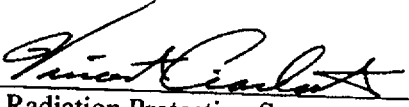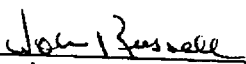# OFFSITE DOSE CALCULATION MANUAL

FOR

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

HOPE CREEK GENERATING STATION
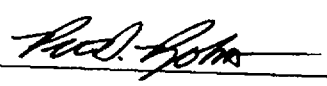
Revision 18

March 1999

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Page 1 of 2

Revision Summary:

PART I   Added PART I, Radiological Effluent Controls in preparation for implementation of NRC
                Generic Letter 89-01. Part I includes the Radiological Effluent Controls that will replace the
                Radiological Effluent Technical Specifications upon NRC approval of the License
                Amendment.

PART II   Revised previous revision of ODCM to become PART II, Calculation Methodologies.
                There are no technical or editorial changes made to the previous revision of the ODCM.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLES

APPENDICES

HOPE CREEK GENERATING STATION
OFFSITE DOSE CALCULATION MANUAL

INTRODUCTION

The Hope Creek Offsite Dose Calculation Manual (ODCM) is a supporting document to the Hope Creek Technical Specifications. The previous Limiting Conditions for Operations that were contained in the Radiological Effluent Technical Specifications (RETS) are now included in the ODCM as Radiological Effluent Controls (REC). The ODCM contains two parts: Part I - Radiological Effluent Controls, and Part II – Calculational Methodologies.

Part I includes the following:

- The Radiological Effluent Controls and Radiological Environmental Monitoring Programs required by Technical Specification 6.8.4
- Descriptions of the information that should be included in the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Report required by Technical Specifications 6.9.1.6 and 6.9.1.7, respectively.

Part II describes methodologies and parameters used for:

- The calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints,
- The calculation of radioactive liquid and gaseous concentrations, dose rates, cumulative quarterly and yearly doses, and projected doses.

Part II also contains a list and graphical description of the specific sample locations for the radiological environmental monitoring program, and the liquid and gaseous waste treatment systems

Until the Hope Creek Technical Specifications are revised to delete the Radiological Effluent Technical Specifications, the ODCM Part I will only be used for information. The Technical Specifications with LCOs and Surveillance Requirements will remain the controlling document. Part I of the ODCM will become the controlling document for Radiological Effluent Control upon NRC approval of LCR-H99-0002.

PART I

RADIOLOGICAL EFFLUENT CONTROLS

PART I

RADIOLOGICAL EFFLUENT CONTROLS

SECTION 1.0

DEFINITIONS

1.0 DEFINITIONS
==
The following terms are defined so that uniform interpretation of these
CONTROLS may be achieved. The defined terms 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.

CHANNEL CALIBRATION

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

CHANNEL CHECK

1.5 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.

CHANNEL FUNCTIONAL TEST

1.6 A CHANNEL FUNCTIONAL TEST shall be:

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

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

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

DEFINITIONS
===

CONTROL

1.10 The present Limiting Conditions for Operation (LCOs) that are contained in the Radiological Effluent Technical Specifications are being transferred to the Offsite Dose Calculation Manual (ODCM) and are being renamed CONTROLS. This is to distinguish between those LCOs which are being retained in the Technical Specifications and those LCOs or CONTROLS that are being transferred to the ODCM.

DOSE EQUIVALENT I-131

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

DEFINITIONS
===

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

DEFINITIONS

===

MEMBER(S) OF THE PUBLIC

1.24 MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the utility, it 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.

OFF-GAS RADWASTE TREATMENT SYSTEM (GASEOUS RADWASTE TREATMENT SYSTEM)

1.26 An OFF-GAS RADWASTE TREATMENT SYSTEM (GASEOUS RADWASTE TREATMENT SYSTEM) is any system designed and installed to reduce radioactive gaseous effluents by collecting reactor coolant system offgases from the main condenser evacuation system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

OFFSITE DOSE CALCULATION MANUAL

1.27 The OFFSITE DOSE CALCULATION MANUAL (ODCM) shall contain the current methodology and parameters used in the calculation of offsite doses due to radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring alarm/trip setpoints, and in the conduct of the radiological environmental monitoring program. The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by Technical Specification section 6.8.4 and (2) descriptions of the information that should be in the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Report required by Technical Specification sections 6.9.1.6 and 6.9.1.7.

DEFINITIONS
==

OPERABLE - OPERABILITY

1.28 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 CONDITION - CONDITION

1.29 An OPERATIONAL CONDITION, i.e., CONDITION, shall be any one inclusive combination of mode switch position and average reactor coolant temperature as specified in Table 1.2.

DEFINITIONS
==

PURGE - PURGING

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

RATED THERMAL POWER

1.35 RATED THERMAL POWER shall be a total reactor core heat transfer rate to the reactor coolant of 3293 MWT.

REPORTABLE EVENT

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

DEFINITIONS
==

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

DEFINITIONS

==

SOURCE CHECK

1.43 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

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

===

UNRESTRICTED AREA
1.50 An UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY
     access to which is not controlled by the licensee for purposes of
     protection of individuals from exposure to radiation and radioactive
     materials, or any area within the SITE BOUNDARY used for residential
     quarters or for industrial, commercial, institutional, and/or
     recreational purposes.

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

VENTING
1.52 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.

TABLE 1.1

SURVEILLANCE FREQUENCY NOTATION

NOTATION	FREQUENCY
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days.
M	At least once per 31 days.
Q	At least once per 92 days.
SA	At least once per 184 days.
A	At least once per 366 days.
R	At least once per 18 months (550 days).
S/U	Prior to each reactor startup.
P	Prior to each radioactive release.
Z	During startup, prior to exceeding 30% of RATED THERMAL POWER, if not performed within the previous 7 days
N.A.	Not applicable.

TABLE 1.2

OPERATIONAL CONDITIONS

CONDITION	MODE SWITCH POSITION	AVERAGE REACTOR COOLANT TEMPERATURE
1. POWER OPERATION	Run	Any temperature
2. STARTUP	Startup/Hot Standby	Any temperature
3. HOT SHUTDOWN	Shutdown[#],[***]	$> 200°F$
4. COLD SHUTDOWN	Shutdown[#],[##],[***]	$\leq 200°F$[+]
5. REFUELING[*]	Shutdown or Refuel[**],[#]	$\leq 140°F$

[#]The reactor mode switch may be placed in the Run, Startup/Hot Standby, or Refuel position to test the switch interlock functions and related instrumentation provided that the control rods are verified to remain fully inserted by a second licensed operator or other technically qualified member of the unit technical staff. If the reactor mode switch is placed in the Refuel position, the one-rod-out interlock shall be OPERABLE.

[##]The reactor mode switch may be placed in the Refuel position while a single control rod drive is being removed from the reactor pressure vessel per Technical Specification 3.9.10.1.

[*]Fuel in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

[**]See Special Test Exceptions Technical Specification sections 3.10.1 and 3.10.3.

[***]The reactor mode switch may be placed in the Refuel position while a single control rod is being recoupled or withdrawn provided that the one-rod-out interlock is OPERABLE.

[+]See Special Test Exception Technical Specification section 3.10.8.

I 1-11

PART I

RADIOLOGICAL EFFLUENT CONTROLS

SECTIONS 3.0 and 4.0

CONTROLS

AND

SURVEILLANCE REQUIREMENTS

CONTROLS
==

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

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 one hour action shall be initiated to place the unit in an OPERATIONAL CONDITION in which the Specification does not apply by placing it, as applicable, in:

   1. At least STARTUP within the next 6 hours,
   2. At least HOT SHUTDOWN within the following 6 hours, and
   3. 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 OPERATIONAL CONDITIONS 4 or 5.

3.0.4 Entry into an OPERATIONAL CONDITION or other specified condition shall not be made when the conditions for the CONTROLS are not met and the associated ACTION requires a shutdown if they are not met within a specified time interval. Entry into an OPERATIONAL CONDITION or other specified condition may be made in accordance with the 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 CONDITIONS as required to comply with ACTION requirements. Exceptions to these requirements are stated in the individual CONTROLS.

3.0.5 Equipment removed from service or declared inoperable to comply with ACTIONS may be returned to service under administrative control solely to perform testing required to demonstrate its OPERABILITY or the OPERABILITY of other equipment. This is an exception to CONTROL 3.0.2 for the system returned to service under administrative control to perform the testing required to demonstrate OPERABILITY.

SURVEILLANCE REQUIREMENTS

4.0.1 Surveillance Requirements shall be met during the OPERATIONAL CONDITIONS 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 its specified surveillance interval with a maximum allowable extension not to exceed 25 percent of the specified surveillance interval.

4.0.3 Failure to perform a Surveillance Requirement within the allowed surveillance interval, defined by Specification 4.0.2, shall constitute a failure to meet the OPERABILITY requirements for a CONTROLS. 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 CONDITION or other specified applicable condition shall not be made unless the Surveillance Requirement(s) associated with the CONTROLS have been performed within the applicable surveillance interval or as otherwise specified. This provision shall not prevent passage through or to OPERATIONAL CONDITIONS as required to comply with ACTION requirements.

3/ 4.3 INSTRUMENTATION

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

==

3.3.7.10 In accordance with Hope Creek Technical Specification 6.8.4.g.1),
the radioactive liquid effluent monitoring instrumentation channels shown in
Table 3.3.7.10-1 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 3.3.7.10-1. Exert best efforts to return the instruments
        to OPERABLE status within 30 days and, if unsuccessful, explain in
        the next Radioactive Effluent Release Report pursuant to CONTROL
        6.9.1.7 why this inoperability was not corrected in a timely manner.

    c.   The provisions of CONTROL 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS

==

4.3.7.10 Each radioactive liquid effluent monitoring instrumentation channel
shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE
CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST at the frequencies
shown in Table 4.3.7.10-1.

TABLE 3.3.7.10-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1. RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
a. Liquid Radwaste Discharge Line to the Cooling Tower Blowdown Line	1	110
2. RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE		
a. Cooling Tower Blowdown Effluent	1	111
3. FLOW RATE MEASUREMENT DEVICES		
a. Liquid Radwaste Discharge Line to Cooling Tower Blowdown Line	1	112
b. Cooling Tower Blowdown Weir	1	112

TABLE 3.3.7.10-1 (Continued)

TABLE NOTATION

ACTION 110 -   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 4.11.1.1.2, 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 111 -   With the number of channels OPERABLE less than required by
              the Minimum Channels OPERABLE requirement, effluent releases
              via this pathway may continue provided that, at least once per
              12 hours, grab samples are collected and analyzed for gross
              radioactivity at a limit of detection of at least 10^{-7}
              microcuries/ml. Otherwise, suspend release of radioactive
              effluents via this pathway.

ACTION 112 -   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 4.3.7.10-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

SURVEILLANCE REQUIREMENTS

FUNCTIONAL INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL TEST
1. RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE				
a. Liquid Radwaste Discharge Line to the Cooling Tower Blowdown Line	D	P	R(3)	Q(1)
2. RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE				
a. Cooling Tower Blowdown Effluent	D	M	R(3)	Q(2)
3. FLOW RATE MEASUREMENT DEVICES				
a. Liquid Radwaste Discharge Line to Cooling Tower Blowdown Line	D(4)	N.A.	R	Q
b. Cooling Tower Blowdown Weir	D(4)	N.A.	R	Q

TABLE 4.3.7.10-1 (Continued)

TABLE NOTATIONS

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

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

    b. Circuit failure, or

    c. Instrument indicates a downscale failure.

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

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

    b. Circuit failure, or

    c. Instrument indicates a downscale 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)/National Institute of Standards and Testing (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NBS/NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration or are NBS/NIST traceable shall be used.

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

INSTRUMENTATION

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

CONTROLS
===

3.3.7.11 In accordance with Hope Creek Technical Specification section
6.8.4.g.1), the radioactive gaseous effluent monitoring instrumentation
channels shown in Table 3.3.7.11-1 shall be OPERABLE with their Alarm/Trip
Setpoints set to ensure that the limits of CONTROLS 3.11.2.1 and 3.11.2.6 are
not exceeded. The Alarm/Trip Setpoints of these channels meeting CONTROLS
3.11.2.1 shall be determined and adjusted in accordance with the methodology
and parameters in the ODCM.

APPLICABILITY: As shown in Table 3.3.7.11-1.

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 3.3.7.11-1. Exert best efforts to return the
       instruments to OPERABLE status within 30 days and, if unsuccessful,
       explain in the next Radioactive Effluent Release Report pursuant to
       CONTROL 6.9.1.7 why this inoperability was not corrected in a timely
       manner.

    c. The provisions of CONTROL 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS
===

4.3.7.11 Each radioactive gaseous effluent monitoring instrumentation channel
shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE
CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST at the frequencies
shown in Table 4.3.7.11-1.

TABLE 3.3.7.11-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	ACTION
1. DELETED			
2. FILTRATION, RECIRCULATION AND VENTILATION MONITORING SYSTEM			
a. Noble Gas Activity Monitor	1	*	123
b. Iodine Sampler	1	*	125
c. Particulate Sampler	1	*	125
d. Flow Rate Monitor	1	*	122
e. Sampler Flow Rate Monitor	1	*	122
3. SOUTH PLANT VENT MONITORING SYSTEM			
a. Noble Gas Activity Monitor	1	*	123
b. Iodine Sampler	1	*	125
c. Particulate Sampler	1	*	125
d. Flow Rate Monitor	1	*	122
e. Sampler Flow Rate Monitor	1	*	122

TABLE 3.3.7.11-1 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MIMIMUM CHANNELS OPERABLE	APPLICABILITY	ACTION
4. NORTH PLANT VENT MONITORING SYSTEM			
a. Noble Gas Activity Monitor	1	*	123
b. Iodine Sampler	1	*	125
c. Particulate Sampler	1	*	125
d. Flow Rate Monitor	1	*	122
e. Sampler Flow Rate Monitor	1	*	122

TABLE 3.3.7.11-1 (Continued)

TABLE NOTATION

*   At all times.

** During operation of the main condenser air ejector.

ACTION 122 -   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.
               Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 123 -   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 taken at least once per 12 hours and
               these samples are analyzed for gross activity within 24 hours. Otherwise,
               suspend release of radioactive effluents via this pathway.

ACTION 124 -   DELETED

ACTION 125 -   With the number of channels OPERABLE less than required by the Minimum
               Channels OPERABLE requirement, effluent releases via this pathway may
               continue provided that within 8 hours samples are continuously collected
               with auxiliary sampling equipment as required in Table 4.11.2.1.2-1.

TABLE 4.3.7.11-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
1. DELETED					
2. FILTRATION, RECIRCULATION AND VENTILATION MONITORING SYSTEM					
a. Noble Gas Activity Monitor	D	M	R(2)	Q(1)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate Monitor	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*
3. SOUTH PLANT VENT MONITORING SYSTEM					
a. Noble Gas Activity Monitor	D	M	R(2)	Q(1)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A	*
c. Particulate Sampler	W	N.A	N.A.	N.A.	*
d. Flow Rate Monitor	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*

TABLE 4.3.7.11-1 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
4. NORTH PLANT VENT MONITORING SYSTEM					
a. Noble Gas Activity Monitor	D	M	R(2)	Q(1)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate Monitor	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*

TABLE 4.3.7.11-1 (Continued)

TABLE NOTATION

* At all times.

** During operation of the main condenser air ejector.

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

      1. Instrument indicates measured levels above the alarm setpoint.

      2. Circuit failure.

      3. Instrument indicates a downscale failure.

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

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1 LIQUID EFFLUENTS

CONCENTRATION

CONTROLS

===

3.11.1.1 In accordance with Hope Creek Technical Specifications 6.8.4.g.2) and 3), the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Figure 5.1.1-1) 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} microcuries/ml total activity.

APPLICABILITY: At all times.

ACTION:

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

SURVEILLANCE REQUIREMENTS

===

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

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 4.11.1.1.1-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/ml)
A. Batch Waste Release[b] Sample Tanks	P Each Batch	P Each Batch	Principal Gamma Emitters[c]	5×10^{-7}
			I-131	1×10^{-6}
	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
	P Each Batch	M Composite[d]	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	P Each Batch	Q Composite[d]	Sr-89, Sr-90	5×10^{-8}
			Fe-55	1×10^{-6}
B. Continuous Releases[e] Station Service Water System (SSWS) (If contaminated as indicated by SACS or RACS system.	NA	M Composite[d]	Principal Gamma Emitters[c]	5×10^{-7}
			I-131	1×10^{-6}
	W Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
	NA	M Composite[d]	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	NA	Q Composite[d]	Sr-89, Sr-90	5×10^{-8}
			Fe-55	1×10^{-6}

TABLE 4.11.1.1.1-1 (Continued)

TABLE NOTATION

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

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

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

Where:

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

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

E is the counting efficiency, as counts per disintegration,

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

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

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

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

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

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

[b]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 4.11.1.1.1-1 (Continued)

TABLE NOTATION

c The principal gamma emitters for which the LLD specification
   applies exclusively are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99,
   Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with
   an LLD of 5×10^{-6}. This 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 Radioactive Effluent Release Report pursuant to CONTROL
   6.9.1.7.

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

e 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.

RADIOACTIVE EFFLUENTS

DOSE

CONTROL
==

3.11.1.2 In accordance with Hope Creek Technical Specifications 6.8.4.g.4) and 5), the dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each reactor unit, to UNRESTRICTED AREAS (see Figure 5.1.1-1) shall be limited:

   a. During any calendar quarter to less than or equal to 1.5 mrems
      to the total 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
      total 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 Technical
      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 CONTROL 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS
==

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

RADIOACTIVE EFFLUENTS

LIQUID WASTE TREATMENT SYSTEM

CONTROLS
==

3.11.1.3 In accordance with Hope Creek Technical Specifications 6.8.4.6), the liquid radwaste treatment system shall be OPERABLE and appropriate portions of the system shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the projected doses due to the liquid effluent, from each reactor unit, to UNRESTRICTED AREAS (see Figure 5.1.1-1) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in any 31-day period.

APPLICABILITY: At all times.

ACTION:

a. With radioactive liquid waste being discharged 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 Technical 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 are not applicable.

SURVEILLANCE REQUIREMENTS
==

4.11.1.3.1 Doses due to liquid releases from each reactor unit to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM.

4.11.1.3.2 The installed liquid radwaste treatment system shall be demonstrated OPERABLE by meeting CONTROLS 3.11.1.1 and 3.11.1.2.

3/4.11.2 GASEOUS EFFLUENTS

DOSE RATE

CONTROLS
===

3.11.2.1 In accordance with Hope Creek Technical Specifications 6.8.4.g.3) and 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 5.1.1-1) shall be listed to the following:

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

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

APPLICABILITY: At all times.

ACTION:

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

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 rates due to iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 4.11.2.1.2-1.

TABLE 4.11.2.1.2-1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/ml)
A. Containment PURGE	P Each PURGE[c]	P Each PURGE[c]	Principal Gamma Emitters[b]	1×10^{-4}
	Grab Sample	P	H-3 (oxide)	1×10^{-6}
B. North Plant Vent South Plant Vent	M[c],[d] Grab Sample	M[c]	Principal Gamma Emitters[b] H-3 (oxide)	1×10^{-4} 1×10^{-6}
C. All Release Types as listed in A and B above.	Continuous[e]	W[f] Charcoal Sample	I-131	1×10^{-12}
	Continuous[e]	W[f] Particulate Sample	Principal Gamma Emitters[b]	1×10^{-11}
	Continuous[e]	Q Composite Particulate Sample	Gross Alpha	1×10^{-11}
	Continuous[e]	Q Composite Particulate Sample	Sr-89, Sr-90	1×10^{-11}
	Continuous[e]	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1×10^{-6}

TABLE 4.11.2.1.2-1 (Continued)

TABLE NOTATION

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

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

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

Where:

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

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

E is the counting efficiency, as counts per disintegration,

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

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

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

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

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

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

TABLE 4.11.2.1.2-1 (Continued)

TABLE NOTATIONS

(b)   The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 in noble gas releases and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, Ce-141 and Ce-144 in iodine and particulate releases. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Radioactive Effluent Release Report pursuant to CONTROL 6.9.1.7.

(c)   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 shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 3; and (2) the noble gas monitor shows that effluent activity has not increased more than a factor of 3.

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

(e)   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 CONTROL 3.11.2.1, 3.11.2.2, and 3.11.2.3.

(f)   Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing, or after removal from sampler. Sampling shall also be performed at least once per 24 hours for at least 7 days following each shutdown, startup or THERMAL POWER change exceeding 15% of RATED THERMAL POWER in 1 hour and analyses 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 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.

RADIOACTIVE EFFLUENTS

DOSE - NOBLE GASES

CONTROLS
===

3.11.2.2 In accordance with Hope Creek Technical Specification 6.8.4.g.5} and 8), the air dose due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the SITE BOUNDARY (see Figure 5.1.1-1) 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 Technical 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 CONTROL 3.0.3 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.

RADIOACTIVE EFFLUENTS

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

CONTROLS
===

3.11.2.3 In accordance with Hope Creek Technical Specifications 6.8.4.g.5) and 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 reactor unit, to areas at and beyond the SITE BOUNDARY (see Figure 5.1.1-1) 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 Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

    b.   The provisions of CONTROL 3.0.3 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.

RADIOACTIVE EFFLUENTS

GASEOUS RADWASTE TREATMENT SYSTEM

CONTROLS
===

3.11.2.4 The GASEOUS RADWASTE TREATMENT SYSTEM shall be in operation.

APPLICABILITY: Whenever the main condenser steam jet air ejector system is in operation.

ACTION:

    a.   With gaseous radwaste from the main condenser air ejector system being discharged without treatment for more than 7 days, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that includes the following information:

        1.   Identification of the 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 are not applicable.

SURVEILLANCE REQUIREMENTS
===

4.11.2.4 The readings of the relevant instruments shall be checked every 12 hours when the main condenser air ejector is in use to ensure that the gaseous radwaste treatment system is functioning.

RADIOACTIVE EFFLUENTS

VENTILATION EXHAUST TREATMENT SYSTEM

CONTROLS
==

3.11.2.5 In accordance with Hope Creek Technical Specifications 6.8.4.g.6),
the VENTILATION EXHAUST TREATMENT SYSTEM for the Reactor Building and the
Service and Radwaste Building shall be OPERABLE and appropriate portions of
this system shall be used to reduce release 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 5.1.1-1) 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 ventilation exhaust being discharged without
          treatment and in excess of the above limits, prepare and submit to
          the Commission within 30 days pursuant to Technical Specification
          6.9.2 a Special Report 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 are not applicable.

SURVEILLANCE REQUIREMENTS
==

4.11.2.5.1 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 the VENTILATION EXHAUST
TREATMENT SYSTEM is not being fully utilized.

4.11.2.5.2 The installed VENTILATION EXHAUST TREATMENT SYSTEM shall be
considered OPERABLE by meeting CONTROLS 3.11.2.1 and 3.11.2.2 and 3.11.2.3.

RADIOACTIVE EFFLUENTS

VENTING OR PURGING

CONTROLS
===

3.11.2.8 VENTING or PURGING of the Mark I containment drywell shall be through either the reactor building ventilation system or the filtration, recirculation and ventilation system.*

APPLICABILITY: Whenever the containment is vented or purged.

ACTION:

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

   b.   The provisions of CONTROL 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS
===

4.11.2.8 The containment shall be determined to be aligned for VENTING or PURGING through either the reactor building ventilation system, the filtration, recirculation and ventilation system, or the hardened torus vent within 4 hours prior to start of and at least once per 12 hours during VENTING or PURGING of the drywell.

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*Following Type A Integrated Leakage Rate Testing, the Mark I containment drywell may be vented through the hardened torus vent.

RADIOACTIVE EFFLUENTS

3/4.11.4 TOTAL DOSE

CONTROLS

==

3.11.4   In accordance with Hope Creek Technical Specification 6.8.4.g.11, 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 total 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 CONTROLS 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 should be made including direct radiation contributions from the units including outside storage tanks, etc. to determine whether the above limits of CONTROLS 3.11.4 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR 20.405c, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentrations of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

b.   The provisions of CONTROL 3.0.3 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.

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

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

CONTROLS

===

3.12.1 In accordance with Hope Creek Technical Specification 6.8.4.h.1), the radiological environmental monitoring program shall be conducted as specified in Table 3.12.1-1.

APPLICABILITY: At all times.

ACTION:

a. With the radiological environmental monitoring program not being conducted as specified in Table 3.12.1-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Technical Specification 6.9.1.6, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeding the reporting levels of Table 3.12.1-2 when averaged over any calendar quarter, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose* to A MEMBER OF THE PUBLIC is less than the calendar year limits of CONTROLS 3.11.1.2, 3.11.2.2, and 3.11.2.3. When more than one of the radionuclides in Table 3.12.1-2 are detected in the sampling medium, this report shall be submitted if:

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

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 CONTROLS 3.11.1.2, 3.11.2.2, and 3.11.2.3. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.9.1.6.

c. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 3.12.1-1, identify specific locations for obtaining replacement samples and add them to the radiological environmental monitoring program within 30 days.

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

CONTROLS (Continued)

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ACTION: (Continued)

The specific locations from which samples were unavailable may then
be deleted from the monitoring program. Pursuant to CONTROL
6.9.1.8, identify the cause of the unavailability of samples and
identify the new location(s) for obtaining replacement samples in
the next Radioactive Effluent Release Report pursuant to CONTROL
6.9.1.8 and also include in the report a revised figure(s) and table
for the ODCM reflecting the new location(s).

d.   The provisions of CONTROL 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS

==

4.12.1 The radiological environmental monitoring samples shall be collected
pursuant to Table 3.12.1-1 from the specific locations given in the table and
figure(s) in the ODCM, and shall be analyzed pursuant to the requirements of
Table 3.12.1-1 and the detection capabilities required by Table 4.12.1-1.

TABLE 3.12.1-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM*

Exposure Pathway and/or Sample (2)	Number of Representative Samples and Sample Locations (1)	Sampling and Collection Frequency	Type and Frequency of Analysis
1. DIRECT RADIATION	Forty-three routine monitoring stations either with two or more dosimeters placed as follows:	Quarterly	Gamma dose quarterly.
	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 land based 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.		

*The number, media, frequency, and location of samples may vary from site to site. This table presents an acceptable minimum program for a site at which each entry is applicable. Local site characteristics must be examined to determine if pathways not covered by this table may significantly contribute to an individual's dose and should be included in the sample program.

TABLE 3.12.1-1 (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
2. AIRBORNE Radioiodine and Particulates	Samples from 5 locations. Three samples from close to the SITE BOUNDARY locations, in different sectors, of a high calculated annual average ground-level D/Q.	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	Radioiodine Canister: I-131 analysis weekly. Particulate Sampler: Gross beta radioactivity analysis following filter change;[3]
	One sample from the vicinity of a community having a high calculated annual average groundlevel D/Q. One sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction.		Gamma isotopic analysis[4] of composite (by location) quarterly.
3. WATERBORNE a. Surface[5]	One sample upstream. One sample downstream. One sample crosstream.	Grab sample monthly.	Gamma isotopic analysis[4] monthly. Composite for tritium analysis quarterly.
b. Ground	Samples from one or two sources only if likely to be affected[7].	Monthly	Gamma isotopic[4] and monthly.

TABLE 3.12.1-1 (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
c. Drinking	One sample of each of one to three the nearest water supplies that could be affected by its discharge.	Composite sample over 2-week period [6] when I-131 analysis is performed, monthly composite otherwise	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year. [8] Composite for gross beta and gama isotopic analyses [4] monthly. Composite for tritium analysis quarterly.
	One sample from a control location.		
d. Sediment	One sample from downstream area One sample from upstream area One sample from cross stream area	Semiannually	Gamma isotopic analysis [4] 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, then, 1 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. [8]	Semimonthly when animals are on pasture, monthly at other times	Gamma isotopic monthly [4] and I-131 analysis semimonthly when animals are on pasture; monthly at other times.
	One sample from milking animals at a control location 15-30 km distant.		

TABLE 3.12.1-1 (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 each commercially and recreationally important species in vicinity of plant discharge area.	Sample in season, or semiannually if they are not seasonal	Gamma isotopic analysis[4] 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[9]	Gamma isotopic analysis[4] on edible portion.

TABLE 3.12.1-1 (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 3.12.1-1 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 hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.9.1.6. 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 6.9.1.7, submit in the next Radioactive Effluent Release Report documentation for a change in the ODCM including a revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples for that pathway and justifying the selection of the new location(s) for obtaining samples.

(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. The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading.

(3) 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.

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

(5) The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream" sample shall be taken in an area beyond but near the mixing zone. "Upstream" samples in an estuary must be taken far enough upstream to be beyond the plant influence. Salt water shall be sampled only when the receiving water is utilized for recreational activities.

TABLE 3.12.1-1 (Continued)

TABLE NOTATION

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

(7) 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.

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

(9) 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 3.12.1-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

REPORTING LEVELS

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m³)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	30,000				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400				
I-131	2*	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200			300	

*For drinking water samples. This is a 40 CFR Part 141 value. If no drinking water pathway exists, a value of 20 pCi/l may be used.

TABLE 4.12.1-1
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[1][2]

LOWER LIMIT OF DETECTION (LLD)[3]

Analysis	Water (pCi/l)	Airborne Particulate or Gas (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	3000					
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		

*LLD for drinking water samples. If no drinking water pathway exists, a value of 10 pCi/l may be used.

TABLE 4.12.1-1 (Continued)   Hope Creek ODCM Rev 18

TABLE NOTATIONS

(1) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.9.1.6.

(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 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:

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

Where:

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

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

E is the counting efficiency, as counts per disintegration,

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

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield, when applicable,

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

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

Typical valves of E, V, Y, and Δ t should be used in the calculation.

TABLE 4.12.1-1 (Continued)   Hope Creek ODCM Rev 18

TABLE NOTATIONS

It should be recognized that the LLD is defined as an a priori
(before the fact) limit representing the capability of a measurement
system and not as an a posteriori (after the fact) limit for a
particular measurement. Analyses shall be performed in such a manner
that the stated LLDs will be achieved under routine conditions.
Occasionally background fluctuations, unavoidable small sample sizes,
the presence of interfering nuclides, or other uncontrollable
circumstances may render these LLDs unachievable. In such cases, the
contributing factors shall be identified and described in the Annual
Radiological Environmental Operating Report pursuant to CONTROL
6.9.1.6.

3/4.12.2 LAND USE CENSUS

CONTROLS
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3.12.2 In accordance with Hope Creek Technical Specifications 6.8.4.h.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 m² (500 ft²) 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, identify the new location(s) in the next Radioactive Effluent Release Report, pursuant to CONTROL 6.9.1.7.

    b.   With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained in accordance with CONTROL 3.12.1, add the new location(s) to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from this monitoring program after October 31 of the year in which this land use census was conducted. Pursuant to CONTROL 6.9.1.7, identify the new location(s) in the next Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

    c.   The provisions of CONTROL 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS
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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, visual 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 6.9.1.6.

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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 3.12.1-1, Part 4.c., shall be followed, including analysis of control samples.

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

CONTROL

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3.12.3 In accordance with Hope Creek Technical Specifications 6.8.4.h.3), analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission.

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 6.9.1.6.

    b.   The provisions of CONTROL 3.0.3 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 Inter-laboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.9.1.6.

PART I

RADIOLOGICAL EFFLUENT CONTROLS

BASES FOR

SECTIONS 3.0 AND 4.0

CONTROLS

AND

SURVEILLANCE REQUIREMENTS

NOTE

The BASES contained in the succeeding pages summarize
the reasons for the CONTROLS in Section 3.0 and 4.0, but
are not part of these CONTROLS

BASES
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3/4.3.7.10 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

The radioactive liquid effluent monitoring 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 points 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.

3/4.3.7.11 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

The radioactive gaseous effluent monitoring 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. This will ensure the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. This instrumentation also includes provisions for monitoring and controlling the concentrations of potentially explosive gas mixtures in the main condenser offgas treatment system. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR part 50.

3/4.11 RADIOACTIVE EFFLUENTS

BASES
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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 10 CFR Part 20, Appendix B, Table II, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC and (2) the limits of 10 CFR Part 20.106(e) to the population. The 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.

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

3/4.11.1.2 DOSE

This specification is provided to implement the requirements of Sections II.A, III.A, and IV.A of Appendix I, 10 CFR Part 50. The 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 40 CFR Part 141. The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

I B 3/4 11-1

BASES

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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 their 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 specification implements the requirements of General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

3/4.11.2 GASEOUS EFFLUENTS

3/4.11.2.1 DOSE RATE

This 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 10 CFR Part 20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR Part 20.106(b)). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, 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 total body or to less than or equal to 3000 mrems/year to the skin.

RADIOACTIVE EFFLUENTS

BASES
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DOSE RATE (Continued)

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.

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

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 Appendix I, 10 CFR Part 50. The CONTROL implements the
guides set forth in Section II.B of Appendix I. The ACTION statements provide
the required operating flexibility and at the same time implement the guides
set forth in Section IV.A of Appendix I to assure that the releases of
radioactive material in gaseous effluents 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 radioactive noble gases in
gaseous effluents are consistent with the methodology provided in Regulatory
Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of
Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part
50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods
for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in
Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977. The
ODCM equations provided for determining the air doses at and beyond the SITE
BOUNDARY are based upon the historical average atmospheric conditions.

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

This CONTROL is provided to implement the requirements of Sections II.C,
III.A and IV.A of Appendix I, 10 CFR Part 50. The CONTROLS are the guides set
forth in Section II.C of Appendix I. The ACTION statements provide the
required operating flexibility and at the same time implement the guides set
forth in Section IV.A of Appendix I to assure that the releases of radioactive
materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as
is reasonably achievable." The ODCM calculational methods specified in the
Surveillance Requirements implement

BASES

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

(Continued)

the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 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 controls for iodine-131, iodine-133, tritium, and radionuclides in particulate form with half lives greater than 8 days are dependent upon the existing radionuclide pathways to man, in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: (1) individual inhalation of airborne radionuclides, (2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, (3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and (4) deposition on the ground with subsequent exposure of man.

3/4.11.2.4 AND 3/4.11.2.5 GASEOUS RADWASTE TREATMENT AND VENTILATION EXHAUST TREATMENT

The OPERABILITY of the GASEOUS RADWASTE TREATMENT SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the system will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 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.

BASES

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3/4.11.2.8 VENTING OR PURGING

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

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 specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant generated radioactive effluents and direct radiation exceed 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems. For sites containing up to 4 reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix 1, and if direct radiation doses from the reactor 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 radius 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 Part 190.11 and 10 CFR Part 20.405c, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in 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

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3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

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

PART I

RADIOLOGICAL EFFLUENT CONTROLS

SECTION 5.0

DESIGN FEATURES

5.0 DESIGN FEATURES

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5.1 SITE

MAP DEFINING UNRESTRICTED AREAS AND SITE BOUNDARY FOR
RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

5.1.1 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 5.1.1-1.

EXCLUSION AREA AND UNRESTRICTED AREAS
AND SITE BOUNDARY FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

FIGURE 5.1.1-1

I 5-2

DELAWARE RIVER

PART I

RADIOLOGICAL EFFLUENT CONTROLS

SECTION 6.0

ADMINISTRATIVE CONTROLS

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ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

6.9.1.6 Routine radiological environmental operating reporting 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.

The annual radiological environmental operating reports shall include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous environmental surveillance reports and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of land use censuses required by CONTROL 3.12.2. If harmful effects or evidence of irreversible damage are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to alleviate the problem.

The annual radiological environmental operating reports shall include summarized and tabulated results in the format of Regulatory Guide 4.8, December 1975 of all radiological environmental samples taken during the report period. Deviations from the sampling program identified in CONTROL 3.12.1 shall be reported. In the event that some results are not available for inclusion with the reports, 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, one covering sampling locations near the SITE BOUNDARY, and a second covering the more distant locations, all keyed to a table giving distances and directions from one reactor; and the results of licensee participation in the Interlaboratory Comparison Program, as required by CONTROL 3.12.3.

The report shall also include the results of specific activity analysis in which the primary coolant exceeded the limits of Technical Specification 3.4.5. The following information shall be included: (1) Reactor power history starting 48 hours prior to the first sample in which the limit was exceeded; (2) Results of the last isotopic analysis for radioiodine performed prior to exceeding the limit, results of analysis while limit was exceeded and results of one analysis after the radioiodine activity was reduced to less than limit. Each result should include date and time of sampling and the radioiodine concentrations; (3) Clean-up system flow history starting 48 hours prior to the first sample in which the limit was exceeded; (4) Graph of the I-131 concentration and one other radioiodine isotope concentration in microcuries per gram as a function of time for the duration of the specific activity above the steady-state level; and (5) The time duration when the specific activity of the primary coolant exceeded the radioiodine limit.

ADMINISTRATIVE CONTROLS

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RADIOACTIVE EFFLUENT RELEASE REPORT

6.9.1.7 Radioactive release reports covering the operation of the unit shall
be submitted by May 1 of each year and in accordance with the requirements of
10CFR50.36a.

The radioactive effluent release report 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.

The radioactive effluent release report shall include an annual summary of
hourly meteorological data collected over the previous year. This annual
summary may be either in the form of an hour-by-hour listing of wind speed,
wind direction, and atmospheric stability, and precipitation (if measured) on
magnetic tape, or in the form of joint frequency distributions of wind speed,
wind direction, and atmospheric stability. The report shall include an
assessment of the radiation doses due to the radioactive liquid and gaseous
effluents released from the unit or station during the previous calendar year.
The report shall also include an assessment of the radiation doses from
radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their
activities inside the SITE BOUNDARY (Figure 5.1.1-1) during the report period.
All assumptions used in making these assessments, i.e., specific activity,
exposure time and location, shall be included in these reports. The historical
annual average meteorology 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 OFFSITE DOSE CALCULATION MANUAL (ODCM).
The Radioactive Effluent Release Report shall identify those radiological
environmental sample parameters and locations where it is not possible or
practicable to continue to obtain samples of the media of choice at the most
desired location or time. In addition, the cause of the unavailability of
samples for the pathway and the new location(s) for obtaining replacement
samples should be identified. The report should also include a revised
figure(s) and table(s) for the ODCM reflecting the new location(s).

ADMINISTRATIVE CONTROLS
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RADIOACTIVE EFFLUENT RELEASE REPORT (Continued)

The radioactive effluent release report shall also include an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous 12 consecutive months to show conformance with 40 CFR 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.

The radioactive effluent release report shall include the following information for each class of solid waste (as defined by 10 CFR 61) shipped offsite during the report period:

a.   Container volume,
b.   Total curie quantity (specify whether determined by measurement or estimate),
c.   Principal radionuclide (specify whether determined by measurement or estimate),
d.   Type of waste (e.g., spent resin, compact dry waste, evaporator bottoms),
e.   Type of container (e.g., LSA, Type A, Type B, Large Quantity), and
f.   Solidification agent (e.g., cement, urea formaldehyde).

The radioactive effluent release report shall include unplanned releases from the site to the UNRESTRICTED AREA of radioactive materials in gaseous and liquid effluents on a quarterly basis.

The radioactive effluent release report shall include any changes to the PROCESS CONTROL PROGRAM (PCP), OFFSITE DOSE CALCULATION MANUAL (ODCM) or radioactive waste systems made during the reporting period.

ADMINISTRATIVE CONTROLS
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6.15 MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS AND SOLID WASTE TREATMENT

SYSTEMS

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

1. Shall be reported to the Commission in the UFSAR for the period in which the evaluation was reviewed by SORC. The discussion of each change shall contain:

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

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

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

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

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

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

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

   h. Documentation of the fact that the change was reviewed and found acceptable by the SORC.

2. Shall become effective upon review and acceptance by the SORC.

PART II

CALCULATIONAL METHODOLOGIES

1.0   LIQUID EFFLUENTS

1.1   Radiation Monitoring Instrumentation and Controls

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

(1)   Alarm (and Automatic Termination) - Liquid Radwaste Discharge Line Monitor provides the alarm and automatic termination of liquid (RE4861) radioactive material releases from the liquid waste management system as required by Technical Specification 3.3.7.10.

Circulating Water Dewatering Sump Discharge Monitor (RE4557) provides alarm and automatic termination of liquid radioactive releases from the circulating dewatering sump. Condensation drains from certain supply ventilation units and liquids from the fill and venting of the circulating water side of the condenser waterboxes are directed to this sump. Automatic termination is performed by trip of the sump pumps on high gamma radiation signal. Controls for releases from the dewatering sump are identified in Appendix G.

(2)   Alarm (Only) - The Cooling-Tower Blowdown Effluent Monitor (RE8817) provides an Alarm function only for releases into the environment as required by Technical Specification 3.3.7.10.

Liquid radioactive waste flow diagrams with the applicable, associated radiation monitoring instrumentation and controls are presented in Figure 1-1.

1.2   Liquid Effluent Monitor Setpoint Determination

Per the requirements of Technical Specification 3.3.7.10, alarm setpoints shall be established for the liquid monitoring instrumentation to ensure that the release concentration limits of Specification 3.11.1.1 are met (i.e., the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentrations specified in 10 CFR 20 Appendix B. Table II, Column 2, (Appendix F) for radionuclides and 2.0E-04 uCi/ml for dissolved or entrained noble gases). The following equation (adopted from NUREG-0133) must be satisfied to meet the liquid effluent restrictions:

$$c \leq \frac{C(F+f)}{f} \qquad (1.1)$$

where:

C =   the effluent concentration limit of Technical Specification (3.11.1.1) implementing the 10 CFR 20 MPC (Appendix F) for the site, in uCi/ml.

c =   the setpoint, in uCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint,

represents a value which, if exceeded, would result in concentrations exceeding the limits of 10 CFR 20 in the UNRESTRICTED AREA.

f = the flow rate at the radiation monitor location, in volume per unit time, but the same units as F, below.

F = the dilution water flow rate as measured prior to the release point, in volume per unit time.

[Note that if no dilution is provided, $c \leq C$. Also, note that when (F) is large compared to (f), then (F + f) = F.]

1.2.1 Liquid Effluent Monitors

The setpoints for the liquid effluent monitors at the Hope Creek Generating Station are determined by the following equation:

$$SP \leq \frac{MPC_e * CTBD * [1 - CF]}{RR} + bkg \qquad (1.2)$$

with:

$$MPC_e = \frac{\Sigma C_i \text{ (gamma)}}{\Sigma \dfrac{C_i \text{ (gamma)}}{MPC_i}} \qquad (1.3)$$

where:

SP = alarm setpoint corresponding to the maximum allowable release rate (uCi/ml).

MPC_e = an effective MPC value for the mixture of radionuclides in the effluent stream, (uCi/ml).

C_i = the concentration of radionuclide in the liquid effluent (uCi/ml).

MPC_i = the MPC value corresponding to radionuclide i from (Appendix F) 10 CFR 20, Appendix B, Table II, Column 2 (uCi/ml).

CTBD = the Cooling-Tower Blowdown Discharge rate at the time of release (gal/min).

RR = the liquid effluent release rate (gal/min) at the monitor location (i.e., at the liquid radwaste monitor, at the TBCW monitor, or at the CTBD monitor).

bkg = the background of the monitor (uCi/ml).

CF = Correction factor to account for non-gamma emitting nuclides and radiation monitor inaccuracies.

The radioactivity monitor setpoint equation (1.2) remains valid during outages when the Cooling-Tower Blowdown discharge is potentially as its lowest value. Reduction of the waste stream flow (RR) may be necessary during these periods to meet the discharge criteria. Procedural restrictions prevent simultaneous liquid releases.

1.2.2 Conservative Default Values

Conservative alarm setpoints for liquid radwaste radiation monitors may be determined through the use of default parameters. Table 1-1 summarized all current default values in use for Hope Creek. They are based upon the following:

(a)   substitution of the effective MPC value with a default value of 7.92E-05 uCi/ml for radwaste releases (Refer to Appendix A for justification);

(b)   substitutions of the Cooling-Tower Blowdown discharge rate with the minimum average flow, in gal/min; and,

(c)   substitutions of the effluent release rate with the highest allowed rate, in gal/min.

(d)   substitution of a 0.8 correction factor (CF) to account for monitor inaccuracies and non-gamma emitting radionuclides.

The use of the conservative alarm setpoint, or a setpoint below the conservative value, is acceptable provided that the value used is at least as conservative as the release specific setpoint calculated in accordance with Equation 1.2 above. Procedural controls exist to verify the setpoint utilized is at or below what is required.

1.3   Liquid Effluent Concentration Limits - 10 CFR 20

Technical Specification 3.11.1.1 limits the concentration of radioactive material in liquid effluents (after dilution in the Cooling-Tower Blowdown Discharge System) to less than the concentrations as specified in 10 CFR 20, Appendix B, Table II, Column 2 (Appendix F) for radionuclides other than noble gases. Noble gases are limited to a diluted concentration of 2.0E-04 uCi/ml. Release rates are controlled and radiation monitor alarm setpoints are established as addressed above to ensure that these concentration limits are not exceeded. However, in the event any liquid release results in an alarm setpoint being exceeded, an evaluation of compliance with the concentration limits of Technical Specification 3.11.1.1 may be performed using the following equation:

$$\frac{C_i}{MPC_i} * \frac{RR}{CTBD + RR} \leq 1 \quad (1.4)$$

where:

C_i =   actual concentration of radionuclide i as measured in the undiluted liquid effluent (uCi/ml).

MPC_i =   the MPC value corresponding to radionuclide i from 10 CFR 20, Appendix B, Table II, Column 2 (Appendix F) (uCi/ml).

        =   2E-04 uCi/ml for dissolved or entrained noble gases.

RR   =   the actual liquid effluent release rate (gal/min)

4

CTBD =   the actual Cooling-Tower Blowdown discharge at the time of release (gal/min).

1.4   Liquid Effluent Dose Calculation - 10 CFR 50

1.4.1   MEMBER OF THE PUBLIC Dose - Liquid Effluents

Technical Specification 3.11.1.2 limits the dose or dose commitment to MEMBERS OF THE PUBLIC from radioactive materials in liquid effluents from Hope Creek Generating Station to:

- during any calendar quarter:
  - ≤ 1.5 mrem to total body
  - ≤ 5.0 mrem to any organ

- during any calendar year:
  - ≤ 3.0 mrem to total body
  - ≤ 10.0 mrem to any organ

Per the surveillance requirements to Technical Specification 4.11.1.2, the following calculation methods shall be used for determining the dose or dose commitment due to the liquid radioactive effluents from Hope Creek.

$$D_o = \frac{8.35E\text{-}04 \ * \ VOL}{CTBD} \ * \ \Sigma \ (C_i \ * \ A_i o) \qquad (1.5)$$

where:

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

$A_i o$ =   site-related ingestion dose commitment factor to the total body or any organ o for radionuclide i (mrem/hr per uCi/ml).

C_i =   average concentration of radionuclide i, in undiluted liquid effluent representative of volume VOL (uCi/ml).

VOL =   volume of liquid effluent released (gal).

CTBD =   Average Cooling-Tower Blowdown discharge rate during release period (gal/min).

8.35E-04 =   conversion factor (1.67E-2 hr/min) and a near field dilution factor of 0.05 (refer to Appendix B, Page B-4 for definition).

5

The site-related ingestion dose/dose commitment factors (A_{io}) are presented in Table 1-2 and have been derived in accordance with NUREG-0133 by the equation:

$$A_{io} = 1.14E+05 \: [(UI * BI_i) + (UF * BF_i)] \: Df_i \qquad (1.6)$$

where:

A_{io}	=	composite dose parameter for the total body or critical organ o of an adult for radionuclide i, for the fish and invertebrate ingestion pathways (mrem/hr per uCi/ml).
1.14E+05=		conversion factor (pCi/uCi * ml/kg per hr/yr).
UI	=	adult invertebrate consumption (5 kg/yr).
Bi_i	=	bioaccumulation factor for radionuclide i in invertebrates from Table 1-3 (pCi/kg per pCi/l).
UF	=	adult fish consumption (21 kg/yr).
Bf_i	=	bioaccumulation factor for nuclide i in fish from Table 1-4 (pCi/kg per pCi/l).
Df_i	=	dose conversion factor for nuclide i for adults in preselected organ, o, from Table E-11 of Regulatory Guide 1.109 (mrem/pCi).

The radionuclides included in the periodic dose assessment per the requirements of Technical Specification 3/4.11.1.2 are those as identified by gamma spectral analysis of the liquid waste samples collected and analyzed per the requirements of Technical Specification 3/4.11.1.1, Table 4.11.1.1.1-1.

Radionuclides requiring radiochemical analysis (e.g., Sr-89 and Sr-90) will be added to the dose analysis at a frequency consistent with the required minimum analysis frequency of Technical Specification Table 4.11.1.1.1-1.

1.4.2 Simplified Liquid Effluent Dose Calculation

In lieu of the individual radionuclide dose assessment as presented in Section 1.4.1, the following simplified dose calculation equation may be used for demonstrating compliance with the dose limits of Technical Specification 3.11.1.2. (Refer to Appendix B for the derivation and justification for this simplified method.)

Total Body

$$D_{tb} = \frac{1.94E+02 * VOL}{CTBD} * \Sigma \: C_i \qquad (1.7)$$

Maximum Organ

$$D_{max} = \frac{4.28E+02 * VOL}{CTBD} * \Sigma \: C_i \qquad (1.8)$$

where:

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

D_{max} = evaluated maximum organ dose (mrem).

C_i = average concentration of radionuclide i, in undiluted liquid effluent representative of the volume VOL (uci/ml).

VOL = volume of liquid effluent released (gal).

CTBD = average Cooling-Tower Blowdown discharge rate during release period (gal/min).

1.94E+02 = conversion factor (1.67E-2 hr/min) the ingestion dose commitment factor (Zn-65, total body -- 2.32E5 mrem/hr per uCi/ml), and the near field dilution factor of 0.05 (See Appendix B).

4.28E+02 = conversion factor (1.67E-2 hr/min) the conversion maximum organ dose conversion factor (Zn-65, Liver -- 5.13E5 mrem/hr per uCi/ml), and the nearfield dilution factor of 0.05 (See Appendix B).

1.5   Liquid Effluent Dose Projections

Technical Specification 3.11.1.3 requires that the liquid radioactive waste processing system be used to reduce the radioactive material levels in the liquid waste prior to release when the 31-day projected doses exceed:

- **0.06 mrem to the total body, or**

- **0.2 mrem to any organ.**

The applicable liquid waste processing system for maintaining radioactive material releases ALARA are the drain filters and demineralizers as delineated in Figure 1-1.

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

$$D_{tbp} = (D_{tb} / d) * 31d \qquad (1.9)$$

$$D_{maxp} = (D_{max} / d) * 31d \qquad (1.10)$$

where:

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

D_{tb} = the total body dose to date for current calendar quarter as determined by equation (1.5) or (1.7).

D_{maxp} = the maximum organ dose to date for current calendar quarter as determined by equation (1.5 or (1.8) (mrem).

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

31d = the number of days of concern.

1.6   Representative Samples

A sample should be representative of the bulk stream or volume of effluent from which it is taken. Prior to sampling, large volumes of liquid waste should be mixed in as short a time interval as practicable to assure that any sediments or particulate solids are distributed uniformly in the waste mixture. Recirculation pumps for liquid waste tanks (collection or sample test tanks) should be capable of recirculating at a rate of not less than two tank volumes in eight hours. Minimum recirculation times and methods of recirculation are controlled by specific plant procedures.

2.0   GASEOUS EFFLUENTS

2.1   Radiation Monitoring Instrumentation and Controls

The gaseous effluent monitoring instrumentation and controls at Hope Creek for controlling and monitoring normal radioactive material releases in accordance with the Radiological Effluent Technical Specifications are summarized as follows:

(1)   Filtration, Recirculation, and Ventilation System -

The FRVS is maintained in a standby condition. Upon reactor building isolation, the FRVS recirculation system recirculates the reactor building air through HEPA and charcoal filters. Releases are made to the atmosphere via a reactor building vent or the South Plant Vent depending on mode of operation. Noble gas monitoring is provided by RE-4811A.

(2)   South Plant Vent -

The SPV receives discharge from the radwaste evaporator, reactor building purge, auxiliary building radwaste area, condensate demineralizer, pipe chase, feedwater heater, and untreated ventilation sources. Effluents are monitored (for noble gas) by the RE-4875B monitor.

(3)   North Plant Vent -

The NPV receives discharge from the gaseous radwaste treatment system (Offgas system) and untreated ventilation air sources. Effluents are monitored (for noble gases) by the RE-4573B monitor.

Gaseous radioactive waste flow diagrams with the applicable, associated radiation monitoring instrumentation controls are presented in Figures 2-1 and 2-2.

2.2   Gaseous Effluent Monitor Setpoint Determination

2.2.1   Plant Vent, FRVS

Per the requirements of Technical Specification 3.3.7.11, alarm setpoints shall be established for the gaseous effluent monitoring instrumentation to ensure that the release rate of noble gases does not exceed the limits of Specification 3.11.2.1, which corresponds to a dose rate at the SITE BOUNDARY of 500 mrem/year to the total body or 3000 mrem/year to the skin. Based on a grab sample analysis of the applicable release (i.e., of FRVS, pipe chase, gaseous radwaste treatment system air, etc.), the radiation monitoring alarm setpoints may be established by the following calculation method. The measured radionuclide concentrations and release rate are used to calculate the fraction of the allowable release rate, as limited by Specification 3.11.2.1, by the equation:

$$\text{FRAC} = [4.72E+02 * X/Q * VF * (C_i * K_i)] / 500 \qquad (2.1)$$

$$\text{FRAC} = [4.72E+02 * X/Q * VF * (C_i * (L_i + 1.1M_i))] / 3000 \qquad (2.2)$$

where:

FRAC = fraction of the allowable release rate based on the identified radionuclide concentrations and the release flow rate.

X/Q = annual average meteorological dispersion to the controlling site boundary location (sec/m3).

VF = ventilation system flow rate for the applicable release point and monitor (ft3/min).

C_i = concentration of noble gas radionuclide i as determined by radioanalysis of grab sample (uCi/cm3)

K_i = total body dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m3), from Table 2-1

L_i = beta skin dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m3), from Table 2-1

M_i = gamma air dose conversion factor for noble gas radionuclide i (mrad/yr per uCi/m3), from Table 2-1

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

4.72E+02 = conversion factor (cm3/ft3 * min/sec)

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

3000 = skin dose rate limit (mrem/yr)

9

Based on the more limiting FRAC (i.e., higher value) as determined above, the alarm setpoints for the applicable monitors may be calculated by the equation:

$$SP = [AF * \Sigma\, C_i\, /\, FRAC] + bkg \qquad (2.3)$$

where:

SP = alarm setpoint corresponding to the maximum allowable release rate (uCi/cc).
FRAC = highest fraction of the allowable release rate as determined in equation (2.2).
bkg = background of the monitor (uCi/cc).
AF = administrative allocation factor for the specific monitor (0.2 NPV, 0.2 SPV, 0.1 FRVS).

The allocation factor (AF) is an administrative control imposed to ensure that combined releases from Salem Units 1 and 2 and Hope Creek will not exceed the regulatory limits on release rate from the site (i.e., the release rate limits of Technical Specification 3.11.2.1). Normally, the combined AF value for Salem Units 1 and 2 is 0.5 (0.25 per unit), with the remainder 0.5 allocated to Hope Creek. Any increase in AF above 0.5 for the Hope Creek Generating Station will be coordinated with the Salem Generating Station to ensure that the combined allocation factors for all units do not exceed 1.0.

2.2.2 Conservative Default Values

A conservative alarm setpoint can be established, in lieu of the individual radionuclide evaluation based on the grab sample analysis, to eliminate the potential of periodically having to adjust the setpoint to reflect minor changes in radionuclide distribution and variations in release flow rate. The alarm setpoint may be conservatively determined by the default values presented in Table 2-2.

These values are based upon:

- the maximum ventilation (or purge) flow rate;
- a radionuclide distribution adopted from ANSI N237- 1976/ANS 18.1 "Source Term Specifications", Table 5 and;
- an administrative allocation factor of 0.5 to conservatively ensure that any releases from Hope Creek do not exceed the maximum allowable release rate.

For the noble gas radionuclide distribution from ANSI N237-1976/ANS 18.1 (Note Table C-1), the alarm setpoint-based-on the total body dose rate is more restrictive than the corresponding setpoint based on the skin dose rate. The resulting conservative, default setpoints are presented in Table 2-2.

10

2.3   Gaseous Effluent Instantaneous Dose Rate Calculations - 10 CFR 20

2.3.1   Site Boundary Dose Rate - Noble Gases

Technical Specification 3.11.2.1a limits the dose rate at the SITE BOUNDARY due to noble gas releases to $\leq$ 500 mrem/yr, total body and $\leq$ 3000 mrem/yr, skin. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event any gaseous releases from the station results in an alarm setpoint (as determined in Section 2.2.1) being exceeded, an evaluation of the SITE BOUNDARY dose rate resulting from the release shall be performed using the following equations:

$$D_{tb} = X/Q * \Sigma (K_i * Q_i) \qquad (2.4)$$

$$D_s = X/Q * \Sigma ((L_i + 1.1M_i) * Q_i \qquad (2.5)$$

where:

D_{tb} = Total body dose rate (mrem/yr).

D_s = skin dose rate (mrem/yr).

X/Q = atmospheric dispersion to the controlling SITE BOUNDARY location (sec/m3).

Q_i = average release rate of radionuclide i over the release period under evaluation (uCi/sec).

K_i = total body dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m3), from Table 2-1

L_i = beta skin dose conversion factor for noble gas radionuclide i (mrad/yr per uCi/m3), from Table 2-1

M_i = gamma air dose conversion factor for noble gas radionuclide i (mrad/yr per uCi/m3, from Table 2-1.

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

As appropriate, simultaneous releases from Salem Units 1 and 2 and Hope Creek will be considered in evaluating compliance with the release rate limits of Specification 3.11.2.1a, following any releases exceeding the above prescribed alarm setpoints. Monitor indications (readings) may be averaged over a time period not to exceed 15 minutes when determining noble gas release rate based on correlation of the monitor reading and monitor sensitivity. The 15-minute averaging is needed to allow for reasonable monitor response to potentially changing radioactive material concentrations and to exclude potential electronic spikes in monitor readings that may be unrelated to radioactive material releases. As identified, any electronic spiking monitor responses may be excluded from the analysis.

NOTE: For administrative purposes, more conservative alarm setpoints than those as prescribed above may be imposed. However, conditions exceeding these more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding the dose limits of Technical Specification 3.11.2.1a. Provided actual releases do not result in radiation

monitor indications exceeding alarm setpoint values based on the above criteria, no further analyses are required for demonstrating compliance with the limits of Specification 3.11.2.1a.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2-3 may be used for evaluating the gaseous effluent dose rate.

2.3.2 Site Boundary Dose Rate - Radioiodine and Particulates

Technical Specification 3.11.2.1b limits the dose rate to $\leq$ 1500 mrem/yr to any organ for I-131, I-133, tritium and particulates with half-lives greater than 8 days. To demonstrate compliance with this limit, an evaluation is performed at a frequency no greater than that corresponding to the sampling and analysis time period (e.g., nominally once per 7 days). The following equation shall be used for the dose rate evaluation:

$$D_o = X/Q \ * \ \Sigma \ (R_{io} \ * \ Q_i) \qquad\qquad (2.6)$$

where:

D_o = average organ dose rate over the sampling time period (mrem/yr).

X/Q = atmospheric dispersion to the controlling SITE BOUNDARY location for the inhalation pathway (sec/m3).

R_{io} = dose parameter for radionuclide i (mrem/yr per uCi/m3) and organ o for the child inhalation pathway from Table 2-4.

Q_i = average release rate over the appropriate sampling period and analysis frequency for radionuclide i - - I-131, I-133, tritium or other radionuclide in particulate form with half-life greater than 8 days (uCi/sec).

By substituting 1500 mrem/yr for D_o and solving for Q, an allowable release rate for I-131 can be determined. Based on the annual average meteorological dispersion (See Table 2-3) and the most limiting potential pathway, age group and organ (inhalation, child, thyroid -- Ri = 1.62E+07 mrem/yr per uCi/m3), the allowable release rate for I-131 is 34.7 uCi/sec. Reducing this release rate by a factor of 2 to account for potential dose contributions from other radioactive particulate material and other release points (e.g., Salem), the corresponding release rate allocated to Hope Creek is 17.4 uCi/sec. For a 7-day period, which is the nominal sampling and analysis frequency for I-131, the cumulative release is 10.5 Ci.

Therefore, as long as the I-131 release in any 7-day period do not exceed 10.5 Ci, no additional analyses are needed for verifying compliance with the Technical Specification 3.11.2.1.b limits on allowable release rate.

2.4   Noble Gas Effluent Dose Calculations - 10 CFR 50

2.4.1   UNRESTRICTED AREA Dose - Noble Gases

Technical Specification 3.11.2.2 requires a periodic assessment of releases of noble gases to evaluate compliance with the quarterly dose limits of $\leq$ 5 mrad, gamma-air and $\leq$ 10 mrad, beta-air and the calendar year limits $\leq$ 10 mrad, gamma-air and $\leq$ 20 mrad, beta-air.

The limits are applicable separately to each generating station and are not combined site limits. The following equations shall be used to calculate the gamma-air and beta-air doses.

$$D_g = 3.17E\text{-}08 * X/Q * \Sigma (M_i * Q_i) \qquad (2.7)$$

$$D_b = 3.17E\text{-}08 * X/Q * \Sigma (N_i * Q_i) \qquad (2.8)$$

where:

D_g = air dose due to gamma emissions for noble gas radionuclides (mrad).

D_b = air dose due to beta emissions for noble gas radionuclides (mrad).

X/Q = atmospheric dispersion to the controlling SITE BOUNDARY location (sec/m3).

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

M_i = air dose factor due to gamma emission from noble gas radionuclide i (mrad/yr per uCi/m3, from Table 2-1.

N_i = air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per uCi/m3, Table 2-1).

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

2.4.2 Simplified Dose Calculation for Noble Gases

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

$$D_g = \frac{3.17E\text{-}08}{0.50} * X/Q * M_{eff} * \Sigma Q_i \qquad (2.9)$$

$$D_b = \frac{3.17E\text{-}08}{0.50} * X/Q * N_{eff} * \Sigma Q_i \qquad (2.10)$$

where:

13

M_{eff} = 8.1E+03, effective gamma-air dose factor (mrad/yr per uCi/m3).

N_{eff} = 8.5E+03, effective beta-air dose factor (mrad/yr per uCi/m3).

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

0.50 = conservatism factor to account for potential variability in the radionuclide distribution.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2-3, may be used for the evaluation of the gamma-air and beta-air doses.

2.5 Radioiodine and Particulate Dose Calculations - 10 CFR 50

2.5.1 UNRESTRICTED AREA Dose - Radioiodine and Particulates

In accordance with the requirements of Technical Specification 3.11.2.3, a periodic assessment shall be performed to evaluate compliance with the quarterly dose limit $\leq$ 15 mrem to any organ. The following equation shall be used to evaluate the maximum organ dose due to release of I-131, I-133, tritium and particulates with half-lives greater than 8 days:

$$D_{aop} = 3.17E\text{-}08 * W * SF_p * \Sigma (R_{iop} * Q_i) \qquad (2.11)$$

where:

D_{aop} = dose or dose commitment via all pathways p and age group a (as identified in Table 2-3) to organ o, including the total body (mrem).

W = atmospheric dispersion parameter to the controlling location(s) as identified in Table 2-3.

X/Q = atmospheric dispersion for inhalation pathway and H-3 dose contribution via other pathways (sec/m3).

D/Q = atmospheric deposition for vegetation, milk and ground plane exposure pathways (1/m2).

R_{iop} = dose factor for radionuclide i (mrem/yr per uCi/m3 or m2 - mrem/yr per uCi/sec) and organ o from Table 2-4 for each age group a and the applicable pathway p as identified in Table 2-3. Values for R_{iop} were derived in accordance with the methods described in NUREG-0133.

Q_i = cumulative release over the period of interest for radionuclide i -- I-131, I-133, H-3 or radioactive material in particulate form with half-life greater than 8 days (uCi).

Sf_p = annual seasonal correction factor to account for fraction of the year that the applicable exposure pathway does not exist.

(1) *For milk and vegetation exposure pathways:*
= A six month fresh vegetation and grazing season (May through October)= 0.5

(2) *For inhalation and ground plane exposure pathways:*
= 1.0

14

For evaluating the maximum exposed individual, the infant age group is controlling for the milk pathway. Only the controlling age group as identified in Table 2-3 need be evaluated for compliance with Technical Specification 3.11.2.3.

2.5.2 Simplified Dose Calculation for Radioiodines and Particulates

In lieu of the individual radionuclide (I-131, I-133 and particulates) dose assessment as presented above, the following simplified dose calculation equation may be used for verifying compliance with the dose limits of Technical Specification 3.11.2.3 (Refer to Appendix D for the derivation and justification of this simplified method).

$$D_{max} = 3.17E\text{-}08 * W * SF_p * RI\text{-}131 * \Sigma Q_i \qquad (2.12)$$

where:

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

RI-131 = I-131 dose parameter for the thyroid for the identified controlling pathway.

= 1.05E+12, infant thyroid dose parameter with the cow-milk pathway controlling (m2 - mrem/yr per uCi/sec).

W = D/Q for radioiodine, 2.87E-10 1/m2.

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

The location of exposure pathways and the maximum organ dose calculation may be based on the available pathways in the surrounding environment of Hope Creek as identified by the annual land-use census (Technical Specification 3.12.2). Otherwise, the dose will be evaluated based on the predetermined controlling pathways as identified in Table 2-3.

2.6 Gaseous Effluent Dose Projection

Technical Specification 3.11.2.4 requires that the VENTILATION EXHAUST TREATMENT SYSTEM be used to reduce radioactive material levels prior to discharge when projected doses in 31-days exceed:

- **0.2 mrad to air from gamma radiation, or**
- **0.4 mrad to air from beta radiation, or**
- **0.3 mrad to any organ of a MEMBER OF THE PUBLIC**

The applicable gaseous processing systems for maintaining radioactive material releases ALARA are the Gaseous Radwaste Treatment System and Exhaust Treatment System as delineated in Figures 2-1 and 2-2.

15

Dose projection are performed at least once per 31-days by the following equations:

$$D_{gp} = (D_g / d) * 31d \qquad (2.13)$$

$$D_{dp} = (D_d / d) * 31d \qquad (2.14)$$

$$D_{maxp} = (D_{max} / d) * 31d \qquad (2.15)$$

where:

D_{gp} = gamma air dose projection for current 31-day period (mrad).

D_g = gamma air dose to date for current calendar quarter as determined by equation (2.7) or (2.9) (mrad).

D_{bp} = beta air dose projection for current 31-day period (mrad).

D_b = beta air dose to date for current calendar quarter as determined by equation (2.8) or (2.10) (mrad).

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

D_{max} = maximum organ dose to date for current calendar quarter as determined by equation (2.11) or (2.12) (mrem).

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

31d   = the number of days of concern.

3.0 SPECIAL DOSE ANALYSIS

3.1 Doses Due to Activities Inside the SITE BOUNDARY

In accordance with Technical Specification 6.9.1.7, the Radioactive Effluent Release Report (RERR) submitted by May 1st of each year shall include an assessment of radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY.

The calculation methods as presented in Sections 2.4 and 2.5 may be used for determining the maximum potential dose to a MEMBER OF THE PUBLIC based on the parameters from Table 2-3 and 2-hours per visit per year. The default value for the meteorological dispersion data as presented in Table 2-3 may be used if current year meteorology is unavailable at the time of NRC reporting. However, a follow-up evaluation shall be performed when the data becomes available.

3.2   Total Dose to MEMBERS OF THE PUBLIC - 40 CFR 190

The Radioactive Effluent Release Report (RERR) submitted by May 1st of each year shall also include an assessment of the radiation dose to the likely most exposed MEMBER OF THE PUBLIC for reactor releases and other nearby uranium fuel cycle courses (including dose contributions from effluents and direct radiation from on-site sources). For the likely most exposed MEMBER OF THE PUBLIC in the vicinity of Artificial Island, the sources of exposure need only consider the Salem Generating station and the Hope Creek Generating Station: No other fuel cycle facilities contribute to the MEMBER OF THE PUBLIC dose for the Artificial Island vicinity.

The dose contribution from the operation of Salem Generating Stations will be estimated based on the methods as presented in the Salem Offsite Dose Calculation Manual (SGS ODCM).

As appropriate for demonstrating/evaluating compliance with the limits of Technical Specification 3.11.4 (40 CFR 190), the results of the environmental monitoring program may be used for providing data on actual measured levels of radioactive material in the actual pathways of exposure.

3.2.1   Effluent Dose Calculations

For purposes of implementing the surveillance requirements of Technical Specification 3/4.11.4 and the reporting requirements of 6.9.1.7 (RERR), dose calculations for the Hope Creek Generating Station may be performed using the calculation methods contained within the ODCM; the conservation controlling pathways and locations of Table 2-4 or the actual pathways and locations as identified by the land use census (Technical Specification 3/4.12.1) may be used. Average annual meteorological dispersion parameters or meteorological conditions concurrent with the release period under evaluation may be used.

3.2.2   Direct Exposure Dose Determination

Any potentially significant direct exposure contribution to off-site individual doses may be evaluated based on the results of the environmental measurements (e.g., TLD, ion chamber measurements) and/or by the use of a radiation transport and shielding calculation method. Only during a non-typical condition will there exist any potential for significant on-site sources at Hope Creek that would yield potentially significant off-site doses (i.e.., in excess of 1 mrem per year to a MEMBER OF THE PUBLIC), that would require detailed evaluation for demonstrating compliance with 40 CFR 190. However, should a situation exist whereby the direct exposure contribution is potentially significant, on-site measurements, off-site measurements and/or calculational techniques will be used for determination of dose for assessing 40 CFR 190 compliance.

17

4.0   RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

4.1   Sampling Program

The operational phase of the Radiological Environmental Monitoring Program (REMP) is conducted in accordance with the requirements of Appendix A Technical Specification 3.12. The objectives of the program are:

- To determine whether any significant increases occur in the concentration of radionuclides in the critical pathways of exposure in the vicinity of Artificial Island;
- To determine if the operation of the Hope Creek Generating Station has resulted in any increase in the inventory of long lived radionuclides in the environment;
- To detect any changes in the ambient gamma radiation levels; and
- To verify that HCGS operations have no detrimental effects on the health and safety of the public or on the environment.

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

NOTE: No public drinking water samples or irrigation water samples are taken as these pathways are not directly effected by liquid effluents discharged from Hope Creek Generating Station.

4.2   Interlaboratory Comparison Program

Technical Specification 3.12.3 requires analyses be performed on radioactive material supplied as part of an Interlaboratory Comparison. Participation in an approved Interlaboratory Comparison Program provides a check on the preciseness of measurements of radioactive materials in environmental samples. A summary of the Interlaboratory Comparison Program results will be provided in the Annual Radiological Environmental Operating Report pursuant to Technical Specifications 6.9.1.7.

5.0   HCGS EXPLOSIVE GAS MONITORING PROGRAM

The Hope Creek Explosive Gas Monitoring program was moved within the Hope Creek Technical Specifications to section 6.8.4.d. This was performed in Technical Specification Amendment 91. Details of the Hope Creek Explosive Gas Monitoring program are maintained in station implementing procedures and are controlled by the 50.59 safety evaluation and procedure processes.

FIGURE 1-1
LIQUID RADWASTE TREATMENT AND MONITORING SYSTEM

Log: RE = Radiation Effluent Monitor

    4861= Liquid Radwaste Monitor
    8817 = Cooling tower Blowdown Monitor
    4557 = Circulating Water Dewatering Sump Monitor

Note 1: Specified equipment is installed but
    not in use. Equipment is pending
    abandonment per DCP 4EC-3634.

19
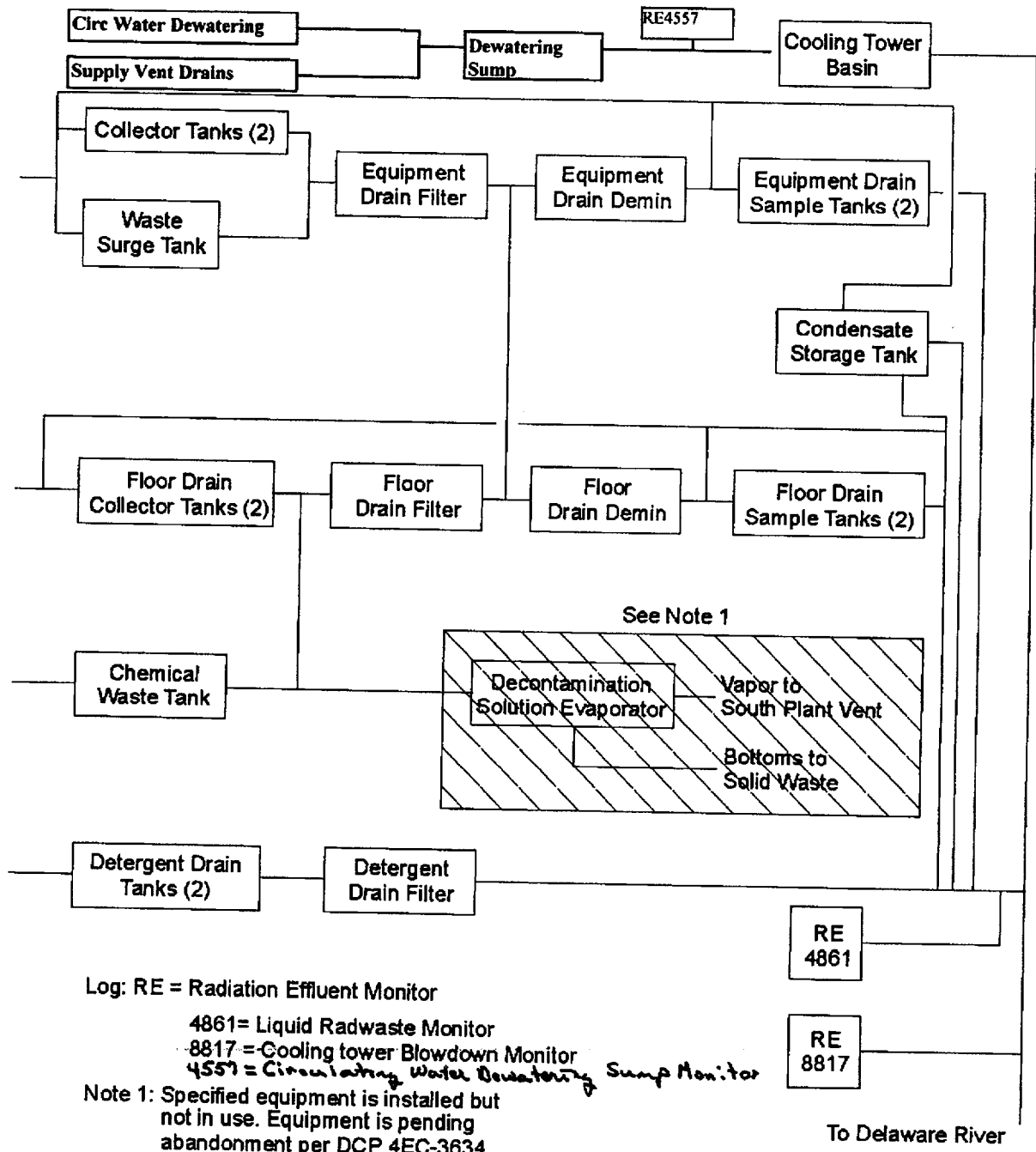
FIGURE 1-2
SOLID RADWASTE PROCESSING SYSTEM

See Note 1

Note 1. Specified equipment is installed but not in use. Equipment is pending abandonment per DCP 4EC-3634.

20
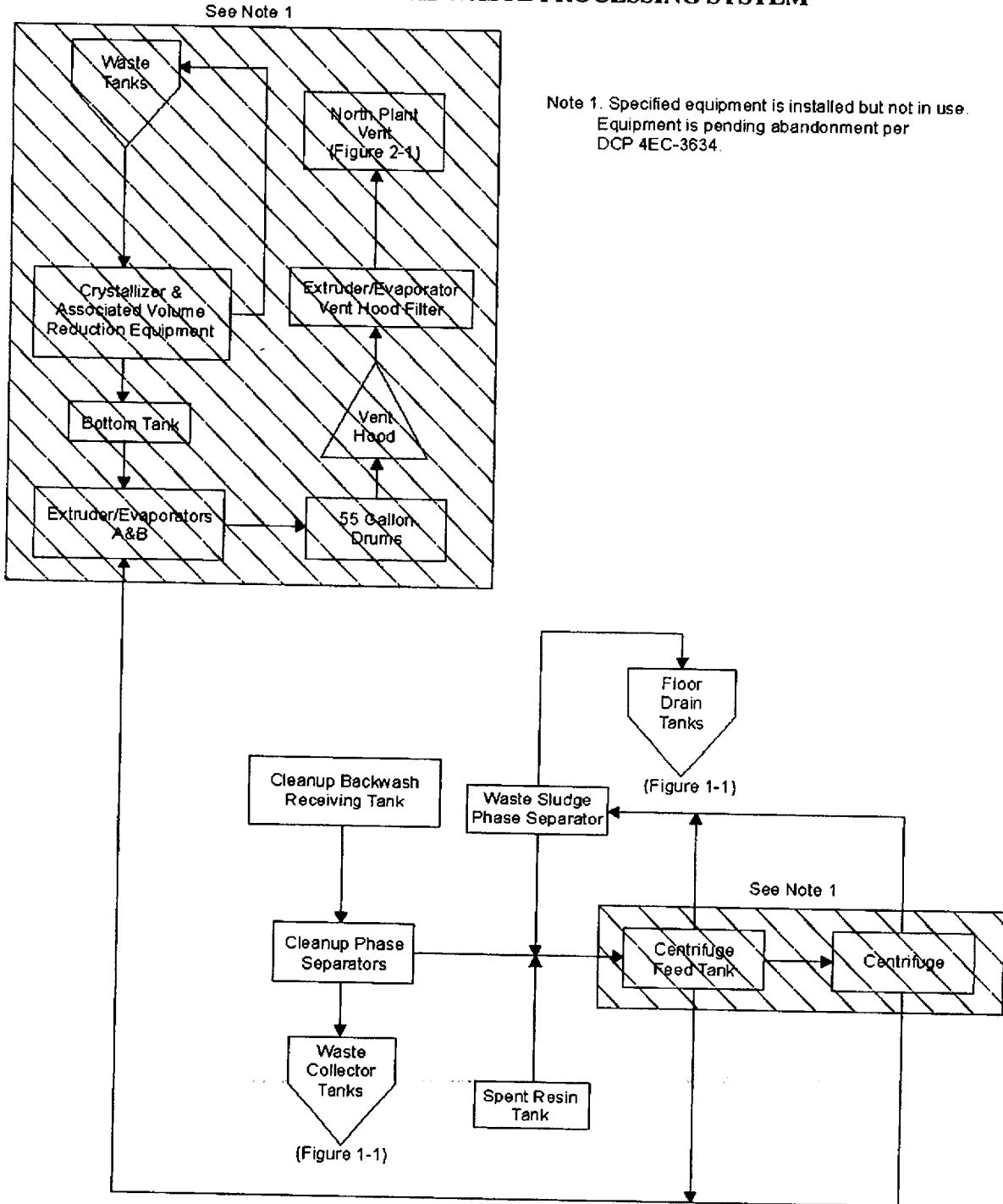
TABLE 1-1
PARAMETERS FOR LIQUID ALARM SETPOINT DETERMINATION

Parameter	Actual Value	Default Value	Units	Comments
MPCe	Calc	7.92E-5*	uCi/ml	Calculated for each batch to be released
MPC I-131	3.0E-07	N/A	uCi/ml	Taken from 10 CFR 20, Appendix B,Table II, Column 2 (Appendix F)
C_i	Measured	N/A	uCi/ml	Taken from gamma spectral analysis of liquid effluent
MPC_i	Measured	N/A	uci/ml	Taken from 10 CFR 20, Appendix B, Table II, Column 2 (Appendix F)
CTBD	Measured	12000	gpm	Cooling tower blowdown discharge
RR	Measured	176	gpm or	Determined prior to release, release rate can be adjusted for Technical Specification compliance
		1300	gpm (CST)	
	Estimated	100	gpm(TBCW)	Maximum flow rate with both pumps running (50 gpm each)
SP (Setpoints)				
A)RE4861	Calc	1.08E-03	uCi/ml	Default alarm setpoints; more conservative values may be used as appropriate and desirable for ensuring regulatory compliance and for maintaining releases ALARA
RE8817	Calc	1.58E-05	uCi/ml	
RE4557	Calc	2.40E-06	uCi/ml	Maximum alarm setpoint for continuous release; more conservative value may be established by plant procedure
B)RE4861	Calc	1.46E-04	uCi/ml	These setpoints are for condensate storage tank releases
RE8817	Calc	1.58E-05	uCi/ml	

* See Appendix A for basis

21

TABLE 1-2
SITE RELATED INGESTION DOSE COMMITMENT FACTOR, A_{io}
(FISH AND INVERTEBRATE CONSUMPTION)
(mrem/hr per uCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	-	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1
C-14	1.45E+4	2.90E+3	2.90E+3	2.90E+3	2.90E+3	2.90E+3	2.90E+3
Na-24	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1
P-32	4.69E+6	2.91E+5	1.81E+5	-	-	-	5.27E+5
Cr-51	-	-	5.58E+0	3.34E+0	1.23E+0	7.40E+0	1.40E+3
Mn-54	-	7.06E+3	1.35E+3	-	2.10E+3	-	2.16E+4
Mn-56	-	1.78E+2	3.15E+1	-	2.26E+2	-	5.67E+3
Fe-55	5.11E+4	3.53E+4	8.23E+3	-	-	1.97E+4	2.03E+4
Fe-59	8.06E+4	1.90E+5	7.27E+4	-	-	5.30E+4	6.32E+5
Co-57	-	1.42E+2	2.36E+2	-	-	-	3.59E+3
Co-58	-	6.03E+2	1.35E+3	-	-	-	1.22E+4
Co-60	-	1.73E+3	3.82E+3	-	-	-	3.25E+4
Ni-63	4.96E+4	3.44E+3	1.67E+3	-	-	-	7.18E+2
Ni-65	2.02E+2	2.62E+1	1.20E+1	-	-	-	6.65E+2
Cu-64	-	2.14E+2	1.01E+2	-	5.40E+2	-	1.83E+4
Zn-65	1.61E+5	5.13E+5	2.32E+5	-	3.43E+5	-	3.23E+5
Zn-69m	5.66E+3	1.36E+4	1.24E+3	-	8.22E+3	-	8.29E+5
Br-82	-	-	4.07E+0	-	-	-	4.67E+0
Br-83	-	-	7.25E-2	-	-	-	1.04E-1
Br-84	-	-	9.39E-2	-	-	-	7.37E-7
Br-85	-	-	3.86E-3	-	-	-	-
Rb-86	-	6.24E+2	2.91E+2	-	-	-	1.23E+2
Rb-88	-	1.79E+0	9.49E-1	-	-	-	2.47E-11
Rb-89	-	1.19E+0	8.34E-1	-	-	-	6.89E-14
Sr-89	4.99E+3	-	1.43E+2	-	-	-	8.00E+2
Sr-90	1.23E+5	-	3.01E+4	-	-	-	3.55E+3
Sr-91	9.18E+1	-	3.71E+0	-	-	-	4.37E+2
Sr-92	3.48E+1	-	1.51E+0	-	-	-	6.90E+2
Y-90	6.06E+0	-	1.63E-1	-	-	-	6.42E+4
Y-91m	5.73E-2	-	2.22E-3	-	-	-	1.68E-1
Y-91	8.88E+1	-	2.37E+0	-	-	-	4.89E+4
Y-92	5.32E-1	-	1.56E-2	-	-	-	9.32E+3
Y-93	1.69E+0	-	4.66E-2	-	-	-	5.35E+4
Zr-95	1.59E+1	5.11E+0	3.46E+0	-	8.02E+0	-	1.62E+4
Zr-97	8.81E-1	1.78E-1	8.13E-2	-	2.68E-1	-	5.51E+4
Nb-95	4.47E+2	2.49E+2	1.34E+2	-	2.46E+2	-	1.51E+6
Nb-97	3.75E+0	9.49E-1	3.46E-1	-	1.11E+0	-	3.50E+3
Mo-99	-	1.28E+2	2.43E+1	-	2.89E+2	-	2.96E+2
Tc-99m	1.30E-2	3.66E-2	4.66E-1	-	5.56E-1	1.79E-2	2.17E+1
Tc-101	1.33E-2	1.92E-2	1.88E-1	-	3.46E-1	9.81E-3	5.77E-14
As-76	4.38E+2	1.16E+3	5.14E+3	3.42E+2	1.39E+3	3.58E+2	4.30E+4

TABLE 1-2 (cont'd)
SITE RELATED INGESTION DOSE COMMITMENT FACTOR, A_{io}
(FISH AND INVERTEBRATE CONSUMPTION)
(mrem/hr per uCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
Ru-103	1.07E+2	-	4.60E+1	-	4.07E+2	-	1.25E+4
Ru-105	8.89E+0	-	3.51E+0	-	1.15E+2	-	5.44E+3
Ru-106	1.59E+3	-	2.01E+2	-	3.06E+3	-	1.03E+5
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	1.56E+3	1.45E+3	8.60E+2	-	2.85E+3	-	5.91E+5
Sb-124	2.77E+2	5.23E+0	1.10E+2	6.71E-1	-	2.15E+2	7.86E+3
Sb-125	1.77E+2	1.98E+0	4.21E+1	1.80E-1	-	1.36E+2	1.95E+3
Te-125m	2.17E+2	7.86E+1	2.91E+1	6.52E+1	8.82E+2	-	8.66E+2
Te-127m	5.48E+2	1.96E+2	6.68E+1	1.40E+2	2.23E+3	-	1.84E+3
Te-127	8.90E+0	3.20E+0	1.93E+0	6.60E+0	3.63E+1	-	7.03E+2
Te-129m	9.31E+2	3.47E+2	1.47E+2	3.20E+2	3.89E+3	-	4.69E+3
Te-129	2.54E+0	9.55E-1	6.19E-1	1.95E+0	1.07E+1	-	1.92E+0
Te-131m	1.40E+2	6.85E+1	5.71E+1	1.08E+2	6.94E+2	-	6.80E+3
Te-131	1.59E+0	6.66E-1	5.03E-1	1.31E+0	6.99E+0	-	2.26E-1
Te-132	2.04E+2	1.32E+2	1.24E+2	1.46E+2	1.27E+3	-	6.24E+3
I-130	3.96E+1	1.17E+2	4.61E+1	9.91E+3	1.82E+2	-	1.01E+2
I-131	2.18E+2	3.12E+2	1.79E+2	1.02E+5	5.35E+2	-	8.23E+1
I-132	1.06E+1	2.85E+1	9.96E+0	9.96E+2	4.54E+1	-	5.35E+0
I-133	7.45E+1	1.30E+2	3.95E+1	1.90E+4	2.26E+2	-	1.16E+2
I-134	5.56E+0	1.51E+1	5.40E+0	2.62E+2	2.40E+1	-	1.32E-2
I-135	2.32E+1	6.08E+1	2.24E+1	4.01E+3	9.75E+1	-	6.87E+1
Cs-134	6.84E+3	1.63E+4	1.33E+4	-	5.27E+3	1.75E+3	2.85E+2
Cs-136	7.16E+2	2.83E+3	2.04E+3	-	1.57E+3	2.16E+2	3.21E+2
Cs-137	8.77E+3	1.20E+4	7.85E+3	-	4.07E+3	1.35E+3	2.32E+2
Cs-138	6.07E+0	1.20E+1	5.94E+0	-	8.81E+0	8.70E-1	5.12E-5
Ba-139	7.85E+0	5.59E-3	2.30E-1	-	5.23E-3	3.17E-3	1.39E+1
Ba-140	1.64E+3	2.06E+0	1.08E+2	-	7.02E-1	1.18E+0	3.38E+3
Ba-141	3.81E+0	2.88E-3	1.29E-1	-	2.68E-3	1.63E-3	1.80E-9
Ba-142	1.72E+0	1.77E-3	1.08E-1	-	1.50E-3	1.00E-3	2.43E-18
La-140	1.57E+0	7.94E-1	2.10E-1	-	-	-	5.83E+4
La-141	8.06E-2	3.67E-2	9.13E-3	-	-	-	2.68E+2
Ce-141	3.43E+0	2.32E+0	2.63E-1	-	1.08E+0	-	8.86E+3
Ce-143	6.04E-1	4.46E+2	4.94E-2	-	1.97E-1	-	1.67E+4
Ce-144	1.79E+2	7.47E+1	9.59E+0	-	4.43E+1	-	6.04E+4
Pr-143	5.79E+0	2.32E+0	2.87E-1	-	1.34E+0	-	2.54E+4
Pr-144	1.90E-2	7.87E-3	9.64E-4	-	4.44E-3	-	2.73E-9
Nd-147	3.96E+0	4.58E+0	2.74E-1	-	2.68E+0	-	2.20E+4
W-187	9.16E+0	7.66E+0	2.68E+0	-	-	-	2.51E+3
Np-239	3.53E-2	3.47E-3	1.91E-3	-	1.08E-2	-	7.11E+2

TABLE 1-3
BIOACCUMULATION FACTORS
(pCi/kg per pCi/liter)*

ELEMENT	SALTWATER FISH	SALTWATER INVERTEBRATES
H	9.0E-01	9.3E-01
C	1.8E+03	1.4E+03
Na	6.7E-02	1.9E-01
P	3.0E+03	3.0E+04
Cr	4.0E+02	2.0E+03
Mn	5.5E+02	4.0E+02
Fe	3.0E+03	2.0E+04
Co	1.0E+02	1.0E+03
Ni	1.0E+02	2.5E+02
Cu	6.7E+02	1.7E+03
Zn	2.0E+03	5.0E+04
Br	1.5E-02	3.1E+00
Rb	8.3E+00	1.7E+01
Sr	2.0E+00	2.0E+01
Y	2.5E+01	1.0E+03
Zr	2.0E+02	8.0E+01
Nb	3.0E+04	1.0E+02
Mo	1.0E+01	1.0E+01
Tc	1.0E+01	5.0E+01
Ru	3.0E+00	1.0E+03
Rh	1.0E+01	2.0E+03
Ag	3.3E+03	3.3E+03
Sb	4.0E+01	5.4E+00
Te	1.0E+01	1.0E+02
I	1.0E+01	5.0E+01
Cs	4.0E+01	2.5E+01
Ba	1.0E+01	1.0E+02
La	2.5E+01	1.0E+03
Ce	1.0E+01	6.0E+02
Pr	2.5E+01	1.0E+03
Nd	2.5E+01	1.0E+03
W	3.0E+01	3.0E+01
Np	1.0E+01	1.0E+01
As	3.3E+02	3.3E+02

* Values in this table are taken from Regulatory Guide 1.109 except for phosphorus (fish) which is adapted from NUREG/CR-1336 and silver, arsenic and antimony which are taken from UCRL 50564, Rev. 1, October 1972.

FIGURE 2-1

GASEOUS RADWASTE TREATMENT SYSTEM

25
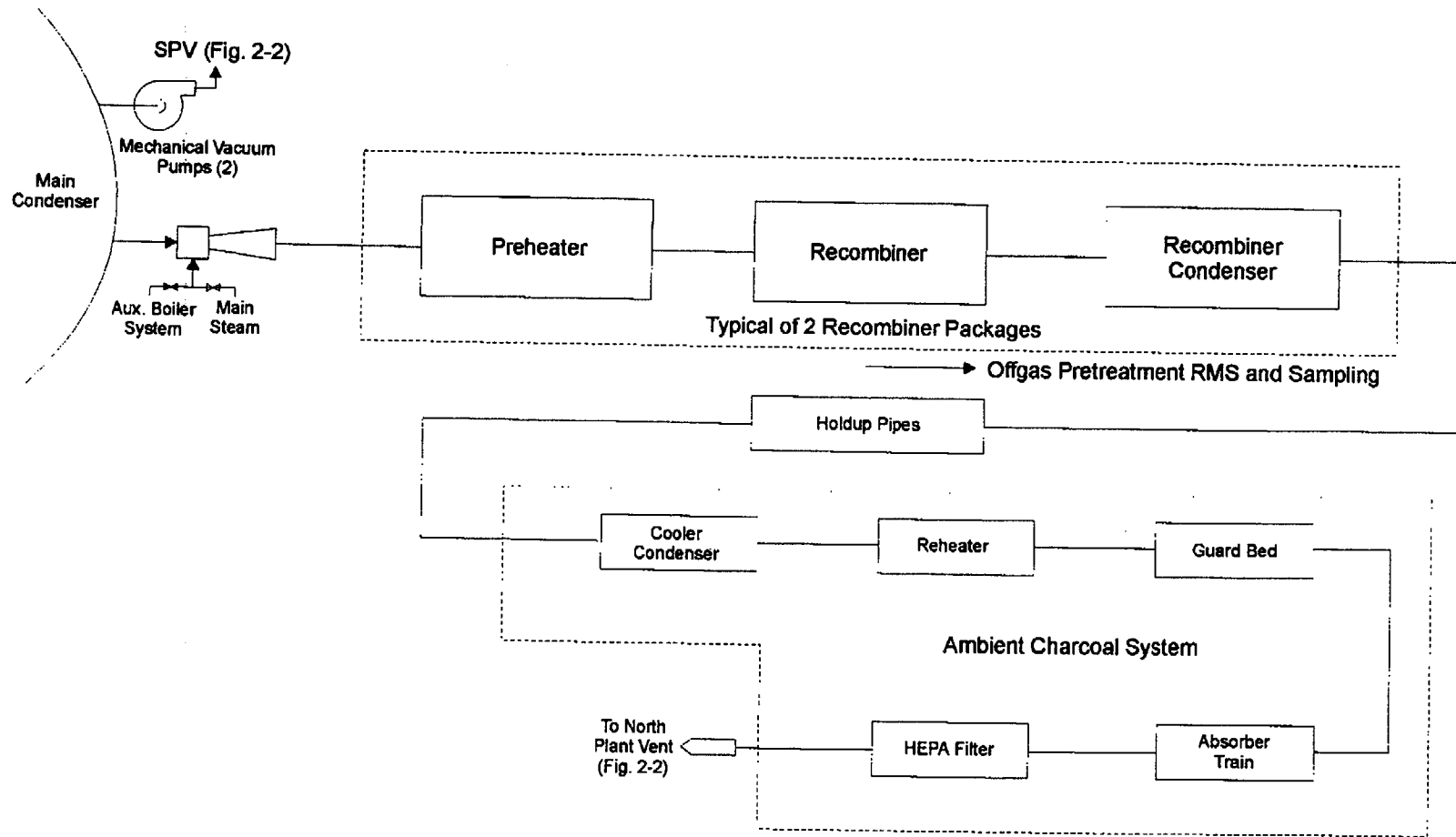
FIGURE 2-2
VENTILATION EXHAUST TREATMENT SYSTEM

R = Roughing Filter   H = HEPA Filter
C = Charcoal Filter   RE = Radiation Effluent Monitor
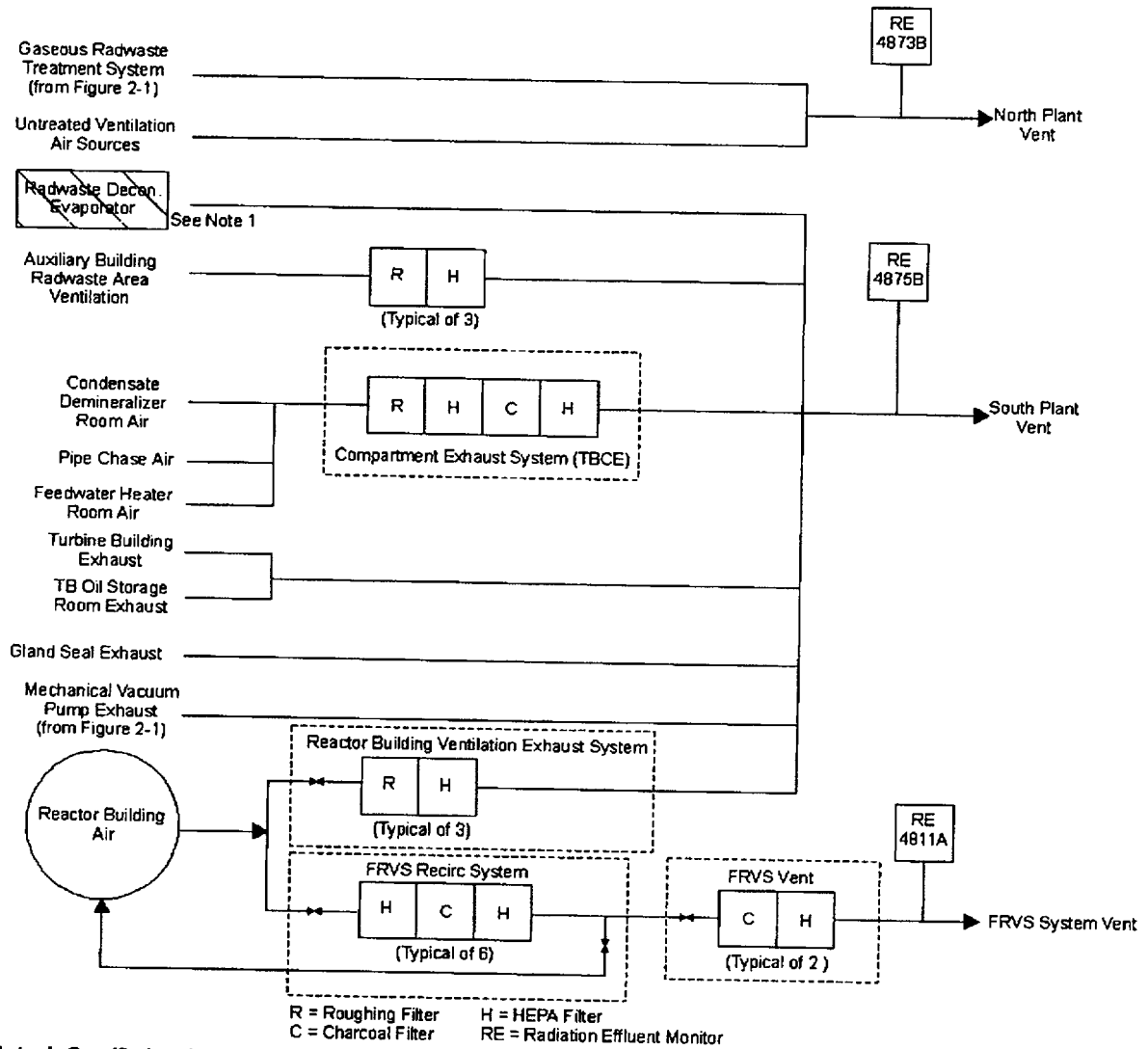
Note 1: Specified equipment is installed but not in use.
        Equipment pending abandonment per DCP 4EC-3634.

26

TABLE 2-1

DOSE FACTORS FOR NOBLE GASES

Radionuclide	Total Body Dose Factor Ki (mrem/yr per uCi/m3)	Skin Dose Factor Li (mrem/yr per uCi/m3)	Gamma Air Dose Factor Mi (mrad/yr per uCi/m3)	Beta Air Dose Factor Ni (mrad/yr per uCi/m3
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

TABLE 2-2
PARAMETERS FOR GASEOUS ALARM
SETPOINT DETERMINATION HOPE CREEK

Parameter	Actual Value	Default Value	Units	Comments
X/Q	Calculated	2.67E-6	sec/m3	From FSAR Table 2.3-31, 0.5 mile, N
VF (NPV)	Measured	41900	ft^3/min	Maximum Operation
VF (SPV)	Measured	440,180	ft^3/min	Maximum Operation
VF (FRVS)	Measured	9000	ft^3/min	Maximum Operation
AF (NPV)	Coordinated with SGS	0.2	Unitless	Administrative allocation factor to ensure release do not exceed
AF (SPV)		0.2	Unitless	release rate limit
AF (FRVS)		0.1	Unitless	
C$_i$ Measured	N/A	uCi/cm^3		
K$_i$ Nuclide	N/A Specific	mrem/yr	Table 2-1 per uCi/m^3	
L$_i$ Nuclide	N/A Specific	mrem/yr	Table 2-1 per uCi/m^3)	
M$_i$ Nuclide	N/A Specific	mrad/yr	Table 2-1 per uCi/m^3	
SP: NPV	Calculated	2.43E-4	uCi/cc	Default alarm Setpoints; more conservative values may be used as deemed appropriate for ensuring ALARA & regulatory compliance
SPV	Calculated	2.31E-5	uCi/cc	
FRVS	Calculated	5.65E-4	uCi/cc	

28

TABLE 2-3

CONTROLLING LOCATIONS, PATHWAYS AND

ATMOSPHERIC DISPERSION FOR DOSE CALCULATIONS*

Tech Spec	Location	Pathway(s)	Age Group	(sec/m3)	(1/m2)
3.11.2.1a	Site Boundary 0.5 Mile, N	Noble Gases direct exposure	N/A	2.67E-06	N/A
3.11.2.1b	Site Boundary 0.5 Mile, N	Inhalation	Child	2.67E-06	N/A
3.11.2.2	Site Boundary 0.5 Mile, N	Gamma-Air Beta-Air	N/A	2.67E-06	N/A
3.11.2.3	Residence/ Dairy - 4.9 Miles, W	Milk, ground plane and inhalation	Infant	7.2E-08	2.87E-10

*   The identified controlling locations, pathways and atmospheric dispersion are from the Artificial Island Radiological Monitoring Program and the Hope Creek FSAR.

Table 2-4
Pathway Dose Factors - Atmospheric Releases
R(io), Inhalation Pathway Dose Factors - ADULT
(mrem/yr per uCi/m3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3
C-14	1.82E+4	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3
P-32	1.32E+6	7.71E+4	-	-	-	8.64E+4	5.01E+4
Cr-51	-	-	5.95E+1	2.28E+1	1.44E+4	3.32E+3	1.00E+2
Mn-54	-	3.96E+4	-	9.84E+3	1.40E+6	7.74E+4	6.30E+3
Fe-55	2.46E+4	1.70E+4	-	-	7.21E+4	6.03E+3	3.94E+3
Fe-59	1.18E+4	2.78E+4	-	-	1.02E+6	1.88E+5	1.06E+4
Co-57	-	6.92E+2	-	-	3.70E+5	3.14E+4	6.71E+2
Co-58	-	1.58E+3	-	-	9.28E+5	1.06E+5	2.07E+3
Co-60	-	1.15E+4	-	-	5.97E+6	2.85E+5	1.48E+4
Ni-63	4.32E+5	3.14E+4	-	-	1.78E+5	1.34E+4	1.45E+4
Zn-65	3.24E+4	1.03E+5	-	6.90E+4	8.64E+5	5.34E+4	4.66E+4
Rb-86	-	1.35E+5	-	-	-	1.66E+4	5.90E+4
Sr-89	3.04E+5	-	-	-	1.40E+6	3.50E+5	8.72E+3
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+6
Y-91	4.62E+5	-	-	-	1.70E+6	3.85E+5	1.24E+4
Zr-95	1.07E+5	3.44E+4	-	5.42E+4	1.77E+6	1.50E+5	2.33E+4
Nb-95	1.41E+4	7.82E+3	-	7.74E+3	5.05E+5	1.04E+5	4.21E+3
Ru-103	1.53E+3	-	-	5.83E+3	5.05E+5	1.10E+5	6.58E+2
Ru-106	6.91E+4	-	-	1.34E+5	9.36E+6	9.12E+5	8.72E+3
Ag-110m	1.08E+4	1.00E+4	-	1.97E+4	4.63E+6	3.02E+5	5.94E+3
Sb-124	3.12E+4	5.89E+2	7.55E+1	-	2.48E+6	4.06E+5	1.24E+4
Sb-125	5.34E+4	5.95E+2	5.40E+1	-	1.74E+6	1.01E+5	1.26E+4
Te-125m	3.42E+3	1.58E+3	1.05E+3	1.24E+4	3.14E+5	7.06E+4	4.67E+2
Te-127m	1.26E+4	5.77E+3	3.29E+3	4.58E+4	9.60E+5	1.50E+5	1.57E+3
Te-129m	9.76E+3	4.67E+3	3.44E+3	3.66E+4	1.16E+6	3.83E+5	1.58E+3
I-131	2.52E+4	3.58E+4	1.19E+7	6.13E+4	-	6.28E+3	2.05E+4
Cs-134	3.73E+5	8.48E+5	-	2.87E+5	9.76E+4	1.04E+4	7.28E+5
Cs-136	3.90E+4	1.46E+5	-	8.56E+4	1.20E+4	1.17E+4	1.10E+5
Cs-137	4.78E+5	6.21E+5	-	2.22E+5	7.52E+4	8.40E+3	4.28E+5
Ba-140	3.90E+4	4.90E+1	-	1.67E+1	1.27E+6	2.18E+5	2.57E+3
Ce-141	1.99E+4	1.35E+4	-	6.26E+3	3.62E+5	1.20E+5	1.53E+3
Ce-144	3.43E+6	1.43E+6	-	8.48E+5	7.78E+6	8.16E+5	1.84E+5
Pr-143	9.36E+3	3.75E+3	-	2.16E+3	2.81E+5	2.00E+5	4.64E+2
Nd-147	5.27E+3	6.10E+3	-	3.56E+3	2.21E+5	1.73E+5	3.65E+2

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Inhalation Pathway Dose Factors - TEENAGER
(mrem/yr per uCi/m3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3
C-14	2.60E+4	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3
P-32	1.89E+6	1.10E+5	-	-	-	9.28E+4	7.16E+4
Cr-51	-	-	7.50E+1	3.07E+1	2.10E+4	3.00E+3	1.35E+2
Mn-54	-	5.11E+4	-	1.27E+4	1.98E+6	6.68E+4	8.40E+3
Fe-55	3.34E+4	2.38E+4	-	-	1.24E+5	6.39E+3	5.54E+3
Fe-59	1.59E+4	3.70E+4	-	-	1.53E+6	1.78E+5	1.43E+4
Co-57	-	6.92E+2	-	-	5.86E+5	3.14E+4	9.20E+2
Co-58	-	2.07E+3	-	-	1.34E+6	9.52E+4	2.78E+3
Co-60	-	1.51E+4	-	-	8.72E+6	2.59E+5	1.98E+4
Ni-63	5.80E+5	4.34E+4	-	-	3.07E+5	1.42E+4	1.98E+4
Zn-65	3.86E+4	1.34E+5	-	8.64E+4	1.24E+6	4.66E+4	6.24E+4
Rb-86	-	1.90E+5	-	-	-	1.77E+4	8.40E+4
Sr-89	4.34E+5	-	-	-	2.42E+6	3.71E+5	1.25E+4
Sr-90	1.08E+8	-	-	-	1.65E+7	7.65E+5	6.68E+6
Y-91	6.61E+5	-	-	-	2.94E+6	4.09E+5	1.77E+4
Zr-95	1.46E+5	4.58E+4	-	6.74E+4	2.69E+6	1.49E+5	3.15E+4
Nb-95	1.86E+4	1.03E+4	-	1.00E+4	7.51E+5	9.68E+4	5.66E+3
Ru-103	2.10E+3	-	-	7.43E+3	7.83E+5	1.09E+5	8.96E+2
Ru-106	9.84E+4	-	-	1.90E+5	1.61E+7	9.60E+5	1.24E+4
Ag-110m	1.38E+4	1.31E+4	-	2.50E+4	6.75E+6	2.73E+5	7.99E+3
Sb-124	4.30E+4	7.94E+2	9.76E+1	-	3.85E+6	3.98E+5	1.68E+4
Sb-125	7.38E+4	8.08E+2	7.04E+1	-	2.74E+6	9.92E+4	1.72E+4
Te-125m	4.88E+3	2.24E+3	1.40E+3	-	5.36E+5	7.50E+4	6.67E+2
Te-127m	1.80E+4	8.16E+3	4.38E+3	6.54E+4	1.66E+6	1.59E+5	2.18E+3
Te-129m	1.39E+4	6.58E+3	4.58E+3	5.19E+4	1.98E+6	4.05E+5	2.25E+3
I-131	3.54E+4	4.91E+4	1.46E+7	8.40E+4	-	6.49E+3	2.64E+4
Cs-134	5.02E+5	1.13E+6	-	3.75E+5	1.46E+5	9.76E+3	5.49E+5
Cs-136	5.15E+4	1.94E+5	-	1.10E+5	1.78E+4	1.09E+4	1.37E+5
Cs-137	6.70E+5	8.48E+5	-	3.04E+5	1.21E+5	8.48E+3	3.11E+5
Ba-140	5.47E+4	6.70E+1	-	2.28E+1	2.03E+6	2.29E+5	3.52E+3
Ce-141	2.84E+4	1.90E+4	-	8.88E+3	6.14E+5	1.26E+5	2.17E+3
Ce-144	4.89E+6	2.02E+6	-	1.21E+6	1.34E+7	8.64E+5	2.62E+5
Pr-143	1.34E+4	5.31E+3	-	3.09E+3	4.83E+5	2.14E+5	6.62E+2
Nd-147	7.86E+3	8.56E+3	-	5.02E+3	3.72E+5	1.82E+5	5.13E+2

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Inhalation Pathway Dose Factors - CHILD
(mrem/yr per uCi/m3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3
C-14	3.59E+4	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3
P-32	2.60E+6	1.14E+5	-	-	-	4.22E+4	9.88E+4
Cr-51	-	-	8.55E+1	2.43E+1	1.70E+4	1.08E+3	1.54E+2
Mn-54	-	4.29E+4	-	1.00E+4	1.58E+6	2.29E+4	9.51E+3
Fe-55	4.74E+4	2.52E+4	-	-	1.11E+5	2.87E+3	7.77E+3
Fe-59	2.07E+4	3.34E+4	-	-	1.27E+6	7.07E+4	1.67E+4
Co-57	-	9.03E+2	-	-	5.07E+5	1.32E+4	1.07E+3
Co-58	-	1.77E+3	-	-	1.11E+6	3.44E+4	3.16E+3
Co-60	-	1.31E+4	-	-	7.07E+6	9.62E+4	2.26E+4
Ni-63	8.21E+5	4.63E+4	-	-	2.75E+5	6.33E+3	2.80E+4
Zn-65	4.26E+4	1.13E+5	-	7.14E+4	9.95E+5	1.63E+4	7.03E+4
Rb-86	-	1.98E+5	-	-		7.99E+3	1.14E+5
Sr-89	5.99E+5	-	-	-	2.16E+6	1.67E+5	1.72E+4
Sr-90	1.01E+8	-	-	-	1.48E+7	3.43E+5	6.44E+6
Y-91	9.14E+5	-	-	-	2.63E+6	1.84E+5	2.44E+4
Zr-95	1.90E+5	4.18E+4	-	5.96E+4	2.23E+6	6.11E+4	3.70E+4
Nb-95	2.35E+4	9.18E+3	-	8.62E+3	6.14E+5	3.70E+4	6.55E+3
Ru-103	2.79E+3	-	-	7.03E+3	6.62E+5	4.48E+4	1.07E+3
Ru-106	1.36E+5	-	-	1.84E+5	1.43E+7	4.29E+5	1.69E+4
Ag-110m	1.69E+4	1.14E+4	-	2.12E+4	5.48E+6	1.00E+5	9.14E+3
Sb-124	5.74E+4	7.40E+2	1.26E+2	-	3.24E+6	1.64E+5	2.00E+4
Sb-125	9.84E+4	7.59E+2	9.10E+1	-	2.32E+6	4.03E+4	2.07E+4
Te-125m	6.73E+3	2.33E+3	1.92E+3	-	4.77E+5	3.38E+4	9.14E+2
Te-127m	2.49E+4	8.55E+3	6.07E+3	6.36E+4	1.48E+6	7.14E+4	3.02E+3
Te-129m	1.92E+4	6.85E+3	6.33E+3	5.03E+4	1.76E+6	1.82E+5	3.04E+3
I-131	4.81E+4	4.81E+4	1.62E+7	7.88E+4	-	2.84E+3	2.73E+4
Cs-134	6.51E+5	1.01E+6	-	3.30E+5	1.21E+5	3.85E+3	2.25E+5
Cs-136	6.51E+4	1.71E+5	-	9.55E+4	1.45E+4	4.18E+3	1.16E+5
Cs-137	9.07E+5	8.25E+5	-	2.82E+5	1.04E+5	3.62E+3	1.28E+5
Ba-140	7.40E+4	6.48E+1	-	2.11E+1	1.74E+6	1.02E+5	4.33E+3
Ce-141	3.92E+4	1.95E+4	-	8.55E+3	5.44E+5	5.66E+4	2.90E+3
Ce-144	6.77E+6	2.12E+6	-	1.17E+6	1.20E+7	3.89E+5	3.61E+5
Pr-143	1.85E+4	5.55E+3	-	3.00E+3	4.33E+5	9.73E+4	9.14E+2
Nd-147	1.08E+4	8.73E+3	-	4.81E+3	3.28E+5	8.21E+4	6.81E+2

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Inhalation Pathway Dose Factors - INFANT
(mrem/yr per uCi/m3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2
C-14	2.65E+4	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3
P-32	2.03E+6	1.12E+5	-	-	-	1.61E+4	7.74E+4
Cr-51	-	-	5.75E+1	1.32E+1	1.28E+4	3.57E+2	8.95E+1
Mn-54	-	2.53E+4	-	4.98E+3	1.00E+6	7.06E+3	4.98E+3
Fe-55	1.97E+4	1.17E+4	-	-	8.69E+4	1.09E+3	3.33E+3
Fe-59	1.36E+4	2.35E+4	-	-	1.02E+6	2.48E+4	9.48E+3
Co-57	-	6.51E+2	-	-	3.79E+5	4.86E+3	6.41E+2
Co-58	-	1.22E+3	-	-	7.77E+5	1.11E+4	1.82E+3
Co-60	-	8.02E+3	-	-	4.51E+6	3.19E+4	1.18E+4
Ni-63	3.39E+5	2.04E+4	-	-	2.09E+5	2.42E+3	1.16E+4
Zn-65	1.93E+4	6.26E+4	-	3.25E+4	6.47E+5	5.14E+4	3.11E+4
Rb-86	-	1.90E+5	-	-	-	3.04E+3	8.82E+4
Sr-89	3.98E+5	-	-	-	2.03E+6	6.40E+4	1.14E+4
Sr-90	4.09E+7	-	-	-	1.12E+7	1.31E+5	2.59E+6
Y-91	5.88E+5	-	-	-	2.45E+6	7.03E+4	1.57E+4
Zr-95	1.15E+5	2.79E+4	-	3.11E+4	1.75E+6	2.17E+4	2.03E+4
Nb-95	1.57E+4	6.43E+3	-	4.72E+3	4.79E+5	1.27E+4	3.78E+3
Ru-103	2.02E+3	-	-	4.24E+3	5.52E+5	1.61E+4	6.79E+2
Ru-106	8.68E+4	-	-	1.07E+5	1.16E+7	1.64E+5	1.09E+4
Ag-110m	9.98E+3	7.22E+3	-	1.09E+4	3.67E+6	3.30E+4	5.00E+3
Sb-124	3.79E+4	5.56E+2	1.01E+2	-	2.65E+6	5.91E+4	1.20E+4
Sb-125	5.17E+4	4.77E+2	6.23E+1	-	1.64E+6	1.47E+4	1.09E+4
Te-125m	4.76E+3	1.99E+3	1.62E+3	-	4.47E+5	1.29E+4	6.58E+2
Te-127m	1.67E+4	6.90E+3	4.87E+3	3.75E+4	1.31E+6	2.73E+4	2.07E+3
Te-129m	1.41E+4	6.09E+3	5.47E+3	3.18E+4	1.68E+6	6.90E+4	2.23E+3
I-131	3.79E+4	4.44E+4	1.48E+7	5.18E+4	-	1.06E+3	1.96E+4
Cs-134	3.96E+5	7.03E+5	-	1.90E+5	7.97E+4	1.33E+3	7.45E+4
Cs-136	4.83E+4	1.35E+5	-	5.64E+4	1.18E+4	1.43E+3	5.29E+4
Cs-137	5.49E+5	6.12E+5	-	1.72E+5	7.13E+4	1.33E+3	4.55E+4
Ba-140	5.60E+4	5.60E+1	-	1.34E+1	1.60E+6	3.84E+4	2.90E+3
Ce-141	2.77E+4	1.67E+4	-	5.25E+3	5.17E+5	2.16E+4	1.99E+3
Ce-144	3.19E+6	1.21E+6	-	5.38E+5	9.84E+6	1.48E+5	1.76E+5
Pr-143	1.40E+4	5.24E+3	-	1.97E+3	4.33E+5	3.72E+4	6.99E+2
Nd-147	7.94E+3	8.13E+3	-	3.15E+3	3.22E+5	3.12E+4	5.00E+2

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Grass-Cow-Milk Pathway Dose Factors - ADULT
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2
C-14	3.63E+5	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4
P-32	1.71E+10	1.06E+9	-	-	-	1.92E+9	6.60E+8
Cr-51	-	-	1.71E+4	6.30E+3	3.80E+4	7.20E+6	2.86E+4
Mn-54	-	8.40E+6	-	2.50E+6	-	2.57E+7	1.60E+6
Fe-55	2.51E+7	1.73E+7	-	-	9.67E+6	9.95E+6	4.04E+6
Fe-59	2.98E+7	7.00E+7	-	-	1.95E+7	2.33E+8	2.68E+7
Co-57	-	1.28E+6	-	-	-	3.25E+7	2.13E+6
Co-58	-	4.72E+6	-	-	-	9.57E+7	1.06E+7
Co-60	-	1.64E+7	-	-	-	3.08E+8	3.62E+7
Ni-63	6.73E+9	4.66E+8	-	-	-	9.73E+7	2.26E+8
Zn-65	1.37E+9	4.36E+9	-	2.92E+9	-	2.75E+9	1.97E+9
Rb-86	-	2.59E+9	-	-	-	5.11E+8	1.21E+9
Sr-89	1.45E+9	-	-	-	-	2.33E+8	4.16E+7
Sr-90	4.68E+10	-	-	-	-	1.35E+9	1.15E+10
Y-91	8.60E+3	-	-	-	-	4.73E+6	2.30E+2
Zr-95	9.46E+2	3.03E+2	-	4.76E+2	-	9.62E+5	2.05E+2
Nb-95	8.25E+4	4.59E+4	-	4.54E+4	-	2.79E+8	2.47E+4
Ru-103	1.02E+3	-	-	3.89E+3	-	1.19E+5	4.39E+2
Ru-106	2.04E+4	-	-	3.94E+4	-	1.32E+6	2.58E+3
Ag-110m	5.83E+7	5.39E+7	-	1.06E+8	-	2.20E+10	3.20E+7
Sb-124	2.57E+7	4.86E+5	6.24E+4	-	2.00E+7	7.31E+8	1.02E+7
Sb-125	2.04E+7	2.28E+5	2.08E+4	-	1.58E+7	2.25E+8	4.86E+6
Te-125m	1.63E+7	5.90E+6	4.90E+6	6.63E+7	-	6.50E+7	2.18E+6
Te-127m	4.58E+7	1.64E+7	1.17E+7	1.86E+8	-	1.54E+8	5.58E+6
Te-129m	6.04E+7	2.25E+7	2.08E+7	2.52E+8	-	3.04E+8	9.57E+6
I-131	2.96E+8	4.24E+8	1.39E+11	7.27E+8	-	1.12E+8	2.43E+8
Cs-134	5.65E+9	1.34E+10	-	4.35E+9	1.44E+9	2.35E+8	1.10E+10
Cs-136	2.61E+8	1.03E+9	-	5.74E+8	7.87E+7	1.17E+8	7.42E+8
Cs-137	7.38E+9	1.01E+10	-	3.43E+9	1.14E+9	1.95E+8	6.61E+9
Ba-140	2.69E+7	3.38E+4	-	1.15E+4	1.93E+4	5.54E+7	1.76E+6
Ce-141	4.84E+3	3.27E+3	-	1.52E+3	-	1.25E+7	3.71E+2
Ce-144	3.58E+5	1.50E+5	-	8.87E+4	-	1.21E+8	1.92E+4
Pr-143	1.59E+2	6.37E+1	-	3.68E+1	-	6.96E+5	7.88E+0
Nd-147	9.42E+1	1.09E+2	-	6.37E+1	-	5.23E+5	6.52E+0

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Grass-Cow-Milk Pathway Dose Factors - TEENAGER
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2
C-14	6.70E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5
P-32	3.15E+10	1.95E+9	-	-	-	2.65E+9	1.22E+9
Cr-51	-	-	2.78E+4	1.10E+4	7.13E+4	8.40E+6	5.00E+4
Mn-54	-	1.40E+7	-	4.17E+6	-	2.87E+7	2.78E+6
Fe-55	4.45E+7	3.16E+7	-	-	2.00E+7	1.37E+7	7.36E+6
Fe-59	5.20E+7	1.21E+8	-	-	3.82E+7	2.87E+8	4.68E+7
Co-57	-	2.25E+6	-	-	-	4.19E+7	3.76E+6
Co-58	-	7.95E+6	-	-	-	1.10E+8	1.83E+7
Co-60	-	2.78E+7	-	-	-	3.62E+8	6.26E+7
Ni-63	1.18E+10	8.35E+8	-	-	-	1.33E+8	4.01E+8
Zn-65	2.11E+9	7.31E+9	-	4.68E+9	-	3.10E+9	3.41E+9
Rb-86	-	4.73E+9	-	-	-	7.00E+8	2.22E+9
Sr-89	2.67E+9	-	-	-	-	3.18E+8	7.66E+7
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+6
Y-91	1.58E+4	-	-	-	-	6.48E+6	4.24E+2
Zr-95	1.65E+3	5.22E+2	-	7.67E+2	-	1.20E+6	3.59E+2
Nb-95	1.41E+5	7.80E+4	-	7.57E+4	-	3.34E+8	4.30E+4
Ru-103	1.81E+3	-	-	6.40E+3	-	1.52E+5	7.75E+2
Ru-106	3.75E+4	-	-	7.23E+4	-	1.80E+6	4.73E+3
Ag-110m	9.63E+7	9.11E+7	-	1.74E+8	-	2.56E+10	5.54E+7
Sb-124	4.59E+7	8.46E+5	1.04E+5	-	4.01E+7	9.25E+8	1.79E+7
Sb-125	3.65E+7	3.99E+5	3.49E+4	-	3.21E+7	2.84E+8	8.54E+6
Te-125m	3.00E+7	1.08E+7	8.39E+6	-	-	8.86E+7	4.02E+6
Te-127m	8.44E+7	2.99E+7	2.01E+7	3.42E+8	-	2.10E+8	1.00E+7
Te-129m	1.11E+8	4.10E+7	3.57E+7	4.62E+8	-	4.15E+8	1.75E+7
I-131	5.38E+8	7.53E+8	2.20E+11	1.30E+9	-	1.49E+8	4.04E+8
Cs-134	9.81E+9	2.31E+10	-	7.34E+9	2.80E+9	2.87E+8	1.07E+10
Cs-136	4.45E+8	1.75E+9	-	9.53E+8	1.50E+8	1.41E+8	1.18E+9
Cs-137	1.34E+10	1.78E+10	-	6.06E+9	2.35E+9	2.53E+8	6.20E+9
Ba-140	4.85E+7	5.95E+4	-	2.02E+4	4.00E+4	7.49E+7	3.13E+6
Ce-141	8.87E+3	1.35E+4	-	2.79E+3	-	1.69E+7	6.81E+2
Ce-144	6.58E+5	2.72E+5	-	1.63E+5	-	1.66E+8	3.54E+4
Pr-143	2.92E+2	1.17E+2	-	6.77E+1	-	9.61E+5	1.45E+1
Nd-147	1.81E+2	1.97E+2	-	1.16E+2	-	7.11E+5	1.18E+1

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Grass-Cow-Milk Pathway Dose Factors - CHILD
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3
C-14	1.65E+6	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5
P-32	7.77E+10	3.64E+9	-	-	-	2.15E+9	3.00E+9
Cr-51	-	-	5.66E+4	1.55E+4	1.03E+5	5.41E+6	1.02E+5
Mn-54	-	2.09E+7	-	5.87E+6	-	1.76E+7	5.58E+6
Fe-55	1.12E+8	5.93E+7	-	-	3.35E+7	1.10E+7	1.84E+7
Fe-59	1.20E+8	1.95E+8	-	-	5.65E+7	2.03E+8	9.71E+7
Co-57	-	3.84E+6	-	-	-	3.14E+7	7.77E+6
Co-58	-	1.21E+7	-	-	-	7.08E+7	3.72E+7
Co-60	-	4.32E+7	-	-	-	2.39E+8	1.27E+8
Ni-63	2.96E+10	1.59E+9	-	-	-	1.07E+8	1.01E+9
Zn-65	4.13E+9	1.10E+10	-	6.94E+9	-	1.93E+9	6.85E+9
Rb-86	-	8.77E+9	-	-	-	5.64E+8	5.39E+9
Sr-89	6.62E+9	-	-	-	-	2.56E+8	1.89E+8
Sr-90	1.12E+11	-	-	-	-	1.51E+9	2.83E+10
Y-91	3.91E+4	-	-	-	-	5.21E+6	1.04E+3
Zr-95	3.84E+3	8.45E+2	-	1.21E+3	-	8.81E+5	7.52E+2
Nb-95	3.18E+5	1.24E+5	-	1.16E+5	-	2.29E+8	8.84E+4
Ru-103	4.29E+3	-	-	1.08E+4	-	1.11E+5	1.65E+3
Ru-106	9.24E+4	-	-	1.25E+5	-	1.44E+6	1.15E+4
Ag-110m	2.09E+8	1.41E+8	-	2.63E+8	-	1.68E+10	1.13E+8
Sb-124	1.09E+8	1.41E+8	2.40E+5	-	6.03E+7	6.79E+8	3.81E+7
Sb-125	8.70E+7	1.41E+6	8.06E+4	-	4.85E+7	2.08E+8	1.82E+7
Te-125m	7.38E+7	2.00E+7	2.07E+7	-	-	7.12E+7	9.84E+6
Te-127m	2.08E+8	5.60E+7	4.97E+7	5.93E+8	-	1.68E+8	2.47E+7
Te-129m	2.72E+8	7.61E+7	8.78E+7	8.00E+8	-	3.32E+8	4.23E+7
I-131	1.30E+9	1.31E+9	4.34E+11	2.15E+9	-	1.17E+8	7.46E+8
Cs-134	2.26E+10	3.71E+10	-	1.15E+10	4.13E+9	2.00E+8	7.83E+9
Cs-136	1.00E+9	2.76E+9	-	1.47E+9	2.19E+8	9.70E+7	1.79E+9
Cs-137	3.22E+10	3.09E+10	-	1.01E+10	3.62E+9	1.93E+8	4.55E+9
Ba-140	1.17E+8	1.03E+5	-	3.34E+4	6.12E+4	5.94E+7	6.84E+6
Ce-141	2.19E+4	1.09E+4	-	4.78E+3	-	1.36E+7	1.62E+3
Ce-144	1.62E+6	5.09E+5	-	2.82E+5	-	1.33E+8	8.66E+4
Pr-143	7.23E+2	2.17E+2	-	1.17E+2	-	7.80E+5	3.59E+1
Nd-147	4.45E+2	3.60E+2	-	1.98E+2	-	5.71E+5	2.79E+1

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Grass-Cow-Milk Pathway Dose Factors - INFANT
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3
C-14	3.23E+6	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5
P-32	1.60E+11	9.42E+9	-	-	-	2.17E+9	6.21E+9
Cr-51	-	-	1.05E+5	2.30E+4	2.05E+5	4.71E+6	1.61E+5
Mn-54	-	3.89E+7	-	8.63E+6	-	1.43E+7	8.83E+6
Fe-55	1.35E+8	8.72E+7	-	-	4.27E+7	1.11E+7	2.33E+7
Fe-59	2.25E+8	3.93E+8	-	-	1.16E+8	1.88E+8	1.55E+8
Co-57	-	8.95E+6	-	-	-	3.05E+7	1.46E+7
Co-58	-	2.43E+7	-	-	-	6.05E+7	6.06E+7
Co-60	-	8.81E+7	-	-	-	2.10E+8	2.08E+8
Ni-63	3.49E+10	2.16E+9	-	-	-	1.07E+8	1.21E+9
Zn-65	5.55E+9	1.90E+10	-	9.23E+9	-	1.61E+10	8.78E+9
Rb-86	-	2.22E+10	-	-	-	5.69E+8	1.10E+10
Sr-89	1.26E+10	-	-	-	-	2.59E+8	3.61E+8
Sr-90	1.22E+11	-	-	-	-	1.52E+9	3.10E+10
Y-91	7.33E+4	-	-	-	-	5.26E+6	1.95E+3
Zr-95	6.83E+3	1.66E+3	-	1.79E+3	-	8.28E+5	1.18E+3
Nb-95	5.93E+5	2.44E+5	-	1.75E+5	-	2.06E+8	1.41E+5
Ru-103	8.69E+3	-	-	1.81E+4	-	1.06E+5	2.91E+3
Ru-106	1.90E+5	-	-	2.25E+5	-	1.44E+6	2.38E+4
Ag-110m	3.86E+8	2.82E+8	-	4.03E+8	-	1.46E+10	1.86E+8
Sb-124	2.09E+8	3.08E+6	5.56E+5	-	1.31E+8	6.46E+8	6.49E+7
Sb-125	1.49E+8	1.45E+6	1.87E+5	-	9.38E+7	1.99E+8	3.07E+7
Te-125m	1.51E+8	5.04E+7	5.07E+7	-	-	7.18E+7	2.04E+7
Te-127m	4.21E+8	1.40E+8	1.22E+8	1.04E+9	-	1.70E+8	5.10E+7
Te-129m	5.59E+8	1.92E+8	2.15E+8	1.40E+9	-	3.34E+8	8.62E+7
I-131	2.72E+9	3.21E+9	1.05E+12	3.75E+9	-	1.15E+8	1.41E+9
Cs-134	3.65E+10	6.80E+10	-	1.75E+10	7.18E+9	1.85E+8	6.87E+9
Cs-136	1.96E+9	5.77E+9	-	2.30E+9	4.70E+8	8.76E+7	2.15E+9
Cs-137	5.15E+10	6.02E+10	-	1.62E+10	6.55E+9	1.88E+8	4.27E+9
Ba-140	2.41E+8	2.41E+5	-	5.73E+4	1.48E+5	5.92E+7	1.24E+7
Ce-141	4.33E+4	2.64E+4	-	8.15E+3	-	1.37E+7	3.11E+3
Ce-144	2.33E+6	9.52E+5	-	3.85E+5	-	1.33E+8	1.30E+5
Pr-143	1.49E+3	5.59E+2	-	2.08E+2	-	7.89E+5	7.41E+1
Nd-147	8.82E+2	9.06E+2	-	3.49E+2	-	5.74E+5	5.55E+1

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Vegetation Pathway Dose Factors - ADULT
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3
C-14	8.97E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5
P-32	1.40E+9	8.73E+7	-	-	-	1.58E+8	5.42E+7
Cr-51	-	-	2.79E+4	1.03E+4	6.19E+4	1.17E+7	4.66E+4
Mn-54	-	3.11E+8	-	9.27E+7	-	9.54E+8	5.94E+7
Fe-55	2.09E+8	1.45E+8	-	-	8.06E+7	8.29E+7	3.37E+7
Fe-59	1.27E+8	2.99E+8	-	-	8.35E+7	9.96E+8	1.14E+8
Co-57	-	1.17E+7	-	-	-	2.97E+8	1.95E+7
Co-58	-	3.09E+7	-	-	-	6.26E+8	6.92E+7
Co-60	-	1.67E+8	-	-	-	3.14E+9	3.69E+8
Ni-63	1.04E+10	7.21E+8	-	-	-	1.50E+8	3.49E+8
Zn-65	3.17E+8	1.01E+9	-	6.75E+8	-	6.36E+8	4.56E+8
Rb-86	-	2.19E+8	-	-	-	4.32E+7	1.02E+8
Sr-89	9.96E+9	-	-	-	-	1.60E+9	2.86E+8
Sr-90	6.05E+11	-	-	-	-	1.75E+10	1.48E+10
Y-91	5.13E+6	-	-	-	-	2.82E+9	1.37E+5
Zr-95	1.19E+6	3.81E+5	-	5.97E+5	-	1.21E+9	2.58E+5
Nb-95	1.42E+5	7.91E+4	-	7.81E+4	-	4.80E+8	4.25E+4
Ru-103	4.80E+6	-	-	1.83E+7	-	5.61E+8	2.07E+6
Ru-106	1.93E+8	-	-	3.72E+8	-	1.25E+10	2.44E+7
Ag-110m	1.06E+7	9.76E+6	-	1.92E+7	-	3.98E+9	5.80E+6
Sb-124	1.04E+8	1.96E+6	2.52E+5	-	8.08E+7	2.95E+9	4.11E+7
Sb-125	1.36E+8	1.52E+6	1.39E+5	-	1.05E+8	1.50E+9	3.25E+7
Te-125m	9.66E+7	3.50E+7	2.90E+7	3.93E+8	-	3.86E+8	1.29E+7
Te-127m	3.49E+8	1.25E+8	8.92E+7	1.42E+9	-	1.17E+9	4.26E+7
Te-129m	2.55E+8	9.50E+7	8.75E+7	1.06E+9	-	1.28E+9	4.03E+7
I-131	8.09E+7	1.16E+8	3.79E+10	1.98E+8	-	3.05E+7	6.63E+7
Cs-134	4.66E+9	1.11E+10	-	3.59E+9	1.19E+9	1.94E+8	9.07E+9
Cs-136	4.20E+7	1.66E+8	-	9.24E+7	1.27E+7	1.89E+7	1.19E+8
Cs-137	6.36E+9	8.70E+9	-	2.95E+9	9.81E+8	1.68E+8	5.70E+9
Ba-140	1.29E+8	1.62E+5	-	5.49E+4	9.25E+4	2.65E+8	8.43E+6
Ce-141	1.96E+5	1.33E+5	-	6.17E+4	-	5.08E+8	1.51E+4
Ce-144	3.29E+7	1.38E+7	-	8.16E+6	-	1.11E+10	1.77E+6
Pr-143	6.34E+4	2.54E+4	-	1.47E+4	-	2.78E+8	3.14E+3
Nd-147	3.34E+4	3.86E+4	-	2.25E+4	-	1.85E+8	2.31E+3

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Vegetation Pathway Dose Factors - TEENAGER
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3
C-14	1.45E+6	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5
P-32	1.61E+9	9.96E+7	-	-	-	1.35E+8	6.23E+7
Cr-51	-	-	3.44E+4	1.36E+4	8.85E+4	1.04E+7	6.20E+4
Mn-54	-	4.52E+8	-	1.35E+8	-	9.27E+8	8.97E+7
Fe-55	3.25E+8	2.31E+8	-	-	1.46E+8	9.98E+7	5.38E+7
Fe-59	1.81E+8	4.22E+8	-	-	1.33E+8	9.98E+8	1.63E+8
Co-57	-	1.79E+7	-	-	-	3.34E+8	3.00E+7
Co-58	-	4.38E+7	-	-	-	6.04E+8	1.01E+8
Co-60	-	2.49E+8	-	-	-	3.24E+9	5.60E+8
Ni-63	1.61E+10	1.13E+9	-	-	-	1.81E+8	5.45E+8
Zn-65	4.24E+8	1.47E+9	-	9.41E+8	-	6.23E+8	6.86E+8
Rb-86	-	2.73E+8	-	-	-	4.05E+7	1.28E+8
Sr-89	1.51E+10	-	-	-	-	1.80E+9	4.33E+8
Sr-90	7.51E+11	-	-	-	-	2.11E+10	1.85E+11
Y-91	7.87E+6	-	-	-	-	3.23E+9	2.11E+5
Zr-95	1.74E+6	5.49E+5	-	8.07E+5	-	1.27E+9	3.78E+5
Nb-95	1.92E+5	1.06E+5	-	1.03E+5	-	4.55E+8	5.86E+4
Ru-103	6.87E+6	-	-	2.42E+7	-	5.74E+8	2.94E+6
Ru-106	3.09E+8	-	-	5.97E+8	-	1.48E+10	3.90E+7
Ag-110m	1.52E+7	1.44E+7	-	2.74E+7	-	4.04E+9	8.74E+6
Sb-124	1.55E+8	2.85E+6	3.51E+5	-	1.35E+8	3.11E+9	6.03E+7
Sb-125	2.14E+8	2.34E+6	2.04E+5	-	1.88E+8	1.66E+9	5.00E+7
Te-125m	1.48E+8	5.34E+7	4.14E+7	-	-	4.37E+8	1.98E+7
Te-127m	5.51E+8	1.96E+8	1.31E+8	2.24E+9	-	1.37E+9	6.56E+7
Te-129m	3.67E+8	1.36E+8	1.18E+8	1.54E+9	-	1.38E+9	5.81E+7
I-131	7.70E+7	1.08E+8	3.14E+10	1.85E+8	-	2.13E+7	5.79E+7
Cs-134	7.09E+9	1.67E+10	-	5.30E+9	2.02E+9	2.08E+8	7.74E+9
Cs-136	4.29E+7	1.69E+8	-	9.19E+7	1.45E+7	1.36E+7	1.13E+8
Cs-137	1.01E+10	1.35E+10	-	4.59E+9	1.78E+9	1.92E+8	4.69E+9
Ba-140	1.38E+8	1.69E+5	-	5.75E+4	1.14E+5	2.13E+8	8.91E+6
Ce-141	2.82E+5	1.88E+5	-	8.86E+4	-	5.38E+8	2.16E+4
Ce-144	5.27E+7	2.18E+7	-	1.30E+7	-	1.33E+10	2.83E+6
Pr-143	7.12E+4	2.84E+4	-	1.65E+4	-	2.34E+8	3.55E+3
Nd-147	3.63E+4	3.94E+4	-	2.32E+4	-	1.42E+8	2.36E+3

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Vegetation Pathway Dose Factors - CHILD
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3
C-14	3.50E+6	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5
P-32	3.37E+9	1.58E+8	-	-	-	9.30E+7	1.30E+8
Cr-51	-	-	6.54E+4	1.79E+4	1.19E+5	6.25E+6	1.18E+5
Mn-54	-	6.61E+8	-	1.85E+8	-	5.55E+8	1.76E+8
Fe-55	8.00E+8	4.24E+8	-	-	2.40E+8	7.86E+7	1.31E+8
Fe-59	4.01E+8	6.49E+8	-	-	1.88E+8	6.76E+8	3.23E+8
Co-57	-	2.99E+7	-	-	-	2.45E+8	6.04E+7
Co-58	-	6.47E+7	-	-	-	3.77E+8	1.98E+8
Co-60	-	3.78E+8	-	-	-	2.10E+9	1.12E+9
Ni-63	3.95E+10	2.11E+9	-	-	-	1.42E+8	1.34E+9
Zn-65	8.12E+8	2.16E+9	-	1.36E+9	-	3.80E+8	1.35E+9
Rb-86	-	4.52E+8	-	-	-	2.91E+7	2.78E+8
Sr-89	3.59E+10	-	-	-	-	1.39E+9	1.03E+9
Sr-90	1.24E+12	-	-	-	-	1.67E+10	3.15E+11
Y-91	1.87E+7	-	-	-	-	2.49E+9	5.01E+5
Zr-95	3.90E+6	8.58E+5	-	1.23E+6	-	8.95E+8	7.64E+5
Nb-95	4.10E+5	1.59E+5	-	1.50E+5	-	2.95E+8	1.14E+5
Ru-103	1.55E+7	-	-	3.89E+7	-	3.99E+8	5.94E+6
Ru-106	7.45E+8	-	-	1.01E+9	-	1.16E+10	9.30E+7
Ag-110m	3.22E+7	2.17E+7	-	4.05E+7	-	2.58E+9	1.74E+7
Sb-124	3.52E+8	4.57E+6	7.78E+5	-	1.96E+8	2.20E+9	1.23E+8
Sb-125	4.99E+8	3.85E+6	4.62E+5	-	2.78E+8	1.19E+9	1.05E+8
Te-125m	3.51E+8	9.50E+7	9.84E+7	-	-	3.38E+8	4.67E+7
Te-127m	1.32E+9	3.56E+8	3.16E+8	3.77E+9	-	1.07E+9	1.57E+8
Te-129m	8.54E+8	2.39E+8	2.75E+8	2.51E+9	-	1.04E+9	1.33E+8
I-131	1.43E+8	1.44E+8	4.76E+10	2.36E+8	-	1.28E+7	8.18E+7
Cs-134	1.60E+10	2.63E+10	-	8.14E+9	2.92E+9	1.42E+8	5.54E+9
Cs-136	8.06E+7	2.22E+8	-	1.18E+8	1.76E+7	7.79E+6	1.43E+8
Cs-137	2.39E+10	2.29E+10	-	7.46E+9	2.68E+9	1.43E+8	3.38E+9
Ba-140	2.77E+8	2.43E+5	-	7.90E+4	1.45E+5	1.40E+8	1.62E+7
Ce-141	6.35E+5	3.26E+5	-	1.43E+5	-	4.07E+8	4.84E+4
Ce-144	1.27E+8	3.98E+7	-	2.21E+7	-	1.04E+10	6.78E+6
Pr-143	1.48E+5	4.46E+4	-	2.41E+4	-	1.60E+8	7.37E+3
Nd-147	7.16E+4	5.80E+4	-	3.18E+4	-	9.18E+7	4.49E+3

40

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Ground Plane Pathway Dose Factors
(m2 * mrem/yr per uCi/sec)

Nuclide	Any Organ
H-3	-
C-14	-
P-32	-
Cr-51	4.68E+6
Mn-54	1.34E+9
Fe-55	-
Fe-59	2.75E+8
Co-58	3.82E+8
Co-60	2.16E+10
Ni-63	-
Zn-65	7.45E+8
Rb-86	8.98E+6
Sr-89	2.16E+4
Sr-90	-
Y-91	1.08E+6
Zr-95	2.48E+8
Nb-95	1.36E+8
Ru-103	1.09E+8
Ru-105	4.21E+8
Ag-110m	3.47E+9
Te-125m	1.55E+6
Te-127m	9.17E+4
Te-129m	2.00E+7
I-131	1.72E+7
Cs-134	6.75E+9
Cs-136	1.49E+8
Cs-137	1.04E+10
Ba-140	2.05E+7
Ce-141	1.36E+7
Ce-144	6.95E+7
Pr-143	-
Nd-147	8.40E+6

41

APPENDIX A

EVALUATION OF DEFAULT MPC VALUES

FOR LIQUID EFFLUENTS

APPENDIX A

Evaluation of Default MPC Value

for Liquid Radwaste Effluent Radiation Monitors

In accordance with the requirements of Technical Specification 3.3.7.10 the radioactive effluent monitors shall be operable with alarm setpoints established to ensure that the concentration of radioactive material at the discharge point does not exceed the MPC value of 10 CFR 20, Appendix B, Table II, Column 2 (Appendix F). The determination of allowable radionuclide concentration and corresponding alarm setpoint is a function of the individual monitor.

In order to limit the need for routinely having to reestablish the alarm setpoints as a function of changing radionuclide distributions, a default alarm setpoint can be established. This default setpoint can be based on an evaluation of the radionuclide distribution from the 1993 to 1995 release data of the liquid effluents from Hope Creek and the effective MPC value for this distribution.

The effective MPC value for a radionuclide distribution is calculated by the equation:

$$MPC_e = \frac{\Sigma \, C_i \, \text{(gamma)}}{\Sigma \, \dfrac{C_i \, \text{(gamma)}}{MPC_i}} \qquad \text{(A.1)}$$

where:

MPC_e = an effective MPC value for a mixture of radionuclides (uCi/ml)
C_i = concentration of radionuclide i in the mixture
MPC_i = the 10 CFR 20, Appendix B, Table II, Column II MPC value for radionuclide i
      (uCi/ml) Appendix F

Considering the average effective MPC values from 1993 thru 1995 releases it is reasonable to select an MPC value of 7.92E-05 uCi/ml as typical of liquid radwaste discharges. This value will be reviewed and adjusted as necessary based on the distribution history of effluents from Hope Creek. Using the value of 7.92E-5 uCi/ml to calculate the default alarm setpoint, results in a setpoint that:

(1) Will not require frequent re-adjustment due to minor variations in the nuclide distribution which are typical of routine plant operations, and;

A-2

(2) Will provide for a liquid radwaste discharge rate (as evaluated for each batch release) that is compatible with plant operations (Refer to Table 1-1).

1.0 Default Setpoint Determination:

Conservative alarm setpoints can be determined through the use of default parameters. Table 1-1 summarizes all current default values in use for Hope Creek.

A. Liquid Radwaste Monitor (RE4861)

$$SP < \frac{MPC_e \ * \ CTBD \ * \ [1 - CF]}{RR} \ + bkg \quad (1.2)$$

Default values from Table 1-1:

MPC_e = 7.92E-5 uci/ml
CTBD = 12000 gpm
RR = 176 gpm (1300 CST)
Bkg = 0 uci/ml
CF = 0.8

$$SP < \frac{7.92E\text{-}5 \ * \ 12000 \ * \ 0.2}{176} \ + 0$$

SP < 1.08E-3 uci/ml

Correction Factor:

A correction factor must be applied to the default setpoint calculation in order to account for radiation monitor uncertainties and the contribution of non-gamma emitting radionuclides such as H-3, Sr, and Fe.

a. Radiation Monitor Inaccuracies:

Hope Creek PSBP 311649 lists a total loop accuracy of 30% for the liquid radwaste radiation monitors. A factor of 0.30 is applied to the default setpoint to ensure the trip setpoint is reached before the analytical limit is obtained.

A-3

<u>b.</u> Non-Gamma Emitting Radionuclides:

Non-gamma emitting radionuclides are analyzed on a monthly and quarterly basis from composite samples of liquid radwaste releases.

Nuclide	MPC (uci.ml)	Activity (uci.ml)	Activity / MPC
H-3	3E-3	1.0E-1	33.3
Fe-55	8E-4	4.7E-4	0.59
Sr-89	3E-6	1.6E-6	0.53
Sr-90	3E-7	2.0E-8	0.07
Total			34.5

The values in the table above represent the historical maximum reactor coolant values for non-gamma emitting nuclides (H3 is an assumed maximum). Reactor coolant values were chosen to represent the maximum concentration of non-gamma emitting radionuclides that could be released from Hope Creek station in liquid effluent. The activity values in the table is further diluted by a minimum factor of 68 prior to release to the Delaware River. The minimum dilution factor is obtained by using the minimum cooling tower blowdown flowrate of 12,000 gpm and the maximum release rate of 176 gpm.

A conservative correction factor for non-gamma emitting radionuclides can be obtained by using the highest Activity / MPC fraction and the minimum dilution factor as follows:

Correction Factor (non-gamma) = 34.5 / 68 = 0.5

An overall correction factor can be obtained by adding the correction factor for radiation monitor inaccuracies and non-gamma emitting radionuclides as follows:

Overall Correction factor =   0.3 + 0.5 = 0.8

<u>B.</u> Cooling Tower Blowdown Radiation Monitor (RE8817)

The cooling tower blowdown radiation monitor provides an Alarm only function for releases into the environment. The cooling tower blowdown is the final release point for liquid effluents from Hope Creek station to the Delaware River.

$SP < MPC_e * 0.2$

$SP < 7.92E-5$ uci/ml $* 0.2$

$\underline{\textit{SP} < \textit{1.58E-5 uci/ml (RE8817)}}$

A-4

C. Turbine Building Circulating Water Dewatering Sump Radiation Monitor (RE4557)

The Turbine Building Circulating Water Dewatering Sump Radiation Monitor (RE4557) provides automatic termination of liquid radioactive releases from the Circulating Water Dewatering Sump. The sump pumps discharge to the circulating water system to the cooling tower. Radioactive materials other than tritium are not normally expected to be discharged through this pathway. Plant design and procedures maintain the setpoint at <2 times background radiation levels. Releases from the sump at gamma activity concentrations less than the monitor setpoint are considered continuous releases since inputs to the sump would occur during discharge. Releases of activity above the setpoint may be performed on a batch basis following sampling and analysis of the sump contents. Hope Creek calculation SP-0004 established a setpoint for the monitor at 1.4E-02 uCi/ml based on a postulated release of reactor steam into the sump. Using the MPCe determined for Liquid Radwaste and Cooling Tower Blowdown monitors, a more conservative maximum default value for batch releases can be determined:

$$SP < \frac{MPC_e * CTBD * [1 - CF]}{RR} + bkg \quad (1.2)$$

Default values from Table 1-1:

MPC$_e$ = 7.92E-5 uci/ml
CTBD   = 12000 gpm
RR   = 100 gpm
Bkg   = 0 uci/ml
CF   = 0.8

$$SP < \frac{7.92E-5 * 12000 * 0.2}{100} + 0$$

SP < 1.90E-3 uci/ml (batch releases only)

For **continuous releases**, the maximum setpoint should be less than *2.4E-6 uci/ml* above background to limit dose consequences from this pathway.

A-5

TABLE A-1
CALCULATION OF EFFECTIVE MPC
HOPE CREEK

NUCLIDE	MPC	1993 ACTIVITY RELEASED (Ci)	1994 ACTIVITY RELEASED (Ci)	1995 ACTIVITY RELEASED (Ci)
Na-24	3.0E-05	1.20E-04	N/D	2.15E-05
Cr-51	2.0E-03	1.57E-01	7.91E-02	1.29E-01
Mn-54	1.0E-04	6.30E-02	1.10E-01	4.12E-01
As-76	2.0E-05	1.03E-05	1.62E-04	8.42E-05
Co-58	9.0E-05	1.35E-03	3.04E-03	2.68E-02
Fe-59	5.0E-05	8.74E-03	1.14E-02	1.12E-01
Co-60	3.0E-05	1.15E-02	6.49E-02	8.48E-02
Zn-65	1.0E-04	7.01E-02	7.79E-02	8.77E-02
Ag-110m	3.0E-05	2.16E-03	1.90E-03	7.42E-03
Zr-97	2.0E-05	1.45E-05	N/D	3.45E-05
Tc-99m	3.0E-03	1.79E-03	1.45E-03	8.68E-04
Cs-134	9.0E-06	N/D	1.11E-06	1.51E-04
Cs-137	2.0E-05	4.85E-05	1.33E-05	2.97E-04
Zn-69m	6.0E-05	2.33E-05	7.22E-05	N/D
Nb-97	9.0E-04	4.33E-04	2.32E-04	N/D
In-115m	4.0E-04	N/D	N/D	2.90E-05
H-3	3.0E-03	6.17E+01	3.33E+01	4.61E+01
Fe-55	8.0E-04	4.51E-02	1.86E-01	5.44E-01
Total Curies (Gamma)		3.16E-01	3.50E-01	8.61E-01
SUM (Ci/MPCi) (Gamma)		2.06E+03	4.42E+03	1.07E+04
SUM (Ci/MPCi) (Non-Gamma)		2.06E+04	1.13E+04	1.60E+04
MPCe (uCi/ml)		1.53E-04	**7.92E-05**	8.04E-05

N/D=Not detected

A-6

APPENDIX B

TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS

LIQUID RADIOACTIVE EFFLUENTS

APPENDIX B

Technical Basis for Effective Dose Factors -
Liquid Effluent Releases

The radioactive liquid effluents from Hope Creek from 1993 through 1995 were evaluated to determine the dose contribution of the radionuclide distribution. This analysis was performed to evaluate the use of a limited dose analysis for determining environmental doses, providing a simplified method of determining compliance with the dose limits of Technical Specification 3.11.1.2. For the expected radionuclide distribution of effluent from Hope Creek during 1993 to 1995, the controlling organ is the liver. The calculated liver dose is predominately a function of the Zn-65 and Fe-55 releases. The radionuclides, Zn-65 and Fe-55 also contribute the large majority of the calculated total body dose. The results of this evaluation are presented in Table B-1.

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

For the evaluation of the maximum organ dose, it is conservative to use the Zn-65 dose conversion factor (5.13E5 mrem/hr per uci/ml). By this approach, the maximum organ dose will be overestimated since this nuclide has the highest organ dose fraction of all the radionuclides evaluated. For the total body calculation, the Zn-65 dose factor (2.32E5 mrem/hr per uCi/ml, total body) is the highest among the identified dominant nuclides.

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

Total Body

$$D_{tb} = \frac{8.35E\text{-}04 \; * \; Vol}{CTBD} * A_{inb} * C_i \qquad (B.1)$$

where:

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

A_{itb} = 2.32E5, total body ingestion dose conversion factor for Zn-65 where A is dose conversion factor, i is isotope which is Zn-65, and TB is the total body (mrem/hr per uCi/ml)

VOL = volume of liquid effluent released (gal)

C_i = total concentration of all radionuclides (uCi/ml)

CTBD = average cooling tower blowdown discharge rate during release period (gal/min)

8.35E-04 = conversion factor (1.67E-2 hr/min) and the near field dilution factor 0.05

Substituting the value for the Zn-65 total body dose conversion factor, the equation simplified to:

$$D_{tb} = \frac{1.94E+2 * VOL}{CTBD} * \Sigma C_i \qquad \text{(B.2)}$$

Maximum Organ

$$Dmax = \frac{8.35E-4 * VOL * Aio, Liver}{CTBD} * \Sigma C_i \qquad \text{(B.3)}$$

Where:

Dmax = maximum organ dose (mrem)

Aio, Liver = 5.13E5, liver ingestion dose conversion factor for Zn-65 where A is dose conversion factor, i is isotope which is Zn-65 and O is maximum organ which is the liver (mrem/hr per uCi/ml).

Substituting the value for Aio the equation simplifies to:

$$Dmax = \frac{4.28E2 * VOL}{CTBD} * \Sigma C_i \qquad \text{(B.4)}$$

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

B-3

Near Field Dilution Factor

The near field dilution factor stems from NUREG-0133, Section 4.1. For plants with cooling towers, such as Hope Creek, a dilution factor is applicable so that the product of the average blowdown flow (in CFS) and the dilution factor is 1000 cfs or less. The average minimum cooling tower blowdown for Hope Creek is 1.90E4 GPM (from FSAR 11.2). This converts to 42 CFS, for conservatism a dilution factor of 20 will be used, giving a dilution flow of 880 CFS. This near field dilution factor of 20 is inverted to a multiple of 0.05, multiplied times the liquid effluent dose equations.

TABLE B-1
Adult Dose Contributions
Fish and Invertebrate Pathways
Hope Creek

Nuclide	Release (Ci)	TB Dose Frac.	GI-LLI Dose Frac.	Liver Dose Frac.	Year
Fe-55	4.51E-2	0.02	0.03	0.04	1993
Fe-55	1.86E-2	0.07	0.08	0.13	1994
Fe-55	5.44E-1	0.15	0.10	0.24	1995
Mn-54	6.30E-2	*	0.04	0.01	1993
Mn-54	1.10E-1	0.01	0.06	0.02	1994
Mn-54	4.12E-1	0.02	0.07	0.03	1995
Co-58	1.35E-3	*	*	*	1993
Co-58	3.04E-3	*	*	*	1994
Co-58	2.68E-2	*	*	*	1995
Fe-59	8.74E-3	0.04	0.18	0.04	1993
Fe-59	1.14E-2	0.04	0.17	0.04	1994
Fe-59	1.12E-1	0.22	0.53	0.22	1995
Co-60	1.15E-2	*	0.01	*	1993
Co-60	6.49E-1	0.01	0.05	*	1994
Co-60	8.48E-2	0.01	0.02	*	1995
Zn-65	7.01E-2	0.93	0.69	0.90	1993
Zn-65	7.79E-2	0.87	0.61	0.81	1994
Zn-65	8.77E-2	0.60	0.23	0.51	1995

* = Less than 0.01

APPENDIX C

TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS

GASEOUS RADIOACTIVE EFFLUENTS

APPENDIX C

**Technical Basis for Effective Dose Factors -
Gaseous Radioactive Effluents**

Overview

The evaluation of doses due to releases of radioactive material to the atmosphere can be simplified by the use of effective dose transfer factors instead of using dose factors which are radionuclide specific. These effective factors, which are based on typical radionuclide distributions of releases, can be applied to the total radioactivity releases to approximate the dose in the environment. Instead of having to perform individual radionuclide dose analysis only a single multiplication (i.e., Keff, Meff, or Neff times the total quantity of radioactive material releases) would be needed. The approach provides a reasonable estimate of the actual dose while eliminating the need for a detailed calculation technique.

Determination of Effective Dose Factors

Effective dose transfer factors are calculated by the following equations:

$$K_{eff} = \Sigma \ (K_i * f_i) \qquad (C.1)$$

Where:

K_{eff} = the effective total body factor due to gamma emissions from all noble gases released.

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

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

$$(L + 1.1M_{eff}) = \Sigma \ ((L_i + 1.1M_i) * f_i) \qquad (C.2)$$

where:

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

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

C-1

$$M_{eff} = \Sigma \ (M_i \ * \ f_i) \qquad\qquad\qquad\qquad (C.3)$$

where:

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

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

$$N_{eff} = \Sigma \ (N_i \ * \ f_i) \qquad\qquad\qquad\qquad (C.4)$$

where:

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

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

Normally, it would be expected that past radioactive effluent data would be used for the determination of the effective dose factors. However, the noble gas releases from Hope Creek have a short history and with continued excellent fuel performance, has hampered efforts in collecting and detecting appreciable noble gas mixes of radionuclides. So, to provide a reasonable basis for the derivation of the effective noble gas dose factors, the source terms from ANSI N237-1976/ANS-18.1, "Source Term Specifications", Table 5 has been used as representing a typical distribution. The effective dose factors as derived are presented in Table C-1.

Application

To provide an additional degree of conservatism, a factor of 0.50 is introduced into the dose calculation process when the effective dose transfer factor is used. This conservatism provides additional assurance that the evaluation of doses by the use of a single effective factor will not significantly underestimate any actual doses in the environment.

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

$$D_g = \frac{3.17E\text{-}08}{0.50} \ * \ X/Q \ * M_{eff} * \ \Sigma \ Q_i \qquad (C.5)$$

$$D_b = \frac{3.17E\text{-}08}{0.50} \ * \ X/Q \ * N_{eff} * \ \Sigma \ Q_i \qquad (C.6)$$

Where:

D_g = air dose due to gamma emissions for the cumulative release of all noble gases (mrad)

D_b = air dose due to beta emissions for the cumulative release of all noble gases (mrad)

X/Q = atmospheric dispersion to the controlling site boundary (sec/m^3)

M_{eff} = 8.1E3, effective gamma-air dose factor (mrad/yr per uCi/m^3)

N_{eff} = 8.5E3, effective beta-air dose factor (mrad/yr per uCi/m^3)

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

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

0.50 = conservatism factor to account for the variability in the effluent data

Combining the constants, the dose calculation equations simplify to:

$$D_g = 5.14E\text{-}4 * X/Q * \Sigma Q_i \qquad \text{(C.7)}$$
$$D_b = 5.39E\text{-}4 * X/Q * \Sigma Q_i \qquad \text{(C.8)}$$

The effective dose factors are to be used on a limited basis for the purpose of facilitating the timely assessment of radioactive effluent releases, particularly during periods of computer malfunction where a detailed dose assessment may be unavailable.

TABLE C-1
Effective Dose Factors

Noble Gases - Total Body and Skin

Radionuclide	f_i	Total Body Effective K_{eff} (mrem/yr per uci/m^3)	Skin Effective $(L + 1.1\ M_{eff})$ (mrem/yr per uci/m^3)
Kr83m	0.01	-----	-----
Kr85m	0.01	1.0E1	2.8E1
Kr87	0.04	2.4E2	6.6E2
Kr88	0.04	5.9E2	7.6E2
Kr89	0.27	4.5E3	7.9E3
Xe133	0.02	5.9E0	1.4E1
Xe135	0.05	9.0E1	2.0E2
Xe135m	0.06	1.9E2	2.6E2
Xe137	0.31	4.4E2	4.3E3
Xe138	0.19	1.7E3	2.7E3
Total		7.8E3	1.7E4

Noble Gases - Air

Radionuclide	f_i	Total Body Effective K_{eff} (mrem/yr per uci/m^3)	Skin Effective $(L + 1.1\ M_{eff})$ (mrem/yr per uci/m^3)
Kr83m	0.01	-----	3.0E0
Kr85m	0.01	1.2E1	2.0E1
Kr87	0.04	2.5E2	4.1E2
Kr88	0.04	6.1E2	1.2E2
Kr89	0.27	4.7E3	2.9E3
Xe133	0.02	7.0E0	2.1E1
Xe135	0.05	9.6E1	1.2E2
Xe135m	0.06	2.0E2	4.4E1
Xe137	0.31	4.7E2	3.9E3
Xe138	0.19	1.8E3	9.0E2
Total		8.1E3	8.4E3

* Based on noble gas distribution from ANSI N237-1976/ANS-18.1, "Source Term Specification".

APPENDIX D

TECHNICAL BASIS FOR EFFECTIVE DOSE PARAMETERS

GASEOUS RADIOACTIVE EFFLUENTS

APPENDIX D

Technical Basis for Effective Dose Parameters

Gaseous Radioactive Effluent Releases

The pathway dose factors for the controlling infant age group were evaluated to determine the controlling pathway, organ and radionuclide. This analysis was performed to provide a simplified method for determining compliance with Technical Specification 3.11.2.3. For the infant age group, the controlling pathway is the grass - cow - milk (g/c/m) pathway. An infant receives a greater radiation dose from the g/c/m pathway than any other pathway. Of this g/c/m pathway, the maximum exposed organ including the total body, is the thyroid, and the highest dose contributor is radionuclide I-131. The results of this evaluation are presented in Table D-1.

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

For the evaluation of the dose commitment via a controlling pathway and age group, it is conservative to use the infant, g/c/m, thyroid, I-131 pathway dose factor ($1.67E12 m^2$*mrem/yr per uCi/sec). By this approach, the maximum dose commitment will be overestimated since I-131 has the highest pathway dose factor of all radionuclides evaluated.

For evaluating compliance with the dose limits of Technical Specification 3.11.2.3, the following simplified equation may be used:

$$D_{max} = 3.17E\text{-}8 * W * RI\text{-}131 * \Sigma\, Q_i \quad (D.1)$$

Where:

D_{max}	= maximum organ dose (mrem)
W	= atmospheric dispersion parameter to the controlling location (s) as identified in Table 2-3.
X/Q	= Atmospheric dispersion for inhalation pathway (sec/m^3)
D/Q	= atmospheric disposition for vegetation, milk and ground plane exposure pathways (m^{-2})
Q_i	= cumulative release over the period of interest for radioiodines and particulates (uCi).
3.17E-8	= conversion factor (yr/sec)
RI-131	= I-131 dose parameter for the thyroid for the identified controlling pathway.
	= 1.05E12, infant thyroid dose parameter with the grass - cow - milk pathway controlling (m^2mrem/yr per uCi/sec)

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

The location of exposure pathways and the maximum organ dose calculation may be based on the available pathways in the surrounding environment of Hope Creek as identified by the annual land-use census (Technical Specification 3.12.2). Otherwise, the dose will be evaluated based on the predetermined controlling pathways as identified in Table 2-3.

TABLE D-1

Infant Dose Contributions

Fraction of Total Organ and Body Dose

Target Organs	Grass - Cow - Milk	PATHWAYS Ground Plane
Total Body	0.02	0.15
Bone	0.23	0.14
Liver	0.09	0.15
Thyroid	0.59	0.15
Kidney	0.02	0.15
Lung	0.01	0.14
GI-LLI	0.02	0.15

TABLE D-2

Fraction of Dose Contribution by Pathway

Pathway	Frac
Grass-Cow-Milk	0.92
Ground Plane	0.08
Inhalation	N/A

APPENDIX E

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM -

SAMPLE TYPE, LOCATION AND ANALYSIS

APPENDIX E

SAMPLE DESIGNATION

Samples are identified by a three part code. The first two letters are the power station identification code, in this case "SA". The next three letters are for the media sampled.

AIO = Air Iodine
APT = Air Particulates
ECH = Hard Shell Blue Crab
ESF = Edible Fish
ESS = Sediment
WWA= Well Water

IDM = Immersion Dose (TLD)
MLK = Milk
PWR = Potable Water (Raw)
PWT = Potable Water (Treated)
SWA = Surface Water

The last four symbols are a location code based on direction and distance from the site. Of these, the first two represent each of the sixteen angular sectors of 22.5 degrees centered about the reactor site. Sector one is divided evenly by the north axis and other sectors are numbered in a clockwise direction; i.e., 2=NNE, 3=NE, 4=ENG, etc. The next digit is a letter which represents the radial distance from the plant:

S = On-site location
A = 0-1 miles off-site
B = 1-2 miles off-site
C = 2-3 miles off-site
D = 3-4 miles off-site

E = 4-5 miles off-site
F = 5-10 miles off-site
G = 10-20 miles off-site
H = > 20 miles off-site

The last number is the station numerical designation within each sector and zone; e.g., 1,2,3,... For example; the designation SA-WWA-5D1 would indicate a sample in the SGS program (SA), consisting of well water (WWA), which had been collected in sector number 5, centered at 90' (due east) with respect to the reactor site at a radical distance of 3 to 4 miles off-site, (therefore, radial distance D). The number 1 indicated that this is sampling station #1 in that particular sector.

The Radiological Environmental Monitoring Program is a common program for both Salem and Hope Creek Generating Stations.

SAMPLING LOCATIONS

All sampling locations and specific information about the individual locations are given in Table E-1. Maps E-1 and E-2 show the locations of sampling stations with respect to the site.

TABLE E-1

A. Direct Radiation Monitoring Locations (IDM)

STATION CODE	STATION LOCATION
1S1	0.55 mi. N of vent
2S2	0.4 mi. NNE of vent
2S4	0.59 mi. NNE of vent
3S1	0.58 mi. NE of vent
4S1	0.60 mi ENE of vent
5S1	1.0 mi. E of vent; site access road
6S2	0.21 mi. ESE of vent; observation building
* 7S1	0.12 mi. SE of vent; station personnel gate
* 10S1	0.14 mi. SSW of vent; circ water bldg.
* 11S1	0.09 mi. SW of vent; service water bldg.
15S1	0.57 mi. NW of vent
16S1	0.54 mi. NNW of vent
4D2	3.7 mi. ENE of vent; Alloway Creek Neck Road
5D1	3.5 mi. E of vent; local farm
10D1	3.9 mi. SSW of vent; Taylor's Bridge Spur
14D1	3.4 mi. WNW of vent; Bay View, Delaware
15D1	3.8 mi. NW of vent; Rt 9, Augustine Beach, DE.
2E1	4.4 mi. NNE of vent; local farm
3E1	4.1 mi. NE of vent; local farm
9E1	4.2 mi. S of vent
11E2	5.0 mi. SW of vent
12E1	4.4 mi. WSW of vent; Thomas Landing
13E1	4.2 mi. W of vent; Diehl House Lab
16E1	4.1 mi. NNW of vent; Port Penn
1F1	5.8 mi. N of vent; Fort Elfsborg
2F2	8.7 mi. NNE of vent; Salem Substation
2F5	7.4 mi. NNE of vent; Salem High School
2F6	7.3 mi. NNE of vent; PSE&G Training Center

TABLE E-1 (Continued)

A. Direct Radiation Monitoring Locations (IDM)

STATION CODE	STATION LOCATION
3F2	5.1 mi. NE of vent; Hancocks Bridge Munc. Bldg
3F3	8.6 mi. NE of vent; Quinton Township School
4F2	6.0 mi. ENE of vent; Mays Lane, Harmersville
5F1	6.5 mi. E of vent; Canton
6F1	6.4 mi. ESE of vent; Stow Neck Road
7F2	9.1 mi. SE of vent; Bayside, NJ
10F2	5.8 mi. SSW of vent; Rt. 9
11F1	6.2 mi. SW of vent; Taylors Bridge, DE.
12F1	9.4 mi. WSW of vent; Townsend Elementary School
13F2	6.5 mi. W of vent; Odessa, DE.
13F3	9.3 mi. W of vent; Redding Middle School
13F4	9.8 mi. W of vent; Middletown, DE.
14F2	6.6 mi. WNW of vent; Boyds Corner
15F3	5.4 mi. NW of vent
16F2	8.1 mi. NNW of vent; Delaware City Public School
1G3	19 mi. N of vent; N. Church St. Wilmington, DE
3G1	17 mi. NE of vent; local farm
10G1	12 mi. SSW of vent; Smyrna, Delaware
16G1	15 mi. NNW of vent; Wilmington Airport
3H1	32 mi. NE of vent; National Park, NJ
14G1	11.8 mi. WNW of vent; Rte 286; Bethel Church Road;Delaware

* TLD locations will be maintained by site area monitoring program

B. Air Sampling Locations (AIO,APT)

STATION CODE	STATION LOCATION
5S1	1.0 mi. E of vent; site access road
5D1	3.5 mi. E of vent; local farm
16E1	4.1 mi. NNW of vent; Port Penn
1F1	5.8 mi. N of vent; Fort Elfsborg
2F6	7.3 mi. NNE of vent; PSE&G Training Center
14G1	11.8 mi. WNW of vent; Rte 286; Bethel Church Road;Delaware

TABLE E-1 (Continued)

C. Surface Water Locations (SWA) - Delaware River

STATION CODE	STATION LOCATION
11A1	0.2 mi. SW of vent; Salem Outfall Area
12C1	2.5 mi. WSW of vent; West bank of Delaware River
7E1	4.5 mi. SE of vent; Delaware River
16F1	6.9 mi. NNW of vent; C&D Canal

D. Ground Water Locations (WWA)

STATION CODE	STATION LOCATION

No public drinking water samples or irrigation water samples are taken as these pathways are not directly affected by liquid effluents discharged from Hope Creek or Salem Generating Stations.

E. Drinking Water Locations (PWR,PWT)

STATION CODE	STATION LOCATION

No public drinking water samples or irrigation water samples are taken as these pathways are not directly affected by liquid effluents discharged from Hope Creek or Salem Generating Stations.

F. Water Sediment Locations (ESS)

STATION CODE	STATION LOCATION
11A1	0.2 mi. SW of vent; Salem outfall area
15A1	0.3 mi. NW of vent; Hope Creek outfall area
16A1	0.7 mi. NNW of vent; South Storm Drain outfall
12C1	2.5 mi. WSW of vent; West bank of Delaware river
7E1	4.5 mi. SE of vent; 1 mi West of Mad Horse River
16F1	6.9 mi. NNW of vent; C&D Canal
6S2	0.2 mi. ESE of vent; observation building

G. Milk Sampling Locations (MLK)

STATION CODE	STATION LOCATION
2F7	5.7 mi. NNE of vent; local farm
11F3	5.3 mi. SW of vent; Townsend DE.
14F4	7.6 mi. WNW of vent; local farm
3G1	17 mi. NE of vent; local farm

TABLE E-1 (Continued)

H. Fish and Invertebrate Locations (ESF,ECH)

STATION CODE	STATION LOCATION
11A1	0.2 mi. SW of vent; Salem outfall area
12C1	2.5 mi. WSW of vent; West bank of Delaware River
7E1	4.5 mi. SE of vent; 1 mi West of Mad Horse Creek

I. Food Product Locations

STATION CODE	STATION LOCATION

The Delaware River at the location of Salem and Hope Creek Nuclear Power Plants is a brackish water source. No irrigation of food products is performed using water in the vicinity from which liquid plant wastes have been discharged.

SAMPLES COLLECTION AND ANALYSIS

Sample	Collection Method	Analysis
Air Particulate	Continuous low volume air sampler. Sample collected every week along with the filter change.	Gross Beta analysis on each weekly sample. Gamma spectrometry shall be performed if gross beta exceeds 10 times the yearly mean of the control station value. Samples shall be analyzed 24 hrs or more after collection to allow for radon and thorium daughter decay. Gamma isotopic analysis on quarterly composites.
Air Iodine	A TEDA impregnated charcoal cartridge is connected to air particulate air sampler and is collected weekly at filter change.	Iodine 131 analysis are performed on each weekly sample.
Crab and Fish	Two batch samples are sealed in a plastic bag or jar and frozen semi-annually or when in season.	Gamma isotopic analysis of edible portion on collection.
Sediment	A sediment sample is taken semi-annually.	Gamma isotopic analysis semi-annually.
Direct	2 TLD's will be collected from each location quarterly.	Gamma dose quarterly.

E-7

SAMPLE COLLECTION AND ANALYSIS (Cont'd)

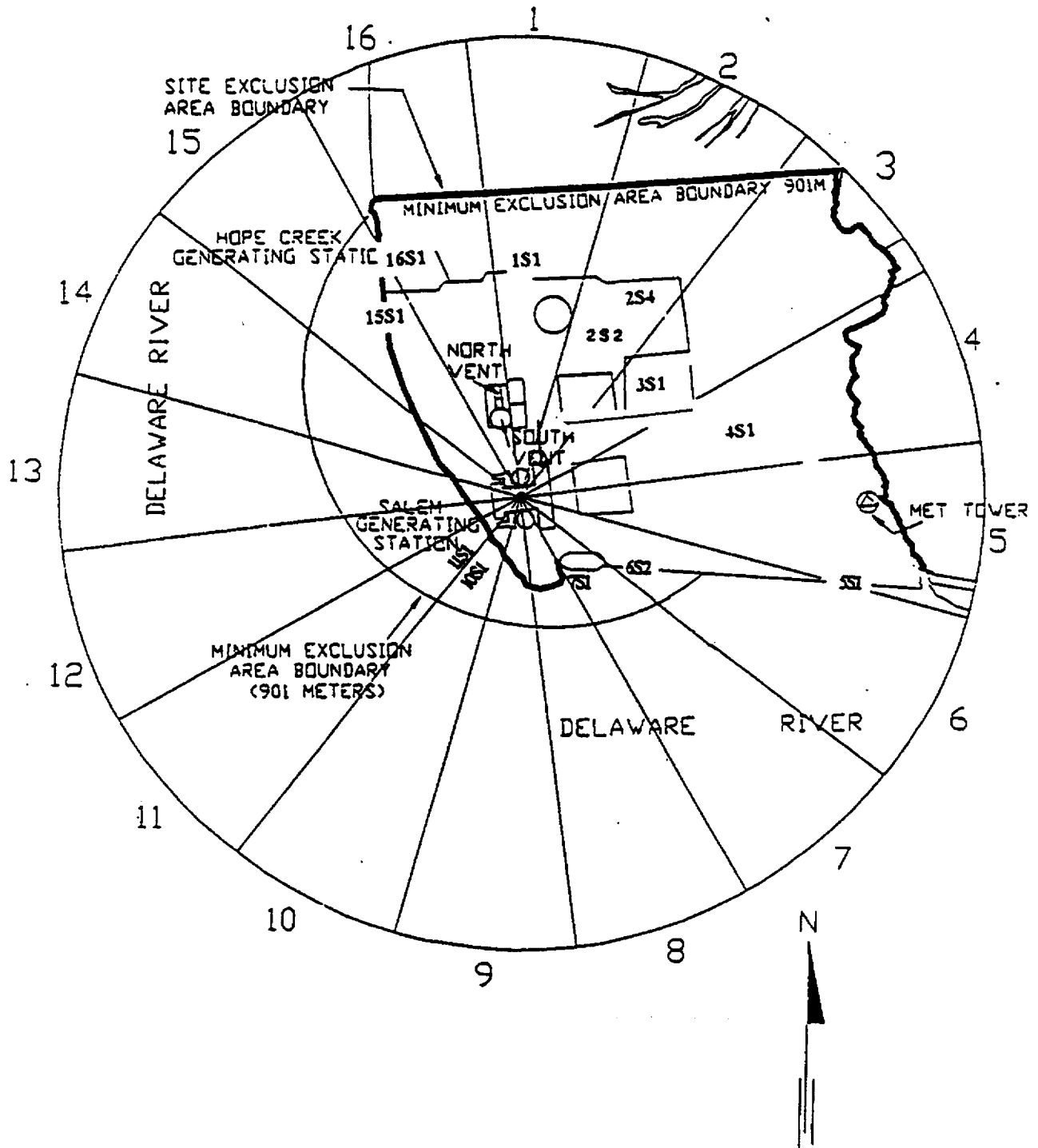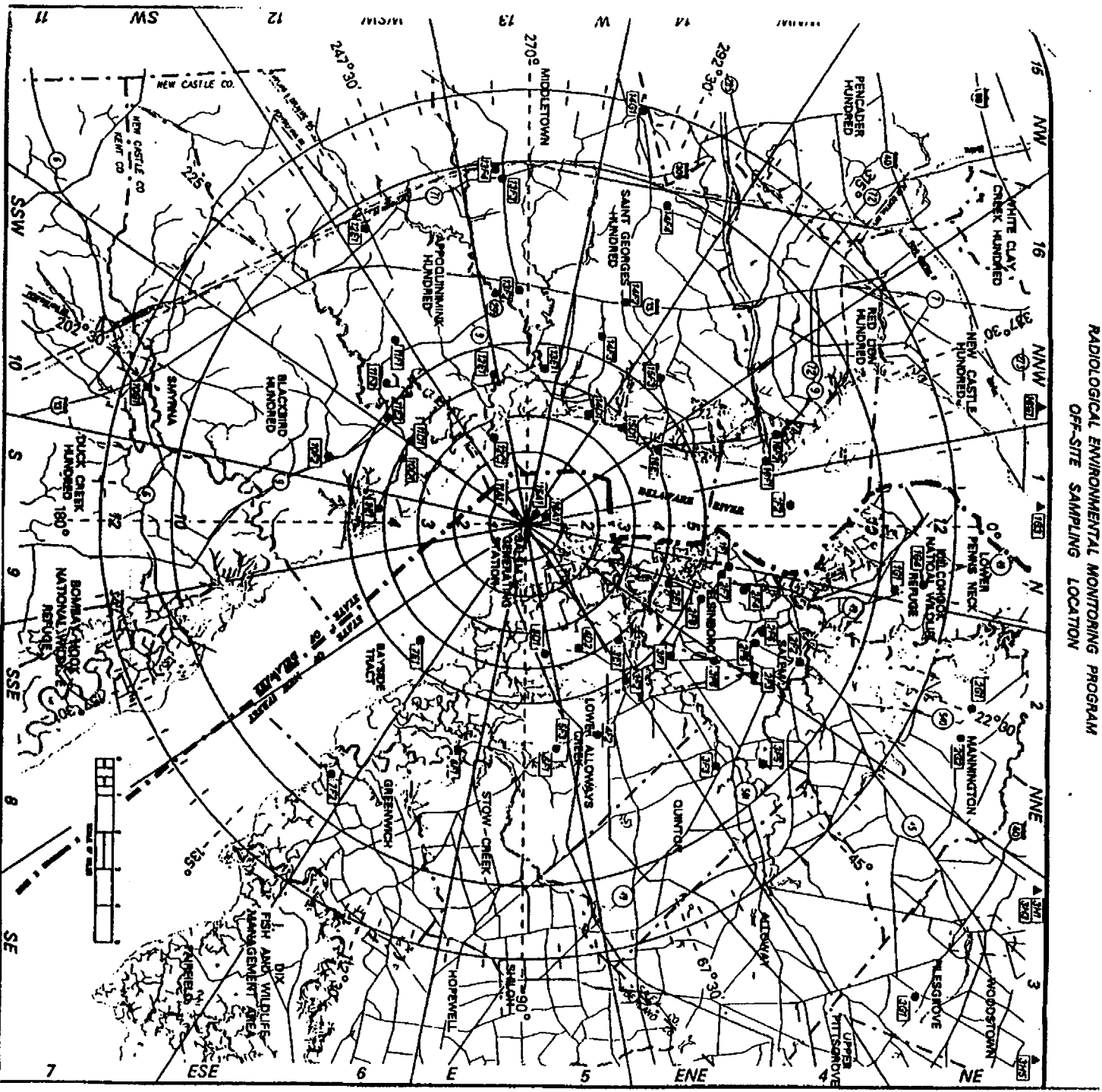| Sample	Collection Method	Analysis
Milk	Sample of fresh milk is collected for each farm semi-monthly when cows are in pasture, monthly at other times.	Gamma isotopic analysis and I-131 analysis on each sample on collection.
Water Potable, Surface)	Sample to be collected monthly providing winter icing conditions allow.	Gamma isotopic monthly H-3 on quarterly surface sample, monthly on ground water sample.

Figure E-1
ONSITE SAMPLING LOCATIONS

Figure E-2

SALEM AND HOPE CREEK GENERATING STATIONS
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
OFF-SITE SAMPLING LOCATION

APPENDIX F

MAXIMUM PERMISSIBLE CONCENTRATIONS

LIQUID EFFLUENTS

The following radionuclide concentrations were obtained from 10 CFR 20 Appendix B, Table II, Column 2 as revised January 1, 1991.

Table F-1
Maximum Permissible Concentrations

Element	Isotope	Soluble Conc (uci/ml)	Insoluble Conc. (uci/ml)
Actinium (89)	Ac-227	2E-6	3E-4
	Ac-228	9E-5	9E-5
Americium (95)	Am-241	4E-6	3E-5
	Am-242m	4E-6	9E-5
	Am-242	1E-4	1E-4
	Am-243	4E-6	3E-5
	Am-244	5E-3	5E-3
Antimony (51)	Sb-122	3E-5	3E-5
	Sb-124	2E-5	2E-5
	Sb-125	1E-4	1E-4
Arsenic (33)	As-73	5E-4	5E-4
	As-74	5E-5	5E-5
	As-76	2E-5	2E-5
	As-77	8E-5	8E-5
Astatine (85)	At-211	2E-6	7E-5
Barium (56)	Ba-131	2E-4	2E-4
	Ba-140	3E-5	2E-5
Berkelium (97)	Bk-249	6E-4	6E-4
	Bk-250	2E-4	2E-4
Beryllium (4)	Be-7	2E-3	2E-3
Bismuth (83)	Bi-206	4E-5	4E-5
	Bi-207	6E-5	6E-5
	Bi-210	4E-5	4E-5
	Bi-212	4E-4	4E-4
Bromine (35)	Br-82	3E-4	4E-5
Cadmium (48)	Cd-109	2E-4	2E-4
	Cd-115m	3E-5	3E-5
	Cd-115	3E-5	4E-5
Calcium (20)	Ca-45	9E-6	2E-4
	Ca-47	5E-5	3E-5

Table F-1 (Continued)

Element	Isotope	Soluble Conc. (uci/ml)	Insoluble Conc. (uci/ml)
Californium (98)	Cf-249	4E-6	2E-5
	Cf-250	1E-5	3E-5
	Cf-251	4E-6	3E-5
	Cf-252	7E-6	7E-6
	Cf-253	1E-4	1E-4
	Cf-254	1E-7	1E-7
Carbon (6)	C-14	8E-4	-------
Cerium (58)	Ce-141	9E-5	9E-5
	Ce-143	4E-5	4E-5
	Ce-144	1E-5	1E-5
Cesium (55)	Cs-131	2E-3	9E-4
	Cs-134m	6E-3	1E-3
	Cs-134	9E-6	4E-5
	Cs-135	1E-4	2E-4
	Cs-136	9E-5	6E-5
	Cs-137	2E-5	4E-5
Chlorine (17)	Cl-36	8E-5	6E-5
	Cl-38	4E-4	4E-4
Chromium (24)	Cr-51	2E-3	2E-3
Cobalt (27)	Co-57	5E-4	4E-4
	Co-58m	3E-3	2E-3
	Co-58	1E-4	9E-5
	Co-60	5E-5	3E-5
Copper (29)	Cu-64	3E-4	2E-4
Curium (96)	Cm-242	2E-5	2E-5
	Cm-243	5E-6	2E-5
	Cm-244	7E-6	3E-5
	Cm-245	4E-6	3E-5
	Cm-246	4E-6	3E-5
	Cm-247	4E-6	2E-5
	Cm-248	4E-7	1E-6
	Cm-249	2E-3	2E-3
Dysprosium (66)	Dy-165	4E-4	4E-4
	Dy-166	4E-5	4E-5

Table F-1 (Continued)

Element	Isotope	Soluble Conc. (uci/ml)	Insoluble Conc. (uci/ml)
Dysprosium (66)	I-135	4E-6	7E-5
Iridium (77)	Ir-190	2E-4	2E-4
	Ir-192	4E-5	4E-5
	Ir-194	3E-5	3E-5
Iron (26)	Fe-55	8E-4	2E-3
	Fe-59	6E-5	5E-5
Lanthanum (57)	La-140	2E-5	2E-5
Einsteinium (99)	Es-253	2E-5	2E-5
	Es-254m	2E-5	2E-5
	Es-254	1E-5	1E-5
	Es-255	3E-5	3E-5
Erbium (68)	Er-169	9E-5	9E-5
	Er-171	1E-4	1E-4
Europium (63)	Eu-152 (9.2 hrs)	6E-5	6E-5
	Eu-152 (13 yrs)	8E-5	8E-5
	Eu-154	2E-5	2E-5
	Eu-155	2E-4	2E-4
Fermium (100)	Fm-254	1E-4	1E-4
	Fm-255	3E-5	3E-5
	Fm-256	9E-7	9E-7
Fluorine (9)	F-18	8E-4	5E-4
Gadolinium (64)	Gd-153	2E-4	2E-4
	Gd-159	8E-5	8E-5
Gallium (31)	Ga-72	4E-5	4E-5
Germanium (32)	Ge-71	2E-3	2E-3
Gold (79)	Au-196	2E-4	1E-4
	Au-198	5E-5	5E-5
	Au-199	2E-4	2E-4
Hafnium (72)	Hf-181	7E-5	7E-5
Holmium (67)	Ho-166	3E-5	3E-5
Hydrogen (3)	H-3	3E-3	3E-3
Indium (49)	In-113m	1E-3	1E-3
	In-114m	2E-5	2E-5
	In-115m	4E-4	4E-4
	In-115	9E-5	9E-5

Table F-1 (Continued)

Element	Isotope	Soluble Conc. (uci/ml)	Insoluble Conc. (uci/ml)
Iodine (53)	I-125	2E-7	2E-4
	I-126	3E-7	9E-5
	I-129	6E-8	2E-4
	I-131	3E-7	6E-5
	I-132	8E-6	2E-4
	I-133	1E-6	4E-5
	I-134	2E-5	6E-4
Lead (82)	Pb-203	4E-4	4E-4
	Pb-210	1E-7	2E-4
	Pb-212	2E-5	2E-5
Lutetium (71)	Lu-177	1E-4	1E-4
Manganese (25)	Mn-52	3E-5	3E-5
	Mn-54	1E-4	1E-4
	Mn-56	1E-4	1E-4
Mercury (80)	Hg-197m	2E-4	2E-4
	Hg-197	3E-4	5E-4
	Hg-203	2E-5	1E-4
Molybdenum (42)	Mo-99	2E-4	4E-5
Neodymium (60)	Nd-144	7E-5	8E-5
	Nd-147	6E-5	6E-5
	Nd-149	3E-4	3E-4
Neptunium (93)	Np-237	3E-6	3E-5
	Np-239	1E-4	1E-4
Nickel (28)	Ni-59	2E-4	2E-3
	Ni-63	3E-5	7E-4
	Ni-65	1E-4	1E-4
Niobium (41)	Nb-93m	4E-4	4E-4
	Nb-95	1E-4	1E-4
	Nb-97	9E-4	9E-4
Osmium (76)	Os-185	7E-5	7E-5
	Os-191m	3E-3	2E-3
	Os-191	2E-4	2E-4
	Os-193	6E-5	5E-5
Palladium (46)	Pd-103	3E-4	3E-4
	Pd-109	9E-5	7E-5

Table F-1 (Continued)

Element	Isotope	Soluble Conc. (uci/ml)	Insoluble Conc. (uci/ml)
Phosphorus (15)	P-32	2E-5	2E-5
Platinum (78)	Pt-191	1E-4	1E-4
	Pt-193m	1E-3	1E-3
	Pt-193	9E-4	2E-3
	Pt-197m	1E-3	9E-4
	Pt-197	1E-4	1E-4
Plutonium (94)	Pu-238	5E-6	3E-5
	Pu-239	5E-6	3E-5
	Pu-240	5E-6	3E-5
	Pu-241	2E-4	1E-3
	Pu-242	5E-6	3E-5
	Pu-243	3E-4	3E-4
Polonium (84)	Po-210	7E-7	3E-5
Potassium (19)	K-42	3E-4	2E-5
Praseodymium(59)	Pr-142	3E-5	3E-5
	Pr-143	5E-5	5E-5
Promethium (61)	Pm-147	2E-4	2E-4
	Pm-149	4E-5	4E-5
Protactinium(91)	Pa-230	2E-4	2E-4
	Pa-231	9E-7	2E-5
	Pa-233	1E-4	1E-4
Radium (88)	Ra-223	7E-7	4E-6
	Ra-224	2E-6	5E-6
	Ra-226	3E-8	3E-5
	Ra-228	3E-8	3E-5
Rhenium (75)	Re-183	6E-4	3E-4
	Re-186	9E-5	5E-5
	Re-187	3E-3	2E-3
	Re-188	6E-5	3E-5
Rhodium (45)	Rh-103m	1E-2	1E-2
	Rh-105	1E-4	1E-4
Rubidium (37)	Rb-86	7E-5	2E-5
	Rb-87	1E-4	2E-4
Ruthenium (44)	Ru-97	4E-4	3E-4
	Ru-103	8E-5	8E-5

F-6

Table F-1 (Continued)

Element	Isotope	Soluble Conc. (uci/ml)	Insoluble Conc. (uci/ml)
	Ru-105	1E-4	1E-4
	Ru-106	1E-5	1E-5
Samarium (62)	Sm-147	6E-5	7E-5
	Sm-151	4E-4	4E-4
	Sm-153	8E-5	8E-5
Scandium (21)	Sc-46	4E-5	4E-5
	Sc-47	9E-5	9E-5
	Sc-48	3E-5	3E-5
Selenium (34)	Se-75	3E-4	3E-4
Silicon (14)	Si-31	9E-4	2E-4
Silver (47)	Ag-105	1E-4	1E-4
	Ag-110m	3E-5	3E-5
	Ag-111	4E-5	4E-5
Sodium (11)	Na-22	4E-5	3E-5
	Na-24	2E-4	3E-5
Strontium (38)	Sr-85m	7E-3	7E-3
	Sr-85	1E-4	2E-4
	Sr-89	3E-6	3E-5
	Sr-90	3E-7	4E-5
	Sr-91	7E-5	5E-5
	Sr-92	7E-5	6E-5
Sulfur (16)	S-35	6E-5	3E-4
Tantalum (73)	Ta-182	4E-5	4E-5
Technetium (43)	Tc-96m	1E-2	1E-2
	Tc-96	1E-4	5E-5
	Tc-97m	4E-4	2E-4
	Tc-97	2E-3	8E-4
	Tc-99m	6E-3	3E-3
	Tc-99	3E-4	2E-4
Tellurium (52)	Te-125m	2E-4	1E-4
	Te-127m	6E-5	5E-5
	Te-127	3E-4	2E-4
	Te-129m	3E-5	2E-5
	Te-129	8E-4	8E-4
	Te-131m	6E-5	4E-5

Table F-1 (Continued)

Element	Isotope	Soluble Conc. (uci/ml)	Insoluble Conc. (uci/ml)
	Te-132	3E-5	2E-5
Terbium (65)	Tb-160	4E-5	4E-5
Thallium (81)	Tl-200	4E-4	2E-4
	Tl-201	3E-4	2E-4
	Tl-202	1E-4	7E-5
	Tl-204	1E-4	6E-5
Thorium (90)	Th-227	2E-5	2E-5
	Th-228	7E-6	1E-5
	Th-230	2E-6	3E-5
	Th-231	2E-4	2E-4
	Th-232	2E-6	4E-5
	Th-natural	2E-6	2E-5
	Th-234	2E-5	2E-5
Thulium (69)	Tm-170	5E-5	5E-5
	Tm-171	5E-4	5E-4
Tin (50)	Sn-113	9E-5	8E-5
	Sn-124	2E-5	2E-5
Tungsten (74)	W-181	4E-4	3E-4
	W-185	1E-4	1E-4
	W-187	7E-5	6E-5
Uranium (92)	U-230	5E-6	5E-6
	U-232	3E-5	3E-5
	U-233	3E-5	3E-5
	U-234	3E-5	3E-5
	U-235	3E-5	3E-5
	U-236	3E-5	3E-5
	U-238	4E-5	4E-5
	U-240	3E-5	3E-5
	U-natural	3E-5	3E-5
Vanadium (23)	V-48	3E-5	3E-5
Ytterbium (70)	Yb-175	1E-4	1E-4

Table F-1 (Continued)

Element	Isotope	Soluble Conc. (uci/ml)	Insoluble Conc. (uci/ml)
Yttrium	Y-90	2E-5	2E-5
	Y-91m	3E-3	3E-3
	Y-91	3E-5	3E-5
	Y-92	6E-5	6E-5
	Y-93	3E-5	3E-5
Zinc (30)	Zn-65	1E-4	2E-4
	Zn-69m	7E-5	6E-5
	Zn-69	2E-3	2E-3
Zirconium (40)	Zr-93	8E-4	8E-4
	Zr-95	6E-5	6E-5
	Zr-97	2E-5	2E-5
Any single radio-nuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radio - active half-life greater than 2 hours		3E-6	3E-6
Any single radio-nuclide not listed above, which decays by alpha emission or spontaneous fission.		3E-8	3E-8

Notes:

1. If the identity of any radionuclide is not known, the limiting values for purposes of this table shall be: 3E-8 uci/ml.

2. If the identity and concentration of each radionuclide are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e. "unity").

APPENDIX G

CONTROLS FOR RELEASES

FROM THE

CIRCULATING WATER DEWATERING SUMP

APPENDIX G

CONTROLS FOR RELEASES FROM THE
CIRCULATING WATER DEWATERING SUMP

The radiation monitoring instrumentation for the circulating water dewatering sump includes an offline gamma scintillation detection (NaI) with a sample flow indicator. The system does not include any discharge flow control device or measurement of discharge flow. Also, the radiation monitor is not included in the current Technical Specifications. As indicated in Appendix A, the setpoint for the radiation monitor is set by design and station procedures to be less than 2x background radiation levels. Releases through the sump at levels below the setpoint are considered continuous releases. In order to control and quantify **continuous** releases from this point, the following sampling and analysis schedule is required:

Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	LLD (uCi/ml)
Continuous Composite	M	Principal Gamma Emitters	5E-7
	M	I-131	1E-6
	M	H-3	1E-5
	M	Gross Alpha	1E-7
Grab sample M	M	Dissolved and Entrained Noble Gases (Gamma emitters)	1E-5
Continuous Composite	Q	Sr-89, Sr-90 Fe-55	5E-8 1E-6

Sampling and analysis for **batch** releases from this point shall be performed to meet the requirements of Technical Specification Table 4.11.1.1.1-1.

The following controls apply to the effluent radiation monitoring system (RY-4557):

MINUMUM OPERABILITY – with the radiation monitoring system inoperable, suspend **continuous** release of radioactive effluents via this pathway. Batch releases may be performed provided ACTION 110 of Technical Specification 3.3.7.10 is implemented.

APPENDIX D

HCGS PCP

REV 3

PUBLIC SERVICE ELECTRIC AND GAS COMPANY
HOPE CREEK GENERATING STATION

PROCESS CONTROL PROGRAM (PCP)
Revision 3   February 15, 1999

APPROVALS:

Operations Superintendent –
Chemistry

SORC Chairman
/Meeting Number

Station General Manager

99-012

2/15/99
Date

2/16/99
Date

2/16/99
Date

After a batch of processed water is collected in a sample tank, a sample is taken and analyzed. If it meets water quality requirements, the water is transferred to the condensate storage tank. If the batch does not meet water quality or radiological concentration specifications (10CFR20 limits); it is reprocessed. Water not meeting condensate storage quality will be diluted and released in a controlled and monitored manner into the station cooling tower blowdown line.

3.2 Floor Drains Filter and Demineralizer

This subsystem processes waste the same as the equipment drain subsystem, except that the waste to be processed is of lower purity. This waste is from floor drains, drains from the fuel pool cooling system and the RHR system flush. After a batch of processed water is collected in a sample tank, a sample is taken and analyzed. If it meets water quality requirements, the water is transferred to the condensate storage tank. If the batch does not meet water quality or radiological concentration specifications (10CFR20 limits), it is reprocessed.

Water not meeting condensate storage quality will be diluted and released in a controlled and monitored manner into the station cooling tower blowdown line.

3.3 Decontamination Solution Evaporator

The Decontamination Solution Evaporator receives laboratory waste, decontamination solutions and sample drain waste which is collected in the chemical waste tank. These wastes are neutralized and if required, buffered with sodium phosphate, then processed by the Decontamination Solution Evaporator. The Decontamination Solution Evaporator is designed to concentrate to a 10% by weight solid concentration. The bottoms are then discharged to the decontamination solution concentrates waste tank. The bottoms are later discharged to the regenerative waste concentrates tanks for processing thru a crystallizer evaporator. In the event the Decontamination Solution Evaporator is unavailable, the chemical waste tank can be drained to the center Radwaste high conductivity sump for processing in the regenerant waste processing subsystem.

3.4 Regenerant Waste Evaporator

The Regenerant Waste Evaporator receives regeneration solutions from the condensate demineralizer and radwaste demineralizer resin regenerations as well as inputs from the high conductivity sumps in the Turbine and Auxiliary Buildings. These wastes are neutralized and then processed by the regenerant waste evaporator. Should the Regenerant Waste Evaporator be unavailable, the contents of the waste neutralizer tank can be transferred to the Floor Drain Collector tank for processing.

The Regenerative Waste Evaporator is designed to concentrate wastes to a 25% by weight solid concentration of sodium sulfate. The bottoms are then discharged to the regenerative waste concentrates tank, where it is processed thru a crystallizer evaporator.

3.5 Detergent Waste

The Detergent Waste System receives waste from laundry drains, personnel decontamination and the chemistry laboratory. These wastes which are normally low in radioactivity, are processed by filtration and then discharged to the cooling tower blowdown line for dilution. If unsuitable for discharge (10CFR20 limits), the waste is processed through the decontamination solution evaporator.

3.6 Crystallizer Evaporator

The Crystallizer Evaporator processes the sodium sulfate waste in the waste evaporator concentrates tank. This waste is concentrated to a 50% by weight concentration and is discharged to the crystallizer bottoms tank. This tank is one of two of the final waste streams that are isolated, sampled and finally introduced for solidification into the asphalt extruder-evaporator.