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TECHNICAL BASIS DOCUMENT

FSV-FRS-TBD-209
REVISION 0

TITLE

FORT ST. VRAIN DECOMMISSIONING PROJECT

FINAL SURVEY REQUIREMENTS FOR THE LIQUID EFFLUENT PATHWAY

REVIEWED BY:	Gerald J Rood	9/11/96 DATE
APPROVED BY:	RESPONSIBLE SUPERVISOR	9/11/96 DATE
APPROVED BY:	PROJECT RADIATION PROTECTION MANAGER	9/11/96 DATE
	9/11/96 EFFECTIVE DATE	

1.0 INTRODUCTION

1.1 Scope

This document describes the scope and the methods to be used by the Public Service Company of Colorado (PSCo) to demonstrate that the Fort St. Vrain (FSV) liquid effluent pathway and the surrounding open-land areas are suitable for release for unrestricted use. This document has been used as the basis for survey design and development of final survey packages related to the liquid effluent pathway and the surrounding open-land areas.

1.2 Discussion

Final survey packages are being prepared and implemented; and it is expected that survey packages will be reviewed and accepted for closure in accordance with this proposed revision.

This guidance will be used by final survey engineers as the guidance for the survey design during preparation of these survey packages, and serves as the basis for the selection of sampling and measurement locations. The specific instructions for collection of samples and exposure rate measurements are formally conveyed to the survey technician in accordance with the protocols and documentation contained in FSV-SC-FRS-I-102, "Survey Design and Package Preparation, Control, Implementation and Closure."

The final survey plan and procedures will be revised upon NRC approval of the methods to be used by PSCo for survey of the FSV liquid effluent pathway and the surrounding open-land areas.

In the event that approval is obtained prior to submittal of these final survey measurements, correspondence will accompany the submittal indicating that the measurements have been collected in accordance with the approved revision, and that the final survey plan and procedures are undergoing revision to comply with the proposed revision.

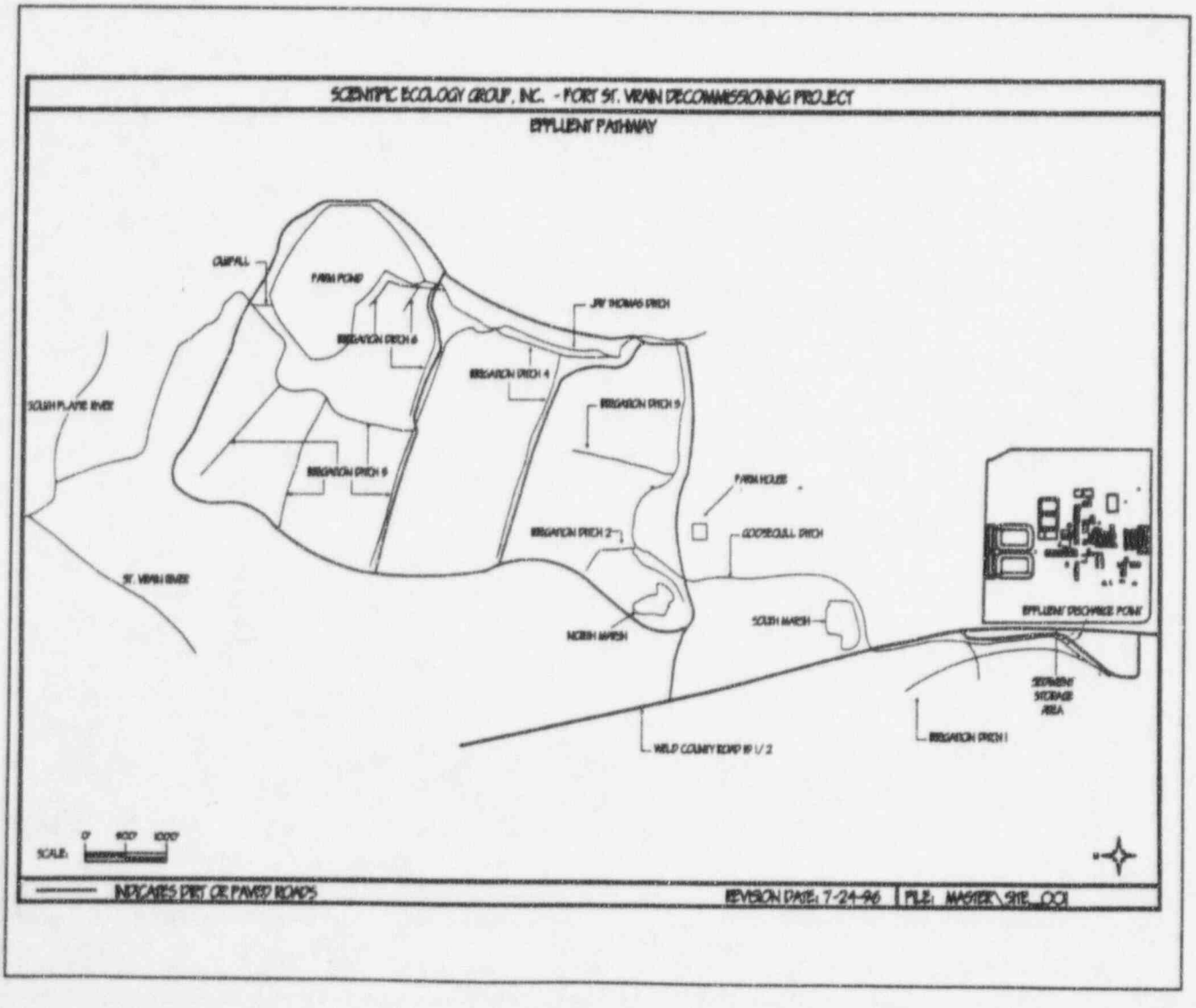
In the event that approval is not obtained prior to submittal of these survey measurements, correspondence will accompany the submittal indicating that the measurements have been collected in accordance with the proposed revision.

In the event that the proposed revision is modified during the approval process such that additional measurements are required, these survey packages will be re-opened and the balance of the data will be collected and included in the survey packages. If additional measurements are required, the Release Records will be similarly modified and re-submitted to the NRC.

2.0 HISTORY AND DESCRIPTION OF THE EFFLUENT PATHWAY

The Liquid Effluent Pathway (LEP) from the discharge point, is composed of the Goosequill Ditch, the Jay Thomas Ditch, the Farm Pond and the South Platte River. The Goosequill Ditch is a concrete-lined culvert (ditch) approximately 7000 feet in length, which begins at the effluent discharge point west of County Road 19½, and terminates at the Jay Thomas Ditch. The Goosequill Ditch is approximately 5 feet wide at the top and one foot wide at the bottom, with sloping sides of approximately 40 inches each. The Jay Thomas Ditch is a stream bed beginning upstream of the intersection with the Goosequill Ditch and terminating at the Farm Pond. The Jay Thomas Ditch is unlined and is 3-6 feet wide, 2-3 feet deep and approximately 2300 feet long. The Farm Pond covers approximately 25 acres and is 2-4 feet deep. The outfall of the pond is a stream bed that eventually terminates at the South Platte River. The LEP is illustrated in Figure 2.1.

Figure 2.1
FSV Liquid Effluent Pathway



Water from the Goosequill Ditch and the Jay Thomas Ditch was routinely diverted for agricultural irrigation of the surrounding fields and pastures. Prior to 1994 the Goosequill Ditch was known to leak water into various adjacent soil areas which provided means for transport of radioactive materials to the surrounding soil. In addition, the ditches were periodically cleaned of vegetation and sediment in order to maintain required flow rates and avoid overflow. The removed material was routinely deposited on the banks immediately adjacent to the ditches.

A review of analysis results for liquid wastes released from FSV indicates that these releases have been well within the requirements of Public Service of Colorado's Offsite Dose Calculation Manual (ODCM). Compliance with the ODCM, and the Radiological Environmental Monitoring Program (REMP) has demonstrated that the total dose from liquid effluents has been maintained at less than 3 mrem/year.

3.0 CONTROL AND MONITORING OF LIQUID EFFLUENTS

The PSCo Offsite Dose Calculation Manual (ODCM) requires that if calculated doses from liquid effluents exceed 3 mrem/yr to the total body or 10 mrem/yr to any organ, then ..."a special report should be submitted to the NRC stating the reason and corrective action to be taken." All liquid releases have been made in compliance with the ODCM and these limits have never been exceeded. The doses for 1994 and 1995 are shown in Table 3.1.

Table 3.1
ODCM Calculated Doses

Year	Whole Body	Maximum Exposed Organ
1994	5.13E-04 mrem	3.29E-03 mrem
1995	2.40E-03 mrem	7.07E-03 mrem

The PSCo ODCM also states:

6.14.3 A pre-operational environmental radiation surveillance program for the Fort St. Vrain Station environs has been conducted for Public Service Company of Colorado by Colorado State University. Continuous operation of this program since March, 1969, has provided baseline data which will be utilized as control values for statistical analysis of the results of the decommissioning radiological surveillance program.

6.14.6 The results of the radiological environmental monitoring are intended to supplement the results of the radiological effluent monitoring by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. Thus, the specified environmental monitoring program provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures to individuals resulting from station decommissioning.

The Radiological Environmental Monitoring Program Summary Report for 1995, prepared by Colorado State University for the Fort St. Vrain Nuclear Generating Station provides the following observations and conclusions:

1. As in every previous report, it was again apparent that for most sample types the variability observed around the mean values was great. This variability is partly due to counting statistics and methodological variation, but principally due to true environmental variation (often termed sampling error). It must be recognized and accounted for in analyses of any set of environmental data before meaningful conclusions can be drawn;

2. Tritium was detected in the effluent pathway periodically through 1995. The release of tritium was indeed much less than in operational years. Since the tritium is released as tritiated water, the dilution by the surrounding hydrosphere is great and consequently the mean values of downstream surface water were not statistically greater than upstream concentrations. No tritium was detected in ground water or any food samples;

3. The Chernobyl world-wide fallout has totally obscured what fission product debris has remained in the FSV environs from the October 1980 Chinese atmospheric nuclear weapon test. The biosphere will contain the Chernobyl fallout, particularly Cs-137, for an equally long period. Nuclear weapon test fallout has, since the inception of the project, been noted to be the predominant source term above natural background. The Chernobyl reactor fire debris was superimposed on the weapons test fallout from 1986 to present. It is the variation in fallout deposition, in addition to the variation in naturally occurring radionuclides, that mandates the large number of environmental samples to detect any possible radioactivity due to facility effluents. A simple comparison of pre-operational and operational values is of little value, for most sample types, because the fallout deposition was considerably greater during the pre-operational period due to world-wide fallout;

4. The prompt and sensitive detection of the Chinese weapon test fallout and the Chernobyl fallout in the past assures that the environmental monitoring program was of adequate scope and sensitivity to detect any accidental releases from the FSV decommissioning; and

5. Release of decommissioning radioactive waste was evident in the Goosequill sediment. Since this is primarily Cs-137 in sediment, its transfer to plant and animal food chains will be negligible.

It can be concluded from the data collected by the environmental monitoring program that the radiation dose commitments calculated for the closest human inhabitants or other parts of the nearby ecosystems due to current facility effluents are negligible. Natural background radiation and the dose commitment from atmospheric fallout are the only known significant sources of radiation dose to the residents of the area.

During the current decommissioning phase of the facility it is concluded that this Radiological Environmental Monitoring Program is more than adequate to detect and quantify any possible routine or accidental release of radioactivity.

4.0 CHARACTERIZATION OF THE LIQUID EFFLUENT PATHWAY

In late summer of 1993, ODCM calculations yielded slightly increased doses. This initial concern prompted the collection of a sediment sample from the inlet to the Farm Pond on 9/29/93. The analysis results of this sample indicated a concentration that was greater than those reported by both the Initial Radiological Site Characterization surveys performed during 1992, and by PSCo's environmental monitoring program. Although the result was below that which would impact the final survey, a potential increase in the radioactivity concentration was indicated.

Sediment and soil samples were periodically collected during 1993 and 1994 to check for buildup of radioactive materials. Between 9/29/93 and 8/25/94, 69 samples were collected from the effluent discharge path. Activities of cobalt-60 ranged from non-detectable to 0.6 pCi/g. The results of these samples were not considered to be abnormally high, although the results indicated that a surveillance should be continued. On 8/25/94, two marshy areas where the goosequill ditch was known to have overflowed were selected for a more detailed evaluation. Each area was gridded and a total of 30 unbiased soil samples were collected. Most of the samples exhibited low concentrations of detectable total activity with the maximum cobalt-60 result being 2.7 pCi/g.

On 11/16/94 two soil samples were collected from the effluent discharge path in an area where known leaks had occurred to evaluate the initial profile of the radionuclide mixture for final survey analysis. One of these sample results indicated a cobalt-60 concentration of 7.7 pCi/g, which was about 50% higher than any of the previous samples.

Between 11/26/94 and 1/20/95 sixty soil and sediment samples were collected and 60 exposure rate measurements (at 30 locations) were taken to better define the scope of the increased concentrations. The highest concentration (41 pCi/g of cobalt-60) was from sediment which had been dredged from the effluent ditch. During this same time frame, 213 in-situ gamma spectroscopy measurements were collected along the liquid effluent pathway, in agricultural dispersion areas, and in areas around and beyond the farm pond. Indications of cobalt-60 and europium radionuclides demonstrated that these radionuclides were present at some locations.

In January 1995 a formal characterization survey plan was developed for the areas surrounding the LEP, and approximately 750 environmental (sediment and soil) samples were collected between 2/95 and 4/95. The intent of the survey was to define the bounds of the areas of increased concentrations within the effluent pathway and surrounding areas. Samples were collected in accordance with approved operating procedures designed to meet final survey quality requirements. Final Survey Procedures were not used and statistical analyses were not performed on the resulting data because the samples would not represent the final condition of the pathway and this characterization survey was considered to be a part of the planning for the initial final survey.

The results from more than one thousand environmental samples collected over the past two years of the decommissioning as a part of the characterization and follow-up characterization surveys have shown that any increased concentrations of radioactive material are present in very localized areas, and are decreasing due to radioactive decay and the effects of weathering. The bounds of these areas are well-defined, and have been previously selected for biased sampling. The areas of increased concentration peaked at their highest concentration at the beginning of 1995, and have been identified by the characterization to be located where:

1. Dredged materials had been removed from the ditches and placed on the banks of the ditches;

2. The ditches have leaked or overflowed and drained into slough or field areas, or;

3. In the early days of the decommissioning project, irrigation may have occurred during discharges or dredging operations.

As a result of the controls described in Section 5.0 and implemented in late 1994 to reduce the quantities of radioactive materials released from FSV, the controls placed on irrigation during discharge, and the natural weathering process of radioactive materials in the environment, the residual concentrations in the effluent pathway are decreasing as indicated by the follow-up characterization survey performed in May and June of 1996.

The following is a chronological presentation of the sampling performed along the effluent discharge path and adjacent areas. For several of the initial samples, only the cobalt-60 results are discussed because this isotope is more restrictive than cesium-137, which was also identified in increased concentrations.

9/29/93 Initial sample collected at the inlet to the farm pond. The total activity result was 3.7 pCi/g (3.05 pCi/g of cesium-137, 0.38 pCi/g of cesium-134 and 0.31 pCi/g of cobalt 60).

12/21/93 Twenty-two samples were collected. These samples consisted of sediments removed from the Goosequill Ditch, soil from adjacent "overflow" areas, and at the inlet to the farm pond. Total activity for these samples ranged from non-detectable to 3.8 pCi/g.

5/10/94 Two samples were collected which yielded total activity results of 4.8 and 5 pCi/g.

7/11/94 A sediment sample was collected adjacent to the outlet of the farm pond. The total activity for this sample was < 1 pCi/g.

8/94

Thirteen samples were collected between 8/8/94 and 8/22/94. Ten of these samples were of silt and clay from the bottom of the farm pond. The remaining three samples were collected adjacent to irrigation ditches routinely used for agricultural purposes. The total activity results for these samples ranged from non-detectable to 1.6 pCi/g.

On 8/25/94, two marshy areas where the Goosequill Ditch was known to have overflowed or leaked were selected for a more detailed evaluation. Each area was gridded and a total of 30 unbiased soil samples were collected. Most of the samples exhibited low concentrations of detectable total activity with the maximum cobalt-60 result being 2.7 pCi/g.

The ditches were inspected prior to the first release of shield water that had been stored in the Reactor Building bladder, to ensure that there were no leaks in the Goosequill Ditch and no potential for overflow during release.

11/16/94

Two samples were collected from the plant effluent discharge path to determine an initial profile of the radionuclide mixture. These samples were collected solely to develop site-specific criteria for concentrations of radioactivity in soils as a part of planning activities for the final survey. One sample result yielded a concentration of cobalt-60 at 7.7 pCi/g., which was higher than any results previously observed during SEG sampling and from Public Service of Colorado's environmental sampling program. This sample result triggered more aggressive sampling of the effluent path.

11/26/94

Forty-two follow-up samples were collected of both sediments recently dredged from the ditch, as well as sediments remaining within the ditch. Soil samples were also collected from an agricultural dispersion area where the effluent path had been diverted in the past. The analysis results of these samples indicated increased concentrations of radioactivity sporadically along the entire discharge path and at an agricultural dispersion trench which was fed from the discharge path. The highest concentration (41 pCi/g of cobalt-60) was from sediment which had been cleared from the effluent ditch. Concentrations in the agricultural dispersion trench ranged to less than MDA to 11.6 pCi/g of cobalt-60.

11/30/94

Six additional follow-up samples of sediment were collected from within the Goosequill Ditch directly down stream from the effluent inlet. All six of these samples had results which ranged from 5.9 pCi/g to 18.5 pCi/g of cobalt-60.

12/94

Additional soil samples and exposure-rate measurements were collected to further define the scope of the contamination in the effluent pathway, and to provide data for planning a characterization survey plan that would characterize the quantities and boundaries of contamination.

All parties agreed that no water would be discharged unless evaluated and approved for release by the WT Project Radiation Protection Manager. It was further agreed that the effluent pathway would be inspected prior to a release, any necessary repairs to avoid leakage or overflow would be performed, and no irrigation would be permitted during a release or during repair or dredging work.

1/95 Technical evaluation completed to determine that existing quantities of chlorine-36 and other beta emitters would have no measurable effect on effluent pathway environs. Recommended concentrations for discharge of 1E-07 μCi/ml for cobalt-60 and 2E-07 μCi/ml for cesium-137. Additional demineralizers and filters were installed to process water to recommended concentrations.

Scoping survey completed and Characterization Plan initiated for LEP.

2/95 The radiological characterization of LEP was performed in February and March of 1995. The final report was issued for review in May 1995 and approved for publication on 6/14/95.

1995-1996 Samples were periodically collected to monitor contamination levels and prior to dredging or repair work in the ditches.

5/28/96 A follow-up sampling plan for the LEP was initiated to evaluate the current radiological status of the LEP and compare the results to NUREG-1500[1] guideline values. These results indicated that NUREG-1500 values could be used, but extensive sampling and averaging over 100 square meters would be required in a limited number of areas.

07/10/96 PSCo suspended the ODCM and REMP programs, and related implementing procedures to reflect the completion of ODCM requirements.

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[1] NRC NUREG-1500, Working Draft Regulatory Guide on Release Criteria for Decommissioning was used for the initial evaluation of the concentrations present in the liquid effluent pathway and surrounding soils. Since that time, the RESRAD computer code has been used to define the concentration SGLV appropriate for FSV in consideration of future use of the site.

5.0 CONTROLS IMPLEMENTED SINCE NOVEMBER, 1994

Additional water-processing equipment was installed and all discharges have been made at concentrations (prior to dilution) that were below the LLD's required by the ODCM. The target concentrations for cesium-137 and cobalt-60 were 2E-07 and 1E-07 μCi/ml, respectively. Results of radiological analysis were reviewed and accepted by the SEG Project Radiation Protection Manager prior to releasing water.

The Goosequill ditch was inspected for leaks and repaired where necessary. The ditch was walked down while in full dilution flow prior to a release to inspect for overflow and leaks.

Dredging materials from the ditch were sampled and placed in a designated storage area for control and disposition.

Irrigation from the ditches was not permitted during discharges or dredging operations.

6.0 CURRENT STATUS OF EFFLUENT PATHWAY

The mechanism of the contamination is well understood and the boundaries of the areas of increased concentration have been well-defined as a result of the characterization and follow-up characterization surveys. As described in Section 4.0, to monitor the impact of liquid discharges and to prepare for the final survey of the Fort St. Vrain liquid effluent pathway, a follow-up sampling plan for the liquid effluent pathway was written and implemented between May 28, 1996 and June 6, 1996. The purpose of implementing the plan was to further characterize and evaluate the current radiological status of the effluent pathway and to confirm our understanding of the affected locations. At that time more than 150 samples were collected within, and adjacent to the pathway. The sample locations were chosen to correspond with the sample locations identified during the characterization survey as having increased concentrations.

Each of the individual soil samples was analyzed for gamma emitting radionuclides and evaluated in terms of the nuclide specific dose conversion factors in the RESRAD model developed for FSV. None of the sample concentrations exceeded the SGLV, and only two of the individual sample concentrations exceeded 50% of the SGLV. (0.68 and 0.55) The results of the characterization survey and the follow-up sampling plan indicate that the radionuclide concentrations peaked in the November, 1994 to January 1995 time frame. The decrease in concentrations is a result of the controls that were implemented, radioactive decay, and natural weathering of the environs.

The last liquid discharge via the liquid effluent pathway was completed on 7/3/96. During the week of 7/22/96, the Goosequill was sampled for radiological and non-radiological constituents. Subsequent to collection of these samples, dilution water will be diverted from the Goosequill and the ditch will be cleaned and final survey will be performed.

Final Survey will be implemented for the balance of the effluent pathway including the surrounding open-land areas during August through September, 1996.

7.0 SURVEY PLAN

The approved FSV final survey plan requirements related to the quality elements, statistical evaluation, and comparison of results to release criteria will be implemented. The proposed changes are related to the collection of exposure rate measurements, the sampling frequency, and investigative actions.

7.1 Site-Specific Guideline Values for Surface Activity

The site-specific guideline values for measurements of total and removable surface activity will be those appropriate for the balance of the site, and contained in FSV-TBD-201, Site-Specific Guideline Values for Surface Activity.

7.2 Site-Specific Guideline Values for Concentrations in Soil and Water

The concentration guideline values for residual concentrations in soil are listed in Table 7.1, and were derived using the RESRAD computer code. The RESRAD model used for this derivation has been included as Attachment 1.

The concentration SGLVs for sediment collected from the Farm Pond and the Jay Thomas Ditch have also been based on these values for soil. This is a conservative approach since these locations consist of permanent surface waters, and external exposure which is the major exposure pathway, would not reasonably occur at these locations.

Table 7.1
Concentration SGLV in Soil/Sediment Based on the FSV RESRAD Model

Nuclide	Dose Conversion Factor (mrem/yr/pCi/g)	SGLV (pCi/g/10 mrem)
Co-60	1.79E+00	5.58E+00
Cs-134	1.27E+00	7.87E+00
Cs-137	5.35E-01	1.87E+01
Eu-152	7.58E-01	1.32E+01
Eu-154	8.27E-01	1.21E+01
Eu-155	2.28E-02	4.39E+02
Fe-55	4.07E-04	2.46E+04
H-3	1.10E-02	9.12E+02

The concentration guideline values for surface water which could be used as drinking water are listed in Table 7.2, and were derived from the Allowable Levels of Intake in Environmental Protection Agency Report 520 (EPA-520) in order to limit the committed effective dose equivalent (CEDE) to 10 mrem/yr. This results in a conservative estimate of the potential dose from the drinking water pathway since this water would require purification which would remove the major contributors to exposure.

Table 7.2
Concentration SGLV in Drinking Water Derived From EPA-520

Nuclide	Dose Conversion Factor (mrem/yr/pCi/ml)	SGLV (pCi/ml/10 mrem)
Co-60	7.28E+00	1.37E+00
Cs-134	5.20E+01	1.92E-01
Cs-137	3.64E+01	2.75E-01
Eu-152	4.55E+00	2.20E+00
Eu-154	7.28E+00	1.37E+00
Eu-155	9.10E-01	1.10E+01
Fe-55	4.04E-01	2.47E+01
H-3	4.55E-02	2.20E+02

7.3 Classification and Associated Sampling Frequency

The basis for classification, the survey requirements, and the investigation/reclassification action levels for each classification are described in Table 7.3. Each of the areas indicated in Table 7.4 will be defined as a survey unit and surveyed as described, with the exception of the Goosequill Ditch, which is described in the paragraph following Table 7.4. The minimum survey requirements are based on the potential for residual radioactivity, and assigned a classification of Affected Class 1, 2 or 3.

Table 7.3
Initial Classification/Survey Requirements and Investigation/Reclassification Action Levels for Affected Open Land Areas

Class	Criteria for Classification	Survey Requirement	Investigation/Reclassification Action Level
Affected Class 1	Area where an individual measurement exceeds 50% the SGLV, or the average of the measurements exceeds 25% of the SGLV.	100% scan, 40 biased and 10 unbiased soil samples, exposure rate measurement at each sampling location.	Individual measurement in excess of the SGLV, or the average of the measurements in excess of 75% of the SGLV. If an individual sample is verified to exceed the SGLV, the average concentration will be determined in accordance with the FSV Final Survey Plan.
Affected Class 2	Area which has been adequately characterized, and there is a high degree of certainty that individual measurements are less than 50% of the SGLV, and the average of the measurements is less than 25% of the SGLV.	10% scan, 40 biased and 10 unbiased soil samples.	Individual measurement in excess of 50% of the SGLV, or the average of the measurements in excess of 25% of the SGLV. If an individual sample, or the average sample results, is verified to exceed the reclassification action level, the survey unit, or portion of the survey unit, will be assigned to Class 1 and resurveyed.
Affected Class 3	Area which has been adequately characterized, and there is a high degree of certainty that individual measurements are less than 25% of the SGLV, and the average of the measurements is less than 10% of the SGLV.	40 biased and 10 unbiased soil samples.	Individual measurement in excess of 25% of the SGLV, or the average of the measurements in excess of 10% of the SGLV. If an individual sample, or the average sample results, is verified to exceed the reclassification action level, the survey unit, or portion of the survey unit, will be assigned to Class 1 and resurveyed.

Biased samples are collected at locations of the most elevated concentrations identified during the characterization surveys, based on knowledge of the liquid effluent pathway. An additional 10 unbiased surface soil/sediment samples will be collected outside of the areas selected for biased sampling within each survey unit to ensure all portions of the survey unit are evaluated with a level of effort commensurate with the potential for concentrations to approach the SGLV. Due to the limited number of samples, these areas will not be gridded as described in the Final Survey Plan, unless an investigation is required as described in Sections 7.5 and 7.6.

Table 7.4
Survey Unit Design for the Effluent Pathway and Surrounding Soil

Survey Unit Description	Max/Avg Fraction of SGLV from Char. Survey	Class for Final Survey	Survey Requirements
Goose Quill Banks	0.07/0.01	3	40 biased, 10 unbiased soil samples.
Jay Thomas Ditch	0.83/0.17	1	40 biased, 10 unbiased sediment samples.
Jay Thomas Banks	0.68/0.15	1	100% scan, 40 biased, 10 unbiased soil samples, exposure rate at each sample.
Irrigation Ditch 2, North and South Marsh[2]	0.47/0.15	1	100% scan, 40 biased, 10 unbiased soil samples, exposure rate at each sample.
Irrigation Ditches 1,3, 4, 5 and 6	0.11/0.06	3	40 biased, 10 unbiased soil samples.
Farm Pond (sediment and water) and Outfall (soil)	0.10/0.05	3	40 biased, 10 unbiased sediment/surface soil samples. 10 water samples.
Permanent Pasture W. of Co. Rd. 19½	0.10/0.03	3	40 biased, 10 unbiased soil samples.
Permanent Pasture E. of Co. Rd.19½, and S.of road to farm house	0.10/0.03	3	40 biased, 10 unbiased soil samples.
Permanent Pasture E. of Co.Rd. 19½, and N. of road to farm house	0.10/0.03	3	40 biased, 10 unbiased soil samples.
Sediment Storage Area: Surface Subsurface	 0.17/0.02 0.44/0.09	1	100% scan, 40 soil samples each (surface and subsurface), exposure rate each surface sample.
Goose Quill Ditch	0.38/0.07 (Prior to Sediment Removal)	Non-Suspect, Affected	All sediment has been removed from this area. >1000 measurements for total and removable activity. See below for details of survey requirements.

[2] The South Marsh was combined with the North Marsh and Irrigation Ditch 2 since physical characteristics and potential for residual radioactivity are similar.

The Goosequill Ditch will be surveyed differently from the survey units described above due to the construction of the ditch which consists primarily of a concrete liner. The ditch has been cleaned to remove nearly all vegetation, sediment and debris. Once the Goosequill Ditch is reasonably dry, it will be surveyed similar to a non-suspect affected surface/structure survey unit. The final configuration of the Goosequill Ditch will present only a low potential for residual activity because the activity is confined primarily to the sediment, which will be removed prior to survey. Measurement locations will be selected at a minimum frequency of 1 per 20 square meters along the entire length of the ditch. At each measurement location a scan survey for total surface activity will be performed over a minimum of 1 square meter of the surface, concentrating on the most suspect surfaces (e.g., bottom of ditch & water lines). Locations of elevated activity will be marked on the surface. At each measurement location, measurements for total and removable activity will be collected at the bottom center-line of the ditch, and approximately (at the water line) one meter up each side from the bottom center-line. Additional measurements for total and removable activity will be collected at any locations where the scan survey indicates elevated activity.

The site-specific guideline values for measurements of total and removable surface activity will be those appropriate for the balance of the site, and contained in FSV-TBD-201, Site-Specific Guideline Values for Surface Activity.

For instances where the measurements for total surface activity (scan or fixed point) are verified to be elevated in excess of the SGLV, exposure rate measurements will be collected at a distance of 1 meter from the center line of the ditch bottom. Regardless of the number of elevated measurement results, the frequency for these measurements is not intended to exceed one measurement per four square meters.

7.4 Exposure Rate Measurements

The localized areas of increased concentration are currently at very low concentrations (maximum of 5-7 total pCi/g), and the background exposure rate due to natural radioactivity and global fallout at FSV is large and variable. Experience gained during the characterization survey (at a time when activity concentrations were higher than those anticipated to be present during the Final Survey), showed the exposure rate measurements to be of limited use in identifying areas containing increased activity concentrations, or locations that may exceed 5 μR/hr above the background exposure rate due to licensed material. Consequently, additional scan surveys and fixed-point measurements for exposure rate are planned for only a limited number of instances. These instances are:

1. Areas with Classification 1 will receive a 100% scan of the area using a NaI detector in the rate meter mode, and a fixed point measurement at each sampling location.

2. Areas with Classification 2 will receive a 10% (minimum) scan of the area using a NaI detector in the rate meter mode.

3. A fixed point measurement will be collected at a distance of 1 meter from locations of elevated surface activity (in excess of the SGLV for total surface activity) identified during the survey for total surface activity within the concrete liner of the Goosequill Ditch.

4. Within the open-land grids defined as a result of investigating elevated concentrations, a 100% scan of the area will be performed using a NaI detector in the rate meter mode, and a fixed point measurement will be collected at each investigation sampling location.

The scan surveys for exposure rate will be performed in accordance with the procedure FSV-SC-FRS-I-105, Final Survey of Open Land Areas.

7.5 Investigation Action Levels and Actions

Farm Pond or Farm Pond Outfall

If an individual sediment or water sample result from the Farm Pond or Farm Pond Outfall exceeds the applicable investigation action level, then 10 additional samples will be collected in the same general area(s) as the initial sample. If the sample in question is from the outfall, the additional samples will be taken upstream and downstream from the original sample within a 100 square meter area. If the sample in question is from pond sediment, the additional samples will be collected approximately equally distributed within an approximate 100 square meter area. The results will be evaluated using applicable averaging protocols from the Final Survey Plan. If the average of these samples exceed the concentration SGLV, additional sampling or remediation will be implemented.

All Other Liquid Effluent Pathway Areas

If an individual sample result (excluding Farm Pond & Farm Pond Outfall samples) exceeds the applicable investigation action level, then a 10 by 10 meter grid, centered around the sample location will be established for investigation. This grid will be divided into 9, 3.3 by 3.3 meter grids and surface soil/sediment samples will be collected from the center of the remaining (outside) grids. In addition, a subsurface sample (6-12 inch region) will be collected at the original sample location. Sample results verified to be in excess of the investigation/reclassification action level will result in the survey unit, or portion of the survey unit, as being assigned to Class 1 and resurveyed. If the sample results are found to be less than the investigation/reclassification action level, then the additional results will be included in the data set for statistical evaluation and reporting purposes.

If an individual sample result (excluding Farm Pond & Farm Pond Outfall samples) exceeds 100% of the concentration SGLV, then a 10 by 10 meter grid, centered around the sample location will be established for investigation. This grid will be divided into 9 (approximately 3.3 by 3.3 meter) grids and surface soil/sediment samples collected from the center of the remaining (outside) grids. In addition a subsurface soil/sediment sample will be collected at the original sample location. The results of the surface samples will be evaluated using the averaging protocols given in the Final Survey Plan.

If an individual sample result (excluding Farm Pond & Farm Pond Outfall samples) exceeds the concentration SGLV by greater than a factor of 3, then the results and the original sample location will be investigated to determine the boundaries of the elevated concentrations and will be remediated as required. The investigation survey will consist of, as a minimum, a 10 by 10 meter grid, centered around the sample location. The grid will be divided into 9, 3.3 by 3.3 meter grids and surface samples collected from the center of the remaining (outside) grids. After any required remediation, samples will be collected in the remediated areas to verify that the individual samples results are less than the concentration SGLV, and that the weighted average is less than the concentration SGLV.

In implementing the investigation surveys multiple grids may overlap. Multiple samples from the same grid are not required. If a sample was previously collected in a grid it may satisfy the current sampling requirements regardless of the sample location within the grid. If natural landscape prevents the establishment of a 10 by 10 meter grid, an equivalent survey area will be established around the sample location based on engineering evaluation.

Goosequill Ditch
The investigation and reclassification action levels for non-suspect surfaces and structures will be implemented. The results of these survey measurements will be evaluated in accordance with the Final Survey Plan and existing procedures.

7.6 Evaluation of Investigation Measurement Results

The results of additional measurements collected as a result of exceeding action levels or concentration SGLV will be evaluated to ensure that the individual sample concentration-to-guideline value ratio does not exceed 3; and that the sample concentration-to-guideline value ratio within the localized area does not exceed $(100/A)^{1/2}$, where A is the area of elevated concentration in square meters. If these conditions are satisfied, the weighted mean for the $100m^2$ containing the area of elevated activity will be tested in accordance with Draft NUREG/CR-5849, Equation 8-10 to ensure the weighted mean does not exceed the concentration SGLV as follows:

$$\overline{x_w} = \frac{1}{n_s} \sum_{i=1}^{n_s} x_i \left[1 - \sum_{k=1}^{n_k} A_k \right] + \sum_{k=1}^{n_k} y_k A_k$$

Where:

$\bar{x}_w$	=	weighted mean including elevated area(s),
n_s	=	number of systematic and random measurements,
x_i	=	systematic and random measurements at point *i*,
n_k	=	number of elevated areas,
A_k	=	fraction of $100m^2$ occupied by elevated area *k*,
y_k	=	area of elevated activity in area *k*.

7.7 Basis and Assumptions Used for the FSV RESRAD Exposure Scenario

The RESRAD exposure scenario developed for the FSV Liquid Effluent Pathway is intended to provide a realistic estimate of the potential doses to the general public following decommissioning. During the development of the RESRAD exposure scenario for FSV, the default parameter values included in the computer code, and the parameter values included in NRC Policy and Guidance Directive (PG-8-08) were reviewed to determine whether these values were appropriate for the conditions at FSV. The parameter values provided in either the RESRAD default data, or PG-8-08 for the Resident Farmer (Scenario C) were used, with the following exceptions:

Table 7.5
RESRAD Parameter Values Used at FSV

Parameter	Reference	Value	Basis
Area of Cont. Zone	RESRAD Default	1.00E+04 m^2	Estimate of FSV total area impacted by effluents discharged through the LEP.
	FSV Parameter	2.07E+05 m^2	
Thickness of Cont. Zone	RESRAD Default	2.0 m	Radioactivity was deposited on the surface, and soil has not been disturbed. Sample results indicate that significant subsurface contamination does not exist. For instances where contamination exceeds action levels in surface soil, subsurface samples are collected.
	FSV Parameter	0.15 m	
Length Parallel to Aquifer	RESRAD Default	1.00E+02 m	The entire length of the LEP was used as a conservative estimate of the potential.
	FSV Parameter	2.65E+03 m	
Basic Radiation Dose Limit	RESRAD Default	30 mrem/yr	The limit for the TEDE from soil is contained in the FSV Final Survey Plan. The limit for the CEDE from water was adopted from EPA Guidance since a limit for surface water cannot be derived by RESRAD.
	FSV Parameter	10 mrem/yr (TEDE soil) 10 mrem/yr (CEDE water)	
Annual Precipitation	RESRAD Default	1.00E+00 m/yr	RESRAD Manual, Figure 9.1, Distribution of Average Annual Precipitation Rates Over US.
	FSV Parameter	5.00E-01 m/yr	
Irrigation/ Irrigation Mode	RESRAD Default	2.00E-01 m/yr, Overhead	Estimate of amount, and actual mode of irrigation.
	FSV Parameter	1.00E+00 m/yr, Ditch	
Onsite Fraction of Time Indoors	PG-8-08 Default	0.21	This owner-controlled land has historically been used as permanent pasture, and would not reasonably be used as the location of a residence.
	FSV Parameter	0.00	
Onsite Fraction of Time Outdoors	RESRAD Default	0.55	This land is infrequently occupied for short periods of duration during the growing season.
	FSV Parameter	0.126	

The model developed for FSV includes considerations regarding the projected use of the open land where the LEP is located. Of these considerations, the Onsite Fractions are the most significant. The assumptions used to select reasonable parameter values for the Onsite Fractions include the following:

1. The open land including the LEP has historically been used as permanent pasture, and it is expected that this land will continue to be used as permanent pasture. The Onsite Fraction (outdoors) has been conservatively estimated to be 0.126 (annual average) to account for the time required for seasonal agricultural activities such as inspection of fence lines, irrigation, and the cultivation and harvesting of a hypothetical garden. This value is based on 10.5 hours per day, 3.5 days per week, during 30.1 weeks per year (April - October).

2. The characterization and follow-up surveys demonstrated that, when averaged over 100 square meters, the average concentrations in the localized areas of increased concentration do not exceed the concentration SGLV obtained when using only default parameter values for Scenario C. Additionally, the characterization and follow-up surveys demonstrated that individual concentrations from the localized areas do not exceed 3 times the concentration SGLV obtained when using only default parameter values for Scenario C.

3. The majority of the residual activity was deposited in localized areas during irrigation of the permanent pasture areas adjacent to, and immediately downgrade of the LEP. The flowpath of the irrigation water was dictated by the irrigation ditches, and by local topography, resulting in well-defined areas of localized activity. As such, the residual concentrations are not present in a configuration which results in an infinite or semi-infinite source as the potential for exposure, which further supports a reduction in the Onsite Fraction (outdoors). These locations have been selected for sampling, and the results of these samples are compared to the concentration SGLV.

4. The potential doses for consumption of fruit, vegetables, grains and aquatic food were included in this evaluation using the default parameter values (RESRAD and/or PG-8-08). Inclusion of these pathways, and the use of the default parameter values at FSV, results in a slight over-estimate of these potential doses since these is no known consumption of these foods. However, these pathways and default values were used to ensure the potential doses from these pathways have been conservatively estimated.

5. The default parameter values for ingestion and inhalation of soil have been used for this evaluation. The presence of the permanent ground cover (grassland pasture), and the absence of tilling activities in this area, result in a conservative estimate of the potential exposure from the ingestion and inhalation pathways. It is unlikely that agricultural economics would warrant alternative use of this land, such as tilling

and/or planting of row-crops, and the use of alternate irrigation methods, which could increase the potential doses, but not beyond the range of doses included in this estimate.

An additional level of confidence is afforded to these assumptions, since this land is owned and controlled by PSCo, and no plans exist for alteration.

8.0 ALARA JUSTIFICATION

The Liquid Effluent Pathway and surrounding open land areas have been thoroughly characterized to the extent that the localized areas of increased concentration are well-defined, including a range of expected concentration values. In consideration of our knowledge of the Liquid Effluent Pathway, the modified approach to the survey described in the Final Survey Plan includes an adequate number of measurements and investigative actions to demonstrate attainment of the release criteria.

An evaluation of previous and expected future land use has been performed, and a reasonable scenario has been defined for the potential exposure of the general public to residual concentrations.

An estimate of the decommissioning exposures associated with implementation of the current Final Survey Plan requirements has been presented which indicates that the potential exposure to decommissioning workers would exceed the exposure to the general public.

An estimate of the decommissioning costs associated with implementation of the current Final Survey Plan requirements has been presented which, in consideration of the above, justifies the use of this approach for survey of the Liquid Effluent Pathway.

8.1 Existing Condition of the Liquid Effluent Pathway and Surrounding Soil

The administrative controls placed on the FSV liquid discharges have been adequate to prevent the radionuclide concentrations in the liquid effluent pathway and surrounding soils from exceeding the concentration SGLV. This is supported by the results of the characterization and follow-up characterization surveys.

The bounds of the localized areas of increased concentration are located adjacent to the LEP and are well-defined. The combined surface area of these localized areas is small relative to the balance of the LEP and surrounding open land areas.

The follow-up characterization survey samples were collected from biased locations, and showed no individual sample results in excess of the concentration SGLV. For localized areas containing the highest concentrations, the average within the 100 square meters was only about 10% of the average concentration SGLV.

A comparison of the results from the characterization and follow-up surveys shows a decrease in the residual concentrations which can be expected to continue due to radioactive decay and the effects of environmental weathering.

The survey design requirements are adequate to confirm our understanding of the residual radioactivity in these localized areas of increased concentration, and to ensure with a high degree of certainty that no undetected areas of elevated concentration exist.

8.2 Basis for the FSV RESRAD Exposure Scenario

The model developed for FSV includes considerations regarding the historical and projected future use of the open land where the LEP is located.

The open land including the LEP has historically been used as permanent pasture, and it is expected that this land will continue to be used as permanent pasture.

The potential doses for consumption of fruit, vegetables, grains and aquatic food were included in this evaluation using the default parameter values (RESRAD and/or PG-8-08), and results in a conservative estimate of these potential doses.

The characterization and follow-up surveys demonstrated that the individual and average concentrations in the localized areas of increased concentration do not exceed the concentration SGLV.

The residual concentrations are not present in a configuration which results in an infinite or semi-infinite source as the potential for exposure, and would result in an average exposure far below 10 mrem/yr.

Agricultural economics would not warrant alternative use of this land, and the absence of tilling activities in this area results in a conservative estimate of the potential exposure from the ingestion and inhalation pathways.

An additional level of confidence is afforded, since this land is owned and controlled by PSCo, and no plans exist for alteration.

8.3 Decommissioning Exposures to Implement Current Survey Requirements

Based on our estimate of approximately 8,000 sample locations, and assuming an average of 0.5 hours per sample (gridding, collecting, etc.), the cumulative exposure to decommissioning workers would be 4.5 times the average exposure to members of the public during the entire first year following decommissioning.

The cumulative exposure for this proposed survey plan would be approximately 7% of the exposure to decommissioning workers that would be required to implement the survey in accordance with the Final Survey Plan.

8.4 Impact on Decommissioning Costs to Implement Current Survey Requirements

In accordance with the Final Survey Plan, the effluent pathway and parts of the surrounding areas would be classified as affected areas because of known radioactive contamination in the ditches and some surrounding areas. If these areas were surveyed as required by the Final Survey Plan, approximately 8,000 sample locations would be required. The industry-average fee for performing standard analysis on a single soil sample is in the range of $75-$120 per sample and does not account for the time required to collect the samples. This combined with the industrial risk would far outweigh any benefit of reducing dose to the general population.

For example 8,000 samples at $80 per sample would incur a cost of $640,000 for analysis alone. Additional costs for survey measurements, sample collection, preparation for analysis, and evaluation and reporting of the additional data would bring the costs to well over $1.0 million.

The cost estimate includes the following:

1. Gridding the designated sample areas.
2. Collecting and processing samples (drying and packaging).
3. Counting and analyzing samples.
4. Performing data analysis on results.
5. Purchasing enough additional processing equipment to increase capacity in order to complete survey in 1996.
6. Disposing of samples after analysis.

Based on historical and survey knowledge of the liquid effluent pathway and the associated source term and its minimum potential impact on the general population, a modified survey should be performed for the pathway and surrounding areas as indicated in Section 7.0. The cost for this proposed survey plan is approximately $60,000 to $70,000 and will result in a cost savings of approximately $1.0 million.

9.0 CONCLUSION

Based on the radiological history of the liquid effluent pathway, the controls that have been implemented, the documented results of the ODCM and the REMP, the additional scoping and characterization surveys, the minimal risk to the general public, and cost, the proposed final survey provides a reasonable approach to demonstrate that the effluent pathway and surrounding open land areas meet the criteria for release for unrestricted use.

10.0 REFERENCES

10.1 FSV Nuclear Station Decommissioning Project, Final Survey Plan for Site Release.

10.2 NRC NUREG-1500, Working Draft Regulatory Guide on Release Criteria for Decommissioning: NRC Staff's Draft for Comment.

10.3 QPF number FSV-286, dated 6/29/96, "Corrective Action Associated with Effluent Pathway and Surrounding Soil Sample Methodology"

10.4 Annual Radioactive Effluent Release Report for the Fort St. Vrain Nuclear Station, March 21, 1996, P-96016.

10.5 Offsite Dose Calculation Manual (ODCM), DPP 5.4.2, Issue 7, DSRC Review 10/11/95.

10.6 Radiological Environmental Monitoring Program Summary Report, 1995, CSU.

10.7 Fort St. Vrain Liquid Effluent Pathway Characterization Report, May 1995, Rev. 0, Approved 6/14/95.

10.8 FSV Liquid Effluent Pathway Follow-Up Sampling Report, July, 1996 Rev 0 (DRAFT)

10.9 Limiting Values of Radionuclide Intake and Air Concentration, and Dose Conversion Factors for Inhalation, Submersion and Ingestion, U.S. Environmental Protection Agency EPA-520, 1988.

10.10 U.S. Department of Energy Residual Radioactive Material Guidelines (RESRAD), Computer Code Version 5.61, 8/28/95.

10.11 NRC Policy and Guidance Directive PG-8-08, Scenarios for Assessing Potential Doses Associated With Residual Radioactivity, May 1994.

ATTACHMENT 1
FSV RESRAD MODEL

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

ATTACHMENT 1
FSV RESRAD MODEL

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)
B-1	Cs-134	4.630E-05	4.630E-05	DCF2(2)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(4)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(6)
B-1	Eu-155	4.140E-05	4.140E-05	DCF2(7)
B-1	Fe-55	2.690E-06	2.690E-06	DCF2(8)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(9)
B-1	H-3	6.400E-08	6.400E-08	DCF2(10)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(11)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-60	2.690E-05	2.690E-05	DCF3(1)
D-1	Cs-134	7.330E-05	7.330E-05	DCF3(2)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(4)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(6)
D-1	Eu-155	1.530E-06	1.530E-06	DCF3(7)
D-1	Fe-55	6.070E-07	6.070E-07	DCF3(8)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(9)
D-1	H-3	6.400E-08	6.400E-08	DCF3(10)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(11)
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-34				
D-34	Cs-134 , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Cs-134 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(2,2)
D-34	Cs-134 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(4,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(4,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(7,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)

File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Fe-55 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Fe-55 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(8,2)
D-34	Fe-55 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(8,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(9,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(9,3)
D-34				
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(10,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(10,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(10,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(11,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(11,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(11,3)
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)
D-5				
D-5	Cs-134 , fish	2.000E+03	2.000E+03	BIOFAC(2,1)
D-5	Cs-134 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(6,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(7,2)
D-5				
D-5	Fe-55 , fish	2.000E+02	2.000E+02	BIOFAC(8,1)
D-5	Fe-55 , crustacea and mollusks	3.200E+03	3.200E+03	BIOFAC(8,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(9,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(9,2)
D-5				
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(10,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(10,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(11,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)

ATTACHMENT 1
FSV RESRAD MODEL

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)		2.073E+05	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)		1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)		2.650E+03	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)		1.000E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)		0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)		1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)		5.000E+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)		1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)		not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)		not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g):	Co-60	1.000E+00	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g):	Cs-134	1.000E+00	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g):	Cs-137	1.000E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g):	Eu-152	1.000E+00	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g):	Eu-154	1.000E+00	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g):	Eu-155	1.000E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g):	Fe-55	1.000E+00	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g):	Gd-152	1.000E+00	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g):	H-3	1.000E+00	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g):	Sr-90	1.000E+00	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L):	Co-60	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L):	Cs-134	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L):	Cs-137	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L):	Eu-152	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L):	Eu-154	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L):	Eu-155	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L):	Fe-55	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L):	Gd-152	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L):	H-3	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L):	Sr-90	not used	0.000E+00	---	W1(11)
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)		1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity		3.000E-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	Humidity in air (g/cm**3)		8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient		5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)		5.000E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)		1.000E+00	2.000E-01	---	RI
R013	Irrigation mode		ditch	overhead	---	IDITCH
R013	Runoff coefficient		2.000E-01	2.000E-01	---	RUNOFF

ATTACHMENT 1
FSV RESRAD MODEL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	3.000E-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
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	3.000E-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	3.111E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Cs-134				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.111E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.111E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.402E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.402E-03	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Eu-155				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.402E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Fe-55				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.111E-03	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	5.758E+02	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.402E-03	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.891E+01	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.031E-01	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R017	Inhalation rate (m**3/yr)	1.051E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	3.000E+00	---	LM
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	5.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	3.300E-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)	1.260E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	1.660E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.100E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	1.000E+02	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.825E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.100E+01	FMEAT
R018	Contamination fraction of milk	-1	-1	0.100E+01	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	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 annual wind speed (m/sec)	not used	2.000E+00	---	WIND
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)

ATTACHMENT 1
FSV RESRAD MODEL

Summary of Pathway Selections

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

ATTACHMENT 1
FSV RESRAD MODEL

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	207300.00 square meters	Co-60	1.000E+00
Thickness:	0.15 meters	Cs-134	1.000E+00
Cover Depth:	0.00 meters	Cs-137	1.000E+00
		Eu-152	1.000E+00
		Eu-154	1.000E+00
		Eu-155	1.000E+00
		Fe-55	1.000E+00
		Gd-152	1.000E+00
		H-3	1.000E+00
		Sr-90	1.000E+00

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 10 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	5.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	1.000E+03
TDOSE(t):	6.376E+00	5.505E+00	3.335E+00	2.021E+00	5.090E-01	2.093E-01	3.806E-02	0.000E+00
M(t):	6.376E-01	5.505E-01	3.335E-01	2.021E-01	5.090E-02	2.093E-02	3.806E-03	0.000E+00

Maximum TDOSE(t): 6.376E+00 mrem/yr at t = 0.000E+00 years

ATTACHMENT 1
FSV RESRAD MODEL

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	1.706E+00	0.2676	5.762E-05	0.0000	0.000E+00	0.0000	3.161E-02	0.0050	4.691E-02	0.0074	6.578E-03	0.0010	6.186E-05	0.0000
Cs-134	1.050E+00	0.1647	1.218E-05	0.0000	0.000E+00	0.0000	4.277E-02	0.0067	1.274E-01	0.0200	4.999E-02	0.0078	1.686E-04	0.0000
Cs-137	3.802E-01	0.0596	8.393E-06	0.0000	0.000E+00	0.0000	2.951E-02	0.0046	9.004E-02	0.0141	3.469E-02	0.0054	1.150E-04	0.0000
Eu-152	7.576E-01	0.1188	5.815E-05	0.0000	0.000E+00	0.0000	2.423E-04	0.0000	4.316E-04	0.0001	6.794E-06	0.0000	1.490E-05	0.0000
Eu-154	8.258E-01	0.1295	7.525E-05	0.0000	0.000E+00	0.0000	3.568E-04	0.0001	6.350E-04	0.0001	1.001E-05	0.0000	2.196E-05	0.0000
Eu-155	2.263E-02	0.0035	1.089E-05	0.0000	0.000E+00	0.0000	5.704E-05	0.0000	1.013E-04	0.0000	1.603E-06	0.0000	3.518E-06	0.0000
Fe-55	0.000E+00	0.0000	7.078E-07	0.0000	0.000E+00	0.0000	9.228E-06	0.0000	3.868E-04	0.0001	9.288E-06	0.0000	1.396E-06	0.0000
Gd-152	0.000E+00	0.0000	6.394E-02	0.0100	0.000E+00	0.0000	6.032E-03	0.0009	1.076E-02	0.0017	1.689E-04	0.0000	3.702E-04	0.0001
H-3	0.000E+00	0.0000	3.873E-03	0.0006	0.000E+00	0.0000	4.578E-03	0.0007	1.274E-03	0.0002	1.234E-03	0.0002	1.472E-07	0.0000
Sr-90	2.911E-03	0.0005	3.447E-04	0.0001	0.000E+00	0.0000	6.765E-01	0.1061	2.997E-01	0.0470	9.924E-02	0.0156	3.518E-04	0.0001
Total	4.746E+00	0.7442	6.838E-02	0.0107	0.000E+00	0.0000	7.917E-01	0.1242	5.777E-01	0.0906	1.919E-01	0.0301	1.109E-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	1.792E+00	0.2810
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.270E+00	0.1992
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	5.345E-01	0.0838
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.584E-01	0.1189
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.269E-01	0.1297
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.280E-02	0.0036
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.074E-04	0.0001
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.127E-02	0.0127
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.096E-02	0.0017
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.079E+00	0.1692
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	6.376E+00	1.0000

*Sum of all water independent and dependent pathways.

ATTACHMENT 1
FSV RESRAD MODEL

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	1.488E+00	0.2703	5.003E-05	0.0000	0.000E+00	0.0000	2.744E-02	0.0050	4.073E-02	0.0074	5.7[illegible]1E-03	0.0010	5.371E-05	0.0000
Cs-134	7.466E-01	0.1356	8.620E-06	0.0000	0.000E+00	0.0000	3.026E-02	0.0055	9.015E-02	0.0164	[illegible]537E-02	0.0064	1.193E-04	0.0000
Cs-137	3.697E-01	0.0672	8.172E-06	0.0000	0.000E+00	0.0000	2.855E-02	0.0052	8.712E-02	0.0158	[illegible]356E-02	0.0061	1.113E-04	0.0000
Eu-152	7.139E-01	0.1297	5.454E-05	0.0000	0.000E+00	0.0000	2.273E-04	0.0000	4.048E-04	0.0001	6.[illegible]2E-06	0.0000	1.398E-05	0.0000
Eu-154	7.576E-01	0.1376	6.872E-05	0.0000	0.000E+00	0.0000	3.258E-04	0.0001	5.798E-04	0.0001	9.141E-06	0.0000	2.005E-05	0.0000
Eu-155	1.956E-02	0.0036	9.359E-06	0.0000	0.000E+00	0.0000	4.900E-05	0.0000	8.707E-05	0.0000	1.377E-06	0.0000	3.023E-06	0.0000
Fe-55	0.000E+00	0.0000	5.422E-07	0.0000	0.000E+00	0.0000	7.069E-06	0.0000	2.963E-04	0.0001	7.115E-06	0.0000	1.069E-06	0.0000
Gd-152	0.000E+00	0.0000	6.317E-02	0.0115	0.000E+00	0.0000	5.960E-03	0.0011	1.063E-02	0.0019	1.669E-04	0.0000	3.658E-04	0.0001
H-3	0.000E+00	0.0000	1.705E-15	0.0000	0.000E+00	0.0000	2.015E-15	0.0000	5.608E-16	0.0000	5.434E-16	0.0000	6.479E-20	0.0000
Sr-90	2.561E-03	0.0005	3.016E-04	0.0001	0.000E+00	0.0000	5.919E-01	0.1075	2.622E-01	0.0476	8.683E-02	0.0158	3.078E-04	0.0001
Total	4.098E+00	0.7445	6.367E-02	0.0116	0.000E+00	0.0000	6.847E-01	0.1244	4.922E-01	0.0894	1.617E-01	0.0294	9.959E-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+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	1.562E+00	0.2838
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.025E-01	0.1639
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	5.191E-01	0.0943
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.146E-01	0.1298
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.586E-01	0.1378
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.971E-02	0.0036
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.121E-04	0.0001
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.029E-02	0.0146
H-3	2.353E-03	0.0004	3.010E-06	0.0000	0.000E+00	0.0000	4.196E-04	0.0001	1.833E-04	0.0000	4.150E-04	0.0001	3.374E-03	0.0006
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.441E-01	0.1715
Total	2.353E-03	0.0004	3.010E-06	0.0000	0.000E+00	0.0000	4.196E-04	0.0001	1.833E-04	0.0000	4.150E-04	0.0001	5.505E+00	1.0000

*Sum of all water independent and dependent pathways.

ATTACHMENT 1
FSV RESRAD MODEL

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+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	8.607E-01	0.2581	2.842E-05	0.0000	0.000E+00	0.0000	1.559E-02	0.0047	2.313E-02	0.0069	3.244E-03	0.0010	1.050E-05	0.0000
Cs-134	1.908E-01	0.0572	2.159E-06	0.0000	0.000E+00	0.0000	7.580E-03	0.0023	2.258E-02	0.0068	8.861E-03	0.0027	2.988E-05	0.0000
Cs-137	3.305E-01	0.0991	7.117E-06	0.0000	0.000E+00	0.0000	2.502E-02	0.0075	7.634E-02	0.0229	2.941E-02	0.0088	9.749E-05	0.0000
Eu-152	5.628E-01	0.1687	4.219E-05	0.0000	0.000E+00	0.0000	1.758E-04	0.0001	3.131E-04	0.0001	4.929E-06	0.0000	1.081E-05	0.0000
Eu-154	5.366E-01	0.1609	4.776E-05	0.0000	0.000E+00	0.0000	2.264E-04	0.0001	4.030E-04	0.0001	6.353E-06	0.0000	1.394E-05	0.0000
Eu-155	1.093E-02	0.0033	5.096E-06	0.0000	0.000E+00	0.0000	2.668E-05	0.0000	4.741E-05	0.0000	7.499E-07	0.0000	1.646E-06	0.0000
Fe-55	0.000E+00	0.0000	1.866E-07	0.0000	0.000E+00	0.0000	2.433E-06	0.0000	1.020E-04	0.0000	2.449E-06	0.0000	3.680E-07	0.0000
Gd-152	0.000E+00	0.0000	6.016E-02	0.0180	0.000E+00	0.0000	5.676E-03	0.0017	1.012E-02	0.0030	1.589E-03	0.0000	3.483E-04	0.0001
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.533E-03	0.0005	1.766E-04	0.0001	0.000E+00	0.0000	3.467E-01	0.1039	1.536E-01	0.0461	5.086E-02	0.0152	1.803E-04	0.0001
Total	2.494E+00	0.7477	6.047E-02	0.0181	0.000E+00	0.0000	4.010E-01	0.1202	2.866E-01	0.0859	9.254E-02	0.0277	7.133E-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 = 5.000E+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	9.027E-01	0.2707
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.298E-01	0.0689
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	4.614E-01	0.1383
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.633E-01	0.1689
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.372E-01	0.1611
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.101E-02	0.0033
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.074E-04	0.0000
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.646E-02	0.0229
H-3	3.724E-13	0.0000	4.764E-16	0.0000	0.000E+00	0.0000	6.639E-14	0.0000	2.900E-14	0.0000	6.568E-14	0.0000	5.339E-13	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.530E-01	0.1658
Total	3.724E-13	0.0000	4.764E-16	0.0000	0.000E+00	0.0000	6.639E-14	0.0000	2.900E-14	0.0000	6.568E-14	0.0000	3.335E+00	1.0000

*Sum of all water independent and dependent pathways.

ATTACHMENT 1
FSV RESRAD MODEL

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	4.338E-01	0.2146	1.400E-05	0.0000	0.000E+00	0.0000	7.677E-03	0.0038	1.139E-02	0.0056	1.598E-03	0.0008	1.502E-05	0.0000
Cs-134	3.463E-02	0.0171	3.823E-07	0.0000	0.000E+00	0.0000	1.342E-03	0.0007	3.998E-03	0.0020	1.569E-03	0.0008	5.289E-06	0.0000
Cs-137	2.871E-01	0.1421	6.027E-06	0.0000	0.000E+00	0.0000	2.119E-02	0.0105	6.466E-02	0.0320	2.491E-02	0.0123	8.256E-05	0.0000
Eu-152	4.177E-01	0.2067	3.057E-05	0.0000	0.000E+00	0.0000	1.274E-04	0.0001	2.269E-04	0.0001	3.572E-06	0.0000	7.834E-06	0.0000
Eu-154	3.483E-01	0.1724	3.027E-05	0.0000	0.000E+00	0.0000	1.435E-04	0.0001	2.554E-04	0.0001	4.027E-06	0.0000	8.834E-06	0.0000
Eu-155	5.280E-03	0.0026	2.381E-06	0.0000	0.000E+00	0.0000	1.247E-05	0.0000	2.216E-05	0.0000	3.504E-07	0.0000	7.691E-07	0.0000
Fe-55	0.000E+00	0.0000	4.915E-08	0.0000	0.000E+00	0.0000	6.408E-07	0.0000	2.686E-05	0.0000	6.449E-07	0.0000	9.692E-08	0.0000
Gd-152	0.000E+00	0.0000	5.654E-02	0.0280	0.000E+00	0.0000	5.334E-03	0.0026	9.512E-03	0.0047	1.493E-04	0.0001	3.274E-04	0.0002
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	8.074E-04	0.0004	9.040E-05	0.0000	0.000E+00	0.0000	1.774E-01	0.0878	7.861E-02	0.0389	2.603E-02	0.0129	9.227E-05	0.0000
Total	1.528E+00	0.7558	5.671E-02	0.0281	0.000E+00	0.0000	2.133E-01	0.1055	1.687E-01	0.0835	5.426E-02	0.0268	5.400E-04	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.
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	4.545E-01	0.2249
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.154E-02	0.0206
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	3.979E-01	0.1969
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.181E-01	0.2069
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.488E-01	0.1726
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.318E-03	0.0026
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.829E-05	0.0000
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.186E-02	0.0356
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.831E-01	0.1400
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	2.021E+00	1.0000

*Sum of all water ndependent and dependent pathways.

ATTACHMENT 1
FSV RESRAD MODEL

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	2.771E-02	0.0544	8.125E-07	0.0000	0.000E+00	0.0000	4.457E-04	0.0009	6.615E-04	0.0013	9.275E-05	0.0002	8.722E-07	0.0000
Cs-134	3.726E-05	0.0001	3.704E-10	0.0000	0.000E+00	0.0000	1.300E-06	0.0000	3.873E-06	0.0000	1.520E-06	0.0000	5.124E-09	0.0000
Cs-137	1.620E-01	0.3182	3.058E-06	0.0000	0.000E+00	0.0000	1.075E-02	0.0211	3.281E-02	0.0645	1.264E-02	0.0248	4.189E-05	0.0001
Eu-152	1.256E-01	0.2467	8.313E-06	0.0000	0.000E+00	0.0000	3.465E-05	0.0001	6.170E-05	0.0001	9.713E-07	0.0000	2.130E-06	0.0000
Eu-154	6.131E-02	0.1205	4.819E-06	0.0000	0.000E+00	0.0000	2.285E-05	0.0000	4.067E-05	0.0001	6.411E-07	0.0000	1.406E-06	0.0000
Eu-155	2.862E-04	0.0006	1.120E-07	0.0000	0.000E+00	0.0000	5.863E-07	0.0000	1.042E-06	0.0000	1.648E-08	0.0000	3.617E-08	0.0000
Fe-55	0.000E+00	0.0000	2.332E-10	0.0000	0.000E+00	0.0000	3.040E-09	0.0000	1.274E-07	0.0000	3.060E-09	0.0000	4.598E-10	0.0000
Gd-152	0.000E+00	0.0000	4.350E-02	0.0855	0.000E+00	0.0000	4.104E-03	0.0081	7.318E-03	0.0144	1.149E-04	0.0002	2.519E-04	0.0005
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.158E-05	0.0001	6.118E-06	0.0000	0.000E+00	0.0000	1.201E-02	0.0236	5.320E-03	0.0105	1.762E-03	0.0035	6.245E-06	0.0000
Total	3.769E-01	0.7406	4.352E-02	0.0855	0.000E+00	0.0000	2.737E-02	0.0538	4.621E-02	0.0908	1.461E-02	0.0287	3.045E-04	0.0006

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	2.891E-02	0.0568
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.396E-05	0.0001
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	2.182E-01	0.4287
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.257E-01	0.2469
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.138E-02	0.1206
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.879E-04	0.0006
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.342E-07	0.0000
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.529E-02	0.1086
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.916E-02	0.0377
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	5.090E-01	1.0000

*Sum of all water independent and dependent pathways.

ATTACHMENT 1
FSV RESRAD MODEL

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	1.733E-03	0.0083	4.586E-08	0.0000	0.000E+00	0.0000	2.515E-05	0.0001	3.733E-05	0.0002	5.235E-06	0.0000	4.923E-08	0.0000
Cs-134	3.929E-08	0.0000	3.488E-13	0.0000	0.000E+00	0.0000	1.225E-09	0.0000	3.649E-09	0.0000	1.431E-09	0.0000	4.827E-12	0.0000
Cs-137	8.956E-02	0.4278	1.509E-06	0.0000	0.000E+00	0.0000	5.303E-03	0.0253	1.618E-02	0.0773	6.234E-03	0.0298	2.067E-05	0.0001
Eu-152	3.699E-02	0.1767	2.198E-06	0.0000	0.000E+00	0.0000	9.160E-06	0.0000	1.631E-05	0.0001	2.568E-07	0.0000	5.632E-07	0.0000
Eu-154	1.058E-02	0.0505	7.460E-07	0.0000	0.000E+00	0.0000	3.537E-06	0.0000	6.295E-06	0.0000	9.924E-08	0.0000	2.177E-07	0.0000
Eu-155	1.536E-05	0.0001	5.119E-0[illegible]	0.0000	0.000E+00	0.0000	2.680E-08	0.0000	4.763E-08	0.0000	7.533E-10	0.0000	1.653E-09	0.0000
Fe-55	0.000E+00	0.0000	1.076E-12	0.0000	0.000E+00	0.0000	1.402E-11	0.0000	5.877E-10	0.0000	1.411E-11	0.0000	2.121E-12	0.0000
Gd-152	0.000E+00	0.0000	3.254E-02	0.1554	0.000E+00	0.0000	3.070E-03	0.0147	5.474E-03	0.0261	8.594E-05	0.0004	1.884E-04	0.0009
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	4.616E-06	0.0000	4.026E-07	0.0000	0.000E+00	0.0000	7.901E-04	0.0038	3.501E-04	0.0017	1.159E-04	0.0006	4.109E-07	0.0000
Total	1.389E-01	0.6634	3.254E-02	0.1554	0.000E+00	0.0000	9.201E-03	0.0440	2.207E-02	0.1054	6.442E-03	0.0308	2.103E-04	0.0010

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	1.801E-03	0.0086
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.560E-08	0.0000
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-01	0.5603
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.702E-02	0.1768
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-02	0.0506
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.544E-05	0.0001
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.191E-10	0.0000
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.135E-02	0.1975
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.262E-03	0.0060
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	2.093E-01	1.0000

*Sum of all water independent and dependent pathways

ATTACHMENT 1
FSV RESRAD MODEL

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	1.410E-06	0.0000	2.737E-11	0.0000	0.000E+00	0.0000	1.501E-08	0.0000	2.228E-08	0.0000	3.125E-09	0.0000	2.938E-11	0.0000
Cs-134	1.182E-15	0.0000	7.492E-21	0.0000	0.000E+00	0.0000	2.630E-17	0.0000	7.836E-17	0.0000	3.074E-17	0.0000	1.037E-19	0.0000
Cs-137	1.696E-02	0.4457	2.034E-07	0.0000	0.000E+00	0.0000	7.149E-04	0.0188	2.182E-03	0.0573	8.404E-04	0.0221	2.786E-06	0.0001
Eu-152	1.459E-03	0.0383	6.231E-08	0.0000	0.000E+00	0.0000	2.597E-07	0.0000	4.624E-07	0.0000	7.280E-09	0.0000	1.597E-08	0.0000
Eu-154	1.102E-04	0.0029	5.546E-09	0.0000	0.000E+00	0.0000	2.630E-08	0.0000	4.680E-08	0.0000	7.378E-10	0.0000	1.619E-09	0.0000
Eu-155	9.056E-09	0.0000	1.804E-12	0.0000	0.000E+00	0.0000	9.447E-12	0.0000	1.679E-11	0.0000	2.655E-13	0.0000	5.827E-13	0.0000
Fe-55	0.000E+00	0.0000	1.226E-18	0.0000	0.000E+00	0.0000	1.598E-17	0.0000	6.699E-16	0.0000	1.609E-17	0.0000	2.417E-18	0.0000
Gd-152	0.000E+00	0.0000	1.242E-02	0.3263	0.000E+00	0.0000	1.172E-03	0.0308	2.089E-03	0.0549	3.280E-05	0.0009	7.190E-05	0.0019
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.005E-09	0.0000	3.526E-10	0.0000	0.000E+00	0.0000	6.921E-07	0.0000	3.066E-07	0.0000	1.015E-07	0.0000	3.599E-10	0.0000
Total	1.853E-02	0.4870	1.242E-02	0.3263	0.000E+00	0.0000	1.887E-03	0.0496	4.272E-03	0.1122	8.733E-04	0.0229	7.471E-05	0.0020

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	1.451E-06	0.0000
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.317E-15	0.0000
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	2.070E-02	0.5440
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.459E-03	0.0383
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.103E-04	0.0029
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.085E-09	0.0000
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.056E-16	0.0000
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.578E-02	0.4147
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.107E-06	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.806E-02	1.0000

*Sum of all water independent and dependent pathways.

ATTACHMENT 1
FSV RESRAD MODEL

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)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
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
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
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
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Gd-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+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.

ATTACHMENT 1
FSV RESRAD MODEL

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	5.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.792E+00	1.562E+00	9.027E-01	4.545E-01	2.891E-02	1.801E-03	1.451E-06	0.000E+00
Cs-134	Cs-134	1.000E+00	1.270E+00	9.025E-01	2.298E-01	4.154E-02	4.396E-05	4.560E-08	1.317E-15	0.000E+00
Cs-137	Cs-137	1.000E+00	5.345E-01	5.191E-01	4.614E-01	3.979E-01	2.182E-01	1.173E-01	2.070E-02	0.000E+00
Eu-152	Eu-152	7.208E-01	5.466E-01	5.151E-01	4.060E-01	3.014E-01	9.059E-02	2.668E-02	1.052E-03	0.000E+00
Eu-152	Eu-152	2.792E-01	2.117E-01	1.995E-01	1.573E-01	1.167E-01	3.509E-02	1.034E-02	4.075E-04	0.000E+00
Eu-152	Gd-152	2.792E-01	0.000E+00	1.417E-16	6.044E-16	1.005E-15	1.505E-15	1.319E-15	5.409E-16	0.000E+00
Eu-152	ΣDSR(j)		2.117E-01	1.995E-01	1.573E-01	1.167E-01	3.509E-02	1.034E-02	4.075E-04	0.000E+00
Eu-154	Eu-154	1.000E+00	8.269E-01	7.586E-01	5.372E-01	3.488E-01	6.138E-02	1.059E-02	1.103E-04	0.000E+00
Eu-155	Eu-155	1.000E+00	2.280E-02	1.971E-02	1.101E-02	5.318E-03	2.879E-04	1.544E-05	9.085E-09	0.000E+00
Fe-55	Fe-55	1.000E+00	4.074E-04	3.121E-04	1.074E-04	2.829E-05	1.342E-07	6.191E-10	7.056E-16	0.000E+00
Gd-152	Gd-152	1.000E+00	8.127E-02	8.029E-02	7.646E-02	7.186E-02	5.529E-02	4.135E-02	1.578E-02	0.000E+00
H-3	H-3	1.000E+00	1.096E-02	3.374E-03	5.339E-13	0.000E+	000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	Sr-90	1.000E+00	1.079E+00	9.441E-01	5.530E-01	2.831E-02	1.916E-02	1.262E-03	1.107E-06	0.000E+00

Branch Fraction is the cumulative factor for the j'th 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 = 10 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	5.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	1.000E+03
Co-60	5.582E+00	6.401E+00	1.108E+01	2.200E+01	3.459E+02	5.554E+03	6.893E+06	*1.131E+15
Cs-134	7.872E+00	1.108E+01	4.351E+01	2.407E+02	2.275E+05	2.193E+08	*1.294E+15	*1.294E+15
Cs-137	1.871E+01	1.927E+01	2.167E+01	2.513E+01	4.583E+01	8.525E+01	4.830E+02	*8.701E+13
Eu-152	1.319E+01	1.399E+01	1.775E+01	2.392E+01	7.957E+01	2.701E+02	6.852E+03	*1.765E+14
Eu-154	1.209E+01	1.318E+01	1.861E+01	2.867E+01	1.629E+02	9.443E+02	9.068E+04	*2.639E+14
Eu-155	4.385E+02	5.072E+02	9.080E+02	1.880E+03	3.473E+04	6.477E+05	1.101E+09	*4.651E+14
Fe-55	2.455E+04	3.204E+04	9.310E+04	3.535E+05	7.451E+07	1.615E+10	*2.409E+15	*2.409E+15
Gd-152	*2.178E+01	*2.178E+01	*2.178E+01	*2.178E+01	*2.178E+01	*2.178E+01	*2.178E+01	*2.178E+01
H-3	9.124E+02	2.964E+03	1.873E+13	*9.594E+15	*9.594E+15	*9.594E+15	*9.594E+15	*9.594E+15
Sr-90	9.267E+00	1.059E+01	1.808E+01	3.533E+01	5.218E+02	7.927E+03	9.034E+06	*1.365E+14

*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	1.792E+00	5.582E+00	1.792E+00	5.582E+00
Cs-134	1.000E+00	0.000E+00	1.270E+00	7.872E+00	1.270E+00	7.872E+00
Cs-137	1.000E+00	0.000E+00	5.345E-01	1.871E+01	5.345E-01	1.871E+01
Eu-152	1.000E+00	0.000E+00	7.584E-01	1.319E+01	7.584E-01	1.319E+01
Eu-154	1.000E+00	0.000E+00	8.269E-01	1.209E+01	8.269E-01	1.209E+01
Eu-155	1.000E+00	0.000E+00	2.280E-02	4.385E+02	2.280E-02	4.385E+02
Fe-55	1.000E+00	0.000E+00	4.074E-04	2.455E+04	4.074E-04	2.455E+04
Gd-152	1.000E+00	0.000E+00	8.127E-02	*2.178E+01	8.127E-02	*2.178E+01
H-3	1.000E+00	0.000E+00	1.096E-02	9.124E+02	1.096E-02	9.124E+02
Sr-90	1.000E+00	0.000E+00	1.079E+00	9.267E+00	1.079E+00	9.267E+00

*At specific activity limit

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

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	5.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.792E+00	1.562E+00	9.027E-01	4.545E-01	2.891E-02	1.801E-03	1.451E-06	0.000E+00
Cs-134	Cs-134	1.000E+00	1.270E+00	9.025E-01	2.298E-01	4.154E-02	4.396E-05	4.560E-08	1.317E-15	0.000E+00
Cs-137	Cs-137	1.000E+00	5.345E-01	5.191E-01	4.614E-01	3.979E-01	2.182E-01	1.173E-01	2.070E-02	0.000E+00
Eu-152	Eu-152	7.208E-01	5.466E-01	5.151E-01	4.060E-01	3.014E-01	9.059E-02	2.668E-02	1.052E-03	0.000E+00
Eu-152	Eu-152	2.792E-01	2.117E-01	1.995E-01	1.573E-01	1.167E-01	3.509E-02	1.034E-02	4.075E-04	0.000E+00
Eu-152	δDOSE(j):		7.584E-01	7.146E-01	5.633E-01	4.181E-01	1.257E-01	3.702E-02	1.459E-03	0.000E+00
Gd-152	Eu-152	2.792E-01	0.000E+00	1.417E-16	6.044E-16	1.005E-15	1.505E-15	1.319E-15	5.409E-16	0.000E+00
Gd-152	Gd-152	1.000E+00	8.127E-02	8.029E-02	7.646E-02	7.186E-02	5.529E-02	4.135E-02	1.578E-02	0.000E+00
Gd-152	δDOSE(j):		8.127E-02	8.029E-02	7.646E-02	7.186E-02	5.529E-02	4.135E-02	1.578E-02	0.000E+00
Eu-154	Eu-154	1.000E+00	8.269E-01	7.586E-01	5.372E-01	3.488E-01	6.138E-02	1.059E-02	1.103E-04	0.000E+00
Eu-155	Eu-155	1.000E+00	2.280E-02	1.971E-02	1.101E-02	5.318E-03	2.879E-04	1.544E-05	9.085E-09	0.000E+00
Fe-55	Fe-55	1.000E+00	4.074E-04	3.121E-04	1.074E-04	2.829E-05	1.342E-07	6.191E-10	7.056E-16	0.000E+00
H-3	H-3	1.000E+00	1.096E-02	3.374E-03	5.339E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	Sr-90	1.000E+00	1.079E+00	9.441E-01	5.530E-01	2.831E-01	1.916E-02	1.262E-03	1.107E-06	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	5.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	1.000E+00	8.741E-01	5.101E-01	2.602E-01	1.763E-02	1.194E-03	1.425E-06	0.000E+00
Cs-134	Cs-134	1.000E+00	1.000E+00	7.123E-01	1.834E-01	3.362E-02	3.800E-05	4.295E-08	1.845E-15	0.000E+00
Cs-137	Cs-137	1.000E+00	1.000E+00	9.741E-01	8.771E-01	7.694E-01	4.555E-01	2.696E-01	7.269E-02	4.119E-12
Eu-152	Eu-152	7.208E-01	7.208E-01	6.806E-01	5.410E-01	4.060E-01	1.288E-01	4.087E-02	2.317E-03	8.491E-26
Eu-152	Eu-152	2.792E-01	2.792E-01	2.636E-01	2.095E-01	1.573E-01	4.989E-02	1.583E-02	8.975E-04	3.289E-26
Eu-152	ΔS(j):		1.000E+00	9.442E-01	7.505E-01	5.633E-01	1.787E-01	5.670E-02	3.215E-03	1.178E-25
Gd-152	Eu-152	2.792E-01	0.000E+00	1.737E-15	7.679E-15	1.324E-14	2.315E-14	2.435E-14	1.997E-14	1.554E-16
Gd-152	Gd-152	1.000E+00	1.000E+00	9.946E-01	9.734E-01	9.474E-01	8.504E-01	7.633E-01	5.826E-01	4.509E-03
Gd-152	ΔS(j):		1.000E+00	9.946E-01	9.734E-01	9.474E-01	8.504E-01	7.633E-01	5.826E-01	4.509E-03
Eu-154	Eu-154	1.000E+00	1.000E+00	9.193E-01	6.565E-01	4.310E-01	8.005E-02	1.487E-02	2.211E-04	3.793E-37
Eu-155	Eu-155	1.000E+00	1.000E+00	8.649E-01	4.840E-01	2.342E-01	1.285E-02	7.049E-04	4.969E-07	0.000E+00
Fe-55	Fe-55	1.000E+00	1.000E+00	7.712E-01	2.728E-01	7.440E-02	4.118E-04	2.279E-06	5.196E-12	0.000E+00
H-3	H-3	1.000E+00	1.000E+00	4.432E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	Sr-90	1.000E+00	1.000E+00	8.808E-01	5.301E-01	2.810E-01	2.219E-02	1.752E-03	3.069E-06	0.000E+00

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