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June 8, 1983

ARTHUR E. LUNDVALL, JR.
VICE PRESIDENT
SUPPLY

Director of Nuclear Reactor Regulation
Attn: Mr. R. A. Clark, Chief
Operating Reactors Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Calvert Cliffs Nuclear Power Plant
Units Nos. 1 & 2; Dockets Nos. 50-317 & 50-318
Main Steam Line Break Inside Containment

Reference: BG&E letter from Mr. A. E. Lundvall, Jr. to Mr. R. A. Clark, dated May 17, 1983, same subject.

Gentlemen:

In the referenced letter, we provided the results of containment pressure and core response analyses for a main steam line break (MSLB) inside containment. The purpose of these analyses was to establish a preliminary basis for determining the adequacy of the proposed main feedwater (MFW) system trip scheme in resolving the concerns raised by I&E Bulletin 80-04. The results of the analyses indicated that an automatic MFW system trip would provide adequate protection against the potential effects of runout MFW flow but that further attention needed to be focused on the areas of flashing (two phase expansion) in the MFW piping and delay times for containment spray actuation.

In addition to the above information, the referenced letter provided responses to several NRC staff questions (NRC letter dated May 10, 1983) concerning various aspects of our justification for continued operation. Our response did not include the results of our statistical evaluation of the actual strengths of materials used in the Calvert Cliffs containments. We stated that this information would be provided in a followup submittal.

The purpose of this letter is to present this statistical evaluation and to provide you with the final results of our analyses performed in connection with Bulletin 80-04.

The containment pressure analyses included a rigorous evaluation of the feedwater flashing phenomenon using the RELAP Code to generate time-dependent feedwater flows during the steam generator blowdown. This

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evaluation resulted in a calculated reduction in the total integrated feedwater input from approximately 100,300 lbm to about 82,100 lbm. In addition, these analyses utilized a more realistic delay time (44 seconds vice 60 seconds) for actuation of the containment sprays.

The results of the containment pressure analysis are presented in Enclosure 1. For your convenience, we have reiterated the analysis assumptions that were used and have highlighted those assumptions and inputs that have changed since our May 17, 1983, submittal. You will note that the peak containment pressure calculated for this event is 46.8 psig assuming the installation of the automatic MFW system trip. Based on these results, we have determined that no further analyses are necessary to demonstrate the efficacy of the MFW system trip.

Enclosure 2 presents the results of the statistical evaluation performed for the strength of materials used in the containment.

If you should have any questions, please do not hesitate to contact us.

Very truly yours,

A. E. Lundvall, Jr.

AEL/BSM/smn
Enclosures

cc: J. A. Biddison, Jr., Esquire
G. F. Trowbridge, Esquire
Messrs. D. H. Jaffe, NRC
R. E. Architzel, NRC
C. Herrick, Franklin Research Center

MAIN STEAM LINE BREAK
FINAL CONTAINMENT RESPONSE ANALYSIS

Calculation of Main Feedwater Flow

Steam generator depressurization data from the latest available MSLB case was used as input to a detailed analysis of main feedwater flow during steam generator blowdown. The main feedwater transient analysis was performed using the RELAP-5 code, the results of which are shown on Table 1. RELAP-5 explicitly models the effects of MFW flashing (which is terminated when isolation occurs at 80 seconds).

Since this analysis yielded feedwater flowrates that were different than those that were used in the steam generator blowdown/depressurization case mentioned above, the steam generator blowdown and main feedwater transient analyses were reiterated to evaluate the impact on feedwater flowrates. The results of this iteration confirm the validity of the flowrate data shown in Table 1 (integral MFW mass input increased only 2%).

Steam Generator Blowdown Analysis

The SGN III computer code was used to calculate the mass/energy release. This NRC approved code is described in detail in Appendix 6B of CESSAR, "Combustion Engineering Standard Safety Analyses Report," Combustion Engineering, Inc., docketed December 19, 1973 (as amended). The SGN III code was, however, modified to provide a pure steam release, less credit for 20% moisture carryover from the 6.3 ft^2 break.

The analysis assumptions are listed in Table 2. The resulting mass/energy release is given in Table 3 and includes the contribution from the unaffected steam generator (until main steam isolation valve closure). Figures 1 and 2 graphically depict the Table 2 data.

Containment Pressure and Temperature Analysis

The steam generator blowdown data discussed above yielded a peak containment pressure of 46.8 psig at 82 seconds with a peak temperature of 273°F. Except for the assumptions listed below, the containment pressure/temperature analysis used the same methods and assumptions in the 1972 MSLB analysis.

a. Containment Spray

Delay time in initiating containment spray was assumed to be 44 seconds from CSAS trip. This is the result of recent conservative calculations which account for: 1) completely dry spray header; 2) initial control valve actuator pressure of 60 psig; 3) actuator bleed valve flow coefficient; 4) actuator spring constant; 5) spray pump curve; 6) piping friction losses. One test case assuming a 60 second delay was run which resulted in containment pressure increase of only 0.08 psig, therefore, spray time delay has minimal effect (FSAR uses 35 seconds).

b. Off-Site Power

No loss of off-site power is assumed. This is consistent with the assumption of continued operation of the RCPs and feedwater pumps. As a result, no additional time delay was included in starting containment air coolers or spray pumps. (FSAR assumes loss of off-site power.)

c. Containment Heat Sinks

Revised heat sink data was taken from FSAR table 14.16-1. These include more metal and higher cooler duties. The FSAR MSLB used older heat sink data which was more conservative since vendor information and as-built information was not yet available. Table 14-16-1 represents accurate as-built conditions.

TABLE 1

FEEDWATER FLOW DATA

TIME	$\frac{lbm}{Sec}$ M FLOW	$\frac{BTU}{Sec}$ ENERGY IN $X10^5$	LBM INT. MASS	BTU INT. ENERGY $X10^5$
0.0	1650.1	6.9201	0.0	0.0
.1	1672.4	7.0125	166.11	.6966
.2	1697.5	7.1169	334.58	1.403
.3	1725.7	7.2341	505.73	2.12
.4	1755.4	7.3573	679.78	2.85
.5	1785.9	7.4842	856.84	3.59
.6	1814.5	7.6031	1036.9	4.35
.7	1843.3	7.723	1218.7	5.113
.8	1872.0	7.842	1405.5	5.89
.9	1900.7	7.9612	1594.1	6.681
1.0	1929.2	8.08	1785.6	8.296
1.5	2044.0	8.556	1.979.8	1.165
2.0	2135.9	8.937	3825.0	1.602
3.0	2272.5	9.503	6030.9	25.25
4.0	2365.5	9.888	8351.4	34.95
5.0	1878.5	7,851	10,486	43.87
6.0	1360.1	4.941	12,134	50.76
7.0	1043.2	4.359	13,326	55.74
7.5	930.34			
8.0	976.5	4.080	14,275	59.71
9.0	1435.1	5.797	15,514	64.88
10.0	1539.5	6.433	17,008	71.12
11.0	1634.6	6.829	18,600	77.77
12.0	1660.8	6.937	20,250	84.67
13.0	1718.6	7.169	21,973	91.86
14.0	1637.0	7.039	23,679	98.97
15.0	1582.1	6.60	25,313	105.79
16.0	1483.1	6.182	26,845	112.18
17.0	1359.1	5.662	28,262	118.09
18.0	1267.7	6.278	29,574	123.55
19.0	1178.3	4.905	30,792	128.62
20.0	1122.5	4.672	31,941	133.40
25.0	1037.1	4.323	33,039	155.42
30.0	1001.8	4.189	42,327	176.71
35.0	955.72	4.013	47,215	197.18
40.0	899.20	3.802	51,854	216.72
45.0	829.36	3.545	56,179	235.10
50.0	734.09	3.236	60,115	252.06
80.0	734.09	3.236	82,138	349.14

TABLE 2

MSLB - MASS/ENERGY RELEASE ANALYSIS

1972 LICENSING METHODS

ASSUMPTIONS

INITIAL POWER LEVEL	100%
INITIAL STEAM GENERATOR LEVEL	35.06' ABOVE TUBESHEET (NORMAL LEVEL)
INITIAL STEAM GENERATOR INVENTORY	141,425 LBM (ADJUSTED 4.0%)
BREAK TYPE	6.3 FT^2 GUILLOTINE AT S.G. NOZZLE
MASS/ENERGY RELEASE	20% MOISTURE CARRYOVER - RUPTURED S.G.
STEAM SEPARATION RATE MULTIPLIER	100
REACTOR TRIP	ON HIGH CONTAINMENT PRESSURE @ 4.75 PSIG
DECAY HEAT	DECAY HEAT CURVE AFTER REACTOR TRIP
MFIV	0.9 SEC. DELAY + 80 SEC. STEP CLOSURE
MSIV	0.9 SEC. DELAY + 6.0 SEC. LINEAR CLOSURE
S.G. ISOLATION LOGIC	ON HIGH CONTAINMENT PRESSURE (4.75 PSIG) OR LOW S.G. PRESSURE (548 PSIA), WHICHEVER OCCURS FIRST
STEAM HEADER K FACTOR	17. (BASED ON 5.585 FT^2 PIPE)
REACTOR COOLANT PUMPS	REMAIN ON
MAIN FEEDWATER	ENCLOSURE 2
AUXILIARY FEEDWATER	0
WATER IN FEED PIPE (FLASHING)	INCLUDED IN ENCLOSURE 2 DATA UNTIL MFW ISOLATION, THEN 335 CU. FT. AT 441 BTU/LBM
STEAM IN HEADER PIPE	4,000 LBM

MAIN STEAM LINE BREAK - PRELIMINARY MASS/ENERGY RELEASE

TIME	ṁ, lbm/sec	ṁh, million BTU/sec
0.1 sec	16168.	17.78
0.18	15941.	17.53
.26	15714.	17.29
.34	15490.	17.04
.50	15059.	16.57
.66	14652.	16.13
.98	13907.	15.32
1.52	12863.	14.18
2.12	11923.	13.15
2.52	11396.	12.57
3.12	10730.	11.84
3.52	10352.	11.42
4.12	9876.	10.90
4.52	9618.	10.62
5.12	9308.	10.28
5.52	9142.	10.10
6.12	8944.	9.883
6.52	8558.	9.433
7.12	7578.	8.275
7.52	6819.	7.376
8.12	6240.	6.693
8.52	6176.	6.623
10.12	5908.	6.330
11.12	5710.	6.113
12.12	5484.0	5.866
13.12	5245.	5.604
14.12	5010.	5.348
16.12	4601.	4.901
18.12	4301.	4.573
20.12	4091.	4.344
22.12	3932.	4.171
25.12	3691.	3.909
28.12	3434.	3.629
30.12	3276.	3.458
35.12	2950.	3.105
40.12	2624.	2.753
45.12	2306.	2.410
47.12	2182.	2.277
48.72	2097.	2.186
48.92	1808.	1.885
49.12	1813.	1.889
50.52	1729.4	1.801
51.12	1686.	1.756
51.72	1415.	1.469
52.12	1211.	1.255
52.32	1081.	1.119
52.52	1177.	1.255
52.72	963.1	0.9956
52.92	888.3	0.9130
53.12	853.2	0.8810
53.32	937.2	0.9928

53.52	803.7	.8294
53.72	748.2	.7717
54.12	801.7	.8443
64.12	730.0	.760
74.12	740.0	.760
80.32	748.8	.772
82.32	489.	.535
82.72	172.	.185
83.32	36.6	.0398
83.72	7.8	.00978
85.32	4.06	.00487
88.52	1.083	.001306
97.32	2.527	.003032
110.0	0.0	0.0

Mass Integral:

260800.lbm

Energy Integral:

2.792×10^8Btu

FIGURE 1 (PAGE 1 OF 2)
CALVERT CLIFFS UNITS 1 AND 2
MSLB - 6.3 FT^2 GUILLOTINE
1972 LICENSING METHODS

MASS RELEASE RATES

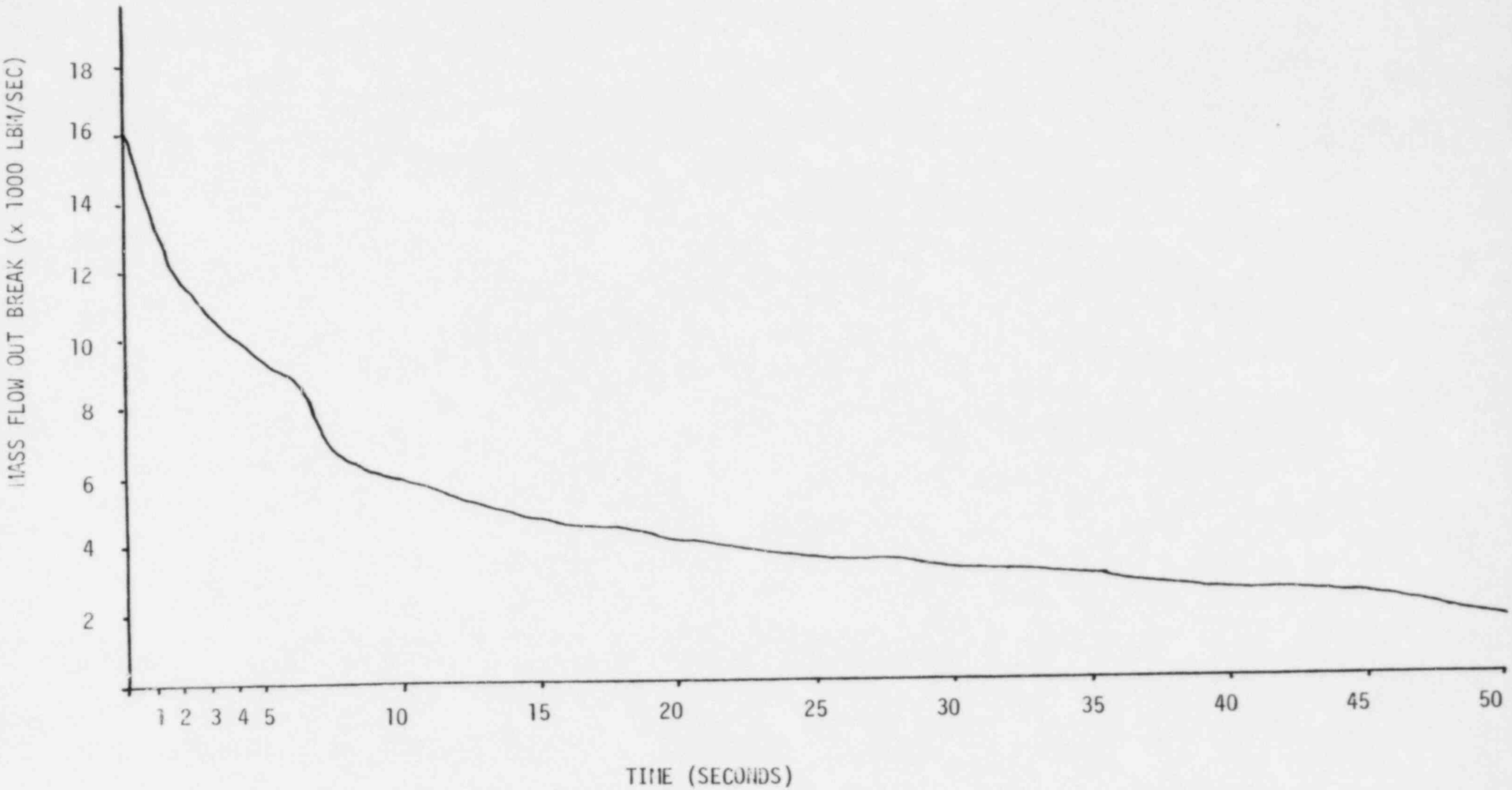


FIGURE 1 (PAGE 2 OF 2)

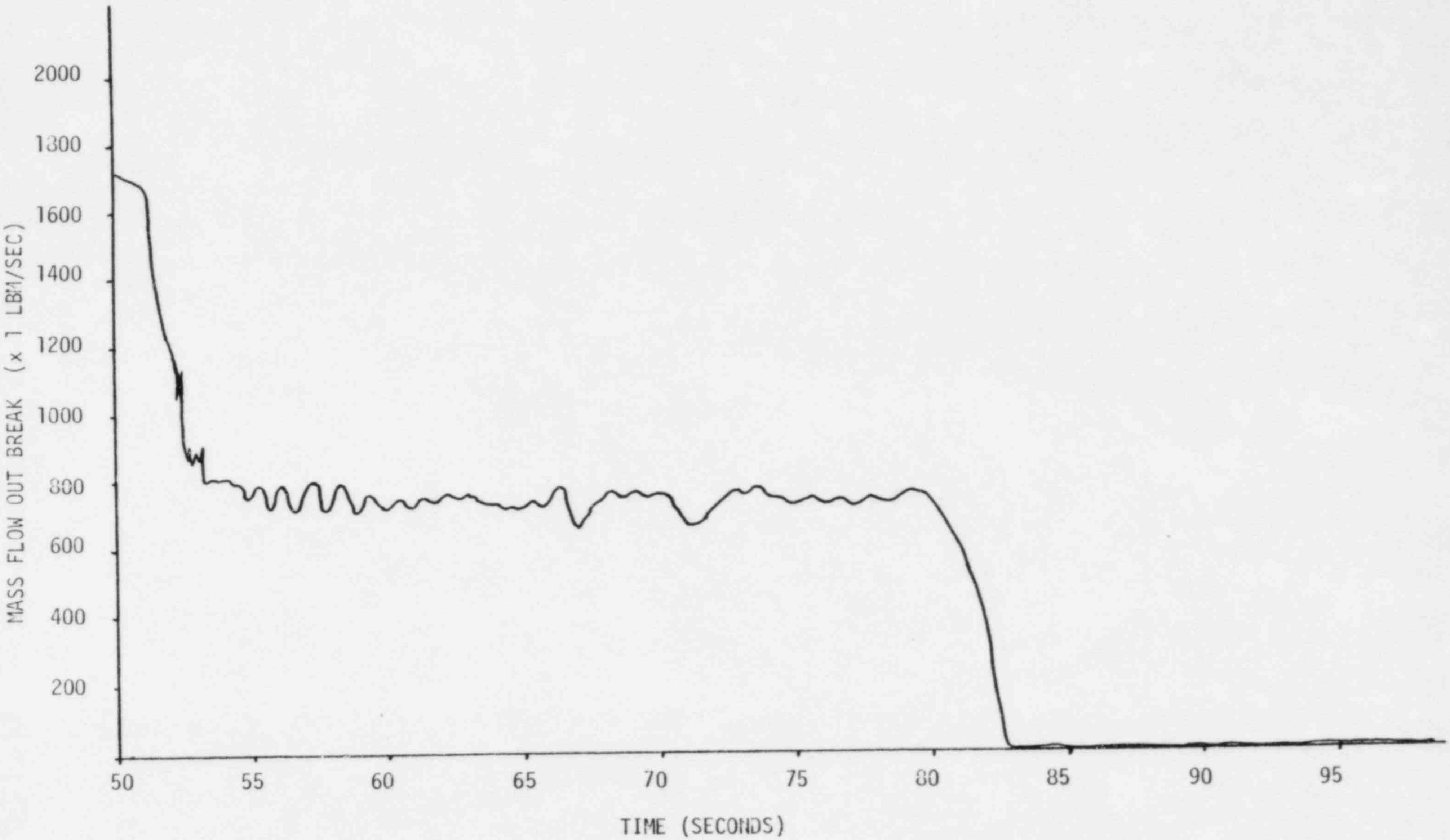


FIGURE 2 (PAGE 1 OF 2)
CALVERT CLIFFS UNITS 1 AND 2
MSLB - 6.3 FT.^{2} GUILLOTINE
1972 LICENSING METHODS

ENERGY RELEASE RATES

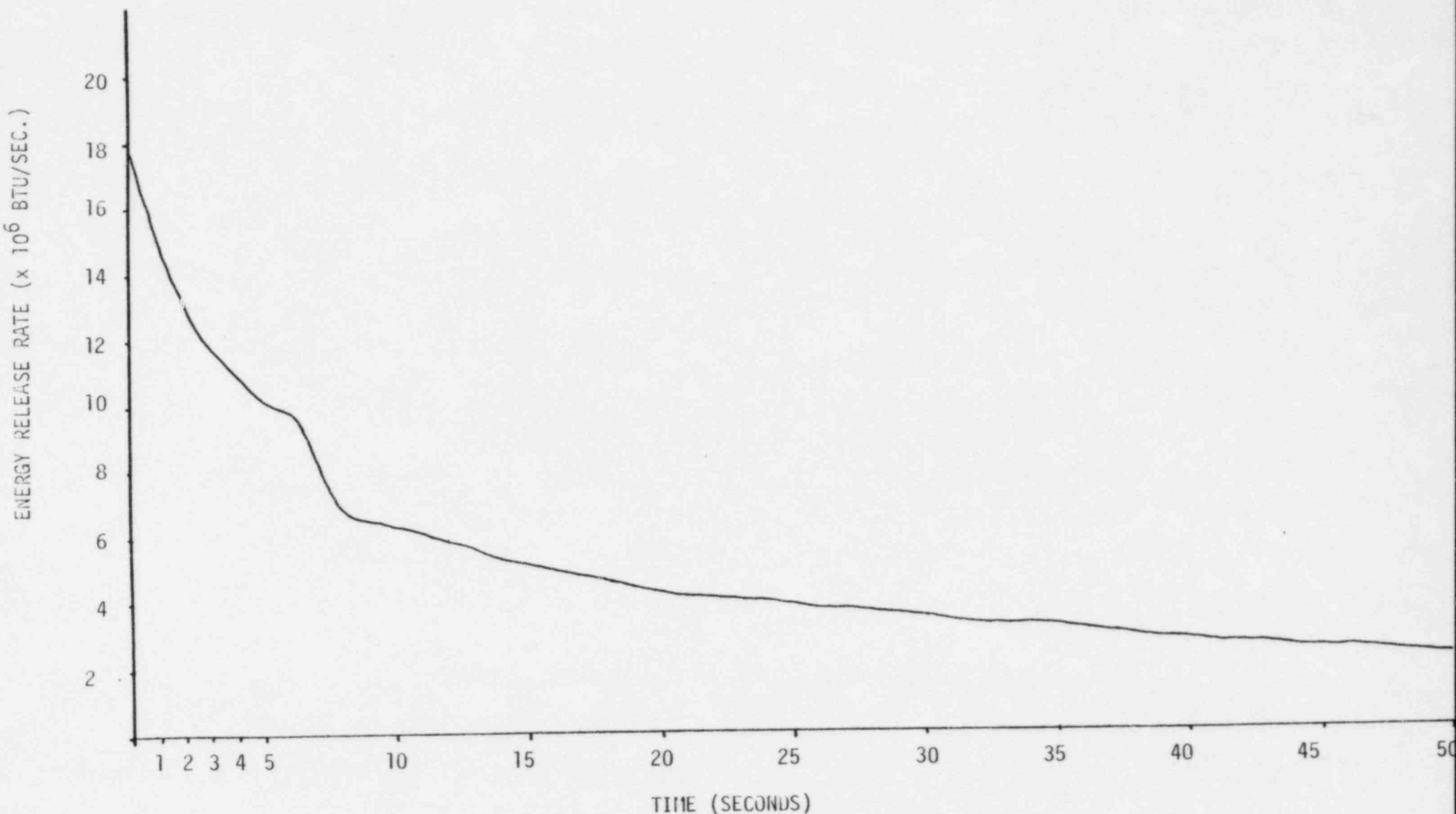
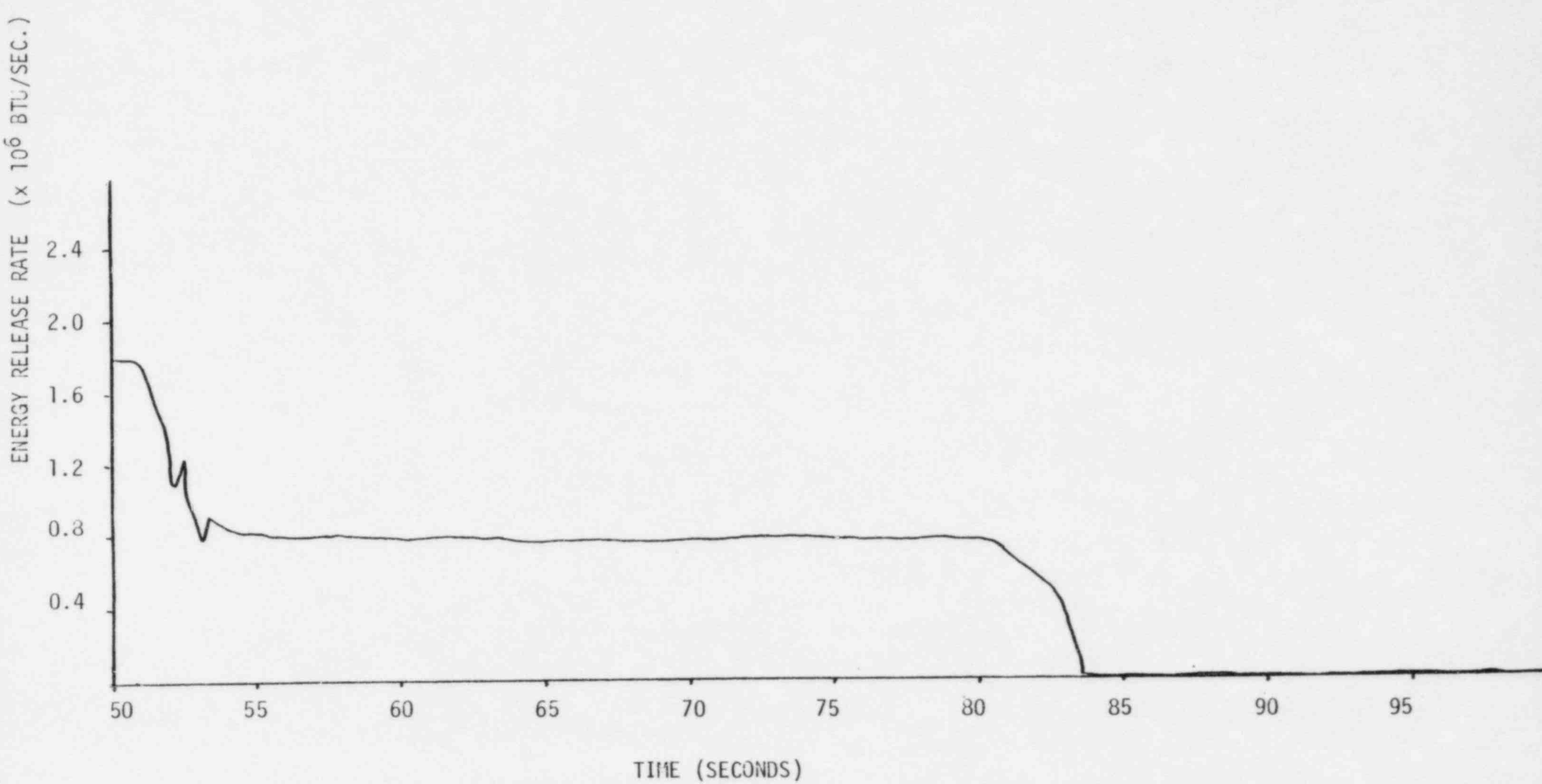


FIGURE 2 (PAGE 2 OF 2)



SUPPLEMENTAL RESPONSE TO
NRC QUESTION NO. 5 DATED 5/10/83

Question No. 5:

You assumed a 20% increase in material strength, it is requested that you make a statistical evaluation of the actual strength of materials used in the construction of the Calvert Cliffs containment and utilized in the design basis capability of the containment.

Response:

A statistical evaluation of the actual strength of materials used in the construction of the Calvert Cliffs containment has been performed. These statistical results indicate that the actual mean of the material strengths based on the sample statistics is approximately 12% higher than the design yield strength of the major reinforcement and 16% higher than the design compressive strength of concrete (at 28 days). The following is a tabulation of the statistical properties of the material strength:

Design Parameter	Description	Design Strength (psi)	No. of Tests n	Mean m (psi)	Standard Deviation σ	Coefficient of Variation ν	(%) Mean Design Strength
f'c	poured 1970	5000	189	5798	338	5.84	16.0
f'c	poured 1971	5000	144	6434	308	4.65	28.7
Fy	#10 bars	60000	58	67239	3481	5.18	12.1
Fy	#11 bars	60000	112	67902	3523	5.19	13.2