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DTE Energy

10CFR50.90
10CFR50.67

December 12, 2003
NRC-03-0095

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington D C 20555-0001

References: 1) Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

2) Detroit Edison Letter to NRC, "Proposed License Amendment for the Implementation of Alternative Radiological Source Term Methodology," NRC-03-0007, dated February 13, 2003

3) Detroit Edison's Letter to NRC, "Response to NRC Request for Additional Information Regarding the Implementation of Alternative Source Term," NRC-03-0053, dated July 8, 2003

Subject: Response to NRC Request for Additional Information Regarding the Implementation of Alternative Source Term

In Reference 2, Detroit Edison requested NRC approval of a proposed license amendment that modifies the Technical Specifications (TS) based on a re-evaluation of the Loss of Coolant Accident (LOCA) radiological dose consequences using the Alternative Source Term (AST) methodology. In Reference 3, Detroit Edison provided responses to NRC request for additional information regarding the proposed license amendment. In reviewing Reference 3, the NRC raised additional questions regarding the modeling of main steam line leakage aerosol deposition credit. These questions were discussed in telephone conversations between the NRC staff and Detroit Edison personnel on August 7, 14 and 22, 2003, and on October 22, 2003.

Enclosure 1 to this letter provides responses to the NRC questions. Enclosure 2 provides a replacement marked up page of the existing TS and a replacement typed

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version of the affected page with the changes incorporated. Enclosure 2 also provides three replacement marked up pages of the existing TS Bases showing the proposed changes. The PAVAN and ARCON96 computer programs' input data provided previously in Reference 3 is not impacted by the current changes; however, the RADTRAD computer program input files and LOCA nuclide information files provided in Reference 3 are replaced with the ones in Enclosure 3 to this letter.

The conclusions made in Reference 2 regarding no significant hazards consideration and categorical exclusion from environmental assessment are not impacted by the changes in this letter.

Should you have any questions or require additional information, please contact Mr. Norman K. Peterson of my staff at (734) 586-4258.

Sincerely,

William J. O'Connor Jr.

Enclosures

cc: H. K. Chernoff
M. A. Ring
NRC Resident Office
Regional Administrator, Region III
Supervisor, Electric Operators,
Michigan Public Service Commission

I, WILLIAM T. O'CONNOR, JR., do hereby affirm that the foregoing statements are based on facts and circumstances which are true and accurate to the best of my knowledge and belief.

WILLIAM T. O'CONNOR, JR.
Vice President - Nuclear Generation

On this 12th day of December, 2003 before me personally appeared William T. O'Connor, Jr., being first duly sworn and says that he executed the foregoing as his free act and deed.

Notary Public

KAREN M. REED
Notary Public, Monroe County, MI
My Commission Expires 09/02/2005

ENCLOSURE 1 TO
NRC-03-0095

FERMI 2 NRC DOCKET NO. 50-341
OPERATING LICENSE NO. NPF-43

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE IMPLEMENTATION OF ALTERNATIVE SOURCE TERM

Response to NRC Request for Additional Information
Regarding the Implementation of Alternative Source Term

Detroit Edison's response is provided after each NRC question (in italics):

NRC Question:

Additional RAI for FERMI AST TAC MB7794

By letter dated July 8, 2003, Detroit Edison responded to a staff request for additional information. The staff finds the responses to be generally acceptable. However, Detroit Edison's response to Questions #3, #6, and #7 regarding its modeling of main steam line leakage aerosol deposition credit has raised additional concerns regarding the acceptability [of] Detroit Edison's approach. Because of incomplete description of the methodology in the initial submittal, the staff was not able to identify these concerns earlier.

Part of your response to Question #7 notes that your approach is "consistent with RADTRAD modeling guidance." RADTRAD is a contractor-prepared computer code. The inclusion of particular modeling options in a code does not constitute that the staff will find their use acceptable in any particular application. The staff notes the explicit statements in Paragraphs 3.2 and 3.3 of Appendix A to RG 1.183 that endorse two modeling options in RADTRAD. However, Section 6.0 of Appendix A does not endorse the use of RADTRAD for main steam line aerosol deposition. In fact this section contains language to the contrary, such as "the model should be based on the assumption of well-mixed volumes." The Brockman[n]-Bixler model incorporated in RADTRAD is not based on well-mixed volumes. However, Paragraph 6.3 does provide for use of other models with suitable justification.

In the response to Questions #3.1 and #3.2, Detroit Edison addressed the assumption of an eight-hour delay period based on plug flow. Response #3.2 provided a brief justification for assuming plug flow. The response stated that "This approach has been previously approved by the NRC in other AST applications such as for the Brunswick Nuclear Power Plant." There are several significant differences between the Brunswick and Fermi analyses:

- *Brunswick did not assume deposition in piping upstream of the inboard MSIV; Page 10 to Enclosure 1 of your response states that piping surface area and volume were calculated from the vessel nozzle to the discharge of the third MSIV.*
- *Brunswick assumed a single failure of one of the inboard MSIVs, reducing the pipe surface area credited for deposition; Fermi did not assume a single failure of an inboard MSIV.*
- *Brunswick did not credit a delay time in the onset of the release; Fermi did.*

- *Brunswick assumed a constant pressure and temperature of 4.33 bars and 560 degree F. over thirty days; Based on Attachment 4 to the response, Fermi assumed 1.36 to 1.0 bar and 560 to 200 degrees over a 96-hour period.*
- *Brunswick provided information to certify that the main steam piping downstream of the third MSIV and the main condenser could meet the prerequisites provided in the staff-approved BWROG report NEDC-31858P-A, thereby establishing a greater holdup volume; Fermi did not provide a similar analysis.*

The staff found that the added conservatism from the above assumptions provided additional margin to compensate for differences in conservatism in plug flow and well-mixed volume assumptions. The Brunswick approach is similar to that approved earlier for the Duane Arnold Energy Center.

Please respond to the following questions:

1. *Given the above, the staff questions whether the approach used is acceptably conservative for use in a design basis accident analysis and requests that Detroit Edison provide an adequate justification for the proposed modeling approach, or re-perform the analyses using methods and assumptions acceptable to the staff. Appendix A of the staff report: AEB-98-03, "Assessment of the Radiological Consequences for the Perry Pilot Plant Application using the Revised (NUREG-1465) Source Term" documents an acceptable methodology. The methodology of this report, which can be found online in ADAMS at ML011230531, was successfully used by at least two additional licensees. The staff has accepted two applications of plug flow in which the licensee has committed to maintaining a seismically rugged drain path from the 3rd MSIV to and through the main condenser as provided in BWROG report NEDC-31858P-A (see Paragraph 6.5 of Appendix A to RG 1.183). The safety evaluations for these amendment requests are available on ADAMS at ML011660142 and ML021480483*

<u>Detroit Edison's Response:</u>

Plug flow based holdup and deposition credit using the Brockmann-Bixler model in the RADTRAD computer program are no longer used in the analyses. The analyses have been re-performed based on the more conservative well-mixed methodology described in AEB-98-03 for modeling the main steam line leakage aerosol deposition.

Table 1 provides a summary of parameters used for crediting main steam line piping deposition for aerosols, elemental and organic iodine.

This same well-mixed modeling approach is also applied to the proposed method for optional adjustment of measured secondary containment bypass leakage for piping deposition described in Reference 2 (Pages 6 and 7 of Enclosure 1). Applying the well-mixed modeling results in a change to the Feedwater penetration evaluation example

provided. Using Approach A (see Reference 2) would require multiplying the measured penetration leak rate by 0.162 instead of 0.0721; and using Approach B would require multiplying the measured leak rate by 6.51 instead of 3.25.

NRC Question:

2. *While the staff agrees that a single isolation valve establishes the mass flow rate through the piping (Response #7), the assumption of a single failure was not directed towards establishing the mass flow rate. Rather, it was directed at the fact that fission product deposition in the primary coolant system was already credited in establishing the release fractions provided in Table 1 of Regulatory Guide 1.183 (and Table 3.12 of NUREG-1465). The release fractions establish the release to containment. Depending on the particular sequence, some deposition of fission products may occur in the main steam lines prior to the release to the containment. This deposition would have already been credited in establishing the release fractions. The assumption of the failed inboard MSIV extends the boundary of the primary coolant system to the second MSIV, reducing the piping volumes in which deposition can be credited. Please provide a justification of why you believe that the main steam piping between the reactor vessel nozzles and the inboard MSIV should be [included] in establishing the deposition volumes and surface areas.*

Detroit Edison's Response:

Credit for inboard main steam piping from the reactor vessel is justified based on the overall conservatism of the revised analysis. The revised analysis eliminates delay due to transport by assuming a well-mixed volume. Also, the outboard piping is assumed to remain at normal steam line temperature for the 30-day duration of the accident.

Similar inboard main steam line piping starting at the reactor pressure vessel nozzles has been credited as a deposition volume in other plants' AST applications (e.g. Perry, Duane Arnold, Brunswick, and Hope Creek).

Perry, Duane Arnold, and Brunswick postulated that the Design Basis Accident – Loss of Coolant Accident (DBA-LOCA) could involve a steam line and, therefore, did not credit inboard piping on one line. Hope Creek credited inboard piping on all lines. The Duane Arnold and Brunswick Safety Evaluation Reports (SERs) indicate that this pipe break and associated single failure assumption exceeded minimum regulatory guidance in that multiple failures are postulated.

The revised analysis assumes a DBA-LOCA involving a recirculation line break. This assumption is consistent with the non-mechanistic source terms delineated in Regulatory Guide 1.183.

In using the AEB-98-03 well-mixed two-node modeling, it is necessary to treat inboard and outboard piping differently. Outboard piping is depressurized and velocities are higher, resulting in less settling or deposition. Therefore, the outboard MSIV is selected as the worst single failure. An outboard MSIV failure results in an increased length of piping with the higher velocity. Conservatively, the outboard MSIV is assumed as a single failure for all steam lines with postulated leakage.

NRC Question:

3. *Based on information provided in Enclosure 4 of the response, you have assumed an MSIV leakage rate of 0.62 cfm for the 100 scfh lines, and 0.31 cfm for the 50 scfh line, prior to 24 hours post-accident and 50 percent of these values after 24 hours. The staff believes that these values are understated. When the proposed MSIV leakage, in scfh, at test conditions (typically 70 degrees and 25 psig) are scaled to peak containment pressure and temperature (typically 40-50 psig and about 250-350 degrees) the TS leakage past the inboard MSIV has been shown to be 1.3-1.6 cfm, at least double the value you have assumed. However, the temperature of the fluid in the steam lines is based on the steam piping temperatures, typically 500-600 degrees. At the steam piping conditions, the flow in scfm is even higher, typically 4-8 cfm. Please explain the basis of the values you used and why these values are adequately conservative since the effectiveness of deposition decreases with increasing flow.*

Detroit Edison's Response:

The analyses have been revised to more conservatively model MSIV leakage. In the re-performed analyses, the MSIV assumed leakage rates are adjusted for pressure and temperature by the following formulas:

Pressure:	Atmospheric / (Atmospheric + Test)	;	[14.7/ (14.7+25)]
Temperature:	(Pipe Wall + 460) / (Test + 460)	;	[(558 + 460) / (60 + 460)]

Where: 558 degrees Fahrenheit is the assumed normal steam temperature and 25 psig is the MSIV test pressure

This adjustment results in leakage rates of 1.2 cfm for the 100 scfh line and 0.60 cfm for the 50 scfh line, for the first 24 hours of the accident. These leakage rates are reduced by 50% after the initial 24 hours of the accident.

The adjusted leakage rates above are about twice the ones used in the previous analyses described in References 2 and 3. As outlined in Table 1 below, the conservatism used in the revised analyses compensates for other effects such as potentially higher volumetric flow rates during the initial few minutes of the accident before containment pressure falls below the MSIV test pressure.

The leakage rates for outboard piping are derived from the rates for the inboard piping established above by conservatively expanding the rates for atmospheric pressure assuming main steam piping remains at the normal steam temperature for the duration of the accident.

NRC Question:

4. *Based on information in Enclosure 1 Page 11 of your response, your steam line temperatures are based on generic analyses reported in a contractor-report. Please explain why these generic results are adequately conservative for Fermi and why assuming a non-constant value provides adequate conservatism.*

Detroit Edison's Response:

As discussed in the response to Question 3 above, the analyses have been conservatively revised to assume a constant steam line temperature of 558 degrees Fahrenheit for inboard and outboard main steam piping for the duration of the accident.

NRC Question:

5. *Based on information in Enclosure 4 to your response, you have also reduced the steam line pressure versus time. Please explain the derivation of these values an[d] why assuming a non-constant value provides adequate conservatism.*

Detroit Edison's Response:

As discussed in the response to Question 3 above, the analyses have been conservatively revised based on constant test pressure for the inboard piping and constant atmospheric pressure for the outboard piping. The 50% flow reduction after 24 hours is supported by the expected post-accident pressure response of the containment.

Primary Containment Chlorine-Bearing Material Update:

On Page 14 of Enclosure 1 to Reference 2, the quantity of chlorine-bearing material present on exposed cables inside containment was conservatively represented as approximately 5,792,250 square centimeters of Hypalon with a 0.514 centimeter thickness (80% of the average cable radius). This chlorine-bearing material is potentially subject to radiolytic breakdown and carryover of the free chlorine radicals as hydrochloric acid to the suppression pool; therefore, it was evaluated for impact on suppression pool pH for the 30-day duration of a LOCA.

During the last refueling outage (RFO9) in April/May 2003, permanent lead shielding blankets were installed inside the primary containment. The outer fabric material encasing the lead wool shielding is a silicone-impregnated fiberglass material that is subject to potential radiolytic breakdown. The breakdown of chlorine, fluorine and sulfur contained in the fabric could potentially result in carryover of hydrogen ions into the suppression pool.

A re-evaluation to consider the effect of the radiolytic breakdown of the recently installed shielding blankets on suppression pool pH levels post-LOCA concluded that the 30-day pool pH would be 7.46 (compared to 7.5 as reported in Table 13 of Reference 2). Furthermore, the re-evaluation considered the potential of installing additional shield blankets in future outages. The results concluded that up to 14 times more blanket material than was installed in RFO9 would be required to cause a suppression pool pH to drop to 7 at 30 days post accident.

Impact on MSIV Leakage and Control Room Unfiltered Inleakage:

As a result of changes to the methodology used in the re-performed analyses described in this letter, some of the input assumptions used had to be revised as described below:

- The MSIV allowable leakage is assumed at a maximum of 100 scfh per steam line and a total of no more than 150 scfh for all four lines
- The Control Room Envelope (CRE) unfiltered inleakage is assumed to be no more than 600 scfm.

All references to total MSIV allowable leakage and CRE unfiltered inleakage in References 2 and 3 should be revised to 150 scfh and 600 scfm, respectively.

Additionally, the revision to the analyses described in this letter results in a change to one page of the proposed Technical Specifications (TSs) submitted in Reference 2. The current 100 scfh combined MSIV leakage rate acceptance criterion for all four main steam lines in Surveillance SR 3.6.1.3.12 on Page 3.6-17 of the TS is revised to 150 scfh (previously proposed: 250 scfh).

Reference 2 also included marked up pages of the Fermi 2 TS Bases pages, for information only. As a result of the re-analyses described herein, the proposed changes to SR 3.6.1.3.11 on page B 3.6.1.3-16, SR 3.6.1.3.12 on page B 3.6.1.3-17, and the References on page B 3.6.1.3-18 have been revised to reflect the re-analyses.

Enclosure 2 to this letter provides a revised marked up page No. 3.6-17 of the existing TS and a typed version of the page incorporating the revised changes. The three revised marked up pages of the TS Bases are also included in the same enclosure.

Analyses Results:

The LOCA radiological consequence results presented in Table 9 of Reference 2 have changed as a result of the revision to the analyses described in this letter. The revised results are presented in Table 2.

Impact on the Significant Hazard Consideration:

A review of the analysis of no significant hazard consideration submitted in Reference 2 in accordance with 10 CFR 50.91(a) against the changes made in response to this NRC RAI and the responses provided earlier in Reference 3 concluded that the analysis is not impacted by these changes. A public notice regarding this license amendment request was published in the Federal Register on May 27, 2003.

Table 1
Summary of Main Steam Line Piping Deposition Credit

Parameter	Value	Basis
1) Leakage Limits	MSIV leakage per line: ≤ 100 scfh Total MSIV leakage for all lines: ≤ 150 scfh	Assumed values. The 100 scfh leak is assigned to the shortest steam line and the 50 scfh balance to the next shortest. This minimizes credit for settling and deposition by conservatively maximizing the velocity of the leakage inside the piping.
2) Steam Line Nodalization	A steam line is modeled as two, well-mixed nodes. The first node is defined as the piping from the RPV nozzle to the inboard MSIV. The second node is defined as the piping between the inboard (first) and third MSIVs, which is the boundary of the seismically analyzed piping. No faulted line is assumed.	This approach is consistent with the nodalization applied in AEB-98-03 for Perry as well as with previously approved analyses performed for Perry, Brunswick, Duane Arnold and Hope Creek. Perry, Brunswick and Duane Arnold assumed a faulted steam line; however, both the Brunswick and Duane Arnold SERs indicate that the faulted line assumption in combination with an MSIV single failure exceed minimum regulatory guidance. The Fermi 2 analysis assumes a worst case single active failure of an MSIV (see below) and assumes no faulted steam line. The non-mechanistic LOCA source terms are applied with the design basis recirculation line break. Table 3 provides a summary of the piping take-off and Table 4 provides the corresponding line nodalization summary.
3) Single Failure Assumptions	The outboard MSIV is assumed to be the worst case single failure. Conservatively, the outboard MSIV is assumed to fail to close for all steam lines with postulated leakage.	An active failure of an inboard MSIV would result in flow through penetration piping to be at containment conditions, i.e. at a lower volumetric flow than the depressurized flow outside of containment. A failure of the outboard MSIV depressurizes and speeds flow through penetration piping. For conservatism, two nodes are used for all steam lines with postulated leakage.
4) Aerosol Deposition	Aerosol removal in the inboard and outboard piping nodes is evaluated using the formulations of the well-mixed methodology in AEB-98-03, Appendix A. This removal credit is implemented in the RADTRAD calculation in the form of an effective filter credit.	This approach is consistent with the recommendations of Reg. Guide 1.183. Furthermore it is conservative in that only horizontal piping is credited and the settling area is assumed to be only the bottom half of this piping. AEB-98-03 indicates that, based on the conservatism of the well-mixed assumption, the median velocity is an acceptable value.

Table 1 Summary of Main Steam Line Piping Deposition Credit		
Parameter	**Value**	**Basis**
	The settling velocity is assumed as the median velocity based on the Monte Carlo analysis presented in AEB-98-03	Table 5 provides a summary of the effective pipe filter efficiencies applied to the MSIV piping leak paths evaluated in the RADTRAD models.
5) Elemental Iodine Deposition	Elemental iodine removal in the inboard and outboard piping nodes is also evaluated using the formulations in AEB-98-03, Appendix A. However, Cline* deposition velocities are used, and with total piping credited, since gravitational settling is not an applicable transport mechanism.	For conservatism, the deposition velocities are based on an assumed constant pipe wall temperature of 558 degrees Fahrenheit for the 30 day accident duration.
6) Organic Iodine Deposition	No organic iodine removal is credited.	Conservative
7) Transit Delay Credit	No plug flow based holdup credit will be taken.	Conservative
8) MSIV Containment Leak Rate	LLRT acceptance criterion is converted to its containment leak rate equivalent by applying pressure and temperature adjustment factors: Pressure: 14.7 / (14.7 + 25) Temperature: (558 + 460)/(60 + 460) After 24 hours, the MSIV leak rate is assumed to decrease by 50%.	The temperature adjustment is an arbitrary conservatism; however, it provides an allowance for other effects such as a potentially higher volumetric flow rate during the estimated 10 minute post-LOCA period before containment pressure falls below the MSIV test pressure. This assumption has been made in accordance with Reg. Guide 1.183, Appendix A. This is supported by the expected post-accident pressure response of the containment and on the basis of the conservatism inherent in the application of the full MSIV leak rate during the first 24 hours, as well as the calculation of MSIV piping filter credit based on a 30-day post-accident constant pipe wall temperature that corresponds to normal steam line conditions with no credit for the expected post-accident cooldown.
9) Flow Rates Inside Piping	Inboard piping flow rates are the same as established above. Flow rates in outboard piping are "expanded" by not applying pressure adjustment.	Conservative. No credit is taken for MS pipe cooling, which would increase settling and deposition in outboard piping.

* J.E.Cline, "MSIV Leakage Iodine Transport Analysis," Letter Report, March 26, 1991 (ADAMS ML003683718) as implemented in NUREG/CR-6604, Supplement 2

Table 2: LOCA Radiological Consequence Analysis			
Location	**Duration**	**TEDE (rem)**	**Regulatory Limit TEDE (rem)**
Control Room	30 days	4.28	5
EAB	Maximum, 2 hours	4.31	25
LPZ	30 days	2.66	25

Table 3 - Main Steam Piping Summary

24.1 Main Steam 26 inch pipe ID (inches)
21.6 Main Steam 24 inch pipe ID (inches)

Horizontal Only

Line A	Line B	Line C	Line D	
1500.4	982.6	1629.1	1487.1	24 inch Outboard Piping, length (inches)
706	462	766	700	24 inch Outboard Piping inside surface area (sq. ft.)
317	208	344	314	24 inch Outboard Piping inside volume (cu. ft.)
479.2	497.6	496.2	481.1	26 inch Outboard Piping, length (inches)
252	262	261	253	26 inch Outboard Piping inside surface area (sq. ft.)
126	131	131	127	26 inch Outboard Piping inside volume (cu. ft.)
958	724	1027	953	**Total Outboard Pipe Surface Area Credit (sq. ft.)**
444	339	475	441	**Total Outboard Pipe Volume Credit (cu. ft.)**

456.6	564.0	564.0	456.6	26 inch Inboard Piping, length (inches)
240	297	297	240	26 inch Inboard Piping inside surface area (sq. ft.)
121	149	149	121	26 inch Inboard Piping inside volume (cu. ft.)
240	297	297	240	**Total Inboard Pipe Surface Area Credit (sq. ft.)**
121	149	149	121	**Total Inboard Pipe Volume Credit (cu. ft.)**

Total

Line A	Line B	Line C	Line D	
2005.9	1486.9	2134.6	1993.5	24 inch Outboard Piping, length (inches)
944	700	1004	938	24 inch Outboard Piping inside surface area (sq. ft.)
424	314	451	421	24 inch Outboard Piping inside volume (cu. ft.)
479.2	497.6	496.2	481.1	26 inch Outboard Piping, length (inches)
252	262	261	253	26 inch Outboard Piping inside surface area (sq. ft.)
126	131	131	127	26 inch Outboard Piping inside volume (cu. ft.)
1196	961	1265	1191	**Total Outboard Pipe Surface Area Credit (sq. ft.)**
550	446	582	548	**Total Outboard Pipe Volume Credit (cu. ft.)**

1210.6	1338.3	1338.3	1210.6	26 inch Inboard Piping, length (inches)
637	704	704	637	26 inch Inboard Piping inside surface area (sq. ft.)
320	353	353	320	26 inch Inboard Piping inside volume (cu. ft.)
637	704	704	637	**Total Inboard Pipe Surface Area Credit (sq. ft.)**
320	353	353	320	**Total Inboard Pipe Volume Credit (cu. ft.)**

Table 4 – Main Steam Line Nodalization

Nodalization (Horizontals)

Line A	Line B	Line C	Line D	
456.6	564.0	564.0	456.6	Node 1 Length (inches)
240	297	297	240	Node 1 Surface Area (sq. ft.)
121	149	149	121	Node 1 Volume (cu. ft.)
1979.6	1480.1	2125.3	1968.2	Node 2 Length (inches)
958	724	1027	953	Node 2 Surface Area (sq. ft.)
444	339	475	441	Node 2 Volume (cu. ft.)

Nodalization (Totals)

Line A	Line B	Line C	Line D	
1210.6	1338.3	1338.3	1210.6	Node 1 Length (inches)
637	704	704	637	Node 1 Surface Area (sq. ft.)
320	353	353	320	Node 1 Volume (cu. ft.)
2485.1	1984.5	2630.8	2474.6	Node 2 Length (inches)
1196	961	1265	1191	Node 2 Surface Area (sq. ft.)
550	446	582	548	Node 2 Volume (cu. ft.)

Table 5 - MSL Decontamination Factors Due to Iodine Deposition

Node	Inboard B	Inboard D	Outboard B	Outboard D
Uncorrected Flow Rate (scfh)	100	50	100	50
Aerosol Settling Velocity (m/s)	1.170E-03	1.170E-03	1.170E-03	1.170E-03
Elemental Deposition Velocity (m/s)	5.359E-06	5.359E-06	5.359E-06	5.359E-06
Flow Rate (0-24 hrs.) corrected for Temp and Press (cfm)	1.208	0.604	3.263	1.631
Aerosol Settling Rate Constant (hr^{-1})	1.38E+01	1.38E+01	1.49E+01	1.49E+01
Elemental Deposition Rate Constant (hr^{-1})	1.26E-01	1.26E-01	1.37E-01	1.37E-01
Aerosol Filter Efficiency (0-24 hrs)	**96.58%**	**97.86%**	**96.23%**	**98.53%**
Aerosol Filter Efficiency (24-720 hrs)	**98.26%**	**98.92%**	**98.08%**	**99.26%**
Elemental Filter Efficiency (0-24 hrs)	**38.06%**	**52.64%**	**23.71%**	**43.50%**
Elemental Filter Efficiency (24-720 hrs)	**55.13%**	**68.97%**	**38.33%**	**60.63%**

Notes: No flow assumed in lines A and C.
No organic iodine removal is credited.

ENCLOSURE 2 TO
NRC-03-0095

FERMI 2 NRC DOCKET NO. 50-341
OPERATING LICENSE NO. NPF-43

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE IMPLEMENTATION OF ALTERNATIVE SOURCE TERM

Replacement Marked Up TS Page No. 3.6-17, a Typed Version of the Same Page, and Replacement TS Bases pages B 3.6.1.3-16, B 3.6.1.3-17 & B 3.6.1.3-18

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.1.3.11	Verify the combined equivalent leakage rate for all secondary containment bypass leakage paths that are not provided with a seal system is ≤ ~~0.04~~ 0.05 L_a when pressurized to ≥ 56.5 psig.	In accordance with the Primary Containment Leakage Rate Testing Program and Inservice Testing Program
SR 3.6.1.3.12	Verify combined MSIV leakage rate for all four main steam lines is ≤ ~~100 scfh~~ 150 scfh and ≤ 100 scfh for any one steam Line when tested at ≥ 25 psig.	In accordance with the Primary Containment Leakage Rate Testing Program
SR 3.6.1.3.13	------------------NOTE------------------ Only required to be met in MODES 1, 2, and 3. -- Verify combined leakage rate through hydrostatically tested lines that penetrate the primary containment is within limits.	In accordance with the Primary Containment Leakage Rate Testing Program

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.1.3.11	Verify the combined equivalent leakage rate for all secondary containment bypass leakage paths that are not provided with a seal system is ≤ 0.05 L_a when pressurized to ≥ 56.5 psig.	In accordance with the Primary Containment Leakage Rate Testing Program and Inservice Testing Program
SR 3.6.1.3.12	Verify combined MSIV leakage rate for all four main steam lines is ≤ 150 scfh and ≤ 100 scfh for any one steam line when tested at ≥ 25 psig.	In accordance with the Primary Containment Leakage Rate Testing Program
SR 3.6.1.3.13	------------------NOTE------------------ Only required to be met in MODES 1, 2, and 3. -- Verify combined leakage rate through hydrostatically tested lines that penetrate the primary containment is within limits.	In accordance with the Primary Containment Leakage Rate Testing Program

BASES

SURVEILLANCE REQUIREMENTS (continued)

The 18 month representative sample test frequency is based on the typical performance of this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. The nominal ten-year maximum limit is based on performance testing. Any EFCV failure will be evaluated per the Corrective Action and the Maintenance Rule programs to determine if additional testing is warranted to ensure overall reliability is maintained. Operating experience has demonstrated that these components are highly reliable and that failures to isolate are very infrequent. Therefore, testing of a representative sample was concluded to be acceptable from a reliability standpoint (Reference 6).

SR 3.6.1.3.10

The TIP shear isolation valves are actuated by explosive charges. An in place functional test is not possible with this design. The explosive squib is removed and tested to provide assurance that the valves will actuate when required. The replacement charge for the explosive squib shall be from the same manufactured batch as the one fired or from another batch that has been certified by having one of the batch successfully fired. No squib will remain in service beyond the expiration of its shelf life or its operating life. The Frequency of 18 months on a STAGGERED TEST BASIS is considered adequate given the administrative controls on replacement charges and the frequent checks of circuit continuity (SR 3.6.1.3.4).

SR 3.6.1.3.11

equivalent

≤ 0.05 La.

Leak rates for secondary containment bypass leakage paths may be adjusted to account for piping deposition credit resulting in reduced equivalent leakage rates.

This SR ensures that the leakage rate of secondary containment bypass leakage paths is ~~less than the specified leakage rate.~~ This provides assurance that the assumptions in the radiological evaluations of Reference 1 are met. The leakage rate of each bypass leakage path is assumed to be the maximum pathway leakage (leakage through the worse of the two isolation valves) unless the penetration is isolated by use of one closed and de-activated automatic valve, closed manual valve, or blind flange. In this case, the leakage rate of the isolated bypass leakage path is assumed to be the actual pathway leakage through the isolation device. If both isolation valves in the penetration are closed, the actual leakage rate is the lesser leakage rate of the two valves. The frequency is required by the Primary

BASES

SURVEILLANCE REQUIREMENTS (continued)

Containment Leakage Rate Testing Program. This SR simply imposes additional acceptance criteria. Additionally, some secondary containment bypass paths (refer to UFSAR 6.2.1.2.2.3) use non-PCIVs and therefore are not addressed by the testing Frequency of 10 CFR 50, Appendix J, testing. To address the testing for these valves, the Frequency also includes a requirement to be in accordance with the Inservice Testing Program.

Secondary containment bypass leakage is also considered part of L_a.

150 scfh, and ≤ 100 scfh for any one steam line,

SR 3.6.1.3.12

The analyses in References 1 and 4 are based on leakage that is less than the specified leakage rate. Leakage through all four main steam lines must be ≤ ~~100 scfh~~ when tested at ≥ P_t (25 psig). ~~This ensures that MSIV leakage is properly accounted for to assure safety analysis assumptions, regarding the MSIV LCS ability to provide a positive pressure seal between MSIVs, remain valid.~~ This leakage test is performed in lieu of 10 CFR 50, Appendix J, Type C test requirements, based on an exemption to 10 CFR 50, Appendix J. As such, this leakage is not combined with the Type B and C leakage rate totals. The Frequency is required by the Primary Containment Leakage Rate Testing Program.

MSIVs have separate leakage limits, and the dose consequence of this leakage path is evaluated separately and added to those calculated from primary containment L_a leakage, including secondary containment bypass leakage.

SR 3.6.1.3.13

Surveillance of hydrostatically tested lines provides assurance that the calculation assumptions of Reference 4 are met. The acceptance criteria for the combined leakage of all hydrostatically tested lines is 1 gpm times the number of valves per penetration, not to exceed 3 gpm, when tested at 1.1 P_a (≥ 62.2 psig). Additionally, a combined leakage rate limit of ≤ 5 gpm when tested at 1.1 P_a (≥ 62.2 psig) is applied for all hydrostatically tested PCIVs that penetrate containment. The combined leakage rates must be demonstrated in accordance with the leakage rate test Frequency required by Primary Containment Leakage Rate Testing Program.

This SR has been modified by a Note that states that these valves are only required to meet the combined leakage rate in MODES 1, 2, and 3, since this is when the Reactor Coolant System is pressurized and primary containment is required.

BASES

SURVEILLANCE REQUIREMENTS (continued)

In some instances, the valves are required to be capable of automatically closing during MODES other than MODES 1, 2, and 3. However, specific leakage limits are not applicable in these other MODES or conditions.

REFERENCES

1. UFSAR, Chapter 15.
2. UFSAR, Table 6.2-2.
3. 10 CFR 50, Appendix J, Option B.
4. UFSAR, Section 6.2.
5. UFSAR, Section 15.6.2.
6. GE BWROG B21-00658-01, "Excess Flow Check Valve Testing Relaxation," dated November 1998.
7. Technical Requirements Manual, Section TR 3.6.3

NO CHANGES TO THIS PAGE

ENCLOSURE 3 TO
NRC-03-0095

FERMI 2 NRC DOCKET NO. 50-341
OPERATING LICENSE NO. NPF-43

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE IMPLEMENTATION OF ALTERNATIVE SOURCE TERM

RADTRAD Files

```
Radtrad 3.03 4/15/2001
 3499MWth Power Level Fermi Unit 2 MSIV Leakage - Separate Compartmentalized
Inboard/Outboard Piping Deposition Credit - AEB-98-03 Type Dep Model - 600 cfm
CR Unfiltered Inleakage
 Nuclide Inventory File:
 c:\program files\radtrad3-03\defaults\fermiast-loca.nif
 Plant Power Level:
  3.4990E+03
 Compartments:
  10
 Compartment 1:
 Containment
   3
  2.9460E+05
   0
   0
   0
   1
   0
 Compartment 2:
 MS Line B Inboard
   3
  1.0600E+02
   0
   0
   0
   0
   0
 Compartment 3:
 MS Line D Inboard
   3
  3.2000E+02
   0
   0
   0
   0
   0
 Compartment 4:
 MS Line A Inboard
   3
  3.2000E+02
   0
   0
   0
   0
   0
 Compartment 5:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
   0
 Compartment 6:
 Control Room
   1
  5.6960E+04
   0
   0
   1
   0
   0
 Compartment 7:
 Hold
   3
  1.0000E+00
   0
   0
```

```
  0
  0
  0
Compartment 8:
MS Line B Outboard
  3
 3.5600E+02
  0
  0
  0
  0
  0
Compartment 9:
MS Line D Outboard
  3
 5.4800E+02
  0
  0
  0
  0
  0
Compartment 10:
MS Line A Outboard
  3
 5.5000E+02
  0
  0
  0
  0
  0
Pathways:
 13
Pathway 1:
Containment to Hold (Other PC Leakage)
  1
  7
  4
Pathway 2:
Containment Leak to Node 1 MSL B
  1
  2
  2
Pathway 3:
Containment Leak to Node 1 MSL D
  1
  3
  2
Pathway 4:
Containment Leak to Node 1 MSL A
  1
  4
  2
Pathway 5:
Filtered Environment to Control Room (Intake)
  5
  6
  2
Pathway 6:
Unfiltered Environment to Control Room (Inleakage)
  5
  6
  2
Pathway 7:
Control Room to Environment (Exhaust)
  6
  5
  2
Pathway 8:
MS Line B Node 1 Inboard to MS Line B Node 2 Outboard
  2
```

```
  8
  2
Pathway 9:
MS Line D Node 1 Inboard to MS Line D Node 2 Outboard
  3
  9
  2
Pathway 10:
MS Line A Node 1 Inboard to MS Line A Node 2 Outboard
  4
  10
  2
Pathway 11:
MS Line B Node 2 Outboard to Environment
  8
  5
  2
Pathway 12:
MS Line D Node 2 Outboard to Environment
  9
  5
  2
Pathway 13:
MS Line A Node 2 Outboard to Environment
  10
  5
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3-03\defaults\fgr11&12.inp
c:\program files\radtrad3-03\defaults\bwr_dba.rft
  0.0000E+00
  1
  9.5000E-01   4.8500E-02   1.5000E-03   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
 10
Compartment 1:
  0
  1
  0
  0
  0
  0
  0
  3
  3
  1.0000E+01
  1
  1
  0.0000E+00   0.0000E+00
Compartment 2:
  0
  1
  0
  0
  0
  0
```

```
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 4:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 5:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 6:
  0
  1
  0
  0
  0
  0
  1
  2.7050E+02
  2
  0.0000E+00   9.5000E+01   9.5000E+01   9.5000E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
Compartment 7:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 8:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 9:
  0
  1
```

```
  0
  0
  0
  0
  0
  0
  0
Compartment 10:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Pathways:
 13
Pathway 1:
  0
  0
  0
  0
  0
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   5.0000E-01
  2.4000E+01   2.5000E-01
  7.2000E+02   0.0000E+00
  0
Pathway 2:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   1.2080E+00   0.0000E+00   0.0000E+00   0.0000E+00
  2.4000E+01   6.0400E-01   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 3:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   6.0400E-01   0.0000E+00   0.0000E+00   0.0000E+00
  2.4000E+01   3.0200E-01   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
```

```
Pathway 4:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  2.4000E+01   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 5:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   4.0570E+02   9.9750E+01   9.9750E+01   9.9750E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 6:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   1.3526E+02   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 7:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   5.4086E+02   1.0000E+02   1.0000E+02   1.0000E+02
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 8:
  0
  0
  0
  0
```

0
1
3

0.0000E+00	1.2080E+00	9.6580E+01	3.8060E+01	0.0000E+00
2.4000E+01	6.0400E-01	9.8260E+01	5.5130E+01	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
0
0
0
0

Pathway 9:

0
0
0
0
0
1
3

0.0000E+00	6.0400E-01	9.7860E+01	5.2640E+01	0.0000E+00
2.4000E+01	3.0200E-01	9.8920E+01	6.8970E+01	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
0
0
0
0

Pathway 10:

0
0
0
0
0
1
3

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2.4000E+01	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
0
0
0
0

Pathway 11:

0
0
0
0
0
1
3

0.0000E+00	3.2630E+00	9.6230E+01	2.3710E+01	0.0000E+00
2.4000E+01	1.6310E+00	9.8080E+01	3.8330E+01	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
0
0
0
0

Pathway 12:

0
0
0
0
0
1

```
  3
  0.0000E+00   1.6310E+00   9.8530E+01   4.3500E+01   0.0000E+00
  2.4000E+01   8.1600E-01   9.9260E+01   6.0630E+01   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 13:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  2.4000E+01   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Dose Locations:
  3
Location 1:
Control Room
  6
  0
  1
  2
  0.0000E+00   3.4700E-04
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   1.0000E+00
  2.4000E+01   6.0000E-01
  9.6000E+01   4.0000E-01
  7.2000E+02   0.0000E+00
Location 2:
EAB
  5
  1
  3
  0.0000E+00   0.0000E+00
  1.1000E+00   2.0900E-04
  3.1000E+00   0.0000E+00
  1
  4
  0.0000E+00   3.4700E-04
  8.0000E+00   1.7500E-04
  2.4000E+01   2.3200E-04
  7.2000E+02   0.0000E+00
  0
Location 3:
LPZ
  5
  1
  5
  0.0000E+00   2.1700E-05
  8.0000E+00   1.4500E-05
  2.4000E+01   6.0200E-06
  9.6000E+01   1.7100E-06
  7.2000E+02   0.0000E+00
  1
  4
```

```
  0.0000E+00   3.5000E-04
  8.0000E+00   1.8000E-04
  2.4000E+01   2.3000E-04
  7.2000E+02   0.0000E+00
  0
Effective Volume Location:
  1
  6
  0.0000E+00   3.1000E-04
  2.0000E+00   2.3300E-04
  8.0000E+00   9.9300E-05
  2.4000E+01   7.0800E-05
  9.6000E+01   5.4800E-05
  7.2000E+02   0.0000E+00
Simulation Parameters:
  1
  0.0000E+00   0.0000E+00
Output Filename:
C:\Documents and Settings\01751\Desktop\Ast Project\Fermi\Fermi AST LOCA Re-
Analysis\Attachment F\(3499MWth) Fermi 2 AEB-98-03 Compartmentalized MSIV
Deposition Model (No Faulted Line - 150 scfh Leak - 600cfm CR Unfilt Inleak).o0
  1
  1
  1
  0
  0
End of Scenario File
```

```
Radtrad 3.03 4/15/2001
 3499 MWth Power Level PC Leak, 15 minute SC bypass, 600 cfm CR bypass
 Nuclide Inventory File:
 c:\program files\radtrad3-03\defaults\fermiast-loca.nif
 Plant Power Level:
  3.4990E+03
 Compartments:
   5
 Compartment 1:
 Containment
   3
  2.9463E+05
   0
   0
   0
   1
   0
 Compartment 2:
 Reactor Building
   3
  1.0000E+00
   0
   0
   0
   0
   0
 Compartment 3:
 Environment
   2
  0.0000E+00
   0
   0
   0
   0
   0
 Compartment 4:
 Control Room
   1
  5.6960E+04
   0
   0
   1
   0
   0
 Compartment 5:
 Hold
   3
  1.0000E+00
   0
   0
   0
   0
   0
 Pathways:
   9
 Pathway 1:
 Containment to Reactor Building
   1
   2
   4
 Pathway 2:
 Filtered Environment to Control Room
   3
   4
   2
 Pathway 3:
 Control Room to  Environment
   4
   3
   2
```

```
Pathway 4:
Unfiltered Environment to Control Room
  3
  4
  2
Pathway 5:
MS Line B Containment to Hold
  1
  5
  2
Pathway 6:
MS Line D Containment to Hold
  1
  5
  2
Pathway 7:
MS Line A  Containment to Hold
  1
  5
  2
Pathway 8:
Containment to  Environment
  1
  3
  4
Pathway 9:
Reactor Building to  Environment
  2
  3
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3-03\defaults\fgr11&12.inp
c:\program files\radtrad3-03\defaults\bwr_dba.rft
  0.0000E+00
  1
  9.5000E-01   4.8500E-02   1.5000E-03   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
  5
Compartment 1:
  0
  1
  0
  0
  0
  0
  0
  3
  3
  1.0000E+01
  0
Compartment 2:
  0
  1
  0
  0
  0
```

```
  0
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 4:
  0
  1
  0
  0
  0
  0
  1
  2.7045E+02
  1
  0.0000E+00   9.5000E+01   9.5000E+01   9.5000E+01
  0
  0
Compartment 5:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Pathways:
  9
Pathway 1:
  0
  0
  0
  0
  0
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   4.7500E-01
  2.4000E+01   2.3750E-01
  7.2000E+02   0.0000E+00
  0
Pathway 2:
  0
  0
  0
  0
  0
  1
  2
  0.0000E+00   4.0570E+02   9.9750E+01   9.9750E+01   9.9750E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
```

0
0
Pathway 3:
0
0
0
0
0
1
3

0.0000E+00	5.4086E+02	9.9000E+01	9.9000E+01	9.9000E+01
5.0000E-01	5.4086E+02	9.9000E+01	9.9000E+01	9.9000E+01
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
0
0
0
0
Pathway 4:
0
0
0
0
0
1
3

0.0000E+00	1.3526E+02	0.0000E+00	0.0000E+00	0.0000E+00
5.0000E-01	1.3526E+02	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
0
0
0
0
Pathway 5:
0
0
0
0
0
1
3

0.0000E+00	1.2080E+00	0.0000E+00	0.0000E+00	0.0000E+00
2.4000E+01	6.0400E-01	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
0
0
0
0
Pathway 6:
0
0
0
0
0
1
3

0.0000E+00	6.0400E-01	0.0000E+00	0.0000E+00	0.0000E+00
2.4000E+01	3.0200E-01	0.0000E+00	0.0000E+00	0.0000E+00
7.2000E+02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

0
0
0
0
0
0

```
Pathway 7:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  2.4000E+01   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Pathway 8:
  0
  0
  0
  0
  0
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   2.5000E-02
  2.4000E+01   1.2500E-02
  7.2000E+02   0.0000E+00
  0
Pathway 9:
  0
  0
  0
  0
  0
  1
  3
  0.0000E+00   1.0000E+05   0.0000E+00   0.0000E+00   0.0000E+00
  2.5000E-01   1.0000E+05   9.9000E+01   9.9000E+01   9.9000E+01
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Dose Locations:
  3
Location 1:
EAB
  3
  1
  3
  0.0000E+00   0.0000E+00
  1.1000E+00   2.0900E-04
  3.1000E+00   0.0000E+00
  1
  4
  0.0000E+00   3.4700E-04
  8.0000E+00   1.7500E-04
  2.4000E+01   2.3200E-04
  7.2000E+02   0.0000E+00
  0
Location 2:
LPZ
```

```
   3
   1
   5
   0.0000E+00   2.1700E-05
   8.0000E+00   1.4500E-05
   2.4000E+01   6.0200E-06
   9.6000E+01   1.7100E-06
   7.2000E+02   0.0000E+00
   1
   4
   0.0000E+00   3.4700E-04
   8.0000E+00   1.7500E-04
   2.4000E+01   2.3200E-04
   7.2000E+02   0.0000E+00
   0
 Location 3:
 Control Room
   4
   0
   1
   2
   0.0000E+00   3.4700E-04
   7.2000E+02   0.0000E+00
   1
   4
   0.0000E+00   1.0000E+00
   2.4000E+01   6.0000E-01
   9.6000E+01   4.0000E-01
   7.2000E+02   0.0000E+00
 Effective Volume Location:
   1
   6
   0.0000E+00   6.1800E-04
   2.0000E+00   4.5300E-04
   8.0000E+00   1.8800E-04
   2.4000E+01   1.2600E-04
   9.6000E+01   8.7000E-05
   7.2000E+02   0.0000E+00
 Simulation Parameters:
   2
   0.0000E+00   1.0000E-01
   1.2000E+01   0.0000E+00
 Output Filename:
 C:\Documents and Settings\01751\Desktop\Ast Project\Fermi\Fermi AST LOCA Re-
Analysis\Attachment F\(3499MWth) PC LEAK - PEAK-Only 5% bypass - (with 150scfh
MSIV Leak) smallCR-with 3 MS H-Lines 600 CR unfiltered.o0
   1
   2
   1
   0
   1
 End of Scenario File
```

```
Radtrad 3.03 4/15/2001
 3499 MWth Power Level ECCS Peak w reduced flashing, 15 min SC bypass, 600 cfm
unfiltered CR intake
 Nuclide Inventory File:
 c:\program files\radtrad3-03\defaults\fermiast-eccs.nif
 Plant Power Level:
  3.4990E+03
 Compartments:
    4
 Compartment 1:
 ECCS FLUID
    3
  9.4934E+05
    0
    0
    0
    0
    0
 Compartment 2:
 Reactor Building
    3
  1.0000E+00
    0
    0
    0
    0
    0
 Compartment 3:
 Environment
    2
  0.0000E+00
    0
    0
    0
    0
    0
 Compartment 4:
 Control Room
    1
  5.6960E+04
    0
    0
    1
    0
    0
 Pathways:
    5
 Pathway 1:
 ECCS FLUID to Reactor Building
    1
    2
    2
 Pathway 2:
 Reactor Building to Environment
    2
    3
    2
 Pathway 3:
 Environment to Control Room
    3
    4
    2
 Pathway 4:
 Control Room to  Environment
    4
    3
    2
 Pathway 5:
 Unfiltered Environment to Control Room
    3
```

```
  4
  2
End of Plant Model File
Scenario Description Name:

Plant Model Filename:

Source Term:
  1
  1   1.0000E+00
c:\program files\radtrad3-03\defaults\fgr11&12.inp
c:\program files\radtrad3-03\defaults\bwr_dba.rft
  0.0000E+00
  1
  9.5000E-01   4.8500E-02   1.5000E-03   1.0000E+00
Overlying Pool:
  0
  0.0000E+00
  0
  0
  0
  0
Compartments:
  4
Compartment 1:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 2:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 3:
  0
  1
  0
  0
  0
  0
  0
  0
  0
Compartment 4:
  0
  1
  0
  0
  0
  0
  1
  2.7045E+02
  1
  0.0000E+00   9.5000E+01   9.5000E+01   9.5000E+01
  0
  0
Pathways:
  5
Pathway 1:
```

```
 0
 0
 0
 0
 0
 1
 3
 0.0000E+00    5.0000E+00    9.8000E+01    9.8000E+01    9.8000E+01
 2.4000E+01    5.0000E+00    9.8000E+01    9.8000E+01    9.8000E+01
 7.2000E+02    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00
 0
 0
 0
 0
 0
 0
Pathway 2:
 0
 0
 0
 0
 0
 1
 3
 0.0000E+00    1.0000E+05    0.0000E+00    0.0000E+00    0.0000E+00
 2.5000E-01    1.0000E+05    9.9000E+01    9.9000E+01    9.9000E+01
 7.2000E+02    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00
 0
 0
 0
 0
 0
 0
Pathway 3:
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00    4.0570E+02    9.9750E+01    9.9750E+01    9.9750E+01
 7.2000E+02    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00
 0
 0
 0
 0
 0
 0
Pathway 4:
 0
 0
 0
 0
 0
 1
 2
 0.0000E+00    5.4086E+02    9.9000E+01    9.9000E+01    9.9000E+01
 7.2000E+02    0.0000E+00    0.0000E+00    0.0000E+00    0.0000E+00
 0
 0
 0
 0
 0
 0
Pathway 5:
 0
 0
 0
 0
```

```
  0
  1
  2
  0.0000E+00   1.3526E+02   0.0000E+00   0.0000E+00   0.0000E+00
  7.2000E+02   0.0000E+00   0.0000E+00   0.0000E+00   0.0000E+00
  0
  0
  0
  0
  0
  0
Dose Locations:
  3
Location 1:
EAB
  3
  1
  3
  0.0000E+00   0.0000E+00
  1.1000E+00   2.0900E-04
  3.1000E+00   0.0000E+00
  1
  4
  0.0000E+00   3.4700E-04
  8.0000E+00   1.7500E-04
  2.4000E+01   2.3200E-04
  7.2000E+02   0.0000E+00
  0
Location 2:
LPZ
  3
  1
  5
  0.0000E+00   2.1700E-05
  8.0000E+00   1.4500E-05
  2.4000E+01   6.0200E-06
  9.6000E+01   1.7100E-06
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   3.4700E-04
  8.0000E+00   1.7500E-04
  2.4000E+01   2.3200E-04
  7.2000E+02   0.0000E+00
  0
Location 3:
Control Room
  4
  0
  1
  2
  0.0000E+00   3.4700E-04
  7.2000E+02   0.0000E+00
  1
  4
  0.0000E+00   1.0000E+00
  2.4000E+01   6.0000E-01
  9.6000E+01   4.0000E-01
  7.2000E+02   0.0000E+00
Effective Volume Location:
  1
  6
  0.0000E+00   3.1000E-04
  2.0000E+00   2.3300E-04
  8.0000E+00   9.9300E-05
  2.4000E+01   7.0800E-05
  9.6000E+01   5.4800E-05
  7.2000E+02   0.0000E+00
Simulation Parameters:
  1
```

```
   0.0000E+00   0.0000E+00
 Output Filename:
 C:\Documents and Settings\01751\Desktop\Ast Project\Fermi\Fermi AST LOCA Re-
Analysis\Attachment F\(3499MWth) ECCS PEAK-600ufil 15min drawdown reduced
flash.o0
   1
   2
   1
   0
   1
 End of Scenario File
```

```
Nuclide Inventory Name:  Source Terms per DC-6120, Rev. 0
 FERMI AST LOCA - 35 GWD/MTU 4.58 MW bundle - in Ci/MW
 Power Level:
  0.1000E+01
 Nuclides:
  60
 Nuclide 001:
 Co-58
   7
  0.6117120000E+07
  0.5800E+02
  0.1529E+03
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 002:
 Co-60
   7
  0.1663401096E+09
  0.6000E+02
  0.1830E+03
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 003:
 Kr-85
   1
  0.3382974720E+09
  0.8500E+02
  0.3736E+03
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 004:
 Kr-85m
   1
  0.1612800000E+05
  0.8500E+02
  0.6693E+04
 Kr-85     0.2100E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 005:
 Kr-87
   1
  0.4578000000E+04
  0.8700E+02
  0.1343E+05
 Rb-87     0.1000E+01
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 006:
 Kr-88
   1
  0.1022400000E+05
  0.8800E+02
  0.1863E+05
 Rb-88     0.1000E+01
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 007:
 Rb-86
   3
  0.1612224000E+07
  0.8600E+02
  0.4767E+02
 none      0.0000E+00
 none      0.0000E+00
```

```
none      0.0000E+00
Nuclide 008:
Sr-89
  5
 0.4363200000E+07
 0.8900E+02
 0.2609E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 009:
Sr-90
  5
 0.9189573120E+09
 0.9000E+02
 0.3295E+04
Y-90      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 010:
Sr-91
  5
 0.3420000000E+05
 0.9100E+02
 0.3263E+05
Y-91m     0.5800E+00
Y-91      0.4200E+00
none      0.0000E+00
Nuclide 011:
Sr-92
  5
 0.9756000000E+04
 0.9200E+02
 0.3463E+05
Y-92      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 012:
Y-90
  9
 0.2304000000E+06
 0.9000E+02
 0.3405E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 013:
Y-91
  9
 0.5055264000E+07
 0.9100E+02
 0.3387E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 014:
Y-92
  9
 0.1274400000E+05
 0.9200E+02
 0.3497E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 015:
Y-93
  9
 0.3636000000E+05
 0.9300E+02
 0.2656E+05
```

```
Zr-93     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 016:
Zr-95
  9
 0.5527872000E+07
 0.9500E+02
 0.4575E+05
Nb-95m    0.7000E-02
Nb-95     0.9900E+00
none      0.0000E+00
Nuclide 017:
Zr-97
  9
 0.6084000000E+05
 0.9700E+02
 0.4322E+05
Nb-97m    0.9500E+00
Nb-97     0.5300E-01
none      0.0000E+00
Nuclide 018:
Nb-95
  9
 0.3036960000E+07
 0.9500E+02
 0.4609E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 019:
Mo-99
  7
 0.2376000000E+06
 0.9900E+02
 0.4988E+05
Tc-99m    0.8800E+00
Tc-99     0.1200E+00
none      0.0000E+00
Nuclide 020:
Tc-99m
  7
 0.2167200000E+05
 0.9900E+02
 0.4428E+05
Tc-99     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 021:
Ru-103
  7
 0.3393792000E+07
 0.1030E+03
 0.4183E+05
Rh-103m   0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 022:
Ru-105
  7
 0.1598400000E+05
 0.1050E+03
 0.2826E+05
Rh-105    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 023:
Ru-106
  7
 0.3181248000E+08
```

```
 0.1060E+03
 0.1558E+05
Rh-106    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 024:
Rh-105
  7
 0.1272960000E+06
 0.1050E+03
 0.2624E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 025:
Sb-127
  4
 0.3326400000E+06
 0.1270E+03
 0.2278E+04
Te-127m   0.1800E+00
Te-127    0.8200E+00
none      0.0000E+00
Nuclide 026:
Sb-129
  4
 0.1555200000E+05
 0.1290E+03
 0.8507E+04
Te-129m   0.2200E+00
Te-129    0.7700E+00
none      0.0000E+00
Nuclide 027:
Te-127
  4
 0.3366000000E+05
 0.1270E+03
 0.2244E+04
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 028:
Te-127m
  4
 0.9417600000E+07
 0.1270E+03
 0.3799E+03
Te-127    0.9800E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 029:
Te-129
  4
 0.4176000000E+04
 0.1290E+03
 0.8084E+04
I-129     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 030:
Te-129m
  4
 0.2903040000E+07
 0.1290E+03
 0.1639E+04
Te-129    0.6500E+00
I-129     0.3500E+00
none      0.0000E+00
Nuclide 031:
Te-131m
```

```
  4
 0.1080000000E+06
 0.1310E+03
 0.5246E+04
Te-131   0.2200E+00
I-131    0.7800E+00
none     0.0000E+00
Nuclide 032:
Te-132
  4
 0.2815200000E+06
 0.1320E+03
 0.3823E+05
I-132    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 033:
I-131
  2
 0.6946560000E+06
 0.1310E+03
 0.2657E+05
Xe-131m  0.1100E-01
none     0.0000E+00
none     0.0000E+00
Nuclide 034:
I-132
  2
 0.8280000000E+04
 0.1320E+03
 0.3901E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 035:
I-133
  2
 0.7488000000E+05
 0.1330E+03
 0.5500E+05
Xe-133m  0.2900E-01
Xe-133   0.9700E+00
none     0.0000E+00
Nuclide 036:
I-134
  2
 0.3156000000E+04
 0.1340E+03
 0.6078E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 037:
I-135
  2
 0.2379600000E+05
 0.1350E+03
 0.5235E+05
Xe-135m  0.1500E+00
Xe-135   0.8500E+00
none     0.0000E+00
Nuclide 038:
Xe-133
  1
 0.4531680000E+06
 0.1330E+03
 0.5412E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
```

```
Nuclide 039:
Xe-135
  1
 0.3272400000E+05
 0.1350E+03
 0.1451E+05
Cs-135   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 040:
Cs-134
  3
 0.6507177120E+08
 0.1340E+03
 0.4793E+04
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 041:
Cs-136
  3
 0.1131840000E+07
 0.1360E+03
 0.1463E+04
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 042:
Cs-137
  3
 0.9467280000E+09
 0.1370E+03
 0.4270E+04
Ba-137m  0.9500E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 043:
Ba-139
  6
 0.4962000000E+04
 0.1390E+03
 0.4843E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 044:
Ba-140
  6
 0.1100736000E+07
 0.1400E+03
 0.4877E+05
La-140   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 045:
La-140
  9
 0.1449792000E+06
 0.1400E+03
 0.5079E+05
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 046:
La-141
  9
 0.1414800000E+05
 0.1410E+03
 0.4422E+05
Ce-141   0.1000E+01
```

```
none      0.0000E+00
none      0.0000E+00
Nuclide 047:
La-142
  9
 0.5550000000E+04
 0.1420E+03
 0.4320E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 048:
Ce-141
  8
 0.2808086400E+07
 0.1410E+03
 0.4477E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 049:
Ce-143
  8
 0.1188000000E+06
 0.1430E+03
 0.4142E+05
Pr-143    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 050:
Ce-144
  8
 0.2456352000E+08
 0.1440E+03
 0.3790E+05
Pr-144m   0.1800E-01
Pr-144    0.9800E+00
none      0.0000E+00
Nuclide 051:
Pr-143
  9
 0.1171584000E+07
 0.1430E+03
 0.4041E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 052:
Nd-147
  9
 0.9486720000E+06
 0.1470E+03
 0.1800E+05
Pm-147    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 053:
Np-239
  8
 0.2034720000E+06
 0.2390E+03
 0.5051E+06
Pu-239    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 054:
Pu-238
  8
 0.2768863824E+10
 0.2380E+03
```

```
 0.8162E+02
U-234    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 055:
Pu-239
  8
 0.7594336440E+12
 0.2390E+03
 0.1041E+02
U-235    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 056:
Pu-240
  8
 0.2062920312E+12
 0.2400E+03
 0.1826E+02
U-236    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 057:
Pu-241
  8
 0.4544294400E+09
 0.2410E+03
 0.3847E+04
U-237    0.2400E-04
Am-241   0.1000E+01
none     0.0000E+00
Nuclide 058:
Am-241
  9
 0.1363919472E+11
 0.2410E+03
 0.4902E+01
Np-237   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 059:
Cm-242
  9
 0.1406592000E+08
 0.2420E+03
 0.1233E+04
Pu-238   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 060:
Cm-244
  9
 0.5715081360E+09
 0.2440E+03
 0.5321E+02
Pu-240   0.1000E+01
none     0.0000E+00
none     0.0000E+00
End of Nuclear Inventory File
```

```
Nuclide Inventory Name:  FERMI-ECCS
 FERMI AST ECCS - 35 GWD/MTU 4.58 MW bundle - in Ci/MW
 Power Level:
  0.1000E+01
 Nuclides:
  60
 Nuclide 001:
 Co-58
   7
  0.6117120000E+07
  0.5800E+02
  0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 002:
 Co-60
   7
  0.1663401096E+09
  0.6000E+02
  0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 003:
 Kr-85
   1
  0.3382974720E+09
  0.8500E+02
  0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 004:
 Kr-85m
   1
  0.1612800000E+05
  0.8500E+02
  0.0000E+00
 Kr-85     0.2100E+00
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 005:
 Kr-87
   1
  0.4578000000E+04
  0.8700E+02
  0.0000E+00
 Rb-87     0.1000E+01
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 006:
 Kr-88
   1
  0.1022400000E+05
  0.8800E+02
  0.0000E+00
 Rb-88     0.1000E+01
 none      0.0000E+00
 none      0.0000E+00
 Nuclide 007:
 Rb-86
   3
  0.1612224000E+07
  0.8600E+02
  0.0000E+00
 none      0.0000E+00
 none      0.0000E+00
```

```
none      0.0000E+00
Nuclide 008:
Sr-89
  5
 0.4363200000E+07
 0.8900E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 009:
Sr-90
  5
 0.9189573120E+09
 0.9000E+02
 0.0000E+00
Y-90      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 010:
Sr-91
  5
 0.3420000000E+05
 0.9100E+02
 0.0000E+00
Y-91m     0.5800E+00
Y-91      0.4200E+00
none      0.0000E+00
Nuclide 011:
Sr-92
  5
 0.9756000000E+04
 0.9200E+02
 0.0000E+00
Y-92      0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 012:
Y-90
  9
 0.2304000000E+06
 0.9000E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 013:
Y-91
  9
 0.5055264000E+07
 0.9100E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 014:
Y-92
  9
 0.1274400000E+05
 0.9200E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 015:
Y-93
  9
 0.3636000000E+05
 0.9300E+02
 0.0000E+00
```

```
Zr-93     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 016:
Zr-95
  9
 0.5527872000E+07
 0.9500E+02
 0.0000E+00
Nb-95m    0.7000E-02
Nb-95     0.9900E+00
none      0.0000E+00
Nuclide 017:
Zr-97
  9
 0.6084000000E+05
 0.9700E+02
 0.0000E+00
Nb-97m    0.9500E+00
Nb-97     0.5300E-01
none      0.0000E+00
Nuclide 018:
Nb-95
  9
 0.3036960000E+07
 0.9500E+02
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 019:
Mo-99
  7
 0.2376000000E+06
 0.9900E+02
 0.0000E+00
Tc-99m    0.8800E+00
Tc-99     0.1200E+00
none      0.0000E+00
Nuclide 020:
Tc-99m
  7
 0.2167200000E+05
 0.9900E+02
 0.0000E+00
Tc-99     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 021:
Ru-103
  7
 0.3393792000E+07
 0.1030E+03
 0.0000E+00
Rh-103m   0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 022:
Ru-105
  7
 0.1598400000E+05
 0.1050E+03
 0.0000E+00
Rh-105    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 023:
Ru-106
  7
 0.3181248000E+08
```

```
 0.1060E+03
 0.0000E+00
Rh-106   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 024:
Rh-105
  7
 0.1272960000E+06
 0.1050E+03
 0.0000E+00
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 025:
Sb-127
  4
 0.3326400000E+06
 0.1270E+03
 0.0000E+00
Te-127m  0.1800E+00
Te-127   0.8200E+00
none     0.0000E+00
Nuclide 026:
Sb-129
  4
 0.1555200000E+05
 0.1290E+03
 0.0000E+00
Te-129m  0.2200E+00
Te-129   0.7700E+00
none     0.0000E+00
Nuclide 027:
Te-127
  4
 0.3366000000E+05
 0.1270E+03
 0.0000E+00
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 028:
Te-127m
  4
 0.9417600000E+07
 0.1270E+03
 0.0000E+00
Te-127   0.9800E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 029:
Te-129
  4
 0.4176000000E+04
 0.1290E+03
 0.0000E+00
I-129    0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 030:
Te-129m
  4
 0.2903040000E+07
 0.1290E+03
 0.0000E+00
Te-129   0.6500E+00
I-129    0.3500E+00
none     0.0000E+00
Nuclide 031:
Te-131m
```

```
  4
 0.1080000000E+06
 0.1310E+03
 0.0000E+00
Te-131    0.2200E+00
I-131     0.7800E+00
none      0.0000E+00
Nuclide 032:
Te-132
  4
 0.2815200000E+06
 0.1320E+03
 0.0000E+00
I-132     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 033:
I-131
  2
 0.6946560000E+06
 0.1310E+03
 0.2657E+05
Xe-131m   0.1100E-01
none      0.0000E+00
none      0.0000E+00
Nuclide 034:
I-132
  2
 0.8280000000E+04
 0.1320E+03
 0.3901E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 035:
I-133
  2
 0.7488000000E+05
 0.1330E+03
 0.5500E+05
Xe-133m   0.2900E-01
Xe-133    0.9700E+00
none      0.0000E+00
Nuclide 036:
I-134
  2
 0.3156000000E+04
 0.1340E+03
 0.6078E+05
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 037:
I-135
  2
 0.2379600000E+05
 0.1350E+03
 0.5235E+05
Xe-135m   0.1500E+00
Xe-135    0.8500E+00
none      0.0000E+00
Nuclide 038:
Xe-133
  1
 0.4531680000E+06
 0.1330E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
```

```
Nuclide 039:
Xe-135
  1
 0.3272400000E+05
 0.1350E+03
 0.0000E+00
Cs-135   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 040:
Cs-134
  3
 0.6507177120E+08
 0.1340E+03
 0.0000E+00
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 041:
Cs-136
  3
 0.1131840000E+07
 0.1360E+03
 0.0000E+00
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 042:
Cs-137
  3
 0.9467280000E+09
 0.1370E+03
 0.0000E+00
Ba-137m  0.9500E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 043:
Ba-139
  6
 0.4962000000E+04
 0.1390E+03
 0.0000E+00
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 044:
Ba-140
  6
 0.1100736000E+07
 0.1400E+03
 0.0000E+00
La-140   0.1000E+01
none     0.0000E+00
none     0.0000E+00
Nuclide 045:
La-140
  9
 0.1449792000E+06
 0.1400E+03
 0.0000E+00
none     0.0000E+00
none     0.0000E+00
none     0.0000E+00
Nuclide 046:
La-141
  9
 0.1414800000E+05
 0.1410E+03
 0.0000E+00
Ce-141   0.1000E+01
```

```
none      0.0000E+00
none      0.0000E+00
Nuclide 047:
La-142
  9
 0.5550000000E+04
 0.1420E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 048:
Ce-141
  8
 0.2808086400E+07
 0.1410E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 049:
Ce-143
  8
 0.1188000000E+06
 0.1430E+03
 0.0000E+00
Pr-143    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 050:
Ce-144
  8
 0.2456352000E+08
 0.1440E+03
 0.0000E+00
Pr-144m   0.1800E-01
Pr-144    0.9800E+00
none      0.0000E+00
Nuclide 051:
Pr-143
  9
 0.1171584000E+07
 0.1430E+03
 0.0000E+00
none      0.0000E+00
none      0.0000E+00
none      0.0000E+00
Nuclide 052:
Nd-147
  9
 0.9486720000E+06
 0.1470E+03
 0.0000E+00
Pm-147    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 053:
Np-239
  8
 0.2034720000E+06
 0.2390E+03
 0.0000E+00
Pu-239    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 054:
Pu-238
  8
 0.2768863824E+10
 0.2380E+03
```

```
 0.0000E+00
U-234     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 055:
Pu-239
  8
 0.7594336440E+12
 0.2390E+03
 0.0000E+00
U-235     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 056:
Pu-240
  8
 0.2062920312E+12
 0.2400E+03
 0.0000E+00
U-236     0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 057:
Pu-241
  8
 0.4544294400E+09
 0.2410E+03
 0.0000E+00
U-237     0.2400E-04
Am-241    0.1000E+01
none      0.0000E+00
Nuclide 058:
Am-241
  9
 0.1363919472E+11
 0.2410E+03
 0.0000E+00
Np-237    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 059:
Cm-242
  9
 0.1406592000E+08
 0.2420E+03
 0.0000E+00
Pu-238    0.1000E+01
none      0.0000E+00
none      0.0000E+00
Nuclide 060:
Cm-244
  9
 0.5715081360E+09
 0.2440E+03
 0.0000E+00
Pu-240    0.1000E+01
none      0.0000E+00
none      0.0000E+00
End of Nuclear Inventory File
```