ATG INC.
ALLIED TECHNOLOGY GROUP

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To: Mike Styvaert
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- for Distribution

From: Lee Young
Lay

Subject: **Revisions to the U.S. Army Fort McClellan 'Burial Mound' Decommissioning Plan**

Please distribute the enclosed copies of the changed elements of the Fort McClellan 'Burial Mound' Decommissioning Plan.

The entirety of the Plan narrative (Volume I) is resubmitted and supersedes the earlier version (of February 1999). Page numbering changed with some additional text. Where text editing has been altered, a vertical line has been placed in the right margin. The submittal of the full narrative is for convenient replacement of the previous text. However, actual changes are limited to:

- Title Page (date)
- Approval Page
- Table of Contents, page *iii.* (Addition of 3.6)
- Section 1.2, page 1-2
- Revised Schedule, page 2-15
- Revised Schedule, page 2-16
- Revised Schedule, page 2-17
- Revised Schedule, page 2-18
- New Section 3.6, page 3-7
- New Section 3.6, page 3-8
- Addition to References, Section 9.0, page 9-2

The technical basis document, Volume II, Appendix 6, Development of Derived Cleanup Guidelines for the Pelham Range 'Burial Mound', has been revised to reflect the appropriate scenario for the proposed unconditional release of the area. This submittal supersedes and replaces the earlier Appendix 6 after the section cover page.

Please replace the Volume I Plan Narrative and Volume II Appendix 6 in their entireties, as provided.

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U.S. Army Fort McClellan
Fort McClellan, Alabama
HQ, IOC Project Number USA 98-046

PHASE II

'BURIAL MOUND'

DECOMMISSIONING PLAN

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July 1999

U.S. ARMY FORT McCLELLAN

'BURIAL MOUND'

DECOMMISSIONING PLAN

APPROVAL PAGE

July 1999

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1.0 GENERAL INFORMATION

This Decommissioning Plan is intended to cover the scope and intent of actions necessary for the effective remediation and post-closure verification for unconditional release of the area known as the 'Burial Mound' at the Fort McClellan U.S. Army installation in Anniston, Alabama. Elements of the work are delineated in sufficient detail to ensure that the efforts are technically adequate and that adherence with requisite regulatory issues is maintained.

The present work is contracted to ATG, Inc. under Modification Number P00002 of Contract Number DAAA09-98-C-0039, by the Headquarters, U.S. Army Industrial Operations Command, Project Number USA 98-046. The internal ATG project number is 10036.01.

Fort McClellan is comprised of three parts, the Main Post, the Choccolocco Corridor, and the Pelham Range occupying 45,679 acres adjacent to Anniston, Alabama. The Main Post encompasses 19,000 acres and contains the majority of the facilities. The Choccolocco Corridor, approximately 4,500 acres, is leased from the State of Alabama and connects the Main Post with the Talladega National Forest to the east. Pelham Range consists of approximately 22,000 acres west of the Main Post.

The Army Base Closure and Realignment Committee (BRAC) has identified Fort McClellan as an installation for closure. There are several radiological issues the Army must resolve prior to closing the installation, and one of the most pressing items of concern is the 'Burial Mound' previously used as a low-level radioactive waste disposal cell. The mound is contaminated with Cs-137 and Co-60. Under the current tasking, ATG has determined acceptable site-specific concentrations for use as guideline values and has developed the comprehensive methodology to effect the removal and disposal of radiologically contaminated material in the 'Burial Mound' and perform a survey for the unconditional release of the area. Disposition of the primary and incidental secondary waste streams shall be at Envirocare of Utah, or other licensed/authorized recipient.

1.1 Origination of Contamination

The history of the base included training exercises for the Army Chemical Corp. for simulated large area radioactive contamination (fallout) from the surface detonation of a small yield (less than 0.5 kiloton) nuclear weapon. The training concept was to raise and lower sealed radioactive sources, and have students perform both ground and aerial surveys to map the radiological fallout pattern. The training facility was utilized to train Radiation Control Teams in support of nuclear weapons testing performed by the Atomic Energy Commission (AEC). There was an AEC license issued for use of the sealed sources.

There were two radiological training areas during the operational period of the mid 1950's through May of 1973, referred to as Rideout Field. The first field, referred to as "Old Rideout Field", contained approximately 600 source storage wells and was located north of Cane Creek, between West Perimeter Road and Centerline Road. The second field, referred to as "New Rideout Field", extended south of Cane Creek along Centerline Road.

The Old Rideout Field used locally fabricated Co-60 sources and higher activity commercially procured Cs-137 sources. While the Co-60 sources were used to simulate a uniform fallout pattern, the Cs-137 sources were used to simulate hot spots within the fallout pattern. The sources were raised and lowered manually from their shielded storage positions, located approximately 6' below the ground surface. An excessive number of leaking locally fabricated Co-60 sources contributed to the formation of the on-site 'Burial Mound' for use as an interim on-site disposal cell. The contaminated soil resulting from historically leaking sources was accumulated and transported to the location which is now designated as the 'Burial Mound'.

1.2 Characterization of the 'Burial Mound'

A recent radiological characterization of the 'Burial Mound' was performed by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM), reference Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound Site, Fort McClellan, Alabama, 29 August - 15 September 1995 and 14 - 28 January 1996. The survey followed much of the protocols of NUREG/CR-5849, including background determination, walkover surface scans, hole logging, and sample analysis. A total of 571 systematic random and select bias samples were analyzed for radiological parameters. Both elevated Co-60 and Cs-137 were observed in surface soil samples, but only elevated Co-60 was found in subsurface samples. The distribution of reported Co-60 concentrations ranges from undetectable levels up to 330 pCi/g, with an arithmetic mean concentration of 1.8 pCi/g. The distribution of Cs-137 concentrations range from background up to 179 pCi/g, with an arithmetic mean of 0.46 pCi/g.

There exists some concern regarding the observed heterogeneity of the 'Burial Mound' as depicted in the CHPPM report. First, an isolated speck of significant Co-60 radioactivity was discovered within one of the discrete surface soil samples. With some effort, an object approximating the "eye of a sewing needle" in size was isolated and determined to be 253,000 pCi / 0.0043 gram, which converts to a specific activity (SpA) of 58.8 uCi per gram. This SpA far exceeds the Envirocare Waste Acceptance Criteria (WAC), which for Co-60 is limited to $3.0E^4$ pCi/gm, and $6.0E^4$ pCi/gm for the Cs-137 limit.

The related concern is with the significant gamma readings recorded during hole logging when samples from the bore hole and nearby indicated only trace amounts of contamination. The trend leads toward a conclusion of significant heterogeneity within the pile. It may appear that both soluble and insoluble contamination exists, and depending on the location of any sample, an aliquot being analyzed may or may not be representative of the balance of the sample media. A remedy to ensure a comprehensive screening of the entire soil population and to serve as a rule-out to prohibit exceeding WAC limits for SpA is engineered into this Plan. (Section 2.1.1).

ATG reviewed the characterization data and developed a Sampling and Analysis Plan (SAP) to complete waste profiling of the 'Burial Mound' for acceptance for disposal at Envirocare of Utah in May 1998. On-site samples were collected by ATG during execution of the SAP, and the samples were subsequently analyzed by Mountain States Analytical, Inc. for the full suite of parameters. The original 10 meter x 10 meter grid was re-established, and 6 grids were discretely sampled to a depth of 6'. Samples were collected at 1' depth increments and field screened for gamma activity prior to shipping for laboratory analysis. The locations of sampling for waste profiling were recorded by their individual proximity within the original 10 m x 10 m grid pattern, as well as logging their respective GPS coordinates.

Preliminary acceptance of the 'Burial Mound' waste stream as LLRW (low-level radioactive waste) was received from Envirocare in October 1998. The requisite Pre-Shipment samples were subsequently forwarded to Envirocare for their footprint analysis in November 1998. Both the Waste Profile Record (EC-0230) and the Pre-Shipment Sample Record (EC-2000) provided a tentative waste delivery date of March 1999, and a tentative volume in the estimated range of 870 cubic yards. Note: Final release criteria had not been determined during waste profiling, which resulted in an estimated final volume being employed.

1.3 Summary of the Physical Description

The actual 'Burial Mound' is observed as a slight elevation standing secluded from adjacent woodlands and drainage areas by open land all around. The 'Burial Mound' is located at the northwest corner of Pelham Range, at the northern end of the Battle Drill Area of Range 24C. The mound is oblong in shape and is approximately 25 meters long by 15 meters wide at coordinates 593300 meters East, 3732500 meters North in Universal Transverse Mercator (UTM) Grid Zone 16. Ref: Industrial Radiation Study No. 27-MH-0987-R2-97, U.S. Army Center for Health Promotion and Preventive Medicine.

The mound is literally an irregular pile of soil to approximately 6' elevation above the surrounding grade, and covered with light vegetation. The footprint encompasses parts of six grids (10 m x 10 m), and contamination has been observed to a depth of 12' below grade.

The area surrounding the 'Burial Mound' is utilized as a training area for students at the U.S. Army Chemical and Military Police Schools, Active Duty Units, Reserve Units and Alabama National Guard Units. Subsequent to BRAC action, the area including the present 'Burial Mound' is to be remediated and turned over to the State for use by the National Guards in September 1999. Possible future occupancy may include bivouacking National Guards, hunters, and trespassers.

1.4 License Status

The first AEC license (BML 1-2861-1) was issued to the Chemical School in 1957. Although substantiating documents (shipping papers) have not been located, reference is made to the proper disposal of all locally fabricated Co-60 sources. Despite the reference to the proper disposal of all locally fabricated Co-60 sources, one such source was found, recovered, and properly disposed of in 1985 from the area referred to as the 'Burial Mound'. [Ref: Industrial Radiation Study No. 27-MH-0987-R2-97, U.S. Army Center for Health Promotion and Preventive Medicine.]

The radiological constituents of the 'Burial Mound' are presently accounted for under existing NRC license number 01-02861-05, docket number 030-17584, for possession and ultimate decontamination and decommissioning activities.[Ref: U.S. Army Chemical School, Radiation Protection Officer, License 01-02861-05.]

The pending remedial actions leading to the closure of the 'Burial Mound' as planned herein shall be performed under the current specific radioactive material license as implemented by the designated contractor. ATG, Inc. shall execute this Plan with oversight of the radiological protection program by the licensee. The Nuclear Regulatory Commission, Region II, is the responsible governing regulatory entity having jurisdiction over the licensed radiological health program.

An urgency exists in the need for a timely license termination immediately upon completion of the 'Burial Mound' site remediation. Other facility installations are to undergo characterization in parallel to the 'Burial Mound' activities, and are governed by the guidelines of a separate Plan. The base is to be closed under the BRAC by September 1, 1999.

2.0 DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

2.1 Decommissioning Objectives, Activities, Tasks and Schedules

The principal elements necessary to facilitate removal and disposal of radiologically contaminated portions of the 'Burial Mound' are indicated in the following breakdown. The end-goal of this remedial action is the timely and economical extraction of known contaminated material from within the 'Burial Mound" and screening/sampling it to rule-out any isolated "hot spots" which may otherwise rival the disposal facility WAC. Subsequent to addressing the impacted material from the CHPPM characterization data, the balance of material in the impacted and immediately adjacent grids will be excavated to the maximum depth in which contamination has been found nearby, and the material will be direct surveyed for sorting by concentration limits. Material will be either rejected as LLRW and staged for disposal, or alternatively accepted for use as fill and staged for future replacement in the excavation.

The soil will be monitored on a conveyor system with NaI detectors and a determined sensitivity sufficient to meet the contaminant guidelines. Systematic samples will be collected after monitoring for on-site laboratory analysis by gamma spectroscopy to determine the correlation between scan instrument sensitivity and actual concentrations in soil. Quality control measures will additionally include splitting samples at a 10% frequency with a third party laboratory.

The waste will be loaded into Intermodal containers and shipped to Envirocare for disposal, with little latency between staging and shipping. The remediated excavation area and ultimately the grounds in the area of monitoring and material staging will be surveyed and sampled following the protocols of MARSSIM. The final status survey will be performed after the final waste shipment has been completed. All samples collected during the verification survey will be analyzed initially on-site to support early demobilization, and split with a third party laboratory for comparative analysis.

A project Final Report will be prepared detailing the events of the remedial action, referencing manifests and survey records, and including release surveys of equipment and areas. Data analysis/reduction will be performed off-site, and will ensure standardization of reporting units, statistical review for adequacy of data, and a comparison of actual residual levels of radioactivity in relation to the prescribed acceptable limits.

2.1.1 Decommissioning Objectives

The objectives of the decommissioning event governed by this Plan are:

2.1.1.1 Development and consensus adoption of site specific criteria for use as guideline values for residual concentrations of the contaminants of concern (i.e., Co-60 and Cs-137) in soil, with this task being completed herein; Ref: Development of Derived Cleanup Guidelines for the Pelham Range Burial Mound, Fort McClellan, Auxier & Associates, January 1999.

2.1.1.2 The removal of the material in the vicinity of the 'Burial Mound' and immediately adjacent grounds;

Below Grade: 8 grids x 10 m x 10 m area x 3.65 m max depth	= 2,926 m^3
Slopes Sides: 14 x 10 m w. x 2.43 m depth x (4.88 m/2) l.	= 831 m^3
Above Grade: 6 grids x 10 m x 10 m area x 1.83 m max elev	= 1,098 m^3
In-Situ Volume:	4,855 m^3
Fluff Factor (Volume factor attributed to soil conditioning)	X 1.3
Removed and Processed Volume:	6,311 m^3

Ref. Attachments 1,2, and 5

2.1.1.3 In-line radiologically screening of soils via an automated conveyor / monitoring system and segregation of materials into 1)impacted (LLRW)[381 m^3]or [498 yd^3] estimated, or 2) non-impacted (backfill)[5930 m^3] with proven instrumentation sensitivity and QC verification by systematic sampling for laboratory analysis;

2.1.1.4 Shipment of LLRW to Envirocare for off-site disposal in a timely manner;

2.1.1.5 Employing results of the preceding survey and progress measurements for development of the verification survey following MARSSIM, and early implementation in the field;

2.1.1.6 Decontamination and release surveys of materials and equipment, and subsequent final waste shipment;

2.1.1.7 Submission of final report to ensure license termination prior to September 1, 1999.

2.1.1.8 Partial re-mobilization upon regulatory approval for backfill and closure of the excavation area.

TABLE 2.1.2 **Decommissioning Activities and Tasks**

Objective	Activity	Task	Description
2.1.1.1 Develop Site-Specific Criteria for Residual Contaminant Concentrations in Soil	1) Preliminary Planning Phase (completed)	1 Detailed Review of Existing Source Term	Identify key contaminants, physical area involved, and the range of existing concentrations.
		2 Preliminary Discussion w/Stakeholders to Reach Consensus	Ensure that scenarios for modeling and technical approach is mutually acceptable.
		3 Develop Concentration. Limits to Meet Dose/Risk Criteria	Apply reference data to conservative scenario for first cut at dose assessment.
		4 Resrad Code / Direct Gamma & Side Pathways	Apply reference computer code for determination of the site-specific dose based assessment
		5 Apply EPA Slope Factors / Risk Based Criteria	Cross-reference dose-based assessment to risk based criteria.
		6 Compare Designed Criteria to Pending Instrument Sensitivities	Perform reality check to ensure that the derived concentrations are within the sensitivity range of instrumentation to be employed.
		7 Submit Results of Site Specific Dose Assessment for Consensus Acceptance	Gain approval prior to adoption into the Decommissioning Plan.
			The development of site specific criteria provides technically defended concentration values with demonstrated minimal risk, while additionally achieving some economical advantage through ultimate waste volume reduction over alternative default values.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.2 Remove Contents of the 'Burial Mound" and the Immediately Adjacent Grounds	1 Mobilization	1 Instrument Calibration	Ensure that all necessary instrumentation to be used in the field are in current calibration.
		2 Refresher Training	Provide necessary refresher training, i.e., 8-hr HAZWOPER, off-site.
		3 Entry Bioassays	All project personnel to submit base line bioassay (urine) samples for third party analysis by gamma spectroscopy.
		4 Travel	Ground travel to Fort McClellan, ~ one-half day's effort from Oak Ridge, TN, from which the primary crew originates.
		5 Site Specific Training	Documented site-specific training to the Decommissioning Plan, the QA Plan, and the HASP, as well as base requirements and logistical review.
		6 Preliminary Survey	A preliminary radiological survey of the general grounds to establish suitability for use as staging / lay-down areas, and to determine background levels for placement of the soil monitoring system.
		7 Implement OE Avoidance Plan	Perform OE survey of pile and immediately adjacent grounds surface to avoid the prospect of encountering ordnance and explosives on the base. Provide continued surveillance during excavation and soil monitoring phase.

TABLE 2.1.2 **Decommissioning Activities and Tasks**

Objective	Activity	Task	Description
2.1.1.2 Remove Contents of the 'Burial Mound" and the Immediately Adjacent Grounds	1 Mobilization	8 Equipment Receipt / Set-up	Equipment will be received and set-up in locations correlating to the results of the preliminary survey. Equipment to include: Office / Lab / break area trailer, storage trailer, generators, Powerscreen modified with monitoring system, skid steer loader, and track-hoe.
		9 Install Security Fencing and Erosion Controls	Orange safety fencing (4') will be placed around the entirety of the controlled area during construction on-site. Silt fencing will be placed to prevent site erosion and/or cross-contamination into/out from the excavation area and the material staging location.
		10 Establish Control Points	A single access will be designated for equipment and vehicular traffic, and for personnel ingress/egress. Personnel frisking instrumentation will be maintained. Equipment and vehicles will require an exit survey if operated in the impacted area.
		11 Issue Radiation Work Permit (RWP)	An RWP will be issued for the remediation, re-characterization, and final survey of the Burial Mound and adjacent grounds. The RWP describes conditions and requirements for working in the area.

TABLE 2.1.2 **Decommissioning Activities and Tasks**

Objective	Activity	Task	Description
2.1.1.2 Remove Contents of the 'Burial Mound" and the Immediately Adjacent Grounds	2 Burial Mound Remediation	1 Degrub Pile	The existing underbrush and small deciduous vegetation will be removed from the Burial Mound above grade pile prior to excavation.
		2 Process Vegetation	All vegetation will be shredded on-site and treated as LLRW for disposal.
		3 Extract Known Contaminated Soil	The above grade pile and the areas of known contamination per the CHPPM characterization report will be removed and monitored first. This permits early assurance of monitoring sensitivity and allows self-decontamination of the equipment by subsequent abrasive action of soil material of less probable contamination from distant areas.
2.1.1.3 In-Line Radiological Screening of Soils for Segregation of Impacted and Non-Impacted Material	1 Burial Mound Remediation	4 Remove Balance of Area Soil	The entirety of soil contents over the 8 grids will be excavated to the 12' depth, which is the deepest observed penetration of contamination observed at a single bore sample location in the CHPPM report. All removed material will undergo direct radiological screening.
		1 Prepare, Radiological Monitor, and Sort Monitored Material	Soil will be processed to break-up the hard clay into a dispersable material, and transfer it by an enclosed chute onto a 3' wide conveyor. The conveyor is curved on the sides to contain material, and has an active area for conveyance of 2' wide. to detect less than the site-specific concentration values prescribed.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.3 In-Line Radiological Screening of Soils for Segregation of Impacted and Non-Impacted Material	1 Burial Mound Remediation	1 Prepare, Radiological Monitor, and Sort Monitored Material Contd.	An array of ten 2"x2" NaI detectors mated to alarming ratemeters and calibrated to the contaminants of concern make-up the stationary monitor under which the conveyor moves the soil. The speed is controlled along with the distance from the detectors, which results in an overall calibrated system with sufficient sensitivity.
		2 Material Sampling and Staging	An alarm of any detector will result in a manual system shut-down and rejection of the material as impacted, requiring containerization. Non-impacted soils will be segregated from impacted material and staged on clean ground cover. Systematic sampling will be performed and on-site analysis provided by gamma spectroscopy. QC samples at a 10% frequency will be split for third party analysis for verification. Impacted material will be packaged in 22 CY Intermodal containers with sliding rigid lids.
2.1.1.4 Shipment of LLRW to Envirocare for Disposal		1 Bulk Waste Packaging	Impacted soil will be placed into the container staged on the ground. Filling will be monitored for manually limiting to approximately 17 CY to maintain gross weight requirements (density of ~ 1.35 tons/CY).

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.4 Shipment of LLRW to Envirocare for Disposal		2 Waste Shipments	The expected (up to) 500 m^3 of impacted soil, vegetation, and PPE will be shipped in campaigns of approximately 4 loads/day, with 10 shipping campaigns stretched out over the soil monitoring period.
2.1.1.5 Verification Survey Following MARSSIM	1 Final Survey	1 Design Sampling Strategy	Employ recent remediation tasks and the earlier CHPPM survey data for development of the final status survey strategy. Area of approximately 7 Class 1 survey units of ~1000 to 2000 m^2, having been just remediated and/or used for handling and staging uncontainerized radioactive materials. No Class 2 or Class 3 areas designated. Determine the number of data points (random samples) following statistical recommendations of MARSSIM. Determine number of data points for target area and for background correlation. Establish data quality objectives. Integrate the survey strategy.
		2 Sample Collection	Tie-in the reference grid system, and install a square grid (10 m x 10 m). Install the triangular grid.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.5 Verification Survey Following MARSSIM	1 Final Survey	2 Sample Collection Contd.	Cross-calibrate the 2" x 2" NaI field instrument to the true exposure response of a Pressurized Ionization Chamber. Perform the designed comprehensive scan survey coverage. Collect the designated number of randomly selected samples.
		3 Third Party Analysis	Provide necessary QA/QC. Complete chain-of-custody records and ship samples to third party laboratory. Have all samples comparably analyzed by gamma spectroscopy.
		4 Data Evaluation	Results will be converted to standardized units. Laboratory analysis and exposure rate measurement QC data will be evaluated for accuracy and precision. Any additional data needs will be identified. Annotate facility drawings to depict grid lay-out and sample locations. Graphically display concentrations on posting plots and histograms for survey units and reference area.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.5 Verification Survey Following MARSSIM	1 Final Survey	5 Data Interpretation	Exposure data meeting acceptance criteria will be evaluated using the Wilcoxon Rank Sum test for each group of survey unit samples. Soil concentration data will be evaluated using the Student t-test. Any findings that are inconclusive or evidence leads to the criteria having not been met will be reported immediately to ensure early project closure. Results will be compared with DQOs established during the design phase.
		6 Report of Survey Findings	The final report will include survey procedures and results, and will follow the general guidance of MARSSIM.
2.1.1.6 Decontamination and Release Surveys of Equipment; and Final Waste Shipment	1 Demobilization	1 Decontaminate Major Equipment	Equipment will be decontaminated as soon as its use on the project has been completed, and decontamination/survey will be a parallel activity with site release survey preparations. The soil monitoring and handling equipment will be decontaminated primarily by passing large volumes of unaffected soil through it during the course of screening the balance of soil form the grids. The known affected material will be handled first. Ultimately, equipment will be freed of all clinging soil product by manual abrasives and supplemented by HEPA vacuum for debris pick-up.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.6 Decontamination and Release Surveys of Equipment; and Final Waste Shipment	1 Demobilization	2 Survey Major Equipment for Release	All areas susceptible to contact with contaminated material will be accessed and direct surveyed for release. Swipe samples will be collected and counted on-site. Survey data will be recorded on equipment diagrams to indicate the location of measurements.
		3 Final Equipment Decon / Survey	The remaining site equipment will be decon upon completion of the post-remediation walkover scan survey of the grounds. Decon will be performed on plastic lay-down areas. Radiological surveys will be performed to ensure effective decon efforts and to ultimately verify that levels of residual activity are acceptable for unconditional release.
		4 Final Waste Shipment	Secondary wastes, including spent filters, PPE, plastic, and deconned/removed residue from equipment, will be packaged along with impacted soil in the final Intermodal container. The final waste container will be scheduled for shipment in between the site remediation and the final verification survey.
		5 Site Clean-up	The work area will be restored to its condition prior to remediation activities. Solid waste will be removed, equipment containerized, and the grounds leveled (i.e., tracks smoothed), prior to performing the final verification survey. No site conditions will be altered after the verification survey has been completed.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.6 Decontamination and Release Surveys of Equipment; and Final Waste Shipment	1 Demobilization	5 Site Clean-up Cont.	Equipment will be shipped and support utilities will be removed upon completion of the verification survey, also.
		6 Exit Bioassays	All site workers will submit a final bioassay (urine) sample for third party analysis to determine the extent of any uptake. Bioassay results will be used to indicate the effectiveness of the radiological controls program when the TEDE is calculated along with the contribution of external exposure. As warranted, internal exposure will be assigned and recorded for an individual.
		7 Return Travel	The balance of project personnel will demobilize upon completion of the final verification survey.
2.1.1.7 Submit Final Report	1 Final Report	1 Receive Third Party Analytical Results	10% of the final samples are to be shipped for third party analysis by gamma spectroscopy. The project budget assumes a routine TAT, expecting ~ 3 weeks for data receipt.
		2 Standardize and Compare Data	Survey and sample results will be reviewed and standardized, and the values will be compared to the release criteria. Statistical tests will be performed, and the acceptance or rejection of results in meeting the criteria will be determined. Data will be compared to the 25 mrem/y release criteria, assuming immediate occupancy by a resident family.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.7 Submit Final Report	1 Final Report	3 Draft Narrative Report	A description of the overall project effort will be drafted to include major activities, waste volumes, manifest copies, and the extent of excavation and soil monitoring. The established governing criteria will be displayed along with the respective references. Emphasis will be placed on the final status survey (MARSSIM).
		4 Assemble Report & Supporting Data	The narrative report, field data, and analytical results will be compiled into a single submittal. The goal is to complete work activities and submit the report for contemplation of NRC license termination prior to September 1, 1999.
2.1.1.8 Closure	1 Remobilization	1 Return Travel	A partial crew re-mobilization to the site will occur upon notification of regulatory approval, indicating verification and acceptance of the site meeting conditions suitable for license termination.
	2 Site Closure	2 Property Restoration	The excavated area of the 'Burial Mound' will be backfilled with the stockpiled monitored soil and imported clean fill, as necessary. The area will be graded and contoured to match the adjacent area.

2.1.3 Procedures

Execution of this Decommissioning Plan will be performed in accordance with the project 'Health and Safety Plan', Appendix 1; the 'Quality Assurance Plan', Appendix 2; the 'OE Avoidance Plan', Appendix 3; and, internally approved ATG Field Operations Procedures submitted as Appendix 4. All Field Operations procedures employed on the project have been previously approved and implemented on earlier ATG / IOC projects of similar scope and work activities. Any changes, additions, or revisions to the procedures will be subject to a review process and require applicable internal approval, as well as acceptance by the U.S. Army IOC Project Manager prior to implementation.

Data and text should be updated, where relevant, by replacement of the existing pages with the latest revised pages. All pages submitted to update, revise, or add pages to the procedure(s) should show the date of change and the change or revision number. A guide page listing the pages to be inserted or revised, or pages to be removed, should accompany the revised pages. When major changes are made, a revised table of contents should be provided.

2.1.4 Schedule

The integrated schedule for the remediation of the Fort McClellan 'Burial Mound' follows in Gantt chart format as developed using Microsoft Project. Upon mobilization, the crew effort is assumed to be working five 10-hour days per week on average.

The actual on-site duration for field activities in the screening of soils, packaging and disposal of LLRW, and performing the final status survey encompasses six calendar weeks. The critical path is the throughput of the large volume of soil from the 'Burial Mound', subsequent depths, and immediately adjacent areas. The productivity of the soil monitor is identified in Section 4.0.

It is anticipated that project on-site activities will be performed during a single ten-hour weekday shift, working five days per week. However, due to the weather-related nature of the objective, the actual work may at times by on a flexible schedule to permit elongation of production during optimal conditions, and reduced site time when conditions jeopardize productivity, i.e., wet conditions. The plan of the day will be communicated with site representatives prior to schedule adjustments.

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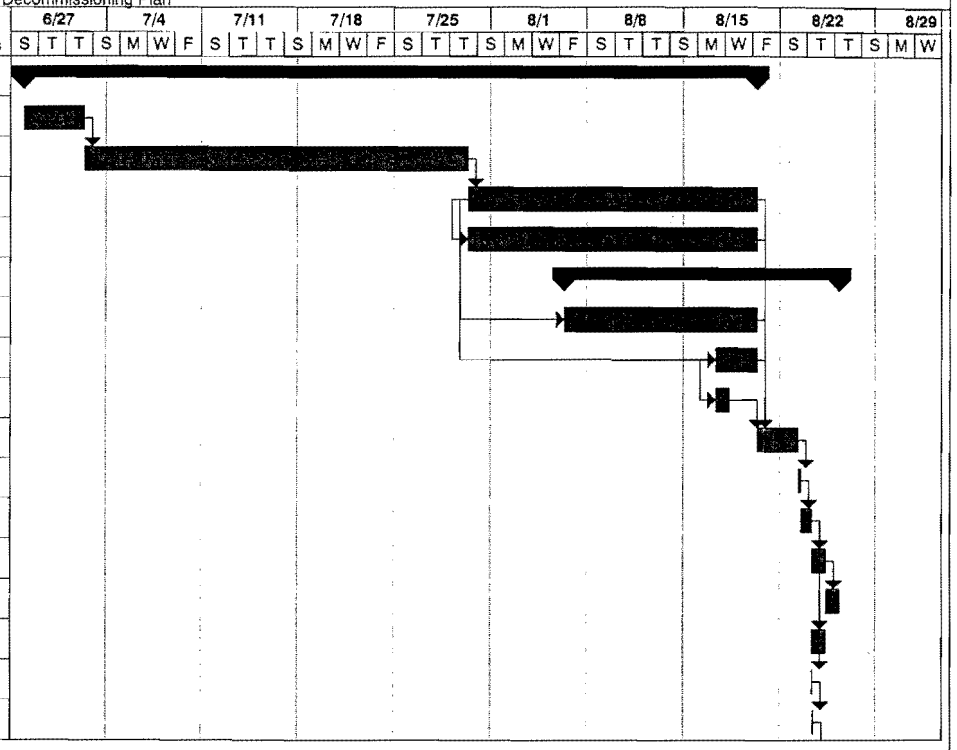
ID	WBS	Task Name	Duration	Start	Finish	Predecessors
1	1	**Planning Phase**	**40 days**	**Mon 6/28/99**	**Fri 8/20/99**	
2	1.1	Decommissioning Plan Submission	5 days	Mon 6/28/99	Fri 7/2/99	
3	1.2	Decommissioning Plan Approval	20 days	Fri 7/2/99	Fri 7/30/99	2
4	1.3	Procurement	15 days	Fri 7/30/99	Fri 8/20/99	3
5	1.4	Schedule Coordination	15 days	Fri 7/30/99	Fri 8/20/99	4SS
6	2	**Mobilization**	**14 days**	**Fri 8/6/99**	**Thu 8/26/99**	
7	2.1	Instrument Calibration	10 days	Fri 8/6/99	Fri 8/20/99	4SS+5 days
8	2.2	Refresher Training	3 days	Tue 8/17/99	Fri 8/20/99	5SS+12 days
9	2.3	Entry Bioassays	1 day	Tue 8/17/99	Wed 8/18/99	8SS
10	2.4	Travel	1 day	Fri 8/20/99	Mon 8/23/99	4,5,7,8,9
11	2.5	Site Specific Training	0.5 days	Mon 8/23/99	Mon 8/23/99	10
12	2.6	Preliminary Radiological Survey	0.5 days	Mon 8/23/99	Tue 8/24/99	11
13	2.7	Surface EO Survey	1 day	Tue 8/24/99	Wed 8/25/99	12
14	2.8	Equipment Set-up	1 day	Wed 8/25/99	Thu 8/26/99	13
15	2.9	Install Security / Sediment Fencing	1 day	Tue 8/24/99	Wed 8/25/99	12
16	2.10	Establish Control Points	0.2 days	Tue 8/24/99	Tue 8/24/99	12
17	2.11	Issue RWP	0.2 days	Tue 8/24/99	Tue 8/24/99	16



Project: Decom. Plan Schedule
Date: Fri 6/25/99

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | External Tasks | Project Summary | Split | Rolled Up Split

ATG, Inc.
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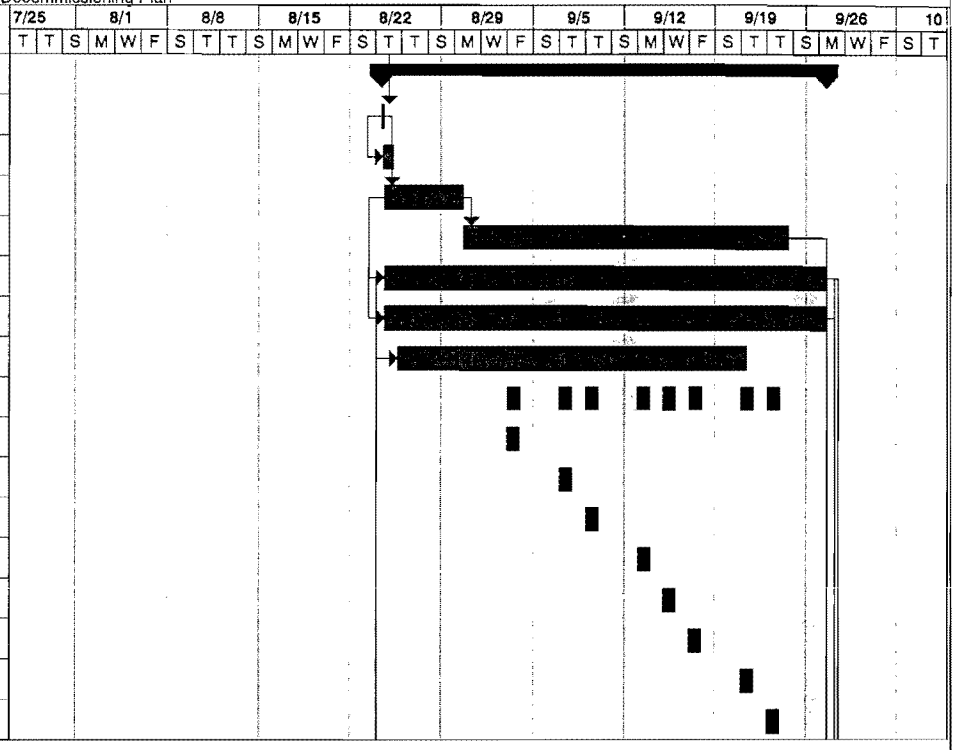
ID	WBS	Task Name	Duration	Start	Finish	Predecessors
18	**3**	**Burial Mound Remediation**	**26.5 days**	**Tue 8/24/99**	**Mon 9/27/99**	
19	3.1	Degrub Pile	0.5 days	Tue 8/24/99	Tue 8/24/99	17
20	3.2	Process Vegetation	0.5 days	Tue 8/24/99	Wed 8/25/99	19SS+0.2 day
21	3.3	Extract Known Contaminated Soil	4 days	Tue 8/24/99	Mon 8/30/99	19
22	3.4	Remove Balance of Area Soil	21 days	Mon 8/30/99	Fri 9/24/99	21
23	3.5	Screen, Monitor, Sort Soil	26 days	Tue 8/24/99	Mon 9/27/99	21SS
24	3.6	Material Sampling & Staging	26 days	Tue 8/24/99	Mon 9/27/99	23SS
25	3.7	Bulk Waste Packaging	20 days	Wed 8/25/99	Tue 9/21/99	23SS+1 day
26	**3.8**	**Expected Waste Shipments**	**16.44 days**	**Fri 9/3/99**	**Thu 9/23/99**	
27	3.8.1	Expected Waste Shipments 1	1 day	Fri 9/3/99	Fri 9/3/99	
28	3.8.2	Expected Waste Shipments 2	1 day	Tue 9/7/99	Tue 9/7/99	
29	3.8.3	Expected Waste Shipments 3	1 day	Thu 9/9/99	Thu 9/9/99	
30	3.8.4	Expected Waste Shipments 4	1 day	Mon 9/13/99	Mon 9/13/99	
31	3.8.5	Expected Waste Shipments 5	1 day	Wed 9/15/99	Wed 9/15/99	
32	3.8.6	Expected Waste Shipments 6	1 day	Fri 9/17/99	Fri 9/17/99	
33	3.8.7	Expected Waste Shipments 7	1 day	Tue 9/21/99	Tue 9/21/99	
34	3.8.8	Expected Waste Shipments 8	1 day	Thu 9/23/99	Thu 9/23/99	



Project: Decom. Plan Schedule
Date: Fri 6/25/99

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | External Tasks | Project Summary | Split | Rolled Up Split

ATG, Inc.
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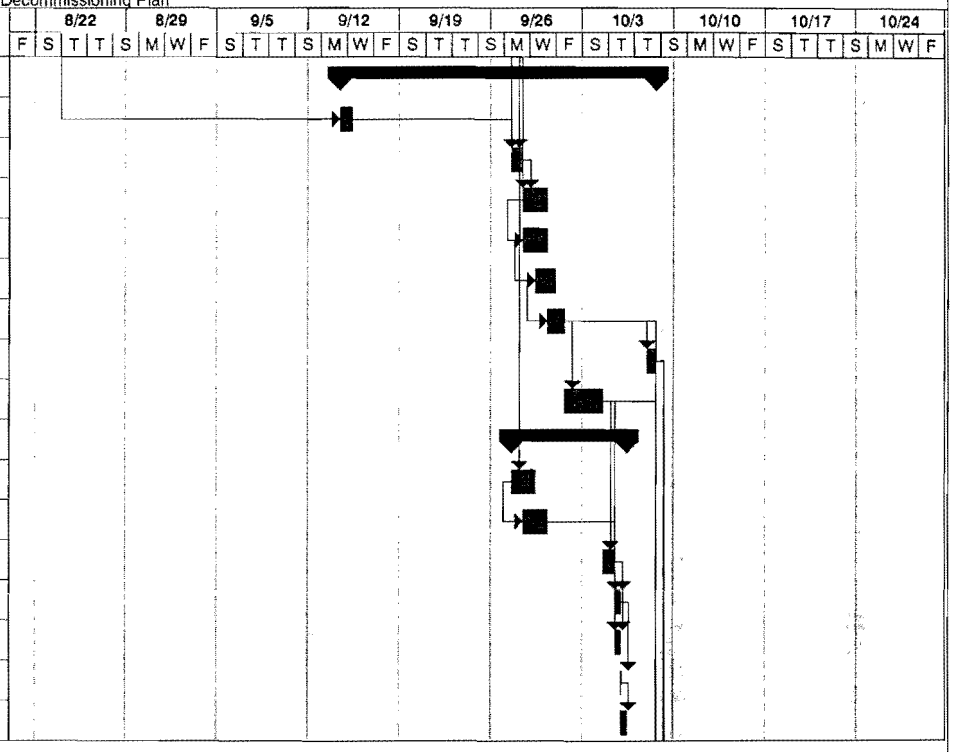
ID	WBS	Task Name	Duration	Start	Finish	Predecessors
35	4	**Final Status Survey**	**22 days**	**Tue 9/14/99**	**Fri 10/8/99**	
36	4.1	Establish Background	1 day	Tue 9/14/99	Wed 9/15/99	23SS+15 days
37	4.2	Re-establish Grid	1 day	Mon 9/27/99	Tue 9/28/99	22,24,36
38	4.3	Walkover Gamma Scan Survey	2 days	Tue 9/28/99	Thu 9/30/99	23,37
39	4.4	Exposure Rate Measurements	2 days	Tue 9/28/99	Thu 9/30/99	38SS
40	4.5	Sampling of Surface Soil	2 days	Wed 9/29/99	Fri 10/1/99	39SS+1 day
41	4.6	On-site Sample Analysis	2 days	Thu 9/30/99	Fri 10/1/99	40SS+1 day
42	4.7	Third Party Analysis	1 day	Fri 10/8/99	Fri 10/8/99	41FS+5 days
43	4.8	Final Remedial Action / Resample	1 day	Fri 10/1/99	Mon 10/4/99	41
44	5	**Demobilization**	**8.1 days**	**Mon 9/27/99**	**Wed 10/6/99**	
45	5.1	Decontaminate Major Equipment	2 days	Mon 9/27/99	Wed 9/29/99	23
46	5.2	Major Equipment Surveys	2 days	Tue 9/28/99	Thu 9/30/99	45SS+1 day
47	5.3	Final Equipment Decon / Survey	1 day	Mon 10/4/99	Tue 10/5/99	43
48	5.4	Final Waste Shipment	0.5 days	Tue 10/5/99	Tue 10/5/99	43,47
49	5.5	Site Clean-up	0.5 days	Tue 10/5/99	Tue 10/5/99	46,47
50	5.6	Exit Bioassys	0.1 days	Tue 10/5/99	Wed 10/6/99	48
51	5.7	Return Travel	0.5 days	Wed 10/6/99	Wed 10/6/99	50

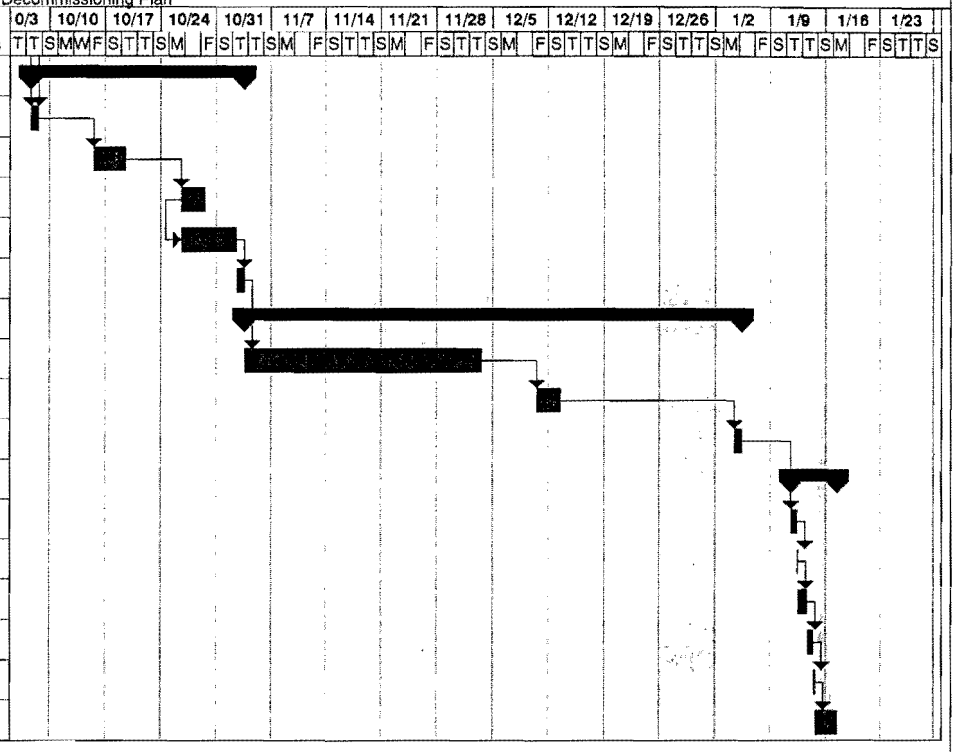


Project: Decom. Plan Schedule
Date: Fri 6/25/99

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | External Tasks | Project Summary | Split | Rolled Up Split

ATG, Inc.
IOC Project Number USA 98-046
Fort McClellan Burial Mound Decommissioning Plan

ID	WBS	Task Name	Duration	Start	Finish	Predecessors
52	6	**Final Report**	**19 days**	**Thu 10/7/99**	**Wed 11/3/99**	
53	6.1	Receive Analytical Results	1 day	Thu 10/7/99	Fri 10/8/99	41,42,43
54	6.2	Standardize & Compare Data	2 days	Fri 10/15/99	Tue 10/19/99	53FS+5 days
55	6.3	Draft Narrative Report	3 days	Tue 10/26/99	Fri 10/29/99	54FS+5 days
56	6.4	Assemble Report & Supporting Data	5 days	Tue 10/26/99	Tue 11/2/99	55SS
57	6.5	Submit Final Report	1 day	Tue 11/2/99	Wed 11/3/99	56
58	7	**License Termination**	**37 days**	**Wed 11/3/99**	**Wed 1/5/00**	
59	7.1	NRC Review of Report	20 days	Wed 11/3/99	Fri 12/3/99	57
60	7.2	Third Party Confirmatory Survey	1 day	Fri 12/10/99	Mon 12/13/99	59FS+5 days
61	7.3	Authorization to Backfill	1 day	Tue 1/4/00	Wed 1/5/00	60FS+10 days
62	8	**Area Closure**	**3.75 days**	**Tue 1/11/00**	**Mon 1/17/00**	
63	8.1	Partial Re-Mob	0.5 days	Tue 1/11/00	Wed 1/12/00	61FS+5 days
64	8.2	Remove Safety & Silt Fencing	0.25 days	Wed 1/12/00	Wed 1/12/00	63
65	8.3	Push in Staged Soil	1.5 days	Wed 1/12/00	Thu 1/13/00	64
66	8.4	Receive & Place Imported Fill	0.5 days	Thu 1/13/00	Fri 1/14/00	65
67	8.5	Final Grading	0.5 days	Fri 1/14/00	Fri 1/14/00	66
68	8.6	Final Demob	0.5 days	Fri 1/14/00	Mon 1/17/00	67



Project: Decom. Plan Schedule
Date: Fri 6/25/99

Task		Summary		Rolled Up Progress		Split	
Progress		Rolled Up Task		External Tasks		Rolled Up Split	
Milestone	◆	Rolled Up Milestone	◇	Project Summary			

2.2 Decommissioning Organization and Responsibilities

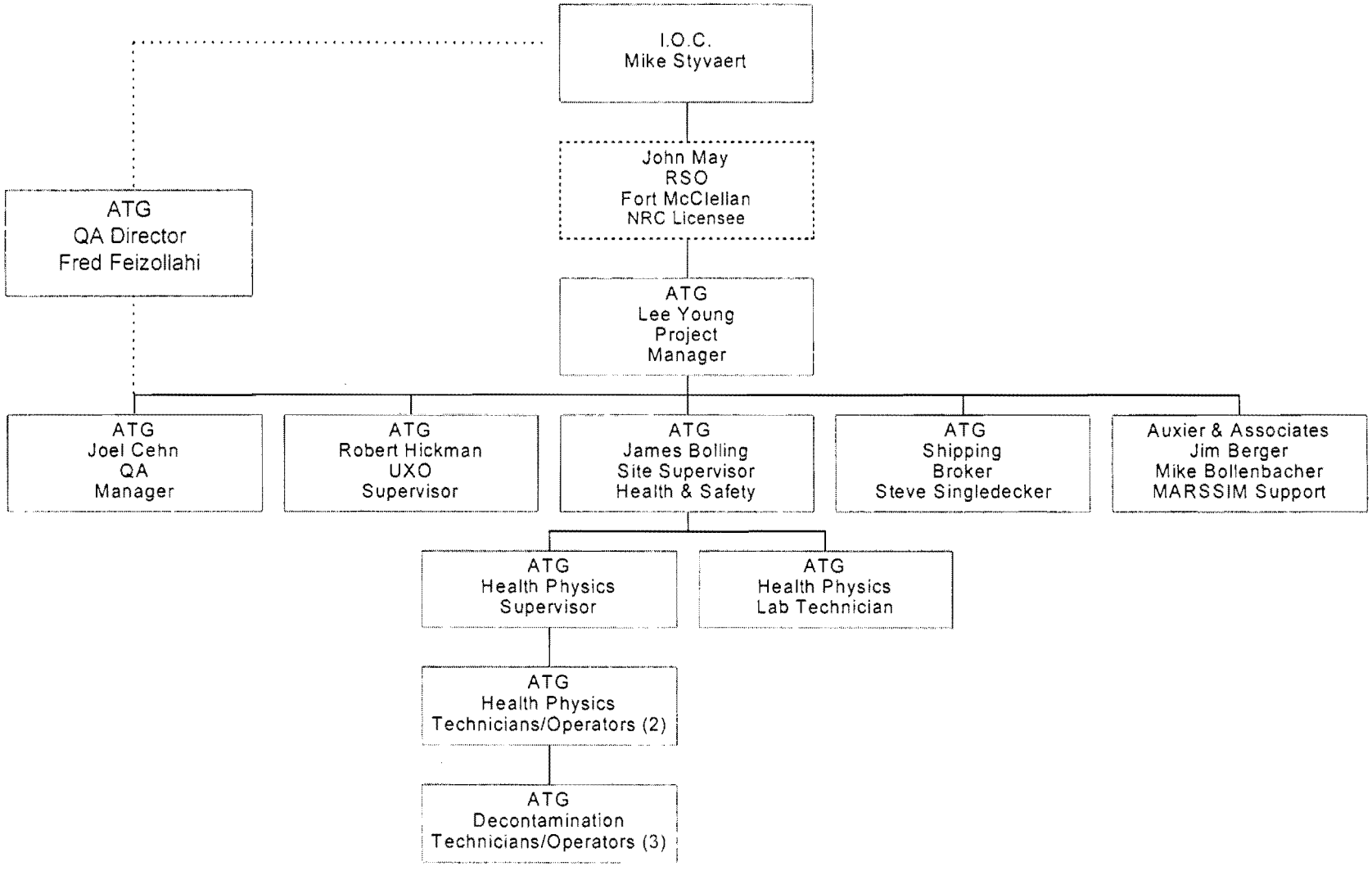
The project organization chart follows. The basic structure depicts the ATG approach, with streamlining by project implementation under the current NRC radioactive material license possessed by the site, which provides for decommissioning of the 'Burial Mound'. Additional benefit may be realized in the prospect of naming the ATG project manager as the designated Radiation Safety Officer for license coverage during any interim in which the facility RPO may be off-site. The slated ATG project manager has served as the licensed Radiation Safety Officer on sites governed by the States of Tennessee and Texas, and for NRC licensees.

The project team provides for integrated activities during the project (see Schedule, Section 2.1.4) to facilitate compressing the overall time on-site. Expertise is provided in the areas of project management, construction / excavation, radiological protection, health and safety, quality assurance, and in military explosives/ordnance. Technical specialties also include the application of MARSSIM in the final status survey, and experienced transportation brokerage of wastes into Envirocare. Key project resumes are provided as Attachment 6.

The basic work force for the range remediation activities will consist of a Project Manager with on-site QA responsibilities, Project Supervisor with combined Health and Safety responsibilities, and a remediation team including 2 senior health physics technicians and 3 decontamination technicians / operators. Supplemental crew include one EOD/UXO Specialist, a health physics lab/count room technician, and an IOC approved Broker during the waste shipment campaigns.

MARSSIM expertise is provided by a subcontractor, Auxier & Associates, including Mr. Jim Berger who drafted the predecessor guide NUREG/CR-5849, and was a contributor to the present survey protocol.

ORGANIZATIONAL CHART



2.3 Training

Each member of the project on-site crew will be trained and qualified as radiation workers. Training records will be maintained on-site as part of meeting the Quality Assurance Plan requirements. Training specific to the project will be performed prior to the start of work activities by the Project Manager or the Health and Safety Manager, and recorded on the Training Record (ATG Form 027). All training records will be retained as part of the permanent project file.

Radiation worker training will include, but not be limited to the following subjects:

1) Radiation Worker Rights
2) Sources of Radiation and Contamination
3) Types of Radiation and Contamination
4) Units of Radiation and Radioactivity
5) Prenatal Exposure (Reg. Guide 8.13)
6) Biological Effects of Radiation
7) Concepts of Radioactive Contamination Control
8) Use of Anti-C Clothing
9) ALARA Concepts
10) Emergency Procedures
11) Use of Radiation and Contamination Detection and Measurement Instrumentation

The personnel assigned to the Fort McClellan 'Burial Mound' project shall have completed the 40 Hour Hazardous Waste Operator and Emergency Response (HAZWOPER) training, and be current in the 8 Hour Refresher. Supervisory personnel shall have completed the 8 Hour HAZWOPER Supervisor training, per 29 CFR 1910.120. All on-site personnel will be required to provide evidence of their current OSHA training (29 CFR 1910.120 e.6) and Medical Certification (29 CFR 1910.120.f)

All respirator wearers will be trained on the specific use of respiratory protective equipment and have documented evidence of current fit testing per 29 CFR 1910.134. Additionally, Site Specific Training will be performed to familiarize the workers with the base and project specific and requirements. Supplemental site-specific training will be documented on a Training Record (ATG Form 027), and will be maintained as part of the permanent project file.

2.4 Contractor Assistance

Allied Technology Group, Inc. (ATG) is the prime contractor for the Decommissioning of the 'Burial Mound' at Fort McClellan.

There will be no lower-tier subcontractors directly involved with performance of the on-site objective., with the limited exception of the IOC-approved broker for shipping to Envirocare, Steve Singledecker, contracted through ADF. All on-site personnel will be trained to and abide by the site specific project Plans.

Auxier and Associates will provide off-site consultation for implementation of the verification survey of the site using the MARSSIM protocols, and will provide subsequent data evaluation. A local subcontractor will provide excavation services for final site restoration, but will be involved only upon closure of site concerns regarding radioactivity and UXO. An ATG representative will accompany final restoration events to ensure that administrative controls are maintained.

3.0 DESCRIPTION OF METHODS USED FOR PROTECTION OF OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

3.1 Facility Radiological History Information

The history of radioactive materials used at the base, and specifically the origination of the 'Burial Mound' was described in Section 1.1. In summary, the base was used for training exercises for the Army Chemical Corp. for simulated large area radioactive contamination (fallout) from the surface detonation of a nuclear weapon. The training concept was to raise and lower sealed radioactive sources, and have students perform both ground and aerial surveys to map the radiological fallout pattern. The training facility was utilized to train Radiation Control Teams in support of nuclear weapons testing performed by the Atomic Energy Commission (AEC).

There were two radiological training areas during the operational period of the mid 1950's through May of 1973, referred to as New and Old Rideout Fields. A large number of source storage wells were placed for use in the training exercises. The majority of the sources used were locally fabricated Co-60 sources and higher activity commercially procured Cs-137 sources. While the Co-60 sources were used to simulate a uniform fallout pattern, the Cs-137 sources were used to simulate hot spots within the fallout pattern. The sources were raised and lowered manually from their shielded storage positions, located approximately 6' below the ground surface. An excessive number of leaking locally fabricated Co-60 sources contributed to the formation of the on-site 'Burial Mound' for use as an interim on-site disposal cell. The contaminated soil resulting from historically leaking sources was accumulated and transported to the location which is now designated as the 'Burial Mound'.

A recent radiological characterization of the 'Burial Mound' was performed by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM), reference Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound Site, Fort McClellan, Alabama, 29 August - 15 September 1995 and 14 - 28 January 1996. The survey followed much of the protocols of NUREG/CR-5849, including background determination, walkover surface scans, hole logging, and sample analysis. A total of 571 systematic random and select bias samples were analyzed for radiological parameters. Both elevated Co-60 and Cs-137 were observed in surface soil samples, but only elevated Co-60 was found in subsurface samples. The observed range of concentrations of radioactivity were observed at 1.6 to 330 pCi/gm of Co-60 and 0.2 to 179 pCi/gm of Cs-137, respectively.

Although the characterization data indicates less than extremely high concentrations, there exists some concern regarding the observed heterogeneity of the 'Burial Mound' as depicted in the CHPPM report. First, an isolated speck of significant Co-60 radioactivity was discovered within one of the discrete surface soil samples. A discrete item with significant SpA exceeding the Envirocare WAC was found and segregated. The related concern is with the significant gamma readings recorded during hole logging when samples from the bore hole and nearby indicated only trace amounts of contamination. The trend leads toward a conclusion of significant heterogeneity, and limits the credibility of sample results being actually representative of the existing source term.

As a result of the earlier characterization, the 'Burial Mound' location was added to the NRC license governing other radioactive materials usage, unrelated to this decommissioning phase. Under the BRAC, Fort McClellan is undergoing closure this year with a target of remediation to strive for submittal of a license termination request prior to September 1, 1999.

3.2 Ensuring that Occupational Radiation Exposures Are As Low As Reasonably Achievable (ALARA)

All of the field work encompassed by this Plan will be performed in accordance with the ATG Project Operational Procedures, included as Appendix 4. These procedures provide information on equipment, special techniques, and practices that will be employed on-site to ensure that exposures are minimal, in keeping with our corporate ALARA policy. Instruction is provided for the use of Radiation Work Permits (RWPs), contamination control practices, the respiratory protection program, and hazard assessment for the appropriate application of personal protective equipment (PPE). Additional project-specific instructions can be found in the Health and Safety Plan, including the use of dosimetry devices and internal monitoring via air sampling and bioassay samples.

A project worker dose projection has been established from data included in the earlier characterization by the Center for Health Promotion and Preventive Medicine (CHPPM) Report "Industrial Radiation Study No. 27-MH-0987-R2-97", Table F-3, and in consideration of the project schedule, per the following:

- Maximum general area dose rate was 11.7 uR/hr @ 1 meter above the ground surface of the burial mound at sample location BM C2-3.

- The referenced exposure (dose) rate was determined by a Reuter Stokes Pressurized Ionization Chamber for which 220 counts of 5-second integrated measurements were averaged electronically.

- The total work time for each individual on the site specifically at the 'Burial Mound' will be 10 hrs per day for 25 days for a total cumulative duration of 250 hours each. The conservative (worst case) assumption is made that each individual will spend the entire work time in activities immediately above the 'Burial Mound'.

- The total dose is estimated as: 11.7 uR/hr x 250 hours = 2925 microRem, rounded to 3 mrem total per worker.

3.3 Health Physics Program

All QA audits, inspections, air sampling, personal protective equipment (PPE) requirements, and surveys will be completed in accordance with Appendix 1, site Health and Safety Plan, Appendix 2, project Quality Assurance Plan, Appendix 3, Ordnance and Explosives Avoidance Plan, and Appendix 4, Field Operations Procedures which are included a integral parts of this plan.

3.4 Contractor Personnel

ATG is the designated subcontractor assigned to implement this Plan to complete the remediation project. There are no additional outside contractors to be affected by radioactive materials associated with this effort. The MARSSIM consultation will be per off-site communications, and the final restoration will be performed after release of the site.

3.5 Radioactive Waste Management

The project objective is the removal of soil within the 'Burial Mound', comprehensive radiological monitoring and systematic verification sampling for appropriate sorting of the contents, and the final disposal of the LLRW fraction of the total volume found to exceed the site criteria. Requisite excavation, material handling, and soil monitoring will be performed in such a manner as to limit the prospect for cross-contamination and eliminate the prospect of dilution of existing elevated concentrations of radioactivity prior to or during the monitoring phase. Results of the planned approach will include: 1) meeting the Envirocare Waste Acceptance Criteria (WAC); and, 2) minimization of the final waste volume by comprehensive screening and sorting.

3.5.1 Waste Profile

The 'Burial Mound' waste stream has been sampled and analyzed for the necessary parameters to complete the waste profile for pursuit of acceptance authorization by Envirocare of Utah. The Burial Mound was sampled by ATG in May of 1998. Sample analysis was performed by Mountain States Analytical, Inc., and the Envirocare Waste Profile Record was completed and submitted, referencing the CHPPM report for radioanalytical data. Subsequent communications resulted in additional analysis of an archived sample for clarifying radiological parameters.

Preliminary acceptance of the 'Burial Mound' waste stream as LLRW (low-level radioactive waste) was received from Envirocare in October 1998. The requisite Pre-Shipment samples were subsequently forwarded to Envirocare for their footprint analysis in November 1998. Both the Waste Profile Record (EC-0230) and the Pre-Shipment Sample Record (EC-2000) provided a tentative waste delivery date of March 1999, and a tentative volume in the estimated range of 870 cubic yards. Note: Final release criteria had not been determined during waste profiling, which resulted in an estimated final volume being employed.

The adoption of site-specific release criteria (Section 6.8.2) per development of this Plan and supporting data permits refinement of the final waste volume. Referencing the CHPPM report and enclosed Attachments 1, 2, and 5 along with Appendix 6, an in-situ soil volume of approximately 383 cubic yards is expected. The assigned volume expansion (fluff factor) of the primarily clay material attributed to the soil excavation and conditioning for placement onto the conveyor / monitor is +30%, resulting in ~ 498 yd^3.

3.5.2 Waste Packaging

The 'Burial Mound' LLRW waste streams will be appropriately packaged early after segregation from the unaffected balance of materials. Soils exceeding criteria via the monitoring system and/or sample analysis will be ultimately packaged in rigid-topped lined Intermodal containers. When not being transferred, any staged waste material will be securely covered with plastic on-site. Secondary wastes, including spent PPE, filters, and plastic materials, will be bagged as it is accumulated throughout the project and packaged with the soil waste stream in the Intermodals.

The waste profile will be amended as applicable to reflect the proportion of non-soil material attributed to the secondary waste stream even at its slight volume ratio over the original profile record for the straight soil, i.e., secondary waste estimated at ~ 2% by volume, but easily less than 10%, and thus not impacting the disposal category type of "soil-like" material.

Even though the profiled LLRW waste stream from the 'Burial Mound' is represented by concentrations of radioactivity which are less than that governed by D.O.T. regulations, the waste will be conservatively conveyed in lined Intermodal containers that meet the general design requirements of a strong tight container as defined in 49CFR173.410. Additionally, the container also complies with 49CFR173.420, meeting the description of a sift-proof non-specification portable tank and closed bulk bin as defined in 49CFR171.8.

Should any impacted material be found to have concentrations of radioactivity in excess of the Envirocare WAC, referencing specific limits of $3.0E^4$ pCi/gm for Co-60, and 6.0E pCi/gm for Cs-137, respectively, the LLRW will be further segregated. Materials exceeding the Envirocare WAC will be contained in D.O.T. packaging (drums) and staged for final disposal at Barnwell under a contract modification.

The density of the clay type soil, depending on the current moisture content, ranges from 92 to 112 lb./ft^3. At the optimum moisture content of 13% and slight recompaction during container loadout and subsequent resettling, the average density of ~ 100 lb./ft^3 is assumed. At 1.35 tons/yd^3, the weight becomes the limiting factor on content capacity. The net payload per Intermodal container is limited to $\leq$ 20 tons, providing a restriction by packaged volume, i.e., 20 tons/1.35 tons/yd^3 = 14.8 yd^3. Thus the quantity of waste packages required is derived from ~ 498 yd^3/14.8 yd^3 = 34.

3.5.3 Waste Manifesting and Transportation

An IOC-approved broker will inspect the containers, contents, loaded packages, and the transportation vehicle. All shipments will meet applicable DOT requirements for packaging and transportation. Additionally, all shipments will be in accordance with the IOC Standard Operating Procedure 'Shipping Procedures for Unwanted Radioactive Materials', May 1997. Also, shipments will comply with ATG Field Procedures for loading, survey, and transportation of radioactive materials per BR-003, Packaging Material for Disposal; BR-004, Shipping of Radioactive Material and Waste; and, BR-006, Brokering.

Dose-to-millicurie conversions will be established via the application of the MicroShield code. Content weights for activity per container will be established by volume/free-board measurement and off-site weighing of the initial packages for assigning an observed density for subsequent use with volume measurements, with subsequent confirmation vehicle weighing.

Note: Alternatively, bucket-scales may be obtained for the actual tracking of individual package content weight by weighing the payload as it is placed. However, due to the relatively small quantity of the waste stream, the application of bucket-scales may not be feasible.

Based upon both the concentration and the total activity per package, the waste will be appropriately manifested and labeled. Packaging with DOT-exempt material will not require vehicle placarding. It is expected that the majority of packages will be classified as Limited Quantity and suitably indicated per 49 CFR 173.421.

The Intermodals will be shipped in campaigns, picked-up by truck carrier at one package per vehicle. Live load-out is not anticipated. The permitted carrier will haul the manifested Intermodals to a railhead in Birmingham, where they will be trans-loaded to rail cars. The transfer will be performed by the carrier. Groups of the Intermodals will ultimately be shipped to the designated disposal facility. Prior notification will be initiated in concert between ATG and the carrier to the disposal facility. Subsequent tracking will be provided by the carrier.

3.5.4 Waste Disposal

The Waste Profile Record has been preliminarily approved, permitting acceptance of the waste stream for disposal as soil-like LLRW. The approximately 13,446 ft^3 of waste will be disposed at Envirocare under an existing contract held by the Army Corps of Engineers and administered by the IOC for this project, or other approved disposal facility.

Note: The presented funding information, Section 8.0, does NOT include disposal costs, which are to be borne by other than the remediation contractor.

3.6 Groundwater Assessment Plan

3.6.1 Introduction

A mound of soil containing low levels of Co-60 and Cs-137 is located at Rideout Field on Pelham Range. The U.S. Nuclear Regulatory Commission (NRC) has requested that the U.S. Army determine whether these radionuclides have leached into the groundwater beneath the mound. A site-specific groundwater assessment plan is included in this decommissioning plan to evaluate potential radiological impacts on groundwater from the historical presence of the 'burial mound' containing Co-60 and Cs-137. The assessment of potential groundwater impacts will involve the installation of three groundwater monitoring wells at the 'burial mound' site by a separate contractor (IT Corporation), sample collection and analyses, and a written report. The elements of the groundwater assessment plan are discussed in detail below.

3.6.2 Site Description and Monitoring Well Locations/Installation

The mound, at the north end of Rideout Field, is located on the northwestern portion of Pelham Range. Rideout Hall and Cane Creek are located approximately 1200 feet and 4200 feet to the north and south, respectively. The topography slopes down from north to south toward Cane Creek. Cane Creek flows toward the west. Presently, the mound is oval shaped and is posted as an area with radioactive materials present. The perimeter of the posted area is approximately 270 feet. There are several armored vehicles located immediately adjacent to the perimeter of the posted area.

It is anticipated that three monitoring wells will be installed at the mound site immediately outside the perirneter of the posted area. Installation of the wells will be performed in accordance with the procedures outlined in the Installation Wide Work Plan (IT 1998a). Two of the monitoring wells will be installed downgradient from the mound and one of the monitoring wells will be installed upgradient from the mound. Groundwater in the residuum is assumed to move south-southwest toward Cane Creek.

3.6.3 Monitoring Well Sampling and Sample Analysis

Upon completion of the well installation task, the wells will be sampled in accordance with the procedures outlined in the Installation Wide Sampling and Analysis Plan (IT 1998b). The SAP will be modified by addendum to include the analytical specifications for C0-60 and Cs-137 in groundwater.

The water samples collected from the monitoring wells will be analyzed for the gamma-emitting radionuclides Co-60 and Cs-137.

3.6.4 Health and Safety

Prior to the initiation of field activities at the site, a site-specific work plan and health and safety plan that outline the work to be completed and the appropriate health and safety requirements for performing the work will be prepared. Each field work task will be performed with radiation protection personnel present. All workers involved in field activities (e.g., drillers, geologists, and sampling technicians) will be trained at an appropriate level of radiological worker safety training.

3.6.5 Investigatively Derived Wastes

All investigatively derived waste will be handled in accordance with the procedures outlined in the Installation Wide Work Plan (IT 1998a).

3.6.6 Reporting

Upon receipt of the sample analytical results from the laboratory, a report will be prepared that describes the field activities performed, the geology and hydrogeology of the site, and the analytical results of the samples. A determination will be made regarding the potential leaching of radionuclides from the mound into the groundwater based on the analytical results.

4.0 MONITORING, SORTING, AND DISPOSAL OF THE 'BURIAL MOUND'

The entirety of material from the earlier eight 10 m x 10 m grids will be removed and radiologically screened to eliminate the prospect of the inadvertent omission of significant contamination attributed to the heterogeneity of the waste stream, coupled with the history of stray specks of high SpA from failed radioactive sealed sources. Material from the top 8' of the sloped perimeter sides will also be removed to comply with OSHA trenching and excavation requirements in lieu of exorbitant shoring efforts, and the resultant volume will be treated as the balance of material for screening. The same methodology was recently employed by ATG for the IOC at the Lake City Army Ammunition Plant in Missouri. The contaminant there was Depleted Uranium fragments. The emissions from the Co-60 and Cs-137 contaminants of the 'Burial Mound' provide greater sensitivity for detection.

4.1 Site Preparations

Pre-mobilization events will be completed as scheduled, including off-site refresher training, updated physicals / fit-tests, instrument calibration, and final procurement and logistical events. Mobilization to the site will be accompanied with site-specific training, the assignment of TLDs and the collection of baseline bioassay samples for third party analysis.

A preliminary radiological screening survey will performed in conjunction with implementation of the OE Avoidance Plan, Appendix 3.

4.1.1 Site Set-Up

Plastic safety fencing will be installed around the perimeter of the entire site. The office / break room / lab trailer will be placed just outside the controlled area. Temporary support utilities will be imported, i.e., generator, lavatories, handwash units, etc. Instrumentation will be set-up and checked to ensure operability, including:

- -MCA with NaI detector and shield
- -Ludlum 2929 dual alpha/beta counter(s)
- -Drying Oven
- -Soil Monitor (Multiple Ludlum 177 Alarming Ratemeters with 44-10 2" x 2" NaI detectors)
- -Ludlum Model 2221 Scaler/Ratemeter with 44-10 NaI detectors for field use
- -Ludlum Model 3 with 44-9 GM probe (friskers)
- -Bicron Micro Rem Meter
- -Air Samplers

The locations of material staging, monitoring and pending segregation will be identified. The PowerScreen soil handling unit will be received and placed for operation. The NaI detector array will be installed and tested for start-up using sources initially, and then known impacted soil from the "Burial Mound" after collection and on-site analysis by gamma spec.

The 'Burial Mound' surface will undergo a screening survey per the OE Avoidance Plan to limit unexploded ordnance hazards. The surface of the mound will be degrubbed, and the vegetation will be shredded and staged on-site for packaging with the initial impacted soil. A comprehensive UXO/EOD survey of the exposed mound area will be performed upon removal of the vegetation.

4.1.2 Base-Line Survey

The location within the fenced controlled area, adjacent to the 'Burial Mound' itself, which will receive the sorted "clean" material upon soil screening, will undergo a baseline survey in parallel with the other set-up activities. The objective is to assure that the ground is not radiologically impacted in association with the 'Burial Mound' prior to covering it with a significant volume of cleared material. Upon completion of the soil removal and screening effort, the surface of the pending mound of monitored and clean soil will be included in the Final Status Survey as a Class 1 area.

An area of approximately 1,200 m^2 slightly distant from the present 'Burial Mound', but within the boundary of the site controlled area, will be initially surveyed as if it represented a probable contamination area per the MARSSIM protocols. Although the vicinity may represent the characteristics of a Class 2 area more closely, it is prudent to perform a comprehensive survey and sample at the higher frequency of a Class 1 area for greater confidence in defense of early ground covering. The expanse of surface area necessary to accommodate the balance of clean material after screening, up to approximately 7,700 yd^3 uncompacted, is significant even with building up. The initially surveyed and radiologically cleared receiving area could feasibly be covered with up to 9' of compacted overburden during the course of the project.

The grid locations will be marked and labeled for cross-reference to both prominent landmarks and for overlay with the pending Class 1 site areas of the Final Status Survey, Section 6.0. Also, see Attachments 2 and 4.

A comprehensive gamma walkover survey will be performed over the area. Any locations identified with increased detectable gamma activity will be marked for subsequent sampling and on-site analysis. Systematic sampling will be performed per MARSSIM, and ten surface samples will be collected systematically, beginning at a random starting location and adopting the triangular pattern for subsequent locations. Initial analysis of the samples will be performed on-site via gamma spectroscopy, and 10% of the samples will additionally be submitted along with the completed chain of custody record for third party (QC) analysis. Data from this baseline ground surface survey will be included in the report package per Section 6.0.

4.2 In-Line Monitoring System

Upon completion of the initial set-up activities and the baseline surface survey of the clean material staging area, excavation of the 'Burial Mound' will begin. Material will be excavated and removed from the pile and grounds below, and conveyed to the monitoring system. The soil conveyor / monitor is a conventional PowerScreen system with a powered screen sizer for culling any large items, a grinder for soil preparation (i.e., breaking up the compacted clay) , and a discharge conveyor. The detector array is added by ATG, and is a series of ten individual calibrated units comprised of alarming ratemeters with NaI detectors, mounted over the conveyor.

4.2.1 Description

The conveyor has an effective width of 24", and a scraper for controlling the maximum height/depth of the product conveyed. The throughput speed is variable. The length of the conveyor is over 20', permitting ample opportunity to stop the system in the event of an alarm and permit segregation of the contaminated payload from other discharged unaffected material at the end destination of the conveyor.

4.2.2 Sensitivity

The calculated sensitivity of the system is demonstrated in Appendix 5. At a conveyor speed of 0.5 m/second, with the detectors at 6" above the conveyor and the soil at a maximum depth of 3" on the conveyor, the sensitivity is calculated to be 1.5 pCi/gm of Co-60 and 2.8 pCi/gm of Cs-137.

The site-specific $DCGL_w$'s (Derived Concentration Guideline Limits) per Section 6.8.2 and Appendix 6 are shown to be 100 pCi/gm for Co-60 and 21 pCi/gm for Cs-137, respectively, to meet the NRC acceptable dose of 25 mrem/y.

The strategy has been determined that compliance can be demonstrated if the combined activity of the two radionuclides does not exceed the lesser value of 21 pCi/gm.

Actual alarm points in the field will be set at 1.5 times the background rate. A 2" x 2" NaI detector will have a nominal background of about 8,000 cpm at the soil conveyor/monitor (variable). Thus, the detector will alarm at 12,000 cpm, or 4,000 net cpm. This corresponds to a uniform contamination level of 8.6 pCi/gm of Co-60 or 16.8 pCi/gm of Cs-137. Since Cs-137 produces a lower detector response, it is prudent to assume that the combined activity is all Cs-137. In this case, the detector will alarm at 16.8 pCi/gm, compared to a DCGL of 21 pCi/gm. This ensures that the concentration criteria for any combination of Co-60 and Cs-137 will be satisfied.

4.3 Verification of Monitored Material

Impacted material tripping an alarm will be segregated by sacrificing the entire length of contents over the halted conveyor as LLRW. Each positive hit represents as much as 1 yd^3 of rejected material unless further sorted by hand or passed back through the monitor. Rejected material will be sampled and analyzed on-site by gamma spec to establish the correlation between monitor system response and actual concentration by analysis. Additionally, batches of non-rejected material will be initially sampled and analyzed on-site for comparison of monitoring system direct measurement response and actual soil concentrations by sample analysis.

4.4 Sorting and Segregation of Waste Streams

An attempt will be made during excavation and removal of the 'Burial Mound' pile and subsurface material, to extract the known contaminated locations first. The CHPPM report has provided evidence of discrete areas of elevated activity (Attachment 5), from which the present impacted volume estimate has been derived. The early extraction of impacted material allows monitoring system assurance testing with actual product, but more importantly, minimizes the prospect and/or appearance of dilution of the impacted material with otherwise intermixed volumes of uncontaminated or lesser contaminated material.

The operation of the conveyor / monitor will become relatively automated. As long as the operable system has no alarms annunciating with the exception of shift start and end point QC checks, the discharged clean material will be accumulated at the end of the conveyor. The clean material pile will be conveyed and placed on the next 6"lift at the staging pile being constructed.

When an alarm goes off indicating elevated activity on the conveyor, the monitoring technician halts the conveyor and flags the impacted area of material (i.e., chalk, lime). The remaining clean material stockpile at the discharge end of the conveyor is removed entirely. The impacted material is then conveyed under the speed of the conveyor to discharge the contents. As practical, the affected material will be discharged into the awaiting equipment bucket for transfer directly to packaging. At times when a high volume of material is found to be impacted, or when the capacity of existing packages has been exhausted, impacted material will be placed on a plastic barrier over the ground, accumulated, and moved to staging. Any impacted materials on-site which cannot immediately be packaged will be enclosed with plastic and secured.

5.0 EQUIPMENT SURVEYS

All equipment having come in direct contact with the suspect materials within the controlled work area on-site will undergo limited decontamination (gross removal) and a formal radiological release survey prior to permitting removal from the project site.

5.1 Regulatory Criteria for Unconditional Release

The limits for residual surface contamination shall conform to that prescribed in "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material", U.S. NRC, April 1993.
The site contaminants, Co-60 and Cs-137, are provided for in the associated table, which lists them as:

NUCLIDES	AVERAGE	MAXIMUM	REMOVABLE
Beta-gamma emitters	5000 dpm/100 cm^2	15000 dpm/100 cm^2	1000 dpm/100 cm^2

5.2 Surface Surveys

Accessible surfaces of equipment will be surface surveyed by scanning with a calibrated ratemeter and a GM pancake probe. Additional measurements will be performed using gamma sensitive instrumentation, i.e., Micro R meter to rule-out any obvious contamination which would warrant decontamination prior to the intensive surface scan. Care will be made to ensure that select regions, including contact points and intakes, are scrutinized intensely.

Data will be recorded in the field on sketches/diagrams of the components. Records will include the name of the surveyor, date, equipment identification, instrumentation by model, serial number, date of calibration, background rate, and observed gross measurement readings. The survey will ultimately be corrected to include standardized units of net dpm/100 cm^2.

5.3 Surface Sampling

Swipe samples will be collected of equipment surfaces during the survey. Swipes will be counted on-site for both alpha and beta-gamma activity on a manual Ludlum Model 2929.

Swipe sample measurements will be documented to include the technician, date, identification of individual swipe sample, instrument background rates, instrument efficiencies, and gross count rate in each channel. The corrected activity will be also recorded in units of net dpm/100 cm^2.

5.4 Instrument Selection

Table 1 lists the radiological detection and measurement instrumentation to be employed for the survey activities, along with typical parameters and detection sensitivities for the type of instrument and its application.

TABLE 1
INSTRUMENTATION FOR RADIOLOGICAL SURVEYS

Type of Measurement	Instrumentation Detector	Instrumentation Meter	Background Rate	4π Efficiency	Detector Sensitivity
Surface Scan beta-gamma	GM Pancake Ludlum 44-9	Ratemeter Ludlum Model 18	50 cpm	0.1	3760 dpm/100cm^2
Surface Scan (alpha)-beta	Gas Proportional Ludlum 43-68	Ratemeter Lud. Model 2221	400 cpm	0.15	980 dpm/100cm^2
Surface Activity beta (alpha)	Gas Proportional Ludlum 43-68	Scaler Lud. Model 2221	400 cpm	0.15	638 dpm/100cm^2
RemovableSurface Activity - beta	Plastic Scint (ZnS) Ludlum 43-10-1	2 Channel Scaler Lud. Model 2929	80 cpm	0.3	727 dpm/100cm^2
RemovableSurface Activity - alpha	Plastic Scint (ZnS) Ludlum 43-10-1	2 Channel Scaler Lud. Model 2929	3 cpm	0.35	151 dpm/100cm^2
Exposure Rates	1" x 1" NaI	Micro R Meter Ludlum Model 19	-	-	< 1 µR/hr
Surface Dose Rates	2" x 2" NaI Lud. Model 44-10	Ratemeter Ludlum Model 18	8,000 - 12,000 cpm	Cs-137 > Co-60 >	900 cpm/µR/hr 450 cpm/µR/hr

Scan sensitivity based on MDA (dpm/100cm^2) = $\dfrac{4.65\sqrt{\dfrac{\text{Bkg (cpm)}}{2 \times \text{Tc (min)}}}}{\text{Eff} \times A/100}$

Where Tc = Meter Response Time
A = Area of Probe

Surface measurement sensitivity based on MDA (dpm/100cm^2)

$$= \frac{2.71 + 4.65\sqrt{\text{Bkg (cpm)} \times \text{Tc (min)}}}{\text{Eff} \times A/100 \times \text{Tc (min)}}$$

6.0 FINAL STATUS RADIATION SURVEY

6.1 Introduction

The area known as the Rideout Field, Pelham Range, Area 24C, at Fort McClellan, Alabama, was used as a low-level radioactive material burial site (up to 1959) and a radiological training area (mid 1960's to 1972). The facility was used to train Radiation Control Teams in support of nuclear weapons testing performed by the Atomic Energy Commission (AEC). The training employed the use of sealed radioactive sources that were raised and lowered to produce radiation fields similar to those associated with fallout from detonation of a nuclear weapon. Students were trained to perform ground and aerial surveys to map the radiation fields present.

The US Army Chemical Center and School training mission was transferred in 1973 from Fort McClellan, Alabama to the US Army Ordnance Center and School at Aberdeen Proving Ground, Maryland. Records indicate that the radioactive materials associated with the burial and training area (primarily Co-60 and Cs-137) were removed and disposed of in off-site licensed facilities around this time. Although the AEC licenses (BML 1-2861-1, BML 1-2861-2, and SNM 344) held by the U.S. Army Chemical Center and School were terminated in 1973, a formal closeout survey was not performed. Since no record of a formal close-out survey could be located, the U. S. Army Toxic and Hazardous Materials Agency requested the U.S. Army Environmental Hygiene Agency, currently the U. S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), to investigate these areas.

The Army Base Closure and Realignment Committee has identified Fort McClellan as an installation for closure. The Fort McClellan Pelham Range will be licensed to the Alabama Army National Guard (USACE, 1998). As part of this closure, the Fort McClellan NRC radioactive materials license number 01-02861-05 will be terminated. Termination of the facility licenses requires submission of a formal decontamination and decommissioning plan.

Previous surveys identified radiological conditions not suitable for unrestricted release. Remedial actions are being planned and the U.S. Army IOC has requested that their contractor design a final status survey to demonstrate the effectiveness of remediation in satisfying applicable radiological guidelines for soil. This Plan describes the scope, objectives, and methodologies of such a survey.

6.2 Results of Previous Radiological Surveys

Radiological surveys of the Burial Mound and several background areas were conducted in August/September 1995 and January 1996 by the U.S. Army Center for Health Promotion and Preventive Medicine. Survey methods and results are presented in "Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound Site, Fort McClellan, Alabama, 29 August –15 September 1995 and 14-28 January 1996" (USACHPPM 1996). These surveys included surface gamma scans to identify discrete areas of elevated activity, gamma exposure rate measurements at 1 meter above the surface, collection and analysis of surface soil samples, collection and analysis of subsurface soil samples, and gamma logging of subsurface sampling core holes.

Background exposure rates ranged from 7.2 to 10.2 μR/h. Background concentrations of Co-60 and Cs-137 in soil samples (surface and subsurface) ranged up to 0.1 pCi/g and 0.3 pCi/g, respectively. Radionuclides from the naturally occurring uranium and thorium decay series and K-40 were present at typical background concentrations.

Surface and subsurface surveys indicated that radiological conditions of most of the Burial Mound are not significantly different than background. In two of the eight 100 m^2 survey grids, isolated locations of elevated activity were identified on the surface of the Burial Mound by the gamma scans. Concentrations of Co-60 and Cs-137 at these locations ranged up to 187 pCi/g and 179 pCi/g, respectively. Gamma exposure rates at 1 meter above the surface ranged up to a maximum of 1.25 μR/h above background on the Burial Mound. Subsurface gamma logging indicated elevated gamma levels to a maximum depth of 3.1 to 3.6 meters below the surrounding soil surface at four locations. Subsurface soil samples contained concentrations of Co-60 and Cs-137 ranging up to 330 pCi/g and 12 pCi/g, respectively. There was no evidence of other radionuclides at above-background concentrations.

6.3 Site Description

The Burial Mound is located in a fenced portion in the northeast corner of the Pelham Range. Mound dimensions are approximately 15 m x 25 m; the Mound is about 1.2 m above the surrounding surface and extends to a depth of approximately 3.7 m below the surface. An area of approximately 9,000 m^2 , including the 'Burial Mound', is the subject of this survey. The area of interest is generally level; conditions of vegetative cover and presence of surface features are not known.

6.4 Organization and Responsibilities

The final survey will be implemented immediately upon completion of site remediation activities by the same contractor, ATG, Inc. Refer to Plan section 2.2 for the organization chart. Note that additional health physics expertise is contracted through Auxier and Associates for final survey plan implementation (consult) and data evaluation.

6.5 Purpose and Scope

The purpose of this Plan is to provide a framework for conducting a final status survey of the soils at the Burial Mound site. The survey will determine the levels and extent of residual radiological material, if any, in site soils and compare the current radiological conditions with the guidelines established for the project (see Section 6.8.2).

6.6 Radiological Contaminants

The potential radiological contaminants are Co-60 and Cs-137 based on previous survey results. Contaminants are present at varying concentrations and ratios.

6.7 General Approach

Guidance provided in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (DoD 1997) will be the basis for this survey. The MARSSIM process was developed collaboratively by the Nuclear Regulatory Commission, Environmental Protection Agency, Department of Energy, and Department of Defense, for use in designing, implementing, and evaluating radiological surveys. This process emphasizes the use of Data Quality Objectives (DQO) and Data Quality Assessment processes, along with a sound program of quality assurance/quality control. The "graded approach" concept is also used to assure that survey efforts are maximized in those areas where there is the highest probability for residual contamination or greatest potential for adverse impacts of residual contamination. Examples of integration of the graded approach into the MARSSIM process include use of site history, site conditions, equipment capabilities, and results as the survey progresses to establish/adjust: degree of scanning coverage of a survey area, survey unit size, sampling frequency, and criteria for evaluation of elevated measurements.

The primary focus of MARSSIM is to demonstrate compliance of a site or facility with regulatory agency criteria for future use without radiological restrictions. This type of survey is known as a "Final Status Survey," and MARSSIM provides highly prescriptive guidance for designing and conducting such a survey.

On the basis of prior surveys, residual contamination of Co-60 and Cs-137 in excess of the established guidelines for unrestricted release (Section 6.8.2), is anticipated on portions of this site. Remediation will therefore be performed to remove contaminants to satisfy acceptable levels. It is anticipated that remediation will include excavation and subsequent sorting of soil from the Burial Mound. An area will be identified for placement of the clean sorted soil. Soil determined to be clean as a result of the sorting process will be spread out at a location inside of the fenced area. This area will be surveyed in the same manner as the remainder of the site prior to and following placement of the sorted soil. The Final Status survey will be implemented, following completion of the remedial actions unit and prior to backfilling or other restoration actions.

This Plan is based on information available at the time of its preparation. The primary source of information used in the design was the "Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound Site, Fort McClellan, Alabama, 29 August –15 September 1995 and 14-28 January 1996" (USACHPPM 1996). It is recognized that additional historic information on site operations, conditions encountered at the time of the survey implementation, and findings as the remediation and/or survey progress may require modifications to this Plan. If modifications are determined necessary, they will be justified and documented, including appropriate project approvals.

Field activities will include:

- surface gamma scans to identify potential locations of contamination,
- exposure rate measurements, and
- sampling of surface soil.

6.8 Survey Objectives

6.8.1 General

The objective of the survey described in this Plan is to determine the radiological conditions of soils at the Burial Mound Site, following remedial actions, for comparison with the guidelines established for the project (see Section 6.8.2).

6.8.2 Radiological Guidelines

The following guidelines (also referred to as $DCGL_W$'s or Derived Concentration Guideline Limits) for residual radionuclide concentrations in soil have been established for individual radionuclides (A&A 1999).

The criteria developed for the Burial Mound Site are 100 pCi/g Co-60 and 21 pCi/g Cs-137 in soil, based on an acceptable dose of 25 mrem/y. The survey objective is to demonstrate compliance that the combined residual concentrations of these two radionuclides are such that the total dose to an exposed individual would be less than 25 mrem/y.

6.8.3 Radiological Survey Parameters

Surface scans of the ground surface will be recorded in count rate (counts/minute (cpm) or counts / second (cps)); the primary purpose of the scans will be to be identify locations where direct gamma radiation levels are elevated, thus suggesting possible radiological contamination in excess of natural background levels. Scanning location and results will be recorded by hand. Relative instrument count rate will be continuously monitored during scanning through use of the audible response signal from the instrument. The estimated scanning sensitivities are 3.4 pCi/g for Co-60 and 6.4 pCi/g for Cs-137 based on a nominal background level of 10,000 cpm at the ground surface with a 2" x 2" scintillation detector in the manual scanning mode. (Table 6.4 of NUREG-1507). The scanning technique is more sensitive for larger areas of contaminated soil. The scan procedure would therefore be capable of identifying areas of soil with Co-60 and/or Cs-137 contamination well below the dose-based criterion.

Exposure rates in μR/h will be used as a surrogate measurement to demonstrate compliance with the concentration criteria for Co-60 and Cs-137 in surface soil. Twenty-one pCi/g of Cs-137 equates to an exposure rate of 6 μR/h above background. The Co-60 concentration associated with an exposure rate of 6 μR/h above background is 4 pCi/g—well below the dose-based criterion of 100 pCi/g. The use of 6 μR/h as a surrogate measurement for the $DCGL_W$ ensures that the concentration criteria for any combination of Co-60 and Cs-137 will be satisfied. Measurements of integrated counts in 0.5 minutes will be performed at "data point" locations, described below, using the 2221/44-10 instrument combination. Count rate will be converted to exposure rate (μR/h) using correlations determined by intercomparison with a Pressurized Ionization Chamber. Results will be tested for compliance, using the non-parametric statistical approach recommended in MARSSIM.

Soil samples will be collected at selected "data point" locations, and analyzed by gamma spectrometry for Co-60 and Cs-137 content. Concentrations will be reported in units of pCi/g, dry weight. Results will be compared with the established criterion.

Results will also be tested for compliance at the 95% confidence level, using the Student t-test approach of NUREG/CR-5849.

6.8.4 Data Quality Objectives

To enable testing of data relative to guidelines, the USACHPPM has established acceptable decision errors for this project. The Type I (alpha) decision error to be used in data testing is 0.05; this provides a confidence level of 95% that the statistical tests will not incorrectly determine that a surveyed area satisfies criteria when, in fact, it does not. The Type II (beta) decision error is also 0.05; this provides a confidence level of 95% that the statistical tests will not incorrectly determine that a surveyed area does not satisfy criteria when, in fact, it does.

Data quality indicators for precision, accuracy, representativeness, completeness, and comparability have been established.

- Precision will be determined by comparison of replicate values from field measurements and sample analysis; the objective will be a relative percent difference of 30% or less at 50% of the criterion value.

- Accuracy is the degree of agreement with the true or known; the objective for this parameter will be +/- 30% at 50% of the criterion value.

- Representativeness and comparability do not have numeric values. Performance for these indicators is assured through the selection and proper implementation of systematic sampling and measurement techniques.

- Completeness refers to the portion of the data that meets acceptance criteria and is therefore useable for statistical testing. The objective is 90% for this project.

When the site is determined to satisfy the established guidelines, a final report will be prepared, documenting the survey procedures and results.

6.9 Background Levels

Actual background levels of Co-60 and Cs-137 in soil and exposure rate were determined for 2 site reference areas as part of the previous surveys (USACHPPM

1996). The values from the "Reconnaissance" Area survey will be used as a starting point for survey design. Those levels are approximately: Co-60 in soil, <0.2 pCi/g; Cs-137 in soil, 0.6 ± 0.4 (1 σ) pCi/g and exposure rate, 8.2 ± 0.8 (1 σ) μR/h. Because these radionuclide concentrations in soil are less than 10% of the guideline values, they are not considered present in background. However, the parameter selected for demonstration of compliance, i.e. exposure rate, has a background level (8.2 μR/h) that is greater than 10% of the guideline implementation value (14.2 μR/h), and is therefore considered as present in background. Prior to initiating field survey activities, these values will be reviewed for appropriateness; additional reference area(s) will be identified and direct gamma radiation levels and/or radionuclide concentrations in soil determined, as necessary. The number of background reference data points is discussed in Section 6.13. Background measurements will be performed in the same manner as site measurements to permit comparisons of site and background data by non-parametric statistical methods.

6.10 Testing for Compliance with Guidelines

As part of the DQO process, the null hypothesis for demonstrating compliance of data with guidelines must be stated. The null hypothesis (H_0) tested is that residual contamination exceeds the acceptance criterion (guideline); by rejecting the null hypothesis, the alternative hypothesis must be accepted and the finding of the evaluation is that the site satisfies the guideline. In accordance with recommendations of MARSSIM, the non-parametric Wilcoxon Rank Sum (WRS) test will be used for this purpose because the survey parameter selected for demonstration of compliance has an associated background. As a supplemental evaluation, results of soil sampling will be compared with the dose-based criterion, using the Student t-test as described in NUREG/CR-5849.

6.11 Classification of Areas by Contamination Potential

For the purposes of guiding the degree and nature of survey coverage, MARSSIM identifies three classifications of areas, according to contamination potential. Class 1 areas have a potential for contamination that exceeds guidelines; Class 2 areas have a potential for contamination, but it is unlikely that the contamination level exceeds the average $DCGL_w$; and Class 3 areas are not expected to contain residual activity in excess of background. Due to the relocation of the material previously present in the Burial Mound during the sorting process, the entire area will be classified as a Class 1 area and will be gamma scanned at essentially 100% coverage. No Class 2 or 3 areas are planned for this final status survey.

6.12 Identification of Survey Units

The site will be divided into survey units following the general guidance of MARSSIM Section 4.6. Approximately 10 Class 1 survey units, typically consisting of approximately 1,000 to 1,700 m^2, are anticipated. Division into specific survey units will be performed at the time of the survey. Survey units will be assigned unique two-digit identifiers and will be referenced to the grid coordinate at the southwest corner of the unit.

Final designation of survey units will be performed after remediation is completed and just prior to initiating post-remediation screening and the final status survey. There will also be one reference area selected at the time of the survey.

6.13 Determination of Data Requirements

The survey plan takes advantage of the strong radiation signal from Co-60 and Cs-137 to identify and quantify areas of soil contamination in the field. Exposure rates will be used as a surrogate for the DCGLs to guide the remediation and determine when remediation is complete and an area is ready for soil sampling. The soil sampling ill be used to confirm that the remediation achieved the DCGLs for each survey.

6.13.1 Exposure Rate Measurements

The Wilcoxon Rank Sum statistical test was used to calculate the number of systematic exposure rate measurements needed to determine the status of a survey unit. This test requires information on the following parameters:

- The $DCGL_w$ defined in Section 6.8.2;
- The Lower Bound of the Grey Area (LBGA) defined in MARSSIM;
- The sigmas of the reported exposure rates in the reference (σ_r) and survey (σ_s) areas;
- The decision error percentiles for the null hypothesis.

A&A has calculated a dose equivalent rate of 6 μR/h, above background, at 1 m above the surface as a surrogate measurement for the $DCGL_w$'s for

guideline concentrations of Co-60 and Cs-137 in soil. The $DCGL_w$, plus the background average, is 14.2 μR/h. This is above the upper range of measured background, 10.2 μR/h. If the 3 sigma background level of 11.2 is taken as the LBGR, and the $DCGL_w$ as 14.2, then Δ, the width of the MARSSIM 'grey zone' is:

$$\begin{aligned}\Delta &= DCGL_w - LBGR \\ &= 14.2\ \mu R/h - 10.2\ \mu R/h \\ &= 3\ \mu R/h\end{aligned}$$

Where,

$DCGL_w$ = The Derived Concentration Guideline

LBGA = Lower Bound of the Grey Area

Once the width of the 'grey area' (Δ) is determined, the 1 sigma values of the reference area (σ_r) and survey areas (σ_s) are used to calculate the Relative Shift. The Relative Shift is the ratio of the width of the 'grey area' to the standard deviation of the measurements made within the survey units (Δ/σ). The one sigma values for the reference and survey areas have been determined to be approximately 1 μR/h, based on survey results obtained during the scoping/characterization phase. The relative shift is then calculated to be:

$$\Delta/\sigma = 3\ \mu R/h\ /\ 1\ \mu R/h = 3$$

Where,

Δ = The width of the 'grey region' defined in MARSSIM, and

σ = Sigma for the reference and survey areas.

MARSSIM recommends a range of 1 to 3 for the Relative Shift, Δ/σ. Three is within this range and will be used to determine the number of measurements required.

Once the Relative Shift is determined, the information can be used in conjunction with the acceptance decision errors on the null hypothesis to determine the number of data points required. In this case, the null hypothesis, (Ho) states that, for each survey unit, the residual radioactivity exceeds the $DCGL_w$. Acceptance decision errors for testing this hypothesis are set at 0.05 for both Type I and Type II errors.

The number of data points for statistical testing the status of each survey unit is obtained directly from MARSSIM (page 5-30, Table 5.3). The number of data points for performing the WRS statistical test is 10 for each survey unit (and the reference area). This number of samples includes an additional 20% to account for missing or unusable data.

Sensitivities of proposed instruments and techniques are such that $DCGL_w$ concentrations can be identified by scans; additional data are not needed for identifying areas of elevated activity.

6.13.2 Soil Sample Collection

Soil samples will be collected at the ground surface immediately below the locations in which integrated direct gamma measurements are to be obtained at the 1 meter elevation. Per the following sections 6.14 and 6.16.2, the described frequency provides an initial estimate of 10 data points for each survey unit. Approximately 70 samples, plus those of the reference area, will be obtained from throughout the site. The soil concentration data collected from these samples will be used in a Student's t-test to confirm the status of the survey unit.

6.14 Data Point Locations

MARSSIM recommends a triangular sampling pattern to increase the probability of identifying small areas of elevated activity. This type pattern will be used for the Burial Mound site, except where a triangular pattern is not practical, because of the size and shape of a specific area to be sampled; for such situations, a square sampling pattern may be used. For example a square pattern is more practical to install and implement than a triangular pattern for survey areas having one dimension that is less than the calculated average spacing between samples. The spacing (L) between samples on a triangular pattern is determined by:

$$L = [\text{Survey Unit Area}/(0.866)\ (\text{number of samples})]^{1/2}$$

For a Class 1 survey unit area of 1,500 m^2 and 10 samples, the area represented by each sample is approximately 150 m^2. The spacing between samples on a triangular pattern for this area is 4 m. If unusual survey unit dimensions and surface features prevent collection of an adequate number of systematic data points for statistical testing, additional points may be obtained from randomly selected locations within the survey unit.

To establish a random-start triangular pattern for a Class 1 survey unit, start from the southwest corner of the survey unit and select a random starting point north and east of this corner. Next, determine the grid coordinates of all locations within the survey unit at 4-m intervals along the same east-west reference grid line as the pattern starting point. Locate a point 3.5 m north (or south) and 2 m east (or west) of one of these locations, and determine the grid coordinates of all the sampling locations within the survey unit at 4-m intervals along an east-west reference grid line, parallel to the initial line of sampling locations. Repeat this process until the entire area to be surveyed is covered by the triangular pattern. For irregular shaped survey units, where use of east-west and north-south grid lines may be inconvenient, the baseline for the sampling pattern may follow the long axis of the survey unit to facilitate implementation.

6.15 Instrumentation

6.15.1 Instruments

The proposed Instrumentation for the Burial Mound Site survey will be the following, (or equivalent):

1) Ludlum Model 2221, scaler/ratemeter
2) Ludlum Model 44-10, gamma sensitive 2" x 2" NaI detector
3) Reuter Stokes, Pressurized Ion Chamber RSS-112
4) Ludlum Model 19, Micro R Meter

6.15.2 Specifications and Uses

6.15.2.1 Ludlum Model 2221

1) Count rate meter set to the operating voltage and input sensitivity characteristics of the detector in use;

2) Will be used as a scaler in continuous and timed collection durations;

3) Will be used as the instrument to configure with the Ludlum Model 44-10.

6.15.2.2 Ludlum Model 44-10

1) Gamma sensitive, 2"x2" NaI detector capable of identifying minimum levels of < 21 pCi/gm and as referenced in final release of MARSSIM manual, equation 6-10, and NUREG-1507. Exact MDC's for scans will be empirically determined upon site arrival and gaining knowledge of site conditions for surface efficiency and personnel for surveyor efficiency.

2) The weighted cpm/μR/h is approximately 900 for Cs-137 and 450 for Co-60.

6.15.2.3 Reuter Stokes RSS-112

1) The RSS-112 is a pressurized Ion Chamber and is considered a primary standard.

2) Intended use will be to establish scintillator response correlations.

6.15.2.4 Ludlum Model 19

1) The Model 19 is a 1" x 1" NaI detector instrument.

2) Its primary use will be for exposure rate measurements for exposure to occupationally and non-occupationally exposed individuals.

3) Quality control will be measured against the RSS-112 PIC.

6.15.3 Maintenance and Instrument Control

All instrumentation will have current calibration (within the past 12 months, or as recommended by the manufacturer). Daily performance checks will be conducted in accordance with individual instrument use procedures. These performance checks will be performed prior to and following daily field activities and at any time the instrument response appears questionable. Only data obtained using instruments that satisfy the performance requirements will be accepted for use in the evaluation.

6.16 Final Status Survey Implementation

6.16.1 Gamma Scans

Following remediation and/or prior to conducting sampling, screening gamma scans will be performed over 100% of surfaces of Class 1 survey units. The surveyor will advance at a speed of approximately 0.5 m/s while passing the detector over the surface in a serpentine pattern. Audible response of the instrument will be monitored, and locations of elevated audible response that are identified will be noted. Based on Section 6.8.2 of NUREG-1507, an increase of 1500 to 2000 cpm is detectable over an ambient level of 10,000 cpm (typical background level for a 2-inch x 2-inch NaI detector). Differences in fill materials, surface covering, structures, and source-to-detector geometry due to excavations and site topography will result in variable ambient direct gamma radiation levels. Therefore, the actual ambient background for a survey unit will be determined at the start of the survey and a scanning response, which is detectable above the background level, will be set as the investigation or screening level, indicating potential contamination exceeding guideline concentrations. As site survey data are collected and evaluated, correlation of instrument response with radionuclide concentrations will be developed to facilitate field identification of locations of elevated activity in excess of site-specific removal goals. Locations exceeding screening levels will be investigated and, if appropriate, remediated; following any remediation, scanning will be repeated to demonstrate effectiveness of the removal actions.

6.16.2 Direct Exposure Rate Measurements

Exposure rate measurements will be performed at systematic data point locations in accordance with the procedure, using a Ludlum Model 2221 meter with a Ludlum Model 44-10 gamma scintillation detector. The measurements will be performed at 3.3 ft above the surface by integrating the count for 0.5 minutes. The Pressurized Ionization Chamber will be used to develop a correlation between the instrument response and true exposure rate. Project-specific forms will be used to record data.

6.16.3 Soil Sampling

Soil samples of approximately 1 kg will be obtained to a depth of 15 cm; samples will be packaged and uniquely identified in accordance with chain–of–custody and site-specific procedures.

6.16.4 Sequence of Field Activities

The sequence of activities will be as follows:

1. If deemed necessary, select a reference survey unit of a similar geological nature to the Mound Burial Site, but not impacted by radiological contamination. Perform 10 exposure rate measurements in this reference area. Measurement locations in the reference survey unit will be selected randomly or systematically, depending on the size and dimensions of the area. The reference locations of each of the samples must be documented.

2. Determine ambient background direct gamma levels for gamma scintillation detectors and establish action levels to correspond to instrument responses, which are detectable above these ambient background levels.

3. Establish reference grids for survey areas and establish boundaries of survey units. Establish pattern for data points (Section 6.14).

4. Conduct surface gamma scans. Identify locations of elevated direct radiation and remediate and/or conduct sampling to determine the extent and concentrations of areas of elevated activity.

5. Establish random-start sampling location patterns.

6. Perform exposure rate measurements. The actual number of systematic measurements will depend on the actual area and pattern of excavation and results as the survey progresses.

7. Perform on-site sample analysis by gamma spectroscopy and send split samples (QC) accompanied with the appropriate chain-of-custody record, to a qualified laboratory for confirmatory analysis at a frequency of 10% of the total sample population.

Area Classification	Number of Survey Units	Samples/Survey Unit	Total Measurements
Reference Area	1	10	10
Class 1	7	10	70

6.16.5 Sample Analysis

Samples will be transferred to a radio-analytical laboratory for analyses in accordance with documented laboratory-specific standard methods. Samples will be dried and homogenized. A portion of each sample will be sealed in calibrated-geometry containers and then analyzed by high-resolution gamma spectrometry. Concentrations of Co-60 and Cs-137 and members of the natural uranium, thorium, and actinium decay series, which may be identified by the spectrometry analysis software, will be determined. In accordance with MARSSIM, analytical techniques will provide a minimum detection level of 50% of the individual radionuclide $DCGL_W$ values for all primary contaminants, with a preferred target minimum detection level of 10% of these individual radionuclide $DCGL_W$ values.

6.16.6 Investigation Levels

Direct radiation levels, identified by scans, that indicate potential residual radioactive contamination above background, will be investigated to identify the source, level, and extent of such residual activity. Areas that contain residual radioactivity concentrations of individual radionuclides or sum-of-ratio concentrations above respective guideline values and remediation goals will also be investigated. Depending upon the levels, extent, and other conditions of contamination, additional sampling and/or measurements may be performed to resolve uncertainties, and data reevaluated. Remediation will be performed, if required, and the location resurveyed.

6.16.7 Quality Control Measurements

A minimum of 5% replicate samples and exposure rate measurements will be performed for field quality control purposes. Other quality control activities are incorporated into specific field survey procedures.

6.17 Data Evaluation

6.17.1 Data Assessment

All data will be reviewed for conformance with indicated procedures and plans. Results will be converted to appropriate units for comparison with criteria and necessary calibration/correlation adjustments performed. All measurement data will be reported in the standard format of X +/- Y (2 σ) and detection capability. Laboratory analyses and exposure rate measurement QC data will be evaluated for accuracy and precision.

Data not meeting design quality objectives will be identified. Additional data needs, if any, will be identified.

- Scan data, locations of elevated direct radiation levels, and sampling locations will be identified on facility drawings.

- Tables of radionuclide concentrations in each sample from the reference area and each survey unit will be prepared.

- Individual sample concentrations will be graphically displayed on posting plots and histograms for each survey unit and reference area for visual identification of trends.

6.17.2 Data Interpretation

Exposure rate data meeting acceptance criteria will be evaluated using the Wilcoxon Rank Sum test. The Wilcoxon Rank Sum test (the method described in Appendix I, Section 11 of MARSSIM) will be conducted for each group of survey unit samples; the reference area sample set will be used for each of these tests. If the WRS test results in rejection of the hypothesis, the test has demonstrated that the survey unit satisfies criteria for unrestricted release. If the data do not reject the hypothesis, a site-specific risk assessment will be performed to determine options for further action.

Soil concentration data will be evaluated using the Student t-test. Findings that are inconclusive because of additional information needs and findings that criteria have not been met will be promptly reported within the project organization structure for early resolution.

6.17.3 Comparison with Project Objectives

Overall project results will be compared with DQOs, established during the design phases of the project.

6.18 Report of Survey Findings

Survey procedures and results will be documented in a report, following the general guidance for Final Status Survey Reports in draft NUREG/CR-5849 (NRC-1992), and submitted by ATG.

7.0 PHYSICAL SECURITY PLAN AND MATERIAL CONTROL AND ACCOUNTING PROVISIONS IN PLACE DURING DECOMMISSIONING

This section is not applicable. Fort McClellan is still an active base and security and material control are conducted by the U.S. Army.

8.0 FUNDING

The following cost estimate depicts the turnkey pricing for the entirety of project execution, from mobilization through remediation, final verification, and return for site closure upon regulatory release. Management, technical and labor support, travel and living expenses, normal consumables (plastic, PPE, etc.) and rentals are provided for the projected level of effort. Waste packaging and transportation is provided for an estimated volume of LLRW up to 500 yd^3 of impacted soil and secondary wastes. Waste volumes in excess of 500 yd^3 would require negotiation of unit rates to accommodate the extended schedule and additional transportation costs.

U.S. Army Fort McClellan HQ, IOC Project Number USA 98-046 Phase II
'Burial Mound' Decommissioning Funding

Direct Labor		**$ 72,709**
Fringe, P/R Tax, Workmans Comp.		**$ 20,569**
M&IE		**$ 31,847**
Travel		**$ 6,337**
Supplies		**$ 21,952**
Rental		**$ 74,818**
Freight		**$ 1,620**
Analysis		**$ 14,100**
Telephone		**$ 2,000**
	Direct Cost	**$245,951**
Overhead	**52.47%**	**$129,051**
Subcontractors		**$130,850**
	Subtotal (G&A Pool)	**$505,852**
G & A	**18.23%**	**$ 92,217**
	Subtotal	**$598,069**
Fee	**12.0%**	**$ 71,768**
	Subtotal	**$669,837**
Facilities Cost of Capital		
0.537% of Total Cost		**$ 1,321**
4.001% of Total Cost through Overhead		**$ 20,239**
Total Phase Cost Estimate		**$691,397**

9.0 REFERENCES

1. U.S. Nuclear Regulatory Commission Radioactive Material License Number 01-02861-05, as amended per docket number 030-17584, U.S. Army Chemical School, Fort McClellan, Alabama.

2. Code of Federal Regulations Title 10, Part 20, *Standards for Protection Against Radiation.*

3. Code of Federal Regulations Title 49, Parts 171 - 177, Transportation.

4. U.S. Nuclear Regulatory Commission Regulatory Guide 3.65, *Standard Format and Content of Decommissioning Plans for Licenses Under 10 CFR Parts 30, 40, and 70*, August 1989.

5. NRC 1998a, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminant and Field Conditions*, NUREG-1507, Nuclear Regulatory Commission, June 1998.

6. NRC 1998b, *A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*, NUREG-1505, Nuclear Regulatory Commission, 1998.

7. NUREG-1575 / EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, December 1997.

8. NUREG/CR-5849 (draft), *Manual for Conducting Radiological Surveys in Support of License Termination*, June 1992.

9. U.S. Nuclear Regulatory Commission Document, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material*, April 1993.

10. *Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound, Fort McClellan, Alabama, 29 August - 15 September 1995 and 14 - 28 January 1996*, U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM).

11. Waste Profile Record, Envirocare of Utah EC-0230, Fort McClellan "Burial Mound", Revision 2, ATG, October 1998.

12. A&A 1999, *Development of Derived Clean-up Guidelines for the Pelham Range 'Burial Mound', Fort McClellan, Alabama*, Auxier & Associates, Inc., February 12, 1999.

13. Envirocare of Utah, Inc. *Radioactive Material License Number UT 2300249 Dated 10/22/98 with Expiration Date of 10/22/2003*, Utah Department of Environmental Quality, Division of Radiation Control.

14. U.S. Army - Industrial Operations Command, Standard Operating Procedure, *Shipping Unwanted Radioactive Materials*, May 1998.

15. IT Corporation 1998a, *Fort McClellan Installation Wide Work Plan, Fort McClellan, Alabama*, IT Corporation, August 1998.

16. IT Corporation 1998b, *Fort McClellan Installation Wide Sampling and Analysis Plan, Fort McClellan, Alabama*, IT Corporation, August 1998.

Development of Derived Cleanup Guidelines for the Pelham Range Burial Mound, Fort McClellan, Revision 1

June 29, 1999

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1.0 Introduction

1.1 Background

Fort McClellan is an army base sited on 45,679 acres adjacent to Anniston, AL. A part of the base, known as Rideout Field, served as a radiological training area from the mid 1950's through May of 1972. The radiological training area was decommissioned and some contaminated soil was excavated and moved to a burial mound located in the northwest corner of the Pelham Range. This mound, called the Pelham Burial Mound in this report, contains elevated concentrations of Co-60 and Cs-137.

1.2 Objective

The Army Base Closure and Realignment Committee has identified Fort McCellan as an installation for closure. Fort McCellan will therefore be closed, and the Pelham Range will be licensed to the Alabama Army National Guard (USACE, 1998). As part of this closure, the Fort's NRC radioactive materials licenses 01-02861-05 will be terminated. Termination of these licenses requires submission of a formal decontamination and decommissioning (D&D) plan. Cleanup levels form an integral part of this D&D plan. This report is intended to present the site-specific derived cleanup guidelines proposed for the Pelham Range Burial Mound and to document the method used to derive them.

1.3 Organization of the Report

The remainder of this report is organized into four sections. Section 2, contains a description of the approach used to derive the cleanup goals. Section 3 contains the results of the exposure assessment performed on selected receptors. Section 4 presents the DCGL's and summarizes the report's recommendations. Appendix A contains the modeling parameters and results that form the basis for the DCGL's developed in this report.

2.0 Description of Approach

In order to terminate a NRC radioactive materials license and release a site, a licensee must demonstrate that the site is suitable for release in accordance with the criteria for decommissioning in Subpart E, "Radiological Criteria for License Termination," of 10 CFR 20, "Standards of Protection Against Radiation." This report uses site-specific information to derive the release criteria that must be met before the license can be terminated and the site licensed to the Alabama Army National Guard. These criteria are based on an annual dose limit of 25 mrem/y to the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity, assuming reasonable and expected use of the land in the future.

Information on the site was assembled and analyzed to develop a conceptual model of the site. This model provided a basis to identify the important sources of contamination, principle means of release and environmental transport, and likely receptors, both now and in the future.

Once these were identified, site-specific derived cleanup guidelines (DCGLs) were calculated using RESRAD version 5.82 (ANL, 1995). RESRAD was developed partially under contract with the NRC and is widely used in the decommissioning industry for calculating doses and soil cleanup criteria.

After the site-specific DCGL's were determined, the philosophy of ALARA was then applied. The DCGLs were compared to the levels detectable by the survey method and the soil sorter equipment. The lowest of these limits was identified as the lowest practical site-specific soil cleanup criteria. These lowest levels are the cleanup criteria proposed for Burial Mound soils.

Because of the bimodal distribution of the radionuclide concentrations in the pile, it is expected that the average concentration of residual contamination in the pile will be much lower than the cleanup criteria. Using measured data, the expected residual concentrations that should result from the application of these cleanup criteria were then determined. These residual concentrations were then compared to the concentrations predicted to produce 25 mrem/y to the critical member of a resident family, assuming immediate occupancy of the site. This commonly applied standard default exposure scenario was selected to determine compliance with unconditional release of the property.

3.0 Exposure Assessment

The purpose of an exposure assessment is to estimate the nature and magnitude of exposures from a site under current and plausible future conditions. This is accomplished by following a phased approach that involves the following tasks:

- Characterizing the exposure setting on and around the site,
- Identifying potentially complete human exposure pathways, and
- Quantifying the magnitude of plausible contaminant intakes by hypothetical receptors.

This section presents a description of the methods used to evaluate exposures from Pelham Mound, and the results of that assessment. The setting and physical characteristics of the Site are summarized below in Section 3.1. Section 3.2 presents the conceptual model describing the sources, contaminant migration, receptors, and exposure routes evaluated for the Mound. The methods used to quantify potential intakes by plausible receptors and the estimated intakes are presented in Section 3.3.

3.1 Characterization of the Site

The following sections summarize information on the physical setting of the site, its history, and its current and projected uses. For more detailed information on these and related subjects, see the Industrial Radiation Study No. 27-MH-0987-R2-97 (USCHPPM, Jan 1996).

3.1.1 Physical Setting

Fort McClellan is an army based sited on 45,679 acres adjacent to Anniston, AL. It is divided into three areas: the Main Post, the Choccolocco Corridor, and the Pelham Range. The Pelham Range Burial Mound is located at UMT coordinates 593300 E, 3732500 N, which is near the northwest corner of Pelham Range, on the northern end of the Battle Drill Area of Range 24C. The mound is oblong in shape and is approximately 25 meters long by 15 meters wide. It extends to three to four meters below grade, and is piled up to approximately two meters above grade in places.

3.1.2 Site History

Part of the area known as Rideout Field served as a radiological training area from the mid 1950's through May of 1972. The area was also used as an active radiological material burial

site as late as 1959. Best information indicates radioactive low-level laboratory waste and contaminated dirt were collected and placed in one burial mound located in the northwest corner of the Pelham Range.

3.1.3 Land Use

The area surrounding the burial mound has historically been used as a maneuver training area for students at the U.S. Army Chemical and Military Police Schools, and by Active Duty, Reserve, and Alabama National Guard units. The area will continue to be used as a maneuver training area for the foreseeable future. The potential for unexploded munitions also exists in some areas of the Pelham Range[1].

Because of its future use and the potential danger to the public from unexploded munitions, access will generally be restricted to authorized personnel only. This restriction will be enforced by limited access along controlled roads, and physical barriers like fences and gates.

3.1.4 Conceptual Model of the Site

The conceptual model for the Pelham Range Burial Mound has been developed to provide the basis for identifying and evaluating the potential risks to human health from radioactive materials at this site. This model presents the relationships between the following elements necessary to construct a complete exposure pathway:

- Sources and contaminants
- Release mechanisms
- Transport pathways
- Exposure routes
- Receptors

Figure 3-1 presents the conceptual model for potential human exposure to the contaminants detected in the Burial Mound soil. The objective of this conceptual model development and the concurrent analysis of potential exposure routes and receptors is to focus subsequent efforts on those pathways and sources that drive the potential impacts on human health risk.

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[1] The Decommissioning Plan includes an OE Avoidance Plan to elminate an unexpected encounter (with odnance and explosives).

The conceptual model illustrated in Figure 3-1 of this appendix traces the exposure pathways and receptors for the Mound from the source through likely release mechanisms and exposure routes to potential receptors. The conceptual model also indicates which exposure routes are carried through the quantitative dose assessment for each receptor under current and far-future land-use scenarios.

3.1.5 Sources and Release Mechanisms

The radionuclides of concern at this site are Co-60 and Cs-137. This material is mixed with soil and the soil has been collected into a discrete pile that extends both above and below grade level. This burial mound is the principle source of radioactive material at this site, and it is a relatively small, discrete area. A previous investigation (USCHPPM, 1996) collected data that indicate the majority of the pile does not contain measurable amounts of Co-60 or Cs-137 (Figures 3-2 and 3-3 of this appendix.)

The exposed surface of the pile is subject to limited water and wind erosion. In addition, rainwater percolating through the pile may mobilize one or both of the contaminants. The impact of these releases are expected to be minimal during the study duration, but they are included the conceptual model for completeness.

3.1.6 Potential Transport Pathways

If released, these contaminants could be transported by wind, surface water, or groundwater to the vicinity of the receptor. In addition, plants may absorb some contaminants via root uptake. Each of these pathways has been included in the exposure assessment calculations made in this report.

3.1.7 Potential Exposure Routes

A receptor can come into contact with the Co-60 and Cs-137 in the Mound in a variety of ways, generally as the result of a receptor's behavior or lifestyle that brings him/her into contact with a contaminated exposure medium. This assessment defines a route mechanism as a stylized description of the behavior that brings a receptor into contact with a contaminated medium.

An exposure route describes how a radionuclide may enter or affect humans. Exposures are divided into two types: internal exposures and external exposures. Internal exposures occur when contaminants enter the human body through inhalation and ingestion. External exposures do not require physical contact and occur when a receptor is close to a source of radiation. Proximity to such a source can result in the irradiation of an individual by penetrating radiation.

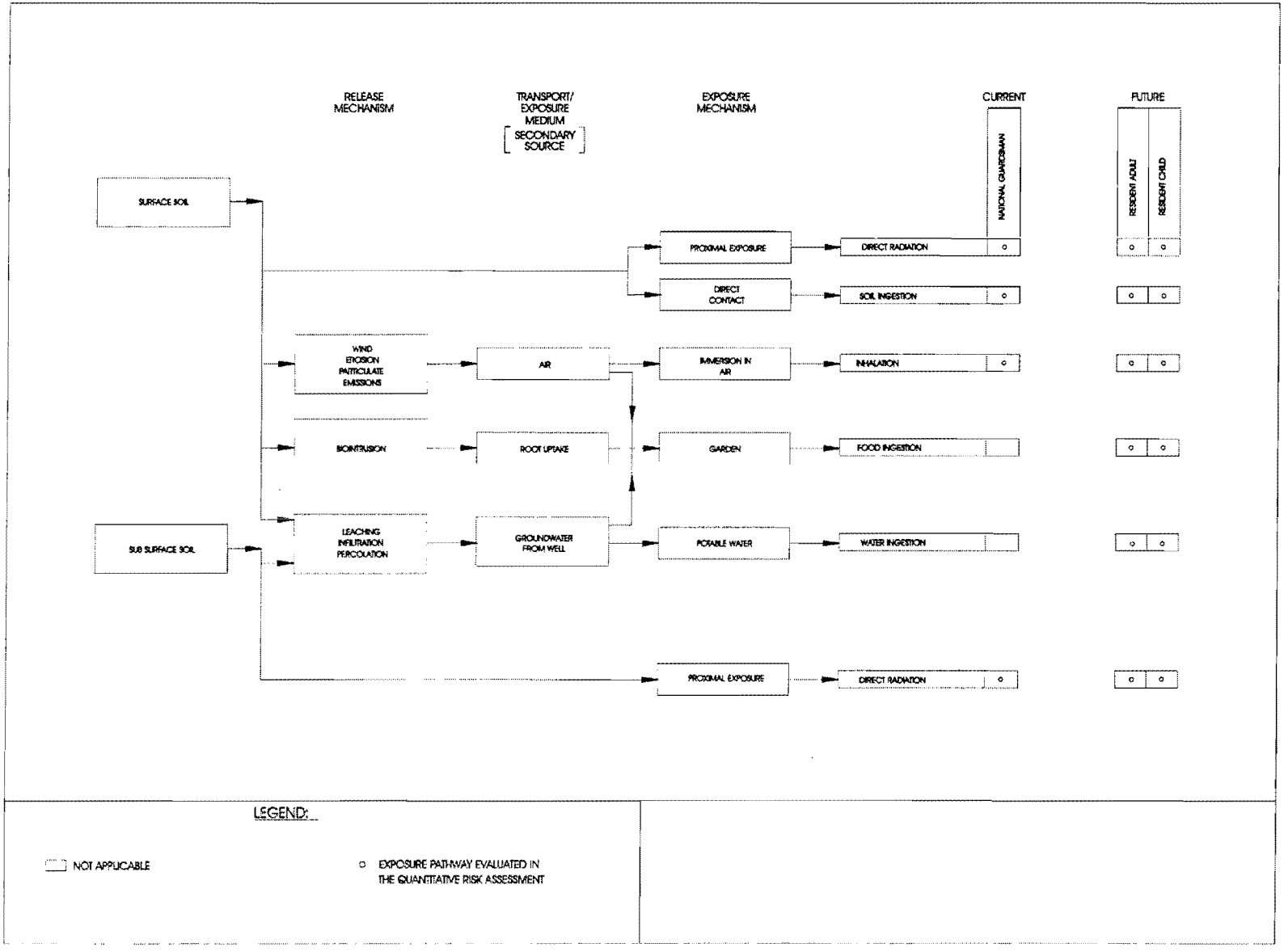

Figure 3-1 Conceptual Model of Exposures for Pelham Range Burial Ground

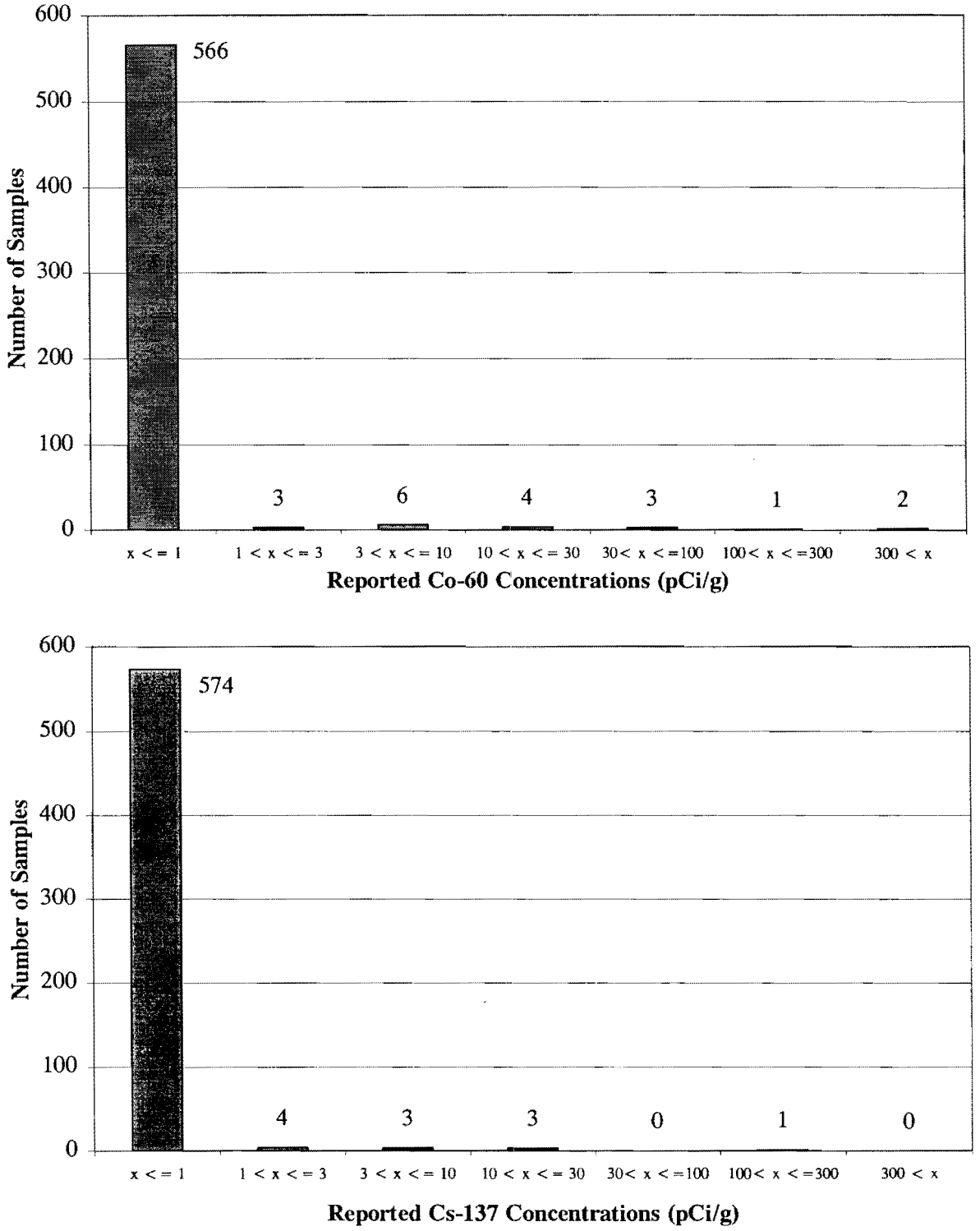

Figure 3.2 Frequency Distributions of Co-60 and Cs-137 Concentrations in Burial Mound Soil (Data from USCHPPM, 1996)

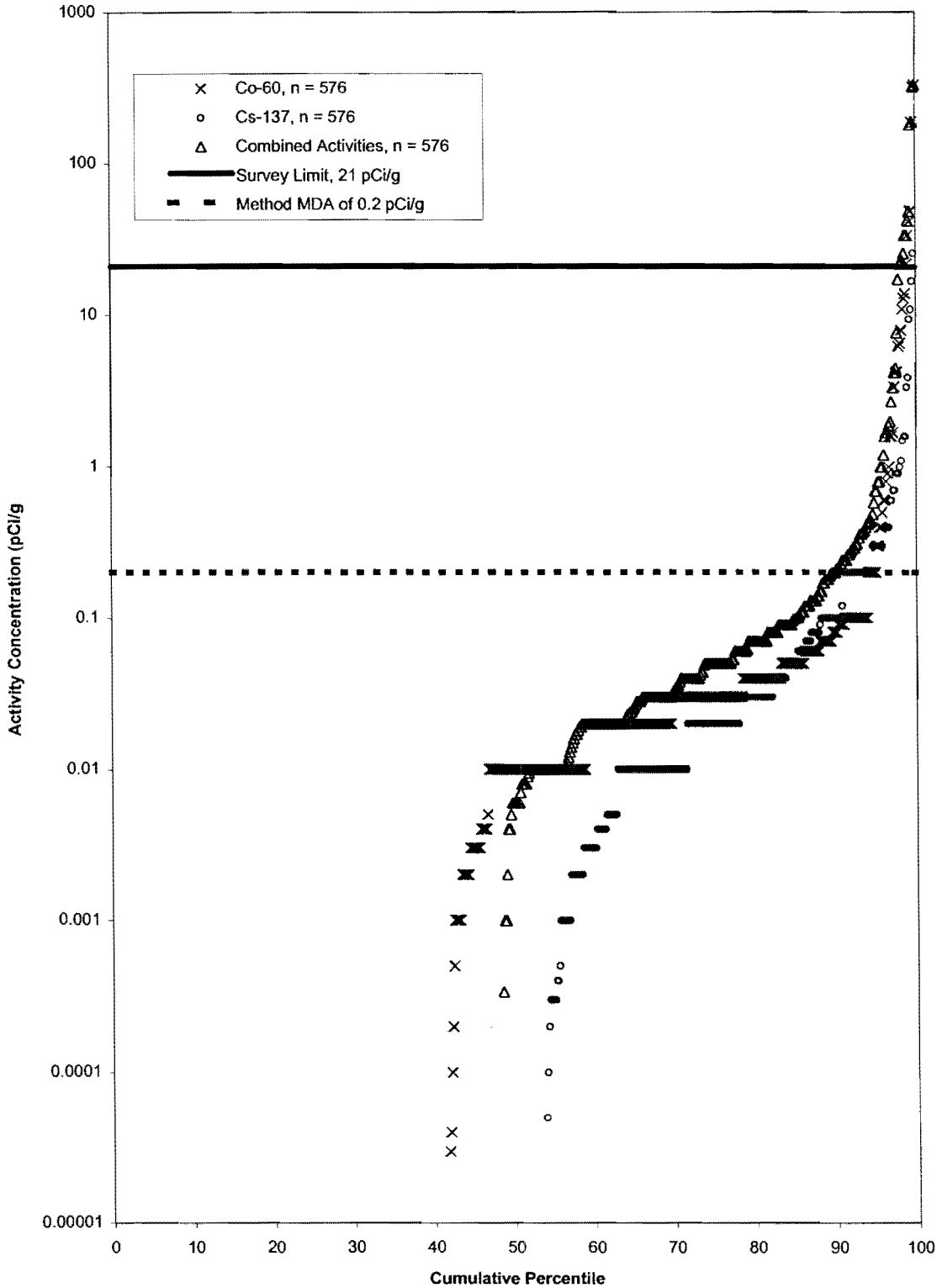

Figure 3-3 Cumulative Probability Plot of Co-60 and Cs-137 Concentrations in Soil

The remainder of this section describes the exposure routes evaluated in this assessment. The receptors evaluated for these exposure routes are described in Sections 3.2.4 and Section 3.2.5.

3.1.7.1 Exposures from Inhalation

This route assumes a receptor is immersed in air containing suspended particulates from the Mound. Subsequent exposures occur via inhalation.

3.1.7.2 Exposures from Ingestion

This route assumes a receptor eats or drinks contaminated soil, food, or water.

3.1.7.3 Direct Exposure to Radiation

Direct exposures to radiation from radioactive material can occur when a receptor is near a radioactive source. Physical contact with a contaminated exposure medium is not necessary for exposure to external radiation to occur. The magnitude of exposure is directly related to the distance of the receptor from the source, the activity of the radionuclides present, and the amount of shielding between the source and the postulated receptor.

3.1.8 Receptor Scenarios Considered

3.1.8.1 Role of Land Use in Receptor Selection

The release criteria for the Pelham Range "Burial Mound" and its surrounding area will be based, in part, on the projected land use of the site. This is because the land use of this site will dictate the types of receptors that may be exposed at the site. The land use will also influence their behavior, and their behavior will influence the types and durations of possible exposures.

This site is currently part of a military base. At decommissioning, it will be licensed to the Alabama Army National Guard for use as a battle drill training area. This land use is expected to continue for the foreseeable future in order to comply with the recommendations of the 1995 Defense Base Closure and Realignment Committee. Therefore public access to the site will be restricted by administrative controls and base security. This land use limits plausible human receptors to military personnel and transient members of the general public.

At some point in the future, the Pelham Range may be released to the general public for unrestricted use. It is not anticipated that this will occur in the near future, but to assess the potential doses from this possibility, hypothetical exposures are assessed from materials in the

Pelham Mound to a family living in a home built on the site after 30 years of use as a National Guard training facility.

3.1.8.2 Receptor Scenarios Considered Under Planned Use Conditions

The possible receptors envisioned for the planned land use at Fort McClellan are military personnel and transient members of the general public. Two receptors have been selected to represent these two classes of exposure, a National Guard soldier on maneuvers and a hunter.

3.1.8.2.1 National Guard Scenario

It is assumed that members of the National Guard spend 14 days a year training at Fort McCellan. This 14 days includes 1 day for mobilization, 1 day for demobilization, and 12 days for maneuvers and training. It was assumed an individual would spend no more than 12 hours a day at the site itself. It is felt that a daily exposure of 12 hours is a very conservative, health protective estimate, because it is unlikely that training activities would allow an individual to spend all their time at one location. These assumptions produce an annual exposure time of 144 hours, which is equivalent to 18 eight hour days. The guardsman is assumed to remain in the Guard for 20 years and receive annual exposures during that period.

3.1.8.2.2 Hunter Scenario

It is assumed that transient exposures could occur to individuals who hunt on Ft. McCellan. A hunter could conceivably build a hunting blind on the site and spend part of each day waiting for game. This site is not as attractive as some surrounding terrain, and it is unlikely that these individuals would spend all of their time on this site, but overestimating the exposure duration in this manner is judged to be health protective.

It was assumed that a hunter will take 1 week of vacation to hunt. Assuming he spends one day building his blind during the weekend before hunting season, he could be present on the site for a total of ten days. If the hunter spends 10 hours a day on this site, the hunter will be in close proximity of the site for 100 hours each year. The hunter is assumed to hunt the site for 30 years.

3.1.8.3 Receptor Scenarios Considered Under Far-Future Use Conditions

This scenario assumes governmental control of the site ceases at 30 years in the future. If administrative controls cease, many types of land use become plausible. In this case, it was judged that residential types of land use would produce the greatest exposure potential.

Therefore, a typical residential scenario has been used to evaluate the exposures from these conditions.

3.1.8.3.1 Resident Adult Scenario

A typical residential adult was selected to represent exposures. This hypothetical resident lives on the property but works elsewhere. This adult spends most of the time indoors, but spends some time engaged in outdoor activities such as light gardening. The resident is assumed to grow his own vegetables and resides at the site for 30 years.

3.1.8.3.2 Resident Child Scenario

A typical residential family consists of both adults and children. A hypothetical child, aged 1 to 6 years old, was selected for evaluation because children are a critical subpopulation that may ingest higher amounts of soil than an adult. The child's behavior pattern is similar to the adult described above, except that less time is spent off-site.

3.1.9 Receptors Selected

Four receptor scenarios were initially considered to be plausible representations of potential uses of this site. Three of these receptors were selected for quantitative evaluation in this study. These potential receptors are described in the Section 3.2.4. Because the radionuclides of potential concern are strong gamma emitters, their most important exposure pathway is external radiation from the ground surface. The total exposure via this pathway is directly proportional to the time exposed to the contaminated ground surface, which means the calculated doses attributed to the receptors will be roughly proportional to the their assumed exposure times.

3.1.9.1 Receptor Selected for Evaluation of Planned Land Use

Two receptors are described in the section introducing potential receptors that were judged to be plausible under the planned use of the site. Table 3-1 presents the parameters describing the behavior of the two receptors. Because the radionuclides of potential concern are strong gamma emitters, their most important exposure pathway is external radiation from the ground surface. The total exposure via this pathway is directly proportional to the time exposed to the contaminated ground surface, which means the calculated doses attributed to the two receptors will be proportional to the their assumed exposure times.

TABLE 3-1 PARAMETERS USED TO ESTIMATE POTENTIAL EXPOSURES FOR THE FORT MCCELLAN PELHAM BURIAL MOUND

	Current Hypothetical Receptor				Future Hypothetical Receptors			
Pathway Parameter (units)	National Guardsman Age 19+		Civilian Hunter Age 19+		Resident Adult Age 19+		Resident Child Age 1-6	
Time and duration of exposure								
ET indoors (hr/d)	0	a	0	b	16.4	c	20.2	d
ET outdoors (hr/d)	12	a	10	b	2	c	3.3	d
EF (d/yr)	12	a	10	b	350	e	350	f
ED (yr)	20	a	30	g	30	e	6	f
Inhalation of dust								
IR (m3/hr)	0.63	h	0.63	h	0.63	h	0.31	i
Incidental ingestion of soil								
IR (kg/d)	0.00005	j	0.00005	j	0.00005	j	0.00020	k
Ingestion of food and water								
IR_{veg} (kg/d)	na	l	na	l	0.309	m	0.129	n
IR_{fruit} (kg/d)	na	l	na	l	0.244	m	0.102	n
IR_{water} (L/d)	na	l	na	l	2.3	o	1.3	p

a - The guardsman is assumed to spend 12 hours a day training outdoors in equipment or facilities located over the burial ground. The training lasts 2 weeks each year, with two days subtracted for mobilization and demobilization activities. The guardsman is assumed to remain in the Guard until eligible for a pension at 20 years.

b - The civilian hunter is assumed to spend 10 hours a day in a blind located on the burial ground site. The hunter is assumed to spend one day prior to hunting season building a blind, and spend 1 week of vacation (five days plus two weekends) each year actively hunting.

c - Recommended values for indoor residential and outdoor exposures from Table 5-176 in Exposure Factors Handbook, EPA 1997.

d - Time weighted average of mean values for indoor residential and outdoor exposures for 1-4 year old from Table 5-131 and Table 15-132 in Exposure Factors Handbook, EPA 1997. (Indoor = 1211 min/d, and Outdoor = 195 min/d).

e - The resident is assumed to spend 30 years living in a house built on the site, and take two weeks of vacation away from the home each year (EPA's 1991 OSWER Directive 9285.6-03.).

f - Reflects six years of life between birth and age 6.

g - The hunter is assumed to hunt the site each year he is in the area. Based on a 30 years residence time (Exposure Factors Handbook, EPA 1997).

h - Inhalation rate of adult. From Table 5-23 of Exposure Factors Handbook, EPA 1997 (15.2 m3/d x d/24 h).

i - Time weighted average of recommended values inhalation rate of children, ages 1-6. From Table 5-23 of Exposure Factors Handbook, EPA 1997. (1 y x 4.5 m3/d+2 y x 6.8 m3/d + 2y x 8.3m3/d + 1y x 10 m3/d) / 6y x d/24 h.

j - Rate of incidental soil ingestion by adult (Exposure Factors Handbook, EPA 1997, Table 4-23).

k - Soil ingestion rate (Exposure Factors Handbook, EPA 1997, pg. 4-24).

l - These receptors are expected to bring their own packaged food and water.

m - 95%tile combined home produced fruit and vegetable ingestion rate by a 71.8 kg adult (Exposure Factors Handbook, EPA 1997, pg. 9-44).

n - 95%tile combined home produced fruit and vegetable ingestion rate by a 30.1 kg child (Exposure Factors Handbook, EPA 1997, pg. 9-44).

o - 90%tile Tap water ingestion rate by an adult (Exposure Factors Handbook, EPA 1997, pg. 3-26).

p - 90%tile Tap water ingestion rate by a 1-10 year old child (Exposure Factors Handbook, EPA 1997, pg. 3-26).

Since the Guardsman Scenario assumes receptor behavior that produces 144 hours of exposure each year, while the Hunter Scenario produces 100 hours a year, the calculated dose from the Hunter Scenario will be less than 70% of the calculated dose from the Guardsman Scenario. Remediating the site to levels which are safe for the Guardsman will therefore insure the safety of the Hunter as well. Therefore, the Guardsman was selected to evaluate the highest plausible exposures from the site's planned land use.

3.1.9.2 Receptors Selected for Evaluation of Far Future Conditions

Two potential receptors, the resident adult and the resident child, are described in the section introducing potential receptors that were judged to be plausible in the unlikely event that the site is released to the public after 30 years. Therefore potential exposures to the resident adult and the resident child were both quantitatively evaluated in this study. Table 3-1 presents the parameters used to quantify the behavior of the two receptors.

3.2 Application of RESRAD

The guardsman and resident scenarios involve activities performed while on top of the burial mound soil. The computer code RESRAD 5.82 (ANL,1993) was used to assess the potential long-term doses from these activities. Default input parameters were used, except where otherwise noted in Table 3-1. Summary input files presented in Appendix A contain a detailed list of parameter values used in the RESRAD calculations for each receptor assessed.

Doses to a guardsman training on a uniform layer of the mound material during 30 years of institutional control were calculated for the following pathways using RESRAD default values:

- Soil ingestion
- Inhalation of resuspended soil, and
- Direct exposure to external radiation.

Doses to a resident living on a uniform layer of the mound material after 30 years of institutional control ends were calculated for the following pathways using RESRAD default values:

- Drinking water
- Food ingestion (home-grown vegetables)
- Soil ingestion
- Inhalation of resuspended soil, and
- Direct exposure to external radiation.

3.3 Summary of Receptor Exposures

The results of the RESRAD runs described in Section 3.3 are summarized in Table 3-2. The residual soil concentrations for the guardsman scenario yield a calculated dose of 25 mrem/y. The soil concentrations at for the residential scenarios will decay to concentrations that yield a calculated dose of 25 mrem/y after the site is used by the National Guard for 30 years.

Table 3-2 Allowable Concentrations in Current Soil For Current and Far-Future Land Use

Guardsman Scenario		Resident Adult Scenario		Resident Child Scenario	
Co-60	Cs-137	Co-60	Cs-137	Co-60	Cs-137
100	478	154	26	123	21

[a] If a resident adult moves onto the site in 30 years, the Co-60 concentration listed here will have decayed to 3 pCi/g, and the Cs-137 concentration will have decayed to 13 pCi/g.

[b] If a resident child moves onto the site in 30 years, the Co-60 concentration listed here will have decayed to 2 pCi/g, and the Cs-137 concentration will have decayed to 11 pCi/g.

3.3.1 Guardsman

Exposures to the hypothetical guardsman evaluated in this study would be dominated by direct gamma radiation emitted directly by the soil. The soil concentrations are based on occupation of the Pelham Mound by a trainee for 144 hours per year. This exposure time is considered excessive, so the resulting derived guidelines calculated for this receptor are judged to be very conservative.

3.3.2 Resident Adult with Garden

Exposures to a hypothetical adult with a garden evaluated in this study would be dominated by direct gamma radiation emitted directly by the soil (over 99% for Co-60 and almost 90% of the Cs-137) . About 10% of the dose from Cs-137 is associated with consumption of food from a garden.

3.3.3 Resident Child with Garden

Exposures to a hypothetical child with a garden evaluated in this study are very similar to those of the adult discussed earlier. They would be dominated by direct gamma radiation emitted directly by the soil (over 99% for Co-60 and almost 90% of the Cs-137) . About 10% of the dose from Cs-137 would be attributable to consumption of food from a garden. The dose based

soil guidelines for the child are lower than for the parent because the child is assumed to spend more time per year on site exposed to the underlying soil.

4.0 Derived Cleanup Guidelines

4.1 Role of Dose Based Criteria

Potential radiation exposures from the Pelham Mound and surrounding areas must be limited to safe levels before the NRC license can be terminated. The NRC has determined that a dose limit of 25 mrem/y is health protective at NRC licensed sites (10CFR20). The Derived Cleanup Guidelines (DCGLs) developed in this document are judged to be meet this requirement under the planned and far future land use proposed for the site.

Application of these DCGLs to the soil pile will result in removal of soil with concentrations exceeding these guidelines. Because only a small percentage of soil samples contained Co-60 or Cs-137 concentrations exceeding the guidelines, it is anticipated that the average concentrations of these two radionuclides in the soil remaining on site will be much less than those required for unconditional release of the site.

4.2 Dose Based Cleanup Guidelines

The dose based cleanup level for a nuclide is the smallest of the soil concentrations calculated for the three receptors (Table 3-2). This assures that final cleanup goals for individual radionuclides are health protective for all the receptors evaluated. The individual dose based Derived Cleanup Guidelines (DCGLs) are 100 pCi/g for Co-60 and 21 pCi/g Cs-137.

4.3 Influence of Multiple Contaminants on Cleanup Guidelines

A multi pathway analysis was used to develop individual dose based DCGL's of 100 pCi/g Co-60 and 21 pCi/g Cs-137. Because Co-60 and Cs-137 are both present at the site, it is necessary to assure that their combined activities do not result in exposures that exceed 25 mrem/y. A simple way of achieving this is to set a combined cleanup standard to be equal to the smaller of the two cleanup criteria in soil. This approach protects human health and the environment at the site and provides one clear, reproducible soil cleanup objective for the proposed remedial activities.

The smaller of the two dose-based cleanup guidelines calculated in this report is the 21 pCi/g limit for Cs-137. This approach would yield a combined cleanup criteria of 21 pCi/g for soil containing both radionuclides.

4.4 Derived Cleanup Guidelines Based on Expected Land Use

The approach used in this report sets 21 pCi/g as the cleanup concentration for site soils containing a mixture of Cs-137 and C-60 at the site. The final set of DCGLs for this site is presented in Table 4-1. The limits for individual nuclides will be applied if it can be demonstrated that only one of these radionuclides is present in the soil. If the presence of both is suspected, the value of 21 pCi/g will be compared to the sum of their activities.

4.5 Impact of DCGLs and Soil Sorting on Final Status of Burial Mound Soil

The previous section presents DCGL's for the Burial Mound soil. For the purpose of this project these become the maximum residual soil concentrations allowed to remain, averaged over a 100 m^2 throughout the survey area. However, the philosophy of ALARA (As Low As Reasonably Achievable) acts as an incentive to reduce the residual concentrations to lower levels, if practical.

The soil sorter is capable of discerning Co-60 and Cs-137 at 9 pCi/g and 16 pCi/g, respectively. These levels are lower than the DCGLs and have been selected as the defacto delineation between soil that will remain on site and soil that will be packaged and transported to an off-site disposal facility.

Analysis of the soil data, collected from various locations and depths of the pile, indicates the bulk of the material in the pile does not contain appreciable levels of either Co-60 or Cs-137. In fact, less than 10% of the samples contain these radionuclides in concentrations exceeding the contract MDA (Figures 3-2 and 3-3 in this appendix). This implies that the pile is essentially clean dirt, with some limited areas of elevated concentration.

The intent of the remedial action is to remove soil containing more than 9 pCi/g Co-60 or 16 pCi/g Cs-137 from the site. If this is done, current sampling results indicate the average concentrations of each isotope in the remaining soil will be at or near 0.1 pCi/g (Table 4-2).

4.6 Health Protectiveness of Expected Residual Soil Contamination Levels.

Once the average expected residual concentration was determined, RESRAD was used to confirm the health-protectiveness of the remedy. This was done by calculating the soil concentrations predicted to produce 25 mrem/y to the critical member of a hypothetical residential family living on the site immediately after remediation.

Based on the results of the residential scenario at 30 years, it was determined that the small child was the critical member of the proposed receptor group. Attachment A of this Appendix

contains the results of these calculations. In summary, these calculations determined that the DCGL at t(0) for Co-60, would be 2.4 pCi/g, while for Cs-137 it would be 10.6 pCi/g. The average concentrations projected for the soil after remediation are well below these levels (Table 4-3).

After remediation, the health protectiveness of the site will be verified. Dose rates from external exposures will be measured throughout the site. The contribution to dose from soil, water, and on-property food sources will be investigated using the measured values of Co-60 and Cs-137 in soil and the RESRAD scenario for immediate occupation by a hypothetical farm family. These results will be used to determine the annual dose to the hypothetical receptor from the remediated site. The post-remediation dose (above background) meet the 25 mrem/y release limit to allow for unconditional release.

Table 4-1 DCGL's of Individual and Mixed Radionuclides at the Pelham Range Burial Mound for Expected Use

Radionuclide	Soil Limit
Co-60	100 pCi/g
Cs-137	21 pCi/g
Co-60 + Cs-137	21 pCi/g

Table 4-2 Summary Statistics for Pelham Field Burial Mound Assuming Various Soil Cleanup Levels

Summary Stats for Cs-137					Summary Stats for Co-60				
Statistic	**No Action**	**DCGL 21 pCi/g**	**Scan Limit 21 pCi/g**	**Sorter Limit 16 pCi/g**	**Statistic**	**No Action**	**DCGL 100 pCi/g**	**Scan Limit 21 pCi/g**	**Sorter Limit 9 pCi/g**
n	585	583	583	581	n	585	582	578	575
mean	0.46	0.11	0.11	0.06	mean	1.83	0.40	0.15	0.08
SD	7.53	0.96	0.96	0.48	SD	20.72	3.32	1.09	0.60
$UCL_{95\%\ mean}$*	**0.97**	**0.18**	**0.18**	**0.09**	**$UCL_{95\%\ mean}$***	**3.24**	**0.63**	**0.22**	**0.13**
Max. value	179.0	17.0	17.0	9.5	Max. value	330.0	49.0	14.0	8.0
95th Prcntl	0.30	0.29	0.29	0.20	95th Prcntl	0.20	0.20	0.10	0.10
iterated t	1.647508	1.647518	1.647518	1.647522	*iterated t*	1.647508	1.647522	1.647541	1.647555
t calc	0.0499958	0.0499957	0.0499957	0.0499962	*t calc*	0.0499958	0.0499957	0.0499957	0.0499956

*The 95% UCL on the arithmetic mean (= ArithMean + (t_score * StDev / SQRT(n))

TABLE 4-3 Summary Comparison of Predicted Soil Concentrations After Remediation, and Concentrations of Soil Required to Produce 25 mrem/y to the Critical Member of a Hypothetical Resident Family

Radionuclide	Predicted Soil Concentrations Required to Produce 25 mrem/y to a Resident Child	Projected $95\%UCL_{mean}$ for Soil Concentration In Pile after Sorting
Co-60	2.4 pCi/g	0.13 pCi/g
Cs-137	10.6 pCi/g	0.09 pCi/g

5.0 References

ANL, 1993 "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0., September 1993." ANL/EAD/LD-2. USDOE, Environmental Assessment Division, Argonne National Laboratory.

ANL, 1998 RESRAD for Windows, 5.82. Environmental Assessment Division, Argonne National Laboratory.

USACE, 1998 "Final Environmental Impact Statement, Disposal and Reuse of Fort McClellan, Alabama, August 1998." US Army Corps of Engineers, Mobile District.

USCHPPM, 1996 "Industrial Radiation Study No 27-MH-0987-R2-97. Pelham Range Burial Mound, Fort McClellan, Alabama. 29 August – 15 September 1995 and 14-28 January 1996. US Army Center for Health Promotion and Preventive Medicine.

USEPA, 1997 "Exposure Factors Handbook, Volumes 1, 2, and 3" August 1997, EPA/600/P-95/002Fa, b, & c. Us Environmental Protection Agency.

Attachment A RESRAD Output

Attachment A RESRAD Output

A.1 Results of RESRAD Calculations for Guardsman Scenario A-1

A.1.1 Co-60: Guardsman Summary Output File A-1

A.1.2 Cs-137: Guardsman Summary Output File A-19

A.2 Results of RESRAD Calculations for Resident Adult Scenario A-37

A.2.1 Co-60: Resident Adult Summary Output File A-37

A.2.2 Cs-137: Resident Adult Summary Output File A-55

A.3 Results of RESRAD Calculations for Resident Child Scenario A-73

A.3.1 Co-60: Resident Child Summary Output File A-73

A.3.2 Cs-137: Resident Child Summary Output File A-92

A.1 Results of RESRAD Calculations for Guardsman Scenario

A.1.1 Co-60: Guardsman Summary Output File

RESRAD, Version 5.82 T½ Limit = 0.5 year 12/15/98 09:15 Page 1

Summary : Co 60, guardsman, 10000m2 File: CO60G10K.RAD

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Time = 1.000E+01 11
Time = 3.000E+01 12
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Dose Conversion Factor (and Related) Parameter Summary
File: DCSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-60	2.190E-04	2.190E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICKD
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Co-60	1.000E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	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
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	not used	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	9.072E+01	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.000E+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	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.640E-02	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)
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)	not used	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	6.000E-01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	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	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Co-60	1.000E+02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.500E+01	2.192E+01	1.684E+01	6.701E+00	4.813E-01	3.458E-02	4.782E-05	1.750E-16	0.000E+00
M(t):	1.000E+00	8.766E-01	6.737E-01	2.680E-01	1.925E-02	1.383E-03	1.913E-06	7.000E-18	0.000E+00

Maximum TDOSE(t): 2.500E+01 mrem/yr at t = 0.000E+00 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 = 0.000E+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.
Co-60	2.500E+01	1.0000	5.516E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.647E-05	0.0000
Total	2.500E+01	1.0000	5.516E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.647E-05	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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.500E+01	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	2.500E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: C060G10K.RAD

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.
Co-60	2.192E+01	1.0000	4.836E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.320E-05	0.0000
Total	2.192E+01	1.0000	4.836E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.320E-05	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.192E+01	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	2.192E+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+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	1.684E+01	1.0000	3.716E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.783E-05	0.0000
Total	1.684E+01	1.0000	3.716E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.783E-05	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		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.684E+01	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	1.684E+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 = 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.
Co-60	6.701E+00	1.0000	1.478E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.094E-06	0.0000
Total	6.701E+00	1.0000	1.478E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.094E-06	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.701E+00	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	6.701E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: CO60G10K.RAD

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.
Co-60	4.813E-01	1.0000	1.062E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.096E-07	0.0000
Total	4.813E-01	1.0000	1.062E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.096E-07	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.813E-01	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	4.813E-01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: CO60G10K.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Co-60	3.458E-02	1.0000	7.630E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.661E-08	0.0000
Total	3.458E-02	1.0000	7.630E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.661E-08	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 = 5.000E+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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.458E-02	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	3.458E-02	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.
Co-60	4.782E-05	1.0000	1.055E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.063E-11	0.0000
Total	4.782E-05	1.0000	1.055E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.063E-11	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.
Co-60	0.000E+00	0.0000	0.000E+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-05	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	4.782E-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.
Co-60	1.750E-16	1.0000	3.861E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.853E-22	0.0000
Total	1.750E-16	1.0000	3.861E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.853E-22	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.750E-16	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	1.750E-16	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: CO60G10K.RAD

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: C060G10K.RAD

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	2.500E-01	2.192E-01	1.684E-01	6.701E-02	4.813E-03	3.458E-04	4.782E-07	1.750E-18	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.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	1.000E+02	1.141E+02	1.484E+02	3.731E+02	5.194E+03	7.230E+04	5.227E+07	*1.131E+15	*1.131E+15

*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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	1.000E+02	0.000E+00	2.500E-01	1.000E+02	2.500E-01	1.000E+02

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	2.500E+01	2.192E+01	1.684E+01	6.701E+00	4.813E-01	3.458E-02	4.782E-05	1.750E-16	0.000E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.000E+02	8.766E+01	6.737E+01	2.680E+01	1.925E+00	1.383E-01	1.913E-04	7.000E-16	0.000E+00

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

A.1.2 Cs-137: Guardsman Summary Output File

RESRAD, Version 5.82 T½ Limit = 0.5 year 12/15/98 09:03 Page 1

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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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	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Cs-137	4.775E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	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
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	not used	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	9.072E+01	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.000E+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	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.640E-02	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)
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)	not used	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	6.000E-01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	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	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Cs-137	4.775E+02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.500E+01	2.442E+01	2.331E+01	1.981E+01	1.244E+01	7.808E+00	2.439E+00	2.322E-02	1.955E-09
M(t):	9.999E-01	9.769E-01	9.325E-01	7.923E-01	4.975E-01	3.123E-01	9.756E-02	9.289E-04	7.821E-11

Maximum TDOSE(t): 2.500E+01 mrem/yr at t = 0.000E+00 years

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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-	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.
Cs-137	2.500E+01	1.0000	3.837E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.350E-04	0.0000
Total	2.500E+01	1.0000	3.837E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.350E-04	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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.500E+01	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	2.500E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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.
Cs-137	2.442E+01	1.0000	3.749E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.295E-04	0.0000
Total	2.442E+01	1.0000	3.749E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.295E-04	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.442E+01	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	2.442E+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+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.
Cs-137	2.331E+01	1.0000	3.578E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.191E-04	0.0000
Total	2.331E+01	1.0000	3.578E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.191E-04	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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.331E+01	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	2.331E+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 = 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.
Cs-137	1.981E+01	1.0000	3.040E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.862E-04	0.0000
Total	1.981E+01	1.0000	3.040E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.862E-04	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.981E+01	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	1.981E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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.
Cs-137	1.244E+01	1.0000	1.909E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.169E-04	0.0000
Total	1.244E+01	1.0000	1.909E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.169E-04	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.244E+01	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	1.244E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	7.808E+00	1.0000	1.199E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.339E-05	0.0000
Total	7.808E+00	1.0000	1.199E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.339E-05	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 = 5.000E+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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.808E+00	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	7.808E+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 = 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.
Cs-137	2.439E+00	1.0000	3.744E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.293E-05	0.0000
Total	2.439E+00	1.0000	3.744E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.293E-05	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.439E+00	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	2.439E+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 = 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.
Cs-137	2.322E-02	1.0000	3.565E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.183E-07	0.0000
Total	2.322E-02	1.0000	3.565E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.183E-07	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.322E-02	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	2.322E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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.
Cs-137	1.955E-09	1.0000	3.001E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.838E-14	0.0000
Total	1.955E-09	1.0000	3.001E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.838E-14	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.955E-09	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	1.955E-09	1.0000

*Sum of all water independent and dependent pathways.

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	5.235E-02	5.114E-02	4.882E-02	4.148E-02	2.604E-02	1.635E-02	5.108E-03	4.863E-05	4.094E-12

*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.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	4.776E+02	4.888E+02	5.121E+02	6.027E+02	9.600E+02	1.529E+03	4.895E+03	5.141E+05	6.106E+12

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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	4.775E+02	0.000E+00	5.235E-02	4.776E+02	5.235E-02	4.776E+02

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.500E+01	2.442E+01	2.331E+01	1.981E+01	1.244E+01	7.808E+00	2.439E+00	2.322E-02	1.955E-09

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	4.775E+02	4.666E+02	4.453E+02	3.784E+02	2.376E+02	1.492E+02	4.660E+01	4.436E-01	3.735E-08

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

A.2 Results of RESRAD Calculations for Resident Adult Scenario

A.2.1 Co-60: Resident Adult Summary Output File

RESRAD, Version 5.82 T½ Limit = 0.5 year 12/14/98 17:38 Page 1

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

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

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-60	2.190E-04	2.190E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Co-60	1.542E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	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 Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	4.057E+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
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	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.000E-02	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)
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)	1.936E+02	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	0.000E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	1.750E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	8.400E+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	not used	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	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	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)	not used	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)	not used	8.000E-02	---	TE(3)
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	not used	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	not used	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	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Co-60	1.542E+02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.298E+03	1.138E+03	8.746E+02	3.480E+02	2.500E+01	1.796E+00	2.483E-03	9.088E-15	0.000E+00
M(t):	5.193E+01	4.552E+01	3.498E+01	1.392E+01	9.998E-01	7.182E-02	9.934E-05	3.635E-16	0.000E+00

Maximum TDOSE(t): 1.298E+03 mrem/yr at t = 0.000E+00 years

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

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-	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.
Co-60	1.266E+03	0.9752	7.935E-04	0.0000	0.000E+00	0.0000	3.212E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	5.336E-02	0.0000
Total	1.266E+03	0.9752	7.935E-04	0.0000	0.000E+00	0.0000	3.212E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	5.336E-02	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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.298E+03	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	1.298E+03	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

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.
Co-60	1.110E+03	0.9752	6.956E-04	0.0000	0.000E+00	0.0000	2.816E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	4.678E-02	0.0000
Total	1.110E+03	0.9752	6.956E-04	0.0000	0.000E+00	0.0000	2.816E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	4.678E-02	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.138E+03	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	1.138E+03	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-	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.
Co-60	8.529E+02	0.9752	5.345E-04	0.0000	0.000E+00	0.0000	2.164E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	3.595E-02	0.0000
Total	8.529E+02	0.9752	5.345E-04	0.0000	0.000E+00	0.0000	2.164E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	3.595E-02	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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.746E+02	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	8.746E+02	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.
Co-60	3.393E+02	0.9752	2.127E-04	0.0000	0.000E+00	0.0000	8.609E+00	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.430E-02	0.0000
Total	3.393E+02	0.9752	2.127E-04	0.0000	0.000E+00	0.0000	8.609E+00	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.430E-02	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.480E+02	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	3.480E+02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

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.
Co-60	2.438E+01	0.9752	1.528E-05	0.0000	0.000E+00	0.0000	6.184E-01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.027E-03	0.0000
Total	2.438E+01	0.9752	1.528E-05	0.0000	0.000E+00	0.0000	6.184E-01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.027E-03	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.500E+01	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	2.500E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Co-60	1.751E+00	0.9752	1.097E-06	0.0000	0.000E+00	0.0000	4.443E-02	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	7.381E-05	0.0000
Total	1.751E+00	0.9752	1.097E-06	0.0000	0.000E+00	0.0000	4.443E-02	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	7.381E-05	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 = 5.000E+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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.796E+00	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	1.796E+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 = 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.
Co-60	2.422E-03	0.9752	1.518E-09	0.0000	0.000E+00	0.0000	6.144E-05	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.021E-07	0.0000
Total	2.422E-03	0.9752	1.518E-09	0.0000	0.000E+00	0.0000	6.144E-05	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.021E-07	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.
Co-60	0.000E+00	0.0000	0.000E+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-03	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	2.483E-03	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.
Co-60	8.863E-15	0.9752	5.554E-21	0.0000	0.000E+00	0.0000	2.248E-16	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	3.736E-19	0.0000
Total	8.863E-15	0.9752	5.554E-21	0.0000	0.000E+00	0.0000	2.248E-16	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	3.736E-19	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.088E-15	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	9.088E-15	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: C060R10K.RAD

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	8.418E+00	7.379E+00	5.671E+00	2.256E+00	1.621E-01	1.164E-02	1.610E-05	5.892E-17	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.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	2.970E+00	3.388E+00	4.409E+00	1.108E+01	1.543E+02	2.147E+03	1.553E+06	*1.131E+15	*1.131E+15

*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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	1.542E+02	0.000E+00	8.418E+00	2.970E+00	8.418E+00	2.970E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.298E+03	1.138E+03	8.746E+02	3.480E+02	2.500E+01	1.796E+00	2.483E-03	9.088E-15	0.000E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.542E+02	1.352E+02	1.039E+02	4.134E+01	2.969E+00	2.133E-01	2.950E-04	1.080E-15	0.000E+00

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

A.2.2 Cs-137: Resident Adult Summary Output File

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Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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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	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICKD
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Cs-137	2.627E+01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	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 Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	4.057E+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
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	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.000E-02	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)
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)	1.936E+02	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	0.000E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	1.750E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	8.400E+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	not used	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	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	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)	not used	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)	not used	8.000E-02	---	TE(3)
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	not used	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	not used	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	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Cs-137	2.627E+01
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	5.025E+01	4.910E+01	4.687E+01	3.982E+01	2.500E+01	1.570E+01	4.903E+00	4.668E-02	3.931E-09
M(t):	2.010E+00	1.964E+00	1.875E+00	1.593E+00	1.000E+00	6.279E-01	1.961E-01	1.867E-03	1.572E-10

Maximum TDOSE(t): 5.025E+01 mrem/yr at t = 0.000E+00 years

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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-	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.
Cs-137	4.515E+01	0.8985	1.969E-05	0.0000	0.000E+00	0.0000	5.085E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.689E-02	0.0003
Total	4.515E+01	0.8985	1.969E-05	0.0000	0.000E+00	0.0000	5.085E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.689E-02	0.0003

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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.025E+01	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	5.025E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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.
Cs-137	4.411E+01	0.8985	1.923E-05	0.0000	0.000E+00	0.0000	4.968E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.651E-02	0.0003
Total	4.411E+01	0.8985	1.923E-05	0.0000	0.000E+00	0.0000	4.968E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.651E-02	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.910E+01	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	4.910E+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+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.
Cs-137	4.211E+01	0.8985	1.836E-05	0.0000	0.000E+00	0.0000	4.742E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.576E-02	0.0003
Total	4.211E+01	0.8985	1.836E-05	0.0000	0.000E+00	0.0000	4.742E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.576E-02	0.0003

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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.687E+01	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	4.687E+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 = 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.
Cs-137	3.578E+01	0.8985	1.560E-05	0.0000	0.000E+00	0.0000	4.029E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.339E-02	0.0003
Total	3.578E+01	0.8985	1.560E-05	0.0000	0.000E+00	0.0000	4.029E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.339E-02	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.982E+01	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	3.982E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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.
Cs-137	2.246E+01	0.8985	9.794E-06	0.0000	0.000E+00	0.0000	2.530E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	8.405E-03	0.0003
Total	2.246E+01	0.8985	9.794E-06	0.0000	0.000E+00	0.0000	2.530E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	8.405E-03	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.500E+01	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	2.500E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	1.410E+01	0.8985	6.149E-06	0.0000	0.000E+00	0.0000	1.588E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	5.277E-03	0.0003
Total	1.410E+01	0.8985	6.149E-06	0.0000	0.000E+00	0.0000	1.588E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	5.277E-03	0.0003

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.570E+01	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	1.570E+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 = 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.
Cs-137	4.406E+00	0.8985	1.921E-06	0.0000	0.000E+00	0.0000	4.961E-01	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.648E-03	0.0003
Total	4.406E+00	0.8985	1.921E-06	0.0000	0.000E+00	0.0000	4.961E-01	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.648E-03	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.903E+00	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	4.903E+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 = 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.
Cs-137	4.194E-02	0.8985	1.829E-08	0.0000	0.000E+00	0.0000	4.723E-03	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.569E-05	0.0003
Total	4.194E-02	0.8985	1.829E-08	0.0000	0.000E+00	0.0000	4.723E-03	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.569E-05	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.668E-02	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	4.668E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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.
Cs-137	3.532E-09	0.8985	1.540E-15	0.0000	0.000E+00	0.0000	3.977E-10	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.321E-12	0.0003
Total	3.532E-09	0.8985	1.540E-15	0.0000	0.000E+00	0.0000	3.977E-10	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.321E-12	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.931E-09	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	3.931E-09	1.0000

*Sum of all water independent and dependent pathways.

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.913E+00	1.869E+00	1.784E+00	1.516E+00	9.517E-01	5.976E-01	1.867E-01	1.777E-03	1.496E-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 <= 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	1.307E+01	1.338E+01	1.401E+01	1.649E+01	2.627E+01	4.184E+01	1.339E+02	1.407E+04	1.671E+11

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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	2.627E+01	0.000E+00	1.913E+00	1.307E+01	1.913E+00	1.307E+01

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	5.025E+01	4.910E+01	4.687E+01	3.982E+01	2.500E+01	1.570E+01	4.903E+00	4.668E-02	3.931E-09

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.627E+01	2.567E+01	2.450E+01	2.082E+01	1.307E+01	8.206E+00	2.563E+00	2.440E-02	2.055E-09

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

A.3 Results of RESRAD Calculations for Resident Child Scenario

A.3.1 Co-60: Resident Child Summary Output File

RESRAD, Version 5.82 T½ Limit = 0.5 year 06/29/99 11:28 Page 1
Summary : Co60, resident child, 10000m2
File : C060CC00.RAD

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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	Co-60	2.190E-04	2.190E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Co-60	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	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 Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	2.720E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	6.000E+00	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	8.390E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.990E-02	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)
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.930E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	0.000E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	7.300E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	4.745E+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	not used	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	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	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)	not used	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)	not used	8.000E-02	---	TE(3)
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	not used	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	not used	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	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Co-60	1.000E+00
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.053E+01	9.233E+00	7.096E+00	2.823E+00	2.028E-01	1.457E-02	2.015E-05	7.373E-17	0.000E+00
M(t):	4.213E-01	3.693E-01	2.838E-01	1.129E-01	8.112E-03	5.827E-04	8.060E-07	2.949E-18	0.000E+00

Maximum TDOSE(t): 1.053E+01 mrem/yr at t = 0.000E+00 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 = 0.000E+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.
Co-60	1.032E+01	0.9801	4.291E-06	0.0000	0.000E+00	0.0000	2.077E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.824E-03	0.0002
Total	1.032E+01	0.9801	4.291E-06	0.0000	0.000E+00	0.0000	2.077E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.824E-03	0.0002

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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.053E+01	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	1.053E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident child, 10000m2
File : CO600000.RAD

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.
Co-60	9.050E+00	0.9801	3.762E-06	0.0000	0.000E+00	0.0000	1.821E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.599E-03	0.0002
Total	9.050E+00	0.9801	3.762E-06	0.0000	0.000E+00	0.0000	1.821E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.599E-03	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.233E+00	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	9.233E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident child, 10000m2
File : 00600000.RAD

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-	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.
Co-60	6.955E+00	0.9801	2.891E-06	0.0000	0.000E+00	0.0000	1.399E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.229E-03	0.0002
Total	6.955E+00	0.9801	2.891E-06	0.0000	0.000E+00	0.0000	1.399E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.229E-03	0.0002

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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.096E+00	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	7.096E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident child, 10000m2
File : C0600C00.RAD

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.
Co-60	2.767E+00	0.9801	1.150E-06	0.0000	0.000E+00	0.0000	5.566E-02	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	4.889E-04	0.0002
Total	2.767E+00	0.9801	1.150E-06	0.0000	0.000E+00	0.0000	5.566E-02	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	4.889E-04	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.823E+00	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	2.823E+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 = 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.
Co-60	1.988E-01	0.9801	8.262E-08	0.0000	0.000E+00	0.0000	3.998E-03	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	3.512E-05	0.0002
Total	1.988E-01	0.9801	8.262E-08	0.0000	0.000E+00	0.0000	3.998E-03	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	3.512E-05	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.028E-01	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	2.028E-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 = 5.000E+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.
Co-60	1.428E-02	0.9801	5.935E-09	0.0000	0.000E+00	0.0000	2.872E-04	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	2.523E-06	0.0002
Total	1.428E-02	0.9801	5.935E-09	0.0000	0.000E+00	0.0000	2.872E-04	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	2.523E-06	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Co-60	0.000E+00	0.0000	0.000E+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-02	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	1.457E-02	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.
Co-60	1.975E-05	0.9801	8.209E-12	0.0000	0.000E+00	0.0000	3.973E-07	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	3.489E-09	0.0002
Total	1.975E-05	0.9801	8.209E-12	0.0000	0.000E+00	0.0000	3.973E-07	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	3.489E-09	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.015E-05	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	2.015E-05	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident child, 10000m2
File : C0600000.RAD

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.
Co-60	7.227E-17	0.9801	3.004E-23	0.0000	0.000E+00	0.0000	1.454E-18	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.277E-20	0.0002
Total	7.227E-17	0.9801	3.004E-23	0.0000	0.000E+00	0.0000	1.454E-18	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.277E-20	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.373E-17	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	7.373E-17	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident child, 10000m2
File : 00600000.RAD

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.053E+01	9.233E+00	7.096E+00	2.823E+00	2.028E-01	1.457E-02	2.015E-05	7.373E-17	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.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	2.374E+00	2.708E+00	3.523E+00	8.856E+00	1.233E+02	1.716E+03	1.241E+06	*1.131E+15	*1.131E+15

*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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	1.000E+00	0.000E+00	1.053E+01	2.374E+00	1.053E+01	2.374E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.053E+01	9.233E+00	7.096E+00	2.823E+00	2.028E-01	1.457E-02	2.015E-05	7.373E-17	0.000E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.000E+00	8.766E-01	6.737E-01	2.680E-01	1.925E-02	1.383E-03	1.913E-06	7.000E-18	0.000E+00

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

A.3.2 Cs-137: Resident Child Summary Output File

RESRAD, Version 5.82 T½ Limit = 0.5 year 06/29/99 11:19 Page 1
Summary : CS137, resident child, 10000m2
File : C137C000.RAD

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

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Cs-137	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	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 Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	2.720E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	6.000E+00	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	8.390E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.990E-02	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)
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.930E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	0.000E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	7.300E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	4.745E+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	not used	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	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	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)	not used	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)	not used	8.000E-02	---	TE(3)
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	not used	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	not used	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	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Cs-137	1.000E+00
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.358E+00	2.304E+00	2.199E+00	1.868E+00	1.173E+00	7.365E-01	2.301E-01	2.190E-03	1.844E-10
M(t):	9.431E-02	9.215E-02	8.796E-02	7.473E-02	4.692E-02	2.946E-02	9.203E-03	8.761E-05	7.377E-12

Maximum TDOSE(t): 2.358E+00 mrem/yr at t = 0.000E+00 years

Summary : CS137, resident child, 10000m2
File : C137C000.RAD

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-	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.
Cs-137	2.161E+00	0.9167	6.250E-07	0.0000	0.000E+00	0.0000	1.930E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.390E-03	0.0014
Total	2.161E+00	0.9167	6.250E-07	0.0000	0.000E+00	0.0000	1.930E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.390E-03	0.0014

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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.358E+00	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	2.358E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2
File : C1370000.RAD

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.
Cs-137	2.112E+00	0.9167	6.107E-07	0.0000	0.000E+00	0.0000	1.886E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.312E-03	0.0014
Total	2.112E+00	0.9167	6.107E-07	0.0000	0.000E+00	0.0000	1.886E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.312E-03	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.304E+00	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	2.304E+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 = 3.000E+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.
Cs-137	2.016E+00	0.9167	5.829E-07	0.0000	0.000E+00	0.0000	1.800E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.162E-03	0.0014
Total	2.016E+00	0.9167	5.829E-07	0.0000	0.000E+00	0.0000	1.800E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.162E-03	0.0014

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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.199E+00	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	2.199E+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 = 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.
Cs-137	1.713E+00	0.9167	4.953E-07	0.0000	0.000E+00	0.0000	1.529E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	2.687E-03	0.0014
Total	1.713E+00	0.9167	4.953E-07	0.0000	0.000E+00	0.0000	1.529E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	2.687E-03	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.868E+00	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	1.868E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2
File : C137CCOO.RAD

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.
Cs-137	1.075E+00	0.9167	3.110E-07	0.0000	0.000E+00	0.0000	9.602E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	1.687E-03	0.0014
Total	1.075E+00	0.9167	3.110E-07	0.0000	0.000E+00	0.0000	9.602E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	1.687E-03	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.173E+00	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	1.173E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2
File : C137C000.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	6.752E-01	0.9167	1.952E-07	0.0000	0.000E+00	0.0000	6.029E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-03	0.0014
Total	6.752E-01	0.9167	1.952E-07	0.0000	0.000E+00	0.0000	6.029E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-03	0.0014

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.365E-01	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	7.365E-01	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2
File : C137C000.RAD

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.
Cs-137	2.109E-01	0.9167	6.099E-08	0.0000	0.000E+00	0.0000	1.883E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.308E-04	0.0014
Total	2.109E-01	0.9167	6.099E-08	0.0000	0.000E+00	0.0000	1.883E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.308E-04	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.301E-01	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	2.301E-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+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.
Cs-137	2.008E-03	0.9167	5.806E-10	0.0000	0.000E+00	0.0000	1.795E-04	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.150E-06	0.0014
Total	2.008E-03	0.9167	5.806E-10	0.0000	0.000E+00	0.0000	1.795E-04	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.150E-06	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.190E-03	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	2.190E-03	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.
Cs-137	1.691E-10	0.9167	4.889E-17	0.0000	0.000E+00	0.0000	1.510E-11	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	2.652E-13	0.0014
Total	1.691E-10	0.9167	4.889E-17	0.0000	0.000E+00	0.0000	1.510E-11	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	2.652E-13	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.844E-10	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	1.844E-10	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2
File : C137C000.RAD

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.358E+00	2.304E+00	2.199E+00	1.868E+00	1.173E+00	7.365E-01	2.301E-01	2.190E-03	1.844E-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 <= 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	1.060E+01	1.085E+01	1.137E+01	1.338E+01	2.131E+01	3.394E+01	1.087E+02	1.141E+04	1.356E+11

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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.000E+00	0.000E+00	2.358E+00	1.060E+01	2.358E+00	1.060E+01

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.358E+00	2.304E+00	2.199E+00	1.868E+00	1.173E+00	7.365E-01	2.301E-01	2.190E-03	1.844E-10

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.000E+00	9.770E-01	9.326E-01	7.924E-01	4.975E-01	3.124E-01	9.757E-02	9.289E-04	7.822E-11

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

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1.0 GENERAL INFORMATION

This Decommissioning Plan is intended to cover the scope and intent of actions necessary for the effective remediation and post-closure verification for unconditional release of the area known as the 'Burial Mound' at the Fort McClellan U.S. Army installation in Anniston, Alabama. Elements of the work are delineated in sufficient detail to ensure that the efforts are technically adequate and that adherence with requisite regulatory issues is maintained.

The present work is contracted to ATG, Inc. under Modification Number P00002 of Contract Number DAAA09-98-C-0039, by the Headquarters, U.S. Army Industrial Operations Command, Project Number USA 98-046. The internal ATG project number is 10036.01.

Fort McClellan is comprised of three parts, the Main Post, the Choccolocco Corridor, and the Pelham Range occupying 45,679 acres adjacent to Anniston, Alabama. The Main Post encompasses 19,000 acres and contains the majority of the facilities. The Choccolocco Corridor, approximately 4,500 acres, is leased from the State of Alabama and connects the Main Post with the Talladega National Forest to the east. Pelham Range consists of approximately 22,000 acres west of the Main Post.

The Army Base Closure and Realignment Committee (BRAC) has identified Fort McClellan as an installation for closure. There are several radiological issues the Army must resolve prior to closing the installation, and one of the most pressing items of concern is the 'Burial Mound' previously used as a low-level radioactive waste disposal cell. The mound is contaminated with Cs-137 and Co-60. Under the current tasking, ATG has determined acceptable site-specific concentrations for use as guideline values and has developed the comprehensive methodology to effect the removal and disposal of radiologically contaminated material in the 'Burial Mound' and perform a survey for the unconditional release of the area. Disposition of the primary and incidental secondary waste streams shall be at Envirocare of Utah, or other licensed/authorized recipient.

1.1 Origination of Contamination

The history of the base included training exercises for the Army Chemical Corp. for simulated large area radioactive contamination (fallout) from the surface detonation of a small yield (less than 0.5 kiloton) nuclear weapon. The training concept was to raise and lower sealed radioactive sources, and have students perform both ground and aerial surveys to map the radiological fallout pattern. The training facility was utilized to train Radiation Control Teams in support of nuclear weapons testing performed by the Atomic Energy Commission (AEC). There was an AEC license issued for use of the sealed sources.

There were two radiological training areas during the operational period of the mid

1950's through May of 1973, referred to as Rideout Field. The first field, referred to as "Old Rideout Field", contained approximately 600 source storage wells and was located north of Cane Creek, between West Perimeter Road and Centerline Road. The second field, referred to as "New Rideout Field", extended south of Cane Creek along Centerline Road.

The Old Rideout Field used locally fabricated Co-60 sources and higher activity commercially procured Cs-137 sources. While the Co-60 sources were used to simulate a uniform fallout pattern, the Cs-137 sources were used to simulate hot spots within the fallout pattern. The sources were raised and lowered manually from their shielded storage positions, located approximately 6' below the ground surface. An excessive number of leaking locally fabricated Co-60 sources contributed to the formation of the on-site 'Burial Mound' for use as an interim on-site disposal cell. The contaminated soil resulting from historically leaking sources was accumulated and transported to the location which is now designated as the 'Burial Mound'.

1.2 Characterization of the 'Burial Mound'

A recent radiological characterization of the 'Burial Mound' was performed by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM), reference Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound Site, Fort McClellan, Alabama, 29 August - 15 September 1995 and 14 - 28 January 1996. The survey followed much of the protocols of NUREG/CR-5849, including background determination, walkover surface scans, hole logging, and sample analysis. A total of 571 systematic random and select bias samples were analyzed for radiological parameters. Both elevated Co-60 and Cs-137 were observed in surface soil samples, but only elevated Co-60 was found in subsurface samples. The observed range of concentrations of radioactivity were observed at 1.6 - 330 pCi/gm of Co-60 and 0.2 -179 pCi/gm of Cs-137, respectively.

There exists some concern regarding the observed heterogeneity of the 'Burial Mound' as depicted in the CHPPM report. First, an isolated speck of significant Co-60 radioactivity was discovered within one of the discrete surface soil samples. With some effort, an object approximating the "eye of a sewing needle" in size was isolated and determined to be 253,000 pCi / 0.0043 gram, which converts to a specific activity (SpA) of 58.8 uCi per gram. This SpA far exceeds the Envirocare Waste Acceptance Criteria (WAC), which for Co-60 is limited to $3.0E^4$ pCi/gm, and $6.0E^4$ pCi/gm for the Cs-137 limit.

The related concern is with the significant gamma readings recorded during hole logging when samples from the bore hole and nearby indicated only trace amounts of contamination. The trend leads toward a conclusion of significant heterogeneity, and limits the credibility of sample results being actually representative of the

existing source term. It may appear that both soluble and insoluble contamination exists, and depending on the location of any sample, an aliquot being analyzed may or may not be representative of the balance of the sample media. A remedy to ensure a comprehensive screening of the entire soil population and to serve as a rule-out to prohibit exceeding the WAC limits for SpA is engineered into this Plan. (See section 2.1.1).

ATG reviewed the characterization data and developed a Sampling and Analysis Plan (SAP) to complete waste profiling of the 'Burial Mound' for acceptance for disposal at Envirocare of Utah in May 1998. On-site samples were collected by ATG during execution of the SAP, and the samples were subsequently analyzed by Mountain States Analytical, Inc. for the full suite of parameters. The original 10 meter x 10 meter grid was re-established, and 6 grids were discretely sampled to a depth of 6'. Samples were collected at 1' depth increments and field screened for gamma activity prior to shipping for laboratory analysis. The locations of sampling for waste profiling were recorded by their individual proximity within the original 10 m x 10 m grid pattern, as well as logging their respective GPS coordinates.

Preliminary acceptance of the 'Burial Mound' waste stream as LLRW (low-level radioactive waste) was received from Envirocare in October 1998. The requisite Pre-Shipment samples were subsequently forwarded to Envirocare for their footprint analysis in November 1998. Both the Waste Profile Record (EC-0230) and the Pre-Shipment Sample Record (EC-2000) provided a tentative waste delivery date of March 1999, and a tentative volume in the estimated range of 870 cubic yards. Note: Final release criteria had not been determined during waste profiling, which resulted in an estimated final volume being employed.

1.3 Summary of the Physical Description

The actual 'Burial Mound' is observed as a slight elevation standing secluded from adjacent woodlands and drainage areas by open land all around. The 'Burial Mound' is located at the northwest corner of Pelham Range, at the northern end of the Battle Drill Area of Range 24C. The mound is oblong in shape and is approximately 25 meters long by 15 meters wide at coordinates 593300 meters East, 3732500 meters North in Universal Transverse Mercator (UTM) Grid Zone 16. Ref: Industrial Radiation Study No. 27-MH-0987-R2-97, U.S. Army Center for Health Promotion and Preventive Medicine.

The mound is literally an irregular pile of soil to approximately 6' elevation above the surrounding grade, and covered with light vegetation. The footprint encompasses parts of six grids (10 m x 10 m), and contamination has been observed to a depth of 12' below grade.

The area surrounding the 'Burial Mound' is utilized as a training area for students at

the U.S. Army Chemical and Military Police Schools, Active Duty Units, Reserve Units and Alabama National Guard Units. Subsequent to BRAC action, the area including the present 'Burial Mound' is to be remediated and turned over to the State for use by the National Guards in September 1999. Possible future occupancy may include bivouacking National Guards, hunters, and trespassers.

1.4 License Status

The first AEC license (BML 1-2861-1) was issued to the Chemical School in 1957. Although substantiating documents (shipping papers) have not been located, reference is made to the proper disposal of all locally fabricated Co-60 sources. Despite the reference to the proper disposal of all locally fabricated Co-60 sources, one such source was found, recovered, and properly disposed of in 1985 from the area referred to as the 'Burial Mound'. Ref: Industrial Radiation Study No. 27-MH-0987-R2-97, U.S. Army Center for Health Promotion and Preventive Medicine.

The radiological constituents of the 'Burial Mound' are presently accounted for under existing NRC license number 01-02861-05, docket number 030-17584, for possession and ultimate decontamination and decommissioning activities. Ref: U.S. Army Chemical School, Radiation Protection Officer, License 01-02861-05.

The pending remedial actions leading to the closure of the 'Burial Mound' as planned herein shall be performed under the current specific radioactive material license as implemented by the designated contractor. ATG, Inc. shall execute this Plan with oversight of the radiological protection program by the licensee. The Nuclear Regulatory Commission, Region II, is the responsible governing regulatory entity having jurisdiction over the licensed radiological health program.

An urgency exists in the need for a timely license termination immediately upon completion of the 'Burial Mound' site remediation. Other facility installations are to undergo characterization in parallel to the 'Burial Mound' activities, and are governed by the guidelines of a separate Plan. The base is to be closed under the BRAC by September 1, 1999.

2.0 DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

2.1 Decommissioning Objectives, Activities, Tasks and Schedules

The principal elements necessary to facilitate removal and disposal of radiologically contaminated portions of the 'Burial Mound' are indicated in the following breakdown. The end-goal of this remedial action is the timely and economical extraction of known contaminated material from within the 'Burial Mound" and screening/sampling it to rule-out any isolated "hot spots" which may otherwise rival the disposal facility WAC. Subsequent to addressing the impacted material from the CHPPM characterization data, the balance of material in the impacted and immediately adjacent grids will be excavated to the maximum depth in which contamination has been found nearby, and the material will be direct surveyed for sorting by concentration limits. Material will be either rejected as LLRW and staged for disposal, or alternatively accepted for use as fill and staged for future replacement in the excavation.

The soil will be monitored on a conveyor system with NaI detectors and a determined sensitivity sufficient to meet the contaminant guidelines. Systematic samples will be collected after monitoring for on-site laboratory analysis by gamma spectroscopy to determine the correlation between scan instrument sensitivity and actual concentrations in soil. Quality control measures will additionally include splitting samples at a 10% frequency with a third party laboratory.

The waste will be loaded into Intermodal containers and shipped to Envirocare for disposal, with little latency between staging and shipping. The remediated excavation area and ultimately the grounds in the area of monitoring and material staging will be surveyed and sampled following the protocols of MARSSIM. The final status survey will be performed after the final waste shipment has been completed. All samples collected during the verification survey will be analyzed initially on-site to support early demobilization, and split with a third party laboratory for comparative analysis.

A project Final Report will be prepared detailing the events of the remedial action, referencing manifests and survey records, and including release surveys of equipment and areas. Data analysis/reduction will be performed off-site, and will ensure standardization of reporting units, statistical review for adequacy of data, and a comparison of actual residual levels of radioactivity in relation to the prescribed acceptable limits.

2.1.1 Decommissioning Objectives

The objectives of the decommissioning event governed by this Plan are:

2.1.1.1 Development and consensus adoption of site specific criteria for use as guideline values for residual concentrations of the contaminants of concern (i.e., Co-60 and Cs-137) in soil, with this task being completed herein; Ref: Development of Derived Cleanup Guidelines for the Pelham Range Burial Mound, Fort McClellan, Auxier & Associates, January 1999.

2.1.1.2 The removal of the material in the vicinity of the 'Burial Mound' and immediately adjacent grounds;

Below Grade: 8 grids x 10 m x 10 m area x 3.65 m max depth	= 2,926 m^3
Slopes Sides: 14 x 10 m w. x 2.43 m depth x (4.88 m/2) l.	= 831 m^3
Above Grade: 6 grids x 10 m x 10 m area x 1.83 m max elev	= 1,098 m^3
In-Situ Volume:	4,855 m^3
Fluff Factor (Volume factor attributed to soil conditioning)	X 1.3
Removed and Processed Volume:	6,311 m^3

Ref. Attachments 1,2, and 5

2.1.1.3 In-line radiologically screening of soils via an automated conveyor / monitoring system and segregation of materials into 1)impacted (LLRW)[381 m^3]or [498 yd^3] estimated, or 2) non-impacted (backfill)[5930 m^3] with proven instrumentation sensitivity and QC verification by systematic sampling for laboratory analysis;

2.1.1.4 Shipment of LLRW to Envirocare for off-site disposal in a timely manner;

2.1.1.5 Employing results of the preceding survey and progress measurements for development of the verification survey following MARSSIM, and early implementation in the field;

2.1.1.6 Decontamination and release surveys of materials and equipment, and subsequent final waste shipment;

2.1.1.7 Submission of final report to ensure license termination prior to September 1, 1999.

2.1.1.8 Partial re-mobilization upon regulatory approval for backfill and closure of the excavation area.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.1 Develop Site-Specific Criteria for Residual Contaminant Concentrations in Soil	1) Preliminary Planning Phase (completed)	1 Detailed Review of Existing Source Term	Identify key contaminants, physical area involved, and the range of existing concentrations.
		2 Preliminary Discussion w/ Stakeholders to Reach Consensus	Ensure that scenarios for modeling and technical approach is mutually acceptable.
		3 Develop Concentration. Limits to Meet Dose/Risk Criteria	Apply reference data to conservative scenario for first cut at dose assessment.
		4 Resrad Code / Direct Gamma & Side Pathways	Apply reference computer code for determination of the site-specific dose based assessment
		5 Apply EPA Slope Factors / Risk Based Criteria	Cross-reference dose-based assessment to risk based criteria.
		6 Compare Designed Criteria to Pending Instrument Sensitivities	Perform reality check to ensure that the derived concentrations are within the sensitivity range of instrumentation to be employed.
		7 Submit Results of Site Specific Dose Assessment for Consensus Acceptance	Gain approval prior to adoption into the Decommissioning Plan.
			The development of site specific criteria provides technically defended concentration values with demonstrated minimal risk, while additionally achieving some economical advantage through ultimate waste volume reduction over alternative default values.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.2 Remove Contents of the 'Burial Mound" and the Immediately Adjacent Grounds	1 Mobilization	1 Instrument Calibration	Ensure that all necessary instrumentation to be used in the field are in current calibration.
		2 Refresher Training	Provide necessary refresher training, i.e., 8-hr HAZWOPER, off-site.
		3 Entry Bioassays	All project personnel to submit base line bioassay (urine) samples for third party analysis by gamma spectroscopy.
		4 Travel	Ground travel to Fort McClellan, ~ one-half day's effort from Oak Ridge, TN, from which the primary crew originates.
		5 Site Specific Training	Documented site-specific training to the Decommissioning Plan, the QA Plan, and the HASP, as well as base requirements and logistical review.
		6 Preliminary Survey	A preliminary radiological survey of the general grounds to establish suitability for use as staging / lay-down areas, and to determine background levels for placement of the soil monitoring system.
		7 Implement OE Avoidance Plan	Perform OE survey of pile and immediately adjacent grounds surface to avoid the prospect of encountering ordnance and explosives on the base. Provide continued surveillance during excavation and soil monitoring phase.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.2 Remove Contents of the 'Burial Mound" and the Immediately Adjacent Grounds	1 Mobilization	8 Equipment Receipt / Set-up	Equipment will be received and set-up in locations correlating to the results of the preliminary survey. Equipment to include: Office / Lab / break area trailer, storage trailer, generators, Powerscreen modified with monitoring system, skid steer loader, and track-hoe.
		9 Install Security Fencing and Erosion Controls	Orange safety fencing (4') will be placed around the entirety of the controlled area during construction on-site. Silt fencing will be placed to prevent site erosion and/or cross-contamination into/out from the excavation area and the material staging location.
		10 Establish Control Points	A single access will be designated for equipment and vehicular traffic, and for personnel ingress/egress. Personnel frisking instrumentation will be maintained. Equipment and vehicles will require an exit survey if operated in the impacted area.
		11 Issue Radiation Work Permit (RWP)	An RWP will be issued for the remediation, re-characterization, and final survey of the Burial Mound and adjacent grounds. The RWP describes conditions and requirements for working in the area.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.2 Remove Contents of the 'Burial Mound" and the Immediately Adjacent Grounds	2 Burial Mound Remediation	1 Degrub Pile	The existing underbrush and small deciduous vegetation will be removed from the Burial Mound above grade pile prior to excavation.
		2 Process Vegetation	All vegetation will be shredded on-site and treated as LLRW for disposal.
		3 Extract Known Contaminated Soil	The above grade pile and the areas of known contamination per the CHPPM characterization report will be removed and monitored first. This permits early assurance of monitoring sensitivity and allows self-decontamination of the equipment by subsequent abrasive action of soil material of less probable contamination from distant areas.
2.1.1.3 In-Line Radiological Screening of Soils for Segregation of Impacted and Non-Impacted Material	1 Burial Mound Remediation	4 Remove Balance of Area Soil	The entirety of soil contents over the 8 grids will be excavated to the 12' depth, which is the deepest observed penetration of contamination observed at a single bore sample location in the CHPPM report. All removed material will undergo direct radiological screening.
		1 Prepare, Radiological Monitor, and Sort Monitored Material	Soil will be processed to break-up the hard clay into a dispersable material, and transfer it by an enclosed chute onto a 3' wide conveyor. The conveyor is curved on the sides to contain material, and has an active area for conveyance of 2' wide. to detect less than the site-specific concentration values prescribed.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.3 In-Line Radiological Screening of Soils for Segregation of Impacted and Non-Impacted Material	1 Burial Mound Remediation	1 Prepare, Radiological Monitor, and Sort Monitored Material Contd.	An array of ten 2"x2" NaI detectors mated to alarming ratemeters and calibrated to the contaminants of concern make-up the stationary monitor under which the conveyor moves the soil. The speed is controlled along with the distance from the detectors, which results in an overall calibrated system with sufficient sensitivity.
		2 Material Sampling and Staging	An alarm of any detector will result in a manual system shut-down and rejection of the material as impacted, requiring containerization. Non-impacted soils will be segregated from impacted material and staged on clean ground cover. Systematic sampling will be performed and on-site analysis provided by gamma spectroscopy. QC samples at a 10% frequency will be split for third party analysis for verification. Impacted material will be packaged in 22 CY Intermodal containers with sliding rigid lids.
2.1.1.4 Shipment of LLRW to Envirocare for Disposal		1 Bulk Waste Packaging	Impacted soil will be placed into the container staged on the ground. Filling will be monitored for manually limiting to approximately 17 CY to maintain gross weight requirements (density of ~ 1.35 tons/CY).

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.4 Shipment of LLRW to Envirocare for Disposal		2 Waste Shipments	The expected (up to) 500 m^3 of impacted soil, vegetation, and PPE will be shipped in campaigns of approximately 4 loads/day, with 10 shipping campaigns stretched out over the soil monitoring period.
2.1.1.5 Verification Survey Following MARSSIM	1 Final Survey	1 Design Sampling Strategy	Employ recent remediation tasks and the earlier CHPPM survey data for development of the final status survey strategy. Area of approximately 7 Class 1 survey units of ~1000 to 2000 m^2, having been just remediated and/or used for handling and staging uncontainerized radioactive materials. No Class 2 or Class 3 areas designated. Determine the number of data points (random samples) following statistical recommendations of MARSSIM. Determine number of data points for target area and for background correlation. Establish data quality objectives. Integrate the survey strategy.
		2 Sample Collection	Tie-in the reference grid system, and install a square grid (10 m x 10 m). Install the triangular grid.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.5 Verification Survey Following MARSSIM	1 Final Survey	2 Sample Collection Contd.	Cross-calibrate the 2" x 2" NaI field instrument to the true exposure response of a Pressurized Ionization Chamber. Perform the designed comprehensive scan survey coverage. Collect the designated number of randomly selected samples.
		3 Third Party Analysis	Provide necessary QA/QC. Complete chain-of-custody records and ship samples to third party laboratory. Have all samples comparably analyzed by gamma spectroscopy.
		4 Data Evaluation	Results will be converted to standardized units. Laboratory analysis and exposure rate measurement QC data will be evaluated for accuracy and precision. Any additional data needs will be identified. Annotate facility drawings to depict grid lay-out and sample locations. Graphically display concentrations on posting plots and histograms for survey units and reference area.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.5 Verification Survey Following MARSSIM	1 Final Survey	5 Data Interpretation	Exposure data meeting acceptance criteria will be evaluated using the Wilcoxon Rank Sum test for each group of survey unit samples. Soil concentration data will be evaluated using the Student t-test. Any findings that are inconclusive or evidence leads to the criteria having not been met will be reported immediately to ensure early project closure. Results will be compared with DQOs established during the design phase.
		6 Report of Survey Findings	The final report will include survey procedures and results, and will follow the general guidance of MARSSIM.
2.1.1.6 Decontamination and Release Surveys of Equipment; and Final Waste Shipment	1 Demobilization	1 Decontaminate Major Equipment	Equipment will be decontaminated as soon as its use on the project has been completed, and decontamination/survey will be a parallel activity with site release survey preparations. The soil monitoring and handling equipment will be decontaminated primarily by passing large volumes of unaffected soil through it during the course of screening the balance of soil form the grids. The known affected material will be handled first. Ultimately, equipment will be freed of all clinging soil product by manual abrasives and supplemented by HEPA vacuum for debris pick-up.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.6 Decontamination and Release Surveys of Equipment; and Final Waste Shipment	1 Demobilization	2 Survey Major Equipment for Release	All areas susceptible to contact with contaminated material will be accessed and direct surveyed for release. Swipe samples will be collected and counted on-site. Survey data will be recorded on equipment diagrams to indicate the location of measurements.
		3 Final Equipment Decon / Survey	The remaining site equipment will be decon upon completion of the post-remediation walkover scan survey of the grounds. Decon will be performed on plastic lay-down areas. Radiological surveys will be performed to ensure effective decon efforts and to ultimately verify that levels of residual activity are acceptable for unconditional release.
		4 Final Waste Shipment	Secondary wastes, including spent filters, PPE, plastic, and deconned/removed residue from equipment, will be packaged along with impacted soil in the final Intermodal container. The final waste container will be scheduled for shipment in between the site remediation and the final verification survey.
		5 Site Clean-up	The work area will be restored to its condition prior to remediation activities. Solid waste will be removed, equipment containerized, and the grounds leveled (i.e., tracks smoothed), prior to performing the final verification survey. No site conditions will be altered after the verification survey has been completed.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.6 Decontamination and Release Surveys of Equipment; and Final Waste Shipment	1 Demobilization	5 Site Clean-up Cont.	Equipment will be shipped and support utilities will be removed upon completion of the verification survey, also.
		6 Exit Bioassays	All site workers will submit a final bioassay (urine) sample for third party analysis to determine the extent of any uptake. Bioassay results will be used to indicate the effectiveness of the radiological controls program when the TEDE is calculated along with the contribution of external exposure. As warranted, internal exposure will be assigned and recorded for an individual.
		7 Return Travel	The balance of project personnel will demobilize upon completion of the final verification survey.
2.1.1.7 Submit Final Report	1 Final Report	1 Receive Third Party Analytical Results	10% of the final samples are to be shipped for third party analysis by gamma spectroscopy. The project budget assumes a routine TAT, expecting ~ 3 weeks for data receipt.
		2 Standardize and Compare Data	Survey and sample results will be reviewed and standardized, and the values will be compared to the release criteria. Statistical tests will be performed, and the acceptance or rejection of results in meeting the criteria will be determined.

TABLE 2.1.2 Decommissioning Activities and Tasks

Objective	Activity	Task	Description
2.1.1.7 Submit Final Report	1 Final Report	3 Draft Narrative Report	A description of the overall project effort will be drafted to include major activities, waste volumes, manifest copies, and the extent of excavation and soil monitoring. The established governing criteria will be displayed along with the respective references. Emphasis will be placed on the final status survey (MARSSIM).
		4 Assemble Report & Supporting Data	The narrative report, field data, and analytical results will be compiled into a single submittal. The goal is to complete work activities and submit the report for contemplation of NRC license termination prior to September 1, 1999.
2.1.1.8 Closure	1 Remobilization	1 Return Travel	A partial crew re-mobilization to the site will occur upon notification of regulatory approval, indicating verification and acceptance of the site meeting conditions suitable for license termination.
	2 Site Closure	2 Property Restoration	The excavated area of the 'Burial Mound' will be backfilled with the stockpiled monitored soil and imported clean fill, as necessary. The area will be graded and contoured to match the adjacent area.

2.1.3 Procedures

Execution of this Decommissioning Plan will be performed in accordance with the project 'Health and Safety Plan', Appendix 1; the 'Quality Assurance Plan', Appendix 2; the 'OE Avoidance Plan', Appendix 3; and, internally approved ATG Field Operations Procedures submitted as Appendix 4. All Field Operations procedures employed on the project have been previously approved and implemented on earlier ATG / IOC projects of similar scope and work activities. Any changes, additions, or revisions to the procedures will be subject to a review process and require applicable internal approval, as well as acceptance by the U.S. Army IOC Project Manager prior to implementation.

Data and text should be updated, where relevant, by replacement of the existing pages with the latest revised pages. All pages submitted to update, revise, or add pages to the procedure(s) should show the date of change and the change or revision number. A guide page listing the pages to be inserted or revised, or pages to be removed, should accompany the revised pages. When major changes are made, a revised table of contents should be provided.

2.1.4 Schedule

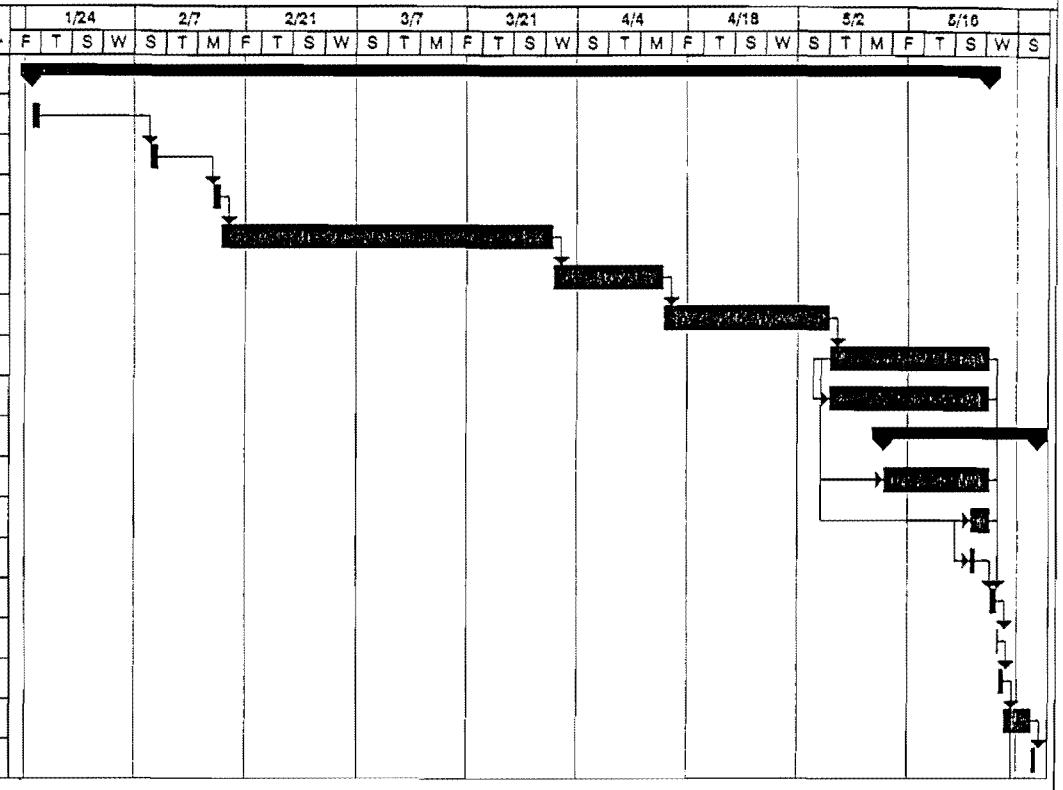
The integrated schedule for the remediation of the Fort McClellan 'Burial Mound' follows in Gantt chart format as developed using Microsoft Project. Upon mobilization, the crew effort is assumed to be working five 10-hour days per week on average.

The actual on-site duration for field activities in the screening of soils, packaging and disposal of LLRW, and performing the final status survey encompasses six calendar weeks. The critical path is the throughput of the large volume of soil from the 'Burial Mound', subsequent depths, and immediately adjacent areas. The productivity of the soil monitor is identified in Section 4.0.

It is anticipated that project on-site activities will be performed during a single ten-hour weekday shift, working five days per week. However, due to the weather-related nature of the objective, the actual work may at times by on a flexible schedule to permit elongation of production during optimal conditions, and reduced site time when conditions jeopardize productivity, i.e., wet conditions. The plan of the day will be communicated with site representatives prior to schedule adjustments.

ATG, Inc.
IOC Project Number USA 98-046
Fort McClellan Burial Mound Decommissioning Plan

ID	WBS	Task Name	Duration	Start	Finish	Predecessor
1	1	**Planning Phase**	**88d**	**Mon 1/25/99**	**Wed 5/26/99**	
2	1.1	Submit Draft Decommissioning Plan	1d	Mon 1/25/99	Mon 1/25/99	
3	1.2	Preliminary Review / Meeting	1d	Tue 2/9/99	Tue 2/9/99	2FS+10d
4	1.3	Submit Decommissioning Plan	1d	Wed 2/17/99	Wed 2/17/99	3FS+5d
5	1.4	Regulatory Comment Period	30d	Thu 2/18/99	Wed 3/31/99	4
6	1.5	Final Plan Submission	10d	Thu 4/1/99	Wed 4/14/99	5
7	1.6	Decommissioning Plan Approval	15d	Thu 4/15/99	Wed 5/5/99	6
8	1.7	Procurement	15d	Thu 5/6/99	Wed 5/26/99	7
9	1.8	Schedule Coordination	15d	Thu 5/6/99	Wed 5/26/99	8SS
10	2	**Mobilization**	**14d**	**Thu 5/13/99**	**Tue 6/1/99**	
11	2.1	Instrument Calibration	10d	Thu 5/13/99	Wed 5/26/99	8SS+5d
12	2.2	Refresher Training	3d	Mon 5/24/99	Wed 5/26/99	9SS+12d
13	2.3	Entry Bioassays	1d	Mon 5/24/99	Mon 5/24/99	12SS
14	2.4	Travel	1d	Wed 5/26/99	Thu 5/27/99	8,9,11,12,13
15	2.5	Site Specific Training	0.5d	Thu 5/27/99	Thu 5/27/99	14
16	2.6	Preliminary Radiological Survey	0.5d	Thu 5/27/99	Fri 5/28/99	15
17	2.7	Surface EO Survey	1d	Fri 5/28/99	Tue 6/1/99	16
18	2.8	Equipment Set-up	1d	Tue 6/1/99	Tue 6/1/99	17

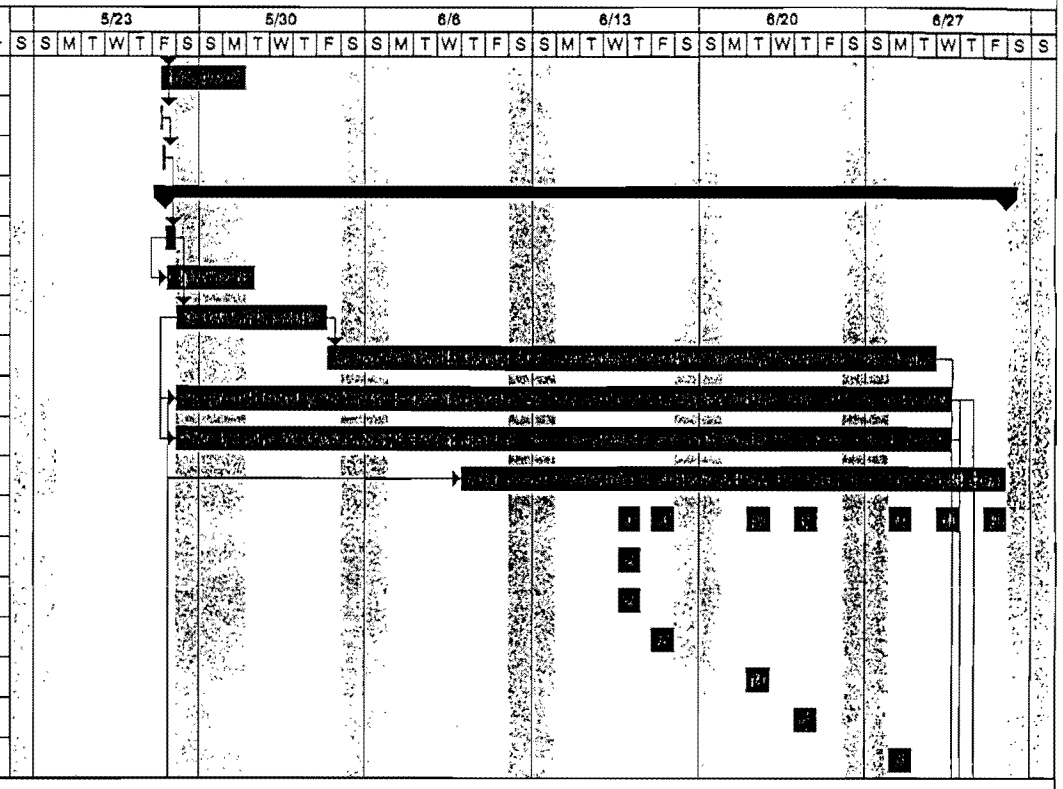


Project: Decom. Plan Schedule
Date: Fri 1/8/99

Task | Milestone | Rolled Up Task | Rolled Up Progress
Progress | Summary | Rolled Up Milestone

ATG, Inc.
IOC Project Number USA 98-046
Fort McClellan Burial Mound Decommissioning Plan

ID	WBS	Task Name	Duration	Start	Finish	Predecessor
19	2.9	Install Security / Sediment Fencing	1d	Fri 5/28/99	Tue 6/1/99	16
20	2.10	Establish Control Points	0.2d	Fri 5/28/99	Fri 5/28/99	16
21	2.11	Issue RWP	0.2d	Fri 5/28/99	Fri 5/28/99	20
22	3	**Burial Mound Remediation**	**28.98d**	**Fri 5/28/99**	**Fri 7/2/99**	
23	3.1	Degrub Pile	0.5d	Fri 5/28/99	Fri 5/28/99	21
24	3.2	Process Vegetation	0.5d	Fri 5/28/99	Tue 6/1/99	23SS+0.2d
25	3.3	Extract Known Contaminated Soil	4d	Fri 5/28/99	Fri 6/4/99	23
26	3.4	Remove Balance of Area Soil	21d	Fri 6/4/99	Wed 6/30/99	25
27	3.5	Screen, Monitor, Sort Soil	26d	Fri 5/28/99	Wed 6/30/99	25SS
28	3.6	Material Sampling & Staging	26d	Fri 5/28/99	Wed 6/30/99	27SS
29	3.7	Bulk Waste Packaging	20d	Thu 6/10/99	Fri 7/2/99	27SS+1d
30	3.8	**Expected Waste Shipments**	**14.48d**	**Wed 6/16/99**	**Fri 7/2/99**	**25FS+10d**
31	3.8.1	Expected Waste Shipments 1	1d	Wed 6/16/99	Thu 6/17/99	
32	3.8.2	Expected Waste Shipments 2	1d	Wed 6/16/99	Thu 6/17/99	
33	3.8.3	Expected Waste Shipments 3	1d	Fri 6/18/99	Fri 6/18/99	
34	3.8.4	Expected Waste Shipments 4	1d	Tue 6/22/99	Tue 6/22/99	
35	3.8.5	Expected Waste Shipments 5	1d	Thu 6/24/99	Thu 6/24/99	
36	3.8.6	Expected Waste Shipments 6	1d	Mon 6/28/99	Mon 6/28/99	

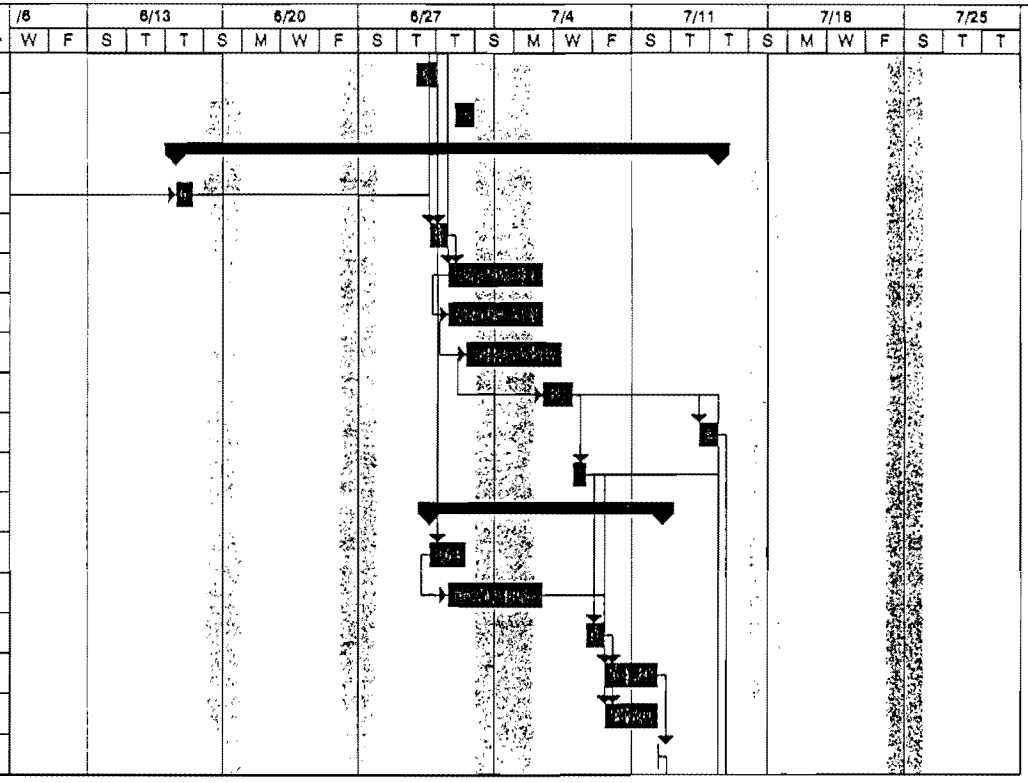


Project: Decom. Plan Schedule
Date: Fri 1/8/99

Task | Milestone | Rolled Up Task | Rolled Up Progress
Progress | Summary | Rolled Up Milestone

ATG, Inc.
IOC Project Number USA 98-046
Fort McClellan Burial Mound Decommissioning Plan

ID	WBS	Task Name	Duration	Start	Finish	Predecessor
37	3.8.7	Expected Waste Shipments 7	1d	Wed 6/30/99	Wed 6/30/99	
38	3.8.8	Expected Waste Shipments 8	1d	Fri 7/2/99	Fri 7/2/99	
39	4	**Final Status Survey**	**22d**	**Thu 6/17/99**	**Thu 7/15/99**	
40	4.1	Establish Background	1d	Thu 6/17/99	Fri 6/18/99	27SS+15d
41	4.2	Re-establish Grid	1d	Wed 6/30/99	Thu 7/1/99	26,28,40
42	4.3	Walkover Gamma Scan Survey	2d	Thu 7/1/99	Tue 7/6/99	27,41
43	4.4	Exposure Rate Measurements	2d	Thu 7/1/99	Tue 7/6/99	42SS
44	4.5	Sampling of Surface Soil	2d	Fri 7/2/99	Wed 7/7/99	43SS+1d
45	4.6	On-site Sample Analysis	2d	Tue 7/6/99	Thu 7/8/99	44SS+1d
46	4.7	Third Party Analysis	1d	Wed 7/14/99	Thu 7/15/99	45FS+5d
47	4.8	Final Remedial Action / Resample	1d	Thu 7/8/99	Thu 7/8/99	45
48	5	**Demobilization**	**8.1d**	**Wed 6/30/99**	**Mon 7/12/99**	
49	5.1	Decontaminate Major Equipment	2d	Wed 6/30/99	Fri 7/2/99	27
50	5.2	Major Equipment Surveys	2d	Thu 7/1/99	Tue 7/6/99	49SS+1d
51	5.3	Final Equipment Decon / Survey	1d	Thu 7/8/99	Fri 7/9/99	47
52	5.4	Final Waste Shipment	0.5d	Fri 7/9/99	Mon 7/12/99	47,51
53	5.5	Site Clean-up	0.5d	Fri 7/9/99	Mon 7/12/99	50,51
54	5.6	Exit Bioassys	0.1d	Mon 7/12/99	Mon 7/12/99	52

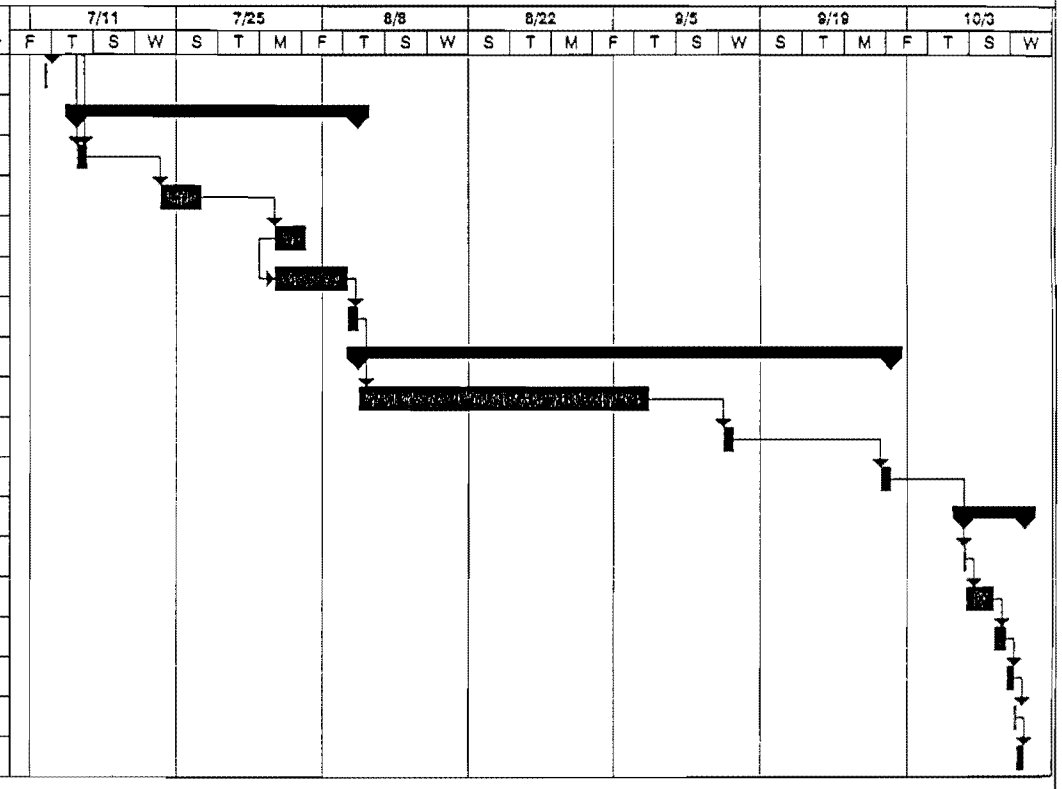


Project: Decom. Plan Schedule
Date: Fri 1/8/99

Task | Milestone | Rolled Up Task | Rolled Up Progress
Progress | Summary | Rolled Up Milestone

ATG, Inc.
IOC Project Number USA 98-046
Fort McClellan Burial Mound Decommissioning Plan

ID	WBS	Task Name	Duration	Start	Finish	Predecessor
55	5.7	Return Travel	0.5d	Mon 7/12/99	Mon 7/12/99	54
56	6	**Final Report**	**19d**	**Thu 7/15/99**	**Wed 8/11/99**	
57	6.1	Receive Analytical Results	1d	Thu 7/15/99	Fri 7/16/99	45,46,47
58	6.2	Standardize & Compare Data	2d	Fri 7/23/99	Tue 7/27/99	57FS+5d
59	6.3	Draft Narrative Report	3d	Tue 8/3/99	Fri 8/6/99	58FS+5d
60	6.4	Assemble Report & Supporting Data	5d	Tue 8/3/99	Tue 8/10/99	59SS
61	6.5	Submit Final Report	1d	Tue 8/10/99	Wed 8/11/99	60
62	7	**License Termination**	**37d**	**Wed 8/11/99**	**Fri 10/1/99**	
63	7.1	NRC Review of Report	20d	Wed 8/11/99	Wed 9/8/99	61
64	7.2	Third Party Confirmatory Survey	1d	Wed 9/15/99	Thu 9/16/99	63FS+5d
65	7.3	Authorization to Backfill	1d	Thu 9/30/99	Fri 10/1/99	64FS+10d
66	8	**Area Closure**	**3.75d**	**Fri 10/8/99**	**Thu 10/14/99**	
67	8.1	Partial Re-Mob	0.5d	Fri 10/8/99	Fri 10/8/99	65FS+5d
68	8.2	Remove Safety & Silt Fencing	0.25d	Fri 10/8/99	Mon 10/11/99	67
69	8.3	Push In Staged Soil	1.5d	Mon 10/11/99	Tue 10/12/99	68
70	8.4	Receive & Place Imported Fill	0.5d	Tue 10/12/99	Wed 10/13/99	69
71	8.5	Final Grading	0.5d	Wed 10/13/99	Wed 10/13/99	70
72	8.6	Final Demob	0.5d	Wed 10/13/99	Thu 10/14/99	71



Project: Decom. Plan Schedule
Date: Fri 1/8/99

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress

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Page 4

2.2 Decommissioning Organization and Responsibilities

The project organization chart follows. The basic structure depicts the ATG approach, with streamlining by project implementation under the current NRC radioactive material license possessed by the site, which provides for decommissioning of the 'Burial Mound'. Additional benefit may be realized in the prospect of naming the ATG project manager as the designated Radiation Safety Officer for license coverage during any interim in which the facility RPO may be off-site. The slated ATG project manager has served as the licensed Radiation Safety Officer on sites governed by the States of Tennessee and Texas, and for NRC licensees.

The project team provides for integrated activities during the project (see Schedule, Section 2.1.4) to facilitate compressing the overall time on-site. Expertise is provided in the areas of project management, construction / excavation, radiological protection, health and safety, quality assurance, and in military explosives/ordnance. Technical specialties also include the application of MARSSIM in the final status survey, and experienced transportation brokerage of wastes into Envirocare. Key project resumes are provided as Attachment 6.

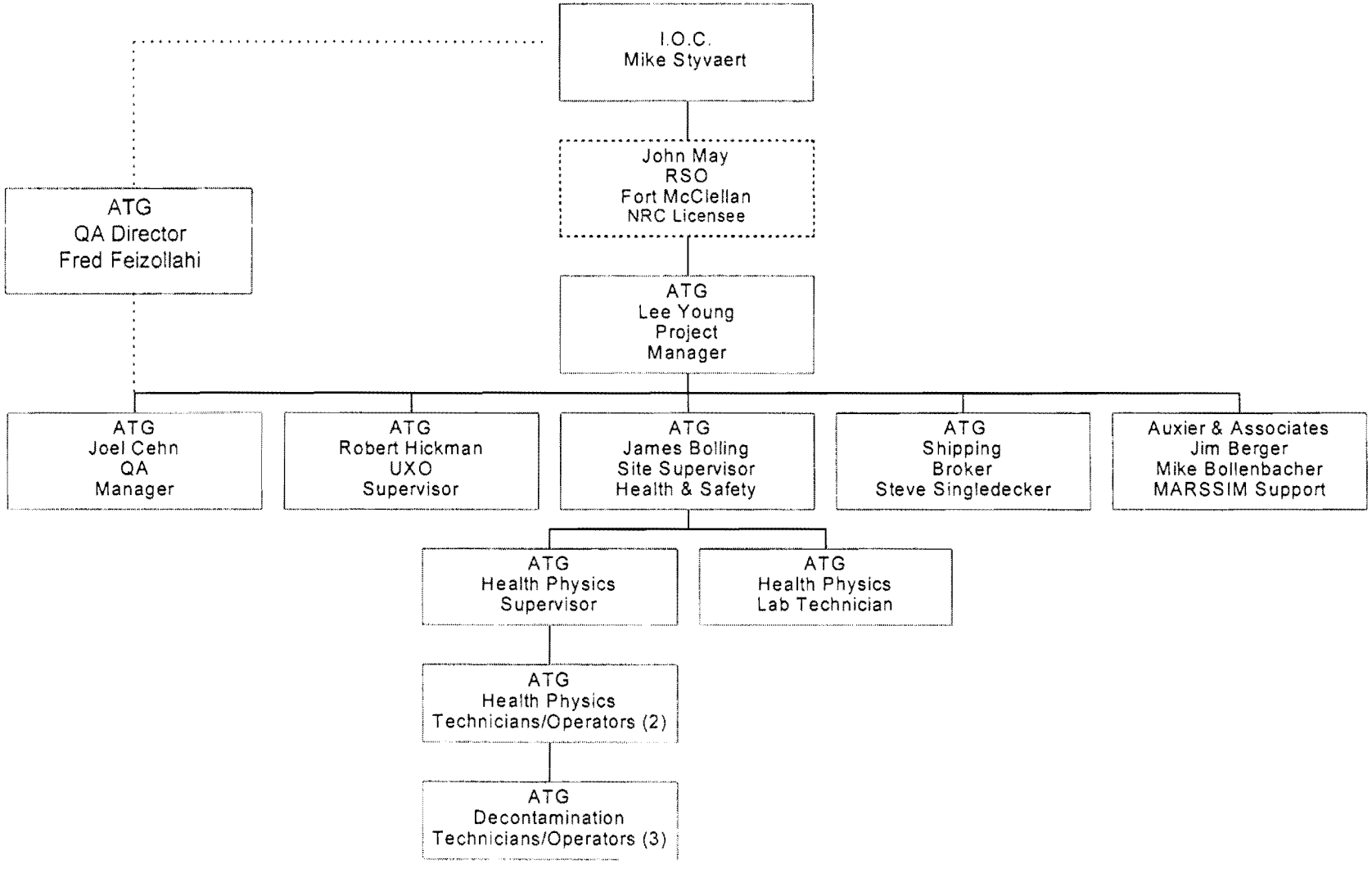
The basic work force for the range remediation activities will consist of a Project Manager with on-site QA responsibilities, Project Supervisor with combined Health and Safety responsibilities, and a remediation team including 2 senior health physics technicians and 3 decontamination technicians / operators. Supplemental crew include one EOD/UXO Specialist, a health physics lab/count room technician, and an IOC approved Broker during the waste shipment campaigns.

MARSSIM expertise is provided by a subcontractor, Auxier & Associates, including Mr. Jim Berger who drafted the predecessor guide NUREG/CR-5849, and was a contributor to the present survey protocol.

'BURIAL MOUND' DECOMMISSIONING PLAN

FORT McCLELLAN

ORGANIZATIONAL CHART



Allied Technology Group

2.3 Training

Each member of the project on-site crew will be trained and qualified as radiation workers. Training records will be maintained on-site as part of meeting the Quality Assurance Plan requirements. Training specific to the project will be performed prior to the start of work activities by the Project Manager or the Health and Safety Manager, and recorded on the Training Record (ATG Form 027). All training records will be retained as part of the permanent project file.

Radiation worker training will include, but not be limited to the following subjects:

1) Radiation Worker Rights
2) Sources of Radiation and Contamination
3) Types of Radiation and Contamination
4) Units of Radiation and Radioactivity
5) Prenatal Exposure (Reg. Guide 8.13)
6) Biological Effects of Radiation
7) Concepts of Radioactive Contamination Control
8) Use of Anti-C Clothing
9) ALARA Concepts
10) Emergency Procedures
11) Use of Radiation and Contamination Detection and Measurement Instrumentation

The personnel assigned to the Fort McClellan 'Burial Mound' project shall have completed the 40 Hour Hazardous Waste Operator and Emergency Response (HAZWOPER) training, and be current in the 8 Hour Refresher. Supervisory personnel shall have completed the 8 Hour HAZWOPER Supervisor training, per 29 CFR 1910.120. All on-site personnel will be required to provide evidence of their current OSHA training (29 CFR 1910.120 e.6) and Medical Certification (29 CFR 1910.120.f)

All respirator wearers will be trained on the specific use of respiratory protective equipment and have documented evidence of current fit testing per 29 CFR 1910.134. Additionally, Site Specific Training will be performed to familiarize the workers with the base and project specific and requirements. Supplemental site-specific training will be documented on a Training Record (ATG Form 027), and will be maintained as part of the permanent project file.

2.4 Contractor Assistance

Allied Technology Group, Inc. (ATG) is the prime contractor for the Decommissioning of the 'Burial Mound' at Fort McClellan. There will be no lower-

tier subcontractors directly involved with performance of the on-site objective., with the limited exception of the IOC-approved broker for shipping to Envirocare, Steve Singledecker, contracted through ADF. All on-site personnel will be trained to and abide by the site specific project Plans.

Auxier and Associates will provide off-site consultation for implementation of the verification survey of the site using the MARSSIM protocols, and will provide subsequent data evaluation. A local subcontractor will provide excavation services for final site restoration, but will be involved only upon closure of site concerns regarding radioactivity and UXO. An ATG representative will accompany final restoration events to ensure that administrative controls are maintained.

3.0 DESCRIPTION OF METHODS USED FOR PROTECTION OF OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

3.1 Facility Radiological History Information

The history of radioactive materials used at the base, and specifically the origination of the 'Burial Mound' was described in Section 1.1. In summary, the base was used for training exercises for the Army Chemical Corp. for simulated large area radioactive contamination (fallout) from the surface detonation of a nuclear weapon. The training concept was to raise and lower sealed radioactive sources, and have students perform both ground and aerial surveys to map the radiological fallout pattern. The training facility was utilized to train Radiation Control Teams in support of nuclear weapons testing performed by the Atomic Energy Commission (AEC).

There were two radiological training areas during the operational period of the mid 1950's through May of 1973, referred to as New and Old Rideout Fields. A large number of source storage wells were placed for use in the training exercises. The majority of the sources used were locally fabricated Co-60 sources and higher activity commercially procured Cs-137 sources. While the Co-60 sources were used to simulate a uniform fallout pattern, the Cs-137 sources were used to simulate hot spots within the fallout pattern. The sources were raised and lowered manually from their shielded storage positions, located approximately 6' below the ground surface. An excessive number of leaking locally fabricated Co-60 sources contributed to the formation of the on-site 'Burial Mound' for use as an interim on-site disposal cell. The contaminated soil resulting from historically leaking sources was accumulated and transported to the location which is now designated as the 'Burial Mound'.

A recent radiological characterization of the 'Burial Mound' was performed by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM), reference Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound Site, Fort McClellan, Alabama, 29 August - 15 September 1995 and 14 - 28 January 1996. The survey followed much of the protocols of NUREG/CR-5849, including background determination, walkover surface scans, hole logging, and sample analysis. A total of 571 systematic random and select bias samples were analyzed for radiological parameters. Both elevated Co-60 and Cs-137 were observed in surface soil samples, but only elevated Co-60 was found in subsurface samples. The observed range of concentrations of radioactivity were observed at 1.6 to 330 pCi/gm of Co-60 and 0.2 to 179 pCi/gm of Cs-137, respectively.

Although the characterization data indicates less than extremely high concentrations, there exists some concern regarding the observed heterogeneity of the 'Burial

Mound' as depicted in the CHPPM report. First, an isolated speck of significant Co-60 radioactivity was discovered within one of the discrete surface soil samples. A discrete item with significant SpA exceeding the Envirocare WAC was found and segregated. The related concern is with the significant gamma readings recorded during hole logging when samples from the bore hole and nearby indicated only trace amounts of contamination. The trend leads toward a conclusion of significant heterogeneity, and limits the credibility of sample results being actually representative of the existing source term.

As a result of the earlier characterization, the 'Burial Mound' location was added to the NRC license governing other radioactive materials usage, unrelated to this decommissioning phase. Under the BRAC, Fort McClellan is undergoing closure this year with a target of remediation to strive for submittal of a license termination request prior to September 1, 1999.

3.2 Ensuring that Occupational Radiation Exposures Are As Low As Reasonably Achievable (ALARA)

All of the field work encompassed by this Plan will be performed in accordance with the ATG Project Operational Procedures, included as Appendix 4. These procedures provide information on equipment, special techniques, and practices that will be employed on-site to ensure that exposures are minimal, in keeping with our corporate ALARA policy. Instruction is provided for the use of Radiation Work Permits (RWPs), contamination control practices, the respiratory protection program, and hazard assessment for the appropriate application of personal protective equipment (PPE). Additional project-specific instructions can be found in the Health and Safety Plan, including the use of dosimetry devices and internal monitoring via air sampling and bioassay samples.

A project worker dose projection has been established from data included in the earlier characterization by the Center for Health Promotion and Preventive Medicine (CHPPM) Report "Industrial Radiation Study No. 27-MH-0987-R2-97", Table F-3, and in consideration of the project schedule, per the following:

- Maximum general area dose rate was 11.7 uR/hr @ 1 meter above the ground surface of the burial mound at sample location BM C2-3.

- The referenced exposure (dose) rate was determined by a Reuter Stokes Pressurized Ionization Chamber for which 220 counts of 5-second integrated measurements were averaged electronically.

- The total work time for each individual on the site specifically at the 'Burial

Mound' will be 10 hrs per day for 25 days for a total cumulative duration of 250 hours each. The conservative (worst case) assumption is made that each individual will spend the entire work time in activities immediately above the 'Burial Mound'.

- The total dose is estimated as: 11.7 uR/hr x 250 hours = 2925 microRem, rounded to 3 mrem total per worker.

3.3 Health Physics Program

All QA audits, inspections, air sampling, personal protective equipment (PPE) requirements, and surveys will be completed in accordance with Appendix 1, site Health and Safety Plan, Appendix 2, project Quality Assurance Plan, Appendix 3, Ordnance and Explosives Avoidance Plan, and Appendix 4, Field Operations Procedures which are included a integral parts of this plan.

3.4 Contractor Personnel

ATG is the designated subcontractor assigned to implement this Plan to complete the remediation project. There are no additional outside contractors to be affected by radioactive materials associated with this effort. The MARSSIM consultation will be per off-site communications, and the final restoration will be performed after release of the site.

3.5 Radioactive Waste Management

The project objective is the removal of soil within the 'Burial Mound', comprehensive radiological monitoring and systematic verification sampling for appropriate sorting of the contents, and the final disposal of the LLRW fraction of the total volume found to exceed the site criteria. Requisite excavation, material handling, and soil monitoring will be performed in such a manner as to limit the prospect for cross-contamination and eliminate the prospect of dilution of existing elevated concentrations of radioactivity prior to or during the monitoring phase. Results of the planned approach will include: 1) meeting the Envirocare Waste Acceptance Criteria (WAC); and, 2) minimization of the final waste volume by comprehensive screening and sorting.

3.5.1 Waste Profile

The 'Burial Mound' waste stream has been sampled and analyzed for the necessary parameters to complete the waste profile for pursuit of acceptance authorization by Envirocare of Utah. The Burial Mound was sampled by ATG in May of 1998. Sample analysis was performed by Mountain States

Analytical, Inc., and the Envirocare Waste Profile Record was completed and submitted, referencing the CHPPM report for radioanalytical data. Subsequent communications resulted in additional analysis of an archived sample for clarifying radiological parameters.

Preliminary acceptance of the 'Burial Mound' waste stream as LLRW (low-level radioactive waste) was received from Envirocare in October 1998. The requisite Pre-Shipment samples were subsequently forwarded to Envirocare for their footprint analysis in November 1998. Both the Waste Profile Record (EC-0230) and the Pre-Shipment Sample Record (EC-2000) provided a tentative waste delivery date of March 1999, and a tentative volume in the estimated range of 870 cubic yards. Note: Final release criteria had not been determined during waste profiling, which resulted in an estimated final volume being employed.

The adoption of site-specific release criteria (Section 6.8.2) per development of this Plan and supporting data permits refinement of the final waste volume. Referencing the CHPPM report and enclosed Attachments 1, 2, and 5 along with Appendix 6, an in-situ soil volume of approximately 383 cubic yards is expected. The assigned volume expansion (fluff factor) of the primarily clay material attributed to the soil excavation and conditioning for placement onto the conveyor / monitor is +30%, resulting in ~ 498 yd^3.

3.5.2 Waste Packaging

The 'Burial Mound' LLRW waste streams will be appropriately packaged early after segregation from the unaffected balance of materials. Soils exceeding criteria via the monitoring system and/or sample analysis will be ultimately packaged in rigid-topped lined Intermodal containers. When not being transferred, any staged waste material will be securely covered with plastic on-site. Secondary wastes, including spent PPE, filters, and plastic materials, will be bagged as it is accumulated throughout the project and packaged with the soil waste stream in the Intermodals. The waste profile will be amended as applicable to reflect the proportion of non-soil material attributed to the secondary waste stream even at its slight volume ratio over the original profile record for the straight soil, i.e., secondary waste estimated at ~ 2% by volume, but easily less than 10%, and thus not impacting the disposal category type of "soil-like" material.

Even though the profiled LLRW waste stream from the 'Burial Mound' is represented by concentrations of radioactivity which are less than that governed by D.O.T. regulations, the waste will be conservatively conveyed

in lined Intermodal containers that meet the general design requirements of a strong tight container as defined in 49CFR173.410. Additionally, the container also complies with 49CFR173.420, meeting the description of a sift-proof non-specification portable tank and closed bulk bin as defined in 49CFR171.8.

Should any impacted material be found to have concentrations of radioactivity in excess of the Envirocare WAC, referencing specific limits of $3.0E^4$ pCi/gm for Co-60, and $6.0E^{4}$pCi/gm for Cs-137, respectively, the LLRW will be further segregated. Materials exceeding the Envirocare WAC will be contained in D.O.T. packaging (drums) and staged for final disposal at Barnwell under a contract modification.

The density of the clay type soil, depending on the current moisture content, ranges from 92 to 112 lb./ft^3. At the optimum moisture content of 13% and slight recompaction during container loadout and subsequent resettling, the average density of ~ 100 lb./ft^3 is assumed. At 1.35 tons/yd^3, the weight becomes the limiting factor on content capacity. The net payload per Intermodal container is limited to $\leq$ 20 tons, providing a restriction by packaged volume, i.e., 20 tons/1.35 tons/yd^3 = 14.8 yd^3. Thus the quantity of waste packages required is derived from ~ 498 yd^3/14.8 yd^3 = 34.

3.5.3 Waste Manifesting and Transportation

An IOC-approved broker will inspect the containers, contents, loaded packages, and the transportation vehicle. All shipments will meet applicable DOT requirements for packaging and transportation. Additionally, all shipments will be in accordance with the IOC Standard Operating Procedure 'Shipping Procedures for Unwanted Radioactive Materials', May 1997. Also, shipments will comply with ATG Field Procedures for loading, survey, and transportation of radioactive materials per BR-003, Packaging Material for Disposal; BR-004, Shipping of Radioactive Material and Waste; and, BR-006, Brokering.

Dose-to-millicurie conversions will be established via the application of the MicroShield code. Content weights for activity per container will be established by volume/free-board measurement and off-site weighing of the initial packages for assigning an observed density for subsequent use with volume measurements, with subsequent confirmation vehicle weighing.

Note: Alternatively, bucket-scales may be obtained for the actual tracking of individual package content weight by weighing the payload as it is placed.

However, due to the relatively small quantity of the waste stream, the application of bucket-scales may not be feasible.

Based upon both the concentration and the total activity per package, the waste will be appropriately manifested and labeled. Packaging with DOT-exempt material will not require vehicle placarding. It is expected that the majority of packages will be classified as Limited Quantity and suitably indicated per 49 CFR 173.421.

The Intermodals will be shipped in campaigns, picked-up by truck carrier at one package per vehicle. Live load-out is not anticipated. The permitted carrier will haul the manifested Intermodals to a railhead in Birmingham, where they will be trans-loaded to rail cars. The transfer will be performed by the carrier. Groups of the Intermodals will ultimately be shipped to the designated disposal facility. Prior notification will be initiated in concert between ATG and the carrier to the disposal facility. Subsequent tracking will be provided by the carrier.

3.5.4 Waste Disposal

The Waste Profile Record has been preliminarily approved, permitting acceptance of the waste stream for disposal as soil-like LLRW. The approximately 13,446 ft^3 of waste will be disposed at Envirocare under an existing contract held by the Army Corps of Engineers and administered by the IOC for this project, or other approved disposal facility.

Note: The presented funding information, Section 8.0, does NOT include disposal costs, which are to be borne by other than the remediation contractor.

4.0 MONITORING, SORTING, AND DISPOSAL OF THE 'BURIAL MOUND'

The entirety of material from the earlier eight 10 m x 10 m grids will be removed and radiologically screened to eliminate the prospect of the inadvertent omission of significant contamination attributed to the heterogeneity of the waste stream, coupled with the history of stray specks of high SpA from failed radioactive sealed sources. Material from the top 8' of the sloped perimeter sides will also be removed to comply with OSHA trenching and excavation requirements in lieu of exorbitant shoring efforts, and the resultant volume will be treated as the balance of material for screening. The same methodology was recently employed by ATG for the IOC at the Lake City Army Ammunition Plant in Missouri. The contaminant there was Depleted Uranium fragments. The emissions from the Co-60 and Cs-137 contaminants of the 'Burial Mound' provide greater sensitivity for detection.

4.1 Site Preparations

Pre-mobilization events will be completed as scheduled, including off-site refresher training, updated physicals / fit-tests, instrument calibration, and final procurement and logistical events. Mobilization to the site will be accompanied with site-specific training, the assignment of TLDs and the collection of baseline bioassay samples for third party analysis.

A preliminary radiological screening survey will performed in conjunction with implementation of the OE Avoidance Plan, Appendix 3.

4.1.1 Site Set-Up

Plastic safety fencing will be installed around the perimeter of the entire site. The office / break room / lab trailer will be placed just outside the controlled area. Temporary support utilities will be imported, i.e., generator, lavatories, handwash units, etc. Instrumentation will be set-up and checked to ensure operability, including:

- -MCA with NaI detector and shield
- -Ludlum 2929 dual alpha/beta counter(s)
- -Drying Oven
- -Soil Monitor (Multiple Ludlum 177 Alarming Ratemeters with 44-10 2" x 2" NaI detectors)
- -Ludlum Model 2221 Scaler/Ratemeter with 44-10 NaI detectors for field use
- -Ludlum Model 3 with 44-9 GM probe (friskers)
- -Bicron Micro Rem Meter
- -Air Samplers

The locations of material staging, monitoring and pending segregation will

be identified. The PowerScreen soil handling unit will be received and placed for operation. The NaI detector array will be installed and tested for start-up using sources initially, and then known impacted soil from the "Burial Mound" after collection and on-site analysis by gamma spec.

The 'Burial Mound' surface will undergo a screening survey per the OE Avoidance Plan to limit unexploded ordnance hazards. The surface of the mound will be degrubbed, and the vegetation will be shredded and staged on-site for packaging with the initial impacted soil. A comprehensive UXO/EOD survey of the exposed mound area will be performed upon removal of the vegetation.

4.1.2 Base-Line Survey

The location within the fenced controlled area, adjacent to the 'Burial Mound' itself, which will receive the sorted "clean" material upon soil screening, will undergo a baseline survey in parallel with the other set-up activities. The objective is to assure that the ground is not radiologically impacted in association with the 'Burial Mound' prior to covering it with a significant volume of cleared material. Upon completion of the soil removal and screening effort, the surface of the pending mound of monitored and clean soil will be included in the Final Status Survey as a Class 1 area.

An area of approximately 1,200 m^2 slightly distant from the present 'Burial Mound', but within the boundary of the site controlled area, will be initially surveyed as if it represented a probable contamination area per the MARSSIM protocols. Although the vicinity may represent the characteristics of a Class 2 area more closely, it is prudent to perform a comprehensive survey and sample at the higher frequency of a Class 1 area for greater confidence in defense of early ground covering. The expanse of surface area necessary to accommodate the balance of clean material after screening, up to approximately 7,700 yd^3 uncompacted, is significant even with building up. The initially surveyed and radiologically cleared receiving area could feasibly be covered with up to 9' of compacted overburden during the course of the project.

The grid locations will be marked and labeled for cross-reference to both prominent landmarks and for overlay with the pending Class 1 site areas of the Final Status Survey, Section 6.0. Also, see Attachments 2 and 4.

A comprehensive gamma walkover survey will be performed over the area. Any locations identified with increased detectable gamma activity will be

marked for subsequent sampling and on-site analysis. Systematic sampling will be performed per MARSSIM, and ten surface samples will be collected systematically, beginning at a random starting location and adopting the triangular pattern for subsequent locations. Initial analysis of the samples will be performed on-site via gamma spectroscopy, and 10% of the samples will additionally be submitted along with the completed chain of custody record for third party (QC) analysis. Data from this baseline ground surface survey will be included in the report package per Section 6.0.

4.2 In-Line Monitoring System

Upon completion of the initial set-up activities and the baseline surface survey of the clean material staging area, excavation of the 'Burial Mound' will begin. Material will be excavated and removed from the pile and grounds below, and conveyed to the monitoring system. The soil conveyor / monitor is a conventional PowerScreen system with a powered screen sizer for culling any large items, a grinder for soil preparation (i.e., breaking up the compacted clay) , and a discharge conveyor. The detector array is added by ATG, and is a series of ten individual calibrated units comprised of alarming ratemeters with NaI detectors, mounted over the conveyor.

4.2.1 Description

The conveyor has an effective width of 24", and a scraper for controlling the maximum height/depth of the product conveyed. The throughput speed is variable. The length of the conveyor is over 20', permitting ample opportunity to stop the system in the event of an alarm and permit segregation of the contaminated payload from other discharged unaffected material at the end destination of the conveyor.

4.2.2 Sensitivity

The calculated sensitivity of the system is demonstrated in Appendix 5. At a conveyor speed of 0.5 m/second, with the detectors at 6" above the conveyor and the soil at a maximum depth of 3" on the conveyor, the sensitivity is calculated to be 1.5 pCi/gm of Co-60 and 2.8 pCi/gm of Cs-137.

The site-specific $DCGL_w$'s (Derived Concentration Guideline Limits) per Section 6.8.2 and Appendix 6 are shown to be 100 pCi/gm for Co-60 and 21 pCi/gm for Cs-137, respectively, to meet the NRC acceptable dose of 25 mrem/y. The strategy has been determined that compliance can be demonstrated if the combined activity of the two radionuclides does not

exceed the lesser value of 21 pCi/gm.

Actual alarm points in the field will be set at 1.5 times the background rate. A 2" x 2" NaI detector will have a nominal background of about 8,000 cpm at the soil conveyor/monitor (variable). Thus, the detector will alarm at 12,000 cpm, or 4,000 net cpm. This corresponds to a uniform contamination level of 8.6 pCi/gm of Co-60 or 16.8 pCi/gm of Cs-137. Since Cs-137 produces a lower detector response, it is prudent to assume that the combined activity is all Cs-137. In this case, the detector will alarm at 16.8 pCi/gm, compared to a DCGL of 21 pCi/gm. This ensures that the concentration criteria for any combination of Co-60 and Cs-137 will be satisfied.

4.3 Verification of Monitored Material

Impacted material tripping an alarm will be segregated by sacrificing the entire length of contents over the halted conveyor as LLRW. Each positive hit represents as much as 1 yd^3 of rejected material unless further sorted by hand or passed back through the monitor. Rejected material will be sampled and analyzed on-site by gamma spec to establish the correlation between monitor system response and actual concentration by analysis. Additionally, batches of non-rejected material will be initially sampled and analyzed on-site for comparison of monitoring system direct measurement response and actual soil concentrations by sample analysis.

4.4 Sorting and Segregation of Waste Streams

An attempt will be made during excavation and removal of the 'Burial Mound' pile and subsurface material, to extract the known contaminated locations first. The CHPPM report has provided evidence of discrete areas of elevated activity (Attachment 5), from which the present impacted volume estimate has been derived. The early extraction of impacted material allows monitoring system assurance testing with actual product, but more importantly, minimizes the prospect and/or appearance of dilution of the impacted material with otherwise intermixed volumes of uncontaminated or lesser contaminated material.

The operation of the conveyor / monitor will become relatively automated. As long as the operable system has no alarms annunciating with the exception of shift start and end point QC checks, the discharged clean material will be accumulated at the end of the conveyor. The clean material pile will be conveyed and placed on the next 6"lift at the staging pile being constructed.

When an alarm goes off indicating elevated activity on the conveyor, the monitoring technician halts the conveyor and flags the impacted area of material (i.e., chalk,

lime). The remaining clean material stockpile at the discharge end of the conveyor is removed entirely. The impacted material is then conveyed under the speed of the conveyor to discharge the contents. As practical, the affected material will be discharged into the awaiting equipment bucket for transfer directly to packaging. At times when a high volume of material is found to be impacted, or when the capacity of existing packages has been exhausted, impacted material will be placed on a plastic barrier over the ground, accumulated, and moved to staging. Any impacted materials on-site which cannot immediately be packaged will be enclosed with plastic and secured.

5.0 EQUIPMENT SURVEYS

All equipment having come in direct contact with the suspect materials within the controlled work area on-site will undergo limited decontamination (gross removal) and a formal radiological release survey prior to permitting removal from the project site.

5.1 Regulatory Criteria for Unconditional Release

The limits for residual surface contamination shall conform to that prescribed in "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material", U.S. NRC, April 1993.
The site contaminants, Co-60 and Cs-137, are provided for in the associated table, which lists them as:

NUCLIDES	AVERAGE	MAXIMUM	REMOVABLE
Beta-gamma emitters	5000 dpm/100 cm^2	15000 dpm/100 cm^2	1000 dpm/100 cm^2

5.2 Surface Surveys

Accessible surfaces of equipment will be surface surveyed by scanning with a calibrated ratemeter and a GM pancake probe. Additional measurements will be performed using gamma sensitive instrumentation, i.e., Micro R meter to rule-out any obvious contamination which would warrant decontamination prior to the intensive surface scan. Care will be made to ensure that select regions, including contact points and intakes, are scrutinized intensely.

Data will be recorded in the field on sketches/diagrams of the components. Records will include the name of the surveyor, date, equipment identification, instrumentation by model, serial number, date of calibration, background rate, and observed gross measurement readings. The survey will ultimately be corrected to include standardized units of net dpm/100 cm^2.

5.3 Surface Sampling

Swipe samples will be collected of equipment surfaces during the survey. Swipes will be counted on-site for both alpha and beta-gamma activity on a manual Ludlum Model 2929. Swipe sample measurements will be documented to include the technician, date, identification of individual swipe sample, instrument background rates, instrument efficiencies, and gross count rate in each channel. The corrected activity will be also recorded in units of net dpm/100 cm^2.

5.4 Instrument Selection

Table 1 lists the radiological detection and measurement instrumentation to be employed for the survey activities, along with typical parameters and detection sensitivities for the type of instrument and its application.

TABLE 1

INSTRUMENTATION FOR RADIOLOGICAL SURVEYS

Type of Measurement	Instrumentation Detector	Instrumentation Meter	Background Rate	4π Efficiency	Detector Sensitivity
Surface Scan beta-gamma	GM Pancake Ludlum 44-9	Ratemeter Ludlum Model 18	50 cpm	0.1	3760 dpm/100cm^2
Surface Scan (alpha)-beta	Gas Proportional Ludlum 43-68	Ratemeter Lud. Model 2221	400 cpm	0.15	980 dpm/100cm^2
Surface Activity beta (alpha)	Gas Proportional Ludlum 43-68	Scaler Lud. Model 2221	400 cpm	0.15	638 dpm/100cm^2
RemovableSurface Activity - beta	Plastic Scint (ZnS) Ludlum 43-10-1	2 Channel Scaler Lud. Model 2929	80 cpm	0.3	727 dpm/100cm^2
RemovableSurface Activity - alpha	Plastic Scint (ZnS) Ludlum 43-10-1	2 Channel Scaler Lud. Model 2929	3 cpm	0.35	151 dpm/100cm^2
Exposure Rates	1" x 1" NaI	Micro R Meter Ludlum Model 19	-	-	< 1 μR/hr
Surface Dose Rates	2" x 2" NaI Lud. Model 44-10	Ratemeter Ludlum Model 18	8,000 - 12,000 cpm	Cs-137 > Co-60 >	900 cpm/μR/hr 450 cpm/μR/hr

Scan sensitivity based on MDA (dpm/100cm^2) =

$$\frac{4.65\sqrt{\frac{\text{Bkg (cpm)}}{2 \times \text{Tc (min)}}}}{\text{Eff} \times \text{A}/100}$$

Where Tc = Meter Response Time
A = Area of Probe

Surface measurement sensitivity based on MDA (dpm/100cm^2)

$$= \frac{2.71 + 4.65\sqrt{\text{Bkg (cpm)} \times \text{Tc (min)}}}{\text{Eff} \times \text{A}/100 \times \text{Tc (min)}}$$

6.0 FINAL STATUS RADIATION SURVEY

6.1 Introduction

The area known as the Rideout Field, Pelham Range, Area 24C, at Fort McClellan, Alabama, was used as a low-level radioactive material burial site (up to 1959) and a radiological training area (mid 1960's to 1972). The facility was used to train Radiation Control Teams in support of nuclear weapons testing performed by the Atomic Energy Commission (AEC). The training employed the use of sealed radioactive sources that were raised and lowered to produce radiation fields similar to those associated with fallout from detonation of a nuclear weapon. Students were trained to perform ground and aerial surveys to map the radiation fields present.

The US Army Chemical Center and School training mission was transferred in 1973 from Fort McClellan, Alabama to the US Army Ordnance Center and School at Aberdeen Proving Ground, Maryland. Records indicate that the radioactive materials associated with the burial and training area (primarily Co-60 and Cs-137) were removed and disposed of in off-site licensed facilities around this time. Although the AEC licenses (BML 1-2861-1, BML 1-2861-2, and SNM 344) held by the U.S. Army Chemical Center and School were terminated in 1973, a formal closeout survey was not performed. Since no record of a formal close-out survey could be located, the U. S. Army Toxic and Hazardous Materials Agency requested the U.S. Army Environmental Hygiene Agency, currently the U. S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), to investigate these areas.

The Army Base Closure and Realignment Committee has identified Fort McClellan as an installation for closure. The Fort McClellan Pelham Range will be licensed to the Alabama Army National Guard (USACE, 1998). As part of this closure, the Fort McClellan NRC radioactive materials license number 01-02861-05 will be terminated. Termination of the facility licenses requires submission of a formal decontamination and decommissioning plan.

Previous surveys identified radiological conditions not suitable for unrestricted release. Remedial actions are being planned and the U.S. Army IOC has requested that their contractor design a final status survey to demonstrate the effectiveness of remediation in satisfying applicable radiological guidelines for soil. This Plan describes the scope, objectives, and methodologies of such a survey.

6.2 Results of Previous Radiological Surveys

Radiological surveys of the Burial Mound and several background areas were conducted in August/September 1995 and January 1996 by the U.S. Army Center for

Health Promotion and Preventive Medicine. Survey methods and results are presented in "Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound Site, Fort McClellan, Alabama, 29 August –15 September 1995 and 14-28 January 1996" (USACHPPM 1996). These surveys included surface gamma scans to identify discrete areas of elevated activity, gamma exposure rate measurements at 1 meter above the surface, collection and analysis of surface soil samples, collection and analysis of subsurface soil samples, and gamma logging of subsurface sampling core holes.

Background exposure rates ranged from 7.2 to 10.2 μR/h. Background concentrations of Co-60 and Cs-137 in soil samples (surface and subsurface) ranged up to 0.1 pCi/g and 0.3 pCi/g, respectively. Radionuclides from the naturally occurring uranium and thorium decay series and K-40 were present at typical background concentrations.

Surface and subsurface surveys indicated that radiological conditions of most of the Burial Mound are not significantly different than background. In two of the eight 100 m^2 survey grids, isolated locations of elevated activity were identified on the surface of the Burial Mound by the gamma scans. Concentrations of Co-60 and Cs-137 at these locations ranged up to 187 pCi/g and 179 pCi/g, respectively. Gamma exposure rates at 1 meter above the surface ranged up to a maximum of 1.25 μR/h above background on the Burial Mound. Subsurface gamma logging indicated elevated gamma levels to a maximum depth of 3.1 to 3.6 meters below the surrounding soil surface at four locations. Subsurface soil samples contained concentrations of Co-60 and Cs-137 ranging up to 330 pCi/g and 12 pCi/g, respectively. There was no evidence of other radionuclides at above-background concentrations.

6.3 Site Description

The Burial Mound is located in a fenced portion in the northeast corner of the Pelham Range. Mound dimensions are approximately 15 m x 25 m; the Mound is about 1.2 m above the surrounding surface and extends to a depth of approximately 3.7 m below the surface. An area of approximately 9,000 m^2 , including the 'Burial Mound', is the subject of this survey. The area of interest is generally level; conditions of vegetative cover and presence of surface features are not known.

6.4 Organization and Responsibilities

The final survey will be implemented immediately upon completion of site remediation activities by the same contractor, ATG, Inc. Refer to Plan section 2.2 for the organization chart. Note that additional health physics expertise is contracted

through Auxier and Associates for final survey plan implementation (consult) and data evaluation.

6.5 Purpose and Scope

The purpose of this Plan is to provide a framework for conducting a final status survey of the soils at the Burial Mound site. The survey will determine the levels and extent of residual radiological material, if any, in site soils and compare the current radiological conditions with the guidelines established for the project (see Section 6.8.2).

6.6 Radiological Contaminants

The potential radiological contaminants are Co-60 and Cs-137 based on previous survey results. Contaminants are present at varying concentrations and ratios.

6.7 General Approach

Guidance provided in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (DoD 1997) will be the basis for this survey. The MARSSIM process was developed collaboratively by the Nuclear Regulatory Commission, Environmental Protection Agency, Department of Energy, and Department of Defense, for use in designing, implementing, and evaluating radiological surveys. This process emphasizes the use of Data Quality Objectives (DQO) and Data Quality Assessment processes, along with a sound program of quality assurance/quality control. The "graded approach" concept is also used to assure that survey efforts are maximized in those areas where there is the highest probability for residual contamination or greatest potential for adverse impacts of residual contamination. Examples of integration of the graded approach into the MARSSIM process include use of site history, site conditions, equipment capabilities, and results as the survey progresses to establish/adjust: degree of scanning coverage of a survey area, survey unit size, sampling frequency, and criteria for evaluation of elevated measurements.

The primary focus of MARSSIM is to demonstrate compliance of a site or facility with regulatory agency criteria for future use without radiological restrictions. This type of survey is known as a "Final Status Survey," and MARSSIM provides highly prescriptive guidance for designing and conducting such a survey. On the basis of prior surveys, residual contamination of Co-60 and Cs-137 in excess of the established guidelines for unrestricted release (Section 6.8.2), is anticipated on portions of this site. Remediation will therefore be performed to remove contaminants to satisfy acceptable levels. It is anticipated that remediation will include excavation and subsequent sorting of soil from the Burial Mound. An area

will be identified for placement of the clean sorted soil. Soil determined to be clean as a result of the sorting process will be spread out at a location inside of the fenced area. This area will be surveyed in the same manner as the remainder of the site prior to and following placement of the sorted soil. The Final Status survey will be implemented, following completion of the remedial actions unit and prior to backfilling or other restoration actions.

This Plan is based on information available at the time of its preparation. The primary source of information used in the design was the "Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound Site, Fort McClellan, Alabama, 29 August –15 September 1995 and 14-28 January 1996" (USACHPPM 1996). It is recognized that additional historic information on site operations, conditions encountered at the time of the survey implementation, and findings as the remediation and/or survey progress may require modifications to this Plan. If modifications are determined necessary, they will be justified and documented, including appropriate project approvals.

Field activities will include:

- surface gamma scans to identify potential locations of contamination,
- exposure rate measurements, and
- sampling of surface soil.

6.8 Survey Objectives

6.8.1 General

The objective of the survey described in this Plan is to determine the radiological conditions of soils at the Burial Mound Site, following remedial actions, for comparison with the guidelines established for the project (see Section 6.8.2).

6.8.2 Radiological Guidelines

The following guidelines (also referred to as $DCGL_W$'s or Derived Concentration Guideline Limits) for residual radionuclide concentrations in soil have been established for individual radionuclides (A&A 1999). The criteria developed for the Burial Mound Site are 100 pCi/g Co-60 and 21 pCi/g Cs-137 in soil, based on an acceptable dose of 25 mrem/y. The survey objective is to demonstrate compliance that the combined residual concentrations of

these two radionuclides are such that the total dose to an exposed individual would be less than 25 mrem/y.

6.8.3 Radiological Survey Parameters

Surface scans of the ground surface will be recorded in count rate (counts/minute (cpm) or counts / second (cps)); the primary purpose of the scans will be to be identify locations where direct gamma radiation levels are elevated, thus suggesting possible radiological contamination in excess of natural background levels. Scanning location and results will be recorded by hand. Relative instrument count rate will be continuously monitored during scanning through use of the audible response signal from the instrument. The estimated scanning sensitivities are 3.4 pCi/g for Co-60 and 6.4 pCi/g for Cs-137 based on a nominal background level of 10,000 cpm at the ground surface with a 2" x 2" scintillation detector in the manual scanning mode. (Table 6.4 of NUREG-1507). The scanning technique is more sensitive for larger areas of contaminated soil. The scan procedure would therefore be capable of identifying areas of soil with Co-60 and/or Cs-137 contamination well below the dose-based criterion.

Exposure rates in μR/h will be used as a surrogate measurement to demonstrate compliance with the concentration criteria for Co-60 and Cs-137 in surface soil. Twenty-one pCi/g of Cs-137 equates to an exposure rate of 6 μR/h above background. The Co-60 concentration associated with an exposure rate of 6 μR/h above background is 4 pCi/g—well below the dose-based criterion of 100 pCi/g. The use of 6 μR/h as a surrogate measurement for the $DCGL_W$ ensures that the concentration criteria for any combination of Co-60 and Cs-137 will be satisfied. Measurements of integrated counts in 0.5 minutes will be performed at "data point" locations, described below, using the 2221/44-10 instrument combination. Count rate will be converted to exposure rate (μR/h) using correlations determined by intercomparison with a Pressurized Ionization Chamber. Results will be tested for compliance, using the non-parametric statistical approach recommended in MARSSIM.

Soil samples will be collected at selected "data point" locations, and analyzed by gamma spectrometry for Co-60 and Cs-137 content. Concentrations will be reported in units of pCi/g, dry weight. Results will be compared with the established criterion. Results will also be

tested for compliance at the 95% confidence level, using the Student t-test approach of NUREG/CR-5849.

6.8.4 Data Quality Objectives

To enable testing of data relative to guidelines, the USACHPPM has established acceptable decision errors for this project. The Type I (alpha) decision error to be used in data testing is 0.05; this provides a confidence level of 95% that the statistical tests will not incorrectly determine that a surveyed area satisfies criteria when, in fact, it does not. The Type II (beta) decision error is also 0.05; this provides a confidence level of 95% that the statistical tests will not incorrectly determine that a surveyed area does not satisfy criteria when, in fact, it does.

Data quality indicators for precision, accuracy, representativeness, completeness, and comparability have been established.

- Precision will be determined by comparison of replicate values from field measurements and sample analysis; the objective will be a relative percent difference of 30% or less at 50% of the criterion value.

- Accuracy is the degree of agreement with the true or known; the objective for this parameter will be +/- 30% at 50% of the criterion value.

- Representativeness and comparability do not have numeric values. Performance for these indicators is assured through the selection and proper implementation of systematic sampling and measurement techniques.

- Completeness refers to the portion of the data that meets acceptance criteria and is therefore useable for statistical testing. The objective is 90% for this project.

When the site is determined to satisfy the established guidelines, a final report will be prepared, documenting the survey procedures and results.

6.9 Background Levels

Actual background levels of Co-60 and Cs-137 in soil and exposure rate were determined for 2 site reference areas as part of the previous surveys (USACHPPM 1996). The values from the "Reconnaissance" Area survey will be used as a starting point for survey design. Those levels are approximately: Co-60 in soil, <0.2 pCi/g; Cs-137 in soil, 0.6 ± 0.4 (1 σ) pCi/g and exposure rate, 8.2 ± 0.8 (1 σ) μR/h. Because these radionuclide concentrations in soil are less than 10% of the guideline values, they are not considered present in background. However, the parameter selected for demonstration of compliance, i.e. exposure rate, has a background level (8.2 μR/h) that is greater than 10% of the guideline implementation value (14.2 μR/h), and is therefore considered as present in background. Prior to initiating field survey activities, these values will be reviewed for appropriateness; additional reference area(s) will be identified and direct gamma radiation levels and/or radionuclide concentrations in soil determined, as necessary. The number of background reference data points is discussed in Section 6.13. Background measurements will be performed in the same manner as site measurements to permit comparisons of site and background data by non-parametric statistical methods.

6.10 Testing for Compliance with Guidelines

As part of the DQO process, the null hypothesis for demonstrating compliance of data with guidelines must be stated. The null hypothesis (H_0) tested is that residual contamination exceeds the acceptance criterion (guideline); by rejecting the null hypothesis, the alternative hypothesis must be accepted and the finding of the evaluation is that the site satisfies the guideline. In accordance with recommendations of MARSSIM, the non-parametric Wilcoxon Rank Sum (WRS) test will be used for this purpose because the survey parameter selected for demonstration of compliance has an associated background. As a supplemental evaluation, results of soil sampling will be compared with the dose-based criterion, using the Student t-test as described in NUREG/CR-5849.

6.11 Classification of Areas by Contamination Potential

For the purposes of guiding the degree and nature of survey coverage, MARSSIM identifies three classifications of areas, according to contamination potential. Class 1 areas have a potential for contamination that exceeds guidelines; Class 2 areas have a potential for contamination, but it is unlikely that the contamination level exceeds the average $DCGL_w$; and Class 3 areas are not expected to contain residual activity in excess of background. Due to the relocation of the material previously present in the Burial Mound during the sorting process, the entire area will be classified as a Class 1 area and will be gamma scanned at essentially 100% coverage. No Class 2 or 3 areas are planned for this final status survey.

6.12 Identification of Survey Units

The site will be divided into survey units following the general guidance of MARSSIM Section 4.6. Approximately 10 Class 1 survey units, typically consisting of approximately 1,000 to 1,700 m^2, are anticipated. Division into specific survey units will be performed at the time of the survey. Survey units will be assigned unique two-digit identifiers and will be referenced to the grid coordinate at the southwest corner of the unit.

Final designation of survey units will be performed after remediation is completed and just prior to initiating post-remediation screening and the final status survey. There will also be one reference area selected at the time of the survey.

6.13 Determination of Data Requirements

The survey plan takes advantage of the strong radiation signal from Co-60 and Cs-137 to identify and quantify areas of soil contamination in the field. Exposure rates will be used as a surrogate for the DCGLs to guide the remediation and determine when remediation is complete and an area is ready for soil sampling. The soil sampling ill be used to confirm that the remediation achieved the DCGLs for each survey.

6.13.1 Exposure Rate Measurements

The Wilcoxon Rank Sum statistical test was used to calculate the number of systematic exposure rate measurements needed to determine the status of a survey unit. This test requires information on the following parameters:

- The $DCGL_w$ defined in Section 6.8.2;
- The Lower Bound of the Grey Area (LBGA) defined in MARSSIM;
- The sigmas of the reported exposure rates in the reference (σ_r) and survey (σ_s) areas;
- The decision error percentiles for the null hypothesis.

A&A has calculated a dose equivalent rate of 6 μR/h, above background, at 1 m above the surface as a surrogate measurement for the $DCGL_w$'s for

guideline concentrations of Co-60 and Cs-137 in soil. The $DCGL_w$, plus the background average, is 14.2 μR/h. This is above the upper range of measured background, 10.2 μR/h. If the 3 sigma background level of 11.2 is taken as the LBGR, and the $DCGL_w$ as 14.2, then Δ, the width of the MARSSIM 'grey zone' is:

$$\begin{aligned}\Delta &= DCGL_w - LBGR \\ &= 14.2\ \mu R/h - 10.2\ \mu R/h \\ &= 3\ \mu R/h\end{aligned}$$

Where,

$DCGL_w$ = The Derived Concentration Guideline

LBGA = Lower Bound of the Grey Area

Once the width of the 'grey area' (Δ) is determined, the 1 sigma values of the reference area (σ_r) and survey areas (σ_s) are used to calculate the Relative Shift. The Relative Shift is the ratio of the width of the 'grey area' to the standard deviation of the measurements made within the survey units (Δ/σ). The one sigma values for the reference and survey areas have been determined to be approximately 1 μR/h, based on survey results obtained during the scoping/characterization phase. The relative shift is then calculated to be:

$$\Delta/\sigma = 3\ \mu R/h\ /\ 1\ \mu R/h = 3$$

Where,

Δ = The width of the 'grey region' defined in MARSSIM, and

σ = Sigma for the reference and survey areas.

MARSSIM recommends a range of 1 to 3 for the Relative Shift, Δ/σ. Three is within this range and will be used to determine the number of measurements required.

Once the Relative Shift is determined, the information can be used in conjunction with the acceptance decision errors on the null hypothesis to determine the number of data points required. In this case, the null hypothesis, (Ho) states that, for each survey unit, the residual radioactivity exceeds the $DCGL_w$. Acceptance decision errors for testing this hypothesis are set at 0.05 for both Type I and Type II errors.

The number of data points for statistical testing the status of each survey unit is obtained directly from MARSSIM (page 5-30, Table 5.3). The number of data points for performing the WRS statistical test is 10 for each survey unit (and the reference area). This number of samples includes an additional 20% to account for missing or unusable data.

Sensitivities of proposed instruments and techniques are such that $DCGL_w$ concentrations can be identified by scans; additional data are not needed for identifying areas of elevated activity.

6.13.2 Soil Sample Collection

Soil samples will be collected at the ground surface immediately below the locations in which integrated direct gamma measurements are to be obtained at the 1 meter elevation. Per the following sections 6.14 and 6.16.2, the described frequency provides an initial estimate of 10 data points for each survey unit. Approximately 70 samples, plus those of the reference area, will be obtained from throughout the site. The soil concentration data collected from these samples will be used in a Student's t-test to confirm the status of the survey unit.

6.14 Data Point Locations

MARSSIM recommends a triangular sampling pattern to increase the probability of identifying small areas of elevated activity. This type pattern will be used for the Burial Mound site, except where a triangular pattern is not practical, because of the size and shape of a specific area to be sampled; for such situations, a square sampling pattern may be used. For example a square pattern is more practical to install and implement than a triangular pattern for survey areas having one dimension that is less than the calculated average spacing between samples. The spacing (L) between samples on a triangular pattern is determined by:

$$L = [\text{Survey Unit Area}/(0.866)\ (\text{number of samples})]^{1/2}$$

For a Class 1 survey unit area of 1,500 m^2 and 10 samples, the area represented by each sample is approximately 150 m^2. The spacing between samples on a triangular pattern for this area is 4 m. If unusual survey unit dimensions and surface features prevent collection of an adequate number of systematic data points for statistical testing, additional points may be obtained from randomly selected locations within the survey unit.

To establish a random-start triangular pattern for a Class 1 survey unit, start from the

southwest corner of the survey unit and select a random starting point north and east of this corner. Next, determine the grid coordinates of all locations within the survey unit at 4-m intervals along the same east-west reference grid line as the pattern starting point. Locate a point 3.5 m north (or south) and 2 m east (or west) of one of these locations, and determine the grid coordinates of all the sampling locations within the survey unit at 4-m intervals along an east-west reference grid line, parallel to the initial line of sampling locations. Repeat this process until the entire area to be surveyed is covered by the triangular pattern. For irregular shaped survey units, where use of east-west and north-south grid lines may be inconvenient, the baseline for the sampling pattern may follow the long axis of the survey unit to facilitate implementation.

6.15 Instrumentation

6.15.1 Instruments

The proposed Instrumentation for the Burial Mound Site survey will be the following, (or equivalent):

1) Ludlum Model 2221, scaler/ratemeter
2) Ludlum Model 44-10, gamma sensitive 2" x 2" NaI detector
3) Reuter Stokes, Pressurized Ion Chamber RSS-112
4) Ludlum Model 19, Micro R Meter

6.15.2 Specifications and Uses

6.15.2.1 Ludlum Model 2221

1) Count rate meter set to the operating voltage and input sensitivity characteristics of the detector in use;

2) Will be used as a scaler in continuous and timed collection durations;

3) Will be used as the instrument to configure with the Ludlum Model 44-10.

6.15.2.2 Ludlum Model 44-10

1) Gamma sensitive, 2"x2" NaI detector capable of identifying minimum levels of < 21 pCi/gm and as

referenced in final release of MARSSIM manual, equation 6-10, and NUREG-1507. Exact MDC's for scans will be empirically determined upon site arrival and gaining knowledge of site conditions for surface efficiency and personnel for surveyor efficiency.

2) The weighted cpm/μR/h is approximately 900 for Cs-137 and 450 for Co-60.

6.15.2.3 Reuter Stokes RSS-112

1) The RSS-112 is a pressurized Ion Chamber and is considered a primary standard.

2) Intended use will be to establish scintillator response correlations.

6.15.2.4 Ludlum Model 19

1) The Model 19 is a 1" x 1" NaI detector instrument.

2) Its primary use will be for exposure rate measurements for exposure to occupationally and non-occupationally exposed individuals.

3) Quality control will be measured against the RSS-112 PIC.

6.15.3 Maintenance and Instrument Control

All instrumentation will have current calibration (within the past 12 months, or as recommended by the manufacturer). Daily performance checks will be conducted in accordance with individual instrument use procedures. These performance checks will be performed prior to and following daily field activities and at any time the instrument response appears questionable. Only data obtained using instruments that satisfy the performance requirements will be accepted for use in the evaluation.

6.16 Final Status Survey Implementation

6.16.1 Gamma Scans

Following remediation and/or prior to conducting sampling, screening gamma scans will be performed over 100% of surfaces of Class 1 survey units. The surveyor will advance at a speed of approximately 0.5 m/s while passing the detector over the surface in a serpentine pattern. Audible response of the instrument will be monitored, and locations of elevated audible response that are identified will be noted. Based on Section 6.8.2 of NUREG-1507, an increase of 1500 to 2000 cpm is detectable over an ambient level of 10,000 cpm (typical background level for a 2-inch x 2-inch NaI detector). Differences in fill materials, surface covering, structures, and source-to-detector geometry due to excavations and site topography will result in variable ambient direct gamma radiation levels. Therefore, the actual ambient background for a survey unit will be determined at the start of the survey and a scanning response, which is detectable above the background level, will be set as the investigation or screening level, indicating potential contamination exceeding guideline concentrations. As site survey data are collected and evaluated, correlation of instrument response with radionuclide concentrations will be developed to facilitate field identification of locations of elevated activity in excess of site-specific removal goals. Locations exceeding screening levels will be investigated and, if appropriate, remediated; following any remediation, scanning will be repeated to demonstrate effectiveness of the removal actions.

6.16.2 Direct Exposure Rate Measurements

Exposure rate measurements will be performed at systematic data point locations in accordance with the procedure, using a Ludlum Model 2221 meter with a Ludlum Model 44-10 gamma scintillation detector. The measurements will be performed at 3.3 ft above the surface by integrating the count for 0.5 minutes. The Pressurized Ionization Chamber will be used to develop a correlation between the instrument response and true exposure rate. Project-specific forms will be used to record data.

6.16.3 Soil Sampling

Soil samples of approximately 1 kg will be obtained to a depth of 15 cm; samples will be packaged and uniquely identified in accordance with chain–of–custody and site-specific procedures.

6.16.4 Sequence of Field Activities

The sequence of activities will be as follows:

1. If deemed necessary, select a reference survey unit of a similar geological nature to the Mound Burial Site, but not impacted by radiological contamination. Perform 10 exposure rate measurements in this reference area. Measurement locations in the reference survey unit will be selected randomly or systematically, depending on the size and dimensions of the area. The reference locations of each of the samples must be documented.

2. Determine ambient background direct gamma levels for gamma scintillation detectors and establish action levels to correspond to instrument responses, which are detectable above these ambient background levels.

3. Establish reference grids for survey areas and establish boundaries of survey units. Establish pattern for data points (Section 6.14).

4. Conduct surface gamma scans. Identify locations of elevated direct radiation and remediate and/or conduct sampling to determine the extent and concentrations of areas of elevated activity.

5. Establish random-start sampling location patterns.

6. Perform exposure rate measurements. The actual number of systematic measurements will depend on the actual area and pattern of excavation and results as the survey progresses.

7. Perform on-site sample analysis by gamma spectroscopy and send split samples (QC) accompanied with the appropriate chain-of-custody record, to a qualified laboratory for confirmatory analysis at a frequency of 10% of the total sample population.

Area Classification	Number of Survey Units	Samples/Survey Unit	Total Measurements
Reference Area	1	10	10
Class 1	7	10	70

6.16.5 Sample Analysis

Samples will be transferred to a radio-analytical laboratory for analyses in

accordance with documented laboratory-specific standard methods. Samples will be dried and homogenized. A portion of each sample will be sealed in calibrated-geometry containers and then analyzed by high-resolution gamma spectrometry. Concentrations of Co-60 and Cs-137 and members of the natural uranium, thorium, and actinium decay series, which may be identified by the spectrometry analysis software, will be determined. In accordance with MARSSIM, analytical techniques will provide a minimum detection level of 50% of the individual radionuclide $DCGL_W$ values for all primary contaminants, with a preferred target minimum detection level of 10% of these individual radionuclide $DCGL_W$ values.

6.16.6 Investigation Levels

Direct radiation levels, identified by scans, that indicate potential residual radioactive contamination above background, will be investigated to identify the source, level, and extent of such residual activity. Areas that contain residual radioactivity concentrations of individual radionuclides or sum-of-ratio concentrations above respective guideline values and remediation goals will also be investigated. Depending upon the levels, extent, and other conditions of contamination, additional sampling and/or measurements may be performed to resolve uncertainties, and data reevaluated. Remediation will be performed, if required, and the location resurveyed.

6.16.7 Quality Control Measurements

A minimum of 5% replicate samples and exposure rate measurements will be performed for field quality control purposes. Other quality control activities are incorporated into specific field survey procedures.

6.17 Data Evaluation

6.17.1 Data Assessment

All data will be reviewed for conformance with indicated procedures and plans. Results will be converted to appropriate units for comparison with criteria and necessary calibration/correlation adjustments performed. All measurement data will be reported in the standard format of X +/- Y (2 σ) and detection capability. Laboratory analyses and exposure rate measurement QC data will be evaluated for accuracy and precision. Data not meeting design quality objectives will be identified. Additional data needs, if any, will be identified.

- Scan data, locations of elevated direct radiation levels, and sampling locations will be identified on facility drawings.

- Tables of radionuclide concentrations in each sample from the reference area and each survey unit will be prepared.

- Individual sample concentrations will be graphically displayed on posting plots and histograms for each survey unit and reference area for visual identification of trends.

6.17.2 Data Interpretation

Exposure rate data meeting acceptance criteria will be evaluated using the Wilcoxon Rank Sum test. The Wilcoxon Rank Sum test (the method described in Appendix I, Section 11 of MARSSIM) will be conducted for each group of survey unit samples; the reference area sample set will be used for each of these tests. If the WRS test results in rejection of the hypothesis, the test has demonstrated that the survey unit satisfies criteria for unrestricted release. If the data do not reject the hypothesis, a site-specific risk assessment will be performed to determine options for further action.

Soil concentration data will be evaluated using the Student t-test. Findings that are inconclusive because of additional information needs and findings that criteria have not been met will be promptly reported within the project organization structure for early resolution.

6.17.3 Comparison with Project Objectives

Overall project results will be compared with DQOs, established during the design phases of the project.

6.18 Report of Survey Findings

Survey procedures and results will be documented in a report, following the general guidance for Final Status Survey Reports in draft NUREG/CR-5849 (NRC-1992), and submitted by ATG.

7.0 PHYSICAL SECURITY PLAN AND MATERIAL CONTROL AND ACCOUNTING PROVISIONS IN PLACE DURING DECOMMISSIONING

This section is not applicable. Fort McClellan is still an active base and security and material control are conducted by the U.S. Army.

8.0 FUNDING

The following cost estimate depicts the turnkey pricing for the entirety of project execution, from mobilization through remediation, final verification, and return for site closure upon regulatory release. Management, technical and labor support, travel and living expenses, normal consumables (plastic, PPE, etc.) and rentals are provided for the projected level of effort. Waste packaging and transportation is provided for an estimated volume of LLRW up to 500 yd^3 of impacted soil and secondary wastes. Waste volumes in excess of 500 yd^3 would require negotiation of unit rates to accommodate the extended schedule and additional transportation costs.

U.S. Army Fort McClellan HQ, IOC Project Number USA 98-046 Phase II
'Burial Mound' Decommissioning Funding

Direct Labor		**$ 72,709**
Fringe, P/R Tax, Workmans Comp.		**$ 20,569**
M&IE		**$ 31,847**
Travel		**$ 6,337**
Supplies		**$ 21,952**
Rental		**$ 74,818**
Freight		**$ 1,620**
Analysis		**$ 14,100**
Telephone		**$ 2,000**
	Direct Cost	**$245,951**
Overhead	**52.47%**	**$129,051**
Subcontractors		**$130,850**
	Subtotal (G&A Pool)	**$505,852**
G & A	**18.23%**	**$ 92,217**
	Subtotal	**$598,069**
Fee	**12.0%**	**$ 71,768**
	Subtotal	**$669,837**
Facilities Cost of Capital		
0.537% of Total Cost		**$ 1,321**
4.001% of Total Cost through Overhead		**$ 20,239**
		=======
Total Phase Cost Estimate		**$691,397**

9.0 REFERENCES

1. U.S. Nuclear Regulatory Commission Radioactive Material License Number 01-02861-05, as amended per docket number 030-17584, U.S. Army Chemical School, Fort McClellan, Alabama.

2. Code of Federal Regulations Title 10, Part 20, *Standards for Protection Against Radiation.*

3. Code of Federal Regulations Title 49, Parts 171 - 177, Transportation.

4. U.S. Nuclear Regulatory Commission Regulatory Guide 3.65, *Standard Format and Content of Decommissioning Plans for Licenses Under 10 CFR Parts 30, 40, and 70*, August 1989.

5. NRC 1998a, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminant and Field Conditions*, NUREG-1507, Nuclear Regulatory Commission, June 1998.

6. NRC 1998b, *A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*, NUREG-1505, Nuclear Regulatory Commission, 1998.

7. NUREG-1575 / EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, December 1997.

8. NUREG/CR-5849 (draft), *Manual for Conducting Radiological Surveys in Support of License Termination*, June 1992.

9. U.S. Nuclear Regulatory Commission Document, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material*, April 1993.

10. *Industrial Radiation Study No. 27-MH-0987-R2-97, Pelham Range Burial Mound, Fort McClellan, Alabama, 29 August - 15 September 1995 and 14 - 28 January 1996*, U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM).

11. Waste Profile Record, Envirocare of Utah EC-0230, Fort McClellan "Burial Mound", Revision 2, ATG, October 1998.

12. A&A 1999, *Development of Derived Clean-up Guidelines for the Pelham Range 'Burial Mound', Fort McClellan, Alabama,* Auxier & Associates, Inc., February 12, 1999.

13. Envirocare of Utah, Inc. *Radioactive Material License Number UT 2300249 Dated 10/22/98 with Expiration Date of 10/22/2003*, Utah Department of Environmental Quality, Division of Radiation Control.

14. U.S. Army - Industrial Operations Command, Standard Operating Procedure, *Shipping Unwanted Radioactive Materials*, May 1998.

APPENDIX 6

DEVELOPMENT OF DERIVED CLEANUP GUIDELINES FOR THE PELHAM RANGE 'BURIAL MOUND'

FORT McCLELLAN

Development of Derived Cleanup Guidelines for the Pelham Range Burial Mound, Fort McClellan

February 12, 1999

Prepared for:
Allied Technology Group
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Prepared by:
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1.0 Introduction

1.1 Background

Fort McClellan is an army base sited on 45,679 acres adjacent to Anniston, AL. A part of the base, known as Rideout Field, served as a radiological training area from the mid 1950's through May of 1972. The radiological training area was decommissioned and some contaminated soil was excavated and moved to a burial mound located in the northwest corner of the Pelham Range. This mound, called the Pelham Burial Mound in this report, contains elevated concentrations of Co-60 and Cs-137.

1.2 Objective

The Army Base Closure and Realignment Committee has identified Fort McCellan as an installation for closure. Fort McCellan will therefore be closed, and the Pelham Range will be licensed to the Alabama Army National Guard (USACE, 1998). As part of this closure, the Fort's NRC radioactive materials licenses 01-02861-05 will be terminated. Termination of these licenses requires submission of a formal decontamination and decommissioning (D&D) plan. Cleanup levels form an integral part of this D&D plan. This report is intended to present the site-specific derived cleanup guidelines proposed for the Pelham Range Burial Mound and to document the method used to derive them.

1.3 Organization of the Report

The remainder of this report is organized into four sections. Section 2, contains a description of the approach used to derive the cleanup goals. Section 3 contains the results of the exposure assessment performed on selected receptors. Section 4 presents the DCGL's and summarizes the report's recommendations. Appendix A contains the modeling parameters and results that form the basis for the DCGL's developed in this report.

2.0 Description of Approach

In order to terminate an NRC radioactive materials license and release a site, a licensee must demonstrate that the site is suitable for release in accordance with the criteria for decommissioning in Subpart E, "Radiological Criteria for License Termination," of 10 CFR 20, "Standards of Protection Against Radiation." This report uses site-specific information to derive the release criteria that must be met before the license can be terminated and the site licensed to the Alabama Army National Guard. These criteria are based on an annual dose limit of 25 mrem/y to the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity, assuming reasonable and expected use of the land in the future.

Information on the site was assembled and analyzed to develop a conceptual model of the site. This model provided a basis to identify the important sources of contamination, principle means of release and environmental transport, and likely receptors, both now and in the far future.

Once these had been identified, site-specific dervived cleanup guidelines (DCGLs) were calculated using RESRAD version 5.82 (ANL, 1995). RESRAD was developed partially under contract with the NRC and is widely used in the decommissioning industry for calculating doses and soil cleanup criteria.

3.0 Exposure Assessment

The purpose of an exposure assessment is to estimate the nature and magnitude of exposures from a site under current and plausible future conditions. This is accomplished by following a phased approach that involves the following tasks:

- Characterizing the exposure setting on and around the site,
- Identifying potentially complete human exposure pathways, and
- Quantifying the magnitude of plausible contaminant intakes by hypothetical receptors.

This section presents a description of the methods used to evaluate exposures from Pelham Mound, and the results of that assessment. The setting and physical characteristics of the Site are summarized below in Section 3.1. Section 3.2 presents the conceptual model describing the sources, contaminant migration, receptors, and exposure routes evaluated for the Mound. The methods used to quantify potential intakes by plausible receptors and the estimated intakes are presented in Section 3.3.

3.1 Characterization of the Site

The following sections summarize information on the physical setting of the site, its history, and its current and projected uses. For more detailed information on these and related subjects, see the Industrial Radiation Study No. 27-MH-0987-R2-97 (USCHPPM, Jan 1996).

3.1.1 Physical Setting

Fort McClellan is an army based sited on 45,679 acres adjacent to Anniston, AL. It is divided into three areas: the Main Post, the Choccolocco Corridor, and the Pelham Range. The Pelham Range Burial Mound is located at UMT coordinates 593300 E, 3732500 N, which is near the northwest corner of Pelham Range, on the northern end of the Battle Drill Area of Range 24C. The mound is oblong in shape and is approximately 25 meters long by 15 meters wide. It extends to three to four meters below grade, and is piled up to approximately two meters above grade in places.

3.1.2 Site History

Part of the area known as Rideout Field served as a radiological training area from the mid 1950's through May of 1972. The area was also used as an active radiological material burial

site as late as 1959. Best information indicates radioactive low-level laboratory waste and contaminated dirt were collected and placed in one burial mound located in the northwest corner of the Pelham Range.

3.1.3 Land Use

The area surrounding the burial mound has historically been used as a maneuver training area for students at the U.S. Army Chemical and Military Police Schools, and by Active Duty, Reserve, and Alabama National Guard units. The area will continue to be used as a maneuver training area for the foreseeable future. The potential for unexploded munitions also exists in some areas of the Pelham Range[1].

Because of its future use and the potential danger to the public from unexploded munitions, access will generally be restricted to authorized personnel only. This restriction will be enforced by limited access along controlled roads, and physical barriers like fences and gates.

3.1.4 Conceptual Model of the Site

The conceptual model for the Pelham Range Burial Mound has been developed to provide the basis for identifying and evaluating the potential risks to human health from radioactive materials at this site. This model presents the relationships between the following elements necessary to construct a complete exposure pathway:

- Sources and contaminants
- Release mechanisms
- Transport pathways
- Exposure routes
- Receptors

Figure 3-1 presents the conceptual model for potential human exposure to the contaminants detected in the Burial Mound soil. The objective of this conceptual model development and the concurrent analysis of potential exposure routes and receptors is to focus subsequent efforts on those pathways and sources that drive the potential impacts on human health risk.

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[1] The Decommissioning Plan includes an OE Avoidance Plan to elminate an unexpected encounter (with odnance and explosives).

The conceptual model illustrated in Figure 3-1 traces the exposure pathways and receptors for the Mound from the source through likely release mechanisms and exposure routes to potential receptors. The conceptual model also indicates which exposure routes are carried through the quantitative dose assessment for each receptor under current and far-future land-use scenarios.

3.1.5 Sources and Release Mechanisms

The radionuclides of concern at this site are Co-60 and Cs-137. This material is mixed with soil and the soil has been collected into a discrete pile that extends both above and below grade level. This burial mound is the principle source of radioactive material at this site, and it is localized in a relatively small, discrete area.

The exposed surface of the pile is subject to limited water and wind erosion. In addition, rainwater percolating through the pile may mobilize one or both of the contaminants. The impact of these releases are expected to be minimal during the study duration, but they are included for completeness.

3.1.6 Potential Transport Pathways

If released, these contaminants could be transported by wind, surface water, or groundwater to the vicinity of the receptor. In addition, plants may absorb some contaminants via root uptake. Each of these pathways has been included in the exposure assessment calculations made in this report.

3.1.7 Potential Exposure Routes

A receptor can come into contact with the Co-60 and Cs-137 in the Mound in a variety of ways, generally as the result of a receptor's behavior or lifestyle that brings him/her into contact with a contaminated exposure medium. This assessment defines a route mechanism as a stylized description of the behavior that brings a receptor into contact with a contaminated medium.

An exposure route describes how a radionuclide may enter or affect the human body. Exposures are divided into two types: internal exposures and external exposures. Internal exposures occur when contaminants are introduced directly into the human body through inhalation and ingestion. External exposures do not require physical contact and occur when a receptor is close to Co-60 or Cs-137. Such exposures result in the irradiation of an individual by penetrating radiation from the radioactive source.

Figure 3-1 Conceptual Model of Exposures for Pelham Range Burial Ground

The remainder of this section describes the exposure routes evaluated in this assessment. The receptors evaluated for these exposure routes are described in Sections 3.2.4 and Section 3.2.5.

3.1.7.1 Exposures from Inhalation

This route assumes a receptor is immersed in air containing suspended particulates from the Mound. Subsequent exposures occur via inhalation.

3.1.7.2 Exposures from Ingestion

This route assumes a receptor eats or drinks contaminated soil, food, or water.

3.1.7.3 Direct Exposure to Radiation

Direct exposures to radiation from radioactive material can occur when a receptor is near a radioactive source. Physical contact with a contaminated exposure medium is not necessary for exposure to external radiation to occur. The magnitude of exposure is directly related to the distance of the receptor from the source, the activity of the radionuclides present, and the amount of shielding between the source and the postulated receptor.

3.1.8 Receptor Scenarios Considered

3.1.8.1 Role of Land Use in Receptor Selection

The release criteria for the Pelham Range "Burial Mound" and its surrounding area will be based, in part, on the projected land use of the site. This is because the land use of this site will dictate the types of receptors that may be exposed at the site. The land use will also influence their behavior, and their behavior will influence the types and durations of possible exposures.

This site is currently part of a military base. At decommissioning, it will be licensed to the Alabama Army National Guard for use as a battle drill training area. This land use is expected to continue for the foreseeable future in order to comply with the recommendations of the 1995 Defense Base Closure and Realignment Committee. Therefore public access to the site will be restricted by administrative controls and base security. This land use limits plausible human receptors to military personnel and transient members of the general public.

At some point in the future, the Pelham Range may be released to the general public for unrestricted use. It is not anticipated that this will occur in the near future, but to assess the potential doses from this possibility, hypothetical exposures are assessed from materials in the

Pelham Mound to a family living in a home built on the site after 30 years of use as a National Guard training facility.

3.1.8.2 Receptor Scenarios Considered Under Planned Use Conditions

The possible receptors envisioned for the planned land use at Fort McClellan are military personnel and transient members of the general public. Two receptors have been selected to represent these two classes of exposure, a National Guard soldier on maneuvers and a hunter.

3.1.8.2.1 National Guard Scenario

It is assumed that members of the National Guard spend 14 days a year training at Fort McCellan. This 14 days includes 1 day for mobilization, 1 day for demobilization, and 12 days for maneuvers and training. It was assumed an individual would spend no more than 12 hours a day at the site itself. It is felt that a daily exposure of 12 hours is a very conservative, health protective estimate, because it is unlikely that training activities would allow an individual to spend all their time at one location. These assumptions produce an annual exposure time of 144 hours, which is equivalent to 18 eight hour days. The guardsman is assumed to remain in the Guard for 20 years and receive annual exposures during that period.

3.1.8.2.2 Hunter Scenario

It is assumed that transient exposures could occur to individuals who hunt on Ft. McCellan. A hunter could conceivably build a hunting blind on the site and spend part of each day waiting for game. This site is not as attractive as some surrounding terrain, and it is unlikely that these individuals would spend all of their time on this site, but overestimating the exposure duration in this manner is judged to be health protective.

It was assumed that a hunter will take 1 week of vacation to hunt. Assuming he spends one day building his blind during the weekend before hunting season, he could be present on the site for a total of ten days. If the hunter spends 10 hours a day on this site, the hunter will be in close proximity of the site for 100 hours each year. The hunter is assumed to hunt the site for 30 years.

3.1.8.3 Receptor Scenarios Considered Under Far-Future Use Conditions

This scenario assumes governmental control of the site ceases at 30 years in the future. If administrative controls cease, many types of land use become plausible. In this case, it was judged that residential types of land use would produce the greatest exposure potential.

Therefore, a typical residential scenario has been used to evaluate the exposures from these conditions.

3.1.8.3.1 Resident Adult Scenario

A typical residential adult was selected to represent exposures. This hypothetical resident lives on the property but works elsewhere. This adult spends most of the time indoors, but spends some time engaged in outdoor activities such as light gardening. The resident is assumed to grow his own vegetables and resides at the site for 30 years.

3.1.8.3.2 Resident Child Scenario

A typical residential family consists of both adults and children. A hypothetical child, aged 1 to 6 years old, was selected for evaluation because children are a critical subpopulation that may ingest higher amounts of soil than an adult. The child's behavior pattern is similar to the adult described above, except that less time is spent off-site.

3.1.9 Receptors Selected

Four receptor scenarios were initially considered to be plausible representations of potential uses of this site. Three of these receptors were selected for quantitative evaluation in this study. These potential receptors are described in the Section 3.2.4. Because the radionuclides of potential concern are strong gamma emitters, their most important exposure pathway is external radiation from the ground surface. The total exposure via this pathway is directly proportional to the time exposed to the contaminated ground surface, which means the calculated doses attributed to the receptors will be roughly proportional to the their assumed exposure times.

3.1.9.1 Receptor Selected for Evaluation of Planned Land Use

Two receptors are described in the section introducing potential receptors that were judged to be plausible under the planned use of the site. Table 3-1 presents the parameters describing the behavior of the two receptors. Because the radionuclides of potential concern are strong gamma emitters, their most important exposure pathway is external radiation from the ground surface. The total exposure via this pathway is directly proportional to the time exposed to the contaminated ground surface, which means the calculated doses attributed to the two receptors will be proportional to the their assumed exposure times.

TABLE 3-1 PARAMETERS USED TO ESTIMATE POTENTIAL EXPOSURES FOR THE FORT MCCELLAN PELHAM BURIAL MOUND

	Current Hypothetical Receptor				Future Hypothetical Receptors			
Pathway Parameter (units)	National Guardsman Age 19+		Civilian Hunter Age 19+		Resident Adult Age 19+		Resident Child Age 1-6	
Time and duration of exposure								
ET indoors (hr/d)	0	a	0	b	16.4	c	20.2	d
ET outdoors (hr/d)	12	a	10	b	2	c	3.3	d
EF (d/yr)	12	a	10	b	350	e	350	f
ED (yr)	20	a	30	g	30	e	6	f
Inhalation of dust								
IR (m3/hr)	0.63	h	0.63	h	0.63	h	0.31	i
Incidental ingestion of soil								
IR (kg/d)	0.00005	j	0.00005	j	0.00005	j	0.00020	k
Ingestion of food and water								
IR_{veg} (kg/d)	na	l	na	l	0.309	m	0.129	n
IR_{fruit} (kg/d)	na	l	na	l	0.244	m	0.102	n
IR_{water} (L/d)	na	l	na	l	2.3	o	1.3	p

a - The guardsman is assumed to spend 12 hours a day training outdoors in equipment or facilities located over the burial ground. The training lasts 2 weeks each year, with two days subtracted for mobilization and demobilization activities. The guardsman is assumed to remain in the Guard until eligible for a pension at 20 years.

b - The civilian hunter is assumed to spend 10 hours a day in a blind located on the burial ground site. The hunter is assumed to spend one day prior to hunting season building a blind, and spend 1 week of vacation (five days plus two weekends) each year actively hunting.

c - Recommended values for indoor residential and outdoor exposures from Table 5-176 in Exposure Factors Handbook, EPA 1997.

d - Time weighted average of mean values for indoor residential and outdoor exposures for 1-4 year old from Table 5-131 and Table 15-132 in Exposure Factors Handbook, EPA 1997. (Indoor = 1211 min/d, and Outdoor = 195 min/d).

e - The resident is assumed to spend 30 years living in a house built on the site, and take two weeks of vacation away from the home each year (EPA's 1991 OSWER Directive 9285.6-03.).

f - Reflects six years of life between birth and age 6.

g - The hunter is assumed to hunt the site each year he is in the area. Based on a 30 years residence time (Exposure Factors Handbook, EPA 1997).

h - Inhalation rate of adult. From Table 5-23 of Exposure Factors Handbook, EPA 1997 (15.2 m3/d x d/24 h).

i - Time weighted average of recommended values inhalation rate of children, ages 1-6. From Table 5-23 of Exposure Factors Handbook, EPA 1997. (1 y x 4.5 m3/d+2 y x 6.8 m3/d + 2y x 8.3m3/d + 1y x 10 m3/d) / 6y x d/24 h.

j - Rate of incidental soil ingestion by adult (Exposure Factors Handbook, EPA 1997, Table 4-23).

k - Soil ingestion rate (Exposure Factors Handbook, EPA 1997, pg. 4-24).

l - These receptors are expected to bring their own packaged food and water.

m - 95%tile combined home produced fruit and vegetable ingestion rate by a 71.8 kg adult (Exposure Factors Handbook, EPA 1997, pg. 9-44).

n - 95%tile combined home produced fruit and vegetable ingestion rate by a 30.1 kg child (Exposure Factors Handbook, EPA 1997, pg. 9-44).

o - 90%tile Tap water ingestion rate by an adult (Exposure Factors Handbook, EPA 1997, pg. 3-26).

p - 90%tile Tap water ingestion rate by a 1-10 year old child (Exposure Factors Handbook, EPA 1997, pg. 3-26).

Since the Guardsman Scenario assumes receptor behavior that produces 144 hours of exposure each year, while the Hunter Scenario produces 100 hours a year, the calculated dose from the Hunter Scenario will be less than 70% of the calculated dose from the Guardsman Scenario. Remediating the site to levels which are safe for the Guardsman will therefore insure the safety of the Hunter as well. Therefore, the Guardsman was selected to evaluate the highest plausible exposures from the site's planned land use.

3.1.9.2 Receptors Selected for Evaluation of Far Future Conditions

Two potential receptors, the resident adult and the resident child, are described in the section introducing potential receptors that were judged to be plausible in the unlikely event that the site is released to the public after 30 years. Therefore potential exposures to the resident adult and the resident child were both quantitatively evaluated in this study. Table 3-1 presents the parameters used to quantify the behavior of the two receptors.

3.2 Application of RESRAD

The guardsman and resident scenarios involve activities performed while on top of the burial mound soil. The computer code RESRAD 5.82 (ANL,1993) was used to assess the potential long-term doses from these activities. Default input parameters were used, except where otherwise noted in Table 3-1. Summary input files presented in Appendix A contain a detailed list of parameter values used in the RESRAD calculations for each receptor assessed.

Doses to a guardsman training on a uniform layer of the mound material during 30 years of institutional control were calculated for the following pathways using RESRAD default values:

- Soil ingestion
- Inhalation of resuspended soil, and
- Direct exposure to external radiation.

Doses to a resident living on a uniform layer of the mound material after 30 years of institutional control ends were calculated for the following pathways using RESRAD default values:

- Drinking water
- Food ingestion (home-grown vegetables)
- Soil ingestion
- Inhalation of resuspended soil, and
- Direct exposure to external radiation.

3.3 Summary of Receptor Exposures

The results of the RESRAD runs described in Section 3.3 are summarized in Table 3-2. The residual soil concentrations for the guardsman scenario yield a calculated dose of 25 mrem/y. The soil concentrations at for the residential scenarios will decay to concentrations that yield a calculated dose of 25 mrem/y after the site is used by the National Guard for 30 years.

Table 3-2 Allowable Concentrations in Current Soil For Current and Far-Future Land Use

Guardsman Scenario		Resident Adult Scenario		Resident Child Scenario	
Co-60	Cs-137	Co-60	Cs-137	Co-60	Cs-137
100	478	154	26	123	21

[a] If a resident adult moves onto the site in 30 years, the Co-60 concentration listed here will have decayed to 3 pCi/g, and the Cs-137 concentration will have decayed to 13 pCi/g.

[b] If a resident child moves onto the site in 30 years, the Co-60 concentration listed here will have decayed to 2 pCi/g, and the Cs-137 concentration will have decayed to 11 pCi/g.

3.3.1 Guardsman

Exposures to the hypothetical guardsman evaluated in this study would be dominated by direct gamma radiation emitted directly by the soil. The soil concentrations are based on occupation of the Pelham Mound by a trainee for 144 hours per year. This exposure time is considered excessive, so the resulting derived guidelines calculated for this receptor are judged to be very conservative.

3.3.2 Resident Adult with Garden

Exposures to a hypothetical adult with a garden evaluated in this study would be dominated by direct gamma radiation emitted directly by the soil (over 99% for Co-60 and almost 90% of the Cs-137) . About 10% of the dose from Cs-137 is associated with consumption of food from a garden.

3.3.3 Resident Child with Garden

Exposures to a hypothetical child with a garden evaluated in this study are very similar to those of the adult discussed earlier. They would be dominated by direct gamma radiation emitted directly by the soil (over 99% for Co-60 and almost 90% of the Cs-137) . About 10% of the dose from Cs-137 would be attributable to consumption of food from a garden. The dose based

4.0 Derived Cleanup Guidelines

4.1 Role of Dose Based Criteria

Potential radiation exposures from the Pelham Mound and surrounding areas must be limited to safe levels before the NRC license can be terminated. The NRC has determined that a dose limit of 25 mrem/y is health protective at NRC licensed sites (10CFR20). The Derived Cleanup Guidelines (DCGLs) developed in this document are judged to be meet this requirement under the planned and far future land use proposed for the site.

4.2 Dose Based Cleanup Guidelines

The dose based cleanup level for a nuclide is the minimum soil concentration calculated for the three receptors (Table 3-2). This assures that final cleanup goals for individual radionuclides are health protective for all the receptors evaluated. The individual dose based Derived Cleanup Guidelines (DCGLs) are 100 pCi/g for Co-60 and 21 pCi/g Cs-137.

4.3 Influence of Multiple Contaminants on Cleanup Guidelines

A multi pathway analysis was use to develop individual dose based DCGL's of 100 pCi/g Co-60 and 21 pCi/g Cs-137. Because Co-60 and Cs-137 are both present at the site, it is necessary to assure that their combined activities do not result in exposures that exceed 25 mrem/y. A simple way of achieving this is to set a combined cleanup standard to be equal to the smaller of the two cleanup criteria in soil. This approach protects human health and the environment at the site and provides one clear, reproducible soil cleanup objective for the proposed remedial activities.

The smaller of the two dose-based cleanup guidelines calculated in this report is the 21 pCi/g limit for Cs-137. This approach would yield a combined cleanup criteria of 21 pCi/g for soil containing both radionuclides.

4.4 Proposed Derived Cleanup Guidelines

The approach used in this report sets 21 pCi/g as the cleanup concentration for site soils containing a mixture of Cs-137 and C-60 at the site. The final set of DCGLs for this site are presented in Table 4-1. The limits for individual nuclides will be applied if it can be demonstrated that only one of these radionuclides is present in the soil. If the presence of both is suspected, the value of 21 pCi/g will be compared to the sum of their activities.

Table 4-1 Final DCGL's for Individual and Mixed Radionuclides at the Pelham Range Burial Mound.

Radionuclide	Soil Limit
Co-60	100 pCi/g
Cs-137	21 pCi/g
Co-60 + Cs-137	21 pCi/g

5.0 References

ANL, 1993 "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0., September 1993." ANL/EAD/LD-2. USDOE, Environmental Assessment Division, Argonne National Laboratory.

ANL, 1998 RESRAD for Windows, 5.82. Environmental Assessment Division, Argonne National Laboratory.

USACE, 1998 "Final Environmental Impact Statement, Disposal and Reuse of Fort McClellan, Alabama, August 1998." US Army Corps of Engineers, Mobile District.

USCHPPM, 1996 "Industrial Radiation Study No 27-MH-0987-R2-97. Pelham Range Burial Mound, Fort McClellan, Alabama. 29 August – 15 September 1995 and 14-28 January 1996. US Army Center for Health Promotion and Preventive Medicine.

USEPA, 1997 "Exposure Factors Handbook, Volumes 1, 2, and 3" August 1997, EPA/600/P-95/002Fa, b, & c. Us Environmental Protection Agency.

Appendix A RESRAD Output

Appendix A RESRAD Output

A.1 Results of RESRAD Calculations for Guardsman Scenario A-1

A.1.1 Co-60: Guardsman Summary Output File A-1

A.1.2 Cs-137: Guardsman Summary Output File A-19

A.2 Results of RESRAD Calculations for Resident Adult Scenario A-37

A.2.1 Co-60: Resident Adult Summary Output File A-37

A.2.2 Cs-137: Resident Adult Summary Output File A-55

A.3 Results of RESRAD Calculations for Resident Child Scenario A-73

A.3.1 Co-60: Resident Child Summary Output File A-73

A.3.2 Cs-137: Resident Child Summary Output File A-91

A.1 Results of RESRAD Calculations for Guardsman Scenario

A.1.1 Co-60: Guardsman Summary Output File

RESRAD, Version 5.82 T½ Limit = 0.5 year 12/15/98 09:15 Page 1
Summary : Co 60, guardsman, 10000m2 File: C060G10K.RAD

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

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-60	2.190E-04	2.190E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Co-60	1.000E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	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
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	not used	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	9.072E+01	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.000E+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	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.640E-02	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)
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)	not used	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	6.000E-01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	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	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Co-60	1.000E+02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.500E+01	2.192E+01	1.684E+01	6.701E+00	4.813E-01	3.458E-02	4.782E-05	1.750E-16	0.000E+00
M(t):	1.000E+00	8.766E-01	6.737E-01	2.680E-01	1.925E-02	1.383E-03	1.913E-06	7.000E-18	0.000E+00

Maximum TDOSE(t): 2.500E+01 mrem/yr at t = 0.000E+00 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 = 0.000E+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.
Co-60	2.500E+01	1.0000	5.516E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.647E-05	0.0000
Total	2.500E+01	1.0000	5.516E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.647E-05	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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.500E+01	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	2.500E+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 = 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.
Co-60	2.192E+01	1.0000	4.836E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.320E-05	0.0000
Total	2.192E+01	1.0000	4.836E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.320E-05	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.192E+01	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	2.192E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: C060G10K.RAD

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-	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.
Co-60	1.684E+01	1.0000	3.716E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.783E-05	0.0000
Total	1.684E+01	1.0000	3.716E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.783E-05	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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.684E+01	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	1.684E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: C060G10K.RAD

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.
Co-60	6.701E+00	1.0000	1.478E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.094E-06	0.0000
Total	6.701E+00	1.0000	1.478E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.094E-06	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.701E+00	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	6.701E+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 = 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.
Co-60	4.813E-01	1.0000	1.062E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.096E-07	0.0000
Total	4.813E-01	1.0000	1.062E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.096E-07	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.813E-01	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	4.813E-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 = 5.000E+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.
Co-60	3.458E-02	1.0000	7.630E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.661E-08	0.0000
Total	3.458E-02	1.0000	7.630E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.661E-08	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 = 5.000E+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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.458E-02	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	3.458E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: CO60G10K.RAD

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.
Co-60	4.782E-05	1.0000	1.055E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.063E-11	0.0000
Total	4.782E-05	1.0000	1.055E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.063E-11	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.
Co-60	0.000E+00	0.0000	0.000E+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-05	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	4.782E-05	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co 60, guardsman, 10000m2 File: CO60G10K.RAD

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.
Co-60	1.750E-16	1.0000	3.861E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.853E-22	0.0000
Total	1.750E-16	1.0000	3.861E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.853E-22	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.750E-16	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	1.750E-16	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	2.500E-01	2.192E-01	1.684E-01	6.701E-02	4.813E-03	3.458E-04	4.782E-07	1.750E-18	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.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	1.000E+02	1.141E+02	1.484E+02	3.731E+02	5.194E+03	7.230E+04	5.227E+07	*1.131E+15	*1.131E+15

*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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	1.000E+02	0.000E+00	2.500E-01	1.000E+02	2.500E-01	1.000E+02

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	2.500E+01	2.192E+01	1.684E+01	6.701E+00	4.813E-01	3.458E-02	4.782E-05	1.750E-16	0.000E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.000E+02	8.766E+01	6.737E+01	2.680E+01	1.925E+00	1.383E-01	1.913E-04	7.000E-16	0.000E+00

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

A.1.2 Cs-137: Guardsman Summary Output File

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Time = 1.000E+00 9
Time = 3.000E+00 10
Time = 1.000E+01 11
Time = 3.000E+01 12
Time = 5.000E+01 13
Time = 1.000E+02 14
Time = 3.000E+02 15
Time = 1.000E+03 16
Dose/Source Ratios Summed Over All Pathways 17
Single Radionuclide Soil Guidelines 17
Dose Per Nuclide Summed Over All Pathways 18
Soil Concentration Per Nuclide 18

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	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Cs-137	4.775E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	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
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	not used	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	9.072E+01	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.000E+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	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.640E-02	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)
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)	not used	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	6.000E-01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	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	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Cs-137	4.775E+02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.500E+01	2.442E+01	2.331E+01	1.981E+01	1.244E+01	7.808E+00	2.439E+00	2.322E-02	1.955E-09
M(t):	9.999E-01	9.769E-01	9.325E-01	7.923E-01	4.975E-01	3.123E-01	9.756E-02	9.289E-04	7.821E-11

Maximum TDOSE(t): 2.500E+01 mrem/yr at t = 0.000E+00 years

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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-	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.
Cs-137	2.500E+01	1.0000	3.837E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.350E-04	0.0000
Total	2.500E+01	1.0000	3.837E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.350E-04	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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.500E+01	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	2.500E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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.
Cs-137	2.442E+01	1.0000	3.749E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.295E-04	0.0000
Total	2.442E+01	1.0000	3.749E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.295E-04	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.442E+01	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	2.442E+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+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.
Cs-137	2.331E+01	1.0000	3.578E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.191E-04	0.0000
Total	2.331E+01	1.0000	3.578E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.191E-04	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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.331E+01	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	2.331E+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 = 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.
Cs-137	1.981E+01	1.0000	3.040E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.862E-04	0.0000
Total	1.981E+01	1.0000	3.040E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.862E-04	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.981E+01	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	1.981E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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.
Cs-137	1.244E+01	1.0000	1.909E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.169E-04	0.0000
Total	1.244E+01	1.0000	1.909E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.169E-04	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.244E+01	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	1.244E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	7.808E+00	1.0000	1.199E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.339E-05	0.0000
Total	7.808E+00	1.0000	1.199E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.339E-05	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 = 5.000E+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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.808E+00	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	7.808E+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 = 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.
Cs-137	2.439E+00	1.0000	3.744E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.293E-05	0.0000
Total	2.439E+00	1.0000	3.744E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.293E-05	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.439E+00	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	2.439E+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 = 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.
Cs-137	2.322E-02	1.0000	3.565E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.183E-07	0.0000
Total	2.322E-02	1.0000	3.565E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.183E-07	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.322E-02	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	2.322E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, guardsman, 10000m2 File: C137G10K.RAD

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.
Cs-137	1.955E-09	1.0000	3.001E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.838E-14	0.0000
Total	1.955E-09	1.0000	3.001E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.838E-14	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.955E-09	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	1.955E-09	1.0000

*Sum of all water independent and dependent pathways.

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	5.235E-02	5.114E-02	4.882E-02	4.148E-02	2.604E-02	1.635E-02	5.108E-03	4.863E-05	4.094E-12

*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.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	4.776E+02	4.888E+02	5.121E+02	6.027E+02	9.600E+02	1.529E+03	4.895E+03	5.141E+05	6.106E+12

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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	4.775E+02	0.000E+00	5.235E-02	4.776E+02	5.235E-02	4.776E+02

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.500E+01	2.442E+01	2.331E+01	1.981E+01	1.244E+01	7.808E+00	2.439E+00	2.322E-02	1.955E-09

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	4.775E+02	4.666E+02	4.453E+02	3.784E+02	2.376E+02	1.492E+02	4.660E+01	4.436E-01	3.735E-08

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

A.2 Results of RESRAD Calculations for Resident Adult Scenario

A.2.1 Co-60: Resident Adult Summary Output File

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RESRAD, Version 5.82     T½ Limit = 0.5 year        12/14/98  17:38    Page   1
Summary : Co60, resident adult, 10000m2                     File: CO60R10K.RAD
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Dose Conversion Factor (and Related) Parameter Summary
File: DCSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-60	2.190E-04	2.190E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICKD
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Co-60	1.542E+02	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	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 Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	4.057E+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
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	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.000E-02	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)
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)	1.936E+02	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	0.000E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	1.750E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	8.400E+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	not used	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	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	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)	not used	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)	not used	8.000E-02	---	TE(3)
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	not used	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	not used	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	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Co-60	1.542E+02
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.298E+03	1.138E+03	8.746E+02	3.480E+02	2.500E+01	1.796E+00	2.483E-03	9.088E-15	0.000E+00
M(t):	5.193E+01	4.552E+01	3.498E+01	1.392E+01	9.998E-01	7.182E-02	9.934E-05	3.635E-16	0.000E+00

Maximum TDOSE(t): 1.298E+03 mrem/yr at t = 0.000E+00 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 = 0.000E+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.
Co-60	1.266E+03	0.9752	7.935E-04	0.0000	0.000E+00	0.0000	3.212E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	5.336E-02	0.0000
Total	1.266E+03	0.9752	7.935E-04	0.0000	0.000E+00	0.0000	3.212E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	5.336E-02	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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.298E+03	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	1.298E+03	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.
Co-60	1.110E+03	0.9752	6.956E-04	0.0000	0.000E+00	0.0000	2.816E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	4.678E-02	0.0000
Total	1.110E+03	0.9752	6.956E-04	0.0000	0.000E+00	0.0000	2.816E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	4.678E-02	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.138E+03	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	1.138E+03	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

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-	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.
Co-60	8.529E+02	0.9752	5.345E-04	0.0000	0.000E+00	0.0000	2.164E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	3.595E-02	0.0000
Total	8.529E+02	0.9752	5.345E-04	0.0000	0.000E+00	0.0000	2.164E+01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	3.595E-02	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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.746E+02	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	8.746E+02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

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.
Co-60	3.393E+02	0.9752	2.127E-04	0.0000	0.000E+00	0.0000	8.609E+00	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.430E-02	0.0000
Total	3.393E+02	0.9752	2.127E-04	0.0000	0.000E+00	0.0000	8.609E+00	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.430E-02	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.480E+02	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	3.480E+02	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.
Co-60	2.438E+01	0.9752	1.528E-05	0.0000	0.000E+00	0.0000	6.184E-01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.027E-03	0.0000
Total	2.438E+01	0.9752	1.528E-05	0.0000	0.000E+00	0.0000	6.184E-01	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.027E-03	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.500E+01	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	2.500E+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 = 5.000E+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.
Co-60	1.751E+00	0.9752	1.097E-06	0.0000	0.000E+00	0.0000	4.443E-02	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	7.381E-05	0.0000
Total	1.751E+00	0.9752	1.097E-06	0.0000	0.000E+00	0.0000	4.443E-02	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	7.381E-05	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 = 5.000E+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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.796E+00	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	1.796E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: CO60R10K.RAD

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.
Co-60	2.422E-03	0.9752	1.518E-09	0.0000	0.000E+00	0.0000	6.144E-05	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.021E-07	0.0000
Total	2.422E-03	0.9752	1.518E-09	0.0000	0.000E+00	0.0000	6.144E-05	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	1.021E-07	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.
Co-60	0.000E+00	0.0000	0.000E+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-03	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	2.483E-03	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident adult, 10000m2 File: C060R10K.RAD

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.
Co-60	8.863E-15	0.9752	5.554E-21	0.0000	0.000E+00	0.0000	2.248E-16	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	3.736E-19	0.0000
Total	8.863E-15	0.9752	5.554E-21	0.0000	0.000E+00	0.0000	2.248E-16	0.0247	0.000E+00	0.0000	0.000E+00	0.0000	3.736E-19	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.088E-15	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	9.088E-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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	8.418E+00	7.379E+00	5.671E+00	2.256E+00	1.621E-01	1.164E-02	1.610E-05	5.892E-17	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.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	2.970E+00	3.388E+00	4.409E+00	1.108E+01	1.543E+02	2.147E+03	1.553E+06	*1.131E+15	*1.131E+15

*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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	1.542E+02	0.000E+00	8.418E+00	2.970E+00	8.418E+00	2.970E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.298E+03	1.138E+03	8.746E+02	3.480E+02	2.500E+01	1.796E+00	2.483E-03	9.088E-15	0.000E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.542E+02	1.352E+02	1.039E+02	4.134E+01	2.969E+00	2.133E-01	2.950E-04	1.080E-15	0.000E+00

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

A.2.2 Cs-137: Resident Adult Summary Output File

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Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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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	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Cs-137	2.627E+01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	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 Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	4.057E+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
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	6.550E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.000E-02	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)
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)	1.936E+02	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	0.000E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	1.750E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	8.400E+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	not used	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	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	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)	not used	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)	not used	8.000E-02	---	TE(3)
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	not used	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	not used	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	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Cs-137	2.627E+01
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	5.025E+01	4.910E+01	4.687E+01	3.982E+01	2.500E+01	1.570E+01	4.903E+00	4.668E-02	3.931E-09
M(t):	2.010E+00	1.964E+00	1.875E+00	1.593E+00	1.000E+00	6.279E-01	1.961E-01	1.867E-03	1.572E-10

Maximum TDOSE(t): 5.025E+01 mrem/yr at t = 0.000E+00 years

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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-	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.
Cs-137	4.515E+01	0.8985	1.969E-05	0.0000	0.000E+00	0.0000	5.085E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.689E-02	0.0003
Total	4.515E+01	0.8985	1.969E-05	0.0000	0.000E+00	0.0000	5.085E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.689E-02	0.0003

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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.025E+01	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	5.025E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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.
Cs-137	4.411E+01	0.8985	1.923E-05	0.0000	0.000E+00	0.0000	4.968E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.651E-02	0.0003
Total	4.411E+01	0.8985	1.923E-05	0.0000	0.000E+00	0.0000	4.968E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.651E-02	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.910E+01	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	4.910E+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+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.
Cs-137	4.211E+01	0.8985	1.836E-05	0.0000	0.000E+00	0.0000	4.742E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.576E-02	0.0003
Total	4.211E+01	0.8985	1.836E-05	0.0000	0.000E+00	0.0000	4.742E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.576E-02	0.0003

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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.687E+01	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	4.687E+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 = 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.
Cs-137	3.578E+01	0.8985	1.560E-05	0.0000	0.000E+00	0.0000	4.029E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.339E-02	0.0003
Total	3.578E+01	0.8985	1.560E-05	0.0000	0.000E+00	0.0000	4.029E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.339E-02	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.982E+01	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	3.982E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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.
Cs-137	2.246E+01	0.8985	9.794E-06	0.0000	0.000E+00	0.0000	2.530E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	8.405E-03	0.0003
Total	2.246E+01	0.8985	9.794E-06	0.0000	0.000E+00	0.0000	2.530E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	8.405E-03	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.500E+01	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	2.500E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	1.410E+01	0.8985	6.149E-06	0.0000	0.000E+00	0.0000	1.588E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	5.277E-03	0.0003
Total	1.410E+01	0.8985	6.149E-06	0.0000	0.000E+00	0.0000	1.588E+00	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	5.277E-03	0.0003

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.570E+01	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	1.570E+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 = 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.
Cs-137	4.406E+00	0.8985	1.921E-06	0.0000	0.000E+00	0.0000	4.961E-01	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.648E-03	0.0003
Total	4.406E+00	0.8985	1.921E-06	0.0000	0.000E+00	0.0000	4.961E-01	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.648E-03	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.903E+00	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	4.903E+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 = 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.
Cs-137	4.194E-02	0.8985	1.829E-08	0.0000	0.000E+00	0.0000	4.723E-03	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.569E-05	0.0003
Total	4.194E-02	0.8985	1.829E-08	0.0000	0.000E+00	0.0000	4.723E-03	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.569E-05	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.668E-02	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	4.668E-02	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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.
Cs-137	3.532E-09	0.8985	1.540E-15	0.0000	0.000E+00	0.0000	3.977E-10	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.321E-12	0.0003
Total	3.532E-09	0.8985	1.540E-15	0.0000	0.000E+00	0.0000	3.977E-10	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	1.321E-12	0.0003

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.931E-09	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	3.931E-09	1.0000

*Sum of all water independent and dependent pathways.

Summary : Cs137, resident, 10000m2 File: C137R10K.RAD

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.913E+00	1.869E+00	1.784E+00	1.516E+00	9.517E-01	5.976E-01	1.867E-01	1.777E-03	1.496E-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 <= 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	1.307E+01	1.338E+01	1.401E+01	1.649E+01	2.627E+01	4.184E+01	1.339E+02	1.407E+04	1.671E+11

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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	2.627E+01	0.000E+00	1.913E+00	1.307E+01	1.913E+00	1.307E+01

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	5.025E+01	4.910E+01	4.687E+01	3.982E+01	2.500E+01	1.570E+01	4.903E+00	4.668E-02	3.931E-09

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.627E+01	2.567E+01	2.450E+01	2.082E+01	1.307E+01	8.206E+00	2.563E+00	2.440E-02	2.055E-09

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

A.3 Results of RESRAD Calculations for Resident Child Scenario

A.3.1 Co-60: Resident Child Summary Output File

```
RESRAD, Version 5.82     T½ Limit = 0.5 year        01/13/99  12:41    Page   1
Summary : Co60, resident child, 10000m2                        File: CO60C10K.RAD
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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	Co-60	2.190E-04	2.190E-04	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICKD
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Co-60	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	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 Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	2.720E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	6.000E+00	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	8.390E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.990E-02	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)
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)	1.930E+02	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	0.000E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	7.300E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	4.745E+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	not used	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	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	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)	not used	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)	not used	8.000E-02	---	TE(3)
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	not used	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	not used	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	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Co-60	1.000E+00
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.053E+01	9.233E+00	7.096E+00	2.823E+00	2.028E-01	1.457E-02	2.015E-05	7.373E-17	0.000E+00
M(t):	4.213E-01	3.693E-01	2.838E-01	1.129E-01	8.112E-03	5.827E-04	8.060E-07	2.949E-18	0.000E+00

Maximum TDOSE(t): 1.053E+01 mrem/yr at t = 0.000E+00 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 = 0.000E+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.
Co-60	1.032E+01	0.9801	4.291E-06	0.0000	0.000E+00	0.0000	2.077E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.824E-03	0.0002
Total	1.032E+01	0.9801	4.291E-06	0.0000	0.000E+00	0.0000	2.077E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.824E-03	0.0002

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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.053E+01	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	1.053E+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 = 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.
Co-60	9.050E+00	0.9801	3.762E-06	0.0000	0.000E+00	0.0000	1.821E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.599E-03	0.0002
Total	9.050E+00	0.9801	3.762E-06	0.0000	0.000E+00	0.0000	1.821E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.599E-03	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.233E+00	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	9.233E+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 = 3.000E+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.
Co-60	6.955E+00	0.9801	2.891E-06	0.0000	0.000E+00	0.0000	1.399E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.229E-03	0.0002
Total	6.955E+00	0.9801	2.891E-06	0.0000	0.000E+00	0.0000	1.399E-01	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.229E-03	0.0002

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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.096E+00	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	7.096E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident child, 10000m2 File: CO60C10K.RAD

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.
Co-60	2.767E+00	0.9801	1.150E-06	0.0000	0.000E+00	0.0000	5.566E-02	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	4.889E-04	0.0002
Total	2.767E+00	0.9801	1.150E-06	0.0000	0.000E+00	0.0000	5.566E-02	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	4.889E-04	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.823E+00	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	2.823E+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 = 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.
Co-60	1.988E-01	0.9801	8.262E-08	0.0000	0.000E+00	0.0000	3.998E-03	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	3.512E-05	0.0002
Total	1.988E-01	0.9801	8.262E-08	0.0000	0.000E+00	0.0000	3.998E-03	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	3.512E-05	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.028E-01	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	2.028E-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 = 5.000E+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.
Co-60	1.428E-02	0.9801	5.935E-09	0.0000	0.000E+00	0.0000	2.872E-04	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	2.523E-06	0.0002
Total	1.428E-02	0.9801	5.935E-09	0.0000	0.000E+00	0.0000	2.872E-04	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	2.523E-06	0.0002

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Co-60	0.000E+00	0.0000	0.000E+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-02	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	1.457E-02	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.
Co-60	1.975E-05	0.9801	8.209E-12	0.0000	0.000E+00	0.0000	3.973E-07	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	3.489E-09	0.0002
Total	1.975E-05	0.9801	8.209E-12	0.0000	0.000E+00	0.0000	3.973E-07	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	3.489E-09	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.015E-05	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	2.015E-05	1.0000

*Sum of all water independent and dependent pathways.

Summary : Co60, resident child, 10000m2 File: CO60C10K.RAD

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.
Co-60	7.227E-17	0.9801	3.004E-23	0.0000	0.000E+00	0.0000	1.454E-18	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.277E-20	0.0002
Total	7.227E-17	0.9801	3.004E-23	0.0000	0.000E+00	0.0000	1.454E-18	0.0197	0.000E+00	0.0000	0.000E+00	0.0000	1.277E-20	0.0002

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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.373E-17	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	7.373E-17	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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-	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.
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.053E+01	9.233E+00	7.096E+00	2.823E+00	2.028E-01	1.457E-02	2.015E-05	7.373E-17	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.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	2.374E+00	2.708E+00	3.523E+00	8.856E+00	1.233E+02	1.716E+03	1.241E+06	*1.131E+15	*1.131E+15

*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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-60	1.000E+00	0.000E+00	1.053E+01	2.374E+00	1.053E+01	2.374E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.053E+01	9.233E+00	7.096E+00	2.823E+00	2.028E-01	1.457E-02	2.015E-05	7.373E-17	0.000E+00

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.000E+00	8.766E-01	6.737E-01	2.680E-01	1.925E-02	1.383E-03	1.913E-06	7.000E-18	0.000E+00

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

A.3.2 Cs-137: Resident Child Summary Output File

RESRAD, Version 5.82 T½ Limit = 0.5 year 01/13/99 12:52 Page 1
Summary : CS137, resident child, 10000m2 File: C137C10K.RAD

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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	Cs-137+D	3.190E-05	3.190E-05	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(1)
D-34	Food transfer factors:			
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(1,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(1,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(1,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

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)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICKD
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+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)	5.000E+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): Cs-137	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	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)	0.000E+00	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
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	4.000E+00	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 Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.666E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	2.720E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	6.000E+00	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	8.390E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.990E-02	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)
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)	1.930E+02	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	0.000E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	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)	7.300E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	4.745E+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	not used	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	0.500E+00	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	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	not used	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)	not used	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)	not used	8.000E-02	---	TE(3)
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	not used	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	not used	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	not used	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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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/cm**3)	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	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Cs-137	1.000E+00
Thickness:	2.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 25 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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.358E+00	2.304E+00	2.199E+00	1.868E+00	1.173E+00	7.365E-01	2.301E-01	2.190E-03	1.844E-10
M(t):	9.431E-02	9.215E-02	8.796E-02	7.473E-02	4.692E-02	2.946E-02	9.203E-03	8.761E-05	7.377E-12

Maximum TDOSE(t): 2.358E+00 mrem/yr at t = 0.000E+00 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 = 0.000E+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.
Cs-137	2.161E+00	0.9167	6.250E-07	0.0000	0.000E+00	0.0000	1.930E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.390E-03	0.0014
Total	2.161E+00	0.9167	6.250E-07	0.0000	0.000E+00	0.0000	1.930E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.390E-03	0.0014

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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.358E+00	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	2.358E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2 File: C137C10K.RAD

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.
Cs-137	2.112E+00	0.9167	6.107E-07	0.0000	0.000E+00	0.0000	1.886E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.312E-03	0.0014
Total	2.112E+00	0.9167	6.107E-07	0.0000	0.000E+00	0.0000	1.886E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.312E-03	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.304E+00	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	2.304E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2 File: C137C10K.RAD

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-	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.
Cs-137	2.016E+00	0.9167	5.829E-07	0.0000	0.000E+00	0.0000	1.800E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.162E-03	0.0014
Total	2.016E+00	0.9167	5.829E-07	0.0000	0.000E+00	0.0000	1.800E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.162E-03	0.0014

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-	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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.199E+00	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	2.199E+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 = 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.
Cs-137	1.713E+00	0.9167	4.953E-07	0.0000	0.000E+00	0.0000	1.529E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	2.687E-03	0.0014
Total	1.713E+00	0.9167	4.953E-07	0.0000	0.000E+00	0.0000	1.529E-01	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	2.687E-03	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.868E+00	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	1.868E+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 = 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.
Cs-137	1.075E+00	0.9167	3.110E-07	0.0000	0.000E+00	0.0000	9.602E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	1.687E-03	0.0014
Total	1.075E+00	0.9167	3.110E-07	0.0000	0.000E+00	0.0000	9.602E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	1.687E-03	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.173E+00	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	1.173E+00	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2 File: C137C10K.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	6.752E-01	0.9167	1.952E-07	0.0000	0.000E+00	0.0000	6.029E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-03	0.0014
Total	6.752E-01	0.9167	1.952E-07	0.0000	0.000E+00	0.0000	6.029E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-03	0.0014

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.365E-01	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	7.365E-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 = 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.
Cs-137	2.109E-01	0.9167	6.099E-08	0.0000	0.000E+00	0.0000	1.883E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.308E-04	0.0014
Total	2.109E-01	0.9167	6.099E-08	0.0000	0.000E+00	0.0000	1.883E-02	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.308E-04	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.301E-01	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	2.301E-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+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.
Cs-137	2.008E-03	0.9167	5.806E-10	0.0000	0.000E+00	0.0000	1.793E-04	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.150E-06	0.0014
Total	2.008E-03	0.9167	5.806E-10	0.0000	0.000E+00	0.0000	1.793E-04	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	3.150E-06	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.190E-03	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	2.190E-03	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2 File: C137C10K.RAD

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.
Cs-137	1.691E-10	0.9167	4.889E-17	0.0000	0.000E+00	0.0000	1.510E-11	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	2.652E-13	0.0014
Total	1.691E-10	0.9167	4.889E-17	0.0000	0.000E+00	0.0000	1.510E-11	0.0819	0.000E+00	0.0000	0.000E+00	0.0000	2.652E-13	0.0014

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.
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.844E-10	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	1.844E-10	1.0000

*Sum of all water independent and dependent pathways.

Summary : CS137, resident child, 10000m2 File: C137C10K.RAD

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.358E+00	2.304E+00	2.199E+00	1.868E+00	1.173E+00	7.365E-01	2.301E-01	2.190E-03	1.844E-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 <= 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 25 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	1.060E+01	1.085E+01	1.137E+01	1.338E+01	2.131E+01	3.394E+01	1.087E+02	1.141E+04	1.356E+11

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 = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.000E+00	0.000E+00	2.358E+00	1.060E+01	2.358E+00	1.060E+01

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	2.358E+00	2.304E+00	2.199E+00	1.868E+00	1.173E+00	7.365E-01	2.301E-01	2.190E-03	1.844E-10

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	5.000E+01	1.000E+02	3.000E+02	1.000E+03
Cs-137	Cs-137	1.000E+00	1.000E+00	9.770E-01	9.326E-01	7.924E-01	4.975E-01	3.124E-01	9.757E-02	9.289E-04	7.822E-11

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