ENCLOSURE 3

PROPOSED

RADIOLOGICAL EFFLUENT

TECHNICAL SPECIFICATIONS

H. B. ROBINSON STEAM ELECTRIC PLANT UNIT NO. 2

OCTOBER 1983

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1.6 INSTRUMENTATION SURVEILLANCE

1.6.1 Action

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

1.6.2 Channel Calibration

Adjustment of channel output such that it responds, with acceptable range and accuracy, to known value of the parameter which the channel monitors. Calibration shall encompass the entire channel, including the sensor and alarm or trip function, and shall be deemed to include the channel functional test.

1.6.3 Channel Check

A qualitative determination of acceptable operability by observation of channel behavior during operation. This determination will include, whenever possible, comparison of the channel with other independent channels measuring the same variable.

1.6.4 Channel Functional Test

Injection of a simulated signal into the channel to verify that it is operable, including alarm and/or trip initiating action.

1.6.5 Source Check

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

1.7 CONTAINMENT INTEGRITY

Containment integrity is defined to exist when:

a. All non-automatic containment isolation valves not required for normal operation are closed and blind flanges are properly installed where required.

b. The equipment door is properly closed and sealed.

c. At least one door in the personnel air lock is properly closed and sealed.

d. All automatic containment isolation trip valves required to be closed during accident conditions are operable or are secured closed except as stated in Specification 3.6.3. Manual valves qualifying as automatic containment isolation valves are secured closed.

e. The uncontrolled containment leakage satisfies Specification 4.4.

1.8 QUADRANT POWER TILT

The quadrant power tilt is defined as the ratio of maximum to average of the upper excore detector currents or the lower excore detector currents, whichever is greater. If one excore is out of service, the three in-service units are used in computing the average.

1.9 FIRE SUPPRESSION WATER SYSTEM

A fire suppression water system shall consist of : a water source; pumps; and distribution piping with associated sectionalizing control or isolation valves.

1.10 STAGGERED TEST BASIS

A Staggered Test Basis shall consist of:

a. A test schedule for n systems, subsystems, trains or designated components obtained by dividing the specified test interval into n equal subintervals.

b. The testing of one system, subsystem, train or designated components at the beginning of each subinterval.

1.11 GASEOUS RADWASTE TREATMENT SYSTEM

The Gaseous Radwaste Treatment System is the system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system off-gases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

1.12 VENTILATION EXHAUST TREATMENT SYSTEM

The Ventilation Exhaust Treatment System is the 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 prior to their release to the environment. Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be Ventilation Exhaust Treatment System components.

1.13 OFFSITE DOSE CALCULATION MANUAL (ODCM)

The Offsite Dose Calculation Manual shall contain the current methodology and parameters used in the calculation of offsite doses due to radioactive gaseous and liquid effluents and the methodology to calculate gaseous and liquid effluent monitoring alarm/trip setpoints; and, the requirements of the environmental radiological monitoring program.

1.14 DOSE EQUIVALENT I-131

The Dose Equivalent I-131 shall be that concentration of I-131 (microcurie/gram) which alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134, and

I-135 actually present. The thyroid dose conversion factors used for this calculation shall be those listed in NRC Regulatory Guide 1.109, Revision 1, October 1977.

1.15 PROCESS CONTROL PROGRAM (PCP)

The Process Control Program (PCP) shall contain the current formulas, sampling, analyses, tests and determinations to be made to ensure that the processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR Part 20, 10 CFR Part 71, and Federal and State regulations and other requirements governing the disposal of the radioactive waste.

1.16 SOLIDIFICATION

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

1.17 PURGE - PURGING

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

1.18 VENTING

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

1.19 SITE BOUNDARY

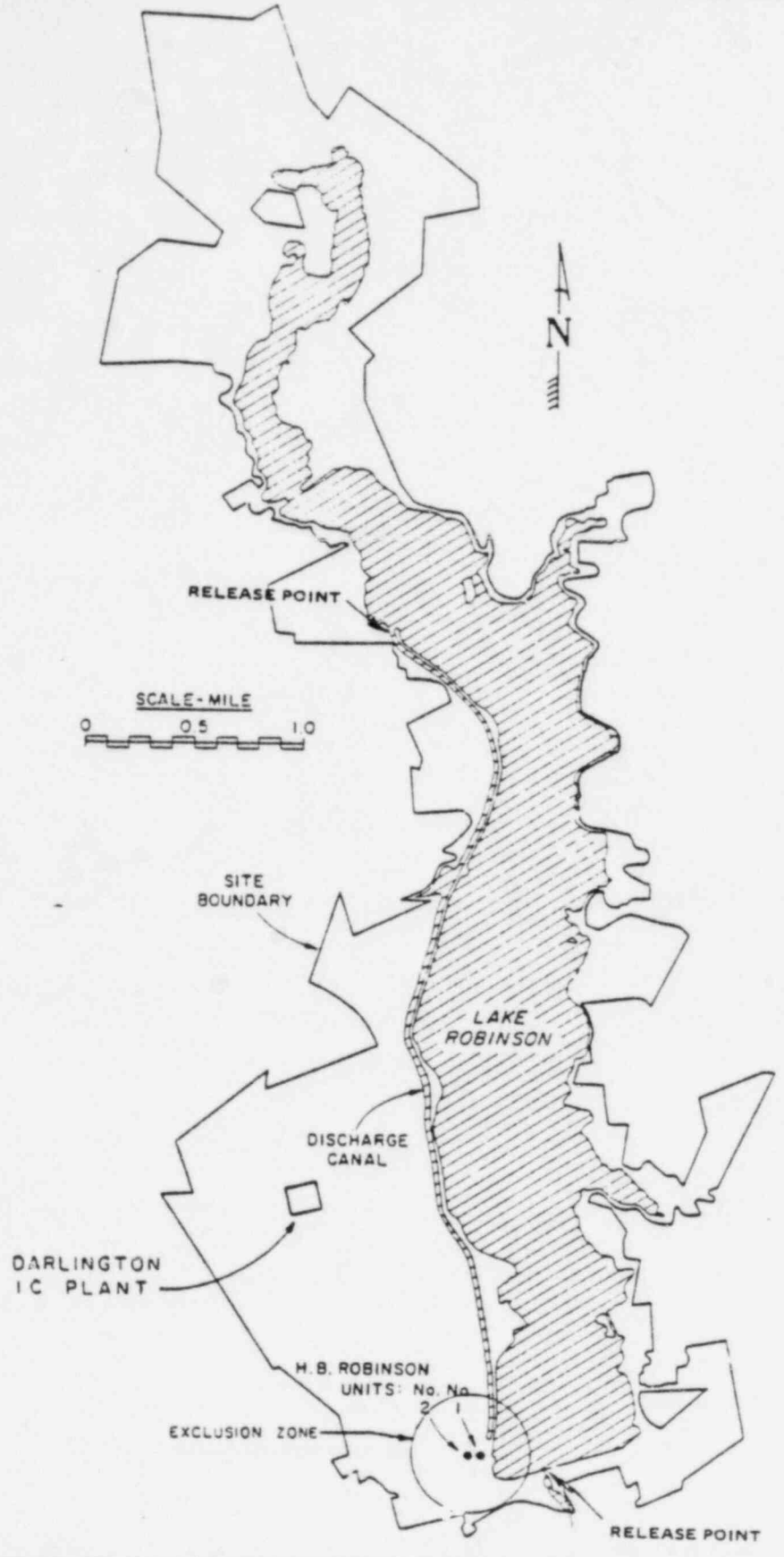
The site boundary shall be that line beyond which the land is not owned, leased, or otherwise controlled by the licensee, as defined by Figure 1.1-1.

1.20 MEMBER(S) OF THE PUBLIC

Member(s) of the public shall include all individuals who by virtue of their occupational status have no formal association with the plant. This category shall include non-employees of the licensee who are permitted to use portions of the site for recreational, occupational or other purposes not associated with plant functions. This category shall not include non-employees such as vending machine servicemen, or postmen who, as part of their formal job function, occasionally enter an area that is controlled by the licensee for the purposes of protection of individuals from exposure to radiation and radioactive materials.

1.21 UNRESTRICTED AREA

Unrestricted area shall be any area at or beyond the Site Boundary to which access 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.



H. B. ROBINSON UNIT 2 Carolina Power & Light Company	PLANT SITE BOUNDARY AND EXCLUSION ZONE	FIGURE 1.1-1

3.5 INSTRUMENTATION SYSTEMS

3.5.1 Operational Safety Instrumentation

Applicability

Applies to plant operational safety instrumentation systems.

Objective

To provide for automatic initiation of the Engineered Safety Features in the event that principal process variable limits are exceeded, and to delineate the conditions of the plant instrumentation and safety circuits necessary to ensure reactor safety.

Specification

3.5.1.1 The Engineered Safety Features initiation instrumentation setting limits shall be as stated in Table 3.5-1.

3.5.1.2 For on-line testing or in the event of a subsystem instrumentation channel failure, plant operation at rated power shall be permitted to continue in accordance with Tables 3.5-2 through 3.5-5.

3.5.1.3 In the event the number of channels of a particular subsystem in service falls below the limits given in the column entitled Minimum Operable Channels, or Minimum Degree of Redundancy cannot be achieved, operation shall be limited according to the requirement shown in Column 3 of Tables 3.5-2 through 3.5-4 and Column 2 of Table 3.5-5.

3.5.2 Radioactive Liquid Effluent Instrumentation

Applicability

Applies to the radioactive liquid effluent instrumentation system.

Objective

To define the operating requirements for the radioactive liquid effluent instrumentation system.

Specification

3.5.2.1 The radioactive liquid effluent monitoring instrumentation channels shown in Table 3.5-6 shall be operable with their alarm/trip setpoints set to ensure that the limits of Specification 3.9.1.1 are not exceeded. The alarm/trip setpoints shall be determined in accordance with the ODCM.

3.5.2.2 With a radioactive liquid monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, without delay suspend the release of radioactive liquid effluent monitored by the affected channel, change the setpoint so it is acceptably conservative, or declare the channel not operable.

3.5.2.3 With less than the minimum number of radioactive liquid effluent monitoring instrumentation operable, take the action shown in Table 3.5-6.

3.5.2.4 The provisions of Specifications 3.0 and 6.9.2.b(2) are not applicable.

3.5.3 Radioactive Gaseous Effluent Instrumentation

Applicability

Applies to the radioactive gaseous effluent instrumentation system.

Objective

To define the operating requirements for the radioactive gaseous effluent instrumentation system.

Specification

3.5.3.1 The radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.5-7 shall be operable with their alarm/trip setpoints set to ensure that the limits of Specification 3.9.3.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with the ODCM.

3.5.3.2 With a radioactive effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, without delay suspend the release of radioactive gaseous effluents, change the setpoint so it is acceptably conservative, or declare the channel not operable.

3.5.3.3 With less than the minimum number of radioactive effluent monitoring instrumentation channels operable take the action shown in Table 3.5-7.

3.5.3.4 The provisions of Specification 3.0 and 6.9.2.b(2) are not applicable.

Basis

Operational Safety Instrumentation

Instrumentation has been provided to sense accident conditions and to initiate operation of the Engineered Safety Features.(1)

Safety Injection System Actuation

Protection against a Loss-of-Coolant or Steam Break accident is brought about by automatic actuation of the Safety Injection System which provides emergency cooling and reduction of reactivity.

The Loss-of-Coolant Accident is characterized by depressurization of the Reactor Coolant System and rapid loss of reactor coolant to the containment. The Engineered Safety Features have been designed to sense these effects of the Loss-of-Coolant Accident by detecting low pressurizer pressure and generate signals actuating the SIS active phase.

The SIS active phase is also actuated by a high containment pressure signal (Hi-Level) brought about by loss of high enthalpy coolant to the containment. This actuation signal acts as a backup to the low pressurizer pressure signal actuation of the SIS and also adds diversity to protection against loss of coolant.

Signals are also provided to actuate the SIS upon sensing the effects of a steam line break accident. Therefore, SIS actuation following a steam line break is designed to occur upon sensing high differential steam pressure between the steam header and steam generator line or upon sensing high steam line flow in coincidence with low reactor coolant average temperature or low steam line pressure.

The increase in the extraction of RCS heat following a steam line break results in reactor coolant temperature and pressure reduction. For this reason, protection against a steam line break accident is also provided by low pressurizer pressure signals actuating safety injection.

Protection is also provided for a steam line break in the containment by actuation of SIS upon high containment pressure.

SIS actuation injects highly borated fluid into the Reactor Coolant System in order to counter the reactivity insertion brought about by cooldown of the reactor coolant which occurs during a steam line break accident.

Containment Spray

The Engineered Safety Features also initiate containment spray upon sensing a high containment pressure signal (Hi-Hi Level). The containment spray acts to reduce containment pressure in the event of a loss of coolant or steam line break accident inside the containment, in order to reduce containment pressure. The containment spray cools the containment directly and limits the release of fission products by absorbing iodine should it be released to the containment.

Containment spray is designed to be actuated at a higher containment pressure (approximately 50% of design containment pressure) than the SIS (10% of design). Since spurious actuation of containment spray is to be avoided, it is initiated only on coincidence of Hi-Hi Level containment pressure sensed by both of the two sets of containment pressure signals provided for its actuation.

Steam Line Isolation

Steam line isolation signals are initiated by the Engineered Safety Features closing all steam line stop valves. In the event of a steam line break, this action prevents continuous, uncontrolled steam release from more than one steam generator by isolating the steam lines on high containment pressure (Hi-Hi-Level) or high steam line flow. Protection is afforded for breaks inside or outside the containment even when it is assumed that there is a single failure in the steam line isolation system.

Feedwater Line Isolation

The feedwater lines are isolated upon actuation of the Safety Injection System in order to prevent excessive cooldown of the reactor coolant system. This mitigates the effect of an accident such as a steam break which, in itself, causes excessive coolant temperature cooldown.

Feedwater line isolation also reduces the consequences of a steam line break inside the containment, by stopping the entry of feedwater.

Setting Limits

a. The Hi-Level containment pressure limit is set at about 10% of design containment pressure. Initiation of Safety Injection protects against Loss-of-Coolant[2] or steam line break[3] accidents as discussed in the safety analysis.

b. The Hi-Hi Level containment pressure limit is set at about 50% of design containment pressure. Initiation of Containment Spray and Steam Line Isolation protects against large Loss-of-Coolant[2] or steam line break accidents,[3] as discussed in the safety analysis.

c. The pressurizer low pressure limit is set substantially below system operating pressure limits. However it is sufficiently high to protect against a Loss-of-Coolant Accident as shown in the safety analysis.[2]

d. The steam line high differential pressure limit is set in the event of a large steam line break accident, as shown in the safety analysis.[3]

e. The high steam line flow limit is set at approximately 40% of the steam flow from no load to 20% and at 110% of full steam flow at full load, with the steam flow differential pressure measurement linearly programmed between

20% load and 100% load in order to protect against large steam line break accidents.[4] The coincident low T_{avg} setting limit for SIS and steam line isolation initiation is set below its hot shutdown value. The coincident steam line pressure setting limit is set below the full load operating pressure. The safety analysis shows that these settings provide protection in the event of a large steam line break.[3]

Instrument Operating Conditions

During plant operations, the complete instrumentation systems will normally be in service. Reactor safety is provided by the Reactor Protection System, which automatically initiates appropriate action to prevent exceeding established limits. Safety is not comprised, however, by continuing operation with certain instrumentation channels out of service since provisions were made for this in the plant design. This specification outlines limiting conditions for operation necessary to preserve the effectiveness of the Reactor Control and Protection System when any one or more of the channels is out of service.

Almost all reactor protection channels are supplied with sufficient redundancy to provide the capability for channel calibration and test at power. Exceptions are backup channels such as reactor coolant pump breakers. The removal of one trip channel on process control equipment is accomplished by placing that channel bistable in a tripped mode; e.g., a two-out-of-three circuit becomes a one-out-of-two circuit. The nuclear instrumenation system channels are not intentionally placed in a tripped mode since the test signal is superimposed on the normal detector signal to test at power. Testing of the NIS power range channel requires (a) bypassing the Dropped Rod protection from NIS, for the channel being tested, (b) defeating the $\Delta T/T_{avg}$ protection CHANNEL SET that is being fed from the NIS channel, and (c) defeating the power mismatch section of T_{avg} control channels when the appropriate NIS channel is being tested. However, the Rod Position System and remaining NIS channels still provide the dropped-rod protection. Testing does not trip the system unless a trip condition exists in a concurrent channel.

Instrumentation to Access Plant Conditions During and Following an Accident

The operability of the accident monitoring instrumentation ensures that sufficient information is available on selected plant parameters to monitor and assess these variables during and following an accident. This capability is consistent with the recommendations of Regulatory Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident," December 1975 and NUREG-0578, "TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations," July 1979.

Radioactive Liquid Effluent 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 setpoints for these instruments shall be calculated in accordance with the procedures 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 are consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

Radioactive Gaseous Effluent 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 in accordance with the procedures 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 are consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

References

(1) FSAR Section 7.5
(2) FSAR Section 14.3
(3) FSAR Section 14.2.5
(4) CP&L Letter to the Directorate of Licensing dated October 23, 1973.

TABLE 3.5-1

ENGINEERED SAFETY FEATURE SYSTEM INITIATION INSTRUMENT SETTING LIMITS

NO.	FUNCTIONAL UNIT	CHANNEL ACTION	SETTING LIMIT
1.	High Containment Pressure (HI Level)	Safety Injection*	$\leq$ 5 psig
2.	High Containment Pressure (HI-HI Level)	a. Containment Spray** b. Steam Line Isolation	$\leq$ 25 psig
3.	Pressurizer Low Pressure	Safety Injection*	$\geq$ 1700 psig
4.	High Differential Pressure Between any Steam Line and the Steam Line Header	Safety Injection*	$\leq$ 150 psi
5.	High Steam Flow in 2/3 Steam Lines***	a. Safety Injection* b. Steam Line Isolation	$\leq$ 40% (at zero load) of full steam flow $\leq$ 40% (at 20% load) of full steam flow $\leq$ 110% (at full load) of full steam flow
	Coincident with Low T_{avg} or Low Steam Line Pressure		$\geq$ 541°F T_{avg}**** $\geq$ 600 psig steam line pressure
6.	Loss of Power		
	a. 480 V Emerg. Bus Undervoltage (Loss of Voltage) Time Delay	Trip Normal Supply Breaker	328 Volts $\pm$ 1 Volt .75 $\pm$ .25 sec.

TABLE 3.5-1 (Continued)

ENGINEERED SAFETY FEATURE SYSTEM INITIATION INSTRUMENT SETTING LIMITS

NO.	FUNCTIONAL UNIT	CHANNEL ACTION	SETTING LIMIT
6. (Cont'd)	b. 480V Emerg. Bus Undervoltage (Degraded Voltage) Time Delay	Trip Normal Supply Breaker	412 Volts $\pm$ 1 Volt 10.0 second delay $\pm$ 0.5 sec.
7.	Containment Radioactivity High	Ventilation Isolation	$\leq$ 2 X reading at the time the alarm is set with known plant conditions

* Initiates also containment isolation (Phase A), feedwater line isolation, and starting of all containment fans.

** Initiates also containment isolation (Phase B).

*** Derived from equivalent ΔP measurements.

**** These setting limits shall be greater than or equal to 524°F and 450 psig when operating under reduced temperature conditions described in the November 11, 1981 license submittal.

TABLE 3.5-2

REACTOR TRIP INSTRUMENTATION LIMITING OPERATING CONDITIONS

NO.	FUNCTIONAL UNIT	1 MINIMUM OPERABLE CHANNELS	2 MINIMUM DEGREE OF REDUNDANCY	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 1 OR 2 CANNOT BE MET
1.	Manual	1	0	Maintain hot shutdown
2.	Nuclear Flux Power Range*	3	2	Maintain hot shutdown
3.	Nuclear Flux Intermediate Range	1	0	Maintain hot shutdown**
4.	Nuclear Flux Source Range	1	0	Maintain hot shutdown***
5.	Overtemperature ΔT	2	1	Maintain hot shutdown
6.	Overpower ΔT	2	1	Maintain hot shutdown
7.	Low Pressurizer Pressure	2	1	Maintain hot shutdown
8.	Hi Pressurizer Pressure	2	1	Maintain hot shutdown
9.	Pressurizer-Hi Water Level	2	1	Maintain hot shutdown
10.	Low Reactor Coolant Flow	2/operable loop	1/operable loop	Maintain hot shutdown
11.	Turbine Trip	2	1	Maintain less than 10% R.P.

TABLE 3.5-2 (Cont'd)

REACTOR TRIP INSTRUMENTATION LIMITING OPERATING CONDITIONS

NO.	FUNCTIONAL UNIT	1 MINIMUM OPERABLE CHANNELS	2 MINIMUM DEGREE OF REDUNDANCY	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 1 OR 2 CANNOT BE MET
12.	Lo Lo Steam Generator Water Level	2	1	Maintain Hot Shutdown
13.	Underfrequency 4 KV System	2	1	Maintain Hot Shutdown
14.	Undervoltage on 4 KV System	2	1	Maintain Hot Shutdown
15.	Control Rod Misalignment Monitor****			
	a. Rod Position Deviation	1	0	Log individual rod position once/hour, and after a load change >10% or after >30 inches of control rod motion
	b. Quadrant Power Tilt Monitor (upper and lower ex-core neutron detectors)	1	0	Log individual upper and lower ion chamber currents once/hour and after a loa change >10% or after >30 inches of contro rod motion

* For zero power physics testing, it is permissible to take one channel out of service.

** When two of four power channels are greater than 10% full power, hot shutdown is not required.

*** When one of two intermediate range channels is greater than 1E-10 amps, hot shutdown is not required.

**** If both rod misalignment monitors (a and b) are inoperable for two hours or more, the nuclear overpower trip shall be reset to 93 percent of rated power in addition to the increased surveillance noted.

R.P. = Rated Power

TABLE 3.5-3

INSTRUMENTATION OPERATING CONDITIONS FOR ENGINEERED SAFETY FEATURES

NO.	FUNCTIONAL UNIT	1 MINIMUM CHANNELS OPERABLE	2 MINIMUM DEGREE OF REDUNDANCY	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 1 OR 2 CANNOT BE MET
1	SAFETY INJECTION			
	a. Manual	1	0	Cold Shutdown
	b. High Containment Pressure (Hi Level)	2	1	Cold Shutdown
	c. High Differential Pressure between any Steam and the Steam Line Header	2	1	Cold Shutdown***
	d. Pressurizer Low Pressure	2	1	Cold Shutdown***
	e. High Steam Flow in 2/3 Steam Lines Coincident with Low T_{avg} or Low Steam Pressure	1/Steam Line 2 T_{avg} Signals 2 Pressure Signals	***** 1 1	Cold Shutdown***

TABLE 3.5-3 (Continued)

INSTRUMENTATION OPERATING CONDITIONS FOR ENGINEERED SAFETY FEATURES

NO.	FUNCTIONAL UNIT	1 MINIMUM CHANNELS OPERABLE	2 MINIMUM DEGREE OF REDUNDANCY	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 1 OR 2 CANNOT BE MET
2.	CONTAINMENT SPRAY			
	a. Manual*	2	0**	Cold Shutdown
	b. High Containment Pressure* (Hi-Hi Level)	2/set	1/set	Cold Shutdown
3.	LOSS OF POWER			
	a. 480V Emerg. Bus Undervoltage (Loss of Voltage)	2/bus(a)	1/bus(b)	Maintain Hot Shutdown
	b. 480V Emerg. Bus Undervoltage (Degraded Voltage)	2/bus	1/bus	Maintain Hot Shutdown(c)

* Also initiates a Phase B containment isolation.
** Must actuate two switches simultaneously.
*** When primary pressure is less than 2000 psig, channels may be blocked.
**** When primary temperature is less than 547°F, channels may be blocked.(d)
***** In this case, the 2/3 high steam flow is already in the trip mode.
(a) During testing and maintenance of one channel, may be reduced to 1/bus.
(b) During testing and maintenance of one channel, may be reduced to 0/bus.
(c) The reactor may remain critical below the power operating conditions with this feature inhibited for the purpose of starting reactor coolant Pumps.
(d) When operating under the reduced temperature conditions described in the November 11, 1981 license submittal, the channels may be blocked when primary temperature is less than 530°F.

TABLE 3.5-4

INSTRUMENT OPERATING CONDITIONS FOR ISOLATION FUNCTIONS

NO.	FUNCTIONAL UNIT	1 MINIMUM OPERABLE CHANNELS	2 MINIMUM DEGREE OF REDUNDANCY	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 1 OR 2 CANNOT BE MET
1.	CONTAINMENT ISOLATION			
	a. Phase A			
	i. Safety Injection	See Item No. 1 of Table 3.5-3		Cold Shutdown
	ii. Manual	1	0	Hot Shutdown
	b. Phase B	See Item No. 2 of Table 3.5-3		
	c. Ventilation Isolation			
	i. High Containment Activity	1	0	Containment shall not be purged.
	ii. Phase A	See Item No. 1.a of Table 3.5-4		

TABLE 3.5-4 (Continued)

INSTRUMENT OPERATING CONDITIONS FOR ISOLATION FUNCTIONS

NO.	FUNCTIONAL UNIT	1 MINIMUM OPERABLE CHANNELS	2 MINIMUM DEGREE OF REDUNDANCY	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 1 OR 2 CANNOT BE MET
2.	STEAM LINE ISOLATION			
	a. High Steam Flow in 2/3 Steam Lines Coincident with Low T_{avg} or Low Steam Pressure	See Item No. 1 of Table 3.5-3		Cold Shutdown
	b. High Containment Pressure	See Item No. 1 of Table 3.5-3		Cold Shutdown
	c. Manual	1/Line	0	Hot Shutdown
3.	FEEDWATER LINE ISOLATION			
	a. Safety Injection	See Item No. 1 of Table 3.5-3		Cold Shutdown

TABLE 3.5-5

(THIS TABLE APPLIES WHEN THE RCS IS > 350°F)

INSTRUMENTATION TO FOLLOW THE COURSE OF AN ACCIDENT

NO.	INSTRUMENT	1 MINIMUM CHANNELS OPERABLE	2 OPERATOR ACTION IF CONDITIONS OF COLUMN 1 CANNOT BE MET
1	Pressurizer Level	2	See Item 9 Table 3.5-2
2	Auxiliary Feedwater Flow Indication (Primary Indication)		Note 1
	SD AFW Pump	1 per S/G	
	MD AFW Pump	1 per S/G	
3	Reactor Coolant System Subcooling Monitor	1	Note 2
4	PORV Position Indicator (Primary)	1	Note 3
5	PORV Blocking Valve Position Indicator (Primary)	1	Note 3
6	Safety Valve Position Indicator (Primary)	1	Note 3

Note 1: The three AFW lines from the MD AFW pumps and the three AFW lines from the SD AFW pump each contain one primary flow indicator (2 AFW flow paths per steam generator for a total of 6 AFW lines). These primary indicators are backed up by the narrow range steam generator level indications. If one or more of the direct AFW flow indicators becomes inoperable when the RCS is > 350°F, restore the indicator(s) to an operable status within 7 days, or prepare and submit a special report to the NRC within the following 14 days detailing the cause(s) of the inoperable indicator(s), the actions being taken to restore the indicator(s) to an operating status, the estimated date for completion of the repairs, and any compensatory action being taken while the indicator(s) is inoperable. The action required when any of the backup indications of AFW flow are inoperable, is described in Table 3.5-2.

(Notes 2 & 3 -- see next page)

TABLE 3.5-5 (Continued)

INSTRUMENTATION TO FOLLOW THE COURSE OF AN ACCIDENT

Note 2 If both channels of the RCS subcooling monitor become inoperable when the RCS is >350°F, restore at least one channel to an operable status within 7 days, or prepare and submit a special report to the NRC within the following 14 days detailing the cause(s) of the inoperable channels, the actions being taken to restore at least one channel to an operable status, the estimated date for completion of the repairs, and any compensatory action being taken while both channels are inoperable.

Note: 3 The Pzr PORVs and Pzr PORV blocking valves both incorporate limit switches for the direct (primary) means of position indication. The backup method of position indication consists of PRT pressure and a temperature element in a common line downstream of the valves. The Pzr safety relief valves incorporate a vibration monitoring system as the primary method of valve position indication. The backup method of position indication consists of a temperature element downstream of each valve and PRT pressure. If the primary method of position indication for either the Pzr PORVs, Pzr PORV blocking valves, or Pzr safety relief valves becomes inoperable when the RCS is >350°F, restore the primary method to an operable status within 7 days, or prepare and submit a special report to the NRC within the following 14 days detailing the cause of the inoperable primary position indication method, the actions being taken to restore it to an operable status, the estimated date for completion of the repairs, and any compensatory action being taken while the primary position indication method is inoperable. If any of the backup methods of position indication for these valves becomes inoperable, it is to be repaired as soon as plant conditions permit.

TABLE 3.5-6

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
1. Liquid Radwaste Effluent Discharge Line		
a. Monitor (RMS-18) provides automatic termination of release upon exceeding alarm/trip setpoint	1	With the number of channels operable less than the MCO requirements: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that prior to initiating a release: 1. Two independent samples are analyzed in accordance with the Surveillance Requirements of Specification 3.9.1.1 and; 2. Two members of the facility staff independently verify the release rate calculations and the discharge line valving.
b. Flow rate measurement device	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may be continued, provided that the flow rate is estimated at least once per 4 hours during actual releases. Pump performance curves generated "in situ" and tank volumes may be used to estimate flow.

*MCO - Minimum Channels Operable

TABLE 3.5-6 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
2. Steam Generator Blowdown Effluent Line		
a. Monitor (RMS-19) provides automatic termination of blowdown from all three Steam Generators upon exceeding alarm/trip setpoint.	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that grab samples are analyzed for gross radioactivity (beta or gamma) with a lower limit of detection of at least 1.0E-07 μ Ci/ml or are analyzed for principle gamma emitters consistent with Table 4.10-1; 1. Once per 24 hours when the specific activity of the secondary coolant is $\leq$ 0.01 μ Ci/ml Dose Equivalent I-131, or; 2. Once per 12 hours when the specific activity of the secondary coolant is > 0.01 μ Ci/ml Dose Equivalent I-131.
b. Flow rate measurement devices - each Steam Generator has its own blowdown flow rate measuring device.	1 per S/G	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that the flow rate for the affected blowdown line(s) is estimated at least once per 24 hours.

*MCO - Minimum Channels Operable

TABLE 3.5-6 (Continued)

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
3. Discharge Canal Flow Note	1	With the number of channels operable less than the MCO requirement suspend effluent release via this pathway
4. Tank Level Indicating Devices		With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and,
a. Refueling Water Storage Tank	1	
b. Monitor Tanks		b. Liquid additions to the affected tank(s) may continue provided that the liquid level for the affected tanks is estimated during all liquid additions to the affected tank(s).
Tank A	1	
Tank B		
c. Waste Condensate Tanks		
Tank C	1	
Tank D	1	
Tank E	1	
d. Temporary Tanks (Note 2)	1 per Tank	

TABLE 3.5-6 (Continued)
RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
5. Containment Fan Cooling Water Monitor (Service Water Effluent Line)		
a. Monitor (RMS-16) does not provide automatic termination of release upon exceeding alarm setpoint.	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that, once per 24 hours, grab samples are collected and analyzed for gross radioactivity (beta or gamma) with a lower limit of detection of at least 1.0E-07 μ Ci/ml or are analyzed for principal gamma emitters consistent with Table 4.10-1.
6. Composite Sampler for Settling Ponds	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that, once per 24 hours, grab samples are collected and analyzed for gross radioactivity (beta or gamma) with lower limit of detection of at least 1.0E-07 μ Ci/ml or are analyzed for principal gamma emitters consistent with Table 4.10-1.

*MCO - Minimum Channels Operable

NOTE TO TABLE 3.5-6

Note 1 - Pump curves for Unit 2 operating circulating water pumps may be used to satisfy this MCO. If no Unit 2 circulating water pumps are operating the pump curves for circulating water pumps operating in Unit 1 may be used to satisfy this MCO.

Note 2 - A temporary tank is defined as any tank having a capacity of $\geq$ 100 gallons used for the receipt or transfer of radioactive liquids.

TABLE 3.5-7

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
1. Plant Vent		
a. Radionoble gas monitor (RMS-14) provides automatic termination of Waste Gas Decay Tank releases upon exceeding alarm/trip setpoint.	1	With the number of channels operable less than the MCO requirements: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that prior to initiating a release: 1. Two independent samples are analyzed in accordance with the Surveillance Requirements of Specification 3.9.3.1 and; 2. Two members of the facility staff independently verify the release rate calculations and the discharge line valving.
b. Radionoble gas monitors RMS-14 and RMS-34 monitor all effluents from Auxiliary Building Ventilation System without providing automatic termination of release upon exceeding their respective alarm setpoints.	1 of the two monitors	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semiannual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that grab samples are collected once per 12 hours and are analyzed for radionoble gases once per 24 hours.

*MCO - Minimum Channels Operable

TABLE 3.5-7 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
1. Plant Vent (Continued)		
c. Radioiodine Sampler (RMS-34)	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent release via this pathway may continue provided that a continuous sample is collected utilizing auxiliary sampling equipment as provided by Table 4.10-2.
d. Particulate Sampler (RMS-34)	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that a continuous sample is collected utilizing auxiliary sampling equipment as required by Table 4.10-2.
e. Sampler flow rate monitor (RMS-34) and Vacuum gauge (RMS-34)	1 of the two monitors	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsucessessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided the flow rate is estimated once per 4 hours.

TABLE 3.5-7 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
1. Plant Vent (Continued)		
f. Plant Vent flow rate monitor	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that flow rate is estimated once per 4 hours.
2. Waste Gas Holdup System Explosive Gas Monitoring System	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 14 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. When continuous monitoring is out of service daily grab samples will be taken and analyzed during normal operations and once per 4 hours during degassing operations.
3. Containment Vessel via Plant Vent		
a. Radionoble gas monitor (RMS-12) provides automatic termination of Containment Vessel releases upon exceeding alarm/trip Setpoint.	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and,

TABLE 3.5-7 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
3. Containment Vessel Via Plant Vent (Continued)		b. Effluent releases via this pathway may continue provided that either of the Plant Vent Radionoble Gas Monitors (RMS-14 or RMS-1 is operable; otherwise, suspend all releases via this pathway.
b. Radioparticulate Monitor (RMS-11) provides automatic termination of containment vessel releases exceeding alarm/trip setpoints	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that either of the Plant Vent Radionoble Gas Monitors (RMS-14 or RMS-1 is operable; otherwise, suspend all releases via this pathway.
c. Sampler flow rate monitor (RMS-11)	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccesaful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that the flow rate is estimated once per 4 hours.
4. Condenser Vacuum Pump Vent		
a. Radionoble gas monitor (RMS-15) diverts effluents from Condenser Vacuum Pump Vent to the Plant Vent upon exceeding alarm/trip setpoint.	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and,

TABLE 3.5-7 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
4. Condenser Vacuum Pump Vent (Continued)		b. Effluent releases via this pathway may continue provided that; 1. Grab samples are collected once per 12 hours and are analyzed within 24 hours for radionoble gases, or; 2. The effluent is diverted to the Plant Vent and RMS-14 is operable.
b. Flow rate measuring devices (one for each Vacuum Pump).	1 for each pump in service	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided the flow rate is estimated once per 4 hours.
5. Fuel Handling Building Lower Level Exhaust Vent		
a. Radionoble gas monitor (RMS-20) trips the exhaust and supply fans for the lower level of the Fuel Handling Building upon exceeding alarm/trip setpoint.	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that grab samples are taken once per 12 hours and analyzed for gross activity within 24 hours.

*MCO - Minimum Channels Operable

TABLE 3.5-7 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
5. Fuel Handling Building Lower Level Exhaust Vent (Continued)		
b. Sampler flow rate monitor (RMS-20)	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided the flow rate is estimated once per 4 hours.
6. Fuel Handling Building Upper Level Exhaust Vent		
a. Radionoble gas monitor (RMS-21) trips the exhaust and supply fans for the upper level of the Fuel Handling Building upon exceeding alarm/trip setpoint.	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided that: 1. The Plant Vent Radionoble Gas Monitor (RMS-14) is operable, 2. Grab samples are collected once per 12 hours and are analyzed within 24 hours for radionoble gases.

*MCO - Minimum Channels Operable

TABLE 3.5-7 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Required Action
6. Fuel Handling Building Upper Level Exhaust Vent (Continued)		
b. Sampler flow rate monitor (RMS-21)	1	With the number of channels operable less than the MCO requirement: a. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Semi-annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Specification 6.9.1.d.4 and, b. Effluent releases via this pathway may continue provided the flow rate is estimated once per 4 hours.

*MCO - Minimum Channels Operable

3.9 RADIOACTIVE EFFLUENTS

3.9.1 Compliance With 10 CFR Part 20 - Radioactive Materials in Liquid Effluents

Applicability

Applies to radioactive material in liquid effluents released from the site to unrestricted areas.

Objective

To define the concentration limits of 10CFR20 for radioactive material in liquid effluents released to unrestricted areas.

Specification

3.9.1.1 The concentration of radioactive material in liquid effluents released at any time from the site to unrestricted areas (see Figure 1.1-1) shall be limited to the concentrations specified in 10CFR20, 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} μCi/ml total activity.

3.9.1.2 With the concentration of radioactive material in liquid effluents released from the site to unrestricted areas exceeding the above limits, without delay restore the concentration to within the above limits. In addition, a prompt notification must be made to the Commission in accordance with Specification 6.9.2(a)(10).

3.9.1.3 In the event that the immediate action required by 3.9.1.2 above cannot be satisfied, the facility shall be placed in hot shutdown

within 12 hours and in cold shutdown within the next 30 hours, and entry into the power operating condition shall not be made unless Specification 3.9.1.1 is met.

3.9.1.4 The provisions of Specifications 3.0 and 6.9.2.b(2) are not applicable.

3.9.2 Compliance With 10 CFR Part 50 - Radioactive Materials in Liquid Effluents

Applicability

Applies to radioactive materials in liquid effluents released from the site to unrestricted areas.

Objective

To define the calculated dose limits of 10CFR50 for radioactive materials in liquid effluents released to unrestricted areas.

Specification

3.9.2.1 The dose commitment at all times to a member of the public from radioactive materials in liquid effluents released to unrestricted areas (See Figure 1.1-1) shall be limited:

a. During any calendar quarter to $\leq$1.5 mrem to the total body and to $\leq$5 mrem to any organ, and
b. During any calendar year to $\leq$3 mrem to the total body and to $\leq$10 mrem to any organ.

3.9.2.2 With the calculated dose commitment from the release of radioactive materials in liquid effluents exceeding any of the limits prescribed by Specification 3.9.2.1 above, prepare and submit a report to the Commission in accordance with Specification 6.9.3.2.

3.9.3 Compliance With 10 CFR Part 20 - Radioactive Materials in Gaseous Effluents

Applicability

Applies to radioactive materials in gaseous effluents released from the site to unrestricted areas.

Objective

To define the dose rate limits for radioactive materials in gaseous effluents released to unrestricted areas.

Specification

3.9.3.1 The dose rate due to radioactive materials in gaseous effluents released from the site boundary (see Figure 1.1-1) shall be limited to the following:

a. For radionoble gases: $\leq$500 mrem/yr to the total body, $\leq$3000 mrem/yr to the skin, and

b. For all I-131, and tritium, and for all radioactive materials in particulate form, inhalation pathway only, with half lives greater than 8 days: $\leq$1500 mrem/yr to any organ.

3.9.3.2 With the dose rate(s) exceeding the above limits, without delay decrease the release rate to within the above limits. In addition, a prompt notification must be made to the Commission in accordance with Specification 6.9.2(a)(10).

3.9.3.3 In the event that the immediate action required by 3.9.3.2 above cannot be satisfied, the facility shall be placed in hot shutdown

within 12 hours and in cold shutdown within the next 30 hours, and entry into the power operating condition shall not be made until Specification 3.9.3.1 is met.

3.9.4 Compliance With 10 CFR Part 50 - Radionoble Gases

Applicability

Applies to radionoble gases released in gaseous effluents to unrestricted areas.

Objective

To define the air dose limits of 10CFR50 for radionoble gases released in gaseous effluents to unrestricted areas.

Specification

3.9.4.1 The air dose commitment due to radionoble gases released in gaseous effluents to areas at and beyond the site boundary (See Figure 1.1-1) shall be limited, at all times, to the following:

a. During any calendar quarter, to $\leq$5 mrad for gamma radiation and $\leq$10 mrad for beta radiation;

b. During any calendar year, to $\leq$10 mrad for gamma radiation and $\leq$20 mrad for beta radiation.

3.9.4.2 With the calculated air dose commitment from radioactive noble gases in gaseous effluents exceeding any of the limits, prescribed by Specification 3.9.4.1 above, prepare and submit a report to the Commission in accordance with Specification 6.9.3.2.

3.9.5 Compliance With 10 CFR Part 50 - Radioiodines, Radioactive Materials in Particulate Form, and Radionuclides Other Than Radionoble Gases

Applicability

Applies to radioiodines, radioactive materials in particulate form, and radionuclides other than radionoble gases released from the site to unrestricted areas.

Objective

To define the dose limits of 10CFR50 for radioiodines, radioactive materials in particulate form, and radionuclides other than radionoble gases released from the site to unrestricted areas.

Specification

3.9.5.1 The dose to a member of the public from I-131, tritium and radioactive materials in particulate form, with half-lives greater than 8 days in gaseous effluents released to unrestricted areas (See Figure 1.1-1), inhalation pathway only, shall be limited, at all times, to the following:

a. During any calendar quarter, $\leq$7.5 mrem to any organ and,

b. During any calendar year, $\leq$15 mrem to any organ.

3.9.5.2 With the calculated dose commitment from the release of I-131, tritium and radioactive materials in particulate form, with half lives greater than 8 days, in gaseous effluents exceeding any of the limits prescribed by Specification 3.9.5.1 above, prepare and submit a report to the Commission in accordance with Specification 6.9.3.2.

3.9.6 Compliance With 40 CFR Part 190 - Radioactive Effluents From Uranium Fuel Cycle Sources

Applicability

Applies to radioactive effluents from uranium fuel cycle sources.

Objective

To define the dose limits of 40CFR190 for radioactive effluents from uranium fuel cycle sources.

Specifications

3.9.6.1 The dose commitment to any member of the public, due to releases of licensed materials and radiation, from uranium fuel cycle sources shall be limited to $\leq$25 mrem to the total body or any organ except the thyroid, which shall be limited to $\leq$ 75 mrem over 12 consecutive months. This specification is applicable to Robinson Unit 2 only for the area within a five mile radius around the Robinson Plant.

3.9.6.2 With the calculated doses from the release of the radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specification 3.9.2.1.a, 3.9.2.1.b, 3.9.4.1.a, 3.9.4.1.b, 3.9.5.1.a, or 3.9.5.1.b, calculations should be made including direct radiation contributions from the reactor units and from outside storage tanks to determine whether the above limits of Specification 3.9.6.1 have been exceeded. If such is the case in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.3.2.d, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR Part 20.405c, shall include an

analysis that estimates the radiation exposure (dose) to a member of the public from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentrations of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the same request is complete.

3.9.6.3 The provisions of Specifications 3.0 and 6.9.2.b(2) are not applicable.

Basis

Compliance With 10 CFR Part 20 - Radioactive Materials in Liquid Effluents

This specification is provided to ensure that the concentration of radioactive materials in liquid effluents released from the site to unrestricted areas will be less than the concentrations specified in 10 CFR Part 20, Appendix B, Table II. This limitation provides the additional assurance that the concentrations of radioactive materials in bodies of water outside the site will result in exposures within 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 radionuclide 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

HASL Procedures Manual, HASL-300 (revised annually), Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination – Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J. K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

Compliance With 10 CFR Part 50 - Radioactive Materials in Liquid Effluents

This specification is provided to implement the requirements of Sections II.A, and III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.A of Appendix I. The action statement provides the required operating flexibility and at the same time implements the guides set forth in Section IV.A of Appendix I of 10 CFR Part 50 to assure that the release of radioactive material in liquid effluents will be kept "as low as is reasonably achievable." The dose calculations in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculative procedures based on models and data, such that the actual exposure of an individual 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 the 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.

Compliance With 10 CFR Part 20 - Radioactive Materials in Gaseous Effluents

This specification is provided to ensure that the dose rate at any time at the site boundary from gaseous effluents from H. B. Robinson Unit No. 2 will be within the annual dose limits of 10 CFR Part 20 for 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 result in the exposure of individuals outside the site boundary, to annual average concentrations within the limits specified in Appendix B Table II of 10 CFR Part 20, (10 CFR Part 20.106(b)). For individuals who may at times be within the site boundary, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary unrestricted area. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rate equivalents above background to an individual in unrestricted areas to $\leq$500 mrem/year to the total body or to $\leq$3000 mrem/year to the skin.

Compliance With 10 CFR Part 50 - Radionoble Gases

This specification is provided to implement the requirements of Section II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The limiting condition for operation implementing the guides provides the required operating flexibility and at the same time implements the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents will be kept "as low as 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 calculative procedures based on models and data such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The methods 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 the 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 dose commitments at the site boundary are based upon historical average atmospheric conditions.

Compliance With 10 CFR Part 50 - Radioiodines, Radioactive Materials in Particulate Form, and Radionuclides Other Than Radionoble Gases

This specification is provided to implement the requirements of Section II.C, III.A, and IV.A of Appendix I, 10 CFR Part 50. The limiting condition for operation implements the guides set forth in Section II.C of Appendix I. The action statement provides the required operating flexibility and at the same time implements the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials as gaseous effluents will be kept "as low as reasonably achievable." The surveillance requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculative procedures based on models and data, such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The methods established in the ODCM 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", Revison 1, July 1977. The ODCM equations provided for determining the commitment are based upon historical average atmospheric conditions.

Compliance With 40 CFR Part 190 - Radioactive Effluents From Uranium Fuel Cycle Sources

This specification is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant generated radioactive effluents and direct radiation exceed 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems. It is highly unlikely that the resultant dose to a member of the public will exceed dose limits of 40 CFR Part 190 if the reactor remains within twice the dose design objectives of Appendix I, and if direct radiation doses from the

reactor unit and outside storage tanks 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 Specifications 3.9.1.1 and 3.9.3.1. 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.

3.16 RADIOACTIVE WASTE SYSTEMS

3.16.1 Liquid Radwaste Treatment System

Applicability

Applies to the liquid radwaste treatment system.

Objective

To define the operating requirements for the liquid radwaste treatment system.

Specification

3.16.1.1 The appropriate portions of the Liquid Radwaste Treatment System shall be maintained and used to reduce the concentrations of radioactive materials in liquid wastes prior to their discharge when the projected dose commitments, due to the release of radioactive liquid effluents to unrestricted areas (See Figure 1.1-1) when averaged over a calendar quarter, would exceed 0.2 mrem to the total body or 0.6 mrem to any organ.

3.16.1.2 With radioactive liquid wastes being discharged without treatment while in excess of the limits of Specification 3.16.1.1 above, prepare and submit a report to the Commission in accordance with Specification 6.9.3.2.b.

3.16.2 Liquid Holdup Tanks*

Applicability

Applies to the liquid holdup tanks.

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* Tanks included in this Specification are those outdoor tanks that are not surrounded by liners, dykes, or walls capable of holding the tank contents and that do not have tank overflows and surrounding area drains connected to the liquid radwaste treatment system. Tanks classed as "Seismic Class 1" are excluded from this Specification.

Objective

To define the operating requirements for the liquid holdup tanks.

Specification

3.16.2.1 The quantity of radioactive material contained in each of the following tanks shall at all times be limited to $\leq$10 curies, excluding tritium and dissolved or entrained noble gases.

a. A monitor tank
b. B monitor tank
c. C Waste Condensate tank
d. D Waste Condensate tank
e. E Waste Condensate tank
f. Any Outside temporary tank*

3.16.2.2 With the quantity of radioactive material in any of the above listed tanks exceeding the above limit, immediately suspend all additions of radioactive material to the tank, within 48 hours reduce the tank contents to within the limit, and the event should be described in the Semiannual Radioactive Effluent Release Report, Specification 6.9.1.d.

3.16.2.3 If Specification 3.16.2.2 is not completed within 48 hours a prompt notification with written followup is required as per Specification 6.9.2.a(10).

3.16.3 Gaseous Radwaste and Ventilation Exhaust Treatment Systems

Applicability

Applies to the gaseous radwaste and ventilation exhaust treatment systems.

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* A temporary tank is defined as any tank having a capacity of $\geq$ 100 gallons used for the receipt or transfer of radioactive liquids.

Objective

To define the operating requirements for the gaseous radwaste and ventilation exhaust treatment systems.

Specificat ..

3.16.3.1 The appropriate portions of the Gaseous Radwaste Treatment System and the Ventilation Exhaust Treatment System shall be maintained and used to reduce the concentrations of radioactive materials in gaseous wastes prior to their discharge when the projected dose commitments due to the release of gaseous effluents to unrestricted areas (See Figure 1.1-1) when averaged over a calendar quarter would exceed:

a. 0.6 mrem for gamma radiation and 1.3 mrem for beta radiation due to radionoble gases or,

b. 1.0 mrem to any organ due to radioiodines, radioactive materials in particulate form, and radionuclides other than radionoble gases.

3.16.3.2 With the Gaseous Radwaste Treatment System and/or the Ventilation Exhaust Treatment System not operable and with radioactive gaseous wastes being discharged without treatment while in excess of the limits of Specification 3.16.3.1 above, prepare and submit a report to the Commission in accordance with Specification 6.9.3.2.b.

3.16.4 Waste Gas Decay Tanks (Hydrogen and Oxygen)

Applicability

Applies to the volumetric hydrogen and oxygen concentration limits for the four Waste Gas Decay Tanks.

Objective

To define operating requirements for the Waste Gas Decay Tanks.

Specification

3.16.4.1 The oxygen concentration in the four Waste Gas Decay Tanks should be limited to $\leq$ 4% by volume when the hydrogen concentration in the same tank exceeds 4% by volume. The hydrogen concentration in the four Waste Gas Decay Tanks should be limited to $\leq$ 4% by volume when the oxygen concentration in the same tank exceeds 4% by volume.

3.16.4.1.a When the concentration of oxygen in a Waste Gas Decay Tank is $>$ 4% but $\leq$ 6% by volume and the hydrogen concentration in the same tank is $>$ 4% by volume, or the concentration of hydrogen in a Waste Gas Decay Tank is $>$ 4% but $\leq$ 6% by volume and the oxygen concentration in the same tank is $>$ 4% by volume, restore one or both to $\leq$ 4% by volume within 48 hrs.

3.16.4.1.b When the concentration of oxygen in a Waste Gas Decay Tank is $>$ 6% by volume and the hydrogen concentration in the same tank is $>$ 4% by volume, or the concentration of hydrogen in a Waste Gas Decay Tank is $>$ 6% by volume and the oxygen concentration in the same tank is $>$ 4% by volume, immediately suspend all additions of waste gas to the affected tank and immediately commence efforts to lower the concentration of one or both to $\leq$ 4% by volume.

3.16.4.2 If the requirements of paragraph 3.16.4.1.a cannot be met within the 48 hour limit, submit a special report to the NRC within the following 14 days which outlines the cause of the occurrence, corrective actions taken to date, corrective actions which will be taken, and any compensatory actions being taken to minimize the potential hazard.

3.16.4.3 If the actions taken to comply with paragraph 3.16.4.1.b do not reduce the concentration of hydrogen and/or oxygen in the affected tank to $\leq$ 6% by volume within 24 hours, a prompt notification with written followup is required per specification 6.9.2.a(10). Once the concentration of hydrogen and/or oxygen in the affected tank is $\leq$ 6% by volume, paragraphs 3.16.4.1.a and 3.16.4.2 apply.

3.16.5 Waste Gas Decay Tanks (Radioactive Materials)

Applicability

Applies to the four Waste Gas Decay Tanks.

Objective

To define the operating requirements for the Waste Gas Decay Tanks.

Specification

3.16.5.1 The quantity of radioactivity contained in each Waste Gas Decay Tank shall at all times be limited to $\leq$ 6.0E5 curies noble gases (considered as Xe-133).

3.16.5.2 With the quantity of radioactive materials in any Waste Gas Decay Tank exceeding the above limit, immediately suspend all additions of radioactive material to the tank and within 48 hours reduce the tank contents to within the limit.

3.16.5.3 If Specification 3.16.5.2 is not completed within 48 hours, a prompt notification with written follow-up is required as per Specification 6.9.2.a(10).

3.16.6 Solidification of Wet Radioactive Waste

Applicability

Applies to the solidification of wet radioactive waste.

Objective

To define the requirements for the solidification of wet radioactive waste.

Specification

3.16.6.1 The Solid Radwaste System shall be used in accordance with a Process Control Program (PCP) to process wet radioactive waste to meet shipping and burial ground requirements.

3.16.6.2 With the provisions of the PCP not satisfied, suspend shipments of defectively processed or defectively packaged solid radioactive waste from the site.

3.16.6.3 If any test specimen, as required by the PCP, fails to verify solidification, the solidification of the batch under test shall be suspended until such time as additional test specimens can be obtained, alternative solidification parameters can be determined in accordance with the PCP, and a subsequent test verifies solidification. The PCP shall be modified as required in accordance with Section 6.15, and solidification of the batch may then be resumed using alternative solidification parameters as determined by the PCP.

Bases

Liquid Radwaste Treatment System

The requirements that the appropriate portions of this system be maintained and used when specified provides assurance that the releases of radioactive

materials in liquid effluents will be kept "as low as reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the Liquid Radwaste Treatment System were specified as the dose design objective set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

Liquid Holdup Tanks

The tanks listed in this Specification include all those outdoor tanks that are not surrounded by liners, dikes, or walls capable of holding the tank contents and that do not have tank overflows and surrounding area drains connected to the liquid radwaste treatment system.

Restricting the quantity of radioactive material contained in the specified tanks provides assurance that in the event of an uncontrolled release of the tanks' contents, the resulting concentrations would be less than the limits of 10 CFR Part 20, Appendix B, Table II, Column 2, at the nearest potable water supply and the nearest surface water supply in an unrestricted area.

Gaseous Radwaste and Ventilation Exhaust Treatment Systems

The requirements that the appropriate portions of these systems be maintained and used when specified provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as the dose design objectives set forth in Section II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

Waste Gas Decay Tanks (Hydrogen and Oxygen)

This specification is provided to ensure that the concentration of potentially explosive gas mixtures contained in the waste gas holdup system is maintained below the flammability limits of hydrogen and oxygen. (Automatic control features are included in the system to prevent the hydrogen and oxygen concentrations from reaching these flammability limits. These automatic control features include isolation of the source of hydrogen and/or oxygen, automatic diversion to recombiners, or injection of dilutants to reduce the concentration below the flammability limits.) Maintaining the concentration of hydrogen and oxygen below their flammability limits provides assurance that the releases of radioactive materials will be controlled in conformance with the requirements of General Design Criterion 60 of Appendix A to 10 CFR Part 50.

Waste Gas Decay Tanks (Radioactive Materials)

The tanks included in this specification are those tanks for which the quantity of radioactivity contained is not limited directly or indirectly by another Technical Specification to a quantity that is less than the quantity that provides assurance that in the event of an uncontrolled release of the tank's contents, the resulting total body exposure to a member of the public at the nearest site boundary will not exceed 0.5 rem in an event of 2 hours duration.

Restricting the quantity of radioactivity contained in each gas storage tank provides assurance that in the event of an uncontrolled release of the tank's contents, the resulting total body exposure to a member of the public at the nearest site boundary will not exceed 0.5 rem. This is consistent with Branch Technical Position ETSB 11-5 in NUREG-0800, July 1981.

Solidification of Wet Radioactive Waste

This specification ensures that the packaging of wet radioactive wastes meets the requirements of 10 CFR Part 20 and 10 CFR Part 71 prior to their shipment from the site for disposal.

3.17 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

3.17.1 Monitoring Program

Applicability

Applies to the radiological environmental monitoring program.

Objective

To define the requirements for implementation of the radiological environmental monitoring program.

Specification

3.17.1.1 The Radiological Environmental Monitoring Program shall be conducted as specified in Table 3.17-1.

3.17.1.2 With the radiological environmental monitoring program not being conducted as specified in Table 3.17-1, in lieu of a Licensee Event Report, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Specification 6.9.1.e, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

3.17.1.3 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 3.17-2 when averaged over any calendar quarter, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.3.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the

potential annual dose* to a member of the public is less than the calendar year limits of Specifications 3.9.2.1, 3.9.4.1, and 3.9.5.1. When more than one of the radionuclides in Table 3.17-2 are detected in the sampling medium, this report shall be submitted if:

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

When radionuclides other than those in Table 3.17-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose* to a member of the public is equal to or greater than the calendar year limits of Specifications 3.9.2.1, 3.9.4.1, and 3.9.5.1. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.

3.17.1.4 With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 3.17-1, identify locations for obtaining replacement samples and add them to the radiological environmental monitoring program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program. In lieu of a Licensee Event Report and pursuant to Specification 6.9.1.d, identify the cause of the unavailability of samples and identify the new location(s) for obtaining replacement samples in the next Semiannual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

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* The methodology and parameters used to estimate the potential annual dose to a member of the public shall be indicated in this report.

3.17.1.5 The provisions of Specifications 3.0 and 6.9.2.b(2) are not applicable.

3.17.1.6 Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, or to malfunction of automatic sampling equipment. If the latter, every effort shall be made to complete corrective action prior to the end of the next sampling period.

3.17.2 Land Use Census

Applicability

Applies to the land use census.

Objective

To define the requirements for the conduct of the land use census.

Specification

3.17.2.1 A land use census shall be conducted and shall identify the location of the nearest milk animal, the nearest residence and the nearest garden of greater than 500 square feet producing fresh leafy vegetables in each of the 16 meteorological sectors within a distance of five miles.

3.17.2.2 With a land use census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Specification 4.10.4.1, in lieu of a Licensee Event Report, identify the new location(s) in the next Semiannual Radioactive Effluent Release report, pursuant to Specification 6.9.1.d.6.

3.17.2.3 With the land use census identifying a location which yields an annual calculated dose or dose commitment of a specific pathway which is 20% greater than that at a current sampling location:

(a) add the new location(s) to the radiological environmental monitoring program within 30 days and,

(b) if desired, delete the sampling location having the lowest calculated dose or dose commitments via the same exposure pathway, excluding the control station location, from the monitoring program after October 31 of the year in which the land use census was conducted, and

(c) identify the new location(s) in the next Semiannual Radioactive Effluent Release Report, Specification 6.9.1.d.4, including a revised figure(s) and table for the ODCM reflecting the new location(s).

3.17.3 Interlaboratory Comparison Program

Applicability

Applies to the interlaboratory comparison program of like media.

Objective

To ensure precision and accuracy of laboratory analyses.

Specification

3.17.3.1 Analyses shall be performed on radioactive materials supplied by EPA as a part of an Interlaboratory Comparison Program of like media within the environmental program as per Table 3.17-1.

3.17.3.2 With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the

Commission in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.e.

3.17.3.3 The provisions of Specifications 3.0 and 6.9.2.b(2) are not applicable.

3.17.3.4 The Interlaboratory Comparison Program shall be described in the ODCM. A summary of the results obtained as part of the above required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.e.

Basis

Monitoring Program

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

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLD). The LLDs required by Table 3.17-3 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined

as an a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for a particular measurement.

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

Land Use Census

This specification is provided to ensure that changes in the use of areas at and beyond the Site Boundary are identified and that modifications to the monitoring program are made if required by the results of the census. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 500 square feet provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Regulatory Guide 1.109, Revision 1 for consumption by a child. To determine this minimum garden size, the following assumptions were used: 1) that 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and 2) a vegetation yield of 2 kg/square meter.

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.

TABLE 3.17-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
1. DIRECT RADIATION[a]	33 routine monitoring stations with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: an inner ring of stations, one in each of the 16 meteorological sectors in the general area of the site boundary; an outer ring of stations, one in each of the 16 meteorological sectors in the 6- to 8-km range from the site; area to serve as a control[b] station.	Quarterly	Gamma dose quarterly.
2. AIRBORNE			
Radioiodine and Particulates	Samples from 5 locations 3 samples from close to the 3 site boundary locations, in different sectors, of the highest calculated annual average groundlevel D/Q. 1 sample from the vicinity of a community having the highest calculated annual average groundlevel D/Q. 1 sample from a control[b] location, as for example 15-30 km distant and in the least prevalent wind direction.	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	Radioiodine Cannister: I-131 analysis weekly. Particulate Sampler: Gross beta radioactivity analysis following filter change;[c] Gamma isotopic analysis[d] of composite (by location) quarterly.

TABLE 3.17-1 (Continued)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
3. WATERBORNE			
a. Surface[e]	1 sample upstream control location[b] 1 sample downstream	Composite sample over 1-month period[f]	Gamma isotopic analysis[d] monthly. Composite for tritium analysis quarterly.
b. Ground[g]	2 samples	Quarterly	Gamma isotopic[d] and tritium analysis quarterly.
c. Sediment from shoreline	1 sample from downstream area with existing or potential recreational value	Semiannually	Gamma isotopic analysis[d] semiannually.
4. INGESTION			
a. Milk	1 sample from milking animals within 5 km distance having the highest dose potential. If there are none, then, 1 sample from milking animals between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per year[h]. 1 sampling from milking animals at a control location[b] 15-30 km distant and in the least prevalent wind direction.	Semimonthly when animals are on pasture, monthly at other times	Gamma isotopic[d] and I-131 analysis semimonthly when animals are on pasture; monthly at other times.
b. Fish	1 sample of each recreationally important species in vicinity of plant discharge area. 1 sample of same species in areas not influenced by plant discharge to serve as control location.[b]	Semiannually	Gamma isotopic analysis[d] on edible portions semiannually.

TABLE 3.17-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
c. Food Products	1 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[i]	Gamma isotopic analyses[d] on edible portion
	Samples of 3 different kinds of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground-level D/Q if milk sampling is not performed.	Monthly when available	Gamma isotopic[d] and I-131 analysis.
	1 sample of each of the similar broad leaf vegetation grown 15-30 km distant in the least prevalent wind direction if milk sampling is not performed.	Monthly when available	Gamma isotopic[d] and I-131 analysis.

TABLE NOTATION

[a]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.

[b]The purpose of this sample is to obtain background information.

TABLE NOTATION

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

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

[e]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.

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

[g]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.

[h]The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.

[i]If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvest occurs continuously, sampling shall be monthly. Attenion shall be paid to including samples of tuborous and root food products.

TABLE 3.17-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Radionuclide	Water (pCi/l)	Airborne (pCi/m^3)	Fish (pCi/Kg,wet)	Milk (pCi/l)	Food Products (pCi/Kg,wet)
H-3	3E+04				
Mn-54	1E+03		3E+04		
Fe-59	4E+02		1E+04		
Co-58	1E+03		3E+04		
Co-60	3E+02		1E+04		
Zn-65	3E+02		2E+04		
Zr-Nb-95	4E+02				
I-131	2E+00	9E-01		3E+00	1E+02
Cs-134	3E+01	1E+01	1E+03	6E+01	1E+03
Cs-137	5E+01	2E+01	2E+03	7E+01	2E+03
Ba-La-140	2E+02			3E+02	

TABLE 3.17-3

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD)[a]

Analysis	Water (pCi/l)	Airborne (pCi/m^3)	Fish (pCi/Kg,wet)	Milk (pCi/l)	Food Products (pCi/Kg,wet)	Sediment (pCi/Kg,dry)
gross beta	4E+00	1E-02				
H-3	3E+03					
Mn-54	1.5E+01		1.3E+02			
Fe-59	3E+01		2.6E+02			
Co-58,60	1.5E+01		1.3E+02			
Zn-65	3E+01		2.6E+02			
Zr-Nb-95	1.5E+01					
I-131[b]	1E+00	7E-02		1E+00	6E+01	
Cs-134	1.5E+01	5E-02	1.3E+02	1.5E+01	6E+01	1.5E+02
Cs-137	1.8E+01	6E-02	1.5E+02	1.8E+01	8E+01	1.8E+02
Ba-La-140	1.5E+01			1.5E+01		

TABLE 3.17-3 (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:

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

Where:

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

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

E is the counting efficiency, as counts per disintegration,

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

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield, when applicable,

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

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

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

It should be recognized that the LLD is defined as 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. Analysis shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant to Specification 6.9.1.e.

[b]LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

TABLE 4.1-1 (Continued)

	Channel Description	Check	Calibrate	Test	Remarks
9.	Analog Rod Position	S (1,2)	R	M	(1) With step counters (2) Following rod motion in excess of six inches when the computer is out of service
10.	Rod Position Bank Counters	S (1,2)	N.A.	N.A.	(1) Following rod motion in excess of six inches when the computer is out of service (2) With analog rod position
11.	Steam Generator Level	S	R	M	
12.	Charging Flow	N.A.	R	N.A.	
13.	Residual Heat Removal Pump Flow	N.A.	R	N.A.	
14.	Boric Acid Tank Level	D (1)	R	N.A.	(1) Bubbler tube rodded weekly
15.	Refueling Water Storage Tank Level	W	R	N.A.	
16.	Boron Injection Tank Level	W	R	N.A.	
17.	Volume Control Tank Level	N.A.	R	N.A.	
18.	Containment Pressure	D	R	B/W (1)	(1) Containment isolation valve signal
19.	Deleted by Amendment No.				
20.	Boric Acid Makeup Flow Channel	N.A.	R	N.A.	

4.10 RADIOACTIVE EFFLUENTS

4.10.1 Radioactive Liquid Effluents

Applicability

Applies to the monitoring of radioactive liquid effluents.

Objective

To ascertain that radioactive liquid effluent releases are being maintained as low as reasonably achievable and within allowable limits.

Specification

4.10.1.1 The radioactivity content of each batch of radioactive liquid waste to be discharged shall be determined prior to release by sampling and analysis in accordance with Table 4.10-1. The results of pre-release analyses shall be used with the calculative methods in the ODCM to assure that the concentration at the point of release to the unrestricted area is maintained within the limits of Specification 3.9.1.1.

4.10.1.2 Analyses of samples composited from batch releases shall be performed in accordance with Table 4.10-1. The results of the post-release analyses shall be used with the calculative methods in the ODCM to assure that the concentrations at the point of release were maintained within the limits of Specification 3.9.1.1.

4.10.1.3 The concentration of radioactive materials in liquid effluents discharged from continuous release points shall be determined by collection and analysis of samples in accordance with Table 4.10-1. The results of the analyses shall be used with the

calculative methods in the ODCM to assure that the concentrations at the point of release are maintained within the limits of Specification 3.9.1.1.

4.10.1.4 Dose Calculations: Cumulative dose commitments for the current calendar quarter and calendar year from liquid effluents shall be determined in accordance with the ODCM once per 31 days.

4.10.2 Radioactive Gaseous Effluents

Applicability

Applies to the monitoring of radioactive gaseous effluents.

Objective

To ascertain that radioactive gaseous effluent releases are being maintained as low as reasonably achievable and within allowable limits.

Specifications

4.10.2.1 The dose rate due to radioactive materials in gaseous effluents shall be determined to be within the limits of Specification 3.9.3.1 in accordance with the methods and procedures of the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 4.10-2.

4.10.3 Radionoble Gases

Applicability

Applies to the determination of cumulative doses from radionoble gases.

Objective

To ascertain that cumulative doses from radionoble gases are being maintained as low as reasonably achievable and within allowable limits.

Specification

4.10.3.1 Cumulative dose commitments for the current calendar quarter and current calendar year shall be determined in accordance with the ODCM once per 31 days.

4.10.4 Radioiodines, Radioactive Materials in Particulate Form, and Radionuclides Other Than Radionoble Gases

Applicability

Applies to the determination of cumulative doses from radioiodines, radioactive materials in particulate form, and radionuclides other than radionoble gases.

Objective

To ascertain that cumulative doses from radioiodines, radioactive materials in particulate form, and radionuclides other than radionoble gases are maintained as low as reasonably achievable and within allowable limits.

Specification

4.10.4.1 Cumulative dose contributions for the current calendar quarter and current calendar year for iodine-131, 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.

4.10.5 Radioactive Effluents From Uranium Fuel Cycle Sources

Applicability

Applies to the determination of cumulative doses from radioactive effluents from uranium fuel cycle sources.

Objective

To ascertain that cumulative doses from radioactive effluents from uranium fuel cycle sources are maintained as low as reasonably achievable and within allowable limits.

Specification

4.10.5.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Specifications 3.9.2.1, 3.9.4.1, and 3.9.5.1 in accordance with the methodology and parameters in the ODCM. For the purposes of this Surveillance Requirement, it may be assumed that fuel cycle sources are negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 5 miles must be considered. In addition, an individual is not considered a member of the public during any period in which he/she is engaged in carrying out any operation which is part of the nuclear fuel cycle.

4.10.5.2 Cumulative dose contributions from direct radiation from the reactor units and from radwaste storage tanks shall be determined in accordance with the methodology and parameters in the ODCM. This requirement is applicable only under conditions set forth in Specification 3.9.6.2.

TABLE 4.10-1 (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:

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

Where:

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

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

E is the counting efficiency, as counts per disintegration,

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

2.22×10^6 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, and

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

TABLE 4.10-1 (continued)

TABLE NOTATION

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 thoroughly mixed whenever possible, to assure representative sampling. Residual liquids in systems such as feedwater heaters and lines cannot be thoroughly mixed for representative samples of their respective system. Grab samples from these systems will be accepted as representative of their respective system.

c. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

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

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

f. Grab sample of continuous flows taken for compositing purposes will be taken in volumes proportional to the existing flow rate of the system in a manner described in the ODCM.

TABLE 4.10-2

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Type of Release	Sampling Frequency	Minimum Analysis Frequency	Required Activity Analysis	Required LLDa µCi/ml
Waste Gas Decay Tanks	P	P	Principal Gamma Emittersc	1E-04
Containment Pressure Reliefs and Containment Purges	We Grab Sampleb	We on Grab Sample	Principal Gamma Emittersc	1E-04
			Tritium	1E-06
Continuous Releases	Me,g,h Grab Sample for Radionoble Gases and Tritium	Me on Grab Sample	Principal Gamma Emittersc	1E-04
1. Plant Vent			Tritium	1E-06
2. Condenser Air Ejector Vent if S/G Activity is >1x10-4 µCi/cc condenser off-gas is routed to plant vent	Continuousd Radioiodine Sample	Wf	I-131 on Sample	1E-12
	Continuousd Particulate Sample	Wf on Sample	Principal Gamma Emittersc	1E-11
	Continuousd Particulate Samples to be Composited	Q on Composite	Sr-89, Sr-90	1E-11
		M on Composite	Alpha	1E-11
	Continuous	Noble Gas Monitor	Noble Gases Gross Beta and Gamma	2E-5 µCi/cc

TABLE 4.10-2 (Continued)

TABLE NOTATION

a. Lower Limit of Detection (LLD) is an "a priori" limit representing the capability of a measurement system. LLD is calculated in accordance with methodology established in the ODCM and Table 4.10-1, Note a.

b. Containment pressure reliefs and purges can be made during the week without sampling by correcting the weekly sample analysis results with the ratio of the Containment Radionoble Gas Monitor (RMS-12) and the Containment Particulate Monitor (RMS-11) readings at the time of sampling to the desired time of the pressure relief.

c. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions, I-131 for halogen emissions, and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measureable and identifiable, together with the above nuclides, shall also be identified and reported.

d. The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation. In addition, these continuous samples are not required for the Condenser Vacuum Pump Vent.

e. Sampling and analysis shall also be performed following shutdown, startup, or a power change exceeding 15 percent of rated power within one hour unless (1) analysis shows that the dose equivalent I-131 concentration in the primary coolant has not increased more than a factor of 3; and (2) the noble gas activity monitor shows that effluent activity has not increased by more than a factor of 3.

TABLE 4.10-2 (continued)

TABLE NOTATION

f. Samples shall be changed once per 7 days and analyses shall be completed within 48 hours after changing (or after removal from sampler). Sampling and analyses shall also be performed once per 24 hours for 7 days following shutdown, start-up or thermal power level change exceeding 15% of rated thermal power in one hour and if I-131 Dose Equivalent in the RCS is greater than 0.1 µCi/cc. When samples collected for 24 hours are analyzed, the corresponding LLD's may be increased by a factor of 10. The analyses shall be performed within 48 hours.

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

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

4.18 RADIOACTIVE EFFLUENT INSTRUMENTATION

4.18.1 Radioactive Liquid Effluent Instrumentation

Applicability

Applies to the radioactive liquid effluent instrumentation system.

Objective

To ascertain that the radioactive liquid effluent instrumentation system is functioning properly in order to accurately monitor radioactive liquid effluent releases.

Specification

4.18.1.1 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated operable by performance of the channel check, source check, channel calibration, and channel functional test operations at the frequencies shown in Table 4.18-1.

4.18.2 Radioactive Gaseous Effluent Instrumentation

Applicability

Applies to the radioactive gaseous effluent instrumentation system.

Objective

To ascertain that the radioactive gaseous effluent instrumentation system is functioning properly in order to accurately monitor radioactive gaseous effluent releases.

Specification

4.18.2.1 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated operable by performance of the channel check, source check, channel calibration, and channel functional test operations at the frequencies shown in Table 4.18-2.

TABLE 4.18-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

Pathway/Instruments	Channel Check	Source Check	Channel Calibration	Channel Functional Test
1. Liquid Radwaste Effluent Line				
a. Monitor (RMS-18)	D	P	R (Note 3)	Q (Note 4)
b. Flow rate measurement device	(Note 1)	N.A.	R	N.A.
2. Steam Generator Blowdown Effluent Line				
a. Monitor (RMS-19)	D	M	R (Note 3)	Q (Note 4)
b. Flow rate measurement devices for measuring flow of sample to RMS-19	(Note 2)	N.A.	N.A.	N.A.
c. Flow rate measuring devices for each steam generator blowdown line	(Note 2)	N.A.	R	N.A.
3. Containment Fan Cooling Water Monitor (Service Water Effluent Line)				
a. Monitor (RMS-16)	D	M	R (Note 3)	Q (Note 5)
4. Tank Level Indicating Devices				
a. Refueling Water Storage Tank	D*	N.A.	R	Q
b. Monitor Tanks A & B	D*	N.A.	R	Q
c. Waste Condensate Tanks C D & E	D*	N.A.	R	Q

* During liquid additions to the tank

NOTES TO TABLE 4.18-1

Note 1 - The channel check shall consist of verifying indication of flow at least once during each batch type release or shall consist of verifying indication of flow at least once per 24 hours for continuous type releases.

Note 2 - The channel check shall consist of verifying indication of flow at least once during each batch type release or shall consist of verifying indication of flow at least once per 24 hours for continuous releases, except during steam generator drain at cold shutdown.

Note 3 - The channel calibration shall be performed using one or more of the reference standards certified by the National Bureau of Standards (NBS) or using standards that have been obtained from suppliers that participate in measurement assurance activities or otherwise NBS traceable.

Note 4 - 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:

1. Instrument indicates measured levels above the alarm/trip setpoint.
2. Power failure.
3. Instrument controls not set in operate mode.

Note 5 - 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. Power failure.
3. Instrument indicates a downscale failure.
4. Instrument controls not set in operate mode.

NOTATION

P	Completed prior to making a radioactive materials release
D	At least once per 24 hours
W	At least once per 7 days
N.A.	Not applicable
M	At least once per 31 days
R	At least once per 18 months
Q	At least once per 92 days

TABLE 4.18-2

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

	Pathway/Instruments	Channel Check	Source Check	Channel Calibration	Channel Functional Test
1.	Plant Vent				
	a. Radionoble gas monitor (RMS-14)	P	P (Note 5)	R	Q (Note 6)
	b. Radionoble gas monitor (RMS-34)	D	M	R(Note 2)	Q
	c. Radioiodine monitor (RMS-34)	W	M	R(Note 3)	Q
	d. Radioparticulate monitor (RMS-34)	W	M	R	Q
	e. Sampler flow rate monitor (RMS-34)	D(Note 1)	N.A.	R	Q
	f. Plant Vent flow rate monitor	D(Note 1)	N.A.	R	N.A.
2.	Containment Vessel via Plant Vent				
	a. Radioparticulate Monitor (RMS-11)	D	D	R(Note 2)	Q
	b. Radionoble gas monitor (RMS-12)	D	P (Note 4)	R(Note 2)	Q
	c. Sampler flow rate monitor (RMS-12)	D	N.A.	R	Q
3.	Condenser Vacuum Pump Vent				
	a. Radionoble gas monitor (RMS-15)	D	M	R(Note 2)	Q (Note 6)
	b. Flow rate measuring devices - one for each Vacuum Pump	D(Note 1)	N.A.	N.A.	N.A.
4.	Fuel Handling Building Lower Level Exhaust Vent				
	a. Radionoble gas monitor (RMS-20)	D	M	R(Note 2)	Q
	b. Sampler flow rate monitor (RMS-20)	D(Note 1)	N.A.	N.A.	N.A.

TABLE 4.18-2 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

	Pathway/Instruments	Channel Check	Source Check	Channel Calibration	Channel Functional Test
5.	Fuel Handling Building Upper Level Exhaust Vent				
	a. Radionoble gas monitor (RMS-21)	D	M	R(Note 2)	Q
	b. Sampler flow rate monitor (RMS-21)	D(Note 1)	N.A.	N.A.	N.A.
6.	Waste Gas Holdup System				
	a. Hydrogen Monitor	D	N.A.	Q (Note 8)	N.A.
	b. Oxygen Monitor	D	N.A.	Q (Note 8)	N.A.

NOTES TO TABLE 4.18-2

Note 1 - The channel check shall consist of verifying indication of flow whenever plant conditions dictate that flow is supposed to be present.

Note 2 - The channel calibration shall be performed using one or more of the reference standards certified by the National Bureau of Standards (NBS) or using standards that have been obtained from suppliers that participate in measurement assurance activities or otherwise NBS traceable.

Note 3 - The channel calibration shall consist of changing the filter and cartridge at the frequency indicated and performing appropriate analyses with NBS traceable calibrated analytical equipment.

Note 4 - Prior to each containment release.

Note 5 - Prior to each Waste Gas Decay Tank release.

Note 6 - 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:

1. Instrument indicates measured levels above the alarm/trip setpoint.
2. Power failure.
3. Instrument controls not set in operate mode.

Note 7 - 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. Power failure.
3. Instrument indicates a downscale failure.
4. Instrument controls not set in operate mode.

Note 8 - The Channel Calibration shall include the use of standard gas samples containing a nominal 3% oxygen, balance nitrogen and 4% hydrogen, balance nitrogen or as recommended by manufacturer.

4.19 RADIOACTIVE WASTE SYSTEMS

4.19.1 Liquid Radwaste Treatment System

Applicability

Applies to the liquid waste treatment system.

Objective

To ascertain that the concentration of radioactive materials in the liquid waste treatment system is maintained as low as reasonably achievable and within allowable limits.

Specification

4.19.1.1 Dose commitments from liquid releases shall be projected at least once per 31 days, in accordance with the ODCM to ensure the provisions of Specification 3.16.1.1 are satisfied when the Liquid Radwaste Treatment System is not in use.

4.19.2 Liquid Holdup Tanks*

Applicability

Applies to liquid holdup tanks.

Objective

To ascertain that the quantity of radioactive material contained in the liquid holdup tanks is maintained as low as reasonably achievable and within allowable limits.

*Tanks included in this Specification are those outdoor tanks that are not surrounded by liners, dykes, or walls capable of holding the tank contents and that do not have tank overflows and surrounding area drains connected to the liquid radwaste treatment system. Tanks classed as "Seismic Class 1" are excluded from this Specification.

Specification

4.19.2.1 The quantity of radioactive material contained in each of the tanks listed in Specification 3.16.2.1 shall be determined to be within the limits specified in Specification 3.16.2.1 by either analyzing a representative sample of the tank's content at least once per 7 days when radioactive materials are being added to the tank or sampling the evaporator output when adding it to the tank.

4.19.3 Gaseous Radwaste and Ventiliation Exhaust Treatment System

Applicability

Applies to the gaseous radwaste and ventilation exhaust treatment system.

Objective

To ascertain that the concentration of radioactive materials in the gaseous radwaste and ventilation exhaust treatment systems is maintained as low as reasonably achievable and within allowable limits.

Specification

4.19.3.1 Dose commitments due to gaseous releases shall be projected at least once per 31 days, in accordance with the ODCM to ensure the provisions of Specification 3.16.3.1 are satisfied.

4.19.4 Waste Gas Decay Tanks (Hydrogen and Oxygen)

Applicability

Applies to the Waste Gas Decay Tanks.

Objective

To ascertain that the concentration of hydrogen and oxygen in the Waste Gas Decay Tanks is maintained as low as reasonably achievable and within allowable limits.

Specification

4.19.4.1 The concentration of hydrogen and oxygen in the Waste Gas Decay Tanks shall be determined to be within the limits specified in Specification 3.16.4.1 by monitoring the waste gases in the Waste Gas Decay Tanks with the hydrogen and oxygen monitors or monitoring procedures required operable by Table 3.5-7 of Specification 3.5.3.1.

4.19.5 Waste Gas Decay Tanks (Radioactive Material)

Applicability

Applies to the Waste Gas Decay Tanks.

Objective

To ascertain that the quantity of radioactive material in the Waste Gas Decay Tanks is maintained as low as reasonably achievable and within allowable limits.

Specification

4.19.5.1 With the primary coolant activity $\geq$100 μ Ci/ml the quantity of radioactive material contained in each Waste Gas Decay Tank shall be determined to be within the limit specified in Specification 3.16.5.1 once per 24 hours when radioactive materials are being added to the tank.

4.19.6 Solidification of Wet Radioactive Waste

Applicability

Applies to the solidification of wet radioactive waste.

Objective

To ascertain that wet radioactive waste is solidified to meet the requirements of 10CFR20, 10CFR71, and burial ground requirements.

Specification

4.19.6.1 The PCP shall be used to verify the solidification of one representative test specimen from every tenth batch of wet radioactive waste.

4.19.6.2 If the initial test specimen from a batch of waste fails to verify solidification, the Process Control Program shall provide for the collection and testing of representative test specimens from each consecutive batch of the same type of wet waste until at least 3 consecutive initial test specimens demonstrate solidification. The Process Control Program shall be modified as required, as provided in Specification 6.15, to assure solidification of subsequent batches of waste.

4.20 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

4.20.1 Monitoring Program

Applicability

Applies to the radiological environmental monitoring program.

Objective

To ascertain that radiological environmental monitoring samples are collected and analyzed in accordance with the radiological environmental monitoring program.

Specification

4.20.1.1 The radiological environmental monitoring samples shall be collected pursuant to Table 3.17-1 from the locations defined in the ODCM and shall be analyzed pursuant to the requirements of Tables 3.17-2 and 3.17-3.

4.20.2 Land Use Census

Applicability

Applies to the land use census.

Objective

To ascertain that the land use census is conducted in accordance with the radiological environmental monitoring program.

Specification

4.20.2.1 The land use census shall be conducted once per 12 months during the growing season, by door-to-door survey, aerial survey, by consulting local agriculture authorities or by broad leaf vegetation sampling of at least three different kinds of vegetation. This sampling 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 3.17-1.4c shall be followed, including analysis of control samples.

4.20.3 Interlaboratory Comparison Program

Applicability

Applies to the Interlaboratory Comparison Program of like media.

Objective

To ensure precision and accuracy of laboratory analyses.

Specification

4.20.3.1 Analyses shall be performed on radioactive materials supplied by EPA as a part of Interlaboratory Comparison Program of like media within the environmental program as per Table 3.17-1 and pursuant to Specifications 3.17.3.2, 3.17.3.3, and 3.17.3.4.

6.5 REVIEW AND AUDIT

6.5.1 The license organization's review and approval process shall assure that the nuclear safety of the facility is maintained.

6.5.1.1 Procedures, Tests, and Experiments

6.5.1.1.1 Written procedures shall be established, implemented, and maintained covering the activities referenced below:

a. The applicable procedures recommended in Appendix "A" of Regulatory Guide 1.33, Rev. 2, February 1978.

b. Refueling operations.

c. Surveillance and test activities of safety-related equipment.

d. Security Plan implementing procedures.

e. Emergency Plan implementing procedures.

f. Fire Protection Program implementing procedures.

g. Radiological Environmental Monitoring Program implementing procedures.

h. Offsite Dose Calculation Manual implementing procedures.

i. Process Control Program implementation procedure.

j. Quality Assurance Program for effluent and environmental monitoring (using the guidance in Regulatory Guide 4.15, December 1977).

6.5.1.1.2 A safety analysis shall be prepared for all procedures, tests, and experiments covering the activities identified in 6.5.1.1.1 and procedures that affect nuclear safety. The analysis shall include a written determination of whether or not the procedure, test, or experiment is a change in the facility as described in the FSAR, involves a change to the Technical Specification, or constitutes an unreviewed safety question as defined in 10CFR50.59(a)(2). This analysis constitutes a first party safety review and may be accomplished by the individual who prepared the document.

6.5.1.6.5 A quorum of the PNSC shall consist of the Chairman, and three members, of which two may be alternates.

6.5.1.6.6 The PNSC activities shall include the following:

a. Perform an overview of Specifications 6.5.1.1, and 6.5.1.2 to assure that processes are effectively maintained.

b. Performance of special reviews, investigations, and reports thereon requested by the Manager - Corporate Nuclear Safety.

c. Annual review of the Security Plan and Emergency Plan.

d. Perform reviews of Specifications 6.5.1.1.6, 6.5.1.2.4, 6.5.1.3.1, and 6.5.1.4.1.

e. Perform review of all events requiring 24 hour notification to the NRC.

f. Review of facility operations to detect potential nuclear safety hazards.

g. Review of every unplanned onsite release of radioactive material to the environs including the preparation and forwarding of reports covering evaluation, recommendations and dispostion of the corrective action to prevent recurrences to the Vice President - Nuclear Operations, Manager - Corporate Nuclear Safety and the Manager - Corporate Quality Assurance.

h. Review of changes to the Process Control Program and the Offsite Dose Calculation Manual.

6.5.1.6.7 In the event of disagreement between the recommendations of the Plant Nuclear Safety Committee and the actions contemplated by the General Manager, the course determined by the General Manager to be more conservative will be followed. The Vice President - Nuclear Operations and the Manager - Corporate Nuclear Safety will be notified within the 24 hours of the disagreement and subsequent actions.

6.5.1.6.8 The PNSC shall maintain written minutes of each meeting that, at a minimum, document the results of all PNSC activities performed under the provisions of these Technical Specifications; and copies shall be provided to the Vice President - Nuclear Operations, and to the Manager - Corporate Nuclear Safety.

(4) The verification of compliance and implementation of the requirements of the Ouality Assurance Program to meet the criteria of Appendix B, 10CFR50, at least once per 24 months.

(5) The Emergency Plan and implementing procedures at least once per 12 months.

(6) The Security Plan and implementing procedures at least once per 12 months.

(7) The Facility Fire Protection Program and implementing procedures at least once per 24 months.

(8) Any other area of facility operation considered appropriate by the Corporate Ouality Assurance Performance Evaluation Unit; the Executive Vice President - Power Supply and Engineering & Construction; or the Senior Vice President - Power Supply.

(9) The Radiological Environmental Monitoring Program and the results thereof at least once per 12 months.

(10) The Offsite Dose Calculation Manual and implementing procedure at least once per 24 months.

(11) The Process Control Program and implementing procedures for solidification of radioactive wastes at least once per 24 months.

(12) The performance of activities required by the Ouality Assurance Program to meet the criteria of Regulatory Guide 4.15, December 1977 at least once per 12 months.

e. Distribute reports and other records to appropriate managers.

6.5.3.3 a. Audit personnel shall be independent of the area audited. Selection for auditing assignments is based on experience or training that establishes that their qualifications are commensurate with the complexity or special nature of the activities to be audited. In selecting auditing personnel, consideration shall be given to special abilities, specialized technical training, prior pertinent experience, personal characteristics, and education.

b. Qualified outside consultants or other individuals independent from those personnel directly involved in plant operation shall be used to augment the audit teams when necessary. Individuals performing the audits may be members of the audited organization; however, they shall not audit activities for which they have immediate responsibility, and while performing the audit, they shall not report to a management representative who has immediate responsibility for the activity audited.

6.5.3.4 Results of plant audits are approved by the Principal QA Specialist - Performance Evaluation Unit, and transmitted to the Executive Vice President - Power Supply and Engineering & Construction; the Senior Vice President - Power Supply; Vice President - Nuclear Operations; General Manager; and the Vice President - Corporate Nuclear Safety & Research; and others, as appropriate within 30 days after the completion of the audit.

6.5.3.5 The Corporate Quality Assurance Audit Program shall be conducted in accordance with written, approved procedures.

c. Monthly Operating Report

Routine reports of operating statistics and shutdown experience shall be submitted on a monthly basis. The report formats set forth in Appendices B, C, and D to Regulatory Guide 1.16 shall be completed in accordance with the instructions provided. The completed forms should be submitted by the tenth of the month following the calendar month covered by the report to the Director, Office of Management and Program Analysis, U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, with a copy to the appropriate NRC regional Office.

d. Semiannual Radioactive Effluent Release Report

Routine radioactive effluent release reports covering the operation of the unit during the previous 6 months shall be submitted within 60 days after January 1 and July 1 of each year. Those portions of the report due within 60 days of January 1, and July 1, shall include:

1. A summary of the quantities of radioactive liquid and gaseous effluent and solid waste released from the Unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and 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.

2. The Radioactive Effluent Release Report to be submitted within 60 days after January 1 of each year shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint

frequency distributions of wind speed, wind direction, and atmospheric stability.* This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year. This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to members of the public due to their activities inside the site boundary (Figure 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 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. [For ORs: approximate and conservative approximate methods are acceptable.] The assessment of radiation doses shall be performed in accordance with the methodology and parameters in the Offsite Dose Calculation Manual (ODCM).

3. The Radioactive Effluent Release Report to be submitted 60 days after January 1 of each year shall also include an assessment of radiation doses to the likely most exposed member of the public from reactor releases and other nearby uranium fuel cycle sources, including doses from primary effluent pathways and direct radiation, for the previous calendar year to show conformance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation.

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* In lieu of submission with the first half year Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

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

   a. Container volume,

   b. Total curie quantity (specify whether determined by measurement or estimate),

   c. Principal radionuclides (specify whether determined by measurement or estimate),

   d. Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms),

   e. Type of container (e.g., LSA, Type A, Type B, Large Quantity), and

   f. Solidification agent or absorbent (e.g., cement, urea formaldehyde).

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

6. The Radioactive Effluent Release Reports shall include any changes made during the reporting period to the Process Control Program (PCP) and to the Offsite Dose Calculation Manual (ODCM), as well as a listing of new locations for dose calculations and/or environmental monitoring identified by the land use census pursuant to Specification 3.17.2.2.

7. Changes to the radioactive waste systems (liquid, gaseous, and solid) shall be reported to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the evaluation was reviewed by the Plant Nuclear Safety Committee (PNSC).* 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 Part 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 an individual in the unrestricted area and to the general population that differ from those previously estimated in the license application and amendments thereto;

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* The licensee may chose to submit the information called for in this Specification as part of the annual FSAR update.

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 PNSC.

8. Changes to the radioactive waste systems (liquid, gaseous, and solid) shall become effective upon review and acceptance by the PNSC.

e. Annual Radiological Environmental Operating Report

Routine radiological environmental operating reports covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year. With the radiological environmental monitoring program not being conducted as specified in Table 3.17-1, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence shall be included.

The Annual Radiological Environmental Operating Reports shall include summaries, interpretations, and 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 operations on the environment. The reports shall also include the results of land use censuses required by Specification 3.17.2.

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

The reports shall also include the following: a summary description of the radiological environmental monitoring program; at least two legible maps* covering all sampling locations keyed to a table giving distances and directions from the centerline of the reactor, the results of licensee participation in the Interlaboratory Comparison Program, required by Specification 3.17.3; discussion of all deviations from the sampling schedule of Table 3.17-1; and discussion of all analyses in which the LLD required by Table 3.17-3 was not achievable.

*One map shall cover stations near the site boundary; a second shall be the more distant stations.

6.9.2 Reportable Occurrences

The Reportable Occurrences of Specifications 6.9.2.a and 6.9.2.b below, including corrective actions and measures to prevent recurrence, shall be reported to the NRC. Supplemental reports may be required to fully describe final resolution of the occurrence. In case of corrected or supplemental reports, a Licensee Event Report (LER) shall be completed and reference made to the original report date.

a. Prompt Notification With Written Followup

The types of events listed below shall be reported within 24 hours by telephone and confirmed by telegraph, mailgram, or facsimile transmission to the Regional Administrator of the NRC Regional Office or his designee no later than the first working day following the event, with a written followup report within 14 days. The written followup report shall include as a minimum, a completed copy of the LER form.

Information provided on the LER shall be supplemented, as needed, by additional narrative material to provide complete explanation of the circumstances surrounding the event.

(1) Failure of the reactor protection system, or other systems subject to limiting safety system settings to initiate the required protective function by the time a monitored parameter reaches the setpoint specified as the limiting safety system setting in the Technical Specifications or failure to complete the required protective function.

Note: Instrument drift discovered as a result of testing need not be reported under this item (but see 6.9.2.a(5), 6.9.2.a(6), and 6.9.2.b(1) below.

(2) Operation of the unit or affected systems when any parameter or operation subject to a LCO is less conservative than the least conservative aspect of the LCO established in the Technical Specifications.

Note: If specified action is taken when a system is found to be operating between the most conversative and least conservative aspects of a LCO listed in the Technical Specifications, the LCO is not considered to have been violated and no report need be submitted under this section (but see 6.9.2.b(2) below).

(3) Abnormal degradation discovered in fuel cladding, reactor coolant pressure boundary or primary containment.

Note: Leakage of valve packing or gaskets within the limits for identified leakage set forth in Technical Specifications need not be reported under this section.

(4) Reactivity anomalies involving disagreement with predicted value of reactivity balance under steady state conditions during power operation greater than or equal to 1% $\Delta k/k$; a calculated reactivity balance indicating a shutdown margin less conservative than specified in the Technical Specifications; short-term reactivity increases that correspond to a reactor startup rate greater than 5 dpm, or if subcritical, an unplanned reactivity insertion of more than 0.5% $\Delta k/k$; or any unplanned criticality.

(5) Failure or malfunction of one or more components which prevents or could prevent, by itself, the fulfillment of the functional requirements of systems required to cope with accidents analyzed in the SAR.

(6) Personnel error or procedural inadequacy which prevents or could prevent, by itself, the fulfillment of the functional requirements of systems required to cope with accidents analyzed in the SAR.

Note: For 6.9.2.a(5) and 6.9.2.a(6) reduced redundancy that does not result in loss of system function need not be reported under this section (but see 6.9.2.b(2) and 6.9.2.b(3) below).

(7) Conditions arising from natural or man-made events that, as a direct result of the event, require plant shutdown, operation of safety systems, or other protective measures required by Technical Specifications.

(8) Errors discovered in the transient or accident analyses or in the methods used for such analyses as described in the SAR or in the bases for the Technical Specifications that have or could have permitted reactor operation in a manner less conservative than assumed in the analyses.

(9) Performance of structures, systems or components that require remedial action or corrective measures to prevent operation in a manner less conservative than assumed in the accident analyses in the FSAR or Technical Specifications bases or discovery during plant life of conditions not specifically considered in the FSAR or Technical Specifications that require remedial action or corrective measures to prevent the existence or development of an unsafe condition.

Note: This item is intended to provide for reporting of potentially generic problems.

(10) Offsite releases of radioactive materials in liquid and gaseous effluents which exceed the limits of Specifications 3.9.1.1, 3.9.3.1, and for tank contents which exceed the limits of Specifications 3.16.2.1 and 3.16.4.3.

b. Thirty-day Written Reports. The reportable occurrences discussed below shall be the subject of written reports to the Regional Administrator of the NRC Regional Office within thirty days of occurrence of the event. The written report shall include, as a minimum, a completed copy of the LER form, used for entering data into the NRC's computer-based file of information concerning licensee events. Information provided on the LER form shall be supplemented, as needed, by additonal narrative material to provide complete explanation of the circumstances surrounding the event.

(1) Reactor protection system or engineered safety feature instrument settings which are found to be less conservative than those established by the Technical Specifications but which do not prevent the fulfullment of the functional requirements of affected systems (but see 6.9.2.a(1) and 6.9.2.a(2) above).

(2) Conditions leading to operation in a degraded mode permitted by a limiting condition for operation or plant shutdown required by a limiting condition for operation (but see 6.9.2.a(2) above).

Note: Routine surveillance testing, instrument calibration or preventive maintenance which require system configurations described in 6.9.2.b(1) and 6.9.2.b(2) above need not be reported except where test results themselves reveal a degraded mode as described above.

(3) Observed inadequacies in the implementation of administrative or procedural controls which threaten to cause reduction of degree of redundancy provided in reactor protection systems or engineered safety feature system (but see 6.9.2.a(6) above).

(4) Abnormal degradation of systems other than those specified in 6.9.2.a(3) above designed to contain radioactive material resulting from the fission process.

Note: Sealed sources or calibration sources are not included under this item. Leakage of valve packing or gaskets within the limits for identified leakage set forth in Technical Specifications need not be reported under this item.

6.9.3 Special Reports

6.9.3.1 Special reports shall be submitted to the Regional Administrator of the NRC Regional Office of within the time period specified for each report. These reports shall be submitted covering the activities identified below pursuant to the requirements of the applicable reference specification:

	Area	Reference	Submittal Date
a.	Containment Leak Rate	4.4	Upon completion of each test

b.	Containment Sample Tendon Surveillance	4.4	Upon completion of the inspection at 25 years of operation
c.	Post-operational Containment Structural Test	4.4	Upon completion of the test at 20 years of operation
d.	Fire Protection System	3.14	As specified by limiting condition for operation
e.	Overpressure Protection System Operation	3.1.2.1.e	Within 30 days of operation
f.	Auxiliary Feedwater Pumps	3.4	Within 30 days after becoming inoperable

6.9.3.2 Special Radiological Effluent Reports

The special radiological effluent reports discussed below shall be the subject of written reports to the Regional Administrator of the NRC Regional Office within thirty days of the occurrence of the event in lieu of a Licensee Event Report (LER).

a. Exceeding any of the limits prescribed by Specification 3.9.2.1, 3.9.4.1, and/or 3.9.5.1. This report shall include the following information(1):

1. The cause for exceeding the limit(s)

2. The corrective action(s) to be taken to reduce the releases of radioactive materials in the affected effluents (i.e. liquid, radionoble gas, and/or

radioiodines, particulates, etc.) within the Specification and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

3. If any of the limits of Specification 3.9.2.1 were exceeded, the report must include a statement that no drinking water source exists that could be affected or include the results of radiological impact on finished drinking water supplied with regards to the requirements of 40CFR141 Safe Drinking Water Act.

b. Exceeding any of the limits prescribed by Specification 3.16.1.1 and/or 3.16.3.1. This report shall include the following information:

1. Identification of equipment or subsystem that rendered the affected radwaste treatment system not operable.

2. The corrective action(s) taken to restore the affected radwaste treatment system to an operable status.

3. A summary description of the action(s) taken to prevent a similar recurrence.

c. Exceeding the reporting level for environmental sample media as specified in Specifications 3.17.1.3. This report shall include the following information:

1. An evaluation of any environmental factor, release condition or other aspect which may have caused the reporting level to be exceeded.

2. A description of action(s) taken or planned to reduce the levels of licensed materials in the affected environmental media to below the reporting level.

d. Exceeding the limits prescribed by Specification 3.9.6.1. This report shall be made in lieu of any other report and shall include the following information:

1. The corrective action(s) to be taken to reduce subsequent releases to prevent recurrence of exceeding the limits prescribed by Specification 3.9.6.1.

2. An analysis which estimates the dose commitment to a member of the general public from uranium fuel cycle source including all effluent pathways and direct radiation, for a 12 month period that includes releases covered by this report.

3. If the release conditions resulting in violation of 40CFR190 has not already been corrected, include a request for a variance in accordance with the provisions of 40CFR190 and include the specified information of 40CFR190.11(b).

b. Records of new and irradiated fuel inventory, fuel transfers and assembly burnup histories.

c. Records of facility radiation and contamination surveys.

d. Records of radiation exposure for all individuals entering radiation control areas.

e. Records of gaseous and liquid radioactive material released to the environs.

f. Records of transient or operational cycles for those facility components designed for a limited number of transients or cycles.

g. Records of training and qualification for current members of the plant staff.

h. Records of in-service inspections performed pursuant to these Technical Specifications.

i. Records of Quality Assurance activities required by the QA program.

j. Records of review performed for changes made to procedures or equipment or reviews of tests and experiments pursuant to 10CFR50.59.

k. Records of meetings of the PNSC and of the independent reviews performed by the Corporate Nuclear Safety Section.

l. Records of data results required by the radiological environmental monitoring program.

6.14 ENVIRONMENTAL QUALIFICATION

6.14.1 By no later than June 30, 1982 all safety-related electrical equipment in the facility shall be qualified in accordance with the provisions of: Division of Operating Reactors "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors" (DOR Guidelines); or, NUREG-0588 "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment" December 1979. Copies of these documents are attached to the Order for Modification of License No. DPR-23 dated October 24, 1980.

6.14.2 By no later than December 1, 1980, complete and auditible records must be available and maintained at a central location which describe the environmental qualification method used for all safety-related electrical equipment in sufficient detail to document the degree of compliance with the DOR Guidelines or NUREG-0588. Thereafter, such records should be updated and maintained current as equipment is replaced, further tested, or otherwise further qualified.

6.15 PROCESS CONTROL PROGRAM (PCP)

6.15.1 The PCP shall be approved by the Commission prior to implementation.

6.15.2 Licensee initiated changes to the PCP:

A. Shall be submitted to the Commission in the Annual Report for the period in which the change(s) was/were made. This submittal shall contain:

1. Sufficiently detailed information to totally support the rationale for the change without benefit of additional or supplemental information;

2. A determination that the change did not reduce the overall conformance of the solidified waste product to existing criteria for solid wastes.

3. Documentation of the fact that the change has been reviewed and found acceptable by the PNSC.

B. Shall become effective upon review and acceptance by the PNSC.

6.16 OFFSITE DOSE CALCUATION MANUAL

6.16.1 The ODCM shall be approved by the Commission prior to implementation.

6.16.2 Licensee initiated changes to the ODCM:

A. Shall be submitted to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the change(s) was made effective. This submittal shall contain:

1. Sufficiently detailed information to totally support the rationale for the change without benefit of additional or supplemental information. Information submitted should consist of a package of those pages of the ODCM to be changed with each page numbered and provided with an approval and date box, together with appropriate analyses or evaluations justifying the change(s);

2. A determination that the change will not reduce the accuracy or reliability of dose calculations or setpoint determinations; and

3. Documentation of the fact that the change has been reviewed and found acceptable by the PNSC.

B. Shall become effective upon review and acceptance by the PNSC.

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

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

1. Shall be reported to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the evaluation was reviewed by the PNSC. 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 10CFR50.59.

   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 an 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 PNSC.

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

*Licensee may chose to submit the information called for in this Specification as part of the annual FSAR Update.

ENCLOSURE 4

OFFSITE DOSE CALCULATION MANUAL

H. B. ROBINSON STEAM ELECTRIC PLANT UNIT NO. 2

OCTOBER 1983

H.B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
OFF-SITE DOSE CALCULATIONAL MANUAL
(ODCM)

Revision 1

DOCKET NO. 50-261

CAROLINA POWER & LIGHT COMPANY

October 6, 1983

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1.0 INTRODUCTION

The Off-Site Dose Calculation Manual (ODCM) provides the information and methodologies to be used by H. B. Robinson Steam Electric Plant Unit 2 (HBR) to assure compliance with Specification 3.9.1, 3.9.2, 3.9.3, 3.9.4, 3.9.5, and 3.9.6 of the H. B. Robinson Technical Specification. These portions are those related to liquid and gaseous radiological effluents. They are intended to show compliance with 10CFR20, 10CFR50.36a, Appendix 1 of 10CFR50, and 40CFR190.

The ODCM is based on "Radiological Effluent Technical Specifications for PWRs (NUREG 0472, Rev. 3, Draft 6), "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants" (NUREG 0133), and guidance from the United States Nuclear Regulatory Commission (NRC). Specific plant procedures for implementation of this manual are presented in H. B. Robinson Unit 2 Plant Operating Manual and the H. B. Robinson Unit 2 Standing Orders. These procedures will be utilized by the operating staff of HBR to assure compliance with technical specifications.

The ODCM has been prepared as generically as possible in order to minimize the need for future revisions. However, some changes to the ODCM will be expected in the future. Any such changes will be properly reviewed and approved as indicated in the Administrative Control Section, Specification 6.16.2, of the HBR Technical Specifications.

2.0 LIQUID EFFLUENTS

2.1 MONITOR ALARM SETPOINT DETERMINATION

This procedure determines the monitor alarm setpoint that indicates if the concentration of radionuclides in the liquid effluent released from the site to unrestricted areas exceeds the concentrations specified in 10CFR20, Appendix B, Table II, Column 2, for radionuclides other than dissolved or entrained noble gases or exceeds a concentration 2×10^{-4} μCi/ml for dissolved or entrained noble gases. The methodology described in Section 2.1.2 provides an alternate means to determine monitor high alarm setpoints that may be used when an analysis is performed prior to release.

2.1.1 Setpoint Based on an Unidentified Radionuclide Mix

The following method applies to liquid releases via the discharge canal when determining the alarm/trip setpoint for the Waste Disposal System Effluent Monitor (RMS-18) and the Steam Generator Blowdown Monitor (RMS-19) during all operational conditions when the radwaste discharge flow rate is maintained constant. This methodology complies with Specification 3.9.1.1 of the RETS by satisfying the following equation:

$$\frac{cf}{F} \leq C$$

where:

C = The effluent concentration limit (Specification 3.9.1.1) implementing 10CFR20 for the site in μCi/ml.

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c = The setpoint, in μCi/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 10CFR20 in the unrestricted area.

f = The waste effluent flow rate in gpm.

F = The dilution water flow rate in gpm.

2.1.1.1 Determine c (the effluent monitor setpoint) in μCi/ml for each of the dilution water flow rates.

where: $c = \frac{CF}{f}$

C = 1×10^{-7} μCi/ml, the effluent concentration limit based on 10CFR20, Appendix B, for an unknown radionuclide mixture.

F = Dilution water flow rate (gpm).

= 160,000 gpm from one circulating water pump[1], Unit 2.
= 250,000 gpm from two circulating water pumps[1], Unit 2.
= 400,000 gpm from three circulating water pumps[1], Unit 2.

or

= 50,000 gpm from one circulating water pump[2], Unit 1.
= 80,000 gpm from two circulating water pumps[2], Unit 1.

f = The maximum acceptable discharge flow rate prior to dilution (gpm).

= 60 gpm for the Waste Disposal System Liquid Effluent Monitor[3].

= 80 gpm for the Steam Generator Blowdown Monitor during normal operation[3].

= 300 gpm for the Steam Generator Blowdown Monitor while draining a steam generator[3].

2.1.1.2 Determine CR (calculated monitor count rate in corrected counts per minute [ccpm]). Attributed to the radionuclides for each of the dilution water flow rates.

$CR = (c)\ (E)$

E = The applicable effluent monitor efficiency located in the Plant Operating Manual, Volume 15, Curve Book. Use the radioactivity concentration "c" to find CR.

2.1.1.3 Determine SP (the monitor alarm/trip setpoint including background [cpm] for each of the dilution water flow rates.

$SP = (T_m CR + \text{Background})$

where: T_m = Fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded due to simultaneous releases from several pathways.

= .50 for the Waste Disposal System Liquid Effluent Monitor (RMS-18).

= .50 for the Steam Generator Blowdown Monitor (RMS-19).

2.1.2 Setpoint Based on an Analysis of Liquid Prior to Discharge

The following method applies to liquid releases via the discharge canal when determining the alarm setpoint for the Waste Disposal System Liquid Effluent Monitor (RMS-18) and the Steam Generator

Blowdown Monitor (RMS-19) when an analysis of the actitivity of the principal gamma emitters has been made prior to each batch released.

2.1.2.1 Determine D (the minimum acceptable dilution factor):

$$D = S\sum_i \frac{Ci}{MPC_i}$$

C_i = Radioactivity concentration of radionuclide "i" in the liquid effluent prior to dilution (μCi/ml) from analysis of the liquid effluent to be released.

MPC_i = The liquid effluent radioactivity limit for radionuclide "i" (μCi/ml) from 10CFR20, Appendix B.

S = 2, A safety factor used as a conservatism to assure that the radionuclide concentrations are less than the limits specified in 10CFR20, Appendix B, at the point of discharge.

2.1.2.3 Determine c (the monitor setpoint concentration [μCi/ml] attributed to the radionuclides for the dilution water flow rate available during the release.

$$c = (\sum_g C_g)\ (\frac{F}{D\ \ f})\ (Tm)$$

where:

C_g = The total radioactivity concentration of gamma-emitting radionuclides in liquid effluent prior to dilution (μCi/ml).

f = The maximum approved discharged flow rate prior to dilution (gpm).

= 60 gpm for the Waste Disposal System Liquid Effluent Monitor[3].

= 80 gpm for the Steam Generator Blowdown Monitor during normal operation[3].

= 300 gpm for the Steam Generator Blowdown Monitor while draining a steam generator.

F = Dilution water flow rate (gpm).

= 160,000 gpm from one circulating water pump[1], Unit 2.
= 250,000 gpm from two circulating water pumps[1], Unit 2.
= 400,000 gpm from three circulating water pumps[1], Unit 2.

or

= 50,000 gpm from one circulating water pump[2], Unit 1.
= 80,000 gpm from two circulating water pumps[2], Unit 1.

T_m = Fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded due to simultaneous releases from more than one pathway.

= .50 for the Waste Disposal System Liquid Effluent Monitor (RMS-18).

= .50 for the Steam Generator Blowdown Monitor (RMS-19).

If it is determined that $\frac{F}{D \quad f} < 1$, the release cannot be made. Reevaluate the discharge flow rate prior to dilution and/or the dilution flow rates.

If $\frac{F}{D \quad f} > 1$, the release may be made.

2.1.2.4 Determine SP (the monitor alarm setpoint [ccpm].

SP = (c) (E_m) t background.

where:

E_m = The applicable effluent monitor efficiency based on "c," from the efficiency curves located in the Plant Operating Manual, Volume 15, Curve Book.

(Left blank intentionally for future revisions)

(Left blank intentionally for future revisions)

(Left blank intentionally for future revisions)

SECTION 2.1 REFERENCES

1. Carolina Power & Light Company Drawing Number G-190825. Using the System Q-H Curve for Emergency Low Water Level.

2. Carolina Power & Light Company, Darlington County S.E. Plant. 1960-182 MW Installation, Unit 1. SYSTEM HEAD CURVES Unit 1 Circulating Water System Draining Quosig.

3. H.B. Robinson Electric Plant Unit 2, Updated Final Safety Analysis Report.

2.2 COMPLIANCE WITH 10CFR20 (LIQUIDS)

Liquid effluents from H.B. Robinson Unit 2 (HBR) will occur both continuously and on a batch basis. The following sections discuss the methodology which will be utilized by the HBR to show compliance with 10CFR20.

2.2.1 Continuous Releases

Steam generator blowdown is continuously released from HBR. Each operational working day grab samples will be taken of steam generator blowdown. These samples are composited at the rate of 100 ml/sgr. An aliquot of the SG composite is analyzed each week for I-131 and various other fission, activation, and corrosion products, as outlined in Table 4.10-1 of the technical specification for HBR. Samples are to be maintained until the end of the quarter and analyzed for strontium. Steam generator volumes are based on blowdown rates. In addition, a monthly analysis will be performed to determine the activity levels of tritium and dissolved and entrained gases. Compliance with 10CFR20 during actual release is established through the steam generator blowdown effluent monitor alarm setpoint. This setpoint is based upon a given radionuclide mix as noted in Section 2.1. However, if a continuous release should occur in which the effluent monitor alarm setpoint is exceeded, then actual compliance with 10CFR20 may be determined utilizing the actual radionuclide mix and the following equation:

$$Conc_i = \frac{C_{ic}\ V_c}{V_{dc}} \qquad (2.2\text{-}1)$$

where:

$Conc_i$ = Concentration of radionuclide "i" at the unrestricted area, $\mu Ci/ml$;

C_{ic} = Concentration of radionuclide "i" in the continuous release, μCi/ml;

V_c = Volume of continuous effluent released, gal;

V_{dc} = Volume of dilution flow during release, gal.

2.2.2 Batch Releases

Batch releases will occur during normal operation. When this does occur at HBR, a continuous release will usually be occurring at the same time. However, during certain shutdown conditions, only batch releases may occur at HBR. Therefore, both situations are treated here to provide the methodology to show compliance with 10CFR20.

2.2.2.1 Prerelease

The radioactivity content of each batch release will be determined prior to release in accordance with Table 4.10-1 of the technical specifications for HBR. HBR will show compliance with 10CFR20 in the following manner:

For the case where only a batch release is to occur, the concentration of the various radionuclides in the batch release, determined in accordance with Table 4.10-1 of the technical specifications for HBR, is multiplied by the ratio of the maximum release rate of the potential batch release to the dilution flow rate to obtain the concentration at the unrestricted area. This calculation is shown in the following equation:

$$Conc_i = \frac{C_{ib} R_b}{D_{fr}} \qquad (2.2\text{-}2)$$

where:

$Conc_i$ = Concentration of radionuclide "i" at the unrestricted area, μCi/ml;

C_{ib} = Concentration of radionuclide "i" in the potential batch release, μCi/ml;

R_b = Release rate of the potential batch release, gpm;

D_{fr} = The dilution flow rate based upon the number of circulating water pumps in service during the release, gpm.

The concentration in the unrestricted area is compared to the concentrations in Appendix B, Table II, Column 2, of 10CFR20. Before release may occur, the mixture of radionuclides released must be of such concentration that Equation 2.2-3 is met.

$$\sum_i \ (Conc_i/MPC_i) \leq 1 \qquad (2.2\text{-}3)$$

where:

MPC_i = Maximum permissible concentration of radionuclide "i" from Appendix B, Table II, Column 2 of 10CFR20, μCi/ml.

For those cases where batch releases may be occurring at the same time that continuous releases are occurring, the concentration in the unrestricted area will be calculated by the following equation:

$$Conc_i = \frac{C_{ib} R_b + C_{ic} R_c}{D_{fr}} \qquad (2.2\text{-}4)$$

where:

R_c = Maximum continuous liquid effluent release rate, gpm.

The mixture of radionuclides released must be of such concentrations that Equation 2.2-3 must be met.

For HBR, the liquid radwaste effluent line discharges to the circulating water system. Therefore, the dilution flow rate (D_{fr}) is a function of the number of circulating water pumps operating. Unit 2 of the H.B. Robinson Steam Electric Plant has three circulating water pumps. Pump curves show that with three pumps operating, the circulating water flow is 400,000 gpm, with two pumps--250,000 gpm, and with one pump--160,000 gpm. Unit 1 of the H.B. Robinson Steam Electric Plant has two circulating water pumps. The circulating water flow is 50,000 gpm with one pump and 80,000 gpm with two pumps. At least one circulating water pump must be operating during any liquid waste discharge.

Batch releases from the HBR liquid radwaste system may occur from the waste condensate tanks, the monitor tanks, and the steam generators. The maximum release rate (R_b) is 300 gpm for the steam generators and 60 gpm from the monitor and waste condensate tanks.

2.2.2.2 Postrelease

The Steam Generation Blowdown Monitor (RMS-19) and the Waste Disposal System Liquid Monitor (RMS-18) setpoint will each be limited to 50 percent of the 10CFR20 limits. These setpoints will ensure that 10CFR20 limits are met. However, because they are based upon a given mix, the possibility exists that the alarm trip setpoints may be exceeded, while 10CFR20 limits are not exceeded. The following methodology is provided to determine whether actual releases exceeded 10CFR20 limits.

The concentration of each radionuclide in the unrestricted area following release from a batch tank will be calculated in the following manner:

For the case where only batch releases are occurring, the total activity of radionuclide "i" released is divided by the actual dilution flow to obtain the concentration in the unrestricted area. This calculation is shown in the following equation:

$$Conc_{ik} = \frac{C_{ikb}\, V_{kb}}{V_{kd}} \qquad (2.2\text{-}5)$$

where:

$Conc_{ik}$ = The concentration of radionuclide "i" at the unrestricted area during release k, μCi/ml;

C_{ikb} = Concentration of radionuclide "i" in the batch release k, μCi/ml;

V_{kb} = Volume of batch release k, gal;

V_{kd} = Actual volume of dilution flow during release k, gal.

To show compliance with 10CFR20, the following relationship must hold:

$$\sum_i \left(Conc_{ik} / MPC_i\right) \leq 1 \qquad (2.2\text{-}6)$$

The actual dilution volume during release k (V_{kd}) is calculated by the following equation:

$$V_{kd} = 60 \sum_k (D_{fr})t_k \qquad (2.2\text{-}7)$$

where:

60 = Conversion factor, min/hr;

t_k = Duration of release k, hr;

D_{fr} = Dilution flow rate from circulating water pumps during release k, gpm.

The circulating water pump flow rates were given in Section 2.2.2.1 above.

For the case where a batch release is occurring at the same time that a continuous release is occurring, the compliance with 10CFR20 limits may be determined by the following equation:

$$Conc_{ik} = \frac{C_{ikb} V_{kb} + C_{ikc} V_{kc}}{V_{kd}} \qquad (2.2\text{-}8)$$

where:

C_{ikc} = Concentration of radionuclide "i" in continuous releases during release period k, μCi/ml;

V_{kc} = Volume of continuous release during period k, gal.

2.3 COMPLIANCE WITH 10CFR50

2.3.1 Cumulation of Doses

The dose contribution from the release of liquid effluents will be calculated once per month, and a cumulative summation of these total body and any organ doses should be maintained for each calendar quarter. The dose contribution for all batch releases will be calculated using the following equation:

$$D_{\tau b} = \sum_k \sum_i A_{i\tau} t_{kb} C_{ikb} F_{kb} e^{-\lambda_i t_p} \qquad (2.3\text{-}1)$$

where:

$D_{\tau b}$ = The cumulative dose commitment to the total body or any organ τ, from batch liquid effluents, mrem;

t_{kb} = The length of time of batch release k over which C_{ikb} and F_{kb} are averaged for each batch liquid release, hours;

C_{ikb} = The average concentration of radionuclide "i" in undiluted batch liquid effluent during batch release k, μCi/ml;

$A_{i\tau}$ = The site-related ingestion dose commitment factor to the total body or any organ τ for each identified principal gamma and beta emitter, mrem-ml per hr-μCi;

λ_i = Radiological decay constant of radionuclide "i", hr^{-1};

= $0.693/(t\ 1/2)_i$

$(t\ 1/2)_i$ = Radiological half-life of radionuclide "i", hr;

t_p = average transport time to reach the point of exposure, hr;

= 24 hours for the fish pathway from Equation A-3 of Regulatory Guide 1.109, Revision 1.

F_{kb} = The near-field average dilution factor for C_{ikb} during any batch liquid effluent release k. Defined as the ratio of the volume of undiluted liquid waste released to the product of the dilution volume from the site discharge structure to unrestricted receiving waters times 1.0. (1.0 is the site-specific applicable factor for the mixing effect of the HBR discharge structure as defined in NUREG-0133, October 1978).

$$= \frac{V_{kb}}{V_{kd} \times 1.0}$$

Where V_{kb} and V_{kd} are as defined in Equation 2.2-5.

The dose factor $A_{i\tau}$ was calculated for an adult for each isotope using the following equation:

$$A_{i\tau} = 1.14 \times 10^5 \, (21 BF_i) \, DF_{i\tau} \qquad (2.3\text{-}2)$$

where:

$$1.14 \times 10^5 = 10^6 \, \frac{pCi}{\mu Ci} \times 10^3 \, \frac{ml}{l} \times \frac{1 \text{ yr}}{8760 \text{ hr}}$$

21 = Adult fish consumption rate from Table E-5 of Regulatory Guide 1.109, Revision 1, kg/yr;

BF_i = Bioaccumulation factor for radionuclide "i" in fish from Table A-1 of Regulatory Guide 1.109, Revision 1, pCi/kg per pCi/l;

$DF_{i\tau}$ = Dose conversion factor for radionuclide "i" for adults for a particular organ τ from Table E-11 of Regulatory Guide 1.109, Revision 1, mrem/pCi.

The potable water pathway does not exist either within Lake Robinson or downstream of the Lake Robinson dam. Therefore, the potable water term was excluded from the calculation of $A_{i\tau}$ values. Table 2.3-1 presents $A_{i\tau}$ values for an adult at HBR. Values of exp $(-\lambda_i t_p)$ are presented in Table 2.3-2 as a function of radionuclide.

As noted in Section 2.2.2, steam generator blowdown is continuously released from HBR. The dose from continuous releases will be calculated using the following equation:

$$D_{\tau c} = \sum_k \sum_i A_{i\tau}\, t_{kc}\, C_{ikc}\, F_{kc}\, e^{-\lambda_i t_p} \qquad (2.3\text{-}3)$$

where:

$D_{\tau c}$ = The cumulative dose commitment to the total body or any organ τ, from liquid effluents for continuous releases, mrem;

t_{kc} = The length of time of continuous release period k over which C_{ikc} and F_{kc} are averaged for all continuous liquid releases, hours;

C_{ikc} = The average concentration of radionuclide "i" in undiluted liquid effluent during continuous release period k from any continuous liquid release, μCi/ml;

F_{kc} = The near-field average dilution factor for C_{ikc} during continuous liquid effluent release k. Defined as the ratio of the volume of undiluted liquid waste released to the product of the dilution volume from the site discharge structure to unrestricted receiving water times 1.0. (1.0 is the site-specific applicable factor for the mixing effect of the HBR discharge structure as defined in NUREG-0133, October 1978).

$$F_{kc} = \frac{V_{kc}}{V_{kd} \times 1.0}$$

Where V_{kc} and V_{kd} are, as defined in Equation 2.2-5, only now distinguished for continuous releases.

The sum of the cumulative dose from all batch and continuous releases for a quarter are compared to one half the design objectives for total body and any organ. The sum of the cumulative doses from all batch and continuous releases for a calendar year are compared to the design objective doses. The following relationships should hold for

HBR to show compliance with Technical Specification 3.9.2.1 of the technical specifications for H.B. Robinson Unit 2.

For the calendar quarter,

$$D_\tau \leq 1.5 \text{ mrem total body} \qquad (2.3\text{-}4)$$

$$D_\tau \leq 5 \text{ mrem any organ} \qquad (2.3\text{-}5)$$

For the calendar year,

$$D_\tau \leq 3 \text{ mrem total body} \qquad (2.3\text{-}6)$$

$$D_\tau \leq 10 \text{ mrem any organ} \qquad (2.3\text{-}7)$$

where:

D_τ = Cumulative total dose to any organ τ or the total body from continuous and batch releases, mrem;

$$= D_{\tau b} + D_{\tau c}$$

The quarterly limits given above represent one half the annual design objective of Section II.A of Appendix I of 10CFR50. If any of the limits in Expressions 2.3-4 through 2.3-7 are exceeded, a special report pursuant to Technical Specification 6.9.3.2 must be filed with the NRC. This report complies with Section IV.A, of Appendix I of 10CRF50.

2.3.2 Projection of Doses

Doses resulting from the release of liquid effluents will be projected once per month. The doses will be projected using Equations 2.3-1 and 2.3-3 with F_{kb} and F_{kc} now based on minimum dilution flow rate (D_{fr}), as given in Equation 2.2-2, rather than dilution volume (V_{kd}) and based upon the maximum release rates (R_b and R_c), as

given in Equation 2.2-4, rather than actual release volume (V_b and V_c). C_{ikb} and C_{ikc} are based on the projected releases for the remainder of the calendar quarter.

TABLE 2.3-1

$A_{i\tau}$ VALUES FOR THE ADULT FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT

(MREM/HR PER MICRO-Ci/ML)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E-01	2.26E 01	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01
C-14	3.13E+04	6.26E 03	6.26E+03	6.26E+03	6.26E+03	6.26E+03	6.26E+03
Na-24	4.07E+02	4.07E 02	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02
P-32	4.62E+07	2.87E 06	1.79E 06	0.00E-01	0.00E-01	0.00E-01	5.19E 06
Cr-51	0.00E-01	0.00E+01	1.27E 00	7.61E-01	2.81E-01	1.69E 00	3.20E 02
Mn-54	0.00E-01	4.38E 03	8.35E 02	0.00E-01	1.30E 03	0.00E-01	1.34E 04
Mn-56	0.00E+01	1.10E 02	1.95E 01	0.00E-01	1.40E 02	0.00E-01	3.51E 03
Fe-55	6.58E 02	4.55E 02	1.06E 02	0.00E-01	0.00E-01	2.54E 02	2.61E 02
Fe-59	1.04E 03	2.44E 03	9.36E 02	0.00E-01	0.00E-01	6.82E 02	8.14E 03
Co-58	0.00E-01	8.92E 01	2.00E 02	0.00E-01	0.00E-01	0.00E-01	1.81E 03
Co-60	0.00E-01	2.56E 02	5.65E 02	0.00E-01	0.00E-01	0.00E-01	4.81E 03
Ni-63	3.11E 04	2.16E 03	1.04E 03	0.00E-01	0.00E-01	0.00E-01	4.50E 02
Ni-65	1.26E 02	1.64E 01	7.49E 00	0.00E-01	0.00E-01	0.00E-01	4.17E 02
Cu-64	0.00E-01	9.97E 00	4.68E 00	0.00E-01	2.51E 01	0.00E-01	8.50E 02
Zn-65	2.32E 04	7.37E 04	3.33E 04	0.00E-01	4.93E 04	0.00E-01	4.64E 04
Zn-69	4.93E 01	9.43E 01	6.56E 00	0.00E-01	6.13E 01	0.00E-01	1.42E 01
Br-83	0.00E-01	0.00E-01	4.04E 01	0.00E-01	0.00E-01	0.00E-01	5.82E 01
Br-84	0.00E-01	0.00E-01	5.24E 01	0.00E-01	0.00E-01	0.00E-01	4.11E-04
Br-85	0.00E-01	0.00E-01	2.15E 00	0.00E-01	0.00E-01	0.00E-01	1.01E-15
Rb-86	0.00E-01	1.01E 05	4.71E 04	0.00E-01	0.00E-01	0.00E-01	1.99E 04
Rb-88	0.00E-01	2.90E 02	1.54E 02	0.00E-01	0.00E-01	0.00E-01	4.00E-09
Rb-89	0.00E-01	1.92E 02	1.35E 02	0.00E-01	0.00E-01	0.00E-01	1.12E-11
Sr-89	2.21E 04	0.00E-01	6.35E 02	0.00E-01	0.00E-01	0.00E-01	3.55E 03
Sr-90	5.44E 05	0.00E-01	1.34E 05	0.00E-01	0.00E-01	0.00E-01	1.57E 04
Sr-91	4.07E 02	0.00E-01	1.64E 01	0.00E-01	0.00E-01	0.00E-01	1.94E 03
Sr-92	1.54E 02	0.00E-01	6.68E 00	0.00E-01	0.00E-01	0.00E-01	3.06E 03
Y-90	5.76E-01	0.00E-01	1.54E-02	0.00E-01	0.00E-01	0.00E-01	6.10E 03
Y-91M	5.44E-03	0.00E-01	2.11E-04	0.00E-01	0.00E-01	0.00E-01	1.60E-02
Y-91	8.44E 00	0.00E-01	2.26E-01	0.00E-01	0.00E-01	0.00E-01	4.64E 03
Y-92	5.06E-02	0.00E-01	1.48E-03	0.00E-01	0.00E-01	0.00E-01	8.86E 02
Y-93	1.60E-01	0.00E-01	4.43E-03	0.00E-01	0.00E-01	0.00E-01	5.09E 03
Zr-95	2.40E-01	7.70E-02	5.21E-02	0.00E-01	1.21E-01	0.00E-01	2.44E 02
Zr-97	1.33E-02	2.68E-03	1.22E-03	0.00E-01	4.04E-03	0.00E-01	8.30E 02
Nb-95	4.47E 02	2.48E 02	1.34E 02	0.00E-01	2.46E 02	0.00E-01	1.51E 06
Mo-99	0.00E-01	1.03E 02	1.96E 01	0.00E-01	2.34E 02	0.00E-01	2.39E 02

TABLE 2.3-1 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
Tc-99M	8.87E-03	2.51E-02	3.19E-01	0.00E-01	3.81E-01	1.23E-02	1.48E+01
Tc-101	9.12E-03	1.31E-02	1.29E-01	0.00E-01	2.37E-01	6.72E-03	3.95E-14
Ru-103	4.43E+00	0.00E-01	1.91E+00	0.00E-01	1.69E+01	0.00E-01	5.17E+02
Ru-105	3.69E-01	0.00E-01	1.46E-01	0.00E-01	4.76E+00	0.00E-01	2.26E+02
Ru-106	6.58E+01	0.00E-01	3.33E+00	0.00E-01	1.27E+02	0.00E-01	4.26E+03
Ag-110M	8.81E-01	8.15E-01	4.84E-01	0.00E-01	1.60E 00	0.00E-01	3.33E 02
Te-125M	2.57E 03	9.30E 02	3.44E 02	7.72E 02	1.04E 04	0.00E-01	1.02E 04
Te-127M	6.48E 03	2.32E 03	7.90E 02	1.66E 03	2.63E 04	0.00E-01	2.17E 04
Te-127	1.05E 02	3.78E+01	2.28E 01	7.80E 01	4.29E 02	0.00E-01	8.31E 03
Te-129M	1.10E 04	4.11E 03	1.74E 03	3.78E 03	4.60E 04	0.00E-01	5.54E 04
Te-129	3.01E 01	1.13E 01	7.33E 00	2.31E 01	1.26E 02	0.00E-01	2.27E 01
Te-131M	1.66E 03	8.10E 02	6.75E 02	1.28E 03	8.21E 03	0.00E-01	8.04E 04
Te-131	1.89E 01	7.88E 00	5.96E 00	1.55E 01	8.26E 01	0.00E-01	2.67E 00
Te-132	2.41E 03	1.56E 03	1.47E 03	1.72E 03	1.50E 04	0.00E-01	7.38E 04
I-130	2.71E 01	8.01E 01	3.16E 01	6.79E 03	1.25E 02	0.00E-01	6.89E 01
I-131	1.49E 02	2.14E 02	1.22E 02	7.00E 04	3.66E 02	0.00E-01	5.64E 01
I-132	7.29E 00	1.95E 01	6.82E 00	6.82E 02	3.11E 01	0.00E-01	3.66E 00
I-133	5.10E 01	8.87E 01	2.70E 01	1.30E 04	1.55E 02	0.00E-01	7.97E 01
I-134	3.81E 00	1.03E 01	3.70E 00	1.79E 02	1.64E 01	0.00E-01	9.01E-03
I-135	1.59E 01	4.17E 01	1.54E 01	2.75E 03	6.68E 01	0.00E-01	4.70E 01
Cs-134	2.98E 05	7.09E 05	5.79E 05	0.00E-01	2.29E 05	7.61E 04	1.24E 04
Cs-136	3.12E 04	1.23E 05	8.86E 04	0.00E-01	6.85E 04	9.38E 03	1.40E 04
Cs-137	3.82E 05	5.22E 05	3.42E 05	0.00E-01	1.77E 05	5.89E 04	1.01E 04
Cs-138	2.64E 02	5.22E 02	2.59E 02	0.00E-01	3.84E 02	3.79E+01	2.23E-03
Ba-139	9.29E-01	6.62E-04	2.72E-02	0.00E-01	6.19E-04	3.75E-04	1.65E 00
Ba-140	1.94E 02	2.44E-01	1.27E 01	0.00E-01	8.30E-02	1.40E-01	4.00E 02
Ba-141	4.51E-01	3.41E-04	1.52E-02	0.00E-01	3.17E-04	1.93E-04	2.13E-10
Ba-142	2.04E-01	2.10E-04	1.28E-02	0.00E-01	1.77E-04	1.19E-04	2.87E-19
La-140	1.50E-01	7.54E-02	1.99E-02	0.00E-01	0.00E-01	0.00E-01	5.54E 03
La-142	7.66E-03	3.48E-03	8.68E-04	0.00E-01	0.00E-01	0.00E-01	2.54E 01
Ce-141	2.24E-02	1.52E-02	1.72E-03	0.00E-01	7.04E-03	0.00E-01	5.79E 01
Ce-143	3.95E-03	2.92E 00	3.23E-04	0.00E-01	1.29E-03	0.00E-01	1.09E 02
Ce-144	1.17E 00	4.88E-01	6.27E-02	0.00E-01	2.90E-01	0.00E-01	3.95E 02
Pr-143	5.51E-01	2.21E-01	2.73E-02	0.00E-01	1.27E-01	0.00E-01	2.41E 03
Pr-144	1.80E-03	7.48E-04	9.16E-05	0.00E-01	4.22E-04	0.00E-01	2.59E-10
Nd-147	3.76E-01	4.35E-01	2.60E-02	0.00E-01	2.54E-01	0.00E-01	2.09E 03
W-187	2.96E 02	2.47E 02	8.65E 01	0.00E-01	0.00E-01	0.00E-01	8.10E 04
Np-239	2.85E-02	2.80E-03	1.54E-03	0.00E-01	8.74E-03	0.00E-01	5.75E 02

TABLE 2.3-2

Values of $e^{-\lambda_i t_p}$ For Liquid Dose Calculations

Radionuclide	λ_i(hr^{-1})	$e^{-\lambda_i t_p}$*	Radionuclide	λ_i(hr^{-1})	$e^{-\lambda_i t_p}$*
H-3	6.43E-6	1.00	Zr-95	4.44E-4	9.89E-1
C-14	1.38E-8	1.00	Zr-97	4.08E-2	3.76E-1
F-18	3.75E-1	1.23E-4	Nb-95	8.25E-4	9.80E-1
Na-24	4.62E-2	3.30E-1	Mo-99	1.03E-2	7.81E-1
P-32	2.02E-3	9.53E-1	Tc-99m	1.16E-1	6.18E-2
Cr-51	1.04E-3	9.75E-1	Tc-101	2.97	0.00
Mn-54	9.53E-5	9.98E-1	Ru-103	7.29E-4	9.83E-1
Mn-56	2.69E-1	1.57E-3	Ru-105	1.56E-1	2.37E-2
Fe-55	3.04E-5	9.99E-1	Ru-106	7.87E-5	9.98E-1
Fe-59	6.42E-4	9.85E-1	Ag-110m	1.14E-4	9.97E-1
Co-58	4.05E-4	9.90E-1	Sb-124	4.81E-4	9.89E-1
Co-60	1.50E-5	1.00	Te-125m	4.98E-4	9.88E-1
Ni-63	8.60E-7	1.00	Te-127m	2.65E-4	9.94E-1
Ni-65	2.71E-1	1.50E-3	Te-127	7.37E-2	1.71E-1
Cu-64	5.42E-2	2.72E-1	Te-129m	8.49E-4	9.80E-1
Zn-65	1.18E-4	9.97E-1	Te-129	6.03E-1	5.19E-7
Zn-69	7.29E-1	2.52E-8	Te-131m	2.31E-2	5.74E-1
Br-83	2.89E-1	9.72E-4	Te-131	1.66	4.99E-18
Br-84	1.31	2.22E-14	Te-132	8.89E-3	8.08E-1
Br-85	1.39E+1	0.00	I-130	5.59E-2	2.61E-1
Rb-86	1.55E-3	9.63E-1	I-131	3.59E-3	9.17E-1
Rb-88	2.33	5.18E-25	I-132	3.01E-1	7.29E-4
Rb-89	2.70	0.00	I-133	3.30E-2	4.53E-1
Sr-89	5.55E-4	9.87E-1	I-134	8.00E-1	4.59E-9
Sr-90	2.80E-6	1.00	I-135	1.03E-1	8.44E-2
Sr-91	7.17E-2	1.79E-1	Cs-134	3.86E-5	9.99E-1
Sr-92	2.56E-1	2.15E-3	Cs-136	2.22E-3	9.48E-1
Y-90	1.08E-2	7.72E-1	Cs-137	2.63E-6	1.00
Y-91m	8.32E-1	2.13E-9	Cs-138	1.29	3.58E-14
Y-91	4.91E-4	9.88E-1	Ba-139	5.02E-1	5.86E-6
Y-92	1.96E-1	9.06E-3	Ba-140	2.26E-3	9.47E-1
Y-93	6.80E-2	1.96E-1	Ba-141	2.31	8.37E-25
Ba-142	3.78	0.00	Pr-143	2.12E-3	9.50E-1
La-140	1.72E-2	6.62E-1	Pr-144	2.41	0.00
La-142	4.52E-1	1.94E-5	Nd-147	2.60E-3	9.40E-1
Ce-141	8.75E-4	9.79E-1	W-187	2.90E-2	4.99E-1
Ce-143	2.09E-2	6.06E-1	Np-239	1.23E-2	7.44E-1
Ce-144	1.02E-4	9.98E-1			

* Note: All values less than 1E-25 are reported as 0.

3.0 GASEOUS EFFLUENTS

3.1 MONITOR ALARM SETPOINT DETERMINATION

This procedure determines the monitor alarm setpoint that indicates if the dose rate in the unestricted areas due to noble gas radionuclides in the gaseous effluent released from the site to areas at and beyond the site boundary exceeds 500 mrem/year to the whole body or exceeds 3000 mrem/year to the skin.

The methodology described in Section 3.1.2 provides an alternative means to determine monitor alarm setpoints that may be used when an analysis of batch releases is performed prior to release.

3.1.1 Setpoint Based on Conservative Radionuclide Mix (Ground and Mixed Mode Releases

Releases through the steam generator flash tank vent can only occur through this vent when significant primary-to-secondary leakage exists within the steam generators and the plant is operating below 30 percent power. Detection of primary-to-secondary leakage is accomplished most effectively by continuously monitoring the condenser vacuum pump vent (RMS-15). Steam generator blowdown is continuously monitored by RMS-19 as a liquid pathway.

The following method applies to gaseous releases via the plant vent and condenser vacuum pump vent when determining the high alarm setpoint for the plant vent gas monitor (RMS-14) and condenser vacuum pump vent gas monitor (RMS-15) during the following operational conditions:

- Continuous release via the plant vent.
- Continuous release via the condenser vacuum pump vent.
- Batch release of containment purge via the plant vent.

- Batch release for containment pressure relief via the plant vent.

- Batch release of waste gas decay tanks via the plant vent.

3.1.1.1 Determine the "mix" (noble gas radionuclides and composition) of the gaseous effluent.

a. Determine the gaseous source terms that are representative of the "mix" of the gaseous effluent. Gaseous source terms are the noble gas activities in the effluent.

Gaseous source terms can be obtained from Table 3.1-1 or from analysis of the gaseous effluent.

b. Determine S_i (the fraction of the total noble gas radioactivity in the gaseous effluent comprised by noble gas radionuclide "i") for each individual noble gas radionuclide in the gaseous effluent.

$$S_i = \frac{A_i}{\sum_i A_i} \qquad (3.1\text{-}1)$$

A_i = The radioactivity of noble gas radionuclide "i" in the gaseous effluent from Table 3.1-1 or from analysis of gaseous effluent to be released.

3.1.1.2 Determine the Q_m (the maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent [μCi/sec]) based upon the whole body exposure limit of 500 mrem/year by:

$$Q_m = \frac{500}{(\overline{X/Q}) \sum_i K_i S_i} \qquad (3.1\text{-}2)$$

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

= 8.1 E-5 sec/m^3 (Continuous Ground Release) from Table A-1, Appendix A.

= 9.9 E-7 sec/m^3 (Continuous Mixed Mode Release) from Table A-10, Appendix A only with upper wind speed $\geq$ 9 mph.

= 5.1 E-5 sec/m^3 (Batch Ground Release) from Table A-7, Appendix A.

= 2.9 E-6 sec/m^3 (Batch Mixed Mode Release) from Table A-16, Appendix A only with upper wind speed $\geq$ 9 mph.

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide "i" ($mrem/yr/\mu Ci/m^3$) from Table 3.1-2.

3.1.1.3 Determine Q_m (the maximum acceptable release rate of all gas radionuclides in the gaseous effluent [$\mu Ci/sec$]) based upon the skin exposure limit of 3000 mrem/yr by:

$$Q_m = \frac{3000}{(\overline{X/Q}) \sum_i [(L_i + 1.1\ M_i)\ S_i]} \qquad (3.1\text{-}3)$$

$L_i + 1.1M_i$ = The total skin dose factor due to emissions from noble gas radionuclide "i" ($mrem/yr/\mu Ci/m^3$) from Table 3.1-2.

3.1.1.4 Determine C_m (the maximum acceptable total radioactivity concentration of all noble gas radionuclides in the gaseous effluent [μCi/cc]).

$$C_m = \frac{2.12\ E\text{-}3\ Q_m}{F} \qquad (3.1\text{-}4)$$

NOTE: Use the lower of the Q_m values obtained in Sections 3.1.1.2 and 3.1.1.3. This will protect both the skin and total body from being exposed to the limit.

where:

F = The maximum acceptable effluent flow rate at the point of release (cfm).

= 60,000 cfm for plant vent.

= 45 cfm for the condenser vacuum pump vent.

2.12 E-3 = Unit conversion constant to convert μCi/sec/cfm to μCi/cc.

3.1.1.5 Determine CR (the calculated monitor count rate above background attributed to the noble gas radionuclides [ccpm]) by:

$$CR = \sum_i (C_m)\ (E_m)$$

E_m = Obtained from the applicable effluent monitor efficiency curve located in the Plant Operating Manual, Volume 15, Curve Book. Use the radioactivity concentration "C_m" to find CR.

3.1.1.6 Determine the HSP (the monitor high alarm setpoint including background [cpm]) by:

$$HSP = T_m CR + \text{background (cpm)} \qquad (3.1\text{-}5)$$

where:

TM = Fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded due to simultaneous releases from several pathways.

= 0.90 percent for Plant Vent Gas Monitor (RMS-14).

= 0.01 percent for the Condenser Vacuum Pump Vent Monitor (RMS-15).

= 0.09 for the Fuel Handling Basement Exhaust Monitor (RMS-20).

3.1.2 Gaseous Effluents Analyzed Prior to Release

The following method applies to gaseous releases via the plant vent when determining the maximum acceptable effluent flow rate at the point of release and the associated high-alarm setpoint based on this flow rate for the plant vent gas monitor (RMS-14) during the following operational conditions:

- Batch release of containment purge.
- Batch release of containment pressure relief.
- Batch release of waste gas decay tanks.

3.1.2.1 Determine R_i (the noble gas release rate [μCi/sec] for radionuclide "i"):

$R_i = 472 (C_i) (F)$

where:

472 = A conversion factor to convert cfm to cc/sec.

C_i = The radioactivity concentration of noble gas radionuclide "i" in the gaseous effluent (μC_i/cc) from the analysis of the gaseous effluent to be released.

F = The maximum acceptable effluent flow rate at the point of release (cfm).

= 45 for the condenser.

= 50,000 for the containment purge.

$$= \frac{2\ E6\ \left(\frac{\Delta\ P}{14.7}\right)\ \left(\frac{273^0}{T_c}\right)}{t}$$ for pressure relief.

$$= \frac{525\ \left(\frac{\Delta\ P_t}{14.7}\right)\ \left(\frac{273^0}{T_c}\right)}{t}$$ for a gas decay tank release

where:

= 2 E6 and 525 are the volumes (ft^3) of the containment and decay tank respectively, and T_c, T_t, $\Delta\ P_c$, and $\Delta\ P_t$ are the respective temperature and change in pressure (psig) following the release of the containment and decay tank.

t = Length of release (min).

3.1.2.2 Determine the monitor alarm setpoint based on total body dose rate:

a. Determine CR_t (the monitor count rate per mrem/yr, total body).

$$CR_t = \frac{C}{(\overline{X/Q}) \sum_i K_i R_i}$$

where:

C = The count rate of the monitor corresponding to the radioactivity concentration in the analyzed sample ($C = C_i$ [x the monitor efficiency]) in cpm.

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

= 5.1 E-5 sec/m^3 (Batch Ground Release) from Table A-7, Appendix A.

= 2.9 E-6 sec/m^3 (Batch Mixed Mode Release) from Table A-16, Appendix A only with upper wind speeds of $\geq$ 9 mph.

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide "i" ($mrem/yr/\mu Ci/m^3$) from Table 3.1-2.

b. Determine S_t (the count rate of the gaseous effluent noble gas monitor at the alarm setpoint based on total body dose rate [ccpm]):

$$S_t = SF \times T_m \times D_t \times CR_t$$

where:

SF = An engineering factor used to provide a margin of safety for cumulative uncertainties of measurements;

= .5;

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

T_m = Fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded due to simultaneous releases from several pathways;

= 0.9 for the Plant Vent Gas Monitor (RMS-14).

3.1.2.3 Determine the monitor alarm setpoint based on the skin dose rate:

a. Determine CR_s (the monitor count rate per mrem/yr, skin):

$$CR_s = \frac{C}{\overline{X/Q} \sum_i (L_i + 1.1\ M_i)\ (R_i)}$$

where:

$L_i + 1.1\ M_i$ = The total skin dose factor due to emissions from noble gas radionuclide "i" (mrem/yr/μCi/m^3) from Table 3.1-2.

b. Determine S_s (the count rate of the gaseous effluent noble gas monitor at the alarm setpoint based on the dose rate to the skin [ccpm]):

$$S_s = SF \times T_m \times D_s \times CR_s$$

where:

D_s = 3000 mrem/yr (the dose rate to the skin limit).

3.1.2.4 Determine the actual gaseous monitor setpoint:

The setpoints that were determined based on the dose rate limits to the total body (S_t) and to the skin (S_s) are compared and the lesser value is used as the actual setpoint.

TABLE 3.1-1

GASEOUS SOURCE TERMS*

	Plant Vent Release[1]		Condenser Vacuum Pump Vent[2]		Containment Purge or Presure Relief		Gas Decay Tanks	
Radionuclide	A_i (Ci/yr)	S_i	A_i (Ci/yr)	S_i	A_i (Ci/yr)	S_i	A_i (Ci/yr)	S_i
Kr-85m	2.0E0	5.26E-2	1.0E0	4.35E-2	0.00	0.00	0.00	0.00
Kr-85	0.00	0.00	0.00	0.00	0.00	0.00	1.6E2	8.00E-1
Kr-87	1.0E0	2.63E-2	0.00	0.00	0.00	0.00	0.00	0.00
Kr-88	3.0E0	7.89E-2	2.0E0	8.70E-2	1.0E0	2.90E-3	0.00	0.00
Xe-131m	0.00	0.00	0.00	0.00	1.0E0	2.90E-3	9.0E0	4.50E-2
Xe-133m	0.00	0.00	0.00	0.00	4.0E0	1.16E-2	0.00	0.00
Xe-133	2.8E1	7.37E-1	1.8E-1	7.83E-1	3.1E2	8.99E-1	3.1E1	1.55E-1
-135	4.0E0	1.05E-1	2.0E-1	8.70E-2	4.0E0	1.16E-2	0.00	0.00
Ar-41	0.00	0.00	0.00	0.00	2.5E1	7.25E-2	0.00	0.00
TOTAL	3.8E1		2.3E1		3.45E2		2.0E2	

*Source terms are based upon GALE Code and not actual releases from the evaluation of H.B. Robinson Unit 2 to demonstrate conformance to the design objectives of 10CFR50, Appendix I, Table 2-4. These values are only for routine releases and not for a complete inventory of gases in an emergency.

[1]These values are used to determine the monitor alarm setpoints for the Plant Vent Gas Monitor (RMS-14) and Fuel Handling Basement Exhaust Monitor (RMS-20).

[2]These values are used to determine the monitor alarm setpoint for the Condenser Vacuum Pump Vent Monitor (RMS-15).

TABLE 3.1-2

DOSE FACTORS AND CONSTANTS*

Radionuclide	Total Whole Body Dose Factor (K_i) (mrem/yr/μCi/m^3)	Total Skin Dose Factor ($L_i + 1.1\ M_i$) mrem/yr/μCi/m^3)
Kr-83m	7.56E-2	2.12E1
Kr-85m	1.17E3	2.81E3
Kr-85	1.61E1	1.36E3
Kr-87	5.92E3	1.65E4
Kr-88	1.47E4	1.91E4
Kr-89	1.66E4	2.91E4
Kr-90	1.56E4	2.52E4
Xe-131m	9.15E1	6.48E2
Xe-133m	2.51E2	1.35E3
Xe-133	2.94E2	6.94E2
Xe-135m	3.12E3	4.41E3
Xe-135	1.81E3	3.97E3
Xe-137	1.42E3	1.39E4
Xe-138	8.83E3	1.43E4
Xe-139	0.00	0.00
Ar-41	8.84E3	1.29E4

*Regulatory Guide 1.109, October 1977, Table B-1 times (1.0 E6 pCi/μCi).

3.2 COMPLIANCE WITH 10CFR20 (GASEOUS)

3.2.1 Noble Gases

The gaseous effluent monitors setpoints are utilized to show compliance with 10CFR20 for noble gases. However, because they are based upon a conservative mix of radionuclides, the possibility exists that the setpoints could be exceeded and yet 10CFR20 limits may actually be met. Therefore, the following methodology has been provided in the event that if the alarm trip setpoints are exceeded, a determination may be made as to whether the actual releases have exceeded 10CFR20.

The dose rate in unrestricted areas resulting from noble gas effluents is limited to 500 mrem/year to the total body and 3000 mrem/year to the skin. Based upon NUREG 0133, the following are used to show compliance with 10CFR20.

$$\sum_i K_i \left[(\overline{X/Q})_v \dot{Q}_{iv} + (\overline{X/Q})_e \dot{Q}_{ie} \right] \leq 500 \text{ mrem/yr} \qquad (3.2\text{-}1)$$

$$\sum_i (L_i + 1.1\, M_i) \left[(\overline{X/Q})\, \dot{Q}_{iv} + (\overline{X/Q})\, \dot{Q}_{ie} \right] \leq 3000 \text{ mrem/yr} \qquad (3.2\text{-}2)$$

where:

$(\overline{X/Q})_v$ = Annual average relative dilution for plant vent releases at the site boundary, sec/m^3.

= From Table A-1 for ground level releases.

= From Table A-10 for mixed mode releases only with upper wind speed of $\geq$ 9 mph.

$(\overline{X/Q})_e$ = Annual average relative dilution for condenser vacuum pump vent releases at the site boundary, sec/m^3.

= From Table A-1 for ground level releases.

K_i = The total body dose factor due to gamma emissions for noble gas radionuclide "i," mrem/year per $\mu Ci/m^3$.

L_i = The skin dose factor due to beta emissions for noble gas radionuclide "i," mrem/year per $\mu Ci/m^3$.

M_i = The air dose factor due to gamma emissions for noble gas radionuclide "i," mrad/year per $\mu Ci/m^3$.

1.1 = The ratio of the tissue to air absorption coefficients over the energy range of the photon of interest, mrem/mrad (reference, NUREG 0133, October 1978).

$\dot{Q}_{ie}$ = The release rate of noble gas radionuclide "i" in gaseous effluents from the condenser vacuum pump vent $\mu Ci/sec$.

$\dot{Q}_{iv}$ = The release rate of noble gas radionuclide "i" in gaseous effluents from the plant vent $\mu Ci/sec$.

The determination of limiting location for implementation of 10CFR20 for noble gases is a function of the radionuclide mix, isotopic release rate, and the meteorology.

The radionuclide mix was based upon source terms calculated using the NRC GALE Code. They were calculated based upon the present operating mode of HBR. They are presented in Table 3.2-1 as a function of release point.

The X/Q value utilized in the equations for implementation of 10CFR20 is based upon the maximum long-term annual average ($\overline{X/Q}$) in the unrestricted area. Table 3.2-2 presents the distances from HBR to the nearest area for each of the 16 sectors as well as to the nearest residence, vegetable garden, cow, goat, and beef animal. Long-term annual average ($\overline{X/Q}$) values for the HBR release points to the special locations in Table 3.2-2 are presented in Appendix A. A description of their deriviation is also provided n this appendix.

To select the limiting location, the highest annual average $\overline{X/Q}$ value for the ground level releases and the mixed mode releases was used. Since mixed mode releases may not necessarily decrease with distance (i.e., the site boundary may not have the highest $\overline{X/Q}$ value), long-term annual average ($\overline{X/Q}$) values, calculated at the midpoint of 10 standard distances as given in Appendix A were also considered. For HBR, mixed mode release X/Q values decrease with distance for all directions except the WNW, NW, and NNW so that the maximum site boundary X/Q is usually greater at the site boundary than at distances greater than the site boundary. In addition, the maximum site boundary X/Q for both the ground level and mixed mode releases occurs at the SSE site boundary. Therefore, the limiting location for implementation of 10CFR20 for noble gases is the SSE site boundary.

Values for K_i, L_i, and M_i, which were used in the determination of the limiting location and which are to be used by HBR in Expressions 3.2-1 and 3.2-2 to show compliance with 10CFR20, are presented in Table 3.2-3. These values were taken from Table B-1 of NRC Regulatory Guide 1.109, Revision 1. The values have been multiplied by 1.0 E6 to convert microcuries to picocuries for use in Expressions 3.2-1 and 3.2-2.

3.2.2 Radioiodines and Particulates

The dose rate in unrestricted area resulting from the release of radioiodines, tritium, and particulates with half-lives $\geq$ 8 days is limited to 1500 mrem/yr to any organ. Based upon NUREG 0133, the following is used to show compliance with 10CFR20.

$$\sum_i \left[P_{i_I} \left[(\overline{X/Q})_v \dot{Q}_{iv} + (\overline{X/Q})_e \dot{Q}_{ie} \right] + (P_{i_M} + P_{i_G}) \left[(\overline{D/Q})_v \dot{Q}_{iv} + (\overline{D/Q})_e \dot{Q}_{ie} \right] + \right.$$

$$\left. (P_{T_I} + P_{T_M}) \left[(\overline{X/Q})_v \dot{Q}_{T_v} + (\overline{X/Q})_e \dot{Q}_{T_e} \right] \right] \leq 1500 \text{ mrem/yr} \qquad (3.2\text{-}3)$$

where:

$(\overline{X/Q})_v$ = Annual average relative dilution for plant vent releases at the site boundary, sec/m^3.

= From Table A-1 for ground-level releases.

= From Table A-10 for mixed mode releases to be used only with upper wind speeds $\geq$ 9 mph.

$(\overline{X/Q})_e$ = Annual average relative dilution for condenser vacuum pump vent releases at site boundary, sec/m^3.

= From Table A-1 for ground-level releases.

$(\overline{D/Q})_v$ = Annual average deposition factor for plant vent releases at site boundary, m^{-2}.

= From Table A-3 for ground-level releases.

= From Table A-12 for mixed mode releases to be used only with upper wind speeds $\geq$ 9 mph.

$(\overline{D/Q})_e$ = Annual average deposition factor for condenser vacuum pump vent releases at the site boundary, m^{-2}.

= From Table A-3 for ground-level releases.

P_{i_I} = Dose parameter for radionuclide "i" for the inhalation pathway, mrem/year per $\mu Ci/m^3$.

P_{i_G} = Dose parameter for radionuclide "i" for the ground plane pathway, mrem/year per $\mu Ci/sec$ per m^{-2}.

P_{i_M} = Dose parameter for radionuclide "i" for either the cow milk or goat milk pathway, mrem/year per $\mu Ci/sec$ per m^{-2}.

P_{T_I} = Dose parameter for tritium for the inhalation pathway, mrem/year per $\mu Cu/m^3$.

$\dot{Q}_{iv}$ = Release rate of radionuclide "i" from the plant vent, $\mu Ci/sec$.

$\dot{Q}_{T_V}$ = Release rate for tritium from the plant vent, $\mu Ci/sec$.

$\dot{Q}_{Te}$ = Release rate of tritium from the condenser vacuum pump vent, $\mu Ci/sec$.

$\dot{Q}_{ie}$ = Release rate of radionuclide "i" from the main condenser vacuum pump vent $\mu Ci/sec$.

In the calculation to show compliance with 10CFR20, only the inhalation, ground plane, cow milk, and goat milk pathways are considered. Equation 3.2-3 is evaluated first at the limiting site boundary. If the 1500 mrem/yr limit is exceeded at the limiting site boundary when all pathways are considered present at this site boundary but the inhalation pathway contributed < 1500 mrem/yr, then Equation 3.2-3 is evaluated at the limiting site boundary is 0.26 miles SSE, and the limiting relay pathway location is the cow milk pathway 4.2 miles E.

The determination of limiting location for implementation of 10CFR20 for radioiodines and particulates is a function of the same parameters as for noble gases plus a fourth, actual receptor pathway. The radionuclide mix was again based upon the source terms calculated using the GALE Code. The mix and the source terms are presented in Table 3.2-1 as a function of release point.

The determination of the controlling site boundary location was based upon the highest site boundary D/Q value. The determination of actual receptor limiting location was based upon the milk pathway D/Q value and the P_i value for the respective milk pathway. Values for P_i were calculated for an infant for various radionuclides for the inhalation, ground plane, cow milk, and goat milk pathways using the methodology of NUREG 0133. The P_i values are presented in Table 3.2-4. A description of the methodology used in calculating the P_i values is presented in Appendix B. The values of P_i reflect, for each radionuclide, the maximum P_i value for any organ for each individual pathway of exposure. The goat milk pathway is present near HBR, as is the cow milk pathway. However, the cow milk pathway P_i values were utilized in the determination of the controlling location because the product of the maximum cow milk pathway D/Q and P_i were greater than those for the goat. In addition, the goat milk is not used for human consumption. For the case of an infant being present at the site at the site boundary or at the real pathway location, the ground plane pathway is not considered as a reasonable exposure pathway (i.e., $P_{i_G} = 0$). However, P_{i_G} values are presented in Table 3.2-4 for completeness.

The annual average D/Q values at the special locations, which will be utilized in Equation 3.2-3, are obtained from the tables presented in Appendix A. The X/Q values which will be utilized in Equation 3.2-3 are also obtained from the tables presented in Appendix A. A description of the derivation of the X/Q and D/Q values is provided in Appendix A.

TABLE 3.2-1

RELEASES FROM H. B. ROBINSON UNIT NO. 2*
(Ci/yr)

Isotope	Plant Vent (Q_v)	Condenser Vacuum Pump Vent (Q_e)	Total
Kr-85m	2.0E0	1.0E0	3.0E0
Kr-85	1.6E2	0.00	1.6E2
Kr-87	1.0E0	0.00	1.0E0
Kr-88	4.0E0	2.0E0	6.0E0
Xe-131m	1.0E1	0.00	1.0E1
Xe-133m	4.0E0	0.00	4.0E0
Xe-133	3.7E2	1.8E1	3.9E2
Xe-135	8.0E0	2.0E0	1.0E1
I-131	3.6E-2	2.3E-2	5.9E-2
I-133	5.4E-2	3.4E-2	9.8E-2
Mn-54	4.7E-3	0.00	4.7E-3
Fe-59	1.6E-3	0.00	1.6E-3
Co-58	1.6E-2	0.00	1.6E-2
Co-60	7.3E-3	0.00	7.3E-3
Sr-89	3.4E-4	0.00	3.4E-4
Sr-90	6.3E-5	0.00	6.3E-5
Cs-134	4.7E-3	0.00	4.7E-3
Cs-137	7.8E-3	0.00	7.8E-3

*Calculations based upon GALE Code and do not reflect actual release data from the Evaluation Comformance to the Design Objectives of 10CFR50, Appendix I. These values are only for routine releases and not for a complete inventory of gases in an emergency.

TABLE 3.2-2

DISTANCE TO SPECIAL LOCATIONS FOR THE
H. B. ROBINSON PLANT (MILES)

Sector	Site Boundary	Milk Cow	Milk Goat	Meat Animal	Nearest Resident	Nearest Garden
NNE	1.26	-	-	1.65	1.3	1.4
NE	1.01	-	-	1.16	1.2	1.3
ENE	0.86	-	-	2.41	0.9	2.2
E	0.61	4.2	-	3.12	0.8	2.8
ESE	0.50	-	-	1.99	0.6	0.6
SE	0.29	-	-	-	0.3	0.3
SSE	0.26	-	-	-	0.3	0.3
S	0.28	-	-	2.32	0.3	0.4
SSW	0.29	-	-	2.08	0.3	0.5
SW	0.36	-	2.5*	2.27	0.4	0.5
WSW	0.36	-	-	2.69	0.4	0.6
W	0.50	-	-	3.97	0.6	0.6
WNW	0.55	-	-	4.07	0.7	0.9
NW	1.23	-	-	1.60	1.3	1.3
NNW	1.89	-	-	2.84	2.9	3.0
N	1.94	-	-	2.93	2.9	2.9

*Milk is not presently used for human consumption.

TABLE 3.2-3

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS*

Radionuclide	Total Body Dose Factor K_i (mrem/yr per $\mu Ci/m^3$)	Skin Dose Factor L_i (mrem/yr per $\mu Ci/m^3$)	Gamma Air Dose Factor M_i (mrad/yr per $\mu Ci/m^3$)	Beta Air Dose Factor N_i (mrad/yr per $\mu Ci/m^3$)
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	8.33E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

*The listed dose factors are for radionuclides that may be detected in gaseous effluents.

TABLE 3.2-4

P_1 VALUES FOR AN INFANT FOR THE
H. B. ROBINSON UNIT NO. 2*

Isotope	Inhalation	Ground Plane	Cow Milk	Goat Milk
H-3	6.47E2	0.00	2.38E3	4.86E3
P-32	2.03E6	0.00	1.60E11	1.93E11
Cr-51	1.28E4	6.67E6	4.79E6	5.65E5
Mn-54	1.00E6	1.09E9	3.89E7	4.68E6
Fe-59	1.02E6	3.92E8	3.93E8	5.11E6
Co-58	7.77E5	5.29E8	6.06E7	7.28E6
Co-60	4.51E6	4.40E9	2.10E8	2.52E7
Zn-65	6.47E5	6.89E8	1.90E10	2.29E9
Rb-86	1.90E5	1.28E7	2.22E10	2.67E9
Sr-89	2.03E6	3.16E4	1.27E10	2.66E10
Sr-90	4.09E7	0.00	1.21E11	2.55E11
Y-91	2.45E6	1.52E6	5.26E6	6.32E5
Zr-95	1.75E6	3.48E8	8.28E5	9.95E4
Nb-95	4.79E5	1.95E8	2.06E8	2.48E7
Ru-103	5.52E5	1.55E8	1.05E5	1.27E4
Ru-106	1.16E7	2.99E8	1.44E6	1.73E5
Ag-110m	3.67E6	3.14E9	1.46E10	1.75E9
Te-127m	1.31E6	1.18E5	1.04E9	1.24E8
Te-129m	1.68E6	2.86E7	1.40E9	1.68E8
Cs-134	7.03E5	2.81E9	6.79E10	2.04E11
Cs-136	1.35E5	2.13E8	5.76E9	1.73E10
Cs-137	6.12E5	1.15E9	6.02E10	1.81E11
Ba-140	1.60E6	2.94E7	2.41E8	2.89E7
Ce-141	5.17E5	1.98E7	1.37E7	1.65E6
Ce-144	9.84E6	5.84E7	1.33E8	1.60E7
I-131	1.48E7	2.46E7	1.06E12	1.27E12
I-132	1.69E5	1.78E6	1.39E2	1.64E2
I-133	3.56E6	3.54E6	9.80E9	1.18E10
I-135	6.96E5	3.67E6	2.27E7	2.68E7

*Units are mrem/yr per $\mu Ci/m^3$ for H-3 and the inhalation pathway and mrem/yr per $\mu Ci/sec$ per m^{-2} for the food and ground plane pathways.

3.3 COMPLIANCE WITH 10CRF50 (GASEOUS)

3.3.1 Noble Gases

3.3.1.1 Cumulation of Doses

Based upon NUREG 0133, the air dose in the unrestricted area due to noble gases released in gaseous effluents can be determined by the following equations:

$$D_\gamma = 3.17 \times 10^{-8} \sum_i M_i \left[(\overline{X/Q})_v \overline{Q}_{iv} + (\overline{X/q})_v \overline{q}_{iv} + (\overline{X/Q})_e \overline{Q}_{ie} \right] \quad (3.3\text{-}1)$$

$$D_\beta = 3.17 \times 10^{-8} \sum_i N_i \left[(\overline{X/Q})_v \overline{Q}_{iv} + (\overline{X/q})_v \overline{q}_{iv} + (\overline{X/Q})_e \overline{Q}_{ie} \right] \quad (3.3\text{-}2)$$

where:

D_γ = The air dose from gamma radiation, mrad.

D_β = The air dose from beta radiation, mrad.

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide "i," mrad/year per $\mu Ci/m^3$.

N_i = The air dose factor due to beta emissions for each identified noble gas radionuclide "i," mrad/year per $\mu Ci/m^3$.

$(\overline{X/Q})_v$ = The annual average dilution for areas at or beyond the unrestricted area boundary for long-term plant vent releases (> 500 hrs/year), sec/m^3.

= From Table A-1 for ground level releases.

= From Table A-10 for mixed mode releases to be used only with upper wind speeds $\geq$ 9 mph.

$(\overline{X/q})_v$ = The dilution for areas at or beyond the unrestricted area boundary for short-term vent releases ($\leq$ 500 hours/year), sec/m^3.

= From Table A-7 for ground level releases.

= From Table A-16 for mixed mode releases.

$(\overline{X/Q})_e$ = Annual average relative dilution for condenser vacuum pump vent releases at the site boundary, (> 500 hours/year), sec/m^3.

= From Table A-1 for ground level releases;

$\overline{q}_{iv}$ = The average release of noble gas radionuclide "i" in gaseous releases for short-term plant releases ($\leq$ 500 hours/year), µCi;

$\bar{Q}_{ie}$ = The average release of noble gas radionuclide "i" in gaseous releases for long-term condenser vacuum pump vent releases (> 500 hours/year), µCi;

$\bar{Q}_{iv}$ = The average release of noble gas radionuclide "i" in gaseous effluents for long-term vent releases (> 500 hours/year), µCi;

3.17×10^{-8} = The inverse of the number of seconds in a year $(sec/year)^{-1}$.

At HBR the limiting location is 0.26 miles SSE. Based upon the tables presented in Appendix A, substitution of the appropriate X/Q values into Equation 3.3-1 would yield an equation with the short-term X/Q value being less than the long-term value. Therefore, for this document, only the long-term annual average $\overline{X/Q}$ values (i.e., the more conservative values) will be used.

The determination of the limiting location for implementation of 10CFR50 is a function of parameters such as radionuclide mix, isotopic release, and meteorology. The radionuclide mix was based upon source terms calculated using the NRC GALE Code and is presented in Table 3.2-1 as a function of release point. The only source of short-term releases from the plant vent are containment purges.

To select the limiting location, the highest annual average $\overline{X/Q}$ value for ground level and mixed mode releases and the highest short-term X/Q value for ground level and mixed mode releases were considered. Since mixed mode releases may increase and then decrease with distance (i.e., the site boundary may not have the highest X/Q value), long-term X/Q values were calculated at the midpoint of 10 standard distances as given in Appendix A. The calculated values decreased with the distance for all but the WNW, NW, and NNW sectors. The values for these sectors were not found to be limiting such that the maximum site boundary X/Q for both long-term and short-term ground level and mixed mode releases occurred at the SSE site boundary. The limiting location for implementation of 10CFR20 for noble gases is the SSE site boundary.
Values for M_i and N_i, which are utilized in the calculation of the gamma air and beta air doses in Equation 3.3-1 to show compliance with 10CFR50, were presented in Table 3.2-3. These values originate from NUREG 0472, Revision 0, and were taken from Table B-1 of the NRC Regulatory Guide 1.109, Revision 1. The values have been multiplied by 1.0 E6 to convert from picocuries to microcuries.

The following relationship should hold for HBR to show compliance with HBR's Technical Specification 3.9.4.1.

For the calendar quarter:

$$D_\gamma \leq 5 \text{ mrad} \qquad (3.3\text{-}3)$$

$$D_\gamma \leq 10 \text{ mrad} \qquad (3.3\text{-}4)$$

For the calendar year:

$$D_\gamma \leq 10 \text{ mrad} \qquad (3.3\text{-}5)$$

$$D_\beta \leq 20 \text{ mrad} \qquad (3.3\text{-}6)$$

The quarterly limits given above represent one-half of the annual design objectives of Section II.B.1 of Appendix I of 10CFR50. If any of the limits of Equations 3.3-3 through 3.3-6 are exceeded, a special report pursuant to Technical Specification 6.9.4.a must be filed with the NRC. This report complies with Section IV.A of Appendix I of 10CFR50.

3.3.1.2 Projection of Doses

Doses resulting from the release of gaseous effluents will be projected once per month. The doses will be projected using Equations 3.3-1 and 3.3-2.

3.3.2 Radioiodine and Particulates

3.3.2.1 Cumulation of Doses

Section II.C of Appendix I of 10CFR50 limits the release of radioiodines and radioactive material in particulate form from each reactor such that estimated dose or dose commitment to an individual in an unrestricted area from all pathways of exposure is not in excess of 15 mrem to any organ. Based upon NUREG 0133, the dose to an organ of an individual from radioiodines, tritium, and particulates with half-lives > 8 days in gaseous effluents released to unrestricted areas can be determined by the following equation:

$$D_\tau = 3.17 \times 10^{-8} \sum_i \Big[R_{i_I} \left[(\overline{X/Q})_v Q_{iv} + (\overline{X/q})_v q_{iv} + (\overline{X/Q})_e Q_{ie} \right] + (R_{i_V} + R_{i_G}) \left[(\overline{D/Q})_v Q_{iv} (\overline{D/q})_v q_{iv} + (\overline{D/Q})_e Q_{ie} \right] + (R_{T_I} + R_{T_V}) \left[(\overline{X/Q})_v Q_{Tv} + (\overline{X/q})_v q_{Tv} + (\overline{X/Q})_e Q_{Te} \right] \Big] \qquad (3.3\text{-}7)$$

where:

D_τ = Dose to any organ τ from radioiodines and particulates , mrem.

3.17×10^{-8} = The inverse of the number of seconds in a year, $(sec/year)^{-1}$.

$(\overline{X/Q})_v$ = Annual average relative concentration for plant vent releases (> 500 hrs/yr) sec/m^3.

= From Table A-1 for ground level releases.

= From Table A-10 for mixed mode releases only to be used with wind speeds > 9 mph.

$(\overline{X/Q})_e$ = Annual average dilution for condenser vacuum pump vent releases (> 500 hours/yr) sec/m^3.

= From Table A-1 for ground level releases.

$(\overline{D/Q})_v$ = Annual average deposition factor for plant vent releases (> 500 hrs/yr) m^{-2}.

= From Table A-3 for ground level releases.

= From Table A-12 for mixed mode releases only to be used with upper wind speeds > 9 mph.

$(D/q)_v$ = Relative deposition factor for short-term plant vent releases ($\leq$ 500 hrs/yr), m^{-2}.

= From Table A-9 for ground level releases.

= From Table A-18 for mixed mode releases only to be used with upper wind speeds > 9 mph.

$(D/Q)_e$ = Annual average relative deposition factor for condenser vacuum pump vent releases (> 500 hrs/yr), m^{-2}.

= From Table A-3 for ground level releases.

Q_{ie} = Release of radionuclide "i" in gaseous effluents for long-term condenser vacuum pump vent releases (> 500 hrs/yr), μCi.

Q_{iv} = Release of radionuclide "i" in gaseous effluents for long-term plant vent releases (> 500 hrs/yr), μCi.

q_{iv} = Release of radionuclide "i" in gaseous effluents for short-term plant vent releases ($\leq$ 500 hrs/yr), μCi.

R_{i_G} = Dose factor for an organ for radionuclide "i" for the ground plane exposure pathway, mrem/yr per μCi/sec per m^{-2}.

R_{i_I} = Dose factor for an organ for radionuclide "i" for the inhalation pathway, mrem/yr per $\mu Ci/m^3$.

R_{i_V} = Dose factor for an organ for radionuclide "i" for the vegetable pathway, mrem/yr per $\mu Ci/m^{-2}$.

R_{T_V} = Dose factor for an organ for tritium for the vegetable pathway, mrem/yr per $\mu Ci/m^3$.

R_{T_I} = Dose factor for an organ for tritium for the inhalation pathway, mrem/yr per $\mu Ci/m^3$.

Q_{TV} = Release of tritium in gaseous effluents for long-term vent releases (> 500 hrs/yr), μCi.

Q_{Te} = Release of tritium in gaseous effluents for long-term condenser vacuum pump releases (> 500 hrs/yr), μCi.

q_{TV} = Release of tritium in gaseous effluents for short-term plant vent releases (≤ 500 hrs/yr), μCi.

To show compliance with 10CFR50, Equation 3.3-7 is evaluated at the limiting pathway location. At HBR this location is the vegetable garden 0.3 miles in the SSE sector. The critical receptor is a child. Substitution of the appropriate X/Q and D/Q values from tables in Appendix A into Equation 3.3-7 would yield an equation with the short-term X/Q and D/Q values being less than the long-term values. Therefore, for this document, only long-term annual X/Q and D/Q values (i.e., more conservative values) are used.

The determination of a limiting location for implementation of 10CFR50 for radioiodines and particulates is a function of:

1. Radionuclide mix and isotopic release
2. Meteorology
3. Exposure pathway
4. Receptor's age

In the determination of the limiting location, the radionuclide mix of radioiodines and particulates was based upon the source terms calculated using the GALE Code. This mix is presented in Table 3.2-1 as a function of release point. The only source of short-term releases from the plant vent is containment purges.

In the determination of the limiting location, all of the exposure pathways, as presented in Table 3.2-2, were evaluated. These include cow milk, goat milk, beef and vegetable ingestion, and inhalation and ground plane exposure. An infant was assumed to be present at all milk pathway locations. A child was assumed to be present at all vegetable garden and beef animal locations. The ground plane exposure pathway was not considered a viable pathway for an infant. Naturally, the inhalation pathway was present everywhere an individual was present.

HBR Technical Specification 4.20.2.1 requires that a land-use census survey be conducted on an annual basis. The age groupings at the various receptor locations are also determined during this survey; a new limiting location and receptor age group can result.

For the determination of the limiting location, the highest D/Q values for the vegetable garden, cow milk, and goat milk pathways were selected. The thyroid dose was calculated at each of these locations using the radionuclide mix and releases of Table 3.2-1. Based upon these calculations, it was determined that the limiting receptor pathway is the vegetable/child pathway.

In the determination of the limiting location, annual average D/Q and X/Q values are used. A description of the derivation of the various X/Q and D/Q values is presented in Appendix A.

Short-term and long-term X/Q and D/Q values for ground level releases and for long-term mixed mode releases are provided in tables in Appendix A. They may be utilized if an additional special location arises different from those presented in the special locations of Table 3.2-2.

Tables 3.3-1 through 3.3-19 present R_i values for the total body, GI-tract, bone, liver , kidney, thyroid, and lung organs for the ground plane, inhalation, cow milk, goat milk, vegetable, and meat ingestion pathways for the infant, child, teen, and adult age groups as appropriate to the pathways. These values were calculated using the methodology described in NUREG 0133 using a grazing period of eight months. A description of the methodology is presented in Appendix B.

The following relationship should hold for HBR to show compliance with HBR Technical Specification 3.9.5.1.

For the calendar quarter:

$$D_\tau \leq 7.5 \text{ mrem} \qquad (3.3\text{-}8)$$

For the calendar year:

$$D_{\tau} \leq 15 \text{ mrem} \qquad (3.3\text{-}9)$$

The quarterly limits given above represent one-half the annual design objectives of Section II.C of Appendix I of 10CFR50. If any of the limits of Equations 3.3-8 or 3.3-9 are exceeded, a special report pursuant to Technical Specification 6.9.4.a must be filed with the NRC. This report complies with Section IV.A of Appendix I of 10CFR50.

3.3.2.2 Projection of Doses

Doses resulting from release of radioiodines and particulates will be projected once per month using Equation 3.3-7.

TABLE 3.3-1

R VALUES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Ground

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Cr-51	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	5.51E 06
Mn-54	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.57E 09
Fe-59	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	3.23E 08
Co-58	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	4.44E 09
Co-60	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.52E 10
Zn-65	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	8.61E 08
Rb-86	8.99E 06	8.99E 06	8.99E 06	8.99E 06	8.99E 06	8.99E 06	8.99E 06	1.03E 07
Sr-89	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.58E 04
Y-91	1.08E 06	1.08E 06	1.08E 06	1.08E 06	1.08E 06	1.08E 06	1.08E 06	1.22E 06
Zr-95	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.89E 08
Nb-95	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.60E 08
Ru-103	1.09E 08	1.09E 08	1.09E 08	1.09E 08	1.09E 08	1.09E 08	1.09E 08	1.27E 08
Ru-106	4.19E 08	4.19E 08	4.19E 08	4.19E 08	4.19E 08	4.19E 08	4.19E 08	5.03E 08
Ag-110M	3.48E 09	3.48E 09	3.48E 09	3.48E 09	3.48E 09	3.48E 09	3.48E 09	4.06E 09
Te-127M	9.15E 04	9.15E 04	9.15E 04	9.15E 04	9.15E 04	9.15E 04	9.15E 04	1.08E 05
Te-129M	2.00E 07	2.00E 07	2.00E 07	2.00E 07	2.00E 07	2.00E 07	2.00E 07	2.34E 07
I-131	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	2.09E 07
I-132	1.24E 06	1.24E 06	1.24E 06	1.24E 06	1.24E 06	1.24E 06	1.24E 06	1.46E 06
I-133	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	3.00E 06
I-135	2.56E 06	2.56E 06	2.56E 06	2.56E 06	2.56E 06	2.56E 06	2.56E 06	2.99E 06
Cs-134	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	7.96E 09
Cs-136	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.69E 08
Cs-137	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.20E 10
Ba-140	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.34E 07
Ce-141	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.53E 07
Ce-144	6.95E 07	6.95E 07	6.95E 07	6.95E 07	6.95E 07	6.95E 07	6.95E 07	8.03E 07

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-2

R VALUES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Veget

AGE GROUP = Adult

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.28E 03	2.28E 03	0.00E 01	2.28E 03	2.28E 03	2.28E 03	2.28E 03	2.28E 03
P-32	5.91E 07	1.72E 08	1.53E 09	9.51E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Cr-51	4.60E 04	1.16E 07	0.00E 01	0.00E 01	1.01E 04	2.75E 04	6.10E 04	0.00E 01
Mn-54	5.83E 07	9.36E 08	0.00E 01	3.05E 08	9.09E 07	0.00E 01	0.00E 01	0.00E 01
Fe-59	1.12E 08	9.75E 08	1.24E 08	2.93E 08	0.00E 01	0.00E 01	8.17E 07	0.00E 01
Co-58	6.71E 07	6.07E 08	0.00E 01	2.99E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Co-60	3.67E 08	3.12E 09	0.00E 01	1.66E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zn-65	5.77E 08	8.04E 08	4.01E 08	1.28E 09	8.54E 08	0.00E 01	0.00E 01	0.00E 01
Rb-86	1.03E 08	4.36E 07	0.00E 01	2.21E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-89	2.87E 08	1.60E 09	1.00E 10	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-90	1.64E 11	1.93E 10	6.70E 11	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y-91	1.34E 05	2.76E 09	5.01E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zr-95	2.51E 05	1.17E 09	1.16E 06	3.71E 05	5.82E 05	0.00E 01	0.00E 01	0.00E 01
Nb-95	4.19E 04	4.73E 08	1.40E 05	7.79E 04	7.70E 04	0.00E 01	0.00E 01	0.00E 01
Ru-103	2.04E 06	5.53E 08	4.74E 06	0.00E 01	1.81E 07	0.00E 01	0.00E 01	0.00E 01
Ru-106	2.46E 07	1.26E 10	1.94E 08	0.00E 01	3.75E 08	0.00E 01	0.00E 01	0.00E 01
Ag-110M	6.23E 06	4.28E 09	1.13E 07	1.05E 07	2.06E 07	0.00E 01	0.00E 01	0.00E 01
Te-127M	6.12E 07	1.68E 09	5.02E 08	1.80E 08	2.04E 09	1.28E 08	0.00E 01	0.00E 01
Te-129M	4.71E 07	1.50E 09	2.98E 08	1.11E 08	1.24E 09	1.02E 08	0.00E 01	0.00E 01
I-131	6.61E 07	3.04E 07	8.07E 07	1.15E 08	1.98E 08	3.78E 10	0.00E 01	0.00E 01
I-132	5.21E 01	2.80E 01	5.57E 01	1.49E 02	2.37E 02	5.21E 03	0.00E 01	0.00E 01
I-133	1.12E 06	3.30E 06	2.11E 06	3.67E 06	6.40E 06	5.39E 08	0.00E 01	0.00E 01
I-135	3.91E 04	1.20E 05	4.05E 04	1.06E 05	1.70E 05	7.00E 06	0.00E 01	0.00E 01
Cs-134	8.83E 09	1.89E 08	4.54E 09	1.08E 10	3.49E 09	0.00E 01	1.16E 09	0.00E 01
Cs-136	1.19E 08	1.88E 07	4.19E 07	1.66E 08	9.21E 07	0.00E 01	1.26E 07	0.00E 01
Cs-137	5.94E 09	1.76E 08	6.63E 09	9.07E 09	3.08E 09	0.00E 01	1.02E 09	0.00E 01
Ba-140	8.40E 06	2.64E 08	1.28E 08	1.61E 05	5.47E 04	0.00E 01	9.22E 04	0.00E 01
Ce-141	1.48E 04	4.99E 08	1.93E 05	1.31E 05	6.07E 04	0.00E 01	0.00E 01	0.00E 01
Ce-144	1.69E 06	1.06E 10	3.15E 07	1.32E 07	7.80E 06	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-3

R VALUES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Veget

AGE GROUP = Teen

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.61E 03	2.61E 03	0.00E 01	2.61E 03	2.61E 03	2.61E 03	2.61E 03	2.61E 03
P-32	6.80E 07	1.47E 08	1.75E 09	1.09E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Cr-51	6.11E 04	1.03E 07	0.00E 01	0.00E 01	1.34E 04	3.39E 04	8.72E 04	0.00E 01
Mn-54	8.79E 07	9.09E 08	0.00E 01	4.43E 08	1.32E 08	0.00E 01	0.00E 01	0.00E 01
Fe-59	1.60E 08	9.78E 08	1.77E 08	4.14E 08	0.00E 01	0.00E 01	1.30E 08	0.00E 01
Co-58	9.79E 07	5.85E 08	0.00E 01	4.25E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Co-60	5.57E 08	3.22E 09	0.00E 01	2.47E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zn-65	8.68E 08	7.88E 08	5.36E 08	1.86E 09	1.19E 09	0.00E 01	0.00E 01	0.00E 01
Rb-86	1.30E 08	4.09E 07	0.00E 01	2.76E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-89	4.36E 08	1.81E 09	1.52E 10	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-90	2.05E 11	2.33E 10	8.32E 11	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y-91	2.06E 05	3.15E 09	7.68E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zr-95	3.68E 05	1.23E 09	1.69E 06	5.35E 05	7.86E 05	0.00E 01	0.00E 01	0.00E 01
Nb-95	5.77E 04	4.48E 08	1.89E 05	1.05E 05	1.02E 05	0.00E 01	0.00E 01	0.00E 01
Ru-103	2.90E 06	5.66E 08	6.78E 06	0.00E 01	2.39E 07	0.00E 01	0.00E 01	0.00E 01
Ru-106	3.93E 07	1.50E 10	3.12E 08	0.00E 01	6.02E 08	0.00E 01	0.00E 01	0.00E 01
Ag-110M	9.39E 06	4.34E 09	1.63E 07	1.54E 07	2.95E 07	0.00E 01	0.00E 01	0.00E 01
Te-127M	9.44E 07	1.98E 09	7.93E 08	2.81E 08	3.22E 09	1.89E 08	0.00E 01	0.00E 01
Te-129M	6.79E 07	1.61E 09	4.29E 08	1.59E 08	1.79E 08	1.38E 08	0.00E 01	0.00E 01
I-131	5.77E 07	2.13E 07	7.68E 07	1.07E 08	1.85E 08	3.14E 10	0.00E 01	0.00E 01
I-132	4.72E 01	5.72E 01	5.02E 01	1.31E 02	2.07E 02	4.43E 03	0.00E 01	0.00E 01
I-133	1.01E 06	2.51E 06	1.96E 06	3.32E 06	5.83E 06	4.64E 08	0.00E 01	0.00E 01
I-135	3.49E 04	1.04E 05	3.65E 04	9.42E 04	1.49E 05	6.06E 06	0.00E 01	0.00E 01
Cs-134	7.54E 09	2.02E 08	6.90E 09	1.62E 10	5.16E 09	0.00E 01	1.97E 09	0.00E 01
Cs-136	1.13E 08	1.35E 07	4.28E 07	1.68E 08	9.16E 07	0.00E 01	1.44E 07	0.00E 01
Cs-137	4.90E 09	2.00E 08	1.06E 10	1.41E 10	4.78E 09	0.00E 01	1.86E 09	0.00E 01
Ba-140	8.88E 06	2.12E 08	1.38E 08	1.69E 05	5.72E 04	0.00E 01	1.14E 05	0.00E 01
Ce-141	2.12E 04	5.29E 08	2.77E 05	1.85E 05	8.70E 04	0.00E 01	0.00E 01	0.00E 01
Ce-144	2.71E 06	1.27E 10	5.04E 07	2.09E 07	1.25E 07	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-4

R VALUES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Veget
AGE GROUP = Child

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	4.04E 03	4.04E 03	0.00E 01	4.04E 03	4.04E 03	4.04E 03	4.04E 03	4.04E 03
P-32	1.42E 08	1.01E 08	3.67E 09	1.72E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Cr-51	1.16E 05	6.15E 06	0.00E 01	0.00E 01	1.76E 04	6.44E 04	1.18E 05	0.00E 01
Mn-54	1.73E 08	5.44E 08	0.00E 01	6.49E 08	1.82E 08	0.00E 01	0.00E 01	0.00E 01
Fe-59	3.17E 08	6.62E 08	3.93E 08	6.36E 08	0.00E 01	0.00E 01	1.84E 08	0.00E 01
Co-58	1.92E 08	3.66E 08	0.00E 01	6.27E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Co-60	1.11E 09	2.08E 09	0.00E 01	3.76E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zn-65	1.70E 09	4.81E 08	1.03E 09	2.74E 09	1.73E 09	0.00E 01	0.00E 01	0.00E 01
Rb-86	2.81E 08	2.94E 07	0.00E 01	4.56E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-89	1.03E 09	1.40E 09	3.62E 10	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-90	3.49E 11	1.86E 10	1.38E 12	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y-91	4.89E 05	2.44E 09	1.83E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zr-95	7.44E 05	8.71E 08	3.80E 06	8.35E 05	1.20E 06	0.00E 01	0.00E 01	0.00E 01
Nb-95	1.12E 05	2.91E 08	4.04E 05	1.57E 05	1.48E 05	0.00E 01	0.00E 01	0.00E 01
Ru-103	5.86E 06	3.94E 08	1.52E 07	0.00E 01	3.84E 07	0.00E 01	0.00E 01	0.00E 01
Ru-106	9.38E 07	1.17E 10	7.52E 08	0.00E 01	1.02E 09	0.00E 01	0.00E 01	0.00E 01
Ag-110M	1.87E 07	2.78E 09	3.46E 07	2.34E 07	4.35E 07	0.00E 01	0.00E 01	0.00E 01
Te-127M	2.26E 08	1.54E 09	1.90E 09	5.12E 08	5.42E 09	4.55E 08	0.00E 01	0.00E 01
Te-129M	1.55E 08	1.22E 09	9.98E 08	2.79E 08	2.93E 09	3.22E 08	0.00E 01	0.00E 01
I-131	8.16E 07	1.23E 07	1.43E 08	1.44E 08	2.36E 08	4.75E 10	0.00E 01	0.00E 01
I-132	7.53E 01	1.93E 02	8.91E 01	1.64E 02	2.51E 02	7.60E 03	0.00E 01	0.00E 01
I-133	1.67E 06	1.78E 06	3.57E 06	4.42E 06	7.36E 06	8.21E 08	0.00E 01	0.00E 01
I-135	5.54E 04	8.92E 04	6.50E 04	1.17E 05	1.79E 05	1.04E 07	0.00E 01	0.00E 01
Cs-134	5.40E 09	1.38E 08	1.56E 10	2.56E 10	7.93E 09	0.00E 01	2.84E 09	0.00E 01
Cs-136	1.43E 08	7.77E 06	8.04E 07	2.21E 08	1.18E 08	0.00E 01	1.76E 07	0.00E 01
Cs-137	3.52E 09	1.50E 08	2.49E 10	2.39E 10	7.78E 09	0.00E 01	2.80E 09	0.00E 01
Ba-140	1.61E 07	1.40E 08	2.76E 08	2.42E 05	7.87E 04	0.00E 01	1.44E 05	0.00E 01
Ce-141	4.75E 04	3.99E 08	6.42E 05	3.20E 05	1.40E 05	0.00E 01	0.00E 01	0.00E 01
Ce-144	6.49E 06	9.94E 09	1.22E 08	3.81E 07	2.11E 07	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-5

R VALUES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Meat

AGE GROUP = Adult

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	3.27E 02	3.27E 02	0.00E 01	3.27E 02	3.27E 02	3.27E 02	3.27E 02	3.27E 02
P-32	1.18E 08	3.43E 08	3.05E 09	1.89E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Cr-51	4.27E 03	1.08E 06	0.00E 01	0.00E 01	9.42E 02	2.56E 03	5.67E 03	0.00E 01
Mn-54	1.06E 06	1.71E 07	0.00E 01	5.57E 06	1.66E 06	0.00E 01	0.00E 01	0.00E 01
Fe-59	1.43E 08	1.25E 09	1.59E 08	3.74E 08	0.00E 01	0.00E 01	1.04E 08	0.00E 01
Co-58	2.43E 07	2.20E 08	0.00E 01	1.08E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Co-60	1.03E 08	8.76E 08	0.00E 01	4.66E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zn-65	3.58E 08	4.98E 08	2.49E 08	7.91E 08	5.29E 08	0.00E 01	0.00E 01	0.00E 01
Rb-86	1.42E 08	6.00E 07	0.00E 01	3.04E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-89	5.23E 06	2.92E 07	1.82E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-90	2.02E 09	2.38E 08	8.22E 09	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y-91	1.80E 04	3.71E 08	6.75E 05	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zr-95	2.43E 05	1.14E 09	1.12E 06	3.59E 05	5.64E 05	0.00E 01	0.00E 01	0.00E 01
Nb-95	4.12E 05	4.65E 09	1.38E 06	7.66E 05	7.58E 05	0.00E 01	0.00E 01	0.00E 01
Rr-103	2.72E 07	7.38E 09	6.32E 07	0.00E 01	2.41E 08	0.00E 01	0.00E 01	0.00E 01
Ru-106	2.19E 08	1.12E 11	1.73E 09	0.00E 01	3.35E 09	0.00E 01	0.00E 01	0.00E 01
Ag-110M	2.34E 06	1.61E 09	4.27E 06	3.95E 06	7.76E 06	0.00E 01	0.00E 01	0.00E 01
Te-127M	1.00E 08	2.76E 09	8.22E 08	2.94E 08	3.34E 09	2.10E 08	0.00E 01	0.00E 01
Te-129M	1.17E 08	3.73E 09	7.40E 08	2.76E 08	3.09E 09	2.54E 08	0.00E 01	0.00E 01
I-131	5.77E 06	2.66E 06	7.04E 06	1.01E 07	1.73E 07	3.30E 09	0.00E 01	0.00E 01
I-133	1.51E-01	4.46E-01	2.85E-01	4.96E-01	8.66E-01	7.29E 01	0.00E 01	0.00E 01
I-135	6.07E-17	1.86E-16	6.28E-17	1.64E-16	2.64E-16	1.08E-14	0.00E 01	0.00E 01
Cs-134	7.81E 08	1.67E 07	4.01E 08	9.55E 08	3.09E 08	0.00E 01	1.03E 08	0.00E 01
Cs-136	2.14E 07	3.33E 06	7.53E 06	2.97E 07	1.65E 07	0.00E 01	2.27E 06	0.00E 01
Cs-137	4.99E 08	1.47E 07	5.57E 08	7.61E 08	2.58E 08	0.00E 01	8.59E 07	0.00E 01
Ba-140	1.20E 06	3.77E 07	1.83E 07	2.30E 04	7.82E 03	0.00E 01	1.32E 04	0.00E 01
Ce-141	6.46E 02	2.18E 07	8.42E 03	5.69E 03	2.65E 03	0.00E 01	0.00E 01	0.00E 01
Ce-144	4.70E 04	2.96E 08	8.75E 05	3.66E 05	2.17E 05	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-6

R VALUES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Meat

AGE GROUP = Teen

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.95E 02	1.95E 02	0.00E 01	1.95E 02	1.95E 02	1.95E 02	1.95E 02	1.95E 02
P-32	9.98E 07	2.16E 08	2.58E 09	1.60E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Cr-51	3.42E 03	5.75E 05	0.00E 01	0.00E 01	7.49E 02	1.90E 03	4.88E 03	0.00E 01
Mn-54	8.43E 05	8.72E 06	0.00E 01	4.25E 06	1.27E 06	0.00E 01	0.00E 01	0.00E 01
Fe-59	1.15E 08	7.02E 08	1.27E 08	2.97E 08	0.00E 01	0.00E 01	9.36E 07	0.00E 01
Co-58	1.93E 07	1.15E 08	0.00E 01	8.36E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Co-60	8.15E 07	4.71E 08	0.00E 01	3.62E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zn-65	2.93E 08	2.57E 08	1.75E 08	6.07E 08	3.89E 08	0.00E 01	0.00E 01	0.00E 01
Rb-86	1.19E 08	3.76E 07	0.00E 01	2.54E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-89	4.40E 06	1.83E 07	1.54E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-90	1.31E 09	1.49E 08	5.32E 09	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y-91	1.52E 04	2.33E 08	5.68E 05	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zr-95	1.95E 05	6.53E 08	8.97E 05	2.83E 05	4.16E 05	0.00E 01	0.00E 01	0.00E 01
Nb-95	3.29E 05	2.55E 09	1.08E 06	5.97E 05	5.79E 05	0.00E 01	0.00E 01	0.00E 01
Ru-103	2.20E 07	4.30E 09	5.15E 07	0.00E 01	1.82E 08	0.00E 01	0.00E 01	0.00E 01
Ru-106	1.84E 08	7.00E 10	1.46E 09	0.00E 01	2.81E 09	0.00E 01	0.00E 01	0.00E 01
Ag-110M	1.86E 06	8.59E 08	3.23E 06	3.06E 06	5.83E 06	0.00E 01	0.00E 01	0.00E 01
Te-127M	8.25E 07	1.73E 09	6.94E 08	2.46E 08	2.81E 09	1.65E 08	0.00E 01	0.00E 01
Te-129M	9.81E 07	2.33E 09	6.20E 08	2.30E 08	2.59E 09	2.00E 08	0.00E 01	0.00E 01
I-131	4.40E 06	1.62E 06	5.85E 06	8.20E 06	1.41E 07	2.39E 09	0.00E 01	0.00E 01
I-133	1.23E-01	3.06E-01	2.39E-01	4.05E-01	7.10E-01	5.65E 01	0.00E 01	0.00E 01
I-135	4.88E-17	1.46E-16	5.11E-17	1.32E-16	2.08E-16	8.46E-15	0.00E 01	0.00E 01
Cs-134	3.48E 08	9.34E 06	3.19E 08	7.51E 08	2.39E 08	0.00E 01	9.11E 07	0.00E 01
Cs-136	1.55E 07	1.86E 06	5.87E 06	2.31E 07	1.26E 07	0.00E 01	1.98E 06	0.00E 01
Cs-137	2.14E 08	8.75E 06	4.62E 08	6.15E 08	2.09E 08	0.00E 01	8.13E 07	0.00E 01
Ba-140	9.76E 05	2.34E 07	1.51E 07	1.86E 04	6.29E 03	0.00E 01	1.25E 04	0.00E 01
Ce-141	5.42E 02	1.35E 07	7.07E 03	4.72E 03	2.22E 03	0.00E 01	0.00E 01	0.00E 01
Ce-144	3.96E 04	1.85E 08	7.37E 05	3.05E 05	1.82E 05	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-7

R VALUES FOR THE H. B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Meat

AGE GROUP = Child

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.36E 02	2.36E 02	0.00E 01	2.36E 02	2.36E 02	2.36E 02	2.36E 02	2.36E 02
P-32	1.87E 08	1.34E 08	4.86E 09	2.27E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Cr-51	5.33E 03	2.83E 05	0.00E 01	0.00E 01	8.09E 02	2.96E 03	5.40E 03	0.00E 01
Mn-54	1.30E 06	4.08E 06	0.00E 01	4.86E 06	1.36E 06	0.00E 01	0.00E 01	0.00E 01
Fe-59	1.82E 08	3.80E 08	2.25E 08	3.65E 08	0.00E 01	0.00E 01	1.06E 08	0.00E 01
Co-53	2.99E 07	5.70E 07	0.00E 01	9.76E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Co-60	1.27E 08	2.38E 08	0.00E 01	4.30E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zn-65	4.35E 08	1.23E 08	2.62E 08	6.99E 08	4.40E 08	0.00E 01	0.00E 01	0.00E 01
Rb-86	2.21E 08	2.32E 07	0.00E 01	3.60E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-89	8.31E 06	1.13E 07	2.91E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Sr-90	1.74E 09	9.26E 07	6.87E 09	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y-91	2.87E 04	1.43E 08	1.07E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Zr-95	3.12E 05	3.65E 08	1.59E 06	3.50E 05	5.01E 05	0.00E 01	0.00E 01	0.00E 01
Nb-95	5.17E 05	1.34E 09	1.86E 06	7.23E 05	6.80E 05	0.00E 01	0.00E 01	0.00E 01
Ru-103	3.58E 07	2.41E 09	9.31E 07	0.00E 01	2.34E 08	0.00E 01	0.00E 01	0.00E 01
Ru-106	3.43E 08	4.27E 10	2.75E 09	0.00E 01	3.71E 09	0.00E 01	0.00E 01	0.00E 01
Ag-110M	2.89E 06	4.30E 08	5.36E 06	3.62E 06	6.74E 06	0.00E 01	0.00E 01	0.00E 01
Te-127M	1.55E 08	1.06E 09	1.31E 09	3.52E 08	3.73E 09	3.13E 08	0.00E 01	0.00E 01
Te-129M	1.81E 08	1.42E 09	1.17E 09	3.26E 08	3.43E 09	3.77E 08	0.00E 01	0.00E 01
I-131	6.20E 06	9.72E 05	1.09E 07	1.09E 07	1.79E 07	3.61E 09	0.00E 01	0.00E 01
I-133	2.07E-01	2.21E-01	4.43E-01	5.48E-01	9.13E-01	1.02E 02	0.00E 01	0.00E 01
I-135	7.87E-17	1.27E-16	9.25E-17	1.66E-16	2.55E-16	1.47E-14	0.00E 01	0.00E 01
Cs-134	1.95E 08	4.93E 06	5.63E 08	9.23E 08	2.86E 08	0.00E 01	1.03E 08	0.00E 01
Cs-136	1.80E 07	9.78E 05	1.01E 07	2.78E 07	1.48E 07	0.00E 01	2.21E 06	0.00E 01
Cs-137	1.20E 08	5.10E 06	8.51E 08	8.15E 08	2.65E 08	0.00E 01	9.55E 07	0.00E 01
Ba-140	1.63E 06	1.42E 07	2.80E 07	2.45E 04	7.97E 03	0.00E 01	1.46E 04	0.00E 01
Ce-141	9.86E 02	8.28E 06	1.33E 04	6.64E 03	2.91E 03	0.00E 01	0.00E 01	0.00E 01
Ce-144	7.42E 04	1.14E 08	1.39E 06	4.36E 05	2.41E 05	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-8

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Cow Milk

AGE GROUP = Adult

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	7.69E 02	7.69E 02	0.00E-01	7.69E 02	7.69E 02	7.69E 02	7.69E 02	7.69E 02
P-32	4.32E 08	1.26E 09	1.12E 10	6.95E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	1.73E 04	4.36E 06	0.00E-01	0.00E-01	3.82E 03	1.04E 04	2.30E 04	0.00E-01
Mn-54	9.76E 05	1.57E 07	0.00E-01	5.11E 06	1.52E 06	0.00E-01	0.00E-01	0.00E-01
Fe-59	1.60E 07	1.39E 08	1.77E 07	4.17E 07	0.00E-01	0.00E-01	1.17E 07	0.00E-01
Co-58	6.28E 06	5.68E 07	0.00E-01	2.80E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Co-60	2.24E 07	1.91E 08	0.00E-01	1.02E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zn-65	1.38E 09	1.92E 09	9.59E 08	3.05E 09	2.04E 09	0.00E-01	0.00E-01	0.00E-01
Rb-86	7.54E 08	3.19E 08	0.00E-01	1.62E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	2.50E 07	1.40E 08	8.70E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-90	7.59E 09	8.94E 08	3.09E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y-91	1.37E 02	2.81E 06	5.11E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zr-95	1.22E 02	5.71E 05	5.62E 02	1.80E 02	2.83E 02	0.00E-01	0.00E-01	0.00E-01
Nb-95	1.48E 04	1.67E 08	4.95E 04	2.75E 04	2.72E 04	0.00E-01	0.00E-01	0.00E-01
Ru-103	2.63E 02	7.14E 04	6.11E 02	0.00E-01	2.33E 03	0.00E-01	0.00E-01	0.00E-01
Ru-106	1.60E 03	8.17E 05	1.26E 04	0.00E-01	2.44E 04	0.00E-01	0.00E-01	0.00E-01
Ag-110M	2.04E 07	1.40E 10	3.71E 07	3.44E 07	6.76E 07	0.00E-01	0.00E-01	0.00E-01
Te-127M	4.11E 06	1.13E 08	3.37E 07	1.21E 07	1.37E 08	8.62E 06	0.00E-01	0.00E-01
Te-129M	6.19E 06	1.97E 08	3.91E 07	1.46E 07	1.63E 08	1.34E 07	0.00E-01	0.00E-01
I-131	1.59E 08	7.32E 07	1.94E 08	2.77E 08	4.76E 08	9.09E 10	0.00E-01	0.00E-01
I-132	1.03E-01	5.51E-02	1.10E-01	2.93E-01	4.67E-01	1.03E 01	0.00E-01	0.00E-01
I-133	1.40E 06	4.13E 06	2.64E 06	4.59E 06	8.01E 06	6.75E 08	0.00E-01	0.00E-01
I-135	9.03E 03	2.76E 04	9.34E 03	2.45E 04	3.92E 04	1.61E 06	0.00E-01	0.00E-01
Cs-134	6.71E 09	1.44E 08	3.45E 09	3.21E 09	2.66E 09	0.00E-01	8.82E 08	0.00E-01
Cs-136	4.73E 08	7.46E 07	1.66E 08	6.57E 08	3.65E 08	0.00E-01	5.01E 07	0.00E-01
Cs-137	4.22E 09	1.25E 08	4.71E 09	6.44E 09	2.19E 09	0.00E-01	7.27E 08	0.00E-01
Ba-140	1.12E 06	3.53E 07	1.71E 07	2.15E 04	7.32E 03	0.00E-01	1.23E 04	0.00E-01
Ce-141	2.23E 02	7.52E 06	2.91E 03	1.97E 03	9.14E 02	0.00E-01	0.00E-01	0.00E-01
Ce-144	1.15E 04	7.26E 07	2.15E 05	8.97E 04	5.32E 04	0.00E-01	0.00E-01	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-9

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Cow Milk

AGE GROUP = Teen

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.00E 03	1.00E 03	0.00E-01	1.00E 03	1.00E 03	1.00E 03	1.00E 03	1.00E 03
P-32	8.00E 08	1.73E 09	2.06E 10	1.28E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	3.02E 04	5.08E 06	0.00E-01	0.00E-01	6.63E 03	1.68E 04	4.32E 04	0.00E-01
Mn-54	1.69E 06	1.75E 07	0.00E-01	8.52E 06	2.54E 06	0.00E-01	0.00E-01	0.00E-01
Fe-59	2.79E 07	1.71E 08	3.10E 07	7.23E 07	0.00E-01	0.00E-01	2.28E 07	0.00E-01
Co-58	1.09E 07	6.50E 07	0.00E-01	4.72E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Co-60	3.88E 07	2.25E 08	0.00E-01	1.72E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zn-65	2.38E 09	2.16E 09	1.47E 09	5.11E 09	3.27E 09	0.00E-01	0.00E-01	0.00E-01
Rb-86	1.39E 09	4.37E 08	0.00E-01	2.95E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	4.59E 07	1.91E 08	1.60E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-90	1.08E 10	1.23E 09	4.37E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y-91	2.52E 02	3.85E 06	9.40E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zr-95	2.13E 02	7.16E 06	9.83E 02	3.10E 02	4.56E 02	0.00E-01	0.00E-01	0.00E-01
Nb-95	2.58E 04	2.00E 08	8.45E 04	4.68E 04	4.54E 04	0.00E-01	0.00E-01	0.00E-01
Ru-103	4.65E 02	9.08E 04	1.09E 03	0.00E-01	3.83E 03	0.00E-01	0.00E-01	0.00E-01
Ru-106	2.93E 03	1.11E 06	2.32E 04	0.00E-01	4.48E 04	0.00E-01	0.00E-01	0.00E-01
Ag-110M	3.53E 07	1.63E 10	6.14E 07	5.81E 07	1.11E 08	0.00E-01	0.00E-01	0.00E-01
Te-127M	7.39E 06	1.55E 08	6.22E 07	2.21E 07	2.52E 08	1.48E 07	0.00E-01	0.00E-01
Te-129M	1.13E 07	2.69E 08	7.15E 07	2.65E 07	2.99E 08	2.31E 07	0.00E-01	0.00E-01
I-131	2.65E 08	9.75E 07	3.52E 08	4.93E 08	8.48E 08	1.44E 11	0.00E-01	0.00E-01
I-132	1.83E-01	2.22E-01	1.94E-01	5.09E-01	8.02E-01	1.71E 01	0.00E-01	0.00E-01
I-133	2.49E 06	6.19E 06	4.82E 06	8.18E 06	1.43E 07	1.14E 09	0.00E-01	0.00E-01
I-135	1.58E 04	4.74E 04	1.66E 04	4.27E 04	6.75E 04	2.75E 06	0.00E-01	0.00E-01
Cs-134	6.54E 09	1.75E 08	5.99E 09	1.41E 10	4.48E 09	0.00E-01	1.71E 09	0.00E-01
Cs-136	7.48E 08	8.97E 07	2.83E 08	1.11E 09	6.07E 08	0.00E-01	9.56E 07	0.00E-01
Cs-137	3.96E 09	1.62E 08	8.54E 09	1.14E 10	3.87E 09	0.00E-01	1.50E 09	0.00E-01
Ba-140	1.99E 06	4.77E 07	3.09E 07	3.79E 04	1.28E 04	0.00E-01	2.55E 04	0.00E-01
Ce-141	4.09E 02	1.02E 07	6.33E 03	3.56E 03	1.68E 03	0.00E-01	0.00E-01	0.00E-01
Ce-144	2.12E 04	9.93E 07	3.95E 05	1.63E 05	9.76E 04	0.00E-01	0.00E-01	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-10

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Cow Milk

AGE GROUP = Child

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.58E 03	1.58E 03	0.00E-01	1.58E 03	1.58E 03	1.58E 03	1.58E 03	1.58E 03
P-32	1.96E 09	1.41E 09	5.09E 10	2.38E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	6.17E 04	3.27E 06	0.00E-01	0.00E-01	9.36E 03	3.42E 04	6.25E 04	0.00E-01
Mn-54	3.39E 06	1.07E 07	0.00E-01	1.27E 07	3.57E 06	0.00E-01	0.00E-01	0.00E-01
Fe-59	5.79E 07	1.21E 08	7.18E 07	1.16E 08	0.00E-01	0.00E-01	3.37E 07	0.00E-01
Co-58	2.21E 07	4.20E 07	0.00E-01	7.21E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Co-60	7.90E 07	1.48E 08	0.00E-01	2.68E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zn-65	4.79E 09	1.35E 09	2.89E 09	7.70E 09	4.85E 09	0.00E-01	0.00E-01	0.00E-01
Rb-86	3.36E 09	3.52E 08	0.00E-01	5.47E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	1.13E 08	1.54E 08	3.97E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-90	1.87E 10	9.95E 08	7.38E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y-91	6.21E 02	3.09E 06	2.32E 04	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zr-95	4.47E 02	5.23E 05	2.28E 03	5.02E 02	7.18E 02	0.00E-01	0.00E-01	0.00E-01
Nb-95	5.31E 04	1.37E 08	1.91E 05	7.42E 04	6.98E 04	0.00E-01	0.00E-01	0.00E-01
Ru-103	9.88E 02	6.65E 04	2.57E 03	0.00E-01	6.47E 03	0.00E-01	0.00E-01	0.00E-01
Ru-106	7.14E 03	8.90E 05	5.72E 04	0.00E-01	7.72E 04	0.00E-01	0.00E-01	0.00E-01
Ag-110M	7.19E 07	1.07E 10	1.33E 08	9.00E 07	1.68E 08	0.00E-01	0.00E-01	0.00E-01
Te-127M	1.82E 07	1.24E 08	1.53E 08	4.13E 07	4.37E 08	3.66E 07	0.00E-01	0.00E-01
Te-129M	2.74E 07	2.15E 08	1.76E 08	4.92E 07	5.18E 08	5.68E 07	0.00E-01	0.00E-01
I-131	4.88E 08	7.64E 07	8.54E 08	8.59E 08	1.41E 09	2.84E 11	0.00E-01	0.00E-01
I-132	3.89E-01	9.95E-01	4.60E-01	8.45E-01	1.29E 00	3.92E 01	0.00E-01	0.00E-01
I-133	5.48E 06	5.84E 06	1.17E 07	1.45E 07	2.41E 07	2.69E 09	0.00E-01	0.00E-01
I-135	3.35E 04	5.39E 04	3.93E 04	7.07E 04	1.08E 05	6.26E 06	0.00E-01	0.00E-01
Cs-134	4.78E 09	1.22E 08	1.38E 10	2.27E 10	7.03E 09	0.00E-01	2.52E 09	0.00E-01
Cs-136	1.14E 09	6.17E 07	6.39E 08	1.76E 09	9.36E 08	0.00E-01	1.40E 08	0.00E-01
Cs-137	2.91E 09	1.23E 08	2.06E 10	1.97E 10	6.42E 09	0.00E-01	2.31E 09	0.00E-01
Ba-140	4.36E 06	3.78E 07	7.47E 07	6.54E 04	2.13E 04	0.00E-01	3.90E 04	0.00E-01
Ce-141	9.73E 02	8.17E 06	1.31E 04	6.55E 03	2.87E 03	0.00E-01	0.00E-01	0.00E-01
Ce-144	5.20E 04	7.96E 07	9.74E 05	3.05E 05	1.69E 05	0.00E-01	0.00E-01	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-11

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Cow Milk

AGE GROUP = Infant

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.40E 03	2.40E 03	0.00E-01	2.40E 03	2.40E 03	2.40E 03	2.40E 03	2.40E 03
P-32	4.06E 09	1.42E 09	1.05E 11	6.17E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	9.77E 04	2.85E 06	0.00E-01	0.00E-01	1.39E 04	6.38E 04	1.24E 05	0.00E-01
Mn-54	5.37E 06	8.71E 06	0.00E-01	2.37E 07	5.25E 06	0.00E-01	0.00E-01	0.00E-01
Fe-59	9.23E 07	1.12E 08	1.34E 08	2.34E 08	0.00E-01	0.00E-01	6.92E 07	0.00E-01
Co-58	3.60E 07	3.59E 07	0.00E-01	1.44E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Co-60	1.29E 08	1.30E 08	0.00E-01	5.47E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zn-65	6.14E 09	1.12E 10	3.88E 09	1.33E 10	6.45E 09	0.00E-01	0.00E-01	0.00E-01
Rb-86	6.86E 09	3.55E 08	0.00E-01	1.39E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	2.17E 08	1.55E 08	7.55E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-90	2.05E 10	1.00E 09	8.04E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y-91	1.16E 08	3.12E 06	4.36E 04	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zr-95	7.01E 02	4.92E 05	4.05E 03	9.88E 02	1.06E 03	0.00E-01	0.00E-01	0.00E-01
Nb-95	8.48E 04	1.24E 08	3.56E 05	1.47E 05	1.05E 05	0.00E-01	0.00E-01	0.00E-01
Ru-103	1.74E 03	6.33E 04	5.21E 03	0.00E-01	1.08E 04	0.00E-01	0.00E-01	0.00E-01
Ru-106	1.47E 04	8.95E 05	1.18E 05	0.00E-01	1.39E 05	0.00E-01	0.00E-01	0.00E-01
Ag-110M	1.19E 08	9.32E 09	2.46E 08	1.80E 08	2.57E 08	0.00E-01	0.00E-01	0.00E-01
Te-127M	3.75E 07	1.25E 08	3.10E 08	1.03E 08	7.64E 08	8.96E 07	0.00E-01	0.00E-01
Te-129M	5.57E 07	2.16E 08	3.62E 08	1.24E 08	9.05E 08	1.39E 08	0.00E-01	0.00E-01
I-131	9.23E 08	7.49E 07	1.78E 09	2.10E 09	2.45E 09	6.90E 11	0.00E-01	0.00E-01
I-132	6.90E-01	1.57E-00	9.55E-01	1.94E 00	2.16E 00	9.09E 01	0.00E-01	0.00E-01
I-133	1.05E 07	6.09E 06	2.47E 07	3.60E 07	4.23E 07	6.55E 09	0.00E-01	0.00E-01
I-135	5.93E 04	5.83E 04	8.17E 04	1.63E 05	1.81E 05	1.46E 07	0.00E-01	0.00E-01
Cs-134	4.19E 09	1.13E 08	2.23E 10	4.15E 10	1.07E 10	0.00E-01	4.38E 09	0.00E-01
Cs-136	1.37E 09	5.58E 07	1.25E 09	3.67E 09	1.46E 09	0.00E-01	2.99E 08	0.00E-01
Cs-137	2.72E 09	1.20E 08	3.28E 10	3.84E 10	1.03E 10	0.00E-01	4.18E 09	0.00E-01
Ba-140	7.91E 06	3.77E 07	1.54E 08	1.54E 05	3.65E 04	0.00E-01	9.43E 04	0.00E-01
Ce-141	1.87E 03	3.21E 06	2.60E 04	1.59E 04	4.90E 03	0.00E-01	0.00E-01	0.00E-01
Ce-144	7.82E 04	8.01E 07	1.40E 06	5.71E 05	2.31E 05	0.00E-01	0.00E-01	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-12

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Goat Milk

AGE GROUP = Adult

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.57E 03	1.57E 03	0.00E-01	1.57E 03	1.57E 03	1.57E 03	1.57E 03	1.57E 03
P-32	5.19E 08	1.51E 09	1.34E 10	8.34E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	2.08E 03	5.23E 05	0.00E-01	0.00E-01	4.58E 02	1.24E 03	2.76E 03	0.00E-01
Mn-54	1.17E 05	1.88E 06	0.00E-01	6.14E 05	1.83E 05	0.00E-01	0.00E-01	0.00E-01
Fe-59	2.08E 05	1.81E 06	2.31E 05	5.42E 05	0.00E-01	0.00E-01	1.51E 05	0.00E-01
Co-58	7.54E 05	6.82E 06	0.00E-01	3.36E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Co-60	2.69E 06	2.29E 07	0.00E-01	1.22E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zn-65	1.65E 08	2.31E 08	1.15E 08	3.66E 08	2.45E 08	0.00E-01	0.00E-01	0.00E-01
Rb-86	9.05E 07	3.83E 07	0.00E-01	1.94E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	5.24E 07	2.93E 08	1.83E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-90	1.59E 10	1.88E 09	6.49E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y-91	1.64E 01	3.37E 05	6.13E 02	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zr-95	1.46E 01	6.85E 04	6.74E 01	2.10E 01	3.39E 01	0.00E-01	0.00E-01	0.00E-01
Nb-95	1.78E 03	2.01E 07	5.94E 03	3.31E 03	3.27E 03	0.00E-01	0.00E-01	0.00E-01
Ru-103	3.16E 01	8.56E 03	7.33E 01	0.00E-01	2.80E 02	0.00E-01	0.00E-01	0.00E-01
Ru-106	1.92E 02	9.81E 04	1.52E 03	0.00E-01	2.93E 03	0.00E-01	0.00E-01	0.00E-01
Ag-110M	2.45E 06	1.68E 09	4.46E 06	4.12E 06	8.11E 06	0.00E-01	0.00E-01	0.00E-01
Te-127M	4.93E 05	1.36E 07	4.05E 06	1.45E 06	1.64E 07	1.03E 06	0.00E-01	0.00E-01
Te-129M	7.43E 05	2.36E 07	4.69E 06	1.75E 06	1.96E 07	1.61E 06	0.00E-01	0.00E-01
I-131	1.91E 08	8.78E 07	2.33E 08	3.33E 08	5.71E 08	1.09E 11	0.00E-01	0.00E-01
I-132	1.23E-01	6.61E-02	1.32E-01	3.52E-01	5.61E-01	1.23E 01	0.00E-01	0.00E-01
I-133	1.68E 06	4.95E 06	3.17E 06	5.51E 06	9.61E 06	8.10E 08	0.00E-01	0.00E-01
I-135	1.08E 04	3.32E 04	1.12E 04	2.94E 04	4.71E 04	1.94E 06	0.00E-01	0.00E-01
Cs-134	2.01E 10	4.31E 08	1.03E 10	2.46E 10	7.97E 09	0.00E-01	2.65E 09	0.00E-01
Cs-136	1.42E 09	2.24E 08	4.99E 08	1.97E 09	1.10E 09	0.00E-01	1.50E 08	0.00E-01
Cs-137	1.27E 10	3.74E 08	1.41E 10	1.93E 10	6.56E 09	0.00E-01	2.18E 09	0.00E-01
Ba-140	1.35E 05	4.23E 06	2.06E 06	2.58E 03	8.78E 02	0.00E-01	1.48E 03	0.00E-01
Ce-141	2.68E 01	9.03E 05	3.49E 02	2.36E 02	1.10E 02	0.00E-01	0.00E-01	0.00E-01
Ce-144	1.38E 03	8.71E 06	2.58E 04	1.08E 04	6.39E 03	0.00E-01	0.00E-01	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-13

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Goat Milk

AGE GROUP = Teen

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.04E 03	2.04E 03	0.00E-01	2.04E 03	2.04E 03	2.04E 03	2.04E 03	2.04E 03
P-32	9.60E 08	2.08E 09	2.48E 10	1.53E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	3.63E 03	6.10E 05	0.00E-01	0.00E-01	7.95E 02	2.02E 03	5.18E 03	0.00E-01
Mn-54	2.03E 05	2.10E 06	0.00E-01	1.02E 06	3.05E 05	0.00E-01	0.00E-01	0.00E-01
Fe-59	3.63E 05	2.22E 06	4.03E 05	9.40E 05	0.00E-01	0.00E-01	2.96E 05	0.00E-01
Co-58	1.30E 06	7.80E 06	0.00E-01	5.66E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Co-60	4.66E 06	2.69E 07	0.00E-01	2.07E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zn-65	2.86E 08	2.60E 08	1.77E 08	6.13E 08	3.93E 08	0.00E-01	0.00E-01	0.00E-01
Rb-86	1.66E 08	5.24E 07	0.00E-01	3.54E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	9.65E 07	4.01E 08	3.37E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-90	2.27E 10	2.58E 09	9.18E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y-91	3.02E 01	4.62E 05	1.13E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zr-95	2.56E 01	8.59E 04	1.18E 02	3.72E 01	5.47E 01	0.00E-01	0.00E-01	0.00E-01
Nb-95	3.09E 03	2.40E 07	1.01E 04	5.62E 03	5.45E 03	0.00E-01	0.00E-01	0.00E-01
Ru-103	5.58E 01	1.09E 04	1.30E 02	0.00E-01	4.60E 02	0.00E-01	0.00E-01	0.00E-01
Ru-106	3.51E 02	1.34E 05	2.79E 03	0.00E-01	5.38E 03	0.00E-01	0.00E-01	0.00E-01
Ag-110M	4.24E 06	1.96E 09	7.37E 06	6.97E 06	1.33E 07	0.00E-01	0.00E-01	0.00E-01
Te-127M	8.87E 05	1.86E 07	7.46E 06	2.65E 06	3.02E 07	1.77E 06	0.00E-01	0.00E-01
Te-129M	1.36E 06	3.22E 07	8.58E 06	3.19E 06	3.59E 07	2.77E 06	0.00E-01	0.00E-01
I-131	3.18E 08	1.17E 08	4.22E 08	5.91E 08	1.02E 09	1.73E 11	0.00E-01	0.00E-01
I-132	2.19E-01	2.66E-01	2.33E-01	6.11E-01	9.62E-01	2.06E 01	0.00E-01	0.00E-01
I-133	2.99E 06	7.43E 06	5.79E 06	9.81E 06	1.72E 07	1.37E 09	0.00E-01	0.00E-01
I-135	1.90E 04	5.63E 04	1.99E 04	5.13E 04	8.10E 04	3.30E 06	0.00E-01	0.00E-01
Cs-134	1.96E 10	5.26E 08	1.80E 10	4.23E 10	1.34E 10	0.00E-01	5.13E 09	0.00E-01
Cs-136	2.25E 09	2.69E 07	8.50E 08	3.34E 09	1.82E 09	0.00E-01	2.87E 08	0.00E-01
Cs-137	1.19E 10	4.85E 08	2.56E 10	3.41E 10	1.16E 10	0.00E-01	4.51E 09	0.00E-01
Ba-140	2.39E 05	5.72E 06	3.71E 06	4.55E 03	1.54E 03	0.00E-01	3.06E 03	0.00E-01
Ce-141	4.91E 01	1.22E 06	6.40E 02	4.27E 02	2.01E 02	0.00E-01	0.00E-01	0.00E-01
Ce-144	2.55E 03	1.19E 07	4.74E 04	1.96E 04	1.17E 04	0.00E-01	0.00E-01	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-14

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Goat Milk

AGE GROUP = Child

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	3.23E 03	3.23E 03	0.00E-01	3.23E 03	3.23E 03	3.23E 03	3.23E 03	3.23E 03
P-32	2.35E 09	1.69E 09	6.11E 10	2.86E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	7.40E 03	3.93E 05	0.00E-01	0.00E-01	1.12E 03	4.11E 03	7.50E 03	0.00E-01
Mn-54	4.07E 05	1.28E 06	0.00E-01	1.53E 06	4.29E 05	0.00E-01	0.00E-01	0.00E-01
Fe-59	7.52E 05	1.57E 06	9.34E 05	1.51E 06	0.00E-01	0.00E-01	4.38E 05	0.00E-01
Co-58	2.65E 06	5.05E 06	0.00E-01	8.65E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Co-60	9.48E 06	1.78E 07	0.00E-01	3.21E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zn-65	5.74E 08	1.62E 08	3.47E 08	9.24E 08	5.82E 08	0.00E-01	0.00E-01	0.00E-01
Rb-86	4.04E 08	4.22E 07	0.00E-01	6.57E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	2.38E 08	3.23E 08	8.34E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-90	3.93E 10	2.09E 09	1.55E 11	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y-91	7.45E 01	3.71E 05	2.79E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zr-95	5.36E 01	6.28E 04	2.74E 02	6.02E 01	8.62E 01	0.00E-01	0.00E-01	0.00E-01
Nb-95	6.37E 03	1.65E 07	2.29E 04	8.91E 03	8.37E 03	0.00E-01	0.00E-01	0.00E-01
Ru-103	1.19E 02	7.98E 03	3.09E 02	0.00E-01	7.77E 02	0.00E-01	0.00E-01	0.00E-01
Ru-106	8.56E 02	1.07E 05	6.86E 03	0.00E-01	9.27E 03	0.00E-01	0.00E-01	0.00E-01
Ag-110M	8.63E 06	1.28E 09	1.60E 07	1.08E 07	2.01E 07	0.00E-01	0.00E-01	0.00E-01
Te-127M	2.18E 06	1.49E 07	1.84E 07	4.95E 06	5.24E 07	4.40E 06	0.00E-01	0.00E-01
Te-129M	3.28E 06	2.58E 07	2.12E 07	5.91E 06	6.21E 07	6.82E 06	0.00E-01	0.00E-01
I-131	5.85E 08	9.17E 07	1.02E 09	1.03E 09	1.69E 09	3.41E 11	0.00E-01	0.00E-01
I-132	4.67E-01	1.19E 00	5.52E-01	1.01E 00	1.55E 00	4.71E 01	0.00E-01	0.00E-01
I-133	6.58E 06	7.00E 06	1.41E 07	1.74E 07	2.90E 07	3.23E 09	0.00E-01	0.00E-01
I-135	4.01E 04	6.47E 04	4.72E 04	8.49E 04	1.30E 05	7.52E 06	0.00E-01	0.00E-01
Cs-134	1.43E 10	3.67E 08	4.14E 10	6.80E 10	2.11E 10	0.00E-01	7.56E 09	0.00E-01
Cs-136	3.41E 09	1.85E 08	1.92E 09	5.27E 09	2.81E 09	0.00E-01	4.19E 08	0.00E-01
Cs-137	8.72E 09	3.70E 08	6.17E 10	5.91E 10	1.93E 10	0.00E-01	6.93E 09	0.00E-01
Ba-140	5.23E 05	4.54E 05	8.96E 06	7.85E 03	2.56E 03	0.00E-01	4.68E 03	0.00E-01
Ce-141	1.17E 02	9.81E 05	1.53E 03	7.36E 02	3.45E 02	0.00E-01	0.00E-01	0.00E-01
Ce-144	6.24E 03	9.55E 06	1.17E 05	3.66E 04	2.03E 04	0.00E-01	0.00E-01	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for innalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-15

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Goat Milk

AGE GROUP = Infant

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	4.90E 03	4.90E 03	0.00E-01	4.90E 03	4.90E 03	4.90E 03	4.90E 03	4.90E 03
P-32	4.88E 09	1.70E 09	1.26E 11	7.40E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	1.17E 04	3.42E 05	0.00E-01	0.00E-01	1.67E 03	7.65E 03	1.49E 04	0.00E-01
Mn-54	6.45E 05	1.04E 06	0.00E-01	2.84E 06	6.30E 05	0.00E-01	0.00E-01	0.00E-01
Fe-59	1.20E 06	1.45E 06	1.74E 06	3.04E 06	0.00E-01	0.00E-01	9.00E 05	0.00E-01
Co-58	4.31E 06	4.31E 06	0.00E-01	1.73E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Co-60	1.55E 07	1.56E 07	0.00E-01	6.56E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zn-65	7.36E 08	1.35E 09	4.66E 08	1.60E 09	7.74E 08	0.00E-01	0.00E-01	0.00E-01
Rb-86	8.23E 08	4.26E 07	0.00E-01	1.67E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	4.55E 08	3.26E 08	1.59E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-90	4.30E 10	2.11E 09	1.69E 11	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y-91	1.39E 02	3.75E 05	5.23E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Zr-95	8.41E 01	5.90E 04	4.85E 02	1.19E 02	1.28E 02	0.00E-01	0.00E-01	0.00E-01
Nb-95	1.02E 04	1.48E 07	4.27E 04	1.76E 04	1.26E 04	0.00E-01	0.00E-01	0.00E-01
Ru-103	2.09E 02	7.60E 03	6.25E 02	0.00E-01	1.30E 03	0.00E-01	0.00E-01	0.00E-01
Ru-106	1.77E 03	1.07E 05	1.41E 04	0.00E-01	1.67E 04	0.00E-01	0.00E-01	0.00E-01
Ag-110M	1.43E 07	1.12E 09	2.95E 07	2.16E 07	3.08E 07	0.00E-01	0.00E-01	0.00E-01
Te-127M	4.51E 06	1.50E 07	3.72E 07	1.23E 07	9.16E 07	1.08E 07	0.00E-01	0.00E-01
Te-129M	6.69E 06	2.59E 07	4.34E 07	1.49E 07	1.09E 08	1.67E 07	0.00E-01	0.00E-01
I-131	1.11E 09	8.99E 07	2.14E 09	2.52E 09	2.94E 09	8.28E 11	0.00E-01	0.00E-01
I-132	8.28E-01	1.88E 00	1.15E 00	2.33E 00	2.59E 00	1.09E 02	0.00E-01	0.00E-01
I-133	1.27E 07	7.31E 06	2.97E 07	4.32E 07	5.08E 07	7.86E 09	0.00E-01	0.00E-01
I-135	7.11E 04	7.06E 04	9.81E 04	1.95E 05	2.17E 05	1.75E 07	0.00E-01	0.00E-01
Cs-134	1.26E 10	3.38E 08	6.68E 10	1.25E 11	3.21E 10	0.00E-01	1.31E 10	0.00E-01
Cs-136	4.11E 09	1.67E 08	3.75E 09	1.10E 10	4.39E 09	0.00E-01	8.98E 08	0.00E-01
Cs-137	8.17E 09	3.61E 08	9.85E 10	1.15E 11	3.10E 10	0.00E-01	1.25E 10	0.00E-01
Ba-140	9.50E 05	4.53E 06	1.84E 07	1.84E 04	4.38E 03	0.00E-01	1.13E 04	0.00E-01
Ce-141	2.24E 02	9.85E 05	3.13E 03	1.91E 03	5.88E 02	0.00E-01	0.00E-01	0.00E-01
Ce-144	9.39E 03	9.61E 06	1.67E 05	6.86E 04	2.77E 04	0.00E-01	0.00E-01	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-16

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Inhal

AGE GROUP = Adult

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.26E 03	1.26E 03	0.00E-01	1.26E 03	1.26E 03	1.26E 03	1.26E 03	1.26E 03
P-32	5.00E 04	8.63E 04	1.32E 06	7.70E 04	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	9.99E 01	3.32E 03	0.00E-01	0.00E-01	2.28E 01	5.94E 01	1.44E 04	0.00E-01
Mn-54	6.29E 03	7.72E 04	0.00E-01	3.95E 04	9.83E 03	0.00E-01	1.40E 06	0.00E-01
Fe-59	1.05E 04	1.88E 05	1.17E 04	2.77E 04	0.00E-01	0.00E-01	1.01E 06	0.00E-01
Co-58	2.07E 03	1.06E 05	0.00E-01	1.58E 03	0.00E-01	0.00E-01	9.27E 05	0.00E-01
Co-60	1.48E 04	2.84E 05	0.00E-01	1.15E 04	0.00E-01	0.00E-01	5.96E 06	0.00E-01
Zn-65	4.65E 04	5.34E 04	3.24E 04	1.03E 05	6.89E 04	0.00E-01	8.63E 05	0.00E-01
Rb-86	5.89E 04	1.66E 04	0.00E-01	1.35E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	8.71E 03	3.49E 05	3.04E 05	0.00E-01	0.00E-01	0.00E-01	1.40E 06	0.00E-01
Sr-90	6.09E 06	7.21E 05	9.91E 07	0.00E-01	0.00E-01	0.00E-01	9.59E 06	0.00E-01
Y-91	1.24E 04	3.84E 05	4.62E 05	0.00E-01	0.00E-01	0.00E-01	1.70E 06	0.00E-01
Zr-95	2.32E 04	1.50E 05	1.07E 05	3.44E 04	5.41E 04	0.00E-01	1.77E 06	0.00E-01
Nb-95	4.20E 03	1.04E 05	1.41E 04	7.80E 03	7.72E 03	0.00E-01	5.04E 05	0.00E-01
Ru-103	6.57E 02	1.10E 05	1.53E 03	0.00E-01	5.82E 03	0.00E-01	5.04E 05	0.00E-01
Ru-106	8.71E 03	9.11E 05	6.90E 04	0.00E-01	1.33E 05	0.00E-01	9.35E 06	0.00E-01
Ag-110M	5.94E 03	3.02E 05	1.08E 04	9.99E 03	1.97E 04	0.00E-01	4.63E 06	0.00E-01
Te-127M	1.57E 03	1.49E 05	1.26E 04	5.76E 03	4.57E 04	3.28E 03	9.59E 05	0.00E-01
Te-129M	1.58E 03	3.83E 05	9.75E 03	4.67E 03	3.65E 04	3.44E 03	1.16E 06	0.00E-01
I-131	2.05E 04	6.27E 03	2.52E 04	3.57E 04	6.12E 04	1.19E 07	0.00E-01	0.00E-01
I-132	1.16E 03	4.06E 02	1.16E 03	3.25E 03	5.18E 03	1.14E 05	0.00E-01	0.00E-01
I-133	4.51E 03	8.87E 03	3.63E 03	1.48E 04	2.58E 04	2.15E 06	0.00E-01	0.00E-01
I-135	2.56E 03	5.24E 03	2.68E 03	6.97E 03	1.11E 04	4.47E 05	0.00E-01	0.00E-01
Cs-134	7.27E 05	1.04E 04	3.72E 05	8.47E 05	2.87E 05	0.00E-01	9.75E 04	0.00E-01
Cs-136	1.10E 05	1.17E 04	3.90E 04	1.46E 05	8.55E 04	0.00E-01	1.20E 04	0.00E-01
Cs-137	4.27E 05	8.39E 03	4.78E 05	6.20E 05	2.22E 05	0.00E-01	7.51E 04	0.00E-01
Ba-140	2.56E 03	2.18E 05	3.90E 04	4.90E 01	1.67E 01	0.00E-01	1.27E 06	0.00E-01
Ce-141	1.53E 03	1.20E 05	1.99E 04	1.35E 04	6.25E 03	0.00E-01	3.61E 05	0.00E-01
Ce-144	1.84E 05	8.15E 05	3.43E 06	1.43E 06	8.47E 05	0.00E-01	7.76E 06	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

Rev. 1

TABLE 3.3-17

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Inhal

AGE GROUP = Teen

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.27E 03	1.27E 03	0.00E-01	1.27E 03	1.27E 03	1.27E 03	1.27E 03	1.27E 03
P-32	7.15E 04	9.27E 04	1.89E 06	1.09E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	1.35E 02	3.00E 03	0.00E-01	0.00E-01	3.07E 01	7.49E 01	2.09E 04	0.00E-01
Mn-54	8.39E 03	6.67E 04	0.00E-01	5.10E 04	1.27E 04	0.00E-01	1.98E 06	0.00E-01
Fe-59	1.43E 04	1.78E 05	1.59E 04	3.69E 04	0.00E-01	0.00E-01	1.53E 06	0.00E-01
Co-58	2.77E 03	9.51E 04	0.00E-01	2.07E 03	0.00E-01	0.00E-01	1.34E 06	0.00E-01
Co-60	1.98E 04	2.59E 05	0.00E-01	1.51E 04	0.00E-01	0.00E-01	8.71E 06	0.00E-01
Zn-65	6.23E 04	4.66E 04	3.85E 04	1.33E 05	8.63E 04	0.00E-01	1.24E 06	0.00E-01
Rb-86	8.39E 04	1.77E 04	0.00E-01	1.90E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	1.25E 04	3.71E 05	4.34E 05	0.00E-01	0.00E-01	0.00E-01	2.41E 06	0.00E-01
Sr-90	6.67E 06	7.64E 05	1.08E 08	0.00E-01	0.00E-01	0.00E-01	1.65E 07	0.00E-01
Y-91	1.77E 04	4.08E 05	6.60E 05	0.00E-01	0.00E-01	0.00E-01	2.93E 06	0.00E-01
Zr-95	3.15E 04	1.49E 05	1.45E 05	4.58E 04	6.73E 04	0.00E-01	2.68E 06	0.00E-01
Nb-95	5.66E 03	9.67E 04	1.85E 04	1.03E 04	9.99E 03	0.00E-01	7.50E 05	0.00E-01
Ru-103	8.95E 02	1.09E 05	2.10E 03	0.00E-01	7.42E 03	0.00E-01	7.82E 05	0.00E-01
Ru-106	1.24E 04	9.59E 05	9.83E 04	0.00E-01	1.90E 05	0.00E-01	1.61E 07	0.00E-01
Ag-110M	7.98E 03	2.72E 05	1.33E 04	1.31E 04	2.50E 04	0.00E-01	6.74E 06	0.00E-01
Te-127M	2.18E 03	1.59E 05	1.80E 04	8.15E 03	6.53E 04	4.38E 03	1.65E 06	0.00E-01
Te-129M	2.24E 03	4.04E 05	1.39E 04	6.57E 03	5.18E 04	4.57E 03	1.97E 06	0.00E-01
I-131	2.64E 04	6.48E 03	3.54E 04	4.90E 04	8.39E 04	1.46E 07	0.00E-01	0.00E-01
I-132	1.57E 03	1.27E 03	1.59E 03	4.37E 03	6.91E 03	1.51E 05	0.00E-01	0.00E-01
I-133	6.21E 03	1.03E 04	1.21E 04	2.05E 04	3.59E 04	2.92E 06	0.00E-01	0.00E-01
I-135	3.48E 03	6.94E 03	3.69E 03	9.43E 03	1.49E 04	6.20E 05	0.00E-01	0.00E-01
Cs-134	5.48E 05	9.75E 03	5.02E 05	1.13E 06	3.75E 05	0.00E-01	1.46E 05	0.00E-01
Cs-136	1.37E 05	1.09E 04	5.14E 04	1.93E 05	1.10E 05	0.00E-01	1.77E 04	0.00E-01
Cs-137	3.11E 05	8.48E 03	6.69E 05	8.47E 05	3.04E 05	0.00E-01	1.21E 05	0.00E-01
Ba-140	3.51E 03	2.28E 05	5.46E 04	6.69E 01	2.28E 01	0.00E-01	2.03E 06	0.00E-01
Ce-141	2.16E 03	1.26E 05	2.84E 04	1.89E 04	8.87E 03	0.00E-01	6.13E 05	0.00E-01
Ce-144	2.62E 05	8.63E 05	4.88E 06	2.02E 06	1.21E 06	0.00E-01	1.33E 07	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

Rev 1

TABLE 3.3-18

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Inhal
AGE GROUP = Child

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.12E 03	1.12E 03	0.00E-01	1.12E 03	1.12E 03	1.12E 03	1.12E 03	1.12E 03
P-32	9.86E 04	4.21E 04	2.60E 06	1.14E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	1.54E 02	1.08E 03	0.00E-01	0.00E-01	2.43E 01	8.53E 01	1.70E 04	0.00E-01
Mn-54	9.50E 03	2.29E 04	0.00E-01	4.29E 04	1.00E 04	0.00E-01	1.57E 06	0.00E-01
Fe-59	1.67E 04	7.06E 04	2.07E 04	3.34E 04	0.00E-01	0.00E-01	1.27E 06	0.00E-01
Co-58	3.16E 03	3.43E 04	0.00E-01	1.77E 03	0.00E-01	0.00E-01	1.10E 06	0.00E-01
Co-60	2.26E 04	9.61E 04	0.00E-01	1.31E 04	0.00E-01	0.00E-01	7.06E 06	0.00E-01
Zn-65	7.02E 04	1.63E 04	4.25E 04	1.13E 05	7.13E 04	0.00E-01	9.94E 05	0.00E-01
Rb-86	1.14E 05	7.98E 03	0.00E-01	1.98E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	1.72E 04	1.67E 05	5.99E 05	0.00E-01	0.00E-01	0.00E-01	2.15E 06	0.00E-01
Sr-90	6.43E 06	3.43E 05	1.01E 08	0.00E-01	0.00E-01	0.00E-01	1.47E 07	0.00E-01
Y-91	2.43E 04	1.84E 05	9.13E 05	0.00E-01	0.00E-01	0.00E-01	2.62E 06	0.00E-01
Zr-95	3.69E 04	6.10E 04	1.90E 05	4.17E 04	5.95E 04	0.00E-01	2.23E 06	0.00E-01
Nb-95	6.54E 03	3.69E 04	2.35E 04	9.16E 03	8.61E 03	0.00E-01	6.13E 05	0.00E-01
Ru-103	1.07E 03	4.47E 04	2.79E 03	0.00E-01	7.02E 03	0.00E-01	6.61E 05	0.00E-01
Ru-106	1.69E 04	4.29E 05	1.36E 05	0.00E-01	1.84E 05	0.00E-01	1.43E 07	0.00E-01
Ag-110M	9.13E 03	1.00E 05	1.68E 04	1.14E 04	2.12E 04	0.00E-01	5.47E 06	0.00E-01
Te-127M	3.01E 03	7.13E 04	2.48E 04	8.53E 03	6.35E 04	6.06E 03	1.48E 06	0.00E-01
Te-129M	3.04E 03	1.81E 05	1.92E 04	6.84E 03	5.02E 04	6.32E 03	1.76E 06	0.00E-01
I-131	2.72E 04	2.84E 03	4.80E 04	4.80E 04	7.87E 04	1.62E 07	0.00E-01	0.00E-01
I-132	1.87E 03	3.20E 03	2.11E 03	4.06E 03	6.24E 03	1.93E 05	0.00E-01	0.00E-01
I-133	7.68E 03	5.47E 03	1.66E 04	2.03E 04	3.37E 04	3.84E 06	0.00E-01	0.00E-01
I-135	4.14E 03	4.43E 03	4.91E 03	8.72E 03	1.34E 04	7.91E 05	0.00E-01	0.00E-01
Cs-134	2.24E 05	3.84E 03	6.50E 05	1.01E 06	3.30E 05	0.00E-01	1.21E 05	0.00E-01
Cs-136	1.16E 05	4.17E 03	6.50E 04	1.71E 05	9.53E 04	0.00E-01	1.45E 04	0.00E-01
Cs-137	1.28E 05	3.61E 03	9.05E 05	8.24E 05	2.82E 05	0.00E-01	1.04E 05	0.00E-01
Ba-140	4.32E 03	1.02E 05	7.39E 04	6.47E 01	2.11E 01	0.00E-01	1.74E 06	0.00E-01
Ce-141	2.89E 03	5.65E 04	3.92E 04	1.95E 04	8.53E 03	0.00E-01	5.43E 05	0.00E-01
Ce-144	3.61E 05	3.88E 05	6.76E 06	2.11E 06	1.17E 06	0.00E-01	1.19E 07	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

TABLE 3.3-19

R VALUES FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT*

PATHWAY = Inhal

AGE GROUP = Infant

Nuclide	T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	6.46E 02	6.46E 02	0.00E-01	6.46E 02	6.46E 02	6.46E 02	6.46E 02	6.46E 02
P-32	7.73E 04	1.61E 04	2.03E 06	1.12E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Cr-51	8.93E 01	3.56E 02	0.00E-01	0.00E-01	1.32E 01	5.75E 01	1.28E 04	0.00E-01
Mn-54	4.98E 03	7.05E 03	0.00E-01	2.53E 04	4.98E 03	0.00E-01	9.98E 05	0.00E-01
Fe-59	9.46E 03	2.47E 04	1.35E 04	2.35E 04	0.00E-01	0.00E-01	1.01E 06	0.00E-01
Co-58	1.82E 03	1.11E 04	0.00E-01	1.22E 03	0.00E-01	0.00E-01	7.75E 05	0.00E-01
Co-60	1.18E 04	3.19E 04	0.00E-01	8.01E 03	0.00E-01	0.00E-01	4.50E 06	0.00E-01
Zn-65	3.10E 04	5.13E 04	1.93E 04	6.25E 04	3.24E 04	0.00E-01	6.46E 05	0.00E-01
Rb-86	8.81E 04	3.03E 03	0.00E-01	1.90E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Sr-89	1.14E 04	6.39E 04	3.97E 05	0.00E-01	0.00E-01	0.00E-01	2.03E 06	0.00E-01
Sr-90	2.59E 06	1.31E 05	4.08E 07	0.00E-01	0.00E-01	0.00E-01	1.12E 07	0.00E-01
Y-91	1.57E 04	7.02E 04	5.87E 05	0.00E-01	0.00E-01	0.00E-01	2.45E 06	0.00E-01
Zr-95	2.03E 04	2.17E 04	1.15E 05	2.78E 04	3.10E 04	0.00E-01	1.75E 06	0.00E-01
Nb-95	3.77E 03	1.27E 04	1.57E 04	6.42E 03	4.71E 03	0.00E-01	4.78E 05	0.00E-01
Ru-103	6.78E 02	1.61E 04	2.01E 03	0.00E-01	4.24E 03	0.00E-01	5.51E 05	0.00E-01
Ru-106	1.09E 04	1.64E 05	8.67E 04	0.00E-01	1.06E 05	0.00E-01	1.15E 07	0.00E-01
Ag-110M	4.99E 03	3.30E 04	9.97E 03	7.21E 03	1.09E 04	0.00E-01	3.66E 06	0.00E-01
Te-127M	2.07E 03	2.73E 04	1.66E 04	6.89E 03	3.75E 04	4.86E 03	1.31E 06	0.00E-01
Te-129M	2.22E 03	6.89E 04	1.41E 04	6.08E 03	3.17E 04	5.47E 03	1.68E 06	0.00E-01
I-131	1.96E 04	1.06E 03	3.79E 04	4.43E 04	5.17E 04	1.48E 07	0.00E-01	0.00E-01
I-132	1.26E 03	1.90E 03	1.69E 03	3.54E 03	3.94E 03	1.69E 05	0.00E-01	0.00E-01
I-133	5.59E 03	2.15E 03	1.32E 04	1.92E 04	2.24E 04	3.55E 06	0.00E-01	0.00E-01
I-135	2.77E 03	1.83E 03	3.86E 03	7.59E 03	8.46E 03	6.95E 05	0.00E-01	0.00E-01
Cs-134	7.44E 04	1.33E 03	3.96E 05	7.02E 05	1.90E 05	0.00E-01	7.95E 04	0.00E-01
Cs-136	5.28E 04	1.43E 03	4.82E 04	1.34E 05	5.63E 04	0.00E-01	1.17E 04	0.00E-01
Cs-137	4.54E 04	1.37E 03	5.48E 05	6.11E 05	1.72E 05	0.00E-01	7.12E 04	0.00E-01
Ba-140	2.89E 03	3.83E 04	5.59E 04	5.59E 01	1.34E 01	0.00E-01	1.59E 06	0.00E-01
Ce-141	1.99E 03	2.15E 04	2.77E 04	1.66E 04	5.24E 03	0.00E-01	5.16E 05	0.00E-01
Ce-144	1.76E 05	1.48E 05	3.19E 06	1.21E 06	5.37E 05	0.00E-01	9.83E 06	0.00E-01

*R Values in units of mrem/yr per micro-Ci/m^{-3} for inhalation and tritium, and in units of M^{-2} mrem/yr per micro-Ci/sec for all others.

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