SHIELDALLOY METALLURGICAL CORPORATION

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Robert L. Swenson
Senior Vice President
General Manager - Alloys and Metals Division

March 15, 1994

Mr. John D. Kinneman, Chief
Site Decommissioning Section
Facilities Radiological Safety & Safeguards Branch
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

RE: Reply to Notice of Violation: Routine Inspection No. 040-07102/93-001
License No. SMB-743
Docket No. 040-07102
Dated January 31, 1994

Dear Mr. Kinneman:

Shieldalloy Metallurgical Corporation (SMC) received your letter on February 16, 1994 which forwarded the findings of the inspection of our Newfield, N.J. facility, conducted on December 2nd and 3rd, 1993, and a Notice of Violation (NOV) of January 31, 1994. Per your discussions on March 7th with C. Scott Eves, the date for submission of a response was extended until March 15, 1994. In accordance with the NOV and 10 CFR 2.201, SMC is writing to respond to the NOV and specifically set forth as requested: 1) the reason for the violation or the basis for disputing it, 2) the corrective actions that have been taken by SMC to resolve the violations, 3) the corrective steps that will be taken to avoid further violations, and 4) the date when full compliance will be achieved.

VIOLATION A:

A. Condition 10 of License No. SMB-743 requires that licensed material be possessed and used in accordance with statements, representations, and procedures contained in an application dated December 23, 1977.

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PDR ADOCK 04007102
C PDR

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RETURN ORIGINAL TO
REGION I

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Item 2 of Chapter IV and Item 1 of Chapter V of the application require that air surveys in the blending area and furnace area be performed monthly.

Contrary to the above, as of December 3, 1993, air surveys in the blending area and furnace area were performed two times in 1993, a frequency less than monthly.

RESPONSE TO VIOLATION A:

1. Shieldalloy has been operating under 1977 application. (The 1977 license expired in 1985, and timely renewal applications were submitted in 1985, 1988 and 1992, none of which resulted in a renewed license.) The 1992 renewal application (as amended in February of 1993) was intended to bring Shieldalloy into compliance with the "new Part 20". In that application, Shieldalloy specified that quarterly air sampling in the blending area and furnace area was conducted, in January 1993, July 1993, October 1993, and January 1994. In the aftermath of the departure of the Radiation Safety Officer (RSO), it was discovered that the second quarter measurements (due in March of 1993) were neglected. However, the Alternate Radiation Safety Officer, who assumed the RSO's responsibilities, resumed quarterly sampling during the third quarter of 1993.

2. The authority for assuring compliance with license conditions as specified in the 1992 Application for Renewal, as amended in June, 1992, has been clearly designated to the RSO. Quarterly sampling has been conducted on schedule since the third quarter of 1993.

3. The Radiation Safety Committee will provide oversight for performance of activities specified in the 1992 Renewal Application, and will assure that future staffing changes will not impact Shieldalloy's ability to demonstrate compliance.

4. Compliance has been achieved since the third quarter of 1993.

VIOLATION B:

B. 10 CFR 20.201(b) requires that each licensee make such surveys as may be necessary to comply with the requirements of Part 20 and which are reasonable under the circumstances to evaluate the extent of radiation hazards that may be present. As defined in 10 CFR 20.201(a), "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions.

Contrary to the above, as of December 3, 1993, the licensee did not make adequate surveys to assure compliance with 10 CFR 20.106, which limits the yearly average concentration of radioactive material in air discharged to unrestricted areas. Specifically, the licensee did not evaluate the impact on the radionuclide concentration in the effluent discharged to unrestricted areas as a result of the enclosure constructed around the electric arc furnace in Department 111, filter bag breakage in the baghouses, and the increase in uranium concentration in pyrochlore received from the Niobec Mine.

RESPONSE TO VIOLATION B:

1. SMC disputes this violation. Shieldalloy believes that it was in compliance with 20.106 based upon finding of a report by ORAU (1981). This report, which summarized the results of stack measurements made in 1981, concluded that effluent concentrations were well below the limits specified in Appendix B, Table II, as required in 20.106. Therefore, additional measurements pursuant to 20.201(b) were not considered to be necessary.

However, since 1981, a new baghouse was installed along with more efficient air flow duct work. To demonstrate whether additional surveys were necessary in light of the regulatory changes forthcoming in the "new Part 20", Shieldalloy performed radiation dose estimates for members of the general public (see Attachment 1) based upon the operating parameters of the new equipment. This evaluation indicated that, pursuant to 20.1302, the calculated total effective dose equivalent to the individual likely to receive the highest

dose from the licensed operation is only a small fraction of the annual dose limit of 100 millirem. Therefore, Shieldalloy still does not believe that additional surveys are necessary.

2. A copy of Shieldalloy's calculations (Attachment 1) to demonstrate compliance with 20.1301/1302 was provided to the USNRC and their consultant in support of the 1992 application review process. Another copy is attached for your reference.

3. Not applicable.

4. Not applicable.

Sincerely,

Robert L. Swenson
General Manager/Senior Vice President
Alloys and Metals Division

RLS:lms

Attachment (1): Radiation Dose Estimates for Members of the General Public at the Newfield, New Jersey Facility

cc: Mary B. Higgins
C. Scott Eves
James P. Valenti
Brian W. Martin
Jay Silberg - Shaw, Pittman, Potts, & Trowbridge
Carol Berger - International Technology Corp.

N-NRC-93 Licensing

INTERNATIONAL TECHNOLOGY CORPORATION

RADIATION DOSE ESTIMATES FOR MEMBERS OF THE GENERAL PUBLIC AT THE NEWFIELD, NEW JERSEY FACILITY

Submitted to:

Shieldalloy Metallurgical Corporation
West Boulevard
Post Office Box 768
Newfield, New Jersey 08344

By:

C. D. Berger
IT Corporation/Nuclear Sciences
1133 21st Street, N.W., Suite 710
Washington, D. C. 20036
(202) 331-8510

Report No. IT/NS-93-107
February 16, 1993

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TABLE OF CONTENTS

INTRODUCTION 1

APPROACH 2

ESTIMATION OF AIR EMISSIONS 3
- Production Area Emissions Based on Baghouse Efficiency 3
- Production Area Emissions Based on 1988 Stack Sampling Data 4
- Storage Area Emissions Based on Radon Emanation Rates 4

ESTIMATION OF OFF-SITE DOSES 5

CONCLUSIONS 7

REFERENCES 9

APPENDIX A: CAP88-PC Reports for Stack Emissions 11

APPENDIX B: CAP88-PC Reports for Storage Yard Emissions 25

INTRODUCTION

Shieldalloy Metallurgical Corporation (Shieldalloy) operates a manufacturing facility located in Newfield, New Jersey. This facility manufactures or has manufactured specialty steel and super alloy additives, primary aluminum master alloys, metal carbides, powdered metals, and optical surfacing products. Raw materials currently used at the facility include ores which contain oxides of columbium (niobium), vanadium, aluminum metal, titanium metal, strontium metal, zirconium metal, and fluoride (titanium and boron) salts. During the manufacturing process, the facility generates slag, dross, bag house dust, and waste waters, among other waste streams.

One of the materials received, used and stored by Shieldalloy contains radioactive material which his classified as "source material" pursuant to Title 10, Code of Federal Regulations, Part 40. It is pyrochlore, a concentrated ore containing columbium (niobium). The pyrochlore contains greater than 0.05% of natural uranium and natural thorium.

Shieldalloy currently holds a U. S. Nuclear Regulatory Commission (USNRC) License (No. SMB-743) allowing possession, use, and storage of source material. The most recent renewal of SMB-743 was granted in July, 1980. Prior to its expiration in July, 1985, Shieldalloy submitted an application for renewal, thus extending SMB-743 until the USNRC acts upon the renewal application. A revised renewal application was submitted on July 18, 1988, and again on June 2, 1992.

On December 15, 1992, the USNRC requested that Shieldalloy provide an analysis of the routine annual average atmospheric releases of radioactivity from the Newfield facility. They also advised that the source term should include significant atmospheric releases of radon and thoron from storage and process areas in addition to the routine radioactivity releases from the baghouses (Hickey, 1993). This report, which contains an evaluation of emission rates and off-site radiation doses, is intended to provide that information. It contains a description of the approach used to evaluate atmospheric releases, an estimate of maximum possible radiation doses to a maximally-exposed member of the general public, and

the regulatory/technical basis for Shieldalloy's atmospheric emissions surveillance and compliance program.

APPROACH

There are a number of license criteria and regulations which must be considered in design of the Shieldalloy effluent monitoring program. For example, the recent application for renewal of Source Material License No. SMB-743 contains a description of the Shieldalloy radiation protection program in the form of a Radiation Protection Program Plan (SMC, 1992). That Plan states that "Off-site dose assessment to the nearest member of the general public shall be completed at a frequency of no less than once per calendar year" (SMC, 1993). In addition, Title 10, Code of Federal Regulations, Part 20.1301 (NRC, 1992), upon which Shieldalloy's 1993 license renewal application is based, states that: "Each licensee shall conduct operations so that -- (1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem in a year" (NRC, 1992). The USNRC also states, in 10 CFR 20.1302, that:

> "The licensee shall make or cause to be made, as appropriate, surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in § 20.1301" (NRC, 1992); and that "A licensee shall show compliance with the annual dose limit in § 20.1301 by -- (1) demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit" (NRC, 1992).

In order to establish whether Shieldalloy meets the § 20.1301 annual dose limit for members of the general public, the calculational methodology permitted by § 20.1302 was used. The following is a description of the general approach:

- The quantity of airborne emissions from production buildings is estimated from the known efficiency of the dust collection system for ferrocolumbium operations.[1]

- The estimated quantity of airborne emissions from storage areas is estimated from known radionuclide concentrations in the radioactive materials deposited in the Storage Yard, and referenced ratios of radon emission to ^{226}Ra concentration.

- The estimated quantity of airborne emissions is used as input to the CAP88-PC computer model, which is a set of computer programs, databases, and associated utility programs for estimation of dose from radionuclide emissions to air as a demonstration of compliance under the National Emission Standards for Hazardous Air Pollutants (EPA, 1992).

ESTIMATION OF AIR EMISSIONS

Production Area Emissions Based on Baghouse Efficiency

As part of the quality control program for production operations, Shieldalloy has determined that of the total quantity (by weight) of feed material that goes into the ferrocolumbium production process in Building D-111, 34% is returned as product (ferrocolumbium alloy), and 58% is returned as slag. The remainder, or 8%, is assumed to enter the dust collection system. For an average production year, this results in approximately 8.01×10^5 pounds, or 3.64×10^5 kg, of material entering the bag house of the dust collection system (Rieman, 1991).

Pursuant to vendor specifications, the efficiency of the dust collection system is a nominal 99% under routine operating conditions.[2] If it is assumed that 1% of all of the material

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[1] The estimated quantity of airborne emissions from this methodology was compared to emission measurements performed by Oak Ridge Associated Universities (ORAU) during a radiological survey of the Newfield site (Berger, 1988) as a measure of validity.

[2] A particulate-sensitive warning system is set to alarm if any bag leakage (breakthrough) occurs.

which enters the baghouse is released to the atmosphere, this results in an annual emission rate of 3.64×10^3 kg of dust.[3]

The maximum measured concentrations of ^{232}Th and ^{238}U in baghouse dust are 76.5 pCi/g and 20 pCi/g, respectively (Berger, 1988 and Teledyne, 1991). If it is assumed that these maximum concentrations apply to all baghouse dust released from D-111, this results in an annual release of approximately 2.78×10^{-4} Ci of ^{232}Th, and 7.28×10^{-5} Ci of ^{238}U.

Production Area Emissions Based on 1988 Stack Sampling Data

During a 1988 survey, ORAU performed stack effluent sampling in the ferrocolumbium production building (D-111). The results of that sampling effort were negative for air emissions above the detection sensitivity of the measurement/analysis methodology. The average of the results reported were less than 6.31×10^{-11} Ci/year for ^{232}Th, and less than 1.34×10^{-7} Ci/year for ^{238}U. These results confirm that radionuclide releases calculated from the specified efficiency of the D-111 bag house are gross over-estimates.

Storage Area Emissions Based on Radon Emanation Rates

In the Shieldalloy Storage Yard, there are, primarily, two slag piles which contain source material and one pile of bag-house dust (lime pile).[4] Each of these are considered to be separate sources of airborne emissions. Since no measurements of airborne emissions from these sources have been completed to date, they are estimated from the known concentration of radium in the piles (Berger, 1988 and Teledyne, 1991), and a referenced ratio for radon emission to ^{226}Ra concentration (UNSCEAR, 1988).

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[3] A 1989 particle size study on D-111 bag house dust indicates that greater than 90% consists of particles greater than 45 μm in diameter (USTC, 1989). Referenced efficiency graphs for fabric filters comparable to those in use in the D-111 bag house show a 100% collection efficiency for particles with diameters greater than 5 μm (ASHRAE, 1989). Therefore, the assumption that 1% of all material that enters the D-111 bag house is released to the atmosphere is clearly conservative.

[4] There also exists a 10 m^3 slag pile which may contain radioactive constituents. Due to its relatively small size, it is not considered to be a significant contributor to the ^{222}Rn source term for the site.

The maximum measured concentration of ^{226}Ra in the piles is 6.9×10^{-11} Ci/g in the Hi-Ratio slag pile, 1.23×10^{-10} Ci/g in the Standard slag pile, and 1.91×10^{-11} Ci/g in the lime pile (Berger, 1988). The surface areas of the three piles are approximately 2,500 m^2, 10,000 m^2, and 2,500 m^2, respectively (Berger, 1988).[5] The referenced ratio of radon emission to radium concentration used for this assessment is 1.53×10^3 (UNSCEAR, 1988).[6] Application of this value to the slag and bag house dust at the Newfield plant indicates an annual ^{222}Rn release rate of 3.47×10^{-3} Ci/y from the Hi-Ratio pile, 2.48×10^{-2} Ci/y from the Standard pile, and 9.61×10^{-4} Ci/y from the lime pile.

ESTIMATION OF OFF-SITE DOSES

The CAP-88 (Clean Air Act Assessment Package-1988) computer model permits assessments of both collective population dose, and maximally exposed individual dose. CAP88-PC uses a modified Gaussian plume equation to estimate the average dispersion of radionuclides released from up to six sources, which may be either elevated stacks, such as the D-111 stack, or uniform area sources, such as the piles of slag and baghouse dust in the Shieldalloy storage yard (EPA, 1992b).

The program computes radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in food, and intake rates to people from ingestion of food produced in the assessment area. Estimates of the radionuclide concentrations in produce, leafy vegetables, milk and meat consumed by humans are made by coupling the output of the atmospheric transport models with the USNRC Regulatory Guide 1.109 Terrestrial food chain models. A library of meteorological data for most major cities is supplied with the code. The following assumptions were used as input to the code for estimating off-site doses from production area emissions at the Newfield Plant:

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[5] The emission-to-concentration ratio is dependent upon soil density, water content, and a number of other factors. From the physical properties of the three piles, the ratio selected is considered to be a conservative value.

[6] The referenced ratio was determined for radium concentrations in soil.

- Wind data from Wilmington, Delaware (Wilmington International Airport) were deemed applicable to conditions at Newfield.
- The annual average rainfall amount is 111.8 cm per year (IT, 1992).
- The annual average temperature is 12°C (IT, 1992).
- The height and diameter of the production building stack are 7.62 and 3.05 meters, respectively (IT, 1992).
- A momentum plume rise was assumed, with a stack emission rate of 990 meters per minute (Berger, 1988).
- Agricultural usage was assumed to fit an "Urban" scenario, wherein over 90% of the milk, meat, and vegetables consumed are from the assessment area.
- The radionuclide release rates were 2.78×10^{-4} Ci/y of ^{232}Th, 2.78×10^{-4} Ci/y of <u>each</u> of the daughters in the thorium decay chain with the exception of ^{208}Tl, 8.1×10^{-9} Ci/y for ^{208}Tl, 7.28×10^{-5}Ci/y of ^{238}U, and 7.28×10^{-5} Ci/y of <u>each</u> of the daughters in the uranium decay chain.

The results of this assessment indicate a maximum annual radiation dose of 0.22 millirem to the maximally-exposed individual, which the computer code indicates is located 300 meters East Southeast of the D-111 stack. Appendix A contains the reports from the CAP88-PC output.

The following assumptions were used as input to the CAP88 code for estimating off-site doses from Storage Yard emissions at the Newfield site:

- Wind data from Wilmington, Delaware (Wilmington International Airport) were deemed applicable to conditions at Newfield.
- The annual average rainfall amount is 111.8 cm per year (IT, 1992).
- The annual average temperature is 12°C (IT, 1992).

- The area of the three sources of emissions are 2,500 m^2 for the Hi-Ratio slag pile, 10,000 m^2 for the Standard slag pile, and 2,500 m^2 for the lime pile (Berger, 1988).
- A momentum plume rise was assumed.
- Agricultural usage was assumed to fit an "Urban" scenario.
- The annual average ^{222}Rn release rate is 3.47×10^{-3} Ci/y from the Hi-Ratio pile, 2.48×10^{-2} Ci/y from the Standard pile, and 9.61×10^{-4} Ci/y from the lime pile.
- The dose contribution from radon daughters was included in the calculation.

The results of this assessment indicate a maximum annual radiation dose of 0.009 millirem to a member of the general public located 50 meters East Southeast of the Storage Yard. Appendix B contains the reports from this CAP88-PC output.

CONCLUSIONS

The emissions estimates and dose assessments presented herein have an associated error due, primarily, to the conservative nature of the assumptions used as input to the calculations. Perhaps the greatest contributor to the error is the estimate of emissions from the production building. The values used for this assessment were based upon specifications of baghouse efficiency which, when compared to measured emissions, results in an annual release rate that is at least three orders of magnitude higher than actually occurs. Consequently, the maximum off-site doses reported herein are also over-estimated by at least three orders of magnitude. However, this approach was selected in order to assure that under-estimations did not result.

In any event, it is clear that, even under these generous circumstances, the off-site doses to the maximally-exposed individual as a result of atmospheric releases from the Shieldalloy plant are negligible. Furthermore, if the basis for off-site dose estimates is baghouse efficiency combined with annual ferrocolumbium production rate, conservative values will

result. Consequently, routine emission measurements are not necessary in order for Shieldalloy to demonstrate conformance with USNRC regulations and license requirements.

REFERENCES

ASHRAE, 1989 — American Society of Heating, Refrigerating and Air Conditioning Engineers, Handbook, "Typical Fractional Efficiency Curves for Dry Collectors", 1989.

Berger, 1988 — Berger, J. D. and A. D. Luck, "Radiological Survey of the Shieldalloy Corporation, Newfield, New Jersey", ORAU Report No. 88/G-75, July, 1988.

DOE, 1988 — U. S. Department of Energy, "External Dose Rate Conversion Factors for Calculation of Dose to the Public", USDOE Report No. DOE/EH-0070, July, 1988.

DOE, 1988b — U. S. Department of Energy, "Internal Dose Conversion Factors for Calculation of Dose to the Public", Report No. DOE/EH-0071, July, 1988.

EPA, 1992 — U. S. Environmental Protection Agency, Title 40, Code of Federal Regulations, Part 61, "National Emission Standards for Hazardous Air Pollutants", January, 1992.

EPA, 1992b — U. S. Environmental Protection Agency, "User's Guide for CAP88-PC, Version 1.0", by Barry S. Parks, Report No. 402-B-92-001, Office of Radiation Programs, March, 1992.

Faraz, 1992 — Faraz, Yawar, U. S. Nuclear Regulatory Commission, letter to Shieldalloy Metallurgical Corporation, December 15, 1992.

Hickey, 1993 — Hickey, John W. N., U. S. Nuclear Regulatory Commission, letter to Mr. David R. Smith, Shieldalloy Metallurgical Corporation, January 14, 1993.

IT, 1992 — IT Corporation, Applicant's Environmental Report for the Newfield, New Jersey Facility", by C. D. Berger, A. Chance, and B. Kelly, IT Corporation Report No. IT/NS-92-118.

IT, 1993 — IT Corporation, "Conceptual Decommissioning Plan for the Newfield, New Jersey Facility", by C. D. Berger and R. J. Duff, IT Corporation Report No. IT/NS-93-104, 1993.

NRC, 1992 — U. S. Nuclear Regulatory Commission, Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation", January 1, 1992.

Rieman, 1991 — Rieman, Craig, R., Shieldalloy Metallurgical Corporation, Letter to Dale Hoffmeyer, U. s. Environmental Protection Agency, "Radionuclide Air Emissions Survey Form", December 17, 1991.

SMC, 1992 — Shieldalloy Metallurgical Corporation, "Application for Amendment and Renewal of Source Material License Number SMB-743", June 2, 1992.

SMC, 1993 — Shieldalloy Metallurgical Corporation, "USNRC Source Material License No. SMB-743, Supplement to Application Dated June 2, 1992", February, 1993.

Teledyne, 1991 — Teledyne Isotopes , "Report of Analysis", September 18, 1991.

UNSCEAR, 1988 — United Nations Scientific Committee on the Effects of Atomic Radiation, "Sources, Effects and Risks of Ionizing Radiation", United Nations, 1988.

USTC, 1989 — United States Testing Company, Inc., Report of Test, Number 032243, March 15, 1989.

APPENDIX A: CAP88-PC Reports for Stack Emissions

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Jan 21, 1993 12:56 am

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Effective Dose Equivalent
(mrem/year)

2.21E-01

At This Location: 300 Meters East Southeast
Source Category: USNRC Licensee
Source Type: Stack
Emission Year: 1991

Comments: Test Run

Dataset Name: Shieldalloy
Dataset Date: Jan 21, 1993 12:55 am
Wind File: WNDFILES\ILG1058.WND

MAXIMALLY EXPOSED INDIVIDUAL
(RN-222 Working Level Calculations Excluded)

Location Of The Individual: 300 Meters East Southeast
Lifetime Fatal Cancer Risk: 2.77E-06

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Dose Equivalent (mrem/y)
GONADS	2.57E-02
BREAST	2.42E-02
R MAR	1.16E-01
LUNGS	1.25E+00
THYROID	2.42E-02
ENDOST	1.24E+00
RMNDR	3.03E-02
EFFEC	2.21E-01

RADIONUCLIDE EMISSIONS DURING THE YEAR 1991

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
TH-232	Y	1.00	2.8E-04	2.8E-04
RA-228	W	1.00	2.8E-04	2.8E-04
AC-228	Y	1.00	2.8E-04	2.8E-04
TH-228	Y	1.00	2.8E-04	2.8E-04
RA-224	W	1.00	2.8E-04	2.8E-04
RN-220	*	0.00	2.8E-04	2.8E-04
PO-216	W	1.00	2.8E-04	2.8E-04
PB-212	D	1.00	2.8E-04	2.8E-04
BI-212	W	1.00	2.8E-04	2.8E-04
TL-208	D	1.00	8.3E-05	8.3E-05
U-238	Y	1.00	7.3E-05	7.3E-05
TH-234	Y	1.00	7.3E-05	7.3E-05
PA-234	Y	1.00	7.3E-05	7.3E-05
U-234	Y	1.00	7.3E-05	7.3E-05
TH-230	Y	1.00	7.3E-05	7.3E-05
RA-226	W	1.00	7.3E-05	7.3E-05
RN-222	*	0.00	7.3E-05	7.3E-05
PO-218	W	1.00	7.3E-05	7.3E-05
PB-214	D	1.00	7.3E-05	7.3E-05
BI-214	W	1.00	7.3E-05	7.3E-05
PO-214	W	1.00	7.3E-05	7.3E-05
PB-210	D	1.00	7.3E-05	7.3E-05
BI-210	W	1.00	7.3E-05	7.3E-05
PO-210	W	1.00	7.3E-05	7.3E-05

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 112 cm/y
Mixing Height: 1000 m

SOURCE INFORMATION

Source Number:	1
Stack Height (m):	7.62
Diameter (m):	3.05
Plume Rise Momentum (m/s): (Exit Velocity)	1.65E+01

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.076	0.000	0.008
Fraction From Assessment Area:	0.924	1.000	0.992
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

50 100 200 300 400 500

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

G E N E R A L D A T A

Non-Radon Individual Assessment
Jan 21, 1993 12:56 am

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Source Category: USNRC Licensee
Source Type: Stack
Emission Year: 1991

Comments: Test Run

Dataset Name: Shieldalloy
Dataset Date: Jan 21, 1993 12:55 am
Wind File: WNDFILES\ILG1058.WND

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
TH-232	Y	1.0	1.12E-05	1.80E-03
RA-228	W	1.0	1.12E-05	1.80E-03
AC-228	Y	1.0	1.12E-05	1.80E-03
TH-228	Y	1.0	1.12E-05	1.80E-03
RA-224	W	1.0	1.12E-05	1.80E-03
RN-220	*	0.0	0.00E+00	0.00E+00
PO-216	W	1.0	1.12E-05	1.80E-03
PB-212	D	1.0	1.12E-05	1.80E-03
BI-212	W	1.0	1.12E-05	1.80E-03
TL-208	D	1.0	1.12E-05	1.80E-03
U-238	Y	1.0	1.12E-05	1.80E-03
TH-234	Y	1.0	1.12E-05	1.80E-03
PA-234	Y	1.0	1.12E-05	1.80E-03
U-234	Y	1.0	1.12E-05	1.80E-03
TH-230	Y	1.0	1.12E-05	1.80E-03
RA-226	W	1.0	1.12E-05	1.80E-03
RN-222	*	0.0	0.00E+00	0.00E+00
PO-218	W	1.0	1.12E-05	1.80E-03
PB-214	D	1.0	1.12E-05	1.80E-03
BI-214	W	1.0	1.12E-05	1.80E-03
PO-214	W	1.0	1.12E-05	1.80E-03
PB-210	D	1.0	1.12E-05	1.80E-03
BI-210	W	1.0	1.12E-05	1.80E-03
PO-210	W	1.0	1.12E-05	1.80E-03

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	DECAY CONSTANT (PER DAY)			TRANSFER COEFFICIENT	
Nuclide	Radio-active (1)	Surface	Water	Milk (2)	Meat (3
TH-232	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-0
RA-228	0.00E+00	5.48E-05	0.00E+00	4.50E-04	2.50E-0
AC-228	0.00E+00	5.48E-05	0.00E+00	2.00E-05	2.50E-0
TH-228	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-0
RA-224	1.91E-01	5.48E-05	0.00E+00	4.50E-04	2.50E-0
RN-220	1.08E+03	5.48E-05	0.00E+00	0.00E+00	0.00E+0
PO-216	1.91E-01	5.48E-05	0.00E+00	3.50E-04	9.50E-0
PB-212	1.91E-01	5.48E-05	0.00E+00	2.50E-04	3.00E-0
BI-212	1.91E-01	5.48E-05	0.00E+00	5.00E-04	4.00E-0
TL-208	1.91E-01	5.48E-05	0.00E+00	2.00E-03	4.00E-0
U-238	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-0
TH-234	2.88E-02	5.48E-05	0.00E+00	5.00E-06	6.00E-0
PA-234	2.48E+00	5.48E-05	0.00E+00	5.00E-06	1.00E-0
U-234	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-0
TH-230	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-0
RA-226	0.00E+00	5.48E-05	0.00E+00	4.50E-04	2.50E-0
RN-222	1.81E-01	5.48E-05	0.00E+00	0.00E+00	0.00E+0
PO-218	3.27E+02	5.48E-05	0.00E+00	3.50E-04	9.50E-0
PB-214	3.72E+01	5.48E-05	0.00E+00	2.50E-04	3.00E-0
BI-214	5.02E+01	5.48E-05	0.00E+00	5.00E-04	4.00E-0
PO-214	3.66E+08	5.48E-05	0.00E+00	3.50E-04	9.50E-0
PB-210	0.00E+00	5.48E-05	0.00E+00	2.50E-04	3.00E-0
BI-210	1.38E-01	5.48E-05	0.00E+00	5.00E-04	4.00E-0
PO-210	0.00E+00	5.48E-05	0.00E+00	3.50E-04	9.50E-0

FOOTNOTES:

(1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
Nuclide	Forage (1)	Edible (2)	Inhalation	Ingestion
TH-232	8.50E-04	3.64E-05	2.00E-04	2.00E-04
RA-228	1.50E-02	6.42E-04	2.00E-01	2.00E-01
AC-228	3.50E-03	1.50E-04	1.00E-03	1.00E-03
TH-228	8.50E-04	3.64E-05	2.00E-04	2.00E-04
RA-224	1.50E-02	6.42E-04	2.00E-01	2.00E-01
RN-220	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PO-216	2.50E-03	1.71E-04	1.00E-01	1.00E-01
PB-212	4.50E-02	3.85E-03	2.00E-01	2.00E-01
BI-212	3.50E-02	2.14E-03	5.00E-02	5.00E-02
TL-208	4.00E-03	1.71E-04	9.50E-01	9.50E-01
U-238	8.50E-03	1.71E-03	2.00E-03	2.00E-01
TH-234	8.50E-04	3.64E-05	2.00E-04	2.00E-04
PA-234	2.50E-03	1.07E-04	1.00E-03	1.00E-03
U-234	8.50E-03	1.71E-03	2.00E-03	2.00E-01
TH-230	8.50E-04	3.64E-05	2.00E-04	2.00E-04
RA-226	1.50E-02	6.42E-04	2.00E-01	2.00E-01
RN-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PO-218	2.50E-03	1.71E-04	1.00E-01	1.00E-01
PB-214	4.50E-02	3.85E-03	2.00E-01	2.00E-01
BI-214	3.50E-02	2.14E-03	5.00E-02	5.00E-02
PO-214	2.50E-03	1.71E-04	1.00E-01	1.00E-01
PB-210	4.50E-02	3.85E-03	2.00E-01	2.00E-01
BI-210	3.50E-02	2.14E-03	5.00E-02	5.00E-02
PO-210	2.50E-03	1.71E-04	1.00E-01	1.00E-01

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pasture and forage (in pCi/kg dry weight per pCi/kg dry soil)

(2) Concentration factor for uptake of nuclide from soil by edibl parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

DECAY CHAIN INGROWTH FACTORS

Nuclide	Parent(s)	Ingrowth Factor(s)
RA-228	TH-232	5.080E+00
AC-228	TH-232	3.580E+04
	RA-228	7.050E+03
TH-228	TH-232	1.300E+01
	RA-228	2.580E+00
RA-224	TH-232	2.340E+03
	RA-228	4.660E+02
	TH-228	1.810E+02
RN-220	TH-232	1.330E+07
	RA-228	2.650E+06
	TH-228	1.030E+06
PO-216	TH-232	4.940E+09
	RA-228	9.830E+08
	TH-228	3.810E+08
PB-212	TH-232	1.930E+04
	RA-228	3.850E+03
	TH-228	1.490E+03
BI-212	TH-232	2.040E+05
	RA-228	4.060E+04
	TH-228	1.570E+04
TL-208	TH-232	1.440E+06
	RA-228	2.880E+05
	TH-228	1.120E+05
PA-234	TH-234	2.961E+04
RA-226	TH-230	1.490E-02
PB-214	TH-230	6.915E+03
	RA-226	4.635E+05
	PO-218	1.138E-01
BI-214	TH-230	9.313E+03
	RA-226	6.240E+05
	PO-218	1.532E-01
	PB-214	1.347E+00
PO-210	PB-210	3.560E+01
	BI-210	3.621E-02

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/sq m, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy veg for human consumption (kg/sq m)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/day, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/day)	1.10E+01
MEAT ANIMAL SLAUGHTER PARAMETERS	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (per day)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	7.60E-02
Meat	8.00E-03
Milk	0.00E+00
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Minimum fractions of food types from outside area listed below are actual fixed values.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Individual Assessment
Jan 21, 1993 12:56 am

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Source Category: USNRC Licensee
Source Type: Stack
Emission Year: 1991

Comments: Test Run

Dataset Name: Shieldalloy
Dataset Date: Jan 21, 1993 12:55 am
Wind File: WNDFILES\ILG1058.WND

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class							
Dir	A	B	C	D	E	F	G	Wind Frequenc
N	1.535	2.214	3.336	4.143	3.210	1.476	0.000	0.077
NNW	1.289	2.309	3.335	3.918	2.965	1.449	0.000	0.034
NW	1.465	2.127	2.436	2.960	2.791	1.422	0.000	0.034
WNW	1.513	1.885	2.668	3.406	2.695	1.351	0.000	0.026
W	1.504	2.124	3.199	3.965	3.029	1.393	0.000	0.035
WSW	1.345	2.104	3.623	4.500	3.287	1.579	0.000	0.050
SW	1.273	2.252	3.195	4.253	3.030	1.456	0.000	0.038
SSW	1.251	1.913	2.911	3.896	3.236	1.458	0.000	0.041
S	1.513	1.990	2.960	3.748	3.228	1.562	0.000	0.059
SSE	1.166	2.057	3.171	4.230	3.298	1.543	0.000	0.058
SE	1.132	2.104	3.495	5.210	3.421	1.538	0.000	0.116
ESE	1.301	1.917	3.412	5.261	3.478	1.537	0.000	0.147
E	1.415	2.043	3.235	4.227	3.490	1.529	0.000	0.080
ENE	1.421	2.154	3.315	3.934	3.315	1.603	0.000	0.075
NE	1.330	2.021	3.428	4.042	3.158	1.510	0.000	0.072
NNE	1.238	1.939	3.020	3.703	2.981	1.477	0.000	0.059

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	2.051	2.975	4.142	5.141	3.441	1.999	0.000
NNW	1.804	3.070	4.084	4.964	3.151	1.974	0.000
NW	1.989	2.851	3.255	3.816	2.915	1.948	0.000
WNW	2.032	2.660	3.348	4.389	2.772	1.874	0.000
W	2.024	2.799	3.915	4.985	3.231	1.919	0.000
WSW	1.868	2.825	4.195	5.594	3.523	2.087	0.000
SW	1.784	2.945	3.850	5.471	3.232	1.980	0.000
SSW	1.758	2.777	3.659	4.951	3.469	1.983	0.000
S	2.032	2.921	3.796	4.914	3.461	2.073	0.000
SSE	1.641	2.891	4.098	5.655	3.534	2.057	0.000
SE	1.590	2.925	4.392	6.655	3.657	2.053	0.000
ESE	1.818	2.767	4.302	6.665	3.711	2.052	0.000
E	1.941	2.988	4.158	5.574	3.722	2.046	0.000
ENE	1.948	2.956	4.082	5.031	3.552	2.105	0.000
NE	1.852	2.856	4.303	5.143	3.383	2.029	0.000
NNE	1.741	2.844	3.854	4.741	3.172	2.000	0.000

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.0049	0.0383	0.0949	0.5717	0.1578	0.1324	0.0000
NNW	0.0203	0.0756	0.1507	0.5387	0.1256	0.0891	0.0000
NW	0.0209	0.0932	0.0953	0.4963	0.1544	0.1400	0.0000
WNW	0.0117	0.0642	0.0883	0.5988	0.1369	0.1003	0.0000
W	0.0065	0.0520	0.0739	0.7226	0.0870	0.0580	0.0000
WSW	0.0046	0.0372	0.0824	0.7517	0.0757	0.0484	0.0000
SW	0.0042	0.0443	0.1076	0.6747	0.0943	0.0749	0.0000
SSW	0.0103	0.0408	0.1165	0.5817	0.1388	0.1119	0.0000
S	0.0051	0.0483	0.1135	0.4899	0.1717	0.1714	0.0000
SSE	0.0050	0.0391	0.1223	0.4773	0.1434	0.2129	0.0000
SE	0.0047	0.0295	0.0998	0.5179	0.1487	0.1993	0.0000
ESE	0.0050	0.0397	0.1043	0.4790	0.1601	0.2118	0.0000
E	0.0096	0.0426	0.1097	0.3690	0.1991	0.2700	0.0000
ENE	0.0065	0.0481	0.1568	0.3367	0.2068	0.2451	0.0000
NE	0.0062	0.0457	0.1446	0.4202	0.1789	0.2043	0.0000
NNE	0.0066	0.0427	0.1132	0.4438	0.1638	0.2299	0.0000
TOT	0.0071	0.0445	0.1118	0.5049	0.1544	0.1774	0.0000

ADDITIONAL WEATHER INFORMATION

Average Air Temperature:	12.0 degrees C
	285.2 K
Precipitation:	111.7 cm/y
Lid Height:	1000 meters
Surface Roughness Length:	0.010 meters
Height Of Wind Measurements:	10.0 meters
Average Wind Speed:	4.277 m/s

Vertical Temperature Gradients:

STABILITY E	0.073 k/m
STABILITY F	0.109 k/m
STABILITY G	0.146 k/m

APPENDIX B: CAP88-PC Reports for Storage Yard Emissions

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Radon Individual Assessment
Jan 21, 1993 3:15 pm

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Effective Dose Equivalent
(mrem/year)

8.71E-03

At This Location: 50 Meters East Southeast
Source Category: USNRC Licensee
Source Type: Area
Emission Year: 1991

Comments: Test Run

Dataset Name: smc-area
Dataset Date: Jan 21, 1993 3:15 pm
Wind File: WNDFILES\ILG1058.WND

RN-222 MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 50 Meters East Southeast
Radon Concentration (pCi/l): 4.07E-04
Decay Product Concentration (WL): 1.09E-06
Lifetime Fatal Cancer Risk: 1.53E-06

RADIONUCLIDE EMISSIONS DURING THE YEAR 1991

Nuclide	Class	Size	Source #1 Ci/y	Source #2 Ci/y	Source #3 Ci/y	TOTAL Ci/y
RN-222	*	0.00	3.5E-03	2.5E-02	9.6E-04	2.9E-02

SITE INFORMATION

Temperature: 12 degrees C
Precipitation: 112 cm/y
Mixing Height: 1000 m

SOURCE INFORMATION

Source Number:	1	2	3
Source Height (m):	0.42	1.68	6.04
Area (sq m):	2.50E+03	1.00E+04	2.50E+03

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

50 100 200 300 400 500

C A P 8 8 - P C

Version 1.00

Clean Air Act Assessment Package - 1988

G E N E R A L D A T A

Radon Individual Assessment
Jan 21, 1993 3:15 pm

Facility: Shieldalloy Metallurgical Corporation
Address: West Boulevard
City: Newfield
State: NJ Zip: 08311

Source Category: USNRC Licensee
Source Type: Area
Emission Year: 1991

Comments: Test Run

Dataset Name: smc-area
Dataset Date: Jan 21, 1993 3:15 pm
Wind File: WNDFILES\ILG1058.WND

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
RN-222	*	0.0	0.00E+00	0.00E+00

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	DECAY CONSTANT (PER DAY)			TRANSFER COEFFICIENT	
Nuclide	Radio-active (1)	Surface	Water	Milk (2)	Meat (3
RN-222	1.81E-01	5.48E-05	0.00E+00	0.00E+00	0.00E+0

FOOTNOTES:
(1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
Nuclide	Forage (1)	Edible (2)	Inhalation	Ingestion
RN-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pasture and forage (in pCi/kg dry weight per pCi/kg dry soil)

(2) Concentration factor for uptake of nuclide from soil by edibl parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/sq m, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy veg for human consumption (kg/sq m)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/day, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/day)	1.10E+01
MEAT ANIMAL SLAUGHTER PARAMETERS	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (per day)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	7.60E-02
Meat	8.00E-03
Milk	0.00E+00
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Minimum fractions of food types from outside area listed below are actual fixed values.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

EXPOSURE LEVELS FOR SHORT-LIFE PROGENY OF RN-222
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (Meters)	Exposure Level (Person WL) (.7 EQF)	Adjusted Equilibrium Fraction	Adjusted Exposure Level
N	50	1.481E-06	0.27	5.651E-07
N	100	5.148E-07	0.27	1.964E-07
N	200	2.333E-07	0.27	9.098E-08
N	300	1.212E-07	0.28	4.814E-08
N	400	7.229E-08	0.28	2.933E-08
N	500	4.818E-08	0.29	1.989E-08
NNW	50	1.265E-06	0.27	4.825E-07
NNW	100	3.366E-07	0.27	1.284E-07
NNW	200	1.110E-07	0.27	4.328E-08
NNW	300	4.496E-08	0.28	1.785E-08
NNW	400	2.672E-08	0.28	1.084E-08
NNW	500	1.778E-08	0.29	7.340E-09
NW	50	1.045E-06	0.27	3.987E-07
NW	100	3.259E-07	0.27	1.243E-07
NW	200	1.206E-07	0.27	4.705E-08
NW	300	6.247E-08	0.28	2.481E-08
NW	400	3.719E-08	0.28	1.509E-08
NW	500	2.477E-08	0.29	1.022E-08
WNW	50	1.037E-06	0.27	3.955E-07
WNW	100	2.965E-07	0.27	1.131E-07
WNW	200	8.894E-08	0.27	3.469E-08
WNW	300	4.100E-08	0.28	1.628E-08
WNW	400	2.441E-08	0.28	9.902E-09
WNW	500	1.626E-08	0.29	6.712E-09
W	50	1.028E-06	0.27	3.922E-07
W	100	3.091E-07	0.27	1.179E-07
W	200	8.783E-08	0.27	3.425E-08
W	300	4.158E-08	0.28	1.651E-08
W	400	2.476E-08	0.28	1.004E-08
W	500	1.650E-08	0.29	6.814E-09
WSW	50	1.175E-06	0.27	4.481E-07
WSW	100	3.421E-07	0.27	1.305E-07
WSW	200	1.002E-07	0.27	3.909E-08
WSW	300	4.959E-08	0.28	1.969E-08
WSW	400	2.952E-08	0.28	1.198E-08
WSW	500	1.968E-08	0.29	8.125E-09
SW	50	1.299E-06	0.27	4.955E-07
SW	100	4.318E-07	0.27	1.647E-07
SW	200	9.973E-08	0.27	3.890E-08
SW	300	4.655E-08	0.28	1.849E-08
SW	400	2.771E-08	0.28	1.124E-08
SW	500	1.846E-08	0.29	7.623E-09
SSW	50	1.620E-06	0.27	6.179E-07
SSW	100	5.615E-07	0.27	2.142E-07
SSW	200	1.321E-07	0.27	5.151E-08

EXPOSURE LEVELS FOR SHORT-LIFE PROGENY OF RN-222
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (Meters)	Exposure Level (Person WL) (.7 EQF)	Adjusted Equilibrium Fraction	Adjusted Exposure Level
SSW	300	6.101E-08	0.28	2.423E-08
SSW	400	3.633E-08	0.28	1.474E-08
SSW	500	2.420E-08	0.29	9.992E-09
S	50	2.099E-06	0.27	8.006E-07
S	100	8.209E-07	0.27	3.131E-07
S	200	2.069E-07	0.27	8.070E-08
S	300	1.045E-07	0.28	4.148E-08
S	400	6.227E-08	0.28	2.527E-08
S	500	4.149E-08	0.29	1.713E-08
SSE	50	2.413E-06	0.27	9.202E-07
SSE	100	1.138E-06	0.27	4.341E-07
SSE	200	2.457E-07	0.27	9.582E-08
SSE	300	1.110E-07	0.28	4.410E-08
SSE	400	6.629E-08	0.28	2.689E-08
SSE	500	4.417E-08	0.29	1.824E-08
SE	50	2.682E-06	0.27	1.023E-06
SE	100	1.347E-06	0.27	5.138E-07
SE	200	4.160E-07	0.27	1.622E-07
SE	300	2.060E-07	0.28	8.179E-08
SE	400	1.230E-07	0.28	4.990E-08
SE	500	8.198E-08	0.29	3.385E-08
ESE	50	2.849E-06	0.27	1.087E-06
ESE	100	1.278E-06	0.27	4.875E-07
ESE	200	5.208E-07	0.27	2.031E-07
ESE	300	2.710E-07	0.28	1.076E-07
ESE	400	1.618E-07	0.28	6.563E-08
ESE	500	1.078E-07	0.29	4.451E-08
E	50	2.617E-06	0.27	9.981E-07
E	100	1.005E-06	0.27	3.832E-07
E	200	3.799E-07	0.27	1.482E-07
E	300	1.806E-07	0.28	7.171E-08
E	400	1.078E-07	0.28	4.376E-08
E	500	7.187E-08	0.29	2.967E-08
ENE	50	2.235E-06	0.27	8.525E-07
ENE	100	8.902E-07	0.27	3.396E-07
ENE	200	3.204E-07	0.27	1.250E-07
ENE	300	1.562E-07	0.28	6.205E-08
ENE	400	9.321E-08	0.28	3.782E-08
ENE	500	6.208E-08	0.29	2.563E-08
NE	50	1.968E-06	0.27	7.507E-07
NE	100	8.220E-07	0.27	3.135E-07
NE	200	2.870E-07	0.27	1.119E-07
NE	300	1.403E-07	0.28	5.573E-08
NE	400	8.371E-08	0.28	3.396E-08
NE	500	5.576E-08	0.29	2.302E-08

EXPOSURE LEVELS FOR SHORT-LIFE PROGENY OF RN-222
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

Wind Toward	Distance (Meters)	Exposure Level (Person WL) (.7 EQF)	Adjusted Equilibrium Fraction	Adjusted Exposure Level
NNE	50	1.775E-06	0.27	6.770E-07
NNE	100	6.616E-07	0.27	2.524E-07
NNE	200	2.622E-07	0.27	1.023E-07
NNE	300	1.275E-07	0.28	5.065E-08
NNE	400	7.613E-08	0.28	3.089E-08
NNE	500	5.074E-08	0.29	2.095E-08