Manufacturing Sciences Corporation

Sampling and Analysis Plan
For Nickel Recycle

November 9, 1998

FINAL DRAFT

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1 Objectives

Recycling of nickel will be conducted in two phases, Phase I and Phase II. Sampling and analyses will follow these phases.

1.1 Phase I Sampling and Analyses Objectives

The sampling and analysis objectives of Phase I are to provide confirmatory proof of the process and methods of contaminated nickel recycle.

During Phase I, production anodes and cationic membranes will be used to produce production cathodes. The *current density*, *anolyte recirculation* and *filtration* will be approximately the same as in the planned Phase II production scale processes.

The same type of sampling planned for the Phase II production processes will be undertaken for Phase I, but with a much greater number of samples collected and analyzed during Phase I. The sampling and analyses during Phase I will demonstrate the capabilities of the system to consistently remove contaminants to the desired level thus allowing the Phase II sampling to focus on only the critical parameters to control the process and to demonstrate the releaseabilty of the finished ingot.

Phase I sampling and analysis is also expected to prove the uniformity of individual cathode ingots and the uniformity of ingots within a process bath.

1.2 Phase II Sampling and Analyses Objectives

Sampling and analyses during Phase II will focus on the critical parameters identified during Phase I. Focusing on critical parameters will assure the process remains stable and produces releasable metal.

The objectives of Phase II are to demonstrate the releasability of the finished ingot. Samples will be collected and analyzed to verify that production cells are operating correctly and producing virtually contaminant free nickel cathodes suitable for unrestricted release.

2 Sampling Plan, Phase I

2.1 Anode Sampling

As the anode ingots are prepared, metallic samples will be collected. The samples may be collected as a liquid when the ingot is poured or as shavings taken either by drilling into the ingot or shaving a small amount from the surface of the ingot.

2.2 Anode Solution (*anolyte*) Sampling

Sampling of the anolyte is important to process control as comparison can be made between the anolyte and the catholyte allowing for determination of the membrane efficiencies.

Samples will be collected in any convenient manner as the anolyte is in constant circulation and will be homogenous. Samples will be identified with appropriate information and submitted to the analytical laboratory following appropriate instructions and/or procedures.

The process manager will determine the scheduling of these samples and the analytical requirements.

2.3 Cathode Solution (*catholyte*) Sampling

The catholyte will be sampled daily as a minimum throughout cathode generation during Phase I. The sample will consist of a volumetric composite of several random samples taken from various points around the cathode, and is to include subsurface samples. The composite sample(s) will be identified with appropriate information and submitted to the analytical laboratory following appropriate instructions and/or procedures.

The data from this sampling will establish the relationship between the technetium and uranium concentrations within the solution and the technetium and uranium concentrations within the refined metal. Catholyte technetium concentration will also provide information on the condition of the cationic membrane. Increases in the concentration of technetium would indicate a possible failure of the membrane. This parameter will be important in process control.

2.4 Cathode Sampling

After the cathode has been removed from the electo-refining bath, removable contamination surveys will be performed following MSC's Work Instruction *Unrestricted Release Survey of Materials*.

Volumetric samples will then be taken from the cathode in a minimum of three different locations. These samples will be collected by drilling through the ingot (*see* MSC Work Instruction *Volumetric Sampling of Refined Nickel Ingots*).

The samples will be identified uniquely with the cathode ingot. The metal will be packaged in a suitable container and submitted to the analytical laboratory following appropriate instructions and/or procedures.

3. Sampling Plan, Phase II

3.1 Anode Sampling

As the anode ingots are prepared, a metallic sample will be collected from each melt batch. The samples may be collected as a liquid when the ingot is poured or as shavings taken either by drilling into the ingot or shaving a small amount from the surface of the ingot.

3.2 Anolyte Sampling

Samples will be collected in any convenient manner as the anolyte is in constant circulation and will be homogenous. Samples will be identified with appropriate information and submitted to the analytical laboratory following appropriate instructions and/or procedures. The process manager will determine the scheduling of these samples and the analytical requirements.

3.3 Catholyte Sampling

The catholyte will be sampled at the start of a new cathode and at the completion of a cathode as a minimum. Additional samples may be collected during cathode generation but will not be required. The catholyte sampling will be the primary focus of the process control and any additional samples that may be collected will be for process control purposes.

Samples may either be grabs or composites. The sample type and collection will be defined from Phase I information to best target critical parameters. The sample(s) will be identified with appropriate information and submitted to the analytical laboratory following appropriate instructions and/or procedures.

3.4 Cathode Sampling

Volumetric sampling of each finished ingot will be performed prior to any unrestricted release. Samples will be taken after all removable contamination surveys have been completed.

The sample(s) will consist of the shavings from a drilling completely through the ingot. The metallic sample will be packaged in a suitable container and submitted to the analytical laboratory following appropriate instructions and/or procedures (*see* Work Instruction for *Volumetric Sampling of Refined Nickel Ingots*).

4 Radiological Analyses, Phases I and II

4.1 Anolyte and Catholyte Analysis

The analytical methods utilized for the anolyte and catholyte process solutions will be very similar to the analysis for the metallic samples (Section 4.2). The primary exception will be in sample count times as count times for the process solutions will likely be shorter. These solutions are process control solutions only and therefore detection levels need not be as stringent as those for unrestricted release. Liquid scintillation and gamma spectroscopy will be utilized.

4.2 Anode and Cathode Analyses

Analysis for ^{99}Tc and for uranium will be conducted using liquid scintillation alpha/beta pulse discrimination techniques. Count time is expected to be approximately 100 minutes per sample.

In both Phases, procedures for analyzing metal samples from anodes and cathodes will be much the same, with the only significant exception being count times. Shorter count times should be adequate for quantifying anode base-line data. However, longer count times will likely be required to achieve the levels of detection necessary for unrestricted release.

Sample size will be approximately 15 grams of material. The sample will be digested in a concentrated acid solution; the anticipated solvent for the material is nitric acid. The dissolved sample will then go through several evaporation and dilution steps prior to a final dilution which will be between 100 mL and 500 mL.

Additionally, a percentage of cathode samples will be analyzed to verify no other radionuclides are present in the refined nickel. Process knowledge indicates that this additional analysis is not necessary, however as a conservative measure this verification will be performed.

5 Quality Control

All laboratory instrumentation will be calibrated, operated, and maintained in accordance with appropriate MSC Instructions, Instructions Guides, and/or Procedures.

6 Records

Records of all measurements and evaluations will be properly identified and maintained for any regulatory or customer review. All records will be maintained in accordance with appropriate MSC Instructions, Instruction Guides, and/or Procedures.

TITLE: UNRESTRICTED RELEASE SURVEY OF MATERIALS

1.0 PURPOSE

The purpose of this Instruction is to provide requirements for the release of material for unrestricted use.

2.0 SCOPE

This procedure details the steps necessary for survey, tracking and documentation of material released for unrestricted use from Manufacturing Sciences Corporation, Kerr Hollow Road facilities.

3.0 REFERENCES

3.1 U. S. Atomic Energy Commission. *Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors,* Retyped by U.S. EPA, August 1997.

3.2 Manufacturing Sciences Corporation. *Radioactive Material License R-01078-L00 submittal.*

4.0 DEFINITIONS

4.1 *Surface Contamination Release Limit* - the allowable surface activity per unit area. The limit is taken from Regulatory Guide 1.86, Table 1 (Attachment 1.) and actual isotopic considerations relative to the material in question.

4.2 *Batch* - materials, items, components, etc. from the same customer with the same MSC Job Number and Customer ID Number. This can consist of a single SMC to several large components to many SMC containers.

4.3 *Unrestricted Release* - an item or items that have met the criteria relative to *surface*, *removable*, and *maximum* activity established by Regulatory Guide 1.86. The item(s) is/are considered to be releasable to non-radiologically controlled areas for unrestricted use.

4.4 *Inaccessible Area* - an area on an item considered for release that cannot be surveyed for unrestricted release with standard survey meters or techniques. The Survey Manager or Designee shall determine unrestricted release status for those items identified with inaccessible areas.

5.0 PRECAUTIONS

None.

6.0 PREREQUISTIES

6.1 Performance of radiological surveys for unrestricted release is limited to personnel who are qualified for the task involved. Qualification is determined in accordance with each individual's Role Proficiency Record.

6.2 Personnel considered to be in training may perform surveys under the guidance of a qualified individual. *Initial* of the completed unrestricted release survey record information by the trainee must be accompanied by the initials or signature of the qualified individual.

6.3 Review and adherence to the Radiation and Industrial Safety Work Permit is required prior to beginning as well as during work activities.

6.4 Calibration of all radiological instrumentation shall be current.

6.5 Response check (source check) of instruments is required prior to beginning work.

6.6 Minimum Detectable Activity (MDA) for hand-held instruments shall be established prior to survey activities. MDA shall be less than the release limits specified for removable radioactivity.

6.7 Background radiation levels must be maintained low enough so that the survey instrument MDA is less than the release limit for the material (*see* Attachment 2. for MDA calculations table for various instruments).

6.8 Minimum detectable activity (MDA) for the Laboratory low level counting instrumentation shall be established prior to survey activities for unrestricted release by laboratory qualified personnel. MDA shall be less than the release limits specified for removable radioactivity.

6.9 The Laboratory low level counting instrumentation shall be the basis for determination of removable contamination for unrestricted release. Utilization of the Laboratory low level counting instrumentation shall be in accordance with the Instruction or Instructional Guide for that instrument.

6.10 Release Limits based on Regulatory Guide 1.86 will be determined for the material being surveyed by the RSO or Designee.

7.0 RESPONSIBILITIES

7.1 Radiation Safety Officer (RSO)

7.1.1 The RSO is responsible for all unrestricted release of materials from MSC.

7.1.2 The RSO may designate responsibilities and/or certain tasks of the unrestricted release program.

7.1.3 The RSO or designee will establish appropriate unrestricted release limits. These established limits will take into account isotopic contamination considerations, material geometry considerations if necessary, material composition considerations if necessary, and any other applicable considerations which may be determined as necessary.

7.2 Survey Manager

7.2.2 The Survey Manager or Designee will provide the Technicians with job assignments. The job assignments will include information on the customer and the *surface contamination release limits*.

7.2.3 The Survey Manager or Designee *may* adjust the limits to be more conservative if this is desired. Any and all adjustments and calculations will be maintained in a log and will be traceable to Customer ID and/or MSC Job Number.

7.2.4 It will be left to the Survey Manager's or Designee's discretion as to how the *surface contamination release limits* will be provided.

7.2.5 The Survey Manager or Designee will evaluate all items that exhibit elevations greater than the provided *surface contamination release limit* which are not subject to immediate rejection. Evaluation will involve maximum activity considerations allowable by U.S. Atomic Energy Commission Regulatory Guide 1.86 (Attachment 1.).

7.2.6 After the surface contamination evaluation is completed, the Survey Manager or Designee will complete the Unrestricted Release Survey Record paperwork by providing the appropriate information after review of the removable contamination survey analyses and officially release the material.

7.2.7 The Survey Manager or Designee shall see that prior to materials leaving the MSC Kerr Hollow Road site for unrestricted release, the materials have a dose rate survey completed by authorized personnel with appropriate instrumentation. Any levels greater than 10 μR/hr above background will be investigated further. Further investigation may require segregation and/or unloading of materials.

7.2.8 The Survey Manager or Designee shall insure that information within the MIS Systems is maintained as current and accurate as possible with regard to Survey Operations specific information.

7.3 Survey Technicians

7.3.1 Survey Technicians are responsible for the completion of surface contamination surveys including all associated paperwork.

7.3.2 Surveys Technicians are responsible for appropriate instrument response checks, background checks, and/or other operational checks which are prescribed.

7.3.3 Survey Technicians are responsible the collection of wipes for evaluation of removable contamination.

7.3.4 Survey Technicians are responsible for maintaining good general housekeeping within the areas utilized for survey.

7.3.5 The RSO or Survey Manager may give Survey Technicians with demonstrated capabilities additional responsibilities.

7.4 MSC Analytical Laboratory will perform contamination survey wipe analysis. Analysis will consist of individual wipe evaluation with low level α/β counting instrumentation. Utilization of this instrumentation will be in accordance with appropriate instructions and instruction guides.

8.0 <u>PROCEDURES FOR UNRESTRICTED RELEASE SURVEYS</u>

8.1 *Manual* Surface Contamination Surveys

8.1.1 On receipt of survey work assignments, record on the appropriate record the *date*, *time*, and *MSC Job Number* of the materials. *Surface Contamination Release Limits* will be provided with survey assignments.

8.1.2 Record the incoming container number and net weight received. Record the appropriate instrumentation information.

8.1.3 Conduct a removable contamination survey on the materials with masslinn wiping material.

8.1.3a This survey should include all reasonably accessible pieces and surfaces with the materials still in the transport containers.

8.1.3b Evaluate the masslinn wipe for contamination. If contamination does not exceed 1,000 dpm per wipe, proceed with surface contamination survey. If, however, contamination exceeds 1,000 dpm, perform an additional gross removable contamination survey on the materials as before and evaluate the wipe(s) again. If the materials fail a second time, notify the Survey Manager or Designee for direction on proceeding.

8.1.4 Remove components from the containers to an appropriate survey area. Record the general area background in µR/hr on the record.

8.1.5 Utilizing appropriate instrumentation, perform a surface scan of the materials. The maximum allowable probe distance while scanning is ½" from the surface of the material. The maximum allowable scan rate is 2" per second.

Note: Inaccessible Areas. Components with inaccessible areas encountered during surface scans will be disassembled to allow access to all surfaces. Those items that cannot be disassembled will be referred to the Survey Manager or Designee for determination.

8.1.5a If, while scanning, a noticeable increase in count rate occurs, hold the probe stationary for at least 25 seconds at the point of increase to allow the count rate to stabilize.

8.1.5b If the count rate exceeds the provided *surface contamination release limits* specified, note the area of the elevated count rate by marking with an appropriate marker.

8.1.5c The piece is *rejected* if (1) greater than 25% of the piece's total surface area exhibits elevations greater than the provided release limit, or if (2) any elevation greater than three times the provided *surface contamination release limit* is detected. All reject pieces will immediately be placed in the appropriate waste container.

8.1.5d If the piece exhibits elevations greater than the release limit but less than *three times* the release limit and covers an area less than 25% of the total surface area, the Survey Manager or Designee will be informed and will then make a determination. The Survey Manager or Designee may make maximum allowable exceptions on a case by case basis.

8.1.5e Point source considerations may be applied if the materials exhibit point source characteristics and the technician performing the survey is qualified with regard to point source considerations. The RSO or Designee will make qualification determinations.

8.1.5f If the piece exhibits ***no elevations***, proceed with wipe collection.

8.1.6 After the piece has passed the surface scan evaluation, the technician will collect removable contamination wipes.

8.1.6a The Survey Technician will take enough 100 cm^2 wipes (with appropriate material, i.e. Mohawk Wipes, other disk wipes) to ensure a representative sampling of the batch surveyed.

8.1.6b The technician shall field check all the wipes associated with the piece just scanned in order to allow segregation of pieces which exhibit removable contamination greater than 1000 dpm/100 cm^2. Field checks are also used to assure that no excessively elevated wipes proceed to the laboratory.

8.1.7 Each Survey Technician will initial or uniquely mark each piece after evaluation and wipe collection.

8.1.8 After wipe collection, wipe field check, and marking of the piece, place the piece into a "clean unrestricted release holding container" and proceed with the next piece.

8.1.9 Collect and assemble the wipes in a manner as to minimize cross contamination and label them appropriately for future laboratory analysis.

8.1.10 At the completion of a "batch" of material, complete the required blocks on the record (net weight released and rejected, container numbers, etc.) and submit the wipes from that batch to the laboratory for evaluation following appropriate laboratory procedures for sample submission.

8.1.11 Turn all related paperwork over to the Survey Manager or Designee, obtain new assignments from the Survey Manager or Designee, and continue as before with the new assignment.

8.2 *Conveyorized* Surface Contamination Surveys

8.2.1 On receipt of survey work assignments, document on the appropriate record the *date*, *time*, and *MSC Job Number* of the materials. *Surface Contamination Release Limits* will be provided with survey assignments.

8.2.2 Record the incoming container number and net weight received. Record the appropriate instrumentation information.

8.2.3 Conduct a removable contamination survey on the materials with masslinn wiping material.

8.2.3a This survey should include all reasonably accessible pieces and surfaces with the materials still in the transport containers.

8.2.3b Evaluate the masslinn wipe for contamination. If there is no contamination > 1,000 dpm per wipe, proceed with surface contamination survey. If, however, contamination exceeds 1,000 dpm per wipe, perform an additional removable contamination survey on the materials as before and evaluate the wipe(s) as before. If the materials fail a second time, notify the Survey Manager or Designee for direction on proceeding.

8.2.4 Only approved personnel shall operate and conduct surface contamination surveys with conveyorized monitoring equipment. Approval requires passing a written examination and displayed operational competence as determined by the RSO or Designee.

8.2.5 All conveyorized monitors will be calibrated annually as a minimum. All instruments will be response checked prior to operations and must meet pre-operational criteria before any materials may be surveyed.

8.2.6 The Survey Technician shall perform a μR/hr background check with an appropriate instrument and record the background on the Unrestricted Release Survey Record. The background should be at or below 50 μR/hr and stable. If it is above 50 μR/hr, the system may not allow operation (the system provides internal checks to ensure alarm levels are obtainable with the current background level).

8.2.7 The Survey Technician shall set the instrument alarm level to the appropriate activity for the materials that will be evaluated. This information will be provided by the RSO or Designee.

8.2.8 The Survey Technician shall complete the appropriate Response Check Form (Attachment 4.) by verifying operation diagnostics checks, response checks, and false alarm checks.

8.2.9 The Survey Technician shall ensure that all materials placed on the belt are positioned correctly. Materials are to be positioned flat on belt and no materials are to be stacked. The belt is laid out with a grid pattern. A minimum of 50% of any grid area *with material* must be covered. Grid areas may be left empty. Materials may cross over into several grids but all grids in question must be covered by at least 50%. Grids may be covered by more than 50%.

Note: Inaccessible Areas. Components with inaccessible areas encountered during surface scans will be disassembled to allow access to all surfaces. Those items that cannot be disassembled will be referred to the Survey Manager or Designee for determination.

8.2.10 During monitoring operations, a new background will be taken at a minimum every two hours. The system is set to automatically take a background after two hours of operation.

8.2.11 Any materials that fail may be re-evaluated. Materials that fail are rejected if they are not re-evaluated. If materials fail again on re-evaluation, they will be rejected. Any rejected materials shall be immediately placed in an appropriate waste container.

8.2.12 If the materials pass monitoring, take enough 100 cm^2 wipes (with appropriate material, i.e. Mohawk Wipes, other disk wipes) to ensure a representative sampling of the batch surveyed. Wipes shall be field checked after collection. Place the materials into the appropriate "clean unrestricted release holding container."

8.2.13 Collect and assemble the wipes in a manner as to minimize cross contamination and label them appropriately for future laboratory analysis.

8.2.14 At the completion of a "batch" of material, complete the required blocks on the record (net weight released and rejected, container numbers, etc.) and submit the wipes from that batch to the laboratory for evaluation following appropriate laboratory procedures for sample submission.

8.2.15 Turn all related paperwork over to the Survey Manager or Designee, obtain new assignments from the Survey Manager or Designee, and continue as before with the new assignment.

8.2.16 At the end of the shift, remove all materials from the belt and power the system down. Power the printer down after the reports have been removed and filed or logged (*note: never advance or retract the printer paper using the knob on the right side of the printer*). The floor under the belt should be swept and all loose debris should be removed. The lower bank of detectors should be periodically vacuumed to remove any debris that may have fallen onto them.

8.3 *Removable* Contamination Surveys

8.3.1 The MSC Analytical Laboratory will analyze the contamination wipes submitted for evaluation with appropriate instrumentation following appropriate Instructions, Instruction Guides, and/or Procedures.

8.3.2 The MSC Analytical Laboratory contamination wipe analysis results will be reported to the Survey Manager or Designee for review and evaluation.

8.3.3 The Survey Manager or Designee will review and evaluate the contamination wipe analysis results and complete the Unrestricted Release Survey Record, supplying the necessary information for the Record.

8.3.3a Review and evaluation of the contamination wipe analysis results will involve comparisons of results against the removable release limits of the relative materials. The removable release limit is taken from Regulatory Guide 1.86.

8.3.3b After removable contamination has been assessed and accepted as passable, the Survey Manager or Designee will complete the Unrestricted Release Survey Record form (Attachment 3.), assemble the documentation for the complete Unrestricted Release Record, review the complete record, and unrestricted release the materials.

8.3.3c All Unrestricted Release Records are MSC QA Records and will be maintained in accordance with approved instructions.

8.4 Refined Nickel Ingot Contamination Surveys

8.4.1 Ensure the surface of the electro-refined nickel ingot (from now on called the "ingot") is clean and dry. Mark the ingot with a unique identifying number using an indelible pen if not already identified.

8.4.2 Perform removable contamination surveys following the above procedures. Either manual or conveyorized means may be utilized for surface contamination surveys.

8.4.3 In addition to surface contamination surveys, each nickel ingot will be volumetrically sampled following MSC Work Instruction *Volumetric Sampling of Refined Nickel Ingots* and analyzed by the analytical laboratory. Analysis results must be within established limits before the nickel may be released for unrestricted use.

8.4.4 Information with regard to unrestricted release of ingots will be summarized on the *Nickel Unrestricted Release Shipment Summary* form (Attachment 6.). No shipments will exceed 20 tons of nickel metal.

8.5 Release Limits

8.5.1 Release Limits are derived directly from U.S. Atomic Energy Commission Regulatory Guide 1.86, Table 1.

8.5.2 Non-detectable isotopes are considered when evaluating materials for unrestricted release by the RSO or Designee.

8.5.3 Isotopic decays and their relative decay intensities and energies are considered when evaluating materials for unrestricted release by the RSO or Designee.

8.5.4 Isotopic information is taken from either client-supplied data and/or MSC analytical evaluation.

8.6 Alarms at Outside Facilities

8.6.1 Any alarms of radiation detectors at outside facilities (i.e. scrap yards or procurers of recycled metals) shall initiate a response by MSC personnel.

8.6.2 As soon as possible after notification of such alarms MSC shall dispatch qualified personnel to the reporting site to verify the cause of the alarm.

8.6.3 MSC personnel will perform appropriate surveys to isolate any suspect materials and take corrective actions, when warranted.

8.6.4 When material that has been positively identified as MSC material and does not meet Unrestricted Release criteria, an internal Non-Conformance Report will be generated, MSC will take possession of the material, TDRH will be notified, and an Exemption For Transport will be requested if appropriate.

8.6.5 All material returned to MSC from an outside alarm response shall be through approval of TDRH.

8.6.6 When material that is not MSC material is identified as exceeding Unrestricted Release criteria, TDRH will be notified and disposition determined in accordance with TDRH direction.

Note: Alarms may be caused by cumulative effect and may not indicate material that does not meet Unrestricted Release criteria.

9.0 RECORDS

The Unrestricted Release Record shall consist of the Unrestricted Release Survey Record (Attachment 3.), materials isotopic evaluations, removable contamination wipes analysis data, and conveyorized survey monitor data if applicable. All Unrestricted Release Records are MSC QA records and shall be maintained in accordance with approved instructions.

10. ATTACHMENTS

10.1 *Table 1.* from U. S. Atomic Energy Commission Regulatory Guide 1.86

10.2 MDA Calculations for Scanning

10.3 Unrestricted Release Survey Record

10.4 Conveyorized Monitor Pre-Operational Response Check Form

10.5 Nickel Unrestricted Release Shipment Summary

Attachments

ATTACHMENT 1. TABLE 1. FROM REGULATORY GUIDE 1.86

Table 1. **from U. S. Atomic Energy Commission Regulatory Guide 1.86**

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDE [a]	AVERAGE [b c]	MAXIMUM [b d]	REMOVABLE [b e]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm /100 cm^2	300 dpm /100 cm^2	20 dpm /100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm /100 cm^2	3,000 dpm /100 cm^2	200 dpm /100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm β-γ/100 cm^2	15,000 dpm β-γ/100 cm^2	1,000 dpm β-γ/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should be applied independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector by background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each object.

[d] The maximum contamination level applied to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of know efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

ATTACHMENT 2. MDA CALCULATIONS FOR SCANNING

Table of MDA Calculations for Scanning

177 Friskers with Pancake GM Probes (44-9)						
Scan Rate (in/sec)	Probe Width (in)	Count Time, T_s (min)	Efficiency	Bkg. R_b (cpm)	Bkg Time, T_b (min)	MDA (dpm)
2	1.9	0.0158	12.5%	50	1	1490.72
2	1.9	0.0158	12.5%	100	1	2108.20
2	1.9	0.0158	12.5%	150	1	2582.00
2	1.9	0.0158	12.5%	200	1	2981.44
2	1.9	0.0158	12.5%	250	1	3333.35
2	1.9	0.0158	12.5%	300	1	3651.50
25 sec Static		0.4200	12.5%	100	1	483.96
		0.4200	12.5%	150	1	592.72
		0.4200	12.5%	200	1	684.42
		0.4200	12.5%	250	1	765.20
		0.4200	12.5%	300	1	838.24
2224 Frisker with 43-89						
Scan Rate (in/sec)	Probe Width (in)	Count Time, T_s (min)	Efficiency	Bkg. R_b (cpm)	Bkg Time, T_b (min)	MDA (dpm)
Probe 43-89 for alpha						
2	2.95	0.0246	20.2%	5	1	235.12
2	2.95	0.0246	20.2%	10	1	332.50
2	2.95	0.0246	20.2%	15	1	407.23
2	2.95	0.0246	20.2%	20	1	470.23
2	2.95	0.0246	20.2%	25	1	525.74
Static Count		0.4200	20.2%	5	1	66.97
		0.4200	20.2%	10	1	94.70
		0.4200	20.2%	15	1	115.99
		0.4200	20.2%	20	1	133.93
		0.4200	20.2%	25	1	149.74
Probe 43-89 for beta						
2	2.95	0.0246	9.2%	50	1	1625.41
2	2.95	0.0246	9.2%	100	1	2298.67
2	2.95	0.0246	9.2%	150	1	2815.29
2	2.95	0.0246	9.2%	200	1	3250.81
2	2.95	0.0246	9.2%	250	1	3634.52
2	2.95	0.0246	9.2%	300	1	3981.42
2	2.95	0.0246	9.2%	400	1	4597.35
2	2.95	0.0246	9.2%	500	1	5139.99
Static Count		0.4200	9.2%	100	1	654.70
		0.4200	9.2%	200	1	925.89
		0.4200	9.2%	300	1	1133.98
		0.4200	9.2%	400	1	1309.40
		0.4200	9.2%	500	1	1463.96

The formula used for the above calculations is on the right. The value for "m" is 1.645 which corresponds to a confidence level of 95%.

$$MDA = \frac{2m\sqrt{\frac{R_b}{T_s} + \frac{R_b}{T_b}}}{eff._{(counting\ instrument)}}$$

ATTACHMENT 3. UNRESTRICTED RELEASE SURVEY RECORD

Customer Name:	
Customer ID Number:	
MSC Job Number(s):	

Date:	
Time:	
μR/hr background:	

RELEASE LIMITS

Survey Instrument	Surface Contamination Release Limits Plane	Point[f]	Max[g]	Removable Release Limits (dpm/100 cm²)	
Pancake G-M					
100 cm² α+β scintillator				*Removable* Release Limits are applied to 100 cm² wipe samples. Wipe samples are analyzed on low level laboratory counting systems or equivalent.	
CWM-10 conveyorized monitor					
100 cm² α+β gas proportional					

SURFACE CONTAMINATION SURVEY TECHNICIANS and INSTRUMENTATION

Technician	Instrument	Serial Number	Cal. Due Date	Inst. Bkg.	Daily Response

SURFACE CONTAMINATION SURVEY RESULTS

MSC Job Number/ Identification Number	Unrestricted Release Holding Container Number/Net Weight Passed		Net Weight Rejected/ Waste Box Number		Tech Initials

REMOVABLE CONTAMINATION ANALYSIS RESULTS SUMMARY

Number of Samples	Number *Above* Limits		Analysis Attached	Reviewer Initials

RELEASE SUMMARY

Total Net Weight Released	Release Bin Number	Date Released	Total Net Weight Rejected	Date Waste

Review: ______________________ ______________________

[f] *Point source* (point) considerations may be evaluated and applied only by qualified survey personal.
[g] *Maximum* (max.) surface contamination evaluation will be performed by the Survey Manager or Designee.

ATTACHMENT 4.

CONVEYORIZED MONITOR PRE-OPERATIONAL RESPONSE CHECK FORM

Date:	*Technician:*
Instrument:	*Instrument S/N:*
Calibration Date:	
Calibration Isotope(s)/Configuration/Geometry:	

Background			
Instrument	*Reading*	*S/N*	*Cal. Due*
Ludlum Model 19 MicroR			
Ludlum Model 44-9 G-M			

Diagnostics			
Item	*YES*	*NO*	*Initial*
All indicators/switches responding?			

Alarm Response Check			
Upper Detector Array Height:		*Count Time (seconds):*	
Alarm Level Activity Setting:			
Check Source Isotope:	*Activity:*	*Configuration:*	
Response Check Data			
Group	*Trial*	*Alarm*	*Comments*
1 & 2			
3 & 4			
5 & 6			
7 & 8			
9 & 10			
Alarm History Printout is attached.		*Signed:*	

ATTACHMENT 5. NICKEL FREE RELEASE SHIPMENT SUMMARY

Shipment Number: ____________________ # Ingots: ____________ Total Weight: ____________

Shipment Date: ____________________ Average Bq/g for shipment: ____________________

Summary

Ingot Number	Weight (lbs.)	Removable Results (dpm/100 cm^2)	Volumetric Results (Bq/gram)	Review Initials

Page _____ of _____ for shipment # ____________

TITLE: UNRESTRICTED RELEASE CALCULATIONS

1.0 PURPOSE

The purpose of this Instruction is to outline the methods and calculations utilized to determine unrestricted release limits for particular materials.

2.0 SCOPE

This procedure details the calculations and methods utilized to determine unrestricted release limits for Manufacturing Sciences Corporation, Kerr Hollow Road Facilities. The release limits take into consideration the hard-to-detect isotopes.

3.0 REFERENCES

3.1 Brookhaven National Laboratory, NNDC. *NuDat Database*, January 1996.

3.2 Erdtman, G. and Soyka, W. *The Gamma Rays of the Radionuclides', ISBN 0-89573-022-7*, 1979.

3.3 U. S. Atomic Energy Commission. *Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors*, Retyped by U.S. EPA, August 1997.

3.4 Manufacturing Sciences Corporation. *Radioactive Material License R-01078-L00 submittal.*

4.0 DEFINITIONS

4.1 *Surface Contamination Release Limit* – the allowable surface activity per unit area. The limit is taken from Regulatory Guide 1.86, Table 1 (Attachment 1.) and actual isotopic considerations relative to the material in question.

4.2 *Decay Progeny* – in this procedure refers to either alpha particles, beta particles, and/or gamma photons. Particles and/or photons may not be considered in calculations if they are sufficiently low in probability or average energy.

4.3 *Unrestricted Release* – an item or items that have met the criteria relative to *surface*, *removable*, and *maximum* activity established by Regulatory Guide 1.86. The item(s) is/are considered to be "clean" and may be released to non-radiologically controlled areas for unrestricted use.

4.4 *Hard-to-detect* – radioactive isotopes which do not emit readily detectable decay progeny. Some examples are ^{55}Fe, ^{63}Ni, and ^{241}Pu.

4.5 *Inaccessible Area* – an area on an item considered for unrestricted release that cannot be surveyed for unrestricted release with standard survey meters or techniques. The Survey Manager or Designee shall determine unrestricted release status for those items identified with inaccessible areas.

5.0 PRECAUTIONS

None.

6.0 PREREQUISITES

6.1 Anyone designated to perform unrestricted release calculations must be technically capable. Determinations of technical competence will be made by the RSO.

6.2 The individual's role proficiency should show authorization to perform and to review unrestricted release calculations.

7.0 RESPONSIBILITIES

7.1 Radiation Safety Officer (RSO)

7.1.1 The RSO or designee will establish appropriate unrestricted release limits. These established limits will take into account isotopic contamination considerations, material geometry considerations if necessary, material composition considerations if necessary, and any other applicable considerations which may be determined as necessary.

7.1.2 The RSO is responsible for all unrestricted release of materials from MSC.

7.1.3 The RSO may designate responsibilities and/or certain tasks of the unrestricted release program.

8.0 PROCEDURES FOR CALCULATIONS OF RELEASE LIMITS

8.1 General Process for Determination of Release Limits

8.1.1 Receipt of isotopic information from client, usually shipping manifest

8.1.2 Isotopic information review and calculations based on isotopes to determine suitable release limit

8.1.3 Request for additional analysis if necessary

8.1.4 Review of information on material, i.e. composition, size, shape, and disposition

8.1.5 Review of additional analysis and subsequent adjustments to isotopic ratios

8.1.6 Issuance of release limit for material, specific to instrumentation

8.2 Isotopic Considerations

8.2.1 The Surface Contamination Release Limit derived from Regulatory Guidance 1.86, Table I. The table is broken down into four groups, each with different criteria. The table lists the average and maximum allowable surface and maximum removable activity levels for the different groups.

Special case by case considerations will be given to source terms which have significant amounts (>25% of the total activity for a particular batch) of transuranics, thoriums, radiums, ^{125}I, ^{126}I, ^{129}I, ^{131}I, ^{133}I, ^{227}Ac, ^{231}Pa, ^{232}U, or ^{90}Sr. These considerations will involve ratios and scaling to accommodate the lower allowable surface contamination and removable contamination levels.

8.2.2 All isotopes in a particular source term are ratioed with respect to total activity.

The formula used for determining ratios:

Ratio for isotope (I_r) = activity for isotope ÷ total activity

8.2.3 The ratios (I_r) of the hard-to-detects are summed. This percentage is removed from the allowable surface activity (from Reg. Guide 1.86, Table I) to determine a scaled allowable surface activity.

Example: A shipment has manifest 25% of the total activity as ^{55}Fe. Applying this to 15,000 dpm per 100 cm^2 would result in a scaled maximum of 11,250 dpm per 100 cm^2.

Allowable – % hard-to-detect = scaled allowable activity
(15,000) (25%) (11,250)

Example: A shipment has manifest 10% ^{63}Ni and 10% ^{55}Fe. Applying this to an allowable average of 5,000 dpm/100 cm^2 over one meter would result in a scaled average surface activity of 4,000 dpm/100 cm^2 over one meter.

Allowable – % hard-to-detect = scaled allowable activity
(5,000) (20%) (4,000)

The hard-to-detects currently recognized are:

^{3}H .... soft beta
^{14}C .... soft beta
^{35}S .... soft beta
^{51}Cr .... very low intensity gamma

^{55}Fe .... soft beta
^{59}Ni .... very low intensity/energy gamma
^{63}Ni .... soft beta
^{106}Ru .... soft beta
^{129}I .... soft beta
^{241}Pu .... soft beta

Some of the above listed isotopes are detectable, but due to low efficiencies they are considered otherwise.

8.2.4 Considerations for Isotopes with Half-lives of Approximately 30 Days or Less

Often, isotopes with relatively short half-lives will be manifest on incoming shipments. The shipment will be evaluated on how long it has been in storage before processing and the origin of the materials. If sufficient storage time for approximately 10 half-lives is evident, the isotopes *may* be removed from the source term.

Examples of isotopes which *may* be considered for removal:

^{51}Cr .... 27.7 days
^{67}Cu .... 2.58 days
^{95}Nb .... 34.98 days
^{103}Ru .... 39.26 days
^{141}Ce .... 32.5 days

This list is not all inclusive as there other isotopes which may be considered for removal after half-life considerations.

8.2.5 Equilibrium Decay Chain Considerations

Isotopes which in reality exist as decay chains in equilibrium and not as single isotopes will occasionally be manifest alone. When this occurs, daughters and/or parents will be added to the source term and their respective progeny considered.

^{238}U will have additional daughters present in equilibrium, unless the ^{238}U has been recently separated. ^{90}Sr will almost always exist with ^{90}Y present in equilibrium. Natural uranium has many daughters present in equilibrium.

These equilibrium chains exist due to the relatively short half-life of the daughter with respect to the parent, so to exist alone would require recent separation of the parent which is a very remote possibility in most cases.

8.2.6 Isotopic Decays, Intensities, and Energies

Isotopic decays, their respective decay progeny, their respective progeny intensities, and their respective progeny energies are considered with respect to total activity.

This relationship is determined for alpha particles, beta particles, and gamma photons for each isotope present. The following formulae are used to express the relationships:

$$S_p = (I_r \bullet I_p)$$

where S_p = source term probability of a particular decay progeny from a particular isotope
I_r = isotopic activity ratio
I_p = probability for a particular decay progeny to occur for a particular isotope

$$E_w = (I_r \bullet I_p \bullet I_e) \div \Sigma_{(I_r \bullet I_p \bullet I_e)}$$

where E_w = isotope specific, weighted energy contribution for a particular decay progeny of the source term in question
I_r = isotopic activity ratio
I_p = probability for a particular decay progeny to occur for a particular isotope
I_e = average energy of particular decay progeny

The summation of the S_p establishes a particular source term's decay progeny intensity and the summation of the relative E_w establishes a particular source term's decay progeny average energy. S_p is used in final release limit calculations, but E_w is for information only at present.

8.2.7 Requests for Additional Analysis

In cases where a high percentage of the hard-to-detect isotopes are manifest or the manifest is not trusted for some reason, additional sampling and analysis is warranted. Additional sampling and analysis allows for determination that the shipping manifest is accurate or inaccurate. Accuracy is determined with activity ratios from the analyses and compared with the activity ratios from the manifest. Ratios are used because it is not realistic to measure all of the activity present in a shipment. In situations where the analysis and the manifest do not correlate, a new source term is developed from the sampling and analysis information.

Health Physics Technicians and/or Survey Technicians typically conduct the sampling. Analysis is performed by the MSC Analytical Laboratory and/or sent out for outside determinations.

8.3 Instrumentation Considerations

8.3.1 Detector Type

Different detectors may be more efficient at detecting different radiations. For example, NaI detectors are much more efficient at detecting gamma radiation than beta radiation and gas proportional detectors are more efficient at detecting beta radiation than gamma radiation. These differences require considerations with regard to unrestricted release.

MSC primarily utilizes three different detectors for unrestricted release surface contamination surveys. These are (1) 44-9 Ludlum pancake detectors, (2) 43-89 Ludlum 100 cm^2 alpha/beta detectors, and (3) 600+ cm^2 plastic scintillation detectors.

The 44-9 is efficient for alpha and beta radiation, but not very efficient for gamma radiation. If gamma radiation is considered with this probe/detector arrangement, gamma efficiencies will be established prior. Only alpha and beta radiation is considered for this detector, unless otherwise noted.

The 43-89 is efficient for alpha and beta radiation, but will detect gamma much more efficiently than the 44-9. It is considered to be similar to the 600+ cm^2 plastic scintillation detectors and the same scaling is utilized for both, with the exception of alpha radiation. The 43-89 also contains a ZnS scintillation material and is efficient for alpha.

The 600+ cm^2 plastic scintillation detectors are part of a conveyorized system. These detectors are efficient for beta and gamma radiation. They have no efficiency for alpha radiation.

It must be noted that actual instrument efficiency is utilized when converting cpm from the instrument to dpm. The delectability considerations above are for establishing release limits for the types of radiation present in a particular source term.

8.3.2 Detector Size

Detector probe area is also a necessary consideration with regard to unrestricted release. Limits are typically considered over 100 cm^2 and many probes are not 100 cm^2 in size. Scaling is done to adjust for probe areas.

Example 1: A Ludlum Model 44-9 (pancake probe) has an active window of 15 cm^2. This is 15% of 100 cm^2. Applying this to the average allowable of 5,000 dpm/cm^2 gives a result of 750 dpm/probe area.

If the scaled allowable of 4,000 dpm/100 cm^2 from the example above is used, the result is 600 dpm/probe area.

Example 2: A probe area of 600 cm^2 is 600% of 100 cm^2. Applying this to the average allowable of 5,000 dpm/100 cm^2 gives a result of 30,000 dpm per probe area. But, due to the size of the probe area (600 cm^2) and the fact that it is larger than 100 cm^2, the average allowable is set no greater than the 15,000 dpm maximum allowable. This is somewhat more conservative than probe area considerations will allow.

8.4 Material Geometry and Composition Considerations

Material geometry must be considered as surfaces must be accessible. Material with areas which are not accessible must be considered on a case by case basis. Considerations will be given regarding process knowledge, material origin, suspected contaminates, and defensibility of those considerations.

Material composition may effect release limit considerations. Considerations may be allowed for contributions of detectable activity which passed through the material from the side not being assayed. This would apply to low density, thin materials such as aluminum sheet or plate. Material composition will be considered on a case by case basis.

8.5 Surface Contamination Release Limit Issuance

After the release limits are scaled for hard-to-detects, adjustments are made for source term probabilities (S_p) and for the particular instrumentation to be used. Instrumentation considerations are based on a particular source term's decay progeny and an instrument's ability to detect certain decay progeny. A final release limit is determined.

The Surface Contamination Release Limit is issued as part of the Unrestricted Release Survey Record. The information is supplied by the individual performing the calculations.

It should be noted that under typical circumstances, contamination distribution is considered to be in the form of a plane source, i.e. the contamination is distributed relatively evenly over the surface of the material. In this situation, probe areas must be considered such as in the case of the 44-9 G-M. The following limits are calculated using the assumption of plane source contamination geometry. Point source contamination geometry (i.e. the contamination distribution is not relatively uniform and is confined to a small area of less than approximately 1 cm^2) limits are not dependent on probe area and thus the probe area is not considered.

8.5.1 Limits for the 44-9 Pancake G-M (Plane Sources)

Active area considerations for the detector establish a maximum average allowable activity per probe/detector area of 750 dpm (8.3.2 *Example 1.*).

Scaling for hard-to-detects is taken from active area considerations (750 dpm).

Detection capability considerations of this detector show an efficiency for alpha and beta radiation, but not for gamma radiation, thus allowing only the alpha and beta components to be considered.

The ΣS_p alpha component (not to include any hard-to-detect) is added to the ΣS_p beta component (not to include any hard-to-detect). The product of this figure, the detector area scaling, and the % hard-to-detect is the release limit for this probe. The formula is:

Release Limit = (ΣS_p alpha + ΣS_p beta) • (750 dpm • % hard-to-detect)

8.5.2 Limits for the 600+ cm^2 Plastic Scintillation Detector (Plane Sources)

Active area considerations for the detector establish a maximum average allowable activity per probe/detector area of 15,000 dpm (8.3.2 *Example 2.*).

Scaling for hard-to-detect is taken from active area considerations (15,000 dpm).

Detection capability considerations of this detector show an efficiency for beta and gamma radiation, but not for alpha radiation, thus allowing only the beta and gamma components to be considered.

The ΣS_p beta component (not to include any hard-to-detect) is added to the ΣS_p gamma component (not to include any hard-to-detect). The product of this figure, the detector area scaling, and the % hard-to-detect is the release limit for this probe/detector. The formula is:

Release Limit = $(\Sigma S_p \beta + \Sigma S_p \gamma)$ • (15,000 dpm • % hard-to-detect)

8.6 Release Limit Issuance for Removable Contamination

Removable contamination levels will be evaluated with low level counting instrumentation located in the MSC Analytical Laboratory. Limits will be determined by scaling calculations considering hard-to-detect isotopes from the allowable limits of Reg. Guide 1.86 for removable contamination. A dpm/100 cm^2 limit will be derived. Removable contamination wipes will cover 100 cm^2.

> *Example*: A shipment manifest with 10% ^3H and having a source term which is not "special case," thus allowing a maximum removable contamination activity level of 1,000 dpm/100 cm^2 for β/γ emitters would be scaled back to 900 dpm/100 cm^2 for removable contamination activity.

8.7 Example of Complete Calculation (Plane Source)

A shipment arrives and the manifest is faxed to the appropriate personnel. The manifest shows the following:

Co-60	2.35 mCi
Cs-137	1.34 mCi
Fe-55	0.81 mCi
Total	4.5 mCi

From this, the ratios are calculated. Reporting is typically in percentage. The ratios for this source term are:

Co-60	52.2 %
Cs-137	29.8 %
Fe-55	18 %

From this source term, 18 % (from ^{55}Fe) must be considered hard-to-detect or *not detectable* and therefore must be considered by scaling.

Scaling is taken from the instrument *maximum* average allowable activity. For the 44-9 pancake G-M, the *maximum* average allowable average activity is 750 dpm (this comes from probe active area considerations as shown in 8.3.2 *Example 1*.). 18% from 750 dpm leaves 615 dpm. For the conveyorized system with 600+ cm^2 detectors, the instrument *maximum* average allowable activity is 15,000 dpm (8.3.2, *Example 2*). 18% from 15,000 dpm leaves 12,300 dpm.

The source term decay progeny probability is determined. Each contributing isotope is considered (Hard-to-detects are considered to be non-contributing).

^{60}Co has three primary decay progeny: two gammas and one beta

beta	95.8 keV average	100%
gamma	1173.2 keV	100%
gamma	1332.5 keV	100%

The beta contribution to the source term is:

I_r for ^{60}Co = 52.2%
I_p for ^{60}Co beta = 100%

S_p = (52.5%) • (100%) = 52.2%

The gamma contribution to the source term is:

<u>1173.2 gamma:</u>
I_p for ^{60}Co = 100%

S_p = (52.2%) • (100%) = 52.2%

<u>1332.5 gamma:</u>
I_p for ^{60}Co = 100%

S_p = (52.2%) • (100%) = 52.2%

Thus the total gamma contribution is 104.4% (52.2 + 52.2).

^{137}Cs has two primary decay progeny: one gamma and one beta

beta .... 156.8 keV average 94.6%
gamma .... 661.6 keV 90%

The beta contribution to the source term is:

I_r for ^{137}Cs = 29.8%
I_p for ^{137}Cs beta = 94.6%

S_p = (29.8%) • (94.6%) = 28.19%

The gamma contribution to the source term is:

I_p for ^{137}Cs = 90%

S_p = (29.8%) • (90%) = 26.82%

The summations of the probabilities for the beta and gamma constituents:

ΣS_p beta = 52.2 (from ^{60}Co) + 28.19 (from ^{137}Cs) = 80.39%

ΣS_p gamma = 104.4 (from ^{60}Co) + 26.82 (from ^{137}Cs) = 131.22%

This source term does not have any alpha constituents, but they would be calculated the same way.

The release limit for the 44-9 pancake G-M:

Since the 44-9 is not considered efficient for gamma, only the beta constituent is considered. From the hard-to-detect scaling, a *maximum* average activity of 615 dpm per probe/detector area has been determined. Following the formula in 8.1.1:

Release Limit = (ΣS_p alpha + ΣS_p beta) • (615 dpm) =
= (0 + 80.39%) • (615 dpm) = 494.4 dpm or <u>494 dpm</u>

The release limit for the 600+ cm^2 plastic scintillation detector:

This detector is efficient for gamma and beta radiation, thus the beta and gamma constituents are considered. From the hard-to-detect scaling, a *maximum* average activity of 12,300 dpm per probe/detector area has been determined. Following the formula in 8.1.2:

Release Limit = (ΣS_p beta + ΣS_p gamma) • (12,300 dpm) =
= (80.39% + 131.22%) • (12,300 dpm) = 26,028 dpm

Since this number is greater than 15,000 dpm, the release limit is set at 15,000 dpm for this detector.

8.8 Special Case Isotopic Source Terms

If a shipment manifest greater than 25% of transuranics, thoriums, radiums, ^{125}I, ^{126}I, ^{129}I, ^{131}I, ^{133}I, ^{227}Ac, ^{231}Pa, ^{232}U, ^{90}Sr, or any combination of the above, then it falls under the special case considerations.

The ratios of the special case isotopes will be combined into like groups as broken down by *Table I* of Reg. Guide 1.86 (Attachment 1). Their contributions to total source term are determined. Release limits will be established to consider their contribution.

8.9 ^{238}U and ^{235}U Source Term Considerations and Enrichment Issues

Enrichment issues are more of a concern for license limit requirements for SNM than they are for unrestricted release monitoring. Due to the SNM site inventory restrictions, incoming materials may be sampled to verify isotopic source terms.

Source terms manifest with uranium source terms, either natural uranium, depleted uranium, or enriched uranium, will be evaluated with the same methods as described above.

Example of Enriched Source Term Calculation

A shipment arrives and the manifest is faxed to the appropriate personnel. Analysis of the manifest shows the following ratios:

U-238............................ 90 %
U-235............................ 10 %

This source term would be considered enriched.

Since ^{238}U is in equilibrium with ^{234}Th, ^{234m}Pa, and ^{234}U, the source term is adjusted to the following:

U-238............................ 24.3 %
Th-234........................... 24.3 %
Pa-234m......................... 24.3 %
U-234............................ 24.3 %

U-235 .... 2.7 %

When the decay progeny of the source term is evaluated, the following is determined for this source term:

Alpha decay .... 51 % @ 4481 keV average
Beta decay .... 41.6 % @ 497.1 keV average
Gamma decay .... 2 % @ 180 keV average

The release limit for the 44-9 pancake G-M (Plane Source):

Since the 44-9 is not considered efficient for gamma, only the alpha and beta constituents are considered. Following the formula in 8.1.1:

Release Limit = (Σ S_p alpha + Σ S_p beta) • (750 dpm) =
= (51 + 41.6%) • (750 dpm) = 694.5 dpm or <u>694 dpm</u>

The release limit for the 600+ cm^2 plastic scintillation detector:

This detector is efficient for gamma and beta radiation, thus the beta and gamma constituents are considered. Following the formula in 8.1.2:

Release Limit = (Σ S_p beta + Σ S_p gamma) • (12,300 dpm) =
= (41.6% + 2.02%) • (15,000 dpm) = <u>6543</u> dpm

9.0 RECORDS

Release Limit calculations will be part of the Unrestricted Release Record. This record shall consist of the Unrestricted Release Survey Record, *materials isotopic evaluations*, removable contamination wipes analysis data, and conveyorized survey monitor data if applicable. All Unrestricted Release Records are MSC QA records and shall be maintained in accordance with approved instructions.

10. ATTACHMENTS

Table 1. from U. S. Atomic Energy Commission Regulatory Guide 1.86

Attachments

ATTACHMENT 1.

Table 1. from U. S. Atomic Energy Commission Regulatory Guide 1.86

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDE [a]	AVERAGE [b c]	MAXIMUM [b d]	REMOVABLE [b e]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm /100 cm^2	300 dpm /100 cm^2	20 dpm /100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm /100 cm^2	3,000 dpm /100 cm^2	200 dpm /100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm β-γ/100 cm^2	15,000 dpm β-γ/100 cm^2	1,000 dpm β-γ/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should be applied independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector by background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each object.

[d] The maximum contamination level applied to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of know efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

TITLE: LABORATORY ANALYSIS OF NICKEL FOR TECHNETIUM-99 AND URANIUM UTILIZING LIQUID SCINTILLATION PDA METHODS

1.0 PURPOSE

The purpose of this instruction is to describe the method of analysis of contaminated Ni after the removal of Tc-99 and Uranium isotopes by electro-refining process to a level that the Nickel may be free-released for use in the private sector.

2.0 SCOPE

This procedure and method applies to analysis of nickel material obtained after electro-refining.

3.0 REFERENCES

3.1 Reference Documents
- a. Sampling and Analysis Plan
- b. Packard Liquid Scintillation Analyzer Instruction Manual
- c. Oxford Gamma Spectrometry Analyzer Instruction Manual
- d. Risk Assessment Analysis

4.0 DEFINITIONS

4.1 RFA: Request for Analysis form

4.2 COC: Chain of Custody form

5.0 PRECAUTIONS

5.1 Use caution when handling chemicals for dissolution of nickel metal. Safety glasses, face shield and protective clothing required.

5.2 Safety glasses or Face shield required when drilling metal ingot.

6.0 PREREQUISITES

6.1 Surface of metal should be cleaned prior to obtaining drillings for analysis.

7.0 RESPONSIBILITIES

7.1 The process engineer is responsible for collection of cathode material and transfer of the material to the laboratory, along with a completed RFA/COC form.

7.2 The Laboratory Manager or his designee is responsible for receiving the material from the process area.

8.0 PROCEDURE

All metallic samples collected during either phase of the study will be treated in the same manner. Alpha analysis will be utilized for uranium determination. Beta analysis will be utilized for Tc-99 determination; betas originating from uranium prompt daughters will be considered in final Tc-99 results.

8.1 Transfer the 20 grams of the nickel sample to a large beaker and slowly add the 125 ml of the nitric acid. (CAUTION- this reaction generates heat and NO_3 fumes). Gently heat on a hot plate at low temperature to increase dissolution of the nickel. If needed, add approximately 1 ml of hydrogen peroxide drop wise to the solution. Gently swirl the solution to mix the material.

8.2 After the nickel has dissolved, continue gentle heat to slowly evaporate the sample to reduce the nitrate concentration. Cool the solution and transfer the material to a 250 ml volumetric flask and dilute to the mark with distilled water. Stopper the flask and mix thoroughly.

8.3 Remove 2 ml and add to a liquid scintillation vial containing 12-15 ml of cocktail. Prepare a duplicate in the same manner and mix the sample thoroughly.

8.4 Place the samples, along with a reagent blank and standards, in the Packard Liquid Scintillation Analyzer and start the count. Use the counting parameters determined using the Alpha/Beta standards.

8.5 Complete the reporting form and transfer a copy to the appropriate staff members. The tabulated form and the original data will be kept on file in the laboratory.

9.0 RECORDS

Chain of Custody forms, Original Data Sheets and Completed Analysis Forms will be maintained as quality records and archived in accordance with MSC's Records Management program.

10.0 ATTACHMENTS

None.

TITLE: VOLUMETRIC SAMPLING OF REFINED NICKEL

1.0 PURPOSE

The purpose of this Work Instruction is to provide guidelines for the sampling of refined nickel ingots.

2.0 SCOPE

This Work Instruction details the methodology for volumetric sampling of ingots, specifically nickel ingots, and the procedures for obtaining volumetric samples of ingots.

3.0 REFERENCES

Cole, Les and Auxier and Associates, Inc. *Risk Analysis: Nickel Contaminated with ^{99}Tc and Uranium*, October 1998.

Manufacturing Sciences Corporation Work Instruction. *Unrestricted Survey of Materials*, July 1998.

Manufacturing Sciences Corporation. *Sampling and Analysis Plan for Nickel Recycle*, November 1998.

4.0 DEFINITIONS

Ingot means refined metal solid directly from either a melt furnace operation or an electro-refining operation.

Unrestricted Release means an item or items that have met the criteria relative to surface, removable, and maximum activity established by Regulatory Guide 1.86. The item(s) is/are considered to be "clean" and may be released to non-radiologically controlled areas for unrestricted use. Volumetric criteria will also be a consideration with regard to refined nickel.

5.0 PRECAUTIONS

Eye protection as a minimum should be worn when performing volumetric sampling.

6.0 PREREQUISITES

Performance of volumetric sampling of nickel ingots shall be conducted by approved personnel. Approval will be given by the RSO or Designee.

7.0 RESPONSIBILITIES

7.1 Radiation Safety Officer (RSO)

7.1.1 The RSO is responsible for all free release of materials from MSC.

7.1.2 The RSO may designate responsibilities and/or certain tasks of the free release program.

7.2 MSC Analytical Laboratory will perform volumetric analysis.

8.0 PROCEDURES FOR VOLUMETRIC SAMPLING OF REFINED NICKEL

8.1 The sampling schedule will be determined by Project Manager.

8.2 Ensure the surface of the electro-refined nickel ingot (also referred to as "finished cathode") is clean and dry. Ingot should be clearly identified prior to sampling.

8.3 Volumetric sampling should occur after the removable contamination survey has been completed and prior to unrestricted release. All materials will remain in radiologically controlled areas until a surface and removable contamination survey has been completed.

8.4 A volumetric sample will be collected using a carbide tipped or equivalently hard drill bit to reduce the contribution of material from the bit to the sample. The bit diameter shall be large enough to ensure an adequate sample volume is achieved.

8.5 The drill bit shall be free of removable and surface contamination. If contamination is present, the bit shall not be used for sampling.

8.6 The sample will consist of drill shavings associated with a drilling completely through the ingot. All shavings will be collected. Each drilling will represent one sample.

8.7 After sample collection, the sample should be labeled and packaged appropriately to minimize cross contamination potential.

8.8 Submit the sample(s) to the laboratory for evaluation following appropriate laboratory procedures for sample submission.

9.0 RECORDS

Sampling information and analysis will be part of the free release record and shall be maintained in accordance with appropriate MSC Instructions, Instruction Guides, and/or Procedures. Records of all measurements and evaluations will be properly identified and maintained for any regulatory or customer review.

10. ATTACHMENTS

None.

Risk Analysis:

Nickel Contaminated with ^{99}Tc and Uranium

November, 1998

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Executive Summary

The Department of Energy (DOE) has been seeking recycling alternatives for radioactively contaminated nickel barrier material used in gaseous diffusion processes. Traditional chemical and mechanical methods of decontaminating radioactive scrap metal are ineffective on the nickel barrier because of the porous nature of the metal and because of the difficulty of removing technetium-99 (^{99}Tc). In addition, the classified configuration of the nickel barrier requires that the material be melted before cleanup. The melting process distributes the contamination throughout the molten metal, making the contaminants volumetric rather than confined to the surface.

Having developed and successfully demonstrated a process that removes both uranium and ^{99}Tc from the nickel barrier, Manufacturing Sciences Corporation is proposing the unrestricted release of their reprocessed nickel, based on the low risk factors associated with the following criteria:

> ^{99}Tc of an average of 3 Bq/g (180 dpm beta/g or 81 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 6 Bq/g (360 dpm/g or 162 pCi/g). The release criteria for uranium (inclusive of ^{234}U, ^{235}U, and ^{238}U, all of which are considered in total) will be an average of 0.3 Bq/g (18 dpm/g or 8.1 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 0.6 Bq/g (36 dpm alpha/g or 16.2 pCi/g).

Manufacturing Sciences Corporation (MSC) secured the services of Auxier & Associates, Inc., to run risk analyses on their reprocessed nickel, basing parameters on the assumption that the nickel would be recycled into end products used directly by consumers. For a conservative analysis, Auxier & Associates selected two potential stainless steel consumer products that would, for an extended period of time, come in direct contact with the human body. These products were flatware representing exposure to an extremity and hip joint prostheses representing exposure to an internal organ. The extent of the analysis performed by Auxier & Associates includes exposure risks to drivers in the transport of MSC's reprocessed nickel ingots, exposure risks from the use of the potential consumer products, and exposure risks from landfill disposal of smelter waste from foundry production processes.

Auxier & Associates found that consumer products made from nickel barrier reprocessed to purity levels proposed by MSC were unlikely to create any identifiable health risks. Comparative analysis revealed, in fact, that the annual exposure to uranium and ^{99}Tc from consumer products made from MSC's reprocessed nickel would be less than the exposure a passenger would

normally receive from a single annual plane trip across the United States. Auxier & Associates also concluded that at MSC's proposed release levels (calculated dose is 0.012 mrem/yr.), the residual radiation in the nickel ingots meets the dose limitation criteria of 10 CFR 20.1402 of not more than 25 mrem/yr. Further, the surface level measurement for residual radionuclides meets the criteria of the long-accepted NRC Regulatory Guide 1.86 for unrestricted release. Based on the results of conservative risk analyses, therefore, the nickel scrap metal decontaminated to MSC's proposed purity levels would be safe for unrestricted release. This publication provides the assumptions, research methods, and results that support the findings by Auxier & Associates.

1.0 Introduction

The Department of Energy's gaseous diffusion plants at Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio, contain large quantities of nickel metal. Because of the porosity of the nickel barrier, both uranium and ^{99}Tc (used in the diffusion processes) are embedded in the metal preventing decontamination by surface cleanup. Melting processes, which render the nickel barrier unclassified, further distribute the contaminants throughout the molten metal. This type of contamination is expressed as *volumetric contamination.*

Manufacturing Sciences Corporation (MSC) is working with BNFL, Inc., in decontaminating three large buildings at the site of the Oak Ridge Gaseous Diffusion Plant, now the East Tennessee Technology Park (ETTP). Contaminated nickel will be removed from these buildings and brought to MSC by personnel who have security clearances issued by DOE. At MSC, the metal will be subjected to a series of processes to remove the uranium and ^{99}Tc that is volumetrically distributed in the nickel.

Since there are vast quantities of high-value nickel at DOE's three gaseous diffusion plants, this resource needs to be reclaimed for reuse in other products. Toward that end, Manufacturing Sciences Corporation has developed and demonstrated processes that are capable of restoring the nickel to levels of purity that render it safe for unrestricted use in other products. Obtaining license for unrestricted release of the metal is problematic, however, because no regulatory standards currently exist for the release of volumetrically contaminated materials. While such materials have been approved for release in the past, they have typically been licensed only on a case-by-case basis and with end-use and site-specific exceptions. These exceptions generally have been granted on the basis of a risk analysis of reasonable, maximal exposures to an individual, a population, or both. At a uranium processing facility in Tennessee, for example, tungsten melted chips with uranium contamination up to 5 pCi/g were licensed to be recycled into other end products. At that same facility, oil contaminants with uranium at 235 pCi/g were released for incineration in a hazardous waste incinerator. At another facility located in Tennessee, steel contaminated with uranium and ^{99}Tc was allowed to be rolled into sheet metal at an unlicensed rolling mill. Other similar licenses outside of Tennessee include the Nuclear Regulatory Commission's (NRC's) release of synthetic Florspar (a steel fluxing agent with uranium contamination at 10 pCi/g) and the state of California's release of copper with cobalt-60 contamination at 20 pCi/g.

This report provides the results of Auxier & Associates's analysis of reasonable, maximal exposures to both individuals and total populations from two hypothetical, stainless steel consumer products made from MSC's reprocessed nickel. The analysis uses MSC's proposed purity levels of 3 Bq/g (81 pCi/g) of ^{99}Tc and 0.3 Bq/g (8.1 pCi/g) of uranium. The data provided in this report was derived following methods and incorporating computer-generated models that have been previously accepted by the Tennessee Division of Radiological Health and other regulatory agencies. Conclusions are based on comparisons of release criteria found in NRC Regulatory Guide 1.86 and license termination criteria found in 10 CFR 20.1402.

2.0 Overview

MSC's internal processes for decontaminating nickel barrier were not included as part of this study. An overview of the nickel reprocessing is presented in this section, however, as background to the analysis performed for this report. Also presented in this overview are the assumptions, methods, and computer models that provide the basis for Auxier & Associates's research conclusions.

2.1 Decontaminating and Reprocessing MSC's Nickel

Nickel barrier from the gaseous diffusion process is removed from the decommissioned facilities at ETTP. At the ETTP site, the nickel goes through a pretreatment process before shipment to MSC. At the MSC facility in Oak Ridge, the nickel is decontaminated and reprocessed into nickel ingots suitable for use in manufacturing stainless steel and other nickel-alloyed end products. The reprocessing includes melting and then electro-refining the nickel. MSC's electro-refining process is proprietary, but the general steps of their nickel reprocessing procedures are outlined in the following paragraphs:

2.1.1 Transporting Candidate Nickel

Because the configuration of the contaminated nickel is classified, personnel with security clearances issued by DOE must remove the nickel barrier from the gaseous diffusion plants, transport it to MSC in sealed containers, and empty it into an induction furnace at the MSC facilities.

2.1.2 Melting Nickel Barrier

Melting the nickel in an induction furnace is the first step in reprocessing the nickel barrier. A fluxing agent is added to the melt, causing most of the uranium (and other contaminates in the nickel) to diffuse into the slag at the top of the melt. The slag is disposed of as radioactive waste. The molten metal is poured into a mold of proper shape and size to serve as the nickel anode in a subsequent electro-refining process.

standard "swipe" test. This Reg Guide specifies other, more restrictive, criteria for more toxic radionuclides, such as radium-226 and iodine-125.

A recent change to the Title 10 Code of Federal Regulations, Part 20, Section 1402 (10 CFR 20.1402) provides further guidance for terminating a radioactive materials license. This section of the regulation specifies that at license termination, the residual radiation at the facility must not cause more than 25 mrem annual dose to any exposed individual. This same standard can be applied to materials from a licensed facility. Reasonably, the materials removed from such a facility should cause only a small fraction of the criterion dose limit.

2.3 Analytical Methods Used In This Study

The basic approach for the analyses in this study was:

1) To identify products with an end use that would reasonably result in maximal, individual exposure to uranium and ^{99}Tc and
2) To analyze the potential risks posed by the use of these products, assuming they were made from MSC's reprocessed nickel. Scenarios were created for analyzing various pathways of exposure so that computer models could calculate applicable doses.

2.3.1 Statistical Assumptions

Considerations underlying the selection of computer models and dose-risk coefficients are extensive and are based on the very best available research on the effects and risks of radiation exposure. The models used in this study are accepted by regulators and other experts in the nuclear industry. Once the dose to the maximally exposed individual was quantified, these models were used to calculate risks by applying established dose-risk coefficients. While there are a number of references containing dose-risk coefficients, the reference used in this study is from the International Conference on Radiation Protection, Publication 60 (ICRP 1990). This publication is the latest available authoritative reference that contains dose-risk coefficients.

The assumptions underlying each scenario are conservative at every point. Providing that the methodology in the use of the models is reliable, the results will also be reliable and will reflect very conservative doses and risks. Since they are based on maximally exposed individuals, therefore, the doses and risks are probably overstated when applied to appreciably sized populations.

2.3.2 Analytical Software

Doses were calculated using the latest available computer models for calculating doses: namely, MicroShield (Grove 1995) ver 4.20, VARSKIN MOD 2 (Durham, 1998), and RESRAD ver 5.80 (ANL, 1995). RESRAD and VARSKIN were developed under contract with the NRC and are widely used in the industry for dose calculations. Microshield is a privately developed program, but it is also widely used in the industry for dose rate calculations.

2.3.3 Technical Expertise

In actual application, a number of iterations are usually examined to allow comparisons among somewhat different assumptions. The most reasonable result is the one ultimately accepted. It is possible, however, to choose results that are not representative. The selection of representative assumptions, therefore, must rely on the expertise and integrity of the researchers. This method is generally accepted in the industry as the one most appropriate for this type of study.

Researchers at Auxier & Associates have made every effort to ensure that the results presented in this report represent those considered most reasonable and logical from among the number of iterations examined. The principle investigator on this study, Mr. Leslie W. Cole, is a Certified Health Physicist (CHP). During the course of his more than 36 years of health physics experience, Mr. Cole has previously performed this type of research and has been successful in obtaining authority for release of materials on other occasions. Mr. Cole was assisted by Mr. Michael K. Bollenbacher, CHP, who has more than 17 years of health physics experience. Mr. Bollenbacher was the principle investigator for a number of risk assessments for the Department of Energy. He also assisted on one of the release studies on which Mr. Cole was the principle investigator. Both Mr. Cole and Mr. Bollenbacher have performed a number of risk assessments for a variety of clients of Auxier & Associates, and each is considered an expert in his field. Additionally, nine other certified health physicists are on staff at Auxier & Associates, all of whom were involved in these risk assessments, dose assessments, and dose reconstructions.

3.0 Research Description

3.1 Selection of Potential Consumer Products

Parameters required to perform the risk analyses were developed using actual and projected data on hypothetical consumer products that could be made from reprocessed nickel. Reprocessed nickel is more likely to be used to produce industrial end products. such as piping, machine parts, fasteners, etc. (There are 1,500,000 tons of stainless steel produced in the United States each year. Stainless steel products considered in this analysis would use only about 13 tons per year.)

For a conservative approach to risk analysis, the research personnel at Auxier & Associates, Inc., evaluated several potential products that would involve individual, direct-contact exposure to MSC's reprocessed nickel. Products considered for analysis included stainless steel flatware, nickel alloy eyeglass frames, stainless steel orthodontic braces, stainless steel hip joint prostheses. and stainless steel hand tools.

The major exposure route from the beta emissions of ^{99}Tc and uranium's prompt daughters (^{231}Th from ^{235}U and ^{234}Th and ^{234}Pa from ^{238}U) is to the skin. Therefore, all of the products considered were semi-quantitatively evaluated using projected exposure times and geometries as well as sensitivities of the target organ(s). Each product was evaluated, for example, according to the size of the metal mass that would come in contact with the individual, the estimated length of time the individual would be exposed. and the extent of the exposed population. Two products emerged as those offering the greatest potential for exposure; namely, stainless steel flatware and stainless steel hip joint prostheses. The considerations used in the selection of these products include:

- *Nickel-Alloy Eyeglasses versus Hip Joint Prostheses:* The eyeglass material would give approximately the same hourly dose as the hip joint prosthesis, but the exposure from the hip joint would be continuous while the eyeglasses would be at least removed for sleeping. In addition, the life of the eyeglasses was estimated to be five years or less while the life of the hip joint was estimated to be ten to fifteen years.
- *Stainless Steel Hand Tools versus Flatware:* The hand tools give relatively the same hourly exposure as the flatware while they are being used. In a cursory analysis of the use of hand tools versus flatware, the researchers concluded that in a lifetime, hands would be in contact with flatware more often and for longer periods than with hand tools. This is true, even in the lifetime of an individual who uses hand tools a great deal, such as a mechanic. Conclusions were based on 1,000 hours per year (one half the normal work year) times 40 years for hand tools versus 600 hours per year for 70 years for flatware.
- *Orthodontic Braces*: Braces made from an alloy containing slightly contaminated nickel

were also considered. The exposure to the gums and inner cheeks from the small mass would be quite small, less than 0.01 mRad/yr. Also, orthodontic braces will be in place for two to three years.

Since the flatware and the hip joint prosthesis were determined to have the highest potential for maximal exposure, these products were selected for quantitative assessment for the purposes of this research. A summary of the products evaluated and associated comments are provided in Table 3-1.

Table 3-1 Selection of Products Evaluated

Product	Evaluated?	Comments
Flatware	Yes	Larger mass. potentially large exposure population.
Orthodontic braces	No	Smaller mass than hip joint
Eyeglasses	No	Smaller mass and less exposure time than hip joint
Hip joint prostheses	Yes	Larger mass, and long exposure time
Hand tools	No	Less exposure time than hip joint. small exposed population.

3.1.1 Waste Disposal Assumptions

There is another potential source of exposure resulting from the disposed waste from the foundry's manufacture of stainless steel made from MSC's reprocessed nickel. To assure that the risk assessment was as conservative as possible, researchers assumed that the uranium would not be partitioned. This means that for the risk calculations, all the uranium was assumed to be *both* in the metal product and in the waste. Experience with remelting ^{99}Tc-contaminated nickel has shown that the ^{99}Tc remains nearly qualitatively with the metal; therefore a partitioning of 90 percent of the ^{99}Tc in the metal product and 10 percent of the ^{99}Tc in the slag was assumed for the risk evaluation.

3.1.2 Flow of Processes and Scenarios Used in Analysis

Figure 3-1 that follows depicts the flow of metal and waste through MSC's reprocessing to the recycling foundry. The scenarios that were selected to assess potential risks from commercial use of the reprocessed nickel are indicated with a footnote.

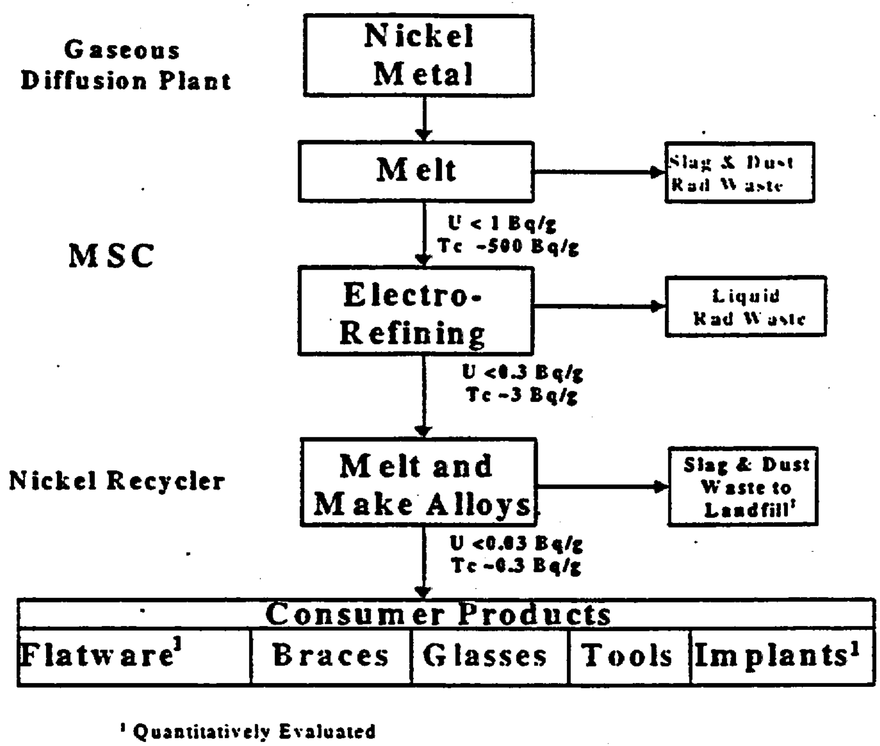

Figure 3-1 Diagram of Potential Consumer Products and Associated Waste Streams Evaluated

3.2 Parameters Used to Analyze Stainless Steel Flatware From Reprocessed Nickel

The parameters used for the risk analyses were based both on actual data taken from various government and academic studies and on quantifiable assumptions made by the researchers. The first risk analysis assumed that the reprocessed nickel would be recycled as an alloy to make stainless steel flatware which would be purchased and used as individual eating utensils. Direct exposure would occur each time the fork, spoon, and knife were used at mealtimes. Exposure was calculated according to the quantitative descriptions that follow:

3.2.1 Exposure Time

The Exposure Factors Handbook (EPA 1989) lists the amounts of time adults spend eating meals at home. The median (50th percentile) value is listed as 5.85 hours per week and the corresponding 90th percentile value is listed at about double that amount of time (or 11.7 hours per week. p. 5-65). Researchers selected the more conservative 90th percentile value as the representative parameter for exposure time. Using this value, the exposure from the flatware would be approximately 600 hours a year.

3.2.2 Exposure Geometry

The dimensions of the flatware used for this calculation were obtained by measuring sample pieces of flatware. The weight of a fork, spoon, and knife averaged 30 g, 35 g, and 50 g, respectively. The surface area of these utensils in contact with an adult's hand during mealtime was calculated using the dimensions of the largest piece of flatware (the table knife) and the human hand. The total area of the knife handle that touched the skin of the fingers and palm was 36 cm^2 ; that is, about 9 cm long (the length of the hand), 1.5 cm wide (the width of the knife), and 0.5 cm thick, with two sides of the flatware contacting the hand. The volume of the knife would be about 6.75 cm^3.

3.2.3 Exposed Population

Population exposure potential was calculated using estimates of both the nickel barrier material available for recycle and reasonable saturation of available markets. Each setting of flatware weighed 115 g (or about 1/4 of a pound). At that weight, there is more than enough nickel in the three gaseous diffusion buildings at ETTP to make 267,800,000 place settings of stainless steel flatware, one set for every person in the United States, with enough stainless steel left over to make a small cooking utensil for each household. Since domestic markets do not exist for such a large quantity of flatware, the researchers assumed that a reasonable number of place settings that could be marketed would be less than 1,000,000 (or 125,000 sets each of 8-place settings). This estimate led to the assumption of 1,000,000 people as the size of the exposed population.

3.2.4 Exposure Point Concentrations

Exposure point concentrations used in this analysis are presented in Table 3-2.

Table 3-2 Concentrations Used in Dose Calculations

Nuclide	Recycled Nickel Activity Concentration (pCi/g)	Product Activity Concentration (pCi/g)	Waste Activity Concentration (pCi/g)
Technetium-99	81	7.29	16.2
Uranium	8.10	2.7E-01	16.2
Uranium-234	5.5080	5.5 E-1	11.0
Uranium-235	0.2430	2.4 E-2	0.5
Uranium-238	2.3490	2.3 E-1	4.7

3.3 Parameters Used to Analyze Stainless Hip Joint Prostheses From Reprocessed Nickel

The parameters used for the risk analysis of hip joint prostheses were based on the assumption that the joint would be made from stainless steel using MSC's reprocessed nickel alloys. The target organ would be the bone surface surrounding the implanted hip joints. This exposure was estimated using the exposure time and geometry noted in the following subsections. Results are summarized in Section 4.

3.3.1 Exposure Time

The exposure time for a hip replacement is 24 hours a day, 365 days (or 8760 hours) a year for an estimated 15 years.

3.3.2 Exposure Geometry

The hip joint prosthesis evaluated was an idealized representation of the hip joint as depicted in Figure 3-2. The figure and associated information used for this study were taken from an Internet Website on hip joint research.[1] The hip ball, which was assumed to measure 3 cm in diameter, would be attached to a cylinder measuring 10 cm long by 1 cm in diameter. The mass of stainless steel in this hypothetical implant would, therefore, be about 176 g and the surface area in contact with surrounding tissue would be approximately 60 cm^2.

The dimensions for the hip joint prosthesis were estimated, as there is no "standard" size. Further, since the hip joint prosthesis is a somewhat complex shape, these dimensions were used for convenience. The area in actual contact with the body was only approximated and would be different for most individuals, since hip joint prostheses must be sized to fit the pelvic area .

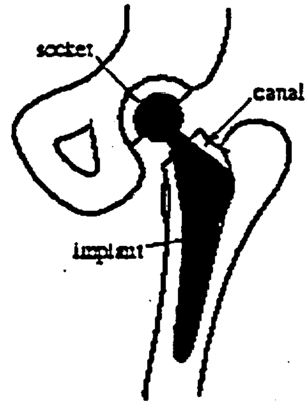

Figure 3-2 Hip Implant[1]

3.3.3 Exposed Population

There are not a large number of hip joint replacements annually, and nickel alloys are not the prevalent materials used. For the purpose of this study, however, researchers considered (1) that 10 percent of the hip joints would be of nickel-based alloy and (2) that for a 10-year period, all of these would be made from recycled nickel with residual uranium and ^{99}Tc. These assumptions yielded an estimate of 18,000 hip joint prostheses, making the maximum exposed population size at 18.000 people.

3.3.4 Exposure Point Concentrations

Exposure point concentrations used in this analysis are also presented in Table 3-2.

3.4 Parameters Used to Analyze Disposal of Recycled Nickel Wastes

Dross, slag, and ash would be produced by the smelting operations at the recycling foundry manufacturing the stainless steel. These wastes would typically be buried in landfills. It is likely that a significant portion of the small amount of uranium and ^{99}Tc from MSC's reprocessed nickel would end up in the dross and slag generated at the foundry. Any uranium carried in the exhaust gas would end up as an oxide in the ash and, therefore, would be collected by the bag house serving the furnace. All this waste material would be trucked to a landfill. To facilitate the analysis of the exposure in a landfill, the activity in 40,000 pounds of recycled nickel was assumed to be evenly dispersed through one 20,000 pound (9080 kg) load of waste (typical landfill operation) over a 407 ft^2 area. The thickness and area of the waste were calculated from the volume of waste carried to the landfill. The volume was derived using a density of 100 pounds per cubic foot.

Researchers concluded that other truckloads were not likely to go into the same disposal cell in the landfill. Further, since more than one landfill would likely be involved, the risk from the disposal of a single truckload would be representative of the risk for the recycled nickel waste. This risk may be repeated for thirty different landfills (using an estimate of 6,000 tons of total nickel divided by 20 tons in a single disposal facility). If the waste from more than one shipment did go to a single landfill, the time factors would assure that no two loads would be disposed of in close proximity. Therefore, two disposals in the same disposal facility would not be greatly different from two disposals in separated facility.

3.4.1 Exposure Time

Exposure time parameters assumed that the target receptors would be residents living in homes built on the landfill over a residence time of 30 years. An additional exposure pathway considered was the residents living near the landfill in the direction of the subsurface waste flowing from the landfill.

3.4.2 Exposure Geometry

The geometry used for the risk analysis of landfill wastes assumed that at a typical landfill, the bulk of the waste handling would involve dumping the truck on the open face of the landfill and spreading it over some nominal area. Researchers assumed a 20,000 pound (9,080 kg) truck load of smelter waste that would be spread as part of a six-inch (0.15m) lift of waste over a 407 ft^2 (37.8 m^2) area.

3.4.3 Exposed Population

Target receptors of population doses from landfills would be residents living in houses built over the waste or in a residence down-gradient from the landfill. Due to the limited number of people that would be subjected to such conditions, no population dose was evaluated.

3.4.4 Exposure Point Concentrations

Exposure point concentrations used in this analysis are presented in Table 3-2.

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[1] From http://www.research.ibm.com/hc/ARTIFACT/artifact.html

3.5 Parameters Used to Analyze Exposure to Drivers Transporting Reprocessed Nickel

In all scenarios there is an additional exposure case. The truck driver hauling the reprocessed nickel from MSC to the metal recycle foundry would be exposed to direct radiation from the reprocessed nickel. The gamma-emitting radionuclides, i.e. the prompt radioactive decay daughters of ^{238}U, would produce a small but calculable dose to the driver(s) involved in this operation.

4.0 Dosimetry

The doses from the three scenarios described in Section 3 were calculated using MicroShield (Grove, 1995), VARSKIN (Durham, 1998), and RESRAD 5.80 (ANL, 1995), as appropriate. Table 4-1 presents the results of these calculations. The details of each analysis (flatware, hip joint prostheses, landfill waste disposal, and transport of reprocessed nickel ingots) are presented in the following sections.

Table 4-1 Calculated Doses from Products Containing Reprocessed Nickel

Mode of Exposure	Maximum Doses (mrem/y)		
	Flatware	Hip Joints	Waste Disposal
Beta dose results	2.2 E-2	1.4 E-1	-
Gamma dose results	2.8 E-6	5.8 E-5	-
Environmental dose results	-	-	0.6

The numbers in Table 4-1 represent the dose to the tissue adjacent to the product rather than the dose to an individual's whole body. The doses can be equated to whole body doses, however, by multiplying the tissue dose by the tissue dose weighting factors. The tissue-weighting factor for both skin and bone surfaces is 0.01.

Both the flatware and the hip joint prosthesis would expose only a small fraction of the total organ, according to the scenarios used to calculate exposure. Conservative fractions of 1 percent to the skin and 1 percent to the bone were assumed in determining the exposure dose and risks from the two potential consumer products. The area actually exposed, however, would be a smaller fraction of both these organs. Based on the fractional assumptions, the total whole body equivalent doses for flatware and hip joint prostheses were 0.00022 mrem/y and 0.0014 mrem/y, respectively. To put these calculated doses into perspective, the added radiation dose for a transcontinental or transatlantic flight would be about 2 or 3 mrem. Other comparisons of radiation exposure that are relevant to this report are provided in Table 4-2.

Table 4-2 Dose Comparisons

Whole Body Equivalent	mrem/yr	Source
Average Natural Background Radiation	300	a
Hip Joint Prosthesis	**0.0014**	b
X-Ray for Hip Joint Prosthesis Implant	130	a
Orthodontic Braces	0.001	b
X-Ray for Orthodontic Braces Preparation	40	a
Glaze on False Teeth (Full Denture)	2	c, d
Nickel Alloy Eyeglass Frames	0.001	b
Thorium Containing Flux on Eyeglasses	0.4	c
Flatware	**0.00022**	b
Glazed Ceramic Tableware (Glaze Containing Uranium)	~1	c, d

[a] NCRP93, 1987.
[b] Calculated in this Report
[c] NCRP95, 1987.
[d] Older Products - No Longer Available Commercially

4.1 Flatware

Exposures from the radionuclides present in stainless steel flatware containing MSC's reprocessed nickel were assumed to occur when the utensils were held in a human hand. The mixture of ^{99}Tc and uranium (plus prompt daughters) produces alpha, beta, and gamma radiation. Alpha radiation has a short range and would be blocked by the dead layer of skin on the hand or on any other part of the body. Doses from the beta radiation component were calculated using the computer code VARSKIN (Durham, 1998). The results are presented in Table 4.3. Gamma doses were calculated using the MicroShield computer code from Grove Engineering (Grove, 1995). Results from the MicroShield calculations are presented in Table 4.4.

Table 4-3 Calculated Beta Doses to the Hand or Hip From Products Containing reprocessed Nickel

Radionuclide [a]	Concentration (pCi/g)		Annual Dose per Unit Activity (mrad-g/pCi)		Annual Dose (mrad)	
	Flatware	Hip Joints	Flatware	Hip Joints	Flatware	Hip Joints
Technetium-99	7.3 E+0	7.3 E+0	1.7 E-3	1.8 E-2	1.2 E-2	1.3 E-1
Uranium-234	5.5 E-1	5.5 E-1	0	0	0	0
Uranium-235 + D	2.4 E-2	2.4 E-2	1.8 E-3	1.9 E-2	4.3 E-5	4.6 E-4
Uranium-238 + D	2.3 E-1	2.3 E-1	4.3 E-2	3.2 E-2	1.0 E-2	7.5 E-3
Total					2.2 E-2	1.4 E-1

VARSKIN requires as input variables the geometry of the source and the names and activities of the radionuclides in the source. The geometries, as well as the list of radionuclides and their activities are described in Section 3. Appendix A.1 contains the VARSKIN output file, which lists the input variables used and the results of the model run. The beta doses are volume averaged values.

Table 4-4 Calculated Gamma Doses to the Hand or Hip From Products Containing Reprocessed Nickel

Radionuclide	Concentration (pCi/g)		Annual Dose per Unit Activity (mrad-g/pCi)		Annual Dose (mrad)	
	Flatware	Hip Joints	Flatware	Hip Joints	Flatware	Hip Joints
Technetium-99	7.3 E+0	7.3 E+0	0	0	0	0
Uranium-234	5.5 E-1	5.5 E-1	1.6 E-8	2.2 E-7	8.5 E-9	1.2 E-7
Uranium-235 + D	2.4 E-2	2.4 E-2	5.6 E-5	1.1 E-3	1.4 E-6	2.6 E-5
Uranium-238 + D	2.3 E-1	2.3 E-1	6.3 E-6	1.3 E-4	1.5 E-6	3.2 E-5
Total					2.8 E-6	5.8 E-5

MicroShield also requires as input variables the geometry of the source and the names and activities of the radionuclides in the source. Appendix B.1 contains the MicroShield output file, which lists the input variables used and the results of the model run.

Population doses for flatware users are the number of people in the postulated exposure group, multiplied by the whole body dose (combined beta and gamma) to which they may be exposed. The whole body dose is determined by multiplying the tissue dose by the tissue weighting factor from Table 2, ICRP 60. For skin, the tissue weighting is 0.01. The fraction of the skin exposed was also considered in the dose and risks calculations. Therefore. the population dose for this flatware scenario was calculated to be 0.22 rad/y (1,000,000 people x 2.2 E -5 rad/y x 0.01). Comparatively, this is the same increase in annual population dose as would be experienced by two or three people who moved from East Tennessee to central Colorado.

4.2 Hip Joint Prostheses

Exposure to any radionuclides present in stainless steel hip joints containing MSC's reprocessed nickel are assumed to occur when the prosthesis is implanted. The mixture of ^{99}Tc and uranium (plus prompt daughters) produces alpha, beta, and gamma radiation. Again, alpha radiation has a short range and would be blocked either by the cement binding the implant to the cortical bone or by the socket into which the ball fits. As with the flatware, doses from the beta radiation component were calculated using VARSKIN and gamma doses were calculated using MicroShield. Results are presented in Tables 4.3 and 4.4, respectively.

Appendix A.2 contains the VARSKIN output file, which lists the input variables used and the results of the model run. The beta doses reported are volume-averaged values. Appendix B.2 contains the MicroShield output file which also lists the input variables used and the results of the model run.

In addition to doses from direct exposure to the implant itself. doses were also estimated from the potential dissolution of the metal while the prosthesis is in the body. These doses were estimated by assuming that 1 micron of the implant's surface (59.7 cm^2) dissolved during the product's lifetime of 10 years. This dissolution would introduce into the blood stream an annual dose of 0.0129 pCi of ^{99}Tc, 0.000879 pCi of ^{234}U, 0.000375 pCi of ^{235}U, and 0.0000388 pCi of ^{238}U. These amounts are equivalent to ingested intakes of 0.016 pCi of ^{99}Tc, 0.022 pCi of ^{234}U, 0.001 pCi of ^{235}U, and 0.009 pCi of ^{238}U (ICRP, 1996, pages 22 and 40, respectively). Using the appropriate dose conversion factors from ICRP 72 (ICRP 1998), these intakes would produce a combined dose of 6×10^{-6} mrem/y. This dose is small compared to potential doses from other pathways. The dissolution scenario is presented here for completeness, but the calculations were not considered further in this evaluation. The amount of the implant that would dissolve was estimated based on reasonable judgement. If large quantities of the prosthesis metal were to dissolve, however, the implant would fail in a much shorter time than the normal use expectancy of hip joint prostheses. Likewise, if the dissolution rate were ten times the assumed rate, the dose would still be much smaller than the direct radiation dose. Based on these options, dissolution scenarios were not further considered.

Population doses for people with MSC's reprocessed nickel hip joint prostheses were calculated using the same method used to calculate the population doses for the flatware. The whole body dose was determined by multiplying the tissue dose by the tissue-weighting factor from Table 2, ICRP 60. For bone surfaces, the tissue weighting is 0.01. The fraction of bone that would be exposed was also considered in the dose and risk calculations. The population dose for the hip joint scenario was calculated to be 0.025 rad/y (18,000 people x 1.4 E -4 rad/y x 0.01). Comparatively, this would be the same increase in annual population dose that would be experienced by five people who moved from a house constructed of wood to a house constructed of brick.

4.3 Landfill Waste Disposal

The landfill exposure scenario involved the disposal of waste from the recycling foundry's operation. The computer code RESRAD 5.80 (ANL,1993) was used to assess the potential long-term doses from this activity. Default input parameters were used, except where otherwise noted. Appendix C contains the detailed output from this simulation.

The activity in 40,000 lb. of recycled nickel (9.8 μCi ^{99}Tc, and 0.98 μCi uranium) was assumed to be partitioned as indicated earlier (that is, all the uranium and 10 percent of the ^{99}Tc remains in the slag). The slag was also assumed to be evenly dispersed through one 20,000 lb. truckload of smelter waste. The waste was assumed to be placed in the landfill and covered with 2 meters of soil and other waste. Doses to a resident living on the landfill were calculated for the following pathways using RESRAD default values:

- Drinking water
- Food ingestion
- Soil ingestion
- Inhalation (both resuspended soil and radon), and
- Direct exposure to external radiation.

Figure 4-1 presents the projected doses over time from this scenario. The maximum projected dose of ^{99}Tc in drinking water was 0.6 mrem at about 7 years after placement of the waste. These doses applied to residents living directly on the landfill. In practice, however, institutional access controls would prevent residential building over a landfill during active operations and would also prevent residential use during post-closure monitoring and maintenance periods required of most landfill operations. Institutional controls commonly last for 30 years after the landfill is closed, so doses to on-site residents during the first 30 years after waste placement should be discounted. As can be seen from Figure 4-1, no discernable doses can be identified in the period between 30 years and 1000 years.

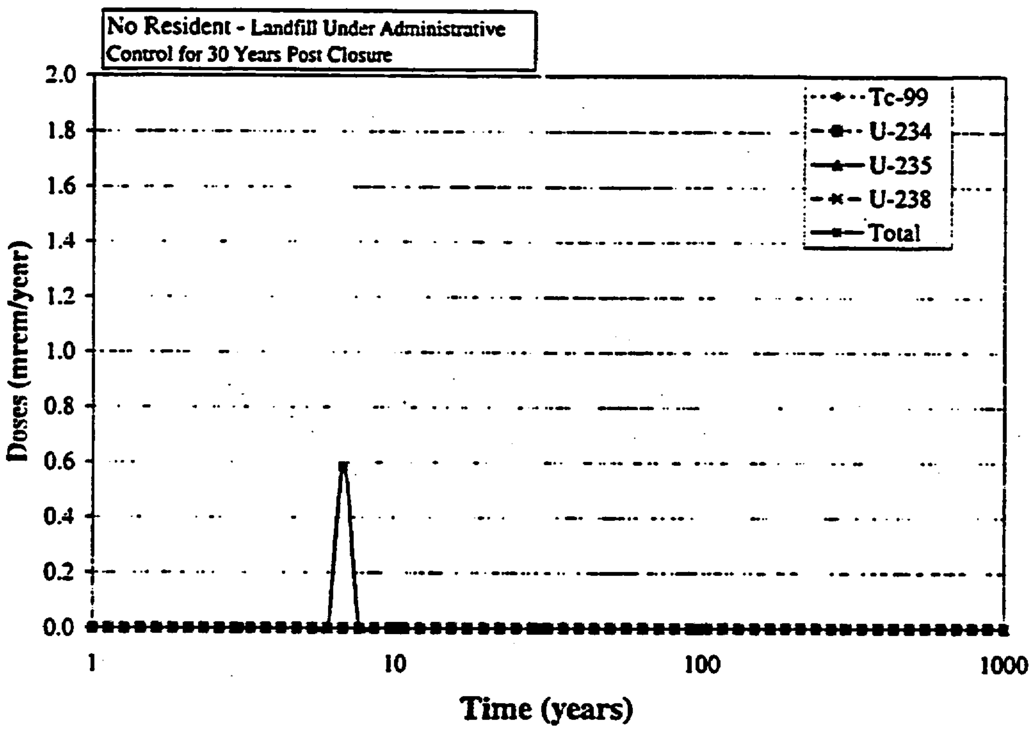

Figure 4-1 Calculated Doses to Resident Living on Reclaimed Land

A second group of residents that may be exposed are those who may live on properties adjacent to the landfill. If the water for these residents were supplied by a well, then they may be exposed to uranium and ^{99}Tc from landfill runoff and leaching. Since adjacent properties are not subject to landfill access control restrictions, residents on adjacent properties could receive doses within the first 30 years. However, the normal dilution and attenuation processes that would occur between the landfill source and the aquifer would mitigate doses to offsite residents. A dilution attenuation factor (DAF) of 10 was used to extrapolate doses to offsite residents from on-site dose rates. The maximum dose to this population would be 0.06 mrem/year, the majority which would come from ^{99}Tc in drinking water. Due to the limited number of people exposed in this scenario, no population dose was evaluated.

The analysis used the technetium chemical form represented by the RESRAD default value. It is, however, unlikely that the ^{99}Tc in the dross would be so soluble. Therefore, the long-term dose would probably be the same if a less soluble form were chosen.

4.4 Exposure From Transporting Reprocessed Nickel Ingots

While not a part of the selected scenarios for dose determinations, the exposure to the truck driver hauling the processed nickel from MSC was evaluated using MicroShield. The exposure from a 20-ton load was calculated at 6×10^{-7} mrem per hour. Of all the nonradiation workers handling the nickel before it is recycled into stainless steel or other nickel alloy products, the truck driver would probably receive the greatest amount of exposure. Assuming he or she would have driven the truck loaded with the MSC nickel for 2000 hours per year, the driver would receive a dose of 1.2 microrem per year. Comparatively, if the same driver were hauling normal soil that contained 0.5 pCi/g of uranium and 0.25 pCi/g of thorium, his or her exposure would be approximately 6×10^{-5} mrem per hour for an annual dose of 120 microrem. The soil activity levels used in this comparison are less than the average soil activity in the United States.

Assuming that the truck driver were the most exposed individual among those who handle the metal, MSC's reprocessed nickel would meet the exposure criterion for residual activity contained in the latest Nuclear Regulatory Rule for license termination (10 CFR 20.1402). Even if there were another individual who would be more highly exposed to the reprocessed nickel than would be the truck driver, it is unlikely that his or her exposure could be significantly more than the hourly exposure calculated for the truck driver. The calculated exposure was based on the truck driver's being one meter from a rectangular block representing a 20-ton batch of the nickel. It is doubtful that any individual would actually be that close to the reprocessed nickel for 2000 hours per year.

5.0 Risk Analysis

The previous section presents the methods and results of the prospective dose assessment for reprocessed nickel barrier. These doses were used to calculate the individual and population risks from using stainless steel end products made from MSC's reprocessed nickel.

5.1 Risks from Products

The absorbed annual doses in rem to the target organs were converted to annual equivalent doses in Sieverts (Sv) to the target organ by converting from rem to Sv (divide by 100) and then applying the appropriate radiation weighting factor from ICRP 60 (ICRP, 1990). Annual doses were converted to lifetime risks by multiplying the annual equivalent doses by the number of years the individual was assumed to be exposed. The lifetime risks are the product of the lifetime doses and the nominal probability coefficients for individual tissues and organs from Table 4 of ICRP 60. The results are presented in Table 5-1.

Table 5-1 Calculated Risks from Recycled Nickel Products

		Lifetime Risk of Cancer Incidence		
Radionuclide		Flatware	Hip Joints	Waste Disposal
Technetium-99		3 E-9	1 E-8	-
Uranium-234		1 E-15	1 E-14	-
Uranium-235 + D		1 E-11	5 E-11	-
Uranium-238 + 2 daughters		3 E-9	8 E-10	-
	Total	6 E-9	1 E-8	1 E-7

The lifetime risks were determined using the doses calculated in Section 4 and a lifetime exposure duration of 70 years for the flatware and 15 years for the hip joint.[2]

[2] Assumes an individual will use flatware for a full lifetime (70 years) and uses the hip joint prosthesis for the expected life of the device (15 years). While some people have had a second hip joint replacement after a device life time of 12 to 15 years, it is unlikely that the material for a second prosthesis would also contain nickel with radioactive contaminants.

5.2 Risk from Applying Smelter Waste Streams to Landfills

The maximum risks to a resident living next to a landfill containing one truckload of smelter waste for 30 years were calculated using RESRAD 5.8 and a dilution/attenuation factor of 10. The total risks from all radionuclides investigated are 1×10^{-7}. These risks are below 10^{-6}, the point of departure used by EPA in CERCLA risk assessments.

5.3 Risk Summary

In Section 4, the dose to an individual making a transcontinental or transatlantic air flight was shown as 2 or 3 mrem per flight. The ICRP 60 provides a dose to risk conversion factor of 7.3 percent per Sv. This is equivalent to 0.000025 Sv x 0.073 Sv^{-1} or 2×10^{-6}. All of the risks quantified in this evaluation are well below this level.

6.0 Regulatory Limits

6.1 Surface Activities

The nickel produced by MSC will be surveyed to assure there is no loose contamination above the limits in Regulatory Guide 1.86 (USAEC, 1974). These limits are 0.17 Bq/cm^2 (1,000 dpm/100cm^2). Results of the bench-scale and pilot-scale tests taken during MSC's proof of process showed that the residual radionuclides, uranium and ^{99}Tc, were homogeneously distributed in the nickel. Because all the radionuclides are either alpha or beta emitters, the metal itself will limit the range of these emissions. Any measurement attempts of the outer surface with a survey meter will be indistinguishable from background. This measurement will meet the criteria for releasing metals with surface contamination, according to the limits for fixed contamination established in Regulatory Guide 1.86 (that is, 0.85 Bq/cm^2 or 5,000 dpm/100cm^2).

The further recycling of the nickel to manufacture stainless steel or other alloys will not alter the homogeneity of the residual radionuclides. Again, the surface would not have sufficient activity to exceed Reg Guide 1.86 limits for total activity. As there would be no source of potential removable contamination on the final products. the limits for removable contamination would also be met.

6.2 Residual Radioactivity

The most recent NRC ruling on license termination (10 CFR 20.1402) stipulates that residual radiation that is distinguishable from background must result in a dose of less than 0.25 mSv (25 mrem) total effective dose equivalent (TEDE) per year to an average member of the critical group. The nickel ingots as released from the MSC facility meet this criterion. The truck driver identified in Sections 3 and 4 would likely be the most exposed individual for the nickel metal as it is released at MSC. The exposure calculated for that individual is 1.2 microrem/y. Since his or her exposure was calculated on a 2,000 hour work year and someone could potentially be exposed for a full year, the maximum exposure would be approximately 5 microrem/y (0.002 percent of the residual radiation limit).

7.0 Conclusions

Nickel in the Department of Energy's Gaseous Diffusion Plants is a valuable resource that can be safely recycled using the methods proposed by Manufacturing Sciences Corporation. Consumer products made from the recycled metal are unlikely to create any identifiable health risks. The conservative calculated risk was three chances in a billion for increased cancer risks from the use of flatware made from MSC's reprocessed nickel and two chances in a billion for increased cancer risks from being fitted with a pair of hip joint prostheses manufactured from the reprocessed nickel.

For comparison, the risk from a single transcontinental or transatlantic plan fligth has greater potential for increasing the risk of cancer than does the lifetime use of the flatware made of stainless steel recycled from MSC's reprocessed nickel. The radiation dose, and the resulting risk, from the x-ray examinations necessary to install the hip joint prothesis would be more than 90,000 times greater than the lifetime dose and risk from a prothesis made of recycled nickel.

The residual radiation in the nickel ingots released from MSC meets the dose limitation criterion of 10 CFR 20.1402 of not more than 25 mrem/yr. The highest calculated dose from the products considered in this report is 0.0014 mrem/y. Measurements on the surface of either the metal ingots produced at MSC or on any product made from that nickel will meet the criteria from the NRC's Reg Guide 1.86, which has long been used as the basis for unrestricted release of materials with residual radionuclides.

8.0 References

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ICRP, 1990. ICRP Publication 60, 1990 Recommendations of the International Commission on Radiological Protection, International Commission on Radiological Protection, Oxford, UK.

NRCP 1987 Ionization Radiation Exposure of the Population of the United States, Report 93, National Council on Radiation Protection and Measurements, Bethesda, MD.

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Appendix A VARSKIN2 Runs for Flatware and Hip Joint Implants

VARSKIN runs were performed for each combination of geometry and beta emitter listed in Table A-1. Each computer run assumed the product contained 1 pCi/g of the selected radionuclide in equilibrium with its prompt daughters. These runs yielded the calculated dose rate per unit activity (mrem-cm^3/min-pCi) for the configuration of interest. Sections A.1 and A.2 contain the output files from the six computer runs performed during this study.

These unit dose rates were then converted into the annual dose rate per unit of activity (mrem-g/y-pCi) by multiplying the unit does rate by the expected exposure duration for that product and the fraction of the organ irradiated. These annual dose rates are linearly dependent on the radionuclide's concentration in the product and can be scaled up or down to match the appropriate concentration.

Table A-1 Summary of Beta Dose Rates Calculated Using VARSKIN

	Dose Rate per Unit Volume of Source [a] (rad-cm3/h-pCi)		Annual Dose per Unit Activity [b] (mrad-g/pCi-y)	
Radionuclide	Flatware	Hip Joints	Two Pieces of Flatware [c]	Two Hip Joints [d]
Technetium-99	5.8 E-10	4.3 E-10	1.7 E-3	1.8 E-2
Uranium-234	nb [e]	nb [e]	nb [e]	nb [e]
Uranium-235 + 1 daughter	6.2 E-10	4.5 E-10	1.8 E-3	1.9 E-2
Thorium-231	6.2 E-10	4.5 E-10	1.8 E-3	1.9 E-2
Uranium-238 + 2 daughters	1.5 E-8	7.6 E-10	4.3 E-2	3.2 E-2
Thorium-234	2.5 E-10	1.7 E-10	7.1 E-4	7.3 E-3
Protactinium-234	1.5 E-8	5.8 E-10	4.3 E-2	2.5 E-2

[a] VARSKIN output.
[b] (Dose Rate per Unit Activity, mrad-g/min-pCi) x (Exposure Time, min/y).
[c] Assumes an exposure time of 36000 min/yr, a source density of 8.02 cm3/g and a skin surface area of 1.8 m^2.
[d] Assumes an exposure time of 525600 min/yr, a source density of 8.02 cm3/g and a skeletal surface area of 11 m^2.
[e] Not a beta emitter.

A.1 Flatware

Beta doses from flatware were modeled for the knife. The knife was selected because it had more surface area than the other pieces of stainless steel flatware in the set. A disk of equivalent surface area directly in contact with the skin was used to represent the geometry of the knife handle in these calculations. An exposure duration of 600 h/y was used to calculate the annual unit dose rate. The results are presented in Table A-1, and the VARSKIN output files are presented below.

A.1.1 Tc99 in Flatware

```
                     Program VARSKIN-MOD2

flatware

         Cylindrical Source Geometry

                Nuclide : Tc-99
      1.8*X90 Distance :    4.806000E-02 cm
   Average Beta Energy :    8.470000E-02 MeV
          No gamma dose calculation
       Source Strength :    1.000000E-06 uCi/cm^3
        Source Density :        8.020000 g/cm^3
      Diameter of Disk :    67702.750000 um
     Thickness of Disk :     1875.000000 um
            Skin Depth :    0.000000E+00 mg/cm^2
    Thickness of Cover :    0.000000E+00 mm
     Air Gap Thickness :    0.000000E+00 mm
      Irradiation Time :    36000.000000 min

  The area of irradiation is larger than      1.0000 square cm

  The beta dose rate averaged over      1.0000 square cm =    1.58E-09 rad/hr
  The total beta dose averaged over      1.0000 square cm =    9.47E-07 rad

  The area of irradiation is larger than      1.0000 square cm

  The beta dose rate averaged over      1.0000 square cm =    2.53E-09 rad/hr
  The total beta dose averaged over      1.0000 square cm =    1.52E-06 rad

  The area of irradiation is larger than      1.0000 square cm

  The beta dose rate averaged over      1.0000 square cm =    2.35E-09 rad/hr
  The total beta dose averaged over      1.0000 square cm =    1.41E-06 rad

  The area of irradiation is larger than      1.0000 square cm

  The beta dose rate averaged over      1.0000 square cm =    2.11E-09 rad/hr
  The total beta dose averaged over      1.0000 square cm =    1.26E-06 rad

  The area of irradiation is larger than      1.0000 square cm

  The beta dose rate averaged over      1.0000 square cm =    1.72E-09 rad/hr
  The total beta dose averaged over      1.0000 square cm =    1.03E-06 rad

  The area of irradiation is larger than      1.0000 square cm

  The beta dose rate averaged over      1.0000 square cm =    1.44E-09 rad/hr
  The total beta dose averaged over      1.0000 square cm =    8.66E-07 rad

  The area of irradiation is larger than      1.0000 square cm

  The beta dose rate averaged over      1.0000 square cm =    1.03E-09 rad/hr
  The total beta dose averaged over      1.0000 square cm =    6.16E-07 rad

  The area of irradiation is larger than      1.0000 square cm

  The beta dose rate averaged over      1.0000 square cm =    1.68E-09 rad/hr
  The total beta dose averaged over      1.0000 square cm =    1.01E-06 rad
```

```
The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.20E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   7.18E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.51E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   9.04E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   9.51E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   5.71E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   7.88E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   4.73E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   5.86E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   3.52E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   4.00E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   2.40E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.21E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.32E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.18E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   7.10E-08 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   5.27E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   3.16E-08 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.84E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.10E-08 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   3.49E-12 rad/hr
The total beta dose averaged over     1.0000 square cm =   2.10E-09 rad
```

DEPTH (mg/cm^2)	DOSE (rad/h)
0.00E+00	1.58E-09
1.33E-04	2.53E-09
5.33E-04	2.35E-09
1.20E-03	2.11E-09
2.13E-03	1.72E-09
3.33E-03	1.44E-09
4.79E-03	1.03E-09
6.52E-03	1.68E-09
8.52E-03	1.20E-09
1.08E-02	1.51E-09
1.33E-02	9.51E-10
1.61E-02	7.88E-10
1.92E-02	5.86E-10
2.25E-02	4.00E-10
2.61E-02	2.21E-10
3.00E-02	1.18E-10
3.41E-02	5.27E-11
3.85E-02	1.84E-11
4.31E-02	3.49E-12

4.81E-02 0.00E+00

```
The dose rate averaged over      .0481 cubic cm between      .00 mg/cm^2
and     48.06 mg/cm^2 =   5.82E-10 rad/hr

The total dose averaged over      .0481 cubic cm between      .00 mg/cm^2
and     48.06 mg/cm^2 =   3.49E-07 rad
```

A.1.2 U235 in Flatware

```
                 Program VARSKIN-MOD2

        Cylindrical Source Geometry

             Nuclide : Th-231
      1.8*X90 Distance :    4.374000E-02 cm
   Average Beta Energy :    7.650000E-02 MeV
       No gamma dose calculation
       Source Strength :    1.000000E-06 uCi/cm^3
        Source Density :        8.020000 g/cm^3
      Diameter of Disk :    67702.750000 um
     Thickness of Disk :     1875.000000 um
            Skin Depth :    0.000000E+00 mg/cm^2
    Thickness of Cover :    0.000000E+00 mm
      Air Gap Thickness :   0.000000E+00 mm
       Irradiation Time :   36000.000000 min

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   1.41E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   8.45E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   2.97E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   1.78E-06 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   2.70E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   1.62E-06 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   2.34E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   1.40E-06 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   1.88E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   1.13E-06 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   1.61E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   9.65E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   1.11E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   6.65E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   1.54E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   9.25E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   1.27E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   7.64E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   1.53E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =   9.20E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =   9.06E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =   5.44E-07 rad

 The area of irradiation is larger than     1.0000 square cm
```

```
The beta dose rate averaged over      1.0000 square cm =   8.24E-10 rad/hr
The total beta dose averaged over      1.0000 square cm =   4.94E-07 rad

The area of irradiation is larger than      1.0000 square cm

The beta dose rate averaged over      1.0000 square cm =   6.70E-10 rad/hr
The total beta dose averaged over      1.0000 square cm =   4.02E-07 rad

The area of irradiation is larger than      1.0000 square cm

The beta dose rate averaged over      1.0000 square cm =   4.45E-10 rad/hr
The total beta dose averaged over      1.0000 square cm =   2.67E-07 rad

The area of irradiation is larger than      1.0000 square cm

The beta dose rate averaged over      1.0000 square cm =   2.74E-10 rad/hr
The total beta dose averaged over      1.0000 square cm =   1.65E-07 rad

The area of irradiation is larger than      1.0000 square cm

The beta dose rate averaged over      1.0000 square cm =   1.49E-10 rad/hr
The total beta dose averaged over      1.0000 square cm =   8.96E-08 rad

The area of irradiation is larger than      1.0000 square cm

The beta dose rate averaged over      1.0000 square cm =   7.04E-11 rad/hr
The total beta dose averaged over      1.0000 square cm =   4.23E-08 rad

The area of irradiation is larger than      1.0000 square cm

The beta dose rate averaged over      1.0000 square cm =   2.50E-11 rad/hr
The total beta dose averaged over      1.0000 square cm =   1.50E-08 rad

The area of irradiation is larger than      1.0000 square cm

The beta dose rate averaged over      1.0000 square cm =   5.33E-12 rad/hr
The total beta dose averaged over      1.0000 square cm =   3.20E-09 rad
```

DEPTH (mg/cm^2)	DOSE (rad/h)
0.00E-00	1.41E-09
1.21E-04	2.97E-09
4.85E-04	2.70E-09
1.09E-03	2.34E-09
1.94E-03	1.88E-09
3.03E-03	1.61E-09
4.36E-03	1.11E-09
5.94E-03	1.54E-09
7.75E-03	1.27E-09
9.81E-03	1.53E-09
1.21E-02	9.06E-10
1.47E-02	8.24E-10
1.74E-02	6.70E-10
2.05E-02	4.45E-10
2.37E-02	2.74E-10
2.73E-02	1.49E-10
3.10E-02	7.04E-11
3.50E-02	2.50E-11
3.93E-02	5.33E-12
4.37E-02	0.00E+00

```
The dose rate averaged over      .0437 cubic cm between      .00 mg/cm^2
and     43.74 mg/cm^2 =   6.18E-10 rad/hr

The total dose averaged over      .0437 cubic cm between      .00 mg/cm^2
and     43.74 mg/cm^2 =   3.71E-07 rad
```

A.1.3 U238 in Flatware

```
                    Program VARSKIN-MOD2


        Cylindrical Source Geometry

                 Nuclide : Th-234
         1.8*X90 Distance :    1.998000E-02 cm
     Average Beta Energy :    4.760000E-02 MeV
             No gamma dose calculation
         Source Strength :    1.000000E-06 uCi/cm^3
          Source Density :        8.020000 g/cm^3
        Diameter of Disk :    67702.750000 um
       Thickness of Disk :     1875.000000 um
              Skin Depth :    0.000000E+00 mg/cm^2
      Thickness of Cover :    0.000000E+00 mm
       Air Gap Thickness :    0.000000E+00 mm
        Irradiation Time :    36000.000000 min

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  1.32E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =  7.90E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  1.14E-09 rad/hr
 The total beta dose averaged over     1.0000 square cm =  6.85E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  8.82E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =  5.29E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  8.02E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =  4.81E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  7.09E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =  4.25E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  4.30E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =  2.58E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  7.03E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =  4.22E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  5.34E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =  3.21E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  2.30E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =  1.38E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  5.21E-10 rad/hr
 The total beta dose averaged over     1.0000 square cm =  3.13E-07 rad

 The area of irradiation is larger than     1.0000 square cm

 The beta dose rate averaged over     1.0000 square cm =  3.75E-10 rad/hr
```

```
The total beta dose averaged over     1.0000 square cm =   2.25E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   3.27E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.96E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.92E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.75E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.75E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.65E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.78E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.07E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.00E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   6.01E-08 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   5.70E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   3.42E-08 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.05E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.23E-08 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   4.81E-12 rad/hr
The total beta dose averaged over     1.0000 square cm =   2.89E-09 rad
```

DEPTH (mg/cm^2)	DOSE (rad/h)
0.00E-00	1.32E-09
5.53E-05	1.14E-09
2.21E-04	8.82E-10
4.98E-04	8.02E-10
8.86E-04	7.09E-10
1.38E-03	4.30E-10
1.99E-03	7.03E-10
2.71E-03	5.34E-10
3.54E-03	2.30E-10
4.48E-03	5.21E-10
5.53E-03	3.75E-10
6.70E-03	3.27E-10
7.97E-03	2.92E-10
9.35E-03	2.75E-10
1.08E-02	1.78E-10
1.25E-02	1.00E-10
1.42E-02	5.70E-11
1.60E-02	2.05E-11
1.79E-02	4.81E-12
2.00E-02	0.00E+00

```
The dose rate averaged over      .0200 cubic cm between       .00 mg/cm^2
and    19.98 mg/cm^2 =   2.47E-10 rad/hr

The total dose averaged over      .0200 cubic cm between       .00 mg/cm^2
and    19.98 mg/cm^2 =   1.48E-07 rad
```

Program VARSKIN-MOD2

Cylindrical Source Geometry

```
                Nuclide : Pa-234
      1.8*X90 Distance :    8.622000E-01 cm
   Average Beta Energy :    8.297000E-01 MeV
         No gamma dose calculation
       Source Strength :    1.000000E-06 uCi/cm^3
        Source Density :        8.020000 g/cm^3
      Diameter of Disk :    67702.750000 um
     Thickness of Disk :     1875.000000 um
            Skin Depth :    0.000000E+00 mg/cm^2
    Thickness of Cover :    0.000000E+00 mm
     Air Gap Thickness :    0.000000E+00 mm
      Irradiation Time :    36000.000000 min

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   8.36E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   5.02E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.06E-07 rad/hr
The total beta dose averaged over     1.0000 square cm =   6.35E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   9.71E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   5.83E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   8.65E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   5.19E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   7.48E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   4.49E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   6.30E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   3.78E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   5.15E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   3.09E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   4.08E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   2.45E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   3.11E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.87E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.29E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.37E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.60E-08 rad/hr
The total beta dose averaged over     1.0000 square cm =   9.61E-06 rad

The area of irradiation is larger than     1.0000 square cm
```

The beta dose rate averaged over 1.0000 square cm = 1.06E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 6.35E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 6.50E-09 rad/hr
The total beta dose averaged over 1.0000 square cm = 3.90E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 3.66E-09 rad/hr
The total beta dose averaged over 1.0000 square cm = 2.20E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.84E-09 rad/hr
The total beta dose averaged over 1.0000 square cm = 1.10E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 7.86E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.71E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 2.70E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 1.62E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 6.50E-11 rad/hr
The total beta dose averaged over 1.0000 square cm = 3.90E-08 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 7.61E-12 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.57E-09 rad

DEPTH (mg/cm^2)	DOSE (rad/h)
0.00E-00	8.36E-08
2.39E-03	1.06E-07
9.55E-03	9.71E-08
2.15E-02	8.65E-08
3.82E-02	7.48E-08
5.97E-02	6.30E-08
8.60E-02	5.15E-06
1.17E-01	4.08E-08
1.53E-01	3.11E-08
1.93E-01	2.29E-08
2.39E-01	1.60E-08
2.89E-01	1.06E-08
3.44E-01	6.50E-09
4.04E-01	3.66E-09
4.68E-01	1.84E-09
5.37E-01	7.86E-10
6.11E-01	2.70E-10
6.90E-01	6.50E-11
7.74E-01	7.61E-12
8.62E-01	0.00E+00

The dose rate averaged over .8622 cubic cm between .00 mg/cm^2
and 862.20 mg/cm^2 = 1.48E-08 rad/hr

The total dose averaged over .8622 cubic cm between .00 mg/cm^2
and 862.20 mg/cm^2 = 8.86E-06 rad

Irradiation time = 3.6E+04 min
The beta dose rate for the 4 radionuclides, averaged over
1 square cm, = 0.00E+00 rad/hr
The total beta dose for the 4 radionuclides, averaged over
1 square cm, = 0.00E-00 rad

A.2 Hip Joint

Beta doses from hip joints were modeled to assess the potential doses from various stainless steel surgical implants. The joint was selected because it had more surface area than the other implants identified. A disk of equivalent surface area directly in contact with the bone was used to represent the geometry of the joint in these calculations. An exposure duration of 8760 h/y was used to calculate the annual unit dose rate. The results are presented in Table A-1, and the VARSKIN output files are presented below.

A.2.1 Tc99 in Hip Joint

```
                  Program VARSKIN-MOD2

Steelhip



          Cylindrical Source Geometry

                 Nuclide : Tc-99
        1.8*X90 Distance :    4.806000E-02 cm
     Average Beta Energy :    8.470000E-02 MeV
            No gamma dose calculation
         Source Strength :    1.000000E-06 uCi/cm^3
          Source Density :        8.020000 g/cm^3
        Diameter of Disk :    87177.980000 um
       Thickness of Disk :     3684.210000 um
              Skin Depth :    0.000000E-00 mg/cm^2
      Thickness of Cover :    0.000000E-00 mm
       Air Gap Thickness :    0.000000E+00 mm
        Irradiation Time :   525600.000000 min

 The area of irradiation is larger than      1.0000 square cm

 The beta dose rate averaged over      1.0000 square cm =   1.04E-09 rad/hr
 The total beta dose averaged over      1.0000 square cm =   9.09E-06 rad

 The area of irradiation is larger than      1.0000 square cm

 The beta dose rate averaged over      1.0000 square cm =   2.46E-09 rad/hr
 The total beta dose averaged over      1.0000 square cm =   2.15E-05 rad

 The area of irradiation is larger than      1.0000 square cm

 The beta dose rate averaged over      1.0000 square cm =   2.18E-09 rad/hr
 The total beta dose averaged over      1.0000 square cm =   1.91E-05 rad

 The area of irradiation is larger than      1.0000 square cm

 The beta dose rate averaged over      1.0000 square cm =   1.88E-09 rad/hr
 The total beta dose averaged over      1.0000 square cm =   1.65E-05 rad

 The area of irradiation is larger than      1.0000 square cm

 The beta dose rate averaged over      1.0000 square cm =   1.57E-09 rad/hr
 The total beta dose averaged over      1.0000 square cm =   1.38E-05 rad

 The area of irradiation is larger than      1.0000 square cm

 The beta dose rate averaged over      1.0000 square cm =   1.28E-09 rad/hr
 The total beta dose averaged over      1.0000 square cm =   1.12E-05 rad

 The area of irradiation is larger than      1.0000 square cm

 The beta dose rate averaged over      1.0000 square cm =   1.53E-09 rad/hr
 The total beta dose averaged over      1.0000 square cm =   1.34E-05 rad
```

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 9.03E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 7.91E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 4.62E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.05E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.05E-09 rad/hr
The total beta dose averaged over 1.0000 square cm = 9.20E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 6.12E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 5.36E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 4.31E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 3.78E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 4.28E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 3.75E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 2.26E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 1.98E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.37E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 1.20E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 9.04E-11 rad/hr
The total beta dose averaged over 1.0000 square cm = 7.92E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 4.84E-11 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.24E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.69E-11 rad/hr
The total beta dose averaged over 1.0000 square cm = 1.48E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 3.50E-12 rad/hr
The total beta dose averaged over 1.0000 square cm = 3.06E-08 rad

DEPTH (mg/cm^2)	DOSE (rad/h)
0.00E+00	1.04E-09
1.33E-04	2.46E-09
5.33E-04	2.18E-09
1.20E-03	1.88E-09
2.13E-03	1.57E-09
3.33E-03	1.28E-09
4.79E-03	1.53E-09
6.52E-03	9.03E-10
8.52E-03	4.62E-10
1.08E-02	1.05E-09
1.33E-02	6.12E-10
1.61E-02	4.31E-10
1.92E-02	4.28E-10
2.25E-02	2.26E-10

```
2.61E-02                    1.37E-10
3.00E-02                    9.04E-11
3.41E-02                    4.84E-11
3.85E-02                    1.69E-11
4.31E-02                    3.50E-12
4.81E-02                    0.00E-00

The dose rate averaged over      .0481 cubic cm between      .00 mg/cm^2
and    48.06 mg/cm^2 =   4.25E-10 rad/hr

The total dose averaged over      .0481 cubic cm between      .00 mg/cm^2
and    48.06 mg/cm^2 =   3.72E-06 rad
```

A.2.2 U235 in Hip Joint

```
                    Program VARSKIN-MOD2


        Cylindrical Source Geometry

                Nuclide : Th-231
       1.8*X90 Distance :   4.374000E-02 cm
    Average Beta Energy :   7.650000E-02 MeV
           No gamma dose calculation
        Source Strength :   1.000000E-06 uCi/cm^3
         Source Density :        8.020000 g/cm^3
       Diameter of Disk :   87177.980000 um
      Thickness of Disk :    3684.210000 um
             Skin Depth :   0.000000E-00 mg/cm^2
     Thickness of Cover :   0.000000E+00 mm
     Air Gap Thickness :   0.000000E+00 mm
      Irradiation Time :  525600.000000 min

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.78E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.56E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.89E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   2.54E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.56E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   2.24E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.14E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.88E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.79E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.57E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.44E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.26E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.45E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.27E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   9.54E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   8.35E-06 rad
```

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 4.65E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.07E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.04E-09 rad/hr
The total beta dose averaged over 1.0000 square cm = 9.11E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 5.45E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.77E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 4.30E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 3.77E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 4.85E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.25E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 2.63E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 2.31E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.67E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 1.46E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.06E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 9.31E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 6.46E-11 rad/hr
The total beta dose averaged over 1.0000 square cm = 5.66E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 2.49E-11 rad/hr
The total beta dose averaged over 1.0000 square cm = 2.18E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 5.36E-12 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.70E-08 rad

DEPTH (mg/cm^2)	DOSE (rad/h)
0.00E+00	1.78E-09
1.21E-04	2.89E-09
4.85E-04	2.56E-09
1.09E-03	2.14E-09
1.94E-03	1.79E-09
3.03E-03	1.44E-09
4.35E-03	1.45E-09
5.94E-03	9.54E-10
7.75E-03	4.65E-10
9.81E-03	1.04E-09
1.21E-02	5.45E-10
1.47E-02	4.30E-10
1.74E-02	4.85E-10
2.05E-02	2.63E-10
2.37E-02	1.67E-10
2.73E-02	1.06E-10
3.10E-02	6.46E-11
3.50E-02	2.49E-11
3.93E-02	5.36E-12
4.37E-02	0.00E+00

```
The dose rate averaged over      .0437 cubic cm between      .00 mg/cm^2
of  and    43.74 mg/cm^2 =   4.54E-10 rad/hr

The total dose averaged over      .0437 cubic cm between      .00 mg/cm^2
and    43.74 mg/cm^2 =   3.97E-06
```

A.2.3 U238 in Hip Joint

```
                    Program VARSKIN-MOD2

        Cylindrical Source Geometry

               Nuclide : Th-234
      1.8*X90 Distance :    1.998000E-02 cm
   Average Beta Energy :    4.760000E-02 MeV
         No gamma dose calculation
       Source Strength :    1.000000E-06 uCi/cm^3
        Source Density :       8.020000 g/cm^3
      Diameter of Disk :    87177.980000 um
     Thickness of Disk :     3684.210000 um
            Skin Depth :    0.000000E+00 mg/cm^2
    Thickness of Cover :    0.000000E+00 mm
     Air Gap Thickness :    0.000000E+00 mm
       Irradiation Time :   525600.000000 min

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   9.03E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   7.91E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.35E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.18E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.24E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.09E-05 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.03E-09 rad/hr
The total beta dose averaged over     1.0000 square cm =   9.06E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   7.53E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   6.60E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   7.08E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   6.20E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   5.03E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   4.40E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   2.60E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   2.28E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.99E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.75E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   3.74E-10 rad/hr
```

```
The total beta dose averaged over     1.0000 square cm =   3.28E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.27E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.11E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   7.56E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   6.63E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.66E-10 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.45E-06 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   9.34E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   8.18E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   6.08E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   5.33E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   6.32E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   5.54E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   4.76E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   4.17E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   1.74E-11 rad/hr
The total beta dose averaged over     1.0000 square cm =   1.53E-07 rad

The area of irradiation is larger than     1.0000 square cm

The beta dose rate averaged over     1.0000 square cm =   4.44E-12 rad/hr
The total beta dose averaged over     1.0000 square cm =   3.89E-08 rad
 DEPTH (mg/cm^2)          DOSE (rad/h)
     0.00E+00                9.03E-10
     5.53E-05                1.35E-09
     2.21E-04                1.24E-09
     4.98E-04                1.03E-09
     8.86E-04                7.53E-10
     1.38E-03                7.08E-10
     1.99E-03                5.03E-10
     2.71E-03                2.60E-10
     3.54E-03                1.99E-10
     4.48E-03                3.74E-10
     5.53E-03                1.27E-10
     6.70E-03                7.56E-11
     7.97E-03                1.66E-10
     9.35E-03                9.34E-11
     1.08E-02                6.08E-11
     1.25E-02                6.32E-11
     1.42E-02                4.76E-11
     1.60E-02                1.74E-11
     1.79E-02                4.44E-12
     2.00E-02                0.00E+00

The dose rate averaged over     .0200 cubic cm between      .00 mg/cm^2
and    19.98 mg/cm^2 =   1.74E-10 rad/hr

The total dose averaged over     .0200 cubic cm between      .00 mg/cm^2
and    19.98 mg/cm^2 =   1.53E-06 rad

                    Program VARSKIN-MOD2
```

Cylindrical Source Geometry

```
            Nuclide : Pa-234
   1.8*X90 Distance :   8.622000E-01 cm
Average Beta Energy :   8.297000E-01 MeV
       No gamma dose calculation
    Source Strength :   1.000000E-06 uCi/cm^3
     Source Density :       8.020000 g/cm^3
   Diameter of Disk :   87177.980000 um
  Thickness of Disk :    3684.210000 um
         Skin Depth :   0.000000E+00 mg/cm^2
 Thickness of Cover :   0.000000E+00 mm
   Air Gap Thickness :  0.000000E+00 mm
    Irradiation Time :  525600.000000 min
```

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 9.99E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 8.75E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.06E-07 rad/hr
The total beta dose averaged over 1.0000 square cm = 9.25E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 9.69E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 8.49E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 8.66E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 7.59E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 7.48E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 6.55E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 6.27E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 5.49E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 5.15E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 4.51E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 4.07E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 3.56E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 3.12E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 2.73E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 2.29E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 2.00E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.61E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 1.41E-04 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.06E-08 rad/hr
The total beta dose averaged over 1.0000 square cm = 9.26E-05 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 6.51E-09 rad/hr
The total beta dose averaged over 1.0000 square cm = 5.70E-05 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 3.67E-09 rad/hr
The total beta dose averaged over 1.0000 square cm = 3.21E-05 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 1.84E-09 rad/hr
The total beta dose averaged over 1.0000 square cm = 1.61E-05 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 7.87E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 6.90E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 2.70E-10 rad/hr
The total beta dose averaged over 1.0000 square cm = 2.37E-06 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 6.49E-11 rad/hr
The total beta dose averaged over 1.0000 square cm = 5.69E-07 rad

The area of irradiation is larger than 1.0000 square cm

The beta dose rate averaged over 1.0000 square cm = 7.60E-12 rad/hr
The total beta dose averaged over 1.0000 square cm = 6.66E-08 rad

DEPTH (mg/cm^2)	DOSE (rad/h)
0.00E+00	9.99E-08
2.39E-03	1.06E-07
9.55E-03	9.69E-08
2.15E-02	8.66E-08
3.82E-02	7.48E-08
5.97E-02	6.27E-08
8.60E-02	5.15E-08
1.17E-01	4.07E-08
1.53E-01	3.12E-08
1.93E-01	2.29E-08
2.39E-01	1.61E-08
2.89E-01	1.06E-08
3.44E-01	6.51E-09
4.04E-01	3.67E-09
4.68E-01	1.84E-09
5.37E-01	7.87E-10
6.11E-01	2.70E-10
6.90E-01	6.49E-11
7.74E-01	7.60E-12
8.62E-01	0.00E+00

The dose rate averaged over .8622 cubic cm between .00 mg/cm^2 and 862.20 mg/cm^2 = 1.48E-08 rad/hr

The total dose averaged over .8622 cubic cm between .00 mg/cm^2 and 862.20 mg/cm^2 = 1.30E-04 rad

Irradiation time = 5.3E+05 min
The beta dose rate for the 4 radionuclides, averaged over 1 square cm, = 0.00E+00 rad/hr
The total beta dose for the 4 radionuclides, averaged over 1 square cm, = 0.00E+00 rad

Appendix B MicroShield Runs for Flatware and Hip Joints

Microshield runs were performed for each combination of geometry and gamma emitter listed in Table B-1. Each computer run assumed the product contained 1 pCi/g of the selected radionuclide in equilibrium with its prompt daughters. These runs yielded the calculated dose rate per unit activity (mrem-g/h-pCi) for the configuration of interest. Sections B.1 and B.2 contain the output files from the six computer runs performed during this study.

These unit dose rates were then converted into the annual dose rate per unit of activity (mrem-g/pCi) by multiplying the unit does rate by the expected exposure duration for that product and the fraction of the organ irradiated. These annual dose rates are linearly dependent on the radionuclide's concentration in the product and can be scaled up or down to match the appropriate concentration.

Table B-1 Summary of Dose Rates Calculated Using Microshield

	Dose Rate per Unit Activity [a] (mrad-g/h-pCi)		Annual Dose per Unit Activity [b] (mrad-g/pCi-y)	
Radionuclide	Dinnerware	Hip Joints	Dinnerware [c]	Hip Joints [d]
Technetium-99	ng [e]	ng [e]	ng [e]	ng [e]
Uranium-234	2.6 E-9	2.5 E-9	1.6 E-8	2.2 E-7
Uranium-235 + 1 daughter	9.3 E-6	1.2 E-5	5.6 E-5	1.1 E-3
Uranium-238 + 2 daughters	1.0 E-6	1.5 E-6	6.3 E-6	1.3 E-4

a Microshield output. see attached output files.
b (Dose Rate per Unit Activity. mrad-g/h-pCi) x (Exposure Time. h/y)
c Assumes an exposure time of 600 min/yr. and a source density of 8.02 cm3/g.
d Assumes an exposure time of 8760 min/yr. and a source density of 8.02 cm3/g.
e Not a gamma emitter.

B.1 Flatware

Doses from flatware were modeled for the knife, which was the heaviest piece of stainless steel flatware. A rectangular volume was used to represent the geometry of a knife handle in these calculations. An exposure duration of 36,000 min/y (600 h/y) was used to calculate the annual unit dose rate.

B.1.1 Summary of Flatware Runs

MicroShield Batch Run Log

Batch Run Started on Wednesday, April 15, 1998 at 12:11 p.m.

Three cases initially in the queue.

CASE	FILE	GEOM	START TIME	ELAPSED	mR/hr w/BUILDUP	SENS. CYCLE
1	DU4REC	13	12:11 p.m.	0:00:10	2.585e-009	(n/a)
2	DU5REC	13	12:11 p.m.	0:00:57	9.312e-006	(n/a)
3	DU5REC	13	12:12 p.m.	0:00:45	1.046e-006	(n/a)

B.1.2 U234 in Flatware

MicroShield 4.20 - Serial #4.20-00745
Auxier & Associates

Page : 1
DOS File: DU4REC.MS4
Run Date: April 15, 1998
Run Time: 12:11 p.m. Wednesday
Duration: 0:00:10

File Ref: ________
Date: __/__/__
By: ________
Checked: ________

Case Title: flatware: U-234 rectangular solid

GEOMETRY 13 - Rectangular Volume

	centimeters	feet	and inches
Dose point coordinate X:	1.5	0.0	.6
Dose point coordinate Y:	4.5	0.0	1.8
Dose point coordinate Z:	0.785	0.0	.3
Rectangular volume width :	1.5	0.0	.6
Rectangular volume length:	0.5	0.0	.2
Rectangular volume height:	9.0	0.0	3.5
Air Gap:	1.0	0.0	.4

Source Volume: 6.75 cm^3 2.38374e-4 cu ft. .41191 cu in.

MATERIAL DENSITIES (g/cm^3)

Material	Source Shield	Air Gap
Air		0.00122
Iron	7.218	
Nickel	0.802	

BUILDUP
Method: Buildup Factor Tables
The material reference is Source

INTEGRATION PARAMETERS

	Quadrature Order
X Direction	8
Y Direction	40
Z Direction	60

SOURCE NUCLIDES

Nuclide	curies	uCi/cm^3
U-234	5.4135e-011	8.0200e-006

============================== RESULTS ==============================

Energy (MeV)	Activity (photons/sec)	Energy Fluence Rate (MeV/sq cm/sec) No Buildup	Energy Fluence Rate (MeV/sq cm/sec) With Buildup	Exposure Rate In Air (mR/hr) No Buildup	Exposure Rate In Air (mR/hr) With Buildup
0.0532	2.364e-003	2.773e-007	3.024e-007	6.595e-010	7.193e-010
0.1214	8.023e-004	9.313e-007	1.191e-006	1.459e-009	1.865e-009
TOTAL:	3.166e-003	1.209e-006	1.493e-006	2.118e-009	2.585e-009

B.1.3 U235 in Flatware

MicroShield 4.20 - Serial #4.20-00745
Auxier & Associates

Page	: 1	File Ref:	________
DOS File:	DU5REC.MS4	Date:	___/___/___
Run Date:	April 15, 1998	By:	________
Run Time:	12:12 p.m. Wednesday	Checked:	________
Duration:	0:00:57		

Case Title: flatware: U-235 + D in rectangular solid

GEOMETRY 13 - Rectangular Volume

	centimeters	feet and inches	
Dose point coordinate X:	1.5	0.0	.6
Dose point coordinate Y:	4.5	0.0	1.8
Dose point coordinate Z:	0.785	0.0	.3
Rectangular volume width :	1.5	0.0	.6
Rectangular volume length:	0.5	0.0	.2
Rectangular volume height:	9.0	0.0	3.5
Air Gap:	1.0	0.0	.4

Source Volume: 6.75 cm^3 2.38374e-4 cu ft. .41191 cu in.

MATERIAL DENSITIES (g/cm^3)

Material	Source Shield	Air Gap
Air		0.00122
Iron	7.218	
Nickel	0.802	

BUILDUP
Method: Buildup Factor Tables
The material reference is Source

INTEGRATION PARAMETERS

	Quadrature Order
X Direction	8
Y Direction	40
Z Direction	60

SOURCE NUCLIDES

Nuclide	curies	uCi/cm^3	Nuclide	curies	uCi/cm^3
Pa-231	5.4135e-011	8.0200e-006	U-235	5.4135e-011	8.0200e-006

Page : 2
DOS File: DUSREC.MS4
Run Date: April 15, 1998
Run Time: 12:12 p.m. Wednesday
Title : flatware: U-235 + D in rectangular solid

============================== RESULTS ==============================

Energy (MeV)	Activity (photons/sec)	Energy Fluence Rate (MeV/sq cm/sec)		Exposure Rate In Air (mR/hr)	
		No Buildup	With Buildup	No Buildup	With Buildup
0.0189	7.010e-003	5.315e-009	5.400e-009	2.200e-010	2.235e-010
0.0275	1.893e-001	1.656e-006	1.698e-006	2.125e-008	2.179e-008
0.0464	4.166e-003	2.944e-007	3.139e-007	9.160e-010	9.765e-010
0.0727	2.203e-003	7.475e-007	8.743e-007	1.241e-009	1.451e-009
0.0916	1.768e-001	1.138e-004	1.400e-004	1.745e-007	2.148e-007
0.1062	8.075e-002	7.242e-005	9.127e-005	1.112e-007	1.401e-007
0.12	3.004e-003	3.414e-006	4.361e-006	5.335e-009	6.815e-009
0.1437	2.147e-001	3.297e-004	4.257e-004	5.370e-007	6.934e-007
0.1633	9.414e-002	1.745e-004	2.257e-004	2.935e-007	3.797e-007
0.1655	2.902e-002	5.479e-005	7.086e-005	9.248e-008	1.196e-007
0.1858	1.108e+000	2.444e-003	3.154e-003	4.241e-006	5.473e-006
0.2038	1.260e-001	3.129e-004	4.023e-004	5.545e-007	7.129e-007
0.2214	2.003e-003	5.510e-006	7.052e-006	9.936e-009	1.272e-008
0.2586	5.488e-003	1.818e-005	2.302e-005	3.373e-008	4.271e-008
0.2837	3.205e-002	1.182e-004	1.486e-004	2.225e-007	2.797e-007
0.3001	4.607e-002	1.813e-004	2.267e-004	3.439e-007	4.301e-007
0.3027	4.607e-002	1.831e-004	2.288e-004	3.476e-007	4.345e-007
0.3313	2.934e-002	1.292e-004	1.601e-004	2.479e-007	3.073e-007
0.3572	3.465e-003	1.661e-005	2.043e-005	3.209e-008	3.948e-008
TOTAL:	2.200e+000	4.160e-003	5.331e-003	7.271e-006	9.312e-006

B.1.4 U238 in Flatware

MicroShield 4.20 - Serial #4.20-00745
Auxier & Associates

Page	: 1	File Ref:	________
DOS File:	DU8REC.MS4	Date:	__/__/__
Run Date:	April 15, 1998	By:	________
Run Time:	12:12 p.m. Wednesday	Checked:	________
Duration:	0:00:45		

Case Title: flatware: U-238 + D in rectangular solid

GEOMETRY 13 - Rectangular Volume

	centimeters	feet and inches	
Dose point coordinate X:	1.5	0.0	.6
Dose point coordinate Y:	4.5	0.0	1.8
Dose point coordinate Z:	0.785	0.0	.3
Rectangular volume width :	1.5	0.0	.6
Rectangular volume length:	0.5	0.0	.2
Rectangular volume height:	9.0	0.0	3.5
Air Gap:	1.0	0.0	.4

Source Volume: 6.75 cm^3 2.38374e-4 cu ft. .41191 cu in.

MATERIAL DENSITIES (g/cm^3)

Material	Source Shield	Air Gap
Air		0.00122
Iron	7.218	
Nickel	0.802	

BUILDUP
Method: Buildup Factor Tables
The material reference is Source

INTEGRATION PARAMETERS

	Quadrature Order
X Direction	8
Y Direction	40
Z Direction	60

SOURCE NUCLIDES

Nuclide	curies	uCi/cm^3	Nuclide	curies	uCi/cm^3
Bi-210	0.0000e+000	0.0000e+000	Bi-214	0.0000e+000	0.0000e+000
Pa-234	8.6616e-014	1.2832e-008	Pa-234m	5.4135e-011	8.0200e-006
Pb-210	0.0000e+000	0.0000e+000	Pb-214	0.0000e+000	0.0000e+000
Po-210	0.0000e+000	0.0000e+000	Po-214	0.0000e+000	0.0000e+000
Po-218	0.0000e+000	0.0000e+000	Ra-226	0.0000e+000	0.0000e+000
Rn-222	0.0000e+000	0.0000e+000	Th-230	0.0000e+000	0.0000e+000
Th-234	5.4135e-011	8.0200e-006	U-234	0.0000e+000	0.0000e+000
U-238	5.4135e-011	8.0200e-006			

Page : 2
DOS File: DU8REC.MS4
Run Date: April 15, 1998
Run Time: 12:12 p.m. Wednesday
Title : flatware: U-238 + D in rectangular solid

============================== RESULTS ==============================

Energy (MeV)	Activity (photons/sec)	Energy Fluence Rate (MeV/sq cm/sec)		Exposure Rate In Air (mR/hr)	
		No Buildup	With Buildup	No Buildup	With Buildup
0.0809	1.972e-001	9.167e-005	1.099e-004	1.445e-007	1.732e-007
0.1172	8.158e-003	8.876e-006	1.132e-005	1.381e-008	1.761e-008
0.2468	6.825e-004	2.140e-006	2.719e-006	3.939e-009	5.005e-009
0.3573	2.072e-004	9.938e-007	1.223e-006	1.921e-009	2.363e-009
0.456	1.536e-004	9.663e-007	1.159e-006	1.894e-009	2.273e-009
0.5569	7.509e-004	5.882e-006	6.917e-006	1.152e-008	1.355e-008
0.6507	4.714e-004	4.377e-006	5.071e-006	8.496e-009	9.843e-009
0.7608	4.983e-003	5.485e-005	6.266e-005	1.049e-007	1.199e-007
0.853	1.683e-003	2.096e-005	2.373e-005	3.956e-008	4.479e-008
0.929	9.383e-003	1.282e-004	1.442e-004	2.391e-007	2.689e-007
1.0012	1.187e-002	1.758e-004	1.966e-004	3.240e-007	3.624e-007
1.119	9.447e-005	1.578e-006	1.750e-006	2.847e-009	3.159e-009
1.2348	6.440e-005	1.195e-006	1.317e-006	2.112e-009	2.327e-009
1.3385	7.911e-005	1.601e-006	1.754e-006	2.774e-009	3.040e-009
1.415	1.677e-004	3.601e-006	3.932e-006	6.153e-009	6.719e-009
1.5144	2.288e-005	5.283e-007	5.746e-007	8.865e-010	9.643e-010
1.6099	5.622e-005	1.385e-006	1.502e-006	2.285e-009	2.478e-009
1.6916	1.144e-004	2.970e-006	3.213e-006	4.832e-009	5.226e-009
1.7911	1.308e-005	3.606e-007	3.890e-007	5.768e-010	6.223e-010
1.9108	3.661e-005	1.081e-006	1.163e-006	1.696e-009	1.824e-009
TOTAL:	2.362e-001	5.090e-004	5.811e-004	9.178e-007	1.046e-006

B.2 Hip Joints

Doses from a hip joint were modeled using a cylinder of equivalent mass and volume as the representative geometry. An exposure duration of 525,600 min/y (8760 h/y) was used to calculate the annual unit dose rate.

B.2.1 Summary of Hip Joint Runs

```
                    MicroShield Batch Run Log
                    =========================

      Batch Run Started on Thursday, April 30, 1998 at 7:08 p.m.

                 Three cases initially in the queue.


CASE   FILE     GEOM   START TIME   ELAPSED  mR/hr w/BUILDUP  SENS. CYCLE
====  ======== ====   ==========   =======  ===============  ==========

 1    HU40CYL   7     7:08 p.m.    0:00:10   2.480e-009        (n/a)
 2    HU50CYL   7     7;08 p.m.    0:00:56   1.237e-005        (n/a)
 3    HU80CYL   7     7:09 p.m.    0:00:47   1.540e-006        (n/a)

Batch run completed on Thursday, April 30, 1998 at 7:10 p.m.

                    TOTAL EXECUTION TIME: 0:01:57
```

B.2.2 U234 Hip Joint

MicroShield 4.20 - Serial #4.20-00745
Auxier & Associates

Page	: 1	File Ref:	________
DOS File:	HU40CYL.MS4	Date:	___/___/___
Run Date:	April 30, 1998	By:	________
Run Time:	7:08 p.m. Thursday	Checked:	________
Duration:	0:00:11		

Case Title: Hip: U-234, outside cylinder.

GEOMETRY 7 - Cylinder Volume - Side Shields

	centimeters	feet and inches	
Dose point coordinate X:	1.734	0.0	.7
Dose point coordinate Y:	6.5	0.0	2.6
Dose point coordinate Z:	0.0	0.0	.0
Cylinder height:	13.0	0.0	5.1
Cylinder radius:	0.734	0.0	.3
Air Gap:	1.0	0.0	.4

Source Volume: 22.0032 cm^3 7.77035e-4 cu ft. 1.34272 cu in.

MATERIAL DENSITIES (g/cm^3)

Material	Source Shield	Transition Shield	Air Gap
Air		0.00122	0.00122
Iron	7.218		
Nickel	0.802		

BUILDUP
Method: Buildup Factor Tables
The material reference is Source

INTEGRATION PARAMETERS

	Quadrature Order
Radial	10
Circumferential	40
Y Direction (axial)	40

SOURCE NUCLIDES

Nuclide	curies	uCi/cm^3	Nuclide	curies	uCi/cm^3
Bi-210	0.0000e+000	0.0000e+000	Bi-214	0.0000e+000	0.0000e+000
Pa-234	0.0000e+000	0.0000e+000	Pa-234m	0.0000e+000	0.0000e+000
Pb-210	0.0000e+000	0.0000e+000	Pb-214	0.0000e+000	0.0000e+000
Po-210	0.0000e+000	0.0000e+000	Po-214	0.0000e+000	0.0000e+000
Po-218	0.0000e+000	0.0000e+000	Ra-226	0.0000e+000	0.0000e+000
Rn-222	0.0000e+000	0.0000e+000	Th-230	0.0000e+000	0.0000e+000
Th-234	0.0000e+000	0.0000e+000	U-234	1.7647e-010	8.0200e-006
U-238	0.0000e+000	0.0000e+000			

============================== RESULTS ==============================

Energy (MeV)	Activity (photons/sec)	Energy Fluence Rate (MeV/sq cm/sec) No Buildup	Energy Fluence Rate (MeV/sq cm/sec) With Buildup	Exposure Rate In Air (mR/hr) No Buildup	Exposure Rate In Air (mR/hr) With Buildup
0.0532	7.704e-003	1.970e-007	2.155e-007	4.685e-010	5.126e-010
0.1214	2.615e-003	8.993e-007	1.256e-006	1.409e-009	1.967e-009
TOTAL:	1.032e-002	1.096e-006	1.471e-006	1.877e-009	2.480e-009

B.2.3 U235 Hip Joint

MicroShield 4.20 - Serial #4.20-00745

Auxier & Associates

Page : 1
DOS File: HU5OCYL.MS4
Run Date: April 30, 1998
Run Time: 7:09 p.m. Thursday
Duration: 0:00:57

File Ref: ________
Date: __/__/__
By: ________
Checked: ________

Case Title: Hip: U-235 + Pa-231, outside cylinder

GEOMETRY 7 - Cylinder Volume - Side Shields

	centimeters	feet and inches	
Dose point coordinate X:	1.734	0.0	.7
Dose point coordinate Y:	6.5	0.0	2.6
Dose point coordinate Z:	0.0	0.0	.0
Cylinder height:	13.0	0.0	5.1
Cylinder radius:	0.734	0.0	.3
Air Gap:	1.0	0.0	.4

Source Volume: 22.0032 cm^3 7.77035e-4 cu ft. 1.34272 cu in.

MATERIAL DENSITIES (g/cm^3)

Material	Source Shield	Transition Shield	Air Gap
Air		0.00122	0.00122
Iron	7.218		
Nickel	0.802		

BUILDUP
Method: Buildup Factor Tables
The material reference is Source

INTEGRATION PARAMETERS

	Quadrature Order
Radial	10
Circumferential	40
Y Direction (axial)	40

SOURCE NUCLIDES

Nuclide	curies	uCi/cm^3	Nuclide	curies	uCi/cm^3
Pa-231	1.7647e-010	8.0200e-006	U-235	1.7647e-010	8.0200e-006

============================== RESULTS ==============================

Energy (MeV)	Activity (photons/sec)	Energy Fluence Rate (MeV/sq cm/sec) No Buildup	Energy Fluence Rate (MeV/sq cm/sec) With Buildup	Exposure Rate In Air (mR/hr) No Buildup	Exposure Rate In Air (mR/hr) With Buildup
0.0189	2.285e-002	2.818e-009	2.862e-009	1.166e-010	1.185e-010
0.0275	6.169e-001	1.014e-006	1.041e-006	1.302e-008	1.336e-008
0.0464	1.358e-002	2.057e-007	2.200e-007	6.401e-010	6.843e-010
0.0727	7.182e-003	5.649e-007	6.683e-007	9.375e-010	1.109e-009
0.0916	5.763e-001	9.492e-005	1.212e-004	1.456e-007	1.859e-007
0.1062	2.632e-001	6.531e-005	8.759e-005	1.003e-007	1.345e-007
0.12	9.794e-003	3.278e-006	4.562e-006	5.122e-009	7.129e-009
0.1437	6.999e-001	3.430e-004	4.994e-004	5.587e-007	8.135e-007
0.1633	3.069e-001	1.901e-004	2.835e-004	3.199e-007	4.771e-007
0.1655	9.460e-002	5.996e-005	8.960e-005	1.012e-007	1.512e-007
0.1858	3.612e+000	2.766e-003	4.194e-003	4.800e-006	7.279e-006
0.2038	4.107e-001	3.623e-004	5.534e-004	6.422e-007	9.807e-007
0.2214	6.529e-003	6.496e-006	9.950e-006	1.171e-008	1.794e-008
0.2586	1.789e-002	2.206e-005	3.373e-005	4.093e-008	6.259e-008
0.2837	1.045e-001	1.456e-004	2.216e-004	2.741e-007	4.171e-007
0.3001	1.502e-001	2.251e-004	3.413e-004	4.270e-007	6.475e-007
0.3027	1.502e-001	2.276e-004	3.449e-004	4.322e-007	6.549e-007
0.3313	9.565e-002	1.627e-004	2.445e-004	3.121e-007	4.692e-007
0.3572	1.130e-002	2.111e-005	3.149e-005	4.080e-008	6.086e-008
TOTAL:	7.170e+000	4.697e-003	7.063e-003	8.227e-006	1.237e-005

B.2.4 U238 Hip Joint

```
                         MicroShield 4.20 -  Serial #4.20-00745
                                  Auxier & Associates
Page     : 1                                     File Ref: __________
DOS File: HU8OCYL.MS4                                Date: ___/___/___
Run Date: April 30, 1998                               By: __________
Run Time:  7:10 p.m. Thursday                     Checked: __________
Duration:  0:00:47

                   Case Title: Hip: U-238 + D, outside cylinder

                   GEOMETRY 7 - Cylinder Volume - Side Shields
                                    centimeters      feet and inches
      Dose point coordinate X:         1.734          0.0       .7
      Dose point coordinate Y:         6.5            0.0      2.6
      Dose point coordinate Z:         0.0            0.0       .0
              Cylinder height:        13.0            0.0      5.1
              Cylinder radius:         0.734          0.0       .3
                      Air Gap:         1.0            0.0       .4

      Source Volume: 22.0032 cm^3   7.77035e-4 cu ft.   1.34272 cu in.
```

MATERIAL DENSITIES (g/cm^3)

Material	Source Shield	Transition Shield	Air Gap
Air		0.00122	0.00122
Iron	7.218		
Nickel	0.802		

BUILDUP
Method: Buildup Factor Tables
The material reference is Source

INTEGRATION PARAMETERS

	Quadrature Order
Radial	10
Circumferential	40
Y Direction (axial)	40

SOURCE NUCLIDES

Nuclide	curies	uCi/cm^3	Nuclide	curies	uCi/cm^3
Bi-210	0.0000e-000	0.0000e+000	Bi-214	0.0000e+000	0.0000e+000
Pa-234	2.8235e-013	1.2832e-008	Pa-234m	1.7647e-010	8.0200e-006
Pb-210	0.0000e+000	0.0000e+000	Pb-214	0.0000e+000	0.0000e+000
Po-210	0.0000e+000	0.0000e+000	Po-214	0.0000e+000	0.0000e+000
Po-218	0.0000e+000	0.0000e+000	Ra-226	0.0000e+000	0.0000e+000
Rn-222	0.0000e+000	0.0000e+000	Th-230	0.0000e+000	0.0000e+000
Th-234	1.7647e-010	8.0200e-006	U-234	0.0000e+000	0.0000e+000
U-238	1.7647e-010	8.0200e-006			

Page : 2
DOS File: HU8OCYL.MS4
Run Date: April 30, 1998
Run Time: 7:10 p.m. Thursday
Title : Hip: U-238 + D, outside cylinder

============================== RESULTS ==============================

Energy (MeV)	Activity (photons/sec)	Energy Fluence Rate (MeV/sq cm/sec)		Exposure Rate In Air (mR/hr)	
		No Buildup	With Buildup	No Buildup	With Buildup
0.0809	6.429e-001	7.212e-005	8.826e-005	1.137e-007	1.391e-007
0.1172	2.659e-002	8.423e-006	1.164e-005	1.311e-008	1.812e-008
0.2468	2.225e-003	2.576e-006	3.944e-006	4.742e-009	7.260e-009
0.3573	6.756e-004	1.264e-006	1.885e-006	2.442e-009	3.642e-009
0.456	5.008e-004	1.265e-006	1.826e-006	2.479e-009	3.580e-009
0.5569	2.448e-003	7.868e-006	1.101e-005	1.541e-008	2.157e-008
0.6507	1.537e-003	5.950e-006	8.122e-006	1.155e-008	1.577e-008
0.7608	1.624e-002	7.574e-005	1.009e-004	1.449e-007	1.929e-007
0.853	5.486e-003	2.928e-005	3.832e-005	5.525e-008	7.232e-008
0.929	3.058e-002	1.805e-004	2.334e-004	3.367e-007	4.352e-007
1.0012	3.869e-002	2.493e-004	3.189e-004	4.595e-007	5.877e-007
1.119	3.079e-004	2.261e-006	2.846e-006	4.080e-009	5.136e-009
1.2348	2.099e-004	1.728e-006	2.146e-006	3.054e-009	3.791e-009
1.3385	2.579e-004	2.331e-006	2.864e-006	4.040e-009	4.963e-009
1.415	5.466e-004	5.269e-006	6.427e-006	9.003e-009	1.098e-008
1.5144	7.459e-005	7.771e-007	9.405e-007	1.304e-009	1.578e-009
1.6099	1.833e-004	2.047e-006	2.462e-006	3.378e-009	4.062e-009
1.6916	3.729e-004	4.408e-006	5.273e-006	7.169e-009	8.577e-009
1.7911	4.262e-005	5.373e-007	6.393e-007	8.594e-010	1.022e-009
1.9108	1.193e-004	1.618e-006	1.914e-006	2.538e-009	3.001e-009
TOTAL:	7.700e-001	6.553e-004	8.437e-004	1.195e-006	1.540e-006

Appendix C Calculation of Land Fill Doses and Risks Using RESRAD 5.80

The doses and risks from placing one truckload of slag from a commercial recycle operation using recycled nickel were calculated using RESRAD 5.80. The physical configuration of the waste was determined by assuming the volume of the truck was spread evenly in a disc 6 inches (15 cm) thick. The truckload of waste was assumed to be spread near the top of the landfill. Because the conceptual model assumes the waste is placed in an active landfill, it assumes that the slag is placed on top of exisiting trash. Therefore, the conceptual model envisions 50 feet of municipal/commercial waste below the slag and 2 meters of municipal/commercial waste and fills above it. All other parameter values used in the model run were standard RESRAD default parameters.

The results of the RESRAD run are presented below. Section C.1 contains a copy of the summary file produced by RESRAD. Section C.2 contains a copy of the detailed output file produced by RESRAD. Section C.3 contains a copy of the risk output file produced by RESRAD.

C.1 Summary Output File

RESRAD, Version 5.80   T« Limit = 0.5 year   05/01/98 11:18   Page 1
Summary : Landfill Risk from Slag and Dross Produced by Nickel Recycling Operation
File : LANDRISK.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(3)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(4)
B-1	Tc-99	8.330E-06	8.330E-06	DCF2(5)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(6)
B-1	U-234	1.320E-01	1.320E-01	DCF2(7)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(8)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(9)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(3)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(4)
D-1	Tc-99	1.460E-06	1.460E-06	DCF3(5)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(6)
D-1	U-234	2.830E-04	2.830E-04	DCF3(7)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(8)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(9)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Tc-99 , plant/soil concentration ratio, dimensionless	5.000E+00	5.000E+00	RTF(5,1)
D-34	Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Tc-99 , fish	2.000E+01	2.000E+01	BIOFAC(5,1)
D-5	Tc-99 , crustacea and mollusks	5.000E+00	5.000E+00	BIOFAC(5,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	3.780E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	7.000E+00	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	3.000E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Tc-99	5.200E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): U-234	3.670E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-235	1.620E-01	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-238	1.570E+00	0.000E+00	---	S1(9)
R012	Concentration in groundwater (pCi/L): Tc-99	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(9)
R013	Cover depth (m)	2.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.600E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-04	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-04	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ

R013 | HCCZ	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---
R013 | BCZ	Contaminated zone b parameter	5.300E+00	5.300E+00	---
R013 | WIND	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---
R013 | HUMID	Humidity in air (g/m**3)	not used	8.000E+00	---
R013 | EVAPTR	Evapotranspiration coefficient	5.000E-01	5.000E-01	---
R013 | PRECIP	Precipitation (m/yr)	1.000E+00	1.000E+00	---
R013 | RI	Irrigation (m/yr)	0.000E+00	2.000E-01	---
R013 | IDITCH	Irrigation mode	overhead	overhead	---
R013 | RUNOFF	Runoff coefficient	2.000E-01	2.000E-01	---
R013 | WAREA	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---
R013 | EPS	Accuracy for water/soil computations	1.000E-03	1.000E-03	---
R014 | DENSAQ	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---
R014 | TPSZ	Saturated zone total porosity	4.000E-01	4.000E-01	---
R014 | EPSZ	Saturated zone effective porosity	2.000E-01	2.000E-01	---
R014 | HCSZ	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---
R014 | HGWT	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---
R014 | BSZ	Saturated zone b parameter	5.300E+00	5.300E+00	---
R014 | VWT	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---

Site-Specific Parameter Summary (continued).

Parameter Menu	Parameter Name	Parameter	User Input	Default	Used by RESRAD (If different from user input)
R014	DWIBWT	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---
R014	MODEL	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---
R014	UW	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---
R015	NS	Number of unsaturated zone strata	1	1	---
R015	H(1)	Unsat. zone 1, thickness (m)	1.520E+01	4.000E+00	---
R015	DENSUZ(1)	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---
R015	TPUZ(1)	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---
R015	EPUZ(1)	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---
R015	BUZ(1)	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---
R015	HCUZ(1)	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---
R016		Distribution coefficients for Tc-99			
R016	DCNUCC(5)	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---
R016	DCNUCU(5,1)	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---
R016	DCNUCS(5)	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---
R016	ALEACH(5)	Leach rate (/yr)	0.000E+00	0.000E+00	8.447E+00
R016	SOLUBK(5)	Solubility constant	0.000E+00	0.000E+00	not used
R016		Distribution coefficients for U-234			
R016	DCNUCC(7)	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---
R016	DCNUCU(7,1)	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---
R016	DCNUCS(7)	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---
R016	ALEACH(7)	Leach rate (/yr)	0.000E+00	0.000E+00	3.541E-02
R016	SOLUBK(7)	Solubility constant	0.000E+00	0.000E+00	not used
R016		Distribution coefficients for U-235			
R016	DCNUCC(8)	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---
R016	DCNUCU(8,1)	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---
R016	DCNUCS(8)	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---
R016	ALEACH(8)	Leach rate (/yr)	0.000E+00	0.000E+00	3.541E-02

R016	Solubility constant	SOLUBK(8)	0.000E+00	0.000E+00	not used
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	DCNUCC(9)	5.000E+01	5.000E+01	---
R016	Unsaturated zone 1 (cm**3/g)	DCNUCU(9,1)	5.000E+01	5.000E+01	---
R016	Saturated zone (cm**3/g)	DCNUCS(9)	5.000E+01	5.000E+01	---
R016	Leach rate (/yr)	ALEACH(9)	0.000E+00	0.000E+00	3.541E-02
R016	Solubility constant	SOLUBK(9)	0.000E+00	0.000E+00	not used
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	DCNUCC(1)	2.000E+01	2.000E+01	---
R016	Unsaturated zone 1 (cm**3/g)	DCNUCU(1,1)	2.000E+01	2.000E+01	---
R016	Saturated zone (cm**3/g)	DCNUCS(1)	2.000E+01	2.000E+01	---
R016	Leach rate (/yr)	ALEACH(1)	0.000E+00	0.000E+00	8.796E-02
R016	Solubility constant	SOLUBK(1)	0.000E+00	0.000E+00	not used

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.541E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.774E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.532E-02	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.963E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED

Menu	Parameter			
R017 SHF3	Shielding factor, inhalation	4.000E-01	4.000E-01	---
R017 SHF1	Shielding factor, external gamma	7.000E-01	7.000E-01	---
R017 FIND	Fraction of time spent indoors	5.000E-01	5.000E-01	---
R017 FOTD	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---
R017 FS	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.
R017	Radii of shape factor array (used if FS = -1):			
R017 RAD_SHAPE(1)	Outer annular radius (m), ring 1:	not used	5.000E+01	---
R017 RAD_SHAPE(2)	Outer annular radius (m), ring 2:	not used	7.071E+01	---
R017 RAD_SHAPE(3)	Outer annular radius (m), ring 3:	not used	0.000E+00	---
R017 RAD_SHAPE(4)	Outer annular radius (m), ring 4:	not used	0.000E+00	---
R017 RAD_SHAPE(5)	Outer annular radius (m), ring 5:	not used	0.000E+00	---
R017 RAD_SHAPE(6)	Outer annular radius (m), ring 6:	not used	0.000E+00	---
R017 RAD_SHAPE(7)	Outer annular radius (m), ring 7:	not used	0.000E+00	---
R017 RAD_SHAPE(8)	Outer annular radius (m), ring 8:	not used	0.000E+00	---
R017 RAD_SHAPE(9)	Outer annular radius (m), ring 9:	not used	0.000E+00	---
R017 RAD_SHAPE(10)	Outer annular radius (m), ring 10:	not used	0.000E+00	---
R017 RAD_SHAPE(11)	Outer annular radius (m), ring 11:	not used	0.000E+00	---
R017 RAD_SHAPE(12)	Outer annular radius (m), ring 12:	not used	0.000E+00	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	1.000E+00	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.189E-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.189E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.189E-02	FMILK

R019 | LFI5	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---
R019 | LFI6	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---
R019 | LWI5	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---
R019 | LWI6	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---
R019 | LSI	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---
R019 | MLFD	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---
R019 | DM	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---
R019 | DROOT	Depth of roots (m)	9.000E-01	9.000E-01	---
R019 | FGWDW	Drinking water fraction from ground water	1.000E+00	1.000E+00	---
R019 | FGWHH	Household water fraction from ground water	1.000E+00	1.000E+00	---
R019 | FGWLW	Livestock water fraction from ground water	1.000E+00	1.000E+00	---
R019 | FGWIR	Irrigation fraction from ground water	1.000E+00	1.000E+00	---
R19B | YV(1)	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---
R19B | YV(2)	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---
R19B | YV(3)	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---
R19B | TE(1)	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---
R19B | TE(2)	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---
R19B | TE(3)	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)

R021	Thickness of building foundation (m)	1.500E-01	1.500E-01	---
FLOOR				
R021	Bulk density of building foundation (g/cm**3)	2.400E+00	2.400E+00	---
DENSFL				
R021	Total porosity of the cover material	4.000E-01	4.000E-01	---
TPCV				
R021	Total porosity of the building foundation	1.000E-01	1.000E-01	---
TPFL				
R021	Volumetric water content of the cover material	5.000E-02	5.000E-02	---
PH2OCV				
R021	Volumetric water content of the foundation	3.000E-02	3.000E-02	---
PH2OFL				
R021	Diffusion coefficient for radon gas (m/sec):			
R021	in cover material	2.000E-06	2.000E-06	---
DIFCV				
R021	in foundation material	3.000E-07	3.000E-07	---
DIFFL				
R021	in contaminated zone soil	2.000E-06	2.000E-06	---
DIFCZ				
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---
HMIX				
R021	Average building air exchange rate (1/hr)	5.000E-01	5.000E-01	---
REXG				
R021	Height of the building (room) (m)	2.500E+00	2.500E+00	---
HRM				
R021	Building interior area factor	0.000E+00	0.000E+00	code computed (time dependent)
FAI				
R021	Building depth below ground surface (m)	-1.000E+00	-1.000E+00	code computed (time dependent)
DMFL				
R021	Emanating power of Rn-222 gas	2.500E-01	2.500E-01	---
EMANA(1)				
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---
EMANA(2)				

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	active
Find peak pathway doses	suppressed

Summary : Landfill Risk from Slag and Dross Produced by Nickel Recycling Operation
File : LANDRISK.RAD

Contaminated Zone Dimensions	
Area:	37.80 square meters
Thickness:	0.15 meters
Cover Depth:	2.00 meters

Initial Soil Concentrations, pCi/g	
Tc-99	5.200E+01
U-234	3.670E+00
U-235	1.620E-01
U-238	1.570E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 30 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.638E-14	1.467E-08	1.268E-07	1.226E-06	7.524E-06	2.646E-05	3.363E-05	3.564E-05
M(t):	5.460E-16	4.891E-10	4.228E-09	4.086E-08	2.508E-07	8.820E-07	1.121E-06	1.188E-06

Maximum TDOSE(t): 1.877E+00 mrem/yr at t = 6.70 ñ 0.01 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 6.700E+00 years

Water Independent Pathways (Inhalation excludes radon)

Soil Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	4.336E-18	0.0000	0.000E+00	0.0000	5.875E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.696E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.305E-14	0.0000	0.000E+00	0.0000	1.551E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.305E-14	0.0000	0.000E+00	0.0000	5.875E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 6.700E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	1.876E+00	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.187E-06	0.0000	1.024E-04	0.0001	1.877E+00	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.875E-07	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.696E-21	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.565E-12	0.0000
Total	1.876E+00	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.187E-06	0.0000	1.024E-04	0.0001	1.877E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	4.329E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.638E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.638E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.329E-21	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.638E-14	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.638E-14	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.075E-19	0.0000	0.000E+00	0.0000	1.467E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	4.216E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.583E-14	0.0000	0.000E+00	0.0000	5.909E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.583E-14	0.0000	0.000E+00	0.0000	1.467E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.467E-08	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.216E-21	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.174E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.467E-08	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	9.318E-19	0.0000	0.000E+00	0.0000	1.268E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	4.012E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.479E-14	0.0000	0.000E+00	0.0000	1.521E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E-00	0.0000	0.000E+00	0.0000
Total	1.480E-14	0.0000	0.000E+00	0.0000	1.268E-07	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.268E-07	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.012E-21	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.669E-13	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.268E-07	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	9.[illegible]E-18	0.0000	0.000E+00	0.0000	1.226E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.460E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	[illegible]	0.0000	0.000E+00	0.0000	4.770E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	[illegible]	0.0000	0.000E+00	0.0000	1.226E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	[illegible]	[illegible]	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.827E-18	0.0000	8.567E-17	0.0000	1.530E-12	0.0000
U-234	[illegible]	[illegible]	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.226E-06	1.0000
U-235	[illegible]	[illegible]	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.460E-21	0.0000
U-238	[illegible]	[illegible]	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.782E-12	0.0000
Total	[illegible]	[illegible]	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.827E-18	0.0000	8.567E-17	0.0000	1.226E-06	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	5.712E-17	0.0000	0.000E+00	0.0000	7.524E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.392E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	5.918E-15	0.0000	0.000E+00	0.0000	8.104E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.975E-15	0.0000	0.000E+00	0.0000	7.524E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.524E-06	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.392E-21	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.105E-11	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.524E-06	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.187E-16	0.0000	0.000E+00	0.0000	2.646E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	4.719E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	5.502E-16	0.0000	0.000E+00	0.0000	6.939E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	7.688E-16	0.0000	0.000E+00	0.0000	2.646E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.646E-05	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.719E-22	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.939E-10	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.646E-05	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	3.543E-16	0.0000	0.000E+00	0.0000	3.363E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.432E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	6.327E-19	0.0000	0.000E+00	0.0000	1.149E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.549E-16	0.0000	0.000E+00	0.0000	3.363E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.363E-05	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.432E-24	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.149E-09	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.363E-05	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	8.750E-16	0.0000	0.000E+00	0.0000	3.556E-05	0.9978	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.000E-20	0.0000	0.000E+00	0.0000	1.220E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	8.750E-16	0.0000	0.000E+00	0.0000	3.557E-05	0.9979	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.556E-05	0.9978
U-235	7.601E-08	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.769E-14	0.0000	8.292E-14	0.0000	7.601E-08	0.0021
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.220E-09	0.0000
Total	7.601E-08	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.769E-14	0.0000	8.292E-14	0.0000	3.564E-05	1.0000

*Sum of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	2.800E-34	6.028E-38	2.803E-45	2.943E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.000E+00	1.883E-31	1.824E-31	1.709E-31	1.364E-31	7.146E-32	7.446E-33	1.164E-35	1.401E-45
U-234	Th-230	1.000E+00	0.000E+00	5.626E-35	1.640E-34	4.953E-34	1.153E-33	2.106E-33	3.915E-33	3.094E-32
U-234	Ra-226	1.000E+00	0.000E+00	3.998E-09	3.456E-08	3.340E-07	2.050E-06	7.209E-06	9.164E-06	9.691E-06
U-234	Pb-210	1.000E+00	0.000E+00	2.545E-38	6.541E-37	2.044E-35	3.456E-34	3.103E-33	8.049E-33	5.580E-32
U-234	_DSR(j)		1.883E-31	3.998E-09	3.456E-08	3.340E-07	2.050E-06	7.209E-06	9.164E-06	9.691E-06
U-235	U-235	1.000E+00	2.672E-20	2.585E-20	2.419E-20	1.917E-20	9.871E-21	9.663E-22	1.263E-24	1.021E-34
U-235	Pa-231	1.000E+00	0.000E+00	1.529E-22	4.289E-22	1.130E-21	1.733E-21	5.514E-22	2.011E-24	4.203E-34
U-235	Ac-227	1.000E+00	0.000E+00	1.798E-23	1.433E-22	1.052E-21	3.163E-21	1.395E-21	5.564E-24	4.692E-07
U-235	_DSR(j)		2.672E-20	2.602E-20	2.476E-20	2.136E-20	1.477E-20	2.913E-21	8.839E-24	4.692E-07
U-238	U-238	1.000E+00	1.043E-14	1.008E-14	9.423E-15	7.431E-15	3.769E-15	3.504E-16	3.953E-19	1.906E-29
U-238	U-234	1.000E+00	0.000E+00	5.170E-37	1.454E-36	3.866E-36	6.078E-36	2.111E-36	9.904E-39	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	7.928E-41	6.849E-40	6.608E-39	4.053E-38	1.509E-37	3.137E-37	2.480E-36
U-238	Ra-226	1.000E+00	0.000E+00	3.764E-15	9.687E-14	3.038E-12	5.162E-11	4.420E-10	7.320E-10	7.768E-10
U-238	Pb-210	1.000E+00	0.000E+00	1.822E-44	1.384E-42	1.424E-40	6.946E-39	1.708E-37	6.410E-37	4.472E-36
U-238	_DSR(j)		1.043E-14	1.385E-14	1.063E-13	3.046E-12	5.162E-11	4.420E-10	7.320E-10	7.768E-10

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* .... BRF(j).
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 30 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	*1.696E+10	*1.696E+10	*1.696E+10	*1.696E+10	*1.696E+10	*1.696E+10	*1.696E+10	*1.696E+10
U-234	*6.245E+09	*6.245E+09	8.681E+08	8.982E+07	1.463E+07	4.161E+06	3.274E+06	3.096E+06
U-235	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06
U-238	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose =   6.70 ñ 0.01 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Tc-99	5.200E+01	6.70 ñ 0.01	3.609E-02	8.313E+02	3.609E-02	8.313E+02
U-234	3.670E+00	1.000E+03	9.691E-06	3.096E+06	1.601E-07	1.874E+08
U-235	1.620E-01	1.000E+03	4.692E-07	*2.160E+06	2.281E-20	*2.160E+06
U-238	1.570E+00	1.000E+03	7.768E-10	*3.360E+05	9.965E-13	*3.360E+05

*At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.530E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	_DOSE(j):		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	_DOSE(j):		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	U-234	1.000E+00	0.000E+00	1.467E-08	1.268E-07	1.226E-06	7.524E-06	2.646E-05	3.363E-05	3.556E-05
Ra-226	U-238	1.000E+00	0.000E+00	5.909E-15	1.521E-13	4.770E-12	8.104E-11	6.939E-10	1.149E-09	1.220E-09
Ra-226	_DOSE(j):		0.000E+00	1.467E-08	1.268E-07	1.226E-06	7.524E-06	2.646E-05	3.363E-05	3.557E-05
Pb-210	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	_DOSE(j):		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	1.000E+00	4.329E-21	4.188E-21	3.919E-21	3.106E-21	1.599E-21	1.565E-22	2.047E-25	0.000E+00
Pa-231	U-235	1.000E+00	0.000E+00	2.477E-23	6.948E-23	1.831E-22	2.808E-22	8.932E-23	3.258E-25	0.000E+00
Ac-227	U-235	1.000E+00	0.000E+00	2.913E-24	2.321E-23	1.704E-22	5.124E-22	2.260E-22	9.014E-25	7.601E-08
U-238	U-238	1.000E+00	1.638E-14	1.583E-14	1.479E-14	1.167E-14	5.918E-15	5.502E-16	6.206E-19	2.993E-29

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	5.200E-01	1.116E-02	5.136E-10	1.075E-35	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.000E+00	3.670E+00	3.542E+00	3.300E+00	2.576E+00	1.269E+00	1.064E-01	8.938E-05	1.537E-15
U-234	U-238	1.000E+00	0.000E+00	4.296E-06	1.201E-05	3.124E-05	4.616E-05	1.290E-05	3.253E-08	1.866E-18
U-234	_S(j):		3.670E+00	3.542E+00	3.300E+00	2.576E+00	1.269E+00	1.064E-01	8.941E-05	1.539E-15
Th-230	U-234	1.000E+00	0.000E+00	3.246E-05	9.402E-05	2.782E-04	6.101E-04	9.033E-04	9.232E-04	8.986E-04
Th-230	U-238	1.000E+00	0.000E+00	1.957E-11	1.680E-10	1.587E-09	9.172E-09	2.769E-08	3.165E-08	3.081E-08
Th-230	_S(j):		0.000E+00	3.246E-05	9.402E-05	2.782E-04	6.101E-04	9.034E-04	9.233E-04	8.987E-04
Ra-226	U-234	1.000E+00	0.000E+00	7.012E-09	6.060E-08	5.852E-07	3.583E-06	1.250E-05	1.553E-05	1.514E-05
Ra-226	U-238	1.000E+00	0.000E+00	2.824E-15	7.266E-14	2.277E-12	3.860E-11	3.279E-10	5.307E-10	5.191E-10
Ra-226	_S(j):		0.000E+00	7.012E-09	6.060E-08	5.852E-07	3.583E-06	1.250E-05	1.553E-05	1.514E-05
Pb-210	U-234	1.000E+00	0.000E+00	7.213E-11	1.844E-09	5.650E-08	9.033E-07	6.666E-06	9.878E-06	9.646E-06
Pb-210	U-238	1.000E+00	0.000E+00	2.184E-17	1.669E-15	1.684E-13	7.767E-12	1.570E-10	3.365E-10	3.308E-10
Pb-210	_S(j):		0.000E+00	7.213E-11	1.844E-09	5.650E-08	9.033E-07	6.666E-06	9.878E-06	9.646E-06
U-235	U-235	1.000E+00	1.620E-01	1.564E-01	1.457E-01	1.137E-01	5.600E-02	4.697E-03	3.949E-06	6.802E-17
Pa-231	U-235	1.000E+00	0.000E+00	3.308E-06	9.246E-06	2.405E-05	3.554E-05	9.928E-06	2.499E-08	1.424E-18
Ac-227	U-235	1.000E+00	0.000E+00	5.121E-08	4.065E-07	2.945E-06	8.532E-06	3.302E-06	9.054E-09	5.309E-19
U-238	U-238	1.000E+00	1.570E+00	1.515E+00	1.412E+00	1.102E+00	5.427E-01	4.552E-02	3.827E-05	6.592E-16

BRF(i) is the branch fraction of the parent nuclide.

C.2 Detailed Output File

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RESRAD, Version 5.80      T« Limit = 0.5 year        05/01/98  11:18    Page   1
 Intrisk : Landfill Risk from Slag and Dross Produced by Nickel Recycling Operation
 File    : LANDRISK.RAD
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Table of Contents

Part III: Intake Quantities and Health Risk Factors

Cancer Risk Slope Factors Summary Table
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Ac-227+D	9.30E-07	9.30E-07	SLPF(1,1)
Sf-1	Pa-231	2.70E-08	2.70E-08	SLPF(2,1)
Sf-1	Pb-210+D	1.50E-10	1.50E-10	SLPF(3,1)
Sf-1	Ra-226+D	6.70E-06	6.70E-06	SLPF(4,1)
Sf-1	Tc-99	6.20E-13	6.20E-13	SLPF(5,1)
Sf-1	Th-230	4.40E-11	4.40E-11	SLPF(6,1)
Sf-1	U-234	2.10E-11	2.10E-11	SLPF(7,1)
Sf-1	U-235+D	2.70E-07	2.70E-07	SLPF(8,1)
Sf-1	U-238+D	6.60E-08	6.60E-08	SLPF(9,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Ac-227+D	7.90E-08	7.90E-08	SLPF(1,2)
Sf-2	Pa-231	2.40E-08	2.40E-08	SLPF(2,2)
Sf-2	Pb-210+D	3.90E-09	3.90E-09	SLPF(3,2)
Sf-2	Ra-226+D	2.70E-09	2.70E-09	SLPF(4,2)
Sf-2	Tc-99	2.90E-12	2.90E-12	SLPF(5,2)
Sf-2	Th-230	1.70E-08	1.70E-08	SLPF(6,2)
Sf-2	U-234	1.40E-08	1.40E-08	SLPF(7,2)
Sf-2	U-235+D	1.30E-08	1.30E-08	SLPF(8,2)
Sf-2	U-238+D	1.20E-08	1.20E-08	SLPF(9,2)
Sf-3	Ingestion, slope factors, 1/(pCi):			
Sf-3	Ac-227+D	6.30E-10	6.30E-10	SLPF(1,3)
Sf-3	Pa-231	1.50E-10	1.50E-10	SLPF(2,3)
Sf-3	Pb-210+D	1.00E-09	1.00E-09	SLPF(3,3)
Sf-3	Ra-226+D	3.00E-10	3.00E-10	SLPF(4,3)
Sf-3	Tc-99	1.40E-12	1.40E-12	SLPF(5,3)
Sf-3	Th-230	3.80E-11	3.80E-11	SLPF(6,3)
Sf-3	U-234	4.40E-11	4.40E-11	SLPF(7,3)
Sf-3	U-235+D	4.70E-11	4.70E-11	SLPF(8,3)
Sf-3	U-238+D	6.20E-11	6.20E-11	SLPF(9,3)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12$	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02@	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02@	KFACTR(1,2)

Cancer Risk Slope Factors Summary Table (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name

Note: Default values followed by '*' were derived by multiplying the dose conversion factors with 7.6E-7 (risk/mrem). For external radiation, the dose conversion factors used for this derivation were obtained from the EPA's Federal Guidance Report No.12, and for inhalation and ingestion, the dose conversion factors were the ones used in RESRAD default database.

Default values followed by '$' were obtained from 'Estimating Radiogenic Cancer Risks', EPA 402-R-93-076, June, 1994.

Default values followed by '#' were taken from individual radionuclides given in HEAST.

Default values followed by '@' were obtained from 'Comparative Dosimetry of Radon in Mines and Homes', National Research Council, 1991.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Nuclide	Inhalation	Plant	Meat	Milk	Total Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	3.757E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	8.574E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	3.924E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.933E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.485E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.489E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.757E-27	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.574E-28	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.924E-22	0.0000
Tc-99	2.161E-08	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	3.992E-14	0.0000	1.210E-12	0.0001	2.161E-08	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.933E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.485E-19	0.0000
Total	2.161E-08	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	3.992E-14	0.0000	1.210E-12	0.0001	2.161E-08	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	4.956E-12	9.825E-12	1.246E-11	2.436E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	4.956E-12	9.825E-12	1.246E-11	2.436E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	3.924E-22	0.0000	0.000E+00	0.0000	5.160E-11	0.0024	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.395E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.485E-19	0.0000	0.000E+00	0.0000	4.147E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.489E-19	0.0000	0.000E+00	0.0000	5.160E-11	0.0024	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	2.161E-08	0.9976	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.992E-14	0.0000	1.210E-12	0.0001	2.161E-08	0.9976
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.160E-11	0.0024
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.395E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.148E-16	0.0000
Total	2.161E-08	0.9976	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.992E-14	0.0000	1.210E-12	0.0001	2.166E-08	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As pCi/yr at t= 1.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Nuclide	Inhalation	Plant	Meat	Milk	Total Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	4.629E-04	4.464E-04	3.378E-04	2.731E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	4.629E-04	4.464E-04	3.378E-04	2.731E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	3.994E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	8.953E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.274E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.837E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.436E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.440E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Pathways** Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All risk	All fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.994E-27	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.953E-28	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.274E-22	0.0000
Tc-99	4.650E-12	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	8.590E-18	0.0000	2.603E-16	0.0001	4.650E-12	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.837E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.436E-19	0.0000
Total	4.650E-12	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	8.590E-18	0.0000	2.603E-16	0.0001	4.650E-12	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radionuclides

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.393E-12	1.069E-11	1.356E-11	2.651E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	5.393E-12	1.069E-11	1.356E-11	2.651E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	4.274E-22	0.0000	0.000E+00	0.0000	5.615E-11	0.9235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.326E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.436E-19	0.0000	0.000E+00	0.0000	4.645E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.440E-19	0.0000	0.000E+00	0.0000	5.615E-11	0.9235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	4.650E-12	0.0765	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.590E-18	0.0000	2.603E-16	0.0000	4.650E-12	0.0765
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.615E-11	0.9235
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.326E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.647E-16	0.0000
Total	4.650E-12	0.0765	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.590E-18	0.0000	2.603E-16	0.0000	6.080E-11	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As pCi/yr at t= 3.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	4.001E-03	3.859E-03	2.920E-03	2.360E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	4.001E-03	3.859E-03	2.920E-03	2.360E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	4.468E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	9.610E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.020E-22	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.655E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.341E-19	0.3834	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.346E-19	0.3848	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Pathways** fract.	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All risk
Ac-227	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.468E-27
Pa-231	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.510E-28
Pb-210	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
Ra-226	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.020E-22
Tc-99	0.6152	2.153E-19	0.6152	0.000E+00	0.0000	0.000E+00	0.0000	3.977E-25	0.0000	1.205E-23	0.0000	2.153E-19
Th-230	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-234	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00
U-235	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.655E-26
U-238	0.3834	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.341E-19
Total	1.0000	2.153E-19	0.6152	0.000E+00	0.0000	0.000E+00	0.0000	3.977E-25	0.0000	1.205E-23	0.0000	3.499E-19

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	6.323E-12	1.253E-11	1.589E-11	3.108E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	6.323E-12	1.253E-11	1.589E-11	3.108E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	5.020E-22	0.0000	0.000E+00	0.0000	6.584E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.198E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.341E-19	0.0000	0.000E+00	0.0000	5.757E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.346E-19	0.0000	0.000E+00	0.0000	6.584E-11	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	2.153E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.977E-25	0.0000	1.205E-23	0.0000	2.153E-19	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.584E-11	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.198E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.758E-16	0.0000
Total	2.153E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.977E-25	0.0000	1.205E-23	0.0000	6.584E-11	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As pCi/yr at t= 1.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.048E-06	0.000E+00	0.000E+00	1.937E-12	5.868E-11	1.048E-06
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.867E-02	3.729E-02	2.822E-02	2.281E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	3.867E-02	3.729E-02	2.822E-02	2.281E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	5.925E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	1.102E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	8.003E-22	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.105E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.058E-19	0.0280	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.066E-19	0.0282	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.925E-27	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.102E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.003E-22	0.0002
Tc-99	3.669E-18	0.9717	0.000E+00	0.0000	0.000E+00	0.0000	6.778E-24	0.0000	2.054E-22	0.0001	3.669E-18	0.9718
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.105E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.058E-19	0.0280
Total	3.669E-18	0.9717	0.000E+00	0.0000	0.000E+00	0.0000	6.778E-24	0.0000	2.054E-22	0.0001	3.775E-18	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.001E-11	1.985E-11	2.517E-11	4.923E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.001E-11	1.985E-11	2.517E-11	4.923E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	8.002E-22	0.0000	0.000E+00	0.0000	1.043E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.807E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.058E-19	0.0000	0.000E+00	0.0000	1.092E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.066E-19	0.0000	0.000E+00	0.0000	1.043E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	3.669E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.778E-24	0.0000	2.054E-22	0.0000	3.669E-18	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.043E-10	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.807E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.092E-15	0.0000
Total	3.669E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.778E-24	0.0000	2.054E-22	0.0000	1.043E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As pCi/yr at t= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.373E-01	2.289E-01	1.732E-01	1.400E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.373E-01	2.289E-01	1.732E-01	1.400E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	7.298E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	1.063E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.782E-21	0.0321	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.084E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	5.368E-20	0.9679	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.546E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All** risk	All** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.298E-27	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.063E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.782E-21	0.0321
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.084E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.368E-20	0.9679
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.546E-20	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.182E-11	4.326E-11	5.485E-11	1.073E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.182E-11	4.326E-11	5.485E-11	1.073E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.782E-21	0.0000	0.000E+00	0.0000	2.272E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.920E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	5.368E-20	0.0000	0.000E+00	0.0000	3.545E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	5.546E-20	0.0000	0.000E+00	0.0000	2.272E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.272E-10	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.920E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.545E-15	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.272E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As pCi/yr at t= 1.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	8.347E-01	8.050E-01	6.091E-01	4.924E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	8.347E-01	8.050E-01	6.091E-01	4.924E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	fract.	Inhalation risk	fract.	Plant risk	fract.	Meat risk	fract.	Milk risk	fract.	Soil risk	fract.
Ac-227	2.259E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.687E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.279E-21	0.4617	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.061E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.990E-21	0.5383	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	9.269E-21	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.259E-27	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.687E-28	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.279E-21	0.4617
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.061E-27	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.990E-21	0.5383
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.269E-21	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	4.824E-11	9.564E-11	1.213E-10	2.372E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	4.824E-11	9.564E-11	1.213E-10	2.372E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	4.279E-21	0.0000	0.000E+00	0.0000	5.023E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.589E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.990E-21	0.0000	0.000E+00	0.0000	1.410E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	9.269E-21	0.0000	0.000E+00	0.0000	5.023E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.023E-10	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.589E-27	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.410E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.023E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As pCi/yr at t= 3.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.061E+00	1.023E+00	7.743E-01	6.259E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.061E+00	1.023E+00	7.743E-01	6.259E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	6.486E-21	0.9991	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	5.629E-24	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.491E-21	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.486E-21	0.9991
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.629E-24	0.0009
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.491E-21	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.738E-11	1.138E-10	1.442E-10	2.821E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	5.738E-11	1.138E-10	1.442E-10	2.821E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	6.485E-21	0.0000	0.000E+00	0.0000	5.975E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	5.851E-24	0.0000	0.000E+00	0.0000	2.044E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	6.491E-21	0.0000	0.000E+00	0.0000	5.975E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.975E-10	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.044E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.975E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As pCi/yr at t= 1.000E+03 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Nuclide	Inhalation	Plant	Meat	Milk	Total Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.136E-06	0.000E+00	0.000E+00	1.195E-12	5.603E-12	5.136E-06
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.122E+00	1.082E+00	8.188E-01	6.619E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.122E+00	1.082E+00	8.188E-01	6.619E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.601E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.601E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	1.377E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.205E-20	0.0000	1.502E-19	0.0000	1.377E-13	1.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.601E-20	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.377E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.205E-20	0.0000	1.502E-19	0.0000	1.377E-13	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	6.066E-11	1.202E-10	1.525E-10	2.982E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	6.066E-11	1.202E-10	1.525E-10	2.982E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.601E-20	0.0000	0.000E+00	0.0000	6.316E-10	0.9997	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	5.490E-25	0.0000	0.000E+00	0.0000	2.166E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.601E-20	0.0000	0.000E+00	0.0000	6.316E-10	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)

and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.316E-10	0.9997
U-235	1.377E-13	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.205E-20	0.0000	1.502E-19	0.0000	1.377E-13	0.0002
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.166E-14	0.0000
Total	1.377E-13	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.205E-20	0.0000	1.502E-19	0.0000	6.317E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

C.3 Risk Output File

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Intrisk : Landfill Risk from Slag and Dross Produced by Nickel Recycling Operation
File : LANDFILL.RAD

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Part III: Intake Quantities and Health Risk Factors

Cancer Risk Slope Factors Summary Table
File: DOSFAC.BIN

0 Menu	Parameter	Current Value	Default	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Ac-227+D	9.30E-07	9.30E-07	SLPF(1,1)
Sf-1	Pa-231	2.70E-08	2.70E-08	SLPF(2,1)
Sf-1	Pb-210+D	1.50E-10	1.50E-10	SLPF(3,1)
Sf-1	Ra-226+D	6.70E-06	6.70E-06	SLPF(4,1)
Sf-1	Tc-99	6.20E-13	6.20E-13	SLPF(5,1)
Sf-1	Th-230	4.40E-11	4.40E-11	SLPF(6,1)
Sf-1	U-234	2.10E-11	2.10E-11	SLPF(7,1)
Sf-1	U-235+D	2.70E-07	2.70E-07	SLPF(8,1)
Sf-1	U-238+D	6.60E-08	6.60E-08	SLPF(9,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Ac-227+D	7.90E-08	7.90E-08	SLPF(1,2)
Sf-2	Pa-231	2.40E-08	2.40E-08	SLPF(2,2)
Sf-2	Pb-210+D	3.90E-09	3.90E-09	SLPF(3,2)
Sf-2	Ra-226+D	2.70E-09	2.70E-09	SLPF(4,2)
Sf-2	Tc-99	2.90E-12	2.90E-12	SLPF(5,2)
Sf-2	Th-230	1.70E-08	1.70E-08	SLPF(6,2)
Sf-2	U-234	1.40E-08	1.40E-08	SLPF(7,2)
Sf-2	U-235+D	1.30E-08	1.30E-08	SLPF(8,2)
Sf-2	U-238+D	1.20E-08	1.20E-08	SLPF(9,2)
Sf-3	Ingestion, slope factors, 1/(pCi):			
Sf-3	Ac-227+D	6.30E-10	6.30E-10	SLPF(1,3)
Sf-3	Pa-231	1.50E-10	1.50E-10	SLPF(2,3)
Sf-3	Pb-210+D	1.00E-09	1.00E-09	SLPF(3,3)
Sf-3	Ra-226+D	3.00E-10	3.00E-10	SLPF(4,3)
Sf-3	Tc-99	1.40E-12	1.40E-12	SLPF(5,3)
Sf-3	Th-230	3.80E-11	3.80E-11	SLPF(6,3)
Sf-3	U-234	4.40E-11	4.40E-11	SLPF(7,3)
Sf-3	U-235+D	4.70E-11	4.70E-11	SLPF(8,3)
Sf-3	U-238+D	6.20E-11	6.20E-11	SLPF(9,3)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-12S	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+02@	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+02@	KFACTR(1,2)

Cancer Risk Slope Factors Summary Table (continued)
File: DOSFAC.BIN

0 Menu	Parameter	Current Value	Default	Parameter Name

Note: Default values followed by '*' were derived by multiplying the dose conversion factors with 7.6E-7 (risk/mrem). For external radiation, the dose conversion factors used for this derivation were obtained from the EPA's Federal Guidance Report No.12, and for inhalation and ingestion, the dose conversion factors were the ones used in RESRAD default database.

Default values followed by '$' were obtained from 'Estimating Radiogenic Cancer Risks', EPA 402-R-93-076, June, 1994.

Default values followed by '#' were taken from individual radionuclides given in HEAST.

Default values followed by '@' were obtained from 'Comparative Dosimetry of Radon in Mines and Homes', National Research Council, 1991.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.085E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.487E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.143E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.561E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.366E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.377E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.085E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.487E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.143E-21	0.0000
Tc-99	6.732E-09	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	1.244E-14	0.0000	3.769E-13	0.0001	6.732E-09	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.561E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.366E-19	0.0000
Total	6.732E-09	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	1.244E-14	0.0000	3.769E-13	0.0001	6.732E-09	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.482E-11	2.937E-11	3.725E-11	7.285E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.482E-11	2.937E-11	3.725E-11	7.285E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.143E-21	0.0000	0.000E+00	0.0000	1.543E-10	0.0224	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	9.895E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.366E-19	0.0000	0.000E+00	0.0000	1.238E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.377E-19	0.0000	0.000E+00	0.0000	1.543E-10	0.0224	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	6.732E-09	0.9775	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.244E-14	0.0000	3.769E-13	0.0001	6.732E-09	0.9776
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.543E-10	0.0224
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.895E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.239E-15	0.0000
Total	6.732E-09	0.9775	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.244E-14	0.0000	3.769E-13	0.0001	6.887E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon): Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways: Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

0

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.387E-03	1.338E-03	1.012E-03	8.184E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.387E-03	1.338E-03	1.012E-03	8.184E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ac-227	1.152E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.594E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.243E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.263E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.214E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.226E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.152E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.594E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.243E-21	0.0000
Tc-99	1.449E-12	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	2.676E-18	0.0000	8.109E-17	0.0001	1.449E-12	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.263E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.214E-29	0.0000
Total	1.449E-12	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	2.676E-18	0.0000	8.109E-17	0.0001	1.449E-12	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.612E-11	3.196E-11	4.053E-11	7.927E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.612E-11	3.196E-11	4.053E-11	7.927E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.243E-21	0.0000	0.000E+00	0.0000	1.679E-10	0.9914	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	9.675E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.214E-19	0.0000	0.000E+00	0.0000	1.387E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.226E-19	0.0000	0.000E+00	0.0000	1.679E-10	0.9914	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	1.449E-12	0.0086	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.676E-18	0.0000	8.109E-17	0.0000	1.449E-12	0.0086
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.679E-10	0.9914
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.675E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.387E-15	0.0000
Total	1.449E-12	0.0086	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.676E-18	0.0000	8.109E-17	0.0000	1.693E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

0

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.199E-02	1.156E-02	8.749E-03	7.073E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.199E-02	1.156E-02	8.749E-03	7.073E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.286E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.778E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.457E-21	0.0032	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	7.698E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.926E-19	0.8514	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.940E-19	0.8546	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.286E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.778E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.457E-21	0.0032
Tc-99	6.706E-20	0.1454	0.000E+00	0.0000	0.000E+00	0.0000	1.239E-25	0.0000	3.754E-24	0.0000	6.706E-20	0.1454
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.698E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.926E-19	0.8514
Total	6.706E-20	0.1454	0.000E+00	0.0000	0.000E+00	0.0000	1.239E-25	0.0000	3.754E-24	0.0000	4.611E-19	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.890E-11	3.747E-11	4.751E-11	9.292E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.890E-11	3.747E-11	4.751E-11	9.292E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00

(Column group heading: Radionuclides)

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

0
Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.457E-21	0.0000	0.000E+00	0.0000	1.968E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	9.262E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.926E-19	0.0000	0.000E+00	0.0000	1.718E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.940E-19	0.0000	0.000E+00	0.0000	1.968E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	6.706E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.239E-25	0.0000	3.754E-24	0.0000	6.706E-20	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.968E-10	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.262E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.719E-15	0.0000
Total	6.706E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.239E-25	0.0000	3.754E-24	0.0000	1.968E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 6.700E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.004E+05	0.000E+00	0.000E+00	4.667E-01	2.184E+01	4.004E+05
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 6.700E+00 years

0

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.550E-02	5.353E-02	4.051E-02	3.274E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	5.550E-02	5.353E-02	4.051E-02	3.274E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 6.700E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	fract.	Inhalation risk	fract.	Plant risk	fract.	Meat risk	fract.	Milk risk	fract.	Soil risk	fract.
Ac-227	1.516E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	3.022E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.890E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	6.753E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.444E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.463E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 6.700E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.516E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.022E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.890E-21	0.0000
Tc-99	1.401E-06	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	1.633E-12	0.0000	7.644E-11	0.0001	1.401E-06	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.753E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.444E-19	0.0000
Total	1.401E-06	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	1.633E-12	0.0000	7.644E-11	0.0001	1.401E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 6.700E+00 years

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.451E-11	4.860E-11	6.162E-11	1.205E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.451E-11	4.860E-11	6.162E-11	1.205E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 6.700E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.890E-21	0.0000	0.000E+00	0.0000	2.552E-10	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.571E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.444E-19	0.0000	0.000E+00	0.0000	2.457E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.463E-19	0.0000	0.000E+00	0.0000	2.552E-10	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 6.700E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	1.401E-06	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.633E-12	0.0000	7.644E-11	0.0001	1.401E-06	0.9998
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.552E-10	0.0002
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.571E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.458E-15	0.0000
Total	1.401E-06	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.633E-12	0.0000	7.644E-11	0.0001	1.402E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon): Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways: Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.265E-07	0.000E+00	0.000E+00	6.033E-13	1.828E-11	3.266E-07
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

0

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.158E-01	1.117E-01	8.449E-02	6.830E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.158E-01	1.117E-01	8.449E-02	6.830E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.689E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	3.154E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.307E-21	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	6.008E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.064E-19	0.2111	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.087E-19	0.2126	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.669E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.154E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.307E-21	0.0016
Tc-99	1.143E-18	0.7873	0.000E+00	0.0000	0.000E+00	0.0000	2.112E-24	0.0000	6.398E-23	0.0000	1.143E-18	0.7874
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.008E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.054E-19	0.2111
Total	1.143E-18	0.7873	0.000E+00	0.0000	0.000E+00	0.0000	2.112E-24	0.0000	6.398E-23	0.0000	1.452E-18	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.991E-11	5.930E-11	7.520E-11	1.471E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.991E-11	5.930E-11	7.520E-11	1.471E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

(The column heads Rn-222 to Bi-212 stand under the spanning heading "Radionuclides".)

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

0
0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.307E-21	0.0000	0.000E+00	0.0000	3.115E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.013E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.064E-19	0.0000	0.000E+00	0.0000	3.257E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.087E-19	0.0000	0.000E+00	0.0000	3.115E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	1.143E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.112E-24	0.0000	6.398E-23	0.0000	1.143E-18	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.115E-10	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.013E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.257E-15	0.0000
Total	1.143E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.112E-24	0.0000	6.398E-23	0.0000	3.115E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon): Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways: Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

0

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	7.089E-01	6.837E-01	5.174E-01	4.182E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	7.089E-01	6.837E-01	5.174E-01	4.182E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 3.000E+01 years

0
0

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ac-227	2.013E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.938E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.017E-21	0.0322	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.961E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.510E-19	0.9678	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.560E-19	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.013E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.938E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.017E-21	0.0322
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.961E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.510E-19	0.9678
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.560E-19	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	6.506E-11	1.290E-10	1.635E-10	3.198E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	6.506E-11	1.290E-10	1.635E-10	3.198E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	5.017E-21	0.0000	0.000E+00	0.0000	6.774E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	5.268E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.510E-19	0.0000	0.000E+00	0.0000	1.055E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.560E-19	0.0000	0.000E+00	0.0000	6.774E-10	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.774E-10	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.268E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.055E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.774E-10	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon): Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways: Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

0

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.473E+00	2.385E+00	1.805E+00	1.459E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.473E+00	2.385E+00	1.805E+00	1.459E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ac-227	5.483E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	6.534E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.100E-20	0.4650	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	2.483E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.266E-20	0.5350	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.367E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.483E-27	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.534E-28	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.100E-20	0.4650
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.483E-27	0.0000
											1.266E-20	0.5350
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.367E-20	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.427E-10	2.829E-10	3.587E-10	7.016E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.427E-10	2.829E-10	3.587E-10	7.016E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.100E-20	0.0000	0.000E+00	0.0000	1.486E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.620E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.266E-20	0.0000	0.000E+00	0.0000	4.165E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.367E-20	0.0000	0.000E+00	0.0000	1.486E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.486E-09	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.620E-27	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.165E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

0

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.072E+00	2.963E+00	2.242E+00	1.813E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	3.072E+00	2.963E+00	2.242E+00	1.813E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

0
Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	fract.	Inhalation risk	fract.	Plant risk	fract.	Meat risk	fract.	Milk risk	fract.	Soil risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.279E-20	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.065E-23	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.280E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.279E-20	0.9992
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.065E-23	0.0008
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.280E-20	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.659E-10	3.289E-10	4.170E-10	8.156E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.659E-10	3.289E-10	4.170E-10	8.156E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.279E-20	0.0000	0.000E+00	0.0000	1.727E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.108E-23	0.0000	0.000E+00	0.0000	5.901E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.280E-20	0.0000	0.000E+00	0.0000	1.727E-09	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.727E-09	1.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.901E-14	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.727E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon): Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways: Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.541E-05	0.000E+00	0.000E+00	3.586E-12	1.681E-11	1.541E-05
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

0

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.995E+00	2.889E+00	2.186E+00	1.767E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	2.995E+00	2.889E+00	2.186E+00	1.767E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+03 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.247E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.247E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	4.131E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.616E-20	0.0000	4.507E-19	0.0000	4.131E-13	1.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.247E-20	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.131E-13	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.616E-20	0.0000	4.507E-19	0.0000	4.131E-13	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.616E-10	3.204E-10	4.063E-10	7.947E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	1.616E-10	3.204E-10	4.063E-10	7.947E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00

(Radionuclides)

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.247E-20	0.0000	0.000E+00	0.0000	1.683E-09	0.9997	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.269E-25	0.0000	0.000E+00	0.0000	5.764E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.247E-20	0.0000	0.000E+00	0.0000	1.683E-09	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.683E-09	0.9997
U-235	4.131E-13	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.616E-20	0.0000	4.507E-19	0.0000	4.131E-13	0.0002
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.764E-14	0.0000
Total	4.131E-13	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.616E-20	0.0000	4.507E-19	0.0000	1.684E-09	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

A.1 Summary Output File

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RESRAD, Version 5.82     T½ Limit = 0.5 year          01/11/99  12:01   Page  1
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 Summary : Nickel Waste - 6000 tons                           File: 6000TON.RAD
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      Part I: Mixture Sums and Single Radionuclide Guidelines
      _______________________________________________________
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Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(3)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(4)
B-1	Tc-99	8.330E-06	8.330E-06	DCF2(5)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(6)
B-1	U-234	1.320E-01	1.320E-01	DCF2(7)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(8)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(9)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(3)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(4)
D-1	Tc-99	1.460E-06	1.460E-06	DCF3(5)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(6)
D-1	U-234	2.830E-04	2.830E-04	DCF3(7)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(8)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(9)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Tc-99 , plant/soil concentration ratio, dimensionless	5.000E+00	5.000E+00	RTF(5,1)
D-34	Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Tc-99 , fish	2.000E+01	2.000E+01	BIOFAC(5,1)
D-5	Tc-99 , crustacea and mollusks	5.000E+00	5.000E+00	BIOFAC(5,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m^2)	1.250E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.262E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	3.000E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.000E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	3.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Tc-99	8.100E+00	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): U-234	1.100E+01	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-235	4.860E-01	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-238	4.700E+00	0.000E+00	---	S1(9)
R012	Concentration in groundwater (pCi/L): Tc-99	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(9)
R013	Cover depth (m)	2.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm^3)	1.600E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-04	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm^3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-04	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m^3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m^2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm^3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m^3 /yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	1.500E+01	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm^3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Tc-99				
R016	Contaminated zone (cm^3/g)	0.000E+00	0.000E+00	4.813E-02	DCNUCC(5)
R016	Unsaturated zone 1 (cm^3/g)	0.000E+00	0.000E+00	4.813E-02	DCNUCU(5,1)
R016	Saturated zone (cm^3 /g)	0.000E+00	0.000E+00	4.813E-02	DCNUCS(5)
R016	Leach rate (/yr)	8.447E+00	0.000E+00	---	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm^3 /g)	5.000E+01	5.000E+01	6.418E+01	DCNUCC(7)
R016	Unsaturated zone 1 (cm^3 /g)	5.000E+01	5.000E+01	6.418E+01	DCNUCU(7,1)
R016	Saturated zone (cm^3 /g)	5.000E+01	5.000E+01	6.418E+01	DCNUCS(7)
R016	Leach rate (/yr)	3.451E-02	0.000E+00	---	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCC(8)
R016	Unsaturated zone 1 (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCU(8,1)
R016	Saturated zone (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCS(8)
R016	Leach rate (/yr)	3.541E-02	0.000E+00	---	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCC(9)
R016	Unsaturated zone 1 (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCU(9,1)
R016	Saturated zone (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCS(9)
R016	Leach rate (/yr)	3.541E-02	0.000E+00	---	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm^3 /g)	2.000E+01	2.000E+01	2.505E+01	DCNUCC(1)
R016	Unsaturated zone 1 (cm^3 /g)	2.000E+01	2.000E+01	2.505E+01	DCNUCU(1,1)
R016	Saturated zone (cm^3 /g)	2.000E+01	2.000E+01	2.505E+01	DCNUCS(1)
R016	Leach rate (/yr)	8.796E-02	0.000E+00	---	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCC(2)
R016	Unsaturated zone 1 (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCU(2,1)
R016	Saturated zone (cm^3 /g)	5.000E+01	5.000E+01	6.254E+01	DCNUCS(2)
R016	Leach rate (/yr)	3.541E-02	0.000E+00	---	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm³ /g)	1.000E+02	1.000E+02	1.251E+02	DCNUCC(3)
R016	Unsaturated zone 1 (cm³ /g)	1.000E+02	1.000E+02	1.251E+02	DCNUCU(3,1)
R016	Saturated zone (cm³ /g)	1.000E+02	1.000E+02	1.251E+02	DCNUCS(3)
R016	Leach rate (/yr)	1.774E-02	0.000E+00	---	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm³ /g)	7.000E+01	7.000E+01	8.755E+01	DCNUCC(4)
R016	Unsaturated zone 1 (cm³ /g)	7.000E+01	7.000E+01	8.755E+01	DCNUCU(4,1)
R016	Saturated zone (cm³ /g)	7.000E+01	7.000E+01	8.755E+01	DCNUCS(4)
R016	Leach rate (/yr)	2.832E-02	0.000E+00	---	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm³ /g)	6.000E+04	6.000E+04	7.500E+04	DCNUCC(6)
R016	Unsaturated zone 1 (cm³ /g)	6.000E+04	6.000E+04	7.500E+04	DCNUCU(6,1)
R016	Saturated zone (cm³ /g)	6.000E+04	6.000E+04	7.500E+04	DCNUCS(6)
R016	Leach rate (/yr)	2.963E-05	0.000E+00	2.963E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R017	Inhalation rate (m³ /yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m³)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.625E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.625E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m^3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m^2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m^2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m^2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm³)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm³)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

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Contaminated Zone Dimensions	
Area:	12500.00 square meters
Thickness:	0.15 meters
Cover Depth:	2.00 meters

Initial Soil Concentrations, pCi/g	
Tc-99	8.100E+00
U-234	1.100E+01
U-235	4.860E-01
U-238	4.700E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 30 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	4.904E-14	4.740E-14	4.429E-14	6.658E-01	6.665E-01	1.789E-14	2.317E-15	1.095E-15	7.460E-07
M(t):	1.635E-15	1.580E-15	1.476E-15	2.219E-02	2.222E-02	5.962E-16	7.724E-17	3.651E-17	2.487E-08

0Maximum TDOSE(t): 6.801E-01 mrem/yr at t = 9.50 ± 0.02 years

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 9.497E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.494E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.048E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.552E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.555E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 9.497E+00 years

0

Water Dependent Pathways

0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Tc-99	5.853E-01	0.8606	8.066E-04	0.0012	0.000E+00	0.0000	7.534E-02	0.1108	8.399E-04	0.0012	1.782E-02	0.0262	6.801E-01	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.494E-17	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.048E-20	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.552E-14	0.0000
Total	5.853E-01	0.8606	8.066E-04	0.0012	0.000E+00	0.0000	7.534E-02	0.1108	8.399E-04	0.0012	1.782E-02	0.0262	6.801E-01	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.299E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.904E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.904E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.299E-20	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.904E-14	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.904E-14	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	3.236E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.265E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.740E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.740E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.236E-19	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.265E-20	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.740E-14	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.740E-14	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.805E-18	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.203E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.429E-14	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.429E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0
Water Dependent Pathways
0

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.805E-18	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.203E-20	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.429E-14	0.9999
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.429E-14	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.418E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.102E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.867E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.868E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	5.729E-01	0.8605	7.898E-04	0.0012	0.000E+00	0.0000	7.379E-02	0.1108	8.247E-04	0.0012	1.747E-02	0.0262	6.658E-01	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.418E-17	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.102E-20	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.867E-14	0.0000
Total	5.729E-01	0.8605	7.898E-04	0.0012	0.000E+00	0.0000	7.379E-02	0.1108	8.247E-04	0.0012	1.747E-02	0.0262	6.658E-01	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.740E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.038E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.492E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.495E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	5.736E-01	0.8605	7.907E-04	0.0012	0.000E+00	0.0000	7.388E-02	0.1108	8.258E-04	0.0012	1.749E-02	0.0262	6.665E-01	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.740E-17	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.038E-20	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.492E-14	0.0000
Total	5.736E-01	0.8605	7.907E-04	0.0012	0.000E+00	0.0000	7.388E-02	0.1108	8.258E-04	0.0012	1.749E-02	0.0262	6.665E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

0
Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.732E-16	0.0097	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	7.176E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.771E-14	0.9903	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.789E-14	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

0
Water Dependent Pathways

0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.732E-16	0.0097
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.176E-21	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.771E-14	0.9903
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.789E-14	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	6.707E-16	0.2895	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.415E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.646E-15	0.7105	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.317E-15	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0
Water Dependent Pathways
0

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.707E-16	0.2895
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.415E-21	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.646E-15	0.7105
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.317E-15	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.093E-15	0.9983	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	4.291E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.893E-18	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.095E-15	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.093E-15	0.9983
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.291E-24	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.893E-18	0.0017
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.095E-15	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.700E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	9.247E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.700E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.700E-15	0.0000
U-235	6.846E-07	0.9177	8.223E-09	0.0110	0.000E+00	0.0000	5.258E-08	0.0705	1.818E-10	0.0002	3.999E-10	0.0005	7.460E-07	1.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.247E-20	0.0000
Total	6.846E-07	0.9177	8.223E-09	0.0110	0.000E+00	0.0000	5.258E-08	0.0705	1.818E-10	0.0002	3.999E-10	0.0005	7.460E-07	1.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	2.800E-34	6.027E-38	2.803E-45	8.219E-02	8.229E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	1.883E-31	1.825E-31	1.714E-31	1.512E-31	1.376E-31	7.341E-32	8.145E-33	1.523E-35	4.204E-45
U-234	Th-230	1.000E+00	0.000E+00	5.629E-35	1.642E-34	3.625E-34	4.874E-34	1.166E-33	2.154E-33	4.017E-33	3.175E-32
U-234	Ra-226	1.000E+00	0.000E+00	2.941E-20	2.550E-19	1.289E-18	2.491E-18	1.574E-17	6.097E-17	9.939E-17	2.455E-16
U-234	Pb-210	1.000E+00	0.000E+00	2.545E-38	6.545E-37	7.549E-36	2.048E-35	3.478E-34	3.158E-33	8.257E-33	5.725E-32
U-234	=DSR(j)		1.883E-31	2.941E-20	2.550E-19	1.289E-18	2.491E-18	1.574E-17	6.097E-17	9.939E-17	2.455E-16
0U-235	U-235	1.000E+00	2.672E-20	2.585E-20	2.419E-20	2.118E-20	1.917E-20	9.870E-21	9.660E-22	1.262E-24	1.017E-34
U-235	Pa-231	1.000E+00	0.000E+00	1.529E-22	4.289E-22	8.750E-22	1.130E-21	1.733E-21	5.512E-22	2.009E-24	4.189E-34
U-235	Ac-227	1.000E+00	0.000E+00	1.798E-23	1.433E-22	6.142E-22	1.052E-21	3.163E-21	1.395E-21	5.559E-24	1.535E-06
U-235	=DSR(j)		2.672E-20	2.602E-20	2.476E-20	2.267E-20	2.136E-20	1.477E-20	2.912E-21	8.830E-24	1.535E-06
0U-238	U-238	1.000E+00	1.043E-14	1.008E-14	9.423E-15	8.227E-15	7.430E-15	3.769E-15	3.503E-16	3.949E-19	1.899E-29
U-238	U-234	1.000E+00	0.000E+00	5.172E-37	1.456E-36	2.991E-36	3.883E-36	6.160E-36	2.209E-36	1.136E-38	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	7.930E-41	6.855E-40	3.445E-39	6.627E-39	4.086E-38	1.539E-37	3.218E-37	2.545E-36
U-238	Ra-226	1.000E+00	0.000E+00	2.769E-26	7.147E-25	8.302E-24	2.264E-23	3.957E-22	3.728E-21	7.937E-21	1.968E-20
U-238	Pb-210	1.000E+00	0.000E+00	1.822E-44	1.384E-42	3.701E-41	1.427E-40	6.982E-39	1.734E-37	6.574E-37	4.589E-36
U-238	=DSR(j)		1.043E-14	1.008E-14	9.423E-15	8.227E-15	7.430E-15	3.769E-15	3.503E-16	4.028E-19	1.968E-20

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 30 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	*1.694E+10	*1.694E+10	*1.694E+10	3.650E+02	3.646E+02	*1.694E+10	*1.694E+10	*1.694E+10	*1.694E+10
U-234	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09	*6.245E+09
U-235	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06	*2.160E+06
U-238	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05	*3.360E+05

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 9.50 ± 0.02 years

0Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Tc-99	8.100E+00	9.50 ± 0.02	8.397E-02	3.573E+02	8.397E-02	3.573E+02
U-234	1.100E+01	1.000E+0?	2.455E-16	*6.245E+09	2.267E-18	*6.245E+09
U-235	4.860E-01	1.000E+0?	1.535E-06	*2.160E+06	2.154E-20	*2.160E+06
U-238	4.700E+00	0.000E+00	1.043E-14	*3.360E+05	7.858E-15	*3.360E+05

*At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	6.658E-01	6.665E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDOSE(j):		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	ΣDOSE(j):		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	U-234	1.000E+00	0.000E+00	3.236E-19	2.805E-18	1.418E-17	2.740E-17	1.732E-16	6.707E-16	1.093E-15	2.700E-15
Ra-226	U-238	1.000E+00	0.000E+00	1.301E-25	3.359E-24	3.902E-23	1.064E-22	1.860E-21	1.752E-20	3.731E-20	8.247E-20
Ra-226	ΣDOSE(j):		0.000E+00	3.236E-19	2.805E-18	1.418E-17	2.740E-17	1.732E-16	6.707E-16	1.093E-15	2.700E-15
Pb-210	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	ΣDOSE(j):		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	1.000E+00	1.299E-20	1.256E-20	1.176E-20	1.029E-20	9.318E-21	4.797E-21	4.695E-22	6.133E-25	0.000E+00
Pa-231	U-235	1.000E+00	0.000E+00	7.431E-23	2.084E-22	4.253E-22	5.493E-22	8.422E-22	2.679E-22	9.765E-25	0.000E+00
Ac-227	U-235	1.000E+00	0.000E+00	8.739E-24	6.963E-23	2.985E-22	5.112E-22	1.537E-21	6.780E-22	2.701E-24	7.460E-07
U-238	U-238	1.000E+00	4.904E-14	4.740E-14	4.429E-14	3.867E-14	3.492E-14	1.771E-14	1.646E-15	1.856E-18	8.827E-29

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	8.100E+00	1.738E-03	7.999E-11	1.695E-25	1.673E-36	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	1.100E+01	1.063E+01	9.918E+00	8.639E+00	7.789E+00	3.906E+00	3.488E-01	3.506E-04	1.129E-14
U-234	U-238	1.000E+00	0.000E+00	1.287E-05	3.599E-05	7.302E-05	9.393E-05	1.400E-04	4.040E-05	1.117E-07	9.027E-18
U-234	=S(j):		1.100E+01	1.063E+01	9.918E+00	8.639E+00	7.790E+00	3.906E+00	3.488E-01	3.507E-04	1.130E-14
0Th-230	U-234	1.000E+00	0.000E+00	9.733E-05	2.822E-04	6.157E-04	8.372E-04	1.849E-03	2.770E-03	2.839E-03	2.763E-03
Th-230	U-238	1.000E+00	0.000E+00	5.859E-11	5.034E-10	2.500E-09	4.766E-09	2.768E-08	8.458E-08	9.720E-08	9.464E-08
Th-230	=S(j):		0.000E+00	9.733E-05	2.822E-04	6.157E-04	8.372E-04	1.849E-03	2.770E-03	2.839E-03	2.764E-03
0Ra-226	U-234	1.000E+00	0.000E+00	2.102E-08	1.818E-07	9.142E-07	1.759E-06	1.083E-05	3.821E-05	4.775E-05	4.656E-05
Ra-226	U-238	1.000E+00	0.000E+00	8.456E-15	2.177E-13	2.515E-12	6.831E-12	1.163E-10	9.983E-10	1.629E-09	1.594E-09
Ra-226	=S(j):		0.000E+00	2.102E-08	1.818E-07	9.142E-07	1.759E-06	1.083E-05	3.821E-05	4.775E-05	4.656E-05
0Pb-210	U-234	1.000E+00	0.000E+00	2.163E-10	8.530E-09	6.307E-08	1.697E-07	2.725E-06	2.033E-05	3.037E-05	2.966E-05
Pb-210	U-238	1.000E+00	0.000E+00	6.538E-17	4.999E-15	1.321E-13	5.051E-13	2.337E-11	4.771E-10	1.033E-09	1.016E-09
Pb-210	=S(j):		0.000E+00	2.163E-10	8.530E-09	6.307E-08	1.697E-07	2.725E-06	2.033E-05	3.037E-05	2.966E-05
0U-235	U-235	1.000E+00	4.860E-01	4.691E-01	4.370E-01	3.793E-01	3.411E-01	1.680E-01	1.409E-02	1.183E-05	2.034E-16
0Pa-231	U-235	1.000E+00	0.000E+00	9.825E-06	2.774E-05	5.617E-05	7.216E-05	1.066E-04	2.977E-05	7.488E-08	4.258E-18
0Ac-227	U-235	1.000E+00	0.000E+00	1.536E-07	1.220E-06	5.189E-06	8.836E-06	2.559E-05	9.902E-06	2.714E-08	1.387E-18
0U-238	U-238	1.000E+00	4.700E+00	4.536E+00	4.226E+00	3.668E+00	3.298E+00	1.625E+00	1.362E-01	1.144E-04	1.967E-15

BRF(i) is the branch fraction of the parent nuclide.
D

A.2 Detailed Output File

RESRAD, Version 5.82 $T_{1/2}$ Limit = 0.5 year   01/11/99 12:01   Page 1

Detailed: Nickel Waste - 6000 tons   File: 6000TON.RAD

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Part II: Source Terms, Factors, and Parameters for Individual Pathways

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Part II: Source Terms, Factors, and Parameters for Individual Pathways

Iteration Log for Computation of the Time of Maximum Tc-99 Dose/Source Ratio
All Pathways Summed

@ Tolerance for tmax = 1.0E-03 (fractional accuracy)

@ Iteration Number	t (years)	DSR(t) (mrem/yr)/(pCi/g)	Step Size (years)	Step Type
0	8.85867E+00	8.28841E-02		
1	8.93561E+00	8.29796E-02	7.69458E-02	parabolic
2	9.34217E+00	8.36395E-02	4.06559E-01	golden section
3	9.59344E+00	8.22326E-02	2.51267E-01	golden section
4	9.18688E+00	8.33549E-02	-1.55292E-01	golden section
5	9.43815E+00	8.38368E-02	9.59756E-02	golden section
6	9.49747E+00	8.39672E-02	5.93161E-02	golden section
7	9.53412E+00	8.24771E-02	3.66595E-02	golden section
8	9.47481E+00	8.39166E-02	-2.26566E-02	golden section
9	9.51147E+00	8.24687E-02	1.40026E-02	golden section
10	9.48797E+00	8.39458E-02	-8.65398E-03	golden section
11	9.49747E+00	8.39672E-02	0.00000E+00	direct

Notes:

1) Step size always from t with current largest DSR(t) .
2) Parabolic step based on parabola maximum through the current best triplet.
3) Golden section step, 0.5*(3-SQRT(5)) of larger interval bracketing maximum, taken only if trial parabolic step fails.
4) Direct step to a previous t only on last iteration and only if prior iteration met convergence test but DSR(t) was smaller than the previous value.

Iteration Log for Computation of the Time of Maximum Total Dose
All Pathways Summed

0 Tolerance for tmax = 1.0E-03 (fractional accuracy)

0 Iteration Number	t (years)	TDOSE(t) (mrem/yr)	Step Size (years)	Step Type
0	8.85867E+00	6.71361E-01		
1	8.93561E+00	6.72135E-01	7.69459E-02	parabolic
2	9.34217E+00	6.77480E-01	4.06559E-01	golden section
3	9.59344E+00	6.66084E-01	2.51267E-01	golden section
4	9.18688E+00	6.75175E-01	-1.55292E-01	golden section
5	9.43815E+00	6.79078E-01	9.59756E-02	golden section
6	9.49747E+00	6.80134E-01	5.93161E-02	golden section
7	9.53412E+00	6.68064E-01	3.66595E-02	golden section
8	9.47481E+00	6.79725E-01	-2.26566E-02	golden section
9	9.51147E+00	6.67997E-01	1.40026E-02	golden section
10	9.48797E+00	6.79962E-01	-8.65399E-03	golden section
11	9.49747E+00	6.80134E-01	0.00000E+00	direct

Notes:

1) Step size always from t with current largest TDOSE(t).
2) Parabolic step based on parabola maximum through the current best triplet.
3) Golden section step, 0.5*(3-SQRT(5)) of larger interval bracketing maximum, taken only if trial parabolic step fails.
4) Direct step to a previous t only on last iteration and only if prior iteration met convergence test but TDOSE(t) was smaller than the previous value.

RESRAD, Version 5.82 $T_{1/2}$ Limit = 0.5 year   01/11/99 12:01   Page 5
Detailed: Nickel Waste - 6000 tons   File: 6000TON.RAD

Source Factors for Ingrowth and Decay
Radioactivity Factors Only
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			ID(j,t) = COMBRF(j)*S1(j,t)/S1(i,0)								
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01	9.997E-01	9.990E-01	9.968E-01
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01	9.997E-01	9.991E-01	9.972E-01
U-234	Th-230	1.000E+00	0.000E+00	9.002E-06	2.701E-05	6.301E-05	9.001E-05	2.700E-04	8.997E-04	2.696E-03	8.949E-03
U-234	Ra-226	1.000E+00	0.000E+00	1.950E-09	1.754E-08	9.545E-08	1.947E-07	1.747E-06	1.921E-05	1.679E-04	1.689E-03
U-234	Pb-210	1.000E+00	0.000E+00	2.004E-11	5.328E-10	6.563E-09	1.870E-08	4.373E-07	1.068E-05	1.363E-04	1.591E-03
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	2.116E-05	6.347E-05	1.481E-04	2.116E-04	6.345E-04	2.114E-03	6.327E-03	2.094E-02
U-235	Ac-227	1.000E+00	0.000E+00	3.332E-07	2.937E-06	1.534E-05	3.037E-05	2.258E-04	1.477E-03	5.667E-03	2.028E-02
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	0.000E+00	2.835E-06	8.505E-06	1.984E-05	2.835E-05	8.505E-05	2.835E-04	8.501E-04	2.831E-03
U-238	Th-230	1.000E+00	0.000E+00	1.276E-11	1.148E-10	6.252E-10	1.276E-09	1.148E-08	1.275E-07	1.147E-06	1.271E-05
U-238	Ra-226	1.000E+00	0.000E+00	1.652E-15	4.954E-14	6.314E-13	1.841E-12	4.958E-11	1.822E-09	4.813E-08	1.654E-06
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	1.033E-15	3.279E-14	1.346E-13	9.704E-12	8.486E-10	3.570E-08	1.509E-06

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: COMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).

Source Factors for Ingrowth and Decay
Combined Radioactivity and Leaching Factors
Parent and Progeny Principal Radionuclide Contributions Indicated

SF(j,t) = BRF(i)*S1(j,t)/S1(i,0)

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	2.145E-04	9.875E-12	2.092E-26	2.066E-37	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	1.000E+00	9.661E-01	9.016E-01	7.854E-01	7.081E-01	3.551E-01	3.170E-02	3.187E-05	1.026E-15
U-234	Th-230	1.000E+00	0.000E+00	8.848E-06	2.565E-05	5.597E-05	7.611E-05	1.681E-04	2.518E-04	2.581E-04	2.512E-04
U-234	Ra-226	1.000E+00	0.000E+00	1.911E-09	1.653E-08	8.311E-08	1.599E-07	9.842E-07	3.474E-06	4.341E-06	4.232E-06
U-234	Pb-210	1.000E+00	0.000E+00	1.966E-11	5.027E-10	5.734E-09	1.543E-08	2.477E-07	1.849E-06	2.761E-06	2.697E-06
@U-235	U-235	1.000E+00	1.000E+00	9.652E-01	8.992E-01	7.805E-01	7.018E-01	3.457E-01	2.898E-02	2.435E-05	4.184E-16
U-235	Pa-231	1.000E+00	0.000E+00	2.042E-05	5.708E-05	1.156E-04	1.485E-04	2.193E-04	6.126E-05	1.541E-07	8.760E-18
U-235	Ac-227	1.000E+00	0.000E+00	3.161E-07	2.509E+06	1.068E-05	1.818E-05	5.266E-05	2.038E-05	5.583E-08	3.266E-18
@U-238	U-238	1.000E+00	1.000E+00	9.652E-01	8.892E-01	7.805E-01	7.018E-01	3.457E-01	2.898E-02	2.435E-05	4.184E-16
U-238	U-234	1.000E+00	0.000E+00	2.738E-06	7.658E-06	1.554E-05	1.999E-05	2.980E-05	8.597E-06	2.376E-08	1.921E-18
U-238	Th-230	1.000E+00	0.000E+00	1.247E-11	1.071E-10	5.320E-10	1.014E-09	5.889E-09	1.800E-08	2.068E-08	2.014E-08
U-238	Ra-226	1.000E+00	0.000E+00	1.799E-15	4.631E-14	5.351E-13	1.454E-12	2.474E-11	2.124E-10	3.467E-10	3.392E-10
U-238	Pb-210	1.000E+00	0.000E+00	1.391E-17	1.064E-15	2.811E-14	1.075E-13	4.973E-12	1.015E-10	2.198E-10	2.161E-10

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The effect of volatilization was also considered when computing the source factors for H-3 and C-14.

Parameters Used for Calculating Cover Depth and Contaminated Zone Thicknesses

0 Cover Erosion rate (vcv): 0.000100 m/yr
Contaminated Zone Erosion rate (vcz): 0.000100 m/yr
Water Table Drop rate (vwt): 0.001000 m/yr
Precipitation rate (Pr): 1.000000 m/yr
Cover Removal Time (Tc): 2.000E+04 yr
Overhead irrigation rate (Irr): 0.200 m/yr Runoff coefficient (Cr): 0.200
Evapotranspiration coeff. (Ce): 0.500 Infiltration rate (In): 0.500 m/yr
Bulk soil density (rhob): 1.500 g/cm**3 Effective porosity (pe): 0.200

0Radio-nuclide (i)	Distribution Coefficient Kd(i),cm**3/g	Leaching Ratio q(i)
Ac-227	2.505006E+01	8.468E-03
Pa-231	6.254296E+01	3.409E-03
Pb-210	1.250522E+02	1.708E-03
Ra-226	8.755154E+01	2.438E-03
Tc-99	4.813198E-02	8.132E-01
Th-230	7.499884E+04	2.853E-06
U-234	6.417962E+01	3.322E-03
U-235	6.254296E+01	3.409E-03
U-238	6.254296E+01	3.409E-03

0

Time Dependence of Source Geometry

Time Dependence of Cover Depth [Cd(i,t)]

Nuclide (i)	Cd(i,t) (meters) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00
Pa-231	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00
Pb-210	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00
Ra-226	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00
Tc-99	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00
Th-230	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00
U-234	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00
U-235	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00
U-238	2.0000E+00	1.9999E+00	1.9997E+00	1.9993E+00	1.9990E+00	1.9970E+00	1.9900E+00	1.9700E+00	1.9000E+00

Time Dependence of Contaminated Zone Thicknesses [T(i,t)]

Nuclide (i)	T(i,t) (meters) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01
Pa-231	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01
Pb-210	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01
Ra-226	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01
Tc-99	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01
Th-230	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01
U-234	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01
U-235	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01
U-238	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01	1.5000E-01

Occupancy, Cover/Depth, and Area Factors for Ground Pathway

Occupancy Factor (FO1): 0.600
Area (A): 12500. sq. meters
Initial cover depth (Cd): 2.000 meters
Initial contaminated zone thickness (T): 0.150 meters

Time Dependence of Cover/Depth Factor [FCTR_COV_DEPTH(i,t)]

Nuclide (i)	FCTR_COV_DEPTH(i,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	4.708E-17	4.717E-17	4.734E-17	4.770E-17	4.797E-17	4.980E-17	5.677E-17	8.255E-17	3.061E-16
Pa-231	6.521E-17	6.533E-17	6.557E-17	6.606E-17	6.643E-17	6.894E-17	7.851E-17	1.138E-16	4.172E-16
Pb-210	3.516E-25	3.526E-25	3.545E-25	3.585E-25	3.616E-25	3.824E-25	4.652E-25	8.144E-25	5.782E-24
Ra-226	2.287E-12	2.290E-12	2.296E-12	2.309E-12	2.318E-12	2.380E-12	2.612E-12	3.407E-12	8.631E-12
Tc-99	3.704E-30	3.716E-30	3.741E-30	3.792E-30	3.831E-30	4.098E-30	5.191E-30	1.020E-29	1.083E-28
Th-230	8.736E-27	8.762E-27	8.815E-27	8.921E-27	9.001E-27	9.556E-27	1.178E-26	2.144E-26	1.741E-25
U-234	7.809E-28	7.833E-28	7.882E-28	7.980E-28	8.055E-28	8.571E-28	1.065E-27	1.981E-27	1.740E-26
U-235	5.884E-20	5.897E-20	5.923E-20	5.975E-20	6.015E-20	6.287E-20	7.337E-20	1.141E-19	5.353E-19
U-238	1.269E-13	1.271E-13	1.275E-13	1.282E-13	1.288E-13	1.326E-13	1.470E-13	1.873E-13	5.522E-13

0

Time Dependence of Area Factor [FCTR_AREA(i,t)]

Nuclide (i)	FCTR_AREA(i,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

Dose Conversion and Environmental Transport Factors for the Ground Pathway (p=1)

0Parent (i)	Product (j)	DCF(j,1)*	ETF(j,1,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.260E-04	2.222E-30	2.230E-30	2.245E-30	2.275E-30	2.298E-30	2.459E-30	3.115E-30	6.118E-30	6.501E-29
0U-234	U-234	4.020E-04	4.685E-28	4.700E-28	4.729E-28	4.788E-28	4.833E-28	5.142E-28	6.390E-28	1.189E-27	1.044E-26
U-234	Th-230	1.210E-03	5.242E-27	5.257E-27	5.289E-27	5.353E-27	5.401E-27	5.734E-27	7.070E-27	1.286E-26	1.044E-25
U-234	Ra-226	1.120E+01	1.372E-12	1.374E-12	1.378E-12	1.385E-12	1.391E-12	1.428E-12	1.567E-12	2.044E-12	5.179E-12
U-234	Pb-210	6.120E-03	2.109E-25	2.115E-25	2.127E-25	2.151E-25	2.169E-25	2.294E-25	2.791E-25	4.886E-25	3.469E-24
0U-235	U-235	7.570E-01	3.530E-20	3.538E-20	3.554E-20	3.585E-20	3.609E-20	3.772E-20	4.402E-20	6.847E-20	3.212E-19
U-235	Pa-231	1.910E-01	3.912E-17	3.920E-17	3.934E-17	3.964E-17	3.986E-17	4.137E-17	4.710E-17	6.828E-17	2.503E-16
U-235	Ac-227	2.010E+00	2.825E-17	2.830E-17	2.841E-17	2.862E-17	2.878E-17	2.988E-17	3.406E-17	4.953E-17	1.836E-16
0U-238	U-238	1.370E-01	7.615E-14	7.627E-14	7.649E-14	7.694E-14	7.728E-14	7.959E-14	8.822E-14	1.184E-13	3.313E-13
U-238	U-234	4.020E-04	4.685E-28	4.700E-28	4.729E-28	4.788E-28	4.833E-28	5.142E-28	6.390E-28	1.189E-27	1.044E-26
U-238	Th-230	1.210E-03	5.242E-27	5.257E-27	5.289E-27	5.353E-27	5.401E-27	5.734E-27	7.070E-27	1.286E-26	1.044E-25
U-238	Ra-226	1.120E+01	1.372E-12	1.374E-12	1.378E-12	1.385E-12	1.391E-12	1.428E-12	1.567E-12	2.044E-12	5.179E-12
U-238	Pb-210	6.120E-03	2.109E-25	2.115E-25	2.127E-25	2.151E-25	2.169E-25	2.294E-25	2.791E-25	4.886E-25	3.469E-24

* - The dose conversion factor units are (mrem/yr)/(pCi/g) at infinite depth and area.

0

Dose/Source Ratios for External Radiation from the Ground (p=1)
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	DSR(j,1,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	2.800E-34	6.027E-38	2.803E-45	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	1.883E-31	1.825E-31	1.714E-31	1.512E-31	1.376E-31	7.341E-32	8.145E-33	1.523E-35	4.204E-45
U-234	Th-230	1.000E+00	0.000E+00	5.629E-35	1.642E-34	3.625E-34	4.974E-34	1.166E-33	2.154E-33	4.017E-33	3.175E-32
U-234	Ra-226	1.000E+00	0.000E+00	2.941E-20	2.550E-19	1.289E-18	2.491E-18	1.574E-17	6.097E-17	9.939E-17	2.455E-16
U-234	Pb-210	1.000E+00	0.000E+00	2.545E-38	6.545E-37	7.549E-36	2.048E-35	3.478E-34	3.158E-33	8.257E-33	5.725E-32
U-234	∑DSR(j)		1.883E-31	2.941E-20	2.550E-19	1.289E-18	2.491E-18	1.574E-17	6.097E-17	9.939E-17	2.455E-16
0U-235	U-235	1.000E+00	2.672E-20	2.585E-20	2.419E-20	2.118E-20	1.917E-20	9.870E-21	9.660E-22	1.262E-24	1.017E-34
U-235	Pa-231	1.000E+00	0.000E+00	1.529E-22	4.289E-22	8.750E-22	1.130E-21	1.733E-21	5.512E-22	2.009E-24	4.189E-34
U-235	Ac-227	1.000E+00	0.000E+00	1.798E-23	1.433E-22	6.142E-22	1.052E-21	3.163E-21	1.395E-21	5.559E-24	1.206E-33
U-235	∑DSR(j)		2.672E-20	2.602E-20	2.476E-20	2.267E-20	2.136E-20	1.477E-20	2.912E-21	8.830E-24	1.726E-33
0U-238	U-238	1.000E+00	1.043E-14	1.008E-14	9.423E-15	8.227E-15	7.430E-15	3.769E-15	3.503E-16	3.949E-19	1.899E-29
U-238	U-234	1.000E+00	0.000E+00	5.172E-37	1.456E-36	2.991E-36	3.883E-36	6.160E-36	2.209E-36	1.136E-38	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	7.930E-41	6.855E-40	3.445E-39	6.627E-39	4.086E-38	1.539E-37	3.218E-37	2.545E-36
U-238	Ra-226	1.000E+00	0.000E+00	2.769E-26	7.147E-25	8.302E-24	2.264E-23	3.957E-22	3.728E-21	7.937E-21	1.968E-20
U-238	Pb-210	1.000E+00	0.000E+00	1.822E-44	1.384E-42	3.701E-41	1.427E-40	6.982E-39	1.734E-37	6.574E-37	4.589E-36
U-238	∑DSR(j)		1.043E-14	1.008E-14	9.423E-15	8.227E-15	7.430E-15	3.769E-15	3.503E-16	4.028E-19	1.968E-20

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Inhalation Pathway, Excluding Radon (p=2)
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	DSR(j,2,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.
0

Pathway Factors for the Inhalation Pathway (radon excluded)

Area (A):	1.2500E+04 m**2	Occupancy Factor (FO2):	4.5000E-01
Area Factor (FA2):	1.7321E-01	Annual Air Intake (FI2):	8.4000E+03 m**3/yr
Cover Depth [Cd(0)]:	2.0000E+00 m	Mass Loading (ASR2):	1.0000E-04 g/m**3
Contaminated Zone Thickness [T(0)]:	1.5000E-01 m	FA2 * FO2 * FI2 * ASR2:	6.5473E-02 g/yr

Nuclide (i)	Depth Factor [FD(i,2,t)] (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-235 +D	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238 +D	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Dose Conversion and Environmental Transport Factors for the Inhalation Pathway, Excluding Radon (p=2)

Parent (i)	Product (j)	DCF(j,2)*	ETF(j,2,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	8.330E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.320E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	3.260E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	8.600E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	2.320E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	1.230E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.280E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	6.720E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-238	1.180E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.320E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	3.260E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	8.600E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	2.320E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Parameters Used for Calculating Indoor and Outdoor Radon Flux

0

	*Floor Material	Cover Material	Contaminated Zone
Radon Diffusion Coefficient (m**2/s)	3.000E-07	2.000E-06	2.000E-06
Total Porosity	1.000E-01	4.000E-01	4.000E-01
Volumetric Water Content	3.000E-02	5.000E-02	3.209E-01
Bulk Density (g/cm**3)	2.400E+00	1.600E+00	1.500E+00
Rn-222 Emanation Coefficient	2.500E-01	2.500E-01	2.500E-01
Initial Thickness (m)	1.500E-01	2.000E+00	1.500E-01

Building Depth Below Ground Surface *(DMFL): -1.000E+00 (m)
Negative DMFL shows building depth adjusted (if necessary) for no penetration
of contaminated zone. Actual values used *(DMFLACT), m:

t=	0.0000E+00	1.0000E+00	3.0000E+00	7.0000E+00	1.0000E+01	3.0000E+01	1.0000E+02	3.0000E+02	1.0000E+03
DMFLACT=	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

Building indoor area factor *(FAI): 0.000E+00
FAI <= 0.0 shows calculated time-dependent value based on amount of wall area
extending into the contaminated zone. Actual values used *(FAIACT):

t=	0.0000E+00	1.0000E+00	3.0000E+00	7.0000E+00	1.0000E+01	3.0000E+01	1.0000E+02	3.0000E+02	1.0000E+03
FAIACT =	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0* - Parameters are used only for indoor radon flux

0

Time Dependence of Outdoor Radon Flux [FLUXO(i,t)]

FLUXO(i,t) (pCi/m**2/s)

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0

Time Dependence of Indoor Radon Flux [FLUXI(i,t)]

FLUXI(i,t) (pCi/m**2/s)

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Parameters Used for Calculating Indoor and Outdoor Radon Concentration

Radon Vertical Dimension of Mixing (HMIX): 2.000E+00 (m)
Average Annual Wind Speed (WIND): 2.000E+00 (m/sec)
Building Room Height (HRM): 2.500E+00 (m)
Building Air Exchange Rate (REXG): 5.000E-01 (1/hr)

0
Time Dependence of Outdoor Radon Concentration [CRNO(i,t)]

0Nuclide (i)	CRNO(i,t) (pCi/m**3) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
Time Dependence of Indoor Radon Concentration [RNCONC(i,t)]

0Nuclide (i)	RNCONC(i,t) (pCi/m**3) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Outdoor Working Levels of Radon [WLOTD(i,t)]

WLOTD(i,t) (WL)

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0

Indoor Working Levels of Radon [WLIND(i,t)]

WLIND(i,t) (WL)

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0

0 Fraction of Time Spent Outdoors (FOTD): 2.500E-01
Fraction of Time Spent Indoors (FIND): 5.000E-01

Dose/Source Ratios for Radon Pathway (p=9)
Subpathway: Outdoor and Indoor Radon Flux
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,9,t) - DSRFGW(j,t) (mrem/yr)/(pCi/g)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	~DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	~DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	~DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Radon Pathway (p=9)
Subpathway: Indoor Radon from Water Usage
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	DSRJOW(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Transport Time Parameters for Unsaturated Zone Stratum No. 1

Stratum thickness [h(1)]:	15.000000 m
Bulk soil material density [rhob(1)]:	1.500000 g/cm**3
Effective porosity [peur(1)]:	0.200000
Hydraulic conductivity [Khur(1)]:	10.000000 m/yr
Total porosity [ptur(1)]:	0.400000
Soil specific b parameter [bur(1)]:	5.300000
Saturation ratio [srur(1)]:	0.802299

Radio-nuclide (i)	Distribution Coefficient Kdur(i,1), cm**3/g	Retardation Factor Rdur(i,1)	Transport Time Dtur(i,1), yr
Ac-227	2.5050E+01	1.1809E+02	5.6844E+02
Pa-231	6.2543E+01	2.9333E+02	1.4120E+03
Pb-210	1.2505E+02	5.8550E+02	2.8185E+03
Ra-226	8.7552E+01	4.1022E+02	1.9747E+03
Tc-99	4.9132E-02	1.2296E+00	5.9193E+00
Th-230	7.4999E+04	3.5055E+05	1.6875E+06
U-234	6.4180E+01	3.0098E+02	1.4489E+03
U-235	6.2543E+01	2.9333E+02	1.4120E+03
U-238	6.2543E+01	2.9333E+02	1.4120E+03

0

Transport Time Parameters for Unsaturated Zone created by the Falling Water Table

Water table drop rate [vwt]:	0.001000 m/yr
Bulk soil material density [rhobaq]:	1.500000 g/cm**3
Effective porosity [peaq]:	0.200000
Hydraulic conductivity [Khaq]:	100.000000 m/yr
Total porosity [ptaq]:	0.400000
Soil specific b parameter [baq]:	5.300000
Saturation ratio [sruaq]:	0.677340

Radio-nuclide (i)	Distribution Coefficient Kdaq(i), cm**3/g	Retardation Factor Rduaq(i)	Minimum Transport Time Dtuaq(i), yr
Ac-227	2.5050E+01	1.3969E+02	2.2359E+01
Pa-231	6.2543E+01	3.4726E+02	1.4665E+02
Pb-210	1.2505E+02	6.9333E+02	6.5191E+02
Ra-226	8.7552E+01	4.8572E+02	2.9925E+02
Tc-99	4.9132E-02	1.2720E+00	2.0407E-03
Th-230	7.4999E+04	4.1522E+05	Infinite
U-234	6.4180E+01	3.5632E+02	1.5482E+02
U-235	6.2543E+01	3.4726E+02	1.4665E+02
U-238	6.2543E+01	3.4726E+02	1.4665E+02

Dilution Factor and Rise Time Parameters for Nondispersion (ND) Model

0

Aquifer contamination depth at well (z): 3.15500E+01 m
Depth of water intake below water table (dw): 1.00000E+01 m
Infiltration rate (In): 5.00000E-01 m/yr
Aquifer water flow rate (Vwfr): 2.00000E+00 m/yr
Hydraulic gradient (J): 2.00000E-02
Hydraulic conductivity of aquifer (Kszh): 1.00000E+02 m/yr
Contaminated zone extent parallel to gradient (l): 1.26200E+02 m
Distance below contaminated zone to water table (h): 0.15000E+02 m
Initial thickness of uncontaminated cover (Cd): 0.20000E+01 m
Initial thickness of contaminated zone (T): 0.15000E+00 m
Effective porosity of saturated zone (pesz): 0.20000E+00

0 Radio-nuclide (i)	Dilution Factor f(i)	Retardation Factor Rdsz(i)	Horizontal Transport Time Onsite Tauh(i), yr	Rise Time dt(i), yr	Decay Time Parameter 1/lamda(i),yr
Ac-227	1.000E+00	9.494E+01	1.198E+03	3.798E+02	3.141E+01
Pa-231	1.000E+00	2.355E+02	2.972E+03	9.421E+02	4.726E+04
Pb-210	1.000E+00	4.699E+02	5.931E+03	1.880E+03	3.217E+01
Ra-226	1.000E+00	3.293E+02	4.156E+03	1.317E+03	2.308E+03
Tc-99	1.000E+00	1.184E+00	1.495E+01	4.737E+00	3.073E+05
Th-230	1.000E+00	2.812E+05	3.549E+06	1.125E+06	1.111E+05
U-234	1.000E+00	2.417E+02	3.050E+03	9.667E+02	3.527E+05
U-235	1.000E+00	2.355E+02	2.972E+03	9.421E+02	1.015E+09
U-238	1.000E+00	2.355E+02	2.972E+03	9.421E+02	6.446E+09

0

Primary Parameters Used for Calculating Water/Soil
Concentration Ratios for Groundwater Pathway Segment

0 Model used: Nondispersion (ND)

Bulk soil density in contaminated zone (rhob): 1.500 g/cm**3

0 Radio-nuclide (i)	Dilution Factor f(i)	Retardation Factor Rdcz(i)	Breakthrough Time Chain year	Breakthrough Time Single Nuclide Dt(i), yr	Rise Time dt(i), yr
Ac-227	1.000E+00	1.181E+02	5.908E+02	5.908E+02	3.798E+02
Pa-231	1.000E+00	2.933E+02	1.559E+03	1.559E+03	9.421E+02
Pb-210	1.000E+00	5.855E+02	1.559E+03	3.470E+03	1.880E+03
Ra-226	1.000E+00	4.102E+02	1.559E+03	2.274E+03	1.317E+03
Tc-99	1.000E+00	1.230E+00	5.921E+00	5.921E+00	4.737E+00
Th-230	1.000E+00	3.506E+05	1.559E+03	Infinite	1.125E+06
U-234	1.000E+00	3.010E+02	1.559E+03	1.604E+03	9.667E+02
U-235	1.000E+00	2.933E+02	1.559E+03	1.559E+03	9.421E+02
U-238	1.000E+00	2.933E+02	1.559E+03	1.559E+03	9.421E+02

Water/Soil Concentration Ratios [WSR(j,1,t)] for Groundwater Pathway Segment

0Parent (i)	Product (j)	Branch Fraction*	WSR(j,1,t) in (pCi/L)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	9.499E+01	9.510E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.857E-07
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

0

Water/Soil Concentration Ratios [WSR(j,2,t)] for Surface Water Pathway Segment

0

Watershed Area (As) = 1.0000E+06 m**2
Contaminated Zone Area (A) = 1.2500E+04 m**2
Dilution Factor (f') = 1.2500E-02
Soil Density (rhob) = 1.5000E+00 kg/m**3

0Parent (i)	Product (j)	Branch Fraction*	WSR(j,2,t) in (pCi/L)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.187E+00	1.189E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.333E-09
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Storage Times For Contaminated Foodstuffs

k	Food Item	STOR_T(k), days
1	non-leafy plants	14
2	leafy plants	1
3	milk	1
4	meat	20
5	fish	7
6	crustacea	7
7	well water	1
8	surface water	1
9	livestock fodder	45

0

Storage Time Ingrowth and Decay Factors

Storage Time for k'th Foodstuff: t = STOR_T(k), days

STOR_TD(i,j,t) = CONCZ(i,j,t)/CONCZ(i,i,0)

Parent (i)	Product (j)	Branch Fraction	t= 1.400E+01	1.000E+00	1.000E+00	2.000E+01	7.000E+00	7.000E+00	1.000E+00	1.000E+00	4.500E+01
Ac-227	Ac-227	1.000E+00	9.988E-01	9.999E-01	9.999E-01	9.983E-01	9.994E-01	9.994E-01	9.999E-01	9.999E-01	9.961E-01
Pa-231	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Pa-231	Ac-227	1.000E+00	1.219E-03	8.716E-05	8.716E-05	1.742E-03	6.099E-04	6.099E-04	8.716E-05	8.716E-05	3.915E-03
Pb-210	Pb-210	1.000E+00	9.988E-01	9.999E-01	9.999E-01	9.983E-01	9.994E-01	9.994E-01	9.999E-01	9.999E-01	9.962E-01
Ra-226	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
Ra-226	Pb-210	1.000E+00	1.191E-03	8.510E-05	8.510E-05	1.701E-03	5.955E-04	5.955E-04	8.510E-05	8.510E-05	3.822E-03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Th-230	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
Th-230	Ra-226	1.000E+00	1.661E-05	1.186E-06	1.186E-06	2.372E-05	8.303E-06	8.303E-06	1.186E-06	1.186E-06	5.337E-05
Th-230	Pb-210	1.000E+00	9.888E-09	5.047E-11	5.047E-11	2.018E-08	2.472E-09	2.472E-09	5.047E-11	5.047E-11	1.021E-07
U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	3.450E-07	2.465E-08	2.465E-08	4.929E-07	1.725E-07	1.725E-07	2.465E-08	2.465E-08	1.109E-06
U-234	Ra-226	1.000E+00	2.865E-12	1.444E-14	1.444E-14	5.846E-12	7.160E-13	7.160E-13	1.444E-14	1.444E-14	2.960E-11
U-234	Pb-210	1.000E+00	1.064E-15	2.613E-17	2.613E-17	3.205E-15	2.317E-17	2.317E-17	2.613E-17	2.613E-17	3.761E-14
U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	8.110E-07	5.793E-08	5.793E-08	1.159E-06	4.055E-07	4.055E-07	5.793E-08	5.793E-08	2.607E-06
U-235	Ac-227	1.000E+00	4.946E-10	2.524E-12	2.524E-12	1.009E-09	1.237E-10	1.237E-10	2.524E-12	2.524E-12	5.105E-09
U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.087E-07	7.762E-09	7.762E-09	1.552E-07	5.433E-08	5.433E-08	7.762E-09	7.762E-09	3.493E-07
U-238	Th-230	1.000E+00	1.876E-14	1.746E-16	1.746E-16	3.828E-14	4.731E-15	4.731E-15	1.746E-16	1.746E-16	1.936E-13
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

CONCZ(i,j,t)/CONCZ(i,i,0) is the concentration ratio of Product(j) at time t to Parent(i) at start of storage time.

Storage Time Correction Factors
Drinking Water from Well and/or Surface
Harvest Time = t - 2.74E-03 yr; Consumption Time = t yr

Parent (i)	Product (j)	Branch Fraction*	CFWW(j,t,1)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Irrigation Water for Nonleafy Plants from Well and/or Surface
Harvest Time = t - 4.11E-02 yr; Consumption Time = t - 3.83E-02 yr

Parent (i)	Product (j)	Branch Fraction*	CFWW(j,t,2)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

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Storage Time Correction Factors
Irrigation Water for Leafy Plants from Well and/or Surface
Harvest Time = t - 5.48E-03 yr; Consumption Time = t - 2.74E-03 yr

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			CFWW(j,t,3)@								
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
@Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Irrigation Water for Livestock (Milk) Fodder from Well and/or Surface
Harvest Time = t - 1.29E-01 yr; Consumption Time = t - 1.26E-01 yr

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			CFWW(j,t,5)@								
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
@Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Irrigation Water for Livestock (Meat) Fodder from Well and/or Surface
Harvest Time = t - 1.81E-01 yr; Consumption Time = t - 1.78E-01 yr

0Parent (i)	Product (j)	Branch Fraction*	CFWW(j,t,7)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
0U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
0U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
0U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Livestock (Milk) Water from Well and/or Surface
Harvest Time = t - 5.48E-03 yr; Consumption Time = t - 2.74E-03 yr

0Parent (i)	Product (j)	Branch Fraction*	CFWW(j,t,4)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
0U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
0U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
0U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors
Livestock (Meat) Water from Well and/or Surface
Harvest Time = t - 5.75E-02 yr; Consumption Time = t - 5.48E-02 yr

@Parent (i)	Product (j)	Branch Fraction*	CFWW(j,t,6)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Nonleafy Plants
Harvest Time = t - 3.83E-02 yr; Consumption Time = t yr

@Parent (i)	Product (j)	Branch Fraction*	CF3(j,1,t)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.300E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.988E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Leafy Plants
Harvest Time = t - 2.74E-03 yr; Consumption Time = t yr

@Parent (i)	Product (j)	Branch Fraction*	CF3(j,2,t)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Livestock (Meat) Fodder
Harvest Time = t - 1.78E-01 yr; Consumption Time = t - 5.48E-02 yr

@Parent (i)	Product (j)	Branch Fraction*	CFLF(j,1,t)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.961E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Livestock (Milk) Fodder
Harvest Time = t - 1.26E-01 yr; Consumption Time = t - 2.74E-03 yr

@Parent (i)	Product (j)	Branch Fraction*	CTLF(j,2,t)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.961E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Meat
Harvest Time = t - 5.48E-02 yr; Consumption Time = t yr

@Parent (i)	Product (j)	Branch Fraction*	CT45(j,1,t)# t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.983E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
#Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Milk
Harvest Time = t - 2.74E-03 yr; Consumption Time = t yr

@Parent (i)	Product (j)	Branch Fraction*	CF45(j,2,t)@ t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.999E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
@Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Storage Time Correction Factors for Fish & Crustacea
Harvest Time = t - 1.92E-02 yr; Consumption Time = t yr

@Parent (i)	Product (j)	Branch Fraction*	CFF(j,1,t)@ t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-234	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
@U-235	U-235	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Pa-231	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-235	Ac-227	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	9.994E-01
@U-238	U-238	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	U-234	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Th-230	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Ra-226	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-238	Pb-210	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
@Correction factor = (concentration in media at consumption time)/(concentration at harvest time).

Area and Depth Factors for Plant (p=3), Meat (p=4), and Milk (p=5) Pathways
Root Uptake from Contaminated Soil (q=1)

Area Factor for Plant Foods [FA(3)] = 0.50

Nuclide (i)	Depth Factor FD(i,1,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Pa-231	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Pb-210	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Ra-226	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Tc-99	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Th-230	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-235	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0

Area and Depth Factors for Plant (p=3), Meat (p=4), and Milk (p=5) Pathways
Foliar Uptake from Contaminated Dust (q=2)

Area Factor for Plant Foods [FA(3)] = 0.50

Nuclide (i)	Depth Factor FD(i,2,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Pa-231	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Pb-210	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Ra-226	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Tc-99	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
Th-230	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-234	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-235	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
U-238	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Area and Depth Factors for Plant (p=3), Meat (p=4), and Milk (p=5) Pathways
Ditch Irrigation (q=3)

Area Factor for Plant Foods [FA(3)] = 0.50

Nuclide (i)	Depth Factor FD(i,3,t) (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ac-227	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
Pa-231	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
Pb-210	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
Ra-226	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
Tc-99	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
Th-230	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
U-234	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
U-235	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
U-238	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

0

Area and Depth Factors for Plant (p=3), Meat (p=4), and Milk (p=5) Pathways
Overhead Irrigation (q=4)

Area Factor for Plant Foods [FA(3)] = 0.50

The Depth Factor Value
FD(i,p,q,t) = 1.0000E+00
is applicable for all radionuclides(i) and times(t).

0

Area and Depth Factors for Meat (p=4) and Milk (p=5) Pathways
Transfer from Livestock Water (q=5) and Soil (q=6) Intake

Area Factor for Meat and Milk [FA(p),p=4,5] = 0.63

The livestock water subpathway (q=5) and livestock soil intake subpathway (q=6)
occur only for the meat (p=4) and milk (p=5) pathways.

Area and Depth Factors for Meat (p=4) and Milk (p=5) Pathways
Transfer from Livestock Water (q=5) and Soil (q=6) Intake

Area Factor for Meat and Milk [FA(p),p=4,5] = 0.63

The livestock water subpathway (q=5) and livestock soil intake subpathway (q=6) occur only for the meat (p=4) and milk (p=5) pathways.

Dose Conversion and Environmental Transport Factors for the Plant Food Pathway (p=3)
Subpathway: Root Uptake from Contaminated Soil (q=1)

0Parent (i)	Product (j)	DCF(j,3)*	ETF(j,3,1,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

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Dose Conversion and Environmental Transport Factors for the Plant Food Pathway (p=3)
Subpathway: Foliar Uptake from Contaminated Dust (q=2)

0Parent (i)	Product (j)	DCF(j,3)*	ETF(j,3,2,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Plant Food Pathway (p=3)
Subpathway: Ditch Irrigation (q=3)

0Parent (i)	Product (j)	DCF(j,3)*	ETF(j,3,3,t) * SF(j,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	2.516E+03	2.519E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.728E-09
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

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Dose Conversion and Environmental Transport Factors for the Plant Food Pathway (p=3)
Subpathway: Overhead Irrigation (q=4)

0Parent (i)	Product (j)	DCF(j,3)*	ETF(j,3,4,t) * SF(j,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	3.724E+03	3.728E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.306E-06
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Fodder Root Uptake from Contaminated Soil (q=1)

0Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,1,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

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Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Fodder Foliar Uptake from Contaminated Dust (q=2)

0Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,2,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Ditch Irrigation (q=3)

Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,3,t) * SF(j,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	4.828E+00	4.835E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.315E-12
U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

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Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Overhead Irrigation (q=4)

Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,4,t) * SF(j,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	4.611E+01	4.617E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.795E-08
U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Meat Pathway (p=4)
Subpathway: Livestock Water (q=5)

0Parent (i)	Product (j)	DCF(j,4)*	ETF(j,4,5,t) * SF(j,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	1.870E+01	1.872E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.326E-09
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Fodder Root Uptake from Contaminated Soil (q=1)

0Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,1,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

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Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Fodder Foliar Uptake from Contaminated Dust (q=2)

0Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,2,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Ditch Irrigation (q=3)

0Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,3,t) * SF(j,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	5.822E+01	5.829E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.557E-12
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

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Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Overhead Irrigation (q=4)

0Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,4,t) * SF(j,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	5.448E+02	5.454E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.126E-08
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Milk Pathway (p=5)
Subpathway: Livestock Water (q=5)

Parent (i)	Product (j)	DCF(j,5)*	ETF(j,5,5,t) * SF(j,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	8.729E+02	8.749E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.434E-08
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose Conversion and Environmental Transport Factors for the Fish Pathway (p=6)

Parent (i)	Product (j)	DCF(j,6)*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			ETF(j,6,t) * SF(j,t) (g/yr)								
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	6.679E+01	6.686E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.143E-06
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

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Dose Conversion and Environmental Transport Factors for the Drinking Water Pathway (p=7)

Parent (i)	Product (j)	DCF(j,7)*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			ETF(j,7,t) * SF(j,t) (g/yr)								
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	4.844E+04	4.850E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.518E-05
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.

Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Subpathway: Root Uptake from Contaminated Soil (q=1)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,3,1,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Subpathway: Foliar Uptake from Contaminated Dust (q=2)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,3,2,t) (mrem/yr)/(pCi/g)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ØU-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ØU-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ØU-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Subpathway: Ditch Irrigation (q=3)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,3,3,t) (mrem/yr)/(pCi/g)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	3.673E-03	3.677E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.896E-11
U-235	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.896E-11
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	∑DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

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Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Subpathway: Overhead Irrigation (q=4)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	DSR(j,3,4,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	5.437E-03	5.443E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	˜DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.081E-07
U-235	˜DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.081E-07
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	˜DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

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Dose/Source Ratios for Internal Radiation from Ingestion of Plant Foods (p=3)
Total for All Subpathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	DSR(j,3,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	9.110E-03	9.121E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.082E-07
U-235	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.082E-07
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Fodder Root Uptake from Contaminated Soil (q=1)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,4,1,t) (mrem/yr)/(pCi/g)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	‾DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	‾DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	‾DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Fodder Foliar Uptake from Contaminated Dust (q=2)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	DSR(j,4,2,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Ditch Irrigation (q=3)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,4,3,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	7.195E-06	7.205E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
©U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	‡DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
©U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.946E-14
U-235	‡DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.946E-14
©U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	‡DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
‡The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Overhead Irrigation (q=4)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	DSR(j,4,4,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	6.732E-05	6.741E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.654E-10
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.654E-10
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Subpathway: Livestock Water (q=5)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	DSR(j,4,5,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	2.730E-05	2.733E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ˆDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.084E-10
U-235	ˆDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.084E-10
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ˆDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

RESRAD, Version 5.82 $T_{1/2}$ Limit = 0.5 year 01/11/99 12:01 Page 51
Detailed: Nickel Waste - 6000 tons File: 6000TON.RAD

Dose/Source Ratios for Internal Radiation from Ingestion of Meat (p=4)
Total for All Subpathways
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,4,t) (mrem/yr)/(pCi/g)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.018E-04	1.020E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.741E-10
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.741E-10
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Subpathway: Fodder Root Uptake from Contaminated Soil (q=1)
Parent and Progeny Principal Radionuclide Contributions Indicated

©Parent (i)	Product (j)	Branch Fraction*	DSR(j,5,1,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
©U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	˜DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
©U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	˜DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
©U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	˜DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

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Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=6)
Subpathway: Fodder Foliar Uptake from Contaminated Dust (q=2)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,5,2,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
⊙U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
⊙U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
⊙U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

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Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Subpathway: Ditch Irrigation (q=3)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	DSR(j,5,3,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	8.500E-05	8.510E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.305E-14
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.305E-14
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Subpathway: Overhead Irrigation (q=4)
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,5,4,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	7.953E-04	7.963E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.147E-10
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.147E-10
U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=6)
Subpathway: Livestock Water (q=6)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	DSR(j,5,5,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.276E-03	1.277E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	~DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.082E-10
U-235	~DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.082E-10
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	~DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from Ingestion of Milk (p=5)
Total for All Subpathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,5,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	2.156E-03	2.159E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.229E-10
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.229E-10
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

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Dose/Source Ratios for Internal Radiation from the Ingestion of Fish (p=6)
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,6,t) (mrem/yr)/(pCi/g)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	9.751E-05	9.762E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.692E-08
U-235	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.692E-08
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Dose/Source Ratios for Internal Radiation from the Ingestion of Drinking Water (p=7)
Parent and Progeny Principal Radionuclide Contributions Indicated

@Parent (i)	Product (j)	Branch Fraction*	DSR(j,7,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	7.073E-02	7.081E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.409E-06
U-235	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.409E-06
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	^DSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.

Plant/Air and Plant/Water Concentration Ratios
0 Mass loading [ASR(3)]: 1.000E-04 g/m**3
Area Factor for Mass Loading [FA(2)]: 1.732E-01

0Nuclide (i)	FAR(i,3,2,1) m**3/g	FAR(i,3,2,2) m**3/g	FWR(i,3,3,1) L/g	FWR(i,3,3,2) L/g	FWR(i,3,4,1) L/g	FWR(i,3,4,2) L/g
Ac-227	5.4545E-02	2.6156E-01	2.8123E-07	4.2212E-07	3.4522E-04	1.6554E-03
Pa-231	5.4545E-02	2.6156E-01	1.1299E-06	1.6593E-06	3.4522E-04	1.6554E-03
Pb-210	5.4545E-02	2.6156E-01	1.1316E-06	1.6630E-06	3.4522E-04	1.6554E-03
Ra-226	5.4545E-02	2.6156E-01	4.5236E-06	6.6456E-06	3.4522E-04	1.6554E-03
Tc-99	5.4545E-02	2.6156E-01	3.0075E-04	3.4684E-04	3.4522E-04	1.6554E-03
Th-230	5.4545E-02	2.6156E-01	1.1333E-07	1.6667E-07	3.4522E-04	1.6554E-03
U-234	5.4545E-02	2.6156E-01	2.8250E-07	4.1487E-07	3.4522E-04	1.6554E-03
U-235	5.4545E-02	2.6156E-01	2.8248E-07	4.1483E-07	3.4522E-04	1.6554E-03
U-238	5.4545E-02	2.6156E-01	2.8248E-07	4.1483E-07	3.4522E-04	1.6554E-03

FAR(i,p,q,k) is the plant/air concentration ratio for airborne contaminated dust, and FWR(i,p,q,k) is the plant/water concentration ratio. See groundwater displays for water/soil concentration ratios.

0

Plant/Soil Concentration Ratios, FSR(i,3,q,k,t)
0 Root Uptake (q=1) and Foliar Dust Deposition (q=2)
Nonleafy (k=1) and/or Leafy (k=2) Vegetables
0 Nuclide(i)

Parent	Product	FSR(i,3,1,k)	FSR(i,3,2,1)	FSR(i,3,2,2)
Tc-99	Tc-99	5.0000E+00	9.4477E-07	4.5304E-06
U-234	U-234	2.5000E-03	9.4477E-07	4.5304E-06
U-234	Th-230	1.0000E-03	9.4477E-07	4.5304E-06
U-234	Ra-226	4.0000E-02	9.4477E-07	4.5304E-06
U-234	Pb-210	1.0000E-02	9.4477E-07	4.5304E-06
U-235	U-235	2.5000E-03	9.4477E-07	4.5304E-06
U-235	Pa-231	1.0000E-02	9.4477E-07	4.5304E-06
U-235	Ac-227	2.5000E-03	9.4477E-07	4.5304E-06
U-238	U-238	2.5000E-03	9.4477E-07	4.5304E-06
U-238	U-234	2.5000E-03	9.4477E-07	4.5304E-06
U-238	Th-230	1.0000E-03	9.4477E-07	4.5304E-06
U-238	Ra-226	4.0000E-02	9.4477E-07	4.5304E-06
U-238	Pb-210	1.0000E-02	9.4477E-07	4.5304E-06

Plant/Soil Concentration Ratio, FPR(j,3,q,k,t)
Ditch Irrigation (q=3)

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			FPR(j,3,3,k,t)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	2.857E-02	2.860E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.264E-14
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

0

Plant/Soil Concentration Ratio, FPR(j,3,q,k,t)
Overhead Irrigation (q=4) and Nonleafy Vegetables (k=1)

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			FPR(j,3,4,1,t) * SF(j,t)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	3.278E-02	3.283E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.437E-11
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Plant/Soil Concentration Ratio, PSR(j,3,q,k,t)
Overhead Irrigation (q=4) and Leafy Vegetables (k=2)
PSR(j,3,4,2,t) * SF(j,t)

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.572E-01	1.574E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.089E-10
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Meat/Fodder, Milk/Fodder, Fodder/Air and Fodder/Water Concentration Ratios

0   FI(4,q): 68.0 kg/day   FI(5,q): 55.0 kg/day   q=1,2,3,4
    FI(4,q): 50.0 L/day   FI(5,q): 160.0 L/day   q=5
    FI(4,q): 0.5 kg/day   FI(5,q):

Nuclide (i)	FCR(i,4) d/kg	FCR(i,5) d/kg	FAR(i,3,2,3) m**3/g	FWR(i,3,3,3) L/g	FWR(i,3,4,3) L/g
Ac-227	2.0000E-05	2.0000E-05	2.8659E-01	1.3287E-07	1.8139E-03
Pa-231	5.0000E-03	5.0000E-06	2.8659E-01	5.3258E-07	1.8139E-03
Pb-210	8.0000E-04	3.0000E-04	2.8659E-01	5.3296E-07	1.8139E-03
Ra-226	1.0000E-03	1.0000E-03	2.8659E-01	2.1312E-06	1.8139E-03
Tc-99	1.0000E-04	1.0000E-03	2.8659E-01	1.8385E-04	1.8139E-03
Th-230	1.0000E-04	5.0000E-06	2.8659E-01	5.3333E-08	1.8139E-03
U-234	3.4000E-04	6.0000E-04	2.8659E-01	1.3315E-07	1.8139E-03
U-235	3.4000E-04	6.0000E-04	2.8659E-01	1.3314E-07	1.8139E-03
U-238	3.4000E-04	6.0000E-04	2.8659E-01	1.3314E-07	1.8139E-03

FI(p,q) are the fodder (q=1,2,3,4), livestock water (q=5) and soil (q=6) intake rates; FCR(i,p) are the transfer coefficients from contaminated fodder of livestock water to meat (p=4) or milk (p=5). FAR(i,3,2,3) are the fodder/air concentration ratios, and FWR(i,3,3,3) and FWR(i,3,4,3) are the fodder/water concentration ratios for ditch and overhead irrigation, respectively.

Fodder/Soil Concentration Ratios, QSR(i,p,q,t), for Meat and Milk Pathways
Root Uptake (q=1) and Foliar Dust Deposition (q=2)

Nuclide(i) Parent	Product	QSR(i,p,1)	QSR(i,p,2)
Tc-99	Tc-99	5.0000E+00	4.9640E-06
U-234	U-234	2.5000E-03	4.9640E-06
U-234	Th-230	1.0000E-03	4.9640E-06
U-234	Ra-226	4.0000E-02	4.9640E-06
U-234	Pb-210	1.0000E-02	4.9640E-06
U-235	U-235	2.5000E-03	4.9640E-06
U-235	Pa-231	1.0000E-02	4.9640E-06
U-235	Ac-227	2.5000E-03	4.9640E-06
U-238	U-238	2.5000E-03	4.9640E-06
U-238	U-234	2.5000E-03	4.9640E-06
U-238	Th-230	1.0000E-03	4.9640E-06
U-238	Ra-226	4.0000E-02	4.9640E-06
U-238	Pb-210	1.0000E-02	4.9640E-06

Fodder/Soil Concentration Ratio, QSR(j,p,q,t), for Meat and Milk Pathways
Ditch Irrigation (q=3)

ØParent (i)	Product (j)	Branch Fraction*	QSR(j,p,3,t) * SF(j,t) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.841E-02	1.841E-02	1.841E-02
ØU-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ØU-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ØU-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Fodder/Soil Concentration Ratio, QSR(j,p,q,t),for Meat and Milk Pathways
Overhead Irrigation (q=4)

@Parent (i)	Product (j)	Branch Fraction*	QSR(j,p,4,t) * SF(j,t) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.722E-01	1.723E-01	1.725E-01
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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Fodder/Soil Concentration Ratio, QSR(j,p,q,t),for Meat and Milk Pathways
Livestock Water (q=5)

@Parent (i)	Product (j)	Branch Fraction*	QSR(j,p,5,t) * SF(j,t) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.498E-02	9.499E-02	9.509E-02
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Meat/Soil Concentration Ratios, FSR(i,4,q,t)
Root Uptake (q=1) and Foliar Dust Deposition (q=2)

Nuclide(i) Parent	Product	FSR(i,4,1)	FSR(i,4,2)
Tc-99	Tc-99	0.0000E+00	0.0000E+00
U-234	U-234	0.0000E+00	0.0000E+00
U-234	Th-230	0.0000E+00	0.0000E+00
U-234	Ra-226	0.0000E+00	0.0000E+00
U-234	Pb-210	0.0000E+00	0.0000E+00
U-235	U-235	0.0000E+00	0.0000E+00
U-235	Pa-231	0.0000E+00	0.0000E+00
U-235	Ac-227	0.0000E+00	0.0000E+00
U-238	U-238	0.0000E+00	0.0000E+00
U-238	U-234	0.0000E+00	0.0000E+00
U-238	Th-230	0.0000E+00	0.0000E+00
U-238	Ra-226	0.0000E+00	0.0000E+00
U-238	Pb-210	0.0000E+00	0.0000E+00

Meat/Soil Concentration Ratio, FSR(j,4,q,t)
Ditch Irrigation (q=3)

FSR(j,4,3,t) * SF(j,t)

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.252E-04	1.253E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.345E-17
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Meat/Soil Concentration Ratio, FSR(j,4,q,t)
Overhead Irrigation (q=4)

FSR(j,4,4,t) * SF(j,t)

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.171E-03	1.173E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.566E-13
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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Meat/Soil Concentration Ratio, FSR(j,4,q,t)
Livestock Water (q=5)

FSR(j,4,5,t) * SF(j,t)

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	4.749E-04	4.755E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.864E-13
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Milk/Soil Concentration Ratios, FTR(i,5,q,t)
Root Uptake (q=1) and Foliar Dust Deposition (q=2)

	Nuclide(i) Parent	Product	FTR(i,5,1)	FTR(i,5,2)
	Tc-99	Tc-99	0.0000E+00	0.0000E+00
0	U-234	U-234	0.0000E+00	0.0000E+00
	U-234	Th-230	0.0000E+00	0.0000E+00
	U-234	Ra-226	0.0000E+00	0.0000E+00
	U-234	Pb-210	0.0000E+00	0.0000E+00
0	U-235	U-235	0.0000E+00	0.0000E+00
	U-235	Pa-231	0.0000E+00	0.0000E+00
	U-235	Ac-227	0.0000E+00	0.0000E+00
0	U-238	U-238	0.0000E+00	0.0000E+00
	U-238	U-234	0.0000E+00	0.0000E+00
	U-238	Th-230	0.0000E+00	0.0000E+00
	U-238	Ra-226	0.0000E+00	0.0000E+00
	U-238	Pb-210	0.0000E+00	0.0000E+00

0

Milk/Soil Concentration Ratio, FTR(j,5,q,t)
Ditch Irrigation (q=3)

FTR(j,5,3,t) * SF(j,t)

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.012E-03	1.814E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.709E-17
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Milk/Soil Concentration Ratio, FSR(j,5,q,t)
Overhead Irrigation (q=4)

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			FSR(j,5,4,t) * SF(j,t)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	9.474E-03	9.486E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.698E-13
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

0

Milk/Soil Concentration Ratio, FSR(j,5,q,t)
Livestock Water (q=5)

@Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			FSR(j,5,5,t) * SF(j,t)								
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.520E-02	1.522E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
@U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.972E-13
@U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Dose/Source Ratios for Soil Ingestion Pathway (p=8)
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	DSR(j,8,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	ˆDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	ˆDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	ˆDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life > 0.5 yr) daughters.
0

Dose Conversion and Environmental Transport Factors for the Soil Ingestion Pathway (p=8)

0Parent (i)	Product (j)	DCF(j,8)*	ETF(j,8,t) (g/yr) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Tc-99	Tc-99	1.460E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-235	U-235	2.670E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pa-231	1.060E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Ac-227	1.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	2.690E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-234	2.830E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Th-230	5.480E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Ra-226	1.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	Pb-210	7.270E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* - The dose conversion factor units are mrem/pCi.
0

A.3 Risk Output File

RESRAD, Version 5.82 $T_{1/2}$ Limit = 0.5 year   01/11/99 12:01   Page 1

Intrisk : Nickel Waste - 6000 tons   File: 6000TON.RAD

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Part III: Intake Quantities and Health Risk Factors

RESRAD, Version 5.82 $T_{1/2}$ Limit = 0.5 year 01/11/99 12:01 Page 2
Intrisk : Nickel Waste - 6000 tons File: 6000TON.RAD

Cancer Risk Slope Factors Summary Table
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	Ac-227+D	9.30E-07	9.30E-07	SLPF(1,1)
Sf-1	Pa-231	2.70E-08	2.70E-08	SLPF(2,1)
Sf-1	Pb-210+D	1.50E-10	1.50E-10	SLPF(3,1)
Sf-1	Ra-226+D	6.70E-06	6.70E-06	SLPF(4,1)
Sf-1	Tc-99	6.20E-13	6.20E-13	SLPF(5,1)
Sf-1	Th-230	4.40E-11	4.40E-11	SLPF(6,1)
Sf-1	U-234	2.10E-11	2.10E-11	SLPF(7,1)
Sf-1	U-235+D	2.70E-07	2.70E-07	SLPF(8,1)
Sf-1	U-238+D	6.60E-08	6.60E-08	SLPF(9,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	Ac-227+D	7.90E-08	7.90E-08	SLPF(1,2)
Sf-2	Pa-231	2.40E-08	2.40E-08	SLPF(2,2)
Sf-2	Pb-210+D	3.90E-09	3.90E-09	SLPF(3,2)
Sf-2	Ra-226+D	2.70E-09	2.70E-09	SLPF(4,2)
Sf-2	Tc-99	2.90E-12	2.90E-12	SLPF(5,2)
Sf-2	Th-230	1.70E-08	1.70E-08	SLPF(6,2)
Sf-2	U-234	1.40E-08	1.40E-08	SLPF(7,2)
Sf-2	U-235+D	1.30E-08	1.30E-08	SLPF(8,2)
Sf-2	U-238+D	1.20E-08	1.20E-08	SLPF(9,2)
Sf-3	Ingestion, slope factors, 1/(pCi):			
Sf-3	Ac-227+D	6.30E-10	6.30E-10	SLPF(1,3)
Sf-3	Pa-231	1.50E-10	1.50E-10	SLPF(2,3)
Sf-3	Pb-210+D	1.00E-09	1.00E-09	SLPF(3,3)
Sf-3	Ra-226+D	3.00E-10	3.00E-10	SLPF(4,3)
Sf-3	Tc-99	1.40E-12	1.40E-12	SLPF(5,3)
Sf-3	Th-230	3.80E-11	3.80E-11	SLPF(6,3)
Sf-3	U-234	4.40E-11	4.40E-11	SLPF(7,3)
Sf-3	U-235+D	4.70E-11	4.70E-11	SLPF(8,3)
Sf-3	U-238+D	6.20E-11	6.20E-11	SLPF(9,3)
Sf-Rn	Radon Inhalation slope factors, 1/(pCi):			
Sf-Rn	Rn-222	1.80E-12	1.80E-128	SLPFRN(1,1)
Sf-Rn	Po-218	3.70E-12	3.70E-12	SLPFRN(1,2)
Sf-Rn	Pb-214	6.20E-12	6.20E-12	SLPFRN(1,3)
Sf-Rn	Bi-214	1.50E-11	1.50E-11	SLPFRN(1,4)
Sf-Rn	Radon K factors, (mrem/WLM):			
Sf-Rn	Rn-222 Indoor	7.60E+02	7.60E+028	KFACTR(1,1)
Sf-Rn	Rn-222 Outdoor	5.70E+02	5.70E+028	KFACTR(1,2)

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Cancer Risk Slope Factors Summary Table (continued)
File: DOSFAC.BIN

0 Menu	Parameter	Current Value	Default	Parameter Name

Note: Default values followed by '*' were derived by multiplying the dose conversion factors with 7.3E-7 (risk/mrem). For external radiation, the dose conversion factors used for this derivation were obtained from the EPA's Federal Guidance Report No.12, and for inhalation and ingestion, the dose conversion factors were the ones used in RESRAD default database.

Default values followed by '§' were obtained from 'Estimating Radiogenic Cancer Risks', EPA 402-R-93-076, June, 1994.

Default values followed by '#' were taken from individual radionuclides given in HEAST.

Default values followed by '&' were obtained from 'Comparative Dosimetry of Radon in Mines and Homes', National Research Council, 1991.

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

0

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.127E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.572E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.188E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.799E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.446E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.458E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.127E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.572E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.128E-21	0.0000
Tc-99	5.495E-06	0.8605	7.576E-09	0.0012	7.078E-07	0.1108	7.813E-09	0.0012	1.675E-07	0.0262	6.386E-06	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.799E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.446E-19	0.0000
Total	5.495E-06	0.8605	7.576E-09	0.0012	7.078E-07	0.1108	7.813E-09	0.0012	1.675E-07	0.0262	6.386E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 0.000E+00 years

0

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. — Water-independent   Water-dep. — Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.188E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.018E-25	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.446E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.458E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	5.495E-06	0.8605	7.576E-09	0.0012	0.000E+00	0.0000	7.078E-07	0.1108	7.813E-09	0.0012	1.675E-07	0.0262	6.386E-06	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.188E-21	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.018E-25	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.446E-19	0.0000
Total	5.495E-06	0.8605	7.576E-09	0.0012	0.000E+00	0.0000	7.078E-07	0.1108	7.813E-09	0.0012	1.675E-07	0.0262	6.386E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon): Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways: Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

Amount of Intake Quantities QINTS(irn,i,t) and QINTSW(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ac-227	1.198E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.686E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.294E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.512E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.298E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.311E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.198E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.686E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.294E-21	0.0000
Tc-99	5.517E-06	0.8605	7.605E-09	0.0012	7.105E-07	0.1108	7.936E-09	0.0012	1.681E-07	0.0262	6.411E-06	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.512E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.298E-19	0.0000
Total	5.517E-06	0.8605	7.605E-09	0.0012	7.105E-07	0.1108	7.936E-09	0.0012	1.681E-07	0.0262	6.411E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+00 years

0

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
	Radionuclides							
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.294E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	9.979E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.298E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.311E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	5.517E-06	0.8605	7.605E-09	0.0012	0.000E+00	0.0000	7.105E-07	0.1108	7.936E-09	0.0012	1.681E-07	0.0262	6.411E-06	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.294E-21	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.979E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.298E-19	0.0000
Total	5.517E-06	0.8605	7.605E-09	0.0012	0.000E+00	0.0000	7.105E-07	0.1108	7.936E-09	0.0012	1.681E-07	0.0262	6.411E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

0

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CRRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	fract.	Inhalation risk	fract.	Plant risk	fract.	Meat risk	fract.	Milk risk	fract.	Soil risk	fract.
Ac-227	1.340E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	2.883E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.520E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	7.965E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.016E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.031E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.340E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.883E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.820E-21	0.0000
Tc-99	5.506E-06	0.8605	7.591E-09	0.0012	7.092E-07	0.1108	7.826E-09	0.0012	1.678E-07	0.0262	6.398E-06	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.865E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.016E-19	0.0000
Total	5.506E-06	0.8605	7.591E-09	0.0012	7.092E-07	0.1108	7.826E-09	0.0012	1.678E-07	0.0262	6.398E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRSPW(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+00 years

0

Radon Pathway	Radionuclides: Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

0
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.520E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	9.594E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	4.016E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.031E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	5.506E-06	0.8605	7.591E-09	0.0012	0.000E+00	0.0000	7.092E-07	0.1108	7.926E-09	0.0012	1.678E-07	0.0262	6.398E-06	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.520E-21	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.594E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.016E-19	0.0000
Total	5.506E-06	0.8605	7.591E-09	0.0012	0.000E+00	0.0000	7.092E-07	0.1108	7.926E-09	0.0012	1.678E-07	0.0262	6.398E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 7.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.924E+05	5.410E+02	5.054E+04	5.649E+02	1.196E+04	4.560E+05
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 7.000E+00 years

0

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 7.000E+00 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	fract.	Inhalation risk	fract.	Plant risk	fract.	Meat risk	fract.	Milk risk	fract.	Soil risk	fract.
Ac-227	1.606E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	3.170E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.019E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	6.875E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.506E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.526E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 7.000E+00 years

Water Dependent Pathways

Radio- Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.606E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.170E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.019E-21	0.0000
Tc-99	1.373E-06	0.8605	1.893E-09	0.0012	1.769E-07	0.1108	1.977E-09	0.0012	4.187E-08	0.0262	1.596E-06	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.975E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.506E-19	0.0000
Total	1.373E-06	0.8605	1.893E-09	0.0012	1.769E-07	0.1108	1.977E-09	0.0012	4.187E-08	0.0262	1.596E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 7.000E+00 years

0

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CRRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 7.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.819E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.898E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.506E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.526E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Excess Cancer Risk CRRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 7.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	1.373E-06	0.8605	1.893E-09	0.0012	0.000E+00	0.0000	1.769E-07	0.1108	1.977E-09	0.0012	4.187E-08	0.0262	1.596E-06	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.819E-21	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.898E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.506E-19	0.0000
Total	1.373E-06	0.8605	1.893E-09	0.0012	0.000E+00	0.0000	1.769E-07	0.1108	1.977E-09	0.0012	4.187E-08	0.0262	1.596E-06	1.0000

***CRRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.929E+05	5.416E+02	5.960E+04	5.654E+02	1.198E+04	4.565E+05
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

0

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	fract.	Inhalation risk	fract.	Plant risk	fract.	Meat risk	fract.	Milk risk	fract.	Soil risk	fract.
Ac-227	1.777E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	1.307E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.426E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	6.311E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.166E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.191E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.777E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.307E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.426E-21	0.0000
Tc-99	1.375E-06	0.8605	1.896E-09	0.0012	1.771E-07	0.1108	1.980E-09	0.0012	4.192E-08	0.0262	1.598E-06	1.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.213E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.166E-19	0.0000
Total	1.375E-06	0.8605	1.896E-09	0.0012	1.771E-07	0.1108	1.980E-09	0.0012	4.192E-08	0.0262	1.598E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+01 years

0

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

(Columns Rn-222 to Bi-212 are Radionuclides.)

Water-ind. == Water-independent Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.426E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	8.421E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	3.166E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	3.191E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	1.375E-06	0.8605	1.896E-09	0.0012	0.000E+00	0.0000	1.771E-07	0.1108	1.980E-09	0.0012	4.192E-08	0.0262	1.598E-06	1.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.426E-21	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.421E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.166E-19	0.0000
Total	1.375E-06	0.8605	1.896E-09	0.0012	0.000E+00	0.0000	1.771E-07	0.1108	1.980E-09	0.0012	4.192E-08	0.0262	1.598E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINTS(irn,i,t) and QINTSW(irn,i,t) for Inhalation of
Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

0

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	2.189E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	3.189E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	5.422E-21	0.0326	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.251E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.607E-19	0.9674	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.661E-19	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

RESRAD, Version 5.82 T½ Limit = 0.5 year 01/11/99 12:01 Page 20
Intrisk : Nickel Waste - 6000 tons File: 6000TON.RAD

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.189E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.189E-27	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.422E-21	0.0326
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.251E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.607E-19	0.9674
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.661E-19	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+01 years

0

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
	Radionuclides							
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

RESRAD, Version 5.82 $T_{1/2}$ Limit = 0.5 year   01/11/99 12:01   Page 21
Intrisk : Nickel Waste - 6000 tons   File: 6000TON.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

0
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	5.422E-21	0.0326	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	5.759E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.607E-19	0.9674	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.661E-19	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.422E-21	0.0326
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.759E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.607E-19	0.9674
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.661E-19	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total Ingestion*
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

0

Radon Pathway	Radionuclides							
	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	6.775E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	8.056E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	1.314E-20	0.4682	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.182E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.493E-20	0.5318	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.808E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.775E-27	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.054E-28	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.314E-20	0.4682
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.182E-27	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.493E-20	0.5318
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.808E-20	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+02 years

0

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

(Column group heading: Radionuclides)

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.314E-20	0.4681	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	1.076E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.493E-20	0.5319	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.808E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.314E-20	0.4681
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.076E-26	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.493E-20	0.5319
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.808E-20	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 3.000E+02 years

0

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Ac-227	3.125E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	2.002E-20	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.683E-23	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.003E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.125E-30	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.002E-20	0.9992
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.621E-23	0.0008
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.003E-20	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 3.000E+02 years

0

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.001E-20	0.9991	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	3.125E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.751E-23	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	2.003E-20	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.001E-20	0.9991
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.125E-30	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.751E-23	0.0009
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.003E-20	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total Ingestion*
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	
Ac-227	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.626E-05	5.856E-07	3.553E-06	1.228E-08	2.702E-08	5.041E-05
Pa-231	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

0

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
	Radionuclides							
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+03 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	4.941E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.941E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio- Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	1.239E-12	0.9177	1.489E-14	0.0110	9.520E-14	0.0705	3.291E-16	0.0002	7.240E-16	0.0005	1.351E-12	1.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.941E-20	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	1.239E-12	0.9177	1.489E-14	0.0110	9.520E-14	0.0705	3.291E-16	0.0002	7.240E-16	0.0005	1.351E-12	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(irn,i,t) and CNRSW(irn,i,t) for Inhalation of
Radon and its Decay Products at t= 1.000E+03 years

0

Radon Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
	Radionuclides							
Water-ind.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Water-dep.	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Water-ind. == Water-independent   Water-dep. == Water-dependent

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

0

Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	4.941E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	1.692E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.941E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.941E-20	0.0000
U-235	1.239E-12	0.9177	1.489E-14	0.0110	0.000E+00	0.0000	9.520E-14	0.0705	3.291E-16	0.0002	7.240E-16	0.0005	1.351E-12	1.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.692E-24	0.0000
Total	1.239E-12	0.9177	1.489E-14	0.0110	0.000E+00	0.0000	9.520E-14	0.0705	3.291E-16	0.0002	7.240E-16	0.0005	1.351E-12	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

JMK

Manufacturing Sciences Corporation

A BNFL Inc. Company — The Metals Recycling Specialists

January 18, 1999

State of Tennessee
Division of Radiological Health
3rd Floor L&C Annex
401 Church Street
Nashville, Tennessee 37243-1532

Attention: Mr. Michael Mobley, Director

Gentlemen:

This letter is a follow-up on our meeting of December 8, 1998 regarding the application for releasing nickel under License R-01078-L00. The information here responds to the issues you raised as well as those raised by members of your staff.

First, we would like to make a revision to the report prepared by Auxier & Associates. The graphic showing the dose to a landfill resident should be replaced. The new graphic, which is more appropriate, focuses on the resident living adjacent to the landfill. The graphic in the report should show the dose to that resident. We have revised the graphic and the related text to emphasize the focus of this part of the report. We ask that you replace pages 18 and 19 in the report with the two revised pages at Enclosure 1 with this letter.

There were also comments regarding the quantity of the commercial landfill disposal of the slag from the recycle foundry. We examined the effect of greater quantities of the slag going to a single landfill. The result is as expected, greater deposition results in a larger dose. The RESRAD results indicate that the dose reaches a maximum at a relatively small quantity of waste. Enclosure 2 discusses this issue. The results in Enclosure 2 are calculated with a different partitioning of the ^{99}Tc in the waste than in the report as submitted in December. Reevaluation of the partitioning indicates that 5% rather than 10% of the ^{99}Tc is likely in the waste. This is not reflective of the separation of the technetium from the nickel but from the recognition that some of the nickel will be oxidized in an open furnace and become part of the slag. Five percent is deemed to be an upper limit of the nickel involved in this oxidation. We assumed that the technetium would stay bound to the nickel in the formation of the oxide.

You also commented on what other radioactive materials may be buried in landfills. We have identified that about 37,000 tons of fly ash is buried in landfills each year from electric power production.

804 Kerr Hollow Road Oak Ridge, TN 37830 Phone (423)481-0455 Fax (423)481-3142

The radioactive content of the fly ash varies but the averages are:

Isotope	pCi/g
K-40	8.2
Pb-210	1.1
Ra-226	1.9
Ra-228	1.8
Th-228	1.4
Th-230	1.4
Th-232	1.9
U-234	1.9
U-238	2.4

There is also a lot of soil placed in landfills. No data is available on the actual quantity of soil buried, but it is considerable. The average radioactive content of the soil is:

Isotopes	pCi/g
K-40	10.0
Ra-226	0.8
Th-232	1.0
U-234	1.5
U-238	1.5

Concerns were also expressed about nickel plated products and products made of unalloyed nickel or of high nickel content. A consideration of these products is in Enclosure 3.

We desire to move ahead on this project as soon as possible. Your timely consideration of this information and the request we left with you in December will be appreciated.

Sincerely,

Bobby R. Adcock

Enclosures

Enclosure 1.

Revised pages for the report: Risk Analysis: Nickel Contaminated with ^{99}Tc and Uranium, November, 1998.

of hip joint prostheses. Likewise, if the dissolution rate were ten times the assumed rate, the dose would still be much smaller than the direct radiation dose. Based on these options, dissolution scenarios were not further considered.

Population doses for people with MSC's reprocessed nickel hip joint prostheses were calculated using the same method used to calculate the population doses for the flatware. The whole body dose was determined by multiplying the tissue dose by the tissue-weighting factor from Table 2, ICRP 60. For bone surfaces, the tissue weighting is 0.01. The fraction of bone that would be exposed was also considered in the dose and risk calculations. The population dose for the hip joint scenario was calculated to be 0.025 rad/y (18,000 people x 1.4 E -4 rad/y x 0.01). Comparatively, this would be the same increase in annual population dose that would be experienced by five people who moved from a house constructed of wood to a house constructed of brick.

4.3 Landfill Waste Disposal

The landfill exposure scenario involved the disposal of waste from the recycling foundry's operation. The computer code RESRAD 5.80 (ANL,1993) was used to assess the potential long-term doses from this activity. Default input parameters were used, except where otherwise noted. Appendix C contains the detailed output from this simulation.

The activity in 40,000 lb. of recycled nickel (9.8 µCi ^{99}Tc, and 0.98 µCi uranium) was assumed to be partitioned as indicated earlier (that is, all the uranium and 10 percent of the ^{99}Tc remains in the slag). The slag was also assumed to be evenly dispersed through one 20,000 lb. truckload of smelter waste. The waste was assumed to be placed in the landfill and covered with 2 meters of soil and other waste. Doses to a resident living on the landfill were calculated for the following pathways using RESRAD default values:

- Drinking water
- Food ingestion
- Soil ingestion
- Inhalation (both re-suspended soil and radon), and
- Direct exposure to external radiation.

The maximum projected dose of ^{99}Tc in drinking water was 0.6 mrem at about 7 years after placement of the waste. These doses applied to residents living directly on the landfill. In practice, however, institutional access controls would prevent residential building over a landfill during active operations and would also prevent residential use during post-closure monitoring and maintenance periods required of most landfill operations. Institutional controls commonly last for 30 years after the landfill is closed, so doses to on-site residents during the first 30 years after waste placement should be discounted.

A second group of residents that may be exposed are those who may live on properties adjacent to the landfill. If the water for these residents were supplied by a well, then they may be exposed to uranium and ^{99}Tc from landfill runoff and leaching. Since adjacent properties are not subject to landfill access control restrictions, residents on adjacent properties could receive doses within the first 30 years. However, the normal dilution and attenuation processes that would occur between the landfill source and the aquifer would mitigate doses to off-site residents. A dilution attenuation factor (DAF) of 10 was used to extrapolate doses to off-site residents from on-site dose rates. The maximum dose to this population would be 0.06 mrem/year, the majority which would come from ^{99}Tc in drinking water. Figure 4 –1 projects the dose over time for the resident living adjacent to the landfill.

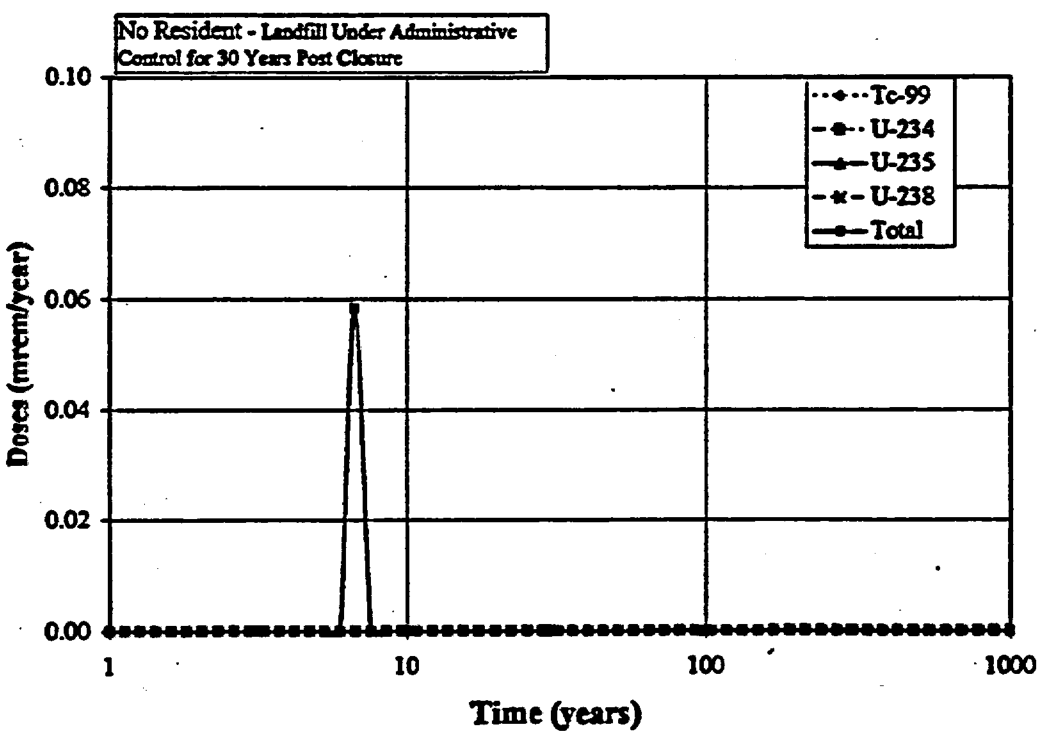


Figure 4-1 Calculated Doses to Resident Living Adjacent to Landfill

Due to the limited number of people exposed in this scenario, no population dose was evaluated. As can be seen from Figure 4-1, no discernible doses can be identified in the period between 30 years and 1000 years.

Enclosure 2.

Disposal of Waste from 6000 Tons of Reprocessed Nickel

1 Waste Disposal Assumptions

The uranium was assumed to be *both* in the metal product and in the waste. Experience with re-melting ^{99}Tc-contaminated nickel has shown that the ^{99}Tc remains nearly qualitatively with the metal; therefore a partitioning of 95 percent of the ^{99}Tc in the metal product and 5 percent of the ^{99}Tc in the slag was assumed for the risk evaluation. This partitioning is dictated not by a consideration that the ^{99}Tc is separated from the nickel in the melting but that, in an open furnace, a portion of the nickel is oxidized and incorporated into the slag and the proportional amount of the ^{99}Tc remains with the nickel. The 5% of the nickel considered to be incorporated into the slag is conservative.

Dross, slag, and ash would be produced by the smelting operations at the recycling foundry manufacturing the stainless steel. These wastes would typically be buried in landfills. It is likely that a small amount of uranium and ^{99}Tc from MSC's reprocessed nickel would end up in the dross and slag generated at the foundry. Any uranium carried in the exhaust gas would end up as an oxide in the ash and, therefore, would be collected by the bag house serving the furnace. All this waste material would be trucked to a landfill. The waste from the entire 6000 tons is unlikely to go to one landfill, however, the dose and risks were calculated for that situation. The waste was assumed to be spread in a 0.15 m thickness over an area of 12,500 ft^2. The thickness and area of the waste were calculated from the volume of waste carried to the landfill. The volume was derived using a density of 100 pounds per cubic foot.

2 Landfill Waste Disposal

The disposal of waste from the recycling foundry's operation is assumed to go to a single landfill. All the reprocessed nickel goes to a single recycle facility. The computer code RESRAD 5.80 (ANL,1993) was used to assess the potential long-term doses from this activity. Default input parameters were used, except where otherwise noted. Appendix A contains the detailed output from this simulation.

The activity in 6,000 tons of recycled nickel was assumed to be partitioned as indicated earlier (that is, all the uranium and 5 percent of the ^{99}Tc remains in the slag). The slag was also assumed to be evenly dispersed through the smelter waste. The waste was assumed to be placed in the landfill and covered with two meters of soil and other waste. Doses to a resident living adjacent to the landfill were calculated for the following pathways using RESRAD default values:

- Drinking water
- Food ingestion
- Soil ingestion
- Inhalation (both re-suspended soil and radon), and
- Direct exposure to external radiation.

The maximum projected dose of ^{99}Tc in drinking water was 6.6 mrem/yr at about 7 years after placement of the waste. RESRAD calculates the dose to a resident living on the landfill, however, institutional access controls would prevent residential building over a landfill during active operations and would also prevent residential use during post-closure monitoring and maintenance periods required of most landfill operations. Institutional controls commonly last for 30 years after the landfill is closed, so doses to on-site residents during the first 30 years after waste placement should be discounted.

Since adjacent properties are not subject to landfill access control restrictions, residents on adjacent properties could receive doses within the first 30 years. However, the normal dilution and attenuation processes that would occur between the landfill source and the aquifer would mitigate doses to off-site residents. A dilution attenuation factor (DAF) of 10 was used to extrapolate doses to off-site residents from on-site dose rates. The maximum dose to this population would be 0.6 mrem/year, the majority which would come from ^{99}Tc in drinking water. Figure 1 presents the projected doses over time for the resident living adjacent to the landfill. As can be seen from Figure 1, no discernible doses can be identified in the period between 30 years and 1000 years.

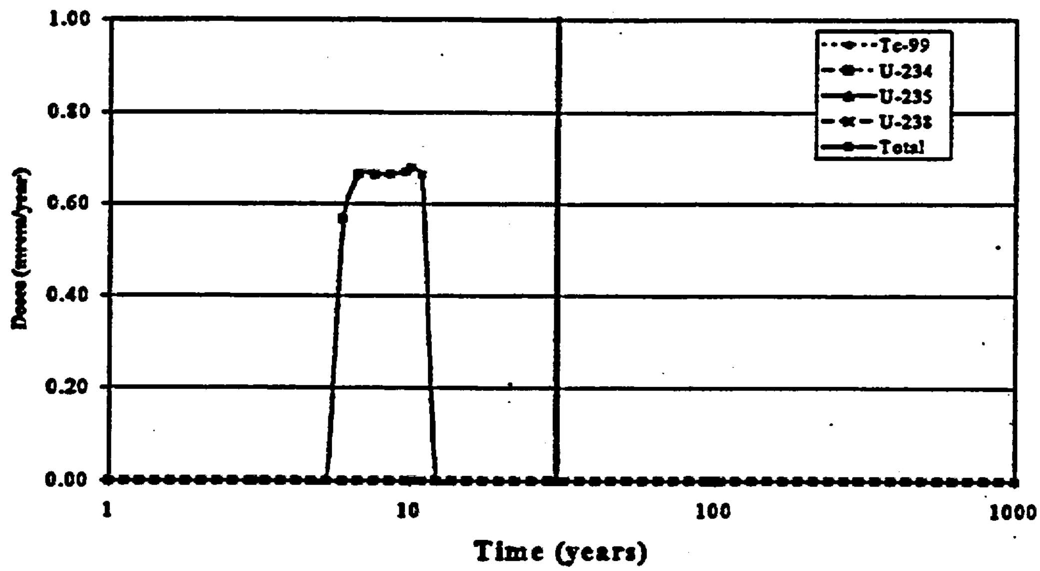
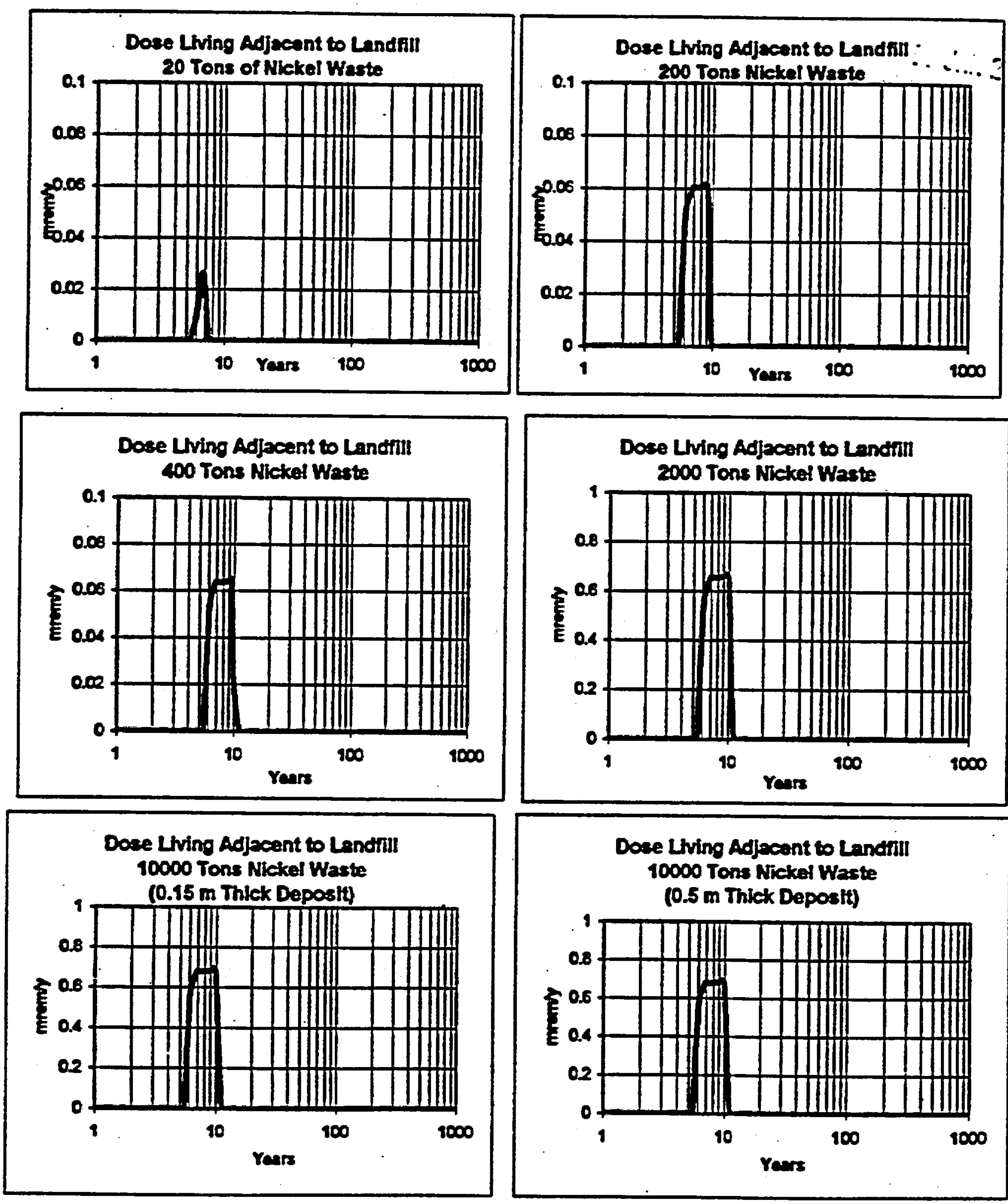


Figure 1 Calculated Doses to Resident Adjacent to Landfill

The assumption that all the nickel went to one recycle facility is a worst case scenario and there is likely to be lesser amounts of waste going to a single landfill. Other quantities of waste from the reprocessed nickel were examined including amounts greater than the waste from 6,000 tons of nickel. Also, the thickness of the material in the landfill was changed to see the effect on dose to the off-site resident.



Doses Living Adjacent to Landfill
(Varying Amounts of Waste)

3 Risks from Landfill Disposal

The risks of excess cancer to the resident on the landfill are calculated by RESRAD. The calculated risk has been adjusted to reflect the risk to the resident living near the landfill as described above. The risk of excess cancer to the off-site resident from the waste from 6,000 tons of waste is 6 E-7. The risk from larger amount of waste calculated and shown in Figure 2 above is less than 7 E-7.

4 Detailed RESRAD Output

Appendix 1 is the detailed RESRAD output for the waste from 6,000 tons of reprocessed nickel. The RESRAD results shown are for the doses and risks to the resident on the landfill as calculated by the program. Three of the routine output files are included. These are the *summary file*, the *detailed output file*, and the *risk output file*. The graphics and discussion above are adjusted for the doses and differ by a factor of ten from the RESRAD output file attached.

Enclosure 3.

Nickel Plated Products and High Nickel Content Products

One possible use of the released nickel from MSC would be in the plating industry. As a plating material, the nickel would be relatively undiluted as compared to stainless steel. The question is would this plating material result in a larger dose from a plated product than from a stainless steel product. Some plated products are considered here.

Also discussed here are the possible products made entirely of nickel or very high nickel content alloys, the nickel of which could be supplied by MSC.

1 Nickel Plated Pistol.

There are a number of nickel plated side arms in use. The primary users are police in the line of duty. The weapons are generally carried in a holster in the policeperson's hip.

While he or she handles the weapon, it is not in contact with the hand nearly as much as the flatware postulated in the risk analysis study. The hip exposure is likewise much less than a hip prosthesis. The weapon is carried in a holster that would provide a high level of shielding for the beta radiation.

Consider the time of exposure. First, the hip. The weapon is carried at most 2000 hours per year - in reality, likely half that time. With the heavy leather holster, the shielding would reduce the exposure to less than one percent of the surface exposure rate. Thus, even if the plating material has ten times the activity as hip prosthesis, it would have a one-fortieth of the level of exposure. In addition, the exposure would be to the skin and not the bone. The estimated risk to the hip would be very much less than the hip prosthesis.

Second, the hand(s). The weapon is handled for care and maintenance in weapons practice and in use as a weapon. The time it is handled is conservatively estimated to be one hour per workday. That would be 250 hours per year. The majority of that time the weapon will held in the normal use attitude. All pistols have a hand grip that will shield the majority of the hand. Even with the higher concentration of residual materials, the actual dose and the risk from the hand exposure would be lower than that from the flatware as indicated in the risk analysis.

It is recognized that the risk is compounded by the exposure to the hip and to the hand. The same is true of the hip prosthesis and the flatware. That is, a person who has a hip prosthesis of recycled stainless steel could also have a set of the flatware made of recycled stainless steel. The additive risks would be less than 1 E-8 for the pistol as it would for the additive risks from the combined hip prosthesis and the flatware.

Population exposure is estimated to be insignificant when compared to the products considered in the risk analysis study.

2 Nickel Plated Whistle

The typical whistle used by sports referees is made of brass and plated with a nickel coating. These whistle are also carried by some people to act as an alarm signal in case of emergency, mugging, etc. The whistles used by the sports officials are the ones most likely to be in use more often.

The same kind of analysis is applied here for the whistle as was applied above for the pistol. Time of use is a major factor. The sports official considered is one who officiates at football games in the fall and for basketball in the winter. At most he would officiate at two football games per week and four basketball games per week. Football games are longer than basketball and the total hours per week are approximately the same in both seasons. The time span is 30 weeks per year with approximately six hours per week officiating. This is a total of 180 hours per year.

As with the pistol there are two types of exposure: the hand and the lips in this case. Most officials carry the whistle on a ring device on the back of their hand and raise it to their mouth to blow. Carried in this manner, the hand is exposed the full time of use and the mouth approximately 5% of the time (estimates by this author). The hand exposure is quite different than with flatware. With flatware the entire surface of the handle is in contact (as considered for the risk analysis) while the ring device holds the whistle slightly away from the hand and provides some shielding at the closest point.

With the higher concentration of residual materials, a hand will not be subjected to a level of exposure that a hand might be from flatware. The exposure to the lips while blowing the whistle will not be enough to cause a larger exposure than that postulated in the risk analysis for the flatware.

The estimated risk from the use of a nickel plated whistle is estimated to be less than 1E-8. Population risk is also much smaller than from the flatware since a smaller number of people would be using whistles with recycle nickel plating (this author's estimate).

3 Products Made from Pure Nickel

There are a number of products made from pure nickel or for relatively undiluted nickel. These products are generally the types of products that are "out of sight" from a consumer point of view. Items such as pipes, tanks, bearings and bearing surfaces are manufactured, transported to the location where they will be used, and installed. There is little contact with these products after they are installed. The time these materials are handled is short compared to the other products analyzed in the risk analysis study and therefore the dose would be insignificant.

Another particular product that could be of some concern is welding rods that have a high nickel content. These welding rods also contain a relatively large quantity of thorium. No adverse effects have resulted from the use of the rods that do not contain the recycle nickel. The added activity from the residual ^{99}Tc and uranium is very small compared to the activity of the thorium and will not significantly increase the risk from their use. The real risk from welding rods is not from radiation exposure, but from burns. The added risk from the small residual of ^{99}Tc and uranium in the recycle nickel or from the thorium is truly small compared to the burn risk.

2/4 ~~MHM~~ JMK she has copy

Manufacturing Sciences Corporation [illegible] 9:31

A BNFL Inc. Company

The Metals Recycling Specialists

JMK

January 29, 1999

Mr. Mike Mobley
Ms. Joelle Key
State of Tennessee
Division of Radiological Health
3rd Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1532

Dear Mike and Joelle:

During the meeting of the 20th of January at the MSC Kerr Hollow Road site, you requested some additional information regarding certain issues. The following items were specifically noted.

1) *The solubility of ^{99}Tc in landfills from commercial foundry wastes (slag).*

   A very soluble form of technetium was assumed in the risk assessment. It was suggested that a closer look at the actual solubility be conducted. MSC is in the process of performing an extended TCLP leachability study of representative slag. A nickel melt to produce the slag for the leachability study will be conducted during the week of 1 February.

2) *Compare volumetric contamination with surface contamination (relative to Reg. Guide 1.86 releasability) of stainless steel products.*

   Attachment 1. contains comparisons of hypothetical sheet stainless steel of varying thickness' contaminated to the allowable limit of Reg. Guide 1.86 with the same geometry steel produced with decontaminated nickel. Total activity in *Bq's* and in *dpm/100 cm²* is assessed.

   From this analysis, 4' × 8' × ¼" or less sheets of stainless steel if released up to the limit of Reg. Guide 1.86 for surface contamination exhibited activity levels higher than the proposed 3 Bq/g; also if, after release, the steel were subsequently recycled and melted into other forms, the resulting stainless steel would exhibit volumetric contamination levels equal to or greater than the proposed 3 Bq/g.

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3) *Research wear from a hip joint.*

Some research has been performed on the subject of corrosion with regard to surgical implants. One study[1] examined "over 100 316LVM stainless implants, removed for various reasons, [and] did not show evidences of pitting corrosion or general attack but did reveal small areas of crevice corrosion in bone plate/bone screw interfaces. A crevice is usually formed by screw head/bone plate countersink contiguity, initiating the corrosion process."[2] Crevice corrosion would not be a concern with regard to hip joint implants as they typically do not use screws.

"Current studies show that 5-10% of hip replacement patients are re-operated on after 15 years for a variety of reasons, such as infection, loosening, or fracture. With current technology, it is extremely rare for a hip joint to "wear out"." This clinic states that they expect a 95% rate of satisfaction from patients after 10 years[3].

Additional to these items, the following information is offered with regard to ^{99}Tc beta particle emission and its ability to penetrate materials: The maximum penetration distance in iron (density of 7.87 g/cc) for a beta particle with a maximum energy of approximately 300 KeV (^{99}Tc max. energy is 292 KeV) is less than 0.1 millimeter[4] and for the average energy ^{99}Tc beta particle (apx. 100 KeV) the distance is likely less than 0.05 millimeter. The density for iron (7.87 g/cc) is less than the density for stainless steel (8.02 g/cc for 304 stainless) and for nickel (8.902 g/cc)[5] and therefore would travel farther in iron than in either stainless or nickel so it can be stated that the distance traveled in stainless steel or in nickel is less than 0.1 millimeter. With this being true, only the first 0.1 millimeter from the surface of the material, be it stainless or pure nickel, will contribute to direct exposures.

If only 0.1 millimeter contributes to direct exposure and measurable surface activity, the maximum activity from the surface of stainless steel[6] (304) would be only 2.89 Bq/100 cm^2 or approximately 175 dpm/100 cm^2; well below acceptable levels of Reg. Guide 1.86.

The calculation would follow this logic:

---

[1] Scales, J. T., G. D. Winter, and H. T. Shirley. Corrosion of Orthopedic Implants, *J. Bone J Surg.*, vol. 41B, no. 4, November 1959.

[2] Peckner and Bernstein. Handbook of Stainless Steels. *McGraw Hill*, 1977.

[3] From *www.hipandkneeclinic.com/hipfaq.htm*

[4] Stanford Research Institute and the U.S. Atomic Energy Commission. SRI Report No. 361, Industrial Uses of Radioactive Fission Products.

[5] Lide. David R. Handbook of Chemistry and Physics, 71st Edition, *CRC Press*, 1990.

[6] 304 Stainless Steel has a maximum allowable nickel content of 12%. 304 was used as it is by far the most common stainless steel produced.

For 304 Stainless Steel (SS)...

Surface Area and Volume calculation:

$10\ cm \times 10\ cm = 100\ cm^2$

$10\ cm \times 10\ cm \times 0.001\ cm = 1\ cm^3$

Total Mass of SS (a) and of nickel content (b) in SS:

(a) $1\ cm^3 \times 8.02\ g/cm^3 = 8.02\ g$ SS total

(b) $8.02\ g\ SS \times 0.12\ {}^{g\ Ni}/_{g\ SS} = 0.9624\ g$ Ni total

If the maximum activity in the nickel is 3 Bq/g, then:

$0.9624\ g\ Ni \times 3\ {}^{Bq\ Tc\text{-}99}/_{g\ Ni} = 2.89$ Bq Tc-99 ...or...

$2.89\ Bq \times 1\ dps/Bq \times 60\ dpm/dps = 173.4$ dpm total or <u>173.4 dpm/100 cm²</u>

For pure nickel (Ni) the calculations would be very similar...

Surface Area and Volume calculation:

$10\ cm \times 10\ cm = 100\ cm^2$

$10\ cm \times 10\ cm \times 0.001\ cm = 1\ cm^3$

Total Mass of nickel:

$1\ cm^3 \times 8.9\ g/cm^3 = 8.9\ g$ Ni total

If the maximum activity in the nickel is 3 Bq/g, then:

$8.9\ g\ Ni \times 3\ {}^{Bq\ Tc\text{-}99}/_{g\ Ni} = 26.7$ Bq Tc-99 ...or...

$26.7\ Bq \times 1\ dps/Bq \times 60\ dpm/dps = 1\ 602$ dpm total or <u>1 602 dpm/100 cm²</u>

This is significant in that regardless of the geometry or of the nickel content, be it pure nickel or stainless steel, the maximum surface activity from Tc-99 at the proposed 3 Bq/g limit will always be lower than the acceptable levels of activity with regard to Reg. Guide 1.86 for surface contamination.

If there is any additional items you would like to have more information on, please contact me or Eric Miller at 423.481.0455.

Sincerely,

Bobby R. Adcock
RSO, MSC

Attachment 1.

Comparison of Reg. Guide 1.86 Released 304 Sheet Stainless Steel with 304 Stainless Steel made from Decontaminated Nickel

The following tables compare the activities from surface contamination and volumetric contamination of stainless steels of varying thicknesses. The volumetric contamination is the result of using feed nickel with a volumetric activity of 3 bq/g in the production of the stainless steel. The surface contamination is the result of assuming uniform surface activities up to the maximum average allowable by Reg Guide 1.86, which is 5000 dpm/100 cm sq. The results indicate that up to approximately 1/4" thickness, the contamination in the steel from the use of decontaminated nickel would be less than the contamination which would be in the steel if it were released to the allowable limit under Reg Guide 1.86. The specific gravity used in calculations for stainless steel (304) was 8.02 and the maximum allowable nickel content for 304 Stainless (12%) was used (from *CRC Handbook of Chemistry and Physics, 71st Ed.*).

Sheet, Stainless, 4' x 8' x 3/64"

width	48 in	121.92 cm
height	96 in	243.84 cm
thickness	3/64 in	0.119 cm
Surface Area	9230 sq in	59 545 sq cm
Volume	216 cu in	3 540 cc
Mass	-	28 388 g

Max contamination from surface @ Reg Guide 1.86 levels
49 621 bq *or* 5 000 dpm/100 cm sq

Max contamination from volume at 3 bq/g nickel
10 220 bq *or* 1 030 dpm/100 cm sq

Sheet, Stainless, 4' x 8' x 1/16"

width	48 in	121.92 cm
height	96 in	243.84 cm
thickness	1/16 in	0.159 cm
Surface Area	9234 sq in	59 574 sq cm
Volume	288 cu in	4 719 cc
Mass	-	37 850 g

Max contamination from surface @ Reg Guide 1.86 levels
49 645 bq *or* 5 000 dpm/100 cm sq

Max contamination from volume at 3 bq/g nickel
13 626 bq *or* 1 372 dpm/100 cm sq

Sheet, Stainless, 4' x 8' x 1/8"

width	48 in	121.92 cm
height	96 in	243.84 cm
thickness	1/8 in	0.318 cm
Surface Area	9252 sq in	59 690 sq cm
Volume	576 cu in	9 439 cc
Mass	-	75 700 g

Max contamination from surface @ Reg Guide 1.86 levels
49 742 bq *or* 5 000 dpm/100 cm sq

Max contamination from volume at 3 bq/g nickel
27 252 bq *or* 2 739 dpm/100 cm sq

Sheet, Stainless, 4' x 8' x 3/16"

width	48 in	121.92 cm
height	96 in	243.84 cm
thickness	3/16 in	0.476 cm
Surface Area	9270 sq in	59 806 sq cm
Volume	864 cu in	14 158 cc
Mass	-	113 551 g

Max contamination from surface @ Reg Guide 1.86 levels
49 839 bq *or* 5 000 dpm/100 cm sq

Max contamination from volume at 3 bq/g nickel
40 878 bq *or* 4 101 dpm/100 cm sq

Sheet, Stainless, 4' x 8' x 1/4"

width	48 in	121.92 cm
height	96 in	243.84 cm
thickness	1/4 in	0.635 cm
Surface Area	9288 sq in	59 922 sq cm

Max contamination from surface @ Reg Guide 1.86 levels
49 935 bq *or* 5 000 dpm/100 cm sq

Max contamination from volume at 3 bq/g nickel
54 504 bq *or* 5 457 dpm/100 cm sq

MHK
JMK

Manufacturing Sciences Corporation

A BNFL Inc. Company

The Metals Recycling Specialists

Thursday, February 18, 1999

Mr. Mike Mobley
Ms. Joelle Key
State of Tennessee
Division of Radiological Health
3rd Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1532

Dear Mike and Joelle:

During the meeting of the 20th of January at the MSC Kerr Hollow Road site, you requested some additional information regarding certain issues. You have received our information regarding two of the items mentioned during the meeting of the 20th, and this letter with enclosures provides information on the remaining item of slag leachability.

On February 5th, an open air test melt was performed in order to simulate secondary melter foundry conditions and produce slag. The test melt feed nickel weight was 11.76 pounds which yielded 11.64 pounds of nickel re-melt and 0.12 pounds of slag, approximately 1% (a 5% yield of slag was used in the Risk Assessment). The slag material was subjected to various tests including TCLP. The results are included in Enclosure 1.

It was learned that the slag material meets the RCRA Metals TCLP leachability standard following typical TCLP methodology. In fact, the slag material is so insoluble that it required a combination of concentrated nitric and hydrofluoric acids just to dissolve approximately 40 % of a mass, with the remainder not going into solution at all.

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ICP analysis of the TCLP filtrate did not reveal any items of concern with regard to the standard elements. Liquid scintillation analysis of the TCLP filtrate showed no detectable Tc-99 and also that only 9.7 % of the uranium in the slag was leachable. The proportion of nickel (and subsequently Tc-99) in the slag was less than expected, approximately 40 % with the remainder of the slag being composed primarily of silicon and oxygen components from the refractory lining.

If there is any additional items you would like to have more information on, please contact me or Eric Miller at 423.481.0455.

Sincerely,

Bobby R. Adcock,
RSO Manufacturing Sciences Corporation

Enclosure 1. TCLP Data on Replicated Secondary Melter Slag

Table 1. Slag Composition

Element	*% Composition*
Nickel	~ 40 %
Uranium	<< 0.01 %
Tc-99	<< 0.01 %
Other (Si, O, trace elements)	~ 60 %

Table 2. Metal Activity *via* LSC

Element	*Ingot*
Uranium	18.9 Bq/g
Tc-99	196.5 Bq/g

Table 3. Slag Activity *via* LSC

Element	*Activity*
Uranium	5.3 Bq U/g slag
Tc-99	30.3 Bq Tc^{99} /g slag

Table 4. TCLP Filtrate Results for RCRA Metals *via* ICP

Element	*Concentration*	*EPA Limit*
Arsenic	< 0.21 mg/L	5 mg/L
Barium	0.48 mg/L	100 mg/L
Cadmium	< 0.004 mg/L	1 mg/L
Chromium	0.44 mg/L	5 mg/L
Lead	0.14 mg/L	5 mg/L
Silver	< 0.08 mg/L	1 mg/L
Selenium	< 0.3 mg/L	1 mg/L

Table 5. Tc-99 and Uranium Analysis of TCLP Filtrate *via* LSC

Element	*Activity (Bq/mL)*	*% Leached*
Uranium	0.026 Bq/mL	9.7 %
Tc-99	0 Bq/mL	0 %

Please note that the activities here are much greater than activities from nickel that would be released and re-melted nickel. The melt stock or feed material for this test was not decontaminated, however the percent leached is representative.

3/24 ~~JMK~~
~~3/25/99 MHM~~
JCG

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
OFFICE CORRESPONDENCE

DATE: March 24, 1999

TO: JCG, MHM

FROM: JMK

SUBJECT: MSC license request for Unrestricted Release of Decontaminated Nickel

Manufacturing Science Corporation (MSC) has submitted a license request to amend license number R-01078-L00. The request is titled "License Amendment Request for Unrestricted release of Decontaminated Nickel" and is dated December 8,1998, with supporting letters dated January 18, 1999; January 29, 1999 and February 18, 1999. Based on the attached analysis which shows that their proposal is conservative compared to other widely accepted regulations, and the very specific targeted pathways analyses submitted by MSC, I recommend approval of this license request.

Comparison of proposed release of volumetrically contaminated nickel to releases under RegGuide 1.86.

The MSC proposal would release nickel contaminated with a maximum per ingot 162 pCi/g Tc-99 and 16.2 pCi/g of Uranium (including U-234, U-235 and U-238). Thus the maximum contamination for any one ingot would be 178 pCi/g. The average for any single shipment will be half or 89 pCi/g. Material released from this process can reasonably be expected to be melted into another material such as stainless steel.

A release of contaminated nickel under RegGuide 1.86 would allow for an average surface contamination in the amount of 5000 dpm/100cm^2 combined Uranium and Tc-99. There is also a maximum surface contamination limit of 15000 dpm/100 cm^2 for an area of 100 cm^2 or less. Once the nickel is released under RegGuide 1.86 it will likely be melted to be used in another material such as stainless steel.

To be conservative, I will compare the maximum volumetric contamination of a single ingot to the average contamination under RegGuide 1.86.

Given: (the proposal contains references for these numbers)
Density of 304 stainless steel – 8.02 g/cc
Percentage of nickel in 304 stainless steel – 12%

Volumetric calculation:

Starting with an ingot of 178 pCi/g and melting it into 304 stainless steel.

$178 pCi/g \times 0.12 = 21.4 pCi/g$

Using the density of 304 stainless steel to convert cubic meters to grams.

RegGuide 1.86 calculation:

Starting with a sheet of nickel with surface contamination of 5000 dpm/100 cm^2. To be conservative I will assume that the metal is only contaminated on one side although RegGuide 1.86 would allow the contamination to be on both sides. When this metal is melted to make it part of the stainless steel the contamination which was on the surface spreads into the metal and thus results in steel with volumetric contamination. I will start with a sheet of nickel that is half an inch (1.3 cm) thick, although this is unusually thick compared to the metal we typically see free released using RegGuide 1.86 standards.

$$\frac{5000 dpm/cm^2}{1.3 cm} = 3846 dpm/cc$$

Converting surface contamination to equivalent volumetric contamination.

$$3846 dpm/cc \times \frac{1 pCi}{2.2 dpm} = 1748 pCi/cc$$

Converting dpm to pCi in nickel

$$1748 pCi/cc \times 0.12 = 209.8 pCi/cc$$

304 stainless steel only contains 12% nickel

$$209.8 pCi/cc \div 8.02 g/cc = 26 pCi/g$$

Using the density of 304 stainless steel to convert cubic meters to grams.

The stainless steel produced from nickel released under RegGuide 1.86 with only half the possible allowed surface contamination, on half inch thick nickel plate could have as much as 26pCi/g of contamination. This is again a conservative assumption because in reality the metal could be stainless steel and be released directly under RegGuide 1.86. If this were the case then the contamination in the steel would no longer have the 12% dilution factor. Nickel with the volumetric contamination in this proposal would at most result in stainless steel with 21.4 pCi/g of contamination. And since this is using the maximum for one ingot there could at most be a very limited amount at this concentration. It is more reasonable to assume the average volumetric contamination for a shipment which would be half and therefore stainless steel made from only this nickel would have only slightly more than 10 pCi/g contamination.

In conclusion, the current proposal by MSC for the free release of volumetrically contaminated nickel is much more conservative than releases made under the widely accepted RegGuide 1.86 standards.

November 15, 1999

Our original comparison of the volumetrically contaminated nickel to materials released under Regulatory Guide 1.86 included a number of conservatisms not considered in the approach used by MSC. These calculations are based on more reasonable assumptions although there is still a number of conservative assumptions. This presents a more realistic approach, rather than the overly conservative assumptions used previously.

Metals, including stainless steel, are currently being released with surface contamination limits established by Regulatory Guide 1.86. According to this guidance, material may be released with residual activity levels of 5000 dpm/100 cm^2. It is reasonable to assume a typical thickness for this metal of 0.5 cm (approx. 0.2 inch), with contamination on both sides. Assuming the density of stainless steel to be 8.02 g/cm^3, when melted the resulting volumetric activity would be:

$$\frac{5000dpm + 5000dpm}{100cm^2} \times \frac{1}{0.5cm} = 200dpm/cc$$

$$\frac{200dpm}{cc} \times \frac{cc}{8.02g} = \frac{24.9dpm}{g}$$

$$\frac{24.9dpm}{g} \times \frac{1pCi}{2.2dpm} = 11.3pCi/g$$

It is conservative to assume that all of the nickel in a batch of stainless steel is this processed nickel. Typically only 4% unalloyed nickel is added to the stainless steel. As a conservative assumption it is assumed that 12% of the nickel in the steel is all the processed unalloyed nickel. The nickel, which is being released at 3 Bq/g Tc-99 and 0.3 Bq/g uranium, when alloyed into stainless steel, yields a stainless steel with levels of:

$$3.3Bq/g \times 0.12 = 0.39Bq/g$$

$$0.39Bq/g \times \frac{1pCi}{0.036Bq} = 11pCi/g$$

4/8 ~~JCG~~
same amendment subject as Amendment 56 & S-01046 approved 3/26

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 18

License Number R-01078-L00

Manufacturing Sciences Corporation
804 Kerr Hollow Road
Oak Ridge, Tennessee 37830

Attention: Bobby R. Adcock, Radiation Safety Officer

Gentlemen:

As requested by Bobby R. Adcock and in accordance with his letters dated December 8, 1998, with attachments, January 18, 1999, with attachments, and February 18, 1999, with attachment, your Tennessee Radioactive Material License number R-01078-L00 is amended as follows:

To add Condition 32. This condition will read as follows:

32. The licensee is authorized in accordance with statements, representations, and procedures contained in letters dated December 8, 1998, with attachments, January 18, 1999, with attachments, and February 18, 1999, with attachment, to conduct unrestricted release of U.S. D.O.E. volumetrically contaminated nickel metal. Nickel metal from the U.S. D.O.E. shall be decontaminated in accordance with procedures approved by the Department and unrestricted release of the decontaminated metal will be based on currently accepted removable surface contamination release criterion (U.S. N.R.C. Regulatory Guide 1.86) with an additional volumetric contamination release for ^{99}Tc of an average of 3Bq/g (180 dpm beta/g or 81 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 6Bq/g (360 dpm beta/g or 162 pCi/g). The release criteria for uranium (inclusive of ^{234}U, ^{235}U, and ^{238}U, all of which are considered in total) will be an average of 0.3 Bq/g (18 dpm/g or 8.1 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 0.6 Bq/g (36 dpm alpha/g or 16.2 pCi/g).

To change Condition 22. This condition will now read as follows:

22. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 8, and 9 of this license in accordance with statements, representations, and procedures contained in application dated April 20, 1995, with attachments, and letter dated November 29, 1995, from Alan L. Liby, and Irrevocable Standby Letter of Credit number TS-10030065, issued by Credit Suisse, and letters dated July 16, 1995, with attachments, August 20, 1995, with attachments, October 3, 1995, with attachment, April 9, 1996, with attachments, May 24, 1996, with attachments, August 8, 1996, with attachments, January 16, 1997, with attachments, March 19, 1997, with attachments, June 16, 1997, with attachments, July 14, 1997, July 30,1997, and August 12, 1997, with attachments, Volume II Radiation Protection Program manual dated February 1995, letter dated October 17, 1997, January 15, 1998, with attachments, February 24, 1998, with attachments, telephone conversation with Bobby Adcock on March 27, 1998, letters dated May

Form RHS 8-7A
(9-92)

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 18

License Number R-01078-L00

12, 1998, with attachments, September 14, 1998, with attachments, October 30, 1998, November 2, 1998, December 8, 1998, with attachments, January 14, 1999, with attachments, January 18, 1999, with attachments, January 21, 1999, with attachments, and February 18, 1999, with attachment.

This amendment is considered effective March 26, 1999.

All other parts of this license remain unchanged.
Date April 8, 1999

For the Commissioner
Tennessee Department of
Environment and Conservation

By [signature]
Johnny C. Graves
Licensing, Registration, Planning Manager
Division of Radiological Health

Form RHS 8-7A
(9-92)

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 20

License Number R-01078-L00

Manufacturing Sciences Corporation
804 Kerr Hollow Road
Oak Ridge, Tennessee 37830

Attention: Bobby R. Adcock, Radiation Safety Officer

Gentlemen:

As requested by Bobby R. Adcock and in accordance with his letter dated September 10, 1999, with attachments, your Tennessee Radioactive Material License Number R-01078-L00 is amended as follows:

To add Condition 33. This condition will read as follows:

33. The licensee is authorized to institute Phase III changes to the Recycle Facility to accommodate security for melting Classified Diffusion Barrier in accordance with statements, representation, and procedures contained in letter dated September 10, 1999, with attachments. The licensee shall afford representatives of the Department with appropriate security clearance the opportunity to inspect the procedures and activities instituted as a result of these changes. This amendment does not authorize additional changes to the declassification melting in the Manufacturing Facility or other changes to the Nickel Electrorefining Plant.

To change Condition 22. This condition will now read as follows:

22. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 8, and 9 of this license in accordance with statements, representations, and procedures contained in application dated April 20, 1995, with attachments, and letter dated November 29, 1995, from Alan L. Liby, and Irrevocable Standby Letter of Credit number TS-10030065, issued by Credit Suisse, and letters dated July 16, 1995, with attachments, August 20, 1995, with attachments, October 3, 1995, with attachment, April 9, 1996, with attachments, May 24, 1996, with attachments, August 8, 1996, with attachments, January 16, 1997, with attachments, March 19, 1997, with attachments, June 16, 1997, with attachments, July 14, 1997, July 30,1997, and August 12, 1997, with attachments, Volume II Radiation Protection Program manual dated February 1995, letter dated October 17, 1997, January 15, 1998, with attachments, February 24, 1998, with attachments, telephone conversation with Bobby Adcock on March 27, 1998, letters dated May 12, 1998, with attachments, September 14, 1998, with attachments, October 30, 1998, November 2, 1998, December 8, 1998, with attachments, January 14, 1999, with attachments, January 18, 1999, with attachments, January 21, 1999, with attachments, January 29, 1999, with attachment, February 18, 1999, with attachment, and September 10, 1999, with attachments.

Form RHS 8-7A
(9-92)

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 20

License Number R-01078-L00

All other parts of this license remain unchanged.
Date October 1, 1999

For the Commissioner
Tennessee Department of
Environment and Conservation

By [signature]
Johnny C. Graves
Licensing, Registration, Planning Manager
Division of Radiological Health

Form RHS 8-7A
(9-92)

Mailed by JCH on 7/14/9

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 19

License Number R-01078-L00

Manufacturing Sciences Corporation
804 Kerr Hollow Road
Oak Ridge, Tennessee 37830

Attention: Bobby R. Adcock, Radiation Safety Officer

Gentlemen:

To correct an error in Amendment 18 of this license due to the omission of references to a letter from the licensee dated January 29, 1999, with attachment, your Tennessee Radioactive Material License Number R-01078-L00 is amended as follows:

To change Conditions 22 and 32. These conditions will now read as follows:

22. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 8, and 9 of this license in accordance with statements, representations, and procedures contained in application dated April 20, 1995, with attachments, and letter dated November 29, 1995, from Alan L. Liby, and Irrevocable Standby Letter of Credit number TS-10030065, issued by Credit Suisse, and letters dated July 16, 1995, with attachments, August 20, 1995, with attachments, October 3, 1995, with attachment, April 9, 1996, with attachments, May 24, 1996, with attachments, August 8, 1996, with attachments, January 16, 1997, with attachments, March 19, 1997, with attachments, June 16, 1997, with attachments, July 14, 1997, July 30,1997, and August 12, 1997, with attachments, Volume II Radiation Protection Program manual dated February 1995, letter dated October 17, 1997, January 15, 1998, with attachments, February 24, 1998, with attachments, telephone conversation with Bobby Adcock on March 27, 1998, letters dated May 12, 1998, with attachments, September 14, 1998, with attachments, October 30, 1998, November 2, 1998, December 8, 1998, with attachments, January 14, 1999, with attachments, January 18, 1999, with attachments, January 21, 1999, with attachments, January 29, 1999, with attachment, and February 18, 1999, with attachment.

32. The licensee is authorized in accordance with statements, representations, and procedures contained in letters dated December 8, 1998, with attachments, January 18, 1999, with attachments, January 29, 1999, with attachment, and February 18, 1999, with attachment, to conduct unrestricted release of U.S. D.O.E. volumetrically contaminated nickel metal. Nickel metal from the U.S. D.O.E. shall be decontaminated in accordance with procedures approved by the Department and unrestricted release of the decontaminated metal will be based on currently accepted removable surface contamination release criterion (U.S. N.R.C. Regulatory Guide 1.86) with an additional volumetric contamination release for ^{99}Tc of an average of 3Bq/g (180 dpm beta/g or 81 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 6Bq/g (360 dpm beta/g or 162 pCi/g). The release criteria for uranium (inclusive of ^{234}U, ^{235}U, and ^{238}U, all of which are considered in total) will be an average of 0.3 Bq/g (18 dpm/g or 8.1 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 0.6 Bq/g (36 dpm alpha/g or 16.2 pCi/g).

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(5-92)

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 19

License Number R-01078-L00

This amendment is considered effective March 26, 1999.

All other parts of this license remain unchanged.
Date July 13, 1999

For the Commissioner
Tennessee Department of
Environment and Conservation

By [signature]
Johnny C. Graves
Licensing/Registration, Planning Manager
Division of Radiological Health

3/26 JCG
3/29 LEN
mailed 3/29/99 3/26 NHH
8FG

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 56

License Number S-01046-L00

Manufacturing Sciences Corporation
804 Kerr Hollow Road
Oak Ridge, Tennessee 37830

Attention: Bobby R. Adcock, Radiation Safety Officer

Gentlemen:

As requested by Bobby R. Adcock and in accordance with his letters dated December 8, 1998, with attachments, January 18, 1999, with attachments, and February 18, 1999, with attachment, your Tennessee Radioactive Material License number S-01046-L00 is amended as follows:

To add Condition 30. This Condition will read as follows:

30. The licensee is authorized in accordance with statements, representations, and procedures contained in letters dated December 8, 1998, with attachments, January 18, 1999, with attachments, and February 18, 1999, with attachment, to conduct unrestricted release of U.S. D.O.E. volumetrically contaminated nickel metal. Nickel metal from the U.S. D.O.E. shall be decontaminated in accordance with procedures approved by the Department and unrestricted release of the decontaminated metal will be based on currently accepted removable surface contamination release criterion (U.S. N.R.C. Regulatory Guide 1.86) with an additional volumetric contamination release criteria for ^{99}Tc of an average of 3Bq/g (180 dpm beta/g or 81 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 6 Bq/g (360 dpm/g or 162 pCi/g). The release criteria for uranium (inclusive of ^{234}U, ^{235}U, and ^{238}U, all of which are considered in total) will be an average of 0.3 Bq/g (18 dpm/g or 8.1 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 0.6 Bq/g (36 dpm alpha/g or 16.2 pCi/g).

To change Condition 23. This Condition will now read as follows:

23. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 8, and 9 of this license in accordance with statements, representations, and procedures contained in application dated April 29, 1994, with attachments, and letters dated January 14, 1994, July 20, 1994, November 3, 1994, with attachments, January 4, 1995, with attachments, January 18, 1995, with attachments, March 15, 1995, with attachments, and July 16, 1995, with attachments, and Volume II Radiation Protection Program manual dated February 1995, and letters dated April 9, 1996, with attachments, May 24, 1996, with attachments, August 8, 1996, with attachments, January 15, 1997, with attachment, January 16, 1997, with attachments, March 19, 1997, with attachments, May 27, 1997, with attachments, July 14, 1997, with attachments, August 12, 1997, with attachments, October 15, 1997, December 30, 1997,

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 56

 License Number S-01046-L00

January 15, 1998, with attachments, February 24, 1998, with attachments, telephone conversation with Bobby Adcock on March 27, 1998, letters dated February 27, 1998, with attachments, March 3, 1998, March 24, 1998, with attachments, April 6, 1998, with attachments, May 12, 1998, with attachments, October 30, 1998, with attachments, December 8, 1998, with attachments, January 14, 1999, with attachments, January 18, 1999, with attachments, and February 18, 1999, with attachment.

All other parts of this license remain unchanged.
Date March 26, 1999

For the Commissioner
Tennessee Department of
Environment and Conservation

By Johnny C. Graves
Johnny C. Graves
Licensing, Registration, Planning Manager
Division of Radiological Health

Form RHS 8-7A
(9-92)

Mailed by JCA on 7/14/99

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 57

License Number S-01046-L00

Manufacturing Sciences Corporation
804 Kerr Hollow Road
Oak Ridge, Tennessee 37830

Attention: Bobby R. Adcock, Radiation Safety Officer

Gentlemen:

To correct an error in Amendment 56 of this license due to the omission of references to a letter from the licensee dated January 29, 1999, with attachment, your Tennessee Radioactive Material License Number S-01046-L00 is amended as follows:

To change Conditions 23 and 30. These conditions will now read as follows:

23. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 8, and 9 of this license in accordance with statements, representations, and procedures contained in application dated April 29, 1994, with attachments, and letters dated January 14, 1994, July 20, 1994, November 3, 1994, with attachments, January 4, 1995, with attachments, January 18, 1995, with attachments, March 15, 1995, with attachments, and July 16, 1995, with attachments, and Volume II Radiation Protection Program manual dated February 1995, and letters dated April 9, 1996, with attachments, May 24, 1996, with attachments, August 8, 1996, with attachments, January 15, 1997, with attachment, January 16, 1997, with attachments, March 19, 1997, with attachments, May 27, 1997, with attachments, July 14, 1997, with attachments, August 12, 1997, with attachments, October 15, 1997, December 30, 1997, January 15, 1998, with attachments, February 24, 1998, with attachments, telephone conversation with Bobby Adcock on March 27, 1998, letters dated February 27, 1998, with attachments, March 3, 1998, March 24, 1998, with attachments, April 6, 1998, with attachments, May 12, 1998, with attachments, October 30, 1998, with attachments, December 8, 1998, with attachments, January 14, 1999, with attachments, January 18, 1999, with attachments, January 29, 1999, with attachment, and February 18, 1999, with attachment.

30. The licensee is authorized in accordance with statements, representations, and procedures contained in letters dated December 8, 1998, with attachments, January 18, 1999, with attachments, January 29, 1999, with attachment, and February 18, 1999, with attachment, to conduct unrestricted release of U.S. D.O.E. volumetrically contaminated nickel metal. Nickel metal from the U.S. D.O.E. shall be decontaminated in accordance with procedures approved by the Department and unrestricted release of the decontaminated metal will be based on currently accepted removable surface contamination release criterion (U.S. N.R.C. Regulatory Guide 1.86) with an additional volumetric contamination release criteria for ^{99}Tc of an average of 3Bq/g (180 dpm beta/g or 81 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 6 Bq/g (360 dpm/g or 162 pCi/g). The release criteria for uranium

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

RADIOACTIVE MATERIAL LICENSE

Amendment 57

 License Number S-01046-L00

(inclusive of ^{234}U, ^{235}U, and ^{238}U, all of which are considered in total) will be an average of 0.3 Bq/g (18 dpm/g or 8.1 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 0.6 Bq/g (36 dpm alpha/g or 16.2 pCi/g).

This amendment is considered effective March 26, 1999.

All other parts of this license remain unchanged.
Date July 13, 1999

For the Commissioner
Tennessee Department of
Environment and Conservation

By Johnny C. Graves
Johnny C. Graves
Licensing, Registration, Planning Manager
Division of Radiological Health

JCG

Manufacturing Sciences Corporation

A BNFL Inc. Company

The Metals Recycling Specialists

September 10, 1999

Mr. Johnny Graves
Tennessee Division of Radiological Health
Department of Environment and Conservation
3rd Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1532

Dear Mr. Graves:

It is requested that MSC License number R-01078-L00 be amended to authorize MSC to implement Phase III of the expansion of the Recycle Facility to receive metal from the ETTP Project. Phase I and II have been implemented in accordance with Amendments 12 and 17.

Phase III will be the changes to the Recycle Facility to accommodate security for melting Classified Diffusion Barrier (enclosure 1). The only radiologically significant change will be to construct a van part in the wall between the incoming storage area and the foundry area. This will allow us to bring a secure sea van to the port and unload into the secured foundry. The van port will be identical to the two van ports between incoming storage and specials areas added in accordance with Amendment 6 dated July 15, 1997. These two van ports have been operated for two years without any difficulties. All precautions identified in my June 16, 1997 and July 14, 1997 letters will be followed.

The original plan was to do the declassification melting in the Manufacturing Facility and to build the Nickel Electrorefining Plant in the Recycle Facility. This has changed and I will be requesting an amendment to the Manufacturing Facility License (S-01046-L00) in the near future.

Please let me know if additional information is needed.

Sincerely,

Bobby R. Adcock,
Radiation Safety Officer

BRA:dmw

Encl: 1

804 Kerr Hollow Road Oak Ridge, TN 37830 Phone (423)481-0455 Fax (423)481-3142

Changes to the Recycle Facility to Accommodate Security for Melting Classified Diffusion Barrier

T.R. MUTH
Date: 8/26/99

1.1 Purpose

Recovery of nickel diffusion barrier from the three building decontamination and decommissioning (D&D) project of K-33, K-31, and K-29 requires melting. The barrier is considered classified restricted data (CRD) and must be safe guarded until the nickel is molten in a furnace. This document describes the facility modifications to accommodate the security needs.

1.2 Background

British Nuclear Fuels (BNFL) Inc has a contract with the department of energy to decontaminate and decommission three buildings at the ETTP sight; K-33, K-31, and K-29. As part of that D&D effort Manufacturing Sciences Corporation (MSC) has a subcontract with BNFL, Inc to disposition the evolved metals. That disposition includes cleaning metals for free release and subsequent recycle; disposing of metals that cannot be economically cleaned; and recycling of 6000 tons of nickel diffusion barrier. The diffusion barrier is considered CRD material. To destroy classified attributes the nickel must be melted. It is estimated that 6000 tons will be melted to accomplish declassification and subsequent resale.

Once melted the cast metal is deemed unclassified. A generic map of MSC's Kerr Hollow Road facility is shown in figure 1 with the modifications highlighted. It is recommended that the reader, remove the map and keep it handy during the reading of this text.

1.3 Processes Requiring Security Safeguards

The processes occurring at MSC's Kerr Hollow Road facility that require security safeguards are: receipt of barrier material; transport of barrier material to the foundry portal; unload into secure storage; transfer to a charging hopper for installation on the melting furnace; and melting the barrier. Once melted the barrier is deemed declassified. After melting the molten nickel is metallurgically refined and finally cast into ingot. After casting the ingot will be considered unclassified material and will be processed accordingly.

1.3.1 Receipt of Material

Diffusion barrier will be packaged at the ETTP site in drums and stored until MSC, Kerr Hollow Road, is prepared to accept a full shipment.. The secure sealand will arrive at the transportation bay designated as Area 1 in figure 1, and be greeted by L-cleared personnel to accept the shipment from the L-cleared transportation personnel. The shipping manifest will be verified and the shipment entered into MSC's material information system (MIS), to verify that the 350 gram site limits for ^{235}U are met. Once the shipment is entered into MSC's system the sealand will be off loaded (without opening) via the overhead crane and placed at the entry point to the foundry, designated Area 2 on figure 1. The Area 2 portal is new and is referenced here to TDEC for review and approval. The ventilation remains negative in the foundry area such that contamination, if any remain inside the foundry.

1.3.2 Unloading into a secure area

Once the sealand container is positioned at the foundry portal the overhead door of the portal will be raised, the end loading doors will be opened and the drums removed via pallet truck and forklift by L-cleared foundry personnel The drums will be placed in Area 3 of figure 1 where security locks restrict access to the casual observer. Once the Sealand is unloaded it will be radiologically surveyed and released as appropriate. Once deemed radiologically clean it will be moved back from the portal. The portal door will be lowered and the foundry secured from access through the transportation bay.

2.0 Security Safeguards During Declassification Melts

Refer to figure 1 .The portal to the foundry via the transportation bay will be opened to allow for docking of the sealand (Area 2 on the map). During docking the portal will be guarded by L-cleared personnel to alert others in the transportation bay that access is restricted. Once docked the portal will be sealed sufficient to deny visual access to the foundry.

When docked and visually secured the sealand will be promptly unloaded with the contents being immediately delivered to the storage are (Area 3). Once unloaded, the sealand will be closed, undocked and removed from the foundry access portal. The access door will be closed and locked from the inside. Sealand containers that require docking at the foundry portal are allowed to do so when L-cleared personnel open the door from the inside. The L-cleared personnel will insure that visual access to classified material is denied during opening of the portal door.

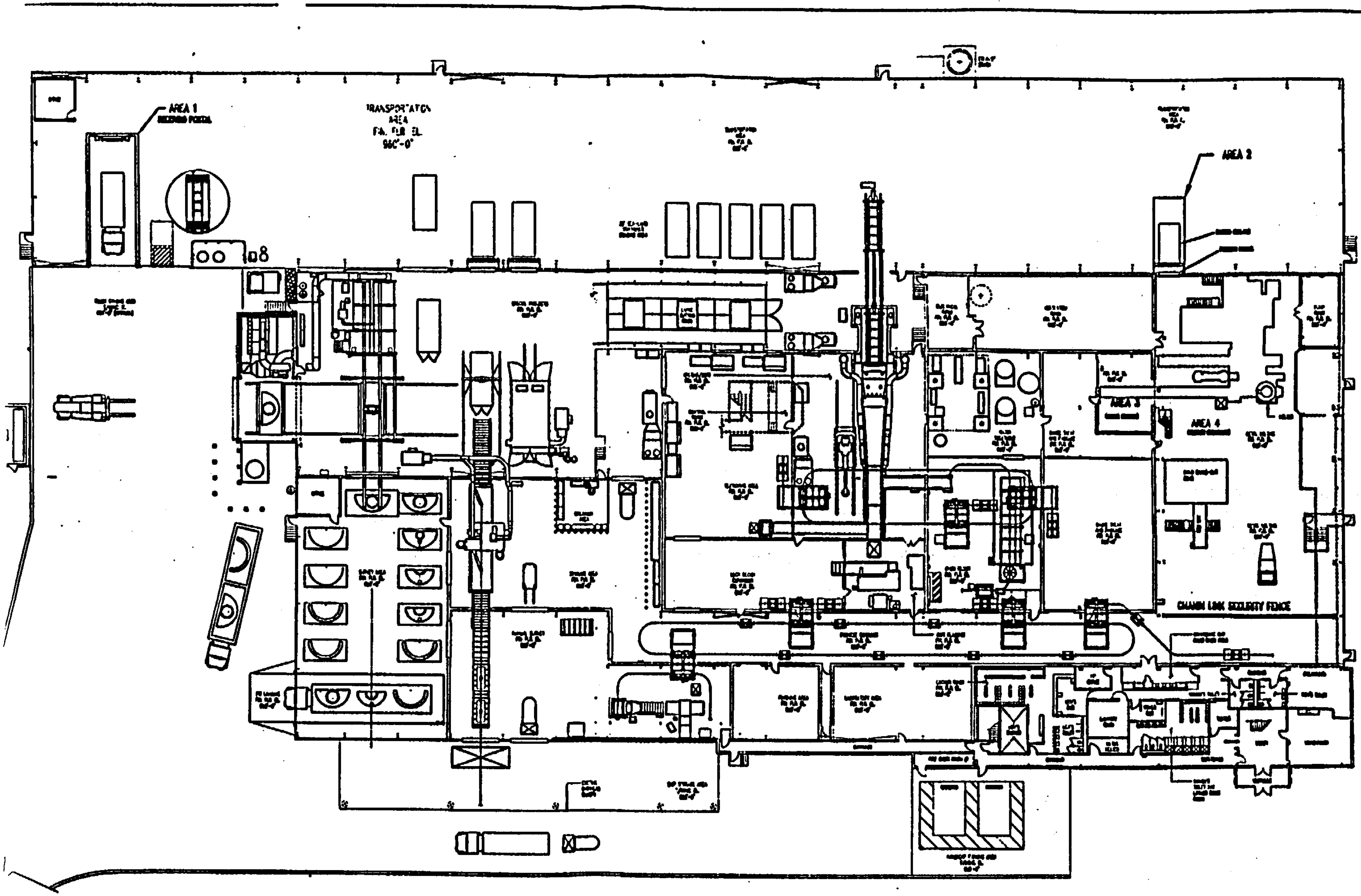
Area 3, the secure storage, has a personnel door labeled *A* and two roll-up doors *B* and *C*. The personnel door will be locked and alarmed with access only by L-cleared personnel. There is no functional routine use for this door. Roll-up door *B* will be locked from the inside of the secure storage room and rarely used. It too has no routine use. Roll-up door *C* will be used on a regular basis to remove material from the storage area, to load barrier into the charging device of the furnace and to store classified cleaning equipment and other tools. When loading and unloading is complete the room will be locked from the foundry side with L-cleared personnel are custodians of the keys.

A chain link fence with privacy slats and visual obstructions will be installed between the crane support beams as shown in figure 1 (Area 4). The fence is necessary to provide a physical barrier to the casual observer. In addition it is at a sufficient distance from the foundry melting activities to eliminate access to any classified attributes even during off-normal events. The fence will have restricted access via a lock / key. Only those with L-clearances will have key access. The fence will have a personnel gate and a forklift gate, both of which remain locked during operation except for necessary traffic of materials and personnel. When the gates are required to be open a buddy system will be employed. Two people, both L-cleared, are required to be in attendance for exit and entry through the secure fence. With this philosophy the openings are always attended when unsecure.

All emergency egress doors for exiting the building (labeled *D*, *E* and *F* on the drawing) will be alarmed and stay alarmed during operations. In the event of an emergency that requires evacuation those doors, when used, will alarm. Door *G* is an internal door and is not used for routine activities. The door will be alarmed at all times. It is an emergency escape route for personnel located in the waste treatment section of the plant and as such the door will not be locked.

Access to the ventilation room is periodic and the double doors *H* will be locked from the foundry side. L-cleared personnel will control access. During necessary excursions to the ventilation room by uncleared personnel, L-cleared escorts will be used. No melting or barrier handling activities will be performed during the escorting activities. Barrier and ancillary equipment where residual barrier can be accessed will be secured prior to escorting activities.

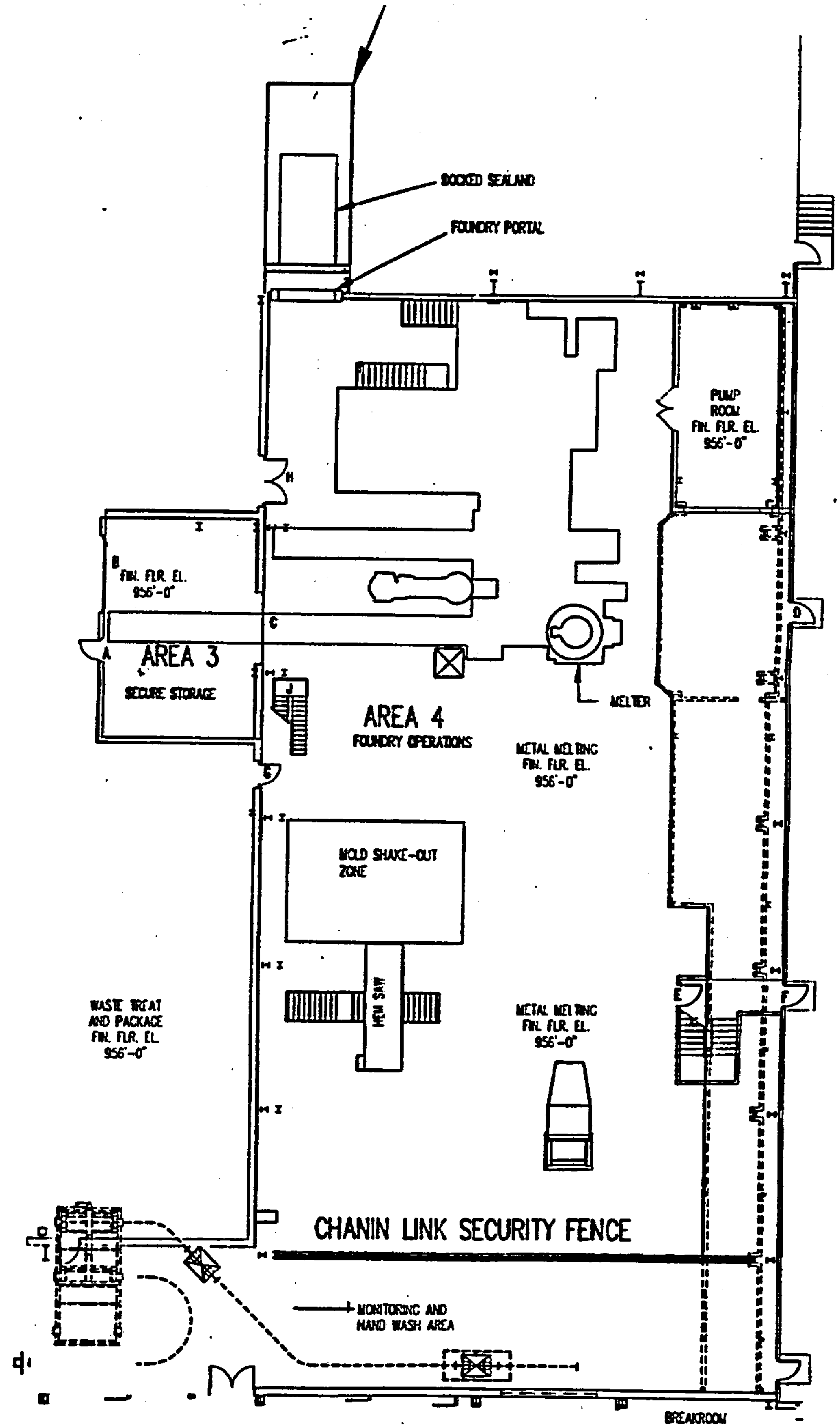
The HEPA filters for the recycle facility are accessed through door *J* at the top of the staircase in Area 4. Periodically health physics personnel will need to access to this location. The door is locked from the Area 4 side; access to the door is only through the security fence. An L-cleared escort will be required when uncleared health physics personnel require access to this room. No melting or barrier handling activities will be performed during the escorting activities. Barrier and ancillary equipment where residual barrier can be accessed will be secured prior to escorting activities.



MANUFACTURING SCIENCES CORPORATION – RECYCLE FACILITY

SCALE: 1/16" = 1'-0"

MANUFACTURING SCIENCES CORPORATION	
TITLE: FOUNDRY SECURITY CHANGES HIGHLIGHTED BOLD	
DATE: AUG. 26, 1999	DWG No: D651007
DRAWN BY: THOMAS R. MUTH	REV: P1
SHEET 1 OF 2	



MANUFACTURING SCIENCES CORPORATION

FOUNDRY SECURITY CHANGES HIGHLIGHTED BOLD

AUG. 26, 1999 | D651007 | P1

THOMAS R. MUTH | 2 OF 2

QUESTION 7

ATTACHMENT 6

From: Sami Sherbini
To: Anthony Huffert
Date: Tue, Jan 4, 2000 8:38 AM
Subject: Re: Stent Dose

Tony,

Your interpretation is correct. Because the doses to the organs that are included in calculating the effective dose are essentially zero, the effective dose will be zero. As you may recall, the organs included in effective dose calculations are those that are believed to be most at risk for radiation induced cancer. As you also noted, the calculation is meant to help determine if the dose over the lifetime of the person with the stent will be high enough to exceed the threshold for deterministic effects in the blood vessel. The deterministic effect in this case would be deterioration of the integrity of the blood vessel resulting from high radiation doses. Assuming the stent to be in place for say 40 years, the total dose to the vessel wall would be 5 mrem/yr x 40 yr = 200 mrem. This is far below the threshold at which any degradation in the vessel wall as a result of radiation effects would be expected, and is closer to the dose the blood vessel would receive from penetrating background radiation in 2-3 years without the stent.

>>> Anthony Huffert 01/04 8:16 AM >>>
Sami -

Thanks for your dose estimate of the stent made of contaminated nickel alloy.

In reviewing the estimate, it's my understanding that the calculated dose of 5 mrem/yr is the dose equivalent to the blood vessel only and is not a Total Effective Dose Equivalent (TEDE) dose. It's my understanding that a TEDE dose, which would take into account organ dose weighting factors, would not be appropriate for this dose estimate because the potential health effect to the blood vessel from the stent would be nonstochastic rather than stochastic, i.e., the potential degradation of the blood vessel wall is the concern rather than the induction of cancer or hereditary effects. Based on this assumption, there should be no health effect from the stent because blood vessel damage from beta radiation would occur at dose rates that are several orders of magnitude greater than 5 mrem/yr.

Please let me know if my interpretation of your dose estimate is accurate.

Tony

>>> Sami Sherbini 01/03 5:17 PM >>>
Tony,

I estimated the dose to the blood vessel from a stent made of a nickel alloy consisting of 56% by weight nickel and 44% titanium (nitonol alloy). This is the alloy used to make stents described in the manufacturer's literature. The dose was calculated to the wall of the blood vessel adjacent to the stent, which is 25 mm long. The stent surface is not solid metal, but consists of a mesh that covers about 20% of the surface of the blood vessel.

The dose was estimated to be 5 mrem/yr to the blood vessel wall, most being due to the beta radiation emitted by the uranium daughters in the nickel.

QUESTION 7

ATTACHMENT 7

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 1, 1999

NOTE TO COMMISSIONER ASSISTANTS

OCM/RM

__ Dennis Rathbun
__ Glenn Tracy
__ Alan Levin
X Patricia Holahan
X Keith McConnell
__ Rickie Beall
__ Bob McOsker
__ Marian Zobler
__ Karen Henderson
__ Terence Chan (T)
__ Barbara Gabriel
__ Frances Marek
__ Terry Agneu

OCM/GJD

__ Brad Jones
X Cynthia Jones
__ Tom Hiltz
__ Joe Olencz
__ Tom Boyce
__ Donna Smith
__ Noble Green

OCM/EM

__ Steve Crockett
X Janet Schlueter
__ James Beall
__ Jeffry Sharkey
__ Cathy Grimes
__ Linda Lewis

OCM/ND

X Maria Lopez-Otin
__ Roger Davis
__ Tony Hsia
__ Pat Castleman
__ John Lubinski
__ Vicki Bolling

OCM/JM

__ Lynne Stauss
__ Margie Doane
__ Brian McCabe
X John Thoma
__ Lorna Pini
__ Tojuana Fortune

FROM: James L. Blaha Jim
Assistant for Operations, OEDO

SUBJECT: RESPONSE TO CHAIRMAN QUESTIONS CONCERNING TWO ITEMS IN THE NOVEMBER 16, 1999 COMMISSION MEMORANDUM ENTITLED "METALS RECYCLING AT BNFL, INC."

The attached is the staff's response relating to Chairman's questions on the subject memorandum.

Attachment: As stated

cc: W. Travers, EDO (w/o attachment)
C. Paperiello, DEDMRS (w/attachment)
F. Miraglia, DEDR (w/o attachment)
P. Norry, DEDM (w/o attachment)
J. Blaha, AO (w/attachment)
N. Mamish, OEDO (w/attachment)
D. Cool, NMSS (w/o attachment)
SECY (w/attachment)
OGC (w/attachment)
OCA (w/o attachment)
OPA (w/o attachment)
EDO R/F (w/attachment)