OFFSITE DOSE CALCULATION MANUAL

FOR

TU ELECTRIC

COMANCHE PEAK STEAM ELECTRIC STATION

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

List of Tables

List of Tables

List of Figures

Cross Reference to Technical Specifications and REC

Document	Number or Section	Requirement	ODCM Section
		PART I-RADIOLOGICAL EFFLUENT CONTROLS (REC)	
Tech Specs	6.8.3.e.1	Effluent monitoring instrumentation operability, surveillance, and setpoint requirements	3/4.3.3.4 and 3/4.3.3.5
Tech Specs	6.8.3.e.2	Limit liquid effluent concentration	3/4.11.1.1
Tech Specs	6.8.3.e.3	Effluent monitoring, sampling, and analysis requirements	3/4.11.1.1 and 3/4.11.2.1
Tech Specs	6.8.3.e.4	Limit doses due to liquid effluents	3/4.11.1.2
Tech Specs	6.8.3.e.5	Determine cumulative and projected doses due to radioactive effluents	3/4.11.1.2, 3/4.11.2.2, 3/4.11.2.3, 3/4.11.1.3, and 3/4.11.2.4
Tech Specs	6.8.3.e.6	Effluent treatment systems operability requirements	3/4.11.1.3 and 3/4.11.2.4
Tech Specs	6.8.3.e.7	Limit gaseous effluent dose rate	3/4.11.2.1
Tech Specs	6.8.3.e.8	Limit noble gas air dose	3/4.11.2.2
Tech Specs	6.8.3.e.9	Limit gaseous effluent iodine and particulate dose	3/4.11.2.3
Tech Specs	6.8.3.e.10	Limit total dose	3/4.11.4
Tech Specs	6.8.3.f.1	Monitoring, sampling, and analysis of radiation in the environment	3/4.12.1
Tech Specs	6.8.3.f.2	Land Use Census	3/4.12.2
Tech Specs	6.8.3.f.3	Interlaboratory Comparison Program	3/4.12.3
		PART II - CALCULATIONAL METHODOLOGIES	
REC	3/4.11.1.1	Liquid effluent concentration	1.1
REC	3/4.11.1.2	Dose due to liquid effluents	1.3
REC	3/4.11.1.3	Dose projections for liquid releases	1.4

Cross Reference to Technical Specifications and REC

Document	Number or Section	Requirement	ODCM Section
REC	3/4.11.2.1.a	Dose rate due to noble gases	2.1.1
REC	3/4.11.2.1.b	Dose rate due to iodine, tritium, and particulates with half lives greater than eight days	2.1.6
REC	3/4.11.2.2	Air dose due to noble gases	2.2.1
REC	3/4.11.2.3	Doses due to iodines, tritium, and particulates with half-lives greater than eight days	2.2.2
REC	3/4.11.2.4	Dose projections for gaseous releases	2.2.3
REC	3/4.11.4	Total dose due to releases of radioactivity and direct radiation	2.2.4
REC	3/4.12.1	Description of radiological environmental sampling locations	3.1
REC	3/4.12.2	Dose calculations for identifying changes to environmental sampling locations	2.2.4
REC	3/4.12.3	Description of the Interlaboratory Comparison Program	3.2
REC	3.3.3.4	Radioactive liquid effluent monitoring channels alarm/trip setpoints	
		o liquid waste monitor (XRE-5253)	1.2.1
		o turbine building sump monitor (1RE-5100)	1.2.2
		o service water monitor (1RE-4269/4270)	1.2.3

Cross Reference to Technical Specifications and REC

Document	Number or Section	Requirement	ODCM Section
REC	3.3.3.5	Radioactive gaseous effluent monitoring channels alarm/trip setpoints	
		o noble gas release rate monitors XRE-5570A and XRE-5570B (WGRM release rate channels)	2.1.3
		o noble gas activity monitors XRE-5570A and XRE-5570B (WRGM low range activity channel) XRE-5567A and XRE-5567B (PIG noble gas channel)	2.1.2
		o waste gas holdup system mon'tor (au⁄iliary building vent monitor) XRE-5701	2.1.4
		o sampler flow rate monitor XFT-5570A2/B2	2.1.3
Tech Specs	3.3.3.1	Radiation monitoring channels alarm/trip setpoint	
		o Containment atmosphere gaseous monitor (containment vent monitor) 1RE-5503	2.1.5
Tech Specs REC	6.9.1.4 6.9.1.4	Assessment of radiation doses due to liquid and gaseous effluents released during the previous year	2.2.4
Tech Specs REC	6.9.1.4 6.9.1.4	Assessment of doses to members of the public inside the site boundary	2.2.4
Tech Specs REC	6.9.1.4 6.9.1.4	Assessment of doses to the most likely exposed member of the public from reactor releases and direct radiation	2.2.4

REFERENCES

1. Boegli, J.S., R. R. Bellamy, W. L. Britz, and R. L. Waterfield, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," NUREG-0133 (October 1978).

2. Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I, U. S. NRC Regulatory Guide 1.109, Rev. 1 (October 1977).

3. "Environmental Report," TU Electric, Comanche Peak Steam Electric Station.

4. "Final Safety Analysis Report," TU Electric, Comanche Peak Steam Electric Station.

5. Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, U.S. NRC Regulatory Guide 1.111 (March 1976).

6. Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Release from Light - Water - Cooled Reactors, U.S. NRC Regulatory Guide 1.111, Rev. 1 (July 1977).

7. Meteorology and Atomic Energy; Edited by Slade, D. H.; U. S. Department of Commerce (July 1968).

8. "Unit 1 Technical Specifications," TU Electric, Comanche Peak Steam Electric Station.

9. Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program (Generic Letter 89-01), USNRC, January 31, 1989.

10. CPSES Technical Evaluation No. RP-90-3077, "Calculation of Site Related Ingestion Dose Commitment Factors For Sb-122."

11. "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," USNRC Regulatory Guide 1.109 (March 1976).

INTRODUCTION

The OFFSITE DOSE CALCULATION MANUAL (ODCM) is a supporting document of the CPSES Technical Specification. Part I of the ODCM contains (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by Technical Specification 6.8.3, (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Semiannual Radioactive Effluent Release Reports required by Technical Specifications 6.9.1.3 and 6.9.1.4, and (3) Controls for Meteorological Monitoring Instrumentation and Sealed Source Leakage. Part II of the ODCM describes the methodology and parameters to be used in the calculation of offsite doses due to radioactive liquid and gaseous effluents and in the calculation of liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints. Part II of the ODCM also contains a list and graphical description of the specific sample locations for the radiological environmental monitoring program. Liquid and Gaseous Radwaste Treatment System configurations are shown in Figures 1.1 and 2.1

The ODCM will be maintained at the plant for use as a reference guide and training document on accepted methodologies and calculations. Changes in the calculation methods or parameters will be incorporated into the ODCM in order to assure that the ODCM represents the present methodology in all applicable areas. TU Electric initiated changes to the ODCM will be implemented in accordance with Section 6.14 of the Technical Specifications.

The ODCM follows the methodology and models suggested by NUREG-0133 (Ref. 1) and Regulatory Guide 1.109, Revision 1 (Ref. 2). Simplifying assumptions have been applied in this manual where applicable to provide a more workable document for implementing the Radiological Effluent Control requirements. This simplified approach will result in a more conservative dose evaluation, but requires the least amount of time for establishing compliance with regulatory requirements.

This manual is designed to provide necessary information in order to simplify the dose calculations. The dose calculations can be optionally expanded to several levels of effort. The complexity of the dose calculations can be expanded by several levels of effort, aiming toward a full calculation in accordance with Regulatory Guide 1.109. Future changes to the ODCM may be initiated to implement more complex calculations as systems become available and are validated that can reliably, economically and properly perform these more complex calculations. A beneficial approach to implementing the Radiological Effluent Control Program and Regulatory Guide 1.21 (Semiannual Radioactive Effluent Release Report) requirements is to use a computerized system to determine the effluent releases and update cumulative doses.

Where additional clarification or information is required to adequately implement certain ODCM requirements, supplemental guidance is provided in Appendix G of Part II.

PART I

RADIOLOGICAL EFFLUENT CONTROLS

SECTION 1.0

DEFINITIONS

1.0 DEFINITIONS

The defined terms of this section appear in capitalized type and are applicable throughout these Controls.

ACTION

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

ANALOG CHANNEL OPERATIONAL TEST

1.3 An ANALOG CHANNEL OPERATIONAL TEST shall be the injection of a simulated signal into the channel as close to the sensor as practicable to verify OPERABILITY of alarm, interlock and/or trip functions. The ANALOG CHANNEL OPERATIONAL TEST shall include adjustments, as necessary, of the alarm, interlock and/or Trip Setpoints such that the Setpoints are within the required range and accuracy.

CHANNEL CALIBRATION

1.5 A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel such that it responds within the required range and accuracy to known values of input. The CHANNEL CALIBRATION shall encompass the entire channel including the sensors and alarm, interlock and/or trip functions and may be performed by any series of sequential, overlapping, or total channel steps such that the entire channel is calibrated.

CHANNEL CHECK

1.6 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.

DIGITAL CHANNEL OPERATIONAL TEST

1.10 A DIGITAL CHANNEL OPERATIONAL TEST shall consist of exercising the digital computer hardware using data base manipulation and injecting simulated process data to verify OPERABILITY of alarm and/or trip functions.

DOSE EQUIVALENT I-131

1.11 DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microCurie/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" or Table E-7 of NRC Regulatory Guide 1.109, Revision 1, October 1977.

FREQUENCY NOTATION

1.15 The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the intervals defined in Table 1.1.

MEMBER(S) OF THE PUBLIC

1.18 MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the licensee, its contractors or vendors. Also excluded from this category are persons who enter the site to service equipment or 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.

OFFSITE DOSE CALCULATION MANUAL

1.19 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 Environmental Radiological Monitoring Program. The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by Section 6.8.3 and (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Semiannual Radioactive Effluent Release Reports required by Specifications 6.9.1.3 and 6.9.1.4.

OPERABLE - OPERABILITY

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

OPERATIONAL MODE - MODE

1.21 An OPERATIONAL MODE (i.e., MODE) shall correspond to any one inclusive combination of core reactivity condition, power level, and average reactor coolant temperature specified in Table 1.2.

PRIMARY PLANT VENTILATION SYSTEM

1.24 A PRIMARY PLANT VENTILATION SYSTEM shall be any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. Such a system is not considered to have any effect on noble gas effluents.

PURGE - PURGING

1.26 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 conditions, in such a manner that replacement air or gas is required to purify the confinement.

RATED THERMAL POWER

1.29 RATED THERMAL POWER shall be a total reactor core heat transfer rate to the reactor coolant of 3411 MWt.

REPORTABLE EVENT

1.31 A REPORTABLE EVENT shall be any of those conditions specified in 10CFR50.73.

SITE BOUNDARY

1.33 The SITE BOUNDARY shall be that line as shown in Figure 5.1-3.

SOURCE CHECK

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

THERMAL POWER

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

UNRESTRICTED AREA

1.41 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.

VENTING

1.42 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.

WASTE GAS HOLDUP SYSTEM

1.43 A WASTE GAS HOLDUP SYSTEM shall be any system designed and installed to reduce radioactive gaseous effluents by collecting Reactor Coolant System offgases from the Reactor Coolant System and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

TABLE 1.1

FREQUENCY NOTATION

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

TABLE 1.2

OPERATIONAL MODES

MODE		REACTIVITY CONDITION, K_{eff}	% RATED THERMAL POWER*	AVERAGE COOLANT TEMPERATURE
1.	POWER OPERATION	≥ 0.99	> 5%	≥ 350°F
2.	STARTUP	≥ 0.99	≤ 5%	≥ 350°F
3.	HOT STANDBY	< 0.99	0	≥ 350°F
4.	HOT SHUTDOWN	< 0.99	0	350°F>T_{avg} > 200°F
5.	COLD SHUTDOWN	< 0.99	0	≤ 200°F
6.	REFUELING**	≤ 0.95	0	≤ 140°F

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

SECTION 2.0

NOT USED

SECTIONS 3.0 AND 4.0

CONTROLS

AND

SURVEILLANCE REQUIREMENTS

3/4.0 APPLICABILITY

CONTROLS

3.0.1 Compliance with the Controls contained in the succeeding Controls is required during the OPERATIONAL MODES or other conditions specified therein; except that upon failure to meet the Control, the associated ACTION requirements shall be met.

3.0.2 Noncompliance with a control shall exist when the requirements of the Control and associated ACTION requirements are not met 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.

3.0.3 When a Control is not met, except as provided in the associated ACTION requirements, within 1 hour action shall be initiated to place the unit in a MODE in which the specification does not apply by placing it, as applicable, in:

a. At least HOT STANDBY within the next 6 hours,
b. At least HOT SHUTDOWN within the following 6 hours, and
c. At least COLD SHUTDOWN within the subsequent 24 hours.

Where corrective measures are completed that permit operation under the ACTION requirements, the action may be taken in accordance with the specified time limits as measured from the time of failure to meet the Control. Exceptions to these requirements are stated in the individual controls.

This control is not applicable in MODE 5 or 6.

3.0.4 Entry into an OPERATIONAL MODE or other specified condition shall not be made when the conditions for the Control are not met and the associated ACTION requires a shutdown if they are not met within a specified time interval. Entry into an OPERATIONAL MODE or specified condition may be made in accordance with ACTION requirements when conformance to them permits continued operation of the facility for an unlimited period of time. This provision shall not prevent passage through or to OPERATIONAL MODES as required to comply with ACTION requirements. Exceptions to these requirements are stated in the individual controls.

The associated basis from the CPSES Technical Specifications applies to this section.

APPLICABILITY

SURVEILLANCE REQUIREMENTS

4.0.1 Surveillance Requirements shall be met during the OPERATIONAL MODES or other conditions specified for individual Controls unless otherwise stated in an individual Surveillance Requirement.

4.0.2 Each Surveillance Requirement shall be performed within the specified time interval with a maximum allowable extension not to exceed 25% of the surveillance interval. Exceptions to these requirements are stated in the individual controls.

4.0.3 Failure to perform a Surveillance Requirement within the allowed surveillance interval, defined by Surveillance Requirement 4.0.2, 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 ACTION requirements are less than 24 hours. Surveillance Requirements do not have to be performed on inoperable equipment.

4.0.4 Entry into an OPERATIONAL MODE or other specified condition shall not be made unless the Surveillance Requirement(s) associated with the Control has been performed within the stated surveillance interval or as otherwise specified. This provision shall not prevent passage through or to OPERATIONAL MODES as required to comply with ACTION requirements. Exceptions to these requirements are stated in the individual controls.

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.3.4 In accordance with CPSES TS 6.8.3.e.1, the radioactive liquid effluent monitoring instrumentation channels shown in Table 3.3-7 shall be OPERABLE with their Alarm/Trip Setpoints set to ensure that the limits of Control 3.11.1.1 are not exceeded. The Alarm/Trip Setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM) .

APPLICABILITY: At all times.

ACTION:

a. With a radioactive liquid effluent monitoring instrumentation channel Alarm/Trip Setpoint less conservative than required by the above Control, immediately suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

b With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.3-7 . Restore the inoperable instrumentation to OPERABLE status within 30 days and, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report pursuant to Control 6.9.1.4 why this inoperability was not corrected in a timely manner.

c. The provisions of Controls 3.0.3 and 3.0.4 are not applicable .

SURVEILLANCE REQUIREMENTS

4.3.3.4 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and DIGITAL CHANNEL OPERATIONAL TEST or ANALOG CHANNEL OPERATIONAL TEST at the frequencies shown in Table 4.3-3 .

TABLE 3.3-7

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1. Radioactivity Monitors Providing Alarm and Automatic Termination of Release		
a. Liquid Radwaste Effluent Line (XRE-5253)	1	30
b. Turbine Building (Floor Drains) Sumps Effluent Line (1RE-5100)	1	31
2. Radioactivity Monitors Providing Alarm But Not Providing Automatic Termination of Release		
a. Service Water System Effluent Line (1RE-4269, 1RE-4270)	1/train	32
3. Flow Rate Measurement Devices		
a. Liquid Radwaste Effluent Line (XFT-5288)	1	33

TABLE 3.3-7 (Continued)

ACTION STATEMENTS

ACTION 30- With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with Control 4.11.1.1.1, 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 31- With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided grab samples are analyzed for radioactivity at a lower limit of detection of no more than 10^{-7} microCurie/ml:

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

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

ACTION 32- With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, operations may continue provided that:

a. With the component cooling water monitors (1RE-4509, 1RE-4510, & 1RE-4511) OPERABLE and indicating an activity of less than $1X10^{-4}$ microCurie/ml, a grab sample is collected and analyzed for radioactivity at a lower limit of detection of no more than 10^{-7} microCurie/ml at least every 31 days; or

b. At least once per 12 hours, grab samples are collected and analyzed for radioactivity at a lower limit of detection of no more than 10^{-7} microCurie/ml.

NOTE: Collection of grab samples is not required when there is no process flow at the monitor. 7

ACTION 33- With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours during actual releases. Pump performance curves generated in place may be used to estimate flow.

TABLE 4.3-3

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	DIGITAL CHANNEL OPERATIONAL TEST
1. Radioactivity Monitors Providing Alarm and Automatic Termination of Release					
a Liquid Radwaste Effluent Line (XRE-5253)	D	P	R(4)	N.A.	Q(1)
b. Turbine Building (Floor Drains) Sumps Effluent Line(1RE-5100)	D	M	R(4)	N.A.	Q(2)
2. Radioactivity Monitors Providing Alarm But Not Providing Automatic Termination of Release					
a. Service Water System Effluent Line (1RE-4269, 1RE-4270)	D	M	R(4)	N.A.	Q(3)
3. Flow Rate Measurement Devices					
a. Liquid Radwaste Effluent Line (XFT-5288)	D(5)	N.A.	R	Q	N.A.

TABLE 4.3-3 (Continued)
TABLE NOTATIONS

(1) The DIGITAL CHANNEL OPERATIONAL TEST shall also demonstrate that automatic isolation of this pathway and Control Room alarm annunciation occur if any of the following conditions exist:

a. Instrument indicates measured levels above the Alarm/Trip Setpoint, or

b. Circuit failure (Channel Out of Service - Loss of Power, Loss of Counts, Loss of Sample Flow, or Check Source Failure).

(2) The DIGITAL CHANNEL OPERATIONAL TEST shall also demonstrate that automatic flow diversion of this pathway (from the Low Volume Waste Treatment System to the Co-Current Waste Treatment System) and Control Room alarm annunciation occur if any of the following conditions exist:

a. Instrument indicates measured levels above the Alarm/Trip Setpoint, or

b. Circuit failure (Channel Out of Service - Loss of Power, Loss of Counts, Loss of Sample Flow, or Check Source Failure).

(3) The DIGITAL CHANNEL OPERATIONAL TEST shall also demonstrate that Control Room alarm annunciation occurs if any of the following conditions exist:

a. Instrument indicates measured levels above the Alarm Setpoint, or

b. Circuit failure (Channel Out of Service - Loss of Power, Loss of Counts, Loss of Sample Flow, or Check Source Failure).

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

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

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.3.5 In accordance with CPSES TS 6.8.3.e.1, the radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.3-8 shall be OPERABLE with their Alarm/Trip Setpoints set to ensure that the limits of Control 3.11.2.1 are not exceeded . The Alarm/Trip Setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the ODCM.

APPLICABILITY: As shown in Table 3.3-8

ACTION:

a. With a radioactive gaseous effluent monitoring instrumentation channel Alarm/Trip Setpoint less conservative than required by the above Control, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.3-8 . Restore the inoperable instrumentation to OPERABLE status within 30 days and, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report pursuant to Control 6.9.1.4 why this inoperability was not corrected in a timely manner.

c. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.3.3.5 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and DIGITAL CHANNEL OPERATIONAL TEST or ANALOG CHANNEL OPERATIONAL TEST at the frequencies shown in Table 4.3-4 .

TABLE 3.3-8

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	ACTION	
1. WASTE GAS HOLDUP SYSTEM				
a. Noble Gas Release Rate Monitor - Providing Alarm and Automatic Termination of Release [XRE-5570A & XRE-5570B (effluent release rate channel)]	1/stack	**	34	
2. PRIMARY PLANT VENTILATION				
a. Noble Gas Release Rate Monitor [XRE-5570A & XRE-5570B (effluent release rate channel)]	1/stack	*	36	
b. Iodine Sampler (WRGM sample skid)	1/stack	*	37	
c. Particulate Sampler	1/stack	*	37	
d. Sampler Flow Rate Monitor, SMPL Flow 1 (X-RFT-5570A-1, X-RFT-5570B-1)	1/stack	*	35	4 4

TABLE 3.3-8 (Continued)

TABLE NOTATIONS

* At all times.
** During Batch Radioactive Releases via this pathway.

ACTION 34- With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, the contents of the tank(s) may be released to the environment provided that prior to initiating the release:

a. The auxiliary building vent duct monitor (XRE-5701) is confirmed OPERABLE, or

b. At least two independent samples of the tank's contents are analyzed, and

c. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge valve lineup.

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 35- With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided the sample flow rate is estimated at least once per 4 hours. 4

ACTION 36- With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that:

(a) A Plant Vent Noble Gas Activity Monitor (XRE-5570A, XRE-5570B (low range activity) or XRE-5567A, XRE-5567B) is OPERABLE, and the plant vent flow rate is estimated at least once per 4 hours; or

(b) The Plant Vent Flow Rate Monitor, PROC FLOW N (X-FT-5570A-1, X-FT-5570B-1), is OPERABLE, and an alternate Plant Vent Noble Gas Activity Monitor is OPERABLE (XRE-5567A, XRE-5567B) or grab samples are taken at least once per 12 hours and these samples are analyzed for radioactivity within 24 hours; or 4

(c) The plant vent flow rate is estimated at least once per 4 hours, and grab samples are taken at least once per 12 hours and these samples are analyzed for radioactivity within 24 hours.

ACTION 37- With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via the affected pathway may continue provided samples are continuously collected with auxiliary sampling equipment as required in Table 4.11-2.

TABLE 4 1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	DIGITAL CHANNEL OPERATIONAL TEST
1. WASTE GAS HOLDUP SYSTEM					
a. Noble Gas Release Rate Monitor - Providing Alarm and Automatic Termination of Release [XRE-5570A, XRE-5570B (effluent release rate channel)]	P	P	R(3)	N.A.	Q(1)
2. PRIMARY PLANT VENTILATION					
a. Noble Gas Release Rate Monitor [XRE-5570A, XRE-5570B (effluent release rate channel)]	D	#	R(3)	N.A.	Q(2)
b. Iodine Sampler (WRGM sample skid)	W(4)	N.A.	N.A.	N.A.	N.A.
c. Particulate Sampler (WRGM Sample Skid)	W(4)	N.A.	N.A.	N.A.	N.A.
d. Sampler Flow Rate Monitor, SMPL Flow 1 (X-RFT-5570A-1, X-RFT-5570B-1)	D	N.A.	R	Q	N.A. 4

TABLE 4.3-4 (Continued)

TABLE NOTATIONS

Prior to any release from the WASTE GAS HOLDUP SYSTEM or containment PURGING or VENTING, not to exceed 31 days.

(1) The DIGITAL CHANNEL OPERATIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occurs if any of the following condition exists:

a. Instrument indicates measured levels above the Alarm/Trip Setpoint, or

b. Circuit failure, (Channel Out of Service - Loss of Power, Loss of Counts, Loss of Sample Flow, or Check Source Failure).

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

a. Instrument indicates measured levels above the Alarm Setpoint, or

b. Circuit failure, (Channel Out of Service - Loss of Power, Loss of Counts, Loss of Sample Flow, or Check Source Failure).

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

(4) The CHANNEL CHECK shall consist of visually verifying that the collection element (i.e., filter or cartridge, etc.) is in place for sampling.

METEOROLOGICAL MONITORING INSTRUMENTATION

CONTROLS

3.3.3.6 The meteorological monitoring instrumentation channels shown in Table 3.3.3-9 shall be OPERABLE.

APPLICABILITY: At all times.

ACTION:

a. With one or more required meteorological monitoring channels inoperable for more than 7 days, prepare and submit a Special Report to the Commission pursuant to CPSES Technical Specification 6.9.2 within the next 10 days outlining the cause of the malfunction and the plans for restoring the channel(s) to OPERABLE status.

SURVEILLANCE REQUIREMENTS

4.3.3.6 Each of the above meteorological monitoring instrumentation channels shall be demonstrated OPERABLE:

a. At least once per 24 hours by performance of a CHANNEL CHECK, and

b. At least once per 184 days by performance of a CHANNEL CALIBRATION.

TABLE 3.3-9

METEOROLOGICAL MONITORING INSTRUMENTATION

INSTRUMENT	LOCATION	MINIMUM OPERABLE
1. WIND SPEED		1 of 3
a. X-SY-4117	Nominal Elev. 60 m.	
b. X-SY-4118	Nominal Elev. 10 m.	
c. X-SY-4128*	Nominal Elev. 10 m.	
2. WIND DIRECTION		1 of 3
a. X-ZY-4115	Nominal Elev. 60 m.	
b. X-ZY-4116	Nominal Elev. 10 m.	
c. X-ZY-4126*	Nominal Elev. 10 m.	
3. AIR TEMPERATURE - Δ T		1 of 2
a. X-TY-4119	Nominal Elev. 60 m. and Nominal Elev. 10 m.	
b. X-TY-4120	Nominal Elev. 60 m. and Nominal Elev. 10 m.	

*Mounted on backup tower.

SEALED SOURCE CONTAMINATION

CONTROLS

3.7.15 Each sealed source containing radioactive material either in excess of 100 microCuries of beta and/or gamma emitting material or 5 microCuries of alpha emitting material shall be free of greater than or equal to 0.005 microCurie of removable contamination.

APPLICABILITY: At all times.

ACTION

With a sealed source having removable contamination in excess of the above limits, immediately withdraw the sealed source from use and either:

1. Decontaminate and repair the sealed source, or

2. Dispose of the sealed source in accordance with Commission Regulations.

SURVEILLANCE REQUIREMENTS

4.7.15.1 Test Requirements - Each sealed source shall be tested for leakage and/or contamination by:

a. The licensee, or

b. Other persons specifically authorized by the Commission or an Agreement State.

The test method shall have a detection sensitivity of at least 0.005 microCurie per test sample.

4.7.15.2 Test Frequencies - Each category of sealed sources (excluding startup sources and fission detectors previously subjected to core flux) shall be tested at the frequency described below.

a. Sources in use - At least once per 6 months for all sealed sources containing radioactive materials:

1) With a half-life greater than 30 days (excluding Hydrogen 3), and

2) In any form other than gas.

b. Stored sources not in use - Each sealed source and fission detector shall be tested prior to use or transfer to another licensee unless tested within the previous 6 months. Sealed sources and fission detectors transferred without a certificate indicating the last test date shall be tested prior to being placed into use; and

c. Startup sources and fission detectors - Each sealed startup source and fission detector shall be tested prior to installation or within 31 days prior to being subjected to core flux and following repair or maintenance to the source.

4.7.15.3 Reports - A report shall be prepared and submitted to the Commission on an annual basis if sealed source or fission detector leakage tests reveal the presence of greater than or equal to 0.005 microCurie of removable contamination.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1 LIQUID EFFLUENTS

CONCENTRATION CONTROLS

3.11.1.1 In accordance with CPSES TS 6.8.3.e.2 and 3, the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Figure 5.1-3) shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} microCurie/ml total activity.

APPLICABILITY: At all times.

ACTION:

(a) 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.

(b) The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

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

TABLE 4.11-1

Radioactive Liquid Waste Sampling and Analysis Program

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (1) (μCi/ml)
1A. Batch Waste Release (2) Tanks to the Circulating Water Discharge a. Waste Monitor Tanks b. Laundry Holdup & Monitor Tanks c. Waste Water Holdup Tanks (8)	P Each Batch	P Each Batch	Principal Gamma Emitters (3)	5.0E-07
			I-131	1.0E-06
			Dissolved & Entrained Gases (Gamma Emitters)	1.0E-05
		M Composite (4)	H-3	1.0E-05
			Gross Alpha	1.0E-07
		Q Composite (4)	Sr-89, Sr-90	5.0E-08
			Fe-55	1.0E-06
1B. Batch Waste Release (2) Tanks to the LVW Pond a. Condensate Polisher Backwash Recovery Tanks (6,7) b. Component Cooling Water Drain Tank (7) c. Waste Water Holdup Tanks (6,8)	P Each Batch	P Each Batch	Principal Gamma Emitters (3)	5.0E-07
			I-131	1.0E-06
			H-3	1.0E-05
2A. Continuous Release (5) to the Circulating Water Discharge a. Low Volume Waste Pond Effluents	Daily Grab Sample (9)	Composite over pond discharge period (4)	Principal Gamma Emitters (3)	5.0E-07
			I-131	1.0E-06
			Dissolved & Entrained Gases (Gamma Emitters)	1.0E-05
			H-3	1.0E-05
			Gross Alpha	1.0E-07
		Q Composite (4)	Sr-89, Sr-90	5.0E-08
			Fe-55	1.0E-06
2B. Continuous Releases (5) to the LVW Pond a. Turbine Bldg. Sump No. 2 Effluents (6,7) a. Turbine Bldg. Sump No. 4 Effluents (6,7)	W Grab Sample	W	Principal Gamma Emitters (3)	5.0E-07
			I-131	1.0E-06
			H-3	1.0E-05

TABLE NOTATIONS

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

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

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

Where:

LLD = the "a priori" lower limit of detection (microCurie per unit mass or volume),

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

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22×10^6 = the number of disintegrations per minute per microCurie,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (sec^{-1}), and

Δt = the elapsed time between the midpoint of sample collection and the time of counting (s).

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

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

(2) 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 by a method described in the ODCM to assure representative sampling.

TABLE 4.11-1 (Continued)

TABLE NOTATIONS

(3) The principal gamma emmiters 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. Ce-144 shall also be measured, but with an LLD of 5×10^{-6}. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Semiannual Radioactive Effluent Release Report pursuant to Control 6.9.1.4 in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

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

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

(6) These waste streams shall be sampled and analyzed, in accordance with this table, if radioactive material is detected in the LVW Pond composite samples in concentrations that exceed 10% of the limits of 10 CFR 20, Appendix B, Table II, Column 2. This sampling shall continue until 2 consecutive samples from the waste stream show that the concentration of radioactive materials in the waste stream is less than or equal to 10% of the limits of 10 CFR 20, Appendix B, Table II, Column 2.

(7) All flow from these waste streams shall be diverted to the Waste Water Holdup Tanks if activity is present in the waste stream in concentrations that exceed the limits of 10 CFR 20, Appendix B, Table II, Column 2. Sampling and analysis of the respective Tanks or sumps are not required when flow is diverted to the Waste Water Holdup Tanks.

(8) Waste Water Holdup Tanks (WWHT) shall be discharged directly to the Circulating Water Discharge Tunnel when results of sample analyses indicate activity in concentrations that exceed the limits of 10 CFR 20, Appendix B, Table II, Column 2. Otherwise, WWHTs may be discharged to the Low Volume Waste Pond. WWHT discharges to the Circulating Water Discharge TUnnel shall be sampled and analyzed per Item 1A.c of this table. WWHT discharges to the LVW Pond shall be sampled and analyzed per ITem 1B.c of this table.

(9) Samples shall be taken at least once per 24 hours while the release is occurring. To be representative of the liquid effluent, the sample volume shall be proportioned to the effluent stream discharge volume. The ratio of sample volume to effluent discharge volume shall be maintained constant for all samples taken for the composite sample.

CONTROLS

3.11.1.2 In accordance with CPSES TS 6.8.3.e.4 and 6.8.3.e.5 the dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each unit, to UNRESTRICTED AREAS (see Figure 5.1-3) shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrems to the whole body and to less than or equal to 5 mrems to any organ, and

b. During any calendar year to less than or equal to 3 mrems to the whole body and to less than or equal to 10 mrems to any organ.

APPLICABILITY: At all times.

ACTION:

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

b. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.2 Culmulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in the ODCM at least once per 31 days.

CONTROLS

3.11.1.3 In accordance with CPSES TS 6.8.3.e.6, the Liquid Radwaste Treatment System shall be OPERABLE and appropriate portions of the system shall be used to reduce releases of radioactivity when the projected doses due to the liquid effluent, from each unit, to UNRESTRICTED AREAS (see Figure 5.1-3) would exceed 0.06 mrem to the whole body or 0.2 mrem to any organ in a 31-day period.

APPLICABILITY: At all times.

ACTION:

a. With radioactive liquid waste being discharged without treatment and in excess of the above limits and any portion of the Liquid Radwaste Treatment System not in operation, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that includes the following information:

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

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

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

b. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.3.1 Doses due to liquid releases from each unit to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM when Liquid Radwaste Treatment Systems are not being fully utilized.

4.11.1.3.2 The installed Liquid Radwaste Treatment System shall be considered OPERABLE by meeting Controls 3.11.1.1 and 3.11.1.2.

CONTROLS

3.11.1.4 The quantity of radioactive material contained in resins transferred to the LVW Pond shall be limited by the following expression:

$$\frac{264}{V} \sum_j \frac{A_j}{C_j} < 1.0$$

excluding tritium, dissolved or entrained noble gases, and radionuclides with less than an 8 day half life,

where:

A_j = pond inventory limit for single radionuclide "j" (Curies),

C_j = 10 CFR 20, Appendix B, Table II, Column 2, concentration for single radionuclide "j" (microCuries/ml),

V = volume of resins in the pond (gallons), and

264 = unit conversion factor (microCuries/Curie per milliliter/gallon). 7

APPLICABILITY: At all times.

ACTION:

a. With the quantity of radioactive material in the LVW Pond exceeding the above limit, immediately suspend all additions of radioactive material to the pond. 7

b. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.4 The quantity of radioactive material contained in each batch of slurry (used powdex resin) to be transferred to the LVW Pond shall be determined to be within the above limit by analyzing a representative sample of the slurry, and batches to be transferred to the LVW Pond shall be limited by the expression: 7

$$\sum_j \frac{Q_j}{C_j} < 0.008 \cdot R \frac{\mu Ci/gm}{\mu Ci/ml}$$

where:

Q_j = concentration of radioactive materials (microCuries/gm) in wet, drained slurry (used powdex resin) for radionuclide "j", excluding tritium, dissolved or entrained noble gases, and radionuclides with less than an 8 day half-life. The analysis shall include at least Ce-144, Cs-134, Cs-137, Co-58 and Co-60. Estimates of the Sr-89 and Sr-90 batch concentration shall be included based on the most recent quarterly composite analysis,

LVW POND RESIN INVENTORY 7

SURVEILLANCE REQUIREMENTS (Continued)

C_j = 10 CFR 20, Appendix B, Table II, Column 2, concentration for single radionuclide "j" (microCuries/milliliter). and 7

R = Slurry volume to resin weight ratio (ml/gm)

3/4.11.2 GASEOUS EFFLUENTS

DOSE RATE

3.11.2.1 In accordance with CPSES TS 6.8.3.e.3 and 6.8.3.e.7, the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY (see Figure 5.1-3) shall be limited to the following:

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

b. For Iodine-131, for Iodine-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.

APPLICABILITY: At all times.

ACTION:

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

(b) The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

4.11.2.1.2 The dose rate due to Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance the methodology and parameters in the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 4.11-2.

TABLE 4.11-2

Radioactive Gaseous Waste Sampling and Analysis Program (*)

GASEOUS RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD)(1) (μCi/ml)
1. Waste Gas Storage Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters(2)	1×10^{-4}
2. Containment Purge or Vent	P Each Release(3) Grab Sample	P Each Release(3)	Principal Gamma Emitters(2)	1×10^{-4}
		M	H-3 (oxide)	1×10^{-6}
3. Plant Vent	M(3), (4), (5) Grab Sample	M(3)	Principal Gamma Emitters(2)	1×10^{-4}
			H-3 (oxide)	1×10^{-6}
	Continuous(6)	W(7) Radioiodine Adsorber	I-131	1×10^{-12}
	Continuous(6)	W(7) Particulate Sample	Principal Gamma Emitters(2)	1×10^{-11}
	Continuous(6)	M Composite Particulate Sample	Gross Alpha	1×10^{-11}
	Continuous(6)	Q Composite Particulate Sample	Sr-89, Sr-90	1×10^{-11}
	Continuous(6)	Noble Gas ** Beta or Gamma	Noble Gas	1×10^{-6}

*Table notations next page

**This sample is continuously analyzed by a radiation monitor

TABLE 4.11-2 (Continued)

TABLE NOTATIONS

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

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

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

Where:

LLD = the "a priori" lower limit of detection (microCurie per unit mass or volume),

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

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22×10^6 = the number of disintegrations per minute per microCurie,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (sec -), and

Δt = the elapsed time between the midpoint of sample collection and the time of counting (s).

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

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

TABLE 4.11-2 (Continued)

TABLE NOTATIONS (Continued)

(2) The principal gamma emitters for which the LLD specification applies include the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 in noble gas releases and Mn-54, Fe-59, Co-58, Co-60, Zn-65, I-131, Cs-134, Cs-137, Ce-141 and Ce-144 in iodine and particulate releases. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Semiannual Radioactive Effluent Release Report, pursuant to Control 6.9.1.4, in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

(3) Sampling and analysis shall also be performed following shutdown, startup, or a THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period. This requirement does not apply if: (1) analysis of primary coolant activity performed pursuant to Technical Specification 4.4.7 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.

(4) Tritium grab samples shall be taken at least once per 24 hours when the refueling canal is flooded.

(5) Tritium grab samples shall be taken at least once per 7 days from the ventilation exhaust from the spent fuel pool area, whenever spent fuel is in the spent fuel pool.

(6) 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 3.11.2.1, 3.11.2.2, and 3.11.2.3.

(7) Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing, or after removal from the 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 within a 1-hour period and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLDs may be increased by a factor of 10. This requirement does not apply if: (1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the reactor 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.

DOSE - NOBLE GASES

CONTROLS

3.11.2.2 In accordance with CPSES TS 6.8.3.e.5 and 6.8.3.e.8, the air dose due to noble gases released in gaseous effluents, from each unit, to areas at and beyond the SITE BOUNDARY (see Figure 5.1-3) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrads for gamma radiation and less than or equal to 10 mrads for beta radiation, and

b. During any calendar year: Less than or equal to 10 mrads for gamma radiation and less than or equal to 20 mrads for beta radiation.

APPLICABILITY: At all times.

ACTION

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

b. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

DOSE - IODINE-131, IODINE-133, TRITIUM, AND RADIOACTIVE MATERIAL IN PARTICULATE FORM

CONTROLS

3.11.2.3 In accordance with CPSES TS 6.8.3.e.5 and 6.8.3.e.9, 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 each unit, to areas at and beyond the SITE BOUNDARY (see Figure 5.1-3) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrems to any organ and,

b. During any calendar year: Less than or equal to 15 mrems to any organ.

APPLICABILITY: At all times.

ACTION:

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

b. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

GASEOUS RADWASTE TREATMENT SYSTEM

CONTROLS

3.11.2.4 In accordance with CPSES TS 6.8.3.e.6, the PRIMARY PLANT VENTILATION SYSTEM and the WASTE GAS HOLDUP SYSTEM shall be OPERABLE and appropriate portions of these systems shall be used to reduce releases of radioactivity when the projected doses in 31 days due to gaseous effluent releases, from each unit, to areas at and beyond the SITE BOUNDARY (see Figure 5.1-3) would exceed:

a. 0.2 mrad to air from gamma radiation, or

b. 0.4 mrad to air from beta radiation, or

c. 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

APPLICABILITY: At all times.

ACTION:

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

1. Identification of any inoperable equipment or subsystems, and the reason for the inoperability,

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

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

b. The provisions of Control 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.2.4.1 Doses due to gaseous releases from each unit to areas at and beyond the SITE BOUNDARY shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM when Gaseous Radwaste Treatment Systems are not being fully utilized.

4.11.2.4.2 The installed PRIMARY PLANT VENTILATION SYSTEM and WASTE GAS HOLDUP SYSTEM shall be considered OPERABLE by meeting Controls 3.11.2.1 and 3.11.2.2 or 3.11.2.3.

3/4.11.4 TOTAL DOSE

CONTROLS

3.11.4 In accordance with CPSES TS 6.8.3.e.10, the annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrems to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

APPLICABILITY: At all times.

ACTION:

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Control 3.11.1.2a., 3.11.1.2b, 3.11.2.2a, 3.11.2.2b, 3.11.2.3a., or 3.11.2.3b., calculations shall be made including direct radiation contributions from the units and from outside storage tanks to determine whether the above limits of Control 3.11.4 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR 20.405c, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and 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.

b. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

3/4.11.4 TOTAL DOSE

SURVEILLANCE REQUIREMENTS

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

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

CONTROLS

3.12.1 In accordance with CPSES TS 6.8.3.f.1, the Radiological Environmental Monitoring Program shall be conducted as specified in Table 3.12-1.

APPLICABILITY: At all times.

ACTION:

a. With the Radiological Environmental Monitoring Program not being conducted as specified in Table 3.12-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Control 6.9.1.3, a description of the reason(s) for not conducting the program as required and the plan 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 3.12-2 when averaged over any calendar quarter, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective action 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 Control 3.11.1.2, 3.11.2.2, or 3.11.2.3. When more than one of the radionuclides in Table 3.12-2 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 3.12-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose* to A MEMBER OF THE PUBLIC from all radionuclides is equal to or greater than the calendar year limits of Control 3.11.1.2, 3.11.2.2, or 3.11.2.3. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the annual Radiological Environmental Operating Report required by Control 6.9.1.3.

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

CONTROLS

ACTION (Continued)

c. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 3.12-1, identify locations for obtaining replacement samples and add them within 30 days to the Radiological Environmental Monitoring Program given in the ODCM. The specific locations from which samples were unavailable may then be deleted from the monitoring program. Pursuant to Control 6.14, submit as a part of or concurrent with the Semiannual 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).

d. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

TABLE 3.12-1

Radiological Environmental Monitoring Program

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
1. Direct Radiation(2)	Forty routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY; An outer ring of stations, one in each meteorological sector in the 6- to 8-km range from the site; and The balance of the stations to be placed in special interest areas such as population centers, nearby residences, schools, and in one or two areas to serve as control stations.	Quarterly.	Gamma dose quarterly
2. Airborne Radioiodine and Particulates	Samples from five locations: Three samples from close to the three SITE BOUNDARY locations, in different sectors, of the highest calculated annual average ground-level D/Q;	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	Radioiodine Cannister: I-131 analysis weekly Particulate Sampler: Gross beta radioactivity analysis following filter change; [4] and gamma isotopic analysis [5] of composite (by location quarterly.

TABLE 3.12-1 (Continued)
Radiological Environmental Monitoring Program

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
	One sample from the vicinity of a community having the highest calculated annual average ground-level D/Q; and		
	One sample from a control location, as for example 15 to 30 km distant and in the least prevalent wind direction. (3)		
3. Waterborne			
a. Surface	Squaw Creek Reservoir (6)	Monthly composite of weekly grab samples.	Gamma isotopic analysis[5] monthly. Composite for tritium analysis quarterly.
	Lake Granbury	Monthly composite of weekly grab samples when Lake Granbury is receiving letdown from SCR. Otherwise, monthly grab sample.[7]	Gamma isotopic analysis[5] monthly. Composite for tritium analysis quarterly.
	Control-Brazos River upstream of Lake Granbury	Monthly	Gamma isotopic analysis[5] monthly. Composite for tritium analysis quarterly.
b. Ground	Samples from two sources if likely to be affected[8].	Quarterly	Gamma isotopic[5] and tritium analysis quarterly.

TABLE 3.12-1 (Continued)
Radiological Environmental Monitoring Program

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
3. Waterborne (Continued)			
c. Drinking	One sample from Squaw Creek Reservoir.	Composite of weekly grab samples over 2-week period when I-131 analysis is performed; monthly composite of weekly grab samples otherwise.	I-131 analysis of each composite sample when the dose calculated for the consumption of the water is greater than 1 mrem per year[9]. Gross beta and gamma isotopic analyses[5] monthly. Composite for tritium analysis quarterly.
d. Sediment from Shoreline	One sample from downstream area with existing or potential recreational value.	Semiannually.	Gamma isotopic analysis[5] semiannually.
4. Ingestion			
a. Milk	Samples from milking animals in three locations within 5 km distance having the highest dose potential. If there are none, sample from milking animals in each of three areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per yr.[9] One sample from milking animals at a control location, 15 to 30 km distant and in the least prevalent wind direction.[3]	Semimonthly when animals are on pasture; monthly at other times.	Gamma isotopic[5] and I-131 analysis semimonthly when animals are on pasture; monthly at other times.

TABLE 3.12-1 (Continued)
Radiological Environmental Monitoring Program

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
4. Ingestion (Continued)			
b. Fish and Invertebrates	One sample of at least two recreationally important species in vicinity of plant discharge area.	Sample semiannually.	Gamma isotopic analysis[5] on edible portions.
	One sample of same species in areas not influenced by plant discharge.		
c. Food Products*	One sample of each principal class of food products from any area that is irrigated by water in which liquid plant wastes have been discharged.	At time of harvest[10]	Gamma isotopic analysis[5] on edible porti .n.
	A sample of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground level D/Q if milk sampling is not performed at all required locations.	Monthly, when available.	Gamma isotopic[5] and I-131 analyses.
	One sample of each of the similar broad leaf vegetation grown 15 to 30 km distant in the least prevalent wind direction (3) if milk sampling is not performed at all required locations.	Monthly, when available.	Gamma isotopic[5] and I-131 analyses.

*Reports from 3 additional airborne radioiodine sample locations may be supplemented for broad leaf vegetation samples.

TABLE 3.12-1 (Continued)

TABLE NOTATIONS

(1) Specific parameters of distance and direction sector from the centerline of one reactor, and additional description where pertinent, shall be provided for each and every sample location in Table 3.12-1 in a table and figure(s) in the ODCM. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and to Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to circumstances such as hazardous conditions, seasonal unavailability, and malfunction of automatic sampling equipment. If specimens are unobtainable due to sampling equipment malfunction, effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to Control 6.9.1.3. 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 specific 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 given in the ODCM. Pursuant to Control 6.14, submit as a part of or concurrent with the next Semiannual 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).

(2) One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation.

(3) The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites that provide valid background data may be substituted.

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

TABLE NOTATIONS (Continued)

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

(6) The Reservoir shall be sampled in an area at or beyond but near the mixing zone. Also, the Reservoir shall be sampled at a distance beyond significant influence of the discharge.

(7) Lake Granbury shall be sampled near the letdown discharge and at a distance beyond significant influence of the discharge.

(8) 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.

(9) The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.

(10) If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvest occurs continuously, sampling shall be monthly. Attention shall be paid to including samples of tuberous and root food products.

TABLE 3.12-2

Reporting Levels for Radioactivity Concentrations in Environmental Samples

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

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

(**) If no drinking water pathway exists, a value of 20 pCi/l may be used.

TABLE 4.12-1
Detection Capabilities for Environmental Sample Analysis (1)(2)

Lower Limit of Detection (LLD) (3)

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m³)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
Gross Beta	4	0.01				
H-3	2000*					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1**	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

*If no drinking water pathway exists, a value of 3000 pCi/l may be used.
**If no drinking water pathway exists, a valve of 15 pCi/l may be used.

TABLE 4.12-1 (Continued)

TABLE NOTATIONS

(1) The list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to Control 6.9.1.3.

(2) Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.

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

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

Where:

LLD = the "a priori" lower limit of detection (picoCurie per unit mass or volume),

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

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22 = the number of disintegrations per minute per picoCurie,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (sec^{-1}), and

Δt = the elapsed time between the midpoint of sample collection and the time of counting(s).

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

TABLE 4.12-1 (Continued)

TABLE NOTATIONS (Continued)

(3) Continued

It should be recognized that the LLD is defined as an *a priori* (before the fact) limit representing the capability of a measurement system and not as an *a posteriori* (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLD's unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant to Control 6.9.1.3.

3/4.12.2 LAND USE CENSUS

CONTROLS

3.12.2 In accordance with CPSES TS 6.8.3.f.2, a Land Use Census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence, and the nearest garden* of greater than 50 m^2 (500 ft^2) producing broad leaf vegetation.

APPLICABILITY: At all times.

ACTION:

a. With a Land Use Census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Control 4.11.2.3, pursuant to Control 6.9.1.4, identify the new location(s) in the next Semiannual Radioactive Effluent Release Report.

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 3.12.1, add the new location(s) within 30 days, to the Radiological Environmental Monitoring Program given in Part II of the ODCM. The sampling locations 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 Control 6.14, submit as a part of or concurrent with the next Semiannual 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).

c. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.12.2 The Land Use Census shall be conducted during the growing season at least once per 12 months using that information that will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities. The results of the Land Use Census shall be included in the Annual Radiological Environmental Operating Report pursuant to Control 6.9.1.3.

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* Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. Specifications for broad leaf vegetation sampling in Table 3.12-1, Item 4.c. shall be followed, including analysis of control samples.

RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4 12.3 INTERLABORATORY COMPARISON PROGRAM

CONTROLS

3.12.3 In accordance with CPSES TS 6.8.3.f.3, analyses shall be performed on all radioactive materials, supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission, that correspond to samples required by Table 3.12-1.

APPLICABILITY: At all times.

ACTION:

a. With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to Control 6.9.1.3.

b. The provisions of Controls 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.12.3 The Interlaboratory Comparison Program shall be described in the ODCM. A summary of the results obtained as part of the above required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report pursuant to Control 6.9.1.3.

BASES

3/4.3.3.4 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

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

3/4.3.3.5 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

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

3/4.3.3.6 METEOROLOGICAL INSTRUMENTATION

The OPERABILITY of the meteorological instrumentation ensures that sufficient meteorological data are 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 protective measures to protect the health and safety of the public and is consistent with the recommendations of the second proposed Revision 1 to Regulatory Guide 1.23, "Onsite Meteorological Programs," April 1986.

3/4.7.15 SOURCE CONTAMINATION

The limitations on removable contamination for sources requiring leak testing, including alpha emitters, are based on 10CFR70.39(c) limits for plutonium. This limitation will ensure that leakage from Byproduct, Source, and Special Nuclear Material sources will not exceed allowable intake values.

Sealed sources are classified into three groups according to their use, with Surveillance Requirements commensurate with the probability of damage to a source in that group. Those sources which are frequently handled are required to be tested more often than those which are not. Sealed sources which are continuously enclosed within a shielded mechanism (i.e., sealed sources within radiation monitoring or boron measuring devices) are considered to be stored and need not be tested unless they are removed from the shielded mechanism.

3/4.11.1 LIQUID EFFLUENTS

3/4.11.1.1 CONCENTRATION

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 10CFR20, Appendix B, Table II, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within: [illegible]e Section II.A design objectives of 10CFR50, Appendix I, to a MEMBER O[illegible]BLIC, and (2) the limits of 10 CFR Part 20.106(e) to the population. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

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

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD and other detection limits can be found in Currie, L.A., "Lower Limit of Detection Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300.

3/4.11.1.2 DOSE

This control is provided to implement the requirements of Sections II.A, III.A and IV.A of 10CFR50, Appendix I. 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 to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." Also, for fresh water sites with drinking water supplies that can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40CFR141. The dose calculation methodology and parameters in the ODCM implement the requirments 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 10CFR50, 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.

DOSE (Continued)

This control applies to the release of radioactive materials in liquid effluents from each unit at the site. For units with shared Radwaste Systems, the liquid effluents from the shared system are to be proportional among the units sharing that system.

3/4.11.1.3 LIQUID RADWASTE TREATMENT SYSTEM

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

This control applies to the release of radioactive materials in liquid effluents from each unit at the site. For units with shared Radwaste Systems, the liquid effluents from the shared system are to be proportioned among the units sharing that system.

3/4.11.1.4 LVW POND RESIN INVENTORY

The inventory limits of the LVW Pond are based on limiting the consequences of an uncontrolled release of the pond inventory. The expression in Control 3.11.1.4 assumes the pond inventory is uniformly mixed, and that the pond is located in an unrestricted area as defined in 10 CFR Part 20, and that the concentration limit in Note 1 to Appendix B of 10 CFR Part 20 applies. This expression limits the total quantity of radioactive materials in resins discharged to the LVW Pond to a value such that the average concentration in the resins, calculated over the total volume of resins in the pond, will not exceed the Maximum Permissible Concentrations (MPCs) specified in 10 CFR 20, Appendix B, Table II, Column 2. Because Control 3.11.1.1 limits the concentration of liquid effluents from other pathways to the LVW Pond to the 10 CFR 20 MPC values, also limiting the average concentration in resins to the MPC values will assure that the average concentration in the pond from all sources, calculated over the total volume of the pond (liquid and resins), will not exceed the 10 CFR 20 MPC values.

LVW POND RESIN INVENTORY (Continued)

The batch limits of slurry to the LVW Pond assure that radioactive material in the slurry transferred to the Pond are "as low as is reasonably achievable" in accordance with 10 CFR 50.36a. The expression in Control 4.11.1.4 assures no batch of slurry will be transferred to the Pond unless the sum of the ratios of the activity of the radionuclides to their respective concentration limitation is less than the ratio of the 10 CFR Part 50, Appendix I, Section II.A, total body level to the 10 CFR 20.105(a), whole body dose limitation, or that:

$$\sum_j \frac{c_j}{C_j} < \frac{3 \text{ mrems/yr}}{500 \text{ mrems/yr}} = 0.006$$

where:

c_j = radioactive slurry concentration for radionuclide "j" entering the UNRESTRICTED AREA POND, in microCuries/milliliter, and

C_j = 10 CFR 20, Appendix B, Table II, Column 2, concentration for single radionuclide "j", in microCuries/milliliter.

The average concentration of radioactive materials in a particular batch of resin slurry released to the LVW Pond is dependent upon the slurry volume to resin weight ratio. Additionally, the wet drained slurry density is approximately 1 gm/ml and the absorption characteristics for gamma radiation are essentially that of water. Therefore,

$$\sum_j \frac{c_j}{C_j} = \sum_j \frac{q_j}{C_j \text{ (R ml/gm)}} < 0.006$$

$$\sum_j \frac{q_j}{C_j} < 0.006 \cdot R \frac{\mu\text{Ci/gm}}{\mu\text{Ci/ml}}$$

where the terms are defined in Control 4.11.1.4.

The batch limits provide assurance that activity input to the LVW Pond will be minimized, and a means of identifying that the radioactive material released is within the inventory limitation of Control 3.11.1.4. 7

3/4.11.2 GASEOUS EFFLUENTS

3/4.11.2.1 DOSE RATE

This control is provided to ensure that the dose at any time at and beyond the SITE BOUNDARY from gaseous effluents from all units on the site will be within the annual dose limits of 10CFR20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentrations of 10CFR20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Table II of 10CFR20, Appendix B (10CFR 20.106(b)). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. The methodology for calculating doses for such MEMBERS OF THE PUBLIC shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrems/year to the whole body or to less than or equal to 3000 mrems/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 mrems/year.

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

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLDs and other detection limits can be found in Currie, L.A., "Lower Limit of Detection Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300.

3/4.11.2.2 DOSE - NOBLE GASES

This control is provided to implement the requirements of Sections II.B, III.A and IV.A of 10CFR50, Appendix I. The control implements the guides set forth in Section I.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of the radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Dose to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977. The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

This control applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared radwaste treatment systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

3/4.11.2.3 DOSE - IODINE-131, IODINE-133, TRITIUM, AND RADIOACTIVE MATERIAL IN PARTICULATE FORM

This control is provided to implement the requirements of Sections II.C, III.A, and IV.A of 10CFR50, Appendix I. 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 to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, " Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specification for Iodine-131, Iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days is dependent upon the existing radionuclide pathways to man in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of the calculations were: (1) individual inhalation of airborne radionucludes, (2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, (3) deposition onto grassy areas where milk animals and meat-producing animals graze with consumption of the milk and meat by man, and (4) deposition on the ground with subsequent exposure of man.

This control applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared radwaste treatment systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

3/4.11.2.4 GASEOUS RADWASTE TREATMENT SYSTEM

The OPERABILITY of the WASTE GAS HOLDUP SYSTEM and the PRIMARY PLANT SYSTEM ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate protions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This control implements the requirements of 10 CFR 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

This control applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

3/4.11.4 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 FR 18525. The control requires the preparation and submittal of a Special Report whenever the calculated doses due to releases of radioactivity and to radiation from uranium fuel cycle sources exceed 25 mrems to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems. For sites containing up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the units (including outside storage tanks, etc.) are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radious of 8 km must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.405(c), is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in Controls 3.11.1.1 and 3.11.2.1. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

BASES

3/4.12.1 MONITORING PROGRAM

The Radiological Environmental Monitoring Program 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 exposure of MEMBERS OF THE PUBLIC resulting from the plant operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the Radiological Effluent Monitoring Program by verifying that the measureable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979. The initially specified monitoring program will be effective for at least the first 3 years of commercial operation. Following this period, program changes may be initiated based on operational experience.

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

Detailed discussion of the LLD, and other detection limits, can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300.

3/4.12.2 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 Radiological Environmental Monitoring Program given in the ODCM are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey or from consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m^2 provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: (1) 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and (2) a vegetation yield of 2 kg/m^2.

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

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

SECTION 5.0

DESIGN FEATURES

MAP DEFINING UNRESTRICTED AREAS AND EXCLUSION AREA BOUNDARY FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

5.1.3 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 MEMBERS OF THE PUBLIC, shall be as shown in Figure 5.1-3.

The definition of UNRESTRICTED AREA used in implementing these Controls has been expanded over that in 10 CFR 20.3(a)(17). The UNRESTRICTED AREA boundary may coincide with the Exclusion (fenced) Area Boundary, as defined in 10 CFR 100.3(a), but the UNRESTRICTED AREA does not include areas over water bodies. The concept of UNRESTRICTED AREAS, established at or beyond the SITE BOUNDARY, is utilized in the Controls to keep levels of radioactive materials in liquid and gaseous effluents as low as is reasonably achievable, pursuant to 10 CFR 50.36a.

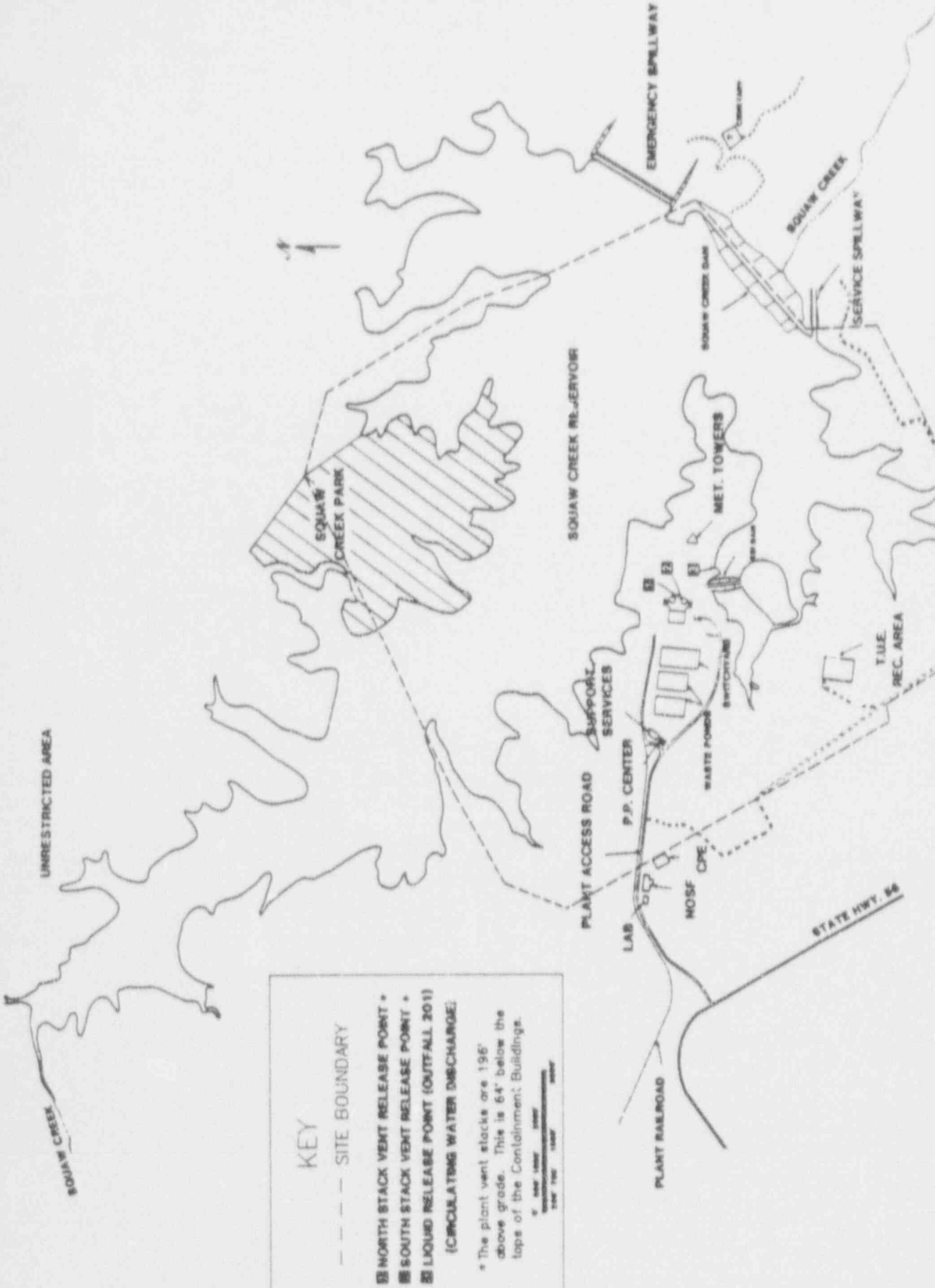

FIGURE 5.1-3
UNRESTRICTED AREA AND SITE BOUNDARY FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

SECTION 6.0

ADMINISTRATIVE CONTROLS

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT*

6.9.1.3 Routine Annual Radiological Environmental Operating Reports covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year. The initial report shall be submitted prior to May 1 of the year following initial criticality and shall include copies of reports of the preoperational Radiological Environmental Monitoring Program of the unit for at least two years prior to initial criticality.

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

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

The reports shall also include the following: a summary description of the Radiological Environmental Monitoring Program; at least two legible maps** covering all sampling locations keyed to a table giving distances and directions from the centerline of one reactor; the results of licensee participation in the Interlaboratory Comparison Program and the corrective action taken if the specified program is not being performed as required by Control 3.12.3; reasons for not conducting the Radiological Environmental Monitoring Program as required by control 3.12.1, and discussion of all deviations from the sampling schedule of Table 3.12.1,; discussion of environmental sample measurements that exceed the reporting levels of Table 3.12.1; and discussion of all analyses in which the LLD required by Table 4.12-1 was not achievable.

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* A single submittal may be made for a multiple unit station.

** One map shall cover stations near the SITE BOUNDARY; a second shall include the more distant stations.

SEMIANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT*

6.9.1.4 Routine Semiannual Radioactive Effluent Release Reports covering the operation of the unit during the previous 6 months of operation shall be submitted within 60 days after January 1 and July 1 of each year. The period of the first report shall begin with the date of initial criticality.

The Semiannual Radioactive Effluent Release Reports shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof. For solid wastes, the format for Table 3 in Appendix B shall be supplemented with three additional categories: class of solid wastes (as defined by 10 CFR Part 61), type of container (e.g., LSA, Type A, Type B, Large Quantity) and SOLIDIFICATION agent or absorbent (e.g., cement, urea formaldehyde).

The Semiannual Radioactive Effluent Release Report to be submitted within 60 days after January 1 of each year shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability.** This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year. This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY (Figure 5.1-3) during the report period. All assumptions used in making these assessments, i.e., specific activity, exposure time, and location, shall be included in these reports. Historical average meteorological conditions or the meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents, as determined by sampling frequency and measurement, shall be used for determining the gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

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* A single submittal may be made for a multiple unit station. The submittal should combine those sections that are common to all units at the station; however, for units with separate radwaste systems, the submittal shall specify the releases of radioactive material from each unit.

** In lieu of submission with the Semiannual Radioactive Effluent Release Report, 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.

SEMIANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

The Semiannual Radioactive Effluent Release Report to be submitted within 60 days after January 1 of each year shall also include an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources, including doses from primary effluent pathways and direct radiation, for the previous calendar year to show conformance with 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation." Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev. 1, October 1977.

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

The Semiannual Radioactive Effluent Release Reports shall include a listing of new locations for dose calculations and/or environmental monitoring identified by the Land Use Census pursuant to Control 3.12.2.

The Semiannual Radioactive Effluent Release Reports shall also include the following: an explanation as to why the inoperability of liquid or gaseous effluent monitoring instrumentation was not corrected within the time specified in Controls 3.3.3.4 or 3.3.3.5, respectively; and a description of the events leading to liquid holdup tanks or gas storage tanks exceeding the Technical Specification limits.

6.14 OFFSITE DOSE CALCULATION MANUAL (ODCM)

Changes to the ODCM:

a. Shall be documented and records of reviews performed shall be retained as required by Specification 6.10.3.o. This documentation shall contain:

   1) Sufficient information to support the change together with the appropriate analyses or evaluations justifying the change(s) and

   2) A determination that the change will maintain the level of radioactive effluent control required by 10 CFR 20.106, 40 CFR Part 190, 10 CFR 50.36a, and Appendix I to 10 CFR Part 50 and not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations.

b. Shall become effective after review and acceptance by the SORC and the approval of the Vice President, Nuclear Operations.

6.14 OFFSITE DOSE CALCULATION MANUAL (ODCM) (continued)

c. Shall be submitted to the Commission in the form of a complete, legible copy of the entire ODCM as a part of or concurrent with the Semiannual Radioactive Effluent Release Report for the period of the report in which any change to the ODCM was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (e.g., month/year) the change was implemented.

PART II

CALCULATIONAL METHODOLOGIES

SECTION 1.0
LIQUID EFFLUENTS

The Comanche Peak Steam Electric Station is located on Squaw Creek Reservoir (SCR), which serves as the point of supply and discharge for the plant circulating water. Radioactive liquid effluent releases from the primary radwaste processing system are batch type releases, from the Laundry Holdup & Monitor Tanks (LHMT) and Waste Monitor Tanks (WMT), discharged to SCR via the Circulating Water Discharge Tunnel. Potentially radioactive liquid effluent releases from secondary systems include a continuous release from the Turbine Building Sumps (TB Sump), and batch releases from the Component Cooling Water Drain Tank (CCWDT), and the Condensate Polisher Backwash Recovery Tanks (CPBRT). These secondary pathways are normally discharged to the Low Volume Waste (LVW) Pond for chemical treatment. The LVW Pond normally discharges to SCR via the circulating Water Discharge Tunnel. Alternatively, secondary waste streams may be routed to the Waste Water Holdup Tanks (WWHT). The WWHTs may be released on a batch basis to the LVW Pond or to SCR via the Circulating Water Discharge Tunnel, depending on the levels of radioactivity present. Table 4.11-1 of Part I of this document requires that secondary waste streams be diverted to the WWHT's if radioactivity is present in the waste stream in concentrations that exceed the limits of 10 CFR 20, Appendix B, Table II, Column 2. Also, releases from the Station Service Water (SSW) System are monitored for radioactivity, although no significant releases of radioactivity are expected from this pathway. 7

A summary of all liquid effluent release sources, volumes, flow rates, and associated radiation monitors is shown in Table 1.1. A flow diagram of all liquid effluent discharge pathways is shown in Figure 1.1. 7

The liquid effluent radiation monitors shown in Figure 1.1 are part of the plant Digital Radiation Monitoring System (DRMS) supplied by Sorrento Electronics (Formerly General Atomics). Since the DRMS monitors provide a digital output, they may be calibrated to read out in the appropriate engineering units (i.e. µCi/ml). The conversion factor for detector output from counts per minute to µCi/ml is determined in the calibration process and input into the database for the monitor microprocessor. 7

1.1 10 CFR 20 AND RADIOLOGICAL EFFLUENT CONTROL COMPLIANCE

To demonstrate compliance with 10 CFR 20.106, ODCM Radiological Effluent Control 3/4.11.1.1 requires that the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS be limited to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2, for radionuclides other than dissolved or entrained noble gases, and to 2E-4 µCi/ml for dissolved or entrained noble gases. 10 CFR 20 compliance is checked for all discharges to SCR via the Circulating Water Discharge Tunnel listed in Table 1.1. Because the LVW Pond is located in an UNRESTRICTED AREA, discharges to the LVW Pond are also checked for 10 CFR 20 compliance. If radioactive materials are present in the LVW Pond discharge in concentrations that exceed 10% of the limits of 10 CFR 20, Appendix B, Table II, Column 2, then all inputs to the LVW Pond are sampled and checked for compliance with 10 CFR 20. The following methodology is used to determine compliance with these limits. 7

7

1.1.1 Isotopic Concentration of the Waste Tank

Determine the isotopic concentration in waste stream to be released:

$$\sum_i C_i = \sum_g C_g + (C_a + C_s + C_t + C_{Fe}) \qquad \text{[Eq. 1-1]}$$

Where: $\sum_i C_i$ = Sum of the concentrations of each radionuclide, in the release (uCi/ml), 7

$\sum_g C_g$ = Sum of the concentrations of each measured gamma emitter, g, (uCi/ml) as required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1.

C_a = concentration of alpha emitters as measured in the most recent composite sample (Ci/ml) required by Radiological Effluent Control 3/4.11.1.1. Table 4.11-1. (Sample analyzed for gross alpha only) 7

C_s = concentration of ^{89}Sr and ^{90}Sr as measured in the most recent composite sample (uCi/ml) required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1. 7

C_t = concentration of ^{3}H as measured in the most recent composite sample (uCi/ml) required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1.

C_{Fe} = concentration of ^{55}Fe as measured in the most recent composite sample (uCi/ml) required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1.

1.1.2 <u>Effluent Flow Rate (f)</u>

The maximum effluent discharge flow rates for each release source are shown in Table 1.1. For pre-release calculations, the maximum effluent flow rate is used. For post-release calculations, the average effluent flow rate during the release may be used. Since the maximum effluent flow rate is used for pre-release calculations, no setpoint is required for the flow measuring device for the effluent release line. 7

7

1.1.3 <u>Dilution of Liquid Effluents</u>

a. Discharges to SCR via Circulating Water Discharge Tunnel

Since liquid effluents from the radwaste treatment system, Waste Water Holdup Tanks and the LVW Pond are mixed with circulating water prior to being discharged to Squaw Creek Reservoir, compliance with 10 CFR 20 is a function of the circulating water flow rate. The maximum circulating water flow rate per plant is 1.1 million gpm. This is determined from the Ingersoll-Rand pump curves (Fig. 1.2) which indicate a flow rate per pump of 275,000 gpm. The actual circulating water dilution flow is given by: 7

$$F(\text{diluting flow}) = (275{,}000\ \text{gpm/pump}) \times (\#\ \text{of pumps}) \times 0.9 \quad [\text{Eq. 1-2}]$$ 7

Where: 0.9 = Safety Factor to compensate for flow fluctuations from the rate predicted by the circulating water pump curves (Fig. 1.2). 7

As an additional consideration, the available dilution flow for any release may be corrected to allow for simultaneous releases from the Radwaste Processing System, a Waste Water Holdup Tank, and/or the LVW Pond (i.e., a radwaste system tank, a Waste Water Holdup Tank, and the LVW Pond may be discharged simultaneously.) For simultaneous releases, the available dilution flow for any release is reduced by the required dilution flow for any other concurrent releases. 7

Also, the resevoir into which the diluted radwaste flows may build up a concentration of radioactive isotopes. It is therefore necessary to account for recirculation of previously discharged radionuclides. This is accomplished as follows: 7

$$F' = F\left(1 - \sum_i (C'_i/MPC_i)\right) \qquad \text{[Eq 1-3]}$$

Where: F' = Adjusted Circulating Water Flow Rate

C'_i = Concentration of radionuclide i in the Reservoir (Ci/ml) as measured in the analysis of the monthly sample of the Reservoir required by Radiological Effluent Control 3/4.12.1, Table 3.12.1. This sample is taken at the circulating water intake structure as indicated by location SW6 on Table 3.1 and Figure 3-1 of this manual.

MPC_i*= Maximum Permissible Concentration of Radionuclide i

F = (275,000 gpm/pump) x (# of pumps) x 0.9

NOTE: If C'_i is less than LLD then $F' = F$ and no adjusted flow rate need be considered in the calculation of ADF. The LLD values used for this determination shall be the LLD valves for water given in Radiological Effluent Control 3/4.12.1, Table 4.12-1.

b. Discharges to the LVW Pond

Secondary release sources are discharged directly to the LVW Pond with no dilution (i.e., F=0)

1.1.4 <u>Actual Dilution Factor (ADF)</u>

ADF is the ratio of the effluent flow rate plus the circulating water flow rate divided by the effluent flow rate.

$$ADF = (f + F)/f \qquad \text{[Eq. 1-4]}$$ 7

Where: f = effluent flow rate (gpm)
F = dilution flow rate (gpm) 7

NOTE: If radioactivity is detected in the Reservoir, an adjusted circulating water flow rate, F', shall be used in place of F in the calculation of ADF. See section 1.1.3 for the calculation of F' (Eq. 1-3). 7
Also, if simultaneous releases are occurring, the available dilution flow shall be reduced by the required dilution flow for any other concurrent release. 1

1.1.5 Required Dilution Factor (RDF)

The required dilution factor ensures that the maximum permissible concentrations expressed in 10CFR20, Appendix B, Table II, Column2*, and a total concentration of dissolved or entrained noble gases of 2×10^{-4} uCi/ml are not exceeded during a discharge. The required dilution factor includes a safety factor of 2 to provide a margin of assurance that the instantaneous concentration limits are not exceeded. 1

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* MPCs listed in 10CFR20 give values for each isotope in both a soluble and insoluble form. The lowest value for each isotope should be used. A value of 2×10^{-4} uCi/ml for dissolved or entrained noble gases shall be used.

$$RDF = \left(\sum_i (C_i/MPC_i)\right) \times SF$$

$$= \left(\sum_g (C_g/MPC_g) + (C_a/MPC_a + C_s/MPC_s + C_t/MPC_t + C_{Fe}/MPC_{Fe})\right) \times SF \quad \text{[Eq. 1-5]}$$ 7

Where: MPC_i* = Maximum Permissible Concentration of Radionuclide i
SF = Safety Factor of 2.

All other variables and subscripts are previously defined.

NOTE: If RDF is less than 1, the release meets discharge limits without dilution. For conservatism, set RDF equal to 1.0. The maximum value for the high alarm setpoint for detector XRE-5253 would then be calculated in accordance with the equation for C_{lw} in Section 1.2.1. 7

1.1.6 <u>10 CFR 20 Compliance</u> 7

Compliance with 10 CFR 20 is demonstrated if the Actual Dilution Factor (ADF) is greater than or equal to the Required Dilution Factor (RDF), or:

$$\frac{RDF}{ADF} \leq 1.0 \quad \text{[Eq. 1-6]}$$

* See footnote on page II 1-6.

1.2 Radiation Monitor Alarm Setpoints 7

1.2.1 Primary Liquid Effluent Monitor XRE-5253 7

To ensure that releases from the primary radwaste processing system do not exceed 10 CFR 20, Appendix B, Table II, Column 2 limits at the point of release to the UNRESTRICTED AREA, a radiation detector (XRE-5253) monitors discharges to the Circulating Water Discharage Tunnel. XRV-5253 is the isolation valve controlled by XRE-5253. The isolation valve shuts automatiacally if the detector alarms on high radiation or a detector operation failure occurs. The methodology for determining the setpoint for detector XRE-5253 is given below. It should be noted that the liquid effluent monitor setpoint values determined using the methodology from this section will be regarded as upper bounds for the actual setpoint adjustments. That is, setpoints may be established at values lower than the calculated values, if desired. Further, if the calculated value should exceed the maximum range of the monitor, the setpoint shall be adjusted to a value that falls within the normal operating range of the monitor. 7

$$C_{lw} = (ADF/RDF) \times \sum_{g} C_{g} \qquad \text{[Eq. 1-7]}$$ 7

Where: C_{lw} = The liquid waste effluent monitor alarm setpoint. This corresponds to the gamma concentration in the undiluted waste stream which after dilution would result in MPC-level releases (μCi/ml).

All other variables are as previously defined.

When considering the mixture of nuclides in the liquid effluent stream in terms of detector sensitivity, the most probable nuclides present would be those referenced in Radiological Effluent Control 3/4.11.1.1, Table 4.11-1 Table Notation 2. Figure 1.3 is a representative energy spectrum response for the RD-33 type detector used in XRE-5253. This curve illustrates that for any given mixture of the most probable gamma emitting nuclides present, the conversion factor between counts per minute and microcuries per milliliter remains relatively constant. In fact between ^{137}Cs and ^{60}Co, the total change in sensitivity is approximately 7%. Because this is well within the accuracy of measurement, there is no need to change the software sensitivity for given varied effluent concentrations. However, should the concentration of previously unexpected nuclides become significant, further evaluation would be required. 7

1.2.2 TURBINE BUILDING SUMP EFFLUENT RADIATION MONITOR 1RE-5100

The purpose of the turbine building sump monitor (1RE-5100) is to monitor turbine building sump discharges and divert this discharge from the Low Volume Waste Pond to the Waste Water Holdup Tanks if radioactivity is detected. Because the only sources of water to the turbine building sump are from the secondary steam system, activity is expected only if a significant primary-to-secondary leak is present. Since detectable radioactivity is not normally present in the Turbine Building Sump, the monitor setpoint should be established as close to background as practical to prevent spurious alarms and yet alarm should not inadvertent radioactive release occur. To this end, the setpoint will be initially established at three (3) times background until further data can be collected. Then, if this setpoint is exceeded, 1RE-5100 will direct valves 1RV-5100A and B to divert the turbine building sumps discharges from the LVW Pond to the Waste Water Holdup Tanks where the effluent can then be

sampled and released in a batch mode to Squaw Creek Reservoir, if required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1. When radioactive materials are detected in the Turbine Building Sump, a setpoint then may be established for 1RE-5100 using the methodology in Section 1.2.1 to ensure that 10 CFR 20 MPC limits are not exceeded in discharges to the LVW Pond.

1.2.3 SERVICE WATER EFFLUENT RADIATION MONITORS 1RE-4269/4270

The concentration of radioactive material in the service water effluent line normally is expected to be insignificant. Therefore, the monitor alert alarm setpoint should be established as close to background as practival to prevent spurious alarms and yet alarm should an inadvertent release occur. To this end, the alarm setpoint will be initially established at three (3) times background until further data can be collected. If this effluent stream should become contaminated, radionuclide concentrations should be determined from grab samples and a radiation monitor alarm setpoint determined as follows:

$$C_{sw} = (\sum_g C_g) \div DF \qquad \text{[Eq. 1-8]}$$

Where: C_{sw} = the Service Water effluent monitor alarm setpoint.

C_g = the concentration of each measured gamma emitter g, observed in the effluent (uCi/ml)

$DF = \sum_i (C_i/MPC_i)$ = the dilution factor required to ensure maximum permissible concentrations are not exceeded.

For this release pathway no additional dilution is available. Therefore, if the calculated DF is greater athan 1.0, any releases occurring via this pathway will result in a violation of Radiological Effluent Control 3/4.11.1.1. If radioactivity is detected in this release stream, doses due to releases from this stream shall be calculated in accordance with the methodology given in Section 1.3, with the near field average dilution factor, F_k, equal to 1.0.

1.3 DOSE CALCULATION FOR LIQUID EFFLUENTS

For implementation of Radiological Effluent Control 3/4.11.1.2, the dose commitment from the release of liquid effluents will be calculated at least once per 31 days and a cumulative summation of the total body and organ dose commitments will be maintained for each calendar quarter and each calendar year. Dose calculations will be performed for releases from the Waste Monitor Tanks, Laundry Holdup & Monitor Tanks, Waste Water Holdup Tanks, and the LVW Pond via the Circulating Water Tunnel at the point of discharge to Squaw Creek Reservoir. Although the LVW Pond is located in an UNRESTRICTED AREA, dose calculations for discharges to the LVW Pond will not be performed because there are no real pathways for exposure to members of the public. Doses for these pathways will be caluclated when the LVW Pond is discharged to Squaw Creek Reservoir. The cumulative dose over the desired time period (e.g., the sum of all doses due to releases during a 31 day period, calendar quarter, or a calendar year) will be calculated using the following equation: 7

$$D_T = \sum_k D_k + \sum_m D(lake)_m \quad \text{[Eq. 1-9]}$$

Where D_T = the dose commitment to the total body or any organ due to all releases during the desired time interval (mRem).

D_k = the dose commitment received by the total body or any organ during the duration of release k(mRem). The equation for calculating D_k is given in Section 1.3.1 (Eq. 1-10)

$D(lake)_m$ = the dose commitment received by the total body or any or any organ during the desired time period, m, (normally m = 31 days) due to the buildup in the lake of previously discharged radionuclides. The equation for calculating $D(lake)_m$ is given in Section 1.3.2 (Eq. 1-12).

1.3.1 Calculation of Dose Due to Liquid Releases

The dose commitment to the total body or any organ due to a release will be calculated using the following equation:

$$D_k = \sum_i A_{i\tau} t_k C_{ik} F_k$$ [Eq. 1-10]

Where: t_k = the time duration of the release k (hrs)

C_{ik} = the isotopic concentration (Ci/ml) of radionuclide i found in the release sample for release k. Concentrations are determined primarily from gamma isotopic analysis of the liquid effluent sample. For Sr-89, SR-90, H-3, Fe-55 and alpha emitters, the last measured value will be used in the dose calculation.

F_k = the near field average dilution factor during a liquid effluent release. This is defined as the ratio of the average undiluted liquid effluent flow rate to the average circulating water flow rate during the release. The average liquid effluent flow rate is based on the actual average flow into the circulating water during the release.

$$F_k = \frac{\text{average undiluted liquid effluent flow rate}}{\text{circulating water flow rate}}$$

A_i = the site related ingestion dose commitment factor for the total body or any organ, , for each identified gamma or beta emitter (mRem/hr per Ci/ml). $A_{i\tau}$ is calculated as follows:

$$A_{i\tau} = 1.14 \times 10^5 \, (U_w/D_w + U_f BF_i) \, DF_i$$ [Eq. 1-11]

Where: 1.14×10^5 = unit conversion factor, 7

U_w = adult water consumption, 730 liters/yr

U_f = adult fish consumption, 21 kg/yr

BF_i = bioaccumulation factor for radionuclide i, in fish from Table A-1, Ref. 2 (pCi/kg per pCi/l)

DF_i = adult dose conversion factor for radionuclide i, from Table E-11, Ref. 2 (mrem/pCi ingested)

D_w = Dilution factor from the near field area within one-quarter mile of the release point to the potable water intake for the adult water consumption; 1.0 for CPSES. (unitless)

Calculated values for $A_{i\tau}$ are given in Table 1.2.

1.3.2 <u>Calculation of Dose Due to Radionuclide Buildup in the Lake</u>

The does contribution due to buildup of previously discharged radionuclides in the lake must be considered in the committed dose calculation only if they are detected in the water of Squaw Creek Reservoir or in fish from Squaw Creek Reservoir. The contribution to the total dose due to this buildup is determined as follows:

$$D(lake)_m = 1.14 \times 10^{-4} \left(\sum_i DF_i (C'_{iw} U_w + C'_{if} U_f) \right) t \quad \text{[Eq. 1-12]}$$

Where: 1.14×10^{-4} = units conversion factor

C'_{iw} = concentration of radionuclide i in the reservoir as measured at the circulating water intake structure shown as location SW6 on Table 3.1 and Figure 3.1 of this manual (pCi/l)

C'_{if} = concentration of radionuclide i in fish sampled from Squaw Creek Reservoir from location F1 on Table 3.1 and Figure 3.1 of this manual (pCi/kg)

t = 744 hrs (31 days) or other time period of interest (hr)

All other variables are previously defined.

NOTE: This calculation is only required if activity is detected in water and/or fish in excess of the appropriate LLD values given in Radiological Effluent Control 3/4.12.1, Table 4.12-1. If the measured activity in water or fish is less than the required LLD values, the concentration for that particular pathway is assumed to be zero.

1.4 DOSE PROJECTIONS FOR LIQUID EFFLUENTS

Radiological Effluent Control 3/4.11.1.3 requires that appropriate subsystems of the liquid radwaste treatment system by used to reduce releases of radioactivity when the projected doses due to the liquid effluent from each reactor unit to UNRESTRICTED AREAS would exceed 0.06 mrem total body or 0.2 mrem to any organ in a 31-day period. The following calculational method is provided for performing this dose projection.

At least once every 31 days, the total dose from all liquid releases for the quarter-to-date will be divided by the number of days into the quarter and multiplied by 31. Also, this dose projection shall include the estimated does due to any anticipated unusual releases during the period for which the projection is made. If this projected dose exceeds 0.06 mrem total body or 0.2 mrem any organ, appropriate portions of the Liquid Radwaste Treatment System shall be used to reduce radioactivity levels prior to release.

1.5 DEFINITIONS OF COMMON LIQUID EFFLUENT PARAMETERS

7

TERM	DEFINITION
ADF	Actual Dilution Factor (unitless). This is defined as the ratio of the effluent flow rate plus the circulating water flow rate divided by the effluent flow rate.
$A_{i\tau}$	The site related ingestion dose commitment factor to the total body or any organ, τ, for each identified gamma or beta emitter, i. (mRem/hr per uCi/ml)
BF_i	Biaccumulation factor for radionuclide, i, in fish from Reg. Guide 1.109. (pCi/kg per pCi/l)
C_a	The concentration of alpha emitters in liquid waste as measured in the analysis of the most recent monthly composite sample required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1. (uCi/ml)
C_{Fe}	The concentration of ^{55}Fe in liquid waste as measured in the analysis of the most recent quarterly composite sample required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1. (uCi/ml)
C_g	The concentration of each measured gamma emitter, g in the waste tank as measured in the analysis of the sample of each batch as required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1 (uCi/ml)
C_i	The concentrations of radionuclide, i, in the waste tank. (uCi/ml)
C'_i	The concentration of radionuclide i in the Reservoir as measured in the analysis of the monthly sample of the Reservoir required by Radiological Effluent Control 3/4.12.1, Table 3.12-1. This sample is taken at the Circulatory Water Intake Structure as indicated by location SW6 on Table 3.1 and Figure 3-1 of this manual. (uCi/ml)
C'_{if}	The concentration of radionuclide i in fish sampled from the reservoir from location F1 on Table 3.1 and Figure 3-1 of this manual (pCi/kg).

C_{ik} The isotopic concentration of radionuclide i found in the pre-release sample for batch release k. Concentrations are determined primarily from gamma isotopic analysis of the liquid effluent sample. For ^{89}Sr, ^{90}Sr, ^{3}H, ^{55}Fe and alpha emitters, the last measured value will be used. (uCi/ml)

C'_{iw} The concentration of radionuclide i in the reservoir as measured at the circulating water intake structure shown as location SW6 on Table 3.1 and Figure 3-1 of this manual (pCi/l).

C_{lw} The liquid waste effluent monitor alarm setpoint. This corresponds to the gamma concentration in the undiluted waste stream which after dilution would result in MPC-level releases. (uCi/ml)

C_s The concentration of ^{89}Sr and ^{90}Sr in liquid waste as measured in the analysis of the most recent quarterly composite sample required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1 (uCi/ml)

C_{sw} The Service Water effluent monitor alarm setpoint. (uCi/ml)

C_t The concentration of ^{3}H in liquid waste as measured in the analysis of the most recent monthly composite sample required by Radiological Effluent Control 3/4.11.1.1, Table 4.11-1 (uCi/ml)

DF_i Adult dose conversion factor for radionuclide, i, from Reg. Guide 1.109 (mrem/pCi ingested)

D_k The dose commitment received by the total body or any organ during the duration of batch release k of liquid effluents. (mRem)

$D(lake)_m$ The dose commitment received by the total body or any organ during a desired time period, m, due to the buildup in the lake of previously discharged radionuclides. (mRem)

D_T The total dose commitment to the total body or any organ due to all releases of liquid effluents during a desired time interval. (mRem)

D_w Dilution factor, from the near field area within 1/4 mile of the release point to the potable water intake for adult water consumption, 1.0 for CPSES (unitless)

f Effluent flow rate. (gpm)

F Circulating water flow rate (or dilution flow rate). (gpm,

F' Adjusted circulating water flow rate to account for buildup of radionuclides in the circulating water due to previous releases. (gpm)

F_k The near field average dilution factor during a liquid effluent release (unitless). This is defined as the ratio of the average undiluted liquid waste flow to the average circulating water flow during the release.

MPC_a Maximum Permissible Concentration* of a mixture of unidentified alpha emitters. (uCi/ml)

MPC_{Fe} Maximum Permissible Concentration* of ^{55}Fe. (uCi/ml)

MPC_g Maximum Permissible Concentration* of each identified gamma emitter, g. (uCi/ml)

MPC_i Maximum Permissible Concentration* of radionuclide, i. (uCi/ml)

MPC_s Maximum Permissible Concentration* of a mixture of ^{89}Sr and ^{90}Sr. (uCi/ml)

MPC_t Maximum Permissible Concentration* of tritium (^3H) (uCi/ml)

SF Safety Factor of 2. Used in the calculation of the Required Dilution Factor (RDF) for liquid releases to provide a margin of assurance that the instantaneous concentration limits are not exceeded.

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*MPCs are given in 10CFR20, Appendix B, Table II, Column 2. Values are given for each isotope in both a soluble and insoluble form. The most conservative (lowest) value for each isotope should be used. A value of 2×10^{-4} uCi/ml for dissolved or entrained noble gas shall be used.

RDF Required Dilution Factor (unitless). This is defined as the dilution factor that ensures the maximum permissible isotopic concentrations expressed in 10CFR20, Appendix B, Table II, Column 2, are not exceeded during a discharge. 7

t_k The time duration of batch release k. (hours)

U_f Adult fish consumption. (kg/yr)

U_w Adult water consumption. (liters/yr)

TABLE 1.1

SUMMARY OF LIQUID RELEASE PATHWAYS

1. RELEASES TO SCR VIA THE CIRC WATER DISCHARGE

Release Source	Release Type	Max Flow Rate (gpm)	Max Vol (gal)	Monitor
WMT-1	Batch	100	5340	XRE-5253
WMT-2	Batch	100	5340	XRE-5253
LHMT-1	Batch	100	5875	XRE-5253
LHMT-2	Batch	100	5875	XRE-5253
WWHT-1	Batch	200	25000	None
WWHT-2	Batch	200	25000	None
LVW Pond	Continuous	1600	-	None

2. RELEASES TO THE LVW POND

Release Source	Release Type	Max Flow Rate (gpm)	Max Vol (gal)	Monitor
CPBRT	Batch	25	8500	None
CCWDT	Batch	40	2300	None
WWHT-1	Batch	200	25000	None
WWHT-2	Batch	200	25000	None
TBSump2 (Unit1)	Continuous	300	-	IRE-5100
TBSump4 (Unit2)	Continuous	300	-	None

3. DIRECT RELEASES TO SCR (SAFE SHUTDOWN IMPOUNDMENT)

Release Source	Release Type	Max Flow Rate (gpm)	Max Vol (gal)	Monitor
SSW Train A	Continuous	17,000	-	IRE-4269
SSW Train B	Continuous	17,000	-	IRE-4270

TABLE 1.2

SITE RELATED INGESTION DOSE COMMITMENT FACTOR $A_{i\tau}$
(mRem/hr per uCi/ml)

ISOTOPE	BONE	LIVER	T-BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00	8.96E+00
C-14	3.15E+04	6.30E+03	6.30E+03	6.30E+03	6.30E+03	6.30E+03	6.30E+03
Na-24	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02	5.48E+02
P-32	4.62E+07	2.87E+06	1.79E+06	0.00E+00	0.00E+00	0.00E+00	5.20E+06
Cr-51	0.00E+00	0.00E+00	1.49E+00	8.94E-01	3.29E-01	1.98E+00	3.76E+02
Mn-54	0.00E+00	4.76E+03	9.08E+02	0.00E+00	1.42E+03	0.00E+00	1.46E+04
Mn-56	0.00E+00	1.20E+02	2.12E+01	0.00E+00	1.52E+02	0.00E+00	3.82E+03
Fe-55	8.87E+02	6.13E+02	1.43E+02	0.00E+00	0.00E+00	3.42E+02	3.52E+0[illegible]
Fe-59	1.40E+03	3.29E+03	1.26E+03	0.00E+00	0.00E+00	9.19E+02	1.10E+04
Co-58	0.00E+00	1.51E+02	3.39E+02	0.00E+00	0.00E+00	0.00E+00	3.06E+03
Co-60	0.00E+00	4.34E+02	9.58E+02	0.00E+00	0.00E+00	0.00E+00	8.16E+03
Ni-63	4.19E+04	2.91E+03	1.41E+03	0.00E+00	0.00E+00	0.00E+00	6.07E+02
Ni-65	1.70E+02	2.21E+01	1.01E+01	0.00E+00	0.00E+00	0.00E+00	5.61E+02
Cu-64	0.00E+00	1.69E+01	7.93E+00	0.00E+00	4.26E+01	0.00E+00	1.44E+03
Zn-65	2.36E+04	7.50E+04	3.39E+04	0.00E+00	5.02E+04	0.00E+00	4.73E+04
Zn-69	5.02E+01	9.60E+01	6.67E+00	0.00E+00	6.24E+01	0.00E+00	1.44E+01
Br-83	0.00E+00	0.00E+00	4.38E+01	0.00E+00	0.00E+00	0.00E+00	6.30E+01
Br-84	0.00E+00	0.00E+00	5.67E+01	0.00E+00	0.00E+00	0.00E+00	4.45E-04
Br-85	0.00E+00	0.00E+00	2.33E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-15
Rb-86	0.00E+00	1.03E+05	4.79E+04	0.00E+00	0.00E+00	0.00E+00	2.03E+04
Rb-88	0.00E+00	2.99E+02	1.59E+02	0.00E+00	0.00E+00	0.00E+00	4.00E-09
Rb-89	0.00E+00	1.98E+02	1.39E+02	0.00E+00	0.00E+00	0.00E+00	1.15E-11
Sr-89	4.78E+04	0.00E+00	1.37E+03	0.00E+00	0.00E+00	0.00E+00	7.66E+03

TABLE 1.2

SITE RELATED INGESTION DOSE COMMITMENT FACTOR $A_{i\tau}$
(mRem/hr per uCi/ml)

ISOTOPE	BONE	LIVER	T-BODY	THYROID	KIDNEY	LUNG	GI-LLI
Sr-90	1.18E+06	0.00E+00	2.88E+05	0.00E+00	0.00E+00	0.00E+00	3.40E+04
Sr-91	8.79E+02	0.00E+00	3.55E+01	0.00E+00	0.00E+00	0.00E+00	4.19E+03
Sr-92	3.33E+02	0.00E+00	1.44E+01	0.00E+00	0.00E+00	0.00E+00	6.60E+03
Y-90	1.38E+00	0.00E+00	3.69E-02	0.00E+00	0.00E+00	0.00E+00	1.46E+04
Y-91m	1.30E-02	0.00E+00	5.04E-04	0.00E+00	0.00E+00	0.00E+00	3.82E-02
Y-91	2.02E+01	0.00E+00	5.39E-01	0.00E+00	0.00E+00	0.00E+00	1.11E+04
Y-92	1.21E-01	0.00E+00	3.53E-03	0.00E+00	0.00E+00	0.00E+00	2.12E+03
Y-93	3.83E-01	0.00E+00	1.06E-02	0.00E+00	0.00E+00	0.00E+00	1.22E+04
Zr-95	2.77E+00	8.88E-01	6.01E-01	0.00E+00	1.39E+00	0.00E+00	2.82E+03
Zr-97	1.53E-01	3.09E-02	1.41E-02	0.00E+00	4.67E-02	0.00E+00	9.57E+03
Nb-95	4.47E+02	2.49E+02	1.34E+02	0.00E+00	2.46E+02	0.00E+00	1.51E+06
Mo-99	0.00E+00	4.62E+02	8.79E+01	0.00E+00	1.05E+03	0.00E+00	1.07E+03
Tc-99m	2.94E-02	8.32E-02	1.06E+00	0.00E+00	1.26E+00	4.07E-02	4.92E+01
Tc-101	3.03E-02	4.36E-02	4.28E-01	0.00E+00	7.85E-01	2.23E-02	1.31E-13
Ru-103	1.98E+01	0.00E+00	8.54E+00	0.00E+00	7.57E+01	0.00E+00	2.31E+03
Ru-105	1.65E+00	0.00E+00	6.51E-01	0.00E+00	2.13E+01	0.00E+00	1.01E+03
Ru-106	2.95E+02	0.00E+00	3.73E+01	0.00E+00	5.69E+02	0.00E+00	1.91E+04
Ag-110m	1.42E+01	1.31E+01	7.80E+00	0.00E+00	[illegible].58E+01	0.00E+00	5.36E+03
Te-125m	2.79E+03	1.01E+03	3.74E+02	8.39E+02	1.13E+04	0.00E+00	1.11E+04
Te-127m	7.05E+03	2.52E+03	8.59E+02	1.80E+03	2.86E+04	0.00E+00	2.36E+04
Te-127	1.14E+02	4.11E+01	2.48E+01	8.48E+01	4.66E+02	0.00E+00	9.03E+03
Te-129m	1.20E+04	4.47E+03	1.89E+03	4.11E+03	5.00E+04	0.00E+00	6.03E+04
Te-129	3.27E+01	1.23E+01	7.96E+00	2.51E+01	1.37E+02	0.00E+00	2.47E+01

TABLE 1.2

SITE RELATED INGESTION DOSE COMMITMENT FACTOR $A_{i\tau}$
(mRem/hr per uCi/ml)

ISOTOPE	BONE	LIVER	T-BODY	THYROID	KIDNEY	LUNG	GI-LLI
Te-131m	1.80E+03	8.81E+02	7.34E+02	1.39E+03	8.92E+03	0.00E+00	8.74E+04
Te-131	2.05E+01	8.57E+00	6.47E+00	1.69E+01	8.98E+01	0.00E+00	2.90E+00
Te-132	2.62E+03	1.70E+03	1.59E+03	1.87E+03	1.63E+04	0.00E+00	8.02E+04
I-130	9.01E+01	2.66E+02	1.05E+02	2.25E+04	4.15E+02	0.00E+00	2.29E+02
I-131	4.96E+02	7.09E+02	4.06E+02	2.32E+05	1.22E+03	0.00E+00	1.87E+02
I-132	2.42E+01	6.47E+01	2.26E+01	2.26E+03	1.03E+02	0.00E+00	1.22E+01
I-133	1.69E+02	2.94E+02	8.97E+01	4.32E+04	5.13E+02	0.00E+00	2.64E+02
I-134	1.26E+01	3.43E+01	1.23E+01	5.94E+02	5.46E+01	0.00E+00	2.99E-02
I-135	5.28E+01	1.38E+02	5.10E+01	9.11E+03	2.22E+02	0.00E+00	1.56E+02
Cs-134	3.03E+05	7.21E+05	5.89E+05	0.00E+00	2.33E+05	7.75E+04	1.26E+04
Cs-136	3.17E+04	1.25E+05	9.01E+04	0.00E+00	6.97E+04	9.55E+03	1.42E+04
Cs-137	3.88E+05	5.31E+05	3.48E+05	0.00E+00	1.80E+05	5.99E+04	1.03E+04
Cs-138	2.69E+02	5.31E+02	2.63E+02	0.00E+00	3.90E+02	3.85E+01	2.27E-03
Ba-139	9.00E+00	6.41E-03	2.64E-01	0.00E+00	5.99E-03	3.64E-03	1.60E+01
Ba-140	1.88E+03	2.37E+00	1.23E+02	0.00E+00	8.05E+01	1.35E+00	3.88E+03
Ba-141	4.37E+00	3.30E-03	1.48E-01	0.00E+00	3.07E-03	1.87E-03	2.00E-09
Ba-142	1.98E+00	2.03E-03	1.24E-01	0.00E+00	1.72E-03	1.15E-03	2.78E-18
La-140	3.58E-01	1.80E-01	4.76E-02	0.00E+00	0.00E+00	0.00E+00	1.32E+04
La-142	1.83E-02	7.55E-03	2.07E-03	0.00E+00	0.00E+00	0.00E+00	6.08E+01
Ce-141	8.01E-01	5.41E-01	6.15E-02	0.00E+00	2.52E-01	0.00E+00	2.07E+03
Ce-143	1.41E-01	1.04E+02	1.16E-02	0.00E+00	4.60E-02	0.00E+00	3.90E+03
Ce-144	4.18E+01	1.75E+01	2.24E+00	0.00E+00	1.04E+01	0.00E+00	1.41E+04
Pr-143	1.32E+00	5.28E-01	6.52E-02	0.00E+00	3.05E-01	0.00E+00	5.77E+03

TABLE 1.2

SITE RELATED INGESTION DOSE COMMITMENT FACTOR $A_{i\tau}$
(mRem/hr per uCi/ml)

ISOTOPE	BONE	LIVER	T-BODY	THYROID	KIDNEY	LUNG	GI-LLI
Pr-144	4.31E-03	1.79E-03	2.19E-04	0.00E+00	1.01E-03	0.00E+00	6.19E-10
Nd-147	9.00E-01	1.04E+00	6.22E-02	0.00E+00	6.08E-01	0.00E+00	4.99E+03
W-187	3.04E+02	2.55E+02	8.90E+01	0.00E+00	0.00E+00	0.00E+00	8.34E+04
Np-239	1.28E-01	1.25E-02	6.91E-03	0.00E+00	3.91E-02	0.00E+00	2.57E+03
*Sb-122	1.98E+01	3.90E-01	5.79E+00	2.69E-01	0.00E+00	1.03E+01	5.68E+03
**Sb-124	2.41E+02	4.54E+00	9.50E+01	5.81E-01	0.00E+00	1.87E+02	6.81E+03
**Br-82	0.00E+00	0.00E+00	1.93E+02	0.00E+00	0.00E+00	0.00E+00	2.22E+02
**Sb-125	1.91E+02	2.05E+00	3.84E+01	1.70E-01	0.00E+00	1.99E+04	1.69E+03

* The adult dose conversion factors, DF_i, for Sb-122 are not published in Reference 2. The calculation of dose conversion factors and site-related ingestion dose commitment factors for Sb-122 is documented in Reference 10.

** The adult dose conversion factors, DF_i, for Sb-124, Sb-125 and Br-82 are not published in Reference 2. The site-related dose commitment factors for Sb-124, Sb-125 and Br-82 were calculated using the "Adult Ingestion Dose Factors" given in Table A-3 of Reference 11, and Equation 1-11 of Part II, Section 1.3.1 of this Manual.

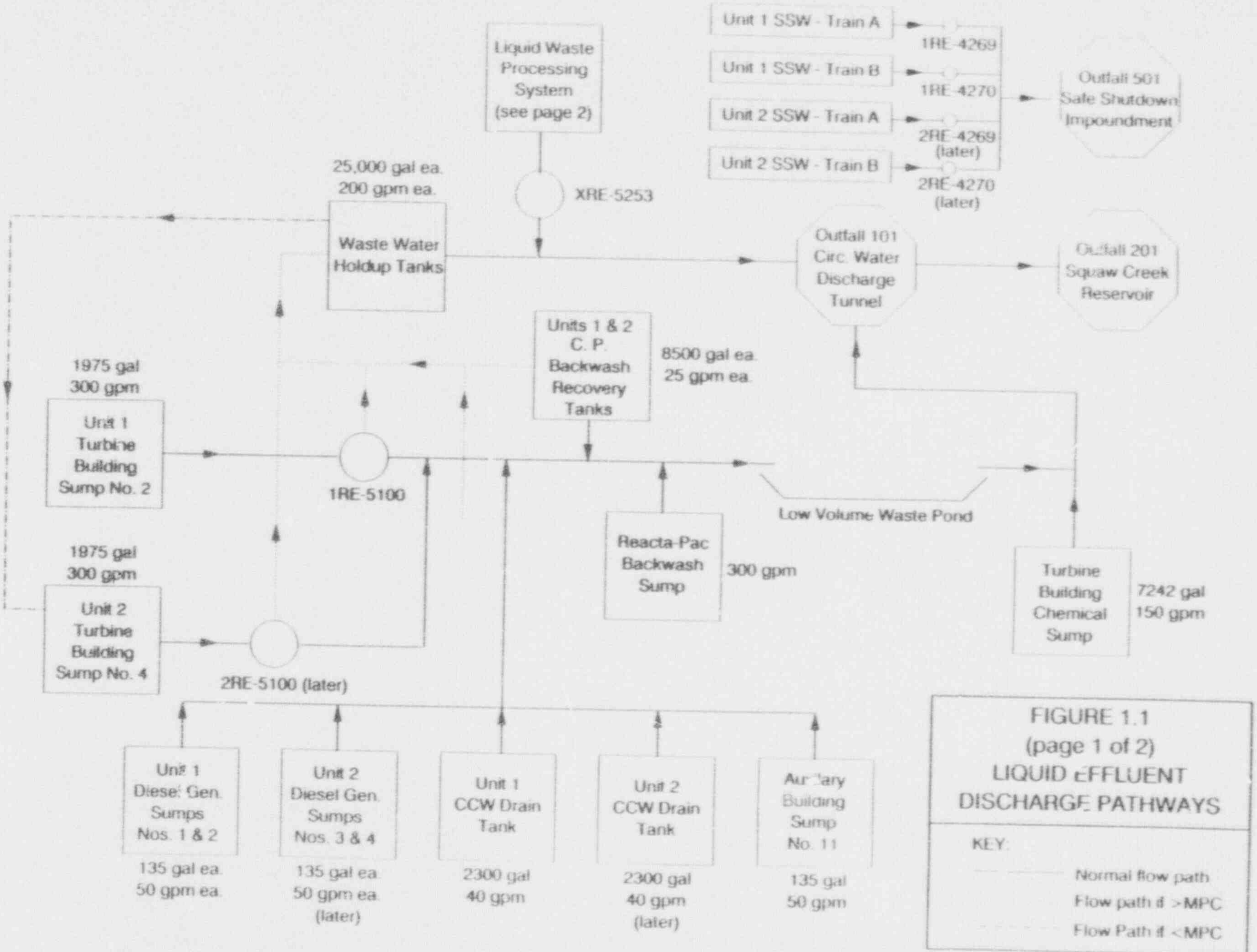


FIGURE 1.1 (page 1 of 2) LIQUID EFFLUENT DISCHARGE PATHWAYS

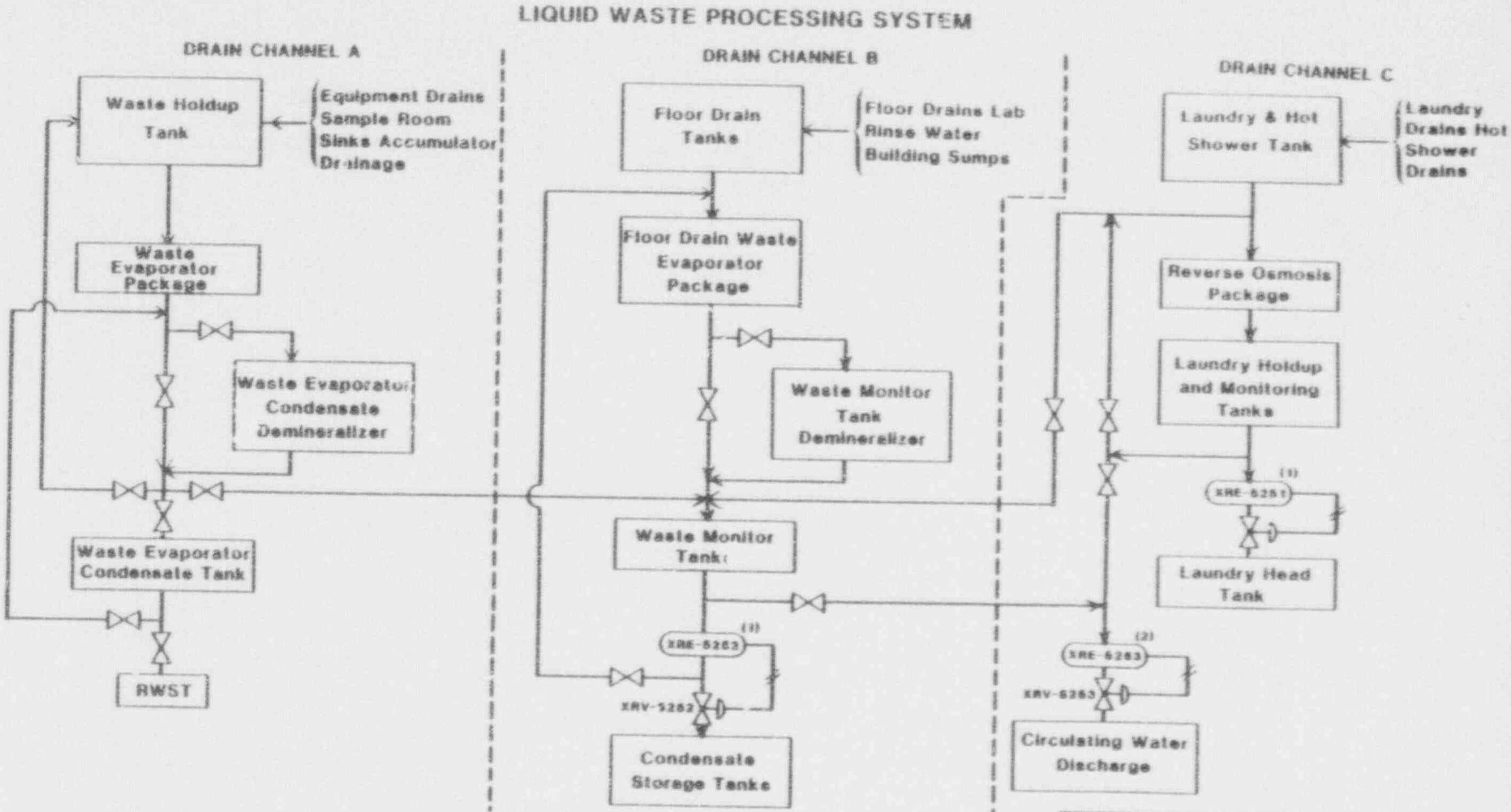


FIGURE 1.1
(page 2 of 2)
LIQUID EFFLUENT
DISCHARGE PATHWAYS

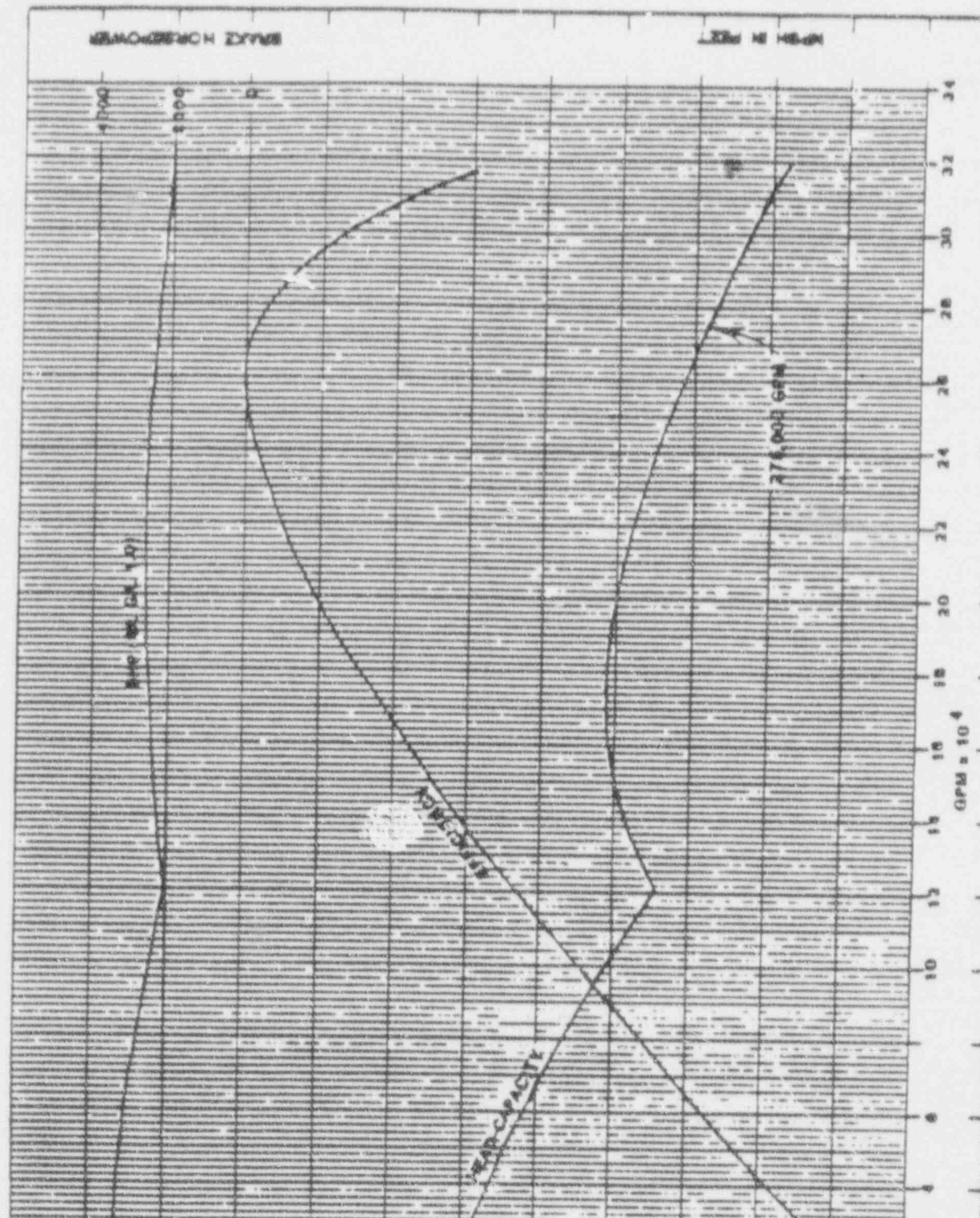
NOTES:
(1) Spared in place
(2) Discharge valve closes on monitor Hi-rad, loss of flow, or channel out-of-service alarms.

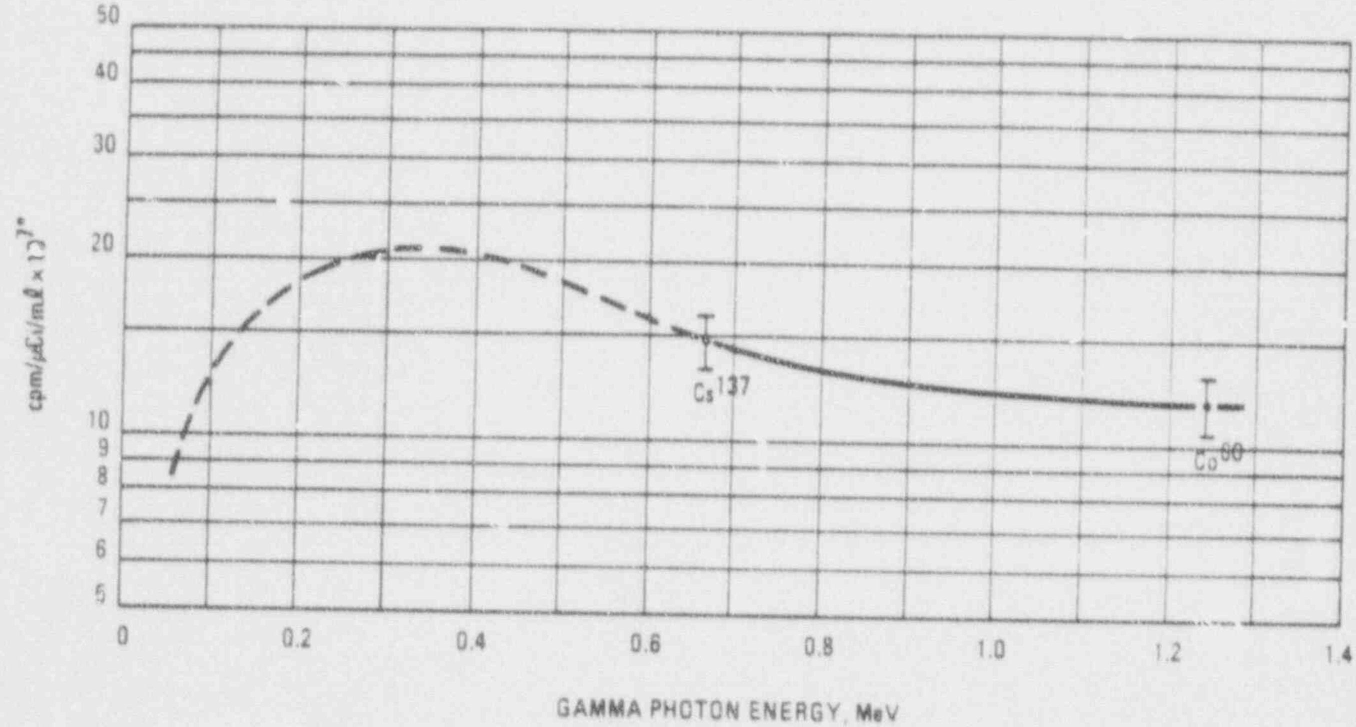
FIGURE 1.2

CIRCULATING WATER PUMP CURVES

INGERSOLL-RAND CURVE # NY-3862-4
for Pump 83 APMA-1
DATE 8/28/77

DESIGN CONDITIONS
GPM 276,000 EFF 88
TH (FT) 28 BHP 2200 SG 1.0
RPM 280 DRIVER 2500
1.15 SF





ENERGY RESPONSE TO GAMMA RADIATIONS

FOR RD-33 TYPE DETECTOR

Figure 1.3

†The broken portion of the curve was generated from early isotopic calibrations using a chamber of similar geometry

*Based on one gamma per disintegration

SECTION 2.0

GASEOUS EFFLUENTS

2.1 GASEOUS EFFLUENT MONITOR SETPOINTS

The gaseous monitor setpoint values as determined using the methodology in the following sections will be regarded as upper bounds for the actual setpoint adjustments. That is, setpoint adjustments are not required if the existing setpoint level corresponds to a lower value than the calculated value. Setpoints may be established at values lower than the calculated values if desired. Further, if the calculated value should exceed the maximum range of the monitor, the setpoint shall be adjusted to a value that falls within the normal operating range of the monitor.

If a calculated setpoint is less than the monitor reading associated with the particular release pathway, no release may be made. Under such circumstances, contributing source terms shall be reduced and the setpoint recalculated.

At CPSES, all gaseous effluents are released to the atmosphere through the two common Plant Vent Stacks (Stacks A & B) (Figure 2.1). Due to the fact that these release points are below the height of the nearest adjacent structure (i.e., containment building), all gaseous releases from these stacks are conservatively assumed to be entrained into the building wake and cavity regions, which results in a conservative ground-level release.

Each Plant Vent Stack is equipped with a Wide Range Gas Monitor (WRGM) and a Particulate, Iodine, and Noble Gas Monitor (PIG). These monitors are part of the plant Digital Radiation Monitoring System (DRMS) supplied by GA Technologies. Since all DRMS monitors provide a digital output, they may be calibrated to read out in the appropriate engineering units (i.e., uCi/ml). The conversion factor for detector output from counts per minute to uCi/ml is determined during the calibration of each individual monitor, and is input into the data base for the monitor microprocessor.

The WRGMs are designated as monitors XRE-5570A and XRE-5570B for
Stacks A and B, respectively. Each WRGM consists of a low range
(10^{-7} to 10^{-1} uCi/cc), mid range (10^{-4} to 10^{2} uCi/cc), and
high range (10^{-1} to 10^{5} uCi/cc) noble gas activity detector. The 4
WRGMs also have an effluent release rate channel which uses inputs
from the appropriate WRGM noble gas activity detectors and the plant
vent stack flow rate detectors (X-FT-5570A-1/B-1) to provide an
indication of noble gas release rate in uCi/sec. Alarm setpoints are
established for the WRGM effluent release rate channel to fulfill the
requirements of Radiological Effluent Control 3/4.3.3.5. Exceeding
the WRGM effluent release rate channel high alarm setpoint also
initiates automatic termination of Waste Gas Decay Tank releases.

The stack PIGs are designated as particulate channels XRE-5568A and XRE-5568B, iodine channels XRE-5575A and XRE-5575B, and noble gas channels XRE-5567A and XRE-5567B for Stacks A and B, respectively. The stack PIG noble gas channels may be used as a back-up to the WRGM when no automatic control functions are required. Therefore, a methodology is provided for calculating the PIG noble gas monitor setpoints. Additionally, methodologies are provided for calculating setpoints for the PIG particulate and iodine channels, although these channels are not required by the Radiological Effluent Controls Program.

Other monitors that may be used for effluent monitoring and control are the Auxiliary Building Ventilation Duct Monitor, XRE-5701, and the Containment PIG Noble Gas Monitor, 1RE-5503. XRE-5701 may be used to monitor Waste Gas Decay Tank releases by monitoring the Auxiliary Building Ventilation Duct. XRE-5701 also provides the automatic control function for termination of Waste Gas Decay Tank releases. 1RE-5503 monitors the Containment atmosphere and provides the only automatic control function for termination of Containment vents or purges.

2.1.1 Dose Rates Due to Noble Gases

For implementation of Radiological Effluent Control 3/4.11.2.1.a, the dose rate to the total body and skin of an individual at the SITE BOUNDARY due to noble gases shall be calculated as follows:

A. Calculate the total body dose rate due to noble gases

$$D_t = (\overline{X/Q}) \sum_{\text{(noble gases)}} K_i \, Q_i \qquad \text{[Eq. 2-1]}$$

Where: D_t = the total body dose rate at the SITE BOUNDARY due to noble gases (mRem/yr)

$(\overline{X/Q})$ = the highest annual average relative concentration at the SITE BOUNDARY (3.3×10^{-6} sec/m^3 in the NNW sector at a distance of 1.29 miles from the plant*.)

NOTE: The annual average $\overline{X/Q}$ is also used in determining setpoints for containment purge or vent as required by Technical Specification 3.3.3.1.

K_i = total body dose factor due to gamma emissions from noble gas radionuclide i from Table 2.1 (mRem/yr per uCi/m^3)

Q_i = the total release rate of radionuclide i from the plant vent stacks (uCi/sec) (See C below for calculation of Q_i)

B. Calculate the skin dose rate due to noble gases

$$D_s = (\overline{X/Q}) \sum_{\text{(noble gases)}} (L_i + 1.1 \, M_i) \, Q_i \qquad \text{[Eq. 2-2]}$$

Where: D_s = the skin dose rate at the SITE BOUNDARY due to noble gases (mRem/yr)

---

*Reference CPSES FSAR, Section 2.3.5.2.

L_i = the skin dose factor due to beta emissions from noble gas radionuclide i from Table 2.1 (mRem/yr per uCi/m^3)

1.1 = conversion factor of mRem skin dose per mRad air dose.

M_i = air dose factor due to gamma emissions from noble gas radionuclide i from Table 2.1 (mRad/yr per uCi/m^3)

All other terms are as previously defined.

C. Calculation of the Q_i term

Q_i is defined as the total release rate (uCi/sec) of radionuclide i from the plant vent stacks. Q_i is given by:

$$Q_i = \sum_v X_{iv} F_v \qquad \text{[Eq. 2-3]}$$

Where: X_{iv} = the concentration of radionuclide i present at each plant vent stack (uCi/cm^3)

F_v = the flow rate at each plant vent stack (cm^3/sec)

v = index over all plant vent stacks

The concentration of radionuclide i present at each plant vent stack monitor due to all release sources (e.g., continuous and batch sources), X_{iv}, is calculated using Eq. 2-4. This calculation is performed for each plant vent stack using the estimated concentration and flow rate for each individual stack.

$$X_{iv} = \frac{X_{ic} F_c + (1/2) X_{iB} F_B}{F_c + (1/2) F_B} \qquad \text{[Eq. 2-4]}$$

where: X_{ic} = The concentration of radionuclide i in the continuous release stream at each stack as sampled in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2 (uCi/cm^3). The samples are taken from each plant vent stack at the WRGM skid.

F_C = The continuous flow rate contribution of each plant stack (cm^3/sec). These flow rates are measured directly in each plant vent stack (X-FT-5570A-1/B-1). | 4

X_{iB} = The concentration of radionuclide i in the batch release as sampled in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. These samples are taken prior to release from the confinement to be released.

F_B = The estimated flow rate contribution associated with the release of the batch source (cm^3/sec)

1/2 = factor to account for distribution of the batch release to each plant vent stack, assuming uniform distribution of the batch release between both stacks. (unitless)

NOTE: If there is no batch release source, F_B and X_{iB} are zero, and $X_{iv} = X_{ic}$.

The flow rate at each plant vent, F_V, is given by:

$$F_V = F_C + (1/2)\ F_B \qquad \text{[Eq. 2-5]}$$

NOTE: If there is no batch release source, F_B is zero, and $F_V = F_C$.

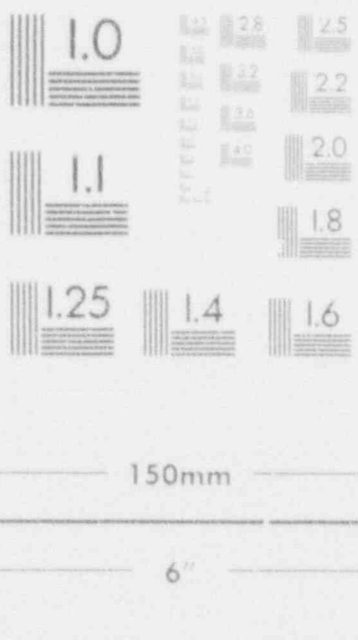
2.1.2 Plant Vent Stack Noble Gas Activity Monitors
XRE-5570A/B (low range noble gas activity) and XRE-5567A/B

These channels may be used for establishing noble gas activity setpoints when no automatic control functions are required by Radiological Effluent Control 3/4.3.3.5. The alarm setpoint for these channels will be calculated using Eqs. 2-6 and 2-7. These calculations will be performed for each plant vent stack.

$$C_G = \text{the lesser of} \begin{cases} X_{GV}\ \dfrac{500}{D_t}\ \times SF \times AF = \dfrac{125\ X_{GV}}{D_t} & \text{[Eq. 2-6]} \\ X_{GV}\ \dfrac{3000}{D_s}\ \times SF \times AF = \dfrac{750\ X_{GV}}{D_s} & \text{[Eq. 2-7]} \end{cases}$$

1

IMAGE EVALUATION TEST TARGET (MT-3)



1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

Where: C_G = The alarm setpoint for each plant vent noble gas activity monitor (uCi/cm^3)

$X_{GV} = \sum_{(noble\ gases)} X_{iv}$

= the concentration of noble gases present at each plant vent stack due to the combined sources as calculated from the radionuclide concentrations determined from the analysis of the appropriate samples taken in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2 (uCi/cm^3). (See Section 2.1.1.C for the determination of X_{iv}).

500 = the dose rate limit to the total body of an individual in an unrestricted area due to noble gases. (mRem/yr)

3000 = the dose rate limit to the skin of the body of an individual in an unrestricted area due to noble gases. (mRem/yr)

SF = Safety Factor of 0.5 applied to compensate for statistical fluctuations, errors of measurement, and non-uniform distribution of release activity between the stacks. (unitless)

AF = Allocation Factor of 0.5 applied to account for releases from both plant stacks simultaneously (unitless). This factor will limit the dose rate contribution from each stack to 1/2 the limit for the site.

2.1.3 Plant Vent Effluent Release Rate and Sample Flow Rate Monitors

A. Plant Vent Stack Release Rate Monitors
XRE-5570A/B (Effluent Release Rate Channel)
The WRGM effluent release rate channels monitor the release rate of radioactive materials from each plant vent stack by combining inputs from the WRGM noble gas activity channel (uCi/cm^3) indication and a stack flow rate (cm^3/sec) indication (X-FT-5570A-1/B-1) to yield an effluent release rate (uCi/sec). By establishing an alarm setpoint for this monitor, an increase in either the noble gas activity or stack flow rate will cause an alarm trip. The WRGM effluent channel also provides an automatic control function for termination of Waste Gas Decay Tank Releases. The setpoint for each plant vent effluent release rate monitor will be calculated using Eq. 2-8. This calculation will be performed for each plant vent stack. 4

$$C_f = C_G F_v \qquad \text{[Eq. 2-8]}$$

where: C_f = The setpoint for each plant vent stack effluent release rate monitor. (uCi/sec)

All other terms are previously defined.

B. Sampler Flow Rate Monitors (X-RFT-5570A-1/B-1) 4
The WRGMs are designed to sample isokinetically from the plant vent stacks. Isokinetic sample flow is maintained automatically by the monitor microprocessor. The sampler flow rate monitors are designed such that if there is a loss of sample flow, the stack monitor automatic control functions are initiated. The loss of sample flow alarm setpoints are established permanently in accordance with vendor specifications.

2.1.4 Auxiliary Building Ventilation Exhaust Monitor XRE-5701

Radiological Effluent Control 3/4.3.3.5, Table 3.3-8, ACTION 34, allows for the Auxiliary Building Ventilation Duct Monitor (XRE-5701) to be used as a backup to the WRGM for monitoring Waste Gas Decay Tank (WGDT) releases. XRE-5701 monitors WGDT releases by measuring activity in the Auxiliary Building Vent Duct and providing an automatic control function for termination of WGDT releases. If required, the alarm setpoint for XRE-5701 will be calculated using the following methodology. The alarm setpoint calculation is based on the following assumptions:

(1) a waste gas decay tank release is the only batch release occurring (i.e., a containment purge or vent is not occurring at the same time).

(2) the source contribution due to other sources in the Auxiliary Building is negligible relative to the source contribution due to the release of the waste gas decay tank.

The concentration at the Auxiliary Building Vent Monitor during a waste gas decay tank release is calculated as follows:

$$X_{iaux} = \frac{X_{iGDT}\ F_{GDT} + X_{iABV}\ F_{ABV}}{F_{GDT} + F_{ABV}} \quad \text{[Eq. 2-9]}$$

From assumption (2) above, ($X_{iGDT}\ F_{GDT} >> X_{iABV}\ F_{ABV}$); therefore, this equation can be reduced to:

$$X_{iaux} = \frac{X_{iGDT}\ F_{GDT}}{F_{aux}} \quad \text{[Eq. 2-10]}$$

Where: X_{iGDT} = the concentration of noble gas radionuclide i (uCi/cm^3) in the WGDT as sampled in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. This sample is taken prior to release from the WGDT.

F_{GDT} = the flow rate contribution associated with the release of a WGDT (cm^3/sec)

X_{iABV} = the concentration of noble gas radionuclide i (uCi/cm^3) in the Auxiliary Building ventilation stream due to sources other than the waste gas decay tanks (see assumption (2), above)

F_{ABV} = the flow rate contribution associated with sources in the Auxiliary Building other than the waste gas decay tanks. This is the measured or estimated flow rate in the auxiliary building vent duct.

F_{aux} = the total flow rate at the Auxiliary Building Ventilation Monitor during the release of a waste gas decay tank = $F_{GDT} + F_{ABV}$

X_{iaux} = the concentration of noble gas radionuclide i at the Auxiliary Building Ventilation Monitor during a waste gas decay tank release.

From Section 2.1.1, Item C, the release rate for radionuclide i at each plant vent stack may be given by:

$$X_{iv} F_v = X_{ic} F_c + (1/2) X_{iB} F_B \quad \text{[Eq. 2-11]}$$

For this case of a batch release of a waste gas decay tank, make the following substitution into this equation (see assumption (1), above):

$$X_{iB} F_B = X_{iaux} F_{aux} \quad \text{[Eq. 2-12]}$$

Therefore,

$$X_{iv} F_v = X_{ic} F_c + (1/2) X_{iaux} F_{aux} \quad \text{[Eq. 2-13]}$$

Now, assuming that the source contribution from the Auxiliary Building vent (due to the release of the waste gas decay tank), $X_{iaux} F_{aux}$, is much greater than the source contribution due to all continuous sources to each plant vent stack, $X_{ic}F_c$, then $X_{iv} F_v$ is approximately equal to 1/2 $X_{iaux} F_{aux}$.

$$X_{iv} F_v = (1/2) X_{iaux} F_{aux} \quad \text{[Eq. 2-14]}$$

At the alarm setpoint concentration at each plant vent monitor, X_{iv} = C_G. Also, the Auxiliary Building Ventilation Monitor alarm setpoint, C_{aux}, corresponds to the noble gas concentration, X_{iaux}, that would result in the alarm setpoint concentration at each plant vent stack monitor. Since plant vent monitor alarm setpoints are calculated separately for each stack, the maximum of the two plant vent stack monitor alarm setpoints should be used in this calculation for C_G. Therefore,

$$C_{Gmax} F_v = (1/2) C_{aux} F_{aux} \quad \text{[Eq. 2-15]}$$

Solving for C_{aux} yields:

$$C_{aux} = \frac{2\, C_{Gmax} F_v}{F_{aux}} \quad \text{[Eq. 2-16]}$$

Where: C_{aux} = the Auxiliary Building ventilation exhaust monitor alarm setpoint (uCi/cm^3)

C_{Gmax} = maximum of the monitor setpoints for the two stacks.

All other variables are previously defined.

2.1.5 Containment Atmosphere Gaseous Monitor 1RE-5503

For implementation of Technical Specification 3/4.3.3.1, the alarm setpoint for the Containment Atmosphere Gaseous Monitor for Containment Ventilation Isolation will be calculated using the following methodology. The alarm setpoint calculation is based on the following assumptions:

(1) a containment purge or vent operation is the only batch release occurring (i.e., a waste gas decay tank purge operation is not occurring at the same time).

(2) the source contributions due to all other continuous sources to the plant vent are negligible relative to the source contribution from Containment Building purge or vent operation.

From Section 2.1.1, Item C, the release rate for radionuclide i at each plant vent stack may be given by:

$$X_{iv} F_v = X_{ic} F_c + (1/2) X_{iB} F_B \qquad \text{[Eq. 2-11]}$$

For this case of a batch release due to a containment purge or vent operation, make the following substitution into this equation (see assumption (1), above)

$$X_{iB} F_B = X_{icont} F_{cont} \qquad \text{[Eq. 2-17]}$$

Where: X_{icont} = the concentration of noble gas radionuclide i (uCi/cm^3) in the containment release stream as sampled in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. This sample is taken prior to release from the Containment Building.

F_{cont} = the flow rate contribution associated with the release of the containment atmosphere (cm^3/sec)

Therefore,

$$X_{iv} F_v = X_{ic} F_c + (1/2) X_{icont} F_{cont} \qquad \text{[Eq. 2-18]}$$

Now, assuming that the source contribution from the containment purge or vent, $X_{icont} F_{cont}$, is much greater than the source contribution due to all continuous sources to each plant vent stack, $X_{ic} F_c$, then $X_{iv} F_v$ is approximately equal to 1/2 $X_{icont} F_{cont}$.

$$X_{iv} F_v = (1/2) X_{icont} F_{cont} \qquad \text{[Eq. 2-19]}$$

At the alarm setpoint concentration at each plant vent monitor, X_{iv} = C_G. Also, the containment atmosphere gaseous monitor alarm setpoint, C_{cont}, corresponds to the noble gas concentration, X_{icont}, that would result in the alarm setpoint concentration at each plant vent stack monitor. Since plant vent monitor alarm setpoints are calculated separately for each stack, the maximum of the two plant vent stack monitor alarm setpoints should be used in this calculation for C_G. Therefore,

$$C_{Gmax} F_v = (1/2)\, C_{cont} F_{cont} \qquad \text{[Eq. 2-20]}$$

Solving for C_{cont} yields:

$$C_{cont} = \frac{2C_{Gmax} F_v}{F_{cont}} \qquad \text{[Eq. 2-21]}$$

Where: C_{cont} = the containment atmosphere gaseous monitor alarm setpoint (uCi/cm^3)

C_{Gmax} = maximum of the monitor setpoints for the two stacks.

All other variables are previously defined.

2.1.6 Dose Rates Due to Radioiodines, Tritium, and Particulates

Organ dose rates due to iodine-131 and iodine-133, tritium, and all radioactive materials in particulate form with half-lives greater than eight days will be calculated to implement the requirements of Radiological Effluent Control 3/4.11.2.1.b as follows:

$$D_o = (\overline{X/Q}) \sum_{IP\&T} P_i Q_i \qquad \text{[Eq. 2-22]}$$

Where: D_o = the total organ dose rate due to iodine-131, iodine-133, particulates with half-lives greater than eight days, and tritium. (mrem/yr)

P_i = pathway dose rate parameter factor for radionuclide, i, (for radioiodines, particulates, and tritium) for the inhalation pathway in mRem/yr per uCi/m^3* (Table 2.2)

IP&T = Iodine-131, iodine-133, particulates with half-lives greater than eight days, and tritium. These are the isotopes over which the summation function is to be performed.

All other variables are previously defined.

2.1.7 Plant Vent Stack Iodine Monitors XRE-5575A/B

The setpoint for the Plant Vent Stack Iodine Monitors should be established to ensure compliance with Radiological Effluent Control 3/4.11.2.1b. These setpoints are not required by Radiological Effluent Control 3/4.3.3.5, Table 3.3-8. The methodology used performs dose rate calculations in accordance with Section 2.1.6 and compares them with the Radiological Effluent Control dose rate limit of 1500 mRem/yr to any organ for compliance. An allocation factor (AF) and safety factor (SF) are also utilized for this determination. Additionally, the ratio of the dose rate due to only I-131 to the dose rate due to I-131 and I-133 is included as a factor in the determination since the stack iodine monitor utilizes a single channel analyzer set on the I-131 photopeak (i.e., only I-131 is detected, not all iodines). The equation for calculating the Iodine Monitor Setpoint for each stack, C_I, is:

$$C_I = X_{IV} \frac{1500}{D_o} \times AF \times SF \left(\frac{D_{I-131}}{D_I}\right) = \frac{375\ (X_{IV})}{D_o} \left(\frac{D_{I-131}}{D_I}\right) \quad \text{[Eq. 2-23]}$$

---

*The latest NRC guidance has deleted the requirement to determine P_i for the ground plane and food pathways. In addition, the critical age group has been changed from infant to child. The methodology used for determining values of P_i is given in Appendix A.

Where: C_I = The setpoint for each plant vent stack Iodine Monitor (uCi/cm^3)

$X_{IV} = \sum_{(iodines)} X_{iv}$

= the concentration of radioiodines present at each plant vent stack due to the combined sources as calculated from the radionuclide concentrations determined from the analysis of the appropriate samples taken in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. (uCi/cm^3) (See Section 2.1.1.c for the determination of X_{iv}).

1500 = the dose rate limit to any organ due to I-131, tritium and particulates with half-lives greater than eight days (mRem/yr)

D_{I-131} = the organ dose rate due to I-131 calculated using Eq. 2-22 considering only I-131.

D_I = the organ dose rate due to I-131 and I-133 calculated using Eq. 2-22 considering only I-131 and I-133.

All other variables are previously defined.

2.1.8 Plant Vent Stack Particulate Monitors XRE-5568A/B

The setpoint for the Plant Vent Stack Particulate Monitors should be established to ensure compliance with Radiological Effluent Control 3/4.11.2.1.b. The methodology used performs dose rate calculations in accordance with Section 2.1.6 and compares them with the Radiological Effluent Control dose rate limit of 1500 mRem/yr to any organ for compliance. An allocation factor (AF) and safety factor (SF) are also utilized for this determination. The equation for calculating the Particulate Monitor Setpoint for each stack, C_p, is:

$$C_p = X_{PV} \frac{1500}{D_o} \times AF \times SF = \frac{375\ (X_{PV})}{D_o} \qquad \text{[Eq. 2-24]}$$

Where: C_p = The setpoint for each plant vent stack Particulate Monitor (uCi/cm^3)

X_{PV} = $\sum_{(particulates)} X_{iv}$

= the concentration of particulates present at each plant vent stack due to the combined sources as calculated from the radionuclide concentrations determined from the analysis of the appropriate samples taken in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. (uCi/cm^3).

All other variables are previously defined.

TABLE 2.1

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

Isotope	γ-Body*** (K)	β-Skin***(L)	γ-Air**(M)	β-Air**(N)
Kr-83m	7.56E-02	---	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

*Values taken from Reference 2, Table B-1

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

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

2.2 GASEOUS EFFLUENT DOSE CALCULATIONS

2.2.1 Dose Due to Noble Gases

For implementation of Radiological Effluent Control 3/4.11.2.2, the cumulative air dose due to noble gases to areas at and beyond the SITE BOUNDARY will be calculated at least once per 31 days and a cumulative summation of the air doses will be maintained for each calendar quarter and each calendar year. The air dose over the desired time period will be calculated as follows:

D_γ = air dose due to gamma emissions from noble gas radionuclides (mrad)

$$D_\gamma = 3.17 \times 10^{-8} \, (X/Q) \sum_{(noble\ gases)} M_i \, Q'_i \qquad \text{[Eq. 2-25]}$$

Where: 3.17×10^{-8} = the fraction of a year represented by one second

Q'_i = the cumulative release of radionuclide i during the period of interest. (uCi) ($Q'_i = Q_i$ (uCi/sec) x release duration (sec)) Q'_i is based on the noble gas activities in each plant vent stack and WGDT or Containment Samples required by Radiological Effluent Control 3/4.11.2.1, Table 4.11-2.

All other variables are previously defined.

D_β = air dose due to beta emissions from noble gas radionuclides (mrad)

$$D_\beta = 3.17 \times 10^{-8} \, (X/Q) \sum_{(noble\ gases)} N_i \, Q'_i \qquad \text{[Eq. 2-26]}$$

Where: N_i = the air dose factor due to beta emissions from noble gas radionuclide i from Table 2.1 (mRad/yr per uCi/m^3).

All other variables are previously defined.

Note: If the methodology in this section is used in determining dose to an individual rather than air dose due to noble gases, substitute K_i for M_i, (L_i + 1.1 M_i) for N_i, and the Annual Average X/Q values from Table 2.4 for the highest annual average relative concentration ($\overline{X/Q}$) at the SITE BOUNDARY. 5

2.2.2 Dose Due to Radioiodines, Tritium, and Particulates

For implementation of Radiological Effluent Control 3/4.11.2.3, the cumulative dose to each organ of an individual due to iodine-131, iodine-133, tritium, and particulates with half-lives greater than 8 days will be calculated at least once per 31 days and a cumulative summation of these doses will be maintained for each calendar quarter and each calendar year. The dose over the desired period will be calculated as follows:

Dp = dose due to all real pathways to organ, o, of an individual in age group, a, from iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than eight days (mRem).

$$Dp = \sum_{PATHS} 3.17 \times 10^{-8} W' \sum_{IP\&T} R^{P}_{i,a,o} \, i \, Q'_i \qquad \text{[Eq. 2-27]}$$

Where: W' = the dispersion parameter for estimating the dose to an individual at the location where the combination of existing pathways and receptor age groups indicates the maximum potential exposures. Locations of interest are listed in Table 2.4, 5

W' = X/Q for the inhalation pathway in sec/m^3. X/Q is the annual average relative concentration at the location of interest. Values for X/Q are listed in Table 2.4. If desired, the highest individual receptor X/Q valve may be used, or

W' = D/Q for the food and ground plane pathways in m^{-2}. D/Q is the annual average deposition at the location of interest. Values for D/Q are listed in Table 2.4. If desired, the highest individual receptor D/Q value may be used.

NOTE: For tritium, the dispersion parameter, W' is taken as the annual average X/Q values from Table 2.4 for inhalation, food and ground plane pathways.

$RP_{i,a,o}$ = dose factor for radionuclide i, pathway p, age group a and organ o, in mRem/yr per uCi/m^3 for the inhalation pathway and m^2(mRem/yr) per uCi/sec for food and ground plane pathways, except for tritium which is in mRem/yr per uCi/m^3 for all pathways. The values for $RP_{i,a,o}$ for each pathway, radionuclide, age group and organ are listed in Table 2.3*.

Q'_i = cumulative release of radionuclide, i, during the period of interest (uCi). Q'_i is based on the activities measured in each plant vent stack from the analyses of the particulate and iodine samples required by Radiological Effluent Control 3/4.11.2.1, Table 4.11-2.

I&PT = Iodines, particulates with half-lives greater than eight days, and tritium. These are the isotopes over which the summation function is to be performed.

PATHS = the real pathways of exposure to individuals at the locations of interest as indicated in Table 2.4. | 5

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*The methodologies used for determining values of $RP_{i,a,o}$ for each pathway are given in Appendices B through F.

2.2.3 Dose Projections for Gaseous Effluents

Radiological Effluent Control 3/4.11.2.4 requires that appropriate subsystems of the Gaseous Radwaste Treatment Systems be used to reduce releases of radioactivity when the projected doses due to the gaseous effluent to areas at and beyond the SITE BOUNDARY would exceed, in a 31-day period, either:

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

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

At least once every 31 days the gamma air dose, beta air dose and the maximum organ dose for the quarter-to-date will be divided by the number of days into the quarter and multiplied by 31. Also, this dose projection shall include the estimated dose due to any anticipated unusual releases during the period for which the projection is made, such as Waste Gas Decay Tank releases. If these projected doses exceed any of the values listed above, appropriate portions of the Gaseous Waste Processing System shall be used to reduce radioactivity levels prior to release.

2.2.4 Dose Calculations to Support Other Requirements

For the purpose of implementing the requirements of Radiological Effluent Control 6.9.1.4, the Semiannual Radioactive Effluent Release Report shall include an assessment of the radiation doses due to radioactive liquid and gaseous effluents from the station during the previous 6 months of operation. This assessment shall be a summary of the doses determined in accordance with Section 1.2 for doses due to liquid effluents, Section 2.2.1 for air doses due to noble gases, and Section 2.2.2 for doses due to iodines, tritium, and particulates. This same report shall also include an assessment of the radiation

doses from radioactive liquid and gaseous effluents to members of the public due to their activities inside the SITE BOUNDARY. This assessment shall be performed in accordance with the methodologies in Sections 1.2, 2.2.1, and 2.2.2, using either historical average or concurrent dispersion and deposition parameters for the locations of interest, and taking into account occupancy factors. All assumptions and factors used in the determination shall be included in the report.

For the purpose of implementing Radiological Effluent Control 3/4.12.2 dose calculations for the new locations identified in the land use census shall be performed using the methodology in Section 2.2.2, substituting the appropriate pathway receptor dose factors and dispersion parameters for the location(s) of interest. Annual average dispersion parameters may be used for these calculations. If the land use census changes, the critical location (i.e., the location where an individual would be exposed to the highest dose) must be reevaluated for the nearest residence, the nearest milk animal, and the nearest vegetable garden. Additionally, when a location is identified that yields a calculated dose 20% greater than at a location where environmental samples are currently being obtained, add the new location within 30 days to the Radiological Environmental Monitoring locations described in Section 3.1 of this manual.

For the purpose of implementing Radiological Effluent Control 3/4.11.4, the total annual dose to any member of the public due to releases of radioactivity and to radiation from uranium fuel cycle sources may be determined by summing the annual doses determined for a member of the public in accordance with the methodology of Sections 1.2, 2.2.1, and 2.2.2 and the direct radiation dose contributions from the units and from outside storage tanks to the particular member of the public. This assessment must be performed in the event calculated doses from the effluent releases exceed twice the limits of Controls 3/4.11.1.2, 3/4.11.2.2, or 3/4.11.2.3. This assessment will be included in the Semi-annual Radioactive Effluent Release Report to be submitted 60 days after January 1 of the year after the assessment was required. Otherwise, no assessments are required.

For the evaluation of doses to real individuals from liquid releases, the same calculation methods as employed in section 1.2 will be used. However, more encompassing and realistic assumptions will be made concerning the dilution and ingestion of radionuclides. The results of the Radiological Environmental Monitoring Program will be used in determining the realistic dose based on actual measured radionuclide concentrations. For the evaluation of doses to real individuals from gaseous releases, the same calculational methods as employed in sections 2.2.1 and 2.2.2 will be used. In section 2.2.1, the total body dose factor should be substituted for the gamma air dose factor (M_i) to determine the total body dose. Otherwise, the same calculational sequence applies. More realistic assumptions will be made concerning the actual location of real individuals, the meteorological conditions, and the consumption of food. Data obtained from the latest land use census should be used to determine locations for evaluating doses. The results of the Radiological Environmental Monitoring Program will be included in determining more realistic doses based on actual measured radionuclide concentrations.

The dose component due to direct radiation may be determined by calculation or actual measurement (e.g., thermoluminescent dosimeters, micro-R meter, etc.). The calculation or actual measurement of direct radiation shall be documented in the Special Report that must be submitted if this determination is required.

TABLE 2.2
PATHWAY DOSE RATE PARAMETER (P1)*

*BASED ON THE INHALATION PATHWAY
FOR THE CHILD AGE GROUP

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	[illegible].12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
RB-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
SR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
NB-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
RU-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.[illegible]E+05	4.48E+04
RU-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
AG-110M	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
TE-125M	6.73E+03	2.33E+03	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04
TE-127M	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
TE-129M	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.[illegible]E+03
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	[illegible]
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
CE-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05
PR-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	4.33E+05	9.73E+04
ND-147	1.08E+04	8.73E+03	6.81E+02	0.00E+00	4.81E+03	3.28E+05	8.21E+04

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: ALL   PATHWAY: GROUND PLANE

NUCLIDE	ORGAN DOSE FACTORS	
	T. BODY	SKIN
H-3	0.00E+00	0.00E+00
P-32	0.00E+00	0.00E+00
CR-51	4.65E+05	5.50E+06
MN-54	1.39E+09	1.62E+09
FE-55	0.00E+00	0.00E+00
FE-59	2.73E+08	3.21E+08
CO-58	3.79E+08	4.44E+08
CO-60	2.15E+10	2.53E+10
NI-63	0.00E+00	0.00E+00
ZN-65	7.47E+08	8.59E+08
RB-86	8.97E+06	1.03E+07
SR-89	2.16E+04	2.51E+04
SR-90	0.00E+00	0.00E+00
Y-91	1.07E+06	1.21E+06
ZR-95	2.45E+08	2.84E+08
NB-95	1.37E+08	1.61E+08
RU-103	1.08E+08	1.26E+08
RU-106	4.22E+08	5.06E+08
AG-110M	3.44E+09	4.01E+09
TE-125M	1.55E+06	2.13E+06
TE-127M	9.17E+04	1.08E+05
TE-129M	1.98E+07	2.31E+07
I-131	1.72E+07	2.09E+07
I-133	2.45E+06	2.98E+06
CS-134	6.86E+09	8.00E+09
CS-136	1.51E+08	1.71E+08
CS-137	1.03E+10	1.20E+10
BA-140	2.06E+07	2.36E+07
CE-141	1.37E+07	1.54E+07
CE-144	6.96E+07	8.05E+07
PR-143	0.00E+00	0.00E+00
ND-147	8.39E+06	1.01E+07

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: ADULT   PATHWAY: GRASS-COW-MILK

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	7.62E+02	7.62E+02	7.62E+02	7.62E+02	7.62E+02	7.62E+02
P-32	1.70E+10	1.06E+09	6.58E+08	0.00E+00	0.00E+00	0.00E+00	1.91E+09
CR-51	0.00E+00	0.00E+00	2.85E+04	1.70E+04	6.28E+03	3.78E+04	7.17E+06
MN-54	0.00E+00	8.40E+06	1.60E+06	0.00E+00	2.50E+06	0.00E+00	2.57E+07
FE-55	2.51E+07	1.73E+07	4.04E+06	0.00E+00	0.00E+00	9.66E+06	9.93E+06
FE-59	2.97E+07	6.97E+07	2.67E+07	0.00E+00	0.00E+00	1.95E+07	2.32E+08
CO-58	0.00E+00	4.71E+06	1.05E+07	0.00E+00	0.00E+00	0.00E+00	9.54E+07
CO-60	0.00E+00	1.64E+07	3.61E+07	0.00E+00	0.00E+00	0.00E+00	3.08E+08
NI-63	6.72E+09	4.65E+08	2.25E+08	0.00E+00	0.00E+00	0.00E+00	9.71E+07
ZN-65	1.37E+09	4.36E+09	1.97E+09	0.00E+00	2.91E+09	0.00E+00	2.74E+09
RB-86	0.00E+00	2.59E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	5.10E+08
SR-89	1.45E+09	0.00E+00	4.16E+07	0.00E+00	0.00E+00	0.00E+00	2.32E+08
SR-90	4.67E+10	0.00E+00	1.15E+10	0.00E+00	0.00E+00	0.00E+00	1.35E+09
Y-91	8.57E+03	0.00E+00	2.29E+02	0.00E+00	0.00E+00	0.00E+00	4.72E+06
ZR-95	9.41E+02	3.02E+02	2.04E+02	0.00E+00	4.74E+02	0.00E+00	9.57E+05
NB-95	8.24E+04	4.58E+04	2.46E+04	0.00E+00	4.53E+04	0.00E+00	2.78E+08
RU-103	1.02E+03	0.00E+00	4.38E+02	0.00E+00	3.88E+03	0.00E+00	1.19E+05
RU-106	2.04E+04	0.00E+00	2.58E+03	0.00E+00	3.93E+04	0.00E+00	1.32E+06
AG-110M	5.81E+07	5.38E+07	3.19E+07	0.00E+00	1.06E+08	0.00E+00	2.19E+10
TE-125M	1.63E+07	5.89E+06	2.18E+06	4.89E+06	6.61E+07	0.00E+00	6.49E+07
TE-127M	4.57E+07	1.63E+07	5.57E+06	1.17E+07	1.86E+08	0.00E+00	1.53E+08
TE-129M	6.01E+07	2.24E+07	9.51E+06	2.06E+07	2.51E+08	0.00E+00	3.02E+08
I-131	2.96E+08	4.23E+08	2.42E+08	1.39E+11	7.25E+08	0.00E+00	1.12E+08
I-133	3.87E+06	6.73E+06	2.05E+06	9.88E+08	1.17E+07	0.00E+00	6.04E+06
CS-134	5.64E+09	1.34E+10	1.10E+10	0.00E+00	4.34E+09	1.44E+09	2.35E+08
CS-136	2.63E+08	1.04E+09	7.48E+08	0.00E+00	5.78E+08	7.92E+07	1.18E+08
CS-137	7.37E+09	1.01E+10	6.60E+09	0.00E+00	3.42E+09	1.14E+09	1.95E+08
BA-140	2.69E+07	3.38E+04	1.76E+06	0.00E+00	1.15E+04	1.94E+04	5.54E+07
CE-141	4.84E+03	3.27E+03	3.71E+02	0.00E+00	1.52E+03	0.00E+00	1.25E+07
CE-144	3.57E+05	1.49E+05	1.92E+04	0.00E+00	8.85E+04	0.00E+00	1.21E+08
PR-143	1.57E+02	6.32E+01	7.81E+00	0.00E+00	3.65E+01	0.00E+00	6.90E+05
ND-147	9.40E+01	1.09E+02	6.50E+00	0.00E+00	6.35E+01	0.00E+00	5.22E+05

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: TEEN PATHWAY: GRASS-COW-MILK

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	9.93E+02	9.93E+02	9.93E+02	9.93E+02	9.93E+02	9.93E+02
P-32	3.15E+10	1.95E+09	1.22E+09	0.00E+00	0.00E+00	0.00E+00	2.65E+09
CR-51	0.00E+00	0.00E+00	4.99E+04	2.77E+04	1.09E+04	7.13E+04	8.39E+06
MN-54	0.00E+00	1.40E+07	2.78E+06	0.00E+00	4.19E+06	0.00E+00	2.88E+07
FE-55	4.46E+07	3.16E+07	7.37E+06	0.00E+00	0.00E+00	2.01E+07	1.37E+07
FE-59	5.19E+07	1.21E+08	4.68E+07	0.00E+00	0.00E+00	3.82E+07	2.86E+08
CO-58	0.00E+00	7.94E+06	1.83E+07	0.00E+00	0.00E+00	0.00E+00	1.10E+08
CO-60	0.00E+00	2.78E+07	6.27E+07	0.00E+00	0.00E+00	0.00E+00	3.62E+08
NI-63	1.18E+10	8.36E+08	4.01E+08	0.00E+00	0.00E+00	0.00E+00	1.33E+08
ZN-65	2.11E+09	7.32E+09	3.42E+09	0.00E+00	4.69E+09	0.00E+00	3.10E+09
RB-86	0.00E+00	4.73E+09	2.22E+09	0.00E+00	0.00E+00	0.00E+00	7.00E+08
SR-89	2.68E+09	0.00E+00	7.67E+07	0.00E+00	0.00E+00	0.00E+00	3.19E+08
SR-90	6.62E+10	0.00E+00	1.63E+10	0.00E+00	0.00E+00	0.00E+00	1.86E+09
Y-91	1.58E+04	0.00E+00	4.24E+02	0.00E+00	0.00E+00	0.00E+00	6.48E+06
ZR-95	1.65E+03	5.21E+02	3.58E+02	0.00E+00	7.65E+02	0.00E+00	1.20E+06
NB-95	1.41E+05	7.82E+04	4.30E+04	0.00E+00	7.58E+04	0.00E+00	3.34E+08
RU-103	1.81E+03	0.00E+00	7.75E+02	0.00E+00	6.39E+03	0.00E+00	1.51E+05
RU-106	3.76E+04	0.00E+00	4.73E+03	0.00E+00	7.24E+04	0.00E+00	1.80E+06
AG-110M	9.64E+07	9.12E+07	5.55E+07	0.00E+00	1.74E+08	0.00E+00	2.56E+10
TE-125M	3.01E+07	1.08E+07	4.02E+06	8.40E+06	0.00E+00	0.00E+00	8.87E+07
TE-127M	8.45E+07	3.00E+07	1.00E+07	2.01E+07	3.42E+08	0.00E+00	2.11E+08
TE-129M	1.10E+08	4.09E+07	1.74E+07	3.56E+07	4.61E+08	0.00E+00	4.14E+08
I-131	5.38E+08	7.53E+08	4.05E+08	2.20E+11	1.30E+09	0.00E+00	1.49E+08
I-133	7.08E+06	1.20E+07	3.66E+06	1.68E+09	2.11E+07	0.00E+00	9.09E+06
CS-134	9.83E+09	2.31E+10	1.07E+10	0.00E+00	7.35E+09	2.81E+09	2.88E+08
CS-136	4.49E+08	1.77E+09	1.19E+09	0.00E+00	9.63E+08	1.52E+08	1.42E+08
CS-137	1.34E+10	1.78E+10	6.21E+09	0.00E+00	6.06E+09	2.36E+09	2.54E+08
BA-140	4.87E+07	5.97E+04	3.14E+06	0.00E+00	2.02E+04	4.01E+04	7.51E+07
CE-141	8.89E+03	5.94E+03	6.82E+02	0.00E+00	2.80E+03	0.00E+00	1.70E+07
CE-144	6.59E+05	2.73E+05	3.54E+04	0.00E+00	1.63E+05	0.00E+00	1.66E+08
PR-143	2.90E+02	1.16E+02	1.44E+01	0.00E+00	6.73E+01	0.00E+00	9.55E+05
ND-147	1.81E+02	1.97E+02	1.18E+01	0.00E+00	1.16E+02	0.00E+00	7.12E+05

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: CHILD PATHWAY: GRASS-COW-MILK

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03
P-32	7.77E+10	3.64E+09	3.00E+09	0.00E+00	0.00E+00	0.00E+00	2.15E+09
CR-51	0.00E+00	0.00E+00	1.02E+05	5.65E+04	1.54E+04	1.03E+05	5.40E+06
MN-54	0.00E+00	2.10E+07	5.59E+06	0.00E+00	5.89E+06	0.00E+00	1.76E+07
FE-55	1.12E+08	5.94E+07	1.84E+07	0.00E+00	0.00E+00	3.36E+07	1.10E+07
FE-59	1.20E+08	1.95E+08	9.70E+07	0.00E+00	0.00E+00	5.65E+07	2.03E+08
CO-58	0.00E+00	1.21E+07	3.72E+07	0.00E+00	0.00E+00	0.00E+00	7.08E+07
CO-60	0.00E+00	4.32E+07	1.27E+08	0.00E+00	0.00E+00	0.00E+00	2.39E+08
NI-63	2.97E+10	1.59E+09	1.01E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
ZN-65	4.14E+09	1.10E+10	6.86E+09	0.00E+00	6.95E+09	0.00E+00	1.94E+09
RB-86	0.00E+00	8.78E+09	5.40E+09	0.00E+00	0.00E+00	0.00E+00	5.65E+08
SR-89	6.63E+09	0.00E+00	1.89E+08	0.00E+00	0.00E+00	0.00E+00	2.57E+08
SR-90	1.12E+11	0.00E+00	2.84E+10	0.00E+00	0.00E+00	0.00E+00	1.51E+09
Y-91	3.91E+04	0.00E+00	1.05E+03	0.00E+00	0.00E+00	0.00E+00	5.21E+06
ZR-95	3.84E+03	8.43E+02	7.51E+02	0.00E+00	1.21E+03	0.00E+00	8.80E+05
NB-95	3.18E+05	1.24E+05	8.86E+04	0.00E+00	1.16E+05	0.00E+00	2.29E+08
RU-103	4.29E+03	0.00E+00	1.65E+03	0.00E+00	1.08E+04	0.00E+00	1.11E+05
RU-106	9.25E+04	0.00E+00	1.15E+04	0.00E+00	1.25E+05	0.00E+00	1.44E+06
AG-110M	2.09E+08	1.41E+08	1.13E+08	0.00E+00	2.63E+08	0.00E+00	1.68E+10
TE-125M	7.39E+07	2.00E+07	9.85E+06	2.07E+07	0.00E+00	0.00E+00	7.13E+07
TE-127M	2.08E+08	5.61E+07	2.47E+07	4.98E+07	5.94E+08	0.00E+00	1.69E+08
TE-129M	2.72E+08	7.59E+07	4.22E+07	8.76E+07	7.98E+08	0.00E+00	3.31E+08
I-131	1.31E+09	1.31E+09	7.46E+08	4.34E+11	2.16E+09	0.00E+00	1.17E+08
I-133	1.72E+07	2.13E+07	8.05E+06	3.95E+09	3.55E+07	0.00E+00	8.58E+06
CS-134	2.27E+10	3.72E+10	7.85E+09	0.00E+00	1.15E+10	4.14E+09	2.01E+08
CS-136	1.01E+09	2.79E+09	1.80E+09	0.00E+00	1.49E+09	2.21E+08	9.80E+07
CS-137	3.23E+10	3.09E+10	4.56E+09	0.00E+00	1.01E+10	3.62E+09	1.93E+08
BA-140	1.18E+08	1.03E+05	6.86E+06	0.00E+00	3.35E+04	6.14E+04	5.96E+07
CE-141	2.19E+04	1.09E+04	1.62E+03	0.00E+00	4.79E+03	0.00E+00	1.36E+07
CE-144	1.63E+06	5.09E+05	8.67E+04	0.00E+00	2.82E+05	0.00E+00	1.33E+08
PR-143	7.18E+02	2.16E+02	3.56E+01	0.00E+00	1.17E+02	0.00E+00	7.75E+05
ND-147	4.45E+02	3.61E+02	2.79E+01	0.00E+00	1.98E+02	0.00E+00	5.71E+05

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: INFANT PATHWAY: GRASS-COW-MILK

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03
P-32	1.60E+11	9.42E+09	6.21E+09	0.00E+00	0.00E+00	0.00E+00	2.17E+09
CR-51	0.00E+00	0.00E+00	1.61E+05	1.05E+05	2.30E+04	2.05E+05	4.70E+06
MN-54	0.00E+00	3.91E+07	8.85E+06	0.00E+00	8.65E+06	0.00E+00	1.43E+07
FE-55	1.35E+08	8.74E+07	2.34E+07	0.00E+00	0.00E+00	4.27E+07	1.11E+07
FE-59	2.25E+08	3.93E+08	1.55E+08	0.00E+00	0.00E+00	1.16E+08	1.88E+08
CO-58	0.00E+00	2.43E+07	6.06E+07	0.00E+00	0.00E+00	0.00E+00	6.05E+07
CO-60	0.00E+00	8.83E+07	2.08E+08	0.00E+00	0.00E+00	0.00E+00	2.10E+08
NI-63	3.50E+10	2.16E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	1.08E+0[illegible]
ZN-65	5.56E+09	1.91E+10	8.79E+09	0.00E+00	9.24E+09	0.00E+00	1.61E+10
RB-86	0.00E+00	2.23E+10	1.10E+10	0.00E+00	0.00E+00	0.00E+00	5.70E+08
SR-89	1.26E+10	0.00E+00	3.62E+08	0.00E+00	0.00E+00	0.00E+00	2.59E+08
SR-90	1.22E+11	0.00E+00	3.10E+10	0.00E+00	0.00E+00	0.00E+00	1.52E+09
Y-91	7.34E+04	0.00E+00	1.95E+03	0.00E+00	0.00E+00	0.00E+00	5.26E+06
ZR-95	6.81E+03	1.66E+03	1.18E+03	0.00E+00	1.79E+03	0.00E+00	8.27E+05
NB-95	5.94E+05	2.45E+05	1.41E+05	0.00E+00	1.75E+05	0.00E+00	2.07E+08
RU-103	8.68E+03	0.00E+00	2.90E+03	0.00E+00	1.81E+04	0.00E+00	1.06E+05
RU-106	1.91E+05	0.00E+00	2.38E+04	0.00E+00	2.25E+05	0.00E+00	1.45E+06
AG-110M	3.86E+08	2.82E+08	1.87E+08	0.00E+00	4.03E+08	0.00E+00	1.46E+10
TE-125M	1.51E+08	5.05E+07	2.04E+07	5.08E+07	0.00E+00	0.00E+00	7.19E+07
TE-127M	4.22E+08	1.40E+08	5.10E+07	1.22E+08	1.04E+09	0.00E+00	1.70E+08
TE-129M	5.58E+08	1.91E+08	8.59E+07	2.14E+08	1.39E+09	0.00E+00	3.33E+08
I-131	2.72E+09	3.21E+09	1.41E+09	1.05E+12	3.75E+09	0.00E+00	1.15E+08
I-133	3.63E+07	5.29E+07	1.55E+07	9.62E+09	6.22E+07	0.00E+00	8.96E+06
CS-134	3.65E+10	6.81E+10	6.88E+09	0.00E+00	1.75E+10	7.19E+09	1.85E+08
CS-136	1.98E+09	5.83E+09	2.18E+09	0.00E+00	2.32E+09	4.75E+08	8.85E+07
CS-137	5.15E+10	6.03E+10	4.27E+09	0.00E+00	1.62E+10	6.55E+09	1.89E+08
BA-140	2.42E+08	2.42E+05	1.25E+07	0.00E+00	5.75E+04	1.49E+05	5.94E+07
CE-141	4.34E+04	2.65E+04	3.12E+03	0.00E+00	8.17E+03	0.00E+00	1.37E+07
CE-144	2.33E+06	9.53E+05	1.30E+05	0.00E+00	3.85E+05	0.00E+00	1.34E+08
PR-143	1.49E+03	5.56E+02	7.37E+01	0.00E+00	2.07E+02	0.00E+00	7.84E+05
ND-147	8.83E+02	9.07E+02	5.55E+01	0.00E+00	3.50E+02	0.00E+00	5.75E+05

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: ADULT PATHWAY: GRASS-COW-MEAT

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	3.24E+02	3.24E+02	3.24E+02	3.24E+02	3.24E+02	3.24E+02
P-32	4.63E+09	2.88E+08	1.79E+08	0.00E+00	0.00E+00	0.00E+00	5.21E+08
CR-51	0.00E+00	0.00E+00	7.04E+03	4.21E+03	1.55E+03	9.35E+03	1.77E+06
MN-54	0.00E+00	9.18E+06	1.75E+06	0.00E+00	2.73E+06	0.00E+00	2.81E+07
FE-55	2.93E+08	2.03E+08	4.73E+07	0.00E+00	0.00E+00	1.13E+08	1.16E+08
FE-59	2.66E+08	6.25E+08	2.39E+08	0.00E+00	0.00E+00	1.75E+08	2.08E+09
CO-58	0.00E+00	1.82E+07	4.09E+07	0.00E+00	0.00E+00	0.00E+00	3.70E+08
CO-60	0.00E+00	7.52E+07	1.66E+08	0.00E+00	0.00E+00	0.00E+00	1.41E+09
NI-63	1.89E+10	1.31E+09	6.33E+08	0.00E+00	0.00E+00	0.00E+00	2.73E+08
ZN-65	3.56E+08	1.13E+09	5.12E+08	0.00E+00	7.57E+08	0.00E+00	7.13E+08
RB-86	0.00E+00	4.87E+08	2.27E+08	0.00E+00	0.00E+00	0.00E+00	9.59E+07
SR-89	3.02E+08	0.00E+00	8.66E+06	0.00E+00	0.00E+00	0.00E+00	4.84E+07
SR-90	1.24E+10	0.00E+00	3.05E+09	0.00E+00	0.00E+00	0.00E+00	3.60E+08
Y-91	1.13E+06	0.00E+00	3.03E+04	0.00E+00	0.00E+00	0.00E+00	6.24E+08
ZR-95	1.87E+06	6.01E+05	4.07E+05	0.00E+00	9.43E+05	0.00E+00	1.90E+09
NB-95	2.30E+06	1.28E+06	6.87E+05	0.00E+00	1.26E+06	0.00E+00	7.76E+09
RU-103	1.05E+08	0.00E+00	4.53E+07	0.00E+00	4.02E+08	0.00E+00	1.23E+10
RU-106	2.80E+09	0.00E+00	3.54E+08	0.00E+00	5.41E+09	0.00E+00	1.81E+11
AG-110M	6.68E+06	6.18E+06	3.67E+06	0.00E+00	1.22E+07	0.00E+00	2.52E+09
TE-125M	3.59E+08	1.30E+08	4.81E+07	1.08E+08	1.46E+09	0.00E+00	1.43E+09
TE-127M	1.12E+09	3.99E+08	1.36E+08	2.85E+08	4.53E+09	0.00E+00	3.74E+09
TE-129M	1.13E+09	4.23E+08	1.79E+08	3.89E+08	4.73E+09	0.00E+00	5.71E+09
I-131	1.08E+07	1.54E+07	8.82E+06	5.04E+09	2.64E+07	0.00E+00	4.06E+06
I-133	3.68E-01	6.41E-01	1.95E-01	9.42E+01	1.12E+00	0.00E+00	5.76E-01
CS-134	6.58E+08	1.57E+09	1.28E+09	0.00E+00	5.07E+08	1.68E+08	2.74E+07
CS-136	1.21E+07	4.78E+07	3.44E+07	0.00E+00	2.66E+07	3.65E+06	5.43E+06
CS-137	8.72E+08	1.19E+09	7.82E+08	0.00E+00	4.05E+08	1.35E+08	2.31E+07
BA-140	2.90E+07	3.64E+04	1.90E+06	0.00E+00	1.24E+04	2.08E+04	5.96E+07
CE-141	1.41E+04	9.51E+03	1.08E+03	0.00E+00	4.42E+03	0.00E+00	3.64E+07
CE-144	1.46E+06	6.10E+05	7.83E+04	0.00E+00	3.62E+05	0.00E+00	4.93E+08
PR-143	2.09E+04	8.40E+03	1.04E+03	0.00E+00	4.85E+03	0.00E+00	9.17E+07
ND-147	7.08E+03	8.18E+03	4.90E+02	0.00E+00	4.78E+03	0.00E+00	3.93E+07

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: TEEN PATHWAY: GRASS-COW-MEAT

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.93E+02	1.93E+02	1.93E+02	1.93E+02	1.93E+02	1.93E+02
P-32	3.91E+09	2.42E+08	1.52E+08	0.00E+00	0.00E+00	0.00E+00	3.29E+08
CR-51	0.00E+00	0.00E+00	5.63E+03	3.13E+03	1.23E+03	8.03E+03	9.46E+05
MN-54	0.00E+00	7.00E+06	1.39E+06	0.00E+00	2.09E+06	0.00E+00	1.44E+07
FE-55	2.38E+08	1.69E+08	3.94E+07	0.00E+00	0.00E+00	1.07E+08	7.31E+07
FE-59	2.12E+08	4.95E+08	1.91E+08	0.00E+00	0.00E+00	1.56E+08	1.17E+09
CO-58	0.00E+00	1.40E+07	3.24E+07	0.00E+00	0.00E+00	0.00E+00	1.94E+08
CO-60	0.00E+00	5.83E+07	1.31E+08	0.00E+00	0.00E+00	0.00E+00	7.60E+08
NI-63	1.52E+10	1.07E+09	5.15E+08	0.00E+00	0.00E+00	0.00E+00	1.71E+08
ZN-65	2.50E+08	8.68E+08	4.05E+08	0.00E+00	5.56E+08	0.00E+00	3.68E+08
RB-86	0.00E+00	4.06E+08	1.91E+08	0.00E+00	0.00E+00	0.00E+00	6.00E+07
SR-89	2.55E+08	0.00E+00	7.29E+06	0.00E+00	0.00E+00	0.00E+00	3.03E+07
SR-90	8.04E+09	0.00E+00	1.99E+09	0.00E+00	0.00E+00	0.00E+00	2.26E+08
Y-91	9.54E+05	0.00E+00	2.56E+04	0.00E+00	0.00E+00	0.00E+00	3.91E+08
ZR-95	1.50E+06	4.73E+05	3.25E+05	0.00E+00	6.95E+05	0.00E+00	1.09E+09
NB-95	1.79E+06	9.95E+05	5.48E+05	0.00E+00	9.64E+05	0.00E+00	4.25E+09
RU-103	8.56E+07	0.00E+00	3.66E+07	0.00E+00	3.02E+08	0.00E+00	7.15E+09
RU-106	2.36E+09	0.00E+00	2.97E+08	0.00E+00	4.54E+09	0.00E+00	1.13E+11
AG-110M	5.06E+06	4.78E+06	2.91E+06	0.00E+00	9.13E+06	0.00E+00	1.34E+09
TE-125M	3.03E+08	1.09E+08	4.05E+07	8.46E+07	0.00E+00	0.00E+00	8.94E+08
TE-127M	9.41E+08	3.34E+08	1.12E+08	2.24E+08	3.81E+09	0.00E+00	2.35E+09
TE-129M	9.49E+08	3.52E+08	1.50E+08	3.06E+08	3.97E+09	0.00E+00	3.56E+09
I-131	8.93E+06	1.25E+07	6.72E+06	3.65E+09	2.15E+07	0.00E+00	2.47E+06
I-133	3.08E-01	5.22E-01	1.59E-01	7.29E+01	9.16E-01	0.00E+00	3.95E-01
CS-134	5.23E+08	1.23E+09	5.71E+08	0.00E+00	3.91E+08	1.49E+08	1.53E+07
CS-136	9.43E+06	3.71E+07	2.49E+07	0.00E+00	2.02E+07	3.18E+06	2.99E+06
CS-137	7.24E+08	9.63E+08	3.35E+08	0.00E+00	3.28E+08	1.27E+08	1.37E+07
BA-140	2.39E+07	2.93E+04	1.54E+06	0.00E+00	9.94E+03	1.97E+04	3.69E+07
CE-141	1.18E+04	7.87E+03	9.05E+02	0.00E+00	3.71E+03	0.00E+00	2.25E+07
CE-144	1.23E+06	5.08E+05	6.60E+04	0.00E+00	3.03E+05	0.00E+00	[illegible].09E+08
PR-143	1.76E+04	7.03E+03	8.76E+02	0.00E+00	4.08E+03	0.00E+00	5.79E+07
ND-147	6.23E+03	6.78E+03	4.06E+02	0.00E+00	3.98E+03	0.00E+00	2.44E+07

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: CHILD PATHWAY: GRASS-COW-MEAT

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02
P-32	7.38E+09	3.45E+08	2.85E+08	0.00E+00	0.00E+00	0.00E+00	2.04E+08
CR-51	0.00E+00	0.00E+00	8.78E+03	4.88E+03	1.33E+03	8.90E+03	4.66E+05
MN-54	0.00E+00	8.01E+06	2.13E+06	0.00E+00	2.25E+06	0.00E+00	6.73E+06
FE-55	4.57E+08	2.43E+08	7.52E+07	0.00E+00	0.00E+00	1.37E+08	4.49E+07
FE-59	3.77E+08	6.10E+08	3.04E+08	0.00E+00	0.00E+00	1.77E+08	6.35E+08
CO-58	0.00E+00	1.64E+07	5.03E+07	0.00E+00	0.00E+00	0.00E+00	9.58E+07
CO-60	0.00E+00	6.93E+07	2.04E+08	0.00E+00	0.00E+00	0.00E+00	3.84E+08
NI-63	2.91E+10	1.56E+09	9.91E+08	0.00E+00	0.00E+00	0.00E+00	1.05E+08
ZN-65	3.76E+08	1.00E+09	6.22E+08	0.00E+00	6.31E+08	0.00E+00	1.76E+08
RB-86	0.00E+00	5.76E+08	3.54E+08	0.00E+00	0.00E+00	0.00E+00	3.71E+07
SR-89	4.82E+08	0.00E+00	1.38E+07	0.00E+00	0.00E+00	0.00E+00	1.87E+07
SR-90	1.04E+10	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	1.40E+08
Y-91	1.80E+06	0.00E+00	4.82E+04	0.00E+00	0.00E+00	0.00E+00	2.40E+08
ZR-95	2.66E+06	5.86E+05	5.21E+05	0.00E+00	8.38E+05	0.00E+00	6.11E+08
NB-95	3.10E+06	1.21E+06	8.63E+05	0.00E+00	1.13E+06	0.00E+00	2.23E+09
RU-103	1.55E+08	0.00E+00	5.96E+07	0.00E+00	3.90E+08	0.00E+00	4.01E+09
RU-106	4.44E+09	0.00E+00	5.54E+08	0.00E+00	6.00E+09	0.00E+00	6.91E+10
AG-110M	8.39E+06	5.67E+06	4.53E+06	0.00E+00	1.06E+07	0.00E+00	6.74E+08
TE-125M	5.69E+08	1.54E+08	7.59E+07	1.60E+08	0.00E+00	0.00E+00	5.49E+08
TE-127M	1.78E+09	4.78E+08	2.11E+08	4.25E+08	5.06E+09	0.00E+00	1.44E+09
TE-129M	1.79E+09	5.00E+08	2.78E+08	5.77E+08	5.26E+09	0.00E+00	2.18E+09
I-131	1.66E+07	1.67E+07	9.48E+06	5.52E+09	2.74E+07	0.00E+00	1.48E+06
I-133	5.72E-01	7.08E-01	2.68E-01	1.31E+02	1.18E+00	0.00E+00	2.85E-01
CS-134	9.23E+08	1.51E+09	3.19E+08	0.00E+00	4.69E+08	1.68E+08	8.16E+06
CS-136	1.63E+07	4.48E+07	2.90E+07	0.00E+00	2.39E+07	3.56E+06	1.57E+06
CS-137	1.33E+09	1.28E+09	1.89E+08	0.00E+00	4.16E+08	1.50E+08	8.00E+06
BA-140	4.42E+07	3.87E+04	2.58E+06	0.00E+00	1.26E+04	2.31E+04	2.24E+07
CE-141	2.22E+04	1.11E+04	1.65E+03	0.00E+00	4.86E+03	0.00E+00	1.38E+07
CE-144	2.32E+06	7.26E+05	1.24E+05	0.00E+00	4.02E+05	0.00E+00	1.89E+08
PR-143	3.33E+04	1.00E+04	1.65E+03	0.00E+00	5.42E+03	0.00E+00	3.60E+07
ND-147	1.17E+04	9.48E+03	7.34E+02	0.00E+00	5.20E+03	0.00E+00	1.50E+07

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: INFANT PATHWAY: GRASS-COW-MEAT

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZR-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AG-110M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-127M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-129M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-136	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PR-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: ADULT   PATHWAY: GRASS-GOAT-MILK

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03
P-32	2.05E+10	1.27E+09	7.92E+03	0.00E+00	0.00E+00	0.00E+00	2.30E+09
CR-51	0.00E+00	0.00E+00	3.43E+03	2.05E+03	7.56E+02	4.55E+03	8.63E+05
MN-54	0.00E+00	1.01E+06	1.93E+05	0.00E+00	3.01E+05	0.00E+00	3.10E+06
FE-55	3.27E+05	2.26E+05	5.26E+04	0.00E+00	0.00E+00	1.26E+05	1.30E+05
FE-59	3.87E+05	9.09E+05	3.48E+05	0.00E+00	0.00E+00	2.54E+05	3.03E+06
CO-58	0.00E+00	5.66E+05	1.27E+06	0.00E+00	0.00E+00	0.00E+00	1.15E+07
CO-60	0.00E+00	1.97E+06	4.35E+06	0.00E+00	0.00E+00	0.00E+00	3.70E+07
NI-63	8.08E+08	5.60E+07	2.71E+07	0.00E+00	0.00E+00	0.00E+00	1.17E+07
ZN-65	1.65E+08	5.24E+08	2.37E+08	0.00E+00	3.51E+08	0.00E+00	3.30E+08
RB-86	0.00E+00	3.12E+08	1.45E+08	0.00E+00	0.00E+00	0.00E+00	6.14E+07
SR-89	3.05E+09	0.00E+00	8.76E+07	0.00E+00	0.00E+00	0.00E+00	4.89E+08
SR-90	9.84E+10	0.00E+00	2.41E+10	0.00E+00	0.00E+00	0.00E+00	2.84E+09
Y-91	1.03E+03	0.00E+00	2.76E+01	0.00E+00	0.00E+00	0.00E+00	5.68E+05
ZR-95	1.13E+02	3.63E+01	2.46E+01	0.00E+00	5.70E+01	0.00E+00	1.15E+05
NB-95	9.92E+03	5.52E+03	2.97E+03	0.00E+00	5.45E+03	0.00E+00	3.35E+07
RU-103	1.22E+02	0.00E+00	5.27E+01	0.00E+00	4.67E+02	0.00E+00	1.43E+04
RU-106	2.45E+03	0.00E+00	3.10E+02	0.00E+00	4.73E+03	0.00E+00	1.59E+05
AG-110M	6.99E+06	6.47E+06	3.84E+06	0.00E+00	1.27E+07	0.00E+00	2.64E+09
TE-125M	1.96E+06	7.09E+05	2.62E+05	5.89E+05	7.96E+06	0.00E+00	7.81E+06
TE-127M	5.50E+06	1.97E+06	6.70E+05	1.41E+06	2.23E+07	0.00E+00	1.84E+07
TE-129M	7.23E+06	2.70E+06	1.14E+06	2.48E+06	3.02E+07	0.00E+00	3.64E+07
I-131	3.56E+08	5.09E+08	2.92E+08	1.67E+11	8.73E+08	0.00E+00	1.34E+08
I-133	4.65E+06	8.10E+06	2.4[illegible]E+[illegible]	1.19E+09	1.41E+07	0.00E+00	7.28E+06
CS-134	1.70E+10	4.04E+10	3.30E+[illegible]	[illegible].00E+00	1.31E+10	4.34E+09	7.07E+08
CS-136	7.92E+08	3.13E+09	2.25E+[illegible]	0.00E+00	1.74E+09	2.38E+08	3.55E+08
CS-137	2.22E+10	3.03E+10	1.99E+10	0.00E+00	1.03E+10	3.42E+09	5.87E+08
BA-140	3.24E+06	4.07E+03	[illegible].12E+05	0.00E+00	1.38E+03	2.33E+03	6.67E+06
CE-141	5.82E+02	3.94E+02	4.47E+01	0.00E+00	1.83E+02	0.00E+00	[illegible]E+06
CE-144	4.30E+04	1.80E+04	2.31E+03	0.00E+00	1.07E+04	0.00E+00	1.45E+07
PR-143	1.90E+01	7.60E+00	9.40E-01	0.00E+00	4.39E+00	0.00E+00	8.30E+04
ND-147	1.13E+01	1.3[illegible]	7.82E-01	0.00E+00	7.65E+00	0.00E+00	6.78E+04

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: TEEN   PATHWAY: GRASS-GOAT-MILK

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.04E+03	2.04E+03	2.04E+03	2.04E+03	2.04E+03	2.04E+03
P-32	3.78E+10	2.34E+09	1.46E+09	0.00E+00	0.00E+00	0.00E+00	3.18E+09
CR-51	0.00E+00	0.00E+00	5.99E+03	3.33E+03	1.31E+03	8.55E+03	1.01E+06
MN-54	0.00E+00	1.68E+06	3.34E+05	0.00E+00	5.02E+05	0.00E+00	3.45E+06
FE-55	5.79E+05	4.11E+05	9.58E+04	0.00E+00	0.00E+00	2.61E+05	1.78E+05
FE-59	6.74E+05	1.57E+06	6.08E+05	0.00E+00	0.00E+00	4.96E+05	3.72E+06
CO-58	0.00E+00	9.53E+05	2.20E+06	0.00E+00	0.00E+00	0.00E+00	1.31E+07
CO-60	0.00E+00	3.34E+06	7.52E+06	0.00E+00	0.00E+00	0.00E+00	4.35E+07
NI-63	1.42E+09	1.00E+08	4.81E+07	0.00E+00	0.00E+00	0.00E+00	[illegible]
ZN-65	2.53E+08	8.78E+08	4.10E+08	0.00E+00	5.62E+08	0.00E+00	3.72E+08
RB-86	0.00E+00	5.67E+08	2.67E+08	0.00E+00	0.00E+00	0.00E+00	8.40E+07
SR-89	5.62E+09	0.00E+00	1.61E+08	0.00E+00	0.00E+00	0.00E+00	6.69E+08
SR-90	1.39E+11	0.00E+00	3.43E+10	0.00E+00	0.00E+00	0.00E+00	3.90E+09
Y-91	1.90E+03	0.00E+00	5.09E+01	0.00E+00	0.00E+00	0.00E+00	7.78E+05
ZR-95	1.98E+02	6.25E+01	4.30E+01	0.00E+00	9.18E+01	0.00E+00	1.44E+05
NB-95	1.69E+04	9.38E+03	5.16E+03	0.00E+00	9.09E+03	0.00E+00	[illegible]
RU-103	2.17E+02	0.00E+00	9.29E+01	0.00E+00	7.66E+02	0.00E+00	1.82E+04
RU-106	4.50E+03	0.00E+00	5.68E+02	0.00E+00	8.69E+03	0.00E+00	2.16E+05
AG-110M	1.16E+07	1.09E+07	6.65E+06	0.00E+00	2.09E+07	0.00E+00	3.07E+09
TE-125M	3.61E+06	1.30E+06	4.82E+05	1.01E+06	0.00E+00	0.00E+00	1.06E+07
TE-127M	1.01E+07	[illegible]	1.20E+06	2.41E+06	4.11E+07	0.00E+00	2.52E+07
TE-129M	1.32E+07	4.90E+06	2.09E+06	4.26E+06	5.53E+07	0.00E+00	4.96E+07
I-131	6.45E+08	9.03E+08	4.85E+08	2.64E+11	1.56E+09	0.00E+00	1.79E+08
I-133	8.49E+06	1.44E+07	4.40E+06	2.01E+09	2.53E+07	0.00E+00	1.09E+07
CS-134	2.95E+10	6.93E+10	3.22E+10	0.00E+00	2.20E+10	8.41E+09	8.62E+08
CS-136	1.35E+09	5.30E+09	3.56E+09	0.00E+00	2.89E+09	4.55E+08	4.27E+08
CS-137	[illegible]	5.34E+10	1.86E+10	0.00E+00	1.82E+10	7.07E+09	7.60E+08
BA-140	5.84E+06	7.16E+03	3.76E+05	0.00E+00	2.43E+03	4.81E+03	9.01E+06
CE-141	1.07E+03	7.12E+02	8.18E+01	0.00E+00	3.35E+02	0.00E+00	2.04E+06
CE-144	7.90E+04	3.27E+04	4.25E+03	0.00E+00	1.95E+04	0.00E+00	1.99E+07
PR-143	3.48E+01	1.39E+01	1.73E+00	0.00E+00	8.08E+00	0.00E+00	1.15E+05
ND-147	2.18E+01	2.37E+01	1.42E+00	0.00E+00	1.39E+01	0.00E+00	8.54E+04

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: CHILD   PATHWAY: GRASS-GOAT-MILK

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03
P-32	9.32E+10	4.36E+09	3.59E+09	0.00E+00	0.00E+00	0.00E+00	2.58E+09
CR-51	0.00E+00	0.00E+0	1.22E+04	6.78E+03	1.85E+03	1.24E+04	6.48E+05
MN-54	0.00E+00	2.52E+0	6.71E+05	0.00E+00	7.06E+05	0.00E+00	2.11E+06
FE-55	1.45E+06	7.71E+0	2.39E+05	0.00E+00	0.00E+00	4.36E+05	1.43E+05
FE-59	1.56E+06	2.53E+06	1.26E+06	0.00E+00	0.00E+00	7.34E+05	2.64E+06
CO-58	0.00E+00	1.46E+06	4.46E+06	0.00E+00	0.00E+00	0.00E+00	8.49E+06
CO-60	0.00E+00	5.18E+06	1.53E+07	0.00E+00	0.00E+00	0.00E+00	2.87E+07
NI-63	3.56E+09	1.91E+08	1.21E+08	0.00E+00	0.00E+00	0.00E+00	1.28E+07
ZN-65	4.96E+08	1.32E+09	8.22E+08	0.00E+00	8.33E+08	0.00E+00	2.32E+08
RB-86	0.00E+00	1.05E+09	6.47E+08	0.00E+00	0.00E+00	0.00E+00	6.77E+07
SR-89	1.39E+10	0.00E+00	3.97E+08	0.00E+00	0.00E+00	0.00E+00	5.39E+08
SR-90	2.35E+11	0.00E+00	5.95E+10	0.00E+00	0.00E+00	0.00E+00	3.16E+09
Y-91	4.69E+03	0.00E+00	1.25E+02	0.00E+00	0.00E+00	0.00E+00	6.24E+05
ZR-95	4.60E+02	1.01E+02	9.00E+01	0.00E+00	1.45E+02	0.00E+00	1.05E+05
NB-95	3.82E+04	1.49E+04	1.06E+04	0.00E+00	1.40E+04	0.00E+00	2.75E+07
RU-103	5.14E+02	0.00E+00	1.98E+02	0.00E+00	1.29E+03	0.00E+00	1.33E+04
RU-106	1.11E+04	0.00E+00	1.38E+03	0.00E+00	1.50E+04	0.00E+00	1.73E+05
AG-110M	2.51E+07	1.69E+07	1.35E+07	0.00E+00	3.15E+07	0.00E+00	2.01E+09
TE-125M	8.86E+06	2.40E+06	1.18E+06	2.49E+06	0.00E+00	0.00E+00	8.55E+06
TE-127M	2.50E+07	6.72E+06	2.96E+06	5.97E+06	7.12E+07	0.00E+00	2.02E+07
TE-129M	3.26E+07	9.10E+06	5.06E+06	1.05E+07	9.56E+07	0.00E+00	3.97E+07
I-131	1.57E+09	1.57E+09	8.95E+08	5.21E+11	2.58E+09	0.00E+00	1.40E+08
I-133	2.06E+07	2.55E+07	9.66E+06	4.74E+09	4.25E+07	0.00E+00	1.03E+07
CS-134	6.80E+10	1.12E+11	2.35E+10	0.00E+00	3.46E+10	1.24E+10	6.01E+08
CS-136	3.04E+09	8.36E+09	5.41E+09	0.00E+00	4.45E+09	6.64E+08	2.94E+08
CS-137	[illegible].68E+10	9.26E+10	1.37E+10	0.00E+00	3.02E+10	1.09E+10	5.80E+08
BA-140	1.41E+07	1.24E+04	8.23E+05	0.00E+00	4.02E+03	7.37E+03	7.15E+06
CE-141	[illegible].65E+03	1.31E+03	1.95E+02	0.00E+00	5.74E+02	0.00E+00	1.63E+06
CE-144	[illegible].95E+05	6.11E+04	1.04E+04	0.00E+00	3.38E+04	0.00E+00	1.59E+07
PR-143	8.61E+01	2.59E+01	4.27E+00	0.00E+00	1.40E+01	0.00E+00	9.29E+04
ND-147	5.34E+01	4.33E+01	3.35E+00	0.00E+00	2.37E+01	0.00E+00	6.85E+04

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: INFANT PATHWAY: GRASS-GOAT-MILK

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03
P-32	1.92E+11	1.13E+10	7.44E+09	0.00E+00	0.00E+00	0.00E+00	2.60E+09
CR-51	0.00E+00	0.00E+00	1.94E+04	1.26E+04	2.76E+03	2.46E+04	5.64E+05
MN-54	0.00E+00	4.68E+06	1.06E+06	0.00E+00	1.04E+06	0.00E+00	1.72E+06
FE-55	1.76E+06	1.14E+06	3.03E+05	0.00E+00	0.00E+00	5.55E+05	1.44E+05
FE-59	2.92E+06	5.10E+06	2.01E+06	0.00E+00	0.00E+00	1.51E+06	2.44E+06
CO-58	0.00E+00	2.91E+06	7.26E+06	0.00E+00	0.00E+00	0.00E+00	7.25E+06
CO-60	0.00E+00	1.06E+07	2.50E+07	0.00E+00	0.00E+00	0.00E+00	2.52E+07
NI-63	4.19E+09	2.59E+08	1.46E+08	0.00E+00	0.00E+00	0.00E+00	1.29E+07
ZN-65	6.67E+08	2.29E+09	1.05E+09	0.00E+00	1.11E+09	0.00E+00	1.93E+09
RB-86	0.00E+00	2.67E+09	1.32E+09	0.00E+00	0.00E+00	0.00E+00	6.83E+07
SR-89	2.65E+10	0.00E+00	7.59E+08	0.00E+00	0.00E+00	0.00E+00	5.44E+08
SR-90	2.55E+11	0.00E+00	6.50E+10	0.00E+00	0.00E+00	0.00E+00	3.19E+09
Y-91	8.80E+03	0.00E+00	2.34E+02	0.00E+00	0.00E+00	0.00E+00	6.31E+05
ZR-95	8.17E+02	1.99E+02	1.41E+02	0.00E+00	2.15E+02	0.00E+00	9.91E+04
NB-95	7.13E+04	2.93E+04	1.70E+04	0.00E+00	2.10E+04	0.00E+00	2.48E+07
RU-103	1.04E+03	0.00E+00	3.48E+02	0.00E+00	2.17E+03	0.00E+00	1.27E+04
RU-106	2.28E+04	0.00E+00	2.85E+03	0.00E+00	2.70E+04	0.00E+00	1.73E+05
AG-110M	4.63E+07	3.38E+07	2.24E+07	0.00E+00	4.84E+07	0.00E+00	1.75E+09
TE-125M	1.81E+07	6.05E+06	2.45E+06	6.09E+06	0.00E+00	0.00E+00	8.62E+06
TE-127M	5.06E+07	1.68E+07	6.12E+06	1.46E+07	1.24E+08	0.00E+00	2.04E+07
TE-129M	6.69E+07	2.29E+07	1.03E+07	2.57E+07	1.67E+08	0.00E+00	3.99E+07
I-131	3.27E+09	3.85E+09	1.69E+09	1.27E+12	4.50E+09	0.00E+00	1.37E+08
I-133	4.36E+07	6.35E+07	1.86E+07	1.15E+10	7.46E+07	0.00E+00	1.07E+07
CS-134	1.09E+11	2.04E+11	2.06E+10	0.00E+00	5.26E+10	2.15E+10	5.55E+08
CS-136	5.94E+09	1.75E+10	6.52E+09	0.00E+00	6.[illegible]6E+09	1.42E+09	2.65E+08
CS-137	1.54E+11	1.81E+11	1.28E+10	0.00E+00	4.85E+10	1.96E+10	5.65E+08
BA-140	2.90E+07	2.90E+04	1.50E+06	0.00E+00	6.89E+03	1.78E+04	7.13E+06
CE-141	5.21E+03	3.18E+03	3.74E+02	0.00E+00	9.79E+02	0.00E+00	1.64E+06
CE-144	2.79E+05	1.14E+05	1.56E+04	0.00E+00	4.62E+04	0.00E+00	1.60E+07
PR-143	1.78E+02	6.66E+01	8.83E+00	0.00E+00	2.48E+01	0.00E+00	9.40E+04
ND-147	1.06E+02	1.09E+02	6.66E+00	0.00E+00	4.19E+01	0.00E+00	6.89E+04

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: ADULT PATHWAY: VEGETATION

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03
P-32	1.40E+09	8.69E+07	5.40E+07	0.00E+00	0.00E+00	0.00E+00	1.57E+08
CR-51	0.00E+00	0.00E+00	4.64E+04	2.77E+04	1.02E+04	6.15E+04	1.17E+07
MN-54	0.00E+00	3.13E+08	5.97E+07	0.00E+00	9.31E+07	0.00E+00	9.58E+08
FE-55	2.10E+08	1.45E+08	3.38E+07	0.00E+00	0.00E+00	8.08E+07	8.31E+07
FE-59	1.26E+08	2.97E+08	1.14E+08	0.00E+00	0.00E+00	8.29E+07	9.89E+08
CO-58	0.00E+00	3.07E+07	6.89E+07	0.00E+00	0.00E+00	0.00E+00	6.23E+08
CO-60	0.00E+00	1.67E+08	3.69E+08	0.00E+00	0.00E+00	0.00E+00	3.14E+09
NI-63	1.04E+10	7.21E+08	3.49E+08	0.00E+00	0.00E+00	0.00E+00	1.50E+08
ZN-65	3.17E+08	1.01E+09	4.56E+08	0.00E+00	6.75E+08	0.00E+00	6.36E+08
RB-86	0.00E+00	2.19E+08	1.02E+08	0.00E+00	0.00E+00	0.00E+00	4.32E+07
SR-89	9.98E+09	0.00E+00	2.86E+08	0.00E+00	0.00E+00	0.00E+00	1.60E+09
SR-90	6.05E+11	0.00E+00	1.48E+11	0.00E+00	0.00E+00	0.00E+00	1.75E+10
Y-91	5.12E+06	0.00E+00	1.37E+05	0.00E+00	0.00E+00	0.00E+00	2.82E+09
ZR-95	1.17E+06	3.77E+05	2.55E+05	0.00E+00	5.91E+05	0.00E+00	1.19E+09
NB-95	1.42E+05	7.92E+04	4.26E+04	0.00E+00	7.83E+04	0.00E+00	4.81E+08
RU-103	4.77E+06	0.00E+00	2.06E+06	0.00E+00	1.82E+07	0.00E+00	5.57E+08
RU-106	1.93E+08	0.00E+00	2.44E+07	0.00E+00	3.72E+08	0.00E+00	1.25E+10
AG-110M	1.05E+07	9.75E+06	5.79E+06	0.00E+00	1.92E+07	0.00E+00	3.98E+09
TE-125M	9.66E+07	3.50E+07	1.29E+07	2.90E+07	3.93E+08	0.00E+00	3.86E+08
TE-127M	3.49E+08	1.25E+08	4.26E+07	8.93E+07	1.42E+09	0.00E+00	1.17E+09
TE-129M	2.51E+08	9.37E+07	3.97E+07	8.63E+07	1.05E+09	0.00E+00	1.26E+09
I-131	8.08E+07	1.16E+08	6.62E+07	3.79E+10	1.98E+08	0.00E+00	3.05E+07
I-133	2.09E+06	3.63E+06	1.11E+06	5.34E+08	6.33E+06	0.00E+00	3.26E+06
CS-134	4.67E+09	1.11E+10	9.08E+09	0.00E+00	3.59E+09	1.19E+09	1.94E+08
CS-136	4.28E+07	1.69E+08	1.22E+08	0.00E+00	9.41E+07	1.29E+07	1.92E+07
CS-137	6.36E+09	8.70E+09	5.70E+09	0.00E+00	2.95E+09	9.81E+08	1.68E+08
BA-140	1.29E+08	1.62E+05	8.47E+06	0.00E+00	5.52E+04	9.29E+04	2.66E+08
CE-141	1.97E+05	1.33E+05	1.51E+04	0.00E+00	6.20E+04	0.00E+00	5.10E+08
CE-144	3.29E+07	1.38E+07	1.77E+06	0.00E+00	8.16E+06	0.00E+00	1.11E+10
PR-143	6.25E+04	2.51E+04	3.10E+03	0.00E+00	1.45E+04	0.00E+00	2.74E+08
ND-147	3.34E+04	3.85E+04	2.31E+03	0.00E+00	2.25E+04	0.00E+00	1.85E+08

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: TEEN PATHWAY: VEGETATION

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03
P-32	1.60E+09	9.91E+07	6.20E+07	0.00E+00	0.00E+00	0.00E+00	1.34E+08
CR-51	0.00E+00	0.00E+00	6.16E+04	3.42E+04	1.35E+04	8.79E+04	1.03E+07
MN-54	0.00E+00	4.54E+08	9.01E+07	0.00E+00	1.36E+08	0.00E+00	9.32E+08
FE-55	3.26E+08	2.31E+08	5.39E+07	0.00E+00	0.00E+00	1.47E+08	1.00E+08
FE-59	1.80E+08	4.19E+08	1.62E+08	0.00E+00	0.00E+00	1.32E+08	9.91E+08
CO-58	0.00E+00	4.36E+07	1.01E+08	0.00E+00	0.00E+00	0.00E+00	6.01E+08
CO-60	0.00E+00	2.49E+08	5.60E+08	0.00E+00	0.00E+00	0.00E+00	3.24E+09
NI-63	1.61E+10	1.13E+09	5.45E+08	0.00E+00	0.00E+00	0.00E+00	1.81E+08
ZN-65	4.24E+08	1.47E+09	6.86E+08	0.00E+00	9.42E+08	0.00E+00	6.23E+08
RB-86	0.00E+00	2.73E+08	1.28E+08	0.00E+00	0.00E+00	0.00E+00	4.04E+07
SR-89	1.52E+10	0.00E+00	4.34E+08	0.00E+00	0.00E+00	0.00E+00	1.80E+09
SR-90	7.51E+11	0.00E+00	1.85E+11	0.00E+00	0.00E+00	0.00E+00	2.11E+10
Y-91	7.84E+06	0.00E+00	2.10E+05	0.00E+00	0.00E+00	0.00E+00	3.22E+09
ZR-95	1.72E+06	5.43E+05	3.73E+05	0.00E+00	7.98E+05	0.00E+00	1.25E+09
NB-95	1.92E+05	1.07E+05	5.87E+04	0.00E+00	1.03E+05	0.00E+00	4.56E+08
RU-103	6.82E+06	0.00E+00	2.92E+06	0.00E+00	2.41E+07	0.00E+00	5.70E+08
RU-106	3.09E+08	0.00E+00	3.90E+07	0.00E+00	5.97E+08	0.00E+00	1.48E+10
AG-110M	1.52E+07	1.43E+07	8.72E+06	0.00E+00	2.74E+07	0.00E+00	4.03E+09
TE-125M	1.48E+08	5.34E+07	1.98E+07	4.14E+07	0.00E+00	0.00E+00	4.37E+08
TE-127M	5.52E+08	1.96E+08	6.56E+07	1.31E+08	2.24E+09	0.00E+00	1.37E+09
TE-129M	3.61E+08	1.34E+08	5.72E+07	1.17E+08	1.51E+09	0.00E+00	1.36E+09
I-131	7.69E+07	1.08E+08	5.78E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07
I-133	1.94E+06	3.29E+06	1.00E+06	4.59E+08	5.77E+06	0.00E+00	2.49E+06
CS-134	7.10E+09	1.67E+10	7.75E+09	0.00E+00	5.31E+09	2.03E+09	2.08E+08
CS-136	4.39E+07	1.73E+08	1.16E+08	0.00E+00	9.41E+07	1.48E+07	1.39E+07
CS-137	1.01E+10	1.35E+10	4.69E+09	0.00E+00	4.59E+09	1.78E+09	1.92E+08
BA-140	1.39E+08	1.71E+05	8.97E+06	0.00E+00	5.78E+04	1.15E+05	2.15E+08
CE-141	2.83E+05	1.89E+05	2.17E+04	0.00E+00	8.90E+04	0.00E+00	5.41E+08
CE-144	5.28E+07	2.18E+07	2.83E+06	0.00E+00	1.30E+07	0.00E+00	1.33E+10
PR-143	6.99E+04	2.79E+04	3.48E+03	0.00E+00	1.62E+04	0.00E+00	2.30E+08
ND-147	3.62E+04	3.94E+04	2.36E+03	0.00E+00	2.31E+04	0.00E+00	1.42E+08

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: CHILD PATHWAY: VEGETATION

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	4.02E+03	4.02E+03	4.02E+03	4.02E+03	4.02E+03	4.02E+03
P-32	3.35E+09	1.57E+08	1.29E+08	0.00E+00	0.00E+00	0.00E+00	9.25E+07
CR-51	0.00E+00	0.00E+00	1.17E+05	6.49E+04	1.77E+04	1.18E+05	6.20E+06
MN-54	0.00E+00	6.65E+08	1.77E+08	0.00E+00	1.86E+08	0.00E+00	5.58E+08
FE-55	8.01E+08	4.25E+08	1.32E+08	0.00E+00	0.00E+00	2.40E+08	7.87E+07
FE-59	3.98E+08	6.44E+08	3.21E+08	0.00E+00	0.00E+00	1.87E+08	6.71E+08
CO-58	0.00E+00	6.44E+07	1.97E+08	0.00E+00	0.00E+00	0.00E+00	3.76E+08
CO-60	0.00E+00	3.78E+08	1.12E+09	0.00E+00	0.00E+00	0.00E+00	2.10E+09
NI-63	3.95E+10	2.11E+09	1.34E+09	0.00E+00	0.00E+00	0.00E+00	1.42E+08
ZN-65	8.12E+08	2.16E+09	1.35E+09	0.00E+00	1.36E+09	0.00E+00	3.80E+08
RB-86	0.00E+00	4.51E+08	2.77E+08	0.00E+00	0.00E+00	0.00E+00	2.90E+07
SR-89	3.60E+10	0.00E+00	1.03E+09	0.00E+00	0.00E+00	0.00E+00	1.39E+09
SR-90	1.24E+12	0.00E+00	3.15E+11	0.00E+00	0.00E+00	0.00E+00	1.67E+10
Y-91	1.87E+07	0.00E+00	4.99E+05	0.00E+00	0.00E+00	0.00E+00	2.49E+09
ZR-95	3.86E+06	8.48E+05	7.55E+05	0.00E+00	1.21E+06	0.00E+00	8.85E+08
NB-95	4.11E+05	1.60E+05	1.14E+05	0.00E+00	1.50E+05	0.00E+00	2.96E+08
RU-103	1.53E+07	0.00E+00	5.90E+06	0.00E+00	3.86E+07	0.00E+00	3.97E+08
RU-106	7.45E+08	0.00E+00	9.30E+07	0.00E+00	1.01E+09	0.00E+00	1.16E+10
AG-110M	3.21E+07	2.17E+07	1.73E+07	0.00E+00	4.04E+07	0.00E+00	2.58E+09
TE-125M	3.51E+08	9.50E+07	4.67E+07	9.84E+07	0.00E+00	0.00E+00	3.38E+08
TE-127M	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	0.00E+00	1.07E+09
TE-129M	8.40E+08	2.35E+08	1.30E+08	2.71E+08	2.47E+09	0.00E+00	1.02E+09
I-131	1.43E+08	1.44E+08	8.18E+07	4.76E+10	2.36E+08	0.00E+00	1.28E+07
I-133	3.53E+06	4.37E+06	1.65E+06	8.12E+08	7.28E+06	0.00E+00	1.76E+06
CS-134	1.60E+10	2.63E+10	5.55E+09	0.00E+00	8.15E+09	2.93E+09	1.42E+08
CS-136	8.28E+07	2.28E+08	1.47E+08	0.00E+00	1.21E+08	1.81E+07	8.00E+06
CS-137	2.39E+10	2.29E+10	3.38E+09	0.00E+00	7.46E+09	2.68E+09	1.43E+08
BA-140	2.79E+08	2.44E+05	1.63E+07	0.00E+00	7.96E+04	1.46E+05	1.41E+08
CE-141	6.57E+05	3.28E+05	4.86E+04	0.00E+00	1.44E+05	0.00E+00	4.09E+08
CE-144	1.27E+08	3.99E+07	6.79E+06	0.00E+00	2.21E+07	0.00E+00	1.04E+10
PR-143	1.45E+05	4.36E+04	7.21E+03	0.00E+00	2.36E+04	0.00E+00	1.57E+08
ND-147	7.15E+04	5.79E+04	4.49E+03	0.00E+00	3.18E+04	0.00E+00	9.18E+07

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: INFANT PATHWAY: VEGETATION

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZR-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AG-110M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-125M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-127M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-129M	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-136	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CE-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PR-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ND-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: ADULT   PATHWAY: INHALATION

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
MN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
FE-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
CO-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
NI-63	4.32E+05	3.14E+04	1.45E+04	0.00E+00	0.00E+00	1.78E+05	1.34E+04
ZN-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
RB-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04
SR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
SR-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05
ZR-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
NB-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05
RU-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05
RU-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05
AG-110M	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05
TE-125M	3.42E+03	1.58E+03	4.67E+02	1.05E+03	1.24E+04	3.14E+05	7.06E+04
TE-127M	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05
TE-129M	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03
CS-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
CS-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
CS-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	[illegible]
BA-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05
PR-143	9.36E+03	3.75E+03	4.64E+02	0.00E+00	2.16E+03	2.81E+05	2.00E+05
ND-147	5.27E+03	6.10E+03	3.65E+02	0.00E+00	3.56E+03	2.21E+05	1.73E+05

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: TEEN PATHWAY: INHALATION

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04
CR-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
MN-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
FE-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
FE-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
CO-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
NI-63	5.80E+05	4.34E+04	1.98E+04	0.00E+00	0.00E+00	3.07E+05	1.42E+04
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04
RB-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04
SR-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	1.42E+06	3.71E+05
SR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05
ZR-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
NB-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04
RU-103	2.10E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05
RU-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05
AG-110M	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05
TE-125M	4.88E+03	2.24E+03	6.67E+02	1.40E+03	0.00E+00	5.36E+05	7.50E+04
TE-127M	1.80E+04	8.16E+03	2.18E+03	4.38E+03	6.54E+04	1.66E+06	1.59E+05
TE-129M	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
CS-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
CS-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
CS-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
BA-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
CE-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05
PR-143	1.34E+04	5.31E+03	6.62E+02	0.00E+00	3.09E+03	4.83E+05	2.14E+05
ND-147	7.86E+03	8.56E+03	5.13E+02	0.00E+00	5.02E+03	3.72E+05	1.82E+05

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: CHILD   PATHWAY: INHALATION

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	11E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
RB-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
SR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
NB-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
RU-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04
RU-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
AG-110M	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
TE-125M	6.73E+03	2.33E+03	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04
TE-127M	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
TE-129M	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
CE-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05
PR-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	4.33E+05	9.73E+04
ND-147	1.08E+04	8.73E+03	6.81E+02	0.00E+00	4.81E+03	3.28E+05	8.21E+04

TABLE 2.3
PATHWAY DOSE FACTORS

AGE GROUP: INFANT PATHWAY: INHALATION

NUCLIDE	ORGAN DOSE FACTORS						
	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
CR-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03
FE-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03
FE-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
CO-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
NI-63	3.39E+05	2.04E+04	1.16E+04	0.00E+00	0.00E+00	2.09E+05	2.42E+03
ZN-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
RB-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03
SR-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
SR-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
NB-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04
RU-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04
RU-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05
AG-110M	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04
TE-125M	4.76E+03	1.99E+03	6.58E+02	1.62E+03	0.00E+00	4.47E+05	1.29E+04
TE-127M	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04
TE-129M	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
CS-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
CS-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
BA-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05
PR-143	1.40E+04	5.24E+03	6.99E+02	0.00E+00	1.97E+03	4.33E+05	3.72E+04
ND-147	7.94E+03	8.13E+03	5.00E+02	0.00E+00	3.15E+03	3.22E+05	3.12E+04

TABLE 2.4
(Sheet 1 of 2)

CONTROLLING RECEPTOR PATHWAYS AND LOCATIONS (NOTE 1), AND ATMOSPHERIC DISPERSION PARAMETERS (FOR DOSE CALCULATIONS REQUIRED BY RADIOLOGICAL EFFLUENT CONTROL 3/4.11.2.3) 5

Sector	Pathway (Note 2)	Distance (Miles)	X/Q (Notes 3, 4)	D/Q (Notes 5, 6)	Rev.
N	Resident	2.20	9.28E-07	5.32E-09	
	Garden	3.3	--	2.10E-09	7
	Milk Cow	4.4	--	1.06E-09	
NNE	Resident	2.30	5.12E-07	2.60E-09	
	Garden	2.40	--	2.30E-09	5
	Milk Cow	None	--	--	
NE	Resident	2.30	3.58E-07	1.28E-09	5
	Garden	2.70	--	8.92E-10	
	Milk Cow	4.9	--	2.38E-10	7
ENE	Resident	2.40	2.58E-07	7.08E-10	5
	Garden	2.5	--	6.10E-10	7
	Milk Cow	None	--	--	5
E	Resident	2.40	3.02E-07	6.62E-10	5
	Garden	3.3	--	3.32E-10	7
	Milk Cow	None	--	--	5
ESE	Resident	2.0	4.7E-07	1.20E-09	7
	Garden	2.30	--	9.00E-10	
	Milk Cow	None	--	--	5
SE	Resident	2.00	7.10E-07	2.80E-09	
	Garden	2.50	--	1.60E-09	5
	Milk Cow	None	--	--	
SSE	Resident	1.60	9.96E-07	5.92E-09	5
	Garden	1.7	--	5.24E-09	7
	Milk Cow	2.20	--	1.80E-09	5
S	Resident	1.60	7.74E-07	4.66E-09	5
	Garden	1.8	--	5.38E-09	
	Milk Cow	None	--	--	7
SSW	Resident	1.90	4.42E-07	2.06E-09	5
	Garden	4.3	--	2.92E-10	7
	Milk Cow	None	--	--	5

TABLE 2.4
(Sheet 2)

CONTROLLING RECEPTOR PATHWAYS AND LOCATIONS (NOTE 1), AND ATMOSPHERIC DISPERSION PARAMETERS (FOR DOSE CALCULATIONS REQUIRED BY RADIOLOGICAL EFFLUENT CONTROL 3/4.11.2.3) 5

Sector	Pathway (Note 2)	Distance (Miles)	X/Q (Notes 3, 4)	D/Q (Notes 5, 6)	
SW	Resident	1.00	1.60E-06	7.50E-09	7
	Garden	1.7	--	1.98E-09	
	Milk Cow	None	--	--	5
WSW	Resident	1.00	1.80E-06	6.50E-09	5
	Garden	1.5	--	2.20E-09	7
	Milk Cow	None	--	--	5
W	Resident	1.50	8.40E-07	2.80E-09	
	Garden	1.50	--	2.80E-09	5
	Milk Cow	None	--	--	
WNW	Resident	4.0	2.00E-07	5.00E-10	7
	Garden	3.00	--	1.04E-09	
	Milk Cow	None	--	--	5
NW	Resident	2.70	6.98E-07	2.24E-09	
	Garden	None	--	--	5
	Milk Cow	None	--	--	
NNW	Resident	2.70	7.62E-07	3.22E-09	5
	Garden	3.6	--	1.60E-09	7
	Milk Cow	None	--	--	

NOTES:
(1) Receptor locations are taken from the nearest receptor locations identified in the CPSES 1991 land use census. 5
(2) In addition to the pathways shown, the inhalation and ground plane pathways are present at the nearest resident.
(3) The units for X/Q are Sec/Cubic Meter.
(4) X/Q Values at distances 1.0, 1.5, 2.0, 2.5, 3.5, 4.0, 4.5, and 6.0 miles were taken from Table 2.3-16, "Average Annual Relative Concentration at CPSES," of the CPSES Environment Report, Operating Licensing Stage (Reference 3). The X/Q values at other distances were determined by linear interpolation.
(5) The units for D/Q are inverse square meters
(6) D/Q values at distances 1.0, 1.5, 2.0, 2.5, 3.5, 4.0, 4.5, and 6.0 miles were taken from Table 2.3-17, "Average Annual Relative Deposition Rate," of the CPSES Environmental Report, Operating License Stage (Reference 3). The D/Q values at other distances were determined by linear interpolation.

2.3 METEOROLOGICAL MODEL

2.3.1 Dispersion Calculations

Atmospheric dispersion for gaseous releases is calculated using a straight line flow Gaussian model similar to the Constant Mean Wind Direction model given in Regulatory Guide 1.111, Section C.1.c. The method given here is modified by including factors to account for plume depletion and effects of the open terrain. The average relative concentration is given by the following equation:

$$\frac{X}{Q} = 2.032\delta\ K \sum_{j,k} \left(\frac{n_{jk}}{N\ r\ \bar{u}_{jk}\ \Sigma_j(r)} \right) \qquad \text{[Eq. 2-29]}$$

Where:

X/Q	=	average concentration normalized by source strength (sec/m^3).
2.032	=	$(2/\pi)^{1/2} \cdot (2\pi/16)^{-1}$
δ	=	plume depletion factor at distance r for the applicable stability class (Figure 2.2). Normally, a value of 1.0 is assumed when undepleted X/Q values are to be used in dose calculations.
K	=	terrain correction factor (Figure 2.5)
n_{jk}	=	the number of hours meteorological conditions are observed to be in a given wind direction, wind speed class, k, and atmospheric stability class, j.
N	=	total hours of valid meteorological data throughout the period of release.

NOTE: If hourly meteorological data are used, all variable subscripts are dropped, n_{jk} and N are set equal to 1, and the hourly averaged meteorological variables are used in the model.

r = downwind distance from the release point to the location of interest (meters)

$\bar{u}_{jk}$ = the average windspeed (midpoint of windspeed class, k) measured at the 10 meter level during stability class j. (meters/sec)

$\Sigma_j(r)$ = the vertical plume spread with a volumetric correction for a release within the building wake cavity, at a distance, r, for stability class, j, expressed in meters.

NOTE: All parameters are considered dimensionless unless otherwise indicated.

The equation for calculating $\Sigma_j(r)$ is:

$$\Sigma_j(r) = \text{the lesser of} \begin{cases} (\sigma_j^2 + 0.5\, b^2/\pi)^{\frac{1}{2}} & \text{[Eq. 2-30]} \\ \sqrt{3}\ \sigma_j & \text{[Eq. 2-31]} \end{cases}$$

Where:

σ_j = the vertical standard deviation of materials in the plume at distance, r, for atmospheric stability class, j, expressed in meters. (Figure 2.3)

0.5 = the building shape factor.

b = the vertical height of the reactor containment structure (79.4 meters)

2.3.2 Deposition Calculations

The relative deposition per unit area is calculated as follows:

$$\frac{D}{Q} = \frac{K\, D_g\, z}{0.3927\ r} \qquad \text{[Eq. 2-32]}$$

Where:

D/Q	=	deposition per unit area normalized by source strength (m^{-2})
D_g	=	relative deposition rate for a ground level release (m^{-1}) (Figure 2.4)
z	=	the fraction of time the wind blows to the sector of interest.

NOTE: If hourly meteorological data are used, z is set equal to one.

0.3927 = the width in radians of a 22.5° sector.

Other variables are as previously defined.

NOTE: All parameters are considered dimensionless unless otherwise indicated.

2.4 DEFINITIONS OF GASEOUS EFFLUENTS PARAMETERS

Term	Definition	Section of Initial Use
AF	= Allocation Factor of 0.5 applied to account for releases from both stacks simultaneously. This factor will limit the dose rate contribution from each stack to 1/2 the limit for the site.	2.1.2
B	= vertical height of the reactor containment structure.	2.3.1
C_G	= the alarm setpoint for each plant vent stack noble gas activity monitor (uCi/cm^3)	2.1.2
C_{Gmax}	= maximum of the monitor setpoints for the two stacks	2.1.4
C_f	= the alarm setpoint for each plant vent stack effluent release rate monitor (uCi/sec)	2.1.3
c_{aux}	= the Auxiliary Building Ventilation Exhaust monitor alarm setpoint. (uCi/cm^3)	2.1.4
c_{cont}	= the Containment Atmosphere Gaseous monitor alarm setpoint. (uCi/cm^3)	2.1.5
C_I	= the setpoint for each plant vent stack Iodine Monitor. (uCi/cm^3)	2.1.7
C_p	= the setpoint for each plant vent stack particulate Monitor. (uCi/cm^3)	2.1.8
D_g	= relative deposition rate for a ground-level release (m^{-1})	2.3.2
D_o	= the total organ dose rate due to tritium, iodines, and particulates with half-lives greater than eight days in gaseous releases. (mRem/yr).	2.1.6
D_p	= dose to any organ of an individual from radioiodines, tritium and radionuclides in particulate from with half-lives greater than eight days. (mRem)	2.2.2

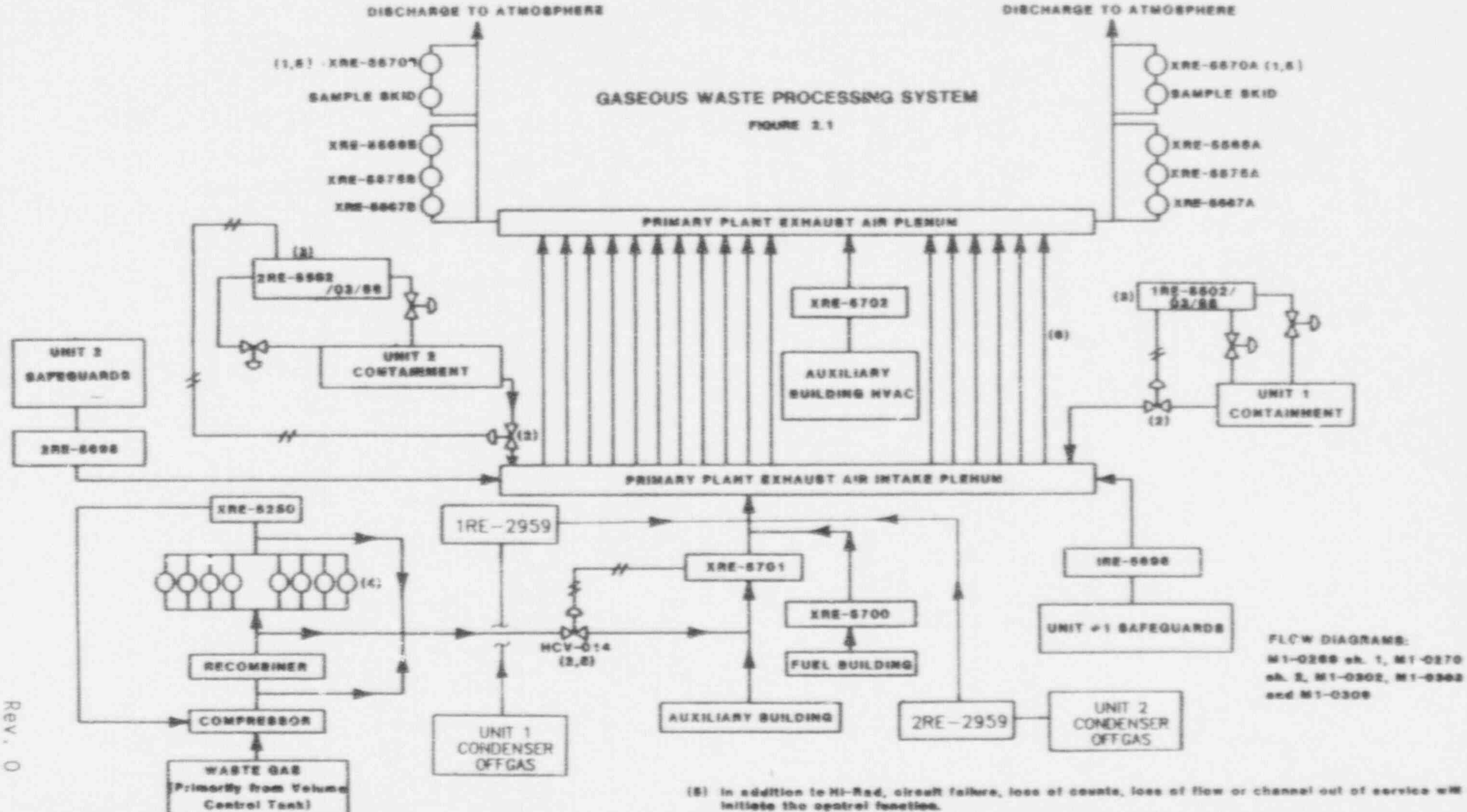
Term	Definition	Section of Initial Use
D_s	= skin dose rate at the SITE BOUNDARY due to noble gases. (mRem/yr)	2.1.1
D_t	= total body dose rate at the SITE BOUNDARY due to noble gases. (mRem/yr)	2.1.1
D_β	= air dose due to beta emissions from noble gases. (mRad)	2.2.1
D_γ	= air dose due to gamma emissions from noble gases (mRad)	2.2.1
D/Q	= the annual average relative deposition at the location of interest. (m^{-2})	2.2.2
δ	= plume depletion factor at distance r for the appropriate stability class (radioiodines and particulates).	2.3.1
F_B	= the estimated flow rate contribution associated with the release rate of the batch source. (cm^3/sec)	2.1.1
F_C	= the continuous flow rate contribution of each plant vent stack. (cm^3/sec)	2.1.1
F_v	= the flow rate at each plant vent stack. (cm^3/sec)	2.1.1
F_{ABV}	= the flow rate contribution associated with the sources in the Auxiliary Building other than the waste gas decay tanks. (cm^3/sec)	2.1.4
F_{aux}	= the total flow rate at the Auxiliary Building Ventilation Monitor during the release of a Waste Gas Decay Tank. (cm^3/sec)	2.1.4
F_{cont}	= the flow rate contribution associated with the release of the Containment Atmosphere. (cm^3/sec)	2.1.5
F_{GDT}	= the flow rate contribution associated with the release of a Waste Gas Decay Tank. (cm^3/sec)	2.1.4

Term	Definition	Section of Initial Use
K	= terrain recirculation factor. (Unitless)	2.3.1
K_i	= total body dose factor due to gamma emissions from noble gas radionuclide i. (mRem/yr per uCi/m^3)	2.1.1
L_i	= skin dose factor due to beta emissions from noble gas radionuclide i. (mRem/yr per uCi/m^3)	2.1.1
M_i	= air dose factor due to gamma emissions from noble gas radionuclide i. (mRem/yr per uCi/m^3)	2.1.1
N_i	= air dose factor due to beta emissions from noble gas radionuclide i. (mRem/yr per uCi/m^3)	2.2.1
n_{jk}	= number of hours meteorological conditions are observed to be in a given wind direction, wind speed class k, and atmospheric stability class j.	2.3.1
N	= total hours of valid meteorological data.	2.3.1
P_i	= dose parameter for radionuclide i, (other than noble gases) for the inhalation pathway (mRem/yr per uCi/cm^3)	2.1.6
Q_i	= total release rate of radionuclide i from the Plant Vent Stacks. (uCi/sec)	2.1.1
Q'_i	= cumulative release of radionuclide i during the period of interest. (uCi)	2.2.1
$RP_{i,a,o}$	= dose factor for radionuclide i, pathway p, and age group a, and organ o. (mRem/yr per uCi/m^3) or (m^2-mRem/yr per uCi/sec)	2.2.2

Term	Definition	Section of Initial Use
r	= distance from the point of release to the location of interest for dispersion calculations. (meters).	2.3.1
SF	= Safety Factor of 0.5 applied to compensate for statistical fluctuations, errors of measurement, and non uniform distribution of release activity between the stacks.	2.1.2
$\Sigma_j(r)$	= vertical plume spread with a volumetric correction for a release within the building wake cavity, at a distance, r, for stability class, j, expressed in meters.	2.3.1
σ_j	= vertical standard deviation of the plume concentration (in meters), at distance, r, for stability category j.	2.3.1
$\bar{u}_{jk}$	= wind speed (midpoint of windspeed class k) at ground level (m/sec) during atmosphere stability class j.	2.3.1
W'	= the dispersion parameter for estimating the dose to an individual at the location where the combination of existing pathways and receptor age groups indicates the maximum exposures.	2.2.2
X/Q	= the annual average relative concentration at the location of interest. (sec/m^3)	2.2.2
$\overline{X/Q}$	= the highest annual average relative concentration at the SITE BOUNDARY. (sec/m^3) (3.3×10^{-6} sec/m^3 in the NNW sector)	2.1.1
X_{iB}	= the concentration of radionuclide i in the batch release stream, (uCi/cm^3) as sampled in accordance with Radiological Effluent Control 3/4.11.2.1, Table :.11-2.	2.1.1

Term	Definition	Section of Initial Use
X_{ic}	= the concentration of radionuclide i in the continuous release stream at each stack as sampled in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. (uCi/cm^3)	2.1.1
X_{iv}	= the concentration of radionuclide i present at each plant vent stack. (uCi/cm^3)	2.1.1
X_{GV}	= the concentration of noble gases present at each plant vent stack due to the combined sources as calculated from the radionuclide concentrations determined from the analysis of the appropriate samples taken in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. (uCi/cm^3)	2.1.2
X_{IV}	= the concentration of radionuclide present at each plant vent stack due to the combined sources as calculated from the radionuclide concentration determined from the analysis of the appropriate samples taken in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. (uCi/cm^3)	2.1.7
X_{iABV}	= the concentration of noble gas radionuclide i in the Auxiliary Building ventilation stream due to sources other than the waste gas decay tanks. (uCi/cm^3)	2.1.4
X_{iaux}	= the concentration of noble gas radionuclide i at the Auxiliary Building ventilation monitor during a waste gas decay tank release. (uCi/cm^3)	2.1.4

Term	Definition	Section of Initial Use
X_{icont}	= the concentration of noble gas radionuclide i in the containment release stream as sampled in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. (uCi/cm^3)	2.1.5
X_{iGDT}	= the concentration of noble gas radionuclide i in the waste gas decay tank as sampled in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. (uCi/cm^3)	2.1.4
X_{pv}	= the concentration of particulates present at each plant vent stack due to the combined sources as calculated from the radionuclide concentration determined from the analysis of the appropriate samples taken in accordance with Radiological Effluent Control 3/4.11.2.1, Table 4.11-2. (uCi/cm^3)	2.1.8
z	= the fraction of time the wind blows to the sector of interest	2.3.2
1.1	= conversion factor of mRem skin dose per mRad air dose.	2.1.1
500	= the dose rate limit to the total body of an individual in an unrestricted area due to noble gases. (mRem/yr)	2.1.2
3000	= the dose rate limit to the skin of the body of an individual in an unrestricted area due to noble gases. (mRem/yr)	2.1.2
1500	= the dose rate limit to any organ due to iodines, tritium, and particulates with half-lives greater than eight days. (mRem/yr)	2.1.7



GASEOUS WASTE PROCESSING SYSTEM

FIGURE 2.1

FLOW DIAGRAMS:
M1-0269 sh. 1, M1-0270 sh. 2, M1-0302, M1-0303 and M1-0309

(1) Wide Range Gas Monitor, Hi-Rad indication closes valve HCV-014 (Waste Gas Release).

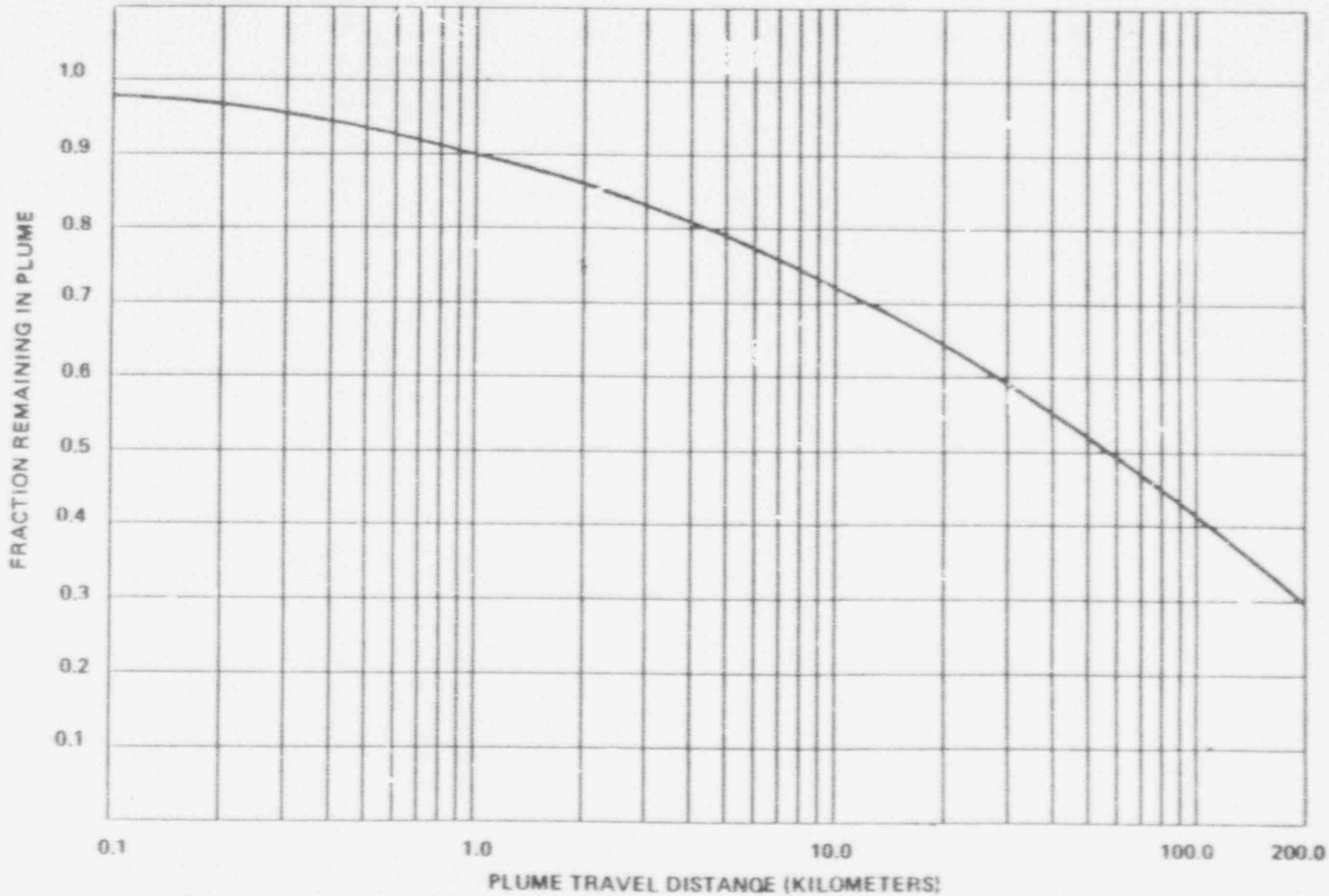
(2) Hi-Rad indication by monitor closes valve.

(3) Hi-Rad indication initiates containment isolation.

(4) Eight gaseous decay tanks can be individually purged (There are two additional tanks for shutdown).

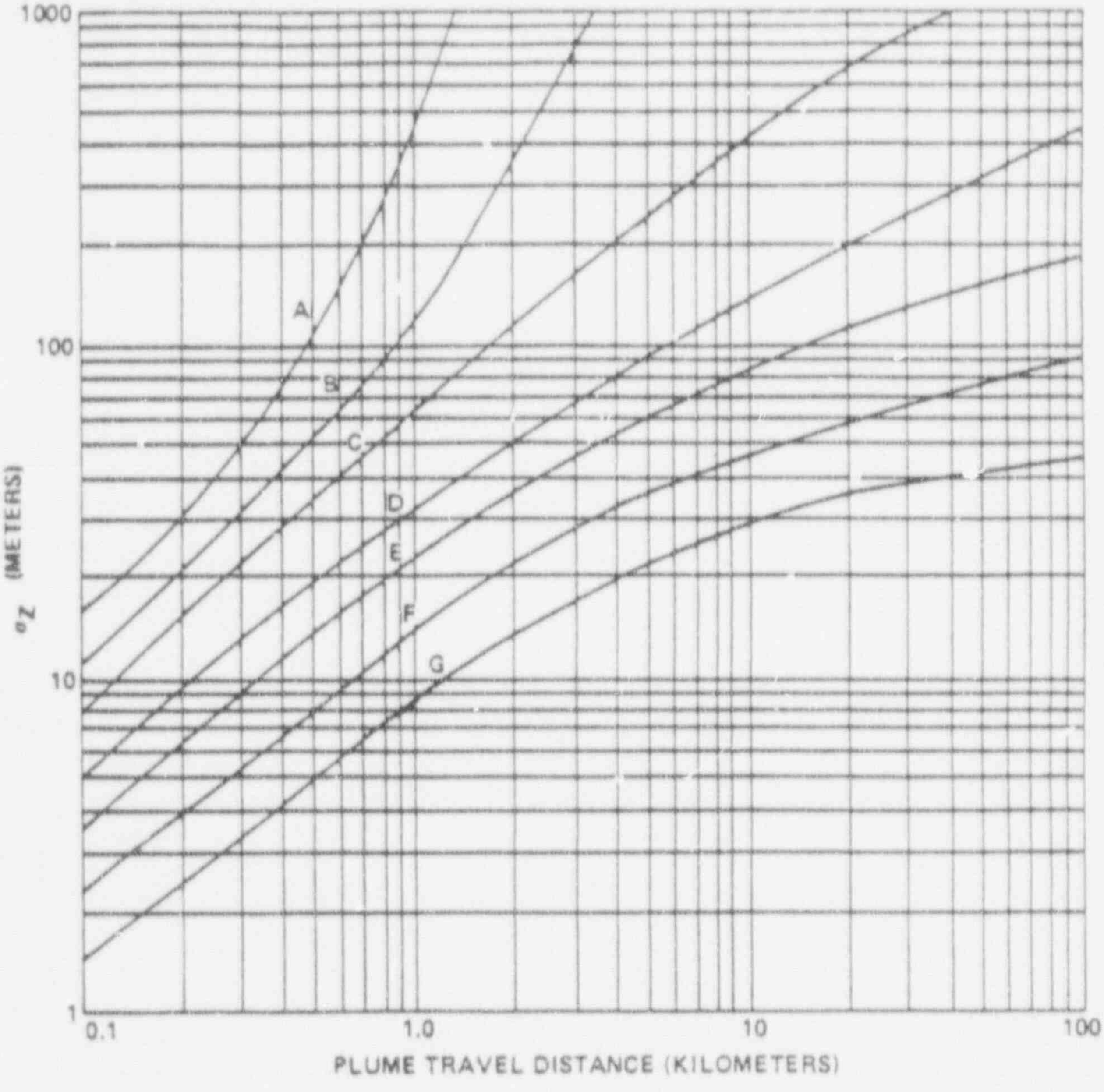
(5) In addition to Hi-Rad, circuit failure, loss of counts, loss of flow or channel out of service will initiate the control function.

(6) Filters are present between the AIR INTAKE PLENUM AND EXHAUST AIR PLENUM. There are sixteen banks of filters divided into TRAIN A and TRAIN B. Each bank consists of a carbon filter, 2HEPA filter, a carbon filter, and a HEPA filter in series.



Plume Depletion Effect for Ground-Level Releases (All Atmospheric Stability Classes)

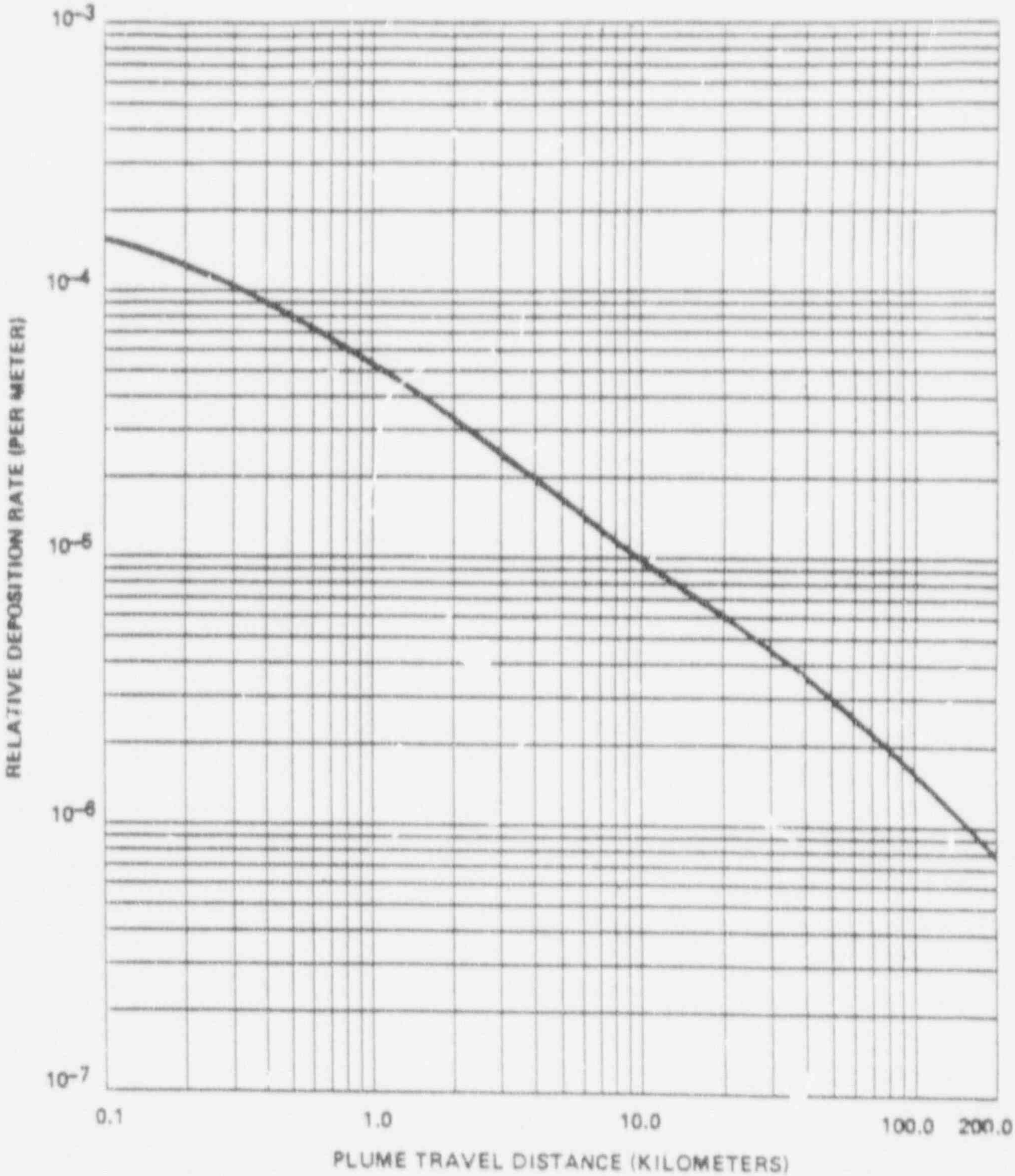
Figure 2.2



Vertical Standard Deviation of Material in a Plume (Letters denote Pasquill Stability Class)

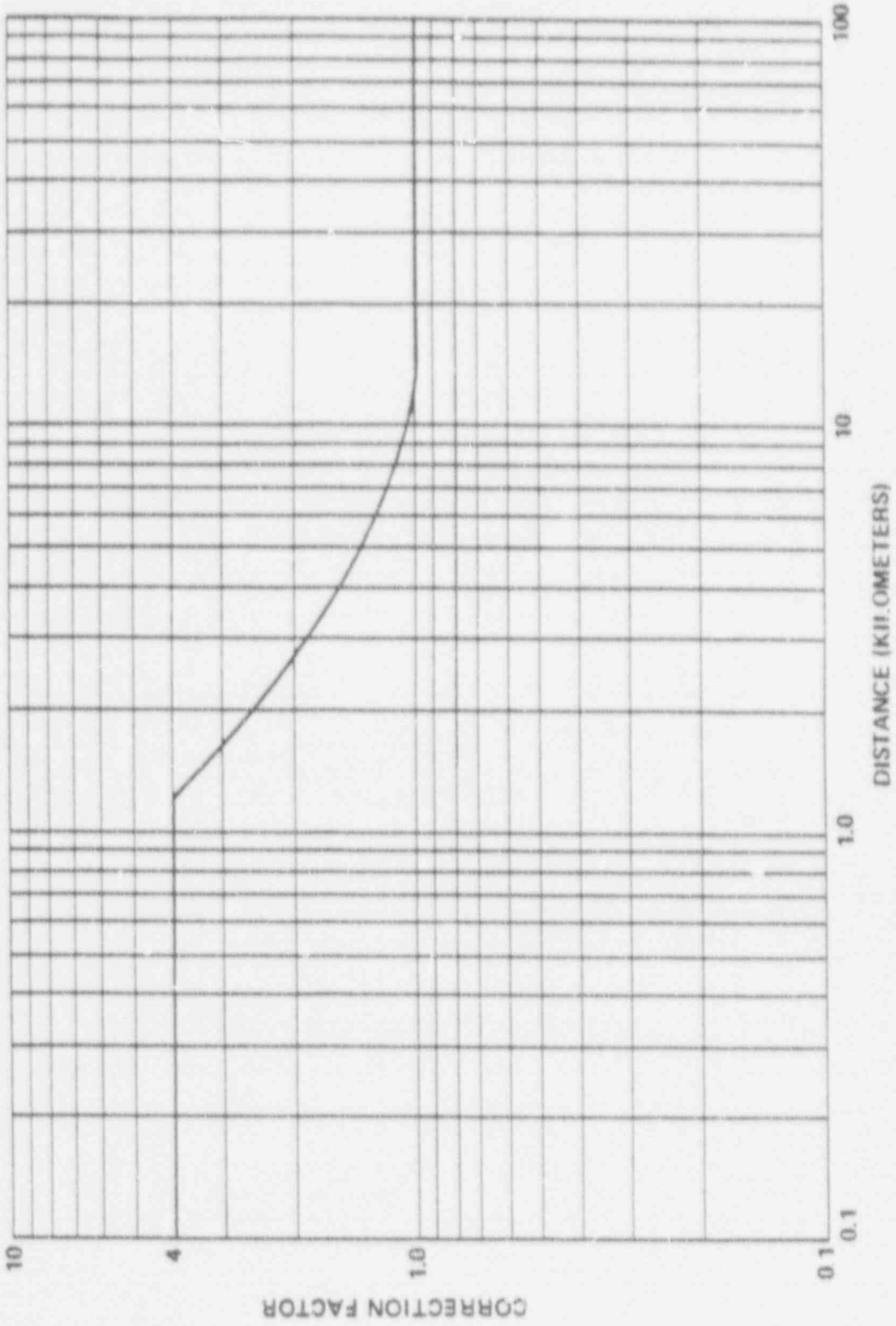
NOTE: THESE ARE STANDARD RELATIONSHIPS AND MAY HAVE TO BE MODIFIED FOR CERTAIN TYPES OF TERRAIN AND/OR CLIMATIC CONDITIONS (E.G., VALLEY, DESERT, OVER WATER).

Figure 2.3



Relative Deposition for Ground-Level Releases (All Atmospheric Stability Classes)

Figure 2.4



Open Terrain Correction Factor

Figure 2.5

SECTION 3.0

RADIOLOGICAL ENVIRONMENTAL MONITORING

3.1 SAMPLING LOCATIONS

Sampling locations as required in Radiological Effluent Control 3/4.12.1, Table 3.12-1 are described in Table 3.1 and shown on the map in Figure 3.1.

NOTE: For the purpose of implementing Radiological Effluent Control 3/4.12.1, sampling locations will be modified as required to reflect the findings of the Land Use Census. Dose calculations used in making this determination will be performed as specified in Section 2.2.4.

The sampling locations shown on Table 3.1 are the minimum locations required for compliance with Radiological Effluent Control 3/4.12.1. If desired, additional locations may be monitored as special studies to evaluate potential pathways of exposure without adding such locations to the monitoring program given in Table 3.1.

3.2 INTERLABORATORY COMPARISON PROGRAM

For the purpose of implementing Radiological Effluent Control 3/4.12.3, TU Electric has contracted Teledyne Isotopes Midwest Laboratory to perform the Interlaboratory Comparison Program. The program is operated by agencies which supply environmental-type samples (e.g., milk or water) containing concentrations of radionuclides known to the issuing agency but not to the participant laboratories. The purpose of the program is to provide an independent check on the laboratory's analytical procedures and to alert it to any possible problems. Participant laboratories measure the concentrations of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher

or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used. Teledyne participates in the environmental sample crosscheck program for milk and water samples conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada. The results of the program are included in the Annual Radiological Environmental Operating Report, as required by CPSES Technical Specification 6.9.1.3.

Table 3.1

Environmental Sampling Locations

Sampling Point	Location (Sector - Miles)	Sample Type(1)
A1	N-1.45 (Squaw Creek Park)	A
A2	N-9.4 (Granbury)	A
A3	E-3.5 (Children's Home)	A
A4	SSE-4.5 (Glen Rose)	A
A5	S/SSW-1.2	A
A6	SW-12.3 (Control)	A
A7	SW/WSW-0.95	A
A8	NW-1.0	A
R1	N-1.45 (Squaw Creek Park)	R
R2	N-4.4	R
R3	N-6.5	R
R4	N-9.4 (Granbury)	R
R5	NNE-1.1	R
R6	NNE-5.65	R
R7	NE-1.7	R
R8	NE-4.8	R
R9	ENE-2.5	R
R10	ENE-5.0	R
R11	E-0.5	R

Table 3.1 (Continued)

Environmental Sampling Locations

Sampling Point	Location (Sector - Miles)	Sample Type(1)
R12	E-1.9	R
R13	E-3.5 (Children's Home)	R
R14	E-4.2	R
R15	ESE-1.4	R
R16	ESE-4.7	R
R17	SE-1.3	R
R18	SE-3.85	R
R19	SE-4.6	R
R20	SSE-1.3	R
R21	SSE-4.4 (Glen Rose)	R
R22	SSE-4.5 (Glen Rose)	R
R23	S-1.5	R
R24	S-4.2	R
R25	SSW-1.1	R
R26	SSW-4.4 (State Park)	R
R27	SW-0.9	R
R28	SW-4.8 (Girl Scout Camp)	R
R29	SW-12.3 (Control)	R
R30	WSW-1.0	R
R31	WSW-5.35	R

Table 3.1 (Continued)

Environmental Sampling Locations

Sampling Point	Location (Sector - Miles)	Sample Type(1)
R32	WSW-7.0	R
R33	W-1.0	R
R34	W-2.0	R
R35	W-5.5	R
R36	WNW-1.0	R
R37	WNW-5.0	R
R38	WNW-6.7	R
R39	NW-1.0	R
R40	NW-5.7	R
R41	NW-9.9 (Tolar)	R
R42	NNW-1.35	R
R43	NNW-4.6	R
SW1	N-1.5 (Squaw Creek Reservoir Marina)	SW
SW2	N-9.9 (Lake Granbury)	SW/DW(2)
SW3	N-19.3 (Control-Brazos River)	SW
SW4	NE-7.4 (Lake Granbury)	SW
SW5	ESE-1.4 (Squaw Creek Reservoir)	SW(3)
SW6	NNW-0.1 (Squaw Creek Reservoir)	SW/DW(4)
GW1	W-1.2 (NOSF potable water)	GW
GW2	WSW-0.1 (Plant potable water)	GW(4),(5)

Table 3.1 (Continued)

Environmental Sampling Locations

Sampling Point	Location (Sector - Miles)	Sample Type[1]	
GW3	SSE-4.6 (Glen Rose)	GW[5]	
GW4	N-9.8 (Granbury)	GW[2],[5]	
GW5	N-1.45 (Squaw Creek Park)	GW[5]	
SS1	NNE-1.0 (Squaw Creek Reservoir)	SS	
SS2	N-9.9 (Lake Granbury)	SS	
SS3	NE-7.4 (Lake Granbury)	SS	
M1	SSE-2.2	M	
M2	not used [6]	M	
M3	not used [6]	M	
M4	SW-13.5 (Control)	M	
F1	ENE-2.0 (Squaw Creek Reservoir)	F	
F2	NNE-8.0 (Lake Granbury)	F	
FP1	ENE-9.0 (Leonard Bros. Pecan Farm)	FP	
FP2	E-4.2 (truck farm)	FP	
FP3	Deleted	FP	6
FP4	SW-12.2 (Control)	FP	6
BL1	N-1.45	BL	
BL2	SW-1.0[7]	BL	
BL3	SW-13.5 (Control)[7]	BL	

(1) Types: A - Air Sample, R - Direct Radiation, SW - Surface Water, GW - Ground Water, SS - Shoreline Sediment, M- Milk, F - Fish; FP - Food Products; BL - Broad Leaf Vegetation.

(2) The municipal water system for the City of Granbury is supplied by surface water from Lake Granbury (location SW2) and ground well water (location GW4). Each of these input supplies for the Granbury municipal water system is sampled. These samples are not required for compliance with Radiological Effluent Control 3/4.12.1, Table 3.12-1, because they are not affected by plant discharges.

(3) This sample (location SW5) is representative of discharges from Squaw Creek Reservoir both down Squaw Creek and to Lake Granbury via the return line to Lake Granbury.

(4) The plant potable water is supplied by surface water from Squaw Creek Reservoir (location SW6) and ground well water (location GW2). Each of these input supplies for plant potable water is sampled.

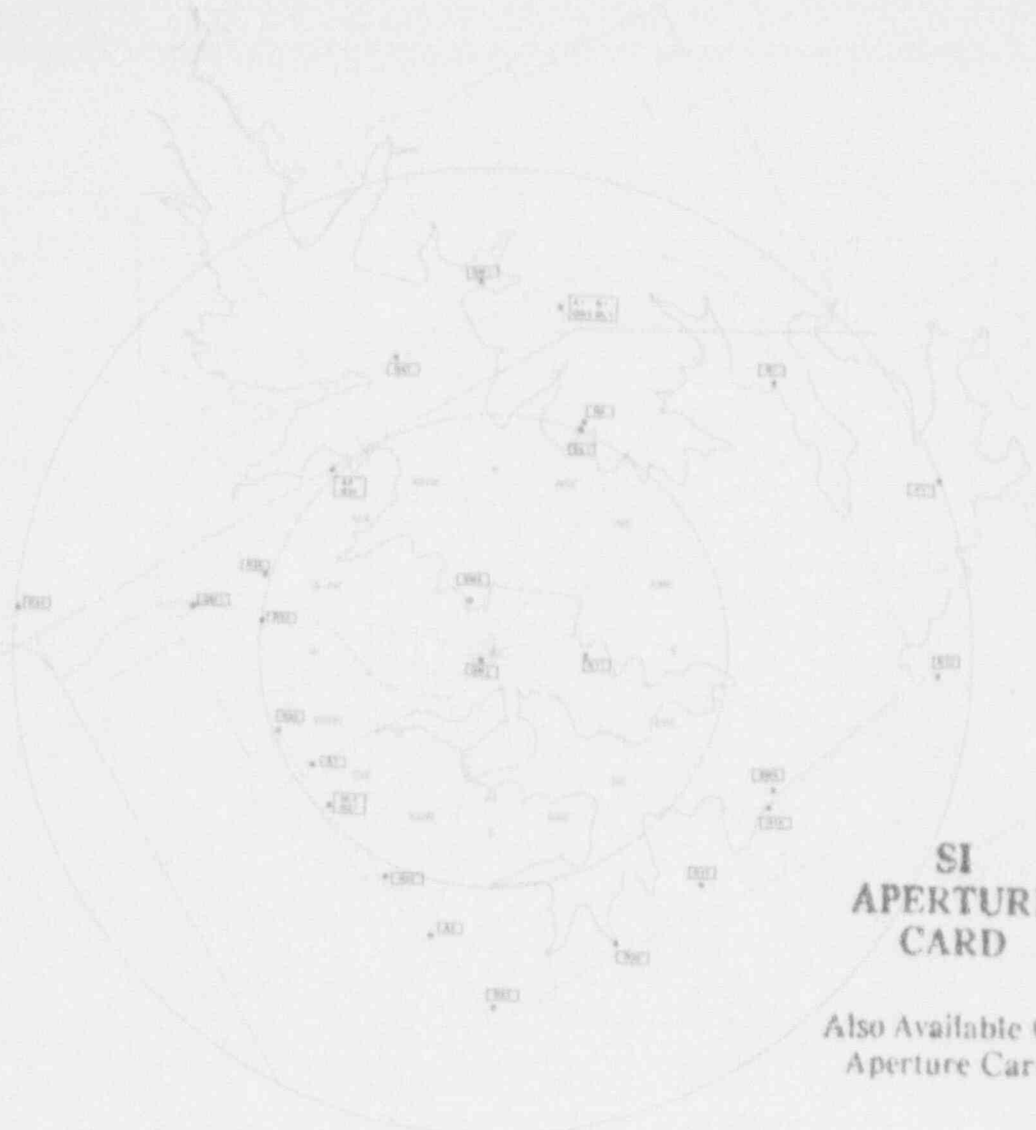
(5) Ground water supplies in the plant site area are not affected by plant liquid effluents as discussed in CPSES FSAR Section 2.4.13 and are therefore not required to be monitored for radioactivity to meet the requirements of the Radiological Environmental Monitoring Program specified in Radiological Effluent Control 3/4.12.1, Table 3.12-1. Although not required for compliance with the Radiological Environmental Monitoring Program groundwater sampling locations are included in the monitoring program to provide confirmation that ground water is not affected by plant discharges.

(6) Due to the current availability of milk sampling locations, milk samples are taken at only two locations (i.e., one sample and one control). If additional milk sampling locations are identified in future land use census, this table will be revised to include up to a maximum of 3 samples and one control, as indicated in the Radiological Environmental Monitoring Program given in Radiological Effluent Control 3/4.12.1, Table 3.12-1.

(7) Per the Radiological Environmental Monitoring Program given in Radiological Effluent Control 3/4.12.1, Table 3.12-1, broad leaf vegetation is required to be sampled only when milk sampling is not

performed at all required locations. Broad leaf sampling will be performed at the specified locations if milk samples are unavailable from any location.

Locations Greater than 2 Miles from the Station



Locations Within 2 Miles of the Station

Figure 3.1

Radiological Environmental

Monitoring Locations

9203030159 - 01

APPENDIX A
PATHWAY DOSE RATE PARAMETER

P_i (inhalation) = K' (BR) DFA_i [Eq. A-1]

where:

P_i = the pathway dose rate parameter for radionuclide, i, (other than noble gases) for the inhalation pathway, in mrem/yr per microcurie/m^3. The dose factors are based on the critical individual organ for the child age group.

K' = conversion factor, 10^6 pCi/microcurie

BR = 3700 m^3/yr, breathing rate for child (Ref. 2, Table E-5)

DFA_i = the maximum organ inhalation dose factor for the child age group for the ith radionuclide (mRem/pCi). Values are taken from Table E-9, Reg. Guide 1.109 (Ref. 2)

Resolution of the units yields:

P_i (inhalation) = 3.7×10^9 DFA_i (mRem/yr per uCi/m^3) [Eq. A-2]

The latest NRC Guidance has deleted the requirement to determine P_i (ground plane) and P_i (food). In addition, the critical age group has been changed from infant to child.

APPENDIX B

INHALATION PATHWAY DOSE FACTOR ($R^I_{i,a,o}$)

$$R^I_{i,a,o} = k' \text{ (BR) } (DFA_{i,a,o}) \text{ (mrem/yr per microcurie/m}^3\text{)} \quad \text{[Eq. B-1]}$$

where:

k' = conversion factor, 10^6 pCi/microcurie

BR = breathing rate, 1400, 3700, 8000, and 8000 m^3/yr for infant, child, teenager, and adult age groups, respectively. (Ref. 2, Table E-5)

$DFA_{i,a,o}$ = the inhalation dose factor for organ, o, of the receptor of a given age group, a, and for the ith radionuclide, in mrem/pCi. The total body is considered as an organ in the selection of $DFA_{i,a,o}$. Values are taken from Tables E-7 through E-10, Reg. Guide 1.109 (Ref.2)

APPENDIX C

GROUND PLANE PATHWAY DOSE FACTOR (R^G_i)

$$R^G_i = k' \, k'' \, (SF) \, DFG_i \, [(1-e^{-\lambda_i t})/\lambda_i] \qquad \text{[Eq. C-1]}$$

where:

k'	= conversion factor, 10^6 pCi/microcurie
k''	= conversion factor, 8760 hr/yr
λ_i	= decay constant for the ith radionuclide, sec^{-1}
t	= the exposure time (this calculation assumes that decay is the only operating removal mechanism) 4.73×10^8 sec. (15 yrs)
DFG_i	= the ground plane dose conversion factor for the ith radionuclide (mrem/hr per pCi/m^2). Values are taken from Table E-6, Reg. Guide 1.109 (Ref. 2). These values apply to all age groups. Dose factors are provided for the total body and skin only. Doses to all other organs are assumed equal to the total body dose.
SF	= 0.7, shielding factor, from Table E-15, Reg. Guide 1.109 (Ref. 2)

APPENDIX D

GRASS COW-MILK PATHWAY DOSE FACTOR ($R^C_{i,a,o}$)

$$R^C_{i,a,o} = k' [(Q_F \times U_{AP}) / (\lambda_i + \lambda_w)] \times (F_m) \times (r) \times (DFL_{i,a,o}) \times [((f_p \times f_s)/ Y_p) + ((1-f_p \times f_s) e^{-\lambda_i t_h})/Y_s] e^{-\lambda_i t_f} \quad \text{[Eq. D-1]}$$

where:

k' = conversion factor, 10^6 picocurie/microcurie (pCi/uci)

Q_F = cow consumption rate, 50 kg/day, (R.G. 1.109)

U_{AP} = Receptor's milk consumption rate; 330, 330, 400, 310 liters/yr for infant, child, teenager, and adult age groups, respectively (R.G. 1.109)

Y_p = agricultural productivity by unit area of pasture feed grass, 0.7 kg/m^2 (NUREG-0133)

Y_s = agricultural productivity by unit area of stored feed, 2.0 kg/m^2, (NUREG 0133)

F_m = stable element transfer coefficient (Table E-1, R.G. 1.109)

r = fraction of deposited activity retained in cow's feed grass, 0.2 for particulates, 1.0 for radioiodine (Table E-15, R.G. 1.109)

$DFL_{i,a,o}$ = the ingestion dose factor for organ, o, and the ith radionuclide for each respective age group, a (Tables E-11 to E-14, R.G. 1.109)

λ_i = decay constant for the ith radionuclide, sec^{-1}

λ_w = decay constant for weathering, 5.73×10^{-7} sec^{-1} (NUREG-0133)

t_f = 1.73×10^5 sec, the transport time from pasture to cow to milk to receptor (Table E-15, R.G. 1.109)

t_h = 7.78 x 10^6 sec, the transport time from pasture to harvest to cow to milk to receptor (Table E-15, R.G. 1.109)

f_p = 1.0, the fraction of the year that the cow is on pasture.

f_s = 1.0, the fraction of the cow feed that is pasture grass while the cow is on pasture.

The concentration of tritium in milk is based on the airborne concentration rather than the deposition. Therefore, R^C_i is based on (X/Q):

$$R^C_{t,a,o} = k'k''' F_m Q_F U_{AP} DFL_{t,a,o} \; (.75\,(.5/H)) \qquad \text{[Eq. D-2]}$$

where:

k''' = 10^3 grams/kg

H = 8 grams/m^3, absolute humidity of the atmosphere

.75 = fraction of total feed grass mass that is water

.5 = ratio of the specific activity of the feed grass water to the atmospheric water. (NUREG-0133)

$DFL_{t,a,o}$ = the ingestion dose factor for tritium and organ, o, for each respective age group, a (Tables E-11 to E-14, R.G. 1.109)

All other parameters and values are as given above.

NOTE: Goat-milk pathway factor, $R^C_{i,a,o}$ will be computed using the cow-milk pathway factor equation. F_m factor for goat-milk will be from Table E-2, R.G. 1.109.

APPENDIX E

COW-MEAT PATHWAY DOSE FACTOR ($R^M_{i,a,o}$)

$$R^M_{i,a,o} = k' (Q_F \times U_{AP})/(\lambda_i + \lambda_w) \times (F_f) \times (r) \times (DFL_{i,a,o}) \times [((f_p \times f_s)/Y_p) + ((1 - f_p f_s) e^{-\lambda_i t_h})/Y_s] \times e^{-\lambda_i t_f} \quad \text{[Eq. E-1]}$$

where:

k' = conversion factor, 10^6 picocurie/microcurie (pCi/uCi)

Q_F = cow consumption rate, 50 kg/day, (R.G. 1.109)

U_{AP} = Receptor's meat consumption rate; 0, 41, 65, 110 kg/yr for infant, child, teenager, and adult age groups, respectively (R.G. 1.109)

F_f = the stable element transfer coefficients, days/kg. (Table E-1, R.G. 1.109)

r = fraction of deposited activity retained in cow's feed grass, 0.2 for particulates, 1.0 for radioiodine (Table E-15, R.G. 1.109)

$DFL_{i,a,o}$ = the ingestion dose factor for organ, o, and the ith radionuclide for each respective age group, a (Tables E-11 to E-14, R.G. 1.109)

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

λ_w = decay constant for weathering, 5.73×10^{-7} sec^{-1} (NUREG-0133)

t_f = 1.73×10^6 sec, the transport time from pasture to receptor (NUREG-0133)

t_h = 7.78×10^6 sec, the transport time from crop to receptor (NUREG-0133)

Y_p = agricultural productivity by unit area of pasture feed grass, 0.7 kg/m^2 (NUREG-0133)

Y_s = agricultural productivity by unit area of stored feed, 2.0 kg/m^2, (NUREG 0133)

f_p = 1.0, the fraction of the year that the cow is on pasture.

f_s = 1.0, the fraction of the cow feed that is pasture grass while the cow is on pasture.

The concentration of tritium in meat is based on its airborne concentration rather than the deposition. Therefore R^M_i is based on (X/Q):

$$R^M_{t,a,o} = k'k''' F_f Q_F U_{AP} (DFL_{t,a,o}) \times 0.75 \times (0.5/H) \qquad \text{[Eq. E-2]}$$

where:

All terms are as defined above and in Appendix D.

APPENDIX F

VEGETATION PATHWAY DOSE FACTOR ($R^V_{i,a,o}$)

$$R^V_{i,a,o} = k' \times [r/ (Y_v (\lambda_i + \lambda_w))] \times (DFL_{i,a,o}) \times [(U^L_A) \; f_L \; e^{-\lambda_i t_L} + U^S_A \; f_g \; e^{-\lambda_i t_h}] \quad \text{[Eq. F-1]}$$

where:

k' = 10^6 picocurie/microcurie (pCi/uCi)

U^L_A = the consumption rate of fresh leafy vegetation, 0, 26, 42, 64 kg/yr for infant, child, teenager, or adult age groups respectively. (R.G. 1.109)

U^S_A = the consumption rate of stored vegetation, 0, 520, 630, 520 kg/yr for infant, child, teenager, or adult age groups respectively. (R.G. 1.109)

f_L = the fraction of the annual intake of fresh leafy vegetation grown locally, 1.0 (NUREG-0133)

f_g = the fraction of the stored vegetation grown locally .76 (NUREG-0133)

t_L = the average time between harvest of leafy vegetation and its consumption, 8.6×10^4 seconds (Table E-15, R.G. 1.109 (24 hrs))

t_h = the average time between harvest of stored leafy vegetation and its consumption, 5.18×10^6 seconds (Table E-15, R.G. 1.109 (60 days))

y_h = the vegetation areal density, 2.0 kg/m^2 (Table E-15, R.G. 1.109)

All other parameters are as previously defined.

The concentration of tritium in vegetation is based on the airborne concentration rather than the deposition. Therefore, $R^V{}_i$ is based on (X/Q)

$$R^V_{t,a,o} = k'k''' [U^L_A f_L + U^S_A f_g] (DFL_{t,a,o}) (.75 (.5/H)) \qquad \text{[Eq. F-2]}$$

where:

All terms are as defined above and in Appendix D.

APPENDIX G

SUPPLEMENTAL GUIDANCE STATEMENTS

SUPPLEMENTAL GUIDANCE STATEMENT #1

SUBJECT: LOWER LIMITS OF DETECTION FOR RADIOLOGICAL ANALYSES REQUIRED BY LIQUID EFFLUENT MONITORING INSTRUMENTATION CONTROL ACTION STATEMENTS

Radiological Effluent Control 3/4.3.3.4, Action Statements 31 and 32 allow for effluent releases to continue when specified liquid effluent monitoring instrumentation is inoperable if grab samples are collected and analyzed for radioactivity at a lower limit of detection (LLD) of no more than 10^{-7} μCi/ml. The basis for this LLD is Regulatory Guide 1.21, Appendix A, Section B.3, which states that the sensitivities of analyses of liquid effluents should be sufficient to permit the measurement of the following concentrations: 10^{-7} μCi/ml by gross radioactivity measurements; 5×10^{-7} μCi/ml of each gamma-emitting radionuclide; 10^{-5} μCi/ml of each of the dissolved and entrained noble gas radionuclides; 10^{-7} μCi/ml of gross alpha radioactivity; 10^{-5} μCi/ml of tritium; and 5×10^{-8} μCi/ml of strontium -89 and strontium -90.

Based on this guidance, compliance with the action statement may be achieved by analysis for gross gamma activity with a LLD of 10^{-7} μCi/ml or by gamma isotopic analysis for principal gamma emitters with an LLD of 5×10^{-7} μCi/ml. If gamma isotopic analysis is performed, the 5×10^{-7} μCi/ml LLD shall apply to those radionuclides listed in Notation 3 of ODCM Table 4.11-1.

SUPPLEMENTAL GUIDANCE STATEMENT #2

SUBJECT: LOWER LIMITS OF DETECTION FOR DISSOLVED AND ENTRAINED GAS ANALYSES REQUIRED BY THE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Radiological Effluent Control 3/4.11.1.1, Table 4.11-1, requires that one batch per month of batch releases be sampled and analyzed for dissolved and entrained gases at an LLD of $1x10^{-5}$ μCi/ml. For purposes of implementing this requirement, it is assumed that the required LLD applies to those noble gas isotopes listed in Notation 2 of ODCM Table 4.11-2.

APPENDIX G

SUPPLEMENTAL GUIDANCE STATEMENT #3

HAS BEEN DELETED 7

CALCULATION OF DOSE DUE TO
TRITIUM LEAKAGE FROM THE TGPWCS

ASSUMPTIONS:

1. The maximum inventory of tritium (700 mCi) in the TGPWCS is released to the Low Volume Retention (LVR) Pond.

2. The volume of water in the LVR Pond is 1E+07 gal.

3. The average discharge flow rate from the LVR Pond to the Circulating Water Discharge is 600 gpm.

4. The duration required to release the LVR Pond is 14 days (336 hrs).

5. The minimum required dilution flow of 500,000 gpm is available.

The dose due to the release of the LVW Pond is calculated using ODCM Equation 1-8:

$D = A_i t_k C_i F_k$

Where:

A_i = the dose conversion factor for tritium; 8.96E+00 mRem/hr per μCi/ml (from ODCM Table 1.1)

t_k = release duration; 336 hrs (from assumption 5)

C_i = the concentration of tritium for the release. The average tritium concentration for the release is determined by dividing the total tritium activity by the total volume of water in the pond which results in an average tritium concentration of 1.85E-05 μCi/ml

F_k = the average dilution factor during the release. The average dilution factor is calculated by dividing the average effluent flow rate by the average circulating water flow rate, resulting in a value of 1.2E-03.

Therefore,:

$$D = \left(8.96E+00 \frac{mRem/hr}{\mu Ci/ml}\right) (336 \text{ hrs}) (1.85E-05 \ \mu Ci/ml) (1.2E-03)$$

$$D = 6.68E-05 \text{ mRem}$$

The calculated dose of 6.68E-05 mRem is 2.2E-03% and 6.7E-04% of the annual dose limits for the total body and any organ, respectively.

SUPPLEMENTAL GUIDANCE STATEMENT #4

SUBJECT: SAMPLING OF CCW DRAIN TANK

Radiological Effluent Control 3/4.11.1.1, Table 4.11-1, requires that the CCW Drain Tank be sampled and analyzed on a batch basis prior to release. This batch sampling requirement may be fulfilled by routing the contents of the CCW Drain Tank to the Waste Water Holdup Tanks and performing the required batch sampling prior to discharge of the Waste Water Holdup Tank.

COMANCHE PEAK STEAM ELECTRIC STATION
OFFSITE DOSE CALCULATION MANUAL
INSTRUCTION SHEET

The following instructional information is being furnished to help insert Revision 7 into the Comanche Peak Steam Electric Station ODCM. In accordance with CPSES Technical Specification 6.14b, this revision of the ODCM became effective when it was approved by the Vice President, Operations on December 4, 1991.

Discard the old sheets and insert the new sheets as indicated below.

Holders of the CPSES ODCM should keep these instruction sheets in the front of the Effective Page Listing as a record of the changes, until a new listing is issued.

<u>Remove</u>	<u>Insert</u>
i thru xiii	i thru xiii
I 3/4-2 I 3/4-5 I 3/4-18 I 3/4-20 I 3/4-22a I 3/4-22b	I 3/4-2 I 3/4-5 I 3/4-18 I 3/4-20 I 3/4-22a I 3/4-22b
I B 3/4-4 I B 3/4-5	I B 3/4-4 I B 3/4-5
II 1-1 thru II 1-25	II 1-1 thru II 1-27
II 2-45 II 2-46	II 2-45 II 2-46
G-3	G-3
EPL-1 thru EPL-8	EPL-1 thru EPL-9

COMANCHE PEAK STEAM ELECTRIC STATION
OFFSITE DOSE CALCULATION MANUAL
INSTRUCTION SHEET

The following instructional information is being furnished to help insert Revision 6 into the Comanche Peak Steam Electric Station ODCM. In accordance with CPSES Technical Specification 6.14b. This Revision of the ODCM became effective when it was approved by the Vice President, Nuclear Operations on July 3, 1991.

Discard the old sheets and insert the new sheets as indicated below.

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Remove	Insert
II 1-15 (Table 1.1)	II 1-15 (Table 1.1)
II 3-3 through	II 3-3 through
II 3-6 (Table 3.1)	II 3-6 (Table 3.1)
II 3-9 (Figure 3.1)	II 3-9 (Figure 3.1)
EPL-5	EPL-5
EPL-7	EPL-7

CPSES - ODCM

List of Effective Pages

Preface

The Effective Page Listing (EPL) provides a tabulation of the current pages in the CPSES ODCM.

Each page in the CPSES ODCM is identified with a page number, including pages that contain tables or figures.

A revision number and date are included on each page. The revision number and date are changed when the change represents a substantive revision to the information that is provided on the page. If the page is revised or reprinted but the revision is not considered substantive (i.e., it is an editorial correction), the revision number will not be changed, but will have the reprint date.

Since the EPL may not be updated with each revision, an Instruction Sheet(s) will be provided for subsequent revisions of the CPSES ODCM; it should be retained immediately in front of the EPL. To identify the effective revision level of a page in the CPSES ODCM, check these Instruction Sheets first and, if not found, the EPL second.

If any effective page cannot be found, notify TU Electric Nuclear Licensing and the required effective pages will be provided. Contact may be made by phone (214/812-8873) or by mail. A marked up copy of pages from the Instruction sheets or the EPL is a convenient way to identify the required pages.

COMANCHE PEAK STEAM ELECTRIC STATION

OFFSITE DOSE CALCULATION MANUAL

List of Effective Pages

CPSES - ODCM

List of Effective Pages

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Effective Page Listing

Page No.	Revision No.
TABLE OF CONTENTS	
i	7
ii	7
iii	7
iv	7
v	7
vi	7
vii	7
viii	7
ix	7
x	7
xi	7
xii	7
xiii	7
PART I	
I 1-0	0
I 1-1	0
I 1-2	0
I 1-3	0
I 1-4	0
I 1-5	0
I 1-6	0
I 2-0	1
I 3/4-0	0
I 3/4-1	0
I 3/4-2	7
I 3/4-3	0
I 3/4-4	0
I 3/4-5	7
I 3/4-6	0
I 3/4-7	0
I 3/4-8	1
I 3/4-9	4
I 3/4-10	4

Effective Page Listing

Page No.	Revision No.
PART I	
I 3/4-11	4
I 3/4-12	0
I 3/4-13	0
I 3/4-14	0
I 3/4-15	0
I 3/4-16	0
I 3/4-17	0
I 3/4-18	7
I 3/4-19	0
I 3/4-20	7
I 3/4-21	0
I 3/4-22	1
I 3/4-22a	7
I 3/4-22b	7
I 3/4-23	0
I 3/4-24	1
I 3/4-25	0
I 3/4-26	0
I 3/4-27	0
I 3/4-28	0
I 3/4-29	0
I 3/4-30	0
I 3/4-31	0
I 3/4-32	0
I 3/4-33	0
I 3/4-34	0
I 3/4-35	0
I 3/4-36 (rev. bar was inadvertently omitted)	1
I 3/4-37 (rev. bar was inadvertently omitted)	1
I 3/4-38 (rev. bar was inadvertently omitted)	1
I 3/4-39	0
I 3/4-40	0
I 3/4-41	0
I 3/4-42 (rev. bar should be deleted)	0
I 3/4-43	0
I 3/4-44	1
I 3/4-45	0

Effective Page Listing

Page No.	Revision No.
PART I	
I B 3/4-0	1
I B 3/4-1	0
I B 3/4-2	0
I B 3/4-3	0
I B 3/4-4	7
I B 3/4-5	7
I B 3/4-6	Oct. 22, 1990
I B 3/4-7	Oct. 22, 1990
I B 3/4-8	Oct. 22, 1990
I B 3/4-9	Oct. 22, 1990
I B 3/4-10	Oct. 22, 1990
I B 3/4-11	Oct. 22, 1990
I B 3/4-12	Oct. 22, 1990
I 5-0	(no revision no. & no date)
I 5-1	0
I 5-2	0
I 6-0	(no revision no. & no date)
I 6-1	0
I 6-2	0
I 6-3	1
I 6-4	0

Effective Page Listing

Page No.	Revision No.
PART II	
II 1-1	7
II 1-2	7
II 1-3	7
II 1-4	7
II 1-5	7
II 1-6	7
II 1-7	7
II 1-8	7
II 1-9	7
II 1-10	7
II 1-11	7
II 1-12	7
II 1-13	7
II 1-14	7
II 1-15	7
II 1-16	7
II 1-17	7
II 1-18	7
II 1-19	7
II 1-20	7
II 1-21	7
II 1-22	7
II 1-23	7
II 1-24	7
II 1-25	7
II 1-26	7
II 1-27	7
II 2-1	0
II 2-2	4
II 2-3	0
II 2-4	0
II 2-5	4
II 2-6	0
II 2-7	4
II 2-8	0
II 2-9	0

Effective Page Listing

Page No.	Revision No.
PART II	
II 2-10	0
II 2-11	0
II 2-12	0
II 2-13	0
II 2-14	1
II 2-15	0
II 2-16	1
II 2-17	0
II 2-18	5
II 2-19	5
II 2-20	0
II 2-21	0
II 2-22	0
II 2-23	0
II 2-24	0
II 2-25	0
II 2-26	0
II 2-27	0
II 2-28	0
II 2-29	0
II 2-30	0
II 2-31	0
II 2-32	0
II 2-33	0
II 2-34	0
II 2-35	0
II 2-36	0
II 2-37	0
II 2-38	0
II 2-39	0
II 2-40	0
II 2-41	0
II 2-42	0
II 2-43	0
II 2-44	0
II 2-45	7

CPSES ODCM

Effective Page Listing

Page No.	Revision No.
PART II	
II 2-46	7
II 2-47	0
II 2-48	0
II 2-49	0
II 2-50	1
II 2-51	0
II 2-52	0
II 2-53	0
II 2-54	0
II 2-55	1
II 2-56	0
II 2-57	0
II 2-58	0
II 2-59	0
II 2-60	0
II 3-1	0
II 3-2	0
II 3-3	7/91
II 3-4	7/91
II 3-5	7/91
II 3-6	6
II 3-7	0
II 3-8	0
II 3-9	6
II A-1	0
II B-1	0
II C-1	1
II D-1	0
II D-2	0
II E-1	0
II E-2	0
II F-1	0
II F-2	0

Effective Page Listing

Page No.	Revision No.
PART II	
G-0	1
G-1	1
G-2	1
G-3	7
G-4	1
G-5	1
G-6	1