Vendors
  - (d) Certain elements of the Entergy Quality Assurance Program Manual are applied to the Process Control Program. **[QAPM, Section A.1.c]**

### 5.6. Dewatering Operations

- [1] Processing requirements during dewatering operations include the following:
- (a) All dewatering operations are performed per approved Plant or vendor operating procedures and instructions.
  - (b) Dewatering limitations and capabilities are verified by vendor Topical Reports or Operating and Testing Procedures.
- [2] Dewatered resin activity limitations include the following:
- (a) Dewatered resins will not be shipped off-site that have activities which will produce greater than 1.0E+8 rads total accumulated dose over 300 years. This is usually verified by comparing the container specific activity at the time of shipment to the following concentration limits for radionuclides with a half-life greater than five years:
    - 10 Ci (0.37 TBq) per cubic foot.
    - 350 uCi (12.95 MBq) per cubic centimeter


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### 5.7. Waste Packaging

Waste in final form will be packaged in accordance with Title 10 and Title 49 of the Code of federal regulations and in accordance with current burial site criteria as is detailed in EN-RW-102.

### 5.8. Administrative Controls

- [1] Information on solid radioactive waste shipped off-site is reported annually to the Nuclear Regulatory Commission in the Annual Radioactive Effluent Release Report as specified by the Offsite Dose Calculation Manual (ODCM) or Technical Specification. **[ANO1 Technical Specifications - 5.6.3] [ANO2 Technical Specifications – 6.6.3] [WF3 Technical Specifications – 6.9.18] [GGNS ODCM – 5.6.3.c] [JAF Technical Specifications – 5.6.3] [PLP ODCM, Appendix A – IV. A].**
- [2] All changes to the PCP SHALL be documented. All records of reviews performed SHALL be retained as required by the Quality Assurance Program. The documentation of the changes **SHALL [GGNS UFSAR, Chapter 16B.1 / TRM – 7.6.3.8 paragraph 2]:**
- (a) Contain sufficient information to support the change with appropriate analyses or evaluations justifying the change.
  - (b) Include a determination that the change will maintain the overall conformance of the solidified waste product (if applicable) to existing requirements of Federal, State or other applicable regulations.
- [3] All changes in the Process Control Program and supporting documentation are included in each site's next Annual Radiological Effluent Release Report to the Nuclear Regulatory Commission. **[ANO ODCM - L3.2.1.C] [VTY TRM 6.12]**
- [4] The changes to EN-RW-105 SHALL become effective upon review and acceptance by the site's General Plant Manager (equivalent title at Palisades is Plant Superintendent) except as listed below:
- (a) For Grand Gulf Nuclear Station, the changes to RW-105 SHALL be accomplished as specified in Grand Gulf Nuclear Station Technical Requirements Manual (TRM) Section 7.6.3.8. The changes SHALL become effective upon review and acceptance by the On-site Safety Review Committee (OSRC) and the approval of the GGNS Plant General Manager. **[GGNS UFSAR, Chapter 16B.1 / TRM – 7.6.3.8 paragraph 2]**

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- (b) For River Bend Nuclear Station, the procedure approval along with changes to RW-105 SHALL be accomplished per the River Bend Nuclear Station Technical Requirements, Section 5.5.14.1. The changes SHALL become effective upon review and acceptance by approval from the River Bend Nuclear Station Plant Manager or Radiation Protection Manager. **[RBS Technical Requirements – 5.5.14.1, 5.5.14.2 & 5.8.2]**
- (c) For Waterford 3, the procedure approval along with changes to RW-105 SHALL be accomplished per Waterford 3 Technical Specifications 6.13.2. The changes SHALL become effective upon review and acceptance by the Waterford 3 General Plant Manager. **[WF3 Technical Specifications – 6.13.2.b]**
- (d) For James A. FitzPatrick Nuclear Station, the procedure approval along with changes to EN-RW-105 SHALL be accomplished per the James A. FitzPatrick Station Technical Specifications, Section 5.6.3. The changes SHALL become effective upon review and acceptance through approval from the James A. FitzPatrick Nuclear Station On-Site Safety Review Committee. **[JAF UFSAR, Chapter 11.3.5]**
- (e) For Vermont Yankee, Changes to the Process Control Program SHALL become effective after review and acceptance by the (OSRC) On-Site Safety Review Committee and the Site VP.
- (f) For IPEC, Changes to the Process Control Program SHALL become effective after final review and acceptance by the On-Site Safety Review Committee (OSRC).

**5.9. Vendor Requirements**

- [1] Vendors performing radwaste services under 10CFR61 and 10CFR71 requirements will be on the Entergy Qualified Supplier's List (QSL). **[QAPM, Section A.1.c]**
- [2] Vendors performing radwaste services on-site are to comply with the following:
  - (a) Dewatering and solidification services SHALL have a NRC-approved Topical Report or other form of certification documenting NRC approval of the processes and associated equipment/containers.
  - (b) All vendor procedures utilized for performing on-site radwaste processing services (to assure compliance with 10 CFR Parts 20, 61 and 71, State Regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste) will be reviewed per the requirements of EN-LI-100, technically by the applicable site's Radiation Protection organization and only be accepted per the approvals specified in Section 5.8 [4].



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- (c) All changes to vendor procedures for ongoing on-site radwaste services will be reviewed technically by the site's Radiation Protection organization and screened per the requirements of EN-LI-100. Significant procedural changes will require the approvals specified in Section 5.8 [4]. During screening, the level of significance for procedural changes on equipment and process parameters may warrant the full 10CFR50.59 documentation and approval process.
- (d) Plant management SHALL review vendor(s) topical reports and test procedures per applicable requirements in Section 5.8.

**NOTE**

The PCP does not have to include the vendor's Topical Report if it has NRC approval, or has been previously submitted to the NRC.

- (e) Plant management review will assure that the vendor's operations and requirements are compatible with the responsibilities and operation of the Plant.
- (f) Training requirements and records listed in Section 5.10 also apply to contracted vendors.

**5.10. Miscellaneous**

[1] Special tools and equipment


- (a) Frequency of Use and Descriptions

Required tools and equipment will vary depending on the specific process and waste container that is used. The various tools and equipment which may be required are detailed in specific procedures developed to govern activities described in this document.

[2] Pre-requisites

- (a) Maintenance of Regulatory Material

Ensure that a current set of DOT, NRC, EPA and applicable State regulations, vendor processing facility and disposal site regulations and requirements are maintained at the site and are readily available for reference. The use of web based regulations is acceptable.

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(b) Representative Radionuclide Sample Data

Ensure that representative radionuclide sample data is on file for each active waste stream. Unless operation conditions or changes in processing methods require increased sample frequency, data is considered to be current if it meets the requirements of EN-RW-104.

(c) Initial and Cyclic Training


- A training program SHALL be developed, implemented and maintained for all personnel involved in processing, packaging, handling and transportation of radioactive waste to ensure radwaste operations are performed within the requirements of NRC Information Bulletin 79-19 and 49CFR Part 172.700 through Part 172.704.
- Training requirements and documentation also apply to contracted on-site vendors.

**NOTE**

Cyclic training is defined as within three years for DOT, and two years for IATA

(d) Specific employee training is required for each person who performs the following job functions [172.702(b)].

- Classifies hazardous materials.
- Packages hazardous materials.
- Fills, loads and/or closes packages.
- Marks and labels packages containing hazardous materials.
- Prepares shipping papers for hazardous materials.
- Offers or accepts hazardous materials for transportation.
- Handles hazardous materials.
- Marks or placards transport vehicles.
- Operates transport vehicles.
- Works in a transportation facility and performs functions in proximity to hazardous materials which are to be transported.
- Inspects or tests packages.

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- (e) Cyclic training is defined as within three years for DOT & within two years for IATA.

Copies of training records are required for as long as a person is employed and 90 days thereafter. The records should include, as a minimum, the following:


- Trainee's name and signature
- Training dates
- Training material or source reference
- Trainer's information

## **6.0 INTERFACES**

- [1] EN-LI-100, "Process Applicability Determination"
- [2] EN-RW-104, "Scaling Factors"
- [3] EN-QV-104, "Entergy Quality Assurance Program Manual Control"

## **7.0 RECORDS**

- [1] Documentation of pertinent data required to classify waste and verify solidification will be maintained on each batch of processed waste as required by approved procedures.
- [2] Documentation will also be maintained to ensure that containers, shipping casks, and methods of packaging wastes meet applicable Federal regulations and disposal site criteria. The records of reviews performed and documents associated with these reviews will be maintained as QA records.

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## 8.0 SITE SPECIFIC COMMITMENTS

Document	Document Section	NMM Procedure Section	Site Applicability
ANO ODCM	L3.2.1.C	5.8 [3]	ANO
ANO1 Technical Specifications	5.6.3	5.8 [1]	ANO
ANO2 Technical Specifications	6.6.3	5.8 [1]	ANO
RBS Technical Requirements	5.5.14	*	RBS
RBS Technical Requirements	5.5.14.1	5.8 [3] 5.8 [4] (b)	RBS
RBS Technical Requirements	5.5.14.2	5.8 [4] (b)	RBS
RBS Technical Requirements	5.8.2	5.8 [4] (b)	RBS
WF3 Technical Specifications	1.22	*	WF3
WF3 Technical Specifications	6.9.18	5.8 [1]	WF3
WF3 Technical Specifications	6.13.2.b	5.8 [4] (c)	WF3
JAF ODCM	6.2.1	5.8 [1]	JAF
JAF Technical Specifications	5.6.3	5.8 [1], 5.8 [4]	JAF
JAF FSAR	Chapters 7 and 11	5.8 [4]	JAF
11759 – NRC IN 79-19	All	*	WF3
GGNS UFSAR, Chapter 16B.1 / TRM	7.6.3.8 paragraph 1	1.0	GGNS
GGNS ODCM	5.6.3.c	5.8 [1]	GGNS
GGNS FSAR	11.4.5.S2	5.9 [2](a)	GGNS
GGNS FSAR	11.4.2.3AS7	5.9 [2](a)	GGNS
IPN-99-079	All	*	IPEC
Appendix B Technical Specifications	Section 4.5, RECS ODCM Part 1	*	IPEC
PLP Technical Specifications	5.5.15	5.8 [4]	PLP
PLP ODCM	Appendix A – IV. A	5.8 [1]	PLP
NRC Letter 1.98.091	All	*	PNPS
NRC Letter 1.88.078	All	*	PNPS
VY Technical Specifications	6.4.H	*	VY
VY ODCM	10.1	5.8 [1]	VY
VY TRM	6.12	5.8 (3)	VY
QAPM	Section A.1.c	*	All

\* Covered by directive as a whole or by various paragraphs of the directive.

## 9.0 ATTACHMENTS

None