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Serial: RNP-RA/01-0083

APR 2 5 2001

United States Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23

ANNUAL OFFSITE DOSE CALCULATION MANUAL SUBMITTAL

Ladies and Gentlemen:

The purpose of this letter is to transmit the attached copy of the Offsite Dose Calculation Manual (ODCM), which includes changes made during the period of January 1, 2000, through December 31, 2000, for the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2. This report is submitted in accordance with HBRSEP, Unit No. 2, Technical Specifications Section 5.5.1(c)(3).

If you have any questions concerning this report, please contact Mr. H. K. Chernoff.

Sincerely,

for B. L. Fletcher
Manager - Regulatory Affairs

DJS/djs

Attachment

c: Mr. L. A. Reyes, NRC, Region II
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NRC Resident Inspector, HBRSEP

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United States Nuclear Regulatory Commission
Attachment to Serial: RNP-RA/01-0083
262 Pages

OFFSITE DOSE CALCULATION MANUAL

(including changes made from January 1 to December 31, 2000)

CAROLINA POWER & LIGHT COMPANY

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

OFF-SITE DOSE CALCULATION MANUAL

(ODCM)

Revision 18

DOCKET NO. 50-261

EFFECTIVE DATE: 2/7/00

REVIEWED BY: _____ DATE 2/1/00

PNSC Chairman

APPROVED BY: _____ DATE 2/1/00

PLANT MANAGER

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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 10 CFR 20, Appendix I of 10 CFR 50, and 40 CFR 190.

The ODCM is based on "Radiological Effluent Technical Specifications for PWRs (NUREG 0472, Rev. 3, Draft 7), "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. These procedures will be utilized by the operating staff of HBR to assure compliance with technical specifications.

Changes to the ODCM which affect the methodologies showing compliance with 10 CFR 20, Appendix I of 10 CFR 50, and 40 CFR 190 will be properly reviewed and approved as indicated in the Administrative Control Section of Plant Technical Specifications. Site specific parameters such as vent fractions, dilution water flow rates (gpm), and liquid/gaseous discharge flow rates are listed in this document as typical system values. Actual values derived from actual operating Plant conditions should be used in lieu of these typical values. Specific Plant procedures control the values of the above parameters; therefore, minimizing the need for frequent revisions to the ODCM.

The Annual Radioactive Effluent Release Report will be prepared as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Waste 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. The Annual Radioactive Effluent Release Report will include an assessment of the radiation doses from radioactive liquid and gaseous effluents using LADTAP and GASPAR software using concurrent meteorology obtained during the report period. This report will be inclusive of the requirements as outlined in the HBR Technical Specifications.

ODCM revisions that change items relocated from the Technical Specifications will have an Unreviewed Safety Question Determination evaluation performed for the change. Relocated requirements are identified in the Technical Requirements Manual, Appendix B.

2.0 LIQUID EFFLUENTS

2.1 MONITOR ALARM SETPOINT DETERMINATION

This methodology determines the monitor alarm setpoint that indicates if the concentration of radionuclides in the liquid effluent released from the site to unrestricted areas exceeds 10 times the concentrations specified in 10 CFR 20, Appendix B, Table 2, 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. Two methodologies may be utilized to calculate monitor alarm setpoints. Section 2.1.1 determines a fixed setpoint based on the worst case assumptions that Cs-134 is the only nuclide being discharged. This is consistent with the limit of 10 CFR 20, Appendix B, Note 2. Section 2.1.2 methodology determines the setpoint based on the radionuclide mix via analysis prior to release to demonstrate compliance with 10 CFR 20, Appendix B, limits and may also be used as an alternative method for calculating setpoints.

2.1.1 Setpoint Based on Cs-134

The following method applies to liquid releases via the discharge canal when determining the alarm/trip setpoint for the Condensate Polisher Liquid Waste Monitor (R-37) and the Steam Generator Blowdown Monitor (R-19A, R-19B, and R-19C) during operational conditions when there is no primary to secondary leaks. The Condensate Polisher Sump discharge (monitored by R-37) discharges to the Settling Ponds prior to release via the discharge canal. Even though the Settling Ponds provide additional dilution prior to discharge, no dilution from the Settling Ponds is used in calculating setpoints for R-37. The setpoint for R-37 is calculated using only circulating water for dilution. This methodology complies with Specification 2.2.1 of the ODCM by satisfying the following equation:

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

where:

C = The effluent concentration limit (Specification 2.2.1) implementing 10 CFR 20 for the site in µCi/ml.

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 10 times the limits of 10 CFR 20 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.

$$\text{where: } c = \frac{C(F + f)}{f}(S)$$

where:

C = 9×10^{-7} µCi/ml, the effluent concentration limit based on 10 times 10 CFR 20, Appendix B, for Cs-134.

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].

f = 160 gpm for each Steam Generator Blowdown Monitor.

= 130 gpm for each Steam Generator Blowdown Monitor while draining a steam generator.

= 300 gpm for the Condensate Polisher Liquid Waste Monitor.

S = 0.5, safety factor used as a conservatism to assure that the radionuclide concentrations are less than 10 times the limits specified in 10 CFR 20, Appendix B, at the point of discharge.

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.

$$SP = (T_m)(CR) + Bkg$$

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.

= 0.16 for each Steam Generator Blowdown Monitor (R-19A, R-19B, and R-19C).

= 0.25 for the Condensate Polisher Liquid Waste (R-37).

Bkg = the monitor background.

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 (R-18), the Steam Generator Blowdown Monitors (R-19A, R-19B, and R-19C), and the Condensate Polisher Liquid Waste Monitor (R-37) when an analysis of the activity of the principal gamma emitters has been made prior to or during the release. The Condensate Polisher Sump discharge (monitored by R-37) discharges to the Settling Ponds prior to release via the discharge canal. Even though the Settling Ponds provide additional dilution prior to discharge, no dilution from the Settling Ponds is used in calculating setpoints for R-37. The setpoint for R-37 is calculated using only circulating water for dilution.

2.1.2.1 Determine D_{req} (the minimum acceptable dilution factor):

$$D_{req} = D_{req,g} + D_{req,ng}$$

$$D_{req,g} = \frac{\sum_{i=g} \frac{C_i}{ECL_i}}{(S)(R_{max})}$$

$$D_{req,ng} = \frac{\sum_{i=g} \frac{C_i}{ECL_i}}{(S)(R_{max})}$$

where:

$D_{req,g}$ = required dilution factor for gamma-emitters.

$D_{req,ng}$ = required dilution factor for non-gamma-emitters (Gross Alpha, H-3, Sr-89, Sr-90, and Fe-55).

ECL_i = effluent concentration limit of nuclide i in µCi/ml.

C_i = the concentration of nuclide i in µCi/ml.

S = 0.5, a safety factor used for conservatism to assure that the radionuclide concentrations are less than the limits specified in 10 CFR Part 20 Appendix B, at the point of discharge.

R_{max} = The maximum ECL ratio limit.

2.1.2.2 Determine the maximum waste flow, R_{max}:

$$R_{cw\,max} = \frac{(F_{avail})(F_{alloc})}{(D_{req} - 1.0)}$$

F_{avail} = Available dilution flow in 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_{alloc} = 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.

= 0.25 for the Waste Disposal System Liquid Effluent Monitor (R-18).

= 0.16 for each of the Steam Generator Blowdown Monitor (R-19A, R-19B or R-19C).

= 0.25 for the Condensate Polisher Liquid Waste (R-37).

If it is determined that $\frac{F_{avail} + F_{waste}}{(D_{req})(F_{waste})} < 1$, the release cannot be made.

Reevaluate the discharge flowrate prior to dilution and/or dilution flow rates.

If $\frac{F_{avail} + F_{waste}}{(D_{req})(F_{waste})} < 1$ the release can be made.

2.1.2.3 Determine the setpoint adjustment factor, S_{adj}

$$S_{adj} = \frac{\frac{((F_{alloc})(F_{avail}) + F_{waste})}{F_{waste}} - D_{req,ng}}{D_{req,g}}$$

F_{waste} = Waste flow anticipated for this release (gpm).

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

= 160 gpm for each Steam Generator Blowdown Monitor.

= 130 gpm for each Steam Generator Blowdown Monitor while draining a steam generator.

= 300 gpm for the Condensate Polisher Liquid Waste Monitor.

2.1.2.4 Determine S_{max} monitor alarm setpoint in µCi/ml:

$$S_{max}\,(\mu Ci/ml) = (S_{adj})(\Sigma C_i)$$

C_i = All gamma-emitting nuclides (µCi/ml).

2.1.2.5 Determine the monitor alarm setpoint (S_{maxcpm}) in CPM:

$$S_{max\,cpm} = (S_{max})(E_m) + Bkg$$

E_m = The applicable effluent monitor efficiency based on S_{max} from the efficiency curves located in the Plant Operating Manual, Volume 15, Curve Book.

Bkg = The monitor background in CPM.

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 Requirements for 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 10 CFR 20 for radioactive material in liquid effluents released to unrestricted areas.

Specification

CONTROLS

2.2.1 The concentration of radioactive material in liquid effluents released at any time from the site to unrestricted areas (see Figure 7-1) shall be limited to 10 times the concentrations specified in 10 CFR 20, Appendix B, Table 2, 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.

ACTIONS

2.2.2 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, notification must be made to the Commission in accordance with 10 CFR 50.72 and 10 CFR 50.73.

2.2.3 The provisions of Specification 8.1 are not applicable.

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 10 times the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. 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 20.1302 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 EC 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).

2.3 COMPLIANCE WITH 10 CFR 20 (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 10 CFR 20.

2.3.1 Continuous Releases

Steam generator blowdown may be a continuous release from HBR. During release periods grab samples will be taken of steam generator blowdown and analyzed for I-131, fission, activation, and corrosion products as outlined in Table 2.8-1 of the ODCM for HBR. These samples are then composited at a rate using the following equation:

$$Vup = Vcp\ [Va/Vt]$$

where:

Vup = Volume to be replaced/updated (milliliters)

Vcp = Volume of the composite (milliliters)

Va = Actual volume released from grab sample (gallons)

Vt = Total waste volume (gallons) released to date, including volume Va, within the compositing period.

Compliance with 10 CFR 20 during actual release is established through the steam generator blowdown effluent monitor alarm setpoint. This setpoint is based upon Cs-134 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 10 CFR 20 may be determined utilizing the actual radionuclide mix and the following equation:

$$Conc_i = \frac{C_{ic}\ V_c}{V_{dc}} \qquad (2.3\text{-}1)$$

where:

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

2.3.2 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 10 CFR 20.

2.3.2.1 Prerelease

The radioactivity content of each batch release will be determined prior to release in accordance with Table 2.8-1 of the ODCM for HBR. HBR will show compliance with 10 CFR 20 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 2.8-1 of the ODCM 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:

$$Conc_i = \frac{C_{ib} R_b}{D_{fr} T_m} \qquad (2.3\text{-}2)$$

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.

Tm = Fraction of dilution flow allocated to this release.

The concentration in the unrestricted area is compared to 10 times the concentrations in Appendix B, Table 2, Column 2, of 10 CFR 20. Before release may occur, the mixture of radionuclides released must be of such concentration that Equation 2.3-3 is met.

$$\Sigma_i \, (Conc_i / (10) EC_i) \leq 1 \qquad (2.3\text{-}3)$$

where:

EC_i = Effluent Concentration Limit of radionuclide "i" from Appendix B, Table 2, Column 2 of 10 CFR 20, 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:

$$Conc_i = \frac{C_{ib} R_b + C_{ic} R_c}{D_{fr} \Sigma T_m} \qquad (2.3\text{-}4)$$

where:

R_c = Maximum continuous liquid effluent release rate, gpm.

ΣT_m = Summation of allocation fractions for those concurrent releases

The mixture of radionuclides released must be of such concentrations that Equation 2.3-3 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 (during drainage). Continuous release may occur from Steam Generator Blowdown and the Condensate Polisher Liquid Waste. The maximum administrative release rate (R_b) is 160 gpm for each of the steam generators, 60 gpm from the monitor and waste condensate tanks, and 300 gpm for the Condensate Polisher Liquid Wastes, and 130 for each of the steam generators during drainage.

2.3.2.2 Postrelease

The Steam Generation Blowdown Monitor (R-19A, R-19B, and R-19C), the Waste Disposal System Liquid Monitor (R-18), and the Condensate Polisher Liquid Waste Monitor (R-37) setpoint will each be limited to 50 percent of 10 times the 10 CFR 20 limits. These setpoints will ensure that 10 times the 10 CFR 20 limits are met. However, because they are based upon a given mix, the possibility exists that the alarm trip setpoints may be exceeded, while 10 times the 10 CFR 20 limits are not exceeded. The following methodology is provided to determine whether actual releases exceeded 10 times the 10 CFR 20 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:

$$Conc_{ik} = \frac{C_{ikb} V_{kb}}{V_{kd}} \qquad (2.3\text{-}5)$$

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 10 CFR 20, the following relationship must hold:

$$\Sigma_i (Conc_{ik} / (10) EC_i) \leq 1 \qquad (2.3\text{-}6)$$

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

$$V_{kd} = 60 \Sigma_k (D_{fr}) t_k \qquad (2.3\text{-}7)$$

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 2.3.2.1 above.

For the case where a batch release is occurring at the same time that a continuous release is occurring, the compliance with 10 CFR 20 limits may be determined by the following equation:

$$Conc_{ik} = \frac{C_{ikb} V_{kb} + C_{ikc} V_{kc}}{V_{kd}} \qquad (2.3\text{-}8)$$

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.

Calculated concentrations are to be compared to 10 times the concentrations in Appendix B, Table 2, Column 2, of 10 CFR 20.

2.4 Requirements for 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 10 CFR 50 for radioactive materials in liquid effluents released to unrestricted areas.

Specification

CONTROLS

2.4.1 The dose commitment at all times to a member of the public from radioactive material in liquid effluents released to unrestricted areas (See Figure 7-1) shall be limited:

a. During any calendar quarter to ≤1.5 mrem to the total body and to ≤5 mrem to any organ, and

b. During any calendar year to ≤3 mrem to the total body and to ≤10 mrem to any organ.

ACTIONS

2.4.2 With the calculated dose commitment from the release of radioactive materials in liquid effluents exceeding any of the limits prescribed by ODCM Specification 2.4.1 above, prepare and submit a report to the Commission in accordance with the ODCM Specification 9.3.

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 Control 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.

2.5.1 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:

$$D_{\tau b} = \Sigma_k \Sigma_i A_{i\tau} t_{kb} C_{ikb} F_{kb} \qquad (2.5\text{-}1)$$

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/hr per μCi/ml;

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 2.3-5.

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

$$A_{i\tau} = 1.14 \times 10^5 (21 BF_i) DF_{i\tau} \qquad (2.5\text{-}2)$$

where:

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

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 2.5-1 presents $A_{i\tau}$ values for an adult at HBR.

As noted in Section 2.3.1, steam generator blowdown is continuously released from HBR. The dose from continuous releases will be calculated using the following equation:

$$D_{\tau c} = \Sigma_k \Sigma_i A_{i\tau} t_{kc} C_{ikc} F_{kc} \qquad (2.5\text{-}3)$$

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 2.3-8 and 2.3-5, respectively, 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 Specification 2.4.1 of the ODCM for H.B. Robinson Unit 2.

For the calendar quarter,

$D_\tau \leq 1.5$ mrem total body (2.5-4)

$D_\tau \leq 5$ mrem any organ (2.5-5)

For the calendar year,

$D_\tau \leq 3$ mrem total body (2.5-6)

$D_\tau \leq 10$ mrem any organ (2.5-7)

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 10 CFR 50. If any of the limits in Expressions 2.5-4 through 2.5-7 are exceeded, a special report pursuant to ODCM Specification 9.3 must be filed with the NRC. This report complies with Section IV.A, of Appendix I of 10 CFR 50.

2.5.2 Projection of Doses

Doses resulting from the release of liquid effluents will be projected once per 31 days. These projections will include a safety margin, based upon expected operational conditions, which will take into consideration both planned and unplanned releases.

Projected dose will be calculated as follows:

$$PD = \frac{31\,(DA + DB)}{(TE)} + M \qquad (2.5\text{-}8)$$

where:

PD = projected doses in mrem.
DA = dose accumulated during current quarter in mrem.
DB = projected dose from this release.
TE = time elapsed in quarter in days.
M = safety margin in mrem.

If the projected doses exceed 0.2 mrem to the whole body or 0.6 mrem to any organ when averaged over a calendar quarter, the liquid radwaste equipment will be operated to reduce the radioactive materials in the liquid effluent.

TABLE 2.5-1

Ait VALUES FOR THE ADULT FOR THE H.B. ROBINSON STEAM ELECTRIC PLANT

(mrem/hr per µCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI	Skin
H-3	0.00E+00	2.27E-01	2.27E-01	2.27E-01	2.27E-01	2.27E-01	2.27E-01	2.27E-01
F-18	2.30E-02	2.13E-02	2.15E-02	2.13E-02	2.13E-02	2.13E-02	2.13E-02	2.51E-02
NA-24	1.35E+02	1.35E+02	1.35E+02	1.35E+02	1.35E+02	1.35E+02	1.35E+02	7.45E-01
CR-51	2.51E-01	2.51E-01	1.49E+00	9.94E-01	5.25E-01	1.90E+00	3.13E+02	2.96E-01
MN-54	7.45E+01	4.45E+03	9.09E+02	7.45E+01	1.38E+03	7.45E+01	1.35E+04	8.74E+01
MN-56	4.86E-02	2.23E-01	7.94E-02	4.86E-02	2.69E-01	4.86E-02	5.60E+00	5.74E-02
FE-55	6.59E+02	4.55E+02	1.06E+02	0.00E+00	0.00E+00	2.54E+02	2.61E+02	0.00E+00
FE-59	1.04E+03	2.42E+03	9.38E+02	1.47E+01	1.47E+01	6.88E+02	8.04E+03	1.72E+01
CO-57	1.01E+01	2.89E+01	4.49E+01	1.01E+01	1.01E+01	1.01E+01	5.41E+02	1.11E+01
CO-58	2.04E+01	1.09E+02	2.19E+02	2.04E+01	2.04E+01	2.04E+01	1.81E+03	2.39E+01
CO-60	1.16E+03	1.41E+03	1.72E+03	1.16E+03	1.16E+03	1.16E+03	5.98E+03	1.36E+03
NI-65	1.88E-01	3.83E-02	2.62E-02	1.60E-02	1.60E-02	1.60E-02	5.83E-01	1.86E-02
CU-64	3.26E-02	2.73E+00	1.30E+00	3.26E-02	6.83E+00	3.26E-02	2.30E+02	3.70E-02
ZN-65	2.32E+04	7.37E+04	3.33E+04	4.02E+01	4.93E+04	4.02E+01	4.64E+04	4.62E+01
BR-82	1.15E+00	1.15E+00	1.42E+03	1.15E+00	1.15E+00	1.15E+00	1.63E+03	1.33E+00
BR-83	2.62E-04	2.62E-04	3.87E-02	2.62E-04	2.62E-04	2.62E-04	5.56E-02	3.81E-04
BR-84	1.09E-02	1.09E-02	1.09E-02	1.09E-02	1.09E-02	1.09E-02	1.09E-02	1.27E-02
RB-86	4.83E-01	9.75E+04	4.54E+04	4.83E-01	4.83E-01	4.83E-01	1.92E+04	5.52E-01
RB-88	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	1.78E-03	2.03E-03
RB-89	6.61E-03	6.61E-03	6.61E-03	6.61E-03	6.61E-03	6.61E-03	6.61E-03	7.93E-03
SR-89	2.19E+04	1.16E-03	6.27E+02	1.16E-03	1.16E-03	1.16E-03	3.51E+03	1.35E-03
SR-90	5.45E+05	0.00E+00	1.34E+05	0.00E+00	0.00E+00	0.00E+00	1.58E+04	0.00E+00
SR-91	7.09E+01	1.16E-01	2.98E+00	1.16E-01	1.16E-01	1.16E-01	3.37E+02	1.35E-01
SR-92	3.76E-01	4.18E-02	5.62E-02	4.18E-02	4.18E-02	4.18E-02	6.66E+00	4.64E-02
Y-91M	5.39E-03	5.39E-03	5.39E-03	5.39E-03	5.39E-03	5.39E-03	5.39E-03	6.24E-03
Y-91	8.41E+00	5.77E-02	2.81E-01	5.77E-02	5.77E-02	5.77E-02	4.60E+03	6.49E-02
Y-92	1.02E-02	9.70E-03	9.72E-03	9.70E-03	9.70E-03	9.70E-03	8.09E+00	1.15E-02
Y-93	4.08E-02	9.86E-03	1.07E-02	9.86E-03	9.86E-03	9.86E-03	9.82E+02	1.35E-02
ZR-95	1.34E+01	1.32E+01	1.32E+01	1.32E+01	1.33E+01	1.32E+01	2.55E+02	1.53E+01
ZR-97	1.64E-01	1.60E-01	1.60E-01	1.59E-01	1.61E-01	1.59E-01	3.11E+02	1.85E-01
NB-95	4.46E+02	2.51E+02	1.39E+02	7.35E+00	2.49E+02	7.35E+00	1.48E+06	8.65E+00
NB-97	9.47E-03	9.47E-03	9.47E-03	9.47E-03	9.47E-03	9.47E-03	1.29E-02	1.11E-02
MO-99	2.15E-01	8.06E+01	1.55E+01	2.15E-01	1.82E+02	2.15E-01	1.86E+02	2.49E-01
TC-99M	1.05E-02	1.15E-02	3.01E-02	9.90E-03	3.40E-02	1.07E-02	9.47E-01	1.13E-02
TC-101	1.09E-03	1.09E-03	1.09E-03	1.09E-03	1.09E-03	1.09E-03	1.09E-03	1.22E-03

TABLE 2.5-1 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI	Skin
RU-103	1.02E+01	5.82E+00	7.70E+00	5.82E+00	2.25E+01	5.82E+00	5.15E+02	6.79E+00
RU-105	4.29E-02	3.42E-02	3.77E-02	3.42E-02	1.47E-01	3.42E-02	5.36E+00	3.88E-02
RU-106	8.85E+01	2.27E+01	3.10E+01	2.27E+01	1.50E+02	2.27E+01	4.28E+03	2.72E+01
AG-110M	1.86E+02	1.86E+02	1.85E+02	1.85E+02	1.86E+02	1.85E+02	5.17E+02	2.16E+02
SN-113	2.00E+03	7.80E+01	1.90E+03	2.80E+01	5.75E+01	7.66E-01	3.50E+04	2.19E+00
SB-124	3.88E+01	3.23E+01	3.48E+01	3.22E+01	3.22E+01	3.73E+01	2.21E+02	3.71E+01
SB-125	1.30E+02	1.26E+02	1.27E+02	1.26E+02	1.26E+02	1.29E+02	1.73E+02	1.42E+02
TE-129M	1.08E+04	4.03E+03	1.71E+03	3.71E+03	4.51E+04	1.06E+00	5.44E+04	1.24E+00
TE-129	1.43E-03	1.42E-03	1.42E-03	1.42E-03	1.49E-03	1.41E-03	1.42E-03	1.67E-03
TE-131M	9.54E+02	4.67E+02	3.89E+02	7.39E+02	4.72E+03	4.32E-01	4.63E+04	5.09E-01
TE-132	1.95E+03	1.26E+03	1.19E+03	1.40E+03	1.22E+04	2.28E-01	5.98E+04	2.68E-01
I-131	1.38E+02	1.97E+02	1.13E+02	6.44E+04	3.38E+02	9.25E-01	5.27E+01	1.12E+00
I-132	7.23E-02	8.11E-02	7.19E-02	5.61E-01	8.95E-02	6.70E-02	6.96E-02	7.88E-02
I-133	2.31E+01	4.01E+01	1.23E+01	5.87E+03	6.98E+01	1.32E-01	3.60E+01	1.60E-01
I-134	2.40E-02	2.40E-02	2.40E-02	2.40E-02	2.40E-02	2.40E-02	2.40E-02	2.85E-02
I-135	1.42E+00	3.50E+00	1.38E+00	2.22E+02	5.54E+00	1.36E-01	3.94E+00	1.59E-01
CS-134	2.98E+05	7.10E+05	5.80E+05	3.69E+02	2.30E+05	7.66E+04	1.28E+04	4.30E+02
CS-136	2.96E+04	1.17E+05	8.42E+04	8.12E+00	6.51E+04	8.93E+03	1.33E+04	9.20E+00
CS-137	3.83E+05	5.23E+05	3.43E+05	5.55E+02	1.78E+05	5.95E+04	1.07E+04	6.47E+02
CS-138	1.93E-02	1.93E-02	1.93E-02	1.93E-02	1.93E-02	1.93E-02	1.93E-02	2.21E-02
BA-139	5.70E-03	5.69E-03	5.69E-03	5.69E-03	5.69E-03	5.69E-03	5.70E-03	6.41E-03
BA-140	1.86E+02	1.34E+00	1.32E+01	1.10E+00	1.18E+00	1.24E+00	3.81E+02	1.26E+00
BA-142	2.41E-03	2.41E-03	2.41E-03	2.41E-03	2.41E-03	2.41E-03	2.41E-03	2.75E-03
LA-140	1.13E+00	1.08E+00	1.05E+00	1.03E+00	1.03E+00	1.03E+00	3.67E+03	1.17E+00
LA-142	4.09E-02	4.09E-02	4.09E-02	4.09E-02	4.09E-02	4.09E-02	4.16E-02	4.90E-02
CE-141	7.57E-01	7.50E-01	7.37E-01	7.35E-01	7.42E-01	7.35E-01	5.75E+01	8.28E-01
CE-143	1.27E-01	1.89E+00	1.25E-01	1.24E-01	1.25E-01	1.24E-01	6.62E+01	1.41E-01
CE-144	4.91E+00	4.23E+00	3.80E+00	3.74E+00	4.03E+00	3.74E+00	3.98E+02	4.32E+00
PR-144	9.87E-05	9.87E-05	9.87E-05	9.87E-05	9.87E-05	9.87E-05	9.87E-05	1.13E-04
HF-181	1.33E+01	1.06E+01	1.09E+01	1.06E+01	1.06E+01	1.06E+01	2.12E+02	1.50E+01
W-187	1.48E+02	1.23E+02	4.32E+01	1.26E-01	1.26E-01	1.26E-01	4.04E+04	1.47E-01
NP-239	1.13E-01	9.41E-02	9.31E-02	9.20E-02	9.85E-02	9.20E-02	4.29E+02	1.06E-01

2.6 Radioactive Liquid Effluent Monitoring Instrumentation

Applicability

Applies to the radioactive liquid effluent instrumentation system.

Objective

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

Specification

CONTROLS

2.6.1 The radioactive liquid effluent monitoring instrumentation channels shown in Table 2.6-1 shall be operable with their alarm/trip setpoint set to ensure that the limits of ODCM Specification 2.2.1 are not exceeded. The alarm/trip setpoints shall be determined in accordance with the ODCM.

ACTIONS

2.6.2 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.

2.6.3 With less than the minimum number of radioactive liquid effluent monitoring instrumentation operable, take the action shown in Table 2.6-1.

2.6.4 The provisions of Specification 8.1 are not applicable.

BASES

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 10 times the limits of 10 CFR Part 20, Appendix B, Table 2, Column 2. 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.

TABLE 2.6-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Compensatory Measures
1. Liquid Radwaste Effluent Discharge Line a. Monitor (R-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 Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Technical Specification 5.6.3 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 ODCM Specification 2.2.1 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 Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Technical Specification 5.6.3 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 2.6-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Compensatory Measures
2. Steam Generator Blowdown Effluent Line a. Monitor (R-19A,B, and C) provides automatic termination of blowdown from the affected Steam Generators upon exceeding alarm/trip setpoint.	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 Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Technical Specification 5.6.3 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 µCi/ml or are analyzed for principle gamma emitters consistent with Table 2.8-1; 1. Once per 24 hours when the specific activity of the secondary coolant is ≤ 0.01 µCi/ml Dose Equivalent I-131, or; 2. Once per 12 hours when the specific activity of the secondary coolant is > 0.01 µCi/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 Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Technical Specification 5.6.3 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 2.6-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Compensatory Measures
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 Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Technical Specification 5.6.3 and, 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).
a. Refueling Water Storage Tank	1	
b. Monitor Tanks	1	
Tank A		
Tank B		
c. Waste Condensate Tanks		
Tank C	1	
Tank D	1	
Tank E	1	
d. Temporary Tanks (Note 2)	1 per Tank	

*MCO - Minimum Channels Operable

TABLE 2.6-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Release Pathway/Instrumentation	MCO*	Compensatory Measures
5. Containment Fan Cooling Water Monitor (Service Water Effluent Line) a. Monitor (R-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 Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Technical Specification 5.6.3 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 µCi/ml or are analyzed for principal gamma emitters consistent with Table 2.8-1.
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 Annual Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner in accordance with Technical Specification 5.6.3 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 µCi/ml or are analyzed for principal gamma emitters consistent with Table 2.8-1.

*MCO - Minimum Channels Operable

NOTES TO TABLE 2.6-1

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 ≥ 100 gallons used for the receipt or transfer of radioactive liquids.

2.7 Radioactive Liquid Effluent Monitoring Instrumentation - Surveillance Requirements

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

SURVEILLANCE REQUIREMENTS

2.7.1 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated operable by performance of the channel check, source check, channel calibration, and Channel Operational Test operations at the frequencies shown in Table 2.7-1.

TABLE 2.7-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

Pathway/Instruments	Channel Check	Source Check	Channel Calibration	Channel Operational Test
1. Liquid Radwaste Effluent Line				
a. Monitor (R-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 (R-19A)	D	M	R (Note 3)	Q (Note 4)
(R-19B)	D	M	R (Note 3)	Q (Note 4)
(R-19C)	D	M	R (Note 3)	Q (Note 4)
b. Flow rate measurement devices for measuring flow of sample to R-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 (R-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
5. Condensate Polisher Waste Monitor (R-37)	D	M	R	Q

* During liquid additions to the tank

NOTE TO TABLE 2.7-1

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 Operational 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 Operational 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

2.8 Radioactive Liquid Effluents Sampling and Analysis Requirements

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

SURVEILLANCE REQUIRMENTS

2.8.1 The radioactivity content of each batch of radioactive liquid waste to be discharge shall be determined prior to release by sampling and analysis in accordance with Table 2.8-1. 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 2.2.1.

2.8.2 Analyses of samples composited from batch releases shall be performed in accordance with Table 2.8-1. 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 2.2.1.

2.8.3 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 2.8-1. 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 2.2.1.

2.8.4 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.

TABLE 2.8-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Type of Release	Sampling Frequency	Minimum Analysis Frequency	Required Activity Analysis	Required LLD[a] µCi/ml
Batch Waste Releases[b]	P Grab Sample	P on Grab Sample	Principal Gamma Emitters[c]	5E-07
			I-131	1E-06
1. Monitor Tanks	P Grab Sample One Batch/M	M on Grab Sample	Dissolved and Entrained Gases (gamma emitters)	1E-05
2. Waste Condensate	P Grab Sample Each Batch and Composited[d]	M on Composite	Tritium	1E-05
			Gross Alpha	1E-07
3. Drainage of Systems	P Grab Sample Each Batch and Composited[d]	Q on Composite	Sr-89, Sr-90	5E-08
			Fe-55	1E-6
Continuous Releases[e]	D Grab Sample	W on Grab Sample	Principal Gamma Emitters[c]	5E-07
1. Steam Generator Blowdown	M Grab Sample	M on Grab Sample	I-131	1E-06
			Dissolved and Entrained Gases (gamma emitters)	1E-05
	M Grab Sample and Composited[d,f]	M on Composite	Tritium	1E-05
			Gross Alpha	1E-07
	D Grab Sample and Composited[d,f]	Q on Composite	Sr-89, Sr-90	5E-08
			Fe-55	1E-06

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:

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

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.

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

TABLE NOTATION

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

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.

2.9 Liquid Radwaste Treatment System

Applicability

Applies to the liquid radwaste treatment system.

Objective

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

CONTROLS

2.9.1 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 7-1) when averaged over a calendar quarter, would exceed 0.2 mrem to the total body or 0.6 mrem to any organ.

ACTIONS

2.9.2 With radioactive liquid wastes being discharged without treatment while in excess of the limits of ODCM Specification 2.9.1 above, prepare and submit a report to the Commission in accordance with ODCM Specification 9.3.b.

SURVEILLANCE REQUIREMENTS

2.9.3 Dose commitments from liquid releases shall be projected at least once per 31 days, in accordance with the ODCM to ensure the provisions of ODCM Specification 2.9.1 are satisfied when the Liquid Radwaste Treatment System is not in use.

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.

3.0 GASEOUS EFFLUENTS

3.1 MONITOR ALARM SETPOINT DETERMINATION

This methodology determines the monitor alarm setpoint if the dose rate in the unrestricted areas due to radionoble gases 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 using a conservative mix (GALE Code).

The methodology described in Section 3.1.2 provides an alternative means to determine monitor alarm setpoints when an analysis 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 blowdown is not going through heat recovery. Detection of primary-to-secondary leakage is accomplished most effectively by continuously monitoring the condenser vacuum pump vent (R-15). Steam generator blowdown is continuously monitored by R-19A, R-19B, and R-19C as a liquid pathway. The condenser vacuum pump vent discharges via plant vent which is monitored by R-14.

The following method applies to gaseous releases via the plant vent when determining the high-alarm setpoint for the plant vent gas monitor (R-14C) and the Fuel Handling Basement Exhaust Monitor (R-20), using the GALE code during the following operational conditions:

- Continuous release via the plant vent (R-14C).
- Continuous release via the Fuel Handling Basement Exhaust (R-20).

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

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 or use the S_i from Table 3.1-1 when using GALE Code.

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

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

3.1.1.2

Determine the Q_m, the maximum acceptable total release rate [μCi/sec] of all noble gas radionuclides in the gaseous effluent

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

based upon the whole body exposure limit of 500 mrem/year by:

$\overline{(X/Q)}$ = 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 (Mixed Mode Release) from Table A-10, Appendix A.

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

3.1.1.3 Determine Q_m, the maximum acceptable release rate [μCi/sec] of all gas radionuclides in the gaseous effluent based upon the skin exposure limit of 3000 mrem/yr by:

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

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

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

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

NOTE: Use the <u>lower</u> 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:

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.

= 0.92 for Plant Vent Gas Monitor (R-14C).

= 0.05 for the Fuel Handling Basement Exhaust Monitor (R-20).

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

= 60,600 cfm for plant vent.

= 10,200 cfm for the fuel-handling building.

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

$$\left[\frac{\text{sec-ft}^3}{\text{min-cc}}\right]$$

SF = An engineering factor used to provide a margin of safety for cumulated measurement uncertainties. = 0.5

3.1.1.5 Determine CR, the calculated monitor count rate above background attributed to the noble gas radionuclides [cpm], by:

$$CR = (C_m)(E_m) \qquad (3.1\text{-}5)$$

where:

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:

$$HSP = CR + \text{background} \qquad (3.1\text{-}6)$$

3.1.2 Setpoint Based on Sample Analysis Prior to Release

The following method applies to gaseous releases when determining the high-alarm setpoint with prior sample analysis and using the maximum acceptable effluent flow rate at the point of release. The method applies to the following conditions.

Batch Releases

- Containment purge.*
- Containment pressure relief.
- Waste gas decay tanks.

Continuous Releases

- Plant vent.
- Fuel handling basement exhaust.
- Environmental and Radiation Control Building Hood Exhaust.
- Containment purge.
- Radwaste Building exhaust vent.

* Batch containment purge is considered as 1 volume of containment air removed.

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

$$R_i = 472 (C_i)(F) \qquad (3.1\text{-}7)$$

where:

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

C_i = The radioactivity concentration of noble gas radionuclide "i" from analysis of gaseous effluent (µCi/cc) from the Plant Vent (stack), Fuel Handling Basement Exhaust, Environmental & Radiation Control (E&RC) Building Hood Exhaust, Radwaste Building Exhaust Vent and the Containment Vessel when R-12 is sampling from the Containment. If there are no isotopes identified in the sample, the EC for Xe-133 may be used as an actual value for the purpose of the setpoint calculation.

Containment Purge--

($\mu Ci/cc_i$ from analysis of Containment Vent) (0.366) +
($\mu Ci/cc_i$ from analysis of Plant Vent) (0.634)

Containment Pressure Relief--

($\mu Ci/cc_i$ from analysis of Containment Vent) (0.040) +
($\mu Ci/cc_i$ from analysis of Plant Vent) (0.960)

Waste Gas Decay Tanks--

($\mu Ci/cc_i$ from analysis of WGDT) (0.0016) +
($\mu Ci/cc_i$ from analysis of Plant Vent) (0.9984)

Waste Gas Decay Tanks during Containment Purge--

(μCi/cc$_i$ from analysis of WGDT) (0.0010) +

(μCi/cc$_i$ from analysis of Plant Vent) (0.633) +

(μCi/cc$_i$ from analysis of C.V.) (0.366)

0.366 =	Dilution correction factor for C.V. Purge	$= \frac{}{(60{,}600+35{,}000)\ \text{CFM}}$
0.634 =	Dilution correction factor for Plant Vent during C.V. Purge	$= \frac{}{(60{,}600 + 35{,}000)\ \text{CFM}}$
0.040 =	Dilution correction factor for C.V. Pressure Relief	$= \frac{}{(60{,}600 + 2500^{*})\ \text{CFM}}$
0.960 =	Dilution correction factor for Plant Vent during C.V. Pressure Relief	$= \frac{}{(60{,}600 + 2500^{*})\ \text{CFM}}$
0.0016 =	Dilution correction factor for Waste Gas Decay Tank	$= \frac{}{(60{,}600 + 100)\ \text{CFM}}$
0.9984 =	Dilution correction factor for Plant Vent during WGDT Release	$= \frac{}{(60{,}600 + 100)\ \text{CFM}}$
0.0010 =	Dilution correction factor for Waste Gas Decay Tank during a Continuous C.V. Purge and Plant Vent Release	$= \frac{}{(60{,}600 + 35{,}000 + 100)\ \text{CFM}}$
0.633 =	Dilution correction factor for Plant Vent during a Continuous C.V. Purge and Plant Vent Release	$= \frac{}{(60{,}600 + 35{,}000 + 100)\ \text{CFM}}$
0.366 =	Dilution correction factor for Continuous C.V. Purge during WGDT Release	$= \frac{}{(60{,}600 + 35{,}000 + 100)\ \text{CFM}}$

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

= 60,600 CFM for the plant vent

= 10,200 CFM for the fuel handling basement exhaust

= 11,500 CFM for the E&RC building hood exhaust

= 15,000 CFM for the Radwaste Building exhaust vent

= 95,600 CFM for the containment vessel purge plus plant vent

= 63,100 CFM for the containment vessel pressure relief

= 60,700 CFM for the waste gas decay tank

= 95,700 CFM for the waste gas decay tank during a continuous containment vessel purge

= 35,000 CFM for containment vessel purge or continuous release

= 2500 CFM for containment vessel pressure relief releases

*2500 CFM--Refer to Appendix B.3 for additional information

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

a. Determine dose rate for total body (mrem/yr).

$$DR_{TB} = (\overline{X/Q})\ \Sigma_i\ K_i\ R_i \qquad (3.1\text{-}8)$$

where:

$\overline{X/Q}$ = 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.

= 8.1 E-5 sec/m^3 (continuous ground release) from Table A-1, Appendix A. To be conservative this can be used for all releases.

= 9.9 E-7 sec/m^3 (continuous mixed mode release) from Table A-10, Appendix A, only with upper wind speeds of $\leq$ 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.

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

b. Determine dose rate for skin (mrem/yr).

$$DR_{SK} = (\overline{X/Q})\ \Sigma_i\ (L_i + 1.1M_i)\ R_i \qquad (3.1\text{-}9)$$

where:

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

c. Determine the noble gas emission Projected Dose Rate Ratio (PDRR) for Total Body and Skin.

$$PDRR_{TB} = \frac{DR_{TB}}{500} \qquad 3.1-10$$

$$PDRR_{SKIN} = \frac{DR_{SKIN}}{3000} \qquad 3.1-11$$

where:

500 = The allowable total body dose rate due to noble gas gamma emissions in mrem/yr.

3000 = The allowable skin dose rate due to noble gas beta emissions in mrem/yr.

d. Determine the maximum monitor setpoint concentration (μCi/cc) for total body and skin.

$$\text{MAXIMUM MONITOR TOTAL BODY SETPOINT} = \frac{(\Sigma_i\ Ci)}{(PDRR_{TB})}(SF)\,(T_m) \qquad 3.1-10$$

$$\text{MAXIMUM MONITOR SKIN SETPOINT} = \frac{(\Sigma_i\ Ci)}{(PDRR_{SKIN})}(SF)\,(T_m) \qquad 3.1-11$$

where:

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

= 0.5

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.

= 0.92 for the Plant Vent Gas Monitor (R-14C).

= 0.05 for the Fuel Handling Basement Exhaust Monitor (R-20).

= 0.01 for other potential release points.

= 0.01 for the E&RC Building Hood Exhaust Monitor (R-22).

= 0.01 for the Radwaste Building exhaust vent Monitor (R-23).

= 0.81 for C.V. releases via R-11 and R-12
[This indicates 0.81 of 10 CFR 20 limits for Containment releases and is also monitored by R-14C. 0.92 = 0.81 + 0.11 (Normal Plant Releases)]

e. Determine the maximum monitor setpoint (CPM) for total body (S_t) and skin (S_s).

S_t = (Maximum total body setpoint in μCi/cc) (monitor efficiency) + Bkg (3.1-14)

S_s = (Maximum skin setpoint in μCi/cc) (monitor efficiency) + Bkg 3.1-15)

Monitor efficiency = Obtained from the applicable effluent monitor efficiency curve located in the Plant Operating Manual, Volume 15, Curve Book. Use the radioactivity concentration (μCi/cc) to find (CPM).

Bkg = The monitor background.

f. 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*

Radionuclide	Plant Vent Release[1] A_i (Ci/yr)	Plant Vent Release[1] S_i	Condenser Vacuum Pump Vent[2] A_i (Ci/yr)	Condenser Vacuum Pump Vent[2] S_i	Containment Purge or Pressure Relief A_i (Ci/yr)	Containment Purge or Pressure Relief S_i	Gas Decay Tanks[3] A_i (Ci/yr)	Gas Decay Tanks[3] 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
Xe-135	4.0E0	1.05E-1	2.0E0	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 (not actual releases) from the evaluation of H.B. Robinson Unit 2 to demonstrate conformance to the design objectives of 10 CFR 50, 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 (R-14C).

[2]These values are used to determine the monitor alarm setpoint for the Condenser Vacuum Pump Vent Monitor (R-15). R-15 is a process monitor and its effluents are monitored by R-14A, R-14B and R-14C. This column is intentionally left for reference.

[3]These values are used to determine the monitor alarm setpoint for the Fuel Handling Basement Exhaust Monitor (R-20).

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 Requirements for 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

CONTROLS

3.2.1 The dose rate due to radioactive materials in gaseous effluents released from the site boundary (see Figure 7-1) shall be limited to the following:

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

b. For I-131, I-133, and tritium, and for all radioactive materials in particulate form, inhalation pathway only, with half lives greater than 8 days: ≤1500 mrem/yr to any organ.

ACTIONS

3.2.2 With the dose rate(s) exceeding the above limits, without delay decrease the release rate to within the above limits. In addition, a notification must be made to the Commission in accordance with 10 CFR 50.72 and 10 CFR 50.73.

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 2, 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 2 of 10 CFR Part 20, (10 CFR Part 20.1302). 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 ≤500 mrem/year to the total body or to ≤3000 mrem/year to the skin.

3.3 COMPLIANCE WITH 10 CFR 20 (GASEOUS)

3.3.1 Noble Gases

The gaseous effluent monitors setpoints are utilized to show compliance with 10 CFR 20 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 10 CFR 20 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 10 CFR 20.

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 10 CFR 20.

$$\Sigma_i \; K_i \; [\,(\overline{X/Q})_v \; \dot{Q}_{iv} + (\overline{X/Q})_e \; \dot{Q}_{ie}] \leq 500 \text{ mrem/yr} \quad (3.3\text{-}1)$$

$$\Sigma_i \; (L_i + 1.1 \; M_i)\,[(\overline{X/Q})_v \; \dot{Q}_{iv} + (\overline{X/Q})_e \; \dot{Q}_{ie}] \leq 3000 \text{ mrem/yr} \quad (3.3\text{-}2)$$

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 used for additional conservatism.

= From Table A-10 for mixed mode releases.

$(\overline{X/Q})_e$ = Annual average relative dilution for the Fuel Handling Basement Exhaust, the Environmental and Radiation Control Building Exhaust, and Radwaste Building Exhaust 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 radwaste building exhaust vent, fuel handling basement exhaust, and the environmental and radiation control building hood exhaust, $\mu Ci/sec$.

$\dot{Q}_{iv}$ = 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 10 CFR 20 for noble gases is a function of the radionuclide mix, release rate, and the meteorology. For the most limiting location, the radionuclide mix will be based on sample analysis of the effluent gases.

The X/Q value utilized in the equations for implementation of 10 CFR 20 is based upon the maximum long-term annual average ($\overline{X/Q}$) in the unrestricted area. Table 3.3-2 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 3.3-2 are presented in Appendix A. A description of their derivation is also provided in 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 10 CFR 20 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 3.3-1 and 3.3-2 to show compliance with 10 CFR 20, are presented in Table 3.3-3. These values were taken from Table B-1 of NRC Regulatory Guide 1.109, Revision 1. The values have been multiplied by 1.0E6 to convert picocuries to microcuries for use in expressions 3.3-1 and 3.3-2.

3.3.2 Radioiodines, Particulates, and Tritium

The dose rate in an 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 10 CFR 20.

$$\Sigma_i \; P_{il} \; [\,(\overline{X/Q})_v \; \dot{Q}_{iv} + (\overline{X/Q})_e \; \dot{Q}_{ie}] \leq 1500 \text{ mrem/yr} \quad (3.3\text{-}3)$$

where:

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

$\dot{Q}_{ie}$ = Release rate of radionuclide "i" from the radwaste building exhaust vent, fuel handling building basement exhaust, and environmental and radiation control building exhaust, μCi/sec.

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

$(\overline{X/Q})_e$ = Annual average relative dilution for fuel handling building basement exhaust, environmental and radiation control building exhaust, and radwaste building exhaust vent releases at the site boundary, sec/m^3.

P_{iI} = The dose parameter for Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days for the inhalation pathway only in the most restrictive sector in mrem/yr per μCi/m^3. The dose factor is based on the most restrictive group (child) and most restrictive organ at the SITE BOUNDARY (see Table 3.3-4).

where:

In the calculation to show compliance with 10 CFR 20, only the inhalation is considered. A description of the methodology used in calculating the P_i values is presented in Appendix B. Compliance with 10 CFR 20 is achieved if the dose rate via inhalation pathway to a child is $\leq$ 1500 mrem/year.

TABLE 3.3-1

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 Conformance to the Design Objectives of 10 CFR 50, Appendix I. These values are only for routine releases and not for a complete inventory of gases in an emergency. Condenser vacuum pump vent is intentionally left in for reference.

TABLE 3.3-2

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 3.3-3

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	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

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

TABLE 3.3-4
P_i VALUES FOR A CHILD FOR
H.B. ROBINSON UNIT NO. 2[1]

Nuclide	P_i Bone	P_i Liver	P_i T.Body	P_i Thyroid	P_i Kidney	P_i Lung	P_i GI-Tract	P_i Skin
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
F-18	6.96E+03	0.00E+00	6.85E+02	0.00E+00	0.00E+00	0.00E+00	1.25E+03	0.00E+00
NA-24	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03	0.00E+00
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04	0.00E+00
MN-56	0.00E+00	1.66E+00	3.12E-01	0.00E+00	1.67E+00	1.31E+04	1.23E+05	0.00E+00
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03	0.00E+00
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04	0.00E+00
CO-57	0.00E+00	9.03E+02	1.07E+03	0.00E+00	0.00E+00	5.07E+05	1.32E+04	0.00E+00
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04	0.00E+00
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04	0.00E+00
NI-65	2.99E+00	2.96E-01	1.64E-01	0.00E+00	0.00E+00	8.18E+03	8.40E+04	0.00E+00
CU-64	0.00E+00	1.99E+00	1.07E+00	0.00E+00	6.03E+00	9.58E+03	3.67E+04	0.00E+00
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04	0.00E+00
BR-82	0.00E+00	0.00E+00	2.09E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	5.48E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03	0.00E+00
RB-88	0.00E+00	5.62E+02	3.66E+02	0.00E+00	0.00E+00	0.00E+00	1.72E+01	0.00E+00
RB-89	0.00E+00	3.45E+02	2.90E+02	0.00E+00	0.00E+00	0.00E+00	1.89E+00	0.00E+00
SR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05	0.00E+00
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05	0.00E+00
SR-91	1.21E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	5.33E+04	1.74E+05	0.00E+00
SR-92	1.31E+01	0.00E+00	5.25E-01	0.00E+00	0.00E+00	2.40E+04	2.42E+05	0.00E+00
Y-91M	5.07E-01	0.00E+00	1.84E-02	0.00E+00	0.00E+00	2.81E+03	1.72E+03	0.00E+00
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05	0.00E+00
Y-92	2.04E+01	0.00E+00	5.81E-01	0.00E+00	0.00E+00	2.39E+04	2.39E+05	0.00E+00
Y-93	1.86E+02	0.00E+00	5.11E+00	0.00E+00	0.00E+00	7.44E+04	3.89E+05	0.00E+00
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04	0.00E+00
ZR-97	1.88E+02	2.72E+01	1.60E+01	0.00E+00	3.88E+01	1.13E+05	3.51E+05	0.00E+00

[1] (a) NUREG 0133, Section 5.2.1.1 (Calculation of P_i (Inhalation)).
(b) Regulatory Guide 1.109 Table E-5, Table E-9 (Breathing Rate Constant and Inhalation do factors).
(c) Units are mrem/yr per $\mu Ci/m^3$

TABLE 3.3-4 (continued)

Nuclide	P_i Bone	P_i Liver	P_i T.Body	P_i Thyroid	P_i Kidney	P_i Lung	P_i GI-Tract	P_i Skin
NB-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04	0.00E+00
NB-97	4.29E-01	7.70E-02	3.50E-02	0.00E+00	8.55E-02	3.42E+03	2.78E+16	0.00E+00
MO-99	0.00E+00	1.72E+02	4.25E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05	0.00E+00
TC-99M	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03	0.00E+00
TC-101	8.10E-05	8.51E-05	1.08E-03	0.00E+00	1.45E-03	5.85E+02	1.63E+01	0.00E+00
RU-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04	0.00E+00
RU-105	1.53E+00	0.00E+00	5.55E-01	0.00E+00	1.34E+00	1.59E+04	9.95E+04	0.00E+00
RU-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05	0.00E+00
AG-110M	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05	0.00E+00
SN-113	8.99E+03	2.90E+02	9.81E+03	1.19E+02	2.03E+02	3.40E+05	7.44E+03	0.00E+00
SB-124	5.74E+04	7.40E+02	2.00E+04	1.26E+02	0.00E+00	3.24E+06	1.64E+05	0.00E+00
SB-125	9.84E+04	7.59E+02	2.07E+04	9.10E+01	0.00E+00	2.32E+06	4.03E+04	0.00E+00
TE-129M	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05	0.00E+00
TE-129	9.77E-02	3.50E-02	2.38E-02	7.14E-02	2.57E-01	2.93E+03	2.55E+04	0.00E+00
TE-131M	1.34E+02	5.92E+01	5.07E+01	9.77E+01	4.00E+02	2.06E+05	3.08E+05	0.00E+00
TE-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05	0.00E+00
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03	0.00E+00
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	0.00E+00	3.20E+03	0.00E+00
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03	0.00E+00
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	0.00E+00	9.55E+02	0.00E+00
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03	0.00E+00
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03	0.00E+00
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03	0.00E+00
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03	0.00E+00
CS-138	6.33E+02	8.40E+02	5.55E+02	0.00E+00	6.22E+02	6.81E+01	2.70E+02	0.00E+00
BA-139	1.84E+00	9.84E-04	5.36E-02	0.00E+00	8.62E-04	5.77E+03	5.77E+04	0.00E+00
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05	0.00E+00
BA-142	4.99E-02	3.60E-05	2.79E-03	0.00E+00	2.91E-05	1.64E+03	2.74E+00	0.00E+00
LA-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05	0.00E+00
LA-142	1.29E+00	4.11E-01	1.29E-01	0.00E+00	0.00E+00	8.70E+03	7.59E+04	0.00E+00
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04	0.00E+00
CE-143	3.66E+02	1.99E+02	2.87E+01	0.00E+00	8.36E+01	1.15E+05	1.27E+05	0.00E+00
CE-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05	0.00E+00
PR-144	5.96E-02	1.85E-02	3.00E-03	0.00E+00	9.77E-03	1.57E+03	1.97E+02	0.00E+00
HF-181	8.33E+04	3.28E+02	8.47E+03	2.76E+02	2.63E+02	7.96E+05	5.29E+04	0.00E+00
W-187	1.63E+01	9.66E+00	4.33E+00	0.00E+00	0.00E+00	4.11E+04	9.10E+04	0.00E+00
NP-239	4.66E+02	3.34E+01	2.35E+01	0.00E+00	9.73E+01	5.81E+04	6.40E+04	0.00E+00

3.4 Requirements for 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 10 CFR 50 for radionoble gases released in gaseous effluents to unrestricted areas.

Specification

CONTROLS

3.4.1 The air dose commitment due to radionoble gases released in gaseous effluents to areas at and beyond the site boundary (See Figure 7-1) shall be limited, at all times, to the following:

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

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

ACTIONS

3.4.2 With the calculated air dose commitment from radioactive noble gases in gaseous effluents exceeding any of the limits, prescribed by ODCM Specification 3.4.1 above, prepare and submit a report to the Commission in accordance with the ODCM Specification 9.3.

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 Control implementing 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 reasonable 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.

3.5 COMPLIANCE WITH 10 CFR 50 (GASEOUS)

3.5.1 Noble Gases

3.5.1.1 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:

$$D_\gamma = 3.17 \times 10^{-8} \Sigma_i M_i [(\overline{X/Q})_v \overline{Q}_{iv} + (\overline{X/q})_v \overline{q}_{iv} + (\overline{X/Q})_e \overline{Q}_{ie}] \quad (3.5\text{-}1)$$

$$D_\beta = 3.17 \times 10^{-8} \Sigma_i N_i [(\overline{X/Q})_v \overline{Q}_{iv} + (\overline{X/q})_v \overline{q}_{iv} + (\overline{X/Q})_e \overline{Q}_{ie}] \quad (3.5\text{-}2)$$

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 used for conservatism.

= From Table A-10 for mixed mode releases.

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

= From Table A-1 for ground level continuous release for conservatism.

= 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 fuel handling basement exhaust, the environmental and radiation control building exhaust, and radwaste building exhaust vent releases at the site boundary, (> 500 hours/year), sec/m^3.

= From Table A-1 for ground level releases;

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

$\overline{Q}_{ie}$ = The average release of noble gas radionuclide "i" in gaseous releases for long-term fuel handling basement exhaust, the environmental and radiation control building exhaust, and radwaste building exhaust (> 500 hours/year), μCi;

$\overline{Q}_{iv}$ = 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 short-term X/Q value into Equation 3.5-1 yields lower dose value than the long-term X/Q values used. In order to be conservative, for purposes of this document only, long-term annual average ($\overline{X/Q}$) values will be used. Should the calculated doses exceed 10 CFR 50 limits, recalculation of doses may be performed using short-term X/Q values for batch releases.

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 10 CFR 20 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 3.5-1 to show compliance with 10 CFR 50 were presented in Table 3.3-3. 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 ODCM Specification 3.4.1.

For the calendar quarter:

$$D_\gamma \leq 5 \text{ mrad} \qquad (3.5\text{-}3)$$

$$D_\beta \leq 10 \text{ mrad} \qquad (3.5\text{-}4)$$

For the calendar year:

$$D_\gamma \leq 10 \text{ mrad} \qquad (3.5\text{-}5)$$

$$D_\beta \leq 20 \text{ mrad} \qquad (3.5\text{-}6)$$

The quarterly limits given above represent one-half of the annual design objectives of Section II.B.1 of Appendix I of 10 CFR 50. If any of the limits of Equations 3.5-3 through 3.5-6 are exceeded, a special report pursuant to ODCM Specification 9.3 must be filed with the NRC. This report complies with Section IV.A of Appendix I of 10 CFR 50.

3.5.1.2 Projection of Doses

Doses resulting from the release of gaseous effluents will be projected once per 31 days. These projections will include a safety margin based upon expected operational conditions which will take into consideration both planned and unplanned releases.

Projected dose will be calculated as follows:

$$PD = \frac{31\,(DA + DB)}{(TE)} + M \qquad (3.5-7)$$

where:

PD = Projected doses in mrem.

DA = Dose accumulated during current quarter in mrem.

DB = Projected dose from this release.

TE = Time elapsed in quarter in days.

M = Safety margin in mrem.

If the projected doses exceed 0.6 mrad for gamma radiation or 1.3 mrad for beta radiation when averaged over a calendar quarter, the ventilation exhaust treatment system will be operated to reduce releases of radioactive materials.

3.5.2 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 10 CFR 50 for radioiodines, radioactive materials in particulate form, and radionuclides other than radionoble gases released from the site to unrestricted areas.

Specification

CONTROLS

3.5.2.1 The dose to a member of the public from I-131, I-133, tritium and radioactive materials in particulate form, with half-lives greater than 8 days in gaseous effluents released to unrestricted areas (See Figure 7-1), shall be limited, at all times, to the following:

a. During any calendar quarter, ≤7.5 mrem to an organ and,

b. During any calendar year, ≤15 mrem to any organ.

ACTIONS

3.5.2.2 With the calculated dose commitment from the release of I-131, I-133, tritium and radioactive materials in particulate form, with half lives greater than 8 days, in gaseous effluents exceeding any of the limits prescribed by ODCM Specification 3.5.2.1 above, prepare and submit a report to the Commission in accordance with ODCM Specfication 9.3.

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 Control 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", Revision 1, July 1977. The ODCM equations provided for determining the commitment are based upon historical average atmospheric conditions.

3.5.3 Radioiodine, Particulates and Tritium

3.5.3.1 Cumulation of Doses

Section II.C of Appendix I of 10 CFR 50 limits the release of radioiodines and radioactive material in particulate form from each reactor such that estimated annual 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:

$$D_\tau = 3.17 \times 10^{-8} \Sigma_i R_{i_I} [(\overline{X/Q})_v Q_{iv} + (\overline{X/Q})_e Q_{ie} + (\overline{X/q})_v q_{iv}] +$$

$$(R_{i_B} + R_{i_M} + R_{iv} + R_{iG}) [(\overline{D/Q})_v Q_{iv} + (\overline{D/q})_v q_{iv} + (\overline{D/Q})_e Q_{ie}] +$$

$$(R_{T_M} + R_{T_B} + R_{T_I} R_{Tv}) [(\overline{X/Q})_v Q_{TV} + (\overline{X/q})_v q_{TV} + (\overline{X/Q})_e Q_{TE}] \quad (3.5\text{-}8)$$

where:

D_τ	=	Dose to any organ τ from I-131, I-133, particulates with ≥ 8 day half-lives, and Tritium in 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 for conservatism.
	=	From Table A-10 for mixed mode releases.
$(\overline{X/Q})_e$	=	Annual average dilution for radwaste building vent, fuel handling basement exhaust, and the environmental and radiation control building hood exhaust releases (> 500 hours/yr), sec/m^3.
	=	From Table A-1 for ground level releases.
$(\overline{X/q})_v$	=	Annual average relative concentration for plant vent releases (≤ 500 hrs/yr), sec/m^3.
	=	From Table A-7 for ground release.
	=	From Table A-16 for mixed mode 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 for conservatism.

= From Table A-12 for mixed mode releases.

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

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

= From Table A-9 for ground level releases.

= From Table A-18 for mixed mode releases.

$(\overline{D/Q})_e$ = Annual average relative deposition factor for radwaste building vent, fuel handling basement exhaust, and the environmental and radiation control building hood exhaust 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 radwaste building vent, fuel handling basement exhaust, and the environmental and radiation control building hood exhaust 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_{iG} = Dose factor for an organ for radionuclide "i" for the ground plane exposure pathway, mrem/yr per μCi/sec per m^{-2}.

R_{iI} = Dose factor for an organ for radionuclide "i" for the inhalation pathway, mrem/yr per μCi/m^3.

R_{iV} = Dose factor for an organ for radionuclide "i" for the vegetable pathway, mrem/yr per μCi/m^{-2}.

R_{TV} = Dose factor for an organ for tritium for the vegetable pathway, mrem/yr per μCi/m^3.

R_{TI} = Dose factor for an organ for tritium for the inhalation pathway, mrem/yr per μCi/m^3.

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

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

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

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

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

Q_{Te} = Release of tritium in gaseous effluents for long-term radwaste building vent, fuel handling basement exhaust, and the environmental and radiation control building hood exhaust (>500 hrs/ yr), μCi.

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

To show compliance with 10 CFR 50, Equation 3.5-8 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 3.5-8 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 10 CFR 50 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 3.3-1 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 3.3-2, 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 ODCM Specification 4.4.1 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 3.3-1. 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 3.3-2.

Tables 3.5-1 through 3.5-19 present R_i values for the total body, GI-tract, bone, liver , kidney, thyroid, skin, 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 ODCM Specification 3.5.2.1.

For the calendar quarter:

$$D_\tau \leq 7.5 \text{ mrem} \qquad (3.5\text{-}9)$$

For the calendar year:

$$D_\tau \leq 15 \text{ mrem} \qquad (3.5\text{-}10)$$

The quarterly limit given above represent one-half the annual design objectives of Section II.C of Appendix I of 10 CFR 50. If any of the limits of Equations 3.5-9 or 3.5-10 are exceeded, a special report pursuant ODCM Specification 9.3 must be filed with the NRC. This report complies with Section IV.A of Appendix I of 10 CFR 50.

3.5.2.2 Projection of Doses

Doses resulting from release of radioiodines and particulate effluents will be projected once per 31 days. These projections will include a safety margin based upon expected operational conditions which will take into consideration both planned and unplanned releases.

Projected dose will be calculated as follows:

$$PD = \frac{31\,(DA + DB)}{(TE)} + M \qquad (3.5\text{-}11)$$

where:

PD = Projected doses in mrem.

DA = Dose accumulated during current quarter in mrem.

DB = Projected dose from this release.

TE = Time elapsed in quarter in days.

M = Safety margin in mrem.

If the projected doses exceed 1.0 mrem to any organ when averaged over a calendar quarter, the ventilation exhaust treatment system will be operated to reduce releases of radioactive materials.

TABLE 3.5-1

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[1]

(Reference Regulatory Guide 1.109)

PATHWAY = Ground

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
F-18	3.96E+05	3.96E+05	3.96E+05	3.96E+05	3.96E+05	3.96E+05	3.96E+05	4.66E+05
NA-24	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.39E+07
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	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.62E+09
MN-56	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	1.07E+06
FE-59	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	3.21E+08
CO-57	1.88E+08	1.88E+08	1.88E+08	1.88E+08	1.88E+08	1.88E+08	1.88E+08	2.07E+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+08
CO-60	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.53E+10
NI-65	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	3.45E+05
CU-64	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.88E+05
ZN-65	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	8.59E+08
BR-82	2.14E+07	2.14E+07	2.14E+07	2.14E+07	2.14E+07	2.14E+07	2.14E+07	2.47E+07
BR-83	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	7.08E+03
BR-84	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.36E+05
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
RB-88	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.78E+04
RB-89	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.48E+05
SR-89	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.51E+04
SR-91	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.51E+06
SR-92	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	8.63E+05
Y-91M	1.00E+05	1.00E+05	1.00E+05	1.00E+05	1.00E+05	1.00E+05	1.00E+05	1.16E+05
Y-91	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.21E+06
Y-92	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	2.14E+05
Y-93	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	2.51E+05
ZR-95	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.84E+08
ZR-97	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	3.44E+06
NB-95	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.37E+08	1.61E+08
NB-97	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	2.07E+05
MO-99	3.99E+06	3.99E+06	3.99E+06	3.99E+06	3.99E+06	3.99E+06	3.99E+06	4.63E+06
TC-99M	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	2.11E+05
TC-101	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.26E+04

[1]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 3.5-1 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
RU-103	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.08E+08	1.26E+08
RU-105	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	7.21E+05
RU-106	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08	4.22E+08	5.07E+08
AG-110M	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09	4.01E+09
SN-113	1.42E+07	1.42E+07	1.42E+07	1.42E+07	1.42E+07	1.42E+07	1.42E+07	4.08E+07
SB-124	5.98E+08	5.98E+08	5.98E+08	5.98E+08	5.98E+08	5.98E+08	5.98E+08	6.90E+08
SB-125	2.34E+09	2.34E+09	2.34E+09	2.34E+09	2.34E+09	2.34E+09	2.34E+09	2.64E+09
TE-129M	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	2.31E+07
TE-129	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	3.10E+04
TE-131M	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	9.46E+06
TE-132	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.98E+06
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	1.25E+06	1.25E+06	1.25E+06	1.25E+06	1.25E+06	1.25E+06	1.25E+06	1.46E+06
I-133	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.98E+06
I-134	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	5.30E+05
I-135	2.53E+06	2.53E+06	2.53E+06	2.53E+06	2.53E+06	2.53E+06	2.53E+06	2.95E+06
CS-134	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	8.00E+09
CS-136	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.71E+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
CS-138	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	4.10E+05
BA-139	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.19E+05
BA-140	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.35E+07
BA-142	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	5.11E+04
LA-140	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07	1.92E+07	2.18E+07
LA-142	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	9.11E+05
CE-141	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.54E+07
CE-143	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.63E+06
CE-144	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	8.04E+07
PR-144	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	2.11E+03
HF-181	1.96E+08	1.96E+08	1.96E+08	1.96E+08	1.96E+08	1.96E+08	1.96E+08	2.80E+08
W-187	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.73E+06
NP-239	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.98E+06

TABLE 3.5-2

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[2]

(Reference Regulatory Guide 1.109)

PATHWAY = Vegetation

AGE GROUP = Adult

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03
F-18	4.22E+00	0.00E+00	4.68E-01	0.00E+00	0.00E+00	0.00E+00	1.25E-01	0.00E+00
NA-24	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05	0.00E+00
CR-51	0.00E+00	0.00E+00	4.59E+04	2.74E+04	1.01E+04	6.09E+04	1.15E+07	0.00E+00
MN-54	0.00E+00	3.08E+08	5.87E+07	0.00E+00	9.15E+07	0.00E+00	9.42E+08	0.00E+00
MN-56	0.00E+00	1.54E+01	2.74E+00	0.00E+00	1.96E+01	0.00E+00	4.93E+02	0.00E+00
FE-55	2.00E+08	1.38E+08	3.22E+07	0.00E+00	0.00E+00	7.70E+07	7.91E+07	0.00E+00
FE-59	1.24E+08	2.90E+08	1.11E+08	0.00E+00	0.00E+00	8.11E+07	9.68E+08	0.00E+00
CO-57	0.00E+00	1.01E+07	1.88E+07	0.00E+00	0.00E+00	0.00E+00	2.86E+08	0.00E+00
CO-58	0.00E+00	2.99E+07	6.70E+07	0.00E+00	0.00E+00	0.00E+00	6.06E+08	0.00E+00
CO-60	0.00E+00	1.67E+08	3.67E+08	0.00E+00	0.00E+00	0.00E+00	3.13E+09	0.00E+00
NI-65	5.97E+01	7.75E+00	3.54E+00	0.00E+00	0.00E+00	0.00E+00	1.97E+02	0.00E+00
CU-64	0.00E+00	9.19E+03	4.31E+03	0.00E+00	2.32E+04	0.00E+00	7.83E+05	0.00E+00
ZN-65	4.01E+08	1.28E+09	5.77E+08	0.00E+00	8.54E+08	0.00E+00	8.04E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	1.55E+06	0.00E+00	0.00E+00	0.00E+00	1.78E+06	0.00E+00
BR-83	0.00E+00	0.00E+00	3.10E+00	0.00E+00	0.00E+00	0.00E+00	4.47E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	2.21E-11	0.00E+00	0.00E+00	0.00E+00	1.73E-16	0.00E+00
RB-86	0.00E+00	2.21E+08	1.03E+08	0.00E+00	0.00E+00	0.00E+00	4.35E+07	0.00E+00
RB-88	0.00E+00	2.66E-22	1.41E-22	0.00E+00	0.00E+00	0.00E+00	3.67E-33	0.00E+00
RB-89	0.00E+00	2.90E-26	2.04E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-89	9.77E+09	0.00E+00	2.80E+08	0.00E+00	0.00E+00	0.00E+00	1.57E+09	0.00E+00
SR-90	6.71E+11	0.00E+00	1.65E+11	0.00E+00	0.00E+00	0.00E+00	1.94E+10	0.00E+00
SR-91	3.02E+05	0.00E+00	1.22E+04	0.00E+00	0.00E+00	0.00E+00	1.44E+06	0.00E+00
SR-92	4.15E+02	0.00E+00	1.79E+01	0.00E+00	0.00E+00	0.00E+00	8.22E+03	0.00E+00
Y-91M	4.76E-09	0.00E+00	1.84E-10	0.00E+00	0.00E+00	0.00E+00	1.40E-08	0.00E+00
Y-91	4.98E+06	0.00E+00	1.33E+05	0.00E+00	0.00E+00	0.00E+00	2.74E+09	0.00E+00
Y-92	8.96E-01	0.00E+00	2.62E-02	0.00E+00	0.00E+00	0.00E+00	1.57E+04	0.00E+00
Y-93	1.68E+02	0.00E+00	4.65E+00	0.00E+00	0.00E+00	0.00E+00	5.34E+06	0.00E+00
ZR-95	1.14E+06	3.66E+05	2.48E+05	0.00E+00	5.75E+05	0.00E+00	1.16E+09	0.00E+00
ZR-97	3.36E+02	6.78E+01	3.10E+01	0.00E+00	1.02E+02	0.00E+00	2.10E+07	0.00E+00
NB-95	1.40E+05	7.80E+04	4.19E+04	0.00E+00	7.71E+04	0.00E+00	4.73E+08	0.00E+00
NB-97	2.02E-06	5.11E-07	1.87E-07	0.00E+00	5.96E-07	0.00E+00	1.89E-03	0.00E+00
MO-99	0.00E+00	6.18E+06	1.18E+06	0.00E+00	1.40E+07	0.00E+00	1.43E+07	0.00E+00

[2]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 3.5-2 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	3.10E+00	8.75E+00	1.11E+02	0.00E+00	1.33E+02	4.29E+00	5.18E+03	0.00E+00
TC-101	6.00E-31	8.64E-31	8.47E-30	0.00E+00	1.56E-29	4.41E-31	0.00E+00	0.00E+00
RU-103	4.72E+06	0.00E+00	2.03E+06	0.00E+00	1.80E+07	0.00E+00	5.51E+08	0.00E+00
RU-105	5.30E+01	0.00E+00	2.09E+01	0.00E+00	6.85E+02	0.00E+00	3.24E+04	0.00E+00
RU-106	1.95E+08	0.00E+00	2.47E+07	0.00E+00	3.76E+08	0.00E+00	1.26E+10	0.00E+00
AG-110M	1.13E+07	1.05E+07	6.22E+06	0.00E+00	2.06E+07	0.00E+00	4.27E+09	0.00E+00
SN-113	1.43E+07	5.50E+05	1.35E+07	1.94E+05	4.04E+05	0.00E+00	2.49E+08	0.00E+00
SB-124	1.01E+08	1.91E+06	4.01E+07	2.45E+05	0.00E+00	7.88E+07	2.87E+09	0.00E+00
SB-125	1.34E+08	1.50E+06	3.20E+07	1.37E+05	0.00E+00	1.04E+08	1.48E+09	0.00E+00
TE-129M	2.94E+08	1.10E+08	4.65E+07	1.01E+08	1.23E+09	0.00E+00	1.48E+09	0.00E+00
TE-129	7.52E-04	2.83E-04	1.83E-04	5.77E-04	3.16E-03	0.00E+00	5.68E-04	0.00E+00
TE-131M	9.63E+05	4.71E+05	3.93E+05	7.46E+05	4.77E+06	0.00E+00	4.68E+07	0.00E+00
TE-132	4.58E+06	2.96E+06	2.78E+06	3.27E+06	2.85E+07	0.00E+00	1.40E+08	0.00E+00
I-131	8.07E+07	1.15E+08	6.61E+07	3.78E+10	1.98E+08	0.00E+00	3.04E+07	0.00E+00
I-132	5.57E+01	1.49E+02	5.21E+01	5.21E+03	2.37E+02	0.00E+00	2.80E+01	0.00E+00
I-133	2.08E+06	3.61E+06	1.10E+06	5.31E+08	6.31E+06	0.00E+00	3.25E+06	0.00E+00
I-134	8.84E-05	2.40E-04	8.59E-05	4.16E-03	3.82E-04	0.00E+00	2.09E-07	0.00E+00
I-135	3.85E+04	1.01E+05	3.72E+04	6.65E+06	1.62E+05	0.00E+00	1.14E+05	0.00E+00
CS-134	4.55E+09	1.08E+10	8.84E+09	0.00E+00	3.50E+09	1.16E+09	1.89E+08	0.00E+00
CS-136	4.26E+07	1.68E+08	1.21E+08	0.00E+00	9.36E+07	1.28E+07	1.91E+07	0.00E+00
CS-137	6.64E+09	9.08E+09	5.95E+09	0.00E+00	3.08E+09	1.03E+09	1.76E+08	0.00E+00
CS-138	3.39E-11	6.70E-11	3.32E-11	0.00E+00	4.92E-11	4.86E-12	2.86E-16	0.00E+00
BA-139	2.70E-02	1.93E-05	7.91E-04	0.00E+00	1.80E-05	1.09E-05	4.79E-02	0.00E+00
BA-140	1.28E+08	1.61E+05	8.40E+06	0.00E+00	5.47E+04	9.22E+04	2.64E+08	0.00E+00
LA-140	1.97E+03	9.95E+02	2.63E+02	0.00E+00	0.00E+00	0.00E+00	7.30E+07	0.00E+00
LA-142	1.92E-04	8.75E-05	2.18E-05	0.00E+00	0.00E+00	0.00E+00	6.39E-01	0.00E+00
CE-141	1.94E+05	1.31E+05	1.49E+04	0.00E+00	6.10E+04	0.00E+00	5.02E+08	0.00E+00
CE-143	9.96E+02	7.36E+05	8.15E+01	0.00E+00	3.24E+02	0.00E+00	2.75E+07	0.00E+00
CE-144	3.15E+07	1.32E+07	1.69E+06	0.00E+00	7.81E+06	0.00E+00	1.07E+10	0.00E+00
PR-144	2.36E-26	9.81E-27	1.20E-27	0.00E+00	5.53E-27	0.00E+00	3.40E-33	0.00E+00
HF-181	9.50E+06	5.36E+04	1.08E+06	3.40E+04	4.47E+04	0.00E+00	7.05E+08	0.00E+00
W-187	3.79E+04	3.17E+04	1.11E+04	0.00E+00	0.00E+00	0.00E+00	1.04E+07	0.00E+00
NP-239	1.43E+03	1.40E+02	7.73E+01	0.00E+00	4.37E+02	0.00E+00	2.88E+07	0.00E+00

TABLE 3.5-3

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[3]

(Reference Regulatory Guide 1.109)

PATHWAY = Vegetation

AGE GROUP = Teen

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03
F-18	3.83E+00	0.00E+00	4.20E-01	0.00E+00	0.00E+00	0.00E+00	3.45E-01	0.00E+00
NA-24	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05	0.00E+00
CR-51	0.00E+00	0.00E+00	6.09E+04	3.38E+04	1.34E+04	8.70E+04	1.02E+07	0.00E+00
MN-54	0.00E+00	4.47E+08	8.86E+07	0.00E+00	1.33E+08	0.00E+00	9.16E+08	0.00E+00
MN-56	0.00E+00	1.39E+01	2.48E+00	0.00E+00	1.76E+01	0.00E+00	9.17E+02	0.00E+00
FE-55	3.10E+08	2.20E+08	5.13E+07	0.00E+00	0.00E+00	1.40E+08	9.53E+07	0.00E+00
FE-59	1.76E+08	4.10E+08	1.58E+08	0.00E+00	0.00E+00	1.29E+08	9.70E+08	0.00E+00
CO-57	0.00E+00	1.72E+07	2.89E+07	0.00E+00	0.00E+00	0.00E+00	3.21E+08	0.00E+00
CO-58	0.00E+00	4.24E+07	9.78E+07	0.00E+00	0.00E+00	0.00E+00	5.85E+08	0.00E+00
CO-60	0.00E+00	2.48E+08	5.58E+08	0.00E+00	0.00E+00	0.00E+00	3.23E+09	0.00E+00
NI-65	5.56E+01	7.10E+00	3.23E+00	0.00E+00	0.00E+00	0.00E+00	3.85E+02	0.00E+00
CU-64	0.00E+00	8.33E+03	3.92E+03	0.00E+00	2.11E+04	0.00E+00	6.46E+05	0.00E+00
ZN-65	5.36E+08	1.86E+09	8.68E+08	0.00E+00	1.19E+09	0.00E+00	7.88E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	1.37E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	2.91E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	2.01E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.75E+08	1.29E+08	0.00E+00	0.00E+00	0.00E+00	4.07E+07	0.00E+00
RB-88	0.00E+00	2.46E-22	1.31E-22	0.00E+00	0.00E+00	0.00E+00	2.11E-29	0.00E+00
RB-89	0.00E+00	2.61E-26	1.84E-26	0.00E+00	0.00E+00	0.00E+00	4.00E-35	0.00E+00
SR-89	1.48E+10	0.00E+00	4.25E+08	0.00E+00	0.00E+00	0.00E+00	1.77E+09	0.00E+00
SR-90	8.33E+11	0.00E+00	2.06E+11	0.00E+00	0.00E+00	0.00E+00	2.34E+10	0.00E+00
SR-91	2.83E+05	0.00E+00	1.12E+04	0.00E+00	0.00E+00	0.00E+00	1.28E+06	0.00E+00
SR-92	3.86E+02	0.00E+00	1.65E+01	0.00E+00	0.00E+00	0.00E+00	9.84E+03	0.00E+00
Y-91M	4.43E-09	0.00E+00	1.69E-10	0.00E+00	0.00E+00	0.00E+00	2.09E-07	0.00E+00
Y-91	7.64E+06	0.00E+00	2.05E+05	0.00E+00	0.00E+00	0.00E+00	3.13E+09	0.00E+00
Y-92	8.42E-01	0.00E+00	2.43E-02	0.00E+00	0.00E+00	0.00E+00	2.31E+04	0.00E+00
Y-93	1.58E+02	0.00E+00	4.33E+00	0.00E+00	0.00E+00	0.00E+00	4.82E+06	0.00E+00
ZR-95	1.67E+06	5.28E+05	3.63E+05	0.00E+00	7.76E+05	0.00E+00	1.22E+09	0.00E+00
ZR-97	3.11E+02	6.15E+01	2.83E+01	0.00E+00	9.33E+01	0.00E+00	1.67E+07	0.00E+00
NB-95	1.89E+05	1.05E+05	5.78E+04	0.00E+00	1.02E+05	0.00E+00	4.49E+08	0.00E+00
NB-97	1.87E-06	4.65E-07	1.70E-07	0.00E+00	5.44E-07	0.00E+00	1.11E-02	0.00E+00
MO-99	0.00E+00	5.67E+06	1.08E+06	0.00E+00	1.30E+07	0.00E+00	1.02E+07	0.00E+00

[3]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 3.5-3 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	2.73E+00	7.62E+00	9.87E+01	0.00E+00	1.13E+02	4.23E+00	5.00E+03	0.00E+00
TC-101	5.58E-31	7.93E-31	7.79E-30	0.00E+00	1.43E-29	4.83E-31	1.36E-37	0.00E+00
RU-103	6.75E+06	0.00E+00	2.88E+06	0.00E+00	2.38E+07	0.00E+00	5.64E+08	0.00E+00
RU-105	4.93E+01	0.00E+00	1.91E+01	0.00E+00	6.22E+02	0.00E+00	3.98E+04	0.00E+00
RU-106	3.13E+08	0.00E+00	3.94E+07	0.00E+00	6.03E+08	0.00E+00	1.50E+10	0.00E+00
AG-110M	1.63E+07	1.54E+07	9.37E+06	0.00E+00	2.94E+07	0.00E+00	4.33E+09	0.00E+00
SN-113	1.88E+07	7.89E+05	2.00E+07	2.60E+05	5.58E+05	0.00E+00	2.26E+08	0.00E+00
SB-124	1.51E+08	2.78E+06	5.88E+07	3.42E+05	0.00E+00	1.32E+08	3.04E+09	0.00E+00
SB-125	2.11E+08	2.30E+06	4.92E+07	2.01E+05	0.00E+00	1.85E+08	1.64E+09	0.00E+00
TE-129M	4.23E+08	1.57E+08	6.69E+07	1.36E+08	1.77E+09	0.00E+00	1.59E+09	0.00E+00
TE-129	7.04E-04	2.63E-04	1.71E-04	5.03E-04	2.96E-03	0.00E+00	3.85E-03	0.00E+00
TE-131M	8.92E+05	4.28E+05	3.57E+05	6.43E+05	4.46E+06	0.00E+00	3.43E+07	0.00E+00
TE-132	4.16E+06	2.64E+06	2.48E+06	2.78E+06	2.53E+07	0.00E+00	8.35E+07	0.00E+00
I-131	7.67E+07	1.07E+08	5.77E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07	0.00E+00
I-132	5.02E+01	1.31E+02	4.72E+01	4.43E+03	2.07E+02	0.00E+00	5.73E+01	0.00E+00
I-133	1.93E+06	3.27E+06	9.99E+05	4.57E+08	5.74E+06	0.00E+00	2.48E+06	0.00E+00
I-134	7.99E-05	2.12E-04	7.61E-05	3.53E-03	3.34E-04	0.00E+00	2.79E-06	0.00E+00
I-135	3.48E+04	8.96E+04	3.32E+04	5.77E+06	1.42E+05	0.00E+00	9.93E+04	0.00E+00
CS-134	6.92E+09	1.63E+10	7.55E+09	0.00E+00	5.17E+09	1.97E+09	2.02E+08	0.00E+00
CS-136	4.36E+07	1.72E+08	1.15E+08	0.00E+00	9.35E+07	1.47E+07	1.38E+07	0.00E+00
CS-137	1.06E+10	1.41E+10	4.90E+09	0.00E+00	4.79E+09	1.86E+09	2.00E+08	0.00E+00
CS-138	3.13E-11	6.01E-11	3.01E-11	0.00E+00	4.44E-11	5.16E-12	2.73E-14	0.00E+00
BA-139	2.54E-02	1.79E-05	7.41E-04	0.00E+00	1.69E-05	1.23E-05	2.27E-01	0.00E+00
BA-140	1.38E+08	1.69E+05	8.87E+06	0.00E+00	5.72E+04	1.13E+05	2.12E+08	0.00E+00
LA-140	1.80E+03	8.86E+02	2.36E+02	0.00E+00	0.00E+00	0.00E+00	5.09E+07	0.00E+00
LA-142	1.77E-04	7.85E-05	1.95E-05	0.00E+00	0.00E+00	0.00E+00	2.39E+00	0.00E+00
CE-141	2.79E+05	1.86E+05	2.14E+04	0.00E+00	8.76E+04	0.00E+00	5.32E+08	0.00E+00
CE-143	9.31E+02	6.77E+05	7.56E+01	0.00E+00	3.04E+02	0.00E+00	2.04E+07	0.00E+00
CE-144	5.05E+07	2.09E+07	2.71E+06	0.00E+00	1.25E+07	0.00E+00	1.27E+10	0.00E+00
PR-144	2.22E-26	9.07E-27	1.12E-27	0.00E+00	5.20E-27	0.00E+00	2.44E-29	0.00E+00
HF-181	1.38E+07	7.58E+04	1.54E+06	4.62E+04	6.30E+04	0.00E+00	6.89E+08	0.00E+00
W-187	3.53E+04	2.87E+04	1.01E+04	0.00E+00	0.00E+00	0.00E+00	7.78E+06	0.00E+00
NP-239	1.38E+03	1.31E+02	7.25E+01	0.00E+00	4.10E+02	0.00E+00	2.10E+07	0.00E+00

TABLE 3.5-4

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[4]

(Reference Regulatory Guide 1.109)

PATHWAY = Vegetation
AGE GROUP = Child

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03
F-18	6.84E+00	0.00E+00	6.78E-01	0.00E+00	0.00E+00	0.00E+00	1.85E+00	0.00E+00
NA-24	3.72E+05	3.72E+05	3.72E+05	3.72E+05	3.72E+05	3.72E+05	3.72E+05	0.00E+00
CR-51	0.00E+00	0.00E+00	1.16E+05	6.42E+04	1.75E+04	1.17E+05	6.14E+06	0.00E+00
MN-54	0.00E+00	6.54E+08	1.74E+08	0.00E+00	1.83E+08	0.00E+00	5.49E+08	0.00E+00
MN-56	0.00E+00	1.82E+01	4.11E+00	0.00E+00	2.20E+01	0.00E+00	2.64E+03	0.00E+00
FE-55	7.63E+08	4.05E+08	1.25E+08	0.00E+00	0.00E+00	2.29E+08	7.50E+07	0.00E+00
FE-59	3.89E+08	6.30E+08	3.14E+08	0.00E+00	0.00E+00	1.83E+08	6.56E+08	0.00E+00
CO-57	0.00E+00	2.88E+07	5.83E+07	0.00E+00	0.00E+00	0.00E+00	2.36E+08	0.00E+00
CO-58	0.00E+00	6.27E+07	1.92E+08	0.00E+00	0.00E+00	0.00E+00	3.65E+08	0.00E+00
CO-60	0.00E+00	3.77E+08	1.11E+09	0.00E+00	0.00E+00	0.00E+00	2.09E+09	0.00E+00
NI-65	1.02E+02	9.60E+00	5.60E+00	0.00E+00	0.00E+00	0.00E+00	1.18E+03	0.00E+00
CU-64	0.00E+00	1.10E+04	6.63E+03	0.00E+00	2.65E+04	0.00E+00	5.15E+05	0.00E+00
ZN-65	1.03E+09	2.74E+09	1.70E+09	0.00E+00	1.72E+09	0.00E+00	4.81E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	2.10E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	5.36E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.41E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	4.55E+08	2.80E+08	0.00E+00	0.00E+00	0.00E+00	2.93E+07	0.00E+00
RB-88	0.00E+00	3.39E-22	2.36E-22	0.00E+00	0.00E+00	0.00E+00	1.66E-23	0.00E+00
RB-89	0.00E+00	3.43E-26	3.05E-26	0.00E+00	0.00E+00	0.00E+00	2.99E-28	0.00E+00
SR-89	3.52E+10	0.00E+00	1.01E+09	0.00E+00	0.00E+00	0.00E+00	1.36E+09	0.00E+00
SR-90	1.38E+12	0.00E+00	3.50E+11	0.00E+00	0.00E+00	0.00E+00	1.86E+10	0.00E+00
SR-91	5.20E+05	0.00E+00	1.96E+04	0.00E+00	0.00E+00	0.00E+00	1.15E+06	0.00E+00
SR-92	7.08E+02	0.00E+00	2.84E+01	0.00E+00	0.00E+00	0.00E+00	1.34E+04	0.00E+00
Y-91M	8.12E-09	0.00E+00	2.95E-10	0.00E+00	0.00E+00	0.00E+00	1.59E-05	0.00E+00
Y-91	1.82E+07	0.00E+00	4.86E+05	0.00E+00	0.00E+00	0.00E+00	2.42E+09	0.00E+00
Y-92	1.55E+00	0.00E+00	4.44E-02	0.00E+00	0.00E+00	0.00E+00	4.48E+04	0.00E+00
Y-93	2.91E+02	0.00E+00	7.98E+00	0.00E+00	0.00E+00	0.00E+00	4.34E+06	0.00E+00
ZR-95	3.75E+06	8.25E+05	7.34E+05	0.00E+00	1.18E+06	0.00E+00	8.60E+08	0.00E+00
ZR-97	5.68E+02	8.20E+01	4.84E+01	0.00E+00	1.18E+02	0.00E+00	1.24E+07	0.00E+00
NB-95	4.04E+05	1.57E+05	1.12E+05	0.00E+00	1.48E+05	0.00E+00	2.91E+08	0.00E+00
NB-97	3.41E-06	6.16E-07	2.88E-07	0.00E+00	6.84E-07	0.00E+00	1.90E-01	0.00E+00
SR-91	5.20E+05	0.00E+00	1.96E+04	0.00E+00	0.00E+00	0.00E+00	1.15E+06	0.00E+00
SR-92	7.08E+02	0.00E+00	2.84E+01	0.00E+00	0.00E+00	0.00E+00	1.34E+04	0.00E+00
Y-91M	8.12E-09	0.00E+00	2.95E-10	0.00E+00	0.00E+00	0.00E+00	1.59E-05	0.00E+00
Y-91	1.82E+07	0.00E+00	4.86E+05	0.00E+00	0.00E+00	0.00E+00	2.42E+09	0.00E+00
Y-92	1.55E+00	0.00E+00	4.44E-02	0.00E+00	0.00E+00	0.00E+00	4.48E+04	0.00E+00

[4]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 3.5-4 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
Y-93	2.91E+02	0.00E+00	7.98E+00	0.00E+00	0.00E+00	0.00E+00	4.34E+06	0.00E+00
ZR-95	3.75E+06	8.25E+05	7.34E+05	0.00E+00	1.18E+06	0.00E+00	8.60E+08	0.00E+00
ZR-97	5.68E+02	8.20E+01	4.84E+01	0.00E+00	1.18E+02	0.00E+00	1.24E+07	0.00E+00
NB-95	4.04E+05	1.57E+05	1.12E+05	0.00E+00	1.48E+05	0.00E+00	2.91E+08	0.00E+00
NB-97	3.41E-06	6.16E-07	2.88E-07	0.00E+00	6.84E-07	0.00E+00	1.90E-01	0.00E+00
MO-99	0.00E+00	7.75E+06	1.92E+06	0.00E+00	1.65E+07	0.00E+00	6.41E+06	0.00E+00
TC-99M	4.70E+00	9.21E+00	1.53E+02	0.00E+00	1.34E+02	4.68E+00	5.24E+03	0.00E+00
TC-101	1.03E-30	1.07E-30	1.36E-29	0.00E+00	1.83E-29	5.68E-31	3.41E-30	0.00E+00
RU-103	1.52E+07	0.00E+00	5.83E+06	0.00E+00	3.82E+07	0.00E+00	3.92E+08	0.00E+00
RU-105	9.02E+01	0.00E+00	3.27E+01	0.00E+00	7.93E+02	0.00E+00	5.89E+04	0.00E+00
RU-106	7.54E+08	0.00E+00	9.40E+07	0.00E+00	1.02E+09	0.00E+00	1.17E+10	0.00E+00
AG-110M	3.45E+07	2.33E+07	1.86E+07	0.00E+00	4.34E+07	0.00E+00	2.77E+09	0.00E+00
SN-113	3.60E+07	1.16E+06	3.93E+07	4.75E+05	7.96E+05	0.00E+00	1.44E+08	0.00E+00
SB-124	3.43E+08	4.46E+06	1.20E+08	7.58E+05	0.00E+00	1.91E+08	2.15E+09	0.00E+00
SB-125	4.91E+08	3.79E+06	1.03E+08	4.55E+05	0.00E+00	2.74E+08	1.17E+09	0.00E+00
TE-129M	9.83E+08	2.74E+08	1.53E+08	3.17E+08	2.89E+09	0.00E+00	1.20E+09	0.00E+00
TE-129	1.30E-03	3.64E-04	3.09E-04	9.30E-04	3.81E-03	0.00E+00	8.12E-02	0.00E+00
TE-131M	1.63E+06	5.63E+05	5.99E+05	1.16E+06	5.45E+06	0.00E+00	2.28E+07	0.00E+00
TE-132	7.46E+06	3.30E+06	3.99E+06	4.81E+06	3.07E+07	0.00E+00	3.32E+07	0.00E+00
I-131	1.43E+08	1.44E+08	8.16E+07	4.75E+10	2.36E+08	0.00E+00	1.28E+07	0.00E+00
I-132	8.92E+01	1.64E+02	7.53E+01	7.60E+03	2.51E+02	0.00E+00	1.93E+02	0.00E+00
I-133	3.52E+06	4.35E+06	1.65E+06	8.08E+08	7.25E+06	0.00E+00	1.75E+06	0.00E+00
I-134	1.42E-04	2.64E-04	1.21E-04	6.07E-03	4.03E-04	0.00E+00	1.75E-04	0.00E+00
I-135	6.18E+04	1.11E+05	5.27E+04	9.86E+06	1.71E+05	0.00E+00	8.48E+04	0.00E+00
CS-134	1.56E+10	2.56E+10	5.41E+09	0.00E+00	7.94E+09	2.85E+09	1.38E+08	0.00E+00
CS-136	8.22E+07	2.26E+08	1.46E+08	0.00E+00	1.20E+08	1.79E+07	7.94E+06	0.00E+00
CS-137	2.50E+10	2.39E+10	3.53E+09	0.00E+00	7.79E+09	2.80E+09	1.50E+08	0.00E+00
CS-138	5.69E-11	7.92E-11	5.02E-11	0.00E+00	5.57E-11	5.99E-12	3.65E-11	0.00E+00
BA-139	4.69E-02	2.50E-05	1.36E-03	0.00E+00	2.18E-05	1.47E-05	2.71E+00	0.00E+00
BA-140	2.76E+08	2.42E+05	1.61E+07	0.00E+00	7.87E+04	1.44E+05	1.40E+08	0.00E+00
LA-140	3.24E+03	1.13E+03	3.82E+02	0.00E+00	0.00E+00	0.00E+00	3.16E+07	0.00E+00
LA-142	3.20E-04	1.02E-04	3.20E-05	0.00E+00	0.00E+00	0.00E+00	2.02E+01	0.00E+00
CE-141	6.46E+05	3.22E+05	4.79E+04	0.00E+00	1.41E+05	0.00E+00	4.02E+08	0.00E+00
CE-143	1.71E+03	9.29E+05	1.35E+02	0.00E+00	3.90E+02	0.00E+00	1.36E+07	0.00E+00
CE-144	1.22E+08	3.82E+07	6.50E+06	0.00E+00	2.11E+07	0.00E+00	9.95E+09	0.00E+00
PR-144	4.11E-26	1.27E-26	2.07E-27	0.00E+00	6.73E-27	0.00E+00	2.74E-23	0.00E+00
HF-181	3.12E+07	1.22E+05	3.14E+06	1.03E+05	9.80E+04	0.00E+00	5.18E+08	0.00E+00
W-187	6.41E+04	3.80E+04	1.70E+04	0.00E+00	0.00E+00	0.00E+00	5.34E+06	0.00E+00
NP-239	2.56E+03	1.84E+02	1.29E+02	0.00E+00	5.31E+02	0.00E+00	1.36E+07	0.00E+00

TABLE 3.5-5

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[5]

(Reference Regulatory Guide 1.109)

PATHWAY = Meat

AGE GROUP = Adult

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	3.24E+02	3.24E+02	3.24E+02	3.24E+02	3.24E+02	3.24E+02	3.24E+02
NA-24	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	0.00E+00
CR-51	0.00E+00	0.00E+00	6.30E+03	3.76E+03	1.39E+03	8.36E+03	1.58E+06	0.00E+00
MN-54	0.00E+00	7.33E+06	1.40E+06	0.00E+00	2.18E+06	0.00E+00	2.24E+07	0.00E+00
FE-55	2.28E+08	1.58E+08	3.68E+07	0.00E+00	0.00E+00	8.81E+07	9.06E+07	0.00E+00
FE-59	2.28E+08	5.36E+08	2.05E+08	0.00E+00	0.00E+00	1.50E+08	1.79E+09	0.00E+00
CO-57	0.00E+00	4.01E+06	7.43E+06	0.00E+00	0.00E+00	0.00E+00	1.13E+08	0.00E+00
CO-58	0.00E+00	1.52E+07	3.40E+07	0.00E+00	0.00E+00	0.00E+00	3.07E+08	0.00E+00
CO-60	0.00E+00	5.96E+07	1.31E+08	0.00E+00	0.00E+00	0.00E+00	1.12E+09	0.00E+00
CU-64	0.00E+00	2.80E-07	1.31E-07	0.00E+00	7.05E-07	0.00E+00	2.38E-05	0.00E+00
ZN-65	3.20E+08	1.02E+09	4.60E+08	0.00E+00	6.81E+08	0.00E+00	6.42E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	1.25E+03	0.00E+00	0.00E+00	0.00E+00	1.43E+03	0.00E+00
RB-86	0.00E+00	4.53E+08	2.11E+08	0.00E+00	0.00E+00	0.00E+00	8.94E+07	0.00E+00
SR-89	2.57E+08	0.00E+00	7.37E+06	0.00E+00	0.00E+00	0.00E+00	4.12E+07	0.00E+00
SR-90	1.03E+10	0.00E+00	2.53E+09	0.00E+00	0.00E+00	0.00E+00	2.98E+08	0.00E+00
SR-91	1.58E-10	0.00E+00	6.39E-12	0.00E+00	0.00E+00	0.00E+00	7.53E-10	0.00E+00
Y-91	9.53E+05	0.00E+00	2.55E+04	0.00E+00	0.00E+00	0.00E+00	5.24E+08	0.00E+00
Y-93	4.87E-12	0.00E+00	1.35E-13	0.00E+00	0.00E+00	0.00E+00	1.55E-07	0.00E+00
ZR-95	1.57E+06	5.02E+05	3.40E+05	0.00E+00	7.88E+05	0.00E+00	1.59E+09	0.00E+00
ZR-97	2.11E-05	4.27E-06	1.95E-06	0.00E+00	6.44E-06	0.00E+00	1.32E+00	0.00E+00
NB-95	2.01E+06	1.12E+06	6.02E+05	0.00E+00	1.11E+06	0.00E+00	6.79E+09	0.00E+00
MO-99	0.00E+00	1.01E+05	1.92E+04	0.00E+00	2.28E+05	0.00E+00	2.33E+05	0.00E+00
TC-99M	4.76E-21	1.35E-20	1.71E-19	0.00E+00	2.04E-19	6.59E-21	7.96E-18	0.00E+00
RU-103	9.15E+07	0.00E+00	3.94E+07	0.00E+00	3.49E+08	0.00E+00	1.07E+10	0.00E+00
RU-105	6.30E-28	0.00E+00	2.49E-28	0.00E+00	8.15E-27	0.00E+00	3.86E-25	0.00E+00
RU-106	2.26E+09	0.00E+00	2.85E+08	0.00E+00	4.36E+09	0.00E+00	1.46E+11	0.00E+00
AG-110M	5.57E+06	5.15E+06	3.06E+06	0.00E+00	1.01E+07	0.00E+00	2.10E+09	0.00E+00
SN-113	3.94E+07	1.52E+06	3.73E+07	5.36E+05	1.12E+06	0.00E+00	6.89E+08	0.00E+00
SB-124	1.66E+07	3.14E+05	6.60E+06	4.03E+04	0.00E+00	1.30E+07	4.72E+08	0.00E+00
SB-125	1.51E+07	1.69E+05	3.59E+06	1.53E+04	0.00E+00	1.16E+07	1.66E+08	0.00E+00
TE-129M	1.07E+09	3.99E+08	1.69E+08	3.67E+08	4.46E+09	0.00E+00	5.38E+09	0.00E+00

[5]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 3.5-5 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TE-131M	4.66E+02	2.28E+02	1.90E+02	3.61E+02	2.31E+03	0.00E+00	2.26E+04	0.00E+00
TE-132	1.46E+06	9.44E+05	8.86E+05	1.04E+06	9.09E+06	0.00E+00	4.46E+07	0.00E+00
I-131	1.06E+07	1.51E+07	8.66E+06	4.95E+09	2.59E+07	0.00E+00	3.99E+06	0.00E+00
I-133	3.72E-01	6.47E-01	1.97E-01	9.51E+01	1.13E+00	0.00E+00	5.82E-01	0.00E+00
I-135	4.69E-17	1.23E-16	4.53E-17	8.10E-15	1.97E-16	0.00E+00	1.39E-16	0.00E+00
CS-134	5.18E+08	1.23E+09	1.01E+09	0.00E+00	3.99E+08	1.32E+08	2.16E+07	0.00E+00
CS-136	1.15E+07	4.54E+07	3.27E+07	0.00E+00	2.53E+07	3.46E+06	5.16E+06	0.00E+00
CS-137	7.04E+08	9.63E+08	6.31E+08	0.00E+00	3.27E+08	1.09E+08	1.86E+07	0.00E+00
BA-140	2.75E+07	3.45E+04	1.80E+06	0.00E+00	1.17E+04	1.98E+04	5.66E+07	0.00E+00
LA-140	3.74E-02	1.89E-02	4.99E-03	0.00E+00	0.00E+00	0.00E+00	1.38E+03	0.00E+00
CE-141	1.24E+04	8.37E+03	9.49E+02	0.00E+00	3.89E+03	0.00E+00	3.20E+07	0.00E+00
CE-143	2.03E-02	1.50E+01	1.66E-03	0.00E+00	6.61E-03	0.00E+00	5.61E+02	0.00E+00
CE-144	1.15E+06	4.82E+05	6.19E+04	0.00E+00	2.86E+05	0.00E+00	3.90E+08	0.00E+00
HF-181	1.79E+08	1.01E+06	2.03E+07	6.41E+05	8.41E+05	0.00E+00	1.33E+10	0.00E+00
W-187	2.08E-02	1.74E-02	6.09E-03	0.00E+00	0.00E+00	0.00E+00	5.71E+00	0.00E+00
NP-239	2.61E-01	2.56E-02	1.41E-02	0.00E+00	8.00E-02	0.00E+00	5.26E+03	0.00E+00

TABLE 3.5-6

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[6]

(Reference Regulatory Guide 1.109)

PATHWAY = Meat

AGE GROUP = Teen

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	1.93E+02	1.93E+02	1.93E+02	1.93E+02	1.93E+02	1.93E+02	1.93E+02
NA-24	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.11E-03	1.11E-03	0.00E+00
CR-51	0.00E+00	0.00E+00	5.04E+03	2.80E+03	1.10E+03	7.19E+03	8.46E+05	0.00E+00
MN-54	0.00E+00	5.59E+06	1.11E+06	0.00E+00	1.67E+06	0.00E+00	1.15E+07	0.00E+00
FE-55	1.86E+08	1.32E+08	3.07E+07	0.00E+00	0.00E+00	8.35E+07	5.69E+07	0.00E+00
FE-59	1.82E+08	4.25E+08	1.64E+08	0.00E+00	0.00E+00	1.34E+08	1.01E+09	0.00E+00
CO-57	0.00E+00	3.59E+06	6.02E+06	0.00E+00	0.00E+00	0.00E+00	6.70E+07	0.00E+00
CO-58	0.00E+00	1.17E+07	2.69E+07	0.00E+00	0.00E+00	0.00E+00	1.61E+08	0.00E+00
CO-60	0.00E+00	4.62E+07	1.04E+08	0.00E+00	0.00E+00	0.00E+00	6.02E+08	0.00E+00
CU-64	0.00E+00	2.28E-07	1.07E-07	0.00E+00	5.77E-07	0.00E+00	1.77E-05	0.00E+00
ZN-65	2.25E+08	7.82E+08	3.65E+08	0.00E+00	5.00E+08	0.00E+00	3.31E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	9.94E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	3.78E+08	1.78E+08	0.00E+00	0.00E+00	0.00E+00	5.60E+07	0.00E+00
SR-89	2.17E+08	0.00E+00	6.21E+06	0.00E+00	0.00E+00	0.00E+00	2.58E+07	0.00E+00
SR-90	6.68E+09	0.00E+00	1.65E+09	0.00E+00	0.00E+00	0.00E+00	1.88E+08	0.00E+00
SR-91	1.33E-10	0.00E+00	5.29E-12	0.00E+00	0.00E+00	0.00E+00	6.04E-10	0.00E+00
Y-91	8.03E+05	0.00E+00	2.15E+04	0.00E+00	0.00E+00	0.00E+00	3.29E+08	0.00E+00
Y-93	4.11E-12	0.00E+00	1.13E-13	0.00E+00	0.00E+00	0.00E+00	1.26E-07	0.00E+00
ZR-95	1.25E+06	3.96E+05	2.72E+05	0.00E+00	5.82E+05	0.00E+00	9.13E+08	0.00E+00
ZR-97	1.76E-05	3.49E-06	1.61E-06	0.00E+00	5.29E-06	0.00E+00	9.44E-01	0.00E+00
NB-95	1.57E+06	8.72E+05	4.80E+05	0.00E+00	8.45E+05	0.00E+00	3.73E+09	0.00E+00
MO-99	0.00E+00	8.33E+04	1.59E+04	0.00E+00	1.91E+05	0.00E+00	1.49E+05	0.00E+00
TC-99M	3.78E-21	1.05E-20	1.37E-19	0.00E+00	1.57E-19	5.85E-21	6.92E-18	0.00E+00
RU-103	7.45E+07	0.00E+00	3.18E+07	0.00E+00	2.63E+08	0.00E+00	6.22E+09	0.00E+00
RU-105	5.27E-28	0.00E+00	2.05E-28	0.00E+00	6.65E-27	0.00E+00	4.26E-25	0.00E+00
RU-106	1.90E+09	0.00E+00	2.39E+08	0.00E+00	3.66E+09	0.00E+00	9.11E+10	0.00E+00
AG-110M	4.21E+06	3.99E+06	2.43E+06	0.00E+00	7.60E+06	0.00E+00	1.12E+09	0.00E+00
SN-113	2.78E+07	1.16E+06	2.95E+07	3.84E+05	8.23E+05	0.00E+00	3.33E+08	0.00E+00
SB-124	1.36E+07	2.50E+05	5.30E+06	3.08E+04	0.00E+00	1.19E+07	2.74E+08	0.00E+00
SB-125	1.24E+07	1.35E+05	2.89E+06	1.18E+04	0.00E+00	1.09E+07	9.61E+07	0.00E+00
TE-129M	8.96E+08	3.32E+08	1.42E+08	2.89E+08	3.75E+09	0.00E+00	3.36E+09	0.00E+00
TE-131M	3.89E+02	1.86E+02	1.55E+02	2.80E+02	1.94E+03	0.00E+00	1.50E+04	0.00E+00

[6]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 3.5-6 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TE-132	1.19E+06	7.56E+05	7.12E+05	7.97E+05	7.25E+06	0.00E+00	2.40E+07	0.00E+00
I-131	8.78E+06	1.23E+07	6.60E+06	3.59E+09	2.12E+07	0.00E+00	2.43E+06	0.00E+00
I-133	3.11E-01	5.28E-01	1.61E-01	7.37E+01	9.26E-01	0.00E+00	3.99E-01	0.00E+00
I-135	3.82E-17	9.83E-17	3.64E-17	6.32E-15	1.55E-16	0.00E+00	1.09E-16	0.00E+00
CS-134	4.12E+08	9.69E+08	4.50E+08	0.00E+00	3.08E+08	1.18E+08	1.21E+07	0.00E+00
CS-136	8.97E+06	3.53E+07	2.37E+07	0.00E+00	1.92E+07	3.03E+06	2.84E+06	0.00E+00
CS-137	5.85E+08	7.78E+08	2.71E+08	0.00E+00	2.65E+08	1.03E+08	1.11E+07	0.00E+00
BA-140	2.27E+07	2.78E+04	1.46E+06	0.00E+00	9.44E+03	1.87E+04	3.50E+07	0.00E+00
LA-140	3.08E-02	1.51E-02	4.02E-03	0.00E+00	0.00E+00	0.00E+00	8.69E+02	0.00E+00
CE-141	1.04E+04	6.94E+03	7.97E+02	0.00E+00	3.27E+03	0.00E+00	1.98E+07	0.00E+00
CE-143	1.71E-02	1.24E+01	1.39E-03	0.00E+00	5.58E-03	0.00E+00	3.74E+02	0.00E+00
CE-144	9.71E+05	4.02E+05	5.22E+04	0.00E+00	2.40E+05	0.00E+00	2.44E+08	0.00E+00
HF-181	1.47E+08	8.06E+05	1.64E+07	4.91E+05	6.70E+05	0.00E+00	7.33E+09	0.00E+00
W-187	1.75E-02	1.42E-02	4.99E-03	0.00E+00	0.00E+00	0.00E+00	3.85E+00	0.00E+00
NP-239	2.28E-01	2.15E-02	1.19E-02	0.00E+00	6.75E-02	0.00E+00	3.46E+03	0.00E+00

TABLE 3.5-7

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[7]

(Reference Regulatory Guide 1.109)

PATHWAY = Meat

AGE GROUP = Child

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	2.33E+02	2.33E+02	2.33E+02	2.33E+02	2.33E+02	2.33E+02	2.33E+02
NA-24	1.77E-03	1.77E-03	1.77E-03	1.77E-03	1.77E-03	1.77E-03	1.77E-03	0.00E+00
CR-51	0.00E+00	0.00E+00	7.85E+03	4.36E+03	1.19E+03	7.96E+03	4.16E+05	0.00E+00
MN-54	0.00E+00	6.39E+06	1.70E+06	0.00E+00	1.79E+06	0.00E+00	5.37E+06	0.00E+00
FE-55	3.56E+08	1.89E+08	5.85E+07	0.00E+00	0.00E+00	1.07E+08	3.50E+07	0.00E+00
FE-59	3.23E+08	5.23E+08	2.60E+08	0.00E+00	0.00E+00	1.51E+08	5.44E+08	0.00E+00
CO-57	0.00E+00	4.69E+06	9.50E+06	0.00E+00	0.00E+00	0.00E+00	3.85E+07	0.00E+00
CO-58	0.00E+00	1.37E+07	4.18E+07	0.00E+00	0.00E+00	0.00E+00	7.97E+07	0.00E+00
CO-60	0.00E+00	5.49E+07	1.62E+08	0.00E+00	0.00E+00	0.00E+00	3.04E+08	0.00E+00
CU-64	0.00E+00	3.06E-07	1.85E-07	0.00E+00	7.41E-07	0.00E+00	1.44E-05	0.00E+00
ZN-65	3.38E+08	9.00E+08	5.60E+08	0.00E+00	5.67E+08	0.00E+00	1.58E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	1.56E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	5.37E+08	3.30E+08	0.00E+00	0.00E+00	0.00E+00	3.45E+07	0.00E+00
SR-89	4.10E+08	0.00E+00	1.17E+07	0.00E+00	0.00E+00	0.00E+00	1.59E+07	0.00E+00
SR-90	8.64E+09	0.00E+00	2.19E+09	0.00E+00	0.00E+00	0.00E+00	1.16E+08	0.00E+00
SR-91	2.50E-10	0.00E+00	9.42E-12	0.00E+00	0.00E+00	0.00E+00	5.51E-10	0.00E+00
Y-91	1.52E+06	0.00E+00	4.06E+04	0.00E+00	0.00E+00	0.00E+00	2.02E+08	0.00E+00
Y-93	7.73E-12	0.00E+00	2.12E-13	0.00E+00	0.00E+00	0.00E+00	1.15E-07	0.00E+00
ZR-95	2.23E+06	4.90E+05	4.36E+05	0.00E+00	7.01E+05	0.00E+00	5.11E+08	0.00E+00
ZR-97	3.28E-05	4.74E-06	2.80E-06	0.00E+00	6.80E-06	0.00E+00	7.18E-01	0.00E+00
NB-95	2.71E+06	1.06E+06	7.55E+05	0.00E+00	9.92E+05	0.00E+00	1.95E+09	0.00E+00
MO-99	0.00E+00	1.16E+05	2.87E+04	0.00E+00	2.47E+05	0.00E+00	9.58E+04	0.00E+00
TC-99M	6.63E-21	1.30E-20	2.15E-19	0.00E+00	1.89E-19	6.60E-21	7.40E-18	0.00E+00
RU-103	1.35E+08	0.00E+00	5.18E+07	0.00E+00	3.39E+08	0.00E+00	3.48E+09	0.00E+00
RU-105	9.84E-28	0.00E+00	3.57E-28	0.00E+00	8.65E-27	0.00E+00	6.42E-25	0.00E+00
RU-106	3.58E+09	0.00E+00	4.46E+08	0.00E+00	4.83E+09	0.00E+00	5.56E+10	0.00E+00
AG-110M	6.99E+06	4.72E+06	3.77E+06	0.00E+00	8.79E+06	0.00E+00	5.61E+08	0.00E+00
SN-113	4.17E+07	1.34E+06	4.56E+07	5.51E+05	9.23E+05	0.00E+00	1.67E+08	0.00E+00
SB-124	2.46E+07	3.19E+05	8.62E+06	5.43E+04	0.00E+00	1.36E+07	1.54E+08	0.00E+00
SB-125	2.25E+07	1.73E+05	4.71E+06	2.08E+04	0.00E+00	1.25E+07	5.37E+07	0.00E+00
TE-129M	1.69E+09	4.71E+08	2.62E+08	5.44E+08	4.96E+09	0.00E+00	2.06E+09	0.00E+00
TE-131M	7.23E+02	2.50E+02	2.66E+02	5.14E+02	2.42E+03	0.00E+00	1.01E+04	0.00E+00

[7]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 3.5-7 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TE-132	2.18E+06	9.65E+05	1.17E+06	1.41E+06	8.96E+06	0.00E+00	9.71E+06	0.00E+00
I-131	1.63E+07	1.64E+07	9.30E+06	5.41E+09	2.69E+07	0.00E+00	1.46E+06	0.00E+00
I-133	5.78E-01	7.15E-01	2.71E-01	1.33E+02	1.19E+00	0.00E+00	2.88E-01	0.00E+00
I-135	6.91E-17	1.24E-16	5.88E-17	1.10E-14	1.91E-16	0.00E+00	9.47E-17	0.00E+00
CS-134	7.26E+08	1.19E+09	2.51E+08	0.00E+00	3.69E+08	1.33E+08	6.43E+06	0.00E+00
CS-136	1.55E+07	4.26E+07	2.75E+07	0.00E+00	2.27E+07	3.38E+06	1.50E+06	0.00E+00
CS-137	1.08E+09	1.03E+09	1.52E+08	0.00E+00	3.36E+08	1.21E+08	6.45E+06	0.00E+00
BA-140	4.19E+07	3.67E+04	2.45E+06	0.00E+00	1.20E+04	2.19E+04	2.12E+07	0.00E+00
LA-140	5.64E-02	1.97E-02	6.64E-03	0.00E+00	0.00E+00	0.00E+00	5.49E+02	0.00E+00
CE-141	1.96E+04	9.76E+03	1.45E+03	0.00E+00	4.28E+03	0.00E+00	1.22E+07	0.00E+00
CE-143	3.21E-02	1.74E+01	2.52E-03	0.00E+00	7.29E-03	0.00E+00	2.55E+02	0.00E+00
CE-144	1.83E+06	5.74E+05	9.77E+04	0.00E+00	3.18E+05	0.00E+00	1.50E+08	0.00E+00
HF-181	2.66E+08	1.04E+06	2.68E+07	8.75E+05	8.35E+05	0.00E+00	4.42E+09	0.00E+00
W-187	3.24E-02	1.92E-02	8.60E-03	0.00E+00	0.00E+00	0.00E+00	2.69E+00	0.00E+00
NP-239	4.29E-01	3.08E-02	2.16E-02	0.00E+00	8.90E-02	0.00E+00	2.28E+03	0.00E+00

TABLE 3.5-8

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[8]

(Reference Regulatory Guide 1.109)

PATHWAY = Cow Milk

AGE GROUP = Adult

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02
F-18	4.57E-03	0.00E+00	5.07E-04	0.00E+00	0.00E+00	0.00E+00	1.35E-04	0.00E+00
NA-24	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	0.00E+00
CR-51	0.00E+00	0.00E+00	2.55E+04	1.53E+04	5.62E+03	3.39E+04	6.42E+06	0.00E+00
MN-54	0.00E+00	6.71E+06	1.28E+06	0.00E+00	2.00E+06	0.00E+00	2.06E+07	0.00E+00
MN-56	0.00E+00	4.21E-03	7.47E-04	0.00E+00	5.35E-03	0.00E+00	1.34E-01	0.00E+00
FE-55	1.96E+07	1.35E+07	3.15E+06	0.00E+00	0.00E+00	7.54E+06	7.75E+06	0.00E+00
FE-59	2.55E+07	5.99E+07	2.30E+07	0.00E+00	0.00E+00	1.67E+07	2.00E+08	0.00E+00
CO-57	0.00E+00	9.10E+05	1.69E+06	0.00E+00	0.00E+00	0.00E+00	2.57E+07	0.00E+00
CO-58	0.00E+00	3.92E+06	8.79E+06	0.00E+00	0.00E+00	0.00E+00	7.95E+07	0.00E+00
CO-60	0.00E+00	1.30E+07	2.87E+07	0.00E+00	0.00E+00	0.00E+00	2.44E+08	0.00E+00
NI-65	3.76E-01	4.88E-02	2.23E-02	0.00E+00	0.00E+00	0.00E+00	1.24E+00	0.00E+00
CU-64	0.00E+00	2.39E+04	1.12E+04	0.00E+00	6.04E+04	0.00E+00	2.04E+06	0.00E+00
ZN-65	1.23E+09	3.93E+09	1.78E+09	0.00E+00	2.63E+09	0.00E+00	2.47E+09	0.00E+00
BR-82	0.00E+00	0.00E+00	3.27E+07	0.00E+00	0.00E+00	0.00E+00	3.75E+07	0.00E+00
BR-83	0.00E+00	0.00E+00	9.98E-02	0.00E+00	0.00E+00	0.00E+00	1.44E-01	0.00E+00
BR-84	0.00E+00	0.00E+00	1.75E-23	0.00E+00	0.00E+00	0.00E+00	1.37E-28	0.00E+00
RB-86	0.00E+00	2.41E+09	1.12E+09	0.00E+00	0.00E+00	0.00E+00	4.76E+08	0.00E+00
SR-89	1.23E+09	0.00E+00	3.54E+07	0.00E+00	0.00E+00	0.00E+00	1.98E+08	0.00E+00
SR-90	3.89E+10	0.00E+00	9.54E+09	0.00E+00	0.00E+00	0.00E+00	1.12E+09	0.00E+00
SR-91	2.91E+04	0.00E+00	1.17E+03	0.00E+00	0.00E+00	0.00E+00	1.38E+05	0.00E+00
SR-92	4.95E-01	0.00E+00	2.14E-02	0.00E+00	0.00E+00	0.00E+00	9.82E+00	0.00E+00
Y-91M	6.27E-20	0.00E+00	2.43E-21	0.00E+00	0.00E+00	0.00E+00	1.84E-19	0.00E+00
Y-91	7.23E+03	0.00E+00	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.98E+06	0.00E+00
Y-92	5.64E-05	0.00E+00	1.65E-06	0.00E+00	0.00E+00	0.00E+00	9.88E-01	0.00E+00
Y-93	2.24E-01	0.00E+00	6.19E-03	0.00E+00	0.00E+00	0.00E+00	7.11E+03	0.00E+00
ZR-95	7.89E+02	2.53E+02	1.71E+02	0.00E+00	3.97E+02	0.00E+00	8.02E+05	0.00E+00
ZR-97	4.34E-01	8.76E-02	4.01E-02	0.00E+00	1.32E-01	0.00E+00	2.71E+04	0.00E+00
NB-95	7.23E+04	4.02E+04	2.16E+04	0.00E+00	3.97E+04	0.00E+00	2.44E+08	0.00E+00
NB-97	3.40E-12	8.59E-13	3.14E-13	0.00E+00	1.00E-12	0.00E+00	3.17E-09	0.00E+00
MO-99	0.00E+00	2.48E+07	4.72E+06	0.00E+00	5.62E+07	0.00E+00	5.76E+07	0.00E+00

[8]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 3.5-8 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	3.35E+00	9.48E+00	1.21E+02	0.00E+00	1.44E+02	4.64E+00	5.61E+03	0.00E+00
RU-103	8.85E+02	0.00E+00	3.81E+02	0.00E+00	3.38E+03	0.00E+00	1.03E+05	0.00E+00
RU-105	8.65E-04	0.00E+00	3.41E-04	0.00E+00	1.12E-02	0.00E+00	5.29E-01	0.00E+00
RU-106	1.64E+04	0.00E+00	2.08E+03	0.00E+00	3.17E+04	0.00E+00	1.06E+06	0.00E+00
AG-110M	4.85E+07	4.49E+07	2.66E+07	0.00E+00	8.82E+07	0.00E+00	1.83E+10	0.00E+00
SN-113	3.87E+06	1.49E+05	3.66E+06	5.26E+04	1.10E+05	0.00E+00	6.77E+07	0.00E+00
SB-124	2.16E+07	4.09E+05	8.58E+06	5.25E+04	0.00E+00	1.68E+07	6.14E+08	0.00E+00
SB-125	1.61E+07	1.80E+05	3.84E+06	1.64E+04	0.00E+00	1.24E+07	1.78E+08	0.00E+00
TE-129M	5.67E+07	2.12E+07	8.98E+06	1.95E+07	2.37E+08	0.00E+00	2.86E+08	0.00E+00
TE-129	2.97E-10	1.12E-10	7.25E-11	2.28E-10	1.25E-09	0.00E+00	2.25E-10	0.00E+00
TE-131M	3.69E+05	1.80E+05	1.50E+05	2.86E+05	1.83E+06	0.00E+00	1.79E+07	0.00E+00
TE-132	2.46E+06	1.59E+06	1.49E+06	1.76E+06	1.53E+07	0.00E+00	7.52E+07	0.00E+00
I-131	2.91E+08	4.16E+08	2.38E+08	1.36E+11	7.13E+08	0.00E+00	1.10E+08	0.00E+00
I-132	1.67E-01	4.47E-01	1.56E-01	1.56E+01	7.12E-01	0.00E+00	8.39E-02	0.00E+00
I-133	3.88E+06	6.74E+06	2.06E+06	9.91E+08	1.18E+07	0.00E+00	6.06E+06	0.00E+00
I-134	2.11E-12	5.72E-12	2.05E-12	9.92E-11	9.10E-12	0.00E+00	4.99E-15	0.00E+00
I-135	1.29E+04	3.38E+04	1.25E+04	2.23E+06	5.42E+04	0.00E+00	3.82E+04	0.00E+00
CS-134	4.45E+09	1.06E+10	8.66E+09	0.00E+00	3.43E+09	1.14E+09	1.85E+08	0.00E+00
CS-136	2.51E+08	9.91E+08	7.14E+08	0.00E+00	5.52E+08	7.56E+07	1.13E+08	0.00E+00
CS-137	5.96E+09	8.15E+09	5.34E+09	0.00E+00	2.77E+09	9.20E+08	1.58E+08	0.00E+00
CS-138	9.72E-24	1.92E-23	9.51E-24	0.00E+00	1.41E-23	1.39E-24	8.19E-29	0.00E+00
BA-139	4.54E-08	3.24E-11	1.33E-09	0.00E+00	3.03E-11	1.84E-11	8.06E-08	0.00E+00
BA-140	2.57E+07	3.23E+04	1.68E+06	0.00E+00	1.10E+04	1.85E+04	5.29E+07	0.00E+00
LA-140	4.52E+00	2.28E+00	6.01E-01	0.00E+00	0.00E+00	0.00E+00	1.67E+05	0.00E+00
LA-142	1.90E-11	8.66E-12	2.16E-12	0.00E+00	0.00E+00	0.00E+00	6.32E-08	0.00E+00
CE-141	4.27E+03	2.89E+03	3.27E+02	0.00E+00	1.34E+03	0.00E+00	1.10E+07	0.00E+00
CE-143	4.16E+01	3.08E+04	3.40E+00	0.00E+00	1.35E+01	0.00E+00	1.15E+06	0.00E+00
CE-144	2.83E+05	1.18E+05	1.52E+04	0.00E+00	7.01E+04	0.00E+00	9.56E+07	0.00E+00
HF-181	8.46E+03	4.77E+01	9.57E+02	3.03E+01	3.97E+01	0.00E+00	6.28E+05	0.00E+00
W-187	6.52E+03	5.45E+03	1.90E+03	0.00E+00	0.00E+00	0.00E+00	1.78E+06	0.00E+00
NP-239	3.67E+00	3.61E-01	1.99E-01	0.00E+00	1.13E+00	0.00E+00	7.41E+04	0.00E+00

TABLE 3.5-9

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[9]

(Reference Regulatory Guide 1.109)

PATHWAY = Cow Milk

AGE GROUP = Teen

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	9.93E+02	9.93E+02	9.93E+02	9.93E+02	9.93E+02	9.93E+02	9.93E+02
F-18	8.16E-03	0.00E+00	8.94E-04	0.00E+00	0.00E+00	0.00E+00	7.35E-04	0.00E+00
NA-24	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06	0.00E+00
CR-51	0.00E+00	0.00E+00	4.46E+04	2.48E+04	9.77E+03	6.36E+04	7.49E+06	0.00E+00
MN-54	0.00E+00	1.12E+07	2.22E+06	0.00E+00	3.34E+06	0.00E+00	2.29E+07	0.00E+00
MN-56	0.00E+00	7.47E-03	1.33E-03	0.00E+00	9.45E-03	0.00E+00	4.91E-01	0.00E+00
FE-55	3.47E+07	2.46E+07	5.74E+06	0.00E+00	0.00E+00	1.56E+07	1.06E+07	0.00E+00
FE-59	4.45E+07	1.04E+08	4.01E+07	0.00E+00	0.00E+00	3.27E+07	2.45E+08	0.00E+00
CO-57	0.00E+00	1.78E+06	2.99E+06	0.00E+00	0.00E+00	0.00E+00	3.32E+07	0.00E+00
CO-58	0.00E+00	6.60E+06	1.52E+07	0.00E+00	0.00E+00	0.00E+00	9.10E+07	0.00E+00
CO-60	0.00E+00	2.20E+07	4.96E+07	0.00E+00	0.00E+00	0.00E+00	2.87E+08	0.00E+00
NI-65	6.88E-01	8.79E-02	4.00E-02	0.00E+00	0.00E+00	0.00E+00	4.76E+00	0.00E+00
CU-64	0.00E+00	4.27E+04	2.01E+04	0.00E+00	1.08E+05	0.00E+00	3.31E+06	0.00E+00
ZN-65	1.90E+09	6.58E+09	3.07E+09	0.00E+00	4.21E+09	0.00E+00	2.79E+09	0.00E+00
BR-82	0.00E+00	0.00E+00	5.68E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	1.84E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.13E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	4.40E+09	2.07E+09	0.00E+00	0.00E+00	0.00E+00	6.51E+08	0.00E+00
SR-89	2.28E+09	0.00E+00	6.52E+07	0.00E+00	0.00E+00	0.00E+00	2.71E+08	0.00E+00
SR-90	5.49E+10	0.00E+00	1.36E+10	0.00E+00	0.00E+00	0.00E+00	1.54E+09	0.00E+00
SR-91	5.34E+04	0.00E+00	2.12E+03	0.00E+00	0.00E+00	0.00E+00	2.42E+05	0.00E+00
SR-92	9.07E-01	0.00E+00	3.87E-02	0.00E+00	0.00E+00	0.00E+00	2.31E+01	0.00E+00
Y-91M	1.15E-19	0.00E+00	4.39E-21	0.00E+00	0.00E+00	0.00E+00	5.42E-18	0.00E+00
Y-91	1.33E+04	0.00E+00	3.56E+02	0.00E+00	0.00E+00	0.00E+00	5.45E+06	0.00E+00
Y-92	1.04E-04	0.00E+00	3.01E-06	0.00E+00	0.00E+00	0.00E+00	2.86E+00	0.00E+00
Y-93	4.14E-01	0.00E+00	1.13E-02	0.00E+00	0.00E+00	0.00E+00	1.26E+04	0.00E+00
ZR-95	1.38E+03	4.35E+02	2.99E+02	0.00E+00	6.40E+02	0.00E+00	1.00E+06	0.00E+00
ZR-97	7.90E-01	1.56E-01	7.20E-02	0.00E+00	2.37E-01	0.00E+00	4.23E+04	0.00E+00
NB-95	1.23E+05	6.84E+04	3.76E+04	0.00E+00	6.63E+04	0.00E+00	2.92E+08	0.00E+00
NB-97	6.19E-12	1.54E-12	5.61E-13	0.00E+00	1.80E-12	0.00E+00	3.67E-08	0.00E+00
MO-99	0.00E+00	4.48E+07	8.55E+06	0.00E+00	1.03E+08	0.00E+00	8.03E+07	0.00E+00

[9]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 3.5-10

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[10]

(Reference Regulatory Guide 1.109)

PATHWAY = Cow Milk

AGE GROUP = Child

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03
F-18	1.94E-02	0.00E+00	1.92E-03	0.00E+00	0.00E+00	0.00E+00	5.25E-03	0.00E+00
NA-24	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06	0.00E+00
CR-51	0.00E+00	0.00E+00	9.09E+04	5.05E+04	1.38E+04	9.21E+04	4.82E+06	0.00E+00
MN-54	0.00E+00	1.67E+07	4.46E+06	0.00E+00	4.69E+06	0.00E+00	1.40E+07	0.00E+00
MN-56	0.00E+00	1.30E-02	2.94E-03	0.00E+00	1.57E-02	0.00E+00	1.89E+00	0.00E+00
FE-55	8.71E+07	4.62E+07	1.43E+07	0.00E+00	0.00E+00	2.61E+07	8.56E+06	0.00E+00
FE-59	1.03E+08	1.67E+08	8.31E+07	0.00E+00	0.00E+00	4.84E+07	1.74E+08	0.00E+00
CO-57	0.00E+00	3.04E+06	6.16E+06	0.00E+00	0.00E+00	0.00E+00	2.49E+07	0.00E+00
CO-58	0.00E+00	1.01E+07	3.09E+07	0.00E+00	0.00E+00	0.00E+00	5.88E+07	0.00E+00
CO-60	0.00E+00	3.42E+07	1.01E+08	0.00E+00	0.00E+00	0.00E+00	1.89E+08	0.00E+00
NI-65	1.68E+00	1.58E-01	9.24E-02	0.00E+00	0.00E+00	0.00E+00	1.94E+01	0.00E+00
CU-64	0.00E+00	7.50E+04	4.53E+04	0.00E+00	1.81E+05	0.00E+00	3.52E+06	0.00E+00
ZN-65	3.72E+09	9.91E+09	6.16E+09	0.00E+00	6.24E+09	0.00E+00	1.74E+09	0.00E+00
BR-82	0.00E+00	0.00E+00	1.16E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.52E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	7.08E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	8.16E+09	5.02E+09	0.00E+00	0.00E+00	0.00E+00	5.25E+08	0.00E+00
SR-89	5.63E+09	0.00E+00	1.61E+08	0.00E+00	0.00E+00	0.00E+00	2.18E+08	0.00E+00
SR-90	9.28E+10	0.00E+00	2.35E+10	0.00E+00	0.00E+00	0.00E+00	1.25E+09	0.00E+00
SR-91	1.31E+05	0.00E+00	4.94E+03	0.00E+00	0.00E+00	0.00E+00	2.89E+05	0.00E+00
SR-92	2.21E+00	0.00E+00	8.88E-02	0.00E+00	0.00E+00	0.00E+00	4.19E+01	0.00E+00
Y-91M	2.80E-19	0.00E+00	1.02E-20	0.00E+00	0.00E+00	0.00E+00	5.49E-16	0.00E+00
Y-91	3.28E+04	0.00E+00	8.78E+02	0.00E+00	0.00E+00	0.00E+00	4.38E+06	0.00E+00
Y-92	2.56E-04	0.00E+00	7.32E-06	0.00E+00	0.00E+00	0.00E+00	7.39E+00	0.00E+00
Y-93	1.02E+00	0.00E+00	2.79E-02	0.00E+00	0.00E+00	0.00E+00	1.51E+04	0.00E+00
ZR-95	3.20E+03	7.04E+02	6.27E+02	0.00E+00	1.01E+03	0.00E+00	7.35E+05	0.00E+00
ZR-97	1.92E+00	2.78E-01	1.64E-01	0.00E+00	3.99E-01	0.00E+00	4.21E+04	0.00E+00
NB-95	2.78E+05	1.08E+05	7.74E+04	0.00E+00	1.02E+05	0.00E+00	2.00E+08	0.00E+00
NB-97	1.50E-11	2.72E-12	1.27E-12	0.00E+00	3.01E-12	0.00E+00	8.38E-07	0.00E+00
MO-99	0.00E+00	8.16E+07	2.02E+07	0.00E+00	1.74E+08	0.00E+00	6.75E+07	0.00E+00

[10]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 3.5-9 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	5.82E+00	1.62E+01	2.10E+02	0.00E+00	2.42E+02	9.01E+00	1.07E+04	0.00E+00
RU-103	1.57E+03	0.00E+00	6.73E+02	0.00E+00	5.55E+03	0.00E+00	1.31E+05	0.00E+00
RU-105	1.58E-03	0.00E+00	6.13E-04	0.00E+00	1.99E-02	0.00E+00	1.28E+00	0.00E+00
RU-106	3.02E+04	0.00E+00	3.81E+03	0.00E+00	5.83E+04	0.00E+00	1.45E+06	0.00E+00
AG-110M	8.02E+07	7.59E+07	4.61E+07	0.00E+00	1.45E+08	0.00E+00	2.13E+10	0.00E+00
SN-113	5.95E+06	2.49E+05	6.33E+06	8.23E+04	1.76E+05	0.00E+00	7.14E+07	0.00E+00
SB-124	3.86E+07	7.11E+05	1.51E+07	8.75E+04	0.00E+00	3.37E+07	7.78E+08	0.00E+00
SB-125	2.89E+07	3.15E+05	6.75E+06	2.76E+04	0.00E+00	2.54E+07	2.25E+08	0.00E+00
TE-129M	1.04E+08	3.85E+07	1.64E+07	3.35E+07	4.34E+08	0.00E+00	3.90E+08	0.00E+00
TE-129	5.48E-10	2.04E-10	1.33E-10	3.91E-10	2.30E-09	0.00E+00	2.99E-09	0.00E+00
TE-131M	6.71E+05	3.22E+05	2.69E+05	4.84E+05	3.36E+06	0.00E+00	2.58E+07	0.00E+00
TE-132	4.39E+06	2.78E+06	2.62E+06	2.93E+06	2.67E+07	0.00E+00	8.81E+07	0.00E+00
I-131	5.28E+08	7.39E+08	3.97E+08	2.16E+11	1.27E+09	0.00E+00	1.46E+08	0.00E+00
I-132	2.96E-01	7.75E-01	2.78E-01	2.61E+01	1.22E+00	0.00E+00	3.38E-01	0.00E+00
I-133	7.08E+06	1.20E+07	3.66E+06	1.68E+09	2.11E+07	0.00E+00	9.09E+06	0.00E+00
I-134	3.74E-12	9.93E-12	3.56E-12	1.65E-10	1.56E-11	0.00E+00	1.31E-13	0.00E+00
I-135	2.29E+04	5.91E+04	2.19E+04	3.80E+06	9.33E+04	0.00E+00	6.54E+04	0.00E+00
CS-134	7.73E+09	1.82E+10	8.44E+09	0.00E+00	5.78E+09	2.21E+09	2.26E+08	0.00E+00
CS-136	4.27E+08	1.68E+09	1.13E+09	0.00E+00	9.16E+08	1.44E+08	1.35E+08	0.00E+00
CS-137	1.08E+10	1.44E+10	5.01E+09	0.00E+00	4.89E+09	1.90E+09	2.05E+08	0.00E+00
CS-138	1.76E-23	3.38E-23	1.69E-23	0.00E+00	2.50E-23	2.91E-24	1.54E-26	0.00E+00
BA-139	8.40E-08	5.91E-11	2.45E-09	0.00E+00	5.57E-11	4.07E-11	7.50E-07	0.00E+00
BA-140	4.64E+07	5.68E+04	2.99E+06	0.00E+00	1.93E+04	3.82E+04	7.15E+07	0.00E+00
LA-140	8.11E+00	3.99E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00	2.29E+05	0.00E+00
LA-142	3.44E-11	1.53E-11	3.80E-12	0.00E+00	0.00E+00	0.00E+00	4.64E-07	0.00E+00
CE-141	7.82E+03	5.22E+03	6.00E+02	0.00E+00	2.46E+03	0.00E+00	1.49E+07	0.00E+00
CE-143	7.65E+01	5.56E+04	6.22E+00	0.00E+00	2.50E+01	0.00E+00	1.67E+06	0.00E+00
CE-144	5.20E+05	2.15E+05	2.80E+04	0.00E+00	1.29E+05	0.00E+00	1.31E+08	0.00E+00
HF-181	1.51E+04	8.32E+01	1.69E+03	5.06E+01	6.91E+01	0.00E+00	7.57E+05	0.00E+00
W-187	1.19E+04	9.72E+03	3.40E+03	0.00E+00	0.00E+00	0.00E+00	2.63E+06	0.00E+00
NP-239	7.01E+00	6.61E-01	3.67E-01	0.00E+00	2.08E+00	0.00E+00	1.06E+05	0.00E+00

TABLE 3.5-10 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	1.33E+01	2.62E+01	4.34E+02	0.00E+00	3.80E+02	1.33E+01	1.49E+04	0.00E+00
RU-103	3.72E+03	0.00E+00	1.43E+03	0.00E+00	9.37E+03	0.00E+00	9.62E+04	0.00E+00
RU-105	3.86E-03	0.00E+00	1.40E-03	0.00E+00	3.39E-02	0.00E+00	2.52E+00	0.00E+00
RU-106	7.45E+04	0.00E+00	9.29E+03	0.00E+00	1.01E+05	0.00E+00	1.16E+06	0.00E+00
AG-110M	1.74E+08	1.17E+08	9.39E+07	0.00E+00	2.19E+08	0.00E+00	1.40E+10	0.00E+00
SN-113	1.17E+07	3.76E+05	1.28E+07	1.54E+05	2.59E+05	0.00E+00	4.67E+07	0.00E+00
SB-124	9.13E+07	1.18E+06	3.20E+07	2.01E+05	0.00E+00	5.07E+07	5.71E+08	0.00E+00
SB-125	6.87E+07	5.30E+05	1.44E+07	6.36E+04	0.00E+00	3.83E+07	1.64E+08	0.00E+00
TE-129M	2.56E+08	7.14E+07	3.97E+07	8.25E+07	7.51E+08	0.00E+00	3.12E+08	0.00E+00
TE-129	1.35E-09	3.77E-10	3.21E-10	9.64E-10	3.95E-09	0.00E+00	8.41E-08	0.00E+00
TE-131M	1.63E+06	5.65E+05	6.02E+05	1.16E+06	5.47E+06	0.00E+00	2.29E+07	0.00E+00
TE-132	1.05E+07	4.64E+06	5.61E+06	6.76E+06	4.31E+07	0.00E+00	4.67E+07	0.00E+00
I-131	1.28E+09	1.29E+09	7.32E+08	4.26E+11	2.11E+09	0.00E+00	1.15E+08	0.00E+00
I-132	7.01E-01	1.29E+00	5.92E-01	5.97E+01	1.97E+00	0.00E+00	1.52E+00	0.00E+00
I-133	1.72E+07	2.13E+07	8.05E+06	3.95E+09	3.55E+07	0.00E+00	8.57E+06	0.00E+00
I-134	8.87E-12	1.65E-11	7.57E-12	3.79E-10	2.52E-11	0.00E+00	1.09E-11	0.00E+00
I-135	5.43E+04	9.77E+04	4.62E+04	8.66E+06	1.50E+05	0.00E+00	7.45E+04	0.00E+00
CS-134	1.78E+10	2.93E+10	6.17E+09	0.00E+00	9.07E+09	3.25E+09	1.58E+08	0.00E+00
CS-136	9.65E+08	2.65E+09	1.72E+09	0.00E+00	1.41E+09	2.11E+08	9.32E+07	0.00E+00
CS-137	2.60E+10	2.49E+10	3.68E+09	0.00E+00	8.12E+09	2.92E+09	1.56E+08	0.00E+00
CS-138	4.27E-23	5.94E-23	3.77E-23	0.00E+00	4.18E-23	4.50E-24	2.74E-23	0.00E+00
BA-139	2.06E-07	1.10E-10	5.98E-09	0.00E+00	9.62E-11	6.48E-11	1.19E-05	0.00E+00
BA-140	1.12E+08	9.80E+04	6.53E+06	0.00E+00	3.19E+04	5.85E+04	5.67E+07	0.00E+00
LA-140	1.94E+01	6.79E+00	2.29E+00	0.00E+00	0.00E+00	0.00E+00	1.89E+05	0.00E+00
LA-142	8.30E-11	2.64E-11	8.28E-12	0.00E+00	0.00E+00	0.00E+00	5.24E-06	0.00E+00
CE-141	1.93E+04	9.61E+03	1.43E+03	0.00E+00	4.21E+03	0.00E+00	1.20E+07	0.00E+00
CE-143	1.88E+02	1.02E+05	1.47E+01	0.00E+00	4.27E+01	0.00E+00	1.49E+06	0.00E+00
CE-144	1.28E+06	4.02E+05	6.85E+04	0.00E+00	2.23E+05	0.00E+00	1.05E+08	0.00E+00
HF-181	3.59E+04	1.40E+02	3.61E+03	1.18E+02	1.13E+02	0.00E+00	5.96E+05	0.00E+00
W-187	2.89E+04	1.71E+04	7.68E+03	0.00E+00	0.00E+00	0.00E+00	2.40E+06	0.00E+00
NP-239	1.73E+01	1.24E+00	8.71E-01	0.00E+00	3.58E+00	0.00E+00	9.17E+04	0.00E+00

TABLE 3.5-11

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[11]

(Reference Regulatory Guide 1.109)

PATHWAY = Cow Milk

AGE GROUP = Infant

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03
F-18	4.04E-02	0.00E+00	3.45E-03	0.00E+00	0.00E+00	0.00E+00	9.51E-03	0.00E+00
NA-24	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	0.00E+00
CR-51	0.00E+00	0.00E+00	1.44E+05	9.40E+04	2.05E+04	1.83E+05	4.20E+06	0.00E+00
MN-54	0.00E+00	3.11E+07	7.05E+06	0.00E+00	6.90E+06	0.00E+00	1.14E+07	0.00E+00
MN-56	0.00E+00	3.19E-02	5.50E-03	0.00E+00	2.74E-02	0.00E+00	2.90E+00	0.00E+00
FE-55	1.05E+08	6.80E+07	1.82E+07	0.00E+00	0.00E+00	3.32E+07	8.63E+06	0.00E+00
FE-59	1.93E+08	3.36E+08	1.33E+08	0.00E+00	0.00E+00	9.94E+07	1.61E+08	0.00E+00
CO-57	0.00E+00	7.10E+06	1.15E+07	0.00E+00	0.00E+00	0.00E+00	2.42E+07	0.00E+00
CO-58	0.00E+00	2.02E+07	5.03E+07	0.00E+00	0.00E+00	0.00E+00	5.03E+07	0.00E+00
CO-60	0.00E+00	6.98E+07	1.65E+08	0.00E+00	0.00E+00	0.00E+00	1.66E+08	0.00E+00
NI-65	3.56E+00	4.03E-01	1.83E-01	0.00E+00	0.00E+00	0.00E+00	3.07E+01	0.00E+00
CU-64	0.00E+00	1.86E+05	8.63E+04	0.00E+00	3.15E+05	0.00E+00	3.83E+06	0.00E+00
ZN-65	5.00E+09	1.71E+10	7.90E+09	0.00E+00	8.31E+09	0.00E+00	1.45E+10	0.00E+00
BR-82	0.00E+00	0.00E+00	1.96E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	9.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.37E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.07E+10	1.02E+10	0.00E+00	0.00E+00	0.00E+00	5.30E+08	0.00E+00
SR-89	1.07E+10	0.00E+00	3.07E+08	0.00E+00	0.00E+00	0.00E+00	2.20E+08	0.00E+00
SR-90	1.01E+11	0.00E+00	2.57E+10	0.00E+00	0.00E+00	0.00E+00	1.26E+09	0.00E+00
SR-91	2.73E+05	0.00E+00	9.87E+03	0.00E+00	0.00E+00	0.00E+00	3.23E+05	0.00E+00
SR-92	4.71E+00	0.00E+00	1.75E-01	0.00E+00	0.00E+00	0.00E+00	5.08E+01	0.00E+00
Y-91M	5.94E-19	0.00E+00	2.03E-20	0.00E+00	0.00E+00	0.00E+00	1.98E-15	0.00E+00
Y-91	6.16E+04	0.00E+00	1.64E+03	0.00E+00	0.00E+00	0.00E+00	4.42E+06	0.00E+00
Y-92	5.44E-04	0.00E+00	1.53E-05	0.00E+00	0.00E+00	0.00E+00	1.04E+01	0.00E+00
Y-93	2.16E+00	0.00E+00	5.90E-02	0.00E+00	0.00E+00	0.00E+00	1.71E+04	0.00E+00
ZR-95	5.69E+03	1.39E+03	9.83E+02	0.00E+00	1.49E+03	0.00E+00	6.91E+05	0.00E+00
ZR-97	4.07E+00	6.99E-01	3.19E-01	0.00E+00	7.04E-01	0.00E+00	4.46E+04	0.00E+00
NB-95	5.19E+05	2.14E+05	1.24E+05	0.00E+00	1.53E+05	0.00E+00	1.81E+08	0.00E+00
NB-97	3.18E-11	6.78E-12	2.45E-12	0.00E+00	5.30E-12	0.00E+00	2.14E-06	0.00E+00
MO-99	0.00E+00	2.09E+08	4.07E+07	0.00E+00	3.12E+08	0.00E+00	6.87E+07	0.00E+00
TC-99M	2.78E+01	5.73E+01	7.37E+02	0.00E+00	6.16E+02	2.99E+01	1.66E+04	0.00E+00

[11]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 3.5-11 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
RU-103	7.54E+03	0.00E+00	2.52E+03	0.00E+00	1.57E+04	0.00E+00	9.17E+04	0.00E+00
RU-105	8.13E-03	0.00E+00	2.74E-03	0.00E+00	5.98E-02	0.00E+00	3.23E+00	0.00E+00
RU-106	1.53E+05	0.00E+00	1.92E+04	0.00E+00	1.81E+05	0.00E+00	1.16E+06	0.00E+00
AG-110M	3.21E+08	2.35E+08	1.55E+08	0.00E+00	3.36E+08	0.00E+00	1.22E+10	0.00E+00
SN-113	1.78E+07	6.79E+05	1.84E+07	2.59E+05	3.65E+05	0.00E+00	3.79E+07	0.00E+00
SB-124	1.76E+08	2.59E+06	5.45E+07	4.67E+05	0.00E+00	1.10E+08	5.43E+08	0.00E+00
SB-125	1.18E+08	1.14E+06	2.43E+07	1.48E+05	0.00E+00	6.83E+07	1.57E+08	0.00E+00
TE-129M	5.25E+08	1.80E+08	8.09E+07	2.02E+08	1.31E+09	0.00E+00	3.14E+08	0.00E+00
TE-129	2.86E-09	9.87E-10	6.69E-10	2.40E-09	7.13E-09	0.00E+00	2.29E-07	0.00E+00
TE-131M	3.45E+06	1.39E+06	1.15E+06	2.82E+06	9.56E+06	0.00E+00	2.34E+07	0.00E+00
TE-132	2.16E+07	1.07E+07	9.98E+06	1.58E+07	6.69E+07	0.00E+00	3.96E+07	0.00E+00
I-131	2.67E+09	3.15E+09	1.38E+09	1.03E+12	3.68E+09	0.00E+00	1.12E+08	0.00E+00
I-132	1.45E+00	2.95E+00	1.05E+00	1.38E+02	3.29E+00	0.00E+00	2.39E+00	0.00E+00
I-133	3.63E+07	5.29E+07	1.55E+07	9.62E+09	6.22E+07	0.00E+00	8.95E+06	0.00E+00
I-134	1.84E-11	3.77E-11	1.34E-11	8.78E-10	4.21E-11	0.00E+00	3.89E-11	0.00E+00
I-135	1.13E+05	2.25E+05	8.19E+04	2.01E+07	2.50E+05	0.00E+00	8.13E+04	0.00E+00
CS-134	2.87E+10	5.36E+10	5.41E+09	0.00E+00	1.38E+10	5.65E+09	1.46E+08	0.00E+00
CS-136	1.88E+09	5.54E+09	2.07E+09	0.00E+00	2.21E+09	4.52E+08	8.42E+07	0.00E+00
CS-137	4.16E+10	4.86E+10	3.45E+09	0.00E+00	1.31E+10	5.29E+09	1.52E+08	0.00E+00
CS-138	9.01E-23	1.47E-22	7.10E-23	0.00E+00	7.31E-23	1.14E-23	2.34E-22	0.00E+00
BA-139	4.39E-07	2.91E-10	1.27E-08	0.00E+00	1.75E-10	1.77E-10	2.78E-05	0.00E+00
BA-140	2.30E+08	2.30E+05	1.19E+07	0.00E+00	5.47E+04	1.41E+05	5.66E+07	0.00E+00
LA-140	4.06E+01	1.60E+01	4.11E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+05	0.00E+00
LA-142	1.74E-10	6.40E-11	1.53E-11	0.00E+00	0.00E+00	0.00E+00	1.09E-05	0.00E+00
CE-141	3.82E+04	2.33E+04	2.74E+03	0.00E+00	7.18E+03	0.00E+00	1.20E+07	0.00E+00
CE-143	3.97E+02	2.64E+05	3.01E+01	0.00E+00	7.68E+01	0.00E+00	1.54E+06	0.00E+00
CE-144	1.84E+06	7.52E+05	1.03E+05	0.00E+00	3.04E+05	0.00E+00	1.05E+08	0.00E+00
HF-181	6.86E+04	3.22E+02	6.06E+03	2.73E+02	1.89E+02	0.00E+00	5.62E+05	0.00E+00
W-187	6.08E+04	4.23E+04	1.46E+04	0.00E+00	0.00E+00	0.00E+00	2.49E+06	0.00E+00
NP-239	3.65E+01	3.26E+00	1.84E+00	0.00E+00	6.51E+00	0.00E+00	9.44E+04	0.00E+00

TABLE 3.5-12

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[12]

(Reference Regulatory Guide 1.109)

PATHWAY = Goat Milk

AGE GROUP = Adult

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03
F-18	5.48E-04	0.00E+00	6.08E-05	0.00E+00	0.00E+00	0.00E+00	1.63E-05	0.00E+00
NA-24	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05	0.00E+00
CR-51	0.00E+00	0.00E+00	3.06E+03	1.83E+03	6.75E+02	4.06E+03	7.70E+05	0.00E+00
MN-54	0.00E+00	8.06E+05	1.54E+05	0.00E+00	2.40E+05	0.00E+00	2.47E+06	0.00E+00
MN-56	0.00E+00	5.05E-04	8.96E-05	0.00E+00	6.42E-04	0.00E+00	1.61E-02	0.00E+00
FE-55	2.54E+05	1.76E+05	4.10E+04	0.00E+00	0.00E+00	9.80E+04	1.01E+05	0.00E+00
FE-59	3.31E+05	7.79E+05	2.98E+05	0.00E+00	0.00E+00	2.18E+05	2.60E+06	0.00E+00
CO-57	0.00E+00	1.09E+05	2.02E+05	0.00E+00	0.00E+00	0.00E+00	3.09E+06	0.00E+00
CO-58	0.00E+00	4.71E+05	1.05E+06	0.00E+00	0.00E+00	0.00E+00	9.54E+06	0.00E+00
CO-60	0.00E+00	1.56E+06	3.44E+06	0.00E+00	0.00E+00	0.00E+00	2.93E+07	0.00E+00
NI-65	4.51E-02	5.86E-03	2.67E-03	0.00E+00	0.00E+00	0.00E+00	1.49E-01	0.00E+00
CU-64	0.00E+00	2.67E+03	1.25E+03	0.00E+00	6.73E+03	0.00E+00	2.27E+05	0.00E+00
ZN-65	1.48E+08	4.71E+08	2.13E+08	0.00E+00	3.15E+08	0.00E+00	2.97E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	3.93E+06	0.00E+00	0.00E+00	0.00E+00	4.50E+06	0.00E+00
BR-83	0.00E+00	0.00E+00	1.20E-02	0.00E+00	0.00E+00	0.00E+00	1.73E-02	0.00E+00
BR-84	0.00E+00	0.00E+00	2.10E-24	0.00E+00	0.00E+00	0.00E+00	1.65E-29	0.00E+00
RB-86	0.00E+00	2.90E+08	1.35E+08	0.00E+00	0.00E+00	0.00E+00	5.71E+07	0.00E+00
SR-89	2.59E+09	0.00E+00	7.44E+07	0.00E+00	0.00E+00	0.00E+00	4.16E+08	0.00E+00
SR-90	8.16E+10	0.00E+00	2.00E+10	0.00E+00	0.00E+00	0.00E+00	2.36E+09	0.00E+00
SR-91	6.10E+04	0.00E+00	2.46E+03	0.00E+00	0.00E+00	0.00E+00	2.91E+05	0.00E+00
SR-92	1.04E+00	0.00E+00	4.50E-02	0.00E+00	0.00E+00	0.00E+00	2.06E+01	0.00E+00
Y-91M	7.52E-21	0.00E+00	2.91E-22	0.00E+00	0.00E+00	0.00E+00	2.21E-20	0.00E+00
Y-91	8.67E+02	0.00E+00	2.32E+01	0.00E+00	0.00E+00	0.00E+00	4.77E+05	0.00E+00
Y-92	6.77E-06	0.00E+00	1.98E-07	0.00E+00	0.00E+00	0.00E+00	1.19E-01	0.00E+00
Y-93	2.69E-02	0.00E+00	7.43E-04	0.00E+00	0.00E+00	0.00E+00	8.53E+02	0.00E+00
ZR-95	9.47E+01	3.04E+01	2.06E+01	0.00E+00	4.76E+01	0.00E+00	9.62E+04	0.00E+00
ZR-97	5.21E-02	1.05E-02	4.81E-03	0.00E+00	1.59E-02	0.00E+00	3.26E+03	0.00E+00
NB-95	8.67E+03	4.82E+03	2.59E+03	0.00E+00	4.77E+03	0.00E+00	2.93E+07	0.00E+00
NB-97	4.08E-13	1.03E-13	3.76E-14	0.00E+00	1.20E-13	0.00E+00	3.80E-10	0.00E+00
MO-99	0.00E+00	2.98E+06	5.67E+05	0.00E+00	6.75E+06	0.00E+00	6.91E+06	0.00E+00

[12]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 3.5-12 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	4.03E-01	1.14E+00	1.45E+01	0.00E+00	1.73E+01	5.57E-01	6.73E+02	0.00E+00
RU-103	1.06E+02	0.00E+00	4.58E+01	0.00E+00	4.05E+02	0.00E+00	1.24E+04	0.00E+00
RU-105	1.04E-04	0.00E+00	4.10E-05	0.00E+00	1.34E-03	0.00E+00	6.35E-02	0.00E+00
RU-106	1.97E+03	0.00E+00	2.50E+02	0.00E+00	3.81E+03	0.00E+00	1.28E+05	0.00E+00
AG-110M	5.82E+06	5.38E+06	3.20E+06	0.00E+00	1.06E+07	0.00E+00	2.20E+09	0.00E+00
SN-113	4.64E+05	1.79E+04	4.39E+05	6.31E+03	1.32E+04	0.00E+00	8.12E+06	0.00E+00
SB-124	2.60E+06	4.90E+04	1.03E+06	6.29E+03	0.00E+00	2.02E+06	7.37E+07	0.00E+00
SB-125	1.94E+06	2.16E+04	4.61E+05	1.97E+03	0.00E+00	1.49E+06	2.13E+07	0.00E+00
TE-129M	6.81E+06	2.54E+06	1.08E+06	2.34E+06	2.84E+07	0.00E+00	3.43E+07	0.00E+00
TE-129	3.57E-11	1.34E-11	8.70E-12	2.74E-11	1.50E-10	0.00E+00	2.69E-11	0.00E+00
TE-131M	4.43E+04	2.17E+04	1.80E+04	3.43E+04	2.19E+05	0.00E+00	2.15E+06	0.00E+00
TE-132	2.95E+05	1.91E+05	1.79E+05	2.11E+05	1.84E+06	0.00E+00	9.02E+06	0.00E+00
I-131	3.49E+08	4.99E+08	2.86E+08	1.64E+11	8.56E+08	0.00E+00	1.32E+08	0.00E+00
I-132	2.00E-01	5.36E-01	1.88E-01	1.88E+01	8.54E-01	0.00E+00	1.01E-01	0.00E+00
I-133	4.65E+06	8.09E+06	2.47E+06	1.19E+09	1.41E+07	0.00E+00	7.27E+06	0.00E+00
I-134	2.53E-12	6.87E-12	2.46E-12	1.19E-10	1.09E-11	0.00E+00	5.99E-15	0.00E+00
I-135	1.55E+04	4.06E+04	1.50E+04	2.68E+06	6.51E+04	0.00E+00	4.58E+04	0.00E+00
CS-134	1.34E+10	3.18E+10	2.60E+10	0.00E+00	1.03E+10	3.41E+09	5.56E+08	0.00E+00
CS-136	7.53E+08	2.97E+09	2.14E+09	0.00E+00	1.65E+09	2.27E+08	3.38E+08	0.00E+00
CS-137	1.79E+10	2.45E+10	1.60E+10	0.00E+00	8.30E+09	2.76E+09	4.73E+08	0.00E+00
CS-138	2.91E-23	5.76E-23	2.85E-23	0.00E+00	4.23E-23	4.18E-24	2.46E-28	0.00E+00
BA-139	5.45E-09	3.88E-12	1.60E-10	0.00E+00	3.63E-12	2.20E-12	9.67E-09	0.00E+00
BA-140	3.08E+06	3.87E+03	2.02E+05	0.00E+00	1.32E+03	2.22E+03	6.35E+06	0.00E+00
LA-140	5.42E-01	2.73E-01	7.22E-02	0.00E+00	0.00E+00	0.00E+00	2.00E+04	0.00E+00
LA-142	2.28E-12	1.04E-12	2.59E-13	0.00E+00	0.00E+00	0.00E+00	7.58E-09	0.00E+00
CE-141	5.12E+02	3.46E+02	3.93E+01	0.00E+00	1.61E+02	0.00E+00	1.32E+06	0.00E+00
CE-143	4.99E+00	3.69E+03	4.09E-01	0.00E+00	1.63E+00	0.00E+00	1.38E+05	0.00E+00
CE-144	3.39E+04	1.42E+04	1.82E+03	0.00E+00	8.41E+03	0.00E+00	1.15E+07	0.00E+00
HF-181	1.01E+03	5.73E+00	1.15E+02	3.63E+00	4.77E+00	0.00E+00	7.53E+04	0.00E+00
W-187	7.82E+02	6.54E+02	2.29E+02	0.00E+00	0.00E+00	0.00E+00	2.14E+05	0.00E+00
NP-239	4.41E-01	4.34E-02	2.39E-02	0.00E+00	1.35E-01	0.00E+00	8.89E+03	0.00E+00

TABLE 3.5-13

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[13]

(Reference Regulatory Guide 1.109)

PATHWAY = Goat Milk

AGE GROUP = Teen

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03
F-18	9.79E-04	0.00E+00	1.07E-04	0.00E+00	0.00E+00	0.00E+00	8.82E-05	0.00E+00
NA-24	5.12E+05	5.12E+05	5.12E+05	5.12E+05	5.12E+05	5.12E+05	5.12E+05	0.00E+00
CR-51	0.00E+00	0.00E+00	5.35E+03	2.97E+03	1.17E+03	7.64E+03	8.99E+05	0.00E+00
MN-54	0.00E+00	1.34E+06	2.66E+05	0.00E+00	4.00E+05	0.00E+00	2.75E+06	0.00E+00
MN-56	0.00E+00	8.96E-04	1.59E-04	0.00E+00	1.13E-03	0.00E+00	5.90E-02	0.00E+00
FE-55	4.51E+05	3.20E+05	7.46E+04	0.00E+00	0.00E+00	2.03E+05	1.38E+05	0.00E+00
FE-59	5.78E+05	1.35E+06	5.21E+05	0.00E+00	0.00E+00	4.25E+05	3.19E+06	0.00E+00
CO-57	0.00E+00	2.14E+05	3.58E+05	0.00E+00	0.00E+00	0.00E+00	3.99E+06	0.00E+00
CO-58	0.00E+00	7.92E+05	1.83E+06	0.00E+00	0.00E+00	0.00E+00	1.09E+07	0.00E+00
CO-60	0.00E+00	2.64E+06	5.95E+06	0.00E+00	0.00E+00	0.00E+00	3.44E+07	0.00E+00
NI-65	8.25E-02	1.05E-02	4.80E-03	0.00E+00	0.00E+00	0.00E+00	5.72E-01	0.00E+00
CU-64	0.00E+00	4.75E+03	2.24E+03	0.00E+00	1.20E+04	0.00E+00	3.69E+05	0.00E+00
ZN-65	2.27E+08	7.90E+08	3.68E+08	0.00E+00	5.05E+08	0.00E+00	3.34E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	6.82E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	2.21E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	3.75E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	5.28E+08	2.48E+08	0.00E+00	0.00E+00	0.00E+00	7.81E+07	0.00E+00
SR-89	4.78E+09	0.00E+00	1.37E+08	0.00E+00	0.00E+00	0.00E+00	5.69E+08	0.00E+00
SR-90	1.15E+11	0.00E+00	2.85E+10	0.00E+00	0.00E+00	0.00E+00	3.24E+09	0.00E+00
SR-91	1.12E+05	0.00E+00	4.46E+03	0.00E+00	0.00E+00	0.00E+00	5.08E+05	0.00E+00
SR-92	1.90E+00	0.00E+00	8.12E-02	0.00E+00	0.00E+00	0.00E+00	4.85E+01	0.00E+00
Y-91M	1.38E-20	0.00E+00	5.26E-22	0.00E+00	0.00E+00	0.00E+00	6.50E-19	0.00E+00
Y-91	1.59E+03	0.00E+00	4.28E+01	0.00E+00	0.00E+00	0.00E+00	6.54E+05	0.00E+00
Y-92	1.25E-05	0.00E+00	3.62E-07	0.00E+00	0.00E+00	0.00E+00	3.43E-01	0.00E+00
Y-93	4.96E-02	0.00E+00	1.36E-03	0.00E+00	0.00E+00	0.00E+00	1.52E+03	0.00E+00
ZR-95	1.66E+02	5.22E+01	3.59E+01	0.00E+00	7.68E+01	0.00E+00	1.21E+05	0.00E+00
ZR-97	9.48E-02	1.88E-02	8.64E-03	0.00E+00	2.84E-02	0.00E+00	5.08E+03	0.00E+00
NB-95	1.48E+04	8.20E+03	4.52E+03	0.00E+00	7.95E+03	0.00E+00	3.51E+07	0.00E+00
NB-97	7.43E-13	1.84E-13	6.73E-14	0.00E+00	2.16E-13	0.00E+00	4.40E-09	0.00E+00
MO-99	0.00E+00	5.38E+06	1.03E+06	0.00E+00	1.23E+07	0.00E+00	9.63E+06	0.00E+00

[13]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 3.5-13 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	6.98E-01	1.95E+00	2.52E+01	0.00E+00	2.90E+01	1.08E+00	1.28E+03	0.00E+00
RU-103	1.89E+02	0.00E+00	8.07E+01	0.00E+00	6.66E+02	0.00E+00	1.58E+04	0.00E+00
RU-105	1.90E-04	0.00E+00	7.36E-05	0.00E+00	2.39E-03	0.00E+00	1.53E-01	0.00E+00
RU-106	3.63E+03	0.00E+00	4.57E+02	0.00E+00	7.00E+03	0.00E+00	1.74E+05	0.00E+00
AG-110M	9.62E+06	9.10E+06	5.54E+06	0.00E+00	1.74E+07	0.00E+00	2.56E+09	0.00E+00
SN-113	7.14E+05	2.99E+04	7.59E+05	9.88E+03	2.12E+04	0.00E+00	8.57E+06	0.00E+00
SB-124	4.63E+06	8.53E+04	1.81E+06	1.05E+04	0.00E+00	4.04E+06	9.33E+07	0.00E+00
SB-125	3.46E+06	3.78E+04	8.10E+05	3.31E+03	0.00E+00	3.04E+06	2.69E+07	0.00E+00
TE-129M	1.25E+07	4.62E+06	1.97E+06	4.02E+06	5.21E+07	0.00E+00	4.68E+07	0.00E+00
TE-129	6.57E-11	2.45E-11	1.60E-11	4.69E-11	2.76E-10	0.00E+00	3.59E-10	0.00E+00
TE-131M	8.06E+04	3.86E+04	3.22E+04	5.81E+04	4.03E+05	0.00E+00	3.10E+06	0.00E+00
TE-132	5.27E+05	3.34E+05	3.14E+05	3.52E+05	3.20E+06	0.00E+00	1.06E+07	0.00E+00
I-131	6.34E+08	8.87E+08	4.76E+08	2.59E+11	1.53E+09	0.00E+00	1.75E+08	0.00E+00
I-132	3.55E-01	9.30E-01	3.34E-01	3.13E+01	1.47E+00	0.00E+00	4.05E-01	0.00E+00
I-133	8.50E+06	1.44E+07	4.40E+06	2.01E+09	2.53E+07	0.00E+00	1.09E+07	0.00E+00
I-134	4.49E-12	1.19E-11	4.28E-12	1.99E-10	1.88E-11	0.00E+00	1.57E-13	0.00E+00
I-135	2.75E+04	7.09E+04	2.63E+04	4.56E+06	1.12E+05	0.00E+00	7.85E+04	0.00E+00
CS-134	2.32E+10	5.46E+10	2.53E+10	0.00E+00	1.73E+10	6.62E+09	6.79E+08	0.00E+00
CS-136	1.28E+09	5.05E+09	3.39E+09	0.00E+00	2.75E+09	4.33E+08	4.06E+08	0.00E+00
CS-137	3.24E+10	4.31E+10	1.50E+10	0.00E+00	1.47E+10	5.70E+09	6.14E+08	0.00E+00
CS-138	5.29E-23	1.02E-22	5.08E-23	0.00E+00	7.50E-23	8.72E-24	4.61E-26	0.00E+00
BA-139	1.01E-08	7.09E-12	2.94E-10	0.00E+00	6.69E-12	4.89E-12	8.99E-08	0.00E+00
BA-140	5.56E+06	6.82E+03	3.58E+05	0.00E+00	2.31E+03	4.58E+03	8.58E+06	0.00E+00
LA-140	9.73E-01	4.78E-01	1.27E-01	0.00E+00	0.00E+00	0.00E+00	2.75E+04	0.00E+00
LA-142	4.12E-12	1.83E-12	4.56E-13	0.00E+00	0.00E+00	0.00E+00	5.57E-08	0.00E+00
CE-141	9.39E+02	6.27E+02	7.20E+01	0.00E+00	2.95E+02	0.00E+00	1.79E+06	0.00E+00
CE-143	9.18E+00	6.68E+03	7.46E-01	0.00E+00	3.00E+00	0.00E+00	2.01E+05	0.00E+00
CE-144	6.24E+04	2.58E+04	3.35E+03	0.00E+00	1.54E+04	0.00E+00	1.57E+07	0.00E+00
HF-181	1.82E+03	9.98E+00	2.03E+02	6.08E+00	8.29E+00	0.00E+00	9.08E+04	0.00E+00
W-187	1.43E+03	1.17E+03	4.09E+02	0.00E+00	0.00E+00	0.00E+00	3.16E+05	0.00E+00
NP-239	8.42E-01	7.94E-02	4.41E-02	0.00E+00	2.49E-01	0.00E+00	1.28E+04	0.00E+00

TABLE 3.5-14

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[14]

(Reference Regulatory Guide 1.109)

PATHWAY = Goat Milk

AGE GROUP = Child

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03
F-18	2.33E-03	0.00E+00	2.31E-04	0.00E+00	0.00E+00	0.00E+00	6.30E-04	0.00E+00
NA-24	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	0.00E+00
CR-51	0.00E+00	0.00E+00	1.09E+04	6.05E+03	1.65E+03	1.11E+04	5.79E+05	0.00E+00
MN-54	0.00E+00	2.01E+06	5.35E+05	0.00E+00	5.63E+05	0.00E+00	1.69E+06	0.00E+00
MN-56	0.00E+00	1.56E-03	3.53E-04	0.00E+00	1.89E-03	0.00E+00	2.26E-01	0.00E+00
FE-55	1.13E+06	6.00E+05	1.86E+05	0.00E+00	0.00E+00	3.40E+05	1.11E+05	0.00E+00
FE-59	1.34E+06	2.17E+06	1.08E+06	0.00E+00	0.00E+00	6.29E+05	2.26E+06	0.00E+00
CO-57	0.00E+00	3.65E+05	7.39E+05	0.00E+00	0.00E+00	0.00E+00	2.99E+06	0.00E+00
CO-58	0.00E+00	1.21E+06	3.71E+06	0.00E+00	0.00E+00	0.00E+00	7.06E+06	0.00E+00
CO-60	0.00E+00	4.11E+06	1.21E+07	0.00E+00	0.00E+00	0.00E+00	2.27E+07	0.00E+00
NI-65	2.02E-01	1.90E-02	1.11E-02	0.00E+00	0.00E+00	0.00E+00	2.33E+00	0.00E+00
CU-64	0.00E+00	8.35E+03	5.05E+03	0.00E+00	2.02E+04	0.00E+00	3.92E+05	0.00E+00
ZN-65	4.46E+08	1.19E+09	7.40E+08	0.00E+00	7.49E+08	0.00E+00	2.09E+08	0.00E+00
BR-82	0.00E+00	0.00E+00	1.40E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	5.42E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	8.49E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	9.79E+08	6.02E+08	0.00E+00	0.00E+00	0.00E+00	6.30E+07	0.00E+00
SR-89	1.18E+10	0.00E+00	3.38E+08	0.00E+00	0.00E+00	0.00E+00	4.58E+08	0.00E+00
SR-90	1.95E+11	0.00E+00	4.94E+10	0.00E+00	0.00E+00	0.00E+00	2.62E+09	0.00E+00
SR-91	2.75E+05	0.00E+00	1.04E+04	0.00E+00	0.00E+00	0.00E+00	6.07E+05	0.00E+00
SR-92	4.65E+00	0.00E+00	1.86E-01	0.00E+00	0.00E+00	0.00E+00	8.81E+01	0.00E+00
Y-91M	3.36E-20	0.00E+00	1.22E-21	0.00E+00	0.00E+00	0.00E+00	6.59E-17	0.00E+00
Y-91	3.94E+03	0.00E+00	1.05E+02	0.00E+00	0.00E+00	0.00E+00	5.25E+05	0.00E+00
Y-92	3.07E-05	0.00E+00	8.78E-07	0.00E+00	0.00E+00	0.00E+00	8.87E-01	0.00E+00
Y-93	1.22E-01	0.00E+00	3.35E-03	0.00E+00	0.00E+00	0.00E+00	1.82E+03	0.00E+00
ZR-95	3.85E+02	8.45E+01	7.53E+01	0.00E+00	1.21E+02	0.00E+00	8.82E+04	0.00E+00
ZR-97	2.31E-01	3.33E-02	1.97E-02	0.00E+00	4.79E-02	0.00E+00	5.05E+03	0.00E+00
NB-95	3.34E+04	1.30E+04	9.29E+03	0.00E+00	1.22E+04	0.00E+00	2.40E+07	0.00E+00
NB-97	1.80E-12	3.26E-13	1.52E-13	0.00E+00	3.62E-13	0.00E+00	1.01E-07	0.00E+00
MO-99	0.00E+00	9.79E+06	2.42E+06	0.00E+00	2.09E+07	0.00E+00	8.10E+06	0.00E+00

[14]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 3.5-14 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	1.60E+00	3.14E+00	5.20E+01	0.00E+00	4.56E+01	1.59E+00	1.79E+03	0.00E+00
RU-103	4.47E+02	0.00E+00	1.72E+02	0.00E+00	1.12E+03	0.00E+00	1.15E+04	0.00E+00
RU-105	4.63E-04	0.00E+00	1.68E-04	0.00E+00	4.07E-03	0.00E+00	3.02E-01	0.00E+00
RU-106	8.93E+03	0.00E+00	1.11E+03	0.00E+00	1.21E+04	0.00E+00	1.39E+05	0.00E+00
AG-110M	2.09E+07	1.41E+07	1.13E+07	0.00E+00	2.62E+07	0.00E+00	1.68E+09	0.00E+00
SN-113	1.40E+06	4.52E+04	1.53E+06	1.85E+04	3.10E+04	0.00E+00	5.61E+06	0.00E+00
SB-124	1.10E+07	1.42E+05	3.84E+06	2.42E+04	0.00E+00	6.08E+06	6.85E+07	0.00E+00
SB-125	8.25E+06	6.36E+04	1.73E+06	7.64E+03	0.00E+00	4.60E+06	1.97E+07	0.00E+00
TE-129M	3.07E+07	8.57E+06	4.76E+06	9.90E+06	9.01E+07	0.00E+00	3.74E+07	0.00E+00
TE-129	1.62E-10	4.53E-11	3.85E-11	1.16E-10	4.74E-10	0.00E+00	1.01E-08	0.00E+00
TE-131M	1.96E+05	6.78E+04	7.22E+04	1.39E+05	6.57E+05	0.00E+00	2.75E+06	0.00E+00
TE-132	1.26E+06	5.57E+05	6.73E+05	8.11E+05	5.17E+06	0.00E+00	5.61E+06	0.00E+00
I-131	1.54E+09	1.55E+09	8.78E+08	5.11E+11	2.54E+09	0.00E+00	1.38E+08	0.00E+00
I-132	8.41E-01	1.55E+00	7.11E-01	7.17E+01	2.36E+00	0.00E+00	1.82E+00	0.00E+00
I-133	2.06E+07	2.55E+07	9.66E+06	4.74E+09	4.25E+07	0.00E+00	1.03E+07	0.00E+00
I-134	1.06E-11	1.98E-11	9.09E-12	4.54E-10	3.02E-11	0.00E+00	1.31E-11	0.00E+00
I-135	6.52E+04	1.17E+05	5.55E+04	1.04E+07	1.80E+05	0.00E+00	8.94E+04	0.00E+00
CS-134	5.35E+10	8.78E+10	1.85E+10	0.00E+00	2.72E+10	9.76E+09	4.73E+08	0.00E+00
CS-136	2.89E+09	7.96E+09	5.15E+09	0.00E+00	4.24E+09	6.32E+08	2.80E+08	0.00E+00
CS-137	7.81E+10	7.48E+10	1.10E+10	0.00E+00	2.44E+10	8.77E+09	4.68E+08	0.00E+00
CS-138	1.28E-22	1.78E-22	1.13E-22	0.00E+00	1.25E-22	1.35E-23	8.21E-23	0.00E+00
BA-139	2.48E-08	1.32E-11	7.18E-10	0.00E+00	1.15E-11	7.78E-12	1.43E-06	0.00E+00
BA-140	1.34E+07	1.18E+04	7.84E+05	0.00E+00	3.83E+03	7.01E+03	6.80E+06	0.00E+00
LA-140	2.33E+00	8.14E-01	2.75E-01	0.00E+00	0.00E+00	0.00E+00	2.27E+04	0.00E+00
LA-142	9.95E-12	3.17E-12	9.94E-13	0.00E+00	0.00E+00	0.00E+00	6.29E-07	0.00E+00
CE-141	2.31E+03	1.15E+03	1.71E+02	0.00E+00	5.05E+02	0.00E+00	1.44E+06	0.00E+00
CE-143	2.25E+01	1.22E+04	1.77E+00	0.00E+00	5.12E+00	0.00E+00	1.79E+05	0.00E+00
CE-144	1.54E+05	4.82E+04	8.21E+03	0.00E+00	2.67E+04	0.00E+00	1.26E+07	0.00E+00
HF-181	4.30E+03	1.68E+01	4.33E+02	1.42E+01	1.35E+01	0.00E+00	7.15E+04	0.00E+00
W-187	3.47E+03	2.05E+03	9.22E+02	0.00E+00	0.00E+00	0.00E+00	2.89E+05	0.00E+00
NP-239	2.07E+00	1.49E-01	1.05E-01	0.00E+00	4.30E-01	0.00E+00	1.10E+04	0.00E+00

TABLE 3.5-15

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[15]

(Reference Regulatory Guide 1.109)

PATHWAY = Goat Milk

AGE GROUP = Infant

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03
F-18	4.85E-03	0.00E+00	4.14E-04	0.00E+00	0.00E+00	0.00E+00	1.14E-03	0.00E+00
NA-24	1.86E+06	1.86E+06	1.86E+06	1.86E+06	1.86E+06	1.86E+06	1.86E+06	0.00E+00
CR-51	0.00E+00	0.00E+00	1.73E+04	1.13E+04	2.46E+03	2.19E+04	5.04E+05	0.00E+00
MN-54	0.00E+00	3.73E+06	8.46E+05	0.00E+00	8.28E+05	0.00E+00	1.37E+06	0.00E+00
MN-56	0.00E+00	3.83E-03	6.60E-04	0.00E+00	3.29E-03	0.00E+00	3.48E-01	0.00E+00
FE-55	1.37E+06	8.84E+05	2.36E+05	0.00E+00	0.00E+00	4.32E+05	1.12E+05	0.00E+00
FE-59	2.50E+06	4.37E+06	1.72E+06	0.00E+00	0.00E+00	1.29E+06	2.09E+06	0.00E+00
CO-57	0.00E+00	8.52E+05	1.39E+06	0.00E+00	0.00E+00	0.00E+00	2.90E+06	0.00E+00
CO-58	0.00E+00	2.42E+06	6.04E+06	0.00E+00	0.00E+00	0.00E+00	6.03E+06	0.00E+00
CO-60	0.00E+00	8.38E+06	1.98E+07	0.00E+00	0.00E+00	0.00E+00	1.99E+07	0.00E+00
NI-65	4.27E-01	4.84E-02	2.20E-02	0.00E+00	0.00E+00	0.00E+00	3.68E+00	0.00E+00
CU-64	0.00E+00	2.08E+04	9.62E+03	0.00E+00	3.51E+04	0.00E+00	4.26E+05	0.00E+00
ZN-65	5.99E+08	2.06E+09	9.48E+08	0.00E+00	9.97E+08	0.00E+00	1.74E+09	0.00E+00
BR-82	0.00E+00	0.00E+00	2.35E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	1.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	1.64E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.48E+09	1.23E+09	0.00E+00	0.00E+00	0.00E+00	6.36E+07	0.00E+00
SR-89	2.25E+10	0.00E+00	6.45E+08	0.00E+00	0.00E+00	0.00E+00	4.62E+08	0.00E+00
SR-90	2.12E+11	0.00E+00	5.40E+10	0.00E+00	0.00E+00	0.00E+00	2.65E+09	0.00E+00
SR-91	5.73E+05	0.00E+00	2.07E+04	0.00E+00	0.00E+00	0.00E+00	6.78E+05	0.00E+00
SR-92	9.89E+00	0.00E+00	3.67E-01	0.00E+00	0.00E+00	0.00E+00	1.07E+02	0.00E+00
Y-91M	7.13E-20	0.00E+00	2.43E-21	0.00E+00	0.00E+00	0.00E+00	2.38E-16	0.00E+00
Y-91	7.40E+03	0.00E+00	1.97E+02	0.00E+00	0.00E+00	0.00E+00	5.30E+05	0.00E+00
Y-92	6.52E-05	0.00E+00	1.83E-06	0.00E+00	0.00E+00	0.00E+00	1.24E+00	0.00E+00
Y-93	2.60E-01	0.00E+00	7.08E-03	0.00E+00	0.00E+00	0.00E+00	2.05E+03	0.00E+00
ZR-95	6.83E+02	1.66E+02	1.18E+02	0.00E+00	1.79E+02	0.00E+00	8.29E+04	0.00E+00
ZR-97	4.89E-01	8.38E-02	3.83E-02	0.00E+00	8.45E-02	0.00E+00	5.35E+03	0.00E+00
NB-95	6.23E+04	2.57E+04	1.48E+04	0.00E+00	1.84E+04	0.00E+00	2.17E+07	0.00E+00
NB-97	3.82E-12	8.14E-13	2.93E-13	0.00E+00	6.36E-13	0.00E+00	2.57E-07	0.00E+00
MO-99	0.00E+00	2.50E+07	4.88E+06	0.00E+00	3.74E+07	0.00E+00	8.24E+06	0.00E+00

[15]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 3.5-15 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
TC-99M	3.33E+00	6.87E+00	8.85E+01	0.00E+00	7.39E+01	3.59E+00	2.00E+03	0.00E+00
RU-103	9.04E+02	0.00E+00	3.02E+02	0.00E+00	1.88E+03	0.00E+00	1.10E+04	0.00E+00
RU-105	9.76E-04	0.00E+00	3.29E-04	0.00E+00	7.17E-03	0.00E+00	3.88E-01	0.00E+00
RU-106	1.84E+04	0.00E+00	2.30E+03	0.00E+00	2.18E+04	0.00E+00	1.40E+05	0.00E+00
AG-110M	3.86E+07	2.81E+07	1.86E+07	0.00E+00	4.03E+07	0.00E+00	1.46E+09	0.00E+00
SN-113	2.13E+06	8.15E+04	2.20E+06	3.10E+04	4.37E+04	0.00E+00	4.55E+06	0.00E+00
SB-124	2.11E+07	3.11E+05	6.54E+06	5.61E+04	0.00E+00	1.32E+07	6.52E+07	0.00E+00
SB-125	1.42E+07	1.37E+05	2.91E+06	1.77E+04	0.00E+00	8.20E+06	1.89E+07	0.00E+00
TE-129M	6.30E+07	2.16E+07	9.71E+06	2.42E+07	1.58E+08	0.00E+00	3.76E+07	0.00E+00
TE-129	3.44E-10	1.18E-10	8.02E-11	2.88E-10	8.56E-10	0.00E+00	2.75E-08	0.00E+00
TE-131M	4.14E+05	1.67E+05	1.38E+05	3.38E+05	1.15E+06	0.00E+00	2.81E+06	0.00E+00
TE-132	2.59E+06	1.28E+06	1.20E+06	1.89E+06	8.02E+06	0.00E+00	4.75E+06	0.00E+00
I-131	3.21E+09	3.78E+09	1.66E+09	1.24E+12	4.41E+09	0.00E+00	1.35E+08	0.00E+00
I-132	1.74E+00	3.54E+00	1.26E+00	1.66E+02	3.95E+00	0.00E+00	2.87E+00	0.00E+00
I-133	4.36E+07	6.35E+07	1.86E+07	1.15E+10	7.46E+07	0.00E+00	1.07E+07	0.00E+00
I-134	2.21E-11	4.52E-11	1.61E-11	1.05E-09	5.05E-11	0.00E+00	4.67E-11	0.00E+00
I-135	1.36E+05	2.70E+05	9.83E+04	2.42E+07	3.00E+05	0.00E+00	9.76E+04	0.00E+00
CS-134	8.62E+10	1.61E+11	1.62E+10	0.00E+00	4.14E+10	1.70E+10	4.37E+08	0.00E+00
CS-136	5.65E+09	1.66E+10	6.21E+09	0.00E+00	6.63E+09	1.35E+09	2.52E+08	0.00E+00
CS-137	1.25E+11	1.46E+11	1.03E+10	0.00E+00	3.92E+10	1.59E+10	4.56E+08	0.00E+00
CS-138	2.70E-22	4.40E-22	2.13E-22	0.00E+00	2.19E-22	3.42E-23	7.03E-22	0.00E+00
BA-139	5.27E-08	3.49E-11	1.53E-09	0.00E+00	2.10E-11	2.12E-11	3.34E-06	0.00E+00
BA-140	2.76E+07	2.76E+04	1.42E+06	0.00E+00	6.56E+03	1.70E+04	6.79E+06	0.00E+00
LA-140	4.87E+00	1.92E+00	4.94E-01	0.00E+00	0.00E+00	0.00E+00	2.25E+04	0.00E+00
LA-142	2.09E-11	7.68E-12	1.84E-12	0.00E+00	0.00E+00	0.00E+00	1.30E-06	0.00E+00
CE-141	4.58E+03	2.80E+03	3.29E+02	0.00E+00	8.62E+02	0.00E+00	1.44E+06	0.00E+00
CE-143	4.77E+01	3.16E+04	3.61E+00	0.00E+00	9.21E+00	0.00E+00	1.85E+05	0.00E+00
CE-144	2.21E+05	9.03E+04	1.24E+04	0.00E+00	3.65E+04	0.00E+00	1.27E+07	0.00E+00
HF-181	8.23E+03	3.87E+01	7.27E+02	3.28E+01	2.27E+01	0.00E+00	6.75E+04	0.00E+00
W-187	7.30E+03	5.08E+03	1.75E+03	0.00E+00	0.00E+00	0.00E+00	2.98E+05	0.00E+00
NP-239	4.38E+00	3.92E-01	2.21E-01	0.00E+00	7.81E-01	0.00E+00	1.13E+04	0.00E+00

TABLE 3.5-16

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[16]

(Reference Regulatory Guide 1.109)

PATHWAY = Inhalation

AGE GROUP = Adult

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
F-18	4.99E+03	0.00E+00	5.54E+02	0.00E+00	0.00E+00	0.00E+00	1.48E+02	0.00E+00
NA-24	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03	0.00E+00
MN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04	0.00E+00
MN-56	0.00E+00	1.24E+00	1.83E-01	0.00E+00	1.30E+00	9.44E+03	2.02E+04	0.00E+00
FE-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03	0.00E+00
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+05	1.88E+05	0.00E+00
CO-57	0.00E+00	6.92E+02	6.71E+02	0.00E+00	0.00E+00	3.70E+05	3.14E+04	0.00E+00
CO-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05	0.00E+00
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05	0.00E+00
NI-65	1.54E+00	2.10E-01	9.12E-02	0.00E+00	0.00E+00	5.60E+03	1.23E+04	0.00E+00
CU-64	0.00E+00	1.46E+00	6.15E-01	0.00E+00	4.62E+00	6.78E+03	4.90E+04	0.00E+00
ZN-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04	0.00E+00
BR-82	0.00E+00	0.00E+00	1.35E+04	0.00E+00	0.00E+00	0.00E+00	1.04E+04	0.00E+00
BR-83	0.00E+00	0.00E+00	2.41E+02	0.00E+00	0.00E+00	0.00E+00	2.32E+02	0.00E+00
BR-84	0.00E+00	0.00E+00	3.13E+02	0.00E+00	0.00E+00	0.00E+00	1.64E-03	0.00E+00
RB-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04	0.00E+00
RB-88	0.00E+00	3.87E+02	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.34E-09	0.00E+00
RB-89	0.00E+00	2.56E+02	1.70E+02	0.00E+00	0.00E+00	0.00E+00	9.28E-12	0.00E+00
SR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05	0.00E+00
SR-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05	0.00E+00
SR-91	6.19E+01	0.00E+00	2.50E+00	0.00E+00	0.00E+00	3.65E+04	1.91E+05	0.00E+00
SR-92	6.74E+00	0.00E+00	2.91E-01	0.00E+00	0.00E+00	1.65E+04	4.30E+04	0.00E+00
Y-91M	2.61E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	1.92E+03	1.33E+00	0.00E+00
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05	0.00E+00
Y-92	1.03E+01	0.00E+00	3.02E-01	0.00E+00	0.00E+00	1.57E+04	7.35E+04	0.00E+00
Y-93	9.44E+01	0.00E+00	2.61E+00	0.00E+00	0.00E+00	4.85E+04	4.22E+05	0.00E+00
ZR-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05	0.00E+00
ZR-97	9.68E+01	1.96E+01	9.04E+00	0.00E+00	2.97E+01	7.87E+04	5.23E+05	0.00E+00
NB-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05	0.00E+00

[16]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 3.5-16 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
NB-97	2.22E-01	5.62E-02	2.05E-02	0.00E+00	6.54E-02	2.40E+03	2.42E+02	0.00E+00
MO-99	0.00E+00	1.21E+02	2.30E+01	0.00E+00	2.91E+02	9.12E+04	2.48E+05	0.00E+00
TC-99M	1.03E-03	2.91E-03	3.70E-02	0.00E+00	4.42E-02	7.64E+02	4.16E+03	0.00E+00
TC-101	4.18E-05	6.02E-05	5.90E-04	0.00E+00	1.08E-03	3.99E+02	1.09E-11	0.00E+00
RU-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05	0.00E+00
RU-105	7.90E-01	0.00E+00	3.11E-01	0.00E+00	1.02E+00	1.10E+04	4.82E+04	0.00E+00
RU-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05	0.00E+00
AG-110M	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05	0.00E+00
SN-113	6.86E+03	2.66E+02	6.48E+03	9.28E+01	1.97E+02	2.99E+05	2.48E+04	0.00E+00
SB-124	3.12E+04	5.89E+02	1.24E+04	7.55E+01	0.00E+00	2.48E+06	4.06E+05	0.00E+00
SB-125	5.34E+04	5.95E+02	1.26E+04	5.40E+01	0.00E+00	1.74E+06	1.01E+05	0.00E+00
TE-129M	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05	0.00E+00
TE-129	4.98E-02	2.39E-02	1.24E-02	3.90E-02	1.87E-01	1.94E+03	1.57E+02	0.00E+00
TE-131M	6.99E+01	4.36E+01	2.90E+01	5.50E+01	3.09E+02	1.46E+05	5.56E+05	0.00E+00
TE-132	2.60E+02	2.15E+02	1.62E+02	1.90E+02	1.46E+03	2.88E+05	5.10E+05	0.00E+00
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03	0.00E+00
I-132	1.16E+03	3.26E+03	1.16E+03	1.14E+05	5.18E+03	0.00E+00	4.06E+02	0.00E+00
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03	0.00E+00
I-134	6.44E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	0.00E+00	1.01E+00	0.00E+00
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	0.00E+00	5.25E+03	0.00E+00
CS-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04	0.00E+00
CS-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04	0.00E+00
CS-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03	0.00E+00
CS-138	3.31E+02	6.21E+02	3.24E+02	0.00E+00	4.80E+02	4.86E+01	1.86E-03	0.00E+00
BA-139	9.36E-01	6.66E-04	2.74E-02	0.00E+00	6.22E-04	3.76E+03	8.96E+02	0.00E+00
BA-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05	0.00E+00
BA-142	2.63E-02	2.70E-05	1.66E-03	0.00E+00	2.29E-05	1.19E+03	1.57E-16	0.00E+00
LA-140	3.44E+02	1.74E+02	4.58E+01	0.00E+00	0.00E+00	1.36E+05	4.58E+05	0.00E+00
LA-142	6.83E-01	3.10E-01	7.72E-02	0.00E+00	0.00E+00	6.33E+03	2.11E+03	0.00E+00
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05	0.00E+00
CE-143	1.86E+02	1.38E+02	1.53E+01	0.00E+00	6.08E+01	7.98E+04	2.26E+05	0.00E+00
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05	0.00E+00
PR-144	3.01E-02	1.25E-02	1.53E-03	0.00E+00	7.05E-03	1.02E+03	2.15E-08	0.00E+00
HF-181	4.56E+04	2.57E+02	5.15E+03	1.63E+03	2.14E+02	5.98E+05	1.29E+05	0.00E+00
W-187	8.48E+00	7.08E+00	2.48E+00	0.00E+00	0.00E+00	2.90E+04	1.55E+05	0.00E+00
NP-239	2.30E+02	2.26E+01	1.24E+01	0.00E+00	7.00E+01	3.76E+04	1.19E+05	0.00E+00

TABLE 3.5-17

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[17]

(Reference Regulatory Guide 1.109)

PATHWAY = Inhalation

AGE GROUP = Teen

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
F-18	5.22E+03	0.00E+00	5.68E+02	0.00E+00	0.00E+00	0.00E+00	3.11E+02	0.00E+00
NA-24	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03	0.00E+00
MN-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04	0.00E+00
MN-56	0.00E+00	1.70E+00	2.52E-01	0.00E+00	1.79E+00	1.52E+04	5.74E+04	0.00E+00
FE-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03	0.00E+00
FE-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05	0.00E+00
CO-57	0.00E+00	9.44E+02	9.20E+02	0.00E+00	0.00E+00	5.86E+05	3.14E+04	0.00E+00
CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04	0.00E+00
CO-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05	0.00E+00
NI-65	2.18E+00	2.93E-01	1.27E-01	0.00E+00	0.00E+00	9.36E+03	3.67E+04	0.00E+00
CU-64	0.00E+00	2.03E+00	8.48E-01	0.00E+00	6.41E+00	1.11E+04	6.14E+04	0.00E+00
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04	0.00E+00
BR-82	0.00E+00	0.00E+00	1.82E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	3.44E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.33E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04	0.00E+00
RB-88	0.00E+00	5.46E+02	2.72E+02	0.00E+00	0.00E+00	0.00E+00	2.92E-05	0.00E+00
RB-89	0.00E+00	3.52E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	3.38E-07	0.00E+00
SR-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05	0.00E+00
SR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05	0.00E+00
SR-91	8.80E+01	0.00E+00	3.51E+00	0.00E+00	0.00E+00	6.07E+04	2.59E+05	0.00E+00
SR-92	9.52E+00	0.00E+00	4.06E-01	0.00E+00	0.00E+00	2.74E+04	1.19E+05	0.00E+00
Y-91M	3.70E-01	0.00E+00	1.42E-02	0.00E+00	0.00E+00	3.20E+03	3.02E+01	0.00E+00
Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05	0.00E+00
Y-92	1.47E+01	0.00E+00	4.29E-01	0.00E+00	0.00E+00	2.68E+04	1.65E+05	0.00E+00
Y-93	1.35E+02	0.00E+00	3.72E+00	0.00E+00	0.00E+00	8.32E+04	5.79E+05	0.00E+00
ZR-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05	0.00E+00
ZR-97	1.38E+02	2.72E+01	1.26E+01	0.00E+00	4.12E+01	1.30E+05	6.30E+05	0.00E+00
NB-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04	0.00E+00

[17]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 3.5-17 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
NB-97	3.14E-01	7.78E-02	2.84E-02	0.00E+00	9.12E-02	3.93E+03	2.17E+03	0.00E+00
MO-99	0.00E+00	1.69E+02	3.22E+01	0.00E+00	4.11E+02	1.54E+05	2.69E+05	0.00E+00
TC-99M	1.38E-03	3.86E-03	4.99E-02	0.00E+00	5.76E-02	1.15E+03	6.13E+03	0.00E+00
TC-101	5.92E-05	8.40E-05	8.24E-04	0.00E+00	1.52E-03	6.67E+02	8.72E-07	0.00E+00
RU-103	2.10E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05	0.00E+00
RU-105	1.12E+00	0.00E+00	4.34E-01	0.00E+00	1.41E+00	1.82E+04	9.04E+04	0.00E+00
RU-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05	0.00E+00
AG-110M	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05	0.00E+00
SN-113	8.16E+03	3.44E+02	8.64E+03	1.13E+02	2.46E+02	4.26E+05	2.03E+04	0.00E+00
SB-124	4.30E+04	7.94E+02	1.68E+04	9.76E+01	0.00E+00	3.85E+06	3.98E+05	0.00E+00
SB-125	7.38E+04	8.08E+02	1.72E+04	7.04E+01	0.00E+00	2.74E+06	9.92E+04	0.00E+00
TE-129M	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05	0.00E+00
TE-129	7.10E-02	3.38E-02	1.76E-02	5.18E-02	2.66E-01	3.30E+03	1.62E+03	0.00E+00
TE-131M	9.84E+01	6.01E+01	4.02E+01	7.25E+01	4.39E+02	2.38E+05	6.21E+05	0.00E+00
TE-132	3.60E+02	2.90E+02	2.19E+02	2.46E+02	1.95E+03	4.49E+05	4.63E+05	0.00E+00
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03	0.00E+00
I-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	0.00E+00	1.27E+03	0.00E+00
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04	0.00E+00
I-134	8.88E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	0.00E+00	2.04E+01	0.00E+00
I-135	3.70E+03	9.44E+03	3.49E+03	6.21E+05	1.49E+04	0.00E+00	6.95E+03	0.00E+00
CS-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03	0.00E+00
CS-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04	0.00E+00
CS-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03	0.00E+00
CS-138	4.66E+02	8.56E+02	4.46E+02	0.00E+00	6.62E+02	7.87E+01	2.70E-01	0.00E+00
BA-139	1.34E+00	9.44E-04	3.90E-02	0.00E+00	8.88E-04	6.46E+03	6.45E+03	0.00E+00
BA-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05	0.00E+00
BA-142	3.70E-02	3.70E-05	2.27E-03	0.00E+00	3.14E-05	1.91E+03	4.79E-10	0.00E+00
LA-140	4.79E+02	2.36E+02	6.26E+01	0.00E+00	0.00E+00	2.14E+05	4.87E+05	0.00E+00
LA-142	9.60E-01	4.25E-01	1.06E-01	0.00E+00	0.00E+00	1.02E+04	1.20E+04	0.00E+00
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05	0.00E+00
CE-143	2.66E+02	1.94E+02	2.16E+01	0.00E+00	8.64E+01	1.30E+05	2.55E+05	0.00E+00
CE-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05	0.00E+00
PR-144	4.30E-02	1.76E-02	2.18E-03	0.00E+00	1.01E-02	1.75E+03	2.35E-04	0.00E+00
HF-181	6.31E+04	3.47E+02	7.04E+03	2.12E+02	2.90E+02	9.36E+05	1.20E+05	0.00E+00
W-187	1.20E+01	9.76E+00	3.43E+00	0.00E+00	0.00E+00	4.74E+04	1.77E+05	0.00E+00
NP-239	3.38E+02	3.19E+01	1.77E+01	0.00E+00	1.00E+02	6.49E+04	1.32E+05	0.00E+00

TABLE 3.5-18

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[18]

(Reference Regulatory Guide 1.109)

PATHWAY = Inhalation

AGE GROUP = Child

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
F-18	6.96E+03	0.00E+00	6.85E+02	0.00E+00	0.00E+00	0.00E+00	1.25E+03	0.00E+00
NA-24	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03	0.00E+00
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04	0.00E+00
MN-56	0.00E+00	1.66E+00	3.12E-01	0.00E+00	1.67E+00	1.31E+04	1.23E+05	0.00E+00
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03	0.00E+00
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04	0.00E+00
CO-57	0.00E+00	9.03E+02	1.07E+03	0.00E+00	0.00E+00	5.07E+05	1.32E+04	0.00E+00
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04	0.00E+00
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04	0.00E+00
NI-65	2.99E+00	2.96E-01	1.64E-01	0.00E+00	0.00E+00	8.18E+03	8.40E+04	0.00E+00
CU-64	0.00E+00	1.99E+00	1.07E+00	0.00E+00	6.03E+00	9.58E+03	3.67E+04	0.00E+00
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04	0.00E+00
BR-82	0.00E+00	0.00E+00	2.09E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	4.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	5.48E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03	0.00E+00
RB-88	0.00E+00	5.62E+02	3.66E+02	0.00E+00	0.00E+00	0.00E+00	1.72E+01	0.00E+00
RB-89	0.00E+00	3.45E+02	2.90E+02	0.00E+00	0.00E+00	0.00E+00	1.89E+00	0.00E+00
SR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05	0.00E+00
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05	0.00E+00
SR-91	1.21E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	5.33E+04	1.74E+05	0.00E+00
SR-92	1.31E+01	0.00E+00	5.25E-01	0.00E+00	0.00E+00	2.40E+04	2.42E+05	0.00E+00
Y-91M	5.07E-01	0.00E+00	1.84E-02	0.00E+00	0.00E+00	2.81E+03	1.72E+03	0.00E+00
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05	0.00E+00
Y-92	2.04E+01	0.00E+00	5.81E-01	0.00E+00	0.00E+00	2.39E+04	2.39E+05	0.00E+00
Y-93	1.86E+02	0.00E+00	5.11E+00	0.00E+00	0.00E+00	7.44E+04	3.89E+05	0.00E+00
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04	0.00E+00
ZR-97	1.88E+02	2.72E+01	1.60E+01	0.00E+00	3.88E+01	1.13E+05	3.51E+05	0.00E+00
NB-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04	0.00E+00

[18]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 3.5-18 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
NB-97	4.29E-01	7.70E-02	3.50E-02	0.00E+00	8.55E-02	3.42E+03	2.78E+16	0.00E+00
MO-99	0.00E+00	1.72E+02	4.25E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05	0.00E+00
TC-99M	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03	0.00E+00
TC-101	8.10E-05	8.51E-05	1.08E-03	0.00E+00	1.45E-03	5.85E+02	1.63E+01	0.00E+00
RU-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04	0.00E+00
RU-105	1.53E+00	0.00E+00	5.55E-01	0.00E+00	1.34E+00	1.59E+04	9.95E+04	0.00E+00
RU-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05	0.00E+00
AG-110M	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05	0.00E+00
SN-113	8.99E+03	2.90E+02	9.81E+03	1.19E+02	2.03E+02	3.40E+05	7.44E+03	0.00E+00
SB-124	5.74E+04	7.40E+02	2.00E+04	1.26E+02	0.00E+00	3.24E+06	1.64E+05	0.00E+00
SB-125	9.84E+04	7.59E+02	2.07E+04	9.10E+01	0.00E+00	2.32E+06	4.03E+04	0.00E+00
TE-129M	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05	0.00E+00
TE-129	9.77E-02	3.50E-02	2.38E-02	7.14E-02	2.57E-01	2.93E+03	2.55E+04	0.00E+00
TE-131M	1.34E+02	5.92E+01	5.07E+01	9.77E+01	4.00E+02	2.06E+05	3.08E+05	0.00E+00
TE-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05	0.00E+00
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03	0.00E+00
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	0.00E+00	3.20E+03	0.00E+00
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03	0.00E+00
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	0.00E+00	9.55E+02	0.00E+00
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03	0.00E+00
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03	0.00E+00
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03	0.00E+00
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03	0.00E+00
CS-138	6.33E+02	8.40E+02	5.55E+02	0.00E+00	6.22E+02	6.81E+01	2.70E+02	0.00E+00
BA-139	1.84E+00	9.84E-04	5.36E-02	0.00E+00	8.62E-04	5.77E+03	5.77E+04	0.00E+00
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05	0.00E+00
BA-142	4.99E-02	3.60E-05	2.79E-03	0.00E+00	2.91E-05	1.64E+03	2.74E+00	0.00E+00
LA-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05	0.00E+00
LA-142	1.29E+00	4.11E-01	1.29E-01	0.00E+00	0.00E+00	8.70E+03	7.59E+04	0.00E+00
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04	0.00E+00
CE-143	3.66E+02	1.99E+02	2.87E+01	0.00E+00	8.36E+01	1.15E+05	1.27E+05	0.00E+00
CE-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05	0.00E+00
PR-144	5.96E-02	1.85E-02	3.00E-03	0.00E+00	9.77E-03	1.57E+03	1.97E+02	0.00E+00
HF-181	8.33E+04	3.28E+02	8.47E+03	2.76E+02	2.63E+02	7.96E+05	5.29E+04	0.00E+00
W-187	1.63E+01	9.66E+00	4.33E+00	0.00E+00	0.00E+00	4.11E+04	9.10E+04	0.00E+00
NP-239	4.66E+02	3.34E+01	2.35E+01	0.00E+00	9.73E+01	5.81E+04	6.40E+04	0.00E+00

TABLE 3.5-19

R VALUES for the H.B. ROBINSON STEAM ELECTRIC PLANT[19]

(Reference Regulatory Guide 1.109)

PATHWAY = Inhalation

AGE GROUP = Infant

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
F-18	5.49E+03	0.00E+00	4.66E+02	0.00E+00	0.00E+00	0.00E+00	8.54E+02	0.00E+00
NA-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	0.00E+00
CR-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02	0.00E+00
MN-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03	0.00E+00
MN-56	0.00E+00	1.54E+00	2.21E-01	0.00E+00	1.10E+00	1.25E+04	7.17E+04	0.00E+00
FE-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03	0.00E+00
FE-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04	0.00E+00
CO-57	0.00E+00	6.51E+02	6.41E+02	0.00E+00	0.00E+00	3.79E+05	4.86E+03	0.00E+00
CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04	0.00E+00
CO-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04	0.00E+00
NI-65	2.39E+00	2.84E-01	1.23E-01	0.00E+00	0.00E+00	8.12E+03	5.01E+04	0.00E+00
CU-64	0.00E+00	1.88E+00	7.74E-01	0.00E+00	3.98E+00	9.30E+03	1.50E+04	0.00E+00
ZN-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04	0.00E+00
BR-82	0.00E+00	0.00E+00	1.33E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-83	0.00E+00	0.00E+00	3.81E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03	0.00E+00
RB-88	0.00E+00	5.57E+02	2.87E+02	0.00E+00	0.00E+00	0.00E+00	3.39E+02	0.00E+00
RB-89	0.00E+00	3.21E+02	2.06E+02	0.00E+00	0.00E+00	0.00E+00	6.82E+01	0.00E+00
SR-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04	0.00E+00
SR-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05	0.00E+00
SR-91	9.56E+01	0.00E+00	3.46E+00	0.00E+00	0.00E+00	5.26E+04	7.34E+04	0.00E+00
SR-92	1.05E+01	0.00E+00	3.91E-01	0.00E+00	0.00E+00	2.38E+04	1.40E+05	0.00E+00
Y-91M	4.07E-01	0.00E+00	1.39E-02	0.00E+00	0.00E+00	2.79E+03	2.35E+03	0.00E+00
Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04	0.00E+00
Y-92	1.64E+01	0.00E+00	4.61E-01	0.00E+00	0.00E+00	2.45E+04	1.27E+05	0.00E+00
Y-93	1.50E+02	0.00E+00	4.07E+00	0.00E+00	0.00E+00	7.64E+04	1.67E+05	0.00E+00
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04	0.00E+00
ZR-97	1.50E+02	2.56E+01	1.17E+01	0.00E+00	2.59E+01	1.10E+05	1.40E+05	0.00E+00
NB-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04	0.00E+00

[19]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 3.5-19 (continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-Tract	Skin
NB-97	3.42E-01	7.29E-02	2.63E-02	0.00E+00	5.70E-02	3.32E+03	2.69E+04	0.00E+00
MO-99	0.00E+00	1.65E+02	3.23E+01	0.00E+00	2.65E+02	1.35E+05	4.87E+04	0.00E+00
TC-99M	1.40E-03	2.88E-03	3.72E-02	0.00E+00	3.11E-02	8.11E+02	2.03E+03	0.00E+00
TC-101	6.51E-05	8.23E-05	8.12E-04	0.00E+00	9.79E-04	5.84E+02	8.44E+02	0.00E+00
RU-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04	0.00E+00
RU-105	1.22E+00	0.00E+00	4.10E-01	0.00E+00	8.99E-01	1.57E+04	4.84E+04	0.00E+00
RU-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05	0.00E+00
AG-110M	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04	0.00E+00
SN-113	4.68E+03	1.74E+02	4.89E+03	6.72E+01	9.94E+01	2.30E+05	2.28E+03	0.00E+00
SB-124	3.04E+04	5.56E+02	1.20E+04	1.01E+02	0.00E+00	2.65E+06	3.42E+04	0.00E+00
SB-125	5.17E+04	4.77E+02	1.09E+04	6.23E+00	5.70E-02	3.32E+03	2.69E+04	0.00E+00
TE-129M	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04	0.00E+00
TE-129	7.88E-02	3.47E-02	1.88E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04	0.00E+00
TE-131M	1.07E+02	5.50E+01	3.63E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05	0.00E+00
TE-132	3.72E+02	2.37E+02	1.76E+02	2.79E+02	1.03E+03	3.40E+05	4.41E+04	0.00E+00
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03	0.00E+00
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	0.00E+00	1.90E+03	0.00E+00
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03	0.00E+00
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.09E+03	0.00E+00	1.29E+03	0.00E+00
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	0.00E+00	1.83E+03	0.00E+00
CS-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03	0.00E+00
CS-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03	0.00E+00
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03	0.00E+00
CS-138	5.05E+02	7.81E+02	3.98E+02	0.00E+00	4.10E+02	6.54E+01	8.76E+02	0.00E+00
BA-139	1.48E+00	9.84E-04	4.30E-02	0.00E+00	5.92E-04	5.95E+03	5.10E+04	0.00E+00
BA-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04	0.00E+00
BA-142	3.98E-02	3.30E-05	1.96E-03	0.00E+00	1.90E-05	1.55E+03	6.93E+02	0.00E+00
LA-140	5.05E+02	2.00E+02	5.15E+01	0.00E+00	0.00E+00	1.68E+05	8.48E+04	0.00E+00
LA-142	1.03E+00	3.77E-01	9.04E-02	0.00E+00	0.00E+00	8.22E+03	5.95E+04	0.00E+00
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04	0.00E+00
CE-143	2.93E+02	1.93E+02	2.21E+01	0.00E+00	5.64E+01	1.16E+05	4.97E+04	0.00E+00
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05	0.00E+00
PR-144	4.79E-02	1.85E-02	2.41E-03	0.00E+00	6.72E-03	1.61E+03	4.28E+03	0.00E+00
HF-181	5.64E+04	2.66E+02	5.05E+03	2.25E+02	1.58E+02	6.72E+05	1.90E+04	0.00E+00
W-187	1.30E+01	9.02E+00	3.12E+00	0.00E+00	0.00E+00	3.96E+04	3.56E+04	0.00E+00
NP-239	3.71E+02	3.32E+01	1.88E+01	0.00E+00	6.62E+01	5.95E+04	2.49E+04	0.00E+00