

INDEXDEFINITIONS

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CALVERT CLIFFS UNIT 1  
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Amendment No.  
 Amendment No.

INDEXLIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

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INDEXBASES

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1.0 DEFINITIONSDEFINED TERMS

1.1 The DEFINED TERMS of this section appear in capitalized type and are applicable throughout these Technical Specifications.

THERMAL POWER

1.2 THERMAL POWER shall be the total reactor core heat transfer rate to the reactor coolant.

RATED THERMAL POWER

1.3 RATED THERMAL POWER shall be a total reactor core heat transfer rate to the reactor coolant of 2700 Mwt. \$

OPERATIONAL MODE

1.4 An OPERATIONAL MODE shall correspond to any one inclusive combination of core reactivity condition, power level and average reactor coolant temperature specified in Table 1.1.

ACTION

1.5 ACTION shall be *that part of a Specification which prescribes* ~~those additional requirements specified as corollary statements to each principle specification and shall be part of the specifications.~~ *remedial measures required under designated conditions.*

OPERABLE - OPERABILITY

1.6 A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s). Implicit in this definition shall be the assumption that all necessary attendant instrumentation, controls, normal and emergency electrical power sources, cooling or seal water, lubrication or other required 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).

## 1.0 DEFINITIONS

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### GASEOUS RADWASTE TREATMENT SYSTEM

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

### MEMBER(S) OF THE PUBLIC

1.30 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.

### OFFSITE DOSE CALCULATION MANUAL (ODCM)

1.31 The OFFSITE DOSE CALCULATION MANUAL shall contain the current methodology and parameters used in the calculation of offsite doses due to radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring alarm/trip setpoints, and in the conduct of the environmental radiological monitoring program.

### PROCESS CONTROL PROGRAM (PCP)

1.32 The PROCESS CONTROL PROGRAM shall contain the current formula, sampling, analyses, tests, and determinations to be made to ensure that the processing and packaging 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 Part 20, 10 CFR Part 71 and Federal and State and local regulations governing the disposal of the radioactive waste.

### PURGE - PURGING

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

1.0 DEFINITIONS (Continued)

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SITE BOUNDARY

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

SOLIDIFICATION

1.35 SOLIDIFICATION shall be the conversion of wet wastes into a form that meets shipping and burial ground requirements.

SOURCE CHECK

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

UNRESTRICTED AREA

1.37 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.

VENTILATION EXHAUST TREATMENT SYSTEM

1.38 A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. Such a system is not considered to have any effect on noble gas effluents. Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

VENTING

1.39 VENTING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.

TABLE 1.2  
FREQUENCY NOTATION

<u>NOTATION</u>	<u>FREQUENCY</u>
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days.
M	At least once per 31 days.
Q	At least once per 92 days.
SA	At least once per 6 months.
R	At least once per 18 months.
S/U	Prior to each reactor startup.
P	Completed prior to each release.
N.A.	Not applicable.

## 5.0 DESIGN FEATURES

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### 5.1 SITE

#### MAP DEFINING THE SITE BOUNDARY AND EFFLUENT RELEASE POINTS

5.1.1 A map of the Calvert Cliffs Nuclear Power Plant site identifying the major plant structures as well as defining the radioactive effluent release points, and the SITE BOUNDARY is shown in Figure 5.1-1.

#### LOW POPULATION ZONE

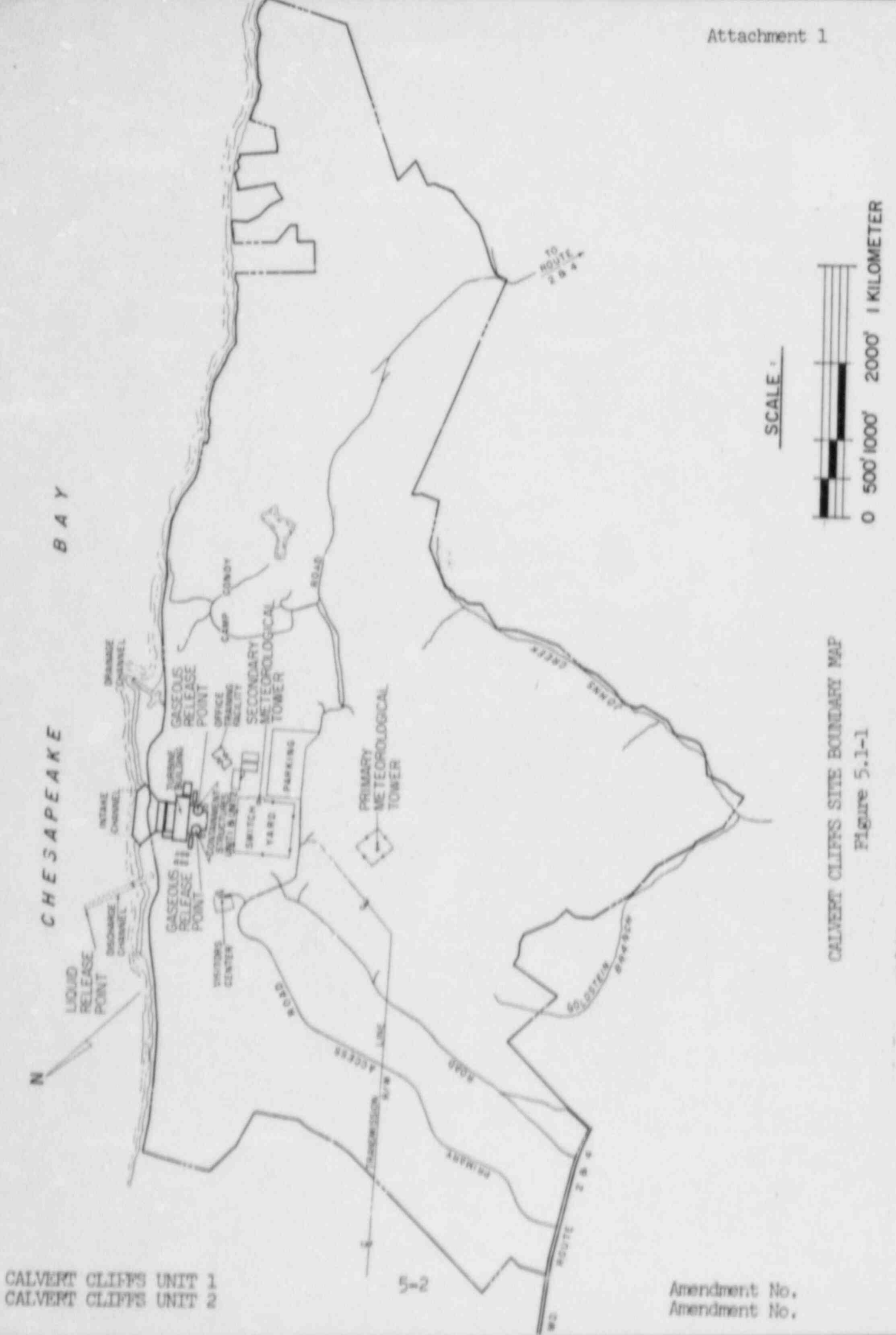
5.1.2 The low population zone shall be as shown in Figure 5.1-2.

### 5.2 CONTAINMENT

#### CONFIGURATION

5.2.1 The reactor containment building is a steel lined, reinforced concrete building of cylindrical shape, with a dome roof and having the following design features:

- a. Nominal inside diameter = 130 feet.
- b. Nominal inside height =  $181 \frac{2}{3}$  feet.
- c. Minimum thickness of concrete walls =  $3 \frac{3}{4}$  feet.
- d. Minimum thickness of concrete roof =  $3 \frac{1}{4}$  feet.
- e. Minimum thickness of concrete floor pad = 10 feet.
- f. Nominal thickness of steel liner =  $\frac{1}{4}$  inches.
- g. Net free volume =  $2 \times 10^6$  cubic feet.



CALVERT CLIFFS SITE BOUNDARY MAP

Figure 5.1-1



3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING3/4.12.1 MONITORING PROGRAMLIMITING CONDITION FOR OPERATION

3.12.1 The radiological environmental monitoring program shall be conducted as specified in Table 3.12-1.

APPLICABILITY: At all times.

ACTION

- a. With the radiological environmental monitoring program not being conducted as specified in Table 3.12-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Specification 6.9.1.7, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.
- b. With the level of radioactivity as the result of plant effluents in an environmental sample at a specified location exceeding the reporting levels of Table 3.12-2, prepare and submit to the Commission within 30 days after receiving the sample analysis, pursuant to Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose\* to a MEMBER OF THE PUBLIC is less than the calendar year limits of Specifications 3.11.1.2, 3.11.2.2, and 3.11.2.3. When more than one of the radionuclides in Table 3.12-2 are detected in the sample this report shall be submitted if:

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

When radionuclides other than those in Table 3.12-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose\* to a MEMBER OF THE PUBLIC is equal to or greater than the calendar year limits of Specifications 3.11.1.2, 3.11.2.2 and 3.11.2.3. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.



### 3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

#### ACTION (Continued)

- c. With fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 3.12-1, identify locations for obtaining replacement samples and add them to the radiological environmental monitoring program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program. Pursuant to Specification 6.9.1.7, identify the cause of the unavailability of samples and identify the new location(s) for obtaining the replacement samples in the next Annual Radiological Environmental Operating Report.
- d. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

### SURVEILLANCE REQUIREMENTS

4.12.i The radiological environmental monitoring samples shall be collected pursuant to Table 3.12-1 from the specific locations given in the table and figure(s) in the ODCM, and shall be analyzed pursuant to the requirements of Table 3.12-1 and the detection capabilities required by table 4.12-1.

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

TABLE 3.12-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

<u>Exposure Pathway and/or Sample</u>	<u>Number of Representative Samples and Sample Locations<sup>a</sup></u>	<u>Sampling and Collection Frequency</u>	<u>Type and Frequency of Analysis</u>
1. DIRECT RADIATION <sup>b</sup>	<p>23 routine monitoring stations (DR1-DR23) either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows:</p> <p>an inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY (DR1-DR9);</p> <p>an outer ring of stations, one in each meteorological sector in the 6- to 8-km range from the site (DR10-DR18);</p> <p>the balance of the stations (DR19-DR23) to be placed in special interest areas such as population centers, nearby residences, schools, and in 1 area to serve as a control station.</p>	At least Quarterly	Gamma dose at least quarterly.
2. AIRBORNE	<p>Samples from 5 locations (A1-A5):</p> <p>3 samples (A1-A3) from close to the 3 SITE BOUNDARY</p>	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	<u>Radioiodine Cannister</u> I-131 analysis weekly.
Radioiodine and Particulates			

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CALVERT CLIFFS UNIT 2

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TABLE 3.12-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

<u>Exposure Pathway and/or Sample</u>	<u>Number of Representative Samples and Sample Locations<sup>a</sup></u>	<u>Sampling and Collection Frequency</u>	<u>Type and Frequency of Analysis</u>
	locations, in different sectors of the highest calculated annual average ground-level D/Q.		<u>Particulate Sampler:</u> Gross beta radioac- tivity analysis follow- ing filter change; <sup>c</sup> Gamma isotopic analysis <sup>d</sup> of compo- site (by location) quarterly.
	1 sample (A4) from the vicinity of a community having the highest calculated annual average ground- level D/Q.		
	1 sample (A5) from a control location, as for example 15-30 km distant and in the least prevalent wind direction.		
3. WATERBORNE			
a. Surface	1 sample at intake area (Wa1) 1 sample at discharge area (Wa2)	Composite sample over 1-month period <sup>e</sup>	Gamma isotopic analysis <sup>d</sup> monthly. Composite for tritium analysis quarterly.
b. Sediment from shoreline	1 sample from downstream area with existing or potential recreational value (Wb1).	Semiannually	Gamma isotopic analysis <sup>d</sup> semi-annu- ally.
4. INGESTION			
a. Fish and Inverte- brates	3 samples of commercially and/or recreationally important species (2 fish species and 1 invertebrate specie) in vicinity of plant discharge area. (Ia1 - Ia3).	Sample in season, or semiannually if they are not seasonal.	Gamma isotopic analysis <sup>d</sup> on edible portions.

Attachment 1

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CALVERT CLIFFS Unit 2

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TABLE 3.12-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

<u>Exposure Pathway and/or Sample</u>	<u>Number of Representative Samples and Sample Locations<sup>a</sup></u>	<u>Sampling and Collection Frequency</u>	<u>Type and Frequency of Analysis</u>
b. Food Products	<p>3 samples of same species in areas not influenced by plant discharge (Ia4 - Ia6).</p> <p>Samples of 3 different kinds of broad leaf vegetation grown near the site boundary at 2 different locations of highest predicted annual average ground-level D/Q (Ib1-Ib6).</p> <p>1 sample of each of the similar broad leaf vegetation grown 15-30 km distant in the least prevalent wind direction (Ib7-Ib9).</p>	<p>Monthly during growing season</p> <p>Monthly during growing season</p>	<p>Gamma isotopic<sup>d</sup> and I-131 analysis.</p> <p>Gamma isotopic<sup>d</sup> and I-131 analysis.</p>



TABLE 3.12-1 (Continued)

TABLE NOTATION

- a The code in parenthesis, e.g. DR1, A1, defines generic sample locations in this specification that can be used to identify the specific locations in the map(s) and table in the ODCM. Specific parameters of distance and direction sector from the central point between the two containment buildings and additional description where pertinent, is provided for each sample location in Table 3.12-1, and in a table and figure(s) in the ODCM. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, October 1978", and to Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to circumstances such as hazardous conditions, seasonal unavailability, and malfunction of automatic sampling equipment. If specimens are unobtainable due to sampling equipment malfunction, effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.7. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program. Pursuant to Specification 6.9.1.7, identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining samples in the next Annual Radiological Environmental Operating Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).
- b One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation. The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading. Due to the geographical limitations, 9 sectors are monitored around the Calvert Cliffs Nuclear Power Plant.
- c Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

TABLE 3.12-1 (Continued)

TABLE NOTATION

- d Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.
- e A composite sample is one in which the quantity (aliquot) of liquid sampled is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow. In this program composite sample aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) in order to assure obtaining a representative sample.

TABLE 3.12-2

## REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

## REPORTING LEVELS

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m <sup>3</sup> )	Fish & Invertebrates (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	20,000*				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400				
I-131	2	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200			300	

\*For drinking water samples. This is a 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used.

TABLE 4.12-1  
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS<sup>a,b</sup>

LOWER LIMIT OF DETECTION (LLD)<sup>c</sup>

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m <sup>3</sup> )	Fish & Invertebrates (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
Gross Beta	4	0.01				
H-3	2000*					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1 <sup>d</sup>	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

\*If no drinking water pathway exists, a value of 3000 pCi/l may be used.



TABLE 4.12-1 (Continued)

TABLE NOTATION

- a This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.7.
- b Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.
- c The LLD is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

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

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

Where:

LLD is the "A priori" lower limit of detection as defined above, as picocuries per unit mass or volume,

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

E is the counting efficiency, as counts per disintegration,

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

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield, when applicable,

$\lambda$  is the radioactive decay constant for the particular radionuclide, and

$\Delta t$  for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting

Typical values of E, V, Y and  $\Delta t$  should be used in the calculation.

TABLE 4.12-1 (Continued)TABLE NOTATION

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.11.

- <sup>d</sup> LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

RADIOLOGICAL ENVIRONMENTAL MONITORINGLAND USE CENSUSLIMITING CONDITION FOR OPERATION

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3.12.2 A land use census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 9 meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden\* of greater than 50 m<sup>2</sup> (500 ft<sup>2</sup>) producing broad leaf vegetation. (For elevated releases as defined in Regulatory Guide 1.111, Revision 1, July 1977, the land use census shall also identify within a distance of 5 km (3 miles) the locations in each of the 9 meteorological sectors of all milk animals and all gardens of greater than 50 m<sup>2</sup> producing broad leaf vegetation).

APPLICABILITY: At all times.

ACTION

- a. With a land use census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Specification 4.11.2.3, identify the new location(s) in the next Annual Radiological Environmental Operating Report, pursuant to Specification 6.9.1.7.
- b. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with Specification 3.12.1, add the new location(s) to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from this monitoring program after (October 31) of the year in which this land use census was conducted. Pursuant to Specification 6.9.1.7, identify the new location(s) in the next Annual Radiological Environmental Operating Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).
- c. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

\*Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the site boundary in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. Specifications for broad leaf vegetation sampling in Table 3.12-1.4b shall be followed, including analysis of control samples.

RADIOLOGICAL ENVIRONMENTAL MONITORING

INTERLABORATORY COMPARISON PROGRAM

LIMITING CONDITION FOR OPERATION

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3.12.3 Analyses shall be performed on all radioactive materials, supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission, that correspond to samples required by Table 3.12-1.

APPLICABILITY: At all times.

ACTION

- a. With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.7.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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



3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORINGBASES

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3/4.12.1 MONITORING PROGRAM

The radiological environmental monitoring program required by this specification provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures to MEMBERS OF THE PUBLIC resulting from the plant operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 4.12-1 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Detailed discussion of the LLD, and other detection limits, can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," anal. Chem. 40, 586-93 (1968), and Hartwell, J. K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORINGBASES

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3/4.12.2 LAND USE CENSUS

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

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

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

ATTACHMENT 2

CALVERT CLIFFS NUCLEAR POWER PLANT

UNIT NOS. 1 AND 2

APPENDIX B

PART I

ENVIRONMENTAL TECHNICAL SPECIFICATIONS

FACILITY OPERATING LICENSE NOS. DPR-53 AND DPR-69

NOTE

Section 3.0, Environmental Surveillance and Monitoring, has been deleted. Any other portion of the Appendix B Part I Environmental Technical Specifications dealing with Environmental Monitoring is hereby superseded by Appendix A Technical Specification Section 3/4.12.

When the Radiological Effluent Technical Specifications (RETS) are fully implemented, Appendix B, Part I will be deleted in its entirety.

ISSUED BY THE U. S. NUCLEAR REGULATORY COMMISSION

Calvert Cliffs Unit 1  
Calvert Cliffs Unit 2

Amendment No.  
Amendment No.

3.0 ENVIRONMENTAL SURVEILLANCE AND MONITORING -- DELETED

~~3.1 Non-Radiological Surveillance - Deleted~~

~~3.1.1 Abiotic - Deleted~~

~~3.1.2 Biotic - Deleted~~

~~3.1.2.a General Aquatic Ecological Surveys - Deleted~~

~~3.1.2.b Impingement of Organisms - Deleted~~

(See Specification 3/4.12 in)  
Appendix A

CALVERT CLIFFS - UNIT 1  
CALVERT CLIFFS - UNIT 2

3.1-1

Amendment No. 49, 70  
Amendment No. 33, 53



### 3.2 Radiological Environmental Monitoring

#### Objective

An environmental radiological monitoring program is conducted to provide data on measurable levels of radiation and radioactive materials in the Calvert Cliffs environs in order to verify that radioactive releases and related public exposures from Calvert Cliffs Unit 2 are within allowable limits.

#### Specifications

- A. Environmental samples shall be collected and analyzed according to Table 3.2-1. Sampling stations are shown in Fig. 3.2-1.
- B. Analytical techniques used shall be such that the detection capabilities listed in Table 3.2-2 are achieved.
- C. During the season when cows are on pasture, samples of fresh milk will be obtained monthly from cows at location indicated in Fig. 3.2-1 and analyzed for their radioiodine content, calculated as iodine-131, within 8 days (one I-131 half-life) of sampling.

#### Reporting Requirement

Reports for the radiological environmental surveillance program shall be made in accordance with Section 5.6.1.a - Part B.

#### Basis

The monitoring program utilizes 30 sampling locations which were selected by considering the projected/anticipated releases of radioeffluents, site meteorology, population distribution and appropriate pathways having a significant potential for radiation exposure to biota and man.

Media which first show changes in radioactivity are sampled most frequently. Those which are less affected by transient changes but are expected to show long-term accumulation are sampled at longer intervals.

The specifications and effluent monitoring requirements in Section 2.4 "Radioactive Effluents" insure that releases of radionuclides in liquid and gaseous effluents

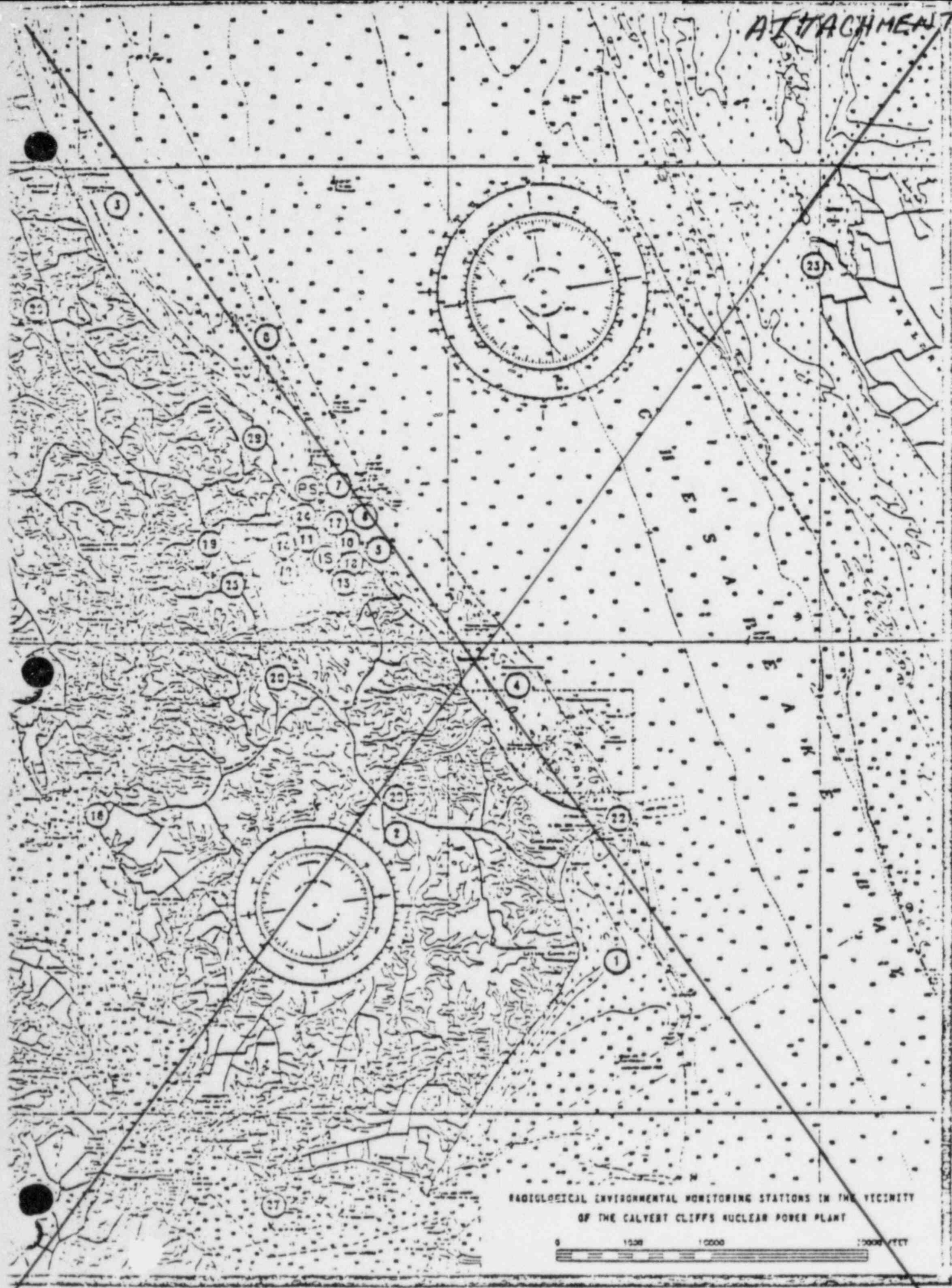


FIG 3.2-1

ENVIRONMENTAL RADIOLOGICAL MONITORING  
CALVERT CLIFFS NUCLEAR POWER PLANT

TYPE OF SAMPLE	SAMPLE POINT	SAMPLE POINT DESCRIPTION	SAMPLE FREQUENCY	ANALYSIS	REMARKS
Fish	1	Commercial pound nets south of Cove Point	Quarterly (if available)	Flesh Gamma spectrum Bone Sr-89, -90	Edible species will be sampled from the catch made by a Commercial Fisherman.
Shellfish oysters (3, 5) crabs (3, 4, PS)	3 4 5 PS	Kenwood Beach* Rocky Point Camp Conoy Plant site - North of Station (8) and west of Station (7)	Quarterly	Flesh Gamma spectrum	The location of crab samples may vary depending upon their availability. Samples will be collected during the blue crab season. A reasonable effort will be made to obtain samples.
Bottom Sediments	5 6 7 8	Camp Conoy Long Beach Plant outfall area Plant intake area	Semiannually	Sr-90 Gamma spectrum	
Bay Water	7 8	Plant outfall area Plant intake area	Monthly	Gamma spectrum Tritium Sr-89, -90	Sr-89, -90 on quarterly composite
Precipitation	IS	On site location	Monthly	Gross beta, H3 Gamma spectrum Sr-89, -90	H3 in quarterly composite samples Sr-89, -90 on quarterly composite All analyses subject to sufficient sample collection.
Ground Water	2 10 21 25	Chesapeake Country Club* On site well Long Beach* White Sands Club*	Quarterly	Gamma spectrum Tritium	

Table 3.2-1 (sh. 1)

ATTACHMENT  
2

TABLE 3.2-1 (Sheet 2)

ENVIRONMENTAL RADIOLOGICAL MONITORING  
CALVERT CLIFFS NUCLEAR POWER PLANT.

TYPE OF SAMPLE	SAMPLE POINT	SAMPLE POINT DESCRIPTION	SAMPLE FREQUENCY	ANALYSIS	REMARKS
Air Iodine	17, 18 20 23	On site locations Lusby Taylors Island*	Continuous collection- cartridge change weekly	I-131	
Soil	11, 12 13	On site locations	Semiannually	Gamma spectrum Sr-90	
Vegetation	14 15, 16	On site location nearby farms	At harvest time	Gamma spectrum Sr-89, -90	Predominant food crops (corn and small grains) will be sampled at harvest time. Corn stalks, if used as a fodder, will also be sampled. Pasture and forage are to be sampled at Sample Point 16 monthly when the cows are on pasture and analyzed for gamma spectrum, Sr-89, -90.
Milk	16 30	Nearby farm Local store (pasteurized milk) in town of Lusby or St. Leonard	Monthly	I-131 Gamma spectrum Sr-89, -90	Samples will be collected when milk is available from location 16. Twice a year (at the beginning of and midway through the pasture season) surveys will be made of the area to determine if any cows are being pastured at locations nearer than Sample Point 16. If cows are found, samples of milk will be obtained for these locations and analyzed as required for Sample Point 16.
Rooted aquatic plants	29	Flag Ponds area	Semiannually (spring & fall)	Gamma spectrum Sr-89, -90	Samples will be collected when rooted aquatic plants are available

ATTACHMENT 2



ENVIRONMENTAL RADIOLOGICAL MONITORING  
CALVERT CLIFFS NUCLEAR POWER PLANT

TYPE OF SAMPLE	SAMPLE POINT	SAMPLE POINT DESCRIPTION	SAMPLE FREQUENCY	ANALYSIS	REMARKS
Air particulates	17, 18	On site locations	Continuous collection- filter change weekly	Gross beta (after a minimum of of 72-hour decay period). Gamma spectrum, Sr-89, -90 on quarterly composites, of weekly samples.	
	19	Knotty Pine			
	20	Lusby			
	21	Long Beach			
	22	Cove Point			
	23	Taylors Island*			
Ambient radiation dosimeters (thermoluminescent)	7	Plant outfall area	Monthly	Ambient radiation dose rate	
	17, 18, 24	On site locations			
	19	Knotty Pine			
	20	Lusby			
	21	Long Beach			
	22	Cove Point			
	23	Taylors Island*			
	25	White Sands Club Sign			
	26	St. Leonard			
	27	Solomons			
	28	Bertha			

- Notes: (1) Asterisks(\*) denote control stations  
(2) An additional TLD is located in Baltimore and may serve as an additional control for ambient radiation.

are properly controlled and monitored. The data obtained as a result of these requirements will permit an evaluation of the performance of the station in terms of radionuclides released to the environment.

The environmental monitoring program requires sufficient sampling locations, types of samples and sensitivity of analyses which, with preoperational and background data, will provide verification of the effectiveness of station radioeffluent control, an indication of measurable change in radiation and radioactivity levels in the environment, and provide reasonable assurance that the design objective releases/doses specified in Section 2.3 are not exceeded.

**TABLE 3.2-2**  
**DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS**

Analysis	Lower Limit of Detection (LLD) <sup>a</sup>					
	Water (pCi/l)	Airborne Particulate or Gas (pCi/m <sup>3</sup> )	Fish, Meat, or Poultry (pCi/kg. wet)	Milk (pCi/l)	Vegetation (pCi/kg. wet)	Soil (pCi/kg. dry)
gross beta	5	$1 \times 10^{-2}$				
<sup>3</sup> H	330					
<sup>54</sup> Mn	15		130			
<sup>59</sup> Fe	30		260			
<sup>58,60</sup> Co	15		130			
<sup>65</sup> Zn	30		260			
<sup>89</sup> Sr	10	$5 \times 10^{-3}$	40	10		
<sup>90</sup> Sr	2	$1 \times 10^{-3}$	8	2		150
<sup>95</sup> Zr-Nb	10					
<sup>131</sup> I	0.4 <sup>b</sup>	$7 \times 10^{-2}$		0.4	80	
<sup>134,137</sup> Cs	15	$1 \times 10^{-2}$	130	15	80	150
<sup>140</sup> Ba-La	15			15		

<sup>a</sup>The nominal lower limit of detection is defined in HASL 300 (Rev. 8/74), pp. D-08-01, 02, 03 at the 95% confidence level. The LLD levels are decay corrected to the end of the total sampling period. The LLD for radionuclides analyzed by gamma spectrometry will vary according to the number of radionuclides encountered in environmental samples.

<sup>b</sup>Applies to drinking water only.

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INSERT THE INFORMATION ON ATTACHED SHEET HERE	
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### ATTACHMENT 3

Add the below Specification titles to  
page IV of the Unit 1 and 2 Technical  
Specifications where indicated under 3/4.3.3  
"Monitoring Instrumentation"

Radioactive Liquid Effluent Monitoring Instrumentation ..... 3/4 3-47

Radioactive Gaseous Effluent Monitoring Instrumentation ..... 3/4 3-52

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CALVERT CLIFFS UNIT 1  
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3/4.11.2 GASEOUS EFFLUENTS . . . . .	B 3/4 11-2
3/4.11.3 SOLID RADIOACTIVE WASTE . . . . .	B 3/4 11-5
3/4.11.4 TOTAL DOSE . . . . .	B 3/4 11-5

INSTRUMENTATIONRADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATIONLIMITING CONDITION FOR OPERATION

---

3.3.3.8 The radioactive liquid effluent monitoring instrumentation channels shown in Table 3.3-12 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 3.11.1.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY: At all times.

ACTION:

- a. With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, without delay suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.
- b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.3-12. Exert best efforts to return the instruments to OPERABLE status within 30 days and, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.
- c. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

---

4.3.3.8 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.3-12.

TABLE 3.3-12

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

<u>INSTRUMENT</u>		<u>MINIMUM CHANNELS OPERABLE</u>	<u>ACTION</u>
1.	GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
a.	Liquid Radwaste Effluent Line	(1)	28
b.	Steam Generator Blowdown Effluent Line	(1)	29
2.	FLOW RATE MEASUREMENT DEVICES		
a.	Liquid Radwaste Effluent Line	(1)	30
b.	Steam Generator Blowdown Effluent Line	(1)	30



TABLE 3.3-12 (Continued)TABLE NOTATION

- ACTION 28 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided that prior to initiating a release:
- At least two independent samples are analyzed in accordance with Specification 4.11.1.1.1, and
  - At least two technically qualified members of the Facility Staff independently verify the release rate calculations and two qualified operators verify the discharge valve line up.
- ACTION 29 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided grab samples are analyzed for gross radioactivity (beta or gamma) at the lower limit of detection defined in Table 4.11-1:
- At least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 microcurie/gram DOSE EQUIVALENT I-131.
  - At least once per 48 hours when the specific activity of the secondary coolant is less than or equal to 0.01 microcurie/gram DOSE EQUIVALENT I-131.
- ACTION 30 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours during actual releases. Pump performance curves may be used to estimate flow.

TABLE 4.3-12

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

<u>INSTRUMENT</u>		<u>CHANNEL CHECK</u>	<u>SOURCE CHECK</u>	<u>CHANNEL CALIBRATION</u>	<u>FUNCTIONAL TEST</u>
1.	GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE				
a.	Liquid Radwaste Effluent Line	D	P	R(2)	SA(1)
b.	Steam Generator Blowdown Effluent Line	D	P	R(2)	SA(1)
2.	FLOW RATE MEASUREMENT DEVICES				
a.	Liquid Radwaste Effluent Line	D(3)	N.A.	R	N.A.
b.	Steam Generator Blowdown Effluent Line	D(3)	N.A.	R	N.A.

TABLE 4.3-12 (Continued)TABLE NOTATION

- (1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway and/or control room alarm annunciation occur if the appropriate following condition(s) exists:
  1. Instrument indicates measured levels above the alarm/trip setpoint.
  2. Circuit failure.
  3. Instrument indicates a downscale failure.
- (2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards traceable to the National Bureau of Standards or using standards that have been obtained from suppliers that participate in measurement assurance activities with NBS. These standards shall permit calibrating the system within its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration can be used.
- (3) CHANNEL CHECK shall consist of verifying indication of flow during periods of release. CHANNEL CHECK shall be made at least once per 24 hours on days on which effluent releases are made.

INSTRUMENTATIONRADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATIONLIMITING CONDITION FOR OPERATION

---

3.3.3.9 The radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.3-13 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 3.11.2.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the ODCM.

APPLICABILITY: As shown in Table 3.3-13

ACTION:

- a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above Specification, without delay suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.
- b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.3-13. Exert best efforts to return the instruments to OPERABLE status within 30 days and, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.
- c. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

---

4.3.3.9 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.3-13.

TABLE 3.3-13  
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

	<u>INSTRUMENT</u>	<u>MINIMUM CHANNELS OPERABLE</u>	<u>APPLICABILITY</u>	<u>ACTION</u>
1.	WASTE GAS HOLDUP SYSTEM			
a.	Noble Gas Activity monitor - Providing Alarm and Automatic Termination of Release	(1)	*	35
b.	Effluent System Flow Rate Measuring Device	(1)	*	36
2.	MAIN VENT SYSTEM			
a.	Noble Gas Activity Monitor	(1)	*	37
b.	Iodine Sampler	(1)	*	38
c.	Particulate Sampler	(1)	*	38



TABLE 3.3-13 (Continued)TABLE NOTATION

\* At all times.

ACTION 35 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, the contents of the tank(s) may be released to the environment:

- a. Using the main vent monitor as a backup and recording RMS readings every 15 minutes during the release, or
- b. Provided that prior to initiating the release, at least two independent samples of the tank's contents are analyzed, and at least two technically qualified members of the Facility Staff independently verify the release rate calculations and two qualified operators verify the discharge valve lineup.

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 36 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours.

ACTION 37 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided either (1) grab samples are taken and analyzed for gross activity at least once per 24 hours, or (2) an equivalent monitor is provided.

ACTION 38 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via the affected pathway may continue provided samples are continuously collected as required in Table 4.11-2 with auxiliary sampling equipment.

TABLE 4.3-13

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

<u>INSTRUMENT</u>		<u>CHANNEL CHECK</u>	<u>SOURCE CHECK</u>	<u>CHANNEL CALIBRATION</u>	<u>CHANNEL FUNCTIONAL TEST</u>	<u>MODES IN WHICH SURVEILLANCE REQUIRED</u>
1.	WASTE GAS HOLDUP SYSTEM					
a.	Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	P	P	R(3)	SA(1)	*
b.	Effluent System Flow Rate Measuring Device	D(4)	N.A.	R	N.A.	*
2.	MAIN VENT SYSTEM					
a.	Noble Gas Activity Monitor	D	M	R(3)	SA(2)	*
b.	Iodine Sampler	W	N.A.	N.A.	N.A.	*
c.	Particulate Sampler	W	N.A.	N.A.	N.A.	*

TABLE 4.3-13 (Continued)TABLE NOTATION

- \* At all times other than when the line is valved out and locked.
- (1) The CHANNEL FUNCTIONAL TEST shall also demonstrate the automatic isolation of this pathway and/or control room alarm annunciation occurs if the appropriate following condition(s) exists:
1. Instrument indicates measure levels above the alarm/trip setpoint.
  2. Circuit failure.
  3. Instrument indicates a downscale failure.
- (2) The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:
1. Instrument indicates measured levels above the alarm setpoint.
  2. Circuit failure.
  3. Instrument indicates a downscale failure.
- (3) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards traceable to the National Bureau of Standards or using standards that have been obtained from suppliers that participate in measurement assurance activities with NBS. These standards shall permit calibrating the system within its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration can be used.
- (4) The CHANNEL CHECK shall consist of verifying indication of flow during periods of release and shall be made at least once per 24 hours on days on which effluent releases are made.

RADIOACTIVE EFFLUENTS

LIQUID EFFLUENTS

CONCENTRATION

LIMITING CONDITION FOR OPERATION

---

3.11.1.1 The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases.

APPLICABILITY: At all times.

ACTION:

- a. With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, without delay restore the concentration to within the above limits.
- b. The provisions of Specifications 3.0.3 and 3.0.4 not applicable.

SURVEILLANCE REQUIREMENTS

---

4.11.1.1.1 Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 4.11-1.

4.11.1.1.2 The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in the ODCM to assure that the concentrations at the point of release are maintained within the limits of Specification 3.11.1.1.

TABLE 4.11-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Minimum Sampling Frequency	Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) <sup>a</sup> (uCi/ml)
A. Batch Waste Releases <sup>b</sup>	P Each Batch	P Each Batch	Principal Gamma Emitters <sup>c</sup>	$5 \times 10^{-7}$
			I-131	$1 \times 10^{-6}$
			Mo-99, Ce-144	$2 \times 10^{-6}$
	P Each Batch	M Composite <sup>d</sup>	H-3	$1 \times 10^{-5}$
			Gross Alpha	$1 \times 10^{-7}$
	P Each Batch	Q Composite <sup>d</sup>	Sr-89, Sr-90	$5 \times 10^{-8}$
B. Turbine Building Sump	M	M	Principal Gamma Emitters <sup>c</sup>	$5 \times 10^{-7}$
			I-131	$1 \times 10^{-6}$
			Mo-99, Ce-144	$2 \times 10^{-6}$



TABLE 4.11-1 (Continued)

TABLE NOTATION

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

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

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

Where:

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

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

E is the counting efficiency, as counts per disintegration,

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

$2.22 \times 10^6$  is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

$\lambda$  is the radioactive decay constant for the particular radionuclide, and

$\Delta t$  is the elapsed time between sample collection, or end of the sample collection period, and time of counting.

Typical values of E, V, Y, and  $\Delta t$  should be used in the calculation.

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

- <sup>b</sup> Prior to sampling Reactor Coolant Waste and Miscellaneous Waste for analyses, each batch shall be isolated, and then thoroughly mixed to assure representative sampling.

TABLE 4.11-1 (Continued)TABLE NOTATION

- <sup>c</sup> The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Cs-134, Cs-137 and Ce-141. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Semiannual Radioactive Effluent Release Report pursuant to Specification 6.9.1.8.
- <sup>d</sup> A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged in which the method of sampling employed results in a specimen that is representative of the liquids released.

## RADIOACTIVE EFFLUENTS

### DOSE

#### LIMITING CONDITION FOR OPERATION

---

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

- a. During any calendar quarter to less than or equal to 3.0 mrem to the total body and to less than or equal to 10 mrem to any organ, and
- b. During any calendar year to less than or equal to 6 mrem to the total body and to less than or equal to 20 mrem to any organ.

APPLICABILITY: At all times.

#### ACTION:

- a. With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

#### SURVEILLANCE REQUIREMENTS

---

4.11.1.2 Monthly cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in the ODCM at least once per 60 days.

## RADIOACTIVE EFFLUENTS

### LIQUID RADWASTE TREATMENT SYSTEM

#### LIMITING CONDITION FOR OPERATION

---

3.11.1.3 The liquid radwaste treatment system shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the calculated doses due to the liquid effluent to UNRESTRICTED AREAS exceeds 0.36 mrem to the total body or 1.20 mrem to any organ in a 92 day period.

APPLICABILITY: At all times.

#### ACTION:

- a. With radioactive liquid waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days pursuant to Specification 6.9.2 a Special Report that includes the following information:
  1. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,
  2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and
  3. Summary description of action(s) taken to prevent a recurrence.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

#### SURVEILLANCE REQUIREMENTS

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4.11.1.3 Monthly doses due to liquid releases to UNRESTRICTED AREAS shall be calculated at least once per 60 days in accordance with the methodology and parameters in the ODCM.

RADIOACTIVE EFFLUENTS

GASEOUS EFFLUENTS

DOSE RATE

LIMITING CONDITION FOR OPERATION

---

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 (see Figure 5.1-1) shall be limited to the following:

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

APPLICABILITY: At all times.

ACTION:

- a. With the dose rate(s) exceeding the above limits, without delay restore the release rate to within the above limit(s).
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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4.11.2.1.1 The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM.

4.11.2.1.2 The dose rate due to iodine-131 and all radionuclides in particulate form with half lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 4.11-2.



TABLE 4.11-2  
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) <sup>a</sup> (uCi/ml)
A. Waste Gas Storage <sup>f,g</sup> Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters <sup>b</sup> (Gaseous Emissions Only)	1x10 <sup>-4</sup>
B. Containment Purge and Vent	P Each Batch <sup>C</sup> Grab Sample	P Each Batch <sup>C</sup>	Principal Gamma Emitters <sup>b</sup> (Gaseous Emissions Only)	1x10 <sup>-4</sup>
C. Main Vent	M Grab Sample <sup>C</sup>	M <sup>C</sup>	Principal Gamma Emitters <sup>b</sup> (Gaseous Emissions Only)	1x10 <sup>-4</sup>
	Continuous <sup>d</sup>	M	H-3	1x10 <sup>-6</sup>
	Continuous <sup>d</sup>	W Charcoal Sample <sup>e</sup>	I-131	1x10 <sup>-12</sup>
	Continuous <sup>d</sup>	W Particulate Sample <sup>e</sup>	Principal Gamma Emitters <sup>b</sup> (I-131, Others)	1x10 <sup>-11</sup>
	Continuous <sup>d</sup>	M Composite Particulate Sample	Gross Alpha	1x10 <sup>-11</sup>
	Continuous <sup>d</sup>	Q Composite Particulate Sample	Sr-89, Sr-90	1x10 <sup>-11</sup>
	Continuous <sup>d</sup>	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1x10 <sup>-6</sup>

TABLE 4.11-2 (Continued)

TABLE NOTATION

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

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

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

Where:

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

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

E is the counting efficiency, as counts per disintegration,

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

$2.22 \times 10^6$  is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

$\lambda$  is the radioactive decay constant for the particular radionuclide, and

$\Delta t$  for plant effluents is the elapsed time between sample collection or end of the sample collection period, and time of counting.

Typical values of E, V, Y, and  $\Delta t$  should be used in the calculation.

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

TABLE 4.11-2 (Continued)TABLE NOTATION

- b The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Seminannual Radioactive Effluent Release Report pursuant to Specification 6.9.1.8.
- c Sampling and analysis shall also be performed following shutdown, startup, or a THERMAL POWER change exceeding 15 percent of RATED THERMAL POWER within one hour unless (1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 5, and (2) the noble gas activity monitor shows that effluent activity has not increased by more than a factor of 5.
- d The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Specifications 3.11.2.1, 3.11.2.2 and 3.11.2.3.
- e Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing, or after removal from sampler. When sample collection time is less than seven days, the corresponding LLDs may be increased by a proportional factor. This requirement does not apply if (1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 5, and (2) the noble gas monitor shows that effluent activity has not increased more than a factor of 5.
- f Waste Gas Decay Tank samples shall be collected and analyzed for oxygen once per week on the in-service tank and following tank isolation. Waste Gas Surge Tank samples shall be collected and analyzed daily during power escalation from MODE 6 through MODE 3, and once per week at all other times.
- g Collect sample and analyze daily for total Curie content per Specification 3.11.2.6 when the Reactor Coolant System specific activity of Xe-133 is greater than 150 uCi/ml.

RADIOACTIVE EFFLUENTSDOSE - NOBLE GASESLIMITING CONDITION FOR OPERATION

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3.11.2.2 The air dose due to noble gases released in gaseous effluents to areas at and beyond the SITE BOUNDARY (see Figure 5.1-1) shall be limited to the following:

- a. During any calendar quarter: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation and,
- b. During any calendar year: Less than or equal to 20 mrad for gamma radiation and less than or equal to 40 mrad for beta radiation.

APPLICABILITY: At all times.

ACTION:

- a. With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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4.11.2.2 Monthly cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with the methodology and parameters in the ODCM at least once per 60 days.

RADIOACTIVE EFFLUENTSDOSE - IODINE-131 AND RADIONUCLIDES IN PARTICULATE FORMLIMITING CONDITION FOR OPERATION

---

3.11.2.3 The dose to a MEMBER OF THE PUBLIC from iodine-131 and all radionuclides in particulate form with half lives greater than 8 days in gaseous effluents released to areas at and beyond the SITE BOUNDARY (see Figure 5.1-1) shall be limited to the following:

- a. During any calendar quarter: Less than or equal to 15 mrems to any organ and,
- b. During any calendar year: Less than or equal to 30 mrems to any organ.
- c. Less than 10% of the limits of 3.11.2.3(a) and (b) as a result of burning contaminated oil.

APPLICABILITY: At all times.

ACTION:

- a. With the calculated dose from the release of iodine-131 and radionuclides in particulate form with half lives greater than 8 days, in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

---

4.11.2.3 Monthly cumulative dose contributions for the current calendar quarter and current calendar year for iodine-131 and radionuclides in particulate form with half lives greater than 8 days shall be determined in accordance with the methodology and parameters in the ODCM at least once per 60 days.



RADIOACTIVE EFFLUENTSGASEOUS RADWASTE TREATMENT SYSTEMLIMITING CONDITION FOR OPERATION

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3.11.2.4 The GASEOUS RADWASTE TREATMENT SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the gaseous effluent air doses due to gaseous effluent releases, to areas at and beyond the SITE BOUNDARY (see Figure 5.1-1) exceeds 1.20 mrad for gamma radiation and 2.4 mrad for beta radiation in a 92 day period. The VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the calculated doses due to gaseous effluent releases, to areas at and beyond the SITE BOUNDARY (see Figure 5.1-1) exceeds 1.8 mrem to any organ in a 92 day period.

APPLICABILITY: At all times.

ACTION:

- a. With gaseous waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that includes the following information:
  1. Explanation of why gaseous radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,
  2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and
  3. Summary description of action(s) taken to prevent a recurrence.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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4.11.2.4.1 Monthly doses due to gaseous releases shall be calculated at least once per 60 days in accordance with the methodology and parameters in the ODCM.

RADIOACTIVE EFFLUENTS

EXPLOSIVE GAS MIXTURE (Hydrogen rich systems not designed to withstand a hydrogen explosion)

LIMITING CONDITION FOR OPERATION

3.11.2.5 The concentration of oxygen in the waste gas holdup system shall be limited to less than or equal to 4% by volume.

APPLICABILITY: At all times

ACTION:

- a. With the concentration of oxygen in a waste gas decay tank greater than 4% by volume immediately suspend all additions of waste gases to that tank and reduce the concentration of oxygen to less than or equal to 4% by volume without delay.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.2.5 The concentrations of oxygen in the waste gas holdup system shall be determined to be within the above limits by the sampling program described in Table 4.11-2.

RADIOACTIVE EFFLUENTS

GAS STORAGE TANKS

LIMITING CONDITION FOR OPERATION

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3.11.2.6 The quantity of radioactivity contained in each gas storage tank shall be limited to less than or equal to 58,500 curies noble gases (considered as Xe-133).

APPLICABILITY: At all times.

ACTION:

- a. With the quantity of radioactive material in any gas storage tank exceeding the above limit, immediately suspend all additions of radioactive material to that tank and within 48 hours reduce the tank contents to within the limit.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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4.11.2.6 The quantity of radioactive material contained in the in-service gas storage tank shall be determined to be within the above limit at least once per 24 hours when the Reactor Coolant System specific activity of Xe-133 is greater than 150 uCi/ml.

RADIOACTIVE EFFLUENTS

SOLID RADIOACTIVE WASTE

LIMITING CONDITION FOR OPERATION

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3.11.3 The solid radwaste program shall be used in accordance with a PROCESS CONTROL PROGRAM to process wet radioactive wastes to meet shipping and burial ground requirements.

APPLICABILITY: At all times.

ACTION:

- a. With the provisions of the PROCESS CONTROL PROGRAM not satisfied, suspend shipments of defectively processed or defectively packaged solid radioactive wastes from the site.
- b. The provision of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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4.11.3 THE PROCESS CONTROL PROGRAM shall be used to verify the SOLIDIFICATION of at least one representative test specimen from at least every tenth batch of each type of wet radioactive waste (e.g., filter sludges, spent resins, evaporator bottoms, boric acid solutions, and sodium sulfate solutions).

RADIOACTIVE EFFLUENTSTOTAL DOSELIMITING CONDITION FOR OPERATION

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 less than or equal to 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem.

APPLICABILITY: At all times.

ACTION:

- a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specification 3.11.1.2.a, 3.11.1.2.b, 3.11.2.2.a, 3.11.2.2.b, 3.11.2.3.a, or 3.11.2.3.b, calculations shall be made including direct radiation contributions from the reactor units and outside storage tanks to determine whether the above limits of Specification 3.11.4 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR Part 20.405c, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentrations of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.
- b. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.4.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Specifications 4.11.1.2, 4.11.2.2, and 4.11.2.3, and in accordance with the methodology and parameters in the ODCM.

4.11.4.2 Cumulative dose contributions from direct radiation from the reactor units and outside storage tanks shall be determined in accordance with the methodology and parameters in the ODCM. This requirement is applicable only under conditions set forth in Specification 3.11.4.a.

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INSTRUMENTATIONBASES

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3/4.3.3.10 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

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

3/4.3.3.11 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of Specification 3.11.2.1.a based on average annual X/Q. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

3/4.11 RADIOACTIVE EFFLUENTSBASES3/4.11.1 LIQUID EFFLUENTS3/4.11.1.1 CONCENTRATION

This specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table II, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC and (2) the limits of 10 CFR Part 20.106(e) to the population.

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

3/4.11.1.2 DOSE

This specification is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977, Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977, and NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants".

## RADIOACTIVE EFFLUENTS

### BASES (Continued)

#### 3/4.11.1.3 LIQUID RADWASTE TREATMENT SYSTEM

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

#### 3/4.11.2 GASEOUS EFFLUENTS

##### 3/4.11.2.1 DOSE RATE

This specification is provided to ensure that the dose at any time at and beyond the SITE BOUNDARY from gaseous effluents from all units on the site will be within the annual dose limits of 10 CFR Part 20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR Part 20.106(b)). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY.

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

RADIOACTIVE EFFLUENTSBASES (Continued)

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3/4.11.2.2 DOSE - NOBLE GASES

This specification is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977, and NUREG-0133 "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants".

The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical annual average atmospheric conditions.



RADIOACTIVE EFFLUENTSBASES (Continued)3/4.11.2.3 DOSE - IODINE 131 AND RADIONUCLIDES IN PARTICULATE FORM

This specification is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Conditions for Operation are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977, Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977, and NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants". These equations also provide for determining the actual doses based upon the historical annual average atmospheric conditions. The release rate specifications for iodine-131, and radionuclides in particulate form with half lives greater than 8 days are dependent upon the existing radionuclide pathways to man, in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

3/4.11.2.4 GASEOUS RADWASTE TREATMENT SYSTEM

The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable".

This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.



RADIOACTIVE EFFLUENTSBASES (Continued)

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3/4.11.2.5 EXPLOSIVE GAS MIXTURE

This specification is provided to ensure that the concentration of potentially explosive gas mixtures contained in the waste gas holdup system is maintained below the flammability limit of oxygen. Maintaining the concentration of oxygen below its flammability limit provides assurance that the releases of radioactive materials will be controlled in conformance with the requirements of General Design Criterion 60 of Appendix A to 10 CFR Part 50.

3/4.11.2.6 GAS STORAGE TANKS

The tanks included in this specification are those tanks for which the quantity of radioactivity contained is not limited directly or indirectly by another Technical Specification to a quantity that is less than the quantity that provides assurance that in the event of an uncontrolled release of the tank's contents, the resulting total body exposure to a MEMBER OF THE PUBLIC at the nearest SITE BOUNDARY will not exceed 10 CFR 100 limits.

Restricting the quantity of radioactivity contained in each gas storage tank provides assurance that in the event of an uncontrolled release of the tank's contents, the resulting total body exposure to a MEMBER OF THE PUBLIC at the nearest SITE BOUNDARY will not exceed accident guidelines.

3/4.11.3 SOLID RADIOACTIVE WASTE

This specification implements the requirements of 10 CFR Part 50.36a and General design Criterion 60 of Appendix A to 10 CFR Part 50. The process parameters are included in the PROCESS CONTROL PROGRAM.

3/4.11.4 TOTAL DOSE

This specification is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant generated radioactive effluents and direct radiation exceed 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible.

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RADIOACTIVE EFFLUENTSBASES

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If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR Part 190.11 and 10 CFR Part 20.405c, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in Specifications 3.11.1.1 and 3.11.2.1. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

ADMINISTRATIVE CONTROLSMEETING FREQUENCY

6.5.1.4 The POSRC shall meet at least once per calendar month and as convened by the POSRC Chairman or his designated alternate.

QUORUM

6.5.1.5 A quorum of the POSRC shall consist of the Chairman or his designated alternate and four members including alternates.

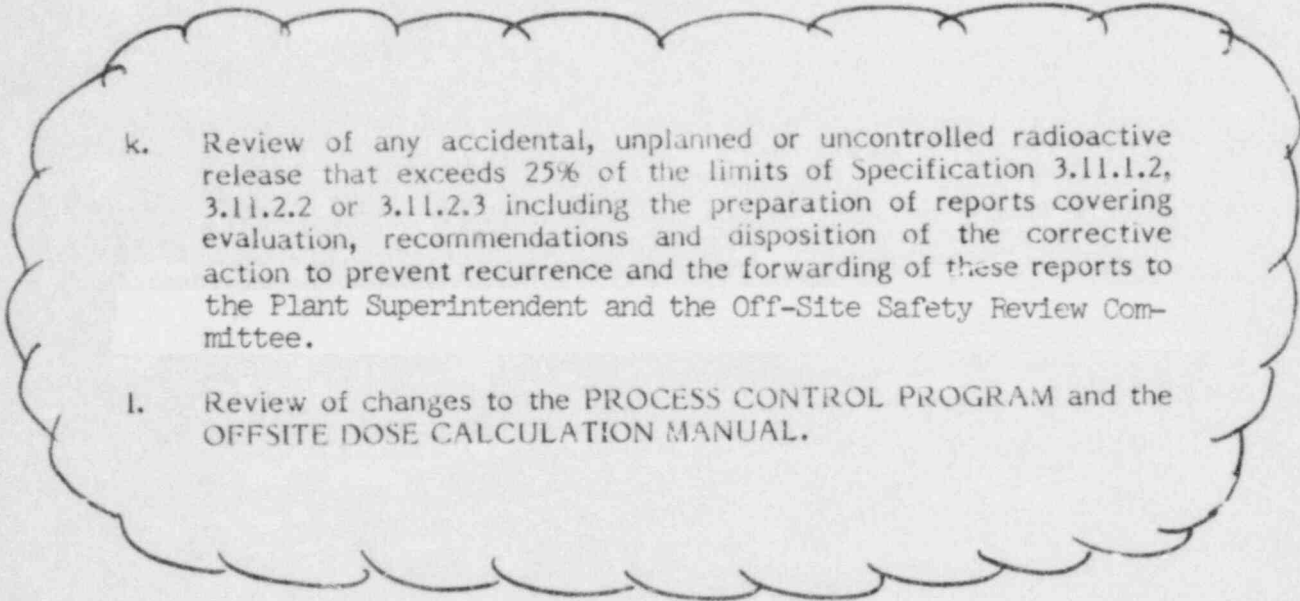
RESPONSIBILITIES

6.5.1.6 The POSRC shall be responsible for:

- a. Review of 1) all procedures required by Specification 6.8 and changes thereto, 2) any other proposed procedures or changes thereto as determined by the Plant Superintendent to affect nuclear safety.
- b. Review of all proposed tests and experiments that affect nuclear safety.
- c. Review of all proposed changes to Appendix "A" Technical Specifications.
- d. Review of all proposed changes or modifications to plant systems or equipment that affect nuclear safety.
- e. Investigation of all violations of the Technical Specifications including the preparation and forwarding of reports covering evaluation and recommendations to prevent recurrence to the Manager - Nuclear Power Department and to the Chairman of the Off Site Safety Review Committee.
- f. Review of all REPORTABLE EVENTS.
- g. Review of facility operations to detect potential safety hazards.
- h. Performance of special reviews, investigations or analyses and reports thereon as requested by the Chairman of the Off Site Safety Review Committee.
- i. Review of the Plant Security Plan and implementing procedures and shall submit recommended changes to the Off Site Safety Review Committee.
- j. Review of the Emergency Plan and implementing procedures and shall submit recommended changes to the Off Site Safety Review Committee.

Insert paragraphs k. and l. from attached sheet here

INSERT THE FOLLOWING INFORMATION AS PARAGRAPHS K. AND L. UNDER TECHNICAL SPECIFICATION 6.5.1.6 , PAGE 6-7:

- 
- k. Review of any accidental, unplanned or uncontrolled radioactive release that exceeds 25% of the limits of Specification 3.11.1.2, 3.11.2.2 or 3.11.2.3 including the preparation of reports covering evaluation, recommendations and disposition of the corrective action to prevent recurrence and the forwarding of these reports to the Plant Superintendent and the Off-Site Safety Review Committee.
  - l. Review of changes to the PROCESS CONTROL PROGRAM and the OFFSITE DOSE CALCULATION MANUAL.



ADMINISTRATIVE CONTROLSAUDITS

6.5.2.8.1 Audits of facility activities shall be performed under the cognizance of the OSSRC. These audits shall encompass: §

- a. The conformance of facility operation to provisions contained within the Technical Specifications and applicable license conditions at least once per 12 months.
- b. The performance, training and qualification of the entire facility staff at least once per 12 months.
- c. The results of actions taken to correct deficiencies occurring in facility equipment, structures, systems or method of operation that affect nuclear safety at least once per 6 months.
- d. The performance of activities required by the Quality Assurance Program to meet the criteria of Appendix "B", 10 CFR 50, at least once per 24 months.
- e. Deleted §
- f. The Safeguards Contingency Plan and implementing procedures at least once per 12 months in accordance with 10 CFR 73.40(d). §
- g. Any other area of facility operation considered appropriate by the OSSRC or the Vice President-Supply.
- h. The Facility Fire Protection Program and implementing procedures at least once per 24 months.
- i. An independent fire protection and loss prevention program inspection and audit shall be performed at least once per 12 months utilizing either qualified offsite licensee personnel or an outside fire protection firm.
- j. An inspection and audit of the fire protection and loss prevention program shall be performed by a qualified outside fire consultant at least once per 36 months.

**INSERT PARAGRAPHS K, l, m, and n FROM ATTACHED SHEET HERE**

6.5.2.8.2 Review of facility activities shall be performed under the cognizance of the OSSRC. These reviews shall encompass:

- a. The Facility Emergency Plan and implementing procedures at least once per 12 months in accordance with 10 CFR Part 50.54(t).

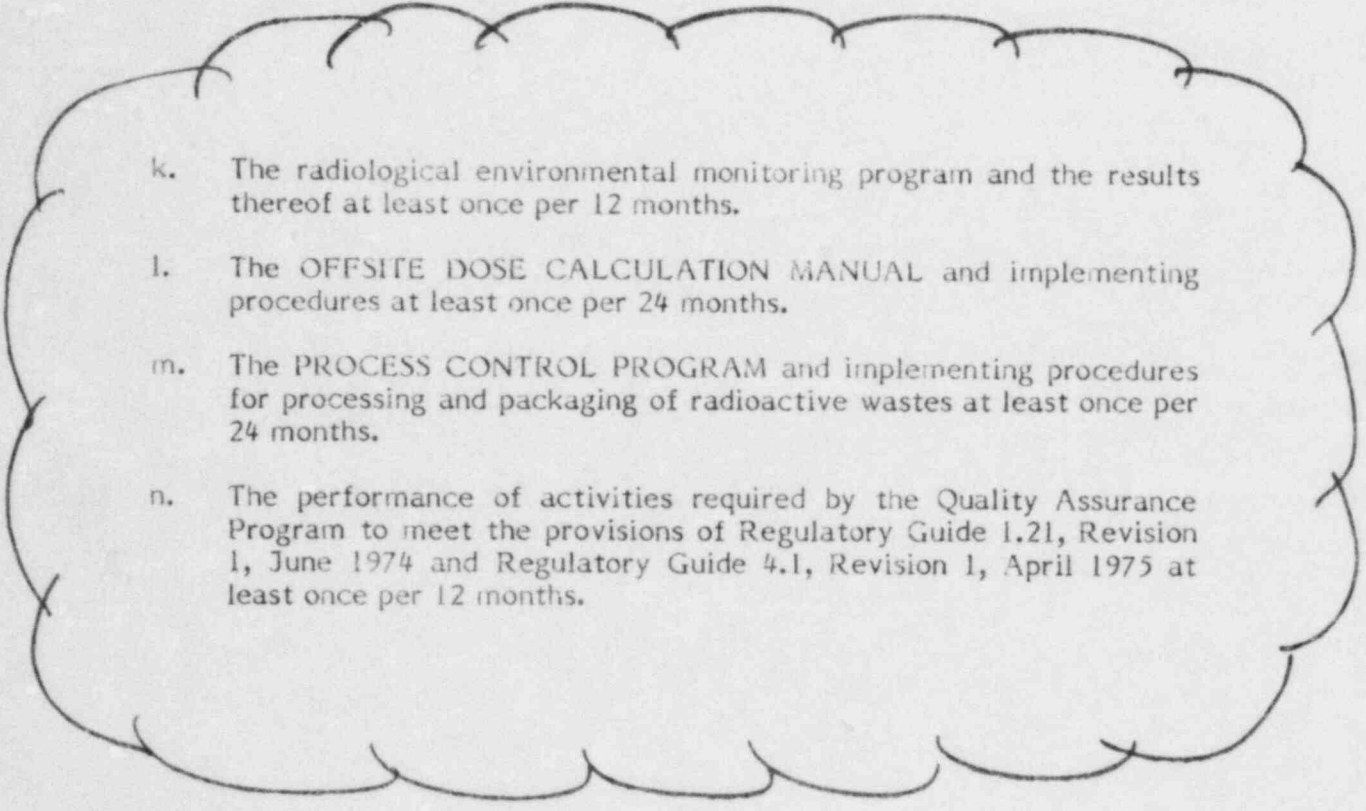
AUTHORITY

6.5.2.9 The OSSRC shall report to and advise the Vice President-Supply on those areas of responsibility specified in Sections 6.5.2.7 and 6.5.2.8.



INSERT THE FOLLOWING PARAGRAPHS:

k, l, m, n. UNDER TECHNICAL SPECIFICATION  
6.5, 2.8.1, PAGE 6-11:

- 
- k. The radiological environmental monitoring program and the results thereof at least once per 12 months.
  - l. The OFFSITE DOSE CALCULATION MANUAL and implementing procedures at least once per 24 months.
  - m. The PROCESS CONTROL PROGRAM and implementing procedures for processing and packaging of radioactive wastes at least once per 24 months.
  - n. The performance of activities required by the Quality Assurance Program to meet the provisions of Regulatory Guide 1.21, Revision 1, June 1974 and Regulatory Guide 4.1, Revision 1, April 1975 at least once per 12 months.

ADMINISTRATIVE CONTROLS6.7 SAFETY LIMIT VIOLATION

6.7.1 The following actions shall be taken in the event a Safety Limit is violated:

- a. The facility shall be placed in at least HOT STANDBY within one hour.
- b. The NRC Operations Center shall be notified by telephone as soon as possible and in all cases within one hour. The Manager - Nuclear Power Department and the OSSRC shall be notified within 24 hours.
- c. A Safety Limit Violation Report shall be prepared. The report shall be reviewed by the POSRC. This report shall describe (1) applicable circumstances preceding the violation, (2) effects of the violation upon facility components, systems or structures, and (3) corrective action taken to prevent recurrence.
- d. The Safety Limit Violation Report shall be submitted to the Commission, the OSSRC and the Manager - Nuclear Power Department within 14 days of the violation.

6.8 PROCEDURES

6.8.1 Written procedures shall be established; implemented and maintained covering the activities referenced below:

- a. The applicable procedures recommended in Appendix "A" of Regulatory Guide 1.33, Revision 2, February 1978.
- b. Refueling operations.
- c. Surveillance and test activities of safety related equipment.
- d. Security Plan implementation.
- e. Emergency Plan implementation.
- f. Fire Protection Program implementation.
- g. The amount of overtime worked by plant staff members performing safety related functions must be limited in accordance with the NRC Policy Statement on working hours (Generic Letter No. 82-12).

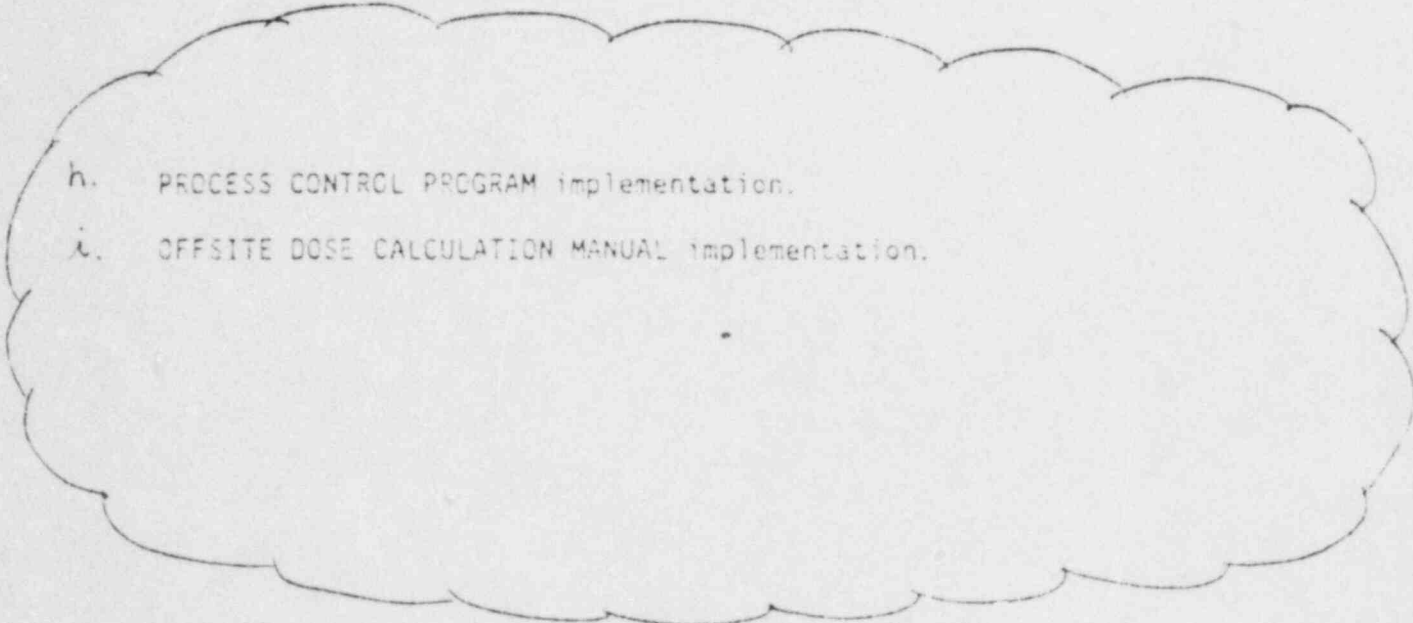
*INSERT PARAGRAPHS h and i FROM ATTACHED SHEET HERE*

6.8.2 Each procedure and administrative policy of 6.8.1 above and changes thereto shall be reviewed by the POSRC and approved by the Plant Superintendent prior to implementation and reviewed periodically as set forth in administrative procedures.

INSERT THE FOLLOWING INFORMATION AS PARAGRAPHS

h. and i.

UNDER TECHNICAL SPECIFICATION 6.3.1, PAGE 6-13:

- 
- h. PROCESS CONTROL PROGRAM implementation.
  - i. OFFSITE DOSE CALCULATION MANUAL implementation.

ADMINISTRATIVE CONTROLSMONTHLY OPERATING REPORT

6.9.1.6 Routine reports of operating statistics and shutdown experience shall be submitted on a monthly basis to the Director, Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, ATTN: Document Control Desk, with a copy to the Regional Administrator and to the NRC Resident Inspector, no later than the 15th of each month following the calendar month covered by the report.

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT\*

6.9.1.7 Routine Radiological Environmental Operating Reports covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year.

The Annual Radiological Environmental Operating Reports shall include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, with operational controls as appropriate, and with previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of land use censuses required by Specification 3.12.2.

The Annual Radiological Environmental Operating Reports shall include the results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in the Table and Figures in the ODCM, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The reports shall also include the following: a summary description of the radiological environmental monitoring program; at least two legible maps\*\* covering all sampling locations keyed to a table giving distances and directions from the central point between the two containment buildings; the results of licensee participation in the Interlaboratory Comparison Program, required by Specification 3.12.3; discussion of all deviations from the sampling schedule of Table 3.12-1; and discussion of all analyses in which the LLD required by Table 4.12-1 was not achievable.



## ADMINISTRATIVE CONTROLS

The Annual Radiological Environmental Operating Report will include the identification of the cause of unavailability of samples (if any), and will describe the locations used for the replacement samples. The report will also include any permanent changes in the sample locations which could appear in the monitoring program. It will include a revised figure(s) and table for the ODCM reflecting the new location(s).

- \* A single submittal may be made.
- \*\* One map shall cover stations near the site boundary; a second shall include the more distant stations.

## SEMIANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT\*

6.9.1.8 Routine Radioactive Effluent Release Reports covering the operation of the unit during the previous 6 months of operation shall be submitted within 60 days after January 1 and July 1 of each.\*\*

The Radioactive Effluent Release Reports shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the plant 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.

The Radioactive Effluent Release Report to be submitted within 60 days after January 1 of each year shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability.\*\*\* 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 assessment of radiation doses shall be performed in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

- \* A single submittal may be made for Calvert Cliffs, since the radwaste systems are common to both units.
- \*\* In lieu of submission with the Semi-Annual Reports, Sr<sup>89</sup>, Sr<sup>90</sup> analyses results may be submitted in a supplementary report within 120 days after January 1 and July 1 of each year.
- \*\*\* In lieu of submission with the first half year Radioactive Effluent Release Report, this summary of required meteorological data may be retained on site in a file that shall be provided to the NRC upon request.



## ADMINISTRATIVE CONTROLS

### SEMIANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (Continued)

The Radioactive Effluent Release Report to be submitted 60 days after January 1 of each year 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 Regulatory Guide 1.109, Rev. 1, October 1977, and NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants".

The Radioactive Effluent Release Reports shall include the following information for each class of solid waste (as defined by 10 CFR Part 61) shipped offsite during the report period:

- a. Container volume,
- b. Total curie quantity (specify whether determined by measurement or estimate),
- c. Principal radionuclides (specify whether determined by measurement or estimate),
- d. Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms),
- e. Solidification agent or absorbent (e.g., cement).

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

The Radioactive Effluent Release Reports shall include any changes made during the reporting period to the PROCESS CONTROL PROGRAM (PCP) and to the OFFSITE DOSE CALCULATION MANUAL (ODCM), as well as a listing of new locations for dose calculations identified by the annual land use census pursuant to Specification 3.12.2.

### SPECIAL REPORTS

6.9.2 Special reports shall be submitted to the Director of the NRC Regional Office listed in Appendix D, 10 CFR Part 20, with a copy to the Director, Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 within the time period specified for each report. These reports shall be submitted covering the activities identified below pursuant to the requirements of the applicable reference specification:

CALVERT CLIFFS UNIT 1  
CALVERT CLIFFS UNIT 2

6-18

Amendment No.  
Amendment No.

ADMINISTRATIVE CONTROLS

- a. ECCS Actuation, Specifications 3.5.2 and 3.5.3.
- b. Inoperable Seismic Monitoring Instrumentation, Specification 3.3.3.3.
- c. Inoperable Meteorological Monitoring Instrumentation, Specification 3.3.3.4.
- d. Seismic event analysis, Specification 4.3.3.3.2.
- e. Core Barrel Movement, Specification 3.4.11.
- f. Fire Detection Instrumentation, Specification 3.3.3.7.
- g. Fire Suppression Systems, Specifications 3.7.11.1, 3.7.11.2, 3.7.11.3, 3.7.11.4 and 3.7.11.5..
- h. Penetration Fire Barriers, Specification 3.7.12.
- i. Steam Generator Tube Inspection Results, Specification 4.4.5.5.
- j. Specific Activity of Primary Coolant, Specification 3.4.8.
- k. Containment Structural Integrity, Specification 4.6.1.6.
- l. Radioactive Effluents -- Calculated Dose and Total Dose, Specifications 3.11.1.2, 3.11.2.2, 3.11.2.3, and 3.11.4.
- m. Radioactive Effluents -- Liquid Radwaste, Gaseous Radwaste and Ventilation Exhaust Treatment Systems Discharges, Specifications 3.11.1.2 and 3.11.2.4.
- n. Radiological Environmental Monitoring Program, Specification 3.12.1.

## ADMINISTRATIVE CONTROLS

- d. Records of radiation exposure for all individuals entering radiation control areas.
- e. Records of gaseous and liquid radioactive material released to the environs.
- f. Records of transient or operational cycles for those facility components identified in Table 5.7.1.
- g. Records of training and qualification for current members of the plant staff.
- h. Records of in-service inspections performed pursuant to these Technical Specifications.
- i. Records of Quality Assurance activities identified in the NRC approved QA Manual as lifetime records.
- j. Records of reviews performed for changes made to procedures or equipment or reviews of tests and experiments pursuant to 10 CFR 50.59.
- k. Records of meetings of the POSRC and the OSSRC.
- l. Records of Environmental Qualification which are covered under the provisions of paragraph 6.13.
- m. Records of the service lives of all snubbers listed on Table 3.7-4 including the date at which the service life commences and associated installation and maintenance records.

INSERT PARAGRAPH N. ON ATTACHED SHEET HERE

### 6.11 RADIATION PROTECTION PROGRAM

Procedures for personnel radiation protection shall be prepared consistent with the requirements of 10 CFR Part 20 and shall be approved, maintained and adhered to for all operations involving personnel radiation exposure.

### 6.12 HIGH RADIATION AREA

6.12.1 In lieu of the "control device" or "alarm signal" required by paragraph 20.203(c)(2) of 10 CFR Part 20:

- a. A high radiation area in which the intensity of radiation is greater than 100 mrem/hr but less than 1000 mrem/hr shall be barricaded and conspicuously posted as a High Radiation Area and entrance thereto shall be controlled by issuance of a Special or Radiation Work Permit and any individual or group of individuals permitted to enter such areas shall be provided with a radiation monitoring device which continuously indicates the radiation dose rate in the area.

INSERT THE FOLLOWING PARAGRAPH AFTER  
ITEM "m." ON Page 6-20:  
(T.S. 6.10.2)

n. Records of analyses required by the radiological environmental monitoring program that would permit evaluation of the accuracy of the analysis at a later date. This should include procedures effective at specified times and QA records showing that these procedures were followed.

ADMINISTRATIVE CONTROLS6.16 PROCESS CONTROL PROGRAM (PCP)

- 6.16.1 The PCP shall be approved by the Commission prior to implementation.
- 6.16.2 Licensee initiated changes to the PCP:
1. Shall be submitted to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the change(s) was made. This submittal shall contain:
    - a. An evaluation supporting the premise that the change did not reduce the overall conformance of the solidified waste product to existing criteria for solid wastes; and
    - b. A reference to the date and the POSRC meeting number in which the change(s) were reviewed and found acceptable to the POSRC.
  2. Shall become effective upon review and approval by the responsible Nuclear Power Department unit and approval of Plant Superintendent.

6.17 OFFSITE DOSE CALCULATION MANUAL (ODCM)

- 6.17.1 The ODCM shall be approved by the Commission prior to implementation.
- 6.17.2 Licensee initiated changes to the ODCM:
1. Shall be submitted to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the change(s) was made effective. This submittal shall contain:
    - a. Sufficient information to support the rationale for the change. Information submitted should consist of a package of those pages of the ODCM to be changed with each page numbered and provided with a change number and/or change date together with appropriate analyses or evaluations justifying the change(s);
    - b. A determination that the change will not reduce the accuracy or reliability of dose calculations or setpoint determinations; and
    - c. Documentation of the fact that the change has been reviewed and found acceptable by the POSRC.
  2. Shall become effective upon review by the POSRC and approval of the Plant Superintendent.



ADMINISTRATIVE CONTROLS

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6.18 MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS AND SOLID  
WASTE TREATMENT SYSTEMS

6.18.1 Licensee initiated major changes to the radioactive waste systems (liquid, gaseous and solid) shall be reported to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the modification to the waste system is completed. The discussion of each change shall contain:

- a. A description of the equipment, components and processes involved.
- b. Documentation of the fact that the change including the safety analysis was reviewed and found acceptable by the POSRC.

CALVERT CLIFFS NUCLEAR POWER PLANT

UNIT NOS. 1 AND 2

APPENDIX B

PART I

\$

ENVIRONMENTAL TECHNICAL SPECIFICATIONS

FACILITY OPERATING LICENSE NOS. DPR-53 AND DPR-69

APPENDIX B PART I IS DELETED  
in its ENTIRETY.

ISSUED BY THE U. S. NUCLEAR REGULATORY COMMISSION

ATTACHMENT (4)

OFFSITE DOSE CALCULATION MANUAL

(ODCM)

CALVERT CLIFFS NUCLEAR POWER PLANT

BALTIMORE GAS AND ELECTRIC COMPANY

## ODCM

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## ODCM

### LIST OF ATTACHMENTS

Attachment (1)	Dose Factors for Noble Gases
Attachment (2)	Radioactive Effluent Monitoring Instrumentation
Attachment (3)	Radioactive Liquid Waste System
Attachment (4)	Liquid Effluents Dose Conversion Factors
Attachment (5)	Liquid Effluents - Adult Dose (Fish and Shellfish Pathway)
Attachment (6)	Radioactive Gaseous Waste System
Attachment (7)	Gaseous Effluents - Pathway Dose Parameters
Attachment (8)	Gaseous Effluents - Effective Dose Factors (Noble Gases)
Attachment (9)	Locations of Environment Sampling Sites
Attachment (10)	Map of Environmental Sampling Sites (10 mile radius)
Attachment (11)	Map of Environmental Sampling Sites (2 mile radius)



## OFFSITE DOSE CALCULATION MANUAL

### 1.0 SETPOINTS

#### 1.1 Liquid Effluents

1.1.1 In accordance with the requirements of Technical Specification 3.3.3.10, alarm setpoints shall be established for the liquid effluent monitoring instrumentation to ensure that the concentration of radioactive material released in liquid effluents does not exceed the limits of 10CFR20 Appendix B, Table II, Column 2.

1.1.2 The setpoint shall be established taking credit for operation of five of the twelve circulating water pumps in accordance with the liquid waste processing description in the Final Safety Analysis Report (FSAR).

1.1.3 Setpoint shall be determined as follows:

$$SP = \sum (A_i \times \text{RMS Response}_i) \times \frac{\text{Dilution Water Flow Rate}}{\text{Discharge Flow Rate}} + \text{Bkgd}$$

Where:

SP = Setpoint (cpm)

$A_i$  = Specific Activity (uCi/ml) of radionuclide i as defined in the Final Safety Analysis Report (FSAR) for Liquid Waste. The radionuclide mixture shall include I-131 (95%), Cs-134 (0.5%), Cs-137 (1.5%), Co-58 (2.2%) and Co-60 (0.25%). The actual uCi/ml shall be determined using the appropriate MPCs as defined in 10CFR20 Appendix B, Table II, Column 2.

$\text{RMS Response}_i$  = Monitor sensitivity (cpm/uCi/ml) for radionuclide i

Dilution Water Flow Rate = Dilution from 5 circulators (1E+06 gpm)

Discharge Flow Rate = Maximum liquid effluent flow rate into  
circulating water (gpm).

a. Liquid Waste (120 gpm)

b. Steam Generator Blowdown (225 gpm per  
generator)

Bkgd = RMS background level (cpm)

## 1.2 Gaseous Effluents

1.2.1 In accordance with the requirements of Technical Specification  
3.3.3.11, alarm setpoints shall be established for the gaseous effluent  
monitoring instrumentation to ensure that the dose rate due to  
radioactive materials released in gaseous effluents does not exceed  
500 mrem/yr (total body) or 3000 mrem/yr (skin).

1.2.2 Setpoint shall be determined as follows:

$$SP = \frac{\sum (A_i \times \text{RMS Response}_i)}{(X/Q) \times (F)} + \text{Bkgd}$$

Where:

SP = Setpoint (cpm)

$A_i$  = Specific Activity (uCi/ml) of noble gas radio  
nuclide i as defined in the Final Safety Analysis  
Report (FSAR) for the radionuclide mixture of  
Xe 133 (95%), Xe 135 (4%) and Kr 88 (1%).

(Refer to Section 1.2.3)

$\text{RMS Reponse}_i$  = monitor sensitivity (cpm/uCi/ml) for  
radionuclide i

$X/Q$  = average annual meteorological dispersion based  
on 1983 meteorological data (2.2E-06 sec/m<sup>3</sup>)

F = System flow rate for release point radiation  
monitor ( $\text{m}^3/\text{sec}$ )

Bkgd = RMS background level (cpm)

1.2.3 The total body dose rate conversion factors (Attachment 1) shall be used to calculate the nuclide concentrations since they are more restrictive than the skin dose factors for the radionuclide mixture of interest, described in the FSAR.

1.2.4 The main vent setpoints shall be set to ensure that simultaneous releases from both U-1 and U-2 Main Vents do not exceed established dose limits at the site boundary.

1.3 The radiation monitor response (cpm) for effluent releases shall be predicted using prerelease data as follows:

$$\text{cpm} = \left[ \sum (A_i \times \text{RMS response}_i) + \text{Bkgd} \right] \times 1.5$$

Where:

$A_i$  = Specific Activity ( $\text{uCi/ml}$ )

$\text{RMS Response}_i$  = ( $\text{cpm/uCi/ml}$ ) for each isotope based on calibrated monitor response tables/graphs supplied by vendors or generated in plant.

Bkgd = RMS background level (cpm)

1.5 = Detector tolerance as defined in FSAR (150% of anticipated count rate)

1.4 The liquid and gaseous waste radiation monitor descriptions including effluent controls and sample points are listed on Attachment (2).

1.5 The radiation monitors have remote visual/audible alarms and visual meter indications at the local detector locations. In addition, remote detector alarms, meters and recorders are located in the Control Room.

## 2.0 RADIOACTIVE LIQUID EFFLUENTS

### 2.1 Processing Equipment and Flow Paths

- 2.1.1 The normal liquid waste processing equipment flow paths and monitoring systems are defined on Attachment (3).
- 2.1.2 Non routine lineups for the liquid waste processing system include tank recirculations, bypass options, extended filtration and ion exchange. These may be utilized as required by system chemical and operational activities.

### 2.2 Liquid Effluent Concentration

- 2.2.1 Routine batch liquid waste releases to the Chesapeake Bay include:
  - a. Miscellaneous Waste
  - b. Reactor Coolant Waste
  - c. Steam Generator Blowdown (Unit 1 and Unit 2)
- 2.2.2 Steam Generator Blowdown is normally discharged to the condensate system and recycled. Discrete volumes are occasionally discharged to the Chesapeake Bay in a batch form rather than a continuous type effluent.
- 2.2.3 Prior to discharge a grab sample of the waste stream(s) shall be collected and analyzed to verify compliance with 10CFR20 Appendix B, Table II, Column 2.

$$\sum \frac{A_i}{MPC_i} \times \frac{\text{Discharge Flow Rate}}{\text{Dilution Water Flow Rate}} \leq 1$$

Where:

$A_i$  = specific activity (uCi/ml) of isotope i from  
waste stream sample

$MPC_i$  = 10CFR20 limit, Appendix B, Table II, Column 2  
(uCi/ml)

(The soluble MPC shall be used if the radionuclide solubility state is unknown.)

Discharge Flow Rate = flow rate (gpm) of waste stream into circulating water.

Dilution Water Flow Rate = dilution from 5 circulators (1E+06 gpm)

2.2.4 Reactor Coolant and Miscellaneous Waste Tank Volumes shall be recirculated prior to sample collection to ensure a representative sample for analysis.

2.2.5 A liquid waste discharge permit shall be prepared for routine batch radioactive liquid releases. The permit shall document the release conditions and approvals, sample analysis results and compliance with the Radiological Effluent Technical Specifications.

2.2.6 Credit for dilution of liquid waste shall be taken for (5) circulating water pumps having a total capacity of 1.0E+06 gpm.

2.2.7 In lieu of using the prerelease sample for post release accounting and monthly/quarterly analyses, a representative composite sample may be collected during the release and used for dose commitment and reporting requirements.

### 2.3 Liquid Effluent Dose

2.3.1 Technical Specification 3.11.1.2 limits the dose or dose commitment to members of the public from radioactive materials in liquid effluents from the Calvert Cliffs Nuclear Power Plant to:

- during any calendar quarter;
- ≤ 3.0 mrem to total body
- ≤ 10.0 mrem to any organ



- during any calendar year;
- $\leq 6.0$  mrem to total body
- $\leq 20.0$  mrem to any organ.

Dose due to liquid effluents may be calculated using the equations in Section 2.3.2 or 2.3.4.

### 2.3.2 Dose Commitment (Expanded Equation)

To fulfill the surveillance requirements of Technical Specification 4.11.1.2, the following calculation may be used for determining the dose or dose commitment due to the liquid radioactive effluents.

$$D_o = \frac{1.67E-02 \times V}{CW} \times \sum (A_i \times C_{io})$$

Where:

$D_o$  = dose or dose commitment to organ o, including total body (mrem)

$1.67E-02$  = conversion factor (hr/min)

$V$  = volume of liquid effluent released (gal)

$CW$  = average circulating water discharge rate during release period (gal/min)

$A_i$  = Specific Activity (uCi/ml) of radionuclide i, in undiluted liquid effluent representative of the volume (V)

$C_{io}$  = site-related ingestion dose conversion factor to the total body or any organ o for radionuclide i (mrem/hr per uCi/ml)

### 2.3.3 Dose Conversion Factors

The site-related dose/dose conversion factors ( $C_{io}$ ) are presented in

Attachment (4) and have been derived in accordance with guidance of NUREG-0133 by the equation:

$$C_{io} = 1.14E+05 \times \left[ (U_F \times BF_i) + (U_I \times BI_i) \right] \times DF_{io}$$

Where:

$C_{io}$  = composite dose conversion factor for the total body or critical organ of an adult for radionuclide i, for the fish and invertebrate ingestion pathways (mrem/hr per uCi/ml)

$1.14E+05$  = conversion factor (pCi/uCi x ml/kg x yr/hr)

$U_F$  = 21 kg/yr, adult fish consumption

$BF_i$  = bioaccumulation factor for radionuclide i in fish (pCi/kg per pCi/l) from Regulatory Guide 1.109, Table A-1

$U_I$  = 5 kg/yr, adult invertebrate consumption

$BI_i$  = bioaccumulation factor for radionuclide i in invertebrate (pCi/kg per pCi/l) from Regulatory Guide 1.109, Table A-1

$DF_{io}$  = dose conversion factor for radionuclide i for adult in the organ o (mrem/pCi) from Regulatory Guide 1.109, Table E-11

For conservatism, no additional dilution by the receiving water body (Chesapeake Bay) has been included in the determination of these site-related dose commitment factors. The radionuclides included in the periodic dose assessment per the requirements of Technical Specification 3/4.11.1.2 are those as identified by gamma spectral analysis of the liquid waste samples collected and analyzed per the requirements of Technical Specification 3/4.11.1, Table 4.11-1.

Radionuclides requiring radiochemical analysis (e.g, Sr-89 and Sr-90) will be added to the dose analysis consistent with the required minimum analysis frequency of Table 4.11-1.

#### 2.3.4 Dose Commitment (Simplified Equation)

In lieu of the individual radionuclide dose assessment as defined in Section 2.3.2, the following simplified dose calculational equation may be used for verifying compliance with the dose limits of Technical Specification 3.11.1.2. Refer to Section 2.3.5 for the derivation and justification for this simplified method.

##### Total Body

$$D_{tb} = \frac{2.22E+02 \times V}{CW} \times \sum A_i$$

##### Maximum Organ

$$D_{max} = \frac{1.70E+03 \times V}{CW} \times \sum A_i$$

Where:

$D_{tb}$  = conservatively evaluated total body dose  
(mrem)

2.22E+02 = conversion factor (hr/min) and the conservative total body dose conversion factor (Cs-134 total body - 1.33E+04 mrem/hr per uCi/ml)

V = volume of liquid effluent released (gal)

CW = average circulating water discharge rate during release period (gal/min)

$A_i$  = average specific activity (uCi/ml) of radionuclide i in undiluted liquid effluent representative of the volume (V)

$D_{\max}$  = conservatively evaluated maximum organ dose  
(mrem)

$1.70E+03$  = conversion factor (hr/min) and the conservative  
maximum organ dose conversion factor (I-131),  
thyroid -  $1.05E+05$  mrem/hr per uCi/ml)

#### 2.3.5 Dose Commitment (Justification for Simplified Approach)

The radioactive liquid effluents for the years 1981, 1982 and 1983 were evaluated to determine the dose contribution of the radionuclide distribution. This analysis was performed to evaluate the use of a limited dose analysis for determining environmental doses, providing a simplified method of determining compliance with the dose limits of Technical Specification 3.11.1.2. For the radionuclide distribution of effluents from Calvert Cliffs, the controlling organ is either the thyroid or the GI-LLI. The calculated thyroid dose is almost exclusively dictated by the radioiodine releases; the GI-LLI dose is primarily a function of the Mn-54, Co-58, Co-60 and Ag-110m releases. The radionuclides, Mn-54, Co-58, Co-60, Sr-90, Cs-134 and Cs-137 contribute essentially all of the calculated total body dose. The results of this evaluation are presented in Attachment (5).

For purposes of simplifying the details of the dose calculation, it is conservative to identify a controlling, dose significant radionuclide and limit the calculation to the use of the dose conversion factor for this nuclide. Multiplication of the total release (i.e., cumulative activity for all radionuclides) by this dose conversion factor provides for a conservative simplified dose calculation.



For the evaluation of the maximum organ dose, it is conservative to use the I-131 thyroid dose conversion ( $1.02\text{E}+05$  mrem/hr per uCi/ml, thyroid). The radionuclide Ag-110m has a higher dose conversion factor ( $5.9\text{E}+05$  mrem/hr per uCi/ml, GI-LLI). However, since Ag-110m releases are typically less than 5% of the total releases, it is conservative (while not being overly restrictive) to use the I-131 factor. By this approach, the maximum organ dose will be routinely overestimated. For 1981, using this simplified conservative method would overestimate the maximum organ dose by a factor of 8; for 1982, the conservatism is a factor 3; and for 1983, a factor of 6.

For the total body calculation, the Cs-134 dose factor ( $1.33\text{E}+04$  mrem/hr per uCi/ml, total body) is the highest among the identified dominant nuclides. There are several reactor-generated radionuclides with higher values (e.g, Zn-65); however, in terms of an overall dose significance, the contribution of these nuclides will be minor, attributable to relative abundances in the effluent streams. For 1981, using this simplified conservative dose calculation would overestimate the total body dose by a factor of 7; for 1982, the conservatism is a factor of 4; and for 1983, a factor 5.

For evaluating compliance with the dose limits of Technical Specification 3.11.1.2, the following simplified equations may be used:

Total Body

$$D_{tb} = \frac{1.67\text{E}-02 \times V}{CW} \times C_{Cs-134} \times \sum A_i$$

Where:

$$D_{tb} = \text{dose to the total body (mrem)}$$



1.67E-02 = conversion factor (hr/min)

V = volume of liquid effluent released (gal)

CW = average circulating water discharge rate during  
release period (gal/min)

$C_{Cs-134} = 1.33E+04$ , total body ingestion dose conversion  
factor for Cs-134 (mrem/hr per uCi/ml)

$A_i$  = total specific activity of all radionuclides  
(uCi/ml)

Substituting the value for the Cs-134 total body dose conversion  
factor, the equation simplifies to:

$$D_{tb} = \frac{2.22E+02 \times V}{CW} \times \sum A_i$$

Maximum Organ

$$D_{max} = \frac{1.67E-02 \times V}{CW} \times C_{I-131} \times \sum A_i$$

Where:

$D_{max}$  = maximum organ dose (mrem)

$C_{I-131} = 1.02E+05$ , thyroid ingestion dose conversion  
factor for I-131 (mrem/hr per uCi/ml)

Substituting the value for  $C_{I-131}$ , the equation simplifies to:

$$D_{max} = \frac{1.70E+03 \times V}{CW} \times \sum A_i$$

Only the maximum organ dose need be evaluated by this simplified  
method since it represents the more limiting (compared with the total  
body dose) for demonstrating compliance with Technical Specification  
3.11.1.2.

Tritium is not included in the limited analysis dose assessment for  
liquid releases, because the potential dose resulting from normal

reactor releases is negligible and is essentially independent of radwaste system operation. The amount of tritium releases annually is about 1000 curies. At Calvert Cliffs, 1000 Ci/yr releases to the Chesapeake Bay produces a calculated whole body dose of  $1.6\text{E-}03$  mrem/yr via the fish and shellfish pathways. This amounts to 0.05% of the design objective dose of 3 mrem/yr. Furthermore, the release of tritium is a function of operating time and power level and is essentially unrelated to radwaste system operation.

### 3.0 RADIOACTIVE GASEOUS EFFLUENTS

#### 3.1 Processing Equipment and Flow Paths

The normal gaseous waste processing flow paths, equipment and monitoring systems are defined in Attachment (6).

#### 3.2 Release Parameters

3.2.1 Routine gaseous waste releases to the environment include:

Batch Releases:        Containment Vents  
                              Containment Purges  
                              Waste Gas Decay Tanks

Continuous Releases: Main Vent Headers

3.2.2 Prior to discharge of batches, a grab sample shall be collected and analyzed for gaseous gamma radionuclides.

3.2.3 Continuous release samples shall be collected and analyzed on a weekly basis in accordance with the Technical Specifications.

3.2.4 Radioactivity buildup and decay shall be accounted for in continuous main vent samples.

3.2.5 All iodines and particulate gamma emitters discharged from the plant shall be accounted for with the continuous main vent header samples since all gaseous effluents are discharged via this path.

3.2.6 A gaseous waste discharge permit shall be prepared for batch releases to document release conditions and approvals, sample analysis results and compliance with Technical Specifications.

3.2.7 Credit shall be taken for main vent dilution from the reactor unit through which a release is conducted.

Unit 1 - Main Vent Flow -  $63.7 \text{ m}^3/\text{sec}$

Unit 2 - Main Vent Flow -  $57.5 \text{ m}^3/\text{sec}$

### 3.3 Gaseous Effluent Dose Rate

#### 3.3.1 Site Boundary Dose Rate (Total Body, Skin)

Technical Specification 3.11.2.1a limits the dose rate at the site boundary due to noble gas releases to  $\leq 500$  mrem/yr, total body and  $\leq 3000$  mrem/yr, skin. Radiation monitor alarm setpoints are established to assure that these release limits are not exceeded. In the event any gaseous releases from the station results in the alarm setpoints being exceeded, an evaluation of the unrestricted area dose rate resulting from the release may be performed using the following equations:

$$\dot{D}_{tb} = X/Q \times (\sum K_i \times \dot{Q}_i)$$

$$\dot{D}_s = X/Q \times (\sum L_i + 1.1M_i) \times \dot{Q}_i$$

Where:

$\dot{D}_{tb}$  = total body dose rate (mrem/yr)

$X/Q$  = atmospheric dispersion to the controlling site boundary  $2.2E-06$  (sec/m<sup>3</sup>)

$K_i$  = total body dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m<sup>3</sup>) from Attachment (1)

$\dot{Q}_i$  = average release rate of radionuclide i over the release period under evaluation (uCi/sec)

$\dot{D}_s$  = skin dose rate (mrem/yr)

$L_i$  = beta skin dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m<sup>3</sup>) from Attachment (1)

$M_i$  = gamma air dose conversion factor for noble gas radionuclide  $i$  (mrad/yr per uCi/m<sup>3</sup>) from Attachment (1)

1.1 = mrem skin dose per mrad gamma air dose (mrem/mrad)

Actual meteorological conditions concurrent with the release period may be used for evaluating the gaseous effluent dose rate.

### 3.3.2 Site Boundary Dose Rate (Radioiodine and Particulates)

For I-131 and particulates with half-lives greater than 8 days, Technical Specification 3.11.2.1.b limits the dose rate to  $\leq 1500$  mrem/yr to any organ. To demonstrate compliance with this limit, an evaluation is performed at a frequency no greater than that corresponding to the sampling and analysis time period (e.g, nominally once per 7 days). The following equation may be used for the dose rate evaluation.

$$\dot{D}_O = X/Q \times (\sum R_i \times \dot{Q}_i)$$

Where:

$\dot{D}_O$  = average organ dose rate over the sampling time period (mrem/yr)

$X/Q$  = atmospheric dispersion to the controlling site boundary for the inhalation pathway (2.2E-06 sec/m<sup>3</sup>)

$R_i$  = dose parameter for radionuclide  $i$ , (mrem/yr per uCi/m<sup>3</sup>) for the child inhalation pathway from Attachment (7)

$\dot{Q}_i$  = average release rate over the appropriate sampling period and analysis frequency for



radionuclide i - I-131 or other radionuclide in particulate form with half-life greater than eight days (uCi/sec)

By substituting 1500 mrem/yr for  $\dot{D}_0$  solving for  $\dot{Q}$ , an allowable release rate for I-131 can be determined. Based on the annual average meteorological dispersion ( $2.2E-06 \text{ sec/m}^3$ ) and the most limiting potential pathway, age group and organ (inhalation pathway, child thyroid -  $R_i = 1.62E+07 \text{ mrem/yr per uCi/m}^3$ ), the allowable release rate for I-131 is 20 uCi/sec. An added conservatism factor of 0.5 has been included in this calculation to account for any potential dose contribution from other radioactive particulate material. For a 7 day period which is the nominal sampling and analysis frequency for I-131, the cumulative allowable release is 12.5 Ci. Therefore, as long as the I-131 releases in any 7 day period do not exceed 12.5 Ci, no additional analyses are needed to verify compliance with the Technical Specification 3.11.2.1.b limits on allowable release rate.

### 3.4 Gaseous Effluent Dose

#### 3.4.1 Gaseous Dose - Noble Gases (Expanded Equation)

Technical Specification 4.11.2.2 requires a periodic assessment of releases of noble gases to evaluate compliance with the quarterly dose limits of ( $\leq 10 \text{ mrad}$ , gamma-air and  $\leq 20 \text{ mrad}$ , beta-air) and the calendar year limits ( $\leq 20 \text{ mrad}$ , gamma-air and  $\leq 40 \text{ mrad}$ , beta-air). The following equations may be used to calculate the gamma-air and beta-air doses:

$$D_{\gamma} = 3.17E-08 \times X/Q \times (\sum M_i \times Q_i)$$

$$D_{\beta} = 3.17E-08 \times X/Q \times (\sum N_i \times Q_i)$$

Where:

$D_{\gamma}$  = air dose due to gamma emissions for noble gas radionuclides (mrad)

3.17E-08 = conversion factor (yr/sec)

X/Q = atmospheric dispersion to the controlling site boundary (2.2E-06 sec/m<sup>3</sup>)

$M_i$  = air dose factor due to gamma emissions from noble gas radionuclide i (mrad/yr per uCi/m<sup>3</sup>) from Attachment (1)

$Q_i$  = cumulative release of noble gas radionuclide i over the period of interest (uCi)

$D_{\beta}$  = air dose due to beta emissions from noble gas radionuclides (mrad)

$N_i$  = air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per uCi/m<sup>3</sup>) Attachment (1)

#### 3.4.2 Gaseous Dose - Noble Gases (Simplified Equation)

in lieu of the individual noble gas radionuclide dose assessment as presented above, the following simplified dose calculation may be used for verifying compliance with the dose limits of Technical Specification 3.11.2.2. (Refer to Section 3.4.5 for the derivation and justification for this simplified method.)

$$D_{\gamma} = 3.17E-08 \times X/Q \times M_{\text{eff}} \times \sum Q_i$$

and

$$D_{\beta} = 3.17E-08 \times X/Q \times N_{\text{eff}} \times \sum Q_i$$

Where:

$M_{\text{eff}} = 3.9\text{E}+02$ , effective gamma-air dose factor  
(mrad/yr per uCi/m<sup>3</sup>)

$N_{\text{eff}} = 1.1\text{E}+03$ , effective beta-air dose factor  
(mrad/yr per uCi/m<sup>3</sup>)

Actual meteorological conditions concurrent with the release period may be used for the evaluation of the gamma-air and beta-air doses.

#### 3.4.3 Gaseous Dose - Radioiodine and Particulates (Expanded Equation)

Per the requirements of Technical Specification 4.11.2.3, a periodic assessment shall be performed to evaluate compliance with the quarterly dose limit ( $\leq 15$  mrem) and calendar year limit ( $\leq 30$  mrem) to any organ. The following equation may be used to evaluate the maximum organ dose due to releases of I-131 and particulates with half-lives greater than 8 days.

$$D_{\text{aop}} = 3.17\text{E}-08 \times W \times (\sum R_i \times Q_i)$$

Where:

$D_{\text{aop}}$  = dose or dose commitment for age group a to organ o, including the total body, via pathway p from I-131 and radionuclides in particulate form with half-life greater than eight days (mrem)

$W$  = atmospheric dispersion parameter (X/Q or D/Q) to the controlling location (residence and vegetable garden at 2200 m, SSE)

X/Q = atmospheric dispersion for inhalation pathway via other pathways ( $4.9\text{E}-07$  sec/m<sup>3</sup>)

D/Q = atmospheric deposition for vegetable milk and meat pathways ( $3.2\text{E}-09$  m<sup>-2</sup>)

$R_i$  = dose factor for radionuclide i, (mrem/yr per uCi/m<sup>3</sup>) or (m<sup>2</sup> - mrem/yr per uCi/sec) from Attachment (7) for each age group a and the applicable pathway p.

Values for  $R_i$  were derived in accordance with the methods described in NUREG-0133.

$Q_i$  = cumulative release over the period of interest for radionuclide i - I-131 or radioactive material in particulate form with half-life greater than 8 days (uCi).

#### 3.4.4 Gaseous Dose - Radioiodine and Particulates (Simplified Equation)

In lieu of the individual radionuclide (I-131 and particulates) dose assessment as presented above, the following simplified dose calculational equation may be used for verifying compliance with the dose limits of Technical Specification 3.11.2.3.

$$D_{\max} = 3.17E-08 \times W \times R_{I-131} \times \sum Q_i$$

Where:

$D_{\max}$  = maximum organ dose (mrem)

$R_{I-131}$  = I-131 dose parameter for the thyroid for the identified controlling pathway

= 4.76E+10, child thyroid dose parameter with the vegetation pathway controlling (m<sup>2</sup> - mrem/yr per uCi/sec)

= 1.05E+12, infant thyroid dose parameter with the cow-milk pathway controlling (m<sup>2</sup> - mrem/yr per uCi/sec)

The ground plane exposure and inhalation pathways need not be considered when the above simplified calculation is used because of the overall negligible contribution of these pathways to the total thyroid dose. It is recognized that for some particulate radionuclides (e.g., Co-60 and Cs-137), the ground exposure pathway may represent a higher dose contribution than either the vegetation or milk pathway. However, use of the I-131 thyroid dose parameter for all radionuclides will maximize the organ dose calculation, especially considering that no other radionuclide has a higher dose parameter for any organ via any pathway than I-131 for the thyroid via the applicable vegetation or milk pathway.

The location of exposure pathways and the maximum organ dose calculation may be based on the available pathways in the surrounding environment of Calvert Cliffs as identified by the annual land-use census (Technical Specification 3.12.2). Otherwise the dose will be evaluated based on the predetermined controlling pathways, i.e., residence and vegetable garden at 2200 m, SSE.

#### 3.4.5 Technical Bases for Effective Dose Factors

The evaluation of doses due to releases of radioactive material to the atmosphere can be simplified by the use of effective dose transfer factors instead of using dose factors which are radionuclide specific. These effective factors, which are based on the typical radionuclide distribution in the releases, can be applied to the total radioactivity released to approximate the dose to the environment (i.e., instead of having to perform individual radionuclide dose analyses only a single multiplication ( $K_{\text{eff}}$ ,  $M_{\text{eff}}$  or  $N_{\text{eff}}$ ) times the total quantity of radioactive material released would be needed). This approach



provides a reasonable estimate of the actual dose while eliminating the need for a detailed calculation.

The effective dose transfer factors are based on past operating data. The radioactive effluent distribution for the past years can be used to derive single effective factors by the following equations:

$$1) \quad K_{\text{eff}} = \sum (K_i) \times (f_i)$$

Where:

$K_{\text{eff}}$  = the effective total body dose factor due to gamma emissions from all noble gases released

$K_i$  = the total body dose factor due to gamma emissions from each noble gas radionuclide  $i$  released

$f_i$  = the fractional abundance of noble gas radionuclide  $i$  relative to the total noble gas activity

$$2) \quad (L + 1.1 M)_{\text{eff}} = \sum (L_i + 1.1 M_i) \times f_i$$

Where:

$(L + 1.1 M)_{\text{eff}}$  = the effective skin dose factor due to beta and gamma emissions from all noble gases released

$(L_i + 1.1 M_i)$  = the skin dose factor due to beta and gamma emissions from each noble gas radionuclide  $i$  released

$$3) \quad M_{\text{eff}} = \sum M_i \times f_i$$

Where:

$M_{\text{eff}}$  = the effective air dose factor due to gamma emissions from all noble gases released

$M_i$  = the air dose factor due to gamma emissions from each noble gas radionuclide  $i$  released

$$4) \quad N_{\text{eff}} = \sum N_i \times f_i$$

Where:

$N_{\text{eff}}$  = the effective air dose factor due to beta emissions from all noble gases released

$N_i$  = the air dose factor due to beta emissions from each noble gas radionuclide  $i$

To determine the appropriate effective factors to be used and to evaluate the degree of variability, the atmospheric radioactive effluents for the past 3 years have been evaluated. Attachment (8) presents the results of this evaluation.

As demonstrated by the data in Attachment (8), the effective dose transfer factors vary little from year to year. The maximum observed variability from the average value is less than 10%. This variability is minor considering other areas of uncertainty and conservatism inherent in the environmental dose calculation models.

For evaluating compliance with the dose limits of Technical Specification 3.11.2.2, the following simplified equations may be used:

$$D_{\gamma} = 3.17\text{E-}08 \times X/Q \times M_{\text{eff}} \times \sum Q_i$$

$$D_{\beta} = 3.17\text{E-}08 \times X/Q \times N_{\text{eff}} \times \sum Q_i$$

Where:

$D_{\gamma}$  = air dose due to gamma emissions for the  
cumulative release of all noble gases (mrad)

$D_{\beta}$  = air dose due to beta emissions for the  
cumulative release of all noble gases (mrad)

$X/Q$  = atmospheric dispersion to the controlling site  
boundary (sec/m<sup>3</sup>)

$M_{\text{eff}}$  = 3.9E+02, effective gamma-air dose factor  
(mrad/yr per uCi/m<sup>3</sup>)

$N_{\text{eff}}$  = 1.1E+03, effective beta-air dose factor  
(mrad/yr per uCi/m<sup>3</sup>)

$Q_i$  = cumulative release for all noble gas  
radionuclides (uCi)

3.17E-08 = conversion factor (yr/sec)

Combining the constants, the dose calculation equations simplify to:

$$D_{\gamma} = 1.24E-05 \times X/Q \times \sum Q_i$$

and

$$D_{\beta} = 3.49E-05 \times X/Q \times \sum Q_i$$

Only the beta-air dose need be evaluated by this simplified method since it represents the more limiting (compared with the gamma-air dose) based on the limits of Technical Specification 3.11.2.2.

The effective dose factors are used on a very limited basis for the purpose of facilitating the timely assessment of radioactive effluent releases, particularly during periods of computer malfunctions where a detailed dose assessment may be unavailable. Dose assessments using the detailed, radionuclide dependent calculation are performed

at least every six months for preparation of the Semi-Annual Radioactive Effluent Reports. Comparisons can be performed at this time to assure that the use of the effective dose factors does not substantially underestimate actual doses.

### 3.5 Camp Conoy/Visitors Center Dose Calculation

- 3.5.1 Camp Conoy and the Visitors Center are the only locations within the Calvert Cliffs Site Boundary that are frequently visited by members of the public. Based on the data in Section 3.5.2 and 3.5.3 any actual exposure to individuals at these locations will be less than the calculated exposure for the site boundary and controlling offsite location. Therefore, no special considerations are required for addressing potential exposure at these onsite locations.
- 3.5.2 Camp Conoy is located in the south east (SE) sector approximately 3000 ft from the plant. Maximum occupancy for any individual at this recreational facility is approximately 900 hours per year. The average annual  $X/Q$  for the SE sector at 3000 ft is  $2.40E-06 \text{ sec/m}^3$ . The dose calculation for the controlling site boundary is more conservative by a factor of 9.
- 3.5.3 The Visitors Center is located in the West North West (WNW) Sector at 1000 ft from the plant. The wind frequency for the WNW sector based on 1983 meteorological data is 4%. Using a conservative basis of 10% wind frequency, an individual visiting the center for 330 hours/year during the periods of worst case meteorological conditions would be most highly exposed. The average annual  $X/Q$  for the WNW sector at 1000 ft is  $8.68E-06 \text{ sec/m}^3$ . The dose calculation for the controlling site boundary is more conservative by a factor 7.

#### 4.0 40CFR190 COMPLIANCE

In accordance with the requirements of Technical Specification 3.11.4, doses to any member of the public due to releases of radioactivity and direct radiation from reactor units and outside storage tanks shall be calculated when doses from liquid or gaseous effluents exceed twice the limits of Technical Specifications 3.11.1.2, 3.11.2.2 or 3.11.2.3.

$$\text{Total Dose (mrem)} = D(L) + D(G) + D(R)$$

Where:

D(L) = Dose (mrem) from liquid effluents based on the yearly isotopic distribution and determined by the equation in Section 2.3.2.

D(G) = Dose (mrem) from gaseous effluents. The maximum exposed individual is in the SSE Sector based on historical X/Q and wind frequencies at 1300 meters. Dose shall be calculated using the equation in Section 3.4.1 and 3.4.3 and substituting average annual X/Q for the year of interest.

D(R) = Dose (mrem) for the maximum exposed individual located in the Southwest (SW) Sector where the direct radiation from the reactor units and outside storage tanks would be most conservative. The dose at the site boundary shall be based on the onsite TLD readings in the general vicinity of the Refueling Water tanks.



## 5.0 RADWASTE SYSTEM MODIFICATIONS

5.1 In accordance with Specification 6.15.1, major changes to the radioactive waste system shall be reported to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the modification to the waste system was completed.

5.2 A major radwaste system modification would include removal or permanent bypass of any of the following equipment:

- Degasifiers
- Reactor Coolant Waste Tanks
- Letdown Filters
- Reactor Coolant Waste Ion Exchangers
- Miscellaneous Waste Ion Exchanger and Filter
- Miscellaneous Waste Tanks
- Waste Gas Decay Tanks
- Waste Gas Surge Tank
- Spent Resin Metering Tank

## 6.0 ENVIRONMENTAL MONITORING

- 6.1 The objectives of the Radiological Environmental Monitoring Program are:
- 6.1.1 To determine whether any statistically significant increase occurs in the concentration of radionuclides in the environment.
  - 6.1.2 To detect any measurable buildup of long-lived radionuclides in the environment.
  - 6.1.3 To monitor and evaluate ambient radiation levels.
  - 6.1.4 To verify that radioactivity and ambient radiation levels attributable to the plant are within the limits specified in the Environmental Radiation Protection Standards as set forth in 40 CFR Part 190.
- 6.2 The radiological environmental monitoring stations are listed in Attachment (9). The location of these stations with respect to the Calvert Cliffs Nuclear Power Plant are shown on topographic maps in Attachments (10) and (11).

Laboratories performing radiochemical analyses on samples obtained from the Radiological Environmental Monitoring Program shall participate in an Interlaboratory Comparison Program, such as the one offered by the Environmental Protection Agency. The choice of the type of samples analyzed should coincide with the type of samples routinely analyzed in the Radiological Environmental Monitoring Program (i.e., gamma isotopic analyses, tritium determinations, gross beta activity analyses, etc.). The actual results shall be compared to the theoretical results reported by the Interlaboratory Comparison Program in order to assess the laboratory's accuracy and precision. If it becomes apparent that the laboratory's results seem biased or that the analysis lacks reproducibility, the detecting instrument shall be checked and the analytical procedure shall be investigated to determine if there are any inherent problems. If such problems manifest themselves, corrective action shall be taken to rectify the situation.

## ATTACHMENT (I)

DOSE FACTORS FOR NOBLE GASES \*

Radionuclide	Total Body Dose Factor $K_i$ (mrem/yr per uCi/m <sup>3</sup> )	Skin Dose Factor $L_i$ (mrem/yr per uCi/m <sup>3</sup> )	Gamma Air Dose Factor $M_i$ (mrad/yr per uCi/m <sup>3</sup> )	Beta Air Dose Factor $N_i$ (mrad/yr per uCi/m <sup>3</sup> )
Kr-83m	7.56E-02	----	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

\* Derived from Reg. Guide 1.109

ATTACHMENT (2)

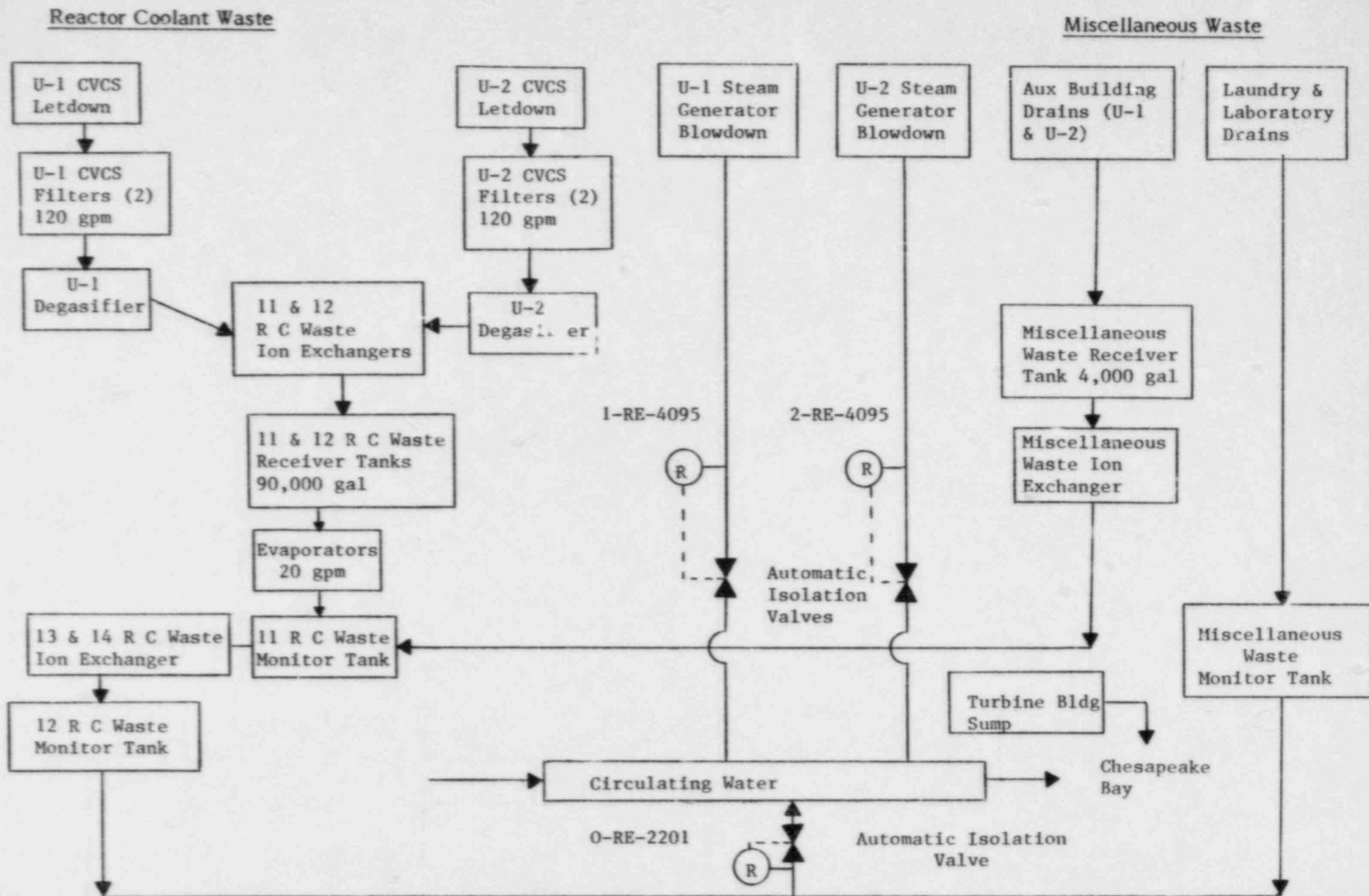
RADIOACTIVE EFFLUENT MONITORING INSTRUMENTATION

	<u>Detector Type</u>	<u>Sample Point</u>	<u>Auto Shutoff Valves and RMS Alarm</u>
<u>Liquid Effluent Monitors</u>			
a. Liquid Waste Discharge (0-RE-2201)	Scintillation (in line)	0-SX-6487 0-SX-6488 RCW-328 MWS-509	0-CV-2201 * 0-CV-2202 * Control Room Alarm
b. Steam Generator Discharge (1(2)-RE-4095)	Scintillation (off line)	Steam Generator Sample Sink	1-CV-4015 * 2-CV-4015 * Control Room Alarm
<u>Gaseous Effluent Monitor</u>			
a. Waste Gas Discharge (0-RE-2191)	GM Tube (in line)	0-SX-2188 0-SX-2189 0-SX-2190	0-CV-2191 * 0-CV-2192 * Control Room Alarm
b. Main Vent Gaseous (1(2)-RE-5415)	GM Tube (off line)	1(2)-5414 I or 1(2)-5414 J	Control Room Alarm
or			
Main Vent Noble Gas (1(2)-RE-5416)	Beta Detector (off line)	1(2)-5414 I or 1(2)-5414 J	Control Room Alarm
(1(2)-RE-5417)			
(1(2)-RE-5418)			

\* Automatic isolation valve controlled by radiation monitor.

# ATTACHMENT (3)

## RADIOACTIVE LIQUID WASTE SYSTEMS CALVERT CLIFFS NUCLEAR POWER PLANT





ATTACHMENT 4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH

AGE GROUP - ADULT

DOSE	ORGAN DOSE FACTOR (MGEM/H2 PER UCI/ML)							TOTAL BODY
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	
1.00E+00	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	3.60E-01
1.00E+01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	6.00E-01
1.00E+02	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	6.47E+05
1.00E+03	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	5.59E+00
1.00E+04	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.35E+03
1.00E+05	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	3.70E+01
1.00E+06	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.76E+05
1.00E+07	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	7.29E+04
1.00E+08	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	2.76E+02
1.00E+09	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.35E+03
1.00E+10	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	7.93E+03
1.00E+11	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.20E+01
1.00E+12	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.01E+02
1.00E+13	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	2.32E+05
1.00E+14	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	4.70E+01
1.00E+15	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	4.00E+00
1.00E+16	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	7.29E-02
1.00E+17	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	9.10E-02
1.00E+18	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	2.90E-02
1.00E+19	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	2.90E-01
1.00E+20	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	8.70E-01
1.00E+21	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.40E+02
1.00E+22	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	3.02E+04
1.00E+23	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	4.15E+00
1.00E+24	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.51E+00
1.00E+25	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.60E+01
1.00E+26	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	2.20E+03
1.00E+27	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	2.70E+00
1.00E+28	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	1.56E+02
1.00E+29	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	4.67E-02
1.00E+30	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	3.70E+00
1.00E+31	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	9.70E-01
1.00E+32	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	2.70E+01
1.00E+33	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	4.70E-01
1.00E+34	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	2.70E+01
1.00E+35	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	0.	4.70E-01

## ATTACHMENT 4

## ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

# MSIA FISH AND WATER TIPS - APRIL 1988

AGE GROUP - ADULT

[illegible]

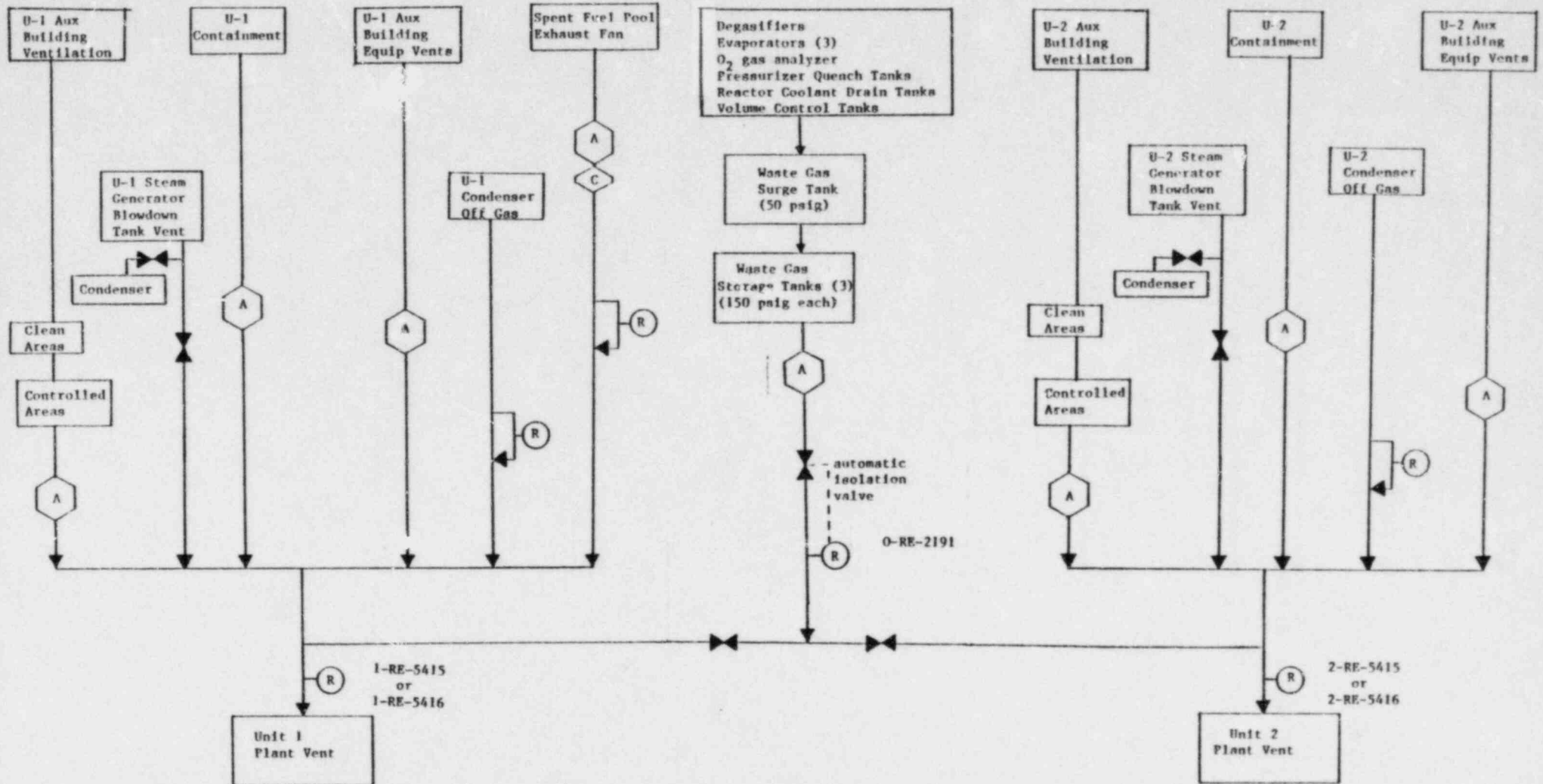
## ATTACHMENT (5)

ADULT DOSE CONTRIBUTIONSFISH AND SHELLFISH PATHWAY

Radionuclide	1981			1982			1983		
	Ci/yr	T.B. Dose Fraction	GI-LLI Dose Fraction	Ci/yr	T.B. Dose Fraction	GI-LLI Dose Fraction	Ci/yr	T.B. Dose Fraction	GI-LLI Dose Fraction
Mn-54	0.38	0.10	0.26	0.043	< 0.01	< 0.01	0.015	0.03	0.02
Co-58	1.27	0.32	0.48	1.5	0.12	0.12	0.60	0.13	0.47
Co-60	0.21	0.15	0.22	0.19	0.04	0.04	0.08	0.05	0.17
Sr-90	0.027	0.15	< 0.01	0.062	0.11	< 0.01	0.007	< 0.01	< 0.01
Ag-110m	----	----	----	0.22	0.01	0.83	0.0077	< 0.01	0.29
Sb-125	0.076	< 0.01	< 0.01	0.27	< 0.01	< 0.01	0.33	< 0.01	0.04
Cs-134	0.051	0.13	< 0.01	0.44	0.34	< 0.01	0.18	0.38	< 0.01
Cs-137	0.10	0.15	< 0.01	0.80	0.37	< 0.01	0.32	0.40	< 0.01

# ATTACHMENT (6)

## RADIOACTIVE GASEOUS WASTE SYSTEM CALVERT CLIFFS NUCLEAR POWER PLANT



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (nrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : ADULT  
 PATHWAY : INHALATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1	H-3	1.264E+03	1.264E+03	0.000E-01	1.264E+03	1.264E+03	1.264E+03	1.264E+03	1.264E+03	W. BODY
2	C-14	3.408E+03	3.408E+03	1.816E+04	3.408E+03	3.408E+03	3.408E+03	3.408E+03	3.408E+03	BONE
3	Na-24	1.024E+04	1.024E+04	1.024E+04	1.024E+04	1.024E+04	1.024E+04	1.024E+04	0.000E-01	W. BODY
4	P-32	5.008E+04	0.000E-01	1.320E+06	7.712E+04	0.000E-01	0.000E-01	8.640E+04	0.000E-01	BONE
5	SC-46	2.480E+05	0.000E-01	4.408E+05	8.560E+05	8.000E+05	0.000E-01	2.584E+05	0.000E-01	LIVER
6	CR-51	1.000E+02	5.952E+01	0.000E-01	0.000E-01	2.280E+01	1.440E+04	3.320E+03	0.000E-01	LUNG
7	MN-54	6.296E+03	0.000E-01	0.000E-01	3.960E+04	9.840E+03	1.400E+06	7.736E+04	0.000E-01	LUNG
8	MN-56	1.832E-01	0.000E-01	0.000E-01	1.240E+00	1.304E+00	9.440E+03	2.024E+04	0.000E-01	GI-LLI
9	FE-55	3.944E+03	0.000E-01	2.456E+04	1.696E+04	0.000E-01	7.208E+04	6.032E+03	0.000E-01	LUNG
10	FE-59	1.056E+04	0.000E-01	1.176E+04	2.776E+04	0.000E-01	1.046E+06	1.880E+05	0.000E-01	LUNG
11	CO-58	2.072E+03	0.000E-01	0.000E-01	1.584E+03	0.000E-01	9.280E+05	1.064E+05	0.000E-01	LUNG
12	CO-60	1.480E+04	0.000E-01	0.000E-01	1.152E+04	0.000E-01	5.968E+06	2.848E+05	0.000E-01	LUNG
13	NI-59	5.416E+03	0.000E-01	3.248E+04	1.168E+04	0.000E-01	6.568E+01	4.888E+03	0.000E-01	LUNG
14	NI-63	1.440E+04	0.000E-01	4.320E+05	3.144E+04	0.000E-01	1.784E+05	1.336E+04	0.000E-01	BONE
15	NI-65	9.120E-02	0.000E-01	1.536E+00	2.096E-01	0.000E-01	5.600E+03	1.232E+04	0.000E-01	GI-LLI
16	CU-64	6.152E-01	0.000E-01	0.000E-01	1.464E+00	4.624E+00	6.784E+03	4.896E+04	0.000E-01	GI-LLI
17	ZN-65	4.656E+04	0.000E-01	3.240E+04	1.032E+05	6.896E+04	8.640E+05	5.344E+04	0.000E-01	LUNG
18	ZN-69	4.520E-03	0.000E-01	3.384E-02	6.512E-02	4.216E-02	9.200E+02	1.632E+01	0.000E-01	LUNG
19	BR-83	2.408E+02	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	2.320E+02	0.000E-01	W. BODY
20	BR-84	3.128E+02	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	1.640E-03	0.000E-01	W. BODY
21	BR-85	1.280E+01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22	RE-86	5.896E+04	0.000E-01	0.000E-01	1.352E+05	0.000E-01	0.000E-01	1.664E+04	0.000E-01	LIVER
23	RE-88	1.928E+02	0.000E-01	0.000E-01	3.872E+02	0.000E-01	0.000E-01	3.344E-09	0.000E-01	LIVER
24	RE-89	1.696E+02	0.000E-01	0.000E-01	2.560E+02	0.000E-01	0.000E-01	9.280E-12	0.000E-01	LIVER
25	SR-89	8.720E+03	0.000E-01	3.040E+05	0.000E-01	0.000E-01	1.400E+06	3.496E+05	0.000E-01	LUNG
26	SR-90	6.096E+06	0.000E-01	9.920E+07	0.000E-01	0.000E-01	9.600E+06	7.216E+05	0.000E-01	BONE
27	SR-91	2.504E+00	0.000E-01	6.192E+01	0.000E-01	0.000E-01	3.648E+04	1.912E+05	0.000E-01	GI-LLI
28	SR-92	2.912E-01	0.000E-01	6.744E+00	0.000E-01	0.000E-01	1.648E+04	4.304E+04	0.000E-01	GI-LLI
29	Y-90	5.608E+01	0.000E-01	2.088E+03	0.000E-01	0.000E-01	1.696E+05	5.056E+05	0.000E-01	GI-LLI
30	Y-91M	1.016E-02	0.000E-01	2.608E-01	0.000E-01	0.000E-01	1.920E+03	1.328E+00	0.000E-01	LUNG
31	Y-91	1.240E+04	0.000E-01	4.624E+05	0.000E-01	0.000E-01	1.704E+06	3.848E+05	0.000E-01	LUNG
32	Y-92	3.016E-01	0.000E-01	1.032E+01	0.000E-01	0.000E-01	1.568E+04	7.352E+04	0.000E-01	GI-LLI
33	Y-93	2.608E+00	0.000E-01	9.440E+01	0.000E-01	0.000E-01	4.848E+04	4.216E+05	0.000E-01	GI-LLI
34	ZR-95	2.328E+04	0.000E-01	1.072E+05	3.440E+04	5.416E+04	1.768E+06	1.504E+05	0.000E-01	LUNG
35	ZR-97	9.040E+00	0.000E-01	9.680E+01	1.960E+01	2.968E+01	7.872E+04	5.232E+05	0.000E-01	GI-LLI



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : ADULT  
 PATHWAY : INHALATION

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36 NB-95	4.208E+03	0.000E-01	1.408E+04	7.816E+03	7.736E+03	5.048E+05	1.040E+05	4.208E+03	LUNG
37 NB-97	2.048E-02	0.000E-01	2.224E-01	5.624E-02	6.544E-02	2.400E+03	2.416E+02	0.000E-01	LUNG
38 MO-99	2.296E+01	0.000E-01	0.000E-01	1.208E+02	2.912E+02	9.120E+04	2.480E+05	0.000E-01	GI-LLI
39 TC-99M	3.704E-02	0.000E-01	1.032E-03	2.912E-03	4.416E-02	7.640E+02	4.160E+03	0.000E-01	GI-LLI
40 TC-101	5.904E-04	0.000E-01	4.176E-05	6.016E-05	1.080E-03	3.992E+02	1.088E-11	0.000E-01	LUNG
41 RU-103	6.584E+02	0.000E-01	1.528E+03	0.000E-01	5.832E+03	5.048E+05	1.104E+05	0.000E-01	LUNG
42 RU-105	3.112E-01	0.000E-01	7.904E-01	0.000E-01	1.016E+00	1.096E+04	4.816E+04	0.000E-01	GI-LLI
43 RU-106	8.720E+03	0.000E-01	6.912E+04	0.000E-01	1.336E+05	9.360E+06	9.120E+05	0.000E-01	LUNG
44 AG-110M	5.944E+03	0.000E-01	1.080E+04	1.000E+04	1.968E+04	4.632E+06	3.024E+05	0.000E-01	LUNG
45 CB-115M	6.360E+03	0.000E-01	0.000E-01	1.968E+05	1.584E+05	1.408E+06	3.840E+05	0.000E-01	LUNG
46 SB-124	1.210E+04	7.352E+01	3.120E+04	5.888E+02	0.000E-01	2.480E+06	4.064E+05	0.000E-01	LUNG
47 TE-125M	4.672E+02	1.048E+03	3.416E+03	1.584E+03	1.240E+04	3.136E+05	7.064E+04	0.000E-01	LUNG
49 TE-127M	1.568E+03	3.288E+03	1.264E+04	5.768E+03	4.576E+04	9.600E+05	1.496E+05	0.000E-01	LUNG
49 TE-127	3.096E-01	1.056E+00	1.400E+00	6.424E-01	5.096E+00	6.512E+03	5.736E+04	0.000E-01	GI-LLI
50 TE-129M	1.584E+03	3.440E+03	9.760E+03	4.672E+03	3.656E+04	1.160E+06	3.832E+05	0.000E-01	LUNG
51 TE-129	1.240E-02	3.896E-02	4.976E-02	2.392E-02	1.872E-01	1.936E+03	1.568E+02	0.000E-01	LUNG
52 TE-131M	2.904E+01	5.501E+01	6.992E+01	4.360E+01	3.088E+02	1.456E+05	5.560E+05	0.000E-01	GI-LLI
53 TE-131	3.592E-03	9.360E-03	1.112E-02	5.952E-03	4.368E-02	1.392E+03	1.840E+01	0.000E-01	LUNG
54 TE-132	1.616E+02	1.896E+02	2.600E+02	2.152E+02	1.456E+03	2.880E+05	5.096E+05	0.000E-01	GI-LLI
55 I-130	5.280E+03	1.136E+06	4.576E+03	1.344E+04	2.088E+04	0.000E-01	7.688E+03	0.000E-01	THYROID
56 I-131	2.048E+04	1.192E+07	2.520E+04	3.576E+04	6.128E+04	0.000E-01	6.280E+03	0.000E-01	THYROID
57 I-132	1.160E+03	1.144E+05	1.160E+03	3.256E+03	5.184E+03	0.000E-01	4.064E+02	0.000E-01	THYROID
58 I-133	4.520E+03	2.152E+06	8.640E+03	1.480E+04	2.584E+04	0.000E-01	8.800E+03	0.000E-01	THYROID
59 I-134	6.152E+02	2.984E+04	6.440E+02	1.728E+03	2.752E+03	0.000E-01	1.008E+00	0.000E-01	THYROID
60 I-135	2.568E+03	4.480E+05	2.680E+03	6.984E+03	1.112E+04	0.000E-01	5.248E+03	0.000E-01	THYROID
61 CS-134	7.280E+05	0.000E-01	3.728E+05	8.480E+05	2.872E+05	9.760E+04	1.040E+04	0.000E-01	LIVER
62 CS-136	1.101E+05	0.000E-01	3.904E+04	1.464E+05	8.560E+04	1.200E+04	1.168E+04	0.000E-01	LIVER
63 CS-137	4.280E+05	0.000E-01	4.784E+05	6.208E+05	2.224E+05	7.520E+01	8.400E+03	0.000E-01	LIVER
64 CS-138	3.210E+02	0.000E-01	3.312E+02	6.208E+02	4.800E+02	4.856E+01	1.864E-03	0.000E-01	LIVER
65 CS-139	1.112E+02	0.000E-01	2.048E+02	2.604E+02	2.440E+02	2.272E+01	0.000E-01	0.000E-01	LIVER
66 BA-139	2.736E-02	0.000E-01	9.360E-01	6.656E-04	6.224E-04	3.760E+03	8.960E+02	0.000E-01	LUNG
67 BA-140	2.568E+03	0.000E-01	3.904E+04	4.904E+01	1.672E+01	1.272E+06	2.184E+05	0.000E-01	LUNG
68 BA-141	3.360E-03	0.000E-01	1.000E-01	7.528E-05	7.000E-05	1.936E+03	1.160E-07	0.000E-01	LUNG
69 BA-142	1.656E-03	0.000E-01	2.632E-02	2.704E-05	2.288E-05	1.192E+03	1.568E-16	0.000E-01	LUNG
70 LA-140	4.584E+01	0.000E-01	3.440E+02	1.736E+02	0.000E-01	1.360E+05	4.584E+05	0.000E-01	GI-LLI

## ATTACHMENT 7

## Pathway Dose Parameters

 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : ADULT

PATHWAY : INHALATION

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	7.720E-02	0.000E-01	6.832E-01	3.104E-01	0.000E-01	6.328E+03	2.112E+03	7.720E-02	LUNG
72 CE-141	1.528E+03	0.000E-01	1.992E+04	1.352E+04	6.264E+03	3.616E+05	1.200E+05	0.000E-01	LUNG
73 CE-143	1.528E+01	0.000E-01	1.864E+02	1.376E+02	6.080E+01	7.976E+04	2.264E+05	0.000E-01	GI-LLI
74 CE-144	1.840E+05	0.000E-01	3.432E+06	1.432E+06	8.480E+05	7.776E+06	8.160E+05	0.000E-01	LUNG
75 PR-143	4.640E+02	0.000E-01	9.360E+03	3.752E+03	2.160E+03	2.808E+05	2.000E+05	0.000E-01	LUNG
76 PR-144	1.528E-03	0.000E-01	3.008E-02	1.248E-02	7.048E-03	1.016E+03	2.152E-08	0.000E-01	LUNG
77 ND-147	3.648E+02	0.000E-01	5.272E+03	6.096E+03	3.560E+03	2.208E+05	1.728E+05	0.000E-01	LUNG
78 W-185	5.448E+01	0.000E-01	1.560E+03	5.176E+02	0.000E-01	4.456E+05	8.560E+04	0.000E-01	LUNG
79 W-187	2.480E+00	0.000E-01	8.480E+00	7.080E+00	0.000E-01	2.904E+04	1.552E+05	0.000E-01	GI-LLI
80 U-235	4.856E+06	0.000E-01	8.000E+07	0.000E-01	1.872E+07	3.920E+08	3.872E+05	0.000E-01	LUNG
81 U-238	4.536E+06	0.000E-01	7.664E+07	0.000E-01	1.744E+07	3.664E+08	9.240E+05	0.000E-01	LUNG
82 NF-239	1.240E+01	0.000E-01	2.296E+02	2.256E+01	7.000E+01	3.760E+04	1.192E+05	0.000E-01	GI-LLI

## ATTACHMENT 7

## Pathway Dose Parameters

 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : TEEN

PATHWAY : INHALATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1	H-3	1.272E+03	1.272E+03	0.000E-01	1.272E+03	1.272E+03	1.272E+03	1.272E+03	1.272E+03	W. BODY
2	C-14	4.872E+03	4.872E+03	2.600E+04	4.872E+03	4.872E+03	4.872E+03	4.872E+03	4.872E+03	BONE
3	NA-24	1.376E+04	1.376E+04	1.376E+04	1.376E+04	1.376E+04	1.376E+04	1.376E+04	1.376E+04	W. BODY
4	P-32	7.160E+04	0.000E-01	1.888E+03	1.096E+05	0.000E-01	0.000E-01	9.280E+04	0.000E-01	BONE
5	SC-46	2.489E+05	0.000E-01	4.408E+05	8.560E+05	8.000E+05	0.000E-01	2.584E+05	0.000E-01	LIVER
6	CR-51	1.352E+02	7.496E+01	0.000E-01	0.000E-01	3.072E+01	2.096E+04	3.000E+03	0.000E-01	LUNG
7	MN-54	8.400E+03	0.000E-01	0.000E-01	5.112E+04	1.272E+04	1.984E+03	6.680E+04	0.000E-01	LUNG
8	MN-56	2.520E-01	0.000E-01	0.000E-01	1.696E+00	1.792E+00	1.520E+04	5.744E+01	0.000E-01	GI-LLI
9	FE-55	5.544E+03	0.000E-01	3.344E+04	2.384E+04	0.000E-01	1.240E+05	6.392E+03	0.000E-01	LUNG
10	FE-59	1.432E+04	0.000E-01	1.592E+04	3.696E+04	0.000E-01	1.528E+03	1.784E+05	0.000E-01	LUNG
11	CO-58	2.776E+03	0.000E-01	0.000E-01	2.072E+03	0.000E-01	1.344E+03	9.520E+04	0.000E-01	LUNG
12	CO-60	1.984E+04	0.000E-01	0.000E-01	1.512E+04	0.000E-01	8.720E+03	2.592E+05	0.000E-01	LUNG
13	NI-59	5.416E+03	0.000E-01	3.240E+04	1.168E+04	0.000E-01	6.568E+01	4.888E+03	0.000E-01	LUNG
14	NI-63	1.976E+04	0.000E-01	5.800E+05	4.344E+04	0.000E-01	3.072E+05	1.416E+04	0.000E-01	BONE
15	NI-65	1.272E-01	0.000E-01	2.184E+00	2.928E-01	0.000E-01	9.360E+03	3.672E+04	0.000E-01	GI-LLI
16	CU-64	8.480E-01	0.000E-01	0.000E-01	2.032E+00	6.408E+00	1.112E+04	6.144E+04	0.000E-01	GI-LLI
17	ZN-65	6.240E+04	0.000E-01	3.856E+04	1.336E+05	8.640E+04	1.240E+03	4.664E+04	0.000E-01	LUNG
18	ZN-69	6.456E-03	0.000E-01	4.832E-02	9.200E-02	6.024E-02	1.584E+03	2.848E+02	0.000E-01	LUNG
19	BR-83	3.440E+02	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
20	BR-84	4.328E+02	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21	BR-85	1.832E+01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22	RB-86	8.400E+04	0.000E-01	0.000E-01	1.904E+05	0.000E-01	0.000E-01	1.768E+04	0.000E-01	LIVER
23	RB-88	2.720E+02	0.000E-01	0.000E-01	5.456E+02	0.000E-01	0.000E-01	2.920E-05	0.000E-01	LIVER
24	RB-89	2.328E+02	0.000E-01	0.000E-01	3.520E+02	0.000E-01	0.000E-01	3.376E-07	0.000E-01	LIVER
25	SR-89	1.248E+04	0.000E-01	4.344E+05	0.000E-01	0.000E-01	2.416E+03	3.712E+05	0.000E-01	LUNG
26	SR-90	6.680E+06	0.000E-01	1.080E+08	0.000E-01	0.000E-01	1.648E+07	7.648E+05	0.000E-01	BONE
27	SR-91	3.512E+00	0.000E-01	8.000E+01	0.000E-01	0.000E-01	6.072E+04	2.592E+05	0.000E-01	GI-LLI
28	SR-92	4.064E-01	0.000E-01	9.520E+00	0.000E-01	0.000E-01	2.744E+04	1.192E+05	0.000E-01	GI-LLI
29	Y-90	8.000E+01	0.000E-01	2.984E+03	0.000E-01	0.000E-01	2.928E+05	5.592E+05	0.000E-01	GI-LLI
30	Y-91M	1.416E-02	0.000E-01	3.704E-01	0.000E-01	0.000E-01	3.200E+03	3.016E+01	0.000E-01	LUNG
31	Y-91	1.768E+04	0.000E-01	6.608E+05	0.000E-01	0.000E-01	2.936E+03	4.088E+05	0.000E-01	LUNG
32	Y-92	4.288E-01	0.000E-01	1.472E+01	0.000E-01	0.000E-01	2.680E+04	1.648E+05	0.000E-01	GI-LLI
33	Y-93	3.720E+00	0.000E-01	1.352E+02	0.000E-01	0.000E-01	8.320E+04	5.792E+05	0.000E-01	GI-LLI
34	ZR-95	3.152E+04	0.000E-01	1.456E+05	4.584E+04	6.736E+04	2.688E+06	1.488E+05	0.000E-01	LUNG
35	ZR-97	1.256E+01	0.000E-01	1.376E+02	2.720E+01	4.120E+01	1.296E+05	6.304E+05	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : TEEN  
 PATHWAY : INHALATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36	NR-95	5.66E+03	0.00E-01	1.85E+04	1.03E+04	1.00E+04	7.51E+05	9.68E+04	5.66E+03	LUNG
37	NB-97	2.04E-02	0.00E-01	2.22E-01	5.62E-02	6.54E-02	2.40E+03	2.41E+02	0.00E-01	LUNG
38	MD-99	3.22E+01	0.00E-01	0.00E-01	1.69E+02	4.11E+02	1.53E+05	2.68E+05	0.00E-01	GI-LLI
39	TC-99M	4.99E-02	0.00E-01	1.38E-03	3.86E-03	5.76E-02	1.15E+03	6.12E+03	0.00E-01	GI-LLI
40	TC-101	8.24E-04	0.00E-01	5.92E-05	8.40E-05	1.52E-03	6.67E+02	8.72E-07	0.00E-01	LUNG
41	RU-103	8.96E+02	0.00E-01	2.10E+03	0.00E-01	7.43E+03	7.83E+05	1.00E+05	0.00E-01	LUNG
42	RU-105	4.33E-01	0.00E-01	1.12E+00	0.00E-01	1.40E+00	1.81E+04	9.04E+04	0.00E-01	GI-LLI
43	RU-106	1.24E+04	0.00E-01	9.84E+04	0.00E-01	1.90E+05	1.60E+07	9.60E+05	0.00E-01	LUNG
44	AG-110M	7.99E+03	0.00E-01	1.38E+04	1.31E+04	2.50E+04	6.75E+06	2.72E+05	0.00E-01	LUNG
45	CD-115M	6.36E+03	0.00E-01	0.00E-01	1.96E+05	1.58E+05	1.40E+05	3.84E+05	0.00E-01	LUNG
46	SB-124	1.24E+04	7.55E+01	3.12E+04	5.88E+02	0.00E-01	2.43E+05	1.40E+05	0.00E-01	LUNG
47	TE-125M	6.67E+02	1.40E+03	4.88E+03	2.24E+03	0.00E-01	5.36E+04	7.50E+04	0.00E-01	LUNG
48	TE-127M	2.18E+03	4.33E+03	1.80E+04	8.16E+03	6.53E+04	1.65E+06	1.57E+05	0.00E-01	GI-LLI
49	TE-127	4.41E-01	1.11E+00	2.00E+00	9.12E+03	5.19E+04	1.97E+04	4.03E+05	0.00E-01	LUNG
50	TE-129M	2.24E+03	4.57E+03	1.39E+04	6.58E+03	5.19E+04	1.97E+04	4.03E+05	0.00E-01	LUNG
51	IE-129	1.76E-02	5.18E-02	7.09E-02	3.37E-02	2.65E-01	3.29E+03	1.61E+03	0.00E-01	LUNG
52	IE-131M	4.02E+01	7.24E+01	9.84E+01	6.00E+01	4.39E+02	2.37E+05	6.20E+05	0.00E-01	GI-LLI
53	IE-131	5.04E-03	1.24E-02	1.57E-02	8.32E-03	6.17E-02	2.33E+03	1.51E+01	0.00E-01	LUNG
54	IE-132	2.19E+02	2.45E+02	3.60E+02	2.90E+02	1.95E+03	4.48E+05	4.63E+05	0.00E-01	GI-LLI
55	I-130	7.18E+03	1.49E+03	6.24E+03	1.79E+04	2.75E+04	0.00E-01	9.12E+03	0.00E-01	THYROID
56	I-131	2.64E+04	1.46E+07	3.54E+04	4.91E+04	8.40E+04	0.00E-01	6.49E+03	0.00E-01	THYROID
57	I-132	1.57E+03	1.51E+05	1.59E+03	4.37E+03	5.92E+03	0.00E-01	1.27E+03	0.00E-01	THYROID
58	I-133	6.22E+03	2.92E+06	1.21E+04	2.04E+04	3.59E+04	0.00E-01	1.03E+04	0.00E-01	THYROID
59	I-134	8.40E+02	3.95E+04	8.89E+02	2.32E+03	3.66E+03	0.00E-01	2.04E+01	0.00E-01	THYROID
60	I-135	3.48E+03	6.20E+05	3.69E+03	9.44E+03	1.49E+04	0.00E-01	6.95E+03	0.00E-01	THYROID
61	CS-134	5.48E+05	0.00E-01	5.02E+05	1.12E+06	3.75E+05	1.46E+05	9.76E+03	0.00E-01	LIVER
62	CS-136	1.36E+05	0.00E-01	5.15E+04	1.93E+05	1.10E+05	1.77E+04	1.08E+04	0.00E-01	LIVER
63	CS-137	3.11E+05	0.00E-01	6.70E+05	8.48E+05	3.04E+05	1.20E+05	8.49E+03	0.00E-01	LIVER
64	CS-138	4.46E+02	0.00E-01	4.65E+02	8.56E+02	6.62E+02	7.87E+01	2.70E-01	0.00E-01	LIVER
65	CS-139	1.11E+02	0.00E-01	2.04E+02	2.90E+02	2.44E+02	2.27E+01	0.00E-01	0.00E-01	LIVER
66	BA-139	3.89E-02	0.00E-01	1.33E+00	9.44E-04	8.89E-04	6.46E+03	6.44E+03	0.00E-01	LUNG
67	BA-140	3.52E+03	0.00E-01	5.47E+04	6.70E+04	2.28E+04	2.03E+05	2.28E+05	0.00E-01	LUNG
68	BA-141	4.74E-03	0.00E-01	1.42E-01	1.05E-04	9.84E-05	3.28E+03	7.46E-04	0.00E-01	LUNG
69	BA-142	2.27E-03	0.00E-01	3.69E-02	3.70E-05	3.13E-05	1.91E+03	4.79E-10	0.00E-01	LUNG
70	LA-140	6.25E+01	0.00E-01	4.79E+02	2.36E+02	0.00E-01	2.14E+05	4.87E+05	0.00E-01	GI-LLI



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : TEEN

PATHWAY : INHALATION

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	1.056E-01	0.000E-01	9.600E-01	4.248E-01	0.000E-01	1.016E+04	1.200E+04	1.056E-01	GI-LLI
72 CE-141	2.168E+03	0.000E-01	2.840E+04	1.896E+04	8.030E+03	6.136E+05	1.264E+05	0.000E-01	LUNG
73 CE-143	2.160E+01	0.000E-01	2.656E+02	1.936E+02	8.640E+01	1.304E+05	2.552E+05	0.000E-01	GI-LLI
74 CE-144	2.624E+05	0.000E-01	4.888E+06	2.024E+06	1.208E+06	1.336E+07	8.640E+05	0.000E-01	LUNG
75 FR-143	6.624E+02	0.000E-01	1.336E+04	5.312E+03	3.088E+03	4.832E+05	2.136E+05	0.000E-01	LUNG
76 FR-144	2.176E-03	0.000E-01	4.296E-02	1.760E-02	1.008E-02	1.752E+03	2.352E-04	0.000E-01	LUNG
77 ND-147	5.128E+02	0.000E-01	7.864E+03	8.560E+03	5.024E+03	3.720E+05	1.824E+05	0.000E-01	LUNG
79 W-185	5.448E+01	0.000E-01	1.560E+03	5.176E+02	0.000E-01	4.456E+05	8.560E+04	0.000E-01	LUNG
79 W-187	3.432E+00	0.000E-01	1.200E+01	9.760E+00	0.000E-01	4.736E+04	1.768E+05	0.000E-01	GI-LLI
80 U-235	4.856E+06	0.000E-01	8.000E+07	0.000E-01	1.872E+07	3.920E+08	3.872E+05	0.000E-01	LUNG
81 U-238	4.536E+06	0.000E-01	7.664E+07	0.000E-01	1.744E+07	3.664E+08	8.240E+05	0.000E-01	LUNG
82 NF-239	1.768E+01	0.000E-01	3.384E+02	3.192E+01	1.000E+02	6.488E+04	1.320E+05	0.000E-01	GI-LLI



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : CHILD  
 PATHWAY : INHALATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1	H-3	1.125E+03	1.125E+03	0.000E-01	1.125E+03	1.125E+03	1.125E+03	1.125E+03	1.125E+03	W. BODY
2	C-14	6.734E+03	6.734E+03	3.589E+04	6.734E+03	6.734E+03	6.734E+03	6.734E+03	6.734E+03	BONE
3	NA-24	1.609E+04	1.609E+04	1.609E+04	1.609E+04	1.609E+04	1.609E+04	1.609E+04	0.000E-01	W. BODY
4	P-32	9.879E+04	0.000E-01	2.605E+06	1.143E+05	0.000E-01	0.000E-01	4.218E+04	0.000E-01	BONE
5	SC-46	1.151E+05	0.000E-01	2.039E+05	3.959E+05	3.700E+05	0.000E-01	1.195E+05	0.000E-01	LIVER
6	CR-51	1.543E+02	8.547E+01	0.000E-01	0.000E-01	2.431E+01	1.698E+04	1.084E+03	0.000E-01	LUNG
7	MN-54	9.509E+03	0.000E-01	0.000E-01	4.292E+04	1.003E+04	1.576E+06	2.290E+04	0.000E-01	LUNG
8	MN-56	3.119E-01	0.000E-01	0.000E-01	1.658E+00	1.672E+00	1.313E+04	1.232E+05	0.000E-01	GI-LLI
9	FE-55	7.770E+03	0.000E-01	4.736E+04	2.516E+04	0.000E-01	1.110E+05	2.867E+03	0.000E-01	LUNG
10	FE-59	1.669E+04	0.000E-01	2.068E+04	3.345E+04	0.000E-01	1.269E+06	7.067E+04	0.000E-01	LUNG
11	CO-58	3.163E+03	0.000E-01	0.000E-01	1.772E+03	0.000E-01	1.106E+06	3.437E+04	0.000E-01	LUNG
12	CO-60	2.264E+04	0.000E-01	0.000E-01	1.313E+04	0.000E-01	7.067E+06	9.620E+04	0.000E-01	LUNG
13	NI-59	2.505E+03	0.000E-01	1.502E+04	5.402E+03	0.000E-01	3.038E+04	2.261E+03	0.000E-01	LUNG
14	NI-63	2.797E+04	0.000E-01	8.214E+05	4.625E+04	0.000E-01	2.749E+05	6.327E+03	0.000E-01	BONE
15	NI-65	1.643E-01	0.000E-01	2.990E+00	2.956E-01	0.000E-01	8.177E+03	8.399E+04	0.000E-01	GI-LLI
16	CU-64	1.073E+00	0.000E-01	0.000E-01	1.994E+00	6.031E+00	9.583E+03	3.670E+04	0.000E-01	GI-LLI
17	ZN-65	7.030E+04	0.000E-01	4.255E+04	1.132E+05	7.141E+04	9.953E+05	1.632E+04	0.000E-01	LUNG
18	ZN-69	8.917E-03	0.000E-01	6.697E-02	9.657E-02	5.846E-02	1.421E+03	1.017E+04	0.000E-01	GI-LLI
19	BR-83	4.736E+02	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
20	BR-84	5.476E+02	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21	BR-85	2.531E+01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22	RD-86	1.143E+05	0.000E-01	0.000E-01	1.983E+05	0.000E-01	0.000E-01	7.992E+03	0.000E-01	LIVER
23	RB-88	3.663E+02	0.000E-01	0.000E-01	5.624E+02	0.000E-01	0.000E-01	1.724E+01	0.000E-01	LIVER
24	RB-89	2.897E+02	0.000E-01	0.000E-01	3.452E+02	0.000E-01	0.000E-01	1.891E+00	0.000E-01	LIVER
25	SR-89	1.724E+04	0.000E-01	5.994E+05	0.000E-01	0.000E-01	2.157E+06	1.672E+05	0.000E-01	LUNG
26	SR-90	6.439E+06	0.000E-01	1.010E+08	0.000E-01	0.000E-01	1.476E+07	3.434E+05	0.000E-01	BONE
27	SR-91	4.508E+00	0.000E-01	1.214E+02	0.000E-01	0.000E-01	5.328E+04	1.739E+05	0.000E-01	GI-LLI
28	SR-92	5.254E-01	0.000E-01	1.310E+01	0.000E-01	0.000E-01	2.401E+04	2.423E+05	0.000E-01	GI-LLI
29	Y-90	1.106E+02	0.000E-01	4.107E+03	0.000E-01	0.000E-01	2.616E+05	2.679E+05	0.000E-01	GI-LLI
30	Y-91M	1.843E-02	0.000E-01	5.069E-01	0.000E-01	0.000E-01	2.812E+03	1.717E+03	0.000E-01	LUNG
31	Y-91	2.439E+04	0.000E-01	9.139E+05	0.000E-01	0.000E-01	2.627E+06	1.839E+05	0.000E-01	LUNG
32	Y-92	5.809E-01	0.000E-01	2.035E+01	0.000E-01	0.000E-01	2.390E+04	2.390E+05	0.000E-01	GI-LLI
33	Y-93	5.106E+00	0.000E-01	1.865E+02	0.000E-01	0.000E-01	7.437E+04	3.885E+05	0.000E-01	GI-LLI
34	ZR-95	3.700E+04	0.000E-01	1.898E+05	4.181E+04	5.957E+04	2.231E+06	6.105E+04	0.000E-01	LUNG
35	ZR-97	1.598E+01	0.000E-01	1.876E+02	2.716E+01	3.885E+01	1.132E+05	3.511E+05	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : CHILD  
 PATHWAY : INHALATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
35	NB-95	6.549E+03	0.000E-01	2.349E+04	9.174E+03	8.621E+03	6.142E+05	3.700E+04	6.549E+03	LUNG
37	NB-97	9.472E-03	0.000E-01	1.029E-01	2.601E-02	3.027E-02	1.110E+03	1.117E+02	0.000E-01	LUNG
38	MO-99	4.255E+01	0.000E-01	0.000E-01	1.724E+02	3.922E+02	1.354E+05	1.265E+05	0.000E-01	LUNG
39	TC-99H	5.772E-02	0.000E-01	1.780E-03	3.432E-03	5.069E-02	9.509E+02	4.810E+03	0.000E-01	GI-LLI
40	TC-101	1.077E-03	0.000E-01	9.103E-05	8.510E-05	1.450E-03	5.846E+02	1.632E+01	0.000E-01	LUNG
41	RU-103	1.073E+03	0.000E-01	2.867E+03	0.000E-01	7.030E+03	6.623E+05	4.477E+04	0.000E-01	LUNG
42	RU-105	5.550E-01	0.000E-01	1.528E+00	0.000E-01	1.343E+00	1.591E+04	9.953E+04	0.000E-01	GI-LLI
43	RU-106	1.691E+04	0.000E-01	1.362E+05	0.000E-01	1.839E+05	1.432E+07	4.292E+05	0.000E-01	LUNG
44	AG-110M	9.139E+03	0.000E-01	1.687E+04	1.140E+04	2.124E+04	5.476E+06	1.003E+05	0.000E-01	LUNG
45	CD-115M	2.941E+03	0.000E-01	0.000E-01	9.102E+04	7.326E+04	6.512E+05	1.776E+05	0.000E-01	LUNG
46	SB-124	5.735E+03	3.493E+01	1.443E+04	2.723E+02	0.000E-01	1.147E+06	1.880E+05	0.000E-01	LUNG
47	TE-125M	9.139E+02	1.924E+03	6.734E+03	2.327E+03	0.000E-01	4.773E+05	3.378E+04	0.000E-01	LUNG
48	TE-127M	3.027E+03	6.068E+03	2.486E+04	8.517E+03	6.364E+04	1.480E+06	7.111E+01	0.000E-01	LUNG
49	TE-127	6.105E-01	1.961E+00	2.771E+00	9.509E-01	7.067E+00	1.003E+01	5.621E+04	0.000E-01	GI-LLI
50	TE-129M	3.041E+03	6.327E+03	1.920E+04	6.845E+03	5.032E+04	1.761E+06	1.817E+05	0.000E-01	LUNG
51	TE-129	2.393E-02	7.111E-02	9.768E-02	3.496E-02	2.568E-01	2.934E+03	2.549E+04	0.000E-01	GI-LLI
52	TE-131M	5.069E+01	9.768E+01	1.343E+02	5.920E+01	3.996E+02	2.057E+05	3.070E+05	0.000E-01	GI-LLI
53	TE-131	6.586E-03	1.698E-02	2.172E-02	8.436E-03	5.883E-02	2.053E+03	1.332E+03	0.000E-01	LUNG
54	TE-132	2.634E+02	3.175E+02	4.810E+02	2.723E+02	1.772E+03	3.774E+05	1.376E+05	0.000E-01	LUNG
55	I-130	8.436E+03	1.846E+06	8.177E+03	1.639E+04	2.446E+04	0.000E-01	5.106E+03	0.000E-01	THYROID
56	I-131	2.727E+04	1.624E+07	4.810E+04	4.810E+04	7.881E+04	0.000E-01	2.842E+03	0.000E-01	THYROID
57	I-132	1.876E+03	1.935E+05	2.116E+03	4.070E+03	6.253E+03	0.000E-01	3.200E+03	0.000E-01	THYROID
58	I-133	7.696E+03	3.819E+06	1.658E+04	2.031E+04	3.378E+04	0.000E-01	5.476E+03	0.000E-01	THYROID
59	I-134	9.953E+02	5.069E+04	1.173E+03	2.161E+03	3.300E+03	0.000E-01	9.546E+02	0.000E-01	THYROID
60	I-135	4.144E+03	7.718E+05	4.921E+03	8.732E+03	1.339E+04	0.000E-01	4.440E+03	0.000E-01	THYROID
61	CS-134	2.246E+05	0.000E-01	6.512E+05	1.014E+06	3.304E+05	1.210E+05	3.849E+03	0.000E-01	LIVER
62	CS-136	1.162E+05	0.000E-01	6.512E+04	1.709E+05	9.546E+04	1.454E+01	4.181E+03	0.000E-01	LIVER
63	CS-137	1.284E+05	0.000E-01	9.065E+05	8.251E+05	2.823E+05	1.040E+05	3.619E+03	0.000E-01	BONE
64	CS-138	5.550E+02	0.000E-01	6.327E+02	8.399E+02	6.216E+02	6.808E+01	2.697E+02	0.000E-01	LIVER
65	CS-139	5.143E+01	0.000E-01	9.472E+01	1.343E+02	1.128E+02	1.051E+01	0.000E-01	0.000E-01	LIVER
66	BA-139	5.365E-02	0.000E-01	1.843E+00	9.842E-04	8.621E-04	5.772E+03	5.772E+04	0.000E-01	GI-LLI
67	BA-140	4.329E+03	0.000E-01	7.400E+04	6.475E+01	2.113E+01	1.743E+06	1.017E+05	0.000E-01	LUNG
68	BA-141	6.364E-03	0.000E-01	1.957E-01	1.091E-04	9.472E-05	2.919E+03	2.753E+02	0.000E-01	LUNG
69	BA-142	2.790E-03	0.000E-01	4.995E-02	3.600E-05	2.912E-05	1.643E+03	2.742E+00	0.000E-01	LUNG
70	LA-140	7.548E+01	0.000E-01	6.438E+02	2.250E+02	0.000E-01	1.828E+05	2.257E+05	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : CHILD  
 PATHWAY : INHALATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71	LA-142	1.291E-01	0.000E-01	1.295E+00	4.107E-01	0.000E-01	8.695E+03	7.585E+04	1.291E-01	GI-LLI
72	CE-141	2.897E+03	0.000E-01	3.922E+04	1.954E+04	8.547E+03	5.439E+05	5.661E+04	0.000E-01	LUNG
73	CE-143	2.875E+01	0.000E-01	3.659E+02	1.987E+02	8.362E+01	1.154E+05	1.273E+05	0.000E-01	GI-LLI
74	CE-144	3.615E+05	0.000E-01	6.771E+06	2.116E+06	1.173E+06	1.195E+07	3.885E+05	0.000E-01	LUNG
75	FR-143	9.139E+02	0.000E-01	1.846E+04	5.550E+03	3.001E+03	4.329E+05	9.731E+04	0.000E-01	LUNG
76	FR-144	2.997E-03	0.000E-01	5.957E-02	1.846E-02	9.768E-03	1.565E+03	1.968E+02	0.000E-01	LUNG
77	ND-147	6.808E+02	0.000E-01	1.080E+04	8.732E+03	4.810E+03	3.282E+05	8.211E+04	0.000E-01	LUNG
78	W-185	2.520E+01	0.000E-01	7.215E+02	2.494E+02	0.000E-01	2.061E+05	3.959E+04	0.000E-01	LUNG
79	W-187	4.329E+00	0.000E-01	1.632E+01	9.657E+00	0.000E-01	4.107E+04	9.102E+04	0.000E-01	GI-LLI
80	U-235	2.246E+06	0.000E-01	3.700E+07	0.000E-01	8.658E+06	1.813E+08	1.791E+05	0.000E-01	LUNG
81	U-238	2.098E+06	0.000E-01	3.545E+07	0.000E-01	8.066E+06	1.695E+08	3.811E+05	0.000E-01	LUNG
82	NF-239	2.349E+01	0.000E-01	4.662E+02	3.345E+01	9.731E+01	5.809E+04	6.401E+04	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : INFANT	NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
PATHWAY : INHALATION										
1 H-3	6.458E+02	6.458E+02	0.000E-01	6.468E+02	6.468E+02	6.468E+02	6.468E+02	6.468E+02	6.468E+02	W. BODY
2 C-14	5.306E+03	5.306E+03	2.646E+04	5.306E+03	5.306E+03	5.306E+03	5.306E+03	5.306E+03	5.306E+03	BONE
3 HA-24	1.056E+04	1.056E+04	1.056E+04	1.056E+04	1.056E+04	1.056E+04	1.056E+04	1.056E+04	1.056E+04	W. BODY
4 F-32	7.742E+04	0.000E-01	2.030E+06	1.124E+05	0.000E-01	0.000E-01	0.000E-01	1.610E+04	0.000E-01	BONE
5 SC-46	4.354E+04	0.000E-01	7.714E+04	1.498E+05	1.400E+05	0.000E-01	0.000E-01	4.522E+04	0.000E-01	LIVER
6 CR-51	8.946E+01	5.754E+01	0.000E-01	0.000E-01	0.000E-01	1.323E+01	1.284E+04	3.570E+02	0.000E-01	LUNG
7 HN-54	4.984E+03	0.000E-01	0.000E-01	1.652E+04	4.984E+03	9.996E+05	7.056E+03	0.000E-01	0.000E-01	LUNG
8 HN-56	2.212E-01	0.000E-01	0.000E-01	1.540E+00	1.106E+00	1.106E+00	1.253E+04	7.168E+04	0.000E-01	GI-LLI
9 FE-55	3.332E+03	0.000E-01	0.000E-01	1.974E+04	1.175E+04	0.000E-01	8.694E+04	1.095E+03	0.000E-01	LUNG
10 FE-59	9.478E+03	0.000E-01	0.000E-01	1.357E+04	2.352E+04	0.000E-01	1.015E+06	2.470E+04	0.000E-01	LUNG
11 CU-58	1.820E+03	0.000E-01	0.000E-01	0.000E-01	1.219E+03	0.000E-01	7.770E+05	1.113E+04	0.000E-01	LUNG
12 CO-60	1.177E+04	0.000E-01	0.000E-01	0.000E-01	8.022E+03	0.000E-01	4.508E+03	3.152E+04	0.000E-01	LUNG
13 NI-59	9.478E+02	0.000E-01	0.000E-01	5.684E+03	2.044E+03	0.000E-01	1.149E+04	8.551E+02	0.000E-01	LUNG
14 NI-63	1.161E+04	0.000E-01	0.000E-01	3.388E+05	2.044E+04	0.000E-01	2.086E+05	2.422E+03	0.000E-01	BONE
15 NI-65	1.231E-01	0.000E-01	0.000E-01	2.394E+00	2.342E-01	0.000E-01	8.120E+03	5.012E+04	0.000E-01	GI-LLI
16 CU-64	7.712E-01	0.000E-01	0.000E-01	0.000E-01	1.876E+00	3.976E+00	9.296E+03	1.498E+04	0.000E-01	GI-LLI
17 ZN-65	3.106E+04	0.000E-01	0.000E-01	1.932E+04	6.258E+04	3.246E+04	6.468E+05	5.133E+04	0.000E-01	LUNG
19 BR-83	7.182E-03	0.000E-01	0.000E-01	5.390E-02	9.674E-02	4.018E-02	1.470E+03	1.352E+04	0.000E-01	GI-LLI
19 BR-83	3.808E+02	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	GI-LLI
20 BR-84	4.064E+02	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21 BR-85	2.044E+01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22 BR-85	8.820E+04	0.000E-01	0.000E-01	0.000E-01	1.904E+05	0.000E-01	0.000E-01	3.038E+03	0.000E-01	LIVER
23 BR-88	2.870E+02	0.000E-01	0.000E-01	0.000E-01	5.572E+02	0.000E-01	0.000E-01	3.382E+02	0.000E-01	LIVER
24 BR-89	2.058E+02	0.000E-01	0.000E-01	0.000E-01	3.206E+02	0.000E-01	0.000E-01	6.818E+01	0.000E-01	LIVER
25 SR-89	1.141E+04	0.000E-01	0.000E-01	3.976E+05	0.000E-01	0.000E-01	2.030E+06	6.398E+04	0.000E-01	LUNG
26 SR-90	2.593E+06	0.000E-01	0.000E-01	4.088E+07	0.000E-01	0.000E-01	1.124E+07	1.310E+05	0.000E-01	BONE
27 SR-91	3.458E+00	0.000E-01	0.000E-01	9.532E+01	0.000E-01	0.000E-01	5.264E+04	7.336E+04	0.000E-01	GI-LLI
28 SR-92	3.906E-01	0.000E-01	0.000E-01	1.050E+01	0.000E-01	0.000E-01	2.390E+04	1.400E+05	0.000E-01	GI-LLI
29 Y-90	8.820E+01	0.000E-01	0.000E-01	3.290E+03	0.000E-01	0.000E-01	2.688E+03	1.040E+05	0.000E-01	LUNG
30 Y-91M	1.386E-02	0.000E-01	0.000E-01	4.074E-01	0.000E-01	0.000E-01	2.786E+03	2.352E+03	0.000E-01	LUNG
31 Y-91	1.568E+04	0.000E-01	0.000E-01	5.880E+05	0.000E-01	0.000E-01	2.450E+06	7.028E+04	0.000E-01	LUNG
32 Y-92	4.606E-01	0.000E-01	0.000E-01	1.639E+01	0.000E-01	0.000E-01	2.450E+04	1.266E+05	0.000E-01	GI-LLI
33 Y-93	4.074E+00	0.000E-01	0.000E-01	1.498E+02	0.000E-01	0.000E-01	7.644E+04	1.666E+05	0.000E-01	GI-LLI
34 ZR-95	2.030E+04	0.000E-01	0.000E-01	1.154E+05	2.786E+04	3.108E+04	1.750E+06	2.170E+04	0.000E-01	LUNG
35 ZR-97	1.170E+01	0.000E-01	0.000E-01	1.498E+02	2.562E+01	2.590E+01	1.103E+05	1.400E+05	0.000E-01	GI-LLI



## ATTACHMENT 7

## Pathway Dose Parameters

 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )AGE : INFANT  
PATHWAY : INHALATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36	NB-95	3.780E+03	0.000E-01	1.568E+04	6.426E+03	4.718E+03	4.788E+05	1.267E+04	3.780E+03	LUNG
37	NB-97	3.584E-03	0.000E-01	3.892E-02	9.842E-03	1.145E-02	4.200E+02	4.229E+01	0.000E-01	LUNG
38	MO-99	3.234E+01	0.000E-01	0.000E-01	1.632E+02	2.646E+02	1.348E+05	4.872E+04	0.000E-01	LUNG
39	TC-99M	3.724E-02	0.000E-01	1.397E-03	2.884E-03	3.108E-02	8.106E+02	2.030E+03	0.000E-01	GI-LLI
40	TC-101	8.120E-04	0.000E-01	6.510E-05	8.232E-05	9.786E-04	5.838E+02	8.442E+02	0.000E-01	GI-LLI
41	RU-103	6.790E+02	0.000E-01	2.016E+03	0.000E-01	4.242E+03	5.516E+05	1.610E+04	0.000E-01	LUNG
42	RU-105	4.102E-01	0.000E-01	1.224E+00	0.000E-01	8.988E-01	1.568E+04	4.814E+04	0.000E-01	GI-LLI
43	RU-106	1.098E+04	0.000E-01	8.680E+04	0.000E-01	1.065E+05	1.156E+07	1.638E+05	0.000E-01	LUNG
44	AG-110M	4.998E+03	0.000E-01	9.982E+03	7.224E+03	1.092E+04	3.668E+06	3.304E+04	0.000E-01	LUNG
45	CD-115M	1.113E+03	0.000E-01	0.000E-01	3.444E+04	2.772E+04	2.464E+05	6.726E+04	0.000E-01	LUNG
46	SB-124	2.170E+03	1.322E+01	5.460E+03	1.030E+02	0.000E-01	4.340E+05	7.112E+04	0.000E-01	LUNG
47	TE-125M	6.580E+02	1.624E+03	4.760E+03	1.988E+03	0.000E-01	4.466E+05	1.291E+04	0.000E-01	LUNG
48	TE-127M	2.072E+03	4.872E+03	1.666E+04	6.902E+03	3.752E+04	1.312E+06	2.730E+04	0.000E-01	LUNG
49	TE-127	4.886E-01	1.848E+00	2.226E+00	9.531E-01	4.858E+00	1.035E+04	2.436E+04	0.000E-01	GI-LLI
50	TE-129M	2.226E+03	5.474E+03	1.414E+04	6.090E+03	3.178E+04	1.680E+06	6.902E+04	0.000E-01	LUNG
51	TE-129	1.876E-02	6.748E-02	7.082E-02	3.472E-02	1.750E-01	2.996E+03	2.632E+04	0.000E-01	GI-LLI
52	TE-131M	3.626E+01	8.932E+01	1.067E+02	5.502E+01	2.646E+02	1.988E+05	1.191E+05	0.000E-01	LUNG
53	TE-131	4.998E-03	1.582E-02	1.736E-02	8.218E-03	3.990E-02	2.058E+03	8.218E+03	0.000E-01	GI-LLI
54	TE-132	1.764E+02	2.786E+02	3.724E+02	2.366E+02	1.035E+03	3.402E+05	4.410E+04	0.000E-01	LUNG
55	I-130	5.572E+03	1.596E+06	6.356E+03	1.387E+04	1.526E+04	0.000E-01	1.988E+03	0.000E-01	THYROID
56	I-131	1.960E+04	1.481E+07	3.794E+04	4.438E+04	5.180E+04	0.000E-01	1.058E+03	0.000E-01	THYROID
57	I-132	1.259E+03	1.694E+05	1.694E+03	3.542E+03	3.948E+03	0.000E-01	1.904E+03	0.000E-01	THYROID
58	I-133	5.600E+03	3.556E+06	1.324E+04	1.918E+04	2.240E+04	0.000E-01	2.156E+03	0.000E-01	THYROID
59	I-134	6.650E+02	4.452E+04	9.212E+02	1.876E+03	2.086E+03	0.000E-01	1.287E+03	0.000E-01	THYROID
60	I-135	2.772E+03	6.958E+05	3.864E+03	7.602E+03	8.470E+03	0.000E-01	1.834E+03	0.000E-01	THYROID
61	CS-134	7.448E+04	0.000E-01	3.962E+05	7.028E+05	1.904E+05	7.966E+04	1.334E+03	0.000E-01	LIVER
62	CS-136	5.292E+04	0.000E-01	4.830E+04	1.345E+05	5.612E+04	1.176E+04	1.428E+03	0.000E-01	LIVER
63	CS-137	1.550E+04	0.000E-01	5.188E+05	6.116E+05	1.722E+05	7.126E+04	1.334E+03	0.000E-01	LIVER
64	CS-138	3.976E+02	0.000E-01	5.054E+02	7.812E+02	4.102E+02	6.538E+01	8.764E+02	0.000E-01	GI-LLI
65	CS-139	1.946E+01	0.000E-01	3.584E+01	5.002E+01	4.270E+01	3.976E+00	0.000E-01	0.000E-01	LIVER
66	BA-139	4.298E-02	0.000E-01	1.484E+00	9.842E-04	5.922E-04	5.950E+03	5.096E+04	0.000E-01	GI-LLI
67	BA-140	2.898E+03	0.000E-01	5.600E+04	5.600E+01	1.343E+01	1.596E+06	3.836E+04	0.000E-01	LUNG
68	BA-141	4.970E-03	0.000E-01	1.568E-01	1.078E-04	6.496E-05	2.968E+03	4.746E+03	0.000E-01	GI-LLI
69	BA-142	1.960E-03	0.000E-01	3.976E-02	3.304E-05	1.904E-05	1.554E+03	6.930E+02	0.000E-01	LUNG
70	LA-140	5.152E+01	0.000E-01	5.054E+02	2.002E+02	0.000E-01	1.680E+05	8.484E+04	0.000E-01	LUNG



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )

AGE : INFANT  
 PATHWAY : INHALATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71	LA-142	9.044E-02	0.000E-01	1.030E+00	3.766E-01	0.000E-01	8.218E+03	5.950E+04	9.044E-02	GI-LLI
72	CE-141	1.988E+03	0.000E-01	2.772E+04	1.666E+04	5.250E+03	5.166E+05	2.156E+04	0.000E-01	LUNG
73	CE-143	2.212E+01	0.000E-01	2.926E+02	1.932E+02	5.642E+01	1.162E+05	4.970E+04	0.000E-01	LUNG
74	CE-144	1.764E+05	0.000E-01	3.192E+06	1.211E+06	5.376E+05	9.842E+06	1.404E+05	0.000E-01	LUNG
75	FR-143	6.986E+02	0.000E-01	1.400E+04	5.236E+03	1.974E+03	4.326E+05	3.724E+04	0.000E-01	LUNG
76	FR-144	2.408E-03	0.000E-01	4.788E-02	1.818E-02	6.720E-03	1.610E+03	4.204E+03	0.000E-01	GI-LLI
77	ND-147	4.998E+02	0.000E-01	7.938E+03	8.134E+03	3.150E+03	3.220E+05	3.122E+04	0.000E-01	LUNG
78	W-185	9.534E+00	0.000E-01	2.730E+02	9.058E+01	0.000E-01	7.798E+04	1.498E+04	0.000E-01	LUNG
79	W-187	3.122E+00	0.000E-01	1.296E+01	9.016E+00	0.000E-01	3.962E+04	3.556E+04	0.000E-01	LUNG
80	U-235	8.498E+05	0.000E-01	1.400E+07	0.000E-01	3.276E+06	6.860E+07	6.776E+04	0.000E-01	LUNG
81	U-238	7.938E+05	0.000E-01	1.341E+07	0.000E-01	3.052E+06	6.412E+07	1.442E+05	0.000E-01	LUNG
82	NP-239	1.876E+01	0.000E-01	3.710E+02	3.318E+01	6.622E+01	5.950E+04	2.492E+04	0.000E-01	LUNG

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu\text{Ci/sec}$ )

AGE : ADULT  
 PATHWAY : VEGETATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1	H-3*	2.260E+03	2.260E+03	0.000E-01	2.260E+03	2.260E+03	2.260E+03	2.260E+03	2.260E+03	W. BODY
2	C-14*	1.793E+05	1.793E+05	8.966E+05	1.793E+05	1.793E+05	1.793E+05	1.793E+05	1.793E+05	BONE
3	Na-24	2.692E+05	2.692E+05	2.692E+05	2.692E+05	2.692E+05	2.692E+05	2.692E+05	2.692E+05	W. BODY
4	P-32	5.433E+07	0.000E-01	1.406E+09	8.740E+07	0.000E-01	0.000E-01	1.580E+08	0.000E-01	BONE
5	SC-46	1.414E+05	0.000E-01	2.505E+05	4.910E+05	4.547E+05	0.000E-01	2.369E+09	0.000E-01	GI-LLI
6	CR-51	4.656E+04	2.783E+04	0.000E-01	0.000E-01	1.026E+04	6.178E+04	1.171E+07	0.000E-01	GI-LLI
7	MN-54	5.969E+07	0.000E-01	0.000E-01	3.128E+08	9.309E+07	0.000E-01	9.583E+08	0.000E-01	GI-LLI
8	MN-56	2.730E+00	0.000E-01	0.000E-01	1.539E+01	1.954E+01	0.000E-01	4.912E+02	0.000E-01	GI-LLI
9	FE-55	3.376E+07	0.000E-01	2.096E+08	1.448E+08	0.000E-01	8.077E+07	8.306E+07	0.000E-01	BONE
10	FE-59	1.135E+08	0.000E-01	1.260E+08	2.961E+08	0.000E-01	8.273E+07	9.869E+08	0.000E-01	GI-LLI
11	CO-58	6.939E+07	0.000E-01	0.000E-01	3.096E+07	0.000E-01	0.000E-01	6.274E+08	0.000E-01	GI-LLI
12	CO-60	3.686E+08	0.000E-01	0.000E-01	1.671E+08	0.000E-01	0.000E-01	3.139E+09	0.000E-01	GI-LLI
13	NI-59	1.306E+08	0.000E-01	7.830E+08	2.685E+08	0.000E-01	0.000E-01	5.530E+07	0.000E-01	BONE
14	NI-63	3.489E+08	0.000E-01	1.040E+10	7.211E+08	0.000E-01	0.000E-01	1.505E+08	0.000E-01	BONE
15	NI-65	3.537E+00	0.000E-01	5.967E+01	7.752E+00	0.000E-01	0.000E-01	1.966E+02	0.000E-01	GI-LLI
16	CU-64	4.267E+03	0.000E-01	0.000E-01	9.090E+03	2.292E+04	0.000E-01	7.739E+05	0.000E-01	GI-LLI
17	ZN-65	4.556E+08	0.000E-01	3.168E+08	1.008E+09	6.742E+08	0.000E-01	6.300E+08	0.000E-01	LIVER
18	ZN-69	1.040E-06	0.000E-01	7.819E-06	1.495E-05	9.716E-06	0.000E-01	2.247E-06	0.000E-01	LIVER
19	BR-83	3.087E+00	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	4.446E+00	0.000E-01	GI-LLI
20	BR-84	2.009E-11	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	1.577E-16	0.000E-01	W. BODY
21	BR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22	RB-86	1.019E+08	0.000E-01	0.000E-01	2.187E+08	0.000E-01	0.000E-01	4.311E+07	0.000E-01	LIVER
23	RB-89	9.892E-23	0.000E-01	0.000E-01	1.863E-22	0.000E-01	0.000E-01	0.000E-01	0.000E-01	LIVER
24	RB-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
25	SR-89	2.857E+09	0.000E-01	9.954E+09	0.000E-01	0.000E-01	0.000E-01	1.596E+09	0.000E-01	BONE
26	SR-90	1.481E+11	0.000E-01	6.046E+11	0.000E-01	0.000E-01	0.000E-01	1.747E+10	0.000E-01	BONE
27	SR-91	1.215E+04	0.000E-01	3.009E+05	0.000E-01	0.000E-01	0.000E-01	1.433E+06	0.000E-01	GI-LLI
28	SR-92	1.784E+01	0.000E-01	4.125E+02	0.000E-01	0.000E-01	0.000E-01	8.172E+03	0.000E-01	GI-LLI
29	Y-90	3.566E+02	0.000E-01	1.330E+04	0.000E-01	0.000E-01	0.000E-01	1.410E+09	0.000E-01	GI-LLI
30	Y-91M	1.909E-10	0.000E-01	4.930E-09	0.000E-01	0.000E-01	0.000E-01	1.448E-08	0.000E-01	GI-LLI
31	Y-91	1.368E+05	0.000E-01	5.116E+06	0.000E-01	0.000E-01	0.000E-01	2.816E+09	0.000E-01	GI-LLI
32	Y-92	2.615E-02	0.000E-01	8.946E-01	0.000E-01	0.000E-01	0.000E-01	1.567E+04	0.000E-01	GI-LLI
33	Y-93	4.751E+00	0.000E-01	1.721E+02	0.000E-01	0.000E-01	0.000E-01	5.457E+06	0.000E-01	GI-LLI
34	ZR-95	2.596E+05	0.000E-01	1.196E+06	3.835E+05	6.019E+05	0.000E-01	1.216E+09	0.000E-01	GI-LLI
35	ZR-97	3.094E+01	0.000E-01	3.354E+02	6.767E+01	1.022E+02	0.000E-01	2.096E+07	0.000E-01	GI-LLI

\* Units are (mrem/yr per  $\mu\text{Ci/m}^3$ )

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : ADULT

PATHWAY : VEGETATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
35	ND-95	4.254E+04	0.000E-01	1.423E+05	7.914E+04	7.822E+04	0.000E-01	4.803E+09	0.000E-01	GI-LLI
37	NB-97	2.516E-07	0.000E-01	2.730E-06	6.889E-07	8.037E-07	0.000E-01	2.542E-03	0.000E-01	GI-LLI
38	ND-99	1.167E+06	0.000E-01	0.000E-01	6.136E+06	1.390E+07	0.000E-01	1.422E+07	0.000E-01	GI-LLI
39	TC-99M	1.113E+02	0.000E-01	3.093E+00	8.740E+00	1.327E+02	4.283E+00	5.172E+03	0.000E-01	GI-LLI
40	TC-101	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
41	RU-103	2.074E+06	0.000E-01	4.815E+06	0.000E-01	1.837E+07	0.000E-01	5.621E+09	0.000E-01	GI-LLI
42	RU-105	2.104E+01	0.000E-01	5.330E+01	0.000E-01	6.888E+02	0.000E-01	3.261E+04	0.000E-01	GI-LLI
43	RU-106	2.441E+07	0.000E-01	1.929E+08	0.000E-01	3.724E+08	0.000E-01	1.248E+10	0.000E-01	GI-LLI
44	AG-110M	5.796E+06	0.000E-01	1.055E+07	9.758E+06	1.919E+07	0.000E-01	3.982E+09	0.000E-01	GI-LLI
45	CD-115M	1.648E+06	0.000E-01	0.000E-01	5.157E+07	4.092E+07	0.000E-01	2.169E+09	0.000E-01	GI-LLI
46	SB-124	4.115E+07	2.517E+05	1.042E+08	1.965E+06	0.000E-01	8.081E+07	2.947E+09	0.000E-01	GI-LLI
47	TC-125M	1.296E+07	2.909E+07	9.672E+07	3.504E+07	3.934E+08	0.000E-01	3.862E+08	0.000E-01	KIDNEY
48	TE-127H	4.255E+07	8.924E+07	3.492E+08	1.248E+08	1.418E+09	0.000E-01	1.171E+09	0.000E-01	KIDNEY
49	TE-127	1.230E+03	1.211E+03	5.684E+03	2.041E+03	2.315E+04	0.000E-01	4.485E+05	0.000E-01	GI-LLI
50	TE-129M	3.955E+07	8.584E+07	2.499E+08	9.323E+07	1.043E+09	0.000E-01	1.258E+09	0.000E-01	GI-LLI
51	TE-129	1.904E-04	5.997E-04	7.813E-04	2.936E-04	3.284E-03	0.000E-01	5.897E-04	0.000E-01	KIDNEY
52	TE-131M	3.705E+05	7.043E+05	9.092E+05	4.446E+05	4.504E+06	0.000E-01	4.415E+07	0.000E-01	GI-LLI
53	TE-131	4.341E-16	1.131E-15	1.375E-15	5.744E-16	6.023E-15	0.000E-01	1.947E-16	0.000E-01	KIDNEY
54	TE-132	2.600E+06	3.058E+06	4.282E+06	2.769E+06	2.668E+07	0.000E-01	1.310E+09	0.000E-01	GI-LLI
55	I-130	4.591E+05	9.861E+07	3.944E+05	1.163E+06	1.816E+06	0.000E-01	1.002E+06	0.000E-01	THYROID
56	I-131	6.622E+07	3.787E+10	8.079E+07	1.155E+08	1.981E+08	0.000E-01	3.049E+07	0.000E-01	THYROID
57	I-132	4.968E+01	4.968E+03	5.308E+01	1.420E+02	2.262E+02	0.000E-01	2.667E+01	0.000E-01	THYROID
58	I-133	1.103E+06	5.318E+08	2.080E+06	3.619E+06	6.314E+06	0.000E-01	3.252E+06	0.000E-01	THYROID
59	I-134	8.306E-05	4.024E-03	8.548E-05	2.322E-04	3.693E-04	0.000E-01	2.024E-07	0.000E-01	THYROID
60	I-135	3.691E+04	6.597E+06	3.820E+04	1.000E+05	1.604E+05	0.000E-01	1.130E+05	0.000E-01	THYROID
61	CS-134	9.076E+09	0.000E-01	4.666E+09	1.110E+10	3.593E+09	1.193E+09	1.943E+08	0.000E-01	LIVER
62	CS-136	1.195E+08	0.000E-01	4.204E+07	1.660E+08	9.235E+07	1.266E+07	1.886E+07	0.000E-01	LIVER
63	CS-137	5.696E+09	0.000E-01	6.358E+09	8.696E+09	2.952E+09	9.813E+08	1.683E+08	0.000E-01	LIVER
64	CS-138	3.554E-11	0.000E-01	3.633E-11	7.174E-11	5.272E-11	5.206E-12	3.061E-16	0.000E-01	LIVER
65	CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
66	BA-139	7.925E-04	0.000E-01	2.707E-02	1.928E-05	1.803E-05	1.094E-05	4.800E-02	0.000E-01	GI-LLI
67	BA-140	8.405E+06	0.000E-01	1.283E+08	1.611E+05	5.479E+04	9.227E+04	2.642E+08	0.000E-01	GI-LLI
68	BA-141	3.389E-23	0.000E-01	1.004E-21	7.589E-25	7.056E-25	0.000E-01	0.000E-01	0.000E-01	BONE
69	BA-142	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
70	LA-140	2.634E+02	0.000E-01	1.978E+03	9.968E+02	0.000E-01	0.000E-01	7.318E+07	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : ADULT  
 PATHWAY : VEGETATION

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	1.508E-05	0.000E-01	1.331E-04	6.051E-05	0.000E-01	0.000E-01	4.419E-01	0.000E-01	GI-LLI
72 CE-141	1.511E+04	0.000E-01	1.970E+05	1.332E+05	6.188E+04	0.000E-01	5.094E+08	0.000E-01	GI-LLI
73 CE-143	8.154E+01	0.000E-01	9.966E+02	7.369E+05	3.244E+02	0.000E-01	2.754E+07	0.000E-01	GI-LLI
74 CE-144	1.765E+06	0.000E-01	3.288E+07	1.375E+07	8.153E+06	0.000E-01	1.112E+10	0.000E-01	GI-LLI
75 PR-143	3.101E+03	0.000E-01	6.256E+04	2.509E+04	1.448E+04	0.000E-01	2.740E+08	0.000E-01	GI-LLI
76 PR-144	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
77 ND-147	2.303E+03	0.000E-01	3.330E+04	3.849E+04	2.250E+04	0.000E-01	1.848E+08	0.000E-01	GI-LLI
78 W-195	6.065E+05	0.000E-01	1.734E+07	5.766E+06	0.000E-01	0.000E-01	6.663E+08	0.000E-01	GI-LLI
79 W-197	1.112E+04	0.000E-01	3.806E+04	3.181E+04	0.000E-01	0.000E-01	1.012E+07	0.000E-01	GI-LLI
80 U-235	3.895E+09	0.000E-01	6.427E+10	0.000E-01	1.499E+10	0.000E-01	6.259E+09	0.000E-01	BONE
81 U-238	3.646E+09	0.000E-01	6.147E+10	0.000E-01	1.402E+10	0.000E-01	1.330E+10	0.000E-01	BONE
82 NP-239	7.693E+01	0.000E-01	1.419E+03	1.396E+02	4.351E+02	0.000E-01	2.863E+07	0.000E-01	GI-LLI



## ATTACHMENT 7

## Pathway Dose Parameters

$$R_i (m^2 - mrem/yr \text{ per } \mu\text{Ci/sec})$$

AGE : TEEN

PATHWAY : VEGETATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1	H-3*	2.589E+03	2.589E+03	0.000E-01	2.589E+03	2.589E+03	2.589E+03	2.589E+03	2.589E+03	W. BODY
2	C-14	2.907E+05	2.907E+05	1.454E+06	2.907E+05	2.907E+05	2.907E+05	2.907E+05	2.907E+05	BONE
3	NA-24	2.390E+05	2.390E+05	2.390E+05	2.390E+05	2.390E+05	2.390E+05	2.390E+05	2.390E+05	W. BODY
4	P-32	6.247E+07	0.000E-01	1.611E+09	9.983E+07	0.000E-01	0.000E-01	1.354E+08	0.000E-01	BONE
5	SC-46	1.549E+05	0.000E-01	2.745E+05	5.380E+05	4.991E+05	0.000E-01	2.595E+09	0.000E-01	GI-LLI
6	CR-51	6.186E+04	3.437E+04	0.000E-01	0.000E-01	1.356E+04	8.832E+04	1.049E+07	0.000E-01	GI-LLI
7	MN-54	9.010E+07	0.000E-01	0.000E-01	4.543E+08	1.355E+08	0.000E-01	9.310E+08	0.000E-01	GI-LLI
8	MN-56	2.429E+00	0.000E-01	0.000E-01	1.388E+01	1.757E+01	0.000E-01	9.131E+02	0.000E-01	BONE
9	FE-55	5.389E+07	0.000E-01	3.259E+08	2.310E+08	0.000E-01	1.466E+08	1.060E+08	0.000E-01	GI-LLI
10	FE-59	1.615E+08	0.000E-01	1.792E+08	4.181E+08	0.000E-01	1.318E+08	9.688E+08	0.000E-01	GI-LLI
11	CO-58	1.013E+08	0.000E-01	0.000E-01	4.394E+07	0.000E-01	0.000E-01	6.057E+08	0.000E-01	GI-LLI
12	CO-60	5.599E+08	0.000E-01	0.000E-01	2.486E+08	0.000E-01	0.000E-01	3.239E+09	0.000E-01	GI-LLI
13	NI-59	1.492E+09	0.000E-01	8.880E+08	3.045E+08	0.000E-01	0.000E-01	6.271E+07	0.000E-01	BONE
14	NI-63	5.442E+08	0.000E-01	1.606E+10	1.135E+09	0.000E-01	0.000E-01	1.806E+08	0.000E-01	BONE
15	NI-65	3.233E+00	0.000E-01	5.554E-01	7.097E+00	0.000E-01	0.000E-01	3.819E+02	0.000E-01	GI-LLI
16	CU-64	3.874E+03	0.000E-01	0.000E-01	8.235E+03	2.084E+04	0.000E-01	4.389E+05	0.000E-01	GI-LLI
17	ZN-65	6.854E+08	0.000E-01	4.231E+08	1.469E+09	9.403E+08	0.000E-01	6.222E+08	0.000E-01	LIVER
18	ZN-69	9.764E-07	0.000E-01	7.323E-06	1.395E-05	9.116E-06	0.000E-01	2.570E-05	0.000E-01	GI-LLI
19	BR-83	2.892E+00	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
20	BR-84	1.827E-11	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21	BR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22	BR-86	1.280E+08	0.000E-01	0.000E-01	2.725E+08	0.000E-01	0.000E-01	4.033E+07	0.000E-01	LIVER
23	BR-88	9.172E-23	0.000E-01	0.000E-01	1.721E-22	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
24	BR-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	LIVER
25	SR-89	4.330E+08	0.000E-01	1.512E+10	0.000E-01	0.000E-01	0.000E-01	1.901E+09	0.000E-01	BONE
26	SR-90	1.854E+11	0.000E-01	7.507E+11	0.000E-01	0.000E-01	0.000E-01	2.107E+10	0.000E-01	BONE
27	SR-91	1.118E+04	0.000E-01	2.811E+05	0.000E-01	0.000E-01	0.000E-01	1.275E+06	0.000E-01	GI-LLI
28	SR-92	1.637E+01	0.000E-01	3.840E+02	0.000E-01	0.000E-01	0.000E-01	9.792E+03	0.000E-01	GI-LLI
29	Y-90	3.347E+02	0.000E-01	1.243E+04	0.000E-01	0.000E-01	0.000E-01	1.025E+08	0.000E-01	GI-LLI
30	Y-90M	1.755E-10	0.000E-01	4.591E-09	0.000E-01	0.000E-01	0.000E-01	2.168E-07	0.000E-01	GI-LLI
31	Y-91	2.103E+05	0.000E-01	7.842E+06	0.000E-01	0.000E-01	0.000E-01	3.215E+09	0.000E-01	GI-LLI
32	Y-92	2.432E-02	0.000E-01	8.407E-01	0.000E-01	0.000E-01	0.000E-01	2.307E+04	0.000E-01	GI-LLI
33	Y-93	4.424E+00	0.000E-01	1.614E+02	0.000E-01	0.000E-01	0.000E-01	4.930E+06	0.000E-01	GI-LLI
34	ZR-95	3.808E+05	0.000E-01	1.755E+06	5.538E+05	4.303E+12	0.000E-01	1.278E+09	0.000E-01	KIDNEY
35	ZR-97	2.830E+01	0.000E-01	3.105E+02	6.144E+01	9.314E+01	0.000E-01	1.664E+07	0.000E-01	GI-LLI

\* Units are (mrem/yr per  $\mu\text{Ci}/\text{m}^3$ )



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : TEEN  
 PATHWAY : VEGETATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36	NB-95	5.865E+04	0.000E-01	1.921E+05	1.065E+05	1.033E+05	0.000E-01	4.554E+09	0.000E-01	GI-LLI
37	NB-97	1.651E-07	0.000E-01	1.791E-06	4.521E-07	5.274E-07	0.000E-01	1.668E-03	0.000E-01	GI-LLI
38	HO-99	1.074E+06	0.000E-01	0.000E-01	5.631E+06	1.289E+07	0.000E-01	1.009E+07	0.000E-01	KIDNEY
39	TC-99M	9.861E+01	0.000E-01	2.728E+00	7.610E+00	1.134E+02	4.224E+00	4.996E+03	0.000E-01	GI-LLI
40	TC-101	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
41	RU-103	2.946E+06	0.000E-01	6.891E+06	0.000E-01	2.429E+07	0.000E-01	5.756E+09	0.000E-01	GI-LLI
42	RU-105	1.922E+01	0.000E-01	4.952E+01	0.000E-01	6.247E+02	0.000E-01	3.998E+04	0.000E-01	GI-LLI
43	RU-106	3.903E+07	0.000E-01	3.097E+08	0.000E-01	5.973E+09	0.000E-01	1.495E+10	0.000E-01	GI-LLI
44	AG-110M	8.735E+06	0.000E-01	1.517E+07	1.436E+07	2.739E+07	0.000E-01	4.034E+09	0.000E-01	GI-LLI
45	CB-115M	1.726E+06	0.000E-01	0.000E-01	5.401E+07	4.285E+07	0.000E-01	2.272E+09	0.000E-01	GI-LLI
46	SB-124	4.433E+07	2.712E+05	1.122E+08	2.116E+06	0.000E-01	8.706E+07	3.175E+09	0.000E-01	GI-LLI
47	TE-125M	1.986E+07	4.150E+07	1.486E+08	5.352E+07	0.000E-01	0.000E-01	4.383E+09	0.000E-01	GI-LLI
48	TE-127M	6.559E+07	1.312E+08	5.515E+08	1.956E+08	2.236E+09	0.000E-01	1.374E+09	0.000E-01	KIDNEY
49	TE-127	1.153E+03	3.696E+03	5.358E+03	1.899E+03	2.170E+04	0.000E-01	4.137E+05	0.000E-01	GI-LLI
50	TE-129M	5.689E+07	1.160E+08	3.594E+08	1.331E+09	1.504E+09	0.000E-01	1.349E+09	0.000E-01	KIDNEY
51	TE-129	1.780E-04	5.225E-04	7.315E-04	2.727E-04	3.070E-03	0.000E-01	4.001E-03	0.000E-01	GI-LLI
52	TE-131M	3.366E+05	6.070E+05	8.416E+05	4.035E+05	4.208E+06	0.000E-01	3.239E+07	0.000E-01	GI-LLI
53	TE-131	3.994E-16	9.849E-16	1.278E-15	5.267E-16	5.588E-15	0.000E-01	1.049E-16	0.000E-01	KIDNEY
54	TE-132	2.319E+06	2.598E+06	3.891E+06	2.464E+06	2.364E+07	0.000E-01	7.805E+07	0.000E-01	GI-LLI
55	I-130	4.074E+05	8.320E+07	3.527E+05	1.020E+06	1.572E+06	0.000E-01	7.841E+05	0.000E-01	THYROID
56	I-131	5.783E+07	3.141E+10	7.689E+07	1.076E+08	1.853E+09	0.000E-01	2.129E+07	0.000E-01	THYROID
57	I-132	4.496E+01	4.221E+03	4.788E+01	1.253E+02	1.973E+02	0.000E-01	5.457E+01	0.000E-01	THYROID
58	I-133	9.998E+05	4.576E+03	1.932E+06	3.279E+06	5.749E+06	0.000E-01	2.480E+06	0.000E-01	THYROID
59	I-134	7.356E-05	3.413E-03	7.726E-05	2.048E-04	3.228E-04	0.000E-01	2.699E-06	0.000E-01	THYROID
60	I-135	3.293E+04	5.715E+06	3.452E+04	8.884E+04	1.403E+05	0.000E-01	9.846E+04	0.000E-01	THYROID
61	CS-134	7.750E+09	0.000E-01	7.097E+09	1.670E+10	5.308E+09	2.027E+09	2.077E+09	0.000E-01	LIVER
62	CS-136	1.133E+09	0.000E-01	4.289E+07	1.688E+09	9.187E+07	1.418E+07	1.358E+07	0.000E-01	LIVER
63	CS-137	4.695E+09	0.000E-01	1.013E+10	1.318E+10	4.585E+09	1.782E+09	1.918E+08	0.000E-01	LIVER
64	CS-138	3.218E-11	0.000E-01	3.352E-11	6.436E-11	4.751E-11	5.529E-12	2.920E-14	0.000E-01	LIVER
65	CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
66	BA-139	7.417E-04	0.000E-01	2.545E-02	1.791E-05	1.688E-05	1.234E-05	2.271E-01	0.000E-01	GI-LLI
67	BA-140	8.882E+06	0.000E-01	1.378E+08	1.689E+05	5.727E+04	1.136E+05	2.126E+08	0.000E-01	GI-LLI
68	BA-141	3.134E-23	0.000E-01	9.387E-22	7.009E-25	6.505E-25	4.798E-25	0.000E-01	0.000E-01	BONE
69	BA-142	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
70	LA-140	2.362E+02	0.000E-01	1.807E+03	8.878E+02	0.000E-01	0.000E-01	5.098E+07	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_1$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : TEEN

PATHWAY : VEGETATION

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	1.351E-05	0.000E-01	1.221E-04	5.424E-05	0.000E-01	0.000E-01	1.651E+00	0.000E-01	GI-LLI
72 CE-141	2.169E+04	0.000E-01	2.827E+05	1.888E+05	8.886E+04	0.000E-01	5.399E+08	0.000E-01	GI-LLI
73 CE-143	7.571E+01	0.000E-01	9.315E+02	6.778E+05	3.040E+02	0.000E-01	2.037E+07	0.000E-01	GI-LLI
74 CE-144	2.833E+06	0.000E-01	5.271E+07	2.181E+07	1.303E+07	0.000E-01	1.325E+10	0.000E-01	GI-LLI
75 PR-143	3.482E+03	0.000E-01	6.995E+04	2.793E+04	1.623E+04	0.000E-01	2.301E+08	0.000E-01	GI-LLI
76 PR-144	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
77 ND-147	2.356E+03	0.000E-01	3.617E+04	3.933E+04	2.310E+04	0.000E-01	1.419E+08	0.000E-01	GI-LLI
78 W-185	6.613E+05	0.000E-01	1.891E+07	6.287E+06	0.000E-01	0.000E-01	7.265E+08	0.000E-01	GI-LLI
79 W-187	1.011E+04	0.000E-01	3.540E+04	2.885E+04	0.000E-01	0.000E-01	7.808E+06	0.000E-01	GI-LLI
80 U-235	4.417E+09	0.000E-01	7.289E+10	0.000E-01	1.700E+10	0.000E-01	7.099E+09	0.000E-01	BONE
81 U-238	4.136E+09	0.000E-01	6.971E+10	0.000E-01	1.591E+10	0.000E-01	1.509E+10	0.000E-01	BONE
92 HP-239	7.217E+01	0.000E-01	1.378E+03	1.299E+02	4.078E+02	0.000E-01	2.090E+07	0.000E-01	GI-LLI

## ATTACHMENT 7

## Pathway Dose Parameters

 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

 AGE : CHILD  
 PATHWAY : VEGETATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1	H-3*	4.008E+03	4.008E+03	0.000E-01	4.008E+03	4.008E+03	4.008E+03	4.008E+03	4.008E+03	W. BODY
2	C-14	7.008E+05	7.008E+05	3.504E+06	7.008E+05	7.008E+05	7.008E+05	7.008E+05	7.008E+05	BONE
3	NA-24	3.732E+05	3.732E+05	3.732E+05	3.732E+05	3.732E+05	3.732E+05	3.732E+05	3.732E+05	W. BODY
4	P-32	1.301E+08	0.000E-01	3.375E+09	1.579E+08	0.000E-01	0.000E-01	9.323E+07	0.000E-01	BONE
5	SC-46	1.239E+05	0.000E-01	2.195E+05	4.302E+05	3.983E+05	0.000E-01	2.075E+09	0.000E-01	GI-LLI
6	CR-51	1.175E+05	6.522E+04	0.000E-01	0.000E-01	1.782E+04	1.191E+05	6.232E+06	0.000E-01	GI-LLI
7	HN-54	1.770E+08	0.000E-01	0.000E-01	6.646E+09	1.843E+08	0.000E-01	5.578E+08	0.000E-01	LIVER
8	HN-56	4.100E+00	0.000E-01	0.000E-01	1.816E+01	2.197E+01	0.000E-01	2.632E+03	0.000E-01	GI-LLI
9	FE-55	1.317E+08	0.000E-01	8.012E+08	4.250E+08	0.000E-01	2.404E+08	7.873E+07	0.000E-01	BONE
10	FE-59	3.200E+08	0.000E-01	3.970E+08	6.423E+08	0.000E-01	1.862E+09	6.688E+08	0.000E-01	GI-LLI
11	CO-58	1.987E+08	0.000E-01	0.000E-01	6.490E+07	0.000E-01	0.000E-01	3.786E+08	0.000E-01	GI-LLI
12	CO-60	1.116E+09	0.000E-01	0.000E-01	3.783E+08	0.000E-01	0.000E-01	2.095E+09	0.000E-01	GI-LLI
13	NI-59	1.190E+08	0.000E-01	7.182E+08	2.463E+08	0.000E-01	0.000E-01	5.072E+07	0.000E-01	BONE
14	NI-63	1.343E+09	0.000E-01	3.949E+10	2.114E+09	0.000E-01	0.000E-01	1.424E+09	0.000E-01	BONE
15	NI-65	5.601E+00	0.000E-01	1.019E+02	9.595E+00	0.000E-01	0.000E-01	1.175E+03	0.000E-01	GI-LLI
16	CU-64	6.561E+03	0.000E-01	0.000E-01	1.086E+04	2.624E+04	0.000E-01	5.098E+05	0.000E-01	GI-LLI
17	ZN-65	1.344E+09	0.000E-01	8.112E+08	2.161E+09	1.362E+09	0.000E-01	3.795E+08	0.000E-01	LIVER
18	ZN-69	1.804E-06	0.000E-01	1.351E-05	1.952E-05	1.184E-05	0.000E-01	1.230E-03	0.000E-01	GI-LLI
19	BR-83	5.334E+00	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
20	SR-84	3.101E-11	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21	BR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22	RB-86	2.767E+08	0.000E-01	0.000E-01	4.500E+08	0.000E-01	0.000E-01	2.895E+07	0.000E-01	LIVER
23	RB-88	1.651E-22	0.000E-01	0.000E-01	2.376E-22	0.000E-01	0.000E-01	1.166E-23	0.000E-01	LIVER
24	RB-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
25	SR-89	1.025E+09	0.000E-01	3.590E+10	0.000E-01	0.000E-01	0.000E-01	1.390E+09	0.000E-01	BONE
26	SR-90	3.152E+11	0.000E-01	1.243E+12	0.000E-01	0.000E-01	0.000E-01	1.675E+10	0.000E-01	BONE
27	SR-91	1.953E+04	0.000E-01	5.175E+05	0.000E-01	0.000E-01	0.000E-01	1.143E+06	0.000E-01	GI-LLI
28	SR-92	2.821E+01	0.000E-01	7.038E+02	0.000E-01	0.000E-01	0.000E-01	1.333E+04	0.000E-01	GI-LLI
29	Y-90	6.177E+02	0.000E-01	2.308E+04	0.000E-01	0.000E-01	0.000E-01	6.570E+07	0.000E-01	GI-LLI
30	Y-91M	3.063E-10	0.000E-01	8.417E-09	0.000E-01	0.000E-01	0.000E-01	1.648E-05	0.000E-01	GI-LLI
31	Y-91	4.990E+05	0.000E-01	1.866E+07	0.000E-01	0.000E-01	0.000E-01	2.485E+09	0.000E-01	GI-LLI
32	Y-92	4.430E-02	0.000E-01	1.548E+00	0.000E-01	0.000E-01	0.000E-01	4.473E+04	0.000E-01	GI-LLI
33	Y-93	8.164E+00	0.000E-01	2.973E+02	0.000E-01	0.000E-01	0.000E-01	4.434E+06	0.000E-01	GI-LLI
34	ZR-95	7.702E+05	0.000E-01	3.936E+06	8.652E+05	1.238E+06	0.000E-01	9.025E+08	0.000E-01	GI-LLI
35	ZR-97	4.833E+01	0.000E-01	5.669E+02	8.191E+01	1.176E+02	0.000E-01	1.241E+07	0.000E-01	GI-LLI

\* Units are (mrem/yr per  $\mu Ci/m^3$ )

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : CHILD  
 PATHWAY : VEGETATION

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
35 NB-95	1.141E+05	0.000E-01	4.101E+05	1.597E+05	1.500E+05	0.000E-01	2.953E+08	0.000E-01	GI-LLI
37 NB-97	1.022E-07	0.000E-01	1.109E-06	2.799E-07	3.265E-07	0.000E-01	1.033E-03	0.000E-01	GI-LLI
38 MO-99	1.903E+06	0.000E-01	0.000E-01	7.693E+06	1.643E+07	0.000E-01	6.362E+06	0.000E-01	KIDNEY
39 TC-99M	1.526E+02	0.000E-01	4.695E+00	9.208E+00	1.338E+02	4.675E+00	5.240E+03	0.000E-01	GI-LLI
40 TC-101	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
41 RU-103	5.959E+06	0.000E-01	1.550E+07	0.000E-01	3.902E+07	0.000E-01	4.008E+08	0.000E-01	GI-LLI
42 RU-105	3.290E+01	0.000E-01	9.070E+01	0.000E-01	7.973E+02	0.000E-01	5.920E+04	0.000E-01	GI-LLI
43 RU-106	9.308E+07	0.000E-01	7.459E+08	0.000E-01	1.007E+09	0.000E-01	1.160E+10	0.000E-01	GI-LLI
44 AG-110M	1.736E+07	0.000E-01	3.216E+07	2.172E+07	4.046E+07	0.000E-01	2.504E+09	0.000E-01	GI-LLI
45 CD-115M	1.359E+06	0.000E-01	0.000E-01	4.251E+07	3.373E+07	0.000E-01	1.708E+09	0.000E-01	GI-LLI
46 SB-124	3.524E+07	2.156E+05	8.921E+07	1.683E+06	0.000E-01	6.921E+07	2.521E+09	0.000E-01	GI-LLI
47 TC-125M	4.683E+07	9.859E+07	3.512E+08	9.520E+07	0.000E-01	0.000E-01	3.309E+08	0.000E-01	BONE
48 TE-127M	1.569E+09	3.161E+09	1.322E+09	3.559E+08	3.769E+09	0.000E-01	1.070E+09	0.000E-01	KIDNEY
49 TE-127	2.120E+03	6.843E+03	9.897E+03	2.666E+03	2.813E+04	0.000E-01	3.862E+05	0.000E-01	GI-LLI
50 TE-129M	1.297E+08	2.693E+08	8.354E+08	2.333E+08	2.453E+09	0.000E-01	1.019E+09	0.000E-01	KIDNEY
51 TE-129	3.215E-04	9.664E-04	1.355E-03	3.781E-04	3.963E-03	0.000E-01	8.431E-02	0.000E-01	GI-LLI
52 TE-131M	5.658E+05	1.093E+06	1.537E+06	5.316E+05	5.146E+06	0.000E-01	2.156E+07	0.000E-01	GI-LLI
53 TE-131	7.003E-16	1.800E-15	2.353E-15	7.174E-16	7.117E-15	0.000E-01	1.236E-14	0.000E-01	GI-LLI
54 TE-132	3.727E+06	4.494E+06	6.972E+06	3.086E+06	2.865E+07	0.000E-01	3.106E+07	0.000E-01	GI-LLI
55 I-130	6.443E+05	1.378E+08	6.189E+05	1.251E+06	1.869E+06	0.000E-01	5.850E+05	0.000E-01	THYROID
56 I-131	8.175E+07	4.757E+10	1.430E+08	1.439E+08	2.362E+08	0.000E-01	1.281E+07	0.000E-01	THYROID
57 I-132	7.181E+01	7.245E+03	8.498E+01	1.562E+02	2.390E+02	0.000E-01	1.830E+02	0.000E-01	THYROID
58 I-133	1.649E+06	8.094E+09	3.523E+06	4.356E+06	7.261E+06	0.000E-01	1.756E+06	0.000E-01	THYROID
59 I-134	1.173E-04	5.864E-03	1.373E-04	2.549E-04	3.898E-04	0.000E-01	1.690E-04	0.000E-01	THYROID
60 I-135	5.220E+04	9.774E+06	6.130E+04	1.103E+05	1.692E+05	0.000E-01	8.407E+04	0.000E-01	THYROID
61 CS-134	5.549E+09	0.000E-01	1.603E+10	2.631E+10	8.152E+09	2.925E+09	1.418E+08	0.000E-01	LIVER
62 CS-136	1.434E+08	0.000E-01	8.062E+07	2.216E+08	1.180E+08	1.760E+07	7.787E+06	0.000E-01	LIVER
63 CS-137	3.380E+09	0.000E-01	2.392E+10	2.290E+10	7.462E+09	2.685E+09	1.434E+08	0.000E-01	BONE
64 CS-138	5.375E-11	0.000E-01	6.097E-11	8.476E-11	5.963E-11	6.417E-12	3.904E-11	0.000E-01	LIVER
65 CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
66 BA-139	1.360E-03	0.000E-01	4.693E-02	2.505E-05	0.188E-05	1.474E-05	2.709E+00	0.000E-01	GI-LLI
67 BA-140	1.611E+07	0.000E-01	2.761E+08	2.419E+05	7.875E+04	1.442E+05	1.399E+08	0.000E-01	BONE
68 BA-141	5.638E-23	0.000E-01	1.732E-21	9.699E-25	8.392E-25	5.698E-24	9.872E-22	0.000E-01	BONE
69 BA-142	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
70 LA-140	3.535E+02	0.000E-01	3.246E+03	1.134E+03	0.000E-01	0.000E-01	3.162E+07	0.000E-01	GI-LLI



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_1$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : CHILD  
 PATHWAY : VEGETATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71	LA-142	2.209E-05	0.000E-01	2.213E-04	7.054E-05	0.000E-01	0.000E-01	1.398E+01	0.000E-01	GI-LLI
72	CE-141	4.854E+04	0.000E-01	6.555E+05	3.269E+05	1.433E+05	0.000E-01	4.078E+08	0.000E-01	GI-LLI
73	CE-143	1.347E+02	0.000E-01	1.715E+03	9.300E+05	3.902E+02	0.000E-01	1.362E+07	0.000E-01	GI-LLI
74	CE-144	6.780E+06	0.000E-01	1.270E+08	3.982E+07	2.205E+07	0.000E-01	1.038E+10	0.000E-01	GI-LLI
75	FR-143	7.216E+03	0.000E-01	1.454E+05	4.367E+04	2.365E+04	0.000E-01	1.569E+08	0.000E-01	GI-LLI
76	FR-144	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	2.632E-23	0.000E-01	GI-LLI
77	ND-147	4.175E+03	0.000E-01	7.140E+04	5.783E+04	3.173E+04	0.000E-01	9.161E+07	0.000E-01	GI-LLI
78	W-195	5.279E+05	0.000E-01	1.509E+07	5.019E+06	0.000E-01	0.000E-01	5.800E+08	0.000E-01	GI-LLI
79	W-197	1.711E+04	0.000E-01	6.439E+04	3.813E+04	0.000E-01	0.000E-01	5.359E+06	0.000E-01	GI-LLI
80	U-235	3.573E+09	0.000E-01	5.895E+10	0.000E-01	1.375E+10	0.000E-01	5.741E+09	0.000E-01	BONE
81	U-238	3.345E+09	0.000E-01	5.638E+10	0.000E-01	1.206E+10	0.000E-01	1.220E+10	0.000E-01	BONE
82	NP-239	1.281E+02	0.000E-01	2.544E+03	1.827E+02	5.282E+02	0.000E-01	1.352E+07	0.000E-01	GI-LLI



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_1$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : INFANT  
 PATHWAY : VEGETATION

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-ILLI	SKIN	CRITICAL
1	H-3*	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
2	C-14	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
3	NA-24	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
4	P-32	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
5	SC-46	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
6	CR-51	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
7	MN-54	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
8	MN-56	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
9	FE-55	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
10	FE-59	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
11	CO-58	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
12	CO-60	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
13	NI-59	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
14	NI-63	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
15	NI-65	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
16	CU-64	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
17	ZN-65	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
18	ZN-69	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
19	BR-83	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
20	BR-84	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21	BR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22	RB-86	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
23	RB-88	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
24	RB-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
25	SR-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
26	SR-90	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
27	SR-91	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
28	SR-92	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
29	Y-90	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
30	Y-91M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
31	Y-91	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
32	Y-92	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
33	Y-93	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
34	ZR-95	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
35	ZR-97	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY

\* Units are (mrem/yr per  $\mu Ci/m^3$ )

$R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36	NB-95	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
37	NB-97	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
38	MO-99	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
39	TC-99M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
40	TC-101	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
41	KU-103	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
42	RU-105	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
43	KU-106	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
44	AS-110M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
45	CD-115M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
46	SB-124	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
47	TE-125M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
48	TE-127M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
49	TE-127	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
50	TE-129M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
51	TE-129	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
52	TE-131M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
53	TE-131	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
54	TE-132	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
55	I-130	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
56	I-131	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
57	I-132	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
58	I-133	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
59	I-134	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
60	I-135	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
61	CS-134	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
62	CS-135	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
63	CS-137	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
64	CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
65	CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
66	BA-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
67	BA-140	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
68	BA-141	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
69	BA-142	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
70	LA-140	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY

Pathway Dose Parameters  
 $R_i$  ( $m^2 - mrem/yr$  per  $\mu Ci/sec$ )

AGE : INFANT  
PATHWAY : VEGETATION

[illegible]

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : ADULT  
 PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1 H-3*	7.639E+02	7.639E+02	0.000E-01	7.629E+02	7.629E+02	7.629E+02	7.629E+02	7.629E+02	W. BODY
2 C-14	7.263E+04	7.263E+04	3.632E+05	7.263E+04	7.263E+04	7.263E+04	7.263E+04	7.263E+04	BONE
3 NA-24	2.459E+06	2.459E+06	2.459E+06	2.459E+06	2.459E+06	2.459E+06	2.459E+06	2.459E+06	W. BODY
4 F-32	6.610E+08	0.000E-01	1.710E+10	1.063E+09	0.000E-01	0.000E-01	1.927E+09	0.000E-01	BONE
5 SE-46	1.013E+02	0.000E-01	1.794E+02	3.517E+02	3.256E+02	0.000E-01	1.697E+06	0.000E-01	GI-LLI
6 CR-51	2.860E+04	1.709E+04	0.000E-01	0.000E-01	6.300E+03	3.795E+04	7.193E+06	0.000E-01	GI-LLI
7 MN-54	1.605E+06	0.000E-01	0.000E-01	8.414E+06	2.504E+06	0.000E-01	2.577E+07	0.000E-01	GI-LLI
8 MN-56	7.324E-04	0.000E-01	0.000E-01	4.129E-03	5.242E-03	0.000E-01	1.316E-01	0.000E-01	GI-LLI
9 FE-55	4.045E+05	0.000E-01	2.511E+07	1.735E+07	0.000E-01	9.680E+06	9.954E+06	0.000E-01	BONE
10 FE-59	2.675E+07	0.000E-01	2.969E+07	6.978E+07	0.000E-01	1.950E+07	2.326E+08	0.000E-01	GI-LLI
11 CO-58	1.059E+07	0.000E-01	0.000E-01	4.724E+06	0.000E-01	0.000E-01	9.575E+07	0.000E-01	GI-LLI
12 CO-60	3.619E+07	0.000E-01	0.000E-01	1.641E+07	0.000E-01	0.000E-01	3.032E+08	0.000E-01	GI-LLI
13 NI-59	8.441E+07	0.000E-01	5.059E+08	1.735E+08	0.000E-01	0.000E-01	3.573E+07	0.000E-01	BONE
14 NI-63	2.257E+08	0.000E-01	6.729E+09	4.664E+08	0.000E-01	0.000E-01	9.731E+07	0.000E-01	BONE
15 NI-65	2.195E-02	0.000E-01	3.702E-01	4.810E-02	0.000E-01	0.000E-01	1.220E+00	0.000E-01	GI-LLI
16 CU-64	1.108E+04	0.000E-01	0.000E-01	2.361E+04	5.952E+04	0.000E-01	2.012E+06	0.000E-01	GI-LLI
17 ZN-65	1.972E+09	0.000E-01	1.371E+09	4.363E+09	2.918E+09	0.000E-01	2.749E+09	0.000E-01	LIVER
18 ZN-69	6.506E-13	0.000E-01	4.892E-12	9.356E-12	6.079E-12	0.000E-01	1.406E-12	0.000E-01	LIVER
19 BR-83	1.020E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	1.469E-01	0.000E-01	GI-LLI
20 ER-84	1.419E-23	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	1.114E-28	0.000E-01	W. BODY
21 BR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22 R9-86	1.207E+09	0.000E-01	0.000E-01	2.591E+09	0.000E-01	0.000E-01	5.109E+08	0.000E-01	LIVER
23 RB-88	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
24 RB-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
25 SR-89	4.162E+07	0.000E-01	1.450E+09	0.000E-01	0.000E-01	0.000E-01	2.322E+08	0.000E-01	BONE
26 SR-90	1.146E+10	0.000E-01	4.680E+10	0.000E-01	0.000E-01	0.000E-01	1.352E+09	0.000E-01	BONE
27 SR-91	1.160E+03	0.000E-01	2.872E+04	0.000E-01	0.000E-01	0.000E-01	1.338E+05	0.000E-01	GI-LLI
29 SR-92	2.092E-02	0.000E-01	4.836E-01	0.000E-01	0.000E-01	0.000E-01	9.582E+05	0.000E-01	GI-LLI
29 Y-90	1.903E+00	0.000E-01	7.096E+01	0.000E-01	0.000E-01	0.000E-01	7.524E+05	0.000E-01	GI-LLI
30 Y-91M	2.485E-21	0.000E-01	6.418E-20	0.000E-01	0.000E-01	0.000E-01	1.805E-19	0.000E-01	GI-LLI
31 Y-91	2.294E+02	0.000E-01	8.589E+03	0.000E-01	0.000E-01	0.000E-01	4.727E+06	0.000E-01	GI-LLI
32 Y-92	1.628E-06	0.000E-01	5.568E-05	0.000E-01	0.000E-01	0.000E-01	9.753E-01	0.000E-01	GI-LLI
33 Y-93	6.398E-03	0.000E-01	2.317E-01	0.000E-01	0.000E-01	0.000E-01	7.349E+03	0.000E-01	GI-LLI
34 ZR-95	2.059E+02	0.000E-01	9.463E+02	3.041E+02	4.773E+02	0.000E-01	9.639E+05	0.000E-01	GI-LLI
35 ZR-97	3.989E-02	0.000E-01	4.323E-01	8.724E-02	1.318E-01	0.000E-01	2.702E+04	0.000E-01	GI-LLI

\* Units are (mrem/yr per  $\mu Ci/m^3$ )



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : ADULT  
 PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36 NB-95	2.468E+04	0.000E-01	8.253E+04	4.591E+04	4.538E+04	0.000E-01	2.786E+08	0.000E-01	GI-LLI
37 NB-97	5.419E-13	0.000E-01	5.880E-12	1.484E-12	1.731E-12	0.000E-01	5.475E-09	0.000E-01	GI-LLI
39 MO-99	4.705E+06	0.000E-01	0.000E-01	2.473E+07	5.600E+07	0.000E-01	5.732E+07	0.000E-01	GI-LLI
39 TC-99M	1.216E+02	0.000E-01	3.378E+00	9.545E+00	1.450E+02	4.377E+00	5.649E+03	0.000E-01	GI-LLI
40 TC-101	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
41 RU-103	4.398E+02	0.000E-01	1.021E+03	0.000E-01	3.896E+03	0.000E-01	1.192E+05	0.000E-01	GI-LLI
42 RU-105	3.425E-04	0.000E-01	8.676E-04	0.000E-01	1.121E-02	0.000E-01	5.307E-01	0.000E-01	GI-LLI
43 RU-106	2.582E+03	0.000E-01	2.040E+04	0.000E-01	3.939E+04	0.000E-01	1.321E+06	0.000E-01	GI-LLI
44 AG-110M	3.200E+07	0.000E-01	5.825E+07	5.389E+07	1.059E+08	0.000E-01	2.199E+10	0.000E-01	GI-LLI
45 CD-115M	3.981E+04	0.000E-01	0.000E-01	1.246E+06	9.884E+05	0.000E-01	5.240E+07	0.000E-01	GI-LLI
46 SB-124	1.021E+07	6.243E+04	2.584E+07	4.873E+05	0.000E-01	2.005E+07	7.310E+08	0.000E-01	GI-LLI
47 TE-125M	2.183E+06	4.702E+06	1.630E+07	5.905E+06	6.629E+07	0.000E-01	6.507E+07	0.000E-01	KIDNEY
48 TE-127M	5.579E+06	1.170E+07	4.578E+07	1.636E+07	1.850E+08	0.000E-01	1.535E+08	0.000E-01	KIDNEY
49 TE-127	1.442E+02	1.937E+02	6.663E+02	2.393E+02	2.714E+03	0.000E-01	5.258E+04	0.000E-01	GI-LLI
50 TE-129M	9.511E+06	2.064E+07	6.009E+07	2.242E+07	2.508E+08	0.000E-01	3.026E+08	0.000E-01	GI-LLI
51 TE-129	9.203E-11	2.584E-10	3.367E-10	1.265E-10	1.415E-09	0.000E-01	2.541E-10	0.000E-01	KIDNEY
52 TE-131M	1.470E+05	2.795E+05	3.608E+05	1.764E+05	1.787E+06	0.000E-01	1.752E+07	0.000E-01	GI-LLI
53 TE-131	0.000E-01	0.000E-01	0.000E-01	0.000E-01	1.913E-32	0.000E-01	0.000E-01	0.000E-01	KIDNEY
54 TE-132	1.452E+06	1.709E+06	2.392E+06	1.547E+06	1.490E+07	0.000E-01	7.319E+07	0.000E-01	GI-LLI
55 I-130	4.980E+05	1.070E+08	4.278E+05	1.262E+06	1.969E+06	0.000E-01	1.036E+06	0.000E-01	THYROID
56 I-131	2.428E+08	1.389E+11	2.963E+08	4.237E+08	7.264E+08	0.000E-01	1.118E+08	0.000E-01	THYROID
57 I-132	1.405E-01	1.405E+01	1.501E-01	4.015E-01	6.397E-01	0.000E-01	7.543E-02	0.000E-01	THYROID
58 I-133	2.056E+06	9.910E+09	3.877E+06	6.743E+06	1.177E+07	0.000E-01	6.061E+06	0.000E-01	THYROID
59 I-134	1.834E-12	8.805E-11	1.887E-12	5.128E-12	8.155E-12	0.000E-01	4.469E-15	0.000E-01	THYROID
60 I-135	1.222E+04	2.184E+06	1.265E+04	3.312E+04	5.311E+04	0.000E-01	3.741E+04	0.000E-01	THYROID
61 CS-134	1.100E+10	0.000E-01	5.652E+09	1.345E+10	4.353E+09	1.445E+09	2.354E+08	0.000E-01	LIVER
62 CS-136	7.425E+08	0.000E-01	2.613E+08	1.032E+09	5.739E+08	7.867E+07	1.172E+08	0.000E-01	LIVER
63 CS-137	6.613E+09	0.000E-01	7.381E+09	1.009E+10	3.427E+09	1.139E+09	1.954E+08	0.000E-01	LIVER
64 CS-138	1.013E-23	0.000E-01	1.036E-23	2.045E-23	1.503E-23	1.484E-24	8.724E-29	0.000E-01	LIVER
65 CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
66 BA-139	1.298E-09	0.000E-01	4.434E-08	3.159E-11	2.953E-11	1.792E-11	7.863E-08	0.000E-01	GI-LLI
67 BA-140	1.760E+06	0.000E-01	2.686E+07	3.374E+04	1.147E+04	1.932E+04	5.531E+07	0.000E-01	GI-LLI
68 BA-141	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
69 BA-142	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
70 LA-140	6.025E-01	0.000E-01	4.523E+00	2.280E+00	0.000E-01	0.000E-01	1.674E+05	0.000E-01	GI-LLI



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu\text{Ci/sec}$ )

AGE : ADULT  
 PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	1.038E-12	0.000E-01	9.161E-12	4.165E-12	0.000E-01	0.000E-01	3.042E-08	0.000E-01	GI-LLI
72 CE-141	3.715E+02	0.000E-01	4.844E+03	3.276E+03	1.521E+03	0.000E-01	1.252E+07	0.000E-01	GI-LLI
73 CE-143	3.406E+00	0.000E-01	4.162E+01	3.078E+04	1.355E+01	0.000E-01	1.150E+06	0.000E-01	GI-LLI
74 CE-144	1.920E+04	0.000E-01	3.577E+05	1.495E+05	8.868E+04	0.000E-01	1.209E+08	0.000E-01	GI-LLI
75 PR-143	7.823E+00	0.000E-01	1.578E+02	6.331E+01	3.654E+01	0.000E-01	6.914E+05	0.000E-01	GI-LLI
76 PR-144	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
77 ND-147	6.509E+00	0.000E-01	9.412E+01	1.088E+02	6.359E+01	0.000E-01	5.272E+05	0.000E-01	GI-LLI
78 W-185	4.539E+01	0.000E-01	1.298E+06	4.315E+05	0.000E-01	0.000E-01	4.987E+07	0.000E-01	GI-LLI
79 W-187	1.915E+03	0.000E-01	6.551E+03	5.476E+03	0.000E-01	0.000E-01	1.794E+06	0.000E-01	GI-LLI
80 U-235	1.878E+08	0.000E-01	3.099E+09	0.000E-01	7.226E+08	0.000E-01	3.018E+08	0.000E-01	BONE
81 U-238	1.758E+08	0.000E-01	2.964E+09	0.000E-01	6.763E+08	0.000E-01	6.415E+08	0.000E-01	BONE
82 HP-239	1.979E-01	0.000E-01	3.652E+00	3.591E-01	1.120E+00	0.000E-01	7.365E+04	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_1$  ( $m^2 - mrem/yr$  per  $\mu Ci/sec$ )

AGE : TEEN  
 PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1 H-3 *	9.938E+02	9.938E+02	0.000E-01	9.938E+02	9.938E+02	9.938E+02	9.938E+02	9.938E+02	W. BODY
2 C-14	1.340E+05	1.340E+05	6.699E+05	1.340E+05	1.340E+05	1.340E+05	1.340E+05	1.340E+05	BONE
3 NA-24	4.294E+06	4.294E+06	4.294E+06	4.294E+06	4.294E+06	4.294E+06	4.294E+06	4.294E+06	W. BODY
4 P-32	1.223E+09	0.000E-01	3.155E+10	1.955E+09	0.000E-01	0.000E-01	2.652E+09	0.000E-01	BONE
5 SC-46	1.307E+02	0.000E-01	2.315E+02	4.538E+02	4.202E+02	0.000E-01	2.182E+06	0.000E-01	GI-LLI
6 CR-51	4.994E+04	2.775E+04	0.000E-01	0.000E-01	1.095E+04	7.131E+04	8.393E+06	0.000E-01	GI-LLI
7 MN-54	2.779E+06	0.000E-01	0.000E-01	1.402E+07	4.181E+06	0.000E-01	2.874E+07	0.000E-01	GI-LLI
8 NH-56	1.302E-03	0.000E-01	0.000E-01	7.320E-03	9.265E-03	0.000E-01	4.818E-01	0.000E-01	GI-LLI
9 FE-55	7.354E+06	0.000E-01	4.454E+07	3.158E+07	0.000E-01	2.003E+07	1.367E+07	0.000E-01	BONE
10 FE-59	4.670E+07	0.000E-01	5.182E+07	1.209E+08	0.000E-01	3.813E+07	2.860E+08	0.000E-01	GI-LLI
11 CO-58	1.833E+07	0.000E-01	0.000E-01	7.953E+06	0.000E-01	0.000E-01	1.092E+08	0.000E-01	GI-LLI
12 CO-60	6.262E+07	0.000E-01	0.000E-01	2.780E+07	0.000E-01	0.000E-01	3.621E+08	0.000E-01	GI-LLI
13 NI-59	1.069E+08	0.000E-01	6.528E+08	2.238E+08	0.000E-01	0.000E-01	4.610E+07	0.000E-01	ECHE
14 NI-63	4.007E+08	0.000E-01	1.182E+10	8.348E+08	0.000E-01	0.000E-01	1.329E+08	0.000E-01	BONE
15 NI-65	3.945E-02	0.000E-01	6.777E-01	8.659E-02	0.000E-01	0.000E-01	4.695E+00	0.000E-01	GI-LLI
16 CU-64	1.779E+04	0.000E-01	0.000E-01	4.206E+04	1.664E+05	0.000E-01	3.262E+06	0.000E-01	GI-LLI
17 ZN-65	3.411E+09	0.000E-01	2.106E+09	7.312E+09	4.690E+09	0.000E-01	3.097E+09	0.000E-01	LIVER
18 ZN-69	1.201E-12	0.000E-01	9.008E-12	1.716E-11	1.121E-11	0.000E-01	3.162E-11	0.000E-01	GI-LLI
19 KR-83	1.879E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
20 KR-84	2.537E-23	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21 KR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22 KR-86	2.219E+09	0.000E-01	0.000E-01	4.723E+09	0.000E-01	0.000E-01	6.989E+08	0.000E-01	LIVER
23 KR-88	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
24 KR-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
25 SR-89	7.655E+07	0.000E-01	2.673E+09	0.000E-01	0.000E-01	0.000E-01	3.184E+08	0.000E-01	BONE
26 SR-90	1.633E+10	0.000E-01	6.612E+10	0.000E-01	0.000E-01	0.000E-01	1.856E+09	0.000E-01	BONE
27 SR-91	2.090E+03	0.000E-01	5.274E+04	0.000E-01	0.000E-01	0.000E-01	2.392E+05	0.000E-01	GI-LLI
28 SR-92	3.773E-02	0.000E-01	8.852E-01	0.000E-01	0.000E-01	0.000E-01	2.255E+01	0.000E-01	GI-LLI
29 Y-90	3.512E+00	0.000E-01	1.304E+02	0.000E-01	0.000E-01	0.000E-01	1.075E+06	0.000E-01	GI-LLI
30 Y-91M	4.492E-21	0.000E-01	1.175E-19	0.000E-01	0.000E-01	0.000E-01	5.548E-18	0.000E-01	GI-LLI
31 Y-91	4.236E+02	0.000E-01	1.590E+04	0.000E-01	0.000E-01	0.000E-01	6.476E+06	0.000E-01	GI-LLI
32 Y-92	2.976E-06	0.000E-01	1.029E-04	0.000E-01	0.000E-01	0.000E-01	2.823E+00	0.000E-01	GI-LLI
33 Y-93	1.171E-02	0.000E-01	4.273E-01	0.000E-01	0.000E-01	0.000E-01	1.305E+04	0.000E-01	GI-LLI
34 ZR-95	3.598E+02	0.000E-01	1.658E+03	5.233E+02	4.065E+09	0.000E-01	1.208E+06	0.000E-01	KIDNEY
35 ZR-97	7.172E-02	0.000E-01	7.870E-01	1.557E-01	2.361E-01	0.000E-01	4.217E+04	0.000E-01	GI-LLI

\* Units are (mrem/yr per  $\mu Ci/m^3$ )

## ATTACHMENT 7

## Pathway Dose Parameters

 $R_i$  ( $m^2 - mrem/yr$  per  $\mu Ci/sec$ )

AGE : TEEN

PATHWAY : COW MILK

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36	NB-95	4.297E+04	0.000E-01	1.407E+05	7.807E+04	7.567E+04	0.000E-01	3.339E+08	0.000E-01	GI-LLI
37	NB-97	6.992E-13	0.000E-01	7.587E-12	1.915E-12	2.234E-12	0.000E-01	7.064E-09	0.000E-01	GI-LLI
38	MO-99	8.514E+06	0.000E-01	0.000E-01	4.464E+07	1.022E+08	0.000E-01	7.996E+07	0.000E-01	KIDNEY
39	TC-99M	2.117E+02	0.000E-01	5.858E+00	1.634E+01	2.435E+02	9.070E+00	1.073E+04	0.000E-01	GI-LLI
40	TC-101	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
41	RU-103	7.761E+02	0.000E-01	1.816E+03	0.000E-01	6.401E+03	0.000E-01	1.517E+05	0.000E-01	GI-LLI
42	RU-105	6.150E-04	0.000E-01	1.585E-03	0.000E-01	1.999E-02	0.000E-01	1.279E+00	0.000E-01	GI-LLI
43	RU-106	4.729E+03	0.000E-01	3.752E+04	0.000E-01	7.237E+04	0.000E-01	1.800E+02	0.000E-01	GI-LLI
44	AG-110M	5.543E+07	0.000E-01	9.629E+07	9.113E+07	1.738E+08	0.000E-01	2.560E+10	0.000E-01	GI-LLI
45	CB-115M	5.136E+04	0.000E-01	0.000E-01	1.607E+06	1.275E+05	0.000E-01	6.761E+07	0.000E-01	GI-LLI
46	SB-124	1.317E+07	8.056E+04	3.334E+07	6.288E+05	0.000E-01	2.586E+07	9.432E+08	0.000E-01	GI-LLI
47	TE-125M	4.018E+06	8.397E+06	3.006E+07	1.083E+07	0.000E-01	0.000E-01	8.857E+07	0.000E-01	GI-LLI
48	TE-127M	1.003E+07	2.007E+07	8.438E+07	2.973E+07	3.420E+08	0.000E-01	2.103E+08	0.000E-01	KIDNEY
49	TE-127	2.658E+02	8.500E+02	1.235E+03	4.777E+02	5.003E+03	0.000E-01	9.536E+04	0.000E-01	GI-LLI
50	TE-127M	1.740E+07	3.547E+07	1.099E+08	4.079E+07	4.599E+08	0.000E-01	4.127E+08	0.000E-01	KIDNEY
51	TE-129	1.500E-10	4.428E-10	6.199E-10	2.311E-10	2.601E-09	0.000E-01	3.390E-09	0.000E-01	GI-LLI
52	TE-131M	2.627E+05	4.736E+05	6.523E+05	3.149E+05	3.283E+05	0.000E-01	2.527E+07	0.000E-01	GI-LLI
53	TE-131	0.000E-01	0.000E-01	0.000E-01	0.000E-01	3.490E-32	0.000E-01	0.000E-01	0.000E-01	KIDNEY
54	TE-132	2.548E+06	2.851E+06	4.275E+06	2.707E+06	2.597E+07	0.000E-01	8.574E+07	0.000E-01	KIDNEY
55	I-130	8.689E+05	1.774E+08	7.521E+08	2.176E+08	3.351E+06	0.000E-01	1.672E+06	0.000E-01	THYROID
56	I-131	4.043E+08	2.193E+11	5.376E+08	7.526E+08	1.296E+09	0.000E-01	1.489E+08	0.000E-01	THYROID
57	I-132	2.500E-01	2.347E+01	2.662E-01	6.965E-01	1.097E+00	0.000E-01	3.034E-01	0.000E-01	THYROID
58	I-133	3.653E+06	1.677E+09	7.080E+06	1.201E+07	2.106E+07	0.000E-01	9.088E+06	0.000E-01	THYROID
59	I-134	3.194E-12	1.482E-10	3.355E-12	8.892E-12	1.402E-11	0.000E-01	1.172E-13	0.000E-01	THYROID
60	I-135	2.144E+04	3.721E+05	2.248E+04	5.785E+04	9.137E+04	0.000E-01	6.411E+04	0.000E-01	THYROID
61	CS-134	1.072E+10	0.000E-01	9.815E+09	2.310E+10	7.340E+09	2.802E+09	2.873E+08	0.000E-01	LIVER
62	CS-136	1.178E+09	0.000E-01	4.419E+08	1.750E+09	9.529E+08	1.502E+09	1.409E+08	0.000E-01	LIVER
63	CS-137	6.202E+09	0.000E-01	1.338E+10	1.781E+10	6.059E+09	2.354E+09	2.533E+08	0.000E-01	LIVER
64	CS-139	1.804E-23	0.000E-01	1.879E-23	3.667E-23	2.663E-23	3.099E-24	1.637E-25	0.000E-01	LIVER
65	CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
66	BA-139	2.397E-09	0.000E-01	8.199E-08	5.729E-11	5.438E-11	3.976E-11	7.314E-07	0.000E-01	GI-LLI
67	BA-140	3.124E+06	0.000E-01	4.849E+07	5.941E+04	2.015E+04	3.995E+04	7.478E+07	0.000E-01	GI-LLI
68	PA-141	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
69	BA-142	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
70	LA-140	1.063E+00	0.000E-01	8.124E+00	3.992E+00	0.000E-01	0.000E-01	2.292E+05	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : TEEN  
 PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	1.028E-12	0.000E-01	1.653E-11	7.341E-12	0.000E-01	0.000E-01	2.235E-07	0.000E-01	GI-LLI
72 CE-141	6.811E+02	0.000E-01	8.891E+03	5.929E+03	2.791E+03	0.000E-01	1.696E+07	0.000E-01	GI-LLI
73 CE-143	6.217E+00	0.000E-01	7.649E+01	5.566E+04	2.497E+01	0.000E-01	1.673E+06	0.000E-01	GI-LLI
74 CE-144	3.537E+04	0.000E-01	6.582E+05	2.724E+05	1.627E+05	0.000E-01	1.655E+08	0.000E-01	GI-LLI
75 FR-143	1.443E+01	0.000E-01	2.900E+02	1.158E+02	6.730E+01	0.000E-01	9.541E+05	0.000E-01	GI-LLI
76 FR-144	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
77 ND-147	1.180E+01	0.000E-01	1.811E+02	1.969E+02	1.157E+02	0.000E-01	7.105E+05	0.000E-01	GI-LLI
78 U-185	5.857E+04	0.000E-01	1.675E+06	5.568E+05	0.000E-01	0.000E-01	6.431E+07	0.000E-01	GI-LLI
79 U-187	3.422E+03	0.000E-01	1.198E+04	9.767E+03	0.000E-01	0.000E-01	2.643E+06	0.000E-01	GI-LLI
80 U-235	2.423E+08	0.000E-01	3.999E+09	0.000E-01	9.324E+08	0.000E-01	3.891E+09	0.000E-01	BONE
81 U-238	2.269E+08	0.000E-01	3.024E+09	0.000E-01	8.726E+08	0.000E-01	8.277E+08	0.000E-01	BONE
82 NP-239	3.651E-01	0.000E-01	6.969E+00	6.573E-01	2.063E+00	0.000E-01	1.057E+03	0.000E-01	GI-LLI



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : CHILD  
 PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1 H-3*	1.570E+03	1.570E+03	0.000E-01	1.570E+03	1.570E+03	1.570E+03	1.570E+03	1.570E+03	W. BODY
2 C-14	3.294E+05	3.294E+05	1.647E+06	3.294E+05	3.294E+05	3.294E+05	3.294E+05	3.294E+05	BONE
3 NA-24	8.932E+06	8.932E+06	8.932E+06	8.932E+06	8.932E+06	8.932E+06	8.932E+06	0.000E-01	W. BODY
4 F-32	2.999E+09	0.000E-01	7.781E+10	3.641E+09	0.000E-01	0.000E-01	2.150E+09	0.000E-01	BONE
5 SC-46	1.078E+02	0.000E-01	1.910E+02	3.744E+02	3.466E+02	0.000E-01	1.906E+06	0.000E-01	GI-LLI
6 CR-51	1.019E+05	5.654E+04	0.000E-01	0.000E-01	1.545E+04	1.032E+05	5.402E+06	0.000E-01	GI-LLI
7 MN-54	5.585E+06	0.000E-01	0.000E-01	2.097E+07	5.879E+06	0.000E-01	1.760E+07	0.000E-01	LIVER
8 MN-56	2.882E-03	0.000E-01	0.000E-01	1.277E-02	1.544E-02	0.000E-01	1.850E+00	0.000E-01	GI-LLI
9 FE-55	1.837E+07	0.000E-01	1.118E+08	5.930E+07	0.000E-01	3.354E+07	1.098E+07	0.000E-01	BONE
10 FE-59	9.686E+07	0.000E-01	1.202E+08	1.944E+08	0.000E-01	5.637E+07	2.025E+08	0.000E-01	GI-LLI
11 CO-58	3.719E+07	0.000E-01	0.000E-01	1.215E+07	0.000E-01	0.000E-01	7.088E+07	0.000E-01	GI-LLI
12 CO-60	1.273E+08	0.000E-01	0.000E-01	4.318E+07	0.000E-01	0.000E-01	2.391E+08	0.000E-01	GI-LLI
13 NI-59	8.985E+07	0.000E-01	5.386E+08	1.847E+08	0.000E-01	0.000E-01	3.803E+07	0.000E-01	BONE
14 NI-63	1.008E+09	0.000E-01	2.964E+10	1.587E+09	0.000E-01	0.000E-01	1.069E+09	0.000E-01	BONE
15 NI-65	9.107E-02	0.000E-01	1.657E+00	1.560E-01	0.000E-01	0.000E-01	1.911E+01	0.000E-01	GI-LLI
16 CU-64	4.465E+04	0.000E-01	0.000E-01	7.392E+04	1.786E+05	0.000E-01	3.470E+06	0.000E-01	GI-LLI
17 ZN-65	6.847E+09	0.000E-01	4.132E+09	1.101E+10	6.937E+09	0.000E-01	1.933E+09	0.000E-01	LIVER
18 ZN-69	2.958E-12	0.000E-01	2.214E-11	3.200E-11	1.941E-11	0.000E-01	2.017E-09	0.000E-01	GI-LLI
19 BR-83	4.617E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
20 BR-84	5.739E-23	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21 BR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22 RB-86	5.387E+09	0.000E-01	0.000E-01	8.760E+09	0.000E-01	0.000E-01	5.635E+08	0.000E-01	LIVER
23 RB-88	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
24 RB-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
25 SR-89	1.890E+08	0.000E-01	6.616E+09	0.000E-01	0.000E-01	0.000E-01	2.561E+08	0.000E-01	BONE
26 SR-90	2.833E+10	0.000E-01	1.117E+11	0.000E-01	0.000E-01	0.000E-01	1.505E+09	0.000E-01	BONE
27 SR-91	4.885E+03	0.000E-01	1.294E+05	0.000E-01	0.000E-01	0.000E-01	2.859E+05	0.000E-01	GI-LLI
28 SR-92	8.668E-02	0.000E-01	2.162E+00	0.000E-01	0.000E-01	0.000E-01	4.094E+01	0.000E-01	GI-LLI
29 Y-90	8.637E+00	0.000E-01	3.227E+02	0.000E-01	0.000E-01	0.000E-01	7.187E+05	0.000E-01	GI-LLI
30 Y-91M	1.045E-20	0.000E-01	2.871E-19	0.000E-01	0.000E-01	0.000E-01	5.622E-16	0.000E-01	GI-LLI
31 Y-91	1.044E+03	0.000E-01	3.904E+04	0.000E-01	0.000E-01	0.000E-01	5.200E+06	0.000E-01	GI-LLI
32 Y-92	7.226E-06	0.000E-01	2.525E-04	0.000E-01	0.000E-01	0.000E-01	7.296E+00	0.000E-01	GI-LLI
33 Y-93	2.881E-02	0.000E-01	1.049E+00	0.000E-01	0.000E-01	0.000E-01	1.565E+04	0.000E-01	GI-LLI
34 ZR-95	7.538E+02	0.000E-01	3.852E+03	8.468E+02	1.212E+03	0.000E-01	8.833E+05	0.000E-01	GI-LLI
35 ZR-97	1.633E-01	0.000E-01	1.915E+00	2.767E-01	3.972E-01	0.000E-01	4.191E+04	0.000E-01	GI-LLI

\* Units are (mrem/yr per  $\mu Ci/m^3$ )



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2 - \text{miam/yr}$  per  $\mu\text{Ci/sec}$ )

AGE : CHILD  
 PATHWAY : COW MILK

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36	NB-95	8.842E+04	0.000E-01	3.178E+05	1.237E+05	1.162E+05	0.000E-01	2.289E+08	0.000E-01	GI-LLI
37	NB-97	5.768E-13	0.000E-01	6.259E-12	1.580E-12	1.843E-12	0.000E-01	5.829E-09	0.000E-01	GI-LLI
38	MO-99	2.009E+07	0.000E-01	0.000E-01	8.123E+07	1.735E+09	0.000E-01	6.719E+07	0.000E-01	KIDNEY
39	TC-99M	4.367E+02	0.000E-01	1.344E+01	2.635E+01	3.829E+02	1.338E+01	1.499E+04	0.000E-01	GI-LLI
40	TC-101	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
41	KU-103	1.651E+03	0.000E-01	4.294E+03	0.000E-01	1.081E+04	0.000E-01	1.110E+05	0.000E-01	GI-LLI
42	KU-105	1.403E-03	0.000E-01	3.849E-03	0.000E-01	3.400E-02	0.000E-01	2.529E+00	0.000E-01	GI-LLI
43	KU-106	1.153E+04	0.000E-01	9.240E+04	0.000E-01	1.248E+05	0.000E-01	1.437E+06	0.000E-01	GI-LLI
44	AO-110M	1.128E+08	0.000E-01	2.089E+08	1.411E+09	2.627E+08	0.000E-01	1.679E+10	0.000E-01	GI-LLI
45	CD-115M	4.237E+04	0.000E-01	0.000E-01	1.326E+06	1.052E+06	0.000E-01	5.579E+07	0.000E-01	GI-LLI
46	SB-124	1.084E+07	6.642E+04	2.751E+07	5.189E+05	0.000E-01	2.134E+07	7.702E+08	0.000E-01	GI-LLI
47	TE-125M	9.841E+06	2.072E+07	7.380E+07	2.600E+07	0.000E-01	0.000E-01	7.121E+07	0.000E-01	BONE
48	TE-127M	2.469E+07	4.974E+07	2.089E+08	5.601E+07	5.932E+08	0.000E-01	1.681E+08	0.000E-01	KIDNEY
49	TE-127	6.513E+02	2.102E+03	3.037E+03	8.190E+02	8.641E+03	0.000E-01	1.187E+05	0.000E-01	GI-LLI
50	TE-129M	4.295E+07	8.734E+07	2.709E+08	7.565E+07	7.955E+08	0.000E-01	3.304E+08	0.000E-01	KIDNEY
51	TE-129	3.630E-10	1.091E-09	1.530E-09	4.259E-10	4.475E-09	0.000E-01	9.529E-08	0.000E-01	GI-LLI
52	TE-131M	5.894E+05	1.137E+06	1.590E+06	5.528E+05	5.351E+06	0.000E-01	2.242E+07	0.000E-01	GI-LLI
53	TE-131	0.000E-01	1.499E-32	1.959E-32	0.000E-01	5.923E-32	0.000E-01	1.029E-31	0.000E-01	GI-LLI
54	TE-132	5.457E+06	6.570E+06	1.021E+07	4.517E+06	4.194E+07	0.000E-01	4.547E+07	0.000E-01	GI-LLI
55	I-130	1.931E+06	3.912E+08	1.759E+08	3.554E+06	5.313E+06	0.000E-01	1.663E+06	0.000E-01	THYROID
56	I-131	7.452E+08	4.333E+11	1.304E+09	1.312E+09	2.153E+09	0.000E-01	1.167E+08	0.000E-01	THYROID
57	I-132	5.321E-01	5.369E+01	6.298E-01	1.157E+00	1.771E+00	0.000E-01	1.362E+00	0.000E-01	THYROID
58	I-133	8.050E+06	3.952E+09	1.720E+07	2.127E+07	3.545E+07	0.000E-01	8.573E+06	0.000E-01	THYROID
59	I-134	6.786E-12	3.393E-10	7.942E-12	1.475E-11	2.256E-11	0.000E-01	9.781E-12	0.000E-01	THYROID
60	I-135	4.529E+04	8.481E+06	5.319E+04	9.575E+04	1.468E+05	0.000E-01	7.295E+04	0.000E-01	THYROID
61	CS-134	7.833E+09	0.000E-01	2.264E+10	3.715E+10	1.151E+10	4.131E+09	2.002E+08	0.000E-01	LIVER
62	CS-135	1.786E+09	0.000E-01	1.004E+09	2.760E+09	1.470E+09	2.192E+08	9.699E+07	0.000E-01	LIVER
63	CS-137	4.555E+09	0.000E-01	3.224E+10	3.086E+10	1.006E+10	3.618E+09	1.932E+08	0.000E-01	BONE
64	CS-139	4.613E-23	0.000E-01	4.554E-23	6.331E-23	4.454E-23	4.793E-24	2.916E-23	0.000E-01	LIVER
65	CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
66	BA-139	5.039E-09	0.000E-01	2.015E-07	1.075E-10	9.392E-11	6.326E-11	1.163E-05	0.000E-01	GI-LLI
67	BA-140	6.631E+06	0.000E-01	1.170E+08	1.025E+05	3.338E+04	6.113E+04	5.930E+07	0.000E-01	BONE
68	BA-141	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
69	BA-142	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
70	LA-140	2.119E+00	0.000E-01	1.945E+01	6.799E+00	0.000E-01	0.000E-01	1.895E+05	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_1$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : CHILD  
 PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	3.984E-12	0.000E-01	3.992E-11	1.272E-11	0.000E-01	0.000E-01	2.522E-06	0.000E-01	GI-LLI
72 CE-141	1.620E+03	0.000E-01	2.187E+04	1.091E+04	4.781E+03	0.000E-01	1.361E+07	0.000E-01	GI-LLI
73 CE-143	1.474E+01	0.000E-01	1.877E+02	1.018E+05	4.270E+01	0.000E-01	1.490E+06	0.000E-01	GI-LLI
74 CE-144	8.660E+04	0.000E-01	1.623E+06	5.087E+05	2.816E+05	0.000E-01	1.326E+08	0.000E-01	GI-LLI
75 FR-143	3.561E+01	0.000E-01	7.177E+02	2.155E+02	1.167E+02	0.000E-01	7.744E+05	0.000E-01	GI-LLI
76 FR-144	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
77 ND-147	2.788E+01	0.000E-01	4.444E+02	3.600E+02	1.975E+02	0.000E-01	5.703E+05	0.000E-01	GI-LLI
78 W-185	4.832E+04	0.000E-01	1.382E+06	4.594E+05	0.000E-01	0.000E-01	5.308E+07	0.000E-01	GI-LLI
79 W-187	7.719E+03	0.000E-01	2.905E+04	1.720E+04	0.000E-01	0.000E-01	2.417E+06	0.000E-01	GI-LLI
80 U-235	1.999E+08	0.000E-01	3.299E+09	0.000E-01	7.693E+08	0.000E-01	3.213E+08	0.000E-01	BONE
81 U-238	1.872E+08	0.000E-01	3.155E+09	0.000E-01	7.199E+08	0.000E-01	6.829E+09	0.000E-01	BONE
82 NP-239	6.657E-01	0.000E-01	1.715E+01	1.232E+00	3.561E+00	0.000E-01	9.115E+04	0.000E-01	GI-LLI

## ATTACHMENT 7

## Pathway Dose Parameters

$$R_i \text{ (m}^2 \text{ - mrem/yr per } \mu\text{Ci/sec)}$$

AGE : INFANT  
PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1 H-3*	2.382E+03	2.382E+03	0.000E-01	2.382E+03	2.382E+03	2.382E+03	2.382E+03	2.382E+03	W. BODY
2 C-14	6.888E+05	6.888E+05	3.226E+06	6.888E+05	6.888E+05	6.888E+05	6.888E+05	6.888E+05	BONE
3 NA-24	1.555E+07	1.555E+07	1.555E+07	1.555E+07	1.555E+07	1.555E+07	1.555E+07	0.000E-01	W. BODY
4 P-32	6.215E+09	0.000E-01	1.603E+11	9.432E+09	0.000E-01	0.000E-01	2.169E+09	0.000E-01	BONE
5 SC-46	1.078E+02	0.000E-01	1.910E+02	3.744E+02	3.466E+02	0.000E-01	1.806E+06	0.000E-01	GI-LLI
6 CR-51	1.614E+05	1.053E+05	0.000E-01	0.000E-01	2.300E+04	2.049E+05	4.704E+06	0.000E-01	GI-LLI
7 MN-54	8.839E+06	0.000E-01	0.000E-01	3.900E+07	8.643E+06	0.000E-01	1.433E+07	0.000E-01	LIVER
8 MN-56	5.389E-03	0.000E-01	0.000E-01	3.126E-02	2.687E-02	0.000E-01	2.840E+00	0.000E-01	GI-LLI
9 FE-55	2.333E+07	0.000E-01	1.351E+08	8.729E+07	0.000E-01	4.267E+07	1.108E+07	0.000E-01	BONE
10 FE-59	1.544E+08	0.000E-01	2.243E+08	3.919E+08	0.000E-01	1.158E+08	1.872E+08	0.000E-01	LIVER
11 CO-58	6.028E+07	0.000E-01	0.000E-01	2.430E+07	0.000E-01	0.000E-01	6.055E+07	0.000E-01	GI-LLI
12 CO-60	2.081E+08	0.000E-01	0.000E-01	8.815E+07	0.000E-01	0.000E-01	2.098E+08	0.000E-01	GI-LLI
13 NI-59	8.985E+07	0.000E-01	5.386E+08	1.847E+08	0.000E-01	0.000E-01	3.803E+07	0.000E-01	BONE
14 NI-63	1.212E+09	0.000E-01	3.493E+10	2.160E+09	0.000E-01	0.000E-01	1.074E+08	0.000E-01	BONE
15 NI-65	1.806E-01	0.000E-01	3.508E+00	3.971E-01	0.000E-01	0.000E-01	3.023E+01	0.000E-01	GI-LLI
16 CU-64	8.509E+04	0.000E-01	0.000E-01	1.837E+05	3.108E+05	0.000E-01	3.772E+06	0.000E-01	GI-LLI
17 ZN-65	8.777E+09	0.000E-01	5.550E+09	1.903E+10	9.229E+09	0.000E-01	1.608E+10	0.000E-01	LIVER
18 ZN-69	6.319E-12	0.000E-01	4.717E-11	8.493E-11	3.529E-11	0.000E-01	6.926E-09	0.000E-01	GI-LLI
19 KR-83	9.802E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
20 KR-84	1.107E-22	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
21 KR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22 RB-86	1.098E+10	0.000E-01	0.000E-01	2.223E+10	0.000E-01	0.000E-01	5.687E+08	0.000E-01	LIVER
23 RB-88	0.000E-01	0.000E-01	0.000E-01	1.311E-32	0.000E-01	0.000E-01	1.276E-32	0.000E-01	LIVER
24 RB-89	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
25 SR-89	3.609E+08	0.000E-01	1.258E+10	0.000E-01	0.000E-01	0.000E-01	2.586E+08	0.000E-01	BONE
26 SR-90	3.096E+10	0.000E-01	1.216E+11	0.000E-01	0.000E-01	0.000E-01	1.518E+09	0.000E-01	BONE
27 SR-91	9.759E+03	0.000E-01	2.696E+05	0.000E-01	0.000E-01	0.000E-01	3.192E+05	0.000E-01	GI-LLI
28 SR-92	1.707E-01	0.000E-01	4.597E+00	0.000E-01	0.000E-01	0.000E-01	4.956E+01	0.000E-01	GI-LLI
29 Y-90	1.830E+01	0.000E-01	6.823E+02	0.000E-01	0.000E-01	0.000E-01	9.422E+05	0.000E-01	GI-LLI
30 Y-91M	2.075E-20	0.000E-01	6.088E-19	0.000E-01	0.000E-01	0.000E-01	2.039E-15	0.000E-01	GI-LLI
31 Y-91	1.952E+03	0.000E-01	7.327E+04	0.000E-01	0.000E-01	0.000E-01	5.252E+04	0.000E-01	GI-LLI
32 Y-92	1.508E-05	0.000E-01	5.367E-04	0.000E-01	0.000E-01	0.000E-01	1.024E+01	0.000E-01	GI-LLI
33 Y-93	6.093E-02	0.000E-01	2.237E+00	0.000E-01	0.000E-01	0.000E-01	1.767E+04	0.000E-01	GI-LLI
34 ZR-95	1.182E+03	0.000E-01	6.841E+03	1.667E+03	1.797E+03	0.000E-01	8.302E+05	0.000E-01	GI-LLI
35 ZR-98	3.170E-01	0.000E-01	4.054E+00	6.958E-01	7.013E-01	0.000E-01	4.438E+04	0.000E-01	GI-LLI

\* Units are (mrem/yr per  $\mu\text{Ci/m}^3$ )



## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : INFANT  
 PATHWAY : COW MILK

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36	NB-95	1.412E+05	0.000E-01	5.932E+05	2.444E+05	1.751E+05	0.000E-01	2.062E+08	0.000E-01	GI-LLI
37	NB-97	5.768E-13	0.000E-01	6.259E-12	1.580E-12	1.843E-12	0.000E-01	5.828E-09	0.000E-01	GI-LLI
38	MO-99	4.049E+07	0.000E-01	0.000E-01	2.077E+08	3.103E+08	0.000E-01	6.841E+07	0.000E-01	KIDNEY
39	TC-99M	7.424E+02	0.000E-01	2.795E+01	5.765E+01	6.202E+02	3.013E+01	1.671E+04	0.000E-01	GI-LLI
40	TC-101	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
41	RU-103	2.908E+03	0.000E-01	8.694E+03	0.000E-01	1.809E+04	0.000E-01	1.057E+05	0.000E-01	GI-LLI
42	RU-105	2.747E-03	0.000E-01	8.156E-03	0.000E-01	5.997E-02	0.000E-01	3.215E+00	0.000E-01	GI-LLI
43	RU-106	2.377E+04	0.000E-01	1.903E+05	0.000E-01	2.251E+05	0.000E-01	1.445E+03	0.000E-01	GI-LLI
44	AG-110M	1.864E+08	0.000E-01	3.860E+08	2.817E+08	4.030E+08	0.000E-01	1.451E+10	0.000E-01	GI-LLI
45	CD-115M	4.237E+04	0.000E-01	0.000E-01	1.326E+06	1.052E+06	0.000E-01	5.578E+07	0.000E-01	GI-LLI
46	SB-124	1.086E+07	6.646E+04	2.751E+07	5.189E+05	0.000E-01	2.134E+07	7.782E+08	0.000E-01	GI-LLI
47	TE-125M	2.039E+07	5.076E+07	1.508E+08	5.043E+07	0.000E-01	0.000E-01	7.186E+07	0.000E-01	BONE
48	TE-127M	5.097E+07	1.217E+08	4.211E+08	1.397E+08	1.037E+09	0.000E-01	1.699E+08	0.000E-01	KIDNEY
49	TE-127	1.386E+03	5.249E+03	6.449E+03	2.160E+03	1.573E+04	0.000E-01	1.354E+05	0.000E-01	GI-LLI
50	TE-129M	8.567E+07	2.136E+08	5.563E+08	1.908E+08	1.391E+09	0.000E-01	3.321E+08	0.000E-01	KIDNEY
51	TE-129	7.568E-10	2.717E-09	3.242E-09	1.118E-09	8.071E-09	0.000E-01	2.591E-07	0.000E-01	GI-LLI
52	TE-131M	1.121E+06	2.753E+06	3.375E+06	1.359E+06	9.347E+06	0.000E-01	2.297E+07	0.000E-01	GI-LLI
53	TE-131	1.166E-32	3.705E-32	4.153E-32	1.534E-32	1.062E-31	0.000E-01	1.678E-30	0.000E-01	GI-LLI
54	TE-132	9.711E+06	1.536E+07	2.102E+07	1.041E+07	6.508E+07	0.000E-01	3.850E+07	0.000E-01	KIDNEY
55	I-130	3.193E+06	8.915E+08	3.614E+06	7.952E+06	8.735E+06	0.000E-01	1.705E+06	0.000E-01	THYROID
56	I-131	1.410E+09	1.054E+12	2.722E+09	3.207E+09	3.745E+09	0.000E-01	1.145E+08	0.000E-01	THYROID
57	I-132	9.416E-01	1.244E+02	1.307E+00	2.653E+00	2.960E+00	0.000E-01	2.149E+00	0.000E-01	THYROID
58	I-133	1.549E+07	9.619E+09	3.633E+07	5.289E+07	6.219E+07	0.000E-01	8.951E+06	0.000E-01	THYROID
59	I-134	1.200E-11	7.966E-10	1.647E-11	3.374E-11	3.772E-11	0.000E-01	3.488E-11	0.000E-01	THYROID
60	I-135	8.025E+04	1.973E+07	1.106E+05	2.201E+05	2.453E+05	0.000E-01	7.961E+04	0.000E-01	THYROID
61	CS-134	6.868E+09	0.000E-01	3.647E+10	6.601E+10	1.751E+10	7.178E+09	1.849E+08	0.000E-01	LIVER
62	CS-136	2.153E+09	0.000E-01	1.961E+09	5.768E+09	2.299E+09	4.700E+08	8.759E+07	0.000E-01	LIVER
63	CS-137	4.269E+09	0.000E-01	5.146E+10	6.024E+10	1.617E+10	6.546E+09	1.883E+08	0.000E-01	LIVER
64	CS-138	7.569E-23	0.000E-01	9.607E-23	1.562E-22	7.789E-23	1.216E-23	2.497E-22	0.000E-01	GI-LLI
65	CS-139	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
66	BA-139	1.241E-08	0.000E-01	4.297E-07	2.812E-10	1.708E-10	1.723E-10	2.715E-05	0.000E-01	GI-LLI
67	BA-140	1.241E+07	0.000E-01	2.408E+08	2.408E+05	5.718E+04	1.479E+05	5.916E+07	0.000E-01	BONE
68	BA-141	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
69	BA-142	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
70	LA-140	4.122E+00	0.000E-01	4.064E+01	1.602E+01	0.000E-01	0.000E-01	1.882E+05	0.000E-01	GI-LLI

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : INFANT  
 PATHWAY : COW MILK

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	7.357E-12	0.000E-01	8.380E-11	3.079E-11	0.000E-01	0.000E-01	5.226E-06	0.000E-01	GI-LLI
72 CE-141	3.112E+03	0.000E-01	4.335E+04	2.641E+04	8.153E+03	0.000E-01	1.366E+07	0.000E-01	GI-LLI
73 CE-143	3.008E+01	0.000E-01	3.974E+02	2.637E+05	7.680E+01	0.000E-01	1.539E+06	0.000E-01	GI-LLI
74 CE-144	1.303E+05	0.000E-01	2.325E+06	9.518E+05	3.846E+05	0.000E-01	1.331E+08	0.000E-01	GI-LLI
75 FR-143	7.360E+01	0.000E-01	1.485E+03	5.552E+02	2.064E+02	0.000E-01	7.835E+05	0.000E-01	GI-LLI
76 FR-144	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
77 ND-117	5.543E+01	0.000E-01	8.809E+02	9.043E+02	3.488E+02	0.000E-01	5.731E+05	0.000E-01	GI-LLI
78 W-185	4.832E+04	0.000E-01	1.382E+06	4.594E+05	0.000E-01	0.000E-01	5.303E+07	0.000E-01	GI-LLI
79 W-187	1.469E+04	0.000E-01	6.114E+04	4.252E+04	0.000E-01	0.000E-01	2.498E+06	0.000E-01	GI-LLI
80 U-235	1.999E+08	0.000E-01	3.299E+09	0.000E-01	7.693E+08	0.000E-01	3.213E+08	0.000E-01	BONE
81 U-239	1.872E+08	0.000E-01	3.155E+09	0.000E-01	7.199E+08	0.000E-01	6.829E+08	0.000E-01	BONE
82 NP-239	1.833E+00	0.000E-01	3.626E+01	3.244E+00	6.468E+00	0.000E-01	9.375E+04	0.000E-01	GI-LLI



## ATTACHMENT 7

### Pathway Dose Parameters

 $R_i \text{ (m}^2 \text{ - mrem/yr per } \mu\text{Ci/sec)}$ 

AGE : ALL  
PATHWAY : GROUND PLANE

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
1	H-3	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
2	C-14	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
3	NA-24	1.198E+07	1.198E+07	1.198E+07	1.198E+07	1.198E+07	1.198E+07	1.198E+07	1.387E+07	SKIN
4	P-32	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
5	SC-46	8.321E+08	8.321E+08	8.321E+08	8.321E+08	8.321E+08	8.321E+08	8.321E+08	9.601E+08	SKIN
6	CR-51	4.638E+05	4.638E+05	4.638E+05	4.638E+05	4.638E+05	4.638E+05	4.638E+05	5.517E+05	SKIN
7	MN-54	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.622E+09	SKIN
8	HI-56	9.030E+05	9.030E+05	9.030E+05	9.030E+05	9.030E+05	9.030E+05	9.030E+05	1.067E+06	SKIN
9	FE-55	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
10	FE-59	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	3.202E+08	SKIN
11	CU-58	3.833E+08	3.833E+08	3.833E+08	3.833E+08	3.833E+08	3.833E+08	3.833E+08	4.490E+08	SKIN
12	CO-60	2.152E+10	2.152E+10	2.152E+10	2.152E+10	2.152E+10	2.152E+10	2.152E+10	2.532E+10	SKIN
13	NI-59	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
14	NI-63	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
15	NI-65	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	3.451E+05	SKIN
16	CU-64	6.051E+05	6.051E+05	6.051E+05	6.051E+05	6.051E+05	6.051E+05	6.051E+05	6.858E+05	SKIN
17	ZN-65	7.410E+08	7.410E+08	7.410E+08	7.410E+08	7.410E+08	7.410E+08	7.410E+08	8.522E+08	SKIN
18	ZN-69	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
19	SR-83	4.897E+03	4.897E+03	4.897E+03	4.897E+03	4.897E+03	4.897E+03	4.897E+03	7.102E+03	SKIN
20	BR-84	2.022E+05	2.022E+05	2.022E+05	2.022E+05	2.022E+05	2.022E+05	2.022E+05	2.358E+05	SKIN
21	BR-85	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
22	BR-86	8.963E+06	8.963E+06	8.963E+06	8.963E+06	8.963E+06	8.963E+06	8.963E+06	1.024E+07	SKIN
23	BR-88	3.287E+04	3.287E+04	3.287E+04	3.287E+04	3.287E+04	3.287E+04	3.287E+04	3.756E+04	SKIN
24	SR-89	1.209E+05	1.209E+05	1.209E+05	1.209E+05	1.209E+05	1.209E+05	1.209E+05	1.450E+05	SKIN
25	SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.507E+04	SKIN
26	SR-90	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
27	SR-91	2.145E+06	2.145E+06	2.145E+06	2.145E+06	2.145E+06	2.145E+06	2.145E+06	2.507E+06	SKIN
28	SR-92	7.762E+05	7.762E+05	7.762E+05	7.762E+05	7.762E+05	7.762E+05	7.762E+05	8.625E+05	SKIN
29	Y-90	4.497E+03	4.497E+03	4.497E+03	4.497E+03	4.497E+03	4.497E+03	4.497E+03	5.314E+03	SKIN
30	Y-91M	1.604E+05	1.604E+05	1.604E+05	1.604E+05	1.604E+05	1.604E+05	1.604E+05	1.163E+05	SKIN
31	Y-91	1.074E+06	1.074E+06	1.074E+06	1.074E+06	1.074E+06	1.074E+06	1.074E+06	1.209E+06	SKIN
32	Y-92	1.804E+05	1.804E+05	1.804E+05	1.804E+05	1.804E+05	1.804E+05	1.804E+05	1.916E+05	SKIN
33	Y-93	1.849E+05	1.849E+05	1.849E+05	1.849E+05	1.849E+05	1.849E+05	1.849E+05	2.531E+05	SKIN
34	ZR-95	2.513E+08	2.513E+08	2.513E+08	2.513E+08	2.513E+08	2.513E+08	2.513E+08	2.915E+08	SKIN
35	ZR-97	2.950E+06	2.950E+06	2.950E+06	2.950E+06	2.950E+06	2.950E+06	2.950E+06	3.443E+06	SKIN

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : ALL  
PATHWAY : GROUND PLANE

NO	ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
36	NB-95	1.366E+08	1.366E+08	1.366E+08	1.366E+08	1.366E+08	1.366E+08	1.366E+08	1.607E+08	SKIN
37	NB-97	1.797E+05	1.797E+05	1.797E+05	1.797E+05	1.797E+05	1.797E+05	1.797E+05	2.109E+05	SKIN
38	MO-99	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	4.620E+06	SKIN
39	TC-99M	1.845E+05	1.845E+05	1.845E+05	1.845E+05	1.845E+05	1.845E+05	1.845E+05	2.115E+05	SKIN
40	TC-101	2.034E+04	2.034E+04	2.034E+04	2.034E+04	2.034E+04	2.034E+04	2.034E+04	2.260E+04	SKIN
41	RU-103	1.093E+08	1.093E+08	1.093E+08	1.093E+08	1.093E+08	1.093E+08	1.093E+08	1.275E+08	SKIN
42	RU-105	6.373E+05	6.373E+05	6.373E+05	6.373E+05	6.373E+05	6.373E+05	6.373E+05	7.223E+05	SKIN
43	RU-106	4.239E+08	4.239E+08	4.239E+08	4.239E+08	4.239E+08	4.239E+08	4.239E+08	5.086E+08	SKIN
44	AG-110M	3.460E+09	3.460E+09	3.460E+09	3.460E+09	3.460E+09	3.460E+09	3.460E+09	4.037E+09	SKIN
45	CD-115M	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
46	SB-124	5.994E+08	5.994E+08	5.994E+08	5.994E+08	5.994E+08	5.994E+08	5.994E+08	6.916E+08	SKIN
47	TE-125M	1.555E+06	1.555E+06	1.555E+06	1.555E+06	1.555E+06	1.555E+06	1.555E+06	2.133E+06	SKIN
48	TE-127M	9.165E+04	9.165E+04	9.165E+04	9.165E+04	9.165E+04	9.165E+04	9.165E+04	1.083E+05	SKIN
49	TE-127	2.991E+03	2.991E+03	2.991E+03	2.991E+03	2.991E+03	2.991E+03	2.991E+03	3.290E+03	SKIN
50	TE-129M	1.967E+07	1.967E+07	1.967E+07	1.967E+07	1.967E+07	1.967E+07	1.967E+07	2.300E+07	SKIN
51	TE-129	2.639E+04	2.639E+04	2.639E+04	2.639E+04	2.639E+04	2.639E+04	2.639E+04	3.122E+04	SKIN
52	TE-131M	8.023E+06	8.023E+06	8.023E+06	8.023E+06	8.023E+06	8.023E+06	8.023E+06	9.455E+06	SKIN
53	TE-131	2.926E+04	2.926E+04	2.926E+04	2.926E+04	2.926E+04	2.926E+04	2.926E+04	3.450E+07	SKIN
54	TE-132	4.220E+06	4.220E+06	4.220E+06	4.220E+06	4.220E+06	4.220E+06	4.220E+06	4.965E+06	SKIN
55	I-130	5.539E+06	5.539E+06	5.539E+06	5.539E+06	5.539E+06	5.539E+06	5.539E+06	6.726E+06	SKIN
56	I-131	1.722E+07	1.722E+07	1.722E+07	1.722E+07	1.722E+07	1.722E+07	1.722E+07	2.091E+07	SKIN
57	I-132	1.238E+06	1.238E+06	1.238E+06	1.238E+06	1.238E+06	1.238E+06	1.238E+06	1.457E+06	SKIN
58	I-133	2.453E+06	2.453E+06	2.453E+06	2.453E+06	2.453E+06	2.453E+06	2.453E+06	2.983E+06	SKIN
59	I-134	4.460E+05	4.460E+05	4.460E+05	4.460E+05	4.460E+05	4.460E+05	4.460E+05	5.296E+05	SKIN
60	I-135	2.520E+06	2.520E+06	2.520E+06	2.520E+06	2.520E+06	2.520E+06	2.520E+06	2.940E+06	SKIN
61	CS-134	6.834E+09	6.834E+09	6.834E+09	6.834E+09	6.834E+09	6.834E+09	6.834E+09	7.972E+09	SKIN
62	CS-136	1.491E+08	1.491E+08	1.491E+08	1.491E+08	1.491E+08	1.491E+08	1.491E+08	1.690E+08	SKIN
63	CS-137	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.202E+10	SKIN
64	CS-138	3.597E+05	3.597E+05	3.597E+05	3.597E+05	3.597E+05	3.597E+05	3.597E+05	4.111E+05	SKIN
65	CS-139	3.115E+04	3.115E+04	3.115E+04	3.115E+04	3.115E+04	3.115E+04	3.115E+04	3.561E+04	SKIN
66	BA-139	1.059E+05	1.059E+05	1.059E+05	1.059E+05	1.059E+05	1.059E+05	1.059E+05	1.191E+05	SKIN
67	BA-140	2.051E+07	2.051E+07	2.051E+07	2.051E+07	2.051E+07	2.051E+07	2.051E+07	2.343E+07	SKIN
68	BA-141	4.179E+04	4.179E+04	4.179E+04	4.179E+04	4.179E+04	4.179E+04	4.179E+04	4.762E+04	SKIN
69	BA-142	4.486E+04	4.486E+04	4.486E+04	4.486E+04	4.486E+04	4.486E+04	4.486E+04	5.110E+04	SKIN
70	LA-140	1.924E+07	1.924E+07	1.924E+07	1.924E+07	1.924E+07	1.924E+07	1.924E+07	2.181E+07	SKIN

## ATTACHMENT 7

Pathway Dose Parameters  
 $R_i$  ( $m^2$  - mrem/yr per  $\mu Ci/sec$ )

AGE : ALL  
 PATHWAY : GROUND PLANE

NO ISOTOPE	W. BODY	THYROID	BONE	LIVER	KIDNEY	LUNG	GI-LLI	SKIN	CRITICAL
71 LA-142	7.359E+05	7.359E+05	7.359E+05	7.359E+05	7.359E+05	7.359E+05	7.359E+05	8.830E+05	SKIN
72 CE-141	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.539E+07	SKIN
73 CE-143	2.314E+06	2.314E+06	2.314E+06	2.314E+06	2.314E+06	2.314E+06	2.314E+06	2.630E+06	SKIN
74 CE-144	6.934E+07	6.934E+07	6.934E+07	6.934E+07	6.934E+07	6.934E+07	6.934E+07	8.017E+07	SKIN
75 FR-143	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
76 PR-144	1.833E+03	1.833E+03	1.833E+03	1.833E+03	1.833E+03	1.833E+03	1.833E+03	2.108E+03	SKIN
77 ND-147	8.389E+06	8.389E+06	8.389E+06	8.389E+06	8.389E+06	8.389E+06	8.389E+06	1.007E+07	SKIN
78 W-185	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
79 W-187	2.358E+06	2.358E+06	2.358E+06	2.358E+06	2.358E+06	2.358E+06	2.358E+06	2.739E+06	SKIN
80 U-235	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
81 U-238	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	0.000E-01	W. BODY
82 NP-239	1.703E+06	1.703E+06	1.703E+06	1.703E+06	1.703E+06	1.703E+06	1.703E+06	1.972E+06	SKIN

## ATTACHMENT (8)

GASEOUS EFFLUENTS - EFFECTIVE DOSE FACTORS FOR NOBLE GASES

<u>Year</u>	Total Body Effective Dose Factor $K_{eff}$ (mrem/yr per $\mu\text{Ci}/\text{m}^3$ )	Skin Effective Dose Factor (L+1.1 M) $M_{eff}$ (mrem/yr per $\mu\text{Ci}/\text{m}^3$ )	Gamma Air Effective Dose Factor $M_{eff}$ (mrad/yr per $\mu\text{Ci}/\text{m}^3$ )	Beta Air Effective Dose Factor $N_{eff}$ (mrad/yr per $\mu\text{Ci}/\text{m}^3$ )
1981	3.6E+02	7.9E+02	4.2E+02	1.1E+03
1982	3.1E+02	7.4E+02	3.7E+02	1.1E+03
1983	3.1E+02	7.4E+02	3.7E+02	1.1E+03
Average	3.3E+02	7.6E+02	3.9E+02	1.1E+03

**LOCATIONS OF THE ENVIRONMENTAL SAMPLING  
SITES FOR THE CALVERT CLIFFS NUCLEAR  
POWER PLANT**

SITE	SAMPLE	SECTOR	DISTANCE *		DESCRIPTION
			KM	MI	
1	DR1	NW	0.6	0.4	Onsite, along cliffs
2	DR2	WNW	2.7	1.7	Route 4, across from auto dump
3	DR3	W	2.3	1.4	Route 4, Giovanni's Tavern
4	DR4	WSW	2.1	1.3	Route 4, across from White Sands
5	DR5	SW	2.1	1.3	Route 4, at Johns Creek
6	DR6, A4	SSW	2.9	1.8	Route 4, at Lusby
7	DR7, A1, Ib4, Ib5, Ib6	S	0.8	0.5	Onsite, near guard house, off Camp Conoy Road
8	DR8, A2	SSE	2.4	1.5	Camp Conoy Road, at the emergency siren
9	DR9, A3	SE	2.5	1.6	Bay Breeze Road
10	DR10	NW	7.8	4.8	Route 765, St. Leonard
11	DR11	WNW	6.5	4.0	Dirt Road, off Mackall & Parran Roads
12	DR12	W	6.7	4.2	Bowen & Mackall Roads
13	DR13	WSW	6.1	3.8	Mackall Road, near Wallville
14	DR14	SW	6.5	4.0	Rodney Point
15	DR15	SSW	6.4	3.9	Mill Bridge & Turner Roads
16	DR16	S	6.7	4.2	Appeal School
17	DR17	SSE	6.1	3.8	Cove Point & Little Cove Point Roads
18	DR18	SE	7.2	4.5	Cove Point



**LOCATIONS OF THE ENVIRONMENTAL SAMPLING  
SITES FOR THE CALVERT CLIFFS NUCLEAR  
POWER PLANT**

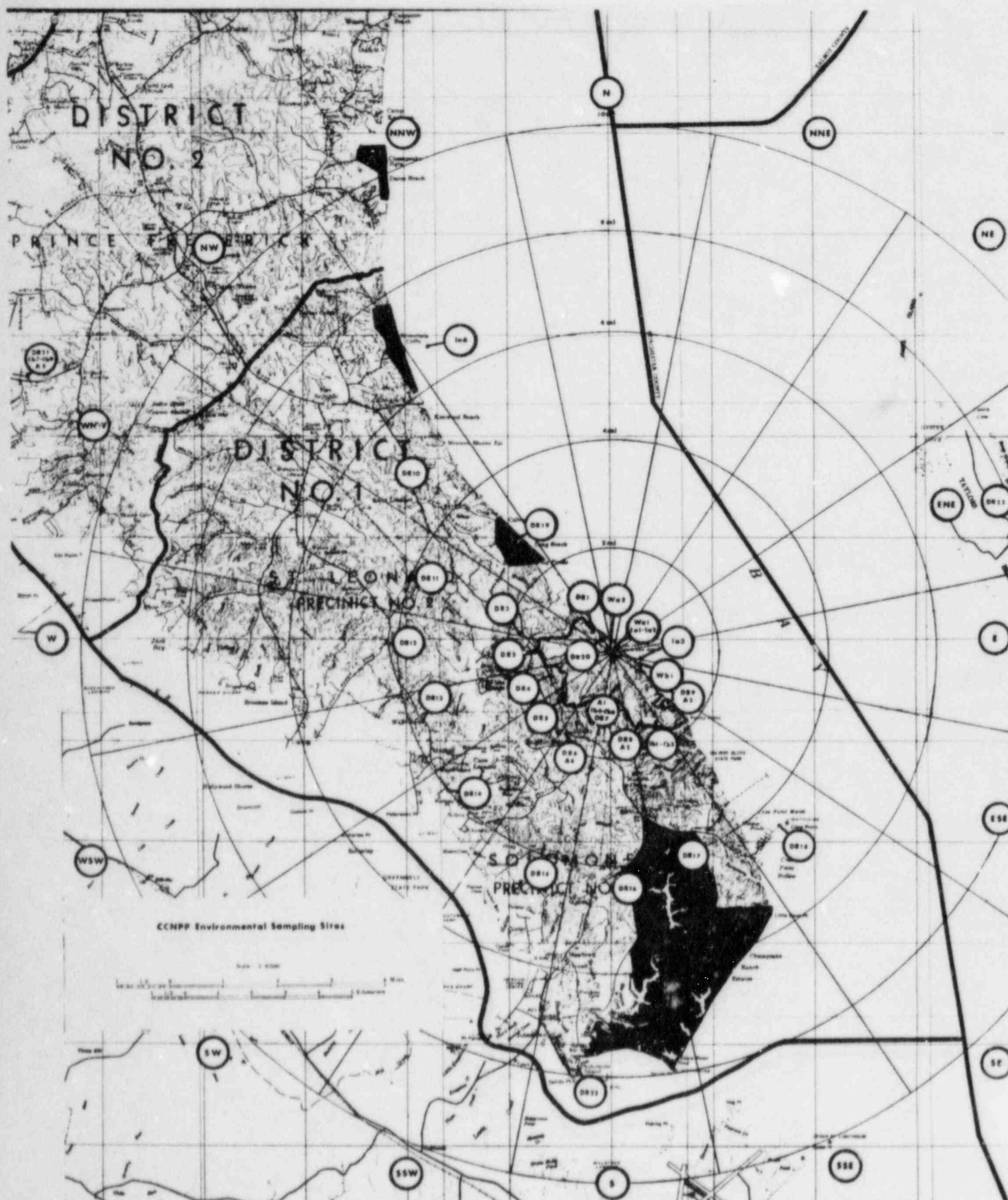
SITE	SAMPLE	SECTOR	DISTANCE *		DESCRIPTION
			KM	MI	
19	DR19	NW	4.5	2.8	Long Beach
20	DR20	NNW	0.6	0.4	Onsite, near shore
21	DR21, A5, Ib7, Ib8, Ib9	WNW	19.3	12.0	At the Emergency Offsite Facility, off Route 231
22	DR22	S	12.9	8.0	Solomons Island
23	DR23	ENE	12.7	7.9	Taylors Island
24	Wa1, Ia1, Ia2	NNE&NE	0.2	0.1	Intake area
25	Wa2	N	0.3	0.2	Discharge area
26	Wb1	ESE	0.6	0.4	Shoreline at Camp Conoy
27	Ib1, Ib2, Ib3	SSE	2.6	1.6	Garden plot off Bay Breeze Road
28	Ia4, Ia5	WNW	N/A	N/A	Patuxent River
29	Ia3	E	0.9	0.6	Camp Conoy
30	Ia6	NNW	10.7	6.6	Kenwood Beach

\* from the Central Point between the two containment buildings.

ATTACHMENT (10)

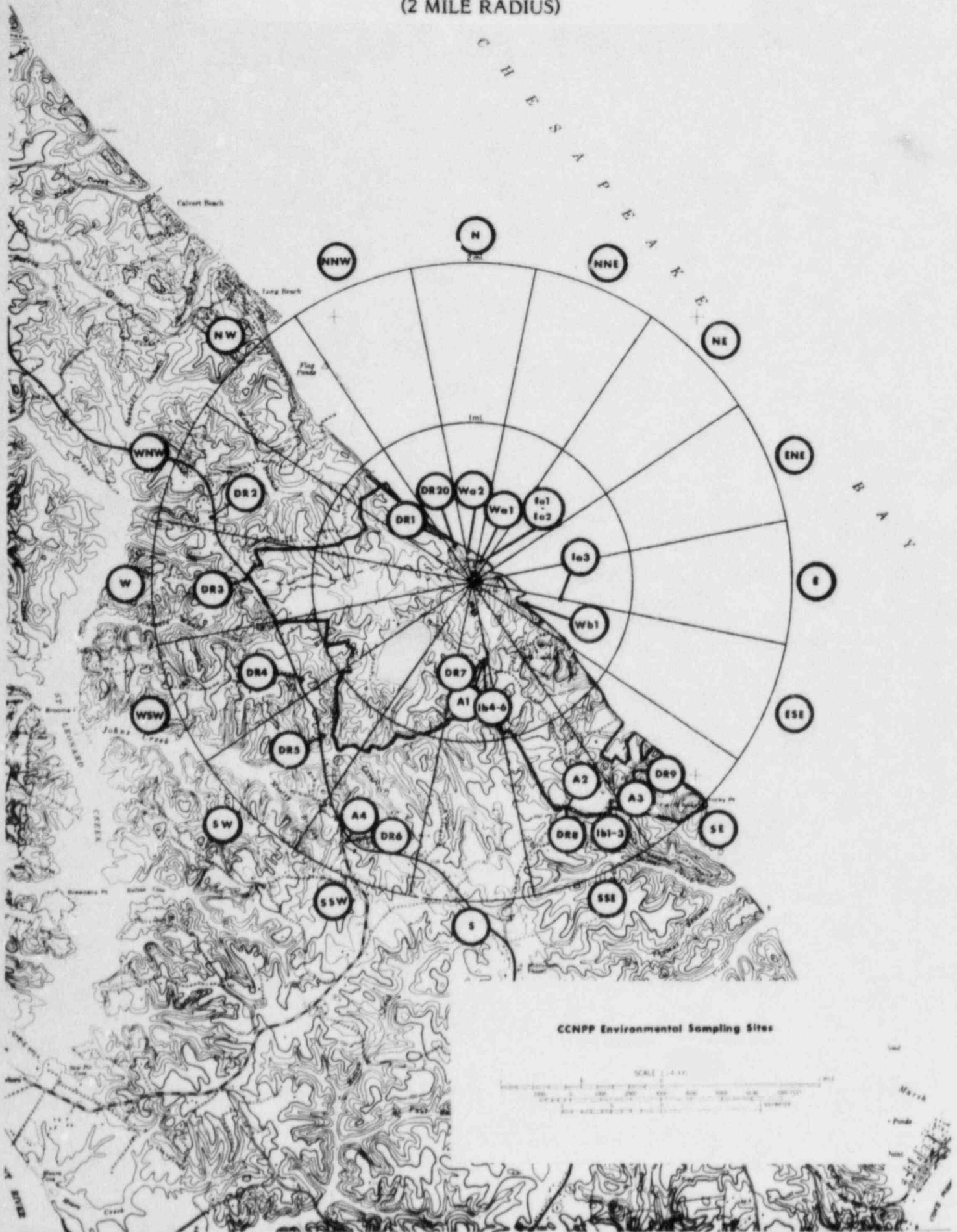
MAP OF ENVIRONMENTAL SAMPLING SITES

(10 MILE RADIUS)



MAP OF ENVIRONMENTAL SAMPLING SITES

(2 MILE RADIUS)



ATTACHMENT (5)  
PROCESS CONTROL PROGRAM  
(PCP)

CALVERT CLIFFS NUCLEAR POWER PLANT  
BALTIMORE GAS AND ELECTRIC COMPANY



## PROCESS CONTROL PROGRAM

### 1.0 WET WASTE

#### 1.1 Dewatering Solids In High Integrity Containers (HIC)

The exhausted ion exchange resin is transferred to a spent resin metering tank. The resin is transferred from the spent resin metering tank to a high integrity container and dewatered. After the dewatering process is complete, as per Radiation Safety Procedures, the HIC is transferred into a CASK and shipped to a burial site.

1.2 Solids such as bead resin, filter cartridges and powdered resin may be dewatered and shipped in HIC's per approved vendor procedures and the HIC certificate of compliance.

1.3 High integrity containers are approved by the individual burial sites as meeting 10 CFR 61 waste form stability requirements.

1.4 Free water determination as defined in 10CFR61 part 61.56 shall be verified by the successful completion and documentation of the vendors approved dewatering procedure.

### 2.0 SOLIDIFICATION

Solidification of the wet waste shall be conducted by a mobile solidification system. The process equipment procedures, solidification agent, QC and PCP program shall meet all of the local, county, federal and state burial criteria.

2.1 The PROCESS CONTROL PROGRAM shall be used to verify the SOLIDIFICATION of at least one representative test specimen from at least every tenth batch of each type of wet radioactive waste (e.g, filter sludges, spent resins, evaporator bottoms, and boric acid solutions).

2.1.1 If any test specimen fails to verify SOLIDIFICATION, the SOLIDIFICATION of the batch under test shall be suspended until



such a time as additional test specimens can be obtained, alternative SOLIDIFICATION parameters can be determined in accordance with the PROCESS CONTROL PROGRAM and a subsequent test verifies SOLIDIFICATION. The SOLIDIFICATION of the batch may then be resumed using alternate SOLIDIFICATION parameters determined by the PROCESS CONTROL PROGRAM.

- 2.1.2 If the initial test specimen from a batch of waste fails to verify SOLIDIFICATION, the PROCESS CONTROL PROGRAM (PCP) shall provide for the collection and testing of representative test specimens from each consecutive batch of the same type of wet waste until at least 3 consecutive initial test specimens demonstrate SOLIDIFICATION. The PCP shall be modified as required, as provided in Specification 6.13, to assure SOLIDIFICATION of subsequent batches of waste.

**- NOTE -**

**At present, radioactive waste is not solidified  
at Calvert Cliffs.**

**3.0 10 CFR 61 REQUIREMENTS**

- 3.1 The waste classification and manifest reporting program was developed by the Calvert Cliffs Nuclear Power Plant to comply with the requirements of 10 CFR 20.311, 10 CFR 61 61.55 and 61.56. The 10 CFR 61 classification requirements will be met using scaling factor methodology as per provisions stated in 10 CFR 61.55.
- 3.2 The scaling factors will be updated by an ongoing analysis program of actual waste streams. The program will initiate with annual samples of available

waste streams and may be modified to longer intervals if the data base warrants.

#### **4.0 VENDOR SERVICES FOR WASTE PROCESSING**

Contractor supplied services and/or systems may be used at Calvert Cliffs for the processing of radioactive waste. For the operation of such process systems, it may be desirable to use process control measures and procedures developed by the contractor specifically for the system. Therefore, previously addressed process control measures for a particular waste stream may be superseded by contractor supplied measures as appropriate. The following discussion addresses the administrative controls that are imposed to assure that contractor supplied services and/or systems for processing radioactive waste for disposal at a burial site are compatible with plant operations, procedures and regulatory requirements.

Prior to the use of any contractor for the processing of waste at Calvert Cliffs, management review of the contractor's process controls and operating procedures is performed for the purpose of assuring a safe operation in accordance with plant procedures and applicable regulatory requirements. For the processing of waste that is intended to be shipped for disposal to a licensed radioactive waste burial site, additional precautions are taken to assure a final waste product that meets the appropriate waste characteristic requirements for solidification or dewatering. In particular, the following items are to be documented by the contractor (or Calvert Cliffs manuals or procedures) prior to utilization for solid waste processing at Calvert Cliffs.

- a general description of the solidification process, including type of solidification agent, major process equipments and interface with plant

equipment, type of wastes that can be processed, and operating parameters;

- a Process Control Program (PCP) that provides for the verification of the generation of a suitable waste product, including items such as representative sampling, laboratory tests to establish waste-to-process medium ratios, and criteria for evaluating acceptability of lab test;
- specifically approved procedures for the operation of the process equipment that will assure operation within the bounds as determined by the Process Control Program (PCP); and,
- appropriate QC check point and acceptance criteria for evaluating the acceptability of the final waste product.