DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	R. A. Schwarz	Date Nov. 30, 1994
Project Title/Work Order		EDT No. 603208
101 SY Pump Removal		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
Westinghouse Hanford Company					
L. Brooks	S5-08	X			
C. E. Brewer	S3-15	X			
D. E. Bullock	T4-09	X			
S. L. Bump	R3-12	X			
L. L. Carter	H0-35	X			
K. J. Cleaveland	E6-37	X			
K. L. Engelhardt	S6-31	X			
S. E. Gedeon	H0-35	X			
J. Greenborg	H0-35	X			
K. D. Haggerty	T4-09	X			
C. E. Hanson	H5-09	X			
D. C. Hetzer	S6-31	X			
L. S. Krogsrud	R3-08	X			
J. W. Lentsch	S7-15	X			
J. C. Mast	H5-09	X			
T. C. Mackey	S2-03	X			
M. L. McElroy	S1-57	X			
R. E. Mendoza	R1-51	X			
K. P. Mortensen	T4-09	X			
D. P. Niebuhr	T4-01	X			
M. J. Ostrom	H5-68	X			
P. L. Owen	TR-01	X			
J. E. Pieper	R3-12	X			
G. A. Ritter	H0-38	X			
R. A. Schwarz (2)	H0-35	X			
R. G. Sobocinski	H5-09	X			
G. F. Vargo	H5-09	X			
T. R. Wilson	H5-09	X			
Central Files (Orig + 2)	L8-04	X			
Project Files (2)	H5-09	X			
O.S.T.I. (2)	L8-07	X			
Los Alamos National Laboratory					
PO Box 1663					
Los Alamos, NM 87545					
John Heneage	K555	X			
Bob White	K555	X			

A-6000-135 (01/93) WEF067

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

13 STA 4 FEB 17 1995

ENGINEERING DATA TRANSMITTAL

1. EDT 603208

2. To: (Receiving Organization) DISTRIBUTION	3. From: (Originating Organization) Radiation Physics and Shielding	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: 101 SY	6. Cog. Engr.: RA Schwarz	7. Purchase Order No.: N/A
8. Originator Remarks: Release of Dose Rate Analysis for the removal of the 101 SY Mixer Pump.		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: 101 SY
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: 12/15/94

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-TI-677		0	Dose Rate Calculations for the Removal of the Mixer Pump form Tank 101 SY	SQ	1	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. R. A. Schwarz	R. A. Schwarz	12/7/94	H0-35	S. L. Bump		12/	R3-12	3 X 1	1
1	1	Cog. Mgr. J. Greenborg	J. Greenborg	12/7/94	H0-35	K. D. Haggerty			T4-09	3 X	
1	1	QA M. L. Mcelroy	M. L. McElroy	12/15/94	S1-57	R. E. Mendoza			R1-51	3	
1	1	Safety L. S. Krogstrud	L S Krogstrud	1/31/95	R3-08	K. L. Engelhardt			S6-31	3	
		Env.				J. R. Biggs			T4-01	3	
1	1	L. L. Carter	L L Carter	12/7/94	H0-35	G. A. Ritter			H0-38	3	
1	1	J. W. Lentsch	John Lentsch	2/2/95	S7-15						
1	1	C. E. Hanson	Carl Hanson	12/7/94	H5-09						
1	1	M. J. Ostrom	Mike J. Ostrom	2-1-95	H5-68						
1	1	D. E. Bullock	D E Bullock	12/7/94	T4-09						

18.	19.	20.	21. DOE APPROVAL (if required)
R. A. Schwarz R A Schwarz 12/7/94 Signature of EDT Originator Date	J. W. Lentsch John Lentsch 2/2/95 Authorized Representative for Receiving Organization Date	J. Greenborg J Greenborg 12/7/94 Cognizant Manager Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-TI-677, REV 0
Document Title:	Dose Rate Calculations for the Removal of the Mixer Pump for Tank 101 SY
Release Date:	2/17/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz

February 17, 1995

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy. Available in paper copy and microfiche. Printed in the United States of America. Available to the U.S. Department of Energy and its contractors from:

U.S. Department of Energy
Office of Scientific and Technical Information (OSTI)
P.O. Box 62
Oak Ridge, TN 37831
Telephone: (615) 576-8401

Available to the public from: U.S. Department of Commerce
National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Telephone: (703) 487-4650

SUPPORTING DOCUMENT	1. Total Pages 161

2. Title	3. Number	4. Rev No.
Dose Rate Calculations for the Removal of the Mixer Pump from Tank 101 SY	WHC-SD-WM-TI-677	0

5. Key Words	6. Author
Tank 101 SY Mixer Pump Dose Rates	Name: R. A. Schwarz R a Schwarz 12/7/94 Signature Organization/Charge Code 8M730/J8M73

7. Abstract

This document summarizes dose rate calculations that have been made for removing the mixer pump from 101 SY. Calculations are documented for removing the pump and providing shielding for the pump once it is inserted into the shipping cask.

8. RELEASE STAMP

OFFICIAL RELEASE BY WHC
DATE FEB 17 1995
13
STA 4

A-6400-073 (08/94) WEF124

Dose Rate Calculations for the Removal of the Mixer Pump from Tank 101 SY

December, 1994

R. A. Schwarz

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Westinghouse Hanford Company
Hanford operations and Engineering Contractor
for the
U. S. Department of Energy

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

TABLE OF CONTENTS

1.0 SUMMARY 6

2.0 SOURCE 6

2.1 TANK SOURCE 7
2.2 EXTERNAL FILM SOURCE 7
2.3 INTERNAL PUMP SOURCE 7
2.4 UPPER SIMULATED SOURCE 7

3.0 GEOMETRY 8
3.1 PUMP GEOMETRY 8
3.2 DETECTOR GEOMETRY 8
3.3 SHIPPING CONTAINER GEOMETRY 8

4.0 CALCULATIONS 9
4.1 CONTOUR PLOT CALCULATIONS 9
4.2 DETECTOR CALCULATIONS 9
4.3 SHOT LOADING CALCULATIONS 10

5.0 GENERATION OF INPUT FILES 10

6.0 DETECTOR DOSE RATES 10
6.1 SHIELDED DETECTOR DOSE RATES 11
6.2 UNSHIELDED DETECTOR DOSE RATES 11
6.3 DETERMINATION OF SOURCE MASS FROM DETECTOR MEASUREMENTS . . . 11

7.0 SHIPPING CONTAINER SHIELDING CALCULATIONS 12
7.1 EXPECTED SHIELDING CONFIGURATION 12
7.2 CONSERVATIVE SHIELDING CONFIGURATION 13

8.0 UNCERTAINTY EVALUATION 13

9.0 PROCEDURE TO DETERMINE CONTAINER SHIELDING FROM MEASURED VALUES . . 14

10.0 CONTOUR PLOTS OF DOSE RATES 15

11.0 REFERENCES 15

LIST OF TABLES

Table 1. Source Composition 16
Table 2. Photon Source per Gram of Waste 17
Table 3. List of MCNP Calculations 18
Table 4. Dose Rate (mrem/hr) at the Shielded Detectors 19
Table 5. Dose Rate (mrem/hr) at the Unshielded Detectors 21
Table 6. Mass per Dose Conversion Factors 23
Table 7. Expected Shipping container Dose Rates at Each Detector Point . 25
Table 8. Maximum Shipping container Dose Rates at Each Detector Point . 27
Table 9. Shipping Container Shielding Configuration for Different Source Terms 29
Table 10. Shipping Container Dose Rates Calculated for Different Source Terms 30
Table 11. Shielded Detector Readings Corresponding to Different Source Terms 32
Table 12. Demonstration of Method for Determining Shielding Configuration 34

LIST OF FIGURES

Figure 1. MCNP Geometry Showing the Mixer Pump Inside Tank 101 SY . . . 36
Figure 2. Internal Source Inside the Mixer Pump 37
Figure 3. MCNP Pump Geometry part 1 38
Figure 4. MCNP Pump Geometry part 2 39
Figure 5. MCNP Pump Geometry part 3 40
Figure 6. MCNP Pump Geometry part 4 41
Figure 7. MCNP Pump Geometry part 5 42
Figure 8. MCNP Pump Geometry part 6 43
Figure 9. MCNP Pump Geometry part 7 44
Figure 10. MCNP Model of the Detector Arrangement 45
Figure 11. Shipping Container Located under Shot Loading Platform . . . 46
Figure 12. Detector Dose Rates from the 68 Gallon Internal Source 21 . . 47
Figure 13. Detector Dose Rates from the 3 mm External Film Source . . . 48
Figure 14. Detector Dose Rates from the Tank Source 49
Figure 15. Detector Dose Rates from the Upper Simulated Source 50
Figure 16. Total Unshielded Detector Dose Rate 51
Figure 17. Total Shielded Detector Dose Rate 52
Figure 18. Comparison of Total Shielded and Unshielded Detector Dose Rates 53
Figure 19. Source Mass Over a 1 Foot Region Centered Around the Detector 54
Figure 20. Mass per Dose Conversion Factors 55
Figure 21. Dose Rates for Worst Case Source with a Lead Shot Shield . . 56
Figure 22. Dose Rates for Worst Case Source with a Steel Shot Shield . . 57
Figure 23. Dose Rates for Worst Case Source with No Shot 58
Figure 24. 119 Gallon Internal Source With 1.64 Factor Applied 59
Figure 25. Worst Case Source with 1.64 Factor Applied 60
Figure 26. 70 % Worst Case Source with 1.64 Factor Applied 61
Figure 27. 50 % Worst Case with 1.64 Factor Applied 62
Figure 28. 10 % Worst Case Source with 1.64 Factor Applied 63
Figure 29. 5 % Worst Case Source with 1.64 Factor Applied 64
Figure 30. 1 % Worst Case Source with 1.64 Factor Applied 65
Figure 31. Shielded Detector Dose Rates for Different Source Intensities 66
Figure 32. Dose Rate (mrem/hr) for Worst Case Source with the Pump Pulled 30 Feet. 67
Figure 33. Dose Rate (mrem/hr) with the Pump Inside the Shipping Container 68
Figure 34. Dose Rate (mrem/hr) with Shipping Container Filled with Lead Shot 69
Figure 35. Dose Rate (mrem/hr) at 55 in. above the Shot Loading Platform 70

APPENDICES

Appendix A: MCNP Input File for the Tank Source 71

Appendix B: MCNP Inernal Source Description 91

Appendix C: MCNP Film Source Description 106

Appendix D: MCNP Simulated Source Description 121

Appendix E: MCNP Input for the Internal Source Shipping Container Calc. 122

Appendix F: MCNP Film Source Shipping Container Calculation 147

1.0 SUMMARY

Plans are currently being made for the removal of the mixer pump in tank 101 SY. Because the pump is contaminated with radioactive waste, it is essential that those involved in the pump removal operation have an indication of the expected dose rates when the pump is removed. Calculations were made to determine the dose rates for removing the pump, inserting the pump into a shipping container and filling the shipping container with either steel or lead shot for shielding.

Gamma ray detectors will be used to measure the dose rates at 1 foot intervals as the pump is pulled from the tank. The measured dose rates will be used to predict the dose rates outside the shipping container for determining the shielding required to reduce the dose rates to less than 100 mrem/hr. The worst case scenario (Reference 1) consists of a thin 3 mm film on the outside of the pump and 68 gallons of waste inside the pump. Given these conditions, the maximum dose rate outside the shipping container with no additional shielding present is 4.4 R/h. When shielded with steel shot, the maximum dose rate is 1.1 R/hr and with lead shot, the maximum dose rate is 73 mrem/hr. Thus, the worst case scenario can be adequately shielded to less than 100 mrem/hr with lead shot.

In the worst case scenario, the location of the source mass is defined with an internal component and an external component. However, when the pump is pulled, it will not be known where the actual waste mass is located. To account for this, the waste is assumed to be in the worst case location. When this conservatism is applied to the worst case scenario, the dose rates outside the shipping container exceed 100 mrem/hr even with lead shot shielding. For these conditions, lead blankets will be required to reduce the dose rates to less than 100 mrem/hr.

2.0 SOURCE

Table 1 lists the isotopic composition of the source obtained from Reference 1. These isotopic concentrations were used in the ORIGEN2 computer code to calculate the photon source term shown in Table 2. 90 % of the gamma ray source is from ^{137}Cs which decays to ^{137m}Ba which emits gamma rays with an energy of 0.662 MeV. The source regions were modeled with a density of 1.74 g/cc. The effects from Brehmsstrahlung were considered negligible, and were left out of the analysis to increase computational efficiency.

In the worst case scenario, the source (Reference 1) consists of 68 gallons internal to the pump and thin 3 mm film on the outside of the pump. In addition to these defined sources, another source was simulated extending from the top of the film region to the top of the riser to account for any contamination that may exist on the upper part of the pump. Dose rate calculations for the removal of the pump also included the dose rate contribution from the tank. Separate calculations were made for each of these source terms to determine how much each source contributes to the total dose rate.

2.1 TANK SOURCE

Figure 1 shows a plot of the MCNP geometry of the 101 SY tank with the mixer pump inserted. The tank source was modeled as a cylinder 600 cm (19′ 8") in radius with a depth of 90 cm (2′ 11") centered around the 42 in. riser in which the pump is inserted. The total volume of the tank source region is 1.018E+8 cc with a total source strength of 2.5613E+15 photons/sec. Even though there is waste beyond this source region, it will not contribute to the dose rates at the top of the riser due to attenuation in the waste. The source sampling was optimized both radially and axially to improve the efficiency of the monte carlo calculation. The nine source cells for this optimization are shown in Figure 1 centered radially around the pump. The waste was not modeled in the region between the outside of the pump and the inside radius of the 42 in. riser because it will not contribute to the dose rate at the top of the riser and would create unnecessary complications in the model.

2.2 EXTERNAL FILM SOURCE

A thin film of waste is assumed to be present on the outside surface of the pump. The thin film in this calculational model extends to 953.8 cm (31′ 3.5") above the bottom of the pump. This film was modeled as 1 mm thick with a volume of 4.737E+4 cc for a total photon source strength of 1.192E+12 photons/sec/cc. Because the worst case film thickness is 3 mm, the calculated dose rates were multiplied by a factor of three. The total volume of a 3 mm thick film is 37.6 gallons with a mass of 247 kg.

2.3 INTERNAL PUMP SOURCE

Figure 2 shows the regions of the pump where the internal source was modeled. The calculational source region is shown in yellow and consists of a total volume of 68 gallons. The internal source was modeled such that the legs of the pump are filled with 55 gallons of waste at a density of 1.74 g/cc. Because the worst case scenario (Reference 1) calls for 68 gallons of waste inside the pump region, the remaining 13 gallons were spread homogeneously throughout the remaining pump volume. This was done by reducing the density of the source in this remaining region from 1.74 g/cc to 0.366 g/cc. The volume of the waste for the internal source region is 2.574E+5 cc for a total photon source strength of 6.475E+12 photons/sec/cc. The total mass of the waste in the internal source region is 448 kg.

2.4 UPPER SIMULATED SOURCE

To assure that the dose rates calculated by this analysis are conservative for all axial elevations, a small source was created to extend from the top of the thin film layer to the detector location. Even though this source presumably does not exist, placing it in the model allows small amounts of contamination within this region to be conservatively included. This source was modeled such that the shipping container will not require any additional shielding to reduce the dose rates below 100 mrem/hr.

The entire source length is 18 feet long and the top of the source will be even with the detectors when the pump is pulled a foot out of the riser. The source was modeled with a radius of 53 cm and was superimposed over the existing geometry. The source was normalized such that the dose rate outside the shipping container with no shielding present will be around 50 mrem/hr. The source region was assigned a photon strength of 2.00E+10 photons/sec/cc and a total mass of 1.4 kg.

3.0 GEOMETRY

The geometry for these calculations consists of a detailed model of the 101 SY tank and a detailed model of the mixer pump. The 101-SY tank geometry was taken from an MCNP model created by Brit Hey (Reference 2). The bottom of the pump is located 2 ft. above the bottom of the tank. The tank was modeled with an inside diameter of 1143 cm (37′ 6") and an inside height of 1426 cm (46′ 9").

3.1 PUMP GEOMETRY

Figures 3 through 9 show the three dimensional geometry used for modeling the pump. The views start at the bottom of the pump and sequence through to the top of the pump. For each figure there is a plot of the pump as modeled and a cut away view of the same section of pump showing the modeling of the internals. For these plots, blue represents the internal waste, magenta represents the external film, and grey represents steel. Figure 3 shows the lower region of the pump with the outlet nozzle and dummy legs. Figure 4 shows the upper region of the nozzle and dummy legs. Figure 5 shows the pump region and Figures 6 through 9 show the upper regions of the pump.

3.2 DETECTOR GEOMETRY

Included in this calculational model are four gamma ray detectors that will be used to monitor the dose rates as the pump is removed from the tank. Two detectors will be low range (2 R/hr range, 1 mrem/hr resolution) Eberline model RO-7 ion chambers and the other two will be medium range (200 R/hr range, 100 mrem/hr resolution) Eberline model RO-7 detectors. Figure 10 shows the configuration of these detectors. The two low range detectors will be collimated with three inches of steel above and below the detector. The collimation will enable a determination of the axial waste mass inside the pump as it is pulled. The collimators are designed to determine the waste present within a 1 foot region of the pump. The two medium range detectors will not be shielded.

3.3 SHIPPING CONTAINER GEOMETRY

Once the pump is removed from the tank, it will be placed inside a shipping container on a truck. the shipping container will be filled with lead and steel shot to reduce the dose rates outside the shipping container to acceptable levels. A shot loading platform will be used to fill the outer shell of the shipping container with either steel or lead shot. Figure 11

shows a view of the pump fully inserted inside the shipping container and located underneath the shot loading platform.

4.0 CALCULATIONS

The MCNP (Reference 3) computer code was used to calculate the dose rates. MCNP is a three dimensional particle transport code that can accurately account for the transport of particles (in this case photons) from scattering events. Table 3 lists the calculations that were made for different locations and shielding configurations for the pump

For all the cases in Table 3, the film and internal pump dose rate calculations are identical except for the source. For those calculations where the tank dose rate is calculated, there have also been changes made to the importances and a dxtran sphere (Reference 3) is included to increase the calculational efficiency. This dxtran sphere is located near the bottom of the riser.

4.1 CONTOUR PLOT CALCULATIONS

The first sequence of calculations shown in Table 3, beginning with files "tank_0," "film_0," and "cell_0," were for calculating the dose rate contour plots for the pump removal process. The pump was moved in steps of three feet each for a total of 21 steps to show the pump rising up 60 feet from its initial position.

Another sequence of calculations was then made to show the contour plots for inserting the pump into the shipping container. These files are shown in Table 3 beginning with "iccask0" and "ifcask0." Contour plots were then created showing the shipping container and pump being lowered onto the truck. These files are shown in Table 3 beginning with "ictruck0" and "iftruck0."

Another series of calculations were then made to show contour plots for filling the shipping container with either steel shot or lead shot. Because there are 24 compartments in the shipping container, 48 calculations were made, one to show the compartment under the shot loading platform prior to inserting the shot, and one to show the dose rates after the shot is loaded. The files for loading the shipping container with steel shot begin with "icshot0" and "ifshot0." The files for loading the shipping container with lead shot begin with "icpbshot0" and "ifpbshot0."

4.2 DETECTOR CALCULATIONS

Another series of calculations were made to determine the dose rate at the detectors for each foot the pump is pulled. The initial input files for these sequences are "idtank_0," "idfilm_0," and "idcell_0." These calculations were used to correlate the amount of source mass within the pump to the detector dose rate. The input files for these cases are very similar to the ones for creating the contour plots except the dose rate is only calculated within the detector regions.

Appendix A contains the MCNP input listing for input file "idtank_0" which has the pump fully inserted in the tank with the gamma ray source inside the tank waste and no source in the pump region. Appendix B contains the MCNP source description for the internal gamma ray source taken from the file "idcell_0." Appendix C contains the MCNP source description for the film gamma ray source taken from the file "idfilm_0". Appendix D contains the MCNP source description for the simulated gamma ray source taken from the file "idfake_0."

4.3 SHOT LOADING CALCULATIONS

Dose rates were also calculated for inserting the pump into the shipping container, and filling of the shipping container with a combination of lead and steel shot. For these calculations, the pump was modeled using an MCNP universe to facilitate moving the pump using transformations. Calculations were made for the different source and shielding configurations identified in Table 3. Appendix E contains the input listing for the internal source calculation after the pump has been inserted in the shipping container (input file "icpdc"). Appendix F contains the external film source description for the same geometry (input file "ifpdc").

All of the files used for these calculations are stored in cfs in the directory /w97555/101sy.

5.0 GENERATION OF INPUT FILES

To efficiently generate the hundreds of input files required for performing these calculations, it was necessary to devise a system that would take an initial input file and modify it for a sequence of geometry and source movements. A master input file and a control file were created for each sequence. A C program then reads the master input file and modifies it, using instructions from the control file, to generate the input files. The master input file has flags indicating the variables to be modified for each step of the sequence. The control file provides an initial value for each variable and the amount that variable will be changed for each step in the sequence.

For every sequence of calculations, the master input file is called "inpmaster" and the control file is called "inpdat." Each sequence also has a controlling C program called "makeinp.c" that is used to generate the input files using the "inpmaster" and "inpdat" files.

6.0 DETECTOR DOSE RATES

To determine the amount of source mass inside the shipping container contributing to the dose rate, it is necessary to determine a correlation between the mass of the source in the worst case calculation and the calculated detector dose rate. To do this, the contribution to the shielded detectors from each of the different source terms was calculated for each foot the pump is pulled. A separate calculation was made to determine the internal and external film source mass over each foot of the pump as it is pulled. By dividing this mass by the corresponding dose rate, a factor can be determined to predict the number of grams/mrem/hr of source over each foot of the pump.

When the pump is actually removed these factors can be used to estimate the actual amount of source mass present in the pump using the measured dose rate readings from the shielded detectors.

6.1 SHIELDED DETECTOR DOSE RATES

Table 4 lists the average dose rates calculated at the shielded detectors for each of the source terms. The 1 sigma statistical uncertainty calculated by MCNP is also included for each dose rate. The dose rate is tabulated for every foot the pump is pulled. The simulated upper source will start contributing immediately to the dose rate, however, the dose rate from the film will not start contributing more than 1 mrem/hr until the pump is pulled 15 feet, the internal source will start contributing at 25 feet. The end of the table lists the maximum dose rate for each source. The maximum total dose rate from all contributions is 1792 mrem/hr.

6.2 UNSHIELDED DETECTOR DOSE RATES

Table 5 lists the average dose rates calculated at the unshielded detectors. The maximum dose rate at these detectors is expected to be 8,871 mrem/hr. Because there is no shielding around this detector, the film source will start contributing more than 1 mrem/hr after the pump is pulled 11 feet and the internal source will start contributing at 21 feet. The maximum tank contribution is 1272 mrem/hr which is substantially higher than the maximum 87 mrem/hr for the shielded detectors. This proves that the shielded detectors are effective in shielding out the majority of the dose rate from the tank.

Table 5 indicates that the dose rates outside the blast shield will be 15.9 mrem/hr prior to removing the pump. Dose rates taken after the pump was initially inserted were 15 mrem/hr at contact with the pump. This indicates that the calculated values are in good agreement with measured dose rate values.

Figure 12 shows a comparison of the average shielded and unshielded dose rates calculated for the 68 gallon internal source. Also included in this plot is the maximum calculated dose rate expected while the pump is being pulled. Figure 13 shows comparison of the 3 mm film dose rates calculated for the two detector types. The spikes in the plot are caused by the film on the pump seals. Figure 14 shows a comparison of the tank dose rates calculated for the two detector types. At 18 feet the dose rate decreases due to the presence of the pump in the riser which will shield out the tank source. Figure 15 shows a comparison of the dose rates for the upper simulated source. Figure 16 shows the total dose rate at the unshielded detector and the source terms that contribute to the total dose rate. Figure 17 shows the total dose rate at the shielded detector and its components. Figure 18 shows a comparison between the total shielded and unshielded dose rates.

6.3 DETERMINATION OF SOURCE MASS FROM DETECTOR MEASUREMENTS

To determine the amount of source mass inside the pump from the measured dose rates and the calculated shielded detector dose rates given in Table 4, it is

necessary to calculate the internal and external source mass present in the worst case model for each foot of the pump as it is pulled out of the riser. Table 6 lists the mass present in the worst case model for the internal source, the external film source, and the simulated upper source. Figure 19 shows a plot of the mass calculated per foot for the worst case model.

The mass in table 6 is divided by the dose rate to determine a factor with units of grams/mrem/hr. The factors for the internal source and the film source are graphed in Figure 20. The factor can then be multiplied by the actual measured dose rates to determine the number of grams present in the pump. Since it will not be known if the mass is inside or outside the pump, the highest factor will be used to conservatively determine the mass present in the pump. On the average, the mass per dose conversion factors for the internal source are 2 times higher than those for the external film source. This means that twice as much waste must be located inside the pump as outside the pump to produce the same dose rate. Thus, the conservative assumption is to calculate the mass assuming the dose rate is typically from the internal pump source to maximize the waste mass. By using the maximum factors, the mass for the worst case scenario is overestimated by 29 %.

7.0 SHIPPING CONTAINER SHIELDING CALCULATIONS

The shipping container into which the pump will be inserted contains a hollow 2 in. region into which either lead or steel shot will be poured to act as a shield. To determine the type of shielding material, if any, required for each compartment, a calculation was made for three different shipping container shielding configurations: no shielding, steel shot, and lead shot. For these calculations, a density of 6.84 g/cc (60 % full density) was used for the lead shot and a density of 4.1 g/cc (52 % full density) was used for the steel shot. A lower packing density was used for steel shot because experimental measurement of the shot currently available predict this lower value, no experimental data was provided for the lead shot.

7.1 EXPECTED SHIELDING CONFIGURATION

Dose rates calculated radially beyond the shipping container for the worst case scenario are given in Table 7 for a container filled with no shot, steel shot, or lead shot. The dose rate is tabulated at one foot intervals that correspond to the same intervals used when pulling the pump. Included in this table is the average shielded detector results from Table 4. The dose rates were calculated at 2 inches from the surface of the shipping container to simulate the actual location of a dose rate detection instrument.

The dose rates in Table 7 are shown graphically in Figures 21 through 23 for the three different shielding configurations. The compartments of the shipping container are superimposed on these plots with the different shielding materials represented by different shading patterns.

From Table 7 it can be seen that the maximum dose rate with no shielding present is 4.36 R/hr, with steel shot the maximum dose rate is 1.12 R/hr and with lead shot the maximum dose rate is 73 mrem/hr. Thus for the worst case

conditions the dose rate outside the shipping container can be reduced to less than 100 mrem/hr using lead shot.

7.2 CONSERVATIVE SHIELDING CONFIGURATION

Because it will not be known if the source is from waste inside the pump or outside the pump, it is necessary to assume that all of the waste is in the most conservative position by using the maximum mass per dose conversion factors from Table 6. Table 8 lists the dose rates calculated for the three different shielding configurations after the maximum multiplier of 1.69 (bottom of Table 8) has been applied. With this factor included, the maximum dose rate outside the shipping container with no shielding is 7.4 R/hr, the maximum dose rate with steel shot is 1.9 R/hr and the maximum dose with lead shot is 124 mrem/hr. When the conservative mass per dose conversion factors are applied, lead blankets with a thickness of 0.635 cm (0.25 in.) with a density of 11.4 g/cc are required to reduce these dose rates to less than 100 mrem/hr.

With the information from table 8 it is possible to determine the minimum shielding material required for each compartment for different source term conditions. Table 9 lists the minimum shielding required for seven different source terms consisting of a conservative 119 gallon internal source case and the worst case scenario at 100%, 70%, 50%, 5% and 1%. Lead blankets will be required for the 119 gallon case and the 100% case to bring the maximum expected dose rates to less than 100 mrem/hr at the surface of the shipping container.

Calculations were made to verify these final shielding configurations. Table 10 lists the resulting dose rates calculated for the shielding configurations provided in Table 9. All of the dose rates fall below the required 100 mrem/hr dose rate at the surface of the shipping container. Figures 24 through 30 show plots of the dose rates outside the shipping container for the final configurations. A plot of the shipping container is superimposed over the dose rate plot to indicate the required shielding.

8.0 UNCERTAINTY EVALUATION

These dose rate calculations are very complex and attempt to take into account a number of different variables. However, the main source of uncertainty will be the mass and location of the source material. As shown in section 7.0, by making a conservative assumption on the location of the source, the dose rates outside the shipping container for the worst case causes an overestimation of the expected dose rate by approximately 70 %.

These calculations are conservative because: (1) they use the worst case internal source term of 68 gallons, (2) a 3 mm external film source and (3) a conservative source mass (29%) is inferred form the detector readings for the worst case source.

Other smaller sources of uncertainty include:

1. Small differences between the calculational model and the actual pump.

2. Small differences in densities and material composition.

3. MCNP calculated statistical uncertainties.

4. Differences in the isotopic source composition.

5. Variations in the measurements.

6. Actual position of measurement instruments relative to positions in the calculations.

9.0 PROCEDURE TO DETERMINE CONTAINER SHIELDING FROM MEASURED VALUES

Table 11 lists the dose rate at the shielded detector that corresponds to each of the different source intensities given in Table 9. Figure 31 shows a graph of this information. As the pump is pulled from the tank, a dose rate measurement will be made at the collimated detectors for each foot the pump is pulled. There is a column in Table 11 where the measured dose rate can be entered. As each measurement is made, it can be compared to the numbers in Table 11 to determine the minimum source configuration with a dose rate larger then the measured dose rate. Once all of the measurements have been made, the minimum case which covers all measured data points will determine the required shielding configuration.

From Table 4 it can be seen that the worst case shielded detector reading is 1792 mrem/hr. Thus if the measured dose rate remains below 2000 mrem/hr, the shielding configurations provided in Table 9 can be used to determine the correct shielding configuration. If the dose rate exceeds 2000 mrem/hr, steps should be taken to further clean the pump. If the pump can not be cleaned enough to reduce the dose rates, the 100% shielding configuration from Table 9 should be used and lead blankets added until the dose rates outside the shipping container are reduce to less than 100 mrem/hr. The application of this method can be seen by comparing the 119 gallon case and the 100 % worst case source (68 gallon) in Table 9. The only difference between these two cases is additional blankets are required for the 119 gallon case.

Because of the conservative nature of these calculations, dose rate measurements should be made to determine if lead blankets are required before they are placed on the shipping container.

Table 12 shows an example of how Table 11 might be filled out for a fictitious pump pull. For each foot the maximum measured dose rate is entered, this dose rate is then compared to the dose rates for each of the different cases and the minimum value that exceeds the measured dose rate is circled. Notice that the circled values cover several cases. Once all of the values have been entered, the maximum case with a circled number is used to determine the shielding configuration. In this example the shielding configuration corresponding to 70 % is used, even though only a few values fall in this range.

10.0 CONTOUR PLOTS OF DOSE RATES

Contour plots of the dose rates were created by using MCNP to calculate the dose rate at up to 2,000 dose point locations using the point detector tally in MCNP. The PV-Wave (Reference 4) visualization package was then used to create contour plots of the dose rates calculated by MCNP.

Figure 32 shows a contour plot of the dose rates for the worst case source after the pump has been pulled 30 feet. Figure 33 shows a contour plot of the dose rates with the pump placed inside the shipping container. Figure 34 shows a contour plot of the dose rates with the shipping container filled with lead shot.

Figure 35 shows a contour plot of the dose rate above the shot loading platform at chest level for the worst case source term with the shipping container located in its worst case location. Notice that the dose rate above the shot loading platform varies from 20 mrem/hr to 200 mrem/hr depending on the distance away from the opening in the platform.

11.0 REFERENCES

1. R. F. Carlstrom, *Packaging Design Criteria Transfer and Disposal of Hydrogen Mitigation Mixer Pump*, WHC-SD-TP-PDC-019, July 1994.

2. Memo, Brit E. Hey to T. R. Benegas, *Dose Rate Calculations in Vicinity of Waste Tank 101-SY Mixer Pump and Shield Plug*, dated September 1, 1992.

3. L. L. Carter, *Certification of MCNP Version 4a for WHC Computer Platforms*, ECN-186708, WHC-SD-MP-SWD-30001, Rev. 6, January 1994.

4. Pv-Wave, Version 4.2, Visual Numerics, Inc.

Table 1. Source Composition

ISOTOPE	CURIES	Curies/gram*
Am 241	1.63e-01	2.29e-07
Pu 238	4.48e-04	6.29e-10
Pu 239	8.97e-03	1.26e-08
Pu 240	2.12e-03	2.98e-09
Pu 241	1.78e-02	2.50e-08
Pu 242	9.92e-08	1.39e-13
Cm 243	1.85e-04	2.60e-10
Cm 244	3.22e-03	4.52e-09
Cm 242	8.02e-05	1.13e-10
Cs 137	2.56e+02	3.60e-04
Ba 137m	2.42e+02	3.40e-04
C 14	6.17e-04	8.67e-10
Sr 90	2.99e+01	4.20e-05
Y 90	2.99e+01	4.20e-05
Tc 99	2.40e-01	3.37e-07
I 129	9.42e-03	1.32e-08
Np 237	2.66e-02	3.74e-08
U 238	3.40e-05	4.78e-11
U 235	3.74e-06	5.26e-12
Se 79	2.14e-04	3.01e-10
Nb 94	2.99e-05	4.20e-11
Nb 93m	2.56e-03	3.60e-09
Co 60	3.33e-01	4.68e-07
Eu 154	2.38e+00	3.34e-06
Ni 59	8.58e-05	1.21e-10
Ni 63	1.37e-02	1.93e-08
U 236	2.53e-06	3.55e-12
TOTAL	561.00	7.88e-04

* Based on 1569 lb mass from Reference 1.

Table 2. Photon Source per Gram of Waste

Energy (MeV)	Photons/sec/gram
0.015	2.70e+05
0.025	4.15e+04
0.038	8.73e+05
0.058	4.45e+04
0.085	2.11e+04
0.125	6.18e+04
0.225	2.46e+04
0.375	7.83e+03
0.662*	1.30e+07
0.850	5.94e+04
1.250	9.90e+04
1.750	1.99e+03
2.250	1.93e-01
2.750	6.33e-04
3.500	6.72e-05
5.000	2.85e-05
7.000	3.26e-06
11.000	3.73e-07
TOTAL	1.45e+07

* Changed from 0.575 to 0.662 to accurately reflect the ^{137m}Ba gamma rays.

Table 3. List of MCNP Calculations

Description	File Names	Runs	Time (hours)	TOTAL (hours)
Tank source for pump pull	tank_0, .., tank_20	21	2	42
Film source for pump pull	film_0, .., film_20	21	2	42
Internal source for pump pull	cell_0, .., cell_20	21	2	42
Detector tank source for pump pull	idtank_0, .., idtank_63	64	4	256
Detector film source for pump pull	idfilm_0, .., idfilm_63	64	2	128
Detector cell source for pump pull	idcell_0, .., idcell_63	63	2	128
Detector simulated source for pump pull	idfake_0,..,idfake_20	21	2	42
Film source for shipping container insertion	ifcask0, .., ifcask15	16	2	32
Cell source for shipping container insertion	iccask0, .., iccask15	16	2	32
Film source for lowering shipping container	iftruck0, .., iftruck9	10	2	20
Cell source for lowering shipping container	ictruck0, .., ictruck9	10	2	20
Film source for lead shot load	ifpbshot0, .., ifpbshot47	48	2	96
Cell source for lead shot load	icpbshot0, .., icpbshot47	48	2	96
Film source for steel shot load	ifshot0, .., ifshot47	48	2	96
Cell source for steel shot load	icshot0, .., icshot47	48	2	96
Tank source for simulation	itank	1	20	20
Cell source for simulation	icell	1	14	14
Film source for simulation	ifilm	1	14	14
100 % source (internal, film, simulated)	icpdc,ifpdc,idpdc	3	2	6
119 gallon source (internal, film, simulated)	icmax,ifmax,idmax	3	2	6
70 % source (internal, film, simualate)	ic70, if70, id70	3	2	6
10 % source (internal, film, simualate)	ic10, if10, id10	3	2	6
5 % source (internal, film, simualate)	ic5, if5, id5	3	2	6
Lead shot (internal, film, simualate)	icpbsur, ifpbsur, ipbfake	3	2	6
Steel shot (internal, film, simualate)	icsur, ifsur, issfake	3	2	6
No shot (internal, film, simualate)	icvsur, ifvsur, ifake	3	2	6
TOTAL				1264

Table 4. Dose Rate (mrem/hr) at the Shielded Detectors

Distance Pulled (ft.)	Tank		Internal		Film		Upper		Total Dose Rate (mrem/hr)
	Dose Rate (mrem/hr)	Uncer.	Dose Rate (mrem/hr)	Uncer.	Dose Rate (mrem/hr)	Uncer.	Dose Rate (mrem/hr)	Uncer.	
0	0.01	(0.73)	0.00	(0.00)	0.00	(0.00)	1.26	(0.13)	1.27
1	3.32	(0.39)	0.00	(0.00)	0.00	(0.00)	3.50	(0.09)	6.81
2	4.51	(0.14)	0.00	(0.00)	0.00	(0.00)	2.79	(0.10)	7.30
3	6.48	(0.12)	0.00	(0.00)	0.00	(0.00)	4.86	(0.09)	11.34
4	9.29	(0.09)	0.00	(0.00)	0.00	(0.00)	4.93	(0.08)	14.22
5	10.58	(0.09)	0.00	(0.00)	0.00	(0.00)	4.64	(0.08)	15.22
6	15.76	(0.12)	0.00	(0.00)	0.00	(0.00)	6.92	(0.08)	22.68
7	13.11	(0.09)	0.00	(0.00)	0.00	(0.00)	8.45	(0.08)	21.56
8	12.80	(0.14)	0.00	(0.00)	0.00	(0.00)	7.04	(0.08)	19.84
9	12.01	(0.11)	0.00	(0.00)	0.00	(0.00)	7.47	(0.08)	19.48
10	11.00	(0.10)	0.00	(0.00)	0.10	(1.00)	5.93	(0.08)	17.04
11	11.92	(0.08)	0.00	(0.00)	0.19	(1.00)	7.55	(0.08)	19.66
12	13.86	(0.10)	0.00	(0.00)	0.00	(0.00)	7.89	(0.08)	21.75
13	9.26	(0.09)	0.00	(0.00)	0.30	(0.71)	7.34	(0.08)	16.90
14	8.86	(0.10)	0.00	(0.00)	0.54	(0.73)	7.94	(0.08)	17.34
15	12.64	(0.09)	0.00	(0.00)	1.83	(0.45)	7.42	(0.08)	21.90
16	12.12	(0.13)	0.00	(0.00)	4.25	(0.29)	7.21	(0.08)	23.59
17	7.01	(0.14)	0.00	(0.00)	12.70	(0.19)	6.70	(0.08)	26.41
18	3.58	(0.44)	0.00	(0.00)	40.56	(0.09)	6.92	(0.10)	51.06
19	2.12	(0.43)	0.00	(0.00)	172.62	(0.07)	1.82	(0.11)	176.56
20	1.52	(0.45)	0.00	(0.00)	337.20	(0.12)	0.00	(0.00)	338.72
21	2.90	(0.42)	0.00	(0.00)	803.10	(0.09)	0.00	(0.00)	806.00
22	4.54	(0.66)	0.58	(1.00)	494.40	(0.10)	0.00	(0.00)	499.52
23	0.70	(0.89)	0.70	(1.00)	629.70	(0.09)	0.00	(0.00)	631.10
24	0.05	(0.66)	0.36	(1.00)	599.40	(0.09)	0.00	(0.00)	599.80
25	0.51	(0.75)	13.48	(0.34)	355.20	(0.10)	0.00	(0.00)	369.19
26	1.49	(0.68)	59.72	(0.22)	391.80	(0.13)	0.00	(0.00)	453.01
27	2.66	(0.44)	477.50	(0.13)	438.30	(0.11)	0.00	(0.00)	918.46
28	8.13	(0.24)	1187.00	(0.09)	514.20	(0.10)	0.00	(0.00)	1709.33
29	13.10	(0.29)	1004.00	(0.11)	717.30	(0.08)	0.00	(0.00)	1734.40
30	6.94	(0.20)	1005.00	(0.10)	513.60	(0.08)	0.00	(0.00)	1525.54
31	7.16	(0.25)	786.90	(0.11)	384.90	(0.09)	0.00	(0.00)	1178.96
32	9.03	(0.39)	831.90	(0.11)	401.40	(0.08)	0.00	(0.00)	1242.33

33	3.82	(0.35)	1163.00	(0.09)	625.20	(0.08)	0.00	(0.00)	1792.02
34	15.98	(0.41)	832.80	(0.10)	466.50	(0.09)	0.00	(0.00)	1315.28
35	15.42	(0.35)	742.00	(0.10)	432.90	(0.08)	0.00	(0.00)	1190.32
36	12.14	(0.33)	593.80	(0.10)	744.90	(0.09)	0.00	(0.00)	1350.84
37	6.63	(0.25)	544.90	(0.11)	618.30	(0.09)	0.00	(0.00)	1169.83
38	6.42	(0.26)	531.70	(0.13)	722.40	(0.09)	0.00	(0.00)	1260.52
39	7.69	(0.21)	701.10	(0.12)	434.10	(0.10)	0.00	(0.00)	1142.89
40	25.01	(0.43)	746.40	(0.12)	342.60	(0.13)	0.00	(0.00)	1114.01
41	5.48	(0.25)	465.10	(0.11)	553.20	(0.09)	0.00	(0.00)	1023.78
42	5.67	(0.24)	608.10	(0.13)	591.90	(0.10)	0.00	(0.00)	1205.67
43	21.85	(0.68)	515.70	(0.12)	758.40	(0.08)	0.00	(0.00)	1295.95
44	7.43	(0.29)	610.60	(0.15)	460.80	(0.10)	0.00	(0.00)	1078.83
45	8.51	(0.27)	598.80	(0.13)	470.10	(0.09)	0.00	(0.00)	1077.41
46	16.39	(0.21)	428.80	(0.14)	632.40	(0.09)	0.00	(0.00)	1077.59
47	22.60	(0.20)	495.70	(0.13)	559.20	(0.08)	0.00	(0.00)	1077.50
48	24.40	(0.14)	495.80	(0.14)	596.10	(0.09)	0.00	(0.00)	1116.30
49	86.66	(0.26)	570.50	(0.14)	459.30	(0.10)	0.00	(0.00)	1116.46
50	63.46	(0.20)	128.80	(0.30)	565.80	(0.10)	0.00	(0.00)	758.06
51	46.55	(0.21)	28.21	(0.35)	136.80	(0.10)	0.00	(0.00)	211.56
52	45.78	(0.21)	18.84	(0.35)	87.21	(0.14)	0.00	(0.00)	151.83
53	48.64	(0.20)	11.57	(0.43)	72.03	(0.14)	0.00	(0.00)	132.24
54	46.19	(0.20)	9.49	(0.38)	53.37	(0.17)	0.00	(0.00)	109.05
55	49.95	(0.20)	5.56	(0.62)	41.61	(0.19)	0.00	(0.00)	97.12
56	46.00	(0.20)	6.36	(0.42)	30.75	(0.21)	0.00	(0.00)	83.11
57	45.98	(0.20)	9.47	(0.52)	30.99	(0.23)	0.00	(0.00)	86.44
58	46.27	(0.21)	2.16	(1.00)	30.21	(0.26)	0.00	(0.00)	78.64
59	47.29	(0.20)	4.38	(0.80)	21.20	(0.33)	0.00	(0.00)	72.87
60	46.91	(0.20)	1.06	(0.75)	19.42	(0.32)	0.00	(0.00)	67.39
61	47.21	(0.20)	7.07	(0.54)	23.28	(0.25)	0.00	(0.00)	77.56
62	47.05	(0.21)	3.49	(1.00)	14.72	(0.37)	0.00	(0.00)	65.26
63	47.47	(0.22)	4.86	(0.80)	8.21	(0.54)	0.00	(0.00)	60.54
Max	86.66		1187.00		803.10		8.45		1792.02

Table 5. Dose Rate (mrem/hr) at the Unshielded Detectors

Distance Pulled (ft.)	Tank		Internal		Film		Upper		Total Dose Rate (mrem/hr)
	Dose Rate (mrem/hr)	Uncer.	Dose Rate (mrem/hr)	Uncer.	Dose Rate (mrem/hr)	Uncer.	Dose Rate (mrem/hr)	Uncer.	
0	7.76	(0.46)	0.00	(0.00)	0.00	(0.00)	8.09	(0.09)	15.85
1	36.72	(0.24)	0.00	(0.00)	0.00	(0.00)	11.89	(0.07)	48.61
2	96.28	(0.12)	0.00	(0.00)	0.00	(0.00)	14.31	(0.07)	110.59
3	140.80	(0.11)	0.00	(0.00)	0.00	(0.00)	21.76	(0.06)	162.56
4	272.80	(0.07)	0.00	(0.00)	0.01	(1.00)	26.25	(0.05)	299.06
5	189.40	(0.07)	0.00	(0.00)	0.00	(0.00)	29.28	(0.05)	218.68
6	233.60	(0.07)	0.00	(0.00)	0.30	(1.00)	34.04	(0.05)	267.94
7	231.00	(0.07)	0.00	(0.00)	0.00	(0.00)	37.51	(0.05)	268.51
8	276.00	(0.07)	0.00	(0.00)	0.84	(1.00)	42.53	(0.05)	319.37
9	206.00	(0.07)	0.00	(0.00)	0.71	(0.72)	38.61	(0.05)	245.32
10	192.30	(0.07)	0.00	(0.00)	0.00	(0.00)	42.49	(0.05)	234.79
11	262.30	(0.07)	0.00	(0.00)	1.44	(1.00)	42.77	(0.05)	306.51
12	276.10	(0.07)	0.00	(0.00)	3.86	(0.60)	43.22	(0.05)	323.18
13	274.30	(0.06)	0.00	(0.00)	2.40	(0.67)	43.37	(0.05)	320.07
14	150.90	(0.07)	0.00	(0.00)	10.67	(0.40)	42.93	(0.05)	204.50
15	193.80	(0.07)	0.00	(0.00)	18.41	(0.24)	42.85	(0.05)	255.06
16	209.90	(0.08)	0.00	(0.00)	112.56	(0.13)	41.51	(0.05)	363.97
17	221.10	(0.08)	0.00	(0.00)	327.60	(0.09)	38.95	(0.05)	587.65
18	45.54	(0.38)	5.39	(1.00)	723.60	(0.05)	27.23	(0.06)	801.76
19	42.03	(0.43)	0.00	(0.00)	1355.70	(0.04)	16.86	(0.07)	1414.59
20	18.69	(0.68)	0.00	(0.00)	2083.50	(0.07)	0.00	(0.00)	2102.19
21	76.84	(0.29)	6.97	(1.00)	3093.00	(0.06)	0.00	(0.00)	3176.81
22	23.94	(0.41)	8.46	(1.00)	3195.00	(0.06)	0.00	(0.00)	3227.40
23	22.38	(0.60)	56.26	(0.72)	3543.00	(0.06)	0.00	(0.00)	3621.64
24	11.45	(0.68)	42.94	(0.44)	3312.00	(0.06)	0.00	(0.00)	3366.39
25	7.05	(0.71)	404.80	(0.16)	2907.60	(0.06)	0.00	(0.00)	3319.45
26	10.89	(0.49)	1205.00	(0.11)	2142.60	(0.07)	0.00	(0.00)	3358.49
27	53.97	(0.44)	2637.00	(0.08)	2832.90	(0.06)	0.00	(0.00)	5523.87
28	259.10	(0.43)	4196.00	(0.07)	3063.00	(0.06)	0.00	(0.00)	7518.10
29	235.20	(0.18)	4605.00	(0.07)	3786.00	(0.05)	0.00	(0.00)	8626.20
30	468.10	(0.18)	4846.00	(0.06)	3195.00	(0.05)	0.00	(0.00)	8509.10
31	251.00	(0.18)	4144.00	(0.07)	3537.00	(0.05)	0.00	(0.00)	7932.00
32	159.00	(0.21)	4377.00	(0.07)	3327.00	(0.05)	0.00	(0.00)	7863.00

33	162.40	(0.33)	5169.00	(0.06)	3540.00	(0.05)	0.00	(0.00)	8871.40
34	206.10	(0.36)	4784.00	(0.06)	3705.00	(0.05)	0.00	(0.00)	8695.10
35	299.30	(0.24)	3909.00	(0.07)	3318.00	(0.05)	0.00	(0.00)	7526.30
36	183.00	(0.25)	3868.00	(0.07)	3990.00	(0.06)	0.00	(0.00)	8041.00
37	132.80	(0.27)	3234.00	(0.08)	4083.00	(0.05)	0.00	(0.00)	7449.80
38	91.49	(0.18)	3383.00	(0.07)	3765.00	(0.06)	0.00	(0.00)	7239.49
39	170.00	(0.24)	3149.00	(0.08)	3087.00	(0.06)	0.00	(0.00)	6406.00
40	240.60	(0.21)	3199.00	(0.07)	3822.00	(0.06)	0.00	(0.00)	7261.60
41	241.40	(0.25)	3411.00	(0.07)	3363.00	(0.06)	0.00	(0.00)	7015.40
42	222.60	(0.17)	3302.00	(0.08)	4119.00	(0.06)	0.00	(0.00)	7643.60
43	131.20	(0.19)	3391.00	(0.08)	3177.00	(0.05)	0.00	(0.00)	6699.20
44	236.90	(0.24)	2936.00	(0.08)	3174.00	(0.05)	0.00	(0.00)	6346.90
45	286.70	(0.22)	3281.00	(0.08)	3177.00	(0.05)	0.00	(0.00)	6744.70
46	289.10	(0.17)	3410.00	(0.08)	3297.00	(0.05)	0.00	(0.00)	6996.10
47	573.10	(0.15)	2994.00	(0.08)	3975.00	(0.05)	0.00	(0.00)	7542.10
48	991.60	(0.14)	3255.00	(0.08)	3450.00	(0.05)	0.00	(0.00)	7696.60
49	1247.00	(0.10)	2134.00	(0.09)	3042.00	(0.06)	0.00	(0.00)	6423.00
50	1200.00	(0.11)	1428.00	(0.10)	2346.60	(0.07)	0.00	(0.00)	4974.60
51	1165.00	(0.11)	500.70	(0.17)	1763.70	(0.07)	0.00	(0.00)	3429.40
52	1260.00	(0.10)	327.00	(0.22)	1131.90	(0.09)	0.00	(0.00)	2718.90
53	1272.00	(0.10)	136.80	(0.28)	694.80	(0.10)	0.00	(0.00)	2103.60
54	1239.00	(0.10)	96.59	(0.26)	505.50	(0.12)	0.00	(0.00)	1841.09
55	1196.00	(0.10)	92.97	(0.31)	365.40	(0.15)	0.00	(0.00)	1654.37
56	1205.00	(0.10)	50.10	(0.57)	254.25	(0.16)	0.00	(0.00)	1509.35
57	1205.00	(0.10)	54.87	(0.42)	239.22	(0.17)	0.00	(0.00)	1499.09
58	1223.00	(0.11)	42.57	(0.43)	142.14	(0.20)	0.00	(0.00)	1407.71
59	1249.00	(0.10)	50.93	(0.46)	115.86	(0.26)	0.00	(0.00)	1415.79
60	1251.00	(0.10)	18.05	(0.76)	73.83	(0.28)	0.00	(0.00)	1342.88
61	1244.00	(0.10)	9.67	(0.71)	108.57	(0.29)	0.00	(0.00)	1362.24
62	1241.00	(0.11)	25.54	(0.52)	73.53	(0.29)	0.00	(0.00)	1340.07
63	1263.00	(0.11)	15.42	(0.78)	31.47	(0.38)	0.00	(0.00)	1309.89
Max	1272.00		5169.00		4119.00		43.37		8871.40

Table 6. Mass per Dose Conversion Factors

Distance Pulled (ft.)	Internal Source Factor			External Film Factor			Upper Source Factor		
	Dose Rate (mrem/hr)	Mass (grams)	Factor (grams/ mrem/hr)	Dose Rate (mrem/hr)	Mass (grams)	Factor (grams/ mrem/hr)	Dose Rate (mrem/hr)	Mass (grams)	Factor (grams/ mrem/hr)
0	0.00	0.00	0.00	0.00	0.00	0.00	1.26	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	3.50	76.63	21.93
2	0.00	0.00	0.00	0.00	0.00	0.00	2.79	76.63	27.47
3	0.00	0.00	0.00	0.00	0.00	0.00	4.86	76.63	15.78
4	0.00	0.00	0.00	0.00	0.00	0.00	4.93	76.63	15.54
5	0.00	0.00	0.00	0.00	0.00	0.00	4.64	76.63	16.50
6	0.00	0.00	0.00	0.00	0.00	0.00	6.92	76.63	11.07
7	0.00	0.00	0.00	0.00	0.00	0.00	8.45	76.63	9.07
8	0.00	0.00	0.00	0.00	0.00	0.00	7.04	76.63	10.88
9	0.00	0.00	0.00	0.00	0.00	0.00	7.47	76.63	10.27
10	0.00	0.00	0.00	0.10	0.00	0.00	5.93	76.63	12.92
11	0.00	0.00	0.00	0.19	0.00	0.00	7.55	76.63	10.15
12	0.00	0.00	0.00	0.00	0.00	0.00	7.89	76.63	9.71
13	0.00	0.00	0.00	0.30	0.00	0.00	7.34	76.63	10.43
14	0.00	0.00	0.00	0.54	0.00	0.00	7.94	76.63	9.65
15	0.00	0.00	0.00	1.83	0.00	0.00	7.42	76.63	10.32
16	0.00	0.00	0.00	4.25	0.00	0.00	7.21	76.63	6.68
17	0.00	0.00	0.00	12.70	0.00	0.00	6.70	76.63	3.95
18	0.00	0.00	0.00	40.56	0.00	0.00	6.92	76.63	1.61
19	0.00	0.00	0.00	172.62	1650.56	9.56	1.82	0.00	0.00
20	0.00	0.00	0.00	337.20	2041.54	6.05	0.00	0.00	0.00
21	0.00	0.00	0.00	803.10	13107.42	16.32	0.00	0.00	0.00
22	0.58	0.00	0.00	494.40	7694.28	15.56	0.00	0.00	0.00
23	0.70	0.00	0.00	629.70	7595.10	12.06	0.00	8.06	0.00
24	0.36	0.00	0.00	599.40	15080.58	25.16	0.00	0.00	0.00
25	13.48	0.00	0.00	355.20	3975.03	11.19	0.00	0.00	0.00
26	59.72	0.00	0.00	391.80	4858.78	12.40	0.00	0.00	0.00
27	477.50	10130.88	21.22	438.30	7276.68	16.60	0.00	0.00	0.00
28	1187.00	37222.20	31.36	514.20	4508.51	8.77	0.00	0.00	0.00
29	1004.00	22826.40	22.74	717.30	15910.56	22.18	0.00	0.00	0.00
30	1005.00	35072.46	34.90	513.60	9453.42	18.41	0.00	0.00	0.00
31	786.90	8654.76	11.00	384.90	5501.88	14.29	0.00	0.00	0.00
32	831.90	17835.00	21.44	401.40	6916.50	17.23	0.00	0.00	0.00

33	1163.00	17852.40	15.35	625.20	13018.68	20.82	0.00	0.00	0.00
34	832.80	17922.00	21.52	466.50	3476.00	7.45	0.00	0.00	0.00
35	742.00	23142.00	31.19	432.90	4384.80	10.13	0.00	0.00	0.00
36	593.80	20131.80	33.90	744.90	13540.68	18.18	0.00	0.00	0.00
37	544.90	17922.00	32.89	618.30	5058.70	8.18	0.00	0.00	0.00
38	531.70	17922.00	33.71	722.40	14887.44	20.61	0.00	0.00	0.00
39	701.10	17939.40	25.59	434.10	3393.00	7.82	0.00	0.00	0.00
40	746.40	17939.40	24.03	342.60	3388.82	9.89	0.00	0.00	0.00
41	465.10	17922.00	38.53	553.20	12627.18	22.83	0.00	0.00	0.00
42	608.10	17922.00	29.47	591.90	4432.30	7.49	0.00	0.00	0.00
43	515.70	17939.40	34.79	758.40	13618.98	17.96	0.00	0.00	0.00
44	610.60	17922.00	29.35	460.80	3391.96	7.36	0.00	0.00	0.00
45	598.80	17922.00	29.93	470.10	3390.91	7.21	0.00	0.00	0.00
46	428.80	17939.40	41.84	632.40	13373.64	21.15	0.00	0.00	0.00
47	495.70	17939.40	36.19	559.20	4674.51	8.36	0.00	0.00	0.00
48	495.80	17922.00	36.15	596.10	12642.84	21.21	0.00	0.00	0.00
49	570.50	20671.20	36.23	459.30	3522.46	7.67	0.00	0.00	0.00
50	128.80	2046.24	15.89	565.80	11494.44	20.32	0.00	0.00	0.00
51	28.21	0.00	0.00	136.80	0.00	0.00	0.00	0.00	0.00
52	18.84	0.00	0.00	87.21	0.00	0.00	0.00	0.00	0.00
53	11.57	0.00	0.00	72.03	0.00	0.00	0.00	0.00	0.00
54	9.49	0.00	0.00	53.37	0.00	0.00	0.00	0.00	0.00
55	5.56	0.00	0.00	41.61	0.00	0.00	0.00	0.00	0.00
56	6.36	0.00	0.00	30.75	0.00	0.00	0.00	0.00	0.00
57	9.47	0.00	0.00	30.99	0.00	0.00	0.00	0.00	0.00
58	2.16	0.00	0.00	30.21	0.00	0.00	0.00	0.00	0.00
59	4.38	0.00	0.00	21.20	0.00	0.00	0.00	0.00	0.00
60	1.06	0.00	0.00	19.42	0.00	0.00	0.00	0.00	0.00
61	7.07	0.00	0.00	23.28	0.00	0.00	0.00	0.00	0.00
62	3.49	0.00	0.00	14.72	0.00	0.00	0.00	0.00	0.00
63	4.86	0.00	0.00	8.21	0.00	0.00	0.00	0.00	0.00
Total		4.49e+05			2.50e+05			1.39e+03	

Table 7. Expected Shipping container Dose Rates at Each Detector Point

Distance Pulled (ft.)	Dose Rate (mrem/hr)			
	Shielded Detector	No Shot	Steel Shot	Lead Shot
0	1.27	6.16	3.37	2.08
1	6.81	8.65	2.38	0.16
2	7.30	10.97	2.74	0.17
3	11.34	17.58	4.09	0.27
4	14.22	18.94	4.83	0.30
5	15.22	21.91	5.38	0.33
6	22.68	24.10	6.19	0.41
7	21.56	26.98	7.22	0.45
8	19.84	27.24	7.13	0.44
9	19.48	28.54	7.54	0.45
10	17.04	33.76	8.18	0.48
11	19.66	39.16	8.31	0.52
12	21.75	41.12	9.08	0.49
13	16.90	55.93	9.75	0.50
14	17.34	71.45	11.91	0.58
15	21.90	99.30	16.74	0.60
16	23.59	161.00	30.14	0.69
17	26.41	243.75	52.31	1.43
18	51.06	467.53	93.71	5.63
19	176.56	871.69	219.37	13.28
20	338.72	1294.74	346.84	25.34
21	806.00	1585.97	432.97	33.67
22	499.52	1658.21	442.74	31.89
23	631.10	1712.01	451.66	31.31
24	599.80	1671.53	420.82	32.41
25	369.19	1549.53	383.36	23.56
26	453.01	1707.93	408.63	24.93
27	918.46	2475.30	593.14	40.45
28	1709.33	3266.26	854.11	60.02
29	1734.40	3821.15	983.21	73.47
30	1525.54	3568.84	932.71	63.34
31	1178.96	3354.64	850.40	51.92
32	1242.33	3338.52	844.91	49.59
33	1792.02	3676.72	947.80	57.87

34	1315.28	4362.12	1122.70	72.19
35	1190.32	4128.01	1071.40	66.90
36	1350.84	4257.92	1069.80	66.57
37	1169.83	4134.11	1114.50	71.70
38	1260.52	4082.91	1059.60	67.85
39	1142.89	4091.81	1063.10	70.33
40	1114.01	3947.40	1037.50	63.70
41	1023.78	3967.01	1059.50	68.40
42	1205.67	4117.41	1118.30	69.76
43	1295.95	4030.30	1100.40	70.62
44	1078.83	4052.30	1026.50	69.77
45	1077.41	4071.30	1058.80	69.63
46	1077.59	4124.00	1086.00	72.73
47	1077.50	4014.10	1072.80	73.22
48	1116.30	3707.50	978.70	70.33
49	1116.46	3148.10	845.30	54.26
50	758.06	2219.80	602.10	39.36
51	211.56	1370.40	318.46	19.24
52	151.83	496.90	100.78	6.01
53	132.24	52.26	14.79	7.28
54	109.05	33.12	12.67	8.07
55	97.12	23.05	10.51	7.53
56	83.11	23.61	9.33	6.81
57	86.44	14.63	7.57	5.61
58	78.64	13.24	6.96	4.98
59	72.87	12.18	5.45	5.26
60	67.39	9.26	5.09	4.15
61	77.56	8.97	4.40	3.33
62	65.26	8.90	3.51	2.93
63	60.54	6.39	3.06	2.66
Max	1792.02	4362.12	1122.70	73.47

Table 8. Maximum Shipping container Dose Rates at Each Detector Point

Distance Pulled (ft.)	Mass (grams)	Detector Dose (mrem/hr)	Max Factor (grams/ mrem/hr)	Multiplier (Max Mass/ Model Mass)	Max Dose Rate (mrem/hr)			Comp. No.	Shot Load
					No Shot	Steel Shot	Lead Shot		
0	0.00	1.26	0.00	1.00	10.41	5.70	3.52	24	No Shot
1	76.63	3.50	21.93	1.00	14.61	4.01	0.26	23	No Shot
2	76.63	2.79	27.47	1.00	18.53	4.63	0.28	23	No Shot
3	76.63	4.86	15.78	1.00	29.67	6.91	0.46	22	No Shot
4	76.63	4.93	15.54	1.00	31.97	8.16	0.51	21	No Shot
5	76.63	4.64	16.50	1.00	36.99	9.08	0.55	21	No Shot
6	76.63	6.92	11.07	1.00	40.69	10.45	0.70	21	No Shot
7	76.63	8.45	9.07	1.00	45.55	12.18	0.77	20	No Shot
8	76.63	7.04	10.88	1.00	45.99	12.04	0.75	20	No Shot
9	76.63	7.47	10.27	1.00	48.18	12.72	0.77	19	No Shot
10	76.63	6.04	12.92	1.02	56.99	13.81	0.81	19	No Shot
11	76.63	7.74	10.15	1.03	66.11	14.02	0.87	19	No Shot
12	76.63	7.89	9.71	1.00	69.42	15.32	0.83	18	No Shot
13	76.63	7.64	10.43	1.04	94.42	16.45	0.85	18	Steel Shot
14	76.63	8.48	9.65	1.07	120.62	20.11	0.98	17	Steel Shot
15	76.63	9.26	10.32	1.25	167.64	28.26	1.01	17	Steel Shot
16	76.63	11.47	6.68	1.00	271.81	50.88	1.16	17	Steel Shot
17	76.63	19.40	3.95	1.00	411.49	88.31	2.42	16	Steel Shot
18	76.63	47.48	1.61	1.00	789.29	158.20	9.51	16	Lead Shot
19	1650.56	174.44	9.56	1.01	1471.59	370.34	22.42	16	Lead Shot
20	2041.54	337.20	6.05	1.00	2185.79	585.54	42.78	15	Lead Shot
21	13107.42	803.10	16.32	1.00	2677.44	730.94	56.83	15	Lead Shot
22	7694.28	494.98	15.56	1.00	2799.40	747.43	53.84	14	Lead Shot
23	7603.16	630.40	12.06	1.00	2890.22	762.50	52.85	14	Lead Shot
24	15080.58	599.76	25.16	1.00	2821.87	710.43	54.71	14	Lead Shot
25	3975.03	368.68	11.19	1.04	2615.93	647.19	39.77	13	Lead Shot
26	4858.78	451.52	12.40	1.15	2883.33	689.84	42.08	13	Lead Shot
27	17407.56	915.80	21.22	1.12	4178.81	1001.34	68.28	13	Lead Shot
28	41730.71	1701.20	31.36	1.28	5514.11	1441.91	101.32	12	Lead Shot*
29	38736.96	1721.30	22.74	1.01	6450.87	1659.85	124.03	11	Lead Shot*
30	44525.88	1518.60	34.90	1.19	6024.93	1574.60	106.94	11	Lead Shot*
31	14156.64	1171.80	14.29	1.18	5663.31	1435.66	87.64	10	Lead Shot
32	24751.50	1233.30	21.44	1.07	5636.10	1426.37	83.72	10	Lead Shot

33	30871.08	1788.20	20.82	1.21	6207.05	1600.08	97.70	10	Lead Shot
34	21398.00	1299.30	21.52	1.31	7364.15	1895.35	121.87	9	Lead Shot*
35	27526.80	1174.90	31.19	1.33	6968.91	1808.74	112.94	9	Lead Shot*
36	33672.48	1338.70	33.90	1.35	7188.23	1806.04	112.38	8	Lead Shot*
37	22980.70	1163.20	32.89	1.66	6979.22	1881.50	121.04	8	Lead Shot*
38	32809.44	1254.10	33.71	1.29	6892.78	1788.82	114.54	8	Lead Shot*
39	21332.40	1135.20	25.59	1.36	6907.81	1794.73	118.73	7	Lead Shot*
40	21328.22	1089.00	24.03	1.23	6664.02	1751.51	107.53	7	Lead Shot*
41	30549.18	1018.30	38.53	1.28	6697.11	1788.65	115.47	7	Lead Shot*
42	22354.30	1200.00	29.47	1.58	6951.02	1887.92	117.77	6	Lead Shot*
43	31558.38	1274.10	34.79	1.40	6803.97	1857.70	119.22	6	Lead Shot*
44	21313.96	1071.40	29.35	1.48	6841.11	1732.94	117.79	5	Lead Shot*
45	21312.91	1068.90	29.93	1.50	6873.19	1787.47	117.55	5	Lead Shot*
46	31313.04	1061.20	41.84	1.42	6962.15	1833.39	122.78	5	Lead Shot*
47	22613.91	1054.90	36.19	1.69	6776.62	1811.10	123.61	4	Lead Shot*
48	30564.84	1091.90	36.15	1.29	6259.01	1652.24	118.73	3	Lead Shot*
49	24193.66	1029.80	36.23	1.54	5314.63	1427.04	91.61	3	Lead Shot
50	13540.68	694.60	20.32	1.04	3747.48	1016.47	66.44	2	Lead Shot
51	0.00	165.01	0.00	1.00	2313.52	537.63	32.49	2	Lead Shot
52	0.00	106.05	0.00	1.00	838.87	170.14	10.15	1	Lead Shot
53	0.00	83.60	0.00	1.00	88.23	24.96	12.30	NA	NA
54	0.00	62.86	0.00	1.00	55.92	21.39	13.63	NA	NA
55	0.00	47.17	0.00	1.00	38.92	17.74	12.71	NA	NA
56	0.00	37.11	0.00	1.00	39.85	15.75	11.50	NA	NA
57	0.00	40.46	0.00	1.00	24.70	12.79	9.47	NA	NA
58	0.00	32.37	0.00	1.00	22.36	11.74	8.42	NA	NA
59	0.00	25.58	0.00	1.00	20.56	9.20	8.89	NA	NA
60	0.00	20.48	0.00	1.00	15.63	8.60	7.01	NA	NA
61	0.00	30.35	0.00	1.00	15.15	7.43	5.62	NA	NA
62	0.00	18.21	0.00	1.00	15.02	5.92	4.94	NA	NA
63	0.00	13.07	0.00	1.00	10.78	5.16	4.50	NA	NA
Max		1788.20	41.84	1.69	7364.15	1895.35	124.03		

Table 9. Shipping Container Shielding Configuration for Different Source Terms

Comp. No.	119 gallon	Expected Worst Case Source					
		100 %	70 %	50 %	10 %	5 %	1 %
1	Lead Shot	Lead Shot	Steel Shot	Steel Shot	No Shot	No Shot	No Shot
2	Lead Shot	Lead Shot	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
3	Lead Shot*	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
4	Lead Shot*	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
5	Lead Shot*	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
6	Lead Shot*	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Lead Shot	No Shot
7	Lead Shot*	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
8	Lead Shot*	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
9	Lead Shot*	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
10	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
11	Lead Shot**	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
12	Lead Shot**	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
13	Lead Shot*	Lead Shot	Lead Shot	Lead Shot	Lead Shot	Steel Shot	No Shot
14	Lead Shot	Lead Shot	Lead Shot	Lead Shot	Steel Shot	Steel Shot	No Shot
15	Lead Shot	Lead Shot	Lead Shot	Lead Shot	Steel Shot	Steel Shot	No Shot
16	Lead Shot	Lead Shot	Lead Shot	Lead Shot	No Shot	No Shot	No Shot
17	Steel Shot	Steel Shot	Steel Shot	Steel Shot	No Shot	No Shot	No Shot
18	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot
19	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot
20	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot
21	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot
22	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot
23	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot
24	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot	No Shot

* 0.25 in. Lead Blanket
** 0.5 in. Lead Blanket (2 X 0.25 in.)

Table 10. Shipping Container Dose Rates Calculated for Different Source Terms

Distance Pulled (ft.)	Comp. No.	119 Gallon	Dose Rate from Percentage of Expected Worst Case Source (mrem/hr)					
			100 %	70 %	50 %	10 %	5 %	1 %
0	24	11.07	10.73	7.60	5.43	2.06	0.55	0.10
1	23	14.65	14.41	10.12	7.23	2.75	0.70	0.15
2	23	18.11	18.11	12.67	9.05	3.49	0.90	0.19
3	22	26.37	26.32	18.37	13.12	5.04	1.35	0.30
4	21	32.18	31.69	22.17	15.83	6.17	1.64	0.32
5	21	35.61	35.00	24.54	17.53	6.73	1.77	0.37
6	21	40.71	40.92	28.64	20.46	7.75	2.00	0.41
7	20	45.58	45.16	31.77	22.70	8.47	2.32	0.46
8	20	48.54	46.63	32.71	23.36	8.67	2.31	0.46
9	19	52.69	50.36	35.46	25.33	9.33	2.60	0.48
10	19	58.40	56.83	40.04	28.60	10.07	2.84	0.57
11	19	64.83	62.95	43.82	31.30	10.96	3.29	0.66
12	18	68.35	65.65	46.43	33.16	11.40	3.51	0.69
13	18	72.63	69.60	50.87	36.33	12.78	4.16	0.94
14	17	32.04	31.67	30.66	21.90	15.23	5.50	1.21
15	17	2.13	2.08	17.24	12.32	19.88	7.90	1.68
16	17	1.89	1.99	22.14	15.81	28.58	12.47	2.72
17	16	3.70	3.75	5.71	4.08	46.71	21.20	4.11
18	16	8.75	8.86	6.33	4.52	78.19	37.22	7.89
19	16	22.21	22.33	15.82	11.30	86.60	44.50	14.72
20	15	41.43	41.34	28.99	20.71	58.61	29.35	21.86
21	15	55.35	55.35	38.54	27.53	74.75	37.50	26.77
22	14	51.85	51.61	36.19	25.85	75.22	37.55	27.99
23	14	54.50	54.26	38.04	27.17	73.48	37.30	28.90
24	14	53.27	53.07	37.07	26.48	68.31	36.62	28.22
25	13	22.26	41.62	29.46	21.04	12.28	33.05	26.16
26	13	29.63	42.57	30.35	21.68	4.96	34.50	28.83
27	13	57.24	53.01	49.80	35.57	7.45	51.85	41.79
28	12	64.04	42.70	72.36	51.69	10.49	73.93	55.14
29	11	59.84	48.60	84.10	60.07	12.18	84.82	64.51
30	11	50.63	46.43	75.87	54.19	10.90	78.23	60.25
31	10	52.21	80.11	62.01	44.29	8.96	69.59	56.63
32	10	44.21	86.61	61.32	43.80	8.90	69.11	56.36
33	10	45.07	80.28	70.61	50.44	10.17	77.71	62.07

34	9	48.57	50.96	80.66	57.61	11.52	93.41	73.64
35	9	44.80	47.65	77.89	55.64	11.15	90.46	69.69
36	8	50.89	50.32	83.17	59.41	11.73	92.16	71.88
37	8	51.82	51.37	83.39	59.57	11.88	93.34	69.79
38	8	49.73	48.49	83.08	59.35	11.91	92.00	68.93
39	7	49.10	49.99	80.86	57.76	11.58	88.88	69.08
40	7	46.68	46.15	75.79	54.13	10.81	86.02	66.64
41	7	47.76	49.79	81.53	58.24	11.56	52.49	66.97
42	6	52.71	52.07	85.06	60.76	12.22	8.61	69.51
43	6	50.90	51.01	84.45	60.32	12.06	8.98	68.04
44	5	49.79	50.47	80.20	57.29	11.52	67.24	68.41
45	5	50.29	48.84	79.77	56.98	11.51	87.15	68.73
46	5	52.73	51.83	85.77	61.27	12.39	89.44	69.62
47	4	52.73	51.62	86.15	61.54	12.40	93.00	67.77
48	3	46.96	47.71	78.84	56.31	11.34	82.92	62.59
49	3	58.60	57.97	68.19	48.70	9.92	72.41	53.15
50	2	66.09	65.85	47.91	34.22	7.00	50.99	37.47
51	2	30.74	31.27	65.48	46.77	23.88	35.15	23.14
52	1	9.58	9.33	91.70	65.50	63.95	34.30	8.39
53	NA	11.89	11.85	11.10	7.93	3.42	2.24	0.88
54	NA	13.71	13.47	10.47	7.48	2.08	1.29	0.56
55	NA	12.60	12.30	9.37	6.69	1.68	1.11	0.39
56	NA	11.36	11.04	8.25	5.90	1.46	0.91	0.40
57	NA	9.84	9.47	7.23	5.16	1.12	0.75	0.25
58	NA	8.38	8.39	6.14	4.39	1.01	0.62	0.22
59	NA	7.51	8.68	6.21	4.44	0.97	0.53	0.21
60	NA	8.09	7.02	5.11	3.65	0.87	0.48	0.16
61	NA	5.45	5.84	4.09	2.92	0.67	0.38	0.15
62	NA	5.03	4.28	3.36	2.40	0.52	0.31	0.15
63	NA	5.09	4.57	3.41	2.43	0.53	0.28	0.11
Max		72.63	86.61	91.70	65.50	86.60	93.41	73.64

Table 11. Shielded Detector Readings Corresponding to Different Source Terms

Distance Pulled (ft.)	Measured Dose Rate (mrem/hr)	Dose Rate (mrem/hr) from Percentage of Expected Worst Case Source					
		100 %	70 %	50 %	10 %	5 %	1 %
0		1.27	0.89	0.64	0.13	0.07	0.02
1		6.81	5.76	5.06	3.66	3.49	3.35
2		7.30	6.46	5.90	4.79	4.65	4.54
3		11.34	9.88	8.91	6.97	6.73	6.53
4		14.22	12.74	11.76	9.78	9.54	9.34
5		15.22	13.83	12.90	11.04	10.81	10.63
6		22.68	20.60	19.22	16.45	16.11	15.83
7		21.56	19.03	17.34	13.96	13.53	13.19
8		19.84	17.73	16.32	13.50	13.15	12.87
9		19.48	17.24	15.74	12.76	12.38	12.08
10		17.04	15.22	14.02	11.60	11.30	11.06
11		19.66	17.34	15.79	12.69	12.31	12.00
12		21.75	19.38	17.81	14.65	14.25	13.94
13		16.90	14.61	13.08	10.02	9.64	9.33
14		17.34	14.79	13.10	9.71	9.28	8.94
15		21.90	19.12	17.27	13.57	13.10	12.73
16		23.59	20.15	17.85	13.27	12.69	12.23
17		26.41	20.59	16.71	8.95	7.98	7.20
18		51.06	36.81	27.32	8.33	5.95	4.05
19		176.56	124.23	89.34	19.56	10.84	3.86
20		338.72	237.56	170.12	35.24	18.38	4.89
21		806.00	565.07	404.45	83.21	43.05	10.93
22		499.52	351.02	252.03	54.04	29.29	9.49
23		631.10	441.98	315.90	63.74	32.22	7.01
24		599.80	419.88	299.93	60.02	30.04	6.05
25		369.19	258.59	184.85	37.38	18.94	4.20
26		453.01	317.56	227.25	46.65	24.07	6.01
27		918.46	643.72	460.56	94.24	48.45	11.82
28		1709.33	1198.97	858.73	178.25	93.19	25.14
29		1734.40	1218.01	873.75	185.23	99.17	30.31
30		1525.54	1069.96	766.24	158.80	82.87	22.12
31		1178.96	827.42	593.06	124.34	65.75	18.88
32		1242.33	872.34	625.68	132.36	70.69	21.36
33		1792.02	1255.56	897.92	182.64	93.23	21.71

34		1315.28	925.49	665.63	145.91	80.95	28.97
35		1190.32	837.85	602.87	132.91	74.17	27.17
36		1350.84	949.23	681.49	146.01	79.08	25.53
37		1169.83	820.87	588.23	122.95	64.79	18.26
38		1260.52	884.29	633.47	131.83	69.12	18.96
39		1142.89	802.33	575.29	121.21	64.45	19.05
40		1114.01	787.31	569.51	133.91	79.46	35.90
41		1023.78	718.29	514.63	107.31	56.39	15.66
42		1205.67	845.67	605.67	125.67	65.67	17.67
43		1295.95	913.72	658.90	149.26	85.56	34.59
44		1078.83	757.41	543.13	114.57	61.00	18.15
45		1077.41	756.74	542.96	115.40	61.95	19.20
46		1077.59	759.23	546.99	122.51	69.45	27.00
47		1077.50	761.03	550.05	128.09	75.35	33.15
48		1116.30	788.73	570.35	133.59	79.00	35.32
49		1116.46	807.52	601.56	189.64	138.15	96.96
50		758.06	549.68	410.76	132.92	98.19	70.41
51		211.56	162.06	129.06	63.05	54.80	48.20
52		151.83	120.02	98.81	56.39	51.08	46.84
53		132.24	107.16	90.44	57.00	52.82	49.48
54		109.05	90.19	77.62	52.48	49.33	46.82
55		97.12	82.97	73.54	54.67	52.31	50.42
56		83.11	71.98	64.56	49.71	47.86	46.37
57		86.44	74.30	66.21	50.03	48.00	46.38
58		78.64	68.93	62.45	49.51	47.89	46.59
59		72.87	65.19	60.08	49.85	48.57	47.55
60		67.39	61.24	57.15	48.96	47.93	47.11
61		77.56	68.46	62.39	50.25	48.73	47.51
62		65.26	59.80	56.16	48.87	47.96	47.23
63		60.54	56.62	54.00	48.78	48.12	47.60
Max		1792.02	1255.56	897.92	189.64	138.15	96.96

Table 12. Demonstration of Method for Determining Shielding Configuration

Distance Pulled (ft.)	Measured Dose Rate (mrem/hr)	Dose Rate (mrem/hr) from Percentage of Expected Worst Case Source					
		100 %	70 %	50 %	10 %	5 %	1 %
0	.800	1.27	0.89	0.64	0.13	0.07	0.02
1	5.00	6.81	5.76	5.06	3.66	3.49	3.35
2	4.50	7.30	6.46	5.90	4.79	4.65	4.54
3	8.90	11.34	9.88	8.91	6.97	6.73	6.53
4	11.00	14.22	12.74	11.76	9.78	9.54	9.34
5	12.00	15.22	13.83	12.90	11.04	10.81	10.63
6	18.00	22.68	20.60	19.22	16.45	16.11	15.83
7	13.50	21.56	19.03	17.34	13.96	13.53	13.19
8	13.40	19.84	17.73	16.32	13.50	13.15	12.87
9	12.30	19.48	17.24	15.74	12.76	12.38	12.08
10	11.20	17.04	15.22	14.02	11.60	11.30	11.06
11	15.00	19.66	17.34	15.79	12.69	12.31	12.00
12	16.00	21.75	19.38	17.81	14.65	14.25	13.94
13	14.00	16.90	14.61	13.08	10.02	9.64	9.33
14	14.50	17.34	14.79	13.10	9.71	9.28	8.94
15	17.00	21.90	19.12	17.27	13.57	13.10	12.73
16	17.50	23.59	20.15	17.85	13.27	12.69	12.23
17	10.00	26.41	20.59	16.71	8.95	7.98	7.20
18	25.00	51.06	36.81	27.32	8.33	5.95	4.05
19	80.00	176.56	124.23	89.34	19.56	10.84	3.86
20	160.00	338.72	237.56	170.12	35.24	18.38	4.89
21	550.00	806.00	565.07	404.45	83.21	43.05	10.93
22	350.00	499.52	351.02	252.03	54.04	29.29	9.49
23	440.00	631.10	441.98	315.90	63.74	32.22	7.01
24	200.00	599.80	419.88	299.93	60.02	30.04	6.05
25	150.00	369.19	258.59	184.85	37.38	18.94	4.20
26	250.00	453.01	317.56	227.25	46.65	24.07	6.01
27	400.00	918.46	643.72	460.56	94.24	48.45	11.82
28	850.00	1709.33	1198.97	858.73	178.25	93.19	25.14
29	870.00	1734.40	1218.01	873.75	185.23	99.17	30.31
30	700.00	1525.54	1069.96	766.20	158.80	82.87	22.12
31	826.55	1178.96	827.42	593.06	124.34	65.75	18.88
32	871.36	1242.33	872.34	625.68	132.36	70.69	21.36
33	895.14	1792.02	1255.56	897.92	182.64	93.23	21.71

34	925.06	1315.28	925.49	665.63	145.91	80.95	28.97
35	600.78	1190.32	837.85	602.87	132.91	74.17	27.17
36	681.32	1350.84	949.23	681.49	146.01	79.08	25.53
37	810.00	1169.83	820.87	588.23	122.95	64.79	18.26
38	630.00	1260.52	884.29	633.47	131.83	69.12	18.96
39	500.00	1142.89	802.33	575.29	121.21	64.45	19.05
40	560.00	1114.01	787.31	569.51	133.91	79.46	35.90
41	512.00	1023.78	718.29	514.63	107.31	56.39	15.66
42	602.33	1205.67	845.67	605.67	125.67	65.67	17.67
43	644.00	1295.95	913.72	658.90	149.26	85.56	34.59
44	750.21	1078.83	757.41	543.13	114.57	61.00	18.15
45	510.18	1077.41	756.74	542.96	115.40	61.95	19.20
46	512.64	1077.59	759.23	546.99	122.51	69.45	27.00
47	600.00	1077.50	761.03	550.05	128.09	75.35	33.15
48	450.00	1116.30	788.73	570.35	133.59	79.00	35.32
49	703.56	1116.46	807.52	601.56	189.64	138.15	96.96
50	350.78	758.06	549.68	410.76	132.92	98.19	70.41
51	115.27	211.56	162.06	129.06	63.05	54.80	48.20
52	55.00	151.83	120.02	98.81	56.39	51.08	46.84
53	56.24	132.24	107.16	90.44	57.00	52.82	49.48
54	68.95	109.05	90.19	77.62	52.48	49.33	46.82
55	70.07	97.12	82.97	73.54	54.67	52.31	50.42
56	58.93	83.11	71.98	64.56	49.71	47.86	46.37
57	58.03	86.44	74.30	66.21	50.03	48.00	46.38
58	58.69	78.64	68.93	62.45	49.51	47.89	46.59
59	59.77	72.87	65.19	60.08	49.85	48.57	47.55
60	56.49	67.39	61.24	57.15	48.96	47.93	47.11
61	49.86	77.56	68.46	62.39	50.25	48.73	47.51
62	54.59	65.26	59.80	56.16	48.87	47.96	47.23
63	51.11	60.54	56.62	54.00	48.78	48.12	47.60
Max		1792.02	1255.56	897.92	189.64	138.15	96.96

Figure 1. MCNP Geometry Showing the Mixer Pump Inside Tank 101 SY

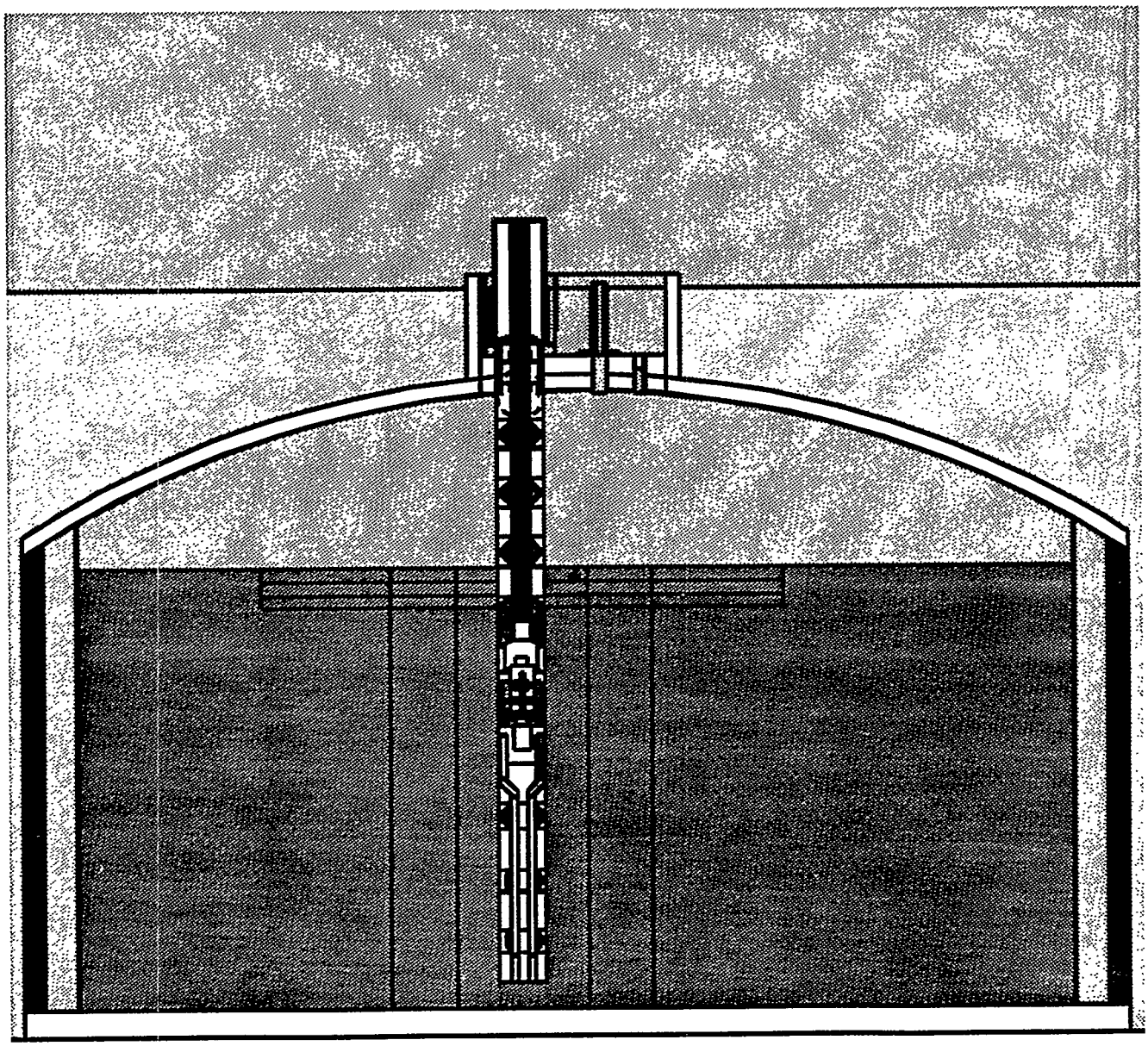


Figure 2. Internal Source Inside the Mixer Pump

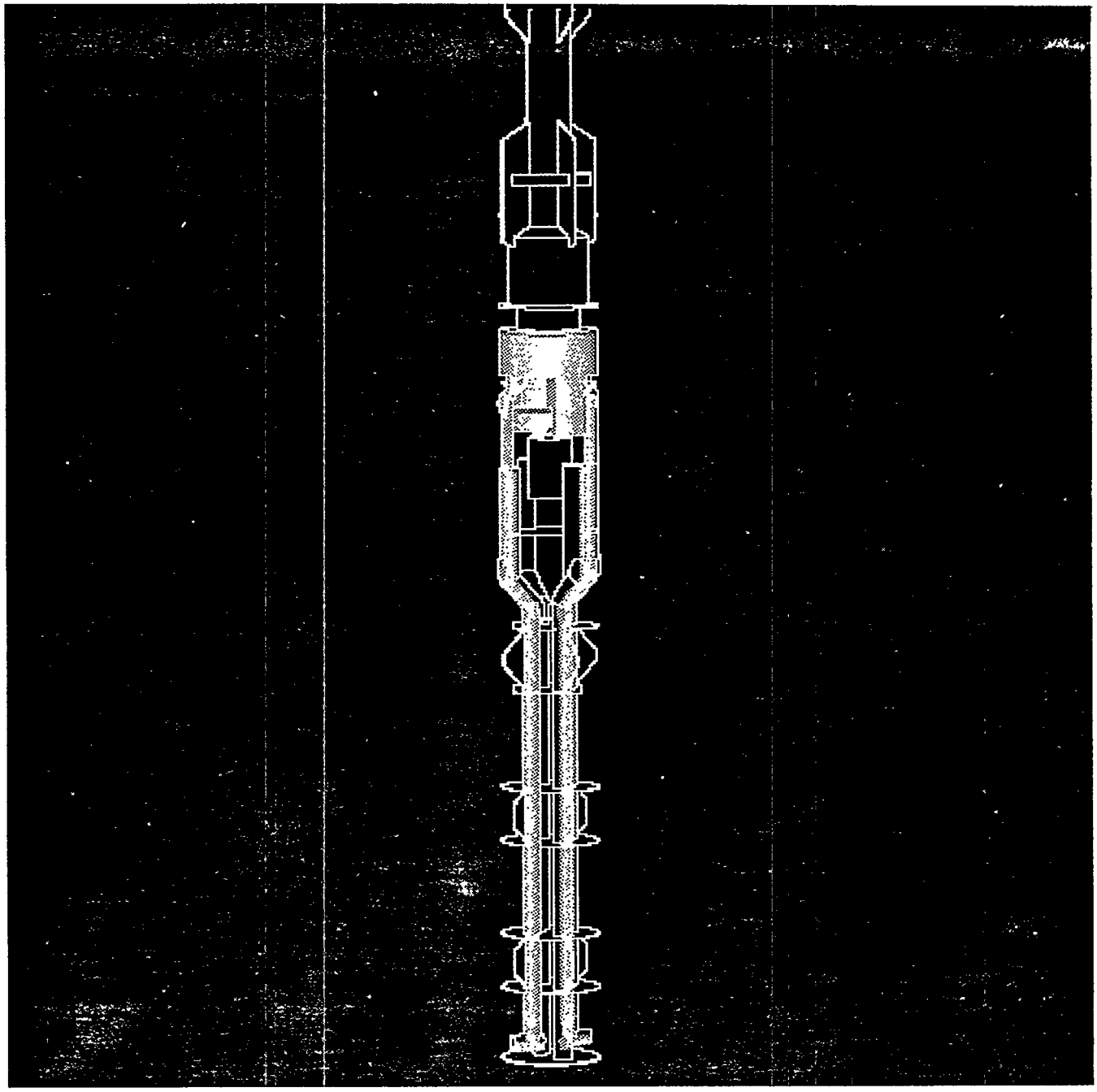


Figure 3. MCNP Pump Geometry part 1

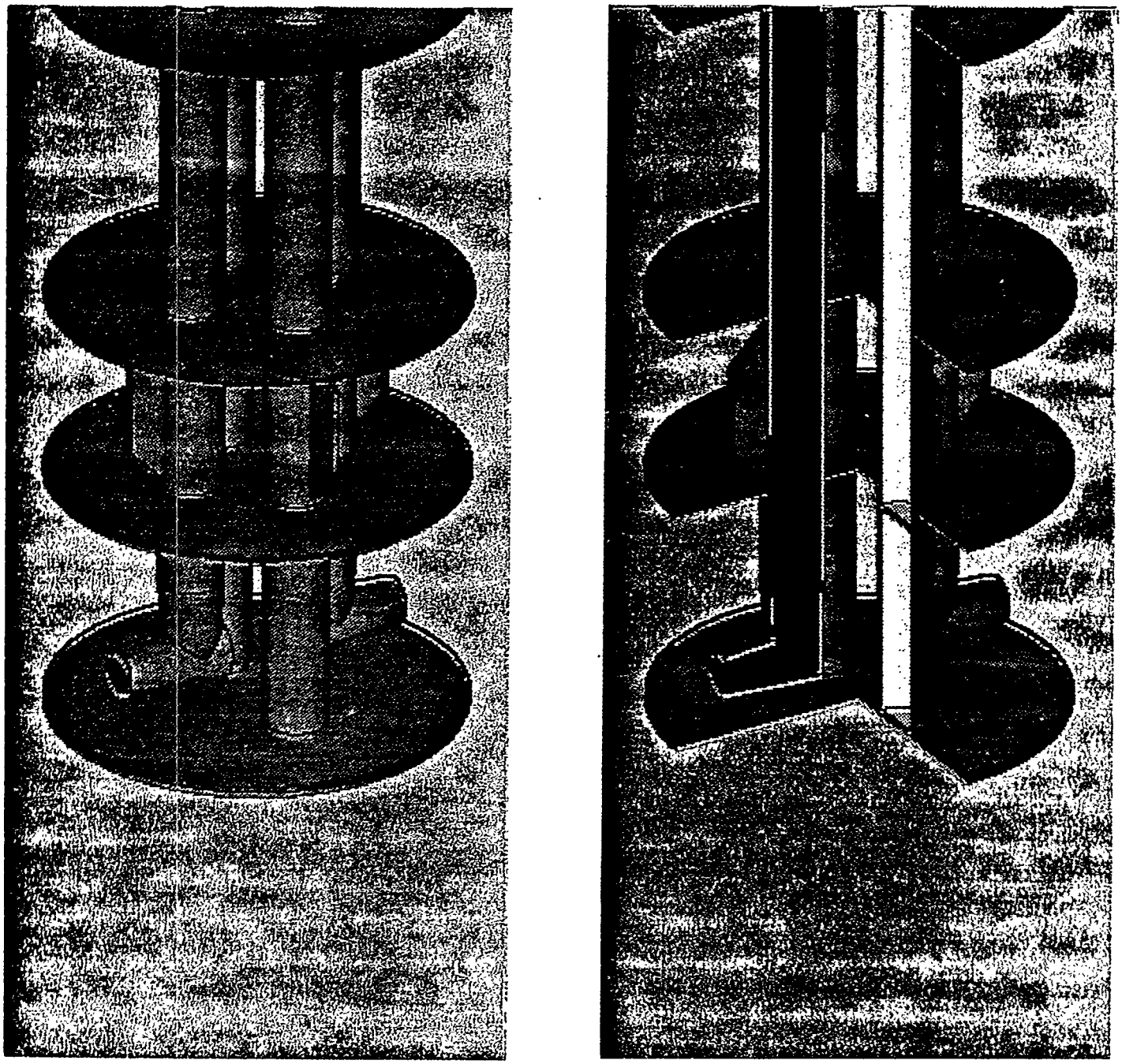


Figure 4. MCNP Pump Geometry part 2

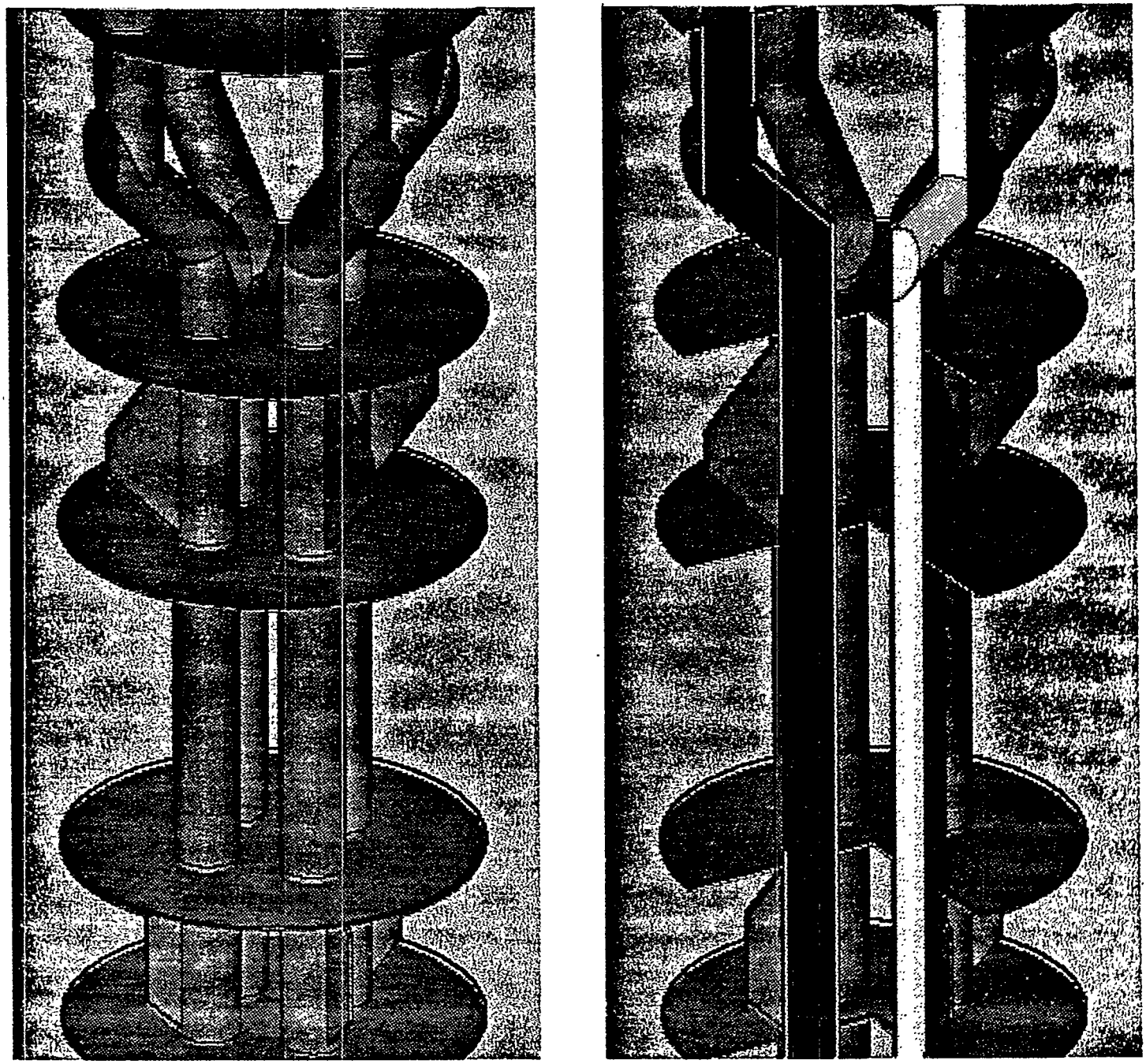


Figure 5. MCNP Pump Geometry part 3

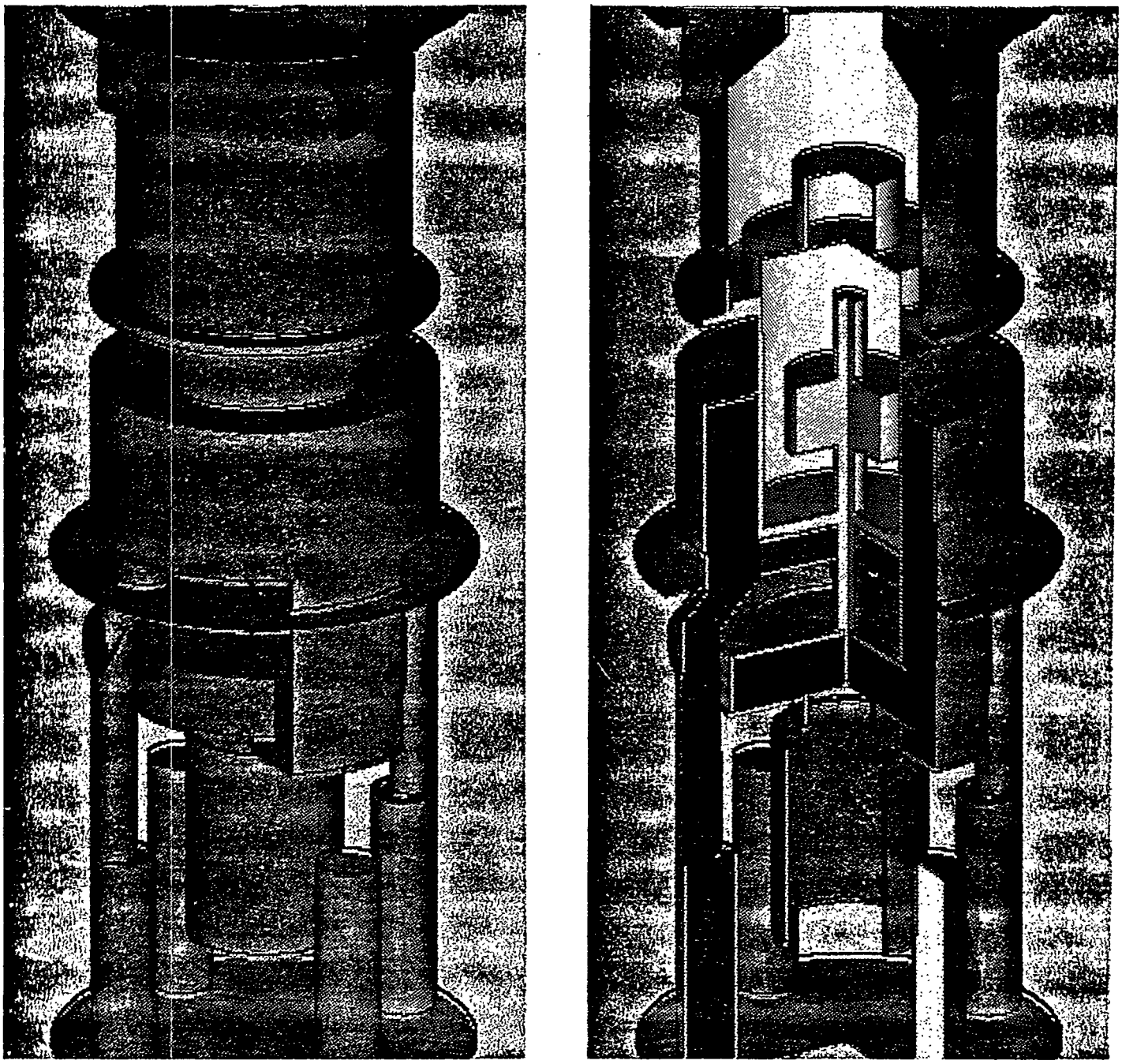


Figure 6. MCNP Pump Geometry part 4

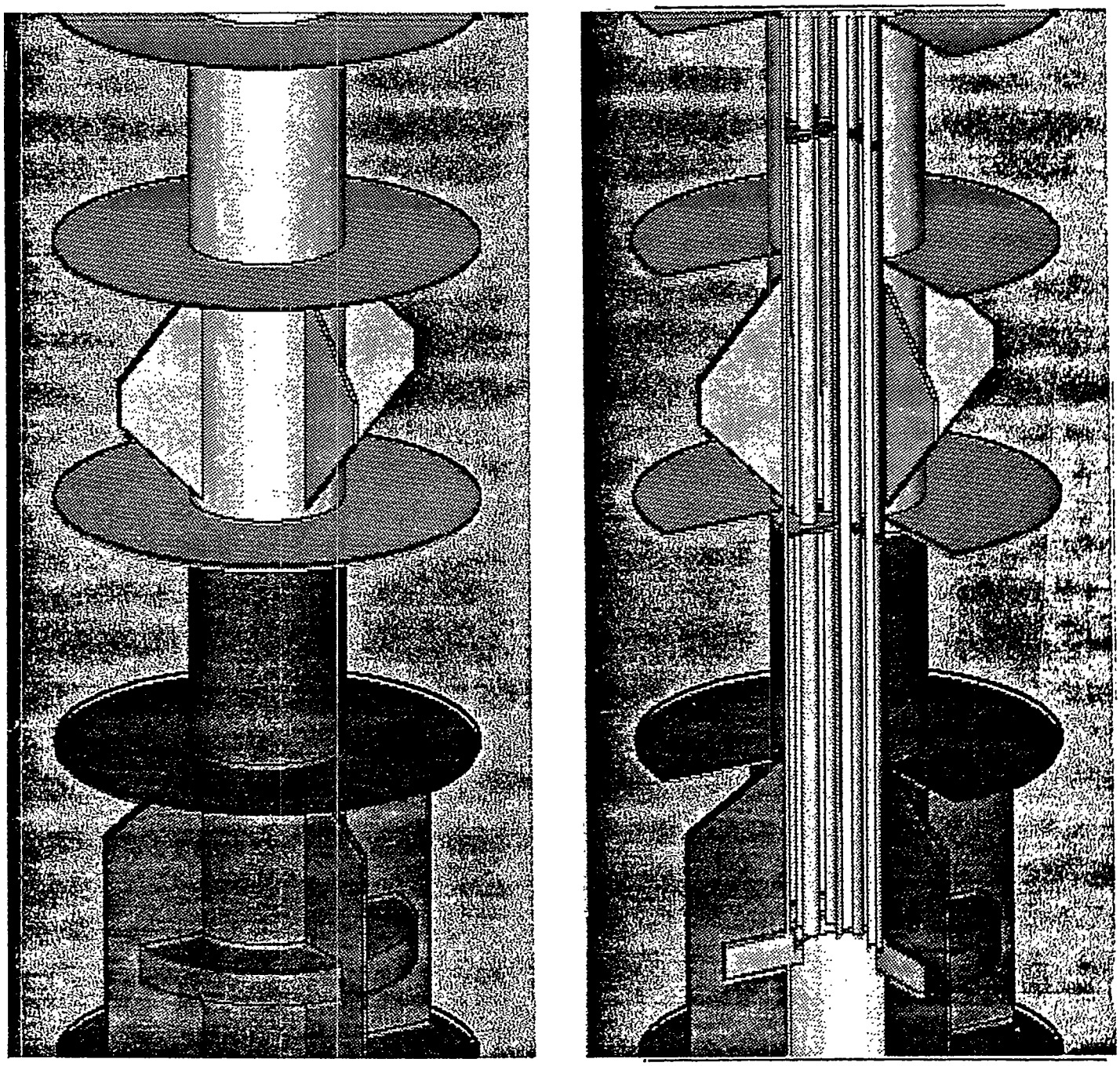


Figure 7. MCNP Pump Geometry part 5

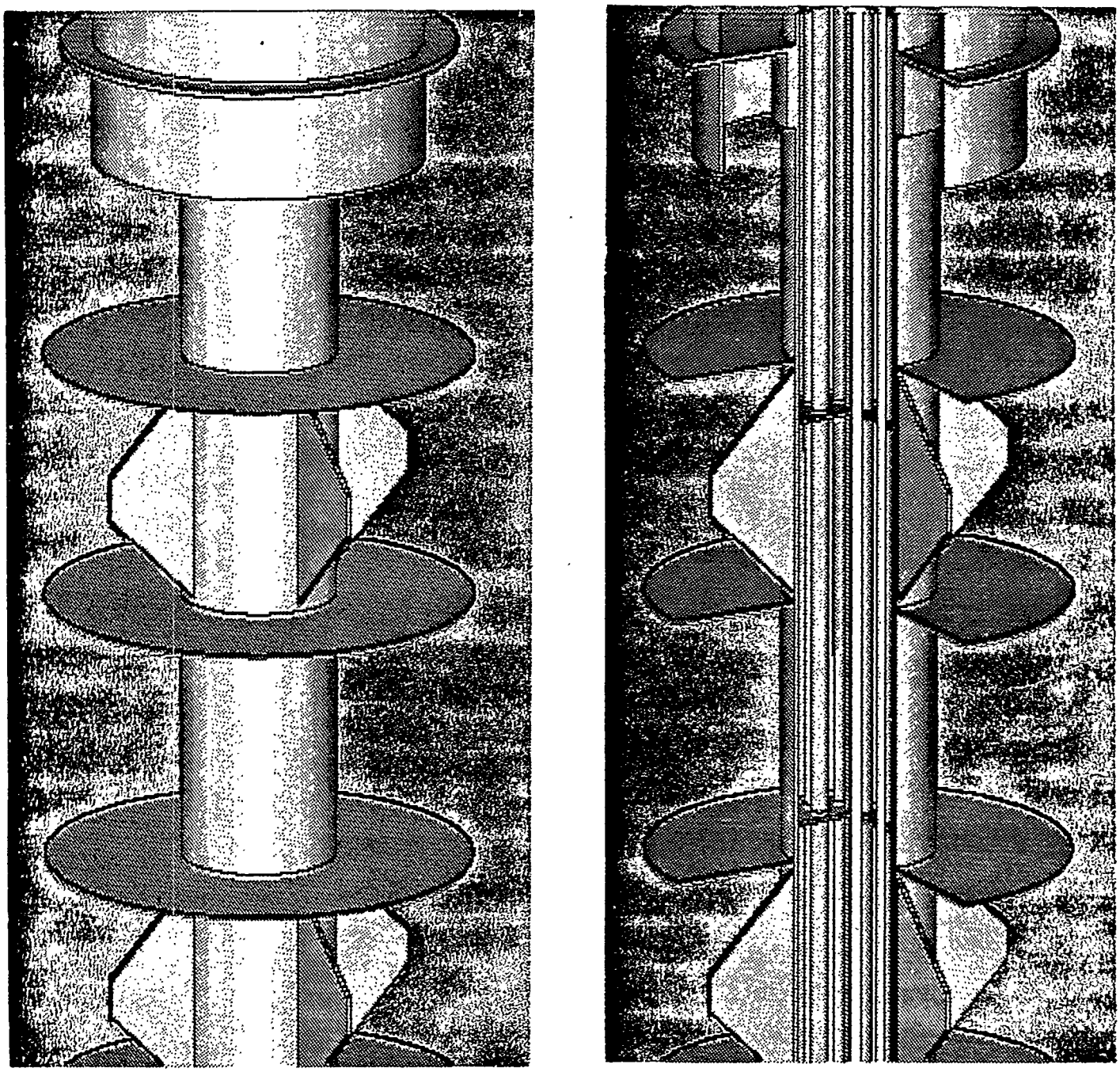


Figure 8. MCNP Pump Geometry part 6

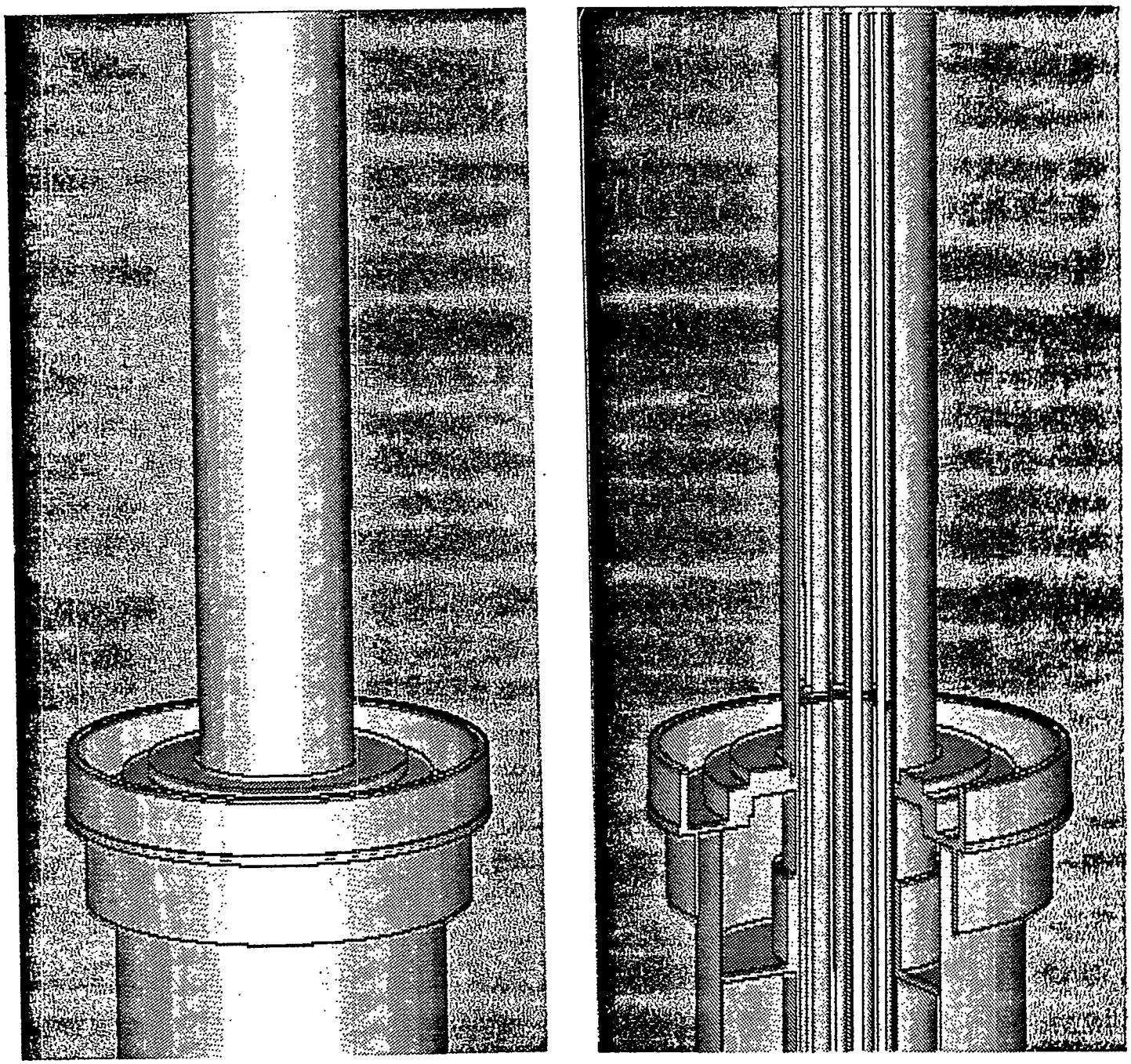
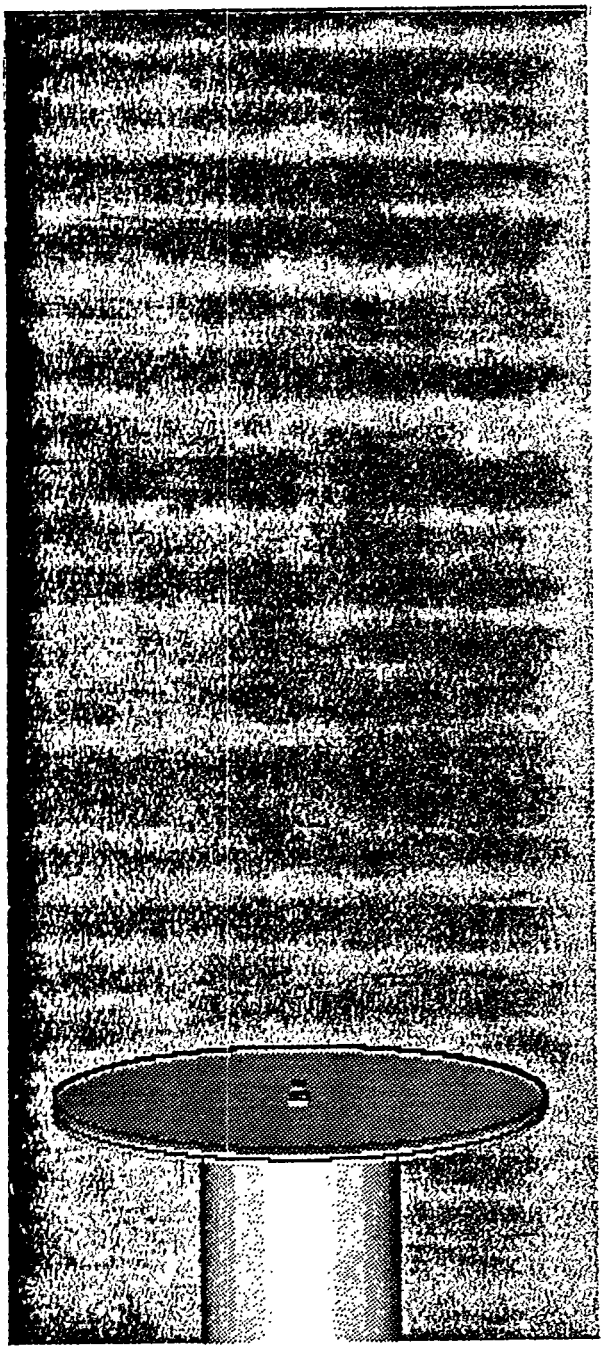


Figure 9. MCNP Pump Geometry part 7



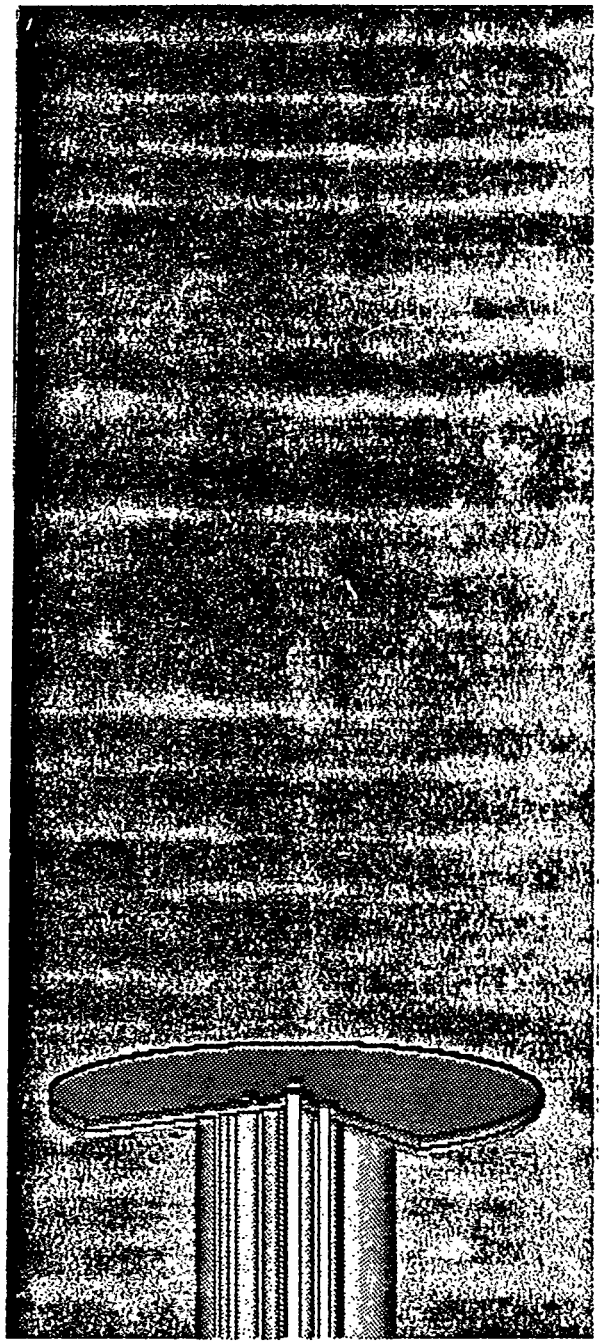
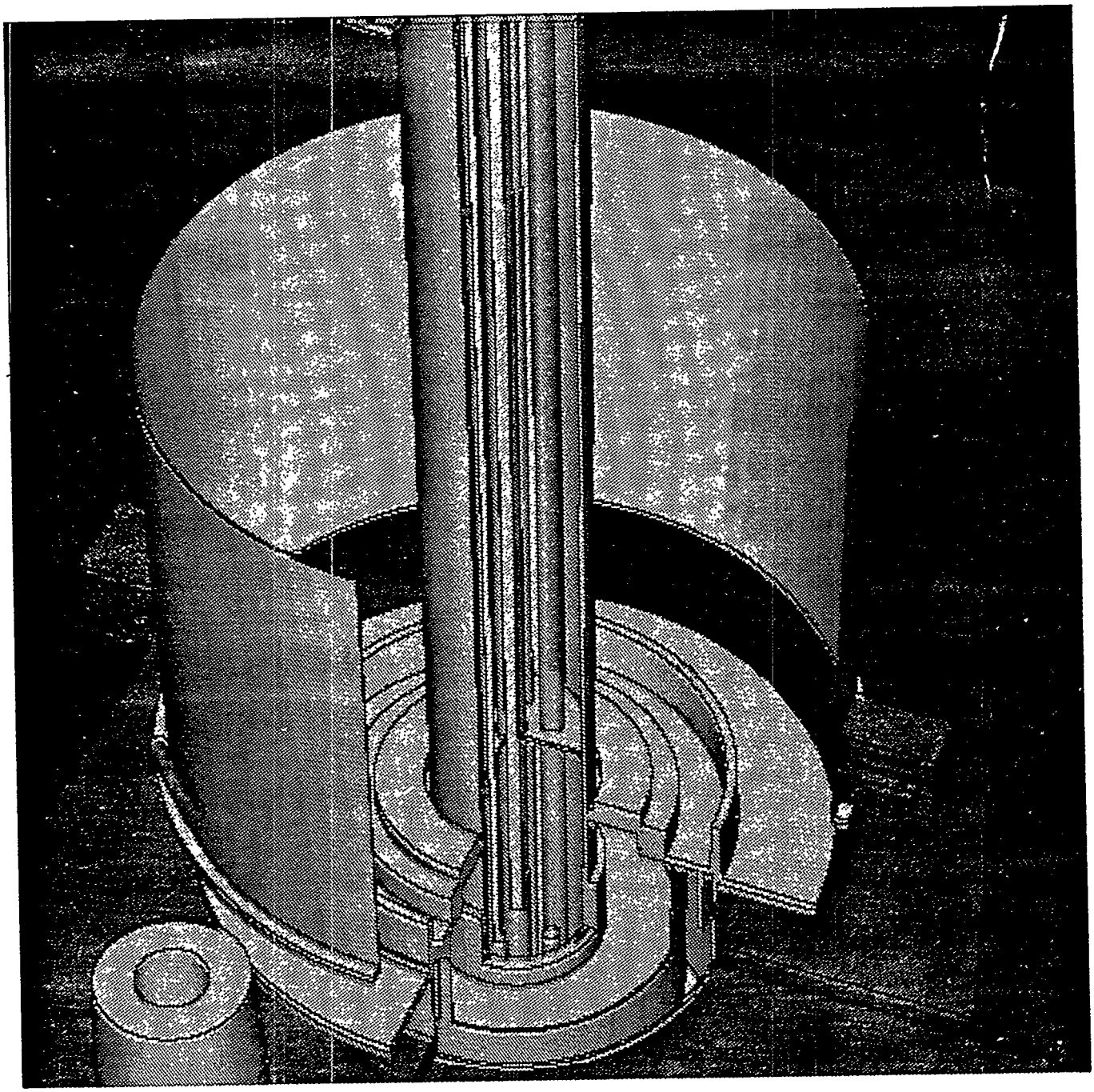


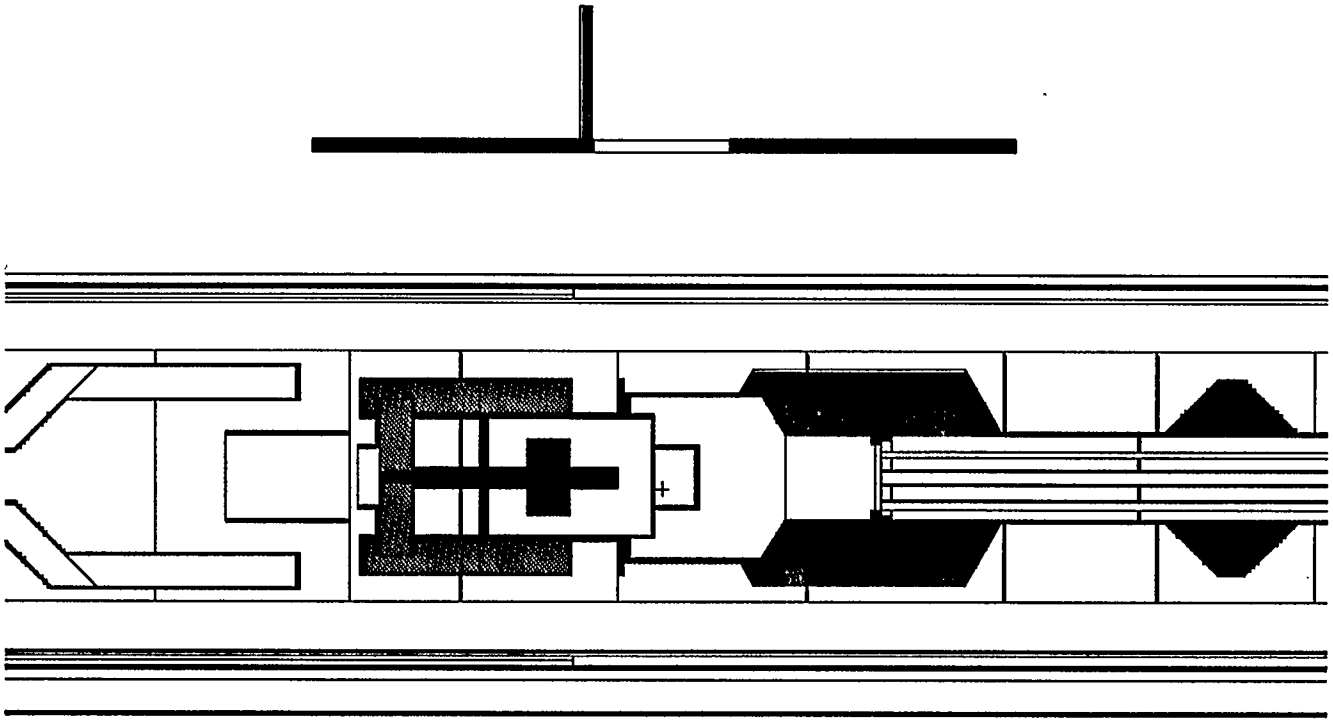
Figure 10. MCNP Model of the Detector Arrangement



11/22/94 12:38:34
PUMP model

Figure 11. Shipping Container Located Under Shot Loading Platform

probid = 11/22/94 12:35:00
basis:
(0.000000, 1.000000, 0.000000)
(0.000000, 0.000000, 1.000000)
origin:
(0.00, 0.00, 300.00)
extent = (300.00, 300.00)



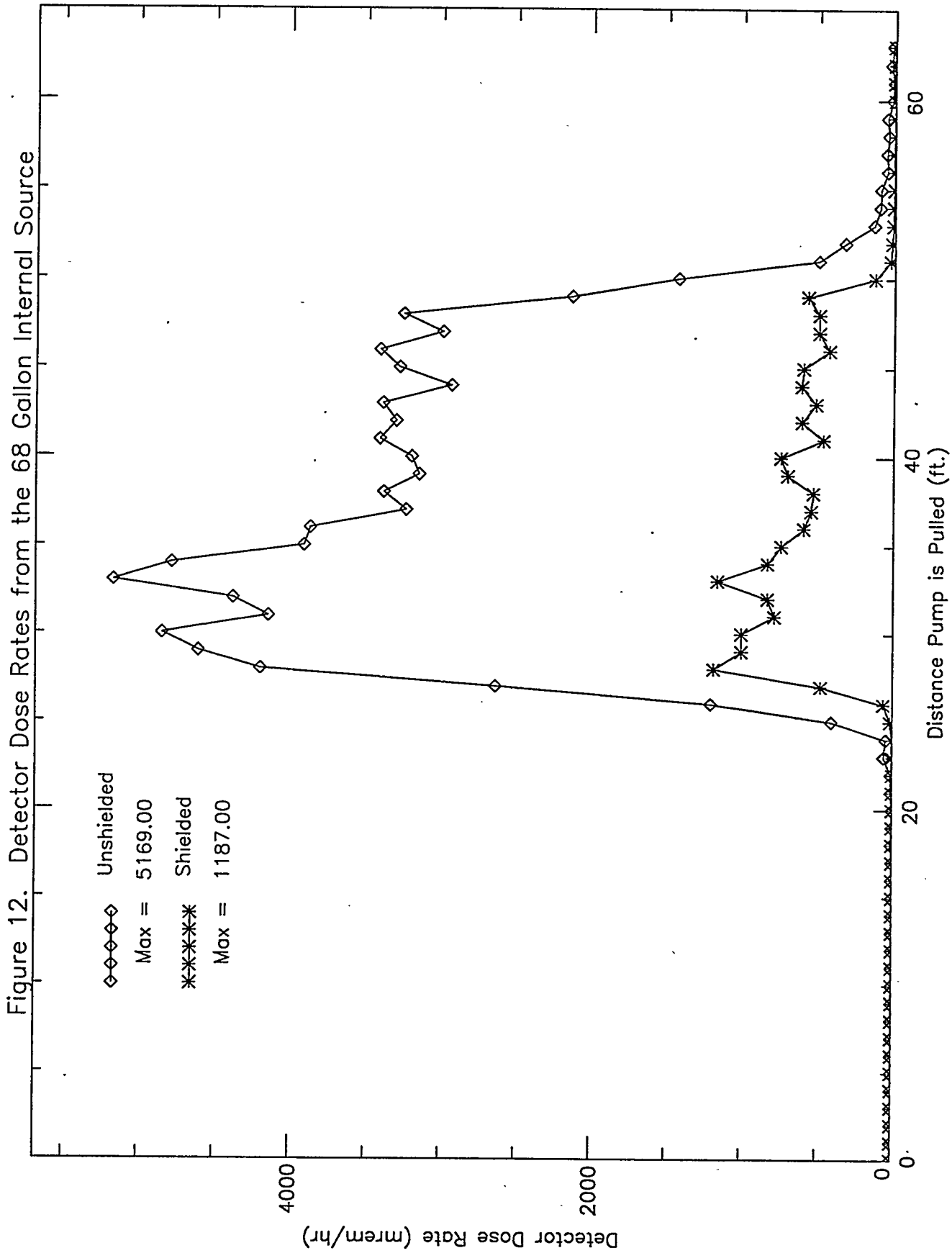


Figure 12. Detector Dose Rates from the 68 Gallon Internal Source

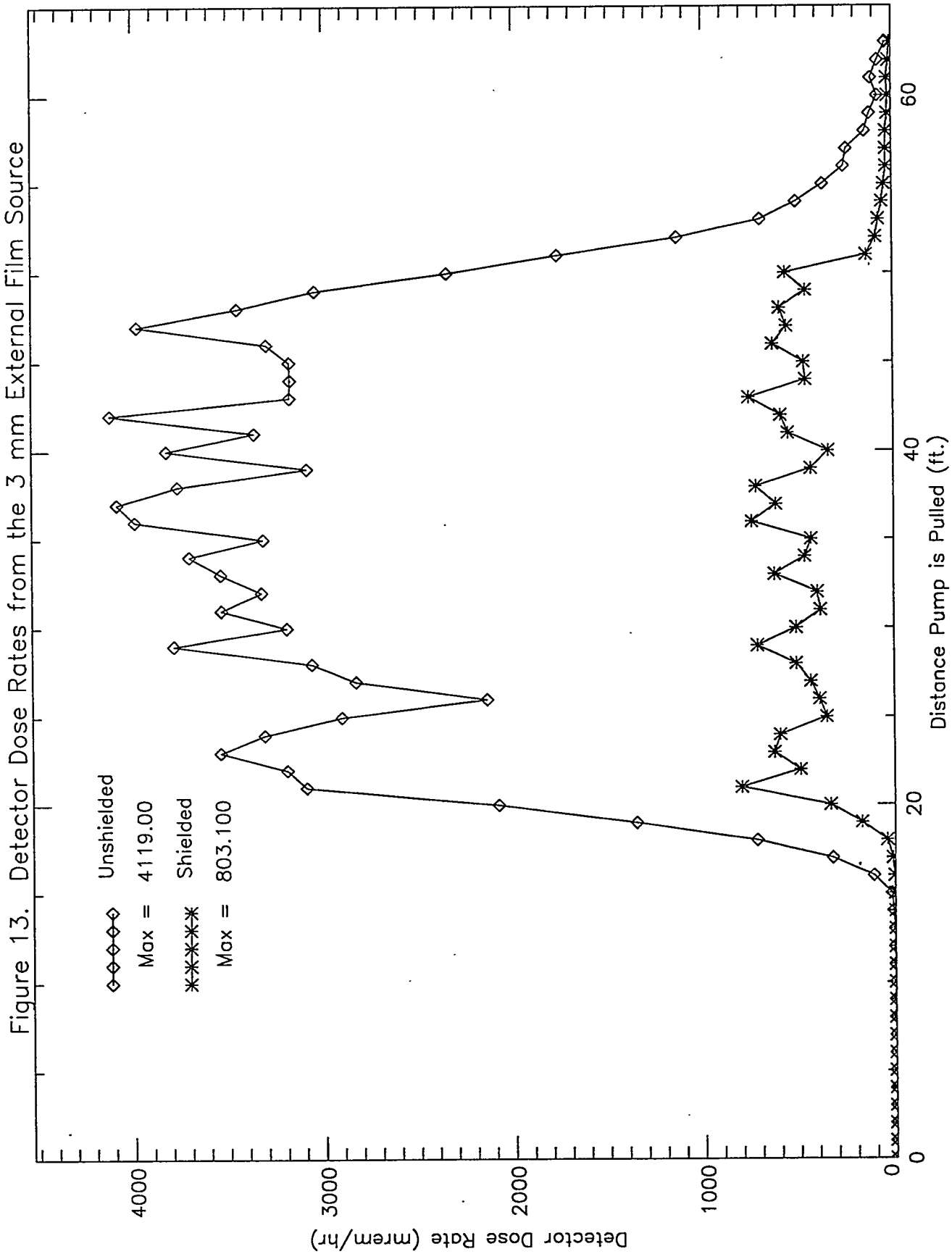


Figure 13. Detector Dose Rates from the 3 mm External Film Source

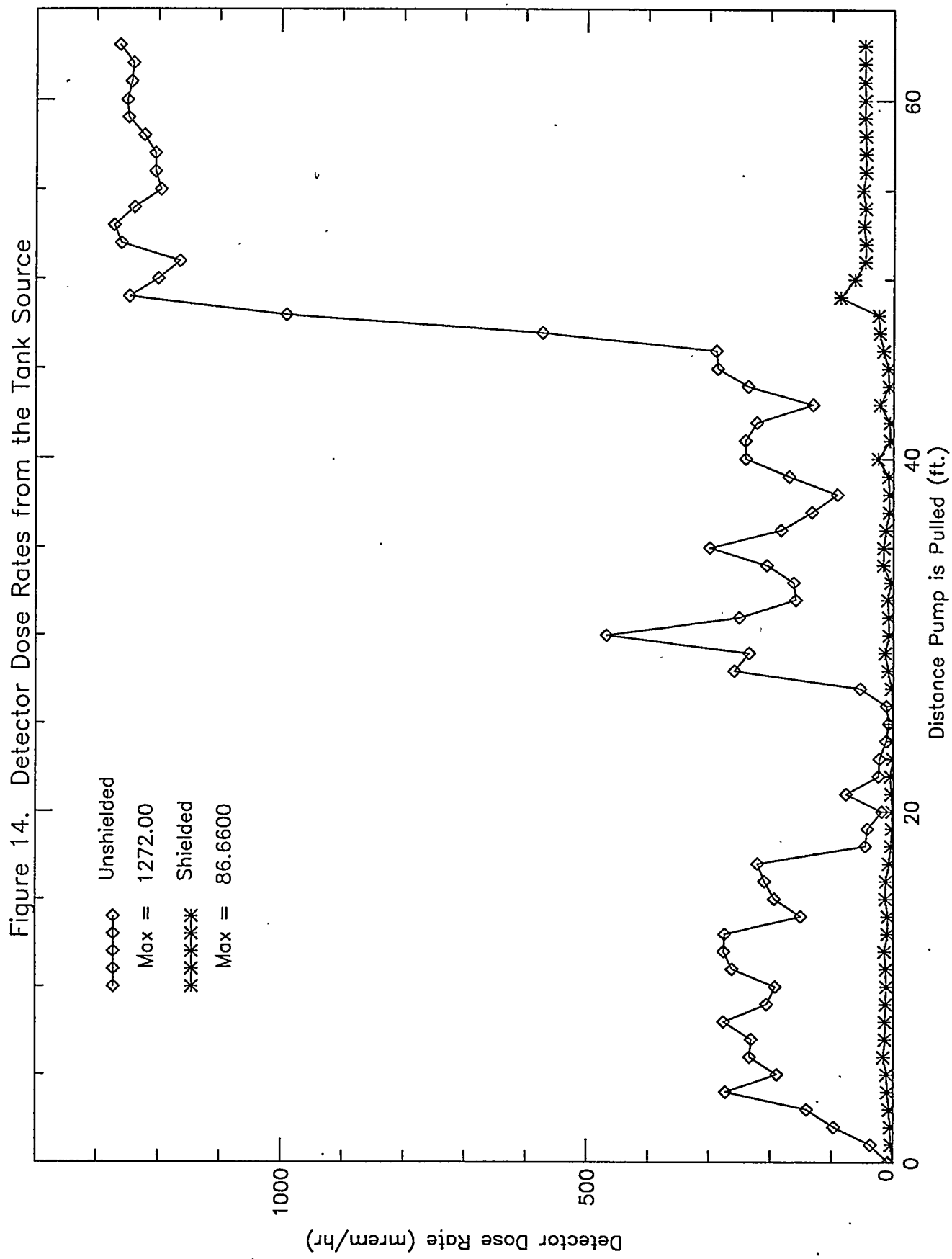


Figure 14. Detector Dose Rates from the Tank Source

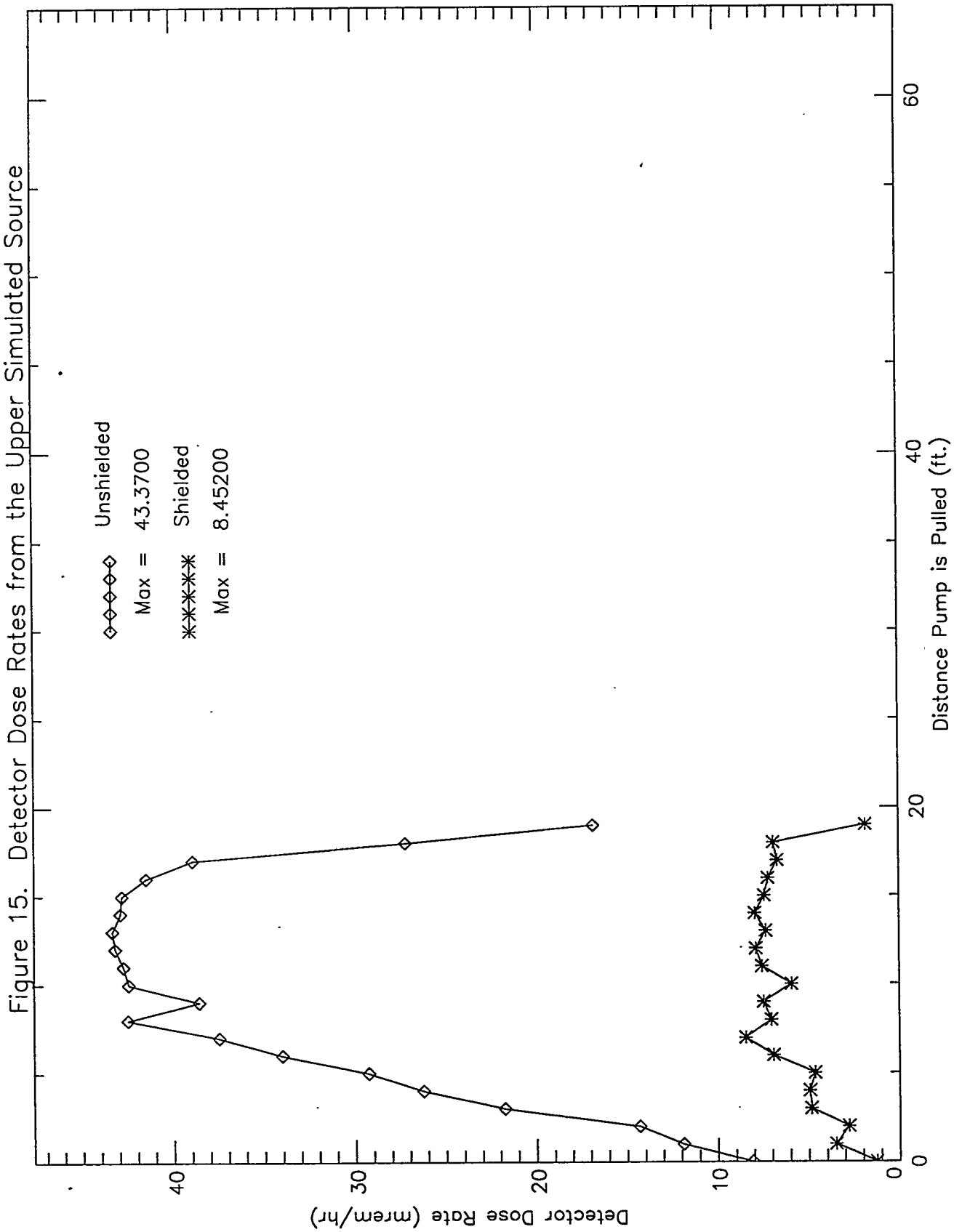


Figure 15. Detector Dose Rates from the Upper Simulated Source

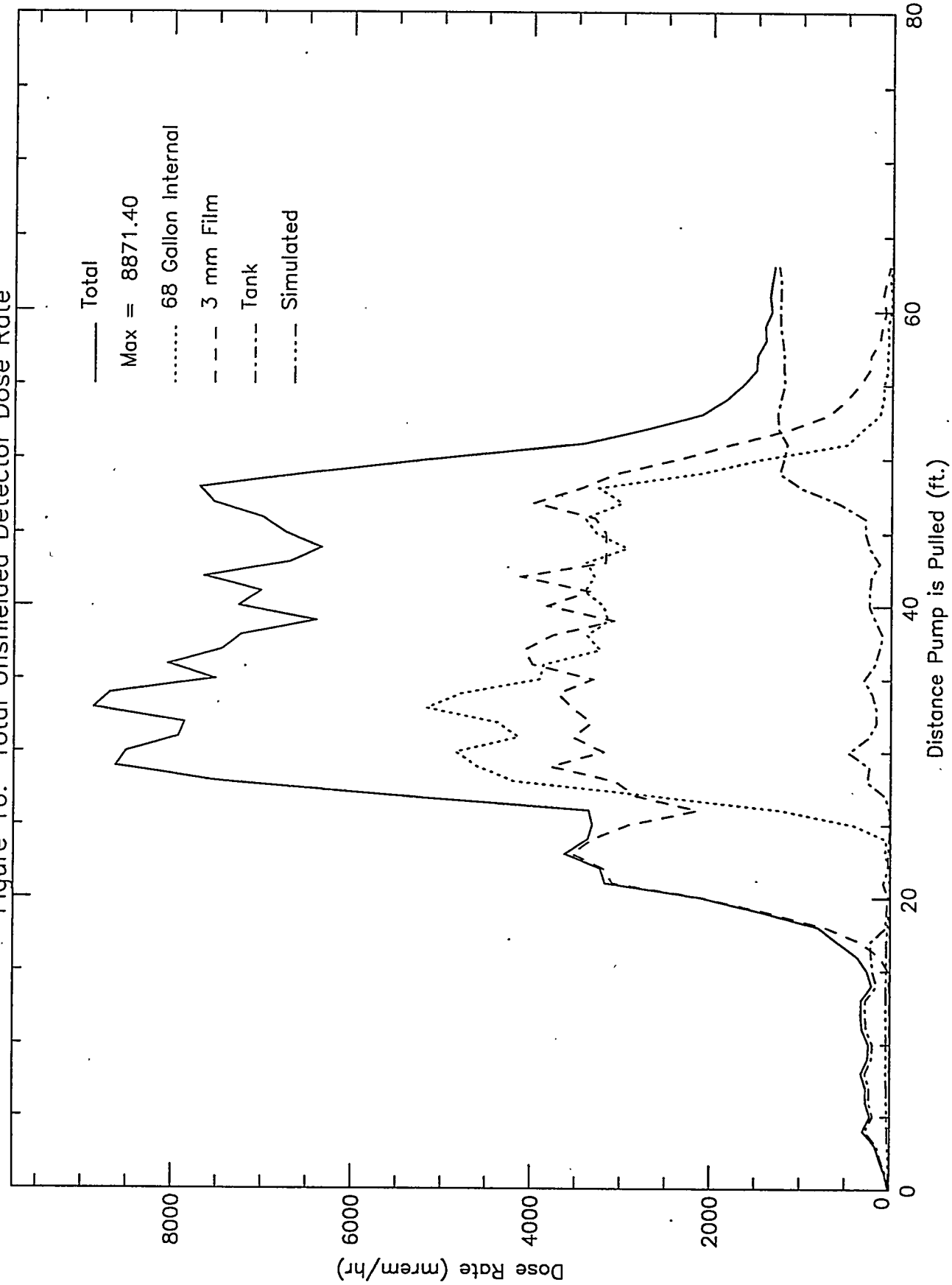


Figure 16. Total Unshielded Detector Dose Rate

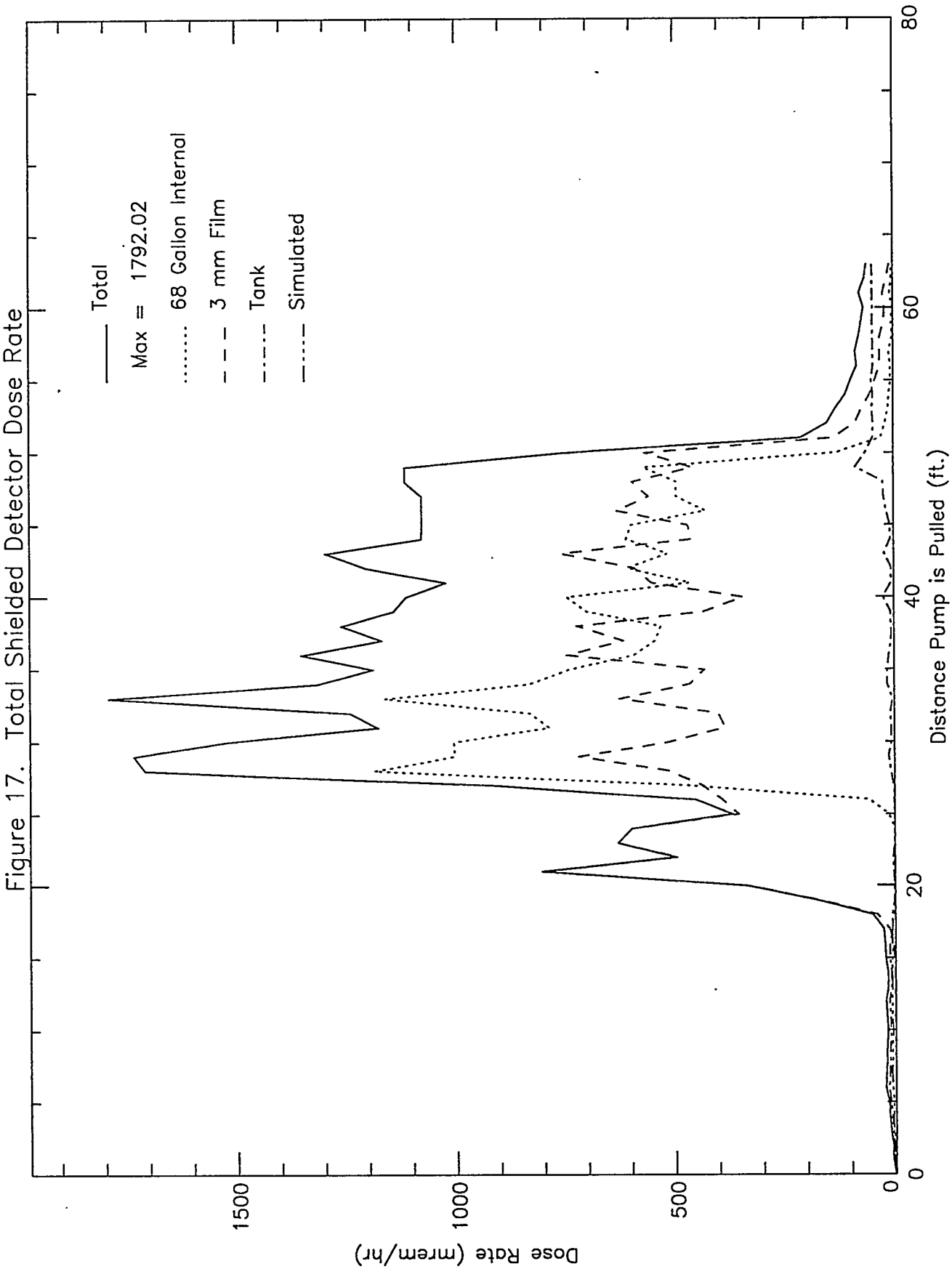


Figure 17. Total Shielded Detector Dose Rate

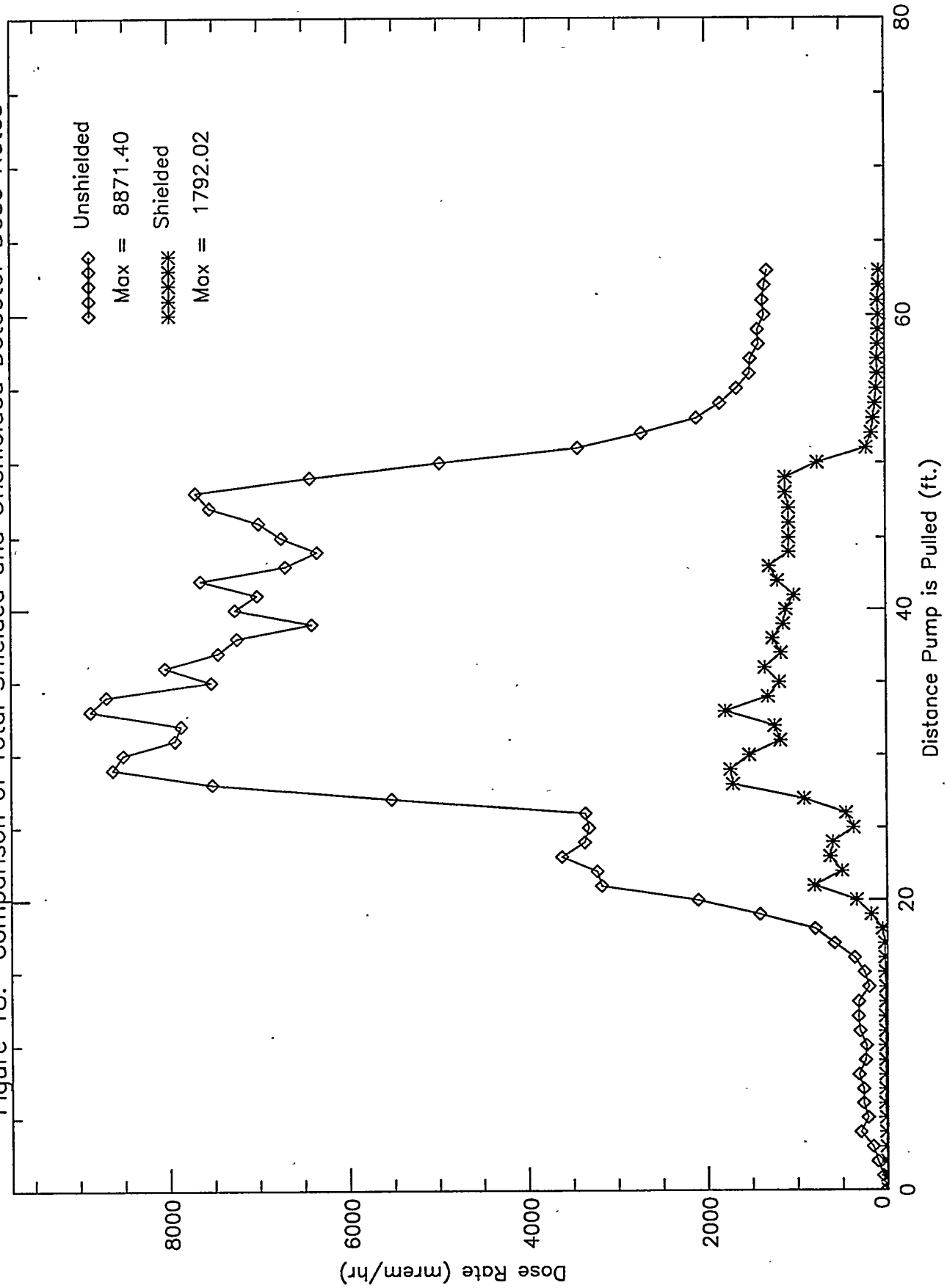


Figure 18. Comparison of Total Shielded and Unshielded Detector Dose Rates

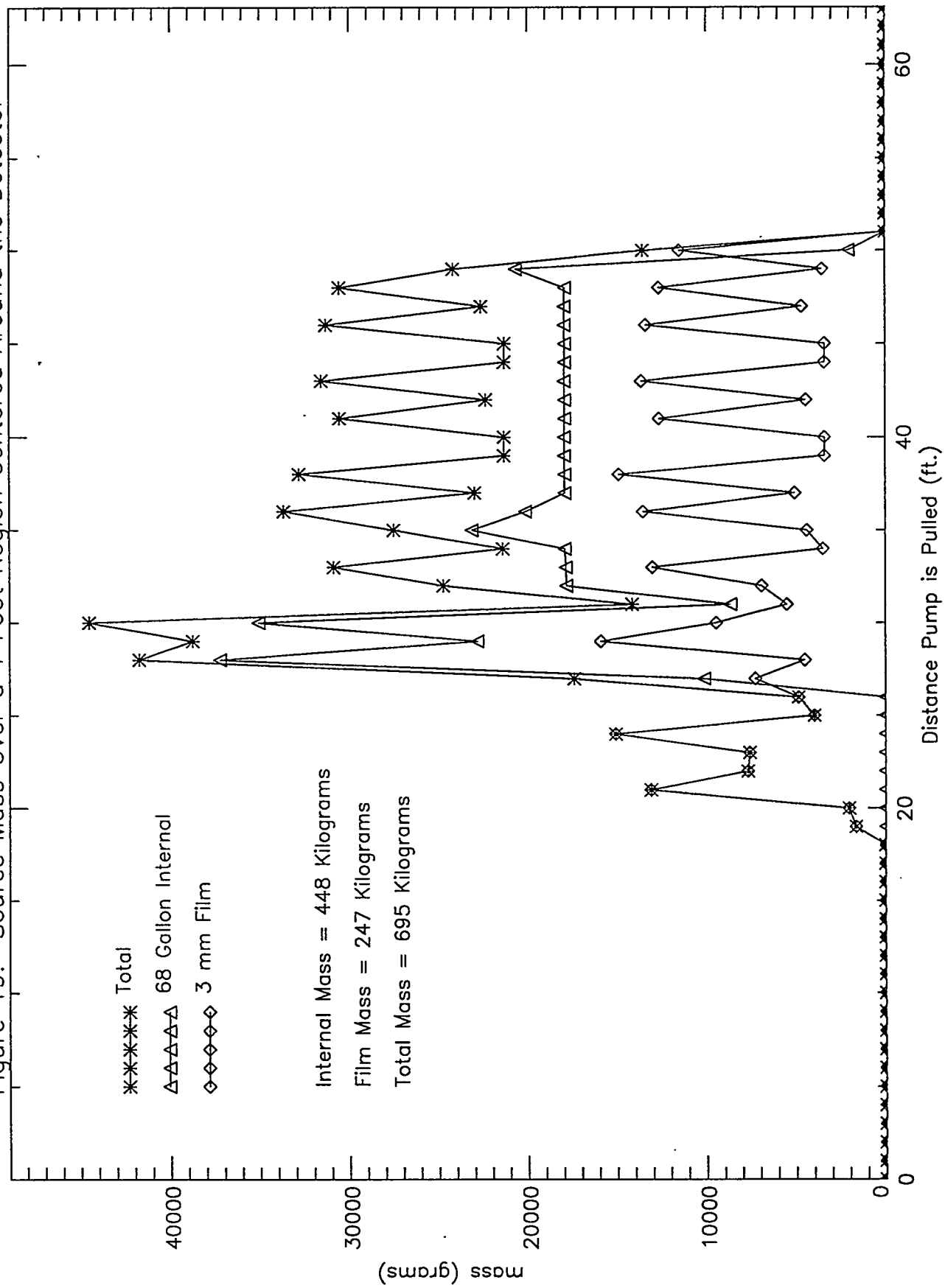


Figure 19. Source Mass Over a 1 Foot Region Centered Around the Detector

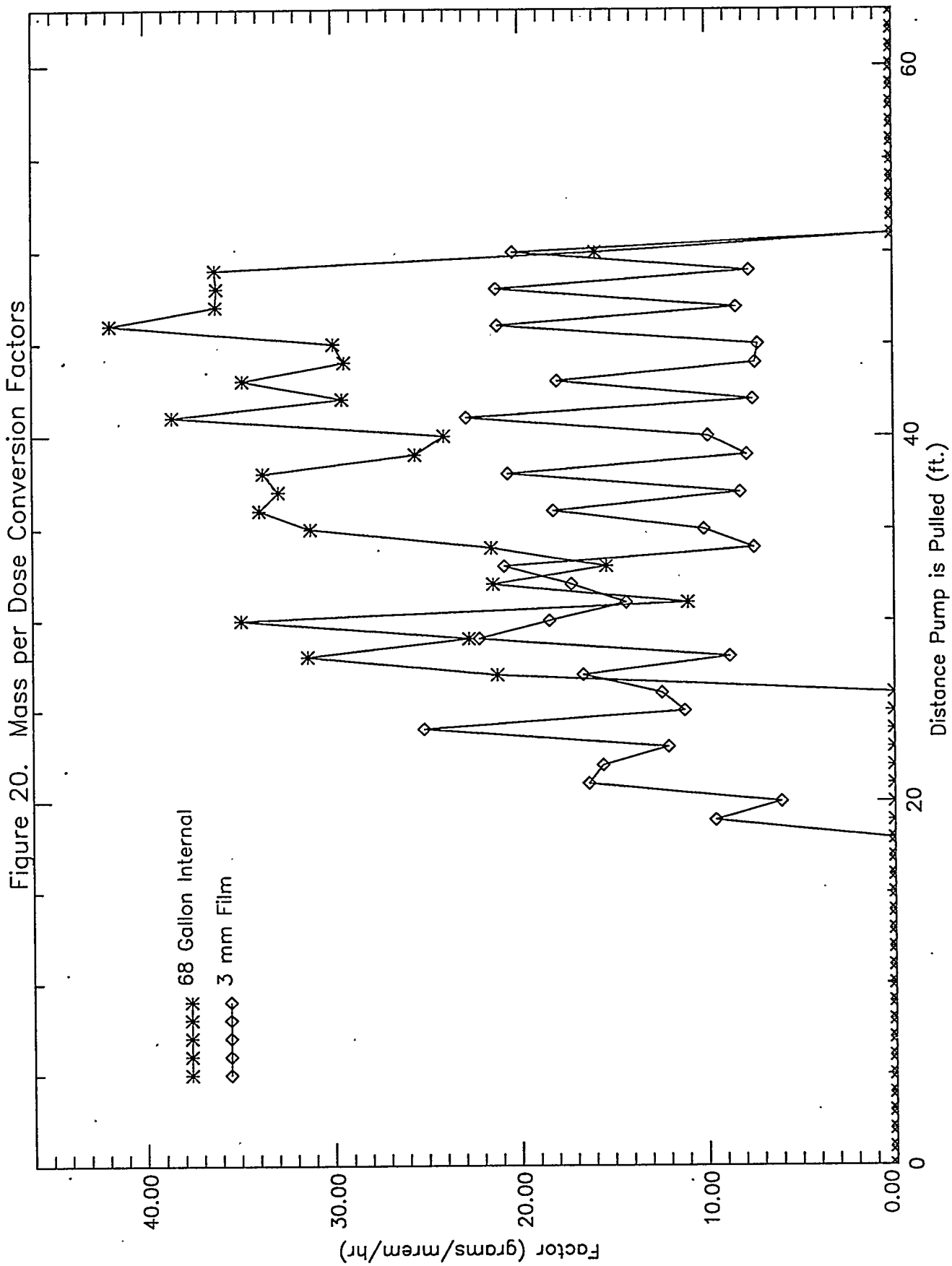


Figure 20. Mass per Dose Conversion Factors

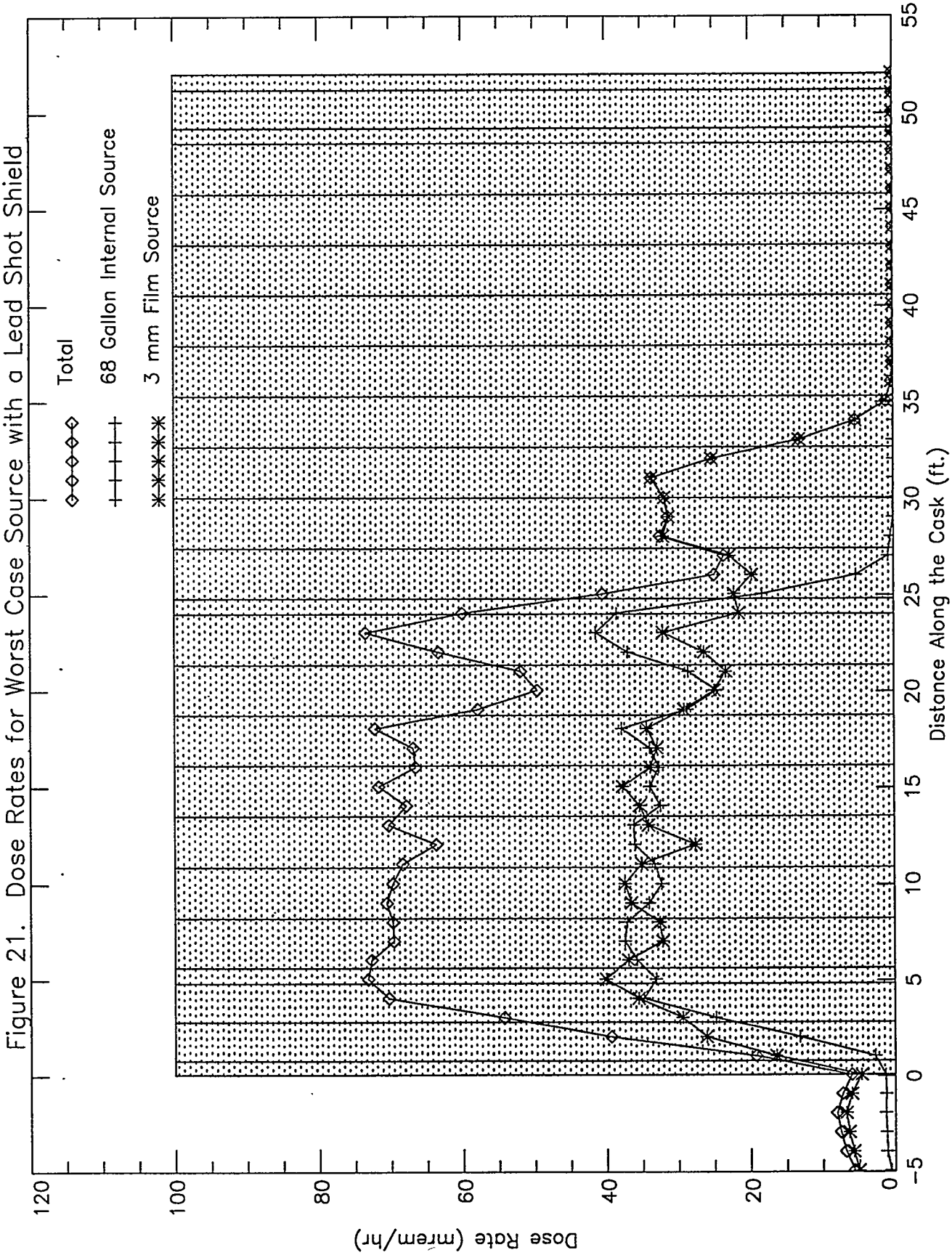


Figure 21. Dose Rates for Worst Case Source Source with a Lead Shot Shield

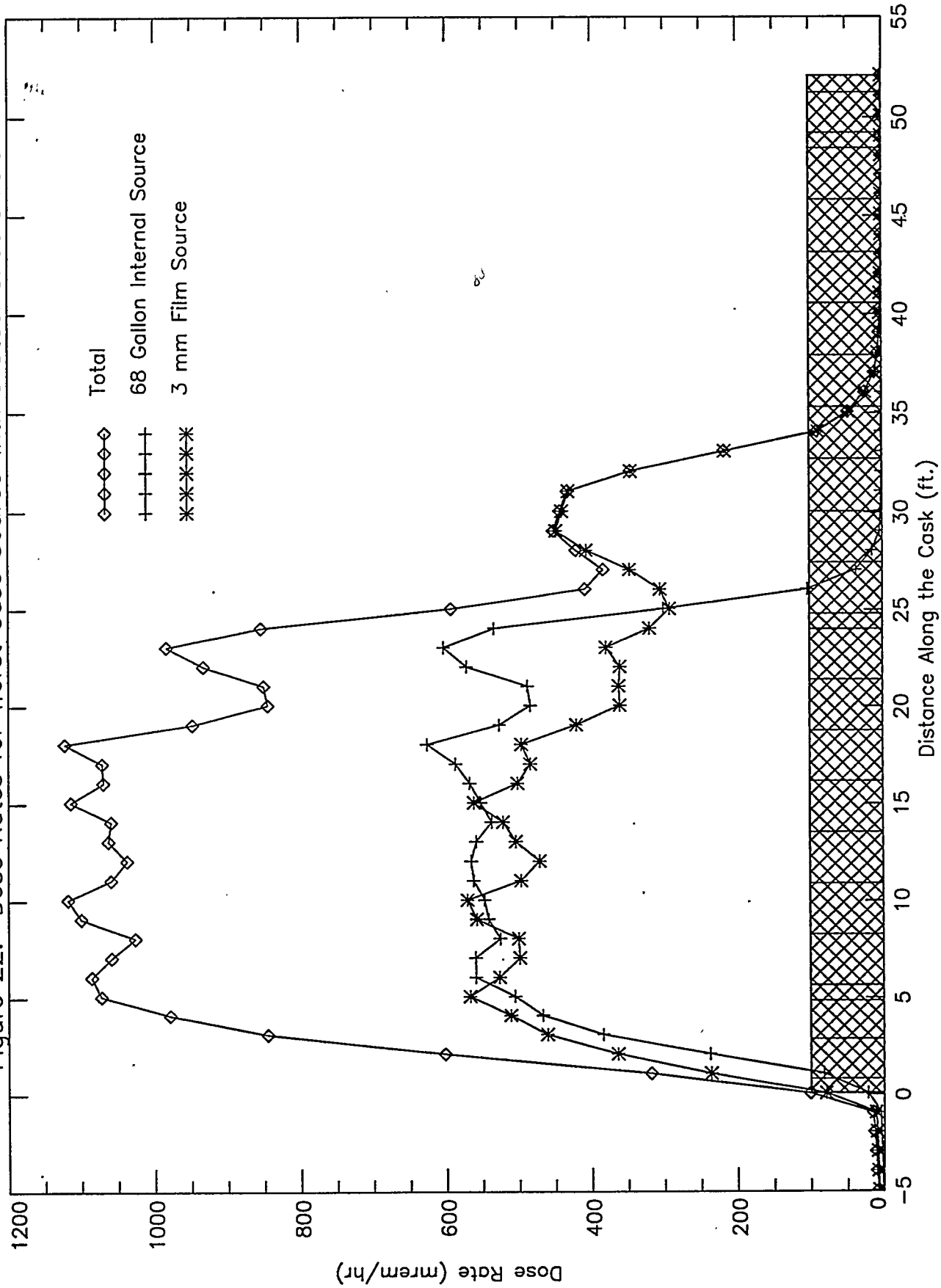


Figure 22. Dose Rates for Worst Case Source Source with a Steel Shot Shield

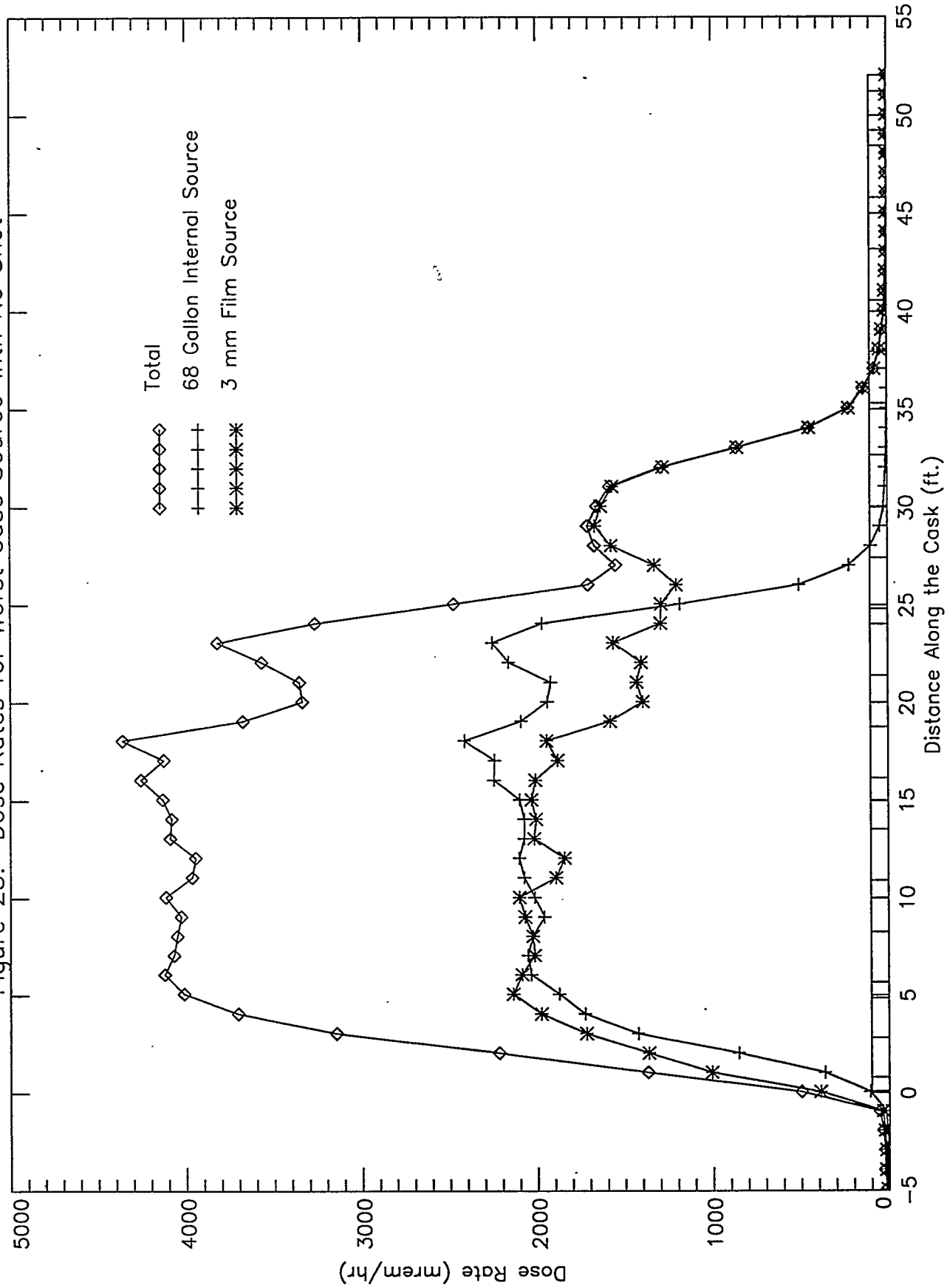


Figure 23. Dose Rates for Worst Case Source with No Shot

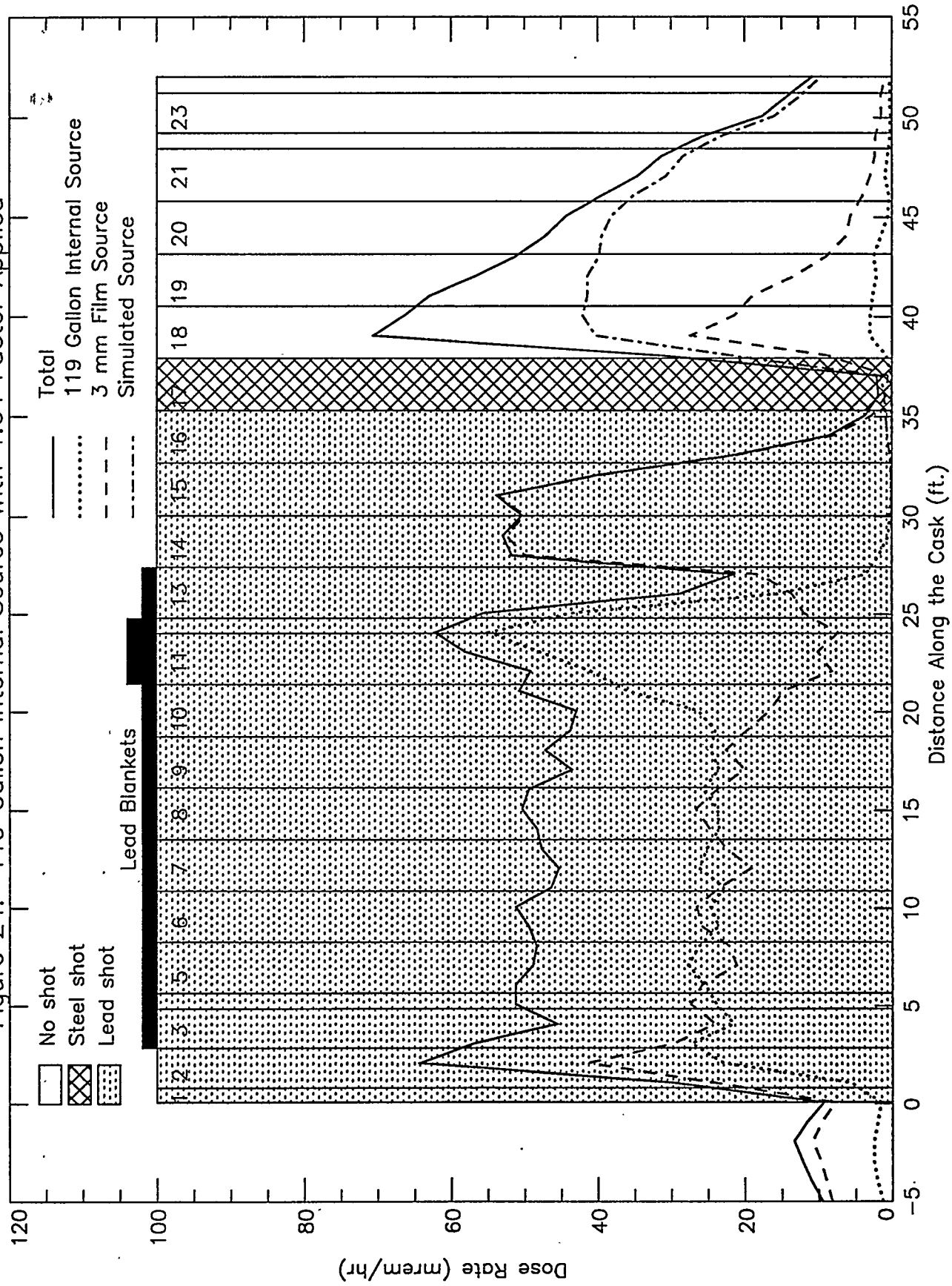


Figure 24. 119 Gallon Internal Source With 1.64 Factor Applied

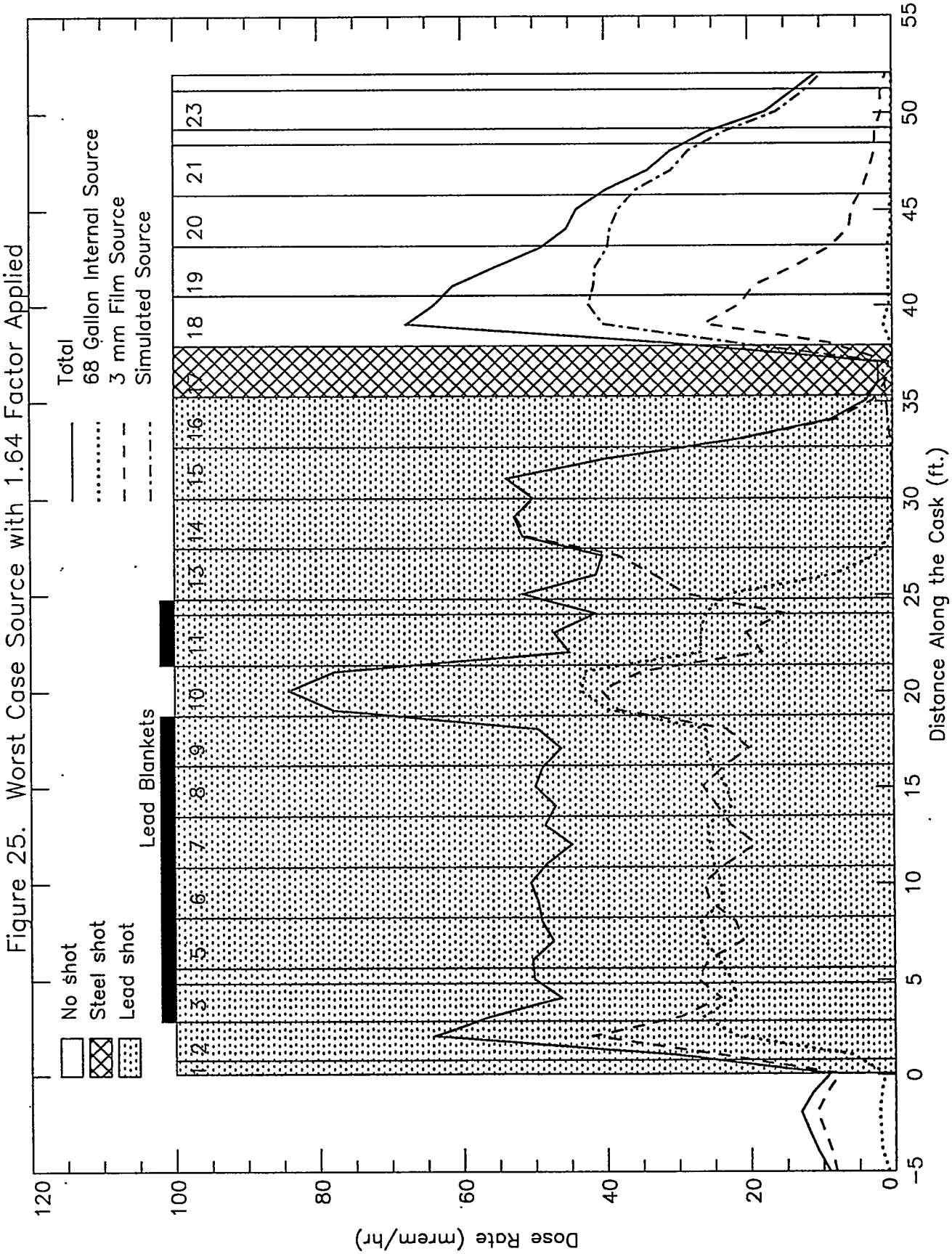


Figure 25. Worst Case Source with 1.64 Factor Applied

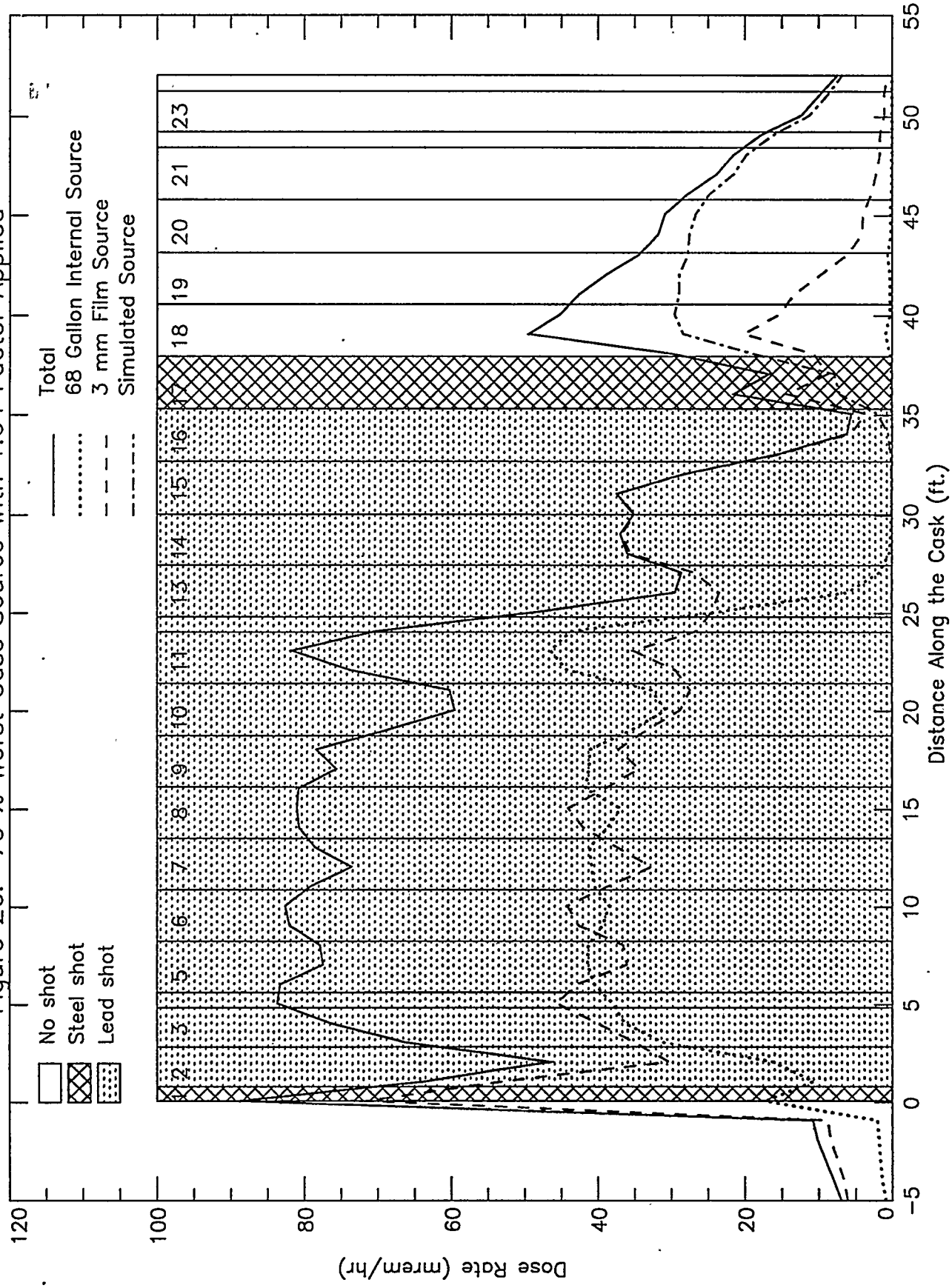


Figure 26. 70 % Worst Case Source with 1.64 Factor Applied

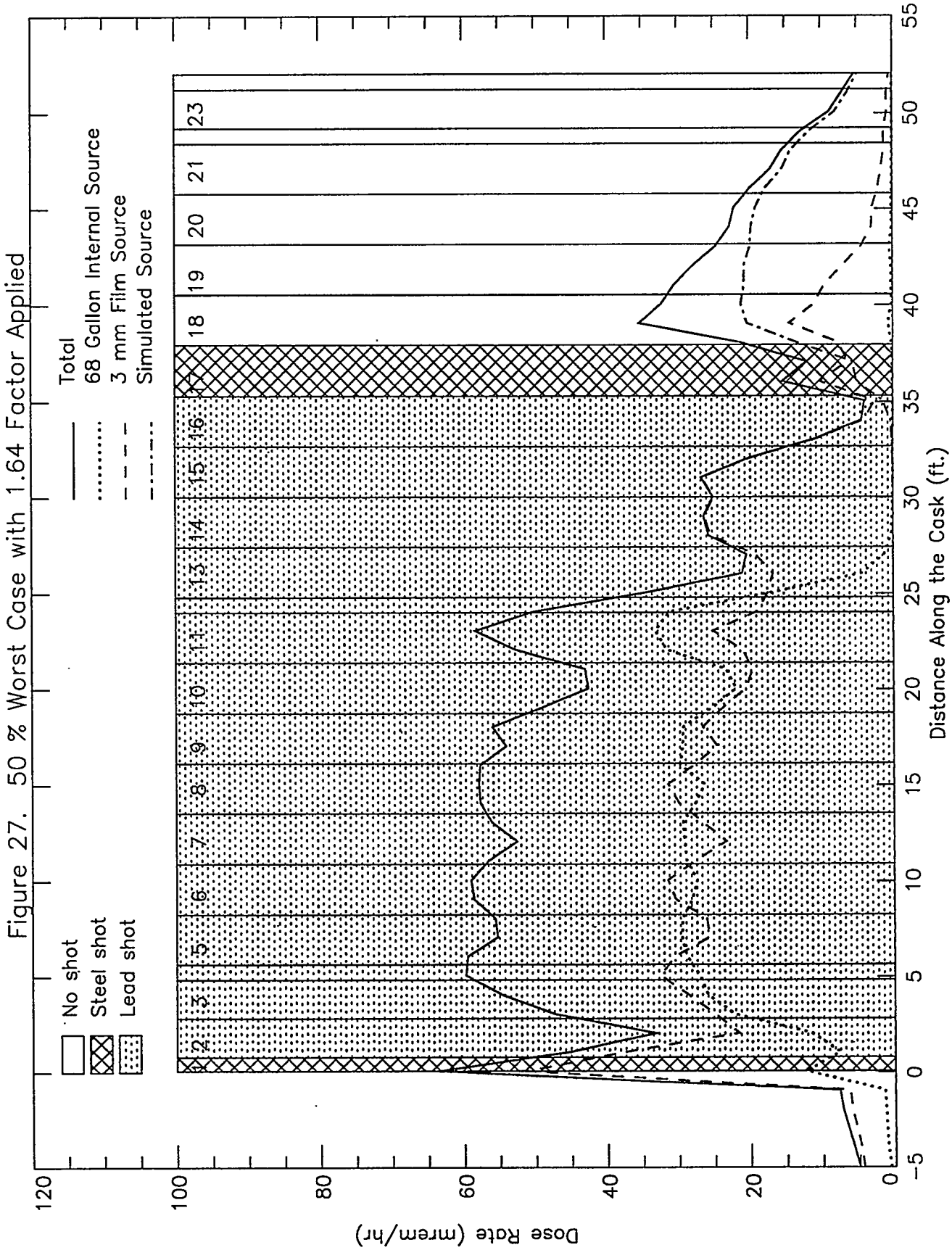


Figure 27. 50 % Worst Case with 1.64 Factor Applied

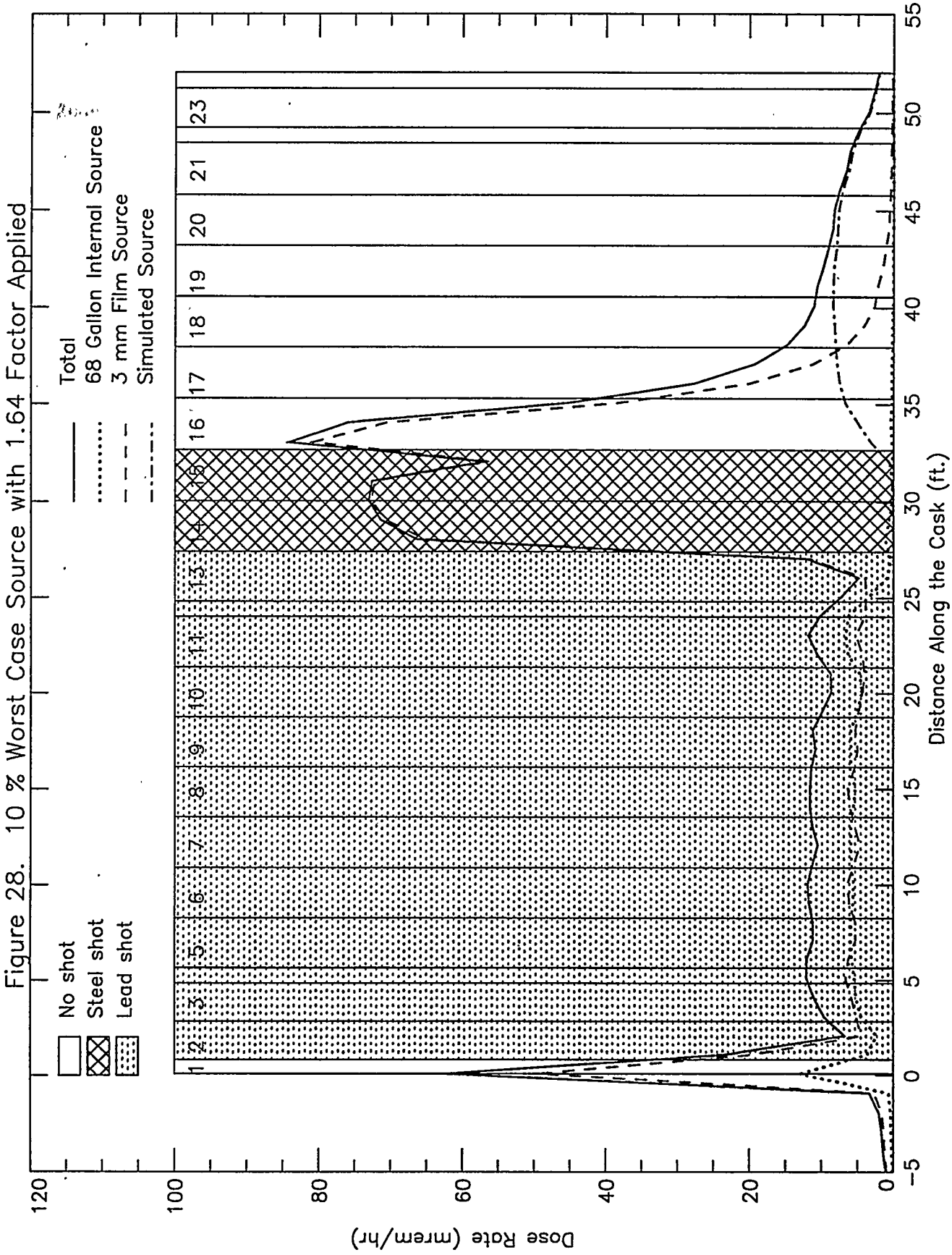


Figure 28. 10 % Worst Case Source with 1.64 Factor Applied

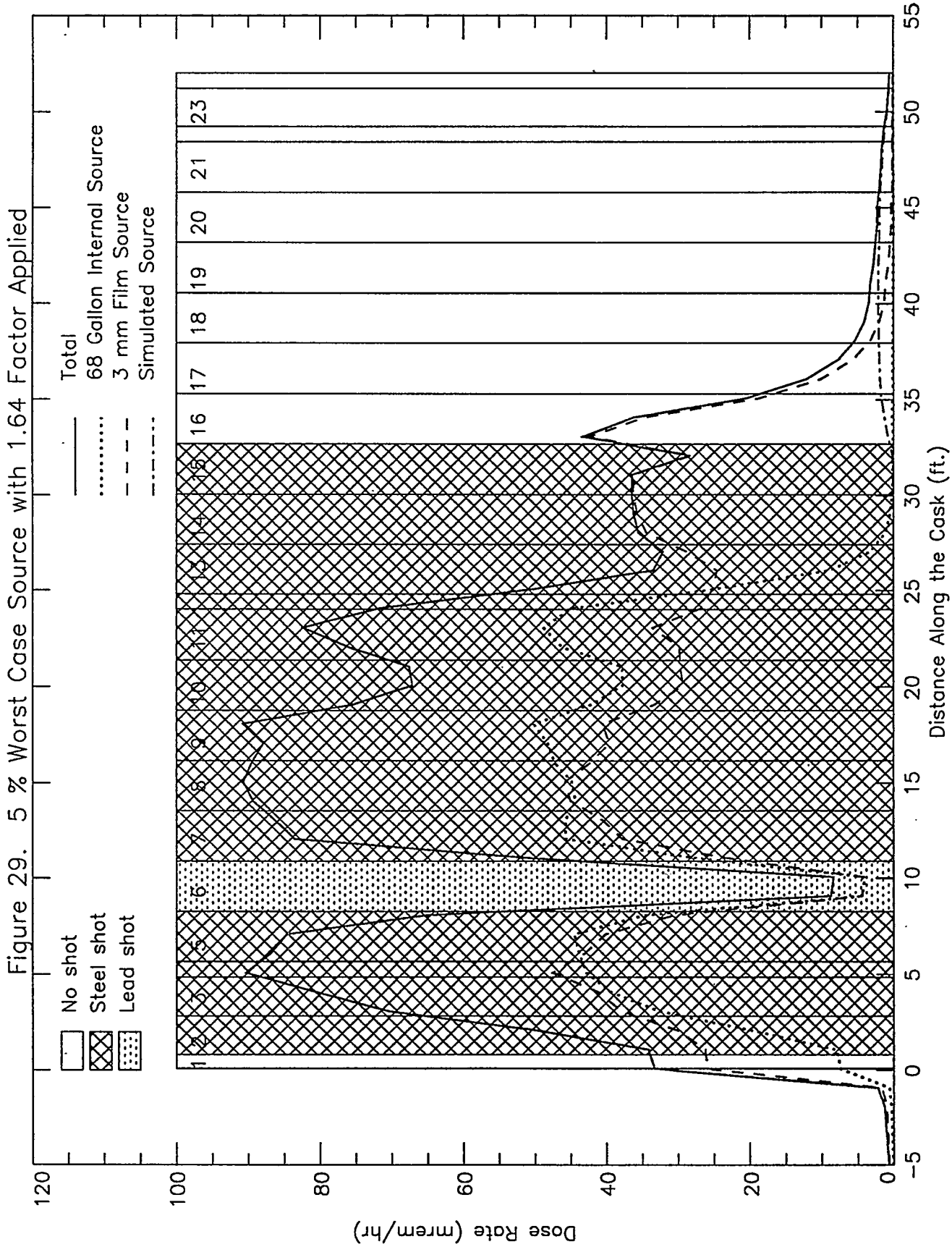


Figure 29. 5 % Worst Case Source with 1.64 Factor Applied

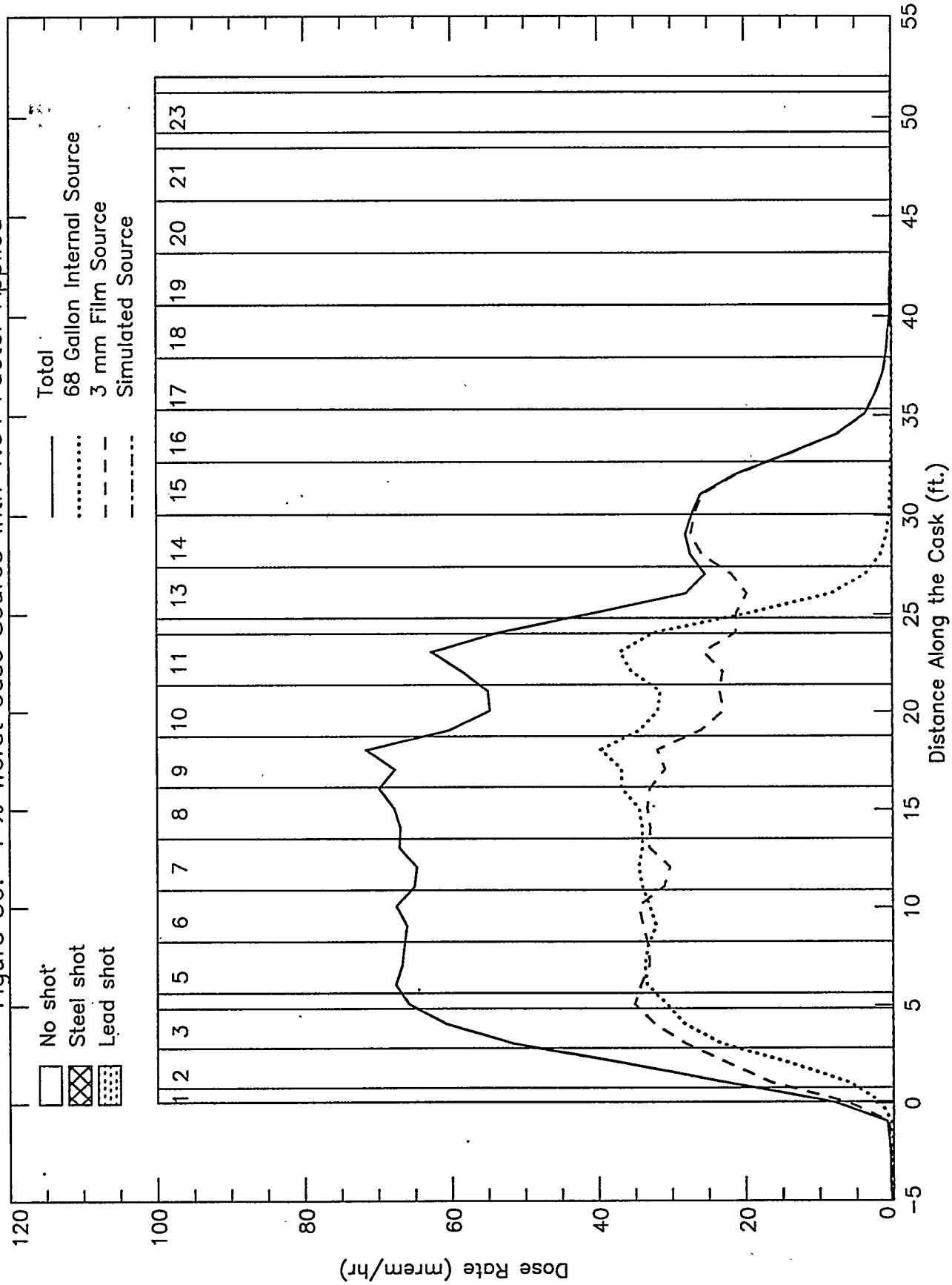


Figure 30. 1 % Worst Case Source Source with 1.64 Factor Applied

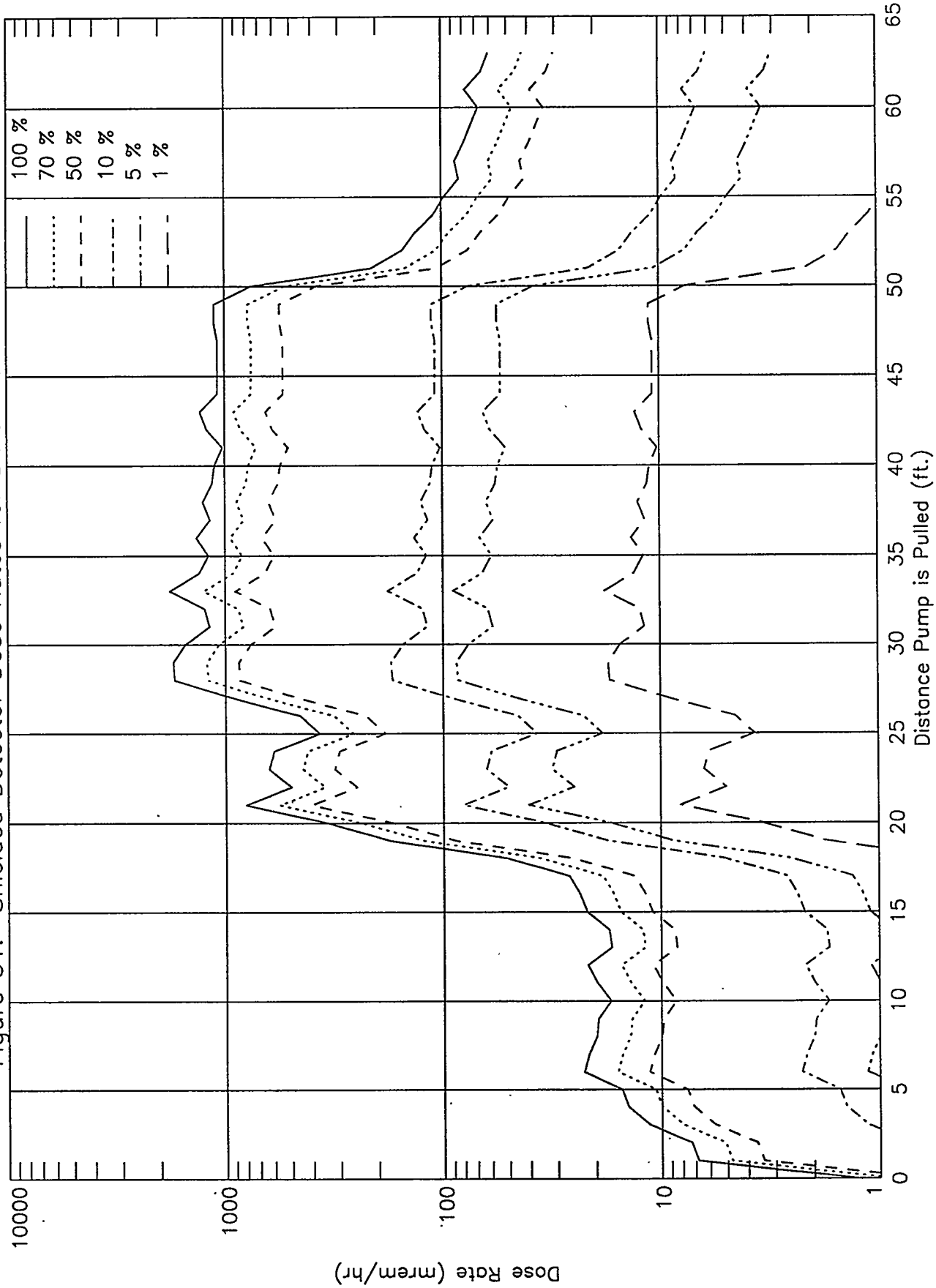
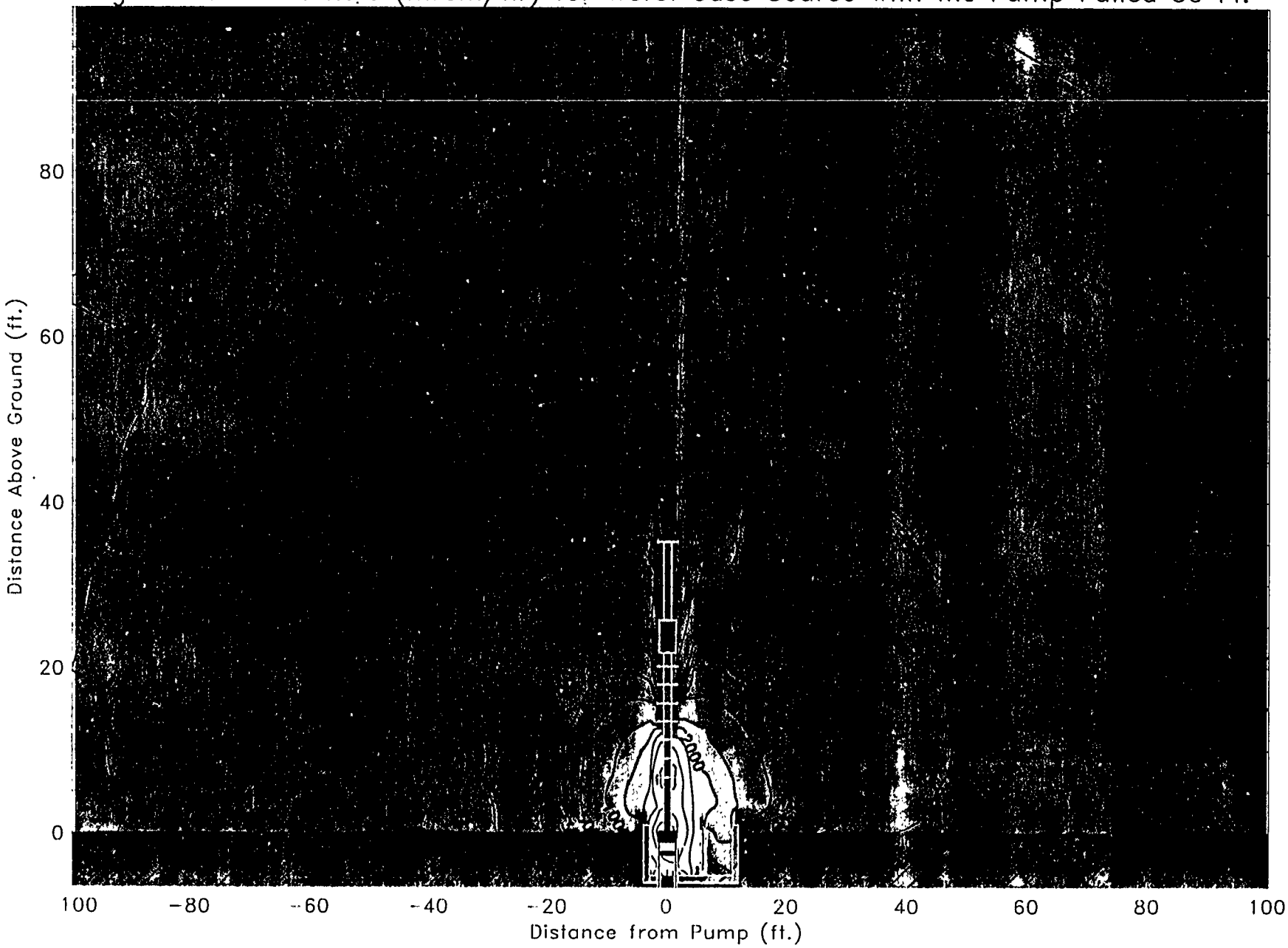


Figure 31. Shielded Detector Dose Rates for Different Source Intensities

Figure 32. Dose Rate (mrem/hr) for Worst Case Source with the Pump Pulled 30 Ft.



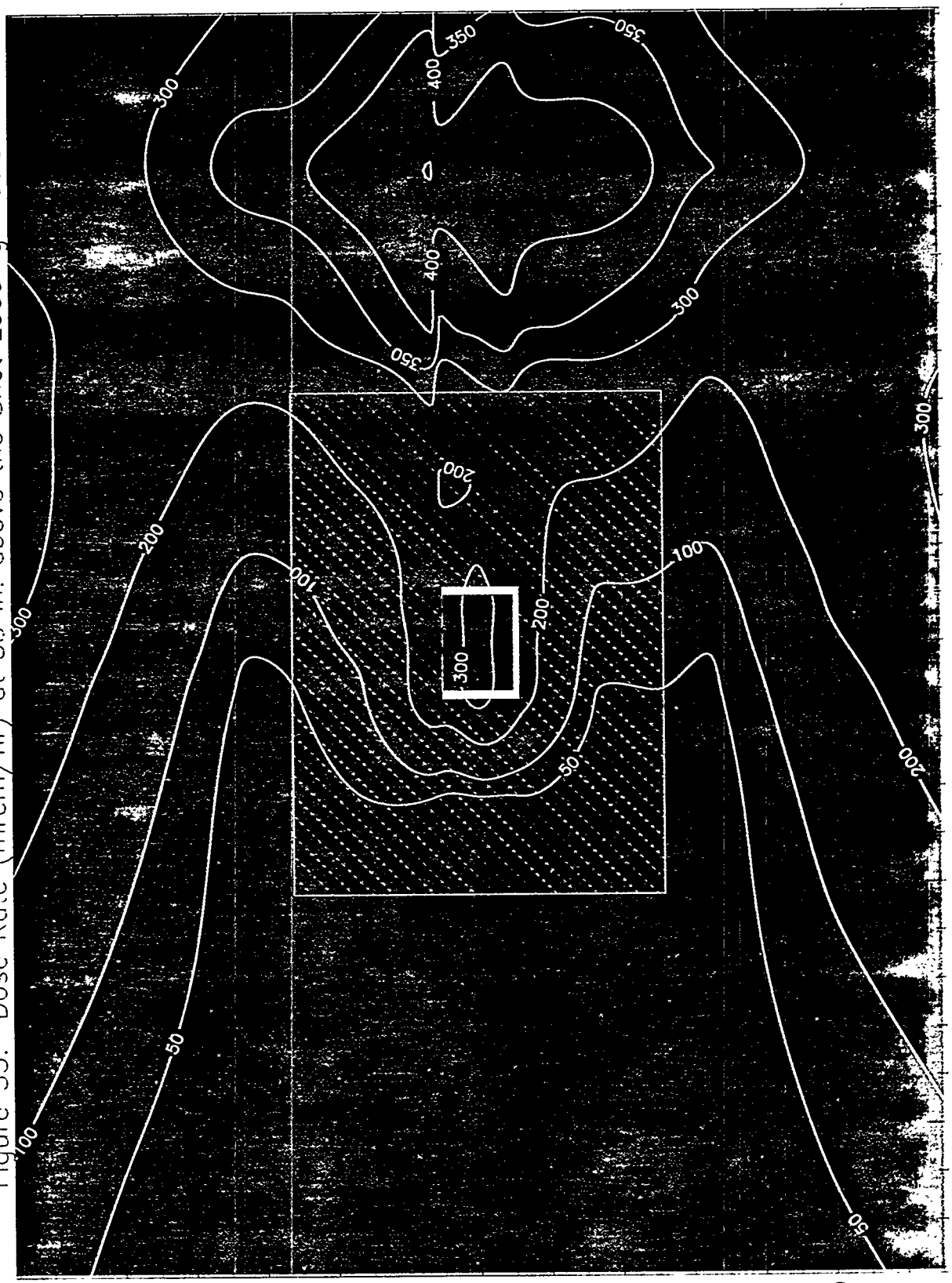


Figure 35. Dose Rate (mrem/hr) at 55 in. above the Shot Loading Platform

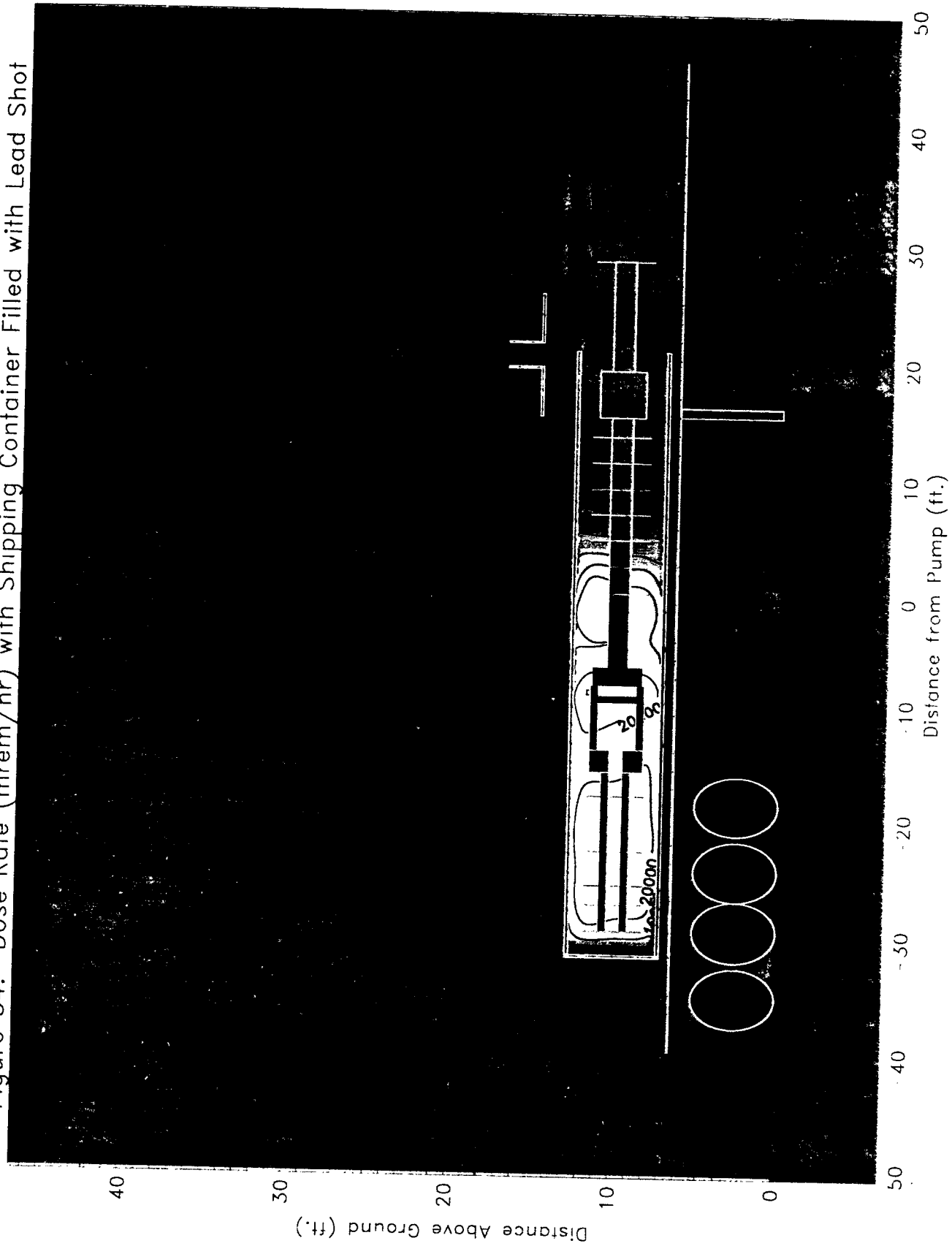


Figure 34. Dose Rate (mrem/hr) with Shipping Container Filled with Lead Shot

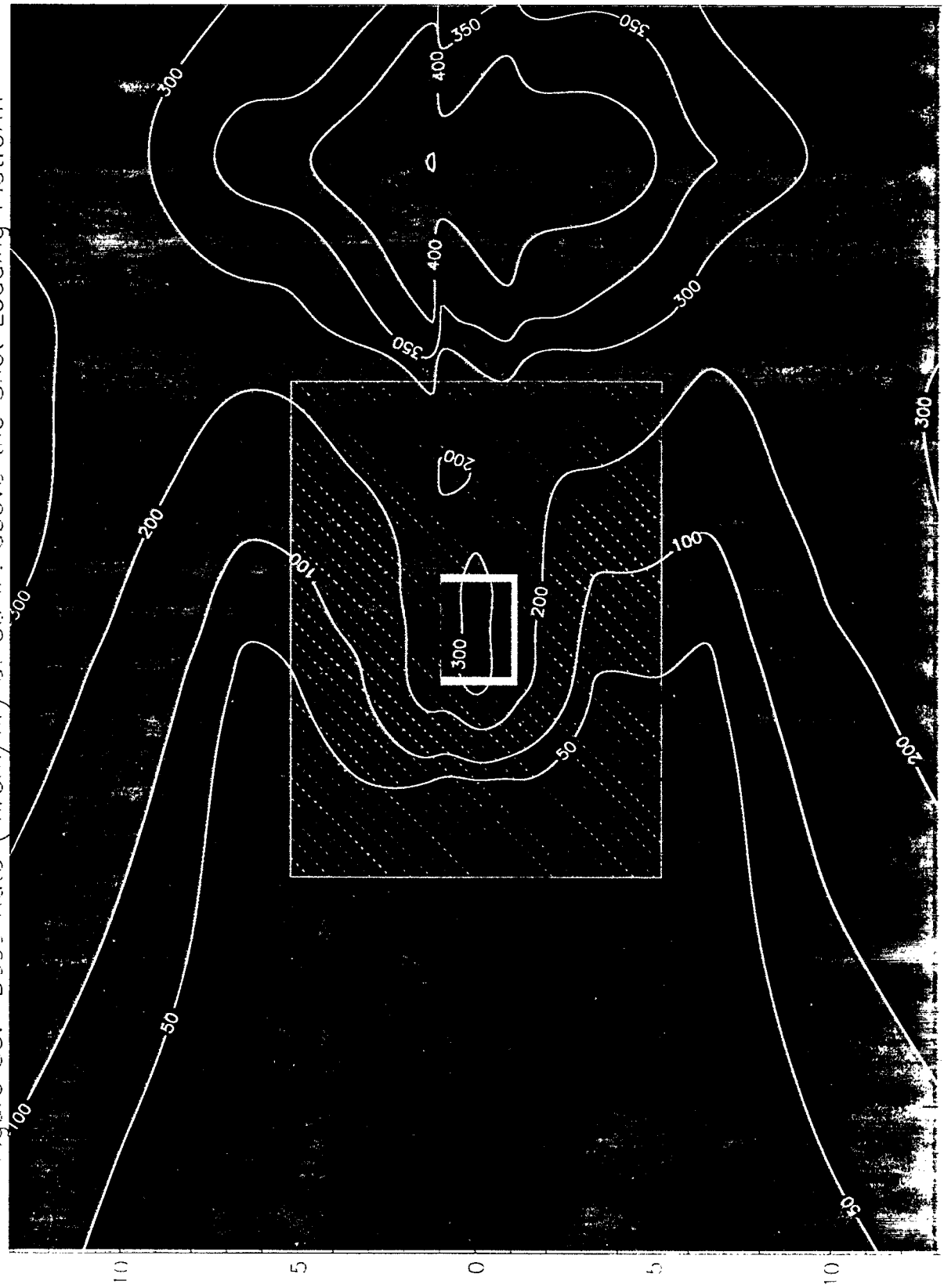


Figure 35. Dose Rate (mrem/hr) at 55 in. above the Shot Loading Platform

Distance from Ductform Opening (ft)

Distance from Shot Loading Platform (ft)

APPENDIX A
MCNP Input File for the Tank Source (file idtank_0)

```
SOURCE gamma dets mvd out 6.5 in, 2 in Fe shld, cell src
  1     1  -1.7400  -9 7 -5 -14
  3     1  -1.7400  -7 11 -10
  4     3  -7.8600  (((-12 13 -8 )(9 :5 ))(-9 :3 ))(7 :10 :-11 )
  5     3  -7.8600  (-6 -9 8 -14 )(9 :5 )
  2     1  -1.7400  9 -3 7 1
  6     3  -7.8600  (9 8 -4 1 )(3 )
  7     1  -1.7400  -204 202 -15 14
  8     3  -7.8600  -204 203 15 -16 14
  9     1  -1.7400  -21 24 -23
 10     1  -1.7400  25 21 -19 -14
 11     1  -1.7400  -25 21 -18 1
 12     3  -7.8600  (((-22 27 -26 )(21 :-24 :23 ))(-25 :19 ))(25 :18 )
 13     3  -7.8600  (-25 22 -17 1 )(18 )
 14     3  -7.8600  (25 22 -20 -14 )(19 )
 15     1  -1.7400  211 209 -28 14
 16     3  -7.8600  -29 28 211 210 14
 17     0  -30 38 -37
 18     3  -7.8600  (((39 -40 -31 )(30 :37 :-38 ))(34 :36 ))(-36 :32 )
 19     3  -7.8600  41 -42 -33
 20     0  36 30 -32 42
 21     3  -7.8600  (36 31 -33 42 )(32 )
 22     3  -7.8600  44 -43 -35
 23     3  -7.8600  (-36 31 -35 -44 )(34 )
 24     0  -36 30 -34 -44
 25     0  -49 53 -52
 26     3  -7.8600  (((-50 -55 54 )(-53 :49 :52 ))(-51 :47 ))(51 :45 )
 27     3  -7.8600  44 -43 -48
 28     0  -44 51 49 -47
 29     3  -7.8600  (51 50 -48 -44 )(47 )
 30     0  -51 49 -45 42
 31     3  -7.8600  (-51 50 -46 42 )(45 )
 32     3  -7.8600  41 -42 -46
 33     3  -7.8600  156 -57 58 -59
 34     3  -7.8600  60 -56 61 -62
 35     3  -7.8600  -64 57 -63 98 103 106 107 101 104 105 109 108
 37     3  -7.8600  76 -73 -71 75
 38     3  -7.8600  78 -77 -74 75
 39     3  -7.8600  66 -79 -80 241
 40     3  -7.8600  -66 -81 82 83
 41     3  -7.8600  -86 79 -84 85
 42     3  -7.8600  -88 -87 75 73
 43     3  -7.8600  -78 89 -87 75
 44     3  -7.8600  -66 -91 90 77
 45     3  -7.8600  -78 -91 93 94
 46     0  ((-66 -90 59 77 )(87 :88 :-73 :-75 ))(-75 :73 :-76 :71 )
 47     0  95 -60 -96
 48     3  -7.8600  -62 97 96 -60
 49     3  -7.8600  98 -102 108 105 109 104 101 107 106 103 99 -100
 50     3  -7.8600  98 -102 108 105 109 104 101 107 106 103 110 -111
 51     3  -7.8600  98 -102 108 105 109 104 101 107 106 103 112 -113
 52     3  -7.8600  98 -102 108 105 109 104 101 107 106 103 114 -115
 53     3  -7.8600  98 -102 108 105 109 104 101 107 106 103 116 -117
 54     3  -7.8600  98 -102 108 105 109 104 101 107 106 103 118 -119
 56     0  114 -58 -118 243 259 245 247 253 249 255 257 251  #52 #35 #53
 57     3  -7.8600  122 -123 -124
 58     0  -45 -41 123
 59     0  -41 123 -32
 60     3  -7.8600  -41 123 32 -33
 61     3  -7.8600  -41 123 45 -46
 62     6  -1.0000  (122 -123 124 -125 )(500 :-375 )
 63     1  -1.7400  -127 130 129 -1
 64     3  -7.8600  129 128 -1 -126 127
 65     1  -1.7400  -130 133 -132
```

```
 66    3  -7.8600  ((-128 -128 -132 131 )(132 :130 :-133 ))(127 :-129 )
 67    1  -1.7400  129 137 -134 -1
 68    1  -1.7400  138 -137 -140
 69    3  -7.8600  -135 136 129 134 -1
 70    3  -7.8600  ((-136 138 -139 )(140 :137 ))(134 :-129 )
 71    3  -7.8600  -59 58 -156 155
 72    3  -7.8600  -59 -155 58 56
 73    3  -7.8600  58 -59 159 -97
 74    3  -7.8600  161 -160 -158 157 -162
 75    3  -7.8600  163 -162 -159 -161
 76    3  -7.8600  -164 165 -166
 77    3  -7.8600  -165 157 -166 167
 78    3  -7.8600  168 -169 166 -170
 79    3  -7.8600  (-157 171 167 -172 ):(-168 166 157 -161 )
 80    3  -7.8600  -171 -173 167 2 #95
 81    1  -0.3660  (173 -184 -2 179 182 -180 )(192 :188 :-189 )
 83    3  -7.8600  -172 184 -181 183 -2 178
 84    3  -7.8600  (180 -181 -184 167 -2 178 )(188 :192 :-189 )
 85    3  -7.8600  (-184 167 -182 183 178 -2 )(188 :192 :-189 )
 86    3  -7.8600  -184 173 182 -180 -179 178
 88    1  -0.3660  -187 -192 190 194
 89    3  -7.8600  187 -188 -192 195
 90    3  -7.8600  (189 -190 -192 191 )
 91    3  -7.8600  192 -193 -188 189 -183
 92    3  -7.8600  -193 192 189 -188 181
 94    1  -0.3660  -184 173 -177 2 #95
 82    3  -7.8600  -176 177 -172 173
 93    3  -7.8600  (-171 187 -195 ):(-187 190 -194 )
 95    3  -7.8  (((((2 -196 195 -172)(439:441))(-437:428))
         (172:457:-458:-167))(443:441))(438:-437)
 96    3  -7.8600  -186 185 195 -197
 97    0  ((-165 -167 196 )(-185 :197 :186 ))(171 :195 )
 98    0  -199 -200 164
 99    3  -7.8600  (-201 -198 -201 164 )(199 :200 )
100    0  (((-161 168 -163 -159 )(201 :198 ))(166 :164 ))(169 :170 )
101    1  -1.7400  (-202 -205 206 -2 )(-204 :430 )
102    3  -7.8600  -172 184 -177 2 #95
103    3  -7.8600  (((-203 207 -208 -2 )(202 :-206 :205 ))(15 :204 ))
         (430 :-204 )
104    1  -1.7400  (-212 -209 213 -2 )(211 :432 )
105    3  -7.8600  (((-434 -210 215 -2 )(212 :209 :-213 ))(-211 :28 ))
         (211 :432 )
106    3  -7.8600  142 -141 -124 33 17 4 46
107    3  -7.8600  144 -143 -124 33 17 4 46
108    3  -7.8600  146 -145 -124 33 17 4 46
109    3  -7.8600  148 -147 -124 33 17 4 46
110    3  -7.8600  149 -150 -124 33 17 4 46
111    3  -7.8600  58 -59 217 -216
112    3  -7.8600  35 20 6 48 -124 151 -152
113    6  -1.0000  (-125 124 151 -152 20 35 6 48 )(-375 :500 )
114    6  -1.0000  (142 -141 -125 124 )(-375 :500 )
115    6  -1.0000  (144 -143 -125 124 )(-375 :500 )
116    6  -1.0000  (146 -145 -125 124 )(-375 :500 )
117    6  -1.0000  (148 -147 -125 124 )(-375 :500 )
118    6  -1.0000  (149 -150 -125 124 )(-375 :500 )
119    3  -7.8600  ((((((153 -154 -124 195 )(-167 :181 :172 :-183 ))
         (-167 :181 :-183 :172 ))(433 :211 ))(-204 :431 ))(-207 :203 ))
         (210 :434 )
120    3  -7.8600  (167 -173 -2 178 182 -180 )(188 :192 :-189 )
121    6  -1.0000  (124 -125 153 -154 )(-375 :500 )
122    3  -7.8600  ((((-124 59 218 -219 )(290 :335 :-289 :-293 ))
         (293 :290 :-289 ))(-265 :-264 :263 :-345 ))(265 :263 :-264 :-345 )
123    3  -7.8600  -124 59 -221 220
124    3  -7.8600  -124 -223 222 59
125    3  -7.8600  -124 59 224 -225
126    3  -7.8600  -124 226 -227 59
127    3  -7.8600  -124 59 228 -229
128    3  -7.8600  -124 59 230 -231
129    3  -7.8600  -124 59 -233 232
```

```
130    6  -1.0000  (((((-125 124 218 -219 )(290 :335 :-289 :-293 ))
          (290 :-289 :293 :-337 ))(-265 :-264 :263 :344 ))
          (265 :-264 :263 :-345 ))(-375 :500 )
131    6  -1.0000  (220 -221 124 -125 )(-375 :500 )
132    6  -1.0000  (222 -223 124 -125 )(-375 :500 )
133    6  -1.0000  (224 -225 124 -125 )(-375 :500 )
134    6  -1.0000  (226 -227 124 -125 )(-375 :500 )
135    6  -1.0000  (228 -229 124 -125 )(-375 :500 )
136    6  -1.0000  (230 -231 124 -125 )(-375 :500 )
137    6  -1.0000  (232 -233 124 -125 )(-375 :500 )
138    3  -7.8600  235 -236 -238 237
139    3  -7.8600  -235 234 59 -239
140    3  -7.8600  240 -234 -239 79
141    3  -7.8600  -243 242 -63 60
142    3  -7.8600  258 -259 60 -63
143    3  -7.8600  246 -247 -63 60
144    3  -7.8600  -245 244 -63 60
145    3  -7.8600  -63 252 -253 60
146    3  -7.8600  248 -249 -63 60
147    3  -7.8600  250 -251 -63 60
148    3  -7.8600  -255 254 -63 60
149    3  -7.8600  256 -257 -63 60
150    0  -63 -256 60
151    0  -63 -254 60
152    0  -258 -63 60
153    0  -63 -242 60
154    0  -63 -246 60
155    0  -244 -63 60
156    0  -63 -250 60
157    0  -63 -248 60
158    0  -252 -63 60
159    3  -7.8600  -261 260 -262 -263 264 59 265
160    3  -7.8600  264 -263 59 -265 -267 266 268
161    3  -7.8600  264 -263 -262 269 -270 265 59
162    3  -7.8600  -272 271 268 -265 59 264 -263
163    3  -7.8600  -274 273 -262 264 -263 59 265
164    3  -7.8600  275 -276 268 -265 264 -263 59
165    3  -7.8600  277 -278 -291 59 289 -290 293
166    3  -7.8600  -279 280 292 -290 289 59 -293
167    3  -7.8600  281 -282 -291 -290 289 59 293
168    3  -7.8600  -284 283 292 -290 289 59 -293
169    3  -7.8600  -286 285 -291 -290 289 59 293
170    3  -7.8600  -288 287 292 289 -290 59 -293
171    3  -7.8600  -124 33 4 17 46 297 -296
172    6  -1.0000  (124 -125 297 -296 )(-375 :500 )
173    3  -7.8600  -294 -299 295 298 4 264 -263
174    3  -7.8600  -302 300 -301 298 4 264 -263
175    3  -7.8600  264 -263 4 -302 298 -304 303
176    3  -7.8600  17 -308 -306 307 305 264 -263
177    3  -7.8600  17 -263 264 309 -310 307 -308
178    3  -7.8600  -312 311 313 17 -263 264 -308
179    3  -7.8600  -315 314 -318 320 33 -290 289
180    3  -7.8600  -321 316 319 46 -290 289 -317
181    3  -7.8600  -324 320 -323 322 33 -290 289
182    3  -7.8600  -321 -327 325 326 46 -290 289
183    3  -7.8600  320 33 -329 328 -324 289 -290
184    3  -7.8600  -331 330 325 -321 46 289 -290
185    3  -7.8600  -189 332 -333 191
186    3  -7.8600  ((-334 59 -335 336 293 -290 289 )(-97 :56 :62 ))
          (159 :162 :160 )
188    0  (-95 -58 159 )(-97 :-96 )
189    0  -56 -61 60 -61 255 257 259 251 249 243 247 253 245
190    3  -7.8600  ((-339 337 338 -293 59 -290 289 )(-97 :56 :62 ))
          (159 :162 :160 )
191    3  -7.8600  ((-340 -344 265 59 341 264 -263 )(-97 :62 :56 ))
          (159 :162 :160 )
192    3  -7.8600  ((-343 345 342 -265 59 264 -263 )(56 :62 :-97 ))
          (159 :162 :160 )
193    1  -1.7400  (346 -122 -125 )(500 :-375 )
```

```
194     1  -1.7400  (123 -347 -125 46 46 33 )(500 :-375 )
195     1  -1.7400  (125 -348 -347 346 )(500 :-375 )
196     1  -1.7400  (-349 350 -132 128 )(-129 :126 )
197     1  -1.7400  -131 350 -128
198     1  -1.7400  -351 126 -1 349 129
199     1  -1.7400  (-352 136 138 -354 )(-129 :135 )
200     1  -1.7400  135 -353 -1 352 129
201     1  -1.7400  -354 139 -136
202     1  -1.7400  17 -355 1 -148  #106 #176 #107 #108 #177
203     1  -1.7400  -357 4 1 -148  #106 #107 #108 #175 #174
204     1  -1.7400  -358 46 347 50 -51 -148  #106 #107 #108 #182 #184
205     1  -1.7400  347 33 -356 -148  #106 #107 #108 #183 #181
206     1  -1.7400  17 -355 418 -25 147  #109 #171 #178 #110
207     1  -1.7400  412 9 -357 4 147  #109 #110 #173 #171
208     1  -1.7400  -358 46 347 424 -51 147  #110 #171 #180
209     1  -1.7400  33 -356 421 36 147  #179 #110 #171
210     1  -1.7400  (125 -348 -360 359 )(-375 :500 )
211     1  -1.7400  (141 -360 -125 355 356 357 358 )(-375 :500 )
212     1  -1.7400  (-125 355 356 357 358 -142 359 )(-375 :500 )
213     1  -1.7400  (-348 125 363 -362 )(-375 :500 )
214     1  -1.7400  (-125 355 356 357 358 143 -362 )(-375 :500 )
215     1  -1.7400  (-125 355 356 357 358 -144 363 )(-375 :500 )
216     1  -1.7400  (-348 125 -366 365 )(-375 :500 )
217     1  -1.7400  (-125 355 356 357 358 365 -146 )(-375 :500 )
218     1  -1.7400  (-125 355 356 357 358 145 -366 )(-375 :500 )
219     1  -1.7400  (368 -367 125 -348 )(-375 :500 )
220     1  -1.7400  (-125 355 356 357 358 -148 368 )(-375 :500 )
221     1  -1.7400  (-125 355 356 357 358 147 -367 )(-375 :500 )
222     1  -1.7400  (-370 369 125 -348 )(-375 :500 )
223     1  -1.7400  (-125 355 356 357 358 -297 369 )(-375 :500 )
224     1  -1.7400  (-125 355 356 357 358 296 -370 )(-375 :500 )
225     1  -1.7400  (371 -372 -348 125 )(-375 :500 )
226     1  -1.7400  (-125 355 356 357 358 -149 371 )(-375 :500 )
227     1  -1.7400  (-125 355 356 357 358 150 -372 )(-375 :500 )
228     1  -1.7400  355 -308 -376 377 378 -374 373  #176
230     0  (((((((((346 -375 -359 )(347 :348 ))(349 :132 :-350 ))
          (351 :1 :-129 ))(357 :-1 ))(352 :-138 :354 ))(353 :1 :-129 ))
          (355 :-1 ))(358 ))(356 )
231     1  -1.7400  373 -374 357 -380 298 -379 381  #175
232     1  -1.7400  -382 384 383 -321 358 385 -386  #184
233     1  -1.7400  320 356 -387 389 -388 385 -386  #183
234     0  (((((-375 359 -363 356 355 358 357 )(348 :360 ))
          (-320 :388 :387 :-389 :-320 :-385 :386 ))(-373 :374 :380 :379 :-381
           :-298 ))(374 :-373 :376 :-377 :-378 :308 ))(386 :-385 :382 :-383
           :-384 :321 )
235     0  (-375 363 -365 355 356 357 358 )(348 :362 )
236     1  -1.7400  -380 391 -390 298 357 373 -374  #174
237     1  -1.7400  355 373 -374 393 -392 377 -308  #177
238     1  -1.7400  -388 320 -394 397 356 385 -386  #181
239     1  -1.7400  -321 -395 383 396 358 385 -386  #182
240     0  (((((365 -375 -368 358 355 356 357 )(348 :366 ))
          (-385 :386 :395 :-383 :-396 :321 ))(-385 :386 :394 :388 :-397 :-320
           ))(374 :-373 :390 :380 :-298 :-391 ))(374 :-373 :392 :-377 :-393
           :308 )
241     0  (-375 368 -369 356 355 357 358 )(348 :367 )
242     1  -1.7400  -398 -399 400 298 357 373 -374  #173
244     1  -1.7400  -401 403 402 355 373 -374 -308  #178
246     1  -1.7400  -404 406 -405 320 356 385 -386  #179
243     1  -1.7400  -321 409 408 358 385 -386 -407  #180
245     0  (((((-375 369 -371 32 356 355 357 358 )(348 :370 ))
          (404 :405 :-406 :-385 :386 :-320 ))(-385 :386 :407 :-408 :-409 :321
           ))(398 :399 :-400 :374 :-373 :-298 ))(374 :-373 :308 :401 :-402
           :-403 )
247     1  -1.7400  (-348 125 -410 411 )(-375 :500 )
248     1  -1.7400  ((8 -412 414 -413 )(6 :9 ))(-9 :4 )
249     1  -1.7400  -8 414 -13
250     1  -1.7400  12 -413 -8
251     1  -1.7400  (-415 6 412 -9 -14 )(152 :-151 )
252     1  -1.7400  ((-418 22 -416 417 )(20 :-25 ))(25 :17 )
```

```
253     1  -1.7400  -22 -416 26
254     1  -1.7400  -27 417 -22
255     1  -1.7400  (-419 20 25 418 -14 )(152 :-151 )
256     1  -1.7400  ((31 -421 420 -422 )(35 :36 ))(33 :-36 )
257     1  -1.7400  -39 420 -31
258     1  -1.7400  -422 40 -31
259     1  -1.7400  (-423 35 421 -36 -43 )(152 :-151 )
260     1  -1.7400  ((-424 50 -425 426 )(48 :-51 ))(46 :51 )
261     1  -1.7400  426 -54 -50
262     1  -1.7400  -425 55 -50
263     1  -1.7400  (-427 48 424 51 -43 )(152 :-151 )
264     1  -1.7400  (152 -410 419 34 423 415 427 -125 )(-375 :500 )
265     1  -1.7400  (419 34 423 415 427 -125 411 -151 )(-375 :500 )
266     0  ((((((((((((-375 371 -411 )(-426 :424 :425 ))(51 :358 ))
         (-51 :427 ))(422 :421 :-420 ))(-36 :356 ))(36 :423 ))
         (418 :416 :-417 ))(25 :355 ))(-25 :419 ))(412 :-414 :413 ))
         (-9 :357 ))(9 :415 ))(372 :348 )
267     1  -1.7400  204 -430 -2
268     3  -7.8600  430 -431 -2 204 203
269     1  -1.7400  -2 -432 -211
270     3  -7.8600  432 -433 -211 -2 210
271     1  -1.7400  -204 428 16 -435 14
272     1  -1.7400  211 210 -436 29 14
273     1  -1.7400  (((203 -428 -429 437 -2 )(16 :204 ))(-204 :431 ))
         (-153 :154 )
274     1  -1.7400  -429 208 -203
275     1  -1.7400  (-207 437 -203 -2 )(-153 :154 :207 )
276     1  -1.7400  (-438 431 -2 204 428 )(-153 :154 )
277     1  -1.7400  (((-439 210 440 -441 -2 )(436 :-211 ))(211 :433 ))
         (-153 :154 )
278     1  -1.7400  -215 440 -210
279     1  -1.7400  (434 -441 -210 -2 )(-153 :154 )
280     1  -1.7400  (-442 195 188 -2 )(-153 :154 )
281     1  -1.7400  (433 -443 -2 -211 439 )(-153 :154 )
282     1  -1.7400  (-445 193 -444 446 )(-183 :181 )
283     1  -1.7400  ((-444 188 442 -193 )(-167 :181 :-183 ))
         (-167 :-183 :181 )
284     1  -1.7400  -189 332 -447 333
285     1  -1.7400  -190 332 -191 448
286     1  -1.7400  ((446 -189 -193 447 )(-167 :-183 :181 ))
         (-167 :180 :-183 )
287     1  -1.7400  -449 59 -216 217
288     1  -1.7400  -58 450 -216 217
289     1  -1.7400  (-452 451 125 -348 )(-375 :500 )
290     1  -1.7400  ((((((-125 154 -452 442 )(211 :443 ))(439 :441 ))
         (-204 :438 ))(428 :-437 ))(454 :-458 :457 :-455 ))(-375 :500 )
291     1  -1.7400  -176 2 -454 172
292     1  -1.7400  (-454 172 458 -457 -2 178 )(154 :-153 )
293     1  -1.7400  ((-183 458 -172 455 178 -2 )(154 :-153 ))
         (444 :445 :-446 )
294     1  -1.7400  ((181 -457 -172 455 178 -2 )(-153 :154 ))
         (-446 :444 :445 )
295     1  -1.7400  ((-167 455 -181 183 -2 178 )(154 :-153 ))(444 :-446 )
296     1  -1.7400  -454 458 -457 455 459 -178
297     1  -1.7400  ((((((-125 451 -153 442 )(211 :443 ))(439 :441 ))
         (-204 :438 ))(428 :-437 ))(454 :-458 :457 :-455 ))(-375 :500 )
298     0  -216 217 -450
299     0  -190 -448 332
300     0  ((((((((-375 411 -216 )(427 :502))(423 :502))(449 :-217 :216 ))
         (419 :14 ))(14 :415 ))(435 :-14 ))(436 :-14 ))(410 :348 )
301     0  ((((((((((216 -375 -451 )(-332 :447 :190 ))(445 :-446 :444 ))
         (442 :-444 ))(436 :-211 ))(211 :443 ))(441 :439 :-440 ))(204 :435 ))
         (438 :-204 ))(428 :429 :-437 ))(454 :-458 :-455 :457 :-459 )
302     1  -1.7400  173 -461 460 -171
303     1  -1.7400  176 173 -460 -454
304     1  -1.7400  462 -171 461 -172
305     1  -1.7400  172 -463 -466 462
306     1  -1.7400  157 -466 -172 465
307     1  -1.7400  (160 -465 157 -162 -159 ) #186 #190 #191 #192
```

```
 308     1  -1.7400  -159 -467 162 -465  #186 #190 #191 #192
 309     1  -1.7400  (((((-468 59 159 -469 )(56 :-97 ))(-220 :221 ))
           (-218 :219 ))(263 :-264 :340 :344 :-341 :343 :-486 :-487 ))
           (-289 :290 :-337 :-338 :339 :334 :335 :-336 )
 310     1  -1.7400  (221 -471 -125 468 )(-375 :500 )
 311     1  -1.7400  (470 -220 -125 468 )(-375 :500 )
 312     1  -1.7400  (470 -471 125 -348 )(-375 :500 )
 313     1  -1.7400  -62 56 -473 468  #186 #190 #191 #192
 314     1  -1.7400  -62 -97 474 468  #186 #190 #191 #192
 315     1  -1.7400  ((-475 62 474 -473 )(-289 :290 ))(263 :-264 )
 316     1  -1.7400  (((-476 -477 468 478 293 385 -386 )(-474 :473 :475 ))
           (159 :467 :465 ))(-489 :488 ) #186
 317     1  -1.7400  (((-479 480 481 -293 468 385 -386 )(-474 :473 :475 ))
           (159 :467 :465 ))(-489 :488 ) #190
 318     1  -1.7400  (((-482 -483 265 468 484 373 -374 )(-474 :475 :473 ))
           (159 :467 :465 ))(-489 :488 ) #191
 319     1  -1.7400  (((-485 486 487 -265 468 373 -374 )(473 :475 :-474 ))
           (159 :467 :465 ))(-489 :488 ) #192
 320     1  -1.7400  (((-375 :500 )219 -488 -125 468 )(-345 :344 :263 :-264 ))
           (335 :-337 :-289 :290 )
 321     1  -1.7400  (((-375 :500 )-218 489 -125 468 )(344 :263 :-264 :-345 ))
           (-289 :290 :-337 :335 )
 322     1  -1.7400  (-488 489 -348 125 )(-375 :500 )
 323     0  ((((((((((-375 451 -462 )(503 :-437 :428 ))(503 :443 :211 :441 ))
           (454 :460 :-503 ))(442 :503 ))(461 :462 :-177 ))(452 :348 ))
           (454 :-458 :457 :-455 :503 ))(428 :-437 ))(-204 :438 :-437 :503 ))
           (441 :439 )
 324     0  (((((((462 -489 -375 )(463 :466 ))(465 :467 :159 ))(468 :-159 ))
           (386 :477 :-385 :-293 :-478 ))(-385 :386 :-481 :-480 :293 ))
           (-373 :374 :-486 :-487 :265 ))(374 :-373 :483 :-484 :-265 )
 325     0  (((((489 -375 -470 468 )(475 :-474 :473 ))(488 :348 ))
           (374 :483 :-373 :482 :-265 ))(374 :-486 :-373 :485 :265 ))
           (477 :386 :-385 :-480 :479 :476 )
 326     0  ((470 -375 -222 59 )(469 :468 ))(348 :471 )
 327     0  (((222 -375 -224 59 )(267 :-268 :-266 :261 :262 :-260 :-264 :263 ))
           (278 :291 :-277 :-280 :279 :-292 :290 :-289 ))(223 :125 )
 328     0  (-375 224 -226 59 )(125 :225 )
 329     0  (((-375 226 -228 59 )(125 :227 ))(282 :291 :-281 :-283 :284 :-292
           :290 :-289 ))(270 :262 :-269 :-271 :-268 :272 :-264 :263 )
 330     0  (-375 228 -230 59 )(125 :229 )
 331     0  (((-375 230 -232 59 )(125 :231 ))(-273 :262 :274 :276 :-268 :-275
           :-264 :263 ))(286 :291 :-285 :-287 :-292 :288 :290 :-289 )
 332     0  ((((((-375 232 -66 59 )(125 :233 ))(-94 :91 :78 :-93 ))
           (87 :78 :-75 :-89 ))(-78 :74 :77 :-75 ))(91 :-77 :66 ))
           (81 :-82 :66 :-83 )
 333     0  (-234 -240 59 66 ):(-79 66 -241 59 )
 334     0  (((((-375 66 -63 59 )(80 :79 ))(86 :84 :-85 :-79 ))(239 :235 ))
           (236 :238 :-237 ))(64 :-57 )
 337     0  56 -58 -114 243 259 245 247 253 249 255 257 251  #49 #50 #51
 338     0  114 -58 118 -63 243 259 245 247 253 249 255 257 251  #54 #35
 339     0  ((((((((((346 375 -501 -66 -462 )(347 :348 ))(348 :-359 :360 ))
           (362 :348 :-363 ))(366 :348 :-365 -462 ))(367 :348 :-368 ))
           (370 :348 :-369 ))(372 :348 :-371 ))(410 :348 :-411 ))
           (452 :348 :-451 ))(-375:500)
 340     0  ((375 66 -501 -63 )(80 :79 ))(84 :86 :-85 :-79 )
 341     0  (((((((((500 375 -501 -66 462 )(488 :348 :-489 ))(471 :348 :-470 ))
           (223 :125 :-222 ))(225 :125 :-224 ))(227 :125 :-226 ))
           (229 :125 :-228 ))(231 :125 :-230 ))(233 :125 :-232 ))
 342     1  -1.7400 43 -502 -427
 343     1  -1.7400 43 -502 -423
 344     1  -1.7400  (((((503 -2 442 -454)(439:441))(-437:428))
           (454:457:-458:-455))(443:441))(438:-437)
c TANK CELLS BELOW
 1000    4  -2.3500  1001 -1002 -1104
 1001    3  -7.8000  1020 -1021 -1102 1001 (-1201 :1202 :-1205 :1206 )
 1002    4  -2.3500  1021 -1029 -1104 1001 (-1201 :1202 :-1205 :1206 )
 1003    3  -7.8000  1020 -1021 -1102 1001 1201 -1202 1205 -1206 1107 1109 1111
 1004    4  -2.3500  (1021 -1029 -1104 1001 1201 -1202 1205 -1206 1107 1109
                      1111)
```

```
 1005     4  -2.3500  (1029 -1039 1001 1201 -1202 1205 -1206 1107 1109 1111)
 1006     3  -7.8000  (1003 -1636 1106 -1107 )(375:-346)
 1007     3  -7.8000  (1636 -1635 1106 -1107 )(375:-346)
 1008     3  -7.8000  (1635 -1324 1106 -1107 )(375:-346)
c     1009     3  -7.8000  (1324 -1633 1106 -1412)(501:-500)
 1009     3  -7.8000  (1324 -500 1106 -1412)(375:-346)
c     1010     2  -0.0012  (1411 -1412 -1634 1633 )(501:63:-346)
 1010     2  -0.0012  (1411 -1412 -1634 500 )(501:63:-346)
 1011     2  -0.0012  (1201 -1202 1205 -1206 1039 -1634 1412 )
                      (-1637:1645) (-1637:1638:1648)
                      (2035:2055:2015) (2005:2040)
                      (1652:-1651:-1662:1661:1663:-1664)
                      (1671:-1679:1680) (1672:-1681:1682)
 1012     2  -0.0012  (1039 -1324 1107 -1412)
 1013     5  -1.4000  -1634 1001 -1080 (1104 :1029 )(-1200 :1203 :-1204 :1207 )
 1014     2  -0.0012  1634 -1080 1081
 1015     2  -0.0012  (1634 -1081 (1083 :1082 ))
 1016     2  -0.0012  (1634 -1083 -1082 (-1200 :1203 :-1204 :1207 :1059 ))
                      (501:63:-346)
          (-1412:1645:1643)
 1017     2  -0.0012  (1201 -1202 -1206 1205 1634 -1059 )(501:63:-346)
          (-1412:1645) (2035:2055:2015)
 1018     3  -7.8000  1101 -1102 1002 -1020
 1019     2  -0.0012  1102 -1103 1002 -1021
 1020     3  -7.8000  1103 -1104 1002 -1021
 1021     3  -7.8000  -1109 1108 1003 -1039
c     1022     2  -0.0012  -1108 1003 -1030
c     1023     4  -2.3500  -1108 1030 -1039
 1024     3  -7.8000  -1111 1110 1003 -1039
 1025     2  -0.0012  -1110 1003 -1030
 1026     4  -2.3500  -1110 1030 -1039
 1027     4  -2.3500  1200 -1201 1204 -1207 1029 -1059 1001
 1028     4  -2.3500  1202 -1203 1204 -1207 1029 -1059 1001
 1029     4  -2.3500  1201 -1202 1204 -1205 1029 -1059 1001
 1030     4  -2.3500  1201 -1202 1206 -1207 1029 -1059 1001
 1031     1  -1.7400  -1101 1002 -1632 1627 (1628 :-1631 )
 1032     2  -0.0012  (1632 -1020 -1101 )(1107 :-1003 )(1109 :-1003 )
            (1111 :-1003 )(375:-346)
c     1033     2  -0.0012  (-1411 1633 -1634 )(375:63:-346)
 1033     2  -0.0012  (-1411 500 -1634 )(501:63:-346)
c     1034     2  -0.0012  (1003 -1633 -1106 )(375:-346)
 1034     2  -0.0012  (1003 -500 -1106 )(375:-346)
c    Source cells
 1035     1  -1.7400  (1629 -1632 -1626 )(375:-346)
 1036     1  -1.7400  1629 -1632 1626 -1627
 1037     1  -1.7400  1629 -1632 1627 -1628
 1038     1  -1.7400  (1630 -1629 -1626 )(375:-346)
 1039     1  -1.7400  1630 -1629 1626 -1627
 1040     1  -1.7400  1630 -1629 1627 -1628
 1041     1  -1.7400  (1631 -1630 -1626 )(375:-346)
 1042     1  -1.7400  1631 -1630 1626 -1627
 1043     1  -1.7400  1631 -1630 1627 -1628
 1044     1  -1.7400  (1002 -1631 -1626 )(375:-346)
 1045     1  -1.7400  1002 -1631 1626 -1627
1046   2 -.0012  1412 -1644 1637 -1643
1047   3 -7.8 1637 -1638 1644 -1648
1048   3 -7.8 1638 -1643 1644 -1645
1049   3 -7.8 1668 -1666 1657 -1658   $conduit
1050   3 -7.8 1667 -1665 1657 -1658   $conduit
 1051     0  1080 :-1001
 1052     0   1639 -1642  1645  1660 -1659 1665 1666 1657 -1658
 1053     3  -7.8   1651  1645 -1690 -1659 1660 1657 -1658  $ 3 in. steel
 1054     3  -7.8   1690  1645 -1691 -1659 1660 1657 -1658  $ 3 in. steel
 1055     3  -7.8   1691  1645 -1692 -1659 1660 1657 -1658  $ 3 in. steel
 1056     3  -7.8   1692  1645 -1639 -1659 1660 1657 -1658  $ 3 in. steel
 1057     3  -7.8   1642  1645 -1652 -1659 1660 1657 -1658  $ 3 in. steel
 1058     3  -7.8   1651  1645 -1652 -1659 1660 1658 -1661
 1059     3  -7.8   1651  1645 -1652 -1659 1660 1662 -1657
 1060     3  -7.8   1651 -1652 1659  -1663 1662 -1661
```

```
 1061     3  -7.8   1651 -1652 1664  -1660 1662 -1661
1062   0  -1668  1669 -1670   $detector volume
1063   0  -1667  1669 -1670   $detector volume
1064   3  -5.797  -1668  1657 -1669   $detector plug (0.47 lbs = 213.19 grams)
1065   3  -4.82  -1668  1670 -1658   $detector reducer (0.39 lbs = 176.9 grams)
1066   3  -5.797  -1667  1657 -1669   $detector plug (0.47 lbs)
1067   3  -4.82  -1667  1670 -1658   $detector reducer (0.39 lbs)
1068   0  -1673 1675 -1676  $Detector volume
1069   0  -1674 1677 -1678  $Detector volume
1070   3  -7.8  -1671 1673 1679 -1680
1071   3  -7.8  -1672 1674 1681 -1682
1072   3  -5.797  -1673  1679 -1675   $detector plug (0.47 lbs = 213.19 grams)
1073   3  -4.82  -1673  1676 -1680   $detector reducer (0.39 lbs = 176.9 grams)
1074   3  -5.797  -1674  1681 -1677   $detector plug (0.47 lbs)
1075   3  -4.82  -1674  1678 -1682   $detector reducer (0.39 lbs)
c    Wand Interface
2000   2 -.0012  1003 -1039 -1108        $ Air in 12" riser
2005   3 -7.8 1039 -2000 2025 -2040  $ 3" plate
2006   3 -7.8 2000 -2001 2025 -2040  $ 3" plate
2007   3 -7.8 2001 -2005 2025 -2040  $ 3" plate
2010   2 -.0012  1039 -2015 -2020  $ air in 6" pipe
2015   3 -7.8  1039 -2015 2020 -2025  $ 6" pipe
2020   3 -4.68  2005 -2015 2025 -2026 $ #8 Steel shot
2021   3 -4.68  2005 -2015 2026 -2027 $ #8 Steel shot
2022   3 -4.68  2005 -2015 2027 -2030 -2050 $ #8 Steel shot
2025   3 -7.8  2005 -2015 -2035 -2055 (2030:2050) $ 14" pipe

c TANK SURFACES BELOW
    1     7  pz  39.0520
    2     7  pz  652.1450
    3     7 c/z  20.0025 0.0000 7.3165
    4     7 c/z  20.0025 0.0000 8.4137
    5     7 c/z  43.0212 0.0000 7.3165
    6     7 c/z  43.0212 0.0000 8.4137
    7     1 c/z  31.5112 0.0000 7.3165
    8     1 c/z  31.5112 0.0000 8.4137
    9     1  px  31.5112
   10     7  px  50.3403
   11     7  px  12.6835
   12     7  px  51.4350
   13     7  px  11.5887
   14     7  pz  565.7850
   15     7 c/z  45.720  0.000  4.859
   16     7 c/z  45.720  0.000  5.715
   17     7 c/z  -20.0025 0.0000 8.4137
   18     7 c/z  -20.0025 0.0000 7.3165
   19     7 c/z  -43.0212 0.0000 7.3165
   20     7 c/z  -43.0212 0.0000 8.4137
   21     2 c/z  -31.5112 0.0000 7.3165
   22     2 c/z  -31.5112 0.0000 8.4137
   23     7  px  -12.6835
   24     7  px  -50.3403
   25     2  px  -31.5112
   26     7  px  -11.5887
   27     7  px  -51.4350
   28     7 c/z  -45.720  0.000  4.859
   29     7 c/z  -45.720  0.000  5.715
   30     3 c/z  0.0000 31.5112 7.3165
   31     3 c/z  0.0000 31.5112 8.4137
   32     7 c/z  0.0000 20.0025 7.3165
   33     7 c/z  0.0000 20.0025 8.4137
   34     7 c/z  0.0000 43.0212 7.3165
   35     7 c/z  0.0000 43.0212 8.4137
   36     3  py  31.5112
   37     7  py  50.3403
   38     7  py  12.6835
   39     7  py  11.5887
   40     7  py  51.4350
   41     7  pz  60.9600
```

```
 42    7  pz  62.2300
 43    7  pz  569.5950
 44    7  pz  568.3250
 45    7 c/z  0.0000 -20.0025 7.3165
 46    7 c/z  0.0000 -20.0025 8.4137
 47    7 c/z  0.0000 -43.0212 7.3165
 48    7 c/z  0.0000 -43.0212 8.4137
 49    4 c/z  0.0000 -31.5112 7.3165
 50    4 c/z  0.0000 -31.5112 8.4137
 51    4  py  -31.5112
 52    7  py  -12.6835
 53    7  py  -50.3403
 54    7  py  -51.4350
 55    7  py  -11.5887
 56    7  pz  839.7875
 57    7  pz  1756.4100
 58    7  cz  19.0500
 59    7  cz  20.3200
 60    7  pz  835.0250
 61    7  cz  17.7800
 62    7  cz  39.3700
 63    7  pz  1758.9500
 64    7  cz  50.8000
 66    7  pz  1471.9300
 71    7  cz  41.9100
 73    7  pz  1432.5600
 74    7  cz  51.4350
 75    7  cz  20.4787
 76    7  pz  1430.0200
 77    7  pz  1383.6650
 78    7  pz  1381.7600
 79    7  pz  1474.4700
 80    7  cz  55.8800
 81    7  cz  50.8000
 82    7  cz  49.5300
 83    7  pz  1449.0700
 84    7  cz  55.2450
 85    7  cz  52.7050
 86    7  pz  1489.7100
 87    7  cz  22.8600
 88    7  pz  1456.6900
 89    7  pz  1361.4400
 90    7  cz  42.5450
 91    7  cz  43.1800
 93    7  cz  41.9100
 94    7  pz  1352.5500
 95    7  pz  832.4850
 96    7  cz  15.0876
 97    7  pz  829.9450
 98    7  cz  3.8100
 99    7  pz  950.2775
100    7  pz  951.5475
101    7 c/z  -8.7986 -5.0800 3.1750
102    7  cz  18.669
103    7 c/z  12.0985 6.9850 1.8250
104    7 c/z  8.7986 -5.0800 2.5400
105    7 c/z  0.0000 -10.1600 1.8250
106    7 c/z  0.0000 12.7000 2.5400
107    7 c/z  -12.0985 6.9850 2.5400
108    7 c/z  -6.9850 -12.0985 1.8250
109    7 c/z  6.9850 -12.0985 2.5400
110    7  pz  1059.4975
111    7  pz  1060.7675
112    7  pz  1171.2575
113    7  pz  1172.5275
114    7  pz  1281.7475
115    7  pz  1283.0175
116    7  pz  1392.2375
117    7  pz  1393.5075
```

118	7	pz	1502.7275
119	7	pz	1503.9975
122	7	pz	0.0000
123	7	pz	1.2700
124	7	cz	45.7200
125	7	cz	55.8800
126	7	k/z	20.0025 0.0000 -129.5400 0.0025 2.5400
127	7	k/z	20.0025 0.0000 -106.6800 0.0025 2.5400
128	7	k/x	127.0000 0.0000 17.7800 0.0051 0.0000
129	7	pz	17.7800
130	7	k/x	109.2200 0.0000 17.7800 0.0051 0.0000
131	7	px	12.1920
132	7	px	41.9100
133	7	px	13.2893
134	7	k/z	-20.0025 0.0000 -106.6800 0.0025 2.5400
135	7	k/z	-20.0025 0.0000 -129.5400 0.0025 2.5400
136	7	k/x	-127.0000 0.0000 17.7800 0.0051 2.5400
137	7	k/x	-109.2200 0.0000 17.7800 0.0051 0.0000
138	7	px	-41.9100
139	7	px	-12.1920
140	7	px	-13.2893
141	7	pz	68.5800
142	7	pz	68.1037
143	7	pz	119.8562
144	7	pz	119.3800
145	7	pz	208.2800
146	7	pz	207.8037
147	7	pz	259.5562
148	7	pz	259.0800
149	7	pz	412.1150
150	7	pz	412.5912
151	7	pz	503.5550
152	7	pz	504.0312
153	7	pz	643.2550
154	7	pz	643.7312
155	7	pz	923.9250
156	7	pz	1052.8300
157	7	pz	718.5025
158	7	pz	783.9075
159	7	pz	791.5275
160	7	cz	38.1000
161	7	cz	37.1475
162	7	kz	803.6560 2.7940 0.0000
163	7	kz	802.8432 2.7940 0.0000
164	7	pz	732.1550
165	7	pz	730.8850
166	7	cz	27.9400
167	7	cz	26.9875
168	7	pz	719.4550
169	7	pz	721.3600
170	7	cz	36.1950
171	7	pz	715.6450
172	7	cz	45.0850
173	7	cz	28.8925
176	7	pz	694.6900
177	7	pz	693.4200
178	7	pz	597.5350
179	7	pz	598.8050
180	7	px	15.2400
181	7	px	16.5100
182	7	px	-15.2400
183	7	px	-16.5100
184	7	cz	43.8150
185	7	pz	674.3700
186	7	pz	693.4200
187	7	pz	621.0300
188	7	pz	622.3000
189	7	pz	605.1550
190	7	pz	606.4250

```
191     7  cz  13.3350
192     7  cz  35.5600
193     7  cz  36.8300
194     7  cz  2.5400
195     7  cz  4.4450
196     7  pz  655.9550
197     7  cz  17.1450
198     7  pz  751.8400
199     7  pz  750.5700
200     7  cz  13.3350
201     7  cz  14.6050
202     5  cz  4.8590
203     5  cz  5.7150
204     5  px  0.0000
205     7  px  50.5816
206     7  px  28.8900
207     7  px  28.0340
208     7  px  51.4604
209     6  cz  4.8590
210     6  cz  5.7150
211     6  px  0.0000
212     7  px  -28.8900
213     7  px  -50.5816
215     7  px  -51.4604
216     7  pz  592.4550
217     7  pz  535.9400
218     7  pz  801.0525
219     7  pz  801.5287
220     7  pz  889.9525
221     7  pz  890.4356
222     7  pz  958.5325
223     7  pz  959.0087
224     7  pz  1029.6525
225     7  pz  1030.1287
226     7  pz  1095.6925
227     7  pz  1096.1687
228     7  pz  1161.7325
229     7  pz  1162.2087
230     7  pz  1232.8525
231     7  pz  1233.3287
232     7  pz  1298.8925
233     7  pz  1299.3687
234     7  pz  1479.5500
235     7  pz  1483.3600
236     7  pz  1487.1700
237     7  cz  21.9075
238     7  cz  34.2900
239     7  cz  40.9600
240     7  cz  33.3400
241     7  cz  34.2900
242     7  cz  3.1359
243     7  cz  3.4529
244     7 c/z  0.0000 12.7000 2.0447
245     7 c/z  0.0000 12.7000 2.2022
246     7 c/z  -12.0985 6.9850 2.0447
247     7 c/z  -12.0985 6.9850 2.2022
248     7 c/z  8.7986 -5.0800 2.0447
249     7 c/z  8.7986 -5.0800 2.2022
250     7 c/z  6.9850 -12.0985 2.0447
251     7 c/z  6.9850 -12.0985 2.2022
252     7 c/z  12.0985 6.9850 1.3310
253     7 c/z  12.0985 6.9850 1.4910
254     7 c/z  0.0000 -10.1600 1.3310
255     7 c/z  0.0000 -10.1600 1.4910
256     7 c/z  -6.9850 -12.0985 1.3310
257     7 c/z  -6.9850 -12.0985 1.4910
258     7 c/z  -8.7986 -5.0800 2.6238
259     7 c/z  -8.7986 -5.0800 3.0150
260     7   p  -1.0000 0.0000 1.0000 941.7050
```

```
261   7   p  1.0000 0.0000 1.0000 1043.3050
262   7  px  45.0850
263   7  py  0.6350
264   7  py  -0.6350
265   7  px  0.0000
266   7   p  1.0000 0.0000 1.0000 941.7050
267   7   p  -1.0000 0.0000 1.0000 1043.3050
268   7  px  -45.0850
269   7   p  -1.0000 0.0000 1.0000 1078.8650
270   7   p  1.0000 0.0000 1.0000 1179.4236
271   7   p  1.0000 0.0000 1.0000 1078.8650
272   7   p  -1.0000 0.0000 1.0000 1179.4236
273   7   p  -1.0000 0.0000 1.0000 1215.0598
274   7   p  1.0000 0.0000 1.0000 1316.6598
275   7   p  1.0000 0.0000 1.0000 1215.0598
276   7   p  -1.0000 0.0000 1.0000 1316.6598
277   7   p  0.0000 -1.0000 1.0000 941.7050
278   7   p  0.0000 1.0000 1.0000 1043.3050
279   7   p  0.0000 -1.0000 1.0000 1043.3050
280   7   p  0.0000 1.0000 1.0000 941.7050
281   7   p  0.0000 -1.0000 1.0000 1078.8650
282   7   p  0.0000 1.0000 1.0000 1179.4236
283   7   p  0.0000 1.0000 1.0000 1078.8650
284   7   p  0.0000 -1.0000 1.0000 1179.4236
285   7   p  0.0000 -1.0000 1.0000 1215.0598
286   7   p  0.0000 1.0000 1.0000 1316.6598
287   7   p  0.0000 1.0000 1.0000 1215.0598
288   7   p  0.0000 -1.0000 1.0000 1316.6598
289   7  px  -0.6350
290   7  px  0.6350
291   7  py  45.0850
292   7  py  -45.0850
293   7  py  0.0000
294   7   p  1.0000 0.0000 1.0000 437.9912
295   7   p  -1.0000 0.0000 1.0000 326.5487
296   7  pz  352.4250
297   7  pz  351.9487
298   7  px  20.0025
299   7  px  50.0062
300   7   p  -1.0000 0.0000 1.0000 182.4037
301   7   p  1.0000 0.0000 1.0000 284.9562
302   7  px  38.8937
303   7   p  -1.0000 0.0000 1.0000 42.7037
304   7   p  1.0000 0.0000 1.0000 145.2562
305   7   p  1.0000 0.0000 1.0000 42.7037
306   7   p  -1.0000 0.0000 1.0000 145.2562
307   7  px  -38.8937
308   7  px  -20.0025
309   7   p  1.0000 0.0000 1.0000 182.4037
310   7   p  -1.0000 0.0000 1.0000 284.9562
311   7   p  1.0000 0.0000 1.0000 326.5487
312   7   p  -1.0000 0.0000 1.0000 437.9912
313   7  px  -50.0062
314   7   p  0.0000 -1.0000 1.0000 326.5487
315   7   p  0.0000 1.0000 1.0000 437.9912
316   7   p  0.0000 1.0000 1.0000 326.5487
317   7   p  0.0000 -1.0000 1.0000 437.9912
318   7  py  50.0062
319   7  py  -50.0062
320   7  py  20.0025
321   7  py  -20.0025
322   7   p  0.0000 -1.0000 1.0000 182.4037
323   7   p  0.0000 1.0000 1.0000 284.9562
324   7  py  38.8937
325   7  py  -38.8937
326   7   p  0.0000 1.0000 1.0000 182.4037
327   7   p  0.0000 -1.0000 1.0000 284.9562
328   7   p  0.0000 -1.0000 1.0000 42.7037
329   7   p  0.0000 1.0000 1.0000 145.2562
```

```
330    7   p  0.0000 1.0000 1.0000 42.7037
331    7   p  0.0000 -1.0000 1.0000 145.2562
332    7  pz  596.2650
333    7  cz  14.6050
334    7   p  0.0000 0.5799 1.0000 900.7475
335    7  py  49.5300
336    7   p  0.0000 -0.5800 1.0000 748.6650
337    7  py  -49.5300
338    7   p  0.0000 0.5799 1.0000 748.6650
339    7   p  0.0000 -0.5799 1.0000 900.7475
340    7   p  0.5799 0.0000 1.0000 900.7475
341    7   p  -0.5799 0.0000 1.0000 748.6650
342    7   p  0.5799 0.0000 1.0000 748.6650
343    7   p  -0.5799 0.0000 1.0000 900.7475
344    7  px  49.5300
345    7  px  -49.5300
346    7  pz  -0.1000
347    7  pz  1.3700
348    7  cz  55.9800
349    7 k/x  128.0000 0.0000 17.7800 0.0051 0.0000
350    7  px  12.0920
351    7 k/z  20.0025 0.0000 -131.5400 0.0025 2.5400
352    7 k/x  -128.0000 0.0000 17.7800 0.0051 0.0000
353    7 k/z  -20.0025 0.0000 -131.5400 0.0025 2.5400
354    7  px  -12.0920
355    7 c/z  -20.0025 0.0000 8.5137
356    7 c/z  0.0000 20.0025 8.5137
357    7 c/z  20.0025 0.0000 8.5137
358    7 c/z  0.0000 -20.0025 8.5137
359    7  pz  68.0037
360    7  pz  68.6800
362    7  pz  119.9562
363    7  pz  119.2800
365    7  pz  207.7037
366    7  pz  208.3800
367    7  pz  259.6562
368    7  pz  258.9800
369    7  pz  351.8487
370    7  pz  352.5250
371    7  pz  412.0150
372    7  pz  412.6912
373    7  py  -0.7350
374    7  py  0.7350
375    7  cz  53.3400
376    7   p  -1.0000 0.0000 1.0000 145.3562
377    7  px  -38.9937
378    7   p  1.0000 0.0000 1.0000 42.6037
379    7   p  1.0000 0.0000 1.0000 145.3562
380    7  px  38.9937
381    7   p  -1.0000 0.0000 1.0000 42.6037
382    7   p  0.0000 -1.0000 1.0000 145.3562
383    7  py  -38.9937
384    7   p  0.0000 1.0000 1.0000 42.6037
385    7  px  -0.7350
386    7  px  0.7350
387    7   p  0.0000 1.0000 1.0000 145.3562
388    7  py  38.9937
389    7   p  0.0000 -1.0000 1.0000 42.6037
390    7   p  1.0000 0.0000 1.0000 285.0562
391    7   p  -1.0000 0.0000 1.0000 182.3037
392    7   p  -1.0000 0.0000 1.0000 285.0562
393    7   p  1.0000 0.0000 1.0000 182.3037
394    7   p  0.0000 1.0000 1.0000 285.0562
395    7   p  0.0000 -1.0000 1.0000 285.0562
396    7   p  0.0000 1.0000 1.0000 182.3037
397    7   p  0.0000 -1.0000 1.0000 182.3037
398    7   p  1.0000 0.0000 1.0000 438.0912
399    7  px  50.1062
400    7   p  -1.0000 0.0000 1.0000 326.4487
```

```
401     7   p  -1.0000 0.0000 1.0000 438.0912
402     7  px  -50.1062
403     7   p  1.0000 0.0000 1.0000 326.4487
404     7   p  0.0000 1.0000 1.0000 438.0912
405     7  py  50.1062
406     7   p  0.0000 -1.0000 1.0000 326.4487
407     7   p  0.0000 -1.0000 1.0000 438.0912
408     7  py  -50.1062
409     7   p  0.0000 1.0000 1.0000 326.4487
410     7  pz  504.1312
411     7  pz  503.4550
412     1 c/z  31.5112 0.0000 8.5137
413     7  px  51.5350
414     7  px  11.4887
415     7 c/z  43.0212 0.0000 8.5137
416     7  px  -11.4887
417     7  px  -51.5350
418     2 c/z  -31.5112 0.0000 8.5137
419     7 c/z  -43.0212 0.0000 8.5137
420     7  py  11.4887
421     3 c/z  0.0000 31.5112 8.5137
422     7  py  51.5350
423     7 c/z  0.0000 43.0212 8.5137
424     4 c/z  0.0000 -31.5112 8.5137
425     7  py  -11.4887
426     7  py  -51.5350
427     7 c/z  0.0000 -43.0212 8.5137
428     5  cz  5.8150
429     7  px  51.5604
430     7 c/z  36.2458 0.0000 7.3165
431     7 c/z  36.2458 0.0000 8.4137
432     7 c/z  -36.2458 0.0000 7.3165
433     7 c/z  -36.2458 0.0000 8.4137
434     7  px  -28.0340
435     7 c/z  45.7200 0.0000 5.8150
436     7 c/z  -45.7200 0.0000 5.8150
437     7  px  27.9340
438     7 c/z  36.2458 0.0000 8.5137
439     6  cz  5.8150
440     7  px  -51.5604
441     7  px  -27.9340
442     7  cz  4.5450
443     7 c/z  -36.2458 0.0000 8.5137
444     7  pz  622.4000
445     7  cz  36.9300
446     7  pz  605.0550
447     7  cz  14.7050
448     7  cz  13.2350
449     7  cz  20.4200
450     7  cz  18.9500
451     7  pz  643.1550
452     7  pz  643.8312
454     7  cz  45.1850
455     7  cz  26.8875
457     7  px  16.6100
458     7  px  -16.6100
459     7  pz  597.4350
460     7  pz  694.7900
461     7  cz  28.9925
462     7  pz  715.5450
463     7  cz  45.1850
465     7  cz  38.2000
466     7  pz  718.6025
467     7  kz  803.7560 2.7940 0.0000
468     7  cz  20.4200
469     7  pz  953.7700
470     7  pz  889.8525
471     7  pz  890.5356
473     7  pz  839.8875
```

```
 474     7  pz  829.8450
 475     7  cz  39.4700
 476     7   p  0.0000 0.5799 1.0000 900.8475
 477     7  py  49.6300
 478     7   p  0.0000 -0.5800 1.0000 748.5650
 479     7   p  0.0000 -0.5799 1.0000 900.8475
 480     7  py  -49.6300
 481     7   p  0.0000 0.5799 1.0000 748.5650
 482     7   p  0.5799 0.0000 1.0000 900.8475
 483     7  px  49.6300
 484     7   p  -0.5799 0.0000 1.0000 748.5650
 485     7   p  -0.5799 0.0000 1.0000 900.8475
 486     7  px  -49.6300
 487     7   p  0.5799 0.0000 1.0000 748.5650
 488     7  pz  801.6287
 489     7  pz  800.9525
 500     8  pz  1533.0000
 501     7  cz  58.4200
 502     7  pz  569.6950
 503     7  pz  652.0450
c   Tank Surfaces
1001     8  pz  -61.0000
1002     8  pz  0.0000
1003     8  pz  1418.0000
1020     8  sz  -892.0000 2318.0000
1021     8  sz  -892.0000 2318.9500
1029     8  sz  -892.0000 2357.0000
1030     8  pz  1476.1400
1039     8  pz  1506.6400
1050     8  pz  1648.0500
1051     8  pz  1655.5000
1052     8  pz  1663.0000
1053     8  pz  1670.5000
1054     8  pz  1678.0000
1055     8  pz  1685.5000
1059     8  pz  1693.0500
1080     8  so  25000.0000
1081     8  so  20000.0000
1082     8  pz  6000.0000
1083     8  cz  10100.0000
1101     8  cz  1143.0000
1102     8  cz  1145.5400
1103     8  cz  1221.5400
1104     8  cz  1267.5400
1106     8 c/z  0.0000 -121.92 53.3400
1107     8 c/z  0.0000 -121.92 54.2900
1108     8 c/z  0.0000 60.96 15.2500
1109     8 c/z  0.0000 60.96 16.2000
1110     8 c/z  0.0000 152.5000 10.2000
1111     8 c/z  0.0000 152.5000 11.1500
1200     8  px  -152.4000
1201     8  px  -121.920
1202     8  px   121.920
1203     8  px  152.4000
1204     8  py  -243.84
1205     8  py  -213.36
1206     8  py  213.36
1207     8  py  243.84
1301     8  pz  745.10
1302     8  pz  747.60
1303     8  pz  850.95
1304     8  pz  852.22
1305     8  pz  981.76
1306     8  pz  983.03
1307     8  pz  1093.52
1308     8  pz  1094.79
1309     8  pz  1205.28
1310     8  pz  1206.55
1311     8  pz  1317.04
```

```
1312    8  pz  1318.31
1313    8  pz  1428.80
1314    8  pz  1430.07
1315    8  pz  1540.56
1316    8  pz  1541.83
1324    8  pz  1530.46
1325    8  pz  1533.0000
1330    8  pz  1696.23
1334    8  pz  1813.23
1335    8  pz  1815.77
1401    8 c/z  0.0000 -121.92 19.0500
1402    8 c/z  0.0000 -121.92 20.3200
1406    8 c/z  0.0000 -121.92 41.9100
1407    8 c/z  0.0000 -121.92 21.9100
1408    8 c/z  0.0000 -121.92 34.2900
1409    8 c/z  0.0000 -121.92 33.3400
1410    8 c/z  0.0000 -121.92 40.9600
1411    8 c/z  0.0000 -121.92 66.0400
1412    8 c/z  0.0000 -121.92 80.0100
1415    8 c/z  0.0000 -121.92 21.5900
1418    8 c/z  0.0000 -121.92 39.3700
1419    8 c/z  0.0000 -121.92 25.4000
1420    8 c/z  -12.700 -121.92  2.045
1421    8 c/z  -12.700 -121.92  2.203
1422    8 c/z  -12.70 -121.92   2.54
1423    8 c/z  -6.990 -79.400  1.332
1424    8 c/z  -6.990 -79.400  1.491
1425    8 c/z  -6.990 -79.400  1.825
1426    8 c/z   5.080 -82.700  2.045
1427    8 c/z   5.080 -82.700  2.203
1428    8 c/z    5.08 -82.70   2.54
1429    8 c/z  12.100 -84.500  2.045
1430    8 c/z  12.100 -84.500  2.203
1431    8 c/z   12.10 -84.50   2.54
1432    8 c/z  10.200 -121.92  1.332
1433    8 c/z   10.20 -121.92   1.67
1434    8 c/z  10.200 -121.92  1.825
1435    8 c/z  12.100 -98.500  1.332
1436    8 c/z   12.10 -98.50   1.67
1437    8 c/z  12.100 -98.500  1.825
1438    8 c/z   5.080 -100.300  2.625
1439    8 c/z   5.080 -100.300  3.016
1440    8 c/z   5.080 -100.300  3.175
1441    8 c/z  -6.990 -103.600  2.045
1442    8 c/z  -6.990 -103.600  2.203
1443    8 c/z   -6.99 -103.60   2.54
1444    8 c/z  0.0000 -121.92 3.1360
1445    8 c/z  0.0000 -121.92 3.4530
1446    8 c/z  0.0000 -121.92 3.8100
1600    8  pz  1015.0000
1601    8  pz  1011.0000
1602    8  pz  1006.0000
1603    8  pz  1001.0000
1604    8  pz  996.0000
1605    8  pz  971.0000
1610    8 c/z  0.0000 -121.92 21.3200
1611    8 c/z  0.0000 -121.92 25.3200
1612    8 c/z  0.0000 -121.92 30.3200
1613    8 c/z  0.0000 -121.92 35.3200
1614    8 c/z  0.0000 -121.92 40.3200
1615    8 c/z  0.0000 -121.92 65.3200
1620    8   s  0.0000 -121.92 745.1000 21.3200
1621    8   s  0.0000 -121.92 745.1000 25.3200
1622    8   s  0.0000 -121.92 745.1000 30.3200
1623    8   s  0.0000 -121.92 745.1000 35.3200
1624    8   s  0.0000 -121.92 745.1000 40.3200
1625    8   s  0.0000 -121.92 745.1000 65.3200
1626    8 c/z  0.0000 -121.92 150.0000
1627    8 c/z  0.0000 -121.92 300.0000
```

```
1628     8 c/z  0.0000 -121.92 600.0000
1629     8  pz  986.0000
1630     8  pz  956.0000
1631     8  pz  926.0000
1632     8  pz  1016.0000
c     1633     8  pz  1533.0000
1634     8  pz  1662.0000
1635     8  pz  1457.5400
1636     8  pz  1431.2700
1637   pz 1564.75
1638   pz 1566.655
1639   pz 1581.895
1640   pz 1577.024
1641   pz 1581.113
1642   pz 1587.293
1643   pz 1694.766
1644   8    c/z 0 -121.92 83.02625
1645   8    c/z 0 -121.92 83.5025
1646   8    c/z 0 -121.92 104.2924
1647   8    c/z 0 -121.92 105.0290
1648   8    c/z 0 -121.92 87.3125
1649   8    c/z 0 -121.92 100.2030
1650   8    c/z 0 -121.92  99.72675
1651   pz  1574.275    $ bot to bot detector shield
1652   pz  1594.9125   $ top of top detector shield
1653   px  -50
1654   px   50
1655   8    py  -121.92
1656   8    c/z 0 -121.92  106
1657   py  -134.62   $3 in. plate
1658   py  -109.22   $3 in. plate
1659   px   107.9525   $3 in. plate
1660   px  -107.9525   $3 in. plate
1661   py  -108.744   $3/16 in. plate
1662   py  -135.096   $3/16 in. plate
1663   px   108.5875   $0.25 in. plate
1664   px  -108.5875   $0.25 in. plate
1665   c/y  -102.4255  1584.594  2.413 $detector
1666   c/y   102.4255  1584.594  2.413 $detector
1667   c/y  -102.4255  1584.594  2.0447 $detector
1668   c/y   102.4255  1584.594  2.0447 $detector
1669   py  -131.82   $
1670   py  -112.014   $
1671   10 c/y  0  1584.594  2.413 $detector
1672   11 c/y  0  1584.594  2.413 $detector
1673   10 c/y  0  1584.594  2.0447 $detector
1674   11 c/y  0  1584.594  2.0447 $detector
1675   10 py  -9.9
1676   10 py   9.9
1677   11 py  -9.9
1678   11 py   9.9
1679   10 py  -12.7
1680   10 py   12.7
1681   11 py  -12.7
1682   11 py   12.7
1690   pz  1576.18    $ bot to bot detector shield
1691   pz  1578.085    $ bot to bot detector shield
1692   pz  1579.99(   $ bot to bot detector shield
c     Wand Interface
2000  9 pz  2.54   $ Importance split
2001  9 pz  5.08   $ Importance split
2005  9 pz  7.62   $ Top of 3" plate
2010  9 pz  142.14 $
2015  9 pz  166.51
2020  9 cz  7.703  $ ID 6" Sch 40
2025  9 cz  8.414  $ OD 6" Sch 40
2026  9 cz  10.0   $ Importance split
2027  9 cz  15.0   $ Importance split
2030  9 cz  16.67  $ ID 14" Sch 40
```

```
2035  9 cz  17.78  $ OD 14" Sch 40
2040  9 cz  45.72  $ OD of 3" plate
2050  9 kz  411.4580 3.834105e-3 -1
2055  9 kz  415.0417 4.244740e-3 -1

  *tr1 31.5119  -121.92 553.47    -45 90 -135    90  0    90    45    90   -45
  *tr2 -31.5119 -121.92  553.47     45 90  -45    90  0    90   135    90    45
  *tr3  0 -90.4081  553.47   0    90    90  90   -45  -135    90    45   -45
  *tr4  0 -153.4319  553.47   0    90    90    90    45   -45    90   135    45
  *tr5 45.7200  -121.92  693.53     45 90  -45    90  0    90   135    90    45
  *tr6 -45.7200  -121.92  693.53   -45 90 -135    90  0    90    45    90   -45
  *tr7 0.0 -121.92 61.07        j  j  j  j  j  j  j  j  j
  *tr8 0.0 0.0 0.0            j  j  j  j  j  j  j  j  j
  *tr9     0 60.96 1506.64
  *tr11   -60.811  -61.11  0      45   135   90   -45  45    90   90    90    0
  *tr10    60.811  -61.11  0     -45 45  90   -135  -45    90   90    90    0
mode     p
phys:p   100 1 1
cut:p    j j 0 0
c ************************************************************
c    IMPORTANCES
imp:p  1 336r    $ Pump cells
c      1000 1001 1002 1003 1004 1005 1006 1007 1008 1009
       0    1    0.3  1    1    1    1    1    4    4
c      1010 1011 1012 1013 1014 1015 1016 1017 1018 1019
       1    1    1    0.5  0    0    1    1    0    0
c      1020 1021 1024 1025 1026 1027 1028 1029
       0    1    1    1    1    1    1    1
c      1030 1031 1032 1033 1034 1035 1036 1037 1038 1039
       1    4e-3 1    1    1    1    1    1    .25  .25
c      1040 1041  1042 1043 1044  1045  1046 1047 1048 1049
       .25  .0625 .0625 .0625 .0625 .0156 1    8    32   64
c      1050 1051  1052 1053 1054 1055 1056 1057  1058 1059 1060
       8    0     64   8    16   32   64   8     8    8    8
c      1061 1062  1063 1064 1065  1066  1067 1068 1069 1070
       64   64    64   64   64    64    64   64   64   64
c      1071 1072  1073 1074 1075
       64   64    64   64   64
c       2000 2005 2006 2007 2010 2015 2020 2021 2022 2025
        0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5  0.5
c   ******************************************************************
dd2      0.5 100
dxt:p    0.0 -121.92 1418 19.05 54.29
c    contributions to dxtran sphere
dxc1:p 0 336r
c      1000 1001 1002 1003 1004 1005 1006 1007 1008 1009
       0    0.2  0    0    0    0    0    0    0    0
c      1010 1011 1012 1013 1014 1015 1016 1017 1018 1019
       0    0    0    0    0    0    0    0    0    0
c      1020 1021 1024 1025 1026 1027 1028 1029
       0    0    r    r    r    0    0    0
c      1030 1031 1032 1033 1034 1035 1036 1037 1038 1039
       0    0    0    0    0    1    1    1    1    1
c      1040 1041  1042 1043 1044  1045  1046 1047 1048 1049
       1    1     1    1    0     0     0    0    0    0
c      1050 1051  1052 1053 1054 1055 1056 1057  1058 1059 1060
       0    0     0    0    0    0    0    0     0    0    0
c      1061 1062  1063 1064 1065  1066  1067 1068 1069 1070
       0    0     0    0    0     0     0    0    0    0
c      1071 1072  1073 1074 1075
       0    0     0    0    0
c       2000 2005 2006 2007 2010 2015 2020 2021 2022 2025
        0    0    0    0    0    0    0    0    0    0
c    ******************************************************************
pd0    1 336r
c      1000 1001 1002 1003 1004 1005 1006 1007 1008 1009
       0    0.5  0.5  0.5  0.5  0.5  1    1    1    1
c      1010 1011 1012 1013 1014 1015 1016 1017 1018 1019
       1    1    1    0.5  0    0    1    1    0    0
```

```
c       1020 1021 1024 1025 1026 1027 1028 1029
        0    0.5  r    r    r    1    1    1
c       1030 1031 1032 1033 1034 1035 1036 1037 1038 1039
        1    0    1    1    1    0.5  0.2  0    .5   .2
c       1040 1041  1042 1043 1044  1045  1046 1047 1048 1049
        0    .5   .2    0    0    0    1    1    1    1
c       1050 1051  1052 1053 1054 1055 1056 1057  1058 1059 1060
        1    0    1    1    1    1    1    1    1    1    1
c       1061 1062  1063 1064 1065  1066  1067 1068 1069 1070
        1    1    1    1    1    1    1    1    1    1
c       1071 1072  1073 1074 1075
        1    1    1    1    1
c        2000 2005 2006 2007 2010 2015 2020 2021 2022 2025
         1    1    1    1    1    1    1    1    1    1
dd      0.2
c ************************************************************
c     SOURCE FROM SUPERNATE IN TANK
c        volume = (600^2)*pi*90 = 1.0179e8
c        1.0179e8*1.74=1.77e+5 Kg
c        1.77e+5*1.446E+07*1000 =2.5613E+15
sdef     cel=d1 axs=0 0 1 pos=0 -121.92 0 rad=fcel d2 ext=fcel d3 erg=d4
         wgt=2.5613E+15
#         si4     sp4
           l       d
           0        0
          1.500E-02   2.699E+05
          2.500E-02   4.147E+04
          3.750E-02   8.726E+05
          5.750E-02   4.447E+04
          8.500E-02   2.107E+04
          1.250E-01   6.175E+04
          2.250E-01   2.458E+04
          3.750E-01   7.830E+03
          6.620E-01   1.296E+07
          8.500E-01   5.944E+04
          1.250E+00   9.904E+04
          1.750E+00   1.987E+03
          2.250E+00   1.927E-01
          2.750E+00   6.331E-04
          3.500E+00   6.718E-05
          5.000E+00   2.851E-05
          7.000E+00   3.260E-06
          1.100E+01   3.727E-07
c           TOTAL     1.446E+07
sc1      SAMPLE CELLS
si1    l 1035 1036 1037 1038 1039 1040 1041 1042 1043
sp1    2.25 6.75   27      2.25  6.75    27       2.25    6.75     27
sb1    2.25 6.75 27        .5625 1.6875 6.75  .140625 .421875 1.6875
sc2      SAMPLE RADIUS
ds2      s 21 22 23  21 22 23  21 22 23
si21     0 150
sp21     -21 1
si22     150 300
sp22     -21 1
si23.    300 600
sp23     -21 1
sc3      SAMPLE EXTENT
ds3      s 31 31 31  32 32 32  33 33 33
si31     986 1016
sp31     -21 0
si32     956 986
sp32     -21 0
si33     926 956
sp33     -21 0
c ************************************************************
m1        1001.50 .4372      $H 101 SY Slurry
          6000.50 .0170      $C
          7014.50 .0579      $N
          8016.50 .3725      $O
```

```
        11023.50 .0975      $Na
        13027.50 .0113      $Al
        15031.50 .0011      $P
        17000.50 .0029      $Cl
        19000.50 .0026      $K
m2       8016.50  .21       $O air number fraction
         7014.50  .79       $N
m3      26000.55 1.0        $Fe iron
m4       8016.50 -.4407     $O concrete weight fraction
        14000.50 -.2157     $Si
        20000.50 -.1306     $Ca
        26000.55 -.0788     $Fe
        13027.50 -.0607     $Al
        12000.50 -.0376     $Mg
        19000.50 -.0066     $K
        11023.50 -.0182     $Na
        22000.50 -.0049     $Ti
         1001.50 -.0031     $H
        25055.50 -.0013     $Mn
        15031.50 -.0009     $P
        16032.50 -.0009     $S
m5      14000.50  .2813     $Si  hanford soil number fraction
         8016.50  .6556     $O
        13027.50  .0123     $Al
        26000.55  .0084     $Fe
        20000.50  .0149     $Ca
        12000.50  .0103     $Mg
        19000.50  .0022     $K
        11023.50  .0034     $Na
         1001.50  .0116     $H
m6       6000.   1   $ Rubber
m7      82000.   1   $ lead shielding for detectors
c       Gamma flux to dose rate conversion factors (mrem/hr)/(p/cm**2/s)
de0    log  .01 .015 .02 .03 .04 .05
            .06 .08 .10 .15 .20 .30
            .40 .50 .60 .80 1.0 1.5
            2.0 3.0 4.0 5.0 6.0 8.0
            10. 12.
df0    log  2.232e-5 5.652e-5 8.568e-5 1.184e-4 1.314e-4 1.382e-4
            1.440e-4 1.624e-4 1.919e-4 2.797e-4 3.708e-4 5.616e-4
            7.416e-4 9.144e-4 1.076e-3 1.379e-3 1.656e-3 2.246e-3
            2.758e-3 3.672e-3 4.500e-3 5.292e-3 6.012e-3 7.488e-3
            8.892e-3 1.040e-2
print  10 60 100 110 126 130 150
prdmp   j -240 1 3
ctme   3700
fc4    Dose points inside detector region
f4:p   1062 1063 t
fc14    Dose points inside detector region
f14:p   1068 1069 t
```

APPENDIX B
MCNP Internal Source Description (from file idcell_0)

```
c   447.81*1.446E+07*1000 =6.4754E+12
c  CELL SOURCE
sdef    cel d1 erg d2 pos fcel d3 rad fcel d4 ext fcel d5 axs fcel d6
        x fcel d7 y fcel d8 z fcel d9
        wgt = 6.4754E+12  eff .001
#        si2    sp2
          l      d
          0        0
         1.500E-02   2.699E+05
         2.500E-02   4.147E+04
         3.750E-02   8.726E+05
         5.750E-02   4.447E+04
         8.500E-02   2.107E+04
         1.250E-01   6.175E+04
         2.250E-01   2.458E+04
         3.750E-01   7.830E+03
         6.620E-01   1.296E+07
         8.500E-01   5.944E+04
         1.250E+00   9.904E+04
         1.750E+00   1.987E+03
         2.250E+00   1.927E-01
         2.750E+00   6.331E-04
         3.500E+00   6.718E-05
         5.000E+00   2.851E-05
         7.000E+00   3.260E-06
         1.100E+01   3.727E-07
c          TOTAL     1.446E+07
#        si1    sp1
          l      d
c     CELL SOURCES
       68 3086.20
       65 3086.20
       67 2387.00
       63 2369.00
       11 65740.00
       2 65280.00
       9 8959.00
       3 8957.00
       10 16360.00
       1 16440.00
       15 4488.00
       7 4526.00
       104 1541.00
       101 1550.00
       269 1712.00
       267 1715.00
       94 28007.65
       88 12141.96
       81 9017.55
c     c          UPPER/LOWER PLATE SOURCES
c            193 980.99
c            194 936.50
c            212 889.70
c            211 889.70
c            215 889.70
c            214 889.70
c            217 889.70
c            218 889.70
c            220 889.70
c            221 889.70
c            223 889.70
c            224 889.70
c            226 889.70
c            227 889.70
```

```
c          265 890.00
c          264 890.00
c          297 806.70
c          290 805.50
c          321 834.90
c          320 834.90
c          311 849.99
c          310 849.99
c     c        OUTER PLATE SOURCES
c          195 0
c          210 0
c          213 0
c          216 0
c          219 0
c          222 0
c          225 0
c          247 0
c          289 0
c          322 0
c          312 0
c     c        PIPE SURFACE SOURCES
c          199 80.07
c          196 79.64
c          201 21.14
c          197 21.14
c          200 82.22
c          198 81.68
c          202 1114.00
c          203 1165.00
c          206 858.90
c          207 897.40
c          204 1373.00
c          205 1331.00
c          208 901.30
c          209 874.70
c          252 222.40
c          248 222.40
c          260 223.40
c          256 222.40
c          255 520.80
c          251 528.30
c          263 547.90
c          259 538.80
c          272 217.60
c          271 219.70
c          277 61.79
c          273 63.19
c          253 31.44
c          249 33.09
c          262 30.81
c          257 30.87
c          254 32.03
c          250 31.84
c          261 30.53
c          258 31.45
c          278 15.16
c          274 14.95
c          279 9.33
c          275 8.82
c          281 41.29
c          276 41.44
c          288 674.68
c          287 723.33
c          285 84.81
c          284 81.86
c          286 290.00
c          282 283.50
c          283 351.50
c          280 82.95
```

```
c            296 126.80
c            295 255.40
c            292 377.60
c            291 1206.54
c            303 379.16
c            302 379.25
c            304 374.51
c            305 86.71
c            306 180.14
c            307 1480.00
c            308 319.20
c            309 1888.00
c            314 346.10
c            315 248.00
c            313 346.10
c            342 22.77
c            343 22.77
c            344 634.92
c     c          FIN SURFACE SOURCES
c            228 81.84
c            231 81.84
c            232 78.54
c            233 77.27
c            237 79.92
c            236 81.84
c            239 78.54
c            238 77.27
c            244 148.70
c            242 153.40
c            243 146.80
c            246 145.70
c            319 546.50
c            318 561.90
c            317 544.70
c            316 543.50
c            293 181.20
c            294 180.30
sc3    POSITION
ds3  l  0  -121.92  78.85            $68
        0  -121.92  78.85            $65
       -20.0025  -121.92  61.07      $67
        20.0025  -121.92  61.07      $63
       -20.0025  -121.92  61.07      $11
        20.0025  -121.92  61.07      $2
        0  -121.92  477.397            $9
        0  -121.92  477.397            $3
       -43.0212  -121.92  61.07      $10
        43.0212  -121.92  61.07      $1
       -45.7200  -121.92  61.07      $15
        45.7200  -121.92  61.07      $7
        0  -121.92  739.25            $104
        0  -121.92  739.25            $101
       -36.2458  -121.92  61.07      $269
        36.2458  -121.92  61.07      $267
        0  -121.92  61.07            $94
        0  -121.92  61.07            $88
        0  -121.92  61.07            $81
c     c     UPPER/LOWER PLATE SOURCES
c     ds3  l   0  -121.92  61.07            $193
c              0  -121.92  61.07            $194
c              0  -121.92  61.07            $212
c              0  -121.92  61.07            $211
c              0  -121.92  61.07            $215
c              0  -121.92  61.07            $214
c              0  -121.92  61.07            $217
c              0  -121.92  61.07            $218
c              0  -121.92  61.07            $220
c              0  -121.92  61.07            $221
c              0  -121.92  61.07            $223
```

```
c            0  -121.92  61.07            $224
c            0  -121.92  61.07            $226
c            0  -121.92  61.07            $227
c            0  -121.92  61.07            $265
c            0  -121.92  61.07            $264
c            0  -121.92  61.07            $297
c            0  -121.92  61.07            $290
c            0  -121.92  61.07            $321
c            0  -121.92  61.07            $320
c            0  -121.92  61.07            $311
c            0  -121.92  61.07            $310
c     c    OUTER PLATE SOURCES
c            0  -121.92  61.07            $195
c            0  -121.92  61.07            $210
c            0  -121.92  61.07            $213
c            0  -121.92  61.07            $216
c            0  -121.92  61.07            $219
c            0  -121.92  61.07            $222
c            0  -121.92  61.07            $225
c            0  -121.92  61.07            $247
c            0  -121.92  61.07            $289
c            0  -121.92  61.07            $322
c            0  -121.92  61.07            $312
c     c    PIPE SURFACE SOURCES
c           0  -121.92  78.85             $199
c           0  -121.92  78.85             $196
c           0  -121.92  78.85             $201
c           0  -121.92  78.85             $197
c           -20.0025  -121.92  61.07      $200
c            20.0025  -121.92  61.07      $198
c           -20.0025  -121.92  61.07      $202
c            20.0025  -121.92  61.07      $203
c           -20.0025  -121.92  61.07      $206
c            20.0025  -121.92  61.07      $207
c           0  -111.5025  61.07      $204
c           0   -71.4975  61.07      $205
c           0  -111.5025  61.07      $208
c           0   -71.4975  61.07      $209
c           0  -121.92  477.397            $252
c           0  -121.92  477.397            $248
c           0  -121.92  477.397            $260
c           0  -121.92  477.397            $256
c           -43.0212  -121.92  61.07      $255 left source leg
c            43.0212  -121.92  61.07      $251 right source leg
c            0 -134.5212  61.07      $263 left dummy leg
c            0  -48.4788  61.07      $259 right dummy leg
c           -45.7200  -121.92  61.07      $272 left small leg
c            45.7200  -121.92  61.07      $271 right small leg
c            0  -121.92  739.25            $277 small slanted pipe
c            0  -121.92  739.25            $273 small slanted pipe
c            0  -121.92  488.87            $253 slanted end cap
c            0  -121.92  488.87            $249 slanted end cap
c            0  -121.92  488.87            $262 slanted end cap
c            0  -121.92  488.87            $257 slanted end cap
c            0  -121.92  528.87            $254 slanted top end cap
c            0  -121.92  528.87            $250 slanted top end cap
c            0  -121.92  528.87            $261 slanted top end cap
c            0  -121.92  528.87            $258 slanted top end cap
c            0  -121.92  687.72            $278 small slanted end cap
c            0  -121.92  687.72            $274 small slanted end cap
c            0  -121.92  711.27            $279 small slanted top end cap
c            0  -121.92  711.27            $275 small slanted top end cap
c           -36.2458  -121.92  61.07      $281 Short pipe
c            36.2458  -121.92  61.07      $276 Short pipe
c            0  -121.92  61.07            $288 Large open pipe
c            0  -121.92  61.07            $287 Large open pipe
c            0  -121.92  61.07            $285 INLET
c            0  -121.92  61.07            $284 INLET
c            0  -121.92  61.07            $286 INLET
```

```
c              0  -121.92  61.07          $282 INLET
c              0  -121.92  61.07          $283 INLET
c              0  -121.92  61.07          $280 ROD
c              0  -121.92  61.07          $296 Inlet cavity film
c              0  -121.92  61.07          $295 inner Inlet cavity film
c              0  -121.92  61.07          $292 inner Inlet cavity film
c              0  -121.92  61.07          $291 pump film
c              0  -121.92  61.07          $303 pump film
c              0  -121.92  61.07          $302 pump film
c              0  -121.92  61.07          $304 pump case film
c              0  -121.92  61.07          $305 pump case film
c              0  -121.92  61.07          $306 pump case film
c              0  -121.92  61.07          $307 pump case film
c              0  -121.92  61.07          $308 cone pump case film
c              0  -121.92  61.07          $309 UPPER LARGE PIPE film
c              0  -121.92  61.07          $314 flange film
c              0  -121.92  61.07          $315 flange film
c              0  -121.92  61.07          $313 flange film
c              0 -134.5212  61.07     $342 left dummy leg cap
c              0  -48.4788  61.07     $343 right dummy leg cap
c              0  -121.92  61.07          $344 below pump
c     c       FIN SURFACE SOURCES
c              0  0  0                $228 lower fin
c              0  0  0                $231 lower fin
c              0  0  0                $232 lower fin
c              0  0  0                $233 lower fin
c              0  0  0                $237 mid fin
c              0  0  0                $236 mid fin
c              0  0  0                $239 mid fin
c              0  0  0                $238 mid fin
c              0  0  0                $244 upper fin
c              0  0  0                $242 upper fin
c              0  0  0                $243 upper fin
c              0  0  0                $246 upper fin
c              0  0  0                $319 pump fin
c              0  0  0                $318 pump fin
c              0  0  0                $317 pump fin
c              0  0  0                $316 pump fin
c              0  0  0                $293 pump side
c              0  0  0                $294 pump side
sc4     RADIUS*************************************
c       68 65 67 63 11  2  9  3 10  1
ds4   s 20 20 21 21 21 21 22 22 21 21
c       15  7 104 101 269  267 94  88  81
        23 23  24  24  21  21  25  26  25
c     c       UPPER/LOWER PLATE SOURCES
c     c       193 194 212 211 215 214 217 218 220 221
c     ds4   s 200 200 200 200 200 200 200 200 200 200
c     c       223 224 226 227 265 264 297 290 321 320
c             200 200 200 200 200 200 200 200 200 200
c     c       311 310
c             200 200
c     c       OUTER PLATE SOURCES
c     c       195 210 213 216 219 222 225 247 289 322 312
c             201 201 201 201 201 201 201 201 201 201 201
c     c       PIPE SURFACE SOURCES
c     c       199 196 210 197 200 198 202 203 206 207
c             202 202 203 203 204 204 205 205 205 205
c     c       204 205 208 209 252 248 260 256 255 251
c             205 205 205 205 206 206 206 206 205 205
c     c       263 259 272 271 277 273 253 249 262 257
c             205 205 207 207 208 208 209 209 209 209
c     c       254 250 261 258 278 274 279 275 281 276
c             209 209 209 209 210 210 210 210 205 205
c     c       288 287 285 284 286 282 283 280 296 295
c             211 212 213 214 215 216 217 218 219 220
c     c       292 291 303 302 304 305 306 307 308 309
c             221 221 222 223 224 225 226 227 228 212
c     c       314 315 313 342 343 344
```

```
c              229 230 229 205 205 231
c      c       FIN SURFACE SOURCES
c      c       228 231 232 233 237 236 239 238 244 242
c                0   0   0   0   0   0   0   0   0   0
c      c       243 246 319 318 317 316 293 294
c                0   0   0   0   0   0   0   0
sc5      EXTENT*************************************
c        68 65 67 63 11  2  9  3 10  1
ds5    s 30 31 32 32 33 33 90 90 36 36
c        15  7 104 101 269  267 94  88  81
         37 37  38  38  40  40  41  42  43
c      c       UPPER/LOWER PLATE SOURCES
c      c       193 194 212 211 215 214 217 218 220 221
c      ds5   s  50  51  52  53  54  55  56  57  58  59
c      c       223 224 226 227 265 264 297 290 321 320
c               60  61  62  63  64  65  66  67  68  69
c      c       311 310
c               70  71
c      c       OUTER PLATE SOURCES
c      c       195 210 213 216 219 222 225 247 289 322 312
c               72  73  74  75  76  77  78  79  80  81  82
c      c     PIPE SURFACE SOURCES
c      c       199 196 201 197 200 198 202 203 206 207
c               83  84  85  86  32  32  87  87  88  88
c      c       204 205 208 209 252 248 260 256 255 251
c               89  89  88  88  90  90  90  90  36  36
c      c       263 259 272 271 277 273 253 249 262 257
c               91  91  37  37  38  38  92  93  92  93
c      c       254 250 261 258 278 274 279 275 281 276
c               94  95  94  95  96  97  98  99 100 100
c      c       288 287 285 284 286 282 283 280 296 295
c               101 101 102 103 104 105 106 107 108 109
c      c       292 291 303 302 304 305 306 307 308 309
c               109 110 111 112 113 114 115 116 117 118
c      c       314 315 313 342 343 344
c               119 120 121 122 122 123
c      c       FIN SURFACE SOURCES
c      c       228 231 232 233 237 236 239 238 244 242
c                0   0   0   0   0   0   0   0   0   0
c      c       243 246 319 318 317 316 293 294
c                0   0   0   0   0   0   0   0
sc6      AXIS***************************************
c        68 65 67 63 11  2  9  3 10  1
ds6    s 11 11 13 13 13 13 14 15 13 13
c        15  7 104 101 269  267 94  88  81
         13 13  18  19  13  13  13  13  13
c      c       UPPER/LOWER PLATE SOURCES
c      c       193 194 212 211 215 214 217 218 220 221
c      ds6   s  13  13  13  13  13  13  13  13  13  13
c      c       223 224 226 227 265 264 297 290 321 320
c               13  13  13  13  13  13  13  13  13  13
c      c       311 310
c               13  13
c      c       OUTER PLATE SOURCES
c      c       195 210 213 216 219 222 225 247 289 322 312
c               13  13  13  13  13  13  13  13  13  13  13
c      c     PIPE SURFACE SOURCES
c      c       199 196 201 197 200 198 202 203 206 207
c               11  11  11  11  13  13  13  13  13  13
c      c       204 205 208 209 252 248 260 256 255 251
c               13  13  13  13  14  15  16  17  13  13
c      c       263 259 272 271 277 273 253 249 262 257
c               13  13  13  13  18  19  11  11  12  12
c      c       254 250 261 258 278 274 279 275 281 276
c               11  11  12  12  11  11  11  11  13  13
c      c       288 287 285 284 286 282 283 280 296 295
c               13  13  13  13  13  13  13  13  13  13
c      c       292 291 303 302 304 305 306 307 308 309
c               13  13  13  13  13  13  13  13  13  13
```

```
c      c       314 315 313 342 343 344
c               13  13  13  13  13  13
c      c       FIN SURFACE SOURCES
c      c       228 231 232 233 237 236 239 238 244 242
c                0   0   0   0   0   0   0   0   0   0
c      c       243 246 319 318 317 316 293 294
c                0   0   0   0   0   0   0   0
sc7      X*************************************
c        68  65  67  63  11   2   9   3  10   1
ds7    s  0   0   0   0   0   0   0   0   0   0
c        15   7 104 101 269 267  94  88  81
          0   0   0   0   0   0   0   0   0
c      c       UPPER/LOWER PLATE SOURCES
c      c       193 194 212 211 215 214 217 218 220 221
c      ds7   s  0   0   0   0   0   0   0   0   0   0
c      c       223 224 226 227 265 264 297 290 321 320
c                0   0   0   0   0   0   0   0   0   0
c      c       311 310
c                0   0
c      c       OUTER PLATE SOURCES
c      c       195 210 213 216 219 222 225 247 289 322 312
c                0   0   0   0   0   0   0   0   0   0   0
c      c     PIPE SURFACE SOURCES
c      c       199 196 201 197 200 198 202 203 206 207
c                0   0   0   0   0   0   0   0   0   0
c      c       204 205 208 209 252 248 260 256 255 251
c                0   0   0   0   0   0   0   0   0   0
c      c       263 259 272 271 277 273 253 249 262 257
c                0   0   0   0   0   0   0   0   0   0
c      c       254 250 261 258 278 274 279 275 281 276
c                0   0   0   0   0   0   0   0   0   0
c      c       288 287 285 284 286 282 283 280 296 295
c                0   0   0   0   0   0   0   0   0   0
c      c       292 291 303 302 304 305 306 307  75 309
c                0   0   0   0   0   0   0   0   0   0
c      c       314 315 313 342 343 344
c                0   0   0   0   0   0
c      c       FIN SURFACE SOURCES
c      c       228 231 232 233 237 236 239 238 244 242
c              300 301 302 302 300 301 302 302 303 304
c      c       243 246 319 318 317 316 293 294
c              302 302 305 306 302 302 307 308
sc8      Y*************************************
c        68  65  67  63  11   2   9   3  10   1
ds8    s  0   0   0   0   0   0   0   0   0   0
c        15   7 104 101 269 267  94  88  81
          0   0   0   0   0   0   0   0   0
c      c       UPPER/LOWER PLATE SOURCES
c      c       193 194 212 211 215 214 217 218 220 221
c      ds8   s  0   0   0   0   0   0   0   0   0   0
c      c       223 224 226 227 265 264 297 290 321 320
c                0   0   0   0   0   0   0   0   0   0
c      c       311 310
c                0   0
c      c       OUTER PLATE SOURCES
c      c       195 210 213 216 219 222 225 247 289 322 312
c                0   0   0   0   0   0   0   0   0   0   0
c      c     PIPE SURFACE SOURCES
c      c       199 196 201 197 200 198 202 203 206 207
c                0   0   0   0   0   0   0   0   0   0
c      c       204 205 208 209 252 248 260 256 255 251
c                0   0   0   0   0   0   0   0   0   0
c      c       263 259 272 271 277 273 253 249 262 257
c                0   0   0   0   0   0   0   0   0   0
c      c       254 250 261 258 278 274 279 275 281 276
c                0   0   0   0   0   0   0   0   0   0
c      c       288 287 285 284 286 282 283 280 296 295
c                0   0   0   0   0   0   0   0   0   0
c      c       292 291 303 302 304 305 306 307  75 309
```

```
c                0   0   0   0   0   0   0   0   0   0
c     c        314 315 313 342 343 344
c                0   0   0   0   0   0
c     c        FIN SURFACE SOURCES
c     c        228 231 232 233 237 236 239 238 244 242
c              400 400 401 402 400 400 401 402 400 400
c     c        243 246 319 318 317 316 293 294
c              403 404 400 400 405 406 407 407
sc9     Z*************************************
c        68  65  67  63  11   2   9   3  10   1
ds9   s   0   0   0   0   0   0   0   0   0   0
c        15   7 104 101 269 267  94  88  81
          0   0   0   0   0   0   0   0   0
c     c        UPPER/LOWER PLATE SOURCES
c     c        193 194 212 211 215 214 217 218 220 221
c     ds9   s   0   0   0   0   0   0   0   0   0   0
c     c        223 224 226 227 265 264 297 290 321 320
c                0   0   0   0   0   0   0   0   0   0
c     c        311 310
c                0   0
c     c        OUTER PLATE SOURCES
c     c        195 210 213 216 219 222 225 247 289 322 312
c                0   0   0   0   0   0   0   0   0   0   0
c     c      PIPE SURFACE SOURCES
c     c        199 196 201 197 200 198 202 203 206 207
c                0   0   0   0   0   0   0   0   0   0
c     c        204 205 208 209 252 248 260 256 255 251
c                0   0   0   0   0   0   0   0   0   0
c     c        263 259 272 271 277 273 253 249 262 257
c                0   0   0   0   0   0   0   0   0   0
c     c        254 250 261 258 278 274 279 275 281 276
c                0   0   0   0   0   0   0   0   0   0
c     c        288 287 285 284 286 282 283 280 296 295
c                0   0   0   0   0   0   0   0   0   0
c     c        292 291 303 302 304 305 306 307  75 309
c                0   0   0   0   0   0   0   0   0   0
c     c        314 315 313 342 343 344
c                0   0   0   0   0   0
c     c        FIN SURFACE SOURCES
c     c        228 231 232 233 237 236 239 238 244 242
c              500 500 500 500 501 501 501 501 502 502
c     c        243 246 319 318 317 316 293 294
c              502 502 503 503 503 503 504 504
sc20   Cone Radius
si20  0  7
sp20    -21   1
sc21   Pipe Radius
si21  0  7.3165
sp21    -21   1
sc22   Slant Pipe Radius
si22  0  7.317
sp22    -21   1
sc23   Small Pipe Radius
si23  0  4.859
sp23    -21   1
sc24   Upper Slant Pipe Radius
si24  0  4.86
sp24    -21   1
sc25   INLET LEG Source Radius
si25  28.8925  43.815
sp25    -21   1
sc26   INLET Source Radius
si26  0  35.56
sp26    -21   1
sc200   PLATE Source Radius
si200  0  55.88
sp200    -21   1
sc201   OUTER PLATE Source Radius
si201  55.88   55.98
```

```
sp201    -21   1
sc202   NOZZLE FILM Source Radius
si202  6.02   8.32
sp202    -21   1
sc203  END NOZZLE FILM Source Radius
si203  0  8.22
sp203    -21   1
sc204  PIPE CONE FILM Source Radius
si204  7  8.6025
sp204    -21   1
sc205  PIPE FILM Source Radius
si205  8.4137 8.5137
sp205    -21   1
sc206  SLANTED PIPE FILM Source Radius
si206  8.4136 8.5138
sp206    -21   1
sc207  SMALL PIPE FILM Source Radius
si207  5.715 5.815
sp207    -21   1
sc208  SMALL SLANTED PIPE FILM Source Radius
si208  5.714 5.816
sp208    -21   1
sc209  LARGE SLANTED PIPE END CAP FILM Source Radius
si209   12.2
sp209    -21   1
sc210  SMALL SLANTED PIPE END CAP FILM Source Radius
si210   8.4
sp210    -21   1
sc211  large open pipe film Source Radius
si211   18.95 19.05
sp211    -21   1
sc212  large open pipe film Source Radius
si212   20.32 20.42
sp212    -21   1
sc213  inlet film Source Radius
si213   13.235 13.335
sp213    -21   1
sc214  inlet film Source Radius
si214   14.605 14.705
sp214    -21   1
sc215  inlet film Source Radius
si215   14.705 36.83
sp215    -21   1
sc216  inlet film Source Radius
si216   36.83 36.93
sp216    -21   1
sc217  inlet film Source Radius
si217   4.545 36.83
sp217    -21   1
sc218  rod film Source Radius
si218   4.445 4.545
sp218    -21   1
sc219  inlet cavity film Source Radius
si219   26.8875 45.185
sp219    -21   1
sc220  inlet cavity film Source Radius
si220   26.8875 26.9875
sp220    -21   1
sc221  inlet cavity film Source Radius
si221   45.085 45.185
sp221    -21   1
sc222  pump film Source Radius
si222   28.8925 45.185
sp222    -21   1
sc223  pump film Source Radius
si223   28.8925 28.9925
sp223    -21   1
sc224  pump case film Source Radius
si224   28.9925 45.085
```

```
sp224    -21   1
sc225  pump case film Source Radius
si225   45.085  45.185
sp225    -21   1
sc226  pump case film Source Radius
si226   38.2  45.085
sp226    -21   1
sc227  pump case film Source Radius
si227   38.1  38.2
sp227    -21   1
sc228  pump case film Source Radius
si228   18.8  38.2
sp228    -21   1
sc229  flange film Source Radius
si229   20.42  39.37
sp229    -21   1
sc230  flange film Source Radius
si230    39.37 39.47
sp230    -21   1
sc231  pump bottom
si231   4.545  45.185
sp231    -21   1
c       EXTENT CARDS
sc30  Cone Extent
si30  -41.91  -13.2893
sp30   -21 0
sc31  Cone Extent
si31  13.2893 41.91
sp31   -21 0
sc32  Pipe Extent
si32  17.78 39.052
sp32   -21 0
sc33  Pipe Extent
si33  39.052 433.5
sp33   -21 0
sc34  Slant Pipe Extent
si34  -50.3403 -12.6835
sp34   -21 0
sc35  Slant Pipe Extent
si35  12.6853  50.3403
sp35   -21 0
sc36  Upper Pipe Extent
si36  462  565.785
sp36   -21 0
sc37  Small Pipe Extent
si37  565.785 630.5
sp37   -21 0
sc38  Upper Slant Pipe Extent
si38  20 90
sp38   -21 0
sc39  Upper Slant Pipe Extent
si39  28.89 50.5816
sp39   -21 0
sc40  Upper Pipe Extent
si40  633.5 652.145
sp40   -21 0
sc41  INLET UPPER RING Source Extent
si41  652.145 693.42
sp41   -21 0
sc42  INLET Source Extent
si42  606.425  621.03
sp42   -21 0
sc43  INLET LEG Source Extent
si43  598.805 652.145
sp43   -21 0
c     PLATE SOURCES
sc50  PLATE Source Extent
si50  -0.1 0
sp50   -21 0
```

```
sc51  PLATE Source Extent
si51  1.27 1.37
sp51   -21 0
sc52  PLATE Source Extent
si52  68.0037 68.1037
sp52   -21 0
sc53  PLATE Source Extent
si53  68.58 68.68
sp53   -21 0
sc54  PLATE Source Extent
si54  119.28 119.38
sp54   -21 0
sc55  PLATE Source Extent
si55  119.8562 119.9562
sp55   -21 0
sc56  PLATE Source Extent
si56  207.7037 207.8037
sp56   -21 0
sc57  PLATE Source Extent
si57  208.28 208.38
sp57   -21 0
sc58  PLATE Source Extent
si58  258.98 259.08
sp58   -21 0
sc59  PLATE Source Extent
si59  259.5562 259.6562
sp59   -21 0
sc60  PLATE Source Extent
si60  351.8487 351.9487
sp60   -21 0
sc61  PLATE Source Extent
si61  352.425 352.525
sp61   -21 0
sc62  PLATE Source Extent
si62  412.015 412.115
sp62   -21 0
sc63  PLATE Source Extent
si63  412.5912 412.6912
sp63   -21 0
sc64  PLATE Source Extent
si64  503.455 503.555
sp64   -21 0
sc65  PLATE Source Extent
si65  504.0312 504.1312
sp65   -21 0
sc66  PLATE Source Extent
si66  643.155 643.255
sp66   -21 0
sc67  PLATE Source Extent
si67  643.7312 643.8312
sp67   -21 0
sc68  PLATE Source Extent
si68  800.9525 801.0525
sp68   -21 0
sc69  PLATE Source Extent
si69  801.5287 801.6287
sp69   -21 0
sc70  PLATE Source Extent
si70  889.8525 889.9525
sp70   -21 0
sc71  PLATE Source Extent
si71  890.4356 890.5356
sp71   -21 0
c     PLATE OUTER SOURCES
sc72  OUTER PLATE Source Extent
si72  -0.1 1.37
sp72   -21 0
sc73  OUTER PLATE Source Extent
si73  68.0037  68.68
```

```
sp73   -21 0
sc74  OUTER PLATE Source Extent
si74  119.28  119.9562
sp74   -21 0
sc75  OUTER PLATE Source Extent
si75  207.7037  208.38
sp75   -21 0
sc76  OUTER PLATE Source Extent
si76  258.98  259.6562
sp76   -21 0
sc77  OUTER PLATE Source Extent
si77  351.8487  352.525
sp77   -21 0
sc78  OUTER PLATE Source Extent
si78  412.015  412.6912
sp78   -21 0
sc79  OUTER PLATE Source Extent
si79  503.455  504.1312
sp79   -21 0
sc80  OUTER PLATE Source Extent
si80  643.155  643.8312
sp80   -21 0
sc81  OUTER PLATE Source Extent
si81  800.9525  801.6287
sp81   -21 0
sc82  OUTER PLATE Source Extent
si82  889.8525  890.5356
sp82   -21 0
c     PIPE FILM SOURCES
sc83  THIN FILM Cone Extent
si83  -41.91  -12.0920
sp83   -21 0
sc84  THIN FILM Cone Extent
si84  12.0920  41.91
sp84   -21 0
sc85  THIN FILM END Cone Extent
si85  -12.192  -12.092
sp85   -21 0
sc86  THIN FILM END Cone Extent
si86  12.092  12.192
sp86   -21 0
sc87  LOWER SOURCE Pipe Extent
si87  39.052 259.08
sp87   -21 0
sc88  UPPER SOURCE Pipe Extent
si88  259.5562 433.5
sp88   -21 0
sc89  LOWER DUMMY Pipe Extent
si89  1.27 259.08
sp89   -21 0
sc90  SLANTED PIPE FILM Extent
si90   0 90
sp90   -21 0
sc91  Upper Pipe Extent
si91  462  569.595
sp91   -21 0
sc92  Slanted end cap  Extent
si92  -11.5887  -11.4887
sp92   -21 0
sc93  Slanted end cap  Extent
si93  11.4887 11.5887
sp93   -21 0
sc94  Slanted upper end cap  Extent
si94  -51.535 -51.435
sp94   -21 0
sc95  Slanted upper end cap  Extent
si95  51.435 51.535
sp95   -21 0
sc96  SMALL Slanted end cap  Extent
```

```
si96  -51.5604 -51.4604
sp96   -21 0
sc97  SMALL Slanted end cap  Extent
si97  51.4604 51.5604
sp97   -21 0
sc98  SMALL Slanted top top top end cap  Extent
si98  -28.034 -27.934
sp98   -21 0
sc99  SMALL Slanted top top top end cap  Extent
si99  27.934 28.034
sp99   -21 0
sc100 short pipe
si100 630 652.145
sp100  -21 0
sc101 large open pipe
si101 535.94 592.455
sp101  -21 0
sc102 INLET film
si102 596.265 606.425
sp102  -21 0
sc103 INLET film
si103 596.265 605.155
sp103  -21 0
sc104 INLET film
si104 605.055 605.155
sp104  -21 0
sc105 INLET film
si105 605.055 622.4
sp105  -21 0
sc106 INLET film
si106 622.3 622.4
sp106  -21 0
sc107 rod film
si107 622.3 652.145
sp107  -21 0
sc108 inlet cavity film
si108 597.435 597.535
sp108  -21 0
sc109 inlet cavity film
si109 597.535 652.145
sp109  -21 0
sc110 pump film
si110 652.145 694.69
sp110  -21 0
sc111 pump film
si111 694.69  694.79
sp111  -21 0
sc112 pump film
si112 694.79  715.645
sp112  -21 0
sc113 pump case film
si113 715.545  715.645
sp113  -21 0
sc114 pump case film
si114 715.545  718.6025
sp114  -21 0
sc115 pump case film
si115 718.5025  718.6025
sp115  -21 0
sc116 pump case film
si116 718.5025  782
sp116  -21 0
sc117 pump case film
si117 780.5  791.5275
sp117  -21 0
sc118 UPPER LARGE PIPE film
si118 791.5275  953.77
sp118  -21 0
sc119 flange film
```

```
si119 829.845  829.945
sp119  -21 0
sc120 flange film
si120 829.845  839.8875
sp120  -21 0
sc121 flange film
si121 839.7875  839.8875
sp121  -21 0
sc122 dummy cap
si122 569.595  569.695
sp122  -21 0
sc123 pump bottom
si123 652.045  652.145
sp123  -21 0
c      AXIS
sc11   X Axis
si11   l  1 0 0
sp11   1
sc12   Y Axis
si12   l  0 1 0
sp12   1
sc13   Z Axis
si13   l  0 0 1
sp13   1
sc14   Axis -X & Z
si14   l  -.7071068 0 .7071068
sp14   1
sc15   Axis X & Z
si15   l   .7071068 0 .7071068
sp15   1
sc16   Axis -Y & Z
si16   l  0 -.7071068  .7071068
sp16   1
sc17   Axis  Y & Z
si17   l  0  .7071068  .7071068
sp17   1
sc18   Axis -X & -Z
si18   l  -.7071068 0 -.7071068
sp18   1
sc19   Axis X & -Z
si19   l   .7071068 0 -.7071068
sp19   1
c      X EXTENT
sc300  lower fin
si300  -39  -28.4
sp300  0  1
sc301  lower fin
si301   28.4   39
sp301  0  1
sc302  lower fin
si302  -.735 .735
sp302  0  1
sc303  upper fin
si303  -50.1062  -28.4
sp303  0  1
sc304  upper fin
si304   28.4   50.1062
sp304  0  1
sc305  pump fin
si305  -49.63  -20
sp305  0  1
sc306  pump fin
si306  20  49.63
sp306  0  1
sc307  pump side
si307  -16.61  -16.51
sp307  0  1
sc308  pump side
si308  16.51  16.61
```

```
sp308  0  1
c      Y EXTENT
sc400  lower fin
si400  -92.235 -90.765
sp400  0  1
sc401  lower fin
si401  -130.5  -119.9
sp401  0  1
sc402  lower fin
si402   -63.1  -52.5
sp402  0  1
sc403  upper fin
si403  -141.6062  -119.9
sp403  0  1
sc404  upper fin
si404  -63.1  -41.3938
sp404  0  1
sc405  pump fin
si405  -141.13  -111.5
sp405  0  1
sc406  pump fin
si406  -71.5  -41.87
sp406  0  1
sc407  pump side
si407  -133.5 -49.5
sp407  0  1
c      Z EXTENT
sc500  lower fin
si500  132.07   178.07
sp500  0  1
sc501  mid fin
si501  272.2  317.67
sp501  0  1
sc502  upper fin
si502  415.97   470.77
sp502  0  1
sc503  pump fin
si503  831.57   950.07
sp503  0  1
sc504  pump side
si504  658.605   713.215
sp504  0  1
```

APPENDIX C
MCNP Film Source Description (from file idfilm_0)

```
c     82.43*1.446E+07*1000 =1.1919E+12
c  FILM SOURCE
sdef    cel d1 erg d2 pos fcel d3 rad fcel d4 ext fcel d5 axs fcel d6
        x fcel d7 y fcel d8 z fcel d9
        wgt = 1.1919e+12  eff .001
#        si2    sp2
          l      d
          0        0
         1.500E-02   2.699E+05
         2.500E-02   4.147E+04
         3.750E-02   8.726E+05
         5.750E-02   4.447E+04
         8.500E-02   2.107E+04
         1.250E-01   6.175E+04
         2.250E-01   2.458E+04
         3.750E-01   7.830E+03
         6.620E-01   1.296E+07
         8.500E-01   5.944E+04
         1.250E+00   9.904E+04
         1.750E+00   1.987E+03
         2.250E+00   1.927E-01
         2.750E+00   6.331E-04
         3.500E+00   6.718E-05
         5.000E+00   2.851E-05
         7.000E+00   3.260E-06
         1.100E+01   3.727E-07
c          TOTAL     1.446E+07
#        si1    sp1
          l      d
c     c     CELL SOURCES
c            68 3086.20
c            65 3086.20
c            67 2387.00
c            63 2369.00
c            11 65740.00
c            2 65280.00
c            9 8959.00
c            3 8957.00
c            10 16360.00
c            1 16440.00
c            15 4488.00
c            7 4526.00
c            104 1541.00
c            101 1550.00
c            269 1712.00
c            267 1715.00
c            94 140688.00
c            88 57723.60
c            81 42870.00
c          UPPER/LOWER PLATE SOURCES
       193 980.99
       194 936.50
       212 889.70
       211 889.70
       215 889.70
       214 889.70
       217 889.70
       218 889.70
       220 889.70
       221 889.70
       223 889.70
       224 889.70
       226 889.70
       227 889.70
```

```
      265 890.00
      264 890.00
      297 806.70
      290 805.50
      321 834.90
      320 834.90
      311 849.99
      310 849.99
c         OUTER PLATE SOURCES
      195 0
      210 0
      213 0
      216 0
      219 0
      222 0
      225 0
      247 0
      289 0
      322 0
      312 0
c         PIPE SURFACE SOURCES
      199 80.07
      196 79.64
      201 21.14
      197 21.14
      200 82.22
      198 81.68
      202 1114.00
      203 1165.00
      206 858.90
      207 897.40
      204 1373.00
      205 1331.00
      208 901.30
      209 874.70
      252 222.40
      248 222.40
      260 223.40
      256 222.40
      255 520.80
      251 528.30
      263 547.90
      259 538.80
      272 217.60
      271 219.70
      277 61.79
      273 63.19
      253 31.44
      249 33.09
      262 30.81
      257 30.87
      254 32.03
      250 31.84
      261 30.53
      258 31.45
      278 15.16
      274 14.95
      279 9.33
      275 8.82
      281 41.29
      276 41.44
      288 674.68
      287 723.33
      285 84.81
      284 81.86
      286 290.00
      282 283.50
      283 351.50
      280 82.95
```

```
      296 126.80
      295 255.40
      292 377.60
      291 1206.54
      303 379.16
      302 379.25
      304 374.51
      305 86.71
      306 180.14
      307 1480.00
      308 319.20
      309 1888.00
      314 346.10
      315 248.00
      313 346.10
      342 22.77
      343 22.77
      344 461.62
c         FIN SURFACE SOURCES
      228 81.84
      231 81.84
      232 78.54
      233 77.27
      237 79.92
      236 81.84
      239 78.54
      238 77.27
      244 148.70
      242 153.40
      243 146.80
      246 145.70
      319 546.50
      318 561.90
      317 544.70
      316 543.50
      293 181.20
      294 180.30
sc3   POSITION
c     ds3  l  0  -121.92  78.85            $68
c             0  -121.92  78.85            $65
c             -20.0025  -121.92  61.07     $67
c              20.0025  -121.92  61.07     $63
c             -20.0025  -121.92  61.07     $11
c              20.0025  -121.92  61.07     $2
c              0  -121.92  477.397          $9
c              0  -121.92  477.397          $3
c             -43.0212  -121.92  61.07     $10
c              43.0212  -121.92  61.07     $1
c             -45.7200  -121.92  61.07     $15
c              45.7200  -121.92  61.07     $7
c              0  -121.92  739.25           $104
c              0  -121.92  739.25           $101
c             -36.2458  -121.92  61.07     $269
c              36.2458  -121.92  61.07     $267
c              0  -121.92  61.07            $94
c              0  -121.92  61.07            $88
c              0  -121.92  61.07            $81
c     UPPER/LOWER PLATE SOURCES
ds3  l   0  -121.92  61.07          $193
         0  -121.92  61.07          $194
         0  -121.92  61.07          $212
         0  -121.92  61.07          $211
         0  -121.92  61.07          $215
         0  -121.92  61.07          $214
         0  -121.92  61.07          $217
         0  -121.92  61.07          $218
         0  -121.92  61.07          $220
         0  -121.92  61.07          $221
         0  -121.92  61.07          $223
```

```
        0  -121.92  61.07            $224
        0  -121.92  61.07            $226
        0  -121.92  61.07            $227
        0  -121.92  61.07            $265
        0  -121.92  61.07            $264
        0  -121.92  61.07            $297
        0  -121.92  61.07            $290
        0  -121.92  61.07            $321
        0  -121.92  61.07            $320
        0  -121.92  61.07            $311
        0  -121.92  61.07            $310
c     OUTER PLATE SOURCES
        0  -121.92  61.07            $195
        0  -121.92  61.07            $210
        0  -121.92  61.07            $213
        0  -121.92  61.07            $216
        0  -121.92  61.07            $219
        0  -121.92  61.07            $222
        0  -121.92  61.07            $225
        0  -121.92  61.07            $247
        0  -121.92  61.07            $289
        0  -121.92  61.07            $322
        0  -121.92  61.07            $312
c     PIPE SURFACE SOURCES
        0  -121.92  78.85            $199
        0  -121.92  78.85            $196
        0  -121.92  78.85            $201
        0  -121.92  78.85            $197
       -20.0025  -121.92  61.07      $200
        20.0025  -121.92  61.07      $198
       -20.0025  -121.92  61.07      $202
        20.0025  -121.92  61.07      $203
       -20.0025  -121.92  61.07      $206
        20.0025  -121.92  61.07      $207
        0  -141.9225   61.07      $204
        0   -101.9175  61.07      $205
        0  -141.9225   61.07      $208
        0   -101.9175  61.07      $209
        0  -121.92  477.397            $252
        0  -121.92  477.397            $248
        0  -121.92  477.397            $260
        0  -121.92  477.397            $256
       -43.0212  -121.92  61.07      $255 left source leg
        43.0212  -121.92  61.07      $251 right source leg
        0 -164.9412  61.07      $263 left dummy leg
        0  -78.8988  61.07      $259 right dummy leg
       -45.7200  -121.92  61.07      $272 left small leg
        45.7200  -121.92  61.07      $271 right small leg
        0  -121.92  739.25            $277 small slanted pipe
        0  -121.92  739.25            $273 small slanted pipe
        0  -121.92  488.87            $253 slanted end cap
        0  -121.92  488.87            $249 slanted end cap
        0  -121.92  488.87            $262 slanted end cap
        0  -121.92  488.87            $257 slanted end cap
        0  -121.92  528.87            $254 slanted top end cap
        0  -121.92  528.87            $250 slanted top end cap
        0  -121.92  528.87            $261 slanted top end cap
        0  -121.92  528.87            $258 slanted top end cap
        0  -121.92  687.72            $278 small slanted end cap
        0  -121.92  687.72            $274 small slanted end cap
        0  -121.92  711.27            $279 small slanted top end cap
        0  -121.92  711.27            $275 small slanted top end cap
       -36.2458  -121.92  61.07      $281 Short pipe
        36.2458  -121.92  61.07      $276 Short pipe
        0  -121.92  61.07            $288 Large open pipe
        0  -121.92  61.07            $287 Large open pipe
        0  -121.92  61.07            $285 INLET
        0  -121.92  61.07            $284 INLET
        0  -121.92  61.07            $286 INLET
```

```
        0  -121.92  61.07            $282 INLET
        0  -121.92  61.07            $283 INLET
        0  -121.92  61.07            $280 ROD
        0  -121.92  61.07            $296 Inlet cavity film
        0  -121.92  61.07            $295 inner Inlet cavity film
        0  -121.92  61.07            $292 inner Inlet cavity film
        0  -121.92  61.07            $291 pump film
        0  -121.92  61.07            $303 pump film
        0  -121.92  61.07            $302 pump film
        0  -121.92  61.07            $304 pump case film
        0  -121.92  61.07            $305 pump case film
        0  -121.92  61.07            $306 pump case film
        0  -121.92  61.07            $307 pump case film
        0  -121.92  61.07            $308 cone pump case film
        0  -121.92  61.07            $309 UPPER LARGE PIPE film
        0  -121.92  61.07            $314 flange film
        0  -121.92  61.07            $315 flange film
        0  -121.92  61.07            $313 flange film
        0 -164.9412  61.07      $342 left dummy leg cap
        0  -78.8988  61.07      $343 right dummy leg cap
        0  -121.92  61.07            $344 below pump
c       FIN SURFACE SOURCES
        0  0  0                $228 lower fin
        0  0  0                $231 lower fin
        0  0  0                $232 lower fin
        0  0  0                $233 lower fin
        0  0  0                $237 mid fin
        0  0  0                $236 mid fin
        0  0  0                $239 mid fin
        0  0  0                $238 mid fin
        0  0  0                $244 upper fin
        0  0  0                $242 upper fin
        0  0  0                $243 upper fin
        0  0  0                $246 upper fin
        0  0  0                $319 pump fin
        0  0  0                $318 pump fin
        0  0  0                $317 pump fin
        0  0  0                $316 pump fin
        0  0  0                $293 pump side
        0  0  0                $294 pump side
sc4     RADIUS****************************************
c     c       68 65 67 63 11  2  9  3 10  1
c     ds4   s 20 20 21 21 21 21 22 22 21 21
c     c       15  7 104 101 269  267 94  88  81
c             23 23  24  24  21  21  25  26  25
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds4   s 200 200 200 200 200 200 200 200 200 200
c       223 224 226 227 265 264 297 290 321 320
        200 200 200 200 200 200 200 200 200 200
c       311 310
        200 200
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
        201 201 201 201 201 201 201 201 201 201 201
c       PIPE SURFACE SOURCES
c       199 196 210 197 200 198 202 203 206 207
        202 202 203 203 204 204 205 205 205 205
c       204 205 208 209 252 248 260 256 255 251
        205 205 205 205 206 206 206 206 205 205
c       263 259 272 271 277 273 253 249 262 257
        205 205 207 207 208 208 209 209 209 209
c       254 250 261 258 278 274 279 275 281 276
        209 209 209 209 210 210 210 210 205 205
c       288 287 285 284 286 282 283 280 296 295
        211 212 213 214 215 216 217 218 219 220
c       292 291 303 302 304 305 306 307 308 309
        221 221 222 223 224 225 226 227 228 212
c       314 315 313 342 343 344
```

```
        229 230 229 205 205 231
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
          0   0   0   0   0   0   0   0   0   0
c       243 246 319 318 317 316 293 294
          0   0   0   0   0   0   0   0
sc5     EXTENT*************************************
c       68 65 67 63 11  2  9  3 10  1
c     ds5   s 30 31 32 32 33 33 90 90 36 36
c     c       15  7 104 101 269  267 94  88  81
c             37 37  38  38  40  40  41  42  43
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds5   s  50  51  52  53  54  55  56  57  58  59
c       223 224 226 227 265 264 297 290 321 320
         60  61  62  63  64  65  66  67  68  69
c       311 310
         70  71
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
         72  73  74  75  76  77  78  79  80  81  82
c     PIPE SURFACE SOURCES
c       199 196 201 197 200 198 202 203 206 207
         83  84  85  86  32  32  87  87  88  88
c       204 205 208 209 252 248 260 256 255 251
         89  89  88  88  90  90  90  90  36  36
c       263 259 272 271 277 273 253 249 262 257
         91  91  37  37  38  38  92  93  92  93
c       254 250 261 258 278 274 279 275 281 276
         94  95  94  95  96  97  98  99 100 100
c       288 287 285 284 286 282 283 280 296 295
        101 101 102 103 104 105 106 107 108 109
c       292 291 303 302 304 305 306 307 308 309
        109 110 111 112 113 114 115 116 117 118
c       314 315 313 342 343 344
        119 120 121 122 122 123
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
          0   0   0   0   0   0   0   0   0   0
c       243 246 319 318 317 316 293 294
          0   0   0   0   0   0   0   0
sc6     AXIS***************************************
c     c       68 65 67 63 11  2  9  3 10  1
c     ds6   s 11 11 13 13 13 13 14 15 13 13
c     c       15  7 104 101 269  267 94  88  81
c             13 13  18  19  13  13  13  13  13
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds6   s  13  13  13  13  13  13  13  13  13  13
c       223 224 226 227 265 264 297 290 321 320
         13  13  13  13  13  13  13  13  13  13
c       311 310
         13  13
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
         13  13  13  13  13  13  13  13  13  13  13
c     PIPE SURFACE SOURCES
c       199 196 201 197 200 198 202 203 206 207
         11  11  11  11  13  13  13  13  13  13
c       204 205 208 209 252 248 260 256 255 251
         13  13  13  13  14  15  16  17  13  13
c       263 259 272 271 277 273 253 249 262 257
         13  13  13  13  18  19  11  11  12  12
c       254 250 261 258 278 274 279 275 281 276
         11  11  12  12  11  11  11  11  13  13
c       288 287 285 284 286 282 283 280 296 295
         13  13  13  13  13  13  13  13  13  13
c       292 291 303 302 304 305 306 307 308 309
         13  13  13  13  13  13  13  13  13  13
```

```
c       314 315 313 342 343 344
         13  13  13  13  13  13
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
          0   0   0   0   0   0   0   0   0   0
c       243 246 319 318 317 316 293 294
          0   0   0   0   0   0   0   0
sc7     X*************************************
c     c        68  65  67  63  11   2   9   3  10   1
c     ds7   s   0   0   0   0   0   0   0   0   0   0
c     c        15   7 104 101 269 267  94  88  81
c               0   0   0   0   0   0   0   0   0
c     c       UPPER/LOWER PLATE SOURCES
c     c       193 194 212 211 215 214 217 218 220 221
ds7   s   0   0   0   0   0   0   0   0   0   0
c       223 224 226 227 265 264 297 290 321 320
          0   0   0   0   0   0   0   0   0   0
c       311 310
          0   0
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
          0   0   0   0   0   0   0   0   0   0   0
c     PIPE SURFACE SOURCES
c       199 196 201 197 200 198 202 203 206 207
          0   0   0   0   0   0   0   0   0   0
c       204 205 208 209 252 248 260 256 255 251
          0   0   0   0   0   0   0   0   0   0
c       263 259 272 271 277 273 253 249 262 257
          0   0   0   0   0   0   0   0   0   0
c       254 250 261 258 278 274 279 275 281 276
          0   0   0   0   0   0   0   0   0   0
c       288 287 285 284 286 282 283 280 296 295
          0   0   0   0   0   0   0   0   0   0
c       292 291 303 302 304 305 306 307  75 309
          0   0   0   0   0   0   0   0   0   0
c       314 315 313 342 343 344
          0   0   0   0   0   0
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
        300 301 302 302 300 301 302 302 303 304
c       243 246 319 318 317 316 293 294
        302 302 305 306 302 302 307 308
sc8     Y*************************************
c     c        68  65  67  63  11   2   9   3  10   1
c     ds8   s   0   0   0   0   0   0   0   0   0   0
c     c        15   7 104 101 269 267  94  88  81
c               0   0   0   0   0   0   0   0   0
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds8   s   0   0   0   0   0   0   0   0   0   0
c       223 224 226 227 265 264 297 290 321 320
          0   0   0   0   0   0   0   0   0   0
c       311 310
          0   0
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
          0   0   0   0   0   0   0   0   0   0   0
c     PIPE SURFACE SOURCES
c       199 196 201 197 200 198 202 203 206 207
          0   0   0   0   0   0   0   0   0   0
c       204 205 208 209 252 248 260 256 255 251
          0   0   0   0   0   0   0   0   0   0
c       263 259 272 271 277 273 253 249 262 257
          0   0   0   0   0   0   0   0   0   0
c       254 250 261 258 278 274 279 275 281 276
          0   0   0   0   0   0   0   0   0   0
c       288 287 285 284 286 282 283 280 296 295
          0   0   0   0   0   0   0   0   0   0
c       292 291 303 302 304 305 306 307  75 309
```

```
          0   0   0   0   0   0   0   0   0   0
c       314 315 313 342 343 344
          0   0   0   0   0   0
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
        400 400 401 402 400 400 401 402 400 400
c       243 246 319 318 317 316 293 294
        403 404 400 400 405 406 407 407
sc9     Z*************************************
c     c        68  65  67  63  11   2   9   3  10   1
c     ds9   s   0   0   0   0   0   0   0   0   0   0
c     c        15   7 104 101 269 267  94  88  81
c               0   0   0   0   0   0   0   0   0
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds9   s   0   0   0   0   0   0   0   0   0   0
c       223 224 226 227 265 264 297 290 321 320
          0   0   0   0   0   0   0   0   0   0
c       311 310
          0   0
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
          0   0   0   0   0   0   0   0   0   0   0
c     PIPE SURFACE SOURCES
c       199 196 201 197 200 198 202 203 206 207
          0   0   0   0   0   0   0   0   0   0
c       204 205 208 209 252 248 260 256 255 251
          0   0   0   0   0   0   0   0   0   0
c       263 259 272 271 277 273 253 249 262 257
          0   0   0   0   0   0   0   0   0   0
c       254 250 261 258 278 274 279 275 281 276
          0   0   0   0   0   0   0   0   0   0
c       288 287 285 284 286 282 283 280 296 295
          0   0   0   0   0   0   0   0   0   0
c       292 291 303 302 304 305 306 307  75 309
          0   0   0   0   0   0   0   0   0   0
c       314 315 313 342 343 344
          0   0   0   0   0   0
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
        500 500 500 500 501 501 501 501 502 502
c       243 246 319 318 317 316 293 294
        502 502 503 503 503 503 504 504
sc20   Cone Radius
si20  0  7
sp20    -21   1
sc21   Pipe Radius
si21  0  7.3165
sp21    -21   1
sc22   Slant Pipe Radius
si22  0  7.317
sp22    -21   1
sc23   Small Pipe Radius
si23  0  4.859
sp23    -21   1
sc24   Upper Slant Pipe Radius
si24  0  4.86
sp24    -21   1
sc25   INLET LEG Source Radius
si25  28.8925  43.815
sp25    -21   1
sc26   INLET Source Radius
si26  0  35.56
sp26    -21   1
sc200   PLATE Source Radius
si200  0  55.88
sp200    -21   1
sc201   OUTER PLATE Source Radius
si201  55.88  55.98
```

```
sp201    -21   1
sc202   NOZZLE FILM Source Radius
si202  6.02   8.32
sp202    -21   1
sc203  END NOZZLE FILM Source Radius
si203  0  8.22
sp203    -21   1
sc204  PIPE CONE FILM Source Radius
si204  7  8.6025
sp204    -21   1
sc205  PIPE FILM Source Radius
si205  8.4137 8.5137
sp205    -21   1
sc206  SLANTED PIPE FILM Source Radius
si206  8.4136 8.5138
sp206    -21   1
sc207  SMALL PIPE FILM Source Radius
si207  5.715 5.815
sp207    -21   1
sc208  SMALL SLANTED PIPE FILM Source Radius
si208  5.714 5.816
sp208    -21   1
sc209  LARGE SLANTED PIPE END CAP FILM Source Radius
si209   12.2
sp209    -21   1
sc210  SMALL SLANTED PIPE END CAP FILM Source Radius
si210   8.4
sp210    -21   1
sc211  large open pipe film Source Radius
si211   18.95 19.05
sp211    -21   1
sc212  large open pipe film Source Radius
si212   20.32 20.42
sp212    -21   1
sc213  inlet film Source Radius
si213   13.235 13.335
sp213    -21   1
sc214  inlet film Source Radius
si214   14.605 14.705
sp214    -21   1
sc215  inlet film Source Radius
si215   14.705 36.83
sp215    -21   1
sc216  inlet film Source Radius
si216   36.83 36.93
sp216    -21   1
sc217  inlet film Source Radius
si217   4.545 36.83
sp217    -21   1
sc218  rod film Source Radius
si218   4.445 4.545
sp218    -21   1
sc219  inlet cavity film Source Radius
si219   26.8875 45.185
sp219    -21   1
sc220  inlet cavity film Source Radius
si220   26.8875 26.9875
sp220    -21   1
sc221  inlet cavity film Source Radius
si221   45.085 45.185
sp221    -21   1
sc222  pump film Source Radius
si222   28.8925 45.185
sp222    -21   1
sc223  pump film Source Radius
si223   28.8925 28.9925
sp223    -21   1
sc224  pump case film Source Radius
si224   28.9925 45.085
```

```
sp224    -21   1
sc225  pump case film Source Radius
si225   45.085  45.185
sp225    -21   1
sc226  pump case film Source Radius
si226   38.2  45.085
sp226    -21   1
sc227  pump case film Source Radius
si227   38.1  38.2
sp227    -21   1
sc228  pump case film Source Radius
si228   18.8  38.2
sp228    -21   1
sc229  flange film Source Radius
si229   20.42  39.37
sp229    -21   1
sc230  flange film Source Radius
si230    39.37 39.47
sp230    -21   1
sc231  pump bottom
si231   4.545  45.185
sp231    -21   1
c       EXTENT CARDS
sc30  Cone Extent
si30  -41.91  -13.2893
sp30   -21 0
sc31  Cone Extent
si31  13.2893 41.91
sp31   -21 0
sc32  Pipe Extent
si32  17.78 39.052
sp32   -21 0
sc33  Pipe Extent
si33  39.052 433.5
sp33   -21 0
sc34  Slant Pipe Extent
si34  -50.3403 -12.6835
sp34   -21 0
sc35  Slant Pipe Extent
si35  12.6853  50.3403
sp35   -21 0
sc36  Upper Pipe Extent
si36  462  565.785
sp36   -21 0
sc37  Small Pipe Extent
si37  565.785 630.5
sp37   -21 0
sc38  Upper Slant Pipe Extent
si38  20 90
sp38   -21 0
sc39  Upper Slant Pipe Extent
si39  28.89 50.5816
sp39   -21 0
sc40  Upper Pipe Extent
si40  633.5 652.145
sp40   -21 0
sc41  INLET UPPER RING Source Extent
si41  652.145 693.42
sp41   -21 0
sc42  INLET Source Extent
si42  606.425  621.03
sp42   -21 0
sc43  INLET LEG Source Extent
si43  598.805 652.145
sp43   -21 0
c     PLATE SOURCES
sc50  PLATE Source Extent
si50  -0.1 0
sp50  -21 0
```

```
sc51  PLATE Source Extent
si51  1.27 1.37
sp51   -21 0
sc52  PLATE Source Extent
si52  68.0037 68.1037
sp52   -21 0
sc53  PLATE Source Extent
si53  68.58 68.68
sp53   -21 0
sc54  PLATE Source Extent
si54  119.28 119.38
sp54   -21 0
sc55  PLATE Source Extent
si55  119.8562 119.9562
sp55   -21 0
sc56  PLATE Source Extent
si56  207.7037 207.8037
sp56   -21 0
sc57  PLATE Source Extent
si57  208.28 208.38
sp57   -21 0
sc58  PLATE Source Extent
si58  258.98 259.08
sp58   -21 0
sc59  PLATE Source Extent
si59  259.5562 259.6562
sp59   -21 0
sc60  PLATE Source Extent
si60  351.8487 351.9487
sp60   -21 0
sc61  PLATE Source Extent
si61  352.425 352.525
sp61   -21 0
sc62  PLATE Source Extent
si62  412.015 412.115
sp62   -21 0
sc63  PLATE Source Extent
si63  412.5912 412.6912
sp63   -21 0
sc64  PLATE Source Extent
si64  503.455 503.555
sp64   -21 0
sc65  PLATE Source Extent
si65  504.0312 504.1312
sp65   -21 0
sc66  PLATE Source Extent
si66  643.155 643.255
sp66   -21 0
sc67  PLATE Source Extent
si67  643.7312 643.8312
sp67   -21 0
sc68  PLATE Source Extent
si68  800.9525 801.0525
sp68   -21 0
sc69  PLATE Source Extent
si69  801.5287 801.6287
sp69   -21 0
sc70  PLATE Source Extent
si70  889.8525 889.9525
sp70   -21 0
sc71  PLATE Source Extent
si71  890.4356 890.5356
sp71   -21 0
c     PLATE OUTER SOURCES
sc72  OUTER PLATE Source Extent
si72  -0.1 1.37
sp72   -21 0
sc73  OUTER PLATE Source Extent
si73  68.0037  68.68
```

```
sp73   -21 0
sc74  OUTER PLATE Source Extent
si74  119.28  119.9562
sp74   -21 0
sc75  OUTER PLATE Source Extent
si75  207.7037  208.38
sp75   -21 0
sc76  OUTER PLATE Source Extent
si76  258.98  259.6562
sp76   -21 0
sc77  OUTER PLATE Source Extent
si77  351.8487  352.525
sp77   -21 0
sc78  OUTER PLATE Source Extent
si78  412.015  412.6912
sp78   -21 0
sc79  OUTER PLATE Source Extent
si79  503.455  504.1312
sp79   -21 0
sc80  OUTER PLATE Source Extent
si80  643.155  643.8312
sp80   -21 0
sc81  OUTER PLATE Source Extent
si81  800.9525  801.6287
sp81   -21 0
sc82  OUTER PLATE Source Extent
si82  889.8525  890.5356
sp82   -21 0
c     PIPE FILM SOURCES
sc83  THIN FILM Cone Extent
si83  -41.91  -12.0920
sp83   -21 0
sc84  THIN FILM Cone Extent
si84  12.0920  41.91
sp84   -21 0
sc85  THIN FILM END Cone Extent
si85  -12.192  -12.092
sp85   -21 0
sc86  THIN FILM END Cone Extent
si86  12.092  12.192
sp86   -21 0
sc87  LOWER SOURCE Pipe Extent
si87  39.052 259.08
sp87   -21 0
sc88  UPPER SOURCE Pipe Extent
si88  259.5562 433.5
sp88   -21 0
sc89  LOWER DUMMY Pipe Extent
si89  1.27 259.08
sp89   -21 0
sc90  SLANTED PIPE FILM Extent
si90   0 90
sp90   -21 0
sc91  Upper Pipe Extent
si91  462  569.595
sp91   -21 0
sc92  Slanted end cap  Extent
si92  -11.5887  -11.4887
sp92   -21 0
sc93  Slanted end cap  Extent
si93  11.4887 11.5887
sp93   -21 0
sc94  Slanted upper end cap  Extent
si94  -51.535 -51.435
sp94   -21 0
sc95  Slanted upper end cap  Extent
si95  51.435 51.535
sp95   -21 0
sc96  SMALL Slanted end cap  Extent
```

```
si96  -51.5604 -51.4604
sp96   -21 0
sc97  SMALL Slanted end cap  Extent
si97  51.4604 51.5604
sp97   -21 0
sc98  SMALL Slanted top top top end cap  Extent
si98  -28.034 -27.934
sp98   -21 0
sc99  SMALL Slanted top top top end cap  Extent
si99  27.934 28.034
sp99   -21 0
sc100 short pipe
si100 630 652.145
sp100  -21 0
sc101 large open pipe
si101 535.94 592.455
sp101  -21 0
sc102 INLET film
si102 596.265 606.425
sp102  -21 0
sc103 INLET film
si103 596.265 605.155
sp103  -21 0
sc104 INLET film
si104 605.055 605.155
sp104  -21 0
sc105 INLET film
si105 605.055 622.4
sp105  -21 0
sc106 INLET film
si106 622.3 622.4
sp106  -21 0
sc107 rod film
si107 622.3 652.145
sp107  -21 0
sc108 inlet cavity film
si108 597.435 597.535
sp108  -21 0
sc109 inlet cavity film
si109 597.535 652.145
sp109  -21 0
sc110 pump film
si110 652.145 694.69
sp110  -21 0
sc111 pump film
si111 694.69  694.79
sp111  -21 0
sc112 pump film
si112 694.79  715.645
sp112  -21 0
sc113 pump case film
si113 715.545  715.645
sp113  -21 0
sc114 pump case film
si114 715.545  718.6025
sp114  -21 0
sc115 pump case film
si115 718.5025  718.6025
sp115  -21 0
sc116 pump case film
si116 718.5025  782
sp116  -21 0
sc117 pump case film
si117 780.5  791.5275
sp117  -21 0
sc118 UPPER LARGE PIPE film
si118 791.5275  953.77
sp118  -21 0
sc119 flange film
```

```
si119 829.845  829.945
sp119  -21 0
sc120 flange film
si120 829.845  839.8875
sp120  -21 0
sc121 flange film
si121 839.7875  839.8875
sp121  -21 0
sc122 dummy cap
si122 569.595  569.695
sp122  -21 0
sc123 pump bottom
si123 652.045  652.145
sp123  -21 0
c      AXIS
sc11   X Axis
si11   l  1 0 0
sp11   1
sc12   Y Axis
si12   l  0 1 0
sp12   1
sc13   Z Axis
si13   l  0 0 1
sp13   1
sc14   Axis -X & Z
si14   l  -.7071068 0 .7071068
sp14   1
sc15   Axis X & Z
si15   l   .7071068 0 .7071068
sp15   1
sc16   Axis -Y & Z
si16   l  0 -.7071068  .7071068
sp16   1
sc17   Axis  Y & Z
si17   l  0  .7071068  .7071068
sp17   1
sc18   Axis -X & -Z
si18   l  -.7071068 0 -.7071068
sp18   1
sc19   Axis X & -Z
si19   l   .7071068 0 -.7071068
sp19   1
c      X EXTENT
sc300  lower fin
si300  -39  -28.4
sp300  0  1
sc301  lower fin
si301  28.4   39
sp301  0  1
sc302  lower fin
si302  -.735 .735
sp302  0  1
sc303  upper fin
si303  -50.1062  -28.4
sp303  0  1
sc304  upper fin
si304   28.4   50.1062
sp304  0  1
sc305  pump fin
si305  -49.63  -20
sp305  0  1
sc306  pump fin
si306  20  49.63
sp306  0  1
sc307  pump side
si307  -16.61  -16.51
sp307  0  1
sc308  pump side
si308  16.51  16.61
```

```
sp308  0  1
c      Y EXTENT
sc400  lower fin
si400  -122.655 -121.185
sp400  0  1
sc401  lower fin
si401  -160.92  -150.32
sp401  0  1
sc402  lower fin
si402   -93.52  -82.92
sp402  0  1
sc403  upper fin
si403  -172.0262  -150.32
sp403  0  1
sc404  upper fin
si404  -93.52  -71.8138
sp404  0  1
sc405  pump fin
si405  -171.55  -141.92
sp405  0  1
sc406  pump fin
si406  -101.92  -72.29
sp406  0  1
sc407  pump side
si407  -163.92 -79.92
sp407  0  1
c      Z EXTENT
sc500  lower fin
si500  132.07   178.07
sp500  0  1
sc501  mid fin
si501  272.2  317.67
sp501  0  1
sc502  upper fin
si502  415.97    470.77
sp502  0  1
sc503  pump fin
si503  831.57   950.07
sp503  0  1
sc504  pump side
si504  658.605   713.215
sp504  0  1
```

APPENDIX D
MCNP Simulated Source Description (from file idfake_0)

```
c  SIMULATED SOURCE
sdef    erg d2  pos 0 -121.92 1358.06  rad d4 ext  d5 axs  0 0 1
        wgt = 2.0E+10
#        si2    sp2
          l      d
          0        0
         1.500E-02   2.699E+05
         2.500E-02   4.147E+04
         3.750E-02   8.726E+05
         5.750E-02   4.447E+04
         8.500E-02   2.107E+04
         1.250E-01   6.175E+04
         2.250E-01   2.458E+04
         3.750E-01   7.830E+03
         6.620E-01   1.296E+07
         8.500E-01   5.944E+04
         1.250E+00   9.904E+04
         1.750E+00   1.987E+03
         2.250E+00   1.927E-01
         2.750E+00   6.331E-04
         3.500E+00   6.718E-05
         5.000E+00   2.851E-05
         7.000E+00   3.260E-06
         1.100E+01   3.727E-07
c          TOTAL     1.446E+07
sc4  Radius
si4   0 53
sp4   -21  1
sc5  Extent
si5   -337.35 211.29
sp5   -21  0
```

APPENDIX E
MCNP Input for the Internal Source Shipping Container Calculation (file icpdc)

```
PDC src PUMP model
  1    1  -1.7400  -9 7 -5 -14                                          u=1
  3    1  -1.7400  -7 11 -10                                            u=1
  4    3  -7.8600  (((-12 13 -8 )(9 :5 ))(-9 :3 ))(7 :10 :-11 )         u=1
  5    3  -7.8600  (-6 -9 8 -14 )(9 :5 )                                u=1
  2    1  -1.7400  9 -3 7 1                                             u=1
  6    3  -7.8600  (9 8 -4 1 )(3 )                                      u=1
  7    1  -1.7400  -204 202 -15 14                                      u=1
  8    3  -7.8600  -204 203 15 -16 14                                   u=1
  9    1  -1.7400  -21 24 -23                                           u=1
 10    1  -1.7400  25 21 -19 -14                                        u=1
 11    1  -1.7400  -25 21 -18 1                                         u=1
 12    3  -7.8600  (((-22 27 -26 )(21 :-24 :23 ))(-25 :19 ))(25 :18 )   u=1
 13    3  -7.8600  (-25 22 -17 1 )(18 )                                 u=1
 14    3  -7.8600  (25 22 -20 -14 )(19 )                                u=1
 15    1  -1.7400  211 209 -28 14                                       u=1
 16    3  -7.8600  -29 28 211 210 14                                    u=1
 17    0  -30 38 -37                                                    u=1
 18    3  -7.8600  (((39 -40 -31 )(30 :37 :-38 ))(34 :36 ))(-36 :32 )   u=1
 19    3  -7.8600  41 -42 -33                                           u=1
 20    0  36 30 -32 42                                                  u=1
 21    3  -7.8600  (36 31 -33 42 )(32 )                                 u=1
 22    3  -7.8600  44 -43 -35                                           u=1
 23    3  -7.8600  (-36 31 -35 -44 )(34 )                               u=1
 24    0  -36 30 -34 -44                                                u=1
 25    0  -49 53 -52                                                    u=1
 26    3  -7.8600  (((-50 -55 54 )(-53 :49 :52 ))(-51 :47 ))(51 :45 )   u=1
 27    3  -7.8600  44 -43 -48                                           u=1
 28    0  -44 51 49 -47                                                 u=1
 29    3  -7.8600  (51 50 -48 -44 )(47 )                                u=1
 30    0  -51 49 -45 42                                                 u=1
 31    3  -7.8600  (-51 50 -46 42 )(45 )                                u=1
 32    3  -7.8600  41 -42 -46                                           u=1
 33    3  -7.8600  156 -57 58 -59                                       u=1
 34    3  -7.8600  60 -56 61 -62                                        u=1
 35    3  -7.8600  -64 57 -63 98 103 106 107 101 104 105 109 108        u=1
 37    3  -7.8600  76 -73 -71 75                                        u=1
 38    3  -7.8600  78 -77 -74 75                                        u=1
 39    3  -7.8600  66 -79 -80 241                                       u=1
 40    3  -7.8600  -66 -81 82 83                                        u=1
 41    3  -7.8600  -86 79 -84 85                                        u=1
 42    3  -7.8600  -88 -87 75 73                                        u=1
 43    3  -7.8600  -78 89 -87 75                                        u=1
 44    3  -7.8600  -66 -91 90 77                                        u=1
 45    3  -7.8600  -78 -91 93 94                                        u=1
 46    0  ((-66 -90 59 77 )(87 :88 :-73 :-75 ))(-75 :73 :-76 :71 )      u=1
 47    0  95 -60 -96                                                    u=1
 48    3  -7.8600  -62 97 96 -60                                        u=1
 49    3  -7.8600  98 -102 108 105 109 104 101 107 106 103 99 -100      u=1
 50    3  -7.8600  98 -102 108 105 109 104 101 107 106 103 110 -111     u=1
 51    3  -7.8600  98 -102 108 105 109 104 101 107 106 103 112 -113     u=1
 52    3  -7.8600  98 -102 108 105 109 104 101 107 106 103 114 -115     u=1
 53    3  -7.8600  98 -102 108 105 109 104 101 107 106 103 116 -117     u=1
 54    3  -7.8600  98 -102 108 105 109 104 101 107 106 103 118 -119     u=1
 56    0  114 -58 -118 243 259 245 247 253 249 255 257 251  #52 #35 #53 u=1
 57    3  -7.8600  122 -123 -124                                       u=1
 58    0  -45 -41 123                                                  u=1
 59    0  -41 123 -32                                                  u=1
 60    3  -7.8600  -41 123 32 -33                                      u=1
 61    3  -7.8600  -41 123 45 -46                                      u=1
 62    6  -1.0000  (122 -123 124 -125 )(500 :-375 )                    u=1
 63    1  -1.7400  -127 130 129 -1                                     u=1
 64    3  -7.8600  129 128 -1 -126 127                                 u=1
 65    1  -1.7400  -130 133 -132                                       u=1
```

```
 66    3  -7.8600  ((-128 -128 -132 131 )(132 :130 :-133 ))(127 :-129 ) u=1
 67    1  -1.7400  129 137 -134 -1                                      u=1
 68    1  -1.7400  138 -137 -140                                        u=1
 69    3  -7.8600  -135 136 129 134 -1                                  u=1
 70    3  -7.8600  ((-136 138 -139 )(140 :137 ))(134 :-129 )            u=1
 71    3  -7.8600  -59 58 -156 155                                      u=1
 72    3  -7.8600  -59 -155 58 56                                       u=1
 73    3  -7.8600  58 -59 159 -97                                       u=1
 74    3  -7.8600  161 -160 -158 157 -162                               u=1
 75    3  -7.8600  163 -162 -159 -161                                   u=1
 76    3  -7.8600  -164 165 -166                                        u=1
 77    3  -7.8600  -165 157 -166 167                                    u=1
 78    3  -7.8600  168 -169 166 -170                                    u=1
 79    3  -7.8600  (-157 171 167 -172 ):(-168 166 157 -161 )            u=1
 80    3  -7.8600  -171 -173 167 2 #95                                  u=1
 81    1  -0.3660  (173 -184 -2 179 182 -180 )(192 :188 :-189 )         u=1
 83    3  -7.8600  -172 184 -181 183 -2 178                             u=1
 84    3  -7.8600  (180 -181 -184 167 -2 178 )(188 :192 :-189 )         u=1
 85    3  -7.8600  (-184 167 -182 183 178 -2 )(188 :192 :-189 )         u=1
 86    3  -7.8600  -184 173 182 -180 -179 178                           u=1
 88    1  -0.3660  -187 -192 190 194                                    u=1
 89    3  -7.8600  187 -188 -192 195                                    u=1
 90    3  -7.8600  (189 -190 -192 191 )                                 u=1
 91    3  -7.8600  192 -193 -188 189 -183                               u=1
 92    3  -7.8600  -193 192 189 -188 181                                u=1
 94    1  -0.3660  -184 173 -177 2 #95                                  u=1
 82    3  -7.8600  -176 177 -172 173                                    u=1
 93    3  -7.8600  (-171 187 -195 ):(-187 190 -194 )                    u=1
 95    3  -7.8  (((((2 -196 195 -172)(439:441))(-437:428))
         (172:457:-458:-167))(443:441))(438:-437)                       u=1
 96    3  -7.8600  -186 185 195 -197                                    u=1
 97    0  ((-165 -167 196 )(-185 :197 :186 ))(171 :195 )                u=1
 98    0  -199 -200 164                                                 u=1
 99    3  -7.8600  (-201 -198 -201 164 )(199 :200 )                     u=1
100    0  (((-161 168 -163 -159 )(201 :198 ))(166 :164 ))(169 :170 )    u=1
101    1  -1.7400  (-202 -205 206 -2 )(-204 :430 )                      u=1
102    3  -7.8600  -172 184 -177 2 #95                                  u=1
103    3  -7.8600  (((-203 207 -208 -2 )(202 :-206 :205 ))(15 :204 ))
         (430 :-204 )                                                   u=1
104    1  -1.7400  (-212 -209 213 -2 )(211 :432 )                       u=1
105    3  -7.8600  (((-434 -210 215 -2 )(212 :209 :-213 ))(-211 :28 ))
         (211 :432 )                                                    u=1
106    3  -7.8600  142 -141 -124 33 17 4 46                             u=1
107    3  -7.8600  144 -143 -124 33 17 4 46                             u=1
108    3  -7.8600  146 -145 -124 33 17 4 46                             u=1
109    3  -7.8600  148 -147 -124 33 17 4 46                             u=1
110    3  -7.8600  149 -150 -124 33 17 4 46                             u=1
111    3  -7.8600  58 -59 217 -216                                      u=1
112    3  -7.8600  35 20 6 48 -124 151 -152                             u=1
113    6  -1.0000  (-125 124 151 -152 20 35 6 48 )(-375 :500 )          u=1
114    6  -1.0000  (142 -141 -125 124 )(-375 :500 )                     u=1
115    6  -1.0000  (144 -143 -125 124 )(-375 :500 )                     u=1
116    6  -1.0000  (146 -145 -125 124 )(-375 :500 )                     u=1
117    6  -1.0000  (148 -147 -125 124 )(-375 :500 )                     u=1
118    6  -1.0000  (149 -150 -125 124 )(-375 :500 )                     u=1
119    3  -7.8600  ((((((153 -154 -124 195 )(-167 :181 :172 :-183 ))
         (-167 :181 :-183 :172 ))(433 :211 ))(-204 :431 ))(-207 :203 ))
         (210 :434 )                                                    u=1
120    3  -7.8600  (167 -173 -2 178 182 -180 )(188 :192 :-189 )         u=1
121    6  -1.0000  (124 -125 153 -154 )(-375 :500 )                     u=1
122    3  -7.8600  ((((-124 59 218 -219 )(290 :335 :-289 :-293 ))
     (293 :290 :-289 ))(-265 :-264 :263 :-345 ))(265 :263 :-264 :-345 ) u=1
123    3  -7.8600  -124 59 -221 220                                     u=1
124    3  -7.8600  -124 -223 222 59                                     u=1
125    3  -7.8600  -124 59 224 -225                                     u=1
126    3  -7.8600  -124 226 -227 59                                     u=1
127    3  -7.8600  -124 59 228 -229                                     u=1
128    3  -7.8600  -124 59 230 -231                                     u=1
129    3  -7.8600  -124 59 -233 232                                     u=1
```

```
130     6  -1.0000  (((((-125 124 218 -219 )(290 :335 :-289 :-293 ))
          (290 :-289 :293 :-337 ))(-265 :-264 :263 :344 ))
          (265 :-264 :263 :-345 ))(-375 :500 )                          u=1
131     6  -1.0000  (220 -221 124 -125 )(-375 :500 )                    u=1
132     6  -1.0000  (222 -223 124 -125 )(-375 :500 )                    u=1
133     6  -1.0000  (224 -225 124 -125 )(-375 :500 )                    u=1
134     6  -1.0000  (226 -227 124 -125 )(-375 :500 )                    u=1
135     6  -1.0000  (228 -229 124 -125 )(-375 :500 )                    u=1
136     6  -1.0000  (230 -231 124 -125 )(-375 :500 )                    u=1
137     6  -1.0000  (232 -233 124 -125 )(-375 :500 )                    u=1
138     3  -7.8600  235 -236 -238 237                                   u=1
139     3  -7.8600  -235 234 59 -239                                    u=1
140     3  -7.8600  240 -234 -239 79                                    u=1
141     3  -7.8600  -243 242 -63 60                                     u=1
142     3  -7.8600  258 -259 60 -63                                     u=1
143     3  -7.8600  246 -247 -63 60                                     u=1
144     3  -7.8600  -245 244 -63 60                                     u=1
145     3  -7.8600  -63 252 -253 60                                     u=1
146     3  -7.8600  248 -249 -63 60                                     u=1
147     3  -7.8600  250 -251 -63 60                                     u=1
148     3  -7.8600  -255 254 -63 60                                     u=1
149     3  -7.8600  256 -257 -63 60                                     u=1
150     0  -63 -256 60                                                  u=1
151     0  -63 -254 60                                                  u=1
152     0  -258 -63 60                                                  u=1
153     0  -63 -242 60                                                  u=1
154     0  -63 -246 60                                                  u=1
155     0  -244 -63 60                                                  u=1
156     0  -63 -250 60                                                  u=1
157     0  -63 -248 60                                                  u=1
158     0  -252 -63 60                                                  u=1
159     3  -7.8600  -261 260 -262 -263 264 59 265                       u=1
160     3  -7.8600  264 -263 59 -265 -267 266 268                       u=1
161     3  -7.8600  264 -263 -262 269 -270 265 59                       u=1
162     3  -7.8600  -272 271 268 -265 59 264 -263                       u=1
163     3  -7.8600  -274 273 -262 264 -263 59 265                       u=1
164     3  -7.8600  275 -276 268 -265 264 -263 59                       u=1
165     3  -7.8600  277 -278 -291 59 289 -290 293                       u=1
166     3  -7.8600  -279 280 292 -290 289 59 -293                       u=1
167     3  -7.8600  281 -282 -291 -290 289 59 293                       u=1
168     3  -7.8600  -284 283 292 -290 289 59 -293                       u=1
169     3  -7.8600  -286 285 -291 -290 289 59 293                       u=1
170     3  -7.8600  -288 287 292 289 -290 59 -293                       u=1
171     3  -7.8600  -124 33 4 17 46 297 -296                            u=1
172     6  -1.0000  (124 -125 297 -296 )(-375 :500 )                    u=1
173     3  -7.8600  -294 -299 295 298 4 264 -263                        u=1
174     3  -7.8600  -302 300 -301 298 4 264 -263                        u=1
175     3  -7.8600  264 -263 4 -302 298 -304 303                        u=1
176     3  -7.8600  17 -308 -306 307 305 264 -263                       u=1
177     3  -7.8600  17 -263 264 309 -310 307 -308                       u=1
178     3  -7.8600  -312 311 313 17 -263 264 -308                       u=1
179     3  -7.8600  -315 314 -318 320 33 -290 289                       u=1
180     3  -7.8600  -321 316 319 46 -290 289 -317                       u=1
181     3  -7.8600  -324 320 -323 322 33 -290 289                       u=1
182     3  -7.8600  -321 -327 325 326 46 -290 289                       u=1
183     3  -7.8600  320 33 -329 328 -324 289 -290                       u=1
184     3  -7.8600  -331 330 325 -321 46 289 -290                       u=1
185     3  -7.8600  -189 332 -333 191                                   u=1
186     3  -7.8600  ((-334 59 -335 336 293 -290 289 )(-97 :56 :62 ))
          (159 :162 :160 )                                              u=1
188     0  (-95 -58 159 )(-97 :-96 )                                    u=1
189     0  -56 -61 60 -61 255 257 259 251 249 243 247 253 245           u=1
190     3  -7.8600  ((-339 337 338 -293 59 -290 289 )(-97 :56 :62 ))
          (159 :162 :160 )                                              u=1
191     3  -7.8600  ((-340 -344 265 59 341 264 -263 )(-97 :62 :56 ))
          (159 :162 :160 )                                              u=1
192     3  -7.8600  ((-343 345 342 -265 59 264 -263 )(56 :62 :-97 ))
          (159 :162 :160 )                                              u=1
193     1  -1.7400  (346 -122 -125 )(500 :-375 )                        u=1
```

```
194    1  -1.7400  (123 -347 -125 46 46 33 )(500 :-375 )                u=1
195    1  -1.7400  (125 -348 -347 346 )(500 :-375 )                     u=1
196    1  -1.7400  (-349 350 -132 128 )(-129 :126 )                     u=1
197    1  -1.7400  -131 350 -128                                        u=1
198    1  -1.7400  -351 126 -1 349 129                                  u=1
199    1  -1.7400  (-352 136 138 -354 )(-129 :135 )                     u=1
200    1  -1.7400  135 -353 -1 352 129                                  u=1
201    1  -1.7400  -354 139 -136                                        u=1
202    1  -1.7400  17 -355 1 -148  #106 #176 #107 #108 #177             u=1
203    1  -1.7400  -357 4 1 -148  #106 #107 #108 #175 #174              u=1
204    1  -1.7400  -358 46 347 50 -51 -148  #106 #107 #108 #182 #184    u=1
205    1  -1.7400  347 33 -356 -148  #106 #107 #108 #183 #181           u=1
206    1  -1.7400  17 -355 418 -25 147  #109 #171 #178 #110             u=1
207    1  -1.7400  412 9 -357 4 147  #109 #110 #173 #171                u=1
208    1  -1.7400  -358 46 347 424 -51 147  #110 #171 #180              u=1
209    1  -1.7400  33 -356 421 36 147  #179 #110 #171                   u=1
210    1  -1.7400  (125 -348 -360 359 )(-375 :500 )                     u=1
211    1  -1.7400  (141 -360 -125 355 356 357 358 )(-375 :500 )         u=1
212    1  -1.7400  (-125 355 356 357 358 -142 359 )(-375 :500 )         u=1
213    1  -1.7400  (-348 125 363 -362 )(-375 :500 )                     u=1
214    1  -1.7400  (-125 355 356 357 358 143 -362 )(-375 :500 )         u=1
215    1  -1.7400  (-125 355 356 357 358 -144 363 )(-375 :500 )         u=1
216    1  -1.7400  (-348 125 -366 365 )(-375 :500 )                     u=1
217    1  -1.7400  (-125 355 356 357 358 365 -146 )(-375 :500 )         u=1
218    1  -1.7400  (-125 355 356 357 358 145 -366 )(-375 :500 )         u=1
219    1  -1.7400  (368 -367 125 -348 )(-375 :500 )                     u=1
220    1  -1.7400  (-125 355 356 357 358 -148 368 )(-375 :500 )         u=1
221    1  -1.7400  (-125 355 356 357 358 147 -367 )(-375 :500 )         u=1
222    1  -1.7400  (-370 369 125 -348 )(-375 :500 )                     u=1
223    1  -1.7400  (-125 355 356 357 358 -297 369 )(-375 :500 )         u=1
224    1  -1.7400  (-125 355 356 357 358 296 -370 )(-375 :500 )         u=1
225    1  -1.7400  (371 -372 -348 125 )(-375 :500 )                     u=1
226    1  -1.7400  (-125 355 356 357 358 -149 371 )(-375 :500 )         u=1
227    1  -1.7400  (-125 355 356 357 358 150 -372 )(-375 :500 )         u=1
228    1  -1.7400  355 -308 -376 377 378 -374 373  #176                 u=1
230    0  (((((((((346 -375 -359 )(347 :348 ))(349 :132 :-350 ))
          (351 :1 :-129 ))(357 :-1 ))(352 :-138 :354 ))(353 :1 :-129 ))
          (355 :-1 ))(358 ))(356 )                                     u=1
231    1  -1.7400  373 -374 357 -380 298 -379 381  #175                 u=1
232    1  -1.7400  -382 384 383 -321 358 385 -386  #184                 u=1
233    1  -1.7400  320 356 -387 389 -388 385 -386  #183                 u=1
234    0  (((((-375 359 -363 356 355 358 357 )(348 :360 ))
          (-320 :388 :387 :-389 :-320 :-385 :386 ))(-373 :374 :380 :379:-381
           :-298 ))(374 :-373 :376 :-377 :-378 :308 ))(386 :-385 :382 :-383
           :-384 :321 )                                                u=1
235    0  (-375 363 -365 355 356 357 358 )(348 :362 )                  u=1
236    1  -1.7400  -380 391 -390 298 357 373 -374  #174                 u=1
237    1  -1.7400  355 373 -374 393 -392 377 -308  #177                 u=1
238    1  -1.7400  -388 320 -394 397 356 385 -386  #181                 u=1
239    1  -1.7400  -321 -395 383 396 358 385 -386  #182                 u=1
240    0  (((((365 -375 -368 358 355 356 357 )(348 :366 ))
          (-385 :386 :395 :-383 :-396 :321 ))(-385 :386 :394 :388 :
           -397 :-320 ))(374 :-373 :390 :380 :-298 :-391 ))(374 :-373
            :392 :-377 :-393 :308 )                                    u=1
241    0  (-375 368 -369 356 355 357 358 )(348 :367 )                  u=1
242    1  -1.7400  -398 -399 400 298 357 373 -374  #173                 u=1
244    1  -1.7400  -401 403 402 355 373 -374 -308  #178                 u=1
246    1  -1.7400  -404 406 -405 320 356 385 -386  #179                 u=1
243    1  -1.7400  -321 409 408 358 385 -386 -407  #180                 u=1
245    0  (((((-375 369 -371 32 356 355 357 358 )(348 :370 ))
          (404 :405 :-406 :-385 :386 :-320 ))(-385 :386 :407 :-408 :
          -409 :321 ))(398 :399 :-400 :374 :-373 :-298 ))(374 :-373 :308
          :401 :-402 :-403 )                                           u=1
247    1  -1.7400  (-348 125 -410 411 )(-375 :500 )                    u=1
248    1  -1.7400  ((8 -412 414 -413 )(6 :9 ))(-9 :4 )                 u=1
249    1  -1.7400  -8 414 -13                                           u=1
250    1  -1.7400  12 -413 -8                                           u=1
251    1  -1.7400  (-415 6 412 -9 -14 )(152 :-151 )                    u=1
252    1  -1.7400  ((-418 22 -416 417 )(20 :-25 ))(25 :17 )             u=1
```

```
253     1  -1.7400  -22 -416 26                                          u=1
254     1  -1.7400  -27 417 -22                                          u=1
255     1  -1.7400  (-419 20 25 418 -14 )(152 :-151 )                    u=1
256     1  -1.7400  ((31 -421 420 -422 )(35 :36 ))(33 :-36 )             u=1
257     1  -1.7400  -39 420 -31                                          u=1
258     1  -1.7400  -422 40 -31                                          u=1
259     1  -1.7400  (-423 35 421 -36 -43 )(152 :-151 )                   u=1
260     1  -1.7400  ((-424 50 -425 426 )(48 :-51 ))(46 :51 )             u=1
261     1  -1.7400  426 -54 -50                                          u=1
262     1  -1.7400  -425 55 -50                                          u=1
263     1  -1.7400  (-427 48 424 51 -43 )(152 :-151 )                    u=1
264     1  -1.7400  (152 -410 419 34 423 415 427 -125 )(-375 :500 )      u=1
265     1  -1.7400  (419 34 423 415 427 -125 411 -151 )(-375 :500 )      u=1
266     0  ((((((((((((-375 371 -411 )(-426 :424 :425 ))(51 :358 ))
          (-51 :427 ))(422 :421 :-420 ))(-36 :356 ))(36 :423 ))
          (418 :416 :-417 ))(25 :355 ))(-25 :419 ))(412 :-414 :413 ))
          (-9 :357 ))(9 :415 ))(372 :348 )                               u=1
267     1  -1.7400  204 -430 -2                                          u=1
268     3  -7.8600  430 -431 -2 204 203                                  u=1
269     1  -1.7400  -2 -432 -211                                         u=1
270     3  -7.8600  432 -433 -211 -2 210                                 u=1
271     1  -1.7400  -204 428 16 -435 14                                  u=1
272     1  -1.7400  211 210 -436 29 14                                   u=1
273     1  -1.7400  (((203 -428 -429 437 -2 )(16 :204 ))(-204 :431 ))
          (-153 :154 )                                                   u=1
274     1  -1.7400  -429 208 -203                                        u=1
275     1  -1.7400  (-207 437 -203 -2 )(-153 :154 :207 )                 u=1
276     1  -1.7400  (-438 431 -2 204 428 )(-153 :154 )                   u=1
277     1  -1.7400  (((-439 210 440 -441 -2 )(436 :-211 ))(211 :433 ))
          (-153 :154 )                                                   u=1
278     1  -1.7400  -215 440 -210                                        u=1
279     1  -1.7400  (434 -441 -210 -2 )(-153 :154 )                      u=1
280     1  -1.7400  (-442 195 188 -2 )(-153 :154 )                       u=1
281     1  -1.7400  (433 -443 -2 -211 439 )(-153 :154 )                  u=1
282     1  -1.7400  (-445 193 -444 446 )(-183 :181 )                     u=1
283     1  -1.7400  ((-444 188 442 -193 )(-167 :181 :-183 ))
          (-167 :-183 :181 )                                             u=1
284     1  -1.7400  -189 332 -447 333                                    u=1
285     1  -1.7400  -190 332 -191 448                                    u=1
286     1  -1.7400  ((446 -189 -193 447 )(-167 :-183 :181 ))
          (-167 :180 :-183 )                                             u=1
287     1  -1.7400  -449 59 -216 217                                     u=1
288     1  -1.7400  -58 450 -216 217                                     u=1
289     1  -1.7400  (-452 451 125 -348 )(-375 :500 )                     u=1
290     1  -1.7400  ((((((-125 154 -452 442 )(211 :443 ))(439 :441 ))
          (-204 :438 ))(428 :-437 ))(454 :-458 :457 :-455 ))(-375 :500 ) u=1
291     1  -1.7400  -176 2 -454 172                                      u=1
292     1  -1.7400  (-454 172 458 -457 -2 178 )(154 :-153 )              u=1
293     1  -1.7400  ((-183 458 -172 455 178 -2 )(154 :-153 ))
          (444 :445 :-446 )                                              u=1
294     1  -1.7400  ((181 -457 -172 455 178 -2 )(-153 :154 ))
          (-446 :444 :445 )                                              u=1
295     1  -1.7400  ((-167 455 -181 183 -2 178 )(154 :-153 ))(444 :-446) u=1
296     1  -1.7400  -454 458 -457 455 459 -178                           u=1
297     1  -1.7400  ((((((-125 451 -153 442 )(211 :443 ))(439 :441 ))
          (-204 :438 ))(428 :-437 ))(454 :-458 :457 :-455 ))(-375 :500)  u=1
298     0  -216 217 -450                                                 u=1
299     0  -190 -448 332                                                 u=1
300     0  ((((((((-375 411 -216 )(427 :502))(423 :502))(449 :-217 :216))
          (419 :14 ))(14 :415 ))(435 :-14 ))(436 :-14 ))(410 :348 )      u=1
301     0  ((((((((((216 -375 -451 )(-332 :447 :190 ))(445 :-446 :444 ))
          (442 :-444 ))(436 :-211 ))(211 :443 ))(441 :439 :-440 ))
          (204 :435 )) (438 :-204 ))(428 :429 :-437 ))(454 :-458 :-455 :457
          :-459 )                                                        u=1
302     1  -1.7400  173 -461 460 -171                                    u=1
303     1  -1.7400  176 173 -460 -454                                    u=1
304     1  -1.7400  462 -171 461 -172                                    u=1
305     1  -1.7400  172 -463 -466 462                                    u=1
306     1  -1.7400  157 -466 -172 465                                    u=1
```

```
  307     1  -1.7400  (160 -465 157 -162 -159 ) #186 #190 #191 #192        u=1
  308     1  -1.7400  -159 -467 162 -465  #186 #190 #191 #192              u=1
  309     1  -1.7400  (((((-468 59 159 -469 )(56 :-97 ))(-220 :221 ))
            (-218 :219 ))(263 :-264 :340 :344 :-341 :343 :-486 :-487 ))
            (-289 :290 :-337 :-338 :339 :334 :335 :-336 )                   u=1
  310     1  -1.7400  (221 -471 -125 468 )(-375 :500 )                     u=1
  311     1  -1.7400  (470 -220 -125 468 )(-375 :500 )                     u=1
  312     1  -1.7400  (470 -471 125 -348 )(-375 :500 )                     u=1
  313     1  -1.7400  -62 56 -473 468  #186 #190 #191 #192                 u=1
  314     1  -1.7400  -62 -97 474 468  #186 #190 #191 #192                 u=1
  315     1  -1.7400  ((-475 62 474 -473 )(-289 :290 ))(263 :-264 )        u=1
  316     1  -1.7400  (((-476 -477 468 478 293 385 -386 )(-474 :473 :475 ))
            (159 :467 :465 ))(-489 :488 ) #186                              u=1
  317     1  -1.7400  (((-479 480 481 -293 468 385 -386 )(-474 :473 :475 ))
            (159 :467 :465 ))(-489 :488 ) #190                              u=1
  318     1  -1.7400  (((-482 -483 265 468 484 373 -374 )(-474 :475 :473 ))
            (159 :467 :465 ))(-489 :488 ) #191                              u=1
  319     1  -1.7400  (((-485 486 487 -265 468 373 -374 )(473 :475 :-474 ))
            (159 :467 :465 ))(-489 :488 ) #192                              u=1
  320     1  -1.7400  (((-375 :500 )219 -488 -125 468 )(-345 :344 :
                      263 :-264 )) (335 :-337 :-289 :290 )                  u=1
  321     1  -1.7400  (((-375 :500 )-218 489 -125 468 )
                      (344 :263 :-264 :-345 ))(-289 :290 :-337 :335 )       u=1
  322     1  -1.7400  (-488 489 -348 125 )(-375 :500 )                     u=1
  323     0  ((((((((((-375 451 -462 )(503 :-437 :428 ))(503 :443 :211 :441 ))
            (454 :460 :-503 ))(442 :503 ))(461 :462 :-177 ))(452 :348 ))
            (454 :-458 :457 :-455 :503 ))(428 :-437 ))(-204 :438 :-437 :503 ))
            (441 :439 )                                                     u=1
  324     0  (((((((462 -489 -375 )(463 :466 ))(465 :467 :159 ))(468 :-159 ))
            (386 :477 :-385 :-293 :-478 ))(-385 :386 :-481 :-480 :293 ))
            (-373 :374 :-486 :-487 :265 ))(374 :-373 :483 :-484 :-265 )     u=1
  325     0  (((((489 -375 -470 468 )(475 :-474 :473 ))(488 :348 ))
            (374 :483 :-373 :482 :-265 ))(374 :-486 :-373 :485 :265 ))
            (477 :386 :-385 :-480 :479 :476 )                               u=1
  326     0  ((470 -375 -222 59 )(469 :468 ))(348 :471 )                   u=1
  327     0  (((222 -375 -224 59 )(267 :-268 :-266 :261 :262 :-260 :
              -264 :263 )) (278 :291 :-277 :-280 :279 :-292 :290 :-289 ))
              (223 :125 )                                                   u=1
  328     0  (-375 224 -226 59 )(125 :225 )                                u=1
  329     0  (((-375 226 -228 59 )(125 :227 ))(282 :291 :-281 :-283 :284 :-292
             :290 :-289 ))(270 :262 :-269 :-271 :-268 :272 :-264 :263 )    u=1
  330     0  (-375 228 -230 59 )(125 :229 )                                u=1
  331     0  (((-375 230 -232 59 )(125 :231 ))(-273 :262 :274 :276 :-268 :-275
             :-264 :263 ))(286 :291 :-285 :-287 :-292 :288 :290 :-289 )    u=1
  332     0  ((((((-375 232 -66 59 )(125 :233 ))(-94 :91 :78 :-93 ))
            (87 :78 :-75 :-89 ))(-78 :74 :77 :-75 ))(91 :-77 :66 ))
            (81 :-82 :66 :-83 )                                             u=1
  333     0  (-234 -240 59 66 ):(-79 66 -241 59 )                          u=1
  334     0  (((((-375 66 -63 59 )(80 :79 ))(86 :84 :-85 :-79 ))(239 :235 ))
            (236 :238 :-237 ))(64 :-57 )                                    u=1
c 335     0  ((-491 492 -493)(-346:500:375))(501:-500:63)                   u=1
  335     0  375 : 63 : -346   u=1   $ best guess as to what above meant
  337     0  56 -58 -114 243 259 245 247 253 249 255 257 251  #49 #50 #51   u=1
  338     0  114 -58 118 -63 243 259 245 247 253 249 255 257 251  #54 #35   u=1
c 339     0  ((((((((((500 375 -501 -66 -462 )(347 :348 ))(348 :-359 :360 ))
c           (362 :348 :-363 ))(366 :348 :-365 -462 ))(367 :348 :-368 ))
c           (370 :348 :-369 ))(372 :348 :-371 ))(410 :348 :-411 ))
c           (452 :348 :-451 ))                                              u=1
c 340     0  ((375 66 -501 -63 )(80 :79 ))(84 :86 :-85 :-79 )              u=1
c 341     0  (((((((((500 375 -501 -66 462 )(488 :348 :-489 ))(471 :348
c                     :-470 ))
c           (223 :125 :-222 ))(225 :125 :-224 ))(227 :125 :-226 ))
c           (229 :125 :-228 ))(231 :125 :-230 ))(233 :125 :-232 ))         u=1
  342     1  -1.7400 43 -502 -427                                          u=1
  343     1  -1.7400 43 -502 -423                                          u=1
  344     1  -1.7400  (((((503 -2 442 -454)(439:441))(-437:428))
            (454:457:-458:-455))(443:441))(438:-437)                        u=1
  345     0  (-606:663) -614 615 -613              u=2 $ outside cask
  346     0   -602  -603   601  fill=1   trcl=7     u=2 $ movable universe
```

```
347     0   607 -640  668 -639                u=2 $ FILLED void
348     0   640 -608  668 -639                u=2 $ FILLED void
350     3  -7.8600  #346 604 -613 -607            u=2 $ cask inner steel
351     0           607 639 -613 -608             u=2 $ cask void
352     3  -7.8600  (608:-605) 606 -613 -609      u=2 $ cask outer steel
353     3  -7.8600   609 -610 611 -612            u=2 $ cask steel added
354     0    609 -610 606 -611                    u=2 $ cask outside air gap
355     0    609 -610 612 -613                    u=2 $ cask outside air gap
356     0    613 -614 -616   #346                 u=2 $ outside cask
357     0   -615:614:616                          u=2 $ outside universe 2
358     0    -626 627 -628 fill=2    trcl=8
359     0   -122 -491    $ DIRT, PARTICLE ignored
360     0   122 -491 (641:-642:643) #362  #361 #368 #369 #370    $ AIR around universe 2
            (-631:632:-633:634:-629:630)
361     3  -7.8600   619 -620 621 -622 617 -618   trcl=9         $ TRUCK
362     3  -7.8600   618 -625 621 -622 623 -624 #358   trcl=9    $ SHIELD
363     3  -7.8600   (-637:638:-635:636)631 -632 633 -634 629 -630            $ PLATFORM
364     0    637 -638 635 -636 629 -630               $ PLATFORM
365     0    605 -604 -607                        u=2 $ void in bottom of cask
366     0  491                                       $ outside world
367     0   -641 642 -643 #358 #362                 $ AIR around universe 2
368     3  -7.8600   630 -650 652 -653 656 -654     $ SHIELD
369     3  -7.8600   630 -650 652 -653 655 -657     $ SHIELD
370     3  -7.8600   630 -650 652 -651 654 -655     $ SHIELD
371     7  -6.84    607 -640  605 -660              u=2 $ FILLED lead
372     7  -6.84    640 -608  605 -660              u=2 $ FILLED lead
373     7  -6.84 607 -640  660 -661               u=2 $ FILLED lead
374     7  -6.84 640 -608  660 -661               u=2 $ FILLED lead
375     7  -6.84 607 -640  661 -662               u=2 $ FILLED lead
376     7  -6.84 640 -608  661 -662               u=2 $ FILLED lead
377     3  -4.1 607 -640  662 -668               u=2 $ FILLED steel
378     3  -4.1 640 -608  662 -668               u=2 $ FILLED steel
379     0            610 -663 606 -664            u=2 $ Lead Blanket
380     7  -11.4       610 -663 664 -665            u=2 $ Lead Blanket
381     0            610 -663 665 -666            u=2 $ Lead Blanket
382     0       610 -663 666 -667            u=2 $ Lead Blanket
383     0            610 -663 667 -613            u=2 $ Lead Blanket

  1        pz  39.0520
  2        pz  652.1450
  3       c/z  20.0025 0.0000 7.3165
  4       c/z  20.0025 0.0000 8.4137
  5       c/z  43.0212 0.0000 7.3165
  6       c/z  43.0212 0.0000 8.4137
  7     1 c/z  31.5112 0.0000 7.3165
  8     1 c/z  31.5112 0.0000 8.4137
  9     1  px  31.5112
 10        px  50.3403
 11        px  12.6835
 12        px  51.4350
 13        px  11.5887
 14        pz  565.7850
 15       c/z  45.720  0.000  4.859
 16       c/z  45.720  0.000  5.715
 17       c/z  -20.0025 0.0000 8.4137
 18       c/z  -20.0025 0.0000 7.3165
 19       c/z  -43.0212 0.0000 7.3165
 20       c/z  -43.0212 0.0000 8.4137
 21     2 c/z  -31.5112 0.0000 7.3165
 22     2 c/z  -31.5112 0.0000 8.4137
 23        px  -12.6835
 24        px  -50.3403
 25     2  px  -31.5112
 26        px  -11.5887
 27        px  -51.4350
 28       c/z  -45.720  0.000  4.859
 29       c/z  -45.720  0.000  5.715
 30     3 c/z  0.0000 31.5112 7.3165
 31     3 c/z  0.0000 31.5112 8.4137
```

```
32        c/z  0.0000 20.0025 7.3165
33        c/z  0.0000 20.0025 8.4137
34        c/z  0.0000 43.0212 7.3165
35        c/z  0.0000 43.0212 8.4137
36      3  py  31.5112
37         py  50.3403
38         py  12.6835
39         py  11.5887
40         py  51.4350
41         pz  60.9600
42         pz  62.2300
43         pz  569.5950
44         pz  568.3250
45        c/z  0.0000 -20.0025 7.3165
46        c/z  0.0000 -20.0025 8.4137
47        c/z  0.0000 -43.0212 7.3165
48        c/z  0.0000 -43.0212 8.4137
49      4 c/z  0.0000 -31.5112 7.3165
50      4 c/z  0.0000 -31.5112 8.4137
51      4  py  -31.5112
52         py  -12.6835
53         py  -50.3403
54         py  -51.4350
55         py  -11.5887
56         pz  839.7875
57         pz  1756.4100
58         cz  19.0500
59         cz  20.3200
60         pz  835.0250
61         cz  17.7800
62         cz  39.3700
63         pz  1758.9500
64         cz  50.8000
66         pz  1471.9300
71         cz  41.9100
73         pz  1432.5600
74         cz  51.4350
75         cz  20.4787
76         pz  1430.0200
77         pz  1383.6650
78         pz  1381.7600
79         pz  1474.4700
80         cz  55.8800
81         cz  50.8000
82         cz  49.5300
83         pz  1449.0700
84         cz  55.2450
85         cz  52.7050
86         pz  1489.7100
87         cz  22.8600
88         pz  1456.6900
89         pz  1361.4400
90         cz  42.5450
91         cz  43.1800
93         cz  41.9100
94         pz  1352.5500
95         pz  832.4850
96         cz  15.0876
97         pz  829.9450
98         cz  3.8100
99         pz  950.2775
100        pz  951.5475
101       c/z  -8.7986 -5.0800 3.1750
102        cz  18.669
103       c/z  12.0985 6.9850 1.8250
104       c/z  8.7986 -5.0800 2.5400
105       c/z  0.0000 -10.1600 1.8250
106       c/z  0.0000 12.7000 2.5400
107       c/z  -12.0985 6.9850 2.5400
```

```
108     c/z  -6.9850 -12.0985 1.8250
109     c/z  6.9850 -12.0985 2.5400
110      pz  1059.4975
111      pz  1060.7675
112      pz  1171.2575
113      pz  1172.5275
114      pz  1281.7475
115      pz  1283.0175
116      pz  1392.2375
117      pz  1393.5075
118      pz  1502.7275
119      pz  1503.9975
122      pz  0.0000
123      pz  1.2700
124      cz  45.7200
125      cz  55.8800
126     k/z  20.0025 0.0000 -129.5400 0.0025 2.5400
127     k/z  20.0025 0.0000 -106.6800 0.0025 2.5400
128     k/x  127.0000 0.0000 17.7800 0.0051 0.0000
129      pz  17.7800
130     k/x  109.2200 0.0000 17.7800 0.0051 0.0000
131      px  12.1920
132      px  41.9100
133      px  13.2893
134     k/z  -20.0025 0.0000 -106.6800 0.0025 2.5400
135     k/z  -20.0025 0.0000 -129.5400 0.0025 2.5400
136     k/x  -127.0000 0.0000 17.7800 0.0051 2.5400
137     k/x  -109.2200 0.0000 17.7800 0.0051 0.0000
138      px  -41.9100
139      px  -12.1920
140      px  -13.2893
141      pz  68.5800
142      pz  68.1037
143      pz  119.8562
144      pz  119.3800
145      pz  208.2800
146      pz  207.8037
147      pz  259.5562
148      pz  259.0800
149      pz  412.1150
150      pz  412.5912
151      pz  503.5550
152      pz  504.0312
153      pz  643.2550
154      pz  643.7312
155      pz  923.9250
156      pz  1052.8300
157      pz  718.5025
158      pz  783.9075
159      pz  791.5275
160      cz  38.1000
161      cz  37.1475
162      kz  803.6560 2.7940 0.0000
163      kz  802.8432 2.7940 0.0000
164      pz  732.1550
165      pz  730.8850
166      cz  27.9400
167      cz  26.9875
168      pz  719.4550
169      pz  721.3600
170      cz  36.1950
171      pz  715.6450
172      cz  45.0850
173      cz  28.8925
176      pz  694.6900
177      pz  693.4200
178      pz  597.5350
179      pz  598.8050
180      px  15.2400
```

```
181        px  16.5100
182        px  -15.2400
183        px  -16.5100
184        cz  43.8150
185        pz  674.3700
186        pz  693.4200
187        pz  621.0300
188        pz  622.3000
189        pz  605.1550
190        pz  606.4250
191        cz  13.3350
192        cz  35.5600
193        cz  36.8300
194        cz  2.5400
195        cz  4.4450
196        pz  655.9550
197        cz  17.1450
198        pz  751.8400
199        pz  750.5700
200        cz  13.3350
201        cz  14.6050
202     5  cz  4.8590
203     5  cz  5.7150
204     5  px  0.0000
205        px  50.5816
206        px  28.8900
207        px  28.0340
208        px  51.4604
209     6  cz  4.8590
210     6  cz. 5.7150
211     6  px  0.0000
212        px  -28.8900
213        px  -50.5816
215        px  -51.4604
216        pz  592.4550
217        pz  535.9400
218        pz  801.0525
219        pz  801.5287
220        pz  889.9525
221        pz  890.4356
222        pz  958.5325
223        pz  959.0087
224        pz  1029.6525
225        pz  1030.1287
226        pz  1095.6925
227        pz  1096.1687
228        pz  1161.7325
229        pz  1162.2087
230        pz  1232.8525
231        pz  1233.3287
232        pz  1298.8925
233        pz  1299.3687
234        pz  1479.5500
235        pz  1483.3600
236        pz  1487.1700
237        cz  21.9075
238        cz  34.2900
239        cz  40.9600
240        cz  33.3400
241        cz  34.2900
242        cz  3.1359
243        cz  3.4529
244       c/z  0.0000 12.7000 2.0447
245       c/z  0.0000 12.7000 2.2022
246       c/z  -12.0985 6.9850 2.0447
247       c/z  -12.0985 6.9850 2.2022
248       c/z  8.7986 -5.0800 2.0447
249       c/z  8.7986 -5.0800 2.2022
250       c/z  6.9850 -12.0985 2.0447
```

```
c/z  6.9850 -12.0985 2.2022
c/z  12.0985 6.9850 1.3310
c/z  12.0985 6.9850 1.4910
c/z  0.0000 -10.1600 1.3310
c/z  0.0000 -10.1600 1.4910
c/z  -6.9850 -12.0985 1.3310
c/z  -6.9850 -12.0985 1.4910
c/z  -8.7986 -5.0800 2.6238
c/z  -8.7986 -5.0800 3.0150
  p  -1.0000 0.0000 1.0000 941.7050
  p  1.0000 0.0000 1.0000 1043.3050
 px  45.0850
 py  0.6350
 py  -0.6350
 px  0.0000
  p  1.0000 0.0000 1.0000 941.7050
  p  -1.0000 0.0000 1.0000 1043.3050
 px  -45.0850
  p  -1.0000 0.0000 1.0000 1078.8650
  p  1.0000 0.0000 1.0000 1179.4236
  p  1.0000 0.0000 1.0000 1078.8650
  p  -1.0000 0.0000 1.0000 1179.4236
  p  -1.0000 0.0000 1.0000 1215.0598
  p  1.0000 0.0000 1.0000 1316.6598
  p  1.0000 0.0000 1.0000 1215.0598
  p  -1.0000 0.0000 1.0000 1316.6598
  p  0.0000 -1.0000 1.0000 941.7050
  p  0.0000 1.0000 1.0000 1043.3050
  p  0.0000 -1.0000 1.0000 1043.3050
  p  0.0000 1.0000 1.0000 941.7050
  p  0.0000 -1.0000 1.0000 1078.8650
  p  0.0000 1.0000 1.0000 1179.4236
  p  0.0000 1.0000 1.0000 1078.8650
  p  0.0000 -1.0000 1.0000 1179.4236
  p  0.0000 -1.0000 1.0000 1215.0598
  p  0.0000 1.0000 1.0000 1316.6598
  p  0.0000 1.0000 1.0000 1215.0598
  p  0.0000 -1.0000 1.0000 1316.6598
 px  -0.6350
 px  0.6350
 py  45.0850
 py  -45.0850
 py  0.0000
  p  1.0000 0.0000 1.0000 437.9912
  p  -1.0000 0.0000 1.0000 326.5487
 pz  352.4250
 pz  351.9487
 px  20.0025
 px  50.0062
  p  -1.0000 0.0000 1.0000 182.4037
  p  1.0000 0.0000 1.0000 284.9562
 px  38.8937
  p  -1.0000 0.0000 1.0000 42.7037
  p  1.0000 0.0000 1.0000 145.2562
  p  1.0000 0.0000 1.0000 42.7037
  p  -1.0000 0.0000 1.0000 145.2562
 px  -38.8937
 px  -20.0025
  p  1.0000 0.0000 1.0000 182.4037
  p  -1.0000 0.0000 1.0000 284.9562
  p  1.0000 0.0000 1.0000 326.5487
  p  -1.0000 0.0000 1.0000 437.9912
 px  -50.0062
  p  0.0000 -1.0000 1.0000 326.5487
  p  0.0000 1.0000 1.0000 437.9912
  p  0.0000 1.0000 1.0000 326.5487
  p  0.0000 -1.0000 1.0000 437.9912
 py  50.0062
 py  -50.0062
```

```
320      py  20.0025
321      py  -20.0025
322       p  0.0000 -1.0000 1.0000 182.4037
323       p  0.0000 1.0000 1.0000 284.9562
324      py  38.8937
325      py  -38.8937
326       p  0.0000 1.0000 1.0000 182.4037
327       p  0.0000 -1.0000 1.0000 284.9562
328       p  0.0000 -1.0000 1.0000 42.7037
329       p  0.0000 1.0000 1.0000 145.2562
330       p  0.0000 1.0000 1.0000 42.7037
331       p  0.0000 -1.0000 1.0000 145.2562
332      pz  596.2650
333      cz  14.6050
334       p  0.0000 0.5799 1.0000 900.7475
335      py  49.5300
336       p  0.0000 -0.5800 1.0000 748.6650
337      py  -49.5300
338       p  0.0000 0.5799 1.0000 748.6650
339       p  0.0000 -0.5799 1.0000 900.7475
340       p  0.5799 0.0000 1.0000 900.7475
341       p  -0.5799 0.0000 1.0000 748.6650
342       p  0.5799 0.0000 1.0000 748.6650
343       p  -0.5799 0.0000 1.0000 900.7475
344      px  49.5300
345      px  -49.5300
346      pz  -0.1000
347      pz  1.3700
348      cz  55.9800
349     k/x  128.0000 0.0000 17.7800 0.0051 0.0000
350      px  12.0920
351     k/z  20.0025 0.0000 -131.5400 0.0025 2.5400
352     k/x  -128.0000 0.0000 17.7800 0.0051 0.0000
353     k/z  -20.0025 0.0000 -131.5400 0.0025 2.5400
354      px  -12.0920
355     c/z  -20.0025 0.0000 8.5137
356     c/z  0.0000 20.0025 8.5137
357     c/z  20.0025 0.0000 8.5137
358     c/z  0.0000 -20.0025 8.5137
359      pz  68.0037
360      pz  68.6800
362      pz  119.9562
363      pz  119.2800
365      pz  207.7037
366      pz  208.3800
367      pz  259.6562
368      pz  258.9800
369      pz  351.8487
370      pz  352.5250
371      pz  412.0150
372      pz  412.6912
373      py  -0.7350
374      py  0.7350
c 375    cz  53.3400
375      cz  57.3400
376       p  -1.0000 0.0000 1.0000 145.3562
377      px  -38.9937
378       p  1.0000 0.0000 1.0000 42.6037
379       p  1.0000 0.0000 1.0000 145.3562
380      px  38.9937
381       p  -1.0000 0.0000 1.0000 42.6037
382       p  0.0000 -1.0000 1.0000 145.3562
383      py  -38.9937
384       p  0.0000 1.0000 1.0000 42.6037
385      px  -0.7350
386      px  0.7350
387       p  0.0000 1.0000 1.0000 145.3562
388      py  38.9937
389       p  0.0000 -1.0000 1.0000 42.6037
```

```
390          p  1.0000 0.0000 1.0000 285.0562
391          p  -1.0000 0.0000 1.0000 182.3037
392          p  -1.0000 0.0000 1.0000 285.0562
393          p  1.0000 0.0000 1.0000 182.3037
394          p  0.0000 1.0000 1.0000 285.0562
395          p  0.0000 -1.0000 1.0000 285.0562
396          p  0.0000 1.0000 1.0000 182.3037
397          p  0.0000 -1.0000 1.0000 182.3037
398          p  1.0000 0.0000 1.0000 438.0912
399         px  50.1062
400          p  -1.0000 0.0000 1.0000 326.4487
401          p  -1.0000 0.0000 1.0000 438.0912
402         px  -50.1062
403          p  1.0000 0.0000 1.0000 326.4487
404          p  0.0000 1.0000 1.0000 438.0912
405         py  50.1062
406          p  0.0000 -1.0000 1.0000 326.4487
407          p  0.0000 -1.0000 1.0000 438.0912
408         py  -50.1062
409          p  0.0000 1.0000 1.0000 326.4487
410         pz  504.1312
411         pz  503.4550
412      1 c/z  31.5112 0.0000 8.5137
413         px  51.5350
414         px  11.4887
415        c/z  43.0212 0.0000 8.5137
416         px  -11.4887
417         px  -51.5350
418      2 c/z  -31.5112 0.0000 8.5137
419        c/z  -43.0212 0.0000 8.5137
420         py  11.4887
421      3 c/z  0.0000 31.5112 8.5137
422         py  51.5350
423        c/z  0.0000 43.0212 8.5137
424      4 c/z  0.0000 -31.5112 8.5137
425         py  -11.4887
426         py  -51.5350
427        c/z  0.0000 -43.0212 8.5137
428      5  cz  5.8150
429         px  51.5604
430        c/z  36.2458 0.0000 7.3165
431        c/z  36.2458 0.0000 8.4137
432        c/z  -36.2458 0.0000 7.3165
433        c/z  -36.2458 0.0000 8.4137
434         px  -28.0340
435        c/z  45.7200 0.0000 5.8150
436        c/z  -45.7200 0.0000 5.8150
437         px  27.9340
438        c/z  36.2458 0.0000 8.5137
439      6  cz  5.8150
440         px  -51.5604
441         px  -27.9340
442         cz  4.5450
443        c/z  -36.2458 0.0000 8.5137
444         pz  622.4000
445         cz  36.9300
446         pz  605.0550
447         cz  14.7050
448         cz  13.2350
449         cz  20.4200
450         cz  18.9500
451         pz  643.1550
452         pz  643.8312
454         cz  45.1850
455         cz  26.8875
457         px  16.6100
458         px  -16.6100
459         pz  597.4350
460         pz  694.7900
```

```
461     cz  28.9925
462     pz  715.5450
463     cz  45.1850
465     cz  38.2000
466     pz  718.6025
467     kz  803.7560 2.7940 0.0000
468     cz  20.4200
469     pz  953.7700
470     pz  889.8525
471     pz  890.5356
473     pz  839.8875
474     pz  829.8450
475     cz  39.4700
476      p  0.0000 0.5799 1.0000 900.8475
477     py  49.6300
478      p  0.0000 -0.5800 1.0000 748.5650
479      p  0.0000 -0.5799 1.0000 900.8475
480     py  -49.6300
481      p  0.0000 0.5799 1.0000 748.5650
482      p  0.5799 0.0000 1.0000 900.8475
483     px  49.6300
484      p  -0.5799 0.0000 1.0000 748.5650
485      p  -0.5799 0.0000 1.0000 900.8475
486     px  -49.6300
487      p  0.5799 0.0000 1.0000 748.5650
488     pz  801.6287
489     pz  800.9525
491     so  40000.000
492     pz  -1200
493     pz  2900
500     pz  0.2000
501     cz  58.4200
502     pz  569.6950
503     pz  652.0450
601     pz -52.07
602     cz  80.01
603     pz 2000.
604     pz -57.15
605     pz -58.42        $ Steel Bottom
606     pz -63.5
607     cz  81.28
608     cz  86.36
609     cz  87.1538
610     cz  87.63
611     pz  511.175
612     pz  855.345
613     pz  1525.905
614     cz  89            $ fill surface
615     pz  -64           $ fill surface
616     pz  2500          $ fill surface
617     pz  196.85        $ truck
618     pz  198.12        $ truck
619     py  -311.785      $ truck
620     py  2299.208      $ truck
621     px  -167.64       $ truck
622     px  167.64        $ truck
623     py  1525.905      $ shield
624     py  1528.445      $ shield
625     pz  411.48        $ shield
626     cz  89.1            $ trans surface
627     pz  -64.1           $ trans surface
628     pz  2500.1          $ trans surface
629     pz  454             $ platform
630     pz  459.08          $ platform
631     px  -160.02          $ platform
632     px   160.02          $ platform
633     py  -160.02          $ platform
634     py   160.02          $ platform
635     px  -30.48          $ platform
```

```
636        px   30.48          $ platform
637        py  -30.48          $ platform
638        py   30.48          $ platform
639        pz   1525.8
640        cz  83.76
641        c/y  0 305.105 92.71
642        py  -2000
643        py   5000
650        pz  520.04          $ platform
651        py  -31.75          $ platform
652        py  -36.86          $ platform
653        py   35.53          $ platform
654        px  -31.75          $ platform
655        px   31.75          $ platform
656        px  -36.86          $ platform
657        px   36.86          $ platform
660        pz   -36.19         $   lead Top (lead Bottom)
661        pz   25.4           $   lead Top (lead Bottom)
662        pz   1095.38        $   lead Top
663        cz  88.265          $ Lead Blanket
664        pz   87.00         $ Lead Blanket
665        pz   511.18        $ Lead Blanket
666        pz   695.33        $ Lead Blanket
667        pz   775.34        $ Lead Blanket
668        pz   1095.38        $   Steel Top
700      py   -1925.16
701      py   -1894.68
702      py   -1864.20
703      py   -1833.72
704      py   -1803.24
705      py   -1772.76
706      py   -1742.28
707      py   -1711.80
708      py   -1681.32
709      py   -1650.84
710      py   -1620.36
711      py   -1589.88
712      py   -1559.40
713      py   -1528.92
714      py   -1498.44
715      py   -1467.96
716      py   -1437.48
717      py   -1407.00
718      py   -1376.52
719      py   -1346.04
720      py   -1315.56
721      py   -1285.08
722      py   -1254.60
723      py   -1224.12
724      py   -1193.64
725      py   -1163.16
726      py   -1132.68
727      py   -1102.20
728      py   -1071.72
729      py   -1041.24
730      py   -1010.76
731      py   -980.28
732      py   -949.80
733      py   -919.32
734      py   -888.84
735      py   -858.36
736      py   -827.88
737      py   -797.40
738      py   -766.92
739      py   -736.44
740      py   -705.96
741      py   -675.48
742      py   -645.00
743      py   -614.52
```

```
744      py   -584.04
745      py   -553.56
746      py   -523.08
747      py   -492.60
748      py   -462.12
749      py   -431.64
750      py   -401.16
751      py   -370.68
752      py   -340.20
753      py   -309.72
754      py   -279.24
755      py   -248.76
756      py   -218.28
757      py   -187.80
758      py   -157.32
759      py   -126.84
760      py   -96.36
761      py   -65.88
762      py   -35.40
763      py   -4.92
764      py   25.56

*tr1 31.5119  0 492.4030   -45    90  -135    90  0    90    45    90   -45
*tr2 -31.5119  0 492.4030    45    90   -45    90  0    90   135    90    45
*tr3  0 31.5119 492.4030  0    90    90    90   -45  -135    90    45   -45
*tr4  0 -31.5119 492.4030  0    90    90    90    45   -45    90   135    45
*tr5 45.7200  0 632.4600    45    90   -45    90  0    90   135    90    45
*tr6 -45.7200  0 632.4600   -45    90  -135    90  0    90    45    90   -45
 tr7  0  0  0  1  0  0  0  1  0  0  0  1  1  $   pump
 tr8  0  -1513.2    305.105  1  0  0  0  0  -1  0  1  0  1  $ cask
 tr9  0  -1513.2    0  1  0  0  0  1  0  0  0  1  1  $ truck
mode    p
phys:p  10  1  1
c      447.81*1.446E+07*1000 =6.4753E+12
sdef    cel d1 erg d2  pos fcel d3 rad fcel d4 ext fcel d5 axs fcel d6
        x fcel d7 y fcel d8 z fcel d9
        wgt = 6.4753E+12  eff .001
#        si2    sp2
          l      d
          0       0
         1.500E-02   2.699E+05
         2.500E-02   4.147E+04
         3.750E-02   8.726E+05
         5.750E-02   4.447E+04
         8.500E-02   2.107E+04
         1.250E-01   6.175E+04
         2.250E-01   2.458E+04
         3.750E-01   7.830E+03
         6.620E-01   1.296E+07
         8.500E-01   5.944E+04
         1.250E+00   9.904E+04
         1.750E+00   1.987E+03
         2.250E+00   1.927E-01
         2.750E+00   6.331E-04
         3.500E+00   6.718E-05
         5.000E+00   2.851E-05
         7.000E+00   3.260E-06
         1.100E+01   3.727E-07
c          TOTAL     1.446E+07
#        si1    sp1
          l      d
c     CELL SOURCES  (cell 346 in filled w/ universe 1)
       358:346:68      3086.20
       358:346:65      3086.20
       358:346:67      2387.00
       358:346:63      2369.00
       358:346:11     65740.00
       358:346:2      65280.00
       358:346:9       8959.00
```

```
      358:346:3        8957.00
      358:346:10      16360.00
      358:346:1       16440.00
      358:346:15       4488.00
      358:346:7        4526.00
      358:346:104      1541.00
      358:346:101      1550.00
      358:346:269      1712.00
      358:346:267      1715.00
      358:346:94      28007.65
      358:346:88      12141.96
      358:346:81       9017.55
c
sc3    POSITION
ds3  l  0  0  17.78          $68
        0  0  17.78          $65
       -20.0025  0  0        $67
        20.0025  0  0        $63
       -20.0025  0  0        $11
        20.0025  0  0        $2
        0  0  416.32753      $9
        0  0  416.32753      $3
       -43.0212  0  0        $10
        43.0212  0  0        $1
       -45.7200  0  0        $15
        45.7200  0  0        $7
        0  0  678.18         $104
        0  0  678.18         $101
       -36.2458  0  0        $269
        36.2458  0  0        $267
        0  0  0              $94
        0  0  0              $88
        0  0  0              $81
sc4     RADIUS*************************************
c       68 65 67 63 11  2  9  3 10  1
ds4   s 20 20 21 21 21 21 22 22 21 21
c       15  7 104 101 269  267 94  88  81
        23 23  24  24  21  21  25  26  25
sc5     EXTENT*************************************
c       68 65 67 63 11  2  9  3 10  1
ds5   s 30 31 32 32 33 33 90 90 36 36
c       15  7 104 101 269  267 94  88  81
        37 37  38  38  40  40  41  42  43
sc6     AXIS***************************************
c       68 65 67 63 11  2  9  3 10  1
ds6   s 11 11 13 13 13 13 14 15 13 13
c       15  7 104 101 269  267 94  88  81
        13 13  18  19  13  13  13  13  13
sc7     X******************************************
c        68  65  67  63  11   2   9   3  10   1
ds7   s   0   0   0   0   0   0   0   0   0   0
c        15   7 104 101 269 267  94  88  81
          0   0   0   0   0   0   0   0   0
sc8     Y******************************************
c        68  65  67  63  11   2   9   3  10   1
ds8   s   0   0   0   0   0   0   0   0   0   0
c        15   7 104 101 269 267  94  88  81
          0   0   0   0   0   0   0   0   0
sc9     Z******************************************
c        68  65  67  63  11   2   9   3  10   1
ds9 . s   0   0   0   0   0   0   0   0   0   0
c        15   7 104 101 269 267  94  88  81
          0   0   0   0   0   0   0   0   0
sc20   Cone Radius
si20  0  7
sp20    -21   1
sc21   Pipe Radius
si21  0  7.3165
sp21    -21   1
```

```
sc22   Slant Pipe Radius
si22  0  7.317
sp22    -21   1
sc23   Small Pipe Radius
si23  0  4.859
sp23    -21   1
sc24   Upper Slant Pipe Radius
si24  0  4.86
sp24    -21   1
sc25   INLET LEG Source Radius
si25  28.8925  43.815
sp25    -21   1
sc26   INLET Source Radius
si26  0  35.56
sp26    -21   1
sc200   PLATE Source Radius
si200  0  55.88
sp200    -21   1
sc201   OUTER PLATE Source Radius
si201  55.88   55.98
sp201    -21   1
sc202   NOZZLE FILM Source Radius
si202  6.02   8.32
sp202    -21   1
sc203  END NOZZLE FILM Source Radius
si203  0  8.22
sp203    -21   1
sc204  PIPE CONE FILM Source Radius
si204  7  8.6025
sp204    -21   1
sc205  PIPE FILM Source Radius
si205  8.4137 8.5137
sp205    -21   1
sc206  SLANTED PIPE FILM Source Radius
si206  8.4136 8.5138
sp206    -21   1
sc207  SMALL PIPE FILM Source Radius
si207  5.715 5.815
sp207    -21   1
sc208  SMALL SLANTED PIPE FILM Source Radius
si208  5.714 5.816
sp208    -21   1
sc209  LARGE SLANTED PIPE END CAP FILM Source Radius
si209   12.2
sp209    -21   1
sc210  SMALL SLANTED PIPE END CAP FILM Source Radius
si210   8.4
sp210    -21   1
sc211  large open pipe film Source Radius
si211   18.95 19.05
sp211    -21   1
sc212  large open pipe film Source Radius
si212   20.32 20.42
sp212    -21   1
sc213  inlet film Source Radius
si213   13.235 13.335
sp213    -21   1
sc214  inlet film Source Radius
si214   14.605 14.705
sp214    -21   1
sc215  inlet film Source Radius
si215   14.705 36.83
sp215    -21   1
sc216  inlet film Source Radius
si216   36.83 36.93
sp216    -21   1
sc217  inlet film Source Radius
si217   4.545 36.83
sp217    -21   1
```

```
sc218  rod film Source Radius
si218   4.445 4.545
sp218    -21   1
sc219  inlet cavity film Source Radius
si219   26.8875 45.185
sp219    -21   1
sc220  inlet cavity film Source Radius
si220   26.8875 26.9875
sp220    -21   1
sc221  inlet cavity film Source Radius
si221   45.085 45.185
sp221    -21   1
sc222  pump film Source Radius
si222   28.8925 45.185
sp222    -21   1
sc223  pump film Source Radius
si223   28.8925 28.9925
sp223    -21   1
sc224  pump case film Source Radius
si224   28.9925 45.085
sp224    -21   1
sc225  pump case film Source Radius
si225   45.085  45.185
sp225    -21   1
sc226  pump case film Source Radius
si226   38.2  45.085
sp226    -21   1
sc227  pump case film Source Radius
si227   38.1  38.2
sp227    -21   1
sc228  pump case film Source Radius
si228   18.8  38.2
sp228    -21   1
sc229  flange film Source Radius
si229   20.42  39.37
sp229    -21   1
sc230  flange film Source Radius
si230    39.37 39.47
sp230    -21   1
sc231  pump bottom
si231   4.545  45.185
sp231    -21   1
c       EXTENT CARDS
sc30  Cone Extent
si30  -41.91  -13.2893
sp30   -21 0
sc31  Cone Extent
si31  13.2893 41.91
sp31   -21 0
sc32  Pipe Extent
si32  17.78 39.052
sp32   -21 0
sc33  Pipe Extent
si33  39.052 433.5
sp33   -21 0
sc34  Slant Pipe Extent
si34  -50.3403 -12.6835
sp34   -21 0
sc35  Slant Pipe Extent
si35  12.6853  50.3403
sp35   -21 0
sc36  Upper Pipe Extent
si36  462  565.785
sp36   -21 0
sc37  Small Pipe Extent
si37  565.785 630.5
sp37   -21 0
sc38  Upper Slant Pipe Extent
si38  20 90
```

```
sp38   -21 0
sc39  Upper Slant Pipe Extent
si39  28.89 50.5816
sp39   -21 0
sc40  Upper Pipe Extent
si40  633.5 652.145
sp40   -21 0
sc41  INLET UPPER RING Source Extent
si41  652.145 693.42
sp41   -21 0
sc42  INLET Source Extent
si42  606.425  621.03
sp42   -21 0
sc43  INLET LEG Source Extent
si43  598.805 652.145
sp43   -21 0
c     PLATE SOURCES
sc50  PLATE Source Extent
si50  -0.1 0
sp50   -21 0
sc51  PLATE Source Extent
si51  1.27 1.37
sp51   -21 0
sc52  PLATE Source Extent
si52  68.0037 68.1037
sp52   -21 0
sc53  PLATE Source Extent
si53  68.58 68.68
sp53   -21 0
sc54  PLATE Source Extent
si54  119.28 119.38
sp54   -21 0
sc55  PLATE Source Extent
si55  119.8562 119.9562
sp55   -21 0
sc56  PLATE Source Extent
si56  207.7037 207.8037
sp56   -21 0
sc57  PLATE Source Extent
si57  208.28 208.38
sp57   -21 0
sc58  PLATE Source Extent
si58  258.98 259.08
sp58   -21 0
sc59  PLATE Source Extent
si59  259.5562 259.6562
sp59   -21 0
sc60  PLATE Source Extent
si60  351.8487 351.9487
sp60   -21 0
sc61  PLATE Source Extent
si61  352.425 352.525
sp61   -21 0
sc62  PLATE Source Extent
si62  412.015 412.115
sp62   -21 0
sc63  PLATE Source Extent
si63  412.5912 412.6912
sp63   -21 0
sc64  PLATE Source Extent
si64  503.455 503.555
sp64   -21 0
sc65  PLATE Source Extent
si65  504.0312 504.1312
sp65   -21 0
sc66  PLATE Source Extent
si66  643.155 643.255
sp66   -21 0
sc67  PLATE Source Extent
```

```
si67  643.7312 643.8312
sp67   -21 0
sc68  PLATE Source Extent
si68  800.9525 801.0525
sp68   -21 0
sc69  PLATE Source Extent
si69  801.5287 801.6287
sp69   -21 0
sc70  PLATE Source Extent
si70  889.8525 889.9525
sp70   -21 0
sc71  PLATE Source Extent
si71  890.4356 890.5356
sp71   -21 0
c     PLATE OUTER SOURCES
sc72  OUTER PLATE Source Extent
si72  -0.1 1.37
sp72   -21 0
sc73  OUTER PLATE Source Extent
si73  68.0037  68.68
sp73   -21 0
sc74  OUTER PLATE Source Extent
si74  119.28  119.9562
sp74   -21 0
sc75  OUTER PLATE Source Extent
si75  207.7037  208.38
sp75   -21 0
sc76  OUTER PLATE Source Extent
si76  258.98  259.6562
sp76   -21 0
sc77  OUTER PLATE Source Extent
si77  351.8487  352.525
sp77   -21 0
sc78  OUTER PLATE Source Extent
si78  412.015  412.6912
sp78   -21 0
sc79  OUTER PLATE Source Extent
si79  503.455  504.1312
sp79   -21 0
sc80  OUTER PLATE Source Extent
si80  643.155  643.8312
sp80   -21 0
sc81  OUTER PLATE Source Extent
si81  800.9525  801.6287
sp81   -21 0
sc82  OUTER PLATE Source Extent
si82  889.8525  890.5356
sp82   -21 0
c     PIPE FILM SOURCES
sc83  THIN FILM Cone Extent
si83  -41.91  -12.0920
sp83   -21 0
sc84  THIN FILM Cone Extent
si84  12.0920  41.91
sp84   -21 0
sc85  THIN FILM END Cone Extent
si85  -12.192  -12.092
sp85   -21 0
sc86  THIN FILM END Cone Extent
si86  12.092  12.192
sp86   -21 0
sc87  LOWER SOURCE Pipe Extent
si87  39.052 259.08
sp87   -21 0
sc88  UPPER SOURCE Pipe Extent
si88  259.5562 433.5
sp88   -21 0
sc89  LOWER DUMMY Pipe Extent
si89  1.27 259.08
```

```
sp89   -21 0
sc90  SLANTED PIPE FILM Extent
si90   0 90
sp90   -21 0
sc91  Upper Pipe Extent
si91  462  569.595
sp91   -21 0
sc92  Slanted end cap  Extent
si92  -11.5887  -11.4887
sp92   -21 0
sc93  Slanted end cap  Extent
si93  11.4887 11.5887
sp93   -21 0
sc94  Slanted upper end cap  Extent
si94  -51.535 -51.435
sp94   -21 0
sc95  Slanted upper end cap  Extent
si95  51.435 51.535
sp95   -21 0
sc96  SMALL Slanted end cap  Extent
si96  -51.5604 -51.4604
sp96   -21 0
sc97  SMALL Slanted end cap  Extent
si97  51.4604 51.5604
sp97   -21 0
sc98  SMALL Slanted top top top end cap  Extent
si98  -28.034 -27.934
sp98   -21 0
sc99  SMALL Slanted top top top end cap  Extent
si99  27.934 28.034
sp99   -21 0
sc100 short pipe
si100 630 652.145
sp100  -21 0
sc101 large open pipe
si101 535.94 592.455
sp101  -21 0
sc102 INLET film
si102 596.265 606.425
sp102  -21 0
sc103 INLET film
si103 596.265 605.155
sp103  -21 0
sc104 INLET film
si104 605.055 605.155
sp104  -21 0
sc105 INLET film
si105 605.055 622.4
sp105  -21 0
sc106 INLET film
si106 622.3 622.4
sp106  -21 0
sc107 rod film
si107 622.3 652.145
sp107  -21 0
sc108 inlet cavity film
si108 597.435 597.535
sp108  -21 0
sc109 inlet cavity film
si109 597.535 652.145
sp109  -21 0
sc110 pump film
si110 652.145 694.69
sp110  -21 0
sc111 pump film
si111 694.69  694.79
sp111  -21 0
sc112 pump film
si112 694.79  715.645
```

```
sp112  -21 0
sc113 pump case film
si113 715.545  715.645
sp113  -21 0
sc114 pump case film
si114 715.545  718.6025
sp114  -21 0
sc115 pump case film
si115 718.5025  718.6025
sp115  -21 0
sc116 pump case film
si116 718.5025  782
sp116  -21 0
sc117 pump case film
si117 780.5  791.5275
sp117  -21 0
sc118 UPPER LARGE PIPE film
si118 791.5275  953.77
sp118  -21 0
sc119 flange film
si119 829.845  829.945
sp119  -21 0
sc120 flange film
si120 829.845  839.8875
sp120  -21 0
sc121 flange film
si121 839.7875  839.8875
sp121  -21 0
sc122 dummy cap
si122 569.595  569.695
sp122  -21 0
sc123 pump bottom
si123 652.045  652.145
sp123  -21 0
c      AXIS
sc11   X Axis
si11   l  1 0 0
sp11   1
sc12   Y Axis
si12   l  0 1 0
sp12   1
sc13   Z Axis
si13   l  0 0 1
sp13   1
sc14   Axis -X & Z
si14   l  -.7071068 0 .7071068
sp14   1
sc15.  Axis X & Z
si15   l   .7071068 0 .7071068
sp15   1
sc16   Axis -Y & Z
si16   l  0 -.7071068  .7071068
sp16   1
sc17   Axis  Y & Z
si17   l  0  .7071068  .7071068
sp17   1
sc18   Axis -X & -Z
si18   l  -.7071068 0 -.7071068
sp18   1
sc19   Axis X & -Z
si19   l   .7071068 0 -.7071068
sp19   1
c      X EXTENT
sc300  lower fin
si300  -39  -28.4
sp300  0  1
sc301  lower fin
si301   28.4   39
sp301  0  1
```

```
sc302  lower fin
si302  -.735 .735
sp302  0  1
sc303  upper fin
si303  -50.1062  -28.4
sp303  0  1
sc304  upper fin
si304   28.4   50.1062
sp304  0  1
sc305  pump fin
si305  -49.63  -20
sp305  0  1
sc306  pump fin
si306  20  49.63
sp306  0  1
sc307  pump side
si307  -16.61  -16.51
sp307  0  1
sc308  pump side
si308  16.51  16.61
sp308  0  1
c      Y EXTENT
sc400  lower fin
si400  -.735 .735
sp400  0  1
sc401  lower fin
si401  -39  -28.4
sp401  0  1
sc402  lower fin
si402   28.4   39
sp402  0  1
sc403  upper fin
si403  -50.1062  -28.4
sp403  0  1
sc404  upper fin
si404   28.4   50.1062
sp404  0  1
sc405  pump fin
si405  -49.63  -20
sp405  0  1
sc406  pump fin
si406  20  49.63
sp406  0  1
sc407  pump side
si407  -42 42
sp407  0  1
c      Z EXTENT
sc500  lower fin
si500  71 117
sp500  0  1
sc501  mid fin
si501  210.5 256.6
sp501  0  1
sc502  upper fin
si502  354.9 409.7
sp502  0  1
sc503  pump fin
si503  770.5 889
sp503  0  1
sc504  pump side
si504  597.535 652.145
sp504  0  1
imp:p     1 336r 8 32 2 1 64 128 1 6r 128 3r 1 0 1 1 1 1
          8 32 8 32 8 32 8 32
          256 256 256 256 256
pd0 •     .1 336r 1 1 1 .1 1 1 .1 11r 0 .1 1 1 1
          1 1 1 1 1 1 1 1
          1 1 1 1 1
m1       1001.50 .4372      $H 101 SY Slurry
```

```
         6000.50 .0170      $C
         7014.50 .0579      $N
         8016.50 .3725      $O
        11023.50 .0975      $Na
        13027.50 .0113      $Al
        15031.50 .0011      $P
        17000.50 .0029      $Cl
        19000.50 .0026      $K
m2       8016.50  .21       $O air number fraction
         7014.50  .79       $N
m3      26000.55 1.0        $Fe iron
m4       8016.50 -.4407     $O concrete weight fraction
        14000.50 -.2157     $Si
        20000.50 -.1306     $Ca
        26000.55 -.0788     $Fe
        13027.50 -.0607     $Al
        12000.50 -.0376     $Mg
        19000.50 -.0066     $K
        11023.50 -.0182     $Na
        22000.50 -.0049     $Ti
         1001.50 -.0031     $H
        25055.50 -.0013     $Mn
        15031.50 -.0009     $P
        16032.50 -.0009     $S
m5      14000.50  .2813     $Si  hanford soil number fraction
         8016.50  .6556     $O
        13027.50  .0123     $Al
        26000.55  .0084     $Fe
        20000.50  .0149     $Ca
        12000.50  .0103     $Mg
        19000.50  .0022     $K
        11023.50  .0034     $Na
         1001.50  .0116     $H
m6       6000.50  1.0       $ RUBBER
m7      82000.50  -1.       $LEAD
de0    log  .01 .015 .02 .03   .04  .05
            .06 .08  .10 .15   .20  .30
            .40 .50  .60 .80  1.0  1.5
           2.0 3.0  4.0 5.0   6.0  8.0
           10. 12.
df0    log  2.232e-5 5.652e-5 8.568e-5 1.184e-4 1.314e-4 1.382e-4
            1.440e-4 1.624e-4 1.919e-4 2.797e-4 3.708e-4 5.616e-4
            7.416e-4 9.144e-4 1.076e-3 1.379e-3 1.656e-3 2.246e-3
            2.758e-3 3.672e-3 4.500e-3 5.292e-3 6.012e-3 7.488e-3
            8.892e-3 1.040e-2
prdmp    j -240 1 3
ctme  120
c     idum   -1
fc2   Dose point on surface 641
f2:p   641
fs2    -700 -701 -702 -703 -704 -705 -706 -707 -708 -709
       -710 -711 -712 -713 -714 -715 -716 -717 -718 -719
       -720 -721 -722 -723 -724 -725 -726 -727 -728 -729
       -730 -731 -732 -733 -734 -735 -736 -737 -738 -739
       -740 -741 -742 -743 -744 -745 -746 -747 -748 -749
       -750 -751 -752 -753 -754 -755 -756 -757 -758 -759
       -760 -761 -762 -763 -764
sd2    17755 17755 17755 17755 17755 17755 17755 17755 17755 17755
       17755 17755 17755 17755 17755 17755 17755 17755 17755 17755
       17755 17755 17755 17755 17755 17755 17755 17755 17755 17755
       17755 17755 17755 17755 17755 17755 17755 17755 17755 17755
       17755 17755 17755 17755 17755 17755 17755 17755 17755 17755
       17755 17755 17755 17755 17755 17755 17755 17755 17755 17755
       17755 17755 17755 17755 17755 17755
```

APPENDIX F
MCNP Film Source Shipping Container Calculation (file ifpdc)

```
c     82.43*1.446E+07*1000 =1.192E+12
sdef    cel d1 erg d2 pos fcel d3 rad fcel d4 ext fcel d5 axs fcel d6
        x fcel d7 y fcel d8 z fcel d9
        wgt = 1.192E+12  eff .001
#        si2    sp2
          l      d
           0       0
         1.500E-02   2.699E+05
         2.500E-02   4.147E+04
         3.750E-02   8.726E+05
         5.750E-02   4.447E+04
         8.500E-02   2.107E+04
         1.250E-01   6.175E+04
         2.250E-01   2.458E+04
         3.750E-01   7.830E+03
         6.620E-01   1.296E+07
         8.500E-01   5.944E+04
         1.250E+00   9.904E+04
         1.750E+00   1.987E+03
         2.250E+00   1.927E-01
         2.750E+00   6.331E-04
         3.500E+00   6.718E-05
         5.000E+00   2.851E-05
         7.000E+00   3.260E-06
         1.100E+01   3.727E-07
c          TOTAL     1.446E+07
#        si1    sp1
          l      d
c          UPPER/LOWER PLATE SOURCES
       358:346:193 980.99
       358:346:194 936.50
       358:346:212 889.70
       358:346:211 889.70
       358:346:215 889.70
       358:346:214 889.70
       358:346:217 889.70
       358:346:218 889.70
       358:346:220 889.70
       358:346:221 889.70
       358:346:223 889.70
       358:346:224 889.70
       358:346:226 889.70
       358:346:227 889.70
       358:346:265 890.00
       358:346:264 890.00
       358:346:297 806.70
       358:346:290 805.50
       358:346:321 834.90
       358:346:320 834.90
       358:346:311 849.99
       358:346:310 849.99
c              OUTER PLATE SOURCES
       358:346:195 51.66
       358:346:210 23.77
       358:346:213 23.76
       358:346:216 23.77
       358:346:219 23.76
       358:346:222 23.77
       358:346:225 23.77
       358:346:247 23.76
       358:346:289 23.76
       358:346:322 23.76
       358:346:312 24.01
c              PIPE SURFACE SOURCES
```

```
358:346:199 80.07
358:346:196 79.64
358:346:201 21.14
358:346:197 21.14
358:346:200 82.22
358:346:198 81.68
358:346:202 1114.00
358:346:203 1165.00
358:346:206 858.90
358:346:207 897.40
358:346:204 1373.00
358:346:205 1331.00
358:346:208 901.30
358:346:209 874.70
358:346:252 222.40
358:346:248 222.40
358:346:260 223.40
358:346:256 222.40
358:346:255 520.80
358:346:251 528.30
358:346:263 547.90
358:346:259 538.80
358:346:272 217.60
358:346:271 219.70
358:346:277 61.79
358:346:273 63.19
358:346:253 31.44
358:346:249 33.09
358:346:262 30.81
358:346:257 30.87
358:346:254 32.03
358:346:250 31.84
358:346:261 30.53
358:346:258 31.45
358:346:278 15.16
358:346:274 14.95
358:346:279 9.33
358:346:275 8.82
358:346:281 41.29
358:346:276 41.44
358:346:288 674.68
358:346:287 723.33
358:346:285 84.81
358:346:284 81.86
358:346:286 290.00
358:346:282 283.50
358:346:283 351.50
358:346:280 82.95
358:346:296 126.80
358:346:295 255.40
358:346:292 377.60
358:346:291 1206.54
358:346:303 379.16
358:346:302 379.25
358:346:304 374.51
358:346:305 86.71
358:346:306 180.14
358:346:307 1480.00
358:346:308 319.20
358:346:309 1888.00
358:346:314 346.10
358:346:315 248.00
358:346:313 346.10
358:346:342 22.77
358:346:343 22.77
358:346:344 461.62
c          FIN SURFACE SOURCES
358:346:228 81.84
358:346:231 81.84
```

```
        358:346:232 78.54
        358:346:233 77.27
        358:346:237 79.92
        358:346:236 81.84
        358:346:239 78.54
        358:346:238 77.27
        358:346:244 148.70
        358:346:242 153.40
        358:346:243 146.80
        358:346:246 145.70
        358:346:319 546.50
        358:346:318 561.90
        358:346:317 544.70
        358:346:316 543.50
        358:346:293 181.20
        358:346:294 180.30
sc3     POSITION
c     UPPER/LOWER PLATE SOURCES
ds3   l  0  0  0            $193
         0  0  0            $194
         0  0  0            $212
         0  0  0            $211
         0  0  0            $215
         0  0  0            $214
         0  0  0            $217
         0  0  0            $218
         0  0  0            $220
         0  0  0            $221
         0  0  0            $223
         0  0  0            $224
         0  0  0            $226
         0  0  0            $227
         0  0  0            $265
         0  0  0            $264
         0  0  0            $297
         0  0  0            $290
         0  0  0            $321
         0  0  0            $320
         0  0  0            $311
         0  0  0            $310
c     OUTER PLATE SOURCES
         0  0  0            $195
         0  0  0            $210
         0  0  0            $213
         0  0  0            $216
         0  0  0            $219
         0  0  0            $222
         0  0  0            $225
         0  0  0            $247
         0  0  0            $289
         0  0  0            $322
         0  0  0            $312
c     PIPE SURFACE SOURCES
        0  0  17.78         $199
        0  0  17.78         $196
        0  0  17.78         $201
        0  0  17.78         $197
       -20.0025  0  0       $200
        20.0025  0  0       $198
       -20.0025  0  0       $202
        20.0025  0  0       $203
       -20.0025  0  0       $206
        20.0025  0  0       $207
        0  -20.0025  0      $204
        0   20.0025  0      $205
        0  -20.0025  0      $208
        0   20.0025  0      $209
        0  0  416.32753     $252
        0  0  416.32753     $248
```

```
 0  0  416.32753      $260
 0  0  416.32753      $256
-43.0212  0  0        $255 left source leg
 43.0212  0  0        $251 right source leg
 0 -43.0212  0        $263 left dummy leg
 0  43.0212  0        $259 right dummy leg
-45.7200  0  0        $272 left small leg
 45.7200  0  0        $271 right small leg
 0  0  678.18         $277 small slanted pipe
 0  0  678.18         $273 small slanted pipe
 0  0  427.8          $253 slanted end cap
 0  0  427.8          $249 slanted end cap
 0  0  427.8          $262 slanted end cap
 0  0  427.8          $257 slanted end cap
 0  0  467.8          $254 slanted top end cap
 0  0  467.8          $250 slanted top end cap
 0  0  467.8          $261 slanted top end cap
 0  0  467.8          $258 slanted top end cap
 0  0  626.65         $278 small slanted end cap
 0  0  626.65         $274 small slanted end cap
 0  0  650.2          $279 small slanted top end cap
 0  0  650.2          $275 small slanted top end cap
-36.2458  0  0        $281 Short pipe
 36.2458  0  0        $276 Short pipe
 0  0  0              $288 Large open pipe
 0  0  0              $287 Large open pipe
 0  0  0              $285 INLET
 0  0  0              $284 INLET
 0  0  0              $286 INLET
 0  0  0              $282 INLET
 0  0  0              $283 INLET
 0  0  0              $280 ROD
 0  0  0              $296 Inlet cavity film
 0  0  0              $295 inner Inlet cavity film
 0  0  0              $292 inner Inlet cavity film
 0  0  0              $291 pump film
 0  0  0              $303 pump film
 0  0  0              $302 pump film
 0  0  0              $304 pump case film
 0  0  0              $305 pump case film
 0  0  0              $306 pump case film
 0  0  0              $307 pump case film
 0  0  0              $308 cone pump case film
 0  0  0              $309 UPPER LARGE PIPE film
 0  0  0              $314 flange film
 0  0  0              $315 flange film
 0  0  0              $313 flange film
 0 -43.0212  0        $342 left dummy leg cap
 0  43.0212  0        $343 right dummy leg cap
 0  0  0              $344 below pump
c FIN SURFACE SOURCES
 0  0  0              $228 lower fin
 0  0  0              $231 lower fin
 0  0  0              $232 lower fin
 0  0  0              $233 lower fin
 0  0  0              $237 mid fin
 0  0  0              $236 mid fin
 0  0  0              $239 mid fin
 0  0  0              $238 mid fin
 0  0  0              $244 upper fin
 0  0  0              $242 upper fin
 0  0  0              $243 upper fin
 0  0  0              $246 upper fin
 0  0  0              $319 pump fin
 0  0  0              $318 pump fin
 0  0  0              $317 pump fin
 0  0  0              $316 pump fin
 0  0  0              $293 pump side
 0  0  0              $294 pump side
```

```
sc4     RADIUS****************************************
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds4   s 200 200 200 200 200 200 200 200 200 200
c       223 224 226 227 265 264 297 290 321 320
        200 200 200 200 200 200 200 200 200 200
c       311 310
        200 200
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
        201 201 201 201 201 201 201 201 201 201 201
c       PIPE SURFACE SOURCES
c       199 196 210 197 200 198 202 203 206 207
        202 202 203 203 204 204 205 205 205 205
c       204 205 208 209 252 248 260 256 255 251
        205 205 205 205 206 206 206 206 205 205
c       263 259 272 271 277 273 253 249 262 257
        205 205 207 207 208 208 209 209 209 209
c       254 250 261 258 278 274 279 275 281 276
        209 209 209 209 210 210 210 210 205 205
c       288 287 285 284 286 282 283 280 296 295
        211 212 213 214 215 216 217 218 219 220
c       292 291 303 302 304 305 306 307 308 309
        221 221 222 223 224 225 226 227 228 212
c       314 315 313 342 343 344
        229 230 229 205 205 231
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
          0   0   0   0   0   0   0   0   0   0
c       243 246 319 318 317 316 293 294
          0   0   0   0   0   0   0   0
sc5     EXTENT****************************************
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds5   s  50  51  52  53  54  55  56  57  58  59
c       223 224 226 227 265 264 297 290 321 320
         60  61  62  63  64  65  66  67  68  69
c       311 310
         70  71
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
         72  73  74  75  76  77  78  79  80  81  82
c     PIPE SURFACE SOURCES
c       199 196 201 197 200 198 202 203 206 207
         83  84  85  86  32  32  87  87  88  88
c       204 205 208 209 252 248 260 256 255 251
         89  89  88  88  90  90  90  90  36  36
c       263 259 272 271 277 273 253 249 262 257
         91  91  37  37  38  38  92  93  92  93
c       254 250 261 258 278 274 279 275 281 276
         94  95  94  95  96  97  98  99 100 100
c       288 287 285 284 286 282 283 280 296 295
        101 101 102 103 104 105 106 107 108 109
c       292 291 303 302 304 305 306 307 308 309
        109 110 111 112 113 114 115 116 117 118
c       314 315 313 342 343 344
        119 120 121 122 122 123
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
          0   0   0   0   0   0   0   0   0   0
c       243 246 319 318 317 316 293 294
          0   0   0   0   0   0   0   0
sc6     AXIS******************************************
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds6   s  13  13  13  13  13  13  13  13  13  13
c       223 224 226 227 265 264 297 290 321 320
         13  13  13  13  13  13  13  13  13  13
c       311 310
```

```
          13  13
c        OUTER PLATE SOURCES
c        195 210 213 216 219 222 225 247 289 322 312
          13  13  13  13  13  13  13  13  13  13  13
c      PIPE SURFACE SOURCES
c        199 196 201 197 200 198 202 203 206 207
          11  11  11  11  13  13  13  13  13  13
c        204 205 208 209 252 248 260 256 255 251
          13  13  13  13  14  15  16  17  13  13
c        263 259 272 271 277 273 253 249 262 257
          13  13  13  13  18  19  11  11  12  12
c        254 250 261 258 278 274 279 275 281 276
          11  11  12  12  11  11  11  11  13  13
c        288 287 285 284 286 282 283 280 296 295
          13  13  13  13  13  13  13  13  13  13
c        292 291 303 302 304 305 306 307 308 309
          13  13  13  13  13  13  13  13  13  13
c        314 315 313 342 343 344
          13  13  13  13  13  13
c        FIN SURFACE SOURCES
c        228 231 232 233 237 236 239 238 244 242
           0   0   0   0   0   0   0   0   0   0
c        243 246 319 318 317 316 293 294
           0   0   0   0   0   0   0   0
sc7      X*************************************
c        UPPER/LOWER PLATE SOURCES
c        193 194 212 211 215 214 217 218 220 221
ds7    s   0   0   0   0   0   0   0   0   0   0
c        223 224 226 227 265 264 297 290 321 320
           0   0   0   0   0   0   0   0   0   0
c        311 310
           0   0
c        OUTER PLATE SOURCES
c        195 210 213 216 219 222 225 247 289 322 312
           0   0   0   0   0   0   0   0   0   0   0
c      PIPE SURFACE SOURCES
c        199 196 201 197 200 198 202 203 206 207
           0   0   0   0   0   0   0   0   0   0
c        204 205 208 209 252 248 260 256 255 251
           0   0   0   0   0   0   0   0   0   0
c        263 259 272 271 277 273 253 249 262 257
           0   0   0   0   0   0   0   0   0   0
c        254 250 261 258 278 274 279 275 281 276
           0   0   0   0   0   0   0   0   0   0
c        288 287 285 284 286 282 283 280 296 295
           0   0   0   0   0   0   0   0   0   0
c        292 291 303 302 304 305 306 307  75 309
           0   0   0   0   0   0   0   0   0   0
c        314 315 313 342 343 344
           0   0   0   0   0   0
c        FIN SURFACE SOURCES
c        228 231 232 233 237 236 239 238 244 242
         300 301 302 302 300 301 302 302 303 304
c        243 246 319 318 317 316 293 294
         302 302 305 306 302 302 307 308
sc8      Y*************************************
c        UPPER/LOWER PLATE SOURCES
c        193 194 212 211 215 214 217 218 220 221
ds8    s   0   0   0   0   0   0   0   0   0   0
c        223 224 226 227 265 264 297 290 321 320
           0   0   0   0   0   0   0   0   0   0
c        311 310
           0   0
c        OUTER PLATE SOURCES
c        195 210 213 216 219 222 225 247 289 322 312
           0   0   0   0   0   0   0   0   0   0   0
c      PIPE SURFACE SOURCES
c        199 196 201 197 200 198 202 203 206 207
           0   0   0   0   0   0   0   0   0   0
```

```
c       204 205 208 209 252 248 260 256 255 251
          0   0   0   0   0   0   0   0   0   0
c       263 259 272 271 277 273 253 249 262 257
          0   0   0   0   0   0   0   0   0   0
c       254 250 261 258 278 274 279 275 281 276
          0   0   0   0   0   0   0   0   0   0
c       288 287 285 284 286 282 283 280 296 295
          0   0   0   0   0   0   0   0   0   0
c       292 291 303 302 304 305 306 307  75 309
          0   0   0   0   0   0   0   0   0   0
c       314 315 313 342 343 344
          0   0   0   0   0   0
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
        400 400 401 402 400 400 401 402 400 400
c       243 246 319 318 317 316 293 294
        403 404 400 400 405 406 407 407
sc9     Z*************************************
c       UPPER/LOWER PLATE SOURCES
c       193 194 212 211 215 214 217 218 220 221
ds9   s   0   0   0   0   0   0   0   0   0   0
c       223 224 226 227 265 264 297 290 321 320
          0   0   0   0   0   0   0   0   0   0
c       311 310
          0   0
c       OUTER PLATE SOURCES
c       195 210 213 216 219 222 225 247 289 322 312
          0   0   0   0   0   0   0   0   0   0   0
c     PIPE SURFACE SOURCES
c       199 196 201 197 200 198 202 203 206 207
          0   0   0   0   0   0   0   0   0   0
c       204 205 208 209 252 248 260 256 255 251
          0   0   0   0   0   0   0   0   0   0
c       263 259 272 271 277 273 253 249 262 257
          0   0   0   0   0   0   0   0   0   0
c       254 250 261 258 278 274 279 275 281 276
          0   0   0   0   0   0   0   0   0   0
c       288 287 285 284 286 282 283 280 296 295
          0   0   0   0   0   0   0   0   0   0
c       292 291 303 302 304 305 306 307  75 309
          0   0   0   0   0   0   0   0   0   0
c       314 315 313 342 343 344
          0   0   0   0   0   0
c       FIN SURFACE SOURCES
c       228 231 232 233 237 236 239 238 244 242
        500 500 500 500 501 501 501 501 502 502
c       243 246 319 318 317 316 293 294
        502 502 503 503 503 503 504 504
sc20   Cone Radius
si20  0  7
sp20    -21   1
sc21   Pipe Radius
si21  0  7.3165
sp21    -21   1
sc22   Slant Pipe Radius
si22  0  7.317
sp22    -21   1
sc23   Small Pipe Radius
si23  0  4.859
sp23    -21   1
sc24   Upper Slant Pipe Radius
si24  0  4.86
sp24    -21   1
sc25   INLET LEG Source Radius
si25  28.8925  43.815
sp25    -21   1
sc26   INLET Source Radius
si26  0  35.56
sp26    -21   1
```

```
sc200   PLATE Source Radius
si200  0  55.88
sp200    -21   1
sc201   OUTER PLATE Source Radius
si201  55.88   55.98
sp201    -21   1
sc202   NOZZLE FILM Source Radius
si202  6.02   8.32
sp202    -21   1
sc203  END NOZZLE FILM Source Radius
si203  0  8.22
sp203    -21   1
sc204  PIPE CONE FILM Source Radius
si204  7  8.6025
sp204    -21   1
sc205  PIPE FILM Source Radius
si205  8.4137 8.5137
sp205    -21   1
sc206  SLANTED PIPE FILM Source Radius
si206  8.4136 8.5138
sp206    -21   1
sc207  SMALL PIPE FILM Source Radius
si207  5.715 5.815
sp207    -21   1
sc208  SMALL SLANTED PIPE FILM Source Radius
si208  5.714 5.816
sp208    -21   1
sc209  LARGE SLANTED PIPE END CAP FILM Source Radius
si209   12.2
sp209    -21   1
sc210  SMALL SLANTED PIPE END CAP FILM Source Radius
si210   8.4
sp210    -21   1
sc211  large open pipe film Source Radius
si211   18.95 19.05
sp211    -21   1
sc212  large open pipe film Source Radius
si212   20.32 20.42
sp212    -21   1
sc213  inlet film Source Radius
si213   13.235 13.335
sp213    -21   1
sc214  inlet film Source Radius
si214   14.605 14.705
sp214    -21   1
sc215  inlet film Source Radius
si215   14.705 36.83
sp215    -21   1
sc216  inlet film Source Radius
si216   36.83 36.93
sp216    -21   1
sc217  inlet film Source Radius
si217   4.545 36.83
sp217    -21   1
sc218  rod film Source Radius
si218   4.445 4.545
sp218    -21   1
sc219  inlet cavity film Source Radius
si219   26.8875 45.185
sp219    -21   1
sc220  inlet cavity film Source Radius
si220   26.8875 26.9875
sp220    -21   1
sc221  inlet cavity film Source Radius
si221   45.085 45.185
sp221    -21   1
sc222  pump film Source Radius
si222   28.8925 45.185
sp222    -21   1
```

```
sc223  pump film Source Radius
si223   28.8925 28.9925
sp223    -21   1
sc224  pump case film Source Radius
si224   28.9925 45.085
sp224    -21   1
sc225  pump case film Source Radius
si225   45.085  45.185
sp225    -21   1
sc226  pump case film Source Radius
si226   38.2  45.085
sp226    -21   1
sc227  pump case film Source Radius
si227   38.1  38.2
sp227    -21   1
sc228  pump case film Source Radius
si228   18.8  38.2
sp228    -21   1
sc229  flange film Source Radius
si229   20.42  39.37
sp229    -21   1
sc230  flange film Source Radius
si230    39.37 39.47
sp230    -21   1
sc231  pump bottom
si231   4.545  45.185
sp231    -21   1
c       EXTENT CARDS
sc30  Cone Extent
si30  -41.91  -13.2893
sp30   -21 0
sc31  Cone Extent
si31  13.2893 41.91
sp31   -21 0
sc32  Pipe Extent
si32  17.78 39.052
sp32   -21 0
sc33  Pipe Extent
si33  39.052 433.5
sp33   -21 0
sc34  Slant Pipe Extent
si34  -50.3403 -12.6835
sp34   -21 0
sc35  Slant Pipe Extent
si35  12.6853  50.3403
sp35   -21 0
sc36  Upper Pipe Extent
si36  462  565.785
sp36   -21 0
sc37  Small Pipe Extent
si37  565.785 630.5
sp37   -21 0
sc38  Upper Slant Pipe Extent
si38  20 90
sp38   -21 0
sc39  Upper Slant Pipe Extent
si39  28.89 50.5816
sp39   -21 0
sc40  Upper Pipe Extent
si40  633.5 652.145
sp40   -21 0
sc41  INLET UPPER RING Source Extent
si41  652.145 693.42
sp41   -21 0
sc42  INLET Source Extent
si42  606.425  621.03
sp42   -21 0
sc43  INLET LEG Source Extent
si43  598.805 652.145
```

```
sp43   -21 0
c      PLATE SOURCES
sc50   PLATE Source Extent
si50   -0.1 0
sp50   -21 0
sc51   PLATE Source Extent
si51   1.27 1.37
sp51   -21 0
sc52   PLATE Source Extent
si52   68.0037 68.1037
sp52   -21 0
sc53   PLATE Source Extent
si53   68.58 68.68
sp53   -21 0
sc54   PLATE Source Extent
si54   119.28 119.38
sp54   -21 0
sc55   PLATE Source Extent
si55   119.8562 119.9562
sp55   -21 0
sc56   PLATE Source Extent
si56   207.7037 207.8037
sp56   -21 0
sc57   PLATE Source Extent
si57   208.28 208.38
sp57   -21 0
sc58   PLATE Source Extent
si58   258.98 259.08
sp58   -21 0
sc59   PLATE Source Extent
si59   259.5562 259.6562
sp59   -21 0
sc60   PLATE Source Extent
si60   351.8487 351.9487
sp60   -21 0
sc61   PLATE Source Extent
si61   352.425 352.525
sp61   -21 0
sc62   PLATE Source Extent
si62   412.015 412.115
sp62   -21 0
sc63   PLATE Source Extent
si63   412.5912 412.6912
sp63   -21 0
sc64   PLATE Source Extent
si64   503.455 503.555
sp64   -21 0
sc65   PLATE Source Extent
si65   504.0312 504.1312
sp65   -21 0
sc66   PLATE Source Extent
si66   643.155 643.255
sp66   -21 0
sc67   PLATE Source Extent
si67   643.7312 643.8312
sp67   -21 0
sc68   PLATE Source Extent
si68   800.9525 801.0525
sp68   -21 0
sc69   PLATE Source Extent
si69   801.5287 801.6287
sp69   -21 0
sc70   PLATE Source Extent
si70   889.8525 889.9525
sp70   -21 0
sc71   PLATE Source Extent
si71   890.4356 890.5356
sp71   -21 0
c      PLATE OUTER SOURCES
```

```
sc72  OUTER PLATE Source Extent
si72  -0.1 1.37
sp72   -21 0
sc73  OUTER PLATE Source Extent
si73  68.0037  68.68
sp73   -21 0
sc74  OUTER PLATE Source Extent
si74  119.28  119.9562
sp74   -21 0
sc75  OUTER PLATE Source Extent
si75  207.7037  208.38
sp75   -21 0
sc76  OUTER PLATE Source Extent
si76  258.98  259.6562
sp76   -21 0
sc77  OUTER PLATE Source Extent
si77  351.8487  352.525
sp77   -21 0
sc78  OUTER PLATE Source Extent
si78  412.015  412.6912
sp78   -21 0
sc79  OUTER PLATE Source Extent
si79  503.455  504.1312
sp79   -21 0
sc80  OUTER PLATE Source Extent
si80  643.155  643.8312
sp80   -21 0
sc81  OUTER PLATE Source Extent
si81  800.9525  801.6287
sp81   -21 0
sc82  OUTER PLATE Source Extent
si82  889.8525  890.5356
sp82   -21 0
c     PIPE FILM SOURCES
sc83  THIN FILM Cone Extent
si83  -41.91  -12.0920
sp83   -21 0
sc84  THIN FILM Cone Extent
si84  12.0920  41.91
sp84   -21 0
sc85  THIN FILM END Cone Extent
si85  -12.192  -12.092
sp85   -21 0
sc86  THIN FILM END Cone Extent
si86  12.092  12.192
sp86   -21 0
sc87  LOWER SOURCE Pipe Extent
si87  39.052 259.08
sp87   -21 0
sc88  UPPER SOURCE Pipe Extent
si88  259.5562 433.5
sp88   -21 0
sc89  LOWER DUMMY Pipe Extent
si89  1.27 259.08
sp89   -21 0
sc90  SLANTED PIPE FILM Extent
si90   0 90
sp90   -21 0
sc91  Upper Pipe Extent
si91  462  569.595
sp91   -21 0
sc92  Slanted end cap  Extent
si92  -11.5887  -11.4887
sp92   -21 0
sc93  Slanted end cap  Extent
si93  11.4887 11.5887
sp93   -21 0
sc94  Slanted upper end cap  Extent
si94  -51.535 -51.435
```

```
sp94   -21 0
sc95  Slanted upper end cap  Extent
si95  51.435 51.535
sp95   -21 0
sc96  SMALL Slanted end cap  Extent
si96  -51.5604 -51.4604
sp96   -21 0
sc97  SMALL Slanted end cap  Extent
si97  51.4604 51.5604
sp97   -21 0
sc98  SMALL Slanted top top top end cap  Extent
si98  -28.034 -27.934
sp98   -21 0
sc99  SMALL Slanted top top top end cap  Extent
si99  27.934 28.034
sp99   -21 0
sc100 short pipe
si100 630 652.145
sp100  -21 0
sc101 large open pipe
si101 535.94 592.455
sp101  -21 0
sc102 INLET film
si102 596.265 606.425
sp102  -21 0
sc103 INLET film
si103 596.265 605.155
sp103  -21 0
sc104 INLET film
si104 605.055 605.155
sp104  -21 0
sc105 INLET film
si105 605.055 622.4
sp105  -21 0
sc106 INLET film
si106 622.3 622.4
sp106  -21 0
sc107 rod film
si107 622.3 652.145
sp107  -21 0
sc108 inlet cavity film
si108 597.435 597.535
sp108  -21 0
sc109 inlet cavity film
si109 597.535 652.145
sp109  -21 0
sc110 pump film
si110 652.145 694.69
sp110  -21 0
sc111 pump film
si111 694.69  694.79
sp111  -21 0
sc112 pump film
si112 694.79  715.645
sp112  -21 0
sc113 pump case film
si113 715.545  715.645
sp113  -21 0
sc114 pump case film
si114 715.545  718.6025
sp114  -21 0
sc115 pump case film
si115 718.5025  718.6025
sp115  -21 0
sc116 pump case film
si116 718.5025  782
sp116  -21 0
sc117 pump case film
si117 780.5  791.5275
```

```
sp117  -21 0
sc118 UPPER LARGE PIPE film
si118 791.5275  953.77
sp118  -21 0
sc119 flange film
si119 829.845  829.945
sp119  -21 0
sc120 flange film
si120 829.845  839.8875
sp120  -21 0
sc121 flange film
si121 839.7875  839.8875
sp121  -21 0
sc122 dummy cap
si122 569.595  569.695
sp122  -21 0
sc123 pump bottom
si123 652.045  652.145
sp123  -21 0
c      AXIS
sc11   X Axis
si11   l  1 0 0
sp11   1
sc12   Y Axis
si12   l  0 1 0
sp12   1
sc13   Z Axis
si13   l  0 0 1
sp13   1
sc14   Axis -X & Z
si14   l  -.7071068 0 .7071068
sp14   1
sc15   Axis X & Z
si15   l   .7071068 0 .7071068
sp15   1
sc16   Axis -Y & Z
si16   l  0 -.7071068  .7071068
sp16   1
sc17   Axis  Y & Z
si17   l  0  .7071068  .7071068
sp17   1
sc18   Axis -X & -Z
si18   l  -.7071068 0 -.7071068
sp18   1
sc19   Axis X & -Z
si19   l   .7071068 0 -.7071068
sp19   1
c      X EXTENT
sc300  lower fin
si300  -39  -28.4
sp300  0  1
sc301  lower fin
si301   28.4   39
sp301  0  1
sc302  lower fin
si302  -.735 .735
sp302  0  1
sc303  upper fin
si303  -50.1062  -28.4
sp303  0  1
sc304  upper fin
si304   28.4   50.1062
sp304  0  1
sc305  pump fin
si305  -49.63  -20
sp305  0  1
sc306  pump fin
si306  20  49.63
sp306  0  1
```

```
sc307  pump side
si307  -16.61  -16.51
sp307  0  1
sc308  pump side
si308  16.51  16.61
sp308  0  1
c      Y EXTENT
sc400  lower fin
si400  -.735 .735
sp400  0  1
sc401  lower fin
si401  -39  -28.4
sp401  0  1
sc402  lower fin
si402   28.4   39
sp402  0  1
sc403  upper fin
si403  -50.1062  -28.4
sp403  0  1
sc404  upper fin
si404   28.4   50.1062
sp404  0  1
sc405  pump fin
si405  -49.63  -20
sp405  0  1
sc406  pump fin
si406  20  49.63
sp406  0  1
sc407  pump side
si407  -42 42
sp407  0  1
c      Z EXTENT
sc500  lower fin
si500  71 117
sp500  0  1
sc501  mid fin
si501  210.5 256.6
sp501  0  1
sc502  upper fin
si502  354.9 409.7
sp502  0  1
sc503  pump fin
si503  770.5 889
sp503  0  1
sc504  pump side
si504  597.535 652.145
sp504  0  1
```