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TS 6.9.1.8
10CFR50.36(a)

Docket Nos. 50-352
50-353
License Nos. NPF-39
NPF-85

April 11, 2000

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Subject: Limerick Generating Station, Units 1 and 2
Offsite Dose Calculation Manual
Revision 20, 8/99

Gentlemen:

Enclosed is the following report:

Offsite Dose Calculation Manual
Revision 20, 8/99

This report are being submitted in accordance with the LGS Technical Specification Section 6.9.1.8 and 10CFR50.36(a). Revisions to the Offsite Calculation Manual are usually submitted with the Annual Radioactive Effluent Release Report for the period of the report in which the change to the ODCM was made. Revision 20 of the Offsite Dose Calculation Manual was omitted from the submittal of the 1999 Annual Radioactive Effluent Release Report.

Very truly yours,

Michael P. Gallagher
Plant Manager

MPG/EWF:ewf

Enclosures (1)

cc: H. J. Miller, Administrator, Region I, USNRC
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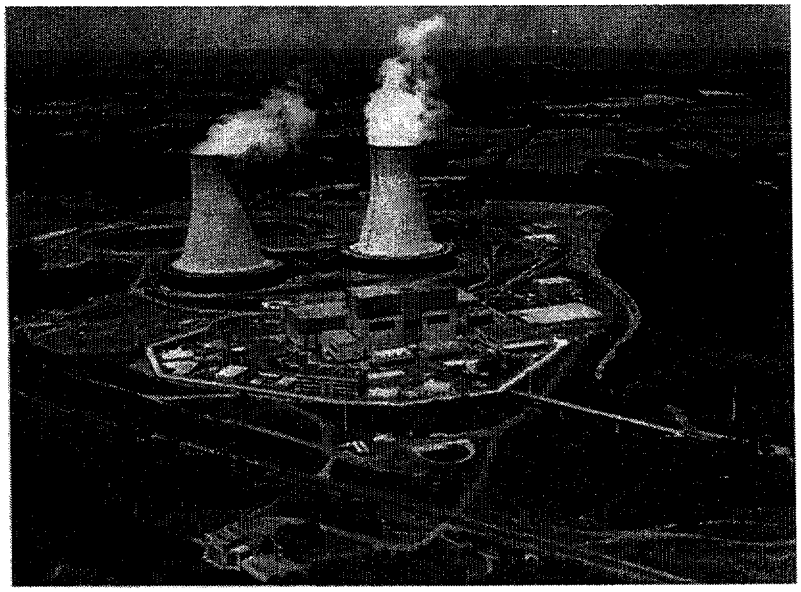

Offsite Dose Calculation Manual

Revision 20

Limerick Generating Station

9/28/99

PORC	YES
SQR	YES
NQA	NO
50.59	YES
RESP.MGR.	YES

LIMERICK GENERATING STATION

UNITS 1 AND 2

OFFSITE DOSE CALCULATION MANUAL

Revision 20

PECO ENERGY COMPANY

DOCKET NOS. 50-352 AND 50-353

Approval: Michael P. Gallagher
Plant Manager

9-5-99
Date

Limerick Generating Station
Offsite Dose Calculation Manual

PURPOSE:

The OFFSITE DOSE CALCULATION MANUAL (ODCM) shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluent, in the calculation of gaseous and liquid effluent monitoring alarm/trip setpoints, and in the conduct of the Radiological Environmental Monitoring Program.

SCOPE:

The ODCM shall also contain the Radioactive Effluent Controls Programs, the Meteorological Monitoring Program, the Radiological Environmental Monitoring Program required by Tech. Spec. Section 6.8.4 and the descriptions of the information that should be included in the Annual Radiological Environmental Operating and Annual Radioactive Effluent Release Reports required by Tech Spec. Sections 6.9.1.7 and 6.9.1.8, respectively.

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PART I

RADIOLOGICAL EFFLUENT CONTROLS

1.0 DEFINITIONS

The following terms are taken from LGS Unit 1/Unit 2 Tech Specs. unless otherwise noted:

1.1 ACTION

ACTION shall be that part of a specification which prescribes remedial measures required under designated conditions.

1.2 CHANNEL CALIBRATION

A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds with the necessary range and accuracy to known values of the parameter which the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel including the sensor and alarm and/or trip functions, and shall include the CHANNEL FUNCTION TEST. The CHANNEL CALIBRATION may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is calibrated.

1.3 CHANNEL CHECK

A CHANNEL CHECK shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.

1.4 CHANNEL FUNCTIONAL TEST

A CHANNEL FUNCTIONAL TEST shall be:

a. Analog channels - the injection of a simulated signal into the channel as close to the sensor as practicable to verify OPERABILITY including alarm and/or trip functions and channel failure trips.

b. Bistable channels - the injection of a simulated signal into the sensor to verify OPERABILITY including alarm and/or trip functions.

The CHANNEL FUNCTIONAL TEST may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is tested.

1.5 CONTINUOUS SAMPLING

Per ASTM Standard (1987) Section II (Water and Environmental Technology), Volume 11.03, Article D1356; is defined as "sampling without interruptions throughout an operation or for a predetermined time." A CONTINUOUS SAMPLE is the opposite of

1.0 DEFINITIONS

a GRAB SAMPLE. The time period involved to secure (shut-down) ventilation or re-establish sampling of the release pathway shall meet the intent of CONTINUOUS SAMPLING. Consistent with industry standards, the time allowance shall not exceed 8 hours.

1.6 DOSE EQUIVALENT I-131

DOSE EQUIVALENT I-131 shall be that concentration of I-131, microcuries per gram, which alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134 and I-135 actually present. The thyroid dose conversion factors used for this calculation shall be those listed in Table III of TID-14844, "Calculation of Distance Factors for Power and Test Reactor Sites."

1.7 FREQUENCY NOTATION

The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the intervals defined in Table I1.1.

1.8 MEMBER(S) OF THE PUBLIC

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

1.9 OFFSITE DOSE CALCULATION MANUAL

The OFFSITE DOSE CALCULATION MANUAL (ODCM) shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints, and in the conduct of the Radiological Environmental Monitoring Program. The ODCM shall also contain (1) the Radioactive Effluents Controls and Radiological Environmental Monitoring Programs required by Technical Specification 6.8.4, (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Annual Radiological Effluent Release Reports required by Technical Specifications 6.9.1.7 and 6.9.1.8, and (3) description of meteorological monitoring controls.

1.0 DEFINITIONS

1.10 OPERABLE - OPERABILITY

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

1.11 OPERATIONAL CONDITION - CONDITION

An OPERATIONAL CONDITION, i.e., CONDITION, shall be any one inclusive combination of mode switch position and average reactor coolant temperature as defined in the Technical Specifications.

1.12 PURGE - PURGING

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

1.13 RATED THERMAL POWER

See current LGS Tech Spec definition.

1.14 REPORTABLE EVENT

A REPORTABLE EVENT shall be any of those conditions specified in Section 50.73 of 10 CFR Part 50.

1.15 SITE BOUNDARY

The SITE BOUNDARY shall be that line as defined in Figure I2.2-1a.

1.16 SOURCE CHECK

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

1.17 THERMAL POWER

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

1.0 DEFINITIONS

1.18 UNRESTRICTED AREA

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.

1.19 VENTILATION EXHAUST TREATMENT SYSTEM

A VENTILATION EXHAUST TREATMENT SYSTEM shall be any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal absorbers 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.

1.20 VENTING

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

1.0 DEFINITIONS

TABLE I1.1

SURVEILLANCE FREQUENCY NOTATION

NOTATION	FREQUENCY
S (Shift)	At least once per 12 hours.
D (Daily)	At least once per 24 hours.
W (Weekly)	At least once per 7 days.
M (Monthly)	At least once per 31 days.
Q (Quarterly)	At least once per 92 days.
SA (Semi-annual)	At least once per 184 days.
A (Annual)	At least once per 366 days.
E	At least once per 18 months (550 days).
R	At least once per 24 months (731 days).
S/U	Prior to each reactor startup.
P	Prior to each radioactive release.
N.A.	Not applicable.

2.0 BASES

2.1 METEOROLOGICAL INSTRUMENTATION

The OPERABILITY of the meteorological monitoring instrumentation ensures that sufficient meteorological data is available for estimating potential radiation doses to the public as a result of routine or accidental release of radioactive materials to the atmosphere. This capability is required to evaluate the need for initiating measures to protect the health and safety of the public. This instrumentation is consistent with the recommendations of Regulatory Guide 1.23 "Onsite Meteorological Programs," February, 1972.

Site data compiled since January 1972 provide correlation between Elevation 1 (Tower 1) and Elevation 1 (Tower 2), and between Elevation 2 (Tower 1) and Elevation 2 (Tower 2). This correlation serves as justification for the use of the appropriate Tower 2 instrument as a back-up to the Tower 1 instrument as shown in Table I3.1-1 and Table I3.1-3.

2.2 MAPS DEFINING UNRESTRICTED AREAS AND SITE BOUNDARY FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

Information regarding radioactive gaseous and liquid effluents, which will allow identification of structures and release points as well as definition of UNRESTRICTED AREAS within the SITE BOUNDARY that are accessible to MEMBER(S) OF THE PUBLIC, shall be as shown in Technical Specifications Figures 5.1.3-1a and 5.1.3-1b.

The exclusion area and low population zone shall be as shown in Figures I2.2-1a and I2.2-1b.

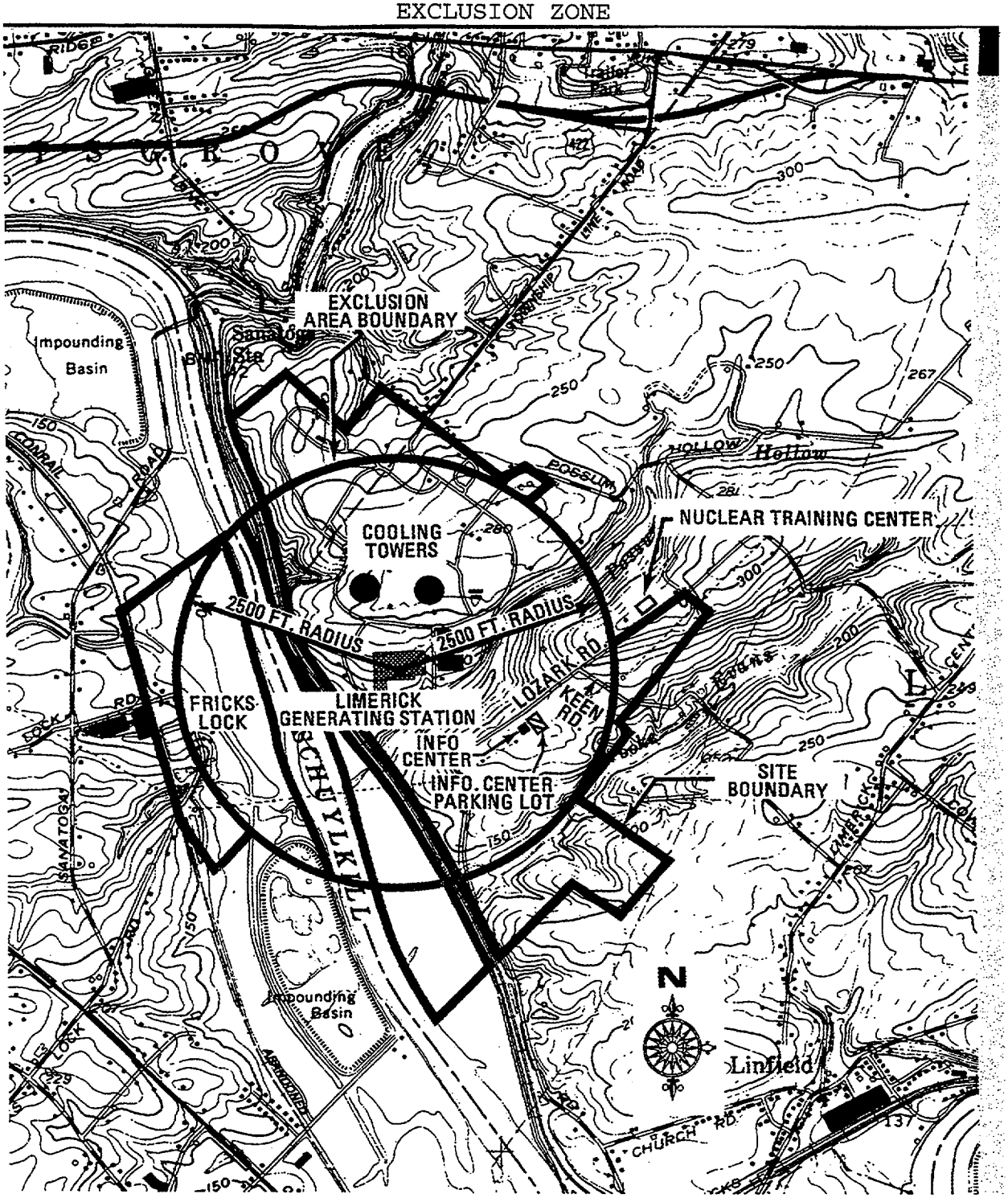
2.3 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

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 in accordance with the procedures in the ODCM Part II to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20 (pre-1994). 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.

2.0 BASES

FIGURE I2.2-1a

EXCLUSION ZONE



2.0 BASES

FIGURE I2.2-1b

LOW POPULATION ZONE

2.0 BASES

2.4 CONCENTRATION IN LIQUID EFFLUENTS

This control 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 (pre-1994). 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 20.1301(e) to the population. The concentration limits for dissolved or entrained noble gases are based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air was converted to an equivalent concentration in water using the methods described in the International Commission on Radiological Protection (ICRP) Publication 2.

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

2.5 DOSE DUE TO LIQUID EFFLUENTS

This Control is provided to implement the requirements of Sections II.A, III.A, and IV.A of Appendix I, 10 CFR Part 50. The Control 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 will be kept "as low as reasonably achievable". Also, for fresh water sites with drinking water supplies which can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR Part 141. 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 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April, 1977.

This control applies to the release of radioactive materials in liquid effluents from the site.

2.6 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 reasonably achievable". This specification implements the requirements of 10 CFR 50.35a, 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.

2.7 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 in accordance with the procedures in the ODCM Part II to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20 (pre-1994). 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.

2.8 DOSE RATE FROM GASEOUS EFFLUENTS

This control is provided to ensure that the dose at any time at and beyond the SITE BOUNDARY from gaseous effluents from the site will be within the annual dose limits of 10 CFR Part 20 (pre-1994) to UNRESTRICTED AREAS. The annual dose limits are the dose associated with the concentrations of 10 CFR Part 20, Appendix B, Table II, Column I (pre-1994). These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual

2.0 BASES

average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (pre-1994). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy factor for that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor for above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, are given in the ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrem/year to the total body or to less than or equal to 3000 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrem/year.

This Control applies to the release of radioactive materials in gaseous effluents from all reactors at the site.

The required detection capability for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually); Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry"; Anal. Chem. 40, 586-93 (1986); and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques." Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

2.9 DOSE - NOBLE GASES

This control is provided to implement the requirements of Sections II.B, III.A, and IV.A of Appendix I, 10 CFR Part 50. The control 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 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 appropriate pathways is unlikely to be substantially underestimated. The dose calculation 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,

2.0 BASES

Appendix I," Revision I, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routing Releases from Light-Water Cooled Reactors," Revision 1, July 1977 with site specific dispersion curves and deposition methodology. The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

2.10 DOSE - IODINE-131, IODINE-133, TRITIUM, AND RADIONUCLIDES IN PARTICULATE FORM

This control is provided to implement the requirements of Sections II.C, III.A, and IV.A of Appendix I, 10 CFR Part 50. The controls 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 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 methods 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 I, 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 with site specific dispersion curves and deposition methodology. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specifications for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days are dependent on the existing radionuclides pathways to man in areas at and beyond the SITE BOUNDARY. The pathways which 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.

2.0 BASES

2.11 VENTILATION EXHAUST TREATMENT SYSTEM

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

2.12 VENTING OR PURGING

This control provides reasonable assurance that releases from drywell purging operations will not exceed the annual dose limits of 10 CFR Part 20 for UNRESTRICTED AREAS.

2.13 TOTAL DOSE

This control is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 CFR 18525. The control requires the preparation and submittal of a Special Report whenever the calculated doses from plant radioactive effluents exceed twice the design objective doses of Appendix I. For sites containing up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR 190 if the individual reactors remain within the reporting requirement level.

The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 5 miles must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release condition resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.2203, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. 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.

2.14 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The Radiological Environmental Monitoring Program (REMP) required by this control provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBER OF THE PUBLIC resulting from the station 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 modeling of the environmental exposure pathways.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table I3.4-3 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not an 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).

2.15 LAND USE CENSUS

This control is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the monitoring program are made if required by the results of the census. The best information from the door-to-door survey, aerial survey or consulting with local agricultural authorities or any combination of these methods 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 500 square feet 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 used: (1) that 20% of the garden was used for growing broad leafy vegetation (i.e.

similar to lettuce and cabbage), and (2) a vegetation yield of 2 kg/Square meter.

2.16 INTERLABORATORY COMPARISON PROGRAM

The requirement for participation in an Interlaboratory Comparison Program ensures 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 reasonably valid for the purpose of Section IV.B.2 of Appendix I to 10 CFR Part 50.

2.17 APPLICABILITY #

2.17.1 Compliance with the controls contained in the following controls section is required during the OPERATIONAL CONDITIONS or other conditions specified therein; except that upon failure to meet the controls, the associated ACTION requirements shall be met.

2.17.2 Non compliance with a control shall exist when the requirements of the control and associated ACTION requirements are not performed within the specified time intervals. If the control is restored prior to expiration of the specified time intervals, completion of the ACTION requirements is not required.

2.17.3 There are no actions in the ODCM which would require an operational condition change.

2.17.4 There are no restrictions on changing operating conditions in any of the controls on the ODCM.

2.17.5 Surveillance Requirements shall be met during the OPERATIONAL CONDITIONS or other conditions specified for individual controls unless otherwise stated in an individual Surveillance Requirement.

2.17.6 Each Surveillance Requirement shall be performed within the specified interval with a maximum allowable extension not to exceed 25% of the surveillance interval.

2.17.7 Failure to perform a Surveillance Requirement within the allowed surveillance interval defined by Bases 2.17.6, shall constitute noncompliance with the OPERABILITY requirements for a control. The time limits of the ACTION requirements are applicable at the time it is identified that a Surveillance Requirement has not been performed. The ACTION requirements may be delayed for up to 24 hours to permit the completion of the surveillance when the allowable outage time limits of the

2.0 BASES

ACTION requirements are less than 24 hours. Surveillance requirements do not have to be performed on inoperable equipment.

The associated bases from the LGS Technical Specifications apply to this section.

2.18 10CFR20

Per Technical Specification Section 6.8.4.d, the Radioactive Effluent Controls Program must conform with limitations specified in 10CFR50.36a, 10CFR Part 50, Appendix I, 10CFR Part 20, Appendix B, Table II, Column 2 (pre-1994 issue) and 40CFR 190. (See Reference 14)

3.0 CONTROLS

3.1 METEOROLOGICAL MONITORING

3.1.1 METEOROLOGICAL MONITORING INSTRUMENTATION

The meteorological monitoring instrumentation channels shown in Table I3.1-1 shall be OPERABLE.

APPLICABILITY: At all times.

ACTION:

With less than the minimum required instrumentation channels operable for more than 7 days, prepare and submit a Special Report to the Commission pursuant to LGS Technical Specification 6.9.2 within the next 10 days outlining the cause of the malfunction and the plans for restoring the instrumentation to OPERABLE status.

SURVEILLANCE REQUIREMENTS

3.1-1 Each of the above required meteorological monitoring instrumentation channels shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK and CHANNEL CALIBRATION operations at the frequencies shown in Table I3.1-2.

3.0 CONTROLS

3.1 METEOROLOGICAL MONITORING

TABLE I3.1-1

METEOROLOGICAL MONITORING INSTRUMENTATION

INSTRUMENT		Tower 1 (Primary)	Tower 2 (Backup)	MINIMUM INSTRUMENT OPERABLE
1. Wind Speed				
a.	Elevation 1	30 feet	159 feet	1
b.	Elevation 2	175 feet	304 feet	1
2. Wind Direction				
a.	Elevation 1	30 feet	159 feet	1
b.	Elevation 2	175 feet	304 feet	1
3. Air Temperature Difference (T)				
a.	Elevations	266 feet 26 feet	300 feet 26 feet	1

TABLE I3.1-2

METEOROLOGICAL MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	Channel Check	Channel CALIBRATION
1. Wind Speed		
a. Elevation 1 (Tower 1 and Tower 2)	D	SA
b. Elevation 2 (Tower 1 and Tower 2)	D	SA
2. Wind Direction		
a. Elevation 1 (Tower 1 and Tower 2)	D	SA
b. Elevation 2 (Tower 1 and Tower 2)	D	SA
3. Air Temperature Difference ()T)		
a. Elevations 266 - 26 ft (Tower 1)	D	SA
b. Elevations 300 - 26 ft (Tower 2)	D	SA

NOTE:
The meteorological towers shall be located as shown on Figure I3.1-1. For backup sources of data retrieval, refer to Table I3.1-3.

3.0 CONTROLS

3.1 METEOROLOGICAL MONITORING

TABLE I3.1-3

METEOROLOGICAL TOWER DATA RETRIEVAL

INSTRUMENT DATA	TOWER 1	TOWER 2	U1PMS	DATA LOGGER Channel #
Wind Speed a. Elev. 1	Strip Chart	Strip Chart	T1SPL(TWR1) T2SPI(TWR2)	1 (TWR1) 14 (TWR2)
Wind Speed b. Elev. 2	Strip Chart	Strip Chart	T1SPI(TWR1) T2SPU(TWR2)	5 (TWR1) 21 (TWR2)
Wind Dir. a. Elev. 1	Strip Chart	Strip Chart	T1DRL(TWR1) T2DRI(TWR2)	0 (TWR1) 13 (TWR2)
Wind Dir. b. Elev. 2	Strip Chart	Strip Chart	T1DRI(TWR1) T2DRU(TWR2)	4 (TWR1) 20 (TWR2)
DELTA T	Multi-pt Rec	Multi-pt Rec	T1DTUL(TWR1) T2DTUL(TWR2)	7 (TWR1) 23 (TWR2)

PRIMARY OPTION:

A) **IF** DATA IS UNAVAILABLE FOR TOWER 1
THEN verify corresponding data available for Tower 2

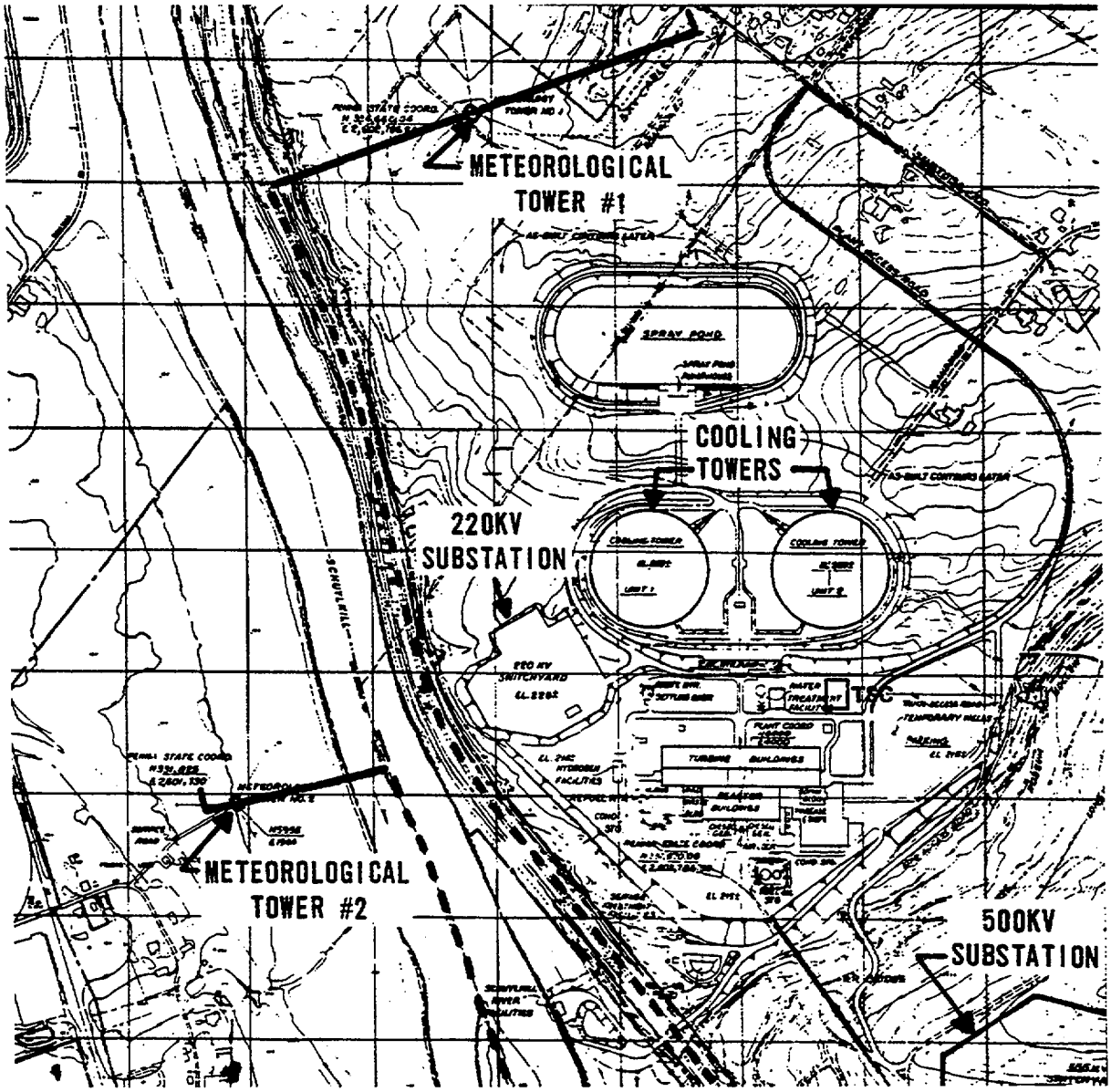
B) DATA IS AVAILABLE FROM U1PMS, DATA LOGGER OR STRIP CHARTS. THE SOURCES OF DATA IN ORDER OF PREFERENCE ARE THE U1PMS, DATA LOGGER OR STRIP CHARTS. DATA LOGGER AND STRIP CHARTS ARE LOCATED IN THE CONTROL ROOM.

3.0 CONTROLS

3.1 METEOROLOGICAL MONITORING

Figure I3.1-1

Meteorological Tower Location



3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

3.2.1 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

The radioactive liquid effluent monitoring instrumentation channels shown in Table I3.2-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that Control I3.2.2 is not exceeded. The alarm/setpoints* of these channels shall be determined and adjusted in accordance with the methodology and parameters in Section II 1.2.

APPLICABILITY: At all times.

ACTION:

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

b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table I3.2-1. Restore the inoperable instrumentation to OPERABLE status within the time specified in the ACTION or explain in the next Annual Radioactive Effluent Release Report why this inoperability was not corrected within the time specified.

SURVEILLANCE REQUIREMENTS

3.2.1-1 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 I3.2-2.

* Excluding the flow rate measuring devices which are not determined and adjusted in accordance with the ODCM.

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

TABLE I3.2-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

	INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1.	Gross Radioactivity Monitors Providing Automatic Termination of Release		
	a. Liquid Radwaste Effluent Line	1	100
	b. A/B RHR Service Water Effluent Line *	1/loop	101
2.	Gross Radioactivity Monitors Not Providing Automatic Termination of Release		
	a. Service Water Effluent Line	1	101
3	Flow Rate Measurement Devices		
	a. Liquid Radwaste Effluent Line	1	102
	b. Discharge Line	1	102

* Termination of the release is accomplished by auto trip of the RHRSW pumps and remote manual closure of isolation valves.

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

ACTION STATEMENTS

Action 100- With less than the Minimum Required Channels operable, effluent releases may continue for up to 14 days provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with Table I3.2-3, and

b. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge line valving;

Otherwise, suspend release of radioactive effluents via this pathway.

Action 101- With less than the Minimum Required Channels operable, effluent releases via this pathway may continue for up to 30 days provided that, at least once per 8 hours, grab samples are collected and analyzed for radioactivity by gamma isotopic analysis (Principal Gamma Emitters, I-131, and Dissolved/ Entrained Gases) at a Lower Limit of Detection as specified in Table I3.2-3 or gross radioactivity (beta or gamma). Gross Beta is analyzed at an LLD of at least 1N7 uCim1. Gross Gamma is analyzed at an LLD of at least 5N7 uCi/m1.

If the A or B RHRSW Process Rad Monitor should become inoperable, sampling is required at least once every eight (8) hours at a sample point common with the inoperable A and/or B RHRSW Process Rad Monitor(s). If a monitor is inoperable but will still continuously sample and annunciate on high activity, i.e. rad monitor bypass switch placed in "Bypass", Chemistry sampling is not required as the continuous monitor sampling complies with the periodic sampling requirement.

Action 102- With less than the Minimum Required Channels operable, effluent releases via this pathway may continue for up to 30 days provided the flow rate is estimated at least once per 4 hours during actual releases. Pump curves generated in situ may be used to estimate flow.

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

TABLE I3.2-2

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

	INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1.	Gross Radioactivity Monitors Providing Automatic Termination of Release				
	a. Liquid Radwaste Effluent Line	D*	D*	R(3)	Q(1)
	b. RHR Service Water System Effluent Line	D	M	R(3)	Q(1)
2.	Gross Radioactivity Monitored Not Providing Automatic Termination of Release				
	a. Service Water System Effluent Line	D	M	R(3)	Q(2)
3.	Flow Rate Measurement Devices				
	a. Liquid Radwaste Effluent Line	D(4)	N.A.	R	Q
	b. Discharge Line	D(4)	N.A.	R	Q

* Daily when in use

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

TABLE I3.2-2 (Continued)

TABLE NOTATIONS

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation will occur if any of the following conditions exists:

1. Instrument indicates measured levels above the alarm/trip setpoint.
2. Circuit failure.
3. Instrument indicates a downscale failure.

(2) The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:

1. Instrument indicates measured levels above the alarm setpoint.
2. Circuit failure.
3. Instrument indicates a downscale failure.

(3) The initial CHANNEL CALIBRATION shall be performed using reference standards certified by the National Institute of Standards and Technology (NIST) obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurements range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used.

(4) CHANNEL CHECK shall consist of verifying indication of flow during periods of release. CHANNEL CHECK shall be made at least once per 24 hours on days on which batch releases are made.

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

3.2.2 CONCENTRATION IN LIQUID EFFLUENTS

The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Figure I2.2-1a,b) shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table II, Column 2 (pre-1994) for radionuclides other than dissolved or entrained nobles gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-4 microcuries/ml total activity (NUREG 0133, Section 2).

APPLICABILITY: At all times.

ACTION:

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

SURVEILLANCE REQUIREMENTS

3.2.2-1 Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table I3.2-3.

3.2.2-2 The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in Section II 1.2 to assure that the concentrations at the point of release are maintained within the limits of Control I3.2.2.

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

TABLE I3.2-3

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (uCi/ml)
A. Batch Waste Release Tanks[b]	P Each Batch	P Each Batch	Principal Gamma Emitters[c]	5E-7
			I-131	1E-6
1. Floor or Equip. Drain Sample Tanks	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)[c]	1E-5
2. Laundry Drain Sample Tank	P Each Batch	M Composite[d]	H-3	1E-5
			Gross Alpha	1E-7
	P Each Batch	Q Composite[d]	Sr-89, Sr-90	5E-8
			Fe-55	1E-6
B. Continuous Release[e]	W Grab Sample	W	Principal Gamma Emitters[c]	5E-7
			I-131	1E-6
1. RHR Service Water System Effluent Line[f]	W Grab Sample	W	Dissolved and Entrained Gases (Gamma Emitters)[c]	1E-5
2. Service Water System Effluent Line[f]	W Grab Sample	M Composite[d]	H-3	1E-5
			Gross Alpha	1E-7
	W Grab Sample	Q Composite[d]	Sr-89, Sr-90	5E-8
			Fe-55	1E-6

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

TABLE I3.2-3 (Continued)

TABLE NOTATIONS

a. The LLD is defined 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 measurement system, which may include radiochemical separation:

$$\text{LLD (Composite)} = \frac{(2.71 + 4.66\sigma_B)\ (\lambda\Delta t_2)}{E \cdot V \cdot 2.22E6 \cdot Y \cdot [\exp\ (-\lambda\Delta t_1)]\ (1-\exp(-\lambda\Delta t_2))}$$

$$\text{LLD (Grab Samples)} = \frac{(2.71 + 4.66\ \sigma_B)}{E \cdot V \cdot 2.22E6 \cdot Y\ (\exp\ -\ \lambda\Delta t_1)}$$

Where:

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

σ_B is the standard deviation of the background counting rate or of the counting rate of 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,

2.22E6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

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

Δt_1 for the plant effluents is the elapsed time between the end of the sample collection and the start of sample count.

Δt_2 for the plant effluents is the elapsed time between the start and the end of sample collection.

TABLE I3.2-3 (Continued)

TABLE NOTATIONS

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

b. A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated, and then thoroughly mixed to assure representative sampling.

c. The principal gamma emitters for which the LLD specification applies include the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144. The dissolved and entrained noble gases (gamma emitters) for which the LLD specification applies include the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, Xe-135m, Xe-138. 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 Annual Radioactive Effluent Release Report pursuant to Control I3.6.

d. The term "Composite Sample" means a combination of individual samples obtained at regular intervals over a time period. Either the volume of each individual sample is proportional to discharge flow rates, or the sampling interval (for constant volume samples) is proportional to flow rates over the time period used to produce the composite.

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

f. Whenever effluent releases are in excess of the monitor's setpoint.

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

3.2.3 DOSE DUE TO LIQUID EFFLUENTS

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released from the site to UNRESTRICTED AREAS (See Figure I2.2-1a) shall be limited:

a. During any calendar quarter to less than or equal to 3 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:

With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which 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. This Special Report shall also include the radiological impact on finished drinking water supplies at the nearest downstream drinking water source.

SURVEILLANCE REQUIREMENTS

3.2.3-1 Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined at least once per 31 days.

3.0 CONTROLS

3.2 RADIOACTIVE LIQUID EFFLUENTS

3.2.4 LIQUID RADWASTE TREATMENT SYSTEM

The liquid radwaste treatment system shall be IN SERVICE and appropriate portions of the system shall be used to reduce the radioactive materials in liquid waste prior to their discharge when the projected doses due to the liquid effluent, from the site, to UNRESTRICTED AREAS (See Figure I2.2-1a) would exceed 0.12 mrem to the total body or 0.4 mrem to any organ in a 31-day period.

APPLICABILITY: At all times.

ACTION:

a. With radioactive liquid waste being discharged without treatment and in excess of the above limits, pursuant to Technical Specification 6.9.2, prepare a Special Report which includes the following information:

1. Explanation of what 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. Submit report to Commission within 30 days.

SURVEILLANCE REQUIREMENTS

3.2.4-1 Dose due to liquid releases from the site to UNRESTRICTED AREAS shall be projected at least once per 31 days.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

3.3.1 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

The radioactive gaseous effluents monitoring instrumentation channels in Table I3.3-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Control I3.3.2.a are not exceeded. The alarm/trip setpoints of the applicable channels shall be determined in accordance with the methodology and parameters in Section II 2.2.

APPLICABILITY: As shown in Table I3.3-1.

ACTION:

a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoints less conservative than required by Section II 2.2, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel or declare the channel inoperable.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table I3.3-1. Restore the inoperable instrumentation to OPERABLE status within the time specified in the ACTION or explain in the next Annual Radioactive Effluent Release Report why this inoperability was not corrected within the time specified.

SURVEILLANCE REQUIREMENTS

3.3.1-1 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION AND CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table I3.3-2.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

TABLE I3.3-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

	INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	ACTION
1.	SOUTH STACK EFFLUENT MONITORING SYSTEM			
	a. Noble Gas Activity Monitor	1	*	111
	b. Iodine Sampler	1	*	112
	c. Particulate Sampler	1	*	112
	d. Effluent System Flow Rate Monitor	1	*	113
	e. Sampler Flow Rate Monitor	1	*	113
2.	NORTH STACK EFFLUENT MONITORING SYSTEM +			
	a. Noble Gas Activity Monitor	1	*	114
	b. Iodine Sampler	1	*	112
	c. Particulate Sampler	1	*	112
	d. Effluent System Flow Rate Monitor	1	*	113
	e. Sampler Flow Rate Monitor	1	*	113
3.	HOT MAINTENANCE SHOP VENTILATION EXHAUST RADIATION MONITOR++			
	a. Iodine Sampler	1	**	115
	b. Particulate Sampler	1	**	115
	c. Effluent System Flow Rate Monitor	1	**	113
	d. Sampler Flow Rate Monitor	1	**	113

\+ The (A or B) North Stack Normal Range Radiation Monitors OR the Wide Range Accident Monitor (Low Range) may be used to satisfy requirements for the North Stack Effluent Monitoring System.

++ Particulate filter and Iodine cartridge replacement does not effect the operability of the system.

* At all times.

** During operation of the hot maintenance shop ventilation system.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

TABLE I3.3-1(Continued)

TABLE NOTATIONS

ACTION STATEMENTS

ACTION 111 - (SS Noble Gas)	With less than the minimum Required Channels OPERABLE, effluent releases via this pathway may continue for up to 30 days provided grab samples are taken at least once per 8 hours and these samples are analyzed for radioactivity by gamma isotopic analysis within 24 hours.
ACTION 112 - (NS and SS Iodine & Part.)	With less than the minimum Required Channels OPERABLE, effluent releases via this pathway may continue for up to 30 days provided samples are continuously collected with auxiliary sampling equipment as required in Table I3.3-3. **IF** the Sample Pump is operable, a particulate and iodine sample can be obtained; **AND** the Minimum Channels Operable requirements are satisfied.
ACTION 113 - (Eff. & Smpl. Flow Rate)	With less than the minimum Required Channels OPERABLE, effluent releases via NS, SS or HMS may continue for up to 30 days provided the flow rate is estimated by adding the nominal flow rates indicated in P&ID M-26 for each in-service fan. This shall be documented in the MCR operations Shift Log at least once per 4 hours.
ACTION 114 - (NS Noble Gas)	With less than the minimum Required Channels OPERABLE, effluent releases via this pathway may continue for up to 30 days provided grab samples are taken at least once per 8 hours and these samples are analyzed for radioactivity by gamma isotopic analysis within 24 hours. The Mechanical Vacuum Pumps may not be operated while in this action statement.
ACTION 115 - (HMS)	With less than the minimum Required Channels OPERABLE, then secure Hot Maintenance Shop Ventilation.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

TABLE I3.3-2

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBR.	CHANNEL FUNCT. TEST	MODES IN WHICH SURVEILLANCE IS REQUIRED
1. SOUTH STACK EFFLUENT MONITORING SYSTEM					
a. Noble Gas Activity Monitor	D	M	R(2)	Q(1)	*
b. Iodine Sampler	W(3)	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W(3)	N.A.	N.A.	N.A.	*
d. Effluent System Flow Rate Monitor	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*
2. NORTH STACK EFFLUENT MONITORING SYSTEM #					
a. Noble Gas Activity Monitor	D	M	R(2)	Q(1)	*
b. Iodine Sampler	W(3)	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W(3)	N.A.	N.A.	N.A.	*
d. Effluent System Flow Rate Monitor	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*
3. HOT MAINTENANCE SHOP VENTILATION EXHAUST RADIATION MONITOR					
a. Iodine Sampler	W(3)	N.A.	N.A.	N.A.	**
b. Particulate Sampler	W(3)	N.A.	N.A.	N.A.	**
c. Effluent System Flow Rate Monitor	D	N.A.	R	Q	**
d. Sampler Flow Rate Monitor	D	N.A.	R	Q	**

Wide Range Accident Monitor (WRAM) surveillance is specified in Technical Specification 3.3.7.5.

* At all times.
** During operation of the hot maintenance shop ventilation exhaust system.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

TABLE I3.3-2(Continued)

TABLE NOTATIONS

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:

1. Instruments indicate measured levels above the alarm/trip setpoint.
2. Circuit failure.
3. Instrument indicates a downscale failure.
4. Instrument controls not set in operate mode.

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Testing (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that are traceable to the initial calibration shall be used.

(3) The iodine cartridges and particulate filters will be changed and analyzed at least once per 7 days.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

3.3.2 SITE BOUNDARY DOSE RATE

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at or beyond the SITE BOUNDARY (See Figure I2.2-1a) shall be limited to:

a. For noble gases: less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin, and

b. For iodine-131, iodine-133, tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: less than or equal to 1500 mrem/yr to any organ. (Inhalation pathways only.)

APPLICABILITY: At all times.

ACTION:

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

SURVEILLANCE REQUIREMENTS

3.3.2-1 The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits.

3.3.2-2 The dose rate due to iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents shall be determined to be within the above limits by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table I3.3-3.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

TABLE I3.3-3

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Point	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (uCi/ml)
A. North Stack/ South Stack	Continuous[d]	Q Comp. Part. Sample	Gross Alpha	1E-11
			Sr-89, Sr-90	1E-11
	M[b] Grab Smpl.	M[b]	Noble Gas	1E-4
			H-3	1E-6
	Continuous[d]	W[c]		
		Char. Smpl.	I-131	1E-12
			I-133	1E-10
		Part. Smpl.	Principal Gamma Emitters[e]	1E-11
	Continuous[d]	Continuous Noble Gas Monitor	Noble Gas Beta or Gamma	1E-6 (Based on Xe-133)
B. Hot Mainten. Shop Vent Exhaust[f]	Continuous[d]	Q Comp. Part. Sample	Gross Alpha	1E-11
			Sr-89, Sr-90	1E-11
	Continuous[d]	W		
		Char. Smpl.	I-131	1E-12
			I-133	1E-10
		Part. Smpl.	Principal Gamma Emitters[e]	1E-11
C. Auxiliary Boiler	Prior to batch release for burn.	P Each batch	I-131	1E-6
			Principal Gamma Emitters[e]	5E-7
		Q Composite Sample	Gross Alpha	1E-7
			Sr-89, Sr-90	5E-8
			H-3	1E-5
			Fe-55	1E-6

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

TABLE I3.3-3 (Continued)
TABLE NOTATIONS

a. The LLD is defined, 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. 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 after the fact limit for a particular measurement.

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

$$\text{LLD (Composite)} = \frac{(2.71 + 4.66\sigma_B)\ (\lambda\Delta t_2)}{E \cdot V \cdot 2.22E6 \cdot Y \cdot [\exp(-\lambda\Delta t_1)](1-\exp(-\lambda\Delta t_2))}$$

$$\text{LLD (Grab Samples)} = \frac{(2.71 + 4.66\ \sigma_B)}{E \cdot V \cdot 2.22E6 \cdot Y\ (\exp - \lambda\Delta t_1)}$$

Where:

LLD is the a priori lower limit of detection as defined above (uCi/cc or uCi/ml),

σ_B is the standard deviation of the background counting rate or of the counting rate of blank sample as appropriate (as cpm), shall be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicted variance.

E is the counting efficiency, as counts per disintegration,

V is the sample size, in units of cc or ml,

2.22E6 is the number of dpm/uCi

Y is the fractional radiochemical yield, when applicable,

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

Δt_1 for the plant effluents is the elapsed time between the end of the sample collection and the start of sample count.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

TABLE I3.3-3 (Continued)
TABLE NOTATIONS

Δt_2 for the plant effluents is the elapsed time between the start and the end of sample collection.

b. Sampling and analyses shall also be performed following shutdown, startup, or a THERMAL POWER change exceeding 15% of the RATED THERMAL POWER within a 1-hour period. This requirement does not apply if (1) analysis show that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 3; and (2) the main condenser offgas pre-treatment radioactivity monitor shows that effluent activity has not increased more than a factor of 3.

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

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 Controls I3.3.2, I3.3.3, and I3.3.4.

e. The principal gamma emitters for which the LLD specification applies include the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, Xe-135m and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, I-131, 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 which are identifiable, together with the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report, pursuant to Control I3.6.

f. Required for the hot maintenance shop ventilation exhaust only during operation of the hot maintenance shop ventilation exhaust system.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

3.3.3 DOSE - NOBLE GASES

The air dose due to noble gases released in gaseous effluents, from the site to areas at and beyond the SITE BOUNDARY (See Figure I2.2-1a) 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:

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

SURVEILLANCE REQUIREMENTS

3.3.3-1 Cumulative dose contributions for the current quarter and current calendar year for noble gases shall be determined every 31 days.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

3.3.4 DOSE - IODINE - 133, TRITIUM, AND RADIONUCLIDES IN PARTICULATE FORM

The dose to a MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released from the site to areas at or beyond the SITE BOUNDARY (See Figure I2.2-1a) shall be limited to the following:

a. During any calendar quarter: less than or equal to 15 mrem to any organ and,

b. During any calendar year: less than or equal to 30 mrem to any organ.

APPLICABILITY: At all times.

ACTION:

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

SURVEILLANCE REQUIREMENTS

3.3.4-1 Cumulative dose contributions for the current calendar quarter and current calendar year for iodine-131, iodine-133, tritium and radionuclides in particulate form with half-lives greater than 8 days shall be determined once per 31 days.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

3.3.5 VENTILATION EXHAUST TREATMENT SYSTEM

The VENTILATION EXHAUST TREATMENT SYSTEM shall be IN SERVICE and appropriate portions of the system shall be used to reduce radioactive material in gaseous waste prior to their discharge when the projected doses due to gaseous effluent releases, from the site to areas at and beyond the SITE BOUNDARY (See Figure I2.2-1a) would exceed 0.6 mrem to any organ in a 31-day period.

APPLICABILITY: At all times.

ACTION:

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 Technical Specification 6.9.2, a Special Report which includes the following information:

1. Explanation of why gaseous radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability.

2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and

3. Summary description of action(s) taken to prevent a recurrence.

SURVEILLANCE REQUIREMENTS

3.3.5-1 Doses due to gaseous releases from the site to areas at and beyond the SITE BOUNDARY shall be projected at least once per 31 days.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

3.3.6 VENTING OR PURGING

The VENTING or PURGING of the Mark II containment shall be through the standby gas treatment system.

APPLICABILITY: Whenever the containment is vented or purged.*

ACTION:

With the requirements of the above specification not satisfied, suspend all VENTING and PURGING of the containment.

SURVEILLANCE REQUIREMENTS

3.3.6-1 The containment shall be determined to be aligned for VENTING or PURGING through the standby gas treatment system within 4 hours prior to start of and at least once per 12 hours during VENTING or PURGING of the containment.

3.3.6-2 Prior to use of the purge system through the standby gas treatment system assure that:

a. Both standby gas treatment system trains are OPERABLE whenever the purge system is in use, and

b. Whenever the purge system is in use during OPERATIONAL CONDITION 1 or 2 or 3, only one of the standby gas treatment system trains shall be used to prevent damage to both trains should a LOCA occur (LCO 3.6.5.3 ACTION a applies during this configuration).

* Except after Containment is deinerted and purged while the reactor is in OPCON 4 or 5
OR for the one inch/two inch vent valves to the Reactor Enclosure Equipment Compartment Exhaust Filters when used for containment pressure control and nitrogen make-up operations.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

3.3.7 TOTAL DOSE

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

APPLICABILITY: At all times.

ACTION:

With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding the limits of Controls I3.2.3.a, I3.2.3.b, I3.3.3.a, I3.3.3.b, I3.3.4.a or I3.3.4.b, calculations shall be made including direct radiation contributions from the reactor units and from outside storage tanks to determine whether the above limits of Control I3.3.7 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR 20.2203, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from the 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 concentration of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

SURVEILLANCE REQUIREMENTS

3.3.7-1 Cumulative dose contributions from liquid and gaseous effluents shall be determined.

3.3.7-2 If the cumulative dose contributions exceed the limits defined in Control I3.3.7, cumulative dose contribution from direct radiation from unit operation shall be determined.

3.0 CONTROLS

3.3 GASEOUS EFFLUENTS

3.3.8 DOSE - INCINERATION OF RADIOACTIVE WASTE OIL

Incineration of radioactive waste oil shall be allowed in accordance with the requirements of 10CFR20.2004. The exhaust stack of the affected auxiliary boiler will be a release point for the radioactive effluents. Doses calculated will be based on the radioactive content of the oil prior to incineration. Dose calculated shall meet the limits specified in Controls I3.3.4 and I3.3.5.

APPLICABILITY: At all times

ACTION:

a. With the radioactive content of waste oil not determined as specified in Table I3.3-3, do not incinerate waste oil.

b. With the calculated dose from the incineration of radioactive waste oil exceeding limits specified in Controls I3.3.4 and I3.3.5, do not incinerate waste oil.

SURVEILLANCE REQUIREMENTS:

3.3.8-1 Dose contributions shall be determined for each batch and summed with other gaseous effluents once per 31 days. Cumulative dose contributions for the current calendar quarter and current calendar year shall be determined once per 31 days.

3.3.8-2 Doses due to gaseous releases from the incineration of radioactive waste oil shall be projected at least once per 31 days.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

3.4.1 MONITORING PROGRAM

The monitoring program shall be conducted as specified in Table I3.4-1.

APPLICABILITY: At all times.

ACTION:

a. With the radiological environmental monitoring program not being conducted as specified in Table I3.4-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report per Control I3.5, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeding the reporting levels of Table I3.4-2 when averaged over any calendar quarter, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of Controls I3.2.3, I3.3.3 and I3.3.4. When more than one of the radionuclides in Table I3.4-2 are detected in the sampling medium, this report shall be submitted if:

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

When radionuclides other than those in Table I3.4-2 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 Controls I3.2.3, I3.3.3 and I3.3.4. 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.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

c. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table I3.4-1, identify locations for obtaining replacement samples and add them to the radiological environmental monitoring program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program. Pursuant to Technical Specification 6.14, submit as a part of or concurrent with the Annual Radioactive Effluent Release Report, a complete, legible copy of the entire ODCM, including a revised figure(s) and table for the ODCM reflecting the new location(s).

SURVEILLANCE REQUIREMENTS

3.4.1-1 The radiological environmental monitoring samples shall be collected pursuant to Table I3.4-1 from the specific locations given in the table and figure(s) in the ODCM and shall be analyzed pursuant to the requirements of Table I3.4-1, with the detection capabilities required by the Table I3.4-3.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

TABLE I3.4-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATION[a]	SAMPLING AND COLLECTION FREQ.	TYPE AND FREQUENCY OF ANALYSIS
1. DIRECT RADIATION[b]	40 routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously placed as follows: (1) An inner ring of stations, one in each meteorological sector, in the general area of the SITE BOUNDARY: (2) An outer ring of stations, one in each meteorological sector, in the 3-9 mile range from the site; (3) The balance of the stations placed in special interest areas such as population centers, nearby residences, schools and in 1 or 2 areas to serve as control stations.	At least Quarterly	Gamma dose at least quarterly.

TABLE I3.4-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATION[a]	SAMPLING AND COLLECTION FREQ.	TYPE AND FREQUENCY OF ANALYSIS
2. AIRBORNE Radioiodine and Particulates	Samples from 5 locations: a. 3 samples from close to the 3 SITE BOUNDRY locations (in different sectors) of the highest calculated annual average ground level b. 1 sample from the vicinity community having one of the highest calculated annual ground level 1 sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction.	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading[c].	Radioiodine canisters: I-131 analysis weekly Particulate Sampler: Gross beta radio activity analysis following filter change:[d] Gamma isotopic analysis[e] of composite (by location) at least quarterly

TABLE I3.4-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATION[a]	SAMPLING AND COLLECTION FREQ.	TYPE AND FREQUENCY OF ANALYSIS
3. WATERBORNE			
a. Surface[f]	1 sample upstream 1 sample downstream	Composite sample over 1-month period[g].	Gamma isotopic analysis[e] monthly. Composite for tritium analysis quarterly.
b. Ground	Samples from 1 or 2 sources only if likely to be affected[h]	Quarterly.	Gamma isotopic[e] and tritium analysis
c. Drinking	1 sample of each on 1 to 3 of the nearest water supplies that could be affected by its discharge. 1 sample from a control location	Monthly. (Composite)	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year.[i] Composite for gross beta and gamma isotopic[e] analysis monthly. Composite for tritium analysis quarterly.

TABLE I3.4-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATION[a]	SAMPLING AND COLLECTION FREQ.	TYPE AND FREQUENCY OF ANALYSIS
d. Sediment from shoreline	1 sample from downstream area with existing or potential recreational value.	Semiannually.	Gamma isotopic analysis[e] semiannually.
4. INGESTION a. Milk	Samples from milking animals in 3 locations within 5 km distance having the highest dose potential. If there are none, then 1 sample from milking animals in each of 3 areas between 5 to 8 km distance where dose are calculated to be greater than 1 mrem per year.[1] 1 sample from milking animals at a control location (15-30 km distance) and in the least wind direction.	Semimonthly when animals are on pasture, monthly at other times.	Gamma isotopic[e] and I-131 analysis semimonthly when animals are on pasture (April 1 - Oct. 1): monthly at other times.

TABLE I3.4-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATION[(a)]	SAMPLING AND COLLECTION FREQ.	TYPE AND FREQUENCY OF ANALYSIS
4. INGESTION			
b. Fish and Invertebrates	1 sample of two recreationally important species in vicinity of plant discharge area. 1 sample of same species in area not influenced by plant discharge.	Sample in season, or semiannually if they are not seasonal.	Gamma isotopic[e] analysis on edible portions.
c. Food Products	Samples of 3 different kinds of broad leaf vegetation grown nearest each of 2 different offsite locations of highest predicted annual average ground level D/Q if milk sampling is not performed.	Monthly when available, if milk sampling is not performed.	Gamma isotopic[e] and I-131 analysis.
	1 sample of each of the similar broad leaf vegetation grown 15-30 km distance in the least prevalent wind direction if milk sampling is not performed.	Monthly when available, if milk sampling is not performed.	Gamma isotopic[e] and I-131 analysis.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

TABLE I3.4-1 (Continued)

TABLE NOTATIONS

a. Specific parameters of distance and direction sector from the centerline of the two reactors and additional description where pertinent, shall be provided for each and every sample location in Table I3.4-1 in a table and figure(s) in the ODCM. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to Control I3.5. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program. Pursuant to Technical Specification 6.14, submit as a part of or concurrent with the next Annual Radioactive Effluent Release Report a complete legible copy of the ODCM including 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 purpose 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.

c. Methodology for recovery of radioiodine shall be described in the ODCM.

d. Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater that 10 times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

e. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

f. The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream sample" shall be taken in an area beyond but near the mixing zone.

g. A composite sample is one in which the quantity (aliquot) of liquid sampled is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow. In this program composite sample aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) in order to assure obtaining a representative sample.

h. Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

i. The dose shall be calculated for the maximum organ and age group.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

TABLE I3.4-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Reporting Levels

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE or GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)
H-3	20,000*				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400**				
I-131	2	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200**			300	

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

** Total for parent and daughter.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

TABLE I3.4-3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[a]

Lower limit of Detection (LLD)[b][c]

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE or GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
Gross Beta	4	0.01				
H-3	2,000					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	1[d]	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

TABLE I3.4-3 (Continued)

TABLE NOTATIONS

(a) This list dose not mean that only these nuclides are to considered. Other peaks that are identifiable at 95% confidence level, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating report pursuant to Control I3.5.

(b) Required detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

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

For a particular measurement system (which may include radiochemical separation):

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

Where:

LLD is the a priori lower limit of detection as defined above (as picocuries per unit mass or volume),

σ_B is the standard deviation of the background counting rate or of the counting rate of 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),

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

TABLE I3.4-3 (Continued)
TABLE NOTATIONS

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

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 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, unavoidably 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 Control I3.5.

(d) LLD for drinking water samples.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

3.4.2 LAND USE CENSUS

A land use census shall be conducted and shall identify within a distance of 8 km (5 miles) the location (in each of the 16 meteorological sectors) of the nearest garden* of greater than 50 m^2 (500 ft^2) producing broad leaf or vegetables.

APPLICABILITY: At all times.

ACTION:

a. With a land use census identifying a location(s) which yields a calculation dose or dose commitment greater than the values currently being calculated in Control I3.3.4, identify the new location(s) in the next Annual Radioactive Effluent Release Report, pursuant to Control I3.6.

b. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained in accordance with Control I3.3.4, add the new location(s) to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s) (via the same exposure pathway) may be deleted from this monitoring program after October 31 of the year in which this land use census was conducted. Pursuant to Technical Specification 6.14, submit as a part of or concurrent with in the next Annual Radioactive Effluent Release Report a complete, legible copy of the entire ODCM including a revised figure(s) and table(s) for the ODCM reflecting the new location(s).

SURVEILLANCE REQUIREMENTS

3.4.2-1 The land use census shall be conducted during the growing season at least once per 12 months using that information that will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities. The results of the land use census are included in the Annual Radiological Environmental Operating Report pursuant to Control I3.5.

* Broad leaf vegetation sampling of at least 3 different kinds of vegetation may be performed at the SITE BOUNDARY in each of 2 different direction sectors with the highest predicted D/Qs in lieu of the garden census. Controls for broad leaf vegetation sampling in Table I3.4-1 item 4.c. shall be followed, including analysis of control samples.

3.0 CONTROLS

3.4 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)

3.4.3 INTERLABORATORY COMPARISON PROGRAM

In accordance with LGS Technical Specification 6.8.4.f, analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program traceable to NIST.

APPLICABILITY: At all times.

ACTION:

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 Control I3.5.

SURVEILLANCE REQUIREMENTS

3.4.3-1 The Interlaboratory Comparison Program shall be described in the Section II 5.2. A summary of the results shall be included in the Annual Radiological Environmental Operating Report pursuant to Control I3.5.

3.0 CONTROLS

3.5 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT*

Routine Annual Radiological Environmental Operating Report covering the operation of Unit 1 and Unit 2 during the previous calendar year shall be submitted prior to May 1 for each year. The initial report was submitted prior to May 1 of the year following initial criticality (1984). A single report is submitted for a multiple unit station. The Annual Radiological Environmental Operating Report shall include summaries, interpretations, and an analysis of trends of the results report period, including a comparison (as appropriate), with preoperational studies, operational controls and 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 census required by Control I3.4.2. The Annual Radiological Environmental Operating Report shall include the results of all radiological environmental samples and of all environmental radiation measurements taken during the report period pursuant to the locations specified in the tables and figures in the OFFSITE DOSE CALCULATION MANUAL, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological 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 report shall also include the following: a summary description of the radiological environmental monitoring program and at least two legible maps. One map shall cover stations near the SITE BOUNDARY; a second shall include the more detailed distant stations. Covering all sampling locations keyed to a table giving distances and directions from the centerline of the reactor plant; the results of licensee participation in the Interlaboratory Comparison Program, required by Control I3.4.3 discussion of all deviations from the Sampling Schedule of Table I3.4-1; and discussion of all analyses in which the LLD required by Table I3.4-3 was not achievable.

3.0 CONTROLS

3.6 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

A Routine Annual Radioactive Effluent Release Report covering the operation of Unit 1 and Unit 2 during the previous year shall be submitted in accordance with Tech Spec section 6.9.1.8. The period of the first report shall begin with the date of initial criticality. A single unit submittal is made for the 2 unit station. The submittal combines those sections that are common to all units at the station. The Annual Radioactive Effluent Release Report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the facility as outlined in Regulatory Guide 1.21, "Measuring, Evaluation, 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 Annual Radioactive Effluent Release Report 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 and atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, atmospheric stability. The licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request. This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from both units during the previous calendar year. This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBER OF THE PUBLIC due to their activities inside the SITE BOUNDARY (Figures I2.2-1a and I2.2-1b) during the report period. All assumptions used in making these assessments shall be included in these reports. The assessment of radiation doses shall be performed in accordance with the methodology and parameters of the OFFSITE DOSE CALCULATION MANUAL (ODCM).

The Annual Radioactive Effluent Release Report shall also include an assessment of radiation doses to the hypothetically highest 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. Dose contribution from liquid and gaseous effluents is calculated based on Regulatory Guide 1.109, Rev 1, October 1977.

3.0 CONTROLS

3.6 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

The Annual Radioactive Effluent Release Reports includes the following information for each type of solid waste (as defined in 10 CFR Part 61) shipped offsite during the report period:

1. Total volume, activity and estimated total % error for each waste type:
   a. Spent resins filter sludges, evaporator bottoms, etc.
   b. Dry compressible waste, contaminated equipment, etc.
   c. Irradiated components, control rods, etc.
   d. Others (describe).

2. Activity and percentage of each principle radionuclide (>1%), for each individual waste type as defined in 1. (a-d) above.

3. The disposition of solid waste shipments (identify the number of shipments, the mode of transport, and the destination).

4. The disposition of irradiated fuel shipments (identify the number of shipments, the mode of transport, and the destination.

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

Changes made during the reporting period to procedure RW-C-100 (formerly the PROCESS CONTROL PROGRAM) and to the ODCM, as well as a listing of new locations for dose calculations and/or environmental monitoring identified by the land use census pursuant to Control I3.4.2. shall be submitted in the form of a complete, legible copy of the entire ODCM as part of or concurrent with the Annual Radiological Effluent Release Report for the period of the report in which any change to the ODCM was made.

The Annual Radioactive Effluent Release Reports includes an explanation as to why the inoperability of liquid or gaseous effluent monitoring instrumentation was not corrected within the time specified in Controls I3.2.1 or I3.3.1, respectively; and description of the events leading to liquid holdup tanks or gas storage tanks exceeding the Control limits.

3.0 CONTROLS

3.7 MAJOR CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS

Licensee-initiated major changes to the radioactive waste systems (liquid, gaseous, and solid):

a. Shall be reported to the Commission in the Annual Radioactive Effluent Release Report for the period in which the change was made effective. The discussion of each change shall contain:

   1. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR 50.59;

   2. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

   3. A detailed description of the equipment, components, and processes involved and the interface with other plant systems;

   4. An evaluation of the change which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto;

   5. An evaluation of the change which shows the expected maximum exposures to individual in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

   6. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid waste, to the actual releases for the period prior to when the changes are to be made;

   7. An estimate of the exposure to plant operating personnel as a result of the change; and

   8. Documentation of the fact that the change was reviewed and found acceptable by the PORC.

b. Shall be reviewed and accepted by the PORC prior to implementation.

PART II

CALCULATION METHODOLOGIES

1.0 LIQUID EFFLUENTS

1.1 RADIATION MONITORING INSTRUMENTATION AND CONTROLS

The liquid effluent monitoring instrumentation and controls at Limerick for controlling and monitoring normal radioactive material releases in accordance with the Limerick Technical Specifications are summarized as follows:

1) Liquid Radwaste System: The liquid radwaste discharge monitor (RISH63-0K604) provides an alarm and automatic termination of radioactive material releases from the liquid radwaste system as required by Technical Specification 6.8.4.d. Additional design features of the liquid radwaste system which prevent inadvertent releases to the environment include 1) redundant discharge valves, 2) single discharge line with loop seal and siphon breaker to eliminate probability of inadvertent discharges, 3) Low Cooling Tower Blowdown flow interlock which isolates the radwaste discharge line.

2) Service Water System: The Service Water discharge monitor (RISH10-1K605 AND RISH10-2K605) provides an alarm upon indication of activity in the service water system as required by Technical Specification 6.8.4.d. While the service water system is not a normal release pathway, the monitor provides an indication of potential problems due to excessive leakage of the heat exchangers. In addition, the service water side of the fuel pool heat exchangers is kept at a higher pressure than the shell side to prevent potential radioactive contamination of the service water.

3) RHR Service Water System: The RHR Service Water Radiation (RHRSW) Monitors (RISH12-0K619A, RISH12-0K619B) provide alarm and automatic termination* of radioactive material release from the RHRSW system, as required by Technical Specification 6.8.4.d. While the RHRSW system is not a normal release pathway, the monitors provide indication of potential problems due to excessive leakage of the heat exchangers.

*Termination of the release is accomplished by auto trip of the RHRSW pumps and remote manual closure of isolation valves.

1.2 LIQUID EFFLUENT MONITOR SETPOINT DETERMINATION

Per the requirements of Technical Specification 6.8.4.d.1, alarm setpoints shall be established for the liquid effluent monitoring instrumentation to ensure that the release concentration limits of Specification 6.8.4.d.2 and 6.8.4.d.3 are met. The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2 (pre-1994), for radionuclides other than noble gases and 2.0E-04 µCi/ml for dissolved or entrained noble gases (NUREG 0133).

1.2.1 Radwaste Discharge Monitor and Discharge Flow Rate - RISH63-0K604

The setpoint for the liquid radwaste discharge monitor and flow rate element are determined by the following equations. The radwaste discharge monitor high-high alarm/isolation setpoint is evaluated at least monthly based on isotopes detected in the liquid radwaste sample tanks released during the previous month or on any specific sample tank being released (ΣC_{igamma}), the required minimum cooling tower blowdown rate during discharge (CTBD), and average liquid radwaste discharge flow (RR). The flow rate determination is calculated for each release and the MPC fraction calculated includes, in the concentration mix, the most recent results from 1) the quarterly composite for SR-89, SR-90 and Fe-55, and 2) the monthly composite for H-3, and 3) the sample(s) for dissolved and entrained noble gases.

If the calculated setpoint is less than the existing setpoint, the setpoint will be reduced to the new value. If the calculated setpoint is greater than the existing setpoint, the setpoint may remain at the lower value or be increased to the calculated value.

The actual setpoint may be reduced to a value less than the calculated setpoint at the discretion of supervision.

If there were no sample tanks released or no activity detected during the previous month, then the calculation is performed using release data from the most recent month during which isotopes were detected. In addition, if there were no sample tanks released during the previous month, supervision may substitute more restrictive values (e.g., tritium) based on the plant sampling data.

1.2.1-1 Setpoint Determination - RISH63-0K604

The setpoint for the liquid radwaste discharge monitor is determined by the following equation:

$$CPM_{(LRD)} \leq$$

$$\left[1 - \frac{(S)(RR)[\Sigma(C_{ibeta}) / MPC_{ibeta})]}{(RR + CTBD)}\right]\left[\frac{(\Sigma C_{igamma})(RR + CTBD)}{(S)(E)(RR)[\Sigma C_{igamma} / MPC_{igamma}]}\right] + BKG_{(LRD)} \quad (1-1)$$

where:

$CPM_{(LRD)}$ = Calculated liquid radwaste discharge monitor (RISH63-0K604) count rate attributable to the gamma emitting radionuclide, cpm

ΣC_{igamma} = the sum of the concentration of the identified gamma emitting nuclides (μCi/ml),

CTBD = the required minimum cooling tower blowdown rate during discharge (gpm),

RR = average liquid radwaste discharge flow (gpm),

$BKG_{(LRD)}$ = background count rate of liquid radwaste discharge monitor (CPM),

E = the gross detection efficiency of the liquid radwaste discharge monitor (μCi/ml/cpm), and

S = 2; margin of safety factor to assure that the release is terminated prior to 10 CFR 20 limits being exceeded. Included in this factor are errors associated with monitor uncertainty, sampling uncertainty, flow rate uncertainty, and the contribution of other release paths (Service Water and RHRSW) which are not normally contaminated.

$\Sigma(C_{igamma}/MPC_{igamma})$ = the effective gamma MPC ratio for the mixture of radionuclides in the liquid radwaste discharge line (unitless).

where:

C_{igamma} = the concentration of each identified gamma emitting radionuclide i in the liquid effluent (undiluted) (μCi/ml)

MPC_{igamma} = the MPC value corresponding to radionuclide i from 10 CFR 20 Appendix B, Table II, Column 2 (dissolved and entrained noble gases MPC = 2.0E-4μCi/ml)

$\Sigma(C_{ibeta}/MPC_{ibeta})$ = the effective nongamma MPC ratio for the mixture of radionuclides in the liquid radwaste discharge line (unitless)

where:

C_{ibeta} = the concentration of each identified nongamma radionuclide i in the liquid effluent (undiluted) (μCi/ml)* (See note below)

MPC_{ibeta} = The MPC value corresponding to radionuclide i from 10 CFR 20, Appendix B, Table II, Column 2

* **NOTE**: The concentration mix must include the most recent sample data for H-3, Sr-89, Sr-90, Fe-55 and gross alpha.

1.2.1-2 Flow Rate Determination

The maximum liquid radwaste tank flow rate discharge to the river is determined by the following equation:

$$FLOW_{(LRD)} \leq \frac{CTBD}{S\left[\sum(C_i / MPC_i) - 1\right]} \qquad (1-2)$$

where:

$FLOW_{(LRD)}$ = flow limit for radwaste discharge line (gpm).

CTBD = required minimum cooling tower blowdown flow during discharge (gpm).

S = 2; margin of safety factor to assure that the release does not exceed 10 CFR 20 limits.

$\Sigma(C_i/MPC_i)$ = the effective MPC ratio for the mixture of radionuclides in the liquid radwaste discharge line (unitless) for $\Sigma(C_i/MPC_i)>1$. If $\Sigma(C_i/MPC_i)\leq 1$, then no flow rate determination is necessary.

where:

C_i = the concentration of each identified radionuclide i in the liquid effluent (undiluted) (μCi/ml)* (See note below)

MPC_i = the MPC value corresponding to radionuclide i from 10 CFR 20 Appendix B, Table II, Column 2, (dissolved and entrained noble gases MPC = 2E-4μCi/ml) (μCi/ml).

* **NOTE**: The concentration mix must include the most recent sample data for H-3, Sr-89, Sr-90, Fe-55 and dissolved and entrained noble gases.

1.2.2 Service Water Radiation Monitor - RISH10-1K605, -2K605

The Service Water Radiation Monitor maximum (High-High) setpoint is determined by the following equation. The setpoint is evaluated every 24 months to assure that a high background count rate does not prevent adequate monitor sensitivity in order to meet the requirements of Technical Specifications 6.8.4.d.2 and 6.8.4.d.3.

The high set point shall be administratively controlled to a value that is less than the High-High set point.

1.2.2-1 Setpoint Determination

The maximum setpoint (High-High) for the Service Water Radiation Monitor is determined by the following equation:

$$CPM_{sw} = (S)(MPC_{Cs-137})(CF) \qquad (1\text{-}3)$$

where:

CPM_{sw} = Calculated Maximum Service Water Radiation Monitor (RISH12-1K605, -2K605) count rate, cpm.

MPC_{Cs-137} = MPC limit for Cs-137 2.0E-05 µCi/ml

CF = Monitor calibration factor - in cpm/µCi/ml

S = Safety Factor, 0.5

1.2.3 RHR Service Water Monitor -RISH12-0K619A, -0K619B

The RHR Service Water Radiation Monitor maximum High-High setpoint is determined by the following equation. The setpoint is evaluated every 24 months to assure that a high background count does not prevent adequate monitor sensitivity in order to meet the Technical Specifications 6.8.4.d.2 and 6.8.4.d.3.

The high set point shall be administratively controlled to a value that is less than the High-High set point.

1.2.3-1 Setpoint Determination

The setpoint (High-High) for the RHR Service Water Radiation Monitor is determined by the following equation:

$$CPM_{RHRSW} = (S)(MPC_{Cs-137})(CF) \qquad (1\text{-}4)$$

where:

CPM_{RHRSW} = Calculated maximum RHR Service Water Radiation Monitor (RISH12-0K619A, -0K619B) count rate, cpm.

MPC_{Cs-137} = MPC limit for Cs-137 2.0E-05 µCi/ml

CF = Monitor calibration factor - in cpm/µCi/ml.

S = Safety Factor, 0.5

1.3 Liquid Effluent Dose Calculation - 10 CFR 50

1.3.1 Dose to Members of the Public

Control I3.2.3 limits the dose or dose commitment to MEMBERS OF THE PUBLIC from radioactive materials in liquid effluents from Limerick Generating Station to:

- during any calendar quarter,
  ≤ 3 mrem to total body
  ≤10 mrem to any organ

- during any calendar year.
  ≤ 6 mrem to total body
  ≤20 mrem to any organ.

Per Control I3.2.3-1 the cumulative dose contribution from liquid effluents for the current calendar quarter and calendar year shall be determined at least once per 31 days in accordance with the following calculation methods. The monthly results are accumulated to give the quarterly doses and the quarterly results are accumulated to give the annual doses.

Receptor Location	Dist. (mi)	Pathways		
		Potable Water	Fish	Shoreline
LGS Outfall	0		X	X
Citizen's Utility	2.5	X	X	X
Phoenixville Water	9.0	X	X	X
Phil. Sub. Water	13.6	X		X
Crew Course	37.8			X

1.3.1-1 Potable Water Pathway

$$R_{apj} = 1100 \frac{U_{ap}}{M_p F} \sum_i Q_i D_{aipj} \exp(-\lambda_i t_p) \qquad (1-5)$$

1.3.1-2 Fish (Aquatic Food) Pathway

$$R_{apj} = 1100 \frac{U_{ap}}{M_p F} \sum_i Q_i B_{ip} D_{aipj} \exp(-\lambda_i t_p) \qquad (1-6)$$

1.3.1-3 Shoreline Deposition Pathway

$$R_{apj} = 110{,}000 \frac{U_{ap} W}{M_p F} \sum_i Q_i T_i D_{aipj} \exp(-\lambda_i t_p)\left[1-\exp(-\lambda_i t_b)\right] \qquad (1-7)$$

where:

B_{ip} = equilibrium bioaccumulation factor for nuclide I in pathway p, expressed as the ratio of the concentration in biota, in pCi/kg, to the radionuclide concentration in water, in pCi/liter (liters/kg)

BIOACCUMULATION FACTORS FOR FRESHWATER FISH (pCi/kg per pCi/liter)

ELEMENT	B_{ip}	ELEMENT	B_{ip}
H	9.0E-1	Nb	3.0E 4
C	4.6E 3	Mo	1.0E 1
Na	1.0E 2	Tc	1.5E 1
P	3.0E 3*	Ru	1.0E 1
Cr	2.0E 2	Rh	1.0E 1
Mn	4.0E 2	Te	4.0E 2
Fe	1.0E 2	I	1.5E 1
Co	5.0E 1	Cs	2.0E 3
Ni	1.0E 2	Ba	4.0E 0
Cu	5.0E 1	La	2.5E 1
Zn	2.0E 3	Ce	1.0E 0
Br	4.2E 2	Pr	2.5E 1
Rb	2.0E 3	Nd	2.5E 1
Sr	3.0E 1	W	1.2E 3
Y	2.5E 1	Np	1.0E 1

Ref: 1) U.S.N.R.C. Reg. Guide 1.109, Rev. 1, Table A-1

2)* Letter LTR 881209L001, from R.J. Clark, U.S.N.R.C., to G.A. Hunger, Philadelphia Electric Co., December 9, 1988, transmitting evaluation of Limerick ODCM.

D_{aipj} = dose factor specific to a given age group a, radionuclide i, pathway p, and organ j which can be used to calculate radiation dose (1) from an intake of a radionuclide, in mrem/pCi, or (2) from exposure to a given concentration of a radionuclide in sediment, in mrem/hr per pCi/m^2. Values are listed in Table II1-1 and Table II1-2.

F = flow rate of liquid effluent from site, cfs.

M_p = dilution factor at point of exposure or at point of withdrawal of drinking water (dimensionless). Values are graphically listed by receptor location in Figures II 1.3.1-1 to II 1.3.1-5. Value will be based on average monthly river flow. M_p appears in the equation denominator because river flow graphs display M_p as dilution flow and not the mixing ratio.

Q_i = total release of nuclide 'i' for time period (Ci).

R_{apj} = total dose for calculation time period to organ j of individuals of age group a from all nuclides i in pathway b (mrem).

T_i = radioactive half-life of nuclide i (days).

U_{ap} = usage factor specifying exposure time or intake rate for an individual of age group a associated with pathway p (hr/yr, liters/yr, or kg/yr) as indicated in the table below.

Pathway	Infant	Child	Teen	Adult
Fish (kg/yr)	--	6.9[a]	16[a]	21[a]
Potable Water (1/yr)	330[a]	510[a]	510[a]	730[a]
Shoreline Recreation (hr/yr)	--	90[b]	600[b]	600[b]

Ref: [a] Regulatory Guide 1.109, Rev 1, Table E-5
[b] EROL Table 5.2.A-3

W = shoreline width factor (dimensionless) = 0.2. Ref: Regulatory Guide 1.109, Rev. 1.

t_b = time period during which sediment is exposed to contaminated water (1.752E+5 hrs) (midpoint of plant life = 20 yrs)

λ_i = radioactive decay constant of nuclide 'i' (hr^{-1})

t_p = 12 hours for delay time for water pathway in hours to allow for nuclide decay during transport through the water purification plant and the water distribution system, Ref: Regulatory Guide 1.109, Rev. 1, App. A.

t_p = 24 hours for delay time for fish pathway to allow for nuclide decay during transport through the food chain, as well as during food preparation. Ref: Regulatory Guide 1.109, Rev. 1, App. A.

t_p = 0 hours for delay time for shoreline pathway. Zero hours are assumed as shoreline activities can occur at the outfall.

1100 = factor to convert from Ci/yr per ft^3/sec to pCi liter.

110,000 = factor to convert from Ci/yr per ft^3/sec to pCi/liter and to account for proportionately constant (100) used in sediment radioactivity model.

1.4 Liquid Effluent Dose Projections

Control I3.2.4 requires that the liquid radwaste treatment system shall be operable and appropriate portions of the systems used to reduce the radioactive materials in liquid waste prior to their discharge when the projected doses due to the liquid effluent to UNRESTRICTED AREAS would exceed:

0.12 mrem/31 days to the total body

or

0.4 mrem/31 days to any organ.

Dose projections are made at least once per 31-days by the following equations:

D_{tbp} = (D_{tb}/d) * 31 days (1-8)

D_{maxp} = (D_{max}/d) * 31 days (1-9)

where:

D_{tbp} = the total body dose projection for the current 31-day period (mrem).

D_{tb} = the total body dose to date for the current calendar quarter as determined by equation 1-5, 1-6, and 1-7 (mrem).

D_{maxp} = the maximum organ dose projection for the current 31-day period (mrem).

D_{max} = the maximum organ dose to date for the current calendar quarter as determined by equations 1-5, 1-6, and 1-7 (mrem).

d = the actual number of days in the current calendar quarter at the end of the release (days).

31 days = the number of days of concern

2.0 GASEOUS EFFLUENTS

2.1 Radiation Monitoring Instrumentation and Controls

The gaseous effluent monitoring instrumentation and controls at Limerick for controlling and monitoring radioactive material releases in accordance with the ODCM Part 1 are summarized as follows:

1) North Vent (Common): The plant gaseous discharges via this vent are monitored by two Particulate, Iodine and Gas (PIG) monitors (RY26-075A and RY26-075B) in parallel and by the Wide Range Accident Monitor (WRAM) (RY26-076). The PIGS have separate Particulate, Iodine, and Gas sampling and monitoring channels but the Controls require only particulate and iodine sampling and noble gas monitoring. The WRAM has extended range (via three channels) noble gas monitoring and particulate and iodine sampling capability. In addition, the WRAM provides an isolation (Group 6A) of the large Drywell Purge and Vent valves.

2) South Vent (one per unit): The plant gaseous discharges via each South Vent are monitored by two redundant PIG monitors (RY26-285A,B). As is the case of the North Vent, each PIG has separate particulate, iodine, and gas sampling and monitoring channels but the Controls require only particulate and iodine sampling with gas monitoring.

3) Hot Maintenance Shop (Common): Due to the composition of the radioactive materials in the effluent steam (i.e., very low potential for noble gas), this release point is sampled by a particulate and iodine (P&I) monitor (RY26-025). The P&I monitor has a separate particulate and iodine sampling and monitoring channels but Controls require only particulate and iodine sampling.

4) Auxiliary Boilers (Common): Waste oil with some amount of radioactive particulate content may be burned in the site auxiliary boilers, as allowed by 10CFR20.2004. In this case, the exhaust stack of the affected auxiliary boiler will be a release point for radioactive effluents. Doses calculated will be based on the radioactive content of the oil sampled prior to incineration. The radioactive effluent will be summed with other effluents from the site and reported to the commission in the Annual Effluent Radiological Release Report.

2.2 GASEOUS EFFLUENT MONITOR SETPOINT DETERMINATION

Control I3.3.1 requires that an alarm setpoint be established for the noble gas effluent monitoring channels (RY26-075A,B,; RY26-185A,B,; RY26-285A,B,; and RY26-076) to ensure that the release rate of radioactive materials does not exceed the limits of Control I3.3.2.a, which corresponds to a dose rate at the SITE BOUNDARY of 500 mrem/yr to the total body or 3000 mrem/yr to the skin.

Control limits are expressed in terms of dose rate, while the instruments which monitor effluents produce data in units of concentration or release rate. It is therefore necessary to identify the isotopes and calculate the corresponding release rate which will result in the dose rate limit being reached at the site boundary. This calculation is made more complex by the use of multiple release points at LGS.

Calculation Bases

The alarm setpoint calculation is performed monthly and is based on analytical results of grab samples from the appropriate release point. The concentration of each identified radionuclide in the grab samples is determined, and the data is used to perform a setpoint calculation for that nuclide mix and release point.

The highest calculated annual average concentration (χ/Q) for an area at or beyond the site boundary (1.1E-05 sec/m^3, NE sector) is used in the setpoint calculation.

Maximum flow rates through the North and South vents are used in alarm setpoint calculations. This is necessary since flow can vary. By using maximum values, any flow less than the maximum will assure that the monitor will alarm before release rate limits are exceeded.

The fractional contribution of noble gas is calculated for each release point. The fractional contribution to the whole body and skin dose rates due to noble gases for the north stack and south stack vents are calculated by taking the product of this fraction and the limiting release rate. A comparison of the release rate for whole body and skin dose rates due to noble gas release is made to determine if the whole body or skin dose limit will be most restrictive. It is expected that the whole body limit will always be most restrictive, but the comparison is necessary to assure compliance with Control I3.3.2.a. The sum of the contributions from each release point, independently calculated for noble gases, will equal the maximum instantaneous release rate allowed from the site.

2.2.1 North Vent Noble Gas Effluent Monitors - RY26-075A-3, RY26-075B-3, AND RY26-076-2

The North Vent Noble Gas Effluent monitor high-high setpoint is calculated monthly based on the grab sample results performed in accordance with Table I3.3-3. Release point grab samples may not identify any radionuclides. In this situation, use the results of the last grab sample which identified radionuclides or use the default setpoint which is based on expected concentration ratios as reported in the UFSAR. If any calculated alarm setpoint is less than the existing monitor setpoint, the setpoint will be reduced to the new value. If the calculated setpoint value is greater than the existing value, the setpoint may remain at the lower value or be increased to the new value.

2.2.1-1 Setpoint Determination

The High-High setpoint is calculated per equation 2-1 or 2.2. The High-High setpoint for the North Vent Noble Gas Effluent Monitor is set at or below the lesser of the $NVSP(Hi\text{-}Hi)_{NGWB}$ OR $NVSP(Hi\text{-}Hi)_{NGSK}$ value. (per equations 2-1 or 2-2)

The high set point shall be administratively controlled to a value that is less than the High-High set point.

$$NVSP(Hi-Hi)_{NGWB} \leq \frac{[VF_{NVNG}][500][\Sigma C_{iNV}]}{[3.471E9]\Sigma[(C_{iNV})(K_i)]} \qquad (2-1)$$

$$NVSP(Hi-Hi)_{NGSK} \leq \frac{[VF_{NVNG}][3000][\Sigma C_{iNV}]}{[3.471E9]\Sigma[(C_{iNV})(L_i + 1.11M_i)]} \qquad (2-2)$$

where:

$NVSP\ (Hi\text{-}Hi)_{NGSK}$ = North Vent High Setpoint - Noble Gas Skin (µCi/cc).

$NVSP\ (Hi\text{-}Hi)_{NGWB}$ = North Vent High-High Setpoint - Noble Gas Whole Body (μCi/cc).

VF_{NVNG} = Fractional contribution to site boundary noble gas dose rate from the North Vent. (unitless).

500 = Total body dose rate limit (mrem/yr)

3000 = Skin Dose rate limit (mrem/yr)

ΣC_{iNV} = Total noble gas activity from North Vent grab sample (μCi/cc)

3.471E9 = Conversion factor

$$\left[\frac{(pCi)(cc)}{(m^3)(\mu Ci)}\right]$$

$$= (1.1E-5\ \text{sec}/m^3)(1E6\ pCi/\mu Ci)(668{,}450\ cfm)(1/60\ \text{min}/\text{sec})(2.832E4\ cc/ft^3)$$

(2-3)

where:

$1.1E\text{-}5\ sec/m^3$ = highest annual average χ/Q (NE Sector)

1E6 pCi/μCi = units conversion

668,450 cfm = maximum North Vent flow rate for two unit operation

1/60 min/sec = units conversion

$2.832E4\ cc/ft^3$ = units conversion

C_{iNV} = concentration of noble gas nuclide i as determined by radioanalysis of North Vent grab sample (μCi/cc)

K_i = Total body dose conversion factor for noble gas nuclide i (mrem/yr per pCi/m^3, from Table II2-1).

L_i = Beta skin dose conversion factor noble gas nuclide i (mrem/yr per $pCim^3$, from Table II2-1).

M_i = Gamma air dose conversion factor for noble gas nuclide i (mrad/yr per pCi/m^3, From Table II2-1).

1.11 = The average ratio of tissue to air energy absorption coefficients (mrem/mrad) (Ref: Regulatory Guide 1.109, Section 2.0).

2.2.2 South Vent Noble Gas Effluent Monitors -RY26-185A-3, RY26185B-3, RY26-285A-3, AND RY26-285B-3

Each unit's South Vent Noble Gas Effluent monitor High-High setpoint is calculated monthly based on the grab sample results performed in accordance with Table I3.3-3. Release point grab samples may not identify any radionuclides. In this situation, use the results of the last grab sample which identified radionuclide or use the default setpoint which is based on expected concentration ratios as reported in the UFSAR. If any calculated alarm setpoint is less than the existing monitor setpoint, the setpoint will be reduced to the new value. If the calculated setpoint value is greater than the existing value, the setpoint may remain at the lower value, or be increased to the new value.

2.2.2-1 Setpoint determination

The High-High setpoint for the South Vent Noble Gas Effluent Monitor is set at the lesser of the $SVSP(Hi-Hi)_{NGWB}$ and $SVSP(Hi-Hi)_{NGSK}$ value. $SVSP(Hi-Hi)_{NGWB}$ and $SVSP(Hi-Hi)_{NGSK}$ are calculated for each unit's South Vent.

The High-High setpoint is calculated per equation 2-4 or 2-5.

The high set point shall be administratively controlled to a value that is less than the High-High set point.

$$SVSP(Hi-Hi)_{NGWB} \leq \frac{[VF_{SVNG}][500][\Sigma C_{isv}]}{[1.2149E9]\Sigma[(C_{isv})(K_i)]} \qquad (2-4)$$

$$SVSP(Hi-Hi)_{NGSK} \leq \frac{[VF_{SVNG}][3000][\Sigma C_{isv}]}{[1.2149E9]\Sigma[(C_{isv})(L_i + 1.11 M_i)]} \qquad (2-5)$$

where:

$SVSP(Hi\text{-}Hi)_{NGWB}$	=	South Vent High-High Setpoint - Noble Gas Whole Body (μCi/cc)
$SVSP(Hi\text{-}Hi)_{NGSK}$	=	South Vent High-High Setpoint - Noble Gas Skin (μCi/cc)
VF_{SVNG}	=	Fractional contribution to site boundary noble gas dose rate from the Unit's South Vent. (unitless)
500	=	Total body dose rate limit (mrem/yr)
3000	=	Skin dose rate limit (mrem/yr)
ΣC_{isv}	=	Total noble gas activity from each unit South Vent grab sample (μCi/cc).
C_{isv}	=	concentration of noble gas nuclide i determined by radioanalysis of South Vent grab sample (μCi/cc)
K_i	=	Total body dose conversion factor for noble gas nuclide i (mrem/yr per pCi/m^3, from Table II2-1).
L_i	=	Beta skin dose conversion factor noble gas nuclide i (mrem/yr per pCi/m^3, From Table II2-1).
M_i	=	Gamma air dose conversion factor for noble gas nuclide i (mrad/yr per pCi/m^3, From Table II2-1).
1.11	=	The average ratio of tissue to air energy absorption coefficients (mrem/mrad) (Ref: Regulatory Guide 1.109, Section 2.0)
1.2149E9	=	Conversion factor

$$\left[\frac{(pCi)(cc)}{(m^3)(\mu Ci)}\right]$$

$$= (1.1E-5 \text{ sec}/m^3)(1E6pCi/\mu Ci)(234{,}000 \text{ cfm})(1/60 \text{ min/sec})(2.83E+4 \text{ cc}/ft^3) \quad (2-6)$$

where:

1.1E-5 sec/m^3	=	highest annual average χ/Q (NE Sector)
1E6 pCi/μCi	=	units conversion
234,000 cfm	=	maximum South Vent flow rate
1/60 min/sec	=	units conversion
2.832E4 cc/ft^3	=	units conversion

2.2.3 Noble Gas Effluent Fractional Contribution

The three release points will be partitioned such that the sum does not exceed 100 percent of the limit (500 mrem/yr whole body noble gas, 3000 mrem/yr, skin noble gas.) The default fraction will be set at 80 percent for the North Vent, 10 percent for the Unit-1 South Vent and 10 percent for the Unit-2 South Vent.

These percentages can vary should operational concentrations warrant such change. However, the sum of the percentages shall be equal to or less than 100%. The following relationship shall be met:

$$VF_{NVNG} + VF_{1SVNG} + VF_{2SVNG} \leq 1 \qquad (2\text{-}7)$$

where:

VF_{NVNG}	=	fractional contribution to site boundary noble gas total body dose rate from the North Vent (unitless).
VF_{1SVNG}	=	fractional contribution to site boundary noble gas total body dose rate from the Unit 1 South Vent (unitless).
VF_{2SVNG}	=	fractional contribution to site boundary noble gas total body dose rate from the Unit 2 South Vent (unitless).

2.2.4 Noble Gas Effluent Default Setpoint

This methodology may be used when grab sample results from either the North Vent or the South Vent do not identify any radionuclides. This methodology is based on expected release concentration ratios as outlined in Section 11.3 of the Limerick UFSAR.

2.2.4-1 North Vent Noble Gas Monitors (RY26-075A-3 and RY26-075B-3). The default High-High setpoint for the North Vent Noble Gas Effluent Monitor is set at or below the NVSP(Hi-Hi)$_{NGD}$ value.

$$NVSP(Hi-Hi)_{NGD} \leq \frac{[8.00E-1][500][1.31E-6]}{[3.471E9][4.37E-9]} \qquad (2-8)$$

$$NVSP(Hi\text{-}Hi)_{NGD} \leq 3.45E\text{-}5\ \mu Ci/cc$$

where:

NVSP(Hi-Hi)$_{NGD}$ = Default North Vent High-High Setpoint - Noble Gas Whole Body (μCi/cc)

8.00E-1 = Default fractional contribution to site boundary noble gas total body dose rate from the North Vent (unitless)

500 = Total body dose rate limit (mrem/yr)

1.31E-6 = Total noble gas concentration from North Vent (μCi/cc)

Ref: a) Based on UFSAR Table 11.3-1.
b) Based on maximum North Vent flow of 668,450 cfm

3.471E9 = Conversion Factor

$$\left[\frac{(pCi)(cc)}{(m^3)(\mu Ci)}\right]$$

4.37E-9 = Summation of the North Vent concentration of noble gas nuclide i multiplied by the corresponding whole body dose factor.

$$\left[\frac{(\mu Ci)(mrem)(m^3)}{(cc)(yr)(pCi)}\right]$$

Ref: a) Based on UFSAR Table 11.3-1.
b) Based on maximum North Vent flow of 668,450 cfm.
c) Table II2-1.

2.2.4-2 South Vent Noble Gas Monitors (RY26-185A-3, RY26-285A-3, RY26-185B-3, and RY26-285B-3). The default High-High setpoint for each Unit's South Vent Noble Gas Effluent Monitor is set at or below the $SVSP(Hi-Hi)_{NGD}$ value.

$$SVSP(Hi-Hi)_{NGD} \leq \frac{[1.00E-1][500][1.02E-7]}{[1.2149E9][2.71E-10]} \qquad (2-9)$$

$$SVSP(Hi-Hi)_{NGD} \leq 1.54E\text{-}5\ \mu Ci/cc$$

where:

$SVSP(Hi-Hi)_{NGD}$ = Default South Vent Setpoint - Noble Gas (μCI/cc)

1.00E-1 = Default fractional contribution to site boundary noble gas total body dose rate from the South Vent (unitless)

500 = Total body dose rate limit (mrem/yr)

1.02E-7 = Total noble gas concentration from South Vent (μCi/cc)

Ref: a) Based UFSAR Table 11.3-1
b) Based on maximum South Vent flow of 234,000 cfm.

1.2149E9 = Conversion factor

$$\left[\frac{(pCi)(cc)}{(m^3)(\mu Ci)}\right]$$

2.71E-10 = Summation of the South Vent concentration of noble gas nuclide i multiplied by the corresponding whole body dose factor.

$$\left[\frac{(\mu Ci)\ (mrem)\ (m^3)}{(cc)\ (yr)\ (pCi)}\right]$$

Ref: a) Based on UFSAR Table 11.3-1.
b) Based on maximum South Vent flow of 234,000 cfm.
c) Table II2-1.

2.2.5 Wide Range Accident Monitor Noble Gas Effluent Monitor (RIX-26-076-4)

The Wide Range Accident Monitor (WRAM) noble gas total effluent channel displays the North Vent noble gas release rate. This monitor has Main Control Room Annunciation as well as a group 6A isolation function on the primary containment purge and vent valves. The isolation setpoint value of $\leq$2.1 µCi/cc specified in Technical Specification 3.3.2-2 is based on the accident dose limits for containment purge during an accident (Ref: UFSAR Section 1.13). For routine operations the total effluent high and high-high setpoints are based upon the methodology of Sections II 2.2.5-1 and II 2.2.5-2. The setpoint units are in microcuries per second using the two unit maximum North Vent flow rate of 668,450 scfm. The total effluent channel High-High setpoint is set at a value less than or equal to ten times the High setpoint (not to exceed the 2.1 :Ci/cc equivalent using the two-unit maximum North Vent flow rate). These values are always more conservative than the Technical Specification Table 3.3.2-2 required value of $\leq$ 2.1µCi/cc.

If the calculated setpoint value is less than the existing monitor setpoint, the setpoint will be reduced to the new value. If the calculated setpoint is greater than the existing value, the setpoint may remain at the lower value, or be increased to the new value.

2.2.5-1 Routine Operations High Setpoint Determination

For routine operations, the High setpoint for the WRAM Noble Gas Total Effluent Channel is set at or below the lesser of the $NVSP(Hi\text{-}Hi)_{NGWB}$ or $NVSP(Hi\text{-}Hi)_{NGSK}$ value when activity is detected. When no activity is detected, the High setpoint is set at or below the $NVSP(Hi\text{-}Hi)_{NGD}$. This setpoint is calculated to ensure compliance with Control I3.3.2.a.

The setpoint values are converted from µCi/cc to µCi/sec using the maximum two-unit North Vent flow rate:

$$\mathbf{NVSP_{TEWB} = [NVSP(Hi\text{-}Hi)_{NGWB} \text{ or } _{NGD}]\ [3.155E8]} \qquad \mathbf{(2\text{-}10)}$$

$$\mathbf{NVSP_{TESK} = [NVSP(Hi\text{-}Hi)_{NGSK}]\ [3.155E8]} \qquad \mathbf{(2\text{-}11)}$$

where:

$NVSP_{TEWB}$ = WRAM total effluent channel North Vent High Setpoint - Noble Gas Whole Body (µCi/sec).

$NVSP_{TESK}$ = WRAM total effluent channel North Vent High Setpoint - Noble Gas Skin (µCi/sec).

$NVSP(Hi\text{-}Hi)_{NGWB}$ or $_{NGD}$ = North Vent High-High Setpoint - Noble Gas Whole Body (µCi/cc) from equation 2-1 or 2-8.

$NVSP(Hi\text{-}Hi)_{NGSK}$ = North Vent High-High Setpoint - Noble Gas Skin (µCi/cc) from equation 2-2.

3.155E8 = Conversion factor (cc/sec).

$$= \mathbf{(668{,}450\ scfm)(1/60\ min/sec)\ (2.832E4\ cc/ft^3)} \qquad \mathbf{(2\text{-}12)}$$

2.2.5-2 Routine Operations High-High Setpoint Determination

For routine operations, the High-High setpoint for the WRAM Noble Gas total effluent channel is set at or below ten times the lesser of the routine operations $NVSP_{TEWB}$ or $NVSP_{TESK}$ value.

$$\mathbf{NVHP_{TEWB} = [NVSP_{TEWB}]\ [10]} \qquad \mathbf{(2\text{-}13)}$$

$$\mathbf{NVHP_{TESK} = [NVSP_{TESK}]\ [10]} \qquad \mathbf{(2\text{-}14)}$$

where:

$NVHP_{TEWB}$ = WRAM total effluent channel North Vent High-High Setpoint Noble Gas Whole Body (µCi/sec).

$NVHP_{TESK}$ = WRAM total effluent channel North Vent High-High Setpoint Noble Gas Skin (µCi/sec).

$NVSP_{TEWB}$ = WRAM total effluent channel North Vent High Setpoint - Noble Gas Whole Body (µCi/sec) from equation 2-10.

$NVSP_{TESK}$ = WRAM total effluent channel North Vent Setpoint - Noble Gas Skin (µCi/sec) from equation 2-11.

10 = multiplication factor to calculate High-High value (unitless)

2.3 Gaseous Effluent Dose Evaluation

Monthly dose calculations are performed based on limiting sector average annual meteorological dispersion parameters. For the noble gas monthly dose calculation, effluent release data are based on the latest grab sample analysis for radionuclide composition. For the iodine and particulate monthly dose calculations, the effluent release radionuclide composition and release activity are based on weekly continuous samples.

The quarterly dose calculations are a summation of the applicable monthly dose results.

2.3.1 Site Boundary Dose Rate - Noble Gases

Control I3.3.2.a 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 ensure that these release limits are not exceeded.

Simultaneous releases from the North and South Vents are considered in evaluating compliance with the release rate limits of Control I3.3.2.a following any releases exceeding the alarm setpoints. Monitor indications (readings) are averaged over time periods not to exceed 60 minutes.

NOTE: For administrative purposes, more conservative alarm setpoints than those required to meet 10 CFR 20 Dose Rate limits are imposed. However, conditions exceeding these more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding the dose limits of Control I3.3.2.a. Provided actual releases do not result in radiation monitor indications exceeding values based on the dose rate limits of Control I3.3.2.a, no further analysis are required for demonstrating compliance with the limits of Control I3.3.2.a.

In the event of a noble gas effluent release exceeding the setpoint value specified in Sections II 2.2.1 or II 2.2.2, the site boundary dose rate from the release is calculated using the methodology stated below. This methodology is based on worst sector (NE) annual average meteorological dispersion but, if further refinement is required to meet the requirements of Control I3.3.2.a, actual meteorological data from the time period of concern may be used to calculate actual meteorological dispersion.

$$D_{TB} = \chi/Q \ (1E+06) \left[\sum_{i=1}^{n}\left(\dot{Q}_i K_i\right)\right] \qquad (2-15)$$

$$D_{\gamma} = \chi/Q \ (1E+06)\left[\sum_{i=1}^{n} \ (L_i + 1.11 M_i)\dot{Q}_i\right] \qquad (2-16)$$

where:

D_{TB} = Total Body Plume Dose Rate (mrem/yr)

D_{γ} = Skin Plume Dose Rate (mrem/yr)

χ/Q = 1.1E-05 highest annual average relative concentration (NE Sector) (sec/m^3)

$\dot{Q}_I$ = The release rate of noble gas nuclide I from all vent releases averaged over one hour (uCi/sec)

K_i = Total body dose factor for noble gas nuclide i. Values are listed in Table II2-1.

$$\left[\frac{mrem - m^3}{\rho Ci - yr}\right]$$

L_i = Skin dose factor for the beta contribution for noble gas nuclide i. Values are listed in Table II2-1.

$$\left[\frac{mrem - m^3}{\rho Ci - yr}\right]$$

1.11 = the average ratio of tissue to air energy absorption coefficients (mrem/mrad) (Ref: Regulatory Guide 1.109, Section 2.)

M_i = Gamma air dose factor for noble gas nuclide i. Values are listed in Table II2-1.

$$\left[\frac{mrad - m^3}{\rho Ci - yr}\right]$$

1E+06 = Units conversion $\rho Ci/\mu Ci$

2.3.2 Site Boundary Dose Rate - Radioiodine and Particulates

Control I3.3.2.b limits the dose rate to ≤1500 mrem/yr to any organ (inhalation pathways only) for I-131, I-133, Tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents. Compliance with Control I3.3.2.b is determined monthly.

Simultaneous releases from the North and South Vents are considered in evaluating compliance with the release rate limits of Control I3.3.2.b. Release activity is based upon the results of the weekly continuous sample analysis performed in accordance with Table I3.3-3.

$$D_{IH} = \chi/Q_{depl} \sum_{i=1}^{n} R_i \dot{Q}_i \qquad (2-17)$$

where:

D_{IH} = Inhalation dose rate (mrem/yr)

χ/Q_{depl} = 1.0E-05 highest average annual depleted χ/Q (NE Sector) (sec/m^3)

R_i = Dose factor for radionuclides other than noble gases for the inhalation pathway only ($mrem/yr/\mu Ci/m^3$) Values are listed in Table II2-2.

$\dot{Q}_i$ = The release rate of radionuclide i other than noble gases from all vent releases ($\mu Ci/s$).

2.3.3 Noble Gas Air Doses

Control I3.3.3 limits the air dose due to noble gases released in gaseous effluents (from both reactor units) to areas at or beyond the SITE BOUNDARY to:

≤ 10 mrad gamma for any quarter
≤ 20 mrad beta for any quarter
≤ 20 mrad gamma during any calendar year
≤ 40 mrad beta during any calendar year

As required by Control I3.3.3-1 Surveillance Requirement, these doses are calculated at least once per 31 days using the results of the most recent grab samples for isotopic composition performed in accordance with Table I3.3-3. The monthly dose calculation is performed using the most limiting average annual meteorological dispersion values. The quarterly doses are based on the summation of the applicable monthly results. The monthly dose calculations are performed in accordance with the methodology below.

$$D_{\gamma AIR} = (3.17E-8)(1.00E+6)\,\chi \Big/ Q\sum_{i=1}^{n} M_i Q_i \qquad (2-18)$$

$$D_{\beta AIR} = (3.17E-8)(1.00E+6)\,\chi \Big/ Q\sum_{i=1}^{n} N_i Q_i \qquad (2-19)$$

where:

$D_{\gamma AIR}$ = Gamma air dose from noble gas releases in MRAD

$D_{\beta AIR}$ = Beta air dose from noble gas release in MRAD

3.17E-8 = Units conversion [year/sec]

1.00E+6 = Units conversion $\rho Ci/\mu Ci$

χ/Q = 1.1E-05, Highest average annual relative concentration (NE Sector) in sec/m^3

Q_i = The release of noble gas radionuclides, i, from all vents in µCi. Releases shall be cumulative over the period of interest.

M_i = Gamma air dose factor for noble gas nuclide i. Values are listed in Table II2-1.

$$\left[\frac{mrad - m^3}{\rho Ci - yr}\right]$$

N_i = Beta air dose factor for noble gas nuclide i. Values are listed in Table II2-1.

$$\left[\frac{mrad - m^3}{\rho Ci - yr}\right]$$

2.3.4 Radioiodine and Particulate Dose Calculations

Control I3.3.4 limits the dose (from both reactor units) to a MEMBER OF THE PUBLIC from I-131, I-133, Tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at or beyond the SITE BOUNDARY to:

≤ 15 mrem to any organ during any calendar quarter
≤ 30 mrem to any organ during any calendar year

As required by Control I3.3.4-1 Surveillance Requirement, these doses are calculated at least once per 31 days using the results of the weekly continuous sample analysis

performed in accordance with Table I3.3-3. The monthly dose calculation is performed using the most limiting average annual meteorological dispersion values. The quarterly doses are based on the summation of the applicable monthly results. The monthly dose calculations are performed in accordance with the methodology below. Total organ dose is obtained by the summation of the organ dose from each pathway.

2.3.4-1 Ground Pathway

$$D_{GPAR} = (3.17E-08)\ D/Q \sum_{i=1}^{n} R_i Q_i \qquad (2\text{-}20)$$

2.3.4-2 Vegetation, Meat, Cow Milk, and Goat Milk Pathway

$$D_{VPAR} = 3.17E-08 \left[\chi/Q \sum_{i=1}^{2} R_i Q_i + D/Q \sum_{i=3}^{n} R_i Q_i \right] \qquad (2-21)$$

2.3.4-3 Inhalation Pathway

$$D_{IPAR} = 3.17E-08 \left[\chi/Q \sum_{i=1}^{2} R_i Q_i + \chi/Q_{depl} \sum_{i=3}^{n} R_i Q_i \right] \qquad (2-22)$$

where:

D_{GPAR}	=	dose from ground pathway due to release of particulates and iodines (mrem).
D_{VPAR}	=	dose from vegetation, meat, cow milk, and goat milk, pathways due to releases of particulates, iodines, and tritium (mrem).
D_{IPAR}	=	dose from inhalation pathway due to release of particulates, iodines, and tritium (mrem).
3.17E-8	=	units conversion (year/sec).
i=1	=	Tritium, H^3
i=2	=	Carbon 14, C^{14}
i=3 thru n	=	all other isotopes (particulate and iodine)
Q_i	=	the release of nuclide i from all vents in µCi. Releases shall be cumulative over the time period of interest.

R_i = dose factor for organ type, age group, and pathway (for radionuclides other than noble gas); dose factors are calculated based on the methodology given in NUREG-0133. - values of R_i are provided in Table II2-2.

χ/Q = 1.1E-05 highest average annual χ/Q (NE sector) (s/m^3)

χ/Q_{depl} = 1.0E-05 highest average depleted χ/Q (NE sector) (s/m^3)

D/Q = 1.82E-9 highest average annual deposition (ESE Sector) ($1/m^2$)

2.3.5 Incineration of Contaminated Oil

2.3.5.1 Site Boundary Dose Rate

The dose rate (mrem/yr) to any organ (inhalation pathway only) for I-131, I-133, Tritium, and all radionuclides in particulate form with half-lives greater than eight (8) days from the incineration of contaminated oil from the auxiliary boiler shall be calculated in accordance with the methodology below.

The dose rate from radioactive particulate release shall be determined by either of two methods. Method (a), total instantaneous release, assumes that the total activity contained in the contaminated oil is released in the first minute of incineration. Method (b) uses the activity release over the entire time of incineration.

For normal operations, it is assumed that Method (a) will be used, since the total activity from the waste oil is expected to contribute an insignificant dose compared to the annual limits. However, in the event that the dose rate calculated is higher than administrative or regulatory limits, then Method (b) may be used because it uses the actual time of release, which results in a more accurate dose and dose rate calculated.

Since the auxiliary boiler stacks are at approximately the same height as the reactor vents and discharge from the auxiliary boiler will also be heated, the use of the reactor vent dispersion values for the calculations is considered conservative.

a. Instantaneous Release Rate Method

$$\dot{Q}_i = \sum_{i=1}^{n} \frac{(C_{iv})(3785)(Z)}{60} \qquad (2-23)$$

where:

$\dot{Q}_i$ = The release rate of radionuclide, i, in gaseous effluents from the auxiliary stack releases, µCi/s.

C_{iv} = activity concentration measured in oil for nuclide, i, in µCi/ml.

3785 = milliliters per gallon.

Z = gallons of oil consumed.

60 = number of seconds used for release.

b. Constant Release Rate Method

$$\dot{Q}_i = \sum_{i=1}^{n} \frac{(C_{iv})(3785)(Z)}{T} \qquad (2-24)$$

where:

$\dot{Q}_i$ = The release rate of radionuclide, i, in gaseous effluents from the auxiliary stack releases, µCi/s.

C_{iv} = activity concentration measured in oil for nuclide, i, in µCi/ml.

3785 = milliliters per gallon.

Z = gallons of oil consumed.

T = number of seconds used to burn oil for release.

The dose rate (mrem/yr) is calculated using equation 2-17. The dose rate calculated must comply with the limits stated in Control I3.3.2.

2.3.5.2 Radioiodine and Particulate Dose Calculations

The dose to an individual from radioactive materials in particulate form and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluents released to areas at and beyond the SITE BOUNDARY from the incineration of contaminated waste oil from the auxiliary boiler stacks shall be calculated in accordance with the methodology below. Doses calculated are based on the radioactive content of oil sampled prior to incineration.

Total curies released:

$$Q_i = \sum_{i=1}^{n} (C_{iv})(3785)(Z) \qquad (2-25)$$

where:

Q_i = the release of radionuclide i, μCi

C_{iv} = activity concentration measured in oil for nuclide, i, in μCi/ml.

3785 = milliliters per gallon.

Z = gallons of oil consumed.

The dose (mrem) is calculated using equations 2-20, 2-21, and 2-22. The dose calculated must comply with limits stated in Control I3.3.4 and I3.3.5. The doses will be summed with cumulative dose contributions for current month, calendar quarter, and calendar year.

2.3.6 Gaseous Effluent Dose Projection

Control I3.3.5 requires the VENTILATION EXHAUST TREATMENT SYSTEM be used to reduce radioactive material levels prior to discharge when projected doses from both units to areas at and beyond the SITE BOUNDARY would exceed 0.6 mrem to any organ in a 31 day period.

A dose projection is performed at least once per 31-days by the following equation:

$$D_{max\,p} = (D_{max/d}) * 31d \qquad (2-26)$$

where:

Dmaxp = maximum organ dose projection for current 31-day period (mrem)

Dmax = maximum organ dose to date for current calendar quarter as determined by summing the organ dose obtained from equation (2-20)(2-21) and (2-22) (mrem).

d = number of days in current calendar quarter at the end of the release.

31d = the number of days of concern.

3.0 Annual Dose Evaluation

3.1 The assessment of radiation doses for the radiation dose assessment report shall be performed utilizing the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses To Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I", Revision 1, October 1977. Any deviations from the methodology provided in Regulatory Guide 1.109 shall be documented in the radiation dose assessment report.

3.2 The meteorological conditions concurrent with the time of release of radioactive materials (as determined by sampling frequency of measurement) or approximate methods shall be used as input to the dose model.

4.0 Special Dose Analysis

4.1 Total Dose to members of the public

Control I3.3.7-2 requires that the annual dose or dose commitment to any MEMBER OF THE PUBLIC, due to releases of radioactivity and radiation, from the uranium fuel cycle shall be limited to:

$\leq$ 25 mrem whole body or any organ except thyroid
$\leq$ 75 mrem thyroid

Control I3.3.7-2 Surveillance Requirement requires that cumulative dose contributions from direct radiation from operations be evaluated when the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceed the limits of Controls I3.2.3.a, 3.2.3.b, 3.3.3.a, 3.3.3.b, 3.3.4.a, or 3.3.4.b. The direct radiation contribution shall be determined by the methodology described below. This methodology calculates the direct radiation contribution which then must be added to the dose or dose commitment determined in accordance with Sections II1.3.1, II2.3.3, and II2.3.4 to determine total dose from all pathways. This evaluation of direct radiation contribution is in accordance with ANSI/ANS 6.6.1-1979 Section 7. The error using this method is estimated to be approximately 8%. The following evaluation is performed for each receptor of concern.

$$D_{DR1} = D_{TTLD1} - D_{X\ BKG} - D_{1EFFL} \qquad (4\text{-}1)$$

where:

D_{DR1} = cumulative dose contribution from direct radiation at the appropriate receptors (mrem).

NOTE: Due to the statistics of radiation measurements and to the conservative nature of effluent calculations it is plausible the D_{DR1} may yield a negative value. In this situation the value for D_{DR1} shall be reported as zero(0).

D_{TTLD} = total dose at receptor of interest (as evaluated by TLD measurement) (mrem).

NOTE: If there is not a TLD location at the actual receptor location, a more conservative location will be used to evaluate Total Dose.

D_{XBKG} = mean of the background dose as evaluated by TLDs at background sites (mrem).

D_{1EFFL} = effluent contribution to dose (as evaluated in sections 2.3.3 and 2.3.4.1).

4.2 Doses Due to Activities Inside the SITE BOUNDARY

In accordance with Control I3.6, the Annual Radioactive Effluent Release Report shall include an assessment of radiation dose from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY.

There are three locations within the SITE BOUNDARY that are accessible to MEMBERS OF THE PUBLIC for activities unrelated to the operation of Limerick Station. These locations are: 1) the railroad tracks which run along the river within the SITE BOUNDARY; 2) the Limerick Information Center, on Longview Road next to the 500kv substation; and 3) Fricks Lock. Of these three locations, the railroad tracks are the closest to the plant confines. Sectors and distances of these locations are provided below:

Sector	Distance to Location (m)
Railroad Tracks:	
S	300
SSW	225
SW	225
WSW	225
W	225
WNW	345
NW	450
Information Center:	
ESE	884
Fricks Lock:	
WSW	450

Annual doses will be calculated in accordance with Reg. Guide 1.109 and assume an occupancy factor of 0.25. The maximum dose calculated will be reported in the Annual Radioactive Effluent Release Report.

5.0 Radiological Environmental Monitoring Program

5.1 Sampling Program

The operational phase of the Radiological Environmental Monitoring Program (REMP) is conducted in accordance with the requirements of Control I3.4. The objectives of the program are:

- To provide data on measurable levels of radiation and radioactive materials in the site environs.

- To evaluate the relationship between quantities of radioactive materials released from LGS and resultant radiation doses to individuals from principal pathways of exposure.

The sampling requirements (type of samples, collection frequency, and analysis) and sample locations are presented in Appendix B.

5.2 Interlaboratory Comparison Program

Technical Specification 6.8.4.f.3 requires analyses be performed on radioactive material supplied as part of an Interlaboratory Comparison.

Participation in an approved Interlaboratory Comparison Program provides a check on the preciseness of measurements of

radioactive material in environmental samples. A summary of the Interlaboratory Comparison Program results is provided in the Annual Radiological Environmental Operating Report pursuant to Control I3.5.

TABLES

TABLE II1-1
INGESTION INDIVIDUAL DOSE FACTORS (D_{aipj})

For liquid effluents

Units For All Ingestion Pathways are:

mrem/pCi

TABLE II1-1

Liquid Dose Factors
From Table E-11 of Reg. Guide 1.109
Ingestion Dose Factors For Adult:

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3	0.000E+00	1.050E-07	1.050E-07	1.050E-07	1.050E-07	1.050E-07	1.050E-07
C14	2.840E-06	5.680E-07	5.680E-07	5.680E-07	5.680E-07	5.680E-07	5.680E-07
Na24	1.700E-06	1.700E-06	1.700E-06	1.700E-06	1.700E-06	1.700E-06	1.700E-06
P32	1.930E-04	1.200E-05	7.460E-06	0.000E+00	0.000E+00	0.000E+00	2.170E-05
Cr51	0.000E+00	0.000E+00	2.660E-09	1.590E-09	5.860E-10	3.530E-09	6.690E-07
Mn54	0.000E+00	4.570E-06	8.720E-07	0.000E+00	1.360E-06	0.000E+00	1.400E-05
Mn56	0.000E+00	1.150E-07	2.040E-08	0.000E+00	1.460E-07	0.000E+00	3.670E-06
Fe55	2.750E-06	1.900E-06	4.430E-07	0.000E+00	0.000E+00	1.060E-06	1.090E-06
Fe59	4.340E-06	1.020E-05	3.910E-06	0.000E+00	0.000E+00	2.850E-06	3.400E-05
Co58	0.000E+00	7.450E-07	1.670E-06	0.000E+00	0.000E+00	0.000E+00	1.510E-05
Co60	0.000E+00	2.140E-06	4.720E-06	0.000E+00	0.000E+00	0.000E+00	4.020E-05
Ni63	1.300E-04	9.010E-06	4.360E-06	0.000E+00	0.000E+00	0.000E+00	1.880E-06
Ni65	5.280E-07	6.860E-08	3.130E-08	0.000E+00	0.000E+00	0.000E+00	1.740E-06
Cu64	0.000E+00	8.330E-08	3.910E-08	0.000E+00	2.100E-07	0.000E+00	7.100E-06
Zn65	4.840E-06	1.540E-05	6.960E-06	0.000E+00	1.030E-05	0.000E+00	9.700E-06
Zn69	1.030E-08	1.970E-08	1.370E-09	0.000E+00	1.280E-08	0.000E+00	2.960E-09
Br83	0.000E+00	0.000E+00	4.020E-08	0.000E+00	0.000E+00	0.000E+00	5.790E-08
Br84	0.000E+00	0.000E+00	5.210E-08	0.000E+00	0.000E+00	0.000E+00	4.090E-13
Br85	0.000E+00	0.000E+00	2.140E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Rb86	0.000E+00	2.110E-05	9.830E-06	0.000E+00	0.000E+00	0.000E+00	4.160E-06
Rb88	0.000E+00	6.050E-08	3.210E-08	0.000E+00	0.000E+00	0.000E+00	8.360E-19
Rb89	0.000E+00	4.010E-08	2.820E-08	0.000E+00	0.000E+00	0.000E+00	2.330E-21
Sr89	3.080E-04	0.000E+00	8.840E-06	0.000E+00	0.000E+00	0.000E+00	4.940E-05
Sr90	7.580E-03	0.000E+00	1.860E-03	0.000E+00	0.000E+00	0.000E+00	2.190E-04
Sr91	5.670E-06	0.000E+00	2.290E-07	0.000E+00	0.000E+00	0.000E+00	2.700E-05
Sr92	2.150E-06	0.000E+00	9.300E-08	0.000E+00	0.000E+00	0.000E+00	4.260E-05
Y90	9.620E-09	0.000E+00	2.580E-10	0.000E+00	0.000E+00	0.000E+00	1.020E-04
Y91m	9.090E-11	0.000E+00	3.520E-12	0.000E+00	0.000E+00	0.000E+00	2.670E-10
Y91	1.410E-07	0.000E+00	3.770E-09	0.000E+00	0.000E+00	0.000E+00	7.760E-05
Y92	8.450E-10	0.000E+00	2.470E-11	0.000E+00	0.000E+00	0.000E+00	1.480E-05
Y93	2.680E-09	0.000E+00	7.400E-11	0.000E+00	0.000E+00	0.000E+00	8.500E-05
Zr95	3.040E-08	9.750E-09	6.600E-09	0.000E+00	1.530E-08	0.000E+00	3.090E-05
Zr97	1.680E-09	3.390E-10	1.550E-10	0.000E+00	5.120E-10	0.000E+00	1.050E-04
Nb95	6.220E-09	3.460E-09	1.860E-09	0.000E+00	3.420E-09	0.000E+00	2.100E-05
Mo99	0.000E-00	4.310E-06	8.200E-07	0.000E+00	9.760E-06	0.000E+00	9.990E-06
Tc99m	2.470E-10	6.980E-10	8.890E-09	0.000E+00	1.060E-08	3.420E-10	4.130E-07
Tc101	2.540E-10	3.660E-10	3.590E-09	0.000E+00	6.590E-09	1.870E-10	1.100E-21
Ru103	1.850E-07	0.000E+00	7.970E-08	0.000E+00	7.060E-07	0.000E+00	2.160E-05
Ru105	1.540E-08	0.000E+00	6.080E-09	0.000E+00	1.990E-07	0.000E+00	9.420E-06
Ru106	2.750E-06	0.000E+00	3.480E-07	0.000E+00	5.310E-06	0.000E+00	1.780E-04
Ag110m	1.600E-07	1.480E-07	8.790E-08	0.000E+00	2.910E-07	0.000E+00	6.040E-05
Te125m	2.680E-06	9.710E-07	3.590E-07	8.060E-07	1.090E-05	0.000E+00	1.070E-05
Te127m	6.770E-06	2.420E-06	8.250E-07	1.730E-06	2.750E-05	0.000E+00	2.270E-05
Te127	1.100E-07	3.950E-08	2.380E-08	8.150E-08	4.480E-07	0.000E+00	8.680E-06
Te129m	1.150E-05	4.290E-06	1.820E-06	3.950E-06	4.800E-05	0.000E+00	5.790E-05
Te129	3.140E-08	1.180E-08	7.650E-09	2.410E-08	1.320E-07	0.000E+00	2.370E-08

TABLE II1-1 (Continued)

Liquid Dose Factors
From Table E-11 of Reg. Guide 1.109
Ingestion Dose Factors For Adult:

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Te131m	1.730E-06	8.460E-07	7.050E-07	1.340E-06	8.570E-06	0.000E+00	8.400E-05
Te131	1.970E-08	8.230E-09	6.220E-09	1.620E-08	8.630E-08	0.000E+00	2.790E-09
Te132	2.520E-06	1.630E-06	1.530E-06	1.800E-06	1.570E-05	0.000E+00	7.710E-05
I130	7.560E-07	2.230E-06	8.800E-07	1.890E-04	3.480E-06	0.000E+00	1.920E-06
I131	4.160E-06	5.950E-06	3.410E-06	1.950E-03	1.020E-05	0.000E+00	1.570E-06
I132	2.030E-07	5.430E-07	1.900E-07	1.900E-05	8.650E-07	0.000E+00	1.020E-07
I133	1.420E-06	2.470E-06	7.530E-07	3.630E-04	4.310E-06	0.000E+00	2.220E-06
I134	1.060E-07	2.880E-07	1.030E-07	4.990E-06	4.580E-07	0.000E+00	2.510E-10
I135	4.430E-07	1.160E-06	4.280E-07	7.650E-05	1.860E-06	0.000E+00	1.310E-06
Cs134	6.220E-05	1.480E-04	1.210E-04	0.000E+00	4.790E-05	1.590E-05	2.590E-06
Cs136	6.510E-06	2.570E-05	1.850E-05	0.000E+00	1.430E-05	1.960E-06	2.920E-06
Cs137	7.970E-05	1.090E-04	7.140E-05	0.000E+00	3.700E-05	1.230E-05	2.110E-06
Cs138	5.520E-08	1.090E-07	5.400E-08	0.000E+00	8.010E-08	7.910E-09	4.650E-13
Ba139	9.700E-08	6.910E-11	2.840E-09	0.000E+00	6.460E-11	3.920E-11	1.720E-07
Ba140	2.030E-05	2.550E-08	1.330E-06	0.000E+00	8.670E-09	1.460E-08	4.180E-05
Ba141	4.710E-08	3.560E-11	1.590E-09	0.000E+00	3.310E-11	2.020E-11	2.220E-17
Ba142	2.130E-08	2.190E-11	1.340E-09	0.000E+00	1.850E-11	1.240E-11	3.000E-26
La140	2.500E-09	1.260E-09	3.330E-10	0.000E+00	0.000E+00	0.000E+00	9.250E-05
La142	1.280E-10	5.820E-11	1.450E-11	0.000E+00	0.000E+00	0.000E+00	4.250E-07
Ce141	9.360E-09	6.330E-09	7.180E-10	0.000E+00	2.940E-09	0.000E+00	2.420E-05
Ce143	1.650E-09	1.220E-06	1.350E-10	0.000E+00	5.370E-10	0.000E+00	4.560E-05
Ce144	4.880E-07	2.040E-07	2.620E-08	0.000E+00	1.210E-07	0.000E+00	1.650E-04
Pr143	9.200E-09	3.690E-09	4.560E-10	0.000E+00	2.130E-09	0.000E+00	4.030E-05
Pr144	3.010E-11	1.250E-11	1.530E-12	0.000E+00	7.050E-12	0.000E+00	4.330E-18
Nd147	6.290E-09	7.270E-09	4.350E-10	0.000E+00	4.250E-09	0.000E+00	3.490E-05
W187	1.030E-07	8.610E-08	3.010E-08	0.000E+00	0.000E+00	0.000E+00	2.820E-05
Np239	1.190E-09	1.170E-10	6.450E-11	0.000E+00	3.650E-10	0.000E+00	2.400E-05

TABLE II1-1 (Continued)

Liquid Dose Factors
From Table E-12 of Reg. Guide 1.109
Ingestion Dose Factors For Teen:

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3	0.000E+00	1.060E-07	1.060E-07	1.060E-07	1.060E-07	1.060E-07	1.060E-07
C14	4.060E-06	8.120E-07	8.120E-07	8.120E-07	8.120E-07	8.120E-07	8.120E-07
Na24	2.300E-06	2.300E-06	2.300E-06	2.300E-06	2.300E-06	2.300E-06	2.300E-06
P32	2.760E-04	1.710E-05	1.070E-05	0.000E+00	0.000E+00	0.000E+00	2.320E-05
Cr51	0.000E+00	0.000E+00	3.600E-09	2.000E-09	7.890E-10	5.140E-09	6.050E-07
Mn54	0.000E+00	5.900E-06	1.170E-06	0.000E+00	1.760E-06	0.000E+00	1.210E-05
Mn56	0.000E+00	1.580E-07	2.810E-08	0.000E+00	2.000E-07	0.000E+00	1.040E-05
Fe55	3.780E-06	2.680E-06	6.250E-07	0.000E+00	0.000E+00	1.700E-06	1.160E-06
Fe59	5.870E-06	1.370E-05	5.290E-06	0.000E+00	0.000E+00	4.320E-06	3.240E-05
Co58	0.000E+00	9.720E-07	2.240E-06	0.000E+00	0.000E+00	0.000E+00	1.340E-05
Co60	0.000E+00	2.810E-06	6.330E-06	0.000E+00	0.000E+00	0.000E+00	3.660E-05
Ni63	1.770E-04	1.250E-05	6.000E-06	0.000E+00	0.000E+00	0.000E+00	1.990E-06
Ni65	7.490E-07	9.570E-08	4.360E-08	0.000E+00	0.000E+00	0.000E+00	5.190E-06
Cu64	0.000E+00	1.150E-07	5.410E-08	0.000E+00	2.910E-07	0.000E+00	8.920E-06
Zn65	5.760E-06	2.000E-05	9.330E-06	0.000E+00	1.280E-05	0.000E+00	8.470E-06
Zn69	1.470E-08	2.800E-08	1.960E-09	0.000E+00	1.830E-08	0.000E+00	5.160E-08
Br83	0.000E+00	0.000E+00	5.740E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Br84	0.000E+00	0.000E+00	7.220E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Br85	0.000E+00	0.000E+00	3.050E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Rb86	0.000E+00	2.980E-05	1.400E-05	0.000E+00	0.000E+00	0.000E+00	4.410E-06
Rb88	0.000E+00	8.520E-08	4.540E-08	0.000E+00	0.000E+00	0.000E+00	7.300E-15
Rb89	0.000E+00	5.500E-08	3.890E-08	0.000E+00	0.000E+00	0.000E+00	8.430E-17
Sr89	4.400E-04	0.000E+00	1.260E-05	0.000E+00	0.000E+00	0.000E+00	5.240E-05
Sr90	8.300E-03	0.000E+00	2.050E-03	0.000E+00	0.000E+00	0.000E+00	2.330E-04
Sr91	8.070E-06	0.000E+00	3.210E-07	0.000E+00	0.000E+00	0.000E+00	3.660E-05
Sr92	3.050E-06	0.000E+00	1.300E-07	0.000E+00	0.000E+00	0.000E+00	7.770E-05
Y90	1.370E-08	0.000E+00	3.690E-10	0.000E+00	0.000E+00	0.000E+00	1.130E-04
Y91m	1.290E-10	0.000E+00	4.930E-12	0.000E+00	0.000E+00	0.000E+00	6.090E-09
Y91	2.010E-07	0.000E+00	5.390E-09	0.000E+00	0.000E+00	0.000E+00	8.240E-05
Y92	1.210E-09	0.000E+00	3.500E-11	0.000E+00	0.000E+00	0.000E+00	3.320E-05
Y93	3.830E-09	0.000E+00	1.050E-10	0.000E+00	0.000E+00	0.000E+00	1.170E-04
Zr95	4.120E-08	1.300E-08	8.940E-09	0.000E+00	1.910E-08	0.000E+00	3.000E-05
Zr97	2.370E-09	4.690E-10	2.160E-10	0.000E+00	7.110E-10	0.000E+00	1.270E-04
Nb95	8.220E-09	4.560E-09	2.510E-09	0.000E+00	4.420E-09	0.000E+00	1.950E-05
Mo99	0.000E+00	6.030E-06	1.150E-06	0.000E+00	1.380E-05	0.000E+00	1.080E-05
Tc99m	3.320E-10	9.260E-10	1.200E-08	0.000E+00	1.380E-08	5.140E-10	6.080E-07
Tc101	3.600E-10	5.120E-10	5.030E-09	0.000E+00	9.260E-09	3.120E-10	8.750E-17
Ru103	2.550E-07	0.000E+00	1.090E-07	0.000E+00	8.990E-07	0.000E+00	2.130E-05
Ru105	2.180E-08	0.000E+00	8.460E-09	0.000E+00	2.750E-07	0.000E+00	1.760E-05
Ru106	3.920E-06	0.000E+00	4.940E-07	0.000E+00	7.560E-06	0.000E+00	1.880E-04
Ag110m	2.050E-07	1.940E-07	1.180E-07	0.000E+00	3.700E-07	0.000E+00	5.450E-05
Te125m	3.830E-06	1.380E-06	5.120E-07	1.070E-06	0.000E+00	0.000E+00	1.130E-05
Te127m	9.670E-06	3.430E-06	1.150E-06	2.300E-06	3.920E-05	0.000E+00	2.410E-05
Te127	1.580E-07	5.600E-08	3.400E-08	1.090E-07	6.400E-07	0.000E+00	1.220E-05
Te129m	1.630E-05	6.050E-06	2.580E-06	5.260E-06	6.820E-05	0.000E+00	6.120E-05
Te129	4.480E-08	1.670E-08	1.090E-08	3.200E-08	1.880E-07	0.000E+00	2.450E-07
Te131m	2.440E-06	1.170E-06	9.760E-07	1.760E-06	1.220E-05	0.000E+00	9.390E-05

TABLE II1-1 (Continued)

Liquid Dose Factors
From Table E-12 of Reg. Guide 1.109
Ingestion Dose Factors For Teen:

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Te131	2.790E-08	1.150E-08	8.720E-09	2.150E-08	1.220E-07	0.000E+00	2.290E-09
Te132	3.490E-06	2.210E-06	2.080E-06	2.330E-06	2.120E-05	0.000E+00	7.000E-05
I130	1.030E-06	2.980E-06	1.190E-06	2.430E-04	4.590E-06	0.000E+00	2.290E-06
I131	5.850E-06	8.190E-06	4.400E-06	2.390E-03	1.410E-05	0.000E+00	1.620E-06
I132	2.790E-07	7.300E-07	2.620E-07	2.460E-05	1.150E-06	0.000E+00	3.180E-07
I133	2.010E-06	3.410E-06	1.040E-06	4.760E-04	5.980E-06	0.000E+00	2.580E-06
I134	1.460E-07	3.870E-07	1.390E-07	6.450E-06	6.100E-07	0.000E+00	5.100E-09
I135	6.100E-07	1.570E-06	5.820E-07	1.010E-04	2.480E-06	0.000E+00	1.740E-06
Cs134	8.370E-05	1.970E-04	9.140E-05	0.000E+00	6.260E-05	2.390E-05	2.450E-06
Cs136	8.590E-06	3.380E-05	2.270E-05	0.000E+00	1.840E-05	2.900E-06	2.720E-06
Cs137	1.120E-04	1.490E-04	5.190E-05	0.000E+00	5.070E-05	1.970E-05	2.120E-06
Cs138	7.760E-08	1.490E-07	7.450E-08	0.000E+00	1.100E-07	1.280E-08	6.760E-11
Ba139	1.390E-07	9.780E-11	4.050E-09	0.000E+00	9.220E-11	6.740E-11	1.240E-06
Ba140	2.840E-05	3.480E-08	1.830E-06	0.000E+00	1.180E-08	2.340E-08	4.380E-05
Ba141	6.710E-08	5.010E-11	2.240E-09	0.000E+00	4.650E-11	3.430E-11	1.430E-13
Ba142	2.990E-08	2.990E-11	1.840E-09	0.000E+00	2.530E-11	1.990E-11	9.180E-20
La140	3.480E-09	1.710E-09	4.550E-10	0.000E+00	0.000E+00	0.000E+00	9.820E-05
La142	1.790E-10	7.950E-11	1.980E-11	0.000E+00	0.000E+00	0.000E+00	2.420E-06
Ce141	1.330E-08	8.880E-09	1.020E-09	0.000E+00	4.180E-09	0.000E+00	2.540E-05
Ce143	2.350E-09	1.710E-06	1.910E-10	0.000E+00	7.670E-10	0.000E+00	5.140E-05
Ce144	6.960E-07	2.880E-07	3.740E-08	0.000E+00	1.720E-07	0.000E+00	1.750E-04
Pr143	1.310E-08	5.230E-09	6.520E-10	0.000E+00	3.040E-09	0.000E+00	4.310E-05
Pr144	4.300E-11	1.760E-11	2.180E-12	0.000E+00	1.010E-11	0.000E+00	4.740E-14
Nd147	9.380E-09	1.020E-08	6.110E-10	0.000E+00	5.990E-09	0.000E+00	3.680E-05
W187	1.460E-07	1.190E-07	4.170E-08	0.000E+00	0.000E+00	0.000E+00	3.220E-05
Np239	1.760E-09	1.660E-10	9.220E-11	0.000E+00	5.210E-10	0.000E+00	2.670E-05

TABLE II1-1 (Continued)

Liquid Dose Factors
From Table E-13 of Reg. Guide 1.109
Ingestion Dose Factors For Child:

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3	0.000E+00	2.030E-07	2.030E-07	2.030E-07	2.030E-07	2.030E-07	2.030E-07
C14	1.210E-05	2.420E-06	2.420E-06	2.420E-06	2.420E-06	2.420E-06	2.420E-06
Na24	5.800E-06	5.800E-06	5.800E-06	5.800E-06	5.800E-06	5.800E-06	5.800E-06
P32	8.250E-04	3.860E-05	3.180E-05	0.000E+00	0.000E+00	0.000E+00	2.280E-05
Cr51	0.000E+00	0.000E+00	8.900E-09	4.940E-09	1.350E-09	9.020E-09	4.720E-07
Mn54	0.000E+00	1.070E-05	2.850E-06	0.000E+00	3.000E-06	0.000E+00	8.980E-06
Mn56	0.000E+00	3.340E-07	7.540E-08	0.000E+00	4.040E-07	0.000E+00	4.840E-05
Fe55	1.150E-05	6.100E-06	1.890E-06	0.000E+00	0.000E+00	3.450E-06	1.130E-06
Fe59	1.650E-05	2.670E-05	1.330E-05	0.000E+00	0.000E+00	7.740E-06	2.780E-05
Co58	0.000E+00	1.800E-06	5.510E-06	0.000E+00	0.000E+00	0.000E+00	1.050E-05
Co60	0.000E+00	5.290E-06	1.560E-05	0.000E+00	0.000E+00	0.000E+00	2.930E-05
Ni63	5.380E-04	2.880E-05	1.830E-05	0.000E+00	0.000E+00	0.000E+00	1.940E-06
Ni65	2.220E-06	2.090E-07	1.220E-07	0.000E+00	0.000E+00	0.000E+00	2.560E-05
Cu64	0.000E+00	2.450E-07	1.480E-07	0.000E+00	5.920E-07	0.000E+00	1.150E-05
Zn65	1.370E-05	3.650E-05	2.270E-05	0.000E+00	2.300E-05	0.000E+00	6.410E-06
Zn69	4.380E-08	6.330E-08	5.850E-09	0.000E+00	3.840E-08	0.000E+00	3.990E-06
Br83	0.000E+00	0.000E+00	1.710E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Br84	0.000E+00	0.000E+00	1.980E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Br85	0.000E+00	0.000E+00	9.120E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Rb86	0.000E+00	6.700E-05	4.120E-05	0.000E+00	0.000E+00	0.000E+00	4.310E-06
Rb88	0.000E+00	1.900E-07	1.320E-07	0.000E+00	0.000E+00	0.000E+00	9.320E-09
Rb89	0.000E+00	1.170E-07	1.040E-07	0.000E+00	0.000E+00	0.000E+00	1.020E-09
Sr89	1.320E-03	0.000E+00	3.770E-05	0.000E+00	0.000E+00	0.000E+00	5.110E-05
Sr90	1.700E-02	0.000E+00	4.310E-03	0.000E+00	0.000E+00	0.000E+00	2.290E-04
Sr91	2.400E-05	0.000E+00	9.060E-07	0.000E+00	0.000E+00	0.000E+00	5.300E-05
Sr92	9.030E-06	0.000E+00	3.620E-07	0.000E+00	0.000E+00	0.000E+00	1.710E-04
Y90	4.110E-08	0.000E+00	1.100E-09	0.000E+00	0.000E+00	0.000E+00	1.170E-04
Y91m	3.820E-10	0.000E+00	1.390E-11	0.000E+00	0.000E+00	0.000E+00	7.480E-07
Y91	6.020E-07	0.000E+00	1.610E-08	0.000E+00	0.000E+00	0.000E+00	8.020E-05
Y92	3.600E-09	0.000E+00	1.030E-10	0.000E+00	0.000E+00	0.000E+00	1.040E-04
Y93	1.140E-08	0.000E+00	3.130E-10	0.000E+00	0.000E+00	0.000E+00	1.700E-04
Zr95	1.160E-07	2.550E-08	2.270E-08	0.000E+00	3.650E-08	0.000E+00	2.660E-05
Zr97	6.990E-09	1.010E-09	5.960E-10	0.000E+00	1.450E-09	0.000E+00	1.530E-04
Nb95	2.250E-08	8.760E-09	6.260E-09	0.000E+00	8.230E-09	0.000E+00	1.620E-05
Mo99	0.000E+00	1.330E-05	3.290E-06	0.000E+00	2.840E-05	0.000E+00	1.100E-05
Tc99m	9.230E-10	1.810E-09	3.000E-08	0.000E+00	2.630E-08	9.190E-10	1.030E-06
Tc101	1.070E-09	1.120E-09	1.420E-08	0.000E+00	1.910E-08	5.920E-10	3.560E-09
Ru103	7.310E-07	0.000E+00	2.810E-07	0.000E+00	1.840E-06	0.000E+00	1.890E-05
Ru105	6.450E-08	0.000E+00	2.340E-08	0.000E+00	5.670E-07	0.000E+00	4.210E-05
Ru106	1.170E-05	0.000E+00	1.460E-06	0.000E+00	1.580E-05	0.000E+00	1.820E-04
Ag110m	5.390E-07	3.640E-07	2.910E-07	0.000E+00	6.780E-07	0.000E+00	4.330E-05
Te125m	1.140E-05	3.090E-06	1.520E-06	3.200E-06	0.000E+00	0.000E+00	1.100E-05
Te127m	2.890E-05	7.780E-06	3.430E-06	6.910E-06	8.240E-05	0.000E+00	2.340E-05
Te127	4.710E-07	1.270E-07	1.010E-07	3.260E-07	1.340E-06	0.000E+00	1.840E-05
Te129m	4.870E-05	1.360E-05	7.560E-06	1.570E-05	1.430E-04	0.000E+00	5.940E-05
Te129	1.340E-07	3.740E-08	3.180E-08	9.560E-08	3.920E-07	0.000E+00	8.340E-06
Te131m	7.200E-06	2.490E-06	2.650E-06	5.120E-06	2.410E-05	0.000E+00	1.010E-04

TABLE II1-1 (Continued)

Liquid Dose Factors
From Table E-13 of Reg. Guide 1.109
Ingestion Dose Factors For Child:

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Te131	8.300E-08	2.530E-08	2.470E-08	6.350E-08	2.510E-07	0.000E+00	4.360E-07
Te132	1.010E-05	4.470E-06	5.400E-06	6.510E-06	4.150E-05	0.000E+00	4.500E-05
I130	2.920E-06	5.900E-06	3.040E-06	6.500E-04	8.820E-06	0.000E+00	2.760E-06
I131	1.720E-05	1.730E-05	9.830E-06	5.720E-03	2.840E-05	0.000E+00	1.540E-06
I132	8.000E-07	1.470E-06	6.760E-07	6.820E-05	2.250E-06	0.000E+00	1.730E-06
I133	5.920E-06	7.320E-06	2.770E-06	1.360E-03	1.220E-05	0.000E+00	2.950E-06
I134	4.190E-07	7.780E-07	3.580E-07	1.790E-05	1.190E-06	0.000E+00	5.160E-07
I135	1.750E-06	3.150E-06	1.490E-06	2.790E-04	4.830E-06	0.000E+00	2.400E-06
Cs134	2.340E-04	3.840E-04	8.100E-05	0.000E+00	1.190E-04	4.270E-05	2.070E-06
Cs136	2.350E-05	6.460E-05	4.180E-05	0.000E+00	3.440E-05	5.130E-06	2.270E-06
Cs137	3.270E-04	3.130E-04	4.620E-05	0.000E+00	1.020E-04	3.670E-05	1.960E-06
Cs138	2.280E-07	3.170E-07	2.010E-07	0.000E+00	2.230E-07	2.400E-08	1.460E-07
Ba139	4.140E-07	2.210E-10	1.200E-08	0.000E+00	1.930E-10	1.300E-10	2.390E-05
Ba140	8.310E-05	7.280E-08	4.850E-06	0.000E+00	2.370E-08	4.340E-08	4.210E-05
Ba141	2.000E-07	1.120E-10	6.510E-09	0.000E+00	9.690E-11	6.580E-10	1.140E-07
Ba142	8.740E-08	6.290E-11	4.880E-09	0.000E+00	5.090E-11	3.700E-11	1.140E-09
La140	1.010E-08	3.530E-09	1.190E-09	0.000E+00	0.000E+00	0.000E+00	9.840E-05
La142	5.240E-10	1.670E-10	5.230E-11	0.000E+00	0.000E+00	0.000E+00	3.310E-05
Ce141	3.970E-08	1.980E-08	2.940E-09	0.000E+00	8.680E-09	0.000E+00	2.470E-05
Ce143	6.990E-09	3.790E-06	5.490E-10	0.000E+00	1.590E-09	0.000E+00	5.550E-05
Ce144	2.080E-06	6.520E-07	1.110E-07	0.000E+00	3.610E-07	0.000E+00	1.700E-04
Pr143	3.930E-08	1.180E-08	1.950E-09	0.000E+00	6.390E-09	0.000E+00	4.240E-05
Pr144	1.290E-10	3.990E-11	6.490E-12	0.000E+00	2.110E-11	0.000E+00	8.590E-08
Nd147	2.790E-08	2.260E-08	1.750E-09	0.000E+00	1.240E-08	0.000E+00	3.580E-05
W187	4.290E-07	2.540E-07	1.140E-07	0.000E+00	0.000E+00	0.000E+00	3.570E-05
Np239	5.250E-09	3.770E-10	2.650E-10	0.000E+00	1.090E-09	0.000E+00	2.790E-05

TABLE II1-1 (Continued)

Liquid Dose Factors
From Table E-14 of Reg. Guide 1.109
Ingestion Dose Factors For Infant:

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3	0.000E+00	3.080E-07	3.080E-07	3.080E-07	3.080E-07	3.080E-07	3.080E-07
C14	2.370E-05	5.060E-06	5.060E-06	5.060E-06	5.060E-06	5.060E-06	5.060E-06
Na24	1.010E-05	1.010E-05	1.010E-05	1.010E-05	1.010E-05	1.010E-05	1.010E-05
P32	1.700E-03	1.000E-04	6.590E-05	0.000E+00	0.000E+00	0.000E+00	2.300E-05
Cr51	0.000E+00	0.000E+00	1.410E-08	9.200E-09	2.010E-09	1.790E-08	4.110E-07
Mn54	0.000E+00	1.990E-05	4.510E-06	0.000E+00	4.410E-06	0.000E+00	7.310E-06
Mn56	0.000E+00	8.180E-07	1.410E-07	0.000E+00	7.030E-07	0.000E+00	7.430E-05
Fe55	1.390E-05	8.980E-06	2.400E-06	0.000E+00	0.000E+00	4.390E-06	1.140E-06
Fe59	3.080E-05	5.380E-05	2.120E-05	0.000E+00	0.000E+00	1.590E-05	2.570E-05
Co58	0.000E+00	3.600E-06	8.980E-06	0.000E+00	0.000E+00	0.000E+00	8.970E-06
Co60	0.000E+00	1.080E-05	2.550E-05	0.000E+00	0.000E+00	0.000E+00	2.570E-05
Ni63	6.340E-04	3.920E-05	2.200E-05	0.000E+00	0.000E+00	0.000E+00	1.950E-06
Ni65	4.700E-06	5.320E-07	2.420E-07	0.000E+00	0.000E+00	0.000E+00	4.050E-05
Cu64	0.000E+00	6.090E-07	2.820E-07	0.000E+00	1.030E-06	0.000E+00	1.250E-05
Zn65	1.840E-05	6.310E-05	2.910E-05	0.000E+00	3.060E-05	0.000E+00	5.330E-05
Zn69	9.330E-08	1.680E-07	1.250E-08	0.000E+00	6.980E-08	0.000E+00	1.370E-05
Br83	0.000E+00	0.000E+00	3.630E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Br84	0.000E+00	0.000E+00	3.820E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Br85	0.000E+00	0.000E+00	1.940E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Rb86	0.000E+00	1.700E-04	8.400E-05	0.000E+00	0.000E+00	0.000E+00	4.350E-06
Rb88	0.000E+00	4.980E-07	2.730E-07	0.000E+00	0.000E+00	0.000E+00	4.850E-07
Rb89	0.000E+00	2.860E-07	1.970E-07	0.000E+00	0.000E+00	0.000E+00	9.740E-08
Sr89	2.510E-03	0.000E+00	7.200E-05	0.000E+00	0.000E+00	0.000E+00	5.160E-05
Sr90	1.850E-02	0.000E+00	4.710E-03	0.000E+00	0.000E+00	0.000E+00	2.310E-04
Sr91	5.000E-05	0.000E+00	1.810E-06	0.000E+00	0.000E+00	0.000E+00	5.920E-05
Sr92	1.920E-05	0.000E+00	7.130E-07	0.000E+00	0.000E+00	0.000E+00	2.070E-04
Y90	8.690E-08	0.000E+00	2.330E-09	0.000E+00	0.000E+00	0.000E+00	1.200E-04
Y91m	8.100E-10	0.000E+00	2.760E-11	0.000E+00	0.000E+00	0.000E+00	2.700E-06
Y91	1.130E-06	0.000E+00	3.010E-08	0.000E+00	0.000E+00	0.000E+00	8.100E-05
Y92	7.650E-09	0.000E+00	2.150E-10	0.000E+00	0.000E+00	0.000E+00	1.460E-04
Y93	2.430E-08	0.000E+00	6.620E-10	0.000E+00	0.000E+00	0.000E+00	1.920E-04
Zr95	2.060E-07	5.020E-08	3.560E-08	0.000E+00	5.410E-08	0.000E+00	2.500E-05
Zr97	1.480E-08	2.540E-09	1.160E-09	0.000E+00	2.560E-09	0.000E+00	1.620E-04
Nb95	4.200E-08	1.730E-08	1.000E-08	0.000E+00	1.240E-08	0.000E+00	1.460E-05
Mo99	0.000E+00	3.400E-05	6.630E-06	0.000E+00	5.080E-05	0.000E+00	1.120E-05
Tc99m	1.920E-09	3.960E-09	5.100E-08	0.000E+00	4.260E-08	2.070E-09	1.150E-06
Tc101	2.270E-09	2.860E-09	2.830E-08	0.000E+00	3.400E-08	1.560E-09	4.860E-07
Ru103	1.480E-06	0.000E+00	4.950E-07	0.000E+00	3.080E-06	0.000E+00	1.800E-05
Ru105	1.360E-07	0.000E+00	4.580E-08	0.000E+00	1.000E-06	0.000E+00	5.410E-05
Ru106	2.410E-05	0.000E+00	3.010E-06	0.000E+00	2.850E-05	0.000E+00	1.830E-04
Ag110m	9.960E-07	7.270E-07	4.810E-07	0.000E+00	1.040E-06	0.000E+00	3.770E-05
Te125m	2.330E-05	7.790E-06	3.150E-06	7.840E-06	0.000E+00	0.000E+00	1.110E-05
Te127m	5.850E-05	1.940E-05	7.080E-06	1.690E-05	1.440E-04	0.000E+00	2.360E-05
Te127	1.000E-06	3.350E-07	2.150E-07	8.140E-07	2.440E-06	0.000E+00	2.100E-05
Te129m	1.000E-04	3.430E-05	1.540E-05	3.840E-05	2.500E-04	0.000E+00	5.970E-05
Te129	2.840E-07	9.790E-08	6.630E-08	2.380E-07	7.070E-07	0.000E+00	2.270E-05
Te131m	1.520E-05	6.120E-06	5.050E-06	1.240E-05	4.210E-05	0.000E+00	1.030E-04

TABLE II1-1 (Continued)

Liquid Dose Factors
From Table E-14 of Reg. Guide 1.109
Ingestion Dose Factors For Infant:

	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Te131	1.760E-07	6.500E-08	4.940E-08	1.570E-07	4.500E-07	0.000E+00	7.110E-06
Te132	2.080E-05	1.030E-05	9.610E-06	1.520E-05	6.440E-05	0.000E+00	3.810E-05
I130	6.000E-06	1.320E-05	5.300E-06	1.480E-03	1.450E-05	0.000E+00	2.830E-06
I131	3.590E-05	4.230E-05	1.860E-05	1.390E-02	4.940E-05	0.000E+00	1.510E-06
I132	1.660E-06	3.370E-06	1.200E-06	1.580E-04	3.760E-06	0.000E+00	2.730E-06
I133	1.250E-05	1.820E-05	5.330E-06	3.310E-03	2.140E-05	0.000E+00	3.080E-06
I134	8.690E-07	1.780E-06	6.330E-07	4.150E-05	1.990E-06	0.000E+00	1.840E-06
I135	3.640E-06	7.240E-06	2.640E-06	6.490E-04	8.070E-06	0.000E+00	2.620E-06
Cs134	3.770E-04	7.030E-04	7.100E-05	0.000E+00	1.810E-04	7.420E-05	1.910E-06
Cs136	4.590E-05	1.350E-04	5.040E-05	0.000E+00	5.380E-05	1.100E-05	2.050E-06
Cs137	5.220E-04	6.110E-04	4.330E-05	0.000E+00	1.640E-04	6.640E-05	1.910E-06
Cs138	4.810E-07	7.820E-07	3.790E-07	0.000E+00	3.900E-07	6.090E-08	1.250E-06
Ba139	8.810E-07	5.840E-10	2.550E-08	0.000E+00	3.510E-10	3.540E-10	5.580E-05
Ba140	1.710E-04	1.710E-07	8.810E-06	0.000E+00	4.060E-08	1.050E-07	4.200E-05
Ba141	4.250E-07	2.910E-10	1.340E-08	0.000E+00	1.750E-10	1.770E-10	5.190E-06
Ba142	1.840E-07	1.530E-10	9.060E-09	0.000E+00	8.810E-11	9.260E-11	7.590E-07
La140	2.110E-08	8.320E-09	2.140E-09	0.000E+00	0.000E+00	0.000E+00	9.770E-05
La142	1.100E-09	4.040E-10	9.670E-11	0.000E+00	0.000E+00	0.000E+00	6.860E-05
Ce141	7.870E-08	4.800E-08	5.650E-09	0.000E+00	1.480E-08	0.000E+00	2.480E-05
Ce143	1.480E-08	9.820E-06	1.120E-09	0.000E+00	2.860E-09	0.000E+00	5.730E-05
Ce144	2.980E-06	1.220E-06	1.670E-07	0.000E+00	4.930E-07	0.000E+00	1.710E-04
Pr143	8.130E-08	3.040E-08	4.030E-09	0.000E+00	1.130E-08	0.000E+00	4.290E-05
Pr144	2.740E-10	1.060E-10	1.380E-11	0.000E+00	3.840E-11	0.000E+00	4.930E-06
Nd147	5.530E-08	5.680E-08	3.480E-09	0.000E+00	2.190E-08	0.000E+00	3.600E-05
W187	9.030E-07	6.280E-07	2.170E-07	0.000E+00	0.000E+00	0.000E+00	3.690E-05
Np239	1.110E-08	9.930E-10	5.610E-10	0.000E+00	1.980E-09	0.000E+00	2.870E-05

TABLE II1-2
From Table E-6 of Reg. Guide 1.109

DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

Element	Total Body(1)	Skin	Element	Total Body(1)	Skin
H-3	0.0	0.0	Ru-103	3.60E-09	4.20E-09
C-14	0.0	0.0	Ru-105	4.50E-09	5.10E-09
NA-24	2.50E-08	2.90E-08	Ru-106	1.50E-09	1.80E-09
P-32	0.0	0.0	Ag-110M	1.80E-08	2.10E-08
Cr-51	2.20E-10	2.60E-10	Te-125M	3.50E-11	4.80E-11
Mn-54	5.80E-09	6.80E-09	Te-127M	1.10E-12	1.30E-12
Mn-56	1.10E-08	1.30E-08	Te-127	1.00E-11	1.10E-11
Fe-55	0.0	0.0	Te-129M	7.70E-10	9.00E-10
Fe-59	8.00E-09	9.40E-09	Te-129	7.10E-10	8.40E-10
Co-58	7.00E-09	8.20E-09	Te-131M	8.40E-09	9.90E-09
Co-60	1.70E-08	2.00E-08	Te-131	2.20E-09	2.60E-06
Ni-63	0.0	0.0	Te-132	1.70E-09	2.00E-09
Ni-65	3.70E-09	4.30E-09	I-130	1.40E-08	1.70E-08
Cu-64	1.50E-09	1.70E-09	I-131	2.80E-09	3.40E-09
Zn-65	4.00E-09	4.60E-09	I-132	1.70E-08	2.00E-08
Zn-69	0.0	0.0	I-133	3.70E-09	4.50E-09
Br-83	6.40E-11	9.30E-11	I-134	1.60E-08	1.90E-08
Br-84	1.20E-08	1.40E-08	I-135	1.20E-08	1.40E-08
Br-85	0.0	0.0	Cs-134	1.20E-08	1.40E-08
Rb-86	6.30E-10	7.20E-10	Cs-136	1.50E-08	1.70E-08
Rb-88	3.50E-09	4.00E-09	Cs-137	4.20E-09	4.90E-09
Rb-89	1.50E-08	1.80E-08	Cs-138	2.10E-08	2.40E-08
Sr-89	5.60E-13	6.50E-13	Ba-139	2.40E-09	2.70E-09
Sr-91	7.10E-09	8.30E-09	Ba-140	2.10E-09	2.40E-09
Sr-92	9.00E-09	1.00E-08	Ba-141	4.30E-09	4.90E-09
Y-90	2.20E-12	2.60E-12	Ba-142	7.90E-09	9.00E-09
Y-91M	3.80E-09	4.40E-09	La-140	1.50E-08	1.70E-08
Y-91	2.40E-11	2.70E-11	La-142	1.50E-08	1.80E-08
Y-92	1.60E-09	1.90E-09	Ce-141	5.50E-10	6.20E-10
Y-93	5.70E-10	7.80E-10	Ce-143	2.20E-09	2.50E-09
Zr-95	5.00E-09	5.80E-09	Ce-144	3.20E-10	3.70E-10
Zr-97	5.50E-09	6.40E-09	Pr-143	0.0	0.0
Nb-95	5.10E-09	6.00E-09	Pr-144	2.00E-10	2.30E-10
Mo-99	1.90E-09	2.20E-09	Nd-147	1.00E-09	1.20E-09
Tc-99M	9.60E-10	1.10E-09	W-187	3.10E-09	3.60E-09
Tc-101	2.70E-09	3.00E-09	Np-239	9.50E-10	1.10E-09

1) Dose Factors for the other organs (Bone, Liver, Thyroid, Kidney, Lung, GI-LLI) are assumed to be the same as the Total Body Dose Factor (Reference Reg. Guide 1.109, Appendix E, Dose Factor).

TABLE II1-3

Assumptions used in Limerick Liquid
Effluent Dose Evaluation

Symbol	Description	Value	Reference(1)
t_b	Period of buildup of activity in sediment(hr)	1.752E+05	Site Specific
t_p	Envtl transit time for water ingestion (hr)	1.200E+01	A-2(2)
t_p	Envtl transit time for fish ingestion (hr)	2.400E+01	A-3(2)
t_p	Envtl transit time for shore exposure (hr)	0.000E+00	Site Specific
U_{ap}	Water ingestion (1/yr) adult	7.300E+02	E-5
U_{ap}	Water ingestion (1/yr) teen	5.100E+02	E-5
U_{ap}	Water ingestion (1/yr) child	5.100E+02	E-5
U_{ap}	Water ingestion (1/yr) infant	3.300E+02	E-5
U_{ap}	Shore exposure (hr/yr) adult	6.000E+02	Site Specific
U_{ap}	Shore exposure (hr/yr) teen	6.000E+02	Site Specific
U_{ap}	Shore exposure (hr/yr) child	9.000E+01	Site Specific
U_{ap}	Shore exposure (hr/yr) infant	0.000E+00	Site Specific
U_{ap}	Fresh water fish ingestion (kg/yr) adult	2.100E+01	E-5
U_{ap}	Fresh water fish ingestion (kg/yr) teen	1.600E+01	E-5
U_{ap}	Fresh water fish ingestion (kg/yr) child	6.900E+00	E-5
U_{ap}	Fresh water fish ingestion (kg/yr) infant	0.000E+00	E-5
W	Shoreline Width Factor (dimensionless)	2.000E-01	A-2(3)

1) The References refer to tables contained in Regulatory Guide 1.109 unless otherwise specified.

2) Equation A-2 and A-3 from Reg. Guide 1.109, Appendix A.

3) Table A-2 from Reg. Guide 1.109, Appendix A.

TABLE II2-1

Dose Factors for Noble Gas from Table B-1 of Reg. Guide 1.109

Radionuclide	Total Body Dose Factor Ki (mrem/yr per pCi/m^3)	Beta Skin Dose Factor Li (mrem/yr per pCi/m^3)	Gamma Air Dose Factor Mi (mrad/yr per pCi/m^3)	Beta Air Dose Factor Ni (mrad/yr per pCi/m^3)
Ar-41	8.84E-03	2.69E-03	9.30E-03	3.28E-03
Kr-83m	7.56E-08	-------	1.93E-05	2.88E-04
Kr-85m	1.17E-03	1.46E-03	1.23E-03	1.97E-03
Kr-85	1.61E-05	1.34E-03	1.72E-05	1.95E-03
Kr-87	5.92E-03	9.73E-03	6.17E-03	1.03E-02
Kr-88	1.47E-02	2.37E-03	1.52E-02	2.93E-03
Kr-89	1.66E-02	1.01E-02	1.73E-02	1.06E-02
Kr-90	1.56E-02	7.29E-03	1.63E-02	7.83E-03
Xe-131m	9.15E-05	4.76E-04	1.56E-04	1.11E-03
Xe-133m	2.51E-04	9.94E-04	3.27E-04	1.48E-03
Xe-133	2.94E-04	3.06E-04	3.53E-04	1.05E-03
Xe-135m	3.12E-03	7.11E-04	3.36E-03	7.39E-04
Xe-135	1.81E-03	1.86E-03	1.92E-03	2.46E-03
Xe-137	1.42E-03	1.22E-02	1.51E-03	1.27E-02
Xe-138	8.83E-03	4.13E-03	9.21E-03	4.75E-03

TABLE II2-2

INGESTION INDIVIDUAL DOSE FACTORS (R_i)
For Gaseous Effluents

UNITS FOR DEPOSITION PATHWAYS
(Pathway Numbers 1-5) are:

m^2-mrem/yr per μCi/sec

UNITS FOR AIRBORNE PATHWAY
(Pathway Numbers 6) is:

mrem/yr per μCi/m^3

Pathway No.	Pathway
1	Ground
2	Vegetable
3	Meat
4	Cow Milk
5	Goat Milk
6	Inhalation

TABLE II2-2 R_i DOSE FACTORS Age: Adult Pathway: Ground

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	4.652E+06	4.652E+06	4.652E+06	4.652E+06	4.652E+06	4.652E+06	5.498E+06	4.652E+06	5.498E+06
MN-54	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.622E+09	1.384E+09	1.622E+09
FE-59	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	3.202E+08	2.725E+08	3.202E+08
CO-58	3.799E+08	3.799E+08	3.799E+08	3.799E+08	3.799E+08	3.799E+08	4.450E+08	3.799E+08	4.450E+08
CO-60	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.620E+10	2.227E+10	2.620E+10
ZN-65	7.455E+08	7.455E+08	7.455E+08	7.455E+08	7.455E+08	7.455E+08	8.574E+08	7.455E+08	8.574E+08
SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.507E+04	2.160E+04	2.507E+04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZR-95	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.845E+08	2.453E+08	2.845E+08
I-131	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	2.089E+07	1.720E+07	2.089E+07
I-133	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.980E+06	2.450E+06	2.980E+06
CS-134	6.917E+09	6.917E+09	6.917E+09	6.917E+09	6.917E+09	6.917E+09	8.070E+09	6.917E+09	8.070E+09
CS-136	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.709E+08	1.508E+08	1.709E+08
CS-137	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.323E+10	1.134E+10	1.323E+10
BA-140	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.347E+07	2.054E+07	2.347E+07
CE-141	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.539E+07	1.365E+07	1.539E+07
CE-144	6.958E+07	6.958E+07	6.958E+07	6.958E+07	6.958E+07	6.958E+07	8.046E+07	6.958E+07	8.046E+07

TABLE II2-2 R_i Dose Factors Age: Adult Pathway: Vegetable

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	2.077E+03	2.077E+03	2.077E+03	2.077E+03	2.077E+03	0.000E+00	2.077E+03	2.077E+03
C-14	2.092E+08	4.184E+07	4.184E+07	4.184E+07	4.184E+07	4.184E+07	0.000E+00	4.184E+07	2.092E+08
CR-51	0.000E+00	0.000E+00	2.104E+04	7.755E+03	4.671E+04	8.853E+06	0.000E+00	3.520E+04	8.853E+06
MN-54	0.000E+00	2.845E+08	0.000E+00	8.468E+07	0.000E+00	8.717E+08	0.000E+00	5.429E+07	8.717E+08
FE-59	1.049E+08	2.466E+08	0.000E+00	0.000E+00	6.889E+07	8.219E+08	0.000E+00	9.452E+07	8.219E+08
CO-58	0.000E+00	2.679E+07	0.000E+00	0.000E+00	0.000E+00	5.431E+08	0.000E+00	6.006E+07	5.431E+08
CO-60	0.000E+00	1.534E+08	0.000E+00	0.000E+00	0.000E+00	2.881E+09	0.000E+00	3.383E+08	2.881E+09
ZN-65	2.876E+08	9.152E+08	0.000E+00	6.121E+08	0.000E+00	5.765E+08	0.000E+00	4.136E+08	9.152E+08
SR-89	8.413E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.349E+09	0.000E+00	2.415E+08	8.413E+09
SR-90	5.555E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.605E+10	0.000E+00	1.363E+11	5.555E+11
ZR-95	1.017E+06	3.261E+05	0.000E+00	5.117E+05	0.000E+00	1.033E+09	0.000E+00	2.207E+05	1.033E+09
I-131	3.564E+07	5.097E+07	1.671E+10	8.738E+07	0.000E+00	1.345E+07	0.000E+00	2.921E+07	1.671E+10
I-133	8.753E+05	1.522E+06	2.238E+08	2.657E+06	0.000E+00	1.368E+06	0.000E+00	4.641E+05	2.238E+08
CS-134	4.273E+09	1.017E+10	0.000E+00	3.291E+09	1.092E+09	1.779E+08	0.000E+00	8.313E+09	1.017E+10
CS-136	2.326E+07	9.184E+07	0.000E+00	5.110E+07	7.004E+06	1.044E+07	0.000E+00	6.611E+07	9.184E+07
CS-137	5.843E+09	7.991E+09	0.000E+00	2.712E+09	9.017E+08	1.547E+08	0.000E+00	5.234E+09	7.991E+09
BA-140	6.906E+07	8.675E+04	0.000E+00	2.950E+04	4.967E+04	1.422E+08	0.000E+00	4.525E+06	1.422E+08
CE-141	1.555E+05	1.052E+05	0.000E+00	4.885E+04	0.000E+00	4.021E+08	0.000E+00	1.193E+04	4.021E+08
CE-144	2.990E+07	1.250E+07	0.000E+00	7.413E+06	0.000E+00	1.011E+10	0.000E+00	1.605E+06	1.011E+10

TABLE II2-2 R_i Dose Factors Age: Adult Pathway: Meat

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	3.248E+02	3.248E+02	3.248E+02	3.248E+02	3.248E+02	0.000E+00	3.248E+02	3.248E+02
C-14	1.304E+08	2.608E+07	2.608E+07	2.608E+07	2.608E+07	2.608E+07	0.000E+00	2.608E+07	1.304E+08
CR-51	0.000E+00	0.000E+00	1.340E+03	4.938E+02	2.974E+03	5.637E+05	0.000E+00	2.241E+03	5.637E+05
MN-54	0.000E+00	4.546E+06	0.000E+00	1.353E+06	0.000E+00	1.393E+07	0.000E+00	8.674E+05	1.393E+07
FE-59	9.381E+07	2.205E+08	0.000E+00	0.000E+00	6.160E+07	7.349E+08	0.000E+00	8.452E+07	7.349E+08
CO-58	0.000E+00	7.213E+06	0.000E+00	0.000E+00	0.000E+00	1.462E+08	0.000E+00	1.617E+07	1.462E+08
CO-60	0.000E+00	4.002E+07	0.000E+00	0.000E+00	0.000E+00	7.518E+08	0.000E+00	8.827E+07	7.518E+08
ZN-65	1.723E+08	5.481E+08	0.000E+00	3.666E+08	0.000E+00	3.452E+08	0.000E+00	2.477E+08	5.481E+08
SR-89	1.098E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.761E+07	0.000E+00	3.151E+06	1.098E+08
SR-90	6.701E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.936E+08	0.000E+00	1.644E+09	6.701E+09
ZR-95	7.238E+05	2.321E+05	0.000E+00	3.643E+05	0.000E+00	7.357E+08	0.000E+00	1.571E+05	7.357E+08
I-131	3.141E+06	4.492E+06	1.472E+09	7.701E+06	0.000E+00	1.185E+06	0.000E+00	2.575E+06	1.472E+09
I-133	1.062E-01	1.847E-01	2.715E+01	3.223E-01	0.000E+00	1.660E-01	0.000E+00	5.631E-02	2.715E+01
CS-134	3.424E+08	8.147E+08	0.000E+00	2.637E+08	8.752E+07	1.426E+07	0.000E+00	6.660E+08	8.147E+08
CS-136	3.548E+06	1.401E+07	0.000E+00	7.793E+06	1.068E+06	1.591E+06	0.000E+00	1.008E+07	1.401E+07
CS-137	4.698E+08	6.425E+08	0.000E+00	2.181E+08	7.251E+07	1.244E+07	0.000E+00	4.209E+08	6.425E+08
BA-140	8.464E+06	1.063E+04	0.000E+00	3.615E+03	6.088E+03	1.743E+07	0.000E+00	5.546E+05	1.743E+07
CE-141	4.615E+03	3.121E+03	0.000E+00	1.450E+03	0.000E+00	1.193E+07	0.000E+00	3.541E+02	1.193E+07
CE-144	7.163E+05	2.994E+05	0.000E+00	1.776E+05	0.000E+00	2.422E+08	0.000E+00	3.846E+04	2.422E+08

TABLE II2-2 R_i Dose Factors Age: Adult Pathway: Cow Milk

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	7.629E+02	7.629E+02	7.629E+02	7.629E+02	7.629E+02	0.000E+00	7.629E+02	7.629E+02
C-14	1.423E+08	2.845E+07	2.845E+07	2.845E+07	2.845E+07	2.845E+07	0.000E+00	2.845E+07	1.423E+08
CR-51	0.000E+00	0.000E+00	5.436E+03	2.004E+03	1.207E+04	2.287E+06	0.000E+00	9.095E+03	2.287E+06
MN-54	0.000E+00	4.167E+06	0.000E+00	1.240E+06	0.000E+00	1.276E+07	0.000E+00	7.951E+05	1.276E+07
FE-59	1.050E+07	2.467E+07	0.000E+00	0.000E+00	6.893E+06	8.223E+07	0.000E+00	9.457E+06	8.223E+07
CO-58	0.000E+00	1.864E+06	0.000E+00	0.000E+00	0.000E+00	3.779E+07	0.000E+00	4.179E+06	3.779E+07
CO-60	0.000E+00	8.733E+06	0.000E+00	0.000E+00	0.000E+00	1.640E+08	0.000E+00	1.926E+07	1.640E+08
ZN-65	6.642E+08	2.114E+09	0.000E+00	1.414E+09	0.000E+00	1.331E+09	0.000E+00	9.552E+08	2.114E+09
SR-89	5.284E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.476E+07	0.000E+00	1.517E+07	5.284E+08
SR-90	2.521E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.283E+08	0.000E+00	6.186E+09	2.521E+10
ZR-95	3.644E+02	1.169E+02	0.000E+00	1.834E+02	0.000E+00	3.704E+05	0.000E+00	7.912E+01	3.704E+05
I-131	8.662E+07	1.239E+08	4.060E+10	2.124E+08	0.000E+00	3.269E+07	0.000E+00	7.100E+07	4.060E+10
I-133	1.131E+06	1.967E+06	2.891E+08	3.432E+06	0.000E+00	1.768E+06	0.000E+00	5.996E+05	2.891E+08
CS-134	2.943E+09	7.002E+09	0.000E+00	2.266E+09	7.523E+08	1.225E+08	0.000E+00	5.725E+09	7.002E+09
CS-136	7.754E+07	3.061E+08	0.000E+00	1.703E+08	2.334E+07	3.478E+07	0.000E+00	2.203E+08	3.061E+08
CS-137	3.977E+09	5.438E+09	0.000E+00	1.846E+09	6.137E+08	1.053E+08	0.000E+00	3.562E+09	5.438E+09
BA-140	7.915E+06	9.942E+03	0.000E+00	3.380E+03	5.692E+03	1.630E+07	0.000E+00	5.186E+05	1.630E+07
CE-141	1.592E+03	1.077E+03	0.000E+00	5.001E+02	0.000E+00	4.117E+06	0.000E+00	1.221E+02	4.117E+06
CE-144	1.758E+05	7.348E+04	0.000E+00	4.358E+04	0.000E+00	5.943E+07	0.000E+00	9.437E+03	5.943E+07

TABLE II2-2 R_i Dose Factors Age: Adult Pathway: Goat Milk

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	1.155E+02	1.155E+02	1.155E+02	1.155E+02	1.155E+02	0.000E+00	1.155E+02	1.155E+02
C-14	1.056E+07	2.111E+06	2.111E+06	2.111E+06	2.111E+06	2.111E+06	0.000E+00	2.111E+06	1.056E+07
CR-51	0.000E+00	0.000E+00	4.840E+01	1.784E+01	1.075E+02	2.037E+04	0.000E+00	8.097E+01	2.037E+04
MN-54	0.000E+00	3.710E+04	0.000E+00	1.104E+04	0.000E+00	1.136E+05	0.000E+00	7.079E+03	1.136E+05
FE-59	1.012E+04	2.379E+04	0.000E+00	0.000E+00	6.648E+03	7.931E+04	0.000E+00	9.121E+03	7.931E+04
CO-58	0.000E+00	1.660E+04	0.000E+00	0.000E+00	0.000E+00	3.364E+05	0.000E+00	3.721E+04	3.364E+05
CO-60	0.000E+00	7.775E+04	0.000E+00	0.000E+00	0.000E+00	1.461E+06	0.000E+00	1.715E+05	1.461E+06
ZN-65	5.914E+06	1.882E+07	0.000E+00	1.259E+07	0.000E+00	1.185E+07	0.000E+00	8.504E+06	1.882E+07
SR-89	8.233E+07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.321E+07	0.000E+00	2.363E+06	8.233E+07
SR-90	3.928E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.135E+08	0.000E+00	9.638E+08	3.928E+09
ZR-95	3.245E+00	1.041E+00	0.000E+00	1.633E+00	0.000E+00	3.298E+03	0.000E+00	7.044E-01	3.298E+03
I-131	7.712E+06	1.103E+07	3.615E+09	1.891E+07	0.000E+00	2.910E+06	0.000E+00	6.321E+06	3.615E+09
I-133	1.007E+05	1.751E+05	2.574E+07	3.056E+05	0.000E+00	1.574E+05	0.000E+00	5.339E+04	2.574E+07
CS-134	6.550E+08	1.559E+09	0.000E+00	5.044E+08	1.674E+08	2.727E+07	0.000E+00	1.274E+09	1.559E+09
CS-136	1.726E+07	6.813E+07	0.000E+00	3.791E+07	5.196E+06	7.741E+06	0.000E+00	4.905E+07	6.813E+07
CS-137	8.851E+08	1.211E+09	0.000E+00	4.109E+08	1.366E+08	2.343E+07	0.000E+00	7.929E+08	1.211E+09
BA-140	7.047E+04	8.852E+01	0.000E+00	3.010E+01	5.068E+01	1.451E+05	0.000E+00	4.617E+03	1.451E+05
CE-141	1.418E+01	9.587E+00	0.000E+00	4.453E+00	0.000E+00	3.665E+04	0.000E+00	1.087E+00	3.665E+04
CE-144	1.565E+03	6.542E+02	0.000E+00	3.880E+02	0.000E+00	5.291E+05	0.000E+00	8.402E+01	5.291E+05

TABLE II2-2 R_i Dose Factors Age: Adult Pathway: Inhalation

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	1.264E+03	1.264E+03	1.264E+03	1.264E+03	1.264E+03	0.000E+00	1.264E+03	1.264E+03
C-14	1.816E+04	3.408E+03	3.408E+03	3.408E+03	3.408E+03	3.408E+03	0.000E+00	3.408E+03	1.816E+04
CR-51	0.000E+00	0.000E+00	5.952E+01	2.280E+01	1.440E+04	3.320E+03	0.000E+00	1.000E+02	1.440E+04
MN-54	0.000E+00	3.960E+04	0.000E+00	9.840E+03	1.400E+06	7.736E+04	0.000E+00	6.296E+03	1.400E+06
FE-59	1.176E+04	2.776E+04	0.000E+00	0.000E+00	1.016E+06	1.880E+05	0.000E+00	1.056E+04	1.016E+06
CO-58	0.000E+00	1.584E+03	0.000E+00	0.000E+00	9.280E+05	1.064E+05	0.000E+00	2.072E+03	9.280E+05
CO-60	0.000E+00	1.152E+04	0.000E+00	0.000E+00	5.968E+06	2.848E+05	0.000E+00	1.480E+04	5.968E+06
ZN-65	3.240E+04	1.032E+05	0.000E+00	6.896E+04	8.640E+05	5.344E+04	0.000E+00	4.656E+04	8.640E+05
SR-89	3.040E+05	0.000E+00	0.000E+00	0.000E+00	1.400E+06	3.496E+05	0.000E+00	8.720E+03	1.400E+06
SR-90	9.920E+07	0.000E+00	0.000E+00	0.000E+00	9.600E+06	7.216E+05	0.000E+00	6.096E+06	9.920E+07
ZR-95	1.072E+05	3.440E+04	0.000E+00	5.416E+04	1.768E+06	1.504E+05	0.000E+00	2.328E+04	1.768E+06
I-131	2.520E+04	3.576E+04	1.192E+07	6.128E+04	0.000E+00	6.280E+03	0.000E+00	2.048E+04	1.192E+07
I-133	8.640E+03	1.480E+04	2.152E+06	2.584E+04	0.000E+00	8.880E+03	0.000E+00	4.520E+03	2.152E+06
CS-134	3.728E+05	8.480E+05	0.000E+00	2.872E+05	9.760E+04	1.040E+04	0.000E+00	7.280E+05	8.480E+05
CS-136	3.904E+04	1.464E+05	0.000E+00	8.560E+04	1.200E+04	1.168E+04	0.000E+00	1.104E+05	1.464E+05
CS-137	4.784E+05	6.208E+05	0.000E+00	2.224E+05	7.520E+04	8.400E+03	0.000E+00	4.280E+05	6.208E+05
BA-140	3.904E+04	4.904E+01	0.000E+00	1.672E+01	1.272E+06	2.184E+05	0.000E+00	2.568E+03	1.272E+06
CE-141	1.992E+04	1.352E+04	0.000E+00	6.264E+03	3.616E+05	1.200E+05	0.000E+00	1.528E+03	3.616E+05
CE-144	3.432E+06	1.432E+06	0.000E+00	8.480E+05	7.776E+06	8.160E+05	0.000E+00	1.840E+05	7.776E+06

TABLE II2-2 R_i Dose Factors Age: Teen Pathway: Ground

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	4.652E+06	4.652E+06	4.652E+06	4.652E+06	4.652E+06	4.652E+06	5.498E+06	4.652E+06	5.498E+06
MN-54	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.622E+09	1.384E+09	1.622E+09
FE-59	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	3.202E+08	2.725E+08	3.202E+08
CO-58	3.799E+08	3.799E+08	3.799E+08	3.799E+08	3.799E+08	3.799E+08	4.450E+08	3.799E+08	4.450E+08
CO-60	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.620E+10	2.227E+10	2.620E+10
ZN-65	7.455E+08	7.455E+08	7.455E+08	7.455E+08	7.455E+08	7.455E+08	8.574E+08	7.455E+08	8.574E+08
SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.507E+04	2.160E+04	2.507E+04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZR-95	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.845E+08	2.453E+08	2.845E+08
I-131	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	2.089E+07	1.720E+07	2.089E+07
I-133	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.980E+06	2.450E+06	2.980E+06
CS-134	6.917E+09	6.917E+09	6.917E+09	6.917E+09	6.917E+09	6.917E+09	8.070E+09	6.917E+09	8.070E+09
CS-136	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.709E+08	1.508E+08	1.709E+08
CS-137	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.323E+10	1.134E+10	1.323E+10
BA-140	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.347E+07	2.054E+07	2.347E+07
CE-141	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.539E+07	1.365E+07	1.539E+07
CE-144	6.958E+07	6.958E+07	6.958E+07	6.958E+07	6.958E+07	6.958E+07	8.046E+07	6.958E+07	8.046E+07

TABLE II2-2 R_i Dose Factors Age: Teen Pathway: Vegetable

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	2.467E+03	2.467E+03	2.467E+03	2.467E+03	2.467E+03	0.000E+00	2.467E+03	2.467E+03
C-14	3.517E+08	7.035E+07	7.035E+07	7.035E+07	7.035E+07	7.035E+07	0.000E+00	7.035E+07	3.517E+08
CR-51	0.000E+00	0.000E+00	2.869E+04	1.132E+04	7.374E+04	8.679E+06	0.000E+00	5.165E+04	8.679E+06
MN-54	0.000E+00	4.304E+08	0.000E+00	1.284E+08	0.000E+00	8.826E+08	0.000E+00	8.535E+07	8.826E+08
FE-59	1.605E+08	3.745E+08	0.000E+00	0.000E+00	1.181E+08	8.856E+08	0.000E+00	1.446E+08	8.856E+08
CO-58	0.000E+00	4.026E+07	0.000E+00	0.000E+00	0.000E+00	5.550E+08	0.000E+00	9.277E+07	5.550E+08
CO-60	0.000E+00	2.367E+08	0.000E+00	0.000E+00	0.000E+00	3.083E+09	0.000E+00	5.332E+08	3.083E+09
ZN-65	4.006E+08	1.391E+09	0.000E+00	8.902E+08	0.000E+00	5.890E+08	0.000E+00	6.488E+08	1.391E+09
SR-89	1.368E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.629E+09	0.000E+00	3.916E+08	1.368E+10
SR-90	7.154E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.008E+10	0.000E+00	1.767E+11	7.154E+11
ZR-95	1.582E+06	4.992E+05	0.000E+00	7.334E+05	0.000E+00	1.152E+09	0.000E+00	3.433E+05	1.152E+09
I-131	3.521E+07	4.930E+07	1.439E+10	8.487E+07	0.000E+00	9.751E+06	0.000E+00	2.648E+07	1.439E+10
I-133	8.131E+05	1.379E+06	1.925E+08	2.419E+06	0.000E+00	1.044E+06	0.000E+00	4.207E+05	1.925E+08
CS-134	6.753E+09	1.589E+10	0.000E+00	5.051E+09	1.928E+09	1.977E+08	0.000E+00	7.374E+09	1.589E+10
CS-136	2.691E+07	1.059E+08	0.000E+00	5.764E+07	9.084E+06	8.520E+06	0.000E+00	7.110E+07	1.059E+08
CS-137	9.656E+09	1.285E+10	0.000E+00	4.371E+09	1.698E+09	1.828E+08	0.000E+00	4.475E+09	1.285E+10
BA-140	8.359E+07	1.024E+05	0.000E+00	3.473E+04	6.887E+04	1.289E+08	0.000E+00	5.386E+06	1.289E+08
CE-141	2.440E+05	1.629E+05	0.000E+00	7.670E+04	0.000E+00	4.661E+08	0.000E+00	1.872E+04	4.661E+08
CE-144	4.993E+07	2.066E+07	0.000E+00	1.234E+07	0.000E+00	1.256E+10	0.000E+00	2.683E+06	1.256E+10

TABLE II2-2 R_i Dose Factors Age: Teen Pathway: Meat

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	1.938E+02	1.938E+02	1.938E+02	1.938E+02	1.938E+02	0.000E+00	1.938E+02	1.938E+02
C-14	1.102E+08	2.203E+07	2.203E+07	2.203E+07	2.203E+07	2.203E+07	0.000E+00	2.203E+07	1.102E+08
CR-51	0.000E+00	0.000E+00	9.958E+02	3.929E+02	2.559E+03	3.012E+05	0.000E+00	1.792E+03	3.012E+05
MN-54	0.000E+00	3.468E+06	0.000E+00	1.034E+06	0.000E+00	7.112E+06	0.000E+00	6.877E+05	7.112E+06
FE-59	7.498E+07	1.750E+08	0.000E+00	0.000E+00	5.518E+07	4.138E+08	0.000E+00	6.757E+07	4.138E+08
CO-58	0.000E+00	5.561E+06	0.000E+00	0.000E+00	0.000E+00	7.666E+07	0.000E+00	1.281E+07	7.666E+07
CO-60	0.000E+00	3.105E+07	0.000E+00	0.000E+00	0.000E+00	4.045E+08	0.000E+00	6.995E+07	4.045E+08
ZN-65	1.211E+08	4.206E+08	0.000E+00	2.692E+08	0.000E+00	1.781E+08	0.000E+00	1.962E+08	4.206E+08
SR-89	9.268E+07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.104E+07	0.000E+00	2.654E+06	9.268E+07
SR-90	4.335E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.217E+08	0.000E+00	1.071E+09	4.335E+09
ZR-95	5.796E+05	1.829E+05	0.000E+00	2.687E+05	0.000E+00	4.221E+08	0.000E+00	1.258E+05	4.221E+08
I-131	2.610E+06	3.654E+06	1.066E+09	6.290E+06	0.000E+00	7.227E+05	0.000E+00	1.963E+06	1.066E+09
I-133	8.882E-02	1.507E-01	2.103E+01	2.642E-01	0.000E+00	1.140E-01	0.000E+00	4.596E-02	2.103E+01
CS-134	2.722E+08	6.408E+08	0.000E+00	2.036E+08	7.774E+07	7.969E+06	0.000E+00	2.973E+08	6.408E+08
CS-136	2.766E+06	1.088E+07	0.000E+00	5.925E+06	9.339E+05	8.759E+05	0.000E+00	7.310E+06	1.088E+07
CS-137	3.901E+08	5.190E+08	0.000E+00	1.766E+08	6.862E+07	7.385E+06	0.000E+00	1.808E+08	5.190E+08
BA-140	6.997E+06	8.574E+03	0.000E+00	2.907E+03	5.765E+03	1.079E+07	0.000E+00	4.509E+05	1.079E+07
CE-141	3.875E+03	2.587E+03	0.000E+00	1.218E+03	0.000E+00	7.401E+06	0.000E+00	2.972E+02	7.401E+06
CE-144	6.036E+05	2.498E+05	0.000E+00	1.492E+05	0.000E+00	1.518E+08	0.000E+00	3.244E+04	1.518E+08

TABLE II2-2 R_i Dose Factors Age: Teen Pathway: Cow Milk

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	9.938E+02	9.938E+02	9.938E+02	9.938E+02	9.938E+02	0.000E+00	9.938E+02	9.938E+02
C-14	2.624E+08	5.248E+07	5.248E+07	5.248E+07	5.248E+07	5.248E+07	0.000E+00	5.248E+07	2.624E+08
CR-51	0.000E+00	0.000E+00	8.823E+03	3.481E+03	2.268E+04	2.669E+06	0.000E+00	1.588E+04	2.669E+06
MN-54	0.000E+00	6.941E+06	0.000E+00	2.071E+06	0.000E+00	1.424E+07	0.000E+00	1.376E+06	1.424E+07
FE-59	1.832E+07	4.275E+07	0.000E+00	0.000E+00	1.348E+07	1.011E+08	0.000E+00	1.651E+07	1.011E+08
CO-58	0.000E+00	3.139E+06	0.000E+00	0.000E+00	0.000E+00	4.327E+07	0.000E+00	7.233E+06	4.327E+07
CO-60	0.000E+00	1.480E+07	0.000E+00	0.000E+00	0.000E+00	1.927E+08	0.000E+00	3.333E+07	1.927E+08
ZN-65	1.020E+09	3.542E+09	0.000E+00	2.267E+09	0.000E+00	1.500E+09	0.000E+00	1.652E+09	3.542E+09
SR-89	9.741E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.160E+08	0.000E+00	2.789E+07	9.741E+08
SR-90	3.562E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.998E+08	0.000E+00	8.797E+09	3.562E+10
ZR-95	6.373E+02	2.011E+02	0.000E+00	2.954E+02	0.000E+00	4.640E+05	0.000E+00	1.383E+02	4.640E+05
I-131	1.572E+08	2.200E+08	6.421E+10	3.788E+08	0.000E+00	4.352E+07	0.000E+00	1.182E+08	6.421E+10
I-133	2.065E+06	3.504E+06	4.891E+08	6.145E+06	0.000E+00	2.651E+06	0.000E+00	1.069E+06	4.891E+08
CS-134	5.110E+09	1.203E+10	0.000E+00	3.822E+09	1.459E+09	1.496E+08	0.000E+00	5.580E+09	1.203E+10
CS-136	1.320E+08	5.195E+08	0.000E+00	2.828E+08	4.457E+07	4.180E+07	0.000E+00	3.489E+08	5.195E+08
CS-137	7.211E+09	9.593E+09	0.000E+00	3.264E+09	1.268E+09	1.365E+08	0.000E+00	3.341E+09	9.593E+09
BA-140	1.429E+07	1.751E+04	0.000E+00	5.936E+03	1.177E+04	2.204E+07	0.000E+00	9.207E+05	2.204E+07
CE-141	2.919E+03	1.949E+03	0.000E+00	9.175E+02	0.000E+00	5.575E+06	0.000E+00	2.239E+02	5.575E+06
CE-144	3.235E+05	1.338E+05	0.000E+00	7.994E+04	0.000E+00	8.133E+07	0.000E+00	1.738E+04	8.133E+07

TABLE II2-2 R_i Dose Factors Age: Teen Pathway: Goat Milk

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	1.470E+02	1.470E+02	1.470E+02	1.470E+02	1.470E+02	0.000E+00	1.470E+02	1.470E+02
C-14	1.903E+07	3.805E+06	3.805E+06	3.805E+06	3.805E+06	3.805E+06	0.000E+00	3.805E+06	1.903E+07
CR-51	0.000E+00	0.000E+00	7.676E+01	3.028E+01	1.973E+02	2.322E+04	0.000E+00	1.382E+02	2.322E+04
MN-54	0.000E+00	6.039E+04	0.000E+00	1.801E+04	0.000E+00	1.238E+05	0.000E+00	1.198E+04	1.238E+05
FE-59	1.727E+04	4.030E+04	0.000E+00	0.000E+00	1.271E+04	9.530E+04	0.000E+00	1.556E+04	9.530E+04
CO-58	0.000E+00	2.731E+04	0.000E+00	0.000E+00	0.000E+00	3.764E+05	0.000E+00	6.293E+04	3.764E+05
CO-60	0.000E+00	1.287E+05	0.000E+00	0.000E+00	0.000E+00	1.677E+06	0.000E+00	2.900E+05	1.677E+06
ZN-65	8.874E+06	3.081E+07	0.000E+00	1.972E+07	0.000E+00	1.305E+07	0.000E+00	1.437E+07	3.081E+07
SR-89	1.483E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.766E+07	0.000E+00	4.247E+06	1.483E+08
SR-90	5.423E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.522E+08	0.000E+00	1.339E+09	5.423E+09
ZR-95	5.544E+00	1.749E+00	0.000E+00	2.570E+00	0.000E+00	4.037E+03	0.000E+00	1.203E+00	4.037E+03
I-131	1.367E+07	1.914E+07	5.586E+09	3.296E+07	0.000E+00	3.787E+06	0.000E+00	1.028E+07	5.586E+09
I-133	1.797E+05	3.048E+05	4.255E+07	5.346E+05	0.000E+00	2.306E+05	0.000E+00	9.297E+04	4.255E+07
CS-134	1.111E+09	2.616E+09	0.000E+00	8.312E+08	3.173E+08	3.253E+07	0.000E+00	1.214E+09	2.616E+09
CS-136	2.871E+07	1.130E+08	0.000E+00	6.151E+07	9.694E+06	9.092E+06	0.000E+00	7.588E+07	1.130E+08
CS-137	1.568E+09	2.086E+09	0.000E+00	7.099E+08	2.759E+08	2.969E+07	0.000E+00	7.267E+08	2.086E+09
BA-140	1.243E+05	1.523E+02	0.000E+00	5.165E+01	1.024E+02	1.917E+05	0.000E+00	8.010E+03	1.917E+05
CE-141	2.540E+01	1.696E+01	0.000E+00	7.983E+00	0.000E+00	4.851E+04	0.000E+00	1.948E+00	4.851E+04
CE-144	2.814E+03	1.164E+03	0.000E+00	6.954E+02	0.000E+00	7.076E+05	0.000E+00	1.512E+02	7.076E+05

TABLE II2-2 R_i Dose Factors Age: Teen Pathway: Inhalation

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	1.272E+03	1.272E+03	1.272E+03	1.272E+03	1.272E+03	0.000E+00	1.272E+03	1.272E+03
C-14	2.600E+04	4.872E+03	4.872E+03	4.872E+03	4.872E+03	4.872E+03	0.000E+00	4.872E+03	2.600E+04
CR-51	0.000E+00	0.000E+00	7.496E+01	3.072E+01	2.096E+04	3.000E+03	0.000E+00	1.352E+02	2.096E+04
MN-54	0.000E+00	5.112E+04	0.000E+00	1.272E+04	1.984E+06	6.680E+04	0.000E+00	8.400E+03	1.984E+06
FE-59	1.592E+04	3.696E+04	0.000E+00	0.000E+00	1.528E+06	1.784E+05	0.000E+00	1.432E+04	1.528E+06
CO-58	0.000E+00	2.072E+03	0.000E+00	0.000E+00	1.344E+06	9.520E+04	0.000E+00	2.776E+03	1.344E+06
CO-60	0.000E+00	1.512E+04	0.000E+00	0.000E+00	8.720E+06	2.592E+05	0.000E+00	1.984E+04	8.720E+06
ZN-65	3.856E+04	1.336E+05	0.000E+00	8.640E+04	1.240E+06	4.664E+04	0.000E+00	6.240E+04	1.240E+06
SR-89	4.344E+05	0.000E+00	0.000E+00	0.000E+00	2.416E+06	3.712E+05	0.000E+00	1.248E+04	2.416E+06
SR-90	1.080E+08	0.000E+00	0.000E+00	0.000E+00	1.648E+07	7.648E+05	0.000E+00	6.680E+06	1.080E+08
ZR-95	1.456E+05	4.584E+04	0.000E+00	6.736E+04	2.688E+06	1.488E+05	0.000E+00	3.152E+04	2.688E+06
I-131	3.544E+04	4.912E+04	1.464E+07	8.400E+04	0.000E+00	6.488E+03	0.000E+00	2.640E+04	1.464E+07
I-133	1.216E+04	2.048E+04	2.920E+06	3.592E+04	0.000E+00	1.032E+04	0.000E+00	6.224E+03	2.920E+06
CS-134	5.024E+05	1.128E+06	0.000E+00	3.752E+05	1.464E+05	9.760E+03	0.000E+00	5.488E+05	1.128E+06
CS-136	5.152E+04	1.936E+05	0.000E+00	1.104E+05	1.776E+04	1.088E+04	0.000E+00	1.368E+05	1.936E+05
CS-137	6.704E+05	8.480E+05	0.000E+00	3.040E+05	1.208E+05	8.480E+03	0.000E+00	3.112E+05	8.480E+05
BA-140	5.472E+04	6.704E+01	0.000E+00	2.280E+01	2.032E+06	2.288E+05	0.000E+00	3.520E+03	2.032E+06
CE-141	2.840E+04	1.896E+04	0.000E+00	8.880E+03	6.136E+05	1.264E+05	0.000E+00	2.168E+03	6.136E+05
CE-144	4.888E+06	2.024E+06	0.000E+00	1.208E+06	1.336E+07	8.640E+05	0.000E+00	2.624E+05	1.336E+07

TABLE II2-2 R_i Dose Factors Age: Child Pathway: Ground

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	4.652E+06	4.652E+06	4.652E+06	4.652E+06	4.652E+06	4.652E+06	5.498E+06	4.652E+06	5.498E+06
MN-54	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.622E+09	1.384E+09	1.622E+09
FE-59	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	3.202E+08	2.725E+08	3.202E+08
CO-58	3.799E+08	3.799E+08	3.799E+08	3.799E+08	3.799E+08	3.799E+08	4.450E+08	3.799E+08	4.450E+08
CO-60	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.620E+10	2.227E+10	2.620E+10
ZN-65	7.455E+08	7.455E+08	7.455E+08	7.455E+08	7.455E+08	7.455E+08	8.574E+08	7.455E+08	8.574E+08
SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.507E+04	2.160E+04	2.507E+04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZR-95	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.845E+08	2.453E+08	2.845E+08
I-131	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	2.089E+07	1.720E+07	2.089E+07
I-133	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.980E+06	2.450E+06	2.980E+06
CS-134	6.917E+09	6.917E+09	6.917E+09	6.917E+09	6.917E+09	6.917E+09	8.070E+09	6.917E+09	8.070E+09
CS-136	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.709E+08	1.508E+08	1.709E+08
CS-137	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.323E+10	1.134E+10	1.323E+10
BA-140	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.347E+07	2.054E+07	2.347E+07
CE-141	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.539E+07	1.365E+07	1.539E+07
CE-144	6.958E+07	6.958E+07	6.958E+07	6.958E+07	6.958E+07	6.958E+07	8.046E+07	6.958E+07	8.046E+07

TABLE II2-2 R_i Dose Factors Age: Child Pathway: Vegetable

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	3.864E+03	3.864E+03	3.864E+03	3.864E+03	3.864E+03	0.000E+00	3.864E+03	3.864E+03
C-14	8.576E+08	1.715E+08	1.715E+08	1.715E+08	1.715E+08	1.715E+08	0.000E+00	1.715E+08	8.576E+08
CR-51	0.000E+00	0.000E+00	5.646E+04	1.543E+04	1.031E+05	5.395E+06	0.000E+00	1.017E+05	5.395E+06
MN-54	0.000E+00	6.377E+08	0.000E+00	1.788E+08	0.000E+00	5.352E+08	0.000E+00	1.699E+08	6.377E+08
FE-59	3.644E+08	5.897E+08	0.000E+00	0.000E+00	1.709E+08	6.140E+08	0.000E+00	2.937E+08	6.140E+08
CO-58	0.000E+00	6.059E+07	0.000E+00	0.000E+00	0.000E+00	3.534E+08	0.000E+00	1.855E+08	3.534E+08
CO-60	0.000E+00	3.645E+08	0.000E+00	0.000E+00	0.000E+00	2.019E+09	0.000E+00	1.075E+09	2.019E+09
ZN-65	7.782E+08	2.073E+09	0.000E+00	1.306E+09	0.000E+00	3.641E+08	0.000E+00	1.289E+09	2.073E+09
SR-89	3.322E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.286E+09	0.000E+00	9.487E+08	3.322E+10
SR-90	1.199E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.615E+10	0.000E+00	3.039E+11	1.199E+12
ZR-95	3.617E+06	7.951E+05	0.000E+00	1.138E+06	0.000E+00	8.294E+08	0.000E+00	7.078E+05	8.294E+08
I-131	6.716E+07	6.755E+07	2.234E+10	1.109E+08	0.000E+00	6.014E+06	0.000E+00	3.839E+07	2.234E+10
I-133	1.482E+06	1.833E+06	3.406E+08	3.055E+06	0.000E+00	7.387E+05	0.000E+00	6.936E+05	3.406E+08
CS-134	1.544E+10	2.533E+10	0.000E+00	7.850E+09	2.817E+09	1.366E+08	0.000E+00	5.343E+09	2.533E+10
CS-136	5.390E+07	1.482E+08	0.000E+00	7.890E+07	1.177E+07	5.206E+06	0.000E+00	9.587E+07	1.482E+08
CS-137	2.306E+10	2.207E+10	0.000E+00	7.194E+09	2.588E+09	1.382E+08	0.000E+00	3.258E+09	2.306E+10
BA-140	1.780E+08	1.559E+05	0.000E+00	5.076E+04	9.296E+04	9.018E+07	0.000E+00	1.039E+07	1.780E+08
CE-141	5.840E+05	2.913E+05	0.000E+00	1.277E+05	0.000E+00	3.634E+08	0.000E+00	4.325E+04	3.634E+08
CE-144	1.219E+08	3.822E+07	0.000E+00	2.116E+07	0.000E+00	9.964E+09	0.000E+00	6.506E+06	9.964E+09

TABLE II2-2 R_i Dose Factors Age: Child Pathway: Meat

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	2.341E+02	2.341E+02	2.341E+02	2.341E+02	2.341E+02	0.000E+00	2.341E+02	2.341E+02
C-14	2.071E+08	4.142E+07	4.142E+07	4.142E+07	4.142E+07	4.142E+07	0.000E+00	4.142E+07	2.071E+08
CR-51	0.000E+00	0.000E+00	1.552E+03	4.240E+02	2.833E+03	1.482E+05	0.000E+00	2.795E+03	1.482E+05
MN-54	0.000E+00	3.967E+06	0.000E+00	1.112E+06	0.000E+00	3.329E+06	0.000E+00	1.057E+06	3.967E+06
FE-59	1.329E+08	2.151E+08	0.000E+00	0.000E+00	6.236E+07	2.240E+08	0.000E+00	1.072E+08	2.240E+08
CO-58	0.000E+00	6.495E+06	0.000E+00	0.000E+00	0.000E+00	3.789E+07	0.000E+00	1.988E+07	3.789E+07
CO-60	0.000E+00	3.688E+07	0.000E+00	0.000E+00	0.000E+00	2.042E+08	0.000E+00	1.087E+08	2.042E+08
ZN-65	1.817E+08	4.842E+08	0.000E+00	3.051E+08	0.000E+00	8.503E+07	0.000E+00	3.011E+08	4.842E+08
SR-89	1.754E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.789E+06	0.000E+00	5.009E+06	1.754E+08
SR-90	5.601E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.545E+07	0.000E+00	1.420E+09	5.601E+09
ZR-95	1.029E+06	2.263E+05	0.000E+00	3.239E+05	0.000E+00	2.361E+08	0.000E+00	2.014E+05	2.361E+08
I-131	4.840E+06	4.868E+06	1.610E+09	7.992E+06	0.000E+00	4.334E+05	0.000E+00	2.766E+06	1.610E+09
I-133	1.650E-01	2.040E-01	3.791E+01	3.400E-01	0.000E+00	8.223E-02	0.000E+00	7.721E-02	3.791E+01
CS-134	4.801E+08	7.878E+08	0.000E+00	2.441E+08	8.761E+07	4.247E+06	0.000E+00	1.662E+08	7.878E+08
CS-136	4.773E+06	1.312E+07	0.000E+00	6.987E+06	1.042E+06	4.611E+05	0.000E+00	8.491E+06	1.312E+07
CS-137	7.185E+08	6.877E+08	0.000E+00	2.241E+08	8.064E+07	4.306E+06	0.000E+00	1.015E+08	7.185E+08
BA-140	1.291E+07	1.131E+04	0.000E+00	3.683E+03	6.745E+03	6.543E+06	0.000E+00	7.538E+05	1.291E+07
CE-141	7.297E+03	3.639E+03	0.000E+00	1.595E+03	0.000E+00	4.540E+06	0.000E+00	5.404E+02	4.540E+06
CE-144	1.138E+06	3.567E+05	0.000E+00	1.975E+05	0.000E+00	9.300E+07	0.000E+00	6.073E+04	9.300E+07

TABLE II2-2 R_i Dose Factors Age: Child Pathway: Cow Milk

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	1.570E+03	1.570E+03	1.570E+03	1.570E+03	1.570E+03	0.000E+00	1.570E+03	1.570E+03
C-14	6.452E+08	1.290E+08	1.290E+08	1.290E+08	1.290E+08	1.290E+08	0.000E+00	1.290E+08	6.452E+08
CR-51	0.000E+00	0.000E+00	1.798E+04	4.914E+03	3.283E+04	1.718E+06	0.000E+00	3.239E+04	1.718E+06
MN-54	0.000E+00	1.039E+07	0.000E+00	2.912E+06	0.000E+00	8.716E+06	0.000E+00	2.766E+06	1.039E+07
FE-59	4.248E+07	6.874E+07	0.000E+00	0.000E+00	1.993E+07	7.157E+07	0.000E+00	3.424E+07	7.157E+07
CO-58	0.000E+00	4.795E+06	0.000E+00	0.000E+00	0.000E+00	2.797E+07	0.000E+00	1.468E+07	2.797E+07
CO-60	0.000E+00	2.298E+07	0.000E+00	0.000E+00	0.000E+00	1.273E+08	0.000E+00	6.777E+07	1.273E+08
ZN-65	2.002E+09	5.332E+09	0.000E+00	3.360E+09	0.000E+00	9.365E+08	0.000E+00	3.316E+09	5.332E+09
SR-89	2.411E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.333E+07	0.000E+00	6.886E+07	2.411E+09
SR-90	6.018E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.107E+08	0.000E+00	1.526E+10	6.018E+10
ZR-95	1.480E+03	3.254E+02	0.000E+00	4.658E+02	0.000E+00	3.394E+05	0.000E+00	2.897E+02	3.394E+05
I-131	3.812E+08	3.834E+08	1.268E+11	6.295E+08	0.000E+00	3.413E+07	0.000E+00	2.179E+08	1.268E+11
I-133	5.018E+06	6.205E+06	1.153E+09	1.034E+07	0.000E+00	2.501E+06	0.000E+00	2.348E+06	1.153E+09
CS-134	1.179E+10	1.934E+10	0.000E+00	5.993E+09	2.151E+09	1.043E+08	0.000E+00	4.080E+09	1.934E+10
CS-136	2.980E+08	8.191E+08	0.000E+00	4.362E+08	6.504E+07	2.878E+07	0.000E+00	5.300E+08	8.191E+08
CS-137	1.737E+10	1.662E+10	0.000E+00	5.418E+09	1.949E+09	1.041E+08	0.000E+00	2.454E+09	1.737E+10
BA-140	3.449E+07	3.022E+04	0.000E+00	9.837E+03	1.801E+04	1.747E+07	0.000E+00	2.013E+06	3.449E+07
CE-141	7.189E+03	3.586E+03	0.000E+00	1.572E+03	0.000E+00	4.473E+06	0.000E+00	5.324E+02	4.473E+06
CE-144	7.975E+05	2.500E+05	0.000E+00	1.384E+05	0.000E+00	6.518E+07	0.000E+00	4.256E+04	6.518E+07

TABLE II2-2 R_i Dose Factors Age: Child Pathway: Goat Milk

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MN-54	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO-58	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZN-65	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-89	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZR-95	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-131	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-133	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-136	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-140	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CE-141	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CE-144	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

TABLE II2-2 R_i Dose Factors Age: Child Pathway: Inhalation

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	1.125E+03	1.125E+03	1.125E+03	1.125E+03	1.125E+03	0.000E+00	1.125E+03	1.125E+03
C-14	3.589E+04	6.734E+03	6.734E+03	6.734E+03	6.734E+03	6.734E+03	0.000E+00	6.734E+03	3.589E+04
CR-51	0.000E+00	0.000E+00	8.547E+01	2.431E+01	1.698E+04	1.084E+03	0.000E+00	1.543E+02	1.698E+04
MN-54	0.000E+00	4.292E+04	0.000E+00	1.003E+04	1.576E+06	2.290E+04	0.000E+00	9.509E+03	1.576E+06
FE-59	2.068E+04	3.345E+04	0.000E+00	0.000E+00	1.269E+06	7.067E+04	0.000E+00	1.669E+04	1.269E+06
CO-58	0.000E+00	1.772E+03	0.000E+00	0.000E+00	1.106E+06	3.437E+04	0.000E+00	3.164E+03	1.106E+06
CO-60	0.000E+00	1.314E+04	0.000E+00	0.000E+00	7.067E+06	9.620E+04	0.000E+00	2.264E+04	7.067E+06
ZN-65	4.255E+04	1.132E+05	0.000E+00	7.141E+04	9.953E+05	1.632E+04	0.000E+00	7.030E+04	9.953E+05
SR-89	5.994E+05	0.000E+00	0.000E+00	0.000E+00	2.157E+06	1.672E+05	0.000E+00	1.724E+04	2.157E+06
SR-90	1.010E+08	0.000E+00	0.000E+00	0.000E+00	1.476E+07	3.434E+05	0.000E+00	6.438E+06	1.010E+08
ZR-95	1.898E+05	4.181E+04	0.000E+00	5.957E+04	2.231E+06	6.105E+04	0.000E+00	3.700E+04	2.231E+06
I-131	4.810E+04	4.810E+04	1.624E+07	7.881E+04	0.000E+00	2.842E+03	0.000E+00	2.727E+04	1.624E+07
I-133	1.658E+04	2.031E+04	3.848E+06	3.378E+04	0.000E+00	5.476E+03	0.000E+00	7.696E+03	3.848E+06
CS-134	6.512E+05	1.014E+06	0.000E+00	3.304E+05	1.210E+05	3.848E+03	0.000E+00	2.246E+05	1.014E+06
CS-136	6.512E+04	1.709E+05	0.000E+00	9.546E+04	1.454E+04	4.181E+03	0.000E+00	1.162E+05	1.709E+05
CS-137	9.065E+05	8.251E+05	0.000E+00	2.823E+05	1.040E+05	3.619E+03	0.000E+00	1.284E+05	9.065E+05
BA-140	7.400E+04	6.475E+01	0.000E+00	2.113E+01	1.743E+06	1.018E+05	0.000E+00	4.329E+03	1.743E+06
CE-141	3.922E+04	1.954E+04	0.000E+00	8.547E+03	5.439E+05	5.661E+04	0.000E+00	2.897E+03	5.439E+05
CE-144	6.771E+06	2.116E+06	0.000E+00	1.173E+06	1.195E+07	3.885E+05	0.000E+00	3.615E+05	1.195E+07

TABLE II2-2 R_i Dose Factors Age: Infant Pathway: Ground

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	4.652E+06	4.652E+06	4.652E+06	4.652E+06	4.652E+06	4.652E+06	5.498E+06	4.652E+06	5.498E+06
MN-54	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.384E+09	1.622E+09	1.384E+09	1.622E+09
FE-59	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	2.725E+08	3.202E+08	2.725E+08	3.202E+08
CO-58	3.799E+08	3.799E+08	3.799E+08	3.799E+08	3.799E+08	3.799E+08	4.450E+08	3.799E+08	4.450E+08
CO-60	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.227E+10	2.620E+10	2.227E+10	2.620E+10
ZN-65	7.455E+08	7.455E+08	7.455E+08	7.455E+08	7.455E+08	7.455E+08	8.574E+08	7.455E+08	8.574E+08
SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.507E+04	2.160E+04	2.507E+04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZR-95	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.453E+08	2.845E+08	2.453E+08	2.845E+08
I-131	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	2.089E+07	1.720E+07	2.089E+07
I-133	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.980E+06	2.450E+06	2.980E+06
CS-134	6.917E+09	6.917E+09	6.917E+09	6.917E+09	6.917E+09	6.917E+09	8.070E+09	6.917E+09	8.070E+09
CS-136	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.508E+08	1.709E+08	1.508E+08	1.709E+08
CS-137	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.134E+10	1.323E+10	1.134E+10	1.323E+10
BA-140	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.054E+07	2.347E+07	2.054E+07	2.347E+07
CE-141	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.365E+07	1.539E+07	1.365E+07	1.539E+07
CE-144	6.958E+07	6.958E+07	6.958E+07	6.958E+07	6.958E+07	6.958E+07	8.046E+07	6.958E+07	8.046E+07

TABLE II2-2 R_i Dose Factors Age: Infant Pathway: Vegetable

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MN-54	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO-58	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZN-65	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-89	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZR-95	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-131	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-133	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-136	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-140	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CE-141	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CE-144	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

TABLE II2-2 R_i Dose Factors Age: Infant Pathway: Meat

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MN-54	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO-58	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZN-65	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-89	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZR-95	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-131	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-133	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-136	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-140	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CE-141	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CE-144	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

TABLE II2-2 R_i Dose Factors Age: Infant Pathway: Cow Milk

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	2.382E+03	2.382E+03	2.382E+03	2.382E+03	2.382E+03	0.000E+00	2.382E+03	2.382E+03
C-14	1.264E+09	2.698E+08	2.698E+08	2.698E+08	2.698E+08	2.698E+08	0.000E+00	2.698E+08	1.264E+09
CR-51	0.000E+00	0.000E+00	3.349E+04	7.316E+03	6.515E+04	1.496E+06	0.000E+00	5.132E+04	1.496E+06
MN-54	0.000E+00	1.931E+07	0.000E+00	4.280E+06	0.000E+00	7.095E+06	0.000E+00	4.377E+06	1.931E+07
FE-59	7.930E+07	1.385E+08	0.000E+00	0.000E+00	4.094E+07	6.617E+07	0.000E+00	5.458E+07	1.385E+08
CO-58	0.000E+00	9.590E+06	0.000E+00	0.000E+00	0.000E+00	2.390E+07	0.000E+00	2.392E+07	2.392E+07
CO-60	0.000E+00	4.692E+07	0.000E+00	0.000E+00	0.000E+00	1.116E+08	0.000E+00	1.108E+08	1.116E+08
ZN-65	2.688E+09	9.219E+09	0.000E+00	4.471E+09	0.000E+00	7.787E+09	0.000E+00	4.251E+09	9.219E+09
SR-89	4.584E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.424E+07	0.000E+00	1.315E+08	4.584E+09
SR-90	6.549E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.178E+08	0.000E+00	1.667E+10	6.549E+10
ZR-95	2.629E+03	6.406E+02	0.000E+00	6.904E+02	0.000E+00	3.190E+05	0.000E+00	4.543E+02	3.190E+05
I-131	7.957E+08	9.376E+08	3.081E+11	1.095E+09	0.000E+00	3.347E+07	0.000E+00	4.123E+08	3.081E+11
I-133	1.060E+07	1.543E+07	2.806E+09	1.814E+07	0.000E+00	2.611E+06	0.000E+00	4.518E+06	2.806E+09
CS-134	1.899E+10	3.541E+10	0.000E+00	9.116E+09	3.737E+09	9.620E+07	0.000E+00	3.576E+09	3.541E+10
CS-136	5.820E+08	1.712E+09	0.000E+00	6.821E+08	1.395E+08	2.599E+07	0.000E+00	6.390E+08	1.712E+09
CS-137	2.773E+10	3.245E+10	0.000E+00	8.711E+09	3.527E+09	1.014E+08	0.000E+00	2.300E+09	3.245E+10
BA-140	7.097E+07	7.097E+04	0.000E+00	1.685E+04	4.358E+04	1.743E+07	0.000E+00	3.657E+06	7.097E+07
CE-141	1.425E+04	8.692E+03	0.000E+00	2.680E+03	0.000E+00	4.491E+06	0.000E+00	1.023E+03	4.491E+06
CE-144	1.143E+06	4.678E+05	0.000E+00	1.890E+05	0.000E+00	6.556E+07	0.000E+00	6.403E+04	6.556E+07

TABLE II2-2 R_i Dose Factors Age: Infant Pathway: Goat Milk

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MN-54	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO-58	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CO-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZN-65	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-89	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ZR-95	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-131	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-133	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-136	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CS-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-140	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CE-141	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CE-144	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

TABLE II2-2 R_i Dose Factors Age: Infant Pathway: Inhalation

	BONE	LIVER	THYROID	KIDNEY	LUNG	GILLI	SKIN	TBODY	MAX VAL
H-3	0.000E+00	6.468E+02	6.468E+02	6.468E+02	6.468E+02	6.468E+02	0.000E+00	6.468E+02	6.468E+02
C-14	2.646E+04	5.306E+03	5.306E+03	5.306E+03	5.306E+03	5.306E+03	0.000E+00	5.306E+03	2.646E+04
CR-51	0.000E+00	0.000E+00	5.754E+01	1.323E+01	1.284E+04	3.570E+02	0.000E+00	8.946E+01	1.284E+04
MN-54	0.000E+00	2.534E+04	0.000E+00	4.984E+03	9.996E+05	7.056E+03	0.000E+00	4.984E+03	9.996E+05
FE-59	1.357E+04	2.352E+04	0.000E+00	0.000E+00	1.015E+06	2.478E+04	0.000E+00	9.478E+03	1.015E+06
CO-58	0.000E+00	1.219E+03	0.000E+00	0.000E+00	7.770E+05	1.113E+04	0.000E+00	1.820E+03	7.770E+05
CO-60	0.000E+00	8.022E+03	0.000E+00	0.000E+00	4.508E+06	3.192E+04	0.000E+00	1.177E+04	4.508E+06
ZN-65	1.932E+04	6.258E+04	0.000E+00	3.248E+04	6.468E+05	5.138E+04	0.000E+00	3.108E+04	6.468E+05
SR-89	3.976E+05	0.000E+00	0.000E+00	0.000E+00	2.030E+06	6.398E+04	0.000E+00	1.141E+04	2.030E+06
SR-90	4.088E+07	0.000E+00	0.000E+00	0.000E+00	1.124E+07	1.310E+05	0.000E+00	2.590E+06	4.088E+07
ZR-95	1.154E+05	2.786E+04	0.000E+00	3.108E+04	1.750E+06	2.170E+04	0.000E+00	2.030E+04	1.750E+06
I-131	3.794E+04	4.438E+04	1.484E+07	5.180E+04	0.000E+00	1.058E+03	0.000E+00	1.960E+04	1.484E+07
I-133	1.324E+04	1.918E+04	3.556E+06	2.240E+04	0.000E+00	2.156E+03	0.000E+00	5.600E+03	3.556E+06
CS-134	3.962E+05	7.028E+05	0.000E+00	1.904E+05	7.966E+04	1.334E+03	0.000E+00	7.448E+04	7.028E+05
CS-136	4.830E+04	1.345E+05	0.000E+00	5.642E+04	1.176E+04	1.428E+03	0.000E+00	5.292E+04	1.345E+05
CS-137	5.488E+05	6.118E+05	0.000E+00	1.722E+05	7.126E+04	1.334E+03	0.000E+00	4.550E+04	6.118E+05
BA-140	5.600E+04	5.600E+01	0.000E+00	1.343E+01	1.596E+06	3.836E+04	0.000E+00	2.898E+03	1.596E+06
CE-141	2.772E+04	1.666E+04	0.000E+00	5.250E+03	5.166E+05	2.156E+04	0.000E+00	1.988E+03	5.166E+05
CE-144	3.192E+06	1.211E+06	0.000E+00	5.376E+05	9.842E+06	1.484E+05	0.000E+00	1.764E+05	9.842E+06

TABLE II2-3

Assumptions Used in Limerick Gaseous Effluent R_i Calculations[1]

Symbol	Description	Value	Reference[2]
f_l	Fraction of annual intake of fresh, leafy vegetation grown locally	0.42	Site Spec.
f_g	Fraction of annual intake of stored vegetation grown locally	0.76	E-15
Y_v	Vegetation area density (kg/m^2)	2.0	E-15
r	Fraction of deposited particulates retained on vegetation	0.20	E-15
r	Fraction of deposited iodines retained on vegetation	1.0	E-15
SF	Shielding factor of residential structures	0.7	E-15
t	Period of buildup of activity in soil (sec)	6.31E08	Site Spec.
t_f	Transport time milkman (sec)	1.73E05	E-15
t_h	Delay time for ingestion of stored feed by animals (sec)	7.78E06	E-15
t_h	Delay time for ingestion of leafy vegetable by man (sec)	8.6E04	E-15
t_h	Delay time for ingestion of other vegetable by man (sec)	5.18E06	E-15
t_s	Time between slaughter and consumption of meat animal (sec)	1.73E06	E-15
Y_p	Grass yield (kg/m**2)	0.7	E-15
Y_s	Stored feed yield (kg/m**2)	2.0	E-15
λ_w	Weathering rate constant for activity on veg (sec^{-1})	5.73E-07	E-15
Q_F	Milk cow feed consumption rate (kg/day wet)	50.0	E-3
Q_F	Beef cattle consumption rate (kg/day wet)	50.0	E-3
Q_F	Goat feed consumption rate (kg/day wet)	6.0	E-3
K	Ground exposure (all age groups) (hr/yr)	8760.0	C-2[3]
BR	Breathing Rate adult (m**3/yr)	8000.0	E-5
BR	Breathing Rate teen (m**3/yr)	8000.0	E-5
BR	Breathing Rate child (m**3/yr)	3700.0	E-5
BR	Breathing Rate infant (m**3/yr)	1400.0	E-5
U_a^l	Leafy veg consumption rate adult (kg/yr)	64.0	E-5
U_a^l	Leafy veg consumption rate teen (kg/yr	42.0	E-5
U_a^l	Leafy veg consumption rate child (kg/yr)	26.0	E-5
U_a^l	Leafy veg consumption rate infant (kg/yr)	0.0	E-5
U_a^s	Stored veg consumption rate adult (kg/yr)	520.0	E-5
U_a^s	Stored veg consumption rate adult (kg/yr)	630.0	E-5
U_a^s	Stored veg consumption rate adult (kg/yr)	520.0	E-5
U_a^s	Stored veg consumption rate adult (kg/yr)	0.0	E-5
U_{ap}	Cow milk consumption rate adult (l/yr)	310.0	E-5
U_{ap}	Cow milk consumption rate teen (l/yr)	400.0	E-5
U_{ap}	Cow milk consumption rate child (l/yr)	330.0	E-5
U_{ap}	Cow milk consumption rate infant (l/yr)	330.0	E-5
U_{ap}	Goat milk consumption rate adult (l/yr)	23.0	Site Spec.
U_{ap}	Goat milk consumption rate teen (l/yr)	29.0	Site Spec.
U_{ap}	Goat milk consumption rate child (l/yr)	0.0	Site Spec.
U_{ap}	Goat milk consumption rate infant (l/yr)	0.0	Site Spec.
U_{ap}	Meat consumption rate adult (kg/yr)	110.0	E-5
U_{ap}	Meat consumption rate teen (kg/yr)	65.0	E-5
U_{ap}	Meat consumption rate child (kg/yr)	41.0	E-5
U_{ap}	Meat consumption rate infant (kg/yr)	0.0	E-5
f_p	Fraction of year animals on pasture	0.75	Site Spec.
f_s	Fraction of feed from pasture when on pasture	0.39	Site Spec.
H	Atmosphere absolute humidity (gm/m**3)	8.0	(4)

NOTES:

1) R_i values are calculated in accordance with the methodologies given in NUREG-0133.
2) The References refer to tables contained in Regulatory Guide 1.109 unless otherwise specified.
3) From Reg. Guide 1.109, Appendix C, Equation C-2
4) From NUREG-0133, Section 5.3.1.3.

TABLE II2-4

Nearest Gaseous Effluent Dose Receptor Distances (Meters)

Direction	Plume Ground Inhalation Pathways	Vegetation Pathway	Meat Pathway	Cow Pathway	Goat Pathway
N	965	2574	3414	7562	0
NNE	805	805	1585	0	0
NE	1287	2414	1097	0	0
ENE	965	2896	3871	0	0
E	965	1770	1890	0	0
ESE	805	1931	4511	1770	1770
SE	1609	1770	7241	0	0
SSE	1609	1931	7224	7562	0
S	1287	1931	3018	3701	0
SSW	1609	2253	1433	2896	0
SW	965	965	2835	4827	0
WSW	1287	1287	2134	4505	0
W	965	3540	4084	0	0
WNW	1126	1126	0	0	0
NW	2092	2574	6660	0	0
NNW	1448	1931	6325	0	0

FIGURES

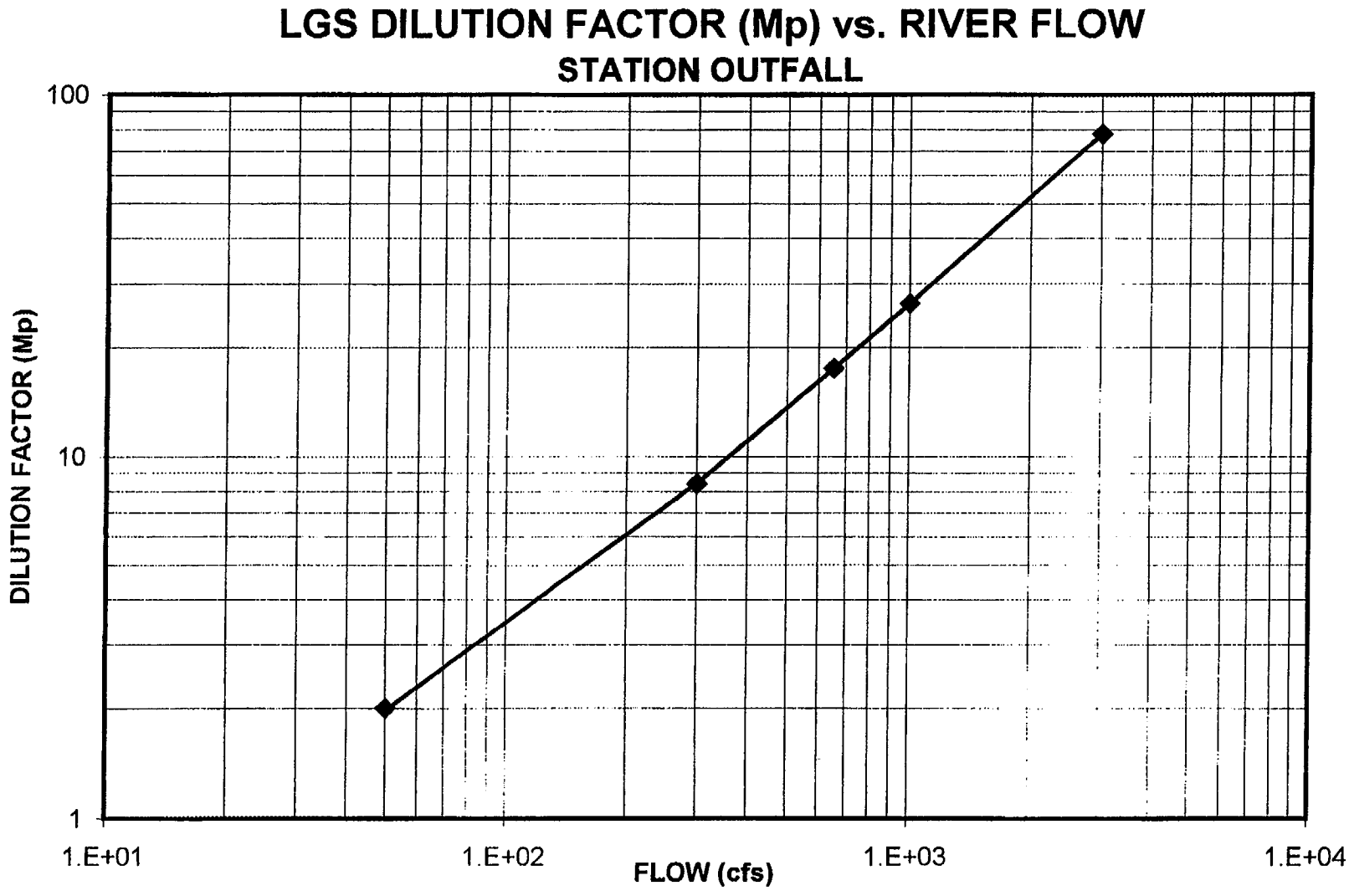


Figure II1.3.1-1

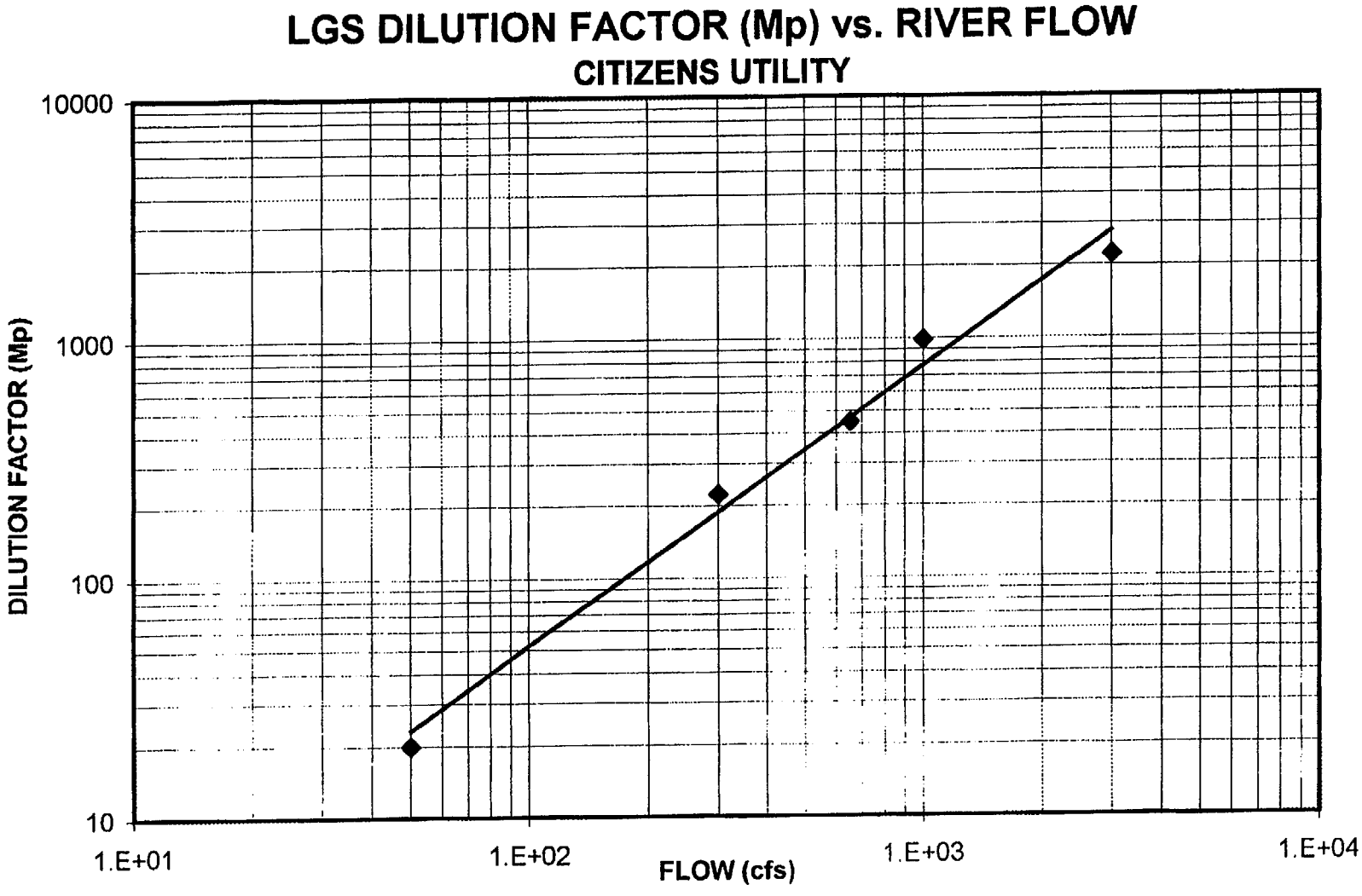


Figure II1.3.1-2

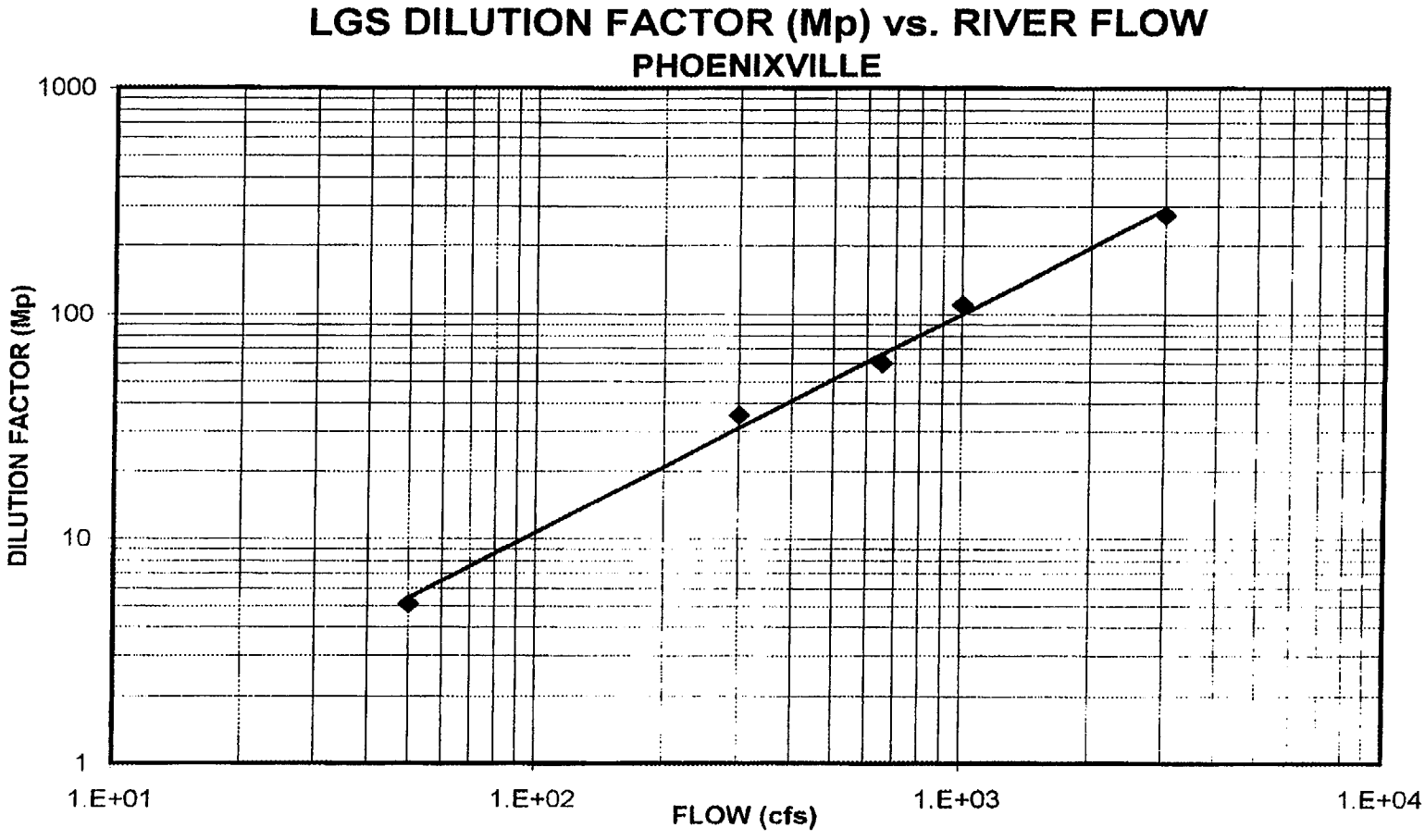


Figure II1.3.1-3

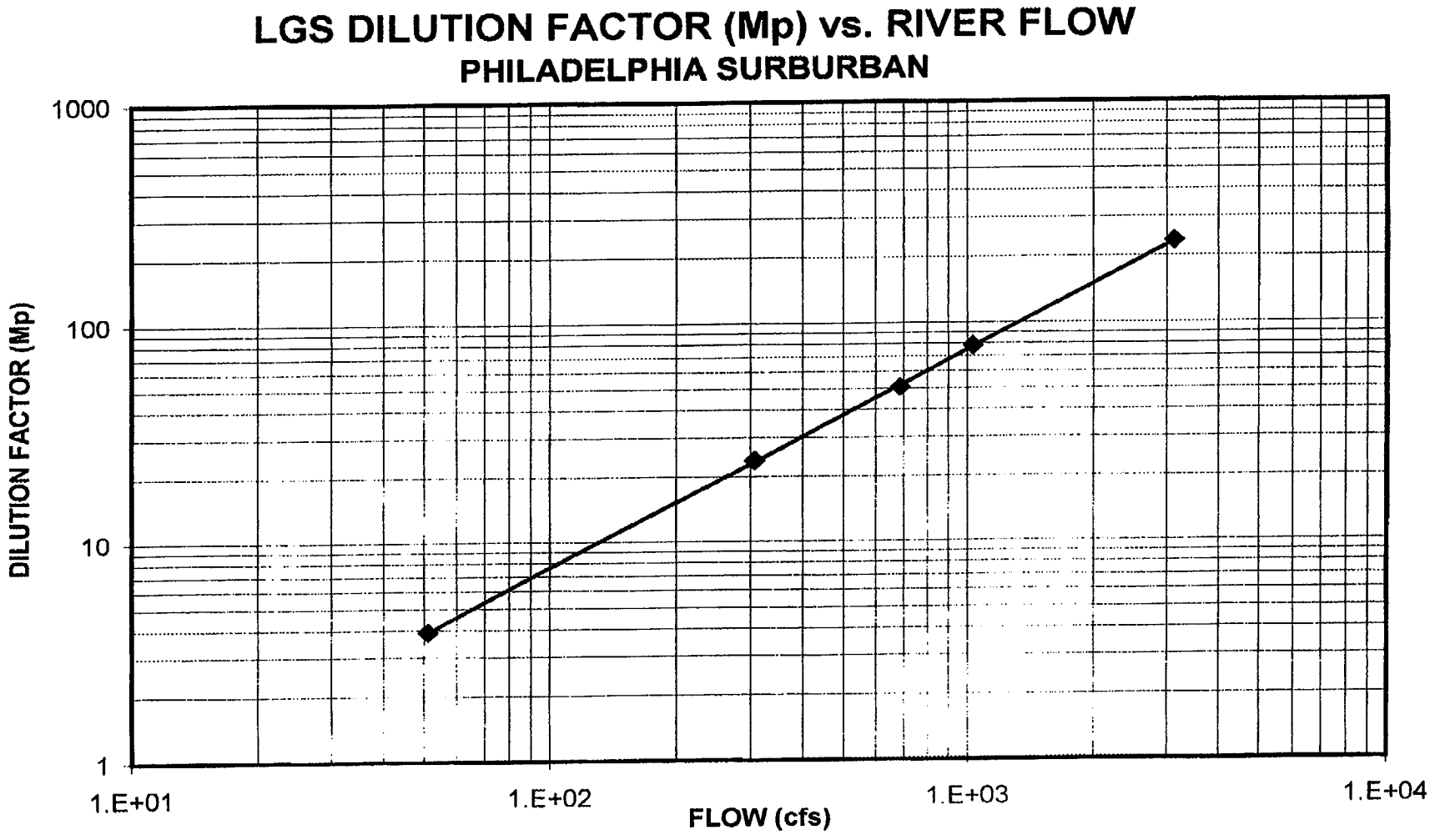


Figure II1.3.1-4

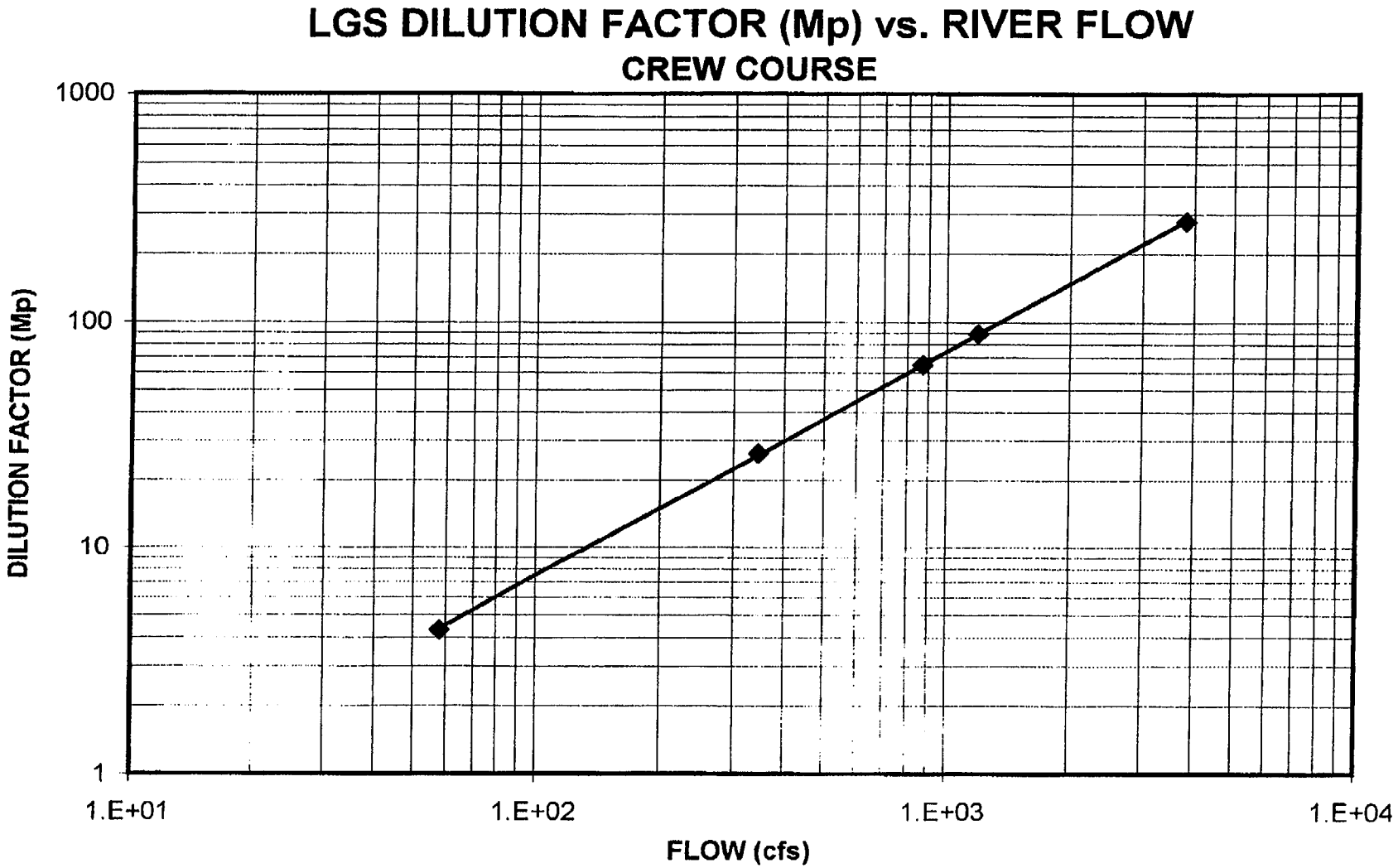


Figure II1.3.1-5

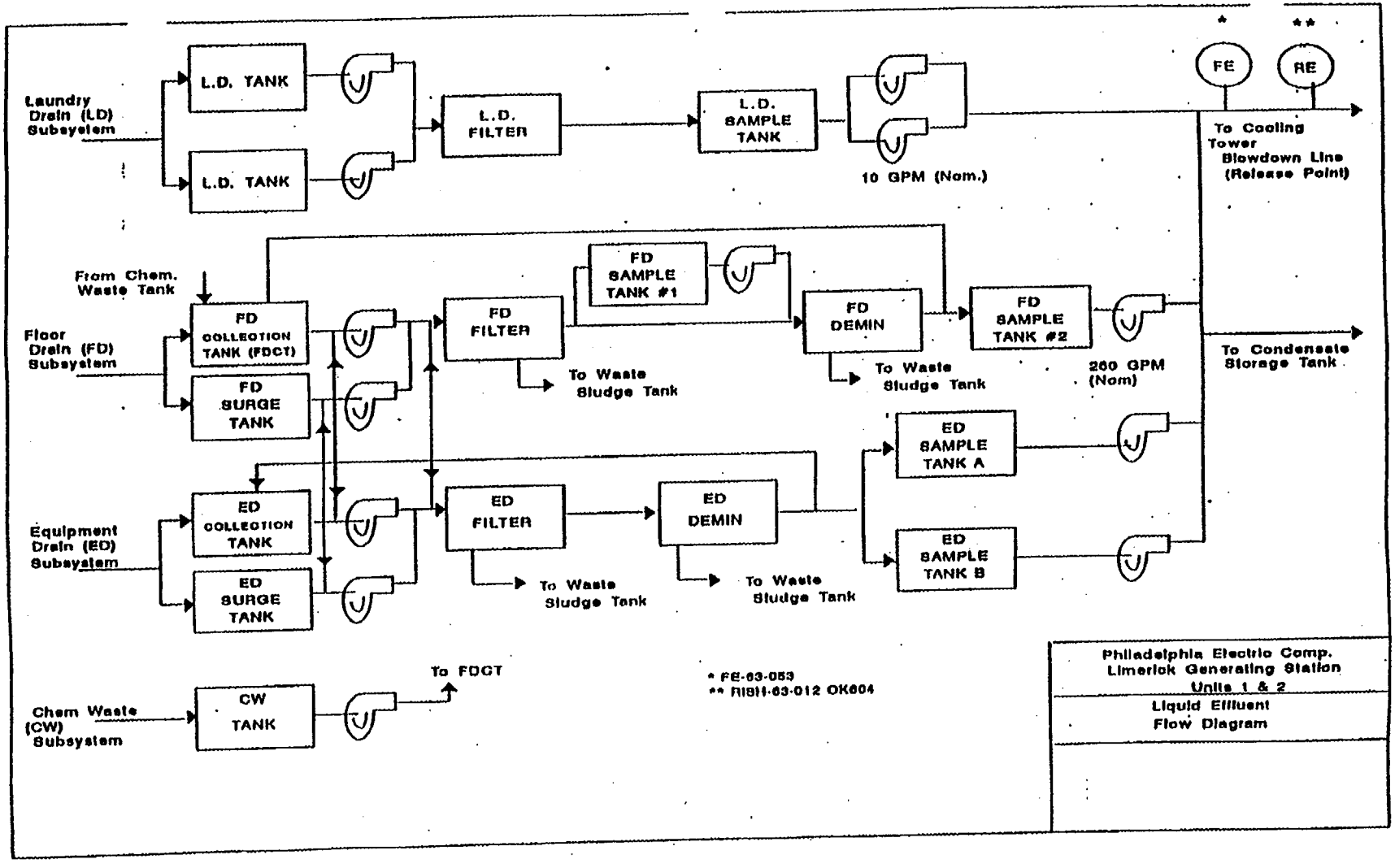

Laundry Drain (LD) Subsystem
L.D. TANK
L.D. TANK
L.D. FILTER
L.D. SAMPLE TANK
10 GPM (Nom.)
FE
RE
To Cooling Tower Blowdown Line (Release Point)
From Chem. Waste Tank
Floor Drain (FD) Subsystem
FD COLLECTION TANK (FDCT)
FD SURGE TANK
FD FILTER
FD SAMPLE TANK #1
To Waste Sludge Tank
FD DEMIN
To Waste Sludge Tank
FD SAMPLE TANK #2
260 GPM (Nom)
To Condensate Storage Tank
Equipment Drain (ED) Subsystem
ED COLLECTION TANK
ED SURGE TANK
ED FILTER
To Waste Sludge Tank
ED DEMIN
To Waste Sludge Tank
ED SAMPLE TANK A
ED SAMPLE TANK B
Chem Waste (CW) Subsystem
CW TANK
To FDCT
* FE-63-053
** RISH-63-012 OK604
Philadelphia Electric Comp.
Limerick Generating Station
Units 1 & 2
Liquid Effluent
Flow Diagram

Figure II1-1

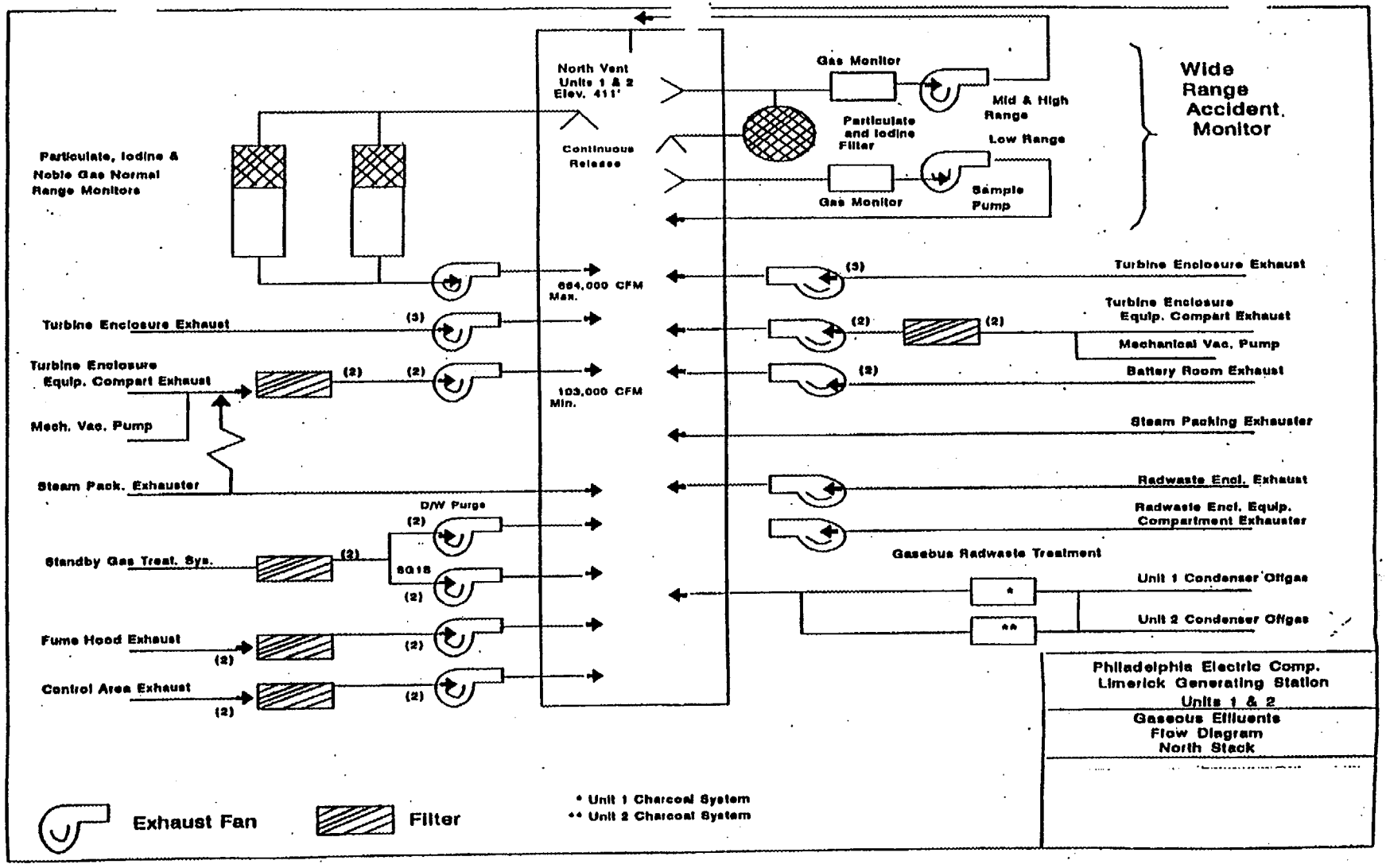

North Vent
Units 1 & 2
Elev. 411'
Continuous
Release
Gas Monitor
Mid & High
Range
Particulate
and Iodine
Filter
Low Range
Gas Monitor
Sample
Pump
Wide
Range
Accident
Monitor
Particulate, Iodine &
Noble Gas Normal
Range Monitors
664,000 CFM
Max.
103,000 CFM
Min.
Turbine Enclosure Exhaust
(3)
Turbine Enclosure
Equip. Compart Exhaust
(2)
(2)
Mech. Vac. Pump
Steam Pack. Exhauster
Turbine Enclosure Exhaust
(3)
Turbine Enclosure
Equip. Compart Exhaust
(2)
(2)
Mechanical Vac. Pump
Battery Room Exhaust
(2)
Steam Packing Exhauster
Radwaste Encl. Exhaust
Radwaste Encl. Equip.
Compartment Exhauster
Gaseous Radwaste Treatment
Unit 1 Condenser Offgas
*
Unit 2 Condenser Offgas
**
D/W Purge
(2)
Standby Gas Treat. Sys.
(2)
SGTS
(2)
Fume Hood Exhaust
(2)
(2)
Control Area Exhaust
(2)
(2)
Philadelphia Electric Comp.
Limerick Generating Station
Units 1 & 2
Gaseous Effluents
Flow Diagram
North Stack
Exhaust Fan
Filter
* Unit 1 Charcoal System
** Unit 2 Charcoal System

Figure II2-1

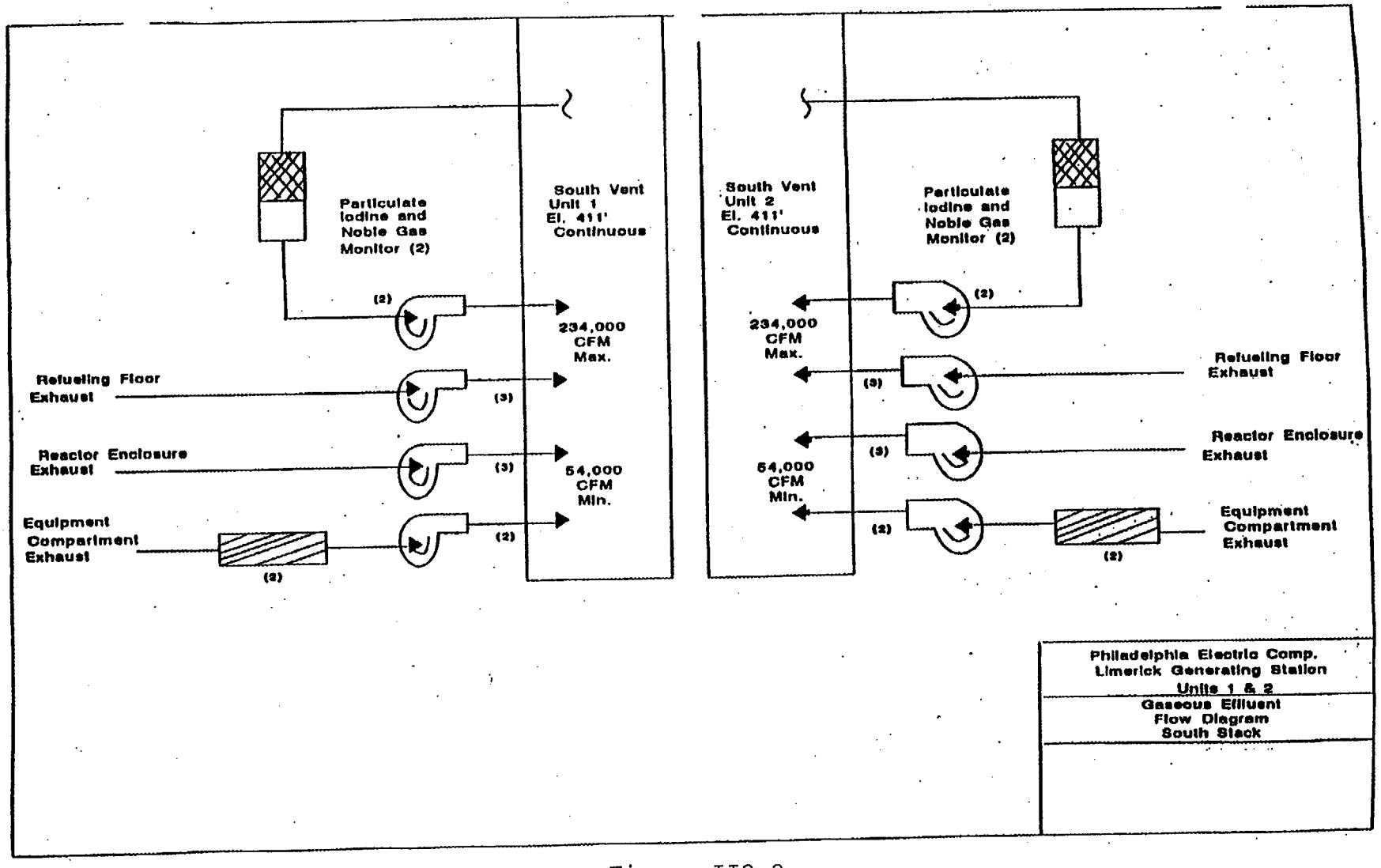

South Vent
Unit 1
El. 411'
Continuous
Particulate
Iodine and
Noble Gas
Monitor (2)
(2)
234,000
CFM
Max.
Refueling Floor
Exhaust
(3)
Reactor Enclosure
Exhaust
(3)
54,000
CFM
Min.
Equipment
Compartment
Exhaust
(2)
(2)
South Vent
Unit 2
El. 411'
Continuous
Particulate
Iodine and
Noble Gas
Monitor (2)
(2)
234,000
CFM
Max.
Refueling Floor
Exhaust
(3)
Reactor Enclosure
Exhaust
(3)
54,000
CFM
Min.
(2)
Equipment
Compartment
Exhaust
(2)
Philadelphia Electric Comp.
Limerick Generating Station
Units 1 & 2
Gaseous Effluent
Flow Diagram
South Stack

Figure II2-2

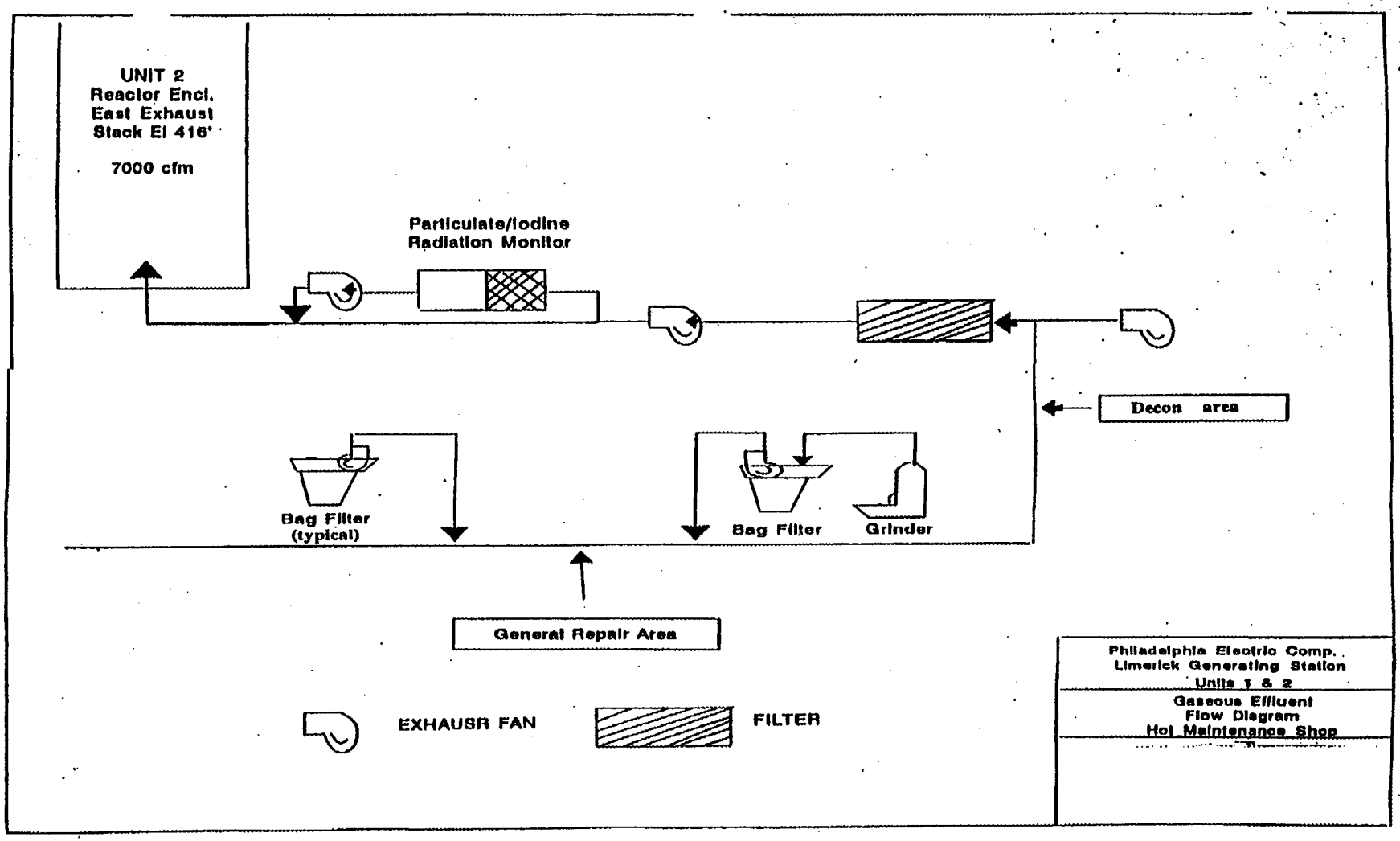

UNIT 2
Reactor Encl.
East Exhaust
Stack El 416'
7000 cfm
Particulate/Iodine
Radiation Monitor
Decon area
Bag Filter
(typical)
Bag Filter
Grinder
General Repair Area
EXHAUSR FAN
FILTER
Philadelphia Electric Comp.
Limerick Generating Station
Units 1 & 2
Gaseous Effluent
Flow Diagram
Hot Maintenance Shop

Figure II2-3

APPENDIX A

TABLE A-1

Technical Specification/ODCM Matrix

Technical Specification*	ODCM Section I Requirement	ODCM Equation Section II
3.3.7.11	3.2.1	1-1 1-2 1-3 1-4
3.3.7.12	3.3.1	2-1 (or 2-9) 2-2 (or 2-9) 2-4 (or 2-10) 2-5 (or 2-10)
3.11.1.1	3.2.2	1-1 1-2 1-3 1-4
3.11.1.2	3.2.3	1-5 1-6 1-7
3.11.1.3	3.2.4	1-8 1-9
3.11.2.1	3.3.2	2-22 2-23
3.11.2.3	3.3.4	2-26 2-27 2-28
3.11.2.2	3.3.3	2-24 2-25
3.11.2.4	3.3.5	2-33
3.11.2.7	3.3.6	2-4 2-5

*Parts of, or the entire Tech. Spec. Section, has been transferred to ODCM via T.S. amendment # 48 for Unit 1 and 11 for Unit 2.

TABLE A-1

Technical Specification/ODCM Matrix

Technical Specification*	ODCM Section I Requirement	ODCM Equation Section II
6.9.1.8	3.6	1-5 1-6 1-7 2-24 2-25 2-26 2-27 2-28
3.11.4	3.3.7	3-1
3.12.1	3.4.1	Section II App. B
6.9.1.7	3.5	1-5
3.12.3	3.4.3	1-6 1-7 2-29 2-30 2-31 2-32 3-2

*Parts of, or the entire Tech. Spec. Section, has been transferred to ODCM via T.S. amendment # 48 for Unit 1 and 11 for Unit 2.

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - SAMPLE TYPE, LOCATION, AND ANALYSIS

TABLE B-1

ODCM - Limerick Generating Station
Radiological Environmental Monitoring Program

	Pathway	Station Code	Location	Collection Method	Analyses
I	Direct	36S2	3,183 feet N of site	1 set of four (4) TLDs from each location at least quarterly	Gamma dose quarterly
	Site Boundary	3S1	2,301 feet NNE of site		
		5S1	2,350 feet NE of site		
		7S1	3,099 feet ENE of site		
		10S3	2,648 feet E of site		
		11S1	2,017 feet ESE of site		
		13S2	2,149 feet SE of site		
		14S1	3,319 feet SSE of site		
		18S2	1,390 feet S of site		
		21S2	977 feet SSW of site		
		23S2	2,793 feet SW of site		
		25S2	2,445 feet WSW of site		
		26S3	2,088 feet W of site		
		29S1	2,886 feet WNW of site		
		31S1	1,395 feet NW of site		
		34S2	3,071 feet NNW of site		
	Intermediate Distance	36D1	18,527 feet N of site		
		2E1	25,112 feet NNE of site		
		4E1	25,221 feet NE of site		
		7E1	22,489 feet ENE of site		
		10E1	20,826 feet E of site		
		10F3	29,442 feet ESE of site		
		13E1	22,772 feet SE of site		
		16F1	26,608 feet SSE of site		
		19D1	18,439 feet S of site		
		20F1	27,648 feet SSW of site		
		24D1	20,972 feet SW of site		
		25D1	21,044 feet WSW of site		
		28D2	20,231 feet W of site		
		29E1	26,110 feet WNW of site		
		31D2	20,446 feet NW of site		
		34E1	24,243 feet NNW of site		

TABLE B-1

	Pathway	Station Code	Location	Collection Method	Analyses
	Distant and Special Interest	5H1 C	130,742 feet NE of site		
		6C1	11,305 feet NE of site		
		9C1	11,377 feet E of site		
		13C1	14,980 feet SE of site		
		15D1	16,877 feet SE of site		
		17B1	8,462 feet S of site		
		20D1	16,157 feet SSW of site		
		31D1	15,853 feet WNW of site		
II.	Airborne Particulates	10S3	2,648 feet E of site	Approximately 1 cfm continuous flow through glass fiber filter which is collected weekly.	Gross beta analysis on each weekly sample. Gamma spectrometry shall be done when gross beta exceeds ten times the yearly mean of control station value. Gross beta analysis done 24 hr after sampling to allow for Radon and Thoron daughter decay. Gamma Spec on quarterly composite.
		11S1	2,017 feet ESE of site		
		14S1	3,319 feet SSE of site		
		13C1	14,980 feet SE of site		
		22G1 C	93,619 feet SW of site		
	Iodine	10S3	2,648 feet E of site	A TEDA impregnated flow-through cartridge is connected to air sampler and is collected weekly at site filter change.	Iodine 131
		11S1	2,017 feet ESE of site		
		14S1	3,319 feet SSE of site		
		13C1	14,980 feet SE of site		
		22G1 C	93,619 feet SW of site		

TABLE B-1

	Pathway	Station Code	Location	Collection Method	Analyses
III.	Water Surface	24SI C 13BI	1,058 feet SW of site 9,225 feet SE of site	Sample collected from a continuous water sampler, monthly. In event sampler is inoperable, weekly grab samples will be collected until sampler returned to service.	Gamma isotopic analysis monthly. H-3 on quarterly composite
	Sediment	16C4	11,510 feet SSE of site	A sediment sample is taken down stream of discharge semi-annually	Gamma isotopic analysis each sample
IV.	Ingestion Milk	18C1 19B1 21B1 9G1 C	12,144 feet S of site 10,317 feet SSW of site 9,263 feet SSW of site 62,304 feet E of site	Sample of fresh milk is collected from each farm biweekly when cows are on pasture (April) through October), monthly at other times.	Gamma isotopic and I-131 analyses on each sample
	Drinking	15F7 15F4 16C2 28F3 C	33,400 feet SSE of site 45,514 feet SE of site 14,034 feet SSE of site 30,811 feet WNW of site	Sample collected from a continuous water sampler monthly. In event sampler is inoperable, weekly grab samples will be collected until sampler returned to service.	Gross beta and gamma isotopic monthly, H-3 on quarterly composite
	Fish	16C5 29C1 C	9,251 feet SE of site 13,725 feet WNW of site	Two species of recreationally important fish (Predator and bottom feeder) sampled in season or semiannuall if not seasonal.	Gamma isotopic analyses on edible portions.

TABLE B-1

Pathway	Station Code	Location	Collection Method	Analyses
Food Products	Two offsite locations of highest predicted annual average ground level D/Q and one location (15- 30 km distance) in the least prevalent wind direction as determined using the results of the most recent annual Landuse Survey.		Samples of three (3) different kinds of broad leaf vegetation monthly when determined using the results of the most recent annual Landuse Survey if milk sampling is not performed.	Gamma isotopic analysis

C = Control Location

Figure B-1
Environmental Sampling Locations On Site or
Near the Limerick Generating Station

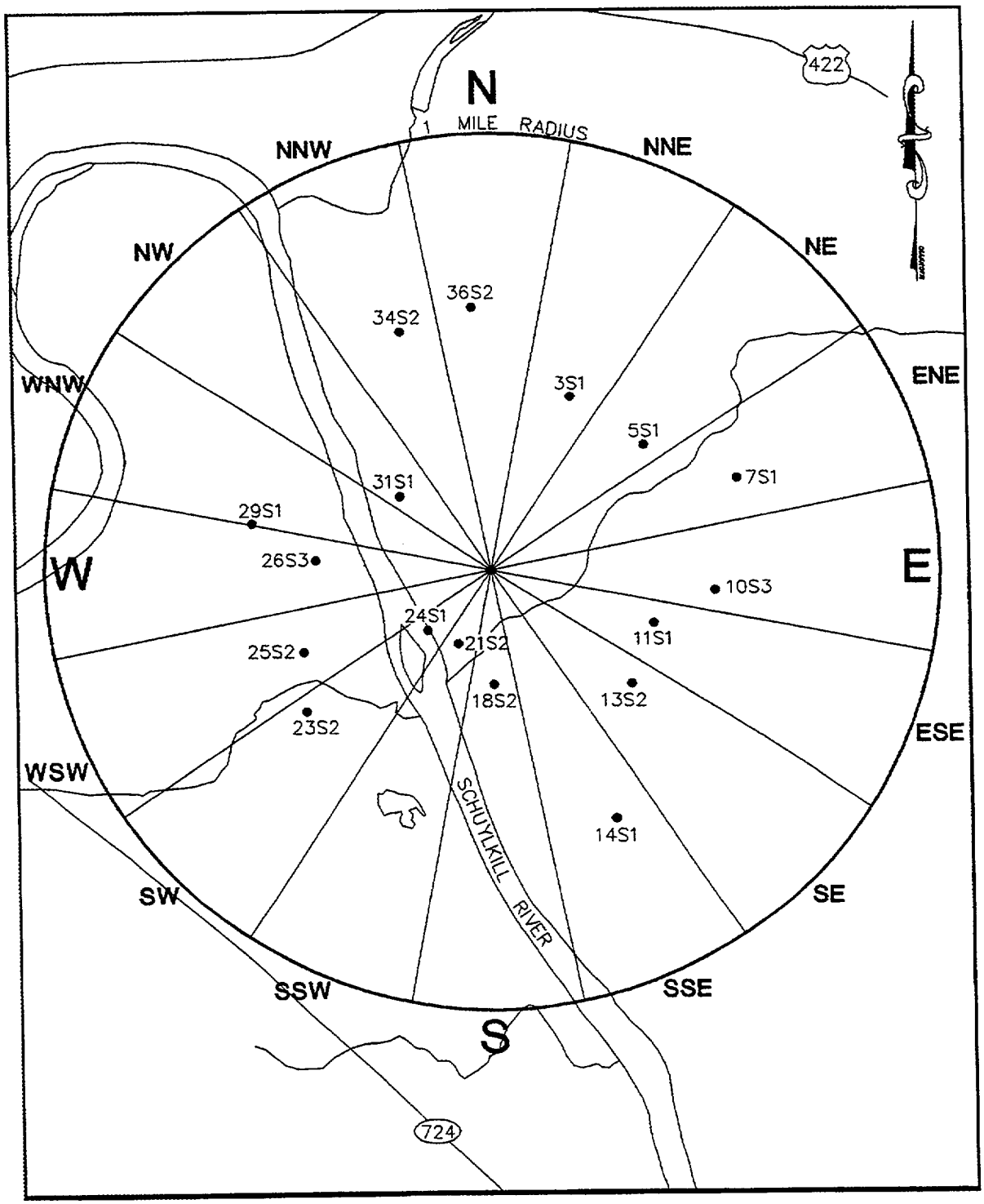


Figure B-2
Environmental Sampling Locations at Distances Less Than Five Miles from the Limerick Generating Station.

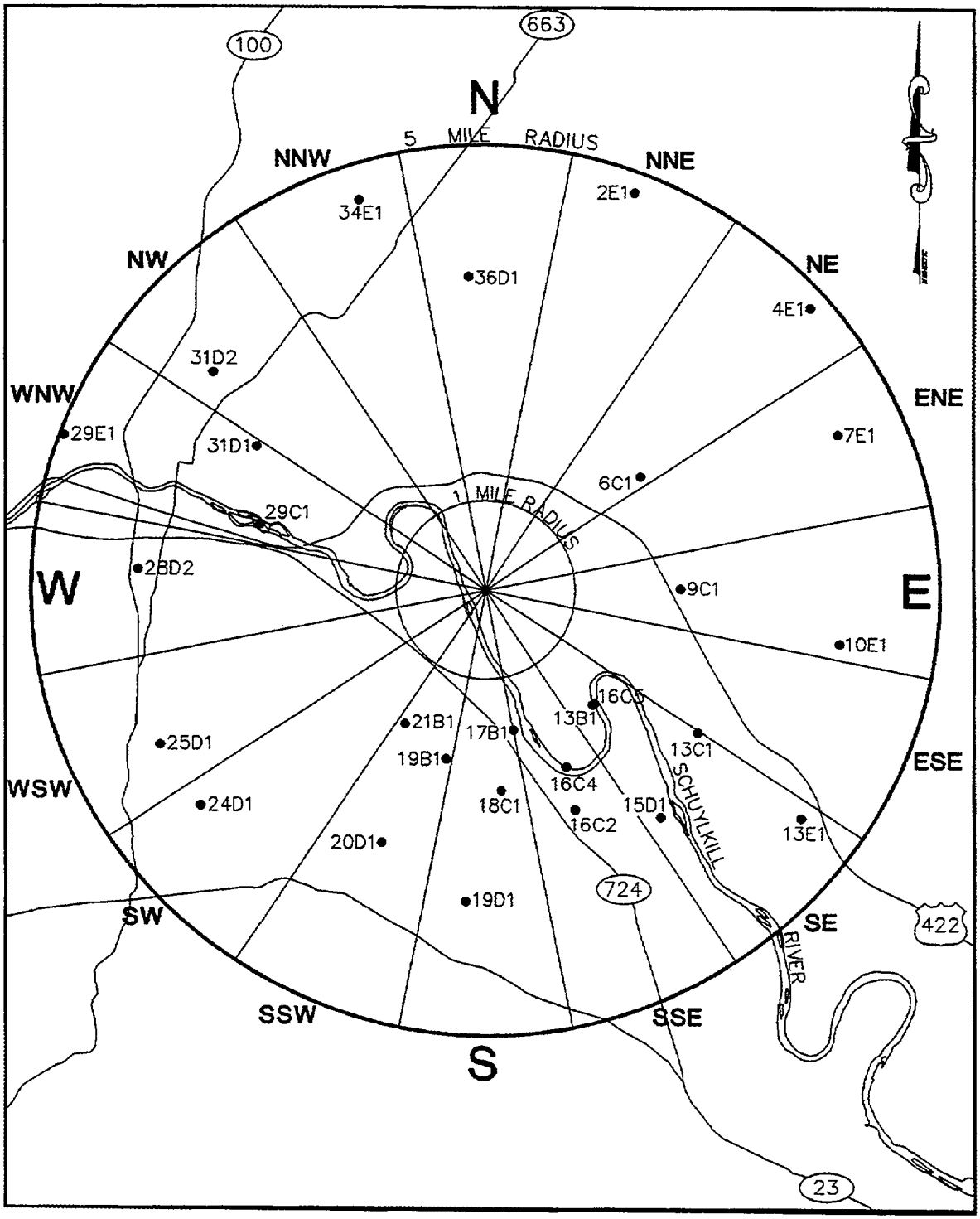
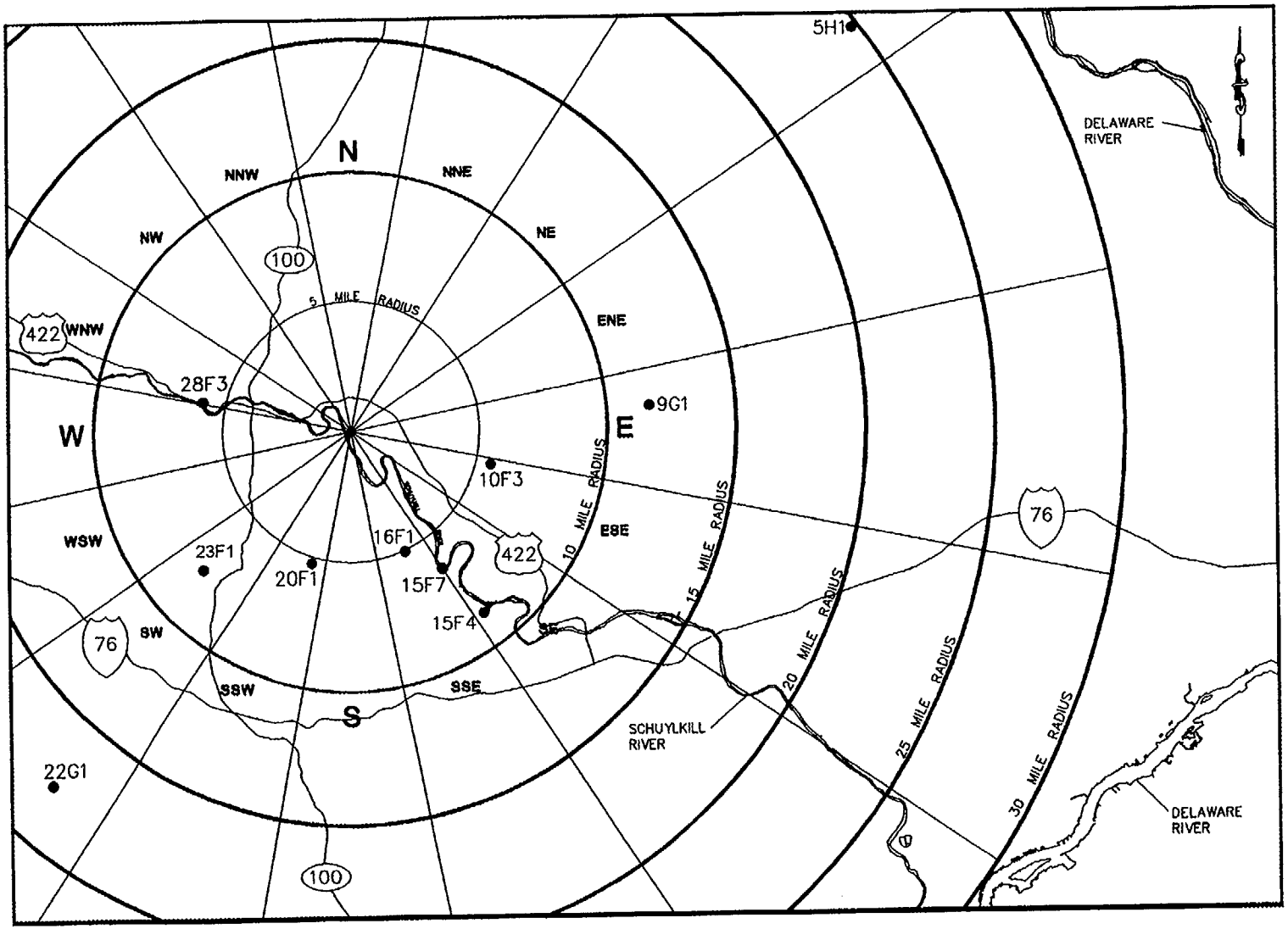


Figure B-3
Environmental Sampling Locations at Distances Greater Than Five Miles from the Limerick Generating Station.



APPENDIX C

ODCM Revision Process

I. REVISION PROCESS

a. The preparer shall ensure the ODCM contains program elements described in Technical Specifications 6.8.4.d,e and f.

b. All pages affected by the change shall contain revision bars in the margin indicating the area of the page changes and the date (month and year) of the change. Revision bars from previous revisions shall be removed.

c. In addition to the requirements of LR-C-9, the following shall also be performed:

1. The preparer of the proposed change shall assemble an ODCM revision package. This package should contain:

a. Proposed page changes.

b. Sufficient information, appropriate analysis or evaluation to support the change.

c. A determination that the changes will maintain the level of effluent control required by 10CFR20.1301, 10CFR20.1302, 40 CFR Part 190, 10CFR50.36a and Appendix I to 10CFR Part 50.

d. A 10CFR50.59 review prepared in accordance with administrative procedures.

e. Other documentation as required by administrative procedures.

2. The preparer shall obtain review of the ODCM revision package utilizing the SQR process in accordance with administrative procedures. This review should include:

a. Branch Manager

b. Cross-disciplinary review (i.e., HP, Chem, R/W, Nuclear Eng. Div. Programs Branch, EP), if required, and

c. Review by Responsible Superintendent

3. Upon satisfactory completion of the SQR and responsible Superintendent reviews, the preparer shall obtain PORC approval of the ODCM revision package.

II. APPROVAL

a. Upon satisfactory completion of PORC review and appropriate review/approval forms, the revised ODCM shall be forwarded to

the Plant Manager for approval signature on the ODCM cover sheet.

III. ISSUANCE

a. The ODCM shall be issued as a complete document. Issuing page changes is not permitted.

b. The ODCM shall contain a cover sheet indicating the ODCM revision number and a Table of Contents. All pages of the ODCM shall be marked with the revision number and date.

c. The preparer shall forward the following to the Document Control Center:

1. Original ODCM for issuance.

2. The ODCM revision package.

3. 10 CFR50.59 reviews.

4. All appropriate review/approval forms.

IV. IMPLEMENTATION

a. Changes to the ODCM shall become effective upon approval of the Plant Manager.

b. A copy of the complete ODCM shall be submitted to the NRC with the Annual Radioactive Release Report for the period of the report in which the change to the ODCM was made.

REFERENCES

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

2. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, July 1977.

3. Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, April 1976.

4. Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," Revision 1, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, April 1977.

5. U.S. Nuclear Regulatory Commission, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE Code)," USNRC Report NUREG-0016, Washington, D.C. 20555, April 1976.

6. U.S. Nuclear Regulatory Commission, "X0QD0Q, Program for the Methodological Evaluation of Routine Effluent Releases at Nuclear Power Stations," USNRC Report NUREG-0324, Washington, D.C. 20555, September, 1977.

7. Title 10, "Energy," Chapter I, Code of Federal Regulations; Part 20, Appendix B, U.S. Government Printing Office, Washington, D.C. 20402, January 1, 1977.

8. Title 10, "Energy," Chapter I, Code of Federal Regulations; Part 100, U.S. Government Printing Office, Washington, D.C. 20404, January 1, 1977.

9. Title 40, "Protection of Environment," Chapter I, Code of Federal Regulations, Part 141, U.S. Government Printing Office, Washington, D.C. 20402, January 1, 1977.

10. 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, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, June 1974.

11. Title 40, "Protection of Environment," Chapter I, Code of Federal Regulations, Part 190, Federal Register, Vol. 42, No. 9, Washington, D.C. 20402, January 13, 1977.

12. U.S. Nuclear Regulatory Commission, "Short Term Diffusion Estimates," Section 2.3.4, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants - LWR Edition, USNRC Report NUREG-75/087, Washington, D.C. 20555, November 1975.

13. U.S. Nuclear Regulatory Commission, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," USNRC Report NUREG-0133, Washington, D.C. 20555, October 1978.

14. Letter From Thomas E. Marley, Director Office of Nuclear Reactor Regulations, To Thomas E. Tipton Vice President and Director Operations, Nuclear Management and Resources Council, 6/30/93.

REFERENCES

15. ANSI N42.14-1991 (Revision of ANSI N42.14-1978) "Calibration and Use of Germanium Spectrometers For the Measurement of Gamma-Ray Emission Rates of Radionuclides", Sect. 6.2.2

16. EML Procedures Manual, H.L. Volchok and G. dePlangue, Editors, U.S. Dept. Of Energy (Revised Annually)

17. L.A. Currie, "Limits For Qualitative Detection and Quantitative Determination - Application to Radiochemistry", Analytical Chemistry, Vol. 40, pp. 586-593 (TABLE II), 1968

18. NUREG/CR-4007, "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements", prepared by NRC by L.A. Currie (Chapter II, Sect. D.2; Chapter III, Sect. C.1), September 1984

19. Tech. Spec. Section 1.24 (Definitions)

20. USNRC Generic Letter, 89-01

21. Tech. Spec. Section 6.14.

22. Tech. Spec. Section 6.5.1.6m.

23. Tech. Spec. Section 6.5.3.

24. Tech. Spec. Section 6.8.4d, e and f.

25. Tech. Spec. Section 6.9.1.8/ODCM Control I.3.6.

26. Tech. Spec. Section 6.10.3m and n.

27. UFSAR, Section 11.5.6.

28. Bechtel, Inc., "Dilution Studies for Routine and Accidental Releases from Limerick Nuclear Plant into the Schuylkill River", March, 1996.

29. ANSI/ANS-6.6.1-1979 "calculation and measurement of direct and scattered gamma radiation from LWR nuclear power plants, Section 7

30. Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June, 1975).