PMBelCOL PEmails

From: Spink, Thomas E [tespink@tva.gov]
Sent: Monday, August 04, 2008 8:31 AM
To: Joseph Sebrosky
Subject: Courtesy email copy of TVA's Response to RAI Letter 63 - Groundwater
Attachments: BLN RAI Response to RAI Letter 063 final r1 20080731.pdf; BELLEFONTE LIQUID TANK FAILURE FINAL 2_1.CHN; BELLEFONTE LIQUID TANK FAILURE FINAL 2_1.ROF

Joe:

I have enclosed a pdf copy of our response to RAI Letter 063 with this email as a courtesy. Also attached are the electronic RESRAD input files. As always, the official submittal has been submitted to the Document Control Desk via paper copy using Federal Express services. The paper copy and CD containing the RESRAD input files should arrive on August 4, 2008.

If you have any questions, please do not hesitate to call me.

Thomas E. Spink
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Nuclear Generation Development
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Chattanooga, TN 37402
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Hearing Identifier: Bellefonte_COL_Public_EX
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Subject: Courtesy email copy of TVA's Response to RAI Letter 63 - Groundwater
Sent Date: 8/4/2008 8:30:46 AM
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From: Spink, Thomas E

Created By: tespink@tva.gov

Recipients:
"Joseph Sebrosky" <Joseph.Sebrosky@nrc.gov>
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Files	**Size**	**Date & Time**
MESSAGE	631	8/4/2008 8:32:21 AM
BLN RAI Response to RAI Letter 063 final r1 20080731.pdf		685552
BELLEFONTE LIQUID TANK FAILURE FINAL 2_1.CHN		37294
BELLEFONTE LIQUID TANK FAILURE FINAL 2_1.ROF		27239

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Tennessee Valley Authority, 1101 Market Street, LP 5A, Chattanooga, Tennessee 37402-2801

August 1, 2008

10 CFR 52.79

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

In the Matter of)
Tennessee Valley Authority)

Docket No. 52-014 and 52-015

BELLEFONTE COMBINED LICENSE APPLICATION – RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION – GROUNDWATER

Reference: Letter from Joseph Sebrosky (NRC) to Andrea L. Sterdis (TVA), Request for Additional Information Letter No. 063 Related to SRP Section 02.04.13 for the Bellefonte Units 3 and 4 Combined License Application, dated July 3, 2008

This letter provides the Tennessee Valley Authority's (TVA) response to the Nuclear Regulatory Commission's (NRC) request for additional information (RAI) items included in the reference letter.

A response to each NRC request in the subject letter is addressed in the enclosure which also identifies any associated changes that will be made in a future revision of the BLN application.

If you should have any questions, please contact Thomas Spink at 1101 Market Street, LP5A, Chattanooga, Tennessee 37402-2801, by telephone at (423) 751-7062, or via email at tespink@tva.gov.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 1ST day of Aug, 2008.

Jack A. Bailey
Vice President, Nuclear Generation Development

Enclosure
cc: See Page 2

cc: (Enclosures)

J. P. Berger, EDF
J. M. Sebrosky, NRC/HQ
E. Cummins, Westinghouse
S. P. Frantz, Morgan Lewis
M.W. Gettler, FP&L
R . Grumbir, NuStart
P. S. Hastings, NuStart
P Hinnenkamp, Entergy
M. C. Kray, NuStart
D. Lindgren, Westinghouse
G. D. Miller, PG&N
M. C. Nolan, Duke Energy
N. T. Simms, Duke Energy
K. N. Slays, NuStart
G. A. Zinke, NuStart

cc: (w/o Enclosure)

B. C. Anderson, NRC/HQ
M.M. Comar, NRC/HQ
B. Hughes/NRC/HQ
R. G. Joshi, NRC/HQ
R. H. Kitchen, PGN
M.C Kray, NuStart
A. M. Monroe, SCE&G
C. R. Pierce, SNC
R. Reister, DOE/PM
L. Reyes, NRC/RII
T. Simms, NRC/HQ

Enclosure
TVA letter dated August 1, 2008
RAI Responses

Responses to NRC Request for Additional Information letter No.063 dated July 3, 2008
(15 pages, including this list)

Subject: Groundwater as discussed in the Final Safety Analysis Report

RAI Number	Date of TVA Response
02.04.13-01	This letter – see following pages
02.04.13-02	This letter – see following pages
02.04.13-03	This letter – see following pages
02.04.13-4a	This letter – see following pages
02.04.13-4b	This letter – see following pages
02.04.13-4c	This letter – see following pages
02.04.13-4d	This letter – see following pages
02.04.13-4e	This letter – see following pages
02.04.13-4f	This letter – see following pages

Associated Additional Attachments / Enclosures	Pages Included
Attachment 02.04.13-04A: Revised Figure 2.4.13-201	1
Attachment 02.04.13-04B: RESRAD Input files	Cover sheet and CD

NRC Letter Dated: July 03, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-01

The private residences across Town Creek, with their groundwater wells, are the water users closest to the site with a potential to be impacted by an accidental release of radioactive liquid effluents. The potential alternative groundwater pathway to the area of these residences is not evaluated in FSAR 2.4.13. Provide a description of the data and analysis used to determine that this alternative pathway was either implausible or is not a bounding pathway. This issue is associated with Attachment 5, items 2 and 29, of the May 13 -16, 2008, hydrology-related safety site trip report dated June 12, 2008 (ADAMS accession number ML081610308).

RAI ID#: 640

BLN RESPONSE:

As stated in the BLN response to NRC RAI Number 2.4.12-02 provided to NRC in TVA Letter BLN-RAI-LTR-062 "a release from the BLN site would have little possibility of impacting the private wells on the opposite side of Town Creek." The referenced response also provides a supporting explanation of the implausibility of groundwater migrating under Town Creek and impacting the residential drinking water wells. Because this is not considered a plausible pathway, the groundwater to residential well scenario was not analyzed as a potential alternative groundwater pathway.

This response is PLANT-SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

No COLA revisions have been identified associated with this response.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

None

NRC Letter Dated: July 03, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-02

The RESRAD groundwater transport model used in FSAR 2.4.13 embodies a conceptual model of groundwater flow consistent with a continuum porous medium. The site geology is described, however, as karst with groundwater flow occurring in fractures, some of which may be solutionally enlarged. Provide the technical basis for representing a fractured site using a continuum model. Provide a description of the data and analysis used to determine that an alternative model of fractured flow and transport was either implausible or is not a bounding scenario. This issue is associated with Attachment 5, items 29 and 34, of the May 13 -16, 2008, hydrology-related safety site trip report dated June 12, 2008 (ADAMS accession number ML081610308).

RAI ID#: 641

BLN RESPONSE:

TVA's letter dated July 23, 2008 documents actions taken to resolve specific action items associated with the NRC Hydrology Related Site Visit Trip Report. Action Item 3 requested TVA to provide a revised porosity analysis. The Groundwater Velocity Evaluation Section (3.0) of the enclosure to the reference letter provides information regarding use of a continuum model to analyze the subsurface groundwater flow.

The descriptions of the subsurface geologic and hydrologic conditions included in the COL Application are intended to characterize the actual conditions of the subsurface geology and groundwater at the BLN. The representation of the subsurface aquifer as an equivalent "porous media" is based on the concept that a poorly defined karst system, as found on the BLN, shows similar properties to, and can be simulated as, movement in a granular media. To account for the inherent unknown conditions (fracture pathways) beneath the surface, the conservative approach of a worst-case scenario (groundwater flow through a postulated single fracture) was employed to "simplify" the complex groundwater pathways in a conservative manner. The description was not intended to infer the subsurface is granular in nature, but used the similarity in properties between the two systems to allow for determination of subsurface flow properties, including a conservative groundwater velocity and flow travel times.

The worst-case method provides a groundwater flow analysis which would be more conservative than the anticipated actual subsurface conditions. Actual site groundwater flow would be through multiple fracture pathways which would exhibit three-dimensional orientations. This tortuous pathway would be less conservative (non-bounding) than the theorized single fracture, or straight-line, approach used in the analysis of groundwater movement. Any attempt to mimic assumed groundwater flow paths would lead to a less than bounding analysis due to the longer flow pathways.

To further add conservatism, the highest value of hydraulic conductivity was used in the calculations. Actual hydraulic conductivity would be highly variable along the actual groundwater pathways and would result in a lower effective hydraulic conductivity for the groundwater flow path; therefore, actual hydraulic conductivity would be less bounding than the highest value measured.

This response is PLANT-SPECIFIC

ASSOCIATED BLN COL APPLICATION REVISIONS:

COLA Part 2, FSAR Chapter 2 revisions are addressed in the subject letter and by reference in this response.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

None

NRC Letter Dated: July 3, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-03

The RESRAD model provides a default volume of 150,000 m^3 of surface water into which radionuclides are discharged at the end of their groundwater flow path. At Bellefonte, this default volume was used to represent a portion of Town Creek. Provide the technical basis for adopting this default volume.

Alternatively, provide the technical basis for a different volume that is more defensible in terms of the actual conditions in Town Creek, and discuss any differences in estimates that result from using this different volume.

Or, as another alternative, use groundwater radionuclide concentrations and flow rates derived from RESRAD as inputs into a surface-water mixing zone model (such as for example CORMIX) that can represent concentrations in surface water in a more physically-based manner. Discuss any differences in estimates that result from using this different modeling approach.

This issue is associated with Attachment 5, item 26, of the May 13 -16, 2008, hydrology-related safety site trip report dated June 12, 2008 (ADAMS accession number ML081610308).

BLN RAI ID: 642

BLN Response

TVA has chosen to provide a technical basis for a different volume that is more defensible in terms of the actual conditions in Town Creek.

As a conservative estimate an approximately 800 square feet portion of Town Creek is assumed to be the receptor location for the affected groundwater from the tank failure. Using he two small inlets to the northwest of MW-1212 as the bounding discharge points and using an average water depth of 5 feet, the water volume for this portion of Town Creek is 9,249,342 cubic feet.

The analysis conservatively assumes that the flow of surface water through the affected portion of Town Creek does not cause radionuclide movement for a period of one year. Individual radionuclide concentrations in Town Creek were modeled using RESRAD-Offsite. The concentrations were calculated on a periodic interval for a maximum of 1000 years. This time period allows all radionuclides to either appear in the receptor body or to be removed by radioactive decay.

This response is PLANT-SPECIFIC

ASSOCIATED BLN COL APPLICATION REVISIONS:

The COLA changes associated with this RAI are contained in the COLA changes 1, 5, and 7 provided with the response to NRC RAI Number 02.04.13-4a.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

None

NRC Letter Dated: July 3, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-04a

During the May 13-16, 2008, hydrology site visit TVA indicated that it would make several changes to the application to clarify issues associated with the ground water review. These clarifications are described below. TVA should provide a commitment or a schedule for when these changes will be made to the Bellefonte COL application. At the beginning of the question there is a cross reference to the item number contained in Attachment 5 of the May 13-16, 2008, hydrology-related safety site trip report dated June 12, 2008 (ADAMS accession number ML081610308).

a) Attachment 5, item 26 of the May 13-16, 2008 trip report stated that TVA should provide a subject matter expert (SME) to discuss the values in the RESRAD input file(s) used in this section.

Commitment: TVA will provide the RESRAD input files, once the input parameters are revised.

BLN RAI ID: 652

BLN Response:

Following the requests for information, the liquid effluent tank accident release model has been adjusted and re-evaluated with the compilation of the various input parameters. The revised electronic RESRAD input files are provided in Attachment 02.04.13-04B. These files contain the changes required due to revised porosity information, minimum Kd, and other changes identified during the review of the tank rupture analysis methodology. These files are only readable from within the RESRAD program.

As a conservative estimate an approximately 800 square feet portion of Town Creek of is assumed to be the receptor location for the affected groundwater from the tank failure. Using the two small inlets to the northwest of MW-1212 as the bounding discharge points and using an average water depth of 5 feet, the water volume for Town Creek is 9,249,342 cubic feet.

The analysis conservatively assumes that the flow of surface water through the affected portion of Town Creek does not cause radionuclide movement for a period of one year. Individual radionuclide concentrations in Town Creek were modeled using RESRAD-Offsite. The concentrations were calculated on a periodic interval for a maximum of 1000 years. This time period allows the radionuclides to either appear in the receptor body or to be removed by radioactive decay.

The lowest available site specific Kd values were used in the conceptual model for conservativism. For those radionuclides not evaluated for the site specific Kd values, the most conservative value of "0" was used. RESRAD was rerun using the revised site specific Kd values or a Kd value of "0."

FSAR Tables 2.4.13-203 and 2.4.13-204 were updated based on the results of the new RESRAD run as identified in the Application Revisions section below. Table 2.4.13-204 was also revised to include a listing for the radionuclide Nb-95.

This response is PLANT-SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

1. COLA Part 2, FSAR Chapter 2, Subsection 2.4.13, second paragraph, will be revised from:

…Town Creek embayment. A straight line flow path is considered the most conservative as the actual groundwater pathways are expected to be more tortuous, transport times much longer, and hydraulic conductivities of the fractures/joints lower. Because of the higher hydraulic conductivities in the soil and deeper bedrock, the majority of groundwater flow is conservatively assumed to be within the epikarst zone. Site specific radiological distribution coefficients (Kd) were measured in three soil borings on the BLN during the 2006 pre-COL application investigation. Results of the isotopic Kd analysis are presented in Table 2.4.13-201.

To read:

…Town Creek embayment. As a conservative approach, an approximately 800 square feet portion of Town Creek is assumed to be the receptor location for the groundwater that is affected by tank failure. The analysis conservatively assumes that the flow of surface water through the affected portion of Town Creek does not cause radionuclide movement for a period of one year. A straight line flow path is considered the most conservative as the actual groundwater pathways are expected to be more tortuous, transport times much longer, and hydraulic conductivities of the fractures/joints lower. Because of the higher hydraulic conductivities in the soil and deeper bedrock, the majority of groundwater flow is conservatively assumed to be within the epikarst zone. Site specific radiological distribution coefficients (Kd) were measured in three soil borings on the BLN site during the 2006 pre-COL application investigation. Results of the isotopic Kd analysis are presented in Table 2.4.13-202. Kd values include the variability reported with each laboratory result. For additional conservatism, the lowest Kd value based on reported value and variability was selected and used in the analysis.

2. COLA Part 2, FSAR Chapter 2, Subsection 2.4.13, 12th paragraph, will be revised from:

The distance from Unit 3 to the Town Creek embayment is 1,188 feet.

To read:

The distance from Unit 3 to the Town Creek embayment is 1,600 feet.

3. COLA Part 2, FSAR Chapter 2, Subsection 2.4.13, 15th paragraph, will be revised from:

This conceptual model is conservative. It provides for the shortest travel distance to Town Creek, includes the limiting fault tank, does not take credit for dilution in Town Creek

To read:

This conceptual model is conservative. It provides for the shortest travel distance to Town Creek, includes the limiting fault tank, and does not take credit for dilution in the water flow through the affected portion of Town Creek.

4. COLA Part 2, FSAR Chapter 2, Subsection 2.4.13, 16th paragraph, will be revised from:

…absorption by the surrounding soils. As discussed in Subsection 2.4.12.1.2, the soils surrounding the auxiliary building at the elevation fo the liquid release are epikarst bedrock, and moderate to highly fractured and corroded limestone. Site specific radiological distribution coefficients (Kd) were measured in three soils borings on the BLN during the 2006 pre-COL application investigation. Results of the isotopic Kd analysis are presented in Table 2.4.13-202. Site-specific groundwater flow velocities and travel times are presented in Table 2.4.12-206.

To read:

…adsorption by the surrounding soils. As discussed in Subsection 2.4.12.1.2, the soils surrounding the auxiliary building at the elevation of the liquid release are epikarst bedrock, and moderate to highly fractured and corroded limestone. Site specific radiological distribution coefficients (Kd) were measured in three soils borings on the BLN during the 2006 pre-COL application investigation. Results of the isotopic Kd analysis are presented in Table 2.4.13-202. Kd values include the variability reported with each laboratory result. To ensure the analysis is conservative, the lowest Kd value based on reported value and variability was selected and used in the analysis. Site-specific groundwater flow velocities and travel times are presented in Table 2.4.12-206.

5. COLA Part 2, FSAR Chapter 2, Subsection 2.4.13, 17th, 18th, and 19th paragraphs, will be revised from:

The highest measured bedrock hydraulic conductivity measured at the site (Subsection 2.4.12) is used. Site-specific parameters such as unsaturated zone density, unsaturated zone porosity, saturated zone porosity, hydraulic conductivity, dispersion coefficients, flow velocities, and travel times used in this model are provided in Table 2.4.13-203.

Radionuclide concentrations in Town Creek were modeled using RESRAD-Offsite (Reference 209). The groundwater pathway mechanism is a first-order release model that considers the effects of different transport rates for radionuclides and progeny nuclides, while allowing decay during the transport process. The concentration of each radionuclide transmitted to the environment is determined by the transport through the groundwater system, dilution by groundwater and infiltrating surface water from the overburden soils, absorption, and decay.

No credit is taken for dilution of radionuclides in Town Creek by water flow. Radionuclides are assumed to remain in Town Creek near the groundwater discharge point for a period of one year. Individual radionuclide concentrations in Town Creek were modeled using RESRAD-Offsite and concentrations were calculated on a periodic interval of approximately 70 days for an evaluation period of 50 years.

To read:

The model uses the lowest available site-specific Kd values. For those radionuclides not evaluated for the site-specific Kd values, the most conservative value of 0 is used. The highest measured bedrock hydraulic conductivity measured at the site (Subsection 2.4.12) is used. Site-specific parameters such as unsaturated zone density, unsaturated zone porosity, saturated zone porosity, hydraulic conductivity, dispersion coefficients, flow velocities, and travel times used in this model are provided in Table 2.4.13-203.

Radionuclide concentrations in Town Creek were modeled using RESRAD-Offsite (Reference 209). The groundwater pathway mechanism is a first-order release model that considers the effects of different transport rates for radionuclides and progeny nuclides, while allowing decay during the transport process. The concentration of each radionuclide transmitted to the environment is determined by the transport through the groundwater system, dilution by groundwater and infiltrating surface water from the overburden soils, adsorption, and decay.

No credit is taken for dilution of radionuclides by water flow through the affected portion of Town Creek. As a conservative approach, a portion of Town Creek of approximately 800 feet is assumed to be the receptor location for the groundwater affected by the tank failure. The water volume for Town Creek was calculated to be 9,249,342 cubic feet using the two small inlets to the Northwest of MW-1212 as the bounding discharge points and an average water depth of 5 feet. The analysis conservatively assumes that the flow of surface water through the affected portion of Town Creek does not cause radionuclide movement for a period of one year. Individual radionuclide concentrations in Town Creek were modeled using RESRAD-Offsite. The concentrations were calculated on a periodic interval to a maximum of 1000 years. This time frame allows all radionuclides to either appear in the receptor body or to be removed by radioactive decay.

6. COLA Part 2, FSAR Chapter 2, Subsection 2.4.13, 22nd paragraph, will be revised from:

The maximum radionuclide concentration for each isotope calculated to be in Town Creek during the 50-year period was used to calculate a fraction of effluent concentration.

To read:

The maximum radionuclide concentration for each isotope calculated to be in Town Creek during the 1,000-year period was used to calculate a fraction of effluent concentration.

7. COLA Part 2, FSAR Chapter 2, Table 2.4.13-203 will be revised as shown below.

The values for Parameter in Table 2.4.13-203 will be revised as identified:

- Cobalt Kd Coefficient is revised from 10,837 to 8,193.
- Cesium Kd Coefficient is revised from 8,377 to 5,411.
- Iron Kd Coefficient is revised from 3,366 to 2,890.
- Iodine Kd Coefficient is revised from 11.7 to 1.4.
- Strontium Kd Coefficient is revised from 92.5 to 80.
- Technetium Kd Coefficient is revised from 0.26 to 0.10.
- Precipitation is revised from 7.200E-1 to 1.33.
- Area of Contaminated Zone is revised from 5.298E+1 to 4.238E+1.
- Contaminated Zone Total Porosity is revised from 4.500E-1 to 1.8E-2.
- Contaminated Zone Hydraulic Conductivity is revised from 1.2465E+3 to 1325.5.
- Unsaturated Zone Hydraulic Conductivity is revised from 1.2465E+3 to 1325.5.
- Saturated Zone Total Porosity is revised from 4.00E-2 to 1.8E-2.
- Saturated Zone Effective Porosity is revised from 4.00E-2 to 1.8E-2.
- Distance to the Nearest Surface Water Body is revised from 362.23 to 487.68.

The Parameter Justification entry in Table 2.4.13-203 for the Area of Contaminated Zone will be revised from:

The contaminated soil area was assumed to be 2 meters in height with 0.45 porosity, thus an area of 7.279 square meters is required to contain 80% of the liquid effluent tank (22,400 gallons)

To read:

The contaminated soil area was assumed to be 2 meters in height, thus an area of 6.51 meters square is required to contain 80% of the liquid effluent tank (22,400 gallons)

The Parameter description entry in Table 2.4.13-203 for the Runoff Coefficient will be revised from:

Coefficient (fraction) of precipitation that runoffs the surface and does not infiltration into the soil

To read:

Coefficient (fraction) of precipitation that runs off the surface and does not infiltrate the soil

8. COLA Part 2, FSAR Chapter 2, Table 2.4.13-204 values will be revised from:

Detected Radionuclide	Radionuclide Concentration microcuries/ml	10 CFR 20 Appendix B Table 2 Column 2 microcuries/ml	Sum of Fractions Contribution(a)
Ag-110m	5.75E-10	6.00E-06	9.58E-05
Ce-144	2.53E-10	3.00E-06	8.43E-05
H-3	4.90E-05	1.00E-03	4.90E-02
Pr-144	2.53E-10	2.00E-05	1.27E-05
			Sum of Fraction Unity Rule Value 4.92E-02

a) Those radionuclides with Sum of Fractions Contribution less than 1.0E-5 are negligible and not included in the table.

To read:

Detected Radionuclide	Radionuclide Concentration microcuries/ml	10 CFR 20 Appendix B Table 2 Column 2 microcuries/ml	Sum of Fractions Contribution(a)
Ag-110m	5.22E-10	6.00E-06	8.70E-05
Ce-144	2.30E-10	3.00E-06	7.68E-05
H-3	3.77E-05	1.00E-03	3.77E-02
Nb-95	2.52E-13	6.00E-09	4.20E-05
Pr-144	2.30E-10	2.00E-05	1.15E-05
			Sum of Fraction Unity Rule Value 3.79E-02

a) Those radionuclides with Sum of Fractions Contribution less than 1.0E-5 are negligible and not included in the table.

ASSOCIATED ATTACHMENTS/ENCLOSURES

Attachment 02.04.13-04B - RESRAD input files (2) on CD:

1 BELLEFONTE LIQUID TANK FAILURE FINAL 2_1.ROF
2 BELLEFONTE LIQUID TANK FAILURE FINAL 2_1.CHN

NRC Letter Dated: July 3, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-04b

b) Attachment 5, item 29 of the May 13-16, 2008 trip report stated that TVA should provide an SME to discuss the basis for the sequence of events and time scales used in the transport analysis The applicant stated that the residence time of one year was chosen to coincide with the annual limits in 10 CFR 20 Appendix B, that the 70-day calculation interval was chosen to reduce computation and the amount of output; and that the 50-year simulation period encompassed all concentration peaks.

Commitment: TVA will provide a technical basis for the selection of a dilution volume in Town Creek.

BLN RAI ID: 653

BLN Response

As a conservative estimate an approximately 800 square feet portion of Town Creek is assumed to be the receptor location for the affected groundwater from the tank failure. Using the two small inlets to the northwest of MW-1212 as the bounding discharge points and an average water depth of 5 feet, the water volume for Town Creek is 9,249,342 cubic feet.

This response is PLANT-SPECIFIC

ASSOCIATED BLN COL APPLICATION REVISIONS:

The COLA changes associated with this RAI are contained in the COLA changes 1, 5, and 7 provided with the response to NRC RAI Number 02.04.13-4a.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

None

NRC Letter Dated: July 3, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-04c

c) Attachment 5, item 30 of the May 13-16, 2008 trip report stated that TVA should provide an SME to discuss the basis for using Parameter Values in Table 2.4.13-203 relative to the minimum observed values as reported in Table 2.4.13-202. The applicant stated they used Kds based on closest measurement to the source not the lowest measurement. Given the likely variability along the pathway, the applicant stated that using the minimum Kd would be conservative and appropriate.

Commitment: TVA will revise transport analyses using the minimum Kds.

BLN RAI ID: 654

BLN Response

The lowest available site specific Kd values were used in the conceptual model for conservativism. For those radionuclides not evaluated for the site specific Kd values, the most conservative value of "0" was used.

This response is PLANT-SPECIFIC

ASSOCIATED BLN COL APPLICATION REVISIONS:

The COLA changes associated with this RAI are contained in the COLA changes 1, 4, and 5 provided with the response to NRC RAI Number 02.04.13-4a.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

None

NRC Letter Dated: July 3, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-04d

d) Attachment 5, item 31 of the May 13-16, 2008 trip report stated that TVA should have a calc package for review (or/and an SME to describe) the computation of the Area of Contaminated Zone in Table 2.4.13-203. The applicant stated the area was based on a 2 meter deep volume sitting atop the saturated zone. The applicant acknowledged an apparent math error in the estimation of the Area of Contaminated Zone.

Commitment: TVA will revise the area based on a corrected computation.

BLN RAI ID: 655

BLN RESPONSE:

Water from the failed effluent holdup tank was assumed to be a volume source term configuration of rectangular shape 2 meters in height and 6.51 meters square, which is a sufficient volume to account for the 22,400 gallons of water from the effluent holdup tank. This equates to a surface area of 42.38 m^2 and a subsequent volume of 84.76 m^3.

This response is PLANT-SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

The COLA changes associated with this RAI are contained in the COLA change 7 provided with the response to NRC RAI Number 02.04.13-4a.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

None

NRC Letter Dated: July 3, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-04e

e) Attachment 5, item 32 of the May 13-16, 2008 trip report stated that TVA should provide an SME to clarify whether the contaminant source is assumed to be directly in the saturated zone as illustrated in Figure 2.4.13-201. If so, explain the use and impact of the contaminated and unsaturated zone parameters. The applicant stated the area was based on a 2 meter deep volume sitting atop the saturated zone.

Commitment: The applicant will revise the figure.

BLN RAI ID: 656

BLN RESPONSE:

FSAR Figure 2.4.13-201 has been updated as identified in the Application Revisions section below and shown in Attachment 02.04.12-04A.

This response is PLANT-SPECIFIC.

ASSOCIATED BLN COL APPLICATION REVISIONS:

COLA Part 2, FSAR, Chapter 2, Figure 2.4.13-201 will be replaced with the revised figure in Attachment 02.04.13-04A.

ASSOCIATED ATTACHMENTS/ENCLOSURES:

Attachment 02.04.13-04A: Revised FSAR Figure 2.4.13-201

NRC Letter Dated: July 3, 2008

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.04.13-04f

f) Attachment 5, item 33 of the May 13-16, 2008 trip report stated that TVA should provide an SME to explain how alternative plausible scenarios, consistent with limited data available, for groundwater radionuclide migration eastward from Unit 4 toward the intake structure on Guntersville Reservoir were filtered to determine that the postulated scenario was conservative. The applicant stated that they are already responding to this item in H8 from the environmental audit.

Commitment: The applicant will provide a written response through the environmental responses to NRC.

BLN RAI ID: 657

BLN RESPONSE

Item H8 from the environmental audit is part of TVA responses to ER requests for information provided by letter dated June 12, 2008. The TVA response is available from ADAMS (ML081680428).

This response is PLANT-SPECIFIC

ASSOCIATED BLN COL APPLICATION REVISIONS;

No COLA revisions have been identified associated with this response

ASSOCIATED ATTACHMENTS/ENCLOSURERS

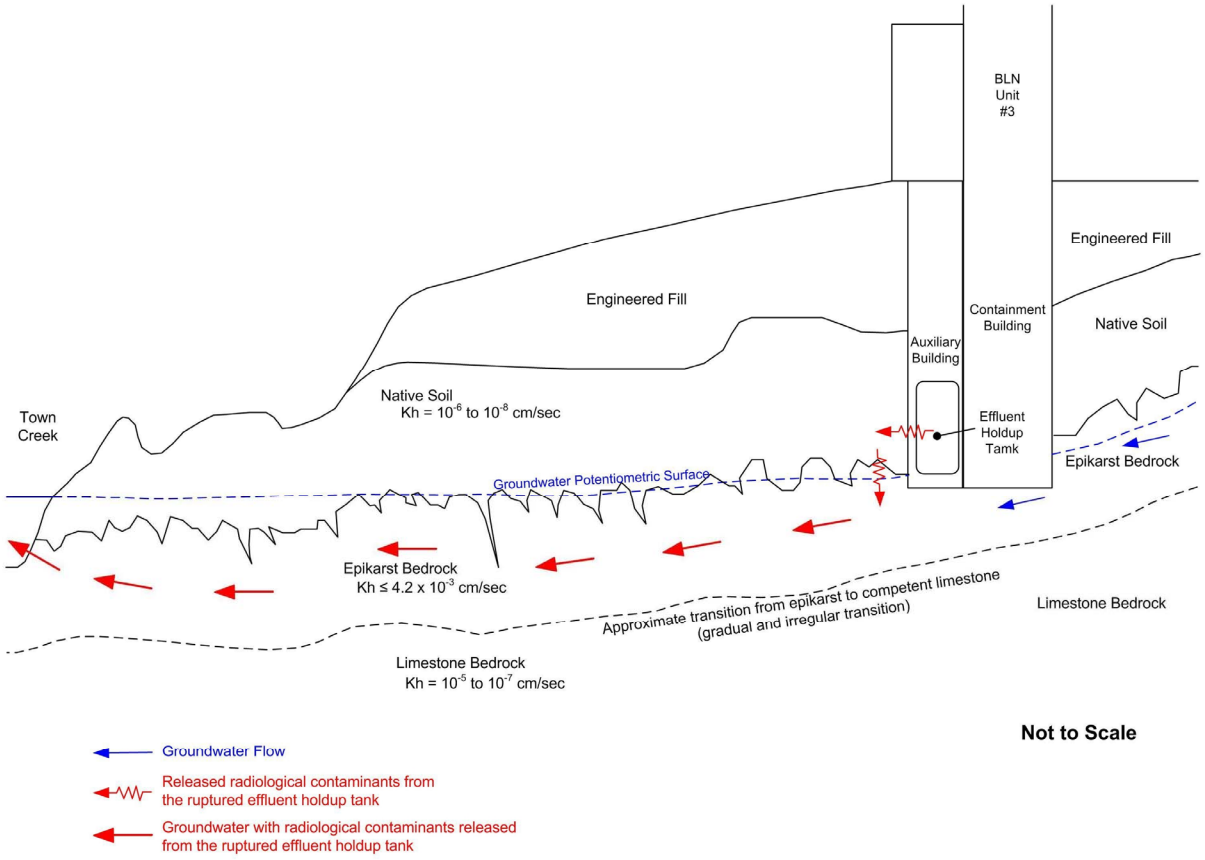
None

Attachment 02.04.13-04A

Revised FSAR Figure 2.4.13-201

Attachment 02.04.13-04A
TVA letter dated August 1, 2008
RAI Responses

Attachment 02.04.13-04A - Revised FSAR Figure 2.4.13-201



Attachment 02.04.13-04B
TVA letter dated August 1, 2008
RAI Responses

Separate electronic files (2) containing the RESRAD input files:

BELLEFONTE LIQUID TANK FAILURE FINAL 2_1.ROF

BELLEFONTE LIQUID TANK FAILURE FINAL 2_1.CHN

All data in Nukes(), order matches NUCNAM list in .ROF file:

#	Nuclide	Half-Life	AtWt	Kd Def	Fraction	nNuc	Decay Chain
001	Ag-110m+D	6.84189E-01	109.9061	0.000E+00	1.000000E+00	01	Ag-110m+D
002	Ba-140	3.48802E-02	139.9106	5.000E+01	1.000000E+00	02	Ba-140 La-140
003	Br-84	6.04610E-05	083.9165	4.900E+01	1.000000E+00	01	Br-84
004	Ce-141	8.89829E-02	140.9083	1.000E+03	1.000000E+00	01	Ce-141
005	Ce-143	3.76450E-03	142.9124	1.000E+03	1.000000E+00	02	Ce-143 Pr-143
006	Ce-144+D	7.78371E-01	143.9136	1.000E+03	1.780000E-05	01	Ce-144+D
007	Ce-144+D	7.78371E-01	143.9136	1.000E+03	9.999822E-01	02	Ce-144+D Pr-144
008	Co-58	1.93840E-01	057.9358	1.000E+03	1.000000E+00	01	Co-58
009	Co-60	5.27100E+00	059.9338	1.000E+03	1.000000E+00	01	Co-60
010	Cr-51	7.58494E-02	050.9448	3.000E+01	1.000000E+00	01	Cr-51
011	Cs-134	2.06200E+00	133.9067	4.600E+03	1.000000E+00	01	Cs-134
012	Cs-136	3.58658E-02	135.9073	4.600E+03	1.000000E+00	01	Cs-136
013	Cs-137+D	3.00000E+01	136.9071	4.600E+03	1.000000E+00	01	Cs-137+D
014	Cs-138	6.12210E-05	137.9110	4.600E+03	1.000000E+00	01	Cs-138
015	Fe-55	2.70000E+00	054.9383	1.000E+03	1.000000E+00	01	Fe-55
016	Fe-59	1.21914E-01	058.9349	1.000E+03	1.000000E+00	01	Fe-59
017	H-3	1.23500E+01	003.0161	0.000E+00	1.000000E+00	01	H-3
018	I-129	1.57000E+07	128.9050	1.000E-01	1.000000E+00	01	I-129
019	I-130	1.41000E-03	129.9067	1.000E-01	1.000000E+00	01	I-130
020	I-132	2.62380E-04	131.9080	1.000E-01	1.000000E+00	01	I-132
021	I-134	1.00010E-04	133.9099	1.000E-01	1.000000E+00	01	I-134
022	La-140	4.59410E-03	139.9095	4.980E+00	1.000000E+00	01	La-140
023	Mn-54	8.55578E-01	053.9404	2.000E+02	1.000000E+00	01	Mn-54
024	Mn-56	2.94150E-04	055.9389	2.000E+02	1.000000E+00	01	Mn-56
025	Mo-99	7.52910E-03	098.9077	1.250E+02	8.760000E-01	03	Mo-99 Tc-99m Tc-99
026	Mo-99	7.52910E-03	098.9077	1.250E+02	1.240000E-01	02	Mo-99 Tc-99
027	Nb-93m	1.36000E+01	092.9064	0.000E+00	1.000000E+00	01	Nb-93m
028	Nb-95	9.62355E-02	094.9068	0.000E+00	1.000000E+00	01	Nb-95
029	Nb-95m	9.87910E-03	094.9068	0.000E+00	1.000000E+00	02	Nb-95m Nb-95
030	Pr-143	3.71253E-02	142.9108	1.570E+02	1.000000E+00	01	Pr-143
031	Pr-144	3.28540E-05	143.9133	1.570E+02	1.000000E+00	01	Pr-144
032	Rb-88	3.38430E-05	087.9113	1.250E+02	1.000000E+00	01	Rb-88
033	Rb-89	2.89000E-05	088.9123	1.250E+02	1.000000E+00	02	Rb-89 Sr-89
034	Rh-103m	1.06700E-04	102.9055	4.000E+00	1.000000E+00	01	Rh-103m
035	Ru-103	1.07543E-01	102.9063	0.000E+00	3.000000E-03	01	Ru-103
036	Ru-103	1.07543E-01	102.9063	0.000E+00	9.970000E-01	02	Ru-103 Rh-103m
037	Sr-89	1.38261E-01	088.9075	3.000E+01	1.000000E+00	01	Sr-89
038	Sr-90	2.91200E+01	089.9077	3.000E+01	1.000000E+00	02	Sr-90 Y-90
039	Sr-91	1.08370E-03	090.9102	3.000E+01	5.780000E-01	03	Sr-91 Y-91m Y-91
040	Sr-91	1.08370E-03	090.9102	3.000E+01	4.220000E-01	02	Sr-91 Y-91
041	Sr-92	3.09150E-04	091.9110	3.000E+01	1.000000E+00	02	Sr-92 Y-92
042	Tc-99	2.13000E+05	098.9063	0.000E+00	1.000000E+00	01	Tc-99
043	Tc-99m	6.86740E-04	098.9063	0.000E+00	1.000000E+00	02	Tc-99m Tc-99
044	Te-127	1.06660E-03	126.9052	0.000E+00	1.000000E+00	01	Te-127
045	Te-127m	2.98426E-01	126.9052	0.000E+00	2.400000E-02	01	Te-127m
046	Te-127m	2.98426E-01	126.9052	0.000E+00	9.760000E-01	02	Te-127m Te-127
047	Te-129	1.32330E-04	128.9066	0.000E+00	1.000000E+00	02	Te-129 I-129
048	Te-129m	9.19918E-02	128.9066	0.000E+00	6.500000E-01	03	Te-129m Te-129 I-129
049	Te-129m	9.19918E-02	128.9066	0.000E+00	3.500000E-01	02	Te-129m I-129
050	Te-132	8.92080E-03	131.9085	0.000E+00	1.000000E+00	02	Te-132 I-132
051	Te-134	7.94740E-05	133.9116	0.000E+00	1.000000E+00	02	Te-134 I-134
052	Y-90	7.30090E-03	089.9072	7.200E+02	1.000000E+00	01	Y-90
053	Y-91	1.60192E-01	090.9073	7.200E+02	1.000000E+00	01	Y-91
054	Y-91m	9.45130E-05	090.9073	7.200E+02	1.000000E+00	02	Y-91m Y-91
055	Y-92	4.03830E-04	091.9089	7.200E+02	1.000000E+00	01	Y-92
056	Y-93	1.15220E-03	092.9096	7.200E+02	1.000000E+00	03	Y-93 Zr-93 Nb-93m
057	Zr-93	1.53000E+06	092.9065	2.200E+03	1.000000E+00	02	Zr-93 Nb-93m
058	Zr-95	1.75168E-01	094.9080	2.200E+03	6.980000E-03	03	Zr-95 Nb-95m Nb-95

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059   Zr-95        1.75168E-01   094.9080   2.200E+03   9.930200E-01   02   Zr-95 Nb-95
--------------
Ag-110m+D : (Ag-110 1.3300E-02)
Ce-144+D  : (Pr-144m 1.7800E-02)
Cs-137+D  : (Ba-137m 9.4600E-01)

Decay Chain: Ag-110m
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Ag-110m 6.842E-01 000 EOCB    9.8670E-01 002 Ag-110  1.3300E-02 000         0.0000E+00
002 Ag-110  7.795E-07 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Ag-110m
 #   Fraction  Nuclides:
001 9.8670E-01 Ag-110m
002 1.3300E-02 Ag-110m Ag-110
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Ag-110m    Fix Level = 0
 #   Fraction  Nuclides:
001 1.0000E+00 Ag-110m+D

Decay Chain: Ba-140
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Ba-140  3.488E-02 002 La-140  1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 La-140  4.594E-03 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Ba-140
 #   Fraction  Nuclides:
001 1.0000E+00 Ba-140  La-140
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Ba-140    Fix Level = 0
 #   Fraction  Nuclides:
002 1.0000E+00 Ba-140     La-140

Decay Chain: Br-84
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Br-84   6.046E-05 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Br-84
 #   Fraction  Nuclides:
001 1.0000E+00 Br-84
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Br-84    Fix Level = 0
 #   Fraction  Nuclides:
003 1.0000E+00 Br-84

Decay Chain: Ce-141
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Ce-141  8.898E-02 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00
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All Threads In Decay Chain: Ce-141
 #   Fraction  Nuclides:
001 1.0000E+00 Ce-141
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Ce-141    Fix Level = 0
 #   Fraction  Nuclides:
004 1.0000E+00 Ce-141

Decay Chain: Ce-143
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Ce-143  3.765E-03 002 Pr-143  1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 Pr-143  3.713E-02 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Ce-143
 #   Fraction  Nuclides:
001 1.0000E+00 Ce-143  Pr-143
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Ce-143    Fix Level = 0
 #   Fraction  Nuclides:
005 1.0000E+00 Ce-143     Pr-143

Decay Chain: Ce-144
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Ce-144  7.784E-01 002 Pr-144m 1.7800E-02 003 Pr-144  9.8220E-01 000         0.0000E+00
002 Pr-144m 1.369E-05 000 EOCB    1.0000E-03 003 Pr-144  9.9900E-01 000         0.0000E+00
003 Pr-144  3.285E-05 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Ce-144
 #   Fraction  Nuclides:
001 1.7800E-05 Ce-144  Pr-144m
002 1.7782E-02 Ce-144  Pr-144m Pr-144
003 9.8220E-01 Ce-144  Pr-144
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Ce-144    Fix Level = 0
 #   Fraction  Nuclides:
006 1.7800E-05 Ce-144+D
007 9.9998E-01 Ce-144+D   Pr-144

Decay Chain: Co-58
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Co-58   1.938E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Co-58
 #   Fraction  Nuclides:
001 1.0000E+00 Co-58
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Co-58    Fix Level = 0
 #   Fraction  Nuclides:
008 1.0000E+00 Co-58
```

```
Decay Chain: Co-60
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Co-60   5.271E+00 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Co-60
 #   Fraction  Nuclides:
001 1.0000E+00 Co-60
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Co-60    Fix Level = 0
 #   Fraction  Nuclides:
009 1.0000E+00 Co-60

Decay Chain: Cr-51
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Cr-51   7.585E-02 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Cr-51
 #   Fraction  Nuclides:
001 1.0000E+00 Cr-51
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Cr-51    Fix Level = 0
 #   Fraction  Nuclides:
010 1.0000E+00 Cr-51

Decay Chain: Cs-134
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Cs-134  2.062E+00 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Cs-134
 #   Fraction  Nuclides:
001 1.0000E+00 Cs-134
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Cs-134    Fix Level = 0
 #   Fraction  Nuclides:
011 1.0000E+00 Cs-134

Decay Chain: Cs-136
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Cs-136  3.587E-02 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Cs-136
 #   Fraction  Nuclides:
001 1.0000E+00 Cs-136
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Cs-136    Fix Level = 0
 #   Fraction  Nuclides:
012 1.0000E+00 Cs-136
```

```
Decay Chain: Cs-137
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Cs-137  3.000E+01 000 EOCB    5.4000E-02 002 Ba-137m 9.4600E-01 000         0.0000E+00
002 Ba-137m 4.852E-06 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Cs-137
 #   Fraction  Nuclides:
001 5.4000E-02 Cs-137
002 9.4600E-01 Cs-137  Ba-137m
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Cs-137    Fix Level = 0
 #   Fraction  Nuclides:
013 1.0000E+00 Cs-137+D

Decay Chain: Cs-138
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Cs-138  6.122E-05 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Cs-138
 #   Fraction  Nuclides:
001 1.0000E+00 Cs-138
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Cs-138    Fix Level = 0
 #   Fraction  Nuclides:
014 1.0000E+00 Cs-138

Decay Chain: Fe-55
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Fe-55   2.700E+00 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Fe-55
 #   Fraction  Nuclides:
001 1.0000E+00 Fe-55
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Fe-55    Fix Level = 0
 #   Fraction  Nuclides:
015 1.0000E+00 Fe-55

Decay Chain: Fe-59
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Fe-59   1.219E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Fe-59
 #   Fraction  Nuclides:
001 1.0000E+00 Fe-59
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Fe-59    Fix Level = 0
 #   Fraction  Nuclides:
```

```
016 1.0000E+00 Fe-59

Decay Chain: H-3
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 H-3     1.235E+01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: H-3
 #   Fraction  Nuclides:
001 1.0000E+00 H-3
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: H-3    Fix Level = 0
 #   Fraction  Nuclides:
017 1.0000E+00 H-3

Decay Chain: I-129
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 I-129   1.570E+07 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: I-129
 #   Fraction  Nuclides:
001 1.0000E+00 I-129
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: I-129    Fix Level = 0
 #   Fraction  Nuclides:
018 1.0000E+00 I-129

Decay Chain: I-130
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 I-130   1.410E-03 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: I-130
 #   Fraction  Nuclides:
001 1.0000E+00 I-130
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: I-130    Fix Level = 0
 #   Fraction  Nuclides:
019 1.0000E+00 I-130

Decay Chain: I-132
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 I-132   2.624E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: I-132
 #   Fraction  Nuclides:
001 1.0000E+00 I-132
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: I-132    Fix Level = 0
 #   Fraction  Nuclides:
```

```
020 1.0000E+00 I-132

Decay Chain: I-134
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 I-134   1.000E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: I-134
 #   Fraction  Nuclides:
001 1.0000E+00 I-134
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: I-134    Fix Level = 0
 #   Fraction  Nuclides:
021 1.0000E+00 I-134

Decay Chain: La-140
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 La-140  4.594E-03 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: La-140
 #   Fraction  Nuclides:
001 1.0000E+00 La-140
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: La-140    Fix Level = 0
 #   Fraction  Nuclides:
022 1.0000E+00 La-140

Decay Chain: Mn-54
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Mn-54   8.556E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Mn-54
 #   Fraction  Nuclides:
001 1.0000E+00 Mn-54
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Mn-54    Fix Level = 0
 #   Fraction  Nuclides:
023 1.0000E+00 Mn-54

Decay Chain: Mn-56
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Mn-56   2.942E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Mn-56
 #   Fraction  Nuclides:
001 1.0000E+00 Mn-56
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Mn-56    Fix Level = 0
 #   Fraction  Nuclides:
```

```
024 1.0000E+00 Mn-56

Decay Chain: Mo-99
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Mo-99   7.529E-03 002 Tc-99m  8.7600E-01 003 Tc-99   1.2400E-01 000         0.0000E+00
002 Tc-99m  6.867E-04 003 Tc-99   1.0000E+00 000         0.0000E+00 000         0.0000E+00
003 Tc-99   2.130E+05 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Mo-99
 #   Fraction  Nuclides:
001 8.7600E-01 Mo-99   Tc-99m  Tc-99
002 1.2400E-01 Mo-99   Tc-99
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Mo-99    Fix Level = 0
 #   Fraction  Nuclides:
025 8.7600E-01 Mo-99      Tc-99m     Tc-99
026 1.2400E-01 Mo-99      Tc-99

Decay Chain: Nb-95
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Nb-95   9.624E-02 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Nb-95
 #   Fraction  Nuclides:
001 1.0000E+00 Nb-95
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Nb-95    Fix Level = 0
 #   Fraction  Nuclides:
027 1.0000E+00 Nb-95

Decay Chain: Pr-143
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Pr-143  3.713E-02 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Pr-143
 #   Fraction  Nuclides:
001 1.0000E+00 Pr-143
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Pr-143    Fix Level = 0
 #   Fraction  Nuclides:
028 1.0000E+00 Pr-143

Decay Chain: Pr-144
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Pr-144  3.285E-05 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Pr-144
 #   Fraction  Nuclides:
001 1.0000E+00 Pr-144
```

```
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Pr-144    Fix Level = 0
 #   Fraction  Nuclides:
029 1.0000E+00 Pr-144

Decay Chain: Rb-88
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Rb-88   3.384E-05 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Rb-88
 #   Fraction  Nuclides:
001 1.0000E+00 Rb-88
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Rb-88    Fix Level = 0
 #   Fraction  Nuclides:
030 1.0000E+00 Rb-88

Decay Chain: Rb-89
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Rb-89   2.890E-05 002 Sr-89   1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 Sr-89   1.383E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Rb-89
 #   Fraction  Nuclides:
001 1.0000E+00 Rb-89   Sr-89
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Rb-89    Fix Level = 0
 #   Fraction  Nuclides:
031 1.0000E+00 Rb-89      Sr-89

Decay Chain: Rh-103m
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Rh-103m 1.067E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Rh-103m
 #   Fraction  Nuclides:
001 1.0000E+00 Rh-103m
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Rh-103m    Fix Level = 0
 #   Fraction  Nuclides:
032 1.0000E+00 Rh-103m

Decay Chain: Ru-103
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Ru-103  1.075E-01 000 EOCB    3.0000E-03 002 Rh-103m 9.9700E-01 000         0.0000E+00
002 Rh-103m 1.067E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Ru-103
```

```
 #   Fraction  Nuclides:
001 3.0000E-03 Ru-103
002 9.9700E-01 Ru-103  Rh-103m
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Ru-103    Fix Level = 0
 #   Fraction  Nuclides:
033 3.0000E-03 Ru-103
034 9.9700E-01 Ru-103     Rh-103m

Decay Chain: Sr-89
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Sr-89   1.383E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Sr-89
 #   Fraction  Nuclides:
001 1.0000E+00 Sr-89
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Sr-89    Fix Level = 0
 #   Fraction  Nuclides:
035 1.0000E+00 Sr-89

Decay Chain: Sr-90
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Sr-90   2.912E+01 002 Y-90    1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 Y-90    7.301E-03 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Sr-90
 #   Fraction  Nuclides:
001 1.0000E+00 Sr-90   Y-90
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Sr-90    Fix Level = 0
 #   Fraction  Nuclides:
036 1.0000E+00 Sr-90      Y-90

Decay Chain: Sr-91
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Sr-91   1.084E-03 002 Y-91m   5.7800E-01 003 Y-91    4.2200E-01 000         0.0000E+00
002 Y-91m   9.451E-05 003 Y-91    1.0000E+00 000         0.0000E+00 000         0.0000E+00
003 Y-91    1.602E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Sr-91
 #   Fraction  Nuclides:
001 5.7800E-01 Sr-91   Y-91m   Y-91
002 4.2200E-01 Sr-91   Y-91
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Sr-91    Fix Level = 0
 #   Fraction  Nuclides:
037 5.7800E-01 Sr-91      Y-91m      Y-91
038 4.2200E-01 Sr-91      Y-91
```

```
Decay Chain: Sr-92
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Sr-92   3.092E-04 002 Y-92    1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 Y-92    4.038E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Sr-92
 #   Fraction  Nuclides:
001 1.0000E+00 Sr-92   Y-92
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Sr-92    Fix Level = 0
 #   Fraction  Nuclides:
039 1.0000E+00 Sr-92      Y-92

Decay Chain: Tc-99m
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Tc-99m  6.867E-04 002 Tc-99   1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 Tc-99   2.130E+05 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Tc-99m
 #   Fraction  Nuclides:
001 1.0000E+00 Tc-99m  Tc-99
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Tc-99m    Fix Level = 0
 #   Fraction  Nuclides:
040 1.0000E+00 Tc-99m     Tc-99

Decay Chain: Te-127m
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Te-127m 2.984E-01 000 EOCB    2.4000E-02 002 Te-127  9.7600E-01 000         0.0000E+00
002 Te-127  1.067E-03 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Te-127m
 #   Fraction  Nuclides:
001 2.4000E-02 Te-127m
002 9.7600E-01 Te-127m Te-127
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Te-127m    Fix Level = 0
 #   Fraction  Nuclides:
041 2.4000E-02 Te-127m
042 9.7600E-01 Te-127m    Te-127

Decay Chain: Te-129
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Te-129  1.323E-04 002 I-129   1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 I-129   1.570E+07 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Te-129
 #   Fraction  Nuclides:
001 1.0000E+00 Te-129  I-129
```

```
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Te-129    Fix Level = 0
 #   Fraction  Nuclides:
043 1.0000E+00 Te-129     I-129

Decay Chain: Te-129m
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Te-129m 9.199E-02 002 Te-129  6.5000E-01 003 I-129   3.5000E-01 000         0.0000E+00
002 Te-129  1.323E-04 003 I-129   1.0000E+00 000         0.0000E+00 000         0.0000E+00
003 I-129   1.570E+07 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Te-129m
 #   Fraction  Nuclides:
001 6.5000E-01 Te-129m Te-129  I-129
002 3.5000E-01 Te-129m I-129
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Te-129m    Fix Level = 0
 #   Fraction  Nuclides:
044 6.5000E-01 Te-129m    Te-129     I-129
045 3.5000E-01 Te-129m    I-129

Decay Chain: Te-132
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Te-132  8.921E-03 002 I-132   1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 I-132   2.624E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Te-132
 #   Fraction  Nuclides:
001 1.0000E+00 Te-132  I-132
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Te-132    Fix Level = 0
 #   Fraction  Nuclides:
046 1.0000E+00 Te-132     I-132

Decay Chain: Te-134
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Te-134  7.947E-05 002 I-134   1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 I-134   1.000E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Te-134
 #   Fraction  Nuclides:
001 1.0000E+00 Te-134  I-134
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Te-134    Fix Level = 0
 #   Fraction  Nuclides:
047 1.0000E+00 Te-134     I-134

Decay Chain: Y-90
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
```

```
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Y-90    7.301E-03 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Y-90
 #   Fraction  Nuclides:
001 1.0000E+00 Y-90
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Y-90    Fix Level = 0
 #   Fraction  Nuclides:
048 1.0000E+00 Y-90

Decay Chain: Y-91
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Y-91    1.602E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Y-91
 #   Fraction  Nuclides:
001 1.0000E+00 Y-91
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Y-91    Fix Level = 0
 #   Fraction  Nuclides:
049 1.0000E+00 Y-91

Decay Chain: Y-91m
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Y-91m   9.451E-05 002 Y-91    1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 Y-91    1.602E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Y-91m
 #   Fraction  Nuclides:
001 1.0000E+00 Y-91m   Y-91
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Y-91m    Fix Level = 0
 #   Fraction  Nuclides:
050 1.0000E+00 Y-91m      Y-91

Decay Chain: Y-92
                         First Branch          Second Branch           Third Branch
                      ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Y-92    4.038E-04 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Y-92
 #   Fraction  Nuclides:
001 1.0000E+00 Y-92
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Y-92    Fix Level = 0
 #   Fraction  Nuclides:
051 1.0000E+00 Y-92

Decay Chain: Y-93
                         First Branch          Second Branch           Third Branch
```

```
                        ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Y-93    1.152E-03 002 Zr-93   1.0000E+00 000         0.0000E+00 000         0.0000E+00
002 Zr-93   1.530E+06 003 Nb-93m  1.0000E+00 000         0.0000E+00 000         0.0000E+00
003 Nb-93m  1.360E+01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Y-93
 #   Fraction  Nuclides:
001 1.0000E+00 Y-93    Zr-93   Nb-93m
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Y-93    Fix Level = 0
 #   Fraction  Nuclides:
052 1.0000E+00 Y-93       Zr-93      Nb-93m

Decay Chain: Zr-95
                            First Branch          Second Branch           Third Branch
                        ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Zr-95   1.752E-01 002 Nb-95m  6.9800E-03 003 Nb-95   9.9302E-01 000         0.0000E+00
002 Nb-95m  9.879E-03 003 Nb-95   1.0000E+00 000         0.0000E+00 000         0.0000E+00
003 Nb-95   9.624E-02 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Zr-95
 #   Fraction  Nuclides:
001 6.9800E-03 Zr-95   Nb-95m  Nb-95
002 9.9302E-01 Zr-95   Nb-95
Total Thread Fractions: 1.0000E+00

Condensed Threads In Decay Chain: Zr-95    Fix Level = 0
 #   Fraction  Nuclides:
053 6.9800E-03 Zr-95      Nb-95m     Nb-95
054 9.9302E-01 Zr-95      Nb-95
```

```
&DB
CODENAME = 'RESRAD-OFFSITE',
HAFTIM = '10 minutes',
DFFILE = 'FGR 11',
SFFILE = 'FGR 13 Morbidity',
TFFILE = 'RESRAD Default Transfer factors',
DOSELIB= 'FGR 11',
RISKLIB= 'FGR 13 Morbidity',
NAIFLXT = 0 ,
NAQFLXT = 0 ,
NSFST = 0 ,
NSWFLXT = 0 ,
NSWCONC = 0 ,
NWWCONC = 0 ,
NANUC =  59 ,
NIY =  8 ,
NPD =  81 ,
NPTS =  1024 ,
NS =  1 ,
NPDS =  88 ,
U_activity = 'pCi' ,
U_dose_unit = 'mrem' ,
nDAll =  3 ,
&END
&INDATA
TITLE = 'RESRAD-OFFSITE Default Parameters',
NPTS = 1024 ,
MESTIME = 0 ,
VERS = '2.0',
XSPACE = 'LINEAR',
MINTINC = 0.125 ,
BRDL = 25,
ED = 50,
NS = 1,
NXBEARING = 59.6,
SOURCEXY(1) = 6.51,
SOURCEXY(2) = 6.51,
AGRIXY(1,1) = 0,
AGRIXY(2,1) = 0,
AGRIXY(3,1) = 0,
AGRIXY(4,1) = 0,
AGRIXY(1,2) = 0,
AGRIXY(2,2) = 0,
AGRIXY(3,2) = 0,
AGRIXY(4,2) = 0,
AGRIXY(1,3) = 0,
AGRIXY(2,3) = 0,
AGRIXY(3,3) = 0,
AGRIXY(4,3) = 0,
AGRIXY(1,4) = 0,
AGRIXY(2,4) = 0,
AGRIXY(3,4) = 0,
AGRIXY(4,4) = 0,
DWELLXY(1) = 0,
DWELLXY(2) = 0,
DWELLXY(3) = 0,
DWELLXY(4) = 0,
SWXY(1) =-150,
SWXY(2) = 150,
SWXY(3) = 487.68,
SWXY(4) = 787.68,
STOR_T(1) = 0,
STOR_T(2) = 0,
STOR_T(3) = 14,
STOR_T(4) = 1,
STOR_T(5) = 1,
STOR_T(6) = 45,
STOR_T(7) = 20,
STOR_T(8) = 1,
STOR_T(9) = 7,
STOR_T(10) = 7,
T(1) = 0,
T(2) = 1,
T(3) = 3,
T(4) = 10,
T(5) = 30,
T(6) = 100,
T(7) = 300,
T(8) = 1000,
T(9) = 0,
T(10) = 0,
PRECIP = 1.45,
WIND = 1.79,
```

```
AREA = 42.3801,
LCZPAQ = 6.51,
DM = 0,
DEPVEL_DUST = .001,
RI = 0,
EVAPTR = .5,
RUNOFF = .84,
RAINEROS = 160,
SLPLENSTPPC = .4,
CRPMANGPC = .003,
CONVPRACPC = 1,
THICK0 = 2,
TPCZ = .018,
VCZ = 1.193E-05,
DENSCZ = 1.4416,
ERODIBILITYCZ = .4,
FCCZ = .3,
BCZ = 5.3,
HCCZ = 1325.5,
COVER0 = 10.21,
TPCV = .4,
VCV = 1.193E-05,
DENSCV = 1.4416,
ERODIBILITYCV = .4,
PH2OCV = .05,
AREAO(1) = 1000,
AREAO(2) = 1000,
AREAO(3) = 10000,
AREAO(4) = 10000,
AREAODWELL = 1000,
FAREA_PLANT(1) = 0,
FAREA_PLANT(2) = 0,
FAREA_PLANT(3) = 0,
FAREA_PLANT(4) = 0,
RIRRIG(1) = 0,
RIRRIG(2) = 0,
RIRRIG(3) = 0,
RIRRIG(4) = 0,
RIRRIGDWELL = 0,
EVAPTRN(1) = .5,
EVAPTRN(2) = .5,
EVAPTRN(3) = .5,
EVAPTRN(4) = .5,
EVAPTRNDWELL = .5,
RUNOF(1) = .2,
RUNOF(2) = .2,
RUNOF(3) = .2,
RUNOF(4) = .2,
RUNOFDWELL = .2,
DPTHMIXG(1) = .15,
DPTHMIXG(2) = .15,
DPTHMIXG(3) = .15,
DPTHMIXG(4) = .15,
DPTHMIXGDWELL = .15,
TMOF(1) = .3,
TMOF(2) = .3,
TMOF(3) = .3,
TMOF(4) = .3,
TMOFDWELL = .3,
EROSN(1) = 1.193E-05,
EROSN(2) = 1.193E-05,
EROSN(3) = 1.193E-05,
EROSN(4) = 1.193E-05,
EROSNDWELL = 0,
RHOB(1) = 1.4416,
RHOB(2) = 1.4416,
RHOB(3) = 1.4416,
RHOB(4) = 1.4416,
RHOBDWELL = 1.4416,
ERODIBILITY(1) = .4,
ERODIBILITY(2) = .4,
ERODIBILITY(3) = .4,
ERODIBILITY(4) = .4,
ERODIBILITYDWELL = 0,
SLPLENSTP(1) = .4,
SLPLENSTP(2) = .4,
SLPLENSTP(3) = .4,
SLPLENSTP(4) = .4,
SLPLENSTPDWELL = .4,
CRPMANG(1) = .003,
CRPMANG(2) = .003,
CRPMANG(3) = .003,
CRPMANG(4) = .003,
```

```
CRPMANGDWELL = .003,
CONVPRAC(1) = 1,
CONVPRAC(2) = 1,
CONVPRAC(3) = 1,
CONVPRAC(4) = 1,
CONVPRACDWELL = 1,
IDISPMOD = 1,
IZONE = 1,
AIRRELHT = .1,
HEATFLX = 0,
ANH = 10,
TABK = 285,
AMIX = 400,
PMIX = 1600,
AGRIELEV(1) = 10,
AGRIELEV(2) = 12,
AGRIELEV(3) = 20,
AGRIELEV(4) = 14,
DWELLELEV = 6,
SWELEV = 26,
WINDSPEED(1) = .89,
WINDSPEED(2) = 2.46,
WINDSPEED(3) = 4.47,
WINDSPEED(4) = 6.93,
WINDSPEED(5) = 9.61,
WINDSPEED(6) = 12.52,
DFREQ(1,1,1) = 1,
DFREQ(2,1,1) = 0,
DFREQ(3,1,1) = 0,
DFREQ(4,1,1) = 0,
DFREQ(5,1,1) = 0,
DFREQ(6,1,1) = 0,
DFREQ(1,2,1) = 0,
DFREQ(2,2,1) = 0,
DFREQ(3,2,1) = 0,
DFREQ(4,2,1) = 0,
DFREQ(5,2,1) = 0,
DFREQ(6,2,1) = 0,
DFREQ(1,3,1) = 0,
DFREQ(2,3,1) = 0,
DFREQ(3,3,1) = 0,
DFREQ(4,3,1) = 0,
DFREQ(5,3,1) = 0,
DFREQ(6,3,1) = 0,
DFREQ(1,4,1) = 0,
DFREQ(2,4,1) = 0,
DFREQ(3,4,1) = 0,
DFREQ(4,4,1) = 0,
DFREQ(5,4,1) = 0,
DFREQ(6,4,1) = 0,
DFREQ(1,5,1) = 0,
DFREQ(2,5,1) = 0,
DFREQ(3,5,1) = 0,
DFREQ(4,5,1) = 0,
DFREQ(5,5,1) = 0,
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OFFLNAQW = 0,
OFFLNAQSN =-146.7,
OFFLNAQSF = 153.3,
EPS = .001,
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NAQSF = 1,
NPSS = 1024,
NPSSF = 1,
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PARENTRF = 0,
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RCIMCM = 0,
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H(2) = 4,
H(3) = 4,
H(4) = 4,
H(5) = 4,
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DENSUZ(2) = 1.5,
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TPUZ(3) = .4,
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EPUZ(4) = .2,
EPUZ(5) = .2,
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FCUZ(3) = .3,
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FCUZ(5) = .3,
HCUZ(1) = 1325.5,
HCUZ(2) = 10,
HCUZ(3) = 10,
HCUZ(4) = 10,
HCUZ(5) = 10,
BUZ(1) = 5.3,
BUZ(2) = 5.3,
BUZ(3) = 5.3,
BUZ(4) = 5.3,
BUZ(5) = 5.3,
ALPHALU(1) = .1,
ALPHALU(2) = .1,
ALPHALU(3) = .1,
ALPHALU(4) = .1,
ALPHALU(5) = .1,
DPTHAQ = 9.144,
DENSAQ = 1.4416,
TPSZ = .018,
EPSZ = .018,
HCSZ = 1325.5,
HGW = .005,
DWIBWT = 10,
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ALPHALOW = 3,
ALPHATW = .4,
ALPHAVW = .1,
RIAQW = 0,
EVAPTRAQW = .5,
RUNOFFAQW = .84,
HGSW = .005,
DPTHAQSW = 10,
ALPHALOSW = 10,
ALPHATSW = 1,
ALPHAVSW = .1,
RIAQSW = 0,
EVAPTRAQSW = .5,
RUNOFFAQSW = .84,
CCOL = 0,
K1COL = 0,
K3COL = 0,
DWI = 510,
FDWI = 1,
FSWD = 1,
FWWD = 0,
HHW = 0,
FSWHH = 0,
FWWHH = 0,
LWI(1) = 0,
LWI(2) = 0,
FSWLV(1) = 0,
FWWLV(1) = 0,
FSWLV(2) = 0,
FWWLV(2) = 0,
FSWIR(1) = 0,
FWWIR(1) = 0,
FSWIR(2) = 0,
FWWIR(2) = 0,
FSWIR(3) = 0,
FWWIR(3) = 0,
FSWIR(4) = 0,
FWWIR(4) = 0,
FSWIRDWELL = 0,
FWWIRDWELL = 0,
NDWI = 4,
NLWI(1) = 0,
NLWI(2) = 0,
UW = 0,
SDR = 0,
VLAKE = 150000,
TLAKE = 1,
ALAKE = 90000,
DFI(1) = 5.4,
DFI(2) = .9,
DVI(1) = 160,
DVI(2) = 14,
DMI(1) = 63,
DMI(2) = 92,
SOIL = 36.5,
FFISH(1) = .5,
FFISH(2) = .5,
FVEG(1) = .5,
FVEG(2) = .5,
FMEMI(1) = 1,
FMEMI(2) = 1,
YIELD(1) = .7,
YIELD(2) = 1.5,
GROWTIME(1) = .17,
GROWTIME(2) = .25,
FOLI_F(1) = 0,
FOLI_F(2) = 0,
RWEATHER(1) = 20,
RWEATHER(2) = 20,
FINTCEPT(1,2) = 0,
FINTCEPT(2,2) = 0,
FINTCEPT(1,1) = 0,
FINTCEPT(2,1) = 0,
DROOT(1) = 0,
DROOT(2) = 0,
YIELD(3) = 1.1,
YIELD(4) = .7,
GROWTIME(3) = .08,
GROWTIME(4) = .17,
FOLI_F(3) = 0,
FOLI_F(4) = 0,
RWEATHER(3) = 20,
RWEATHER(4) = 20,
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FINTCEPT(3,2) = 0,
FINTCEPT(4,2) = 0,
FINTCEPT(3,1) = 0,
FINTCEPT(4,1) = 0,
DROOT(3) = 0,
DROOT(4) = 0,
LFI(1,1) = 0,
LFI(1,2) = 0,
LFI(2,1) = 0,
LFI(2,2) = 0,
LSI(1,1) = 0,
LSI(1,2) = 0,
LSI(2,1) = 0,
LSI(2,2) = 0,
INHALR = 0,
MLINH = 0,
MLFD = 0,
SHF3 = 0,
SHF1 = 0,
FS =-1,
RAD_SHAPE(1) = .4166667,
RAD_SHAPE(2) = .8333333,
RAD_SHAPE(3) = 1.25,
RAD_SHAPE(4) = 1.666667,
RAD_SHAPE(5) = 2.083333,
RAD_SHAPE(6) = 2.5,
RAD_SHAPE(7) = 2.916667,
RAD_SHAPE(8) = 3.333333,
RAD_SHAPE(9) = 3.75,
RAD_SHAPE(10) = 4.166667,
RAD_SHAPE(11) = 4.583333,
RAD_SHAPE(12) = 5,
RAD_SHAPE(13) = .8333333,
RAD_SHAPE(14) = 1.666667,
RAD_SHAPE(15) = 2.5,
RAD_SHAPE(16) = 3.333333,
RAD_SHAPE(17) = 4.166667,
RAD_SHAPE(18) = 5,
RAD_SHAPE(19) = 5.833333,
RAD_SHAPE(20) = 6.666667,
RAD_SHAPE(21) = 7.5,
RAD_SHAPE(22) = 8.333333,
RAD_SHAPE(23) = 9.166667,
RAD_SHAPE(24) = 10,
FRACA(1) = .5,
FRACA(2) = 1,
FRACA(3) = 1,
FRACA(4) = 1,
FRACA(5) = 1,
FRACA(6) = 1,
FRACA(7) = 1,
FRACA(8) = .61,
FRACA(9) = .21,
FRACA(10) = .096,
FRACA(11) = 0,
FRACA(12) = 0,
FRACA(13) = .2,
FRACA(14) = .3,
FRACA(15) = .2,
FRACA(16) = .28,
FRACA(17) = .27,
FRACA(18) = .22,
FRACA(19) = .27,
FRACA(20) = .22,
FRACA(21) = .13,
FRACA(22) = .06,
FRACA(23) = .016,
FRACA(24) = 0,
FIND = 0,
FOTD = 0,
FINDDWELL = 0,
FOTDDWELL = 0,
OCCUPANCY(1) = 0,
OCCUPANCY(2) = 0,
OCCUPANCY(3) = 0,
OCCUPANCY(4) = 0,
DIFCV = .000002,
DIFCZ = .000002,
DIFFL = .0000003,
FLOOR1 = .15,
DENSFL = 2.4,
TPFL = .1,
PH2OFL = .03,
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 HRM = 2.5,
 REXG = .5,
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 EMANA(1) = .25,
 EMANA(2) = .15,
 DMC = .3,
 C14EVSN = .0000007,
 C12EVSN = 1E-10,
 CAIR = .98,
 CSOIL = .02,
 C12CZ = .03,
 C12WTR = .00002,
 C12PLANT(1) = .4,
 C12PLANT(2) = .09,
 C12PLANT(3) = .09,
 C12PLANT(4) = .4,
 C12MEAT_MILK(1) = .24,
 C12MEAT_MILK(2) = .07,
 HUMID = 8,
 H2OPLANT(1) = .8,
 H2OPLANT(2) = .8,
 H2OPLANT(3) = .8,
 H2OPLANT(4) = .8,
 H2OMEAT_MILK(1) = .6,
 H2OMEAT_MILK(2) = .88,
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 'Ce-144+D', 'Ce-144+D', 'Co-58', 'Co-60', 'Cr-51', 'Cs-134',
 'Cs-136', 'Cs-137+D', 'Cs-138', 'Fe-55', 'Fe-59', 'H-3', 'I-129',
 'I-130', 'I-132', 'I-134', 'La-140', 'Mn-54', 'Mn-56', 'Mo-99',
 'Mo-99', 'Nb-93m', 'Nb-95', 'Nb-95m', 'Pr-143', 'Pr-144', 'Rb-88',
 'Rb-89', 'Rh-103m', 'Ru-103', 'Ru-103', 'Sr-89', 'Sr-90', 'Sr-91',
 'Sr-91', 'Sr-92', 'Tc-99', 'Tc-99m', 'Te-127', 'Te-127m', 'Te-127m',
 'Te-129', 'Te-129m', 'Te-129m', 'Te-132', 'Te-134', 'Y-90',
 'Y-91', 'Y-91m', 'Y-92', 'Y-93', 'Zr-93', 'Zr-95', 'Zr-95',
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  696900, 1010000, 505000, 373700, 505, 131.3, 1010000, .01515,
  11110, 949400, 222200, 313.1, 676.7, 171700, 2*212100, 0, 161.6,
  0, 151.5, 121.2, 15200000, 69690, 3*141.4, 1111, 49.49, 2*1717,
  414.1, 0, 202000, 0, 2*767.6, 3838, 2*2626, 79790, 11110, 13.13,
  141.4, 929.2, 343.4, 111.1, 0, 2*161.6,
 DCACTC = 7*0, 8193, 10836, 0, 4*5411, 2*2890, 0, 4*1.4, 0, 2*180,
  2*90, 10*0, 5*80, 2*.1, 16*0,
 DCACTDWE = 0, 50, 49, 6*1000, 30, 4*4600, 2*1000, 0, 4*.1, 4.98,
  2*200, 2*125, 3*0, 2*157, 2*125, 4, 2*0, 5*30, 10*0, 5*720, 3*2200,
 DCACTSWB = 7*0, 8193, 10836, 0, 4*5411, 2*2890, 0, 4*1.4, 0, 2*180,
  2*90, 10*0, 5*80, 2*.1, 16*0,
 DCACTU1 = 7*0, 8193, 10836, 0, 4*5411, 2*2890, 0, 4*1.4, 0, 2*180,
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 DCACTS = 7*0, 8193, 10836, 0, 4*5411, 2*2890, 0, 4*1.4, 0, 2*180,
  2*90, 10*0, 5*80, 2*.1, 16*0,
 DCACTV1 = 0, 50, 49, 6*1000, 30, 4*4600, 2*1000, 0, 4*.1, 4.98,
  2*200, 2*125, 3*0, 2*157, 2*125, 4, 2*0, 5*30, 10*0, 5*720, 3*2200,
 DCACTV2 = 0, 50, 49, 6*1000, 30, 4*4600, 2*1000, 0, 4*.1, 4.98,
  2*200, 2*125, 3*0, 2*157, 2*125, 4, 2*0, 5*30, 10*0, 5*720, 3*2200,
 DCACTL1 = 0, 50, 49, 6*1000, 30, 4*4600, 2*1000, 0, 4*.1, 4.98,
  2*200, 2*125, 3*0, 2*157, 2*125, 4, 2*0, 5*30, 10*0, 5*720, 3*2200,
 DCACTL2 = 0, 50, 49, 6*1000, 30, 4*4600, 2*1000, 0, 4*.1, 4.98,
  2*200, 2*125, 3*0, 2*157, 2*125, 4, 2*0, 5*30, 10*0, 5*720, 3*2200,
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 SOLUBK0 = 59*0,
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 SHGSW = 5,
 NSENA = 1,
 NUM_SAMPS = 0, NUMVAR = 0, NUMRELVAR = 0,
 SELPATH = 64,
 NAIFLXT = 0 ,
 NAQFLXT = 0 ,
 NSFST = 0 ,
 NSWFLXT = 0 ,
 NSWCONC = 0 ,
 NWWCONC = 0 ,
 STARFILEREAD = 0 ,
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 SAVEGTDATA = 0 ,
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  2*5, 8*.6, 5*.0025, 3*.001, .15, .005, .76, 4*.002, 2*.08, .00025,
  4*.04, 2*.001, 4.8, 4*.02, .0025, 2*.3, 2*.13, 3*.01, 2*.0025,
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 72  78
Vertices
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