

VIRGINIA ELECTRIC AND POWER COMPANY  
RICHMOND, VIRGINIA 23261

W. L. STEWART  
VICE PRESIDENT  
NUCLEAR OPERATIONS

April 25, 1983

Mr. Harold R. Denton, Director  
Office of Nuclear Reactor Regulation  
Attn: Mr. Robert A. Clark, Chief  
Operating Reactors Branch No. 3  
Division of Licensing  
U. S. Nuclear Regulatory Commission  
Washington, DC 20555

Serial No. 726A  
GLD:cdk:0379C  
Docket Nos. 50-338  
50-339  
License Nos. NPF-4  
NPF-7

Gentlemen:

SUPPLEMENT TO AMENDMENT TO OPERATING LICENSES NPF-4 AND NPF-7  
NORTH ANNA NUCLEAR POWER STATION UNIT NOS. 1 AND 2  
REACTOR COOLANT AVERAGE TEMPERATURE OF 587.8°F

In our letter dated December 30, 1982 (Serial No. 726), Vepco requested an amendment to operating licenses NPF-4 and NPF-7 to allow operation of North Anna Unit Nos. 1 and 2 at a reactor coolant system average temperature of 587.8°F. This letter provides in Attachment 1 supplemental information in answer to questions discussed with members of the Staff's Containment Systems Branch on March 9, 1983.

Should you have any further questions, please contact us at your earliest convenience.

Very truly yours,

*W. L. Stewart*  
W. L. Stewart

Attachment

- (1) Response to Containment Systems Branch for  
North Anna Operation at RCS Average  
Temperature of 587.8°F

cc: Mr. James P. O'Reilly  
Regional Administrator  
Region II

A001

B304290055 B30425  
PDR ADOCK 05000338  
P PDR

ATTACHMENT 1

RESPONSE TO CONTAINMENT SYSTEMS BRANCH

FOR NORTH ANNA OPERATION

AT RCS AVERAGE TEMPERATURE OF 587.8°F

QUESTION 1:

Provide containment LOCA reanalysis mass and energy release table for the pump suction DER corresponding to operation with a TAVE of 587.8°F.

RESPONSE:

Tables 1-1 thru 1-3, provide mass and energy release data for the following limiting containment LOCA analysis cases presented in the Balance of Plant Safety Evaluation for the 7.5°F uprate (Reference 1, Enclosure 2).

<u>Containment Calculation</u>	<u>7.5°F Uprate Value</u>	<u>Mass/Energy Data</u>
Peak Pressure	40.62 Psig	Table 1-1
Subatmospheric Peak	-.11 Psig	Table 1-2
Depressurization Time	3320 Seconds	Table 1-3

It should be noted that the attached mass and energy release data was generated by LOCTIC to maximize peak containment pressures and depressurization times. This data has no direct relation to the mass and energy release data presented in Table 5 of the NSSS Safety Evaluation (Reference 1, Enclosure 1). The data in that table was generated as part of Westinghouse's LOCA-ECCS analysis and was calculated using assumptions which maximize clad temperature.

QUESTION 2:

Address the differences in analysis and input between the LOCA containment reanalysis as specified in Question 1 and the previous analysis in the FSAR

RESPONSE:

The containment LOCA analysis results presented in the UFSAR and in the Balance of Plant (BOP) Safety Evaluation for the 7.5°F uprating, were generated using Stone & Webster's LOCTIC code. However, for the 7.5°F uprating calculations, the current version of the LOCTIC code was used. Calculations performed by Stone & Webster have shown that the different versions have negligible effect on the containment analysis.

Although there were no differences in the containment model parameters (such as containment free volume, temperature and heat sinks, etc.) used in the UFSAR and 7.5°F uprating analyses, there were differences in several parameters used in the generation of LOCA mass and energy and release rates. These differences are discussed below.

## I UPDATED-RELATED PARAMETER DIFFERENCES

### A. Steam Generator (SG) secondary fluid temperature

For the UFSAR analyses, an initial steam generator secondary fluid temperature of 525.2°F was used. For the 7.5°F uprating analysis, an uprated value of 535.8°F. was used.

## II NON-UPRATE RELATED PARAMETERS DIFFERENCES

The following nonuprate-related parameter differences included in the 7.5 F uprate analysis have been found to have a minimal impact on the containment LOCA analysis results.

### A. SG Secondary Liquid Volume

For the UFSAR analyses, an initial SG secondary liquid mass of 89,600 lbm per SG was used. For the 7.5°F uprate analyses, Stone & Webster studied the impact of applying a Westinghouse-recommended  $\pm 10\%$  margin to the SG Secondary liquid mass. It was found that reducing the mass 10% gave the most conservative results. Therefore, a mass of 80640 lbm was used in the 7.5°F. uprate analyses.

### B. Accumulator Flow Rate

For the UFSAR analyses, accumulator flow rate was input as a function of time. This function had been based on a bounding LOCA analysis performed by Westinghouse. For the 7.5°F uprate analyses, LOCTIC generated accumulator flow rates based on system conditions. This avoided a mass imbalance present when using the forcing function flow input.

### C. Reactor Vessel Volume Below Top of Core

For the UFSAR calculations, a value of 2448 ft<sup>3</sup> was used for the volume of water below the top of the core. For the 7.5°F uprate analyses, a more correct value of 1947 ft<sup>3</sup> was used.

### D. Core Heat Transfer Coefficient During Reflood

For the existing UFSAR calculations, a core reflood heat transfer coefficient of 1000 BTU/hr-ft<sup>2</sup>-°F was used in the analysis runs to calculate the 1st and 2nd containment peaks, and a RESAR 3 Curve (Reference attached Figure 2-1) was used in the analysis runs to calculate Depressurization Time and the 3rd containment peak. For the 7.5°F uprate, the value of 1000 was judged as overly conservative and a value of 3 times the RESAR-3 curve was used for 7.5°F uprate analysis runs.

The combined effect of the above changes produces minor differences from the UFSAR results, as confirmed by the data in response to Question 1.



References:

1. Letter from W. L. Stewart (Vepco) to Harold R. Denton (NRC), dated December 30, 1982, Serial No. 726, "Amendment to Operating Licenses NPF-4 and NPF-7, North Anna Power Station Unit Nos. 1 and 2, Proposed Technical Specification Change."

Table 1-1  
MASS AND ENERGY RELEASE DATA  
LIMITING CONTAINMENT-LOCA ANALYSIS FOR PEAK CONTAINMENT PRESSURE  
7.50F UPRATING/NORTH ANNA POWER STATION

MASS AND ENERGY RELEASE RATES, SPILLAGE RATES, AND INTEGRATED RELEASES AND SPILLAGE

NOTE: RATE DATA IS CONSTANT OVER THE TIME INTERVAL AND IS EQUAL TO THE CHANGE IN THE INTEGRATED DATA OVER THE TIME INTERVAL DIVIDED BY THE DURATION OF THE INTERVAL

RATE DATA				INTEGRATED DATA			
TIME INTERVAL (SEC)	END (SEC)	MASS (LBM/SEC)	ENERGY (BTU/SEC)	TIME (SEC)	MASS (LBM)	ENERGY (BTU)	SPILLAGE (LBM)
0.0	0.1	0.1214E+04	9.7044E+07	0.1	0.1214E+03	9.7044E+06	0.0
0.1	1.0	3.6136E+04	2.0904E+07	1.0	4.0644E+07	2.3510E+07	0.0
1.0	2.0	3.4997E+04	2.0477E+07	2.0	7.5640E+04	4.3995E+07	0.0
2.0	3.0	3.5043E+04	2.0704E+07	3.0	1.1070E+05	6.4701E+07	0.0
3.0	4.0	3.4005E+04	2.0600E+07	4.0	1.4551E+05	8.5309E+07	0.0
4.0	5.0	3.4320E+04	2.0479E+07	5.0	1.7903E+05	1.0587E+08	0.0
5.0	6.0	3.3659E+04	2.0142E+07	6.0	2.1349E+05	1.2601E+08	0.0
6.0	7.0	3.2672E+04	1.9595E+07	7.0	2.4616E+05	1.4560E+08	0.0
7.0	8.0	3.1468E+04	1.8828E+07	8.0	2.7763E+05	1.6403E+08	0.0
8.0	9.0	3.0440E+04	1.8129E+07	9.0	3.0007E+05	1.8256E+08	0.0
9.0	10.0	2.9504E+04	1.7408E+07	10.0	3.3757E+05	2.0001E+08	0.0
10.0	11.0	1.8342E+04	1.2547E+07	11.0	3.5594E+05	2.1258E+08	0.0
11.0	12.0	4.6595E+03	7.0536E+06	12.0	3.6259E+05	2.1943E+08	0.0
12.0	13.0	4.4787E+03	5.3619E+06	13.0	3.6707E+05	2.2499E+08	0.0
13.0	14.0	3.2907E+03	3.9644E+06	14.0	3.7036E+05	2.2896E+08	0.0
14.0	15.0	2.1507E+03	2.5979E+06	15.0	3.7252E+05	2.3155E+08	0.0
15.0	16.0	1.4118E+03	1.7024E+06	16.0	3.7393E+05	2.3326E+08	0.0
16.0	17.0	9.3375E+02	1.1253E+06	17.0	3.7466E+05	2.3436E+08	0.0
17.0	18.0	6.4294E+02	7.9830E+05	18.0	3.7552E+05	2.3518E+08	0.0
18.0	19.0	5.0050E+02	6.1206E+05	19.0	3.7603E+05	2.3579E+08	0.0
19.0	20.0	4.0356E+02	4.8592E+05	20.0	3.7644E+05	2.3620E+08	0.0
20.0	21.0	3.3349E+02	4.0211E+05	21.0	3.7677E+05	2.3668E+08	0.0
21.0	22.0	2.8437E+02	3.4298E+05	22.0	3.7705E+05	2.3702E+08	0.0
22.0	23.0	2.5449E+02	3.0054E+05	23.0	3.7731E+05	2.3732E+08	0.0
23.0	24.0	2.3162E+02	2.7291E+05	24.0	3.7754E+05	2.3760E+08	0.0
24.0	25.0	1.4831E+02	1.7747E+05	25.0	3.7769E+05	2.3777E+08	0.0
25.0	26.0	4.6649E+02	4.0336E+05	26.0	3.7815E+05	2.3830E+08	5.6973E+04
26.0	27.0	2.9956E+02	3.9138E+05	27.0	3.7845E+05	2.3877E+08	3.3657E+03
27.0	28.0	3.0356E+02	3.9646E+05	28.0	3.7876E+05	2.3916E+08	5.5778E+03
28.0	29.0	3.4501E+02	4.5122E+05	29.0	3.7910E+05	2.3962E+08	6.1403E+03
29.0	30.0	4.1440E+02	5.3938E+05	30.0	3.7952E+05	2.4015E+08	6.5617E+03
30.0	35.0	4.9010E+02	6.3542E+05	35.0	3.8197E+05	2.4333E+08	3.4002E+04
35.0	40.0	4.9810E+02	6.4092E+05	40.0	3.8446E+05	2.4656E+08	4.9043E+04
40.0	45.0	4.9559E+02	6.4057E+05	45.0	3.8694E+05	2.4976E+08	4.9046E+04
45.0	50.0	4.9250E+02	6.3574E+05	50.0	3.8940E+05	2.5294E+08	4.9466E+04

Table 1-1 Continued

## MASS AND ENERGY RELEASE RATES, SPILLAGE RATES, AND INTEGRATED RELEASES AND SPILLAGE

NOTE: RATE DATA IS CONSTANT OVER THE TIME INTERVAL AND IS EQUAL TO THE CHANGE IN THE INTEGRATED DATA OVER THE TIME INTERVAL DIVIDED BY THE DURATION OF THE INTERVAL

RATE DATA				INTEGRATED DATA			
TIME INTERVAL (SEC)	END (SEC)	MASS (LBH/SEC)	ENERGY (BTU/SEC)	TIME (SEC)	MASS (LBH)	ENERGY (BTU)	SPILLAGE (LBH)
50.0	55.0	4.0200E+02	4.2157E+05	55.0	3.9101E+05	2.5605E+08	5.0157E+04
55.0	60.0	4.7029E+02	4.0592E+05	60.0	3.9414E+05	2.5900E+08	5.0951E+04
60.0	72.5	4.4864E+02	5.7704E+05	72.5	3.9977E+05	2.6629E+08	5.2732E+04
72.5	85.0	4.2408E+02	5.4398E+05	85.0	4.0507E+05	2.7309E+08	5.4468E+04
85.0	105.0	4.0199E+02	5.1393E+05	105.0	4.1311E+05	2.8337E+08	5.6824E+04
105.0	140.0	3.7694E+02	4.7904E+05	140.0	4.2630E+05	3.0013E+08	6.0630E+04
140.0	190.0	3.4099E+02	4.2940E+05	190.0	4.4335E+05	3.2140E+08	6.9445E+04
190.0	240.0	2.4655E+02	3.0937E+05	240.0	4.5568E+05	3.3707E+08	8.7124E+04
240.0	290.0	2.0594E+02	2.5272E+05	290.0	4.6598E+05	3.4971E+08	1.0089E+05
290.0	340.0	2.0061E+02	2.4040E+05	340.0	4.7601E+05	3.6173E+08	1.3092E+05
340.0	390.0	1.6979E+02	2.0157E+05	390.0	4.8950E+05	3.7101E+08	1.5949E+05
390.0	500.0	1.0001E+02	1.2017E+05	500.0	4.9630E+05	3.8591E+08	2.1315E+05
500.0	650.0	9.9431E+01	1.1777E+05	650.0	5.1129E+05	4.0357E+08	2.9444E+05
650.0	900.0	9.1834E+01	1.0751E+05	900.0	5.3425E+05	4.3045E+08	4.3102E+05
900.0	1150.0	6.4261E+01	9.9887E+04	1150.0	5.5532E+05	4.5542E+08	5.7110E+05
1150.0	1400.0	6.0375E+01	9.4641E+04	1400.0	5.7542E+05	4.7900E+08	7.1149E+05
1400.0	1650.0	7.2325E+01	6.3005E+04	1650.0	5.9350E+05	5.0031E+08	8.5553E+05
1650.0	1900.0	6.5609E+01	7.5042E+04	1900.0	6.0990E+05	5.1879E+08	1.0019E+06
1900.0	2150.0	5.9433E+01	6.6600E+04	2150.0	6.2477E+05	5.3614E+08	1.1503E+06
2150.0	2400.0	5.3889E+01	6.2077E+04	2400.0	6.3024E+05	5.5166E+08	1.3001E+06
2400.0	2650.0	4.9439E+01	5.6890E+04	2650.0	6.5040E+05	5.6500E+08	1.4500E+06
2650.0	2900.0	4.6370E+01	5.3268E+04	2900.0	6.6210E+05	5.7921E+08	1.6010E+06
2900.0	3150.0	4.4044E+01	5.0654E+04	3150.0	6.7320E+05	5.9107E+08	1.7529E+06
3150.0	3400.0	4.2284E+01	4.8595E+04	3400.0	6.8377E+05	6.0402E+08	1.9037E+06
3400.0	3650.0	4.1989E+01	4.8249E+04	3650.0	6.9427E+05	6.1600E+08	2.0430E+06
3650.0	4300.0	4.1690E+01	4.7905E+04	4300.0	7.2470E+05	6.5105E+08	2.4156E+06
4300.0	5130.0	3.9219E+01	4.5057E+04	5130.0	7.5012E+05	6.8404E+08	2.8006E+06
5130.0	5080.0	3.4066E+01	4.2351E+04	5080.0	7.8177E+05	7.1661E+08	3.1870E+06
5080.0	6630.0	3.5330E+01	4.0409E+04	6630.0	8.0826E+05	7.4707E+08	3.5744E+06
6630.0	7380.0	3.4279E+01	3.9390E+04	7380.0	8.3397E+05	7.7661E+08	3.9659E+06
7380.0	8130.0	3.3354E+01	3.8330E+04	8130.0	8.5899E+05	8.0536E+08	4.3541E+06
8130.0	8080.0	3.2471E+01	3.7314E+04	8080.0	8.8334E+05	8.3335E+08	4.7472E+06
8080.0	9630.0	3.1600E+01	3.6541E+04	9630.0	9.0719E+05	8.6075E+08	5.1300E+06
9630.0	10380.0	3.1291E+01	3.5954E+04	10380.0	9.3046E+05	8.8772E+08	5.5105E+06
10380.0	11130.0	3.0702E+01	3.5275E+04	11130.0	9.5369E+05	9.1417E+08	5.9236E+06

Table 1-1 Continued

MASS AND ENERGY RELEASE RATES, SPILLAGE RATES, AND INTEGRATED RELEASES AND SPILLAGE

NOTE: RATE DATA IS CONSTANT OVER THE TIME INTERVAL AND IS EQUAL TO THE CHANGE IN THE INTEGRATED DATA OVER THE TIME INTERVAL DIVIDED BY THE DURATION OF THE INTERVAL

TIME INTERVAL		RATE DATA				INTEGRATED DATA				
START	END	MASS	ENERGY	MASS	ENERGY	TIME	MASS	ENERGY	MASS	ENERGY
(SEC)	(SEC)	(LBM/SEC)	(BTU/SEC)	(LBM/SEC)	(BTU/SEC)	(SEC)	(LBM)	(BTU)	(LBM)	(BTU)
11130.0	11660.0	3.0173E+01	3.4669E+09	5.2921E+02	4.5121E+09	11660.0	9.7632E+05	9.4017E+08	6.3168E+06	5.2357E+08



Table 1-2  
MASS AND ENERGY RELEASE DATA  
LIMITING CONTAINMENT LOCA ANALYSIS FOR SUBATMOSPHERIC PEAK CONTAINMENT PRESSURE  
7.5% UP-RATING/NORTH ANNA POWER STATION

MASS AND ENERGY RELEASE RATES, SPILLAGE RATES, AND INTEGRATED RELEASES AND SPILLAGE

NOTE: RATE DATA IS CONSTANT OVER THE TIME INTERVAL AND IS EQUAL TO THE CHANGE IN THE INTEGRATED DATA OVER THE TIME INTERVAL DIVIDED BY THE DURATION OF THE INTERVAL

TIME INTERVAL				RATE DATA				INTEGRATED DATA			
START (SEC)	END (SEC)	(SEC)		MASS (LBM/SEC)	ENERGY (BTU/SEC)	SPILLAGE (LBM/SEC)		MASS (LBM)	ENERGY (BTU)	SPILLAGE (LBM)	
0.0	0.1	0.1	0.1214E+04	4.7044E+07	0.0	0.0	0.1	0.1214E+03	4.7044E+06	0.0	0.0
0.1	1.0	0.9	3.4136E+04	2.0904E+07	0.0	0.0	1.0	0.0644E+04	2.3510E+07	0.0	0.0
1.0	2.0	1.0	3.4997E+04	2.0477E+07	0.0	0.0	2.0	7.5640E+04	4.3995E+07	0.0	0.0
2.0	3.0	1.0	3.5043E+04	2.0706E+07	0.0	0.0	3.0	1.1070E+05	6.4701E+07	0.0	0.0
3.0	4.0	1.0	3.4005E+04	2.0608E+07	0.0	0.0	4.0	1.4551E+05	8.5389E+07	0.0	0.0
4.0	5.0	1.0	3.4320E+04	2.0479E+07	0.0	0.0	5.0	1.7903E+05	1.0587E+08	0.0	0.0
5.0	6.0	1.0	3.2659E+04	2.0142E+07	0.0	0.0	6.0	2.1349E+05	1.2601E+08	0.0	0.0
6.0	7.0	1.0	3.2472E+04	1.9595E+07	0.0	0.0	7.0	2.4616E+05	1.4560E+08	0.0	0.0
7.0	8.0	1.0	3.1468E+04	1.8620E+07	0.0	0.0	8.0	2.7733E+05	1.6443E+08	0.0	0.0
8.0	9.0	1.0	3.0440E+04	1.8129E+07	0.0	0.0	9.0	3.0807E+05	1.8256E+08	0.0	0.0
9.0	10.0	1.0	2.9506E+04	1.7440E+07	0.0	0.0	10.0	3.3757E+05	2.0001E+08	0.0	0.0
10.0	11.0	1.0	1.8362E+04	1.2567E+07	0.0	0.0	11.0	3.5594E+05	2.1250E+08	0.0	0.0
11.0	12.0	1.0	4.4595E+03	7.0536E+06	0.0	0.0	12.0	3.4259E+05	2.1963E+08	0.0	0.0
12.0	13.0	1.0	4.7878E+03	5.3619E+06	0.0	0.0	13.0	3.4707E+05	2.2499E+08	0.0	0.0
13.0	14.0	1.0	3.2907E+03	3.9644E+06	0.0	0.0	14.0	3.7036E+05	2.2896E+08	0.0	0.0
14.0	15.0	1.0	2.1507E+03	2.5974E+06	0.0	0.0	15.0	3.7252E+05	2.3155E+08	0.0	0.0
15.0	16.0	1.0	1.4116E+03	1.7024E+06	0.0	0.0	16.0	3.7193E+05	2.3326E+08	0.0	0.0
16.0	17.0	1.0	9.3375E+02	1.1253E+06	0.0	0.0	17.0	3.7406E+05	2.3430E+08	0.0	0.0
17.0	18.0	1.0	6.4294E+02	7.9830E+05	0.0	0.0	18.0	3.7552E+05	2.3510E+08	0.0	0.0
18.0	19.0	1.0	5.0850E+02	6.1206E+05	0.0	0.0	19.0	3.7603E+05	2.3579E+08	0.0	0.0
19.0	20.0	1.0	4.0356E+02	4.8592E+05	0.0	0.0	20.0	3.7444E+05	2.3620E+08	0.0	0.0
20.0	21.0	1.0	3.3369E+02	4.0212E+05	0.0	0.0	21.0	3.7677E+05	2.3660E+08	0.0	0.0
21.0	22.0	1.0	2.8037E+02	3.4298E+05	0.0	0.0	22.0	3.7705E+05	2.3702E+08	0.0	0.0
22.0	23.0	1.0	2.5469E+02	3.0054E+05	0.0	0.0	23.0	3.7731E+05	2.3732E+08	0.0	0.0
23.0	24.0	1.0	2.3142E+02	2.7291E+05	0.0	0.0	24.0	3.7754E+05	2.3760E+08	0.0	0.0
24.0	25.0	1.0	1.0506E+02	2.1774E+05	0.0	0.0	25.0	3.7772E+05	2.3761E+08	0.0	0.0
25.0	26.0	1.0	2.4294E+02	3.3962E+05	7.0724E+01	4.2535E+03	26.0	3.7799E+05	2.3815E+08	7.0724E+01	4.2535E+03
26.0	27.0	1.0	4.1912E+02	5.4374E+05	2.2443E+03	1.3501E+05	27.0	3.7841E+05	2.3870E+08	2.3351E+03	1.3927E+05
27.0	28.0	1.0	2.9231E+02	3.8190E+05	2.3752E+03	1.4013E+05	28.0	3.7870E+05	2.3908E+08	4.7103E+03	2.7940E+05
28.0	29.0	1.0	3.2950E+02	4.3016E+05	1.0975E+03	6.4311E+04	29.0	3.7903E+05	2.3951E+08	5.8077E+03	3.4371E+05
29.0	30.0	1.0	3.0131E+02	4.9704E+05	4.8991E+02	2.8103E+04	30.0	3.7941E+05	2.4001E+08	6.2977E+03	3.7161E+05
30.0	31.0	1.0	4.0557E+02	6.2974E+05	5.1926E+03	2.7701E+05	31.0	3.8104E+05	2.4315E+08	3.2261E+04	1.7560E+06
31.0	32.0	1.0	4.9571E+02	6.4161E+05	2.7714E+03	1.4697E+05	32.0	3.8432E+05	2.4633E+08	4.110E+04	2.8917E+06
32.0	33.0	1.0	4.9447E+02	6.3940E+05	2.2109E+01	1.5000E+01	33.0	3.8679E+05	2.4950E+08	4.4119E+04	2.9910E+06
33.0	34.0	1.0	4.9372E+02	6.3753E+05	6.9047E+01	5.7116E+03	34.0	3.8926E+05	2.5275E+08	4.4644E+04	2.5204E+06



Table 1-3  
MASS AND ENERGY RELEASE DATA  
LIMITING CONTAINMENT LOCA ANALYSIS FOR MAXIMUM DEPRESSURIZATION TIME  
7.5°F UPDATING/NORTH ANNA POWER STATION

MASS AND ENERGY RELEASE RATES, SPILLAGE RATES, AND INTEGRATED RELEASES AND SPILLAGE

NOTE: RATE DATA IS CONSTANT OVER THE TIME INTERVAL AND IS EQUAL TO THE CHANGE IN THE INTEGRATED DATA OVER THE TIME INTERVAL DIVIDED BY THE DURATION OF THE INTERVAL

RATE DATA				INTEGRATED DATA			
TIME INTERVAL (SEC)	END (SEC)	START (SEC)	TIME (SEC)	MASS (LBM/SEC)	ENERGY (BTU/SEC)	SPILLAGE (LBM/SEC)	ENERGY (BTU/SEC)
0.0	0.1	0.1219E+09	0.1	0.1219E+03	9.7045E+06	0.0	0.0
0.1	1.0	3.6101E+09	1.0	4.0613E+04	2.3496E+07	0.0	0.0
1.0	2.0	3.4997E+09	2.0	7.5559E+04	9.3932E+07	0.0	0.0
2.0	3.0	3.4909E+09	3.0	1.1054E+05	6.4572E+07	0.0	0.0
3.0	4.0	3.4719E+09	4.0	1.4524E+05	0.5100E+07	0.0	0.0
4.0	5.0	3.4217E+09	5.0	1.7997E+05	1.0557E+08	0.0	0.0
5.0	6.0	3.3550E+09	6.0	2.1303E+05	1.2561E+08	0.0	0.0
6.0	7.0	3.2500E+09	7.0	2.4562E+05	1.4512E+08	0.0	0.0
7.0	8.0	3.1410E+09	8.0	2.7704E+05	1.6307E+08	0.0	0.0
8.0	9.0	3.0411E+09	9.0	3.0795E+05	1.8195E+08	0.0	0.0
9.0	10.0	2.9496E+09	10.0	3.3695E+05	1.9934E+08	0.0	0.0
10.0	11.0	1.8640E+09	11.0	3.5659E+05	2.1249E+08	0.0	0.0
11.0	12.0	6.5572E+03	12.0	3.6319E+05	2.1945E+08	0.0	0.0
12.0	13.0	4.8990E+03	13.0	3.6759E+05	2.2470E+08	0.0	0.0
13.0	14.0	3.2639E+03	14.0	3.7004E+05	2.2671E+08	0.0	0.0
14.0	15.0	2.1252E+03	15.0	3.7290E+05	2.3120E+08	0.0	0.0
15.0	16.0	1.3932E+03	16.0	3.7937E+05	2.3294E+08	0.0	0.0
16.0	17.0	9.1937E+02	17.0	3.7529E+05	2.3407E+08	0.0	0.0
17.0	18.0	6.5444E+02	18.0	3.7595E+05	2.3405E+08	0.0	0.0
18.0	19.0	5.0175E+02	19.0	3.7645E+05	2.3546E+08	0.0	0.0
19.0	20.0	3.9019E+02	20.0	3.7605E+05	2.3594E+08	0.0	0.0
20.0	21.0	3.2969E+02	21.0	3.7710E+05	2.3639E+08	0.0	0.0
21.0	22.0	2.8106E+02	22.0	3.7794E+05	2.3667E+08	0.0	0.0
22.0	23.0	2.5161E+02	23.0	3.7771E+05	2.3697E+08	0.0	0.0
23.0	24.0	2.2969E+02	24.0	3.7794E+05	2.3724E+08	0.0	0.0
24.0	25.0	1.7362E+02	25.0	3.7811E+05	2.3745E+08	0.0	0.0
25.0	26.0	3.4694E+02	26.0	3.7809E+05	2.3722E+08	0.0	0.0
26.0	27.0	3.6801E+02	27.0	3.7805E+05	2.3840E+08	0.0	0.0
27.0	28.0	2.9107E+02	28.0	3.7919E+05	2.3870E+08	0.0	0.0
28.0	29.0	3.3367E+02	29.0	3.7994E+05	2.3922E+08	0.0	0.0
29.0	30.0	3.7875E+02	30.0	3.7980E+05	2.3971E+08	0.0	0.0
30.0	31.0	4.0739E+02	31.0	3.8000E+05	2.4017E+08	0.0	0.0
31.0	32.0	5.0716E+02	32.0	3.8000E+05	2.4017E+08	0.0	0.0
32.0	33.0	5.0254E+02	33.0	3.8000E+05	2.4017E+08	0.0	0.0
33.0	34.0	4.9304E+02	34.0	3.8000E+05	2.4017E+08	0.0	0.0
34.0	35.0	4.9304E+02	35.0	3.8000E+05	2.4017E+08	0.0	0.0
35.0	36.0	4.9304E+02	36.0	3.8000E+05	2.4017E+08	0.0	0.0
36.0	37.0	4.9304E+02	37.0	3.8000E+05	2.4017E+08	0.0	0.0
37.0	38.0	4.9304E+02	38.0	3.8000E+05	2.4017E+08	0.0	0.0
38.0	39.0	4.9304E+02	39.0	3.8000E+05	2.4017E+08	0.0	0.0
39.0	40.0	4.9304E+02	40.0	3.8000E+05	2.4017E+08	0.0	0.0
40.0	41.0	4.9304E+02	41.0	3.8000E+05	2.4017E+08	0.0	0.0
41.0	42.0	4.9304E+02	42.0	3.8000E+05	2.4017E+08	0.0	0.0
42.0	43.0	4.9304E+02	43.0	3.8000E+05	2.4017E+08	0.0	0.0
43.0	44.0	4.9304E+02	44.0	3.8000E+05	2.4017E+08	0.0	0.0
44.0	45.0	4.9304E+02	45.0	3.8000E+05	2.4017E+08	0.0	0.0
45.0	46.0	4.9304E+02	46.0	3.8000E+05	2.4017E+08	0.0	0.0
46.0	47.0	4.9304E+02	47.0	3.8000E+05	2.4017E+08	0.0	0.0
47.0	48.0	4.9304E+02	48.0	3.8000E+05	2.4017E+08	0.0	0.0
48.0	49.0	4.9304E+02	49.0	3.8000E+05	2.4017E+08	0.0	0.0
49.0	50.0	4.9304E+02	50.0	3.8000E+05	2.4017E+08	0.0	0.0



Table 1-3 Continued

## HAZS AND ENERGY RELEASE RATES, SPILLAGE RATES, AND INTEGRATED RELEASES AND SPILLAGE

NOTE: RATE DATA IS CONSTANT OVER THE TIME INTERVAL AND IS EQUAL TO THE CHANGE IN THE INTEGRATED DATA OVER THE TIME INTERVAL DIVIDED BY THE DURATION OF THE INTERVAL

TIME INTERVAL				RATE DATA				SPILLAGE				INTEGRATED DATA				SPILLAGE			
START	END	TIME	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS	HAZS
(SEC)	(SEC)	(SEC)	(LBM/SEC)	(BTU/SEC)	(LBM/SEC)	(BTU/SEC)	(LBM/SEC)	(BTU/SEC)	(LBM/SEC)	(BTU/SEC)	(LBM/SEC)	(BTU/SEC)	(LBM/SEC)	(BTU/SEC)	(LBM/SEC)	(BTU/SEC)	(LBM/SEC)	(BTU/SEC)	(BTU)
50.0	55.0	55.0	4.0336E+02	4.2372E+05	1.3636E+02	1.2097E+04	1.2097E+04	1.2097E+04	1.2097E+04	1.2097E+04	1.2097E+04	2.5573E+08	3.9224E+05	2.5573E+08	3.9224E+05	2.5573E+08	3.9224E+05	2.5573E+08	3.9224E+05
55.0	60.0	60.0	4.7179E+02	4.0826E+05	1.5715E+02	1.3268E+04	1.3268E+04	1.3268E+04	1.3268E+04	1.3268E+04	1.3268E+04	2.5077E+08	3.9460E+05	2.5077E+08	3.9460E+05	2.5077E+08	3.9460E+05	2.5077E+08	3.9460E+05
60.0	72.5	72.5	4.5003E+02	5.7930E+05	1.4336E+02	1.1350E+04	1.1350E+04	1.1350E+04	1.1350E+04	1.1350E+04	1.1350E+04	2.6601E+08	4.0022E+05	2.6601E+08	4.0022E+05	2.6601E+08	4.0022E+05	2.6601E+08	4.0022E+05
72.5	85.0	85.0	4.2532E+02	5.4613E+05	1.3632E+02	1.0012E+04	1.0012E+04	1.0012E+04	1.0012E+04	1.0012E+04	1.0012E+04	2.7209E+08	4.0554E+05	2.7209E+08	4.0554E+05	2.7209E+08	4.0554E+05	2.7209E+08	4.0554E+05
85.0	105.0	105.0	4.0290E+02	5.1566E+05	1.1700E+02	7.9212E+03	7.9212E+03	7.9212E+03	7.9212E+03	7.9212E+03	7.9212E+03	2.8315E+08	4.1360E+05	2.8315E+08	4.1360E+05	2.8315E+08	4.1360E+05	2.8315E+08	4.1360E+05
105.0	140.0	140.0	3.7764E+02	4.8068E+05	1.0690E+02	6.5425E+03	6.5425E+03	6.5425E+03	6.5425E+03	6.5425E+03	6.5425E+03	2.9997E+08	4.2601E+05	2.9997E+08	4.2601E+05	2.9997E+08	4.2601E+05	2.9997E+08	4.2601E+05
140.0	190.0	190.0	3.4150E+02	4.3108E+05	1.7539E+02	9.2666E+03	9.2666E+03	9.2666E+03	9.2666E+03	9.2666E+03	9.2666E+03	3.2152E+08	4.4309E+05	3.2152E+08	4.4309E+05	3.2152E+08	4.4309E+05	3.2152E+08	4.4309E+05
190.0	240.0	240.0	2.4670E+02	3.1004E+05	3.5392E+02	4.5087E+04	4.5087E+04	4.5087E+04	4.5087E+04	4.5087E+04	4.5087E+04	3.3701E+08	4.5623E+05	3.3701E+08	4.5623E+05	3.3701E+08	4.5623E+05	3.3701E+08	4.5623E+05
240.0	290.0	290.0	2.0594E+02	2.5272E+05	4.3533E+02	4.7237E+04	4.7237E+04	4.7237E+04	4.7237E+04	4.7237E+04	4.7237E+04	3.4968E+08	4.6653E+05	3.4968E+08	4.6653E+05	3.4968E+08	4.6653E+05	3.4968E+08	4.6653E+05
290.0	340.0	340.0	2.0061E+02	2.4040E+05	4.4066E+02	4.6441E+04	4.6441E+04	4.6441E+04	4.6441E+04	4.6441E+04	4.6441E+04	3.6160E+08	4.7650E+05	3.6160E+08	4.7650E+05	3.6160E+08	4.7650E+05	3.6160E+08	4.7650E+05
340.0	390.0	390.0	1.9235E+02	2.2667E+05	4.4093E+02	4.7342E+04	4.7342E+04	4.7342E+04	4.7342E+04	4.7342E+04	4.7342E+04	3.7312E+08	4.8618E+05	3.7312E+08	4.8618E+05	3.7312E+08	4.8618E+05	3.7312E+08	4.8618E+05
390.0	500.0	500.0	1.8420E+02	1.2370E+05	5.3702E+02	9.2030E+04	9.2030E+04	9.2030E+04	9.2030E+04	9.2030E+04	9.2030E+04	4.0673E+08	5.1204E+05	4.0673E+08	5.1204E+05	4.0673E+08	5.1204E+05	4.0673E+08	5.1204E+05
500.0	650.0	650.0	9.6071E+01	1.1362E+05	5.8526E+02	9.8001E+04	9.8001E+04	9.8001E+04	9.8001E+04	9.8001E+04	9.8001E+04	4.3000E+08	5.2804E+05	4.3000E+08	5.2804E+05	4.3000E+08	5.2804E+05	4.3000E+08	5.2804E+05
650.0	900.0	900.0	6.9039E+01	1.0724E+05	5.5233E+02	9.0452E+04	9.0452E+04	9.0452E+04	9.0452E+04	9.0452E+04	9.0452E+04	4.2906E+08	5.3432E+05	4.2906E+08	5.3432E+05	4.2906E+08	5.3432E+05	4.2906E+08	5.3432E+05
900.0	1150.0	1150.0	6.2299E+01	9.7579E+04	5.5910E+02	8.7300E+04	8.7300E+04	8.7300E+04	8.7300E+04	8.7300E+04	8.7300E+04	4.5424E+08	5.5409E+05	4.5424E+08	5.5409E+05	4.5424E+08	5.5409E+05	4.5424E+08	5.5409E+05
1150.0	1400.0	1400.0	7.0119E+01	9.1910E+04	5.4330E+02	5.3600E+04	5.3600E+04	5.3600E+04	5.3600E+04	5.3600E+04	5.3600E+04	4.7724E+08	5.7442E+05	4.7724E+08	5.7442E+05	4.7724E+08	5.7442E+05	4.7724E+08	5.7442E+05
1400.0	1650.0	1650.0	7.0116E+01	8.1366E+04	5.7299E+02	1.0970E+04	1.0970E+04	1.0970E+04	1.0970E+04	1.0970E+04	1.0970E+04	4.9750E+08	5.9195E+05	4.9750E+08	5.9195E+05	4.9750E+08	5.9195E+05	4.9750E+08	5.9195E+05
1650.0	1900.0	1900.0	4.4654E+01	7.4675E+04	5.8149E+02	1.1130E+04	1.1130E+04	1.1130E+04	1.1130E+04	1.1130E+04	1.1130E+04	5.1630E+08	6.0012E+05	5.1630E+08	6.0012E+05	5.1630E+08	6.0012E+05	5.1630E+08	6.0012E+05
1900.0	2150.0	2150.0	5.9007E+01	6.9145E+04	5.0000E+02	1.1263E+04	1.1263E+04	1.1263E+04	1.1263E+04	1.1263E+04	1.1263E+04	5.3350E+08	6.2307E+05	5.3350E+08	6.2307E+05	5.3350E+08	6.2307E+05	5.3350E+08	6.2307E+05
2150.0	2400.0	2400.0	5.5333E+01	6.3675E+04	5.9326E+02	1.1362E+04	1.1362E+04	1.1362E+04	1.1362E+04	1.1362E+04	1.1362E+04	5.4955E+08	6.3690E+05	5.4955E+08	6.3690E+05	5.4955E+08	6.3690E+05	5.4955E+08	6.3690E+05
2400.0	2650.0	2650.0	5.1570E+01	5.9454E+04	5.9478E+02	1.1430E+04	1.1430E+04	1.1430E+04	1.1430E+04	1.1430E+04	1.1430E+04	5.6442E+08	6.4979E+05	5.6442E+08	6.4979E+05	5.6442E+08	6.4979E+05	5.6442E+08	6.4979E+05
2650.0	2900.0	2900.0	4.0492E+01	5.5900E+04	5.9600E+02	1.1469E+04	1.1469E+04	1.1469E+04	1.1469E+04	1.1469E+04	1.1469E+04	5.7841E+08	6.6194E+05	5.7841E+08	6.6194E+05	5.7841E+08	6.6194E+05	5.7841E+08	6.6194E+05
2900.0	3150.0	3150.0	4.6071E+01	5.3025E+04	5.9983E+02	1.1491E+04	1.1491E+04	1.1491E+04	1.1491E+04	1.1491E+04	1.1491E+04	5.9167E+08	6.7346E+05	5.9167E+08	6.7346E+05	5.9167E+08	6.7346E+05	5.9167E+08	6.7346E+05
3150.0	3400.0	3400.0	4.3056E+01	5.0452E+04	6.0011E+02	1.1499E+04	1.1499E+04	1.1499E+04	1.1499E+04	1.1499E+04	1.1499E+04	6.0426E+08	6.8443E+05	6.0426E+08	6.8443E+05	6.0426E+08	6.8443E+05	6.0426E+08	6.8443E+05
3400.0	3650.0	3650.0	4.3203E+01	4.9674E+04	5.5055E+02	3.1820E+04	3.1820E+04	3.1820E+04	3.1820E+04	3.1820E+04	3.1820E+04	6.1670E+08	6.9523E+05	6.1670E+08	6.9523E+05	6.1670E+08	6.9523E+05	6.1670E+08	6.9523E+05
3650.0	4300.0	4300.0	4.2576E+01	4.8994E+04	5.0777E+02	5.7433E+04	5.7433E+04	5.7433E+04	5.7433E+04	5.7433E+04	5.7433E+04	6.5243E+08	7.2431E+05	6.5243E+08	7.2431E+05	6.5243E+08	7.2431E+05	6.5243E+08	7.2431E+05
4300.0	5130.0	5130.0	3.9933E+01	4.5090E+04	5.1073E+02	5.4783E+04	5.4783E+04	5.4783E+04	5.4783E+04	5.4783E+04	5.4783E+04	6.8684E+08	7.5626E+05	6.8684E+08	7.5626E+05	6.8684E+08	7.5626E+05	6.8684E+08	7.5626E+05
5130.0	5800.0	5800.0	3.7417E+01	4.2991E+04	5.1357E+02	5.4056E+04	5.4056E+04	5.4056E+04	5.4056E+04	5.4056E+04	5.4056E+04	7.1909E+08	7.8432E+05	7.1909E+08	7.8432E+05	7.1909E+08	7.8432E+05	7.1909E+08	7.8432E+05
5800.0	6630.0	6630.0	3.5673E+01	4.1024E+04	5.1544E+02	5.5058E+04	5.5058E+04	5.5058E+04	5.5058E+04	5.5058E+04	5.5058E+04	7.4986E+08	8.1107E+05	7.4986E+08	8.1107E+05	7.4986E+08	8.1107E+05	7.4986E+08	8.1107E+05
6630.0	7380.0	7380.0	3.4755E+01	3.9973E+04	5.1634E+02	5.5995E+04	5.5995E+04	5.5995E+04	5.5995E+04	5.5995E+04	5.5995E+04	7.7984E+08	8.3714E+05	7.7984E+08	8.3714E+05	7.7984E+08	8.3714E+05	7.7984E+08	8.3714E+05
7380.0	8130.0	8130.0	3.3078E+01	3.6941E+04	5.1722E+02	5.4107E+04	5.4107E+04	5.4107E+04	5.4107E+04	5.4107E+04	5.4107E+04	8.0906E+08	8.4255E+05	8.0906E+08	8.4255E+05	8.0906E+08	8.4255E+05	8.0906E+08	8.4255E+05
8130.0	8880.0	8880.0	3.3000E+01	3.7950E+04	5.1610E+02	5.4104E+04	5.4104E+04	5.4104E+04	5.4104E+04	5.4104E+04	5.4104E+04	8.3752E+08	8.6730E+05	8.3752E+08	8.6730E+05	8.3752E+08	8.6730E+05	8.3752E+08	8.6730E+05
8880.0	9630.0	9630.0	3.2331E+01	3.7132E+04	5.1076E+02	5.1076E+04	5.1076E+04	5.1076E+04	5.1076E+04	5.1076E+04	5.1076E+04	8.6541E+08	9.1155E+05	8.6541E+08	9.1155E+05	8.6541E+08	9.1155E+05	8.6541E+08	9.1155E+05
9630.0	10380.0	10380.0	3.1757E+01	3.6521E+04	5.1933E+02	5.4343E+04	5.4343E+04	5.4343E+04	5.4343E+04	5.4343E+04	5.4343E+04	8.9200E+08	9.3566E+05	8.9200E+08	9.3566E+05	8.9200E+08	9.3566E+05	8.9200E+08	9.3566E+05
10380.0	11130.0	11130.0	3.1269E+01	3.5957E+04	5.1903E+02	5.4366E+04	5.4366E+04	5.4366E+04	5.4366E+04	5.4366E+04	5.4366E+04	9.1976E+08	9.5062E+05	9.1976E+08	9.5062E+05	9.1976E+08	9.5062E+05	9.1976E+08	9.5062E+05



Table 1-3 Continued

## MASS AND ENERGY RELEASE RATES, SPILLAGE RATES, AND INTEGRATED RELEASES AND SPILLAGE

NOTE: RATE DATA IS CONSTANT OVER THE TIME INTERVAL AND IS EQUAL TO THE CHANGE IN THE INTEGRATED DATA OVER THE TIME INTERVAL DIVIDED BY THE DURATION OF THE INTERVAL

RATE DATA						INTEGRATED DATA				
TIME INTERVAL		BLowdown		SPILLAGE		TIME	BLowdown		SPILLAGE	
START	END	MASS	ENERGY	MASS	ENERGY		MASS	ENERGY	MASS	ENERGY
(SEC)	(SEC)	(LBIV/SEC)	(BTU/SEC)	(LBIV/SEC)	(BTU/SEC)	(SEC)	(LBIV)	(BTU)	(LBIV)	(BTU)
11130.0	11000.0	3.0700E+01	3.5392E+04	5.2039E+02	5.6359E+04	11000.0	9.8190E+05	9.4631E+08	6.3266E+06	5.9471E+08

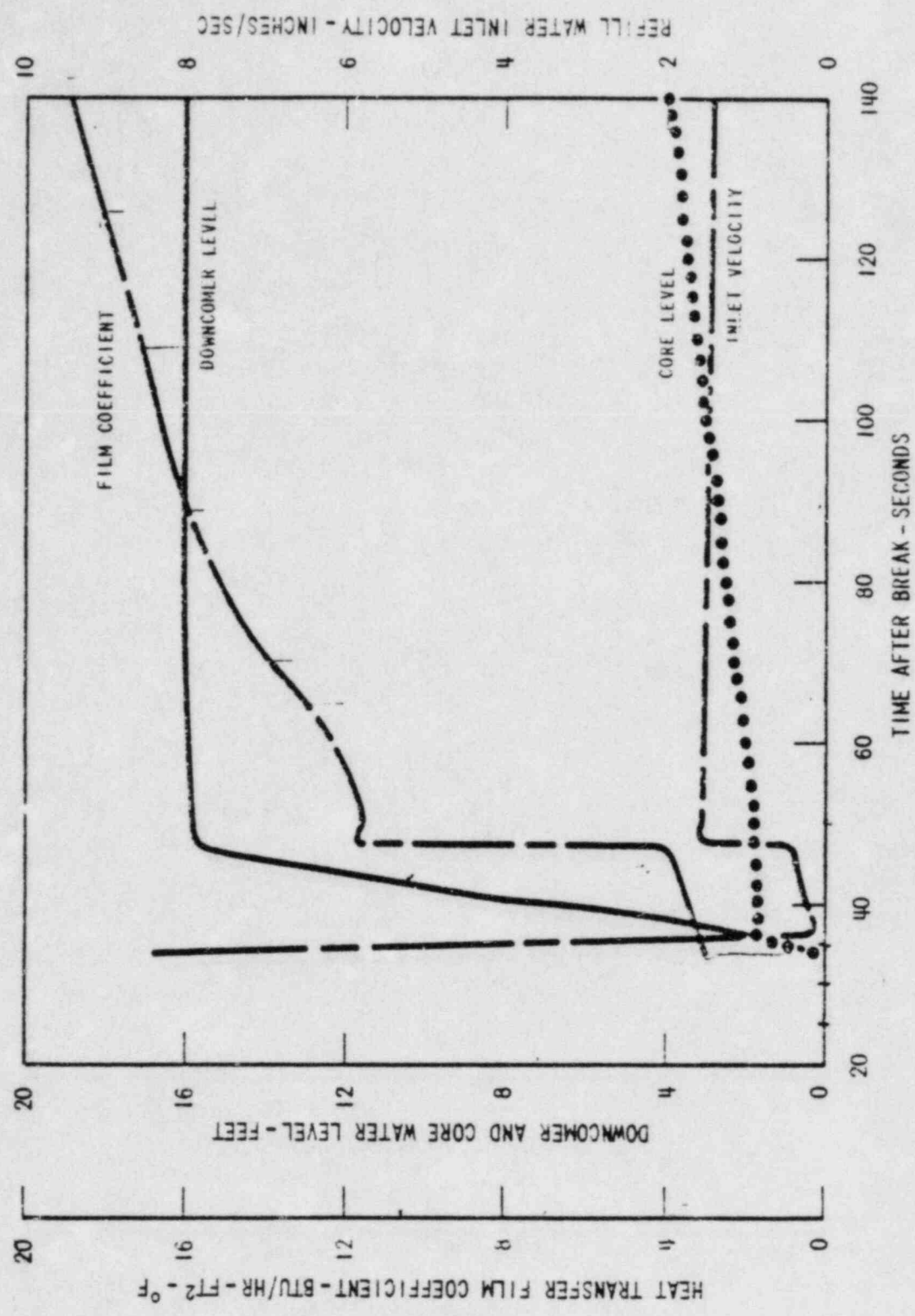


Figure 15.4-21. Double Ended Cold Leg Break (Guillotine)