APPENDIX A

DESCRIPTIVE DATA ASSUMED FOR EACH PARAMETRIC CASE

Table A-1(a) Plant Parameters for Parametric Study										
Parametric Case	Containment Type	Cont. Inside Diameter	Cont. Free Volume	Cont. Spray Act. Set Point	Switchover Pool Height	Switchover Time	Maximum Pool Height	Maximum Time to Switchover	Sump Location	Sump-Screen Hole Size
Units	-	ft	ft^3	psig	ft	min	ft	min	-	in.
1	Dry	105	?	30	5.3	30	5.5	65	exposed	0.125
2	Dry	135	2.980	18.2	2.24	9.59	4.7	18.37	remote	0.115
3	Dry	146	2.600	8.5	4.5	20	11	20	remote	0.09
4	Ice	115	?	2.9	5.5	20	14	58	?	0.204
5	Dry	116	1.550	?	2.93	15.2	4.75	43	int. exp.	0.25
6	Ice	115	?	2.9	?	?	?	?	int. exp.	0.250
7	Dry	140	2.900	20	0.82	13.23	6.1	15	?	0.152
8	Ice	115	?	2.9	5.5	20	14	58	?	0.204
9	Dry	140	2.700	21.5	3.5	35	9.41	63	remote	0.12
10	Dry	150	2.340	14	1.92	20	7.5	30	int. exp.	0.3
11	Dry	130	2.000	4.75	5.25	480	5.25	480	exposed	0.224
12	Dry	126	?	?	5.33	25	6.89	33	?	0.25
13	Dry	130	2.000	30	1.74	29.17	5.89	29.17	remote	0.125
14	Dry	116	2.090	30	6	25	9.18	25	exposed	0.132
15	Dry	140	2.700	18	3.84	21.3	4.14	25.9	?	0.097
16	Dry	130	2.000	4.75	5.25	480	5.25	480	exposed	0.224
17	Dry	110	1.050	5	5.4	20	6.78	24	remote	0.1783
18	Ice	106	?	2.81	2.5	30	13.2	60	exposed	0.25
19	Dry	135	2.610	22	2.1	13.3	4.1	166.1	int. exp.	0.125
20	Dry	140	2.700	21.5	3.5	35	9.41	63	remote	0.12
21	Dry	140	2.680	3	5.43	20	11.45	20	remote	0.078
22	Dry	130	2.100	25	1.5	25	5.5	52	?	0.221
23	Dry	135	2.980	18.2	2.24	9.59	4.7	18.37	remote	0.115
24	Dry	140	2.900	20	0.82	13.23	6.1	15	?	0.152
25	Dry	150	3.300	9.5	3.6	?	?	?	remote	0.25
26	Dry	116	1.910	10	4.27	30	4.27	30	exposed	0.12
27	Dry	135	2.500	27	2.12	14	4.41	26	remote	0.125
28	Dry	140	2.620	25.3	3.67	15	5.5	23	remote	0.125
29	Dry	140	2.900	20	0.82	13.23	6.1	15	?	0.152
30	Dry	140	2.630	22	2.73	14.4	5.42	57.5	int. exp.	0.125
31	Dry	140	2.900	20	0.82	13.23	6.1	15	?	0.152
32	Sub	126	?	13.05	0.9	3.42	6.1	89	exposed	0.1197
33	Dry	140	2.500	27	1.9	13	4.5	26	?	0.25
34	Dry	105	?	23	3.25	12	8.5	24	int. exp.	?
35	Dry	116	1.550	?	2.93	15.2	4.75	43	int. exp.	0.25
36	Dry	130	2.000	30	4	27	7	40	remote	0.25
37	Sub	126	1.800	10.3	0.7	2.2	4.7	73	exposed	0.75
38	Dry	146	2.600	8.5	4.5	20	11	20	remote	0.09

Table A-1(a) Plant Parameters for Parametric Study (cont)										
Parametric Case	Containment Type	Cont. Inside Diameter	Cont. Free Volume	Cont. Spray Act. Set Point	Switchover Pool Height	Switchover Time	Maximum Pool Height	Maximum Time to Switchover	Sump Location	Sump-Screen Hole Size
Units	-	ft	ft^3	psig	ft	min	ft	min	-	in.
39	Dry	130	2.500	10	3	25	7.3	29	int. exp.	0.125
40	Sub	126	1.800	8	5.8	45	9.9	201	remote	0.094
41	Ice	115	1.220	3	7	20	21	100	?	0.12
42	Dry	140	2.620	25.3	3.67	15	5.5	23	remote	0.125
43	Dry	140	2.630	22	2.73	14.4	5.42	57.5	int. exp.	0.125
44	Dry	130	2.030	27	3.5	21.67	9.5	29	int. exp.	0.12
45	Dry	116	1.600	3.7	3.5	20	6.83	20	?	0.132
46	Dry	140	2.500	?	2.13	25.54	2.25	26	int. exp.	0.25
47	Dry	135	2 610	24	1.75	22.12	3.5	45	int. exp.	0.25
48	Sub	126	?	13.05	0.9	3.42	6.1	89	exposed	0.1197
49	Ice	115	?	3	8.52	10.2	14.42	15	exposed	0.25
50	Ice	115	1.220	3	7	20	21	100	?	0.12
51	Dry	116	1.780	8.6	7	30	11.5	30	remote	0.1875
52	Dry	146	2.600	8.5	4.5	20	11	20	remote	0.09
53	Ice	115	?	2.9	?	?	?	?	int. exp.	0.250
54	Dry	105	?	30	5.3	30	5.5	65	exposed	0.125
55	Dry	130	1.920	9.48	4.59	30	7.6	30	exposed	0.09375
56	Dry	130	2.030	27	3.5	21.67	9.5	29	int. exp.	0.12
57	Dry	108	?	23	3.5	12.4	8	30.9	int. exp.	1
58	Sub	140	1.030	8	?	?	?	?	?	?
59	Sub	126	1.800	10.3	0.7	2.2	4.7	73	exposed	0.75
60	Dry	105	0.997	28	2.78	43	5.4	43	exposed	0.1875
61	Dry	105	?	23	3.25	12	8.5	24	int. exp.	?
62	Dry	150	2.340	14	1.92	0.33	7.5	0.5	int. exp.	0.3
63	Dry	116	1.910	10	4.27	30	4.27	30	exposed	0.12
64	Ice	106	?	2.81	2.5	30	13.2	60	exposed	0.25
65	Dry	116	1.910	10	4.27	30	4.27	30	exposed	0.12
66	Sub	126	1.800	8	5.8	45	9.9	201	remote	?
67	Dry	150	3.300	9.5	3.6	?	?	?	remote	0.25
68	Dry	140	2.500	?	0.5	20	2.75		int. exp.	0.25
69	Dry	130	2.870	23	2	35	6.7	35	?	0.25

Table A-1(b) Additional Plant Parameters for Parametric Study

Parametric Case	Total Screen Area	Height of Sump Screen	Area at Switchover	Area at Maximum Pool Depth	Reported NPSH Margin	Fibrous Insulation	Reflective Metallic Insulation	Part. (Cal-Sil) Insulation	Other Insulation	Dominant Fiber	Type of Other Insulation
Units	ft^2	ft	ft^2	ft^2	ft-water	%	%	%	%	-	-
1	42.4	6	37.5	38.9	10.02	yes	yes	yes	0	FG/Wool/Tmat	
2	260	6.25	93.2	195.5	5	13 4	85.7	0.9	0	Transco	
3	210	4.5	210	210	3.8	20.0	80.0	0	0	NUKON/Tmat	
4	135	?	67.5	135	1.7	50	50	<1	<<1	?	
5	51.31	1	51.31	51.31	8.2	yes	yes	yes	0	NUKON/Wool	
6	66	5.25	66	66	9	21	33	46	0	?	
7	12.67	1.5	6.93	12.67	4.3	0	100	0	0	?	
8	135	?	67.5	135	1.7	50	50	<1	<<1	?	
9	11.64	0	11.64	11.64	2.6	100.0	0	0	0	NUKON	
10	104	3.5	20.4	104	1.9	yes	yes	yes	yes	FG/Wool	Foam
11	229	3.5	229	229	3	80.0	0	20.0	0	FG/Wool/Tmat	
12	93.2	below	93.2	93.2		yes	yes	0	0	Temp Mat	
13	214.4	below	214.4	214.4		9.0	91.0	0	0	NUKON	
14	204	4.75	204	204	0.96	17.4	67.5	15.2	0	?	
15	368	2.2	368	368	0.54	100	0	0	0	NUKON	
16	229	3.5	229	229	3	80.0	0	20.0	0	FG/Wool/Tmat	
17	57	3.5	57	57	1.1	74.6	0	25.4	0	FG/Wool	
18	28.4	3	23.67	28.4	9.26	0	100	0	0	?	
19	36.1	below	36.1	36.1	3.3	36.0	10.0	39.3	14.7	Wool/FG	Gyp, Foam, Poly
20	11.64	0	11.64	11.64	2.6	100.0	0	0	0	NUKON	
21	225	5	225	225	7.35	85	15	0	0	FG/Tmat	
22	85.4	0	85.4	85.4	4.2	yes	yes	yes	0	FG/Wool/Tmat	
23	260	6.25	93.2	195.5	5	13.4	85.7	0.9	0	Transco	
24	12.67	1.5	6.93	12.67	4.3	0	100	0	0	?	
25	414	3	414	414	3.5	yes	yes	0	0	?	
26	93	below	93	93	1.5	20.0	75.0	5.0	0	FG/Wool	
27	392	8.667	95.9	199.5	0.9	yes	yes	0	yes	NUKON	
28	134	3.75	131.1	134	1.1	55.0	30.0	15.0	0	NUKON/Wool	
29	12.67	1.5	6.93	12.67	4.3	0	100	0	0	?	
30	127.93	5	44.94	62.1	3.6	1	50	48	1	?	
31	12.67	1.5	6.93	12.67	4.3	0	100	0	0	?	
32	168	6.25	24.2	164	0.7	65.0	30.0	5.0	0	FG/Wool	
33	692	7	187.8	444.9	0.9	yes	yes	yes	?	?	
34	51	2.75	51	51	13	3.7	96.3	0	0	?	
35	62.75	1	62.75	62.75	8.2	yes	yes	yes	0	NUKON/Wool	
36	86.4	below	86.4	86.4	1.3	50.0	30 0	0	20.0	NUKON/Wool	Neoprene
37	158	5	22.1	148.5	0.83	35.0	60.0	5.0	0	FG/Wool	

Table A-1(b) Additional Plant Parameters for Parametric Study (cont)											
Parametric Case	Total Screen Area	Height of Sump Screen	Area at Switchover	Area at Maximum Pool Depth	Reported NPSH Margin	Fibrous Insulation	Reflective Metallic Insulation	Part. (Cal-Sil) Insulation	Other Insulation	Dominant Fiber	Type of Other Insulation
Units	ft^2	ft	ft^2	ft^2	ft-water	%	%	%	%	-	-
38	210	4.5	210	210	3.8	20.0	80.0	0	0	NUKON/Tmat	
39	318	3	318	318	?	40.0	60.0	0	0	NUKON/Tranco	
40	201	5	201	201	0.9	10	75	15	0	?	
41	330	6	330	330	5.25	60.0	40.0	0	0	?	Armaflex (Foam)
42	134	3.75	131.1	134	3.9	55.0	30.0	15.0	0	NUKON/Wool	
43	127.93	5	45.65	59.89	3.6	1	50	48	1	?	
44	37.5	2.5	37.5	37.5	1.3	0.5	80.0	0.0	19.5	Temp Mat	Foam
45	70	0	70	70	0	yes	yes	yes	0	FG/Wool	
46	571	0	571	571	1.07	87.0	10.0	3.0	0	NUKON/Wool	
47	48	0	48	48	0.97	31.9	8.9	42.2	17.0	Tmat/FG	Foam
48	168	6.25	24.2	164	0.7	65.0	30.0	5.0	0	FG/Wool	
49	187.2	8	187.2	187.2	1.7	0	95.0	0	5.0	?	
50	330	6	330	330	5.25	20.0	80.0	0	0	?	Armaflex (Foam)
51	150	7	150	150	0.62	9.3	31.7	59.0	0	?	
52	210	4.5	210	210	3.8	20.0	80.0	0	0	NUKON/Tmat	
53	66	5.25	66	66	9	21	33	46	0	?	
54	42.4	6	37.5	38.9	10.02	yes	yes	yes	0	FG/Wool/Tmat	
55	115.4	0	115.4	115.4	1.01	yes	yes	yes	0.0	NUKON/Wool	
56	37.5	2.5	37.5	37.5	1.3	0.5	80.0	0.0	19.5	Temp Mat	Foam
57	39.62	5.083	27.3	39.6	17	1	61	38	0	?	
58	?	?	?	?	15.1	?	?	?	?	?	
59	158	5	22.1	148.5	0.83	35.0	60.0	5.0	0	FG/Wool	
60	108	below	108	108	5.6	44.5	6.4	12.7	36.4	?	Vinycel (resin)
61	51	2.75	51	51	13	3.7	96.3	0	0	?	
62	104	3.5	20.4	104	1.9	yes	yes	yes	yes	FG/Wool	Foam
63	93	below	93	93	1.5	20.0	75.0	5.0	0	FG/Wool	
64	28.4	3	23.67	28.4	9.26	0	100	0	0	?	
65	93	below	93	93	1.5	20.0	75.0	5.0	0	FG/Wool	
66	224	5	224	224	0.6	0	80	20	0	?	
67	414	3	414	414	3.5	yes	yes	0	0	?	
68	370	0	370	370	2.1	15.0	60 0	25.0	0	NUKON/Wool	
69	125	2	125	125	2.4	2.0	98.0	0	0	NUKON	

Table A-2 Data Used in Calculation of Head Loss – ECCS/Screen Characteristics						
#	SLOCA Flow Rate (gpm)	Full Flow (gpm)	Fav. Screen Area (ft^2)	Unfav. Screen Area (ft^2)	Fav. ΔH_f (ft)	Unfav. ΔH_f (ft)
1	2500	7600	38.87	37.45	0	0
2	2500	18424	195.52	93.18	1.1	1.1
3	8900	19740	210.00	210.00	3.9	1.84
4	8900	18416	135.00	67.50	4.3	0.41
5	8900	10000	51.31	51.31	1.5	1.5
6	8900	15600	66.00	66.00	2.35	1.12
7	2500	14200	12.67	6.93	4.3	0.41
8	8900	18416	135.00	67.50	0.7	0.45
9	2500	14200	11.64	11.64	2.75	2.65
10	2500	16000	104.00	20.40	3.8	3.8
11	8900	10498	229.00	229.00	12	0
12	8900	7600	93.20	93.20	12	0
13	2500	10000	214.40	214.40	12	0
14	2500	10720	204.00	204.00	3.8	3.8
15	2500	14200	368.00	368.00	9	9
16	8900	10498	229.00	229.00	12	0
17	8900	15100	57.00	57.00	4.3	0.41
18	8900	15600	28.40	23.67	2.75	2.65
19	2500	10300	36.10	36.10	0.9	0.9
20	2500	14200	11.64	11.64	2.35	1.12
21	8900	16000	225.00	225.00	3.5	3.5
22	2500	10498	85.40	85.40	3.5	3.5
23	2500	18424	195.52	93.18	3	3
24	2500	14200	12.67	6.93	2.6	2.6
25	8900	17400	414.00	414.00	15.1	0
26	8900	10720	93.00	93.00	12	0
27	2500	19920	199.46	95.89	2.4	2.4
28	2500	17500	134.00	131.14	1.7	1.7
29	2500	14200	12.67	6.93	1.9	0.96
30	2500	11836	62.10	44.94	7.35	7.35
31	2500	14200	12.67	6.93	1.7	1.7
32	8900	12100	163.97	24.19	1.3	1.3
33	2500	10008	444.86	187.83	3	3
34	2500	7600	51.00	51.00	0.97	0.97
35	8900	10000	62.75	62.75	9.26	1.25

Table A-2 Data used in Calculation of Head Loss – ECCS/Screen Characteristics (cont)						
#	SLOCA Flow Rate (gpm)	Full Flow (gpm)	Fav. Screen Area (ft^2)	Unfav. Screen Area (ft^2)	Fav. ΔH_f (ft)	Unfav. ΔH_f (ft)
36	2500	11000	86.40	86.40	9.26	1.25
37	8900	10000	148.52	22.12	13	13
38	8900	19740	210.00	210.00	5.25	5.25
39	8900	12114	318.00	318.00	12	0
40	8900	15960	201.00	201.00	9	9
41	8900	15600	330.00	330.00	0.54	0.54
42	2500	17500	134.00	131.14	5.25	5.25
43	2500	11836	59.89	45.65	2.6	2.6
44	2500	17610	37.50	37.50	4.3	0.41
45	8900	9625	70.00	70.00	0.9	0.9
46	8900	15330	571.00	571.00	5.6	5.6
47	2500	13314	48.00	48.00	1.5	1.5
48	8900	12100	163.97	24.19	8.2	8.2
49	8900	15600	187.20	187.20	2.1	2.1
50	8900	15600	330.00	330.00	0.96	0.96
51	8900	17050	150.00	150.00	1.7	1.7
52	8900	19740	210.00	210.00	3.6	1.37
53	8900	15600	66.00	66.00	4.2	4.2
54	2500	7600	38.87	37.45	1.3	1.3
55	8900	10480	115.40	115.40	0.9	0.9
56	2500	17610	37.50	37.50	1.1	1.1
57	2500	9200	39.62	27.28	3.6	1.37
58	8900	15900	800.00	10.00	13	0
59	8900	10000	148.52	22.12	1.9	1.9
60	2500	5600	108.00	108.00	0.7	0.45
61	2500	7600	51.00	51.00	1.07	1.07
62	2500	16000	104.00	20.40	0.62	0.62
63	8900	10720	93.00	93.00	3.8	3.8
64	8900	15600	28.40	23.67	1.01	1.01
65	8900	10720	93.00	93.00	0.83	0.35
66	8900	15800	224.00	224.00	8.2	8.2
67	8900	17400	414.00	414.00	17	1.75
68	8900	15300	370.00	370.00	0.83	0.35
69	2500	11000	125.00	125.00	3.3	3.3

Table A-3 Data Used in Calculation of Head Loss – Insulation Characteristics												
#	Favorable Fiber	Favorable RMI	Favorable Particulate	Unfav. Fiber	Unfav. RMI	Unfav. Particulate	Favorable Fiber Fab Density (lbm/ft^3)	Unfav. Fiber Fab Density (lbm/ft^3)	Favorable Fiber Mat Density (lbm/ft^3)	Unfav. Fiber Mat Density (lbm/ft^3)	Favorable Svf (ft^2/ft^3)	Unfav. Svf (ft^2/ft^3)
1	0.050	0.850	0.010	0.500	0.010	0.490	2.4	11.3	175	159	171000	137000
2	0.134	0.857	0.009	0.134	0.857	0.009	2.4	2.4	175	175	171000	171000
3	0.200	0.800	0.000	0.200	0.800	0.000	2.4	11.3	175	159	171000	137000
4	0.500	0.500	0.000	0.500	0.500	0.000	2.4	11.3	175	159	171000	137000
5	0.050	0.850	0.100	0.500	0.010	0.490	2.4	8.0	175	160	171000	96000
6	0.210	0.330	0.460	0.210	0.330	0.460	2.4	11.3	175	159	171000	137000
7	0.000	1.000	0.000	0.000	1.000	0.000	2.4	11.3	175	159	171000	137000
8	0.500	0.500	0.000	0.500	0.500	0.000	2.4	11.3	175	159	171000	137000
9	1.000	0.000	0.000	1.000	0.000	0.000	2.4	2.4	175	175	171000	171000
10	0.050	0.850	0.100	0.500	0.010	0.490	2.4	8.0	175	160	171000	96000
11	0.800	0.000	0.200	0.800	0.000	0.200	2.4	11.3	175	159	171000	137000
12	0.050	0.950	0.000	0.990	0.010	0.000	11.3	11.3	159	159	137000	137000
13	0.090	0.910	0.000	0.090	0.910	0.000	2.4	2.4	175	175	171000	171000
14	0.174	0.675	0.152	0.174	0.675	0.152	2.4	11.3	175	159	171000	137000
15	1.000	0.000	0.000	1.000	0.000	0.000	2.4	2.4	175	175	171000	171000
16	0.800	0.000	0.200	0.800	0.000	0.200	2.4	11.3	175	159	171000	137000
17	0.746	0.000	0.254	0.746	0.000	0.254	2.4	8.0	175	160	171000	96000
18	0.000	1.000	0.000	0.000	1.000	0.000	2.4	8.0	175	160	171000	96000
19	0.360	0.100	0.393	0.360	0.100	0.393	2.4	8.0	175	160	171000	96000
20	1.000	0.000	0.000	1.000	0.000	0.000	2.4	2.4	175	175	171000	171000
21	0.850	0.150	0.000	0.850	0.150	0.000	2.4	11.3	175	159	171000	137000
22	0.800	0.000	0.200	0.800	0.000	0.200	2.4	11.3	175	159	171000	137000
23	0.134	0.857	0.009	0.134	0.857	0.009	2.4	2.4	175	175	171000	171000
24	0.000	1.000	0.000	0.000	1.000	0.000	2.4	11.3	175	159	171000	137000

Table A-3 Data used in Calculation of Head Loss – Insulation Characteristics (cont.)												
#	Favorable Fiber	Favorable RMI	Favorable Particulate	Unfav. Fiber	Unfav. RMI	Unfav. Particulate	Favorable Fiber Fab Density (lbm/ft^3)	Unfav. Fiber Fab Density (lbm/ft^3)	Favorable Fiber Mat Density (lbm/ft^3)	Unfav. Fiber Mat Density (lbm/ft^3)	Favorable Svf (ft^2/ft^3)	Unfav. Svf (ft^2/ft^3)
25	0.050	0.950	0.000	0.990	0.010	0.000	2.4	8.0	175	160	171000	96000
26	0.200	0.750	0.050	0.200	0.750	0.050	2.4	8.0	175	160	171000	96000
27	0.050	0.950	0.000	0.990	0.010	0.000	2.4	2.4	175	175	171000	171000
28	0.550	0.300	0.150	0.550	0.300	0.150	2.4	8.0	175	160	171000	96000
29	0.000	1.000	0.000	0.000	1.000	0.000	2.4	11.3	175	159	171000	137000
30	0.010	0.500	0.480	0.010	0.500	0.480	2.4	11.3	175	159	171000	137000
31	0.000	1.000	0.000	0.000	1.000	0.000	2.4	11.3	175	159	171000	137000
32	0.650	0.300	0.050	0.650	0.300	0.050	2.4	8.0	175	160	171000	96000
33	0.050	0.850	0.100	0.500	0.010	0.490	2.4	11.3	175	159	171000	137000
34	0.037	0.963	0.000	0.037	0.963	0.000	2.4	11.3	175	159	171000	137000
35	0.050	0.850	0.100	0.500	0.010	0.490	2.4	8.0	175	160	171000	96000
36	0.500	0.300	0.000	0.500	0.300	0.000	8.0	8.0	160	160	96000	96000
37	0.350	0.600	0.050	0.350	0.600	0.050	2.4	8.0	175	160	171000	96000
38	0.200	0.800	0.000	0.200	0.800	0.000	2.4	11.3	175	159	171000	137000
39	0.400	0.600	0.000	0.400	0.600	0.000	2.4	2.4	175	175	171000	171000
40	0.100	0.750	0.150	0.100	0.750	0.150	2.4	11.3	175	159	171000	137000
41	0.600	0.400	0.000	0.600	0.400	0.000	2.4	11.3	175	159	171000	137000
42	0.550	0.300	0.150	0.550	0.300	0.150	2.4	8.0	175	160	171000	96000
43	0.010	0.500	0.480	0.010	0.500	0.480	2.4	11.3	175	159	171000	137000
44	0.005	0.800	0.000	0.005	0.800	0.000	11.3	11.3	159	159	137000	137000
45	0.050	0.850	0.100	0.500	0.010	0.490	2.4	8.0	175	160	171000	96000
46	0.870	0.100	0.030	0.870	0.100	0.030	2.4	8.0	175	160	171000	96000
47	0.319	0.089	0.422	0.319	0.089	0.422	2.4	11.3	175	159	171000	137000
48	0.650	0.300	0.050	0.650	0.300	0.050	2.4	8.0	175	160	171000	96000
49	0.000	0.950	0.000	0.000	0.950	0.000	2.4	11.3	175	159	171000	137000

Table A-3 Data used in Calculation of Head Loss – Insulation Characteristics (cont.)												
#	Fav. Fib	Fav. RMI	Fav. Mic	Unfav. Fib	Unfav. RMI	Unfav. Mic	Fav. Fiber Fab Den (lbm/ft3)	Unfav. Fiber Fab Den (lbm/ft3)	Fav. Fiber Mat Den (lbm/ft3)	Unfav. Fiber Mat Den (lbm/ft3)	Fav. Svf (ft2/ft3)	Unfav. Svf (ft2/ft3)
50	0.200	0.800	0.000	0.200	0.800	0.000	2.4	11.3	175	159	171000	137000
51	0.093	0.317	0.590	0.093	0.317	0.590	2.4	11.3	175	159	171000	137000
52	0.200	0.800	0.000	0.200	0.800	0.000	2.4	11.3	175	159	171000	137000
53	0.210	0.330	0.460	0.210	0.330	0.460	2.4	11.3	175	159	171000	137000
54	0.050	0.850	0.100	0.500	0.010	0.490	2.4	11.3	175	159	171000	137000
55	0.050	0.850	0.100	0.500	0.010	0.490	2.4	11.3	175	159	171000	137000
56	0.005	0.800	0.000	0.005	0.800	0.000	11.3	11.3	159	159	137000	137000
57	0.010	0.610	0.380	0.010	0.610	0.380	2.4	11.3	175	159	171000	137000
58	0.050	0.850	0.100	0.800	0.000	0.200	2.4	11.3	175	159	171000	137000
59	0.350	0.600	0.050	0.350	0.600	0.050	2.4	8.0	175	160	171000	96000
60	0.445	0.040	0.127	0.445	0.040	0.127	2.4	11.3	175	159	171000	137000
61	0.037	0.963	0.000	0.037	0.963	0.000	2.4	11.3	175	159	171000	137000
62	0.050	0.850	0.100	0.500	0.010	0.490	2.4	8.0	175	160	171000	96000
63	0.200	0.750	0.050	0.200	0.750	0.050	2.4	8.0	175	160	171000	96000
64	0.000	1.000	0.000	0.000	1.000	0.000	2.4	8.0	175	160	171000	96000
65	0.200	0.750	0.050	0.200	0.750	0.050	2.4	8.0	175	160	171000	96000
66	0.000	0.800	0.200	0.000	0.800	0.200	2.4	11.3	175	159	171000	137000
67	0.050	0.950	0.000	0.990	0.010	0.000	2.4	8.0	175	160	171000	96000
68	0.150	0.600	0.250	0.150	0.600	0.250	2.4	8.0	175	160	171000	96000
69	0.020	0.980	0.000	0.020	0.980	0.000	2.4	2.4	175	175	171000	171000

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Table A-4 Determination of Screen Submerged Fraction/Area for Use in ΔH Calculations										
	Switchover		Maximum Pool		Total Screen Area (ft^2)	Height of Screen (ft)	Submerged Fraction		Submerged Area	
ID No.	Pool Height (ft)	Time (min)	Pool Height (ft)	Time (min)			Low	High	Unfav. Area (ft^2)	Fav. Area (ft^2)
1	5.3	30	5.5	65	42.4	6	0.88	0.92	37.5	38.9
2	2.24	9.59	4.7	18.37	260	6.25	0.36	0.75	93.2	195.5
3	4.5	20	11	20	210	4.5	1	1	210	210
4	5.5	20	14	58	135	Unknown	0.5	1	67.5	135
5	2.93	15.2	4.75	43	51.31	1	1	1	51.31	51.31
6	Unknown	Unknown	Unknown	Unknown	66	5.25	1	1	66.0	66.0
7	0.82	13.23	6.1	15	12.67	1.5	0.55	1	6.93	12.67
8	5.5	20	14	58	135	Unknown	0.5	1	67.5	135
9	3.5	35	9.41	63	11.64	0	1	1	11.64	11.64
10	1.92	20	7.5	30	104	3.5	0.55	1	20.4	104
11	5.25	480	5.25	480	229	3.5	1	1	229	229
12	5.33	25	6.89	33	93.2	below	1	1	93.2	93.2
13	1.74	29.17	5.89	29.17	214.4	below	1	1	214.4	214.4
14	6	25	9.18	25	204	4.75	1	1	204	204
15	3.84	21.3	4.14	25.9	368	2.2	1	1	368	368
16	5.25	480	5.25	480	229	3.5	1	1	229	229
17	5.4	20	6.78	24	57	3.5	1	1	57	57
18	2.5	30	13.2	60	28.4	3	0.83	1	23.67	28.4
19	2.1	13.3	4.1	166.1	36.1	below	1	1	36.1	36.1
20	3.5	35	9.41	63	11.64	0	1	1	11.64	11.64
21	5.43	20	11.45	20	225	5	1	1	225	225
22	1.5	25	5.5	52	85.4	0	1	1	85.4	85.4
23	2.24	9.59	4.7	18.37	260	6.25	0.36	0.75	93.2	195.5
24	0.82	13.23	6.1	15	12.67	1.5	0.55	1	6.93	12.67
25	3.6	Unknown	Unknown	Unknown	414	3	1	1	414	414
26	4.27	30	4.27	30	93	below	1	1	93	93
27	2.12	14	4.41	26	392	8.667	0.24	0.51	95.9	199.5
28	3.67	15	5.5	23	134	3.75	0.98	1	131.1	134
29	0.82	13.23	6.1	15	12.67	1.5	0.55	1	6.93	12.67
30	2.73	14.4	5.42	57.5	127.93	5	0.55	1	44.94	62.10
31	0.82	13.23	6.1	15	12.67	1.5	0.55	1	6.93	12.67
32	0.9	3.42	6.1	89	168	6.25	0.14	0.98	24.2	164.0
33	1.9	13	4.5	26	692	7	0.27	0.64	187.8	444.9
34	3.25	12	8.5	24	51	2.75	1	1	51	51
35	2.93	15.2	4.75	43	62.75	1	1	1	62.75	62.75

Table A-4 Determination of Screen Submerged Fraction/Area for Use in ΔH Calculations (cont).										
	Switchover		Maximum Pool		Total Screen Area (ft^2)	Height of Screen (ft)	Submerged Fraction		Submerged Area	
ID No.	Pool Height (ft)	Time (min)	Pool Height (ft)	Time (min)			Low	High	Unfav. Area (ft^2)	Fav. Area (ft^2)
36	4	27	7	40	86.4	below	1	1	86.4	86.4
37	0.7	2.2	4.7	73	158	5	0.14	0.94	22.1	148.5
38	4.5	20	11	20	210	4.5	1	1	210	210
39	3	25	7.3	29	318	3	1	1	318	318
40	5.8	45	9.9	201	201	5	1	1	201	201
41	7	20	21	100	330	6	1	1	330	330
42	3.67	15	5.5	23	134	3.75	0.98	1	131.1	134
43	2.73	14.4	5.42	57.5	127.93	5	0.55	1	45.65	59.89
44	3.5	21.67	9.5	29	37.5	2.5	1	1	37.5	37.5
45	3.5	20	6.83	20	70	0	1	1	70	70
46	2.13	25.54	2.25	26	571	0	1.00	1.00	571.0	571.0
47	1.75	22.12	3.5	45	48	0	1	1	48	48
48	0.9	3.42	6.1	89	168	6.25	0.14	0.98	24.2	164.0
49	8.52	10.2	14.42	15	187.2	8	1	1	187.2	187.2
50	7	20	21	100	330	6	1	1	330	330
51	7	30	11.5	30	150	7	1	1	150	150
52	4.5	20	11	20	210	4.5	1	1	210	210
53	Unknown	Unknown	Unknown	Unknown	66	5.25	1	1	66.0	66.0
54	5.3	30	5.5	65	42.4	6	0.88	0.92	37.5	38.9
55	4.59	30	7.6	30	115.4	0	1	1	115.4	115.4
56	3.5	21.67	9.5	29	37.5	2.5	1	1	37.5	37.5
57	3.5	12.4	8	30.9	39.62	5.083	0.69	1	27.3	39.6
58	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	-	-	-	-
59	0.7	2.2	4.7	73	158	5	0.14	0.94	22.1	148.5
60	2.78	43	5.4	43	108	below	1	1	108	108
61	3.25	12	8.5	24	51	2.75	1	1	51	51
62	1.92	0.33	7.5	0.5	104	3.5	1	1	20.4	104
63	4.27	30	4.27	30	93	below	1	1	93	93
64	2.5	30	13.2	60	28.4	3	0.83	1	23.67	28.4
65	4.27	30	4.27	30	93	below	1	1	93	93
66	5.8	45	9.9	201	224	5	1	1	224	224
67	3.6	Unknown	Unknown	Unknown	414	3	1	1	414	414
68	0.5	20	2.75	Unknown	370	0	1.00	1.00	370.0	370.0
69	2	35	6.7	35	125	2	1	1	125	125

Note: Submerged fractions were estimated for parametric cases where data were not known.

Table A-5 Calculation of ΔH_f						
ID No.	Reported NPSH Margin (ft)	Switchover Pool Height (ft)	Screen Height (ft)	Min Calc	Favorable ΔH_f (ft)	Unfavorable ΔH_f (ft)
1	10.02	5.3	6	2.65	2.75	2.65
2	5	2.24	6.25	1.12	2.35	1.12
3	3.8	4.5	4.5	3.8	3.8	3.8
4	1.7	5.5	Unknown	1.7	1.7	1.7
5	8.2	2.93	1	8.2	8.2	8.2
6	9	Unknown	5.25	9	9	9
7	4.3	0.82	1.5	0.41	4.3	0.41
8	1.7	5.5	Unknown	1.7	1.7	1.7
9	2.6	3.5	0	2.6	2.6	2.6
10	1.9	1.92	3.5	0.96	1.9	0.96
11	3	5.25	3.5	3	3	3
12	None Reported	5.33	0	N.A.	12	0
13	None Reported	1.74	0	N.A.	12	0
14	0.96	6	4.75	0.96	0.96	0.96
15	0.54	3.84	2.2	0.54	0.54	0.54
16	3	5.25	3.5	3	3	3
17	1.1	5.4	3.5	1.1	1.1	1.1
18	9.26	2.5	3	1.25	9.26	1.25
19	3.3	2.1	0	3.3	3.3	3.3
20	2.6	3.5	0	2.6	2.6	2.6
21	7.35	5.43	5	7.35	7.35	7.35
22	4.2	1.5	0	4.2	4.2	4.2
23	5	2.24	6.25	1.12	2.35	1.12
24	4.3	0.82	1.5	0.41	4.3	0.41
25	3.5	3.6	3	3.5	3.5	3.5
26	1.5	4.27	below	1.5	1.5	1.5
27	0.9	2.12	8.667	0.9	0.9	0.9
28	1.1	3.67	3.75	1.1	1.1	1.1
29	4.3	0.82	1.5	0.41	4.3	0.41
30	3.6	2.73	5	1.365	3.6	1.37
31	4.3	0.82	1.5	0.41	4.3	0.41
32	0.7	0.9	6.25	0.45	0.7	0.45
33	0.9	1.9	7	0.9	0.9	0.9
34	13	3.25	2.75	13	13	13
35	8.2	2.93	1	8.2	8.2	8.2

Table A-5. Calculation of ΔH_f (cont.)						
ID No.	Reported NPSH Margin (ft)	Switchover Pool Height (ft)	Screen Height (ft)	Min Calc	Favorable ΔH_f (ft)	Unfavorable ΔH_f (ft)
36	1.3	4	below	1.3	1.3	1.3
37	0.83	0.7	5	0.35	0.83	0.35
38	3.8	4.5	4.5	3.8	3.8	3.8
39	None Reported	3	3	N.A.	12	0
40	0.9	5.8	5	0.9	0.9	0.9
41	5.25	7	6	5.25	5.25	5.25
42	3.9	3.67	3.75	1.835	3.9	1.84
43	3.6	2.73	5	1.365	3.6	1.37
44	1.3	3.5	2.5	1.3	1.3	1.3
45	0	3.5	0	0	0	0
46	1.07	2.13	0	1.07	1.07	1.07
47	0.97	1.75	0	0.97	0.97	0.97
48	0.7	0.9	6.25	0.45	0.7	0.45
49	1.7	8.52	8	1.7	1.7	1.7
50	5.25	7	6	5.25	5.25	5.25
51	0.62	7	7	0.62	0.62	0.62
52	3.8	4.5	4.5	3.8	3.8	3.8
53	9	Unknown	5.25	9	9	9
54	10.02	5.3	6	2.65	2.75	2.65
55	1.01	4.59	0	1.01	1.01	1.01
56	1.3	3.5	2.5	1.3	1.3	1.3
57	17	3.5	5.083	1.75	17	1.75
58	15.1	Unknown	Unknown	15.1	15.1	0
59	0.83	0.7	5	0.35	0.83	0.35
60	5.6	2.78	0	5.6	5.6	5.6
61	13	3.25	2.75	13	13	13
62	1.9	1.92	3.5	0.96	1.9	1.9
63	1.5	4.27	below	1.5	1.5	1.5
64	9.26	2.5	3	1.25	9.26	1.25
65	1.5	4.27	below	1.5	1.5	1.5
66	0.6	5.8	5	0.6	0.6	0.6
67	3.5	3.6	3	3.5	3.5	3.5
68	2.1	0.5	0	2.1	2.1	2.1
69	2.4	2	2	2.4	2.4	2.4

Notes:

1. Where no $NPSH_{Margin}$ was reported in the survey, values of 0 ft-H_2O and 12 ft-H_2O were assumed for minimum and maximum NPSH margin, respectively.
2. For fully submerged screens, ΔH_f was assumed to be equal to the reported $NPSH_{Margin}$. For partially submerged screens, ΔH_f was calculated to be the lesser of the reported $NPSH_{Margin}$ and half the pool height.

Table A-6 Screen Characteristics					
ID No.	Sump Location	Screen Hole Size (in.)	ID No.	Sump Location	Screen Hole Size (in.)
1	exposed	0.125	36	remote	0.25
2	remote	0.115	37	exposed	0.75
3	remote	0.09	38	remote	0.09
4	Unknown	0.204	39	int. exp.	0.125
5	int. exp.	0.25	40	remote	0.094
6	int. exp.	0.250	41	Unknown	0.12
7	Unknown	0.152	42	remote	0.125
8	Unknown	0.204	43	int. exp.	0.125
9	remote	0.12	44	int. exp.	0.12
10	int. exp.	0.3	45	Unknown	0.132
11	exposed	0.224	46	int. exp.	0.25
12	Unknown	0.25	47	int. exp.	0.25
13	remote	0.125	48	exposed	0.1197
14	exposed	0.132	49	exposed	0.25
15	Unknown	0.097	50	Unknown	0.12
16	exposed	0.224	51	remote	0.1875
17	remote	0.1783	52	remote	0.09
18	exposed	0.25	53	int. exp.	0.250
19	int. exp.	0.125	54	exposed	0.125
20	remote	0.12	55	exposed	0.09375
21	remote	0.078	56	int. exp.	0.12
22	Unknown	0.221	57	int. exp.	1
23	remote	0.115	58	Unknown	Unknown
24	Unknown	0.152	59	exposed	0.75
25	remote	0.25	60	exposed	0.1875
26	exposed	0.12	61	int. exp.	Unknown
27	remote	0.125	62	int. exp.	0.3
28	remote	0.125	63	exposed	0.12
29	Unknown	0.152	64	exposed	0.25
30	int. exp.	0.125	65	exposed	0.12
31	Unknown	0.152	66	remote	Unknown
32	exposed	0.1197	67	remote	0.25
33	Unknown	0.25	68	int. exp.	0.25
34	int. exp.	Unknown	69	Unknown	0.25
35	int. exp.	0.25			

APPENDIX B

FAILURE-THRESHOLD DEBRIS LOADING FOR EACH PARAMETRIC CASE

INTRODUCTION

The minimum mass of particulate needed to cause blockage for a specified fiber volume was determined for

- each parameter case;
- the small-, medium-, and large-break scenarios;
- full-ECCS flow and half-ECCS flow (for MLOCA and LLOCA); and
- both favorable and unfavorable parameter values.

In addition, the range of expected debris generated and transported to the sump screen was compared with fiber/particulate debris combinations predicted to cause blockage. The results for each parameter case were combined into a set of four plots presented on a single page. Because so much input data and synthesized analysis is presented together in a generic format, these figures are, in some cases, relatively complex.

The first plot on each page (upper left) provides tabular data associated with that particular case. These data include the ranges (favorable to unfavorable conditions) of debris expected on the sump screen, the screen area, the $NPSH_{Margin}$, the small-break and full-ECCS flow rates. Also shown in the first plot are the fiber debris volumes and miscellaneous particulate mass plotted on a linear scale.

The second plot (upper right) on each page shows the results for the SLOCA scenario. Both the favorable (solid line) and unfavorable (dashed line) minimum-particulate-mass curves are plotted. Note the log-scales. For example, in parametric case 1, the primary difference between favorable and unfavorable conditions was the composition of insulation. The plant has fiber, RMI, and particulate insulation, but the relative fractions of each were not reported. In addition, the type of fiber was not reported. Therefore, favorable conditions assumed very little fiber and very little particulate insulation; i.e., most of the insulation was assumed to be RMI. Conversely, the unfavorable conditions assumed little RMI but equal quantities of fiber and particulate insulations. Further, the favorable conditions assumed the fiber was LDFG, such as Nukon, but the unfavorable conditions assumed the fibrous insulation was high-density fiberglass, such as Temp Mat. High-density fiberglass will cause a larger head loss than low-density fiberglass. As shown in the second plot for case 1, it would take substantially less particulate to block the screen for the unfavorable conditions than it would for the favorable conditions. The gap between the two curves provides some measure of the uncertainty associated with predicting blockage. The square symbol represents the threshold debris loadings needed to cause blockage, i.e., where induced head loss is equal to the sump failure criterion, ΔH_f. The volume of fiber at the squares is just sufficient to create a uniform 1/8-in. layer of fiber across the sump screen assumed for the associated parametric case. The plotted curves rise vertically at the square symbols indicating that without the threshold layer of fiber (fiber volume less than that of the threshold conditions), an unlimited mass of particulate would not cause blockage. This was a fundamental assumption common to all the head-loss calculations with regard to particulates.

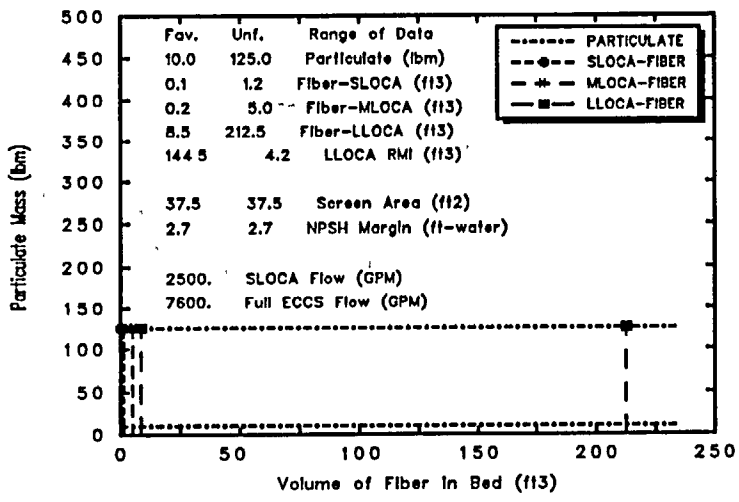
The ranges of expected debris on the screen for the SLOCA are shown as a dashed-line box on the second plot, and the boundaries of the box are highlighted on the axes with the circle symbol. Note that the expected mass of particulate includes both particulate-insulation debris and miscellaneous particulate transported to the screen. The range of particulate for the SLOCA is printed near the top of the plot.

The third plot (lower left) on each page provides information similar to the second plot but for the MLOCA. Where only one flow rate was assumed for the SLOCA scenarios, two flow rates were assumed for the MLOCA and LLOCA scenarios, i.e., full ECCS flow and one-half of the total ECCS flow rate. This was intended to illustrate the effect of operating with one train of the ECCS instead of two trains of the ECCS.

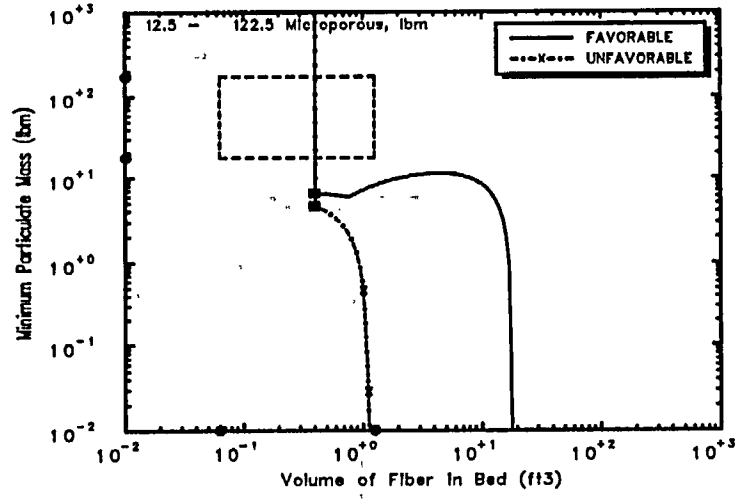
Therefore, the third plot has four minimum-particulate curves, i.e., favorable and unfavorable conditions at full- and half-ECCS flow.

The fourth plot (lower right) on each page shows the same information for the LLOCA as the third plot shows for the MLOCA. Actually, the minimum-particulate head-loss curves are the same for the MLOCA and LLOCA scenarios, but the expected debris ranges are substantially different.

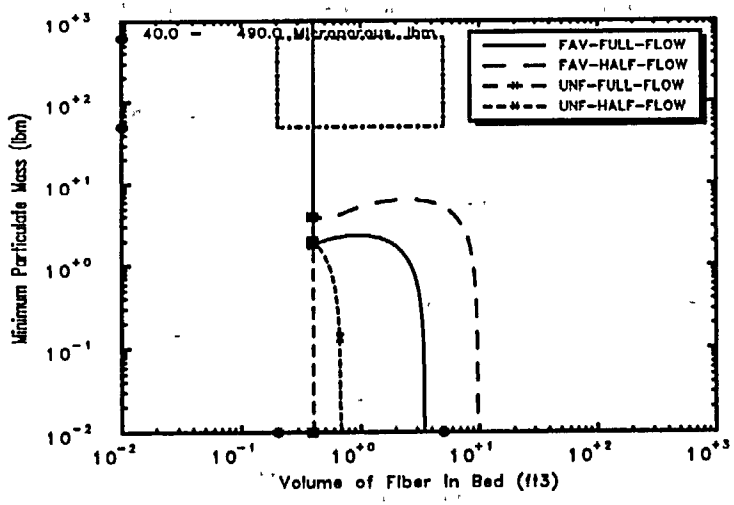
When the figures are examined for each parametric case, it becomes evident that the sump failure curves for some plants intersect the dashed box defining the range of fibrous and particulate debris that may be expected to transport to the sump. All debris combinations within the box and to the right of the failure-threshold will induce head loss in excess of the sump failure criterion. For all debris combinations to the left of the failure threshold, the sump will continue to function as required. Thus, the proportion of the area in the expected-range box that lies to the right of the curve provides a rough indication of the sump failure potential for these intermediate cases. For example, in case 1, approximately 73% of all reasonable debris loadings would provide debris conditions leading to sump blockage following an SLOCA. Table B-1, listed at the end of the figures, provides this percentage for the SLOCA, MLOCA and LLOCA for each of the 69 parametric cases.



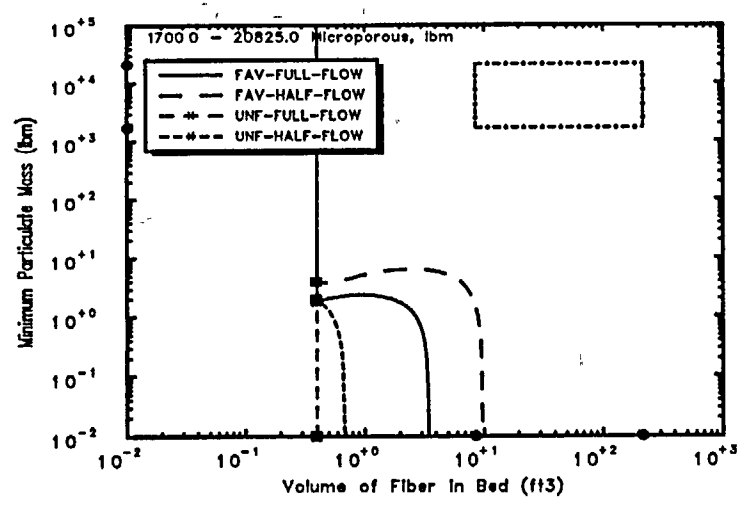
Parametric Case: 1 Debris Potential



Parametric Case: 1 Small LOCA

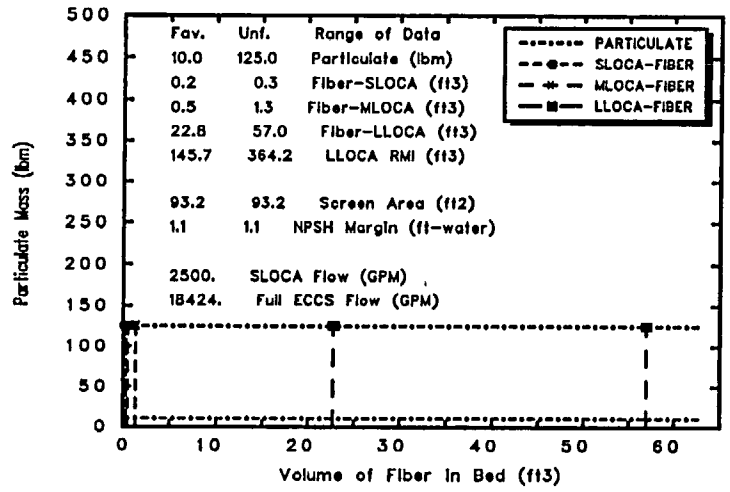


Parametric Case: 1 Medium LOCA

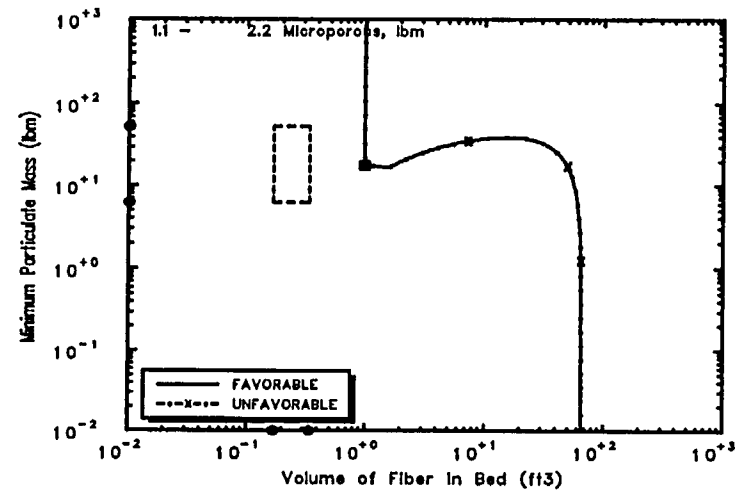


Parametric Case: 1 Large LOCA

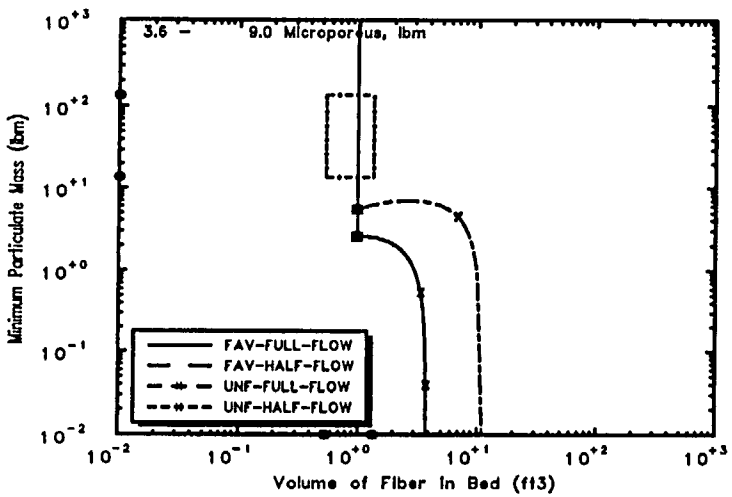
Figure B-1 Parametric Case 1



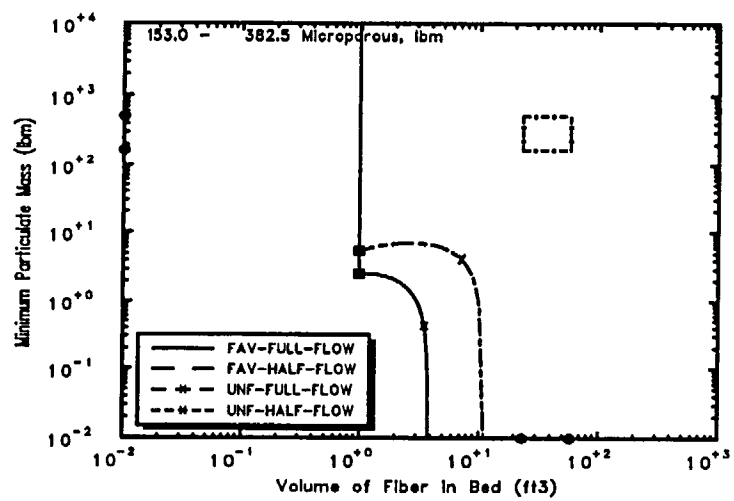
Parametric Case: 2 Debris Potential



Parametric Case: 2 Small LOCA

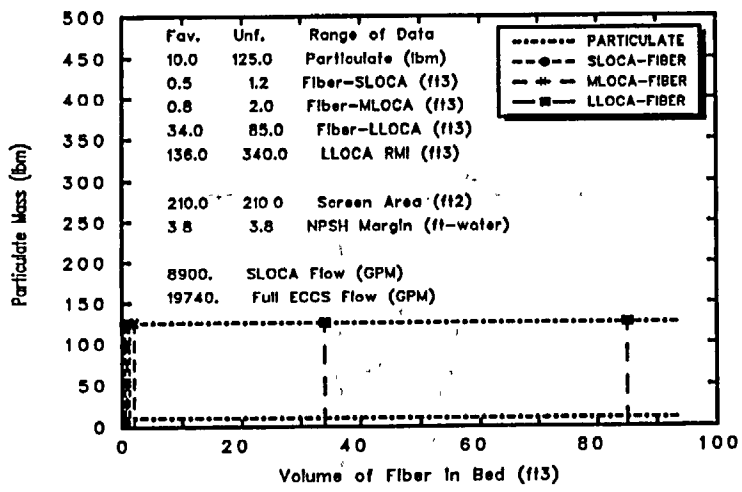


Parametric Case: 2 Medium LOCA

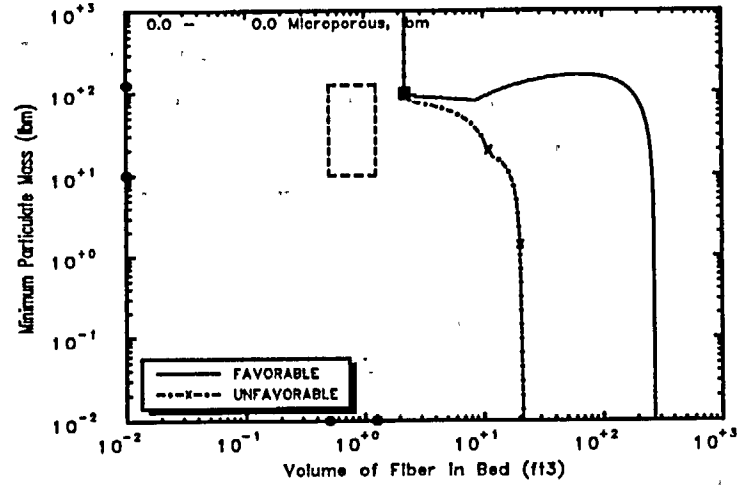


Parametric Case: 2 Large LOCA

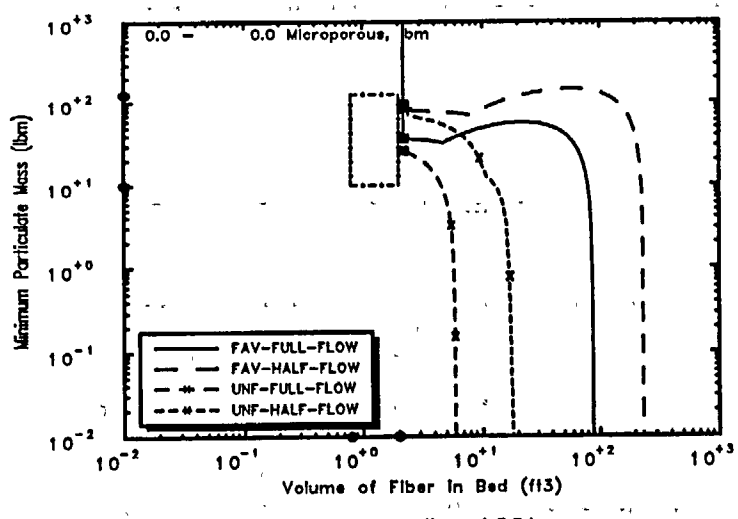
Figure B-2 Parametric Case 2



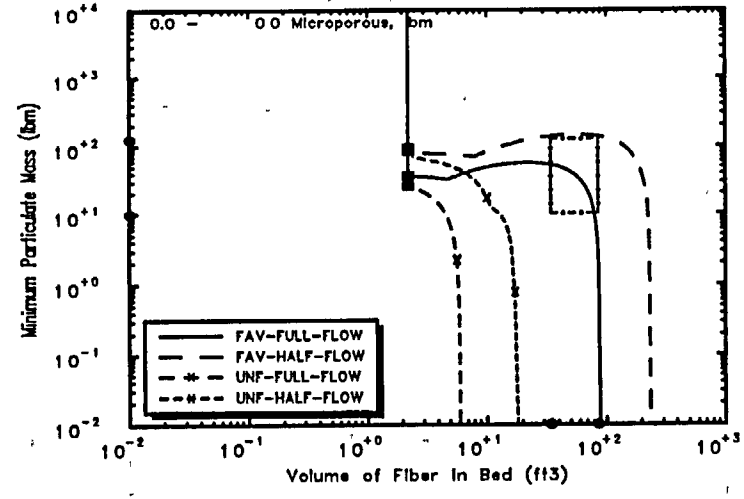
Parametric Case: 3 Debris Potential



Parametric Case: 3 Small LOCA

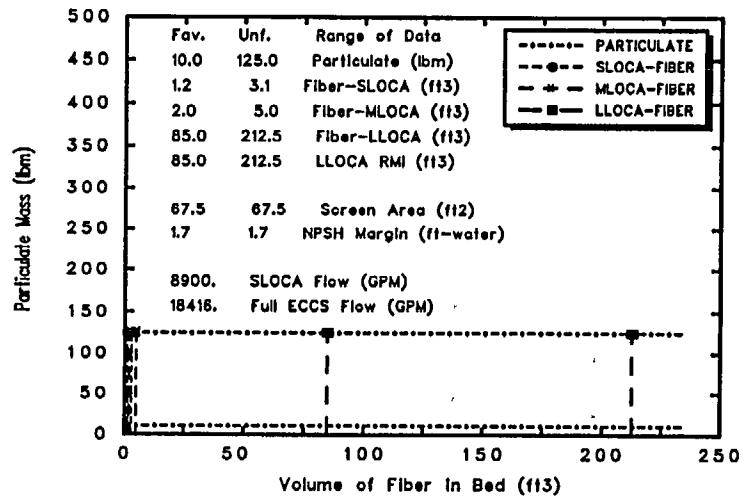


Parametric Case: 3 Medium LOCA

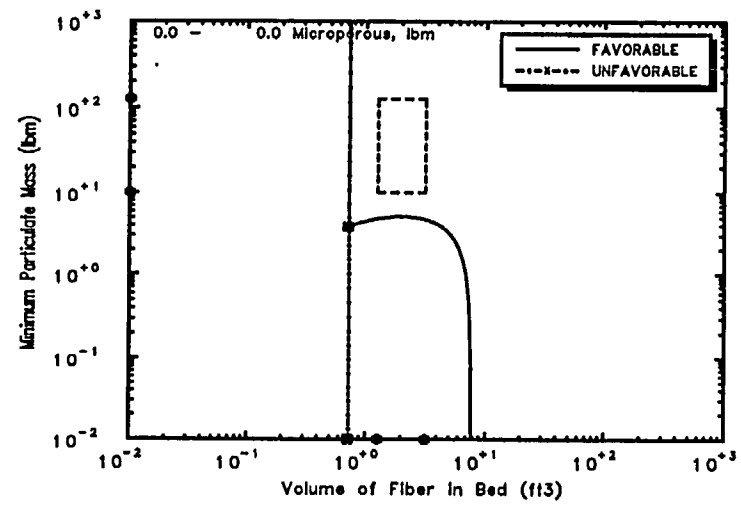


Parametric Case: 3 Large LOCA

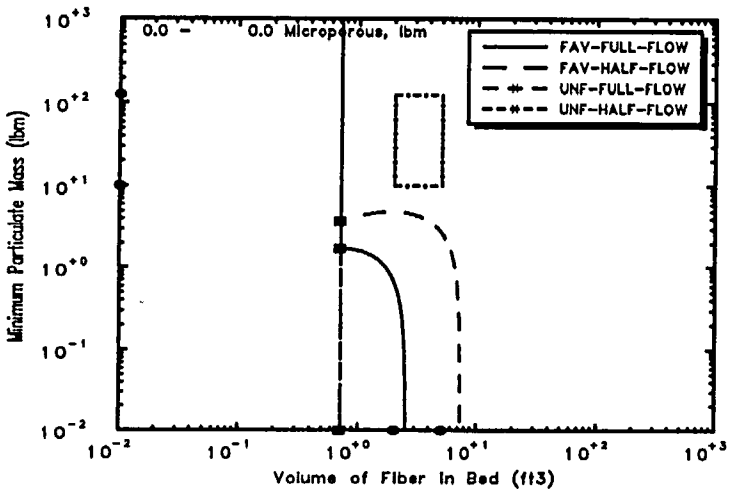
Figure B-3 Parametric Case 3



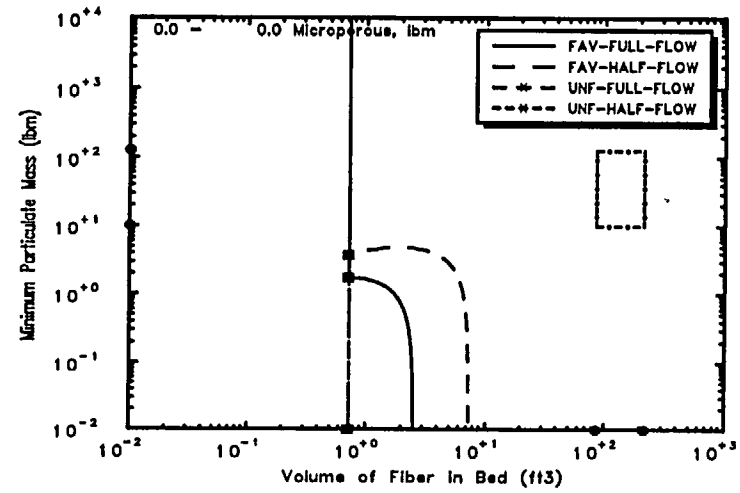
Parametric Case: 4 Debris Potential



Parametric Case: 4 Small LOCA

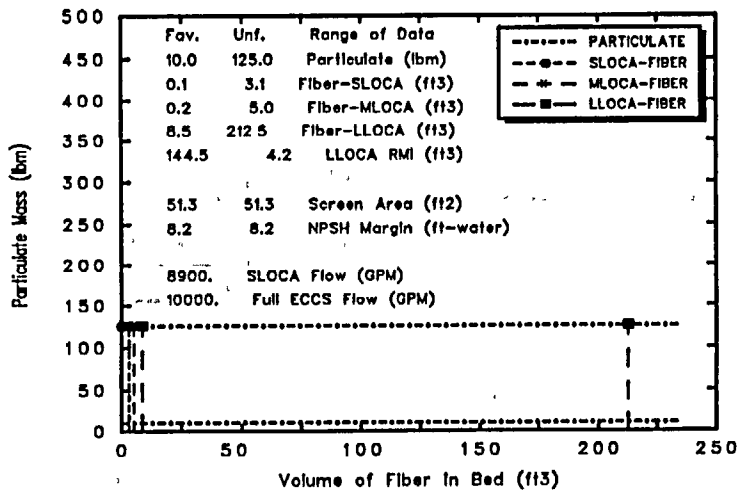


Parametric Case: 4 Medium LOCA

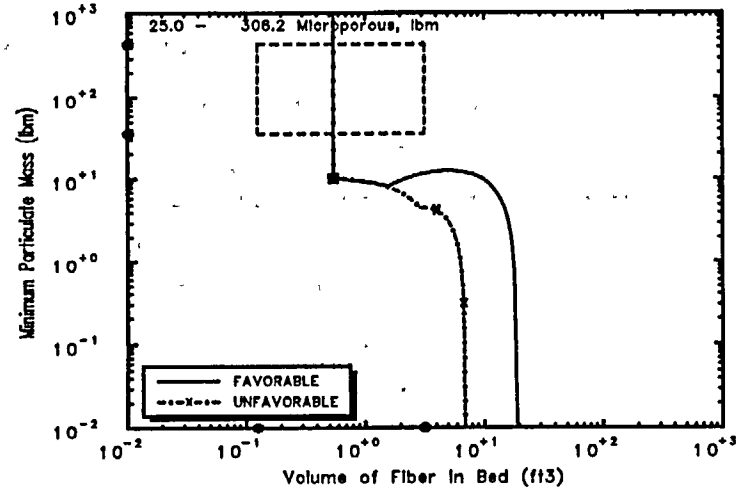


Parametric Case: 4 Large LOCA

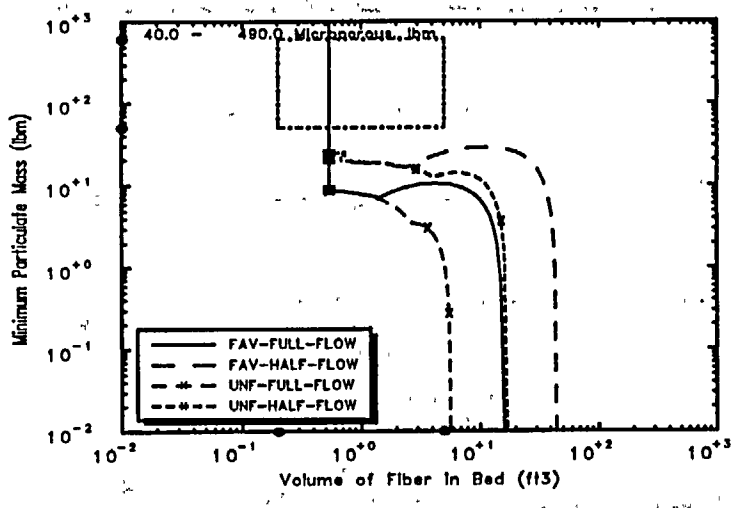
Figure B-4 Parametric Case 4



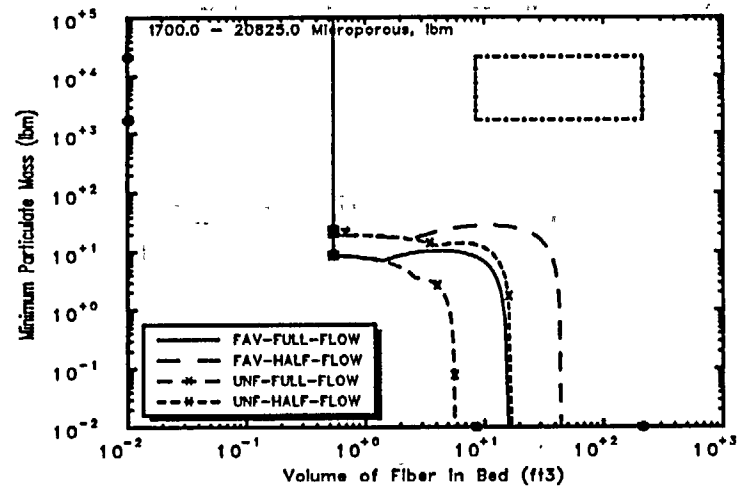
Parametric Case: 5 Debris Potential



Parametric Case: 5 Small LOCA

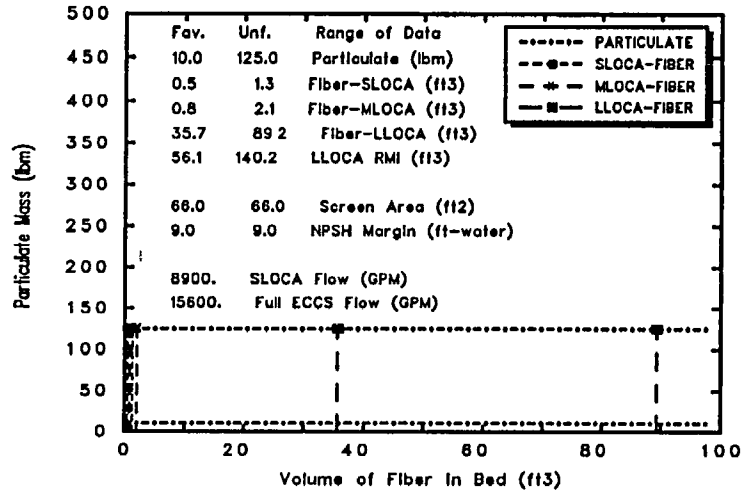


Parametric Case: 5 Medium LOCA

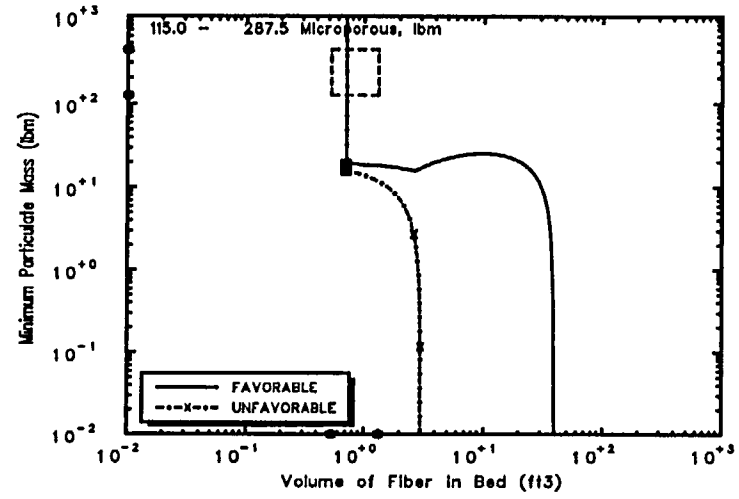


Parametric Case: 5 Large LOCA

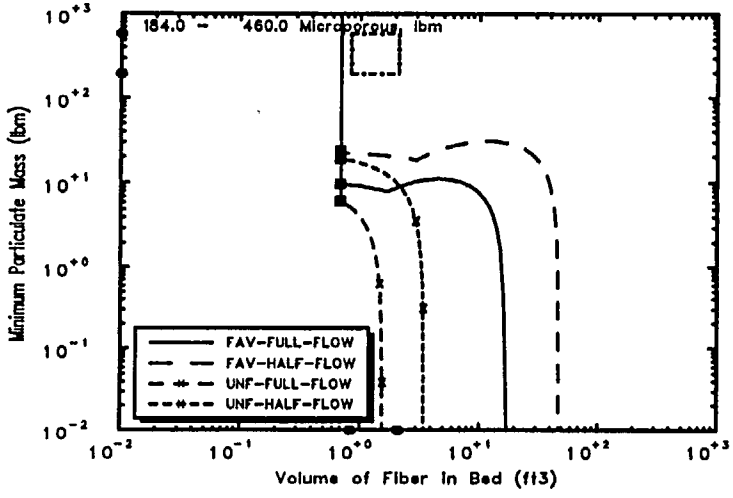
Figure B-5 Parametric Case 5



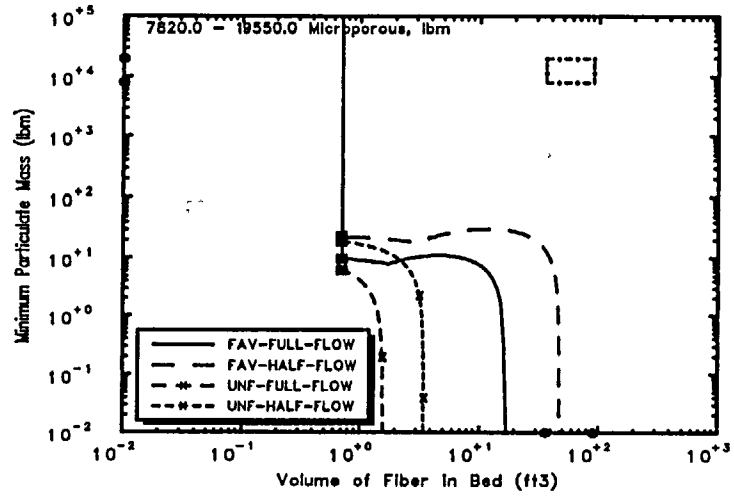
Parametric Case: 6 Debris Potential



Parametric Case: 6 Small LOCA

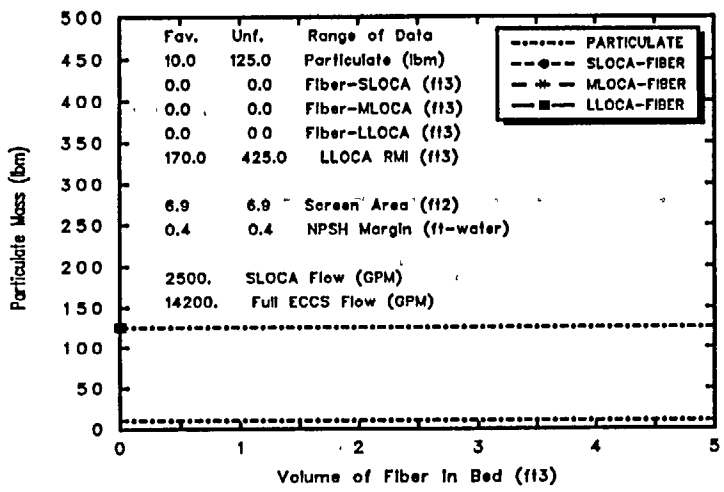


Parametric Case: 6 Medium LOCA

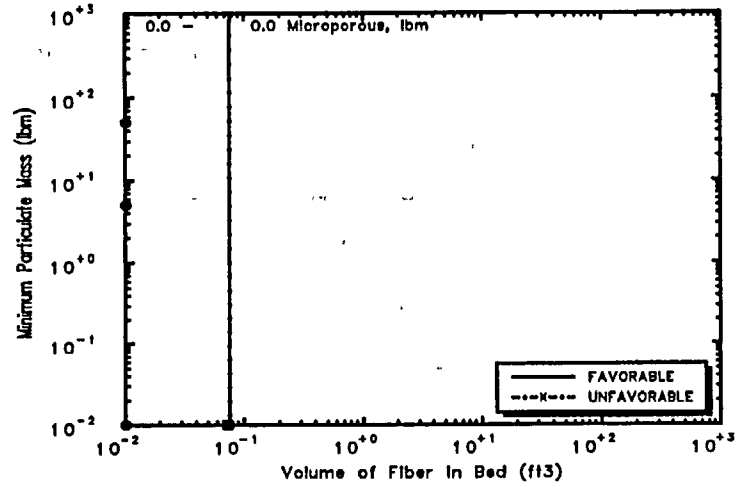


Parametric Case: 6 Large LOCA

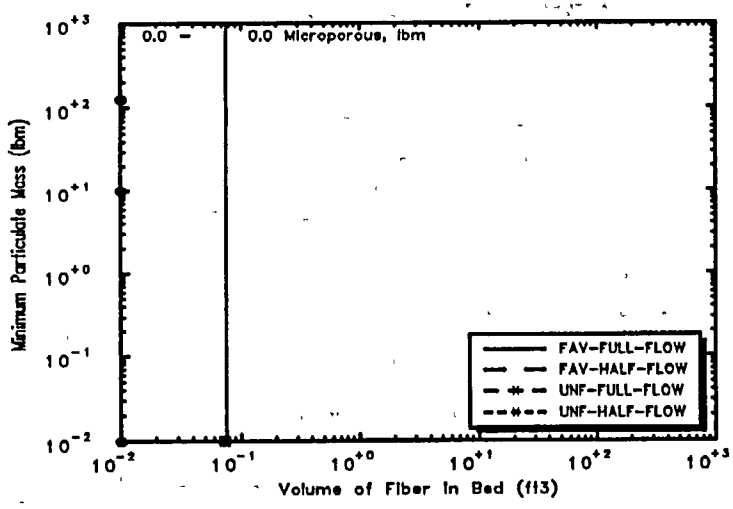
Figure B-6 Parametric Case 6



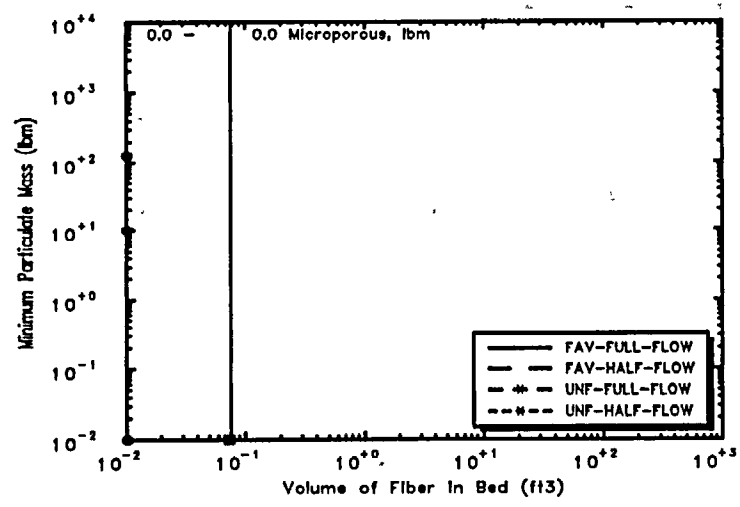
Parametric Case: 7 Debris Potential



Parametric Case: 7 Small LOCA

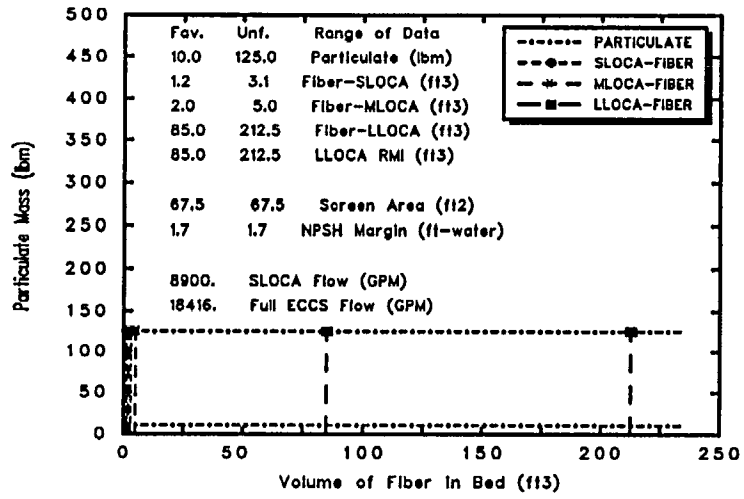


Parametric Case: 7 Medium LOCA

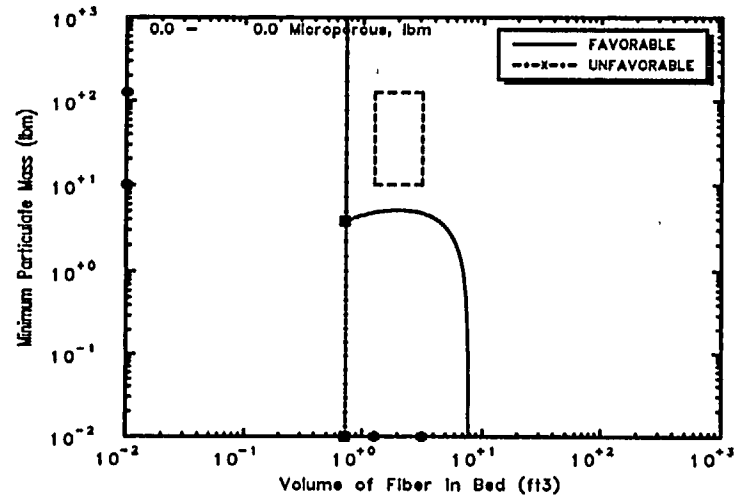


Parametric Case: 7 Large LOCA

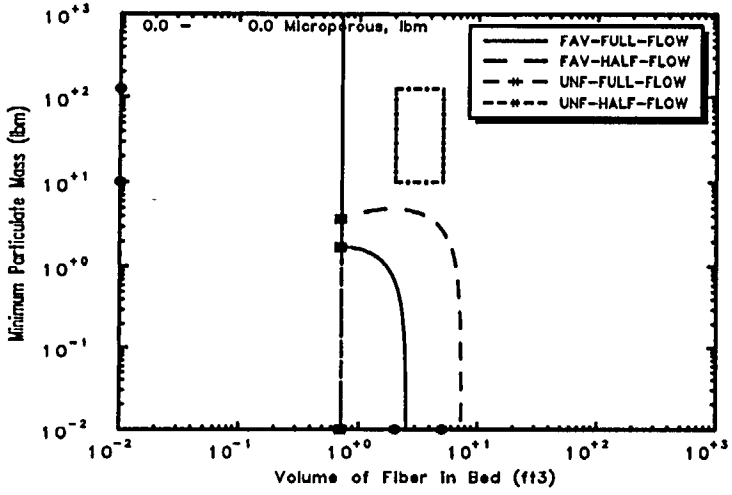
Figure B-7 Parametric Case 7 (Note: No fiber in this case, so no debris boxes presented)



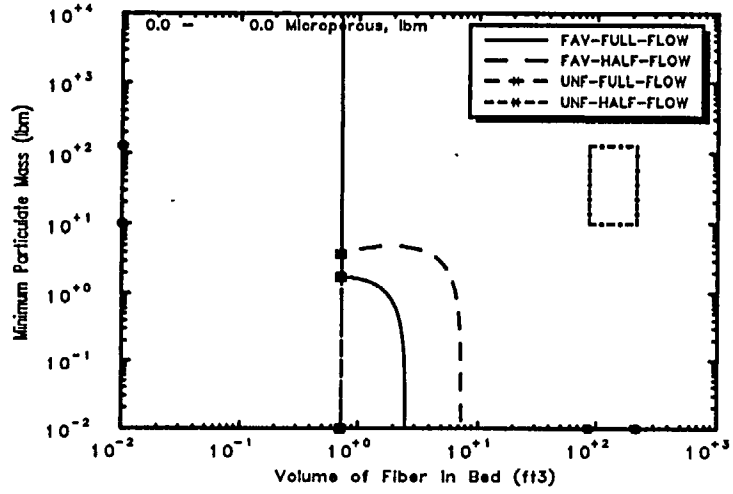
Parametric Case: 8 Debris Potential



Parametric Case: 8 Small LOCA



Parametric Case: 8 Medium LOCA



Parametric Case: 8 Large LOCA

Figure B-8 Parametric Case 8

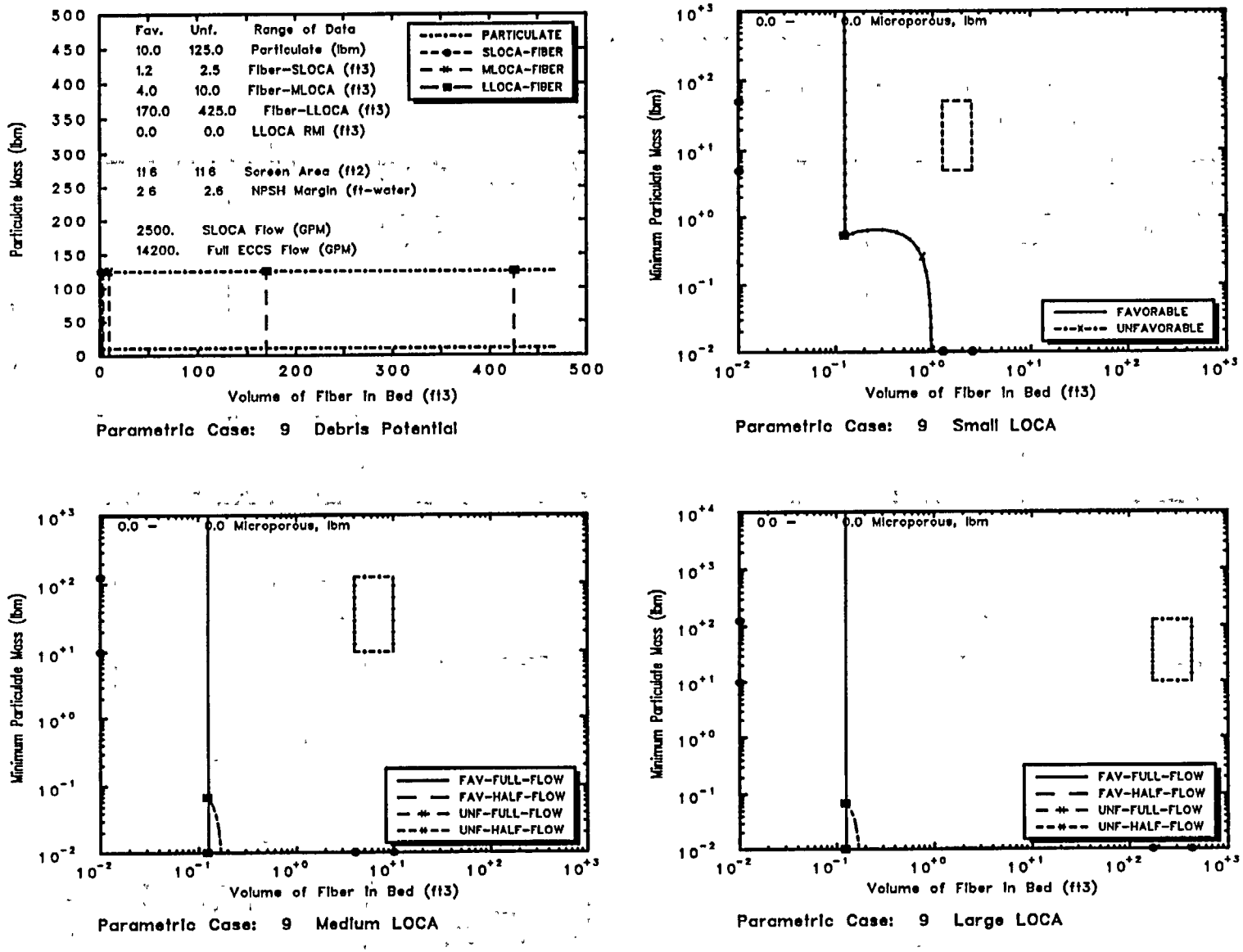
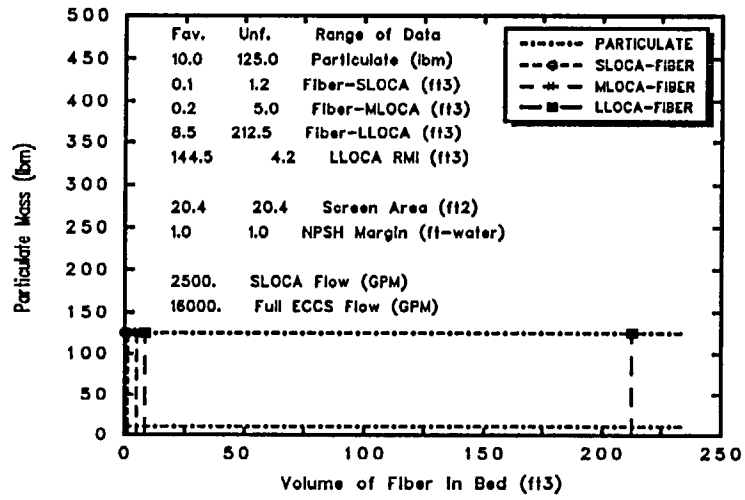
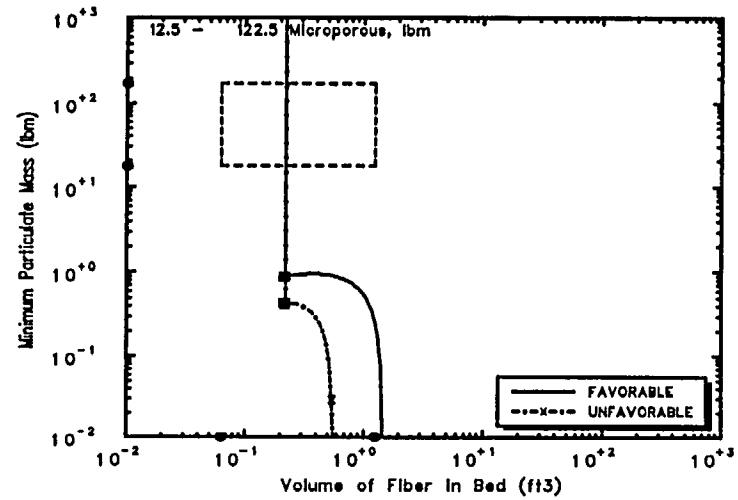


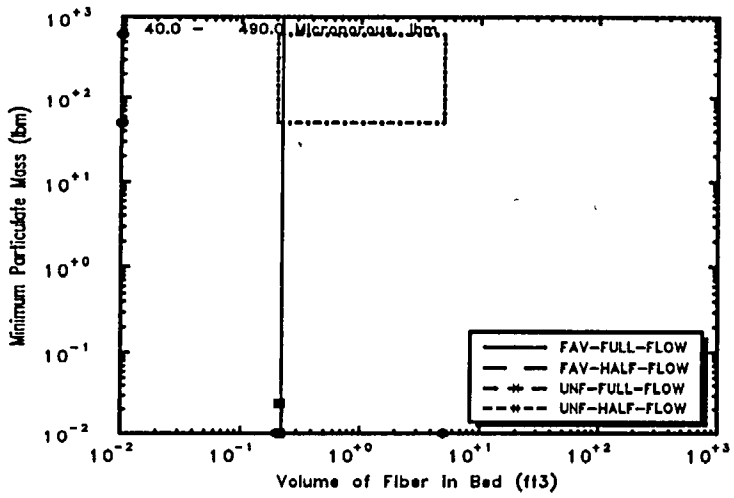
Figure B-9 Parametric Case 9



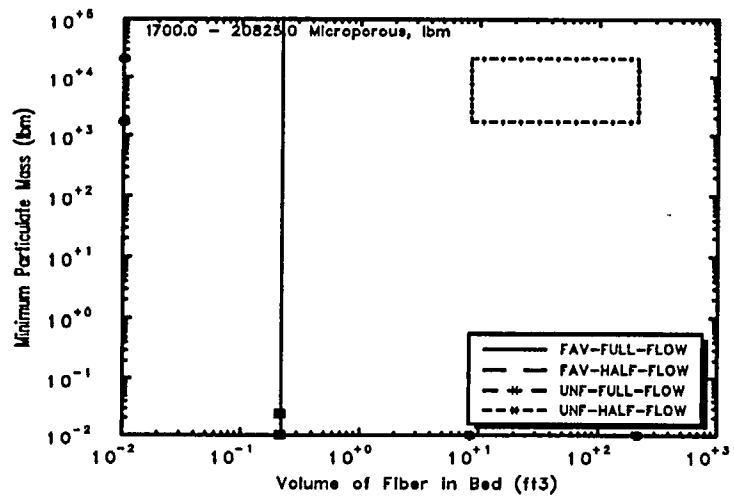
Parametric Case: 10 Debris Potential



Parametric Case: 10 Small LOCA

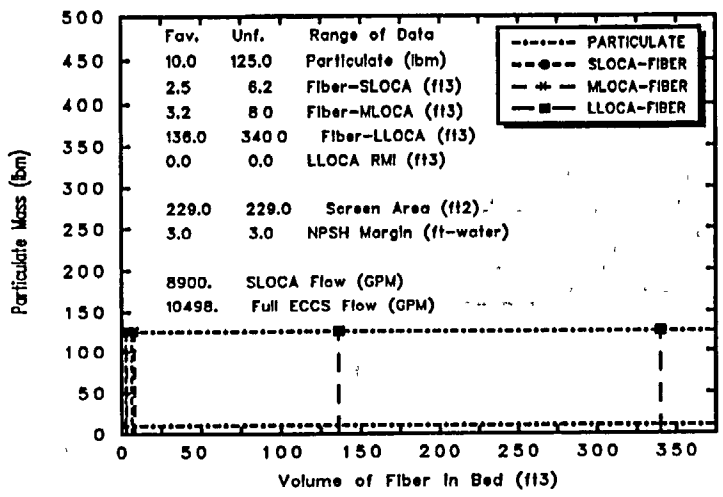


Parametric Case: 10 Medium LOCA

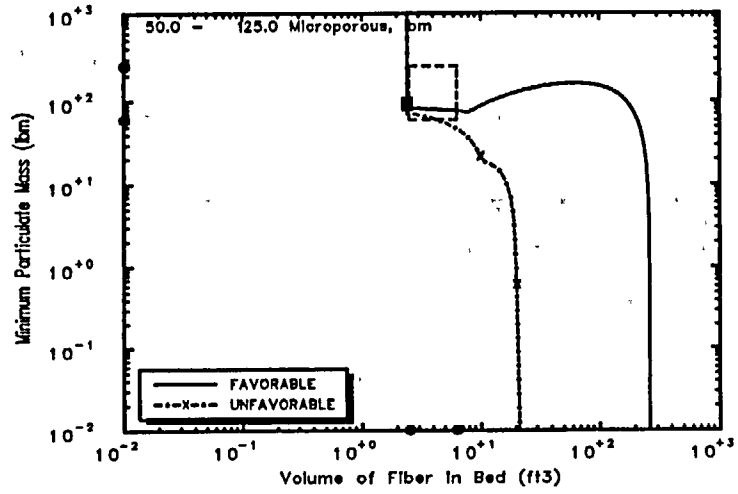


Parametric Case: 10 Large LOCA

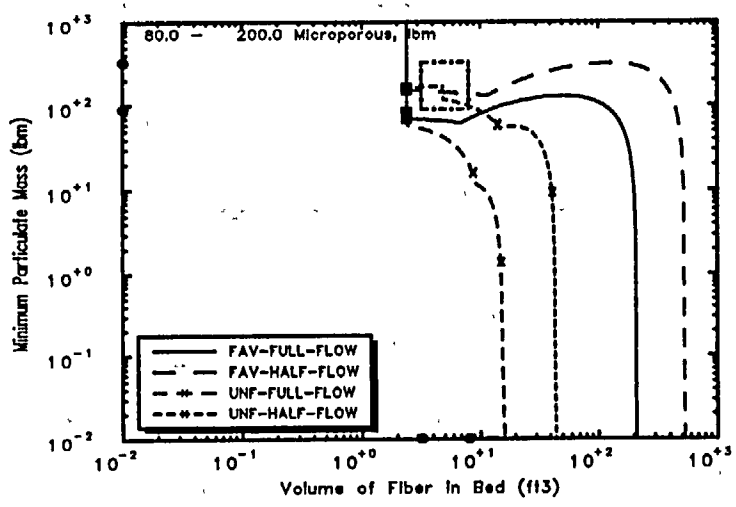
Figure B-10 Parametric Case 10



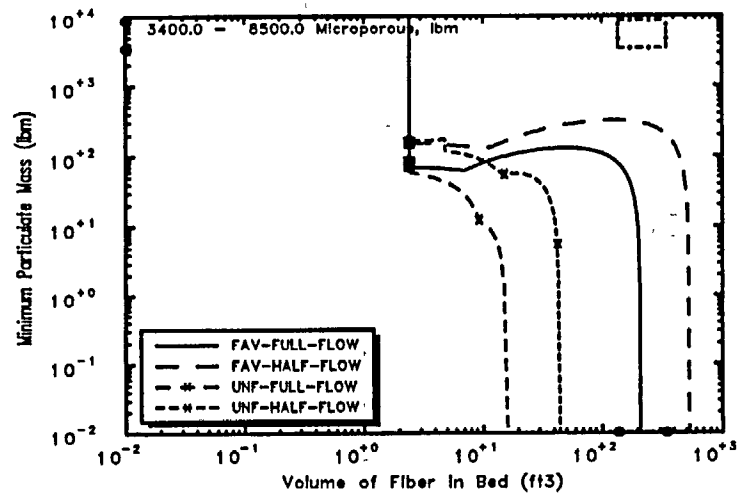
Parametric Case: 11 Debris Potential



Parametric Case: 11 Small LOCA

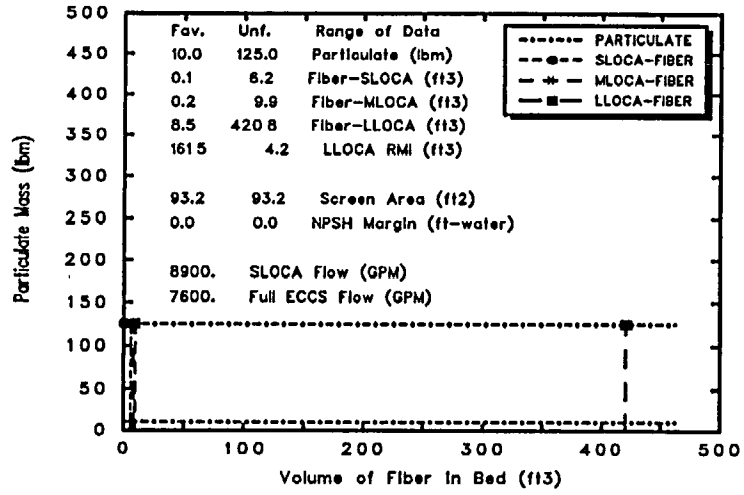


Parametric Case: 11 Medium LOCA

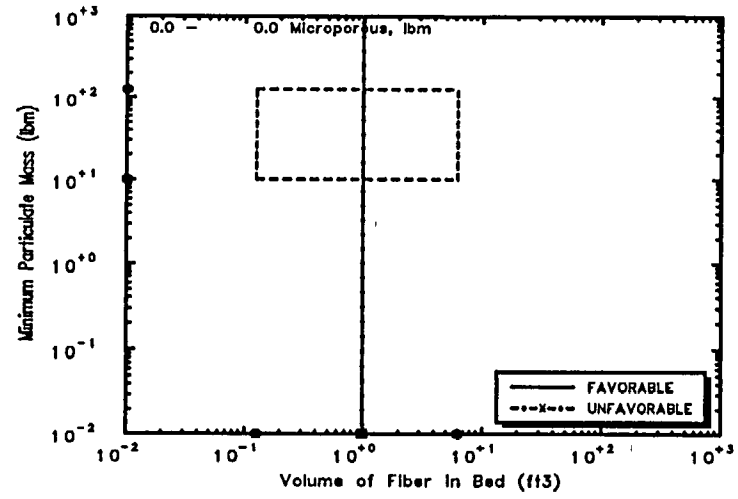


Parametric Case: 11 Large LOCA

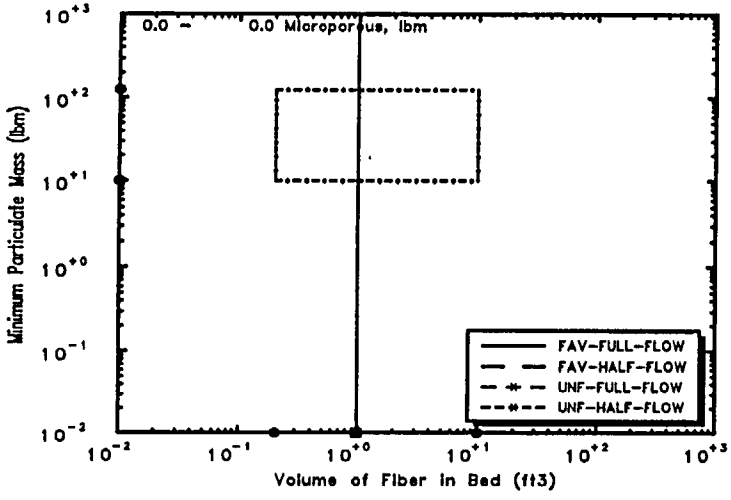
Figure B-11 Parametric Case 11



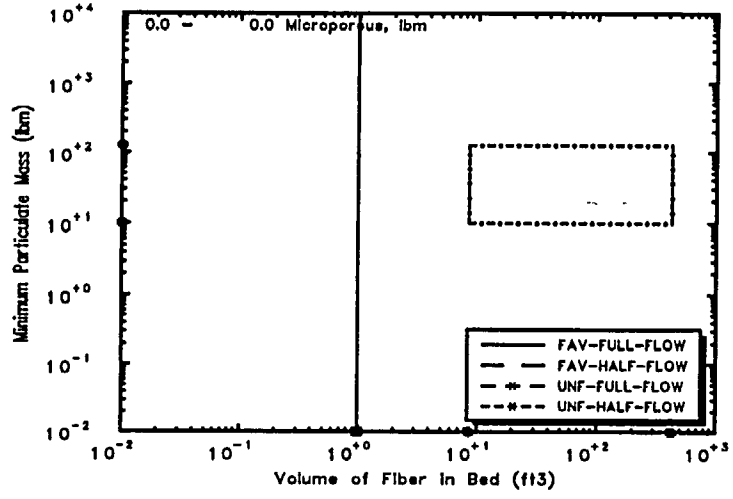
Parametric Case: 12 Debris Potential



Parametric Case: 12 Small LOCA

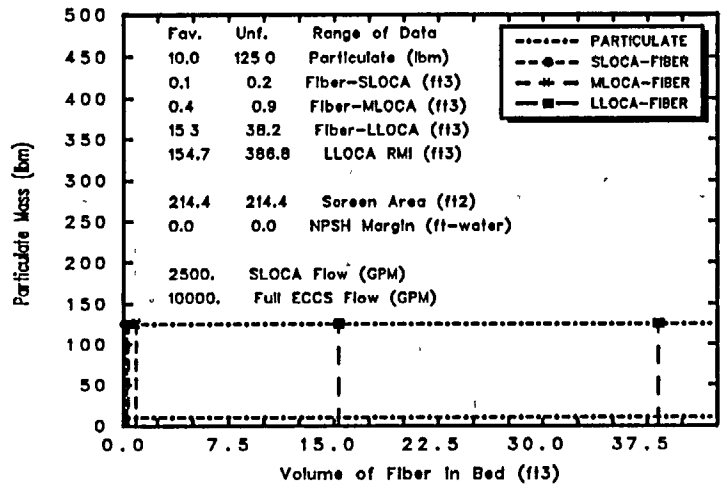


Parametric Case: 12 Medium LOCA

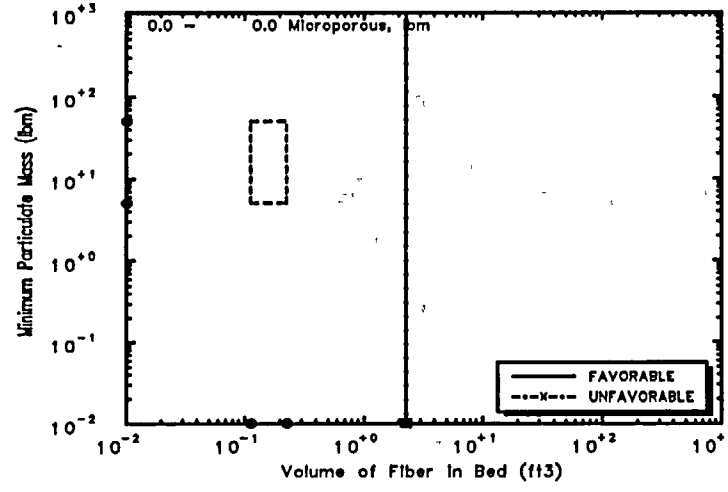


Parametric Case: 12 Large LOCA

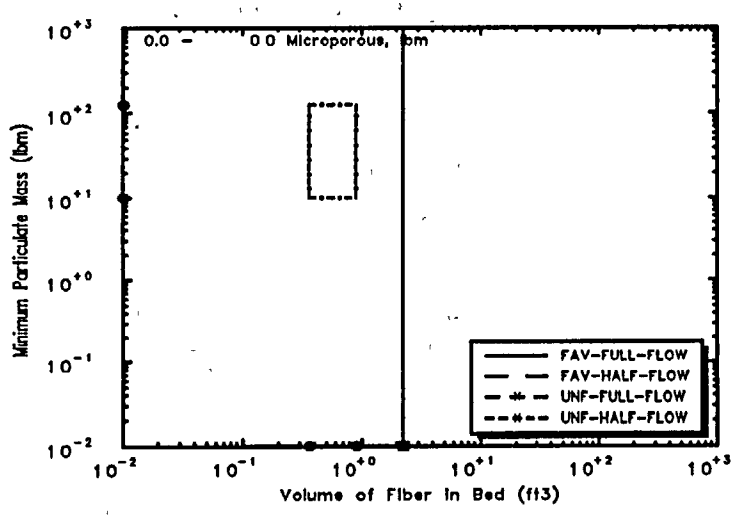
Figure B-12 Parametric Case 12



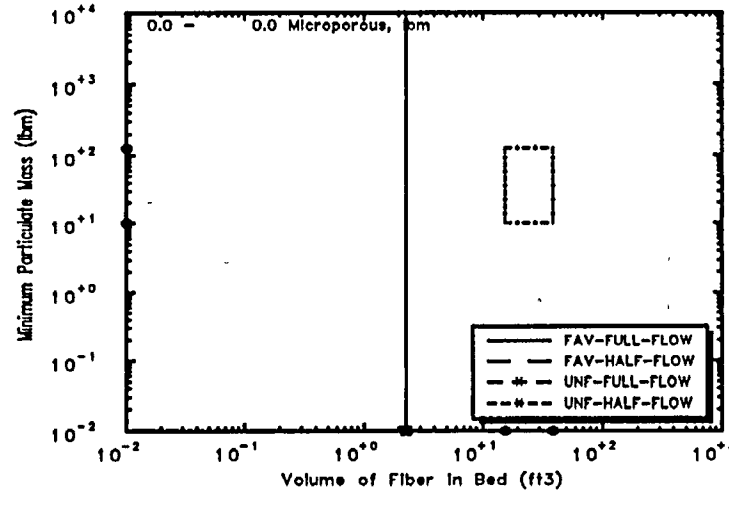
Parametric Case: 13 Debris Potential



Parametric Case: 13 Small LOCA

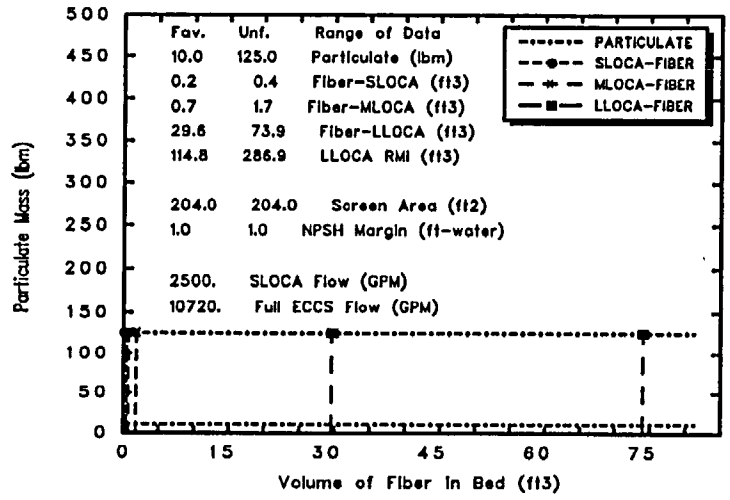


Parametric Case: 13 Medium LOCA

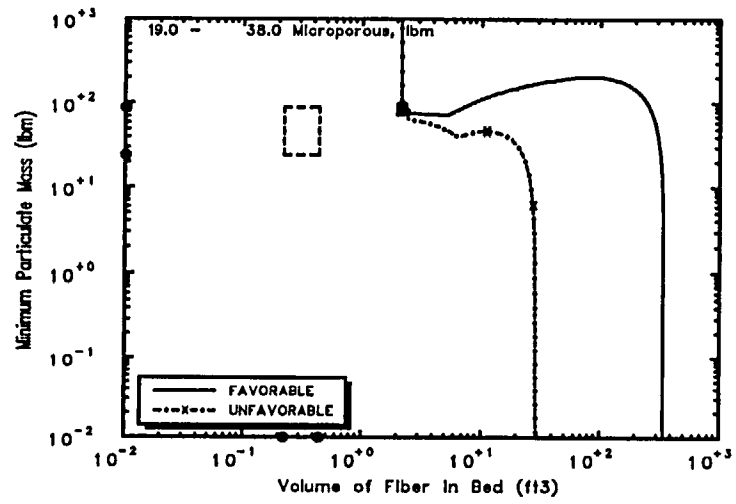


Parametric Case: 13 Large LOCA

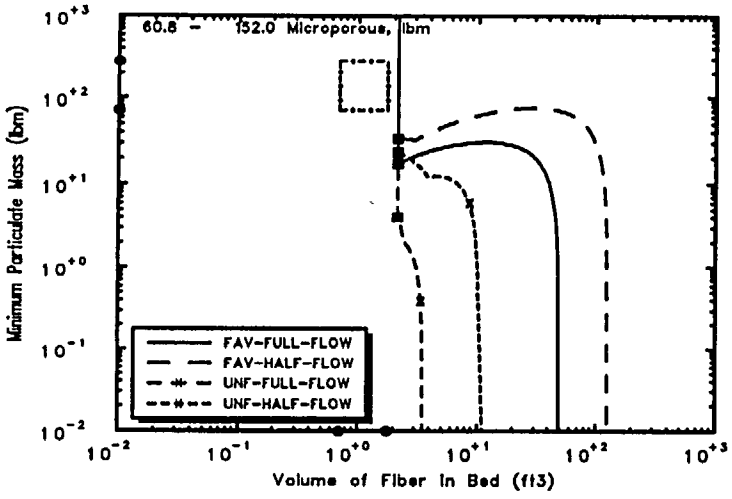
Figure B-13 Parametric Case 13



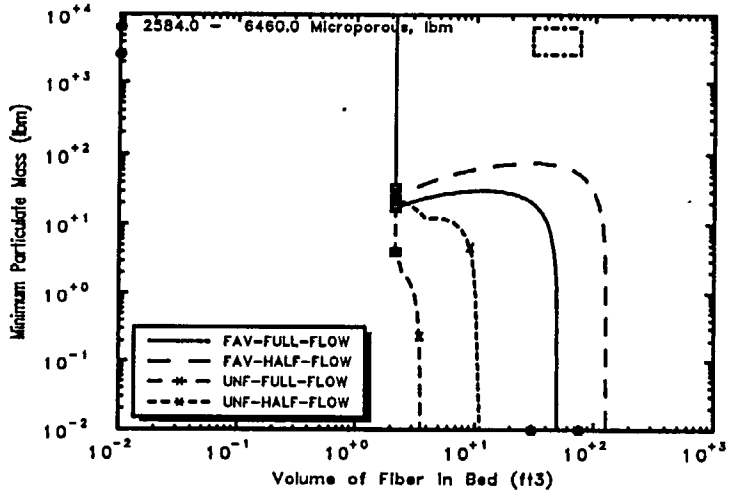
Parametric Case: 14 Debris Potential



Parametric Case: 14 Small LOCA

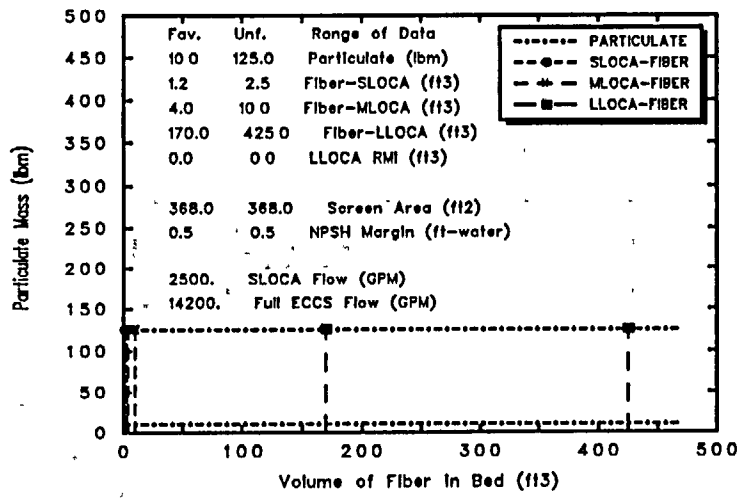


Parametric Case: 14 Medium LOCA

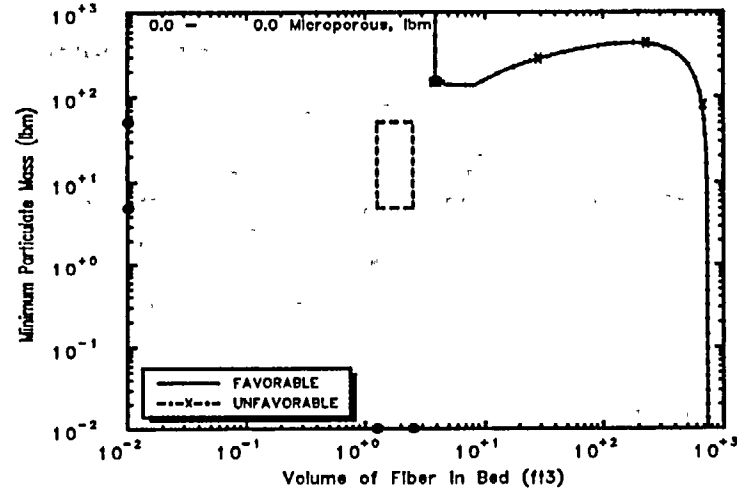


Parametric Case: 14 Large LOCA

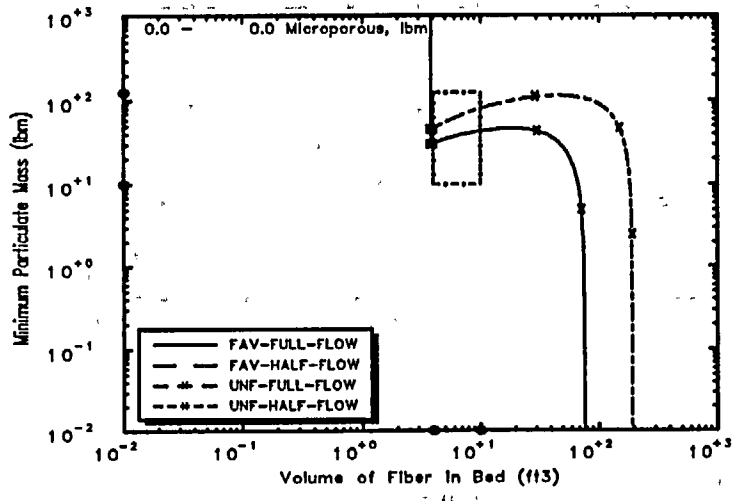
Figure B-14 Parametric Case 14



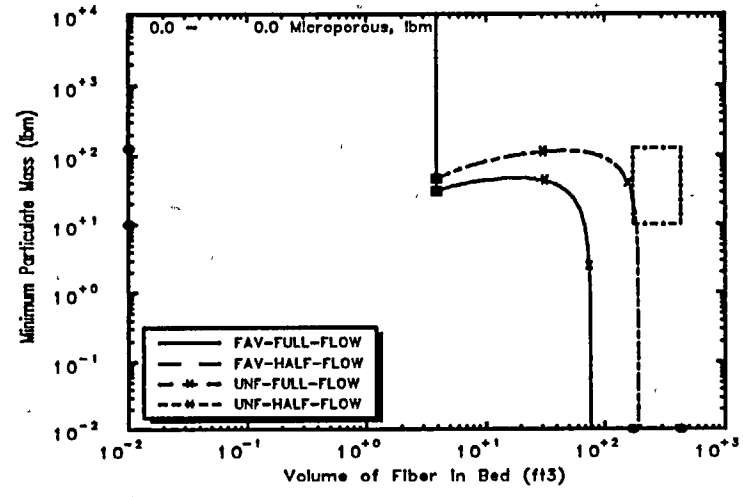
Parametric Case: 15 Debris Potential



Parametric Case: 15 Small LOCA

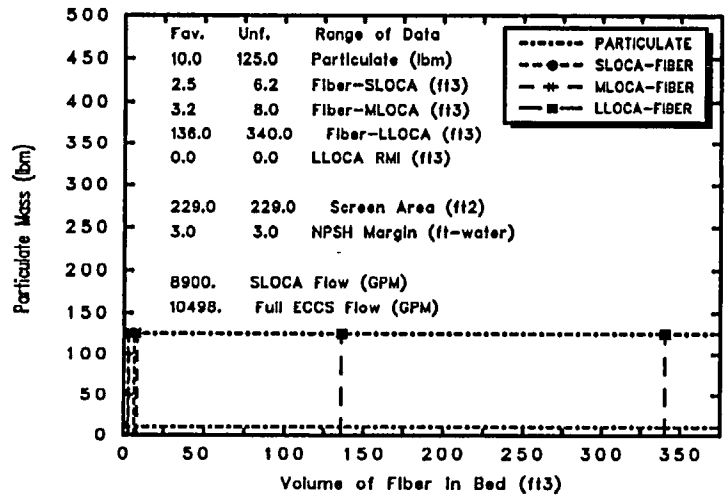


Parametric Case: 15 Medium LOCA

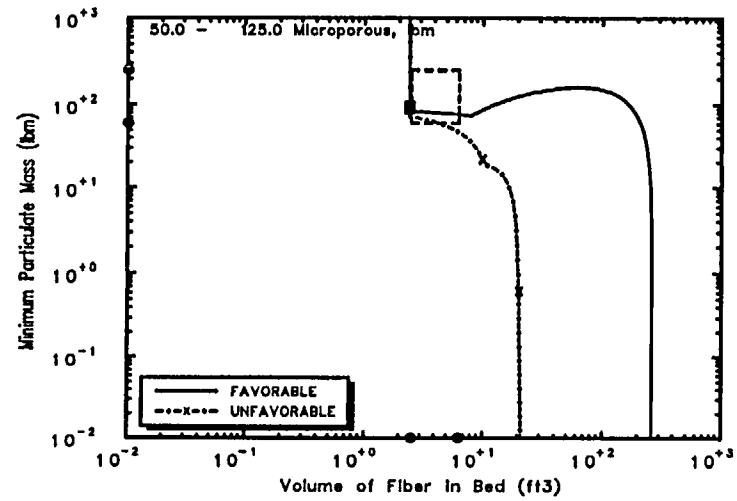


Parametric Case: 15 Large LOCA

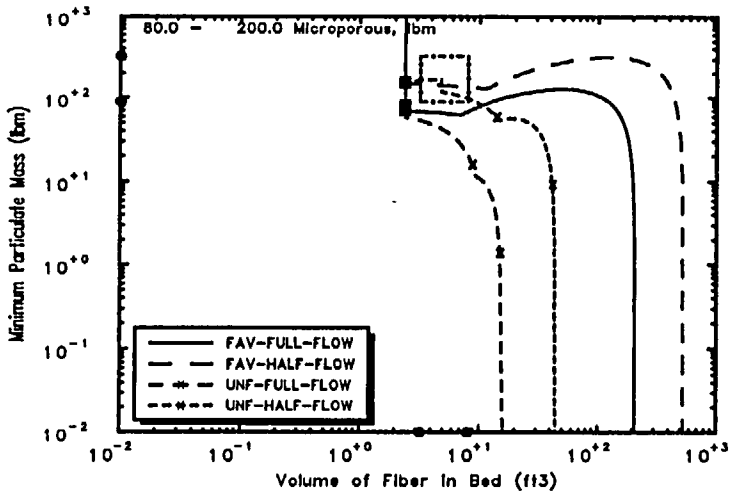
Figure B-15 Parametric Case 15



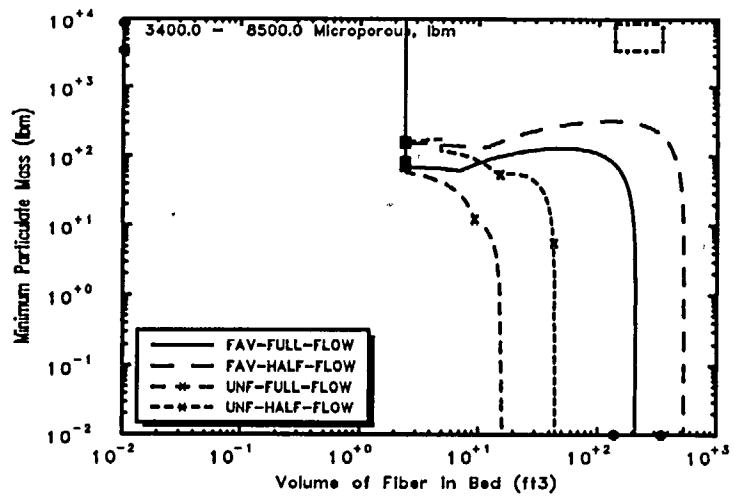
Parametric Case: 16 Debris Potential



Parametric Case: 16 Small LOCA



Parametric Case: 16 Medium LOCA



Parametric Case: 16 Large LOCA

Figure B-16 Parametric Case 16

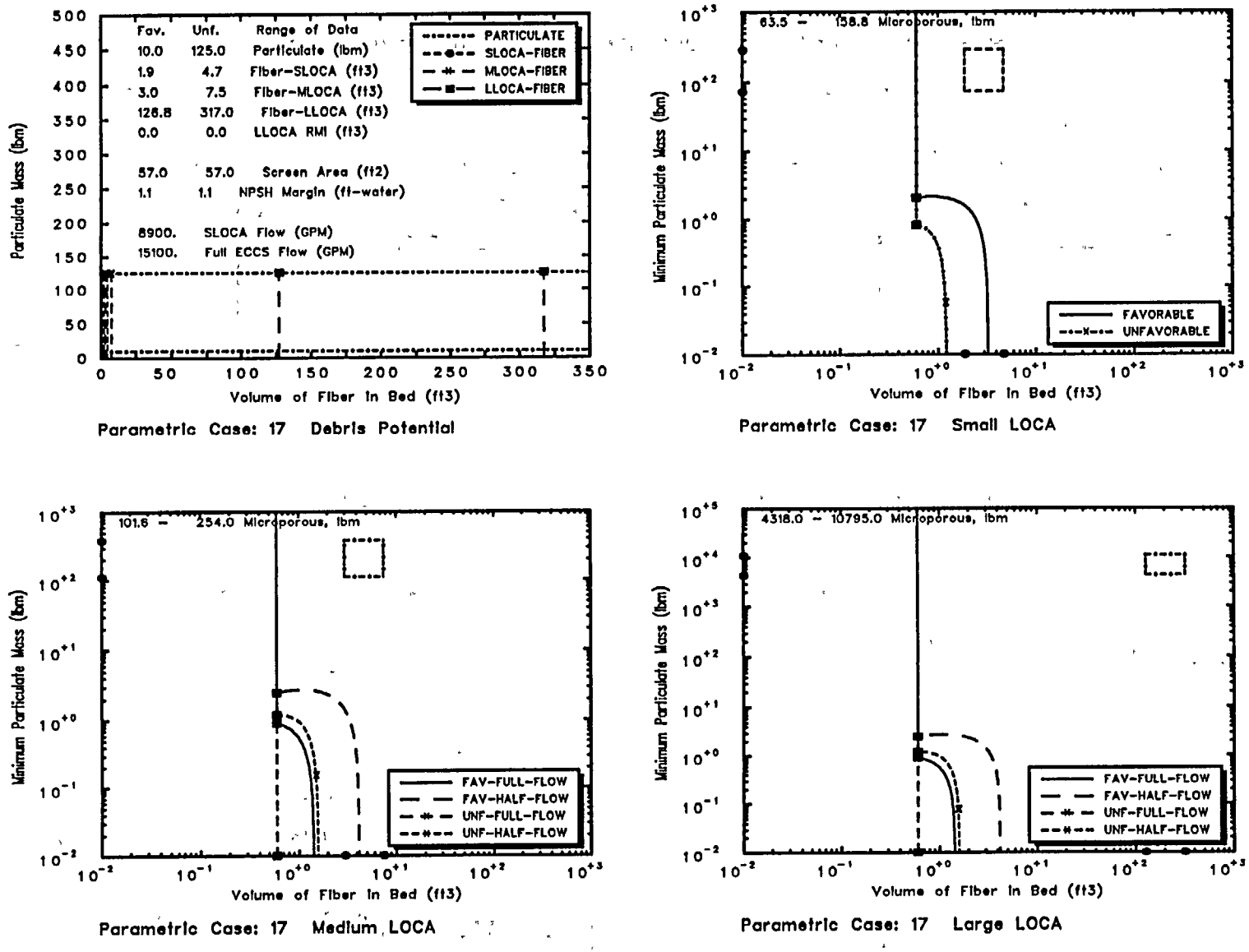
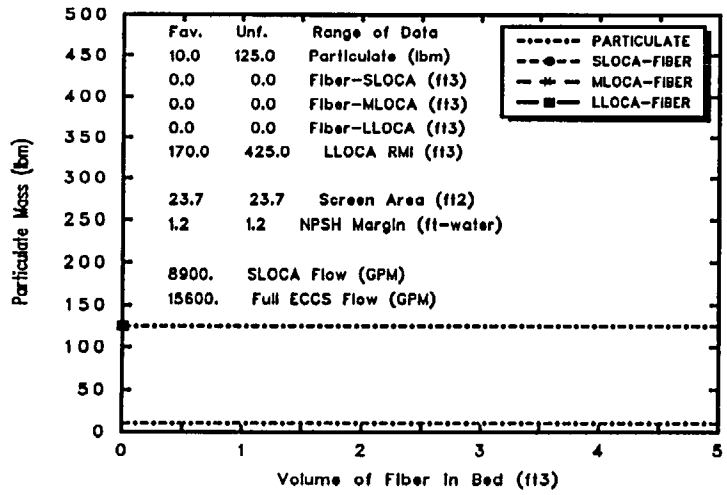
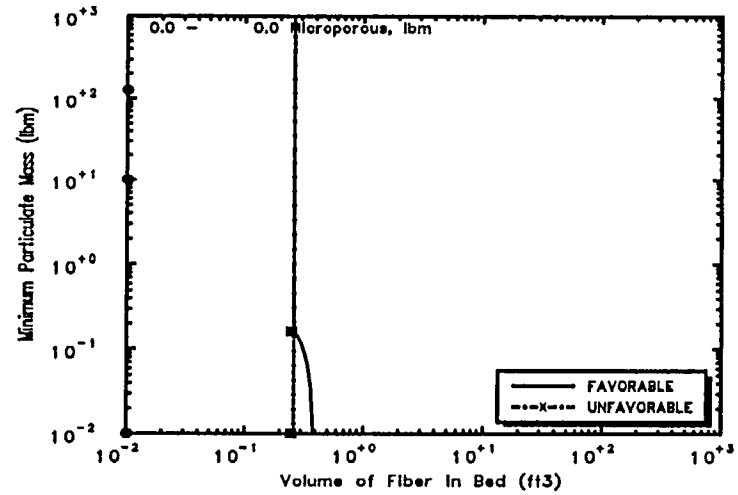


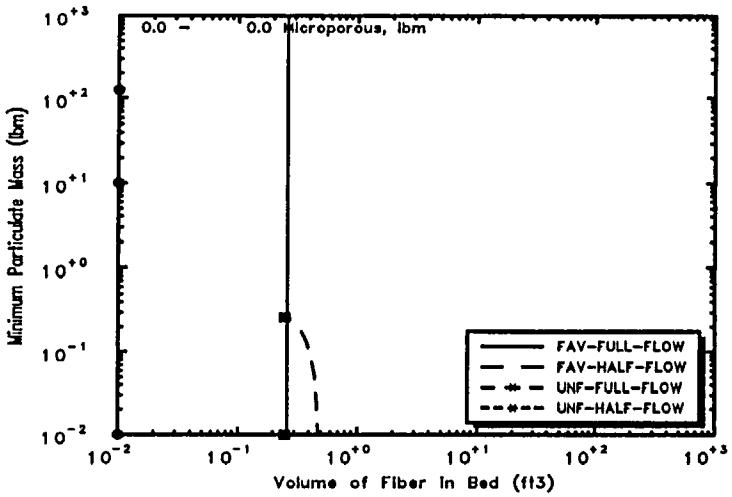
Figure B-17 Parametric Case 17



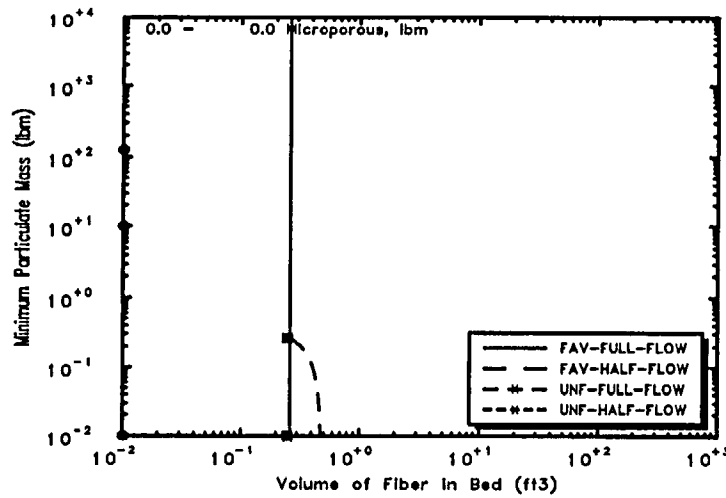
Parametric Case: 18 Debris Potential



Parametric Case: 18 Small LOCA

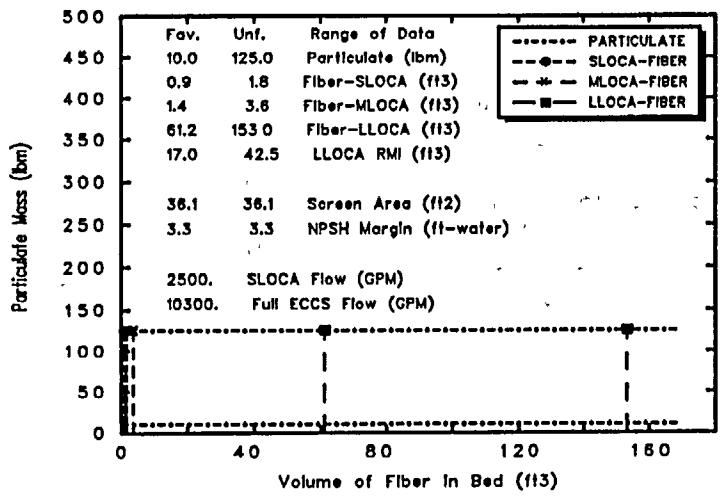


Parametric Case: 18 Medium LOCA

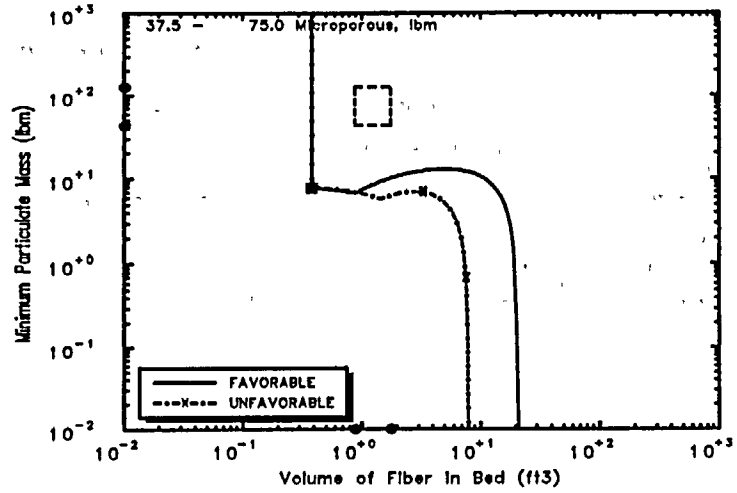


Parametric Case: 18 Large LOCA

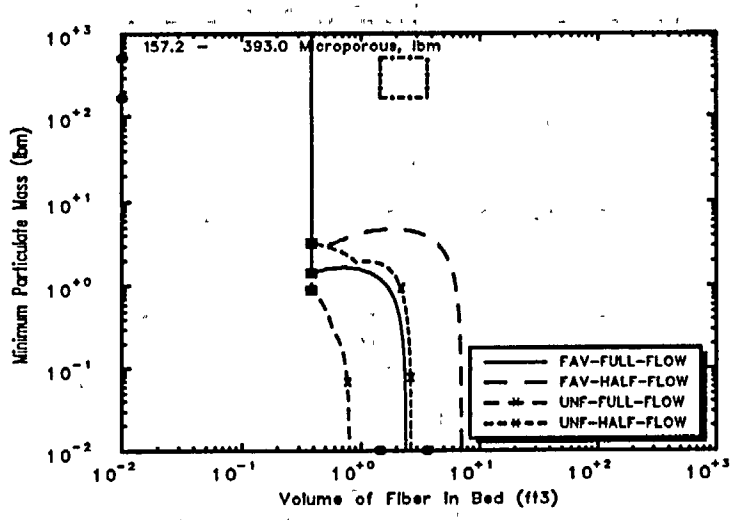
Figure B-18 Parametric Case 18 (Note: No fiber in this case, so no debris boxes presented.)



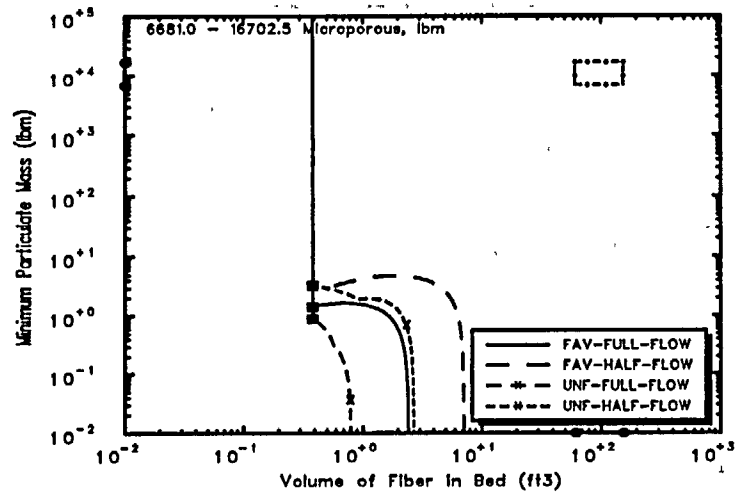
Parametric Case: 19 Debris Potential



Parametric Case: 19 Small LOCA

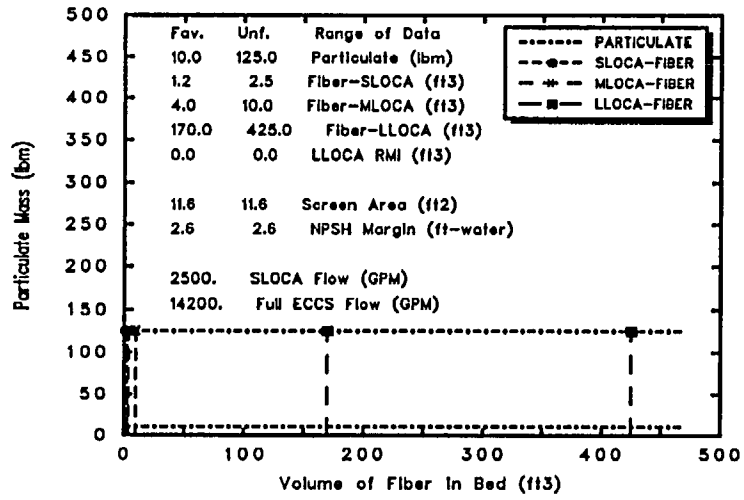


Parametric Case: 19 Medium LOCA

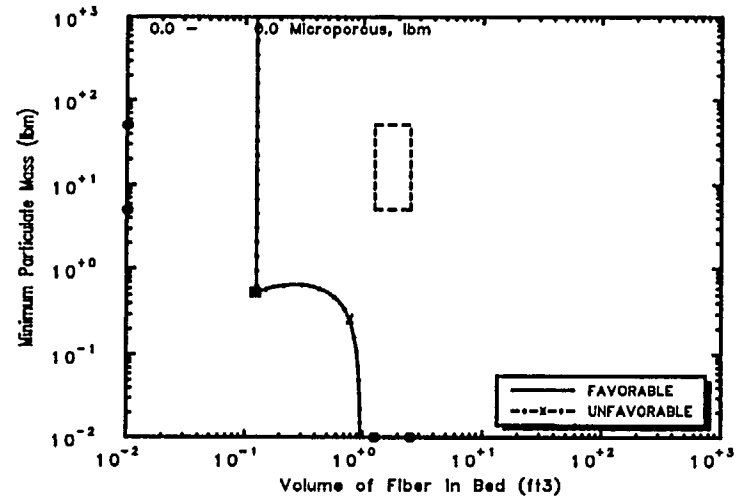


Parametric Case: 19 Large LOCA

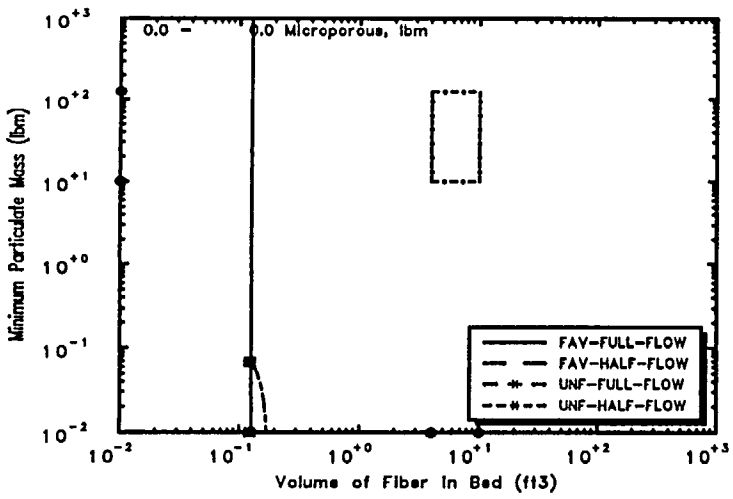
Figure B-19 Parametric Case 19



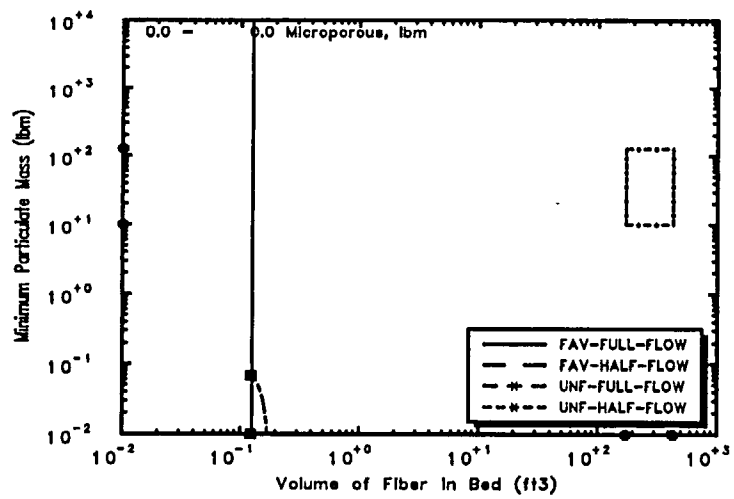
Parametric Case: 20 Debris Potential



Parametric Case: 20 Small LOCA

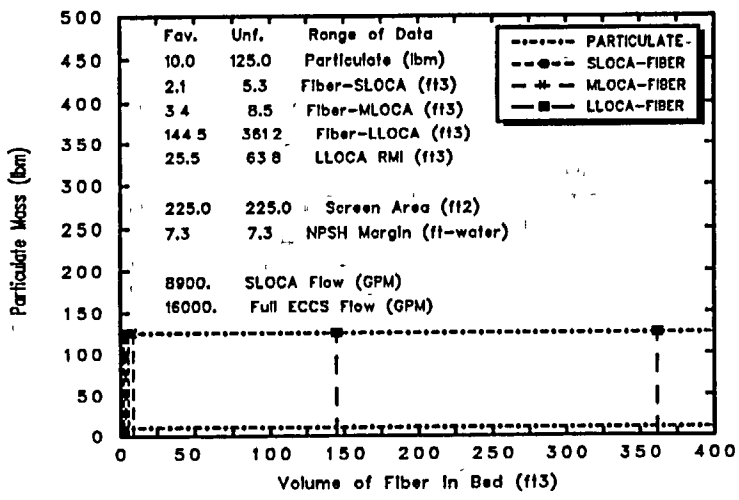


Parametric Case: 20 Medium LOCA

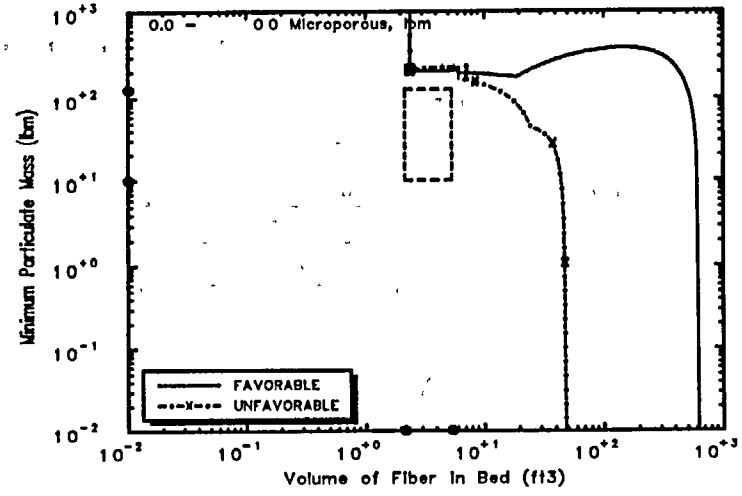


Parametric Case: 20 Large LOCA

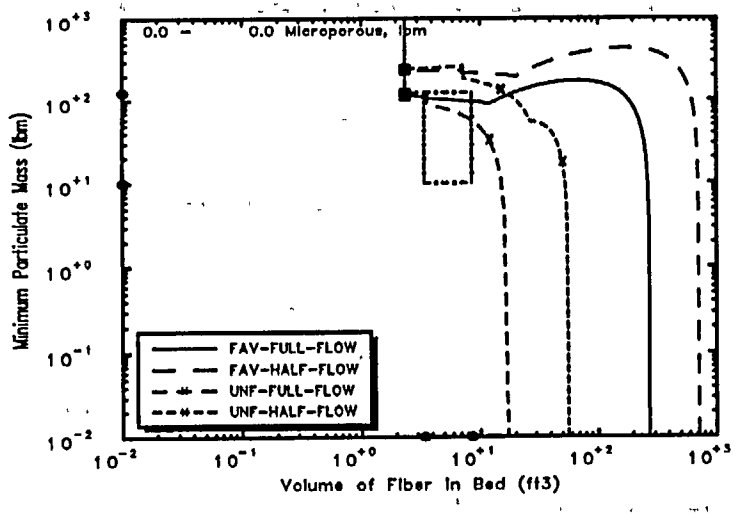
Figure B-20 Parametric Case 20



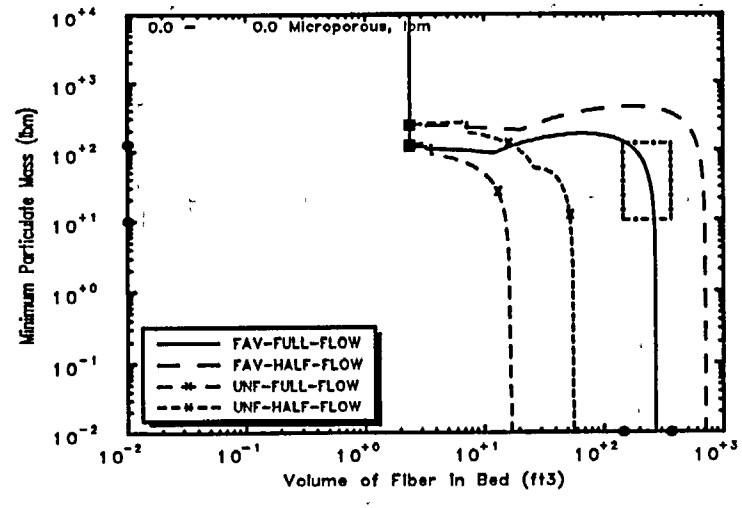
Parametric Case: 21 Debris Potential



Parametric Case: 21 Small LOCA

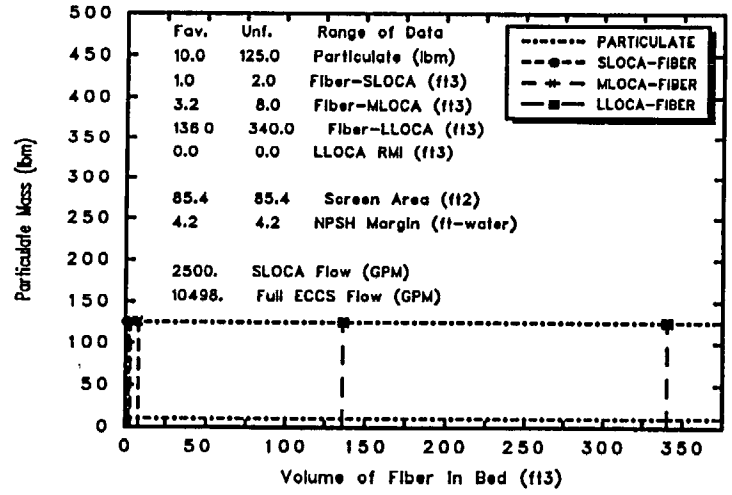


Parametric Case: 21 Medium LOCA

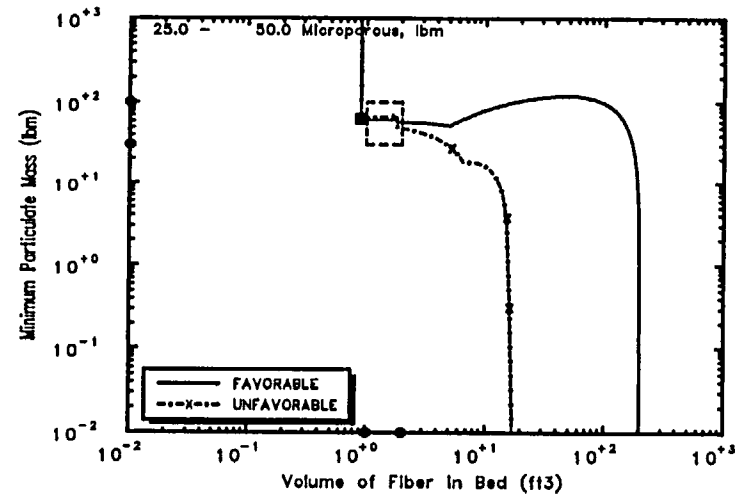


Parametric Case: 21 Large LOCA

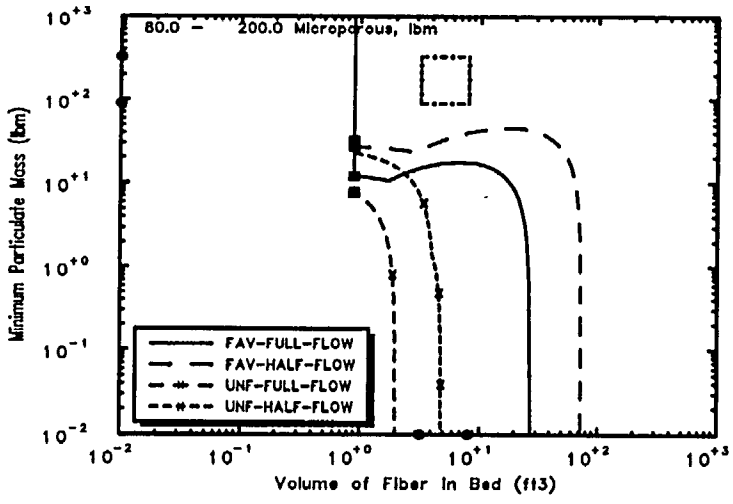
Figure B-21 Parametric Case 21



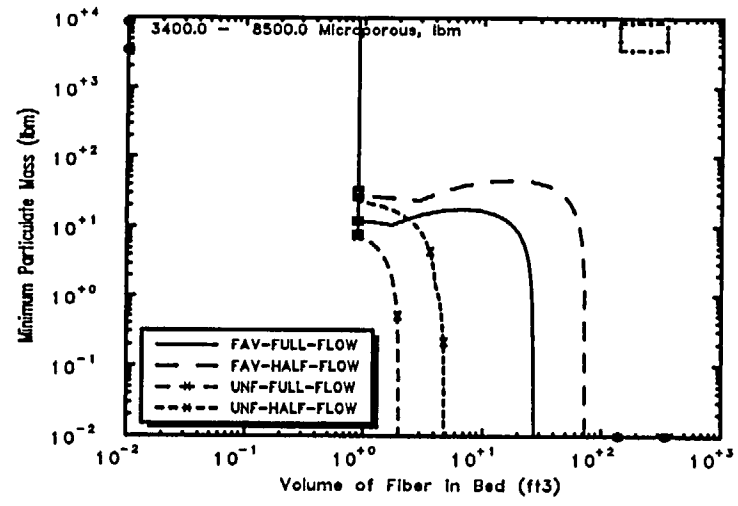
Parametric Case: 22 Debris Potential



Parametric Case: 22 Small LOCA

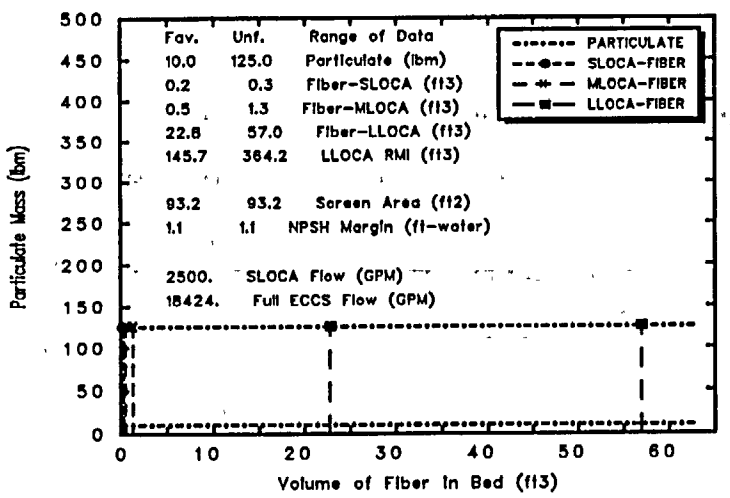


Parametric Case: 22 Medium LOCA

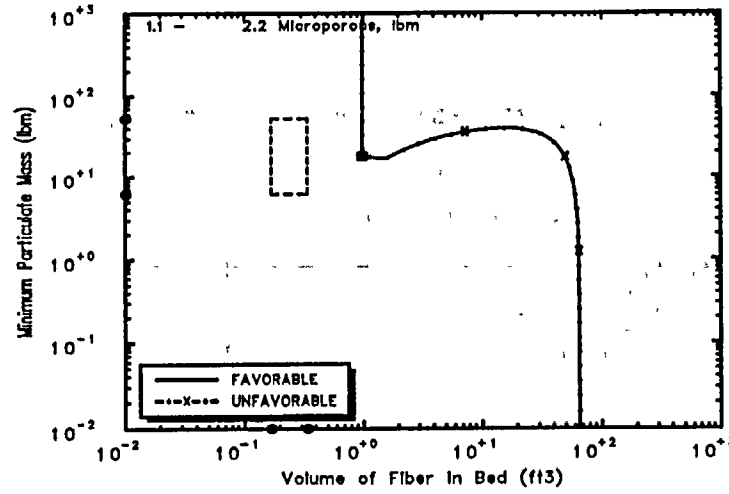


Parametric Case: 22 Large LOCA

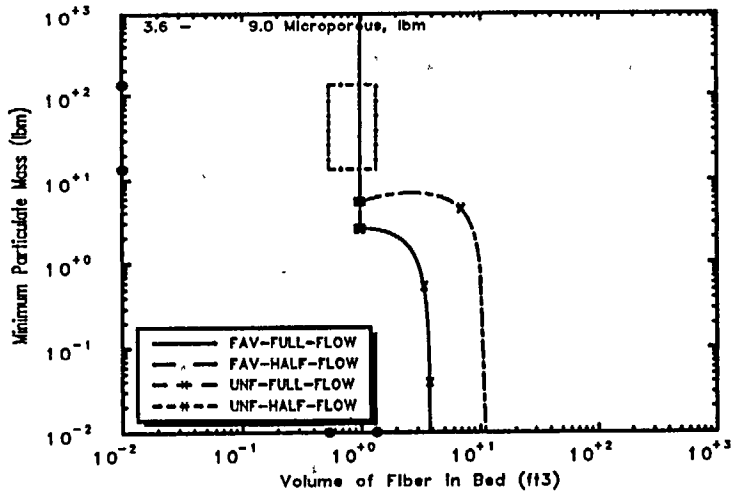
Figure B-22 Parametric Case 22



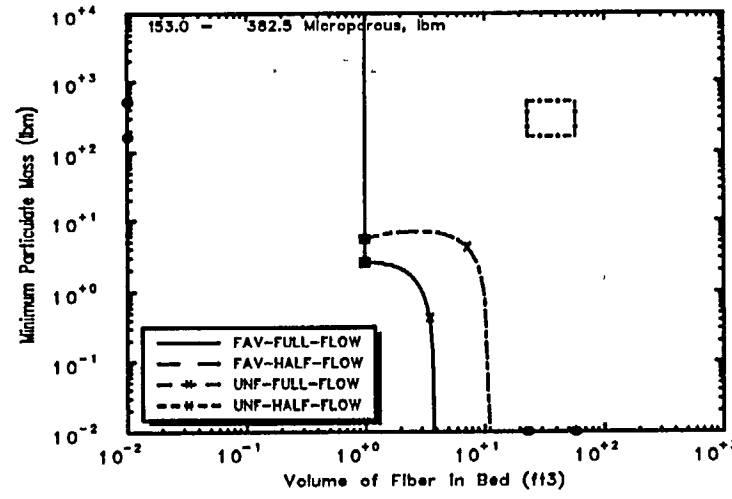
Parametric Case: 23 Debris Potential



Parametric Case: 23 Small LOCA

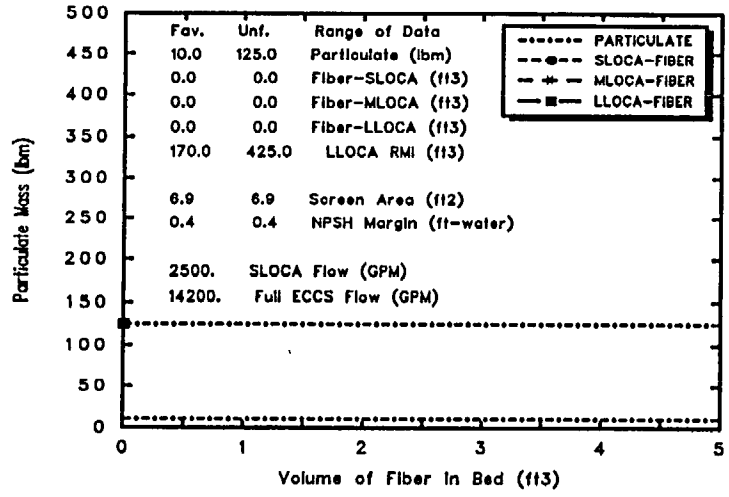


Parametric Case: 23 Medium LOCA

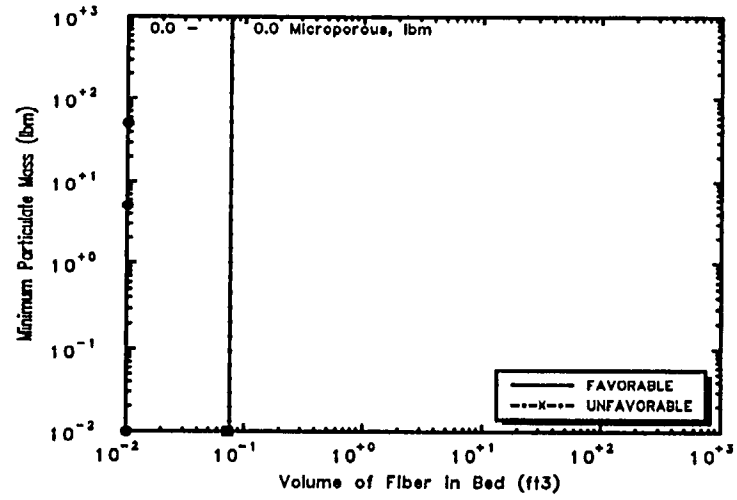


Parametric Case: 23 Large LOCA

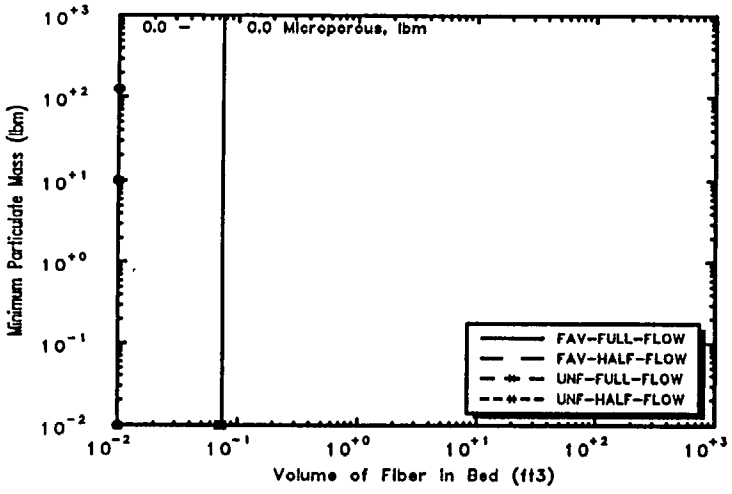
Figure B-23 Parametric Case 23



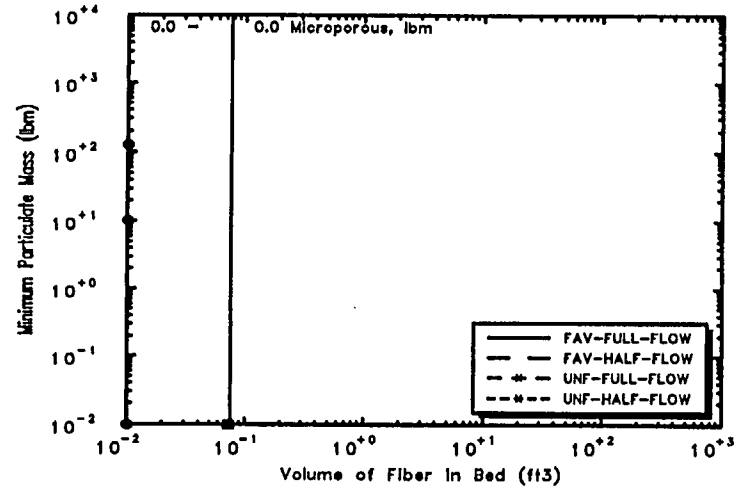
Parametric Case: 24 Debris Potential



Parametric Case: 24 Small LOCA



Parametric Case: 24 Medium LOCA



Parametric Case: 24 Large LOCA

Figure B-24 Parametric Case 24 (Note: No fiber in this case, so no debris boxes presented.)

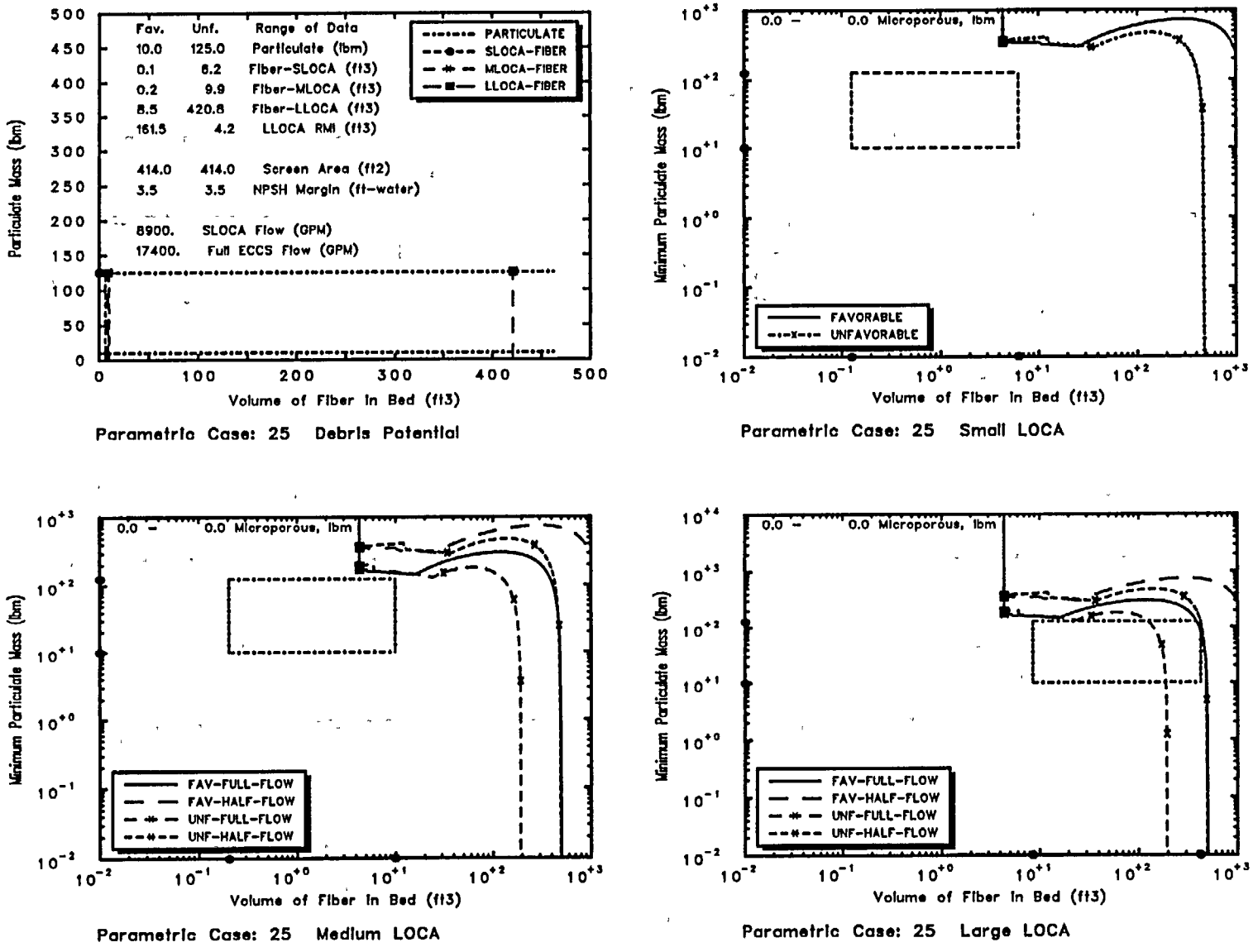
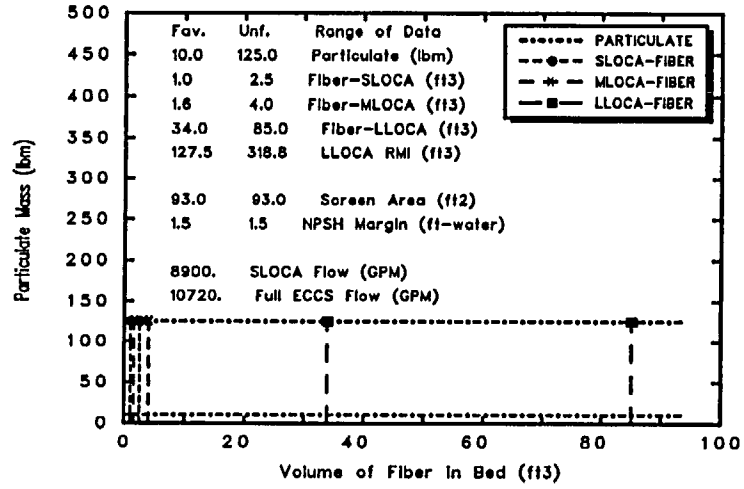
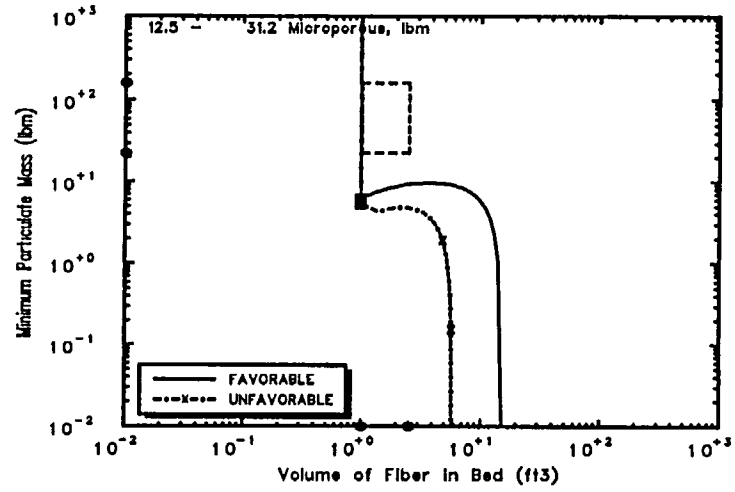


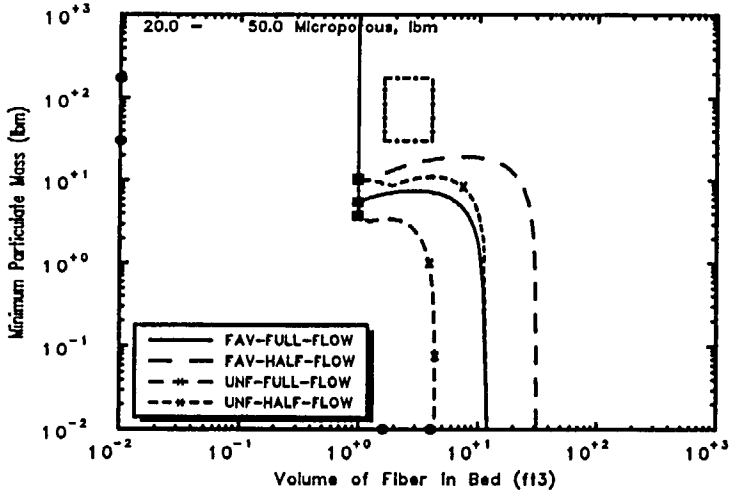
Figure B-25 Parametric Case 25



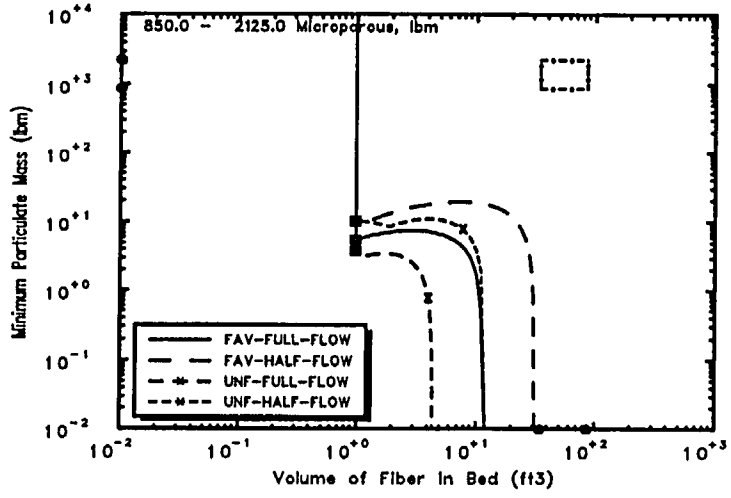
Parametric Case: 26 Debris Potential



Parametric Case: 26 Small LOCA

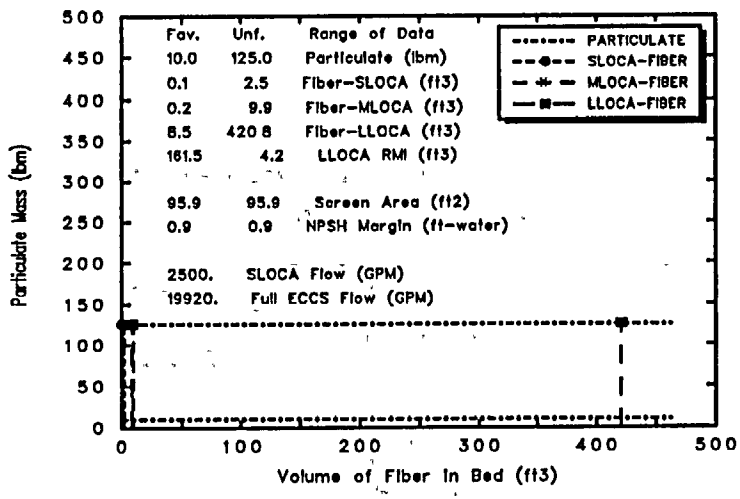


Parametric Case: 26 Medium LOCA

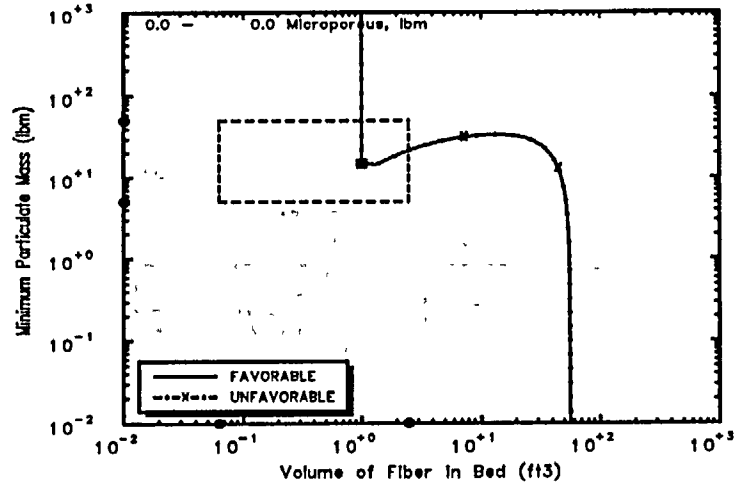


Parametric Case: 26 Large LOCA

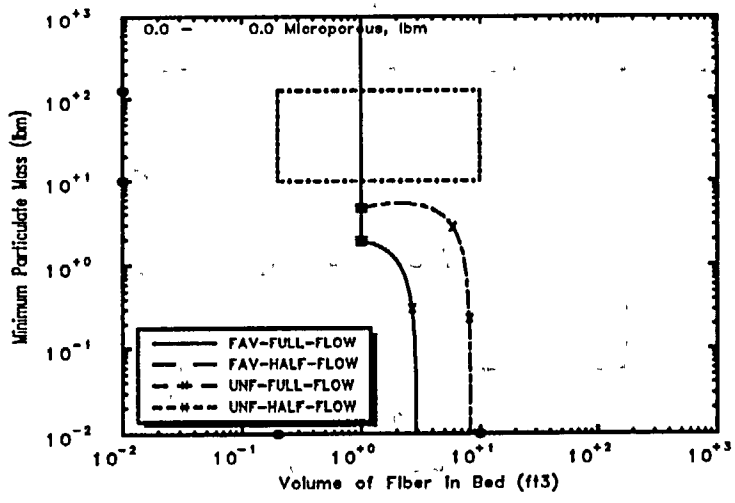
Figure B-26 Parametric Case 26



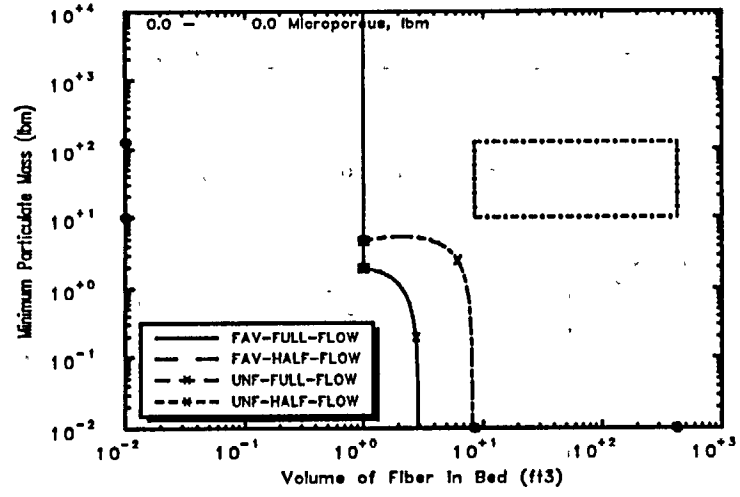
Parametric Case: 27 Debris Potential



Parametric Case: 27 Small LOCA

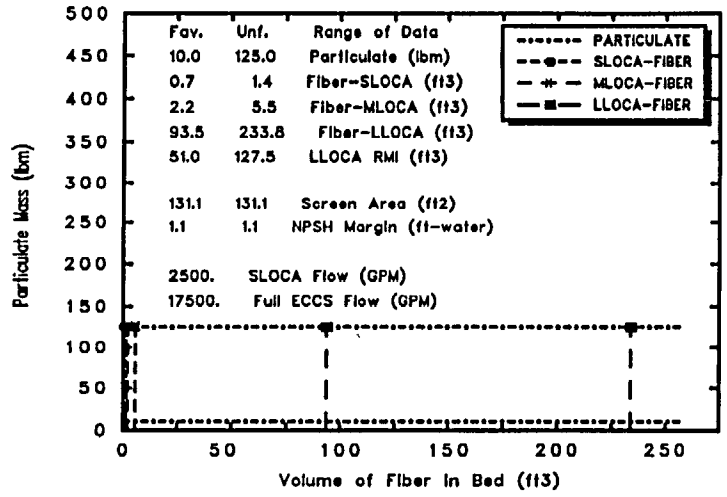


Parametric Case: 27 Medium LOCA

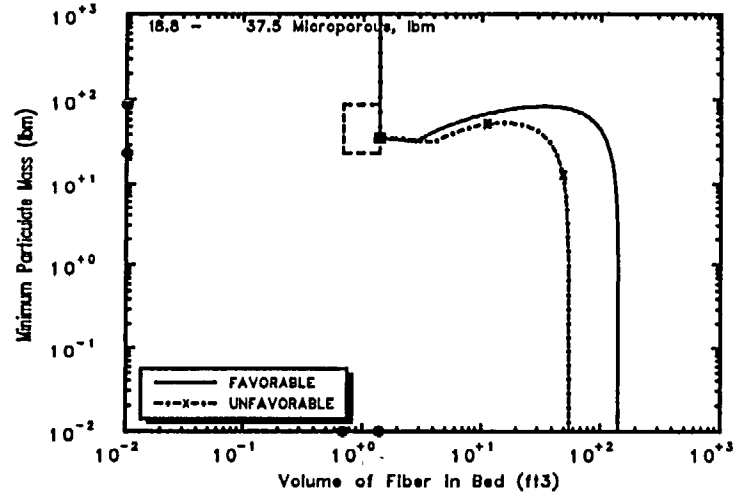


Parametric Case: 27 Large LOCA

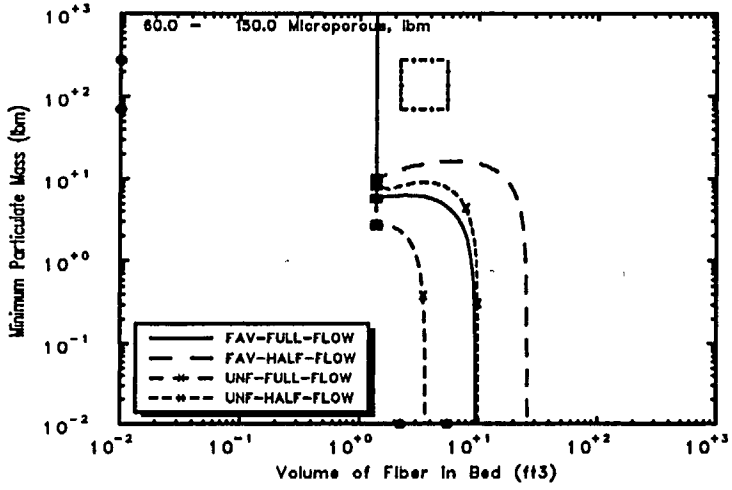
Figure B-27 Parametric Case 27



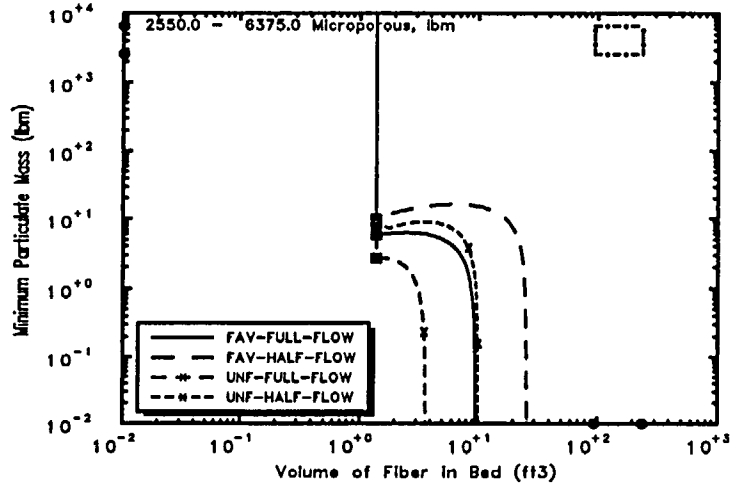
Parametric Case: 28 Debris Potential



Parametric Case: 28 Small LOCA

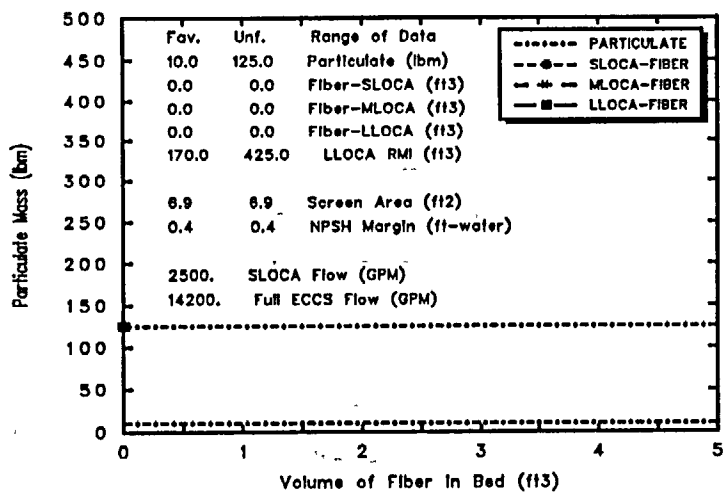


Parametric Case: 28 Medium LOCA

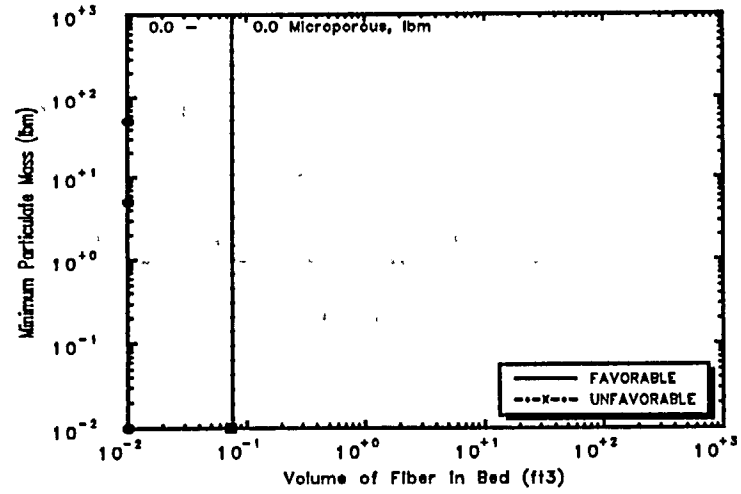


Parametric Case: 28 Large LOCA

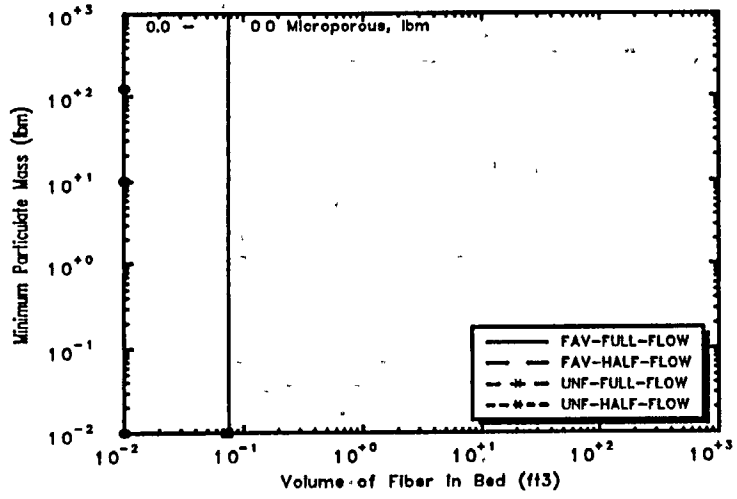
Figure B-28 Parametric Case 28



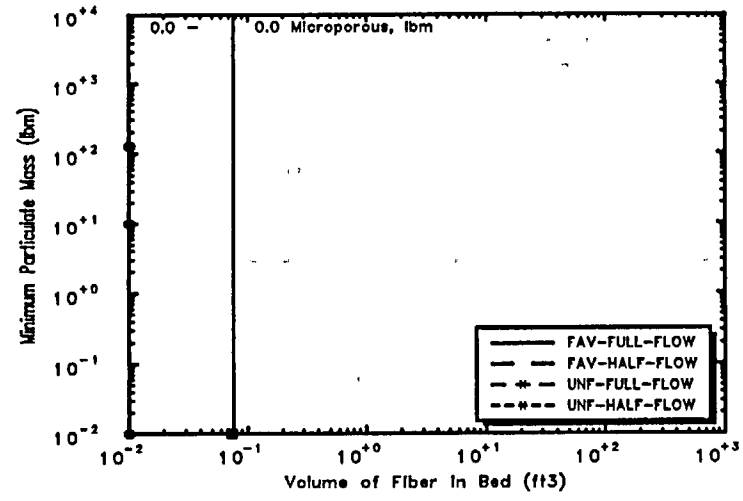
Parametric Case: 29 Debris Potential



Parametric Case: 29 Small LOCA

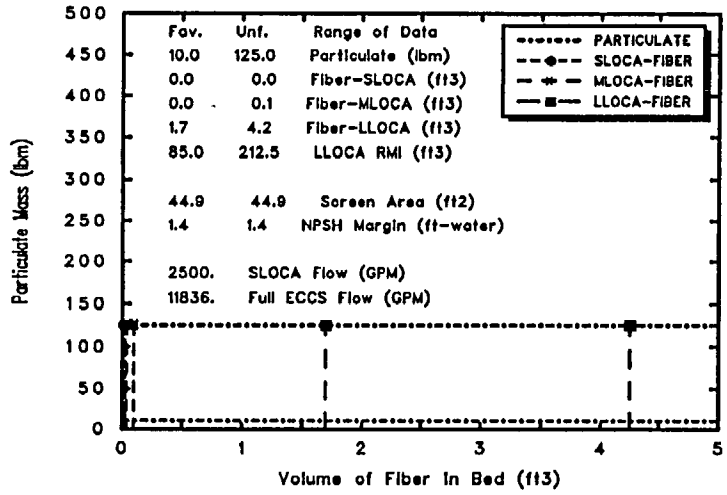


Parametric Case: 29 Medium LOCA

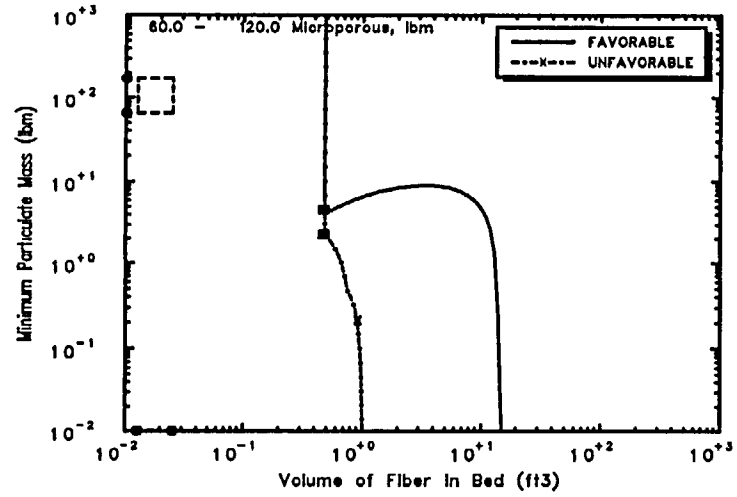


Parametric Case: 29 Large LOCA

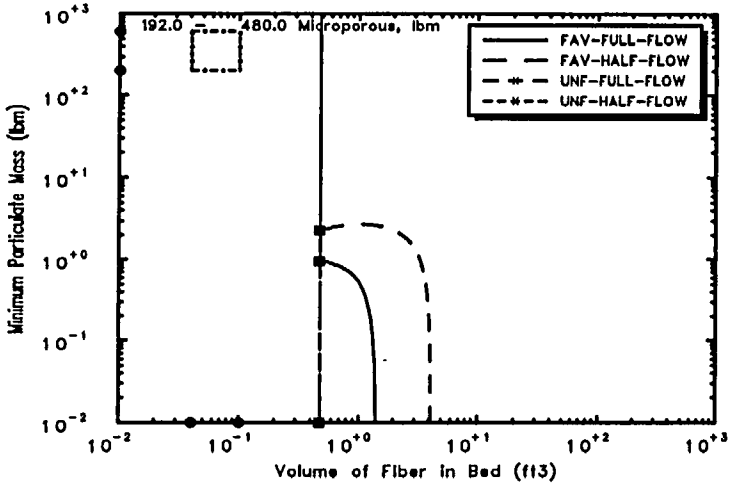
Figure B-29 Parametric Case 29 (Note: No fiber in this case, so no debris boxes presented.)



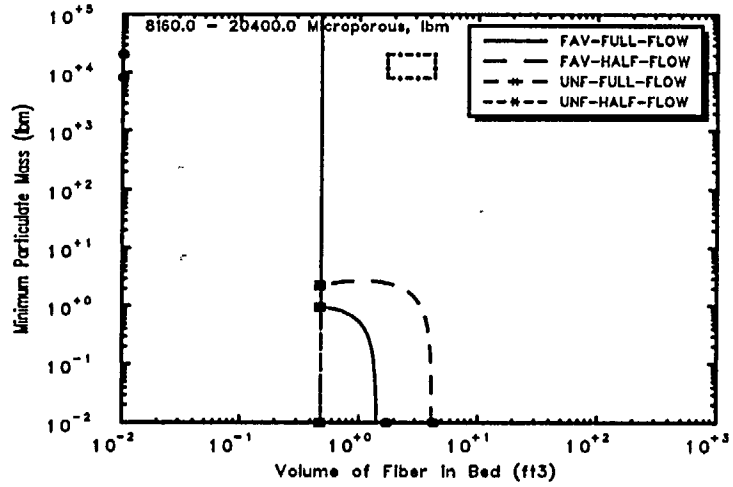
Parametric Case: 30 Debris Potential



Parametric Case: 30 Small LOCA

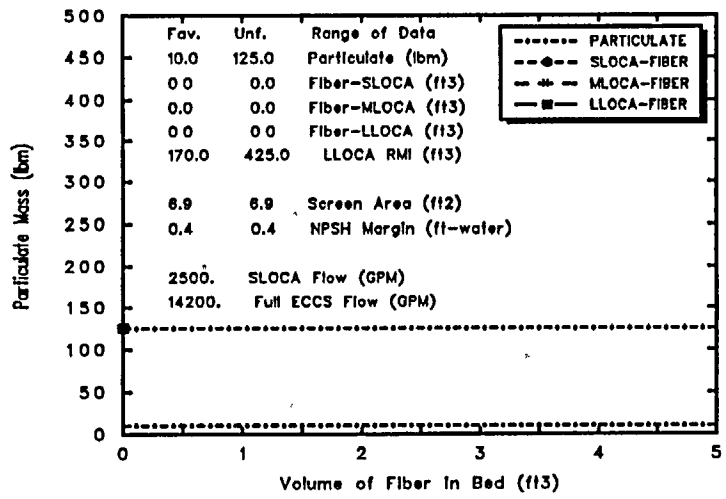


Parametric Case: 30 Medium LOCA

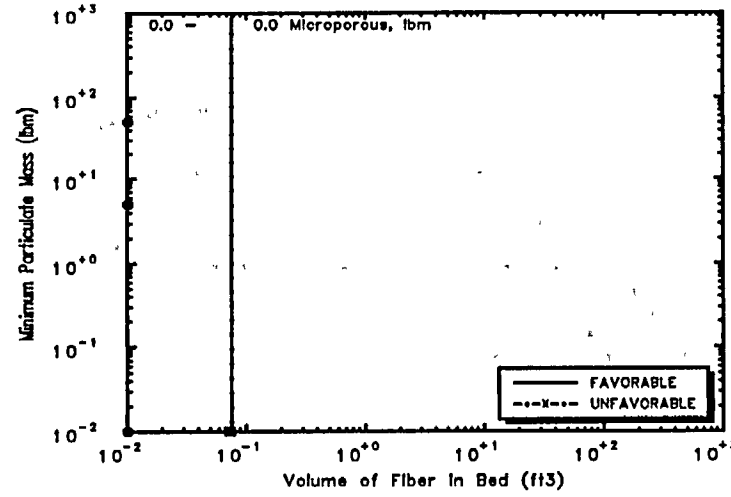


Parametric Case: 30 Large LOCA

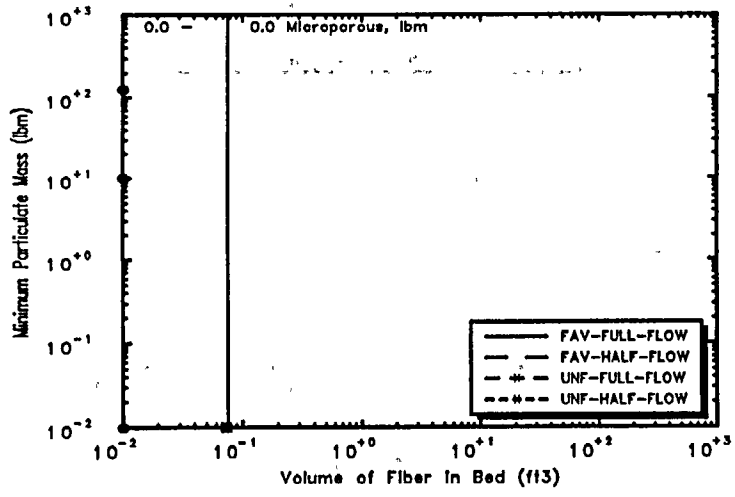
Figure B-30 Parametric Case 30



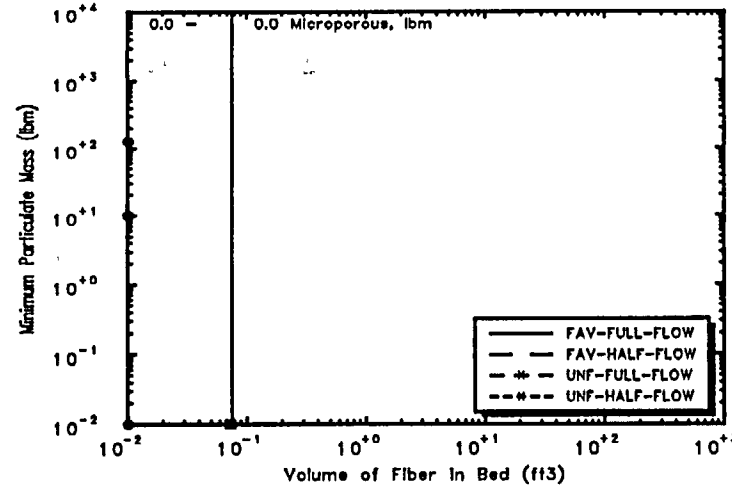
Parametric Case: 31 Debris Potential



Parametric Case: 31 Small LOCA

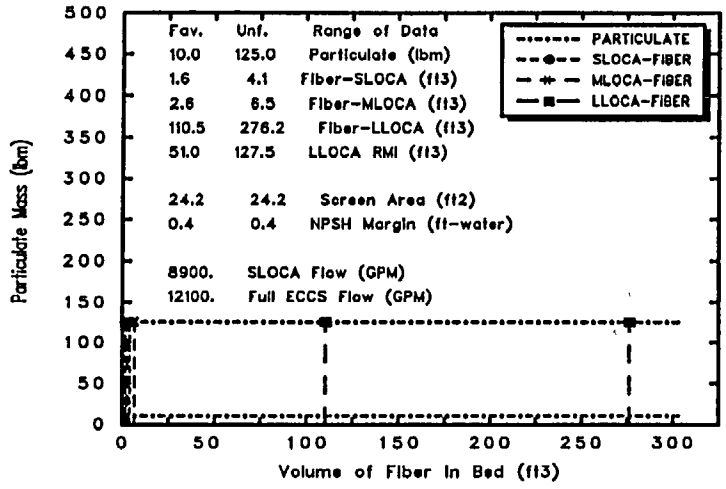


Parametric Case: 31 Medium LOCA

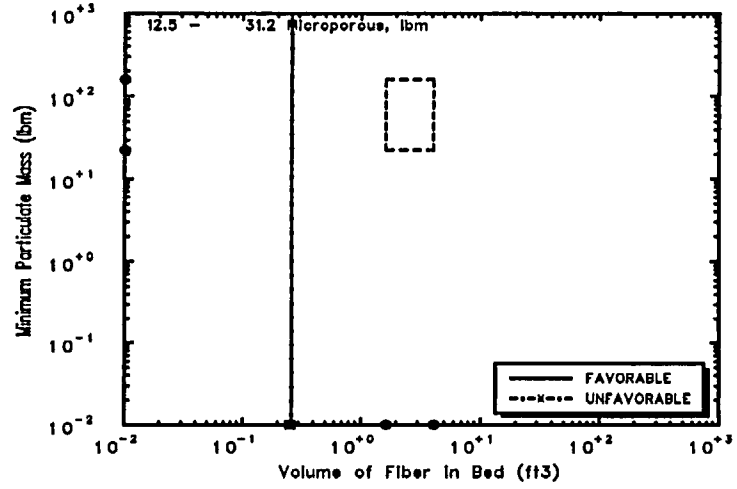


Parametric Case: 31 Large LOCA

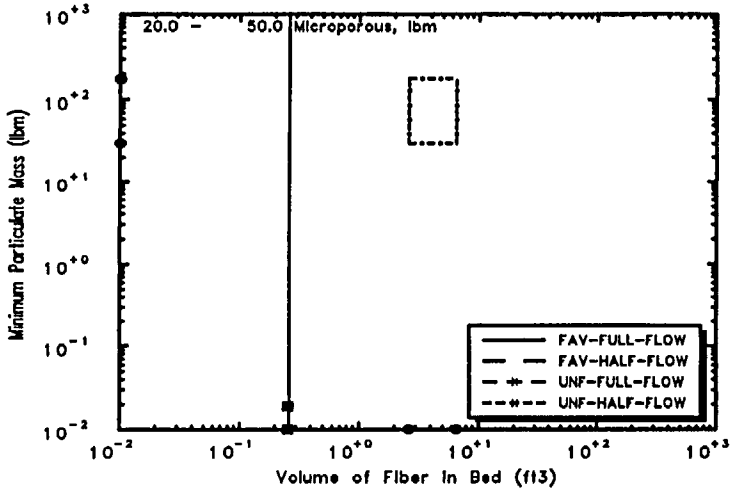
Figure B-31 Parametric Case 31 (Note: No fiber in this case, so no debris boxes presented.)



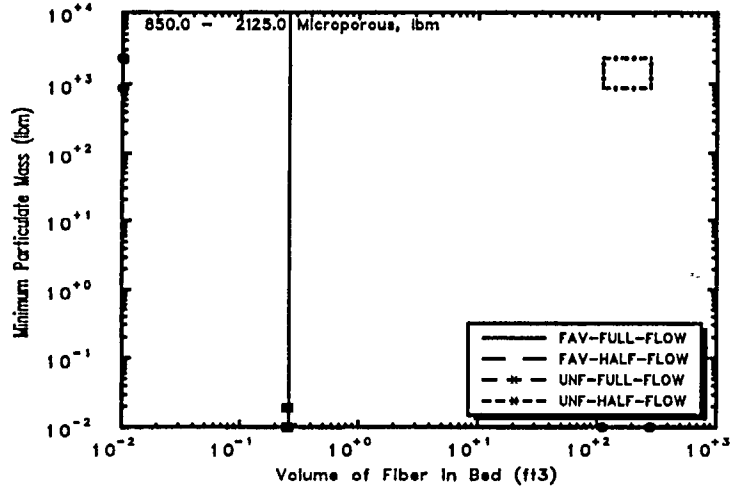
Parametric Case: 32 Debris Potential



Parametric Case: 32 Small LOCA

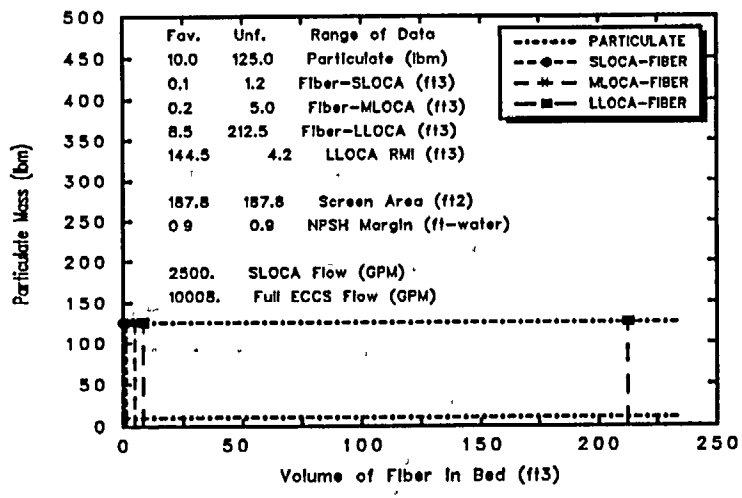


Parametric Case: 32 Medium LOCA

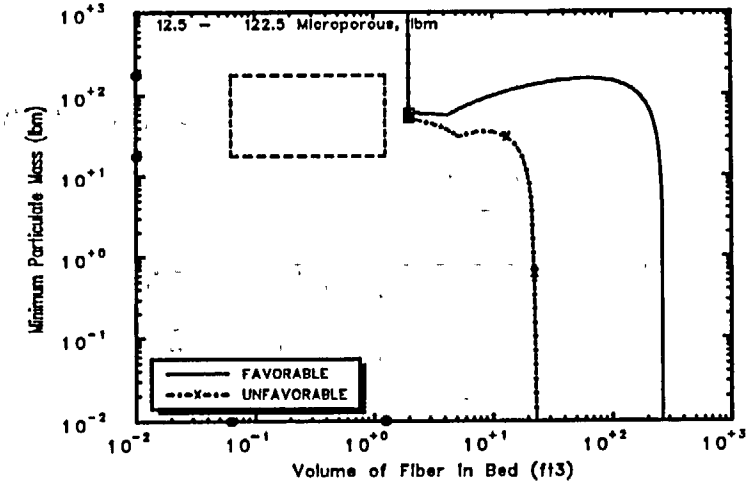


Parametric Case: 32 Large LOCA

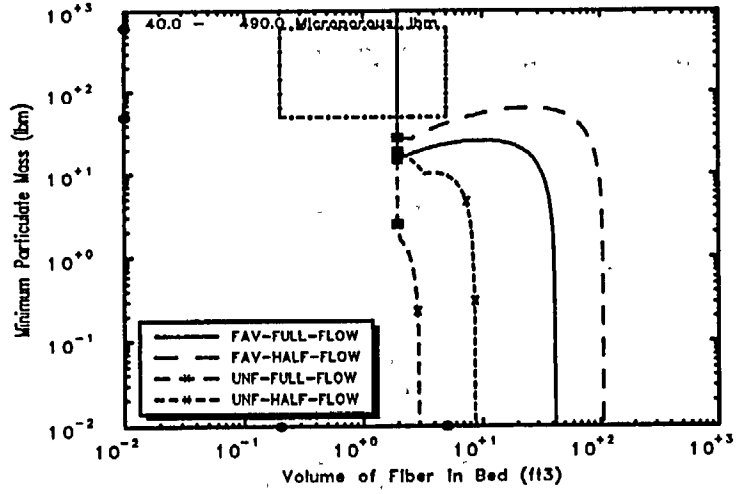
Figure B-32 Parametric Case 32



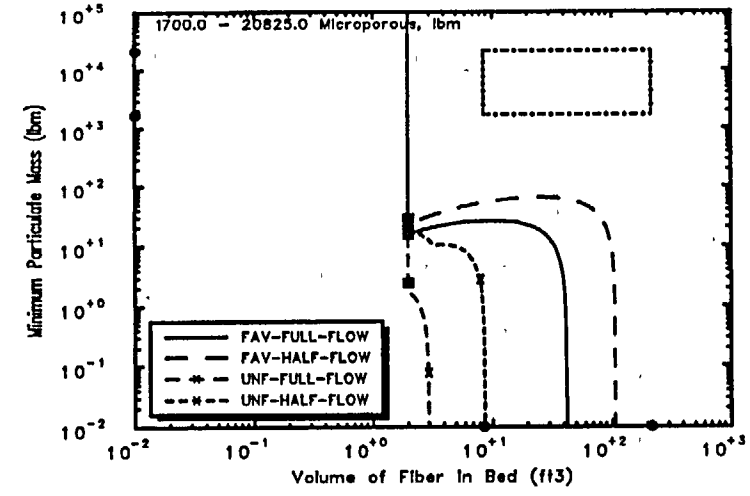
Parametric Case: 33 Debris Potential



Parametric Case: 33 Small LOCA

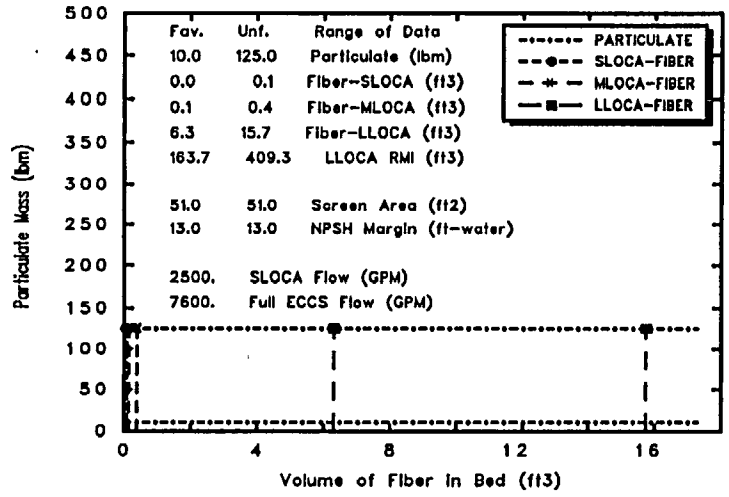


Parametric Case: 33 Medium LOCA

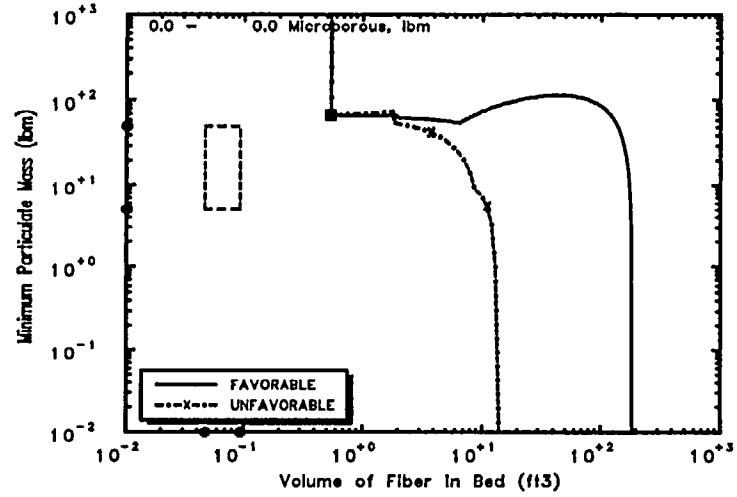


Parametric Case: 33 Large LOCA

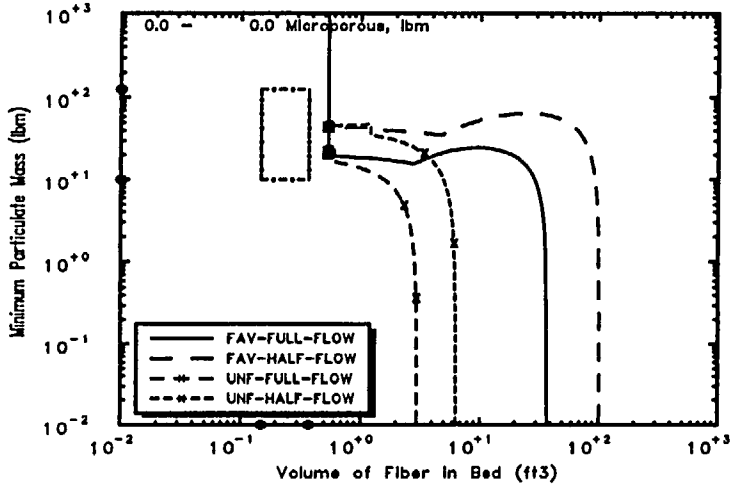
Figure B-33 Parametric Case 33



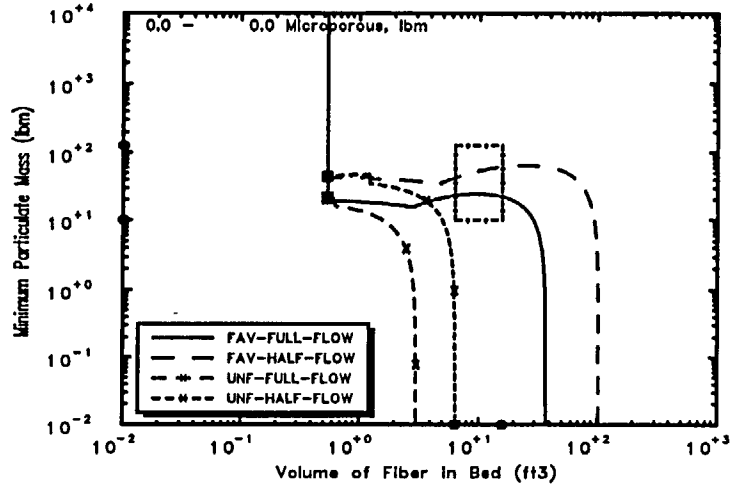
Parametric Case: 34 Debris Potential



Parametric Case: 34 Small LOCA



Parametric Case: 34 Medium LOCA



Parametric Case: 34 Large LOCA

Figure B-34 Parametric Case 34

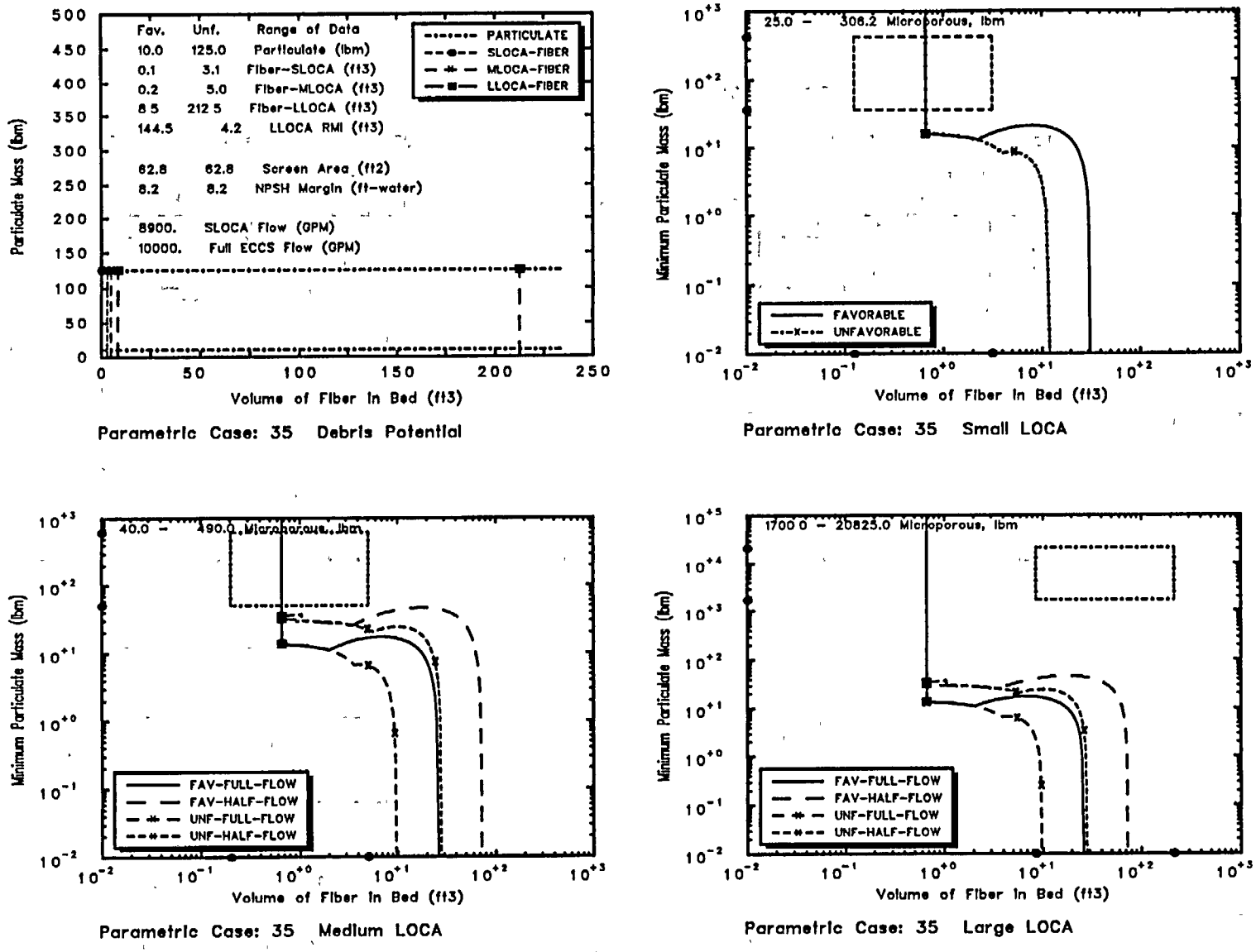
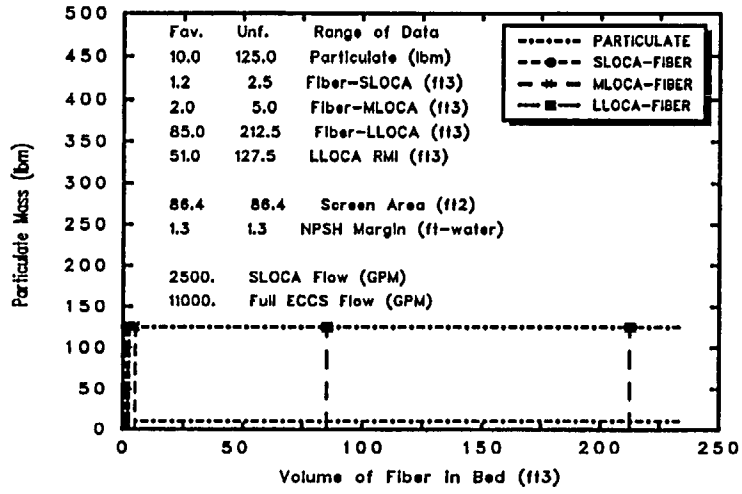
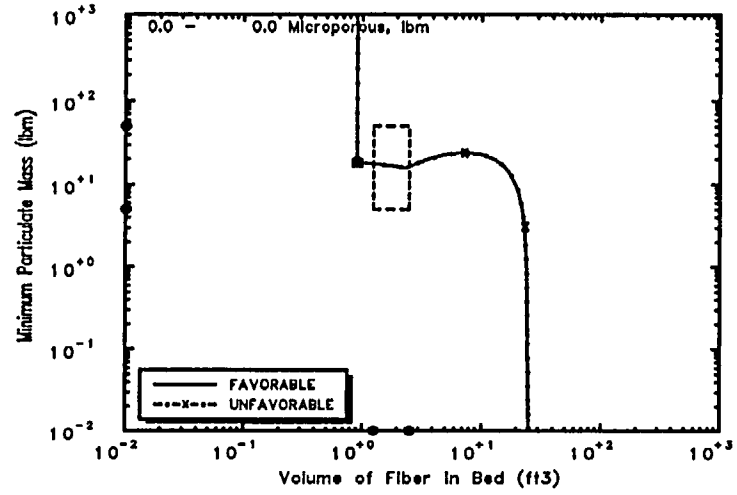


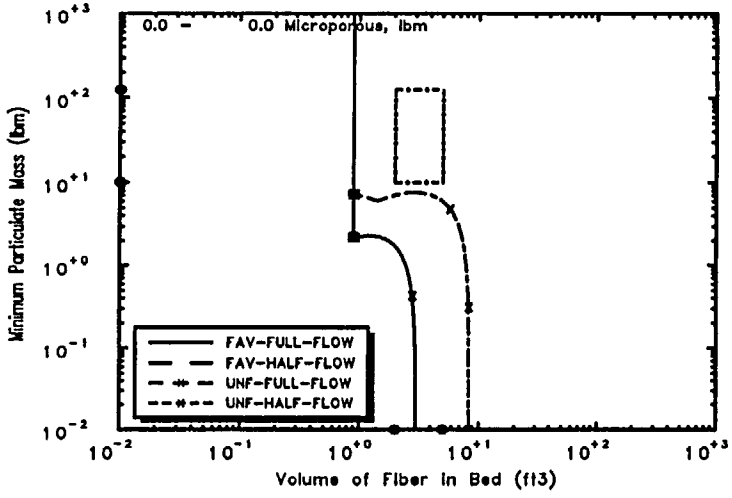
Figure B-35 Parametric Case 35



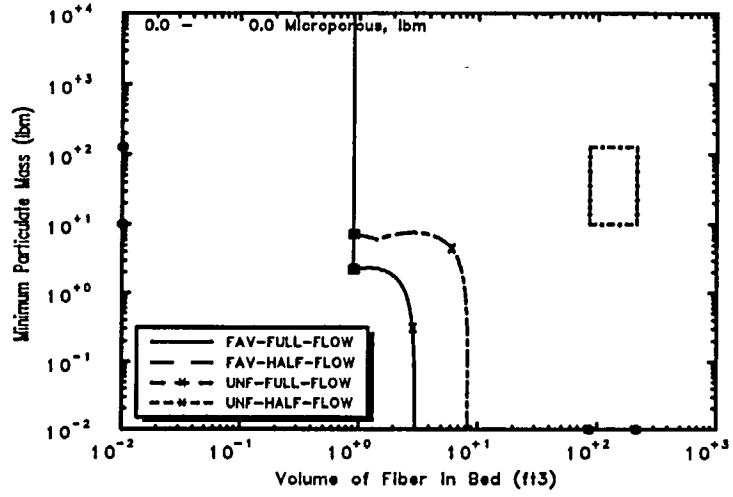
Parametric Case: 36 Debris Potential



Parametric Case: 36 Small LOCA

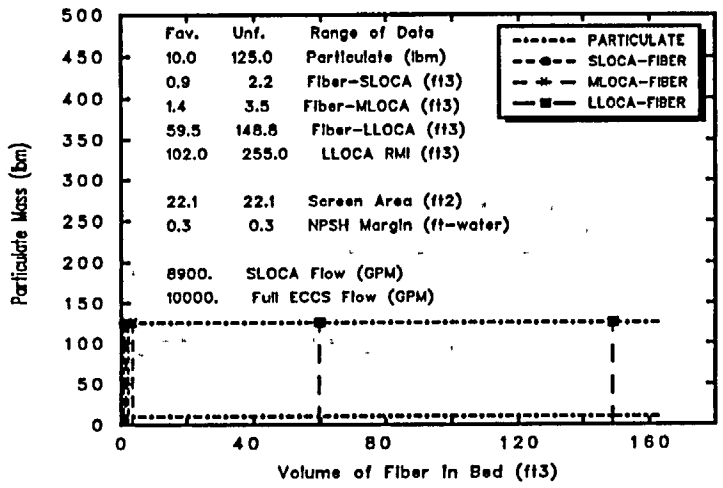


Parametric Case: 36 Medium LOCA

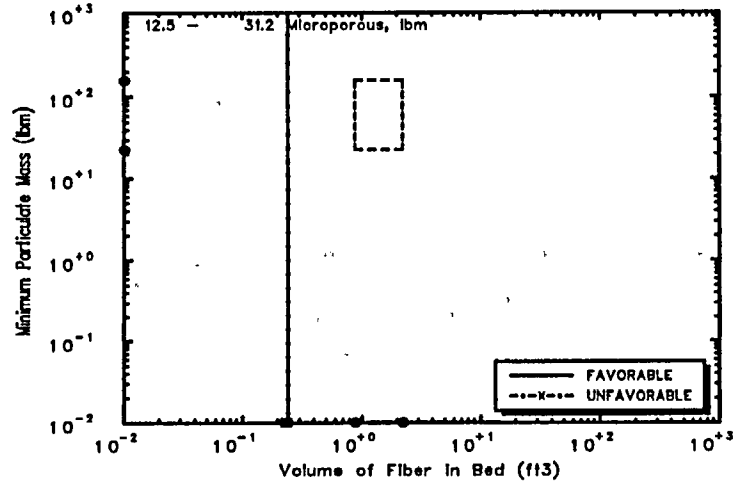


Parametric Case: 36 Large LOCA

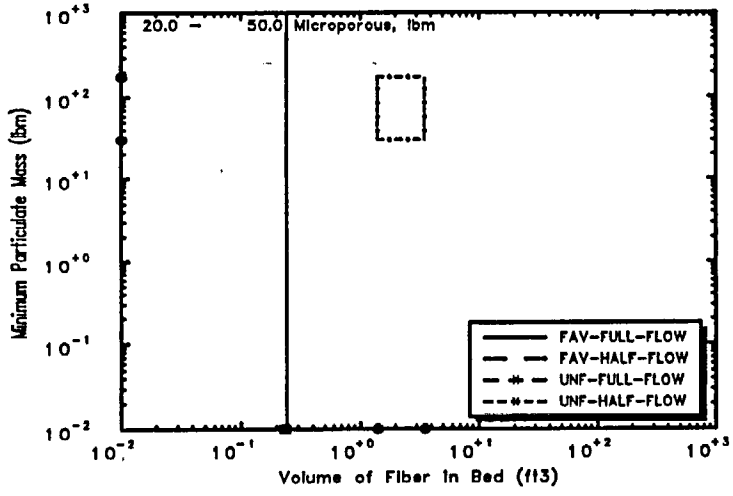
Figure B-36 Parametric Case 36



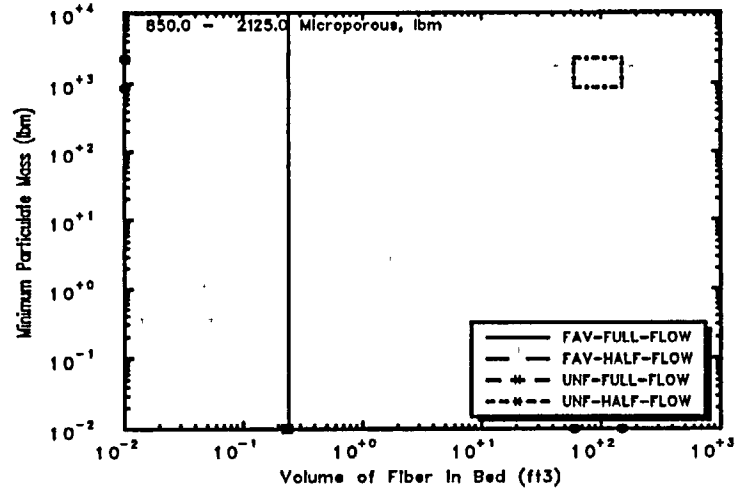
Parametric Case: 37 Debris Potential



Parametric Case: 37 Small LOCA



Parametric Case: 37 Medium LOCA



Parametric Case: 37 Large LOCA

Figure B-37 Parametric Case 37

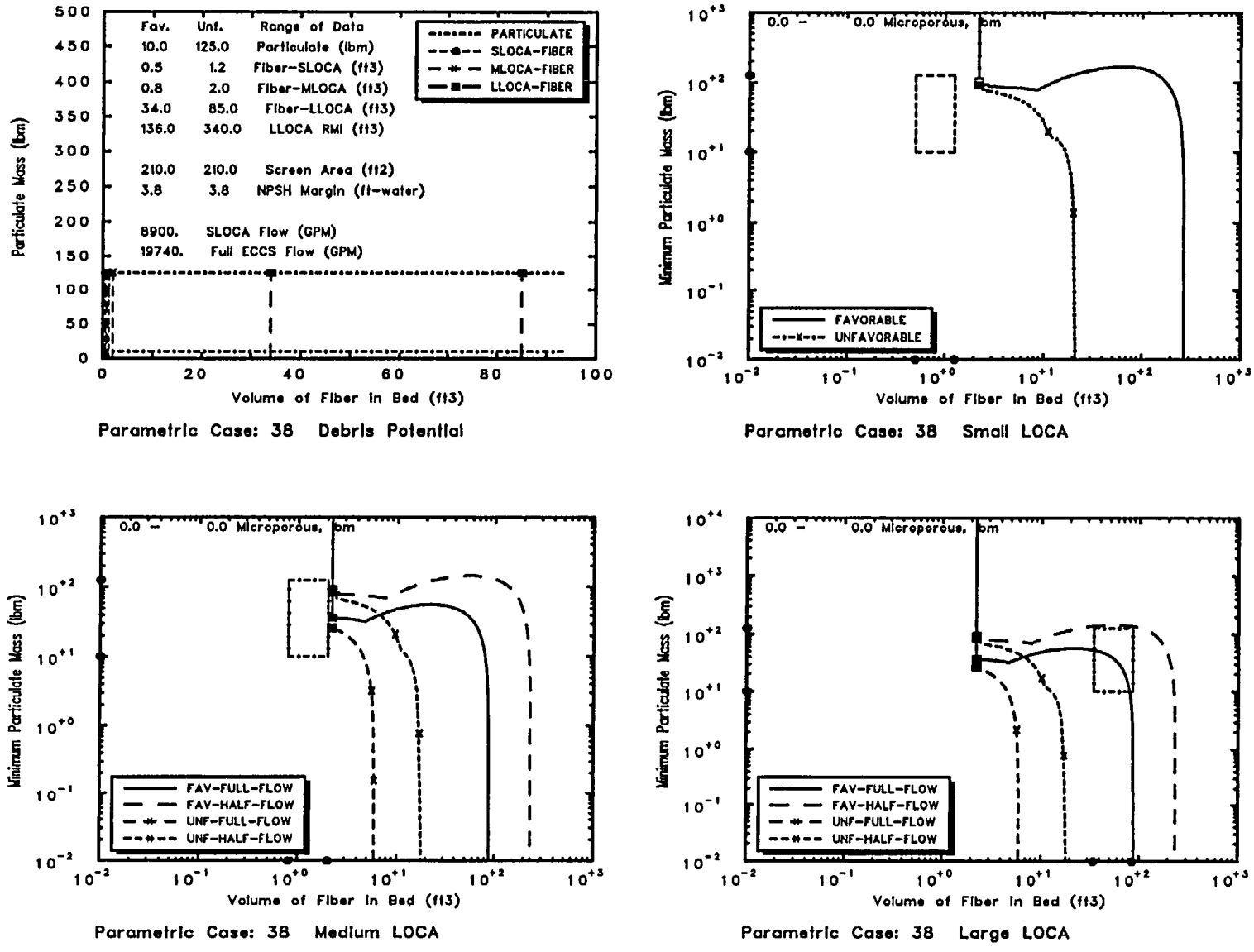
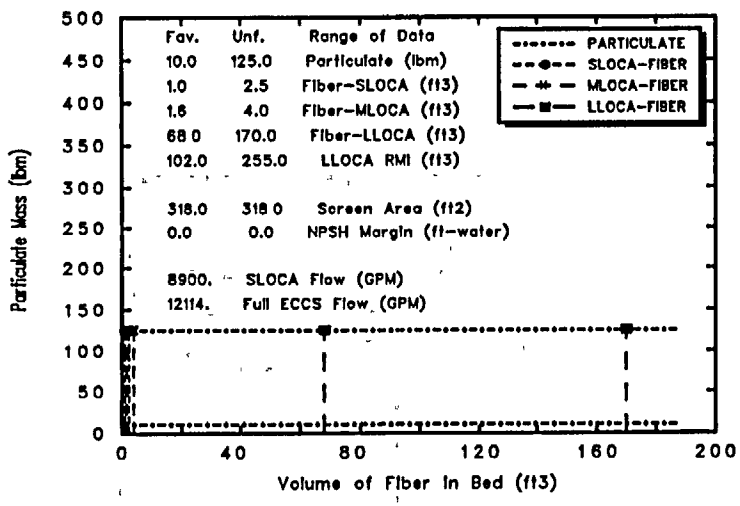
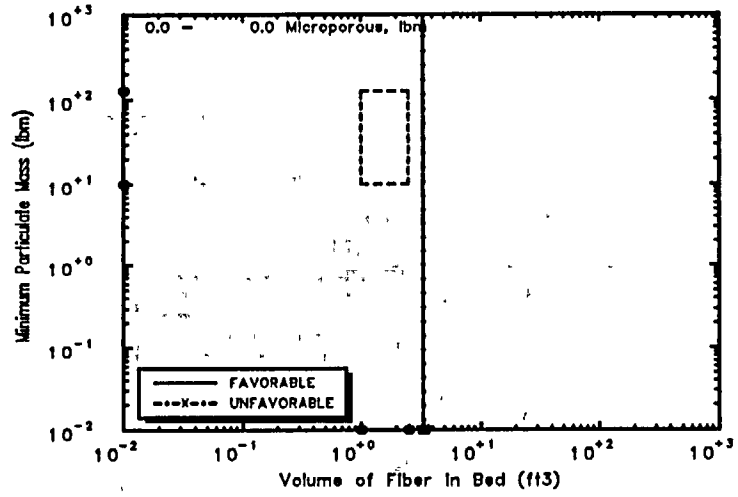


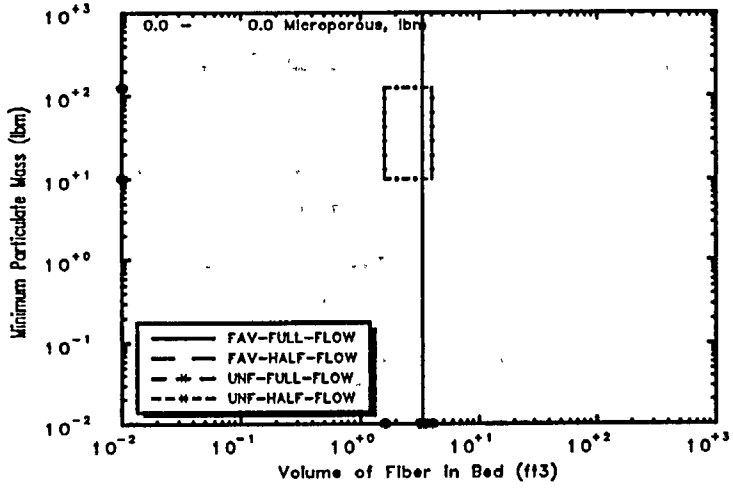
Figure B-38 Parametric Case 38



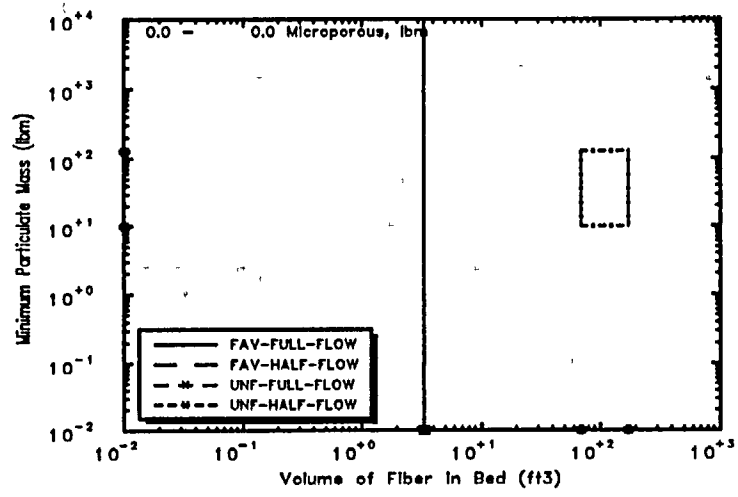
Parametric Case: 39 Debris Potential



Parametric Case: 39 Small LOCA

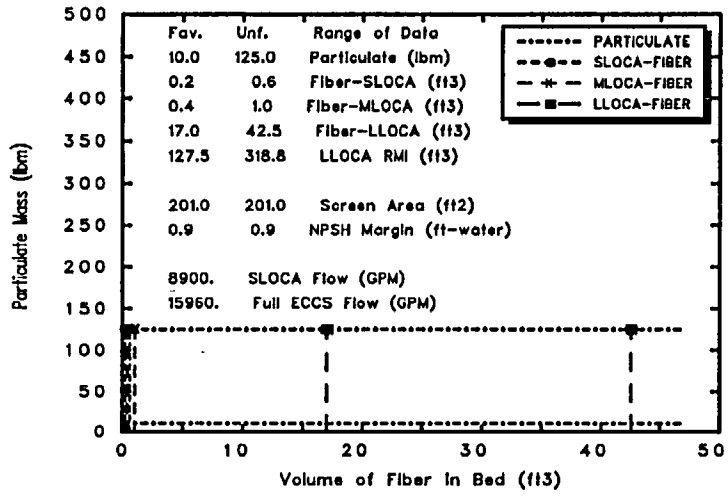


Parametric Case: 39 Medium LOCA

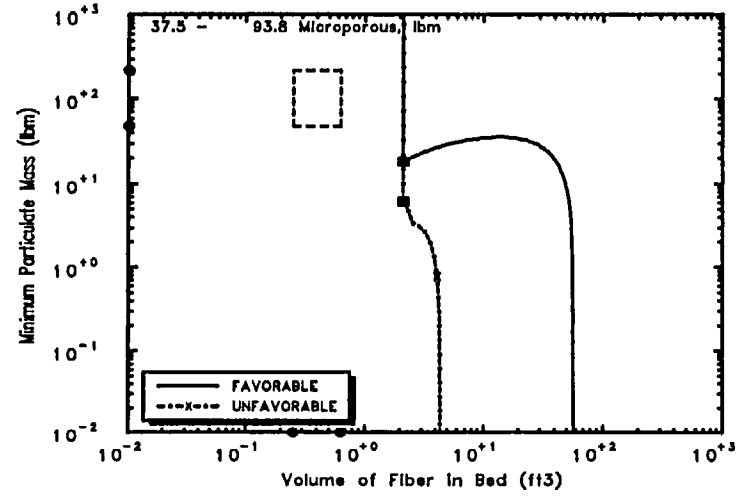


Parametric Case: 39 Large LOCA

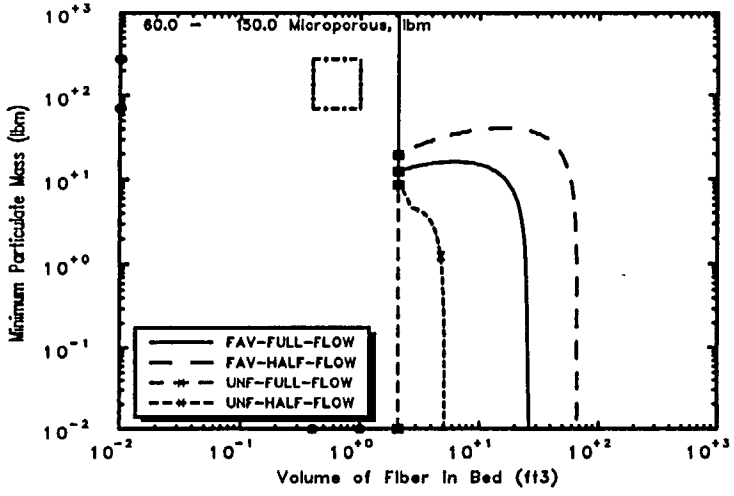
Figure B-39 Parametric Case 39



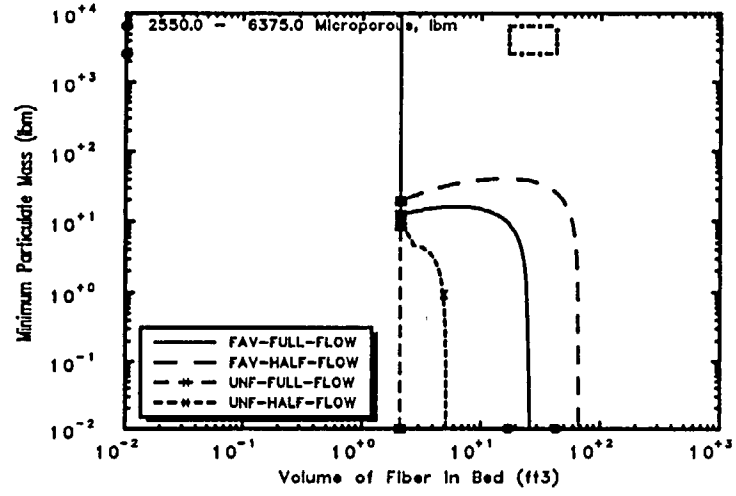
Parametric Case: 40 Debris Potential



Parametric Case: 40 Small LOCA

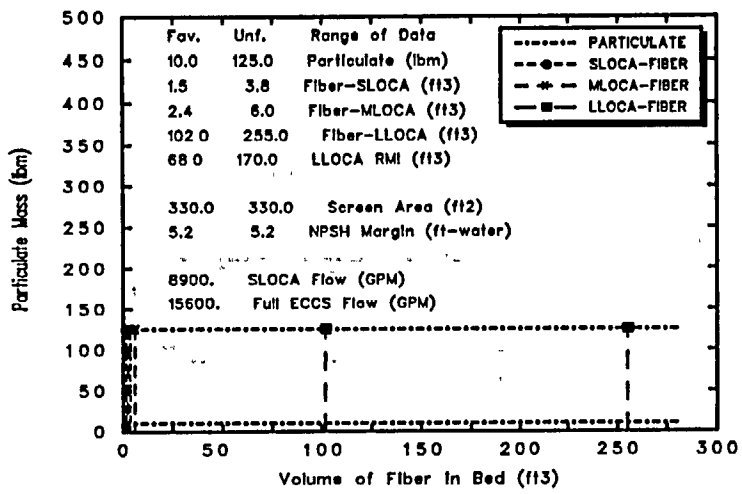


Parametric Case: 40 Medium LOCA

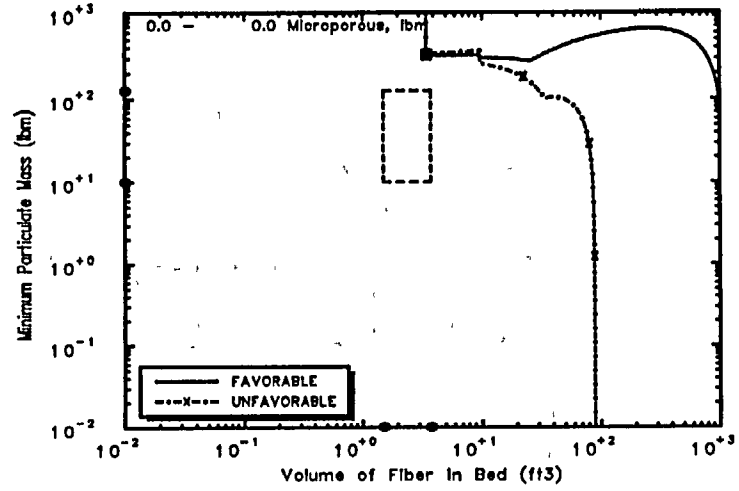


Parametric Case: 40 Large LOCA

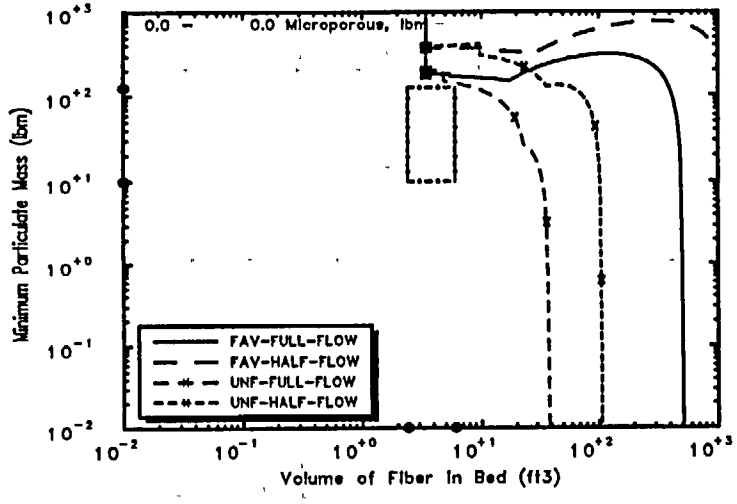
Figure B-40 Parametric Case 40



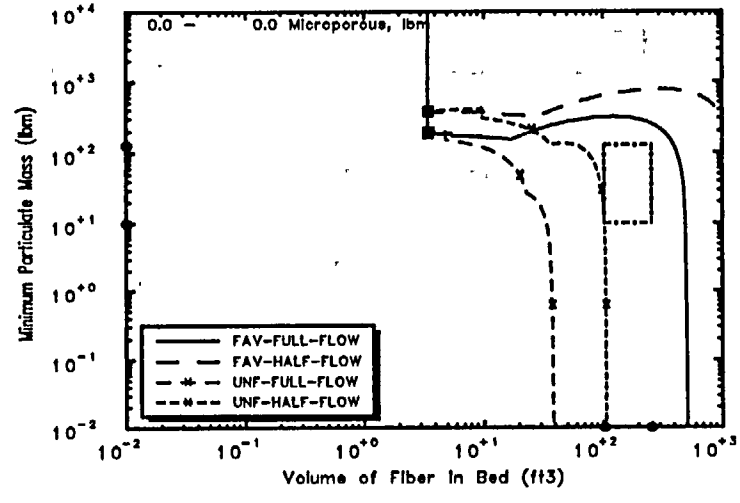
Parametric Case: 41 Debris Potential



Parametric Case: 41 Small LOCA

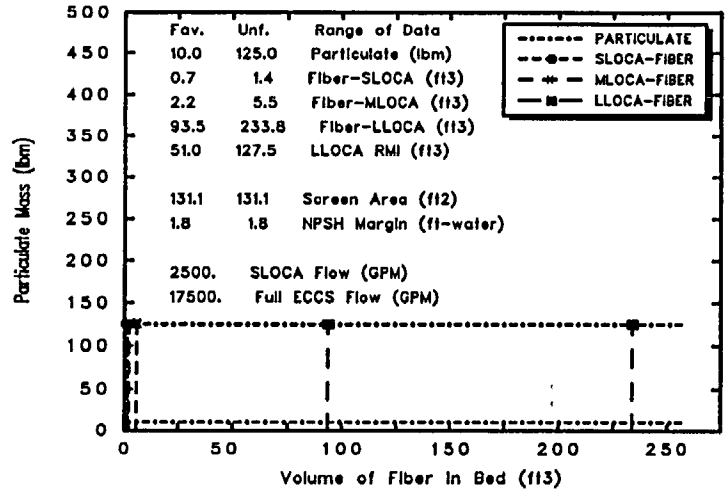


Parametric Case: 41 Medium LOCA

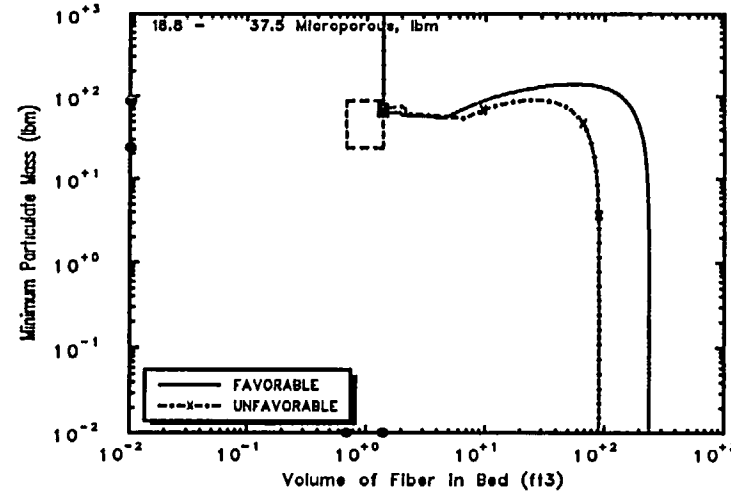


Parametric Case: 41 Large LOCA

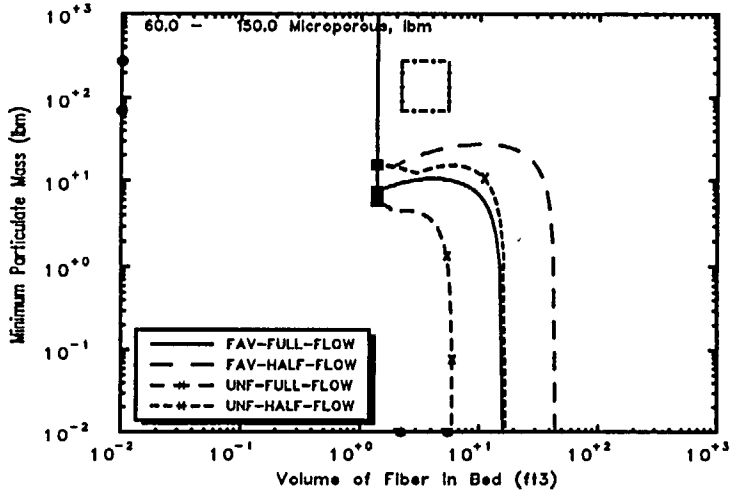
Figure B-41 Parametric Case 41



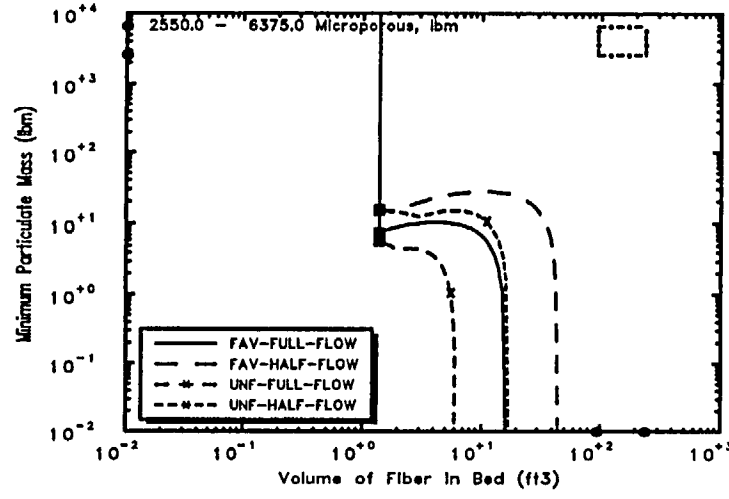
Parametric Case: 42 Debris Potential



Parametric Case: 42 Small LOCA

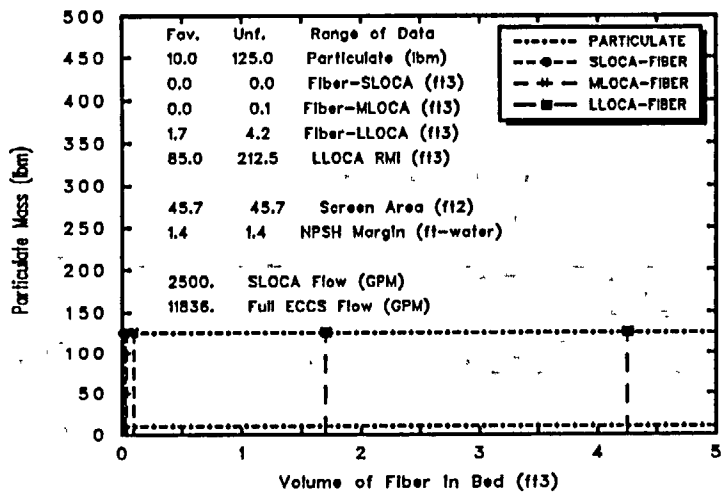


Parametric Case: 42 Medium LOCA

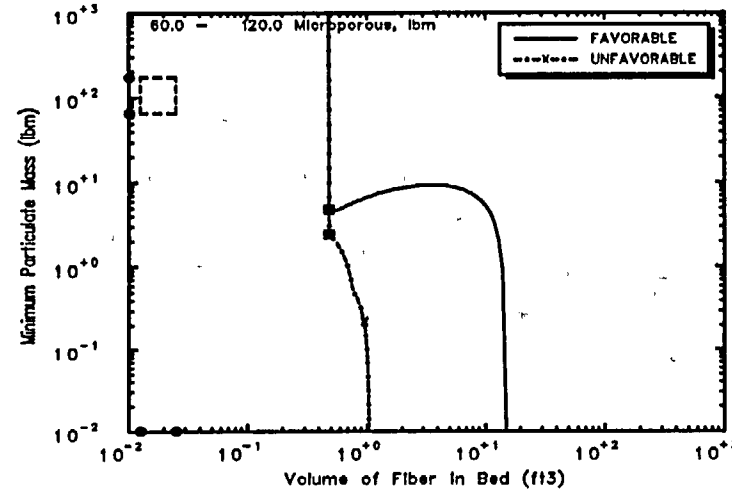


Parametric Case: 42 Large LOCA

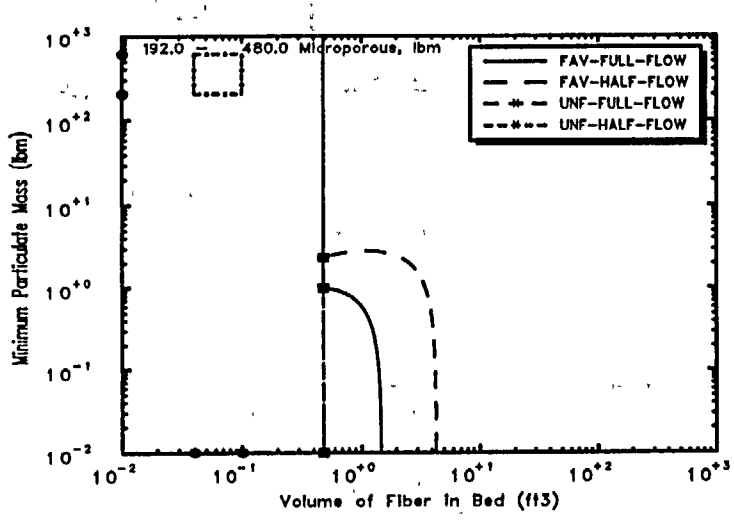
Figure B-42 Parametric Case 42



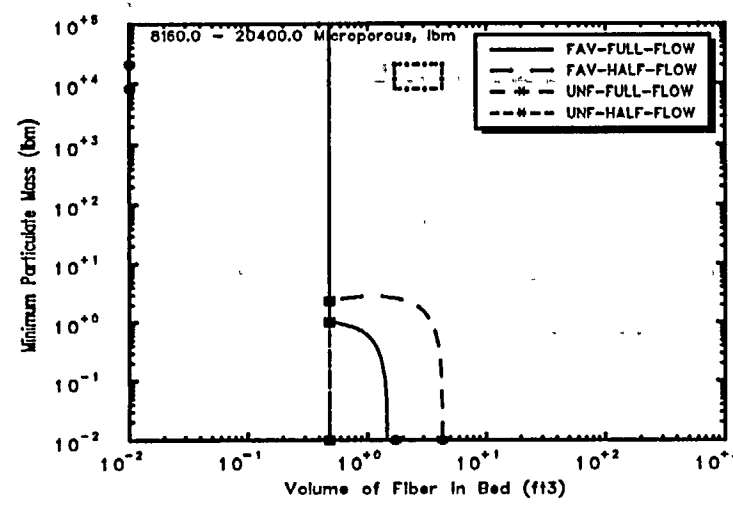
Parametric Case: 43 Debris Potential



Parametric Case: 43 Small LOCA

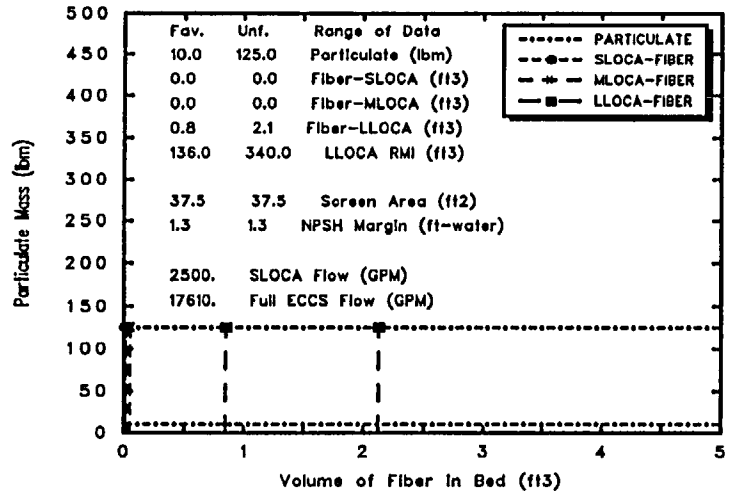


Parametric Case: 43 Medium LOCA

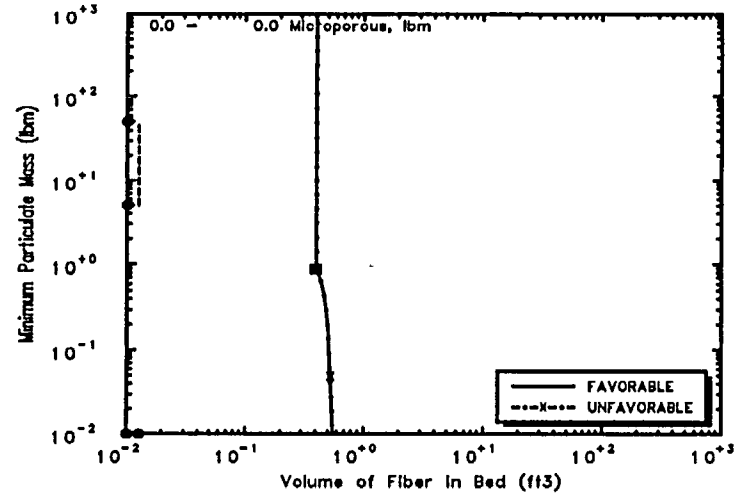


Parametric Case: 43 Large LOCA

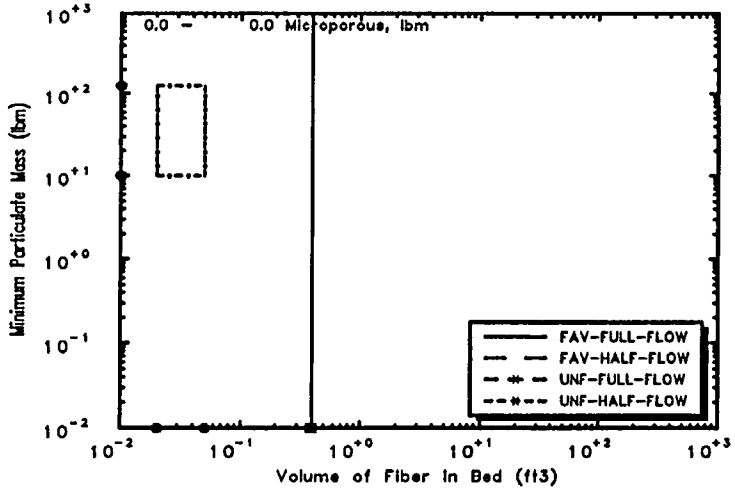
Figure B-43 Parametric Case 43



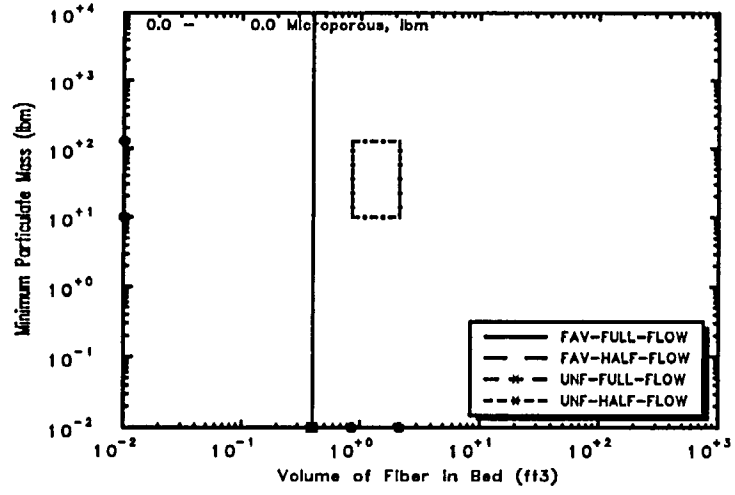
Parametric Case: 44 Debris Potential



Parametric Case: 44 Small LOCA

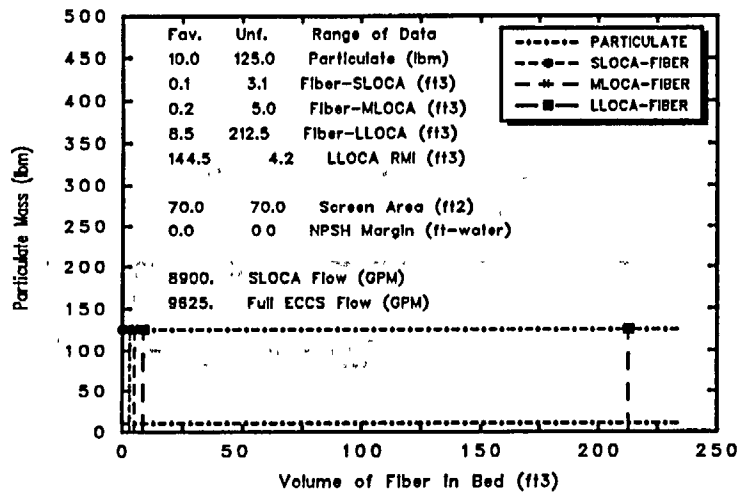


Parametric Case: 44 Medium LOCA

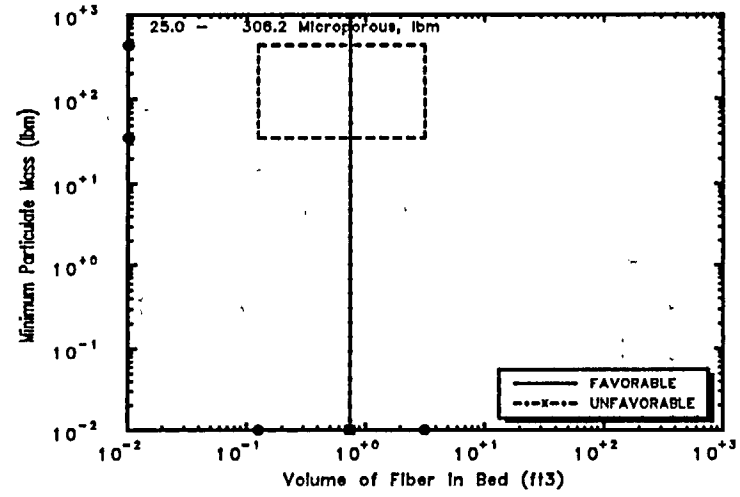


Parametric Case: 44 Large LOCA

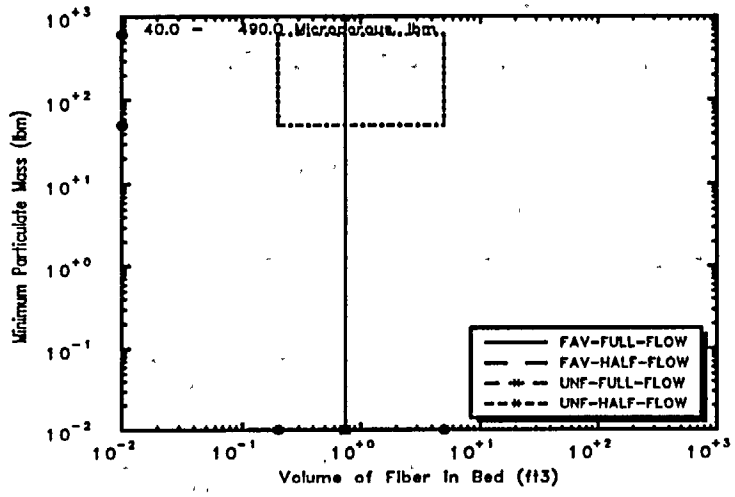
Figure B-44 Parametric Case 44



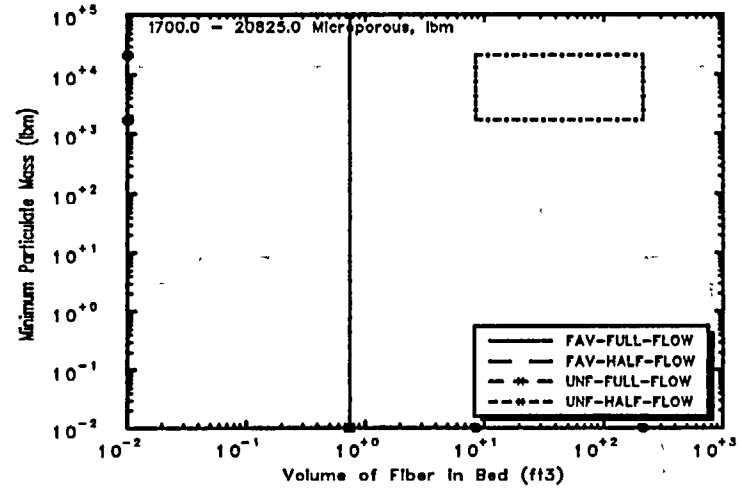
Parametric Case: 45 Debris Potential



Parametric Case: 45 Small LOCA

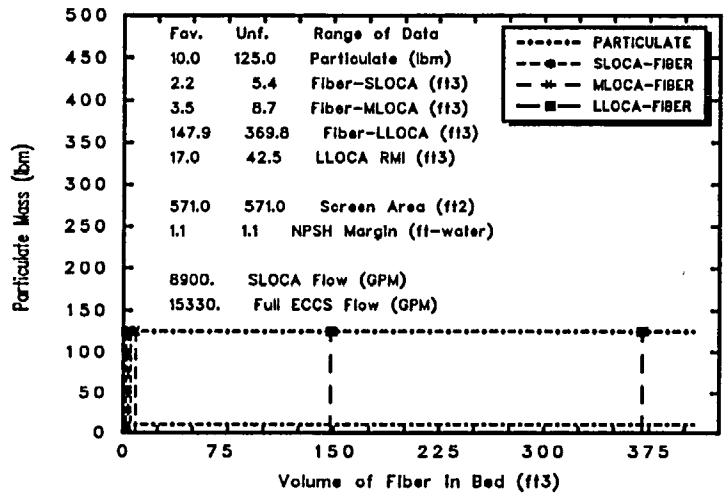


Parametric Case: 45 Medium LOCA

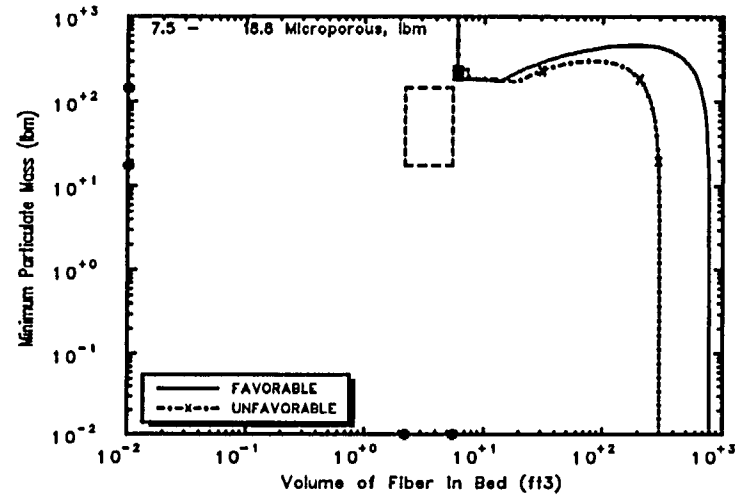


Parametric Case: 45 Large LOCA

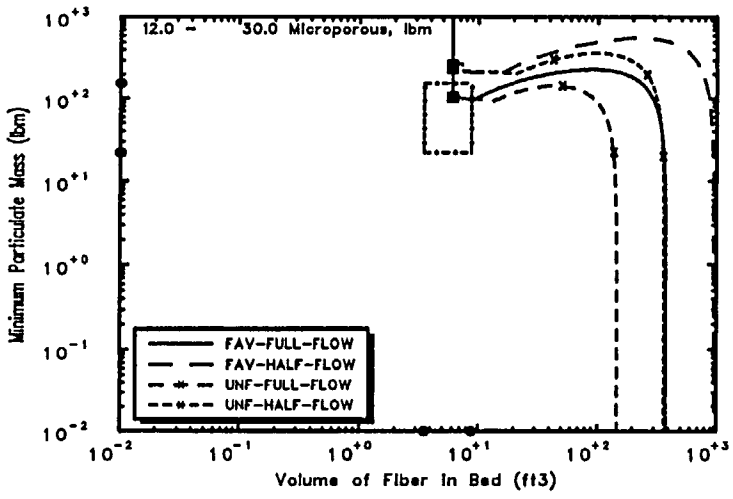
Figure B-45 Parametric Case 45



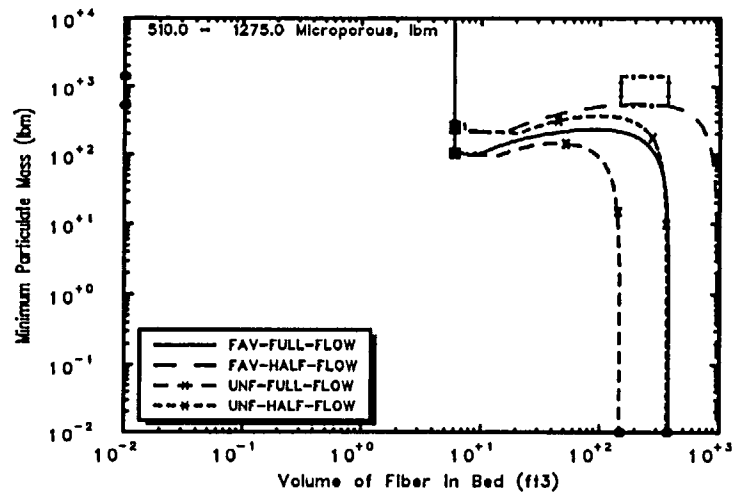
Parametric Case: 46 Debris Potential



Parametric Case: 46 Small LOCA

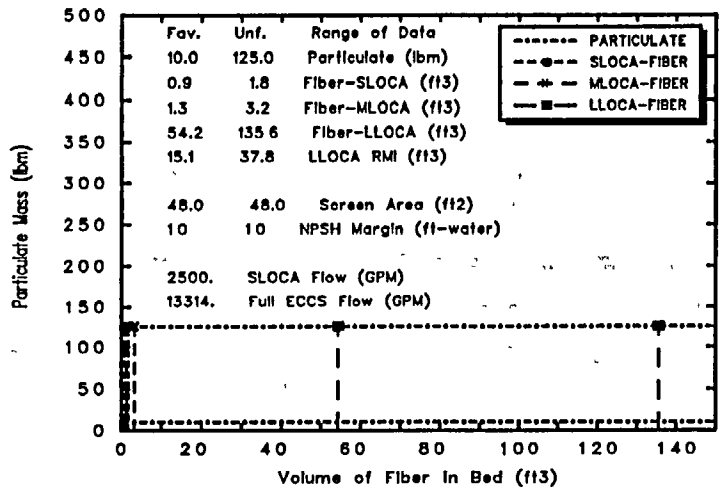


Parametric Case: 46 Medium LOCA

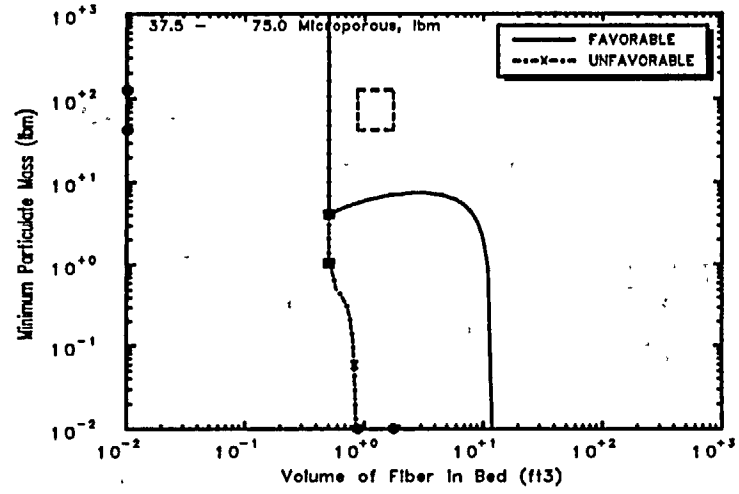


Parametric Case: 46 Large LOCA

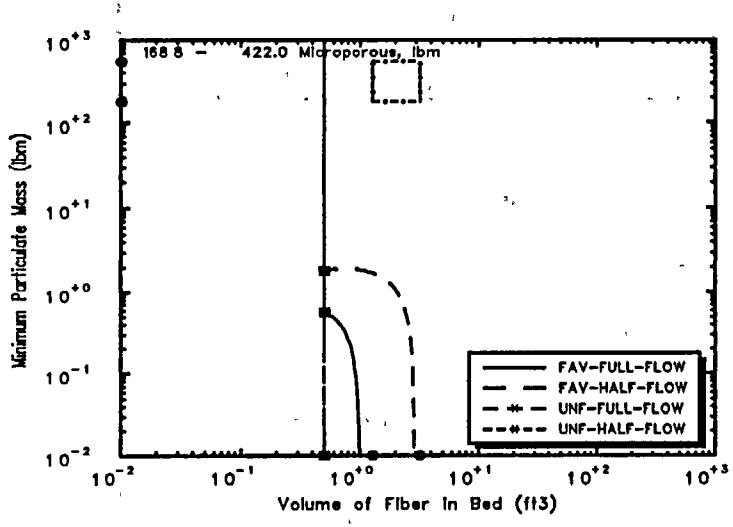
Figure B-46 Parametric Case 46



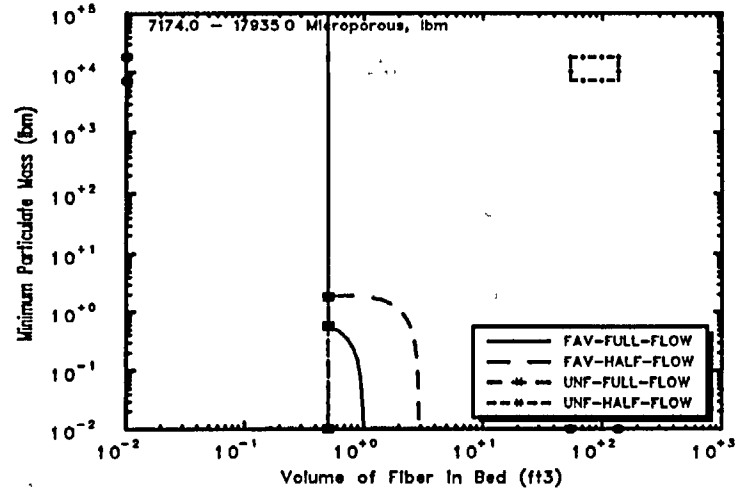
Parametric Case: 47 Debris Potential



Parametric Case: 47 Small LOCA

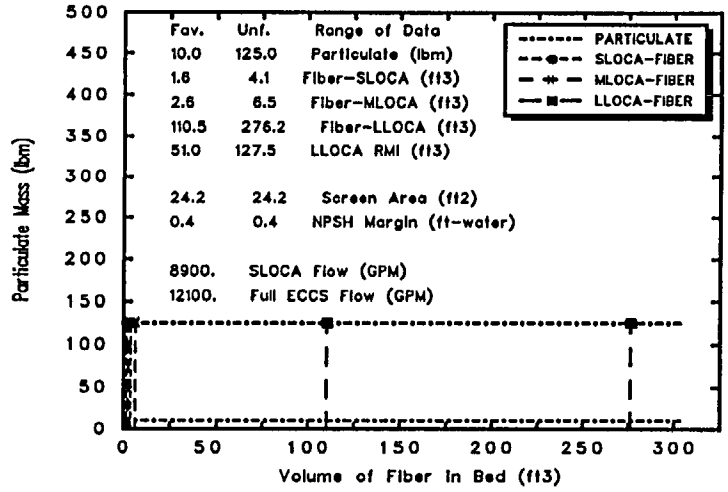


Parametric Case: 47 Medium LOCA

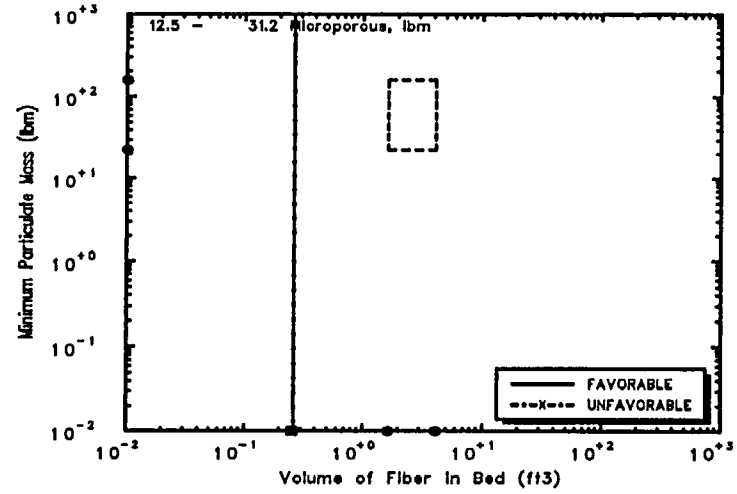


Parametric Case: 47 Large LOCA

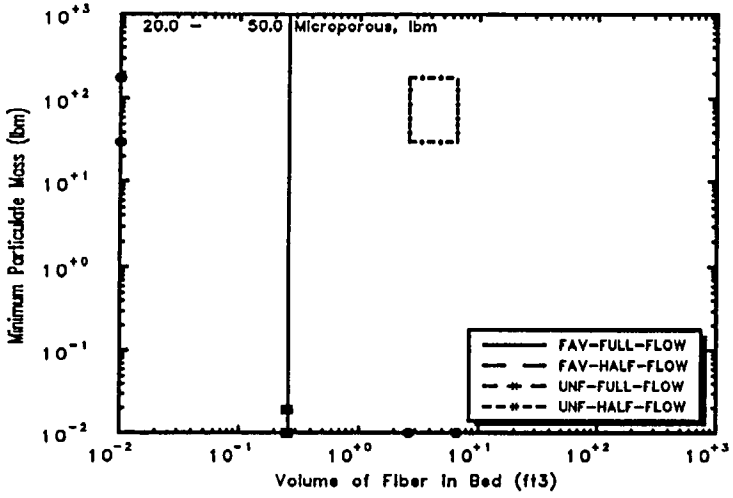
Figure B-47 Parametric Case 47



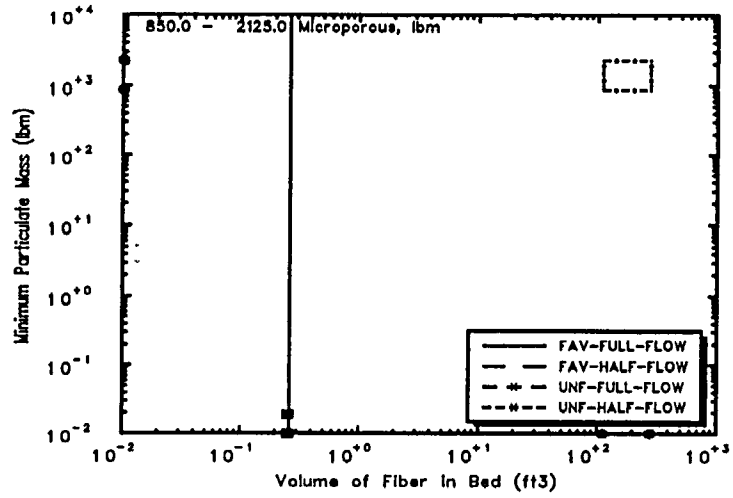
Parametric Case: 48 Debris Potential



Parametric Case: 48 Small LOCA

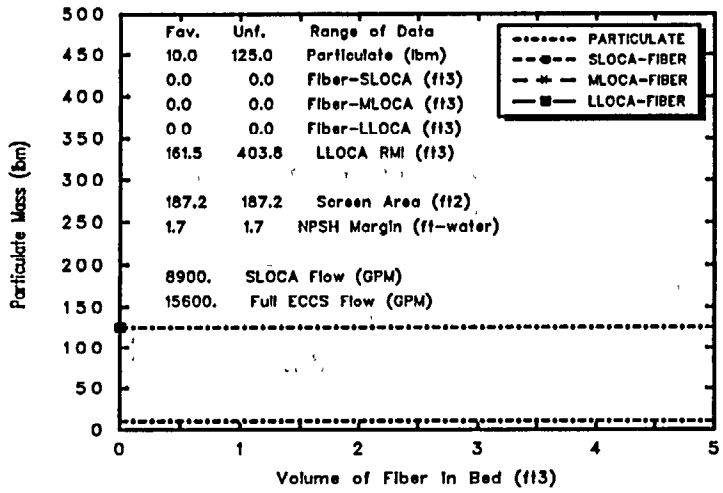


Parametric Case: 48 Medium LOCA

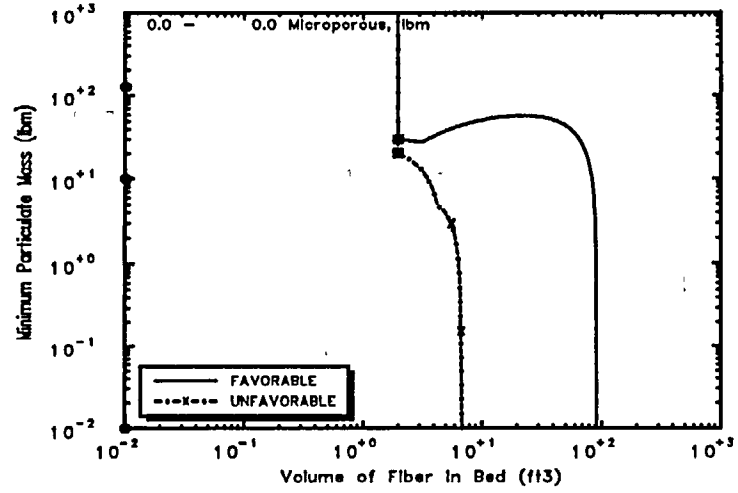


Parametric Case: 48 Large LOCA

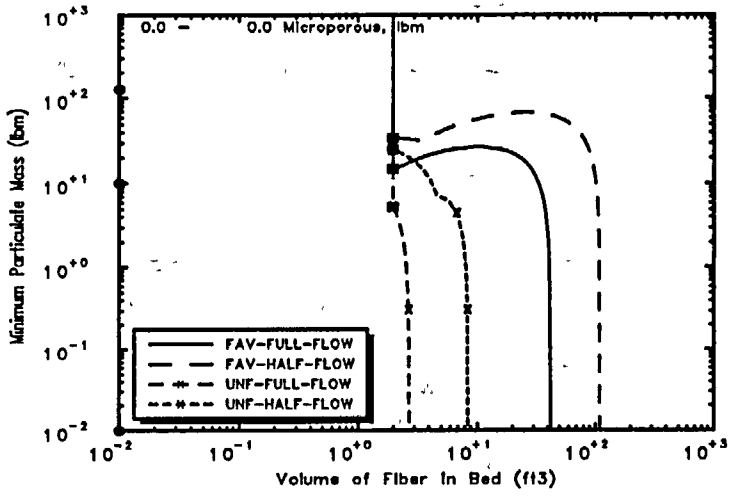
Figure B-48 Parametric Case 48



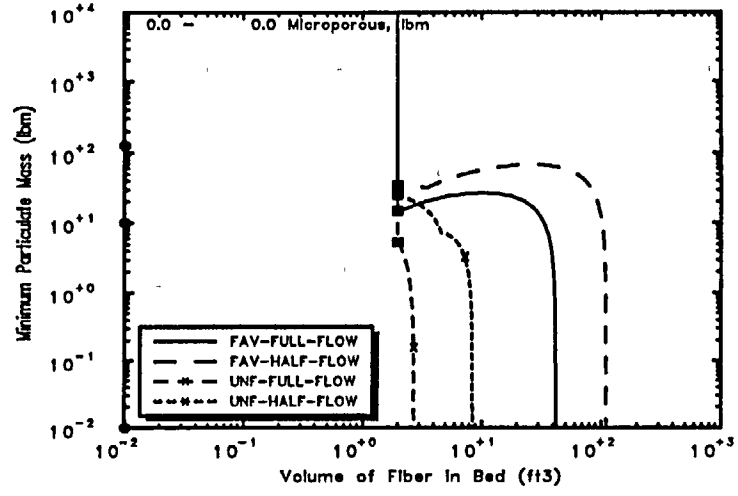
Parametric Case: 49 Debris Potential



Parametric Case: 49 Small LOCA

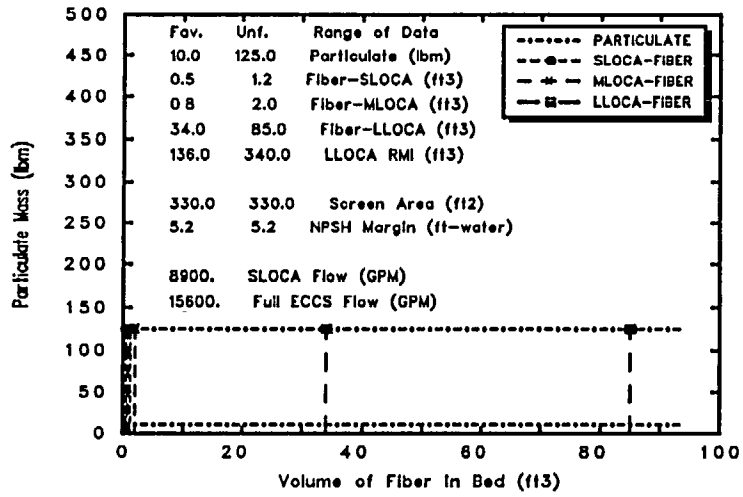


Parametric Case: 49 Medium LOCA

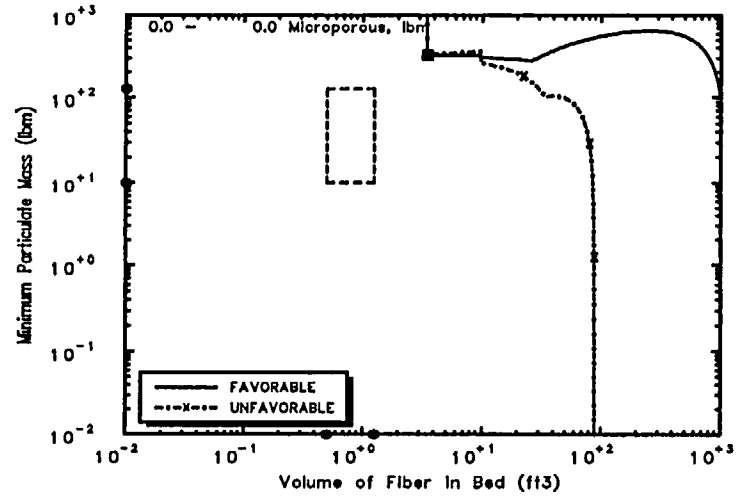


Parametric Case: 49 Large LOCA

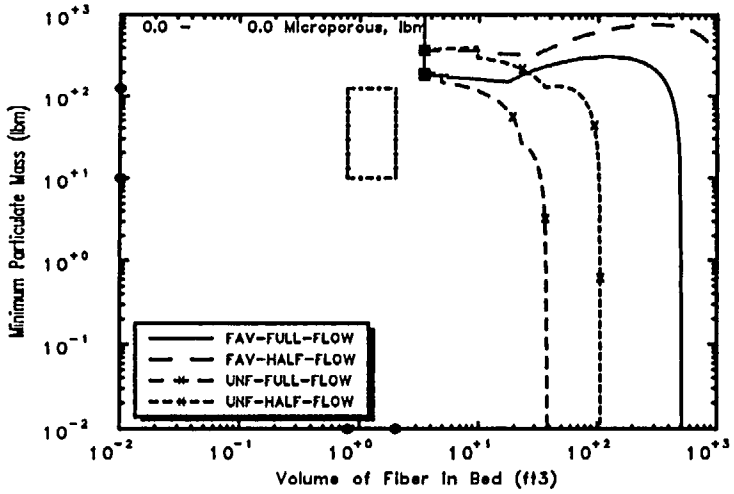
Figure B-49 Parametric Case 49 (Note: No fiber in this case, so no debris boxes presented.)



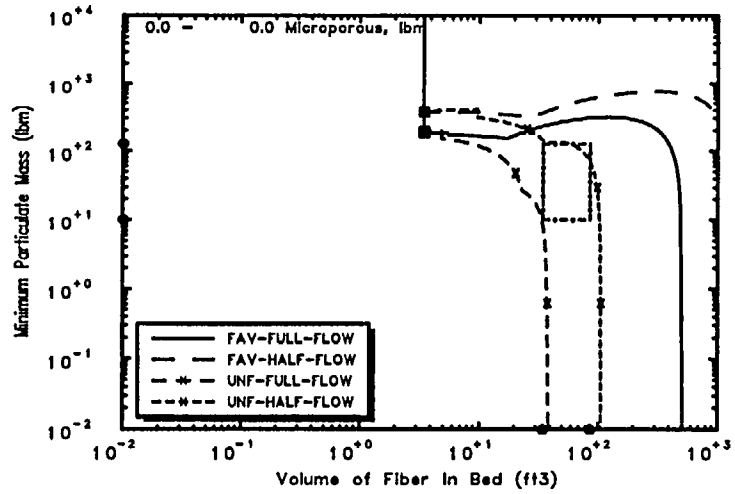
Parametric Case: 50 Debris Potential



Parametric Case: 50 Small LOCA

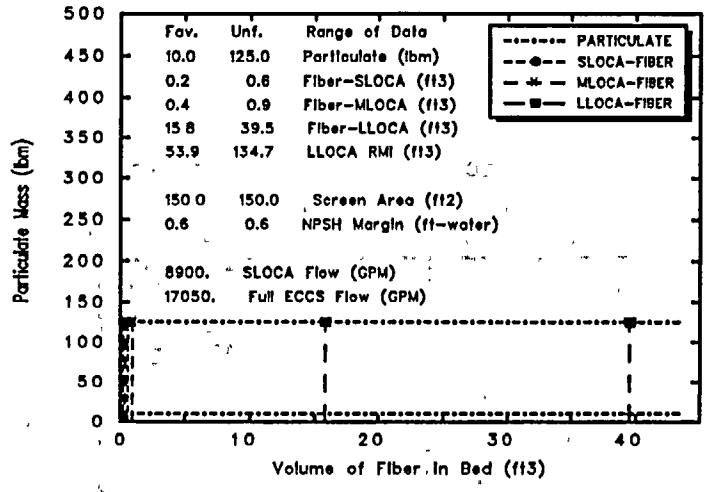


Parametric Case: 50 Medium LOCA

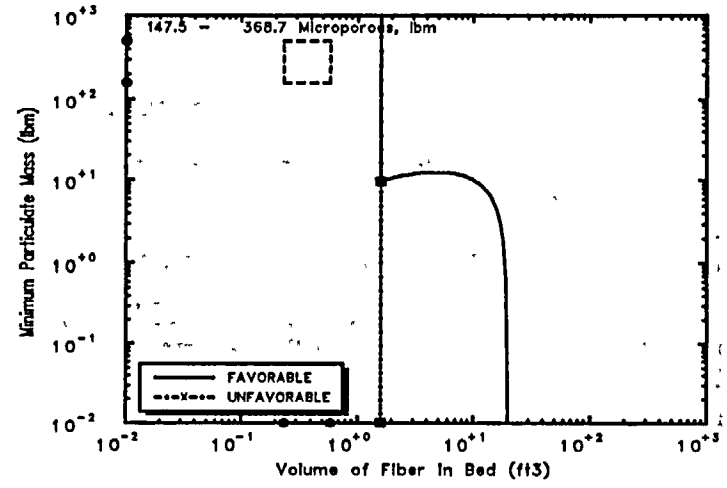


Parametric Case: 50 Large LOCA

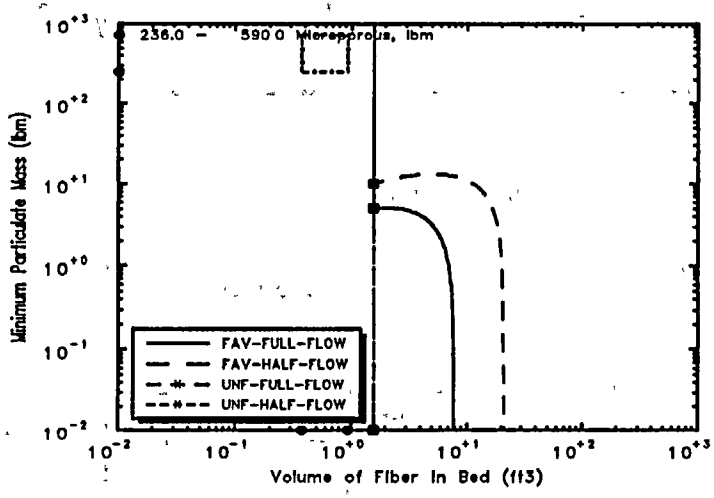
Figure B-50 Parametric Case 50



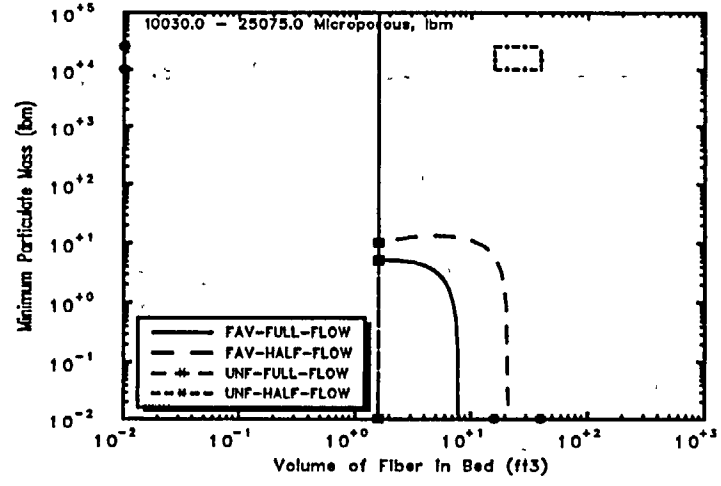
Parametric Case: 51 Debris Potential



Parametric Case: 51 Small LOCA

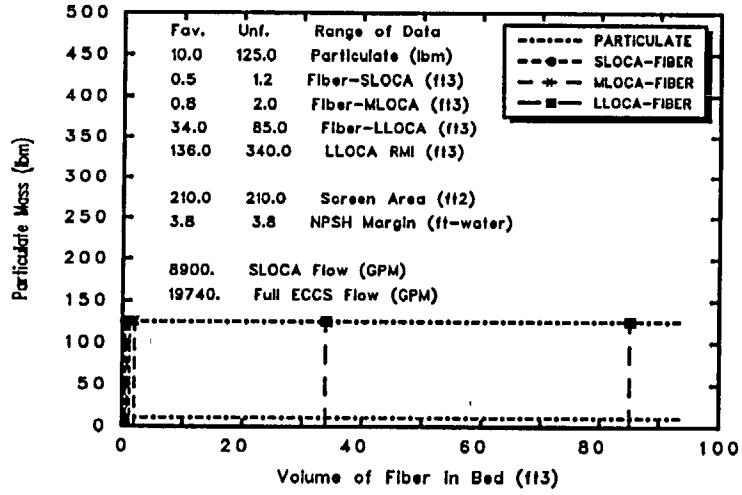


Parametric Case: 51 Medium LOCA

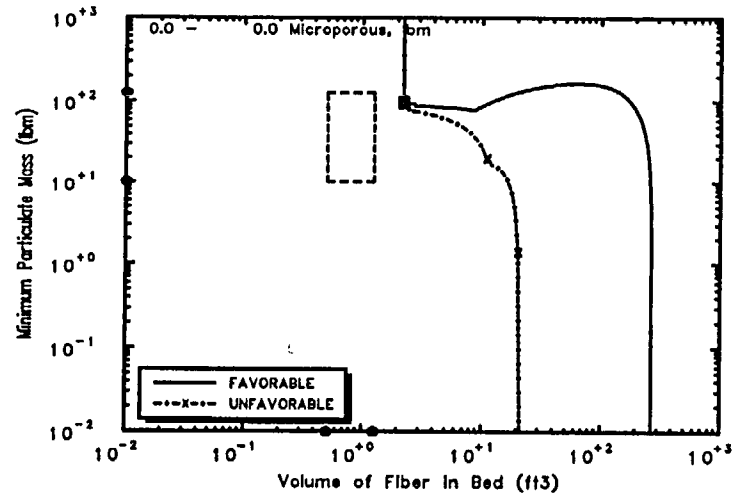


Parametric Case: 51 Large LOCA

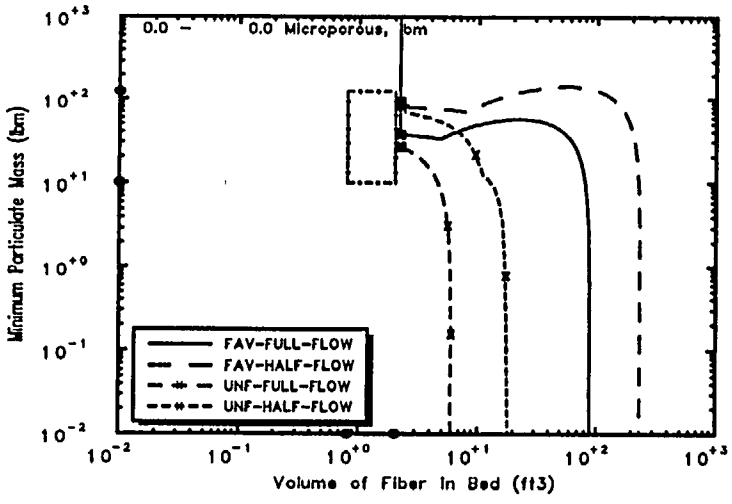
Figure B-51 Parametric Case 51



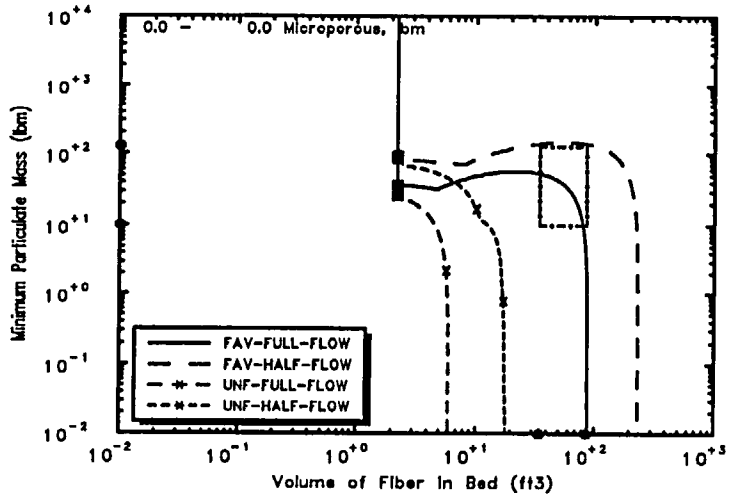
Parametric Case: 52 Debris Potential



Parametric Case: 52 Small LOCA

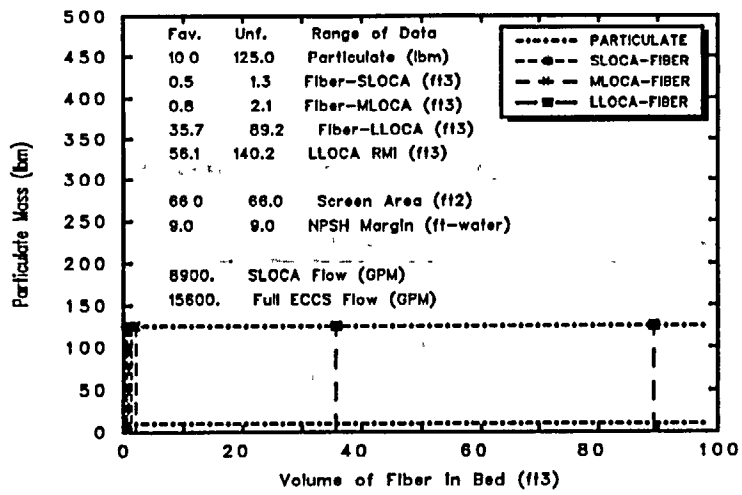


Parametric Case: 52 Medium LOCA

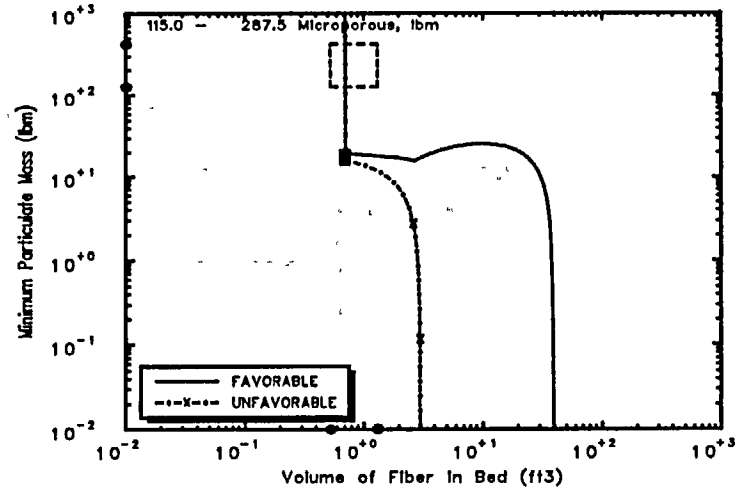


Parametric Case: 52 Large LOCA

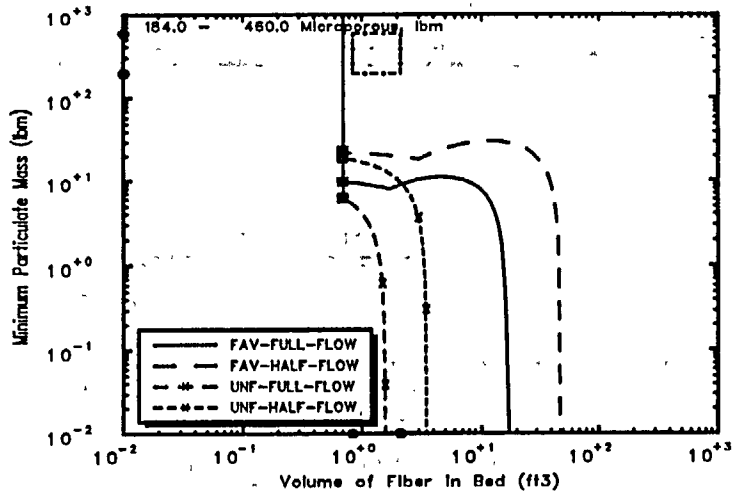
Figure B-52 Parametric Case 52



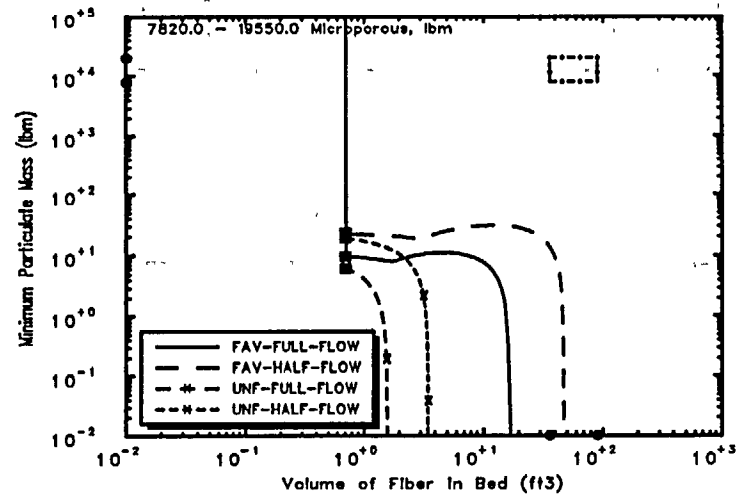
Parametric Case: 53 Debris Potential



Parametric Case: 53 Small LOCA

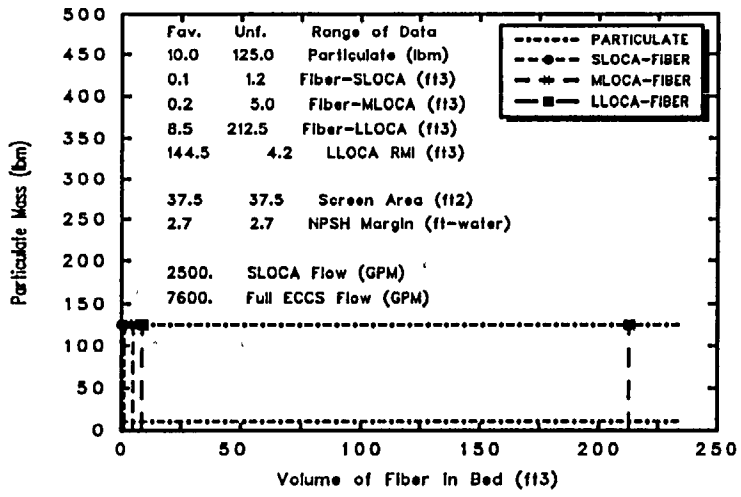


Parametric Case: 53 Medium LOCA

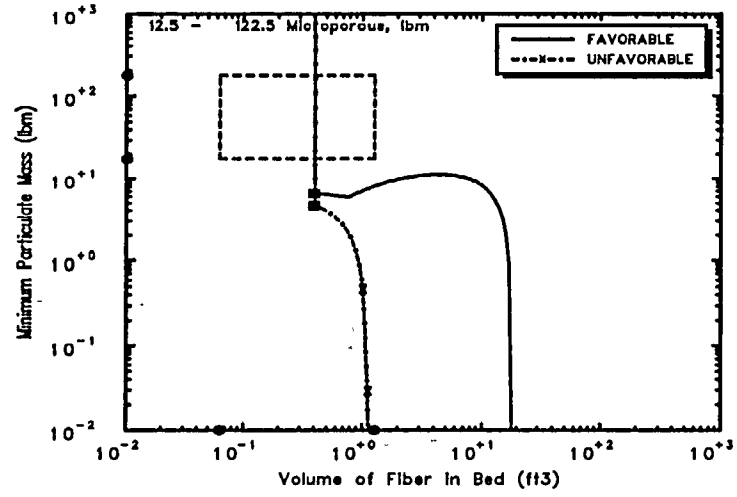


Parametric Case: 53 Large LOCA

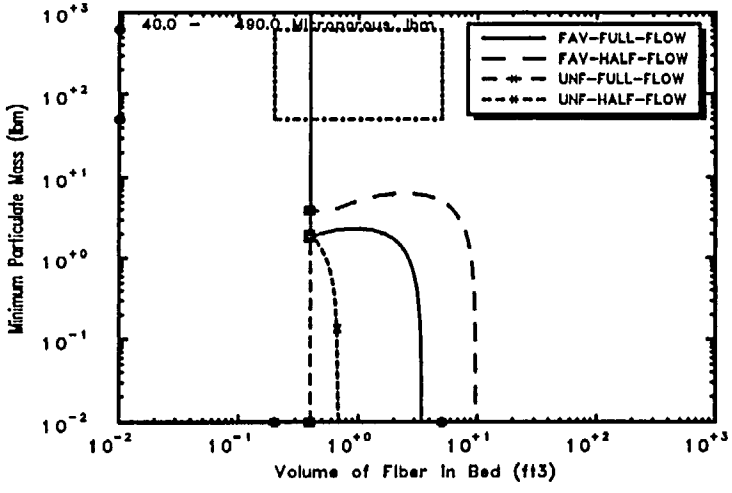
Figure B-53 Parametric Case 53



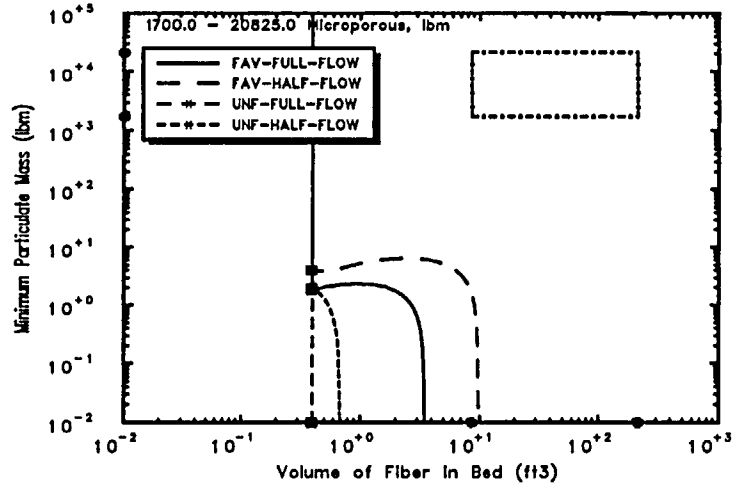
Parametric Case: 54 Debris Potential



Parametric Case: 54 Small LOCA



Parametric Case: 54 Medium LOCA



Parametric Case: 54 Large LOCA

Figure B-54 Parametric Case 54

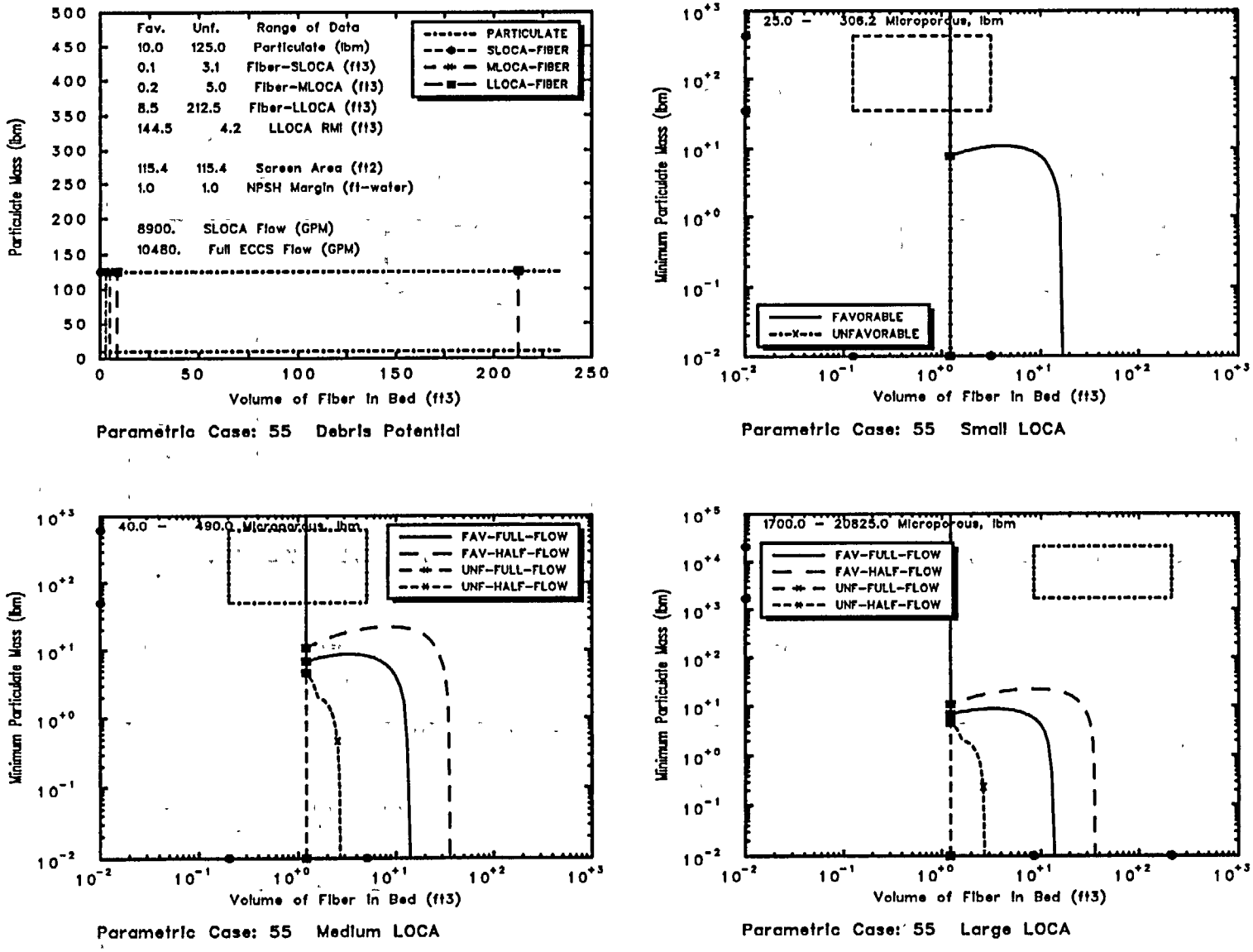
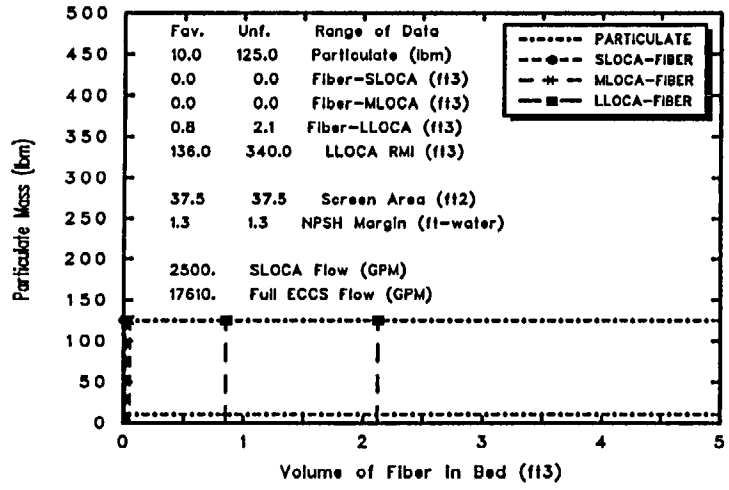
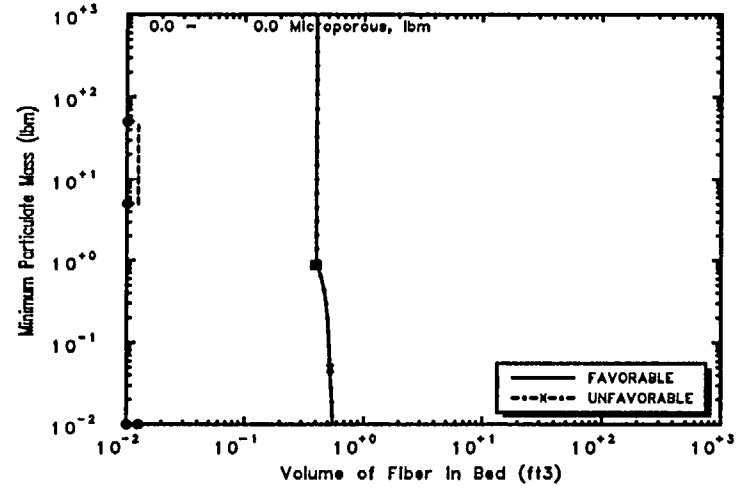


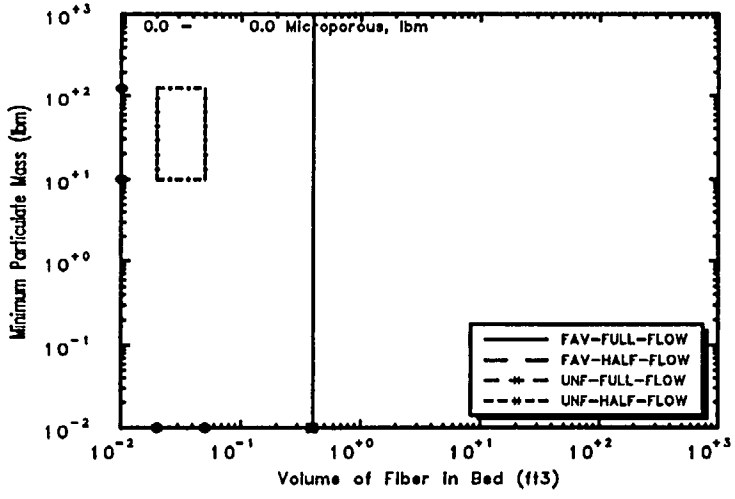
Figure B-55 Parametric Case 55



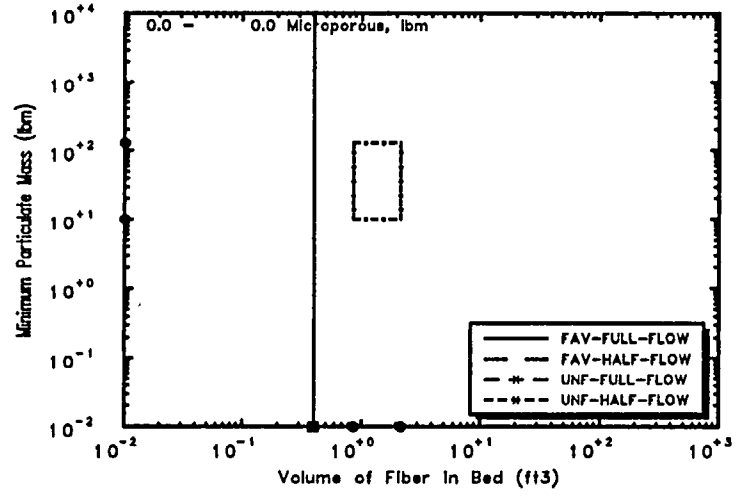
Parametric Case: 56 Debris Potential



Parametric Case: 56 Small LOCA

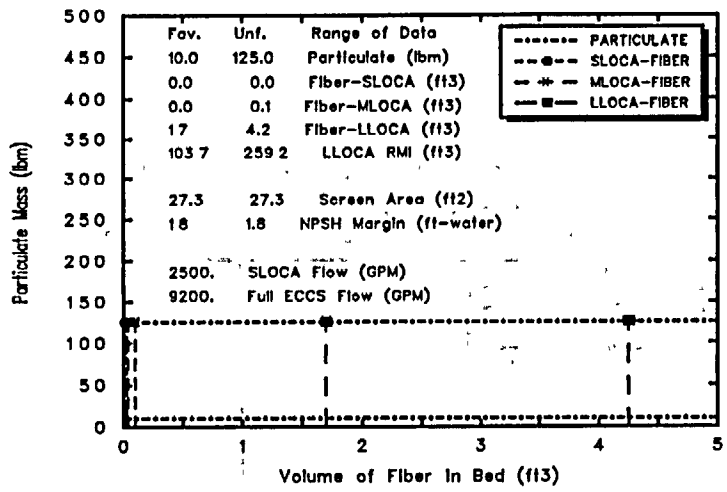


Parametric Case: 56 Medium LOCA

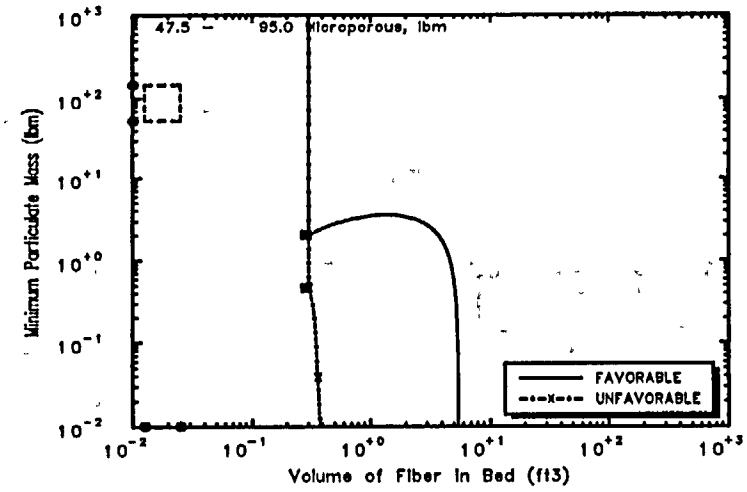


Parametric Case: 56 Large LOCA

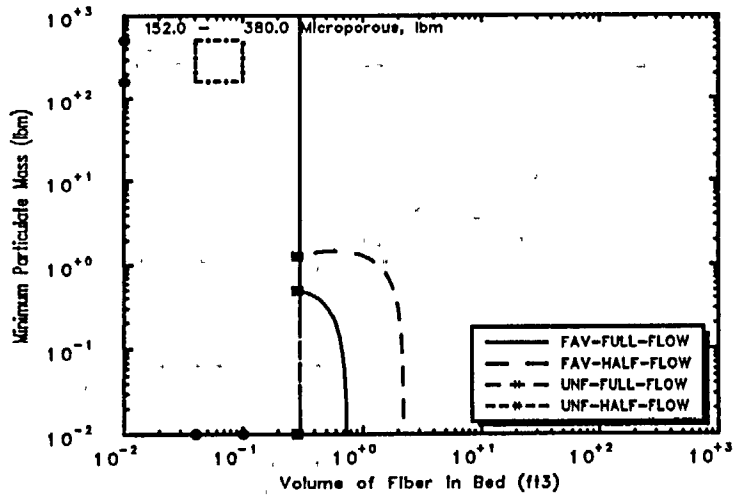
Figure B-56 Parametric Case 56



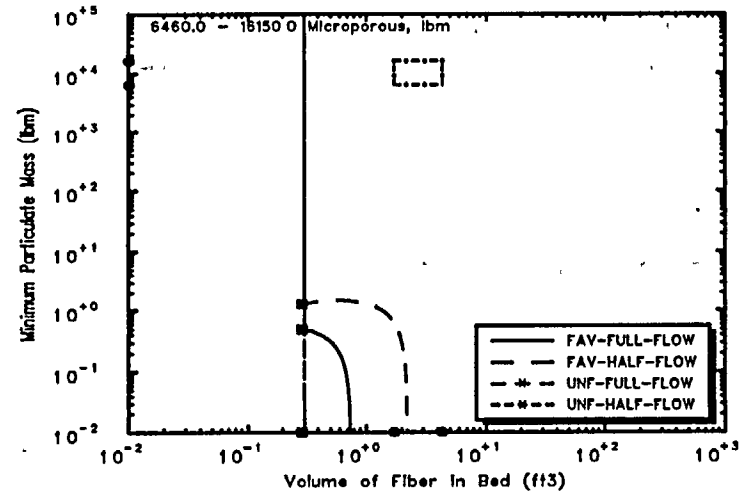
Parametric Case: 57 Debris Potential



Parametric Case: 57 Small LOCA

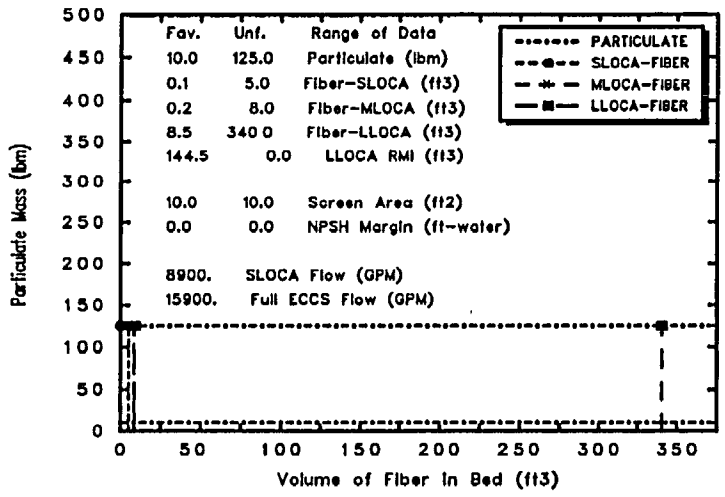


Parametric Case: 57 Medium LOCA

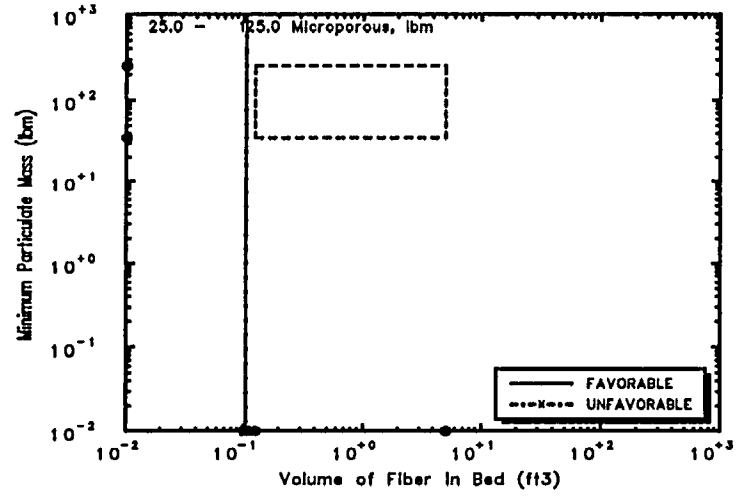


Parametric Case: 57 Large LOCA

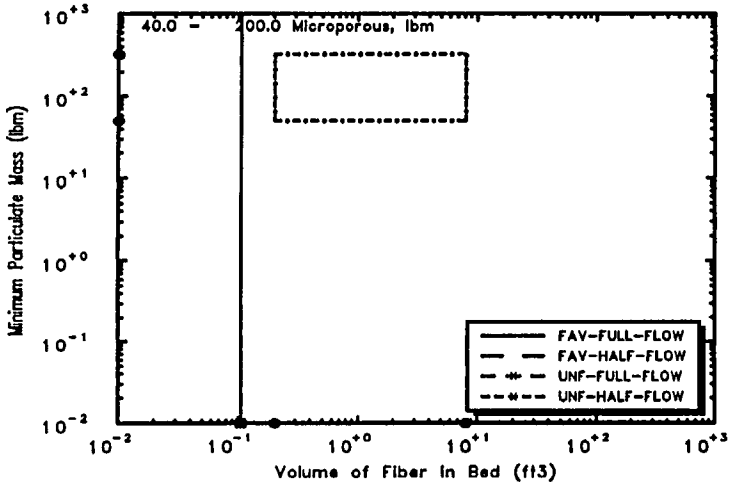
Figure B-57 Parametric Case 57



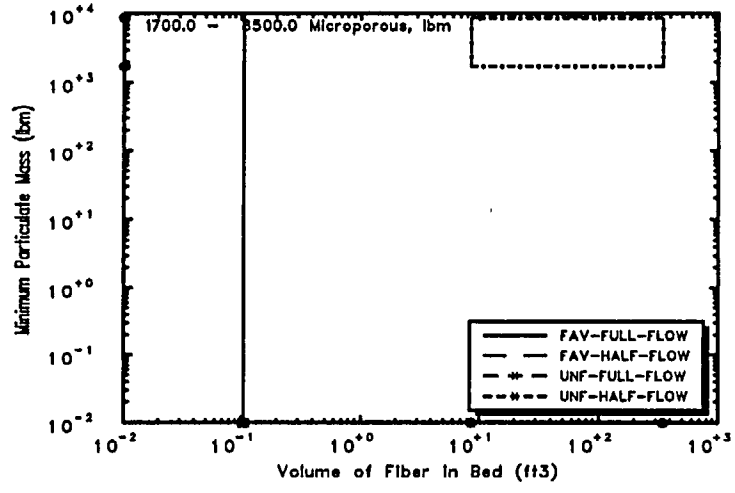
Parametric Case: 58 Debris Potential



Parametric Case: 58 Small LOCA

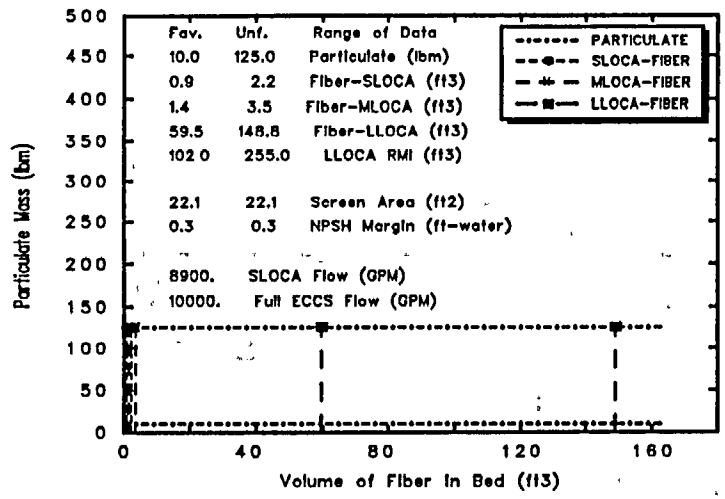


Parametric Case: 58 Medium LOCA

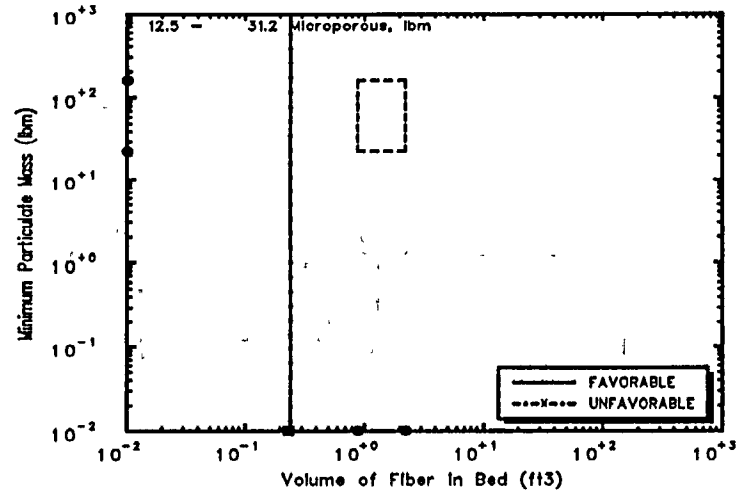


Parametric Case: 58 Large LOCA

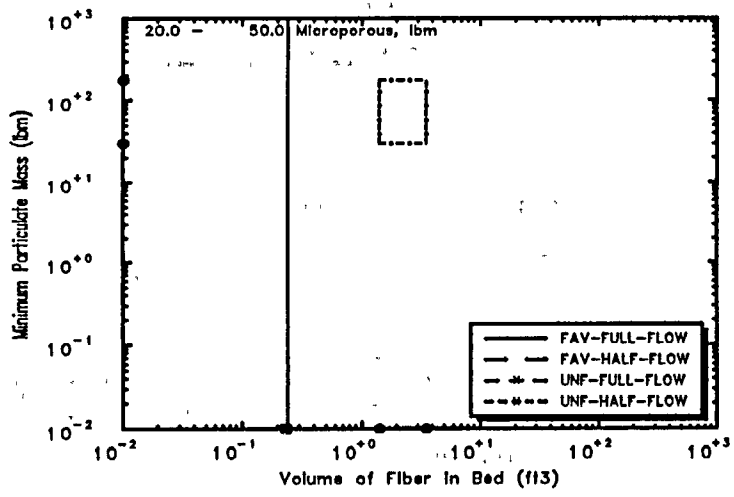
Figure B-58 Parametric Case 58



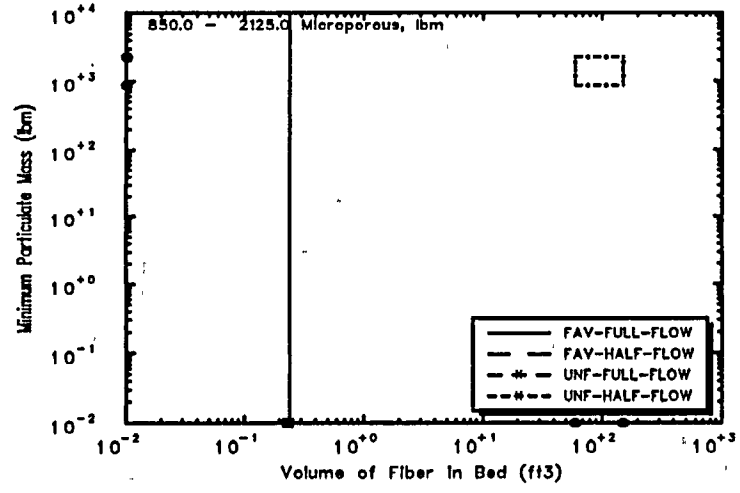
Parametric Case: 59 Debris Potential



Parametric Case: 59 Small LOCA



Parametric Case: 59 Medium LOCA



Parametric Case: 59 Large LOCA

Figure B-59 Parametric Case 59

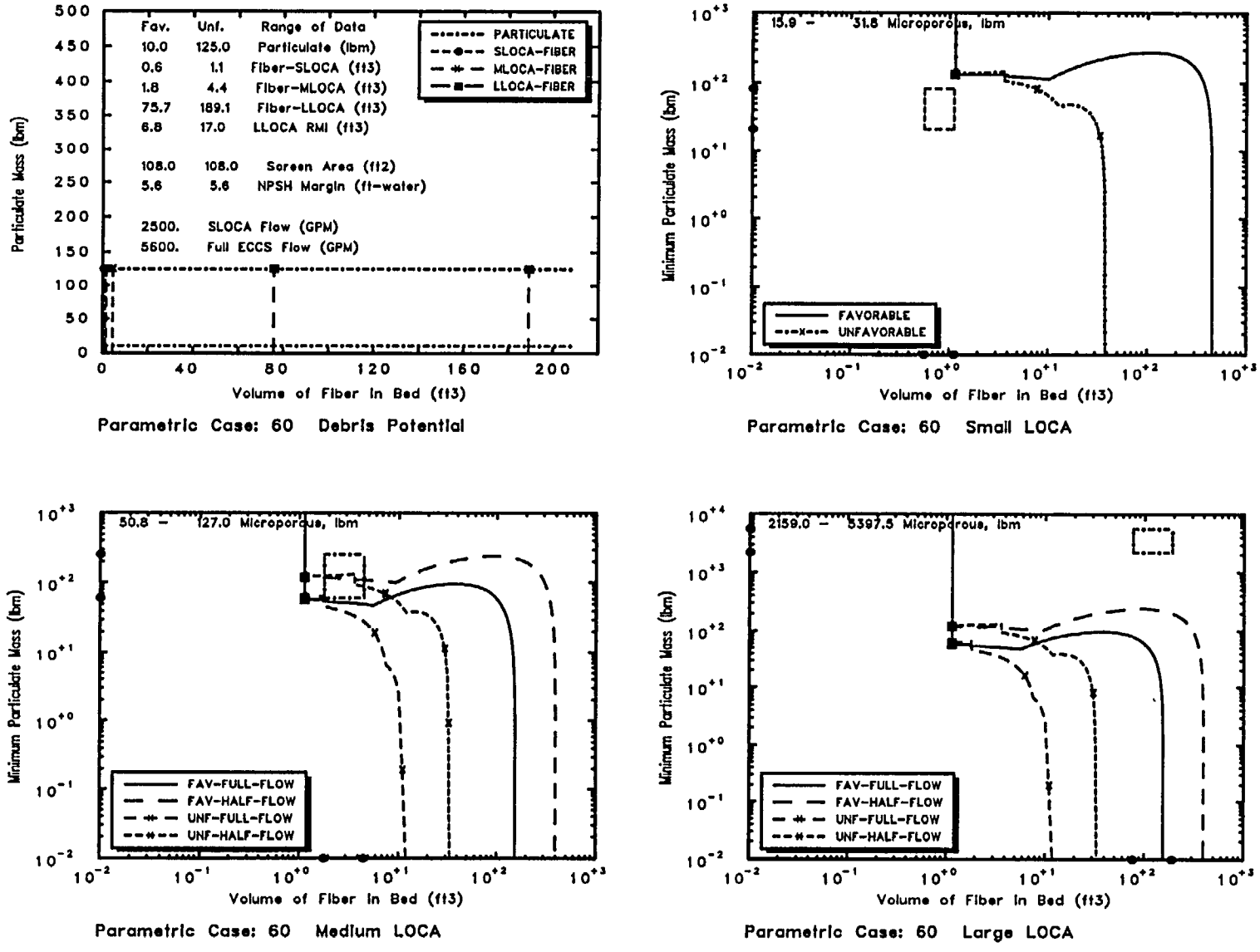


Figure B-60 Parametric Case 60

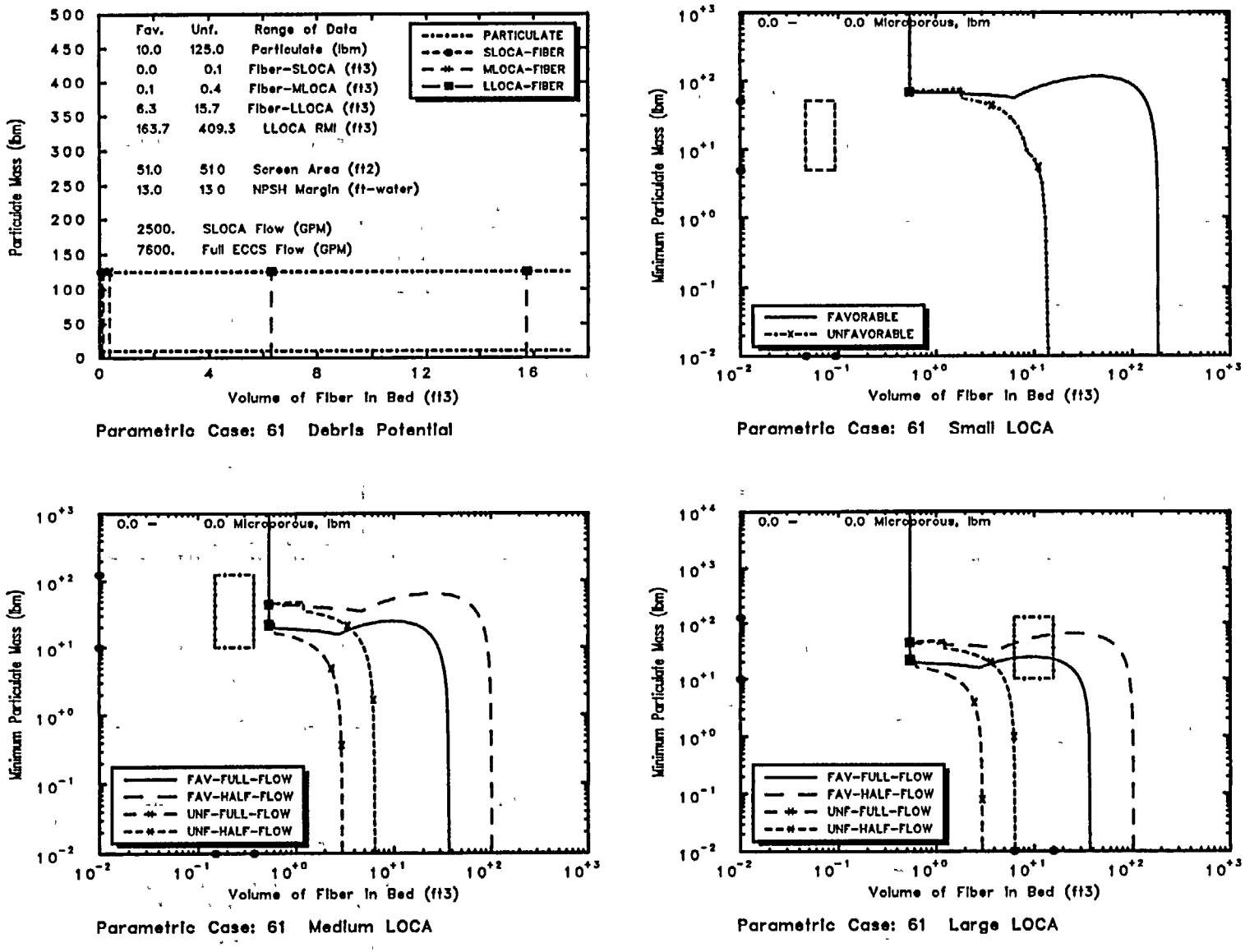
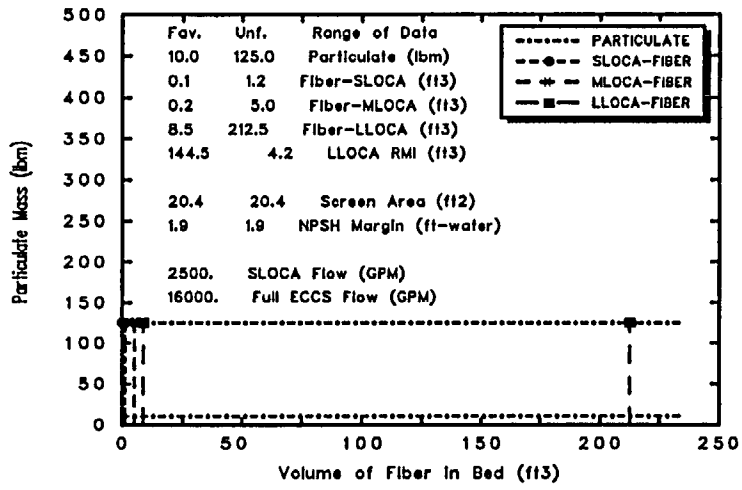
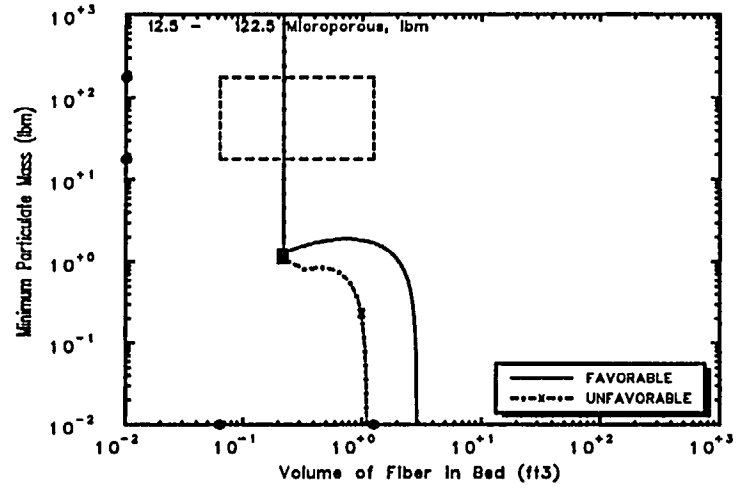


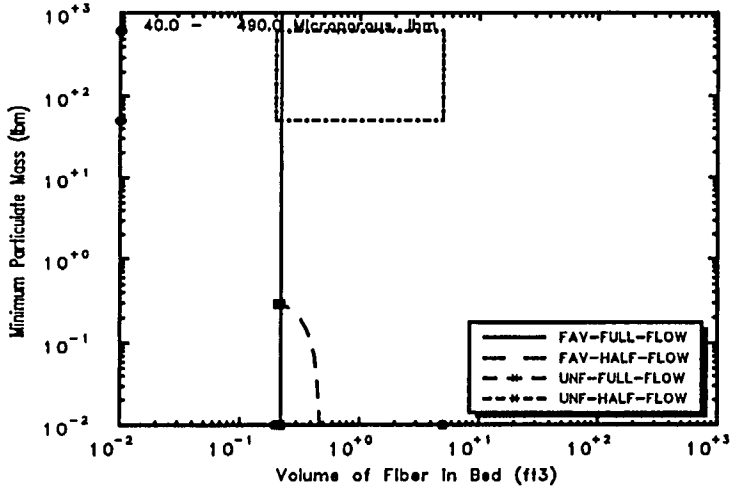
Figure B-61 Parametric Case 61



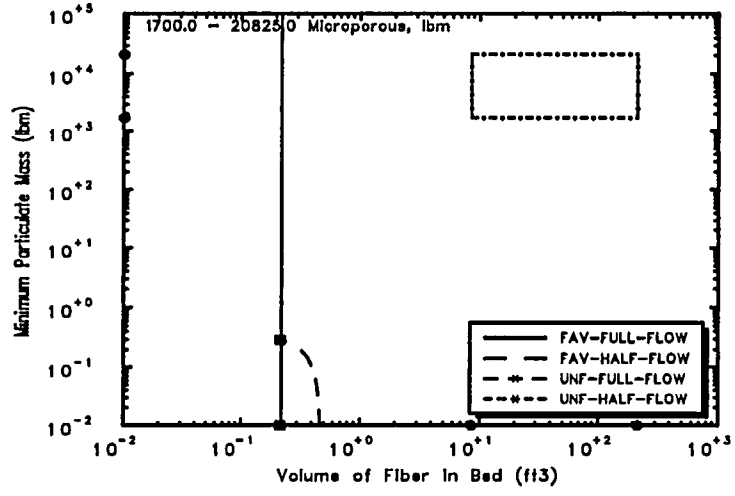
Parametric Case: 62 Debris Potential



Parametric Case: 62 Small LOCA

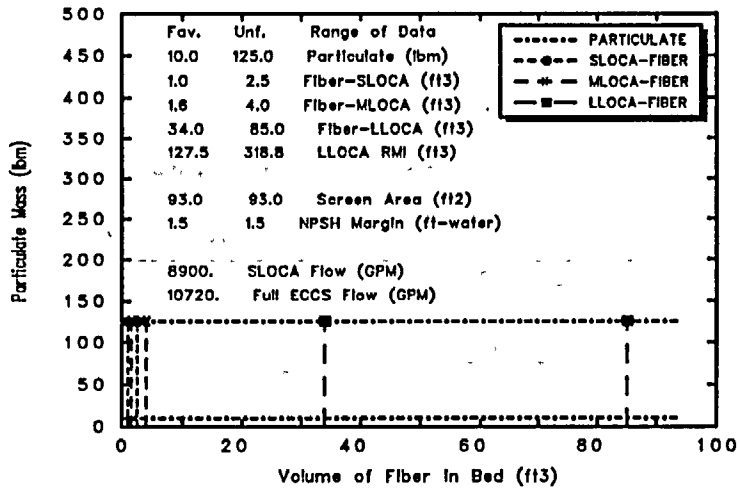


Parametric Case: 62 Medium LOCA

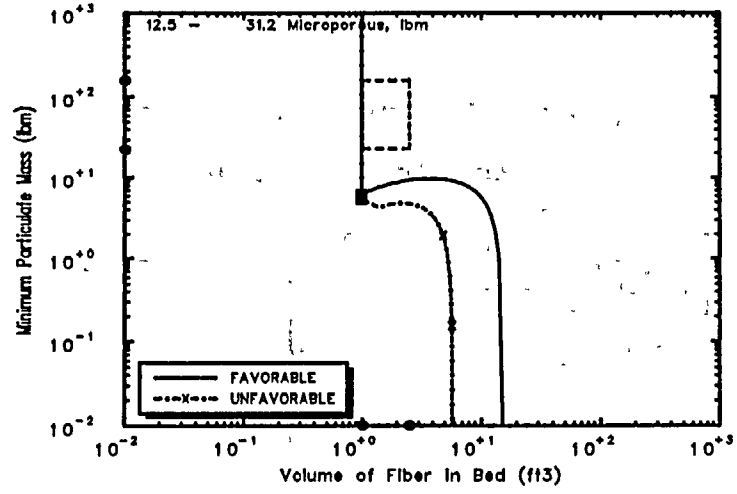


Parametric Case: 62 Large LOCA

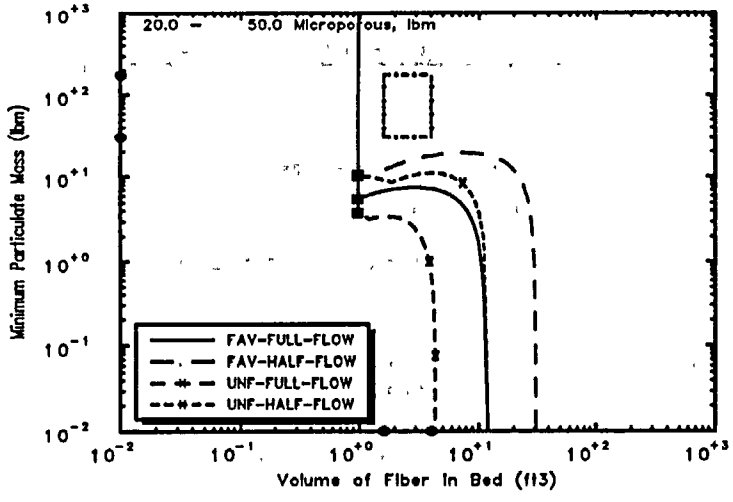
Figure B-62 Parametric Case 62



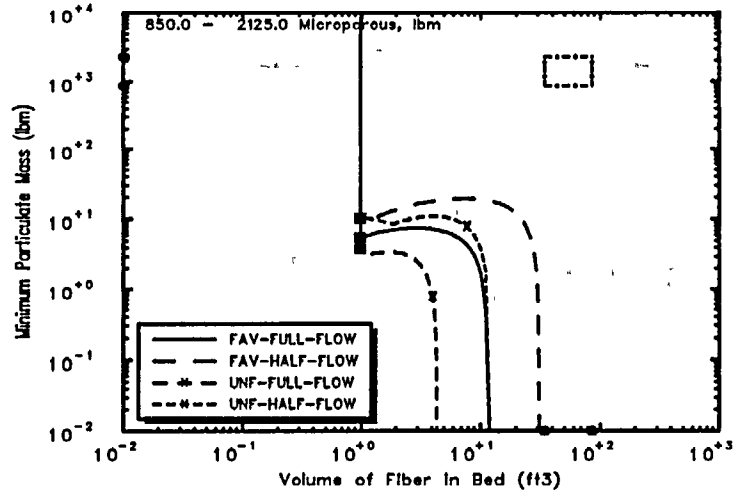
Parametric Case: 63 Debris Potential



Parametric Case: 63 Small LOCA

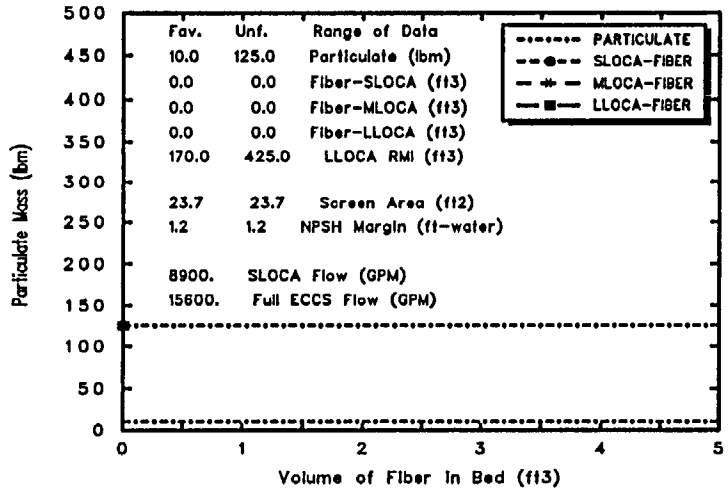


Parametric Case: 63 Medium LOCA

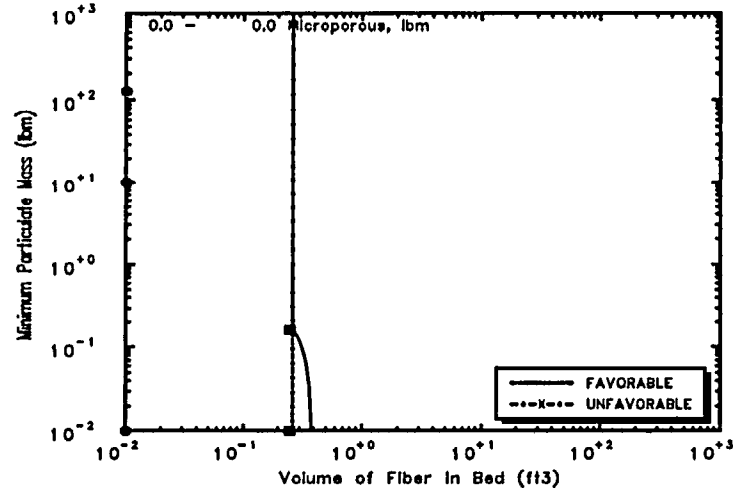


Parametric Case: 63 Large LOCA

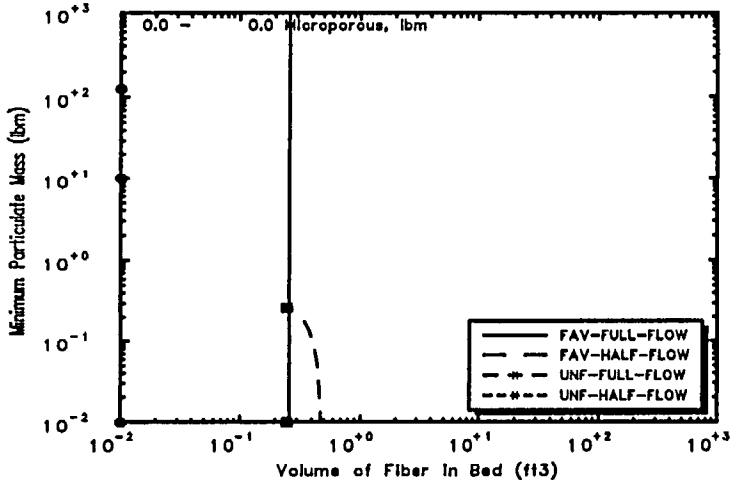
Figure B-63 Parametric Case 63



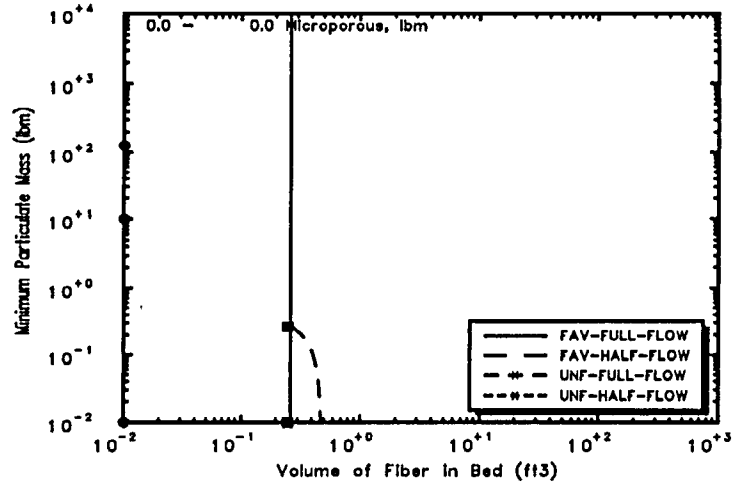
Parametric Case: 64 Debris Potential



Parametric Case: 64 Small LOCA



Parametric Case: 64 Medium LOCA



Parametric Case: 64 Large LOCA

Figure B-64 Parametric Case 64 (Note: No fiber in this case, so no debris boxes presented.)

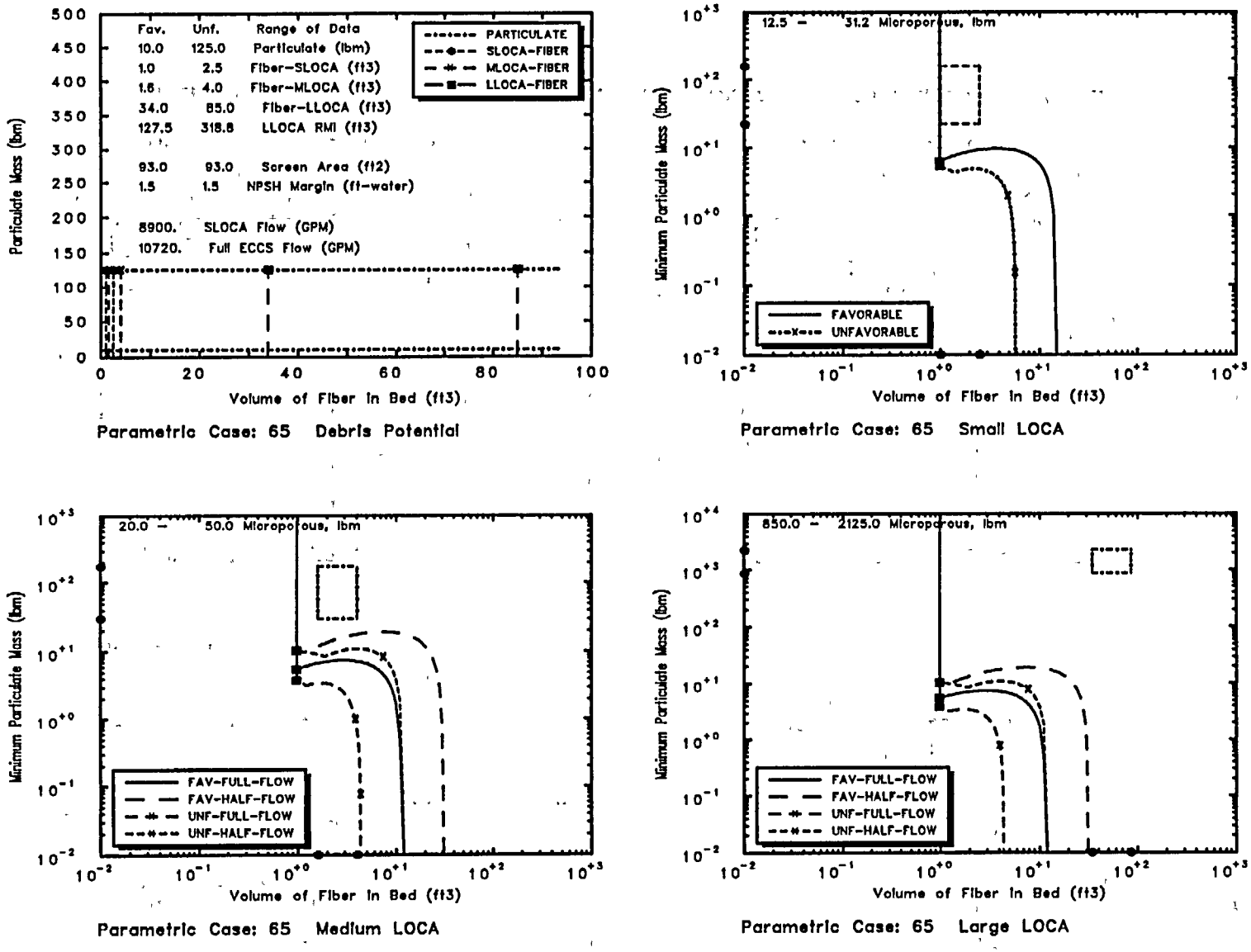
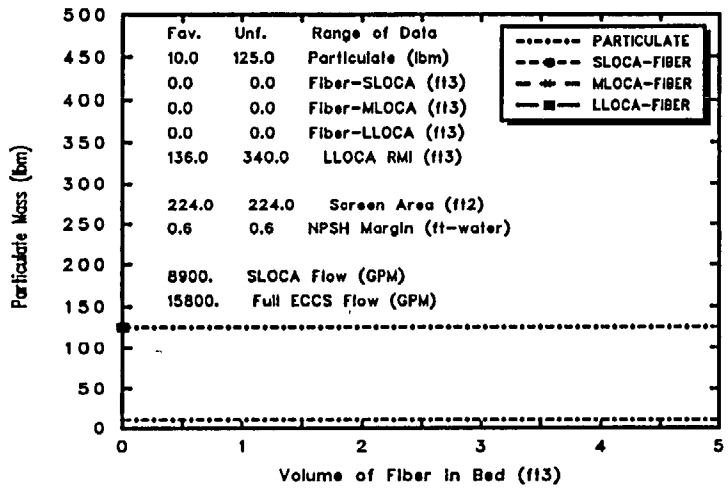
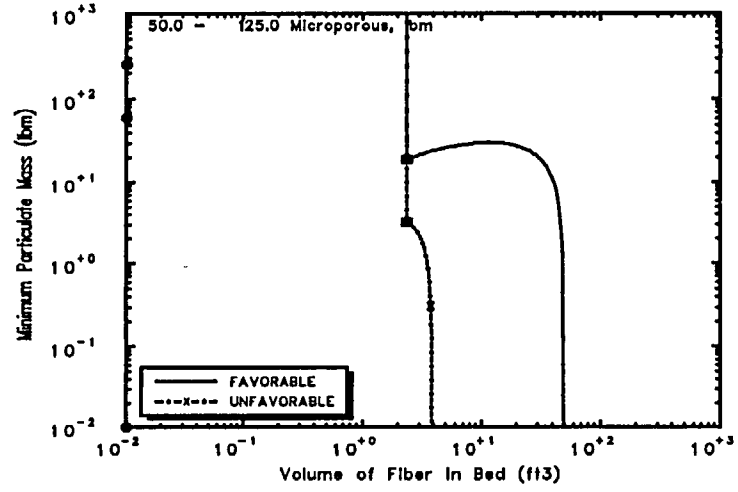


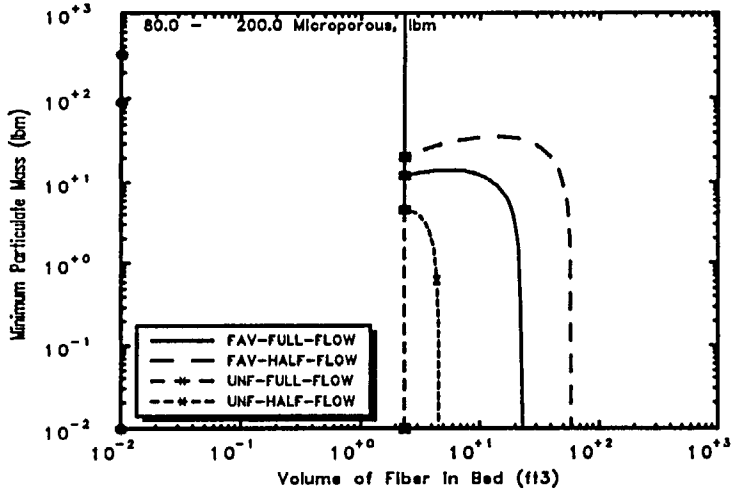
Figure B-65 Parametric Case 65



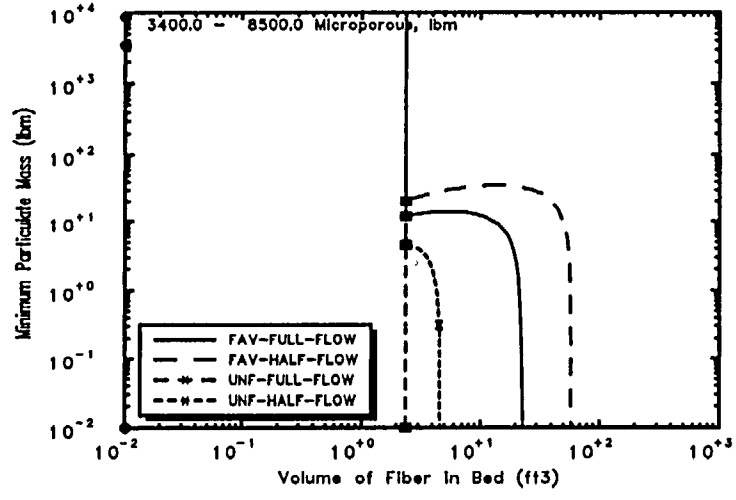
Parametric Case: 66 Debris Potential



Parametric Case: 66 Small LOCA

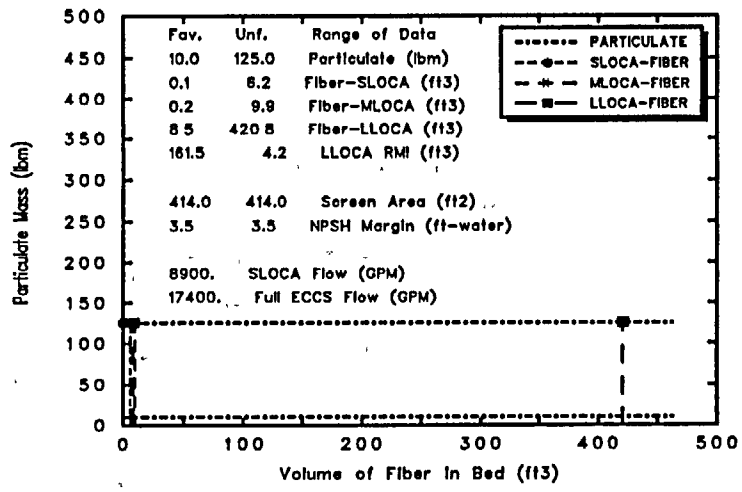


Parametric Case: 66 Medium LOCA

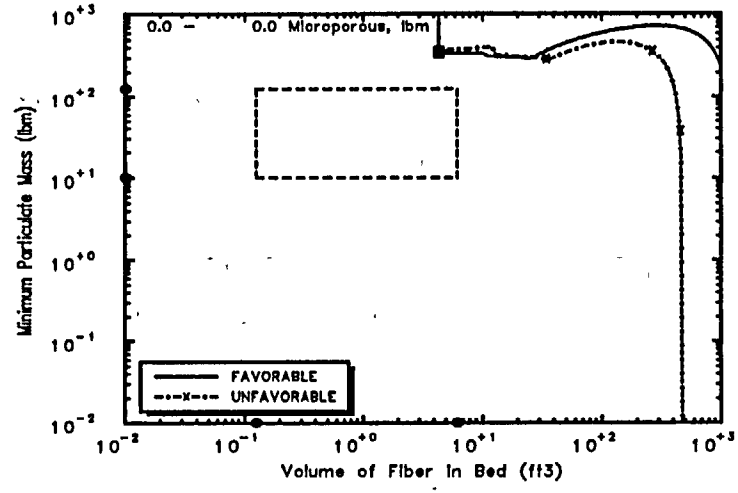


Parametric Case: 66 Large LOCA

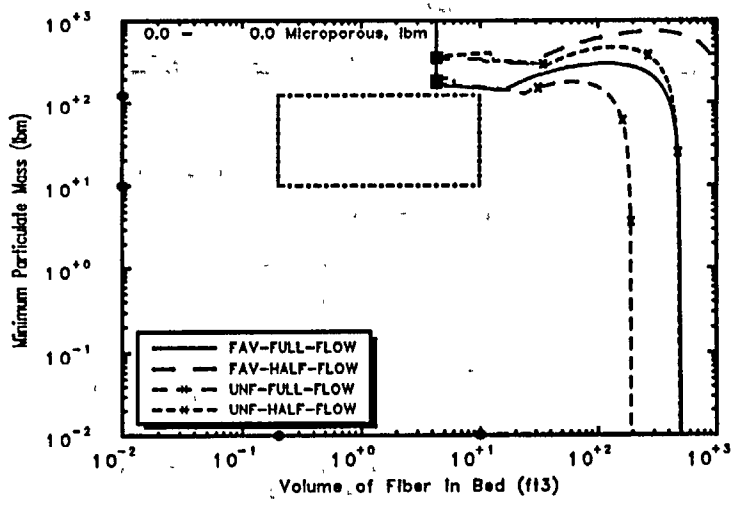
Figure B-66 Parametric Case 66 (Note: No fiber in this case, so no debris boxes presented.)



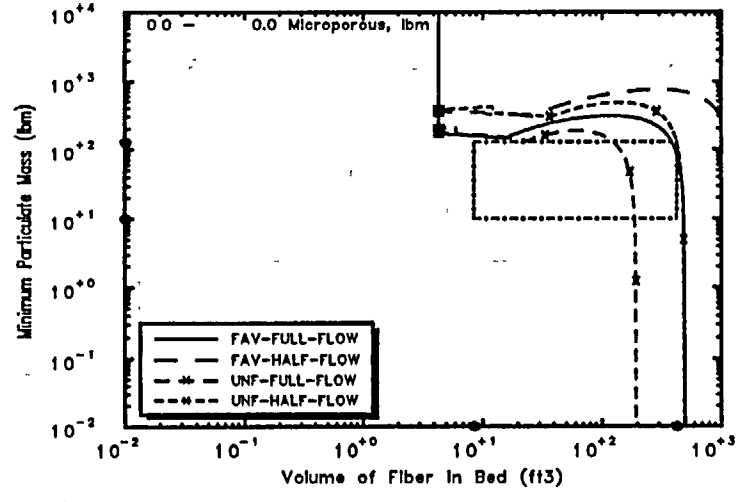
Parametric Case: 67 Debris Potential



Parametric Case: 67 Small LOCA



Parametric Case: 67 Medium LOCA



Parametric Case: 67 Large LOCA

Figure B-67 Parametric Case 67

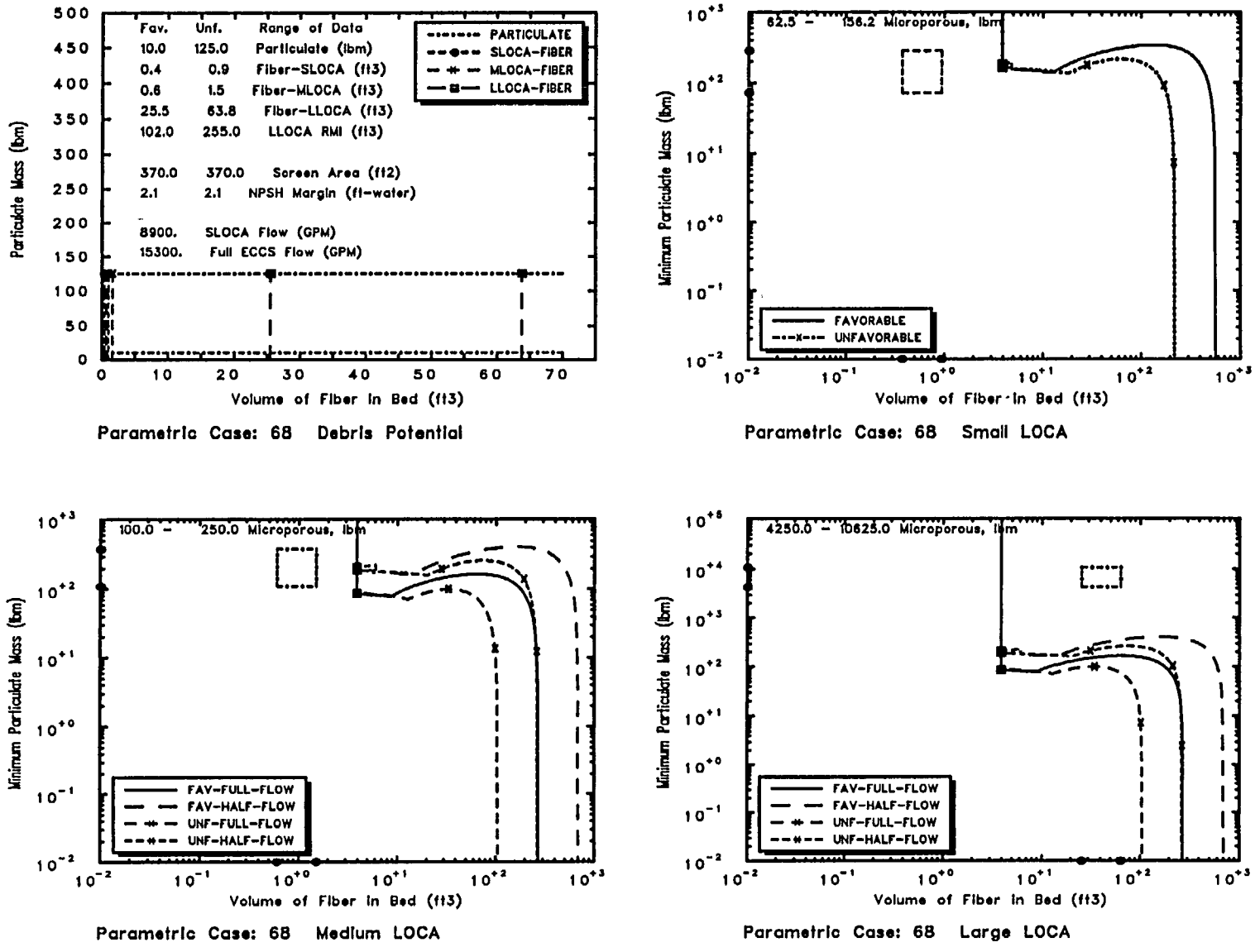
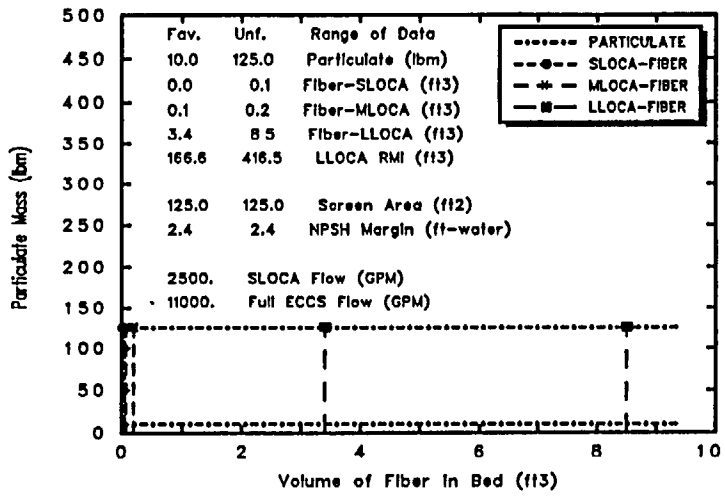
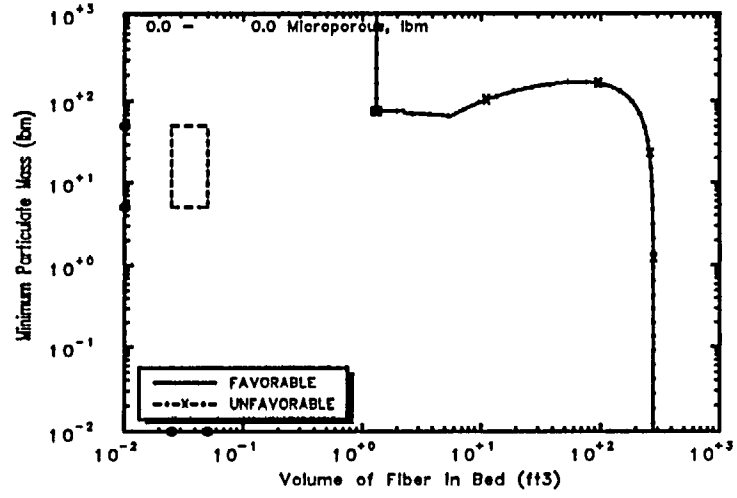


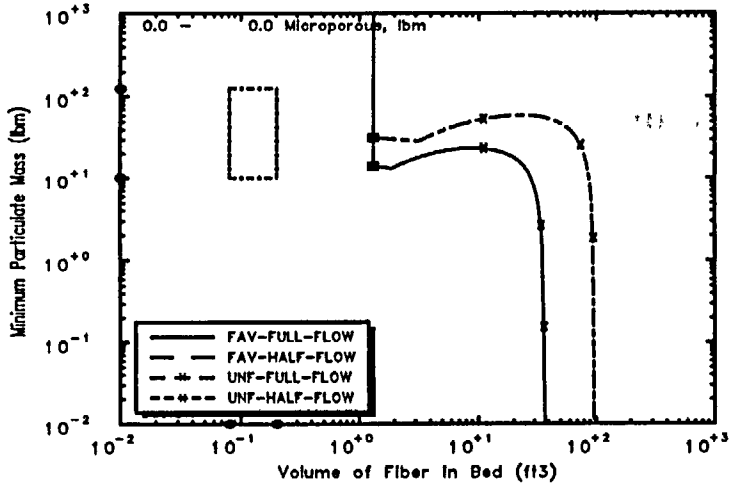
Figure B-68 Parametric Case 68



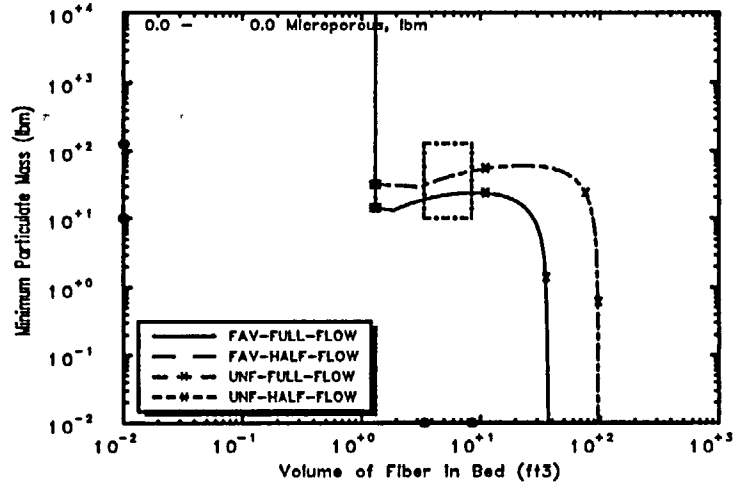
Parametric Case: 69 Debris Potential



Parametric Case: 69 Small LOCA



Parametric Case: 69 Medium LOCA



Parametric Case: 69 Large LOCA

Figure B-69 Parametric Case 69

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Table B-1 Fraction of Debris-Transport Box Above FTDL Curve										
	SLOCA		MLOCA				LLOCA			
	Single Flow		Half Flow		Full Flow		Half Flow		Full Flow	
Case	Fav.	Unfav.	Fav.	Unfav.	Fav.	Unfav.	Fav.	Unfav.	Fav.	Unfav.
1	0.731	0.731	0.96	0.96	0.96	0.96	1	1	1	1
2	0	0	0.459	0.459	0.459	0.459	1	1	1	1
3	0	0	0	0	0	0	0	1	0.821	1
4	1	1	1	1	1	1	1	1	1	1
5	0.867	0.867	0.93	0.93	0.93	0.93	1	1	1	1
6	0.803	0.803	1	1	1	1	1	1	1	1
7	0	0	0	0	0	0	0	0	0	0
8	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1
10	0.88	0.88	0.997	0.997	0.997	0.997	1	1	1	1
11	0.905	0.995	0.781	0.84	1	1	1	1	1	1
12	0.86	0.86	0.921	0.921	0.921	0.921	1	1	1	1
13	0	0	0	0	0	0	1	1	1	1
14	0	0	0	0	0	0	1	1	1	1
15	0	0	0.509	0.509	0.751	0.751	0.997	0.997	1	1
16	0.905	0.995	0.781	0.84	1	1	1	1	1	1
17	1	1	1	1	1	1	1	1	1	1
18	0	0	0	0	0	0	0	0	0	0
19	1	1	1	1	1	1	1	1	1	1
20	1	1	1	1	1	1	1	1	1	1
21	0	0	0	0	0.204	0.438	0	1	0.697	1
22	0.568	0.525	1	1	1	1	1	1	1	1
23	0	0	0.459	0.459	0.459	0.459	1	1	1	1
24	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0.019	0.644
26	1	1	1	1	1	1	1	1	1	1
27	0.443	0.443	0.918	0.918	0.918	0.918	1	1	1	1
28	0.014	0.013	1	1	1	1	1	1	1	1
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	1	1	1	1
31	0	0	0	0	0	0	0	0	0	0
32	1	1	1	1	1	1	1	1	1	1
33	0	0	0.634	0.634	0.634	0.634	1	1	1	1

Table B-1 Fraction of Debris-Transport Box Above FTDL Curve (cont)										
	SLOCA Single Flow		MLOCA Half Flow		MLOCA Full Flow		LLOCA Half Flow		LLOCA Full Flow	
Case	Fav.	Unfav.	Fav.	Unfav.	Fav.	Unfav.	Fav.	Unfav.	Fav.	Unfav.
34	0	0	0	0	0	0	0.598	1	0.878	1
35	0.828	0.828	0.906	0.906	0.906	0.906	1	1	1	1
36	0.742	0.742	1	1	1	1	1	1	1	1
37	1	1	1	1	1	1	1	1	1	1
38	0	0	0	0	0	0	0	1	0.821	1
39	0	0	0.286	0.286	0.286	0.286	1	1	1	1
40	0	0	0	0	0	0	1	1	1	1
41	0	0	0	0	0	0	0	1	0	1
42	0.005	0.002	1	1	1	1	1	1	1	1
43	0	0	0	0	0	0	1	1	1	1
44	0	0	0	0	0	0	1	1	1	1
45	0.802	0.802	0.89	0.89	0.89	0.89	1	1	1	1
46	0	0	0	0	0.217	0.203	0.973	1	1	1
47	1	1	1	1	1	1	1	1	1	1
48	1	1	1	1	1	1	1	1	1	1
49	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0.119	0	1
51	0	0	0	0	0	0	1	1	1	1
52	0	0	0	0	0	0	0	1	0.821	1
53	0.803	0.803	1	1	1	1	1	1	1	1
54	0.731	0.731	0.96	0.96	0.96	0.96	1	1	1	1
55	0.645	0.645	0.791	0.791	0.791	0.791	1	1	1	1
56	0	0	0	0	0	0	1	1	1	1
57	0	0	0	0	0	0	1	1	1	1
58	1	1	1	1	1	1	1	1	1	1
59	1	1	1	1	1	1	1	1	1	1
60	0	0	0.725	0.714	1	1	1	1	1	1
61	0	0	0	0	0	0	0.598	1	0.878	1
62	0.88	0.88	0.997	0.997	0.997	0.997	1	1	1	1
63	1	1	1	1	1	1	1	1	1	1
64	0	0	0	0	0	0	0	0	0	0
65	1	1	1	1	1	1	1	1	1	1
66	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0.019	0.644
68	0	0	0	0	0	0	1	1	1	1
69	0	0	0	0	0	0	0.729	0.729	0.897	0.897

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10. SUPPLEMENTARY NOTES
M. L. Marshall, NRC Project Manager

11. ABSTRACT *(200 words or less)*

This report documents a parametric evaluation of operating U. S. pressurized water reactors (PWR) plants that was conducted, as part of the resolution of the Nuclear Regulatory Commission (NRC) Generic-Safety-Issue (GSI) 191, to access whether or not Emergency Core Cooling Systems (ECCS) recirculation sump failure is a plausible concern. The purpose of the GSI-191 study is to determine if the transport and accumulation of debris in a containment following a loss-of-coolant accident (LOCA) will impede the operation of the ECCS in operating PWRs. In the event of a LOCA within the containment of a PWR, thermal insulation and other materials in the vicinity of the break will be damaged and dislodged. A fraction of this material would be transported to the recirculation (or emergency) sump and accumulate on the screen thereby forming a debris bed. Excessive head loss across this bed could prevent or impede the flow of water into the core or containment.

The parametric evaluation identified a range of conditions in which PWR ECCS could fail in the recirculation mode of operation; thereby forming a credible technical basis for making a determination that sump blockage is a generic concern for PWRs However, the likelihood that sufficient quantities could transport and accumulate on the recirculation sump screen to severely impede recirculation flow is plant specific. The primary limitation of the parametric evaluation was a general lack of plant specific data. A review of PWR plant design features and limited plant specific data did, however, indicate that adverse conditions exist in several plants

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating this report)*

Emergency Core Cooling System, Recirculation Sump, Loss of Coolant Accident, Debris, Thermal Insulation, Containment Coatings, ECCS Pump Net Positive Suction Head, Sump Screen Head Loss

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