

W3F1-2023-0032

10 CFR 50.36a

April 27, 2023

ATTN: Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Subject: Annual Radioactive Effluent Release Report (ARERR) 2022 with Revised ODCM  
  
Waterford Steam Electric Station, Unit 3  
Docket No. 50-382  
Renewed Facility Operating License No. NPF-38

Attached is the Annual Radioactive Effluent Release Report for the period of January 1 through December 31, 2022, which includes a copy of the revised Offsite Dose Calculation Manual (ODCM). This report is submitted pursuant to the requirements of Waterford 3 Technical Specification Sections 6.9.1.8 and 6.14.2.c.

There are no commitments contained in this submittal.

If you have any questions, please contact Leia Milster, Regulatory Assurance Manager, at 504-739-6250.

Respectfully,

A handwritten signature in black ink, appearing to read 'Leia Milster', written in a cursive style.

Leia Milster

LM/llb

Enclosure: Annual Radioactive Effluent Release Report – 2022 (Including Revised ODCM)

cc: NRC Region IV Regional Administrator  
NRC Senior Resident Inspector – Waterford Steam Electric Station, Unit 3  
NRC Project Manager – Waterford Steam Electric Station, Unit 3  
Entergy Legal, General Sr Counsel

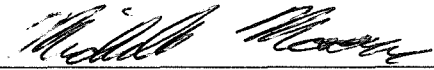
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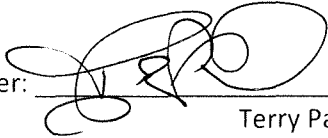
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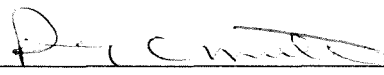
Annual Radioactive Effluent Release Report CY 2022 (Including Revised ODCM)

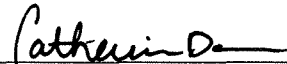
(369 pages follow)

**2022 Annual Radioactive Effluent Release Report  
Waterford 3  
Document Number: 50-382**

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<b>Plant: Waterford 3</b>	<b>Page 1 of 42</b>
	<b>YEAR: 2022</b>
<b>Document Number: 50-382</b>	
<b>Annual Radioactive Effluent Release Report</b>	

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**Annual Radioactive Effluent Release Report****1.0 INTRODUCTION**

Waterford 3, license number 50-382, is a single unit Combustion Engineering nuclear steam supply plant. Both liquid and gaseous effluents are released in accordance with the Offsite Dose Calculation Manual (ODCM). The Annual Radioactive Effluent Release Report is submitted as required by Waterford 3 Technical Specification 6.9.1.8. It covers the period from January 1, 2022 through December 31, 2022, where the plant had an average power level of 76.68%. Information in this report is presented in the format outlined in Appendix B of Regulatory Guide 1.21 and in Section 5.8.1 of the Offsite Dose Calculation Manual (UNT-005-014).

The information contained in this report includes:

- A summary of the quantities of radioactive liquid and gaseous effluents and solid wastes released from the plant during the reporting period.
- A summary of the meteorological data collected during 2022.
- Assessment of radiation doses due to liquid and gaseous radioactive effluents released during 2022.
- A discussion of Unplanned/Abnormal releases that occurred during the reporting period.
- A submittal of changes to the Offsite Dose Calculation Manual and Process Control Program during this reporting period.
- A discussion of why required radioactive effluent monitoring instrumentation was not returned to service within the time specified.
- A discussion of any instances in which effluent samples were not collected within the required frequency.

**Annual Radioactive Effluent Release Report****2.0 SUPPLEMENTAL INFORMATION****2.1 Regulatory Limits**

The ODCM (by reference) and the Technical Requirements Manual (TRM) (directly) contain the limits to which Waterford 3 must adhere. Because of the "as low as reasonably achievable" (ALARA) philosophy at Waterford 3, actions are taken to reduce the amount of radiation released to the environment. Liquid and gaseous release data show that the dose from Waterford 3 is considerably below the ODCM/TRM limits. This data reveals that the radioactive effluents have an overall minimal dose contribution to the surrounding environment. The following are the limits required by the ODCM:

1. Fission and activation gases:
  - a. Noble gases dose rate due to radioactive materials released in gaseous effluents from the areas at and beyond the site boundary shall be limited to the following:
    - Less than or equal to 500 mrem/year to the total body
    - Less than or equal to 3000 mrem/year to the skin
  - b. Noble gas air dose due to noble gases released in gaseous effluents to areas at and beyond the site boundary shall be limited to the following:
    - 1) Quarterly
      - Less than or equal to 5 mrad gamma
      - Less than or equal to 10 mrad beta
    - 2) Yearly
      - Less than or equal to 10 mrad gamma
      - Less than or equal to 20 mrad beta
2. Iodine, tritium, and all radionuclides in particulate form with half-lives greater than 8 days:
  - a. The dose rate for Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:
    - Less than or equal to 1500 mrem/yr to any organ
  - b. The dose to a MEMBER OF THE PUBLIC from Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:
    - 1) Quarterly
      - Less than or equal to 7.5 mrem to any organ
    - 2) Yearly
      - Less than or equal to 15 mrem to any organ

**Annual Radioactive Effluent Release Report**

3. Liquid Effluents Dose
  - a. The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to unrestricted areas shall be limited to the following:
    - 1) Quarterly
      - Less than or equal to 1.5 mrem total body
      - Less than or equal to 5 mrem any organ
    - 2) Yearly
      - Less than or equal to 3 mrem total body
      - Less than or equal to 10 mrem any organ
4. Total Dose (40CFR190)
  - a. The annual dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to the following:
    - Less than or equal to 25 mrem total body or any organ except thyroid.
    - Less than or equal to 75 mrem to the thyroid

**2.2 Maximum Permissible Concentrations**

1. Fission & Activation Gases, Iodines, and Particulates with Half Lives > Eight (8) Days

For gaseous effluents, maximum permissible concentrations are not directly used in release rate calculations since the applicable limits are expressed in terms of dose rate at the site boundary.
2. Liquid Effluents

The concentration of radioactive material released from the site to unrestricted areas shall be limited to ten times the concentration 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 total concentration released shall be limited to 2.0E-4 microcuries/ml.

**2.3 Average Energy**

1. This is not applicable to Waterford 3 effluent specifications. The average energy (E-Bar) is not required to be calculated from effluent release data. E-Bar for the Reactor Coolant System (RCS) is supplied as additional information in the report further below.



**Annual Radioactive Effluent Release Report****2.4 Measurements & Approximations of Total Radioactivity**

1. The quantification of radioactivity in liquid and gaseous effluents was accomplished by performing the sampling and radiological analysis of effluents in accordance with the requirements of Tables 4.11-1 and 4.11-2 of the Technical Requirements Manual (TRM).

- a. Fission & activation gases

For continuous releases, a gas grab sample was analyzed at least monthly for noble gases using gamma spectroscopy. Each week a Gas Ratio (GR) was calculated according to the following equation:

$$GR = \frac{\text{Average Weekly Noble Gas Monitor Reading}}{\text{Monitor Reading During Noble Gas Sampling}}$$

The monthly sample analysis and weekly Gas Ratio were then used to determine noble gases discharged continuously for the previous week. For gas decay tank and containment purge batch releases, a gas grab sample was analyzed prior to release to determine noble gas concentrations in the batch. In all cases, the total radioactivity in gaseous effluents was determined from measured concentrations of each radionuclide present and the total volume discharged.

- b. Iodines and Particulates

Iodines and particulates discharged were sampled using a continuous sampler which contained a charcoal cartridge and a particulate filter. Each week the charcoal cartridge and particulate filter were analyzed for gamma emitters using gamma spectroscopy. The determined radionuclide concentrations and effluent volumes discharged were used to calculate the previous week's activity released. The particulate samples were composited and analyzed quarterly for Sr-89 and Sr-90 by a contract laboratory (Teledyne Brown Engineering). Particulate gross alpha activity was measured weekly using gas-flow proportional counting techniques. The determined activities were used to estimate effluent concentrations in subsequent releases until the next scheduled analysis was performed.

- c. Tritium

Tritium is collected by passing a known volume of the sample stream through a bubbler. The collected samples are analyzed by liquid scintillation. Grab samples of continuous releases were analyzed at least monthly, and containment purge batch releases are analyzed prior to release. The determined concentrations were used to estimate tritium activity in subsequent releases until the next scheduled analysis was performed.

- d. Carbon-14

Carbon-14 release rates were estimated using the annual Carbon-14 production rate obtained from the Waterford 3 Final Safety Analysis Report (FSAR), a gaseous release fraction of 98%, a Carbon-14 carbon dioxide fraction of 30%, and 280.04 (76.68%) days equivalent full power operation. Release of Carbon-14 was assumed to be continuous.

**Annual Radioactive Effluent Release Report**

## e. Liquid Effluents

For continuous releases, samples were collected weekly and analyzed using gamma spectroscopy. The measured concentrations were used to determine radionuclide concentrations in the following week's releases. For batch releases, gamma analysis was performed on the sample prior to release.

For both continuous and batch releases, composite samples were analyzed quarterly by a contract laboratory (Teledyne Brown Engineering) for Sr-89, Sr-90, and Fe-55. Samples were composited and analyzed monthly for tritium and gross alpha using liquid scintillation and gas flow proportional counting techniques, respectively. For radionuclides measured in the composite samples, the measured concentrations in the composite samples from the previous month or quarter were used to estimate released quantities of these isotopes in liquid effluents during the current month or quarter when the analysis results became available.

The total radioactivity in liquid effluent releases was determined from the measured and estimated concentrations of each radionuclide present and the total volume of the effluent discharged.

## f. Estimated Total Error Present

Estimates of measurement and analytical error for gaseous and liquid effluents are calculated (bound by a conservative estimate of 25%) as follows:

$$E_T = \sqrt{[(E_1)^2 + (E_2)^2 + \dots (E_n)^2]}$$

Where:  $E_T$  = total percent error

$E_1 \dots E_n$  = percent error due to calibration standards,  
Laboratory analysis, instruments, sample flow, etc.

**Annual Radioactive Effluent Release Report****2.5 Batch Releases:****2.5.1 Liquid**

1. Number of batch releases: 88
2. Total time period for all batch releases: 25963 min
3. Maximum time period for a batch release: 348 min
4. Average time period for a batch release: 295 min
5. Minimum time period for a batch release: 244 min
6. Average stream flow during periods of effluent release into flowing streams:  
564877.4 f<sup>3</sup>/s

**2.5.2 Gaseous**

1. Number of batch releases: 5
2. Total time period for all batch releases: 1843 min
3. Maximum time period for a batch release: 644 min
4. Average time period for a batch release: 368.6 min
5. Minimum time period for a batch release: 4 min

**2.6 Abnormal Releases**

2.6.1 There were no abnormal releases during the reporting period.

**2.6.2 Liquid**

1. Number of releases: NR
2. Total Activity (Ci) released: NR

**2.6.3 Gaseous**

1. Number of releases: NR
2. Total Activity (Ci) released: NR

**2.7 Non-routine, Planned Discharges**

1. There were no non-routine, planned discharges for the reporting period.

**2.8 Radioactive Waste Treatment System Changes**

1. During the reporting period, no major changes were made to any Radioactive Waste Systems. All major changes to Radioactive Waste Systems are included in Waterford 3's FSAR updates.

**Annual Radioactive Effluent Release Report****2.9 Land Use Census Changes**

A land use census performed in 2022 did not identify the need for any changes to locations being used for effluent dose calculations or radiological environmental sampling. Milk sampling is no longer available for the REMP program due to owner getting rid of milking cows. The ODCM was revised on 6/15/2021 after the 2020 land use census to reflect this change. With broad leaf sampling in place in accordance with TRM 3/4.12.1 Table 3.12-1 Radiological Environmental Monitoring Program, Waterford 3 meets TRM requirements, having three broad leaf sampling sites in the place of milk samples when milk samples are unavailable.

**2.10 Effluent Monitor Instrument Inoperability**

Technical Requirements Manual (TRM) Specifications 3.3.3.10 and 3.3.3.11 require reporting in the Annual Radioactive Effluent Release Report of why designated inoperable effluent monitoring instrumentation was not restored to operability within the time specified in the Action Statement. Waterford 3 had the Liquid Waste Management and Boron Waste Management effluent radiation monitors inoperable greater than the 30 days specified in the action statement of the TRM 3.3.3.10, Radioactive Liquid Effluent. Fuel Handling Building A had TRM 3.3.3.11, Radioactive Gaseous Effluent, violation during period of inoperability. Details on each monitor is listed below:

**Gaseous Waste System (GWM) Radiation Monitor (PRMIRE0648)**

Time Required by Specifications to Restore Operability: 30 Days if release is occurring

Period of Inoperability: 11/11/2021 at 12:30 to 2/28/2022 at 16:20 (109 days)

Batch releases performed with monitor out of service: None.

Cause of Inoperability: On 11/15/2021, when calibration of the radiation monitor was finished, it was found that Channel 3 (Pseudo Channel) items 11 and 13 no longer matched. Technicians performed a data base compare and found that the items matched in the RM-80 and Master but did not match in the RM-11. No releases have occurred during the period of inoperability; therefore, there was no TRM entry during the time in inoperability.

**Main Condenser Evacuation System Wide Range Gas Monitor (MCES WRGM) (PRMIRE0002)**

Time Required by Specifications to Restore Operability: 30 Days if release is occurring

Period of Inoperability: 4/2/2022 at 11:15 to 6/9/2022 at 15:35 (68 days)

Releases performed with monitor out of service: None.

Cause of Inoperability: On 4/2/2022 at 11:15, condenser vacuum was broken for Refuel 24 work. Condenser vacuum was reestablished on 6/16/2022 at 02:18. TRM Table 3.3-13, Radioactive Gaseous Effluent Monitoring Instrumentation, states that MCES WRGM must be operable when MCES is under a vacuum. Since vacuum was not established during the period of inoperability, there was no TRM entry.

**Annual Radioactive Effluent Release Report****Steam Generator Blowdown (SGBD) Radiation Monitor (PRMIRE0100X)**

Time Required by Specifications to Restore Operability: 30 Days if release is occurring

Period of Inoperability: 4/2/2022 at 07:52 to 6/11/2022 at 23:15 (70 days)

Releases performed with monitor out of service: 2

Cause of Inoperability: On 4/2/2022 at 07:52, the monitor went inoperable due to loss of sample flow from lowering SG pressures for Refuel 24. No releases occurred during the period of inoperability. TS 3.3.3.1, Radiation Monitoring Instrumentation, is only applicable during Modes 1, 2, 3, and 4. The plant exited Mode 4 and went into Mode 5 on 4/2/2022 at 10:32. The plant went back in Mode 4 on 6/7/2022 at 8:20. There was no TRM/TS entry during the time in inoperability.

**Fuel Handling Building (FHB) Particulate Iodine Gas (PIG) A Radiation Monitor (PRMIRE5107A)**

Time Required by Specifications to Restore Operability: 30 Days if release is occurring

Period of Inoperability: 4/24/2022 at 8:56 to 6/1/2022 at 11:15 (38 days) and 9/27/2022 at 16:47 to 1/16/2023 at 14:15 (111 days)

Releases performed with monitor out of service: continuous release occurred using FHB B.

Cause of Inoperability: From 4/24/2022 at 8:56 to 6/1/2022 at 11:15, FHB particulate monitor was inoperable. Particulate monitor has no affect on operability requirements specified in TRM 3.3.3.11, Radioactive Gaseous Effluents. 9/27/2022 at 16:47, FHB particulate monitor was inoperable. All of FHB A was declared inoperable for detector replacement on 12/22/2022 at 10:45. On 12/26/2022 at 07:33, Control Room operators restarted FHB Normal Exhaust Fan A. At the time, operators did not recognize the exhaust fan was being started with the inoperable FHB PIG A. Since they had not notified Chemistry to perform alternate sampling per TRM 3.3.3.11, Radioactive Gaseous Effluent, the site was not in compliance with this TRM. At 19:45 on 12/26/2022, the oncoming shift recognized FHB Exhaust Fan A was running and swapped to FHB Exhaust Fan B. This was a TRM violation and is documented in CR-WF3-2022-08242. Two other TRM entries were made during the period of inoperability. TRM 3.3.3.11, Radioactive Gaseous Effluent, entry was made on 1/11/2023 from 05:03 to 08:21 and on 1/11/2023 at 13:41 to 1/13/2023 at 04:07. Waterford did not enter the TRM for more than 30 days during these two occurrences. FHB B was operable during other periods of FHB A inoperability. In total, there were two TRM entries and one TRM violation.

**Annual Radioactive Effluent Release Report****Plant Stack (PS) Particulate Iodine Gas (PIG) A Radiation Monitor (PRMIRE0100.1S)**

Time Required by Specifications to Restore Operability: 30 Days if release is occurring

Period of Inoperability: 5/25/2022 at 09:00 to 9/16/2022 at 16:00 (114 days) and 11/16/2022 at 10:00 to 1/10/2023 at 19:45 (56 days)

Releases performed with monitor out of service: continuous release occurred using Plant Stack B radiation monitor

Cause of Inoperability: On 5/25/2022 at 09:00 Plant Stack A Particulate Monitor went inoperable due to the particulate monitor erroneously entering into alert and alarm. The particulate monitor is not TS/TRM related. The whole radiation monitor then went inoperable due to functional test going late on 7/1/2022. On 11/16/2022 at 10:00 Plant Stack A Noble Gas Monitor went inoperable due to the monitor reading erratically and dropping in and out of Operate Failure. The whole radiation monitor then went inoperable due to functional test going late on 1/7/2023. TRM Table 3.3-13, Radioactive Gaseous Effluent Monitoring Instrumentation, covers the TRMs associated with Plant Stack. TRM 3.3.3.11-3a1 (noble gas activity monitor providing alarm and automatic termination of containment purge) is entered if Plant Stack B radiation monitor is also out of service. TRM 3.3.3.11-3a2 (noble gas activity monitor), 3.3.3.11-3b (iodine sampler), 3.3.3.11-3c (particulate sampler), 3.3.3.11-3d (sampler flow rate monitor), and 3.3.3.11-3e (waste flow rate monitor) are entered if both Plant Stack Wide Range Gas Monitor (WRGM) and Plant Stack B radiation monitor are also out of service. Plant Stack B and Plant Stack WRGM remained in service during Plant Stack A periods of inoperability; therefore, no TRM entry was made.

**Boron Waste Management (BWM) Radiation Monitor (PRMIRE0627)**

Time Required by Specifications to Restore Operability: 30 Days if release is occurring

Period of Inoperability: 11/16/2022 at 16:53 to current

Batch releases performed with monitor out of service: 2

Cause of Inoperability: On 11/16/2022 at 16:53, Boron Waste Management Radiation Monitor was found to have an incorrect engineering conversion factor. The current background of the monitor was roughly 7 times the maximum background. This issue was identified via the Waterford 3's CR-WF3-2022-6367 extent of cause. The correct methodology for detector calibration and background determination based on the communication with Radiation Monitor Vendor and/or General Atomics has been established and procedure revision is in progress. Once procedure revision is complete, calibration of detector with correct conversion factor can occur. Per TRM Table 3.3-12, Radioactive Liquid Effluent Monitoring Instrumentation, and TRM 3/4.11.1, Liquid Effluents, Chemistry is to collect and analyze at least two independent samples and have two technically qualified members independently verify release rate calculations prior to a release. The valve lineup must be independently verified by operations, and flow rate must be estimated every four hours during a release. There were two releases during the period of inoperability. The first release was from 3/5/2023 at 3:25 to 3/5/2023 at 7:42. The second release was from 3/16/2023 at 19:16 to 3/16/2023 at 23:55. TRM 3.3.3.10-1a and 3.3.3.10-1b in TRM table 3.3-12, Radioactive Liquid Effluent Monitoring Instrumentation, was entered.

**Annual Radioactive Effluent Release Report****Liquid Waste Management (LWM) Radiation Monitor (PRMIRE0647)**

Time Required by Specifications to Restore Operability: 30 Days if release is occurring

Period of Inoperability: 11/16/2022 at 16:53 to 1/4/2023 at 20:25 (49 days)

Batch releases performed with monitor out of service: 2

Cause of Inoperability: On 11/16/2022 at 16:53, Liquid Waste Management Radiation Monitor was found to have an incorrect engineering conversion factor. The current background of the monitor was roughly 7 times the maximum background. This issue was identified via the Waterford 3's CR-WF3-2022-6367 extent of cause. The correct methodology for detector calibration and background determination based on the communication with Radiation Monitor Vendor and/or General Atomics was established, procedure was revised, and calibration of detector with correct MCA and conversion factor was complete. Per TRM Table 3.3-12, Radioactive Liquid Effluent Monitoring Instrumentation, and TRM 3/4.11.1, Liquid Effluents, Chemistry is to collect and analyze at least two independent samples and have two technically qualified members independently verify release rate calculations prior to a release. The valve lineup must be independently verified by operations, and flow rate must be estimated every four hours during a release. There were two releases during the period of inoperability. The first release was from 11/30/2022 at 14:30 to 11/30/2022 at 19:40. The second release was from 12/20/2022 at 11:39 to 12/20/2022 at 16:21. TRM 3.3.3.10-2a and 3.3.3.10-2b in TRM table 3.3-12, Radioactive Liquid Effluent Monitoring Instrumentation, was entered.

**2.11 Offsite Dose Calculation Manual Changes**

1. Revision 309 of the Offsite Dose Calculation Manual, UNT-005-014, became effective on January 4, 2022. This revision was to correct typo errors in equations 5, 8, 9, 10, and 11 in section 5.4, Gaseous Effluents. Equation 5 was mistyped in revision 6. Equations 8, 9, 10, and 11 were mistyped in revision 305. These typos were discovered during the 2021 Pre-NRC inspection and documented in CR-WF3-2021-5563. In section 5.8.1, Annual Radioactive Effluent Release Report, steps 4 and 5 were removed from 5.8.1.d (information for each class of solid waste) to align with Reg Guide 1.21. These two steps were not required for completing the Annual Radioactive Effluent Release Report (documented in CR-WF3-2021-4915 and CR-GGN-2017-6772). A copy of the entire ODCM with changes is attached to this report.

**2.12 Process Control Program (PCP) Changes**

1. There were no changes to the Process Control Program, EN-RW-105, in 2022.

**2.13 NON-REMP Groundwater Monitoring Results (NEI 07-07)**

1. Groundwater wells were monitored at Waterford 3 during 2022 as part of the NEI Groundwater Protection Initiative; these samples are not part of the Radiological Environmental Monitoring Program. Sampling of the ten installed wells was conducted on a quarterly basis. All results were less than minimum detectable activity for gamma emitters and tritium during 2022.

## Annual Radioactive Effluent Release Report

A summary of all groundwater monitoring well sample results for 2022 is presented below:

Groundwater Well Results (pCi/L)														
Sample Date Time	well	Tritium	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
2/23/2022 14:30	MW-3	< 646.00	< 6.46	< 5.49	< 14.10	< 6.38	< 14.30	< 5.42	< 11.30	< 7.50	< 6.59	< 6.41	< 27.20	< 8.24
5/3/2022 15:10	MW-3	< 541.00	< 5.81	< 8.69	< 13.30	< 8.09	< 14.80	< 6.88	< 11.20	< 7.38	< 8.49	< 6.57	< 28.90	< 9.62
8/16/2022 13:50	MW-3	< 531.00	< 5.21	< 6.21	< 10.80	< 6.32	< 14.90	< 4.15	< 9.08	< 6.98	< 7.50	< 6.64	< 24.80	< 9.29
11/16/2022 10:50	MW-3	< 530.00	< 7.43	< 6.88	< 15.10	< 5.70	< 16.20	< 7.84	< 10.30	< 12.30	< 8.23	< 7.86	< 32.30	< 7.78
2/23/2022 13:15	MW-4	< 626.00	< 6.98	< 7.78	< 14.30	< 5.85	< 15.20	< 6.79	< 12.70	< 11.10	< 6.96	< 7.21	< 32.40	< 11.90
5/3/2022 14:10	MW-4	< 537.00	< 5.27	< 5.96	< 16.50	< 9.02	< 16.40	< 8.73	< 14.40	< 10.20	< 6.75	< 8.00	< 16.20	< 10.00
8/16/2022 14:35	MW-4	< 458.00	< 5.60	< 6.80	< 12.20	< 8.49	< 11.20	< 5.01	< 11.90	< 7.88	< 5.93	< 5.98	< 27.70	< 9.91
11/16/2022 9:30	MW-4	< 564.00	< 4.38	< 6.36	< 13.10	< 4.68	< 9.39	< 6.93	< 9.87	< 8.41	< 7.37	< 6.63	< 26.00	< 9.95
2/23/2022 12:10	MW-5	< 589.00	< 5.04	< 4.19	< 12.80	< 5.06	< 7.87	< 5.82	< 8.55	< 8.79	< 6.44	< 5.16	< 20.50	< 7.60
5/3/2022 12:35	MW-5	< 565.00	< 7.65	< 6.96	< 14.20	< 8.07	< 13.30	< 6.67	< 13.10	< 8.25	< 8.88	< 7.66	< 22.80	< 8.89
5/3/2022 12:55	MW-5 DUP	< 566.00	< 6.17	< 6.43	< 14.30	< 5.55	< 9.35	< 6.51	< 10.90	< 7.84	< 8.14	< 7.26	< 28.70	< 7.90
8/16/2022 16:00	MW-5	< 474.00	< 6.94	< 6.65	< 15.00	< 8.14	< 15.60	< 8.79	< 13.70	< 8.45	< 6.97	< 6.83	< 26.70	< 9.06
8/16/2022 16:30	MW-5 DUP	< 476.00	< 7.32	< 5.19	< 15.30	< 7.94	< 14.00	< 7.36	< 10.20	< 7.67	< 5.00	< 6.01	< 25.30	< 11.70
11/16/2022 8:35	MW-5	< 541.00	< 7.16	< 7.40	< 16.50	< 10.20	< 17.50	< 7.30	< 13.30	< 11.90	< 7.93	< 7.31	< 32.70	< 9.13
2/23/2022 10:50	MW-6	< 604.00	< 7.78	< 6.82	< 16.30	< 7.82	< 14.90	< 6.47	< 12.40	< 10.30	< 8.63	< 7.14	< 31.30	< 12.20
5/3/2022 11:30	MW-6	< 536.00	< 5.71	< 6.29	< 14.50	< 5.54	< 12.30	< 7.24	< 12.10	< 9.63	< 8.23	< 8.26	< 26.00	< 6.40
8/16/2022 17:15	MW-6	< 501.00	< 6.41	< 6.08	< 14.10	< 7.16	< 11.10	< 7.16	< 8.98	< 8.12	< 8.80	< 5.98	< 25.80	< 11.10
11/15/2022 16:10	MW-6	< 520.00	< 5.76	< 6.81	< 12.70	< 6.74	< 10.50	< 7.02	< 11.80	< 9.15	< 4.67	< 5.50	< 28.30	< 10.00
2/23/2022 9:50	MW-7	< 580.00	< 5.72	< 5.48	< 12.50	< 5.75	< 13.30	< 6.24	< 10.40	< 8.53	< 6.58	< 5.55	< 27.80	< 9.07
5/3/2022 10:15	MW-7	< 557.00	< 7.03	< 6.22	< 14.70	< 7.49	< 13.90	< 7.66	< 10.20	< 8.08	< 7.22	< 8.36	< 24.70	< 8.27
8/17/2022 8:55	MW-7	< 476.00	< 7.33	< 5.61	< 17.80	< 7.92	< 13.50	< 7.79	< 11.60	< 8.43	< 9.27	< 7.73	< 21.40	< 8.71
11/15/2022 12:55	MW-7	< 547.00	< 4.50	< 5.96	< 12.70	< 7.47	< 9.94	< 5.60	< 10.30	< 11.90	< 8.72	< 5.78	< 28.20	< 9.42
11/15/2022 13:30	MW-7 DUP	< 537.00	< 4.69	< 6.50	< 16.30	< 5.75	< 11.90	< 7.50	< 12.50	< 12.00	< 6.08	< 7.15	< 34.80	< 11.30
2/23/2022 8:30	MW-8	< 572.00	< 5.27	< 5.17	< 14.10	< 6.49	< 10.90	< 6.57	< 10.10	< 6.55	< 6.55	< 6.33	< 20.90	< 8.94
5/3/2022 9:15	MW-8	< 548.00	< 6.78	< 6.61	< 13.80	< 6.92	< 8.77	< 6.14	< 10.80	< 6.53	< 8.37	< 6.69	< 27.70	< 8.59
8/17/2022 9:55	MW-8	< 478.00	< 5.02	< 6.31	< 11.00	< 7.25	< 13.60	< 7.03	< 11.10	< 7.44	< 6.67	< 6.42	< 21.80	< 6.66
11/15/2022 14:40	MW-8	< 588.00	< 5.73	< 6.01	< 12.00	< 5.40	< 13.30	< 7.49	< 11.20	< 11.10	< 6.19	< 6.52	< 32.20	< 11.40
2/23/2022 7:40	MW-9	< 564.00	< 4.57	< 4.43	< 8.85	< 5.14	< 9.23	< 4.41	< 8.39	< 6.21	< 4.20	< 3.85	< 18.50	< 6.31
2/23/2022 7:50	MW-9 DUP	< 627.00	< 5.35	< 4.93	< 8.55	< 6.01	< 7.79	< 6.20	< 8.03	< 7.90	< 6.39	< 5.57	< 23.10	< 8.55
5/2/2022 17:20	MW-9	< 536.00	< 6.14	< 6.19	< 16.80	< 6.57	< 14.20	< 6.93	< 12.90	< 9.59	< 6.86	< 6.20	< 27.00	< 9.55
8/17/2022 10:55	MW-9	< 486.00	< 5.94	< 5.81	< 14.70	< 6.60	< 10.40	< 5.99	< 10.40	< 7.61	< 7.46	< 6.30	< 26.40	< 9.26
11/15/2022 15:35	MW-9	< 528.00	< 6.48	< 7.59	< 12.80	< 8.16	< 13.20	< 8.99	< 13.50	< 12.70	< 9.18	< 8.18	< 30.30	< 11.50
2/22/2022 17:50	MW-10	< 545.00	< 6.79	< 5.75	< 14.00	< 9.30	< 15.80	< 7.66	< 12.90	< 9.11	< 8.86	< 6.97	< 26.90	< 11.40
5/2/2022 16:05	MW-10	< 541.00	< 6.15	< 6.65	< 15.20	< 7.36	< 10.50	< 8.83	< 13.40	< 9.11	< 8.52	< 7.87	< 37.30	< 10.50
8/17/2022 12:00	MW-10	< 599.00	< 6.02	< 7.32	< 12.50	< 8.18	< 11.80	< 7.13	< 10.80	< 6.88	< 8.00	< 5.95	< 24.50	< 6.04
11/16/2022 11:50	MW-10	< 581.00	< 7.35	< 7.02	< 14.20	< 9.08	< 13.40	< 6.31	< 12.00	< 10.80	< 6.82	< 7.92	< 32.80	< 7.80



## Annual Radioactive Effluent Release Report

Groundwater Well Results (pCi/L)														
Sample Date Time	well	Tritium	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
2/22/2022 16:20	MW-11	< 523.00	< 6.39	< 5.98	< 12.00	< 9.34	< 9.53	< 7.42	< 9.79	< 10.10	< 7.22	< 7.40	< 25.40	< 10.90
5/2/2022 14:55	MW-11	< 561.00	< 5.19	< 5.62	< 12.80	< 7.51	< 12.10	< 6.37	< 10.50	< 9.30	< 6.51	< 6.25	< 27.80	< 7.30
8/17/2022 12:55	MW-11	< 468.00	< 5.70	< 7.00	< 11.80	< 6.62	< 12.10	< 6.14	< 12.80	< 6.39	< 8.79	< 6.27	< 23.40	< 6.42
11/16/2022 13:20	MW-11	< 558.00	< 5.98	< 5.57	< 13.00	< 8.10	< 14.60	< 6.31	< 11.90	< 9.56	< 6.53	< 6.92	< 27.70	< 8.13
2/22/2022 15:25	MW-12	< 551.00	< 6.17	< 7.35	< 12.10	< 5.25	< 11.20	< 6.52	< 9.73	< 9.50	< 8.30	< 7.28	< 28.80	< 4.29
5/2/2022 13:35	MW-12	< 512.00	< 7.00	< 6.97	< 14.30	< 7.92	< 11.90	< 7.08	< 11.70	< 12.50	< 10.10	< 7.70	< 32.00	< 10.60
8/16/2022 12:15	MW-12	< 565.00	< 6.32	< 6.40	< 10.70	< 8.29	< 15.50	< 7.82	< 11.60	< 8.44	< 6.21	< 6.52	< 25.20	< 8.23
11/15/2022 11:45	MW-12	< 534.00	< 7.23	< 5.97	< 15.60	< 6.74	< 12.10	< 6.84	< 14.10	< 13.00	< 7.00	< 8.49	< 32.60	< 9.44

## 2.14 Unprotected Outside Storage Tank Radioactivity Limit

1. Technical Specification 3/4.11.1.4 specifies that the quantity of radioactivity contained in each unprotected outdoor storage tank be maintained less than or equal to 7.85E-04 Curies (excluding tritium and dissolved and entrained noble gases). At no time during the reporting period was this value exceeded.

## 2.15 Gaseous Storage Tank Total Radioactivity Limit

1. Technical Specification 3/4.11.2.6 specifies that the quantity of radioactivity contained in each gas storage tank be maintained less than or equal to 8.5E+04 Curies noble gas (considered as Xe-133 equivalent). At no time during the reporting period was this value exceeded.

## 2.16 Errata/Corrections to Previous ARERRs

1. The 2021 ARERR had an error in section 2.14, Unprotected Outside Storage Tank Radioactivity Limit. The section stated "Technical Specification 3/4.11.2.6". The correct Technical Specification is Technical Specification 3/4.11.1.4. The affected page in its entirety is on page 1 of Attachment 3 in this report.
2. The 2021 ARERR section 6.2, Dose to Members of the Public Inside the Site Boundary, had an error for the maximum exposed organ. In the 2021 report, 1.07E-3 mrem is stated. The correct number is 1.07E-2 mrem. The affected page in its entirety is on page 2 of Attachment 3 in this report.
3. The 2019, 2020, and 2021 ARERR reports had an error in section 7.2, Stability Class. Table 21, Classification of Atmospheric Stability, the stability condition for the pasquill category B all read "Moderately Stable" when the table should read "Moderately Unstable". The affected pages in its entirety are on pages 3-5 of Attachment 3 in this report.

## 2.17 Other Information

1. Unavailability of REMP Milk Samples

Due to the unavailability of three milk sampling locations within five kilometers of the plant, Broad Leaf sampling is performed in accordance with Technical Requirements Manual (TRM) Table 3.12-1. The collection of milk occurred until 6/15/2021 when the newest revision of the ODCM became effective at WF3. Before 6/15/2021, milk was collected, when available, from the control location and one identified sampling location as indicated in UNT-005-014, Offsite Dose Calculation Manual, Attachment 13.

**Annual Radioactive Effluent Release Report**

## 2. Activity Released Via Secondary Pathways

The following secondary release paths were continuously monitored for radioactivity:

- The Hot Machine Shop Exhaust (AH-35)
- Decontamination Shop Exhaust (AH-34)
- The RAB H&V Equipment Room Ventilation System Exhaust (E-41A and E-41B)
- The Switchgear/Cable Vault Area Ventilation System (AH-25)

Continuous sampling for these areas is maintained to demonstrate the operability of installed treatment systems and to verify integrity of barriers separating primary and secondary ventilation systems. Sampling for these areas was limited to continuous particulate and iodine sampling and monthly noble gas grab sampling. The activity released via these secondary pathways resulted from routine operations and remained below significant levels.

## 3. Missed Effluent Samples

There were two effluent misses during 2022.

The first miss was TRM 3.3.3.11 for FHB PIG Normal Ventilation Radiation Monitors, PRM-IRE-5017A and PRM-IRE-5107B, noble gas. TRM 3.3.3.11 was entered on 3/21/22 10:17, and alternate sampling was established 3/21/22 10:57. Due to the requirements of TRM 3.3.3.11, the first Noble Gas sample was required to be sampled at 3/21/22 22:17 based upon the time the radiation monitors were declared inoperable. The first Noble Gas was sampled 3/21/22 22:57 based on the time alternate sampling was established and not the time the action statement was entered. The first required Noble Gas sample was 30 minutes late. The Noble Gas activity result of the 3/21/22 22:57 sample was less than detectable. Gaseous trends for Fuel Handling Ventilation A were reviewed via PI trends and gaseous trends were normal with no indication of increased noble gas activity. FHB A and B PIGs still had process flow during this time. This TRM miss is documented in CR-WF3-2022-01581.

The second miss was TRM 3.3.3.11 for Fuel Handling Particulate Iodine Gas (FHB PIG) Noble Gas compensatory actions on 4/4/2022. Per TRM 3.3.3.11, Radioactive Gaseous Effluent, noble gas was to be collected at least once per 12 hours and the sample collected analyzed for gross activity within 24 hours. On 4-4-22 the 12 hour noble gas was grabbed at 20:00, within the required limits. The sample was not analyzed within 24 hours. Bracketed samples from 4-4-22 09:03 and 4-5-22 07:22 were less than lower detection limits. This TRM miss is documented in CR-WF3-2022-02066.

## 4. Reactor Coolant System Average Energy (E-Bar)

Reactor Coolant System E-Bar calculations were performed on 2/14/2022 and 7/27/2022 with values of 0.1167 and 0.1503 MeV/disintegration, respectively. Reactor Coolant System E-Bar is supplied for information only and is not used for effluent dose calculations.

## Annual Radioactive Effluent Release Report

## 3.0 GASEOUS EFFLUENTS

3.1 Gas Effluent and Waste Disposal Report

Table 1, Gaseous Effluents-Summation of All Releases - Waterford 3

A.	Fission & Activation Gases	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1.	Total Release	Ci	2.13E-03	4.32E-01	0.00E+00	3.19E-01	2.50E+01
2.	Average release rate for the period	μCi/sec	2.73E-04	5.49E-02	0.00E+00	4.01E-02	

B.	Iodine						
1.	Total Iodine – 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.50E+01
2.	Average release rate for the period	μCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

C.	Particulates						
1.	Particulates with half-lives > 8 days	Ci	2.05E-07	1.50E-04	9.25E-07	1.62E-06	2.50E+01
2.	Average release rate for the period	μCi/sec	2.64E-08	1.91E-05	1.16E-07	2.03E-07	

D.	Tritium						
1.	Total Release	Ci	6.20E+00	1.18E+01	7.83E+00	1.16E+01	2.50E+01
2.	Average release rate for the period	μCi/sec	7.97E-01	1.51E+00	9.85E-01	1.45E+00	

E.	Carbon-14						
1.	Total Release	Ci	2.54E+00	2.53E+00	2.54E+00	2.54E+00	
2.	Average release rate for the period	μCi/sec	3.26E-01	3.21E-01	3.19E-01	3.19E-01	

% of limit is on the Radiological Impact on Man Table

## Annual Radioactive Effluent Release Report

Table 2, Gaseous Effluents – Ground Level Release - Batch Mode - Waterford 3

Radionuclide Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
<b>Fission Gases</b>						
Ar-41	Ci	1.96E-03	3.44E-01	0.00E+00	2.86E-01	6.32E-01
Xe-133	Ci	1.69E-04	8.72E-02	0.00E+00	3.22E-02	1.20E-01
Total for Period	Ci	2.13E-03	4.32E-01	0.00E+00	3.19E-01	7.53E-01
<b>Iodines</b>						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>Particulates</b>						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>Tritium</b>						
H-3	Ci	3.67E-03	4.02E-01	0.00E+00	7.64E-01	1.17E+00
<b>Gross Alpha</b>						
Alpha	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3, Gaseous Effluents – Ground Level Release - Continuous Mode - Waterford 3

Radionuclide Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
<b>Fission Gases</b>						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>Iodines</b>						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>Particulates</b>						
Co-58	Ci	0.00E+00	3.13E-05	0.00E+00	0.00E+00	3.13E-05
Co-60	Ci	0.00E+00	9.68E-06	6.77E-07	1.14E-06	1.15E-05
Cr-51	Ci	0.00E+00	7.92E-05	0.00E+00	0.00E+00	7.92E-05
Cs-137	Ci	2.05E-07	3.56E-07	1.01E-07	2.83E-07	9.45E-07
Fe-59	Ci	0.00E+00	3.75E-07	0.00E+00	0.00E+00	3.75E-07
Mn-54	Ci	0.00E+00	4.99E-07	0.00E+00	0.00E+00	4.99E-07
Nb-95	Ci	0.00E+00	1.67E-05	1.47E-07	1.42E-07	1.70E-05
Os-191	Ci	0.00E+00	3.10E-06	0.00E+00	4.95E-08	3.15E-06
Sn-113	Ci	0.00E+00	1.21E-06	0.00E+00	0.00E+00	1.21E-06
Zr-95	Ci	0.00E+00	8.07E-06	0.00E+00	0.00E+00	8.07E-06
Total for Period	Ci	2.05E-07	1.50E-04	9.25E-07	1.62E-06	1.53E-04
<b>Tritium</b>						
H-3	Ci	6.20E+00	1.14E+01	7.83E+00	1.08E+01	3.62E+01

## Annual Radioactive Effluent Release Report

## 4.0 LIQUID EFFLUENTS

4.1 Liquid Effluent and Waste Disposal Report

Table 4, Liquid Effluents-Summation of All Releases – Waterford 3

A.	Fission & Activation Products	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Est. Total Error %
1.	Total Release (not including tritium, gases or alpha)	Ci	4.40E-04	8.13E-03	9.21E-03	8.72E-04	2.50E+01
2.	Average diluted concentration during period	μCi/mL	1.34E-11	1.98E-10	2.16E-10	5.16E-11	
<b>B. Tritium</b>							
1.	Total Release	Ci	2.68E+02	1.40E+02	2.91E+01	5.92E+00	2.50E+01
2.	Average diluted concentration during period.	μCi/mL	8.15E-06	3.41E-06	6.80E-07	3.50E-07	
<b>C. Dissolved &amp; Entrained Gases</b>							
1.	Total Release	Ci	1.35E-03	1.86E-03	4.90E-04	1.82E-05	2.50E+01
2.	Average diluted concentration during period	μCi/mL	4.11E-11	4.53E-11	1.15E-11	1.07E-12	
<b>D. Gross Alpha Activity</b>							
1.	Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.50E+01
E.	Volume Of Waste Released (prior to dilution)	Liters	6.77E+06	1.29E+07	8.51E+06	5.67E+06	
F.	Volume Of Dilution Water Used During Period	Liters	3.28E+10	4.10E+10	4.27E+10	1.69E+10	

% of limit is on the Radiological Impact on Man Table

## Annual Radioactive Effluent Release Report

Table 5, Batch Mode Liquid Effluents -Waterford 3

Nuclides Released	Unit	Batch Mode				Total
		Quarter 1	Quarter 2	Quarter 3	Quarter 4	
Co-58	Ci	2.05E-05	6.12E-04	1.06E-03	1.22E-05	1.70E-03
Co-60	Ci	3.04E-04	7.11E-04	1.29E-03	1.91E-04	2.50E-03
Cr-51	Ci	0.00E+00	1.43E-03	1.80E-03	0.00E+00	3.23E-03
Cs-134	Ci	0.00E+00	0.00E+00	4.36E-06	0.00E+00	4.36E-06
Cs-137	Ci	1.08E-06	0.00E+00	1.89E-06	0.00E+00	2.97E-06
Cs-138	Ci	0.00E+00	8.44E-06	0.00E+00	0.00E+00	8.44E-06
Fe-55	Ci	0.00E+00	2.71E-03	2.02E-03	6.43E-05	4.79E-03
Fe-59	Ci	0.00E+00	7.57E-05	6.35E-05	0.00E+00	1.39E-04
H-3	Ci	2.68E+02	1.40E+02	2.90E+01	5.89E+00	4.43E+02
Mn-54	Ci	9.65E-06	7.18E-05	1.97E-04	8.57E-06	2.87E-04
Na-24	Ci	0.00E+00	3.97E-06	0.00E+00	0.00E+00	3.97E-06
Nb-95	Ci	0.00E+00	6.29E-04	1.49E-03	1.84E-05	2.14E-03
Ni-56	Ci	0.00E+00	1.22E-05	1.02E-05	0.00E+00	2.24E-05
Np-239	Ci	0.00E+00	1.42E-05	0.00E+00	0.00E+00	1.42E-05
Sb-124	Ci	0.00E+00	3.73E-04	2.35E-05	1.04E-05	4.07E-04
Sb-125	Ci	1.05E-04	1.09E-03	4.09E-04	5.53E-04	2.16E-03
Sb-126	Ci	0.00E+00	1.56E-05	0.00E+00	0.00E+00	1.56E-05
Zn-65	Ci	0.00E+00	3.96E-05	3.85E-05	0.00E+00	7.81E-05
Zr-95	Ci	0.00E+00	3.44E-04	8.05E-04	1.38E-05	1.16E-03
Total for Period	Ci	2.68E+02	1.40E+02	2.90E+01	5.89E+00	4.43E+02
Ar-41	Ci	0.00E+00	5.47E-06	0.00E+00	0.00E+00	5.47E-06
Xe-133	Ci	1.35E-03	1.65E-03	4.83E-04	1.82E-05	3.50E-03
Xe-135	Ci	4.86E-06	1.76E-04	6.47E-06	0.00E+00	1.87E-04
Xe-138	Ci	0.00E+00	2.51E-05	0.00E+00	0.00E+00	2.51E-05
Total for Period	Ci	1.35E-03	1.86E-03	4.89E-04	1.82E-05	3.72E-03

## Annual Radioactive Effluent Release Report

Table 6, Continuous Mode Liquid Effluents – Waterford 3

Nuclides Released	Unit	Continuous Mode				Total
		Quarter 1	Quarter 2	Quarter 3	Quarter 4	
H-3	Ci	1.63E-02	2.59E-02	9.60E-03	3.21E-02	8.39E-02
Total for Period	Ci	1.63E-02	2.59E-02	9.60E-03	3.21E-02	8.39E-02

## Annual Radioactive Effluent Release Report

## 5.0 SOLID WASTE SUMMARY

5.1 Solid Waste Shipped Offsite for Burial or Disposal (Not Irradiated Fuel)5.1.1 Types of Waste

Table 7, Types of Solid Waste Summary - Waterford 3

Types of Waste	Total Quantity (m <sup>3</sup> )	Total Activity (Ci)	Est. Total Error (%)
<b>a. Spent resins, filters, sludges, evaporator bottoms, etc.</b>	5.12E+01	2.23E+02	2.50E+01
<b>Waste Class</b>			
A	2.35E+01	1.70E+01	
B	3.03E+00	8.18E+01	
C	0.00E+00	0.00E+00	
Unclassified	0.00E+00	0.00E+00	
<b>b. Dry compressible waste, contaminated equip, etc.</b>	1.53E+02	7.76E-01	2.50E+01
<b>Waste Class</b>			
A	7.57E+02	2.11E+00	
B	0.00E+00	0.00E+00	
C	0.00E+00	0.00E+00	
Unclassified	0.00E+00	0.00E+00	
<b>c. Irradiated components, control rods, etc.</b>	1.69E-02	1.04E-01	2.50E+01
<b>Waste Class</b>			
A	0.00E+00	0.00E+00	
B	0.00E+00	0.00E+00	
C	0.00E+00	0.00E+00	
Unclassified	0.00E+00	0.00E+00	
<b>d. Other – Used Oil</b>	1.31E+01	1.29E-01	2.50E+01
<b>Waste Class</b>			
A	2.05E+01	6.42E-03	
B	0.00E+00	0.00E+00	
C	0.00E+00	0.00E+00	
Unclassified	0.00E+00	0.00E+00	



## Annual Radioactive Effluent Release Report

## 5.1.2

Estimate of major nuclide composition (by waste type) only >1% <sup>[Note 1]</sup> are reported.

Table 8, Major Nuclides – Waterford 3

Major Nuclide Composition	%	Curies
a. Spent resins, filters, sludges, evaporator bottoms, etc.		
Be-7	2.09%	2.07E+00
Mn-54	12.48%	1.23E+01
Fe-55	10.69%	1.06E+01
Co-58	16.4%	1.62E+01
Co-60	37.18%	3.67E+01
Ni-63	14.72%	1.45E+01
Zn-65	3.45%	3.40E+00
Cs-137	1.73%	1.71E+00
b. Dry compressible waste, contaminated equip, etc.		
H-3	4.59%	9.67E-02
Be-7	6.96%	1.46E-01
Cr-51	3.91%	8.22E-02
Mn-54	4.77%	1.00E-01
Fe-55	12.37%	2.60E-01
Co-58	40.93%	8.62E-01
Co-60	9.09%	1.91E-01
Ni-63	5.99%	1.26E-01
Zn-65	3.54%	7.46E-02
Zr-95	1.35%	2.83E-02
Nb-95	1.99%	4.20E-02
Cs-137	3.55%	7.48E-02
c. Irradiated components, control rods, etc.		
NR	NR	NR

## Annual Radioactive Effluent Release Report

Table 8, Major Nuclides – Waterford 3

Table 8, Major Nuclides – Waterford 3		
d. Other		
K-40	64.58%	4.10E-03
Mn-54	1.18%	7.48E-05
Fe-55	10.85%	6.89E-04
Co-60	12.52%	7.96E-04
Ni-63	8.35%	5.31E-04

[Note 1] – “Major” radionuclide is equivalent to a “principal” radionuclide, i.e. greater than 1 percent of total activity.

## Annual Radioactive Effluent Release Report

5.1.3 Solid Waste Disposition

Table 9, Solid Waste Disposition (Specify Site or Unit)

Number of Shipments	Mode of Transportation	Destination
16	Hittman Transport	Energy Solutions Bear Creek Processing 1560 Bear Creek Road Oak Ridge, TN 37830
2	Hittman Transport	Energy Solutions, Gallaher Rd 628 Gallaher Road Kingston, TN 37763
4	Hittman Transport	Energy Solutions-Memphis 1790 Dock Street Memphis, TN 38106
1	Hittman Transport	Resin Solutions, Erwin 151 T.C. Runion Road Erwin, TN 37650

Table 10, Irradiated Fuel Shipments Disposition (Specify Site or Unit)

Number of Shipments	Mode of Transportation	Destination
None	N/A	N/A

## Annual Radioactive Effluent Release Report

## 6.0 RADIOLOGICAL IMPACT TO MAN

6.1 10CFR Part50, Appendix I Evaluation

Table 11, Dose Assessment – Waterford 3

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Liquid Effluent Dose Limit, Total Body	1.5 mrem	1.5 mrem	1.5 mrem	1.5 mrem	3 mrem
Total Body Dose (mrem)	2.20E-04	1.59E-04	4.52E-05	4.84E-06	4.29E-04
% of Limit	1.47E-02	1.06E-02	3.01E-03	3.23E-04	1.43E-02
Liquid Effluent Dose Limit, Any Organ	5 mrem	5 mrem	5 mrem	5 mrem	10 mrem
Maximum Organ Dose (mrem)	2.26E-04	2.38E-04	1.82E-04	1.12E-05	6.58E-04
% of Limit	4.52E-03	4.76E-03	3.64E-03	2.24E-04	6.58E-03
Gaseous Effluent Dose Limit, Gamma Air	5 mrad	5 mrad	5 mrad	5 mrad	10 mrad
Gamma Air Dose (mrad)	1.10E-05	1.95E-03	0.00E+00	1.61E-03	3.57E-03
% of Limit	2.20E-04	3.90E-02	0.00E+00	3.22E-02	3.57E-02
Gaseous Effluent Dose Limit, Beta Air	10 mrad	10 mrad	10 mrad	10 mrad	20 mrad
Beta Air Dose (mrad)	3.97E-06	7.35E-04	0.00E+00	5.86E-04	1.33E-03
% of Limit	3.97E-05	7.35E-03	0.00E+00	5.86E-03	6.65E-03
Gaseous Effluent Organ Dose Limit (Iodine, Tritium, Particulates with > 8 day half-life)	7.5 mrem	7.5 mrem	7.5 mrem	7.5 mrem	15 mrem
Gaseous Effluent Organ Dose (Iodine, Tritium, Particulates with > 8 day half-life) (mrem)	3.98E-03	7.75E-03	5.03E-03	7.42E-03	2.42E-02
% of Limit	5.31E-02	1.03E-01	6.71E-02	9.89E-02	1.61E-01

**Annual Radioactive Effluent Release Report****6.2 Dose to Members of the Public Inside the Site Boundary**

The Member of the Public inside the site boundary expected to have the maximum exposure due to gaseous effluents, carbon-14, and direct shine would be an employee at the Waterford 1 and 2 fossil fuel plants, located in the NW sector at a distance of approximately 670 meters (0.42 miles) from the reactor building.

The doses for such an individual were determined by scaling the full-time occupancy doses due to airborne effluents, carbon-14, and direct shine by the occupancy time due to a normal working year. Based on an assumed occupancy of 25% (40-hour work week) and the fact that all employees are adults, the calculated doses were determined to be

1.24E-03 mrem to the skin

1.01E-02 mrem to the maximum exposed organ (bone)

7.14E-01 mrem to the Total Body

All doses for receptors inside the site boundary were calculated according to the methodology described in the Waterford 3 Offsite Dose Calculation Manual considering only the inhalation and ground plane exposure pathways.

**6.3 Dose to a Member of the Public due to Release of Radioactive Material in Groundwater**

There were no releases of radioactive material in groundwater during the reporting period; therefore, there was no additional dose to a MEMBER OF THE PUBLIC associated with off-site releases of licensed radioactive material via groundwater.

## Annual Radioactive Effluent Release Report

**6.4 40CFR Part 190 Evaluation for an Individual in the Unrestricted Area**

Table 12, EPA 40 CFR PART 190 Evaluation

	Whole Body	Thyroid	Any Other Organ
Dose Limit	25 mrem	75 mrem	25 mrem
Dose (mrem)	8.64E-01	8.61E-01	2.79E+00
% of Limit	3.46E+00	1.15E+00	1.12E+01

Liquid dose, gaseous dose including C14, direct shine from each unit, ISFSI and any other nuclear power related facility within 5 miles of the station are considered when calculating dose compliance with 40 CFR 190

**6.5 40CFR Part 190 Calculation**

Table 13, EPA 40 CFR Part 190 Calculation

	Unit	Total Body	Thyroid	Max Organ
Routine Airborne Effluents NG Dose (mrem)	WF3	3.39E-03	NA	NA
Particulate and Iodine Dose (mrem)	WF3	2.42E-02	2.42E-02	2.42E-02
Routine Liquid Effluents (mrem)	WF3	4.29E-04	3.89E-04	6.58E-04
Airborne Releases of C <sup>14</sup> (mrem)	WF3	4.81E-01	4.81E-01	2.41E+00
Ground Water & Storm Drain Totals (mrem)	WF3	0.00E+00	0.00E+00	0.00E+00
Direct Shine from areas such as dry cask storage, radwaste storage, Equipment Mausoleums (mrem)	WF3	3.55E-01	3.55E-01	3.55E-01
Total 40 CFR 190 Dose (mrem)	WF3	8.64E-01	8.61E-01	2.79E+00

## Annual Radioactive Effluent Release Report

**7.0 METEOROLOGICAL DATA**

An Annual Meteorological Monitoring Program Report is maintained on site and is available for review upon request.

**7.1 Joint Frequency Distributions**

1. Period of Record: 01/01/2022 – 12/31/2022
2. Elevation: 10 m
3. Total period of calm hours: 3

**Table 14, Hours of Each Wind Speed and Direction -Stability A**

Wind Speed (m/s)												
Wind Direction	0.23-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18.00	Total
N	0.00	0.00	3.00	3.00	8.00	33.00	21.00	6.00	0.00	0.00	0.00	74.00
NNE	1.00	1.00	1.00	4.00	11.00	11.00	8.00	1.00	0.00	0.00	0.00	38.00
NE	0.00	1.00	1.00	4.00	49.00	95.00	18.00	0.00	0.00	0.00	0.00	168.00
ENE	0.00	0.00	2.00	1.00	10.00	49.00	10.00	0.00	0.00	0.00	0.00	72.00
E	0.00	0.00	0.00	0.00	1.00	3.00	1.00	0.00	0.00	0.00	0.00	5.00
ESE	0.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	4.00
SE	0.00	0.00	0.00	0.00	0.00	12.00	11.00	7.00	0.00	0.00	0.00	30.00
SSE	0.00	0.00	0.00	1.00	9.00	50.00	23.00	13.00	0.00	0.00	0.00	96.00
S	0.00	0.00	0.00	4.00	32.00	35.00	13.00	14.00	1.00	0.00	0.00	99.00
SSW	0.00	0.00	2.00	5.00	9.00	15.00	14.00	22.00	0.00	0.00	0.00	67.00
SW	0.00	0.00	0.00	1.00	7.00	18.00	4.00	0.00	0.00	0.00	0.00	30.00
WSW	2.00	1.00	0.00	2.00	6.00	25.00	8.00	0.00	0.00	0.00	0.00	44.00
W	2.00	0.00	0.00	0.00	4.00	6.00	4.00	0.00	0.00	0.00	0.00	16.00
WNW	0.00	0.00	1.00	0.00	2.00	8.00	10.00	3.00	0.00	0.00	0.00	24.00
NW	1.00	0.00	0.00	0.00	0.00	3.00	5.00	1.00	0.00	0.00	0.00	10.00
NNW	0.00	0.00	1.00	3.00	4.00	6.00	6.00	0.00	0.00	0.00	0.00	20.00
Total	6.00	3.00	12.00	28.00	153.00	370.00	157.00	67.00	1.00	0.00	0.00	797.00

## Annual Radioactive Effluent Release Report

1. Period of Record: 01/01/2022 – 12/31/2022
2. Elevation: 10 m
3. Total period of calm hours: 3

Table 15, Hours of Each Wind Speed and Direction -Stability B

Wind Speed (m/s)												
Wind Direction	0.23-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18.00	Total
N	1.00	0.00	0.00	4.00	17.00	34.00	15.00	3.00	0.00	0.00	0.00	74.00
NNE	0.00	0.00	4.00	6.00	8.00	11.00	10.00	0.00	0.00	0.00	0.00	39.00
NE	0.00	0.00	0.00	3.00	21.00	42.00	7.00	0.00	0.00	0.00	0.00	73.00
ENE	0.00	0.00	1.00	0.00	11.00	35.00	9.00	0.00	0.00	0.00	0.00	56.00
E	0.00	0.00	0.00	1.00	4.00	3.00	0.00	0.00	0.00	0.00	0.00	8.00
ESE	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	2.00
SE	0.00	0.00	0.00	0.00	4.00	19.00	15.00	5.00	0.00	0.00	0.00	43.00
SSE	0.00	0.00	0.00	1.00	9.00	31.00	13.00	4.00	0.00	0.00	0.00	58.00
S	0.00	0.00	1.00	1.00	21.00	30.00	7.00	0.00	1.00	0.00	0.00	61.00
SSW	0.00	0.00	4.00	4.00	11.00	13.00	14.00	2.00	2.00	0.00	0.00	50.00
SW	0.00	0.00	3.00	1.00	15.00	15.00	3.00	0.00	0.00	0.00	0.00	37.00
WSW	0.00	1.00	0.00	4.00	26.00	17.00	1.00	0.00	0.00	0.00	0.00	49.00
W	1.00	0.00	1.00	4.00	7.00	4.00	1.00	0.00	0.00	0.00	0.00	18.00
WNW	1.00	0.00	1.00	3.00	8.00	7.00	3.00	0.00	0.00	0.00	0.00	23.00
NW	0.00	0.00	0.00	1.00	8.00	1.00	2.00	1.00	0.00	0.00	0.00	13.00
NNW	0.00	0.00	0.00	1.00	8.00	5.00	3.00	0.00	0.00	0.00	0.00	17.00
Total	3.00	1.00	16.00	34.00	178.00	268.00	103.00	15.00	3.00	0.00	0.00	621.00



## Annual Radioactive Effluent Release Report

1. Period of Record: 01/01/2022 – 12/31/2022
2. Elevation: 10 m
3. Total period of calm hours: 3

Table 16, Hours of Each Wind Speed and Direction -Stability C

Wind Speed (m/s)												
Wind Direction	0.23-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18.00	Total
N	0.00	0.00	3.00	8.00	24.00	26.00	20.00	4.00	0.00	0.00	0.00	85.00
NNE	0.00	0.00	4.00	14.00	21.00	20.00	9.00	1.00	0.00	0.00	0.00	69.00
NE	0.00	0.00	2.00	7.00	42.00	59.00	5.00	0.00	0.00	0.00	0.00	115.00
ENE	0.00	0.00	2.00	1.00	15.00	24.00	5.00	0.00	0.00	0.00	0.00	47.00
E	0.00	0.00	2.00	1.00	2.00	3.00	0.00	0.00	0.00	0.00	0.00	8.00
ESE	0.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	4.00
SE	0.00	0.00	0.00	1.00	5.00	19.00	13.00	6.00	0.00	0.00	0.00	44.00
SSE	0.00	0.00	0.00	1.00	8.00	29.00	23.00	3.00	0.00	0.00	0.00	64.00
S	0.00	1.00	3.00	5.00	15.00	28.00	17.00	1.00	5.00	0.00	0.00	75.00
SSW	0.00	1.00	1.00	3.00	11.00	15.00	4.00	2.00	0.00	0.00	0.00	37.00
SW	0.00	0.00	3.00	1.00	15.00	17.00	2.00	1.00	0.00	0.00	0.00	39.00
WSW	0.00	1.00	3.00	7.00	22.00	14.00	1.00	0.00	0.00	0.00	0.00	48.00
W	1.00	0.00	2.00	9.00	14.00	12.00	1.00	0.00	0.00	0.00	0.00	39.00
WNW	0.00	0.00	2.00	13.00	16.00	10.00	1.00	0.00	0.00	0.00	0.00	42.00
NW	0.00	0.00	1.00	3.00	8.00	4.00	3.00	1.00	0.00	0.00	0.00	20.00
NNW	0.00	0.00	1.00	4.00	9.00	7.00	12.00	0.00	0.00	0.00	0.00	33.00
Total	1.00	3.00	30.00	79.00	228.00	288.00	116.00	19.00	5.00	0.00	0.00	769.00

## Annual Radioactive Effluent Release Report

1. Period of Record: 01/01/2022 – 12/31/2022
2. Elevation: 10 m
3. Total period of calm hours: 3

Table 17, Hours of Each Wind Speed and Direction -Stability D

Wind Speed (m/s)												
Wind Direction	0.23-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18.0	Total
N	0.00	4.00	15.00	24.00	90.00	78.00	66.00	14.00	3.00	0.00	0.00	294.00
NNE	2.00	3.00	11.00	26.00	35.00	85.00	48.00	2.00	0.00	0.00	0.00	212.00
NE	1.00	3.00	12.00	31.00	111.00	90.00	25.00	0.00	0.00	0.00	0.00	273.00
ENE	2.00	2.00	6.00	13.00	36.00	74.00	24.00	3.00	0.00	0.00	0.00	160.00
E	0.00	0.00	5.00	7.00	20.00	20.00	8.00	3.00	0.00	0.00	0.00	63.00
ESE	0.00	2.00	4.00	1.00	8.00	20.00	1.00	0.00	0.00	0.00	0.00	36.00
SE	1.00	0.00	3.00	3.00	18.00	79.00	62.00	7.00	0.00	0.00	0.00	173.00
SSE	0.00	1.00	3.00	6.00	51.00	115.00	52.00	15.00	0.00	0.00	0.00	243.00
S	0.00	0.00	19.00	23.00	59.00	78.00	24.00	14.00	5.00	0.00	0.00	222.00
SSW	2.00	1.00	15.00	18.00	38.00	49.00	24.00	17.00	4.00	0.00	0.00	168.00
SW	1.00	4.00	17.00	20.00	31.00	30.00	12.00	4.00	0.00	0.00	0.00	119.00
WSW	3.00	6.00	16.00	20.00	26.00	18.00	2.00	0.00	0.00	0.00	0.00	91.00
W	4.00	7.00	19.00	28.00	34.00	17.00	0.00	0.00	0.00	0.00	0.00	109.00
WNW	1.00	3.00	13.00	26.00	20.00	17.00	10.00	0.00	0.00	0.00	0.00	90.00
NW	0.00	5.00	13.00	9.00	30.00	12.00	15.00	0.00	0.00	0.00	0.00	84.00
NNW	1.00	1.00	8.00	15.00	35.00	59.00	36.00	7.00	2.00	0.00	0.00	164.00
Total	18.00	42.00	179.00	270.00	642.00	841.00	409.00	86.00	14.00	0.00	0.00	2501.00

## Annual Radioactive Effluent Release Report

1. Period of Record: 01/01/2022 – 12/31/2022
2. Elevation: 10 m
3. Total period of calm hours: 3

Table 18, Hours of Each Wind Speed and Direction -Stability E

Wind Direction	Wind Speed (m/s)											Total
	0.23-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18.00	
N	5.00	9.00	17.00	32.00	69.00	36.00	10.00	0.00	0.00	0.00	0.00	178.00
NNE	4.00	6.00	24.00	28.00	83.00	96.00	6.00	0.00	0.00	0.00	0.00	247.00
NE	1.00	4.00	11.00	35.00	111.00	42.00	15.00	0.00	0.00	0.00	0.00	219.00
ENE	1.00	5.00	8.00	14.00	41.00	47.00	6.00	0.00	0.00	0.00	0.00	122.00
E	0.00	0.00	7.00	11.00	16.00	11.00	7.00	0.00	0.00	0.00	0.00	52.00
ESE	1.00	4.00	6.00	5.00	16.00	29.00	4.00	0.00	0.00	0.00	0.00	65.00
SE	2.00	2.00	11.00	8.00	44.00	71.00	14.00	0.00	0.00	0.00	0.00	152.00
SSE	1.00	7.00	17.00	43.00	95.00	59.00	4.00	0.00	0.00	0.00	0.00	226.00
S	4.00	5.00	40.00	56.00	101.00	20.00	0.00	0.00	0.00	0.00	0.00	226.00
SSW	5.00	9.00	59.00	36.00	49.00	6.00	1.00	0.00	0.00	0.00	0.00	165.00
SW	6.00	11.00	39.00	41.00	40.00	12.00	0.00	0.00	0.00	0.00	0.00	149.00
WSW	13.00	14.00	32.00	39.00	21.00	7.00	0.00	0.00	0.00	0.00	0.00	126.00
W	11.00	14.00	69.00	40.00	20.00	3.00	0.00	0.00	0.00	0.00	0.00	157.00
WNW	5.00	15.00	21.00	17.00	12.00	3.00	0.00	0.00	0.00	0.00	0.00	73.00
NW	4.00	2.00	15.00	16.00	21.00	5.00	0.00	0.00	0.00	0.00	0.00	63.00
NNW	6.00	9.00	8.00	14.00	20.00	18.00	0.00	0.00	0.00	0.00	0.00	75.00
Total	69.00	116.00	384.00	435.00	759.00	465.00	67.00	0.00	0.00	0.00	0.00	2295.00





## Annual Radioactive Effluent Release Report

7.2 Stability Class

Table 21, Classification of Atmospheric Stability

Stability Condition	Pasquill Categories	Hours (Percentage)
Extremely Unstable	A	9.10
Moderately Unstable	B	7.09
Slightly Unstable	C	8.78
Neutral	D	28.55
Slightly Stable	E	26.20
Moderately Stable	F	13.28
Extremely Stable	G	5.18

**Attachment 1**

**Revised Offsite Dose Calculation Manual**

**Page 1 of 1**

Due to the size of the document, the revised Offsite Dose Calculation Manual, revision 309, is attached as a separate document to this report.

**Annual Radioactive Effluent Release Report**

**Attachment 2**

**Revised Process Control Program**

**Page 1 of 1**

N/A



## Annual Radioactive Effluent Release Report

Attachment 3

Page 1 of 5

## Errata/Corrections to Previous ARERRs

Waterford 3	Year: 2021	Page 11 of 38
Annual Radioactive Effluent Release Report		

Groundwater Well Results (pCi/l)														
Sample Date Time	well	Tritium	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
3/2/2021 13:35	MW-11	< 535	< 4.75	< 6.41	< 13.90	< 7.91	< 14.10	< 6.83	< 11.40	< 9.91	< 7.11	< 7.79	< 32.40	< 14.40
5/25/2021 17:35	MW-11	< 558	< 5.14	< 8.37	< 14.40	< 6.43	< 13.60	< 8.04	< 10.70	< 11.30	< 8.02	< 6.02	< 29.10	< 10.30
8/11/2021 12:35	MW-11	< 525	< 5.57	< 6.76	< 11.50	< 7.55	< 11.00	< 5.84	< 9.99	< 8.36	< 6.74	< 4.59	< 25.20	< 6.43
11/17/2021 9:30	MW-11	< 599	< 6.79	< 7.02	< 13.60	< 8.97	< 12.90	< 8.46	< 11.90	< 9.82	< 8.31	< 7.27	< 27.90	< 9.12
3/3/2021 7:55	MW-12	< 527	< 8.76	< 6.52	< 18.40	< 9.21	< 13.10	< 6.19	< 12.00	< 9.96	< 9.38	< 8.12	< 37.20	< 12.00
3/3/2021 8:10	MW-12 DUP	< 523	< 7.84	< 8.31	< 15.60	< 8.45	< 15.10	< 8.66	< 14.90	< 13.40	< 8.78	< 6.96	< 32.30	< 10.20
5/25/2021 14:05	MW-12	< 533	< 6.21	< 5.63	< 10.90	< 4.92	< 13.00	< 6.46	< 10.30	< 12.40	< 6.51	< 7.14	< 34.00	< 3.77
8/10/2021 13:30	MW-12	< 522	< 4.55	< 6.34	< 17.70	< 5.74	< 11.10	< 5.85	< 12.40	< 9.20	< 5.90	< 6.92	< 33.30	< 13.90
11/16/2021 9:30	MW-12	< 597	< 5.48	< 7.69	< 12.90	< 5.60	< 14.30	< 8.61	< 11.50	< 8.63	< 6.98	< 8.34	< 28.40	< 8.48

**214** Unprotected Outside Storage Tank Radioactivity Limit

- 1 Technical Specification 3/4.11.1.4 specifies that the quantity of radioactivity contained in each unprotected outdoor storage tank be maintained less than or equal to 7.85E-04 Curies (excluding tritium and dissolved and entrained noble gases). At no time during the reporting period was this value exceeded.

**215** Gaseous Storage Tank Total Radioactivity Limit

- 1 Technical Specification 3/4.11.2.6 specifies that the quantity of radioactivity contained in each gas storage tank be maintained less than or equal to 8.5E+04 Curies noble gas (considered as Xe-133 equivalent). At no time during the reporting period was this value exceeded.

**216** Errata/Corrections to Previous ARERRs

- 1 The 2018, 2019, and 2020 ARERR had an error in the introduction. In EN-CY-131, Annual Radioactive Effluent Release Report, step 5.1.3.1 states information that must be included in the introduction of the ARERR, including the license number. All three reports do not have the license number in the introduction. The affected pages in its entirety are in Attachment 3 of this report.
- 2 The 2020 ARERR section 5.1.2 had an error with table 8. EN-CY-131, Annual Radioactive Effluent Release Report, step 5.1.2.1 says to report results of measurements, including percentages, in external floating point form (i.e. 1.06E+07). The affected page in its entirety is in Attachment 3 of this report.

**217** Other Information

## 1. Unavailability of REMP Milk Samples

Due to the unavailability of three milk sampling locations within five kilometers of the plant, Broad Leaf sampling is performed in accordance with Technical Requirements Manual (TRM) Table 3.12-1. The collection of milk occurred until 6/15/2021 when the newest revision of the ODCM became effective at WF3. Before 6/15/2021, milk was collected, when available, from the control location and one identified sampling location as indicated in UNT-005-014, Offsite Dose Calculation Manual, Attachment 7.13.

**Errata/Corrections to Previous ARERRs**

**62 Dose to Members of the Public Inside the Site Boundary**

The Member of the Public inside the site boundary expected to have the maximum exposure due to gaseous effluents, carbon-14, and direct shine would be an employee at the Waterford 1 and 2 fossil fuel plants, located in the NW sector at a distance of approximately 670 meters (0.42 miles) from the reactor building.

The doses for such an individual were determined by scaling the full-time occupancy doses due to airborne effluents, carbon-14, and direct shine by the occupancy time due to a normal working year. Based on an assumed occupancy of 25% (40-hour work week) and the fact that all employees are adults, the calculated doses were determined to be:

- 3.28E-04 mrem to the skin
- 1.07E-02 mrem to the maximum exposed organ (bone)
- 7.59E-01 mrem to the Total Body

All doses for receptors inside the site boundary were calculated according to the methodology described in the Waterford 3 Offsite Dose Calculation Manual considering only the inhalation and ground plane exposure pathways.

**63 Dose to a Member of the Public due to Release of Radioactive Material in Groundwater**

There were no releases of radioactive material in groundwater during the reporting period; therefore, there was no additional dose to a MEMBER OF THE PUBLIC associated with off-site releases of licensed radioactive material via groundwater.

**72**     **Stability Class**

<b>Table 21, Classification of Atmospheric Stability</b>		
Stability Condition	Pasquill Categories	Hours (Percentage)
Extremely Unstable	A	3.83
Moderately Unstable	B	4.92
Slightly Unstable	C	6.22
Neutral	D	31.98
Slightly Stable	E	32.98
Moderately Stable	F	13.26
Extremely Stable	G	6.82

Errata/Corrections to Previous ARERRs


72 **Stability Class**

<b>Table 21, Classification of Atmospheric Stability</b>		
Stability Condition	Pasquill Categories	Hours (Percentage)
Extremely Unstable	A	3.85
Moderately Unstable	B	4.67
Slightly Unstable	C	7.68
Neutral	D	35.09
Slightly Stable	E	31.28
Moderately Stable	F	11.74
Extremely Stable	G	5.69

72 **Stability Class**

**Table 21, Classification of Atmospheric Stability**

Stability Condition	Pasquill Categories	Hours (Percentage)
Extremely Unstable	A	5.57
Moderately Unstable	B	6.02
Slightly Unstable	C	8.31
Neutral	D	34.4
Slightly Stable	E	27.6
Moderately Stable	F	11.64
Extremely Stable	G	5.39

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		<b>INFORMATIONAL USE</b>	<b>Rev. 309</b>
UNT-005-014			
Offsite Dose Calculation Manual			

Effective Date: 01/04/2022	
Procedure Owner:	Jeffrey Bourgeois
Title:	Chemistry Manager
Approval Authority:	Jeffrey Bourgeois
Title:	Chemistry Manager

**Process Applicability Exclusion:** Yes  No

<b>Revision Summary</b>	
<b>Location</b>	<b>Description of Changes</b>
5.4	Corrected typo errors in equations 5, 8, 9, 10, and 11. The typo in equation 5 was mistyped in Revision 6. Equations 8, 9, 10, and 11 were mistyped in Revision 305. These typos were discovered during the 2021 Pre-NRC Inspection. See CR-WF3-2021-5563.
5.8.1.d	Removed Steps 4 and 5 to align with Reg Guide 1.21. Steps 4 and 5 are not required in the Annual Radioactive Effluent Release Report. See CR-GGN-2017-06772 and CR-WF3-2021-04915.

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**Offsite Dose Calculation Manual****1.0 PURPOSE AND SCOPE**

1. The Offsite Dose Calculation Manual (ODCM) is a supporting document of the Waterford 3 Technical Specifications. The ODCM provides:
  - a. The Radiological Effluent Specifications and Radiological Environmental Monitoring Program required by Technical Specification 6.8.4
  - b. The detailed Radiological Environmental Monitoring Program (REMP)
  - c. The description of the Radiological Environmental Monitoring Interlaboratory Comparison Program
  - d. The liquid and gaseous radwaste block flow diagram
  - e. The Radioactive Liquid and Gaseous Waste Sampling and Analysis Technical general methodology to be used to calculate dose to individuals due to releases of radioactive gaseous and liquid effluents from the Waterford 3 site
  - f. The general methodology to be used to calculate effluent monitor setpoints and allowable release rates to ensure compliance with the Radiological Effluent Controls, 10 CFR 20, and 10 CFR 50 criteria
  - g. The methodology to be used to ensure representative sampling of liquids
  - h. The methodology to be used to comply with 40 CFR 190 criteria
  - i. The methodology to be used to comply with 10 CFR 72.104 criteria

**2.0 REFERENCES/COMMITMENTS****2.1 Performance References**

1. Certificate of Compliance Waterford 3 Technical Specification 5.4, Radioactive Effluent Control Program
2. EN-LI-102, Corrective Action Program
3. NUREG/CR-1276, User's Manual for LADTAP II - A computer program for calculating radiation exposure to man from routine release of nuclear reactor liquid effluents
4. NUREG-0172, Age Specific Radiation Dose Commitment Factors for a One Year Chronic Intake
5. TRM 3/4.11.1.1 Liquid Effluents Concentration
6. TRM 3/4.11.1.2 Liquid Effluents Dose
7. TRM 3/4.11.1.3 Liquid Effluents Liquid Radwaste Treatment System
8. TRM 3/4.3.3.10 Radioactive Liquid Effluent Monitoring Instrumentation

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9. TRM 3/4.11.2.1 Gaseous Effluents Dose Rate
10. TRM 3/4.11.2.2 Gaseous Effluents Dose - Noble Gases
11. TRM 3/4.11.2.3 Gaseous Effluents Dose Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form
12. TRM 3/4.11.2.4 Gaseous Effluents Gaseous Radwaste Treatment
13. TRM 3/4. 11.4, Radioactive Effluents Total Dose
14. TRM Table 3.12-1 Radiological Environmental Monitoring Program
15. TRM 3/4.12.1 Radiological Environmental Monitoring Program
16. TRM Table 3.3-12 Radioactive Liquid Monitoring Instrumentation
17. TRM Table 3.3-13 Radioactive Gaseous Monitoring Instrumentation
18. UNT-006-010, Event Notification and Reporting
19. USNRC NUREG 0133, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, October 1978
20. USNRC Regulatory Guide 1.21, Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants, Revision 1, June 1974
21. USNRC 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
22. Waterford 3 Final Safety Analysis Report (FSAR) Chapter 2
23. Waterford 3 Technical Requirements Manual (TRM)
24. Waterford 3 Technical Specification 1.36, Unrestricted Area
25. Waterford 3 Technical Specification 3/4.11.1.4, Liquid Holdup Tanks
26. Waterford 3 Technical Specification 3/4.11.2.6, Gas Storage Tanks
27. Waterford 3 Technical Specification 5.1.3, Map Defining Unrestricted Areas for Radioactive Gaseous and Liquid Effluents
28. Waterford 3 Technical Specification 6.8.4.f, Radioactive Effluent Controls Program
29. Waterford 3 Technical Specification 6.8.4.g, Radiological Environmental Monitoring Program
30. Waterford 3 Technical Specification 6.9.1.7, Annual Radiological Environmental Operating Report

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31. Waterford 3 Technical Specification 6.9.1.8, Annual Radioactive Effluent Release Report
32. Waterford 3 Technical Specification 6.9.2, Special Reports
33. Waterford 3 Technical Specification 6.13, Process Control Program (PCP)
34. Waterford 3 Technical Specification 6.14, Offsite Dose Calculation Manual (ODCM)
35. 10 CFR 20, Standards for Protection against Radiation
36. 10 CFR 50, Domestic Licensing of Production and Utilization Facilities
37. 40 CFR 190, Environmental Radiation Protection Standards for Nuclear Power Operations
38. 10 CFR 72.104, Criteria for Radioactive Materials in Effluents and Direct Radiation from an Independent Spent Fuel Storage Installation (ISFSI) or Monitored Retrievable Storage (MRS)
39. 10 CFR 20.1003, Definitions
40. 10 CFR 100.3, Definitions
41. 10 CFR 50.36a, Technical Specification on Effluents from Nuclear Power Reactors
42. 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Waste
43. 10 CFR 50.59, Changes, Tests and Experiments
44. 40 CFR 302 Designation, Reportable Quantities, and Notification

**2.2 Developmental References**

1. HASL-300, HASL Procedures Manual; Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination Application to Radiochemistry", Anal Chem. 40, 586-93, (1968)
2. International Atomic Energy Agency (IAEA) Safety Series No.57, Generic Models and Parameters for Assessing the Environmental Transfer of Radionuclides from Routine Releases, Exposures of Critical Groups
3. Radiological Health Handbook, U.S. Department of Health, Education and Welfare, January 1970

**2.3 Commitments**

1. Generic Letter 89-01, Supplement No. 1. (November 1990), NUREG-1301, Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors

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2. USNRC Generic Letter 89-01, Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program
3. IR 86-07 Section 7, Records and reports of radioactive effluents: note missing or late analysis results in future reports
4. NUREG/CR-4007, Currie, L.A., "Lower Limit of Detection; Definition and Elaboration of a proposed Position of Radiological Effluent and Environmental Measurements", (September 1984)
5. USNRC Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Gaseous-Effluents from Light-Water-Cooled Reactors, July 1977
6. USNRC Regulatory Guide 1.113, Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, April 1977

#### 2.4 Obligations

Step	Source Document	Description	Commitment Number
Section 5.3, 5.8, 5.9	10CFR20.2001.01	Radioactivity in Effluents in unrestricted areas	P-642
Section 5.3, 5.8, 5.9	10CFR20.1302	Radioactivity in Effluents in unrestricted areas	P-722
Section 5.2, 5.4, 5.8	TS 4.3.3.11.1A	Radioactive Gaseous Effluent Monitoring Instrumentation Channel Check – Waste Gas Holdup System Noble Gas Activity	P-2414
Section 5.2, 5.3, 5.4, 5.9	TS 4.11.4.1	Radioactive Effluents – Total Dose to Public from Liquid & Gaseous Effluents - Determination	P-2733

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Section 5.6, 5.8 Attachment 11, 12	TS 6.15	Administrative Controls – Major Changes to Radioactive Liquid, Gaseous, and Solid Waste Treatment Systems	P-2810
Sections 5.5, 5.7, 5.8 Attachment 13 - 18	FSARQ 810.010.7.A	Environmental Radiological Surveillance and Monitoring Program	P-3900
Sections 5.3, 5.5, 5.6, 5.8, 5.9	EMPL 6.4.2.C	Radiological Assessment of Liquid Effluent Discharge	P-5927
Sections 5.2 – 5.10	TS 6.8.1.J	Administrative Controls Required Procedures & Programs	P-7831
Sections 5.9	TS 6.8.4.B.2	Administrative Controls for Airborne Radiation Monitoring under Accident Conditions	P-8014
Sections 5.3, 5.4, 5.5, 5.8, 5.10	40CFR190.10.A	Maximum Annual Dose Equivalent Standards for Normal Operations	P-8614
Sections 5.5, 5.7, 5.8	ANSI N13.2 Section 4.3	Environmental Monitoring to Ensure that Limits are not Exceeded	P-9897
Sections 5.5, 5.7, 5.8 Attachment 13 - 18	ANSI N13.2 Section 5.3.4.2.2	Routine Environmental Surveys during Operations	P-9915
Section 5.8	RG 1.21 Section APP.B	Format for Effluent and Waste Disposal Report	P-10526

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Section 5.8	RG 1.21 Section APP.B	Effluent and Waste Disposal Report to contain discussion of Radiological Impact of Facility Operation on Man	P-10527
Section 5.8	RG 1.21 Section APP.B	Reporting of Meteorological Data in Effluent and Waste Disposal Report	P-10528
Section 5.8	RG 1.21 Section APP.B.A.1	Effluent and Waste Disposal Report to contain Regulatory Limits for Releases	P-10529
Section 5.8	RG 1.21 Section APP.B.A.2	Effluent and Waste Disposal Report to include Effluent Concentrations used in Calculations	P-10530
Section 5.8	RG 1.21 Section APP.B.A.3	Effluent and Waste Disposal Report to include Average Energy Value	P-10531
Section 5.8	RG 1.21 Section APP.B.A.4	Effluent and Waste Disposal Report to include Description of Measurements and Approximations of Total Radioactivity	P-10532
Section 5.8	RG 1.21 Section APP.B.A.5	Effluent and Waste Disposal Report to include Information on batch Releases	P-10533
Section 5.8	RG 1.21 Section APP.B.A.6	Abnormal Releases to be included in Effluent and Waste Disposal Report	P-10534
Section 5.8	RG 1.21 Section APP.B.B	Effluent and Waste Disposal Report for Gaseous Effluents	P-10535

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Section 5.8	RG 1.21 Section APP.B.B.1	Effluent and Waste Disposal Report: Information to be reported for Fission & Activation Gases Released	P-10536
Section 5.8	RG 1.21 Section APP.B.B.2	Effluent and Waste Disposal Report: Information to be reported for Iodines in Gaseous Effluents	P-10537
Section 5.8	RG 1.21 Section APP.B.B.3	Effluent and Waste Disposal Report: Information to be reported on Radioactive Material in Particulate Form	P-10538
Section 5.8	RG 1.21 Section APP.B.B.4	Effluent and Waste Disposal Report: Information to be reported about Tritium in Gaseous Effluents	P-10539
Section 5.8	RG 1.21 Section APP.B.C	Effluent and Waste Disposal Report for Liquid Effluents	P-10540
Section 5.8	RG 1.21 Section APP.B.C.1	Effluent and Waste Disposal Report: Mixed Fission & Activation Products in Liquid Effluents	P-10541
Section 5.8	RG 1.21 Section APP.B.C.2	Effluent and Waste Disposal Report: Tritium in Liquid Effluent	P-10542
Section 5.8	RG 1.21 Section APP.B.C.3	Effluent and Waste Disposal Report: Dissolved & Entrained Gases in Liquid Effluents	P-10543

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Section 5.8	RG 1.21 Section APP.B.C.4	Effluent and Waste Disposal Report: Alpha Radioactivity in Liquid Effluents	P-10544
Section 5.8	RG 1.21 Section APP.B.C.5	Effluent and Waste Disposal Report: Volume of Liquid Effluents	P-10545
Section 5.8	RG 1.21 Section APP.B.C.6	Effluent and Waste Disposal Report: Stream Flow Data for Liquid Effluents	P-10546
Section 5.8	RG 1.21 Section APP.B.D	Effluent and Waste Disposal Report: Reporting of Solid Waste Shipments	P-10547
Section 5.8	RG 1.21 Section APP.B.E	Effluent and Waste Disposal Report: Radiological Impact on Man	P-10548
Section 5.8	RG 1.21 Section APP.B.F	Effluent and Waste Disposal Report: Meteorological Data	P-10549
Sections 5.5, 5.7, 5.8, 5.9	ANSI N545 Section 7.1	REMP TLD System Reporting Requirements	P-11192
Section 5.5, 5.7	RG 4.1 Section C.2.E	Program for Monitoring Radioactivity in the Environs Quality Control	P-11261
Section 5.5, 5.7	RG 4.1 Section C.2.C	Program for Monitoring Radioactivity in the Environs Program scope results and record Retention	P-11266
Section 5.5, 5.7	RG 4.1 Section C.2.D	Program for Monitoring Radioactivity in the Environs Sample Analyses	P-11267



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Section 5.5, 5.8	RG 1.23 Section C.5	Meteorological Program – Modification Controls	P-11583
Section 5.8	RG 1.23 Section C.6	Meteorological Program – Data Compilation	P-11584
Section 5.8	RG 1.23 Section C.6	Meteorological Program – Atmospheric Stability Classes	P-11585
Section 5.8	RG 1.23 Section C.6	Meteorological Program – Data Compilation and Averaging	P-11586
Sections 5.3, 5.5	EMPL 7.4.11.A	Projecting Liquid Release Dose	P-12964
Sections 5.3, 5.4	TRM 3.3.3.11	Radioactive Gaseous Effluent Monitoring Instrumentation – LCO	P-13695
Section 5.8	TS 6.10.3.D	Records of Radioactive Material Released	P-15616
Section 5.3, 5.9	INPO SOER 83-02 section REC.12	Steam Generator Tube Ruptures	P-16478
Entire procedure	TS 6.14	Administrative Controls – Offsite Dose Calculation Manual (ODCM)	P-17760
Sections 5.5, 5.7, 5.8, 5.9	TS 6.8.4.6	Administrative Controls – Radiological Environmental Monitoring Program	P-17897
Sections 5.3, 5.4, 5.8	TS 6.8.4.G	Administrative Controls – Radioactive Effluent Controls Program	P-17898

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Sections 5.3	IN 94-07	Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Internal Action: Incorporate sample for release into procedure	P-22350
Sections 5.3, 5.4, 5.8	TS 6.8.4.F	Administrative Controls – Radioactive Effluent Controls Program	P-22822

### 3.0 DEFINITIONS

1. LIQUID RADWASTE TREATMENT SYSTEM shall be any system designed and installed to reduce radioactive material in effluents by passing liquid waste through filters and/or absorption or exchange media (e.g. Ion Exchanger Resin, Charcoal etc) and/or other reduction processes (e.g. reverse osmosis, etc) for the purpose of removing radioactive materials from the liquid system prior to the release to the environment.
2. LOWER LIMITS OF DETECTION (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.

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

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

$$LLD = \frac{4.66 S_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot e^{-\lambda \Delta t}}$$

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,

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V is the sample size in units of mass or volume,  $2.22 \times 10^6$  is the number of disintegrations per minute per microcurie,

Y is the fraction radiochemical yield, when applicable,

$\lambda$  is the radioactive decay constant for the particular radionuclide, and

$\Delta t$  for plant effluents is the elapsed time between the midpoint of sample collection and the time of counting. For environmental samples it is the elapsed time between sample collection, or end of the sample collection period, and time of counting. Typical values of E, V, Y, and  $\Delta t$  should be used in the calculation.

3. A MAJOR CHANGE to a radioactive waste system shall be any alteration or modification to the system that causes waste characteristics (e.g. chemical composition, pH, etc.), waste form or waste activity (e.g. equipment decontamination factor change) in liquid, gaseous, or solid effluents to change, thereby requiring a re-evaluation of the effluent source terms.
4. OFFSITE DOSE CALCULATION MANUAL (ODCM) shall be comprised of the radiological effluent technical specifications and methodology contained within this procedure and applicable sections of the Technical Requirements Manual (TRM) as listed on Attachment 23 of this procedure.
5. An UNPLANNED/ABNORMAL RELEASE is defined as any unplanned, uncontrolled or unmonitored release of radioactive material to the UNRESTRICTED AREA for liquids or to the SITE BOUNDARY for gases. This includes any unplanned, uncontrolled or unmonitored releases where the radiological consequences may be minimal but where the potential exists for more serious radiological consequences if allowed to recur. Incidents that are to be classified as UNPLANNED/ABNORMAL RELEASES do not include releases that fall within the guidelines of a Secondary Release Pathway. Secondary Release Pathways are usually known and have been previously evaluated or considered.
6. UNRESTRICTED AREA (T.S. 1.36) shall be any area to which access is neither limited nor controlled by the licensee. The definition of UNRESTRICTED AREA used in implementing these Technical Specifications has been expanded over that in 10 CFR 20.1003. The UNRESTRICTED AREA boundary may coincide with the Exclusion (fenced) Area boundary, as defined in 10 CFR 100.3(a), but the UNRESTRICTED AREA does not include areas over water bodies. For calculations performed pursuant to 10 CFR 50.36a, the concept of UNRESTRICTED AREAS, established at or beyond the SITE BOUNDARY, is utilized in the Controls to keep levels of radioactive materials in liquid and gaseous effluents as low as is reasonably achievable, see Attachment 1.

**Offsite Dose Calculation Manual****4.0 RESPONSIBILITIES**

1. The Chemistry Manager is responsible for the following:
  - a. ensuring Radiological Effluent Specifications, the Radiological Effluent Monitoring Program and Radiological Environmental Monitoring Program (REMP) is performed as required according to procedures and methodologies established by this document.
  - b. ensuring the Annual Effluent Release Report and the Annual Radiological Environmental Operating Report are performed and issued as required.
  - c. ensuring the Land Use Census is performed as required.
2. General Manager, Plant Operations has lead responsibility for ensuring implementation of the Radiological Effluent Specifications and Radiological Environmental Monitoring Program.

**Offsite Dose Calculation Manual****5.0 INSTRUCTIONS****5.1 SITE CHARACTERISTICS**

Waterford 3 SES Site Characteristics is provided in Chapter 2 of Waterford 3 Final Safety Analysis Report (FSAR) (Sections 2.1.1, 2.1.2 and 2.1.3).

A map of the SITE BOUNDARIES for establishing effluent release limits along with radioactive effluent release points are **GIVEN** in Attachment 1. The release point elevations for gaseous effluents are also **PROVIDED** in Attachment 1. The nearest distances to the boundary line are shown in Attachment 2 of this procedure.

**5.2 SPECIFICATIONS AND SURVEILLANCE REQUIREMENTS**

1. Compliance with the SPECIFICATIONS contained in this procedure **AND** the Technical Requirements Manual (TRM) is **REQUIRED** during the conditions specified therein; except that failure to meet the SPECIFICATIONS **REQUIRES** that the associated ACTION requirements shall be met.
2. Noncompliance with this procedure **AND** the TRM shall exist when the requirements of the SPECIFICATION **AND/OR** associated ACTION requirements are **NOT** met within the specified time intervals. **IF** the SPECIFICATION is restored prior to expiration of the specified time intervals, **THEN** completion of the ACTION requirements is NOT REQUIRED.
3. Surveillance Requirements shall be **APPLICABLE** during all conditions specified for individual systems unless otherwise stated in an individual Surveillance Requirement.
4. Each Surveillance Requirement shall be **PERFORMED** within the specified time interval with a maximum allowable extension not to exceed 25% of the surveillance interval.
5. Failure to perform a Surveillance Requirement within the specified time interval shall **CONSTITUTE** a failure to meet the OPERABILITY requirements for a Specific System for Operation. Exceptions to these requirements are **STATED** in the individual specifications. Surveillance Requirements do not have to be **PERFORMED** on inoperable equipment.
6. Failure to **COMPLY** with the compensatory ACTION requirements **OR** failure to **COMPLETE** the surveillance requirements within the specified time shall be **DOCUMENTED AND EVALUATED** in accordance with EN-LI-102 the Corrective Action Program, Condition Report **AND** UNT-006-010, Event Notification and Reporting procedures.

## Offsite Dose Calculation Manual

### 5.3 LIQUID EFFLUENTS

#### 1. Liquid Effluent Dose Calculation

#### NOTE

The Offsite Dose Calculation Manual (ODCM) follows the general models suggested by NUREG 0133 **AND** Regulatory Guide 1.109. However, alternate calculation methods from those presented may be used provided the overall methodology is acceptable **AND** consistent with regulation **OR** provided the alternate methodology is conservative. In addition, the most up-to-date dose conversion factors **AND** bioaccumulation factors may be **SUBSTITUTED** in lieu of Regulatory Guide 1.109 values.

#### NOTE

In-plant procedures, which are consistent with the methodology presented in this document, contain step-by-step dose calculations.

- a. The dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas are **CALCULATED** for the purpose of implementing Step 2 using the following expression:

$$D_{t\ell} = \Delta t_{\ell} F_{\ell} \sum_{i=1}^n A_{it} C_{i\ell} \quad (1)$$

$$D_t = \sum_{\ell=1}^m D_{t\ell} \quad (2)$$

$D_{t\ell}$  = the cumulative dose commitment to the total body **OR** any organ (t) from the liquid effluents for each liquid release in mrem during time period ( $\ell$ )

$D_t$  = the cumulative dose commitment to the total body **OR** any organ (t) from the liquid effluents for all ( $\ell$ ) time periods

$\Delta t_{\ell}$  = ..... the length of the  $\ell$ th time period over which the release is made, in hours

$C_{i\ell}$  = the concentration of radionuclide (i) in undiluted liquid effluent during time period  $\Delta t_{\ell}$  from any liquid release, in  $\mu\text{Ci/ml}$

$A_{it}$  = the site-related liquid ingestion dose commitment factor to the total body **OR** any organ (t) for each identified nuclide (i) in mrem-ml/hr-  $\mu\text{Ci}$  (Attachment 3)

### Offsite Dose Calculation Manual

$F_i$  = the near field average dilution factor for  $C_{it}$  during any liquid effluent release. Defined as the ratio of the undiluted liquid waste flow during release to the average flow from the site discharge structure to site boundary receiving waters

$$= \frac{\text{liquid radioactive waste flow}}{\text{discharge structure exit flow}}$$

The liquid radioactive waste flow is the maximum flow from the effluent release. The discharge structure exit flow is the flow during disposal from the discharge structure release point into the receiving water body. For radionuclides NOT determined in each batch **OR** weekly composite, the dose contribution to the current calendar quarter cumulative summation may be **APPROXIMATED** by using a ratio of concentrations based on the previous monthly **OR** quarterly composite analyses.

- b. Equation (1) in Step 5.3.1.a for calculating the dose contributions requires the use of a dose factor,  $A_{it}$ , for each nuclide (i) which embodies the dose factors **AND** dilution factors for the points of pathway origin. The adult total body dose factor **AND** the adult organ dose factor for each radionuclide will be used from Table E-11 of Regulatory Guide 1.109; thus, the list contains critical organ dose factors for various organs. The dose factor is written:

$$A_{it} = K_o \left( \frac{U_w}{D_w} + U_f B E_i \right) D C F_{it} \quad (3)$$

where:

$A_{it}$  = Composite dose parameter for the total body **OR** critical organ (t) of an adult for nuclide (i) for all appropriate pathways (mrem-ml/hr- $\mu$ Ci);

$K_o$  = Unit conversion factor

$$= 1.14E + 5 = 10^6 \frac{\text{pCi}}{\mu\text{Ci}} \cdot 10^3 \frac{\text{ml}}{\text{l}} \div 8760 \frac{\text{hr}}{\text{yr}}$$

$U_w$  = 730 l/yr adult water consumption (Reg. Guide 1.109, Table E-5)

$D_w$  = Dilution factor from near field area to potable water intake

= 220 for discharges from the circulating water discharge into the Mississippi River (based on the ratio of the average Mississippi River flow to the maximum discharge flow)

= 1 for discharges into the 40 Arpent Canal (based on the assumption that dilution from the near field area to a potable water intake is negligible)

## Offsite Dose Calculation Manual

$U_f = 21$  kg/yr, adult fish consumption (Reg. Guide 1.109, Table E-5)

$BF_i =$  Bioaccumulation factor for nuclide (i) in fish (pCi/kg per pCi/l) from Attachment 22

$DCF_{it} =$  Ingestion Dose conversion factor for nuclide (i) and organ (t) for adults (mrem/pCi), from Attachment 21

### 2. Liquid Effluent Monitor Setpoint Calculation Methodology

Technical Requirements Manual (TRM) Specifications 3/4.11.1.1 **AND** 3/4.3.3.10 require the liquid effluent monitoring instrumentation alarm/trip setpoints be **SET** so that the concentration of radioactive material released from the site is limited to 10 times the Effluent concentration values 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 2E-4  $\mu$ Ci/ml total activity. This section presents the method to be **USED** for determining setpoints in accordance with TRM Surveillance Requirements 3/4.11.1.1 **AND** 3/4.3.3.10

- a. The calculated setpoints for the liquid effluent monitors satisfy the following equation:

$$c = \frac{(SF) (RF) (F + f) \sum_{i=1}^n C_i}{(TEC)(f + F')} \quad (4)$$

where:

$c =$  the setpoint, in  $\mu$ Ci/ml, of the liquid effluent monitor measuring the radioactivity concentration in the effluent line prior to complete dilution **AND** subsequent release. This setpoint represents a value which, if exceeded would result in concentrations exceeding 10 times the Effluent concentration values of 10 CFR 20, Appendix B, Table 2. Column 2, to an UNRESTRICTED AREA

$SF =$  Safety Factor to ensure that the effluent limit is not exceeded. A value of 0.8 is normally used for SF

$RF =$  Release Fraction allocated to this release (to be used only in situations of simultaneous or concurrent release)

$f =$  the undiluted liquid effluents flow as measured at the liquid effluent monitor location in gpm

$F =$  the dilution water flow as determined via pump curves **OR** other appropriate measures that determine correct plant operating configuration in gpm



## Offsite Dose Calculation Manual

### NOTE

If  $F$  is large compared to  $f$  then  $F + f \approx F$ . If there is no additional dilution,  $F' = 0$ .

$F'$  = additional dilution flow at the radiation monitor for liquid effluent radiation monitors that have additional dilution prior to actual withdrawal of the monitored fluid, in gpm

= 1000 (maximum) for Steam Generator Blowdown **OR** Auxiliary Component Cooling Water releases to the circulating water system

= 0 for all other liquid release points

$C_i$  = the undiluted concentration in  $\mu\text{Ci/ml}$  for all gamma emitting radionuclides (i). The value will be derived from radioanalysis of liquid effluent to be released. This value will be supplied for each liquid release.

$$TEC = \sum_{i=1}^n \frac{C_i}{10EC_i} + \sum_{j=1}^m \frac{C_j}{10EC_j}$$

$C_j$  = the undiluted concentration, in  $\mu\text{Ci/ml}$ , for all non-gamma emitting radionuclides (j). This value will be derived from radioanalysis of composite liquid effluents released. This value will be supplied for each liquid release based upon the most recent analysis results.

$$\frac{C_i}{10EC_i} = \text{The undiluted gamma } EC_i \text{ fraction for all gamma emitting radionuclides (i)}$$

$$\frac{C_j}{10EC_j} = \text{The undiluted non-gamma } EC_j \text{ fraction for all non-gamma emitting radionuclides (j)}$$

$10EC_i$  = 10 times the Effluent Concentration for the applicable gamma-emitting isotopes (i) from 10 CFR 20, Appendix B, Table 2, Column 2

$10EC_j$  = 10 times the Effluent Concentration for the applicable non-gamma emitting isotopes (j) from 10 CFR 20, Appendix B, Table 2, Column 2

- b. The values of  $C_i$  **AND**  $C_j$  will be **MEASURED** for each release as appropriate **AND** the parameters for  $f$ ,  $F'$  **AND**  $F$  will be **SUPPLIED** based on current plant operating configurations. The setpoint will be **CALCULATED** in terms of  $\mu\text{Ci/ml}$  **AND** the liquid effluent monitor will be **ADJUSTED** as necessary to ensure liquid releases are secured prior to exceeding 10 times the Effluent concentration values specified in 10 CFR 20, Appendix B, Table 2, Column 2 to an UNRESTRICTED AREA.

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## c. Representative Liquid Sampling

Prior to grab sampling liquid waste tanks, methods should be **USED** to guarantee representative sampling. Large volumes of liquid waste should be **MIXED** in as short a time as possible **AND** uniformly **DISTRIBUTED** prior to sampling. To determine the minimum mixing time for tanks from which releases are made, the following tests were **PERFORMED** prior to initial use for release purposes.

- 1) The tank **WAS** filled to a known volume.
- 2) A specific quantity of a selected chemical **AND/OR** sediments was **ADDED** to the tank.
- 3) Recirculation was **INITIATED** through the normal path.
- 4) Periodic samples were **TAKEN** until equilibrium was **REACHED**.
- 5) The time **OBSERVED** to completely mix the tank is **USED** as a minimum recirculation time prior to effluent sampling. Records of the test will be **MAINTAINED**.

## d. Dose Projection for Liquid Effluents

At least once every 31 days, the total dose from all liquid releases for the quarter-to-date will be **DIVIDED** by the number of days expired in the quarter **AND MULTIPLIED** by 31.

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5.4 GASEOUS EFFLUENTS

**NOTE**

The Offsite Dose Calculation Manual (ODCM) follows the general models suggested by NUREG 0133 **AND** Regulatory Guide 1.109. However, alternate calculation methods from those presented may be used provided the overall methodology is acceptable **AND** consistent with regulation **OR** provided the alternate methodology is conservative. In addition, the most up-to-date dose conversion factors **AND** bioaccumulation factors may be **SUBSTITUTED** in lieu of Regulatory Guide 1.109 values.

**NOTE**

In-plant procedures, which are consistent with the methodology presented in this document, contain step-by-step dose calculations.

1. Calculational Methodology for Gaseous Effluent Dose Rate

This section presents the calculational methods used for calculating gaseous effluent doses in fulfillment of Specification.

- The dose rate due to the radioactive materials released in gaseous effluents from the site to areas at **AND** beyond the SITE BOUNDARY shall be **LIMITED** to the following values **AND** expressions:

Release rate limit for Noble Gases:

$$\overline{(X/Q)}_v \sum_{i=1}^n K_i Q_{iv} \leq 500 \frac{mrem}{yr} \text{ total body} \quad (5)$$

$$\overline{(X/Q)}_v \sum_{i=1}^n (L_i + 1.1M_i) Q_{iv} \leq 3000 \frac{mrem}{yr} \text{ skin} \quad (6)$$

Release rate limit for Iodine-131, Iodine-133, Tritium and for all radionuclides in particulate form with half-lives greater than 8 days:

$$\overline{(X/Q)}_v \sum_{i=1}^n P_{it} Q_{iv} \leq 1500 \frac{mrem}{yr} \text{ any organ} \quad (7)$$

where:

$\overline{(X/Q)}_v = 1.1E-5 \text{ sec/m}^3$  in the ESE sector at 0.6 mile for all vent releases (v) (the highest calculated annual average dispersion factor at the SITE BOUNDARY based on historical data Attachment 2). The actual X/Q for the time of release may be **DETERMINED** and **USED** under certain circumstances.

$\sum_{i=1}^n$  = summation for all identified radionuclides

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$K_i$  = the total body dose factor due to gamma emissions for each identified radionuclide (i) in units of mrem/yr per  $\mu\text{Ci}/\text{m}^3$  (Attachment 4)

$L_i$  = the skin dose factor due to beta emissions for each identified radionuclide (i) in units of mrad/yr per  $\mu\text{Ci}/\text{m}^3$  (Attachment 4)

$M_i$  = the air dose factor due to gamma emissions for each identified radionuclide (i) in units of mrad/yr per  $\mu\text{Ci}/\text{m}^3$  (Attachment 4). The constant 1.1 converts air dose to skin dose

$P_{it}$  = the thyroid dose parameter for Iodine-131, Iodine-133, tritium, **AND** radionuclides in particulate form with half-lives greater than 8 days (i) for the inhalation pathway only, in mrem/yr per  $\mu\text{Ci}/\text{m}^3$  (Attachment 19). The dose factor is based on the most restrictive age group (child) and most restrictive organ at the SITE BOUNDARY

**NOTE**

All radioiodines are assumed to be released in elemental form.

$Q_{iv}$  = the average release rate of radionuclides (i) (either noble gas **OR** Iodine-131, Iodine-133, tritium, **AND** radionuclides in the particulate form with half-lives greater than 8 days, as appropriate) during the time of release from all vent releases (v). Value is averaged over one hour **AND** is in units of  $\mu\text{Ci}/\text{sec}$ .

2. Calculational Methodology for Noble Gas Doses

The air dose due to noble gases released in gaseous effluents to areas at **OR** beyond the SITE BOUNDARY will be **DETERMINED** by the following expressions:

a. During any calendar quarter,

for gamma radiation:

$$D_\gamma = (1.14E - 4) \overline{(X/Q)}_v \sum_{i=1}^n M_i \sum_{j=1}^m \Delta t_j Q_{ijv} \quad (8)$$

for beta radiation:

$$D_\beta = (1.14E - 4) \overline{(X/Q)}_v \sum_{i=1}^n N_i \sum_{j=1}^m \Delta t_j Q_{ijv} \quad (9)$$

b. During any calendar year,

for gamma radiation:

$$D_\gamma = (1.14E - 4) \overline{(X/Q)}_v \sum_{i=1}^n M_i \sum_{j=1}^m \Delta t_j Q_{ijv} \quad (10)$$

for beta radiation:

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$$D_{\beta} = (1.14E - 4) \overline{(X/Q)}_v \sum_{i=1}^n N_i \sum_{j=1}^m \Delta t_j Q_{ijv} \quad (11)$$

where:

$D_{\gamma}$  = the total gamma ( $\gamma$ ) air dose from gaseous effluents for the total time period **AND** not to exceed 5 mrad quarterly **AND** 10 mrad yearly

$D_{\beta}$  = the total beta ( $\beta$ ) air dose from gaseous effluents for the total time period **AND** not to exceed 10 mrad quarterly **AND** 20 mrad yearly

1.14E-04 = a constant of (1 yr/8760 hr)

$\overline{(X/Q)}_v = 1.1E-5 \text{ sec/m}^3$  in the ESE sector at 0.6 mile for all vent releases (v). The actual X/Q for the time of release may be determined **AND** used under certain circumstances.

$M_i$  **AND**  $N_i$  = the gamma and beta air dose factors (respectively) for a uniform semi-infinite cloud of radionuclide (i) in mrad/yr per  $\mu\text{Ci/m}^3$  (Attachment 4)

$\Delta t_j$  = the length of the jth time period over which  $Q_{ijv}$  are accumulated for all gaseous releases in hours

$Q_{ijv}$  = the average release rate of radionuclides (i) in gaseous effluent from all vent releases (v) in  $\mu\text{Ci/sec}$  during the time period  $\Delta t_j$

3. Calculational Methodology for Doses Due to Radioiodines, Tritium, **AND** Radioactive Materials in Particulate Form

The dose to an individual from Iodine-131, Iodine-133, tritium, **AND** radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at **AND** beyond the SITE BOUNDARY will be **DETERMINED** by the following expressions:

During any calendar quarter:

$$D_{ita} = 1.14E - 4 \Delta t \sum_{i=1}^n R_{ita} W_v Q_{iv} \quad (12)$$

During any calendar year:

$$D_{ita} = 1.14E - 4 \Delta t \sum_{i=1}^n R_{ita} W_v Q_{iv} \quad (13)$$

where:

$D_{ita}$  = the cumulative dose to an organ (t), age group (a), due to radionuclides (i) in gaseous effluents; not to exceed 7.5 mrem quarterly or 15 mrem yearly

1.14E-4 = a constant of unit conversion

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$$= 1 \text{ yr}/8760 \text{ hr}$$

$\Delta t$  = the time required for the release in hours for all releases per quarter **OR** per year

$W_v$  = the dispersion parameter for estimating the dose to an individual at the controlling location for long term vent releases (v)

=  $(\overline{x/Q})_v$  for the inhalation pathway from vent releases (v) in  $\text{sec}/\text{m}^3$ , from historical data, at the location of the critical receptor (Attachment 2)

=  $(\overline{D/Q})_v$  for the food **AND** ground plane pathways from vent releases (v) in  $1/\text{m}^2$ , from historical data at the location of the critical receptor (Attachment 2), with the exception of tritium, which shall use  $\overline{W}_v = (\overline{x/Q})_v$

$R_{ita}$  = the dose factor from each identified radionuclide (i), for each applicable organ (t), **AND** age group (a), in  $\text{mrem}/\text{yr}$  per  $\mu\text{Ci}/\text{m}^3$  for the inhalation pathway (Attachment 5) **AND** in  $\text{mrem}/\text{yr}$  per  $\mu\text{Ci}/\text{m}^2\text{-sec}$  for the food **AND** ground plane pathways (Attachments 6 through 10). For sectors with real pathways within 5 miles of the plant, the values of  $R_i$  are used based on these real pathways. ( $R_i$ 's were calculated using the methodology found in NUREG 0133 (Pages 31-36).

$Q_{iv}$  = the average release rate of radionuclides (i) in gaseous effluent from all vent releases (v) in  $\mu\text{Ci}/\text{sec}$

4. Gaseous Effluent Monitor Setpoint Calculational Methodology

- a. The calculated high alarm/flow termination setpoint is the maximum value for that particular release. An administrative Safety Factor (SF) will be **UTILIZED** in the setpoint calculation. To allow for simultaneous releases from common **OR** different release points, a Release Fraction (RF) may be **USED** to allocate percentages of the total allowable release.
- b. Since the noble gas dose rates are more limiting than the radioiodine dose rate, gaseous setpoints will be based on noble gas dose rates (less than **OR** equal to 500  $\text{mrem}/\text{yr}$  total body, **AND** less than or equal to 3000  $\text{mrem}/\text{yr}$  skin). Specifically, gaseous setpoints will be based on the most limiting of the following equations:

1) Total body ( $Q_{tb}$ ):

$$Q_{tb} = \frac{(500 \frac{\text{mrem}}{\text{yr}})(\text{RF})(\text{SF})}{(\overline{x/Q})_v \left[ \frac{\sum_{i=1}^n K_i Q_{iv}}{\sum_{i=1}^n Q_{iv}} \right]} \quad (14)$$

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where:

$Q_{tb}$  = maximum release rate allowed to give a limiting total body dose rate of 500 mrem/yr in  $\mu\text{Ci}/\text{sec}$

$\sum_{i=1}^n$  = summation of all nuclides considered

$K_i$  = the total body dose factor due to gamma emissions for each identified radionuclide (i) in units of mrem/yr per  $\mu\text{Ci}/\text{m}^3$  (Attachment 4)

$Q_{iv}$  = average release rate of isotope (i) from the release point (v) in  $\mu\text{Ci}/\text{sec}$

$\overline{\left(\frac{x}{Q}\right)}_v = 1.1\text{E-}5 \text{ sec}/\text{m}^3$  (in the ESE sector at 0.6 mile). The sector with highest value of annual average atmospheric dispersion factor at the site boundary for the release point (v) in question

RF = release fraction allotted to release point in consideration

SF = administrative safety factor to account for uncontrollable variables (sampling, monitoring errors, etc.). A value of 0.8 is normally used for SF.

2) For Skin ( $Q_{\text{skin}}$ ):

$$Q_{\text{skin}} = \frac{(3000 \frac{\text{mrem}}{\text{yr}})(\text{RF})(\text{SF})}{\overline{\left(\frac{x}{Q}\right)}_v \left[ \sum_{i=1}^n (L_i + 1.1M_i)Q_{iv} \right] \left[ \sum_{i=1}^n Q_{iv} \right]} \quad (15)$$

Where:

all terms are as defined in Step (a) for  $Q_{tb}$ , except:

$Q_{\text{skin}}$  = maximum release rate allowed to give a limiting skin dose of 3000 mrem/yr in  $\mu\text{Ci}/\text{sec}$

$L_i$  = skin dose factor due to beta emissions for each identified radionuclide (i) in units of mrem/yr per  $\mu\text{Ci}/\text{m}^3$  (Attachment 4)

1.1 = conversion factor to convert from air to skin dose

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$M_i$  = air dose factor due to gamma emissions for identified noble gas isotope (i) in units of mrad/yr per  $\mu\text{Ci}/\text{m}^3$  (Attachment 4)

- c. The monitor setpoint is **CALCULATED** in the following manner:

$$\text{SN} = \frac{Q}{(F_{\max})(472)} \quad (16)$$

where:

SN = maximum monitor setpoint in  $\mu\text{Ci}/\text{cm}^3$

Q = Minimum value of  $Q_{\text{tb}}$  or  $Q_{\text{skin}}$  ( $\mu\text{Ci}/\text{sec}$ )

$F_{\max}$  = maximum effluent flow rate (cfm)

472 = Unit conversion, CFM to  $\text{cm}^3/\text{sec}$

5. Dose Projection due to Gaseous Effluents

- a. At least once every 31 days the gamma air dose, beta air dose, **AND** the maximum organ dose for the month-to-quarter will be **DIVIDED** by the number of days into the quarter **AND MULTIPLIED** by 31.



**Offsite Dose Calculation Manual****5.5 40 CFR190 DOSE EVALUATION**

For the evaluation of doses to real individuals from liquid releases, the same calculational methods as employed in Section 5.3.d will be **USED**. However, more encompassing **AND** realistic assumptions will be **MADE** concerning the dilution **AND** ingestion of radionuclides by individuals who **LIVE AND FISH** in the Waterford 3 area.

The results of the Radiological Environmental Monitoring Program will be **USED** in **DETERMINING** the realistic dose based on actual measured radionuclide concentrations. For the evaluation of doses to real individuals from gaseous releases, the same calculational methods as employed in Sections 5.4.2 and 5.4.3 will be **USED**. The total body dose factor should be **SUBSTITUTED** for the gamma air dose factor ( $M_i$ ) to **DETERMINE** the total body dose. Otherwise, the same calculational sequence applies. More realistic assumptions will be **MADE** concerning the actual location of real individuals, the meteorological conditions, **AND** the consumption of food. Data **OBTAINED** from the latest land use census should be **USED** to **DETERMINE** locations for evaluating doses. The results of the Radiological Environmental Monitoring Program will be **INCLUDED** in **DETERMINING** more realistic doses based on actual measured radionuclide concentrations.

Cumulative dose contributions from direct radiation, from the reactor unit, from Independent Spent Fuel Storage Installation (ISFSI) operations, **AND** from Radwaste Storage Tanks shall be **DETERMINED** utilizing the results of routine plant perimeter surveys, TLD data, **OR** a combination of both when necessary.

**5.6 LIQUID AND GASEOUS RADWASTE PROCESSES**

The block flow diagrams of the radwaste systems are shown in Attachments 11 **AND** 12. In order to obtain a more detailed description, **SEE** the appropriate sections of the Final Safety Analysis Report (FSAR).

**Offsite Dose Calculation Manual****5.7 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REQUIREMENTS**

1. The Radiological Environmental Monitoring Program (REMP) is expounded on in Attachment 13, **AND** the Sample Location Table, Attachment 14. Attachment 15 explains the sector **AND** zone designations for the sample locations. Attachments 16, 17, **AND** 18 **SHOW** the sample locations within the 2, 10, **AND** 50- mile radius of Waterford 3.

Deviations are **PERMITTED** from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment, **AND** other legitimate reasons. **IF** specimens are unobtainable due to sampling equipment malfunction, **THEN** every effort shall be made to **COMPLETE** corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be **DOCUMENTED** in the Annual Radiological Environmental Operating Report. It is recognized, at times, it may not be possible **OR** practical to continue to obtain samples of the media of choice at the most desired location **OR** time. In these instances, suitable alternative media **AND** locations may be **CHOSEN** for the particular pathway in question **AND** appropriate substitutions **MADE** within 30 days in the Radiological Environmental Monitoring Programs.

2. Description of the Interlaboratory Comparison Program

Quality assurance in radiological environmental sampling will be **MAINTAINED** through participation in a selected Radiological Laboratory Quality Assurance Program. The summary of results will be **PRESENTED** in tabular form **AND** will **INCLUDE** the type of analysis, the preparation (collection) date, the date the results are returned, the mean of the analyses (usually triplicate), the standard deviation, the date the values are released for information, the known value, the three standard deviation limit, **AND** a two standard deviation/three standard deviation warning/action flag. **IF** the sample analysis indicates results outside the three standard deviation range, **THEN** the corrective actions taken to prevent a recurrence will be **DOCUMENTED AND SUBMITTED** along with all results when the Annual Radiological Environmental Operating Report is **SUBMITTED**.

3. Dispersion Parameters For Critical Locations

The dispersion parameters for the site boundary **AND** where necessary, as identified by the Land Use Census, are listed in Attachment 2. This table will be subject to changes based on the Land Use Census **AND** historical data.

**Offsite Dose Calculation Manual****5.8 ROUTINE EFFLUENT RELEASE REPORTS**

## 1. Annual Radioactive Effluent Release Report

A routine Radioactive Effluent Release Report covering the operation of the unit during the previous twelve months shall be **SUBMITTED** as specified in Waterford 3 SES, Technical Specification 6.9.1.8 prior to May 1 of each year. The radioactive effluent release report shall **INCLUDE**:

- a. A summary of the quantities of radioactive liquid, gaseous effluents **AND** solid waste released from the units as outlined in Regulatory Guide 1.21, with data summarized on a quarterly basis following the format of Appendix B thereof
- b. An annual summary of hourly meteorological data collected over the previous year; this annual summary may be either in the form of an hour-by-hour listing of wind speed, wind direction, atmospheric stability, **AND** precipitation (if measured) on magnetic tape, **OR** in the form of joint frequency distributions of wind speed, wind direction, **AND** atmospheric stability.

In lieu of submission with the Radioactive Effluent Release Report, the summary of required meteorological data may be **FILED** on site **AND** shall be **PROVIDED** to the NRC upon request. This same report shall **INCLUDE** an **ASSESSMENT** of the radiation doses due to the radioactive liquid **AND** gaseous effluents released from the unit or station during the previous calendar year. This same report shall also **INCLUDE** an assessment of the radiation doses from radioactive liquid **AND** gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY (Attachment 1) during the reporting period. All assumptions **USED** in making these assessments (i.e., specific activity, exposure time **AND** location) shall be **INCLUDED** in these reports. The meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents, as determined by sampling frequency **AND** measurement, shall be **USED** for determining the gaseous pathway doses. The assessment of radiation doses shall be **PERFORMED** in accordance with the methodology **AND** parameters in this manual.

- c. An assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases **AND** other nearby uranium fuel cycle sources, including doses from primary effluent pathways **AND** direct radiation, for the previous calendar year to show conformance with 40 CFR 190, "Environmental Radiation Standards for Nuclear Power Operation" **AND** 10 CFR 72.104, "Criteria for Radioactive Materials in Effluents and Direct Radiation from an Independent Spent Fuel Storage Installation (ISFSI) **OR** Monitored Retrievable Storage (MRS)". Acceptable methods for calculating the dose contribution from liquid **AND** gaseous effluents are given in Regulatory Guide 1.109, Rev. 1, and NUREG-0133.

**Offsite Dose Calculation Manual**

- d. The following information for each class of solid waste (as defined by 10 CFR 61) shipped off site during the report period:
- 1) Total curie quantity (specify whether determined by measurement **OR** estimate)
  - 2) Principal radionuclides (specify whether determined by measurement **OR** estimate)
  - 3) Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms)
- e. A list **AND** description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous **AND** liquid effluents made during the reporting period
- f. Any changes to the Process Control Program (PCP) **OR** the Offsite Dose Calculation Manual (ODCM), pursuant to Technical Specification 6.13 **AND** 6.14, as well as a listing of new locations for dose calculations **AND/OR** environmental monitoring identified by the land use census; it shall also **INCLUDE** information of any MAJOR CHANGES to Radioactive Waste Systems if the information is not submitted as part of the annual Final Safety Analysis Report (FSAR) update. Any changes made to the sections of the Waterford 3 Technical Requirements Manual (TRM) listed on Attachment 23 shall be **INCLUDED** as part of submittal of the changes made to the ODCM.
- 1) The submittal providing information on ODCM changes shall **CONTAIN**:
    - a) Sufficiently detailed information to totally support the rationale for the change without benefit of additional or supplemental information; information **SUBMITTED** should consist of a complete legible copy of the ODCM including the sections of the TRM listed on Attachment 23 together with appropriate analyses **OR** evaluations justifying the change(s), if applicable.
    - b) A determination that the change did not reduce the accuracy **OR** reliability of dose calculations **OR** setpoint determinations
    - c) Documentation of the fact that the change has been reviewed **AND** found acceptable by the Onsite Safety Review Committee (OSRC)
  - 2) The submittal providing information on PCP changes shall **CONTAIN**:
    - a) Information submitted should **CONSIST** of a complete legible copy of the PCP, together with appropriate analyses **OR** evaluations, justifying the changes(s), if applicable.
    - b) Documentation of the fact that the change has been **REVIEWED AND FOUND** acceptable by the OSRC

**Offsite Dose Calculation Manual****NOTE**

Radioactive Waste System change information may be submitted as part of the annual FSAR update in lieu of the Annual Radioactive Effluent Release Report.

- 3) The submittal providing information on licensee initiated MAJOR CHANGES to the radioactive waste systems (liquid, gaseous, **AND** solid) shall **CONTAIN**:
  - a) A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR 50.59
  - b) Detailed information to totally support the reason for the change without benefit of additional **OR** supplemental information
  - c) A detailed description of the equipment, components **AND** processes involved **AND** the interfaces with other plant systems
  - d) An evaluation of the change which shows the predicted releases of radioactive materials in liquid **AND** gaseous effluents **AND/OR** quantity of solid waste that differ from those previously predicted in the license application **AND** amendments thereto
  - e) An evaluation of the change which shows the expected maximum exposures a member of the Public in the unrestricted area **AND** to the general population that differ from those previously estimated in the license application **AND** amendments thereto
  - f) A comparison of the predicted releases of radioactive materials, in liquid **AND** gaseous effluents **AND** in solid waste, to the actual releases for the period before the changes are to be made
  - g) An estimate of the exposure to plant operating personnel as a result of the change
  - h) Documentation of the fact that the change was reviewed **AND** found acceptable by the OSRC
  - i) Changes to Radioactive Waste Systems performed using the plant design change process will be reported as per design change procedures.

**Offsite Dose Calculation Manual**

- g. If applicable, a description of events which led to exceeding the following limiting condition for operation.
- 1) The dose rate due to radioactive materials released in gaseous effluents from the site to areas at **AND** beyond the SITE BOUNDARY shall be limited to TRM Specification 3/4.11.2.1.
  - 2) The quantity of radioactive material contained in each unprotected tank shall be limited to Technical Specification 3/4.11.1.4.
- h. If applicable, identify the cause of the unavailability of milk **OR** fresh leafy vegetable samples at locations required by TRM Specification Table 3.12-1. The new location(s) for obtaining replacement samples shall be **IDENTIFIED. REVISED** figure(s) **AND** table for the ODCM reflecting the new locations shall be **INCLUDED** in the report.
- i. **IDENTIFY** the new location(s) if a land use census identifies an environmental sampling location that yields a calculated dose **OR** dose commitment greater than the values currently being calculated pursuant to TRM Specification 3/4.11.2.3.
- j. **IDENTIFY** the new location(s), **AND INCLUDE** a **REVISED** figure(s) **AND** table for the ODCM reflecting the new location(s) if a land use census identifies an environmental sampling location(s) that yields a calculated dose **OR** dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained pursuant to TRM Specification 3/4.12.1.
- k. With less than the minimum number of radioactive liquid **OR** gaseous effluent monitoring instrumentation channels operable for 30 days **OR** longer, as required by TRM Specification Table 3.3-12 or 3.3-13, **EXPLAIN** in the next Annual Radioactive Effluent Release Report, pursuant to Technical Specification 6.9.1.8, why this inoperability was not corrected within the time specified.
- l. **IDENTIFY** any missing **OR** late analysis results for radioactive effluent samples **COLLECTED** during the reporting period.
- m. **IF** there are any late or missing effluent samples, **THEN:**
- 1) **NOTIFY** Shift Manager.
  - 2) **WRITE** a Condition Report.

**Offsite Dose Calculation Manual**

2. Annual Radioactive Effluent Release Report for Dry Fuel Storage pursuant to 10CRF72.44(d)(e)
  - a. The following shall be **SUBMITTED** in accordance with the Waterford 3 Certificate of Compliance Technical Specification 5.4 within 60 days after the end of the 12-month monitoring period:
    - 1) An annual Radioactive Effluent Release Report specifying the quantity of each of the principal radionuclides released to the environment in liquid **AND** in gaseous effluents during the previous 12 months of operation
    - 2) Other information as may be required by the Commission to estimate maximum potential radiation dose commitment to the public resulting from effluent releases during the previous twelve months

**Offsite Dose Calculation Manual****5.9 SPECIAL EFFLUENT REPORTS**

1. The Shift Manager shall be immediately **NOTIFIED AND** a Condition Report promptly **INITIATED** whenever any of the following specifications have been **EXCEEDED**. A Special Report shall be **PREPARED** for submittal to the NRC within 30-day period, as per the ACTION requirement of the specification that has been **EXCEEDED**.
  - Technical Requirements Manual (TRM) Radioactive Liquid Effluent Dose Specification 3/4.11.1.2
  - TRM Radioactive Liquid Waste Treatment System Specification 3/4.11.1.3
  - TRM Radioactive Gaseous Effluent Dose, Noble Gas Specification 3/4.11.2.2
  - TRM Radioactive Gaseous Effluent Dose, Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form Specification 3/4.11.2.3
  - TRM Radioactive Gaseous Waste Treatment System Specification 3/4.11.2.4
  - TRM Radioactive Effluent Total Dose Specification 3/4.11.4
2. Environmental Protection Agency Reportable Quantities

If any of TRM Specifications 3/4.11.1.1, 3/4.11.1.2, 3/4.11.2.1, 3/4.11.2.2, 3/4.11.2.3 have been **EXCEEDED**, an evaluation of the Radioactivity released verses EPA Reportable Quantities (RQ's) shall be **PERFORMED** as soon as practical.

The Shift Manager shall be immediately **NOTIFIED AND** a Condition Report promptly **INITIATED** whenever any radionuclide released over a 24-hour period is greater than **OR** equal to the Environmental Protection Agency Reportable Quantity (EPA RQ). Notification requirements shall be **PERFORMED** as per UNT-006-010, Event Notification and Reporting. Recipients of notification are: The National Response Center, the State Emergency Response Commission, **AND** the Local Emergency Planning Committee. Methods for determination of reportability **AND** the Reportable Quantities values for radionuclides are contained within 40 CFR 302.

3. Unplanned/Abnormal Effluent Releases
  - a. A Condition Report should be **INITIATED**, in accordance with EN-LI-102, for an UNPLANNED/ABNORMAL RELEASE to ensure that reporting requirements are **DETERMINED**. The Condition Report shall also serve to **DOCUMENT** causes **AND** corrective actions. Major liquid spills **OR** gaseous releases can occur through improper valve line-up, pipe breakage, **OR** leakage. Each incident should be **TREATED** on a case-by-case basis.

The Condition Report shall **INCLUDE**:

- a description of the event **AND** equipment **INVOLVED**



**Offsite Dose Calculation Manual**

- cause(s) for the release
- consequences of the release (if known **OR** available)
- actions taken to prevent recurrence

It is recognized all elements that are to be **INCLUDED** in the Condition Report (listed above) may not be known when the Condition Report is **INITIATED**. These items should be **INCLUDED** while using the normal Condition Reporting process.

All Condition Reports for UNPLANNED/ABNORMAL RELEASES shall be **REVIEWED** by:

OnSite Safety Review Committee (OSRC)

Safety Review Committee (SRC)

The Vice President - Operations

The OSRC shall **REVIEW** evaluations, recommendations, **AND** the disposition of corrective action(s) to prevent recurrence as documented in the Condition Report. These reports will be **FORWARDED** to the Safety Review Committee **AND** the Vice President - Operations for additional **REVIEW**.

- b. **PREPARE** an effluent assessment report for each occurrence of an UNPLANNED/ABNORMAL RELEASE of radioactive materials. The purpose of this report is to **DOCUMENT** offsite impacts due to radioactive effluent releases. This report should **INCLUDE** a description of the event, remedial actions, results of sampling **AND** analysis (if applicable). The assessment should **INCLUDE** evaluations of the following:

- concentrations of radioactive materials in unrestricted areas
- doses to the most likely exposed member of the public
- any environmental impacts due to radioactivity in the environment

All assumptions **AND** calculations used should be **DESCRIBED AND PROVIDED** when necessary to support the conclusions. Doses should be **CALCULATED** in accordance with the methods **AND** parameters contained within the ODCM. Each occurrence of an UNPLANNED/ABNORMAL RELEASE should also be **INCLUDED** in the Annual Effluent Release Report covering the period for which the event occurred as per Step 5.8.1.e.

Each effluent assessment report shall be **REVIEWED** by:

- OSRC
- SRC
- The Vice President - Operations

**Offsite Dose Calculation Manual****5.10 SECONDARY RELEASE PATHS**

1. This section **ADDRESSES** potential release pathways which **SHOULD NOT** contribute more than 10% of the annual doses evaluated in this manual. The Offsite Dose Calculation Manual (ODCM) methodology for calculation of doses will be **APPLIED** to an applicable release path if a likely potential arises for contributing more than 10% of the annual doses evaluated in this manual.
2. Secondary Release Paths are **EXPECTED** to release trivial quantities of radionuclides. Some examples of Secondary Release Paths are listed below:
  - Unmonitored Secondary System Steam Vents/Reliefs
  - Decon Shop/Hot Machine Shop Exhaust
  - Turbine Building Ventilation Exhaust
  - Unmonitored Tank Atmospheric Vents
  - Radioactive Waste Compactor Building
  - Radioactive Waste Solidification Building
  - Cooling Tower Atmospheric Entrainment

**6.0 RECORDS**

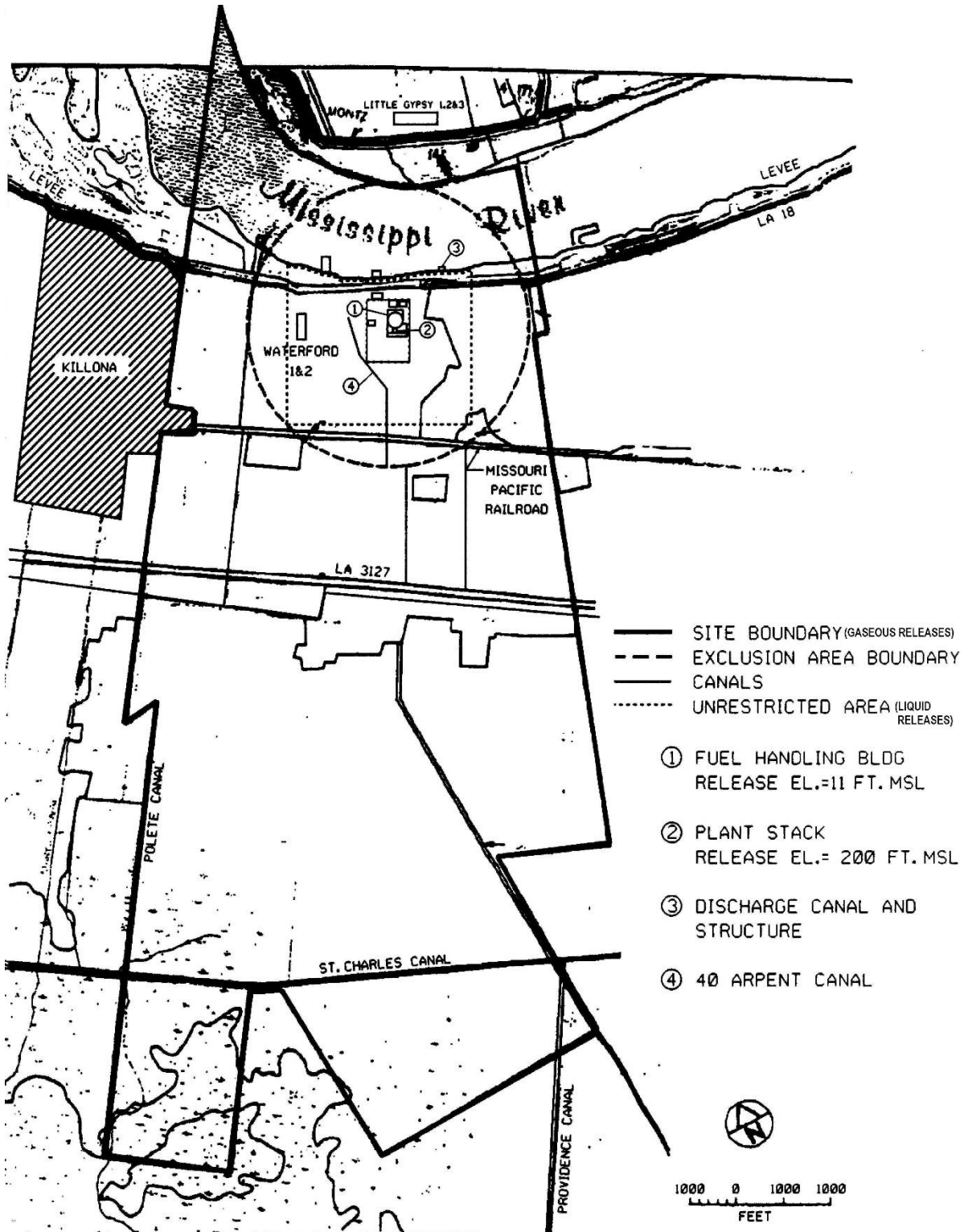
1. There are no records generated by this procedure.

Offsite Dose Calculation Manual

Attachment 1

Page 1 of 1

Boundaries for Radioactive Gaseous and Liquid Effluents



Offsite Dose Calculation Manual

Attachment 2

Historical Average Dispersion and Deposition Parameters For Areas At or Beyond the Unrestricted Area Boundary

ANNUAL AVERAGE ATMOSPHERIC DISPERSION AND DEPOSITION PARAMETERS  
BASED ON HISTORICAL METEOROLOGICAL DATA AND CURRENT LAND USE CENSUS

Receptor Type or Location	Direction from Site	Sector Location	Distance		X/Q No Decay Undepleted	D/Q
			(miles)	(meters)		
Site Boundary	N <sup>a</sup>	A	0.8	1287	1.0e-05	2.4e-08
	NNE <sup>a</sup>	B	0.6	966	1.6e-05	3.4e-08
	NE <sup>a</sup>	C	0.6	966	1.5e-05	2.8e-08
	ENE <sup>a</sup>	D	0.6	966	1.6e-05	2.5e-08
	E	E	0.8	1287	6.9e-06	1.3e-08
	ESE	F	0.6	966	1.1e-05	2.3e-08
	SE	G	0.6	966	1.1e-05	3.1e-08
	SSE	H	0.8	1287	6.3e-06	2.4e-08
	S	J	1.6	2575	8.9e-07	2.7e-09
	SSW	K	3.1	4989	3.0e-07	7.9e-10
	SW	L	3.4	5472	3.3e-07	9.1e-10
	WSW	M	1.5	2414	1.7e-06	4.9e-09
	W	N	1.0	1609	2.3e-06	7.3e-09
	WNW	P	0.8	1287	7.5e-06	2.7e-08
	NW	Q	0.8	1287	1.0e-05	3.2e-08
	NNW	R	0.9	1448	9.4e-06	2.4e-08
	Residence	N	A	0.9	1448	7.8e-06
NNE		B	1.3	2092	3.0e-06	5.8e-09
NE		C	0.9	1448	6.3e-06	1.2e-08
ENE		D	0.9	1448	6.8e-06	1.1e-08
E		E	2.2	3541	7.4e-07	1.0e-09
ESE		F	3.1	4989	3.7e-07	4.8e-10
SE		G	4.0	6437	2.3e-07	3.6e-10
W		N	1.0	1609	2.3e-06	7.3e-09
WNW		P	0.9	1448	5.6e-06	2.0e-08
NW		Q	0.9	1448	7.7e-06	2.3e-08
Milk Cow	NNW <sup>b</sup>	Q	0.9	1448	7.7e-06	2.3e-08
	NW	Q	4.9	7886	2.6e-07	4.1e-10
Vegetable Garden	N	A	1.0	1609	6.1e-06	1.4e-08
	NNE	B	1.3	2092	3.0e-06	5.8e-09
	NE	C	0.9	1448	6.3e-06	1.2e-08
	ENE	D	0.9	1448	6.8e-06	1.1e-08
	E	E	2.2	3541	7.4e-07	1.0e-09
	ESE	F	2.2	3541	7.0e-07	1.1e-09
	SE	G	2.3	3701	6.2e-07	1.3e-09
	WSW	M	1.5	2414	1.7e-06	4.9e-09
	W	N	1.1	1770	1.9e-06	5.7e-09
	WNW	P	0.9	1448	5.6e-06	2.0e-08
	NW	Q	0.9	1448	7.7e-06	2.3e-08
Beef Cow	NNW	R	3.0	4828	7.7e-06	1.3e-09
	E	E	3.2	5150	3.7e-07	4.2e-10
	ESE	F	3.5	5633	3.0e-07	3.6e-10
	SE	G	4.5	7242	1.9e-07	2.8e-10
	WSW	M	1.2	1931	2.7e-06	8.6e-09
	WNW	P	0.9	1448	5.6e-06	2.0e-08
	NW	Q	0.9	1448	7.7e-06	2.3e-08

Notes: <sup>a</sup> The site boundary in this sector is located over water. The location cannot be occupied continuously for the life of the plant.

<sup>b</sup> The animals at this location do not produce milk for human consumption.

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : Circulating Water Discharge to Mississippi River  
 Dilution Factor DW = 220.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.52e-01	1.52e-01	1.52e-01	1.52e-01	1.52e-01	1.52e-01
Be-10	1.64e+01	2.54e+00	4.10e-01	0.00e+00	1.92e+00	0.00e+00	1.38e+02
C-14	3.13e+04	6.26e+03	6.26e+03	6.26e+03	6.26e+03	6.26e+03	6.26e+03
N-13	3.00e+03	3.00e+03	3.00e+03	3.00e+03	3.00e+03	3.00e+03	3.00e+03
F-18	1.52e+01	0.00e+00	1.68e+00	0.00e+00	0.00e+00	0.00e+00	4.50e-01
Na-22	4.17e+03	4.17e+03	4.17e+03	4.17e+03	4.17e+03	4.17e+03	4.17e+03
Na-24	4.08e+02	4.08e+02	4.08e+02	4.08e+02	4.08e+02	4.08e+02	4.08e+02
P-32	4.62e+07	2.87e+06	1.79e+06	0.00e+00	0.00e+00	0.00e+00	5.19e+06
Ca-41	1.78e+04	0.00e+00	1.92e+03	0.00e+00	0.00e+00	0.00e+00	1.77e+01
Sc-46	2.85e-02	5.53e-02	1.61e-02	0.00e+00	5.16e-02	0.00e+00	2.69e+02
Cr-51	0.00e+00	0.00e+00	1.27e+00	7.62e-01	2.81e-01	1.69e+00	3.21e+02
Mn-54	0.00e+00	4.38e+03	8.35e+02	0.00e+00	1.30e+03	0.00e+00	1.34e+04
Mn-56	0.00e+00	1.10e+02	1.95e+01	0.00e+00	1.40e+02	0.00e+00	3.52e+03
Fe-55	6.59e+02	4.56e+02	1.06e+02	0.00e+00	0.00e+00	2.54e+02	2.61e+02
Fe-59	1.04e+03	2.45e+03	9.38e+02	0.00e+00	0.00e+00	6.83e+02	8.15e+03
Co-57	0.00e+00	2.10e+01	3.49e+01	0.00e+00	0.00e+00	0.00e+00	5.33e+02
Co-58	0.00e+00	8.95e+01	2.01e+02	0.00e+00	0.00e+00	0.00e+00	1.81e+03
Co-60	0.00e+00	2.57e+02	5.67e+02	0.00e+00	0.00e+00	0.00e+00	4.83e+03
Ni-59	2.34e+03	8.03e+02	3.91e+02	0.00e+00	0.00e+00	0.00e+00	1.65e+02
Ni-63	3.12e+04	2.16e+03	1.05e+03	0.00e+00	0.00e+00	0.00e+00	4.51e+02
Ni-65	1.27e+02	1.64e+01	7.51e+00	0.00e+00	0.00e+00	0.00e+00	4.17e+02
Cu-64	0.00e+00	1.00e+01	4.70e+00	0.00e+00	2.52e+01	0.00e+00	8.53e+02
Zn-65	2.32e+04	7.37e+04	3.33e+04	0.00e+00	4.93e+04	0.00e+00	4.64e+04
Zn-69	4.93e+01	9.43e+01	6.56e+00	0.00e+00	6.13e+01	0.00e+00	1.42e+01
Zn-69m	8.14e+02	1.95e+03	1.79e+02	0.00e+00	1.18e+03	0.00e+00	1.19e+05
Se-79	0.00e+00	1.07e+03	1.79e+02	0.00e+00	1.85e+03	0.00e+00	2.19e+02
Br-82	0.00e+00	0.00e+00	2.27e+03	0.00e+00	0.00e+00	0.00e+00	2.61e+03
Br-83	0.00e+00	0.00e+00	4.04e+01	0.00e+00	0.00e+00	0.00e+00	5.82e+01
Br-84	0.00e+00	0.00e+00	5.24e+01	0.00e+00	0.00e+00	0.00e+00	4.11e-04
Br-85	0.00e+00	0.00e+00	2.15e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/hr per  $\mu\text{Ci/ml}$ .

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : Circulating Water Discharge to Mississippi River  
 Dilution Factor DW = 220.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.01e+05	4.71e+04	0.00e+00	0.00e+00	0.00e+00	1.99e+04
Rb-87	0.00e+00	5.89e+04	2.05e+04	0.00e+00	0.00e+00	0.00e+00	2.76e+03
Rb-88	0.00e+00	2.90e+02	1.54e+02	0.00e+00	0.00e+00	0.00e+00	4.00e-09
Rb-89	0.00e+00	1.92e+02	1.35e+02	0.00e+00	0.00e+00	0.00e+00	1.12e-11
Sr-89	2.22e+04	0.00e+00	6.38e+02	0.00e+00	0.00e+00	0.00e+00	3.57e+03
Sr-90	6.29e+05	0.00e+00	1.26e+04	0.00e+00	0.00e+00	0.00e+00	1.58e+04
Sr-91	4.09e+02	0.00e+00	1.65e+01	0.00e+00	0.00e+00	0.00e+00	1.95e+03
Sr-92	1.55e+02	0.00e+00	6.71e+00	0.00e+00	0.00e+00	0.00e+00	3.08e+03
Y-90	5.79e-01	0.00e+00	1.55e-02	0.00e+00	0.00e+00	0.00e+00	6.14e+03
Y-91	8.49e+00	0.00e+00	2.27e-01	0.00e+00	0.00e+00	0.00e+00	4.67e+03
Y-91m	5.47e-03	0.00e+00	2.12e-04	0.00e+00	0.00e+00	0.00e+00	1.61e-02
Y-92	5.09e-02	0.00e+00	1.49e-03	0.00e+00	0.00e+00	0.00e+00	8.91e+02
Y-93	1.61e-01	0.00e+00	4.46e-03	0.00e+00	0.00e+00	0.00e+00	5.12e+03
Zr-93	3.46e-01	1.94e-02	9.02e-03	0.00e+00	7.34e-02	0.00e+00	2.01e+01
Zr-95	2.52e-01	8.07e-02	5.46e-02	0.00e+00	1.27e-01	0.00e+00	2.56e+02
Zr-97	1.39e-02	2.81e-03	1.28e-03	0.00e+00	4.24e-03	0.00e+00	8.69e+02
Nb-93m	1.83e+01	5.98e+00	1.47e+00	0.00e+00	6.88e+00	0.00e+00	2.76e+03
Nb-95	4.47e+00	2.49e+00	1.34e+00	0.00e+00	2.46e+00	0.00e+00	1.51e+04
Nb-97	3.75e-02	9.49e-03	3.46e-03	0.00e+00	1.11e-02	0.00e+00	3.50e+01
Mo-93	0.00e+00	1.83e+02	4.94e+00	0.00e+00	5.18e+01	0.00e+00	2.97e+01
Mo-99	0.00e+00	1.05e+02	1.99e+01	0.00e+00	2.37e+02	0.00e+00	2.43e+02
Tc-101	9.22e-03	1.33e-02	1.30e-01	0.00e+00	2.39e-01	6.79e-03	3.99e-14
Tc-99	4.54e+00	6.75e+00	1.82e+00	0.00e+00	8.49e+01	5.73e-01	2.21e+02
Tc-99m	8.96e-03	2.53e-02	3.23e-01	0.00e+00	3.85e-01	1.24e-02	1.50e+01
Ru-103	4.50e+00	0.00e+00	1.94e+00	0.00e+00	1.72e+01	0.00e+00	5.25e+02
Ru-105	3.75e-01	0.00e+00	1.48e-01	0.00e+00	4.84e+00	0.00e+00	2.29e+02
Ru-106	6.69e+01	0.00e+00	8.46e+00	0.00e+00	1.29e+02	0.00e+00	4.33e+03
Rh-105	2.94e+00	2.15e+00	1.42e+00	0.00e+00	9.14e+00	0.00e+00	3.43e+02
Pd-107	0.00e+00	3.57e+00	2.29e-01	0.00e+00	3.21e+01	0.00e+00	2.22e+01
Pd-109	0.00e+00	4.30e+00	9.70e-01	0.00e+00	2.46e+01	0.00e+00	4.77e+02

Conversion factors are in units of mrem/hr per µCi/ml.

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : Circulating Water Discharge to Mississippi River  
 Dilution Factor DW = 220.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	9.42e-01	8.71e-01	5.17e-01	0.00e+00	1.71e+00	0.00e+00	3.55e+02
Ag-111	3.42e-01	1.43e-01	7.12e-02	0.00e+00	4.61e-01	0.00e+00	2.62e+02
Cd-113m	0.00e+00	1.52e+03	4.89e+01	0.00e+00	1.68e+03	0.00e+00	1.23e+04
Cd-115m	0.00e+00	8.82e+02	2.81e+01	0.00e+00	7.00e+02	0.00e+00	3.71e+04
Sn-123	2.23e+05	3.70e+03	5.45e+03	3.15e+03	0.00e+00	0.00e+00	4.55e+05
Sn-125	5.98e+04	1.21e+03	2.71e+03	9.98e+02	0.00e+00	0.00e+00	7.47e+05
Sn-126	6.07e+05	1.20e+04	1.72e+04	3.53e+03	0.00e+00	0.00e+00	1.75e+05
Sb-124	7.76e+00	1.47e-01	3.08e+00	1.88e-02	0.00e+00	6.04e+00	2.20e+02
Sb-125	4.96e+00	5.54e-02	1.18e+00	5.05e-03	0.00e+00	3.83e+00	5.46e+01
Sb-126	3.19e+00	6.49e-02	1.15e+00	1.95e-02	0.00e+00	1.95e+00	2.61e+02
Sb-127	7.15e-01	1.57e-02	2.74e-01	8.59e-03	0.00e+00	4.24e-01	1.64e+02
Te-125m	2.57e+03	9.30e+02	3.44e+02	7.72e+02	1.04e+04	0.00e+00	1.03e+04
Te-127	1.05e+02	3.78e+01	2.28e+01	7.81e+01	4.29e+02	0.00e+00	8.32e+03
Te-127m	6.49e+03	2.32e+03	7.90e+02	1.66e+03	2.63e+04	0.00e+00	2.17e+04
Te-129	3.01e+01	1.13e+01	7.33e+00	2.31e+01	1.26e+02	0.00e+00	2.27e+01
Te-129m	1.10e+04	4.11e+03	1.74e+03	3.78e+03	4.60e+04	0.00e+00	5.55e+04
Te-131	1.89e+01	7.88e+00	5.96e+00	1.55e+01	8.27e+01	0.00e+00	2.67e+00
Te-131m	1.66e+03	8.10e+02	6.75e+02	1.28e+03	8.21e+03	0.00e+00	8.05e+04
Te-132	2.41e+03	1.56e+03	1.47e+03	1.72e+03	1.50e+04	0.00e+00	7.39e+04
Te-133m	4.43e+01	2.59e+01	2.49e+01	3.75e+01	2.56e+02	0.00e+00	8.87e+00
Te-134	3.10e+01	2.03e+01	1.25e+01	2.71e+01	1.96e+02	0.00e+00	3.44e-02
I-129	1.19e+02	1.02e+02	3.34e+02	2.62e+05	2.19e+02	0.00e+00	1.61e+01
I-130	2.74e+01	8.09e+01	3.19e+01	6.86e+03	1.26e+02	0.00e+00	6.97e+01
I-131	1.51e+02	2.16e+02	1.24e+02	7.08e+04	3.70e+02	0.00e+00	5.70e+01
I-132	7.37e+00	1.97e+01	6.89e+00	6.89e+02	3.14e+01	0.00e+00	3.70e+00
I-133	5.15e+01	8.96e+01	2.73e+01	1.32e+04	1.56e+02	0.00e+00	8.06e+01
I-134	3.85e+00	1.05e+01	3.74e+00	1.81e+02	1.66e+01	0.00e+00	9.11e-03
I-135	1.61e+01	4.21e+01	1.55e+01	2.78e+03	6.75e+01	0.00e+00	4.75e+01
Cs-134	2.98e+05	7.09e+05	5.79e+05	0.00e+00	2.29e+05	7.61e+04	1.24e+04
Cs-134m	1.02e+02	2.15e+02	1.10e+02	0.00e+00	1.16e+02	1.83e+01	7.57e+01

Conversion factors are in units of mrem/hr per µCi/ml.

## Offsite Dose Calculation Manual

## Attachment 3

## Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : Circulating Water Discharge to Mississippi River  
 Dilution Factor DW = 220.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	9.34e+04	8.62e+04	3.83e+04	0.00e+00	3.26e+04	9.77e+03	2.02e+03
Cs-136	3.12e+04	1.23e+05	8.86e+04	0.00e+00	6.85e+04	9.39e+03	1.40e+04
Cs-137	3.82e+05	5.22e+05	3.42e+05	0.00e+00	1.77e+05	5.89e+04	1.01e+04
Cs-138	2.64e+02	5.22e+02	2.59e+02	0.00e+00	3.84e+02	3.79e+01	2.23e-03
Cs-139	1.63e+02	2.43e+02	8.86e+01	0.00e+00	1.95e+02	1.77e+01	5.27e-21
Ba-139	9.66e-01	6.88e-04	2.83e-02	0.00e+00	6.43e-04	3.90e-04	1.71e+00
Ba-140	2.02e+02	2.54e-01	1.32e+01	0.00e+00	8.63e-02	1.45e-01	4.16e+02
Ba-141	4.69e-01	3.54e-04	1.58e-02	0.00e+00	3.29e-04	2.01e-04	2.21e-10
Ba-142	2.12e-01	2.18e-04	1.33e-02	0.00e+00	1.84e-04	1.23e-04	2.99e-19
La-140	1.51e-01	7.59e-02	2.01e-02	0.00e+00	0.00e+00	0.00e+00	5.57e+03
La-141	1.92e-02	5.96e-03	9.76e-04	0.00e+00	0.00e+00	0.00e+00	7.11e+02
La-142	7.71e-03	3.51e-03	8.73e-04	0.00e+00	0.00e+00	0.00e+00	2.56e+01
Ce-141	2.59e-02	1.75e-02	1.99e-03	0.00e+00	8.15e-03	0.00e+00	6.71e+01
Ce-143	4.57e-03	3.38e+00	3.74e-04	0.00e+00	1.49e-03	0.00e+00	1.26e+02
Ce-144	1.35e+00	5.66e-01	7.26e-02	0.00e+00	3.35e-01	0.00e+00	4.57e+02
Pr-143	5.54e-01	2.22e-01	2.75e-02	0.00e+00	1.28e-01	0.00e+00	2.43e+03
Pr-144	1.81e-03	7.53e-04	9.21e-05	0.00e+00	4.25e-04	0.00e+00	2.61e-10
Nd-147	3.79e-01	4.38e-01	2.62e-02	0.00e+00	2.56e-01	0.00e+00	2.10e+03
Pm-147	4.54e+00	4.27e-01	1.73e-01	0.00e+00	8.07e-01	0.00e+00	5.38e+02
Pm-148	4.32e-01	7.17e-02	3.61e-02	0.00e+00	1.36e-01	0.00e+00	5.63e+03
Pm-148m	1.85e+00	4.79e-01	3.66e-01	0.00e+00	7.23e-01	0.00e+00	4.06e+03
Pm-149	9.15e-02	1.29e-02	5.29e-03	0.00e+00	2.45e-02	0.00e+00	2.43e+03
Pm-151	4.20e-02	7.05e-03	3.56e-03	0.00e+00	1.26e-02	0.00e+00	1.94e+03
Sm-151	4.16e+00	7.17e-01	1.72e-01	0.00e+00	8.01e-01	0.00e+00	3.16e+02
Sm-153	5.16e-02	4.31e-02	3.14e-03	0.00e+00	1.39e-02	0.00e+00	1.54e+03
Eu-152	1.17e+01	2.67e+00	2.35e+00	0.00e+00	1.66e+01	0.00e+00	1.54e+03
Eu-154	3.70e+01	4.55e+00	3.24e+00	0.00e+00	2.18e+01	0.00e+00	3.30e+03
Eu-155	5.18e+00	7.35e-01	4.74e-01	0.00e+00	3.39e+00	0.00e+00	5.78e+02
Eu-156	8.25e-01	6.38e-01	1.03e-01	0.00e+00	4.26e-01	0.00e+00	4.37e+03
Tb-160	2.83e+00	0.00e+00	3.53e-01	0.00e+00	1.17e+00	0.00e+00	2.61e+03

Conversion factors are in units of mrem/hr per  $\mu\text{Ci/ml}$ .



Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : Circulating Water Discharge to Mississippi River  
 Dilution Factor DW = 220.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.63e+01	5.08e+00	3.85e+00	0.00e+00	7.59e+00	0.00e+00	1.54e+03
W-181	2.85e+01	9.28e+00	9.94e-01	0.00e+00	0.00e+00	0.00e+00	1.06e+03
W-185	1.16e+03	3.88e+02	4.08e+01	0.00e+00	0.00e+00	0.00e+00	4.48e+04
W-187	2.96e+02	2.47e+02	8.65e+01	0.00e+00	0.00e+00	0.00e+00	8.10e+04
Pb-210	3.67e+06	1.05e+06	1.30e+05	0.00e+00	2.95e+06	0.00e+00	5.37e+02
Bi-210	1.67e+01	1.15e+02	9.58e+00	0.00e+00	1.39e+03	0.00e+00	1.72e+03
Po-210	4.26e+05	9.05e+05	1.03e+05	0.00e+00	3.02e+06	0.00e+00	7.62e+04
Ra-223	5.97e+05	9.19e+02	1.19e+05	0.00e+00	2.61e+04	0.00e+00	3.85e+04
Ra-224	1.93e+05	4.68e+02	3.88e+04	0.00e+00	1.32e+04	0.00e+00	4.08e+04
Ra-225	7.88e+05	9.34e+02	1.57e+05	0.00e+00	2.65e+04	0.00e+00	3.67e+04
Ra-226	3.63e+07	6.89e+02	2.64e+07	0.00e+00	1.96e+04	0.00e+00	3.99e+04
Ra-228	1.34e+07	3.75e+02	1.45e+07	0.00e+00	1.06e+04	0.00e+00	6.77e+03
Ac-225	2.65e+02	3.65e+02	1.78e+01	0.00e+00	4.16e+01	0.00e+00	2.45e+04
Ac-227	1.13e+05	1.49e+04	6.69e+03	0.00e+00	4.82e+03	0.00e+00	4.93e+03
Th-227	9.89e+02	1.79e+01	2.85e+01	0.00e+00	1.02e+02	0.00e+00	3.90e+04
Th-228	3.58e+04	6.06e+02	1.21e+03	0.00e+00	3.37e+03	0.00e+00	4.06e+04
Th-229	9.82e+05	2.81e+04	1.62e+04	0.00e+00	1.36e+05	0.00e+00	5.64e+03
Th-230	1.49e+05	8.45e+03	4.12e+03	0.00e+00	4.08e+04	0.00e+00	4.35e+03
Th-232	1.66e+05	7.22e+03	1.08e+02	0.00e+00	3.48e+04	0.00e+00	3.70e+03
Th-234	5.78e+00	3.40e-01	1.67e-01	0.00e+00	1.93e+00	0.00e+00	8.16e+03
Pa-231	1.10e+05	4.11e+03	4.25e+03	0.00e+00	2.31e+04	0.00e+00	1.92e+03
Pa-233	1.41e-01	2.83e-02	2.44e-02	0.00e+00	1.07e-01	0.00e+00	4.38e+02
U-232	2.13e+04	0.00e+00	1.52e+03	0.00e+00	2.31e+03	0.00e+00	3.50e+02
U-233	4.50e+03	0.00e+00	2.73e+02	0.00e+00	1.05e+03	0.00e+00	3.24e+02
U-234	4.32e+03	0.00e+00	2.67e+02	0.00e+00	1.03e+03	0.00e+00	3.17e+02
U-235	4.14e+03	0.00e+00	2.51e+02	0.00e+00	9.66e+02	0.00e+00	4.03e+02
U-236	4.14e+03	0.00e+00	2.56e+02	0.00e+00	9.87e+02	0.00e+00	2.98e+02
U-237	2.85e-01	0.00e+00	7.59e-02	0.00e+00	1.17e+00	0.00e+00	1.00e+02
U-238	3.96e+03	0.00e+00	2.35e+02	0.00e+00	9.04e+02	0.00e+00	2.84e+02
Np-237	3.06e+04	2.18e+03	1.35e+03	0.00e+00	1.00e+04	0.00e+00	1.93e+03

Conversion factors are in units of mrem/hr per µCi/ml.

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : Circulating Water Discharge to Mississippi River  
 Dilution Factor DW = 220.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.33e-01	8.97e-03	5.18e-03	0.00e+00	3.04e-02	0.00e+00	8.34e+02
Np-239	2.89e-02	2.85e-03	1.57e-03	0.00e+00	8.88e-03	0.00e+00	5.84e+02
Pu-238	5.52e+03	6.99e+02	1.50e+02	0.00e+00	6.41e+02	0.00e+00	6.39e+02
Pu-239	6.35e+03	7.63e+02	1.67e+02	0.00e+00	7.10e+02	0.00e+00	5.83e+02
Pu-240	6.34e+03	7.62e+02	1.67e+02	0.00e+00	7.09e+02	0.00e+00	5.94e+02
Pu-241	1.37e+02	6.52e+00	2.91e+00	0.00e+00	1.34e+01	0.00e+00	1.23e+01
Pu-242	5.88e+03	7.35e+02	1.61e+02	0.00e+00	6.84e+02	0.00e+00	5.72e+02
Pu-244	6.87e+03	8.42e+02	1.85e+02	0.00e+00	7.84e+02	0.00e+00	8.52e+02
Am-241	4.55e+04	4.25e+04	3.26e+03	0.00e+00	2.45e+04	0.00e+00	4.47e+03
Am-242m	4.58e+04	3.99e+04	3.27e+03	0.00e+00	2.44e+04	0.00e+00	5.63e+03
Am-243	4.54e+04	4.16e+04	3.19e+03	0.00e+00	2.40e+04	0.00e+00	5.24e+03
Cm-242	1.24e+03	1.32e+03	8.25e+01	0.00e+00	3.75e+02	0.00e+00	4.77e+03
Cm-243	3.61e+04	3.31e+04	2.26e+03	0.00e+00	1.05e+04	0.00e+00	4.70e+03
Cm-244	2.75e+04	2.57e+04	1.73e+03	0.00e+00	8.07e+03	0.00e+00	4.55e+03
Cm-245	5.65e+04	4.92e+04	3.47e+03	0.00e+00	1.62e+04	0.00e+00	4.24e+03
Cm-246	5.60e+04	4.91e+04	3.46e+03	0.00e+00	1.61e+04	0.00e+00	4.16e+03
Cm-247	5.46e+04	4.84e+04	3.41e+03	0.00e+00	1.59e+04	0.00e+00	5.47e+03
Cm-248	4.54e+05	3.99e+05	2.81e+04	0.00e+00	1.31e+05	0.00e+00	8.85e+04
Cf-252	1.57e+04	0.00e+00	3.79e+02	0.00e+00	0.00e+00	0.00e+00	1.73e+04

Conversion factors are in units of mrem/hr per  $\mu\text{Ci/ml}$ .

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : 40 Arpent Canal  
 Dilution Factor DW = 1.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.29e-01	1.29e-01	1.29e-01	1.29e-01	1.29e-01	1.29e-01
Be-10	1.52e+01	2.35e+00	3.80e-01	0.00e+00	1.78e+00	0.00e+00	1.28e+02
C-14	3.13e+04	6.26e+03	6.26e+03	6.26e+03	6.26e+03	6.26e+03	6.26e+03
N-13	3.00e+03	3.00e+03	3.00e+03	3.00e+03	3.00e+03	3.00e+03	3.00e+03
F-18	1.49e+01	0.00e+00	1.66e+00	0.00e+00	0.00e+00	0.00e+00	4.43e-01
Na-22	4.17e+03	4.17e+03	4.17e+03	4.17e+03	4.17e+03	4.17e+03	4.17e+03
Na-24	4.07e+02	4.07e+02	4.07e+02	4.07e+02	4.07e+02	4.07e+02	4.07e+02
P-32	4.62e+07	2.87e+06	1.79e+06	0.00e+00	0.00e+00	0.00e+00	5.19e+06
Ca-41	1.77e+04	0.00e+00	1.92e+03	0.00e+00	0.00e+00	0.00e+00	1.76e+01
Sc-46	2.64e-02	5.12e-02	1.49e-02	0.00e+00	4.78e-02	0.00e+00	2.49e+02
Cr-51	0.00e+00	0.00e+00	1.27e+00	7.61e-01	2.81e-01	1.69e+00	3.20e+02
Mn-54	0.00e+00	4.38e+03	8.35e+02	0.00e+00	1.30e+03	0.00e+00	1.34e+04
Mn-56	0.00e+00	1.10e+02	1.95e+01	0.00e+00	1.40e+02	0.00e+00	3.51e+03
Fe-55	6.58e+02	4.55e+02	1.06e+02	0.00e+00	0.00e+00	2.54e+02	2.61e+02
Fe-59	1.04e+03	2.44e+03	9.36e+02	0.00e+00	0.00e+00	6.82e+02	8.14e+03
Co-57	0.00e+00	2.09e+01	3.48e+01	0.00e+00	0.00e+00	0.00e+00	5.31e+02
Co-58	0.00e+00	8.92e+01	2.00e+02	0.00e+00	0.00e+00	0.00e+00	1.81e+03
Co-60	0.00e+00	2.56e+02	5.65e+02	0.00e+00	0.00e+00	0.00e+00	4.81e+03
Ni-59	2.34e+03	8.02e+02	3.90e+02	0.00e+00	0.00e+00	0.00e+00	1.65e+02
Ni-63	3.11e+04	2.16e+03	1.04e+03	0.00e+00	0.00e+00	0.00e+00	4.50e+02
Ni-65	1.26e+02	1.64e+01	7.49e+00	0.00e+00	0.00e+00	0.00e+00	4.17e+02
Cu-64	0.00e+00	9.97e+00	4.68e+00	0.00e+00	2.51e+01	0.00e+00	8.50e+02
Zn-65	2.32e+04	7.37e+04	3.33e+04	0.00e+00	4.93e+04	0.00e+00	4.64e+04
Zn-69	4.93e+01	9.43e+01	6.56e+00	0.00e+00	6.13e+01	0.00e+00	1.42e+01
Zn-69m	8.14e+02	1.95e+03	1.79e+02	0.00e+00	1.18e+03	0.00e+00	1.19e+05
Se-79	0.00e+00	1.07e+03	1.79e+02	0.00e+00	1.85e+03	0.00e+00	2.19e+02
Br-82	0.00e+00	0.00e+00	2.27e+03	0.00e+00	0.00e+00	0.00e+00	2.60e+03
Br-83	0.00e+00	0.00e+00	4.04e+01	0.00e+00	0.00e+00	0.00e+00	5.82e+01
Br-84	0.00e+00	0.00e+00	5.24e+01	0.00e+00	0.00e+00	0.00e+00	4.11e-04
Br-85	0.00e+00	0.00e+00	2.15e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/hr per µCi/ml.

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : 40 Arpent Canal  
 Dilution Factor DW = 1.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.01e+05	4.71e+04	0.00e+00	0.00e+00	0.00e+00	1.99e+04
Rb-87	0.00e+00	5.89e+04	2.05e+04	0.00e+00	0.00e+00	0.00e+00	2.76e+03
Rb-88	0.00e+00	2.90e+02	1.54e+02	0.00e+00	0.00e+00	0.00e+00	4.00e-09
Rb-89	0.00e+00	1.92e+02	1.35e+02	0.00e+00	0.00e+00	0.00e+00	1.12e-11
Sr-89	2.21e+04	0.00e+00	6.35e+02	0.00e+00	0.00e+00	0.00e+00	3.55e+03
Sr-90	6.26e+05	0.00e+00	1.26e+04	0.00e+00	0.00e+00	0.00e+00	1.57e+04
Sr-91	4.07e+02	0.00e+00	1.64e+01	0.00e+00	0.00e+00	0.00e+00	1.94e+03
Sr-92	1.54e+02	0.00e+00	6.68e+00	0.00e+00	0.00e+00	0.00e+00	3.06e+03
Y-90	5.76e-01	0.00e+00	1.54e-02	0.00e+00	0.00e+00	0.00e+00	6.10e+03
Y-91	8.44e+00	0.00e+00	2.26e-01	0.00e+00	0.00e+00	0.00e+00	4.64e+03
Y-91m	5.44e-03	0.00e+00	2.11e-04	0.00e+00	0.00e+00	0.00e+00	1.60e-02
Y-92	5.06e-02	0.00e+00	1.48e-03	0.00e+00	0.00e+00	0.00e+00	8.86e+02
Y-93	1.60e-01	0.00e+00	4.43e-03	0.00e+00	0.00e+00	0.00e+00	5.09e+03
Zr-93	3.30e-01	1.85e-02	8.61e-03	0.00e+00	7.01e-02	0.00e+00	1.92e+01
Zr-95	2.40e-01	7.70e-02	5.21e-02	0.00e+00	1.21e-01	0.00e+00	2.44e+02
Zr-97	1.33e-02	2.68e-03	1.22e-03	0.00e+00	4.04e-03	0.00e+00	8.30e+02
Nb-93m	1.83e+01	5.98e+00	1.47e+00	0.00e+00	6.87e+00	0.00e+00	2.76e+03
Nb-95	4.47e+00	2.48e+00	1.34e+00	0.00e+00	2.46e+00	0.00e+00	1.51e+04
Nb-97	3.75e-02	9.48e-03	3.46e-03	0.00e+00	1.11e-02	0.00e+00	3.50e+01
Mo-93	0.00e+00	1.80e+02	4.86e+00	0.00e+00	5.10e+01	0.00e+00	2.92e+01
Mo-99	0.00e+00	1.03e+02	1.96e+01	0.00e+00	2.34e+02	0.00e+00	2.39e+02
Tc-101	9.12e-03	1.31e-02	1.29e-01	0.00e+00	2.37e-01	6.72e-03	3.95e-14
Tc-99	4.49e+00	6.68e+00	1.80e+00	0.00e+00	8.40e+01	5.67e-01	2.18e+02
Tc-99m	8.87e-03	2.51e-02	3.19e-01	0.00e+00	3.81e-01	1.23e-02	1.48e+01
Ru-103	4.43e+00	0.00e+00	1.91e+00	0.00e+00	1.69e+01	0.00e+00	5.17e+02
Ru-105	3.69e-01	0.00e+00	1.46e-01	0.00e+00	4.76e+00	0.00e+00	2.26e+02
Ru-106	6.58e+01	0.00e+00	8.33e+00	0.00e+00	1.27e+02	0.00e+00	4.26e+03
Rh-105	2.90e+00	2.12e+00	1.40e+00	0.00e+00	9.00e+00	0.00e+00	3.38e+02
Pd-107	0.00e+00	3.52e+00	2.25e-01	0.00e+00	3.16e+01	0.00e+00	2.18e+01
Pd-109	0.00e+00	4.24e+00	9.55e-01	0.00e+00	2.42e+01	0.00e+00	4.69e+02

Conversion factors are in units of mrem/hr per µCi/ml.

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : 40 Arpent Canal  
 Dilution Factor DW = 1.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	8.81e-01	8.15e-01	4.84e-01	0.00e+00	1.60e+00	0.00e+00	3.33e+02
Ag-111	3.20e-01	1.34e-01	6.66e-02	0.00e+00	4.32e-01	0.00e+00	2.46e+02
Cd-113m	0.00e+00	1.52e+03	4.88e+01	0.00e+00	1.68e+03	0.00e+00	1.23e+04
Cd-115m	0.00e+00	8.81e+02	2.81e+01	0.00e+00	6.99e+02	0.00e+00	3.71e+04
Sn-123	2.23e+05	3.70e+03	5.45e+03	3.15e+03	0.00e+00	0.00e+00	4.55e+05
Sn-125	5.98e+04	1.21e+03	2.71e+03	9.98e+02	0.00e+00	0.00e+00	7.47e+05
Sn-126	6.07e+05	1.20e+04	1.72e+04	3.53e+03	0.00e+00	0.00e+00	1.75e+05
Sb-124	6.70e+00	1.27e-01	2.66e+00	1.63e-02	0.00e+00	5.22e+00	1.90e+02
Sb-125	4.29e+00	4.79e-02	1.02e+00	4.36e-03	0.00e+00	3.30e+00	4.72e+01
Sb-126	2.75e+00	5.60e-02	9.94e-01	1.69e-02	0.00e+00	1.69e+00	2.25e+02
Sb-127	6.18e-01	1.35e-02	2.37e-01	7.42e-03	0.00e+00	3.66e-01	1.41e+02
Te-125m	2.57e+03	9.30e+02	3.44e+02	7.72e+02	1.04e+04	0.00e+00	1.02e+04
Te-127	1.05e+02	3.78e+01	2.28e+01	7.80e+01	4.29e+02	0.00e+00	8.31e+03
Te-127m	6.48e+03	2.32e+03	7.90e+02	1.66e+03	2.63e+04	0.00e+00	2.17e+04
Te-129	3.01e+01	1.13e+01	7.33e+00	2.31e+01	1.26e+02	0.00e+00	2.27e+01
Te-129m	1.10e+04	4.11e+03	1.74e+03	3.78e+03	4.60e+04	0.00e+00	5.54e+04
Te-131	1.89e+01	7.88e+00	5.96e+00	1.55e+01	8.26e+01	0.00e+00	2.67e+00
Te-131m	1.66e+03	8.10e+02	6.75e+02	1.28e+03	8.21e+03	0.00e+00	8.04e+04
Te-132	2.41e+03	1.56e+03	1.47e+03	1.72e+03	1.50e+04	0.00e+00	7.38e+04
Te-133m	4.42e+01	2.59e+01	2.49e+01	3.74e+01	2.56e+02	0.00e+00	8.87e+00
Te-134	3.10e+01	2.03e+01	1.24e+01	2.71e+01	1.96e+02	0.00e+00	3.44e-02
I-129	1.17e+02	1.01e+02	3.31e+02	2.60e+05	2.17e+02	0.00e+00	1.59e+01
I-130	2.71e+01	8.01e+01	3.16e+01	6.79e+03	1.25e+02	0.00e+00	6.89e+01
I-131	1.49e+02	2.14e+02	1.22e+02	7.00e+04	3.66e+02	0.00e+00	5.64e+01
I-132	7.29e+00	1.95e+01	6.82e+00	6.82e+02	3.11e+01	0.00e+00	3.66e+00
I-133	5.10e+01	8.87e+01	2.70e+01	1.30e+04	1.55e+02	0.00e+00	7.97e+01
I-134	3.81e+00	1.03e+01	3.70e+00	1.79e+02	1.64e+01	0.00e+00	9.01e-03
I-135	1.59e+01	4.17e+01	1.54e+01	2.75e+03	6.68e+01	0.00e+00	4.70e+01
Cs-134	2.98e+05	7.09e+05	5.79e+05	0.00e+00	2.29e+05	7.61e+04	1.24e+04
Cs-134m	1.02e+02	2.15e+02	1.10e+02	0.00e+00	1.16e+02	1.83e+01	7.57e+01

Conversion factors are in units of mrem/hr per µCi/ml.

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : 40 Arpent Canal  
 Dilution Factor DW = 1.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	9.34e+04	8.62e+04	3.83e+04	0.00e+00	3.26e+04	9.77e+03	2.02e+03
Cs-136	3.12e+04	1.23e+05	8.86e+04	0.00e+00	6.85e+04	9.38e+03	1.40e+04
Cs-137	3.82e+05	5.22e+05	3.42e+05	0.00e+00	1.77e+05	5.89e+04	1.01e+04
Cs-138	2.64e+02	5.22e+02	2.59e+02	0.00e+00	3.84e+02	3.79e+01	2.23e-03
Cs-139	1.63e+02	2.43e+02	8.86e+01	0.00e+00	1.95e+02	1.77e+01	5.27e-21
Ba-139	9.29e-01	6.62e-04	2.72e-02	0.00e+00	6.19e-04	3.75e-04	1.65e+00
Ba-140	1.94e+02	2.44e-01	1.27e+01	0.00e+00	8.30e-02	1.40e-01	4.00e+02
Ba-141	4.51e-01	3.41e-04	1.52e-02	0.00e+00	3.17e-04	1.93e-04	2.13e-10
Ba-142	2.04e-01	2.10e-04	1.28e-02	0.00e+00	1.77e-04	1.19e-04	2.87e-19
La-140	1.50e-01	7.54e-02	1.99e-02	0.00e+00	0.00e+00	0.00e+00	5.54e+03
La-141	1.91e-02	5.93e-03	9.70e-04	0.00e+00	0.00e+00	0.00e+00	7.06e+02
La-142	7.66e-03	3.48e-03	8.68e-04	0.00e+00	0.00e+00	0.00e+00	2.54e+01
Ce-141	2.24e-02	1.52e-02	1.72e-03	0.00e+00	7.04e-03	0.00e+00	5.79e+01
Ce-143	3.95e-03	2.92e+00	3.23e-04	0.00e+00	1.29e-03	0.00e+00	1.09e+02
Ce-144	1.17e+00	4.88e-01	6.27e-02	0.00e+00	2.90e-01	0.00e+00	3.95e+02
Pr-143	5.51e-01	2.21e-01	2.73e-02	0.00e+00	1.27e-01	0.00e+00	2.41e+03
Pr-144	1.80e-03	7.48e-04	9.16e-05	0.00e+00	4.22e-04	0.00e+00	2.59e-10
Nd-147	3.76e-01	4.35e-01	2.60e-02	0.00e+00	2.54e-01	0.00e+00	2.09e+03
Pm-147	4.51e+00	4.24e-01	1.72e-01	0.00e+00	8.02e-01	0.00e+00	5.34e+02
Pm-148	4.29e-01	7.12e-02	3.59e-02	0.00e+00	1.35e-01	0.00e+00	5.60e+03
Pm-148m	1.84e+00	4.76e-01	3.64e-01	0.00e+00	7.18e-01	0.00e+00	4.03e+03
Pm-149	9.10e-02	1.29e-02	5.25e-03	0.00e+00	2.43e-02	0.00e+00	2.41e+03
Pm-151	4.17e-02	7.00e-03	3.54e-03	0.00e+00	1.25e-02	0.00e+00	1.93e+03
Sm-151	4.13e+00	7.12e-01	1.71e-01	0.00e+00	7.96e-01	0.00e+00	3.14e+02
Sm-153	5.13e-02	4.28e-02	3.12e-03	0.00e+00	1.38e-02	0.00e+00	1.53e+03
Eu-152	1.17e+01	2.66e+00	2.33e+00	0.00e+00	1.65e+01	0.00e+00	1.53e+03
Eu-154	3.68e+01	4.52e+00	3.22e+00	0.00e+00	2.17e+01	0.00e+00	3.28e+03
Eu-155	5.15e+00	7.30e-01	4.71e-01	0.00e+00	3.37e+00	0.00e+00	5.75e+02
Eu-156	8.20e-01	6.34e-01	1.02e-01	0.00e+00	4.24e-01	0.00e+00	4.35e+03
Tb-160	2.81e+00	0.00e+00	3.51e-01	0.00e+00	1.16e+00	0.00e+00	2.59e+03

Conversion factors are in units of mrem/hr per µCi/ml.

Offsite Dose Calculation Manual

Attachment 3

Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : 40 Arpent Canal  
 Dilution Factor DW = 1.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.62e+01	5.05e+00	3.83e+00	0.00e+00	7.54e+00	0.00e+00	1.53e+03
W-181	2.85e+01	9.28e+00	9.94e-01	0.00e+00	0.00e+00	0.00e+00	1.06e+03
W-185	1.16e+03	3.88e+02	4.08e+01	0.00e+00	0.00e+00	0.00e+00	4.48e+04
W-187	2.96e+02	2.47e+02	8.65e+01	0.00e+00	0.00e+00	0.00e+00	8.10e+04
Pb-210	3.66e+06	1.05e+06	1.30e+05	0.00e+00	2.94e+06	0.00e+00	5.36e+02
Bi-210	1.66e+01	1.14e+02	9.48e+00	0.00e+00	1.38e+03	0.00e+00	1.71e+03
Po-210	4.26e+05	9.05e+05	1.03e+05	0.00e+00	3.02e+06	0.00e+00	7.61e+04
Ra-223	5.95e+05	9.16e+02	1.19e+05	0.00e+00	2.60e+04	0.00e+00	3.84e+04
Ra-224	1.93e+05	4.67e+02	3.87e+04	0.00e+00	1.32e+04	0.00e+00	4.07e+04
Ra-225	7.85e+05	9.31e+02	1.57e+05	0.00e+00	2.65e+04	0.00e+00	3.66e+04
Ra-226	3.61e+07	6.87e+02	2.63e+07	0.00e+00	1.95e+04	0.00e+00	3.97e+04
Ra-228	1.34e+07	3.73e+02	1.45e+07	0.00e+00	1.06e+04	0.00e+00	6.75e+03
Ac-225	2.63e+02	3.63e+02	1.77e+01	0.00e+00	4.13e+01	0.00e+00	2.44e+04
Ac-227	1.12e+05	1.48e+04	6.64e+03	0.00e+00	4.79e+03	0.00e+00	4.90e+03
Th-227	9.84e+02	1.78e+01	2.84e+01	0.00e+00	1.01e+02	0.00e+00	3.88e+04
Th-228	3.56e+04	6.03e+02	1.21e+03	0.00e+00	3.35e+03	0.00e+00	4.04e+04
Th-229	9.77e+05	2.79e+04	1.62e+04	0.00e+00	1.35e+05	0.00e+00	5.61e+03
Th-230	1.48e+05	8.40e+03	4.09e+03	0.00e+00	4.06e+04	0.00e+00	4.32e+03
Th-232	1.65e+05	7.18e+03	1.08e+02	0.00e+00	3.46e+04	0.00e+00	3.68e+03
Th-234	5.75e+00	3.38e-01	1.66e-01	0.00e+00	1.92e+00	0.00e+00	8.12e+03
Pa-231	1.08e+05	4.06e+03	4.19e+03	0.00e+00	2.28e+04	0.00e+00	1.89e+03
Pa-233	1.39e-01	2.79e-02	2.40e-02	0.00e+00	1.05e-01	0.00e+00	4.32e+02
U-232	1.98e+04	0.00e+00	1.41e+03	0.00e+00	2.14e+03	0.00e+00	3.25e+02
U-233	4.17e+03	0.00e+00	2.53e+02	0.00e+00	9.72e+02	0.00e+00	3.00e+02
U-234	4.00e+03	0.00e+00	2.48e+02	0.00e+00	9.53e+02	0.00e+00	2.94e+02
U-235	3.84e+03	0.00e+00	2.33e+02	0.00e+00	8.95e+02	0.00e+00	3.74e+02
U-236	3.84e+03	0.00e+00	2.37e+02	0.00e+00	9.15e+02	0.00e+00	2.76e+02
U-237	2.64e-01	0.00e+00	7.04e-02	0.00e+00	1.09e+00	0.00e+00	9.29e+01
U-238	3.67e+03	0.00e+00	2.17e+02	0.00e+00	8.38e+02	0.00e+00	2.63e+02
Np-237	3.02e+04	2.15e+03	1.33e+03	0.00e+00	9.86e+03	0.00e+00	1.90e+03

Conversion factors are in units of mrem/hr per µCi/ml.

## Offsite Dose Calculation Manual

## Attachment 3

## Site Related Liquid Ingestion Dose Commitment Factors (Aj) for Individual Nuclides

Ai factors for Adult age group by nuclide.  
 Waterford Steam Electric Station Unit III  
 Discharge point : 40 Arpent Canal  
 Dilution Factor DW = 1.0

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.28e-01	8.83e-03	5.10e-03	0.00e+00	2.99e-02	0.00e+00	8.21e+02
Np-239	2.85e-02	2.80e-03	1.54e-03	0.00e+00	8.74e-03	0.00e+00	5.75e+02
Pu-238	5.28e+03	6.69e+02	1.43e+02	0.00e+00	6.13e+02	0.00e+00	6.12e+02
Pu-239	6.07e+03	7.30e+02	1.60e+02	0.00e+00	6.80e+02	0.00e+00	5.58e+02
Pu-240	6.07e+03	7.29e+02	1.60e+02	0.00e+00	6.79e+02	0.00e+00	5.68e+02
Pu-241	1.32e+02	6.24e+00	2.78e+00	0.00e+00	1.28e+01	0.00e+00	1.17e+01
Pu-242	5.63e+03	7.03e+02	1.54e+02	0.00e+00	6.54e+02	0.00e+00	5.47e+02
Pu-244	6.57e+03	8.05e+02	1.77e+02	0.00e+00	7.50e+02	0.00e+00	8.15e+02
Am-241	4.52e+04	4.22e+04	3.24e+03	0.00e+00	2.44e+04	0.00e+00	4.44e+03
Am-242m	4.55e+04	3.97e+04	3.25e+03	0.00e+00	2.42e+04	0.00e+00	5.59e+03
Am-243	4.51e+04	4.13e+04	3.17e+03	0.00e+00	2.39e+04	0.00e+00	5.21e+03
Cm-242	1.23e+03	1.31e+03	8.20e+01	0.00e+00	3.72e+02	0.00e+00	4.74e+03
Cm-243	3.59e+04	3.29e+04	2.24e+03	0.00e+00	1.05e+04	0.00e+00	4.67e+03
Cm-244	2.73e+04	2.56e+04	1.72e+03	0.00e+00	8.02e+03	0.00e+00	4.52e+03
Cm-245	5.61e+04	4.89e+04	3.45e+03	0.00e+00	1.61e+04	0.00e+00	4.21e+03
Cm-246	5.57e+04	4.88e+04	3.44e+03	0.00e+00	1.60e+04	0.00e+00	4.14e+03
Cm-247	5.43e+04	4.81e+04	3.39e+03	0.00e+00	1.58e+04	0.00e+00	5.44e+03
Cm-248	4.51e+05	3.97e+05	2.79e+04	0.00e+00	1.30e+05	0.00e+00	8.80e+04
Cf-252	1.56e+04	0.00e+00	3.76e+02	0.00e+00	0.00e+00	0.00e+00	1.72e+04

Conversion factors are in units of mrem/hr per  $\mu\text{Ci/ml}$ .



Offsite Dose Calculation Manual

Attachment 4

Dose Factors for Exposure to a Semi-Infinite Cloud of Noble Gases

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

$$* \frac{mrad - m^3}{\mu Ci - yr}$$

$$** \frac{mrem - m^3}{\mu Ci - yr}$$

Extracted from Table B-1 of Regulatory Guide 1.109, Revision 1, 1977, multiplied by 1E6 pCi/μCi.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, R<sub>i</sub>

R<sub>i</sub> factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway R<sub>i</sub>

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	7.18e+02	7.18e+02	7.18e+02	7.18e+02	7.18e+02	7.18e+02
Be-10	1.58e+06	2.45e+05	3.97e+04	0.00e+00	0.00e+00	1.78e+06	1.34e+05
C-14	1.82e+04	3.41e+03	3.41e+03	3.41e+03	3.41e+03	3.41e+03	3.41e+03
N-13	5.02e+01	5.02e+01	5.02e+01	5.02e+01	5.02e+01	5.02e+01	5.02e+01
F-18	3.77e+03	0.00e+00	4.15e+02	0.00e+00	0.00e+00	0.00e+00	7.39e+01
Na-22	1.04e+05	1.04e+05	1.04e+05	1.04e+05	1.04e+05	1.04e+05	1.04e+05
Na-24	1.02e+04	1.02e+04	1.02e+04	1.02e+04	1.02e+04	1.02e+04	1.02e+04
P-32	1.32e+06	7.71e+04	5.01e+04	0.00e+00	0.00e+00	0.00e+00	8.64e+04
Ca-41	3.06e+05	0.00e+00	3.30e+04	0.00e+00	0.00e+00	3.06e+04	2.29e+03
Sc-46	4.41e+05	8.56e+05	2.49e+05	0.00e+00	7.99e+05	0.00e+00	2.58e+05
Cr-51	0.00e+00	0.00e+00	1.00e+02	5.95e+01	2.28e+01	1.44e+04	3.32e+03
Mn-54	0.00e+00	3.96e+04	6.30e+03	0.00e+00	9.84e+03	1.40e+06	7.74e+04
Mn-56	0.00e+00	1.24e+00	1.83e-01	0.00e+00	1.30e+00	9.44e+03	2.02e+04
Fe-55	2.46e+04	1.70e+04	3.94e+03	0.00e+00	0.00e+00	7.21e+04	6.03e+03
Fe-59	1.18e+04	2.78e+04	1.06e+04	0.00e+00	0.00e+00	1.02e+06	1.88e+05
Co-57	0.00e+00	6.92e+02	6.71e+02	0.00e+00	0.00e+00	3.70e+05	3.14e+04
Co-58	0.00e+00	1.58e+03	2.07e+03	0.00e+00	0.00e+00	9.28e+05	1.06e+05
Co-60	0.00e+00	1.15e+04	1.48e+04	0.00e+00	0.00e+00	5.97e+06	2.85e+05
Ni-59	3.25e+04	1.17e+04	5.42e+03	0.00e+00	0.00e+00	6.56e+04	4.89e+03
Ni-63	4.32e+05	3.14e+04	1.45e+04	0.00e+00	0.00e+00	1.78e+05	1.34e+04
Ni-65	1.54e+00	2.10e-01	9.12e-02	0.00e+00	0.00e+00	5.60e+03	1.23e+04
Cu-64	0.00e+00	1.46e+00	6.15e-01	0.00e+00	4.62e+00	6.78e+03	4.90e+04
Zn-65	3.24e+04	1.03e+05	4.66e+04	0.00e+00	6.90e+04	8.64e+05	5.34e+04
Zn-69	3.38e-02	6.51e-02	4.52e-03	0.00e+00	4.22e-02	9.20e+02	1.63e+01
Zn-69m	8.16e+00	1.96e+01	1.79e+00	0.00e+00	1.18e+01	1.90e+04	1.37e+05
Se-79	0.00e+00	3.06e+03	4.87e+02	0.00e+00	4.55e+03	3.58e+05	2.66e+04
Br-82	0.00e+00	0.00e+00	1.35e+04	0.00e+00	0.00e+00	0.00e+00	1.04e+04
Br-83	0.00e+00	0.00e+00	2.41e+02	0.00e+00	0.00e+00	0.00e+00	2.32e+02
Br-84	0.00e+00	0.00e+00	3.13e+02	0.00e+00	0.00e+00	0.00e+00	1.64e-03
Br-85	0.00e+00	0.00e+00	1.28e+01	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/yr per μCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.35e+05	5.90e+04	0.00e+00	0.00e+00	0.00e+00	1.66e+04
Rb-87	0.00e+00	7.89e+04	2.57e+04	0.00e+00	0.00e+00	0.00e+00	2.30e+03
Rb-88	0.00e+00	3.87e+02	1.93e+02	0.00e+00	0.00e+00	0.00e+00	3.34e-09
Rb-89	0.00e+00	2.56e+02	1.70e+02	0.00e+00	0.00e+00	0.00e+00	9.28e-12
Sr-89	3.04e+05	0.00e+00	8.72e+03	0.00e+00	0.00e+00	1.40e+06	3.50e+05
Sr-90	2.87e+07	0.00e+00	5.77e+05	0.00e+00	0.00e+00	9.60e+06	7.22e+05
Sr-91	6.19e+01	0.00e+00	2.50e+00	0.00e+00	0.00e+00	3.65e+04	1.91e+05
Sr-92	6.74e+00	0.00e+00	2.91e-01	0.00e+00	0.00e+00	1.65e+04	4.30e+04
Y-90	2.09e+03	0.00e+00	5.61e+01	0.00e+00	0.00e+00	1.70e+05	5.06e+05
Y-91	4.62e+05	0.00e+00	1.24e+04	0.00e+00	0.00e+00	1.70e+06	3.85e+05
Y-91m	2.61e-01	0.00e+00	1.02e-02	0.00e+00	0.00e+00	1.92e+03	1.33e+00
Y-92	1.03e+01	0.00e+00	3.02e-01	0.00e+00	0.00e+00	1.57e+04	7.35e+04
Y-93	9.44e+01	0.00e+00	2.61e+00	0.00e+00	0.00e+00	4.85e+04	4.22e+05
Zr-93	4.18e+05	2.34e+04	1.10e+04	0.00e+00	8.88e+04	1.70e+05	1.21e+04
Zr-95	1.07e+05	3.44e+04	2.33e+04	0.00e+00	5.42e+04	1.77e+06	1.50e+05
Zr-97	9.68e+01	1.96e+01	9.04e+00	0.00e+00	2.97e+01	7.87e+04	5.23e+05
Nb-93m	2.48e+05	8.08e+04	1.99e+04	0.00e+00	9.28e+04	2.49e+05	1.90e+04
Nb-95	1.41e+04	7.82e+03	4.21e+03	0.00e+00	7.74e+03	5.05e+05	1.04e+05
Nb-97	2.22e-01	5.62e-02	2.05e-02	0.00e+00	6.54e-02	2.40e+03	2.42e+02
Mo-93	0.00e+00	9.36e+03	2.54e+02	0.00e+00	2.84e+03	4.09e+05	3.03e+04
Mo-99	0.00e+00	1.21e+02	2.30e+01	0.00e+00	2.91e+02	9.12e+04	2.48e+05
Tc-101	4.18e-05	6.02e-05	5.90e-04	0.00e+00	1.08e-03	3.99e+02	1.09e-11
Tc-99	2.50e+02	3.71e+02	1.00e+02	0.00e+00	4.68e+03	8.08e+05	6.03e+04
Tc-99m	1.03e-03	2.91e-03	3.70e-02	0.00e+00	4.42e-02	7.64e+02	4.16e+03
Ru-103	1.53e+03	0.00e+00	6.58e+02	0.00e+00	5.83e+03	5.05e+05	1.10e+05
Ru-105	7.90e-01	0.00e+00	3.11e-01	0.00e+00	1.02e+00	1.10e+04	4.82e+04
Ru-106	6.91e+04	0.00e+00	8.72e+03	0.00e+00	1.34e+05	9.36e+06	9.12e+05
Rh-105	7.39e+00	5.38e+00	3.54e+00	0.00e+00	2.29e+01	1.93e+04	8.72e+04
Pd-107	0.00e+00	6.62e+02	4.70e+01	0.00e+00	5.26e+03	7.58e+04	5.65e+03
Pd-109	0.00e+00	3.70e+00	9.28e-01	0.00e+00	1.88e+01	1.48e+04	1.22e+05

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.08e+04	1.00e+04	5.94e+03	0.00e+00	1.97e+04	4.63e+06	3.02e+05
Ag-111	3.40e+02	1.42e+02	7.10e+01	0.00e+00	4.59e+02	1.86e+05	2.23e+05
Cd-113m	0.00e+00	1.23e+06	3.98e+04	0.00e+00	1.37e+06	1.66e+06	1.27e+05
Cd-115m	0.00e+00	1.97e+05	6.36e+03	0.00e+00	1.58e+05	1.41e+06	3.84e+05
Sn-123	2.42e+05	5.34e+03	7.86e+03	4.54e+03	0.00e+00	2.30e+06	3.14e+05
Sn-125	9.28e+03	2.50e+02	5.62e+02	2.07e+02	0.00e+00	5.90e+05	5.45e+05
Sn-126	1.26e+06	3.34e+04	4.80e+04	9.84e+03	0.00e+00	9.36e+06	1.27e+05
Sb-124	3.12e+04	5.89e+02	1.24e+04	7.55e+01	0.00e+00	2.48e+06	4.06e+05
Sb-125	5.34e+04	5.95e+02	1.26e+04	5.40e+01	0.00e+00	1.74e+06	1.01e+05
Sb-126	3.60e+03	7.30e+01	1.30e+03	2.20e+01	0.00e+00	7.66e+05	4.81e+05
Sb-127	2.64e+02	5.78e+00	1.02e+02	3.18e+00	0.00e+00	1.64e+05	3.02e+05
Te-125m	3.42e+03	1.58e+03	4.67e+02	1.05e+03	1.24e+04	3.14e+05	7.06e+04
Te-127	1.40e+00	6.42e-01	3.10e-01	1.06e+00	5.10e+00	6.51e+03	5.74e+04
Te-127m	1.26e+04	5.77e+03	1.57e+03	3.29e+03	4.58e+04	9.60e+05	1.50e+05
Te-129	4.98e-02	2.39e-02	1.24e-02	3.90e-02	1.87e-01	1.94e+03	1.57e+02
Te-129m	9.76e+03	4.67e+03	1.58e+03	3.44e+03	3.66e+04	1.16e+06	3.83e+05
Te-131	1.11e-02	5.95e-03	3.59e-03	9.36e-03	4.37e-02	1.39e+03	1.84e+01
Te-131m	6.99e+01	4.36e+01	2.90e+01	5.50e+01	3.09e+02	1.46e+05	5.56e+05
Te-132	2.60e+02	2.15e+02	1.62e+02	1.90e+02	1.46e+03	2.88e+05	5.10e+05
Te-133m	5.79e-02	4.32e-02	3.34e-02	5.02e-02	2.99e-01	4.41e+03	6.12e+01
Te-134	3.07e-02	2.58e-02	1.26e-02	2.75e-02	1.74e-01	3.47e+03	2.38e-01
I-129	1.98e+04	1.69e+04	5.53e+04	4.43e+07	3.62e+04	0.00e+00	1.78e+03
I-130	4.58e+03	1.34e+04	5.28e+03	1.14e+06	2.09e+04	0.00e+00	7.69e+03
I-131	2.52e+04	3.58e+04	2.05e+04	1.19e+07	6.13e+04	0.00e+00	6.28e+03
I-132	1.16e+03	3.26e+03	1.16e+03	1.14e+05	5.18e+03	0.00e+00	4.06e+02
I-133	8.64e+03	1.48e+04	4.52e+03	2.15e+06	2.58e+04	0.00e+00	8.88e+03
I-134	6.44e+02	1.73e+03	6.15e+02	2.98e+04	2.75e+03	0.00e+00	1.01e+00
I-135	2.68e+03	6.98e+03	2.57e+03	4.48e+05	1.11e+04	0.00e+00	5.25e+03
Cs-134	3.73e+05	8.48e+05	7.28e+05	0.00e+00	2.87e+05	9.76e+04	1.04e+04
Cs-134m	1.27e+02	2.56e+02	1.38e+02	0.00e+00	1.46e+02	2.34e+01	6.34e+01

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.17e+05	1.03e+05	4.79e+04	0.00e+00	4.09e+04	1.26e+04	1.69e+03
Cs-136	3.90e+04	1.46e+05	1.10e+05	0.00e+00	8.56e+04	1.20e+04	1.17e+04
Cs-137	4.78e+05	6.21e+05	4.28e+05	0.00e+00	2.22e+05	7.52e+04	8.40e+03
Cs-138	3.31e+02	6.21e+02	3.24e+02	0.00e+00	4.80e+02	4.86e+01	1.86e-03
Cs-139	2.05e+02	2.90e+02	1.11e+02	0.00e+00	2.44e+02	2.27e+01	4.39e-21
Ba-139	9.36e-01	6.66e-04	2.74e-02	0.00e+00	6.22e-04	3.76e+03	8.96e+02
Ba-140	3.90e+04	4.90e+01	2.57e+03	0.00e+00	1.67e+01	1.27e+06	2.18e+05
Ba-141	1.00e-01	7.53e-05	3.36e-03	0.00e+00	7.00e-05	1.94e+03	1.16e-07
Ba-142	2.63e-02	2.70e-05	1.66e-03	0.00e+00	2.29e-05	1.19e+03	1.57e-16
La-140	3.44e+02	1.74e+02	4.58e+01	0.00e+00	0.00e+00	1.36e+05	4.58e+05
La-141	4.27e+00	1.33e+00	2.17e-01	0.00e+00	0.00e+00	1.08e+04	5.85e+04
La-142	6.83e-01	3.10e-01	7.72e-02	0.00e+00	0.00e+00	6.33e+03	2.11e+03
Ce-141	1.99e+04	1.35e+04	1.53e+03	0.00e+00	6.26e+03	3.62e+05	1.20e+05
Ce-143	1.86e+02	1.38e+02	1.53e+01	0.00e+00	6.08e+01	7.98e+04	2.26e+05
Ce-144	3.43e+06	1.43e+06	1.84e+05	0.00e+00	8.48e+05	7.78e+06	8.16e+05
Pr-143	9.36e+03	3.75e+03	4.64e+02	0.00e+00	2.16e+03	2.81e+05	2.00e+05
Pr-144	3.01e-02	1.25e-02	1.53e-03	0.00e+00	7.05e-03	1.02e+03	2.15e-08
Nd-147	5.27e+03	6.10e+03	3.65e+02	0.00e+00	3.56e+03	2.21e+05	1.73e+05
Pm-147	6.70e+05	6.30e+04	2.55e+04	0.00e+00	1.19e+05	5.28e+05	4.43e+04
Pm-148	3.07e+03	5.10e+02	2.56e+02	0.00e+00	9.60e+02	3.13e+05	4.64e+05
Pm-148m	7.86e+04	2.03e+04	1.55e+04	0.00e+00	3.08e+04	1.71e+06	3.34e+05
Pm-149	2.75e+02	3.90e+01	1.59e+01	0.00e+00	7.35e+01	5.77e+04	2.00e+05
Pm-151	6.80e+01	1.14e+01	5.77e+00	0.00e+00	2.04e+01	3.15e+04	1.60e+05
Sm-151	6.87e+05	1.18e+05	2.84e+04	0.00e+00	1.33e+05	3.56e+05	2.60e+04
Sm-153	1.36e+02	1.14e+02	8.32e+00	0.00e+00	3.67e+01	3.31e+04	1.26e+05
Eu-152	1.90e+06	4.33e+05	3.81e+05	0.00e+00	2.68e+06	2.74e+06	1.27e+05
Eu-154	5.92e+06	7.28e+05	5.18e+05	0.00e+00	3.49e+06	4.67e+06	2.72e+05
Eu-155	8.08e+05	1.14e+05	7.37e+04	0.00e+00	5.27e+05	7.57e+05	4.76e+04
Eu-156	1.54e+04	1.18e+04	1.92e+03	0.00e+00	7.96e+03	6.85e+05	3.60e+05
Tb-160	1.77e+05	0.00e+00	2.20e+04	0.00e+00	7.28e+04	1.54e+06	2.14e+05

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	2.70e+06	8.40e+05	6.40e+05	0.00e+00	1.26e+06	3.15e+06	1.27e+05
W-181	4.98e+01	1.62e+01	1.74e+00	0.00e+00	0.00e+00	1.37e+04	2.02e+03
W-185	1.56e+03	5.18e+02	5.45e+01	0.00e+00	0.00e+00	4.46e+05	8.56e+04
W-187	8.48e+00	7.08e+00	2.48e+00	0.00e+00	0.00e+00	2.90e+04	1.55e+05
Pb-210	2.11e+08	5.38e+07	6.70e+06	0.00e+00	1.70e+08	2.10e+08	1.21e+04
Bi-210	1.85e+03	1.27e+04	1.06e+03	0.00e+00	1.54e+05	8.88e+06	2.36e+05
Po-210	3.18e+06	6.88e+06	7.66e+05	0.00e+00	2.36e+07	2.51e+08	3.35e+05
Ra-223	1.44e+06	2.22e+03	2.88e+05	0.00e+00	6.28e+04	2.04e+08	2.27e+06
Ra-224	1.58e+05	3.82e+02	3.17e+04	0.00e+00	1.08e+04	7.02e+07	2.41e+06
Ra-225	2.40e+06	2.85e+03	4.79e+05	0.00e+00	8.08e+04	2.34e+08	2.17e+06
Ra-226	1.00e+09	1.91e+04	7.31e+08	0.00e+00	5.42e+05	9.36e+08	2.35e+06
Ra-228	3.53e+08	9.84e+03	3.82e+08	0.00e+00	2.78e+05	1.29e+09	4.00e+05
Ac-225	3.38e+06	4.66e+06	2.27e+05	0.00e+00	5.30e+05	1.77e+08	2.02e+06
Ac-227	1.84e+10	2.44e+09	1.09e+09	0.00e+00	7.86e+08	1.93e+09	4.06e+05
Th-227	1.74e+06	3.14e+04	5.00e+04	0.00e+00	1.78e+05	3.02e+08	2.67e+06
Th-228	1.60e+09	2.71e+07	5.42e+07	0.00e+00	1.51e+08	8.08e+09	2.79e+06
Th-229	1.21e+11	3.47e+09	2.01e+09	0.00e+00	1.70e+10	2.90e+10	3.86e+05
Th-230	1.83e+10	1.05e+09	5.09e+08	0.00e+00	5.12e+09	4.97e+09	2.98e+05
Th-232	2.05e+10	8.96e+08	7.23e+06	0.00e+00	4.38e+09	4.77e+09	2.54e+05
Th-234	1.30e+04	7.65e+02	3.76e+02	0.00e+00	4.33e+03	1.51e+06	5.62e+05
Pa-231	4.06e+10	1.53e+09	1.58e+09	0.00e+00	8.56e+09	4.60e+08	3.55e+05
Pa-233	9.68e+03	1.94e+03	1.67e+03	0.00e+00	7.32e+03	2.82e+05	8.16e+04
U-232	4.11e+08	0.00e+00	2.93e+07	0.00e+00	4.45e+07	1.78e+09	3.37e+05
U-233	8.72e+07	0.00e+00	5.28e+06	0.00e+00	2.03e+07	4.26e+08	3.11e+05
U-234	8.32e+07	0.00e+00	5.17e+06	0.00e+00	1.99e+07	4.18e+08	3.05e+05
U-235	8.00e+07	0.00e+00	4.86e+06	0.00e+00	1.87e+07	3.92e+08	3.87e+05
U-236	8.00e+07	0.00e+00	4.96e+06	0.00e+00	1.91e+07	4.00e+08	2.86e+05
U-237	2.94e+02	0.00e+00	7.82e+01	0.00e+00	1.21e+03	8.16e+04	9.60e+04
U-238	7.66e+07	0.00e+00	4.54e+06	0.00e+00	1.74e+07	3.66e+08	2.73e+05
Np-237	1.25e+10	8.00e+09	5.50e+08	0.00e+00	4.08e+09	4.18e+08	3.94e+05

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 5

## Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	2.37e+03	5.76e+02	3.69e+01	0.00e+00	2.18e+02	8.16e+04	1.70e+05
Np-239	2.30e+02	2.03e+02	1.24e+01	0.00e+00	7.00e+01	3.76e+04	1.19e+05
Pu-238	1.14e+10	7.77e+09	5.52e+08	0.00e+00	2.37e+09	1.46e+09	3.62e+05
Pu-239	1.33e+10	8.56e+09	6.20e+08	0.00e+00	2.64e+09	1.38e+09	3.30e+05
Pu-240	1.32e+10	8.56e+09	6.18e+08	0.00e+00	2.63e+09	1.38e+09	3.37e+05
Pu-241	2.74e+08	6.95e+07	1.03e+07	0.00e+00	4.74e+07	1.22e+06	6.92e+03
Pu-242	1.22e+10	8.24e+09	5.97e+08	0.00e+00	2.54e+09	1.32e+09	3.24e+05
Pu-244	1.43e+10	9.44e+09	6.83e+08	0.00e+00	2.91e+09	1.51e+09	4.82e+05
Am-241	1.34e+10	9.04e+09	5.37e+08	0.00e+00	4.03e+09	4.85e+08	3.68e+05
Am-242m	1.36e+10	8.48e+09	5.38e+08	0.00e+00	4.01e+09	1.95e+08	4.63e+05
Am-243	1.34e+10	8.80e+09	5.26e+08	0.00e+00	3.96e+09	4.60e+08	4.32e+05
Cm-242	1.78e+08	1.42e+08	7.87e+06	0.00e+00	3.58e+07	3.14e+08	3.93e+05
Cm-243	8.80e+09	6.09e+09	3.69e+08	0.00e+00	1.72e+09	5.05e+08	3.87e+05
Cm-244	6.70e+09	4.70e+09	2.81e+08	0.00e+00	1.31e+09	4.85e+08	3.74e+05
Cm-245	1.39e+10	9.12e+09	5.71e+08	0.00e+00	2.66e+09	4.68e+08	3.49e+05
Cm-246	1.38e+10	9.12e+09	5.70e+08	0.00e+00	2.66e+09	4.77e+08	3.43e+05
Cm-247	1.34e+10	8.96e+09	5.62e+08	0.00e+00	2.62e+09	4.68e+08	4.50e+05
Cm-248	1.12e+11	7.41e+10	4.63e+09	0.00e+00	2.16e+10	3.86e+09	7.27e+06
Cf-252	4.34e+09	0.00e+00	1.86e+08	0.00e+00	0.00e+00	1.59e+09	1.42e+06

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	7.25e+02	7.25e+02	7.25e+02	7.25e+02	7.25e+02	7.25e+02
Be-10	2.22e+06	3.46e+05	5.67e+04	0.00e+00	0.00e+00	3.07e+06	1.42e+05
C-14	2.60e+04	4.87e+03	4.87e+03	4.87e+03	4.87e+03	4.87e+03	4.87e+03
N-13	6.92e+01	6.92e+01	6.92e+01	6.92e+01	6.92e+01	6.92e+01	6.92e+01
F-18	5.22e+03	0.00e+00	5.68e+02	0.00e+00	0.00e+00	0.00e+00	3.11e+02
Na-22	1.41e+05	1.41e+05	1.41e+05	1.41e+05	1.41e+05	1.41e+05	1.41e+05
Na-24	1.38e+04	1.38e+04	1.38e+04	1.38e+04	1.38e+04	1.38e+04	1.38e+04
P-32	1.89e+06	1.10e+05	7.16e+04	0.00e+00	0.00e+00	0.00e+00	9.28e+04
Ca-41	3.24e+05	0.00e+00	3.50e+04	0.00e+00	0.00e+00	8.08e+08	2.42e+03
Sc-46	5.79e+05	1.13e+06	3.34e+05	0.00e+00	1.08e+06	0.00e+00	2.38e+05
Cr-51	0.00e+00	0.00e+00	1.35e+02	7.50e+01	3.07e+01	2.10e+04	3.00e+03
Mn-54	0.00e+00	5.11e+04	8.40e+03	0.00e+00	1.27e+04	1.98e+06	6.68e+04
Mn-56	0.00e+00	1.70e+00	2.52e-01	0.00e+00	1.79e+00	1.52e+04	5.74e+04
Fe-55	3.34e+04	2.38e+04	5.54e+03	0.00e+00	0.00e+00	1.24e+05	6.39e+03
Fe-59	1.59e+04	3.70e+04	1.43e+04	0.00e+00	0.00e+00	1.53e+06	1.78e+05
Co-57	0.00e+00	9.44e+02	9.20e+02	0.00e+00	0.00e+00	5.86e+05	3.14e+04
Co-58	0.00e+00	2.07e+03	2.78e+03	0.00e+00	0.00e+00	1.34e+06	9.52e+04
Co-60	0.00e+00	1.51e+04	1.98e+04	0.00e+00	0.00e+00	8.72e+06	2.59e+05
Ni-59	4.35e+04	1.62e+04	7.39e+03	0.00e+00	0.00e+00	1.13e+05	5.18e+03
Ni-63	5.80e+05	4.34e+04	1.98e+04	0.00e+00	0.00e+00	3.07e+05	1.42e+04
Ni-65	2.18e+00	2.93e-01	1.27e-01	0.00e+00	0.00e+00	9.36e+03	3.67e+04
Cu-64	0.00e+00	2.03e+00	8.48e-01	0.00e+00	6.41e+00	1.11e+04	6.14e+04
Zn-65	3.86e+04	1.34e+05	6.24e+04	0.00e+00	8.64e+04	1.24e+06	4.66e+04
Zn-69	4.83e-02	9.20e-02	6.46e-03	0.00e+00	6.02e-02	1.58e+03	2.85e+02
Zn-69m	1.15e+01	2.71e+01	2.49e+00	0.00e+00	1.65e+01	3.14e+04	1.71e+05
Se-79	0.00e+00	4.34e+03	6.97e+02	0.00e+00	6.50e+03	6.17e+05	2.82e+04
Br-82	0.00e+00	0.00e+00	1.82e+04	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
Br-84	0.00e+00	0.00e+00	4.33e+02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	1.83e+01	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.90e+05	8.40e+04	0.00e+00	0.00e+00	0.00e+00	1.77e+04
Rb-87	0.00e+00	1.12e+05	3.66e+04	0.00e+00	0.00e+00	0.00e+00	2.44e+03
Rb-88	0.00e+00	5.46e+02	2.72e+02	0.00e+00	0.00e+00	0.00e+00	2.92e-05
Rb-89	0.00e+00	3.52e+02	2.33e+02	0.00e+00	0.00e+00	0.00e+00	3.38e-07
Sr-89	4.34e+05	0.00e+00	1.25e+04	0.00e+00	0.00e+00	2.42e+06	3.71e+05
Sr-90	3.31e+07	0.00e+00	6.66e+05	0.00e+00	0.00e+00	1.65e+07	7.65e+05
Sr-91	8.80e+01	0.00e+00	3.51e+00	0.00e+00	0.00e+00	6.07e+04	2.59e+05
Sr-92	9.52e+00	0.00e+00	4.06e-01	0.00e+00	0.00e+00	2.74e+04	1.19e+05
Y-90	2.98e+03	0.00e+00	8.00e+01	0.00e+00	0.00e+00	2.93e+05	5.59e+05
Y-91	6.61e+05	0.00e+00	1.77e+04	0.00e+00	0.00e+00	2.94e+06	4.09e+05
Y-91m	3.70e-01	0.00e+00	1.42e-02	0.00e+00	0.00e+00	3.20e+03	3.02e+01
Y-92	1.47e+01	0.00e+00	4.29e-01	0.00e+00	0.00e+00	2.68e+04	1.65e+05
Y-93	1.35e+02	0.00e+00	3.72e+00	0.00e+00	0.00e+00	8.32e+04	5.79e+05
Zr-93	5.46e+05	2.70e+04	1.47e+04	0.00e+00	9.28e+04	2.94e+05	1.28e+04
Zr-95	1.46e+05	4.58e+04	3.15e+04	0.00e+00	6.74e+04	2.69e+06	1.49e+05
Zr-97	1.38e+02	2.72e+01	1.26e+01	0.00e+00	4.12e+01	1.30e+05	6.30e+05
Nb-93m	3.31e+05	1.09e+05	2.73e+04	0.00e+00	1.27e+05	4.29e+05	2.02e+04
Nb-95	1.86e+04	1.03e+04	5.66e+03	0.00e+00	1.00e+04	7.51e+05	9.68e+04
Nb-97	3.14e-01	7.78e-02	2.84e-02	0.00e+00	9.12e-02	3.93e+03	2.17e+03
Mo-93	0.00e+00	1.33e+04	3.62e+02	0.00e+00	4.05e+03	7.05e+05	3.19e+04
Mo-99	0.00e+00	1.69e+02	3.22e+01	0.00e+00	4.11e+02	1.54e+05	2.69e+05
Tc-101	5.92e-05	8.40e-05	8.24e-04	0.00e+00	1.52e-03	6.67e+02	8.72e-07
Tc-99	3.58e+02	5.26e+02	1.43e+02	0.00e+00	6.68e+03	1.39e+06	6.39e+04
Tc-99m	1.38e-03	3.86e-03	4.99e-02	0.00e+00	5.76e-02	1.15e+03	6.13e+03
Ru-103	2.10e+03	0.00e+00	8.96e+02	0.00e+00	7.43e+03	7.83e+05	1.09e+05
Ru-105	1.12e+00	0.00e+00	4.34e-01	0.00e+00	1.41e+00	1.82e+04	9.04e+04
Ru-106	9.84e+04	0.00e+00	1.24e+04	0.00e+00	1.90e+05	1.61e+07	9.60e+05
Rh-105	1.06e+01	7.58e+00	4.99e+00	0.00e+00	3.23e+01	3.27e+04	9.84e+04
Pd-107	0.00e+00	9.36e+02	6.71e+01	0.00e+00	7.51e+03	1.30e+05	5.99e+03
Pd-109	0.00e+00	5.25e+00	1.33e+00	0.00e+00	2.69e+01	2.55e+04	1.57e+05

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.38e+04	1.31e+04	7.99e+03	0.00e+00	2.50e+04	6.75e+06	2.73e+05
Ag-111	4.86e+02	2.02e+02	1.01e+02	0.00e+00	6.54e+02	3.20e+05	2.40e+05
Cd-113m	0.00e+00	1.74e+06	5.68e+04	0.00e+00	1.94e+06	2.87e+06	1.34e+05
Cd-115m	0.00e+00	2.78e+05	9.12e+03	0.00e+00	2.26e+05	2.42e+06	4.08e+05
Sn-123	3.45e+05	7.55e+03	1.12e+04	6.04e+03	0.00e+00	3.97e+06	3.33e+05
Sn-125	1.33e+04	3.54e+02	7.99e+02	2.76e+02	0.00e+00	1.01e+06	5.83e+05
Sn-126	1.74e+06	4.31e+04	6.59e+04	1.14e+04	0.00e+00	1.38e+07	1.34e+05
Sb-124	4.30e+04	7.94e+02	1.68e+04	9.76e+01	0.00e+00	3.85e+06	3.98e+05
Sb-125	7.38e+04	8.08e+02	1.72e+04	7.04e+01	0.00e+00	2.74e+06	9.92e+04
Sb-126	4.95e+03	1.02e+02	1.78e+03	2.80e+01	0.00e+00	1.24e+06	4.81e+05
Sb-127	3.71e+02	7.94e+00	1.40e+02	4.17e+00	0.00e+00	2.65e+05	3.15e+05
Te-125m	4.88e+03	2.24e+03	6.67e+02	1.40e+03	0.00e+00	5.36e+05	7.50e+04
Te-127	2.01e+00	9.12e-01	4.42e-01	1.42e+00	7.28e+00	1.12e+04	8.08e+04
Te-127m	1.80e+04	8.16e+03	2.18e+03	4.38e+03	6.54e+04	1.66e+06	1.59e+05
Te-129	7.10e-02	3.38e-02	1.76e-02	5.18e-02	2.66e-01	3.30e+03	1.62e+03
Te-129m	1.39e+04	6.58e+03	2.25e+03	4.58e+03	5.19e+04	1.98e+06	4.05e+05
Te-131	1.58e-02	8.32e-03	5.04e-03	1.24e-02	6.18e-02	2.34e+03	1.51e+01
Te-131m	9.84e+01	6.01e+01	4.02e+01	7.25e+01	4.39e+02	2.38e+05	6.21e+05
Te-132	3.60e+02	2.90e+02	2.19e+02	2.46e+02	1.95e+03	4.49e+05	4.63e+05
Te-133m	8.08e-02	5.86e-02	4.57e-02	6.54e-02	4.06e-01	6.97e+03	9.84e+02
Te-134	4.25e-02	3.48e-02	2.91e-02	3.57e-02	2.33e-01	5.40e+03	1.10e+01
I-129	2.82e+04	2.35e+04	3.92e+04	2.93e+07	4.21e+04	0.00e+00	1.83e+03
I-130	6.24e+03	1.79e+04	7.17e+03	1.49e+06	2.75e+04	0.00e+00	9.12e+03
I-131	3.54e+04	4.91e+04	2.64e+04	1.46e+07	8.40e+04	0.00e+00	6.49e+03
I-132	1.59e+03	4.38e+03	1.58e+03	1.51e+05	6.92e+03	0.00e+00	1.27e+03
I-133	1.22e+04	2.05e+04	6.22e+03	2.92e+06	3.59e+04	0.00e+00	1.03e+04
I-134	8.88e+02	2.32e+03	8.40e+02	3.95e+04	3.66e+03	0.00e+00	2.04e+01
I-135	3.70e+03	9.44e+03	3.49e+03	6.21e+05	1.49e+04	0.00e+00	6.95e+03
Cs-134	5.02e+05	1.13e+06	5.49e+05	0.00e+00	3.75e+05	1.46e+05	9.76e+03
Cs-134m	1.76e+02	3.48e+02	1.88e+02	0.00e+00	2.03e+02	3.65e+01	1.62e+02

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.66e+05	1.46e+05	3.58e+04	0.00e+00	5.84e+04	2.16e+04	1.78e+03
Cs-136	5.15e+04	1.94e+05	1.37e+05	0.00e+00	1.10e+05	1.78e+04	1.09e+04
Cs-137	6.70e+05	8.48e+05	3.11e+05	0.00e+00	3.04e+05	1.21e+05	8.48e+03
Cs-138	4.66e+02	8.56e+02	4.46e+02	0.00e+00	6.62e+02	7.87e+01	2.70e-01
Cs-139	2.92e+02	4.10e+02	1.58e+02	0.00e+00	3.47e+02	3.89e+01	1.33e-13
Ba-139	1.34e+00	9.44e-04	3.90e-02	0.00e+00	8.88e-04	6.46e+03	6.45e+03
Ba-140	5.47e+04	6.70e+01	3.52e+03	0.00e+00	2.28e+01	2.03e+06	2.29e+05
Ba-141	1.42e-01	1.06e-04	4.74e-03	0.00e+00	9.84e-05	3.29e+03	7.46e-04
Ba-142	3.70e-02	3.70e-05	2.27e-03	0.00e+00	3.14e-05	1.91e+03	4.79e-10
La-140	4.79e+02	2.36e+02	6.26e+01	0.00e+00	0.00e+00	2.14e+05	4.87e+05
La-141	6.10e+00	1.88e+00	3.10e-01	0.00e+00	0.00e+00	1.85e+04	1.23e+05
La-142	9.60e-01	4.25e-01	1.06e-01	0.00e+00	0.00e+00	1.02e+04	1.20e+04
Ce-141	2.84e+04	1.90e+04	2.17e+03	0.00e+00	8.88e+03	6.14e+05	1.26e+05
Ce-143	2.66e+02	1.94e+02	2.16e+01	0.00e+00	8.64e+01	1.30e+05	2.55e+05
Ce-144	4.89e+06	2.02e+06	2.62e+05	0.00e+00	1.21e+06	1.34e+07	8.64e+05
Pr-143	1.34e+04	5.31e+03	6.62e+02	0.00e+00	3.09e+03	4.83e+05	2.14e+05
Pr-144	4.30e-02	1.76e-02	2.18e-03	0.00e+00	1.01e-02	1.75e+03	2.35e-04
Nd-147	7.86e+03	8.56e+03	5.13e+02	0.00e+00	5.02e+03	3.72e+05	1.82e+05
Pm-147	9.20e+05	8.80e+04	3.60e+04	0.00e+00	1.68e+05	9.12e+05	4.70e+04
Pm-148	4.35e+03	7.10e+02	3.58e+02	0.00e+00	1.28e+03	5.22e+05	4.91e+05
Pm-148m	1.06e+05	2.68e+04	2.10e+04	0.00e+00	4.06e+04	2.56e+06	3.28e+05
Pm-149	3.93e+02	5.51e+01	2.27e+01	0.00e+00	1.05e+02	9.92e+04	2.23e+05
Pm-151	9.60e+01	1.59e+01	8.08e+00	0.00e+00	2.86e+01	5.25e+04	1.82e+05
Sm-151	8.56e+05	1.68e+05	3.89e+04	0.00e+00	1.82e+05	6.14e+05	2.82e+04
Sm-153	1.94e+02	1.61e+02	1.18e+01	0.00e+00	5.25e+01	5.69e+04	1.42e+05
Eu-152	2.37e+06	5.75e+05	5.04e+05	0.00e+00	2.67e+06	4.01e+06	1.08e+05
Eu-154	7.54e+06	9.84e+05	6.88e+05	0.00e+00	4.35e+06	7.30e+06	2.67e+05
Eu-155	1.60e+06	1.57e+05	9.68e+04	0.00e+00	6.12e+05	1.21e+07	4.78e+05
Eu-156	2.16e+04	1.62e+04	2.64e+03	0.00e+00	1.09e+04	1.10e+06	3.65e+05
Tb-160	2.43e+05	0.00e+00	3.03e+04	0.00e+00	9.60e+04	2.38e+06	2.08e+05

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	3.52e+06	1.09e+06	7.90e+05	0.00e+00	1.60e+06	4.99e+06	1.34e+05
W-181	7.12e+01	2.30e+01	2.41e+00	0.00e+00	0.00e+00	2.36e+04	2.15e+03
W-185	2.22e+03	7.34e+02	7.78e+01	0.00e+00	0.00e+00	7.68e+05	9.12e+04
W-187	1.20e+01	9.76e+00	3.43e+00	0.00e+00	0.00e+00	4.74e+04	1.77e+05
Pb-210	2.47e+08	6.62e+07	8.56e+06	0.00e+00	2.36e+08	3.62e+08	1.28e+04
Bi-210	2.64e+03	1.81e+04	1.51e+03	0.00e+00	2.19e+05	1.53e+07	2.55e+05
Po-210	4.54e+06	9.76e+06	1.10e+06	0.00e+00	3.37e+07	4.33e+08	3.56e+05
Ra-223	2.06e+06	3.14e+03	4.11e+05	0.00e+00	8.96e+04	3.51e+08	2.43e+06
Ra-224	2.26e+05	5.42e+02	4.52e+04	0.00e+00	1.54e+04	1.21e+08	2.63e+06
Ra-225	3.42e+06	4.03e+03	6.85e+05	0.00e+00	1.15e+05	4.03e+08	2.31e+06
Ra-226	1.06e+09	2.70e+04	7.90e+08	0.00e+00	7.74e+05	1.62e+09	2.49e+06
Ra-228	4.27e+08	1.39e+04	4.70e+08	0.00e+00	3.98e+05	2.22e+09	4.24e+05
Ac-225	4.83e+06	6.60e+06	3.25e+05	0.00e+00	7.58e+05	3.05e+08	2.16e+06
Ac-227	1.99e+10	2.95e+09	1.18e+09	0.00e+00	8.56e+08	3.33e+09	4.30e+05
Th-227	2.47e+06	4.45e+04	7.14e+04	0.00e+00	2.54e+05	5.20e+08	2.86e+06
Th-228	2.08e+09	3.50e+07	7.02e+07	0.00e+00	1.96e+08	1.35e+10	2.96e+06
Th-229	1.23e+11	3.55e+09	2.05e+09	0.00e+00	1.74e+10	4.19e+10	4.10e+05
Th-230	1.87e+10	1.07e+09	5.19e+08	0.00e+00	5.24e+09	7.18e+09	3.16e+05
Th-232	2.09e+10	9.12e+08	7.37e+06	0.00e+00	4.48e+09	6.88e+09	2.69e+05
Th-234	1.86e+04	1.08e+03	5.37e+02	0.00e+00	6.18e+03	2.61e+06	5.99e+05
Pa-231	4.26e+10	1.60e+09	1.66e+09	0.00e+00	8.96e+09	7.93e+08	3.77e+05
Pa-233	1.34e+04	2.59e+03	2.31e+03	0.00e+00	9.76e+03	4.31e+05	8.00e+04
U-232	5.85e+08	0.00e+00	4.18e+07	0.00e+00	6.35e+07	3.07e+09	3.57e+05
U-233	1.24e+08	0.00e+00	7.54e+06	0.00e+00	2.90e+07	7.34e+08	3.30e+05
U-234	1.18e+08	0.00e+00	7.38e+06	0.00e+00	2.84e+07	7.19e+08	3.23e+05
U-235	1.14e+08	0.00e+00	6.94e+06	0.00e+00	2.67e+07	6.75e+08	4.10e+05
U-236	1.14e+08	0.00e+00	7.09e+06	0.00e+00	2.73e+07	6.90e+08	3.03e+05
U-237	4.20e+02	0.00e+00	1.12e+02	0.00e+00	1.73e+03	1.41e+05	1.03e+05
U-238	1.09e+08	0.00e+00	6.48e+06	0.00e+00	2.50e+07	6.31e+08	2.90e+05
Np-237	1.31e+10	8.48e+09	5.77e+08	0.00e+00	4.28e+09	7.19e+08	4.18e+05

Conversion factors are in units of mrem/yr per µCi/cubic meter.

## Offsite Dose Calculation Manual

## Attachment 5

## Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.38e+03	8.16e+02	5.27e+01	0.00e+00	3.10e+02	1.40e+05	1.90e+05
Np-239	3.38e+02	2.88e+02	1.77e+01	0.00e+00	1.00e+02	6.49e+04	1.32e+05
Pu-238	1.20e+10	8.24e+09	5.78e+08	0.00e+00	2.48e+09	2.50e+09	3.83e+05
Pu-239	1.38e+10	8.96e+09	6.44e+08	0.00e+00	2.75e+09	2.34e+09	3.50e+05
Pu-240	1.38e+10	8.96e+09	6.43e+08	0.00e+00	2.74e+09	2.34e+09	3.57e+05
Pu-241	2.99e+08	7.65e+07	1.12e+07	0.00e+00	5.18e+07	2.08e+06	7.34e+03
Pu-242	1.28e+10	8.64e+09	6.20e+08	0.00e+00	2.65e+09	2.26e+09	3.43e+05
Pu-244	1.50e+10	9.92e+09	7.10e+08	0.00e+00	3.03e+09	2.58e+09	5.11e+05
Am-241	1.42e+10	9.60e+09	5.68e+08	0.00e+00	4.26e+09	8.40e+08	3.90e+05
Am-242m	1.43e+10	9.04e+09	5.72e+08	0.00e+00	4.24e+09	3.37e+08	4.91e+05
Am-243	1.42e+10	9.36e+09	5.56e+08	0.00e+00	4.17e+09	7.93e+08	4.58e+05
Cm-242	2.54e+08	2.01e+08	1.13e+07	0.00e+00	5.12e+07	5.41e+08	4.17e+05
Cm-243	9.52e+09	6.64e+09	4.00e+08	0.00e+00	1.87e+09	8.72e+08	4.10e+05
Cm-244	7.35e+09	5.22e+09	3.10e+08	0.00e+00	1.45e+09	8.40e+08	3.97e+05
Cm-245	1.46e+10	9.76e+09	6.02e+08	0.00e+00	2.82e+09	8.08e+08	3.70e+05
Cm-246	1.45e+10	9.76e+09	6.02e+08	0.00e+00	2.81e+09	8.24e+08	3.63e+05
Cm-247	1.42e+10	9.52e+09	5.93e+08	0.00e+00	2.77e+09	8.08e+08	4.78e+05
Cm-248	1.18e+11	7.86e+10	4.89e+09	0.00e+00	2.28e+10	6.66e+09	7.70e+06
Cf-252	5.73e+09	0.00e+00	2.46e+08	0.00e+00	0.00e+00	2.74e+09	1.51e+06

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

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Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
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Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	6.40e+02	6.40e+02	6.40e+02	6.40e+02	6.40e+02	6.40e+02
Be-10	3.12e+06	3.64e+05	7.84e+04	0.00e+00	0.00e+00	2.74e+06	6.36e+04
C-14	3.59e+04	6.73e+03	6.73e+03	6.73e+03	6.73e+03	6.73e+03	6.73e+03
N-13	8.62e+01	8.62e+01	8.62e+01	8.62e+01	8.62e+01	8.62e+01	8.62e+01
F-18	6.96e+03	0.00e+00	6.84e+02	0.00e+00	0.00e+00	0.00e+00	1.25e+03
Na-22	1.63e+05	1.63e+05	1.63e+05	1.63e+05	1.63e+05	1.63e+05	1.63e+05
Na-24	1.61e+04	1.61e+04	1.61e+04	1.61e+04	1.61e+04	1.61e+04	1.61e+04
P-32	2.60e+06	1.14e+05	9.88e+04	0.00e+00	0.00e+00	0.00e+00	4.22e+04
Ca-41	2.61e+05	0.00e+00	2.85e+04	0.00e+00	0.00e+00	2.67e+08	1.09e+03
Sc-46	7.29e+05	9.99e+05	3.85e+05	0.00e+00	8.84e+05	0.00e+00	9.06e+04
Cr-51	0.00e+00	0.00e+00	1.54e+02	8.55e+01	2.43e+01	1.70e+04	1.08e+03
Mn-54	0.00e+00	4.29e+04	9.51e+03	0.00e+00	1.00e+04	1.58e+06	2.29e+04
Mn-56	0.00e+00	1.66e+00	3.12e-01	0.00e+00	1.67e+00	1.31e+04	1.23e+05
Fe-55	4.74e+04	2.52e+04	7.77e+03	0.00e+00	0.00e+00	1.11e+05	2.87e+03
Fe-59	2.07e+04	3.34e+04	1.67e+04	0.00e+00	0.00e+00	1.27e+06	7.07e+04
Co-57	0.00e+00	9.03e+02	1.07e+03	0.00e+00	0.00e+00	5.07e+05	1.32e+04
Co-58	0.00e+00	1.77e+03	3.16e+03	0.00e+00	0.00e+00	1.11e+06	3.44e+04
Co-60	0.00e+00	1.31e+04	2.26e+04	0.00e+00	0.00e+00	7.07e+06	9.62e+04
Ni-59	6.14e+04	1.73e+04	1.05e+04	0.00e+00	0.00e+00	1.01e+05	2.33e+03
Ni-63	8.21e+05	4.62e+04	2.80e+04	0.00e+00	0.00e+00	2.75e+05	6.33e+03
Ni-65	2.99e+00	2.96e-01	1.64e-01	0.00e+00	0.00e+00	8.18e+03	8.40e+04
Cu-64	0.00e+00	1.99e+00	1.07e+00	0.00e+00	6.03e+00	9.58e+03	3.67e+04
Zn-65	4.26e+04	1.13e+05	7.03e+04	0.00e+00	7.14e+04	9.95e+05	1.63e+04
Zn-69	6.70e-02	9.66e-02	8.92e-03	0.00e+00	5.85e-02	1.42e+03	1.02e+04
Zn-69m	1.58e+01	2.69e+01	3.18e+00	0.00e+00	1.56e+01	2.72e+04	1.00e+05
Se-79	0.00e+00	4.55e+03	9.62e+02	0.00e+00	6.33e+03	5.51e+05	1.27e+04
Br-82	0.00e+00	0.00e+00	2.09e+04	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
Br-84	0.00e+00	0.00e+00	5.48e+02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	2.53e+01	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

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Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.98e+05	1.14e+05	0.00e+00	0.00e+00	0.00e+00	7.99e+03
Rb-87	0.00e+00	1.17e+05	5.07e+04	0.00e+00	0.00e+00	0.00e+00	1.10e+03
Rb-88	0.00e+00	5.62e+02	3.66e+02	0.00e+00	0.00e+00	0.00e+00	1.72e+01
Rb-89	0.00e+00	3.45e+02	2.90e+02	0.00e+00	0.00e+00	0.00e+00	1.89e+00
Sr-89	5.99e+05	0.00e+00	1.72e+04	0.00e+00	0.00e+00	2.16e+06	1.67e+05
Sr-90	3.85e+07	0.00e+00	7.66e+05	0.00e+00	0.00e+00	1.48e+07	3.43e+05
Sr-91	1.21e+02	0.00e+00	4.59e+00	0.00e+00	0.00e+00	5.33e+04	1.74e+05
Sr-92	1.31e+01	0.00e+00	5.25e-01	0.00e+00	0.00e+00	2.40e+04	2.42e+05
Y-90	4.11e+03	0.00e+00	1.11e+02	0.00e+00	0.00e+00	2.62e+05	2.68e+05
Y-91	9.14e+05	0.00e+00	2.44e+04	0.00e+00	0.00e+00	2.63e+06	1.84e+05
Y-91m	5.07e-01	0.00e+00	1.84e-02	0.00e+00	0.00e+00	2.81e+03	1.72e+03
Y-92	2.03e+01	0.00e+00	5.81e-01	0.00e+00	0.00e+00	2.39e+04	2.39e+05
Y-93	1.86e+02	0.00e+00	5.11e+00	0.00e+00	0.00e+00	7.44e+04	3.88e+05
Zr-93	7.66e+05	2.89e+04	2.05e+04	0.00e+00	1.11e+05	2.63e+05	5.44e+03
Zr-95	1.90e+05	4.18e+04	3.70e+04	0.00e+00	5.96e+04	2.23e+06	6.11e+04
Zr-97	1.88e+02	2.72e+01	1.60e+01	0.00e+00	3.88e+01	1.13e+05	3.51e+05
Nb-93m	4.70e+05	1.17e+05	3.85e+04	0.00e+00	1.27e+05	3.85e+05	9.06e+03
Nb-95	2.35e+04	9.18e+03	6.55e+03	0.00e+00	8.62e+03	6.14e+05	3.70e+04
Nb-97	4.29e-01	7.70e-02	3.60e-02	0.00e+00	8.55e-02	3.42e+03	2.78e+04
Mo-93	0.00e+00	1.39e+04	5.00e+02	0.00e+00	3.92e+03	6.29e+05	1.40e+04
Mo-99	0.00e+00	1.72e+02	4.26e+01	0.00e+00	3.92e+02	1.35e+05	1.27e+05
Tc-101	8.10e-05	8.51e-05	1.08e-03	0.00e+00	1.45e-03	5.85e+02	1.63e+01
Tc-99	4.96e+02	5.51e+02	1.98e+02	0.00e+00	6.48e+03	1.25e+06	2.87e+04
Tc-99m	1.78e-03	3.48e-03	5.77e-02	0.00e+00	5.07e-02	9.51e+02	4.81e+03
Ru-103	2.79e+03	0.00e+00	1.07e+03	0.00e+00	7.03e+03	6.62e+05	4.48e+04
Ru-105	1.53e+00	0.00e+00	5.55e-01	0.00e+00	1.34e+00	1.59e+04	9.95e+04
Ru-106	1.36e+05	0.00e+00	1.69e+04	0.00e+00	1.84e+05	1.43e+07	4.29e+05
Rh-105	1.45e+01	7.77e+00	6.62e+00	0.00e+00	3.10e+01	2.89e+04	4.92e+04
Pd-107	0.00e+00	9.80e+02	9.29e+01	0.00e+00	7.29e+03	1.17e+05	2.69e+03
Pd-109	0.00e+00	5.48e+00	1.83e+00	0.00e+00	2.61e+01	2.28e+04	9.58e+04

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.69e+04	1.14e+04	9.14e+03	0.00e+00	2.12e+04	5.48e+06	1.00e+05
Ag-111	6.70e+02	2.10e+02	1.39e+02	0.00e+00	6.33e+02	2.86e+05	1.10e+05
Cd-113m	0.00e+00	1.82e+06	7.84e+04	0.00e+00	1.90e+06	2.57e+06	6.03e+04
Cd-115m	0.00e+00	2.92e+05	1.25e+04	0.00e+00	2.19e+05	2.17e+06	1.84e+05
Sn-123	4.77e+05	7.92e+03	1.55e+04	8.40e+03	0.00e+00	3.55e+06	1.50e+05
Sn-125	1.83e+04	3.68e+02	1.09e+03	3.81e+02	0.00e+00	8.99e+05	2.65e+05
Sn-126	2.31e+06	3.85e+04	8.73e+04	1.05e+04	0.00e+00	1.12e+07	6.03e+04
Sb-124	5.74e+04	7.40e+02	2.00e+04	1.26e+02	0.00e+00	3.24e+06	1.64e+05
Sb-125	9.84e+04	7.58e+02	2.07e+04	9.10e+01	0.00e+00	2.32e+06	4.03e+04
Sb-126	6.36e+03	9.69e+01	2.28e+03	3.70e+01	0.00e+00	1.06e+06	2.10e+05
Sb-127	5.03e+02	7.73e+00	1.74e+02	5.59e+00	0.00e+00	2.28e+05	1.41e+05
Te-125m	6.73e+03	2.33e+03	9.14e+02	1.92e+03	0.00e+00	4.77e+05	3.38e+04
Te-127	2.77e+00	9.51e-01	6.10e-01	1.96e+00	7.07e+00	1.00e+04	5.62e+04
Te-127m	2.49e+04	8.55e+03	3.02e+03	6.07e+03	6.36e+04	1.48e+06	7.14e+04
Te-129	9.77e-02	3.50e-02	2.38e-02	7.14e-02	2.57e-01	2.93e+03	2.55e+04
Te-129m	1.92e+04	6.84e+03	3.04e+03	6.33e+03	5.03e+04	1.76e+06	1.82e+05
Te-131	2.17e-02	8.44e-03	6.59e-03	1.70e-02	5.88e-02	2.05e+03	1.33e+03
Te-131m	1.34e+02	5.92e+01	5.07e+01	9.77e+01	4.00e+02	2.06e+05	3.08e+05
Te-132	4.81e+02	2.72e+02	2.63e+02	3.17e+02	1.77e+03	3.77e+05	1.38e+05
Te-133m	1.08e-01	5.59e-02	5.55e-02	8.58e-02	3.74e-01	5.92e+03	1.76e+04
Te-134	5.66e-02	3.26e-02	3.48e-02	4.59e-02	2.11e-01	4.55e+03	1.80e+03
I-129	3.88e+04	2.37e+04	2.11e+04	1.58e+07	4.00e+04	0.00e+00	7.96e+02
I-130	8.18e+03	1.64e+04	8.44e+03	1.85e+06	2.45e+04	0.00e+00	5.11e+03
I-131	4.81e+04	4.81e+04	2.73e+04	1.62e+07	7.88e+04	0.00e+00	2.84e+03
I-132	2.12e+03	4.07e+03	1.88e+03	1.94e+05	6.25e+03	0.00e+00	3.20e+03
I-133	1.66e+04	2.03e+04	7.70e+03	3.85e+06	3.38e+04	0.00e+00	5.48e+03
I-134	1.17e+03	2.16e+03	9.95e+02	5.07e+04	3.30e+03	0.00e+00	9.55e+02
I-135	4.92e+03	8.73e+03	4.14e+03	7.92e+05	1.34e+04	0.00e+00	4.44e+03
Cs-134	6.51e+05	1.01e+06	2.25e+05	0.00e+00	3.30e+05	1.21e+05	3.85e+03
Cs-134m	2.34e+02	3.30e+02	2.26e+02	0.00e+00	1.83e+02	3.09e+01	2.93e+02

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.



Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	2.31e+05	1.53e+05	1.65e+04	0.00e+00	5.66e+04	1.93e+04	8.03e+02
Cs-136	6.51e+04	1.71e+05	1.16e+05	0.00e+00	9.55e+04	1.45e+04	4.18e+03
Cs-137	9.06e+05	8.25e+05	1.28e+05	0.00e+00	2.82e+05	1.04e+05	3.62e+03
Cs-138	6.33e+02	8.40e+02	5.55e+02	0.00e+00	6.22e+02	6.81e+01	2.70e+02
Cs-139	4.03e+02	4.26e+02	2.15e+02	0.00e+00	3.36e+02	3.46e+01	2.68e-02
Ba-139	1.84e+00	9.84e-04	5.36e-02	0.00e+00	8.62e-04	5.77e+03	5.77e+04
Ba-140	7.40e+04	6.48e+01	4.33e+03	0.00e+00	2.11e+01	1.74e+06	1.02e+05
Ba-141	1.96e-01	1.09e-04	6.36e-03	0.00e+00	9.47e-05	2.92e+03	2.75e+02
Ba-142	5.00e-02	3.60e-05	2.79e-03	0.00e+00	2.91e-05	1.64e+03	2.74e+00
La-140	6.44e+02	2.25e+02	7.55e+01	0.00e+00	0.00e+00	1.83e+05	2.26e+05
La-141	8.44e+00	1.96e+00	4.26e-01	0.00e+00	0.00e+00	1.66e+04	1.62e+05
La-142	1.30e+00	4.11e-01	1.29e-01	0.00e+00	0.00e+00	8.70e+03	7.58e+04
Ce-141	3.92e+04	1.95e+04	2.90e+03	0.00e+00	8.55e+03	5.44e+05	5.66e+04
Ce-143	3.66e+02	1.99e+02	2.87e+01	0.00e+00	8.36e+01	1.15e+05	1.27e+05
Ce-144	6.77e+06	2.12e+06	3.61e+05	0.00e+00	1.17e+06	1.20e+07	3.88e+05
Pr-143	1.85e+04	5.55e+03	9.14e+02	0.00e+00	3.00e+03	4.33e+05	9.73e+04
Pr-144	5.96e-02	1.85e-02	3.00e-03	0.00e+00	9.77e-03	1.57e+03	1.97e+02
Nd-147	1.08e+04	8.73e+03	6.81e+02	0.00e+00	4.81e+03	3.28e+05	8.21e+04
Pm-147	1.30e+06	9.32e+04	5.03e+04	0.00e+00	1.65e+05	8.14e+05	2.11e+04
Pm-148	5.96e+03	7.18e+02	4.62e+02	0.00e+00	1.22e+03	4.59e+05	2.22e+05
Pm-148m	1.22e+05	2.42e+04	2.42e+04	0.00e+00	3.60e+04	2.12e+06	1.32e+05
Pm-149	5.44e+02	5.77e+01	3.13e+01	0.00e+00	1.02e+02	8.88e+04	1.08e+05
Pm-151	1.32e+02	1.60e+01	1.04e+01	0.00e+00	2.72e+01	4.59e+04	9.25e+04
Sm-151	1.16e+06	1.76e+05	5.51e+04	0.00e+00	1.81e+05	5.48e+05	1.27e+04
Sm-153	2.68e+02	1.67e+02	1.61e+01	0.00e+00	5.07e+01	5.07e+04	6.92e+04
Eu-152	2.75e+06	5.07e+05	5.96e+05	0.00e+00	2.12e+06	3.33e+06	4.22e+04
Eu-154	1.01e+07	9.21e+05	8.40e+05	0.00e+00	4.03e+06	6.14e+06	1.10e+05
Eu-155	2.07e+06	1.50e+05	1.18e+05	0.00e+00	5.59e+05	1.03e+06	1.99e+05
Eu-156	2.92e+04	1.57e+04	3.24e+03	0.00e+00	1.01e+04	9.40e+05	1.57e+05
Tb-160	2.88e+05	0.00e+00	3.58e+04	0.00e+00	8.58e+04	1.98e+06	8.44e+04

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	4.96e+06	1.04e+06	8.77e+05	0.00e+00	1.48e+06	4.18e+06	6.03e+04
W-181	9.84e+01	2.41e+01	3.33e+00	0.00e+00	0.00e+00	2.11e+04	9.66e+02
W-185	3.07e+03	7.70e+02	1.08e+02	0.00e+00	0.00e+00	6.88e+05	4.11e+04
W-187	1.63e+01	9.66e+00	4.33e+00	0.00e+00	0.00e+00	4.11e+04	9.10e+04
Pb-210	2.97e+08	6.84e+07	1.18e+07	0.00e+00	2.33e+08	3.23e+08	5.74e+03
Bi-210	3.64e+03	1.89e+04	2.09e+03	0.00e+00	2.13e+05	1.37e+07	1.19e+05
Po-210	6.29e+06	1.02e+07	1.51e+06	0.00e+00	3.27e+07	3.88e+08	1.60e+05
Ra-223	2.85e+06	3.29e+03	5.70e+05	0.00e+00	8.73e+04	3.14e+08	1.11e+06
Ra-224	3.12e+05	5.66e+02	6.25e+04	0.00e+00	1.50e+04	1.08e+08	1.24e+06
Ra-225	4.74e+06	4.22e+03	9.47e+05	0.00e+00	1.12e+05	3.60e+08	1.05e+06
Ra-226	8.66e+08	2.83e+04	7.10e+08	0.00e+00	7.51e+05	1.44e+09	1.12e+06
Ra-228	5.51e+08	1.46e+04	6.22e+08	0.00e+00	3.85e+05	1.99e+09	1.90e+05
Ac-225	6.70e+06	6.92e+06	4.48e+05	0.00e+00	7.36e+05	2.73e+08	9.88e+05
Ac-227	1.84e+10	2.98e+09	1.14e+09	0.00e+00	6.55e+08	2.97e+09	1.93e+05
Th-227	3.42e+06	4.66e+04	9.88e+04	0.00e+00	2.47e+05	4.66e+08	1.29e+06
Th-228	2.98e+09	3.85e+07	1.01e+08	0.00e+00	2.00e+08	1.24e+10	1.33e+06
Th-229	8.07e+10	2.12e+09	1.34e+09	0.00e+00	1.05e+10	4.00e+10	1.85e+05
Th-230	1.22e+10	6.40e+08	3.40e+08	0.00e+00	3.15e+09	6.84e+09	1.42e+05
Th-232	1.36e+10	5.44e+08	4.74e+06	0.00e+00	2.69e+09	6.55e+09	1.21e+05
Th-234	2.57e+04	1.14e+03	7.40e+02	0.00e+00	5.99e+03	2.33e+06	2.71e+05
Pa-231	3.19e+10	1.06e+09	1.27e+09	0.00e+00	5.77e+09	7.10e+08	1.69e+05
Pa-233	1.53e+04	2.40e+03	2.68e+03	0.00e+00	8.81e+03	3.61e+05	3.31e+04
U-232	8.10e+08	0.00e+00	5.77e+07	0.00e+00	6.18e+07	2.75e+09	1.60e+05
U-233	1.72e+08	0.00e+00	1.04e+07	0.00e+00	2.82e+07	6.55e+08	1.48e+05
U-234	1.65e+08	0.00e+00	1.02e+07	0.00e+00	2.76e+07	6.44e+08	1.45e+05
U-235	1.58e+08	0.00e+00	9.58e+06	0.00e+00	2.59e+07	6.03e+08	1.84e+05
U-236	1.58e+08	0.00e+00	9.80e+06	0.00e+00	2.65e+07	6.18e+08	1.36e+05
U-237	5.81e+02	0.00e+00	1.54e+02	0.00e+00	1.68e+03	1.26e+05	4.77e+04
U-238	1.51e+08	0.00e+00	8.95e+06	0.00e+00	2.42e+07	5.66e+08	1.30e+05
Np-237	1.01e+10	5.99e+09	4.40e+08	0.00e+00	2.74e+09	6.44e+08	1.87e+05

Conversion factors are in units of mrem/yr per µCi/cubic meter.

## Offsite Dose Calculation Manual

## Attachment 5

## Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	4.66e+03	8.51e+02	7.29e+01	0.00e+00	3.02e+02	1.25e+05	9.25e+04
Np-239	4.66e+02	3.01e+02	2.35e+01	0.00e+00	9.73e+01	5.81e+04	6.40e+04
Pu-238	9.44e+09	5.92e+09	4.48e+08	0.00e+00	1.65e+09	2.25e+09	1.72e+05
Pu-239	1.03e+10	6.22e+09	4.74e+08	0.00e+00	1.77e+09	2.12e+09	1.57e+05
Pu-240	1.03e+10	6.22e+09	4.70e+08	0.00e+00	1.76e+09	2.11e+09	1.60e+05
Pu-241	2.94e+08	6.48e+07	1.08e+07	0.00e+00	4.07e+07	1.87e+06	3.29e+03
Pu-242	9.58e+09	5.99e+09	4.55e+08	0.00e+00	1.70e+09	2.04e+09	1.54e+05
Pu-244	1.12e+10	6.84e+09	5.22e+08	0.00e+00	1.95e+09	2.33e+09	2.29e+05
Am-241	1.10e+10	6.81e+09	4.59e+08	0.00e+00	2.82e+09	7.47e+08	1.75e+05
Am-242m	1.14e+10	6.51e+09	4.70e+08	0.00e+00	2.85e+09	3.01e+08	2.21e+05
Am-243	1.09e+10	6.59e+09	4.44e+08	0.00e+00	2.75e+09	7.10e+08	2.05e+05
Cm-242	3.51e+08	2.10e+08	1.55e+07	0.00e+00	4.96e+07	4.85e+08	1.87e+05
Cm-243	8.58e+09	5.25e+09	3.68e+08	0.00e+00	1.38e+09	7.77e+08	1.84e+05
Cm-244	7.18e+09	4.37e+09	3.07e+08	0.00e+00	1.13e+09	7.47e+08	1.78e+05
Cm-245	1.13e+10	6.81e+09	4.74e+08	0.00e+00	1.86e+09	7.22e+08	1.66e+05
Cm-246	1.12e+10	6.81e+09	4.74e+08	0.00e+00	1.86e+09	7.36e+08	1.63e+05
Cm-247	1.09e+10	6.73e+09	4.66e+08	0.00e+00	1.83e+09	7.22e+08	2.15e+05
Cm-248	9.06e+10	5.55e+10	3.85e+09	0.00e+00	1.51e+10	5.96e+09	3.46e+06
Cf-252	8.07e+09	0.00e+00	3.45e+08	0.00e+00	0.00e+00	2.45e+09	6.81e+05

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 5

Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	3.68e+02	3.68e+02	3.68e+02	3.68e+02	3.68e+02	3.68e+02
Be-10	1.33e+06	1.75e+05	3.71e+04	0.00e+00	0.00e+00	2.09e+06	2.42e+04
C-14	2.65e+04	5.31e+03	5.31e+03	5.31e+03	5.31e+03	5.31e+03	5.31e+03
N-13	6.15e+01	6.15e+01	6.15e+01	6.15e+01	6.15e+01	6.15e+01	6.15e+01
F-18	5.49e+03	0.00e+00	4.66e+02	0.00e+00	0.00e+00	0.00e+00	8.54e+02
Na-22	1.03e+05	1.03e+05	1.03e+05	1.03e+05	1.03e+05	1.03e+05	1.03e+05
Na-24	1.06e+04	1.06e+04	1.06e+04	1.06e+04	1.06e+04	1.06e+04	1.06e+04
P-32	2.03e+06	1.12e+05	7.74e+04	0.00e+00	0.00e+00	0.00e+00	1.61e+04
Ca-41	1.05e+05	0.00e+00	1.14e+04	0.00e+00	0.00e+00	9.72e+07	4.14e+02
Sc-46	5.25e+05	7.57e+05	2.37e+05	0.00e+00	4.98e+05	0.00e+00	3.07e+04
Cr-51	0.00e+00	0.00e+00	8.95e+01	5.75e+01	1.32e+01	1.28e+04	3.57e+02
Mn-54	0.00e+00	2.53e+04	4.98e+03	0.00e+00	4.98e+03	1.00e+06	7.06e+03
Mn-56	0.00e+00	1.54e+00	2.21e-01	0.00e+00	1.10e+00	1.25e+04	7.17e+04
Fe-55	1.97e+04	1.17e+04	3.33e+03	0.00e+00	0.00e+00	8.69e+04	1.09e+03
Fe-59	1.36e+04	2.35e+04	9.48e+03	0.00e+00	0.00e+00	1.01e+06	2.48e+04
Co-57	0.00e+00	6.51e+02	6.41e+02	0.00e+00	0.00e+00	3.79e+05	4.86e+03
Co-58	0.00e+00	1.22e+03	1.82e+03	0.00e+00	0.00e+00	7.77e+05	1.11e+04
Co-60	0.00e+00	8.02e+03	1.18e+04	0.00e+00	0.00e+00	4.51e+06	3.19e+04
Ni-59	2.53e+04	7.62e+03	4.34e+03	0.00e+00	0.00e+00	7.67e+04	8.88e+02
Ni-63	3.39e+05	2.04e+04	1.16e+04	0.00e+00	0.00e+00	2.09e+05	2.42e+03
Ni-65	2.39e+00	2.84e-01	1.23e-01	0.00e+00	0.00e+00	8.12e+03	5.01e+04
Cu-64	0.00e+00	1.88e+00	7.74e-01	0.00e+00	3.98e+00	9.30e+03	1.50e+04
Zn-65	1.93e+04	6.26e+04	3.11e+04	0.00e+00	3.25e+04	6.47e+05	5.14e+04
Zn-69	5.39e-02	9.67e-02	7.18e-03	0.00e+00	4.02e-02	1.47e+03	1.32e+04
Zn-69m	1.26e+01	2.58e+01	2.34e+00	0.00e+00	1.04e+01	2.67e+04	4.09e+04
Se-79	0.00e+00	3.15e+03	5.88e+02	0.00e+00	3.46e+03	4.19e+05	4.84e+03
Br-82	0.00e+00	0.00e+00	1.33e+04	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
Br-84	0.00e+00	0.00e+00	4.00e+02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	2.04e+01	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

## Offsite Dose Calculation Manual

## Attachment 5

## Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.90e+05	8.82e+04	0.00e+00	0.00e+00	0.00e+00	3.04e+03
Rb-87	0.00e+00	9.95e+04	3.70e+04	0.00e+00	0.00e+00	0.00e+00	4.19e+02
Rb-88	0.00e+00	5.57e+02	2.87e+02	0.00e+00	0.00e+00	0.00e+00	3.39e+02
Rb-89	0.00e+00	3.21e+02	2.06e+02	0.00e+00	0.00e+00	0.00e+00	6.82e+01
Sr-89	3.98e+05	0.00e+00	1.14e+04	0.00e+00	0.00e+00	2.03e+06	6.40e+04
Sr-90	1.55e+07	0.00e+00	3.12e+05	0.00e+00	0.00e+00	1.12e+07	1.31e+05
Sr-91	9.56e+01	0.00e+00	3.46e+00	0.00e+00	0.00e+00	5.26e+04	7.34e+04
Sr-92	1.05e+01	0.00e+00	3.91e-01	0.00e+00	0.00e+00	2.38e+04	1.40e+05
Y-90	3.29e+03	0.00e+00	8.82e+01	0.00e+00	0.00e+00	2.69e+05	1.04e+05
Y-91	5.88e+05	0.00e+00	1.57e+04	0.00e+00	0.00e+00	2.45e+06	7.03e+04
Y-91m	4.07e-01	0.00e+00	1.39e-02	0.00e+00	0.00e+00	2.79e+03	2.35e+03
Y-92	1.64e+01	0.00e+00	4.61e-01	0.00e+00	0.00e+00	2.45e+04	1.27e+05
Y-93	1.50e+02	0.00e+00	4.07e+00	0.00e+00	0.00e+00	7.64e+04	1.67e+05
Zr-93	3.14e+05	1.33e+04	8.65e+03	0.00e+00	4.47e+04	1.92e+05	2.07e+03
Zr-95	1.15e+05	2.79e+04	2.03e+04	0.00e+00	3.11e+04	1.75e+06	2.17e+04
Zr-97	1.50e+02	2.56e+01	1.17e+01	0.00e+00	2.59e+01	1.10e+05	1.40e+05
Nb-93m	1.93e+05	5.03e+04	1.61e+04	0.00e+00	5.15e+04	2.93e+05	3.46e+03
Nb-95	1.57e+04	6.43e+03	3.78e+03	0.00e+00	4.72e+03	4.79e+05	1.27e+04
Nb-97	3.42e-01	7.29e-02	2.63e-02	0.00e+00	5.70e-02	3.32e+03	2.69e+04
Mo-93	0.00e+00	9.04e+03	3.11e+02	0.00e+00	2.16e+03	4.76e+05	5.26e+03
Mo-99	0.00e+00	1.65e+02	3.23e+01	0.00e+00	2.65e+02	1.35e+05	4.87e+04
Tc-101	6.51e-05	8.23e-05	8.12e-04	0.00e+00	9.79e-04	5.84e+02	8.44e+02
Tc-99	2.93e+02	3.75e+02	1.24e+02	0.00e+00	3.49e+03	9.48e+05	1.09e+04
Tc-99m	1.40e-03	2.88e-03	3.72e-02	0.00e+00	3.11e-02	8.11e+02	2.03e+03
Ru-103	2.02e+03	0.00e+00	6.79e+02	0.00e+00	4.24e+03	5.52e+05	1.61e+04
Ru-105	1.22e+00	0.00e+00	4.10e-01	0.00e+00	8.99e-01	1.57e+04	4.84e+04
Ru-106	8.68e+04	0.00e+00	1.09e+04	0.00e+00	1.07e+05	1.16e+07	1.64e+05
Rh-105	1.16e+01	7.57e+00	5.08e+00	0.00e+00	2.10e+01	2.91e+04	1.92e+04
Pd-107	0.00e+00	6.89e+02	5.75e+01	0.00e+00	3.85e+03	8.88e+04	1.03e+03
Pd-109	0.00e+00	5.49e+00	1.47e+00	0.00e+00	1.79e+01	2.35e+04	3.99e+04

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

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Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	9.98e+03	7.22e+03	5.00e+03	0.00e+00	1.09e+04	3.67e+06	3.30e+04
Ag-111	5.25e+02	2.03e+02	1.08e+02	0.00e+00	4.27e+02	2.88e+05	4.23e+04
Cd-113m	0.00e+00	9.34e+05	3.70e+04	0.00e+00	8.12e+05	1.96e+06	2.31e+04
Cd-115m	0.00e+00	2.42e+05	8.67e+03	0.00e+00	1.32e+05	2.06e+06	7.03e+04
Sn-123	2.93e+05	5.89e+03	1.02e+04	5.98e+03	0.00e+00	3.11e+06	5.71e+04
Sn-125	1.41e+04	3.51e+02	8.40e+02	3.46e+02	0.00e+00	9.00e+05	1.02e+05
Sn-126	1.16e+06	2.02e+04	4.93e+04	5.38e+03	0.00e+00	6.90e+06	2.31e+04
Sb-124	3.79e+04	5.56e+02	1.20e+04	1.01e+02	0.00e+00	2.65e+06	5.91e+04
Sb-125	5.17e+04	4.77e+02	1.09e+04	6.23e+01	0.00e+00	1.64e+06	1.47e+04
Sb-126	4.31e+03	8.41e+01	1.55e+03	3.29e+01	0.00e+00	9.63e+05	7.46e+04
Sb-127	3.95e+02	7.06e+00	1.23e+02	5.04e+00	0.00e+00	2.16e+05	5.29e+04
Te-125m	4.76e+03	1.99e+03	6.58e+02	1.62e+03	0.00e+00	4.47e+05	1.29e+04
Te-127	2.23e+00	9.53e-01	4.89e-01	1.85e+00	4.86e+00	1.03e+04	2.44e+04
Te-127m	1.67e+04	6.90e+03	2.07e+03	4.87e+03	3.75e+04	1.31e+06	2.73e+04
Te-129	7.88e-02	3.47e-02	1.88e-02	6.75e-02	1.75e-01	3.00e+03	2.63e+04
Te-129m	1.41e+04	6.09e+03	2.23e+03	5.47e+03	3.18e+04	1.68e+06	6.90e+04
Te-131	1.74e-02	8.22e-03	5.00e-03	1.58e-02	3.99e-02	2.06e+03	8.22e+03
Te-131m	1.07e+02	5.50e+01	3.63e+01	8.93e+01	2.65e+02	1.99e+05	1.19e+05
Te-132	3.72e+02	2.37e+02	1.76e+02	2.79e+02	1.03e+03	3.40e+05	4.41e+04
Te-133m	8.58e-02	5.03e-02	3.84e-02	7.73e-02	2.41e-01	5.49e+03	2.23e+04
Te-134	4.45e-02	2.86e-02	2.35e-02	4.07e-02	1.34e-01	4.10e+03	3.54e+03
I-129	3.02e+04	2.23e+04	1.62e+04	1.46e+07	2.63e+04	0.00e+00	2.97e+02
I-130	6.36e+03	1.39e+04	5.57e+03	1.60e+06	1.53e+04	0.00e+00	1.99e+03
I-131	3.79e+04	4.44e+04	1.96e+04	1.48e+07	5.18e+04	0.00e+00	1.06e+03
I-132	1.69e+03	3.54e+03	1.26e+03	1.69e+05	3.95e+03	0.00e+00	1.90e+03
I-133	1.32e+04	1.92e+04	5.60e+03	3.56e+06	2.24e+04	0.00e+00	2.16e+03
I-134	9.21e+02	1.88e+03	6.65e+02	4.45e+04	2.09e+03	0.00e+00	1.29e+03
I-135	3.86e+03	7.60e+03	2.77e+03	6.96e+05	8.47e+03	0.00e+00	1.83e+03
Cs-134	3.96e+05	7.03e+05	7.45e+04	0.00e+00	1.90e+05	7.97e+04	1.33e+03
Cs-134m	1.85e+02	2.94e+02	1.55e+02	0.00e+00	1.19e+02	2.80e+01	1.62e+02

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

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Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.40e+05	1.21e+05	6.62e+03	0.00e+00	3.61e+04	1.41e+04	3.05e+02
Cs-136	4.83e+04	1.35e+05	5.29e+04	0.00e+00	5.64e+04	1.18e+04	1.43e+03
Cs-137	5.49e+05	6.12e+05	4.55e+04	0.00e+00	1.72e+05	7.13e+04	1.33e+03
Cs-138	5.05e+02	7.81e+02	3.98e+02	0.00e+00	4.10e+02	6.54e+01	8.76e+02
Cs-139	3.25e+02	4.24e+02	1.71e+02	0.00e+00	2.31e+02	3.54e+01	1.86e+01
Ba-139	1.48e+00	9.84e-04	4.30e-02	0.00e+00	5.92e-04	5.95e+03	5.10e+04
Ba-140	5.60e+04	5.60e+01	2.90e+03	0.00e+00	1.34e+01	1.60e+06	3.84e+04
Ba-141	1.57e-01	1.08e-04	4.97e-03	0.00e+00	6.50e-05	2.97e+03	4.75e+03
Ba-142	3.98e-02	3.30e-05	1.96e-03	0.00e+00	1.90e-05	1.55e+03	6.93e+02
La-140	5.05e+02	2.00e+02	5.15e+01	0.00e+00	0.00e+00	1.68e+05	8.48e+04
La-141	6.79e+00	1.96e+00	3.43e-01	0.00e+00	0.00e+00	1.71e+04	8.34e+04
La-142	1.03e+00	3.77e-01	9.04e-02	0.00e+00	0.00e+00	8.22e+03	5.95e+04
Ce-141	2.77e+04	1.67e+04	1.99e+03	0.00e+00	5.25e+03	5.17e+05	2.16e+04
Ce-143	2.93e+02	1.93e+02	2.21e+01	0.00e+00	5.64e+01	1.16e+05	4.97e+04
Ce-144	3.19e+06	1.21e+06	1.76e+05	0.00e+00	5.38e+05	9.84e+06	1.48e+05
Pr-143	1.40e+04	5.24e+03	6.99e+02	0.00e+00	1.97e+03	4.33e+05	3.72e+04
Pr-144	4.79e-02	1.85e-02	2.41e-03	0.00e+00	6.72e-03	1.61e+03	4.28e+03
Nd-147	7.94e+03	8.13e+03	5.00e+02	0.00e+00	3.15e+03	3.22e+05	3.12e+04
Pm-147	5.47e+05	4.30e+04	2.18e+04	0.00e+00	6.90e+04	6.37e+05	8.05e+03
Pm-148	4.68e+03	6.75e+02	3.42e+02	0.00e+00	8.06e+02	4.48e+05	8.46e+04
Pm-148m	7.00e+04	1.74e+04	1.39e+04	0.00e+00	2.03e+04	1.71e+06	4.72e+04
Pm-149	4.34e+02	5.71e+01	2.49e+01	0.00e+00	6.94e+01	9.10e+04	4.21e+04
Pm-151	1.05e+02	1.54e+01	7.77e+00	0.00e+00	1.82e+01	4.55e+04	3.61e+04
Sm-151	4.73e+05	9.03e+04	2.28e+04	0.00e+00	7.34e+04	4.17e+05	4.84e+03
Sm-153	2.14e+02	1.65e+02	1.27e+01	0.00e+00	3.46e+01	5.18e+04	2.70e+04
Eu-152	1.10e+06	2.48e+05	2.41e+05	0.00e+00	8.32e+05	2.07e+06	1.38e+04
Eu-154	4.14e+06	4.84e+05	3.43e+05	0.00e+00	1.60e+06	4.27e+06	3.98e+04
Eu-155	8.36e+05	8.01e+04	4.84e+04	0.00e+00	2.21e+05	7.28e+05	7.27e+04
Eu-156	2.18e+04	1.34e+04	2.16e+03	0.00e+00	6.27e+03	8.57e+05	5.80e+04
Tb-160	1.57e+05	0.00e+00	1.96e+04	0.00e+00	4.48e+04	1.55e+06	3.00e+04

Conversion factors are in units of mrem/yr per µCi/cubic meter.

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Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
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Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	2.03e+06	4.30e+05	3.51e+05	0.00e+00	5.91e+05	2.87e+06	2.31e+04
W-181	6.80e+01	2.04e+01	2.34e+00	0.00e+00	0.00e+00	1.86e+04	3.68e+02
W-185	2.20e+03	6.76e+02	7.81e+01	0.00e+00	0.00e+00	6.27e+05	1.57e+04
W-187	1.30e+01	9.02e+00	3.12e+00	0.00e+00	0.00e+00	3.96e+04	3.56e+04
Pb-210	1.21e+08	2.83e+07	4.80e+06	0.00e+00	9.59e+07	2.46e+08	2.20e+03
Bi-210	2.88e+03	1.86e+04	1.65e+03	0.00e+00	1.44e+05	1.39e+07	4.58e+04
Po-210	4.17e+06	7.88e+06	9.97e+05	0.00e+00	1.82e+07	3.36e+08	6.10e+04
Ra-223	2.18e+06	3.16e+03	4.37e+05	0.00e+00	5.82e+04	3.15e+08	4.26e+05
Ra-224	2.48e+05	5.60e+02	4.96e+04	0.00e+00	1.02e+04	1.11e+08	4.79e+05
Ra-225	3.60e+06	4.03e+03	7.18e+05	0.00e+00	7.43e+04	3.60e+08	4.02e+05
Ra-226	3.47e+08	2.04e+04	2.87e+08	0.00e+00	4.12e+05	1.10e+09	4.27e+05
Ra-228	2.24e+08	1.07e+04	2.52e+08	0.00e+00	2.14e+05	1.53e+09	7.27e+04
Ac-225	5.17e+06	6.61e+06	3.47e+05	0.00e+00	4.89e+05	2.74e+08	3.79e+05
Ac-227	7.41e+09	1.23e+09	4.59e+08	0.00e+00	2.60e+08	2.27e+09	7.38e+04
Th-227	2.55e+06	4.24e+04	7.34e+04	0.00e+00	1.58e+05	4.58e+08	4.94e+05
Th-228	1.18e+09	1.54e+07	4.00e+07	0.00e+00	7.85e+07	6.51e+09	5.07e+05
Th-229	3.19e+10	8.32e+08	5.33e+08	0.00e+00	1.30e+09	1.78e+10	7.03e+04
Th-230	4.84e+09	2.51e+08	1.35e+08	0.00e+00	1.23e+09	3.05e+09	5.42e+04
Th-232	5.40e+09	2.14e+08	3.21e+06	0.00e+00	1.06e+09	2.93e+09	4.61e+04
Th-234	1.86e+04	1.00e+03	5.38e+02	0.00e+00	3.78e+03	2.27e+06	1.04e+05
Pa-231	1.27e+10	4.20e+08	5.07e+08	0.00e+00	2.27e+09	5.39e+08	6.45e+04
Pa-233	9.58e+03	1.85e+03	1.67e+03	0.00e+00	5.15e+03	3.07e+05	1.27e+04
U-232	3.60e+08	0.00e+00	2.98e+07	0.00e+00	3.36e+07	2.09e+09	6.10e+04
U-233	7.62e+07	0.00e+00	5.36e+06	0.00e+00	1.53e+07	4.98e+08	5.64e+04
U-234	7.31e+07	0.00e+00	5.25e+06	0.00e+00	1.50e+07	4.89e+08	5.53e+04
U-235	7.01e+07	0.00e+00	4.93e+06	0.00e+00	1.41e+07	4.59e+08	7.03e+04
U-236	7.01e+07	0.00e+00	5.04e+06	0.00e+00	1.44e+07	4.69e+08	5.19e+04
U-237	4.55e+02	0.00e+00	1.21e+02	0.00e+00	1.13e+03	1.28e+05	1.83e+04
U-238	6.71e+07	0.00e+00	4.61e+06	0.00e+00	1.32e+07	4.28e+08	4.96e+04
Np-237	4.03e+09	2.39e+09	1.76e+08	0.00e+00	1.08e+09	4.89e+08	7.14e+04

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.



## Offsite Dose Calculation Manual

## Attachment 5

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## Inhalation Pathway Doses Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Inhalation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.74e+03	8.47e+02	5.82e+01	0.00e+00	2.06e+02	1.29e+05	3.61e+04
Np-239	3.71e+02	2.98e+02	1.88e+01	0.00e+00	6.62e+01	5.95e+04	2.49e+04
Pu-238	3.77e+09	2.35e+09	1.78e+08	0.00e+00	6.50e+08	1.26e+09	6.57e+04
Pu-239	4.10e+09	2.46e+09	1.88e+08	0.00e+00	6.93e+08	1.19e+09	5.99e+04
Pu-240	4.10e+09	2.45e+09	1.88e+08	0.00e+00	6.92e+08	1.19e+09	6.10e+04
Pu-241	1.18e+08	2.59e+07	4.35e+06	0.00e+00	1.61e+07	1.07e+06	1.26e+03
Pu-242	3.81e+09	2.37e+09	1.81e+08	0.00e+00	6.68e+08	1.14e+09	5.88e+04
Pu-244	4.44e+09	2.72e+09	2.07e+08	0.00e+00	7.64e+08	1.31e+09	8.76e+04
Am-241	4.41e+09	2.73e+09	1.83e+08	0.00e+00	1.11e+09	5.68e+08	6.69e+04
Am-242m	4.55e+09	2.60e+09	1.89e+08	0.00e+00	1.12e+09	2.30e+08	8.41e+04
Am-243	4.34e+09	2.63e+09	1.78e+08	0.00e+00	1.08e+09	5.39e+08	7.84e+04
Cm-242	1.79e+08	1.21e+08	7.98e+06	0.00e+00	2.37e+07	4.16e+08	7.14e+04
Cm-243	3.46e+09	2.13e+09	1.48e+08	0.00e+00	5.47e+08	5.94e+08	7.03e+04
Cm-244	2.90e+09	1.78e+09	1.24e+08	0.00e+00	4.49e+08	5.71e+08	6.80e+04
Cm-245	4.51e+09	2.74e+09	1.90e+08	0.00e+00	7.32e+08	5.49e+08	6.34e+04
Cm-246	4.48e+09	2.74e+09	1.90e+08	0.00e+00	7.32e+08	5.59e+08	6.23e+04
Cm-247	4.35e+09	2.70e+09	1.86e+08	0.00e+00	7.21e+08	5.49e+08	8.19e+04
Cm-248	3.61e+10	2.23e+10	1.54e+09	0.00e+00	5.94e+09	4.52e+09	1.32e+06
Cf-252	3.32e+09	0.00e+00	1.41e+08	0.00e+00	0.00e+00	1.92e+09	2.59e+05

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 6

Page 1 of 6

Ground – Plant Deposition Pathway Dose Factors Due to Radionuclides Other Than Noble Gas, R<sub>j</sub>

R<sub>i</sub> factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Ground Plane Exposure Pathway R<sub>i</sub>

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
H-3	0.00e+00	0.00e+00
Be-10	0.00e+00	0.00e+00
C-14	0.00e+00	0.00e+00
N-13	4.02e+04	4.66e+04
F-18	3.96e+05	4.66e+05
Na-22	1.14e+10	1.28e+10
Na-24	1.19e+07	1.39e+07
P-32	0.00e+00	0.00e+00
Ca-41	9.89e+09	1.16e+10
Sc-46	8.33e+08	9.61e+08
Cr-51	4.66e+06	5.51e+06
Mn-54	1.39e+09	1.63e+09
Mn-56	9.02e+05	1.07e+06
Fe-55	0.00e+00	0.00e+00
Fe-59	2.73e+08	3.21e+08
Co-57	1.88e+08	2.06e+08
Co-58	3.79e+08	4.44e+08
Co-60	2.15e+10	2.53e+10
Ni-59	0.00e+00	0.00e+00
Ni-63	0.00e+00	0.00e+00
Ni-65	2.97e+05	3.45e+05
Cu-64	6.07e+05	6.88e+05
Zn-65	7.47e+08	8.59e+08
Zn-69	0.00e+00	0.00e+00
Zn-69m	1.27e+06	1.49e+06
Se-79	0.00e+00	0.00e+00
Br-82	2.13e+07	2.47e+07
Br-83	4.87e+03	7.08e+03
Br-84	2.03e+05	2.36e+05
Br-85	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

## Offsite Dose Calculation Manual

## Attachment 6

Page 2 of 6

## Ground – Plant Deposition Pathway Dose Factors Due to Radionuclides Other Than Noble Gas, Rj

Ri factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Ground Plane Exposure Pathway Ri

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Rb-86	8.99e+06	1.03e+07
Rb-87	0.00e+00	0.00e+00
Rb-88	3.31e+04	3.78e+04
Rb-89	1.23e+05	1.48e+05
Sr-89	2.16e+04	2.51e+04
Sr-90	0.00e+00	0.00e+00
Sr-91	2.15e+06	2.51e+06
Sr-92	7.77e+05	8.63e+05
Y-90	4.49e+03	5.31e+03
Y-91	1.07e+06	1.21e+06
Y-91m	1.00e+05	1.16e+05
Y-92	1.80e+05	2.14e+05
Y-93	1.83e+05	2.51e+05
Zr-93	0.00e+00	0.00e+00
Zr-95	2.45e+08	2.84e+08
Zr-97	2.96e+06	3.44e+06
Nb-93m	1.66e+06	2.03e+08
Nb-95	1.37e+08	1.61e+08
Nb-97	1.80e+05	2.12e+05
Mo-93	6.63e+07	2.70e+09
Mo-99	3.99e+06	4.63e+06
Tc-101	2.04e+04	2.26e+04
Tc-99	0.00e+00	0.00e+00
Tc-99m	1.84e+05	2.11e+05
Ru-103	1.08e+08	1.26e+08
Ru-105	6.36e+05	7.21e+05
Ru-106	4.22e+08	5.07e+08
Rh-105	7.42e+05	8.65e+05
Pd-107	0.00e+00	0.00e+00
Pd-109	1.50e+04	1.72e+04

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

## Offsite Dose Calculation Manual

## Attachment 6

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## Ground – Plant Deposition Pathway Dose Factors Due to Radionuclides Other Than Noble Gas, Rj

Ri factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Ground Plane Exposure Pathway Ri

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Ag-110m	3.44e+09	4.01e+09
Ag-111	1.02e+06	1.20e+06
Cd-113m	4.77e+06	5.39e+06
Cd-115m	0.00e+00	0.00e+00
Sn-123	0.00e+00	6.37e+09
Sn-125	4.19e+06	4.85e+06
Sn-126	2.61e+10	2.90e+10
Sb-124	5.98e+08	6.90e+08
Sb-125	2.34e+09	2.64e+09
Sb-126	8.50e+07	9.55e+07
Sb-127	1.69e+07	1.95e+07
Te-125m	1.55e+06	2.13e+06
Te-127	2.98e+03	3.28e+03
Te-127m	9.16e+04	1.08e+05
Te-129	2.62e+04	3.10e+04
Te-129m	1.98e+07	2.31e+07
Te-131	2.92e+04	3.45e+07
Te-131m	8.03e+06	9.46e+06
Te-132	4.23e+06	4.98e+06
Te-133m	4.41e+05	5.00e+05
Te-134	2.22e+04	2.66e+04
I-129	1.31e+09	2.18e+09
I-130	5.51e+06	6.69e+06
I-131	1.72e+07	2.09e+07
I-132	1.25e+06	1.46e+06
I-133	2.45e+06	2.98e+06
I-134	4.47e+05	5.30e+05
I-135	2.53e+06	2.95e+06
Cs-134	6.86e+09	8.00e+09
Cs-134m	5.73e+04	6.74e+04

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

## Offsite Dose Calculation Manual

## Attachment 6

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## Ground – Plant Deposition Pathway Dose Factors Due to Radionuclides Other Than Noble Gas, Rj

Ri factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Ground Plane Exposure Pathway Ri

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Cs-135	0.00e+00	0.00e+00
Cs-136	1.51e+08	1.71e+08
Cs-137	1.03e+10	1.20e+10
Cs-138	3.59e+05	4.10e+05
Cs-139	3.14e+04	3.59e+04
Ba-139	1.06e+05	1.19e+05
Ba-140	2.05e+07	2.35e+07
Ba-141	4.17e+04	4.75e+04
Ba-142	4.49e+04	5.11e+04
La-140	1.92e+07	2.18e+07
La-141	3.13e+04	3.50e+04
La-142	7.60e+05	9.11e+05
Ce-141	1.37e+07	1.54e+07
Ce-143	2.31e+06	2.63e+06
Ce-144	6.95e+07	8.04e+07
Pr-143	0.00e+00	0.00e+00
Pr-144	1.83e+03	2.11e+03
Nd-147	8.39e+06	1.01e+07
Pm-147	0.00e+00	0.00e+00
Pm-148	1.89e+07	2.18e+07
Pm-148m	4.45e+08	2.58e+09
Pm-149	4.22e+04	4.90e+04
Pm-151	1.98e+06	2.07e+06
Sm-151	1.32e+08	5.76e+08
Sm-153	4.02e+05	4.47e+05
Eu-152	1.46e+10	1.69e+10
Eu-154	2.19e+10	2.53e+10
Eu-155	1.91e+08	2.17e+08
Eu-156	8.83e+07	1.01e+08
Tb-160	4.74e+08	5.51e+08

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

## Offsite Dose Calculation Manual

## Attachment 6

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## Ground – Plant Deposition Pathway Dose Factors Due to Radionuclides Other Than Noble Gas, Rj

Ri factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Ground Plane Exposure Pathway Ri

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Ho-166m	2.57e+10	2.89e+10
W-181	1.94e+05	2.59e+05
W-185	0.00e+00	0.00e+00
W-187	2.35e+06	2.73e+06
Pb-210	2.95e+07	3.86e+07
Bi-210	0.00e+00	0.00e+00
Po-210	5.70e+03	6.54e+03
Ra-223	1.31e+07	1.57e+07
Ra-224	2.49e+07	2.80e+07
Ra-225	9.50e+05	1.36e+06
Ra-226	1.85e+10	2.14e+10
Ra-228	1.61e+10	1.88e+10
Ac-225	1.22e+07	1.38e+07
Ac-227	4.61e+09	5.54e+09
Th-227	7.21e+06	8.91e+06
Th-228	4.72e+09	5.31e+09
Th-229	6.38e+09	7.83e+09
Th-230	1.89e+10	2.18e+10
Th-232	8.70e+09	1.16e+10
Th-234	2.03e+06	2.39e+06
Pa-231	6.38e+09	7.83e+09
Pa-233	2.72e+07	3.14e+07
U-232	7.00e+06	7.27e+07
U-233	6.67e+09	8.12e+09
U-234	1.83e+06	4.61e+08
U-235	9.28e+09	1.16e+10
U-236	6.09e+04	5.22e+07
U-237	5.16e+06	6.71e+06
U-238	3.19e+08	4.35e+08
Np-237	4.06e+09	4.64e+09

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

Offsite Dose Calculation Manual

Attachment 6

Ground – Plant Deposition Pathway Dose Factors Due to Radionuclides Other Than Noble Gas, Rj

Ri factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Ground Plane Exposure Pathway Ri

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Np-238	4.54e+06	5.19e+06
Np-239	1.71e+06	1.98e+06
Pu-238	3.56e+06	4.92e+07
-----		
Pu-239	2.29e+06	2.23e+07
Pu-240	3.77e+06	5.22e+07
Pu-241	9.66e+06	1.43e+07
-----		
Pu-242	3.19e+06	4.64e+07
Pu-244	2.60e+09	2.79e+09
Am-241	1.98e+08	2.86e+08
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Am-242m	7.29e+07	5.05e+08
Am-243	3.77e+09	4.35e+09
Cm-242	6.85e+05	2.87e+06
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Cm-243	5.59e+09	7.05e+09
Cm-244	6.40e+06	3.97e+07
Cm-245	2.75e+09	3.48e+09
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Cm-246	2.90e+06	4.35e+07
Cm-247	6.38e+09	7.54e+09
Cm-248	1.98e+10	1.52e+10
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Cf-252	4.46e+10	4.87e+10

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, R<sub>i</sub>

R<sub>i</sub> factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway R<sub>i</sub>

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	4.35e+02	4.35e+02	4.35e+02	4.35e+02	4.35e+02	4.35e+02
Be-10	2.46e+06	3.79e+05	6.14e+04	0.00e+00	2.87e+05	0.00e+00	2.07e+07
C-14	2.63e+08	5.27e+07	5.27e+07	5.27e+07	5.27e+07	5.27e+07	5.27e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	4.65e-03	0.00e+00	5.15e-04	0.00e+00	0.00e+00	0.00e+00	1.38e-04
Na-22	5.29e+09	5.29e+09	5.29e+09	5.29e+09	5.29e+09	5.29e+09	5.29e+09
Na-24	2.44e+06	2.44e+06	2.44e+06	2.44e+06	2.44e+06	2.44e+06	2.44e+06
P-32	1.71e+10	1.06e+09	6.61e+08	0.00e+00	0.00e+00	0.00e+00	1.92e+09
Ca-41	1.14e+10	0.00e+00	1.24e+09	0.00e+00	0.00e+00	0.00e+00	1.14e+07
Sc-46	1.79e+02	3.48e+02	1.01e+02	0.00e+00	3.25e+02	0.00e+00	1.70e+06
Cr-51	0.00e+00	0.00e+00	2.86e+04	1.71e+04	6.30e+03	3.79e+04	7.19e+06
Mn-54	0.00e+00	8.41e+06	1.61e+06	0.00e+00	2.50e+06	0.00e+00	2.58e+07
Mn-56	0.00e+00	4.15e-03	7.37e-04	0.00e+00	5.27e-03	0.00e+00	1.33e-01
Fe-55	2.51e+07	1.73e+07	4.05e+06	0.00e+00	0.00e+00	9.68e+06	9.95e+06
Fe-59	2.97e+07	6.98e+07	2.68e+07	0.00e+00	0.00e+00	1.95e+07	2.33e+08
Co-57	0.00e+00	1.28e+06	2.13e+06	0.00e+00	0.00e+00	0.00e+00	3.25e+07
Co-58	0.00e+00	4.71e+06	1.06e+07	0.00e+00	0.00e+00	0.00e+00	9.55e+07
Co-60	0.00e+00	1.64e+07	3.62e+07	0.00e+00	0.00e+00	0.00e+00	3.08e+08
Ni-59	5.05e+08	1.73e+08	8.44e+07	0.00e+00	0.00e+00	0.00e+00	3.57e+07
Ni-63	6.73e+09	4.66e+08	2.26e+08	0.00e+00	0.00e+00	0.00e+00	9.73e+07
Ni-65	3.76e-01	4.88e-02	2.23e-02	0.00e+00	0.00e+00	0.00e+00	1.24e+00
Cu-64	0.00e+00	2.39e+04	1.12e+04	0.00e+00	6.03e+04	0.00e+00	2.04e+06
Zn-65	1.37e+09	4.37e+09	1.97e+09	0.00e+00	2.92e+09	0.00e+00	2.75e+09
Zn-69	2.18e-12	4.17e-12	2.90e-13	0.00e+00	2.71e-12	0.00e+00	6.26e-13
Zn-69m	1.81e+05	4.35e+05	3.98e+04	0.00e+00	2.64e+05	0.00e+00	2.66e+07
Se-79	0.00e+00	9.15e+08	1.53e+08	0.00e+00	1.58e+09	0.00e+00	1.87e+08
Br-82	0.00e+00	0.00e+00	3.23e+07	0.00e+00	0.00e+00	0.00e+00	3.70e+07
Br-83	0.00e+00	0.00e+00	9.87e-02	0.00e+00	0.00e+00	0.00e+00	1.42e-01
Br-84	0.00e+00	0.00e+00	1.73e-23	0.00e+00	0.00e+00	0.00e+00	1.36e-28
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.59e+09	1.21e+09	0.00e+00	0.00e+00	0.00e+00	5.12e+08
Rb-87	0.00e+00	2.85e+09	9.92e+08	0.00e+00	0.00e+00	0.00e+00	1.34e+08
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	1.45e+09	0.00e+00	4.16e+07	0.00e+00	0.00e+00	0.00e+00	2.33e+08
Sr-90	5.38e+10	0.00e+00	1.08e+09	0.00e+00	0.00e+00	0.00e+00	1.35e+09
Sr-91	2.90e+04	0.00e+00	1.17e+03	0.00e+00	0.00e+00	0.00e+00	1.38e+05
Sr-92	4.95e-01	0.00e+00	2.14e-02	0.00e+00	0.00e+00	0.00e+00	9.81e+00
Y-90	7.09e+01	0.00e+00	1.90e+00	0.00e+00	0.00e+00	0.00e+00	7.52e+05
Y-91	8.59e+03	0.00e+00	2.30e+02	0.00e+00	0.00e+00	0.00e+00	4.73e+06
Y-91m	6.27e-20	0.00e+00	2.43e-21	0.00e+00	0.00e+00	0.00e+00	1.84e-19
Y-92	5.64e-05	0.00e+00	1.65e-06	0.00e+00	0.00e+00	0.00e+00	9.88e-01
Y-93	2.24e-01	0.00e+00	6.19e-03	0.00e+00	0.00e+00	0.00e+00	7.11e+03
Zr-93	1.62e+03	9.04e+01	4.21e+01	0.00e+00	3.43e+02	0.00e+00	9.39e+04
Zr-95	9.43e+02	3.03e+02	2.05e+02	0.00e+00	4.75e+02	0.00e+00	9.59e+05
Zr-97	4.34e-01	8.76e-02	4.01e-02	0.00e+00	1.32e-01	0.00e+00	2.71e+04
Nb-93m	4.91e+05	1.60e+05	3.95e+04	0.00e+00	1.84e+05	0.00e+00	7.40e+07
Nb-95	8.26e+04	4.59e+04	2.47e+04	0.00e+00	4.54e+04	0.00e+00	2.79e+08
Nb-97	6.58e-12	1.66e-12	6.07e-13	0.00e+00	1.94e-12	0.00e+00	6.14e-09
Mo-93	0.00e+00	4.35e+08	1.18e+07	0.00e+00	1.23e+08	0.00e+00	7.07e+07
Mo-99	0.00e+00	2.48e+07	4.72e+06	0.00e+00	5.61e+07	0.00e+00	5.74e+07
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	2.42e+07	3.59e+07	9.70e+06	0.00e+00	4.52e+08	3.05e+06	1.17e+09
Tc-99m	3.34e+00	9.44e+00	1.20e+02	0.00e+00	1.43e+02	4.63e+00	5.59e+03
Ru-103	1.02e+03	0.00e+00	4.39e+02	0.00e+00	3.89e+03	0.00e+00	1.19e+05
Ru-105	8.64e-04	0.00e+00	3.41e-04	0.00e+00	1.12e-02	0.00e+00	5.29e-01
Ru-106	2.04e+04	0.00e+00	2.58e+03	0.00e+00	3.94e+04	0.00e+00	1.32e+06
Rh-105	3.46e+05	2.53e+05	1.67e+05	0.00e+00	1.08e+06	0.00e+00	4.03e+07
Pd-107	0.00e+00	1.14e+07	7.26e+05	0.00e+00	1.02e+08	0.00e+00	7.04e+07
Pd-109	0.00e+00	4.49e+04	1.01e+04	0.00e+00	2.56e+05	0.00e+00	4.98e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	5.82e+07	5.39e+07	3.20e+07	0.00e+00	1.06e+08	0.00e+00	2.20e+10
Ag-111	6.47e+06	2.71e+06	1.35e+06	0.00e+00	8.74e+06	0.00e+00	4.97e+09
Cd-113m	0.00e+00	2.94e+06	9.43e+04	0.00e+00	3.24e+06	0.00e+00	2.37e+07
Cd-115m	0.00e+00	1.26e+06	4.02e+04	0.00e+00	9.99e+05	0.00e+00	5.30e+07
Sn-123	5.36e+08	8.88e+06	1.31e+07	7.55e+06	0.00e+00	0.00e+00	1.09e+09
Sn-125	5.68e+07	1.14e+06	2.58e+06	9.47e+05	0.00e+00	0.00e+00	7.09e+08
Sn-126	1.63e+09	3.23e+07	4.64e+07	9.51e+06	0.00e+00	0.00e+00	4.69e+08
Sb-124	2.57e+07	4.86e+05	1.02e+07	6.24e+04	0.00e+00	2.00e+07	7.31e+08
Sb-125	2.04e+07	2.28e+05	4.86e+06	2.08e+04	0.00e+00	1.58e+07	2.25e+08
Sb-126	5.63e+06	1.15e+05	2.03e+06	3.45e+04	0.00e+00	3.45e+06	4.60e+08
Sb-127	4.53e+05	9.93e+03	1.74e+05	5.45e+03	0.00e+00	2.69e+05	1.04e+08
Te-125m	1.63e+07	5.90e+06	2.18e+06	4.90e+06	6.63e+07	0.00e+00	6.50e+07
Te-127	6.56e+02	2.35e+02	1.42e+02	4.86e+02	2.67e+03	0.00e+00	5.17e+04
Te-127m	4.58e+07	1.64e+07	5.58e+06	1.17e+07	1.86e+08	0.00e+00	1.53e+08
Te-129	2.92e-10	1.10e-10	7.11e-11	2.24e-10	1.23e-09	0.00e+00	2.20e-10
Te-129m	6.02e+07	2.25e+07	9.53e+06	2.07e+07	2.51e+08	0.00e+00	3.03e+08
Te-131	3.95e-33	1.65e-33	1.25e-33	3.25e-33	1.73e-32	0.00e+00	5.60e-34
Te-131m	3.62e+05	1.77e+05	1.47e+05	2.80e+05	1.79e+06	0.00e+00	1.76e+07
Te-132	2.40e+06	1.55e+06	1.46e+06	1.72e+06	1.50e+07	0.00e+00	7.35e+07
Te-133m	2.19e-13	1.28e-13	1.24e-13	1.86e-13	1.27e-12	0.00e+00	4.40e-14
Te-134	9.41e-19	6.16e-19	3.78e-19	8.22e-19	5.95e-18	0.00e+00	1.04e-21
I-129	7.58e+08	6.51e+08	2.14e+09	1.68e+12	1.40e+09	0.00e+00	1.03e+08
I-130	4.21e+05	1.24e+06	4.90e+05	1.05e+08	1.94e+06	0.00e+00	1.07e+06
I-131	2.96e+08	4.24e+08	2.43e+08	1.39e+11	7.26e+08	0.00e+00	1.12e+08
I-132	1.67e-01	4.47e-01	1.56e-01	1.56e+01	7.12e-01	0.00e+00	8.39e-02
I-133	3.88e+06	6.74e+06	2.06e+06	9.91e+08	1.18e+07	0.00e+00	6.06e+06
I-134	2.11e-12	5.72e-12	2.05e-12	9.92e-11	9.10e-12	0.00e+00	4.99e-15
I-135	1.29e+04	3.38e+04	1.25e+04	2.23e+06	5.42e+04	0.00e+00	3.82e+04
Cs-134	5.65e+09	1.34e+10	1.10e+10	0.00e+00	4.35e+09	1.44e+09	2.35e+08
Cs-134m	1.76e-01	3.70e-01	1.89e-01	0.00e+00	2.01e-01	3.16e-02	1.31e-01

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.81e+09	1.67e+09	7.41e+08	0.00e+00	6.32e+08	1.89e+08	3.90e+07
Cs-136	2.63e+08	1.04e+09	7.48e+08	0.00e+00	5.78e+08	7.93e+07	1.18e+08
Cs-137	7.38e+09	1.01e+10	6.61e+09	0.00e+00	3.43e+09	1.14e+09	1.95e+08
Cs-138	9.72e-24	1.92e-23	9.50e-24	0.00e+00	1.41e-23	1.39e-24	8.18e-29
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	2.69e+07	3.38e+04	1.76e+06	0.00e+00	1.15e+04	1.93e+04	5.54e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	3.00e-05	9.31e-06	1.52e-06	0.00e+00	0.00e+00	0.00e+00	1.11e+00
La-142	1.90e-11	8.66e-12	2.16e-12	0.00e+00	0.00e+00	0.00e+00	6.32e-08
Ce-141	4.84e+03	3.28e+03	3.72e+02	0.00e+00	1.52e+03	0.00e+00	1.25e+07
Ce-143	4.16e+01	3.08e+04	3.40e+00	0.00e+00	1.35e+01	0.00e+00	1.15e+06
Ce-144	3.58e+05	1.50e+05	1.92e+04	0.00e+00	8.87e+04	0.00e+00	1.21e+08
Pr-143	1.58e+02	6.33e+01	7.83e+00	0.00e+00	3.66e+01	0.00e+00	6.92e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	9.42e+01	1.09e+02	6.51e+00	0.00e+00	6.36e+01	0.00e+00	5.22e+05
Pm-147	2.87e+03	2.70e+02	1.09e+02	0.00e+00	5.10e+02	0.00e+00	3.40e+05
Pm-148	5.93e+01	9.85e+00	4.96e+00	0.00e+00	1.86e+01	0.00e+00	7.74e+05
Pm-148m	8.57e+02	2.22e+02	1.70e+02	0.00e+00	3.35e+02	0.00e+00	1.88e+06
Pm-149	4.28e+00	6.05e-01	2.47e-01	0.00e+00	1.14e+00	0.00e+00	1.13e+05
Pm-151	6.47e-01	1.09e-01	5.48e-02	0.00e+00	1.94e-01	0.00e+00	2.99e+04
Sm-151	2.67e+03	4.60e+02	1.10e+02	0.00e+00	5.14e+02	0.00e+00	2.03e+05
Sm-153	1.99e+00	1.66e+00	1.21e-01	0.00e+00	5.36e-01	0.00e+00	5.92e+04
Eu-152	7.51e+03	1.71e+03	1.50e+03	0.00e+00	1.06e+04	0.00e+00	9.86e+05
Eu-154	2.38e+04	2.92e+03	2.08e+03	0.00e+00	1.40e+04	0.00e+00	2.12e+06
Eu-155	3.25e+03	4.61e+02	2.97e+02	0.00e+00	2.13e+03	0.00e+00	3.62e+05
Eu-156	2.52e+02	1.95e+02	3.14e+01	0.00e+00	1.30e+02	0.00e+00	1.33e+06
Tb-160	1.49e+03	0.00e+00	1.86e+02	0.00e+00	6.16e+02	0.00e+00	1.37e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.04e+04	3.26e+03	2.47e+03	0.00e+00	4.87e+03	0.00e+00	9.89e+05
W-181	3.39e+04	1.11e+04	1.18e+03	0.00e+00	0.00e+00	0.00e+00	1.26e+06
W-185	1.29e+06	4.32e+05	4.54e+04	0.00e+00	0.00e+00	0.00e+00	4.99e+07
W-187	6.52e+03	5.45e+03	1.91e+03	0.00e+00	0.00e+00	0.00e+00	1.79e+06
Pb-210	7.32e+10	2.09e+10	2.60e+09	0.00e+00	5.88e+10	0.00e+00	1.07e+07
Bi-210	3.56e+05	2.46e+06	2.04e+05	0.00e+00	2.96e+07	0.00e+00	3.67e+07
Po-210	7.42e+08	1.58e+09	1.79e+08	0.00e+00	5.25e+09	0.00e+00	1.33e+08
Ra-223	1.22e+11	1.88e+08	2.44e+10	0.00e+00	5.33e+09	0.00e+00	7.89e+09
Ra-224	1.41e+10	3.42e+07	2.83e+09	0.00e+00	9.65e+08	0.00e+00	2.98e+09
Ra-225	1.90e+11	2.25e+08	3.79e+10	0.00e+00	6.39e+09	0.00e+00	8.85e+09
Ra-226	1.87e+13	3.55e+08	1.36e+13	0.00e+00	1.01e+10	0.00e+00	2.05e+10
Ra-228	6.87e+12	1.91e+08	7.43e+12	0.00e+00	5.42e+09	0.00e+00	3.46e+09
Ac-225	6.17e+04	8.49e+04	4.15e+03	0.00e+00	9.67e+03	0.00e+00	5.70e+06
Ac-227	7.21e+07	9.56e+06	4.28e+06	0.00e+00	3.09e+06	0.00e+00	3.16e+06
Th-227	2.80e+05	5.06e+03	8.06e+03	0.00e+00	2.88e+04	0.00e+00	1.10e+07
Th-228	1.88e+07	3.18e+05	6.35e+05	0.00e+00	1.77e+06	0.00e+00	2.13e+07
Th-229	5.26e+08	1.50e+07	8.69e+06	0.00e+00	7.26e+07	0.00e+00	3.02e+06
Th-230	7.96e+07	4.52e+06	2.20e+06	0.00e+00	2.18e+07	0.00e+00	2.33e+06
Th-232	8.89e+07	3.86e+06	5.80e+04	0.00e+00	1.86e+07	0.00e+00	1.98e+06
Th-234	1.85e+03	1.09e+02	5.33e+01	0.00e+00	6.16e+02	0.00e+00	2.61e+06
Pa-231	1.58e+08	5.95e+06	6.14e+06	0.00e+00	3.34e+07	0.00e+00	2.77e+06
Pa-233	1.28e+02	2.58e+01	2.22e+01	0.00e+00	9.70e+01	0.00e+00	3.99e+05
U-232	1.59e+10	0.00e+00	1.14e+09	0.00e+00	1.73e+09	0.00e+00	2.62e+08
U-233	3.37e+09	0.00e+00	2.04e+08	0.00e+00	7.84e+08	0.00e+00	2.42e+08
U-234	3.23e+09	0.00e+00	2.00e+08	0.00e+00	7.69e+08	0.00e+00	2.37e+08
U-235	3.10e+09	0.00e+00	1.88e+08	0.00e+00	7.23e+08	0.00e+00	3.02e+08
U-236	3.10e+09	0.00e+00	1.92e+08	0.00e+00	7.38e+08	0.00e+00	2.23e+08
U-237	5.65e+04	0.00e+00	1.50e+04	0.00e+00	2.32e+05	0.00e+00	1.99e+07
U-238	2.96e+09	0.00e+00	1.75e+08	0.00e+00	6.76e+08	0.00e+00	2.13e+08
Np-237	4.87e+07	3.46e+06	2.14e+06	0.00e+00	1.59e+07	0.00e+00	3.07e+06

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## Offsite Dose Calculation Manual

## Attachment 7

## Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.62e+01	9.75e-01	5.63e-01	0.00e+00	3.30e+00	0.00e+00	9.06e+04
Np-239	3.68e+00	3.61e-01	1.99e-01	0.00e+00	1.13e+00	0.00e+00	7.41e+04
Pu-238	9.73e+06	1.23e+06	2.64e+05	0.00e+00	1.13e+06	0.00e+00	1.13e+06
Pu-239	1.12e+07	1.35e+06	2.95e+05	0.00e+00	1.25e+06	0.00e+00	1.03e+06
Pu-240	1.12e+07	1.34e+06	2.95e+05	0.00e+00	1.25e+06	0.00e+00	1.05e+06
Pu-241	2.42e+05	1.15e+04	5.12e+03	0.00e+00	2.36e+04	0.00e+00	2.16e+04
Pu-242	1.04e+07	1.30e+06	2.84e+05	0.00e+00	1.21e+06	0.00e+00	1.01e+06
Pu-244	1.21e+07	1.49e+06	3.26e+05	0.00e+00	1.38e+06	0.00e+00	1.50e+06
Am-241	2.89e+07	2.70e+07	2.07e+06	0.00e+00	1.56e+07	0.00e+00	2.84e+06
Am-242m	2.94e+07	2.56e+07	2.10e+06	0.00e+00	1.56e+07	0.00e+00	3.61e+06
Am-243	2.91e+07	2.67e+07	2.05e+06	0.00e+00	1.54e+07	0.00e+00	3.36e+06
Cm-242	7.27e+05	7.73e+05	4.83e+04	0.00e+00	2.19e+05	0.00e+00	2.79e+06
Cm-243	2.31e+07	2.12e+07	1.45e+06	0.00e+00	6.75e+06	0.00e+00	3.01e+06
Cm-244	1.76e+07	1.65e+07	1.11e+06	0.00e+00	5.17e+06	0.00e+00	2.91e+06
Cm-245	3.62e+07	3.16e+07	2.23e+06	0.00e+00	1.04e+07	0.00e+00	2.72e+06
Cm-246	3.59e+07	3.15e+07	2.22e+06	0.00e+00	1.04e+07	0.00e+00	2.67e+06
Cm-247	3.50e+07	3.11e+07	2.19e+06	0.00e+00	1.02e+07	0.00e+00	3.51e+06
Cm-248	2.91e+08	2.56e+08	1.80e+07	0.00e+00	8.42e+07	0.00e+00	5.68e+07
Cf-252	9.92e+06	0.00e+00	2.39e+05	0.00e+00	0.00e+00	0.00e+00	1.09e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	5.66e+02	5.66e+02	5.66e+02	5.66e+02	5.66e+02	5.66e+02
Be-10	4.47e+06	6.92e+05	1.13e+05	0.00e+00	5.29e+05	0.00e+00	2.83e+07
C-14	4.86e+08	9.72e+07	9.72e+07	9.72e+07	9.72e+07	9.72e+07	9.72e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	8.30e-03	0.00e+00	9.10e-04	0.00e+00	0.00e+00	0.00e+00	7.48e-04
Na-22	9.18e+09	9.18e+09	9.18e+09	9.18e+09	9.18e+09	9.18e+09	9.18e+09
Na-24	4.27e+06	4.27e+06	4.27e+06	4.27e+06	4.27e+06	4.27e+06	4.27e+06
P-32	3.15e+10	1.95e+09	1.22e+09	0.00e+00	0.00e+00	0.00e+00	2.65e+09
Ca-41	1.57e+10	0.00e+00	1.70e+09	0.00e+00	0.00e+00	0.00e+00	1.56e+07
Sc-46	3.04e+02	5.92e+02	1.76e+02	0.00e+00	5.67e+02	0.00e+00	2.02e+06
Cr-51	0.00e+00	0.00e+00	4.99e+04	2.77e+04	1.09e+04	7.13e+04	8.39e+06
Mn-54	0.00e+00	1.40e+07	2.78e+06	0.00e+00	4.18e+06	0.00e+00	2.87e+07
Mn-56	0.00e+00	7.36e-03	1.31e-03	0.00e+00	9.32e-03	0.00e+00	4.85e-01
Fe-55	4.45e+07	3.16e+07	7.36e+06	0.00e+00	0.00e+00	2.00e+07	1.37e+07
Fe-59	5.18e+07	1.21e+08	4.67e+07	0.00e+00	0.00e+00	3.81e+07	2.86e+08
Co-57	0.00e+00	2.24e+06	3.76e+06	0.00e+00	0.00e+00	0.00e+00	4.19e+07
Co-58	0.00e+00	7.94e+06	1.83e+07	0.00e+00	0.00e+00	0.00e+00	1.09e+08
Co-60	0.00e+00	2.78e+07	6.26e+07	0.00e+00	0.00e+00	0.00e+00	3.62e+08
Ni-59	8.82e+08	3.11e+08	1.50e+08	0.00e+00	0.00e+00	0.00e+00	4.88e+07
Ni-63	1.18e+10	8.35e+08	4.01e+08	0.00e+00	0.00e+00	0.00e+00	1.33e+08
Ni-65	6.87e-01	8.78e-02	4.00e-02	0.00e+00	0.00e+00	0.00e+00	4.76e+00
Cu-64	0.00e+00	4.26e+04	2.00e+04	0.00e+00	1.08e+05	0.00e+00	3.30e+06
Zn-65	2.11e+09	7.32e+09	3.41e+09	0.00e+00	4.68e+09	0.00e+00	3.10e+09
Zn-69	4.01e-12	7.65e-12	5.35e-13	0.00e+00	5.00e-12	0.00e+00	1.41e-11
Zn-69m	3.30e+05	7.79e+05	7.15e+04	0.00e+00	4.74e+05	0.00e+00	4.28e+07
Se-79	0.00e+00	1.67e+09	2.81e+08	0.00e+00	2.92e+09	0.00e+00	2.56e+08
Br-82	0.00e+00	0.00e+00	5.61e+07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	1.82e-01	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	3.09e-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	4.73e+09	2.22e+09	0.00e+00	0.00e+00	0.00e+00	7.00e+08
Rb-87	0.00e+00	5.24e+09	1.83e+09	0.00e+00	0.00e+00	0.00e+00	1.83e+08
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	2.67e+09	0.00e+00	7.66e+07	0.00e+00	0.00e+00	0.00e+00	3.19e+08
Sr-90	8.13e+10	0.00e+00	1.63e+09	0.00e+00	0.00e+00	0.00e+00	1.86e+09
Sr-91	5.33e+04	0.00e+00	2.12e+03	0.00e+00	0.00e+00	0.00e+00	2.42e+05
Sr-92	9.07e-01	0.00e+00	3.86e-02	0.00e+00	0.00e+00	0.00e+00	2.31e+01
Y-90	1.30e+02	0.00e+00	3.51e+00	0.00e+00	0.00e+00	0.00e+00	1.07e+06
Y-91	1.58e+04	0.00e+00	4.24e+02	0.00e+00	0.00e+00	0.00e+00	6.48e+06
Y-91m	1.15e-19	0.00e+00	4.39e-21	0.00e+00	0.00e+00	0.00e+00	5.42e-18
Y-92	1.04e-04	0.00e+00	3.01e-06	0.00e+00	0.00e+00	0.00e+00	2.86e+00
Y-93	4.13e-01	0.00e+00	1.13e-02	0.00e+00	0.00e+00	0.00e+00	1.26e+04
Zr-93	2.76e+03	1.36e+02	7.43e+01	0.00e+00	4.81e+02	0.00e+00	1.29e+05
Zr-95	1.65e+03	5.20e+02	3.58e+02	0.00e+00	7.65e+02	0.00e+00	1.20e+06
Zr-97	7.90e-01	1.56e-01	7.20e-02	0.00e+00	2.37e-01	0.00e+00	4.23e+04
Nb-93m	8.55e+05	2.81e+05	7.03e+04	0.00e+00	3.28e+05	0.00e+00	1.01e+08
Nb-95	1.41e+05	7.81e+04	4.30e+04	0.00e+00	7.57e+04	0.00e+00	3.34e+08
Nb-97	1.20e-11	2.98e-12	1.09e-12	0.00e+00	3.48e-12	0.00e+00	7.11e-08
Mo-93	0.00e+00	7.93e+08	2.17e+07	0.00e+00	2.27e+08	0.00e+00	9.65e+07
Mo-99	0.00e+00	4.47e+07	8.53e+06	0.00e+00	1.02e+08	0.00e+00	8.01e+07
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	4.46e+07	6.56e+07	1.79e+07	0.00e+00	8.33e+08	6.78e+06	1.61e+09
Tc-99m	5.80e+00	1.62e+01	2.10e+02	0.00e+00	2.41e+02	8.97e+00	1.06e+04
Ru-103	1.81e+03	0.00e+00	7.74e+02	0.00e+00	6.38e+03	0.00e+00	1.51e+05
Ru-105	1.58e-03	0.00e+00	6.13e-04	0.00e+00	1.99e-02	0.00e+00	1.27e+00
Ru-106	3.75e+04	0.00e+00	4.73e+03	0.00e+00	7.24e+04	0.00e+00	1.80e+06
Rh-105	6.38e+05	4.61e+05	3.03e+05	0.00e+00	1.96e+06	0.00e+00	5.87e+07
Pd-107	0.00e+00	2.07e+07	1.34e+06	0.00e+00	1.87e+08	0.00e+00	9.63e+07
Pd-109	0.00e+00	8.22e+04	1.87e+04	0.00e+00	4.75e+05	0.00e+00	8.29e+06

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Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	9.63e+07	9.11e+07	5.54e+07	0.00e+00	1.74e+08	0.00e+00	2.56e+10
Ag-111	1.19e+07	4.95e+06	2.49e+06	0.00e+00	1.61e+07	0.00e+00	6.90e+09
Cd-113m	0.00e+00	5.38e+06	1.73e+05	0.00e+00	5.95e+06	0.00e+00	3.23e+07
Cd-115m	0.00e+00	2.30e+06	7.41e+04	0.00e+00	1.84e+06	0.00e+00	7.27e+07
Sn-123	9.88e+08	1.62e+07	2.40e+07	1.30e+07	0.00e+00	0.00e+00	1.49e+09
Sn-125	1.05e+08	2.08e+06	4.72e+06	1.64e+06	0.00e+00	0.00e+00	9.85e+08
Sn-126	2.89e+09	5.38e+07	8.23e+07	1.42e+07	0.00e+00	0.00e+00	6.43e+08
Sb-124	4.59e+07	8.46e+05	1.79e+07	1.04e+05	0.00e+00	4.01e+07	9.25e+08
Sb-125	3.65e+07	3.99e+05	8.55e+06	3.49e+04	0.00e+00	3.21e+07	2.84e+08
Sb-126	1.00e+07	2.05e+05	3.61e+06	5.68e+04	0.00e+00	7.20e+06	5.94e+08
Sb-127	8.23e+05	1.76e+04	3.11e+05	9.25e+03	0.00e+00	5.60e+05	1.40e+08
Te-125m	3.00e+07	1.08e+07	4.02e+06	8.39e+06	0.00e+00	0.00e+00	8.86e+07
Te-127	1.22e+03	4.31e+02	2.61e+02	8.38e+02	4.92e+03	0.00e+00	9.38e+04
Te-127m	8.44e+07	2.99e+07	1.00e+07	2.01e+07	3.42e+08	0.00e+00	2.10e+08
Te-129	5.37e-10	2.00e-10	1.31e-10	3.84e-10	2.25e-09	0.00e+00	2.94e-09
Te-129m	1.10e+08	4.09e+07	1.74e+07	3.55e+07	4.61e+08	0.00e+00	4.13e+08
Te-131	7.22e-33	2.98e-33	2.26e-33	5.57e-33	3.16e-32	0.00e+00	5.93e-34
Te-131m	6.58e+05	3.15e+05	2.63e+05	4.75e+05	3.29e+06	0.00e+00	2.53e+07
Te-132	4.29e+06	2.72e+06	2.56e+06	2.87e+06	2.61e+07	0.00e+00	8.61e+07
Te-133m	3.95e-13	2.24e-13	2.18e-13	3.13e-13	2.22e-12	0.00e+00	9.07e-13
Te-134	1.68e-18	1.08e-18	1.12e-18	1.38e-18	1.03e-17	0.00e+00	6.22e-20
I-129	1.39e+09	1.17e+09	1.96e+09	1.43e+12	2.10e+09	0.00e+00	1.37e+08
I-130	7.41e+05	2.14e+06	8.56e+05	1.75e+08	3.30e+06	0.00e+00	1.65e+06
I-131	5.37e+08	7.52e+08	4.04e+08	2.20e+11	1.30e+09	0.00e+00	1.49e+08
I-132	2.96e-01	7.75e-01	2.78e-01	2.61e+01	1.22e+00	0.00e+00	3.38e-01
I-133	7.08e+06	1.20e+07	3.66e+06	1.68e+09	2.11e+07	0.00e+00	9.09e+06
I-134	3.74e-12	9.92e-12	3.56e-12	1.65e-10	1.56e-11	0.00e+00	1.31e-13
I-135	2.29e+04	5.90e+04	2.19e+04	3.80e+06	9.33e+04	0.00e+00	6.54e+04
Cs-134	9.81e+09	2.31e+10	1.07e+10	0.00e+00	7.34e+09	2.80e+09	2.87e+08
Cs-134m	3.13e-01	6.49e-01	3.34e-01	0.00e+00	3.61e-01	6.34e-02	4.32e-01

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Offsite Dose Calculation Manual

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Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	3.33e+09	3.05e+09	7.13e+08	0.00e+00	1.16e+09	4.21e+08	5.34e+07
Cs-136	4.48e+08	1.76e+09	1.18e+09	0.00e+00	9.60e+08	1.51e+08	1.42e+08
Cs-137	1.34e+10	1.78e+10	6.20e+09	0.00e+00	6.06e+09	2.35e+09	2.53e+08
Cs-138	1.76e-23	3.38e-23	1.69e-23	0.00e+00	2.50e-23	2.91e-24	1.54e-26
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	4.85e+07	5.95e+04	3.13e+06	0.00e+00	2.02e+04	4.00e+04	7.48e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	5.52e-05	1.70e-05	2.80e-06	0.00e+00	0.00e+00	0.00e+00	3.01e+00
La-142	3.43e-11	1.53e-11	3.80e-12	0.00e+00	0.00e+00	0.00e+00	4.64e-07
Ce-141	8.88e+03	5.93e+03	6.81e+02	0.00e+00	2.79e+03	0.00e+00	1.70e+07
Ce-143	7.65e+01	5.56e+04	6.21e+00	0.00e+00	2.50e+01	0.00e+00	1.67e+06
Ce-144	6.58e+05	2.72e+05	3.54e+04	0.00e+00	1.63e+05	0.00e+00	1.66e+08
Pr-143	2.90e+02	1.16e+02	1.44e+01	0.00e+00	6.73e+01	0.00e+00	9.55e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	1.81e+02	1.97e+02	1.18e+01	0.00e+00	1.16e+02	0.00e+00	7.11e+05
Pm-147	5.15e+03	4.89e+02	1.99e+02	0.00e+00	9.32e+02	0.00e+00	4.65e+05
Pm-148	1.09e+02	1.77e+01	8.93e+00	0.00e+00	3.20e+01	0.00e+00	1.06e+06
Pm-148m	1.49e+03	3.78e+02	2.96e+02	0.00e+00	5.73e+02	0.00e+00	2.38e+06
Pm-149	7.88e+00	1.11e+00	4.54e-01	0.00e+00	2.11e+00	0.00e+00	1.63e+05
Pm-151	1.18e+00	1.95e-01	9.88e-02	0.00e+00	3.51e-01	0.00e+00	4.38e+04
Sm-151	4.35e+03	8.37e+02	1.96e+02	0.00e+00	9.17e+02	0.00e+00	2.84e+05
Sm-153	3.65e+00	3.02e+00	2.22e-01	0.00e+00	9.88e-01	0.00e+00	8.53e+04
Eu-152	1.22e+04	2.93e+03	2.58e+03	0.00e+00	1.36e+04	0.00e+00	1.08e+06
Eu-154	3.94e+04	5.08e+03	3.58e+03	0.00e+00	2.27e+04	0.00e+00	2.69e+06
Eu-155	8.48e+03	8.18e+02	5.07e+02	0.00e+00	3.20e+03	0.00e+00	4.69e+06
Eu-156	4.55e+02	3.41e+02	5.57e+01	0.00e+00	2.30e+02	0.00e+00	1.74e+06
Tb-160	2.65e+03	0.00e+00	3.31e+02	0.00e+00	1.05e+03	0.00e+00	1.72e+06

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Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
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Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.78e+04	5.48e+03	3.97e+03	0.00e+00	8.03e+03	0.00e+00	1.35e+06
W-181	6.27e+04	2.02e+04	2.12e+03	0.00e+00	0.00e+00	0.00e+00	1.72e+06
W-185	2.39e+06	7.88e+05	8.33e+04	0.00e+00	0.00e+00	0.00e+00	6.81e+07
W-187	1.19e+04	9.73e+03	3.41e+03	0.00e+00	0.00e+00	0.00e+00	2.63e+06
Pb-210	1.12e+11	3.36e+10	4.33e+09	0.00e+00	1.06e+11	0.00e+00	1.46e+07
Bi-210	6.57e+05	4.49e+06	3.76e+05	0.00e+00	5.46e+07	0.00e+00	5.13e+07
Po-210	1.37e+09	2.88e+09	3.31e+08	0.00e+00	9.68e+09	0.00e+00	1.81e+08
Ra-223	2.25e+11	3.42e+08	4.50e+10	0.00e+00	9.83e+09	0.00e+00	1.09e+10
Ra-224	2.62e+10	6.25e+07	5.22e+09	0.00e+00	1.79e+09	0.00e+00	4.20e+09
Ra-225	3.50e+11	4.11e+08	6.98e+10	0.00e+00	1.18e+10	0.00e+00	1.22e+10
Ra-226	2.57e+13	6.49e+08	1.91e+13	0.00e+00	1.85e+10	0.00e+00	2.80e+10
Ra-228	1.08e+13	3.49e+08	1.20e+13	0.00e+00	9.98e+09	0.00e+00	4.74e+09
Ac-225	1.14e+05	1.55e+05	7.63e+03	0.00e+00	1.78e+04	0.00e+00	7.89e+06
Ac-227	1.02e+08	1.51e+07	6.07e+06	0.00e+00	4.38e+06	0.00e+00	4.32e+06
Th-227	5.16e+05	9.27e+03	1.49e+04	0.00e+00	5.29e+04	0.00e+00	1.51e+07
Th-228	3.32e+07	5.56e+05	1.12e+06	0.00e+00	3.13e+06	0.00e+00	2.91e+07
Th-229	7.13e+08	2.05e+07	1.18e+07	0.00e+00	9.92e+07	0.00e+00	4.13e+06
Th-230	1.08e+08	6.13e+06	2.99e+06	0.00e+00	2.99e+07	0.00e+00	3.18e+06
Th-232	1.21e+08	5.24e+06	8.13e+04	0.00e+00	2.55e+07	0.00e+00	2.71e+06
Th-234	3.39e+03	1.99e+02	9.86e+01	0.00e+00	1.13e+03	0.00e+00	3.60e+06
Pa-231	2.15e+08	8.08e+06	8.38e+06	0.00e+00	4.54e+07	0.00e+00	3.79e+06
Pa-233	2.30e+02	4.42e+01	3.95e+01	0.00e+00	1.67e+02	0.00e+00	5.05e+05
U-232	2.94e+10	0.00e+00	2.10e+09	0.00e+00	3.18e+09	0.00e+00	3.58e+08
U-233	6.18e+09	0.00e+00	3.76e+08	0.00e+00	1.45e+09	0.00e+00	3.32e+08
U-234	5.93e+09	0.00e+00	3.68e+08	0.00e+00	1.42e+09	0.00e+00	3.25e+08
U-235	5.68e+09	0.00e+00	3.46e+08	0.00e+00	1.33e+09	0.00e+00	4.13e+08
U-236	5.68e+09	0.00e+00	3.54e+08	0.00e+00	1.36e+09	0.00e+00	3.05e+08
U-237	1.04e+05	0.00e+00	2.77e+04	0.00e+00	4.28e+05	0.00e+00	2.76e+07
U-238	5.43e+09	0.00e+00	3.24e+08	0.00e+00	1.25e+09	0.00e+00	2.91e+08
Np-237	6.63e+07	4.76e+06	2.92e+06	0.00e+00	2.16e+07	0.00e+00	4.19e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 7

## Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	6.65e+01	1.78e+00	1.04e+00	0.00e+00	6.10e+00	0.00e+00	1.31e+05
Np-239	7.01e+00	6.62e-01	3.67e-01	0.00e+00	2.08e+00	0.00e+00	1.06e+05
Pu-238	1.34e+07	1.71e+06	3.63e+05	0.00e+00	1.55e+06	0.00e+00	1.54e+06
Pu-239	1.53e+07	1.85e+06	4.01e+05	0.00e+00	1.71e+06	0.00e+00	1.41e+06
Pu-240	1.52e+07	1.85e+06	4.01e+05	0.00e+00	1.71e+06	0.00e+00	1.43e+06
Pu-241	3.48e+05	1.67e+04	7.34e+03	0.00e+00	3.40e+04	0.00e+00	2.94e+04
Pu-242	1.41e+07	1.78e+06	3.87e+05	0.00e+00	1.65e+06	0.00e+00	1.38e+06
Pu-244	1.65e+07	2.03e+06	4.43e+05	0.00e+00	1.88e+06	0.00e+00	2.05e+06
Am-241	3.94e+07	3.72e+07	2.84e+06	0.00e+00	2.13e+07	0.00e+00	3.89e+06
Am-242m	4.02e+07	3.54e+07	2.89e+06	0.00e+00	2.14e+07	0.00e+00	4.93e+06
Am-243	3.97e+07	3.66e+07	2.80e+06	0.00e+00	2.10e+07	0.00e+00	4.60e+06
Cm-242	1.34e+06	1.41e+06	8.88e+04	0.00e+00	4.05e+05	0.00e+00	3.82e+06
Cm-243	3.24e+07	3.00e+07	2.04e+06	0.00e+00	9.51e+06	0.00e+00	4.12e+06
Cm-244	2.51e+07	2.37e+07	1.59e+06	0.00e+00	7.41e+06	0.00e+00	3.98e+06
Cm-245	4.94e+07	4.34e+07	3.04e+06	0.00e+00	1.42e+07	0.00e+00	3.72e+06
Cm-246	4.90e+07	4.34e+07	3.04e+06	0.00e+00	1.42e+07	0.00e+00	3.65e+06
Cm-247	4.77e+07	4.27e+07	2.99e+06	0.00e+00	1.40e+07	0.00e+00	4.80e+06
Cm-248	3.96e+08	3.52e+08	2.47e+07	0.00e+00	1.15e+08	0.00e+00	7.73e+07
Cf-252	1.70e+07	0.00e+00	4.10e+05	0.00e+00	0.00e+00	0.00e+00	1.50e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	8.97e+02	8.97e+02	8.97e+02	8.97e+02	8.97e+02	8.97e+02
Be-10	1.11e+07	1.29e+06	2.79e+05	0.00e+00	9.13e+05	0.00e+00	2.26e+07
C-14	1.19e+09	2.39e+08	2.39e+08	2.39e+08	2.39e+08	2.39e+08	2.39e+08
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	1.97e-02	0.00e+00	1.96e-03	0.00e+00	0.00e+00	0.00e+00	5.34e-03
Na-22	1.90e+10	1.90e+10	1.90e+10	1.90e+10	1.90e+10	1.90e+10	1.90e+10
Na-24	8.88e+06	8.88e+06	8.88e+06	8.88e+06	8.88e+06	8.88e+06	8.88e+06
P-32	7.78e+10	3.64e+09	3.00e+09	0.00e+00	0.00e+00	0.00e+00	2.15e+09
Ca-41	2.28e+10	0.00e+00	2.49e+09	0.00e+00	0.00e+00	0.00e+00	1.25e+07
Sc-46	6.83e+02	9.36e+02	3.61e+02	0.00e+00	8.29e+02	0.00e+00	1.37e+06
Cr-51	0.00e+00	0.00e+00	1.02e+05	5.65e+04	1.54e+04	1.03e+05	5.40e+06
Mn-54	0.00e+00	2.10e+07	5.59e+06	0.00e+00	5.88e+06	0.00e+00	1.76e+07
Mn-56	0.00e+00	1.28e-02	2.90e-03	0.00e+00	1.55e-02	0.00e+00	1.86e+00
Fe-55	1.12e+08	5.93e+07	1.84e+07	0.00e+00	0.00e+00	3.35e+07	1.10e+07
Fe-59	1.20e+08	1.95e+08	9.69e+07	0.00e+00	0.00e+00	5.64e+07	2.03e+08
Co-57	0.00e+00	3.84e+06	7.77e+06	0.00e+00	0.00e+00	0.00e+00	3.14e+07
Co-58	0.00e+00	1.21e+07	3.71e+07	0.00e+00	0.00e+00	0.00e+00	7.07e+07
Co-60	0.00e+00	4.32e+07	1.27e+08	0.00e+00	0.00e+00	0.00e+00	2.39e+08
Ni-59	2.22e+09	5.90e+08	3.76e+08	0.00e+00	0.00e+00	0.00e+00	3.91e+07
Ni-63	2.96e+10	1.59e+09	1.01e+09	0.00e+00	0.00e+00	0.00e+00	1.07e+08
Ni-65	1.68e+00	1.58e-01	9.24e-02	0.00e+00	0.00e+00	0.00e+00	1.94e+01
Cu-64	0.00e+00	7.49e+04	4.52e+04	0.00e+00	1.81e+05	0.00e+00	3.51e+06
Zn-65	4.13e+09	1.10e+10	6.85e+09	0.00e+00	6.94e+09	0.00e+00	1.93e+09
Zn-69	9.87e-12	1.43e-11	1.32e-12	0.00e+00	8.65e-12	0.00e+00	8.99e-10
Zn-69m	8.06e+05	1.37e+06	1.62e+05	0.00e+00	7.98e+05	0.00e+00	4.47e+07
Se-79	0.00e+00	3.12e+09	6.92e+08	0.00e+00	5.07e+09	0.00e+00	2.05e+08
Br-82	0.00e+00	0.00e+00	1.15e+08	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	4.47e-01	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	7.00e-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	8.77e+09	5.39e+09	0.00e+00	0.00e+00	0.00e+00	5.64e+08
Rb-87	0.00e+00	9.75e+09	4.52e+09	0.00e+00	0.00e+00	0.00e+00	1.46e+08
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	6.62e+09	0.00e+00	1.89e+08	0.00e+00	0.00e+00	0.00e+00	2.56e+08
Sr-90	1.68e+11	0.00e+00	3.38e+09	0.00e+00	0.00e+00	0.00e+00	1.50e+09
Sr-91	1.31e+05	0.00e+00	4.94e+03	0.00e+00	0.00e+00	0.00e+00	2.89e+05
Sr-92	2.21e+00	0.00e+00	8.88e-02	0.00e+00	0.00e+00	0.00e+00	4.19e+01
Y-90	3.22e+02	0.00e+00	8.63e+00	0.00e+00	0.00e+00	0.00e+00	9.18e+05
Y-91	3.90e+04	0.00e+00	1.04e+03	0.00e+00	0.00e+00	0.00e+00	5.20e+06
Y-91m	2.80e-19	0.00e+00	1.02e-20	0.00e+00	0.00e+00	0.00e+00	5.49e-16
Y-92	2.56e-04	0.00e+00	7.32e-06	0.00e+00	0.00e+00	0.00e+00	7.39e+00
Y-93	1.02e+00	0.00e+00	2.79e-02	0.00e+00	0.00e+00	0.00e+00	1.51e+04
Zr-93	6.87e+03	2.57e+02	1.83e+02	0.00e+00	9.95e+02	0.00e+00	9.75e+04
Zr-95	3.83e+03	8.42e+02	7.50e+02	0.00e+00	1.21e+03	0.00e+00	8.79e+05
Zr-97	1.92e+00	2.78e-01	1.64e-01	0.00e+00	3.99e-01	0.00e+00	4.21e+04
Nb-93m	2.15e+06	5.37e+05	1.77e+05	0.00e+00	5.80e+05	0.00e+00	8.10e+07
Nb-95	3.18e+05	1.24e+05	8.84e+04	0.00e+00	1.16e+05	0.00e+00	2.29e+08
Nb-97	2.91e-11	5.26e-12	2.46e-12	0.00e+00	5.84e-12	0.00e+00	1.62e-06
Mo-93	0.00e+00	1.49e+09	5.34e+07	0.00e+00	3.92e+08	0.00e+00	7.53e+07
Mo-99	0.00e+00	8.14e+07	2.01e+07	0.00e+00	1.74e+08	0.00e+00	6.73e+07
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	1.10e+08	1.23e+08	4.40e+07	0.00e+00	1.44e+09	1.08e+07	1.29e+09
Tc-99m	1.33e+01	2.61e+01	4.32e+02	0.00e+00	3.79e+02	1.32e+01	1.48e+04
Ru-103	4.28e+03	0.00e+00	1.65e+03	0.00e+00	1.08e+04	0.00e+00	1.11e+05
Ru-105	3.85e-03	0.00e+00	1.40e-03	0.00e+00	3.39e-02	0.00e+00	2.51e+00
Ru-106	9.24e+04	0.00e+00	1.15e+04	0.00e+00	1.25e+05	0.00e+00	1.44e+06
Rh-105	1.56e+06	8.40e+05	7.18e+05	0.00e+00	3.35e+06	0.00e+00	5.21e+07
Pd-107	0.00e+00	3.88e+07	3.30e+06	0.00e+00	3.25e+08	0.00e+00	7.71e+07
Pd-109	0.00e+00	1.53e+05	4.59e+04	0.00e+00	8.22e+05	0.00e+00	9.05e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	2.09e+08	1.41e+08	1.13e+08	0.00e+00	2.63e+08	0.00e+00	1.68e+10
Ag-111	2.94e+07	9.20e+06	6.07e+06	0.00e+00	2.78e+07	0.00e+00	5.63e+09
Cd-113m	0.00e+00	1.00e+07	4.27e+05	0.00e+00	1.03e+07	0.00e+00	2.59e+07
Cd-115m	0.00e+00	4.29e+06	1.83e+05	0.00e+00	3.19e+06	0.00e+00	5.83e+07
Sn-123	2.44e+09	3.03e+07	5.95e+07	3.21e+07	0.00e+00	0.00e+00	1.20e+09
Sn-125	2.57e+08	3.88e+06	1.15e+07	4.03e+06	0.00e+00	0.00e+00	7.98e+08
Sn-126	6.85e+09	8.54e+07	1.95e+08	2.34e+07	0.00e+00	0.00e+00	5.14e+08
Sb-124	1.09e+08	1.41e+06	3.81e+07	2.40e+05	0.00e+00	6.03e+07	6.79e+08
Sb-125	8.70e+07	6.71e+05	1.82e+07	8.06e+04	0.00e+00	4.85e+07	2.08e+08
Sb-126	2.29e+07	3.51e+05	8.23e+06	1.34e+05	0.00e+00	1.09e+07	4.62e+08
Sb-127	1.98e+06	3.07e+04	6.88e+05	2.21e+04	0.00e+00	8.60e+05	1.12e+08
Te-125m	7.38e+07	2.00e+07	9.84e+06	2.07e+07	0.00e+00	0.00e+00	7.12e+07
Te-127	2.99e+03	8.06e+02	6.41e+02	2.07e+03	8.50e+03	0.00e+00	1.17e+05
Te-127m	2.08e+08	5.60e+07	2.47e+07	4.97e+07	5.93e+08	0.00e+00	1.68e+08
Te-129	1.33e-09	3.70e-10	3.15e-10	9.46e-10	3.88e-09	0.00e+00	8.25e-08
Te-129m	2.71e+08	7.58e+07	4.21e+07	8.75e+07	7.97e+08	0.00e+00	3.31e+08
Te-131	1.77e-32	5.40e-33	5.27e-33	1.36e-32	5.36e-32	0.00e+00	9.31e-32
Te-131m	1.60e+06	5.54e+05	5.89e+05	1.14e+06	5.36e+06	0.00e+00	2.25e+07
Te-132	1.03e+07	4.54e+06	5.48e+06	6.61e+06	4.21e+07	0.00e+00	4.57e+07
Te-133m	9.46e-13	3.82e-13	4.74e-13	7.33e-13	3.63e-12	0.00e+00	2.92e-11
Te-134	3.99e-18	1.79e-18	2.39e-18	3.15e-18	1.66e-17	0.00e+00	1.82e-17
I-129	3.43e+09	2.11e+09	1.88e+09	1.38e+12	3.55e+09	0.00e+00	1.06e+08
I-130	1.73e+06	3.50e+06	1.80e+06	3.86e+08	5.23e+06	0.00e+00	1.64e+06
I-131	1.30e+09	1.31e+09	7.45e+08	4.33e+11	2.15e+09	0.00e+00	1.17e+08
I-132	7.01e-01	1.29e+00	5.92e-01	5.97e+01	1.97e+00	0.00e+00	1.52e+00
I-133	1.72e+07	2.13e+07	8.05e+06	3.95e+09	3.55e+07	0.00e+00	8.57e+06
I-134	8.87e-12	1.65e-11	7.57e-12	3.79e-10	2.52e-11	0.00e+00	1.09e-11
I-135	5.43e+04	9.77e+04	4.62e+04	8.66e+06	1.50e+05	0.00e+00	7.45e+04
Cs-134	2.26e+10	3.71e+10	7.84e+09	0.00e+00	1.15e+10	4.13e+09	2.00e+08
Cs-134m	7.42e-01	1.10e+00	7.18e-01	0.00e+00	5.80e-01	9.59e-02	1.39e+00

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Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	8.19e+09	5.71e+09	5.85e+08	0.00e+00	2.01e+09	6.72e+08	4.27e+07
Cs-136	1.01e+09	2.78e+09	1.80e+09	0.00e+00	1.48e+09	2.21e+08	9.77e+07
Cs-137	3.22e+10	3.09e+10	4.55e+09	0.00e+00	1.01e+10	3.62e+09	1.93e+08
Cs-138	4.27e-23	5.94e-23	3.77e-23	0.00e+00	4.18e-23	4.50e-24	2.74e-23
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	1.17e+08	1.03e+05	6.84e+06	0.00e+00	3.34e+04	6.12e+04	5.93e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	1.36e-04	3.17e-05	6.89e-06	0.00e+00	0.00e+00	0.00e+00	7.06e+00
La-142	8.30e-11	2.64e-11	8.28e-12	0.00e+00	0.00e+00	0.00e+00	5.24e-06
Ce-141	2.19e+04	1.09e+04	1.62e+03	0.00e+00	4.78e+03	0.00e+00	1.36e+07
Ce-143	1.88e+02	1.02e+05	1.47e+01	0.00e+00	4.27e+01	0.00e+00	1.49e+06
Ce-144	1.62e+06	5.09e+05	8.66e+04	0.00e+00	2.82e+05	0.00e+00	1.33e+08
Pr-143	7.18e+02	2.16e+02	3.56e+01	0.00e+00	1.17e+02	0.00e+00	7.75e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	4.45e+02	3.60e+02	2.79e+01	0.00e+00	1.98e+02	0.00e+00	5.71e+05
Pm-147	1.29e+04	9.19e+02	4.94e+02	0.00e+00	1.62e+03	0.00e+00	3.72e+05
Pm-148	2.66e+02	3.20e+01	2.07e+01	0.00e+00	5.44e+01	0.00e+00	8.54e+05
Pm-148m	3.06e+03	6.09e+02	6.09e+02	0.00e+00	9.03e+02	0.00e+00	1.72e+06
Pm-149	1.94e+01	2.07e+00	1.12e+00	0.00e+00	3.65e+00	0.00e+00	1.41e+05
Pm-151	2.88e+00	3.51e-01	2.28e-01	0.00e+00	5.95e-01	0.00e+00	3.98e+04
Sm-151	1.05e+04	1.57e+03	4.93e+02	0.00e+00	1.62e+03	0.00e+00	2.27e+05
Sm-153	9.02e+00	5.61e+00	5.41e-01	0.00e+00	1.71e+00	0.00e+00	7.46e+04
Eu-152	2.52e+04	4.59e+03	5.45e+03	0.00e+00	1.94e+04	0.00e+00	7.54e+05
Eu-154	9.46e+04	8.51e+03	7.77e+03	0.00e+00	3.74e+04	0.00e+00	1.98e+06
Eu-155	1.94e+04	1.39e+03	1.09e+03	0.00e+00	5.22e+03	0.00e+00	3.49e+06
Eu-156	1.10e+03	5.88e+02	1.22e+02	0.00e+00	3.79e+02	0.00e+00	1.33e+06
Tb-160	5.61e+03	0.00e+00	6.96e+02	0.00e+00	1.67e+03	0.00e+00	1.24e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	4.44e+04	9.30e+03	7.86e+03	0.00e+00	1.32e+04	0.00e+00	1.08e+06
W-181	1.54e+05	3.79e+04	5.21e+03	0.00e+00	0.00e+00	0.00e+00	1.38e+06
W-185	5.89e+06	1.47e+06	2.06e+05	0.00e+00	0.00e+00	0.00e+00	5.48e+07
W-187	2.89e+04	1.71e+04	7.69e+03	0.00e+00	0.00e+00	0.00e+00	2.41e+06
Pb-210	2.42e+11	6.21e+10	1.06e+10	0.00e+00	1.87e+11	0.00e+00	1.17e+07
Bi-210	1.62e+06	8.38e+06	9.29e+05	0.00e+00	9.45e+07	0.00e+00	4.25e+07
Po-210	3.37e+09	5.39e+09	8.14e+08	0.00e+00	1.68e+10	0.00e+00	1.45e+08
Ra-223	5.55e+11	6.41e+08	1.11e+11	0.00e+00	1.70e+10	0.00e+00	8.84e+09
Ra-224	6.43e+10	1.17e+08	1.29e+10	0.00e+00	3.09e+09	0.00e+00	3.53e+09
Ra-225	8.62e+11	7.70e+08	1.72e+11	0.00e+00	2.04e+10	0.00e+00	9.89e+09
Ra-226	3.78e+13	1.21e+09	3.11e+13	0.00e+00	3.21e+10	0.00e+00	2.24e+10
Ra-228	2.52e+13	6.53e+08	2.82e+13	0.00e+00	1.73e+10	0.00e+00	3.80e+09
Ac-225	2.81e+05	2.89e+05	1.88e+04	0.00e+00	3.09e+04	0.00e+00	6.43e+06
Ac-227	1.69e+08	2.72e+07	1.05e+07	0.00e+00	5.99e+06	0.00e+00	3.46e+06
Th-227	1.27e+06	1.73e+04	3.67e+04	0.00e+00	9.17e+04	0.00e+00	1.22e+07
Th-228	8.33e+07	1.07e+06	2.82e+06	0.00e+00	5.55e+06	0.00e+00	2.33e+07
Th-229	9.67e+08	2.43e+07	1.61e+07	0.00e+00	1.19e+08	0.00e+00	3.31e+06
Th-230	1.46e+08	7.32e+06	4.08e+06	0.00e+00	3.57e+07	0.00e+00	2.55e+06
Th-232	1.63e+08	6.25e+06	1.24e+05	0.00e+00	3.05e+07	0.00e+00	2.17e+06
Th-234	8.40e+03	3.71e+02	2.43e+02	0.00e+00	1.97e+03	0.00e+00	2.90e+06
Pa-231	2.91e+08	9.63e+06	1.16e+07	0.00e+00	5.27e+07	0.00e+00	3.03e+06
Pa-233	4.68e+02	7.30e+01	8.18e+01	0.00e+00	2.69e+02	0.00e+00	3.73e+05
U-232	7.24e+10	0.00e+00	5.18e+09	0.00e+00	5.51e+09	0.00e+00	2.87e+08
U-233	1.53e+10	0.00e+00	9.26e+08	0.00e+00	2.51e+09	0.00e+00	2.65e+08
U-234	1.47e+10	0.00e+00	9.09e+08	0.00e+00	2.46e+09	0.00e+00	2.60e+08
U-235	1.41e+10	0.00e+00	8.51e+08	0.00e+00	2.31e+09	0.00e+00	3.30e+08
U-236	1.41e+10	0.00e+00	8.72e+08	0.00e+00	2.36e+09	0.00e+00	2.44e+08
U-237	2.57e+05	0.00e+00	6.83e+04	0.00e+00	7.42e+05	0.00e+00	2.27e+07
U-238	1.35e+10	0.00e+00	7.98e+08	0.00e+00	2.16e+09	0.00e+00	2.33e+08
Np-237	9.17e+07	6.05e+06	4.03e+06	0.00e+00	2.49e+07	0.00e+00	3.36e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.64e+02	3.32e+00	2.55e+00	0.00e+00	1.06e+01	0.00e+00	1.14e+05
Np-239	1.73e+01	1.24e+00	8.71e-01	0.00e+00	3.58e+00	0.00e+00	9.17e+04
Pu-238	1.96e+07	2.27e+06	5.20e+05	0.00e+00	1.89e+06	0.00e+00	1.23e+06
Pu-239	2.12e+07	2.27e+06	5.45e+05	0.00e+00	2.01e+06	0.00e+00	1.13e+06
Pu-240	2.11e+07	2.35e+06	5.45e+05	0.00e+00	2.01e+06	0.00e+00	1.15e+06
Pu-241	6.35e+05	2.59e+04	1.32e+04	0.00e+00	4.86e+04	0.00e+00	2.36e+04
Pu-242	1.96e+07	2.27e+06	5.25e+05	0.00e+00	1.93e+06	0.00e+00	1.10e+06
Pu-244	2.29e+07	2.60e+07	6.01e+05	0.00e+00	2.22e+06	0.00e+00	1.65e+06
Am-241	5.54e+07	4.77e+07	4.16e+06	0.00e+00	2.54e+07	0.00e+00	3.11e+06
Am-242m	5.76e+07	4.61e+07	4.28e+06	0.00e+00	2.59e+07	0.00e+00	3.95e+06
Am-243	5.51e+07	4.65e+07	4.04e+06	0.00e+00	2.49e+07	0.00e+00	3.68e+06
Cm-242	3.30e+06	2.63e+06	2.19e+05	0.00e+00	7.02e+05	0.00e+00	3.06e+06
Cm-243	5.26e+07	4.27e+07	3.38e+06	0.00e+00	1.27e+07	0.00e+00	3.30e+06
Cm-244	4.43e+07	3.59e+07	2.84e+06	0.00e+00	1.04e+07	0.00e+00	3.19e+06
Cm-245	6.87e+07	5.51e+07	4.32e+06	0.00e+00	1.69e+07	0.00e+00	2.98e+06
Cm-246	6.79e+07	5.51e+07	4.32e+06	0.00e+00	1.69e+07	0.00e+00	2.92e+06
Cm-247	6.62e+07	5.43e+07	4.24e+06	0.00e+00	1.66e+07	0.00e+00	3.85e+06
Cm-248	5.51e+08	4.48e+08	3.50e+07	0.00e+00	1.37e+08	0.00e+00	6.21e+07
Cf-252	4.25e+07	0.00e+00	1.03e+06	0.00e+00	0.00e+00	0.00e+00	1.20e+07

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Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.36e+03	1.36e+03	1.36e+03	1.36e+03	1.36e+03	1.36e+03
Be-10	1.41e+07	2.05e+06	4.25e+05	0.00e+00	1.35e+06	0.00e+00	2.29e+07
C-14	2.34e+09	5.00e+08	5.00e+08	5.00e+08	5.00e+08	5.00e+08	5.00e+08
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	4.12e-02	0.00e+00	3.51e-03	0.00e+00	0.00e+00	0.00e+00	9.67e-03
Na-22	3.18e+10	3.18e+10	3.18e+10	3.18e+10	3.18e+10	3.18e+10	3.18e+10
Na-24	1.55e+07	1.55e+07	1.55e+07	1.55e+07	1.55e+07	1.55e+07	1.55e+07
P-32	1.60e+11	9.43e+09	6.21e+09	0.00e+00	0.00e+00	0.00e+00	2.17e+09
Ca-41	2.46e+10	0.00e+00	2.69e+09	0.00e+00	0.00e+00	0.00e+00	1.26e+07
Sc-46	1.30e+03	1.88e+03	5.86e+02	0.00e+00	1.23e+03	0.00e+00	1.22e+06
Cr-51	0.00e+00	0.00e+00	1.61e+05	1.05e+05	2.30e+04	2.05e+05	4.70e+06
Mn-54	0.00e+00	3.90e+07	8.84e+06	0.00e+00	8.64e+06	0.00e+00	1.43e+07
Mn-56	0.00e+00	3.14e-02	5.42e-03	0.00e+00	2.70e-02	0.00e+00	2.86e+00
Fe-55	1.35e+08	8.73e+07	2.33e+07	0.00e+00	0.00e+00	4.27e+07	1.11e+07
Fe-59	2.24e+08	3.92e+08	1.54e+08	0.00e+00	0.00e+00	1.16e+08	1.87e+08
Co-57	0.00e+00	8.95e+06	1.46e+07	0.00e+00	0.00e+00	0.00e+00	3.05e+07
Co-58	0.00e+00	2.42e+07	6.05e+07	0.00e+00	0.00e+00	0.00e+00	6.04e+07
Co-60	0.00e+00	8.81e+07	2.08e+08	0.00e+00	0.00e+00	0.00e+00	2.10e+08
Ni-59	2.61e+09	7.99e+08	4.50e+08	0.00e+00	0.00e+00	0.00e+00	3.95e+07
Ni-63	3.49e+10	2.16e+09	1.21e+09	0.00e+00	0.00e+00	0.00e+00	1.07e+08
Ni-65	3.56e+00	4.03e-01	1.83e-01	0.00e+00	0.00e+00	0.00e+00	3.07e+01
Cu-64	0.00e+00	1.86e+05	8.62e+04	0.00e+00	3.15e+05	0.00e+00	3.82e+06
Zn-65	5.55e+09	1.90e+10	8.78e+09	0.00e+00	9.23e+09	0.00e+00	1.61e+10
Zn-69	2.10e-11	3.79e-11	2.82e-12	0.00e+00	1.57e-11	0.00e+00	3.09e-09
Zn-69m	1.70e+06	3.48e+06	3.17e+05	0.00e+00	1.41e+06	0.00e+00	4.82e+07
Se-79	0.00e+00	7.77e+09	1.44e+09	0.00e+00	9.00e+09	0.00e+00	2.07e+08
Br-82	0.00e+00	0.00e+00	1.93e+08	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	9.49e-01	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	1.35e-22	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

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Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.23e+10	1.10e+10	0.00e+00	0.00e+00	0.00e+00	5.69e+08
Rb-87	0.00e+00	2.19e+10	8.69e+09	0.00e+00	0.00e+00	0.00e+00	1.48e+08
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	1.26e+10	0.00e+00	3.61e+08	0.00e+00	0.00e+00	0.00e+00	2.59e+08
Sr-90	1.86e+11	0.00e+00	3.77e+09	0.00e+00	0.00e+00	0.00e+00	1.52e+09
Sr-91	2.73e+05	0.00e+00	9.87e+03	0.00e+00	0.00e+00	0.00e+00	3.23e+05
Sr-92	4.71e+00	0.00e+00	1.75e-01	0.00e+00	0.00e+00	0.00e+00	5.08e+01
Y-90	6.82e+02	0.00e+00	1.83e+01	0.00e+00	0.00e+00	0.00e+00	9.41e+05
Y-91	7.33e+04	0.00e+00	1.95e+03	0.00e+00	0.00e+00	0.00e+00	5.25e+06
Y-91m	5.94e-19	0.00e+00	2.03e-20	0.00e+00	0.00e+00	0.00e+00	1.98e-15
Y-92	5.44e-04	0.00e+00	1.53e-05	0.00e+00	0.00e+00	0.00e+00	1.04e+01
Y-93	2.16e+00	0.00e+00	5.90e-02	0.00e+00	0.00e+00	0.00e+00	1.71e+04
Zr-93	7.94e+03	3.78e+02	2.28e+02	0.00e+00	1.11e+03	0.00e+00	9.83e+04
Zr-95	6.80e+03	1.66e+03	1.18e+03	0.00e+00	1.79e+03	0.00e+00	8.26e+05
Zr-97	4.07e+00	6.99e-01	3.19e-01	0.00e+00	7.04e-01	0.00e+00	4.46e+04
Nb-93m	2.52e+06	6.83e+05	2.13e+05	0.00e+00	6.66e+05	0.00e+00	8.16e+07
Nb-95	5.93e+05	2.44e+05	1.41e+05	0.00e+00	1.75e+05	0.00e+00	2.06e+08
Nb-97	6.16e-11	1.31e-11	4.74e-12	0.00e+00	1.03e-11	0.00e+00	4.15e-06
Mo-93	0.00e+00	3.49e+09	1.12e+08	0.00e+00	6.97e+08	0.00e+00	7.47e+07
Mo-99	0.00e+00	2.08e+08	4.06e+07	0.00e+00	3.11e+08	0.00e+00	6.86e+07
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	2.22e+08	3.00e+08	9.36e+07	0.00e+00	2.53e+09	2.92e+07	1.30e+09
Tc-99m	2.77e+01	5.70e+01	7.35e+02	0.00e+00	6.14e+02	2.98e+01	1.66e+04
Ru-103	8.67e+03	0.00e+00	2.90e+03	0.00e+00	1.80e+04	0.00e+00	1.05e+05
Ru-105	8.12e-03	0.00e+00	2.74e-03	0.00e+00	5.97e-02	0.00e+00	3.23e+00
Ru-106	1.90e+05	0.00e+00	2.38e+04	0.00e+00	2.25e+05	0.00e+00	1.44e+06
Rh-105	3.32e+06	2.17e+06	1.46e+06	0.00e+00	6.03e+06	0.00e+00	5.39e+07
Pd-107	0.00e+00	9.79e+07	6.95e+06	0.00e+00	5.59e+08	0.00e+00	7.78e+07
Pd-109	0.00e+00	4.05e+05	9.78e+04	0.00e+00	1.49e+06	0.00e+00	9.95e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	3.86e+08	2.82e+08	1.86e+08	0.00e+00	4.03e+08	0.00e+00	1.46e+10
Ag-111	6.17e+07	2.40e+07	1.27e+07	0.00e+00	5.01e+07	0.00e+00	5.72e+09
Cd-113m	0.00e+00	1.74e+07	6.42e+05	0.00e+00	1.32e+07	0.00e+00	2.62e+07
Cd-115m	0.00e+00	1.03e+07	3.59e+05	0.00e+00	5.40e+06	0.00e+00	5.89e+07
Sn-123	4.57e+09	7.14e+07	1.19e+08	7.18e+07	0.00e+00	0.00e+00	1.21e+09
Sn-125	5.37e+08	1.00e+07	2.39e+07	9.86e+06	0.00e+00	0.00e+00	8.05e+08
Sn-126	1.14e+10	1.49e+08	3.70e+08	3.93e+07	0.00e+00	0.00e+00	5.18e+08
Sb-124	2.09e+08	3.08e+06	6.49e+07	5.56e+05	0.00e+00	1.31e+08	6.46e+08
Sb-125	1.50e+08	1.45e+06	3.08e+07	1.87e+05	0.00e+00	8.65e+07	1.99e+08
Sb-126	4.20e+07	8.23e+05	1.52e+07	3.22e+05	0.00e+00	2.64e+07	4.35e+08
Sb-127	4.17e+06	7.44e+04	1.29e+06	5.31e+04	0.00e+00	2.15e+06	1.11e+08
Te-125m	1.51e+08	5.04e+07	2.04e+07	5.07e+07	0.00e+00	0.00e+00	7.18e+07
Te-127	6.34e+03	2.13e+03	1.36e+03	5.16e+03	1.55e+04	0.00e+00	1.33e+05
Te-127m	4.21e+08	1.40e+08	5.10e+07	1.22e+08	1.04e+09	0.00e+00	1.70e+08
Te-129	2.81e-09	9.69e-10	6.56e-10	2.36e-09	7.00e-09	0.00e+00	2.25e-07
Te-129m	5.57e+08	1.91e+08	8.58e+07	2.14e+08	1.39e+09	0.00e+00	3.33e+08
Te-131	3.76e-32	1.39e-32	1.05e-32	3.35e-32	9.61e-32	0.00e+00	1.52e-30
Te-131m	3.38e+06	1.36e+06	1.12e+06	2.76e+06	9.36e+06	0.00e+00	2.29e+07
Te-132	2.11e+07	1.05e+07	9.75e+06	1.54e+07	6.54e+07	0.00e+00	3.87e+07
Te-133m	1.98e-12	9.05e-13	8.65e-13	1.74e-12	6.17e-12	0.00e+00	9.76e-11
Te-134	8.25e-18	4.14e-18	4.27e-18	7.39e-18	2.79e-17	0.00e+00	9.46e-17
I-129	7.06e+09	5.23e+09	3.83e+09	3.36e+12	6.19e+09	0.00e+00	1.05e+08
I-130	3.56e+06	7.83e+06	3.14e+06	8.78e+08	8.60e+06	0.00e+00	1.68e+06
I-131	2.72e+09	3.21e+09	1.41e+09	1.05e+12	3.74e+09	0.00e+00	1.14e+08
I-132	1.45e+00	2.95e+00	1.05e+00	1.38e+02	3.29e+00	0.00e+00	2.39e+00
I-133	3.63e+07	5.29e+07	1.55e+07	9.62e+09	6.22e+07	0.00e+00	8.95e+06
I-134	1.84e-11	3.77e-11	1.34e-11	8.78e-10	4.21e-11	0.00e+00	3.89e-11
I-135	1.13e+05	2.25e+05	8.19e+04	2.01e+07	2.50e+05	0.00e+00	8.13e+04
Cs-134	3.65e+10	6.80e+10	6.87e+09	0.00e+00	1.75e+10	7.18e+09	1.85e+08
Cs-134m	1.55e+00	2.58e+00	1.30e+00	0.00e+00	9.94e-01	2.29e-01	2.04e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.31e+10	1.19e+10	6.22e+08	0.00e+00	3.40e+09	1.29e+09	4.31e+07
Cs-136	1.98e+09	5.81e+09	2.17e+09	0.00e+00	2.32e+09	4.74e+08	8.83e+07
Cs-137	5.15e+10	6.02e+10	4.27e+09	0.00e+00	1.62e+10	6.55e+09	1.88e+08
Cs-138	9.01e-23	1.47e-22	7.10e-23	0.00e+00	7.31e-23	1.14e-23	2.34e-22
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	2.41e+08	2.41e+05	1.24e+07	0.00e+00	5.72e+04	1.48e+05	5.92e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	2.89e-04	8.39e-05	1.46e-05	0.00e+00	0.00e+00	0.00e+00	9.62e+00
La-142	1.74e-10	6.40e-11	1.53e-11	0.00e+00	0.00e+00	0.00e+00	1.09e-05
Ce-141	4.34e+04	2.64e+04	3.11e+03	0.00e+00	8.15e+03	0.00e+00	1.37e+07
Ce-143	3.97e+02	2.64e+05	3.01e+01	0.00e+00	7.68e+01	0.00e+00	1.54e+06
Ce-144	2.33e+06	9.52e+05	1.30e+05	0.00e+00	3.85e+05	0.00e+00	1.33e+08
Pr-143	1.49e+03	5.55e+02	7.36e+01	0.00e+00	2.06e+02	0.00e+00	7.84e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	8.81e+02	9.05e+02	5.55e+01	0.00e+00	3.49e+02	0.00e+00	5.74e+05
Pm-147	1.57e+04	1.32e+03	6.44e+02	0.00e+00	1.98e+03	0.00e+00	3.75e+05
Pm-148	5.57e+02	8.04e+01	4.05e+01	0.00e+00	9.60e+01	0.00e+00	8.58e+05
Pm-148m	4.90e+03	1.24e+03	9.74e+02	0.00e+00	1.43e+03	0.00e+00	1.62e+06
Pm-149	4.13e+01	5.42e+00	2.37e+00	0.00e+00	6.59e+00	0.00e+00	1.46e+05
Pm-151	6.10e+00	8.90e-01	4.50e-01	0.00e+00	1.06e+00	0.00e+00	4.12e+04
Sm-151	1.19e+04	2.74e+03	5.92e+02	0.00e+00	1.86e+03	0.00e+00	2.29e+05
Sm-153	1.91e+01	1.47e+01	1.13e+00	0.00e+00	3.09e+00	0.00e+00	7.71e+04
Eu-152	2.76e+04	7.34e+03	6.19e+03	0.00e+00	2.06e+04	0.00e+00	6.52e+05
Eu-154	1.09e+05	1.51e+04	9.05e+03	0.00e+00	4.09e+04	0.00e+00	1.88e+06
Eu-155	2.18e+04	2.51e+03	1.30e+03	0.00e+00	5.63e+03	0.00e+00	3.36e+06
Eu-156	2.23e+03	1.38e+03	2.19e+02	0.00e+00	6.37e+02	0.00e+00	1.30e+06
Tb-160	8.75e+03	0.00e+00	1.09e+03	0.00e+00	2.49e+03	0.00e+00	1.17e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 7

Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	5.14e+04	1.11e+04	8.76e+03	0.00e+00	1.47e+04	0.00e+00	1.09e+06
W-181	3.23e+05	9.91e+04	1.11e+04	0.00e+00	0.00e+00	0.00e+00	1.39e+06
W-185	1.23e+07	3.85e+06	4.39e+05	0.00e+00	0.00e+00	0.00e+00	5.51e+07
W-187	6.09e+04	4.23e+04	1.46e+04	0.00e+00	0.00e+00	0.00e+00	2.49e+06
Pb-210	2.69e+11	7.23e+10	1.21e+10	0.00e+00	2.20e+11	0.00e+00	1.18e+07
Bi-210	3.42e+06	2.20e+07	1.96e+06	0.00e+00	1.71e+08	0.00e+00	4.33e+07
Po-210	6.88e+09	1.32e+10	1.64e+09	0.00e+00	2.80e+10	0.00e+00	1.47e+08
Ra-223	1.15e+12	1.68e+09	2.31e+11	0.00e+00	3.06e+10	0.00e+00	8.97e+09
Ra-224	1.36e+11	3.07e+08	2.72e+10	0.00e+00	5.60e+09	0.00e+00	3.60e+09
Ra-225	1.78e+12	2.01e+09	3.54e+11	0.00e+00	3.66e+10	0.00e+00	9.98e+09
Ra-226	4.08e+13	3.13e+09	3.38e+13	0.00e+00	5.73e+10	0.00e+00	2.26e+10
Ra-228	2.82e+13	1.69e+09	3.18e+13	0.00e+00	3.09e+10	0.00e+00	3.83e+09
Ac-225	5.85e+05	7.51e+05	3.92e+04	0.00e+00	5.51e+04	0.00e+00	6.51e+06
Ac-227	1.84e+08	3.15e+07	1.15e+07	0.00e+00	6.40e+06	0.00e+00	3.49e+06
Th-227	2.61e+06	4.37e+04	7.49e+04	0.00e+00	1.61e+05	0.00e+00	1.24e+07
Th-228	9.94e+07	1.36e+06	3.36e+06	0.00e+00	6.36e+06	0.00e+00	2.35e+07
Th-229	1.04e+09	2.60e+07	1.73e+07	0.00e+00	1.25e+08	0.00e+00	3.33e+06
Th-230	1.56e+08	7.82e+06	4.36e+06	0.00e+00	3.75e+07	0.00e+00	2.57e+06
Th-232	1.74e+08	6.70e+06	6.79e+04	0.00e+00	3.20e+07	0.00e+00	2.18e+06
Th-234	1.70e+04	9.26e+02	4.91e+02	0.00e+00	3.41e+03	0.00e+00	2.92e+06
Pa-231	3.11e+08	1.03e+07	1.24e+07	0.00e+00	5.51e+07	0.00e+00	3.06e+06
Pa-233	8.05e+02	1.58e+02	1.41e+02	0.00e+00	4.32e+02	0.00e+00	3.78e+05
U-232	9.95e+10	0.00e+00	8.88e+09	0.00e+00	9.74e+09	0.00e+00	2.89e+08
U-233	2.09e+10	0.00e+00	1.59e+09	0.00e+00	4.44e+09	0.00e+00	2.68e+08
U-234	2.01e+10	0.00e+00	1.56e+09	0.00e+00	4.36e+09	0.00e+00	2.62e+08
U-235	1.92e+10	0.00e+00	1.46e+09	0.00e+00	4.08e+09	0.00e+00	3.33e+08
U-236	1.92e+10	0.00e+00	1.50e+09	0.00e+00	4.15e+09	0.00e+00	2.46e+08
U-237	5.39e+05	0.00e+00	1.44e+05	0.00e+00	1.34e+06	0.00e+00	2.30e+07
U-238	1.84e+10	0.00e+00	1.37e+09	0.00e+00	3.82e+09	0.00e+00	2.35e+08
Np-237	9.87e+07	6.54e+06	4.32e+06	0.00e+00	2.61e+07	0.00e+00	3.39e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 7

## Cow's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Cow's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.49e+02	8.78e+00	5.40e+00	0.00e+00	1.92e+01	0.00e+00	1.17e+05
Np-239	3.65e+01	3.26e+00	1.84e+00	0.00e+00	6.51e+00	0.00e+00	9.44e+04
Pu-238	2.11e+07	2.47e+06	5.59e+05	0.00e+00	1.99e+06	0.00e+00	1.24e+06
Pu-239	2.27e+07	2.55e+06	5.82e+05	0.00e+00	2.11e+06	0.00e+00	1.14e+06
Pu-240	2.27e+07	2.55e+06	5.82e+05	0.00e+00	2.11e+06	0.00e+00	1.16e+06
Pu-241	6.97e+05	2.89e+04	1.45e+04	0.00e+00	5.20e+04	0.00e+00	2.38e+04
Pu-242	2.11e+07	2.45e+06	5.61e+05	0.00e+00	2.02e+06	0.00e+00	1.11e+06
Pu-244	2.45e+07	2.81e+06	6.43e+05	0.00e+00	2.32e+06	0.00e+00	1.66e+06
Am-241	5.95e+07	5.17e+07	4.44e+06	0.00e+00	2.67e+07	0.00e+00	3.14e+06
Am-242m	6.21e+07	5.02e+07	4.65e+06	0.00e+00	2.73e+07	0.00e+00	3.98e+06
Am-243	5.92e+07	5.06e+07	4.36e+06	0.00e+00	2.62e+07	0.00e+00	3.71e+06
Cm-242	5.15e+06	4.77e+06	3.42e+05	0.00e+00	9.84e+05	0.00e+00	3.09e+06
Cm-243	5.75e+07	4.72e+07	3.69e+06	0.00e+00	1.34e+07	0.00e+00	3.33e+06
Cm-244	4.84e+07	3.98e+07	3.11e+06	0.00e+00	1.11e+07	0.00e+00	3.22e+06
Cm-245	7.36e+07	5.96e+07	4.65e+06	0.00e+00	1.78e+07	0.00e+00	3.00e+06
Cm-246	7.28e+07	5.96e+07	4.65e+06	0.00e+00	1.77e+07	0.00e+00	2.95e+06
Cm-247	7.12e+07	5.88e+07	4.57e+06	0.00e+00	1.74e+07	0.00e+00	3.88e+06
Cm-248	5.88e+08	4.85e+08	3.77e+07	0.00e+00	1.44e+08	0.00e+00	6.25e+07
Cf-252	4.93e+07	0.00e+00	1.19e+06	0.00e+00	0.00e+00	0.00e+00	1.21e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, R<sub>j</sub>

R<sub>i</sub> factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway R<sub>i</sub>

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.85e+02	1.85e+02	1.85e+02	1.85e+02	1.85e+02	1.85e+02
Be-10	8.72e+06	1.35e+06	2.18e+05	0.00e+00	1.02e+06	0.00e+00	7.35e+07
C-14	2.41e+08	4.83e+07	4.83e+07	4.83e+07	4.83e+07	4.83e+07	4.83e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Na-22	1.39e+09	1.39e+09	1.39e+09	1.39e+09	1.39e+09	1.39e+09	1.39e+09
Na-24	1.39e-03	1.39e-03	1.39e-03	1.39e-03	1.39e-03	1.39e-03	1.39e-03
P-32	4.66e+09	2.90e+08	1.80e+08	0.00e+00	0.00e+00	0.00e+00	5.24e+08
Ca-41	2.03e+09	0.00e+00	2.19e+08	0.00e+00	0.00e+00	0.00e+00	2.02e+06
Sc-46	1.76e+05	3.41e+05	9.91e+04	0.00e+00	3.18e+05	0.00e+00	1.66e+09
Cr-51	0.00e+00	0.00e+00	7.05e+03	4.21e+03	1.55e+03	9.36e+03	1.77e+06
Mn-54	0.00e+00	9.18e+06	1.75e+06	0.00e+00	2.73e+06	0.00e+00	2.81e+07
Mn-56	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Fe-55	2.93e+08	2.03e+08	4.72e+07	0.00e+00	0.00e+00	1.13e+08	1.16e+08
Fe-59	2.66e+08	6.24e+08	2.39e+08	0.00e+00	0.00e+00	1.74e+08	2.08e+09
Co-57	0.00e+00	5.63e+06	9.37e+06	0.00e+00	0.00e+00	0.00e+00	1.43e+08
Co-58	0.00e+00	1.82e+07	4.09e+07	0.00e+00	0.00e+00	0.00e+00	3.70e+08
Co-60	0.00e+00	7.52e+07	1.66e+08	0.00e+00	0.00e+00	0.00e+00	1.41e+09
Ni-59	1.42e+08	4.87e+07	2.37e+07	0.00e+00	0.00e+00	0.00e+00	1.00e+07
Ni-63	1.89e+09	1.31e+08	6.33e+07	0.00e+00	0.00e+00	0.00e+00	2.73e+07
Ni-65	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Zn-65	3.56e+08	1.13e+09	5.12e+08	0.00e+00	7.57e+08	0.00e+00	7.13e+08
Zn-69	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-69m	1.87e-05	4.48e-05	4.10e-06	0.00e+00	2.71e-05	0.00e+00	2.73e-03
Se-79	0.00e+00	1.08e+08	1.81e+07	0.00e+00	1.87e+08	0.00e+00	2.21e+07
Br-82	0.00e+00	0.00e+00	1.23e+03	0.00e+00	0.00e+00	0.00e+00	1.41e+03
Br-83	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per μCi/sec for all nuclides except H-3, which is in units of mrem/yr per μCi/cubic meter.



Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	4.88e+08	2.27e+08	0.00e+00	0.00e+00	0.00e+00	9.61e+07
Rb-87	0.00e+00	1.05e+09	3.64e+08	0.00e+00	0.00e+00	0.00e+00	4.90e+07
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	3.02e+08	0.00e+00	8.66e+06	0.00e+00	0.00e+00	0.00e+00	4.84e+07
Sr-90	1.43e+10	0.00e+00	2.87e+08	0.00e+00	0.00e+00	0.00e+00	3.59e+08
Sr-91	1.58e-10	0.00e+00	6.39e-12	0.00e+00	0.00e+00	0.00e+00	7.53e-10
Sr-92	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-90	1.08e+02	0.00e+00	2.90e+00	0.00e+00	0.00e+00	0.00e+00	1.15e+06
Y-91	1.13e+06	0.00e+00	3.03e+04	0.00e+00	0.00e+00	0.00e+00	6.23e+08
Y-91m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-92	1.69e-39	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.96e-35
Y-93	4.87e-12	0.00e+00	1.35e-13	0.00e+00	0.00e+00	0.00e+00	1.55e-07
Zr-93	3.90e+06	2.18e+05	1.02e+05	0.00e+00	8.27e+05	0.00e+00	2.27e+08
Zr-95	1.87e+06	6.01e+05	4.07e+05	0.00e+00	9.43e+05	0.00e+00	1.90e+09
Zr-97	2.11e-05	4.27e-06	1.95e-06	0.00e+00	6.44e-06	0.00e+00	1.32e+00
Nb-93m	1.95e+07	6.35e+06	1.57e+06	0.00e+00	7.31e+06	0.00e+00	2.93e+09
Nb-95	2.30e+06	1.28e+06	6.87e+05	0.00e+00	1.26e+06	0.00e+00	7.76e+09
Nb-97	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mo-93	0.00e+00	1.65e+08	4.45e+06	0.00e+00	4.67e+07	0.00e+00	2.68e+07
Mo-99	0.00e+00	1.01e+05	1.91e+04	0.00e+00	2.28e+05	0.00e+00	2.33e+05
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	1.37e+08	2.04e+08	5.51e+07	0.00e+00	2.57e+09	1.73e+07	6.67e+09
Tc-99m	4.74e-21	1.34e-20	1.71e-19	0.00e+00	2.04e-19	6.57e-21	7.93e-18
Ru-103	1.05e+08	0.00e+00	4.53e+07	0.00e+00	4.02e+08	0.00e+00	1.23e+10
Ru-105	6.30e-28	0.00e+00	2.49e-28	0.00e+00	8.14e-27	0.00e+00	3.85e-25
Ru-106	2.80e+09	0.00e+00	3.54e+08	0.00e+00	5.40e+09	0.00e+00	1.81e+11
Rh-105	3.79e+00	2.78e+00	1.83e+00	0.00e+00	1.18e+01	0.00e+00	4.42e+02
Pd-107	0.00e+00	1.61e+06	1.03e+05	0.00e+00	1.45e+07	0.00e+00	9.99e+06
Pd-109	0.00e+00	1.49e-06	3.35e-07	0.00e+00	8.47e-06	0.00e+00	1.64e-04

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	6.68e+06	6.18e+06	3.67e+06	0.00e+00	1.22e+07	0.00e+00	2.52e+09
Ag-111	1.46e+05	6.12e+04	3.05e+04	0.00e+00	1.97e+05	0.00e+00	1.12e+08
Cd-113m	0.00e+00	4.60e+06	1.47e+05	0.00e+00	5.06e+06	0.00e+00	3.70e+07
Cd-115m	0.00e+00	1.49e+06	4.76e+04	0.00e+00	1.18e+06	0.00e+00	6.27e+07
Sn-123	5.53e+09	9.15e+07	1.35e+08	7.78e+07	0.00e+00	0.00e+00	1.13e+10
Sn-125	1.76e+08	3.55e+06	7.99e+06	2.94e+06	0.00e+00	0.00e+00	2.20e+09
Sn-126	1.85e+10	3.66e+08	5.27e+08	1.08e+08	0.00e+00	0.00e+00	5.33e+09
Sb-124	1.98e+07	3.74e+05	7.85e+06	4.80e+04	0.00e+00	1.54e+07	5.62e+08
Sb-125	1.91e+07	2.13e+05	4.55e+06	1.94e+04	0.00e+00	1.47e+07	2.10e+08
Sb-126	1.96e+06	3.99e+04	7.08e+05	1.20e+04	0.00e+00	1.20e+06	1.60e+08
Sb-127	1.71e+04	3.75e+02	6.58e+03	2.06e+02	0.00e+00	1.02e+04	3.92e+06
Te-125m	3.59e+08	1.30e+08	4.81e+07	1.08e+08	1.46e+09	0.00e+00	1.43e+09
Te-127	2.21e-10	7.94e-11	4.78e-11	1.64e-10	9.01e-10	0.00e+00	1.74e-08
Te-127m	1.12e+09	3.99e+08	1.36e+08	2.85e+08	4.53e+09	0.00e+00	3.74e+09
Te-129	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-129m	1.13e+09	4.23e+08	1.80e+08	3.90e+08	4.74e+09	0.00e+00	5.71e+09
Te-131	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-131m	4.57e+02	2.23e+02	1.86e+02	3.54e+02	2.26e+03	0.00e+00	2.22e+04
Te-132	1.43e+06	9.23e+05	8.66e+05	1.02e+06	8.89e+06	0.00e+00	4.36e+07
Te-133m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-129	1.30e+08	1.12e+08	3.66e+08	2.87e+11	2.40e+08	0.00e+00	1.77e+07
I-130	2.18e-06	6.42e-06	2.53e-06	5.44e-04	1.00e-05	0.00e+00	5.52e-06
I-131	1.08e+07	1.54e+07	8.82e+06	5.04e+09	2.64e+07	0.00e+00	4.06e+06
I-132	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
I-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Cs-134	6.58e+08	1.56e+09	1.28e+09	0.00e+00	5.06e+08	1.68e+08	2.74e+07
Cs-134m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	2.14e+08	1.97e+08	8.76e+07	0.00e+00	7.47e+07	2.24e+07	4.62e+06
Cs-136	1.21e+07	4.76e+07	3.43e+07	0.00e+00	2.65e+07	3.63e+06	5.41e+06
Cs-137	8.72e+08	1.19e+09	7.81e+08	0.00e+00	4.05e+08	1.35e+08	2.31e+07
Cs-138	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-140	2.88e+07	3.61e+04	1.88e+06	0.00e+00	1.23e+04	2.07e+04	5.92e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-140	3.75e-02	1.89e-02	4.99e-03	0.00e+00	0.00e+00	0.00e+00	1.39e+03
La-141	3.46e-37	1.07e-37	1.76e-38	0.00e+00	0.00e+00	0.00e+00	1.28e-32
La-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-141	1.41e+04	9.50e+03	1.08e+03	0.00e+00	4.41e+03	0.00e+00	3.63e+07
Ce-143	2.03e-02	1.50e+01	1.66e-03	0.00e+00	6.61e-03	0.00e+00	5.61e+02
Ce-144	1.46e+06	6.09e+05	7.83e+04	0.00e+00	3.61e+05	0.00e+00	4.93e+08
Pr-143	2.10e+04	8.42e+03	1.04e+03	0.00e+00	4.86e+03	0.00e+00	9.19e+07
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	7.08e+03	8.18e+03	4.90e+02	0.00e+00	4.78e+03	0.00e+00	3.93e+07
Pm-147	9.64e+05	9.07e+04	3.67e+04	0.00e+00	1.71e+05	0.00e+00	1.14e+08
Pm-148	1.98e+03	3.29e+02	1.65e+02	0.00e+00	6.21e+02	0.00e+00	2.58e+07
Pm-148m	2.16e+05	5.59e+04	4.27e+04	0.00e+00	8.43e+04	0.00e+00	4.74e+08
Pm-149	5.15e+00	7.28e-01	2.97e-01	0.00e+00	1.37e+00	0.00e+00	1.36e+05
Pm-151	5.64e-03	9.46e-04	4.78e-04	0.00e+00	1.69e-03	0.00e+00	2.60e+02
Sm-151	9.45e+05	1.63e+05	3.90e+04	0.00e+00	1.82e+05	0.00e+00	7.19e+07
Sm-153	1.17e+00	9.80e-01	7.15e-02	0.00e+00	3.17e-01	0.00e+00	3.49e+04
Eu-152	2.55e+06	5.81e+05	5.10e+05	0.00e+00	3.60e+06	0.00e+00	3.35e+08
Eu-154	8.09e+06	9.95e+05	7.08e+05	0.00e+00	4.76e+06	0.00e+00	7.21e+08
Eu-155	1.09e+06	1.54e+05	9.93e+04	0.00e+00	7.10e+05	0.00e+00	1.21e+08
Eu-156	3.77e+04	2.92e+04	4.71e+03	0.00e+00	1.95e+04	0.00e+00	2.00e+08
Tb-160	3.92e+05	0.00e+00	4.89e+04	0.00e+00	1.62e+05	0.00e+00	3.61e+08

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	3.26e+06	1.02e+06	7.72e+05	0.00e+00	1.52e+06	0.00e+00	3.09e+08
W-181	3.02e+04	9.84e+03	1.05e+03	0.00e+00	0.00e+00	0.00e+00	1.12e+06
W-185	1.08e+06	3.61e+05	3.79e+04	0.00e+00	0.00e+00	0.00e+00	4.17e+07
W-187	2.25e-02	1.88e-02	6.56e-03	0.00e+00	0.00e+00	0.00e+00	6.15e+00
Pb-210	1.21e+10	3.46e+09	4.31e+08	0.00e+00	9.75e+09	0.00e+00	1.77e+06
Bi-210	2.72e+05	1.88e+06	1.56e+05	0.00e+00	2.26e+07	0.00e+00	2.80e+07
Po-210	9.62e+09	2.04e+10	2.32e+09	0.00e+00	6.81e+10	0.00e+00	1.72e+09
Ra-223	6.16e+10	9.49e+07	1.23e+10	0.00e+00	2.69e+09	0.00e+00	3.98e+09
Ra-224	7.05e+08	1.71e+06	1.41e+08	0.00e+00	4.81e+07	0.00e+00	1.49e+08
Ra-225	1.23e+11	1.46e+08	2.46e+10	0.00e+00	4.15e+09	0.00e+00	5.75e+09
Ra-226	2.82e+13	5.35e+08	2.05e+13	0.00e+00	1.52e+10	0.00e+00	3.10e+10
Ra-228	1.03e+13	2.87e+08	1.11e+13	0.00e+00	8.12e+09	0.00e+00	5.19e+09
Ac-225	7.54e+07	1.04e+08	5.07e+06	0.00e+00	1.18e+07	0.00e+00	6.98e+09
Ac-227	3.07e+11	4.07e+10	1.82e+10	0.00e+00	1.31e+10	0.00e+00	1.34e+10
Th-227	2.02e+06	3.66e+04	5.83e+04	0.00e+00	2.08e+05	0.00e+00	7.97e+07
Th-228	2.61e+08	4.43e+06	8.85e+06	0.00e+00	2.46e+07	0.00e+00	2.97e+08
Th-229	7.46e+09	2.13e+08	1.23e+08	0.00e+00	1.03e+09	0.00e+00	4.28e+07
Th-230	1.13e+09	6.42e+07	3.13e+07	0.00e+00	3.10e+08	0.00e+00	3.30e+07
Th-232	1.26e+09	5.48e+07	8.23e+05	0.00e+00	2.64e+08	0.00e+00	2.81e+07
Th-234	1.56e+04	9.19e+02	4.51e+02	0.00e+00	5.21e+03	0.00e+00	2.21e+07
Pa-231	8.99e+15	3.38e+14	3.49e+14	0.00e+00	1.90e+15	0.00e+00	1.57e+14
Pa-233	4.60e+09	9.28e+08	7.98e+08	0.00e+00	3.49e+09	0.00e+00	1.44e+13
U-232	3.85e+09	0.00e+00	2.75e+08	0.00e+00	4.16e+08	0.00e+00	6.31e+07
U-233	8.12e+08	0.00e+00	4.92e+07	0.00e+00	1.89e+08	0.00e+00	5.85e+07
U-234	7.79e+08	0.00e+00	4.82e+07	0.00e+00	1.86e+08	0.00e+00	5.72e+07
U-235	7.47e+08	0.00e+00	4.53e+07	0.00e+00	1.74e+08	0.00e+00	7.28e+07
U-236	7.47e+08	0.00e+00	4.62e+07	0.00e+00	1.78e+08	0.00e+00	5.37e+07
U-237	2.15e+03	0.00e+00	5.72e+02	0.00e+00	8.83e+03	0.00e+00	7.55e+05
U-238	7.15e+08	0.00e+00	4.23e+07	0.00e+00	1.63e+08	0.00e+00	5.13e+07
Np-237	6.91e+08	4.91e+07	3.04e+07	0.00e+00	2.26e+08	0.00e+00	4.35e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 8

## Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.43e+00	3.85e-02	2.22e-02	0.00e+00	1.30e-01	0.00e+00	3.58e+03
Np-239	2.61e-01	2.57e-02	1.41e-02	0.00e+00	8.00e-02	0.00e+00	5.26e+03
Pu-238	2.42e+07	3.06e+06	6.56e+05	0.00e+00	2.81e+06	0.00e+00	2.80e+06
Pu-239	2.78e+07	3.34e+06	7.33e+05	0.00e+00	3.11e+06	0.00e+00	2.56e+06
Pu-240	2.78e+07	3.34e+06	7.33e+05	0.00e+00	3.11e+06	0.00e+00	2.60e+06
Pu-241	6.00e+05	2.85e+04	1.27e+04	0.00e+00	5.84e+04	0.00e+00	5.35e+04
Pu-242	2.58e+07	3.22e+06	7.06e+05	0.00e+00	3.00e+06	0.00e+00	2.51e+06
Pu-244	3.01e+07	3.69e+06	8.10e+05	0.00e+00	3.44e+06	0.00e+00	3.74e+06
Am-241	4.07e+08	3.80e+08	2.92e+07	0.00e+00	2.19e+08	0.00e+00	4.00e+07
Am-242m	4.17e+08	3.63e+08	2.98e+07	0.00e+00	2.22e+08	0.00e+00	5.12e+07
Am-243	4.14e+08	3.78e+08	2.91e+07	0.00e+00	2.19e+08	0.00e+00	4.77e+07
Cm-242	9.56e+06	1.02e+07	6.36e+05	0.00e+00	2.89e+06	0.00e+00	3.67e+07
Cm-243	3.28e+08	3.00e+08	2.05e+07	0.00e+00	9.57e+07	0.00e+00	4.27e+07
Cm-244	2.49e+08	2.33e+08	1.57e+07	0.00e+00	7.32e+07	0.00e+00	4.12e+07
Cm-245	5.14e+08	4.48e+08	3.16e+07	0.00e+00	1.48e+08	0.00e+00	3.86e+07
Cm-246	5.10e+08	4.48e+08	3.15e+07	0.00e+00	1.47e+08	0.00e+00	3.79e+07
Cm-247	4.97e+08	4.41e+08	3.11e+07	0.00e+00	1.45e+08	0.00e+00	4.99e+07
Cm-248	4.14e+09	3.64e+09	2.56e+08	0.00e+00	1.20e+09	0.00e+00	8.06e+08
Cf-252	1.39e+08	0.00e+00	3.34e+06	0.00e+00	0.00e+00	0.00e+00	1.53e+08

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.10e+02	1.10e+02	1.10e+02	1.10e+02	1.10e+02	1.10e+02
Be-10	7.26e+06	1.12e+06	1.83e+05	0.00e+00	8.59e+05	0.00e+00	4.60e+07
C-14	2.04e+08	4.08e+07	4.08e+07	4.08e+07	4.08e+07	4.08e+07	4.08e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Na-22	1.10e+09	1.10e+09	1.10e+09	1.10e+09	1.10e+09	1.10e+09	1.10e+09
Na-24	1.11e-03	1.11e-03	1.11e-03	1.11e-03	1.11e-03	1.11e-03	1.11e-03
P-32	3.94e+09	2.44e+08	1.53e+08	0.00e+00	0.00e+00	0.00e+00	3.31e+08
Ca-41	1.28e+09	0.00e+00	1.38e+08	0.00e+00	0.00e+00	0.00e+00	1.26e+06
Sc-46	1.36e+05	2.65e+05	7.87e+04	0.00e+00	2.54e+05	0.00e+00	9.04e+08
Cr-51	0.00e+00	0.00e+00	5.64e+03	3.13e+03	1.24e+03	8.05e+03	9.48e+05
Mn-54	0.00e+00	7.00e+06	1.39e+06	0.00e+00	2.09e+06	0.00e+00	1.44e+07
Mn-56	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Fe-55	2.38e+08	1.69e+08	3.94e+07	0.00e+00	0.00e+00	1.07e+08	7.31e+07
Fe-59	2.12e+08	4.95e+08	1.91e+08	0.00e+00	0.00e+00	1.56e+08	1.17e+09
Co-57	0.00e+00	4.53e+06	7.59e+06	0.00e+00	0.00e+00	0.00e+00	8.45e+07
Co-58	0.00e+00	1.41e+07	3.24e+07	0.00e+00	0.00e+00	0.00e+00	1.94e+08
Co-60	0.00e+00	5.83e+07	1.31e+08	0.00e+00	0.00e+00	0.00e+00	7.60e+08
Ni-59	1.13e+08	4.00e+07	1.92e+07	0.00e+00	0.00e+00	0.00e+00	6.28e+06
Ni-63	1.52e+09	1.07e+08	5.15e+07	0.00e+00	0.00e+00	0.00e+00	1.71e+07
Ni-65	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Zn-65	2.50e+08	8.69e+08	4.05e+08	0.00e+00	5.56e+08	0.00e+00	3.68e+08
Zn-69	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-69m	1.56e-05	3.67e-05	3.37e-06	0.00e+00	2.23e-05	0.00e+00	2.02e-03
Se-79	0.00e+00	9.07e+07	1.52e+07	0.00e+00	1.58e+08	0.00e+00	1.39e+07
Br-82	0.00e+00	0.00e+00	9.76e+02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	4.07e+08	1.91e+08	0.00e+00	0.00e+00	0.00e+00	6.02e+07
Rb-87	0.00e+00	8.79e+08	3.07e+08	0.00e+00	0.00e+00	0.00e+00	3.07e+07
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	2.55e+08	0.00e+00	7.29e+06	0.00e+00	0.00e+00	0.00e+00	3.03e+07
Sr-90	9.89e+09	0.00e+00	1.98e+08	0.00e+00	0.00e+00	0.00e+00	2.26e+08
Sr-91	1.33e-10	0.00e+00	5.29e-12	0.00e+00	0.00e+00	0.00e+00	6.03e-10
Sr-92	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-90	9.11e+01	0.00e+00	2.45e+00	0.00e+00	0.00e+00	0.00e+00	7.52e+05
Y-91	9.54e+05	0.00e+00	2.56e+04	0.00e+00	0.00e+00	0.00e+00	3.91e+08
Y-91m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-92	1.43e-39	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.93e-35
Y-93	4.11e-12	0.00e+00	1.13e-13	0.00e+00	0.00e+00	0.00e+00	1.26e-07
Zr-93	3.05e+06	1.50e+05	8.21e+04	0.00e+00	5.32e+05	0.00e+00	1.42e+08
Zr-95	1.50e+06	4.73e+05	3.25e+05	0.00e+00	6.95e+05	0.00e+00	1.09e+09
Zr-97	1.76e-05	3.49e-06	1.61e-06	0.00e+00	5.29e-06	0.00e+00	9.44e-01
Nb-93m	1.55e+07	5.10e+06	1.28e+06	0.00e+00	5.96e+06	0.00e+00	1.84e+09
Nb-95	1.79e+06	9.96e+05	5.48e+05	0.00e+00	9.65e+05	0.00e+00	4.26e+09
Nb-97	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mo-93	0.00e+00	1.37e+08	3.76e+06	0.00e+00	3.94e+07	0.00e+00	1.67e+07
Mo-99	0.00e+00	8.31e+04	1.59e+04	0.00e+00	1.90e+05	0.00e+00	1.49e+05
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	1.16e+08	1.70e+08	4.65e+07	0.00e+00	2.16e+09	1.76e+07	4.17e+09
Tc-99m	3.77e-21	1.05e-20	1.36e-19	0.00e+00	1.57e-19	5.83e-21	6.90e-18
Ru-103	8.57e+07	0.00e+00	3.66e+07	0.00e+00	3.02e+08	0.00e+00	7.16e+09
Ru-105	5.27e-28	0.00e+00	2.04e-28	0.00e+00	6.65e-27	0.00e+00	4.25e-25
Ru-106	2.36e+09	0.00e+00	2.97e+08	0.00e+00	4.55e+09	0.00e+00	1.13e+11
Rh-105	3.21e+00	2.32e+00	1.52e+00	0.00e+00	9.84e+00	0.00e+00	2.95e+02
Pd-107	0.00e+00	1.35e+06	8.69e+04	0.00e+00	1.22e+07	0.00e+00	6.26e+06
Pd-109	0.00e+00	1.24e-06	2.83e-07	0.00e+00	7.19e-06	0.00e+00	1.25e-04

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Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	5.06e+06	4.79e+06	2.91e+06	0.00e+00	9.13e+06	0.00e+00	1.34e+09
Ag-111	1.23e+05	5.12e+04	2.57e+04	0.00e+00	1.67e+05	0.00e+00	7.14e+07
Cd-113m	0.00e+00	3.85e+06	1.24e+05	0.00e+00	4.26e+06	0.00e+00	2.32e+07
Cd-115m	0.00e+00	1.25e+06	4.02e+04	0.00e+00	9.96e+05	0.00e+00	3.94e+07
Sn-123	4.66e+09	7.66e+07	1.13e+08	6.13e+07	0.00e+00	0.00e+00	7.05e+09
Sn-125	1.49e+08	2.96e+06	6.71e+06	2.32e+06	0.00e+00	0.00e+00	1.40e+09
Sn-126	1.50e+10	2.80e+08	4.28e+08	7.38e+07	0.00e+00	0.00e+00	3.34e+09
Sb-124	1.62e+07	2.98e+05	6.31e+06	3.67e+04	0.00e+00	1.41e+07	3.26e+08
Sb-125	1.56e+07	1.71e+05	3.66e+06	1.49e+04	0.00e+00	1.37e+07	1.22e+08
Sb-126	1.60e+06	3.28e+04	5.76e+05	9.07e+03	0.00e+00	1.15e+06	9.49e+07
Sb-127	1.43e+04	3.05e+02	5.38e+03	1.60e+02	0.00e+00	9.70e+03	2.42e+06
Te-125m	3.03e+08	1.09e+08	4.05e+07	8.47e+07	0.00e+00	0.00e+00	8.94e+08
Te-127	1.88e-10	6.65e-11	4.04e-11	1.29e-10	7.60e-10	0.00e+00	1.45e-08
Te-127m	9.42e+08	3.34e+08	1.12e+08	2.24e+08	3.82e+09	0.00e+00	2.35e+09
Te-129	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-129m	9.50e+08	3.53e+08	1.50e+08	3.07e+08	3.98e+09	0.00e+00	3.57e+09
Te-131	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-131m	3.81e+02	1.83e+02	1.52e+02	2.75e+02	1.90e+03	0.00e+00	1.47e+04
Te-132	1.17e+06	7.39e+05	6.96e+05	7.79e+05	7.09e+06	0.00e+00	2.34e+07
Te-133m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-129	1.09e+08	9.21e+07	1.54e+08	1.12e+11	1.65e+08	0.00e+00	1.07e+07
I-130	1.75e-06	5.07e-06	2.02e-06	4.13e-04	7.80e-06	0.00e+00	3.89e-06
I-131	8.94e+06	1.25e+07	6.72e+06	3.65e+09	2.15e+07	0.00e+00	2.48e+06
I-132	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
I-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-135	3.82e-17	9.82e-17	3.64e-17	6.32e-15	1.55e-16	0.00e+00	1.09e-16
Cs-134	5.23e+08	1.23e+09	5.71e+08	0.00e+00	3.91e+08	1.49e+08	1.53e+07
Cs-134m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

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Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
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Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.80e+08	1.65e+08	3.86e+07	0.00e+00	6.31e+07	2.28e+07	2.89e+06
Cs-136	9.41e+06	3.70e+07	2.49e+07	0.00e+00	2.02e+07	3.18e+06	2.98e+06
Cs-137	7.24e+08	9.63e+08	3.36e+08	0.00e+00	3.28e+08	1.27e+08	1.37e+07
Cs-138	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-140	2.38e+07	2.91e+04	1.53e+06	0.00e+00	9.88e+03	1.96e+04	3.67e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-140	3.08e-02	1.51e-02	4.03e-03	0.00e+00	0.00e+00	0.00e+00	8.69e+02
La-141	2.92e-37	8.97e-38	1.48e-38	0.00e+00	0.00e+00	0.00e+00	1.59e-32
La-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-141	1.18e+04	7.88e+03	9.05e+02	0.00e+00	3.71e+03	0.00e+00	2.25e+07
Ce-143	1.71e-02	1.24e+01	1.39e-03	0.00e+00	5.58e-03	0.00e+00	3.74e+02
Ce-144	1.23e+06	5.08e+05	6.60e+04	0.00e+00	3.04e+05	0.00e+00	3.09e+08
Pr-143	1.77e+04	7.05e+03	8.79e+02	0.00e+00	4.10e+03	0.00e+00	5.81e+07
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	6.24e+03	6.78e+03	4.06e+02	0.00e+00	3.98e+03	0.00e+00	2.45e+07
Pm-147	7.93e+05	7.53e+04	3.07e+04	0.00e+00	1.44e+05	0.00e+00	7.16e+07
Pm-148	1.66e+03	2.71e+02	1.36e+02	0.00e+00	4.89e+02	0.00e+00	1.62e+07
Pm-148m	1.72e+05	4.36e+04	3.41e+04	0.00e+00	6.60e+04	0.00e+00	2.74e+08
Pm-149	4.34e+00	6.10e-01	2.50e-01	0.00e+00	1.16e+00	0.00e+00	8.98e+04
Pm-151	4.72e-03	7.79e-04	3.94e-04	0.00e+00	1.40e-03	0.00e+00	1.75e+02
Sm-151	7.07e+05	1.36e+05	3.19e+04	0.00e+00	1.49e+05	0.00e+00	4.61e+07
Sm-153	9.88e-01	8.18e-01	6.02e-02	0.00e+00	2.67e-01	0.00e+00	2.31e+04
Eu-152	1.89e+06	4.56e+05	4.02e+05	0.00e+00	2.12e+06	0.00e+00	1.68e+08
Eu-154	6.15e+06	7.93e+05	5.59e+05	0.00e+00	3.55e+06	0.00e+00	4.19e+08
Eu-155	1.30e+06	1.25e+05	7.76e+04	0.00e+00	4.90e+05	0.00e+00	7.18e+08
Eu-156	3.12e+04	2.34e+04	3.82e+03	0.00e+00	1.58e+04	0.00e+00	1.20e+08
Tb-160	3.19e+05	0.00e+00	3.98e+04	0.00e+00	1.26e+05	0.00e+00	2.06e+08

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	2.55e+06	7.84e+05	5.68e+05	0.00e+00	1.15e+06	0.00e+00	1.93e+08
W-181	2.56e+04	8.25e+03	8.62e+02	0.00e+00	0.00e+00	0.00e+00	7.02e+05
W-185	9.14e+05	3.01e+05	3.19e+04	0.00e+00	0.00e+00	0.00e+00	2.60e+07
W-187	1.88e-02	1.53e-02	5.37e-03	0.00e+00	0.00e+00	0.00e+00	4.15e+00
Pb-210	8.47e+09	2.55e+09	3.28e+08	0.00e+00	8.05e+09	0.00e+00	1.11e+06
Bi-210	2.30e+05	1.57e+06	1.32e+05	0.00e+00	1.91e+07	0.00e+00	1.80e+07
Po-210	8.13e+09	1.71e+10	1.96e+09	0.00e+00	5.75e+10	0.00e+00	1.08e+09
Ra-223	5.21e+10	7.92e+07	1.04e+10	0.00e+00	2.27e+09	0.00e+00	2.51e+09
Ra-224	5.97e+08	1.43e+06	1.19e+08	0.00e+00	4.09e+07	0.00e+00	9.59e+07
Ra-225	1.04e+11	1.22e+08	2.08e+10	0.00e+00	3.50e+09	0.00e+00	3.63e+09
Ra-226	1.77e+13	4.48e+08	1.32e+13	0.00e+00	1.28e+10	0.00e+00	1.93e+10
Ra-228	7.45e+12	2.40e+08	8.21e+12	0.00e+00	6.85e+09	0.00e+00	3.25e+09
Ac-225	6.37e+07	8.70e+07	4.27e+06	0.00e+00	9.98e+06	0.00e+00	4.42e+09
Ac-227	1.99e+11	2.94e+10	1.18e+10	0.00e+00	8.54e+09	0.00e+00	8.41e+09
Th-227	1.71e+06	3.07e+04	4.93e+04	0.00e+00	1.75e+05	0.00e+00	5.01e+07
Th-228	2.12e+08	3.55e+06	7.16e+06	0.00e+00	2.00e+07	0.00e+00	1.86e+08
Th-229	4.63e+09	1.33e+08	7.68e+07	0.00e+00	6.45e+08	0.00e+00	2.68e+07
Th-230	7.00e+08	3.99e+07	1.94e+07	0.00e+00	1.94e+08	0.00e+00	2.07e+07
Th-232	7.84e+08	3.40e+07	5.28e+05	0.00e+00	1.66e+08	0.00e+00	1.76e+07
Th-234	1.31e+04	7.70e+02	3.82e+02	0.00e+00	4.39e+03	0.00e+00	1.40e+07
Pa-231	5.59e+15	2.10e+14	2.18e+14	0.00e+00	1.18e+15	0.00e+00	9.85e+13
Pa-233	3.79e+09	7.29e+08	6.52e+08	0.00e+00	2.75e+09	0.00e+00	8.33e+12
U-232	3.24e+09	0.00e+00	2.32e+08	0.00e+00	3.51e+08	0.00e+00	3.96e+07
U-233	6.83e+08	0.00e+00	4.15e+07	0.00e+00	1.60e+08	0.00e+00	3.66e+07
U-234	6.56e+08	0.00e+00	4.07e+07	0.00e+00	1.57e+08	0.00e+00	3.59e+07
U-235	6.28e+08	0.00e+00	3.82e+07	0.00e+00	1.47e+08	0.00e+00	4.56e+07
U-236	6.28e+08	0.00e+00	3.91e+07	0.00e+00	1.50e+08	0.00e+00	3.37e+07
U-237	1.81e+03	0.00e+00	4.83e+02	0.00e+00	7.45e+03	0.00e+00	4.80e+05
U-238	6.01e+08	0.00e+00	3.58e+07	0.00e+00	1.38e+08	0.00e+00	3.21e+07
Np-237	4.31e+08	3.10e+07	1.90e+07	0.00e+00	1.40e+08	0.00e+00	2.73e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 8

## Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.20e+00	3.22e-02	1.87e-02	0.00e+00	1.10e-01	0.00e+00	2.36e+03
Np-239	2.28e-01	2.15e-02	1.19e-02	0.00e+00	6.75e-02	0.00e+00	3.46e+03
Pu-238	1.52e+07	1.94e+06	4.13e+05	0.00e+00	1.77e+06	0.00e+00	1.75e+06
Pu-239	1.74e+07	2.11e+06	4.56e+05	0.00e+00	1.94e+06	0.00e+00	1.60e+06
Pu-240	1.73e+07	2.10e+06	4.56e+05	0.00e+00	1.94e+06	0.00e+00	1.63e+06
Pu-241	3.95e+05	1.90e+04	8.33e+03	0.00e+00	3.86e+04	0.00e+00	3.34e+04
Pu-242	1.61e+07	2.03e+06	4.40e+05	0.00e+00	1.87e+06	0.00e+00	1.57e+06
Pu-244	1.88e+07	2.31e+06	5.04e+05	0.00e+00	2.14e+06	0.00e+00	2.34e+06
Am-241	2.54e+08	2.40e+08	1.83e+07	0.00e+00	1.37e+08	0.00e+00	2.51e+07
Am-242m	2.61e+08	2.30e+08	1.88e+07	0.00e+00	1.39e+08	0.00e+00	3.21e+07
Am-243	2.58e+08	2.38e+08	1.82e+07	0.00e+00	1.37e+08	0.00e+00	2.99e+07
Cm-242	8.06e+06	8.50e+06	5.35e+05	0.00e+00	2.44e+06	0.00e+00	2.30e+07
Cm-243	2.10e+08	1.95e+08	1.32e+07	0.00e+00	6.17e+07	0.00e+00	2.68e+07
Cm-244	1.63e+08	1.54e+08	1.03e+07	0.00e+00	4.81e+07	0.00e+00	2.58e+07
Cm-245	3.21e+08	2.82e+08	1.98e+07	0.00e+00	9.24e+07	0.00e+00	2.42e+07
Cm-246	3.18e+08	2.82e+08	1.97e+07	0.00e+00	9.20e+07	0.00e+00	2.38e+07
Cm-247	3.10e+08	2.78e+08	1.94e+07	0.00e+00	9.07e+07	0.00e+00	3.12e+07
Cm-248	2.58e+09	2.29e+09	1.60e+08	0.00e+00	7.49e+08	0.00e+00	5.02e+08
Cf-252	1.09e+08	0.00e+00	2.63e+06	0.00e+00	0.00e+00	0.00e+00	9.58e+07

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Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.34e+02	1.34e+02	1.34e+02	1.34e+02	1.34e+02	1.34e+02
Be-10	1.38e+07	1.60e+06	3.46e+05	0.00e+00	1.13e+06	0.00e+00	2.81e+07
C-14	3.83e+08	7.67e+07	7.67e+07	7.67e+07	7.67e+07	7.67e+07	7.67e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Na-22	1.75e+09	1.75e+09	1.75e+09	1.75e+09	1.75e+09	1.75e+09	1.75e+09
Na-24	1.77e-03	1.77e-03	1.77e-03	1.77e-03	1.77e-03	1.77e-03	1.77e-03
P-32	7.43e+09	3.47e+08	2.86e+08	0.00e+00	0.00e+00	0.00e+00	2.05e+08
Ca-41	1.42e+09	0.00e+00	1.55e+08	0.00e+00	0.00e+00	0.00e+00	7.77e+05
Sc-46	2.34e+05	3.21e+05	1.24e+05	0.00e+00	2.84e+05	0.00e+00	4.69e+08
Cr-51	0.00e+00	0.00e+00	8.79e+03	4.88e+03	1.33e+03	8.91e+03	4.66e+05
Mn-54	0.00e+00	8.01e+06	2.13e+06	0.00e+00	2.25e+06	0.00e+00	6.72e+06
Mn-56	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Fe-55	4.57e+08	2.42e+08	7.51e+07	0.00e+00	0.00e+00	1.37e+08	4.49e+07
Fe-59	3.76e+08	6.09e+08	3.03e+08	0.00e+00	0.00e+00	1.77e+08	6.34e+08
Co-57	0.00e+00	5.92e+06	1.20e+07	0.00e+00	0.00e+00	0.00e+00	4.85e+07
Co-58	0.00e+00	1.64e+07	5.03e+07	0.00e+00	0.00e+00	0.00e+00	9.58e+07
Co-60	0.00e+00	6.93e+07	2.04e+08	0.00e+00	0.00e+00	0.00e+00	3.84e+08
Ni-59	2.18e+08	5.80e+07	3.69e+07	0.00e+00	0.00e+00	0.00e+00	3.85e+06
Ni-63	2.91e+09	1.56e+08	9.91e+07	0.00e+00	0.00e+00	0.00e+00	1.05e+07
Ni-65	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cu-64	0.00e+00	3.07e-07	1.85e-07	0.00e+00	7.41e-07	0.00e+00	1.44e-05
Zn-65	3.75e+08	1.00e+09	6.22e+08	0.00e+00	6.30e+08	0.00e+00	1.76e+08
Zn-69	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-69m	2.91e-05	4.95e-05	5.85e-06	0.00e+00	2.88e-05	0.00e+00	1.61e-03
Se-79	0.00e+00	1.29e+08	2.87e+07	0.00e+00	2.10e+08	0.00e+00	8.48e+06
Br-82	0.00e+00	0.00e+00	1.53e+03	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	5.77e+08	3.55e+08	0.00e+00	0.00e+00	0.00e+00	3.71e+07
Rb-87	0.00e+00	1.25e+09	5.80e+08	0.00e+00	0.00e+00	0.00e+00	1.88e+07
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	4.82e+08	0.00e+00	1.38e+07	0.00e+00	0.00e+00	0.00e+00	1.87e+07
Sr-90	1.57e+10	0.00e+00	3.15e+08	0.00e+00	0.00e+00	0.00e+00	1.40e+08
Sr-91	2.50e-10	0.00e+00	9.42e-12	0.00e+00	0.00e+00	0.00e+00	5.51e-10
Sr-92	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-90	1.72e+02	0.00e+00	4.61e+00	0.00e+00	0.00e+00	0.00e+00	4.91e+05
Y-91	1.80e+06	0.00e+00	4.82e+04	0.00e+00	0.00e+00	0.00e+00	2.40e+08
Y-91m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-92	2.69e-39	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	7.76e-35
Y-93	7.73e-12	0.00e+00	2.12e-13	0.00e+00	0.00e+00	0.00e+00	1.15e-07
Zr-93	5.80e+06	2.17e+05	1.55e+05	0.00e+00	8.41e+05	0.00e+00	8.24e+07
Zr-95	2.66e+06	5.86e+05	5.21e+05	0.00e+00	8.38e+05	0.00e+00	6.11e+08
Zr-97	3.28e-05	4.74e-06	2.80e-06	0.00e+00	6.80e-06	0.00e+00	7.18e-01
Nb-93m	2.99e+07	7.46e+06	2.45e+06	0.00e+00	8.05e+06	0.00e+00	1.12e+09
Nb-95	3.10e+06	1.21e+06	8.62e+05	0.00e+00	1.13e+06	0.00e+00	2.23e+09
Nb-97	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mo-93	0.00e+00	1.97e+08	7.07e+06	0.00e+00	5.19e+07	0.00e+00	9.98e+06
Mo-99	0.00e+00	1.16e+05	2.86e+04	0.00e+00	2.47e+05	0.00e+00	9.57e+04
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	2.19e+08	2.44e+08	8.75e+07	0.00e+00	2.87e+09	2.15e+07	2.56e+09
Tc-99m	6.61e-21	1.30e-20	2.15e-19	0.00e+00	1.88e-19	6.58e-21	7.37e-18
Ru-103	1.55e+08	0.00e+00	5.96e+07	0.00e+00	3.90e+08	0.00e+00	4.01e+09
Ru-105	9.83e-28	0.00e+00	3.57e-28	0.00e+00	8.64e-27	0.00e+00	6.42e-25
Ru-106	4.44e+09	0.00e+00	5.54e+08	0.00e+00	5.99e+09	0.00e+00	6.90e+10
Rh-105	6.01e+00	3.23e+00	2.76e+00	0.00e+00	1.29e+01	0.00e+00	2.00e+02
Pd-107	0.00e+00	1.93e+06	1.64e+05	0.00e+00	1.61e+07	0.00e+00	3.83e+06
Pd-109	0.00e+00	1.77e-06	5.32e-07	0.00e+00	9.51e-06	0.00e+00	1.05e-04

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	8.39e+06	5.67e+06	4.53e+06	0.00e+00	1.06e+07	0.00e+00	6.74e+08
Ag-111	2.33e+05	7.28e+04	4.81e+04	0.00e+00	2.20e+05	0.00e+00	4.46e+07
Cd-113m	0.00e+00	5.50e+06	2.34e+05	0.00e+00	5.66e+06	0.00e+00	1.42e+07
Cd-115m	0.00e+00	1.78e+06	7.58e+04	0.00e+00	1.32e+06	0.00e+00	2.42e+07
Sn-123	8.81e+09	1.09e+08	2.15e+08	1.16e+08	0.00e+00	0.00e+00	4.32e+09
Sn-125	2.80e+08	4.22e+06	1.25e+07	4.37e+06	0.00e+00	0.00e+00	8.67e+08
Sn-126	2.72e+10	3.39e+08	7.74e+08	9.32e+07	0.00e+00	0.00e+00	2.04e+09
Sb-124	2.92e+07	3.79e+05	1.02e+07	6.46e+04	0.00e+00	1.62e+07	1.83e+08
Sb-125	2.85e+07	2.20e+05	5.97e+06	2.64e+04	0.00e+00	1.59e+07	6.80e+07
Sb-126	2.80e+06	4.28e+04	1.01e+06	1.64e+04	0.00e+00	1.34e+06	5.64e+07
Sb-127	2.63e+04	4.06e+02	9.11e+03	2.92e+02	0.00e+00	1.14e+04	1.48e+06
Te-125m	5.69e+08	1.54e+08	7.59e+07	1.60e+08	0.00e+00	0.00e+00	5.49e+08
Te-127	3.53e-10	9.51e-11	7.57e-11	2.44e-10	1.00e-09	0.00e+00	1.38e-08
Te-127m	1.77e+09	4.78e+08	2.11e+08	4.24e+08	5.06e+09	0.00e+00	1.44e+09
Te-129	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-129m	1.79e+09	5.00e+08	2.78e+08	5.77e+08	5.26e+09	0.00e+00	2.18e+09
Te-131	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-131m	7.09e+02	2.45e+02	2.61e+02	5.04e+02	2.37e+03	0.00e+00	9.94e+03
Te-132	2.13e+06	9.43e+05	1.14e+06	1.37e+06	8.76e+06	0.00e+00	9.49e+06
Te-133m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-129	2.06e+08	1.26e+08	1.13e+08	8.27e+10	2.13e+08	0.00e+00	6.36e+06
I-130	3.13e-06	6.33e-06	3.26e-06	6.97e-04	9.46e-06	0.00e+00	2.96e-06
I-131	1.66e+07	1.67e+07	9.48e+06	5.51e+09	2.74e+07	0.00e+00	1.48e+06
I-132	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-133	5.78e-01	7.15e-01	2.70e-01	1.33e+02	1.19e+00	0.00e+00	2.88e-01
I-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Cs-134	9.22e+08	1.51e+09	3.19e+08	0.00e+00	4.69e+08	1.68e+08	8.16e+06
Cs-134m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	3.39e+08	2.36e+08	2.42e+07	0.00e+00	8.34e+07	2.78e+07	1.77e+06
Cs-136	1.62e+07	4.46e+07	2.89e+07	0.00e+00	2.38e+07	3.54e+06	1.57e+06
Cs-137	1.33e+09	1.28e+09	1.88e+08	0.00e+00	4.16e+08	1.50e+08	7.99e+06
Cs-138	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-140	4.39e+07	3.85e+04	2.56e+06	0.00e+00	1.25e+04	2.29e+04	2.22e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	5.50e-37	1.28e-37	2.78e-38	0.00e+00	0.00e+00	0.00e+00	2.85e-32
La-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-141	2.22e+04	1.11e+04	1.65e+03	0.00e+00	4.86e+03	0.00e+00	1.38e+07
Ce-143	3.21e-02	1.74e+01	2.52e-03	0.00e+00	7.29e-03	0.00e+00	2.55e+02
Ce-144	2.32e+06	7.26e+05	1.24e+05	0.00e+00	4.02e+05	0.00e+00	1.89e+08
Pr-143	3.34e+04	1.00e+04	1.66e+03	0.00e+00	5.43e+03	0.00e+00	3.61e+07
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	1.17e+04	9.48e+03	7.34e+02	0.00e+00	5.20e+03	0.00e+00	1.50e+07
Pm-147	1.52e+06	1.08e+05	5.81e+04	0.00e+00	1.91e+05	0.00e+00	4.38e+07
Pm-148	3.11e+03	3.74e+02	2.42e+02	0.00e+00	6.35e+02	0.00e+00	9.98e+06
Pm-148m	2.70e+05	5.37e+04	5.37e+04	0.00e+00	7.96e+04	0.00e+00	1.51e+08
Pm-149	8.19e+00	8.71e-01	4.72e-01	0.00e+00	1.54e+00	0.00e+00	5.94e+04
Pm-151	8.80e-03	1.07e-03	6.96e-04	0.00e+00	1.81e-03	0.00e+00	1.21e+02
Sm-151	1.31e+06	1.95e+05	6.13e+04	0.00e+00	2.01e+05	0.00e+00	2.82e+07
Sm-153	1.86e+00	1.16e+00	1.12e-01	0.00e+00	3.53e-01	0.00e+00	1.54e+04
Eu-152	3.00e+06	5.46e+05	6.49e+05	0.00e+00	2.31e+06	0.00e+00	8.97e+07
Eu-154	1.13e+07	1.02e+06	9.27e+05	0.00e+00	4.46e+06	0.00e+00	2.36e+08
Eu-155	2.27e+06	1.63e+05	1.28e+05	0.00e+00	6.11e+05	0.00e+00	4.09e+08
Eu-156	5.77e+04	3.09e+04	6.39e+03	0.00e+00	1.99e+04	0.00e+00	7.01e+07
Tb-160	5.16e+05	0.00e+00	6.40e+04	0.00e+00	1.54e+05	0.00e+00	1.14e+08

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	4.86e+06	1.02e+06	8.59e+05	0.00e+00	1.45e+06	0.00e+00	1.18e+08
W-181	4.80e+04	1.18e+04	1.62e+03	0.00e+00	0.00e+00	0.00e+00	4.30e+05
W-185	1.72e+06	4.30e+05	6.02e+04	0.00e+00	0.00e+00	0.00e+00	1.60e+07
W-187	3.49e-02	2.06e-02	9.27e-03	0.00e+00	0.00e+00	0.00e+00	2.90e+00
Pb-210	1.40e+10	3.60e+09	6.17e+08	0.00e+00	1.08e+10	0.00e+00	6.79e+05
Bi-210	4.34e+05	2.24e+06	2.49e+05	0.00e+00	2.53e+07	0.00e+00	1.14e+07
Po-210	1.53e+10	2.45e+10	3.70e+09	0.00e+00	7.61e+10	0.00e+00	6.60e+08
Ra-223	9.80e+10	1.13e+08	1.96e+10	0.00e+00	3.00e+09	0.00e+00	1.56e+09
Ra-224	1.12e+09	2.04e+06	2.25e+08	0.00e+00	5.40e+07	0.00e+00	6.17e+07
Ra-225	1.96e+11	1.75e+08	3.91e+10	0.00e+00	4.63e+09	0.00e+00	2.25e+09
Ra-226	2.00e+13	6.39e+08	1.64e+13	0.00e+00	1.70e+10	0.00e+00	1.18e+10
Ra-228	1.32e+13	3.43e+08	1.48e+13	0.00e+00	9.09e+09	0.00e+00	1.99e+09
Ac-225	1.20e+08	1.24e+08	8.05e+06	0.00e+00	1.32e+07	0.00e+00	2.75e+09
Ac-227	2.52e+11	4.05e+10	1.56e+10	0.00e+00	8.92e+09	0.00e+00	5.15e+09
Th-227	3.22e+06	4.38e+04	9.30e+04	0.00e+00	2.32e+05	0.00e+00	3.10e+07
Th-228	4.07e+08	5.21e+06	1.38e+07	0.00e+00	2.71e+07	0.00e+00	1.14e+08
Th-229	4.80e+09	1.21e+08	8.01e+07	0.00e+00	5.91e+08	0.00e+00	1.64e+07
Th-230	7.26e+08	3.64e+07	2.03e+07	0.00e+00	1.77e+08	0.00e+00	1.27e+07
Th-232	8.10e+08	3.11e+07	6.15e+05	0.00e+00	1.51e+08	0.00e+00	1.08e+07
Th-234	2.49e+04	1.10e+03	7.19e+02	0.00e+00	5.83e+03	0.00e+00	8.58e+06
Pa-231	5.78e+15	1.91e+14	2.30e+14	0.00e+00	1.05e+15	0.00e+00	6.03e+13
Pa-233	5.91e+09	9.20e+08	1.03e+09	0.00e+00	3.39e+09	0.00e+00	4.70e+12
U-232	6.11e+09	0.00e+00	4.37e+08	0.00e+00	4.65e+08	0.00e+00	2.42e+07
U-233	1.29e+09	0.00e+00	7.82e+07	0.00e+00	2.12e+08	0.00e+00	2.24e+07
U-234	1.24e+09	0.00e+00	7.68e+07	0.00e+00	2.08e+08	0.00e+00	2.20e+07
U-235	1.19e+09	0.00e+00	7.19e+07	0.00e+00	1.95e+08	0.00e+00	2.79e+07
U-236	1.19e+09	0.00e+00	7.37e+07	0.00e+00	1.99e+08	0.00e+00	2.06e+07
U-237	3.42e+03	0.00e+00	9.09e+02	0.00e+00	9.87e+03	0.00e+00	3.02e+05
U-238	1.14e+09	0.00e+00	6.74e+07	0.00e+00	1.82e+08	0.00e+00	1.97e+07
Np-237	4.56e+08	3.01e+07	2.00e+07	0.00e+00	1.24e+08	0.00e+00	1.67e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



## Offsite Dose Calculation Manual

## Attachment 8

## Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	2.27e+00	4.59e-02	3.53e-02	0.00e+00	1.46e-01	0.00e+00	1.57e+03
Np-239	4.29e-01	3.08e-02	2.17e-02	0.00e+00	8.91e-02	0.00e+00	2.28e+03
Pu-238	1.70e+07	1.97e+06	4.52e+05	0.00e+00	1.64e+06	0.00e+00	1.07e+06
Pu-239	1.85e+07	1.97e+06	4.74e+05	0.00e+00	1.75e+06	0.00e+00	9.80e+05
Pu-240	1.83e+07	2.05e+06	4.74e+05	0.00e+00	1.75e+06	0.00e+00	9.99e+05
Pu-241	5.51e+05	2.25e+04	1.14e+04	0.00e+00	4.21e+04	0.00e+00	2.05e+04
Pu-242	1.70e+07	1.97e+06	4.56e+05	0.00e+00	1.67e+06	0.00e+00	9.60e+05
Pu-244	1.99e+07	2.26e+07	5.22e+05	0.00e+00	1.93e+06	0.00e+00	1.43e+06
Am-241	2.73e+08	2.35e+08	2.05e+07	0.00e+00	1.25e+08	0.00e+00	1.53e+07
Am-242m	2.86e+08	2.29e+08	2.12e+07	0.00e+00	1.29e+08	0.00e+00	1.96e+07
Am-243	2.74e+08	2.31e+08	2.01e+07	0.00e+00	1.24e+08	0.00e+00	1.83e+07
Cm-242	1.52e+07	1.21e+07	1.01e+06	0.00e+00	3.23e+06	0.00e+00	1.41e+07
Cm-243	2.61e+08	2.12e+08	1.68e+07	0.00e+00	6.28e+07	0.00e+00	1.64e+07
Cm-244	2.20e+08	1.78e+08	1.41e+07	0.00e+00	5.17e+07	0.00e+00	1.58e+07
Cm-245	3.41e+08	2.74e+08	2.15e+07	0.00e+00	8.40e+07	0.00e+00	1.48e+07
Cm-246	3.37e+08	2.74e+08	2.15e+07	0.00e+00	8.38e+07	0.00e+00	1.45e+07
Cm-247	3.29e+08	2.70e+08	2.11e+07	0.00e+00	8.26e+07	0.00e+00	1.91e+07
Cm-248	2.74e+09	2.23e+09	1.74e+08	0.00e+00	6.81e+08	0.00e+00	3.09e+08
Cf-252	2.08e+08	0.00e+00	5.03e+06	0.00e+00	0.00e+00	0.00e+00	5.87e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Be-10	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
C-14	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Na-22	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Na-24	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
P-32	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ca-41	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sc-46	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cr-51	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mn-54	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mn-56	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Fe-55	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Fe-59	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Co-57	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Co-58	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Co-60	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ni-59	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ni-63	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ni-65	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cu-64	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-65	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-69	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-69m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Se-79	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-82	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-87	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-90	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-91	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-92	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-90	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-91	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-91m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-92	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-93	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zr-93	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zr-95	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zr-97	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nb-93m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nb-95	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nb-97	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mo-93	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mo-99	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ru-103	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ru-105	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ru-106	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rh-105	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pd-107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pd-109	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ag-111	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cd-113m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cd-115m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sn-123	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sn-125	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sn-126	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sb-124	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sb-125	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sb-126	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sb-127	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-125m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-127	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-127m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-129	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-129m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-131	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-131m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-132	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-133m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-129	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-130	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-131	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-132	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-133	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-135	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-134m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-136	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-137	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-138	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-140	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-140	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-143	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pr-143	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-147	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-148	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-148m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-149	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-151	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sm-151	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sm-153	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-152	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-154	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-155	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-156	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tb-160	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-136	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-137	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-138	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-140	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-140	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-143	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pr-143	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-147	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-148	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-148m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-149	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-151	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sm-151	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sm-153	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-152	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-154	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-155	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-156	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tb-160	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 8

Meat Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Meat & Poultry Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Np-239	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-238	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-239	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-240	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-241	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-242	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-244	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Am-241	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Am-242m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Am-243	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-242	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-243	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-244	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-245	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-246	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-247	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-248	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cf-252	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, R<sub>i</sub>

R<sub>i</sub> factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway R<sub>i</sub>

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.29e+03	1.29e+03	1.29e+03	1.29e+03	1.29e+03	1.29e+03
Be-10	2.55e+08	3.93e+07	6.36e+06	0.00e+00	2.97e+07	0.00e+00	2.15e+09
C-14	2.28e+08	4.55e+07	4.55e+07	4.55e+07	4.55e+07	4.55e+07	4.55e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	4.26e+00	0.00e+00	4.72e-01	0.00e+00	0.00e+00	0.00e+00	1.26e-01
Na-22	1.32e+09	1.32e+09	1.32e+09	1.32e+09	1.32e+09	1.32e+09	1.32e+09
Na-24	2.68e+05	2.68e+05	2.68e+05	2.68e+05	2.68e+05	2.68e+05	2.68e+05
P-32	1.40e+09	8.73e+07	5.42e+07	0.00e+00	0.00e+00	0.00e+00	1.58e+08
Ca-41	1.48e+10	0.00e+00	1.60e+09	0.00e+00	0.00e+00	0.00e+00	1.47e+07
Sc-46	2.51e+05	4.86e+05	1.41e+05	0.00e+00	4.54e+05	0.00e+00	2.37e+09
Cr-51	0.00e+00	0.00e+00	4.64e+04	2.77e+04	1.02e+04	6.16e+04	1.17e+07
Mn-54	0.00e+00	3.13e+08	5.97e+07	0.00e+00	9.31e+07	0.00e+00	9.58e+08
Mn-56	0.00e+00	1.53e+01	2.72e+00	0.00e+00	1.94e+01	0.00e+00	4.89e+02
Fe-55	2.10e+08	1.45e+08	3.38e+07	0.00e+00	0.00e+00	8.08e+07	8.31e+07
Fe-59	1.26e+08	2.96e+08	1.14e+08	0.00e+00	0.00e+00	8.28e+07	9.88e+08
Co-57	0.00e+00	1.17e+07	1.94e+07	0.00e+00	0.00e+00	0.00e+00	2.97e+08
Co-58	0.00e+00	3.07e+07	6.89e+07	0.00e+00	0.00e+00	0.00e+00	6.23e+08
Co-60	0.00e+00	1.67e+08	3.69e+08	0.00e+00	0.00e+00	0.00e+00	3.14e+09
Ni-59	7.82e+08	2.68e+08	1.31e+08	0.00e+00	0.00e+00	0.00e+00	5.53e+07
Ni-63	1.04e+10	7.21e+08	3.49e+08	0.00e+00	0.00e+00	0.00e+00	1.50e+08
Ni-65	5.96e+01	7.75e+00	3.54e+00	0.00e+00	0.00e+00	0.00e+00	1.97e+02
Cu-64	0.00e+00	9.15e+03	4.29e+03	0.00e+00	2.31e+04	0.00e+00	7.79e+05
Zn-65	3.17e+08	1.01e+09	4.56e+08	0.00e+00	6.75e+08	0.00e+00	6.36e+08
Zn-69	5.06e-06	9.67e-06	6.72e-07	0.00e+00	6.28e-06	0.00e+00	1.45e-06
Zn-69m	2.24e+04	5.38e+04	4.92e+03	0.00e+00	3.26e+04	0.00e+00	3.29e+06
Se-79	0.00e+00	2.11e+08	3.52e+07	0.00e+00	3.65e+08	0.00e+00	4.31e+07
Br-82	0.00e+00	0.00e+00	1.50e+06	0.00e+00	0.00e+00	0.00e+00	1.72e+06
Br-83	0.00e+00	0.00e+00	3.01e+00	0.00e+00	0.00e+00	0.00e+00	4.33e+00
Br-84	0.00e+00	0.00e+00	2.14e-11	0.00e+00	0.00e+00	0.00e+00	1.68e-16
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per μCi/sec for all nuclides except H-3, which is in units of mrem/yr per μCi/cubic meter.



Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.19e+08	1.02e+08	0.00e+00	0.00e+00	0.00e+00	4.32e+07
Rb-87	0.00e+00	9.86e+08	3.43e+08	0.00e+00	0.00e+00	0.00e+00	4.62e+07
Rb-88	0.00e+00	2.64e-22	1.40e-22	0.00e+00	0.00e+00	0.00e+00	3.65e-33
Rb-89	0.00e+00	2.88e-26	2.03e-26	0.00e+00	0.00e+00	0.00e+00	1.67e-39
Sr-89	9.96e+09	0.00e+00	2.86e+08	0.00e+00	0.00e+00	0.00e+00	1.60e+09
Sr-90	6.95e+11	0.00e+00	1.40e+10	0.00e+00	0.00e+00	0.00e+00	1.75e+10
Sr-91	3.02e+05	0.00e+00	1.22e+04	0.00e+00	0.00e+00	0.00e+00	1.44e+06
Sr-92	4.15e+02	0.00e+00	1.79e+01	0.00e+00	0.00e+00	0.00e+00	8.21e+03
Y-90	1.33e+04	0.00e+00	3.56e+02	0.00e+00	0.00e+00	0.00e+00	1.41e+08
Y-91	5.11e+06	0.00e+00	1.37e+05	0.00e+00	0.00e+00	0.00e+00	2.81e+09
Y-91m	4.76e-09	0.00e+00	1.84e-10	0.00e+00	0.00e+00	0.00e+00	1.40e-08
Y-92	8.96e-01	0.00e+00	2.62e-02	0.00e+00	0.00e+00	0.00e+00	1.57e+04
Y-93	1.68e+02	0.00e+00	4.65e+00	0.00e+00	0.00e+00	0.00e+00	5.34e+06
Zr-93	3.35e+06	1.88e+05	8.73e+04	0.00e+00	7.11e+05	0.00e+00	1.95e+08
Zr-95	1.17e+06	3.77e+05	2.55e+05	0.00e+00	5.91e+05	0.00e+00	1.19e+09
Zr-97	3.36e+02	6.78e+01	3.10e+01	0.00e+00	1.02e+02	0.00e+00	2.10e+07
Nb-93m	2.02e+06	6.60e+05	1.63e+05	0.00e+00	7.59e+05	0.00e+00	3.05e+08
Nb-95	1.42e+05	7.91e+04	4.25e+04	0.00e+00	7.82e+04	0.00e+00	4.80e+08
Nb-97	2.84e-06	7.19e-07	2.63e-07	0.00e+00	8.39e-07	0.00e+00	2.65e-03
Mo-93	0.00e+00	6.02e+08	1.63e+07	0.00e+00	1.71e+08	0.00e+00	9.78e+07
Mo-99	0.00e+00	6.14e+06	1.17e+06	0.00e+00	1.39e+07	0.00e+00	1.42e+07
Tc-101	5.93e-31	8.55e-31	8.39e-30	0.00e+00	1.54e-29	4.37e-31	0.00e+00
Tc-99	1.00e+07	1.49e+07	4.02e+06	0.00e+00	1.88e+08	1.27e+06	4.87e+08
Tc-99m	3.06e+00	8.66e+00	1.10e+02	0.00e+00	1.31e+02	4.24e+00	5.12e+03
Ru-103	4.77e+06	0.00e+00	2.05e+06	0.00e+00	1.82e+07	0.00e+00	5.57e+08
Ru-105	5.29e+01	0.00e+00	2.09e+01	0.00e+00	6.84e+02	0.00e+00	3.24e+04
Ru-106	1.93e+08	0.00e+00	2.44e+07	0.00e+00	3.72e+08	0.00e+00	1.25e+10
Rh-105	8.01e+04	5.86e+04	3.86e+04	0.00e+00	2.49e+05	0.00e+00	9.34e+06
Pd-107	0.00e+00	1.18e+07	7.53e+05	0.00e+00	1.06e+08	0.00e+00	7.30e+07
Pd-109	0.00e+00	2.23e+04	5.02e+03	0.00e+00	1.27e+05	0.00e+00	2.47e+06

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.05e+07	9.74e+06	5.79e+06	0.00e+00	1.92e+07	0.00e+00	3.98e+09
Ag-111	2.11e+05	8.81e+04	4.39e+04	0.00e+00	2.84e+05	0.00e+00	1.62e+08
Cd-113m	0.00e+00	2.52e+08	8.10e+06	0.00e+00	2.78e+08	0.00e+00	2.03e+09
Cd-115m	0.00e+00	5.34e+07	1.70e+06	0.00e+00	4.24e+07	0.00e+00	2.25e+09
Sn-123	1.71e+09	2.84e+07	4.18e+07	2.41e+07	0.00e+00	0.00e+00	3.49e+09
Sn-125	3.84e+07	7.74e+05	1.74e+06	6.40e+05	0.00e+00	0.00e+00	4.79e+08
Sn-126	6.77e+09	1.34e+08	1.92e+08	3.94e+07	0.00e+00	0.00e+00	1.95e+09
Sb-124	1.04e+08	1.96e+06	4.11e+07	2.51e+05	0.00e+00	8.07e+07	2.94e+09
Sb-125	1.37e+08	1.53e+06	3.25e+07	1.39e+05	0.00e+00	1.05e+08	1.50e+09
Sb-126	7.07e+06	1.44e+05	2.55e+06	4.33e+04	0.00e+00	4.34e+06	5.78e+08
Sb-127	5.22e+05	1.14e+04	2.00e+05	6.28e+03	0.00e+00	3.10e+05	1.19e+08
Te-125m	9.65e+07	3.50e+07	1.29e+07	2.90e+07	3.93e+08	0.00e+00	3.85e+08
Te-127	5.61e+03	2.02e+03	1.21e+03	4.16e+03	2.29e+04	0.00e+00	4.43e+05
Te-127m	3.49e+08	1.25e+08	4.25e+07	8.92e+07	1.42e+09	0.00e+00	1.17e+09
Te-129	7.13e-04	2.68e-04	1.74e-04	5.48e-04	3.00e-03	0.00e+00	5.38e-04
Te-129m	2.51e+08	9.37e+07	3.98e+07	8.63e+07	1.05e+09	0.00e+00	1.26e+09
Te-131	1.25e-15	5.21e-16	3.94e-16	1.03e-15	5.47e-15	0.00e+00	1.77e-16
Te-131m	9.10e+05	4.45e+05	3.71e+05	7.05e+05	4.51e+06	0.00e+00	4.42e+07
Te-132	4.30e+06	2.78e+06	2.61e+06	3.07e+06	2.68e+07	0.00e+00	1.31e+08
Te-133m	2.12e-05	1.24e-05	1.19e-05	1.79e-05	1.22e-04	0.00e+00	4.24e-06
Te-134	3.19e-08	2.09e-08	1.28e-08	2.79e-08	2.02e-07	0.00e+00	3.54e-11
I-129	1.31e+09	1.13e+09	3.69e+09	2.90e+12	2.42e+09	0.00e+00	1.78e+08
I-130	3.90e+05	1.15e+06	4.54e+05	9.75e+07	1.79e+06	0.00e+00	9.90e+05
I-131	8.07e+07	1.15e+08	6.62e+07	3.78e+10	1.98e+08	0.00e+00	3.05e+07
I-132	5.57e+01	1.49e+02	5.21e+01	5.21e+03	2.37e+02	0.00e+00	2.80e+01
I-133	2.08e+06	3.61e+06	1.10e+06	5.31e+08	6.31e+06	0.00e+00	3.25e+06
I-134	8.84e-05	2.40e-04	8.59e-05	4.16e-03	3.82e-04	0.00e+00	2.09e-07
I-135	3.85e+04	1.01e+05	3.72e+04	6.65e+06	1.62e+05	0.00e+00	1.14e+05
Cs-134	4.67e+09	1.11e+10	9.08e+09	0.00e+00	3.59e+09	1.19e+09	1.94e+08
Cs-134m	6.57e+00	1.38e+01	7.06e+00	0.00e+00	7.49e+00	1.18e+00	4.87e+00

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.56e+09	1.44e+09	6.40e+08	0.00e+00	5.46e+08	1.63e+08	3.37e+07
Cs-136	4.26e+07	1.68e+08	1.21e+08	0.00e+00	9.37e+07	1.28e+07	1.91e+07
Cs-137	6.36e+09	8.70e+09	5.70e+09	0.00e+00	2.95e+09	9.81e+08	1.68e+08
Cs-138	3.39e-11	6.70e-11	3.32e-11	0.00e+00	4.92e-11	4.86e-12	2.86e-16
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	2.70e-02	1.92e-05	7.91e-04	0.00e+00	1.80e-05	1.09e-05	4.79e-02
Ba-140	1.28e+08	1.61e+05	8.41e+06	0.00e+00	5.48e+04	9.23e+04	2.64e+08
Ba-141	8.94e-22	6.76e-25	3.02e-23	0.00e+00	6.28e-25	3.83e-25	4.21e-31
Ba-142	3.88e-39	0.00e+00	2.44e-40	0.00e+00	0.00e+00	0.00e+00	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
La-141	5.98e-01	1.85e-01	3.04e-02	0.00e+00	0.00e+00	0.00e+00	2.21e+04
La-142	1.92e-04	8.75e-05	2.18e-05	0.00e+00	0.00e+00	0.00e+00	6.39e-01
Ce-141	1.97e+05	1.33e+05	1.51e+04	0.00e+00	6.19e+04	0.00e+00	5.09e+08
Ce-143	9.95e+02	7.36e+05	8.14e+01	0.00e+00	3.24e+02	0.00e+00	2.75e+07
Ce-144	3.29e+07	1.38e+07	1.77e+06	0.00e+00	8.16e+06	0.00e+00	1.11e+10
Pr-143	6.26e+04	2.51e+04	3.10e+03	0.00e+00	1.45e+04	0.00e+00	2.74e+08
Pr-144	2.36e-26	9.81e-27	1.20e-27	0.00e+00	5.53e-27	0.00e+00	3.40e-33
Nd-147	3.33e+04	3.85e+04	2.30e+03	0.00e+00	2.25e+04	0.00e+00	1.85e+08
Pm-147	5.74e+06	5.39e+05	2.18e+05	0.00e+00	1.02e+06	0.00e+00	6.79e+08
Pm-148	1.96e+04	3.25e+03	1.64e+03	0.00e+00	6.14e+03	0.00e+00	2.55e+08
Pm-148m	8.29e+05	2.15e+05	1.64e+05	0.00e+00	3.24e+05	0.00e+00	1.82e+09
Pm-149	1.69e+03	2.39e+02	9.77e+01	0.00e+00	4.52e+02	0.00e+00	4.48e+07
Pm-151	3.36e+02	5.65e+01	2.85e+01	0.00e+00	1.01e+02	0.00e+00	1.55e+07
Sm-151	5.52e+06	9.52e+05	2.28e+05	0.00e+00	1.06e+06	0.00e+00	4.20e+08
Sm-153	8.20e+02	6.84e+02	5.00e+01	0.00e+00	2.21e+02	0.00e+00	2.44e+07
Eu-152	1.55e+07	3.52e+06	3.09e+06	0.00e+00	2.18e+07	0.00e+00	2.03e+09
Eu-154	4.92e+07	6.05e+06	4.31e+06	0.00e+00	2.90e+07	0.00e+00	4.39e+09
Eu-155	6.39e+06	9.07e+05	5.85e+05	0.00e+00	4.18e+06	0.00e+00	7.13e+08
Eu-156	1.08e+05	8.35e+04	1.35e+04	0.00e+00	5.58e+04	0.00e+00	5.72e+08
Tb-160	1.96e+06	0.00e+00	2.44e+05	0.00e+00	8.09e+05	0.00e+00	1.81e+09

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	2.16e+07	6.75e+06	5.13e+06	0.00e+00	1.01e+07	0.00e+00	2.05e+09
W-181	5.33e+05	1.74e+05	1.86e+04	0.00e+00	0.00e+00	0.00e+00	1.98e+07
W-185	1.73e+07	5.77e+06	6.07e+05	0.00e+00	0.00e+00	0.00e+00	6.67e+08
W-187	3.79e+04	3.17e+04	1.11e+04	0.00e+00	0.00e+00	0.00e+00	1.04e+07
Pb-210	1.22e+12	3.48e+11	4.33e+10	0.00e+00	9.79e+11	0.00e+00	1.78e+08
Bi-210	1.18e+06	8.17e+06	6.78e+05	0.00e+00	9.83e+07	0.00e+00	1.22e+08
Po-210	2.01e+10	4.26e+10	4.85e+09	0.00e+00	1.42e+11	0.00e+00	3.59e+09
Ra-223	2.74e+10	4.23e+07	5.49e+09	0.00e+00	1.20e+09	0.00e+00	1.77e+09
Ra-224	3.08e+09	7.47e+06	6.19e+08	0.00e+00	2.11e+08	0.00e+00	6.51e+08
Ra-225	4.99e+10	5.92e+07	9.97e+09	0.00e+00	1.68e+09	0.00e+00	2.33e+09
Ra-226	2.42e+13	4.60e+08	1.76e+13	0.00e+00	1.31e+10	0.00e+00	2.66e+10
Ra-228	8.76e+12	2.44e+08	9.47e+12	0.00e+00	6.91e+09	0.00e+00	4.41e+09
Ac-225	2.11e+07	2.90e+07	1.42e+06	0.00e+00	3.31e+06	0.00e+00	1.95e+09
Ac-227	1.49e+11	1.97e+10	8.84e+09	0.00e+00	6.37e+09	0.00e+00	6.52e+09
Th-227	1.41e+08	2.55e+06	4.06e+06	0.00e+00	1.45e+07	0.00e+00	5.55e+09
Th-228	3.70e+10	6.27e+08	1.25e+09	0.00e+00	3.49e+09	0.00e+00	4.20e+10
Th-229	1.09e+12	3.12e+10	1.80e+10	0.00e+00	1.51e+11	0.00e+00	6.26e+09
Th-230	1.65e+11	9.38e+09	4.57e+09	0.00e+00	4.53e+10	0.00e+00	4.82e+09
Th-232	1.84e+11	8.01e+09	1.20e+08	0.00e+00	3.86e+10	0.00e+00	4.10e+09
Th-234	1.17e+06	6.89e+04	3.38e+04	0.00e+00	3.91e+05	0.00e+00	1.65e+09
Pa-231	3.29e+11	1.23e+10	1.27e+10	0.00e+00	6.92e+10	0.00e+00	5.75e+09
Pa-233	9.05e+04	1.82e+04	1.57e+04	0.00e+00	6.87e+04	0.00e+00	2.82e+08
U-232	3.30e+11	0.00e+00	2.36e+10	0.00e+00	3.58e+10	0.00e+00	5.42e+09
U-233	6.98e+10	0.00e+00	4.23e+09	0.00e+00	1.63e+10	0.00e+00	5.02e+09
U-234	6.70e+10	0.00e+00	4.14e+09	0.00e+00	1.59e+10	0.00e+00	4.92e+09
U-235	6.42e+10	0.00e+00	3.89e+09	0.00e+00	1.50e+10	0.00e+00	6.26e+09
U-236	6.42e+10	0.00e+00	3.97e+09	0.00e+00	1.53e+10	0.00e+00	4.62e+09
U-237	1.84e+05	0.00e+00	4.89e+04	0.00e+00	7.55e+05	0.00e+00	6.45e+07
U-238	6.15e+10	0.00e+00	3.64e+09	0.00e+00	1.40e+10	0.00e+00	4.41e+09
Np-237	1.01e+11	7.18e+09	4.44e+09	0.00e+00	3.30e+10	0.00e+00	6.36e+09

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.45e+04	3.91e+02	2.26e+02	0.00e+00	1.32e+03	0.00e+00	3.63e+07
Np-239	1.43e+03	1.40e+02	7.73e+01	0.00e+00	4.37e+02	0.00e+00	2.88e+07
Pu-238	5.04e+10	6.38e+09	1.37e+09	0.00e+00	5.86e+09	0.00e+00	5.84e+09
Pu-239	5.81e+10	6.98e+09	1.53e+09	0.00e+00	6.50e+09	0.00e+00	5.34e+09
Pu-240	5.80e+10	6.97e+09	1.53e+09	0.00e+00	6.49e+09	0.00e+00	5.43e+09
Pu-241	1.25e+09	5.92e+07	2.64e+07	0.00e+00	1.22e+08	0.00e+00	1.11e+08
Pu-242	5.39e+10	6.72e+09	1.47e+09	0.00e+00	6.26e+09	0.00e+00	5.23e+09
Pu-244	6.28e+10	7.70e+09	1.69e+09	0.00e+00	7.17e+09	0.00e+00	7.80e+09
Am-241	5.86e+10	5.47e+10	4.20e+09	0.00e+00	3.16e+10	0.00e+00	5.76e+09
Am-242m	6.09e+10	5.31e+10	4.35e+09	0.00e+00	3.24e+10	0.00e+00	7.48e+09
Am-243	6.04e+10	5.53e+10	4.25e+09	0.00e+00	3.20e+10	0.00e+00	6.97e+09
Cm-242	1.22e+09	1.30e+09	8.14e+07	0.00e+00	3.70e+08	0.00e+00	4.71e+09
Cm-243	4.78e+10	4.38e+10	2.99e+09	0.00e+00	1.40e+10	0.00e+00	6.23e+09
Cm-244	3.63e+10	3.40e+10	2.28e+09	0.00e+00	1.07e+10	0.00e+00	6.00e+09
Cm-245	7.52e+10	6.55e+10	4.62e+09	0.00e+00	2.16e+10	0.00e+00	5.64e+09
Cm-246	7.45e+10	6.54e+10	4.61e+09	0.00e+00	2.15e+10	0.00e+00	5.54e+09
Cm-247	7.27e+10	6.44e+10	4.54e+09	0.00e+00	2.12e+10	0.00e+00	7.28e+09
Cm-248	6.04e+11	5.31e+11	3.74e+10	0.00e+00	1.75e+11	0.00e+00	1.18e+11
Cf-252	1.98e+10	0.00e+00	4.77e+08	0.00e+00	0.00e+00	0.00e+00	2.18e+10

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.47e+03	1.47e+03	1.47e+03	1.47e+03	1.47e+03	1.47e+03
Be-10	4.07e+08	6.31e+07	1.03e+07	0.00e+00	4.82e+07	0.00e+00	2.58e+09
C-14	3.69e+08	7.38e+07	7.38e+07	7.38e+07	7.38e+07	7.38e+07	7.38e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	3.87e+00	0.00e+00	4.24e-01	0.00e+00	0.00e+00	0.00e+00	3.48e-01
Na-22	2.01e+09	2.01e+09	2.01e+09	2.01e+09	2.01e+09	2.01e+09	2.01e+09
Na-24	2.38e+05	2.38e+05	2.38e+05	2.38e+05	2.38e+05	2.38e+05	2.38e+05
P-32	1.61e+09	9.96e+07	6.23e+07	0.00e+00	0.00e+00	0.00e+00	1.35e+08
Ca-41	1.79e+10	0.00e+00	1.94e+09	0.00e+00	0.00e+00	0.00e+00	1.77e+07
Sc-46	3.61e+05	7.02e+05	2.08e+05	0.00e+00	6.72e+05	0.00e+00	2.39e+09
Cr-51	0.00e+00	0.00e+00	6.16e+04	3.42e+04	1.35e+04	8.80e+04	1.04e+07
Mn-54	0.00e+00	4.54e+08	9.01e+07	0.00e+00	1.36e+08	0.00e+00	9.32e+08
Mn-56	0.00e+00	1.38e+01	2.46e+00	0.00e+00	1.75e+01	0.00e+00	9.09e+02
Fe-55	3.26e+08	2.31e+08	5.39e+07	0.00e+00	0.00e+00	1.47e+08	1.00e+08
Fe-59	1.79e+08	4.18e+08	1.62e+08	0.00e+00	0.00e+00	1.32e+08	9.90e+08
Co-57	0.00e+00	1.79e+07	2.99e+07	0.00e+00	0.00e+00	0.00e+00	3.33e+08
Co-58	0.00e+00	4.36e+07	1.00e+08	0.00e+00	0.00e+00	0.00e+00	6.01e+08
Co-60	0.00e+00	2.49e+08	5.60e+08	0.00e+00	0.00e+00	0.00e+00	3.24e+09
Ni-59	1.20e+09	4.24e+08	2.04e+08	0.00e+00	0.00e+00	0.00e+00	6.64e+07
Ni-63	1.61e+10	1.13e+09	5.45e+08	0.00e+00	0.00e+00	0.00e+00	1.81e+08
Ni-65	5.55e+01	7.09e+00	3.23e+00	0.00e+00	0.00e+00	0.00e+00	3.85e+02
Cu-64	0.00e+00	8.29e+03	3.90e+03	0.00e+00	2.10e+04	0.00e+00	6.43e+05
Zn-65	4.24e+08	1.47e+09	6.86e+08	0.00e+00	9.42e+08	0.00e+00	6.23e+08
Zn-69	4.73e-06	9.02e-06	6.31e-07	0.00e+00	5.89e-06	0.00e+00	1.66e-05
Zn-69m	2.08e+04	4.90e+04	4.50e+03	0.00e+00	2.98e+04	0.00e+00	2.69e+06
Se-79	0.00e+00	3.39e+08	5.70e+07	0.00e+00	5.91e+08	0.00e+00	5.18e+07
Br-82	0.00e+00	0.00e+00	1.32e+06	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	2.82e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	1.95e-11	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.73e+08	1.28e+08	0.00e+00	0.00e+00	0.00e+00	4.05e+07
Rb-87	0.00e+00	1.59e+09	5.55e+08	0.00e+00	0.00e+00	0.00e+00	5.55e+07
Rb-88	0.00e+00	2.44e-22	1.30e-22	0.00e+00	0.00e+00	0.00e+00	2.09e-29
Rb-89	0.00e+00	2.59e-26	1.83e-26	0.00e+00	0.00e+00	0.00e+00	3.98e-35
Sr-89	1.51e+10	0.00e+00	4.33e+08	0.00e+00	0.00e+00	0.00e+00	1.80e+09
Sr-90	9.22e+11	0.00e+00	1.84e+10	0.00e+00	0.00e+00	0.00e+00	2.11e+10
Sr-91	2.82e+05	0.00e+00	1.12e+04	0.00e+00	0.00e+00	0.00e+00	1.28e+06
Sr-92	3.86e+02	0.00e+00	1.65e+01	0.00e+00	0.00e+00	0.00e+00	9.83e+03
Y-90	1.24e+04	0.00e+00	3.34e+02	0.00e+00	0.00e+00	0.00e+00	1.02e+08
Y-91	7.83e+06	0.00e+00	2.10e+05	0.00e+00	0.00e+00	0.00e+00	3.21e+09
Y-91m	4.43e-09	0.00e+00	1.69e-10	0.00e+00	0.00e+00	0.00e+00	2.09e-07
Y-92	8.42e-01	0.00e+00	2.43e-02	0.00e+00	0.00e+00	0.00e+00	2.31e+04
Y-93	1.58e+02	0.00e+00	4.33e+00	0.00e+00	0.00e+00	0.00e+00	4.82e+06
Zr-93	5.03e+06	2.48e+05	1.35e+05	0.00e+00	8.77e+05	0.00e+00	2.34e+08
Zr-95	1.72e+06	5.43e+05	3.73e+05	0.00e+00	7.98e+05	0.00e+00	1.25e+09
Zr-97	3.11e+02	6.15e+01	2.83e+01	0.00e+00	9.33e+01	0.00e+00	1.67e+07
Nb-93m	3.09e+06	1.02e+06	2.55e+05	0.00e+00	1.19e+06	0.00e+00	3.66e+08
Nb-95	1.92e+05	1.07e+05	5.87e+04	0.00e+00	1.03e+05	0.00e+00	4.56e+08
Nb-97	2.63e-06	6.54e-07	2.39e-07	0.00e+00	7.65e-07	0.00e+00	1.56e-02
Mo-93	0.00e+00	9.63e+08	2.64e+07	0.00e+00	2.76e+08	0.00e+00	1.17e+08
Mo-99	0.00e+00	5.64e+06	1.08e+06	0.00e+00	1.29e+07	0.00e+00	1.01e+07
Tc-101	5.52e-31	7.85e-31	7.71e-30	0.00e+00	1.42e-29	4.78e-31	1.34e-37
Tc-99	1.63e+07	2.39e+07	6.52e+06	0.00e+00	3.04e+08	2.47e+06	5.85e+08
Tc-99m	2.70e+00	7.54e+00	9.77e+01	0.00e+00	1.12e+02	4.18e+00	4.95e+03
Ru-103	6.82e+06	0.00e+00	2.91e+06	0.00e+00	2.40e+07	0.00e+00	5.69e+08
Ru-105	4.92e+01	0.00e+00	1.91e+01	0.00e+00	6.20e+02	0.00e+00	3.97e+04
Ru-106	3.09e+08	0.00e+00	3.90e+07	0.00e+00	5.97e+08	0.00e+00	1.48e+10
Rh-105	7.52e+04	5.43e+04	3.56e+04	0.00e+00	2.31e+05	0.00e+00	6.91e+06
Pd-107	0.00e+00	1.89e+07	1.22e+06	0.00e+00	1.71e+08	0.00e+00	8.78e+07
Pd-109	0.00e+00	2.07e+04	4.71e+03	0.00e+00	1.20e+05	0.00e+00	2.09e+06

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.52e+07	1.43e+07	8.72e+06	0.00e+00	2.73e+07	0.00e+00	4.03e+09
Ag-111	2.01e+05	8.35e+04	4.20e+04	0.00e+00	2.72e+05	0.00e+00	1.17e+08
Cd-113m	0.00e+00	4.06e+08	1.30e+07	0.00e+00	4.49e+08	0.00e+00	2.44e+09
Cd-115m	0.00e+00	7.94e+07	2.56e+06	0.00e+00	6.35e+07	0.00e+00	2.51e+09
Sn-123	2.72e+09	4.46e+07	6.61e+07	3.57e+07	0.00e+00	0.00e+00	4.11e+09
Sn-125	3.84e+07	7.65e+05	1.73e+06	6.01e+05	0.00e+00	0.00e+00	3.62e+08
Sn-126	1.05e+10	1.96e+08	3.00e+08	5.17e+07	0.00e+00	0.00e+00	2.34e+09
Sb-124	1.54e+08	2.84e+06	6.02e+07	3.50e+05	0.00e+00	1.35e+08	3.11e+09
Sb-125	2.14e+08	2.34e+06	5.01e+07	2.05e+05	0.00e+00	1.88e+08	1.67e+09
Sb-126	7.45e+06	1.52e+05	2.68e+06	4.21e+04	0.00e+00	5.34e+06	4.41e+08
Sb-127	4.82e+05	1.03e+04	1.82e+05	5.42e+03	0.00e+00	3.28e+05	8.19e+07
Te-125m	1.48e+08	5.34e+07	1.98e+07	4.14e+07	0.00e+00	0.00e+00	4.37e+08
Te-127	5.29e+03	1.88e+03	1.14e+03	3.65e+03	2.14e+04	0.00e+00	4.09e+05
Te-127m	5.51e+08	1.96e+08	6.56e+07	1.31e+08	2.23e+09	0.00e+00	1.37e+09
Te-129	6.68e-04	2.49e-04	1.63e-04	4.77e-04	2.80e-03	0.00e+00	3.65e-03
Te-129m	3.61e+08	1.34e+08	5.72e+07	1.17e+08	1.51e+09	0.00e+00	1.36e+09
Te-131	1.16e-15	4.78e-16	3.62e-16	8.93e-16	5.07e-15	0.00e+00	9.52e-17
Te-131m	8.42e+05	4.04e+05	3.37e+05	6.07e+05	4.21e+06	0.00e+00	3.24e+07
Te-132	3.90e+06	2.47e+06	2.33e+06	2.61e+06	2.37e+07	0.00e+00	7.83e+07
Te-133m	1.94e-05	1.10e-05	1.07e-05	1.54e-05	1.09e-04	0.00e+00	4.45e-05
Te-134	2.89e-08	1.85e-08	1.94e-08	2.37e-08	1.77e-07	0.00e+00	1.07e-09
I-129	2.12e+09	1.78e+09	2.97e+09	2.17e+12	3.19e+09	0.00e+00	2.08e+08
I-130	3.49e+05	1.01e+06	4.03e+05	8.22e+07	1.55e+06	0.00e+00	7.75e+05
I-131	7.68e+07	1.08e+08	5.78e+07	3.14e+10	1.85e+08	0.00e+00	2.13e+07
I-132	5.02e+01	1.31e+02	4.72e+01	4.43e+03	2.07e+02	0.00e+00	5.72e+01
I-133	1.93e+06	3.27e+06	9.99e+05	4.57e+08	5.74e+06	0.00e+00	2.48e+06
I-134	7.99e-05	2.12e-04	7.61e-05	3.53e-03	3.34e-04	0.00e+00	2.79e-06
I-135	3.48e+04	8.96e+04	3.32e+04	5.76e+06	1.42e+05	0.00e+00	9.93e+04
Cs-134	7.10e+09	1.67e+10	7.75e+09	0.00e+00	5.31e+09	2.03e+09	2.08e+08
Cs-134m	5.95e+00	1.23e+01	6.33e+00	0.00e+00	6.86e+00	1.20e+00	8.20e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	2.53e+09	2.32e+09	5.42e+08	0.00e+00	8.84e+08	3.20e+08	4.05e+07
Cs-136	4.37e+07	1.72e+08	1.15e+08	0.00e+00	9.36e+07	1.48e+07	1.38e+07
Cs-137	1.01e+10	1.35e+10	4.69e+09	0.00e+00	4.59e+09	1.78e+09	1.92e+08
Cs-138	3.13e-11	6.01e-11	3.00e-11	0.00e+00	4.44e-11	5.16e-12	2.73e-14
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	2.54e-02	1.79e-05	7.40e-04	0.00e+00	1.69e-05	1.23e-05	2.27e-01
Ba-140	1.38e+08	1.69e+05	8.89e+06	0.00e+00	5.73e+04	1.14e+05	2.13e+08
Ba-141	8.36e-22	6.24e-25	2.79e-23	0.00e+00	5.79e-25	4.27e-25	1.78e-27
Ba-142	3.57e-39	0.00e+00	2.20e-40	0.00e+00	0.00e+00	0.00e+00	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
La-141	5.59e-01	1.72e-01	2.84e-02	0.00e+00	0.00e+00	0.00e+00	3.05e+04
La-142	1.77e-04	7.84e-05	1.95e-05	0.00e+00	0.00e+00	0.00e+00	2.39e+00
Ce-141	2.83e+05	1.89e+05	2.17e+04	0.00e+00	8.89e+04	0.00e+00	5.40e+08
Ce-143	9.30e+02	6.77e+05	7.56e+01	0.00e+00	3.04e+02	0.00e+00	2.04e+07
Ce-144	5.27e+07	2.18e+07	2.83e+06	0.00e+00	1.30e+07	0.00e+00	1.33e+10
Pr-143	7.00e+04	2.79e+04	3.48e+03	0.00e+00	1.62e+04	0.00e+00	2.30e+08
Pr-144	2.22e-26	9.07e-27	1.12e-27	0.00e+00	5.20e-27	0.00e+00	2.44e-29
Nd-147	3.62e+04	3.93e+04	2.36e+03	0.00e+00	2.31e+04	0.00e+00	1.42e+08
Pm-147	9.04e+06	8.57e+05	3.49e+05	0.00e+00	1.64e+06	0.00e+00	8.15e+08
Pm-148	1.83e+04	2.98e+03	1.50e+03	0.00e+00	5.39e+03	0.00e+00	1.78e+08
Pm-148m	1.17e+06	2.96e+05	2.31e+05	0.00e+00	4.48e+05	0.00e+00	1.86e+09
Pm-149	1.58e+03	2.23e+02	9.13e+01	0.00e+00	4.24e+02	0.00e+00	3.28e+07
Pm-151	3.13e+02	5.16e+01	2.61e+01	0.00e+00	9.28e+01	0.00e+00	1.16e+07
Sm-151	7.92e+06	1.52e+06	3.58e+05	0.00e+00	1.67e+06	0.00e+00	5.17e+08
Sm-153	7.66e+02	6.34e+02	4.67e+01	0.00e+00	2.07e+02	0.00e+00	1.79e+07
Eu-152	2.20e+07	5.30e+06	4.67e+06	0.00e+00	2.46e+07	0.00e+00	1.95e+09
Eu-154	7.18e+07	9.26e+06	6.53e+06	0.00e+00	4.14e+07	0.00e+00	4.89e+09
Eu-155	1.46e+07	1.41e+06	8.73e+05	0.00e+00	5.52e+06	0.00e+00	8.09e+09
Eu-156	1.24e+05	9.31e+04	1.52e+04	0.00e+00	6.26e+04	0.00e+00	4.76e+08
Tb-160	2.94e+06	0.00e+00	3.66e+05	0.00e+00	1.16e+06	0.00e+00	1.90e+09

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	2.53e+09	2.32e+09	5.42e+08	0.00e+00	8.84e+08	3.20e+08	4.05e+07
Cs-136	4.37e+07	1.72e+08	1.15e+08	0.00e+00	9.36e+07	1.48e+07	1.38e+07
Cs-137	1.01e+10	1.35e+10	4.69e+09	0.00e+00	4.59e+09	1.78e+09	1.92e+08
Cs-138	3.13e-11	6.01e-11	3.00e-11	0.00e+00	4.44e-11	5.16e-12	2.73e-14
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	2.54e-02	1.79e-05	7.40e-04	0.00e+00	1.69e-05	1.23e-05	2.27e-01
Ba-140	1.38e+08	1.69e+05	8.89e+06	0.00e+00	5.73e+04	1.14e+05	2.13e+08
Ba-141	8.36e-22	6.24e-25	2.79e-23	0.00e+00	5.79e-25	4.27e-25	1.78e-27
Ba-142	3.57e-39	0.00e+00	2.20e-40	0.00e+00	0.00e+00	0.00e+00	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
La-141	5.59e-01	1.72e-01	2.84e-02	0.00e+00	0.00e+00	0.00e+00	3.05e+04
La-142	1.77e-04	7.84e-05	1.95e-05	0.00e+00	0.00e+00	0.00e+00	2.39e+00
Ce-141	2.83e+05	1.89e+05	2.17e+04	0.00e+00	8.89e+04	0.00e+00	5.40e+08
Ce-143	9.30e+02	6.77e+05	7.56e+01	0.00e+00	3.04e+02	0.00e+00	2.04e+07
Ce-144	5.27e+07	2.18e+07	2.83e+06	0.00e+00	1.30e+07	0.00e+00	1.33e+10
Pr-143	7.00e+04	2.79e+04	3.48e+03	0.00e+00	1.62e+04	0.00e+00	2.30e+08
Pr-144	2.22e-26	9.07e-27	1.12e-27	0.00e+00	5.20e-27	0.00e+00	2.44e-29
Nd-147	3.62e+04	3.93e+04	2.36e+03	0.00e+00	2.31e+04	0.00e+00	1.42e+08
Pm-147	9.04e+06	8.57e+05	3.49e+05	0.00e+00	1.64e+06	0.00e+00	8.15e+08
Pm-148	1.83e+04	2.98e+03	1.50e+03	0.00e+00	5.39e+03	0.00e+00	1.78e+08
Pm-148m	1.17e+06	2.96e+05	2.31e+05	0.00e+00	4.48e+05	0.00e+00	1.86e+09
Pm-149	1.58e+03	2.23e+02	9.13e+01	0.00e+00	4.24e+02	0.00e+00	3.28e+07
Pm-151	3.13e+02	5.16e+01	2.61e+01	0.00e+00	9.28e+01	0.00e+00	1.16e+07
Sm-151	7.92e+06	1.52e+06	3.58e+05	0.00e+00	1.67e+06	0.00e+00	5.17e+08
Sm-153	7.66e+02	6.34e+02	4.67e+01	0.00e+00	2.07e+02	0.00e+00	1.79e+07
Eu-152	2.20e+07	5.30e+06	4.67e+06	0.00e+00	2.46e+07	0.00e+00	1.95e+09
Eu-154	7.18e+07	9.26e+06	6.53e+06	0.00e+00	4.14e+07	0.00e+00	4.89e+09
Eu-155	1.46e+07	1.41e+06	8.73e+05	0.00e+00	5.52e+06	0.00e+00	8.09e+09
Eu-156	1.24e+05	9.31e+04	1.52e+04	0.00e+00	6.26e+04	0.00e+00	4.76e+08
Tb-160	2.94e+06	0.00e+00	3.66e+05	0.00e+00	1.16e+06	0.00e+00	1.90e+09

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.36e+04	3.63e+02	2.11e+02	0.00e+00	1.24e+03	0.00e+00	2.66e+07
Np-239	1.38e+03	1.31e+02	7.25e+01	0.00e+00	4.10e+02	0.00e+00	2.10e+07
Pu-238	6.08e+10	7.79e+09	1.65e+09	0.00e+00	7.08e+09	0.00e+00	7.01e+09
Pu-239	6.95e+10	8.44e+09	1.83e+09	0.00e+00	7.79e+09	0.00e+00	6.42e+09
Pu-240	6.94e+10	8.42e+09	1.83e+09	0.00e+00	7.78e+09	0.00e+00	6.53e+09
Pu-241	1.58e+09	7.56e+07	3.32e+07	0.00e+00	1.54e+08	0.00e+00	1.33e+08
Pu-242	6.44e+10	8.13e+09	1.76e+09	0.00e+00	7.50e+09	0.00e+00	6.29e+09
Pu-244	7.53e+10	9.27e+09	2.02e+09	0.00e+00	8.59e+09	0.00e+00	9.36e+09
Am-241	7.02e+10	6.62e+10	5.06e+09	0.00e+00	3.79e+10	0.00e+00	6.92e+09
Am-242m	7.33e+10	6.46e+10	5.27e+09	0.00e+00	3.90e+10	0.00e+00	8.99e+09
Am-243	7.23e+10	6.68e+10	5.11e+09	0.00e+00	3.84e+10	0.00e+00	8.39e+09
Cm-242	1.95e+09	2.06e+09	1.29e+08	0.00e+00	5.90e+08	0.00e+00	5.57e+09
Cm-243	5.88e+10	5.45e+10	3.70e+09	0.00e+00	1.73e+10	0.00e+00	7.49e+09
Cm-244	4.54e+10	4.30e+10	2.88e+09	0.00e+00	1.34e+10	0.00e+00	7.21e+09
Cm-245	9.00e+10	7.92e+10	5.54e+09	0.00e+00	2.59e+10	0.00e+00	6.78e+09
Cm-246	8.92e+10	7.91e+10	5.53e+09	0.00e+00	2.58e+10	0.00e+00	6.66e+09
Cm-247	8.70e+10	7.79e+10	5.45e+09	0.00e+00	2.54e+10	0.00e+00	8.75e+09
Cm-248	7.23e+11	6.42e+11	4.50e+10	0.00e+00	2.10e+11	0.00e+00	1.41e+11
Cf-252	2.98e+10	0.00e+00	7.18e+08	0.00e+00	0.00e+00	0.00e+00	2.62e+10

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	2.29e+03	2.29e+03	2.29e+03	2.29e+03	2.29e+03	2.29e+03
Be-10	9.92e+08	1.15e+08	2.49e+07	0.00e+00	8.16e+07	0.00e+00	2.02e+09
C-14	8.89e+08	1.78e+08	1.78e+08	1.78e+08	1.78e+08	1.78e+08	1.78e+08
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	6.90e+00	0.00e+00	6.84e-01	0.00e+00	0.00e+00	0.00e+00	1.87e+00
Na-22	4.09e+09	4.09e+09	4.09e+09	4.09e+09	4.09e+09	4.09e+09	4.09e+09
Na-24	3.71e+05	3.71e+05	3.71e+05	3.71e+05	3.71e+05	3.71e+05	3.71e+05
P-32	3.37e+09	1.58e+08	1.30e+08	0.00e+00	0.00e+00	0.00e+00	9.30e+07
Ca-41	2.55e+10	0.00e+00	2.79e+09	0.00e+00	0.00e+00	0.00e+00	1.40e+07
Sc-46	7.85e+05	1.08e+06	4.14e+05	0.00e+00	9.52e+05	0.00e+00	1.57e+09
Cr-51	0.00e+00	0.00e+00	1.17e+05	6.50e+04	1.78e+04	1.19e+05	6.21e+06
Mn-54	0.00e+00	6.65e+08	1.77e+08	0.00e+00	1.86e+08	0.00e+00	5.58e+08
Mn-56	0.00e+00	1.81e+01	4.08e+00	0.00e+00	2.19e+01	0.00e+00	2.62e+03
Fe-55	8.01e+08	4.25e+08	1.32e+08	0.00e+00	0.00e+00	2.40e+08	7.87e+07
Fe-59	3.97e+08	6.43e+08	3.20e+08	0.00e+00	0.00e+00	1.86e+08	6.69e+08
Co-57	0.00e+00	2.98e+07	6.04e+07	0.00e+00	0.00e+00	0.00e+00	2.44e+08
Co-58	0.00e+00	6.44e+07	1.97e+08	0.00e+00	0.00e+00	0.00e+00	3.75e+08
Co-60	0.00e+00	3.78e+08	1.12e+09	0.00e+00	0.00e+00	0.00e+00	2.10e+09
Ni-59	2.95e+09	7.86e+08	5.01e+08	0.00e+00	0.00e+00	0.00e+00	5.22e+07
Ni-63	3.95e+10	2.11e+09	1.34e+09	0.00e+00	0.00e+00	0.00e+00	1.42e+08
Ni-65	1.02e+02	9.59e+00	5.60e+00	0.00e+00	0.00e+00	0.00e+00	1.17e+03
Cu-64	0.00e+00	1.09e+04	6.60e+03	0.00e+00	2.64e+04	0.00e+00	5.13e+05
Zn-65	8.12e+08	2.16e+09	1.35e+09	0.00e+00	1.36e+09	0.00e+00	3.80e+08
Zn-69	8.73e-06	1.26e-05	1.17e-06	0.00e+00	7.66e-06	0.00e+00	7.96e-04
Zn-69m	3.81e+04	6.49e+04	7.67e+03	0.00e+00	3.77e+04	0.00e+00	2.11e+06
Se-79	0.00e+00	6.20e+08	1.37e+08	0.00e+00	1.01e+09	0.00e+00	4.06e+07
Br-82	0.00e+00	0.00e+00	2.03e+06	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	5.20e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	3.30e-11	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases,  
Rj

Ri factors for Child age group by nuclide.  
Waterford Steam Electric Station  
Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	4.52e+08	2.78e+08	0.00e+00	0.00e+00	0.00e+00	2.90e+07
Rb-87	0.00e+00	2.90e+09	1.35e+09	0.00e+00	0.00e+00	0.00e+00	4.35e+07
Rb-88	0.00e+00	3.37e-22	2.34e-22	0.00e+00	0.00e+00	0.00e+00	1.65e-23
Rb-89	0.00e+00	3.42e-26	3.04e-26	0.00e+00	0.00e+00	0.00e+00	2.98e-28
Sr-89	3.59e+10	0.00e+00	1.03e+09	0.00e+00	0.00e+00	0.00e+00	1.39e+09
Sr-90	1.87e+12	0.00e+00	3.77e+10	0.00e+00	0.00e+00	0.00e+00	1.67e+10
Sr-91	5.20e+05	0.00e+00	1.96e+04	0.00e+00	0.00e+00	0.00e+00	1.15e+06
Sr-92	7.07e+02	0.00e+00	2.84e+01	0.00e+00	0.00e+00	0.00e+00	1.34e+04
Y-90	2.30e+04	0.00e+00	6.17e+02	0.00e+00	0.00e+00	0.00e+00	6.56e+07
Y-91	1.86e+07	0.00e+00	4.98e+05	0.00e+00	0.00e+00	0.00e+00	2.48e+09
Y-91m	8.12e-09	0.00e+00	2.95e-10	0.00e+00	0.00e+00	0.00e+00	1.59e-05
Y-92	1.55e+00	0.00e+00	4.43e-02	0.00e+00	0.00e+00	0.00e+00	4.48e+04
Y-93	2.91e+02	0.00e+00	7.98e+00	0.00e+00	0.00e+00	0.00e+00	4.34e+06
Zr-93	1.23e+07	4.59e+05	3.27e+05	0.00e+00	1.78e+06	0.00e+00	1.74e+08
Zr-95	3.86e+06	8.48e+05	7.54e+05	0.00e+00	1.21e+06	0.00e+00	8.84e+08
Zr-97	5.68e+02	8.20e+01	4.84e+01	0.00e+00	1.18e+02	0.00e+00	1.24e+07
Nb-93m	7.64e+06	1.91e+06	6.26e+05	0.00e+00	2.06e+06	0.00e+00	2.87e+08
Nb-95	4.10e+05	1.60e+05	1.14e+05	0.00e+00	1.50e+05	0.00e+00	2.95e+08
Nb-97	4.80e-06	8.68e-07	4.05e-07	0.00e+00	9.63e-07	0.00e+00	2.68e-01
Mo-93	0.00e+00	1.77e+09	6.36e+07	0.00e+00	4.67e+08	0.00e+00	8.97e+07
Mo-99	0.00e+00	7.70e+06	1.91e+06	0.00e+00	1.64e+07	0.00e+00	6.37e+06
Tc-101	1.02e-30	1.06e-30	1.35e-29	0.00e+00	1.81e-29	5.62e-31	3.38e-30
Tc-99	3.93e+07	4.38e+07	1.57e+07	0.00e+00	5.16e+08	3.87e+06	4.59e+08
Tc-99m	4.65e+00	9.12e+00	1.51e+02	0.00e+00	1.32e+02	4.63e+00	5.19e+03
Ru-103	1.53e+07	0.00e+00	5.89e+06	0.00e+00	3.86e+07	0.00e+00	3.96e+08
Ru-105	9.01e+01	0.00e+00	3.27e+01	0.00e+00	7.92e+02	0.00e+00	5.88e+04
Ru-106	7.45e+08	0.00e+00	9.30e+07	0.00e+00	1.01e+09	0.00e+00	1.16e+10
Rh-105	1.38e+05	7.43e+04	6.35e+04	0.00e+00	2.96e+05	0.00e+00	4.60e+06
Pd-107	0.00e+00	3.47e+07	2.95e+06	0.00e+00	2.90e+08	0.00e+00	6.89e+07
Pd-109	0.00e+00	2.90e+04	8.69e+03	0.00e+00	1.55e+05	0.00e+00	1.71e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	3.21e+07	2.17e+07	1.73e+07	0.00e+00	4.04e+07	0.00e+00	2.58e+09
Ag-111	3.78e+05	1.18e+05	7.81e+04	0.00e+00	3.57e+05	0.00e+00	7.25e+07
Cd-113m	0.00e+00	7.42e+08	3.16e+07	0.00e+00	7.64e+08	0.00e+00	1.91e+09
Cd-115m	0.00e+00	1.42e+08	6.04e+06	0.00e+00	1.05e+08	0.00e+00	1.93e+09
Sn-123	6.54e+09	8.11e+07	1.59e+08	8.60e+07	0.00e+00	0.00e+00	3.20e+09
Sn-125	7.43e+07	1.12e+06	3.33e+06	1.16e+06	0.00e+00	0.00e+00	2.30e+08
Sn-126	2.45e+10	3.05e+08	6.95e+08	8.38e+07	0.00e+00	0.00e+00	1.84e+09
Sb-124	3.52e+08	4.56e+06	1.23e+08	7.76e+05	0.00e+00	1.95e+08	2.20e+09
Sb-125	4.99e+08	3.85e+06	1.05e+08	4.62e+05	0.00e+00	2.78e+08	1.19e+09
Sb-126	1.40e+07	2.15e+05	5.04e+06	8.24e+04	0.00e+00	6.70e+06	2.83e+08
Sb-127	8.72e+05	1.35e+04	3.03e+05	9.71e+03	0.00e+00	3.78e+05	4.91e+07
Te-125m	3.50e+08	9.50e+07	4.67e+07	9.83e+07	0.00e+00	0.00e+00	3.38e+08
Te-127	9.76e+03	2.63e+03	2.09e+03	6.76e+03	2.78e+04	0.00e+00	3.81e+05
Te-127m	1.32e+09	3.56e+08	1.57e+08	3.16e+08	3.77e+09	0.00e+00	1.07e+09
Te-129	1.24e-03	3.45e-04	2.94e-04	8.82e-04	3.62e-03	0.00e+00	7.70e-02
Te-129m	8.40e+08	2.35e+08	1.30e+08	2.71e+08	2.47e+09	0.00e+00	1.03e+09
Te-131	2.14e-15	6.51e-16	6.35e-16	1.63e-15	6.46e-15	0.00e+00	1.12e-14
Te-131m	1.54e+06	5.32e+05	5.66e+05	1.09e+06	5.15e+06	0.00e+00	2.16e+07
Te-132	6.99e+06	3.10e+06	3.74e+06	4.51e+06	2.87e+07	0.00e+00	3.12e+07
Te-133m	3.48e-05	1.41e-05	1.74e-05	2.70e-05	1.34e-04	0.00e+00	1.07e-03
Te-134	5.16e-08	2.32e-08	3.10e-08	4.08e-08	2.15e-07	0.00e+00	2.36e-07
I-129	5.11e+09	3.13e+09	2.80e+09	2.05e+12	5.29e+09	0.00e+00	1.58e+08
I-130	6.12e+05	1.24e+06	6.37e+05	1.36e+08	1.85e+06	0.00e+00	5.78e+05
I-131	1.43e+08	1.44e+08	8.16e+07	4.75e+10	2.36e+08	0.00e+00	1.28e+07
I-132	8.91e+01	1.64e+02	7.53e+01	7.60e+03	2.51e+02	0.00e+00	1.93e+02
I-133	3.52e+06	4.35e+06	1.65e+06	8.08e+08	7.25e+06	0.00e+00	1.75e+06
I-134	1.42e-04	2.64e-04	1.21e-04	6.07e-03	4.03e-04	0.00e+00	1.75e-04
I-135	6.18e+04	1.11e+05	5.26e+04	9.86e+06	1.71e+05	0.00e+00	8.48e+04
Cs-134	1.60e+10	2.63e+10	5.55e+09	0.00e+00	8.15e+09	2.93e+09	1.42e+08
Cs-134m	1.06e+01	1.57e+01	1.02e+01	0.00e+00	8.26e+00	1.37e+00	1.98e+01

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	6.10e+09	4.25e+09	4.36e+08	0.00e+00	1.50e+09	5.01e+08	3.18e+07
Cs-136	8.23e+07	2.26e+08	1.46e+08	0.00e+00	1.21e+08	1.80e+07	7.95e+06
Cs-137	2.39e+10	2.29e+10	3.38e+09	0.00e+00	7.46e+09	2.68e+09	1.43e+08
Cs-138	5.69e-11	7.91e-11	5.02e-11	0.00e+00	5.57e-11	5.99e-12	3.64e-11
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	4.69e-02	2.50e-05	1.36e-03	0.00e+00	2.18e-05	1.47e-05	2.70e+00
Ba-140	2.76e+08	2.42e+05	1.61e+07	0.00e+00	7.88e+04	1.44e+05	1.40e+08
Ba-141	1.54e-21	8.64e-25	5.02e-23	0.00e+00	7.47e-25	5.07e-24	8.79e-22
Ba-142	6.46e-39	0.00e+00	3.61e-40	0.00e+00	0.00e+00	0.00e+00	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
La-141	1.04e+00	2.41e-01	5.24e-02	0.00e+00	0.00e+00	0.00e+00	5.37e+04
La-142	3.20e-04	1.02e-04	3.19e-05	0.00e+00	0.00e+00	0.00e+00	2.02e+01
Ce-141	6.55e+05	3.27e+05	4.85e+04	0.00e+00	1.43e+05	0.00e+00	4.08e+08
Ce-143	1.71e+03	9.29e+05	1.35e+02	0.00e+00	3.90e+02	0.00e+00	1.36e+07
Ce-144	1.27e+08	3.98e+07	6.78e+06	0.00e+00	2.21e+07	0.00e+00	1.04e+10
Pr-143	1.45e+05	4.37e+04	7.22e+03	0.00e+00	2.36e+04	0.00e+00	1.57e+08
Pr-144	4.11e-26	1.27e-26	2.07e-27	0.00e+00	6.73e-27	0.00e+00	2.74e-23
Nd-147	7.14e+04	5.78e+04	4.48e+03	0.00e+00	3.17e+04	0.00e+00	9.16e+07
Pm-147	2.21e+07	1.58e+06	8.48e+05	0.00e+00	2.79e+06	0.00e+00	6.39e+08
Pm-148	3.36e+04	4.04e+03	2.62e+03	0.00e+00	6.87e+03	0.00e+00	1.08e+08
Pm-148m	2.28e+06	4.54e+05	4.54e+05	0.00e+00	6.73e+05	0.00e+00	1.28e+09
Pm-149	2.93e+03	3.12e+02	1.69e+02	0.00e+00	5.52e+02	0.00e+00	2.13e+07
Pm-151	5.72e+02	6.96e+01	4.53e+01	0.00e+00	1.18e+02	0.00e+00	7.90e+06
Sm-151	1.88e+07	2.80e+06	8.81e+05	0.00e+00	2.89e+06	0.00e+00	4.06e+08
Sm-153	1.42e+03	8.83e+02	8.51e+01	0.00e+00	2.69e+02	0.00e+00	1.17e+07
Eu-152	4.47e+07	8.14e+06	9.66e+06	0.00e+00	3.44e+07	0.00e+00	1.34e+09
Eu-154	1.69e+08	1.52e+07	1.39e+07	0.00e+00	6.68e+07	0.00e+00	3.53e+09
Eu-155	3.27e+07	2.35e+06	1.84e+06	0.00e+00	8.82e+06	0.00e+00	5.89e+09
Eu-156	2.58e+05	1.38e+05	2.86e+04	0.00e+00	8.89e+04	0.00e+00	3.13e+08
Tb-160	6.01e+06	0.00e+00	7.46e+05	0.00e+00	1.79e+06	0.00e+00	1.33e+09

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	7.94e+07	1.66e+07	1.40e+07	0.00e+00	2.37e+07	0.00e+00	1.93e+09
W-181	2.03e+06	4.98e+05	6.85e+04	0.00e+00	0.00e+00	0.00e+00	1.81e+07
W-185	6.44e+07	1.61e+07	2.25e+06	0.00e+00	0.00e+00	0.00e+00	5.99e+08
W-187	6.41e+04	3.80e+04	1.70e+04	0.00e+00	0.00e+00	0.00e+00	5.34e+06
Pb-210	3.47e+12	8.90e+11	1.53e+11	0.00e+00	2.68e+12	0.00e+00	1.68e+08
Bi-210	2.06e+06	1.07e+07	1.18e+06	0.00e+00	1.20e+08	0.00e+00	5.41e+07
Po-210	7.66e+10	1.23e+11	1.85e+10	0.00e+00	3.81e+11	0.00e+00	3.30e+09
Ra-223	5.77e+10	6.67e+07	1.15e+10	0.00e+00	1.77e+09	0.00e+00	9.20e+08
Ra-224	5.36e+09	9.73e+06	1.07e+09	0.00e+00	2.58e+08	0.00e+00	2.94e+08
Ra-225	1.22e+11	1.09e+08	2.44e+10	0.00e+00	2.89e+09	0.00e+00	1.40e+09
Ra-226	4.23e+13	1.35e+09	3.47e+13	0.00e+00	3.59e+10	0.00e+00	2.51e+10
Ra-228	2.76e+13	7.16e+08	3.10e+13	0.00e+00	1.90e+10	0.00e+00	4.16e+09
Ac-225	4.16e+07	4.29e+07	2.79e+06	0.00e+00	4.58e+06	0.00e+00	9.54e+08
Ac-227	3.01e+11	4.84e+10	1.86e+10	0.00e+00	1.07e+10	0.00e+00	6.16e+09
Th-227	3.88e+08	5.28e+06	1.12e+07	0.00e+00	2.80e+07	0.00e+00	3.73e+09
Th-228	1.41e+11	1.81e+09	4.77e+09	0.00e+00	9.40e+09	0.00e+00	3.95e+10
Th-229	1.73e+12	4.34e+10	2.88e+10	0.00e+00	2.12e+11	0.00e+00	5.91e+09
Th-230	2.61e+11	1.31e+10	7.28e+09	0.00e+00	6.37e+10	0.00e+00	4.55e+09
Th-232	2.91e+11	1.12e+10	2.21e+08	0.00e+00	5.45e+10	0.00e+00	3.87e+09
Th-234	3.61e+06	1.59e+05	1.04e+05	0.00e+00	8.46e+05	0.00e+00	1.25e+09
Pa-231	5.20e+11	1.72e+10	2.07e+10	0.00e+00	9.41e+10	0.00e+00	5.42e+09
Pa-233	2.34e+05	3.65e+04	4.09e+04	0.00e+00	1.34e+05	0.00e+00	1.86e+08
U-232	1.29e+12	0.00e+00	9.24e+10	0.00e+00	9.83e+10	0.00e+00	5.12e+09
U-233	2.73e+11	0.00e+00	1.65e+10	0.00e+00	4.48e+10	0.00e+00	4.74e+09
U-234	2.62e+11	0.00e+00	1.62e+10	0.00e+00	4.40e+10	0.00e+00	4.65e+09
U-235	2.51e+11	0.00e+00	1.52e+10	0.00e+00	4.12e+10	0.00e+00	5.90e+09
U-236	2.51e+11	0.00e+00	1.56e+10	0.00e+00	4.21e+10	0.00e+00	4.35e+09
U-237	3.26e+05	0.00e+00	8.65e+04	0.00e+00	9.39e+05	0.00e+00	2.87e+07
U-238	2.40e+11	0.00e+00	1.43e+10	0.00e+00	3.85e+10	0.00e+00	4.16e+09
Np-237	1.64e+11	1.08e+10	7.20e+09	0.00e+00	4.45e+10	0.00e+00	6.00e+09

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases,  
Rj

Ri factors for Child age group by nuclide.  
Waterford Steam Electric Station  
Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	2.51e+04	5.08e+02	3.91e+02	0.00e+00	1.62e+03	0.00e+00	1.74e+07
Np-239	2.56e+03	1.84e+02	1.29e+02	0.00e+00	5.31e+02	0.00e+00	1.36e+07
Pu-238	8.73e+10	1.01e+10	2.32e+09	0.00e+00	8.44e+09	0.00e+00	5.50e+09
Pu-239	9.48e+10	1.01e+10	2.43e+09	0.00e+00	8.97e+09	0.00e+00	5.03e+09
Pu-240	9.41e+10	1.05e+10	2.43e+09	0.00e+00	8.97e+09	0.00e+00	5.13e+09
Pu-241	2.82e+09	1.15e+08	5.85e+07	0.00e+00	2.15e+08	0.00e+00	1.05e+08
Pu-242	8.75e+10	1.01e+10	2.34e+09	0.00e+00	8.60e+09	0.00e+00	4.93e+09
Pu-244	1.02e+11	1.16e+11	2.68e+09	0.00e+00	9.92e+09	0.00e+00	7.35e+09
Am-241	9.67e+10	8.32e+10	7.25e+09	0.00e+00	4.43e+10	0.00e+00	5.43e+09
Am-242m	1.03e+11	8.22e+10	7.64e+09	0.00e+00	4.63e+10	0.00e+00	7.06e+09
Am-243	9.85e+10	8.31e+10	7.23e+09	0.00e+00	4.45e+10	0.00e+00	6.58e+09
Cm-242	4.69e+09	3.74e+09	3.12e+08	0.00e+00	9.98e+08	0.00e+00	4.35e+09
Cm-243	9.36e+10	7.61e+10	6.03e+09	0.00e+00	2.25e+10	0.00e+00	5.87e+09
Cm-244	7.87e+10	6.37e+10	5.05e+09	0.00e+00	1.85e+10	0.00e+00	5.67e+09
Cm-245	1.23e+11	9.85e+10	7.72e+09	0.00e+00	3.02e+10	0.00e+00	5.32e+09
Cm-246	1.21e+11	9.85e+10	7.72e+09	0.00e+00	3.01e+10	0.00e+00	5.23e+09
Cm-247	1.18e+11	9.70e+10	7.57e+09	0.00e+00	2.97e+10	0.00e+00	6.87e+09
Cm-248	9.85e+11	8.01e+11	6.26e+10	0.00e+00	2.45e+11	0.00e+00	1.11e+11
Cf-252	7.28e+10	0.00e+00	1.76e+09	0.00e+00	0.00e+00	0.00e+00	2.05e+10

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Be-10	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
C-14	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Na-22	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Na-24	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
P-32	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ca-41	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sc-46	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cr-51	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mn-54	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mn-56	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Fe-55	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Fe-59	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Co-57	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Co-58	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Co-60	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ni-59	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ni-63	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ni-65	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cu-64	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-65	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-69	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zn-69m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Se-79	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-82	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

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Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases,  
Rj

Ri factors for Infant age group by nuclide.  
Waterford Steam Electric Station  
Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-87	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-90	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-91	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-92	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-90	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-91	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-91m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-92	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Y-93	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zr-93	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zr-95	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zr-97	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nb-93m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nb-95	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nb-97	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mo-93	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Mo-99	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ru-103	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ru-105	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ru-106	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rh-105	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pd-107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pd-109	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ag-111	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cd-113m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cd-115m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sn-123	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sn-125	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sn-126	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sb-124	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sb-125	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sb-126	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sb-127	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-125m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-127	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-127m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-129	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-129m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-131	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-131m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-132	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-133m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Te-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-129	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-130	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-131	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-132	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-133	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
I-135	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-134	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-134m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-136	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-137	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-138	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-140	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-140	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-143	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ce-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pr-143	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-147	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-148	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-148m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-149	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pm-151	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sm-151	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sm-153	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-152	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-154	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-155	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Eu-156	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tb-160	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases,  
Rj

Ri factors for Infant age group by nuclide.  
Waterford Steam Electric Station  
Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
W-181	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
W-185	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
W-187	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pb-210	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Bi-210	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Po-210	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ra-223	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ra-224	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ra-225	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ra-226	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ra-228	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ac-225	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ac-227	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Th-227	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Th-228	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Th-229	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Th-230	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Th-232	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Th-234	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pa-231	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pa-233	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
U-232	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
U-233	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
U-234	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
U-235	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
U-236	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
U-237	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
U-238	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Np-237	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 9

Leafy Vegetable Pathway Dose Factors Due to Radionuclides Other Than Noble Gases,  
Rj

Ri factors for Infant age group by nuclide.  
Waterford Steam Electric Station  
Pathway : Gaseous Release Leafy/Produce Vegetation Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Np-239	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-238	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-239	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-240	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-241	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-242	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Pu-244	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Am-241	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Am-242m	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Am-243	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-242	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-243	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-244	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-245	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-246	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-247	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cm-248	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cf-252	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, R<sub>j</sub>

R<sub>i</sub> factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway R<sub>i</sub>

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	8.88e+02	8.88e+02	8.88e+02	8.88e+02	8.88e+02	8.88e+02
Be-10	2.95e+05	4.55e+04	7.36e+03	0.00e+00	3.44e+04	0.00e+00	2.49e+06
C-14	2.63e+08	5.27e+07	5.27e+07	5.27e+07	5.27e+07	5.27e+07	5.27e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	5.58e-04	0.00e+00	6.19e-05	0.00e+00	0.00e+00	0.00e+00	1.65e-05
Na-22	6.35e+08	6.35e+08	6.35e+08	6.35e+08	6.35e+08	6.35e+08	6.35e+08
Na-24	2.93e+05	2.93e+05	2.93e+05	2.93e+05	2.93e+05	2.93e+05	2.93e+05
P-32	2.05e+10	1.28e+09	7.93e+08	0.00e+00	0.00e+00	0.00e+00	2.31e+09
Ca-41	1.37e+09	0.00e+00	1.48e+08	0.00e+00	0.00e+00	0.00e+00	1.37e+06
Sc-46	2.15e+01	4.18e+01	1.22e+01	0.00e+00	3.90e+01	0.00e+00	2.04e+05
Cr-51	0.00e+00	0.00e+00	3.43e+03	2.05e+03	7.55e+02	4.55e+03	8.62e+05
Mn-54	0.00e+00	1.01e+06	1.93e+05	0.00e+00	3.00e+05	0.00e+00	3.09e+06
Mn-56	0.00e+00	4.98e-04	8.84e-05	0.00e+00	6.33e-04	0.00e+00	1.59e-02
Fe-55	3.26e+05	2.26e+05	5.26e+04	0.00e+00	0.00e+00	1.26e+05	1.29e+05
Fe-59	3.86e+05	9.07e+05	3.48e+05	0.00e+00	0.00e+00	2.54e+05	3.02e+06
Co-57	0.00e+00	1.54e+05	2.55e+05	0.00e+00	0.00e+00	0.00e+00	3.89e+06
Co-58	0.00e+00	5.66e+05	1.27e+06	0.00e+00	0.00e+00	0.00e+00	1.15e+07
Co-60	0.00e+00	1.97e+06	4.34e+06	0.00e+00	0.00e+00	0.00e+00	3.70e+07
Ni-59	6.06e+07	2.08e+07	1.01e+07	0.00e+00	0.00e+00	0.00e+00	4.29e+06
Ni-63	8.07e+08	5.60e+07	2.71e+07	0.00e+00	0.00e+00	0.00e+00	1.17e+07
Ni-65	4.51e-02	5.86e-03	2.67e-03	0.00e+00	0.00e+00	0.00e+00	1.49e-01
Cu-64	0.00e+00	2.66e+03	1.25e+03	0.00e+00	6.72e+03	0.00e+00	2.27e+05
Zn-65	1.65e+08	5.24e+08	2.37e+08	0.00e+00	3.50e+08	0.00e+00	3.30e+08
Zn-69	2.62e-13	5.00e-13	3.48e-14	0.00e+00	3.25e-13	0.00e+00	7.52e-14
Zn-69m	2.18e+04	5.22e+04	4.78e+03	0.00e+00	3.16e+04	0.00e+00	3.19e+06
Se-79	0.00e+00	1.10e+08	1.83e+07	0.00e+00	1.90e+08	0.00e+00	2.25e+07
Br-82	0.00e+00	0.00e+00	3.88e+06	0.00e+00	0.00e+00	0.00e+00	4.44e+06
Br-83	0.00e+00	0.00e+00	1.18e-02	0.00e+00	0.00e+00	0.00e+00	1.71e-02
Br-84	0.00e+00	0.00e+00	2.08e-24	0.00e+00	0.00e+00	0.00e+00	1.63e-29
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per μCi/sec for all nuclides except H-3, which is in units of mrem/yr per μCi/cubic meter.



## Offsite Dose Calculation Manual

## Attachment 10

## Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	3.11e+08	1.45e+08	0.00e+00	0.00e+00	0.00e+00	6.14e+07
Rb-87	0.00e+00	3.42e+08	1.19e+08	0.00e+00	0.00e+00	0.00e+00	1.60e+07
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	3.05e+09	0.00e+00	8.74e+07	0.00e+00	0.00e+00	0.00e+00	4.89e+08
Sr-90	1.13e+11	0.00e+00	2.27e+09	0.00e+00	0.00e+00	0.00e+00	2.84e+09
Sr-91	6.10e+04	0.00e+00	2.46e+03	0.00e+00	0.00e+00	0.00e+00	2.90e+05
Sr-92	1.04e+00	0.00e+00	4.50e-02	0.00e+00	0.00e+00	0.00e+00	2.06e+01
Y-90	8.51e+00	0.00e+00	2.28e-01	0.00e+00	0.00e+00	0.00e+00	9.02e+04
Y-91	1.03e+03	0.00e+00	2.76e+01	0.00e+00	0.00e+00	0.00e+00	5.67e+05
Y-91m	7.52e-21	0.00e+00	2.91e-22	0.00e+00	0.00e+00	0.00e+00	2.21e-20
Y-92	6.77e-06	0.00e+00	1.98e-07	0.00e+00	0.00e+00	0.00e+00	1.19e-01
Y-93	2.69e-02	0.00e+00	7.43e-04	0.00e+00	0.00e+00	0.00e+00	8.53e+02
Zr-93	1.94e+02	1.09e+01	5.05e+00	0.00e+00	4.11e+01	0.00e+00	1.13e+04
Zr-95	1.13e+02	3.63e+01	2.46e+01	0.00e+00	5.70e+01	0.00e+00	1.15e+05
Zr-97	5.21e-02	1.05e-02	4.81e-03	0.00e+00	1.59e-02	0.00e+00	3.26e+03
Nb-93m	5.89e+04	1.92e+04	4.74e+03	0.00e+00	2.21e+04	0.00e+00	8.88e+06
Nb-95	9.91e+03	5.51e+03	2.96e+03	0.00e+00	5.45e+03	0.00e+00	3.34e+07
Nb-97	7.89e-13	2.00e-13	7.29e-14	0.00e+00	2.33e-13	0.00e+00	7.37e-10
Mo-93	0.00e+00	5.22e+07	1.41e+06	0.00e+00	1.48e+07	0.00e+00	8.49e+06
Mo-99	0.00e+00	2.97e+06	5.66e+05	0.00e+00	6.73e+06	0.00e+00	6.89e+06
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	2.90e+06	4.31e+06	1.16e+06	0.00e+00	5.43e+07	3.66e+05	1.41e+08
Tc-99m	4.01e-01	1.13e+00	1.44e+01	0.00e+00	1.72e+01	5.55e-01	6.71e+02
Ru-103	1.22e+02	0.00e+00	5.26e+01	0.00e+00	4.66e+02	0.00e+00	1.43e+04
Ru-105	1.04e-04	0.00e+00	4.09e-05	0.00e+00	1.34e-03	0.00e+00	6.34e-02
Ru-106	2.45e+03	0.00e+00	3.10e+02	0.00e+00	4.73e+03	0.00e+00	1.58e+05
Rh-105	4.15e+04	3.04e+04	2.00e+04	0.00e+00	1.29e+05	0.00e+00	4.84e+06
Pd-107	0.00e+00	1.36e+06	8.72e+04	0.00e+00	1.22e+07	0.00e+00	8.45e+06
Pd-109	0.00e+00	5.39e+03	1.22e+03	0.00e+00	3.08e+04	0.00e+00	5.97e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 10

## Page 3 of 24

## Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	6.99e+06	6.46e+06	3.84e+06	0.00e+00	1.27e+07	0.00e+00	2.64e+09
Ag-111	7.77e+05	3.25e+05	1.62e+05	0.00e+00	1.05e+06	0.00e+00	5.96e+08
Cd-113m	0.00e+00	3.53e+05	1.13e+04	0.00e+00	3.88e+05	0.00e+00	2.84e+06
Cd-115m	0.00e+00	1.51e+05	4.82e+03	0.00e+00	1.20e+05	0.00e+00	6.36e+06
Sn-123	6.43e+07	1.07e+06	1.57e+06	9.06e+05	0.00e+00	0.00e+00	1.31e+08
Sn-125	6.81e+06	1.37e+05	3.09e+05	1.14e+05	0.00e+00	0.00e+00	8.50e+07
Sn-126	1.96e+08	3.87e+06	5.56e+06	1.14e+06	0.00e+00	0.00e+00	5.63e+07
Sb-124	3.09e+06	5.83e+04	1.22e+06	7.49e+03	0.00e+00	2.40e+06	8.77e+07
Sb-125	2.45e+06	2.74e+04	5.84e+05	2.49e+03	0.00e+00	1.89e+06	2.70e+07
Sb-126	6.75e+05	1.37e+04	2.44e+05	4.13e+03	0.00e+00	4.14e+05	5.52e+07
Sb-127	5.44e+04	1.19e+03	2.09e+04	6.54e+02	0.00e+00	3.23e+04	1.24e+07
Te-125m	1.95e+06	7.08e+05	2.62e+05	5.88e+05	7.95e+06	0.00e+00	7.80e+06
Te-127	7.87e+01	2.82e+01	1.70e+01	5.83e+01	3.20e+02	0.00e+00	6.21e+03
Te-127m	5.49e+06	1.96e+06	6.69e+05	1.40e+06	2.23e+07	0.00e+00	1.84e+07
Te-129	3.50e-11	1.32e-11	8.53e-12	2.69e-11	1.47e-10	0.00e+00	2.64e-11
Te-129m	7.22e+06	2.69e+06	1.14e+06	2.48e+06	3.02e+07	0.00e+00	3.64e+07
Te-131	4.74e-34	1.98e-34	1.50e-34	3.90e-34	2.08e-33	0.00e+00	6.72e-35
Te-131m	4.34e+04	2.12e+04	1.77e+04	3.36e+04	2.15e+05	0.00e+00	2.11e+06
Te-132	2.88e+05	1.86e+05	1.75e+05	2.06e+05	1.80e+06	0.00e+00	8.82e+06
Te-133m	2.63e-14	1.54e-14	1.48e-14	2.23e-14	1.52e-13	0.00e+00	5.28e-15
Te-134	1.13e-19	7.39e-20	4.53e-20	9.86e-20	7.14e-19	0.00e+00	1.25e-22
I-129	9.10e+07	7.82e+07	2.56e+08	2.01e+11	1.68e+08	0.00e+00	1.24e+07
I-130	5.06e+04	1.49e+05	5.89e+04	1.26e+07	2.33e+05	0.00e+00	1.28e+05
I-131	3.55e+07	5.08e+07	2.91e+07	1.67e+10	8.71e+07	0.00e+00	1.34e+07
I-132	2.00e-02	5.36e-02	1.88e-02	1.88e+00	8.54e-02	0.00e+00	1.01e-02
I-133	4.65e+05	8.09e+05	2.47e+05	1.19e+08	1.41e+06	0.00e+00	7.27e+05
I-134	2.53e-13	6.87e-13	2.46e-13	1.19e-11	1.09e-12	0.00e+00	5.99e-16
I-135	1.55e+03	4.06e+03	1.50e+03	2.68e+05	6.51e+03	0.00e+00	4.58e+03
Cs-134	1.70e+10	4.03e+10	3.30e+10	0.00e+00	1.31e+10	4.33e+09	7.06e+08
Cs-134m	5.28e-01	1.11e+00	5.68e-01	0.00e+00	6.02e-01	9.49e-02	3.92e-01

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	5.43e+09	5.01e+09	2.22e+09	0.00e+00	1.89e+09	5.68e+08	1.17e+08
Cs-136	7.90e+08	3.12e+09	2.24e+09	0.00e+00	1.73e+09	2.38e+08	3.54e+08
Cs-137	2.21e+10	3.03e+10	1.98e+10	0.00e+00	1.03e+10	3.42e+09	5.86e+08
Cs-138	2.91e-23	5.76e-23	2.85e-23	0.00e+00	4.23e-23	4.18e-24	2.46e-28
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	3.23e+06	4.05e+03	2.11e+05	0.00e+00	1.38e+03	2.32e+03	6.64e+06
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	3.60e-06	1.12e-06	1.83e-07	0.00e+00	0.00e+00	0.00e+00	1.33e-01
La-142	2.28e-12	1.04e-12	2.59e-13	0.00e+00	0.00e+00	0.00e+00	7.58e-09
Ce-141	5.81e+02	3.93e+02	4.46e+01	0.00e+00	1.83e+02	0.00e+00	1.50e+06
Ce-143	4.99e+00	3.69e+03	4.09e-01	0.00e+00	1.63e+00	0.00e+00	1.38e+05
Ce-144	4.29e+04	1.79e+04	2.30e+03	0.00e+00	1.06e+04	0.00e+00	1.45e+07
Pr-143	1.89e+01	7.60e+00	9.39e-01	0.00e+00	4.39e+00	0.00e+00	8.30e+04
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	1.13e+01	1.31e+01	7.81e-01	0.00e+00	7.63e+00	0.00e+00	6.27e+04
Pm-147	3.44e+02	3.24e+01	1.31e+01	0.00e+00	6.11e+01	0.00e+00	4.08e+04
Pm-148	7.12e+00	1.18e+00	5.95e-01	0.00e+00	2.23e+00	0.00e+00	9.28e+04
Pm-148m	1.03e+02	2.66e+01	2.04e+01	0.00e+00	4.02e+01	0.00e+00	2.26e+05
Pm-149	5.13e-01	7.26e-02	2.96e-02	0.00e+00	1.37e-01	0.00e+00	1.36e+04
Pm-151	7.76e-02	1.30e-02	6.58e-03	0.00e+00	2.33e-02	0.00e+00	3.58e+03
Sm-151	3.20e+02	5.52e+01	1.32e+01	0.00e+00	6.16e+01	0.00e+00	2.43e+04
Sm-153	2.39e-01	1.99e-01	1.45e-02	0.00e+00	6.43e-02	0.00e+00	7.10e+03
Eu-152	9.01e+02	2.05e+02	1.80e+02	0.00e+00	1.27e+03	0.00e+00	1.18e+05
Eu-154	2.85e+03	3.50e+02	2.49e+02	0.00e+00	1.68e+03	0.00e+00	2.54e+05
Eu-155	3.90e+02	5.53e+01	3.57e+01	0.00e+00	2.55e+02	0.00e+00	4.35e+04
Eu-156	3.02e+01	2.34e+01	3.77e+00	0.00e+00	1.56e+01	0.00e+00	1.60e+05
Tb-160	1.79e+02	0.00e+00	2.23e+01	0.00e+00	7.39e+01	0.00e+00	1.65e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.25e+03	3.91e+02	2.97e+02	0.00e+00	5.84e+02	0.00e+00	1.19e+05
W-181	4.07e+03	1.33e+03	1.42e+02	0.00e+00	0.00e+00	0.00e+00	1.51e+05
W-185	1.55e+05	5.18e+04	5.45e+03	0.00e+00	0.00e+00	0.00e+00	5.99e+06
W-187	7.83e+02	6.54e+02	2.29e+02	0.00e+00	0.00e+00	0.00e+00	2.14e+05
Pb-210	8.78e+09	2.51e+09	3.12e+08	0.00e+00	7.06e+09	0.00e+00	1.29e+06
Bi-210	4.27e+04	2.95e+05	2.45e+04	0.00e+00	3.55e+06	0.00e+00	4.40e+06
Po-210	8.90e+07	1.89e+08	2.15e+07	0.00e+00	6.30e+08	0.00e+00	1.59e+07
Ra-223	1.47e+10	2.26e+07	2.93e+09	0.00e+00	6.40e+08	0.00e+00	9.46e+08
Ra-224	1.70e+09	4.11e+06	3.40e+08	0.00e+00	1.16e+08	0.00e+00	3.58e+08
Ra-225	2.28e+10	2.70e+07	4.55e+09	0.00e+00	7.67e+08	0.00e+00	1.06e+09
Ra-226	2.24e+12	4.26e+07	1.63e+12	0.00e+00	1.21e+09	0.00e+00	2.46e+09
Ra-228	8.25e+11	2.30e+07	8.91e+11	0.00e+00	6.50e+08	0.00e+00	4.15e+08
Ac-225	7.40e+03	1.02e+04	4.98e+02	0.00e+00	1.16e+03	0.00e+00	6.85e+05
Ac-227	8.65e+06	1.15e+06	5.14e+05	0.00e+00	3.70e+05	0.00e+00	3.79e+05
Th-227	3.36e+04	6.07e+02	9.67e+02	0.00e+00	3.45e+03	0.00e+00	1.32e+06
Th-228	2.25e+06	3.81e+04	7.62e+04	0.00e+00	2.12e+05	0.00e+00	2.55e+06
Th-229	6.31e+07	1.80e+06	1.04e+06	0.00e+00	8.72e+06	0.00e+00	3.62e+05
Th-230	9.55e+06	5.43e+05	2.64e+05	0.00e+00	2.62e+06	0.00e+00	2.79e+05
Th-232	1.07e+07	4.64e+05	6.96e+03	0.00e+00	2.24e+06	0.00e+00	2.37e+05
Th-234	2.22e+02	1.30e+01	6.40e+00	0.00e+00	7.39e+01	0.00e+00	3.13e+05
Pa-231	1.90e+07	7.14e+05	7.37e+05	0.00e+00	4.01e+06	0.00e+00	3.32e+05
Pa-233	1.53e+01	3.09e+00	2.66e+00	0.00e+00	1.16e+01	0.00e+00	4.78e+04
U-232	1.91e+09	0.00e+00	1.37e+08	0.00e+00	2.07e+08	0.00e+00	3.14e+07
U-233	4.04e+08	0.00e+00	2.45e+07	0.00e+00	9.41e+07	0.00e+00	2.91e+07
U-234	3.88e+08	0.00e+00	2.40e+07	0.00e+00	9.23e+07	0.00e+00	2.85e+07
U-235	3.71e+08	0.00e+00	2.25e+07	0.00e+00	8.67e+07	0.00e+00	3.62e+07
U-236	3.71e+08	0.00e+00	2.30e+07	0.00e+00	8.86e+07	0.00e+00	2.67e+07
U-237	6.78e+03	0.00e+00	1.81e+03	0.00e+00	2.79e+04	0.00e+00	2.38e+06
U-238	3.56e+08	0.00e+00	2.11e+07	0.00e+00	8.11e+07	0.00e+00	2.55e+07
Np-237	5.84e+06	4.15e+05	2.57e+05	0.00e+00	1.91e+06	0.00e+00	3.68e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 10

## Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	4.34e+00	1.17e-01	6.75e-02	0.00e+00	3.96e-01	0.00e+00	1.09e+04
Np-239	4.41e-01	4.34e-02	2.39e-02	0.00e+00	1.35e-01	0.00e+00	8.89e+03
Pu-238	1.17e+06	1.48e+05	3.17e+04	0.00e+00	1.36e+05	0.00e+00	1.35e+05
Pu-239	1.34e+06	1.62e+05	3.54e+04	0.00e+00	1.50e+05	0.00e+00	1.24e+05
Pu-240	1.34e+06	1.61e+05	3.54e+04	0.00e+00	1.50e+05	0.00e+00	1.26e+05
Pu-241	2.90e+04	1.38e+03	6.14e+02	0.00e+00	2.83e+03	0.00e+00	2.59e+03
Pu-242	1.25e+06	1.56e+05	3.41e+04	0.00e+00	1.45e+05	0.00e+00	1.21e+05
Pu-244	1.45e+06	1.78e+05	3.91e+04	0.00e+00	1.66e+05	0.00e+00	1.80e+05
Am-241	3.47e+06	3.24e+06	2.48e+05	0.00e+00	1.87e+06	0.00e+00	3.41e+05
Am-242m	3.53e+06	3.07e+06	2.52e+05	0.00e+00	1.88e+06	0.00e+00	4.33e+05
Am-243	3.50e+06	3.20e+06	2.46e+05	0.00e+00	1.85e+06	0.00e+00	4.03e+05
Cm-242	8.72e+04	9.27e+04	5.80e+03	0.00e+00	2.63e+04	0.00e+00	3.35e+05
Cm-243	2.77e+06	2.54e+06	1.74e+05	0.00e+00	8.10e+05	0.00e+00	3.62e+05
Cm-244	2.11e+06	1.98e+06	1.33e+05	0.00e+00	6.20e+05	0.00e+00	3.49e+05
Cm-245	4.35e+06	3.79e+06	2.67e+05	0.00e+00	1.25e+06	0.00e+00	3.26e+05
Cm-246	4.31e+06	3.78e+06	2.67e+05	0.00e+00	1.24e+06	0.00e+00	3.20e+05
Cm-247	4.21e+06	3.73e+06	2.63e+05	0.00e+00	1.22e+06	0.00e+00	4.21e+05
Cm-248	3.50e+07	3.07e+07	2.17e+06	0.00e+00	1.01e+07	0.00e+00	6.82e+06
Cf-252	1.19e+06	0.00e+00	2.87e+04	0.00e+00	0.00e+00	0.00e+00	1.31e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.16e+03	1.16e+03	1.16e+03	1.16e+03	1.16e+03	1.16e+03
Be-10	5.36e+05	8.30e+04	1.35e+04	0.00e+00	6.34e+04	0.00e+00	3.40e+06
C-14	4.86e+08	9.72e+07	9.72e+07	9.72e+07	9.72e+07	9.72e+07	9.72e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	9.97e-04	0.00e+00	1.09e-04	0.00e+00	0.00e+00	0.00e+00	8.97e-05
Na-22	1.10e+09	1.10e+09	1.10e+09	1.10e+09	1.10e+09	1.10e+09	1.10e+09
Na-24	5.12e+05	5.12e+05	5.12e+05	5.12e+05	5.12e+05	5.12e+05	5.12e+05
P-32	3.79e+10	2.35e+09	1.47e+09	0.00e+00	0.00e+00	0.00e+00	3.18e+09
Ca-41	1.89e+09	0.00e+00	2.04e+08	0.00e+00	0.00e+00	0.00e+00	1.87e+06
Sc-46	3.65e+01	7.11e+01	2.11e+01	0.00e+00	6.81e+01	0.00e+00	2.42e+05
Cr-51	0.00e+00	0.00e+00	5.99e+03	3.33e+03	1.31e+03	8.55e+03	1.01e+06
Mn-54	0.00e+00	1.68e+06	3.34e+05	0.00e+00	5.02e+05	0.00e+00	3.45e+06
Mn-56	0.00e+00	8.83e-04	1.57e-04	0.00e+00	1.12e-03	0.00e+00	5.81e-02
Fe-55	5.79e+05	4.10e+05	9.57e+04	0.00e+00	0.00e+00	2.60e+05	1.78e+05
Fe-59	6.74e+05	1.57e+06	6.07e+05	0.00e+00	0.00e+00	4.96e+05	3.72e+06
Co-57	0.00e+00	2.69e+05	4.52e+05	0.00e+00	0.00e+00	0.00e+00	5.03e+06
Co-58	0.00e+00	9.52e+05	2.19e+06	0.00e+00	0.00e+00	0.00e+00	1.31e+07
Co-60	0.00e+00	3.34e+06	7.51e+06	0.00e+00	0.00e+00	0.00e+00	4.34e+07
Ni-59	1.06e+08	3.74e+07	1.80e+07	0.00e+00	0.00e+00	0.00e+00	5.86e+06
Ni-63	1.42e+09	1.00e+08	4.81e+07	0.00e+00	0.00e+00	0.00e+00	1.59e+07
Ni-65	8.25e-02	1.05e-02	4.80e-03	0.00e+00	0.00e+00	0.00e+00	5.72e-01
Cu-64	0.00e+00	4.75e+03	2.23e+03	0.00e+00	1.20e+04	0.00e+00	3.68e+05
Zn-65	2.53e+08	8.78e+08	4.09e+08	0.00e+00	5.62e+08	0.00e+00	3.72e+08
Zn-69	4.82e-13	9.18e-13	6.42e-14	0.00e+00	6.00e-13	0.00e+00	1.69e-12
Zn-69m	3.96e+04	9.35e+04	8.57e+03	0.00e+00	5.68e+04	0.00e+00	5.14e+06
Se-79	0.00e+00	2.01e+08	3.38e+07	0.00e+00	3.50e+08	0.00e+00	3.07e+07
Br-82	0.00e+00	0.00e+00	6.73e+06	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	2.18e-02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	3.71e-24	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	5.67e+08	2.67e+08	0.00e+00	0.00e+00	0.00e+00	8.40e+07
Rb-87	0.00e+00	6.28e+08	2.19e+08	0.00e+00	0.00e+00	0.00e+00	2.19e+07
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	5.62e+09	0.00e+00	1.61e+08	0.00e+00	0.00e+00	0.00e+00	6.69e+08
Sr-90	1.71e+11	0.00e+00	3.41e+09	0.00e+00	0.00e+00	0.00e+00	3.90e+09
Sr-91	1.12e+05	0.00e+00	4.46e+03	0.00e+00	0.00e+00	0.00e+00	5.08e+05
Sr-92	1.90e+00	0.00e+00	8.11e-02	0.00e+00	0.00e+00	0.00e+00	4.85e+01
Y-90	1.56e+01	0.00e+00	4.21e-01	0.00e+00	0.00e+00	0.00e+00	1.29e+05
Y-91	1.90e+03	0.00e+00	5.08e+01	0.00e+00	0.00e+00	0.00e+00	7.77e+05
Y-91m	1.38e-20	0.00e+00	5.26e-22	0.00e+00	0.00e+00	0.00e+00	6.50e-19
Y-92	1.25e-05	0.00e+00	3.62e-07	0.00e+00	0.00e+00	0.00e+00	3.43e-01
Y-93	4.96e-02	0.00e+00	1.36e-03	0.00e+00	0.00e+00	0.00e+00	1.52e+03
Zr-93	3.31e+02	1.63e+01	8.91e+00	0.00e+00	5.77e+01	0.00e+00	1.54e+04
Zr-95	1.98e+02	6.25e+01	4.30e+01	0.00e+00	9.18e+01	0.00e+00	1.44e+05
Zr-97	9.48e-02	1.88e-02	8.64e-03	0.00e+00	2.84e-02	0.00e+00	5.08e+03
Nb-93m	1.03e+05	3.37e+04	8.44e+03	0.00e+00	3.94e+04	0.00e+00	1.21e+07
Nb-95	1.69e+04	9.37e+03	5.16e+03	0.00e+00	9.08e+03	0.00e+00	4.01e+07
Nb-97	1.44e-12	3.57e-13	1.30e-13	0.00e+00	4.18e-13	0.00e+00	8.53e-09
Mo-93	0.00e+00	9.51e+07	2.60e+06	0.00e+00	2.73e+07	0.00e+00	1.16e+07
Mo-99	0.00e+00	5.37e+06	1.02e+06	0.00e+00	1.23e+07	0.00e+00	9.62e+06
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	5.35e+06	7.87e+06	2.14e+06	0.00e+00	9.99e+07	8.14e+05	1.93e+08
Tc-99m	6.96e-01	1.94e+00	2.51e+01	0.00e+00	2.89e+01	1.08e+00	1.27e+03
Ru-103	2.17e+02	0.00e+00	9.29e+01	0.00e+00	7.66e+02	0.00e+00	1.81e+04
Ru-105	1.89e-04	0.00e+00	7.35e-05	0.00e+00	2.39e-03	0.00e+00	1.53e-01
Ru-106	4.50e+03	0.00e+00	5.67e+02	0.00e+00	8.68e+03	0.00e+00	2.16e+05
Rh-105	7.66e+04	5.54e+04	3.63e+04	0.00e+00	2.35e+05	0.00e+00	7.04e+06
Pd-107	0.00e+00	2.49e+06	1.60e+05	0.00e+00	2.25e+07	0.00e+00	1.16e+07
Pd-109	0.00e+00	9.87e+03	2.24e+03	0.00e+00	5.70e+04	0.00e+00	9.95e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.16e+07	1.09e+07	6.65e+06	0.00e+00	2.08e+07	0.00e+00	3.07e+09
Ag-111	1.43e+06	5.93e+05	2.98e+05	0.00e+00	1.93e+06	0.00e+00	8.28e+08
Cd-113m	0.00e+00	6.46e+05	2.08e+04	0.00e+00	7.14e+05	0.00e+00	3.88e+06
Cd-115m	0.00e+00	2.75e+05	8.89e+03	0.00e+00	2.20e+05	0.00e+00	8.72e+06
Sn-123	1.19e+08	1.95e+06	2.88e+06	1.56e+06	0.00e+00	0.00e+00	1.79e+08
Sn-125	1.26e+07	2.50e+05	5.66e+05	1.96e+05	0.00e+00	0.00e+00	1.18e+08
Sn-126	3.47e+08	6.46e+06	9.87e+06	1.70e+06	0.00e+00	0.00e+00	7.72e+07
Sb-124	5.51e+06	1.01e+05	2.15e+06	1.25e+04	0.00e+00	4.81e+06	1.11e+08
Sb-125	4.38e+06	4.79e+04	1.03e+06	4.19e+03	0.00e+00	3.85e+06	3.41e+07
Sb-126	1.20e+06	2.46e+04	4.33e+05	6.81e+03	0.00e+00	8.64e+05	7.13e+07
Sb-127	9.88e+04	2.11e+03	3.73e+04	1.11e+03	0.00e+00	6.72e+04	1.68e+07
Te-125m	3.60e+06	1.30e+06	4.82e+05	1.01e+06	0.00e+00	0.00e+00	1.06e+07
Te-127	1.46e+02	5.17e+01	3.14e+01	1.01e+02	5.91e+02	0.00e+00	1.13e+04
Te-127m	1.01e+07	3.59e+06	1.20e+06	2.41e+06	4.10e+07	0.00e+00	2.52e+07
Te-129	6.45e-11	2.40e-11	1.57e-11	4.61e-11	2.71e-10	0.00e+00	3.53e-10
Te-129m	1.32e+07	4.90e+06	2.09e+06	4.26e+06	5.53e+07	0.00e+00	4.96e+07
Te-131	8.67e-34	3.57e-34	2.71e-34	6.68e-34	3.79e-33	0.00e+00	7.11e-35
Te-131m	7.89e+04	3.79e+04	3.16e+04	5.69e+04	3.95e+05	0.00e+00	3.04e+06
Te-132	5.15e+05	3.26e+05	3.07e+05	3.44e+05	3.13e+06	0.00e+00	1.03e+07
Te-133m	4.74e-14	2.69e-14	2.62e-14	3.76e-14	2.66e-13	0.00e+00	1.09e-13
Te-134	2.01e-19	1.29e-19	1.35e-19	1.65e-19	1.23e-18	0.00e+00	7.47e-21
I-129	1.67e+08	1.41e+08	2.35e+08	1.71e+11	2.52e+08	0.00e+00	1.64e+07
I-130	8.89e+04	2.57e+05	1.03e+05	2.10e+07	3.96e+05	0.00e+00	1.98e+05
I-131	6.45e+07	9.03e+07	4.85e+07	2.63e+10	1.55e+08	0.00e+00	1.79e+07
I-132	3.55e-02	9.30e-02	3.34e-02	3.13e+00	1.47e-01	0.00e+00	4.05e-02
I-133	8.50e+05	1.44e+06	4.40e+05	2.01e+08	2.53e+06	0.00e+00	1.09e+06
I-134	4.49e-13	1.19e-12	4.28e-13	1.98e-11	1.88e-12	0.00e+00	1.57e-14
I-135	2.75e+03	7.09e+03	2.63e+03	4.56e+05	1.12e+04	0.00e+00	7.85e+03
Cs-134	2.94e+10	6.93e+10	3.22e+10	0.00e+00	2.20e+10	8.41e+09	8.62e+08
Cs-134m	9.40e-01	1.95e+00	1.00e+00	0.00e+00	1.08e+00	1.90e-01	1.30e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	9.98e+09	9.15e+09	2.14e+09	0.00e+00	3.49e+09	1.26e+09	1.60e+08
Cs-136	1.34e+09	5.29e+09	3.55e+09	0.00e+00	2.88e+09	4.54e+08	4.26e+08
Cs-137	4.02e+10	5.34e+10	1.86e+10	0.00e+00	1.82e+10	7.06e+09	7.60e+08
Cs-138	5.29e-23	1.02e-22	5.08e-23	0.00e+00	7.49e-23	8.72e-24	4.61e-26
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	5.82e+06	7.14e+03	3.75e+05	0.00e+00	2.42e+03	4.80e+03	8.98e+06
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	6.63e-06	2.04e-06	3.36e-07	0.00e+00	0.00e+00	0.00e+00	3.61e-01
La-142	4.12e-12	1.83e-12	4.56e-13	0.00e+00	0.00e+00	0.00e+00	5.57e-08
Ce-141	1.07e+03	7.12e+02	8.17e+01	0.00e+00	3.35e+02	0.00e+00	2.04e+06
Ce-143	9.18e+00	6.68e+03	7.46e-01	0.00e+00	2.99e+00	0.00e+00	2.01e+05
Ce-144	7.90e+04	3.27e+04	4.24e+03	0.00e+00	1.95e+04	0.00e+00	1.99e+07
Pr-143	3.48e+01	1.39e+01	1.73e+00	0.00e+00	8.08e+00	0.00e+00	1.15e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	2.17e+01	2.36e+01	1.42e+00	0.00e+00	1.39e+01	0.00e+00	8.53e+04
Pm-147	6.18e+02	5.86e+01	2.39e+01	0.00e+00	1.12e+02	0.00e+00	5.58e+04
Pm-148	1.31e+01	2.13e+00	1.07e+00	0.00e+00	3.84e+00	0.00e+00	1.27e+05
Pm-148m	1.79e+02	4.54e+01	3.55e+01	0.00e+00	6.87e+01	0.00e+00	2.86e+05
Pm-149	9.45e-01	1.33e-01	5.45e-02	0.00e+00	2.53e-01	0.00e+00	1.96e+04
Pm-151	1.42e-01	2.34e-02	1.19e-02	0.00e+00	4.21e-02	0.00e+00	5.26e+03
Sm-151	5.22e+02	1.00e+02	2.36e+01	0.00e+00	1.10e+02	0.00e+00	3.41e+04
Sm-153	4.38e-01	3.63e-01	2.67e-02	0.00e+00	1.19e-01	0.00e+00	1.02e+04
Eu-152	1.46e+03	3.52e+02	3.10e+02	0.00e+00	1.63e+03	0.00e+00	1.29e+05
Eu-154	4.73e+03	6.10e+02	4.30e+02	0.00e+00	2.73e+03	0.00e+00	3.22e+05
Eu-155	1.02e+03	9.82e+01	6.08e+01	0.00e+00	3.84e+02	0.00e+00	5.63e+05
Eu-156	5.46e+01	4.09e+01	6.68e+00	0.00e+00	2.75e+01	0.00e+00	2.09e+05
Tb-160	3.18e+02	0.00e+00	3.97e+01	0.00e+00	1.26e+02	0.00e+00	2.06e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	2.14e+03	6.58e+02	4.76e+02	0.00e+00	9.63e+02	0.00e+00	1.62e+05
W-181	7.53e+03	2.43e+03	2.54e+02	0.00e+00	0.00e+00	0.00e+00	2.07e+05
W-185	2.87e+05	9.46e+04	1.00e+04	0.00e+00	0.00e+00	0.00e+00	8.17e+06
W-187	1.43e+03	1.17e+03	4.09e+02	0.00e+00	0.00e+00	0.00e+00	3.16e+05
Pb-210	1.34e+10	4.03e+09	5.19e+08	0.00e+00	1.27e+10	0.00e+00	1.75e+06
Bi-210	7.88e+04	5.39e+05	4.51e+04	0.00e+00	6.55e+06	0.00e+00	6.16e+06
Po-210	1.64e+08	3.45e+08	3.97e+07	0.00e+00	1.16e+09	0.00e+00	2.18e+07
Ra-223	2.71e+10	4.11e+07	5.40e+09	0.00e+00	1.18e+09	0.00e+00	1.30e+09
Ra-224	3.14e+09	7.50e+06	6.26e+08	0.00e+00	2.15e+08	0.00e+00	5.04e+08
Ra-225	4.20e+10	4.93e+07	8.38e+09	0.00e+00	1.41e+09	0.00e+00	1.46e+09
Ra-226	3.08e+12	7.78e+07	2.29e+12	0.00e+00	2.22e+09	0.00e+00	3.36e+09
Ra-228	1.30e+12	4.19e+07	1.44e+12	0.00e+00	1.20e+09	0.00e+00	5.68e+08
Ac-225	1.37e+04	1.86e+04	9.16e+02	0.00e+00	2.14e+03	0.00e+00	9.46e+05
Ac-227	1.22e+07	1.81e+06	7.29e+05	0.00e+00	5.26e+05	0.00e+00	5.18e+05
Th-227	6.19e+04	1.11e+03	1.79e+03	0.00e+00	6.35e+03	0.00e+00	1.82e+06
Th-228	3.98e+06	6.67e+04	1.35e+05	0.00e+00	3.75e+05	0.00e+00	3.49e+06
Th-229	8.56e+07	2.46e+06	1.42e+06	0.00e+00	1.19e+07	0.00e+00	4.95e+05
Th-230	1.29e+07	7.36e+05	3.59e+05	0.00e+00	3.58e+06	0.00e+00	3.82e+05
Th-232	1.45e+07	6.28e+05	9.75e+03	0.00e+00	3.06e+06	0.00e+00	3.25e+05
Th-234	4.07e+02	2.39e+01	1.18e+01	0.00e+00	1.36e+02	0.00e+00	4.32e+05
Pa-231	2.58e+07	9.69e+05	1.01e+06	0.00e+00	5.44e+06	0.00e+00	4.55e+05
Pa-233	2.76e+01	5.31e+00	4.74e+00	0.00e+00	2.00e+01	0.00e+00	6.06e+04
U-232	3.52e+09	0.00e+00	2.52e+08	0.00e+00	3.82e+08	0.00e+00	4.30e+07
U-233	7.42e+08	0.00e+00	4.51e+07	0.00e+00	1.74e+08	0.00e+00	3.98e+07
U-234	7.12e+08	0.00e+00	4.42e+07	0.00e+00	1.71e+08	0.00e+00	3.90e+07
U-235	6.82e+08	0.00e+00	4.15e+07	0.00e+00	1.60e+08	0.00e+00	4.95e+07
U-236	6.82e+08	0.00e+00	4.24e+07	0.00e+00	1.63e+08	0.00e+00	3.66e+07
U-237	1.25e+04	0.00e+00	3.33e+03	0.00e+00	5.14e+04	0.00e+00	3.31e+06
U-238	6.52e+08	0.00e+00	3.88e+07	0.00e+00	1.50e+08	0.00e+00	3.49e+07
Np-237	7.96e+06	5.71e+05	3.50e+05	0.00e+00	2.59e+06	0.00e+00	5.03e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 10

## Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	7.98e+00	2.14e-01	1.24e-01	0.00e+00	7.32e-01	0.00e+00	1.57e+04
Np-239	8.42e-01	7.94e-02	4.41e-02	0.00e+00	2.49e-01	0.00e+00	1.28e+04
Pu-238	1.60e+06	2.05e+05	4.35e+04	0.00e+00	1.87e+05	0.00e+00	1.85e+05
Pu-239	1.83e+06	2.22e+05	4.81e+04	0.00e+00	2.05e+05	0.00e+00	1.69e+05
Pu-240	1.83e+06	2.22e+05	4.81e+04	0.00e+00	2.05e+05	0.00e+00	1.72e+05
Pu-241	4.18e+04	2.00e+03	8.81e+02	0.00e+00	4.08e+03	0.00e+00	3.53e+03
Pu-242	1.70e+06	2.14e+05	4.64e+04	0.00e+00	1.97e+05	0.00e+00	1.66e+05
Pu-244	1.98e+06	2.44e+05	5.31e+04	0.00e+00	2.26e+05	0.00e+00	2.47e+05
Am-241	4.73e+06	4.46e+06	3.41e+05	0.00e+00	2.55e+06	0.00e+00	4.66e+05
Am-242m	4.83e+06	4.25e+06	3.47e+05	0.00e+00	2.57e+06	0.00e+00	5.92e+05
Am-243	4.76e+06	4.40e+06	3.36e+05	0.00e+00	2.52e+06	0.00e+00	5.52e+05
Cm-242	1.61e+05	1.69e+05	1.07e+04	0.00e+00	4.86e+04	0.00e+00	4.59e+05
Cm-243	3.88e+06	3.60e+06	2.44e+05	0.00e+00	1.14e+06	0.00e+00	4.95e+05
Cm-244	3.01e+06	2.85e+06	1.90e+05	0.00e+00	8.89e+05	0.00e+00	4.78e+05
Cm-245	5.92e+06	5.21e+06	3.65e+05	0.00e+00	1.71e+06	0.00e+00	4.46e+05
Cm-246	5.88e+06	5.21e+06	3.64e+05	0.00e+00	1.70e+06	0.00e+00	4.39e+05
Cm-247	5.73e+06	5.13e+06	3.59e+05	0.00e+00	1.68e+06	0.00e+00	5.76e+05
Cm-248	4.76e+07	4.22e+07	2.96e+06	0.00e+00	1.38e+07	0.00e+00	9.27e+06
Cf-252	2.04e+06	0.00e+00	4.92e+04	0.00e+00	0.00e+00	0.00e+00	1.79e+06

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Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.83e+03	1.83e+03	1.83e+03	1.83e+03	1.83e+03	1.83e+03
Be-10	1.33e+06	1.55e+05	3.35e+04	0.00e+00	1.10e+05	0.00e+00	2.71e+06
C-14	1.19e+09	2.39e+08	2.39e+08	2.39e+08	2.39e+08	2.39e+08	2.39e+08
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	2.37e-03	0.00e+00	2.35e-04	0.00e+00	0.00e+00	0.00e+00	6.41e-04
Na-22	2.28e+09	2.28e+09	2.28e+09	2.28e+09	2.28e+09	2.28e+09	2.28e+09
Na-24	1.07e+06	1.07e+06	1.07e+06	1.07e+06	1.07e+06	1.07e+06	1.07e+06
P-32	9.33e+10	4.37e+09	3.60e+09	0.00e+00	0.00e+00	0.00e+00	2.58e+09
Ca-41	2.74e+09	0.00e+00	2.99e+08	0.00e+00	0.00e+00	0.00e+00	1.50e+06
Sc-46	8.20e+01	1.12e+02	4.33e+01	0.00e+00	9.94e+01	0.00e+00	1.64e+05
Cr-51	0.00e+00	0.00e+00	1.22e+04	6.78e+03	1.85e+03	1.24e+04	6.48e+05
Mn-54	0.00e+00	2.52e+06	6.70e+05	0.00e+00	7.06e+05	0.00e+00	2.11e+06
Mn-56	0.00e+00	1.54e-03	3.48e-04	0.00e+00	1.86e-03	0.00e+00	2.23e-01
Fe-55	1.45e+06	7.71e+05	2.39e+05	0.00e+00	0.00e+00	4.36e+05	1.43e+05
Fe-59	1.56e+06	2.53e+06	1.26e+06	0.00e+00	0.00e+00	7.33e+05	2.63e+06
Co-57	0.00e+00	4.60e+05	9.32e+05	0.00e+00	0.00e+00	0.00e+00	3.77e+06
Co-58	0.00e+00	1.45e+06	4.45e+06	0.00e+00	0.00e+00	0.00e+00	8.49e+06
Co-60	0.00e+00	5.18e+06	1.53e+07	0.00e+00	0.00e+00	0.00e+00	2.87e+07
Ni-59	2.66e+08	7.08e+07	4.51e+07	0.00e+00	0.00e+00	0.00e+00	4.70e+06
Ni-63	3.56e+09	1.90e+08	1.21e+08	0.00e+00	0.00e+00	0.00e+00	1.28e+07
Ni-65	2.02e-01	1.90e-02	1.11e-02	0.00e+00	0.00e+00	0.00e+00	2.33e+00
Cu-64	0.00e+00	8.34e+03	5.04e+03	0.00e+00	2.02e+04	0.00e+00	3.92e+05
Zn-65	4.96e+08	1.32e+09	8.22e+08	0.00e+00	8.33e+08	0.00e+00	2.32e+08
Zn-69	1.18e-12	1.71e-12	1.58e-13	0.00e+00	1.04e-12	0.00e+00	1.08e-10
Zn-69m	9.68e+04	1.65e+05	1.95e+04	0.00e+00	9.58e+04	0.00e+00	5.37e+06
Se-79	0.00e+00	3.75e+08	8.31e+07	0.00e+00	6.09e+08	0.00e+00	2.46e+07
Br-82	0.00e+00	0.00e+00	1.38e+07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	5.36e-02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	8.40e-24	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

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Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.05e+09	6.47e+08	0.00e+00	0.00e+00	0.00e+00	6.77e+07
Rb-87	0.00e+00	1.17e+09	5.42e+08	0.00e+00	0.00e+00	0.00e+00	1.75e+07
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	1.39e+10	0.00e+00	3.97e+08	0.00e+00	0.00e+00	0.00e+00	5.38e+08
Sr-90	3.53e+11	0.00e+00	7.11e+09	0.00e+00	0.00e+00	0.00e+00	3.16e+09
Sr-91	2.75e+05	0.00e+00	1.04e+04	0.00e+00	0.00e+00	0.00e+00	6.07e+05
Sr-92	4.65e+00	0.00e+00	1.86e-01	0.00e+00	0.00e+00	0.00e+00	8.81e+01
Y-90	3.87e+01	0.00e+00	1.04e+00	0.00e+00	0.00e+00	0.00e+00	1.10e+05
Y-91	4.68e+03	0.00e+00	1.25e+02	0.00e+00	0.00e+00	0.00e+00	6.24e+05
Y-91m	3.36e-20	0.00e+00	1.22e-21	0.00e+00	0.00e+00	0.00e+00	6.59e-17
Y-92	3.07e-05	0.00e+00	8.78e-07	0.00e+00	0.00e+00	0.00e+00	8.87e-01
Y-93	1.22e-01	0.00e+00	3.35e-03	0.00e+00	0.00e+00	0.00e+00	1.82e+03
Zr-93	8.24e+02	3.09e+01	2.20e+01	0.00e+00	1.19e+02	0.00e+00	1.17e+04
Zr-95	4.60e+02	1.01e+02	9.00e+01	0.00e+00	1.45e+02	0.00e+00	1.05e+05
Zr-97	2.31e-01	3.33e-02	1.97e-02	0.00e+00	4.79e-02	0.00e+00	5.05e+03
Nb-93m	2.58e+05	6.45e+04	2.12e+04	0.00e+00	6.96e+04	0.00e+00	9.72e+06
Nb-95	3.81e+04	1.49e+04	1.06e+04	0.00e+00	1.40e+04	0.00e+00	2.75e+07
Nb-97	3.49e-12	6.31e-13	2.95e-13	0.00e+00	7.00e-13	0.00e+00	1.95e-07
Mo-93	0.00e+00	1.78e+08	6.40e+06	0.00e+00	4.70e+07	0.00e+00	9.03e+06
Mo-99	0.00e+00	9.77e+06	2.42e+06	0.00e+00	2.09e+07	0.00e+00	8.08e+06
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	1.32e+07	1.47e+07	5.28e+06	0.00e+00	1.73e+08	1.30e+06	1.54e+08
Tc-99m	1.60e+00	3.13e+00	5.19e+01	0.00e+00	4.55e+01	1.59e+00	1.78e+03
Ru-103	5.14e+02	0.00e+00	1.98e+02	0.00e+00	1.29e+03	0.00e+00	1.33e+04
Ru-105	4.62e-04	0.00e+00	1.68e-04	0.00e+00	4.06e-03	0.00e+00	3.02e-01
Ru-106	1.11e+04	0.00e+00	1.38e+03	0.00e+00	1.50e+04	0.00e+00	1.72e+05
Rh-105	1.88e+05	1.01e+05	8.62e+04	0.00e+00	4.02e+05	0.00e+00	6.25e+06
Pd-107	0.00e+00	4.66e+06	3.96e+05	0.00e+00	3.90e+07	0.00e+00	9.25e+06
Pd-109	0.00e+00	1.84e+04	5.51e+03	0.00e+00	9.86e+04	0.00e+00	1.09e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	2.51e+07	1.69e+07	1.35e+07	0.00e+00	3.15e+07	0.00e+00	2.01e+09
Ag-111	3.53e+06	1.10e+06	7.29e+05	0.00e+00	3.33e+06	0.00e+00	6.76e+08
Cd-113m	0.00e+00	1.20e+06	5.13e+04	0.00e+00	1.24e+06	0.00e+00	3.11e+06
Cd-115m	0.00e+00	5.15e+05	2.19e+04	0.00e+00	3.83e+05	0.00e+00	7.00e+06
Sn-123	2.93e+08	3.63e+06	7.14e+06	3.85e+06	0.00e+00	0.00e+00	1.44e+08
Sn-125	3.09e+07	4.66e+05	1.38e+06	4.83e+05	0.00e+00	0.00e+00	9.57e+07
Sn-126	8.22e+08	1.02e+07	2.33e+07	2.81e+06	0.00e+00	0.00e+00	6.17e+07
Sb-124	1.30e+07	1.69e+05	4.57e+06	2.88e+04	0.00e+00	7.23e+06	8.15e+07
Sb-125	1.04e+07	8.05e+04	2.19e+06	9.67e+03	0.00e+00	5.82e+06	2.49e+07
Sb-126	2.75e+06	4.21e+04	9.88e+05	1.61e+04	0.00e+00	1.31e+06	5.55e+07
Sb-127	2.38e+05	3.68e+03	8.26e+04	2.65e+03	0.00e+00	1.03e+05	1.34e+07
Te-125m	8.85e+06	2.40e+06	1.18e+06	2.48e+06	0.00e+00	0.00e+00	8.54e+06
Te-127	3.59e+02	9.67e+01	7.69e+01	2.48e+02	1.02e+03	0.00e+00	1.40e+04
Te-127m	2.50e+07	6.72e+06	2.96e+06	5.97e+06	7.12e+07	0.00e+00	2.02e+07
Te-129	1.59e-10	4.44e-11	3.78e-11	1.14e-10	4.65e-10	0.00e+00	9.90e-09
Te-129m	3.26e+07	9.09e+06	5.06e+06	1.05e+07	9.56e+07	0.00e+00	3.97e+07
Te-131	2.13e-33	6.48e-34	6.33e-34	1.63e-33	6.43e-33	0.00e+00	1.12e-32
Te-131m	1.92e+05	6.65e+04	7.07e+04	1.37e+05	6.43e+05	0.00e+00	2.70e+06
Te-132	1.23e+06	5.44e+05	6.58e+05	7.93e+05	5.05e+06	0.00e+00	5.48e+06
Te-133m	1.13e-13	4.59e-14	5.69e-14	8.80e-14	4.36e-13	0.00e+00	3.50e-12
Te-134	4.79e-19	2.15e-19	2.87e-19	3.78e-19	1.99e-18	0.00e+00	2.19e-18
I-129	4.12e+08	2.53e+08	2.26e+08	1.65e+11	4.26e+08	0.00e+00	1.27e+07
I-130	2.08e+05	4.20e+05	2.16e+05	4.63e+07	6.28e+05	0.00e+00	1.97e+05
I-131	1.56e+08	1.57e+08	8.94e+07	5.20e+10	2.58e+08	0.00e+00	1.40e+07
I-132	8.41e-02	1.54e-01	7.10e-02	7.17e+00	2.36e-01	0.00e+00	1.82e-01
I-133	2.06e+06	2.55e+06	9.66e+05	4.74e+08	4.25e+06	0.00e+00	1.03e+06
I-134	1.06e-12	1.98e-12	9.09e-13	4.54e-11	3.02e-12	0.00e+00	1.31e-12
I-135	6.52e+03	1.17e+04	5.55e+03	1.04e+06	1.80e+04	0.00e+00	8.94e+03
Cs-134	6.79e+10	1.11e+11	2.35e+10	0.00e+00	3.45e+10	1.24e+10	6.01e+08
Cs-134m	2.23e+00	3.30e+00	2.15e+00	0.00e+00	1.74e+00	2.88e-01	4.17e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	2.46e+10	1.71e+10	1.76e+09	0.00e+00	6.04e+09	2.02e+09	1.28e+08
Cs-136	3.04e+09	8.34e+09	5.40e+09	0.00e+00	4.44e+09	6.63e+08	2.93e+08
Cs-137	9.67e+10	9.26e+10	1.37e+10	0.00e+00	3.02e+10	1.09e+10	5.80e+08
Cs-138	1.28e-22	1.78e-22	1.13e-22	0.00e+00	1.25e-22	1.35e-23	8.21e-23
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	1.41e+07	1.23e+04	8.20e+05	0.00e+00	4.01e+03	7.34e+03	7.12e+06
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
La-140	2.33e+00	8.15e-01	2.75e-01	0.00e+00	0.00e+00	0.00e+00	2.27e+04
La-141	1.63e-05	3.81e-06	8.27e-07	0.00e+00	0.00e+00	0.00e+00	8.47e-01
La-142	9.95e-12	3.17e-12	9.94e-13	0.00e+00	0.00e+00	0.00e+00	6.29e-07
Ce-141	2.62e+03	1.31e+03	1.94e+02	0.00e+00	5.74e+02	0.00e+00	1.63e+06
Ce-143	2.25e+01	1.22e+04	1.77e+00	0.00e+00	5.12e+00	0.00e+00	1.79e+05
Ce-144	1.95e+05	6.10e+04	1.04e+04	0.00e+00	3.38e+04	0.00e+00	1.59e+07
Pr-143	8.62e+01	2.59e+01	4.28e+00	0.00e+00	1.40e+01	0.00e+00	9.30e+04
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	5.34e+01	4.32e+01	3.35e+00	0.00e+00	2.37e+01	0.00e+00	6.85e+04
Pm-147	1.54e+03	1.10e+02	5.93e+01	0.00e+00	1.95e+02	0.00e+00	4.46e+04
Pm-148	3.19e+01	3.84e+00	2.48e+00	0.00e+00	6.52e+00	0.00e+00	1.03e+05
Pm-148m	3.67e+02	7.31e+01	7.31e+01	0.00e+00	1.08e+02	0.00e+00	2.06e+05
Pm-149	2.33e+00	2.48e-01	1.34e-01	0.00e+00	4.38e-01	0.00e+00	1.69e+04
Pm-151	3.46e-01	4.21e-02	2.74e-02	0.00e+00	7.13e-02	0.00e+00	4.78e+03
Sm-151	1.26e+03	1.88e+02	5.92e+01	0.00e+00	1.94e+02	0.00e+00	2.73e+04
Sm-153	1.08e+00	6.73e-01	6.49e-02	0.00e+00	2.05e-01	0.00e+00	8.95e+03
Eu-152	3.03e+03	5.51e+02	6.54e+02	0.00e+00	2.33e+03	0.00e+00	9.05e+04
Eu-154	1.14e+04	1.02e+03	9.33e+02	0.00e+00	4.49e+03	0.00e+00	2.37e+05
Eu-155	2.32e+03	1.67e+02	1.31e+02	0.00e+00	6.27e+02	0.00e+00	4.19e+05
Eu-156	1.32e+02	7.06e+01	1.46e+01	0.00e+00	4.55e+01	0.00e+00	1.60e+05
Tb-160	6.73e+02	0.00e+00	8.35e+01	0.00e+00	2.00e+02	0.00e+00	1.49e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	5.33e+03	1.12e+03	9.43e+02	0.00e+00	1.59e+03	0.00e+00	1.30e+05
W-181	1.85e+04	4.55e+03	6.25e+02	0.00e+00	0.00e+00	0.00e+00	1.66e+05
W-185	7.07e+05	1.76e+05	2.47e+04	0.00e+00	0.00e+00	0.00e+00	6.58e+06
W-187	3.47e+03	2.06e+03	9.22e+02	0.00e+00	0.00e+00	0.00e+00	2.89e+05
Pb-210	2.90e+10	7.45e+09	1.28e+09	0.00e+00	2.24e+10	0.00e+00	1.40e+06
Bi-210	1.94e+05	1.01e+06	1.11e+05	0.00e+00	1.13e+07	0.00e+00	5.10e+06
Po-210	4.05e+08	6.47e+08	9.77e+07	0.00e+00	2.01e+09	0.00e+00	1.74e+07
Ra-223	6.65e+10	7.69e+07	1.33e+10	0.00e+00	2.04e+09	0.00e+00	1.06e+09
Ra-224	7.72e+09	1.40e+07	1.55e+09	0.00e+00	3.71e+08	0.00e+00	4.24e+08
Ra-225	1.03e+11	9.24e+07	2.07e+10	0.00e+00	2.45e+09	0.00e+00	1.19e+09
Ra-226	4.54e+12	1.45e+08	3.73e+12	0.00e+00	3.85e+09	0.00e+00	2.69e+09
Ra-228	3.02e+12	7.83e+07	3.39e+12	0.00e+00	2.08e+09	0.00e+00	4.56e+08
Ac-225	3.37e+04	3.47e+04	2.26e+03	0.00e+00	3.71e+03	0.00e+00	7.72e+05
Ac-227	2.03e+07	3.27e+06	1.26e+06	0.00e+00	7.19e+05	0.00e+00	4.15e+05
Th-227	1.53e+05	2.08e+03	4.41e+03	0.00e+00	1.10e+04	0.00e+00	1.47e+06
Th-228	1.00e+07	1.28e+05	3.38e+05	0.00e+00	6.66e+05	0.00e+00	2.80e+06
Th-229	1.16e+08	2.92e+06	1.93e+06	0.00e+00	1.43e+07	0.00e+00	3.97e+05
Th-230	1.75e+07	8.79e+05	4.89e+05	0.00e+00	4.28e+06	0.00e+00	3.06e+05
Th-232	1.95e+07	7.50e+05	1.49e+04	0.00e+00	3.66e+06	0.00e+00	2.60e+05
Th-234	1.01e+03	4.45e+01	2.91e+01	0.00e+00	2.36e+02	0.00e+00	3.48e+05
Pa-231	3.49e+07	1.16e+06	1.39e+06	0.00e+00	6.32e+06	0.00e+00	3.64e+05
Pa-233	5.62e+01	8.76e+00	9.81e+00	0.00e+00	3.23e+01	0.00e+00	4.47e+04
U-232	8.68e+09	0.00e+00	6.22e+08	0.00e+00	6.61e+08	0.00e+00	3.44e+07
U-233	1.84e+09	0.00e+00	1.11e+08	0.00e+00	3.01e+08	0.00e+00	3.18e+07
U-234	1.76e+09	0.00e+00	1.09e+08	0.00e+00	2.95e+08	0.00e+00	3.12e+07
U-235	1.69e+09	0.00e+00	1.02e+08	0.00e+00	2.77e+08	0.00e+00	3.96e+07
U-236	1.69e+09	0.00e+00	1.05e+08	0.00e+00	2.83e+08	0.00e+00	2.92e+07
U-237	3.09e+04	0.00e+00	8.20e+03	0.00e+00	8.90e+04	0.00e+00	2.72e+06
U-238	1.61e+09	0.00e+00	9.58e+07	0.00e+00	2.59e+08	0.00e+00	2.79e+07
Np-237	1.10e+07	7.26e+05	4.83e+05	0.00e+00	2.99e+06	0.00e+00	4.03e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.97e+01	3.98e-01	3.07e-01	0.00e+00	1.27e+00	0.00e+00	1.36e+04
Np-239	2.07e+00	1.49e-01	1.05e-01	0.00e+00	4.30e-01	0.00e+00	1.10e+04
Pu-238	2.35e+06	2.72e+05	6.24e+04	0.00e+00	2.27e+05	0.00e+00	1.48e+05
Pu-239	2.55e+06	2.72e+05	6.54e+04	0.00e+00	2.41e+05	0.00e+00	1.35e+05
Pu-240	2.53e+06	2.82e+05	6.54e+04	0.00e+00	2.41e+05	0.00e+00	1.38e+05
Pu-241	7.62e+04	3.11e+03	1.58e+03	0.00e+00	5.83e+03	0.00e+00	2.84e+03
Pu-242	2.35e+06	2.72e+05	6.30e+04	0.00e+00	2.31e+05	0.00e+00	1.32e+05
Pu-244	2.74e+06	3.12e+06	7.21e+04	0.00e+00	2.67e+05	0.00e+00	1.97e+05
Am-241	6.65e+06	5.72e+06	4.99e+05	0.00e+00	3.05e+06	0.00e+00	3.73e+05
Am-242m	6.91e+06	5.53e+06	5.13e+05	0.00e+00	3.11e+06	0.00e+00	4.74e+05
Am-243	6.61e+06	5.58e+06	4.85e+05	0.00e+00	2.99e+06	0.00e+00	4.42e+05
Cm-242	3.96e+05	3.16e+05	2.63e+04	0.00e+00	8.43e+04	0.00e+00	3.68e+05
Cm-243	6.31e+06	5.13e+06	4.06e+05	0.00e+00	1.52e+06	0.00e+00	3.96e+05
Cm-244	5.32e+06	4.30e+06	3.41e+05	0.00e+00	1.25e+06	0.00e+00	3.83e+05
Cm-245	8.24e+06	6.61e+06	5.18e+05	0.00e+00	2.03e+06	0.00e+00	3.57e+05
Cm-246	8.14e+06	6.61e+06	5.18e+05	0.00e+00	2.02e+06	0.00e+00	3.51e+05
Cm-247	7.95e+06	6.52e+06	5.08e+05	0.00e+00	1.99e+06	0.00e+00	4.62e+05
Cm-248	6.61e+07	5.38e+07	4.21e+06	0.00e+00	1.64e+07	0.00e+00	7.45e+06
Cf-252	5.10e+06	0.00e+00	1.23e+05	0.00e+00	0.00e+00	0.00e+00	1.44e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	2.78e+03	2.78e+03	2.78e+03	2.78e+03	2.78e+03	2.78e+03
Be-10	1.69e+06	2.46e+05	5.09e+04	0.00e+00	1.62e+05	0.00e+00	2.74e+06
C-14	2.34e+09	5.00e+08	5.00e+08	5.00e+08	5.00e+08	5.00e+08	5.00e+08
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	4.94e-03	0.00e+00	4.22e-04	0.00e+00	0.00e+00	0.00e+00	1.16e-03
Na-22	3.82e+09	3.82e+09	3.82e+09	3.82e+09	3.82e+09	3.82e+09	3.82e+09
Na-24	1.85e+06	1.85e+06	1.85e+06	1.85e+06	1.85e+06	1.85e+06	1.85e+06
P-32	1.92e+11	1.13e+10	7.46e+09	0.00e+00	0.00e+00	0.00e+00	2.60e+09
Ca-41	2.95e+09	0.00e+00	3.22e+08	0.00e+00	0.00e+00	0.00e+00	1.51e+06
Sc-46	1.56e+02	2.25e+02	7.03e+01	0.00e+00	1.48e+02	0.00e+00	1.47e+05
Cr-51	0.00e+00	0.00e+00	1.94e+04	1.26e+04	2.76e+03	2.46e+04	5.64e+05
Mn-54	0.00e+00	4.68e+06	1.06e+06	0.00e+00	1.04e+06	0.00e+00	1.72e+06
Mn-56	0.00e+00	3.77e-03	6.50e-04	0.00e+00	3.24e-03	0.00e+00	3.43e-01
Fe-55	1.76e+06	1.13e+06	3.03e+05	0.00e+00	0.00e+00	5.55e+05	1.44e+05
Fe-59	2.92e+06	5.10e+06	2.01e+06	0.00e+00	0.00e+00	1.51e+06	2.43e+06
Co-57	0.00e+00	1.07e+06	1.75e+06	0.00e+00	0.00e+00	0.00e+00	3.66e+06
Co-58	0.00e+00	2.91e+06	7.26e+06	0.00e+00	0.00e+00	0.00e+00	7.25e+06
Co-60	0.00e+00	1.06e+07	2.50e+07	0.00e+00	0.00e+00	0.00e+00	2.52e+07
Ni-59	3.13e+08	9.59e+07	5.40e+07	0.00e+00	0.00e+00	0.00e+00	4.74e+06
Ni-63	4.19e+09	2.59e+08	1.45e+08	0.00e+00	0.00e+00	0.00e+00	1.29e+07
Ni-65	4.27e-01	4.83e-02	2.20e-02	0.00e+00	0.00e+00	0.00e+00	3.68e+00
Cu-64	0.00e+00	2.07e+04	9.60e+03	0.00e+00	3.51e+04	0.00e+00	4.26e+05
Zn-65	6.66e+08	2.28e+09	1.05e+09	0.00e+00	1.11e+09	0.00e+00	1.93e+09
Zn-69	2.52e-12	4.54e-12	3.38e-13	0.00e+00	1.89e-12	0.00e+00	3.70e-10
Zn-69m	2.04e+05	4.17e+05	3.80e+04	0.00e+00	1.69e+05	0.00e+00	5.78e+06
Se-79	0.00e+00	9.33e+08	1.73e+08	0.00e+00	1.08e+09	0.00e+00	2.48e+07
Br-82	0.00e+00	0.00e+00	2.32e+07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	1.14e-01	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	1.62e-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 10

## Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.67e+09	1.32e+09	0.00e+00	0.00e+00	0.00e+00	6.83e+07
Rb-87	0.00e+00	2.63e+09	1.04e+09	0.00e+00	0.00e+00	0.00e+00	1.77e+07
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	2.64e+10	0.00e+00	7.58e+08	0.00e+00	0.00e+00	0.00e+00	5.43e+08
Sr-90	3.91e+11	0.00e+00	7.92e+09	0.00e+00	0.00e+00	0.00e+00	3.19e+09
Sr-91	5.73e+05	0.00e+00	2.07e+04	0.00e+00	0.00e+00	0.00e+00	6.78e+05
Sr-92	9.89e+00	0.00e+00	3.67e-01	0.00e+00	0.00e+00	0.00e+00	1.07e+02
Y-90	8.18e+01	0.00e+00	2.19e+00	0.00e+00	0.00e+00	0.00e+00	1.13e+05
Y-91	8.79e+03	0.00e+00	2.34e+02	0.00e+00	0.00e+00	0.00e+00	6.30e+05
Y-91m	7.13e-20	0.00e+00	2.43e-21	0.00e+00	0.00e+00	0.00e+00	2.38e-16
Y-92	6.52e-05	0.00e+00	1.83e-06	0.00e+00	0.00e+00	0.00e+00	1.24e+00
Y-93	2.60e-01	0.00e+00	7.08e-03	0.00e+00	0.00e+00	0.00e+00	2.05e+03
Zr-93	9.53e+02	4.54e+01	2.73e+01	0.00e+00	1.34e+02	0.00e+00	1.18e+04
Zr-95	8.16e+02	1.99e+02	1.41e+02	0.00e+00	2.14e+02	0.00e+00	9.91e+04
Zr-97	4.89e-01	8.38e-02	3.83e-02	0.00e+00	8.45e-02	0.00e+00	5.35e+03
Nb-93m	3.03e+05	8.19e+04	2.56e+04	0.00e+00	8.00e+04	0.00e+00	9.79e+06
Nb-95	7.12e+04	2.93e+04	1.70e+04	0.00e+00	2.10e+04	0.00e+00	2.48e+07
Nb-97	7.39e-12	1.58e-12	5.68e-13	0.00e+00	1.23e-12	0.00e+00	4.97e-07
Mo-93	0.00e+00	4.18e+08	1.35e+07	0.00e+00	8.37e+07	0.00e+00	8.96e+06
Mo-99	0.00e+00	2.50e+07	4.87e+06	0.00e+00	3.73e+07	0.00e+00	8.23e+06
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	2.67e+07	3.60e+07	1.12e+07	0.00e+00	3.04e+08	3.50e+06	1.56e+08
Tc-99m	3.32e+00	6.84e+00	8.82e+01	0.00e+00	7.36e+01	3.58e+00	1.99e+03
Ru-103	1.04e+03	0.00e+00	3.48e+02	0.00e+00	2.17e+03	0.00e+00	1.27e+04
Ru-105	9.75e-04	0.00e+00	3.28e-04	0.00e+00	7.17e-03	0.00e+00	3.88e-01
Ru-106	2.28e+04	0.00e+00	2.85e+03	0.00e+00	2.70e+04	0.00e+00	1.73e+05
Rh-105	3.98e+05	2.60e+05	1.75e+05	0.00e+00	7.23e+05	0.00e+00	6.47e+06
Pd-107	0.00e+00	1.17e+07	8.34e+05	0.00e+00	6.70e+07	0.00e+00	9.34e+06
Pd-109	0.00e+00	4.86e+04	1.17e+04	0.00e+00	1.79e+05	0.00e+00	1.19e+06

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Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	4.63e+07	3.38e+07	2.24e+07	0.00e+00	4.83e+07	0.00e+00	1.75e+09
Ag-111	7.40e+06	2.88e+06	1.52e+06	0.00e+00	6.01e+06	0.00e+00	6.86e+08
Cd-113m	0.00e+00	2.09e+06	7.70e+04	0.00e+00	1.58e+06	0.00e+00	3.14e+06
Cd-115m	0.00e+00	1.24e+06	4.31e+04	0.00e+00	6.48e+05	0.00e+00	7.07e+06
Sn-123	5.48e+08	8.57e+06	1.43e+07	8.61e+06	0.00e+00	0.00e+00	1.45e+08
Sn-125	6.45e+07	1.20e+06	2.86e+06	1.18e+06	0.00e+00	0.00e+00	9.66e+07
Sn-126	1.36e+09	1.79e+07	4.44e+07	4.71e+06	0.00e+00	0.00e+00	6.22e+07
Sb-124	2.51e+07	3.70e+05	7.78e+06	6.67e+04	0.00e+00	1.57e+07	7.75e+07
Sb-125	1.79e+07	1.74e+05	3.69e+06	2.25e+04	0.00e+00	1.04e+07	2.39e+07
Sb-126	5.04e+06	9.88e+04	1.82e+06	3.87e+04	0.00e+00	3.17e+06	5.22e+07
Sb-127	5.01e+05	8.93e+03	1.55e+05	6.37e+03	0.00e+00	2.58e+05	1.33e+07
Te-125m	1.81e+07	6.05e+06	2.45e+06	6.09e+06	0.00e+00	0.00e+00	8.62e+06
Te-127	7.61e+02	2.55e+02	1.64e+02	6.20e+02	1.86e+03	0.00e+00	1.60e+04
Te-127m	5.05e+07	1.68e+07	6.12e+06	1.46e+07	1.24e+08	0.00e+00	2.04e+07
Te-129	3.37e-10	1.16e-10	7.87e-11	2.83e-10	8.40e-10	0.00e+00	2.70e-08
Te-129m	6.69e+07	2.29e+07	1.03e+07	2.57e+07	1.67e+08	0.00e+00	3.99e+07
Te-131	4.51e-33	1.67e-33	1.27e-33	4.02e-33	1.15e-32	0.00e+00	1.82e-31
Te-131m	4.06e+05	1.63e+05	1.35e+05	3.31e+05	1.12e+06	0.00e+00	2.75e+06
Te-132	2.53e+06	1.25e+06	1.17e+06	1.85e+06	7.84e+06	0.00e+00	4.64e+06
Te-133m	2.37e-13	1.09e-13	1.04e-13	2.09e-13	7.40e-13	0.00e+00	1.17e-11
Te-134	9.91e-19	4.97e-19	5.12e-19	8.87e-19	3.35e-18	0.00e+00	1.14e-17
I-129	8.47e+08	6.28e+08	4.59e+08	4.03e+11	7.43e+08	0.00e+00	1.26e+07
I-130	4.27e+05	9.40e+05	3.77e+05	1.05e+08	1.03e+06	0.00e+00	2.01e+05
I-131	3.26e+08	3.85e+08	1.69e+08	1.26e+11	4.49e+08	0.00e+00	1.37e+07
I-132	1.74e-01	3.54e-01	1.26e-01	1.66e+01	3.95e-01	0.00e+00	2.87e-01
I-133	4.36e+06	6.35e+06	1.86e+06	1.15e+09	7.46e+06	0.00e+00	1.07e+06
I-134	2.21e-12	4.52e-12	1.61e-12	1.05e-10	5.05e-12	0.00e+00	4.67e-12
I-135	1.36e+04	2.70e+04	9.83e+03	2.42e+06	3.00e+04	0.00e+00	9.76e+03
Cs-134	1.09e+11	2.04e+11	2.06e+10	0.00e+00	5.25e+10	2.15e+10	5.54e+08
Cs-134m	4.64e+00	7.73e+00	3.90e+00	0.00e+00	2.98e+00	6.86e-01	6.12e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 10

## Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	3.94e+10	3.58e+10	1.87e+09	0.00e+00	1.02e+10	3.88e+09	1.29e+08
Cs-136	5.93e+09	1.74e+10	6.51e+09	0.00e+00	6.95e+09	1.42e+09	2.65e+08
Cs-137	1.54e+11	1.81e+11	1.28e+10	0.00e+00	4.85e+10	1.96e+10	5.65e+08
Cs-138	2.70e-22	4.40e-22	2.13e-22	0.00e+00	2.19e-22	3.42e-23	7.03e-22
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	2.89e+07	2.89e+04	1.49e+06	0.00e+00	6.87e+03	1.78e+04	7.10e+06
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	3.47e-05	1.01e-05	1.75e-06	0.00e+00	0.00e+00	0.00e+00	1.15e+00
La-142	2.09e-11	7.67e-12	1.84e-12	0.00e+00	0.00e+00	0.00e+00	1.30e-06
Ce-141	5.20e+03	3.17e+03	3.74e+02	0.00e+00	9.79e+02	0.00e+00	1.64e+06
Ce-143	4.77e+01	3.16e+04	3.61e+00	0.00e+00	9.21e+00	0.00e+00	1.85e+05
Ce-144	2.79e+05	1.14e+05	1.56e+04	0.00e+00	4.62e+04	0.00e+00	1.60e+07
Pr-143	1.78e+02	6.67e+01	8.84e+00	0.00e+00	2.48e+01	0.00e+00	9.41e+04
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	1.06e+02	1.09e+02	6.65e+00	0.00e+00	4.19e+01	0.00e+00	6.88e+04
Pm-147	1.88e+03	1.59e+02	7.72e+01	0.00e+00	2.37e+02	0.00e+00	4.50e+04
Pm-148	6.68e+01	9.65e+00	4.86e+00	0.00e+00	1.15e+01	0.00e+00	1.03e+05
Pm-148m	5.88e+02	1.49e+02	1.17e+02	0.00e+00	1.71e+02	0.00e+00	1.94e+05
Pm-149	4.96e+00	6.50e-01	2.84e-01	0.00e+00	7.91e-01	0.00e+00	1.75e+04
Pm-151	7.32e-01	1.07e-01	5.40e-02	0.00e+00	1.27e-01	0.00e+00	4.94e+03
Sm-151	1.43e+03	3.29e+02	7.10e+01	0.00e+00	2.24e+02	0.00e+00	2.75e+04
Sm-153	2.29e+00	1.77e+00	1.36e-01	0.00e+00	3.71e-01	0.00e+00	9.25e+03
Eu-152	3.32e+03	8.81e+02	7.43e+02	0.00e+00	2.47e+03	0.00e+00	7.82e+04
Eu-154	1.30e+04	1.81e+03	1.09e+03	0.00e+00	4.91e+03	0.00e+00	2.26e+05
Eu-155	2.61e+03	3.01e+02	1.56e+02	0.00e+00	6.75e+02	0.00e+00	4.04e+05
Eu-156	2.67e+02	1.66e+02	2.63e+01	0.00e+00	7.65e+01	0.00e+00	1.56e+05
Tb-160	1.05e+03	0.00e+00	1.31e+02	0.00e+00	2.99e+02	0.00e+00	1.40e+05

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 10

Goat's Milk Pathway Dose Factors Due to Radionuclides Other Than Noble Gases, Rj

Ri factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Gaseous Release Goat's Milk Pathway Ri

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	6.17e+03	1.33e+03	1.05e+03	0.00e+00	1.76e+03	0.00e+00	1.31e+05
W-181	3.87e+04	1.19e+04	1.33e+03	0.00e+00	0.00e+00	0.00e+00	1.67e+05
W-185	1.48e+06	4.62e+05	5.27e+04	0.00e+00	0.00e+00	0.00e+00	6.62e+06
W-187	7.31e+03	5.08e+03	1.76e+03	0.00e+00	0.00e+00	0.00e+00	2.99e+05
Pb-210	3.23e+10	8.67e+09	1.45e+09	0.00e+00	2.64e+10	0.00e+00	1.42e+06
Bi-210	4.10e+05	2.64e+06	2.36e+05	0.00e+00	2.05e+07	0.00e+00	5.20e+06
Po-210	8.25e+08	1.58e+09	1.97e+08	0.00e+00	3.35e+09	0.00e+00	1.76e+07
Ra-223	1.38e+11	2.02e+08	2.77e+10	0.00e+00	3.67e+09	0.00e+00	1.08e+09
Ra-224	1.64e+10	3.69e+07	3.26e+09	0.00e+00	6.72e+08	0.00e+00	4.33e+08
Ra-225	2.14e+11	2.41e+08	4.25e+10	0.00e+00	4.40e+09	0.00e+00	1.20e+09
Ra-226	4.90e+12	3.76e+08	4.06e+12	0.00e+00	6.88e+09	0.00e+00	2.72e+09
Ra-228	3.39e+12	2.02e+08	3.81e+12	0.00e+00	3.71e+09	0.00e+00	4.59e+08
Ac-225	7.02e+04	9.01e+04	4.71e+03	0.00e+00	6.61e+03	0.00e+00	7.81e+05
Ac-227	2.21e+07	3.78e+06	1.37e+06	0.00e+00	7.69e+05	0.00e+00	4.19e+05
Th-227	3.13e+05	5.24e+03	8.99e+03	0.00e+00	1.93e+04	0.00e+00	1.49e+06
Th-228	1.19e+07	1.63e+05	4.04e+05	0.00e+00	7.63e+05	0.00e+00	2.82e+06
Th-229	1.24e+08	3.12e+06	2.07e+06	0.00e+00	1.50e+07	0.00e+00	4.00e+05
Th-230	1.88e+07	9.38e+05	5.23e+05	0.00e+00	4.50e+06	0.00e+00	3.08e+05
Th-232	2.09e+07	8.05e+05	8.14e+03	0.00e+00	3.85e+06	0.00e+00	2.62e+05
Th-234	2.04e+03	1.11e+02	5.90e+01	0.00e+00	4.10e+02	0.00e+00	3.51e+05
Pa-231	3.74e+07	1.23e+06	1.49e+06	0.00e+00	6.61e+06	0.00e+00	3.67e+05
Pa-233	9.66e+01	1.89e+01	1.69e+01	0.00e+00	5.19e+01	0.00e+00	4.53e+04
U-232	1.19e+10	0.00e+00	1.07e+09	0.00e+00	1.17e+09	0.00e+00	3.47e+07
U-233	2.51e+09	0.00e+00	1.91e+08	0.00e+00	5.33e+08	0.00e+00	3.21e+07
U-234	2.41e+09	0.00e+00	1.88e+08	0.00e+00	5.23e+08	0.00e+00	3.14e+07
U-235	2.31e+09	0.00e+00	1.76e+08	0.00e+00	4.90e+08	0.00e+00	4.00e+07
U-236	2.31e+09	0.00e+00	1.80e+08	0.00e+00	4.99e+08	0.00e+00	2.95e+07
U-237	6.47e+04	0.00e+00	1.73e+04	0.00e+00	1.61e+05	0.00e+00	2.76e+06
U-238	2.21e+09	0.00e+00	1.64e+08	0.00e+00	4.58e+08	0.00e+00	2.82e+07
Np-237	1.18e+07	7.85e+05	5.18e+05	0.00e+00	3.13e+06	0.00e+00	4.06e+05

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## Offsite Dose Calculation Manual

## Attachment 10

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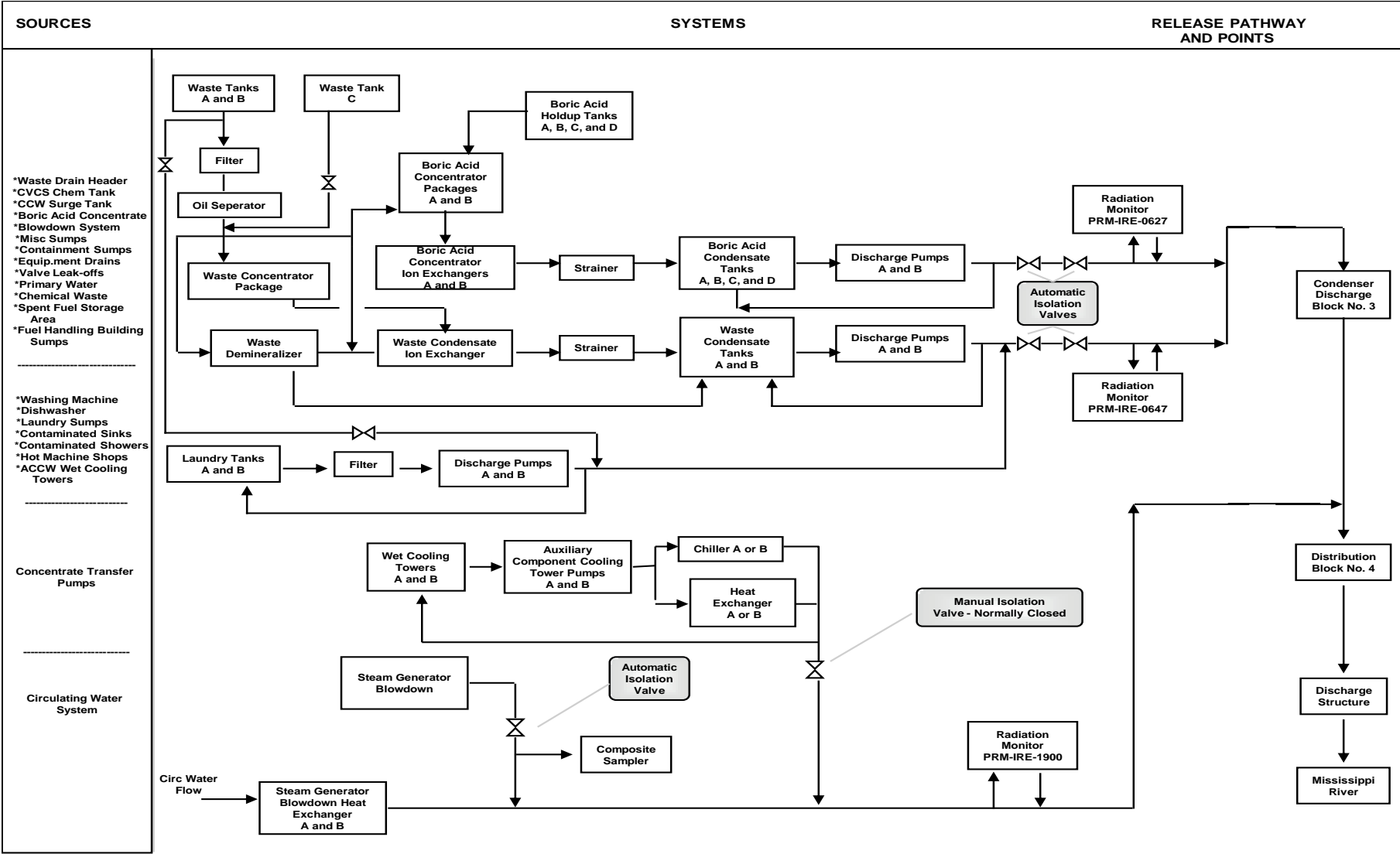
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Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	4.19e+01	1.05e+00	6.48e-01	0.00e+00	2.30e+00	0.00e+00	1.41e+04
Np-239	4.38e+00	3.92e-01	2.21e-01	0.00e+00	7.81e-01	0.00e+00	1.13e+04
Pu-238	2.53e+06	2.96e+05	6.71e+04	0.00e+00	2.39e+05	0.00e+00	1.49e+05
Pu-239	2.72e+06	3.06e+05	6.99e+04	0.00e+00	2.53e+05	0.00e+00	1.36e+05
Pu-240	2.72e+06	3.06e+05	6.99e+04	0.00e+00	2.53e+05	0.00e+00	1.39e+05
Pu-241	8.37e+04	3.47e+03	1.74e+03	0.00e+00	6.24e+03	0.00e+00	2.86e+03
Pu-242	2.53e+06	2.94e+05	6.73e+04	0.00e+00	2.43e+05	0.00e+00	1.34e+05
Pu-244	2.94e+06	3.38e+05	7.72e+04	0.00e+00	2.78e+05	0.00e+00	1.99e+05
Am-241	7.14e+06	6.21e+06	5.33e+05	0.00e+00	3.20e+06	0.00e+00	3.76e+05
Am-242m	7.45e+06	6.02e+06	5.58e+05	0.00e+00	3.28e+06	0.00e+00	4.78e+05
Am-243	7.11e+06	6.07e+06	5.23e+05	0.00e+00	3.14e+06	0.00e+00	4.46e+05
Cm-242	6.17e+05	5.72e+05	4.10e+04	0.00e+00	1.18e+05	0.00e+00	3.71e+05
Cm-243	6.90e+06	5.67e+06	4.43e+05	0.00e+00	1.61e+06	0.00e+00	3.99e+05
Cm-244	5.81e+06	4.78e+06	3.74e+05	0.00e+00	1.33e+06	0.00e+00	3.86e+05
Cm-245	8.84e+06	7.16e+06	5.58e+05	0.00e+00	2.13e+06	0.00e+00	3.60e+05
Cm-246	8.74e+06	7.16e+06	5.58e+05	0.00e+00	2.13e+06	0.00e+00	3.54e+05
Cm-247	8.54e+06	7.06e+06	5.48e+05	0.00e+00	2.09e+06	0.00e+00	4.65e+05
Cm-248	7.06e+07	5.82e+07	4.52e+06	0.00e+00	1.73e+07	0.00e+00	7.50e+06
Cf-252	5.92e+06	0.00e+00	1.43e+05	0.00e+00	0.00e+00	0.00e+00	1.45e+06

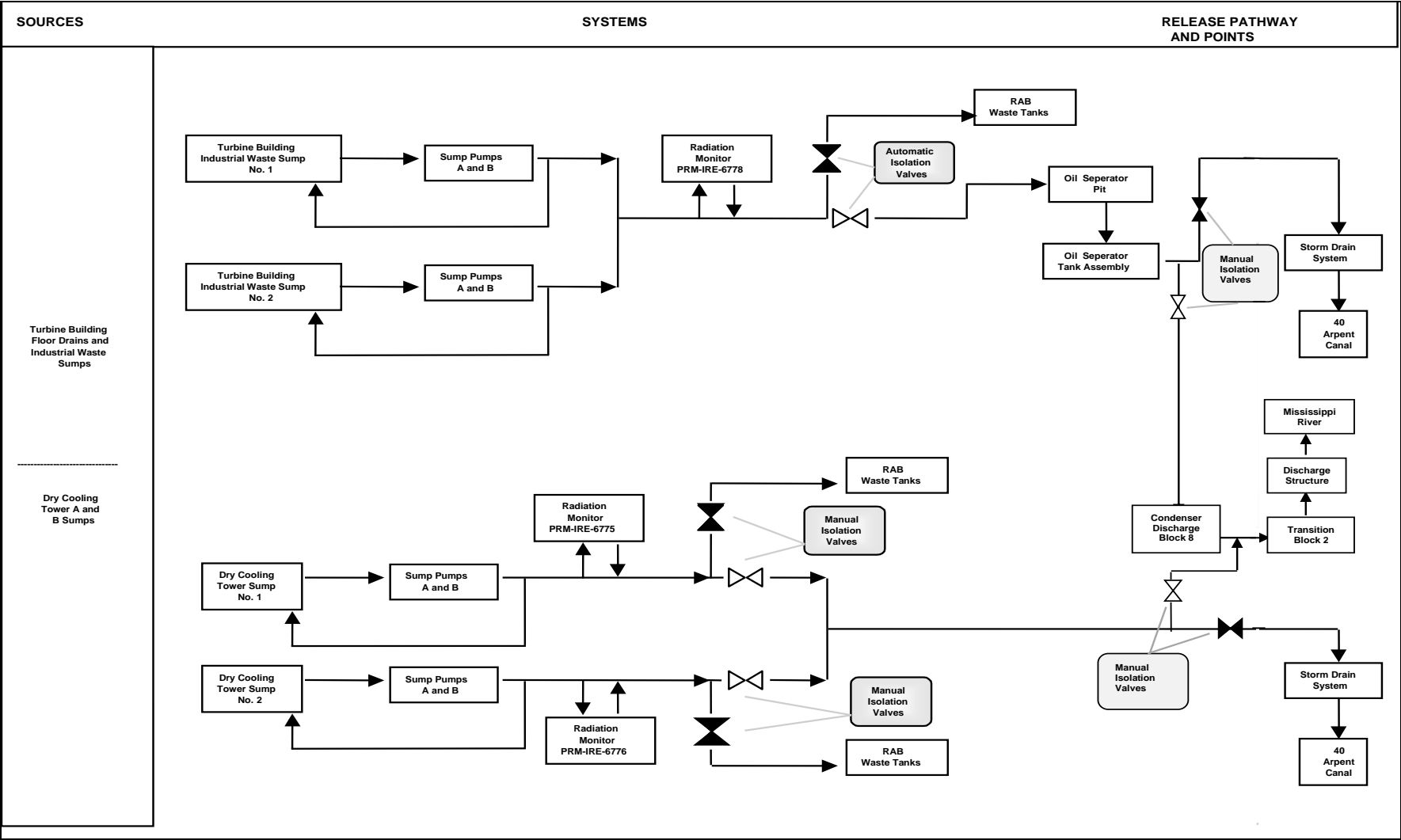
Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

**Attachment 11** **Page 1 of 2**  
**Liquid Waste Management System Effluent Sources and Release Pathways and Points**





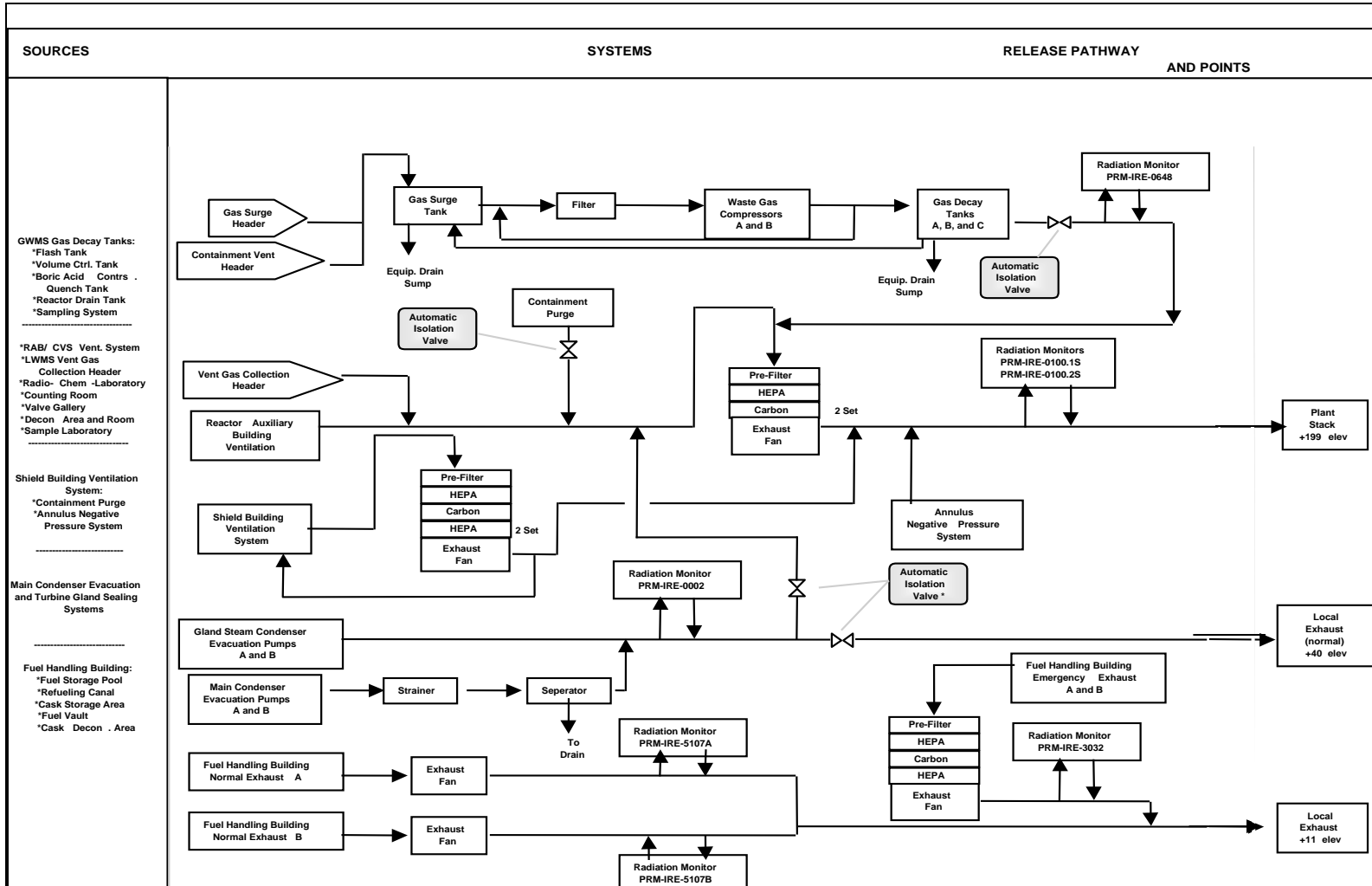
**Liquid Waste Management System Effluent Sources and Release Pathways and Points**



Offsite Dose Calculation Manual

Attachment 12

Gaseous Effluent Sources, Gaseous Waste Management System Effluent Sources and Exhaust Release Points



⊗ \* Automatic Isolation Valves (Auto Direct Feature Disabled)

**Radiological Environmental Monitoring Program**

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES & SAMPLE LOCATIONS	SAMPLING AND COLLECTION FREQUENCY*	TYPE AND FREQUENCY OF ANALYSIS	VOLUME**
TLD	A-2, B-1, C-1, D-2, E-1, F-2, G-2, H-2, J-2, K-1, L-1, M-1, N-1, P-1, Q-1, R-1, A-5, B-4, D-5, E-5, F-4, G-4, H-8, P-6, Q-5, R-6, F-9, G-8, E-15, J-15, E-26	Quarterly	TLD <sup>(1)</sup> gamma dose quarterly	N/A
RADIOIODINE AND PARTICULATES	APF-1, APQ-1, APP-1	Bi-Weekly	gross beta <sup>(2)</sup> , I-131 bi-weekly	285 m <sup>3</sup> /wk
	APC-1, APE-26	Quarterly Composite	gamma isotopic <sup>(2)</sup> quarterly	3700 m <sup>3</sup> / qtr
DRINKING WATER / SURFACE WATER <sup>(3)</sup>	DWF-2 <sup>(4)</sup> / SWF-2 <sup>(4)</sup> DWE-5 <sup>(4)</sup> / SWE-5 <sup>(4)</sup> DWP-7 / SWP-7 SWK-1 <sup>(12)(13)</sup>	Quarterly Composite <sup>(5)</sup>	H-3 gross beta, gamma isotopic quarterly	Homogeneous 8 liters
		Monthly Composite <sup>(10)</sup>	I-131 <sup>(7)</sup> monthly	
SHORELINE SEDIMENT	SHWK-1, SHWE-3, SHWQ-6	Annually	gamma isotopic annually	2 kilograms
MILK <sup>(14)</sup>	Unavailable	Quarterly	gamma isotopic, I-131 quarterly	8 liters
FISH	FH-1, FH-2, FH-3	In season or Annually <sup>(9)</sup>	gamma isotopic annually	500 grams
BROAD LEAF	BLQ-1, BLB-1, BLE-20	Quarterly	gamma isotopic, I-131 quarterly	500 grams
SANITARY SYSTEM <sup>(11)</sup>	SWR-1	Monthly Composite <sup>(10)</sup>	gamma isotopic monthly	Homogeneous
		Quarterly Composite <sup>(5)</sup>	H-3 quarterly	4 liters

\* Sample collection at specific locations may be increased at any time in order to increase the effectiveness of the REMF.

\*\* These are typical volumes used to meet LLDs. Actual volumes are used in the calculations.

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Offsite Dose Calculation Manual		

**Radiological Environmental Monitoring Program**

1. One or more instrument, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. A TLD is considered one phosphor, two or more phosphors in a packet are considered two or more dosimeters. Geographical limitations affect siting of dosimeters.
2. Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.
3. Drinking Water and Surface Water samples are identical where designated.
4. The downstream sample is beyond the mixing zone.
5. A composite sample will contain aliquots of sample taken proportional to the quantity of flowing liquid that results in a specimen representative of the liquid flow.
6. DELETED
7. 7. This analysis will be performed when the dose calculated for the consumption of water is greater than 1 mrem per year as calculated for maximum organ and age group.
8. DELETED
9. Striped mullet, gizzard shad, freshwater drum, and catfish will be collected. If they are not available, then substitute species will be collected and identified in reporting.

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**Radiological Environmental Monitoring Program**

10. An analysis frequency of every 4 weeks satisfies this requirement. The maximum frequency is monthly.
11. Sanitary System Sampling and analysis performed additionally for this location. This sampling requirement is not derived directly from REMP requirements, but it represents another possible environmental interface with the plant. Information from this sample location will not normally be included in the Annual Radiological Environmental Operating Report.
12. Monthly composite is analyzed for gamma isotopic.
13. Gross beta is not required for surface water in accordance with TRM Table 3.12-1.
14. If milk is unavailable, follow guidelines in TRM 3/4.12.1 Table 3.12-1. If milk sample become available following the next Land Use Census, the new samples and a control sample will be added to REMP

## Offsite Dose Calculation Manual

Attachment 14

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## Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
<b>DIRECT RADIATION (TLD)</b>			
A-2	(Eastbank) Located on pole on LA 628 at Zephirin L. Periloux Fire House.	188° 1.27	N 30.01381 W 90.46780
B-1	(Eastbank) Located on fence west of Little Gypsy.	200° 0.75	N 30.00576 W 90.46672
C-1	(Eastbank) Located on fence at Little Gypsy Cooling Water Intake structure.	219° 0.67	N 30.00307 W 90.46401
D-2	(Eastbank) Located on pole on levee at west entrance to Bonnet Carre Spillway.	238° 1.24	N 30.00471 W 90.45343

## Offsite Dose Calculation Manual

Attachment 14

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## Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b><u>DIRECT RADIATION (TLD) (continued)</u></b>		
E-1	(Westbank) Located on pole on LA 18 east of Waterford 3 plant entrance.	277° 0.41	N 29.99468 W 90.46437
F-2	(Westbank) Located on fence on LA 3142 south of LA 18.	294° 1.15	N 29.98842 W 90.45387
G-2	(Westbank) Located on fence on LA 3142 north of railroad overpass.	309° 1.26	N 29.98371 W 90.45498
H-2	(Westbank) Located on fence on LA 3142 north of LA 3127/3142 intersection.	327° 1.54	N 29.97659 W 90.45753

## Offsite Dose Calculation Manual

Attachment 14

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## Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b><u>DIRECT RADIATION (TLD) (continued)</u></b>		
J-2	(Westbank) Located on fence south of LA 3127 west of LA 3127/3142 intersection.	356° 1.38	N 29.97546 W 90.47003
K-1	(Westbank) Located on stop sign at entrance to Entergy Education Center on LA 3127.	23° 1.06	N 29.98153 W 90.47843
L-1	(Westbank) Located on gate on LA 3127 west of LA 3127/3142 intersection.	42° 1.06	N 29.98427 W 90.48314
M-1	(Westbank) Located on south fence at Waterford 1 and 2.	67° 0.76	N 29.99148 W 90.48286
N-1	(Westbank) Located on pole at corner of Railroad Avenue and School House Road.	93° 0.98	N 29.99649 W 90.48739



## Offsite Dose Calculation Manual

Attachment 14

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Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b><u>DIRECT RADIATION (TLD) (continued)</u></b>		
P-1	(Westbank) Located on fence enclosing air sample station APP-1.	119° 0.84	N 30.00158 W 90.48323
Q-1	(Westbank) Located on fence enclosing air sample station APQ-1.	132° 0.81	N 30.00355 W 90.48091
R-1	(Westbank) Located at Waterford 1 and 2 Cooling Water Intake Structure.	147° 0.51	N 30.00181 W 90.47564
A-5	(Eastbank) Located on pole at intersection of Oswald Avenue and US 61.	177° 4.59	N 30.06212 W 90.47334
B-4	(Eastbank) Located on pole near weigh station on US 61.	197° 3.75	N 30.04717 W 90.45130

## Offsite Dose Calculation Manual

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Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b><u>DIRECT RADIATION (TLD) (continued)</u></b>		
D-5	(Eastbank) Located on gate on shell road north of US 61/LA 48 intersection.	249° 4.09	N 30.01628 W 90.40730
E-5	(Eastbank) Located on fence on Wesco St. off LA 48.	271° 3.90	N 29.99385 W 90.40610
F-4	(Westbank) Located on pole behind house at 646 Aquarius St. in Hahnville.	289° 3.53	N 29.97818 W 90.41582
G-4	(Westbank) Located on pole on LA 3160 north of railroad track.	309° 3.30	N 29.96507 W 90.42867

## Offsite Dose Calculation Manual

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Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b><u>DIRECT RADIATION (TLD) (continued)</u></b>		
H-8	(Westbank) Located on pole in front of Hahnville High School.	331° 8.13	N 29.89178 W 90.40725
P-6	(Westbank) Located on fence at LA 640/railroad track intersection.	107° 5.58	N 30.02121 W 90.55941
Q-5	(Westbank) Located on pole on LA 18 across from Mississippi River marker 137.	129° 5.01	N 30.04274 W 90.53464
R-6	(Eastbank) Located on fence on LA 3223 near railroad crossing.	160° 5.52	N 30.07108 W 90.50183
F-9	(Eastbank) Located on fence north of railroad tracks on Jonathan St.	294° 8.18	N 29.94563 W 90.34739

## Offsite Dose Calculation Manual

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## Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<u>DIRECT RADIATION (TLD) (continued)</u>		
G-8	(Westbank) Located on back fence of Luling Entergy office.	305° 7.74	N 29.93055 W 90.36592
E-15	(Eastbank) Located on fence on Alliance Avenue.	275° 11.7	N 29.97695 W 90.27658
J-15	(Westbank) Located on pole near LA 631/Hwy 90 intersection in Des Allemands.	357° 11.7	N 29.82575 W 90.46457
E-26*	(Westbank) Located at Entergy office on Virgil St. in Gretna.	100° 25.8	N 29.92629 W 90.04723

\* DENOTES CONTROL LOCATIONS

## Offsite Dose Calculation Manual

Attachment 14

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## Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b><u>AIRBORNE</u></b>		
APP-1	(Westbank) Located in soybean/sugarcane field on Short St. in Killona.	119° 0.84	N 30.00158 W 90.48323
APQ-1	(Westbank) Located in soybean/sugarcane field off LA 18 east of LA 18/3141 intersection.	132° 0.81	N 30.00356 W 90.48093
APF-1	(Westbank) Located on north side of Secondary Meteorological Tower.	299° 0.35	N 29.99302 W 90.46601
APC-1	(Eastbank) Located inside Little Gypsy Cooling Water Intake Structure fence.	219° 0.67	N 30.00307 W 90.46401
APE-26*	(Westbank) Located at Entergy office on Virgil St. in Gretna.	100° 25.8	N 29.92629 W 90.04723

\* DENOTES CONTROL LOCATIONS

## Offsite Dose Calculation Manual

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## Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b>BROAD LEAF</b>		
BLQ-1	(Westbank) Located near air sample station APQ-1.	132° 0.83	N 30.00367 W 90.48132
BLB-1	(Eastbank) Located west of Little Gypsy on LA 628.	197° 0.81	N 30.00665 W 90.46691
BLE-20*	(Westbank) Located on property of Nine Mile Point in Westwego.	280° 19.7	N 29.94142 W 90.14909

\* DENOTES CONTROL LOCATION(S)

## Offsite Dose Calculation Manual

Attachment 14

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## Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b><u>INGESTION</u></b>		
	<b><u>MILK</u></b>		
	<b><u>FISH</u></b>		
FH-1*	Upstream of the plant intake structure.	N/A	N/A
FH-2	Downstream of the plant discharge structure.	N/A	N/A
FH-3	(Westbank) Waterways downstream of plant discharge directed to 40 Arpent Canal.	N/A	N/A

\* DENOTES CONTROL LOCATIONS

N/A - Not Applicable for this sampling location.

## Offsite Dose Calculation Manual

Attachment 14

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Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
	<b><u>WATERBORNE</u></b>		
SWK-1	(Westbank) Located at 40 Arpent Canal south of the plant.	14° 0.49	N 29.98866 W 90.47324
SHWE-3	(Westbank) Located at Foot Ferry Landing on LA 18.	276° 2.99	N 29.99063 W 90.42151
SHWK-1	(Westbank) Located at 40 Arpent Canal south of plant.	14° 0.49	N 29.98866 W 90.47324
SHWQ-6*	(Eastbank) Located on LA 628 east of Reserve ferry landing.	129° 5.99	N 30.05154 W 90.54748
DWE-5 SWE-5	(Eastbank) Located at St. Charles Parish Waterworks in New Sarpy.	277° 4.59	N 29.98622 W 90.39525
DWP-7* SWP-7*	(Westbank) Located at St. John Parish Waterworks in Edgard.	117° 7.37	N 30.04629 W 90.57931
DWF-2 SWF-2	(Westbank) Located at Dow Chemical Plant drinking water canal.	302° 1.51	N 29.98371 W 90.44989

\* DENOTES CONTROL LOCATIONS



## Offsite Dose Calculation Manual

Attachment 14

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## Sample Location Table

LOCATION NUMBER	LOCATION DESCRIPTION	BEARING/ MILES TO PLANT	Position Latitude Longitude
<b>SANITARY SYSTEM</b>			
SWR-1**	Sewage lift station Northwest of MSB.	153° 0.10	N 29.99684 W 90.47184

\*\* Sampling requirements are not derived directly from REMP requirements therefore results will not appear in the annual report. However, it represents another possible environmental interface with the plant.

**Attachment 15** **Page 1 of 1**  
**Sector and Zone Designators for Radiological Sampling and Monitoring Points**

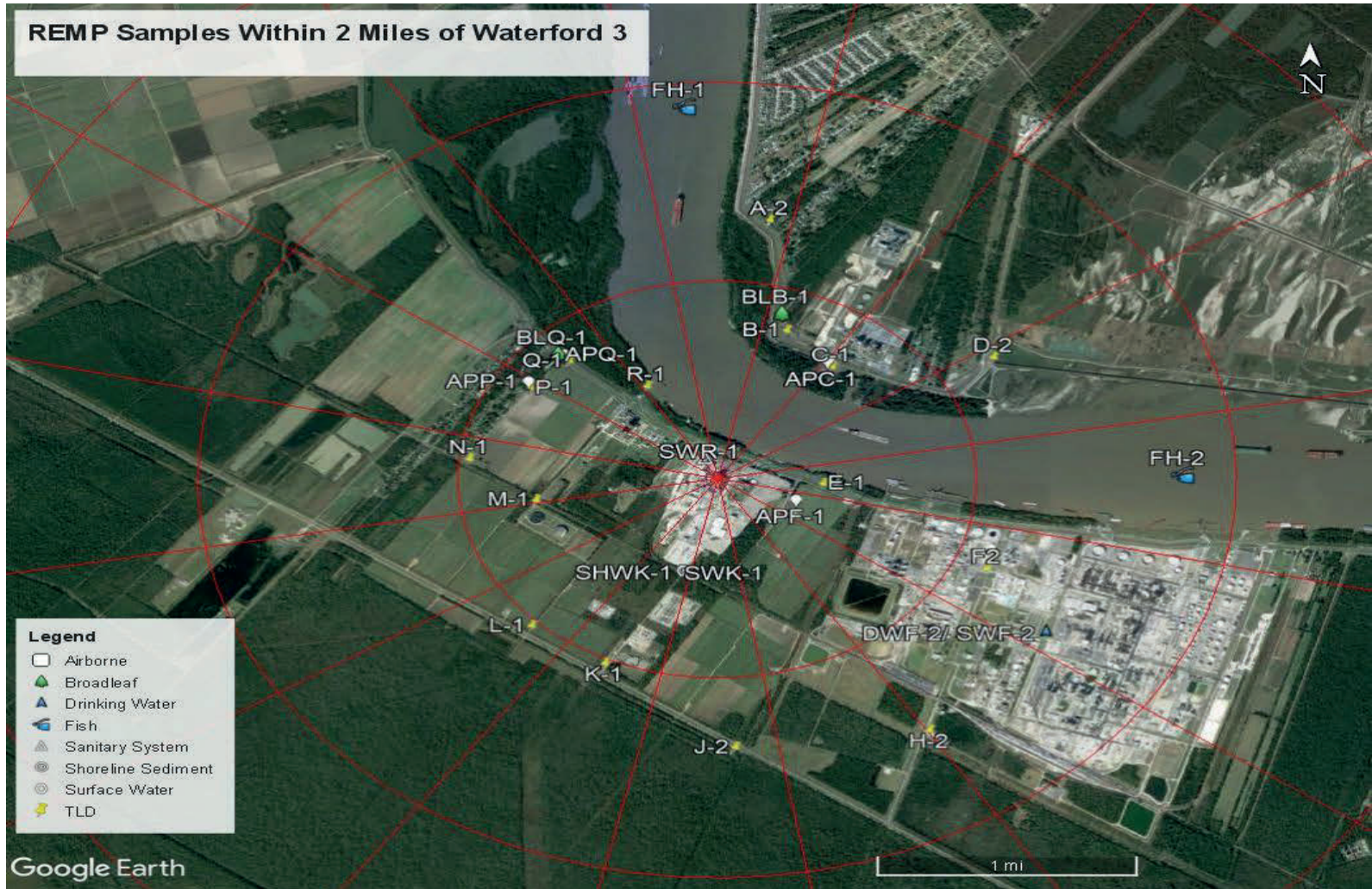
SECTOR NOMENCLATURE		ZONE NOMENCLATURE	
CENTERLINE OF SECTOR IN DEGREES TRUE NORTH FROM FACILITY	22 1/2° SECTOR	MILES FROM FACILITY	ZONE
0 & 360	*A N	0-1	1
22 1/2	B NNE	1-2	2
45	C NE	2-3	3
67 1/2	D ENE	3-4	4
90	E E	4-5	5
112 1/2	F ESE	5-6	6
135	G SE	6-7	7
157 1/2	H OR SSE	7-8	8
180	J S	8-9	9
202 1/2	K SSW	9-10	10
225	L SW	10-15	15
247 1/2	M WSW	15-20	20
270	N W	20-25	25
292 1/2	P WNW	25-30	30
315	Q NW	30-35	35
337 1/2	R NNW	35-40	40
		40-45	45
		45-50	50

AREA SEGMENT - An area is identified by a Sector and Zone designator. Thus, area N-1 is that area which lies between 348 3/4 and 11 1/4 degrees true north from the facility out to a radius of 1 mile. Area G-4 would be that area between 123 3/4 to 146 1/4 degrees and the 3- and 4-mile arcs from the facility. For Airborne, Ingestion (milk), and Food Products pathways, the sector designator will be preceded by acronyms AP, MK, and FP, respectively.

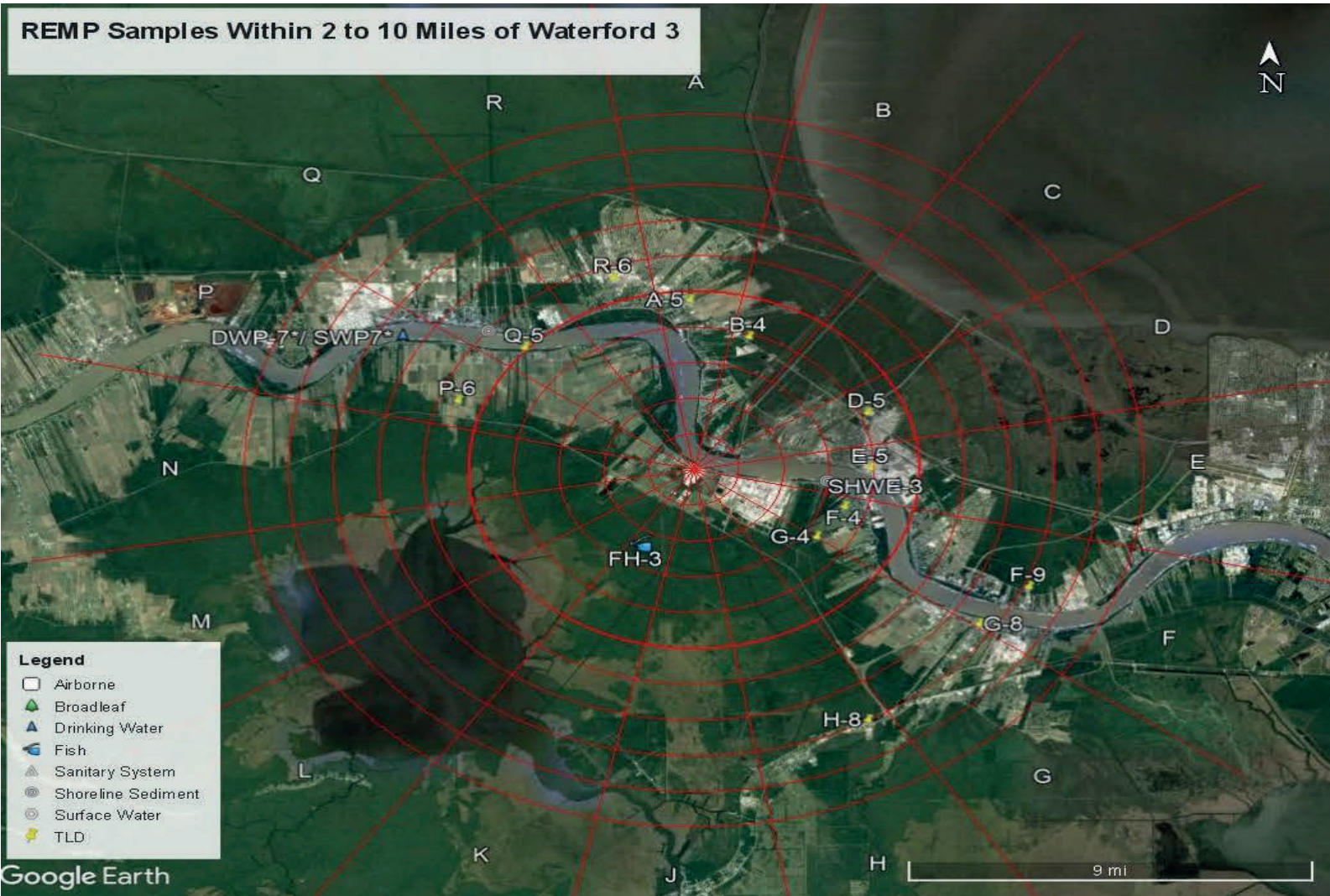
\* The letters I and O have been omitted from these sector designators so as to eliminate possible confusion between letters and numbers.

REMP Sampling Locations Within 2 Miles of Waterford 3

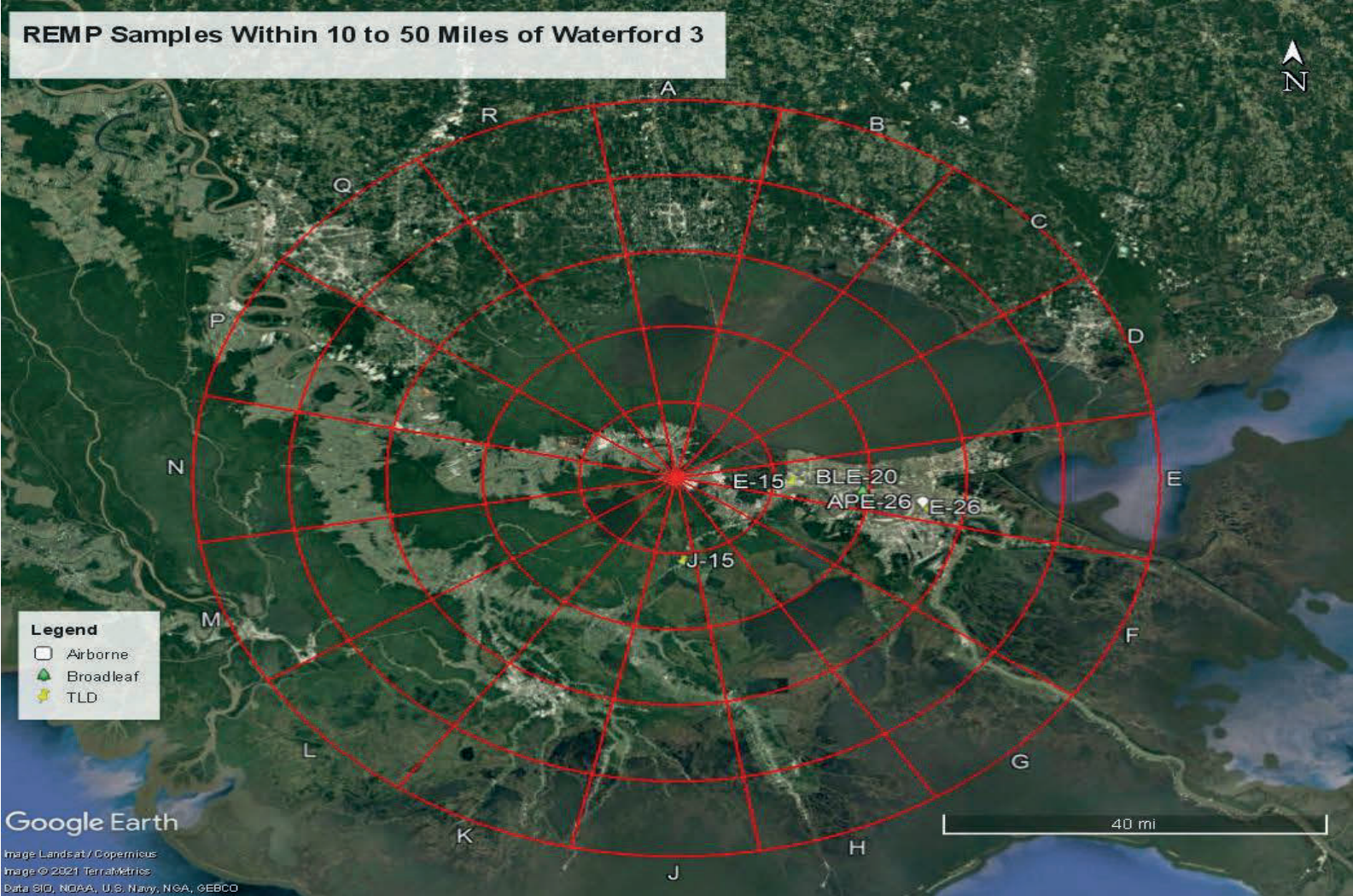
WITHIN 2 MILES OF WATERFORD 3



REMP Samples 2 to 10 Miles From Waterford 3



**REMP Samples 10 to 50 Miles From Waterford 3**



Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, P<sub>i</sub>

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	7.18e+02	7.18e+02	7.18e+02	7.18e+02	7.18e+02	7.18e+02
Be-10	1.58e+06	2.45e+05	3.97e+04	0.00e+00	0.00e+00	1.78e+06	1.34e+05
C-14	1.82e+04	3.41e+03	3.41e+03	3.41e+03	3.41e+03	3.41e+03	3.41e+03
N-13	5.02e+01	5.02e+01	5.02e+01	5.02e+01	5.02e+01	5.02e+01	5.02e+01
F-18	3.77e+03	0.00e+00	4.15e+02	0.00e+00	0.00e+00	0.00e+00	7.39e+01
Na-22	1.04e+05	1.04e+05	1.04e+05	1.04e+05	1.04e+05	1.04e+05	1.04e+05
Na-24	1.02e+04	1.02e+04	1.02e+04	1.02e+04	1.02e+04	1.02e+04	1.02e+04
P-32	1.32e+06	7.71e+04	5.01e+04	0.00e+00	0.00e+00	0.00e+00	8.64e+04
Ca-41	3.06e+05	0.00e+00	3.30e+04	0.00e+00	0.00e+00	3.06e+04	2.29e+03
Sc-46	4.41e+05	8.56e+05	2.49e+05	0.00e+00	7.99e+05	0.00e+00	2.58e+05
Cr-51	0.00e+00	0.00e+00	1.00e+02	5.95e+01	2.28e+01	1.44e+04	3.32e+03
Mn-54	0.00e+00	3.96e+04	6.30e+03	0.00e+00	9.84e+03	1.40e+06	7.74e+04
Mn-56	0.00e+00	1.24e+00	1.83e-01	0.00e+00	1.30e+00	9.44e+03	2.02e+04
Fe-55	2.46e+04	1.70e+04	3.94e+03	0.00e+00	0.00e+00	7.21e+04	6.03e+03
Fe-59	1.18e+04	2.78e+04	1.06e+04	0.00e+00	0.00e+00	1.02e+06	1.88e+05
Co-57	0.00e+00	6.92e+02	6.71e+02	0.00e+00	0.00e+00	3.70e+05	3.14e+04
Co-58	0.00e+00	1.58e+03	2.07e+03	0.00e+00	0.00e+00	9.28e+05	1.06e+05
Co-60	0.00e+00	1.15e+04	1.48e+04	0.00e+00	0.00e+00	5.97e+06	2.85e+05
Ni-59	3.25e+04	1.17e+04	5.42e+03	0.00e+00	0.00e+00	6.56e+04	4.89e+03
Ni-63	4.32e+05	3.14e+04	1.45e+04	0.00e+00	0.00e+00	1.78e+05	1.34e+04
Ni-65	1.54e+00	2.10e-01	9.12e-02	0.00e+00	0.00e+00	5.60e+03	1.23e+04
Cu-64	0.00e+00	1.46e+00	6.15e-01	0.00e+00	4.62e+00	6.78e+03	4.90e+04
Zn-65	3.24e+04	1.03e+05	4.66e+04	0.00e+00	6.90e+04	8.64e+05	5.34e+04
Zn-69	3.38e-02	6.51e-02	4.52e-03	0.00e+00	4.22e-02	9.20e+02	1.63e+01
Zn-69m	8.16e+00	1.96e+01	1.79e+00	0.00e+00	1.18e+01	1.90e+04	1.37e+05
Se-79	0.00e+00	3.06e+03	4.87e+02	0.00e+00	4.55e+03	3.58e+05	2.66e+04
Br-82	0.00e+00	0.00e+00	1.35e+04	0.00e+00	0.00e+00	0.00e+00	1.04e+04
Br-83	0.00e+00	0.00e+00	2.41e+02	0.00e+00	0.00e+00	0.00e+00	2.32e+02
Br-84	0.00e+00	0.00e+00	3.13e+02	0.00e+00	0.00e+00	0.00e+00	1.64e-03
Br-85	0.00e+00	0.00e+00	1.28e+01	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/yr per μCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.35e+05	5.90e+04	0.00e+00	0.00e+00	0.00e+00	1.66e+04
Rb-87	0.00e+00	7.89e+04	2.57e+04	0.00e+00	0.00e+00	0.00e+00	2.30e+03
Rb-88	0.00e+00	3.87e+02	1.93e+02	0.00e+00	0.00e+00	0.00e+00	3.34e-09
Rb-89	0.00e+00	2.56e+02	1.70e+02	0.00e+00	0.00e+00	0.00e+00	9.28e-12
Sr-89	3.04e+05	0.00e+00	8.72e+03	0.00e+00	0.00e+00	1.40e+06	3.50e+05
Sr-90	2.87e+07	0.00e+00	5.77e+05	0.00e+00	0.00e+00	9.60e+06	7.22e+05
Sr-91	6.19e+01	0.00e+00	2.50e+00	0.00e+00	0.00e+00	3.65e+04	1.91e+05
Sr-92	6.74e+00	0.00e+00	2.91e-01	0.00e+00	0.00e+00	1.65e+04	4.30e+04
Y-90	2.09e+03	0.00e+00	5.61e+01	0.00e+00	0.00e+00	1.70e+05	5.06e+05
Y-91	4.62e+05	0.00e+00	1.24e+04	0.00e+00	0.00e+00	1.70e+06	3.85e+05
Y-91m	2.61e-01	0.00e+00	1.02e-02	0.00e+00	0.00e+00	1.92e+03	1.33e+00
Y-92	1.03e+01	0.00e+00	3.02e-01	0.00e+00	0.00e+00	1.57e+04	7.35e+04
Y-93	9.44e+01	0.00e+00	2.61e+00	0.00e+00	0.00e+00	4.85e+04	4.22e+05
Zr-93	4.18e+05	2.34e+04	1.10e+04	0.00e+00	8.88e+04	1.70e+05	1.21e+04
Zr-95	1.07e+05	3.44e+04	2.33e+04	0.00e+00	5.42e+04	1.77e+06	1.50e+05
Zr-97	9.68e+01	1.96e+01	9.04e+00	0.00e+00	2.97e+01	7.87e+04	5.23e+05
Nb-93m	2.48e+05	8.08e+04	1.99e+04	0.00e+00	9.28e+04	2.49e+05	1.90e+04
Nb-95	1.41e+04	7.82e+03	4.21e+03	0.00e+00	7.74e+03	5.05e+05	1.04e+05
Nb-97	2.22e-01	5.62e-02	2.05e-02	0.00e+00	6.54e-02	2.40e+03	2.42e+02
Mo-93	0.00e+00	9.36e+03	2.54e+02	0.00e+00	2.84e+03	4.09e+05	3.03e+04
Mo-99	0.00e+00	1.21e+02	2.30e+01	0.00e+00	2.91e+02	9.12e+04	2.48e+05
Tc-101	4.18e-05	6.02e-05	5.90e-04	0.00e+00	1.08e-03	3.99e+02	1.09e-11
Tc-99	2.50e+02	3.71e+02	1.00e+02	0.00e+00	4.68e+03	8.08e+05	6.03e+04
Tc-99m	1.03e-03	2.91e-03	3.70e-02	0.00e+00	4.42e-02	7.64e+02	4.16e+03
Ru-103	1.53e+03	0.00e+00	6.58e+02	0.00e+00	5.83e+03	5.05e+05	1.10e+05
Ru-105	7.90e-01	0.00e+00	3.11e-01	0.00e+00	1.02e+00	1.10e+04	4.82e+04
Ru-106	6.91e+04	0.00e+00	8.72e+03	0.00e+00	1.34e+05	9.36e+06	9.12e+05
Rh-105	7.39e+00	5.38e+00	3.54e+00	0.00e+00	2.29e+01	1.93e+04	8.72e+04
Pd-107	0.00e+00	6.62e+02	4.70e+01	0.00e+00	5.26e+03	7.58e+04	5.65e+03
Pd-109	0.00e+00	3.70e+00	9.28e-01	0.00e+00	1.88e+01	1.48e+04	1.22e+05

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.08e+04	1.00e+04	5.94e+03	0.00e+00	1.97e+04	4.63e+06	3.02e+05
Ag-111	3.40e+02	1.42e+02	7.10e+01	0.00e+00	4.59e+02	1.86e+05	2.23e+05
Cd-113m	0.00e+00	1.23e+06	3.98e+04	0.00e+00	1.37e+06	1.66e+06	1.27e+05
Cd-115m	0.00e+00	1.97e+05	6.36e+03	0.00e+00	1.58e+05	1.41e+06	3.84e+05
Sn-123	2.42e+05	5.34e+03	7.86e+03	4.54e+03	0.00e+00	2.30e+06	3.14e+05
Sn-125	9.28e+03	2.50e+02	5.62e+02	2.07e+02	0.00e+00	5.90e+05	5.45e+05
Sn-126	1.26e+06	3.34e+04	4.80e+04	9.84e+03	0.00e+00	9.36e+06	1.27e+05
Sb-124	3.12e+04	5.89e+02	1.24e+04	7.55e+01	0.00e+00	2.48e+06	4.06e+05
Sb-125	5.34e+04	5.95e+02	1.26e+04	5.40e+01	0.00e+00	1.74e+06	1.01e+05
Sb-126	3.60e+03	7.30e+01	1.30e+03	2.20e+01	0.00e+00	7.66e+05	4.81e+05
Sb-127	2.64e+02	5.78e+00	1.02e+02	3.18e+00	0.00e+00	1.64e+05	3.02e+05
Te-125m	3.42e+03	1.58e+03	4.67e+02	1.05e+03	1.24e+04	3.14e+05	7.06e+04
Te-127	1.40e+00	6.42e-01	3.10e-01	1.06e+00	5.10e+00	6.51e+03	5.74e+04
Te-127m	1.26e+04	5.77e+03	1.57e+03	3.29e+03	4.58e+04	9.60e+05	1.50e+05
Te-129	4.98e-02	2.39e-02	1.24e-02	3.90e-02	1.87e-01	1.94e+03	1.57e+02
Te-129m	9.76e+03	4.67e+03	1.58e+03	3.44e+03	3.66e+04	1.16e+06	3.83e+05
Te-131	1.11e-02	5.95e-03	3.59e-03	9.36e-03	4.37e-02	1.39e+03	1.84e+01
Te-131m	6.99e+01	4.36e+01	2.90e+01	5.50e+01	3.09e+02	1.46e+05	5.56e+05
Te-132	2.60e+02	2.15e+02	1.62e+02	1.90e+02	1.46e+03	2.88e+05	5.10e+05
Te-133m	5.79e-02	4.32e-02	3.34e-02	5.02e-02	2.99e-01	4.41e+03	6.12e+01
Te-134	3.07e-02	2.58e-02	1.26e-02	2.75e-02	1.74e-01	3.47e+03	2.38e-01
I-129	1.98e+04	1.69e+04	5.53e+04	4.43e+07	3.62e+04	0.00e+00	1.78e+03
I-130	4.58e+03	1.34e+04	5.28e+03	1.14e+06	2.09e+04	0.00e+00	7.69e+03
I-131	2.52e+04	3.58e+04	2.05e+04	1.19e+07	6.13e+04	0.00e+00	6.28e+03
I-132	1.16e+03	3.26e+03	1.16e+03	1.14e+05	5.18e+03	0.00e+00	4.06e+02
I-133	8.64e+03	1.48e+04	4.52e+03	2.15e+06	2.58e+04	0.00e+00	8.88e+03
I-134	6.44e+02	1.73e+03	6.15e+02	2.98e+04	2.75e+03	0.00e+00	1.01e+00
I-135	2.68e+03	6.98e+03	2.57e+03	4.48e+05	1.11e+04	0.00e+00	5.25e+03
Cs-134	3.73e+05	8.48e+05	7.28e+05	0.00e+00	2.87e+05	9.76e+04	1.04e+04
Cs-134m	1.27e+02	2.56e+02	1.38e+02	0.00e+00	1.46e+02	2.34e+01	6.34e+01

Conversion factors are in units of mrem/yr per µCi/cubic meter.



Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.17e+05	1.03e+05	4.79e+04	0.00e+00	4.09e+04	1.26e+04	1.69e+03
Cs-136	3.90e+04	1.46e+05	1.10e+05	0.00e+00	8.56e+04	1.20e+04	1.17e+04
Cs-137	4.78e+05	6.21e+05	4.28e+05	0.00e+00	2.22e+05	7.52e+04	8.40e+03
Cs-138	3.31e+02	6.21e+02	3.24e+02	0.00e+00	4.80e+02	4.86e+01	1.86e-03
Cs-139	2.05e+02	2.90e+02	1.11e+02	0.00e+00	2.44e+02	2.27e+01	4.39e-21
Ba-139	9.36e-01	6.66e-04	2.74e-02	0.00e+00	6.22e-04	3.76e+03	8.96e+02
Ba-140	3.90e+04	4.90e+01	2.57e+03	0.00e+00	1.67e+01	1.27e+06	2.18e+05
Ba-141	1.00e-01	7.53e-05	3.36e-03	0.00e+00	7.00e-05	1.94e+03	1.16e-07
Ba-142	2.63e-02	2.70e-05	1.66e-03	0.00e+00	2.29e-05	1.19e+03	1.57e-16
La-140	3.44e+02	1.74e+02	4.58e+01	0.00e+00	0.00e+00	1.36e+05	4.58e+05
La-141	4.27e+00	1.33e+00	2.17e-01	0.00e+00	0.00e+00	1.08e+04	5.85e+04
La-142	6.83e-01	3.10e-01	7.72e-02	0.00e+00	0.00e+00	6.33e+03	2.11e+03
Ce-141	1.99e+04	1.35e+04	1.53e+03	0.00e+00	6.26e+03	3.62e+05	1.20e+05
Ce-143	1.86e+02	1.38e+02	1.53e+01	0.00e+00	6.08e+01	7.98e+04	2.26e+05
Ce-144	3.43e+06	1.43e+06	1.84e+05	0.00e+00	8.48e+05	7.78e+06	8.16e+05
Pr-143	9.36e+03	3.75e+03	4.64e+02	0.00e+00	2.16e+03	2.81e+05	2.00e+05
Pr-144	3.01e-02	1.25e-02	1.53e-03	0.00e+00	7.05e-03	1.02e+03	2.15e-08
Nd-147	5.27e+03	6.10e+03	3.65e+02	0.00e+00	3.56e+03	2.21e+05	1.73e+05
Pm-147	6.70e+05	6.30e+04	2.55e+04	0.00e+00	1.19e+05	5.28e+05	4.43e+04
Pm-148	3.07e+03	5.10e+02	2.56e+02	0.00e+00	9.60e+02	3.13e+05	4.64e+05
Pm-148m	7.86e+04	2.03e+04	1.55e+04	0.00e+00	3.08e+04	1.71e+06	3.34e+05
Pm-149	2.75e+02	3.90e+01	1.59e+01	0.00e+00	7.35e+01	5.77e+04	2.00e+05
Pm-151	6.80e+01	1.14e+01	5.77e+00	0.00e+00	2.04e+01	3.15e+04	1.60e+05
Sm-151	6.87e+05	1.18e+05	2.84e+04	0.00e+00	1.33e+05	3.56e+05	2.60e+04
Sm-153	1.36e+02	1.14e+02	8.32e+00	0.00e+00	3.67e+01	3.31e+04	1.26e+05
Eu-152	1.90e+06	4.33e+05	3.81e+05	0.00e+00	2.68e+06	2.74e+06	1.27e+05
Eu-154	5.92e+06	7.28e+05	5.18e+05	0.00e+00	3.49e+06	4.67e+06	2.72e+05
Eu-155	8.08e+05	1.14e+05	7.37e+04	0.00e+00	5.27e+05	7.57e+05	4.76e+04
Eu-156	1.54e+04	1.18e+04	1.92e+03	0.00e+00	7.96e+03	6.85e+05	3.60e+05
Tb-160	1.77e+05	0.00e+00	2.20e+04	0.00e+00	7.28e+04	1.54e+06	2.14e+05

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	2.70e+06	8.40e+05	6.40e+05	0.00e+00	1.26e+06	3.15e+06	1.27e+05
W-181	4.98e+01	1.62e+01	1.74e+00	0.00e+00	0.00e+00	1.37e+04	2.02e+03
W-185	1.56e+03	5.18e+02	5.45e+01	0.00e+00	0.00e+00	4.46e+05	8.56e+04
W-187	8.48e+00	7.08e+00	2.48e+00	0.00e+00	0.00e+00	2.90e+04	1.55e+05
Pb-210	2.11e+08	5.38e+07	6.70e+06	0.00e+00	1.70e+08	2.10e+08	1.21e+04
Bi-210	1.85e+03	1.27e+04	1.06e+03	0.00e+00	1.54e+05	8.88e+06	2.36e+05
Po-210	3.18e+06	6.88e+06	7.66e+05	0.00e+00	2.36e+07	2.51e+08	3.35e+05
Ra-223	1.44e+06	2.22e+03	2.88e+05	0.00e+00	6.28e+04	2.04e+08	2.27e+06
Ra-224	1.58e+05	3.82e+02	3.17e+04	0.00e+00	1.08e+04	7.02e+07	2.41e+06
Ra-225	2.40e+06	2.85e+03	4.79e+05	0.00e+00	8.08e+04	2.34e+08	2.17e+06
Ra-226	1.00e+09	1.91e+04	7.31e+08	0.00e+00	5.42e+05	9.36e+08	2.35e+06
Ra-228	3.53e+08	9.84e+03	3.82e+08	0.00e+00	2.78e+05	1.29e+09	4.00e+05
Ac-225	3.38e+06	4.66e+06	2.27e+05	0.00e+00	5.30e+05	1.77e+08	2.02e+06
Ac-227	1.84e+10	2.44e+09	1.09e+09	0.00e+00	7.86e+08	1.93e+09	4.06e+05
Th-227	1.74e+06	3.14e+04	5.00e+04	0.00e+00	1.78e+05	3.02e+08	2.67e+06
Th-228	1.60e+09	2.71e+07	5.42e+07	0.00e+00	1.51e+08	8.08e+09	2.79e+06
Th-229	1.21e+11	3.47e+09	2.01e+09	0.00e+00	1.70e+10	2.90e+10	3.86e+05
Th-230	1.83e+10	1.05e+09	5.09e+08	0.00e+00	5.12e+09	4.97e+09	2.98e+05
Th-232	2.05e+10	8.96e+08	7.23e+06	0.00e+00	4.38e+09	4.77e+09	2.54e+05
Th-234	1.30e+04	7.65e+02	3.76e+02	0.00e+00	4.33e+03	1.51e+06	5.62e+05
Pa-231	4.06e+10	1.53e+09	1.58e+09	0.00e+00	8.56e+09	4.60e+08	3.55e+05
Pa-233	9.68e+03	1.94e+03	1.67e+03	0.00e+00	7.32e+03	2.82e+05	8.16e+04
U-232	4.11e+08	0.00e+00	2.93e+07	0.00e+00	4.45e+07	1.78e+09	3.37e+05
U-233	8.72e+07	0.00e+00	5.28e+06	0.00e+00	2.03e+07	4.26e+08	3.11e+05
U-234	8.32e+07	0.00e+00	5.17e+06	0.00e+00	1.99e+07	4.18e+08	3.05e+05
U-235	8.00e+07	0.00e+00	4.86e+06	0.00e+00	1.87e+07	3.92e+08	3.87e+05
U-236	8.00e+07	0.00e+00	4.96e+06	0.00e+00	1.91e+07	4.00e+08	2.86e+05
U-237	2.94e+02	0.00e+00	7.82e+01	0.00e+00	1.21e+03	8.16e+04	9.60e+04
U-238	7.66e+07	0.00e+00	4.54e+06	0.00e+00	1.74e+07	3.66e+08	2.73e+05
Np-237	1.25e+10	8.00e+09	5.50e+08	0.00e+00	4.08e+09	4.18e+08	3.94e+05

Conversion factors are in units of mrem/yr per µCi/cubic meter.

## Offsite Dose Calculation Manual

## Attachment 19

## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	2.37e+03	5.76e+02	3.69e+01	0.00e+00	2.18e+02	8.16e+04	1.70e+05
Np-239	2.30e+02	2.03e+02	1.24e+01	0.00e+00	7.00e+01	3.76e+04	1.19e+05
Pu-238	1.14e+10	7.77e+09	5.52e+08	0.00e+00	2.37e+09	1.46e+09	3.62e+05
Pu-239	1.33e+10	8.56e+09	6.20e+08	0.00e+00	2.64e+09	1.38e+09	3.30e+05
Pu-240	1.32e+10	8.56e+09	6.18e+08	0.00e+00	2.63e+09	1.38e+09	3.37e+05
Pu-241	2.74e+08	6.95e+07	1.03e+07	0.00e+00	4.74e+07	1.22e+06	6.92e+03
Pu-242	1.22e+10	8.24e+09	5.97e+08	0.00e+00	2.54e+09	1.32e+09	3.24e+05
Pu-244	1.43e+10	9.44e+09	6.83e+08	0.00e+00	2.91e+09	1.51e+09	4.82e+05
Am-241	1.34e+10	9.04e+09	5.37e+08	0.00e+00	4.03e+09	4.85e+08	3.68e+05
Am-242m	1.36e+10	8.48e+09	5.38e+08	0.00e+00	4.01e+09	1.95e+08	4.63e+05
Am-243	1.34e+10	8.80e+09	5.26e+08	0.00e+00	3.96e+09	4.60e+08	4.32e+05
Cm-242	1.78e+08	1.42e+08	7.87e+06	0.00e+00	3.58e+07	3.14e+08	3.93e+05
Cm-243	8.80e+09	6.09e+09	3.69e+08	0.00e+00	1.72e+09	5.05e+08	3.87e+05
Cm-244	6.70e+09	4.70e+09	2.81e+08	0.00e+00	1.31e+09	4.85e+08	3.74e+05
Cm-245	1.39e+10	9.12e+09	5.71e+08	0.00e+00	2.66e+09	4.68e+08	3.49e+05
Cm-246	1.38e+10	9.12e+09	5.70e+08	0.00e+00	2.66e+09	4.77e+08	3.43e+05
Cm-247	1.34e+10	8.96e+09	5.62e+08	0.00e+00	2.62e+09	4.68e+08	4.50e+05
Cm-248	1.12e+11	7.41e+10	4.63e+09	0.00e+00	2.16e+10	3.86e+09	7.27e+06
Cf-252	4.34e+09	0.00e+00	1.86e+08	0.00e+00	0.00e+00	1.59e+09	1.42e+06

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	7.25e+02	7.25e+02	7.25e+02	7.25e+02	7.25e+02	7.25e+02
Be-10	2.22e+06	3.46e+05	5.67e+04	0.00e+00	0.00e+00	3.07e+06	1.42e+05
C-14	2.60e+04	4.87e+03	4.87e+03	4.87e+03	4.87e+03	4.87e+03	4.87e+03
N-13	6.92e+01	6.92e+01	6.92e+01	6.92e+01	6.92e+01	6.92e+01	6.92e+01
F-18	5.22e+03	0.00e+00	5.68e+02	0.00e+00	0.00e+00	0.00e+00	3.11e+02
Na-22	1.41e+05	1.41e+05	1.41e+05	1.41e+05	1.41e+05	1.41e+05	1.41e+05
Na-24	1.38e+04	1.38e+04	1.38e+04	1.38e+04	1.38e+04	1.38e+04	1.38e+04
P-32	1.89e+06	1.10e+05	7.16e+04	0.00e+00	0.00e+00	0.00e+00	9.28e+04
Ca-41	3.24e+05	0.00e+00	3.50e+04	0.00e+00	0.00e+00	8.08e+08	2.42e+03
Sc-46	5.79e+05	1.13e+06	3.34e+05	0.00e+00	1.08e+06	0.00e+00	2.38e+05
Cr-51	0.00e+00	0.00e+00	1.35e+02	7.50e+01	3.07e+01	2.10e+04	3.00e+03
Mn-54	0.00e+00	5.11e+04	8.40e+03	0.00e+00	1.27e+04	1.98e+06	6.68e+04
Mn-56	0.00e+00	1.70e+00	2.52e-01	0.00e+00	1.79e+00	1.52e+04	5.74e+04
Fe-55	3.34e+04	2.38e+04	5.54e+03	0.00e+00	0.00e+00	1.24e+05	6.39e+03
Fe-59	1.59e+04	3.70e+04	1.43e+04	0.00e+00	0.00e+00	1.53e+06	1.78e+05
Co-57	0.00e+00	9.44e+02	9.20e+02	0.00e+00	0.00e+00	5.86e+05	3.14e+04
Co-58	0.00e+00	2.07e+03	2.78e+03	0.00e+00	0.00e+00	1.34e+06	9.52e+04
Co-60	0.00e+00	1.51e+04	1.98e+04	0.00e+00	0.00e+00	8.72e+06	2.59e+05
Ni-59	4.35e+04	1.62e+04	7.39e+03	0.00e+00	0.00e+00	1.13e+05	5.18e+03
Ni-63	5.80e+05	4.34e+04	1.98e+04	0.00e+00	0.00e+00	3.07e+05	1.42e+04
Ni-65	2.18e+00	2.93e-01	1.27e-01	0.00e+00	0.00e+00	9.36e+03	3.67e+04
Cu-64	0.00e+00	2.03e+00	8.48e-01	0.00e+00	6.41e+00	1.11e+04	6.14e+04
Zn-65	3.86e+04	1.34e+05	6.24e+04	0.00e+00	8.64e+04	1.24e+06	4.66e+04
Zn-69	4.83e-02	9.20e-02	6.46e-03	0.00e+00	6.02e-02	1.58e+03	2.85e+02
Zn-69m	1.15e+01	2.71e+01	2.49e+00	0.00e+00	1.65e+01	3.14e+04	1.71e+05
Se-79	0.00e+00	4.34e+03	6.97e+02	0.00e+00	6.50e+03	6.17e+05	2.82e+04
Br-82	0.00e+00	0.00e+00	1.82e+04	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
Br-84	0.00e+00	0.00e+00	4.33e+02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	1.83e+01	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.90e+05	8.40e+04	0.00e+00	0.00e+00	0.00e+00	1.77e+04
Rb-87	0.00e+00	1.12e+05	3.66e+04	0.00e+00	0.00e+00	0.00e+00	2.44e+03
Rb-88	0.00e+00	5.46e+02	2.72e+02	0.00e+00	0.00e+00	0.00e+00	2.92e-05
Rb-89	0.00e+00	3.52e+02	2.33e+02	0.00e+00	0.00e+00	0.00e+00	3.38e-07
Sr-89	4.34e+05	0.00e+00	1.25e+04	0.00e+00	0.00e+00	2.42e+06	3.71e+05
Sr-90	3.31e+07	0.00e+00	6.66e+05	0.00e+00	0.00e+00	1.65e+07	7.65e+05
Sr-91	8.80e+01	0.00e+00	3.51e+00	0.00e+00	0.00e+00	6.07e+04	2.59e+05
Sr-92	9.52e+00	0.00e+00	4.06e-01	0.00e+00	0.00e+00	2.74e+04	1.19e+05
Y-90	2.98e+03	0.00e+00	8.00e+01	0.00e+00	0.00e+00	2.93e+05	5.59e+05
Y-91	6.61e+05	0.00e+00	1.77e+04	0.00e+00	0.00e+00	2.94e+06	4.09e+05
Y-91m	3.70e-01	0.00e+00	1.42e-02	0.00e+00	0.00e+00	3.20e+03	3.02e+01
Y-92	1.47e+01	0.00e+00	4.29e-01	0.00e+00	0.00e+00	2.68e+04	1.65e+05
Y-93	1.35e+02	0.00e+00	3.72e+00	0.00e+00	0.00e+00	8.32e+04	5.79e+05
Zr-93	5.46e+05	2.70e+04	1.47e+04	0.00e+00	9.28e+04	2.94e+05	1.28e+04
Zr-95	1.46e+05	4.58e+04	3.15e+04	0.00e+00	6.74e+04	2.69e+06	1.49e+05
Zr-97	1.38e+02	2.72e+01	1.26e+01	0.00e+00	4.12e+01	1.30e+05	6.30e+05
Nb-93m	3.31e+05	1.09e+05	2.73e+04	0.00e+00	1.27e+05	4.29e+05	2.02e+04
Nb-95	1.86e+04	1.03e+04	5.66e+03	0.00e+00	1.00e+04	7.51e+05	9.68e+04
Nb-97	3.14e-01	7.78e-02	2.84e-02	0.00e+00	9.12e-02	3.93e+03	2.17e+03
Mo-93	0.00e+00	1.33e+04	3.62e+02	0.00e+00	4.05e+03	7.05e+05	3.19e+04
Mo-99	0.00e+00	1.69e+02	3.22e+01	0.00e+00	4.11e+02	1.54e+05	2.69e+05
Tc-101	5.92e-05	8.40e-05	8.24e-04	0.00e+00	1.52e-03	6.67e+02	8.72e-07
Tc-99	3.58e+02	5.26e+02	1.43e+02	0.00e+00	6.68e+03	1.39e+06	6.39e+04
Tc-99m	1.38e-03	3.86e-03	4.99e-02	0.00e+00	5.76e-02	1.15e+03	6.13e+03
Ru-103	2.10e+03	0.00e+00	8.96e+02	0.00e+00	7.43e+03	7.83e+05	1.09e+05
Ru-105	1.12e+00	0.00e+00	4.34e-01	0.00e+00	1.41e+00	1.82e+04	9.04e+04
Ru-106	9.84e+04	0.00e+00	1.24e+04	0.00e+00	1.90e+05	1.61e+07	9.60e+05
Rh-105	1.06e+01	7.58e+00	4.99e+00	0.00e+00	3.23e+01	3.27e+04	9.84e+04
Pd-107	0.00e+00	9.36e+02	6.71e+01	0.00e+00	7.51e+03	1.30e+05	5.99e+03
Pd-109	0.00e+00	5.25e+00	1.33e+00	0.00e+00	2.69e+01	2.55e+04	1.57e+05

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.38e+04	1.31e+04	7.99e+03	0.00e+00	2.50e+04	6.75e+06	2.73e+05
Ag-111	4.86e+02	2.02e+02	1.01e+02	0.00e+00	6.54e+02	3.20e+05	2.40e+05
Cd-113m	0.00e+00	1.74e+06	5.68e+04	0.00e+00	1.94e+06	2.87e+06	1.34e+05
Cd-115m	0.00e+00	2.78e+05	9.12e+03	0.00e+00	2.26e+05	2.42e+06	4.08e+05
Sn-123	3.45e+05	7.55e+03	1.12e+04	6.04e+03	0.00e+00	3.97e+06	3.33e+05
Sn-125	1.33e+04	3.54e+02	7.99e+02	2.76e+02	0.00e+00	1.01e+06	5.83e+05
Sn-126	1.74e+06	4.31e+04	6.59e+04	1.14e+04	0.00e+00	1.38e+07	1.34e+05
Sb-124	4.30e+04	7.94e+02	1.68e+04	9.76e+01	0.00e+00	3.85e+06	3.98e+05
Sb-125	7.38e+04	8.08e+02	1.72e+04	7.04e+01	0.00e+00	2.74e+06	9.92e+04
Sb-126	4.95e+03	1.02e+02	1.78e+03	2.80e+01	0.00e+00	1.24e+06	4.81e+05
Sb-127	3.71e+02	7.94e+00	1.40e+02	4.17e+00	0.00e+00	2.65e+05	3.15e+05
Te-125m	4.88e+03	2.24e+03	6.67e+02	1.40e+03	0.00e+00	5.36e+05	7.50e+04
Te-127	2.01e+00	9.12e-01	4.42e-01	1.42e+00	7.28e+00	1.12e+04	8.08e+04
Te-127m	1.80e+04	8.16e+03	2.18e+03	4.38e+03	6.54e+04	1.66e+06	1.59e+05
Te-129	7.10e-02	3.38e-02	1.76e-02	5.18e-02	2.66e-01	3.30e+03	1.62e+03
Te-129m	1.39e+04	6.58e+03	2.25e+03	4.58e+03	5.19e+04	1.98e+06	4.05e+05
Te-131	1.58e-02	8.32e-03	5.04e-03	1.24e-02	6.18e-02	2.34e+03	1.51e+01
Te-131m	9.84e+01	6.01e+01	4.02e+01	7.25e+01	4.39e+02	2.38e+05	6.21e+05
Te-132	3.60e+02	2.90e+02	2.19e+02	2.46e+02	1.95e+03	4.49e+05	4.63e+05
Te-133m	8.08e-02	5.86e-02	4.57e-02	6.54e-02	4.06e-01	6.97e+03	9.84e+02
Te-134	4.25e-02	3.48e-02	2.91e-02	3.57e-02	2.33e-01	5.40e+03	1.10e+01
I-129	2.82e+04	2.35e+04	3.92e+04	2.93e+07	4.21e+04	0.00e+00	1.83e+03
I-130	6.24e+03	1.79e+04	7.17e+03	1.49e+06	2.75e+04	0.00e+00	9.12e+03
I-131	3.54e+04	4.91e+04	2.64e+04	1.46e+07	8.40e+04	0.00e+00	6.49e+03
I-132	1.59e+03	4.38e+03	1.58e+03	1.51e+05	6.92e+03	0.00e+00	1.27e+03
I-133	1.22e+04	2.05e+04	6.22e+03	2.92e+06	3.59e+04	0.00e+00	1.03e+04
I-134	8.88e+02	2.32e+03	8.40e+02	3.95e+04	3.66e+03	0.00e+00	2.04e+01
I-135	3.70e+03	9.44e+03	3.49e+03	6.21e+05	1.49e+04	0.00e+00	6.95e+03
Cs-134	5.02e+05	1.13e+06	5.49e+05	0.00e+00	3.75e+05	1.46e+05	9.76e+03
Cs-134m	1.76e+02	3.48e+02	1.88e+02	0.00e+00	2.03e+02	3.65e+01	1.62e+02

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.66e+05	1.46e+05	3.58e+04	0.00e+00	5.84e+04	2.16e+04	1.78e+03
Cs-136	5.15e+04	1.94e+05	1.37e+05	0.00e+00	1.10e+05	1.78e+04	1.09e+04
Cs-137	6.70e+05	8.48e+05	3.11e+05	0.00e+00	3.04e+05	1.21e+05	8.48e+03
Cs-138	4.66e+02	8.56e+02	4.46e+02	0.00e+00	6.62e+02	7.87e+01	2.70e-01
Cs-139	2.92e+02	4.10e+02	1.58e+02	0.00e+00	3.47e+02	3.89e+01	1.33e-13
Ba-139	1.34e+00	9.44e-04	3.90e-02	0.00e+00	8.88e-04	6.46e+03	6.45e+03
Ba-140	5.47e+04	6.70e+01	3.52e+03	0.00e+00	2.28e+01	2.03e+06	2.29e+05
Ba-141	1.42e-01	1.06e-04	4.74e-03	0.00e+00	9.84e-05	3.29e+03	7.46e-04
Ba-142	3.70e-02	3.70e-05	2.27e-03	0.00e+00	3.14e-05	1.91e+03	4.79e-10
La-140	4.79e+02	2.36e+02	6.26e+01	0.00e+00	0.00e+00	2.14e+05	4.87e+05
La-141	6.10e+00	1.88e+00	3.10e-01	0.00e+00	0.00e+00	1.85e+04	1.23e+05
La-142	9.60e-01	4.25e-01	1.06e-01	0.00e+00	0.00e+00	1.02e+04	1.20e+04
Ce-141	2.84e+04	1.90e+04	2.17e+03	0.00e+00	8.88e+03	6.14e+05	1.26e+05
Ce-143	2.66e+02	1.94e+02	2.16e+01	0.00e+00	8.64e+01	1.30e+05	2.55e+05
Ce-144	4.89e+06	2.02e+06	2.62e+05	0.00e+00	1.21e+06	1.34e+07	8.64e+05
Pr-143	1.34e+04	5.31e+03	6.62e+02	0.00e+00	3.09e+03	4.83e+05	2.14e+05
Pr-144	4.30e-02	1.76e-02	2.18e-03	0.00e+00	1.01e-02	1.75e+03	2.35e-04
Nd-147	7.86e+03	8.56e+03	5.13e+02	0.00e+00	5.02e+03	3.72e+05	1.82e+05
Pm-147	9.20e+05	8.80e+04	3.60e+04	0.00e+00	1.68e+05	9.12e+05	4.70e+04
Pm-148	4.35e+03	7.10e+02	3.58e+02	0.00e+00	1.28e+03	5.22e+05	4.91e+05
Pm-148m	1.06e+05	2.68e+04	2.10e+04	0.00e+00	4.06e+04	2.56e+06	3.28e+05
Pm-149	3.93e+02	5.51e+01	2.27e+01	0.00e+00	1.05e+02	9.92e+04	2.23e+05
Pm-151	9.60e+01	1.59e+01	8.08e+00	0.00e+00	2.86e+01	5.25e+04	1.82e+05
Sm-151	8.56e+05	1.68e+05	3.89e+04	0.00e+00	1.82e+05	6.14e+05	2.82e+04
Sm-153	1.94e+02	1.61e+02	1.18e+01	0.00e+00	5.25e+01	5.69e+04	1.42e+05
Eu-152	2.37e+06	5.75e+05	5.04e+05	0.00e+00	2.67e+06	4.01e+06	1.08e+05
Eu-154	7.54e+06	9.84e+05	6.88e+05	0.00e+00	4.35e+06	7.30e+06	2.67e+05
Eu-155	1.60e+06	1.57e+05	9.68e+04	0.00e+00	6.12e+05	1.21e+07	4.78e+05
Eu-156	2.16e+04	1.62e+04	2.64e+03	0.00e+00	1.09e+04	1.10e+06	3.65e+05
Tb-160	2.43e+05	0.00e+00	3.03e+04	0.00e+00	9.60e+04	2.38e+06	2.08e+05

Conversion factors are in units of mrem/yr per μCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	3.52e+06	1.09e+06	7.90e+05	0.00e+00	1.60e+06	4.99e+06	1.34e+05
W-181	7.12e+01	2.30e+01	2.41e+00	0.00e+00	0.00e+00	2.36e+04	2.15e+03
W-185	2.22e+03	7.34e+02	7.78e+01	0.00e+00	0.00e+00	7.68e+05	9.12e+04
W-187	1.20e+01	9.76e+00	3.43e+00	0.00e+00	0.00e+00	4.74e+04	1.77e+05
Pb-210	2.47e+08	6.62e+07	8.56e+06	0.00e+00	2.36e+08	3.62e+08	1.28e+04
Bi-210	2.64e+03	1.81e+04	1.51e+03	0.00e+00	2.19e+05	1.53e+07	2.55e+05
Po-210	4.54e+06	9.76e+06	1.10e+06	0.00e+00	3.37e+07	4.33e+08	3.56e+05
Ra-223	2.06e+06	3.14e+03	4.11e+05	0.00e+00	8.96e+04	3.51e+08	2.43e+06
Ra-224	2.26e+05	5.42e+02	4.52e+04	0.00e+00	1.54e+04	1.21e+08	2.63e+06
Ra-225	3.42e+06	4.03e+03	6.85e+05	0.00e+00	1.15e+05	4.03e+08	2.31e+06
Ra-226	1.06e+09	2.70e+04	7.90e+08	0.00e+00	7.74e+05	1.62e+09	2.49e+06
Ra-228	4.27e+08	1.39e+04	4.70e+08	0.00e+00	3.98e+05	2.22e+09	4.24e+05
Ac-225	4.83e+06	6.60e+06	3.25e+05	0.00e+00	7.58e+05	3.05e+08	2.16e+06
Ac-227	1.99e+10	2.95e+09	1.18e+09	0.00e+00	8.56e+08	3.33e+09	4.30e+05
Th-227	2.47e+06	4.45e+04	7.14e+04	0.00e+00	2.54e+05	5.20e+08	2.86e+06
Th-228	2.08e+09	3.50e+07	7.02e+07	0.00e+00	1.96e+08	1.35e+10	2.96e+06
Th-229	1.23e+11	3.55e+09	2.05e+09	0.00e+00	1.74e+10	4.19e+10	4.10e+05
Th-230	1.87e+10	1.07e+09	5.19e+08	0.00e+00	5.24e+09	7.18e+09	3.16e+05
Th-232	2.09e+10	9.12e+08	7.37e+06	0.00e+00	4.48e+09	6.88e+09	2.69e+05
Th-234	1.86e+04	1.08e+03	5.37e+02	0.00e+00	6.18e+03	2.61e+06	5.99e+05
Pa-231	4.26e+10	1.60e+09	1.66e+09	0.00e+00	8.96e+09	7.93e+08	3.77e+05
Pa-233	1.34e+04	2.59e+03	2.31e+03	0.00e+00	9.76e+03	4.31e+05	8.00e+04
U-232	5.85e+08	0.00e+00	4.18e+07	0.00e+00	6.35e+07	3.07e+09	3.57e+05
U-233	1.24e+08	0.00e+00	7.54e+06	0.00e+00	2.90e+07	7.34e+08	3.30e+05
U-234	1.18e+08	0.00e+00	7.38e+06	0.00e+00	2.84e+07	7.19e+08	3.23e+05
U-235	1.14e+08	0.00e+00	6.94e+06	0.00e+00	2.67e+07	6.75e+08	4.10e+05
U-236	1.14e+08	0.00e+00	7.09e+06	0.00e+00	2.73e+07	6.90e+08	3.03e+05
U-237	4.20e+02	0.00e+00	1.12e+02	0.00e+00	1.73e+03	1.41e+05	1.03e+05
U-238	1.09e+08	0.00e+00	6.48e+06	0.00e+00	2.50e+07	6.31e+08	2.90e+05
Np-237	1.31e+10	8.48e+09	5.77e+08	0.00e+00	4.28e+09	7.19e+08	4.18e+05

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.



## Offsite Dose Calculation Manual

## Attachment 19

## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.38e+03	8.16e+02	5.27e+01	0.00e+00	3.10e+02	1.40e+05	1.90e+05
Np-239	3.38e+02	2.88e+02	1.77e+01	0.00e+00	1.00e+02	6.49e+04	1.32e+05
Pu-238	1.20e+10	8.24e+09	5.78e+08	0.00e+00	2.48e+09	2.50e+09	3.83e+05
Pu-239	1.38e+10	8.96e+09	6.44e+08	0.00e+00	2.75e+09	2.34e+09	3.50e+05
Pu-240	1.38e+10	8.96e+09	6.43e+08	0.00e+00	2.74e+09	2.34e+09	3.57e+05
Pu-241	2.99e+08	7.65e+07	1.12e+07	0.00e+00	5.18e+07	2.08e+06	7.34e+03
Pu-242	1.28e+10	8.64e+09	6.20e+08	0.00e+00	2.65e+09	2.26e+09	3.43e+05
Pu-244	1.50e+10	9.92e+09	7.10e+08	0.00e+00	3.03e+09	2.58e+09	5.11e+05
Am-241	1.42e+10	9.60e+09	5.68e+08	0.00e+00	4.26e+09	8.40e+08	3.90e+05
Am-242m	1.43e+10	9.04e+09	5.72e+08	0.00e+00	4.24e+09	3.37e+08	4.91e+05
Am-243	1.42e+10	9.36e+09	5.56e+08	0.00e+00	4.17e+09	7.93e+08	4.58e+05
Cm-242	2.54e+08	2.01e+08	1.13e+07	0.00e+00	5.12e+07	5.41e+08	4.17e+05
Cm-243	9.52e+09	6.64e+09	4.00e+08	0.00e+00	1.87e+09	8.72e+08	4.10e+05
Cm-244	7.35e+09	5.22e+09	3.10e+08	0.00e+00	1.45e+09	8.40e+08	3.97e+05
Cm-245	1.46e+10	9.76e+09	6.02e+08	0.00e+00	2.82e+09	8.08e+08	3.70e+05
Cm-246	1.45e+10	9.76e+09	6.02e+08	0.00e+00	2.81e+09	8.24e+08	3.63e+05
Cm-247	1.42e+10	9.52e+09	5.93e+08	0.00e+00	2.77e+09	8.08e+08	4.78e+05
Cm-248	1.18e+11	7.86e+10	4.89e+09	0.00e+00	2.28e+10	6.66e+09	7.70e+06
Cf-252	5.73e+09	0.00e+00	2.46e+08	0.00e+00	0.00e+00	2.74e+09	1.51e+06

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	6.40e+02	6.40e+02	6.40e+02	6.40e+02	6.40e+02	6.40e+02
Be-10	3.12e+06	3.64e+05	7.84e+04	0.00e+00	0.00e+00	2.74e+06	6.36e+04
C-14	3.59e+04	6.73e+03	6.73e+03	6.73e+03	6.73e+03	6.73e+03	6.73e+03
N-13	8.62e+01	8.62e+01	8.62e+01	8.62e+01	8.62e+01	8.62e+01	8.62e+01
F-18	6.96e+03	0.00e+00	6.84e+02	0.00e+00	0.00e+00	0.00e+00	1.25e+03
Na-22	1.63e+05	1.63e+05	1.63e+05	1.63e+05	1.63e+05	1.63e+05	1.63e+05
Na-24	1.61e+04	1.61e+04	1.61e+04	1.61e+04	1.61e+04	1.61e+04	1.61e+04
P-32	2.60e+06	1.14e+05	9.88e+04	0.00e+00	0.00e+00	0.00e+00	4.22e+04
Ca-41	2.61e+05	0.00e+00	2.85e+04	0.00e+00	0.00e+00	2.67e+08	1.09e+03
Sc-46	7.29e+05	9.99e+05	3.85e+05	0.00e+00	8.84e+05	0.00e+00	9.06e+04
Cr-51	0.00e+00	0.00e+00	1.54e+02	8.55e+01	2.43e+01	1.70e+04	1.08e+03
Mn-54	0.00e+00	4.29e+04	9.51e+03	0.00e+00	1.00e+04	1.58e+06	2.29e+04
Mn-56	0.00e+00	1.66e+00	3.12e-01	0.00e+00	1.67e+00	1.31e+04	1.23e+05
Fe-55	4.74e+04	2.52e+04	7.77e+03	0.00e+00	0.00e+00	1.11e+05	2.87e+03
Fe-59	2.07e+04	3.34e+04	1.67e+04	0.00e+00	0.00e+00	1.27e+06	7.07e+04
Co-57	0.00e+00	9.03e+02	1.07e+03	0.00e+00	0.00e+00	5.07e+05	1.32e+04
Co-58	0.00e+00	1.77e+03	3.16e+03	0.00e+00	0.00e+00	1.11e+06	3.44e+04
Co-60	0.00e+00	1.31e+04	2.26e+04	0.00e+00	0.00e+00	7.07e+06	9.62e+04
Ni-59	6.14e+04	1.73e+04	1.05e+04	0.00e+00	0.00e+00	1.01e+05	2.33e+03
Ni-63	8.21e+05	4.62e+04	2.80e+04	0.00e+00	0.00e+00	2.75e+05	6.33e+03
Ni-65	2.99e+00	2.96e-01	1.64e-01	0.00e+00	0.00e+00	8.18e+03	8.40e+04
Cu-64	0.00e+00	1.99e+00	1.07e+00	0.00e+00	6.03e+00	9.58e+03	3.67e+04
Zn-65	4.26e+04	1.13e+05	7.03e+04	0.00e+00	7.14e+04	9.95e+05	1.63e+04
Zn-69	6.70e-02	9.66e-02	8.92e-03	0.00e+00	5.85e-02	1.42e+03	1.02e+04
Zn-69m	1.58e+01	2.69e+01	3.18e+00	0.00e+00	1.56e+01	2.72e+04	1.00e+05
Se-79	0.00e+00	4.55e+03	9.62e+02	0.00e+00	6.33e+03	5.51e+05	1.27e+04
Br-82	0.00e+00	0.00e+00	2.09e+04	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
Br-84	0.00e+00	0.00e+00	5.48e+02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	2.53e+01	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.98e+05	1.14e+05	0.00e+00	0.00e+00	0.00e+00	7.99e+03
Rb-87	0.00e+00	1.17e+05	5.07e+04	0.00e+00	0.00e+00	0.00e+00	1.10e+03
Rb-88	0.00e+00	5.62e+02	3.66e+02	0.00e+00	0.00e+00	0.00e+00	1.72e+01
Rb-89	0.00e+00	3.45e+02	2.90e+02	0.00e+00	0.00e+00	0.00e+00	1.89e+00
Sr-89	5.99e+05	0.00e+00	1.72e+04	0.00e+00	0.00e+00	2.16e+06	1.67e+05
Sr-90	3.85e+07	0.00e+00	7.66e+05	0.00e+00	0.00e+00	1.48e+07	3.43e+05
Sr-91	1.21e+02	0.00e+00	4.59e+00	0.00e+00	0.00e+00	5.33e+04	1.74e+05
Sr-92	1.31e+01	0.00e+00	5.25e-01	0.00e+00	0.00e+00	2.40e+04	2.42e+05
Y-90	4.11e+03	0.00e+00	1.11e+02	0.00e+00	0.00e+00	2.62e+05	2.68e+05
Y-91	9.14e+05	0.00e+00	2.44e+04	0.00e+00	0.00e+00	2.63e+06	1.84e+05
Y-91m	5.07e-01	0.00e+00	1.84e-02	0.00e+00	0.00e+00	2.81e+03	1.72e+03
Y-92	2.03e+01	0.00e+00	5.81e-01	0.00e+00	0.00e+00	2.39e+04	2.39e+05
Y-93	1.86e+02	0.00e+00	5.11e+00	0.00e+00	0.00e+00	7.44e+04	3.88e+05
Zr-93	7.66e+05	2.89e+04	2.05e+04	0.00e+00	1.11e+05	2.63e+05	5.44e+03
Zr-95	1.90e+05	4.18e+04	3.70e+04	0.00e+00	5.96e+04	2.23e+06	6.11e+04
Zr-97	1.88e+02	2.72e+01	1.60e+01	0.00e+00	3.88e+01	1.13e+05	3.51e+05
Nb-93m	4.70e+05	1.17e+05	3.85e+04	0.00e+00	1.27e+05	3.85e+05	9.06e+03
Nb-95	2.35e+04	9.18e+03	6.55e+03	0.00e+00	8.62e+03	6.14e+05	3.70e+04
Nb-97	4.29e-01	7.70e-02	3.60e-02	0.00e+00	8.55e-02	3.42e+03	2.78e+04
Mo-93	0.00e+00	1.39e+04	5.00e+02	0.00e+00	3.92e+03	6.29e+05	1.40e+04
Mo-99	0.00e+00	1.72e+02	4.26e+01	0.00e+00	3.92e+02	1.35e+05	1.27e+05
Tc-101	8.10e-05	8.51e-05	1.08e-03	0.00e+00	1.45e-03	5.85e+02	1.63e+01
Tc-99	4.96e+02	5.51e+02	1.98e+02	0.00e+00	6.48e+03	1.25e+06	2.87e+04
Tc-99m	1.78e-03	3.48e-03	5.77e-02	0.00e+00	5.07e-02	9.51e+02	4.81e+03
Ru-103	2.79e+03	0.00e+00	1.07e+03	0.00e+00	7.03e+03	6.62e+05	4.48e+04
Ru-105	1.53e+00	0.00e+00	5.55e-01	0.00e+00	1.34e+00	1.59e+04	9.95e+04
Ru-106	1.36e+05	0.00e+00	1.69e+04	0.00e+00	1.84e+05	1.43e+07	4.29e+05
Rh-105	1.45e+01	7.77e+00	6.62e+00	0.00e+00	3.10e+01	2.89e+04	4.92e+04
Pd-107	0.00e+00	9.80e+02	9.29e+01	0.00e+00	7.29e+03	1.17e+05	2.69e+03
Pd-109	0.00e+00	5.48e+00	1.83e+00	0.00e+00	2.61e+01	2.28e+04	9.58e+04

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.69e+04	1.14e+04	9.14e+03	0.00e+00	2.12e+04	5.48e+06	1.00e+05
Ag-111	6.70e+02	2.10e+02	1.39e+02	0.00e+00	6.33e+02	2.86e+05	1.10e+05
Cd-113m	0.00e+00	1.82e+06	7.84e+04	0.00e+00	1.90e+06	2.57e+06	6.03e+04
Cd-115m	0.00e+00	2.92e+05	1.25e+04	0.00e+00	2.19e+05	2.17e+06	1.84e+05
Sn-123	4.77e+05	7.92e+03	1.55e+04	8.40e+03	0.00e+00	3.55e+06	1.50e+05
Sn-125	1.83e+04	3.68e+02	1.09e+03	3.81e+02	0.00e+00	8.99e+05	2.65e+05
Sn-126	2.31e+06	3.85e+04	8.73e+04	1.05e+04	0.00e+00	1.12e+07	6.03e+04
Sb-124	5.74e+04	7.40e+02	2.00e+04	1.26e+02	0.00e+00	3.24e+06	1.64e+05
Sb-125	9.84e+04	7.58e+02	2.07e+04	9.10e+01	0.00e+00	2.32e+06	4.03e+04
Sb-126	6.36e+03	9.69e+01	2.28e+03	3.70e+01	0.00e+00	1.06e+06	2.10e+05
Sb-127	5.03e+02	7.73e+00	1.74e+02	5.59e+00	0.00e+00	2.28e+05	1.41e+05
Te-125m	6.73e+03	2.33e+03	9.14e+02	1.92e+03	0.00e+00	4.77e+05	3.38e+04
Te-127	2.77e+00	9.51e-01	6.10e-01	1.96e+00	7.07e+00	1.00e+04	5.62e+04
Te-127m	2.49e+04	8.55e+03	3.02e+03	6.07e+03	6.36e+04	1.48e+06	7.14e+04
Te-129	9.77e-02	3.50e-02	2.38e-02	7.14e-02	2.57e-01	2.93e+03	2.55e+04
Te-129m	1.92e+04	6.84e+03	3.04e+03	6.33e+03	5.03e+04	1.76e+06	1.82e+05
Te-131	2.17e-02	8.44e-03	6.59e-03	1.70e-02	5.88e-02	2.05e+03	1.33e+03
Te-131m	1.34e+02	5.92e+01	5.07e+01	9.77e+01	4.00e+02	2.06e+05	3.08e+05
Te-132	4.81e+02	2.72e+02	2.63e+02	3.17e+02	1.77e+03	3.77e+05	1.38e+05
Te-133m	1.08e-01	5.59e-02	5.55e-02	8.58e-02	3.74e-01	5.92e+03	1.76e+04
Te-134	5.66e-02	3.26e-02	3.48e-02	4.59e-02	2.11e-01	4.55e+03	1.80e+03
I-129	3.88e+04	2.37e+04	2.11e+04	1.58e+07	4.00e+04	0.00e+00	7.96e+02
I-130	8.18e+03	1.64e+04	8.44e+03	1.85e+06	2.45e+04	0.00e+00	5.11e+03
I-131	4.81e+04	4.81e+04	2.73e+04	1.62e+07	7.88e+04	0.00e+00	2.84e+03
I-132	2.12e+03	4.07e+03	1.88e+03	1.94e+05	6.25e+03	0.00e+00	3.20e+03
I-133	1.66e+04	2.03e+04	7.70e+03	3.85e+06	3.38e+04	0.00e+00	5.48e+03
I-134	1.17e+03	2.16e+03	9.95e+02	5.07e+04	3.30e+03	0.00e+00	9.55e+02
I-135	4.92e+03	8.73e+03	4.14e+03	7.92e+05	1.34e+04	0.00e+00	4.44e+03
Cs-134	6.51e+05	1.01e+06	2.25e+05	0.00e+00	3.30e+05	1.21e+05	3.85e+03
Cs-134m	2.34e+02	3.30e+02	2.26e+02	0.00e+00	1.83e+02	3.09e+01	2.93e+02

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	2.31e+05	1.53e+05	1.65e+04	0.00e+00	5.66e+04	1.93e+04	8.03e+02
Cs-136	6.51e+04	1.71e+05	1.16e+05	0.00e+00	9.55e+04	1.45e+04	4.18e+03
Cs-137	9.06e+05	8.25e+05	1.28e+05	0.00e+00	2.82e+05	1.04e+05	3.62e+03
Cs-138	6.33e+02	8.40e+02	5.55e+02	0.00e+00	6.22e+02	6.81e+01	2.70e+02
Cs-139	4.03e+02	4.26e+02	2.15e+02	0.00e+00	3.36e+02	3.46e+01	2.68e-02
Ba-139	1.84e+00	9.84e-04	5.36e-02	0.00e+00	8.62e-04	5.77e+03	5.77e+04
Ba-140	7.40e+04	6.48e+01	4.33e+03	0.00e+00	2.11e+01	1.74e+06	1.02e+05
Ba-141	1.96e-01	1.09e-04	6.36e-03	0.00e+00	9.47e-05	2.92e+03	2.75e+02
Ba-142	5.00e-02	3.60e-05	2.79e-03	0.00e+00	2.91e-05	1.64e+03	2.74e+00
La-140	6.44e+02	2.25e+02	7.55e+01	0.00e+00	0.00e+00	1.83e+05	2.26e+05
La-141	8.44e+00	1.96e+00	4.26e-01	0.00e+00	0.00e+00	1.66e+04	1.62e+05
La-142	1.30e+00	4.11e-01	1.29e-01	0.00e+00	0.00e+00	8.70e+03	7.58e+04
Ce-141	3.92e+04	1.95e+04	2.90e+03	0.00e+00	8.55e+03	5.44e+05	5.66e+04
Ce-143	3.66e+02	1.99e+02	2.87e+01	0.00e+00	8.36e+01	1.15e+05	1.27e+05
Ce-144	6.77e+06	2.12e+06	3.61e+05	0.00e+00	1.17e+06	1.20e+07	3.88e+05
Pr-143	1.85e+04	5.55e+03	9.14e+02	0.00e+00	3.00e+03	4.33e+05	9.73e+04
Pr-144	5.96e-02	1.85e-02	3.00e-03	0.00e+00	9.77e-03	1.57e+03	1.97e+02
Nd-147	1.08e+04	8.73e+03	6.81e+02	0.00e+00	4.81e+03	3.28e+05	8.21e+04
Pm-147	1.30e+06	9.32e+04	5.03e+04	0.00e+00	1.65e+05	8.14e+05	2.11e+04
Pm-148	5.96e+03	7.18e+02	4.62e+02	0.00e+00	1.22e+03	4.59e+05	2.22e+05
Pm-148m	1.22e+05	2.42e+04	2.42e+04	0.00e+00	3.60e+04	2.12e+06	1.32e+05
Pm-149	5.44e+02	5.77e+01	3.13e+01	0.00e+00	1.02e+02	8.88e+04	1.08e+05
Pm-151	1.32e+02	1.60e+01	1.04e+01	0.00e+00	2.72e+01	4.59e+04	9.25e+04
Sm-151	1.16e+06	1.76e+05	5.51e+04	0.00e+00	1.81e+05	5.48e+05	1.27e+04
Sm-153	2.68e+02	1.67e+02	1.61e+01	0.00e+00	5.07e+01	5.07e+04	6.92e+04
Eu-152	2.75e+06	5.07e+05	5.96e+05	0.00e+00	2.12e+06	3.33e+06	4.22e+04
Eu-154	1.01e+07	9.21e+05	8.40e+05	0.00e+00	4.03e+06	6.14e+06	1.10e+05
Eu-155	2.07e+06	1.50e+05	1.18e+05	0.00e+00	5.59e+05	1.03e+06	1.99e+05
Eu-156	2.92e+04	1.57e+04	3.24e+03	0.00e+00	1.01e+04	9.40e+05	1.57e+05
Tb-160	2.88e+05	0.00e+00	3.58e+04	0.00e+00	8.58e+04	1.98e+06	8.44e+04

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	4.96e+06	1.04e+06	8.77e+05	0.00e+00	1.48e+06	4.18e+06	6.03e+04
W-181	9.84e+01	2.41e+01	3.33e+00	0.00e+00	0.00e+00	2.11e+04	9.66e+02
W-185	3.07e+03	7.70e+02	1.08e+02	0.00e+00	0.00e+00	6.88e+05	4.11e+04
W-187	1.63e+01	9.66e+00	4.33e+00	0.00e+00	0.00e+00	4.11e+04	9.10e+04
Pb-210	2.97e+08	6.84e+07	1.18e+07	0.00e+00	2.33e+08	3.23e+08	5.74e+03
Bi-210	3.64e+03	1.89e+04	2.09e+03	0.00e+00	2.13e+05	1.37e+07	1.19e+05
Po-210	6.29e+06	1.02e+07	1.51e+06	0.00e+00	3.27e+07	3.88e+08	1.60e+05
Ra-223	2.85e+06	3.29e+03	5.70e+05	0.00e+00	8.73e+04	3.14e+08	1.11e+06
Ra-224	3.12e+05	5.66e+02	6.25e+04	0.00e+00	1.50e+04	1.08e+08	1.24e+06
Ra-225	4.74e+06	4.22e+03	9.47e+05	0.00e+00	1.12e+05	3.60e+08	1.05e+06
Ra-226	8.66e+08	2.83e+04	7.10e+08	0.00e+00	7.51e+05	1.44e+09	1.12e+06
Ra-228	5.51e+08	1.46e+04	6.22e+08	0.00e+00	3.85e+05	1.99e+09	1.90e+05
Ac-225	6.70e+06	6.92e+06	4.48e+05	0.00e+00	7.36e+05	2.73e+08	9.88e+05
Ac-227	1.84e+10	2.98e+09	1.14e+09	0.00e+00	6.55e+08	2.97e+09	1.93e+05
Th-227	3.42e+06	4.66e+04	9.88e+04	0.00e+00	2.47e+05	4.66e+08	1.29e+06
Th-228	2.98e+09	3.85e+07	1.01e+08	0.00e+00	2.00e+08	1.24e+10	1.33e+06
Th-229	8.07e+10	2.12e+09	1.34e+09	0.00e+00	1.05e+10	4.00e+10	1.85e+05
Th-230	1.22e+10	6.40e+08	3.40e+08	0.00e+00	3.15e+09	6.84e+09	1.42e+05
Th-232	1.36e+10	5.44e+08	4.74e+06	0.00e+00	2.69e+09	6.55e+09	1.21e+05
Th-234	2.57e+04	1.14e+03	7.40e+02	0.00e+00	5.99e+03	2.33e+06	2.71e+05
Pa-231	3.19e+10	1.06e+09	1.27e+09	0.00e+00	5.77e+09	7.10e+08	1.69e+05
Pa-233	1.53e+04	2.40e+03	2.68e+03	0.00e+00	8.81e+03	3.61e+05	3.31e+04
U-232	8.10e+08	0.00e+00	5.77e+07	0.00e+00	6.18e+07	2.75e+09	1.60e+05
U-233	1.72e+08	0.00e+00	1.04e+07	0.00e+00	2.82e+07	6.55e+08	1.48e+05
U-234	1.65e+08	0.00e+00	1.02e+07	0.00e+00	2.76e+07	6.44e+08	1.45e+05
U-235	1.58e+08	0.00e+00	9.58e+06	0.00e+00	2.59e+07	6.03e+08	1.84e+05
U-236	1.58e+08	0.00e+00	9.80e+06	0.00e+00	2.65e+07	6.18e+08	1.36e+05
U-237	5.81e+02	0.00e+00	1.54e+02	0.00e+00	1.68e+03	1.26e+05	4.77e+04
U-238	1.51e+08	0.00e+00	8.95e+06	0.00e+00	2.42e+07	5.66e+08	1.30e+05
Np-237	1.01e+10	5.99e+09	4.40e+08	0.00e+00	2.74e+09	6.44e+08	1.87e+05

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	4.66e+03	8.51e+02	7.29e+01	0.00e+00	3.02e+02	1.25e+05	9.25e+04
Np-239	4.66e+02	3.01e+02	2.35e+01	0.00e+00	9.73e+01	5.81e+04	6.40e+04
Pu-238	9.44e+09	5.92e+09	4.48e+08	0.00e+00	1.65e+09	2.25e+09	1.72e+05
Pu-239	1.03e+10	6.22e+09	4.74e+08	0.00e+00	1.77e+09	2.12e+09	1.57e+05
Pu-240	1.03e+10	6.22e+09	4.70e+08	0.00e+00	1.76e+09	2.11e+09	1.60e+05
Pu-241	2.94e+08	6.48e+07	1.08e+07	0.00e+00	4.07e+07	1.87e+06	3.29e+03
Pu-242	9.58e+09	5.99e+09	4.55e+08	0.00e+00	1.70e+09	2.04e+09	1.54e+05
Pu-244	1.12e+10	6.84e+09	5.22e+08	0.00e+00	1.95e+09	2.33e+09	2.29e+05
Am-241	1.10e+10	6.81e+09	4.59e+08	0.00e+00	2.82e+09	7.47e+08	1.75e+05
Am-242m	1.14e+10	6.51e+09	4.70e+08	0.00e+00	2.85e+09	3.01e+08	2.21e+05
Am-243	1.09e+10	6.59e+09	4.44e+08	0.00e+00	2.75e+09	7.10e+08	2.05e+05
Cm-242	3.51e+08	2.10e+08	1.55e+07	0.00e+00	4.96e+07	4.85e+08	1.87e+05
Cm-243	8.58e+09	5.25e+09	3.68e+08	0.00e+00	1.38e+09	7.77e+08	1.84e+05
Cm-244	7.18e+09	4.37e+09	3.07e+08	0.00e+00	1.13e+09	7.47e+08	1.78e+05
Cm-245	1.13e+10	6.81e+09	4.74e+08	0.00e+00	1.86e+09	7.22e+08	1.66e+05
Cm-246	1.12e+10	6.81e+09	4.74e+08	0.00e+00	1.86e+09	7.36e+08	1.63e+05
Cm-247	1.09e+10	6.73e+09	4.66e+08	0.00e+00	1.83e+09	7.22e+08	2.15e+05
Cm-248	9.06e+10	5.55e+10	3.85e+09	0.00e+00	1.51e+10	5.96e+09	3.46e+06
Cf-252	8.07e+09	0.00e+00	3.45e+08	0.00e+00	0.00e+00	2.45e+09	6.81e+05

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	3.68e+02	3.68e+02	3.68e+02	3.68e+02	3.68e+02	3.68e+02
Be-10	1.33e+06	1.75e+05	3.71e+04	0.00e+00	0.00e+00	2.09e+06	2.42e+04
C-14	2.65e+04	5.31e+03	5.31e+03	5.31e+03	5.31e+03	5.31e+03	5.31e+03
N-13	6.15e+01	6.15e+01	6.15e+01	6.15e+01	6.15e+01	6.15e+01	6.15e+01
F-18	5.49e+03	0.00e+00	4.66e+02	0.00e+00	0.00e+00	0.00e+00	8.54e+02
Na-22	1.03e+05	1.03e+05	1.03e+05	1.03e+05	1.03e+05	1.03e+05	1.03e+05
Na-24	1.06e+04	1.06e+04	1.06e+04	1.06e+04	1.06e+04	1.06e+04	1.06e+04
P-32	2.03e+06	1.12e+05	7.74e+04	0.00e+00	0.00e+00	0.00e+00	1.61e+04
Ca-41	1.05e+05	0.00e+00	1.14e+04	0.00e+00	0.00e+00	9.72e+07	4.14e+02
Sc-46	5.25e+05	7.57e+05	2.37e+05	0.00e+00	4.98e+05	0.00e+00	3.07e+04
Cr-51	0.00e+00	0.00e+00	8.95e+01	5.75e+01	1.32e+01	1.28e+04	3.57e+02
Mn-54	0.00e+00	2.53e+04	4.98e+03	0.00e+00	4.98e+03	1.00e+06	7.06e+03
Mn-56	0.00e+00	1.54e+00	2.21e-01	0.00e+00	1.10e+00	1.25e+04	7.17e+04
Fe-55	1.97e+04	1.17e+04	3.33e+03	0.00e+00	0.00e+00	8.69e+04	1.09e+03
Fe-59	1.36e+04	2.35e+04	9.48e+03	0.00e+00	0.00e+00	1.01e+06	2.48e+04
Co-57	0.00e+00	6.51e+02	6.41e+02	0.00e+00	0.00e+00	3.79e+05	4.86e+03
Co-58	0.00e+00	1.22e+03	1.82e+03	0.00e+00	0.00e+00	7.77e+05	1.11e+04
Co-60	0.00e+00	8.02e+03	1.18e+04	0.00e+00	0.00e+00	4.51e+06	3.19e+04
Ni-59	2.53e+04	7.62e+03	4.34e+03	0.00e+00	0.00e+00	7.67e+04	8.88e+02
Ni-63	3.39e+05	2.04e+04	1.16e+04	0.00e+00	0.00e+00	2.09e+05	2.42e+03
Ni-65	2.39e+00	2.84e-01	1.23e-01	0.00e+00	0.00e+00	8.12e+03	5.01e+04
Cu-64	0.00e+00	1.88e+00	7.74e-01	0.00e+00	3.98e+00	9.30e+03	1.50e+04
Zn-65	1.93e+04	6.26e+04	3.11e+04	0.00e+00	3.25e+04	6.47e+05	5.14e+04
Zn-69	5.39e-02	9.67e-02	7.18e-03	0.00e+00	4.02e-02	1.47e+03	1.32e+04
Zn-69m	1.26e+01	2.58e+01	2.34e+00	0.00e+00	1.04e+01	2.67e+04	4.09e+04
Se-79	0.00e+00	3.15e+03	5.88e+02	0.00e+00	3.46e+03	4.19e+05	4.84e+03
Br-82	0.00e+00	0.00e+00	1.33e+04	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
Br-84	0.00e+00	0.00e+00	4.00e+02	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	2.04e+01	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem/yr per  $\mu$ Ci/cubic meter.



## Offsite Dose Calculation Manual

## Attachment 19

## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.90e+05	8.82e+04	0.00e+00	0.00e+00	0.00e+00	3.04e+03
Rb-87	0.00e+00	9.95e+04	3.70e+04	0.00e+00	0.00e+00	0.00e+00	4.19e+02
Rb-88	0.00e+00	5.57e+02	2.87e+02	0.00e+00	0.00e+00	0.00e+00	3.39e+02
Rb-89	0.00e+00	3.21e+02	2.06e+02	0.00e+00	0.00e+00	0.00e+00	6.82e+01
Sr-89	3.98e+05	0.00e+00	1.14e+04	0.00e+00	0.00e+00	2.03e+06	6.40e+04
Sr-90	1.55e+07	0.00e+00	3.12e+05	0.00e+00	0.00e+00	1.12e+07	1.31e+05
Sr-91	9.56e+01	0.00e+00	3.46e+00	0.00e+00	0.00e+00	5.26e+04	7.34e+04
Sr-92	1.05e+01	0.00e+00	3.91e-01	0.00e+00	0.00e+00	2.38e+04	1.40e+05
Y-90	3.29e+03	0.00e+00	8.82e+01	0.00e+00	0.00e+00	2.69e+05	1.04e+05
Y-91	5.88e+05	0.00e+00	1.57e+04	0.00e+00	0.00e+00	2.45e+06	7.03e+04
Y-91m	4.07e-01	0.00e+00	1.39e-02	0.00e+00	0.00e+00	2.79e+03	2.35e+03
Y-92	1.64e+01	0.00e+00	4.61e-01	0.00e+00	0.00e+00	2.45e+04	1.27e+05
Y-93	1.50e+02	0.00e+00	4.07e+00	0.00e+00	0.00e+00	7.64e+04	1.67e+05
Zr-93	3.14e+05	1.33e+04	8.65e+03	0.00e+00	4.47e+04	1.92e+05	2.07e+03
Zr-95	1.15e+05	2.79e+04	2.03e+04	0.00e+00	3.11e+04	1.75e+06	2.17e+04
Zr-97	1.50e+02	2.56e+01	1.17e+01	0.00e+00	2.59e+01	1.10e+05	1.40e+05
Nb-93m	1.93e+05	5.03e+04	1.61e+04	0.00e+00	5.15e+04	2.93e+05	3.46e+03
Nb-95	1.57e+04	6.43e+03	3.78e+03	0.00e+00	4.72e+03	4.79e+05	1.27e+04
Nb-97	3.42e-01	7.29e-02	2.63e-02	0.00e+00	5.70e-02	3.32e+03	2.69e+04
Mo-93	0.00e+00	9.04e+03	3.11e+02	0.00e+00	2.16e+03	4.76e+05	5.26e+03
Mo-99	0.00e+00	1.65e+02	3.23e+01	0.00e+00	2.65e+02	1.35e+05	4.87e+04
Tc-101	6.51e-05	8.23e-05	8.12e-04	0.00e+00	9.79e-04	5.84e+02	8.44e+02
Tc-99	2.93e+02	3.75e+02	1.24e+02	0.00e+00	3.49e+03	9.48e+05	1.09e+04
Tc-99m	1.40e-03	2.88e-03	3.72e-02	0.00e+00	3.11e-02	8.11e+02	2.03e+03
Ru-103	2.02e+03	0.00e+00	6.79e+02	0.00e+00	4.24e+03	5.52e+05	1.61e+04
Ru-105	1.22e+00	0.00e+00	4.10e-01	0.00e+00	8.99e-01	1.57e+04	4.84e+04
Ru-106	8.68e+04	0.00e+00	1.09e+04	0.00e+00	1.07e+05	1.16e+07	1.64e+05
Rh-105	1.16e+01	7.57e+00	5.08e+00	0.00e+00	2.10e+01	2.91e+04	1.92e+04
Pd-107	0.00e+00	6.89e+02	5.75e+01	0.00e+00	3.85e+03	8.88e+04	1.03e+03
Pd-109	0.00e+00	5.49e+00	1.47e+00	0.00e+00	1.79e+01	2.35e+04	3.99e+04

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
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Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	9.98e+03	7.22e+03	5.00e+03	0.00e+00	1.09e+04	3.67e+06	3.30e+04
Ag-111	5.25e+02	2.03e+02	1.08e+02	0.00e+00	4.27e+02	2.88e+05	4.23e+04
Cd-113m	0.00e+00	9.34e+05	3.70e+04	0.00e+00	8.12e+05	1.96e+06	2.31e+04
Cd-115m	0.00e+00	2.42e+05	8.67e+03	0.00e+00	1.32e+05	2.06e+06	7.03e+04
Sn-123	2.93e+05	5.89e+03	1.02e+04	5.98e+03	0.00e+00	3.11e+06	5.71e+04
Sn-125	1.41e+04	3.51e+02	8.40e+02	3.46e+02	0.00e+00	9.00e+05	1.02e+05
Sn-126	1.16e+06	2.02e+04	4.93e+04	5.38e+03	0.00e+00	6.90e+06	2.31e+04
Sb-124	3.79e+04	5.56e+02	1.20e+04	1.01e+02	0.00e+00	2.65e+06	5.91e+04
Sb-125	5.17e+04	4.77e+02	1.09e+04	6.23e+01	0.00e+00	1.64e+06	1.47e+04
Sb-126	4.31e+03	8.41e+01	1.55e+03	3.29e+01	0.00e+00	9.63e+05	7.46e+04
Sb-127	3.95e+02	7.06e+00	1.23e+02	5.04e+00	0.00e+00	2.16e+05	5.29e+04
Te-125m	4.76e+03	1.99e+03	6.58e+02	1.62e+03	0.00e+00	4.47e+05	1.29e+04
Te-127	2.23e+00	9.53e-01	4.89e-01	1.85e+00	4.86e+00	1.03e+04	2.44e+04
Te-127m	1.67e+04	6.90e+03	2.07e+03	4.87e+03	3.75e+04	1.31e+06	2.73e+04
Te-129	7.88e-02	3.47e-02	1.88e-02	6.75e-02	1.75e-01	3.00e+03	2.63e+04
Te-129m	1.41e+04	6.09e+03	2.23e+03	5.47e+03	3.18e+04	1.68e+06	6.90e+04
Te-131	1.74e-02	8.22e-03	5.00e-03	1.58e-02	3.99e-02	2.06e+03	8.22e+03
Te-131m	1.07e+02	5.50e+01	3.63e+01	8.93e+01	2.65e+02	1.99e+05	1.19e+05
Te-132	3.72e+02	2.37e+02	1.76e+02	2.79e+02	1.03e+03	3.40e+05	4.41e+04
Te-133m	8.58e-02	5.03e-02	3.84e-02	7.73e-02	2.41e-01	5.49e+03	2.23e+04
Te-134	4.45e-02	2.86e-02	2.35e-02	4.07e-02	1.34e-01	4.10e+03	3.54e+03
I-129	3.02e+04	2.23e+04	1.62e+04	1.46e+07	2.63e+04	0.00e+00	2.97e+02
I-130	6.36e+03	1.39e+04	5.57e+03	1.60e+06	1.53e+04	0.00e+00	1.99e+03
I-131	3.79e+04	4.44e+04	1.96e+04	1.48e+07	5.18e+04	0.00e+00	1.06e+03
I-132	1.69e+03	3.54e+03	1.26e+03	1.69e+05	3.95e+03	0.00e+00	1.90e+03
I-133	1.32e+04	1.92e+04	5.60e+03	3.56e+06	2.24e+04	0.00e+00	2.16e+03
I-134	9.21e+02	1.88e+03	6.65e+02	4.45e+04	2.09e+03	0.00e+00	1.29e+03
I-135	3.86e+03	7.60e+03	2.77e+03	6.96e+05	8.47e+03	0.00e+00	1.83e+03
Cs-134	3.96e+05	7.03e+05	7.45e+04	0.00e+00	1.90e+05	7.97e+04	1.33e+03
Cs-134m	1.85e+02	2.94e+02	1.55e+02	0.00e+00	1.19e+02	2.80e+01	1.62e+02

Conversion factors are in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.40e+05	1.21e+05	6.62e+03	0.00e+00	3.61e+04	1.41e+04	3.05e+02
Cs-136	4.83e+04	1.35e+05	5.29e+04	0.00e+00	5.64e+04	1.18e+04	1.43e+03
Cs-137	5.49e+05	6.12e+05	4.55e+04	0.00e+00	1.72e+05	7.13e+04	1.33e+03
Cs-138	5.05e+02	7.81e+02	3.98e+02	0.00e+00	4.10e+02	6.54e+01	8.76e+02
Cs-139	3.25e+02	4.24e+02	1.71e+02	0.00e+00	2.31e+02	3.54e+01	1.86e+01
Ba-139	1.48e+00	9.84e-04	4.30e-02	0.00e+00	5.92e-04	5.95e+03	5.10e+04
Ba-140	5.60e+04	5.60e+01	2.90e+03	0.00e+00	1.34e+01	1.60e+06	3.84e+04
Ba-141	1.57e-01	1.08e-04	4.97e-03	0.00e+00	6.50e-05	2.97e+03	4.75e+03
Ba-142	3.98e-02	3.30e-05	1.96e-03	0.00e+00	1.90e-05	1.55e+03	6.93e+02
La-140	5.05e+02	2.00e+02	5.15e+01	0.00e+00	0.00e+00	1.68e+05	8.48e+04
La-141	6.79e+00	1.96e+00	3.43e-01	0.00e+00	0.00e+00	1.71e+04	8.34e+04
La-142	1.03e+00	3.77e-01	9.04e-02	0.00e+00	0.00e+00	8.22e+03	5.95e+04
Ce-141	2.77e+04	1.67e+04	1.99e+03	0.00e+00	5.25e+03	5.17e+05	2.16e+04
Ce-143	2.93e+02	1.93e+02	2.21e+01	0.00e+00	5.64e+01	1.16e+05	4.97e+04
Ce-144	3.19e+06	1.21e+06	1.76e+05	0.00e+00	5.38e+05	9.84e+06	1.48e+05
Pr-143	1.40e+04	5.24e+03	6.99e+02	0.00e+00	1.97e+03	4.33e+05	3.72e+04
Pr-144	4.79e-02	1.85e-02	2.41e-03	0.00e+00	6.72e-03	1.61e+03	4.28e+03
Nd-147	7.94e+03	8.13e+03	5.00e+02	0.00e+00	3.15e+03	3.22e+05	3.12e+04
Pm-147	5.47e+05	4.30e+04	2.18e+04	0.00e+00	6.90e+04	6.37e+05	8.05e+03
Pm-148	4.68e+03	6.75e+02	3.42e+02	0.00e+00	8.06e+02	4.48e+05	8.46e+04
Pm-148m	7.00e+04	1.74e+04	1.39e+04	0.00e+00	2.03e+04	1.71e+06	4.72e+04
Pm-149	4.34e+02	5.71e+01	2.49e+01	0.00e+00	6.94e+01	9.10e+04	4.21e+04
Pm-151	1.05e+02	1.54e+01	7.77e+00	0.00e+00	1.82e+01	4.55e+04	3.61e+04
Sm-151	4.73e+05	9.03e+04	2.28e+04	0.00e+00	7.34e+04	4.17e+05	4.84e+03
Sm-153	2.14e+02	1.65e+02	1.27e+01	0.00e+00	3.46e+01	5.18e+04	2.70e+04
Eu-152	1.10e+06	2.48e+05	2.41e+05	0.00e+00	8.32e+05	2.07e+06	1.38e+04
Eu-154	4.14e+06	4.84e+05	3.43e+05	0.00e+00	1.60e+06	4.27e+06	3.98e+04
Eu-155	8.36e+05	8.01e+04	4.84e+04	0.00e+00	2.21e+05	7.28e+05	7.27e+04
Eu-156	2.18e+04	1.34e+04	2.16e+03	0.00e+00	6.27e+03	8.57e+05	5.80e+04
Tb-160	1.57e+05	0.00e+00	1.96e+04	0.00e+00	4.48e+04	1.55e+06	3.00e+04

Conversion factors are in units of mrem/yr per µCi/cubic meter.

## Offsite Dose Calculation Manual

## Attachment 19

## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	2.03e+06	4.30e+05	3.51e+05	0.00e+00	5.91e+05	2.87e+06	2.31e+04
W-181	6.80e+01	2.04e+01	2.34e+00	0.00e+00	0.00e+00	1.86e+04	3.68e+02
W-185	2.20e+03	6.76e+02	7.81e+01	0.00e+00	0.00e+00	6.27e+05	1.57e+04
W-187	1.30e+01	9.02e+00	3.12e+00	0.00e+00	0.00e+00	3.96e+04	3.56e+04
Pb-210	1.21e+08	2.83e+07	4.80e+06	0.00e+00	9.59e+07	2.46e+08	2.20e+03
Bi-210	2.88e+03	1.86e+04	1.65e+03	0.00e+00	1.44e+05	1.39e+07	4.58e+04
Po-210	4.17e+06	7.88e+06	9.97e+05	0.00e+00	1.82e+07	3.36e+08	6.10e+04
Ra-223	2.18e+06	3.16e+03	4.37e+05	0.00e+00	5.82e+04	3.15e+08	4.26e+05
Ra-224	2.48e+05	5.60e+02	4.96e+04	0.00e+00	1.02e+04	1.11e+08	4.79e+05
Ra-225	3.60e+06	4.03e+03	7.18e+05	0.00e+00	7.43e+04	3.60e+08	4.02e+05
Ra-226	3.47e+08	2.04e+04	2.87e+08	0.00e+00	4.12e+05	1.10e+09	4.27e+05
Ra-228	2.24e+08	1.07e+04	2.52e+08	0.00e+00	2.14e+05	1.53e+09	7.27e+04
Ac-225	5.17e+06	6.61e+06	3.47e+05	0.00e+00	4.89e+05	2.74e+08	3.79e+05
Ac-227	7.41e+09	1.23e+09	4.59e+08	0.00e+00	2.60e+08	2.27e+09	7.38e+04
Th-227	2.55e+06	4.24e+04	7.34e+04	0.00e+00	1.58e+05	4.58e+08	4.94e+05
Th-228	1.18e+09	1.54e+07	4.00e+07	0.00e+00	7.85e+07	6.51e+09	5.07e+05
Th-229	3.19e+10	8.32e+08	5.33e+08	0.00e+00	1.30e+09	1.78e+10	7.03e+04
Th-230	4.84e+09	2.51e+08	1.35e+08	0.00e+00	1.23e+09	3.05e+09	5.42e+04
Th-232	5.40e+09	2.14e+08	3.21e+06	0.00e+00	1.06e+09	2.93e+09	4.61e+04
Th-234	1.86e+04	1.00e+03	5.38e+02	0.00e+00	3.78e+03	2.27e+06	1.04e+05
Pa-231	1.27e+10	4.20e+08	5.07e+08	0.00e+00	2.27e+09	5.39e+08	6.45e+04
Pa-233	9.58e+03	1.85e+03	1.67e+03	0.00e+00	5.15e+03	3.07e+05	1.27e+04
U-232	3.60e+08	0.00e+00	2.98e+07	0.00e+00	3.36e+07	2.09e+09	6.10e+04
U-233	7.62e+07	0.00e+00	5.36e+06	0.00e+00	1.53e+07	4.98e+08	5.64e+04
U-234	7.31e+07	0.00e+00	5.25e+06	0.00e+00	1.50e+07	4.89e+08	5.53e+04
U-235	7.01e+07	0.00e+00	4.93e+06	0.00e+00	1.41e+07	4.59e+08	7.03e+04
U-236	7.01e+07	0.00e+00	5.04e+06	0.00e+00	1.44e+07	4.69e+08	5.19e+04
U-237	4.55e+02	0.00e+00	1.21e+02	0.00e+00	1.13e+03	1.28e+05	1.83e+04
U-238	6.71e+07	0.00e+00	4.61e+06	0.00e+00	1.32e+07	4.28e+08	4.96e+04
Np-237	4.03e+09	2.39e+09	1.76e+08	0.00e+00	1.08e+09	4.89e+08	7.14e+04

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 19

## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Inhalation Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.74e+03	8.47e+02	5.82e+01	0.00e+00	2.06e+02	1.29e+05	3.61e+04
Np-239	3.71e+02	2.98e+02	1.88e+01	0.00e+00	6.62e+01	5.95e+04	2.49e+04
Pu-238	3.77e+09	2.35e+09	1.78e+08	0.00e+00	6.50e+08	1.26e+09	6.57e+04
Pu-239	4.10e+09	2.46e+09	1.88e+08	0.00e+00	6.93e+08	1.19e+09	5.99e+04
Pu-240	4.10e+09	2.45e+09	1.88e+08	0.00e+00	6.92e+08	1.19e+09	6.10e+04
Pu-241	1.18e+08	2.59e+07	4.35e+06	0.00e+00	1.61e+07	1.07e+06	1.26e+03
Pu-242	3.81e+09	2.37e+09	1.81e+08	0.00e+00	6.68e+08	1.14e+09	5.88e+04
Pu-244	4.44e+09	2.72e+09	2.07e+08	0.00e+00	7.64e+08	1.31e+09	8.76e+04
Am-241	4.41e+09	2.73e+09	1.83e+08	0.00e+00	1.11e+09	5.68e+08	6.69e+04
Am-242m	4.55e+09	2.60e+09	1.89e+08	0.00e+00	1.12e+09	2.30e+08	8.41e+04
Am-243	4.34e+09	2.63e+09	1.78e+08	0.00e+00	1.08e+09	5.39e+08	7.84e+04
Cm-242	1.79e+08	1.21e+08	7.98e+06	0.00e+00	2.37e+07	4.16e+08	7.14e+04
Cm-243	3.46e+09	2.13e+09	1.48e+08	0.00e+00	5.47e+08	5.94e+08	7.03e+04
Cm-244	2.90e+09	1.78e+09	1.24e+08	0.00e+00	4.49e+08	5.71e+08	6.80e+04
Cm-245	4.51e+09	2.74e+09	1.90e+08	0.00e+00	7.32e+08	5.49e+08	6.34e+04
Cm-246	4.48e+09	2.74e+09	1.90e+08	0.00e+00	7.32e+08	5.59e+08	6.23e+04
Cm-247	4.35e+09	2.70e+09	1.86e+08	0.00e+00	7.21e+08	5.49e+08	8.19e+04
Cm-248	3.61e+10	2.23e+10	1.54e+09	0.00e+00	5.94e+09	4.52e+09	1.32e+06
Cf-252	3.32e+09	0.00e+00	1.41e+08	0.00e+00	0.00e+00	1.92e+09	2.59e+05

Conversion factors are in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	4.35e+02	4.35e+02	4.35e+02	4.35e+02	4.35e+02	4.35e+02
Be-10	2.46e+06	3.79e+05	6.14e+04	0.00e+00	2.87e+05	0.00e+00	2.07e+07
C-14	2.63e+08	5.27e+07	5.27e+07	5.27e+07	5.27e+07	5.27e+07	5.27e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	4.65e-03	0.00e+00	5.15e-04	0.00e+00	0.00e+00	0.00e+00	1.38e-04
Na-22	5.29e+09	5.29e+09	5.29e+09	5.29e+09	5.29e+09	5.29e+09	5.29e+09
Na-24	2.44e+06	2.44e+06	2.44e+06	2.44e+06	2.44e+06	2.44e+06	2.44e+06
P-32	1.71e+10	1.06e+09	6.61e+08	0.00e+00	0.00e+00	0.00e+00	1.92e+09
Ca-41	1.14e+10	0.00e+00	1.24e+09	0.00e+00	0.00e+00	0.00e+00	1.14e+07
Sc-46	1.79e+02	3.48e+02	1.01e+02	0.00e+00	3.25e+02	0.00e+00	1.70e+06
Cr-51	0.00e+00	0.00e+00	2.86e+04	1.71e+04	6.30e+03	3.79e+04	7.19e+06
Mn-54	0.00e+00	8.41e+06	1.61e+06	0.00e+00	2.50e+06	0.00e+00	2.58e+07
Mn-56	0.00e+00	4.15e-03	7.37e-04	0.00e+00	5.27e-03	0.00e+00	1.33e-01
Fe-55	2.51e+07	1.73e+07	4.05e+06	0.00e+00	0.00e+00	9.68e+06	9.95e+06
Fe-59	2.97e+07	6.98e+07	2.68e+07	0.00e+00	0.00e+00	1.95e+07	2.33e+08
Co-57	0.00e+00	1.28e+06	2.13e+06	0.00e+00	0.00e+00	0.00e+00	3.25e+07
Co-58	0.00e+00	4.71e+06	1.06e+07	0.00e+00	0.00e+00	0.00e+00	9.55e+07
Co-60	0.00e+00	1.64e+07	3.62e+07	0.00e+00	0.00e+00	0.00e+00	3.08e+08
Ni-59	5.05e+08	1.73e+08	8.44e+07	0.00e+00	0.00e+00	0.00e+00	3.57e+07
Ni-63	6.73e+09	4.66e+08	2.26e+08	0.00e+00	0.00e+00	0.00e+00	9.73e+07
Ni-65	3.76e-01	4.88e-02	2.23e-02	0.00e+00	0.00e+00	0.00e+00	1.24e+00
Cu-64	0.00e+00	2.39e+04	1.12e+04	0.00e+00	6.03e+04	0.00e+00	2.04e+06
Zn-65	1.37e+09	4.37e+09	1.97e+09	0.00e+00	2.92e+09	0.00e+00	2.75e+09
Zn-69	2.18e-12	4.17e-12	2.90e-13	0.00e+00	2.71e-12	0.00e+00	6.26e-13
Zn-69m	1.81e+05	4.35e+05	3.98e+04	0.00e+00	2.64e+05	0.00e+00	2.66e+07
Se-79	0.00e+00	9.15e+08	1.53e+08	0.00e+00	1.58e+09	0.00e+00	1.87e+08
Br-82	0.00e+00	0.00e+00	3.23e+07	0.00e+00	0.00e+00	0.00e+00	3.70e+07
Br-83	0.00e+00	0.00e+00	9.87e-02	0.00e+00	0.00e+00	0.00e+00	1.42e-01
Br-84	0.00e+00	0.00e+00	1.73e-23	0.00e+00	0.00e+00	0.00e+00	1.36e-28
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.59e+09	1.21e+09	0.00e+00	0.00e+00	0.00e+00	5.12e+08
Rb-87	0.00e+00	2.85e+09	9.92e+08	0.00e+00	0.00e+00	0.00e+00	1.34e+08
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	1.45e+09	0.00e+00	4.16e+07	0.00e+00	0.00e+00	0.00e+00	2.33e+08
Sr-90	5.38e+10	0.00e+00	1.08e+09	0.00e+00	0.00e+00	0.00e+00	1.35e+09
Sr-91	2.90e+04	0.00e+00	1.17e+03	0.00e+00	0.00e+00	0.00e+00	1.38e+05
Sr-92	4.95e-01	0.00e+00	2.14e-02	0.00e+00	0.00e+00	0.00e+00	9.81e+00
Y-90	7.09e+01	0.00e+00	1.90e+00	0.00e+00	0.00e+00	0.00e+00	7.52e+05
Y-91	8.59e+03	0.00e+00	2.30e+02	0.00e+00	0.00e+00	0.00e+00	4.73e+06
Y-91m	6.27e-20	0.00e+00	2.43e-21	0.00e+00	0.00e+00	0.00e+00	1.84e-19
Y-92	5.64e-05	0.00e+00	1.65e-06	0.00e+00	0.00e+00	0.00e+00	9.88e-01
Y-93	2.24e-01	0.00e+00	6.19e-03	0.00e+00	0.00e+00	0.00e+00	7.11e+03
Zr-93	1.62e+03	9.04e+01	4.21e+01	0.00e+00	3.43e+02	0.00e+00	9.39e+04
Zr-95	9.43e+02	3.03e+02	2.05e+02	0.00e+00	4.75e+02	0.00e+00	9.59e+05
Zr-97	4.34e-01	8.76e-02	4.01e-02	0.00e+00	1.32e-01	0.00e+00	2.71e+04
Nb-93m	4.91e+05	1.60e+05	3.95e+04	0.00e+00	1.84e+05	0.00e+00	7.40e+07
Nb-95	8.26e+04	4.59e+04	2.47e+04	0.00e+00	4.54e+04	0.00e+00	2.79e+08
Nb-97	6.58e-12	1.66e-12	6.07e-13	0.00e+00	1.94e-12	0.00e+00	6.14e-09
Mo-93	0.00e+00	4.35e+08	1.18e+07	0.00e+00	1.23e+08	0.00e+00	7.07e+07
Mo-99	0.00e+00	2.48e+07	4.72e+06	0.00e+00	5.61e+07	0.00e+00	5.74e+07
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	2.42e+07	3.59e+07	9.70e+06	0.00e+00	4.52e+08	3.05e+06	1.17e+09
Tc-99m	3.34e+00	9.44e+00	1.20e+02	0.00e+00	1.43e+02	4.63e+00	5.59e+03
Ru-103	1.02e+03	0.00e+00	4.39e+02	0.00e+00	3.89e+03	0.00e+00	1.19e+05
Ru-105	8.64e-04	0.00e+00	3.41e-04	0.00e+00	1.12e-02	0.00e+00	5.29e-01
Ru-106	2.04e+04	0.00e+00	2.58e+03	0.00e+00	3.94e+04	0.00e+00	1.32e+06
Rh-105	3.46e+05	2.53e+05	1.67e+05	0.00e+00	1.08e+06	0.00e+00	4.03e+07
Pd-107	0.00e+00	1.14e+07	7.26e+05	0.00e+00	1.02e+08	0.00e+00	7.04e+07
Pd-109	0.00e+00	4.49e+04	1.01e+04	0.00e+00	2.56e+05	0.00e+00	4.98e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 19

## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	5.82e+07	5.39e+07	3.20e+07	0.00e+00	1.06e+08	0.00e+00	2.20e+10
Ag-111	6.47e+06	2.71e+06	1.35e+06	0.00e+00	8.74e+06	0.00e+00	4.97e+09
Cd-113m	0.00e+00	2.94e+06	9.43e+04	0.00e+00	3.24e+06	0.00e+00	2.37e+07
Cd-115m	0.00e+00	1.26e+06	4.02e+04	0.00e+00	9.99e+05	0.00e+00	5.30e+07
Sn-123	5.36e+08	8.88e+06	1.31e+07	7.55e+06	0.00e+00	0.00e+00	1.09e+09
Sn-125	5.68e+07	1.14e+06	2.58e+06	9.47e+05	0.00e+00	0.00e+00	7.09e+08
Sn-126	1.63e+09	3.23e+07	4.64e+07	9.51e+06	0.00e+00	0.00e+00	4.69e+08
Sb-124	2.57e+07	4.86e+05	1.02e+07	6.24e+04	0.00e+00	2.00e+07	7.31e+08
Sb-125	2.04e+07	2.28e+05	4.86e+06	2.08e+04	0.00e+00	1.58e+07	2.25e+08
Sb-126	5.63e+06	1.15e+05	2.03e+06	3.45e+04	0.00e+00	3.45e+06	4.60e+08
Sb-127	4.53e+05	9.93e+03	1.74e+05	5.45e+03	0.00e+00	2.69e+05	1.04e+08
Te-125m	1.63e+07	5.90e+06	2.18e+06	4.90e+06	6.63e+07	0.00e+00	6.50e+07
Te-127	6.56e+02	2.35e+02	1.42e+02	4.86e+02	2.67e+03	0.00e+00	5.17e+04
Te-127m	4.58e+07	1.64e+07	5.58e+06	1.17e+07	1.86e+08	0.00e+00	1.53e+08
Te-129	2.92e-10	1.10e-10	7.11e-11	2.24e-10	1.23e-09	0.00e+00	2.20e-10
Te-129m	6.02e+07	2.25e+07	9.53e+06	2.07e+07	2.51e+08	0.00e+00	3.03e+08
Te-131	3.95e-33	1.65e-33	1.25e-33	3.25e-33	1.73e-32	0.00e+00	5.60e-34
Te-131m	3.62e+05	1.77e+05	1.47e+05	2.80e+05	1.79e+06	0.00e+00	1.76e+07
Te-132	2.40e+06	1.55e+06	1.46e+06	1.72e+06	1.50e+07	0.00e+00	7.35e+07
Te-133m	2.19e-13	1.28e-13	1.24e-13	1.86e-13	1.27e-12	0.00e+00	4.40e-14
Te-134	9.41e-19	6.16e-19	3.78e-19	8.22e-19	5.95e-18	0.00e+00	1.04e-21
I-129	7.58e+08	6.51e+08	2.14e+09	1.68e+12	1.40e+09	0.00e+00	1.03e+08
I-130	4.21e+05	1.24e+06	4.90e+05	1.05e+08	1.94e+06	0.00e+00	1.07e+06
I-131	2.96e+08	4.24e+08	2.43e+08	1.39e+11	7.26e+08	0.00e+00	1.12e+08
I-132	1.67e-01	4.47e-01	1.56e-01	1.56e+01	7.12e-01	0.00e+00	8.39e-02
I-133	3.88e+06	6.74e+06	2.06e+06	9.91e+08	1.18e+07	0.00e+00	6.06e+06
I-134	2.11e-12	5.72e-12	2.05e-12	9.92e-11	9.10e-12	0.00e+00	4.99e-15
I-135	1.29e+04	3.38e+04	1.25e+04	2.23e+06	5.42e+04	0.00e+00	3.82e+04
Cs-134	5.65e+09	1.34e+10	1.10e+10	0.00e+00	4.35e+09	1.44e+09	2.35e+08
Cs-134m	1.76e-01	3.70e-01	1.89e-01	0.00e+00	2.01e-01	3.16e-02	1.31e-01

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.81e+09	1.67e+09	7.41e+08	0.00e+00	6.32e+08	1.89e+08	3.90e+07
Cs-136	2.63e+08	1.04e+09	7.48e+08	0.00e+00	5.78e+08	7.93e+07	1.18e+08
Cs-137	7.38e+09	1.01e+10	6.61e+09	0.00e+00	3.43e+09	1.14e+09	1.95e+08
Cs-138	9.72e-24	1.92e-23	9.50e-24	0.00e+00	1.41e-23	1.39e-24	8.18e-29
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	2.69e+07	3.38e+04	1.76e+06	0.00e+00	1.15e+04	1.93e+04	5.54e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	3.00e-05	9.31e-06	1.52e-06	0.00e+00	0.00e+00	0.00e+00	1.11e+00
La-142	1.90e-11	8.66e-12	2.16e-12	0.00e+00	0.00e+00	0.00e+00	6.32e-08
Ce-141	4.84e+03	3.28e+03	3.72e+02	0.00e+00	1.52e+03	0.00e+00	1.25e+07
Ce-143	4.16e+01	3.08e+04	3.40e+00	0.00e+00	1.35e+01	0.00e+00	1.15e+06
Ce-144	3.58e+05	1.50e+05	1.92e+04	0.00e+00	8.87e+04	0.00e+00	1.21e+08
Pr-143	1.58e+02	6.33e+01	7.83e+00	0.00e+00	3.66e+01	0.00e+00	6.92e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	9.42e+01	1.09e+02	6.51e+00	0.00e+00	6.36e+01	0.00e+00	5.22e+05
Pm-147	2.87e+03	2.70e+02	1.09e+02	0.00e+00	5.10e+02	0.00e+00	3.40e+05
Pm-148	5.93e+01	9.85e+00	4.96e+00	0.00e+00	1.86e+01	0.00e+00	7.74e+05
Pm-148m	8.57e+02	2.22e+02	1.70e+02	0.00e+00	3.35e+02	0.00e+00	1.88e+06
Pm-149	4.28e+00	6.05e-01	2.47e-01	0.00e+00	1.14e+00	0.00e+00	1.13e+05
Pm-151	6.47e-01	1.09e-01	5.48e-02	0.00e+00	1.94e-01	0.00e+00	2.99e+04
Sm-151	2.67e+03	4.60e+02	1.10e+02	0.00e+00	5.14e+02	0.00e+00	2.03e+05
Sm-153	1.99e+00	1.66e+00	1.21e-01	0.00e+00	5.36e-01	0.00e+00	5.92e+04
Eu-152	7.51e+03	1.71e+03	1.50e+03	0.00e+00	1.06e+04	0.00e+00	9.86e+05
Eu-154	2.38e+04	2.92e+03	2.08e+03	0.00e+00	1.40e+04	0.00e+00	2.12e+06
Eu-155	3.25e+03	4.61e+02	2.97e+02	0.00e+00	2.13e+03	0.00e+00	3.62e+05
Eu-156	2.52e+02	1.95e+02	3.14e+01	0.00e+00	1.30e+02	0.00e+00	1.33e+06
Tb-160	1.49e+03	0.00e+00	1.86e+02	0.00e+00	6.16e+02	0.00e+00	1.37e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.04e+04	3.26e+03	2.47e+03	0.00e+00	4.87e+03	0.00e+00	9.89e+05
W-181	3.39e+04	1.11e+04	1.18e+03	0.00e+00	0.00e+00	0.00e+00	1.26e+06
W-185	1.29e+06	4.32e+05	4.54e+04	0.00e+00	0.00e+00	0.00e+00	4.99e+07
W-187	6.52e+03	5.45e+03	1.91e+03	0.00e+00	0.00e+00	0.00e+00	1.79e+06
Pb-210	7.32e+10	2.09e+10	2.60e+09	0.00e+00	5.88e+10	0.00e+00	1.07e+07
Bi-210	3.56e+05	2.46e+06	2.04e+05	0.00e+00	2.96e+07	0.00e+00	3.67e+07
Po-210	7.42e+08	1.58e+09	1.79e+08	0.00e+00	5.25e+09	0.00e+00	1.33e+08
Ra-223	1.22e+11	1.88e+08	2.44e+10	0.00e+00	5.33e+09	0.00e+00	7.89e+09
Ra-224	1.41e+10	3.42e+07	2.83e+09	0.00e+00	9.65e+08	0.00e+00	2.98e+09
Ra-225	1.90e+11	2.25e+08	3.79e+10	0.00e+00	6.39e+09	0.00e+00	8.85e+09
Ra-226	1.87e+13	3.55e+08	1.36e+13	0.00e+00	1.01e+10	0.00e+00	2.05e+10
Ra-228	6.87e+12	1.91e+08	7.43e+12	0.00e+00	5.42e+09	0.00e+00	3.46e+09
Ac-225	6.17e+04	8.49e+04	4.15e+03	0.00e+00	9.67e+03	0.00e+00	5.70e+06
Ac-227	7.21e+07	9.56e+06	4.28e+06	0.00e+00	3.09e+06	0.00e+00	3.16e+06
Th-227	2.80e+05	5.06e+03	8.06e+03	0.00e+00	2.88e+04	0.00e+00	1.10e+07
Th-228	1.88e+07	3.18e+05	6.35e+05	0.00e+00	1.77e+06	0.00e+00	2.13e+07
Th-229	5.26e+08	1.50e+07	8.69e+06	0.00e+00	7.26e+07	0.00e+00	3.02e+06
Th-230	7.96e+07	4.52e+06	2.20e+06	0.00e+00	2.18e+07	0.00e+00	2.33e+06
Th-232	8.89e+07	3.86e+06	5.80e+04	0.00e+00	1.86e+07	0.00e+00	1.98e+06
Th-234	1.85e+03	1.09e+02	5.33e+01	0.00e+00	6.16e+02	0.00e+00	2.61e+06
Pa-231	1.58e+08	5.95e+06	6.14e+06	0.00e+00	3.34e+07	0.00e+00	2.77e+06
Pa-233	1.28e+02	2.58e+01	2.22e+01	0.00e+00	9.70e+01	0.00e+00	3.99e+05
U-232	1.59e+10	0.00e+00	1.14e+09	0.00e+00	1.73e+09	0.00e+00	2.62e+08
U-233	3.37e+09	0.00e+00	2.04e+08	0.00e+00	7.84e+08	0.00e+00	2.42e+08
U-234	3.23e+09	0.00e+00	2.00e+08	0.00e+00	7.69e+08	0.00e+00	2.37e+08
U-235	3.10e+09	0.00e+00	1.88e+08	0.00e+00	7.23e+08	0.00e+00	3.02e+08
U-236	3.10e+09	0.00e+00	1.92e+08	0.00e+00	7.38e+08	0.00e+00	2.23e+08
U-237	5.65e+04	0.00e+00	1.50e+04	0.00e+00	2.32e+05	0.00e+00	1.99e+07
U-238	2.96e+09	0.00e+00	1.75e+08	0.00e+00	6.76e+08	0.00e+00	2.13e+08
Np-237	4.87e+07	3.46e+06	2.14e+06	0.00e+00	1.59e+07	0.00e+00	3.07e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Adult age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.62e+01	9.75e-01	5.63e-01	0.00e+00	3.30e+00	0.00e+00	9.06e+04
Np-239	3.68e+00	3.61e-01	1.99e-01	0.00e+00	1.13e+00	0.00e+00	7.41e+04
Pu-238	9.73e+06	1.23e+06	2.64e+05	0.00e+00	1.13e+06	0.00e+00	1.13e+06
Pu-239	1.12e+07	1.35e+06	2.95e+05	0.00e+00	1.25e+06	0.00e+00	1.03e+06
Pu-240	1.12e+07	1.34e+06	2.95e+05	0.00e+00	1.25e+06	0.00e+00	1.05e+06
Pu-241	2.42e+05	1.15e+04	5.12e+03	0.00e+00	2.36e+04	0.00e+00	2.16e+04
Pu-242	1.04e+07	1.30e+06	2.84e+05	0.00e+00	1.21e+06	0.00e+00	1.01e+06
Pu-244	1.21e+07	1.49e+06	3.26e+05	0.00e+00	1.38e+06	0.00e+00	1.50e+06
Am-241	2.89e+07	2.70e+07	2.07e+06	0.00e+00	1.56e+07	0.00e+00	2.84e+06
Am-242m	2.94e+07	2.56e+07	2.10e+06	0.00e+00	1.56e+07	0.00e+00	3.61e+06
Am-243	2.91e+07	2.67e+07	2.05e+06	0.00e+00	1.54e+07	0.00e+00	3.36e+06
Cm-242	7.27e+05	7.73e+05	4.83e+04	0.00e+00	2.19e+05	0.00e+00	2.79e+06
Cm-243	2.31e+07	2.12e+07	1.45e+06	0.00e+00	6.75e+06	0.00e+00	3.01e+06
Cm-244	1.76e+07	1.65e+07	1.11e+06	0.00e+00	5.17e+06	0.00e+00	2.91e+06
Cm-245	3.62e+07	3.16e+07	2.23e+06	0.00e+00	1.04e+07	0.00e+00	2.72e+06
Cm-246	3.59e+07	3.15e+07	2.22e+06	0.00e+00	1.04e+07	0.00e+00	2.67e+06
Cm-247	3.50e+07	3.11e+07	2.19e+06	0.00e+00	1.02e+07	0.00e+00	3.51e+06
Cm-248	2.91e+08	2.56e+08	1.80e+07	0.00e+00	8.42e+07	0.00e+00	5.68e+07
Cf-252	9.92e+06	0.00e+00	2.39e+05	0.00e+00	0.00e+00	0.00e+00	1.09e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	5.66e+02	5.66e+02	5.66e+02	5.66e+02	5.66e+02	5.66e+02
Be-10	4.47e+06	6.92e+05	1.13e+05	0.00e+00	5.29e+05	0.00e+00	2.83e+07
C-14	4.86e+08	9.72e+07	9.72e+07	9.72e+07	9.72e+07	9.72e+07	9.72e+07
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	8.30e-03	0.00e+00	9.10e-04	0.00e+00	0.00e+00	0.00e+00	7.48e-04
Na-22	9.18e+09	9.18e+09	9.18e+09	9.18e+09	9.18e+09	9.18e+09	9.18e+09
Na-24	4.27e+06	4.27e+06	4.27e+06	4.27e+06	4.27e+06	4.27e+06	4.27e+06
P-32	3.15e+10	1.95e+09	1.22e+09	0.00e+00	0.00e+00	0.00e+00	2.65e+09
Ca-41	1.57e+10	0.00e+00	1.70e+09	0.00e+00	0.00e+00	0.00e+00	1.56e+07
Sc-46	3.04e+02	5.92e+02	1.76e+02	0.00e+00	5.67e+02	0.00e+00	2.02e+06
Cr-51	0.00e+00	0.00e+00	4.99e+04	2.77e+04	1.09e+04	7.13e+04	8.39e+06
Mn-54	0.00e+00	1.40e+07	2.78e+06	0.00e+00	4.18e+06	0.00e+00	2.87e+07
Mn-56	0.00e+00	7.36e-03	1.31e-03	0.00e+00	9.32e-03	0.00e+00	4.85e-01
Fe-55	4.45e+07	3.16e+07	7.36e+06	0.00e+00	0.00e+00	2.00e+07	1.37e+07
Fe-59	5.18e+07	1.21e+08	4.67e+07	0.00e+00	0.00e+00	3.81e+07	2.86e+08
Co-57	0.00e+00	2.24e+06	3.76e+06	0.00e+00	0.00e+00	0.00e+00	4.19e+07
Co-58	0.00e+00	7.94e+06	1.83e+07	0.00e+00	0.00e+00	0.00e+00	1.09e+08
Co-60	0.00e+00	2.78e+07	6.26e+07	0.00e+00	0.00e+00	0.00e+00	3.62e+08
Ni-59	8.82e+08	3.11e+08	1.50e+08	0.00e+00	0.00e+00	0.00e+00	4.88e+07
Ni-63	1.18e+10	8.35e+08	4.01e+08	0.00e+00	0.00e+00	0.00e+00	1.33e+08
Ni-65	6.87e-01	8.78e-02	4.00e-02	0.00e+00	0.00e+00	0.00e+00	4.76e+00
Cu-64	0.00e+00	4.26e+04	2.00e+04	0.00e+00	1.08e+05	0.00e+00	3.30e+06
Zn-65	2.11e+09	7.32e+09	3.41e+09	0.00e+00	4.68e+09	0.00e+00	3.10e+09
Zn-69	4.01e-12	7.65e-12	5.35e-13	0.00e+00	5.00e-12	0.00e+00	1.41e-11
Zn-69m	3.30e+05	7.79e+05	7.15e+04	0.00e+00	4.74e+05	0.00e+00	4.28e+07
Se-79	0.00e+00	1.67e+09	2.81e+08	0.00e+00	2.92e+09	0.00e+00	2.56e+08
Br-82	0.00e+00	0.00e+00	5.61e+07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	1.82e-01	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	3.09e-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	4.73e+09	2.22e+09	0.00e+00	0.00e+00	0.00e+00	7.00e+08
Rb-87	0.00e+00	5.24e+09	1.83e+09	0.00e+00	0.00e+00	0.00e+00	1.83e+08
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	2.67e+09	0.00e+00	7.66e+07	0.00e+00	0.00e+00	0.00e+00	3.19e+08
Sr-90	8.13e+10	0.00e+00	1.63e+09	0.00e+00	0.00e+00	0.00e+00	1.86e+09
Sr-91	5.33e+04	0.00e+00	2.12e+03	0.00e+00	0.00e+00	0.00e+00	2.42e+05
Sr-92	9.07e-01	0.00e+00	3.86e-02	0.00e+00	0.00e+00	0.00e+00	2.31e+01
Y-90	1.30e+02	0.00e+00	3.51e+00	0.00e+00	0.00e+00	0.00e+00	1.07e+06
Y-91	1.58e+04	0.00e+00	4.24e+02	0.00e+00	0.00e+00	0.00e+00	6.48e+06
Y-91m	1.15e-19	0.00e+00	4.39e-21	0.00e+00	0.00e+00	0.00e+00	5.42e-18
Y-92	1.04e-04	0.00e+00	3.01e-06	0.00e+00	0.00e+00	0.00e+00	2.86e+00
Y-93	4.13e-01	0.00e+00	1.13e-02	0.00e+00	0.00e+00	0.00e+00	1.26e+04
Zr-93	2.76e+03	1.36e+02	7.43e+01	0.00e+00	4.81e+02	0.00e+00	1.29e+05
Zr-95	1.65e+03	5.20e+02	3.58e+02	0.00e+00	7.65e+02	0.00e+00	1.20e+06
Zr-97	7.90e-01	1.56e-01	7.20e-02	0.00e+00	2.37e-01	0.00e+00	4.23e+04
Nb-93m	8.55e+05	2.81e+05	7.03e+04	0.00e+00	3.28e+05	0.00e+00	1.01e+08
Nb-95	1.41e+05	7.81e+04	4.30e+04	0.00e+00	7.57e+04	0.00e+00	3.34e+08
Nb-97	1.20e-11	2.98e-12	1.09e-12	0.00e+00	3.48e-12	0.00e+00	7.11e-08
Mo-93	0.00e+00	7.93e+08	2.17e+07	0.00e+00	2.27e+08	0.00e+00	9.65e+07
Mo-99	0.00e+00	4.47e+07	8.53e+06	0.00e+00	1.02e+08	0.00e+00	8.01e+07
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	4.46e+07	6.56e+07	1.79e+07	0.00e+00	8.33e+08	6.78e+06	1.61e+09
Tc-99m	5.80e+00	1.62e+01	2.10e+02	0.00e+00	2.41e+02	8.97e+00	1.06e+04
Ru-103	1.81e+03	0.00e+00	7.74e+02	0.00e+00	6.38e+03	0.00e+00	1.51e+05
Ru-105	1.58e-03	0.00e+00	6.13e-04	0.00e+00	1.99e-02	0.00e+00	1.27e+00
Ru-106	3.75e+04	0.00e+00	4.73e+03	0.00e+00	7.24e+04	0.00e+00	1.80e+06
Rh-105	6.38e+05	4.61e+05	3.03e+05	0.00e+00	1.96e+06	0.00e+00	5.87e+07
Pd-107	0.00e+00	2.07e+07	1.34e+06	0.00e+00	1.87e+08	0.00e+00	9.63e+07
Pd-109	0.00e+00	8.22e+04	1.87e+04	0.00e+00	4.75e+05	0.00e+00	8.29e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	9.63e+07	9.11e+07	5.54e+07	0.00e+00	1.74e+08	0.00e+00	2.56e+10
Ag-111	1.19e+07	4.95e+06	2.49e+06	0.00e+00	1.61e+07	0.00e+00	6.90e+09
Cd-113m	0.00e+00	5.38e+06	1.73e+05	0.00e+00	5.95e+06	0.00e+00	3.23e+07
Cd-115m	0.00e+00	2.30e+06	7.41e+04	0.00e+00	1.84e+06	0.00e+00	7.27e+07
Sn-123	9.88e+08	1.62e+07	2.40e+07	1.30e+07	0.00e+00	0.00e+00	1.49e+09
Sn-125	1.05e+08	2.08e+06	4.72e+06	1.64e+06	0.00e+00	0.00e+00	9.85e+08
Sn-126	2.89e+09	5.38e+07	8.23e+07	1.42e+07	0.00e+00	0.00e+00	6.43e+08
Sb-124	4.59e+07	8.46e+05	1.79e+07	1.04e+05	0.00e+00	4.01e+07	9.25e+08
Sb-125	3.65e+07	3.99e+05	8.55e+06	3.49e+04	0.00e+00	3.21e+07	2.84e+08
Sb-126	1.00e+07	2.05e+05	3.61e+06	5.68e+04	0.00e+00	7.20e+06	5.94e+08
Sb-127	8.23e+05	1.76e+04	3.11e+05	9.25e+03	0.00e+00	5.60e+05	1.40e+08
Te-125m	3.00e+07	1.08e+07	4.02e+06	8.39e+06	0.00e+00	0.00e+00	8.86e+07
Te-127	1.22e+03	4.31e+02	2.61e+02	8.38e+02	4.92e+03	0.00e+00	9.38e+04
Te-127m	8.44e+07	2.99e+07	1.00e+07	2.01e+07	3.42e+08	0.00e+00	2.10e+08
Te-129	5.37e-10	2.00e-10	1.31e-10	3.84e-10	2.25e-09	0.00e+00	2.94e-09
Te-129m	1.10e+08	4.09e+07	1.74e+07	3.55e+07	4.61e+08	0.00e+00	4.13e+08
Te-131	7.22e-33	2.98e-33	2.26e-33	5.57e-33	3.16e-32	0.00e+00	5.93e-34
Te-131m	6.58e+05	3.15e+05	2.63e+05	4.75e+05	3.29e+06	0.00e+00	2.53e+07
Te-132	4.29e+06	2.72e+06	2.56e+06	2.87e+06	2.61e+07	0.00e+00	8.61e+07
Te-133m	3.95e-13	2.24e-13	2.18e-13	3.13e-13	2.22e-12	0.00e+00	9.07e-13
Te-134	1.68e-18	1.08e-18	1.12e-18	1.38e-18	1.03e-17	0.00e+00	6.22e-20
I-129	1.39e+09	1.17e+09	1.96e+09	1.43e+12	2.10e+09	0.00e+00	1.37e+08
I-130	7.41e+05	2.14e+06	8.56e+05	1.75e+08	3.30e+06	0.00e+00	1.65e+06
I-131	5.37e+08	7.52e+08	4.04e+08	2.20e+11	1.30e+09	0.00e+00	1.49e+08
I-132	2.96e-01	7.75e-01	2.78e-01	2.61e+01	1.22e+00	0.00e+00	3.38e-01
I-133	7.08e+06	1.20e+07	3.66e+06	1.68e+09	2.11e+07	0.00e+00	9.09e+06
I-134	3.74e-12	9.92e-12	3.56e-12	1.65e-10	1.56e-11	0.00e+00	1.31e-13
I-135	2.29e+04	5.90e+04	2.19e+04	3.80e+06	9.33e+04	0.00e+00	6.54e+04
Cs-134	9.81e+09	2.31e+10	1.07e+10	0.00e+00	7.34e+09	2.80e+09	2.87e+08
Cs-134m	3.13e-01	6.49e-01	3.34e-01	0.00e+00	3.61e-01	6.34e-02	4.32e-01

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	3.33e+09	3.05e+09	7.13e+08	0.00e+00	1.16e+09	4.21e+08	5.34e+07
Cs-136	4.48e+08	1.76e+09	1.18e+09	0.00e+00	9.60e+08	1.51e+08	1.42e+08
Cs-137	1.34e+10	1.78e+10	6.20e+09	0.00e+00	6.06e+09	2.35e+09	2.53e+08
Cs-138	1.76e-23	3.38e-23	1.69e-23	0.00e+00	2.50e-23	2.91e-24	1.54e-26
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	4.85e+07	5.95e+04	3.13e+06	0.00e+00	2.02e+04	4.00e+04	7.48e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	5.52e-05	1.70e-05	2.80e-06	0.00e+00	0.00e+00	0.00e+00	3.01e+00
La-142	3.43e-11	1.53e-11	3.80e-12	0.00e+00	0.00e+00	0.00e+00	4.64e-07
Ce-141	8.88e+03	5.93e+03	6.81e+02	0.00e+00	2.79e+03	0.00e+00	1.70e+07
Ce-143	7.65e+01	5.56e+04	6.21e+00	0.00e+00	2.50e+01	0.00e+00	1.67e+06
Ce-144	6.58e+05	2.72e+05	3.54e+04	0.00e+00	1.63e+05	0.00e+00	1.66e+08
Pr-143	2.90e+02	1.16e+02	1.44e+01	0.00e+00	6.73e+01	0.00e+00	9.55e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	1.81e+02	1.97e+02	1.18e+01	0.00e+00	1.16e+02	0.00e+00	7.11e+05
Pm-147	5.15e+03	4.89e+02	1.99e+02	0.00e+00	9.32e+02	0.00e+00	4.65e+05
Pm-148	1.09e+02	1.77e+01	8.93e+00	0.00e+00	3.20e+01	0.00e+00	1.06e+06
Pm-148m	1.49e+03	3.78e+02	2.96e+02	0.00e+00	5.73e+02	0.00e+00	2.38e+06
Pm-149	7.88e+00	1.11e+00	4.54e-01	0.00e+00	2.11e+00	0.00e+00	1.63e+05
Pm-151	1.18e+00	1.95e-01	9.88e-02	0.00e+00	3.51e-01	0.00e+00	4.38e+04
Sm-151	4.35e+03	8.37e+02	1.96e+02	0.00e+00	9.17e+02	0.00e+00	2.84e+05
Sm-153	3.65e+00	3.02e+00	2.22e-01	0.00e+00	9.88e-01	0.00e+00	8.53e+04
Eu-152	1.22e+04	2.93e+03	2.58e+03	0.00e+00	1.36e+04	0.00e+00	1.08e+06
Eu-154	3.94e+04	5.08e+03	3.58e+03	0.00e+00	2.27e+04	0.00e+00	2.69e+06
Eu-155	8.48e+03	8.18e+02	5.07e+02	0.00e+00	3.20e+03	0.00e+00	4.69e+06
Eu-156	4.55e+02	3.41e+02	5.57e+01	0.00e+00	2.30e+02	0.00e+00	1.74e+06
Tb-160	2.65e+03	0.00e+00	3.31e+02	0.00e+00	1.05e+03	0.00e+00	1.72e+06

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Offsite Dose Calculation Manual

Attachment 19

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Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.78e+04	5.48e+03	3.97e+03	0.00e+00	8.03e+03	0.00e+00	1.35e+06
W-181	6.27e+04	2.02e+04	2.12e+03	0.00e+00	0.00e+00	0.00e+00	1.72e+06
W-185	2.39e+06	7.88e+05	8.33e+04	0.00e+00	0.00e+00	0.00e+00	6.81e+07
W-187	1.19e+04	9.73e+03	3.41e+03	0.00e+00	0.00e+00	0.00e+00	2.63e+06
Pb-210	1.12e+11	3.36e+10	4.33e+09	0.00e+00	1.06e+11	0.00e+00	1.46e+07
Bi-210	6.57e+05	4.49e+06	3.76e+05	0.00e+00	5.46e+07	0.00e+00	5.13e+07
Po-210	1.37e+09	2.88e+09	3.31e+08	0.00e+00	9.68e+09	0.00e+00	1.81e+08
Ra-223	2.25e+11	3.42e+08	4.50e+10	0.00e+00	9.83e+09	0.00e+00	1.09e+10
Ra-224	2.62e+10	6.25e+07	5.22e+09	0.00e+00	1.79e+09	0.00e+00	4.20e+09
Ra-225	3.50e+11	4.11e+08	6.98e+10	0.00e+00	1.18e+10	0.00e+00	1.22e+10
Ra-226	2.57e+13	6.49e+08	1.91e+13	0.00e+00	1.85e+10	0.00e+00	2.80e+10
Ra-228	1.08e+13	3.49e+08	1.20e+13	0.00e+00	9.98e+09	0.00e+00	4.74e+09
Ac-225	1.14e+05	1.55e+05	7.63e+03	0.00e+00	1.78e+04	0.00e+00	7.89e+06
Ac-227	1.02e+08	1.51e+07	6.07e+06	0.00e+00	4.38e+06	0.00e+00	4.32e+06
Th-227	5.16e+05	9.27e+03	1.49e+04	0.00e+00	5.29e+04	0.00e+00	1.51e+07
Th-228	3.32e+07	5.56e+05	1.12e+06	0.00e+00	3.13e+06	0.00e+00	2.91e+07
Th-229	7.13e+08	2.05e+07	1.18e+07	0.00e+00	9.92e+07	0.00e+00	4.13e+06
Th-230	1.08e+08	6.13e+06	2.99e+06	0.00e+00	2.99e+07	0.00e+00	3.18e+06
Th-232	1.21e+08	5.24e+06	8.13e+04	0.00e+00	2.55e+07	0.00e+00	2.71e+06
Th-234	3.39e+03	1.99e+02	9.86e+01	0.00e+00	1.13e+03	0.00e+00	3.60e+06
Pa-231	2.15e+08	8.08e+06	8.38e+06	0.00e+00	4.54e+07	0.00e+00	3.79e+06
Pa-233	2.30e+02	4.42e+01	3.95e+01	0.00e+00	1.67e+02	0.00e+00	5.05e+05
U-232	2.94e+10	0.00e+00	2.10e+09	0.00e+00	3.18e+09	0.00e+00	3.58e+08
U-233	6.18e+09	0.00e+00	3.76e+08	0.00e+00	1.45e+09	0.00e+00	3.32e+08
U-234	5.93e+09	0.00e+00	3.68e+08	0.00e+00	1.42e+09	0.00e+00	3.25e+08
U-235	5.68e+09	0.00e+00	3.46e+08	0.00e+00	1.33e+09	0.00e+00	4.13e+08
U-236	5.68e+09	0.00e+00	3.54e+08	0.00e+00	1.36e+09	0.00e+00	3.05e+08
U-237	1.04e+05	0.00e+00	2.77e+04	0.00e+00	4.28e+05	0.00e+00	2.76e+07
U-238	5.43e+09	0.00e+00	3.24e+08	0.00e+00	1.25e+09	0.00e+00	2.91e+08
Np-237	6.63e+07	4.76e+06	2.92e+06	0.00e+00	2.16e+07	0.00e+00	4.19e+06

Conversion factors are in units of square meter-mrem/yr per µCi/sec for all nuclides except H-3, which is in units of mrem/yr per µCi/cubic meter.



Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Teen age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	6.65e+01	1.78e+00	1.04e+00	0.00e+00	6.10e+00	0.00e+00	1.31e+05
Np-239	7.01e+00	6.62e-01	3.67e-01	0.00e+00	2.08e+00	0.00e+00	1.06e+05
Pu-238	1.34e+07	1.71e+06	3.63e+05	0.00e+00	1.55e+06	0.00e+00	1.54e+06
Pu-239	1.53e+07	1.85e+06	4.01e+05	0.00e+00	1.71e+06	0.00e+00	1.41e+06
Pu-240	1.52e+07	1.85e+06	4.01e+05	0.00e+00	1.71e+06	0.00e+00	1.43e+06
Pu-241	3.48e+05	1.67e+04	7.34e+03	0.00e+00	3.40e+04	0.00e+00	2.94e+04
Pu-242	1.41e+07	1.78e+06	3.87e+05	0.00e+00	1.65e+06	0.00e+00	1.38e+06
Pu-244	1.65e+07	2.03e+06	4.43e+05	0.00e+00	1.88e+06	0.00e+00	2.05e+06
Am-241	3.94e+07	3.72e+07	2.84e+06	0.00e+00	2.13e+07	0.00e+00	3.89e+06
Am-242m	4.02e+07	3.54e+07	2.89e+06	0.00e+00	2.14e+07	0.00e+00	4.93e+06
Am-243	3.97e+07	3.66e+07	2.80e+06	0.00e+00	2.10e+07	0.00e+00	4.60e+06
Cm-242	1.34e+06	1.41e+06	8.88e+04	0.00e+00	4.05e+05	0.00e+00	3.82e+06
Cm-243	3.24e+07	3.00e+07	2.04e+06	0.00e+00	9.51e+06	0.00e+00	4.12e+06
Cm-244	2.51e+07	2.37e+07	1.59e+06	0.00e+00	7.41e+06	0.00e+00	3.98e+06
Cm-245	4.94e+07	4.34e+07	3.04e+06	0.00e+00	1.42e+07	0.00e+00	3.72e+06
Cm-246	4.90e+07	4.34e+07	3.04e+06	0.00e+00	1.42e+07	0.00e+00	3.65e+06
Cm-247	4.77e+07	4.27e+07	2.99e+06	0.00e+00	1.40e+07	0.00e+00	4.80e+06
Cm-248	3.96e+08	3.52e+08	2.47e+07	0.00e+00	1.15e+08	0.00e+00	7.73e+07
Cf-252	1.70e+07	0.00e+00	4.10e+05	0.00e+00	0.00e+00	0.00e+00	1.50e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	8.97e+02	8.97e+02	8.97e+02	8.97e+02	8.97e+02	8.97e+02
Be-10	1.11e+07	1.29e+06	2.79e+05	0.00e+00	9.13e+05	0.00e+00	2.26e+07
C-14	1.19e+09	2.39e+08	2.39e+08	2.39e+08	2.39e+08	2.39e+08	2.39e+08
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	1.97e-02	0.00e+00	1.96e-03	0.00e+00	0.00e+00	0.00e+00	5.34e-03
Na-22	1.90e+10	1.90e+10	1.90e+10	1.90e+10	1.90e+10	1.90e+10	1.90e+10
Na-24	8.88e+06	8.88e+06	8.88e+06	8.88e+06	8.88e+06	8.88e+06	8.88e+06
P-32	7.78e+10	3.64e+09	3.00e+09	0.00e+00	0.00e+00	0.00e+00	2.15e+09
Ca-41	2.28e+10	0.00e+00	2.49e+09	0.00e+00	0.00e+00	0.00e+00	1.25e+07
Sc-46	6.83e+02	9.36e+02	3.61e+02	0.00e+00	8.29e+02	0.00e+00	1.37e+06
Cr-51	0.00e+00	0.00e+00	1.02e+05	5.65e+04	1.54e+04	1.03e+05	5.40e+06
Mn-54	0.00e+00	2.10e+07	5.59e+06	0.00e+00	5.88e+06	0.00e+00	1.76e+07
Mn-56	0.00e+00	1.28e-02	2.90e-03	0.00e+00	1.55e-02	0.00e+00	1.86e+00
Fe-55	1.12e+08	5.93e+07	1.84e+07	0.00e+00	0.00e+00	3.35e+07	1.10e+07
Fe-59	1.20e+08	1.95e+08	9.69e+07	0.00e+00	0.00e+00	5.64e+07	2.03e+08
Co-57	0.00e+00	3.84e+06	7.77e+06	0.00e+00	0.00e+00	0.00e+00	3.14e+07
Co-58	0.00e+00	1.21e+07	3.71e+07	0.00e+00	0.00e+00	0.00e+00	7.07e+07
Co-60	0.00e+00	4.32e+07	1.27e+08	0.00e+00	0.00e+00	0.00e+00	2.39e+08
Ni-59	2.22e+09	5.90e+08	3.76e+08	0.00e+00	0.00e+00	0.00e+00	3.91e+07
Ni-63	2.96e+10	1.59e+09	1.01e+09	0.00e+00	0.00e+00	0.00e+00	1.07e+08
Ni-65	1.68e+00	1.58e-01	9.24e-02	0.00e+00	0.00e+00	0.00e+00	1.94e+01
Cu-64	0.00e+00	7.49e+04	4.52e+04	0.00e+00	1.81e+05	0.00e+00	3.51e+06
Zn-65	4.13e+09	1.10e+10	6.85e+09	0.00e+00	6.94e+09	0.00e+00	1.93e+09
Zn-69	9.87e-12	1.43e-11	1.32e-12	0.00e+00	8.65e-12	0.00e+00	8.99e-10
Zn-69m	8.06e+05	1.37e+06	1.62e+05	0.00e+00	7.98e+05	0.00e+00	4.47e+07
Se-79	0.00e+00	3.12e+09	6.92e+08	0.00e+00	5.07e+09	0.00e+00	2.05e+08
Br-82	0.00e+00	0.00e+00	1.15e+08	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	4.47e-01	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	7.00e-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	8.77e+09	5.39e+09	0.00e+00	0.00e+00	0.00e+00	5.64e+08
Rb-87	0.00e+00	9.75e+09	4.52e+09	0.00e+00	0.00e+00	0.00e+00	1.46e+08
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	6.62e+09	0.00e+00	1.89e+08	0.00e+00	0.00e+00	0.00e+00	2.56e+08
Sr-90	1.68e+11	0.00e+00	3.38e+09	0.00e+00	0.00e+00	0.00e+00	1.50e+09
Sr-91	1.31e+05	0.00e+00	4.94e+03	0.00e+00	0.00e+00	0.00e+00	2.89e+05
Sr-92	2.21e+00	0.00e+00	8.88e-02	0.00e+00	0.00e+00	0.00e+00	4.19e+01
Y-90	3.22e+02	0.00e+00	8.63e+00	0.00e+00	0.00e+00	0.00e+00	9.18e+05
Y-91	3.90e+04	0.00e+00	1.04e+03	0.00e+00	0.00e+00	0.00e+00	5.20e+06
Y-91m	2.80e-19	0.00e+00	1.02e-20	0.00e+00	0.00e+00	0.00e+00	5.49e-16
Y-92	2.56e-04	0.00e+00	7.32e-06	0.00e+00	0.00e+00	0.00e+00	7.39e+00
Y-93	1.02e+00	0.00e+00	2.79e-02	0.00e+00	0.00e+00	0.00e+00	1.51e+04
Zr-93	6.87e+03	2.57e+02	1.83e+02	0.00e+00	9.95e+02	0.00e+00	9.75e+04
Zr-95	3.83e+03	8.42e+02	7.50e+02	0.00e+00	1.21e+03	0.00e+00	8.79e+05
Zr-97	1.92e+00	2.78e-01	1.64e-01	0.00e+00	3.99e-01	0.00e+00	4.21e+04
Nb-93m	2.15e+06	5.37e+05	1.77e+05	0.00e+00	5.80e+05	0.00e+00	8.10e+07
Nb-95	3.18e+05	1.24e+05	8.84e+04	0.00e+00	1.16e+05	0.00e+00	2.29e+08
Nb-97	2.91e-11	5.26e-12	2.46e-12	0.00e+00	5.84e-12	0.00e+00	1.62e-06
Mo-93	0.00e+00	1.49e+09	5.34e+07	0.00e+00	3.92e+08	0.00e+00	7.53e+07
Mo-99	0.00e+00	8.14e+07	2.01e+07	0.00e+00	1.74e+08	0.00e+00	6.73e+07
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	1.10e+08	1.23e+08	4.40e+07	0.00e+00	1.44e+09	1.08e+07	1.29e+09
Tc-99m	1.33e+01	2.61e+01	4.32e+02	0.00e+00	3.79e+02	1.32e+01	1.48e+04
Ru-103	4.28e+03	0.00e+00	1.65e+03	0.00e+00	1.08e+04	0.00e+00	1.11e+05
Ru-105	3.85e-03	0.00e+00	1.40e-03	0.00e+00	3.39e-02	0.00e+00	2.51e+00
Ru-106	9.24e+04	0.00e+00	1.15e+04	0.00e+00	1.25e+05	0.00e+00	1.44e+06
Rh-105	1.56e+06	8.40e+05	7.18e+05	0.00e+00	3.35e+06	0.00e+00	5.21e+07
Pd-107	0.00e+00	3.88e+07	3.30e+06	0.00e+00	3.25e+08	0.00e+00	7.71e+07
Pd-109	0.00e+00	1.53e+05	4.59e+04	0.00e+00	8.22e+05	0.00e+00	9.05e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	2.09e+08	1.41e+08	1.13e+08	0.00e+00	2.63e+08	0.00e+00	1.68e+10
Ag-111	2.94e+07	9.20e+06	6.07e+06	0.00e+00	2.78e+07	0.00e+00	5.63e+09
Cd-113m	0.00e+00	1.00e+07	4.27e+05	0.00e+00	1.03e+07	0.00e+00	2.59e+07
Cd-115m	0.00e+00	4.29e+06	1.83e+05	0.00e+00	3.19e+06	0.00e+00	5.83e+07
Sn-123	2.44e+09	3.03e+07	5.95e+07	3.21e+07	0.00e+00	0.00e+00	1.20e+09
Sn-125	2.57e+08	3.88e+06	1.15e+07	4.03e+06	0.00e+00	0.00e+00	7.98e+08
Sn-126	6.85e+09	8.54e+07	1.95e+08	2.34e+07	0.00e+00	0.00e+00	5.14e+08
Sb-124	1.09e+08	1.41e+06	3.81e+07	2.40e+05	0.00e+00	6.03e+07	6.79e+08
Sb-125	8.70e+07	6.71e+05	1.82e+07	8.06e+04	0.00e+00	4.85e+07	2.08e+08
Sb-126	2.29e+07	3.51e+05	8.23e+06	1.34e+05	0.00e+00	1.09e+07	4.62e+08
Sb-127	1.98e+06	3.07e+04	6.88e+05	2.21e+04	0.00e+00	8.60e+05	1.12e+08
Te-125m	7.38e+07	2.00e+07	9.84e+06	2.07e+07	0.00e+00	0.00e+00	7.12e+07
Te-127	2.99e+03	8.06e+02	6.41e+02	2.07e+03	8.50e+03	0.00e+00	1.17e+05
Te-127m	2.08e+08	5.60e+07	2.47e+07	4.97e+07	5.93e+08	0.00e+00	1.68e+08
Te-129	1.33e-09	3.70e-10	3.15e-10	9.46e-10	3.88e-09	0.00e+00	8.25e-08
Te-129m	2.71e+08	7.58e+07	4.21e+07	8.75e+07	7.97e+08	0.00e+00	3.31e+08
Te-131	1.77e-32	5.40e-33	5.27e-33	1.36e-32	5.36e-32	0.00e+00	9.31e-32
Te-131m	1.60e+06	5.54e+05	5.89e+05	1.14e+06	5.36e+06	0.00e+00	2.25e+07
Te-132	1.03e+07	4.54e+06	5.48e+06	6.61e+06	4.21e+07	0.00e+00	4.57e+07
Te-133m	9.46e-13	3.82e-13	4.74e-13	7.33e-13	3.63e-12	0.00e+00	2.92e-11
Te-134	3.99e-18	1.79e-18	2.39e-18	3.15e-18	1.66e-17	0.00e+00	1.82e-17
I-129	3.43e+09	2.11e+09	1.88e+09	1.38e+12	3.55e+09	0.00e+00	1.06e+08
I-130	1.73e+06	3.50e+06	1.80e+06	3.86e+08	5.23e+06	0.00e+00	1.64e+06
I-131	1.30e+09	1.31e+09	7.45e+08	4.33e+11	2.15e+09	0.00e+00	1.17e+08
I-132	7.01e-01	1.29e+00	5.92e-01	5.97e+01	1.97e+00	0.00e+00	1.52e+00
I-133	1.72e+07	2.13e+07	8.05e+06	3.95e+09	3.55e+07	0.00e+00	8.57e+06
I-134	8.87e-12	1.65e-11	7.57e-12	3.79e-10	2.52e-11	0.00e+00	1.09e-11
I-135	5.43e+04	9.77e+04	4.62e+04	8.66e+06	1.50e+05	0.00e+00	7.45e+04
Cs-134	2.26e+10	3.71e+10	7.84e+09	0.00e+00	1.15e+10	4.13e+09	2.00e+08
Cs-134m	7.42e-01	1.10e+00	7.18e-01	0.00e+00	5.80e-01	9.59e-02	1.39e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	8.19e+09	5.71e+09	5.85e+08	0.00e+00	2.01e+09	6.72e+08	4.27e+07
Cs-136	1.01e+09	2.78e+09	1.80e+09	0.00e+00	1.48e+09	2.21e+08	9.77e+07
Cs-137	3.22e+10	3.09e+10	4.55e+09	0.00e+00	1.01e+10	3.62e+09	1.93e+08
Cs-138	4.27e-23	5.94e-23	3.77e-23	0.00e+00	4.18e-23	4.50e-24	2.74e-23
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	1.17e+08	1.03e+05	6.84e+06	0.00e+00	3.34e+04	6.12e+04	5.93e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	1.36e-04	3.17e-05	6.89e-06	0.00e+00	0.00e+00	0.00e+00	7.06e+00
La-142	8.30e-11	2.64e-11	8.28e-12	0.00e+00	0.00e+00	0.00e+00	5.24e-06
Ce-141	2.19e+04	1.09e+04	1.62e+03	0.00e+00	4.78e+03	0.00e+00	1.36e+07
Ce-143	1.88e+02	1.02e+05	1.47e+01	0.00e+00	4.27e+01	0.00e+00	1.49e+06
Ce-144	1.62e+06	5.09e+05	8.66e+04	0.00e+00	2.82e+05	0.00e+00	1.33e+08
Pr-143	7.18e+02	2.16e+02	3.56e+01	0.00e+00	1.17e+02	0.00e+00	7.75e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	4.45e+02	3.60e+02	2.79e+01	0.00e+00	1.98e+02	0.00e+00	5.71e+05
Pm-147	1.29e+04	9.19e+02	4.94e+02	0.00e+00	1.62e+03	0.00e+00	3.72e+05
Pm-148	2.66e+02	3.20e+01	2.07e+01	0.00e+00	5.44e+01	0.00e+00	8.54e+05
Pm-148m	3.06e+03	6.09e+02	6.09e+02	0.00e+00	9.03e+02	0.00e+00	1.72e+06
Pm-149	1.94e+01	2.07e+00	1.12e+00	0.00e+00	3.65e+00	0.00e+00	1.41e+05
Pm-151	2.88e+00	3.51e-01	2.28e-01	0.00e+00	5.95e-01	0.00e+00	3.98e+04
Sm-151	1.05e+04	1.57e+03	4.93e+02	0.00e+00	1.62e+03	0.00e+00	2.27e+05
Sm-153	9.02e+00	5.61e+00	5.41e-01	0.00e+00	1.71e+00	0.00e+00	7.46e+04
Eu-152	2.52e+04	4.59e+03	5.45e+03	0.00e+00	1.94e+04	0.00e+00	7.54e+05
Eu-154	9.46e+04	8.51e+03	7.77e+03	0.00e+00	3.74e+04	0.00e+00	1.98e+06
Eu-155	1.94e+04	1.39e+03	1.09e+03	0.00e+00	5.22e+03	0.00e+00	3.49e+06
Eu-156	1.10e+03	5.88e+02	1.22e+02	0.00e+00	3.79e+02	0.00e+00	1.33e+06
Tb-160	5.61e+03	0.00e+00	6.96e+02	0.00e+00	1.67e+03	0.00e+00	1.24e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	4.44e+04	9.30e+03	7.86e+03	0.00e+00	1.32e+04	0.00e+00	1.08e+06
W-181	1.54e+05	3.79e+04	5.21e+03	0.00e+00	0.00e+00	0.00e+00	1.38e+06
W-185	5.89e+06	1.47e+06	2.06e+05	0.00e+00	0.00e+00	0.00e+00	5.48e+07
W-187	2.89e+04	1.71e+04	7.69e+03	0.00e+00	0.00e+00	0.00e+00	2.41e+06
Pb-210	2.42e+11	6.21e+10	1.06e+10	0.00e+00	1.87e+11	0.00e+00	1.17e+07
Bi-210	1.62e+06	8.38e+06	9.29e+05	0.00e+00	9.45e+07	0.00e+00	4.25e+07
Po-210	3.37e+09	5.39e+09	8.14e+08	0.00e+00	1.68e+10	0.00e+00	1.45e+08
Ra-223	5.55e+11	6.41e+08	1.11e+11	0.00e+00	1.70e+10	0.00e+00	8.84e+09
Ra-224	6.43e+10	1.17e+08	1.29e+10	0.00e+00	3.09e+09	0.00e+00	3.53e+09
Ra-225	8.62e+11	7.70e+08	1.72e+11	0.00e+00	2.04e+10	0.00e+00	9.89e+09
Ra-226	3.78e+13	1.21e+09	3.11e+13	0.00e+00	3.21e+10	0.00e+00	2.24e+10
Ra-228	2.52e+13	6.53e+08	2.82e+13	0.00e+00	1.73e+10	0.00e+00	3.80e+09
Ac-225	2.81e+05	2.89e+05	1.88e+04	0.00e+00	3.09e+04	0.00e+00	6.43e+06
Ac-227	1.69e+08	2.72e+07	1.05e+07	0.00e+00	5.99e+06	0.00e+00	3.46e+06
Th-227	1.27e+06	1.73e+04	3.67e+04	0.00e+00	9.17e+04	0.00e+00	1.22e+07
Th-228	8.33e+07	1.07e+06	2.82e+06	0.00e+00	5.55e+06	0.00e+00	2.33e+07
Th-229	9.67e+08	2.43e+07	1.61e+07	0.00e+00	1.19e+08	0.00e+00	3.31e+06
Th-230	1.46e+08	7.32e+06	4.08e+06	0.00e+00	3.57e+07	0.00e+00	2.55e+06
Th-232	1.63e+08	6.25e+06	1.24e+05	0.00e+00	3.05e+07	0.00e+00	2.17e+06
Th-234	8.40e+03	3.71e+02	2.43e+02	0.00e+00	1.97e+03	0.00e+00	2.90e+06
Pa-231	2.91e+08	9.63e+06	1.16e+07	0.00e+00	5.27e+07	0.00e+00	3.03e+06
Pa-233	4.68e+02	7.30e+01	8.18e+01	0.00e+00	2.69e+02	0.00e+00	3.73e+05
U-232	7.24e+10	0.00e+00	5.18e+09	0.00e+00	5.51e+09	0.00e+00	2.87e+08
U-233	1.53e+10	0.00e+00	9.26e+08	0.00e+00	2.51e+09	0.00e+00	2.65e+08
U-234	1.47e+10	0.00e+00	9.09e+08	0.00e+00	2.46e+09	0.00e+00	2.60e+08
U-235	1.41e+10	0.00e+00	8.51e+08	0.00e+00	2.31e+09	0.00e+00	3.30e+08
U-236	1.41e+10	0.00e+00	8.72e+08	0.00e+00	2.36e+09	0.00e+00	2.44e+08
U-237	2.57e+05	0.00e+00	6.83e+04	0.00e+00	7.42e+05	0.00e+00	2.27e+07
U-238	1.35e+10	0.00e+00	7.98e+08	0.00e+00	2.16e+09	0.00e+00	2.33e+08
Np-237	9.17e+07	6.05e+06	4.03e+06	0.00e+00	2.49e+07	0.00e+00	3.36e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 19

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## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Child age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.64e+02	3.32e+00	2.55e+00	0.00e+00	1.06e+01	0.00e+00	1.14e+05
Np-239	1.73e+01	1.24e+00	8.71e-01	0.00e+00	3.58e+00	0.00e+00	9.17e+04
Pu-238	1.96e+07	2.27e+06	5.20e+05	0.00e+00	1.89e+06	0.00e+00	1.23e+06
Pu-239	2.12e+07	2.27e+06	5.45e+05	0.00e+00	2.01e+06	0.00e+00	1.13e+06
Pu-240	2.11e+07	2.35e+06	5.45e+05	0.00e+00	2.01e+06	0.00e+00	1.15e+06
Pu-241	6.35e+05	2.59e+04	1.32e+04	0.00e+00	4.86e+04	0.00e+00	2.36e+04
Pu-242	1.96e+07	2.27e+06	5.25e+05	0.00e+00	1.93e+06	0.00e+00	1.10e+06
Pu-244	2.29e+07	2.60e+07	6.01e+05	0.00e+00	2.22e+06	0.00e+00	1.65e+06
Am-241	5.54e+07	4.77e+07	4.16e+06	0.00e+00	2.54e+07	0.00e+00	3.11e+06
Am-242m	5.76e+07	4.61e+07	4.28e+06	0.00e+00	2.59e+07	0.00e+00	3.95e+06
Am-243	5.51e+07	4.65e+07	4.04e+06	0.00e+00	2.49e+07	0.00e+00	3.68e+06
Am-242	3.30e+06	2.63e+06	2.19e+05	0.00e+00	7.02e+05	0.00e+00	3.06e+06
Cm-243	5.26e+07	4.27e+07	3.38e+06	0.00e+00	1.27e+07	0.00e+00	3.30e+06
Cm-244	4.43e+07	3.59e+07	2.84e+06	0.00e+00	1.04e+07	0.00e+00	3.19e+06
Cm-245	6.87e+07	5.51e+07	4.32e+06	0.00e+00	1.69e+07	0.00e+00	2.98e+06
Cm-246	6.79e+07	5.51e+07	4.32e+06	0.00e+00	1.69e+07	0.00e+00	2.92e+06
Cm-247	6.62e+07	5.43e+07	4.24e+06	0.00e+00	1.66e+07	0.00e+00	3.85e+06
Cm-248	5.51e+08	4.48e+08	3.50e+07	0.00e+00	1.37e+08	0.00e+00	6.21e+07
Cf-252	4.25e+07	0.00e+00	1.03e+06	0.00e+00	0.00e+00	0.00e+00	1.20e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.36e+03	1.36e+03	1.36e+03	1.36e+03	1.36e+03	1.36e+03
Be-10	1.41e+07	2.05e+06	4.25e+05	0.00e+00	1.35e+06	0.00e+00	2.29e+07
C-14	2.34e+09	5.00e+08	5.00e+08	5.00e+08	5.00e+08	5.00e+08	5.00e+08
N-13	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
F-18	4.12e-02	0.00e+00	3.51e-03	0.00e+00	0.00e+00	0.00e+00	9.67e-03
Na-22	3.18e+10	3.18e+10	3.18e+10	3.18e+10	3.18e+10	3.18e+10	3.18e+10
Na-24	1.55e+07	1.55e+07	1.55e+07	1.55e+07	1.55e+07	1.55e+07	1.55e+07
P-32	1.60e+11	9.43e+09	6.21e+09	0.00e+00	0.00e+00	0.00e+00	2.17e+09
Ca-41	2.46e+10	0.00e+00	2.69e+09	0.00e+00	0.00e+00	0.00e+00	1.26e+07
Sc-46	1.30e+03	1.88e+03	5.86e+02	0.00e+00	1.23e+03	0.00e+00	1.22e+06
Cr-51	0.00e+00	0.00e+00	1.61e+05	1.05e+05	2.30e+04	2.05e+05	4.70e+06
Mn-54	0.00e+00	3.90e+07	8.84e+06	0.00e+00	8.64e+06	0.00e+00	1.43e+07
Mn-56	0.00e+00	3.14e-02	5.42e-03	0.00e+00	2.70e-02	0.00e+00	2.86e+00
Fe-55	1.35e+08	8.73e+07	2.33e+07	0.00e+00	0.00e+00	4.27e+07	1.11e+07
Fe-59	2.24e+08	3.92e+08	1.54e+08	0.00e+00	0.00e+00	1.16e+08	1.87e+08
Co-57	0.00e+00	8.95e+06	1.46e+07	0.00e+00	0.00e+00	0.00e+00	3.05e+07
Co-58	0.00e+00	2.42e+07	6.05e+07	0.00e+00	0.00e+00	0.00e+00	6.04e+07
Co-60	0.00e+00	8.81e+07	2.08e+08	0.00e+00	0.00e+00	0.00e+00	2.10e+08
Ni-59	2.61e+09	7.99e+08	4.50e+08	0.00e+00	0.00e+00	0.00e+00	3.95e+07
Ni-63	3.49e+10	2.16e+09	1.21e+09	0.00e+00	0.00e+00	0.00e+00	1.07e+08
Ni-65	3.56e+00	4.03e-01	1.83e-01	0.00e+00	0.00e+00	0.00e+00	3.07e+01
Cu-64	0.00e+00	1.86e+05	8.62e+04	0.00e+00	3.15e+05	0.00e+00	3.82e+06
Zn-65	5.55e+09	1.90e+10	8.78e+09	0.00e+00	9.23e+09	0.00e+00	1.61e+10
Zn-69	2.10e-11	3.79e-11	2.82e-12	0.00e+00	1.57e-11	0.00e+00	3.09e-09
Zn-69m	1.70e+06	3.48e+06	3.17e+05	0.00e+00	1.41e+06	0.00e+00	4.82e+07
Se-79	0.00e+00	7.77e+09	1.44e+09	0.00e+00	9.00e+09	0.00e+00	2.07e+08
Br-82	0.00e+00	0.00e+00	1.93e+08	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	9.49e-01	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	1.35e-22	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .



Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.23e+10	1.10e+10	0.00e+00	0.00e+00	0.00e+00	5.69e+08
Rb-87	0.00e+00	2.19e+10	8.69e+09	0.00e+00	0.00e+00	0.00e+00	1.48e+08
Rb-88	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Rb-89	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Sr-89	1.26e+10	0.00e+00	3.61e+08	0.00e+00	0.00e+00	0.00e+00	2.59e+08
Sr-90	1.86e+11	0.00e+00	3.77e+09	0.00e+00	0.00e+00	0.00e+00	1.52e+09
Sr-91	2.73e+05	0.00e+00	9.87e+03	0.00e+00	0.00e+00	0.00e+00	3.23e+05
Sr-92	4.71e+00	0.00e+00	1.75e-01	0.00e+00	0.00e+00	0.00e+00	5.08e+01
Y-90	6.82e+02	0.00e+00	1.83e+01	0.00e+00	0.00e+00	0.00e+00	9.41e+05
Y-91	7.33e+04	0.00e+00	1.95e+03	0.00e+00	0.00e+00	0.00e+00	5.25e+06
Y-91m	5.94e-19	0.00e+00	2.03e-20	0.00e+00	0.00e+00	0.00e+00	1.98e-15
Y-92	5.44e-04	0.00e+00	1.53e-05	0.00e+00	0.00e+00	0.00e+00	1.04e+01
Y-93	2.16e+00	0.00e+00	5.90e-02	0.00e+00	0.00e+00	0.00e+00	1.71e+04
Zr-93	7.94e+03	3.78e+02	2.28e+02	0.00e+00	1.11e+03	0.00e+00	9.83e+04
Zr-95	6.80e+03	1.66e+03	1.18e+03	0.00e+00	1.79e+03	0.00e+00	8.26e+05
Zr-97	4.07e+00	6.99e-01	3.19e-01	0.00e+00	7.04e-01	0.00e+00	4.46e+04
Nb-93m	2.52e+06	6.83e+05	2.13e+05	0.00e+00	6.66e+05	0.00e+00	8.16e+07
Nb-95	5.93e+05	2.44e+05	1.41e+05	0.00e+00	1.75e+05	0.00e+00	2.06e+08
Nb-97	6.16e-11	1.31e-11	4.74e-12	0.00e+00	1.03e-11	0.00e+00	4.15e-06
Mo-93	0.00e+00	3.49e+09	1.12e+08	0.00e+00	6.97e+08	0.00e+00	7.47e+07
Mo-99	0.00e+00	2.08e+08	4.06e+07	0.00e+00	3.11e+08	0.00e+00	6.86e+07
Tc-101	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tc-99	2.22e+08	3.00e+08	9.36e+07	0.00e+00	2.53e+09	2.92e+07	1.30e+09
Tc-99m	2.77e+01	5.70e+01	7.35e+02	0.00e+00	6.14e+02	2.98e+01	1.66e+04
Ru-103	8.67e+03	0.00e+00	2.90e+03	0.00e+00	1.80e+04	0.00e+00	1.05e+05
Ru-105	8.12e-03	0.00e+00	2.74e-03	0.00e+00	5.97e-02	0.00e+00	3.23e+00
Ru-106	1.90e+05	0.00e+00	2.38e+04	0.00e+00	2.25e+05	0.00e+00	1.44e+06
Rh-105	3.32e+06	2.17e+06	1.46e+06	0.00e+00	6.03e+06	0.00e+00	5.39e+07
Pd-107	0.00e+00	9.79e+07	6.95e+06	0.00e+00	5.59e+08	0.00e+00	7.78e+07
Pd-109	0.00e+00	4.05e+05	9.78e+04	0.00e+00	1.49e+06	0.00e+00	9.95e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	3.86e+08	2.82e+08	1.86e+08	0.00e+00	4.03e+08	0.00e+00	1.46e+10
Ag-111	6.17e+07	2.40e+07	1.27e+07	0.00e+00	5.01e+07	0.00e+00	5.72e+09
Cd-113m	0.00e+00	1.74e+07	6.42e+05	0.00e+00	1.32e+07	0.00e+00	2.62e+07
Cd-115m	0.00e+00	1.03e+07	3.59e+05	0.00e+00	5.40e+06	0.00e+00	5.89e+07
Sn-123	4.57e+09	7.14e+07	1.19e+08	7.18e+07	0.00e+00	0.00e+00	1.21e+09
Sn-125	5.37e+08	1.00e+07	2.39e+07	9.86e+06	0.00e+00	0.00e+00	8.05e+08
Sn-126	1.14e+10	1.49e+08	3.70e+08	3.93e+07	0.00e+00	0.00e+00	5.18e+08
Sb-124	2.09e+08	3.08e+06	6.49e+07	5.56e+05	0.00e+00	1.31e+08	6.46e+08
Sb-125	1.50e+08	1.45e+06	3.08e+07	1.87e+05	0.00e+00	8.65e+07	1.99e+08
Sb-126	4.20e+07	8.23e+05	1.52e+07	3.22e+05	0.00e+00	2.64e+07	4.35e+08
Sb-127	4.17e+06	7.44e+04	1.29e+06	5.31e+04	0.00e+00	2.15e+06	1.11e+08
Te-125m	1.51e+08	5.04e+07	2.04e+07	5.07e+07	0.00e+00	0.00e+00	7.18e+07
Te-127	6.34e+03	2.13e+03	1.36e+03	5.16e+03	1.55e+04	0.00e+00	1.33e+05
Te-127m	4.21e+08	1.40e+08	5.10e+07	1.22e+08	1.04e+09	0.00e+00	1.70e+08
Te-129	2.81e-09	9.69e-10	6.56e-10	2.36e-09	7.00e-09	0.00e+00	2.25e-07
Te-129m	5.57e+08	1.91e+08	8.58e+07	2.14e+08	1.39e+09	0.00e+00	3.33e+08
Te-131	3.76e-32	1.39e-32	1.05e-32	3.35e-32	9.61e-32	0.00e+00	1.52e-30
Te-131m	3.38e+06	1.36e+06	1.12e+06	2.76e+06	9.36e+06	0.00e+00	2.29e+07
Te-132	2.11e+07	1.05e+07	9.75e+06	1.54e+07	6.54e+07	0.00e+00	3.87e+07
Te-133m	1.98e-12	9.05e-13	8.65e-13	1.74e-12	6.17e-12	0.00e+00	9.76e-11
Te-134	8.25e-18	4.14e-18	4.27e-18	7.39e-18	2.79e-17	0.00e+00	9.46e-17
I-129	7.06e+09	5.23e+09	3.83e+09	3.36e+12	6.19e+09	0.00e+00	1.05e+08
I-130	3.56e+06	7.83e+06	3.14e+06	8.78e+08	8.60e+06	0.00e+00	1.68e+06
I-131	2.72e+09	3.21e+09	1.41e+09	1.05e+12	3.74e+09	0.00e+00	1.14e+08
I-132	1.45e+00	2.95e+00	1.05e+00	1.38e+02	3.29e+00	0.00e+00	2.39e+00
I-133	3.63e+07	5.29e+07	1.55e+07	9.62e+09	6.22e+07	0.00e+00	8.95e+06
I-134	1.84e-11	3.77e-11	1.34e-11	8.78e-10	4.21e-11	0.00e+00	3.89e-11
I-135	1.13e+05	2.25e+05	8.19e+04	2.01e+07	2.50e+05	0.00e+00	8.13e+04
Cs-134	3.65e+10	6.80e+10	6.87e+09	0.00e+00	1.75e+10	7.18e+09	1.85e+08
Cs-134m	1.55e+00	2.58e+00	1.30e+00	0.00e+00	9.94e-01	2.29e-01	2.04e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.31e+10	1.19e+10	6.22e+08	0.00e+00	3.40e+09	1.29e+09	4.31e+07
Cs-136	1.98e+09	5.81e+09	2.17e+09	0.00e+00	2.32e+09	4.74e+08	8.83e+07
Cs-137	5.15e+10	6.02e+10	4.27e+09	0.00e+00	1.62e+10	6.55e+09	1.88e+08
Cs-138	9.01e-23	1.47e-22	7.10e-23	0.00e+00	7.31e-23	1.14e-23	2.34e-22
Cs-139	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
Ba-140	2.41e+08	2.41e+05	1.24e+07	0.00e+00	5.72e+04	1.48e+05	5.92e+07
Ba-141	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ba-142	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	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
La-141	2.89e-04	8.39e-05	1.46e-05	0.00e+00	0.00e+00	0.00e+00	9.62e+00
La-142	1.74e-10	6.40e-11	1.53e-11	0.00e+00	0.00e+00	0.00e+00	1.09e-05
Ce-141	4.34e+04	2.64e+04	3.11e+03	0.00e+00	8.15e+03	0.00e+00	1.37e+07
Ce-143	3.97e+02	2.64e+05	3.01e+01	0.00e+00	7.68e+01	0.00e+00	1.54e+06
Ce-144	2.33e+06	9.52e+05	1.30e+05	0.00e+00	3.85e+05	0.00e+00	1.33e+08
Pr-143	1.49e+03	5.55e+02	7.36e+01	0.00e+00	2.06e+02	0.00e+00	7.84e+05
Pr-144	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Nd-147	8.81e+02	9.05e+02	5.55e+01	0.00e+00	3.49e+02	0.00e+00	5.74e+05
Pm-147	1.57e+04	1.32e+03	6.44e+02	0.00e+00	1.98e+03	0.00e+00	3.75e+05
Pm-148	5.57e+02	8.04e+01	4.05e+01	0.00e+00	9.60e+01	0.00e+00	8.58e+05
Pm-148m	4.90e+03	1.24e+03	9.74e+02	0.00e+00	1.43e+03	0.00e+00	1.62e+06
Pm-149	4.13e+01	5.42e+00	2.37e+00	0.00e+00	6.59e+00	0.00e+00	1.46e+05
Pm-151	6.10e+00	8.90e-01	4.50e-01	0.00e+00	1.06e+00	0.00e+00	4.12e+04
Sm-151	1.19e+04	2.74e+03	5.92e+02	0.00e+00	1.86e+03	0.00e+00	2.29e+05
Sm-153	1.91e+01	1.47e+01	1.13e+00	0.00e+00	3.09e+00	0.00e+00	7.71e+04
Eu-152	2.76e+04	7.34e+03	6.19e+03	0.00e+00	2.06e+04	0.00e+00	6.52e+05
Eu-154	1.09e+05	1.51e+04	9.05e+03	0.00e+00	4.09e+04	0.00e+00	1.88e+06
Eu-155	2.18e+04	2.51e+03	1.30e+03	0.00e+00	5.63e+03	0.00e+00	3.36e+06
Eu-156	2.23e+03	1.38e+03	2.19e+02	0.00e+00	6.37e+02	0.00e+00	1.30e+06
Tb-160	8.75e+03	0.00e+00	1.09e+03	0.00e+00	2.49e+03	0.00e+00	1.17e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	5.14e+04	1.11e+04	8.76e+03	0.00e+00	1.47e+04	0.00e+00	1.09e+06
W-181	3.23e+05	9.91e+04	1.11e+04	0.00e+00	0.00e+00	0.00e+00	1.39e+06
W-185	1.23e+07	3.85e+06	4.39e+05	0.00e+00	0.00e+00	0.00e+00	5.51e+07
W-187	6.09e+04	4.23e+04	1.46e+04	0.00e+00	0.00e+00	0.00e+00	2.49e+06
Pb-210	2.69e+11	7.23e+10	1.21e+10	0.00e+00	2.20e+11	0.00e+00	1.18e+07
Bi-210	3.42e+06	2.20e+07	1.96e+06	0.00e+00	1.71e+08	0.00e+00	4.33e+07
Po-210	6.88e+09	1.32e+10	1.64e+09	0.00e+00	2.80e+10	0.00e+00	1.47e+08
Ra-223	1.15e+12	1.68e+09	2.31e+11	0.00e+00	3.06e+10	0.00e+00	8.97e+09
Ra-224	1.36e+11	3.07e+08	2.72e+10	0.00e+00	5.60e+09	0.00e+00	3.60e+09
Ra-225	1.78e+12	2.01e+09	3.54e+11	0.00e+00	3.66e+10	0.00e+00	9.98e+09
Ra-226	4.08e+13	3.13e+09	3.38e+13	0.00e+00	5.73e+10	0.00e+00	2.26e+10
Ra-228	2.82e+13	1.69e+09	3.18e+13	0.00e+00	3.09e+10	0.00e+00	3.83e+09
Ac-225	5.85e+05	7.51e+05	3.92e+04	0.00e+00	5.51e+04	0.00e+00	6.51e+06
Ac-227	1.84e+08	3.15e+07	1.15e+07	0.00e+00	6.40e+06	0.00e+00	3.49e+06
Th-227	2.61e+06	4.37e+04	7.49e+04	0.00e+00	1.61e+05	0.00e+00	1.24e+07
Th-228	9.94e+07	1.36e+06	3.36e+06	0.00e+00	6.36e+06	0.00e+00	2.35e+07
Th-229	1.04e+09	2.60e+07	1.73e+07	0.00e+00	1.25e+08	0.00e+00	3.33e+06
Th-230	1.56e+08	7.82e+06	4.36e+06	0.00e+00	3.75e+07	0.00e+00	2.57e+06
Th-232	1.74e+08	6.70e+06	6.79e+04	0.00e+00	3.20e+07	0.00e+00	2.18e+06
Th-234	1.70e+04	9.26e+02	4.91e+02	0.00e+00	3.41e+03	0.00e+00	2.92e+06
Pa-231	3.11e+08	1.03e+07	1.24e+07	0.00e+00	5.51e+07	0.00e+00	3.06e+06
Pa-233	8.05e+02	1.58e+02	1.41e+02	0.00e+00	4.32e+02	0.00e+00	3.78e+05
U-232	9.95e+10	0.00e+00	8.88e+09	0.00e+00	9.74e+09	0.00e+00	2.89e+08
U-233	2.09e+10	0.00e+00	1.59e+09	0.00e+00	4.44e+09	0.00e+00	2.68e+08
U-234	2.01e+10	0.00e+00	1.56e+09	0.00e+00	4.36e+09	0.00e+00	2.62e+08
U-235	1.92e+10	0.00e+00	1.46e+09	0.00e+00	4.08e+09	0.00e+00	3.33e+08
U-236	1.92e+10	0.00e+00	1.50e+09	0.00e+00	4.15e+09	0.00e+00	2.46e+08
U-237	5.39e+05	0.00e+00	1.44e+05	0.00e+00	1.34e+06	0.00e+00	2.30e+07
U-238	1.84e+10	0.00e+00	1.37e+09	0.00e+00	3.82e+09	0.00e+00	2.35e+08
Np-237	9.87e+07	6.54e+06	4.32e+06	0.00e+00	2.61e+07	0.00e+00	3.39e+06

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 19

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## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for Infant age group by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Cow's Milk (food) Pathway for Pi

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	3.49e+02	8.78e+00	5.40e+00	0.00e+00	1.92e+01	0.00e+00	1.17e+05
Np-239	3.65e+01	3.26e+00	1.84e+00	0.00e+00	6.51e+00	0.00e+00	9.44e+04
Pu-238	2.11e+07	2.47e+06	5.59e+05	0.00e+00	1.99e+06	0.00e+00	1.24e+06
Pu-239	2.27e+07	2.55e+06	5.82e+05	0.00e+00	2.11e+06	0.00e+00	1.14e+06
Pu-240	2.27e+07	2.55e+06	5.82e+05	0.00e+00	2.11e+06	0.00e+00	1.16e+06
Pu-241	6.97e+05	2.89e+04	1.45e+04	0.00e+00	5.20e+04	0.00e+00	2.38e+04
Pu-242	2.11e+07	2.45e+06	5.61e+05	0.00e+00	2.02e+06	0.00e+00	1.11e+06
Pu-244	2.45e+07	2.81e+06	6.43e+05	0.00e+00	2.32e+06	0.00e+00	1.66e+06
Am-241	5.95e+07	5.17e+07	4.44e+06	0.00e+00	2.67e+07	0.00e+00	3.14e+06
Am-242m	6.21e+07	5.02e+07	4.65e+06	0.00e+00	2.73e+07	0.00e+00	3.98e+06
Am-243	5.92e+07	5.06e+07	4.36e+06	0.00e+00	2.62e+07	0.00e+00	3.71e+06
Cm-242	5.15e+06	4.77e+06	3.42e+05	0.00e+00	9.84e+05	0.00e+00	3.09e+06
Cm-243	5.75e+07	4.72e+07	3.69e+06	0.00e+00	1.34e+07	0.00e+00	3.33e+06
Cm-244	4.84e+07	3.98e+07	3.11e+06	0.00e+00	1.11e+07	0.00e+00	3.22e+06
Cm-245	7.36e+07	5.96e+07	4.65e+06	0.00e+00	1.78e+07	0.00e+00	3.00e+06
Cm-246	7.28e+07	5.96e+07	4.65e+06	0.00e+00	1.77e+07	0.00e+00	2.95e+06
Cm-247	7.12e+07	5.88e+07	4.57e+06	0.00e+00	1.74e+07	0.00e+00	3.88e+06
Cm-248	5.88e+08	4.85e+08	3.77e+07	0.00e+00	1.44e+08	0.00e+00	6.25e+07
Cf-252	4.93e+07	0.00e+00	1.19e+06	0.00e+00	0.00e+00	0.00e+00	1.21e+07

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$  for all nuclides except H-3, which is in units of mrem/yr per  $\mu\text{Ci}/\text{cubic meter}$ .

## Offsite Dose Calculation Manual

## Attachment 19

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## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Ground Plane Pathway for Pi

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
H-3	0.00e+00	0.00e+00
Be-10	0.00e+00	0.00e+00
C-14	0.00e+00	0.00e+00
N-13	5.75e+04	6.65e+04
F-18	5.66e+05	6.66e+05
Na-22	3.88e+09	4.36e+09
Na-24	1.71e+07	1.98e+07
P-32	0.00e+00	0.00e+00
Ca-41	9.42e+08	1.11e+09
Sc-46	1.13e+09	1.31e+09
Cr-51	6.65e+06	7.86e+06
Mn-54	1.10e+09	1.29e+09
Mn-56	1.29e+06	1.52e+06
Fe-55	0.00e+00	0.00e+00
Fe-59	3.89e+08	4.57e+08
Co-57	1.63e+08	1.79e+08
Co-58	5.26e+08	6.16e+08
Co-60	4.40e+09	5.18e+09
Ni-59	0.00e+00	0.00e+00
Ni-63	0.00e+00	0.00e+00
Ni-65	4.24e+05	4.93e+05
Cu-64	8.67e+05	9.82e+05
Zn-65	6.88e+08	7.92e+08
Zn-69	0.00e+00	0.00e+00
Zn-69m	1.82e+06	2.13e+06
Se-79	0.00e+00	0.00e+00
Br-82	3.05e+07	3.53e+07
Br-83	6.96e+03	1.01e+04
Br-84	2.89e+05	3.38e+05
Br-85	0.00e+00	0.00e+00

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

## Offsite Dose Calculation Manual

## Attachment 19

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## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Ground Plane Pathway for Pi

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Rb-86	1.28e+07	1.47e+07
Rb-87	0.00e+00	0.00e+00
Rb-88	4.72e+04	5.40e+04
Rb-89	1.76e+05	2.11e+05
Sr-89	3.07e+04	3.56e+04
Sr-90	0.00e+00	0.00e+00
Sr-91	3.07e+06	3.59e+06
Sr-92	1.11e+06	1.23e+06
Y-90	6.42e+03	7.58e+03
Y-91	1.51e+06	1.70e+06
Y-91m	1.43e+05	1.66e+05
Y-92	2.58e+05	3.06e+05
Y-93	2.62e+05	3.58e+05
Zr-93	0.00e+00	0.00e+00
Zr-95	3.43e+08	3.98e+08
Zr-97	4.23e+06	4.92e+06
Nb-93m	2.21e+05	2.69e+07
Nb-95	1.95e+08	2.30e+08
Nb-97	2.57e+05	3.02e+05
Mo-93	6.33e+06	2.57e+08
Mo-99	5.71e+06	6.61e+06
Tc-101	2.91e+04	3.23e+04
Tc-99	0.00e+00	0.00e+00
Tc-99m	2.63e+05	3.01e+05
Ru-103	1.54e+08	1.80e+08
Ru-105	9.09e+05	1.03e+06
Ru-106	3.00e+08	3.60e+08
Rh-105	1.06e+06	1.24e+06
Pd-107	0.00e+00	0.00e+00
Pd-109	2.15e+04	2.46e+04

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

Offsite Dose Calculation Manual

Attachment 19

Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Ground Plane Pathway for Pi

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Ag-110m	3.13e+09	3.65e+09
Ag-111	1.46e+06	1.71e+06
Cd-113m	6.21e+05	7.01e+05
Cd-115m	0.00e+00	0.00e+00
Sn-123	0.00e+00	7.82e+09
Sn-125	5.99e+06	6.93e+06
Sn-126	2.49e+09	2.76e+09
Sb-124	8.42e+08	9.71e+08
Sb-125	7.58e+08	8.55e+08
Sb-126	1.21e+08	1.36e+08
Sb-127	2.41e+07	2.79e+07
Te-125m	2.19e+06	3.00e+06
Te-127	4.25e+03	4.68e+03
Te-127m	1.18e+05	1.40e+05
Te-129	3.75e+04	4.43e+04
Te-129m	2.82e+07	3.30e+07
Te-131	4.17e+04	4.93e+07
Te-131m	1.15e+07	1.35e+07
Te-132	6.05e+06	7.12e+06
Te-133m	6.30e+05	7.14e+05
Te-134	3.17e+04	3.80e+04
I-129	1.24e+08	2.07e+08
I-130	7.87e+06	9.56e+06
I-131	2.46e+07	2.98e+07
I-132	1.78e+06	2.09e+06
I-133	3.50e+06	4.26e+06
I-134	6.38e+05	7.58e+05
I-135	3.61e+06	4.21e+06
Cs-134	2.82e+09	3.28e+09
Cs-134m	8.18e+04	9.63e+04

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .



## Offsite Dose Calculation Manual

## Attachment 19

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## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Ground Plane Pathway for Pi

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Cs-135	0.00e+00	0.00e+00
Cs-136	2.16e+08	2.44e+08
Cs-137	1.15e+09	1.34e+09
Cs-138	5.13e+05	5.86e+05
Cs-139	4.49e+04	5.13e+04
Ba-139	1.51e+05	1.70e+05
Ba-140	2.93e+07	3.35e+07
Ba-141	5.96e+04	6.79e+04
Ba-142	6.41e+04	7.30e+04
La-140	2.74e+07	3.11e+07
La-141	4.47e+04	5.01e+04
La-142	1.09e+06	1.30e+06
Ce-141	1.95e+07	2.20e+07
Ce-143	3.30e+06	3.75e+06
Ce-144	5.85e+07	6.77e+07
Pr-143	0.00e+00	0.00e+00
Pr-144	2.62e+03	3.01e+03
Nd-147	1.20e+07	1.44e+07
Pm-147	0.00e+00	0.00e+00
Pm-148	2.70e+07	3.11e+07
Pm-148m	6.34e+08	3.67e+09
Pm-149	6.03e+04	7.00e+04
Pm-151	2.83e+06	2.96e+06
Sm-151	1.32e+07	5.78e+07
Sm-153	5.75e+05	6.39e+05
Eu-152	1.98e+09	2.29e+09
Eu-154	2.15e+09	2.48e+09
Eu-155	8.74e+07	9.93e+07
Eu-156	1.26e+08	1.44e+08
Tb-160	6.57e+08	7.64e+08

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

## Offsite Dose Calculation Manual

## Attachment 19

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## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Ground Plane Pathway for Pi

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Ho-166m	2.46e+09	2.76e+09
W-181	2.43e+05	3.24e+05
W-185	0.00e+00	0.00e+00
W-187	3.36e+06	3.90e+06
Pb-210	3.53e+06	4.62e+06
Bi-210	0.00e+00	0.00e+00
Po-210	6.84e+03	7.85e+03
Ra-223	1.87e+07	2.24e+07
Ra-224	3.56e+07	4.00e+07
Ra-225	1.36e+06	1.94e+06
Ra-226	1.77e+09	2.04e+09
Ra-228	3.12e+09	3.64e+09
Ac-225	1.75e+07	1.97e+07
Ac-227	5.44e+08	6.53e+08
Th-227	1.03e+07	1.27e+07
Th-228	2.06e+09	2.32e+09
Th-229	6.08e+08	7.46e+08
Th-230	1.80e+09	2.07e+09
Th-232	8.29e+08	1.11e+09
Th-234	2.89e+06	3.42e+06
Pa-231	6.08e+08	7.46e+08
Pa-233	3.89e+07	4.49e+07
U-232	7.12e+05	7.40e+06
U-233	6.35e+08	7.74e+08
U-234	1.75e+05	4.39e+07
U-235	8.84e+08	1.11e+09
U-236	5.80e+03	4.97e+06
U-237	7.37e+06	9.58e+06
U-238	3.04e+07	4.14e+07
Np-237	3.87e+08	4.42e+08

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

## Offsite Dose Calculation Manual

## Attachment 19

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## Dose Factors Due to Radionuclides Other Than Noble Gases, Pi

Pi factors for all age groups by nuclide.  
 Waterford Steam Electric Station  
 Pathway : Ground Plane Pathway for Pi

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Np-238	6.48e+06	7.41e+06
Np-239	2.44e+06	2.83e+06
Pu-238	3.58e+05	4.95e+06
Pu-239	2.18e+05	2.13e+06
Pu-240	3.59e+05	4.97e+06
Pu-241	1.24e+06	1.84e+06
Pu-242	3.04e+05	4.42e+06
Pu-244	2.47e+08	2.66e+08
Am-241	4.60e+07	6.64e+07
Am-242m	7.17e+06	4.96e+07
Am-243	3.59e+08	4.14e+08
Cm-242	7.72e+05	3.23e+06
Cm-243	6.28e+08	7.91e+08
Cm-244	7.86e+05	4.88e+06
Cm-245	2.62e+08	3.31e+08
Cm-246	2.76e+05	4.14e+06
Cm-247	6.08e+08	7.18e+08
Cm-248	1.88e+09	1.44e+09
Cf-252	1.59e+10	1.73e+10

Conversion factors are in units of square meter-mrem/yr per  $\mu\text{Ci}/\text{sec}$ .

## Offsite Dose Calculation Manual

## Attachment 20

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## Dose Conversion Factors All Age Groups by Nuclide (Ground Plane)

Ground Plane Dose Conversion factors for all age groups by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
H-3	0.00e+00	0.00e+00
Be-10	0.00e+00	0.00e+00
C-14	0.00e+00	0.00e+00
N-13	7.60e-09	8.80e-09
F-18	6.80e-09	8.00e-09
Na-22	1.60e-08	1.80e-08
Na-24	2.50e-08	2.90e-08
P-32	0.00e+00	0.00e+00
Ca-41	3.41e-09	4.01e-09
Sc-46	1.30e-08	1.50e-08
Cr-51	2.20e-10	2.60e-10
Mn-54	5.80e-09	6.80e-09
Mn-56	1.10e-08	1.30e-08
Fe-55	0.00e+00	0.00e+00
Fe-59	8.00e-09	9.40e-09
Co-57	9.10e-10	1.00e-09
Co-58	7.00e-09	8.20e-09
Co-60	1.70e-08	2.00e-08
Ni-59	0.00e+00	0.00e+00
Ni-63	0.00e+00	0.00e+00
Ni-65	3.70e-09	4.30e-09
Cu-64	1.50e-09	1.70e-09
Zn-65	4.00e-09	4.60e-09
Zn-69	0.00e+00	0.00e+00
Zn-69m	2.90e-09	3.40e-09
Se-79	0.00e+00	0.00e+00
Br-82	1.90e-08	2.20e-08
Br-83	6.40e-11	9.30e-11
Br-84	1.20e-08	1.40e-08
Br-85	0.00e+00	0.00e+00

Conversion factors are in units of mrem/hr per pCi/square meter.

Offsite Dose Calculation Manual

Attachment 20

Dose Conversion Factors All Age Groups by Nuclide (Ground Plane)

Ground Plane Dose Conversion factors for all age groups by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Rb-86	6.30e-10	7.20e-10
Rb-87	0.00e+00	0.00e+00
Rb-88	3.50e-09	4.00e-09
Rb-89	1.50e-08	1.80e-08
Sr-89	5.60e-13	6.50e-13
Sr-90	0.00e+00	0.00e+00
Sr-91	7.10e-09	8.30e-09
Sr-92	9.00e-09	1.00e-08
Y-90	2.20e-12	2.60e-12
Y-91	2.40e-11	2.70e-11
Y-91m	3.80e-09	4.40e-09
Y-92	1.60e-09	1.90e-09
Y-93	5.70e-10	7.80e-10
Zr-93	0.00e+00	0.00e+00
Zr-95	5.00e-09	5.80e-09
Zr-97	5.50e-09	6.40e-09
Nb-93m	8.20e-13	1.00e-10
Nb-95	5.10e-09	6.00e-09
Nb-97	4.60e-09	5.40e-09
Mo-93	2.29e-11	9.32e-10
Mo-99	1.90e-09	2.20e-09
Tc-101	2.70e-09	3.00e-09
Tc-99	0.00e+00	0.00e+00
Tc-99m	9.60e-10	1.10e-09
Ru-103	3.60e-09	4.20e-09
Ru-105	4.50e-09	5.10e-09
Ru-106	1.50e-09	1.80e-09
Rh-105	6.60e-10	7.70e-10
Pd-107	0.00e+00	0.00e+00
Pd-109	3.50e-11	4.00e-11

Conversion factors are in units of mrem/hr per pCi/square meter.

## Offsite Dose Calculation Manual

## Attachment 20

## Page 3 of 6

## Dose Conversion Factors All Age Groups by Nuclide (Ground Plane)

Ground Plane Dose Conversion factors for all age groups by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Ag-110m	1.80e-08	2.10e-08
Ag-111	1.80e-10	2.10e-10
Cd-113m	2.30e-12	2.60e-12
Cd-115m	0.00e+00	0.00e+00
Sn-123	0.00e+00	6.46e-08
Sn-125	5.70e-10	6.60e-10
Sn-126	9.00e-09	1.00e-08
Sb-124	1.30e-08	1.50e-08
Sb-125	3.10e-09	3.50e-09
Sb-126	8.90e-09	1.00e-08
Sb-127	5.70e-09	6.60e-09
Te-125m	3.50e-11	4.80e-11
Te-127	1.00e-11	1.10e-11
Te-127m	1.10e-12	1.30e-12
Te-129	7.10e-10	8.40e-10
Te-129m	7.70e-10	9.00e-10
Te-131	2.20e-09	2.60e-06
Te-131m	8.40e-09	9.90e-09
Te-132	1.70e-09	2.00e-09
Te-133m	1.50e-08	1.70e-08
Te-134	1.00e-09	1.20e-09
I-129	4.50e-10	7.50e-10
I-130	1.40e-08	1.70e-08
I-131	2.80e-09	3.40e-09
I-132	1.70e-08	2.00e-08
I-133	3.70e-09	4.50e-09
I-134	1.60e-08	1.90e-08
I-135	1.20e-08	1.40e-08
Cs-134	1.20e-08	1.40e-08
Cs-134m	6.20e-10	7.30e-10

Conversion factors are in units of mrem/hr per pCi/square meter.

Offsite Dose Calculation Manual

Attachment 20

Dose Conversion Factors All Age Groups by Nuclide (Ground Plane)

Ground Plane Dose Conversion factors for all age groups by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Cs-135	0.00e+00	0.00e+00
Cs-136	1.50e-08	1.70e-08
Cs-137	4.20e-09	4.90e-09
-----		
Cs-138	2.10e-08	2.40e-08
Cs-139	6.30e-09	7.20e-09
Ba-139	2.40e-09	2.70e-09
-----		
Ba-140	2.10e-09	2.40e-09
Ba-141	4.30e-09	4.90e-09
Ba-142	7.90e-09	9.00e-09
-----		
La-140	1.50e-08	1.70e-08
La-141	2.50e-10	2.80e-10
La-142	1.50e-08	1.80e-08
-----		
Ce-141	5.50e-10	6.20e-10
Ce-143	2.20e-09	2.50e-09
Ce-144	3.20e-10	3.70e-10
-----		
Pr-143	0.00e+00	0.00e+00
Pr-144	2.00e-10	2.30e-10
Nd-147	1.00e-09	1.20e-09
-----		
Pm-147	0.00e+00	0.00e+00
Pm-148	4.60e-09	5.30e-09
Pm-148m	1.41e-08	8.16e-08
-----		
Pm-149	2.50e-11	2.90e-11
Pm-151	2.20e-09	2.30e-09
Sm-151	4.80e-11	2.10e-10
-----		
Sm-153	2.70e-10	3.00e-10
Eu-152	7.37e-09	8.53e-09
Eu-154	7.80e-09	9.00e-09
-----		
Eu-155	3.81e-10	4.33e-10
Eu-156	7.60e-09	8.70e-09
Tb-160	8.60e-09	1.00e-08

Conversion factors are in units of mrem/hr per pCi/square meter.

## Offsite Dose Calculation Manual

## Attachment 20

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## Dose Conversion Factors All Age Groups by Nuclide (Ground Plane)

Ground Plane Dose Conversion factors for all age groups by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Ho-166m	8.90e-09	1.00e-08
W-181	2.10e-12	2.80e-12
W-185	0.00e+00	0.00e+00
W-187	3.10e-09	3.60e-09
Pb-210	1.30e-11	1.70e-11
Bi-210	0.00e+00	0.00e+00
Po-210	5.40e-14	6.20e-14
Ra-223	1.50e-09	1.80e-09
Ra-224	8.90e-09	1.00e-08
Ra-225	8.40e-11	1.20e-10
Ra-226	6.40e-09	7.40e-09
Ra-228	1.20e-08	1.40e-08
Ac-225	1.60e-09	1.80e-09
Ac-227	2.00e-09	2.40e-09
Th-227	5.10e-10	6.30e-10
Th-228	8.90e-09	1.00e-08
Th-229	2.20e-09	2.70e-09
Th-230	6.50e-09	7.50e-09
Th-232	3.00e-09	4.00e-09
Th-234	1.10e-10	1.30e-10
Pa-231	2.20e-09	2.70e-09
Pa-233	1.30e-09	1.50e-09
U-232	2.59e-12	2.69e-11
U-233	2.30e-09	2.80e-09
U-234	6.32e-13	1.59e-10
U-235	3.20e-09	4.00e-09
U-236	2.10e-14	1.80e-11
U-237	1.00e-09	1.30e-09
U-238	1.10e-10	1.50e-10
Np-237	1.40e-09	1.60e-09

Conversion factors are in units of mrem/hr per pCi/square meter.



## Offsite Dose Calculation Manual

## Attachment 20

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## Dose Conversion Factors All Age Groups by Nuclide (Ground Plane)

Ground Plane Dose Conversion factors for all age groups by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors	
	T. Body	Skin
Np-238	2.80e-09	3.20e-09
Np-239	9.50e-10	1.10e-09
Pu-238	1.30e-12	1.80e-11
Pu-239	7.90e-13	7.70e-12
Pu-240	1.30e-12	1.80e-11
Pu-241	4.60e-12	6.80e-12
Pu-242	1.10e-12	1.60e-11
Pu-244	8.95e-10	9.62e-10
Am-241	1.80e-10	2.60e-10
Am-242m	2.60e-11	1.80e-10
Am-243	1.30e-09	1.50e-09
Cm-242	5.50e-12	2.30e-11
Cm-243	2.30e-09	2.90e-09
Cm-244	2.90e-12	1.80e-11
Cm-245	9.50e-10	1.20e-09
Cm-246	1.00e-12	1.50e-11
Cm-247	2.20e-09	2.60e-09
Cm-248	6.81e-09	5.23e-09
Cf-252	6.60e-08	7.20e-08

Conversion factors are in units of mrem/hr per pCi/square meter.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	8.98e-08	8.98e-08	8.98e-08	8.98e-08	8.98e-08	8.98e-08
Be-10	1.98e-04	3.06e-05	4.96e-06	0.00e+00	0.00e+00	2.22e-04	1.67e-05
C-14	2.27e-06	4.26e-07	4.26e-07	4.26e-07	4.26e-07	4.26e-07	4.26e-07
N-13	6.27e-09	6.27e-09	6.27e-09	6.27e-09	6.27e-09	6.27e-09	6.27e-09
F-18	4.71e-07	0.00e+00	5.19e-08	0.00e+00	0.00e+00	0.00e+00	9.24e-09
Na-22	1.30e-05	1.30e-05	1.30e-05	1.30e-05	1.30e-05	1.30e-05	1.30e-05
Na-24	1.28e-06	1.28e-06	1.28e-06	1.28e-06	1.28e-06	1.28e-06	1.28e-06
P-32	1.65e-04	9.64e-06	6.26e-06	0.00e+00	0.00e+00	0.00e+00	1.08e-05
Ca-41	3.83e-05	0.00e+00	4.13e-06	0.00e+00	0.00e+00	3.83e-06	2.86e-07
Sc-46	5.51e-05	1.07e-04	3.11e-05	0.00e+00	9.99e-05	0.00e+00	3.23e-05
Cr-51	0.00e+00	0.00e+00	1.25e-08	7.44e-09	2.85e-09	1.80e-06	4.15e-07
Mn-54	0.00e+00	4.95e-06	7.87e-07	0.00e+00	1.23e-06	1.75e-04	9.67e-06
Mn-56	0.00e+00	1.55e-10	2.29e-11	0.00e+00	1.63e-10	1.18e-06	2.53e-06
Fe-55	3.07e-06	2.12e-06	4.93e-07	0.00e+00	0.00e+00	9.01e-06	7.54e-07
Fe-59	1.47e-06	3.47e-06	1.32e-06	0.00e+00	0.00e+00	1.27e-04	2.35e-05
Co-57	0.00e+00	8.65e-08	8.39e-08	0.00e+00	0.00e+00	4.62e-05	3.93e-06
Co-58	0.00e+00	1.98e-07	2.59e-07	0.00e+00	0.00e+00	1.16e-04	1.33e-05
Co-60	0.00e+00	1.44e-06	1.85e-06	0.00e+00	0.00e+00	7.46e-04	3.56e-05
Ni-59	4.06e-06	1.46e-06	6.77e-07	0.00e+00	0.00e+00	8.20e-06	6.11e-07
Ni-63	5.40e-05	3.93e-06	1.81e-06	0.00e+00	0.00e+00	2.23e-05	1.67e-06
Ni-65	1.92e-10	2.62e-11	1.14e-11	0.00e+00	0.00e+00	7.00e-07	1.54e-06
Cu-64	0.00e+00	1.83e-10	7.69e-11	0.00e+00	5.78e-10	8.48e-07	6.12e-06
Zn-65	4.05e-06	1.29e-05	5.82e-06	0.00e+00	8.62e-06	1.08e-04	6.68e-06
Zn-69	4.23e-12	8.14e-12	5.65e-13	0.00e+00	5.27e-12	1.15e-07	2.04e-09
Zn-69m	1.02e-09	2.45e-09	2.24e-10	0.00e+00	1.48e-09	2.38e-06	1.71e-05
Se-79	0.00e+00	3.83e-07	6.09e-08	0.00e+00	5.69e-07	4.47e-05	3.33e-06
Br-82	0.00e+00	0.00e+00	1.69e-06	0.00e+00	0.00e+00	0.00e+00	1.30e-06
Br-83	0.00e+00	0.00e+00	3.01e-08	0.00e+00	0.00e+00	0.00e+00	2.90e-08
Br-84	0.00e+00	0.00e+00	3.91e-08	0.00e+00	0.00e+00	0.00e+00	2.05e-13
Br-85	0.00e+00	0.00e+00	1.60e-09	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.69e-05	7.37e-06	0.00e+00	0.00e+00	0.00e+00	2.08e-06
Rb-87	0.00e+00	9.86e-06	3.21e-06	0.00e+00	0.00e+00	0.00e+00	2.88e-07
Rb-88	0.00e+00	4.84e-08	2.41e-08	0.00e+00	0.00e+00	0.00e+00	4.18e-19
Rb-89	0.00e+00	3.20e-08	2.12e-08	0.00e+00	0.00e+00	0.00e+00	1.16e-21
Sr-89	3.80e-05	0.00e+00	1.09e-06	0.00e+00	0.00e+00	1.75e-04	4.37e-05
Sr-90	3.59e-03	0.00e+00	7.21e-05	0.00e+00	0.00e+00	1.20e-03	9.02e-05
Sr-91	7.74e-09	0.00e+00	3.13e-10	0.00e+00	0.00e+00	4.56e-06	2.39e-05
Sr-92	8.43e-10	0.00e+00	3.64e-11	0.00e+00	0.00e+00	2.06e-06	5.38e-06
Y-90	2.61e-07	0.00e+00	7.01e-09	0.00e+00	0.00e+00	2.12e-05	6.32e-05
Y-91	5.78e-05	0.00e+00	1.55e-06	0.00e+00	0.00e+00	2.13e-04	4.81e-05
Y-91m	3.26e-11	0.00e+00	1.27e-12	0.00e+00	0.00e+00	2.40e-07	1.66e-10
Y-92	1.29e-09	0.00e+00	3.77e-11	0.00e+00	0.00e+00	1.96e-06	9.19e-06
Y-93	1.18e-08	0.00e+00	3.26e-10	0.00e+00	0.00e+00	6.06e-06	5.27e-05
Zr-93	5.22e-05	2.92e-06	1.37e-06	0.00e+00	1.11e-05	2.13e-05	1.51e-06
Zr-95	1.34e-05	4.30e-06	2.91e-06	0.00e+00	6.77e-06	2.21e-04	1.88e-05
Zr-97	1.21e-08	2.45e-09	1.13e-09	0.00e+00	3.71e-09	9.84e-06	6.54e-05
Nb-93m	3.10e-05	1.01e-05	2.49e-06	0.00e+00	1.16e-05	3.11e-05	2.38e-06
Nb-95	1.76e-06	9.77e-07	5.26e-07	0.00e+00	9.67e-07	6.31e-05	1.30e-05
Nb-97	2.78e-11	7.03e-12	2.56e-12	0.00e+00	8.18e-12	3.00e-07	3.02e-08
Mo-93	0.00e+00	1.17e-06	3.17e-08	0.00e+00	3.55e-07	5.11e-05	3.79e-06
Mo-99	0.00e+00	1.51e-08	2.87e-09	0.00e+00	3.64e-08	1.14e-05	3.10e-05
Tc-101	5.22e-15	7.52e-15	7.38e-14	0.00e+00	1.35e-13	4.99e-08	1.36e-21
Tc-99	3.13e-08	4.64e-08	1.25e-08	0.00e+00	5.85e-07	1.01e-04	7.54e-06
Tc-99m	1.29e-13	3.64e-13	4.63e-12	0.00e+00	5.52e-12	9.55e-08	5.20e-07
Ru-103	1.91e-07	0.00e+00	8.23e-08	0.00e+00	7.29e-07	6.31e-05	1.38e-05
Ru-105	9.88e-11	0.00e+00	3.89e-11	0.00e+00	1.27e-10	1.37e-06	6.02e-06
Ru-106	8.64e-06	0.00e+00	1.09e-06	0.00e+00	1.67e-05	1.17e-03	1.14e-04
Rh-105	9.24e-10	6.73e-10	4.43e-10	0.00e+00	2.86e-09	2.41e-06	1.09e-05
Pd-107	0.00e+00	8.27e-08	5.87e-09	0.00e+00	6.57e-07	9.47e-06	7.06e-07
Pd-109	0.00e+00	4.63e-10	1.16e-10	0.00e+00	2.35e-09	1.85e-06	1.52e-05

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.35e-06	1.25e-06	7.43e-07	0.00e+00	2.46e-06	5.79e-04	3.78e-05
Ag-111	4.25e-08	1.78e-08	8.87e-09	0.00e+00	5.74e-08	2.33e-05	2.79e-05
Cd-113m	0.00e+00	1.54e-04	4.97e-06	0.00e+00	1.71e-04	2.08e-04	1.59e-05
Cd-115m	0.00e+00	2.46e-05	7.95e-07	0.00e+00	1.98e-05	1.76e-04	4.80e-05
Sn-123	3.02e-05	6.67e-07	9.82e-07	5.67e-07	0.00e+00	2.88e-04	3.92e-05
Sn-125	1.16e-06	3.12e-08	7.03e-08	2.59e-08	0.00e+00	7.37e-05	6.81e-05
Sn-126	1.58e-04	4.18e-06	6.00e-06	1.23e-06	0.00e+00	1.17e-03	1.59e-05
Sb-124	3.90e-06	7.36e-08	1.55e-06	9.44e-09	0.00e+00	3.10e-04	5.08e-05
Sb-125	6.67e-06	7.44e-08	1.58e-06	6.75e-09	0.00e+00	2.18e-04	1.26e-05
Sb-126	4.50e-07	9.13e-09	1.62e-07	2.75e-09	0.00e+00	9.57e-05	6.01e-05
Sb-127	3.30e-08	7.22e-10	1.27e-08	3.97e-10	0.00e+00	2.05e-05	3.77e-05
Te-125m	4.27e-07	1.98e-07	5.84e-08	1.31e-07	1.55e-06	3.92e-05	8.83e-06
Te-127	1.75e-10	8.03e-11	3.87e-11	1.32e-10	6.37e-10	8.14e-07	7.17e-06
Te-127m	1.58e-06	7.21e-07	1.96e-07	4.11e-07	5.72e-06	1.20e-04	1.87e-05
Te-129	6.22e-12	2.99e-12	1.55e-12	4.87e-12	2.34e-11	2.42e-07	1.96e-08
Te-129m	1.22e-06	5.84e-07	1.98e-07	4.30e-07	4.57e-06	1.45e-04	4.79e-05
Te-131	1.39e-12	7.44e-13	4.49e-13	1.17e-12	5.46e-12	1.74e-07	2.30e-09
Te-131m	8.74e-09	5.45e-09	3.63e-09	6.88e-09	3.86e-08	1.82e-05	6.95e-05
Te-132	3.25e-08	2.69e-08	2.02e-08	2.37e-08	1.82e-07	3.60e-05	6.37e-05
Te-133m	7.24e-12	5.40e-12	4.17e-12	6.27e-12	3.74e-11	5.51e-07	7.65e-09
Te-134	3.84e-12	3.22e-12	1.57e-12	3.44e-12	2.18e-11	4.34e-07	2.97e-11
I-129	2.48e-06	2.11e-06	6.91e-06	5.54e-03	4.53e-06	0.00e+00	2.22e-07
I-130	5.72e-07	1.68e-06	6.60e-07	1.42e-04	2.61e-06	0.00e+00	9.61e-07
I-131	3.15e-06	4.47e-06	2.56e-06	1.49e-03	7.66e-06	0.00e+00	7.85e-07
I-132	1.45e-07	4.07e-07	1.45e-07	1.43e-05	6.48e-07	0.00e+00	5.08e-08
I-133	1.08e-06	1.85e-06	5.65e-07	2.69e-04	3.23e-06	0.00e+00	1.11e-06
I-134	8.05e-08	2.16e-07	7.69e-08	3.73e-06	3.44e-07	0.00e+00	1.26e-10
I-135	3.35e-07	8.73e-07	3.21e-07	5.60e-05	1.39e-06	0.00e+00	6.56e-07
Cs-134	4.66e-05	1.06e-04	9.10e-05	0.00e+00	3.59e-05	1.22e-05	1.30e-06
Cs-134m	1.59e-08	3.20e-08	1.72e-08	0.00e+00	1.83e-08	2.93e-09	7.92e-09

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.46e-05	1.29e-05	5.99e-06	0.00e+00	5.11e-06	1.57e-06	2.11e-07
Cs-136	4.88e-06	1.83e-05	1.38e-05	0.00e+00	1.07e-05	1.50e-06	1.46e-06
Cs-137	5.98e-05	7.76e-05	5.35e-05	0.00e+00	2.78e-05	9.40e-06	1.05e-06
Cs-138	4.14e-08	7.76e-08	4.05e-08	0.00e+00	6.00e-08	6.07e-09	2.33e-13
Cs-139	2.56e-08	3.63e-08	1.39e-08	0.00e+00	3.05e-08	2.84e-09	5.49e-31
Ba-139	1.17e-10	8.32e-14	3.42e-12	0.00e+00	7.78e-14	4.70e-07	1.12e-07
Ba-140	4.88e-06	6.13e-09	3.21e-07	0.00e+00	2.09e-09	1.59e-04	2.73e-05
Ba-141	1.25e-11	9.41e-15	4.20e-13	0.00e+00	8.75e-15	2.42e-07	1.45e-17
Ba-142	3.29e-12	3.38e-15	2.07e-13	0.00e+00	2.86e-15	1.49e-07	1.96e-26
La-140	4.30e-08	2.17e-08	5.73e-09	0.00e+00	0.00e+00	1.70e-05	5.73e-05
La-141	5.34e-10	1.66e-10	2.71e-11	0.00e+00	0.00e+00	1.35e-06	7.31e-06
La-142	8.54e-11	3.88e-11	9.65e-12	0.00e+00	0.00e+00	7.91e-07	2.64e-07
Ce-141	2.49e-06	1.69e-06	1.91e-07	0.00e+00	7.83e-07	4.52e-05	1.50e-05
Ce-143	2.33e-08	1.72e-08	1.91e-09	0.00e+00	7.60e-09	9.97e-06	2.83e-05
Ce-144	4.29e-04	1.79e-04	2.30e-05	0.00e+00	1.06e-04	9.72e-04	1.02e-04
Pr-143	1.17e-06	4.69e-07	5.80e-08	0.00e+00	2.70e-07	3.51e-05	2.50e-05
Pr-144	3.76e-12	1.56e-12	1.91e-13	0.00e+00	8.81e-13	1.27e-07	2.69e-18
Nd-147	6.59e-07	7.62e-07	4.56e-08	0.00e+00	4.45e-07	2.76e-05	2.16e-05
Pm-147	8.37e-05	7.87e-06	3.19e-06	0.00e+00	1.49e-05	6.60e-05	5.54e-06
Pm-148	3.84e-07	6.37e-08	3.20e-08	0.00e+00	1.20e-07	3.91e-05	5.80e-05
Pm-148m	9.82e-06	2.54e-06	1.94e-06	0.00e+00	3.85e-06	2.14e-04	4.18e-05
Pm-149	3.44e-08	4.87e-09	1.99e-09	0.00e+00	9.19e-09	7.21e-06	2.50e-05
Pm-151	8.50e-09	1.42e-09	7.21e-10	0.00e+00	2.55e-09	3.94e-06	2.00e-05
Sm-151	8.59e-05	1.48e-05	3.55e-06	0.00e+00	1.66e-05	4.45e-05	3.25e-06
Sm-153	1.70e-08	1.42e-08	1.04e-09	0.00e+00	4.59e-09	4.14e-06	1.58e-05
Eu-152	2.38e-04	5.41e-05	4.76e-05	0.00e+00	3.35e-04	3.43e-04	1.59e-05
Eu-154	7.40e-04	9.10e-05	6.48e-05	0.00e+00	4.36e-04	5.84e-04	3.40e-05
Eu-155	1.01e-04	1.43e-05	9.21e-06	0.00e+00	6.59e-05	9.46e-05	5.95e-06
Eu-156	1.93e-06	1.48e-06	2.40e-07	0.00e+00	9.95e-07	8.56e-05	4.50e-05
Tb-160	2.21e-05	0.00e+00	2.75e-06	0.00e+00	9.10e-06	1.92e-04	2.68e-05

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	3.37e-04	1.05e-04	8.00e-05	0.00e+00	1.57e-04	3.94e-04	1.59e-05
W-181	6.23e-09	2.03e-09	2.17e-10	0.00e+00	0.00e+00	1.71e-06	2.53e-07
W-185	1.95e-07	6.47e-08	6.81e-09	0.00e+00	0.00e+00	5.57e-05	1.07e-05
W-187	1.06e-09	8.85e-10	3.10e-10	0.00e+00	0.00e+00	3.63e-06	1.94e-05
Pb-210	2.64e-02	6.73e-03	8.37e-04	0.00e+00	2.12e-02	2.62e-02	1.51e-06
Bi-210	2.31e-07	1.59e-06	1.32e-07	0.00e+00	1.92e-05	1.11e-03	2.95e-05
Po-210	3.97e-04	8.60e-04	9.58e-05	0.00e+00	2.95e-03	3.14e-02	4.19e-05
Ra-223	1.80e-04	2.77e-07	3.60e-05	0.00e+00	7.85e-06	2.55e-02	2.84e-04
Ra-224	1.98e-05	4.78e-08	3.96e-06	0.00e+00	1.35e-06	8.77e-03	3.01e-04
Ra-225	3.00e-04	3.56e-07	5.99e-05	0.00e+00	1.01e-05	2.92e-02	2.71e-04
Ra-226	1.25e-01	2.39e-06	9.14e-02	0.00e+00	6.77e-05	1.17e-01	2.94e-04
Ra-228	4.41e-02	1.23e-06	4.78e-02	0.00e+00	3.48e-05	1.61e-01	5.00e-05
Ac-225	4.23e-04	5.82e-04	2.84e-05	0.00e+00	6.63e-05	2.21e-02	2.52e-04
Ac-227	2.30e+00	3.05e-01	1.36e-01	0.00e+00	9.82e-02	2.41e-01	5.08e-05
Th-227	2.17e-04	3.92e-06	6.25e-06	0.00e+00	2.22e-05	3.77e-02	3.34e-04
Th-228	2.00e-01	3.39e-03	6.77e-03	0.00e+00	1.89e-02	1.01e+00	3.49e-04
Th-229	1.51e+01	4.34e-01	2.51e-01	0.00e+00	2.13e+00	3.62e+00	4.83e-05
Th-230	2.29e+00	1.31e-01	6.36e-02	0.00e+00	6.40e-01	6.21e-01	3.73e-05
Th-232	2.56e+00	1.12e-01	9.04e-04	0.00e+00	5.47e-01	5.96e-01	3.17e-05
Th-234	1.63e-06	9.56e-08	4.70e-08	0.00e+00	5.41e-07	1.89e-04	7.03e-05
Pa-231	5.08e+00	1.91e-01	1.98e-01	0.00e+00	1.07e+00	5.75e-02	4.44e-05
Pa-233	1.21e-06	2.42e-07	2.09e-07	0.00e+00	9.15e-07	3.52e-05	1.02e-05
U-232	5.14e-02	0.00e+00	3.66e-03	0.00e+00	5.56e-03	2.22e-01	4.21e-05
U-233	1.09e-02	0.00e+00	6.60e-04	0.00e+00	2.54e-03	5.32e-02	3.89e-05
U-234	1.04e-02	0.00e+00	6.46e-04	0.00e+00	2.49e-03	5.22e-02	3.81e-05
U-235	1.00e-02	0.00e+00	6.07e-04	0.00e+00	2.34e-03	4.90e-02	4.84e-05
U-236	1.00e-02	0.00e+00	6.20e-04	0.00e+00	2.39e-03	5.00e-02	3.57e-05
U-237	3.67e-08	0.00e+00	9.77e-09	0.00e+00	1.51e-07	1.02e-05	1.20e-05
U-238	9.58e-03	0.00e+00	5.67e-04	0.00e+00	2.18e-03	4.58e-02	3.41e-05
Np-237	1.56e+00	1.00e+00	6.87e-02	0.00e+00	5.10e-01	5.22e-02	4.92e-05

Conversion factors are in units of mrem per pCi inhaled.

## Offsite Dose Calculation Manual

## Attachment 21

## Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	2.96e-07	7.20e-08	4.61e-09	0.00e+00	2.72e-08	1.02e-05	2.13e-05
Np-239	2.87e-08	2.54e-08	1.55e-09	0.00e+00	8.75e-09	4.70e-06	1.49e-05
Pu-238	1.43e+00	9.71e-01	6.90e-02	0.00e+00	2.96e-01	1.82e-01	4.52e-05
Pu-239	1.66e+00	1.07e+00	7.75e-02	0.00e+00	3.30e-01	1.72e-01	4.13e-05
Pu-240	1.65e+00	1.07e+00	7.73e-02	0.00e+00	3.29e-01	1.72e-01	4.21e-05
Pu-241	3.42e-02	8.69e-03	1.29e-03	0.00e+00	5.93e-03	1.52e-04	8.65e-07
Pu-242	1.53e+00	1.03e+00	7.46e-02	0.00e+00	3.17e-01	1.65e-01	4.05e-05
Pu-244	1.79e+00	1.18e+00	8.54e-02	0.00e+00	3.64e-01	1.89e-01	6.03e-05
Am-241	1.68e+00	1.13e+00	6.71e-02	0.00e+00	5.04e-01	6.06e-02	4.60e-05
Am-242m	1.70e+00	1.06e+00	6.73e-02	0.00e+00	5.01e-01	2.44e-02	5.79e-05
Am-243	1.68e+00	1.10e+00	6.57e-02	0.00e+00	4.95e-01	5.75e-02	5.40e-05
Cm-242	2.22e-02	1.77e-02	9.84e-04	0.00e+00	4.48e-03	3.92e-02	4.91e-05
Cm-243	1.10e+00	7.61e-01	4.61e-02	0.00e+00	2.15e-01	6.31e-02	4.84e-05
Cm-244	8.37e-01	5.88e-01	3.51e-02	0.00e+00	1.64e-01	6.06e-02	4.68e-05
Cm-245	1.74e+00	1.14e+00	7.14e-02	0.00e+00	3.33e-01	5.85e-02	4.36e-05
Cm-246	1.73e+00	1.14e+00	7.13e-02	0.00e+00	3.33e-01	5.96e-02	4.29e-05
Cm-247	1.68e+00	1.12e+00	7.03e-02	0.00e+00	3.28e-01	5.85e-02	5.63e-05
Cm-248	1.40e+01	9.26e+00	5.79e-01	0.00e+00	2.70e+00	4.82e-01	9.09e-04
Cf-252	5.43e-01	0.00e+00	2.33e-02	0.00e+00	0.00e+00	1.99e-01	1.78e-04

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	9.06e-08	9.06e-08	9.06e-08	9.06e-08	9.06e-08	9.06e-08
Be-10	2.78e-04	4.33e-05	7.09e-06	0.00e+00	0.00e+00	3.84e-04	1.77e-05
C-14	3.25e-06	6.09e-07	6.09e-07	6.09e-07	6.09e-07	6.09e-07	6.09e-07
N-13	8.65e-09	8.65e-09	8.65e-09	8.65e-09	8.65e-09	8.65e-09	8.65e-09
F-18	6.52e-07	0.00e+00	7.10e-08	0.00e+00	0.00e+00	0.00e+00	3.89e-08
Na-22	1.76e-05	1.76e-05	1.76e-05	1.76e-05	1.76e-05	1.76e-05	1.76e-05
Na-24	1.72e-06	1.72e-06	1.72e-06	1.72e-06	1.72e-06	1.72e-06	1.72e-06
P-32	2.36e-04	1.37e-05	8.95e-06	0.00e+00	0.00e+00	0.00e+00	1.16e-05
Ca-41	4.05e-05	0.00e+00	4.38e-06	0.00e+00	0.00e+00	1.01e-01	3.03e-07
Sc-46	7.24e-05	1.41e-04	4.18e-05	0.00e+00	1.35e-04	0.00e+00	2.98e-05
Cr-51	0.00e+00	0.00e+00	1.69e-08	9.37e-09	3.84e-09	2.62e-06	3.75e-07
Mn-54	0.00e+00	6.39e-06	1.05e-06	0.00e+00	1.59e-06	2.48e-04	8.35e-06
Mn-56	0.00e+00	2.12e-10	3.15e-11	0.00e+00	2.24e-10	1.90e-06	7.18e-06
Fe-55	4.18e-06	2.98e-06	6.93e-07	0.00e+00	0.00e+00	1.55e-05	7.99e-07
Fe-59	1.99e-06	4.62e-06	1.79e-06	0.00e+00	0.00e+00	1.91e-04	2.23e-05
Co-57	0.00e+00	1.18e-07	1.15e-07	0.00e+00	0.00e+00	7.33e-05	3.93e-06
Co-58	0.00e+00	2.59e-07	3.47e-07	0.00e+00	0.00e+00	1.68e-04	1.19e-05
Co-60	0.00e+00	1.89e-06	2.48e-06	0.00e+00	0.00e+00	1.09e-03	3.24e-05
Ni-59	5.44e-06	2.02e-06	9.24e-07	0.00e+00	0.00e+00	1.41e-05	6.48e-07
Ni-63	7.25e-05	5.43e-06	2.47e-06	0.00e+00	0.00e+00	3.84e-05	1.77e-06
Ni-65	2.73e-10	3.66e-11	1.59e-11	0.00e+00	0.00e+00	1.17e-06	4.59e-06
Cu-64	0.00e+00	2.54e-10	1.06e-10	0.00e+00	8.01e-10	1.39e-06	7.68e-06
Zn-65	4.82e-06	1.67e-05	7.80e-06	0.00e+00	1.08e-05	1.55e-04	5.83e-06
Zn-69	6.04e-12	1.15e-11	8.07e-13	0.00e+00	7.53e-12	1.98e-07	3.56e-08
Zn-69m	1.44e-09	3.39e-09	3.11e-10	0.00e+00	2.06e-09	3.92e-06	2.14e-05
Se-79	0.00e+00	5.43e-07	8.71e-08	0.00e+00	8.13e-07	7.71e-05	3.53e-06
Br-82	0.00e+00	0.00e+00	2.28e-06	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	4.30e-08	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	5.41e-08	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	2.29e-09	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem per pCi inhaled.



Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.38e-05	1.05e-05	0.00e+00	0.00e+00	0.00e+00	2.21e-06
Rb-87	0.00e+00	1.40e-05	4.58e-06	0.00e+00	0.00e+00	0.00e+00	3.05e-07
Rb-88	0.00e+00	6.82e-08	3.40e-08	0.00e+00	0.00e+00	0.00e+00	3.65e-15
Rb-89	0.00e+00	4.40e-08	2.91e-08	0.00e+00	0.00e+00	0.00e+00	4.22e-17
Sr-89	5.43e-05	0.00e+00	1.56e-06	0.00e+00	0.00e+00	3.02e-04	4.64e-05
Sr-90	4.14e-03	0.00e+00	8.33e-05	0.00e+00	0.00e+00	2.06e-03	9.56e-05
Sr-91	1.10e-08	0.00e+00	4.39e-10	0.00e+00	0.00e+00	7.59e-06	3.24e-05
Sr-92	1.19e-09	0.00e+00	5.08e-11	0.00e+00	0.00e+00	3.43e-06	1.49e-05
Y-90	3.73e-07	0.00e+00	1.00e-08	0.00e+00	0.00e+00	3.66e-05	6.99e-05
Y-91	8.26e-05	0.00e+00	2.21e-06	0.00e+00	0.00e+00	3.67e-04	5.11e-05
Y-91m	4.63e-11	0.00e+00	1.77e-12	0.00e+00	0.00e+00	4.00e-07	3.77e-09
Y-92	1.84e-09	0.00e+00	5.36e-11	0.00e+00	0.00e+00	3.35e-06	2.06e-05
Y-93	1.69e-08	0.00e+00	4.65e-10	0.00e+00	0.00e+00	1.04e-05	7.24e-05
Zr-93	6.83e-05	3.38e-06	1.84e-06	0.00e+00	1.16e-05	3.67e-05	1.60e-06
Zr-95	1.82e-05	5.73e-06	3.94e-06	0.00e+00	8.42e-06	3.36e-04	1.86e-05
Zr-97	1.72e-08	3.40e-09	1.57e-09	0.00e+00	5.15e-09	1.62e-05	7.88e-05
Nb-93m	4.14e-05	1.36e-05	3.41e-06	0.00e+00	1.59e-05	5.36e-05	2.52e-06
Nb-95	2.32e-06	1.29e-06	7.08e-07	0.00e+00	1.25e-06	9.39e-05	1.21e-05
Nb-97	3.92e-11	9.72e-12	3.55e-12	0.00e+00	1.14e-11	4.91e-07	2.71e-07
Mo-93	0.00e+00	1.66e-06	4.52e-08	0.00e+00	5.06e-07	8.81e-05	3.99e-06
Mo-99	0.00e+00	2.11e-08	4.03e-09	0.00e+00	5.14e-08	1.92e-05	3.36e-05
Tc-101	7.40e-15	1.05e-14	1.03e-13	0.00e+00	1.90e-13	8.34e-08	1.09e-16
Tc-99	4.48e-08	6.58e-08	1.79e-08	0.00e+00	8.35e-07	1.74e-04	7.99e-06
Tc-99m	1.73e-13	4.83e-13	6.24e-12	0.00e+00	7.20e-12	1.44e-07	7.66e-07
Ru-103	2.63e-07	0.00e+00	1.12e-07	0.00e+00	9.29e-07	9.79e-05	1.36e-05
Ru-105	1.40e-10	0.00e+00	5.42e-11	0.00e+00	1.76e-10	2.27e-06	1.13e-05
Ru-106	1.23e-05	0.00e+00	1.55e-06	0.00e+00	2.38e-05	2.01e-03	1.20e-04
Rh-105	1.32e-09	9.48e-10	6.24e-10	0.00e+00	4.04e-09	4.09e-06	1.23e-05
Pd-107	0.00e+00	1.17e-07	8.39e-09	0.00e+00	9.39e-07	1.63e-05	7.49e-07
Pd-109	0.00e+00	6.56e-10	1.66e-10	0.00e+00	3.36e-09	3.19e-06	1.96e-05

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.73e-06	1.64e-06	9.99e-07	0.00e+00	3.13e-06	8.44e-04	3.41e-05
Ag-111	6.07e-08	2.52e-08	1.26e-08	0.00e+00	8.17e-08	4.00e-05	3.00e-05
Cd-113m	0.00e+00	2.17e-04	7.10e-06	0.00e+00	2.43e-04	3.59e-04	1.68e-05
Cd-115m	0.00e+00	3.48e-05	1.14e-06	0.00e+00	2.82e-05	3.03e-04	5.10e-05
Sn-123	4.31e-05	9.44e-07	1.40e-06	7.55e-07	0.00e+00	4.96e-04	4.16e-05
Sn-125	1.66e-06	4.42e-08	9.99e-08	3.45e-08	0.00e+00	1.26e-04	7.29e-05
Sn-126	2.18e-04	5.39e-06	8.24e-06	1.42e-06	0.00e+00	1.72e-03	1.68e-05
Sb-124	5.38e-06	9.92e-08	2.10e-06	1.22e-08	0.00e+00	4.81e-04	4.98e-05
Sb-125	9.23e-06	1.01e-07	2.15e-06	8.80e-09	0.00e+00	3.42e-04	1.24e-05
Sb-126	6.19e-07	1.27e-08	2.23e-07	3.50e-09	0.00e+00	1.55e-04	6.01e-05
Sb-127	4.64e-08	9.92e-10	1.75e-08	5.21e-10	0.00e+00	3.31e-05	3.94e-05
Te-125m	6.10e-07	2.80e-07	8.34e-08	1.75e-07	0.00e+00	6.70e-05	9.38e-06
Te-127	2.51e-10	1.14e-10	5.52e-11	1.77e-10	9.10e-10	1.40e-06	1.01e-05
Te-127m	2.25e-06	1.02e-06	2.73e-07	5.48e-07	8.17e-06	2.07e-04	1.99e-05
Te-129	8.87e-12	4.22e-12	2.20e-12	6.48e-12	3.32e-11	4.12e-07	2.02e-07
Te-129m	1.74e-06	8.23e-07	2.81e-07	5.72e-07	6.49e-06	2.47e-04	5.06e-05
Te-131	1.97e-12	1.04e-12	6.30e-13	1.55e-12	7.72e-12	2.92e-07	1.89e-09
Te-131m	1.23e-08	7.51e-09	5.03e-09	9.06e-09	5.49e-08	2.97e-05	7.76e-05
Te-132	4.50e-08	3.63e-08	2.74e-08	3.07e-08	2.44e-07	5.61e-05	5.79e-05
Tb-133m	1.01e-11	7.33e-12	5.71e-12	8.18e-12	5.07e-11	8.71e-07	1.23e-07
Te-134	5.31e-12	4.35e-12	3.64e-12	4.46e-12	2.91e-11	6.75e-07	1.37e-09
I-129	3.53e-06	2.94e-06	4.90e-06	3.66e-03	5.26e-06	0.00e+00	2.29e-07
I-130	7.80e-07	2.24e-06	8.96e-07	1.86e-04	3.44e-06	0.00e+00	1.14e-06
I-131	4.43e-06	6.14e-06	3.30e-06	1.83e-03	1.05e-05	0.00e+00	8.11e-07
I-132	1.99e-07	5.47e-07	1.97e-07	1.89e-05	8.65e-07	0.00e+00	1.59e-07
I-133	1.52e-06	2.56e-06	7.78e-07	3.65e-04	4.49e-06	0.00e+00	1.29e-06
I-134	1.11e-07	2.90e-07	1.05e-07	4.94e-06	4.58e-07	0.00e+00	2.55e-09
I-135	4.62e-07	1.18e-06	4.36e-07	7.76e-05	1.86e-06	0.00e+00	8.69e-07
Cs-134	6.28e-05	1.41e-04	6.86e-05	0.00e+00	4.69e-05	1.83e-05	1.22e-06
Cs-134m	2.20e-08	4.35e-08	2.35e-08	0.00e+00	2.54e-08	4.56e-09	2.02e-08

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Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	2.08e-05	1.82e-05	4.47e-06	0.00e+00	7.30e-06	2.70e-06	2.23e-07
Cs-136	6.44e-06	2.42e-05	1.71e-05	0.00e+00	1.38e-05	2.22e-06	1.36e-06
Cs-137	8.38e-05	1.06e-04	3.89e-05	0.00e+00	3.80e-05	1.51e-05	1.06e-06
Cs-138	5.82e-08	1.07e-07	5.58e-08	0.00e+00	8.28e-08	9.84e-09	3.38e-11
Cs-139	3.65e-08	5.12e-08	1.97e-08	0.00e+00	4.34e-08	4.86e-09	1.66e-23
Ba-139	1.67e-10	1.18e-13	4.87e-12	0.00e+00	1.11e-13	8.08e-07	8.06e-07
Ba-140	6.84e-06	8.38e-09	4.40e-07	0.00e+00	2.85e-09	2.54e-04	2.86e-05
Ba-141	1.78e-11	1.32e-14	5.93e-13	0.00e+00	1.23e-14	4.11e-07	9.33e-14
Ba-142	4.62e-12	4.63e-15	2.84e-13	0.00e+00	3.92e-15	2.39e-07	5.99e-20
La-140	5.99e-08	2.95e-08	7.82e-09	0.00e+00	0.00e+00	2.68e-05	6.09e-05
La-141	7.63e-10	2.35e-10	3.87e-11	0.00e+00	0.00e+00	2.31e-06	1.54e-05
La-142	1.20e-10	5.31e-11	1.32e-11	0.00e+00	0.00e+00	1.27e-06	1.50e-06
Ce-141	3.55e-06	2.37e-06	2.71e-07	0.00e+00	1.11e-06	7.67e-05	1.58e-05
Ce-143	3.32e-08	2.42e-08	2.70e-09	0.00e+00	1.08e-08	1.63e-05	3.19e-05
Ce-144	6.11e-04	2.53e-04	3.28e-05	0.00e+00	1.51e-04	1.67e-03	1.08e-04
Pr-143	1.67e-06	6.64e-07	8.28e-08	0.00e+00	3.86e-07	6.04e-05	2.67e-05
Pr-144	5.37e-12	2.20e-12	2.72e-13	0.00e+00	1.26e-12	2.19e-07	2.94e-14
Nd-147	9.83e-07	1.07e-06	6.41e-08	0.00e+00	6.28e-07	4.65e-05	2.28e-05
Pm-147	1.15e-04	1.10e-05	4.50e-06	0.00e+00	2.10e-05	1.14e-04	5.87e-06
Pm-148	5.44e-07	8.88e-08	4.48e-08	0.00e+00	1.60e-07	6.52e-05	6.14e-05
Pm-148m	1.32e-05	3.35e-06	2.62e-06	0.00e+00	5.07e-06	3.20e-04	4.10e-05
Pm-149	4.91e-08	6.89e-09	2.84e-09	0.00e+00	1.31e-08	1.24e-05	2.79e-05
Pm-151	1.20e-08	1.99e-09	1.01e-09	0.00e+00	3.57e-09	6.56e-06	2.27e-05
Sm-151	1.07e-04	2.10e-05	4.86e-06	0.00e+00	2.27e-05	7.68e-05	3.53e-06
Sm-153	2.43e-08	2.01e-08	1.47e-09	0.00e+00	6.56e-09	7.11e-06	1.77e-05
Eu-152	2.96e-04	7.19e-05	6.30e-05	0.00e+00	3.34e-04	5.01e-04	1.35e-05
Eu-154	9.43e-04	1.23e-04	8.60e-05	0.00e+00	5.44e-04	9.12e-04	3.34e-05
Eu-155	2.00e-04	1.96e-05	1.21e-05	0.00e+00	7.65e-05	1.51e-03	5.97e-05
Eu-156	2.70e-06	2.03e-06	3.30e-07	0.00e+00	1.36e-06	1.37e-04	4.56e-05
Tb-160	3.04e-05	0.00e+00	3.79e-06	0.00e+00	1.20e-05	2.97e-04	2.60e-05

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Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	4.40e-04	1.36e-04	9.87e-05	0.00e+00	2.00e-04	6.24e-04	1.68e-05
W-181	8.90e-09	2.88e-09	3.01e-10	0.00e+00	0.00e+00	2.95e-06	2.69e-07
W-185	2.78e-07	9.17e-08	9.73e-09	0.00e+00	0.00e+00	9.60e-05	1.14e-05
W-187	1.50e-09	1.22e-09	4.29e-10	0.00e+00	0.00e+00	5.92e-06	2.21e-05
Pb-210	3.09e-02	8.28e-03	1.07e-03	0.00e+00	2.95e-02	4.52e-02	1.60e-06
Bi-210	3.30e-07	2.26e-06	1.89e-07	0.00e+00	2.74e-05	1.91e-03	3.19e-05
Po-210	5.68e-04	1.22e-03	1.37e-04	0.00e+00	4.21e-03	5.41e-02	4.45e-05
Ra-223	2.57e-04	3.93e-07	5.14e-05	0.00e+00	1.12e-05	4.39e-02	3.04e-04
Ra-224	2.83e-05	6.77e-08	5.65e-06	0.00e+00	1.93e-06	1.51e-02	3.29e-04
Ra-225	4.28e-04	5.04e-07	8.56e-05	0.00e+00	1.44e-05	5.04e-02	2.89e-04
Ra-226	1.33e-01	3.38e-06	9.87e-02	0.00e+00	9.67e-05	2.02e-01	3.11e-04
Ra-228	5.34e-02	1.74e-06	5.88e-02	0.00e+00	4.97e-05	2.78e-01	5.30e-05
Ac-225	6.04e-04	8.25e-04	4.06e-05	0.00e+00	9.47e-05	3.81e-02	2.70e-04
Ac-227	2.49e+00	3.69e-01	1.48e-01	0.00e+00	1.07e-01	4.16e-01	5.38e-05
Th-227	3.09e-04	5.56e-06	8.93e-06	0.00e+00	3.18e-05	6.50e-02	3.57e-04
Th-228	2.60e-01	4.37e-03	8.78e-03	0.00e+00	2.45e-02	1.69e+00	3.70e-04
Th-229	1.54e+01	4.44e-01	2.56e-01	0.00e+00	2.18e+00	5.24e+00	5.12e-05
Th-230	2.34e+00	1.34e-01	6.49e-02	0.00e+00	6.55e-01	8.98e-01	3.95e-05
Th-232	2.61e+00	1.14e-01	9.21e-04	0.00e+00	5.60e-01	8.60e-01	3.36e-05
Th-234	2.32e-06	1.35e-07	6.71e-08	0.00e+00	7.73e-07	3.26e-04	7.49e-05
Pa-231	5.32e+00	2.00e-01	2.07e-01	0.00e+00	1.12e+00	9.91e-02	4.71e-05
Pa-233	1.68e-06	3.24e-07	2.89e-07	0.00e+00	1.22e-06	5.39e-05	1.00e-05
U-232	7.31e-02	0.00e+00	5.23e-03	0.00e+00	7.94e-03	3.84e-01	4.46e-05
U-233	1.55e-02	0.00e+00	9.42e-04	0.00e+00	3.63e-03	9.18e-02	4.12e-05
U-234	1.48e-02	0.00e+00	9.23e-04	0.00e+00	3.55e-03	8.99e-02	4.04e-05
U-235	1.42e-02	0.00e+00	8.67e-04	0.00e+00	3.34e-03	8.44e-02	5.13e-05
U-236	1.42e-02	0.00e+00	8.86e-04	0.00e+00	3.41e-03	8.62e-02	3.79e-05
U-237	5.25e-08	0.00e+00	1.40e-08	0.00e+00	2.16e-07	1.76e-05	1.29e-05
U-238	1.36e-02	0.00e+00	8.10e-04	0.00e+00	3.12e-03	7.89e-02	3.62e-05
Np-237	1.64e+00	1.06e+00	7.21e-02	0.00e+00	5.35e-01	8.99e-02	5.22e-05

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	4.23e-07	1.02e-07	6.59e-09	0.00e+00	3.88e-08	1.75e-05	2.38e-05
Np-239	4.23e-08	3.60e-08	2.21e-09	0.00e+00	1.25e-08	8.11e-06	1.65e-05
Pu-238	1.50e+00	1.03e+00	7.22e-02	0.00e+00	3.10e-01	3.12e-01	4.79e-05
Pu-239	1.73e+00	1.12e+00	8.05e-02	0.00e+00	3.44e-01	2.93e-01	4.37e-05
Pu-240	1.72e+00	1.12e+00	8.04e-02	0.00e+00	3.43e-01	2.93e-01	4.46e-05
Pu-241	3.74e-02	9.56e-03	1.40e-03	0.00e+00	6.47e-03	2.60e-04	9.17e-07
Pu-242	1.60e+00	1.08e+00	7.75e-02	0.00e+00	3.31e-01	2.82e-01	4.29e-05
Pu-244	1.87e+00	1.24e+00	8.88e-02	0.00e+00	3.79e-01	3.23e-01	6.39e-05
Am-241	1.77e+00	1.20e+00	7.10e-02	0.00e+00	5.32e-01	1.05e-01	4.88e-05
Am-242m	1.79e+00	1.13e+00	7.15e-02	0.00e+00	5.30e-01	4.21e-02	6.14e-05
Am-243	1.77e+00	1.17e+00	6.95e-02	0.00e+00	5.21e-01	9.91e-02	5.72e-05
Cm-242	3.17e-02	2.51e-02	1.41e-03	0.00e+00	6.40e-03	6.76e-02	5.21e-05
Cm-243	1.19e+00	8.30e-01	5.00e-02	0.00e+00	2.34e-01	1.09e-01	5.13e-05
Cm-244	9.19e-01	6.53e-01	3.88e-02	0.00e+00	1.81e-01	1.05e-01	4.96e-05
Cm-245	1.83e+00	1.22e+00	7.53e-02	0.00e+00	3.52e-01	1.01e-01	4.63e-05
Cm-246	1.81e+00	1.22e+00	7.52e-02	0.00e+00	3.51e-01	1.03e-01	4.54e-05
Cm-247	1.77e+00	1.19e+00	7.41e-02	0.00e+00	3.46e-01	1.01e-01	5.97e-05
Cm-248	1.47e+01	9.83e+00	6.11e-01	0.00e+00	2.85e+00	8.32e-01	9.63e-04
Cf-252	7.16e-01	0.00e+00	3.07e-02	0.00e+00	0.00e+00	3.43e-01	1.89e-04

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.73e-07	1.73e-07	1.73e-07	1.73e-07	1.73e-07	1.73e-07
Be-10	8.43e-04	9.83e-05	2.12e-05	0.00e+00	0.00e+00	7.41e-04	1.72e-05
C-14	9.70e-06	1.82e-06	1.82e-06	1.82e-06	1.82e-06	1.82e-06	1.82e-06
N-13	2.33e-08	2.33e-08	2.33e-08	2.33e-08	2.33e-08	2.33e-08	2.33e-08
F-18	1.88e-06	0.00e+00	1.85e-07	0.00e+00	0.00e+00	0.00e+00	3.37e-07
Na-22	4.41e-05	4.41e-05	4.41e-05	4.41e-05	4.41e-05	4.41e-05	4.41e-05
Na-24	4.35e-06	4.35e-06	4.35e-06	4.35e-06	4.35e-06	4.35e-06	4.35e-06
P-32	7.04e-04	3.09e-05	2.67e-05	0.00e+00	0.00e+00	0.00e+00	1.14e-05
Ca-41	7.06e-05	0.00e+00	7.70e-06	0.00e+00	0.00e+00	7.21e-02	2.94e-07
Sc-46	1.97e-04	2.70e-04	1.04e-04	0.00e+00	2.39e-04	0.00e+00	2.45e-05
Cr-51	0.00e+00	0.00e+00	4.17e-08	2.31e-08	6.57e-09	4.59e-06	2.93e-07
Mn-54	0.00e+00	1.16e-05	2.57e-06	0.00e+00	2.71e-06	4.26e-04	6.19e-06
Mn-56	0.00e+00	4.48e-10	8.43e-11	0.00e+00	4.52e-10	3.55e-06	3.33e-05
Fe-55	1.28e-05	6.80e-06	2.10e-06	0.00e+00	0.00e+00	3.00e-05	7.75e-07
Fe-59	5.59e-06	9.04e-06	4.51e-06	0.00e+00	0.00e+00	3.43e-04	1.91e-05
Co-57	0.00e+00	2.44e-07	2.88e-07	0.00e+00	0.00e+00	1.37e-04	3.58e-06
Co-58	0.00e+00	4.79e-07	8.55e-07	0.00e+00	0.00e+00	2.99e-04	9.29e-06
Co-60	0.00e+00	3.55e-06	6.12e-06	0.00e+00	0.00e+00	1.91e-03	2.60e-05
Ni-59	1.66e-05	4.67e-06	2.83e-06	0.00e+00	0.00e+00	2.73e-05	6.29e-07
Ni-63	2.22e-04	1.25e-05	7.56e-06	0.00e+00	0.00e+00	7.43e-05	1.71e-06
Ni-65	8.08e-10	7.99e-11	4.44e-11	0.00e+00	0.00e+00	2.21e-06	2.27e-05
Cu-64	0.00e+00	5.39e-10	2.90e-10	0.00e+00	1.63e-09	2.59e-06	9.92e-06
Zn-65	1.15e-05	3.06e-05	1.90e-05	0.00e+00	1.93e-05	2.69e-04	4.41e-06
Zn-69	1.81e-11	2.61e-11	2.41e-12	0.00e+00	1.58e-11	3.84e-07	2.75e-06
Zn-69m	4.26e-09	7.28e-09	8.59e-10	0.00e+00	4.22e-09	7.36e-06	2.71e-05
Se-79	0.00e+00	1.23e-06	2.60e-07	0.00e+00	1.71e-06	1.49e-04	3.43e-06
Br-82	0.00e+00	0.00e+00	5.66e-06	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	1.28e-07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	1.48e-07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	6.84e-09	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem per pCi inhaled.

## Offsite Dose Calculation Manual

## Attachment 21

## Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	5.36e-05	3.09e-05	0.00e+00	0.00e+00	0.00e+00	2.16e-06
Rb-87	0.00e+00	3.16e-05	1.37e-05	0.00e+00	0.00e+00	0.00e+00	2.96e-07
Rb-88	0.00e+00	1.52e-07	9.90e-08	0.00e+00	0.00e+00	0.00e+00	4.66e-09
Rb-89	0.00e+00	9.33e-08	7.83e-08	0.00e+00	0.00e+00	0.00e+00	5.11e-10
Sr-89	1.62e-04	0.00e+00	4.66e-06	0.00e+00	0.00e+00	5.83e-04	4.52e-05
Sr-90	1.04e-02	0.00e+00	2.07e-04	0.00e+00	0.00e+00	3.99e-03	9.28e-05
Sr-91	3.28e-08	0.00e+00	1.24e-09	0.00e+00	0.00e+00	1.44e-05	4.70e-05
Sr-92	3.54e-09	0.00e+00	1.42e-10	0.00e+00	0.00e+00	6.49e-06	6.55e-05
Y-90	1.11e-06	0.00e+00	2.99e-08	0.00e+00	0.00e+00	7.07e-05	7.24e-05
Y-91	2.47e-04	0.00e+00	6.59e-06	0.00e+00	0.00e+00	7.10e-04	4.97e-05
Y-91m	1.37e-10	0.00e+00	4.98e-12	0.00e+00	0.00e+00	7.60e-07	4.64e-07
Y-92	5.50e-09	0.00e+00	1.57e-10	0.00e+00	0.00e+00	6.46e-06	6.46e-05
Y-93	5.04e-08	0.00e+00	1.38e-09	0.00e+00	0.00e+00	2.01e-05	1.05e-04
Zr-93	2.07e-04	7.80e-06	5.55e-06	0.00e+00	3.00e-05	7.10e-05	1.47e-06
Zr-95	5.13e-05	1.13e-05	1.00e-05	0.00e+00	1.61e-05	6.03e-04	1.65e-05
Zr-97	5.07e-08	7.34e-09	4.32e-09	0.00e+00	1.05e-08	3.06e-05	9.49e-05
Nb-93m	1.27e-04	3.17e-05	1.04e-05	0.00e+00	3.44e-05	1.04e-04	2.45e-06
Nb-95	6.35e-06	2.48e-06	1.77e-06	0.00e+00	2.33e-06	1.66e-04	1.00e-05
Nb-97	1.16e-10	2.08e-11	9.74e-12	0.00e+00	2.31e-11	9.23e-07	7.52e-06
Mo-93	0.00e+00	3.76e-06	1.35e-07	0.00e+00	1.06e-06	1.70e-04	3.78e-06
Mo-99	0.00e+00	4.66e-08	1.15e-08	0.00e+00	1.06e-07	3.66e-05	3.42e-05
Tc-101	2.19e-14	2.30e-14	2.91e-13	0.00e+00	3.92e-13	1.58e-07	4.41e-09
Tc-99	1.34e-07	1.49e-07	5.35e-08	0.00e+00	1.75e-06	3.37e-04	7.75e-06
Tc-99m	4.81e-13	9.41e-13	1.56e-11	0.00e+00	1.37e-11	2.57e-07	1.30e-06
Ru-103	7.55e-07	0.00e+00	2.90e-07	0.00e+00	1.90e-06	1.79e-04	1.21e-05
Ru-105	4.13e-10	0.00e+00	1.50e-10	0.00e+00	3.63e-10	4.30e-06	2.69e-05
Ru-106	3.68e-05	0.00e+00	4.57e-06	0.00e+00	4.97e-05	3.87e-03	1.16e-04
Rh-105	3.91e-09	2.10e-09	1.79e-09	0.00e+00	8.39e-09	7.82e-06	1.33e-05
Pd-107	0.00e+00	2.65e-07	2.51e-08	0.00e+00	1.97e-06	3.16e-05	7.26e-07
Pd-109	0.00e+00	1.48e-09	4.95e-10	0.00e+00	7.06e-09	6.16e-06	2.59e-05

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	4.56e-06	3.08e-06	2.47e-06	0.00e+00	5.74e-06	1.48e-03	2.71e-05
Ag-111	1.81e-07	5.68e-08	3.75e-08	0.00e+00	1.71e-07	7.73e-05	2.98e-05
Cd-113m	0.00e+00	4.93e-04	2.12e-05	0.00e+00	5.13e-04	6.94e-04	1.63e-05
Cd-115m	0.00e+00	7.88e-05	3.39e-06	0.00e+00	5.93e-05	5.86e-04	4.97e-05
Sn-123	1.29e-04	2.14e-06	4.19e-06	2.27e-06	0.00e+00	9.59e-04	4.05e-05
Sn-125	4.95e-06	9.94e-08	2.95e-07	1.03e-07	0.00e+00	2.43e-04	7.17e-05
Sn-126	6.23e-04	1.04e-05	2.36e-05	2.84e-06	0.00e+00	3.02e-03	1.63e-05
Sb-124	1.55e-05	2.00e-07	5.41e-06	3.41e-08	0.00e+00	8.76e-04	4.43e-05
Sb-125	2.66e-05	2.05e-07	5.59e-06	2.46e-08	0.00e+00	6.27e-04	1.09e-05
Sb-126	1.72e-06	2.62e-08	6.16e-07	1.00e-08	0.00e+00	2.86e-04	5.67e-05
Sb-127	1.36e-07	2.09e-09	4.70e-08	1.51e-09	0.00e+00	6.17e-05	3.82e-05
Te-125m	1.82e-06	6.29e-07	2.47e-07	5.20e-07	0.00e+00	1.29e-04	9.13e-06
Te-127	7.49e-10	2.57e-10	1.65e-10	5.30e-10	1.91e-09	2.71e-06	1.52e-05
Te-127m	6.72e-06	2.31e-06	8.16e-07	1.64e-06	1.72e-05	4.00e-04	1.93e-05
Te-129	2.64e-11	9.45e-12	6.44e-12	1.93e-11	6.94e-11	7.93e-07	6.89e-06
Te-129m	5.19e-06	1.85e-06	8.22e-07	1.71e-06	1.36e-05	4.76e-04	4.91e-05
Te-131	5.87e-12	2.28e-12	1.78e-12	4.59e-12	1.59e-11	5.55e-07	3.60e-07
Te-131m	3.63e-08	1.60e-08	1.37e-08	2.64e-08	1.08e-07	5.56e-05	8.32e-05
Te-132	1.30e-07	7.36e-08	7.12e-08	8.58e-08	4.79e-07	1.02e-04	3.72e-05
Tb-133m	2.93e-11	1.51e-11	1.50e-11	2.32e-11	1.01e-10	1.60e-06	4.77e-06
Te-134	1.53e-11	8.81e-12	9.40e-12	1.24e-11	5.71e-11	1.23e-06	4.87e-07
I-129	1.05e-05	6.40e-06	5.71e-06	4.28e-03	1.08e-05	0.00e+00	2.15e-07
I-130	2.21e-06	4.43e-06	2.28e-06	4.99e-04	6.61e-06	0.00e+00	1.38e-06
I-131	1.30e-05	1.30e-05	7.37e-06	4.39e-03	2.13e-05	0.00e+00	7.68e-07
I-132	5.72e-07	1.10e-06	5.07e-07	5.23e-05	1.69e-06	0.00e+00	8.65e-07
I-133	4.48e-06	5.49e-06	2.08e-06	1.04e-03	9.13e-06	0.00e+00	1.48e-06
I-134	3.17e-07	5.84e-07	2.69e-07	1.37e-05	8.92e-07	0.00e+00	2.58e-07
I-135	1.33e-06	2.36e-06	1.12e-06	2.14e-04	3.62e-06	0.00e+00	1.20e-06
Cs-134	1.76e-04	2.74e-04	6.07e-05	0.00e+00	8.93e-05	3.27e-05	1.04e-06
Cs-134m	6.33e-08	8.92e-08	6.12e-08	0.00e+00	4.94e-08	8.35e-09	7.92e-08

Conversion factors are in units of mrem per pCi inhaled.



Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	6.23e-05	4.13e-05	4.45e-06	0.00e+00	1.53e-05	5.22e-06	2.17e-07
Cs-136	1.76e-05	4.62e-05	3.14e-05	0.00e+00	2.58e-05	3.93e-06	1.13e-06
Cs-137	2.45e-04	2.23e-04	3.47e-05	0.00e+00	7.63e-05	2.81e-05	9.78e-07
Cs-138	1.71e-07	2.27e-07	1.50e-07	0.00e+00	1.68e-07	1.84e-08	7.29e-08
Cs-139	1.09e-07	1.15e-07	5.80e-08	0.00e+00	9.08e-08	9.36e-09	7.23e-12
Ba-139	4.98e-10	2.66e-13	1.45e-11	0.00e+00	2.33e-13	1.56e-06	1.56e-05
Ba-140	2.00e-05	1.75e-08	1.17e-06	0.00e+00	5.71e-09	4.71e-04	2.75e-05
Ba-141	5.29e-11	2.95e-14	1.72e-12	0.00e+00	2.56e-14	7.89e-07	7.44e-08
Ba-142	1.35e-11	9.73e-15	7.54e-13	0.00e+00	7.87e-15	4.44e-07	7.41e-10
La-140	1.74e-07	6.08e-08	2.04e-08	0.00e+00	0.00e+00	4.94e-05	6.10e-05
La-141	2.28e-09	5.31e-10	1.15e-10	0.00e+00	0.00e+00	4.48e-06	4.37e-05
La-142	3.50e-10	1.11e-10	3.49e-11	0.00e+00	0.00e+00	2.35e-06	2.05e-05
Ce-141	1.06e-05	5.28e-06	7.83e-07	0.00e+00	2.31e-06	1.47e-04	1.53e-05
Ce-143	9.89e-08	5.37e-08	7.77e-09	0.00e+00	2.26e-08	3.12e-05	3.44e-05
Ce-144	1.83e-03	5.72e-04	9.77e-05	0.00e+00	3.17e-04	3.23e-03	1.05e-04
Pr-143	4.99e-06	1.50e-06	2.47e-07	0.00e+00	8.11e-07	1.17e-04	2.63e-05
Pr-144	1.61e-11	4.99e-12	8.10e-13	0.00e+00	2.64e-12	4.23e-07	5.32e-08
Nd-147	2.92e-06	2.36e-06	1.84e-07	0.00e+00	1.30e-06	8.87e-05	2.22e-05
Pm-147	3.52e-04	2.52e-05	1.36e-05	0.00e+00	4.45e-05	2.20e-04	5.70e-06
Pm-148	1.61e-06	1.94e-07	1.25e-07	0.00e+00	3.30e-07	1.24e-04	6.01e-05
Pm-148m	3.31e-05	6.55e-06	6.55e-06	0.00e+00	9.74e-06	5.72e-04	3.58e-05
Pm-149	1.47e-07	1.56e-08	8.45e-09	0.00e+00	2.75e-08	2.40e-05	2.92e-05
Pm-151	3.57e-08	4.33e-09	2.82e-09	0.00e+00	7.35e-09	1.24e-05	2.50e-05
Sm-151	3.14e-04	4.75e-05	1.49e-05	0.00e+00	4.89e-05	1.48e-04	3.43e-06
Sm-153	7.24e-08	4.51e-08	4.35e-09	0.00e+00	1.37e-08	1.37e-05	1.87e-05
Eu-152	7.42e-04	1.37e-04	1.61e-04	0.00e+00	5.73e-04	9.00e-04	1.14e-05
Eu-154	2.74e-03	2.49e-04	2.27e-04	0.00e+00	1.09e-03	1.66e-03	2.98e-05
Eu-155	5.60e-04	4.05e-05	3.18e-05	0.00e+00	1.51e-04	2.79e-04	5.39e-05
Eu-156	7.89e-06	4.23e-06	8.75e-07	0.00e+00	2.72e-06	2.54e-04	4.24e-05
Tb-160	7.79e-05	0.00e+00	9.67e-06	0.00e+00	2.32e-05	5.34e-04	2.28e-05

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.34e-03	2.81e-04	2.37e-04	0.00e+00	4.01e-04	1.13e-03	1.63e-05
W-181	2.66e-08	6.52e-09	8.99e-10	0.00e+00	0.00e+00	5.71e-06	2.61e-07
W-185	8.31e-07	2.08e-07	2.91e-08	0.00e+00	0.00e+00	1.86e-04	1.11e-05
W-187	4.41e-09	2.61e-09	1.17e-09	0.00e+00	0.00e+00	1.11e-05	2.46e-05
Pb-210	8.03e-02	1.85e-02	3.18e-03	0.00e+00	6.31e-02	8.74e-02	1.55e-06
Bi-210	9.85e-07	5.11e-06	5.65e-07	0.00e+00	5.76e-05	3.70e-03	3.21e-05
Po-210	1.70e-03	2.76e-03	4.09e-04	0.00e+00	8.85e-03	1.05e-01	4.32e-05
Ra-223	7.69e-04	8.89e-07	1.54e-04	0.00e+00	2.36e-05	8.48e-02	3.00e-04
Ra-224	8.44e-05	1.53e-07	1.69e-05	0.00e+00	4.06e-06	2.92e-02	3.34e-04
Ra-225	1.28e-03	1.14e-06	2.56e-04	0.00e+00	3.02e-05	9.74e-02	2.84e-04
Ra-226	2.34e-01	7.66e-06	1.92e-01	0.00e+00	2.03e-04	3.90e-01	3.02e-04
Ra-228	1.49e-01	3.94e-06	1.68e-01	0.00e+00	1.04e-04	5.37e-01	5.14e-05
Ac-225	1.81e-03	1.87e-03	1.21e-04	0.00e+00	1.99e-04	7.37e-02	2.67e-04
Ac-227	4.96e+00	8.05e-01	3.07e-01	0.00e+00	1.77e-01	8.04e-01	5.22e-05
Th-227	9.24e-04	1.26e-05	2.67e-05	0.00e+00	6.67e-05	1.26e-01	3.49e-04
Th-228	8.06e-01	1.04e-02	2.72e-02	0.00e+00	5.41e-02	3.34e+00	3.59e-04
Th-229	2.18e+01	5.74e-01	3.63e-01	0.00e+00	2.83e+00	1.08e+01	4.99e-05
Th-230	3.30e+00	1.73e-01	9.20e-02	0.00e+00	8.52e-01	1.85e+00	3.84e-05
Th-232	3.68e+00	1.47e-01	1.28e-03	0.00e+00	7.28e-01	1.77e+00	3.27e-05
Th-234	6.94e-06	3.07e-07	2.00e-07	0.00e+00	1.62e-06	6.31e-04	7.32e-05
Pa-231	8.62e+00	2.86e-01	3.43e-01	0.00e+00	1.56e+00	1.92e-01	4.57e-05
Pa-233	4.14e-06	6.48e-07	7.25e-07	0.00e+00	2.38e-06	9.77e-05	8.95e-06
U-232	2.19e-01	0.00e+00	1.56e-02	0.00e+00	1.67e-02	7.42e-01	4.33e-05
U-233	4.64e-02	0.00e+00	2.82e-03	0.00e+00	7.62e-03	1.77e-01	4.00e-05
U-234	4.46e-02	0.00e+00	2.76e-03	0.00e+00	7.47e-03	1.74e-01	3.92e-05
U-235	4.27e-02	0.00e+00	2.59e-03	0.00e+00	7.01e-03	1.63e-01	4.98e-05
U-236	4.27e-02	0.00e+00	2.65e-03	0.00e+00	7.16e-03	1.67e-01	3.67e-05
U-237	1.57e-07	0.00e+00	4.17e-08	0.00e+00	4.53e-07	3.40e-05	1.29e-05
U-238	4.09e-02	0.00e+00	2.42e-03	0.00e+00	6.55e-03	1.53e-01	3.51e-05
Np-237	2.72e+00	1.62e+00	1.19e-01	0.00e+00	7.41e-01	1.74e-01	5.06e-05

Conversion factors are in units of mrem per pCi inhaled.

## Offsite Dose Calculation Manual

## Attachment 21

## Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.26e-06	2.30e-07	1.97e-08	0.00e+00	8.16e-08	3.39e-05	2.50e-05
Np-239	1.26e-07	8.14e-08	6.35e-09	0.00e+00	2.63e-08	1.57e-05	1.73e-05
Pu-238	2.55e+00	1.60e+00	1.21e-01	0.00e+00	4.47e-01	6.08e-01	4.65e-05
Pu-239	2.79e+00	1.68e+00	1.28e-01	0.00e+00	4.78e-01	5.72e-01	4.24e-05
Pu-240	2.79e+00	1.68e+00	1.27e-01	0.00e+00	4.77e-01	5.71e-01	4.33e-05
Pu-241	7.94e-02	1.75e-02	2.93e-03	0.00e+00	1.10e-02	5.06e-04	8.90e-07
Pu-242	2.59e+00	1.62e+00	1.23e-01	0.00e+00	4.60e-01	5.50e-01	4.16e-05
Pu-244	3.02e+00	1.85e+00	1.41e-01	0.00e+00	5.27e-01	6.30e-01	6.20e-05
Am-241	2.97e+00	1.84e+00	1.24e-01	0.00e+00	7.63e-01	2.02e-01	4.73e-05
Am-242m	3.07e+00	1.76e+00	1.27e-01	0.00e+00	7.71e-01	8.14e-02	5.96e-05
Am-243	2.94e+00	1.78e+00	1.20e-01	0.00e+00	7.42e-01	1.92e-01	5.55e-05
Cm-242	9.48e-02	5.68e-02	4.20e-03	0.00e+00	1.34e-02	1.31e-01	5.06e-05
Cm-243	2.32e+00	1.42e+00	9.95e-02	0.00e+00	3.74e-01	2.10e-01	4.98e-05
Cm-244	1.94e+00	1.18e+00	8.31e-02	0.00e+00	3.06e-01	2.02e-01	4.82e-05
Cm-245	3.05e+00	1.84e+00	1.28e-01	0.00e+00	5.03e-01	1.95e-01	4.49e-05
Cm-246	3.02e+00	1.84e+00	1.28e-01	0.00e+00	5.03e-01	1.99e-01	4.41e-05
Cm-247	2.94e+00	1.82e+00	1.26e-01	0.00e+00	4.95e-01	1.95e-01	5.80e-05
Cm-248	2.45e+01	1.50e+01	1.04e+00	0.00e+00	4.08e+00	1.61e+00	9.35e-04
Cf-252	2.18e+00	0.00e+00	9.33e-02	0.00e+00	0.00e+00	6.62e-01	1.84e-04

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	2.63e-07	2.63e-07	2.63e-07	2.63e-07	2.63e-07	2.63e-07
Be-10	9.49e-04	1.25e-04	2.65e-05	0.00e+00	0.00e+00	1.49e-03	1.73e-05
C-14	1.89e-05	3.79e-06	3.79e-06	3.79e-06	3.79e-06	3.79e-06	3.79e-06
N-13	4.39e-08	4.39e-08	4.39e-08	4.39e-08	4.39e-08	4.39e-08	4.39e-08
F-18	3.92e-06	0.00e+00	3.33e-07	0.00e+00	0.00e+00	0.00e+00	6.10e-07
Na-22	7.37e-05	7.37e-05	7.37e-05	7.37e-05	7.37e-05	7.37e-05	7.37e-05
Na-24	7.54e-06	7.54e-06	7.54e-06	7.54e-06	7.54e-06	7.54e-06	7.54e-06
P-32	1.45e-03	8.03e-05	5.53e-05	0.00e+00	0.00e+00	0.00e+00	1.15e-05
Ca-41	7.48e-05	0.00e+00	8.16e-06	0.00e+00	0.00e+00	6.94e-02	2.96e-07
Sc-46	3.75e-04	5.41e-04	1.69e-04	0.00e+00	3.56e-04	0.00e+00	2.19e-05
Cr-51	0.00e+00	0.00e+00	6.39e-08	4.11e-08	9.45e-09	9.17e-06	2.55e-07
Mn-54	0.00e+00	1.81e-05	3.56e-06	0.00e+00	3.56e-06	7.14e-04	5.04e-06
Mn-56	0.00e+00	1.10e-09	1.58e-10	0.00e+00	7.86e-10	8.95e-06	5.12e-05
Fe-55	1.41e-05	8.39e-06	2.38e-06	0.00e+00	0.00e+00	6.21e-05	7.82e-07
Fe-59	9.69e-06	1.68e-05	6.77e-06	0.00e+00	0.00e+00	7.25e-04	1.77e-05
Co-57	0.00e+00	4.65e-07	4.58e-07	0.00e+00	0.00e+00	2.71e-04	3.47e-06
Co-58	0.00e+00	8.71e-07	1.30e-06	0.00e+00	0.00e+00	5.55e-04	7.95e-06
Co-60	0.00e+00	5.73e-06	8.41e-06	0.00e+00	0.00e+00	3.22e-03	2.28e-05
Ni-59	1.81e-05	5.44e-06	3.10e-06	0.00e+00	0.00e+00	5.48e-05	6.34e-07
Ni-63	2.42e-04	1.46e-05	8.29e-06	0.00e+00	0.00e+00	1.49e-04	1.73e-06
Ni-65	1.71e-09	2.03e-10	8.79e-11	0.00e+00	0.00e+00	5.80e-06	3.58e-05
Cu-64	0.00e+00	1.34e-09	5.53e-10	0.00e+00	2.84e-09	6.64e-06	1.07e-05
Zn-65	1.38e-05	4.47e-05	2.22e-05	0.00e+00	2.32e-05	4.62e-04	3.67e-05
Zn-69	3.85e-11	6.91e-11	5.13e-12	0.00e+00	2.87e-11	1.05e-06	9.44e-06
Zn-69m	8.98e-09	1.84e-08	1.67e-09	0.00e+00	7.45e-09	1.91e-05	2.92e-05
Se-79	0.00e+00	2.25e-06	4.20e-07	0.00e+00	2.47e-06	2.99e-04	3.46e-06
Br-82	0.00e+00	0.00e+00	9.49e-06	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	2.72e-07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	2.86e-07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	1.46e-08	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.36e-04	6.30e-05	0.00e+00	0.00e+00	0.00e+00	2.17e-06
Rb-87	0.00e+00	7.11e-05	2.64e-05	0.00e+00	0.00e+00	0.00e+00	2.99e-07
Rb-88	0.00e+00	3.98e-07	2.05e-07	0.00e+00	0.00e+00	0.00e+00	2.42e-07
Rb-89	0.00e+00	2.29e-07	1.47e-07	0.00e+00	0.00e+00	0.00e+00	4.87e-08
Sr-89	2.84e-04	0.00e+00	8.15e-06	0.00e+00	0.00e+00	1.45e-03	4.57e-05
Sr-90	1.11e-02	0.00e+00	2.23e-04	0.00e+00	0.00e+00	8.03e-03	9.36e-05
Sr-91	6.83e-08	0.00e+00	2.47e-09	0.00e+00	0.00e+00	3.76e-05	5.24e-05
Sr-92	7.50e-09	0.00e+00	2.79e-10	0.00e+00	0.00e+00	1.70e-05	1.00e-04
Y-90	2.35e-06	0.00e+00	6.30e-08	0.00e+00	0.00e+00	1.92e-04	7.43e-05
Y-91	4.20e-04	0.00e+00	1.12e-05	0.00e+00	0.00e+00	1.75e-03	5.02e-05
Y-91m	2.91e-10	0.00e+00	9.90e-12	0.00e+00	0.00e+00	1.99e-06	1.68e-06
Y-92	1.17e-08	0.00e+00	3.29e-10	0.00e+00	0.00e+00	1.75e-05	9.04e-05
Y-93	1.07e-07	0.00e+00	2.91e-09	0.00e+00	0.00e+00	5.46e-05	1.19e-04
Zr-93	2.24e-04	9.51e-06	6.18e-06	0.00e+00	3.19e-05	1.37e-04	1.48e-06
Zr-95	8.24e-05	1.99e-05	1.45e-05	0.00e+00	2.22e-05	1.25e-03	1.55e-05
Zr-97	1.07e-07	1.83e-08	8.36e-09	0.00e+00	1.85e-08	7.88e-05	1.00e-04
Nb-93m	1.38e-04	3.59e-05	1.15e-05	0.00e+00	3.68e-05	2.09e-04	2.47e-06
Nb-95	1.12e-05	4.59e-06	2.70e-06	0.00e+00	3.37e-06	3.42e-04	9.05e-06
Nb-97	2.44e-10	5.21e-11	1.88e-11	0.00e+00	4.07e-11	2.37e-06	1.92e-05
Mo-93	0.00e+00	6.46e-06	2.22e-07	0.00e+00	1.54e-06	3.40e-04	3.76e-06
Mo-99	0.00e+00	1.18e-07	2.31e-08	0.00e+00	1.89e-07	9.63e-05	3.48e-05
Tc-101	4.65e-14	5.88e-14	5.80e-13	0.00e+00	6.99e-13	4.17e-07	6.03e-07
Tc-99	2.09e-07	2.68e-07	8.85e-08	0.00e+00	2.49e-06	6.77e-04	7.82e-06
Tc-99m	9.98e-13	2.06e-12	2.66e-11	0.00e+00	2.22e-11	5.79e-07	1.45e-06
Ru-103	1.44e-06	0.00e+00	4.85e-07	0.00e+00	3.03e-06	3.94e-04	1.15e-05
Ru-105	8.74e-10	0.00e+00	2.93e-10	0.00e+00	6.42e-10	1.12e-05	3.46e-05
Ru-106	6.20e-05	0.00e+00	7.77e-06	0.00e+00	7.61e-05	8.26e-03	1.17e-04
Rh-105	8.26e-09	5.41e-09	3.63e-09	0.00e+00	1.50e-08	2.08e-05	1.37e-05
Pd-107	0.00e+00	4.92e-07	4.11e-08	0.00e+00	2.75e-06	6.34e-05	7.33e-07
Pd-109	0.00e+00	3.92e-09	1.05e-09	0.00e+00	1.28e-08	1.68e-05	2.85e-05

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Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	7.13e-06	5.16e-06	3.57e-06	0.00e+00	7.80e-06	2.62e-03	2.36e-05
Ag-111	3.75e-07	1.45e-07	7.75e-08	0.00e+00	3.05e-07	2.06e-04	3.02e-05
Cd-113m	0.00e+00	6.67e-04	2.64e-05	0.00e+00	5.80e-04	1.40e-03	1.65e-05
Cd-115m	0.00e+00	1.73e-04	6.19e-06	0.00e+00	9.41e-05	1.47e-03	5.02e-05
Sn-123	2.09e-04	4.21e-06	7.28e-06	4.27e-06	0.00e+00	2.22e-03	4.08e-05
Sn-125	1.01e-05	2.51e-07	6.00e-07	2.47e-07	0.00e+00	6.43e-04	7.26e-05
Sn-126	8.30e-04	1.44e-05	3.52e-05	3.84e-06	0.00e+00	4.93e-03	1.65e-05
Sb-124	2.71e-05	3.97e-07	8.56e-06	7.18e-08	0.00e+00	1.89e-03	4.22e-05
Sb-125	3.69e-05	3.41e-07	7.78e-06	4.45e-08	0.00e+00	1.17e-03	1.05e-05
Sb-126	3.08e-06	6.01e-08	1.11e-06	2.35e-08	0.00e+00	6.88e-04	5.33e-05
Sb-127	2.82e-07	5.04e-09	8.76e-08	3.60e-09	0.00e+00	1.54e-04	3.78e-05
Te-125m	3.40e-06	1.42e-06	4.70e-07	1.16e-06	0.00e+00	3.19e-04	9.22e-06
Te-127	1.59e-09	6.81e-10	3.49e-10	1.32e-09	3.47e-09	7.39e-06	1.74e-05
Te-127m	1.19e-05	4.93e-06	1.48e-06	3.48e-06	2.68e-05	9.37e-04	1.95e-05
Te-129	5.63e-11	2.48e-11	1.34e-11	4.82e-11	1.25e-10	2.14e-06	1.88e-05
Te-129m	1.01e-05	4.35e-06	1.59e-06	3.91e-06	2.27e-05	1.20e-03	4.93e-05
Te-131	1.24e-11	5.87e-12	3.57e-12	1.13e-11	2.85e-11	1.47e-06	5.87e-06
Te-131m	7.62e-08	3.93e-08	2.59e-08	6.38e-08	1.89e-07	1.42e-04	8.51e-05
Te-132	2.66e-07	1.69e-07	1.26e-07	1.99e-07	7.39e-07	2.43e-04	3.15e-05
Tb-133m	6.13e-11	3.59e-11	2.74e-11	5.52e-11	1.72e-10	3.92e-06	1.59e-05
Te-134	3.18e-11	2.04e-11	1.68e-11	2.91e-11	9.59e-11	2.93e-06	2.53e-06
I-129	2.16e-05	1.59e-05	1.16e-05	1.04e-02	1.88e-05	0.00e+00	2.12e-07
I-130	4.54e-06	9.91e-06	3.98e-06	1.14e-03	1.09e-05	0.00e+00	1.42e-06
I-131	2.71e-05	3.17e-05	1.40e-05	1.06e-02	3.70e-05	0.00e+00	7.56e-07
I-132	1.21e-06	2.53e-06	8.99e-07	1.21e-04	2.82e-06	0.00e+00	1.36e-06
I-133	9.46e-06	1.37e-05	4.00e-06	2.54e-03	1.60e-05	0.00e+00	1.54e-06
I-134	6.58e-07	1.34e-06	4.75e-07	3.18e-05	1.49e-06	0.00e+00	9.21e-07
I-135	2.76e-06	5.43e-06	1.98e-06	4.97e-04	6.05e-06	0.00e+00	1.31e-06
Cs-134	2.83e-04	5.02e-04	5.32e-05	0.00e+00	1.36e-04	5.69e-05	9.53e-07
Cs-134m	1.32e-07	2.10e-07	1.11e-07	0.00e+00	8.50e-08	2.00e-08	1.16e-07

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.00e-04	8.66e-05	4.73e-06	0.00e+00	2.58e-05	1.01e-05	2.18e-07
Cs-136	3.45e-05	9.61e-05	3.78e-05	0.00e+00	4.03e-05	8.40e-06	1.02e-06
Cs-137	3.92e-04	4.37e-04	3.25e-05	0.00e+00	1.23e-04	5.09e-05	9.53e-07
Cs-138	3.61e-07	5.58e-07	2.84e-07	0.00e+00	2.93e-07	4.67e-08	6.26e-07
Cs-139	2.32e-07	3.03e-07	1.22e-07	0.00e+00	1.65e-07	2.53e-08	1.33e-08
Ba-139	1.06e-09	7.03e-13	3.07e-11	0.00e+00	4.23e-13	4.25e-06	3.64e-05
Ba-140	4.00e-05	4.00e-08	2.07e-06	0.00e+00	9.59e-09	1.14e-03	2.74e-05
Ba-141	1.12e-10	7.70e-14	3.55e-12	0.00e+00	4.64e-14	2.12e-06	3.39e-06
Ba-142	2.84e-11	2.36e-14	1.40e-12	0.00e+00	1.36e-14	1.11e-06	4.95e-07
La-140	3.61e-07	1.43e-07	3.68e-08	0.00e+00	0.00e+00	1.20e-04	6.06e-05
La-141	4.85e-09	1.40e-09	2.45e-10	0.00e+00	0.00e+00	1.22e-05	5.96e-05
La-142	7.36e-10	2.69e-10	6.46e-11	0.00e+00	0.00e+00	5.87e-06	4.25e-05
Ce-141	1.98e-05	1.19e-05	1.42e-06	0.00e+00	3.75e-06	3.69e-04	1.54e-05
Ce-143	2.09e-07	1.38e-07	1.58e-08	0.00e+00	4.03e-08	8.30e-05	3.55e-05
Ce-144	2.28e-03	8.65e-04	1.26e-04	0.00e+00	3.84e-04	7.03e-03	1.06e-04
Pr-143	1.00e-05	3.74e-06	4.99e-07	0.00e+00	1.41e-06	3.09e-04	2.66e-05
Pr-144	3.42e-11	1.32e-11	1.72e-12	0.00e+00	4.80e-12	1.15e-06	3.06e-06
Nd-147	5.67e-06	5.81e-06	3.57e-07	0.00e+00	2.25e-06	2.30e-04	2.23e-05
Pm-147	3.91e-04	3.07e-05	1.56e-05	0.00e+00	4.93e-05	4.55e-04	5.75e-06
Pm-148	3.34e-06	4.82e-07	2.44e-07	0.00e+00	5.76e-07	3.20e-04	6.04e-05
Pm-148m	5.00e-05	1.24e-05	9.94e-06	0.00e+00	1.45e-05	1.22e-03	3.37e-05
Pm-149	3.10e-07	4.08e-08	1.78e-08	0.00e+00	4.96e-08	6.50e-05	3.01e-05
Pm-151	7.52e-08	1.10e-08	5.55e-09	0.00e+00	1.30e-08	3.25e-05	2.58e-05
Sm-151	3.38e-04	6.45e-05	1.63e-05	0.00e+00	5.24e-05	2.98e-04	3.46e-06
Sm-153	1.53e-07	1.18e-07	9.06e-09	0.00e+00	2.47e-08	3.70e-05	1.93e-05
Eu-152	7.83e-04	1.77e-04	1.72e-04	0.00e+00	5.94e-04	1.48e-03	9.88e-06
Eu-154	2.96e-03	3.46e-04	2.45e-04	0.00e+00	1.14e-03	3.05e-03	2.84e-05
Eu-155	5.97e-04	5.72e-05	3.46e-05	0.00e+00	1.58e-04	5.20e-04	5.19e-05
Eu-156	1.56e-05	9.59e-06	1.54e-06	0.00e+00	4.48e-06	6.12e-04	4.14e-05
Tb-160	1.12e-04	0.00e+00	1.40e-05	0.00e+00	3.20e-05	1.11e-03	2.14e-05

Conversion factors are in units of mrem per pCi inhaled.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.45e-03	3.07e-04	2.51e-04	0.00e+00	4.22e-04	2.05e-03	1.65e-05
W-181	4.86e-08	1.46e-08	1.67e-09	0.00e+00	0.00e+00	1.33e-05	2.63e-07
W-185	1.57e-06	4.83e-07	5.58e-08	0.00e+00	0.00e+00	4.48e-04	1.12e-05
W-187	9.26e-09	6.44e-09	2.23e-09	0.00e+00	0.00e+00	2.83e-05	2.54e-05
Pb-210	8.62e-02	2.02e-02	3.43e-03	0.00e+00	6.85e-02	1.76e-01	1.57e-06
Bi-210	2.06e-06	1.33e-05	1.18e-06	0.00e+00	1.03e-04	9.96e-03	3.27e-05
Po-210	2.98e-03	5.63e-03	7.12e-04	0.00e+00	1.30e-02	2.40e-01	4.36e-05
Ra-223	1.56e-03	2.26e-06	3.12e-04	0.00e+00	4.16e-05	2.25e-01	3.04e-04
Ra-224	1.77e-04	4.00e-07	3.54e-05	0.00e+00	7.30e-06	7.91e-02	3.42e-04
Ra-225	2.57e-03	2.88e-06	5.13e-04	0.00e+00	5.31e-05	2.57e-01	2.87e-04
Ra-226	2.48e-01	1.46e-05	2.05e-01	0.00e+00	2.94e-04	7.83e-01	3.05e-04
Ra-228	1.60e-01	7.61e-06	1.80e-01	0.00e+00	1.53e-04	1.09e+00	5.19e-05
Ac-225	3.69e-03	4.72e-03	2.48e-04	0.00e+00	3.49e-04	1.96e-01	2.71e-04
Ac-227	5.29e+00	8.76e-01	3.28e-01	0.00e+00	1.86e-01	1.62e+00	5.27e-05
Th-227	1.82e-03	3.03e-05	5.24e-05	0.00e+00	1.13e-04	3.27e-01	3.53e-04
Th-228	8.46e-01	1.10e-02	2.86e-02	0.00e+00	5.61e-02	4.65e+00	3.62e-04
Th-229	2.28e+01	5.94e-01	3.81e-01	0.00e+00	9.32e-01	1.27e+01	5.02e-05
Th-230	3.46e+00	1.79e-01	9.65e-02	0.00e+00	8.82e-01	2.18e+00	3.87e-05
Th-232	3.86e+00	1.53e-01	2.29e-03	0.00e+00	7.54e-01	2.09e+00	3.29e-05
Th-234	1.33e-05	7.17e-07	3.84e-07	0.00e+00	2.70e-06	1.62e-03	7.40e-05
Pa-231	9.10e+00	3.00e-01	3.62e-01	0.00e+00	1.62e+00	3.85e-01	4.61e-05
Pa-233	6.84e-06	1.32e-06	1.19e-06	0.00e+00	3.68e-06	2.19e-04	9.04e-06
U-232	2.57e-01	0.00e+00	2.13e-02	0.00e+00	2.40e-02	1.49e+00	4.36e-05
U-233	5.44e-02	0.00e+00	3.83e-03	0.00e+00	1.09e-02	3.56e-01	4.03e-05
U-234	5.22e-02	0.00e+00	3.75e-03	0.00e+00	1.07e-02	3.49e-01	3.95e-05
U-235	5.01e-02	0.00e+00	3.52e-03	0.00e+00	1.01e-02	3.28e-01	5.02e-05
U-236	5.01e-02	0.00e+00	3.60e-03	0.00e+00	1.03e-02	3.35e-01	3.71e-05
U-237	3.25e-07	0.00e+00	8.65e-08	0.00e+00	8.08e-07	9.13e-05	1.31e-05
U-238	4.79e-02	0.00e+00	3.29e-03	0.00e+00	9.40e-03	3.06e-01	3.54e-05
Np-237	2.88e+00	1.71e+00	1.26e-01	0.00e+00	7.69e-01	3.49e-01	5.10e-05

Conversion factors are in units of mrem per pCi inhaled.



## Offsite Dose Calculation Manual

## Attachment 21

## Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Inhalation Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	2.67e-06	6.05e-07	4.16e-08	0.00e+00	1.47e-07	9.19e-05	2.58e-05
Np-239	2.65e-07	2.13e-07	1.34e-08	0.00e+00	4.73e-08	4.25e-05	1.78e-05
Pu-238	2.69e+00	1.68e+00	1.27e-01	0.00e+00	4.64e-01	9.03e-01	4.69e-05
Pu-239	2.93e+00	1.76e+00	1.34e-01	0.00e+00	4.95e-01	8.47e-01	4.28e-05
Pu-240	2.93e+00	1.75e+00	1.34e-01	0.00e+00	4.94e-01	8.47e-01	4.36e-05
Pu-241	8.43e-02	1.85e-02	3.11e-03	0.00e+00	1.15e-02	7.62e-04	8.97e-07
Pu-242	2.72e+00	1.69e+00	1.29e-01	0.00e+00	4.77e-01	8.15e-01	4.20e-05
Pu-244	3.17e+00	1.94e+00	1.48e-01	0.00e+00	5.46e-01	9.33e-01	6.26e-05
Am-241	3.15e+00	1.95e+00	1.31e-01	0.00e+00	7.94e-01	4.06e-01	4.78e-05
Am-242m	3.25e+00	1.86e+00	1.35e-01	0.00e+00	8.03e-01	1.64e-01	6.01e-05
Am-243	3.10e+00	1.88e+00	1.27e-01	0.00e+00	7.72e-01	3.85e-01	5.60e-05
Cm-242	1.28e-01	8.65e-02	5.70e-03	0.00e+00	1.69e-02	2.97e-01	5.10e-05
Cm-243	2.47e+00	1.52e+00	1.06e-01	0.00e+00	3.91e-01	4.24e-01	5.02e-05
Cm-244	2.07e+00	1.27e+00	8.89e-02	0.00e+00	3.21e-01	4.08e-01	4.86e-05
Cm-245	3.22e+00	1.96e+00	1.36e-01	0.00e+00	5.23e-01	3.92e-01	4.53e-05
Cm-246	3.20e+00	1.96e+00	1.36e-01	0.00e+00	5.23e-01	3.99e-01	4.45e-05
Cm-247	3.11e+00	1.93e+00	1.33e-01	0.00e+00	5.15e-01	3.92e-01	5.85e-05
Cm-248	2.58e+01	1.59e+01	1.10e+00	0.00e+00	4.24e+00	3.23e+00	9.43e-04
Cf-252	2.37e+00	0.00e+00	1.01e-01	0.00e+00	0.00e+00	1.37e+00	1.85e-04

Conversion factors are in units of mrem per pCi inhaled.

## Offsite Dose Calculation Manual

## Attachment 21

## Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	5.99e-08	5.99e-08	5.99e-08	5.99e-08	5.99e-08	5.99e-08
Be-10	3.18e-06	4.91e-07	7.94e-08	0.00e+00	3.71e-07	0.00e+00	2.68e-05
C-14	2.84e-06	5.68e-07	5.68e-07	5.68e-07	5.68e-07	5.68e-07	5.68e-07
N-13	8.36e-09	8.36e-09	8.36e-09	8.36e-09	8.36e-09	8.36e-09	8.36e-09
F-18	6.24e-07	0.00e+00	6.92e-08	0.00e+00	0.00e+00	0.00e+00	1.85e-08
Na-22	1.74e-05	1.74e-05	1.74e-05	1.74e-05	1.74e-05	1.74e-05	1.74e-05
Na-24	1.70e-06	1.70e-06	1.70e-06	1.70e-06	1.70e-06	1.70e-06	1.70e-06
P-32	1.93e-04	1.20e-05	7.46e-06	0.00e+00	0.00e+00	0.00e+00	2.17e-05
Ca-41	1.85e-04	0.00e+00	2.00e-05	0.00e+00	0.00e+00	0.00e+00	1.84e-07
Sc-46	5.51e-09	1.07e-08	3.11e-09	0.00e+00	9.99e-09	0.00e+00	5.21e-05
Cr-51	0.00e+00	0.00e+00	2.66e-09	1.59e-09	5.86e-10	3.53e-09	6.69e-07
Mn-54	0.00e+00	4.57e-06	8.72e-07	0.00e+00	1.36e-06	0.00e+00	1.40e-05
Mn-56	0.00e+00	1.15e-07	2.04e-08	0.00e+00	1.46e-07	0.00e+00	3.67e-06
Fe-55	2.75e-06	1.90e-06	4.43e-07	0.00e+00	0.00e+00	1.06e-06	1.09e-06
Fe-59	4.34e-06	1.02e-05	3.91e-06	0.00e+00	0.00e+00	2.85e-06	3.40e-05
Co-57	0.00e+00	1.75e-07	2.91e-07	0.00e+00	0.00e+00	0.00e+00	4.44e-06
Co-58	0.00e+00	7.45e-07	1.67e-06	0.00e+00	0.00e+00	0.00e+00	1.51e-05
Co-60	0.00e+00	2.14e-06	4.72e-06	0.00e+00	0.00e+00	0.00e+00	4.02e-05
Ni-59	9.76e-06	3.35e-06	1.63e-06	0.00e+00	0.00e+00	0.00e+00	6.90e-07
Ni-63	1.30e-04	9.01e-06	4.36e-06	0.00e+00	0.00e+00	0.00e+00	1.88e-06
Ni-65	5.28e-07	6.86e-08	3.13e-08	0.00e+00	0.00e+00	0.00e+00	1.74e-06
Cu-64	0.00e+00	8.33e-08	3.91e-08	0.00e+00	2.10e-07	0.00e+00	7.10e-06
Zn-65	4.84e-06	1.54e-05	6.96e-06	0.00e+00	1.03e-05	0.00e+00	9.70e-06
Zn-69	1.03e-08	1.97e-08	1.37e-09	0.00e+00	1.28e-08	0.00e+00	2.96e-09
Zn-69m	1.70e-07	4.08e-07	3.73e-08	0.00e+00	2.47e-07	0.00e+00	2.49e-05
Se-79	0.00e+00	2.63e-06	4.39e-07	0.00e+00	4.55e-06	0.00e+00	5.38e-07
Br-82	0.00e+00	0.00e+00	2.26e-06	0.00e+00	0.00e+00	0.00e+00	2.59e-06
Br-83	0.00e+00	0.00e+00	4.02e-08	0.00e+00	0.00e+00	0.00e+00	5.79e-08
Br-84	0.00e+00	0.00e+00	5.21e-08	0.00e+00	0.00e+00	0.00e+00	4.09e-13
Br-85	0.00e+00	0.00e+00	2.14e-09	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.11e-05	9.83e-06	0.00e+00	0.00e+00	0.00e+00	4.16e-06
Rb-87	0.00e+00	1.23e-05	4.28e-06	0.00e+00	0.00e+00	0.00e+00	5.76e-07
Rb-88	0.00e+00	6.05e-08	3.21e-08	0.00e+00	0.00e+00	0.00e+00	8.36e-19
Rb-89	0.00e+00	4.01e-08	2.82e-08	0.00e+00	0.00e+00	0.00e+00	2.33e-21
Sr-89	3.08e-04	0.00e+00	8.84e-06	0.00e+00	0.00e+00	0.00e+00	4.94e-05
Sr-90	8.71e-03	0.00e+00	1.75e-04	0.00e+00	0.00e+00	0.00e+00	2.19e-04
Sr-91	5.67e-06	0.00e+00	2.29e-07	0.00e+00	0.00e+00	0.00e+00	2.70e-05
Sr-92	2.15e-06	0.00e+00	9.30e-08	0.00e+00	0.00e+00	0.00e+00	4.26e-05
Y-90	9.62e-09	0.00e+00	2.58e-10	0.00e+00	0.00e+00	0.00e+00	1.02e-04
Y-91	1.41e-07	0.00e+00	3.77e-09	0.00e+00	0.00e+00	0.00e+00	7.76e-05
Y-91m	9.09e-11	0.00e+00	3.52e-12	0.00e+00	0.00e+00	0.00e+00	2.67e-10
Y-92	8.45e-10	0.00e+00	2.47e-11	0.00e+00	0.00e+00	0.00e+00	1.48e-05
Y-93	2.68e-09	0.00e+00	7.40e-11	0.00e+00	0.00e+00	0.00e+00	8.50e-05
Zr-93	4.18e-08	2.34e-09	1.09e-09	0.00e+00	8.87e-09	0.00e+00	2.43e-06
Zr-95	3.04e-08	9.75e-09	6.60e-09	0.00e+00	1.53e-08	0.00e+00	3.09e-05
Zr-97	1.68e-09	3.39e-10	1.55e-10	0.00e+00	5.12e-10	0.00e+00	1.05e-04
Nb-93m	2.55e-08	8.32e-09	2.05e-09	0.00e+00	9.57e-09	0.00e+00	3.84e-06
Nb-95	6.22e-09	3.46e-09	1.86e-09	0.00e+00	3.42e-09	0.00e+00	2.10e-05
Nb-97	5.22e-11	1.32e-11	4.82e-12	0.00e+00	1.54e-11	0.00e+00	4.87e-08
Mo-93	0.00e+00	7.51e-06	2.03e-07	0.00e+00	2.13e-06	0.00e+00	1.22e-06
Mo-99	0.00e+00	4.31e-06	8.20e-07	0.00e+00	9.76e-06	0.00e+00	9.99e-06
Tc-101	2.54e-10	3.66e-10	3.59e-09	0.00e+00	6.59e-09	1.87e-10	1.10e-21
Tc-99	1.25e-07	1.86e-07	5.02e-08	0.00e+00	2.34e-06	1.58e-08	6.08e-06
Tc-99m	2.47e-10	6.98e-10	8.89e-09	0.00e+00	1.06e-08	3.42e-10	4.13e-07
Ru-103	1.85e-07	0.00e+00	7.97e-08	0.00e+00	7.06e-07	0.00e+00	2.16e-05
Ru-105	1.54e-08	0.00e+00	6.08e-09	0.00e+00	1.99e-07	0.00e+00	9.42e-06
Ru-106	2.75e-06	0.00e+00	3.48e-07	0.00e+00	5.31e-06	0.00e+00	1.78e-04
Rh-105	1.21e-07	8.85e-08	5.83e-08	0.00e+00	3.76e-07	0.00e+00	1.41e-05
Pd-107	0.00e+00	1.47e-07	9.40e-09	0.00e+00	1.32e-06	0.00e+00	9.11e-07
Pd-109	0.00e+00	1.77e-07	3.99e-08	0.00e+00	1.01e-06	0.00e+00	1.96e-05

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	1.60e-07	1.48e-07	8.79e-08	0.00e+00	2.91e-07	0.00e+00	6.04e-05
Ag-111	5.81e-08	2.43e-08	1.21e-08	0.00e+00	7.84e-08	0.00e+00	4.46e-05
Cd-113m	0.00e+00	3.18e-06	1.02e-07	0.00e+00	3.50e-06	0.00e+00	2.56e-05
Cd-115m	0.00e+00	1.84e-06	5.87e-08	0.00e+00	1.46e-06	0.00e+00	7.74e-05
Sn-123	3.11e-05	5.15e-07	7.59e-07	4.38e-07	0.00e+00	0.00e+00	6.33e-05
Sn-125	8.33e-06	1.68e-07	3.78e-07	1.39e-07	0.00e+00	0.00e+00	1.04e-04
Sn-126	8.45e-05	1.67e-06	2.40e-06	4.92e-07	0.00e+00	0.00e+00	2.43e-05
Sb-124	2.80e-06	5.29e-08	1.11e-06	6.79e-09	0.00e+00	2.18e-06	7.95e-05
Sb-125	1.79e-06	2.00e-08	4.26e-07	1.82e-09	0.00e+00	1.38e-06	1.97e-05
Sb-126	1.15e-06	2.34e-08	4.15e-07	7.04e-09	0.00e+00	7.05e-07	9.40e-05
Sb-127	2.58e-07	5.65e-09	9.90e-08	3.10e-09	0.00e+00	1.53e-07	5.90e-05
Te-125m	2.68e-06	9.71e-07	3.59e-07	8.06e-07	1.09e-05	0.00e+00	1.07e-05
Te-127	1.10e-07	3.95e-08	2.38e-08	8.15e-08	4.48e-07	0.00e+00	8.68e-06
Te-127m	6.77e-06	2.42e-06	8.25e-07	1.73e-06	2.75e-05	0.00e+00	2.27e-05
Te-129	3.14e-08	1.18e-08	7.65e-09	2.41e-08	1.32e-07	0.00e+00	2.37e-08
Te-129m	1.15e-05	4.29e-06	1.82e-06	3.95e-06	4.80e-05	0.00e+00	5.79e-05
Te-131	1.97e-08	8.23e-09	6.22e-09	1.62e-08	8.63e-08	0.00e+00	2.79e-09
Te-131m	1.73e-06	8.46e-07	7.05e-07	1.34e-06	8.57e-06	0.00e+00	8.40e-05
Te-132	2.52e-06	1.63e-06	1.53e-06	1.80e-06	1.57e-05	0.00e+00	7.71e-05
Te-133m	4.62e-08	2.70e-08	2.60e-08	3.91e-08	2.67e-07	0.00e+00	9.26e-09
Te-134	3.24e-08	2.12e-08	1.30e-08	2.83e-08	2.05e-07	0.00e+00	3.59e-11
I-129	3.27e-06	2.81e-06	9.21e-06	7.23e-03	6.04e-06	0.00e+00	4.44e-07
I-130	7.56e-07	2.23e-06	8.80e-07	1.89e-04	3.48e-06	0.00e+00	1.92e-06
I-131	4.16e-06	5.95e-06	3.41e-06	1.95e-03	1.02e-05	0.00e+00	1.57e-06
I-132	2.03e-07	5.43e-07	1.90e-07	1.90e-05	8.65e-07	0.00e+00	1.02e-07
I-133	1.42e-06	2.47e-06	7.53e-07	3.63e-04	4.31e-06	0.00e+00	2.22e-06
I-134	1.06e-07	2.88e-07	1.03e-07	4.99e-06	4.58e-07	0.00e+00	2.51e-10
I-135	4.43e-07	1.16e-06	4.28e-07	7.65e-05	1.86e-06	0.00e+00	1.31e-06
Cs-134	6.22e-05	1.48e-04	1.21e-04	0.00e+00	4.79e-05	1.59e-05	2.59e-06
Cs-134m	2.13e-08	4.48e-08	2.29e-08	0.00e+00	2.43e-08	3.83e-09	1.58e-08

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.95e-05	1.80e-05	7.99e-06	0.00e+00	6.81e-06	2.04e-06	4.21e-07
Cs-136	6.51e-06	2.57e-05	1.85e-05	0.00e+00	1.43e-05	1.96e-06	2.92e-06
Cs-137	7.97e-05	1.09e-04	7.14e-05	0.00e+00	3.70e-05	1.23e-05	2.11e-06
Cs-138	5.52e-08	1.09e-07	5.40e-08	0.00e+00	8.01e-08	7.91e-09	4.65e-13
Cs-139	3.41e-08	5.08e-08	1.85e-08	0.00e+00	4.07e-08	3.70e-09	1.10e-30
Ba-139	9.70e-08	6.91e-11	2.84e-09	0.00e+00	6.46e-11	3.92e-11	1.72e-07
Ba-140	2.03e-05	2.55e-08	1.33e-06	0.00e+00	8.67e-09	1.46e-08	4.18e-05
Ba-141	4.71e-08	3.56e-11	1.59e-09	0.00e+00	3.31e-11	2.02e-11	2.22e-17
Ba-142	2.13e-08	2.19e-11	1.34e-09	0.00e+00	1.85e-11	1.24e-11	3.00e-26
La-140	2.50e-09	1.26e-09	3.33e-10	0.00e+00	0.00e+00	0.00e+00	9.25e-05
La-141	3.19e-10	9.90e-11	1.62e-11	0.00e+00	0.00e+00	0.00e+00	1.18e-05
La-142	1.28e-10	5.82e-11	1.45e-11	0.00e+00	0.00e+00	0.00e+00	4.25e-07
Ce-141	9.36e-09	6.33e-09	7.18e-10	0.00e+00	2.94e-09	0.00e+00	2.42e-05
Ce-143	1.65e-09	1.22e-06	1.35e-10	0.00e+00	5.37e-10	0.00e+00	4.56e-05
Ce-144	4.88e-07	2.04e-07	2.62e-08	0.00e+00	1.21e-07	0.00e+00	1.65e-04
Pr-143	9.20e-09	3.69e-09	4.56e-10	0.00e+00	2.13e-09	0.00e+00	4.03e-05
Pr-144	3.01e-11	1.25e-11	1.53e-12	0.00e+00	7.05e-12	0.00e+00	4.33e-18
Nd-147	6.29e-09	7.27e-09	4.35e-10	0.00e+00	4.25e-09	0.00e+00	3.49e-05
Pm-147	7.54e-08	7.09e-09	2.87e-09	0.00e+00	1.34e-08	0.00e+00	8.93e-06
Pm-148	7.17e-09	1.19e-09	5.99e-10	0.00e+00	2.25e-09	0.00e+00	9.35e-05
Pm-148m	3.07e-08	7.95e-09	6.08e-09	0.00e+00	1.20e-08	0.00e+00	6.74e-05
Pm-149	1.52e-09	2.15e-10	8.78e-11	0.00e+00	4.06e-10	0.00e+00	4.03e-05
Pm-151	6.97e-10	1.17e-10	5.91e-11	0.00e+00	2.09e-10	0.00e+00	3.22e-05
Sm-151	6.90e-08	1.19e-08	2.85e-09	0.00e+00	1.33e-08	0.00e+00	5.25e-06
Sm-153	8.57e-10	7.15e-10	5.22e-11	0.00e+00	2.31e-10	0.00e+00	2.55e-05
Eu-152	1.95e-07	4.44e-08	3.90e-08	0.00e+00	2.75e-07	0.00e+00	2.56e-05
Eu-154	6.15e-07	7.56e-08	5.38e-08	0.00e+00	3.62e-07	0.00e+00	5.48e-05
Eu-155	8.60e-08	1.22e-08	7.87e-09	0.00e+00	5.63e-08	0.00e+00	9.60e-06
Eu-156	1.37e-08	1.06e-08	1.71e-09	0.00e+00	7.08e-09	0.00e+00	7.26e-05
Tb-160	4.70e-08	0.00e+00	5.86e-09	0.00e+00	1.94e-08	0.00e+00	4.33e-05

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	2.70e-07	8.43e-08	6.40e-08	0.00e+00	1.26e-07	0.00e+00	2.56e-05
W-181	9.91e-09	3.23e-09	3.46e-10	0.00e+00	0.00e+00	0.00e+00	3.68e-07
W-185	4.05e-07	1.35e-07	1.42e-08	0.00e+00	0.00e+00	0.00e+00	1.56e-05
W-187	1.03e-07	8.61e-08	3.01e-08	0.00e+00	0.00e+00	0.00e+00	2.82e-05
Pb-210	1.53e-02	4.37e-03	5.44e-04	0.00e+00	1.23e-02	0.00e+00	2.24e-06
Bi-210	4.61e-07	3.18e-06	2.64e-07	0.00e+00	3.83e-05	0.00e+00	4.75e-05
Po-210	3.56e-04	7.56e-04	8.59e-05	0.00e+00	2.52e-03	0.00e+00	6.36e-05
Ra-223	4.97e-03	7.65e-06	9.94e-04	0.00e+00	2.17e-04	0.00e+00	3.21e-04
Ra-224	1.61e-03	3.90e-06	3.23e-04	0.00e+00	1.10e-04	0.00e+00	3.40e-04
Ra-225	6.56e-03	7.78e-06	1.31e-03	0.00e+00	2.21e-04	0.00e+00	3.06e-04
Ra-226	3.02e-01	5.74e-06	2.20e-01	0.00e+00	1.63e-04	0.00e+00	3.32e-04
Ra-228	1.12e-01	3.12e-06	1.21e-01	0.00e+00	8.83e-05	0.00e+00	5.64e-05
Ac-225	4.40e-06	6.06e-06	2.96e-07	0.00e+00	6.90e-07	0.00e+00	4.07e-04
Ac-227	1.87e-03	2.48e-04	1.11e-04	0.00e+00	8.00e-05	0.00e+00	8.19e-05
Th-227	1.37e-05	2.48e-07	3.95e-07	0.00e+00	1.41e-06	0.00e+00	5.40e-04
Th-228	4.96e-04	8.40e-06	1.68e-05	0.00e+00	4.67e-05	0.00e+00	5.63e-04
Th-229	1.36e-02	3.89e-04	2.25e-04	0.00e+00	1.88e-03	0.00e+00	7.81e-05
Th-230	2.06e-03	1.17e-04	5.70e-05	0.00e+00	5.65e-04	0.00e+00	6.02e-05
Th-232	2.30e-03	1.00e-04	1.50e-06	0.00e+00	4.82e-04	0.00e+00	5.12e-05
Th-234	8.01e-08	4.71e-09	2.31e-09	0.00e+00	2.67e-08	0.00e+00	1.13e-04
Pa-231	4.10e-03	1.54e-04	1.59e-04	0.00e+00	8.64e-04	0.00e+00	7.17e-05
Pa-233	5.26e-09	1.06e-09	9.12e-10	0.00e+00	3.99e-09	0.00e+00	1.64e-05
U-232	4.13e-03	0.00e+00	2.95e-04	0.00e+00	4.47e-04	0.00e+00	6.78e-05
U-233	8.71e-04	0.00e+00	5.28e-05	0.00e+00	2.03e-04	0.00e+00	6.27e-05
U-234	8.36e-04	0.00e+00	5.17e-05	0.00e+00	1.99e-04	0.00e+00	6.14e-05
U-235	8.01e-04	0.00e+00	4.86e-05	0.00e+00	1.87e-04	0.00e+00	7.81e-05
U-236	8.01e-04	0.00e+00	4.96e-05	0.00e+00	1.91e-04	0.00e+00	5.76e-05
U-237	5.52e-08	0.00e+00	1.47e-08	0.00e+00	2.27e-07	0.00e+00	1.94e-05
U-238	7.67e-04	0.00e+00	4.54e-05	0.00e+00	1.75e-04	0.00e+00	5.50e-05
Np-237	1.26e-03	8.96e-05	5.54e-05	0.00e+00	4.12e-04	0.00e+00	7.94e-05

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Adult age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.37e-08	3.69e-10	2.13e-10	0.00e+00	1.25e-09	0.00e+00	3.43e-05
Np-239	1.19e-09	1.17e-10	6.45e-11	0.00e+00	3.65e-10	0.00e+00	2.40e-05
Pu-238	6.30e-04	7.98e-05	1.71e-05	0.00e+00	7.32e-05	0.00e+00	7.30e-05
Pu-239	7.25e-04	8.71e-05	1.91e-05	0.00e+00	8.11e-05	0.00e+00	6.66e-05
Pu-240	7.24e-04	8.70e-05	1.91e-05	0.00e+00	8.10e-05	0.00e+00	6.78e-05
Pu-241	1.57e-05	7.45e-07	3.32e-07	0.00e+00	1.53e-06	0.00e+00	1.40e-06
Pu-242	6.72e-04	8.39e-05	1.84e-05	0.00e+00	7.81e-05	0.00e+00	6.53e-05
Pu-244	7.84e-04	9.61e-05	2.11e-05	0.00e+00	8.95e-05	0.00e+00	9.73e-05
Am-241	7.55e-04	7.05e-04	5.41e-05	0.00e+00	4.07e-04	0.00e+00	7.42e-05
Am-242m	7.61e-04	6.63e-04	5.43e-05	0.00e+00	4.05e-04	0.00e+00	9.34e-05
Am-243	7.54e-04	6.90e-04	5.30e-05	0.00e+00	3.99e-04	0.00e+00	8.70e-05
Cm-242	2.06e-05	2.19e-05	1.37e-06	0.00e+00	6.22e-06	0.00e+00	7.92e-05
Cm-243	5.99e-04	5.49e-04	3.75e-05	0.00e+00	1.75e-04	0.00e+00	7.81e-05
Cm-244	4.56e-04	4.27e-04	2.87e-05	0.00e+00	1.34e-04	0.00e+00	7.55e-05
Cm-245	9.38e-04	8.17e-04	5.76e-05	0.00e+00	2.69e-04	0.00e+00	7.04e-05
Cm-246	9.30e-04	8.16e-04	5.75e-05	0.00e+00	2.68e-04	0.00e+00	6.91e-05
Cm-247	9.07e-04	8.04e-04	5.67e-05	0.00e+00	2.64e-04	0.00e+00	9.09e-05
Cm-248	7.54e-03	6.63e-03	4.67e-04	0.00e+00	2.18e-03	0.00e+00	1.47e-03
Cf-252	2.61e-04	0.00e+00	6.29e-06	0.00e+00	0.00e+00	0.00e+00	2.88e-04

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	6.04e-08	6.04e-08	6.04e-08	6.04e-08	6.04e-08	6.04e-08
Be-10	4.48e-06	6.94e-07	1.13e-07	0.00e+00	5.30e-07	0.00e+00	2.84e-05
C-14	4.06e-06	8.12e-07	8.12e-07	8.12e-07	8.12e-07	8.12e-07	8.12e-07
N-13	1.15e-08	1.15e-08	1.15e-08	1.15e-08	1.15e-08	1.15e-08	1.15e-08
F-18	8.64e-07	0.00e+00	9.47e-08	0.00e+00	0.00e+00	0.00e+00	7.78e-08
Na-22	2.34e-05	2.34e-05	2.34e-05	2.34e-05	2.34e-05	2.34e-05	2.34e-05
Na-24	2.30e-06	2.30e-06	2.30e-06	2.30e-06	2.30e-06	2.30e-06	2.30e-06
P-32	2.76e-04	1.71e-05	1.07e-05	0.00e+00	0.00e+00	0.00e+00	2.32e-05
Ca-41	1.97e-04	0.00e+00	2.13e-05	0.00e+00	0.00e+00	0.00e+00	1.95e-07
Sc-46	7.24e-09	1.41e-08	4.18e-09	0.00e+00	1.35e-08	0.00e+00	4.80e-05
Cr-51	0.00e+00	0.00e+00	3.60e-09	2.00e-09	7.89e-10	5.14e-09	6.05e-07
Mn-54	0.00e+00	5.90e-06	1.17e-06	0.00e+00	1.76e-06	0.00e+00	1.21e-05
Mn-56	0.00e+00	1.58e-07	2.81e-08	0.00e+00	2.00e-07	0.00e+00	1.04e-05
Fe-55	3.78e-06	2.68e-06	6.25e-07	0.00e+00	0.00e+00	1.70e-06	1.16e-06
Fe-59	5.87e-06	1.37e-05	5.29e-06	0.00e+00	0.00e+00	4.32e-06	3.24e-05
Co-57	0.00e+00	2.38e-07	3.99e-07	0.00e+00	0.00e+00	0.00e+00	4.44e-06
Co-58	0.00e+00	9.72e-07	2.24e-06	0.00e+00	0.00e+00	0.00e+00	1.34e-05
Co-60	0.00e+00	2.81e-06	6.33e-06	0.00e+00	0.00e+00	0.00e+00	3.66e-05
Ni-59	1.32e-05	4.66e-06	2.24e-06	0.00e+00	0.00e+00	0.00e+00	7.31e-07
Ni-63	1.77e-04	1.25e-05	6.00e-06	0.00e+00	0.00e+00	0.00e+00	1.99e-06
Ni-65	7.49e-07	9.57e-08	4.36e-08	0.00e+00	0.00e+00	0.00e+00	5.19e-06
Cu-64	0.00e+00	1.15e-07	5.41e-08	0.00e+00	2.91e-07	0.00e+00	8.92e-06
Zn-65	5.76e-06	2.00e-05	9.33e-06	0.00e+00	1.28e-05	0.00e+00	8.47e-06
Zn-69	1.47e-08	2.80e-08	1.96e-09	0.00e+00	1.83e-08	0.00e+00	5.16e-08
Zn-69m	2.40e-07	5.66e-07	5.19e-08	0.00e+00	3.44e-07	0.00e+00	3.11e-05
Se-79	0.00e+00	3.73e-06	6.27e-07	0.00e+00	6.50e-06	0.00e+00	5.70e-07
Br-82	0.00e+00	0.00e+00	3.04e-06	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	5.74e-08	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	7.22e-08	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	3.05e-09	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem per pCi ingested.



Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	2.98e-05	1.40e-05	0.00e+00	0.00e+00	0.00e+00	4.41e-06
Rb-87	0.00e+00	1.75e-05	6.11e-06	0.00e+00	0.00e+00	0.00e+00	6.11e-07
Rb-88	0.00e+00	8.52e-08	4.54e-08	0.00e+00	0.00e+00	0.00e+00	7.30e-15
Rb-89	0.00e+00	5.50e-08	3.89e-08	0.00e+00	0.00e+00	0.00e+00	8.43e-17
Sr-89	4.40e-04	0.00e+00	1.26e-05	0.00e+00	0.00e+00	0.00e+00	5.24e-05
Sr-90	1.02e-02	0.00e+00	2.04e-04	0.00e+00	0.00e+00	0.00e+00	2.33e-04
Sr-91	8.07e-06	0.00e+00	3.21e-07	0.00e+00	0.00e+00	0.00e+00	3.66e-05
Sr-92	3.05e-06	0.00e+00	1.30e-07	0.00e+00	0.00e+00	0.00e+00	7.77e-05
Y-90	1.37e-08	0.00e+00	3.69e-10	0.00e+00	0.00e+00	0.00e+00	1.13e-04
Y-91	2.01e-07	0.00e+00	5.39e-09	0.00e+00	0.00e+00	0.00e+00	8.24e-05
Y-91m	1.29e-10	0.00e+00	4.93e-12	0.00e+00	0.00e+00	0.00e+00	6.09e-09
Y-92	1.21e-09	0.00e+00	3.50e-11	0.00e+00	0.00e+00	0.00e+00	3.32e-05
Y-93	3.83e-09	0.00e+00	1.05e-10	0.00e+00	0.00e+00	0.00e+00	1.17e-04
Zr-93	5.53e-08	2.73e-09	1.49e-09	0.00e+00	9.65e-09	0.00e+00	2.58e-06
Zr-95	4.12e-08	1.30e-08	8.94e-09	0.00e+00	1.91e-08	0.00e+00	3.00e-05
Zr-97	2.37e-09	4.69e-10	2.16e-10	0.00e+00	7.11e-10	0.00e+00	1.27e-04
Nb-93m	3.44e-08	1.13e-08	2.83e-09	0.00e+00	1.32e-08	0.00e+00	4.07e-06
Nb-95	8.22e-09	4.56e-09	2.51e-09	0.00e+00	4.42e-09	0.00e+00	1.95e-05
Nb-97	7.37e-11	1.83e-11	6.68e-12	0.00e+00	2.14e-11	0.00e+00	4.37e-07
Mo-93	0.00e+00	1.06e-05	2.90e-07	0.00e+00	3.04e-06	0.00e+00	1.29e-06
Mo-99	0.00e+00	6.03e-06	1.15e-06	0.00e+00	1.38e-05	0.00e+00	1.08e-05
Tc-101	3.60e-10	5.12e-10	5.03e-09	0.00e+00	9.26e-09	3.12e-10	8.75e-17
Tc-99	1.79e-07	2.63e-07	7.17e-08	0.00e+00	3.34e-06	2.72e-08	6.44e-06
Tc-99m	3.32e-10	9.26e-10	1.20e-08	0.00e+00	1.38e-08	5.14e-10	6.08e-07
Ru-103	2.55e-07	0.00e+00	1.09e-07	0.00e+00	8.99e-07	0.00e+00	2.13e-05
Ru-105	2.18e-08	0.00e+00	8.46e-09	0.00e+00	2.75e-07	0.00e+00	1.76e-05
Ru-106	3.92e-06	0.00e+00	4.94e-07	0.00e+00	7.56e-06	0.00e+00	1.88e-04
Rh-105	1.73e-07	1.25e-07	8.20e-08	0.00e+00	5.31e-07	0.00e+00	1.59e-05
Pd-107	0.00e+00	2.08e-07	1.34e-08	0.00e+00	1.88e-06	0.00e+00	9.66e-07
Pd-109	0.00e+00	2.51e-07	5.70e-08	0.00e+00	1.45e-06	0.00e+00	2.53e-05

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Offsite Dose Calculation Manual

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Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	2.05e-07	1.94e-07	1.18e-07	0.00e+00	3.70e-07	0.00e+00	5.45e-05
Ag-111	8.29e-08	3.44e-08	1.73e-08	0.00e+00	1.12e-07	0.00e+00	4.80e-05
Cd-113m	0.00e+00	4.51e-06	1.45e-07	0.00e+00	4.99e-06	0.00e+00	2.71e-05
Cd-115m	0.00e+00	2.60e-06	8.39e-08	0.00e+00	2.08e-06	0.00e+00	8.23e-05
Sn-123	4.44e-05	7.29e-07	1.08e-06	5.84e-07	0.00e+00	0.00e+00	6.71e-05
Sn-125	1.19e-05	2.37e-07	5.37e-07	1.86e-07	0.00e+00	0.00e+00	1.12e-04
Sn-126	1.16e-04	2.16e-06	3.30e-06	5.69e-07	0.00e+00	0.00e+00	2.58e-05
Sb-124	3.87e-06	7.13e-08	1.51e-06	8.78e-09	0.00e+00	3.38e-06	7.80e-05
Sb-125	2.48e-06	2.71e-08	5.80e-07	2.37e-09	0.00e+00	2.18e-06	1.93e-05
Sb-126	1.59e-06	3.25e-08	5.71e-07	8.99e-09	0.00e+00	1.14e-06	9.41e-05
Sb-127	3.63e-07	7.76e-09	1.37e-07	4.08e-09	0.00e+00	2.47e-07	6.16e-05
Te-125m	3.83e-06	1.38e-06	5.12e-07	1.07e-06	0.00e+00	0.00e+00	1.13e-05
Te-127	1.58e-07	5.60e-08	3.40e-08	1.09e-07	6.40e-07	0.00e+00	1.22e-05
Te-127m	9.67e-06	3.43e-06	1.15e-06	2.30e-06	3.92e-05	0.00e+00	2.41e-05
Te-129	4.48e-08	1.67e-08	1.09e-08	3.20e-08	1.88e-07	0.00e+00	2.45e-07
Te-129m	1.63e-05	6.05e-06	2.58e-06	5.26e-06	6.82e-05	0.00e+00	6.12e-05
Te-131	2.79e-08	1.15e-08	8.72e-09	2.15e-08	1.22e-07	0.00e+00	2.29e-09
Te-131m	2.44e-06	1.17e-06	9.76e-07	1.76e-06	1.22e-05	0.00e+00	9.39e-05
Te-132	3.49e-06	2.21e-06	2.08e-06	2.33e-06	2.12e-05	0.00e+00	7.00e-05
Te-133m	6.44e-08	3.66e-08	3.56e-08	5.11e-08	3.62e-07	0.00e+00	1.48e-07
Te-134	4.47e-08	2.87e-08	3.00e-08	3.67e-08	2.74e-07	0.00e+00	1.66e-09
I-129	4.66e-06	3.92e-06	6.54e-06	4.77e-03	7.01e-06	0.00e+00	4.57e-07
I-130	1.03e-06	2.98e-06	1.19e-06	2.43e-04	4.59e-06	0.00e+00	2.29e-06
I-131	5.85e-06	8.19e-06	4.40e-06	2.39e-03	1.41e-05	0.00e+00	1.62e-06
I-132	2.79e-07	7.30e-07	2.62e-07	2.46e-05	1.15e-06	0.00e+00	3.18e-07
I-133	2.01e-06	3.41e-06	1.04e-06	4.76e-04	5.98e-06	0.00e+00	2.58e-06
I-134	1.46e-07	3.87e-07	1.39e-07	6.45e-06	6.10e-07	0.00e+00	5.10e-09
I-135	6.10e-07	1.57e-06	5.82e-07	1.01e-04	2.48e-06	0.00e+00	1.74e-06
Cs-134	8.37e-05	1.97e-04	9.14e-05	0.00e+00	6.26e-05	2.39e-05	2.45e-06
Cs-134m	2.94e-08	6.09e-08	3.13e-08	0.00e+00	3.39e-08	5.95e-09	4.05e-08

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Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	2.78e-05	2.55e-05	5.96e-06	0.00e+00	9.73e-06	3.52e-06	4.46e-07
Cs-136	8.59e-06	3.38e-05	2.27e-05	0.00e+00	1.84e-05	2.90e-06	2.72e-06
Cs-137	1.12e-04	1.49e-04	5.19e-05	0.00e+00	5.07e-05	1.97e-05	2.12e-06
Cs-138	7.76e-08	1.49e-07	7.45e-08	0.00e+00	1.10e-07	1.28e-08	6.76e-11
Cs-139	4.87e-08	7.17e-08	2.63e-08	0.00e+00	5.79e-08	6.34e-09	3.33e-23
Ba-139	1.39e-07	9.78e-11	4.05e-09	0.00e+00	9.22e-11	6.74e-11	1.24e-06
Ba-140	2.84e-05	3.48e-08	1.83e-06	0.00e+00	1.18e-08	2.34e-08	4.38e-05
Ba-141	6.71e-08	5.01e-11	2.24e-09	0.00e+00	4.65e-11	3.43e-11	1.43e-13
Ba-142	2.99e-08	2.99e-11	1.84e-09	0.00e+00	2.53e-11	1.99e-11	9.18e-20
La-140	3.48e-09	1.71e-09	4.55e-10	0.00e+00	0.00e+00	0.00e+00	9.82e-05
La-141	4.55e-10	1.40e-10	2.31e-11	0.00e+00	0.00e+00	0.00e+00	2.48e-05
La-142	1.79e-10	7.95e-11	1.98e-11	0.00e+00	0.00e+00	0.00e+00	2.42e-06
Ce-141	1.33e-08	8.88e-09	1.02e-09	0.00e+00	4.18e-09	0.00e+00	2.54e-05
Ce-143	2.35e-09	1.71e-06	1.91e-10	0.00e+00	7.67e-10	0.00e+00	5.14e-05
Ce-144	6.96e-07	2.88e-07	3.74e-08	0.00e+00	1.72e-07	0.00e+00	1.75e-04
Pr-143	1.31e-08	5.23e-09	6.52e-10	0.00e+00	3.04e-09	0.00e+00	4.31e-05
Pr-144	4.30e-11	1.76e-11	2.18e-12	0.00e+00	1.01e-11	0.00e+00	4.74e-14
Nd-147	9.38e-09	1.02e-08	6.11e-10	0.00e+00	5.99e-09	0.00e+00	3.68e-05
Pm-147	1.05e-07	9.96e-09	4.06e-09	0.00e+00	1.90e-08	0.00e+00	9.47e-06
Pm-148	1.02e-08	1.66e-09	8.36e-10	0.00e+00	3.00e-09	0.00e+00	9.90e-05
Pm-148m	4.14e-08	1.05e-08	8.21e-09	0.00e+00	1.59e-08	0.00e+00	6.61e-05
Pm-149	2.17e-09	3.05e-10	1.25e-10	0.00e+00	5.81e-10	0.00e+00	4.49e-05
Pm-151	9.87e-10	1.63e-10	8.25e-11	0.00e+00	2.93e-10	0.00e+00	3.66e-05
Sm-151	8.73e-08	1.68e-08	3.94e-09	0.00e+00	1.84e-08	0.00e+00	5.70e-06
Sm-153	1.22e-09	1.01e-09	7.43e-11	0.00e+00	3.30e-10	0.00e+00	2.85e-05
Eu-152	2.45e-07	5.90e-08	5.20e-08	0.00e+00	2.74e-07	0.00e+00	2.17e-05
Eu-154	7.91e-07	1.02e-07	7.19e-08	0.00e+00	4.56e-07	0.00e+00	5.39e-05
Eu-155	1.74e-07	1.68e-08	1.04e-08	0.00e+00	6.57e-08	0.00e+00	9.63e-05
Eu-156	1.92e-08	1.44e-08	2.35e-09	0.00e+00	9.69e-09	0.00e+00	7.36e-05
Tb-160	6.47e-08	0.00e+00	8.07e-09	0.00e+00	2.56e-08	0.00e+00	4.19e-05

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Offsite Dose Calculation Manual

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Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Teen age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	3.57e-07	1.10e-07	7.96e-08	0.00e+00	1.61e-07	0.00e+00	2.71e-05
W-181	1.42e-08	4.58e-09	4.79e-10	0.00e+00	0.00e+00	0.00e+00	3.90e-07
W-185	5.79e-07	1.91e-07	2.02e-08	0.00e+00	0.00e+00	0.00e+00	1.65e-05
W-187	1.46e-07	1.19e-07	4.17e-08	0.00e+00	0.00e+00	0.00e+00	3.22e-05
Pb-210	1.81e-02	5.44e-03	7.01e-04	0.00e+00	1.72e-02	0.00e+00	2.37e-06
Bi-210	6.59e-07	4.51e-06	3.77e-07	0.00e+00	5.48e-05	0.00e+00	5.15e-05
Po-210	5.09e-04	1.07e-03	1.23e-04	0.00e+00	3.60e-03	0.00e+00	6.75e-05
Ra-223	7.11e-03	1.08e-05	1.42e-03	0.00e+00	3.10e-04	0.00e+00	3.43e-04
Ra-224	2.31e-03	5.52e-06	4.61e-04	0.00e+00	1.58e-04	0.00e+00	3.71e-04
Ra-225	9.37e-03	1.10e-05	1.87e-03	0.00e+00	3.15e-04	0.00e+00	3.27e-04
Ra-226	3.22e-01	8.13e-06	2.39e-01	0.00e+00	2.32e-04	0.00e+00	3.51e-04
Ra-228	1.37e-01	4.41e-06	1.51e-01	0.00e+00	1.26e-04	0.00e+00	5.98e-05
Ac-225	6.29e-06	8.59e-06	4.22e-07	0.00e+00	9.85e-07	0.00e+00	4.36e-04
Ac-227	2.05e-03	3.03e-04	1.22e-04	0.00e+00	8.81e-05	0.00e+00	8.68e-05
Th-227	1.96e-05	3.52e-07	5.65e-07	0.00e+00	2.01e-06	0.00e+00	5.75e-04
Th-228	6.80e-04	1.14e-05	2.30e-05	0.00e+00	6.41e-05	0.00e+00	5.97e-04
Th-229	1.43e-02	4.11e-04	2.37e-04	0.00e+00	1.99e-03	0.00e+00	8.28e-05
Th-230	2.16e-03	1.23e-04	6.00e-05	0.00e+00	5.99e-04	0.00e+00	6.38e-05
Th-232	2.42e-03	1.05e-04	1.63e-06	0.00e+00	5.11e-04	0.00e+00	5.43e-05
Th-234	1.14e-07	6.68e-09	3.31e-09	0.00e+00	3.81e-08	0.00e+00	1.21e-04
Pa-231	4.31e-03	1.62e-04	1.68e-04	0.00e+00	9.10e-04	0.00e+00	7.60e-05
Pa-233	7.33e-09	1.41e-09	1.26e-09	0.00e+00	5.32e-09	0.00e+00	1.61e-05
U-232	5.89e-03	0.00e+00	4.21e-04	0.00e+00	6.38e-04	0.00e+00	7.19e-05
U-233	1.24e-03	0.00e+00	7.54e-05	0.00e+00	2.90e-04	0.00e+00	6.65e-05
U-234	1.19e-03	0.00e+00	7.39e-05	0.00e+00	2.85e-04	0.00e+00	6.51e-05
U-235	1.14e-03	0.00e+00	6.94e-05	0.00e+00	2.67e-04	0.00e+00	8.28e-05
U-236	1.14e-03	0.00e+00	7.09e-05	0.00e+00	2.73e-04	0.00e+00	6.11e-05
U-237	7.89e-08	0.00e+00	2.10e-08	0.00e+00	3.24e-07	0.00e+00	2.09e-05
U-238	1.09e-03	0.00e+00	6.49e-05	0.00e+00	2.50e-04	0.00e+00	5.83e-05
Np-237	1.33e-03	9.55e-05	5.85e-05	0.00e+00	4.33e-04	0.00e+00	8.41e-05

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Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.95e-08	5.22e-10	3.04e-10	0.00e+00	1.79e-09	0.00e+00	3.83e-05
Np-239	1.76e-09	1.66e-10	9.22e-11	0.00e+00	5.21e-10	0.00e+00	2.67e-05
Pu-238	6.70e-04	8.58e-05	1.82e-05	0.00e+00	7.80e-05	0.00e+00	7.73e-05
Pu-239	7.65e-04	9.29e-05	2.01e-05	0.00e+00	8.57e-05	0.00e+00	7.06e-05
Pu-240	7.64e-04	9.27e-05	2.01e-05	0.00e+00	8.56e-05	0.00e+00	7.19e-05
Pu-241	1.75e-05	8.40e-07	3.69e-07	0.00e+00	1.71e-06	0.00e+00	1.48e-06
Pu-242	7.09e-04	8.94e-05	1.94e-05	0.00e+00	8.25e-05	0.00e+00	6.92e-05
Pu-244	8.28e-04	1.02e-04	2.22e-05	0.00e+00	9.45e-05	0.00e+00	1.03e-04
Am-241	7.98e-04	7.53e-04	5.75e-05	0.00e+00	4.31e-04	0.00e+00	7.87e-05
Am-242m	8.07e-04	7.11e-04	5.80e-05	0.00e+00	4.30e-04	0.00e+00	9.90e-05
Am-243	7.96e-04	7.35e-04	5.62e-05	0.00e+00	4.22e-04	0.00e+00	9.23e-05
Cm-242	2.94e-05	3.10e-05	1.95e-06	0.00e+00	8.89e-06	0.00e+00	8.40e-05
Cm-243	6.50e-04	6.03e-04	4.09e-05	0.00e+00	1.91e-04	0.00e+00	8.28e-05
Cm-244	5.04e-04	4.77e-04	3.19e-05	0.00e+00	1.49e-04	0.00e+00	8.00e-05
Cm-245	9.90e-04	8.71e-04	6.10e-05	0.00e+00	2.85e-04	0.00e+00	7.46e-05
Cm-246	9.82e-04	8.70e-04	6.09e-05	0.00e+00	2.84e-04	0.00e+00	7.33e-05
Cm-247	9.57e-04	8.57e-04	6.00e-05	0.00e+00	2.80e-04	0.00e+00	9.63e-05
Cm-248	7.95e-03	7.06e-03	4.95e-04	0.00e+00	2.31e-03	0.00e+00	1.55e-03
Cf-252	3.47e-04	0.00e+00	8.37e-06	0.00e+00	0.00e+00	0.00e+00	3.05e-04

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.16e-07	1.16e-07	1.16e-07	1.16e-07	1.16e-07	1.16e-07
Be-10	1.35e-05	1.57e-06	3.39e-07	0.00e+00	1.11e-06	0.00e+00	2.75e-05
C-14	1.21e-05	2.42e-06	2.42e-06	2.42e-06	2.42e-06	2.42e-06	2.42e-06
N-13	3.10e-08	3.10e-08	3.10e-08	3.10e-08	3.10e-08	3.10e-08	3.10e-08
F-18	2.49e-06	0.00e+00	2.47e-07	0.00e+00	0.00e+00	0.00e+00	6.74e-07
Na-22	5.88e-05	5.88e-05	5.88e-05	5.88e-05	5.88e-05	5.88e-05	5.88e-05
Na-24	5.80e-06	5.80e-06	5.80e-06	5.80e-06	5.80e-06	5.80e-06	5.80e-06
P-32	8.25e-04	3.86e-05	3.18e-05	0.00e+00	0.00e+00	0.00e+00	2.28e-05
Ca-41	3.47e-04	0.00e+00	3.79e-05	0.00e+00	0.00e+00	0.00e+00	1.90e-07
Sc-46	1.97e-08	2.70e-08	1.04e-08	0.00e+00	2.39e-08	0.00e+00	3.95e-05
Cr-51	0.00e+00	0.00e+00	8.90e-09	4.94e-09	1.35e-09	9.02e-09	4.72e-07
Mn-54	0.00e+00	1.07e-05	2.85e-06	0.00e+00	3.00e-06	0.00e+00	8.98e-06
Mn-56	0.00e+00	3.34e-07	7.54e-08	0.00e+00	4.04e-07	0.00e+00	4.84e-05
Fe-55	1.15e-05	6.10e-06	1.89e-06	0.00e+00	0.00e+00	3.45e-06	1.13e-06
Fe-59	1.65e-05	2.67e-05	1.33e-05	0.00e+00	0.00e+00	7.74e-06	2.78e-05
Co-57	0.00e+00	4.93e-07	9.98e-07	0.00e+00	0.00e+00	0.00e+00	4.04e-06
Co-58	0.00e+00	1.80e-06	5.51e-06	0.00e+00	0.00e+00	0.00e+00	1.05e-05
Co-60	0.00e+00	5.29e-06	1.56e-05	0.00e+00	0.00e+00	0.00e+00	2.93e-05
Ni-59	4.02e-05	1.07e-05	6.82e-06	0.00e+00	0.00e+00	0.00e+00	7.10e-07
Ni-63	5.38e-04	2.88e-05	1.83e-05	0.00e+00	0.00e+00	0.00e+00	1.94e-06
Ni-65	2.22e-06	2.09e-07	1.22e-07	0.00e+00	0.00e+00	0.00e+00	2.56e-05
Cu-64	0.00e+00	2.45e-07	1.48e-07	0.00e+00	5.92e-07	0.00e+00	1.15e-05
Zn-65	1.37e-05	3.65e-05	2.27e-05	0.00e+00	2.30e-05	0.00e+00	6.41e-06
Zn-69	4.38e-08	6.33e-08	5.85e-09	0.00e+00	3.84e-08	0.00e+00	3.99e-06
Zn-69m	7.10e-07	1.21e-06	1.43e-07	0.00e+00	7.03e-07	0.00e+00	3.94e-05
Se-79	0.00e+00	8.43e-06	1.87e-06	0.00e+00	1.37e-05	0.00e+00	5.53e-07
Br-82	0.00e+00	0.00e+00	7.55e-06	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	1.71e-07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	1.98e-07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	9.12e-09	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	6.70e-05	4.12e-05	0.00e+00	0.00e+00	0.00e+00	4.31e-06
Rb-87	0.00e+00	3.95e-05	1.83e-05	0.00e+00	0.00e+00	0.00e+00	5.92e-07
Rb-88	0.00e+00	1.90e-07	1.32e-07	0.00e+00	0.00e+00	0.00e+00	9.32e-09
Rb-89	0.00e+00	1.17e-07	1.04e-07	0.00e+00	0.00e+00	0.00e+00	1.02e-09
Sr-89	1.32e-03	0.00e+00	3.77e-05	0.00e+00	0.00e+00	0.00e+00	5.11e-05
Sr-90	2.56e-02	0.00e+00	5.15e-04	0.00e+00	0.00e+00	0.00e+00	2.29e-04
Sr-91	2.40e-05	0.00e+00	9.06e-07	0.00e+00	0.00e+00	0.00e+00	5.30e-05
Sr-92	9.03e-06	0.00e+00	3.62e-07	0.00e+00	0.00e+00	0.00e+00	1.71e-04
Y-90	4.11e-08	0.00e+00	1.10e-09	0.00e+00	0.00e+00	0.00e+00	1.17e-04
Y-91	6.02e-07	0.00e+00	1.61e-08	0.00e+00	0.00e+00	0.00e+00	8.02e-05
Y-91m	3.82e-10	0.00e+00	1.39e-11	0.00e+00	0.00e+00	0.00e+00	7.48e-07
Y-92	3.60e-09	0.00e+00	1.03e-10	0.00e+00	0.00e+00	0.00e+00	1.04e-04
Y-93	1.14e-08	0.00e+00	3.13e-10	0.00e+00	0.00e+00	0.00e+00	1.70e-04
Zr-93	1.67e-07	6.25e-09	4.45e-09	0.00e+00	2.42e-08	0.00e+00	2.37e-06
Zr-95	1.16e-07	2.55e-08	2.27e-08	0.00e+00	3.65e-08	0.00e+00	2.66e-05
Zr-97	6.99e-09	1.01e-09	5.96e-10	0.00e+00	1.45e-09	0.00e+00	1.53e-04
Nb-93m	1.05e-07	2.62e-08	8.61e-09	0.00e+00	2.83e-08	0.00e+00	3.95e-06
Nb-95	2.25e-08	8.76e-09	6.26e-09	0.00e+00	8.23e-09	0.00e+00	1.62e-05
Nb-97	2.17e-10	3.92e-11	1.83e-11	0.00e+00	4.35e-11	0.00e+00	1.21e-05
Mo-93	0.00e+00	2.41e-05	8.65e-07	0.00e+00	6.35e-06	0.00e+00	1.22e-06
Mo-99	0.00e+00	1.33e-05	3.29e-06	0.00e+00	2.84e-05	0.00e+00	1.10e-05
Tc-101	1.07e-09	1.12e-09	1.42e-08	0.00e+00	1.91e-08	5.92e-10	3.56e-09
Tc-99	5.35e-07	5.96e-07	2.14e-07	0.00e+00	7.02e-06	5.27e-08	6.25e-06
Tc-99m	9.23e-10	1.81e-09	3.00e-08	0.00e+00	2.63e-08	9.19e-10	1.03e-06
Ru-103	7.31e-07	0.00e+00	2.81e-07	0.00e+00	1.84e-06	0.00e+00	1.89e-05
Ru-105	6.45e-08	0.00e+00	2.34e-08	0.00e+00	5.67e-07	0.00e+00	4.21e-05
Ru-106	1.17e-05	0.00e+00	1.46e-06	0.00e+00	1.58e-05	0.00e+00	1.82e-04
Rh-105	5.14e-07	2.76e-07	2.36e-07	0.00e+00	1.10e-06	0.00e+00	1.71e-05
Pd-107	0.00e+00	4.72e-07	4.01e-08	0.00e+00	3.95e-06	0.00e+00	9.37e-07
Pd-109	0.00e+00	5.67e-07	1.70e-07	0.00e+00	3.04e-06	0.00e+00	3.35e-05

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Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	5.39e-07	3.64e-07	2.91e-07	0.00e+00	6.78e-07	0.00e+00	4.33e-05
Ag-111	2.48e-07	7.76e-08	5.12e-08	0.00e+00	2.34e-07	0.00e+00	4.75e-05
Cd-113m	0.00e+00	1.02e-05	4.34e-07	0.00e+00	1.05e-05	0.00e+00	2.63e-05
Cd-115m	0.00e+00	5.89e-06	2.51e-07	0.00e+00	4.38e-06	0.00e+00	8.01e-05
Sn-123	1.33e-04	1.65e-06	3.24e-06	1.75e-06	0.00e+00	0.00e+00	6.52e-05
Sn-125	3.55e-05	5.35e-07	1.59e-06	5.55e-07	0.00e+00	0.00e+00	1.10e-04
Sn-126	3.33e-04	4.15e-06	9.46e-06	1.14e-06	0.00e+00	0.00e+00	2.50e-05
Sb-124	1.11e-05	1.44e-07	3.89e-06	2.45e-08	0.00e+00	6.16e-06	6.94e-05
Sb-125	7.16e-06	5.52e-08	1.50e-06	6.63e-09	0.00e+00	3.99e-06	1.71e-05
Sb-126	4.40e-06	6.73e-08	1.58e-06	2.58e-08	0.00e+00	2.10e-06	8.87e-05
Sb-127	1.06e-06	1.64e-08	3.68e-07	1.18e-08	0.00e+00	4.60e-07	5.97e-05
Te-125m	1.14e-05	3.09e-06	1.52e-06	3.20e-06	0.00e+00	0.00e+00	1.10e-05
Te-127	4.71e-07	1.27e-07	1.01e-07	3.26e-07	1.34e-06	0.00e+00	1.84e-05
Te-127m	2.89e-05	7.78e-06	3.43e-06	6.91e-06	8.24e-05	0.00e+00	2.34e-05
Te-129	1.34e-07	3.74e-08	3.18e-08	9.56e-08	3.92e-07	0.00e+00	8.34e-06
Te-129m	4.87e-05	1.36e-05	7.56e-06	1.57e-05	1.43e-04	0.00e+00	5.94e-05
Te-131	8.30e-08	2.53e-08	2.47e-08	6.35e-08	2.51e-07	0.00e+00	4.36e-07
Te-131m	7.20e-06	2.49e-06	2.65e-06	5.12e-06	2.41e-05	0.00e+00	1.01e-04
Te-132	1.01e-05	4.47e-06	5.40e-06	6.51e-06	4.15e-05	0.00e+00	4.50e-05
Te-133m	1.87e-07	7.56e-08	9.37e-08	1.45e-07	7.18e-07	0.00e+00	5.77e-06
Te-134	1.29e-07	5.80e-08	7.74e-08	1.02e-07	5.37e-07	0.00e+00	5.89e-07
I-129	1.39e-05	8.53e-06	7.62e-06	5.58e-03	1.44e-05	0.00e+00	4.29e-07
I-130	2.92e-06	5.90e-06	3.04e-06	6.50e-04	8.82e-06	0.00e+00	2.76e-06
I-131	1.72e-05	1.73e-05	9.83e-06	5.72e-03	2.84e-05	0.00e+00	1.54e-06
I-132	8.00e-07	1.47e-06	6.76e-07	6.82e-05	2.25e-06	0.00e+00	1.73e-06
I-133	5.92e-06	7.32e-06	2.77e-06	1.36e-03	1.22e-05	0.00e+00	2.95e-06
I-134	4.19e-07	7.78e-07	3.58e-07	1.79e-05	1.19e-06	0.00e+00	5.16e-07
I-135	1.75e-06	3.15e-06	1.49e-06	2.79e-04	4.83e-06	0.00e+00	2.40e-06
Cs-134	2.34e-04	3.84e-04	8.10e-05	0.00e+00	1.19e-04	4.27e-05	2.07e-06
Cs-134m	8.44e-08	1.25e-07	8.16e-08	0.00e+00	6.59e-08	1.09e-08	1.58e-07

Conversion factors are in units of mrem per pCi ingested.



## Offsite Dose Calculation Manual

## Attachment 21

## Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	8.30e-05	5.78e-05	5.93e-06	0.00e+00	2.04e-05	6.81e-06	4.33e-07
Cs-136	2.35e-05	6.46e-05	4.18e-05	0.00e+00	3.44e-05	5.13e-06	2.27e-06
Cs-137	3.27e-04	3.13e-04	4.62e-05	0.00e+00	1.02e-04	3.67e-05	1.96e-06
Cs-138	2.28e-07	3.17e-07	2.01e-07	0.00e+00	2.23e-07	2.40e-08	1.46e-07
Cs-139	1.45e-07	1.61e-07	7.74e-08	0.00e+00	1.21e-07	1.22e-08	1.45e-11
Ba-139	4.14e-07	2.21e-10	1.20e-08	0.00e+00	1.93e-10	1.30e-10	2.39e-05
Ba-140	8.31e-05	7.28e-08	4.85e-06	0.00e+00	2.37e-08	4.34e-08	4.21e-05
Ba-141	2.00e-07	1.12e-10	6.51e-09	0.00e+00	9.69e-11	6.58e-10	1.14e-07
Ba-142	8.74e-08	6.29e-11	4.88e-09	0.00e+00	5.09e-11	3.70e-11	1.14e-09
La-140	1.01e-08	3.53e-09	1.19e-09	0.00e+00	0.00e+00	0.00e+00	9.84e-05
La-141	1.36e-09	3.17e-10	6.88e-11	0.00e+00	0.00e+00	0.00e+00	7.05e-05
La-142	5.24e-10	1.67e-10	5.23e-11	0.00e+00	0.00e+00	0.00e+00	3.31e-05
Ce-141	3.97e-08	1.98e-08	2.94e-09	0.00e+00	8.68e-09	0.00e+00	2.47e-05
Ce-143	6.99e-09	3.79e-06	5.49e-10	0.00e+00	1.59e-09	0.00e+00	5.55e-05
Ce-144	2.08e-06	6.52e-07	1.11e-07	0.00e+00	3.61e-07	0.00e+00	1.70e-04
Pr-143	3.93e-08	1.18e-08	1.95e-09	0.00e+00	6.39e-09	0.00e+00	4.24e-05
Pr-144	1.29e-10	3.99e-11	6.49e-12	0.00e+00	2.11e-11	0.00e+00	8.59e-08
Nd-147	2.79e-08	2.26e-08	1.75e-09	0.00e+00	1.24e-08	0.00e+00	3.58e-05
Pm-147	3.18e-07	2.27e-08	1.22e-08	0.00e+00	4.01e-08	0.00e+00	9.19e-06
Pm-148	3.02e-08	3.63e-09	2.35e-09	0.00e+00	6.17e-09	0.00e+00	9.70e-05
Pm-148m	1.03e-07	2.05e-08	2.05e-08	0.00e+00	3.04e-08	0.00e+00	5.78e-05
Pm-149	6.49e-09	6.90e-10	3.74e-10	0.00e+00	1.22e-09	0.00e+00	4.71e-05
Pm-151	2.92e-09	3.55e-10	2.31e-10	0.00e+00	6.02e-10	0.00e+00	4.03e-05
Sm-151	2.56e-07	3.81e-08	1.20e-08	0.00e+00	3.94e-08	0.00e+00	5.53e-06
Sm-153	3.65e-09	2.27e-09	2.19e-10	0.00e+00	6.91e-10	0.00e+00	3.02e-05
Eu-152	6.15e-07	1.12e-07	1.33e-07	0.00e+00	4.73e-07	0.00e+00	1.84e-05
Eu-154	2.30e-06	2.07e-07	1.89e-07	0.00e+00	9.09e-07	0.00e+00	4.81e-05
Eu-155	4.82e-07	3.47e-08	2.72e-08	0.00e+00	1.30e-07	0.00e+00	8.69e-05
Eu-156	5.62e-08	3.01e-08	6.23e-09	0.00e+00	1.94e-08	0.00e+00	6.83e-05
Tb-160	1.66e-07	0.00e+00	2.06e-08	0.00e+00	4.94e-08	0.00e+00	3.68e-05

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Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.08e-06	2.26e-07	1.91e-07	0.00e+00	3.22e-07	0.00e+00	2.63e-05
W-181	4.23e-08	1.04e-08	1.43e-09	0.00e+00	0.00e+00	0.00e+00	3.79e-07
W-185	1.73e-06	4.32e-07	6.05e-08	0.00e+00	0.00e+00	0.00e+00	1.61e-05
W-187	4.29e-07	2.54e-07	1.14e-07	0.00e+00	0.00e+00	0.00e+00	3.57e-05
Pb-210	4.75e-02	1.22e-02	2.09e-03	0.00e+00	3.67e-02	0.00e+00	2.30e-06
Bi-210	1.97e-06	1.02e-05	1.13e-06	0.00e+00	1.15e-04	0.00e+00	5.17e-05
Po-210	1.52e-03	2.43e-03	3.67e-04	0.00e+00	7.56e-03	0.00e+00	6.55e-05
Ra-223	2.12e-02	2.45e-05	4.24e-03	0.00e+00	6.50e-04	0.00e+00	3.38e-04
Ra-224	6.89e-03	1.25e-05	1.38e-03	0.00e+00	3.31e-04	0.00e+00	3.78e-04
Ra-225	2.80e-02	2.50e-05	5.59e-03	0.00e+00	6.62e-04	0.00e+00	3.21e-04
Ra-226	5.75e-01	1.84e-05	4.72e-01	0.00e+00	4.88e-04	0.00e+00	3.41e-04
Ra-228	3.85e-01	9.99e-06	4.32e-01	0.00e+00	2.65e-04	0.00e+00	5.81e-05
Ac-225	1.88e-05	1.94e-05	1.26e-06	0.00e+00	2.07e-06	0.00e+00	4.31e-04
Ac-227	4.12e-03	6.63e-04	2.55e-04	0.00e+00	1.46e-04	0.00e+00	8.43e-05
Th-227	5.85e-05	7.96e-07	1.69e-06	0.00e+00	4.22e-06	0.00e+00	5.63e-04
Th-228	2.07e-03	2.65e-05	7.00e-05	0.00e+00	1.38e-04	0.00e+00	5.79e-04
Th-229	2.35e-02	5.91e-04	3.92e-04	0.00e+00	2.89e-03	0.00e+00	8.04e-05
Th-230	3.55e-03	1.78e-04	9.91e-05	0.00e+00	8.67e-04	0.00e+00	6.19e-05
Th-232	3.96e-03	1.52e-04	3.01e-06	0.00e+00	7.41e-04	0.00e+00	5.27e-05
Th-234	3.42e-07	1.51e-08	9.88e-09	0.00e+00	8.01e-08	0.00e+00	1.18e-04
Pa-231	7.07e-03	2.34e-04	2.81e-04	0.00e+00	1.28e-03	0.00e+00	7.37e-05
Pa-233	1.81e-08	2.82e-09	3.16e-09	0.00e+00	1.04e-08	0.00e+00	1.44e-05
U-232	1.76e-02	0.00e+00	1.26e-03	0.00e+00	1.34e-03	0.00e+00	6.98e-05
U-233	3.72e-03	0.00e+00	2.25e-04	0.00e+00	6.10e-04	0.00e+00	6.45e-05
U-234	3.57e-03	0.00e+00	2.21e-04	0.00e+00	5.98e-04	0.00e+00	6.32e-05
U-235	3.42e-03	0.00e+00	2.07e-04	0.00e+00	5.61e-04	0.00e+00	8.03e-05
U-236	3.42e-03	0.00e+00	2.12e-04	0.00e+00	5.73e-04	0.00e+00	5.92e-05
U-237	2.36e-07	0.00e+00	6.27e-08	0.00e+00	6.81e-07	0.00e+00	2.08e-05
U-238	3.27e-03	0.00e+00	1.94e-04	0.00e+00	5.24e-04	0.00e+00	5.66e-05
Np-237	2.23e-03	1.47e-04	9.79e-05	0.00e+00	6.05e-04	0.00e+00	8.16e-05

Conversion factors are in units of mrem per pCi ingested.

## Offsite Dose Calculation Manual

## Attachment 21

## Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Child age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	5.83e-08	1.18e-09	9.08e-10	0.00e+00	3.76e-09	0.00e+00	4.04e-05
Np-239	5.25e-09	3.77e-10	2.65e-10	0.00e+00	1.09e-09	0.00e+00	2.79e-05
Pu-238	1.19e-03	1.38e-04	3.16e-05	0.00e+00	1.15e-04	0.00e+00	7.50e-05
Pu-239	1.29e-03	1.38e-04	3.31e-05	0.00e+00	1.22e-04	0.00e+00	6.85e-05
Pu-240	1.28e-03	1.43e-04	3.31e-05	0.00e+00	1.22e-04	0.00e+00	6.98e-05
Pu-241	3.87e-05	1.58e-06	8.04e-07	0.00e+00	2.96e-06	0.00e+00	1.44e-06
Pu-242	1.19e-03	1.38e-04	3.19e-05	0.00e+00	1.17e-04	0.00e+00	6.71e-05
Pu-244	1.39e-03	1.58e-03	3.65e-05	0.00e+00	1.35e-04	0.00e+00	1.00e-04
Am-241	1.36e-03	1.17e-03	1.02e-04	0.00e+00	6.23e-04	0.00e+00	7.64e-05
Am-242m	1.40e-03	1.12e-03	1.04e-04	0.00e+00	6.30e-04	0.00e+00	9.61e-05
Am-243	1.34e-03	1.13e-03	9.83e-05	0.00e+00	6.06e-04	0.00e+00	8.95e-05
Cm-242	8.78e-05	7.01e-05	5.84e-06	0.00e+00	1.87e-05	0.00e+00	8.16e-05
Cm-243	1.28e-03	1.04e-03	8.24e-05	0.00e+00	3.08e-04	0.00e+00	8.03e-05
Cm-244	1.08e-03	8.74e-04	6.93e-05	0.00e+00	2.54e-04	0.00e+00	7.77e-05
Cm-245	1.67e-03	1.34e-03	1.05e-04	0.00e+00	4.11e-04	0.00e+00	7.24e-05
Cm-246	1.65e-03	1.34e-03	1.05e-04	0.00e+00	4.10e-04	0.00e+00	7.11e-05
Cm-247	1.61e-03	1.32e-03	1.03e-04	0.00e+00	4.04e-04	0.00e+00	9.35e-05
Cm-248	1.34e-02	1.09e-02	8.52e-04	0.00e+00	3.33e-03	0.00e+00	1.51e-03
Cf-252	1.05e-03	0.00e+00	2.54e-05	0.00e+00	0.00e+00	0.00e+00	2.96e-04

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00e+00	1.76e-07	1.76e-07	1.76e-07	1.76e-07	1.76e-07	1.76e-07
Be-10	1.71e-05	2.49e-06	5.16e-07	0.00e+00	1.64e-06	0.00e+00	2.78e-05
C-14	2.37e-05	5.06e-06	5.06e-06	5.06e-06	5.06e-06	5.06e-06	5.06e-06
N-13	5.85e-08	5.85e-08	5.85e-08	5.85e-08	5.85e-08	5.85e-08	5.85e-08
F-18	5.19e-06	0.00e+00	4.43e-07	0.00e+00	0.00e+00	0.00e+00	1.22e-06
Na-22	9.83e-05	9.83e-05	9.83e-05	9.83e-05	9.83e-05	9.83e-05	9.83e-05
Na-24	1.01e-05	1.01e-05	1.01e-05	1.01e-05	1.01e-05	1.01e-05	1.01e-05
P-32	1.70e-03	1.00e-04	6.59e-05	0.00e+00	0.00e+00	0.00e+00	2.30e-05
Ca-41	3.74e-04	0.00e+00	4.08e-05	0.00e+00	0.00e+00	0.00e+00	1.91e-07
Sc-46	3.75e-08	5.41e-08	1.69e-08	0.00e+00	3.56e-08	0.00e+00	3.53e-05
Cr-51	0.00e+00	0.00e+00	1.41e-08	9.20e-09	2.01e-09	1.79e-08	4.11e-07
Mn-54	0.00e+00	1.99e-05	4.51e-06	0.00e+00	4.41e-06	0.00e+00	7.31e-06
Mn-56	0.00e+00	8.18e-07	1.41e-07	0.00e+00	7.03e-07	0.00e+00	7.43e-05
Fe-55	1.39e-05	8.98e-06	2.40e-06	0.00e+00	0.00e+00	4.39e-06	1.14e-06
Fe-59	3.08e-05	5.38e-05	2.12e-05	0.00e+00	0.00e+00	1.59e-05	2.57e-05
Co-57	0.00e+00	1.15e-06	1.87e-06	0.00e+00	0.00e+00	0.00e+00	3.92e-06
Co-58	0.00e+00	3.60e-06	8.98e-06	0.00e+00	0.00e+00	0.00e+00	8.97e-06
Co-60	0.00e+00	1.08e-05	2.55e-05	0.00e+00	0.00e+00	0.00e+00	2.57e-05
Ni-59	4.73e-05	1.45e-05	8.17e-06	0.00e+00	0.00e+00	0.00e+00	7.16e-07
Ni-63	6.34e-04	3.92e-05	2.20e-05	0.00e+00	0.00e+00	0.00e+00	1.95e-06
Ni-65	4.70e-06	5.32e-07	2.42e-07	0.00e+00	0.00e+00	0.00e+00	4.05e-05
Cu-64	0.00e+00	6.09e-07	2.82e-07	0.00e+00	1.03e-06	0.00e+00	1.25e-05
Zn-65	1.84e-05	6.31e-05	2.91e-05	0.00e+00	3.06e-05	0.00e+00	5.33e-05
Zn-69	9.33e-08	1.68e-07	1.25e-08	0.00e+00	6.98e-08	0.00e+00	1.37e-05
Zn-69m	1.50e-06	3.06e-06	2.79e-07	0.00e+00	1.24e-06	0.00e+00	4.24e-05
Se-79	0.00e+00	2.10e-05	3.90e-06	0.00e+00	2.43e-05	0.00e+00	5.58e-07
Br-82	0.00e+00	0.00e+00	1.27e-05	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-83	0.00e+00	0.00e+00	3.63e-07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-84	0.00e+00	0.00e+00	3.82e-07	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Br-85	0.00e+00	0.00e+00	1.94e-08	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Conversion factors are in units of mrem per pCi ingested.

## Offsite Dose Calculation Manual

## Attachment 21

## Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Rb-86	0.00e+00	1.70e-04	8.40e-05	0.00e+00	0.00e+00	0.00e+00	4.35e-06
Rb-87	0.00e+00	8.88e-05	3.52e-05	0.00e+00	0.00e+00	0.00e+00	5.98e-07
Rb-88	0.00e+00	4.98e-07	2.73e-07	0.00e+00	0.00e+00	0.00e+00	4.85e-07
Rb-89	0.00e+00	2.86e-07	1.97e-07	0.00e+00	0.00e+00	0.00e+00	9.74e-08
Sr-89	2.51e-03	0.00e+00	7.20e-05	0.00e+00	0.00e+00	0.00e+00	5.16e-05
Sr-90	2.83e-02	0.00e+00	5.74e-04	0.00e+00	0.00e+00	0.00e+00	2.31e-04
Sr-91	5.00e-05	0.00e+00	1.81e-06	0.00e+00	0.00e+00	0.00e+00	5.92e-05
Sr-92	1.92e-05	0.00e+00	7.13e-07	0.00e+00	0.00e+00	0.00e+00	2.07e-04
Y-90	8.69e-08	0.00e+00	2.33e-09	0.00e+00	0.00e+00	0.00e+00	1.20e-04
Y-91	1.13e-06	0.00e+00	3.01e-08	0.00e+00	0.00e+00	0.00e+00	8.10e-05
Y-91m	8.10e-10	0.00e+00	2.76e-11	0.00e+00	0.00e+00	0.00e+00	2.70e-06
Y-92	7.65e-09	0.00e+00	2.15e-10	0.00e+00	0.00e+00	0.00e+00	1.46e-04
Y-93	2.43e-08	0.00e+00	6.62e-10	0.00e+00	0.00e+00	0.00e+00	1.92e-04
Zr-93	1.93e-07	9.19e-09	5.54e-09	0.00e+00	2.71e-08	0.00e+00	2.39e-06
Zr-95	2.06e-07	5.02e-08	3.56e-08	0.00e+00	5.41e-08	0.00e+00	2.50e-05
Zr-97	1.48e-08	2.54e-09	1.16e-09	0.00e+00	2.56e-09	0.00e+00	1.62e-04
Nb-93m	1.23e-07	3.33e-08	1.04e-08	0.00e+00	3.25e-08	0.00e+00	3.98e-06
Nb-95	4.20e-08	1.73e-08	1.00e-08	0.00e+00	1.24e-08	0.00e+00	1.46e-05
Nb-97	4.59e-10	9.79e-11	3.53e-11	0.00e+00	7.65e-11	0.00e+00	3.09e-05
Mo-93	0.00e+00	5.65e-05	1.82e-06	0.00e+00	1.13e-05	0.00e+00	1.21e-06
Mo-99	0.00e+00	3.40e-05	6.63e-06	0.00e+00	5.08e-05	0.00e+00	1.12e-05
Tc-101	2.27e-09	2.86e-09	2.83e-08	0.00e+00	3.40e-08	1.56e-09	4.86e-07
Tc-99	1.08e-06	1.46e-06	4.55e-07	0.00e+00	1.23e-05	1.42e-07	6.31e-06
Tc-99m	1.92e-09	3.96e-09	5.10e-08	0.00e+00	4.26e-08	2.07e-09	1.15e-06
Ru-103	1.48e-06	0.00e+00	4.95e-07	0.00e+00	3.08e-06	0.00e+00	1.80e-05
Ru-105	1.36e-07	0.00e+00	4.58e-08	0.00e+00	1.00e-06	0.00e+00	5.41e-05
Ru-106	2.41e-05	0.00e+00	3.01e-06	0.00e+00	2.85e-05	0.00e+00	1.83e-04
Rh-105	1.09e-06	7.13e-07	4.79e-07	0.00e+00	1.98e-06	0.00e+00	1.77e-05
Pd-107	0.00e+00	1.19e-06	8.45e-08	0.00e+00	6.79e-06	0.00e+00	9.46e-07
Pd-109	0.00e+00	1.50e-06	3.62e-07	0.00e+00	5.51e-06	0.00e+00	3.68e-05

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	9.96e-07	7.27e-07	4.81e-07	0.00e+00	1.04e-06	0.00e+00	3.77e-05
Ag-111	5.20e-07	2.02e-07	1.07e-07	0.00e+00	4.22e-07	0.00e+00	4.82e-05
Cd-113m	0.00e+00	1.77e-05	6.52e-07	0.00e+00	1.34e-05	0.00e+00	2.66e-05
Cd-115m	0.00e+00	1.42e-05	4.93e-07	0.00e+00	7.41e-06	0.00e+00	8.09e-05
Sn-123	2.49e-04	3.89e-06	6.50e-06	3.91e-06	0.00e+00	0.00e+00	6.58e-05
Sn-125	7.41e-05	1.38e-06	3.29e-06	1.36e-06	0.00e+00	0.00e+00	1.11e-04
Sn-126	5.53e-04	7.26e-06	1.80e-05	1.91e-06	0.00e+00	0.00e+00	2.52e-05
Sb-124	2.14e-05	3.15e-07	6.63e-06	5.68e-08	0.00e+00	1.34e-05	6.60e-05
Sb-125	1.23e-05	1.19e-07	2.53e-06	1.54e-08	0.00e+00	7.12e-06	1.64e-05
Sb-126	8.06e-06	1.58e-07	2.91e-06	6.19e-08	0.00e+00	5.07e-06	8.35e-05
Sb-127	2.23e-06	3.98e-08	6.90e-07	2.84e-08	0.00e+00	1.15e-06	5.91e-05
Te-125m	2.33e-05	7.79e-06	3.15e-06	7.84e-06	0.00e+00	0.00e+00	1.11e-05
Te-127	1.00e-06	3.35e-07	2.15e-07	8.14e-07	2.44e-06	0.00e+00	2.10e-05
Te-127m	5.85e-05	1.94e-05	7.08e-06	1.69e-05	1.44e-04	0.00e+00	2.36e-05
Te-129	2.84e-07	9.79e-08	6.63e-08	2.38e-07	7.07e-07	0.00e+00	2.27e-05
Te-129m	1.00e-04	3.43e-05	1.54e-05	3.84e-05	2.50e-04	0.00e+00	5.97e-05
Te-131	1.76e-07	6.50e-08	4.94e-08	1.57e-07	4.50e-07	0.00e+00	7.11e-06
Te-131m	1.52e-05	6.12e-06	5.05e-06	1.24e-05	4.21e-05	0.00e+00	1.03e-04
Te-132	2.08e-05	1.03e-05	9.61e-06	1.52e-05	6.44e-05	0.00e+00	3.81e-05
Te-133m	3.91e-07	1.79e-07	1.71e-07	3.45e-07	1.22e-06	0.00e+00	1.93e-05
Te-134	2.67e-07	1.34e-07	1.38e-07	2.39e-07	9.03e-07	0.00e+00	3.06e-06
I-129	2.86e-05	2.12e-05	1.55e-05	1.36e-02	2.51e-05	0.00e+00	4.24e-07
I-130	6.00e-06	1.32e-05	5.30e-06	1.48e-03	1.45e-05	0.00e+00	2.83e-06
I-131	3.59e-05	4.23e-05	1.86e-05	1.39e-02	4.94e-05	0.00e+00	1.51e-06
I-132	1.66e-06	3.37e-06	1.20e-06	1.58e-04	3.76e-06	0.00e+00	2.73e-06
I-133	1.25e-05	1.82e-05	5.33e-06	3.31e-03	2.14e-05	0.00e+00	3.08e-06
I-134	8.69e-07	1.78e-06	6.33e-07	4.15e-05	1.99e-06	0.00e+00	1.84e-06
I-135	3.64e-06	7.24e-06	2.64e-06	6.49e-04	8.07e-06	0.00e+00	2.62e-06
Cs-134	3.77e-04	7.03e-04	7.10e-05	0.00e+00	1.81e-04	7.42e-05	1.91e-06
Cs-134m	1.76e-07	2.93e-07	1.48e-07	0.00e+00	1.13e-07	2.60e-08	2.32e-07

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cs-135	1.33e-04	1.21e-04	6.30e-06	0.00e+00	3.44e-05	1.31e-05	4.37e-07
Cs-136	4.59e-05	1.35e-04	5.04e-05	0.00e+00	5.38e-05	1.10e-05	2.05e-06
Cs-137	5.22e-04	6.11e-04	4.33e-05	0.00e+00	1.64e-04	6.64e-05	1.91e-06
Cs-138	4.81e-07	7.82e-07	3.79e-07	0.00e+00	3.90e-07	6.09e-08	1.25e-06
Cs-139	3.10e-07	4.24e-07	1.62e-07	0.00e+00	2.19e-07	3.30e-08	2.66e-08
Ba-139	8.81e-07	5.84e-10	2.55e-08	0.00e+00	3.51e-10	3.54e-10	5.58e-05
Ba-140	1.71e-04	1.71e-07	8.81e-06	0.00e+00	4.06e-08	1.05e-07	4.20e-05
Ba-141	4.25e-07	2.91e-10	1.34e-08	0.00e+00	1.75e-10	1.77e-10	5.19e-06
Ba-142	1.84e-07	1.53e-10	9.06e-09	0.00e+00	8.81e-11	9.26e-11	7.59e-07
La-140	2.11e-08	8.32e-09	2.14e-09	0.00e+00	0.00e+00	0.00e+00	9.77e-05
La-141	2.89e-09	8.38e-10	1.46e-10	0.00e+00	0.00e+00	0.00e+00	9.61e-05
La-142	1.10e-09	4.04e-10	9.67e-11	0.00e+00	0.00e+00	0.00e+00	6.86e-05
Ce-141	7.87e-08	4.80e-08	5.65e-09	0.00e+00	1.48e-08	0.00e+00	2.48e-05
Ce-143	1.48e-08	9.82e-06	1.12e-09	0.00e+00	2.86e-09	0.00e+00	5.73e-05
Ce-144	2.98e-06	1.22e-06	1.67e-07	0.00e+00	4.93e-07	0.00e+00	1.71e-04
Pr-143	8.13e-08	3.04e-08	4.03e-09	0.00e+00	1.13e-08	0.00e+00	4.29e-05
Pr-144	2.74e-10	1.06e-10	1.38e-11	0.00e+00	3.84e-11	0.00e+00	4.93e-06
Nd-147	5.53e-08	5.68e-08	3.48e-09	0.00e+00	2.19e-08	0.00e+00	3.60e-05
Pm-147	3.88e-07	3.27e-08	1.59e-08	0.00e+00	4.88e-08	0.00e+00	9.27e-06
Pm-148	6.32e-08	9.13e-09	4.60e-09	0.00e+00	1.09e-08	0.00e+00	9.74e-05
Pm-148m	1.65e-07	4.18e-08	3.28e-08	0.00e+00	4.80e-08	0.00e+00	5.44e-05
Pm-149	1.38e-08	1.81e-09	7.90e-10	0.00e+00	2.20e-09	0.00e+00	4.86e-05
Pm-151	6.18e-09	9.01e-10	4.56e-10	0.00e+00	1.07e-09	0.00e+00	4.17e-05
Sm-151	2.90e-07	6.67e-08	1.44e-08	0.00e+00	4.53e-08	0.00e+00	5.58e-06
Sm-153	7.72e-09	5.97e-09	4.58e-10	0.00e+00	1.25e-09	0.00e+00	3.12e-05
Eu-152	6.74e-07	1.79e-07	1.51e-07	0.00e+00	5.02e-07	0.00e+00	1.59e-05
Eu-154	2.64e-06	3.67e-07	2.20e-07	0.00e+00	9.95e-07	0.00e+00	4.58e-05
Eu-155	5.42e-07	6.25e-08	3.23e-08	0.00e+00	1.40e-07	0.00e+00	8.37e-05
Eu-156	1.14e-07	7.06e-08	1.12e-08	0.00e+00	3.26e-08	0.00e+00	6.67e-05
Tb-160	2.59e-07	0.00e+00	3.24e-08	0.00e+00	7.37e-08	0.00e+00	3.45e-05

Conversion factors are in units of mrem per pCi ingested.

Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Ho-166m	1.25e-06	2.69e-07	2.13e-07	0.00e+00	3.57e-07	0.00e+00	2.66e-05
W-181	8.85e-08	2.72e-08	3.04e-09	0.00e+00	0.00e+00	0.00e+00	3.82e-07
W-185	3.62e-06	1.13e-06	1.29e-07	0.00e+00	0.00e+00	0.00e+00	1.62e-05
W-187	9.03e-07	6.28e-07	2.17e-07	0.00e+00	0.00e+00	0.00e+00	3.69e-05
Pb-210	5.28e-02	1.42e-02	2.38e-03	0.00e+00	4.33e-02	0.00e+00	2.32e-06
Bi-210	4.16e-06	2.68e-05	2.39e-06	0.00e+00	2.08e-04	0.00e+00	5.27e-05
Po-210	3.10e-03	5.93e-03	7.41e-04	0.00e+00	1.26e-02	0.00e+00	6.61e-05
Pb-223	4.41e-02	6.42e-05	8.82e-03	0.00e+00	1.17e-03	0.00e+00	3.43e-04
Ra-224	1.46e-02	3.29e-05	2.91e-03	0.00e+00	6.00e-04	0.00e+00	3.86e-04
Ra-225	5.78e-02	6.52e-05	1.15e-02	0.00e+00	1.19e-03	0.00e+00	3.24e-04
Ra-226	6.20e-01	4.76e-05	5.14e-01	0.00e+00	8.71e-04	0.00e+00	3.44e-04
Ra-228	4.32e-01	2.58e-05	4.86e-01	0.00e+00	4.73e-04	0.00e+00	5.86e-05
Ac-225	3.92e-05	5.03e-05	2.63e-06	0.00e+00	3.69e-06	0.00e+00	4.36e-04
Ac-227	4.49e-03	7.67e-04	2.79e-04	0.00e+00	1.56e-04	0.00e+00	8.50e-05
Th-227	1.20e-04	2.01e-06	3.45e-06	0.00e+00	7.41e-06	0.00e+00	5.70e-04
Th-228	2.47e-03	3.38e-05	8.36e-05	0.00e+00	1.58e-04	0.00e+00	5.84e-04
Th-229	2.52e-02	6.33e-04	4.20e-04	0.00e+00	3.03e-03	0.00e+00	8.10e-05
Th-230	3.80e-03	1.90e-04	1.06e-04	0.00e+00	9.12e-04	0.00e+00	6.24e-05
Th-232	4.24e-03	1.63e-04	1.65e-06	0.00e+00	7.79e-04	0.00e+00	5.31e-05
Th-234	6.92e-07	3.77e-08	2.00e-08	0.00e+00	1.39e-07	0.00e+00	1.19e-04
Pa-231	7.57e-03	2.50e-04	3.02e-04	0.00e+00	1.34e-03	0.00e+00	7.44e-05
Pa-233	3.11e-08	6.09e-09	5.43e-09	0.00e+00	1.67e-08	0.00e+00	1.46e-05
U-232	2.42e-02	0.00e+00	2.16e-03	0.00e+00	2.37e-03	0.00e+00	7.04e-05
U-233	5.08e-03	0.00e+00	3.87e-04	0.00e+00	1.08e-03	0.00e+00	6.51e-05
U-234	4.88e-03	0.00e+00	3.80e-04	0.00e+00	1.06e-03	0.00e+00	6.37e-05
U-235	4.67e-03	0.00e+00	3.56e-04	0.00e+00	9.93e-04	0.00e+00	8.10e-05
U-236	4.67e-03	0.00e+00	3.64e-04	0.00e+00	1.01e-03	0.00e+00	5.98e-05
U-237	4.95e-07	0.00e+00	1.32e-07	0.00e+00	1.23e-06	0.00e+00	2.11e-05
U-238	4.47e-03	0.00e+00	3.33e-04	0.00e+00	9.28e-04	0.00e+00	5.71e-05
Np-237	2.40e-03	1.59e-04	1.05e-04	0.00e+00	6.34e-04	0.00e+00	8.23e-05

Conversion factors are in units of mrem per pCi ingested.



Offsite Dose Calculation Manual

Attachment 21

Dose Conversion Factors All Age Groups by Nuclide (Inhalation and Ingestion)

Ingestion Dose Conversion factors for Infant age group by nuclide.  
Waterford Steam Electric Station

Nuclide	Organ Dose Conversion Factors						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Np-238	1.24e-07	3.12e-09	1.92e-09	0.00e+00	6.81e-09	0.00e+00	4.17e-05
Np-239	1.11e-08	9.93e-10	5.61e-10	0.00e+00	1.98e-09	0.00e+00	2.87e-05
Pu-238	1.28e-03	1.50e-04	3.40e-05	0.00e+00	1.21e-04	0.00e+00	7.57e-05
Pu-239	1.38e-03	1.55e-04	3.54e-05	0.00e+00	1.28e-04	0.00e+00	6.91e-05
Pu-240	1.38e-03	1.55e-04	3.54e-05	0.00e+00	1.28e-04	0.00e+00	7.04e-05
Pu-241	4.25e-05	1.76e-06	8.82e-07	0.00e+00	3.17e-06	0.00e+00	1.45e-06
Pu-242	1.28e-03	1.49e-04	3.41e-05	0.00e+00	1.23e-04	0.00e+00	6.77e-05
Pu-244	1.49e-03	1.71e-04	3.91e-05	0.00e+00	1.41e-04	0.00e+00	1.01e-04
Am-241	1.46e-03	1.27e-03	1.09e-04	0.00e+00	6.55e-04	0.00e+00	7.70e-05
Am-242m	1.51e-03	1.22e-03	1.13e-04	0.00e+00	6.64e-04	0.00e+00	9.69e-05
Am-243	1.44e-03	1.23e-03	1.06e-04	0.00e+00	6.36e-04	0.00e+00	9.03e-05
Cm-242	1.37e-04	1.27e-04	9.10e-06	0.00e+00	2.62e-05	0.00e+00	8.23e-05
Cm-243	1.40e-03	1.15e-03	8.98e-05	0.00e+00	3.27e-04	0.00e+00	8.10e-05
Cm-244	1.18e-03	9.70e-04	7.59e-05	0.00e+00	2.71e-04	0.00e+00	7.84e-05
Cm-245	1.79e-03	1.45e-03	1.13e-04	0.00e+00	4.32e-04	0.00e+00	7.30e-05
Cm-246	1.77e-03	1.45e-03	1.13e-04	0.00e+00	4.31e-04	0.00e+00	7.17e-05
Cm-247	1.73e-03	1.43e-03	1.11e-04	0.00e+00	4.24e-04	0.00e+00	9.43e-05
Cm-248	1.43e-02	1.18e-02	9.16e-04	0.00e+00	3.50e-03	0.00e+00	1.52e-03
Cf-252	1.22e-03	0.00e+00	2.95e-05	0.00e+00	0.00e+00	0.00e+00	2.99e-04

Conversion factors are in units of mrem per pCi ingested.

**Offsite Dose Calculation Manual****Attachment 22****Page 1 of 18****Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual**

Values for Ai, Pi, and Ri were calculated as per NUREG-0133. Recommended values for various factors in the calculations were as specified in NUREG-0133. The location of most of the recommended factors are contained in USNRC Regulatory Guide 1.109, NUREG 0172, and NUREG/CR 1276. All factors used in Waterford-3 SES's calculations are for the maximum individual and are not site specific. The various factors are discussed below.

- Stable element transfer coefficients for vegetation, cow's milk, goat's milk and meat (Attachment 22, pages 10 - 12) were obtained from NUREG/CR 1276.
- Animal consumption rates (Attachment 22, page 2) were obtained from USNRC Regulatory Guide 1.109.
- Usage or consumption rates for adult, teen, child, and infant age groups (Attachment 22, page 3) were obtained from USNRC Regulatory Guide 1.109. These values are for the maximum exposed individual.
- External dose factors for standing on contaminated ground (Attachment 20) were obtained from NUREG/CR 1276.
- Bioaccumulation factors for freshwater and saltwater vertebrates and invertebrates (Attachment 22, page 13 - 15) were obtained from NUREG/CR 1276.
- Inhalation and ingestion dose factors for adult, teen, child, and infant age groups (Attachment 21) were obtained from NUREG/CR 1276.
- Radionuclide half-lives and decay constants are included Attachment 22, pages 4 - 9.
- Other factors (Attachment 22, page 16 - 18) used were obtained from USNRC Regulatory Guide 1.109 for various parameters

**Offsite Dose Calculation Manual****Attachment 22**

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**Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual**

Animal Consumption rates.  
Waterford Steam Electric Station

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Milk cow's feed intake rate: 50.00 kg/day

Milk cow's water intake rate: 60.00 l/day

Beef cow's feed intake rate: 50.00 kg/day

Beef cow's water intake rate: 50.00 l/day

Goat's feed intake rate: 6.00 kg/day

Goat's water intake rate: 8.00 l/day

## Offsite Dose Calculation Manual

## Attachment 22

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offside Dose Calculation Manual

Consumption rates for MAXIMAL individuals.  
Waterford Steam Electric Station

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produce veg	usage rate for the Adult	:	520.0	kg/yr
produce veg	usage rate for the Teen	:	630.0	kg/yr
produce veg	usage rate for the Child	:	520.0	kg/yr
produce veg	usage rate for the Infant	:	0.0	kg/yr
-----				
leafy veg	usage rate for the Adult	:	64.0	kg/yr
leafy veg	usage rate for the Teen	:	42.0	kg/yr
leafy veg	usage rate for the Child	:	26.0	kg/yr
leafy veg	usage rate for the Infant	:	0.0	kg/yr
-----				
milk	usage rate for the Adult	:	310.0	l/yr
milk	usage rate for the Teen	:	400.0	l/yr
milk	usage rate for the Child	:	330.0	l/yr
milk	usage rate for the Infant	:	330.0	l/yr
-----				
meat/poultry	usage rate for the Adult	:	110.0	kg/yr
meat/poultry	usage rate for the Teen	:	65.0	kg/yr
meat/poultry	usage rate for the Child	:	41.0	kg/yr
meat/poultry	usage rate for the Infant	:	0.0	kg/yr
-----				
fish	usage rate for the Adult	:	21.0	kg/yr
fish	usage rate for the Teen	:	16.0	kg/yr
fish	usage rate for the Child	:	6.9	kg/yr
fish	usage rate for the Infant	:	0.0	kg/yr
-----				
seafood	usage rate for the Adult	:	5.0	kg/yr
seafood	usage rate for the Teen	:	3.8	kg/yr
seafood	usage rate for the Child	:	1.7	kg/yr
seafood	usage rate for the Infant	:	0.0	kg/yr
-----				
drink h2o	usage rate for the Adult	:	730.0	l/yr
drink h2o	usage rate for the Teen	:	510.0	l/yr
drink h2o	usage rate for the Child	:	510.0	l/yr
drink h2o	usage rate for the Infant	:	330.0	l/yr
-----				
shore rec	usage rate for the Adult	:	12.0	hr/yr
shore rec	usage rate for the Teen	:	67.0	hr/yr
shore rec	usage rate for the Child	:	14.0	hr/yr
shore rec	usage rate for the Infant	:	0.0	hr/yr
-----				
inhalation	usage rate for the Adult	:	8000.0	m3/yr
inhalation	usage rate for the Teen	:	8000.0	m3/yr
inhalation	usage rate for the Child	:	3700.0	m3/yr
inhalation	usage rate for the Infant	:	1400.0	m3/yr

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## Offsite Dose Calculation Manual

## Attachment 22

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Radionuclide Parameters used.  
Waterford Steam Electric Station

Nuclide	Parameters	
	Half-life	Decay constant
H-3	1.2280e+01 years	1.7899e-09 1/seconds
Be-10	1.6000e+06 years	1.3737e-14 1/seconds
C-14	5.7300e+03 years	3.8359e-12 1/seconds
N-13	9.9700e+00 minutes	1.1587e-03 1/seconds
F-18	1.8300e+00 hours	1.0521e-04 1/seconds
Na-22	2.6000e+00 years	8.4537e-09 1/seconds
Na-24	1.5000e+01 hours	1.2836e-05 1/seconds
P-32	1.4290e+01 days	5.6141e-07 1/seconds
Ca-41	1.3000e+05 years	1.6907e-13 1/seconds
Sc-46	8.3800e+01 days	9.5734e-08 1/seconds
Cr-51	2.7704e+01 days	2.8958e-07 1/seconds
Mn-54	3.1270e+02 days	2.5656e-08 1/seconds
Mn-56	2.5758e+00 hours	7.4750e-05 1/seconds
Fe-55	2.7000e+00 years	8.1406e-09 1/seconds
Fe-59	4.4630e+01 days	1.7976e-07 1/seconds
Co-57	2.7000e+02 days	2.9713e-08 1/seconds
Co-58	7.0800e+01 days	1.1331e-07 1/seconds
Co-60	5.2710e+00 years	4.1699e-09 1/seconds
Ni-59	7.5000e+04 years	2.9306e-13 1/seconds
Ni-63	1.0010e+02 years	2.1958e-10 1/seconds
Ni-65	2.5200e+00 hours	7.6405e-05 1/seconds
Cu-64	1.2701e+01 hours	1.5160e-05 1/seconds
Zn-65	2.4440e+02 days	3.2825e-08 1/seconds
Zn-69	5.5600e+01 minutes	2.0778e-04 1/seconds
Zn-69m	1.3800e+01 hours	1.3952e-05 1/seconds
Se-79	6.5000e+04 years	3.3815e-13 1/seconds
Br-82	1.4700e+00 days	5.4575e-06 1/seconds
Br-83	2.3900e+00 hours	8.0561e-05 1/seconds
Br-84	3.1800e+01 minutes	3.6328e-04 1/seconds
Br-85	1.7200e+02 seconds	4.0299e-03 1/seconds

## Offsite Dose Calculation Manual

## Attachment 22

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Radionuclide Parameters used.  
Waterford Steam Electric Station

Nuclide	Parameters	
	Half-life	Decay constant
Rb-86	1.8660e+01 days	4.2993e-07 1/seconds
Rb-87	4.6000e+10 years	4.7782e-19 1/seconds
Rb-88	1.7800e+01 minutes	6.4901e-04 1/seconds
Rb-89	1.5440e+01 minutes	7.4822e-04 1/seconds
Sr-89	5.0550e+01 days	1.5870e-07 1/seconds
Sr-90	2.8600e+01 years	7.6852e-10 1/seconds
Sr-91	9.5000e+00 hours	2.0267e-05 1/seconds
Sr-92	2.7100e+00 hours	7.1048e-05 1/seconds
Y-90	6.4100e+01 hours	3.0038e-06 1/seconds
Y-91	5.8510e+01 days	1.3711e-07 1/seconds
Y-91m	4.9710e+01 minutes	2.3240e-04 1/seconds
Y-92	3.5400e+00 hours	5.4390e-05 1/seconds
Y-93	1.0100e+01 hours	1.9063e-05 1/seconds
Zr-93	1.5000e+06 years	1.4653e-14 1/seconds
Zr-95	6.4020e+01 days	1.2531e-07 1/seconds
Zr-97	1.6900e+01 hours	1.1393e-05 1/seconds
Nb-93m	1.3600e+01 years	1.6161e-09 1/seconds
Nb-95	3.5060e+01 days	2.2882e-07 1/seconds
Nb-97	1.2300e+00 hours	1.5654e-04 1/seconds
Mo-93	3.5000e+03 years	6.2799e-12 1/seconds
Mo-99	6.6020e+01 hours	2.9164e-06 1/seconds
Tc-101	1.4200e+01 minutes	8.1355e-04 1/seconds
Tc-99	2.1400e+05 years	1.0271e-13 1/seconds
Tc-99m	6.0200e+00 hours	3.1984e-05 1/seconds
Ru-103	3.9350e+01 days	2.0388e-07 1/seconds
Ru-105	4.4400e+00 hours	4.3365e-05 1/seconds
Ru-106	3.6820e+02 days	2.1789e-08 1/seconds
Rh-105	1.4700e+00 days	5.4575e-06 1/seconds
Pd-107	6.5000e+06 years	3.3815e-15 1/seconds
Pd-109	1.3500e+01 hours	1.4262e-05 1/seconds

## Offsite Dose Calculation Manual

## Attachment 22

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Radionuclide Parameters used.  
Waterford Steam Electric Station

Nuclide	Parameters	
	Half-life	Decay constant
Ag-110m	2.4985e+02 days	3.2109e-08 1/seconds
Ag-111	7.4500e+00 days	1.0769e-06 1/seconds
Cd-113m	1.4600e+01 years	1.5054e-09 1/seconds
Cd-115m	4.4600e+01 days	1.7988e-07 1/seconds
Sn-123	1.2900e+02 days	6.2190e-08 1/seconds
Sn-125	9.6200e+00 days	8.3394e-07 1/seconds
Sn-126	1.0000e+05 years	2.1980e-13 1/seconds
Sb-124	6.0200e+01 days	1.3326e-07 1/seconds
Sb-125	2.7700e+00 years	7.9349e-09 1/seconds
Sb-126	1.2500e+01 days	6.4180e-07 1/seconds
Sb-127	9.3000e+01 hours	2.0703e-06 1/seconds
Te-125m	5.8000e+01 days	1.3832e-07 1/seconds
Te-127	9.3500e+00 hours	2.0593e-05 1/seconds
Te-127m	1.0900e+02 days	7.3601e-08 1/seconds
Te-129	6.9600e+01 minutes	1.6598e-04 1/seconds
Te-129m	3.3600e+01 days	2.3877e-07 1/seconds
Te-131	2.5000e+01 minutes	4.6210e-04 1/seconds
Te-131m	3.0000e+01 hours	6.4180e-06 1/seconds
Te-132	7.8200e+01 hours	2.4622e-06 1/seconds
Te-133m	5.5400e+01 minutes	2.0853e-04 1/seconds
Te-134	4.1800e+01 minutes	2.7637e-04 1/seconds
I-129	1.5700e+07 years	1.4000e-15 1/seconds
I-130	1.2360e+01 hours	1.5578e-05 1/seconds
I-131	8.0400e+00 days	9.9783e-07 1/seconds
I-132	2.3000e+00 hours	8.3713e-05 1/seconds
I-133	2.0800e+01 hours	9.2568e-06 1/seconds
I-134	5.2600e+01 minutes	2.1963e-04 1/seconds
I-135	6.6100e+00 hours	2.9129e-05 1/seconds
Cs-134	2.0620e+00 years	1.0659e-08 1/seconds
Cs-134m	2.9000e+00 hours	6.6393e-05 1/seconds

## Offsite Dose Calculation Manual

## Attachment 22

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Radionuclide Parameters used.  
Waterford Steam Electric Station

Nuclide	Parameters	
	Half-life	Decay constant
Cs-135	2.0000e+06 years	1.0990e-14 1/seconds
Cs-136	1.3160e+01 days	6.0962e-07 1/seconds
Cs-137	3.0170e+01 years	7.2852e-10 1/seconds
Cs-138	3.2200e+01 minutes	3.5877e-04 1/seconds
Cs-139	9.4000e+00 minutes	1.2290e-03 1/seconds
Ba-139	8.3100e+01 minutes	1.3902e-04 1/seconds
Ba-140	1.2789e+01 days	6.2730e-07 1/seconds
Ba-141	1.8270e+01 minutes	6.3232e-04 1/seconds
Ba-142	1.0700e+01 minutes	1.0797e-03 1/seconds
La-140	4.0220e+01 hours	4.7872e-06 1/seconds
La-141	3.9300e+00 hours	4.8993e-05 1/seconds
La-142	9.5400e+01 minutes	1.2109e-04 1/seconds
Ce-141	3.2500e+01 days	2.4685e-07 1/seconds
Ce-143	3.3000e+01 hours	5.8346e-06 1/seconds
Ce-144	2.8430e+02 days	2.8219e-08 1/seconds
Pr-143	1.3560e+01 days	5.9163e-07 1/seconds
Pr-144	1.7280e+01 minutes	6.6854e-04 1/seconds
Nd-147	1.0980e+01 days	7.3065e-07 1/seconds
Pm-147	2.6200e+00 years	8.3891e-09 1/seconds
Pm-148	5.3700e+00 days	1.4940e-06 1/seconds
Pm-148m	4.1300e+01 days	1.9425e-07 1/seconds
Pm-149	2.2100e+00 days	3.6301e-06 1/seconds
Pm-151	1.1800e+00 days	6.7988e-06 1/seconds
Sm-151	9.3000e+01 years	2.3634e-10 1/seconds
Sm-153	1.9500e+00 days	4.1141e-06 1/seconds
Eu-152	1.2700e+01 years	1.7307e-09 1/seconds
Eu-154	1.6000e+02 years	1.3737e-10 1/seconds
Eu-155	1.8000e+00 years	1.2211e-08 1/seconds
Eu-156	1.5200e+01 days	5.2780e-07 1/seconds
Tb-160	7.2100e+01 days	1.1127e-07 1/seconds



## Offsite Dose Calculation Manual

## Attachment 22

## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Radionuclide Parameters used.  
Waterford Steam Electric Station

Nuclide	Parameters	
	Half-life	Decay constant
Ho-166m	1.2000e+03 years	1.8316e-11 1/seconds
W-181	1.2100e+02 days	6.6302e-08 1/seconds
W-185	7.5100e+01 days	1.0682e-07 1/seconds
W-187	2.3830e+01 hours	8.0798e-06 1/seconds
Pb-210	2.0400e+01 years	1.0774e-09 1/seconds
Bi-210	5.0100e+00 days	1.6013e-06 1/seconds
Po-210	1.3800e+02 days	5.8134e-08 1/seconds
Ra-223	1.1400e+01 days	7.0373e-07 1/seconds
Ra-224	3.6600e+00 days	2.1919e-06 1/seconds
Ra-225	1.4800e+01 days	5.4206e-07 1/seconds
Ra-226	1.6000e+03 years	1.3737e-11 1/seconds
Ra-228	5.7500e+00 years	3.8225e-09 1/seconds
Ac-225	1.0000e+01 days	8.0225e-07 1/seconds
Ac-227	2.1800e+01 years	1.0082e-09 1/seconds
Th-227	1.8500e+01 days	4.3365e-07 1/seconds
Th-228	1.9100e+00 years	1.1508e-08 1/seconds
Th-229	7.3400e+03 years	2.9945e-12 1/seconds
Th-230	7.7000e+04 years	2.8545e-13 1/seconds
Th-232	1.4100e+10 years	1.5588e-18 1/seconds
Th-234	2.4100e+01 days	3.3289e-07 1/seconds
Pa-231	3.2800e+04 years	6.7011e-13 1/seconds
Pa-233	2.7400e+01 days	2.9279e-07 1/seconds
U-232	7.2000e+01 years	3.0527e-10 1/seconds
U-233	1.5800e+05 years	1.3911e-13 1/seconds
U-234	2.4800e+05 years	8.8627e-14 1/seconds
U-235	7.0400e+08 years	3.1221e-17 1/seconds
U-236	3.3400e+07 years	6.5807e-16 1/seconds
U-237	6.7500e+00 days	1.1885e-06 1/seconds
U-238	4.7000e+09 years	4.6765e-18 1/seconds
Np-237	2.1400e+06 years	1.0271e-14 1/seconds

## Offsite Dose Calculation Manual

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Radionuclide Parameters used.  
Waterford Steam Electric Station

Nuclide	Parameters	
	Half-life	Decay constant
Np-238	2.1200e+00 days	3.7842e-06 1/seconds
Np-239	2.3550e+00 days	3.4066e-06 1/seconds
Pu-238	8.7800e+01 years	2.5034e-10 1/seconds
Pu-239	2.4100e+04 years	9.1201e-13 1/seconds
Pu-240	6.5400e+03 years	3.3608e-12 1/seconds
Pu-241	1.5200e+01 years	1.4460e-09 1/seconds
Pu-242	3.8700e+05 years	5.6795e-14 1/seconds
Pu-244	8.2600e+07 years	2.6610e-16 1/seconds
Am-241	4.3300e+00 years	5.0761e-09 1/seconds
Am-242m	1.5200e+02 years	1.4460e-10 1/seconds
Am-243	7.3800e+03 years	2.9783e-12 1/seconds
Cm-242	1.6300e+02 days	4.9218e-08 1/seconds
Cm-243	2.8500e+01 years	7.7121e-10 1/seconds
Cm-244	1.8100e+01 years	1.2143e-09 1/seconds
Cm-245	8.5000e+03 years	2.5858e-12 1/seconds
Cm-246	4.8200e+03 years	4.5601e-12 1/seconds
Cm-247	1.5600e+07 years	1.4089e-15 1/seconds
Cm-248	3.6100e+05 years	6.0885e-14 1/seconds
Cf-252	2.4600e+00 years	8.9348e-09 1/seconds

Offsite Dose Calculation Manual

Attachment 22

Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Stable Element Transfer Coefficients by nuclide.  
Waterford Steam Electric Station

Element	Stable Element Transfer Data			
	Biv Veg/Soil	Fm Cow Milk	Ff Meat	Fm Goat Milk
H	4.80e+00	1.00e-02	1.20e-02	1.70e-01
He	5.00e-02	2.00e-02	2.00e-02	2.00e-02
Li	8.30e-04	5.00e-02	1.00e-02	5.00e-02
Be	4.20e-04	1.00e-04	1.00e-03	1.00e-04
B	1.20e-01	2.70e-03	8.00e-04	2.70e-03
C	5.50e+00	1.20e-02	3.10e-02	1.00e-01
N	7.50e+00	2.20e-02	7.70e-02	2.20e-02
O	1.60e+00	2.00e-02	1.60e-02	2.00e-02
F	6.50e-04	1.40e-02	1.50e-01	1.40e-02
Ne	1.40e-01	2.00e-02	2.00e-02	2.00e-02
Na	5.20e-02	4.00e-02	3.00e-02	4.00e-02
Mg	1.30e-01	1.00e-02	5.00e-03	1.00e-02
Al	1.80e-04	5.00e-04	1.50e-03	5.00e-04
Si	1.50e-04	1.00e-04	4.00e-05	1.00e-04
P	1.10e+00	2.50e-02	4.60e-02	2.50e-01
S	5.90e-01	1.80e-02	1.00e-01	1.80e-02
Cl	5.00e+00	5.00e-02	8.00e-02	5.00e-02
Ar	6.00e-01	2.00e-02	2.00e-02	2.00e-02
K	3.70e-01	1.00e-02	1.20e-02	1.00e-02
Ca	3.60e-02	8.00e-03	4.00e-03	8.00e-03
Sc	1.10e-03	5.00e-06	1.60e-02	5.00e-06
Ti	5.40e-05	5.00e-06	3.10e-02	5.00e-06
V	1.30e-03	1.00e-03	2.30e-03	1.00e-03
Cr	2.50e-04	2.20e-03	2.40e-03	2.20e-03
Mn	2.90e-02	2.50e-04	8.00e-04	2.50e-04
Fe	6.60e-04	1.20e-03	4.00e-02	1.30e-04
Co	9.40e-03	1.00e-03	1.30e-02	1.00e-03
Ni	1.90e-02	6.70e-03	5.30e-03	6.70e-03
Cu	1.20e-01	1.40e-02	8.00e-03	1.30e-02
Zn	4.00e-01	3.90e-02	3.00e-02	3.90e-02
Ga	2.50e-04	5.00e-05	1.30e+00	5.00e-05
Ge	1.00e-01	5.00e-04	2.00e+01	5.00e-04
As	1.00e-02	6.00e-03	2.00e-03	6.00e-03
Se	1.30e+00	4.50e-02	1.50e-02	4.50e-02
Br	7.60e-01	5.00e-02	2.60e-02	5.00e-02

Units for transfer data are derived as follows:

Biv -> pCi/kg in vegetation per pCi/kg in soil (no units),

Fm -> pCi/liter in milk per pCi/day ingested by animal (days/liter),

Ff -> pCi/kg in meat per pCi/day ingested by animal (days/kg).

Offsite Dose Calculation Manual

Attachment 22

Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Stable Element Transfer Coefficients by nuclide.  
Waterford Steam Electric Station

Element	Stable Element Transfer Data			
	Biv Veg/Soil	Fm Cow Milk	Ff Meat	Fm Goat Milk
Kr	3.00e+00	2.00e-02	2.00e-02	2.00e-02
Rb	1.30e-01	3.00e-02	3.10e-02	3.00e-02
Sr	1.70e-02	8.00e-04	6.00e-04	1.40e-02
Y	2.60e-03	1.00e-05	4.60e-03	1.00e-05
Zr	1.70e-04	5.00e-06	3.40e-02	5.00e-06
Nb	9.40e-03	2.50e-03	2.80e-01	2.50e-03
Mo	1.20e-01	7.50e-03	8.00e-03	7.50e-03
Tc	2.50e-01	2.50e-02	4.00e-01	2.50e-02
Ru	5.00e-02	1.00e-06	4.00e-01	1.00e-06
Rh	1.30e+01	1.00e-02	1.50e-03	1.00e-02
Pd	5.00e+00	1.00e-02	4.00e-03	1.00e-02
Ag	1.50e-01	5.00e-02	1.70e-02	5.00e-02
Cd	3.00e-01	1.20e-04	5.30e-04	1.20e-04
In	2.50e-01	1.00e-04	8.00e-03	1.00e-04
Sn	2.50e-03	2.50e-03	8.00e-02	2.50e-03
Sb	1.10e-02	1.50e-03	4.00e-03	1.50e-03
Te	1.30e+00	1.00e-03	7.70e-02	1.00e-03
I	2.00e-02	6.00e-03	2.90e-03	6.00e-03
Xe	1.00e+01	2.00e-02	2.00e-02	2.00e-02
Cs	1.00e-02	1.20e-02	4.00e-03	3.00e-01
Ba	5.00e-03	4.00e-04	3.20e-03	4.00e-04
La	2.50e-03	5.00e-06	2.00e-04	5.00e-06
Ce	2.50e-03	1.00e-04	1.20e-03	1.00e-04
Pr	2.50e-03	5.00e-06	4.70e-03	5.00e-06
Nd	2.40e-03	5.00e-06	3.30e-03	5.00e-06
Pm	2.50e-03	5.00e-06	4.80e-03	5.00e-06
Sm	2.50e-03	5.00e-06	5.00e-03	5.00e-06
Eu	2.50e-03	5.00e-06	4.80e-03	5.00e-06
Gd	2.60e-03	5.00e-06	3.60e-03	5.00e-06
Tb	2.60e-03	5.00e-06	4.40e-03	5.00e-06
Dy	2.50e-03	5.00e-06	5.30e-03	5.00e-06
Ho	2.60e-03	5.00e-06	4.40e-03	5.00e-06
Er	2.50e-03	5.00e-06	4.00e-03	5.00e-06
Tm	2.60e-03	5.00e-06	4.40e-03	5.00e-06
Yb	2.50e-03	5.00e-06	4.00e-03	5.00e-06

Units for transfer data are derived as follows:

- Biv -> pCi/kg in vegetation per pCi/kg in soil (no units),
- Fm -> pCi/liter in milk per pCi/day ingested by animal (days/liter),
- Ff -> pCi/kg in meat per pCi/day ingested by animal (days/kg).

## Offsite Dose Calculation Manual

## Attachment 22

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Stable Element Transfer Coefficients by nuclide.  
Waterford Steam Electric Station

Element	Stable Element Transfer Data			
	Biv Veg/Soil	Fm Cow Milk	Ff Meat	Fm Goat Milk
Lu	2.60e-03	5.00e-06	4.40e-03	5.00e-06
Hf	1.70e-04	5.00e-06	4.00e-01	5.00e-06
Ta	6.30e-03	2.50e-02	1.60e+00	2.50e-02
W	1.80e-02	5.00e-04	1.39e-03	5.00e-04
Re	2.50e-01	2.50e-02	8.00e-03	2.50e-02
Os	5.00e-02	5.00e-03	4.00e-01	5.00e-03
Ir	1.30e+01	5.00e-03	1.50e-03	5.00e-03
Pt	5.00e-01	5.00e-03	4.00e-03	5.00e-03
Au	2.50e-03	5.00e-03	8.00e-03	5.00e-03
Hg	3.80e-01	3.80e-02	2.60e-01	3.80e-02
Tl	2.50e-01	2.20e-02	4.00e-02	2.20e-02
Pb	6.80e-02	6.20e-04	2.90e-04	6.20e-04
Bi	1.50e-01	5.00e-04	1.30e-02	5.00e-04
Po	1.50e-01	3.00e-04	1.20e-02	3.00e-04
At	2.50e-01	5.00e-02	8.00e+00	5.00e-02
Rn	3.50e+00	2.00e-02	2.00e-02	2.00e-02
Fr	1.00e-02	5.00e-02	2.00e-02	5.00e-02
Ra	3.10e-04	8.00e-03	3.40e-02	8.00e-03
Ac	2.50e-03	5.00e-06	6.00e-02	5.00e-06
Th	4.20e-03	5.00e-06	2.00e-04	5.00e-06
Pa	2.50e-03	5.00e-06	8.00e+02	5.00e-06
U	2.50e-03	5.00e-04	3.40e-04	5.00e-04
Np	2.50e-03	5.00e-06	2.00e-04	5.00e-06
Pu	2.50e-04	2.00e-06	1.40e-05	2.00e-06
Am	2.50e-04	5.00e-06	2.00e-04	5.00e-06
Cm	2.50e-03	5.00e-06	2.00e-04	5.00e-06
Bk	2.50e-03	5.00e-06	2.00e-04	5.00e-06
Cf	2.50e-03	5.00e-06	2.00e-04	5.00e-06
Es	2.50e-03	5.00e-06	2.00e-04	5.00e-06
Fm	2.50e-03	5.00e-06	2.00e-04	5.00e-06

Units for transfer data are derived as follows:

Biv -> pCi/kg in vegetation per pCi/kg in soil (no units),

Fm -> pCi/liter in milk per pCi/day ingested by animal (days/liter),

Ff -> pCi/kg in meat per pCi/day ingested by animal (days/kg).

Offsite Dose Calculation Manual

Attachment 22

Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Bioaccumulation Factors for Aquatic Organisms by element.  
Waterford Steam Electric Station

Element	Bioaccumulation Factors			
	Fresh Water	Fresh Water	Salt Water	Salt Water
	Fish	Invert.	Fish	Invert.
H	9.00e-01	9.00e-01	9.00e-01	9.30e-01
He	1.00e+00	1.00e+00	1.00e+00	1.00e+00
Li	5.00e-01	4.00e+01	5.00e-01	5.00e-01
Be	2.00e+00	1.00e+01	2.00e+02	2.00e+02
B	2.20e-01	5.00e+01	2.20e-01	4.40e-01
C	4.60e+03	9.10e+03	1.80e+03	1.40e+03
N	1.50e+05	1.50e+05	6.00e+04	1.70e+04
O	9.20e-01	9.20e-01	9.60e-01	9.60e-01
F	1.00e+01	1.00e+02	3.60e+00	3.60e+00
Ne	1.00e+00	1.00e+00	1.00e+00	1.00e+00
Na	1.00e+02	2.00e+02	6.70e-02	1.90e-01
Mg	5.00e+01	1.00e+02	7.70e-01	7.70e-01
Al	1.00e+01	6.30e+01	1.00e+01	6.00e+01
Si	2.50e+00	2.50e+01	1.00e+01	3.30e+01
P	1.00e+05	2.00e+04	2.90e+04	3.00e+04
S	7.50e+02	1.00e+02	1.70e+00	4.40e-01
Cl	5.00e+01	1.00e+02	1.30e-02	1.90e-02
Ar	1.00e+00	1.00e+00	1.00e+00	1.00e+00
K	1.00e+03	8.30e+02	1.10e+01	6.60e+00
Ca	4.00e+01	3.30e+02	5.00e-01	1.30e+01
Sc	2.00e+00	1.00e+03	2.00e+00	1.00e+04
Ti	1.00e+03	3.00e+03	1.00e+03	1.00e+03
V	1.00e+01	3.00e+03	1.00e+01	5.00e+01
Cr	2.00e+02	2.00e+03	4.00e+02	2.00e+03
Mn	4.00e+02	9.00e+04	5.50e+02	4.00e+02
Fe	1.00e+02	3.20e+03	3.00e+03	2.00e+04
Co	5.00e+01	2.00e+02	1.00e+02	1.00e+03
Ni	1.00e+02	1.00e+02	1.00e+02	2.50e+02
Cu	5.00e+01	4.00e+02	6.70e+02	1.70e+03
Zn	2.00e+03	1.00e+04	2.00e+03	5.00e+04
Ga	3.30e+02	6.70e+02	3.30e+02	6.70e+02
Ge	3.30e+03	3.30e+01	3.30e+03	1.70e+04
As	1.00e+02	4.00e+01	3.30e+02	3.30e+02
Se	1.70e+02	1.70e+02	4.00e+03	1.00e+03
Br	4.20e+02	3.30e+02	1.50e-02	3.10e+00
Kr	1.00e+00	1.00e+00	1.00e+00	1.00e+00
Rb	2.00e+03	1.00e+03	8.30e+00	1.70e+01

Bioaccumulation factors in units of pCi/kg per pCi/liter.

Offsite Dose Calculation Manual

Attachment 22

Specific Factors Used to Determine Ai, Pi, Ri Values for the Offside Dose Calculation Manual

Bioaccumulation Factors for Aquatic Organisms by element.  
Waterford Steam Electric Station

Element	Bioaccumulation Factors			
	Fresh Water Fish	Fresh Water Invert.	Salt Water Fish	Salt Water Invert.
Sr	3.00e+01	1.00e+02	2.00e+00	2.00e+01
Y	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Zr	3.30e+00	6.70e+00	2.00e+02	8.00e+01
Nb	3.00e+02	1.00e+02	3.00e+04	1.00e+02
Mo	1.00e+01	1.00e+01	1.00e+01	1.00e+01
Tc	1.50e+01	5.00e+00	1.00e+01	5.00e+01
Ru	1.00e+01	3.00e+02	3.00e+00	1.00e+03
Rh	1.00e+01	3.00e+02	1.00e+01	2.00e+03
Pd	1.00e+01	3.00e+02	1.00e+01	2.00e+03
Ag	2.30e+00	7.70e+02	3.30e+03	3.30e+03
Cd	2.00e+02	2.00e+03	3.00e+03	2.50e+05
In	1.00e+05	1.00e+05	1.00e+05	1.00e+05
Sn	3.00e+03	1.00e+03	3.00e+03	1.00e+03
Sb	1.00e+00	1.00e+01	4.00e+01	5.00e+00
Te	4.00e+02	6.10e+03	1.00e+01	1.00e+02
I	1.50e+01	5.00e+00	1.00e+01	5.00e+01
Xe	1.00e+00	1.00e+00	1.00e+00	1.00e+00
Cs	2.00e+03	1.00e+03	4.00e+01	2.50e+01
Ba	4.00e+00	2.00e+02	1.00e+01	1.00e+02
La	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Ce	1.00e+00	1.00e+03	1.00e+01	6.00e+02
Pr	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Nd	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Pm	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Sm	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Eu	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Gd	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Tb	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Dy	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Ho	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Er	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Tm	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Yb	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Lu	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Hf	3.30e+00	6.70e+00	2.00e+02	2.00e+01
Ta	3.00e+04	6.70e+02	3.00e+04	1.70e+04
W	1.20e+03	1.00e+01	3.00e+01	3.00e+01

Bioaccumulation factors in units of pCi/kg per pCi/liter.

Offsite Dose Calculation Manual

Attachment 22

Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Bioaccumulation Factors for Aquatic Organisms by element.  
Waterford Steam Electric Station

Element	Bioaccumulation Factors			
	Fresh Water Fish	Fresh Water Invert.	Salt Water Fish	Salt Water Invert.
Re	1.20e+02	6.00e+01	4.80e+00	6.00e+01
Os	1.00e+01	3.00e+02	1.00e+01	2.00e+03
Ir	1.00e+01	3.00e+02	1.00e+01	2.00e+03
Pt	1.00e+02	3.00e+02	1.00e+02	2.00e+03
Au	3.30e+01	5.00e+01	3.30e+01	3.30e+01
Hg	1.00e+03	1.00e+05	1.70e+03	3.30e+04
Tl	1.00e+04	1.50e+04	1.00e+04	1.50e+04
Pb	1.00e+02	1.00e+02	3.00e+02	1.00e+03
Bi	1.50e+01	2.40e+01	1.50e+01	2.40e+01
Po	5.00e+02	2.00e+04	3.00e+02	5.00e+03
At	1.50e+01	5.00e+00	1.00e+01	5.00e+01
Rn	1.00e+00	1.00e+00	1.00e+00	1.00e+00
Fr	4.00e+02	1.00e+02	3.00e+01	2.00e+01
Ra	5.00e+01	2.50e+02	5.00e+01	1.00e+02
Ac	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Th	3.00e+01	5.00e+02	1.00e+04	2.00e+03
Pa	1.10e+01	1.10e+02	1.00e+01	1.00e+01
U	2.00e+00	6.00e+01	1.00e+01	1.00e+01
Np	1.00e+01	4.00e+02	1.00e+01	1.00e+01
Pu	3.50e+00	1.00e+02	3.00e+00	2.00e+02
Am	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Cm	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Bk	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Cf	2.50e+01	1.00e+03	2.50e+01	1.00e+03
Es	1.00e+01	1.00e+02	1.00e+01	1.00e+01
Fm	1.00e+01	1.00e+02	1.00e+01	1.00e+01

Bioaccumulation factors in units of pCi/kg per pCi/liter.



## Offsite Dose Calculation Manual

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offside Dose Calculation Manual

Site Specific Parameters used.

Parameter No. : 1  
Description : fraction of ingested produce grown in region  
Formula Symbol : fg  
Value : 0.760  
Units : none

Parameter No. : 2  
Description : fraction of leafy vegetables grown in region  
Formula Symbol : fL  
Value : 1.000  
Units : none

Parameter No. : 4  
Description : fraction of activity retained on crops for airborne  
particulates  
Formula Symbol : r  
Value : 0.200  
Units : none

Parameter No. : 5  
Description : fraction of activity retained on crops for airborne  
radioiodines  
Formula Symbol : r  
Value : 1.000  
Units : none

Parameter No. : 6  
Description : building shielding factor for maximum individuals  
Formula Symbol : SF  
Value : 0.700  
Units : none

Parameter No. : 11  
Description : period of long term buildup of activity in soil or sediment  
Formula Symbol : t  
Value : 131400.000  
Units : hr

Parameter No. : 12  
Description : transport time from animal feed-milk-man max individuals  
Formula Symbol : tf  
Value : 2.000  
Units : days

Parameter No. : 15  
Description : time delay for harvest of veg/crops and ingestion by  
animals - stored feed  
Formula Symbol : th  
Value : 2160.000  
Units : hr

## Offsite Dose Calculation Manual

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offside Dose Calculation Manual

Paramater No. : 16  
Description : time delay for harvest of veg/crops and ingestion by  
man - leafy veg max indivd  
Formula Symbol : tL  
Value : 24.000  
Units : hr

Paramater No. : 17  
Description : time delay for harvest of veg/crops and ingestion by  
man - produce veg max ind  
Formula Symbol : th  
Value : 1440.000  
Units : hr

Paramater No. : 37  
Description : agricultural productivity by unit area stored feed  
feed-animal-man  
Formula Symbol : Ys  
Value : 2.000  
Units : kg/m2

Paramater No. : 38  
Description : agricultural productivity by unit area pasture grass  
feed-animal-man  
Formula Symbol : Yp  
Value : 0.700  
Units : kg/m2

Paramater No. : 41  
Description : time from slaughter of meat animal to consumption  
Formula Symbol : tf  
Value : 20.000  
Units : days

Paramater No. : 43  
Description : agricultural productivity by unit area crops/veg-man  
Formula Symbol : Yv  
Value : 2.000  
Units : kg/m2

Paramater No. : 44  
Description : rate constant for removal of activity on plants by weathering  
Formula Symbol : lambda-w  
Value : 2.062938e-3  
Units : hr-1

Paramater No. : 69  
Description : fraction of year that milk cows are on pasture  
Formula Symbol : fp  
Value : 1.000  
Units : none

## Offsite Dose Calculation Manual

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## Specific Factors Used to Determine Ai, Pi, Ri Values for the Offsite Dose Calculation Manual

Parameter No. : 70  
Description : fraction of year that milk goats are on pasture  
Formula Symbol : fp  
Value : 1.000  
Units : none

Parameter No. : 71  
Description : fraction of year that beef cows are on pasture  
Formula Symbol : fp  
Value : 1.000  
Units : none

Parameter No. : 73  
Description : fraction of milk cow's intake from pasture  
Formula Symbol : fs  
Value : 1.000  
Units : none

Parameter No. : 74  
Description : fraction of milk goat's intake from pasture  
Formula Symbol : fs  
Value : 1.000  
Units : none

Parameter No. : 75  
Description : fraction of beef cow's intake from pasture  
Formula Symbol : fs  
Value : 1.000  
Units : none

Parameter No. : 88  
Description : absolute relative humidity in the atmosphere  
Formula Symbol : H  
Value : 8.000  
Units : g/m<sup>3</sup>

## Offsite Dose Calculation Manual

## Attachment 23

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## ODCM Specifications Contained in the Waterford 3 Technical Requirements Manual

TRM SPECIFICATION	TRM TABLE OR SECTION	DESCRIPTION
3.11.1.1	Section 3/4.11.1	Liquid Effluents - Concentration
4.11.1.1.1	Table 4.11-1	Radioactive Liquid Waste Sampling and Analysis Program
3.11.1.2	Section 3/4.11.1	Liquid Effluents - Dose
3.11.1.3	Section 3/4.11.1	Liquid Radwaste Treatment System
3.11.2.1	Section 3/4.11.2	Gaseous Effluents - Dose Rate
4.11.2.1.2	Table 4.11-2	Radioactive Gaseous Waste Sampling and Analysis Program
3.11.2.2	Section 3/4.11.2	Gaseous Effluents - Dose Rate (Noble Gases)
3.11.2.3	Section 3/4.11.2	Gaseous Effluents - Dose Rate (I-131, I-133, Tritium and Particulates)
3.11.2.4	Section 3/4.11.2	Gaseous Radwaste Treatment
3.11.4	Section 3/4.11.4	Total Dose
3.3.3.10	Section 3/4.3.3	Radioactive Liquid Effluent Monitoring Instrumentation
4.3.3.10	Table 3.3-12	Radioactive Liquid Effluent Monitoring Instrumentation
3.3.3.11	Section 3/4.3.3	Radioactive Gaseous Effluent Monitoring Instrumentation
4.3.3.11	Table 3.3-12	Radioactive Gaseous Effluent Monitoring Instrumentation
3.12.1	Section 3/4.12.1	Radiological Environmental Monitoring Program
3.12.1	Table 3.12-1	Radiological Environmental Monitoring Program
3.12.2	Table 3.12-2	Reporting Levels For Radioactivity Concentrations in Environmental Samples
3.12.2	Table 4.12-1	Detection Capabilities For Environmental Sample Analysis Lower Limits of Detection
3.12.2	Section 3/4.12.2	Land Use Census
3.12.3	Section 3/4.12.3	Interlaboratory Comparison Program
3/4.3.3.10	Section 3/4.3	Radioactive Liquid Effluent Monitoring Instrumentation Basis
3/4.3.3.11	Section 3/4.3	Radioactive Gaseous Effluent Monitoring Instrumentation Basis
3/4.11.1.1	Section 3/4.11	Liquid Effluents Concentration Basis
3/4.11.1.2	Section 3/4.11	Liquid Effluents Dose Basis
3/4.11.1.3	Section 3/4.11	Liquid Radwaste Treatment System Basis
3/4.11.2.1	Section 3/4.11	Gaseous Effluents Dose Rate Basis
3/4.11.2.2	Section 3/4.11	Gaseous Effluents Dose - Noble Gases Basis
3/4.11.2.3	Section 3/4.11	Gaseous Effluents Dose - I-131, I-133, Tritium and Particulates Basis
3/4.11.2.4	Section 3/4.11	Gaseous Radwaste Treatment System Basis
3/4.11.4	Section 3/4.11	Total Dose Basis
3/4.12.1	Section 3/4.12	Radiological Environmental Monitoring Program Basis
3/4.12.2	Section 3/4.12	Land Use Census Basis
3/4.12.3	Section 3/4.12	Interlaboratory Comparison Program Basis