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MATHEWS,E.R. Wisconsin Public Service Corp.
RECIP.NAME RECIPIENT AFFILIATION
SCHWENCER,A. Operating Reactors Branch 1

SUBJECT: Forwards Westinghouse reanalysis description,time sequence of events & generic sensitivity study results to document ECCS reanalysis re zirc/water reaction calculation. Calculated peak clad temp does not exceed 2200 F. (see report)

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WISCONSIN PUBLIC SERVICE CORPORATION

P.O. Box 1200, Green Bay, Wisconsin 54305

December 14, 1979

Mr. A. Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Gentlemen:

Docket No. 50-305
Operating License DPR-43
ECCS Reanalysis - Zirc/Water Reaction Calculation

Enclosed please find forty (40) copies of the following documents:

Attachment 1 - LOCA reanalysis description, results, conclusions and references.

Attachment 2 - Time sequence of events by table and figures.

Attachment 3 - Generic Sensitivity Study Results.

This Large Break Loss of Coolant Accident (LOCA) analysis report was prepared by Westinghouse Electric Corporation using the approved "February 1978" ECCS evaluation model. This analysis was performed to factor in a correction to the clad-water heat of reaction and to incorporate other ECCS evaluation model improvements. As discussed in the report conclusions, the effect of Upper Plenum Injection (UPI) was not included in the analysis. The Westinghouse UPI model was presented in a meeting with the NRC staff in September 1979 and the final report was submitted in early December 1979.

The results of the enclosed analysis show that the calculated peak clad temperature does not exceed 2200°F based on a total core peaking factor of 2.27. Currently, we have been restricted by confirming order to a total peaking factor of 2.16 due to the zirc-water reaction. Since the total peaking factor limit of 2.16 does not restrict plant operation, and since the UPI models

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for both Westinghouse and Exxon (current fuel vendors) have not been completed, we are not requesting a Technical Specification Amendment at this time. We will continue to operate with a total peaking factor limit at Kewaunee of 2.16 until such time as the UPI models have been accepted and updated analyses are complete.

Very truly yours,

E.R. Mathews

E. R. Mathews, Vice President
Power Supply & Engineering

snf

Enc.

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LOCA REANALYSIS

The Loss of Coolant Accident (LOCA) has been re-analyzed for Kewaunee. The following information amends the Safety Analysis Report section on Major Reactor Coolant System Pipe Ruptures.

The description of the various aspects of the LOCA analysis is given in WCAP-8339[2]. The individual computer codes which comprise the Westinghouse Emergency Core Cooling System (ECCS) evaluation model are described in detail in separate reports [3-6] along with code modifications specified in references 7, 10, and 11. The analysis presented here was performed with the February 1978 version of the evaluation model which includes modifications delineated in references 12, 13, 14, and 15.

Results

The analysis of the loss of coolant accident is performed at 102 percent of the licensed core power rating. The peak linear power and total core power used in the analysis are given in Table 2. Since there is margin between the value of peak linear power density used in this analysis and the value of the peak linear power density expected during plant operation, the peak clad temperature calculated in this analysis is greater than the maximum clad temperature expected to exist.

Table 1 presents the occurence time for various events throughout the accident transient.

Table 2 presents selected input values and results from the hot fuel rod thermal transient calculation. For these results, the hot spot is defined as the location of maximum peak clad temperatures. That location is specified in Table 14.3-2a for the break analyzed. The location is indicated in feet, which presents elevation above the bottom of the active fuel stack.

Table 3 presents a summary of the various containment systems parameters and structural parameters which were used as input to the COCO computer code [6] used in this analysis.

Tables 4 and 5 present reflood mass and energy releases to the containment, and the broken loop accumulator mass and energy release to the containment, respectively.

The results of several sensitivity studies are reported[8]. These results are for conditions which are not limiting in nature and hence are reported on a generic basis.

Figures 1 through 17 present the transients for the principal parameters for the break sizes analyzed. The following items are noted:

Figures 1 - 3:	Quality, mass velocity and clad heat transfer coefficient for the hotspot and burst locations.
Figures 4 - 6:	Core pressure, break flow, and core pressure drop. The break flow is the sum of the flowrates from both ends of the guillotine break. The core pressure drop is taken as the pressure just before the core inlet to the pressure just beyond the core outlet.
Figures 7 - 9:	Clad temperature, fluid temperature and core flow. The clad and fluid temperatures are for the hot spot and burst locations.
Figures 10 - 11:	Downcomer and core water level during reflood, and flooding rate.
Figures 12 - 13:	Emergency core cooling system flowrates, for both accumulator and pumped safety injection.
Figures 14 - 15:	Containment pressure and core power transients.
Figures 16 - 17:	Break energy release during blowdown and the containment wall condensing heat transfer coefficient for the worst break.

Conclusions - Thermal Analysis

For breaks up to and including the double ended severance of a reactor coolant pipe, the Emergency Core Cooling System will meet the Acceptance Criteria as presented in 10CFR50.46 [1]. That is:

1. The calculated peak clad temperature does not exceed 2200°F based on a total core peaking factor of 2.27.

2. The amount of fuel element cladding that reacts chemically with water or steam does not exceed 1 percent of the total amount of Zircalloy in the reactor.

3. The clad temperature transient is terminated at a time when the core geometry is still amenable to cooling. The cladding oxidation limits of 17% are not exceeded during or after quenching.

4. The core temperature is reduced and decay heat is removed for an extended period of time, as required by the long-lived radioactivity remaining in the core.

The effects of upper plenum injection were dismissed with the staff[16-20]. The modeling of upper plenum injection has been shown to be a benefit for the Kewaunee Plant per the above references. Westinghouse is currently developing a model for 2 loop plants. However, this model has not been completed, thus the results presented herein represent a conservative analysis without explicit modeling of upper plenum injections.

Attached in Appendix A, are the results of a generic sensitivity study for a typical 2-loop plant with 14 x 14 fuel. This sensitivity study was performed to demonstrate that the limiting break does not change due to a correction in the metal-water heat of reaction calculation which is included in the February 1978 version of the Westinghouse ECCS evaluation model. The results of this generic sensitivity study show that the limiting break for Westinghouse plants of this type is a double-ended cold leg guillotine with a discharge coefficient of 0.4. Since this agrees with past sensitivity studies [8,9] only the limiting break for Kewaunee is printed here.

References for Section 15.4.1

1. "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Cooled Nuclear Power Reactors", 10CFR50.46 and Appendix K of 10CFR50.46. Federal Register, Volume 39, Number 3, January 4, 1974.

2. Bordelon, F.M., Massie, H.W., and Zordan, T.A., "Westinghouse ECCS Evaluation Model-Summary", WCAP-8339, July 1974.

3. Bordelon, F.M., et al., "SATAN-VI Program: Comprehensive Space-Time Dependent Analysis of Loss-of-Coolant", WCAP-8302 (Proprietary Version), WCAP-8306 (Non-Proprietary Version), June 1974.

4. Bordelon, F.M., et al., "LOCTA-IV Program: Loss-of-Coolant Transient Analysis", WCAP-8301 (Proprietary Version), WCAP-8305 (Non-Proprietary Version), June 1974.

5. Kelly, R.D., et al., "Calculational Model for Core Reflooding after a Loss-of-Coolant Accident (WREFLOOD Code)". WCAP-8170 (Proprietary Version), WCAP-8171 (Non-Proprietary Version), June 1974.

6. Bordelon, F.M., and Murphy E.T., "Containment Pressure Analysis Code (COCO)", WCAP-8327 (Proprietary Version), WCAP-8326 (Non-Proprietary Version), June 1974.

7. Bordelon, F.M., et al., "The Westinghouse ECCS Evaulation Model: Supplementary Information", WCAP-8471 (Proprietary Version), WCAP-8472 (Non-Proprietary Version), January 1975.

8. Salvatori, R., "Westinghouse ECCS - Plant Sensitivity Studies", WCAP-8340 (Proprietary Version), WCAP-8356 (Non-Proprietary Version), July 1974.

9. Delsignore T., et al., "Westinghouse ECCS Two-Loop Sensitivity Studies (14 x 14)", WCAP 8854, (Non-Proprietary Version), September 1976.

10. "Westinghouse ECCS Evaluation Model, October, 1975 Versions", WCAP-8622 (Proprietary Version), WCAP-8623 (Non-Proprietary Version), November, 1975.

11. Letter from C. Eicheldinger of Westinghouse Electric Corporation to D.B. Vassalo of the Nuclear Regulatory Commission, letter number NS-CE-924, January 23, 1976.

12. Kelly, R.D., Thompson, C.M., et al., "Westinghouse Emergency Core Cooling System Evaluation Model for Analyzing Large LOCA's During Operation with One Loop Out of Service for Plants without Loop Isolation Valves", WCAP-9166, February, 1978.

13. Eicheldinger, C., "Westinghouse ECCS Evaluation Model, February 1978 Version", WCAP-9220 (Proprietary Version), WCAP-9221 (Non-Proprietary Version), February, 1978.

14. Letter from T.M. Anderson of Westinghouse Electric Corporation to John Stolz of the Nuclear Regulatory Commission, letter number NS-TMA-1830, June, 1978.

15. Letter from T.M. Anderson of Westinghouse Electric Corporation to John Stolz of the Nuclear Regulatory Commission, letter number NS-TMA-1834, June 20, 1978.

16. "Safety Evaluation Report on ECCS Evaluation Model for Westinghouse Two-Loop Plants", November, 1977.

17.* Letter from R. L. Kelly of Westinghouse Electric Corporation to C.W. Giesler of Wisconsin Public Service Corp., letter number WPS-78-2, February 24, 1978.

18. "NRC Questions Regarding the 1/16/78 Submittal by Westinghouse Designed Two-Loop Plant Operators", February 1, 1978.

19. Refer to Reference 17.

* Wisconsin Public Service Corporation should supply the proper references which were formally transmitted to the NRC.

20. "Safety Evaluation Report on Interim ECCS Evaluation model for Westinghouse Two-Loop Plants", March 1978.

TABLE 1

LARGE BREAK - TIME SEQUENCE OF EVENTS

EVENT	OCCURRENCE TIME (SECONDS)		
	DECLG, C_D = 0.4	DECLG, C_D = _____	DECLG, C_D = _____
Accident Initiation	0.0	0.0	0.0
Reactor Trip Signal	.56		
Safety Injection Signal	.65		
Start Accumulator Injection	10.1		
End of ECC Bypass	19.88		
End of Blowdown	19.88		
Bottom of Core Recovery	32.8		
Accumuators Empty	42.0		
Start Pumped ECC Injection	25.65		

LARGE BREAK - ANALYSIS INPUT AND RESULTS

Quantities in the Calculations:

Licensed Core Power Rating	102% of 1650 MWt
Total Core Peaking Factor	2.27
Peak Linear Power	102% of 14.2 kw/ft
Accumulator Water Volume	1250 cubic feet per tank
Accumulator Pressure	700 PSIA
Number of Safety Injection Pumps Operating	2
Steam Generator Tube Plugging Level	1 percent (uniform)
Fuel Parameters - Cycle Generic	Region Generic

Results

	DECLG, C_D = 0.4	DECLG, C_D = ____	DECLG, C_D = ____
Peak Clad Temperature (°F)	2198	____	____
Location (feet)	7.5	____	____
Maximum Local Clad/Water Reaction (%)	8.2	____	____
Location (feet)	7.5	____	____
Total Core Clad/Water Reaction (%)	<0.3	____	____
Hot Rod Burst Time (seconds)	26.2	____	____
Location (feet)	6.0	____	____

TABLE 3

DRY CONTAINMENT DATA

NET FREE VOLUME	1.37×10^6 ft^3
INITIAL CONDITIONS	
Pressure	14.7 psia
Temperature	90°F
RWST Temperature	70°F
Service Water Temperature	32°F
Outside Temperature	-20°F
SPRAY SYSTEM	
Number of Pumps Operating	2
Runout Flow Rate	1600 gpm/each
Actuation Time	15 sec
SAFEGUARDS FAN COOLERS	
Number of Fan Coolers Operating	4
Fastest Post-Accident Initiation of Fan Coolers	15 sec

STRUCTURAL HEAT SINKS

Thickness (in.)	Area (ft.^{2})
1.5 steel	26381
.75 steel	17318
.25 steel/12 concrete	7860
1.5 steel	17823
.75 steel	9877
.375 steel	6800
.5 steel	44000
.75 steel	4823
.25 steel	32000
.1875 steel	35125
.09 steel	12400
.144 steel	1695
.1 steel	6000
1.44 steel	2200
12 concrete	3400
12 concrete	37400
6 concrete	19700
6 concrete	5300
3 concrete	2370
3 concrete	5200

TABLE 3 (Contd.)

PAINTED SURFACES

Thickness (in.)	Minimum Painted Area (ft.^{2})	Paint Thickness (mils)
	26381	7 (on steel)
	17318	11 (on steel)
	17823	11 (on steel)
	9877	3 (on steel)
	37400	8 (on concrete)
	5300	8 (on concrete)
	5200	8 (on concrete)

TABLE 4

REFLOOD MASS AND ENERGY RELEASES

Time (sec.)	Mass Flow (lb./sec.)	Energy Flow (BTU/sec.)
33.3	.002	3.03
37.9	34.3	44240
46.8	151.9	90167
61.1	227.3	104198
79.0	238.1	102042
99.4	243.2	99493
121.9	247.1	96794
173.1	254.2	91081
235.1	261.8	84995

TABLE 5

BROKEN LOOP ACCUMULATOR MASS AND ENERGY RELEASE

Time (sec.)	Mass Flow (lb./sec.)	Energy Flow (BTU/sec.)
0.	4876.356	292044.975
1.010	4527.087	271127.262
2.010	4248.180	254423.486
3.010	4017.422	240603.419
4.010	3823.387	228982.659
5.010	3656.604	218994.021
6.010	3509.887	210207.162
7.010	3379.125	202375.818
8.010	3261.112	195307.971
9.010	3154.399	188916.954
10.010	3058.012	183144.325
11.010	2970.315	177892.167
12.010	2890.075	173086.580
13.010	2815.948	168647.149
14.010	2747.294	164535.424
15.010	2683.841	160735.264
16.010	2626.158	157280.625
17.010	2573.196	154108.712
18.010	2524.328	151182.018
19.010	2479.053	148470.500
20.042	2451.864	146842.145
20.048	2451.822	146839.624
20.088	2450.306	146748.842
20.218	2444.885	146424.134
20.218	2444.885	146424.134
20.289	2441.946	146248.122
20.489	2433.716	145755.232
20.689	2425.573	145267.540
20.889	2417.489	144783.439
21.089	2409.483	144303.936
21.289	2401.555	143829.137
21.489	2393.713	143359.477
21.689	2385.960	142895.119
21.889	2378.256	142433.755
22.089	2370.630	141977.018
22.289	2363.076	141524.633
22.489	2355.600	141076.881
22.649	2349.677	140722.131
22.659	2349.308	140700.061
23.159	2329.378	139506.464
23.659	2309.915	138340.831
24.159	2290.900	137202.020
24.659	2272.315	136088.954
25.159	2254.143	135000.619
25.659	2236.368	133936.054

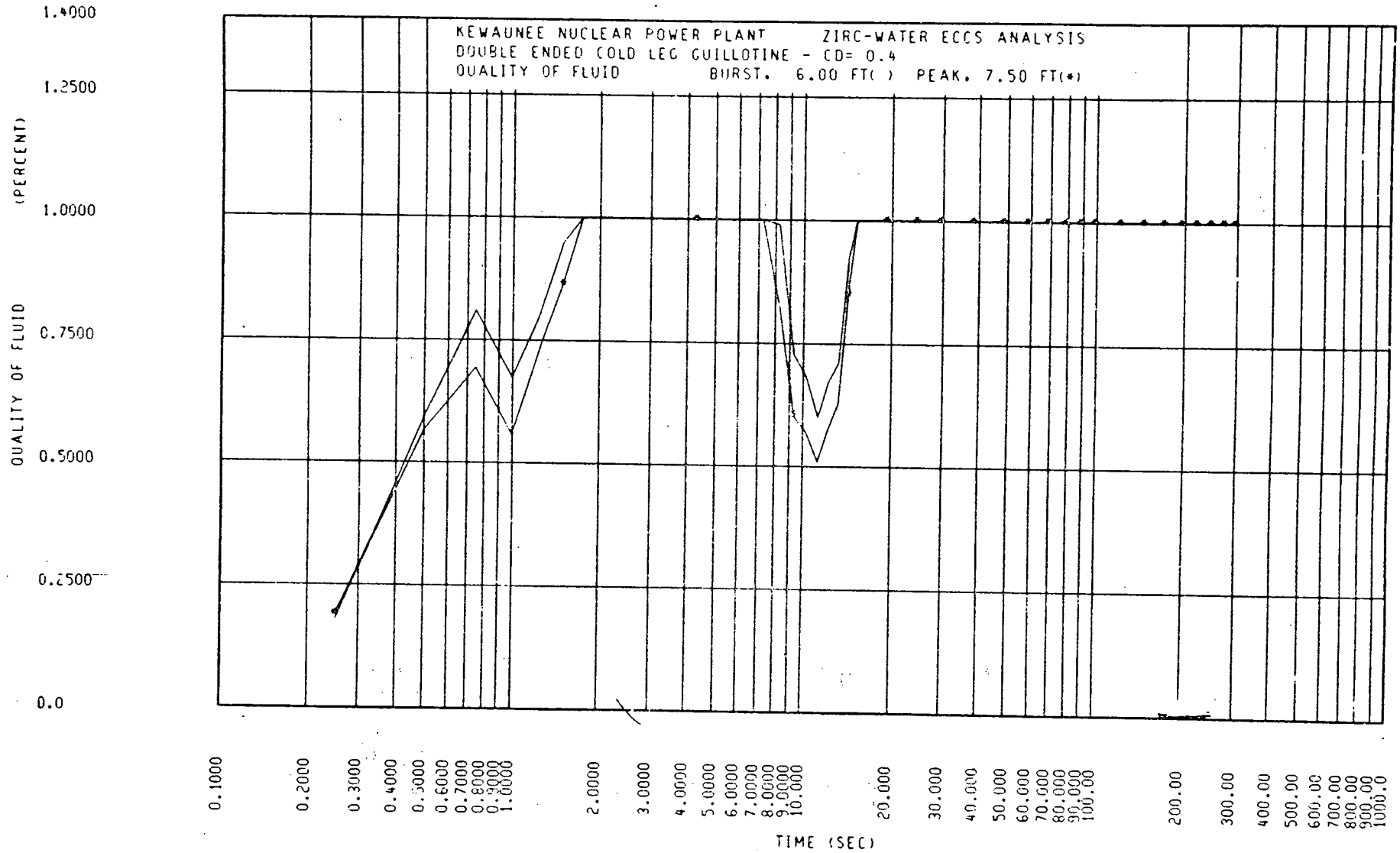

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
QUALITY OF FLUID BURST. 6.00 FT( ) PEAK. 7.50 FT(*)
QUALITY OF FLUID (PERCENT)
1.4000
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
0.8000
0.9000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.0
TIME (SEC)

FIGURE 1

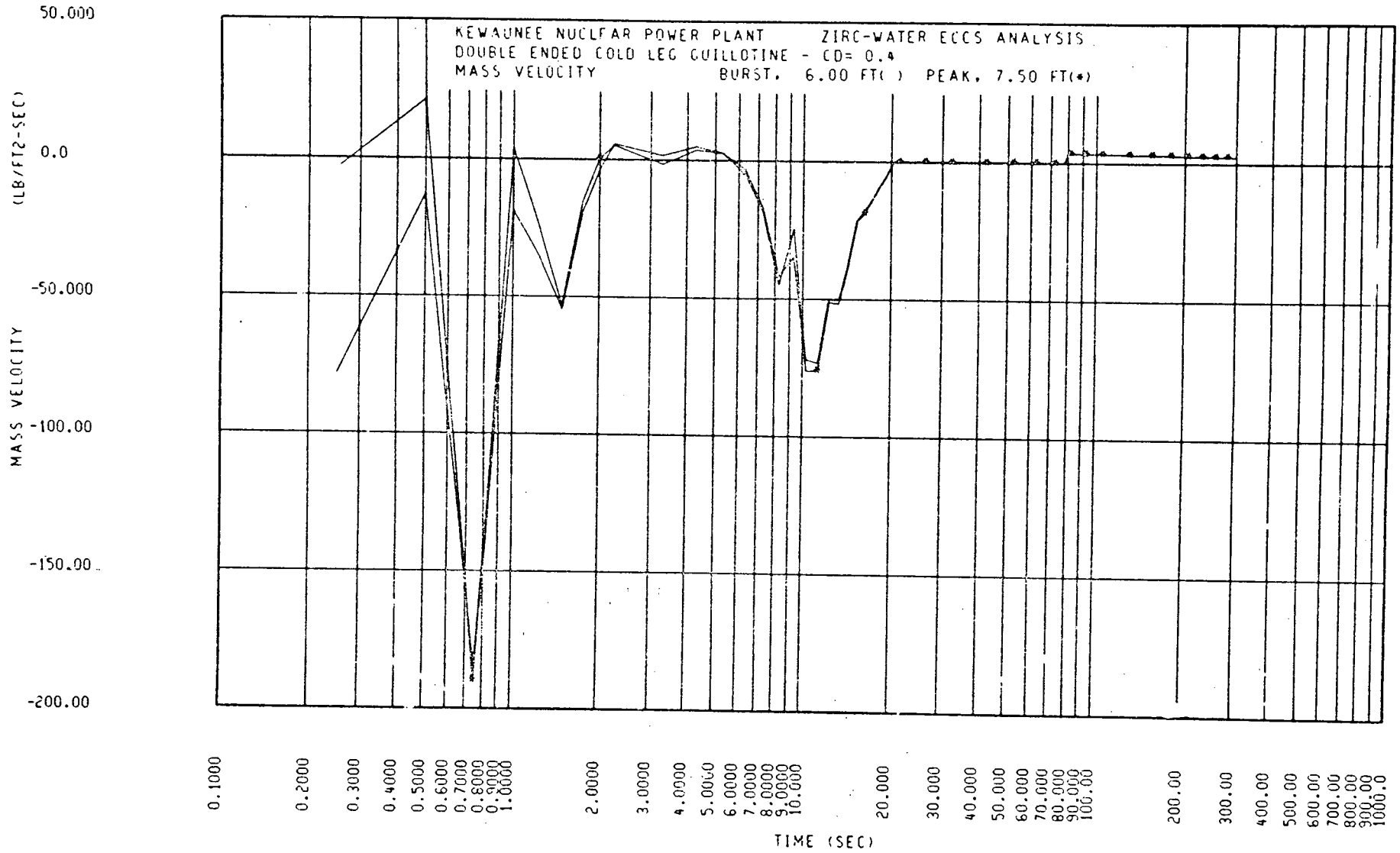

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
MASS VELOCITY BURST, 6.00 FT( ) PEAK, 7.50 FT(*)
MASS VELOCITY (LB/FT2-SEC)
50.000
0.0
-50.000
-100.00
-150.00
-200.00
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
0.8000
0.9000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.0
TIME (SEC)

FIGURE 2

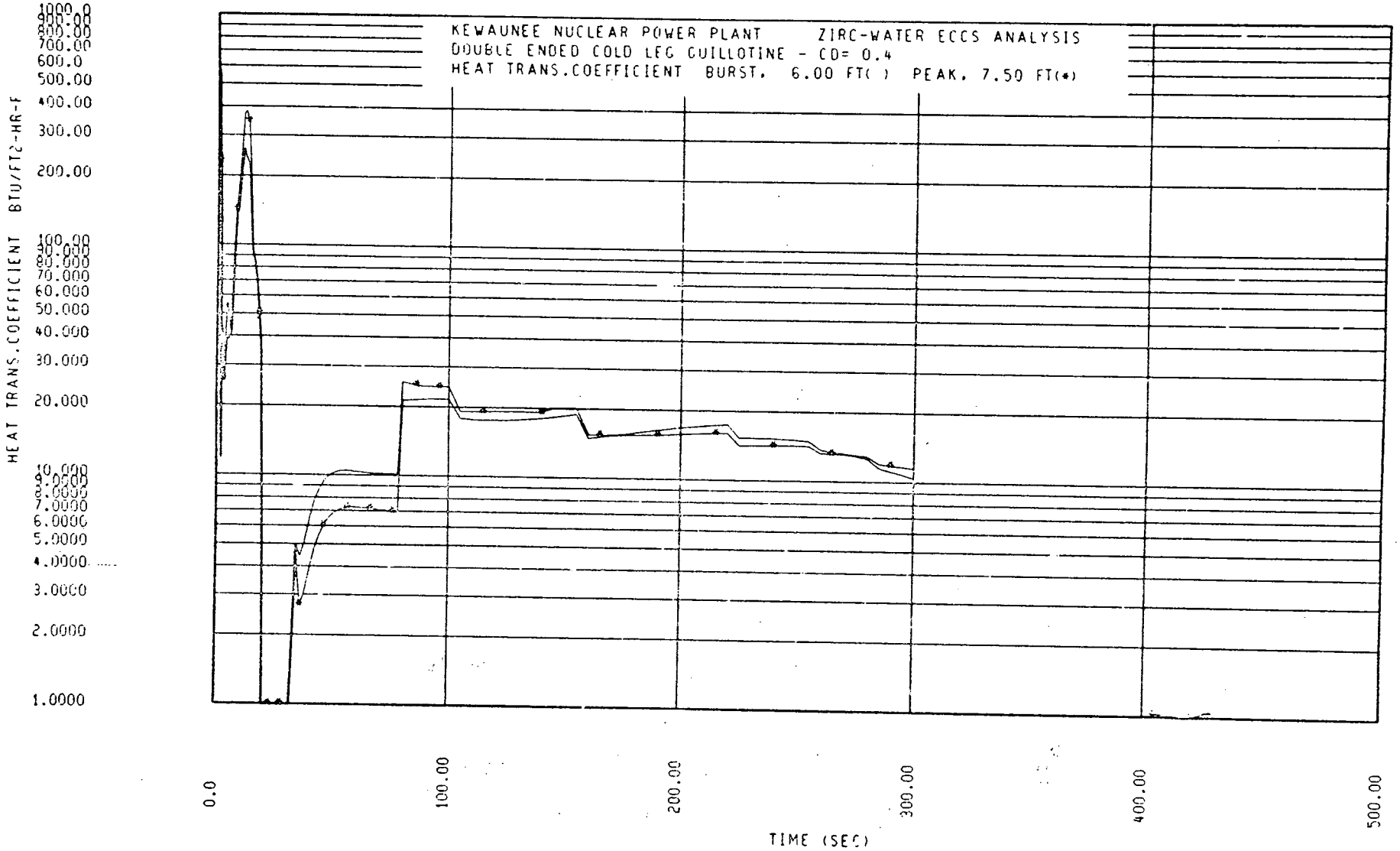

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
HEAT TRANS.COEFFICIENT BURST. 6.00 FT( ) PEAK. 7.50 FT(*)
HEAT TRANS.COEFFICIENT BTU/FT2-HR-F
1000.0
900.00
800.00
700.00
600.0
500.00
400.00
300.00
200.00
100.00
90.000
80.000
70.000
60.000
50.000
40.000
30.000
20.000
10.000
9.0000
8.0000
7.0000
6.0000
5.0000
4.0000
3.0000
2.0000
1.0000
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 3

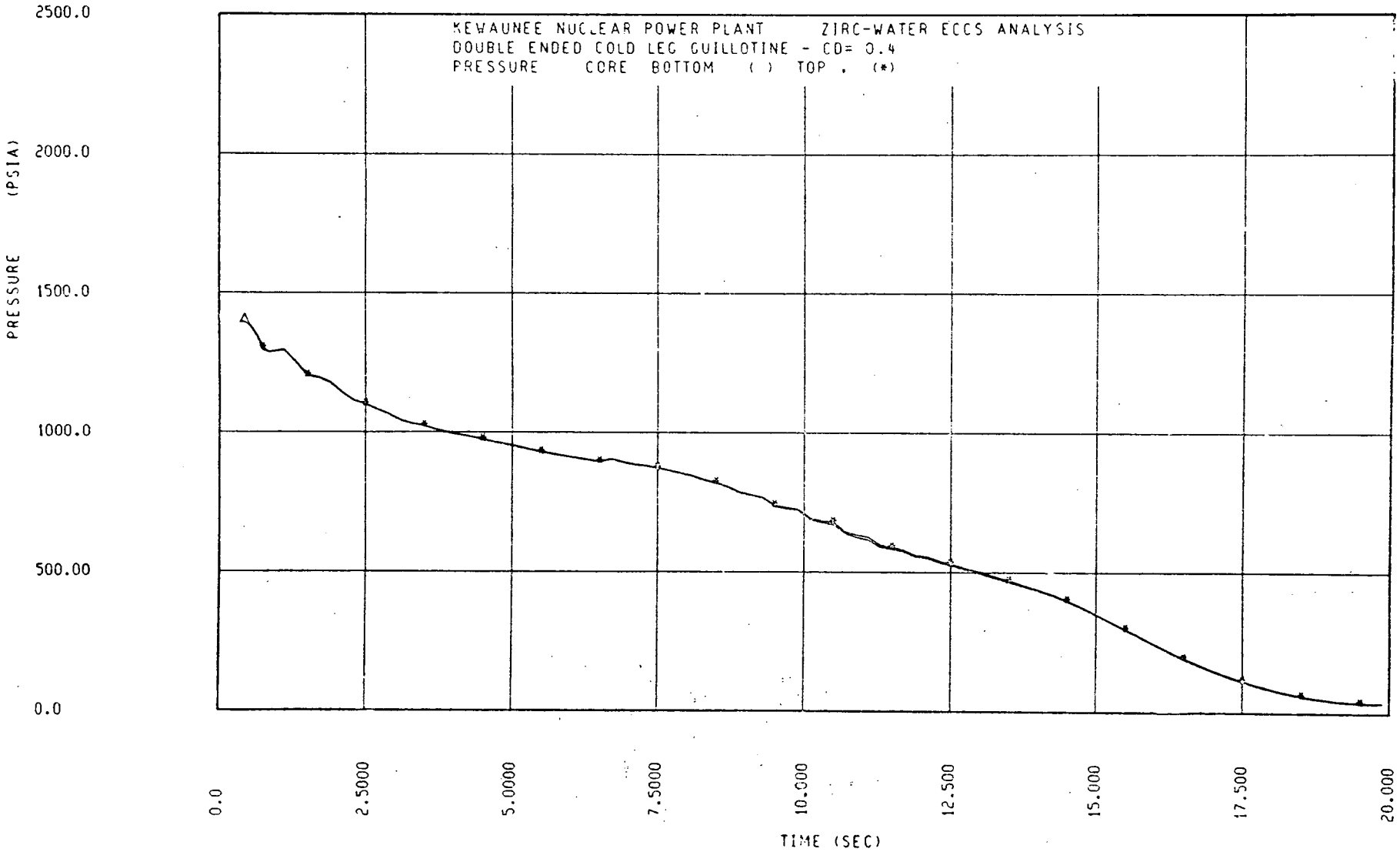

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
PRESSURE CORE BOTTOM ( ) TOP , (*)
PRESSURE (PSIA)
2500.0
2000.0
1500.0
1000.0
500.00
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 4

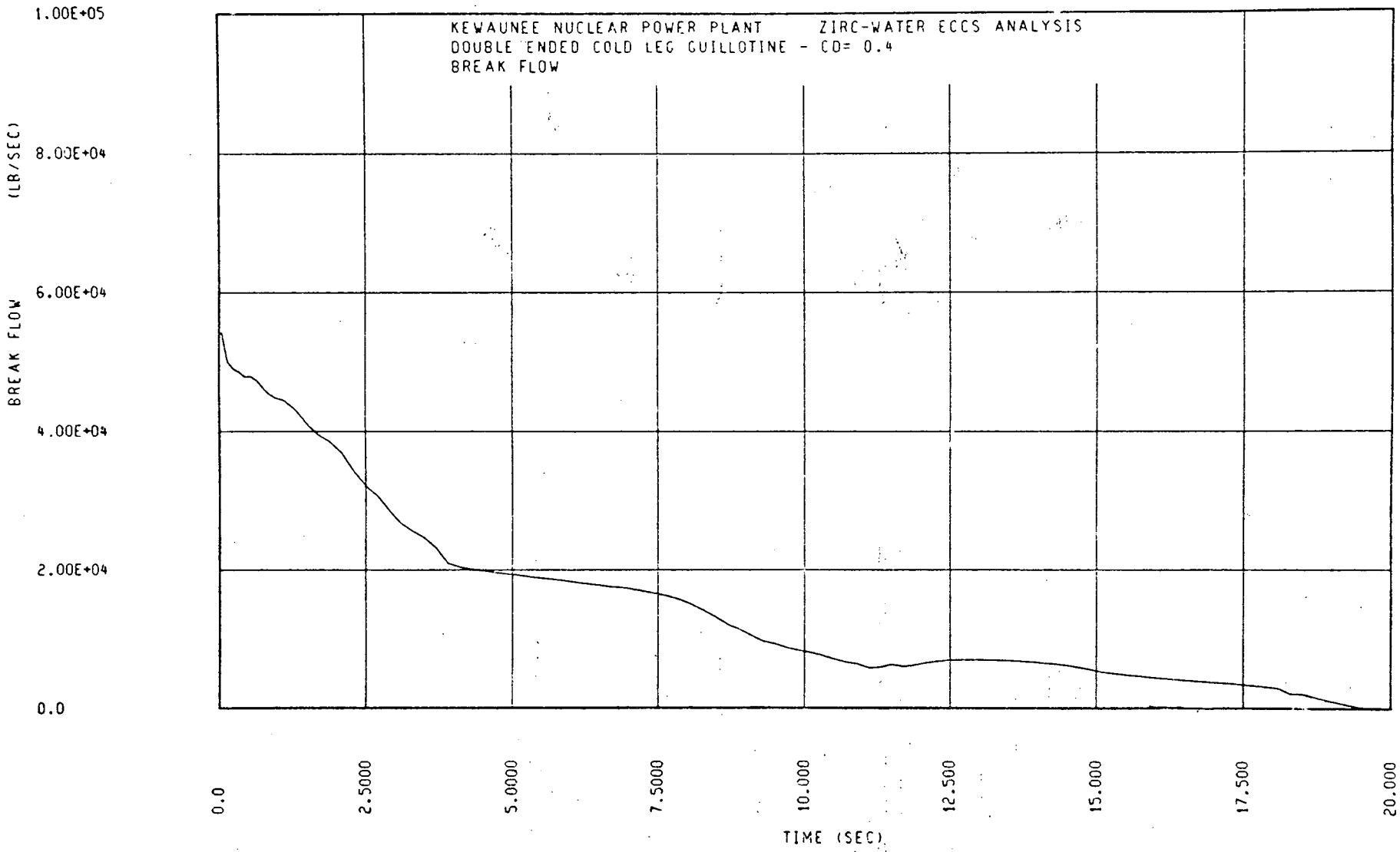

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
BREAK FLOW
BREAK FLOW (LB/SEC)
1.00E+05
8.00E+04
6.00E+04
4.00E+04
2.00E+04
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 5

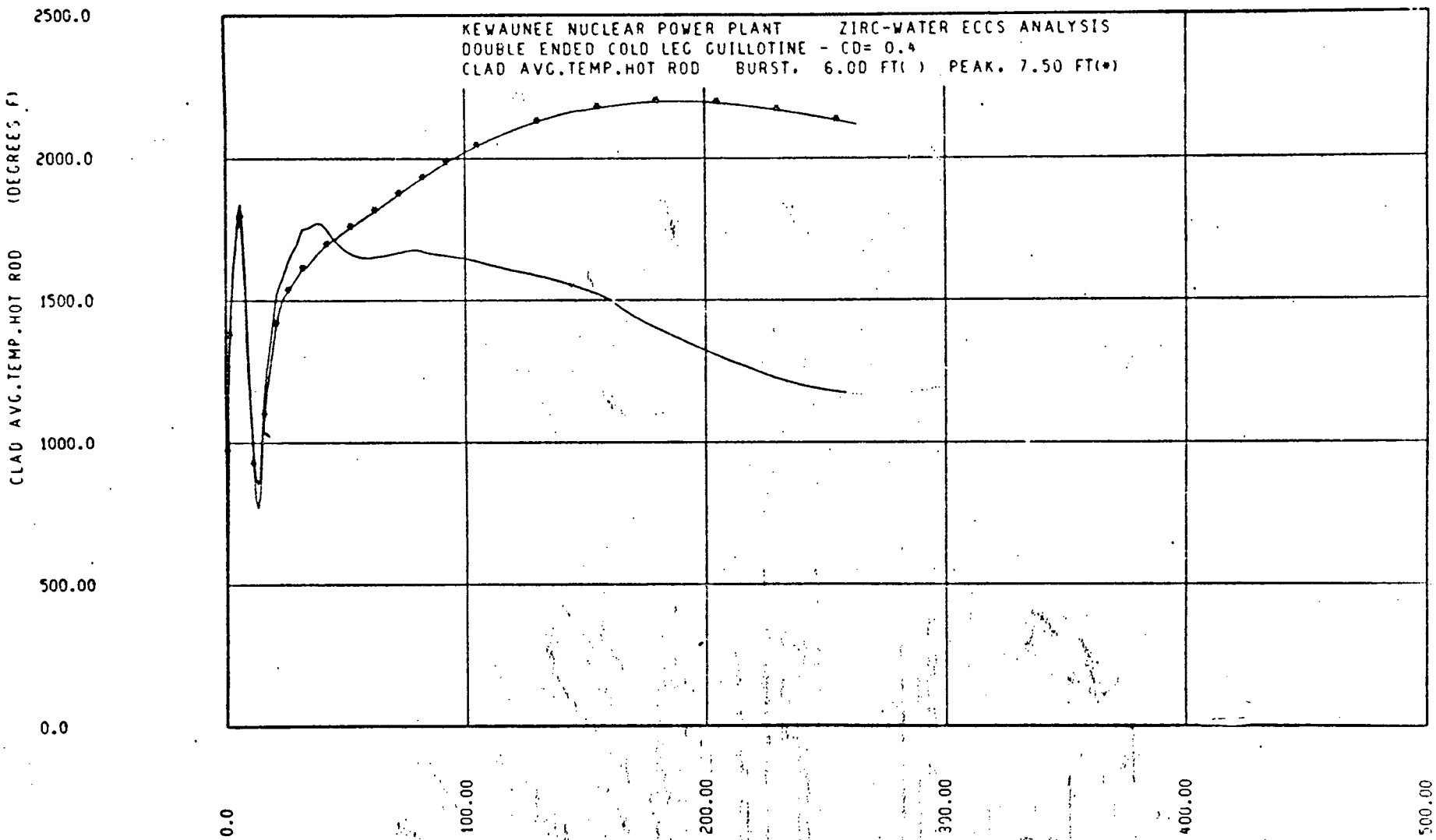

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
CLAD AVG.TEMP.HOT ROD BURST. 6.00 FT( ) PEAK. 7.50 FT(*)
CLAD AVG.TEMP.HOT ROD (DEGREES F)
2500.0
2000.0
1500.0
1000.0
500.00
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 7

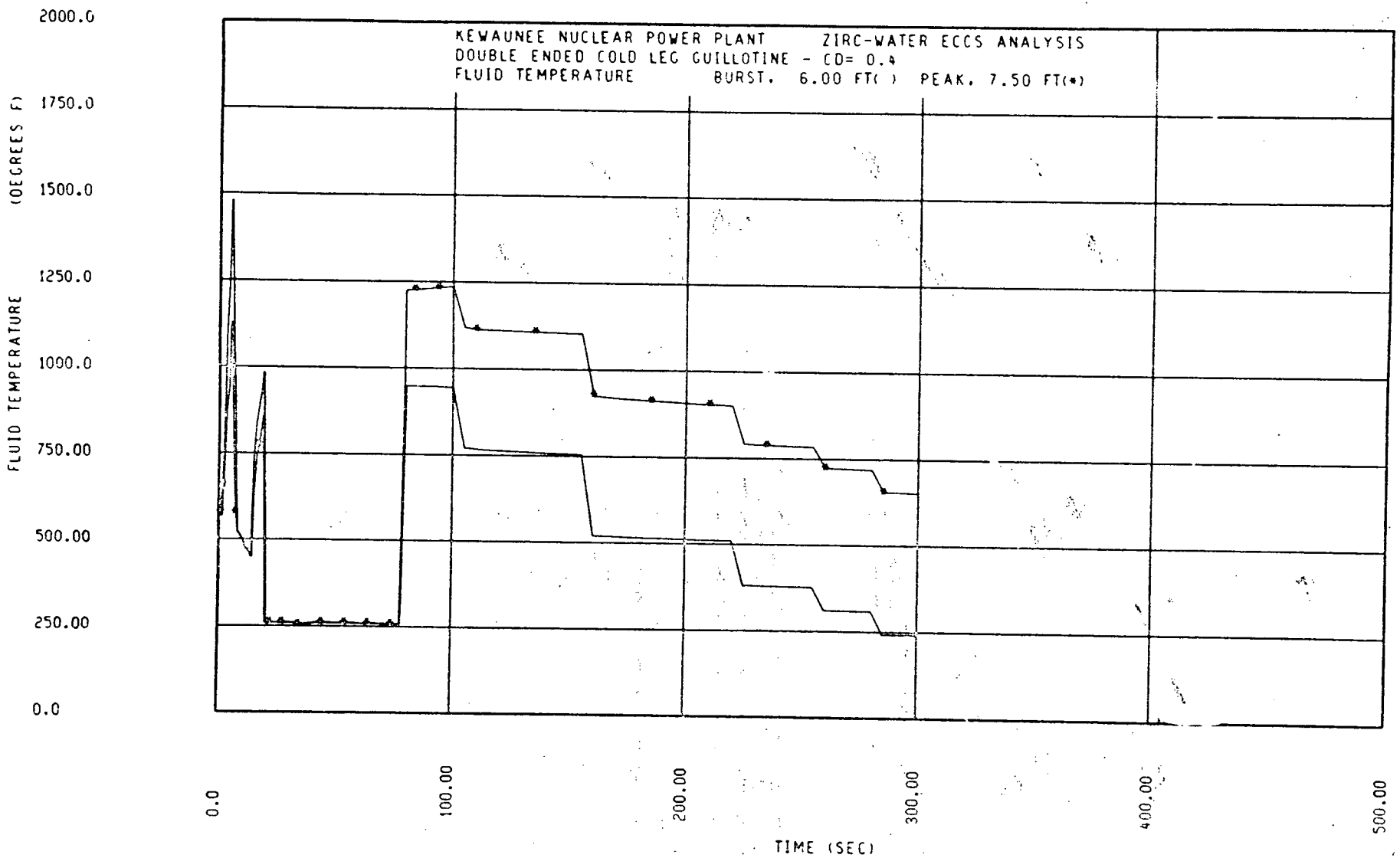

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
FLUID TEMPERATURE BURST. 6.00 FT( ) PEAK. 7.50 FT(*)
FLUID TEMPERATURE (DEGREES F)
2000.0
1750.0
1500.0
1250.0
1000.0
750.00
500.00
250.00
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 8

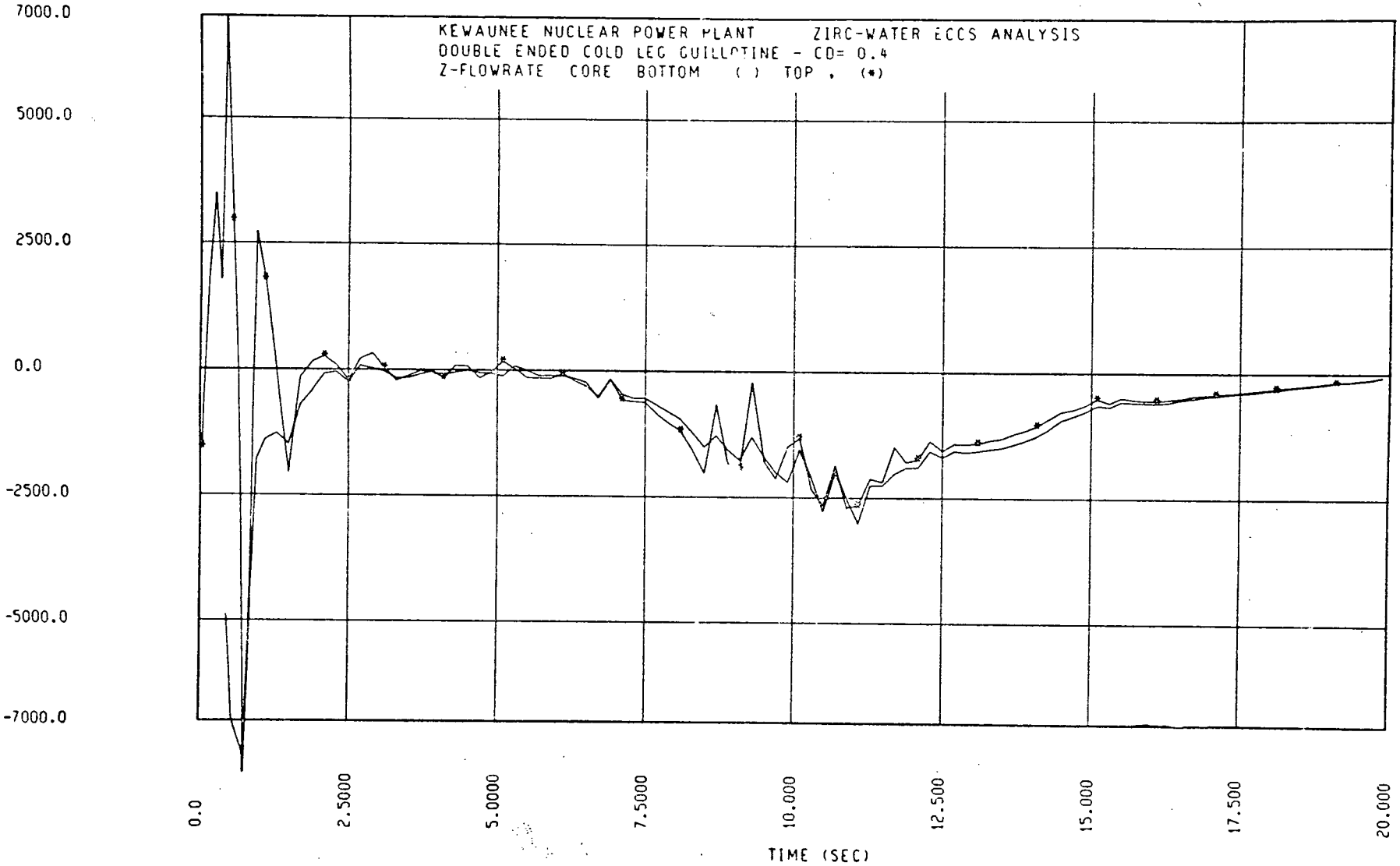

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
Z-FLOWRATE CORE BOTTOM ( ) TOP , (*)
7000.0
5000.0
2500.0
0.0
-2500.0
-5000.0
-7000.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 9

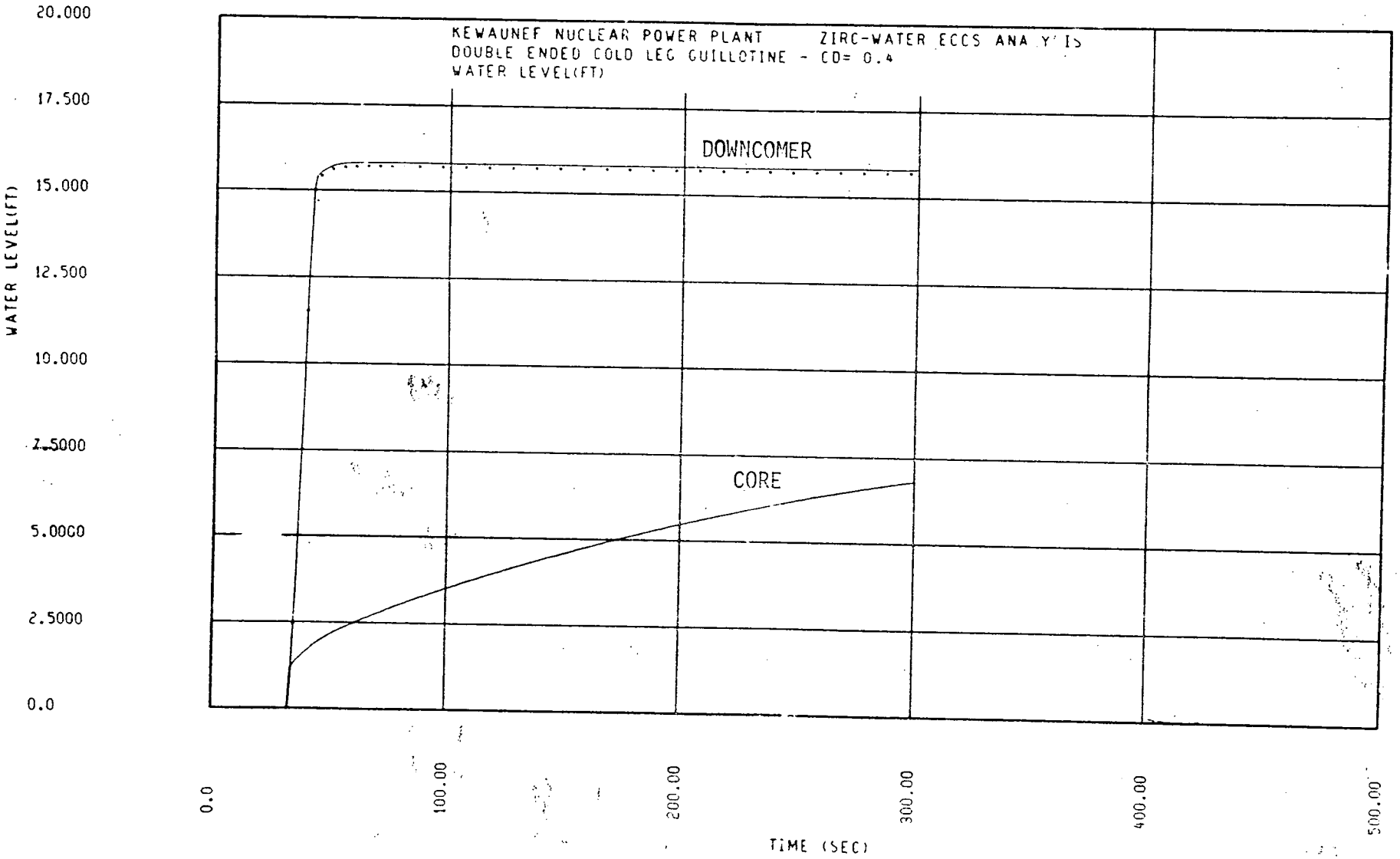

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
WATER LEVEL(FT)
DOWNCOMER
CORE
WATER LEVEL(FT)
20.000
17.500
15.000
12.500
10.000
7.5000
5.0000
2.5000
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 10

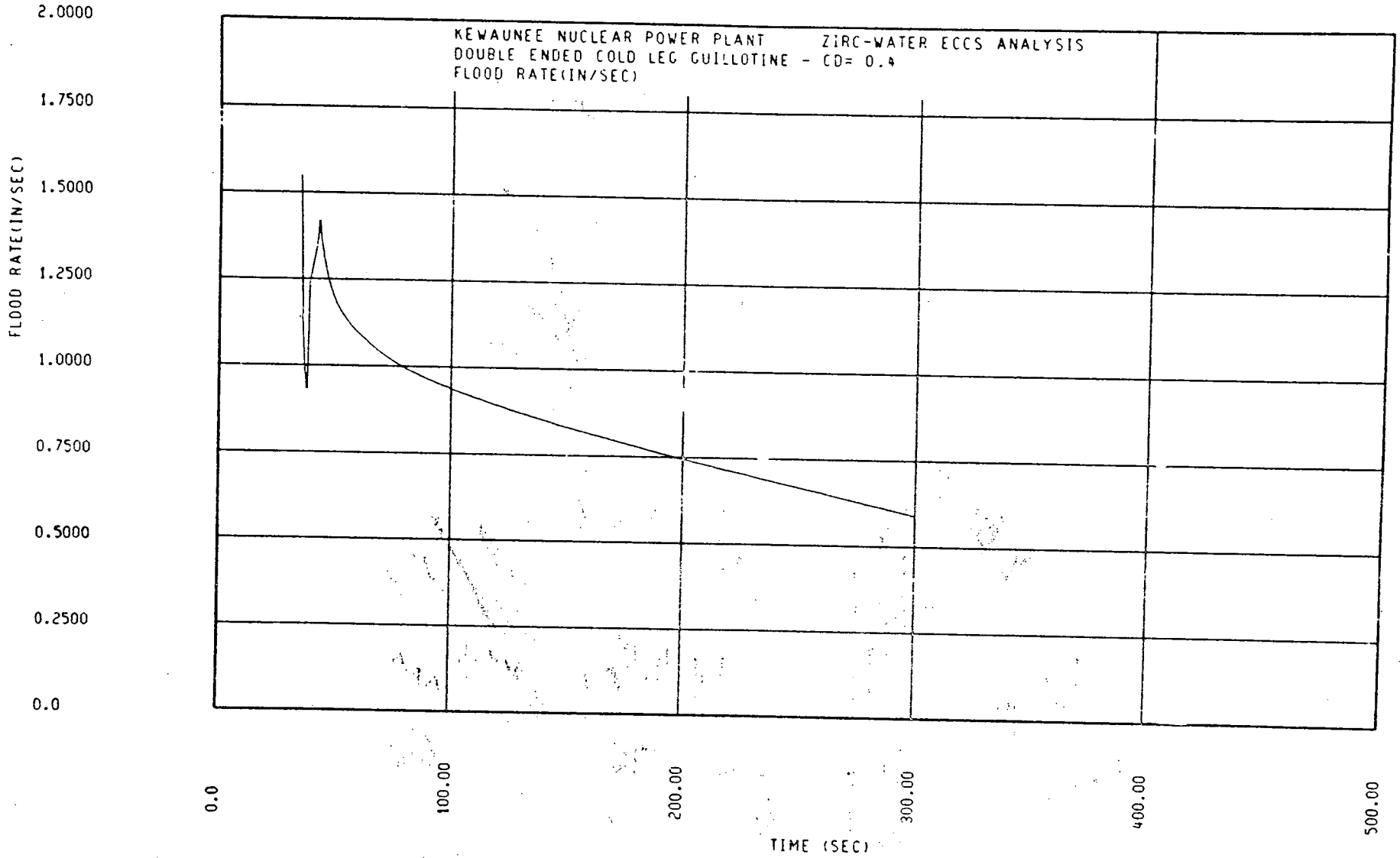

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
FLOOD RATE(IN/SEC)
FLOOD RATE(IN/SEC)
2.0000
1.7500
1.5000
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 11

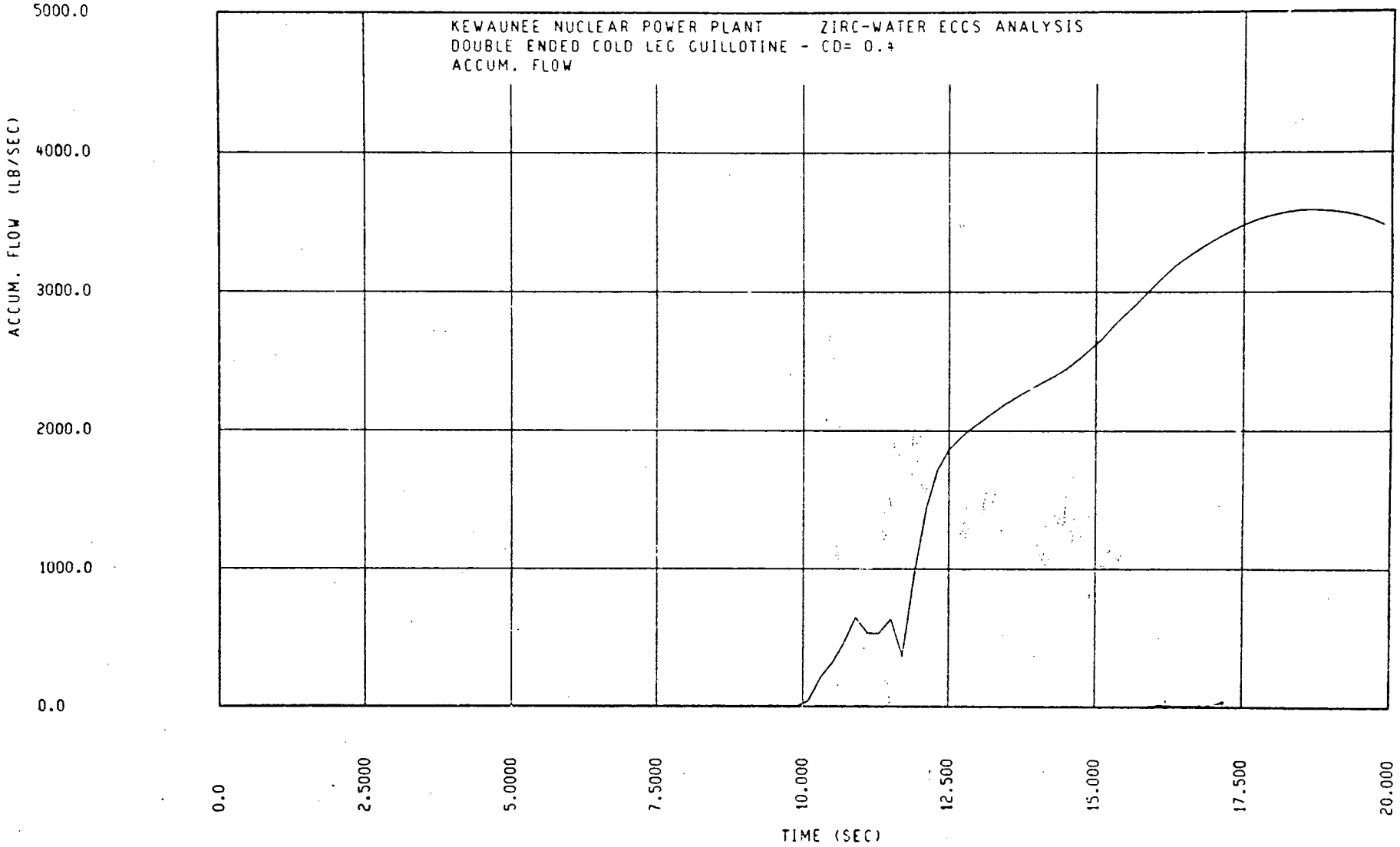
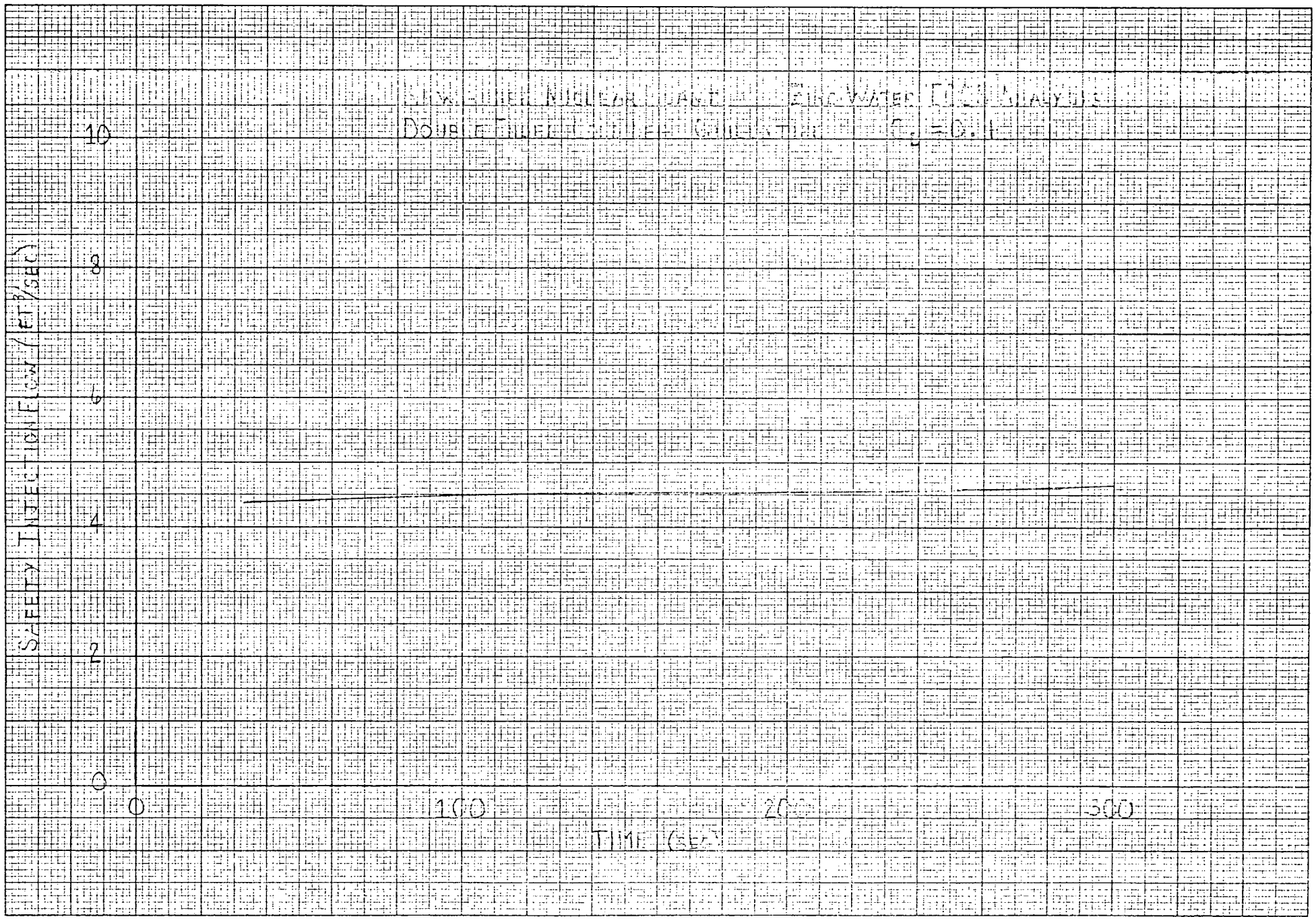

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
ACCUM. FLOW
ACCUM. FLOW (LB/SEC)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

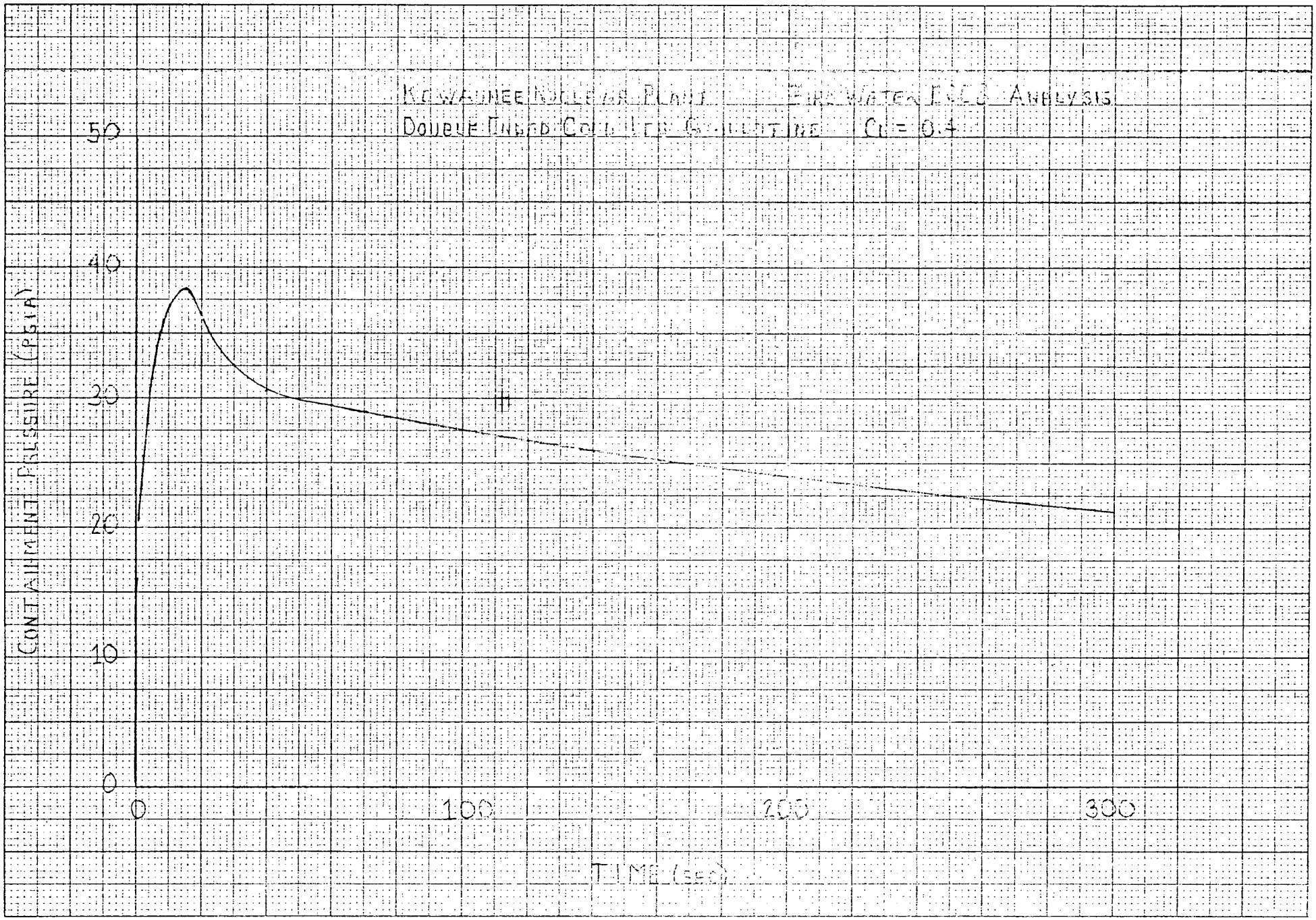
FIGURE 12

K+E 10 X 10 TO ½ INCH 46 1320
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

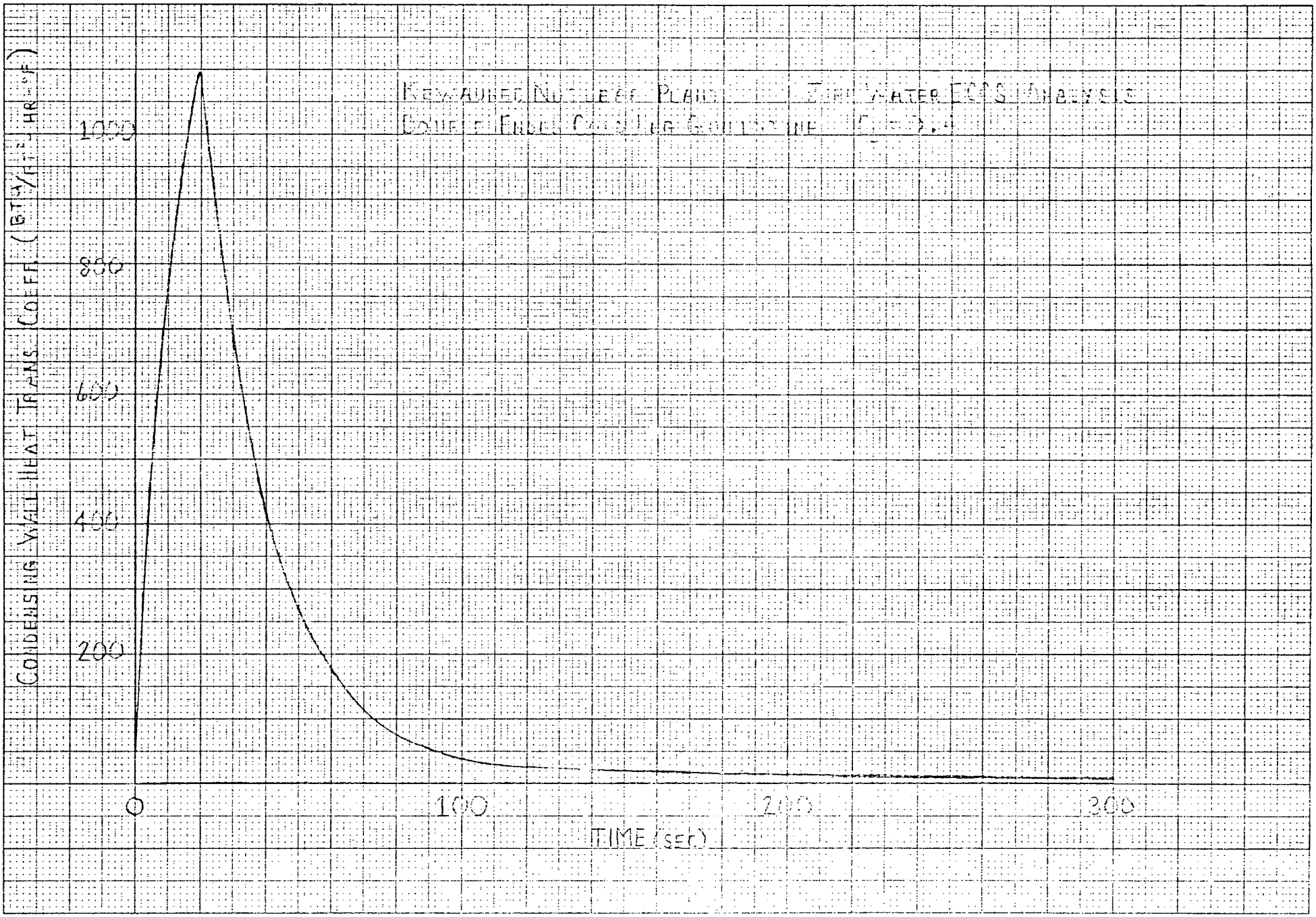


K+E 10 X 10 TO 1 INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1320



K+E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.



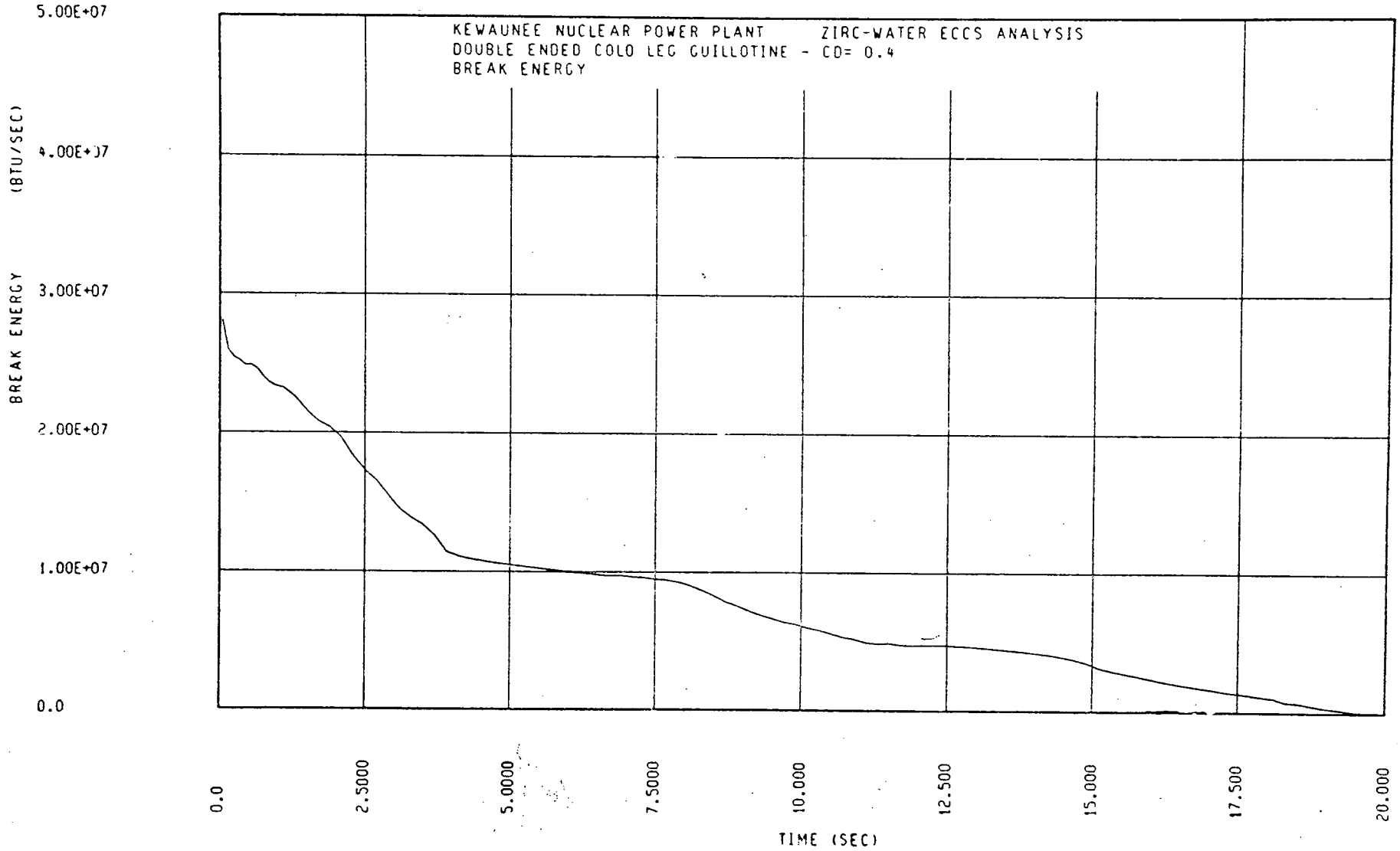

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
BREAK ENERGY
BREAK ENERGY (BTU/SEC)
5.00E+07
4.00E+07
3.00E+07
2.00E+07
1.00E+07
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 16

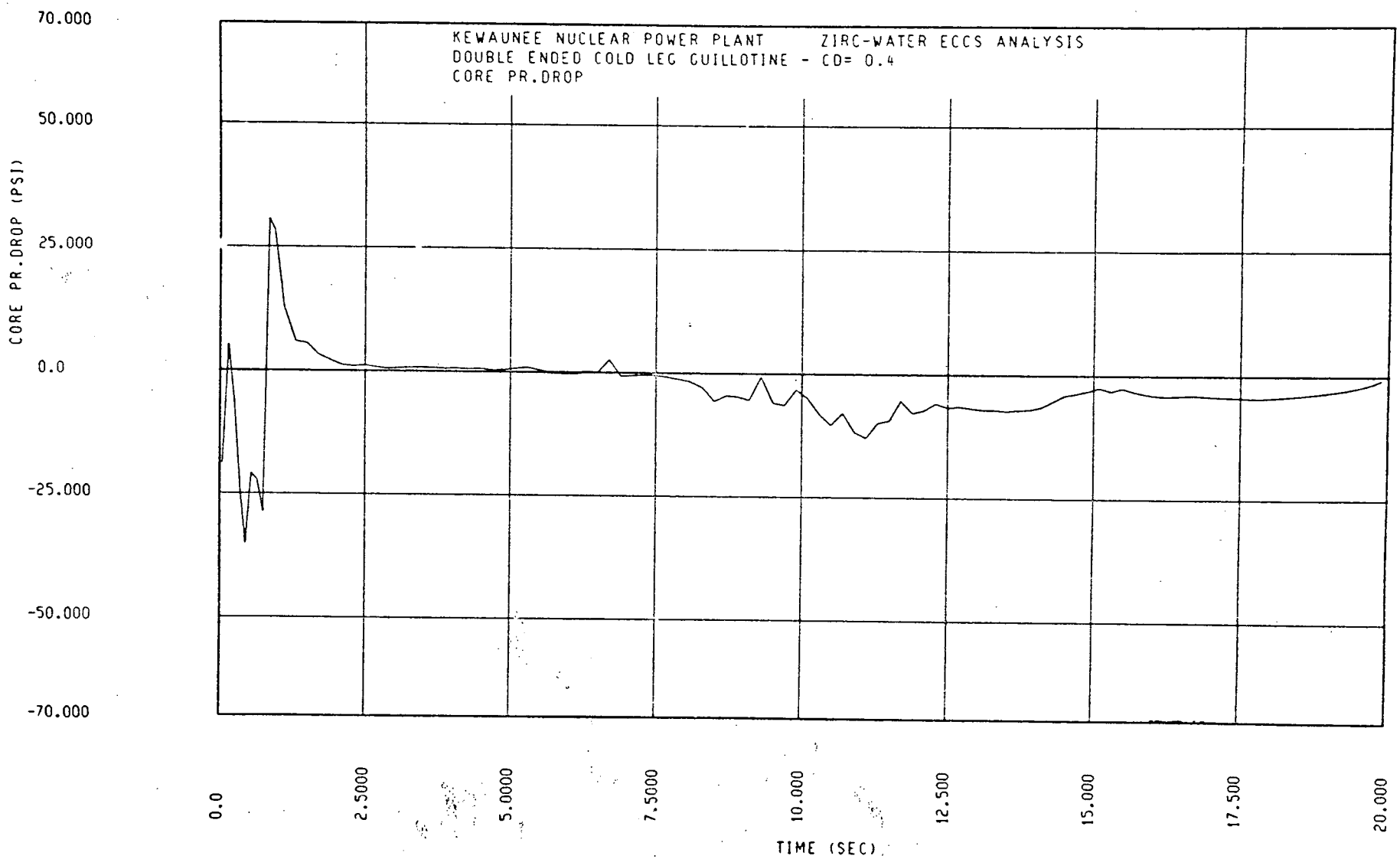

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
CORE PR.DROP
CORE PR.DROP (PSI)
70.000
50.000
25.000
0.0
-25.000
-50.000
-70.000
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 6

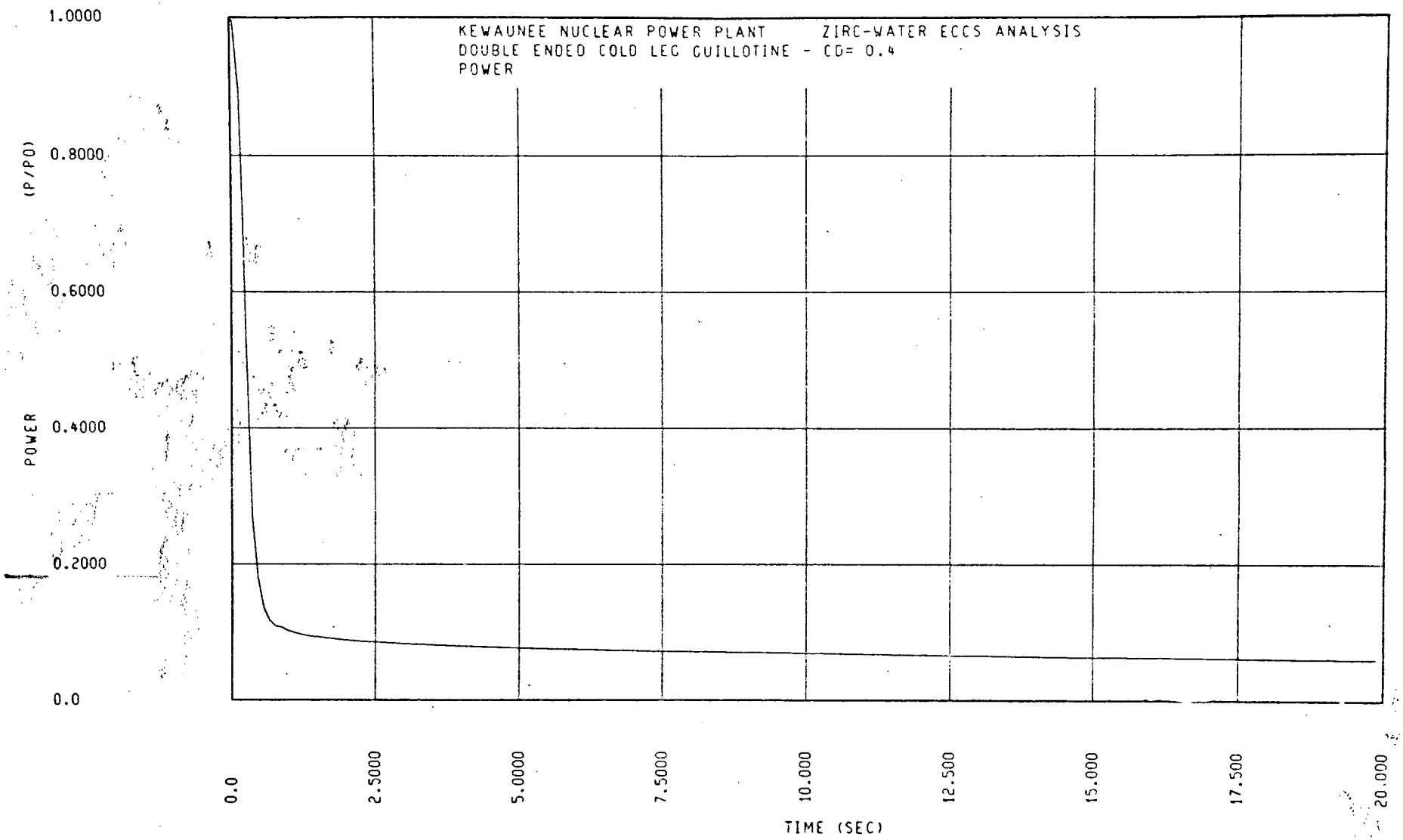

KEWAUNEE NUCLEAR POWER PLANT ZIRC-WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE - CD= 0.4
POWER
POWER (P/PO)
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 15

APPENDIX A

Generic Sensitivity Study Results

for

2-Loop Plant With 14 x 14 Fuel

TABLE 1

Large Break - Time Sequence of Events

EVENT	OCCURENCE TIME (SECONDS)		
	DECLG, C_D =1.0	DECLG, C_D =0.6	DECLG, C_D = 0.4
Accident Initiation	0.0	0.0	0.0
Reactor Trip Signal	0.52	0.53	0.54
Safety Injection Signal	0.48	0.56	0.67
Start Accumulator Injection	5.7	7.5	9.8
End of ECC Bypass	15.15	16.75	19.96
End of Blowdown	15.15	16.75	19.96
Bottom of Core Recovery	28.6	30.0	32.8
Accumulators Empty	37.5	39.1	42.1
Start Pumped ECC Injection	25.48	25.56	25.6

TABLE 2

LARGE BREAK - ANALYSIS INPUT AND RESULTS

Quantities in the calculations:

Licensed core power rating	102% of 1650 MWt
Total core peaking factor	2.31
Peak linear power	102% of 14.3 kw/ft
Accumulator water volume	1250 cubic feet per tank
Accumulator pressure	700 PSIA
Number of Safety Injection Pumps Operating	2
Steam Generator Tube Plugging Level	1 percent (uniform)

Fuel Parameters - Cycle Generic Region Generic

Results	DECLG, C_D = 1.0	DECLG, C_D = 0.6	DECLG, C_D = 0.4
Peak clad temperature (^oF)	1936	1964	2193
Location (feet)	7.5	7.5	7.5
Maximum local clad/water reaction (%)	4.1	4.5	9.1
Location (feet)	7.5	7.5	7.5
Total core clad/water reaction(%)	<0.3	<0.3	<0.3
Hot rod burst time (seconds)	78.0	70.6	25.6
Location (feet)	7.0	6.75	5.75

TABLE 3

DRY CONTAINMENT DATA

NET FREE VOLUME	1.37×10^6 ft^3
INITIAL CONDITIONS	
Pressure	14.7 psia
Temperature	90° F
RWST Temperature	70° F
Service Water Temperature	32° F
Outside Temperature	20° F
SPRAY SYSTEM	
Number of Pumps Operating	2
Runout Flow Rate	1600 gpm/each
Actuation Time	15 sec
SAFEGUARDS FAN COOLERS	
Number of Fan Coolers Operating	4
Fastest Post-Accident Initiation of Fan Coolers	15 sec
STRUCTURAL HEAT SINKS	
Thickness (in.)	Area (ft^2)
1.5steel	41300
0.75 steel	32000
0.25 steel 12 concrete	7860
0.375 steel	6800
0.25 steel	32000
0.5 steel	44000
0.145 steel	1695
0.09 steel	12400
0.1 steel	6000
0.1875 steel	13125
1.44 steel	2200
12 concrete	40800
6 concrete	25070
3 concrete	7570

TABLE 3 (cont'd)

PAINTED SURFACES

Steel Thickness (in)	Minimum Painted Area (ft^2)	Paint Thickness (mils)
1.5	41300	11
.75	32000	11
.5	44000	11
.375	6800	11
.1875	13125	11
.145	1695	11
1.44	2200	11

Concrete Thickness (in)	Minimum Painted Area (ft^2)	Paint Thickness (mils)
12	4080	18
6	25070	18
3	7570	18

TABLE 4

REFLOOD MASS AND ENERGY RELEASE, C_D = 0.4 DCCLG

Time	Mass Flow (lb/sec)	Energy Flow (BTU/sec)
33.4	.002	2.43
38.0	34.16	44025.1
47.0	137.97	85563.1
61.3	225.22	102148.2
79.2	237.1	100581.8
99.5	242.07	98133.1
121.7	245.93	95368.0
171.6	252.7	89344.0
230.0	259.35	82964.7
300.6	266.46	76280.0
395.7	276.64	69442.6

TABLE 5

Broken Loop Accumulator Mass and Energy Release

Time	Mass Flow (lb/sec)	Energy Flow (BTU/sec)
0.0	4876.4	292005.
2.0	4249	254469.0
4.0	3823.0	228957.0
6.0	3508.5	210127.0
8.0	3258.7	195166.0
10.0	3053.7	182888.0
12.0	2884.2	172734.0
14.0	2739.8	164089.0
16.0	2617.0	156730.0
18.0	2513.9	150557.0
22.0	2351.7	140842.0
25.7	2214.2	132606.0
25.8	0.0	0.0

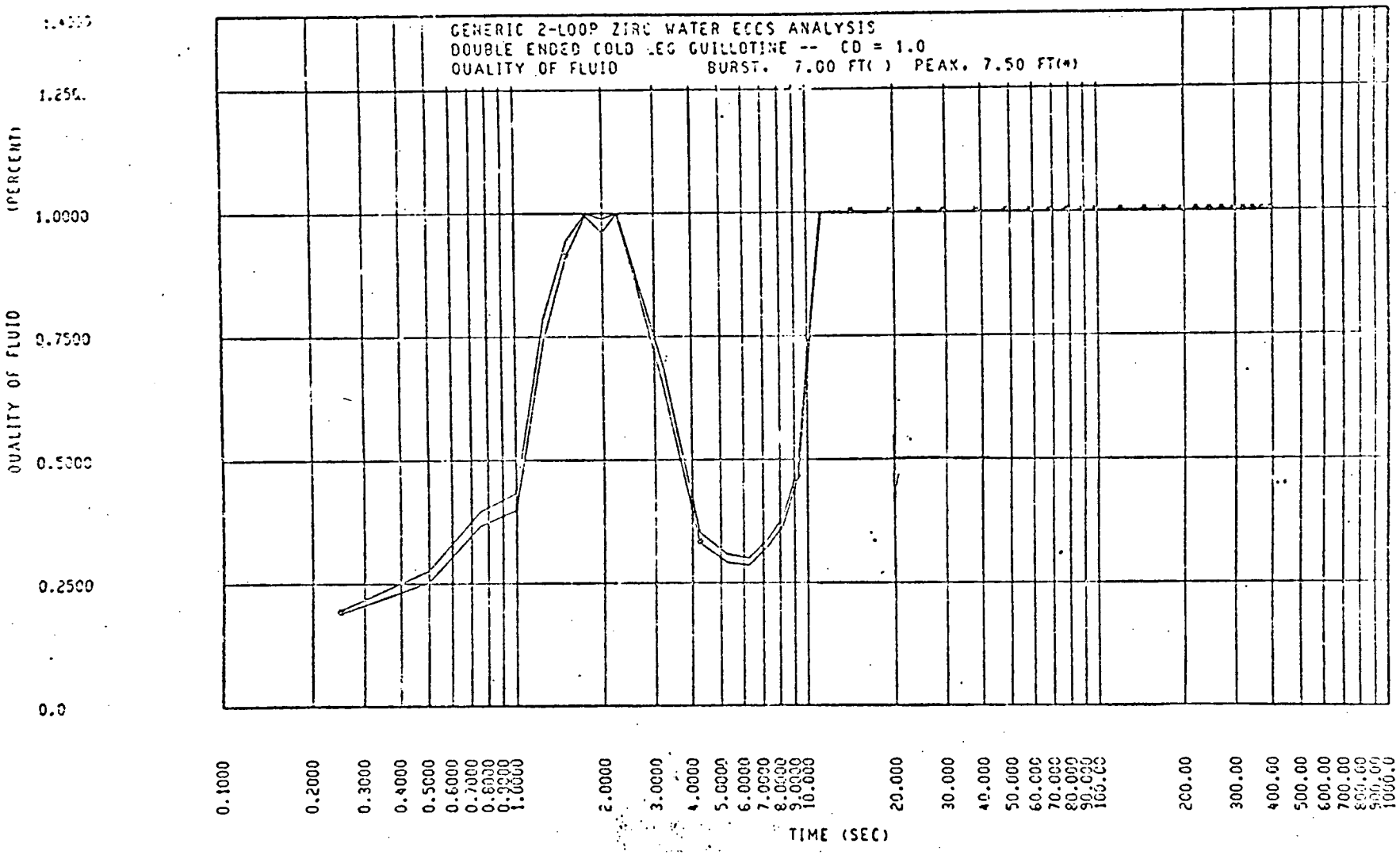

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
QUALITY OF FLUID BURST. 7.00 FT( ) PEAK. 7.50 FT(*)
QUALITY OF FLUID (PERCENT)
1.0000
0.7500
0.5000
0.2500
0.0
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
0.8000
0.9000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.0
TIME (SEC)

FIGURE 1a

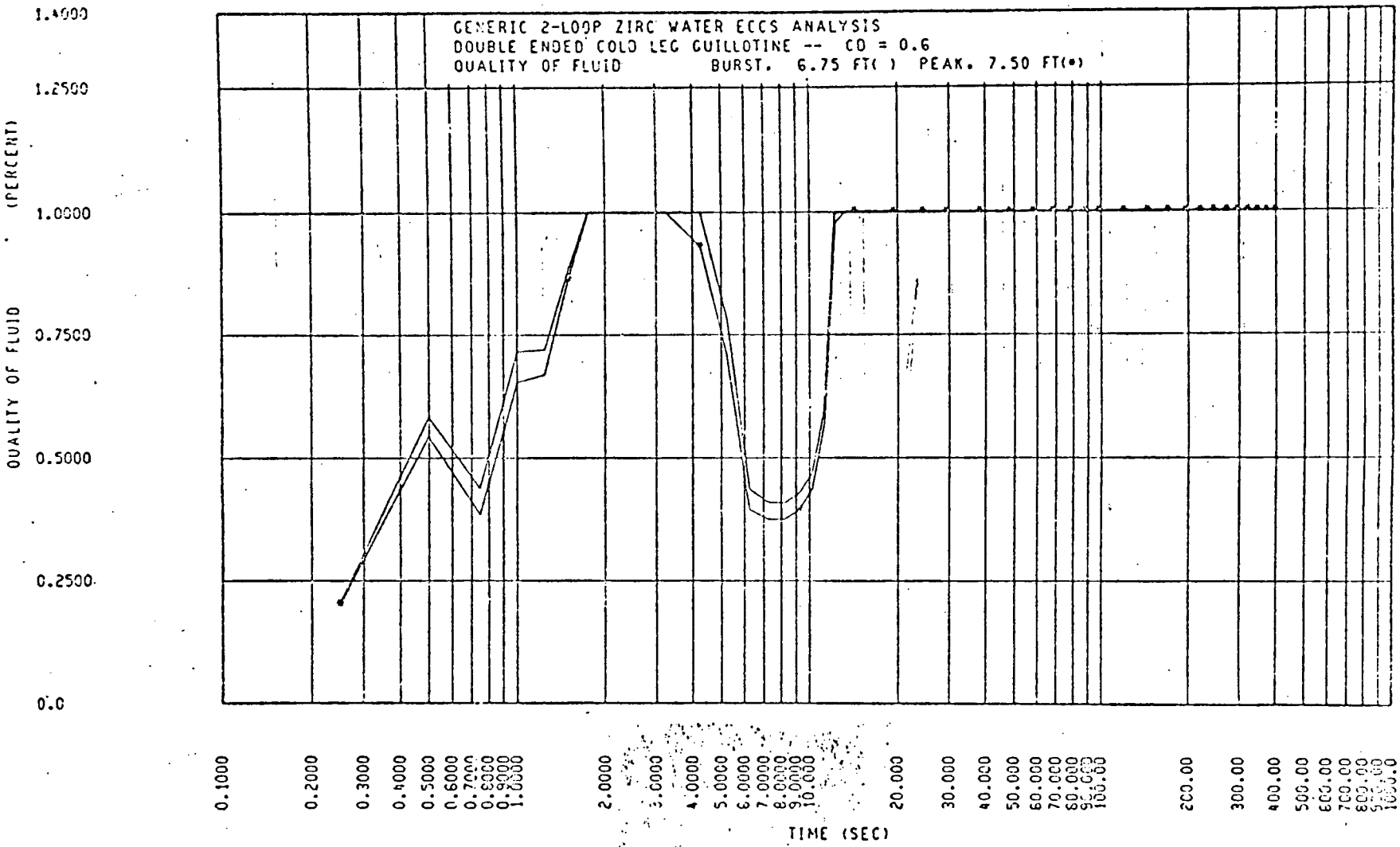

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
QUALITY OF FLUID BURST. 6.75 FT( ) PEAK. 7.50 FT(•)
QUALITY OF FLUID (PERCENT)
1.1000
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
0.8000
0.9000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.0
TIME (SEC)

FIGURE 1b

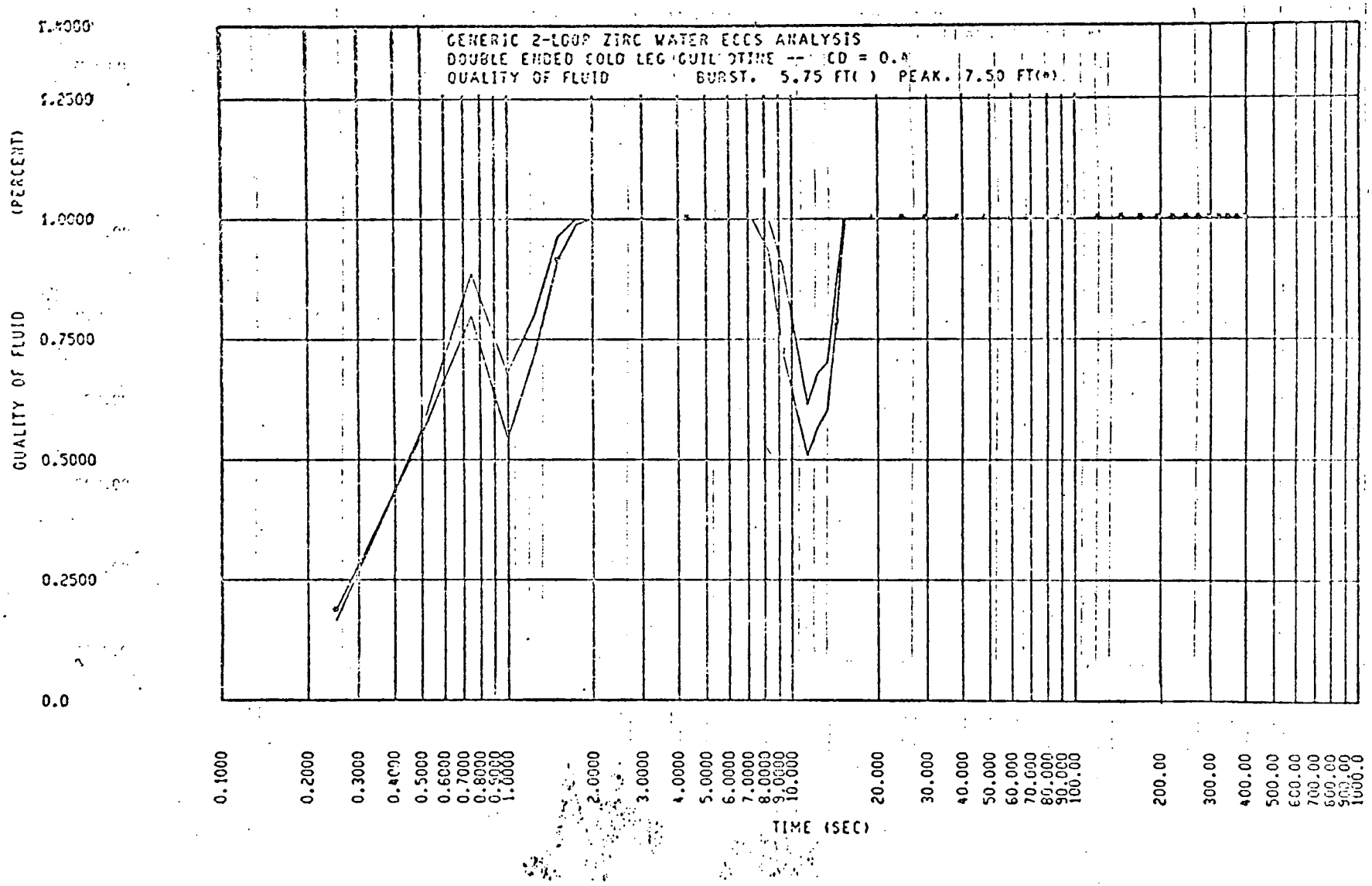

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.8
QUALITY OF FLUID BURST. 5.75 FT( ) PEAK. 7.50 FT(*)
QUALITY OF FLUID (PERCENT)
1.5000
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
0.8000
0.9000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.0
TIME (SEC)

FIGURE 1c

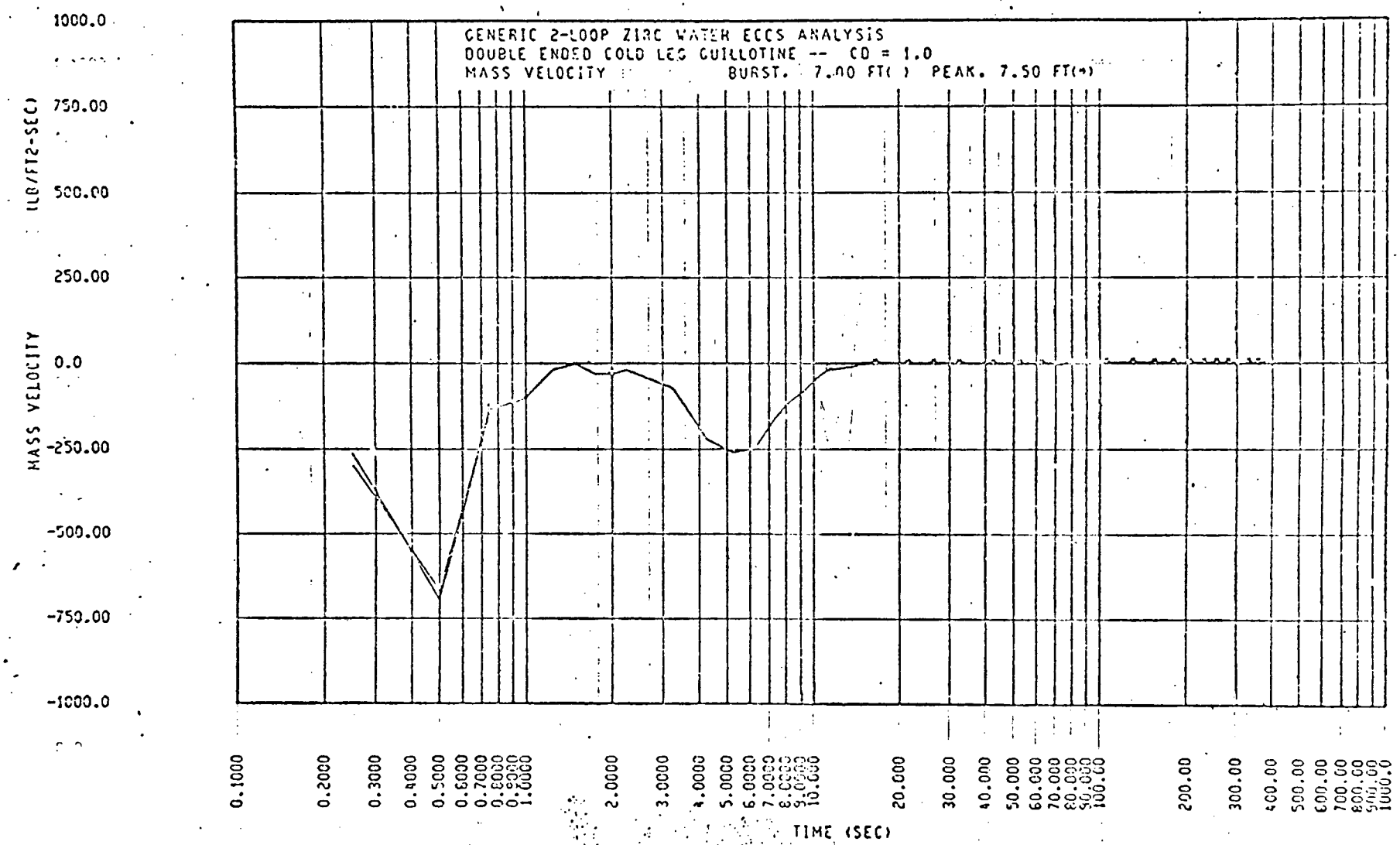

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
MASS VELOCITY BURST. 7.00 FT( ) PEAK. 7.50 FT(*)
MASS VELOCITY (LB/FT2-SEC)
1000.0
750.00
500.00
250.00
0.0
-250.00
-500.00
-750.00
-1000.0
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
0.8000
0.9000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.0
TIME (SEC)

FIGURE 2a

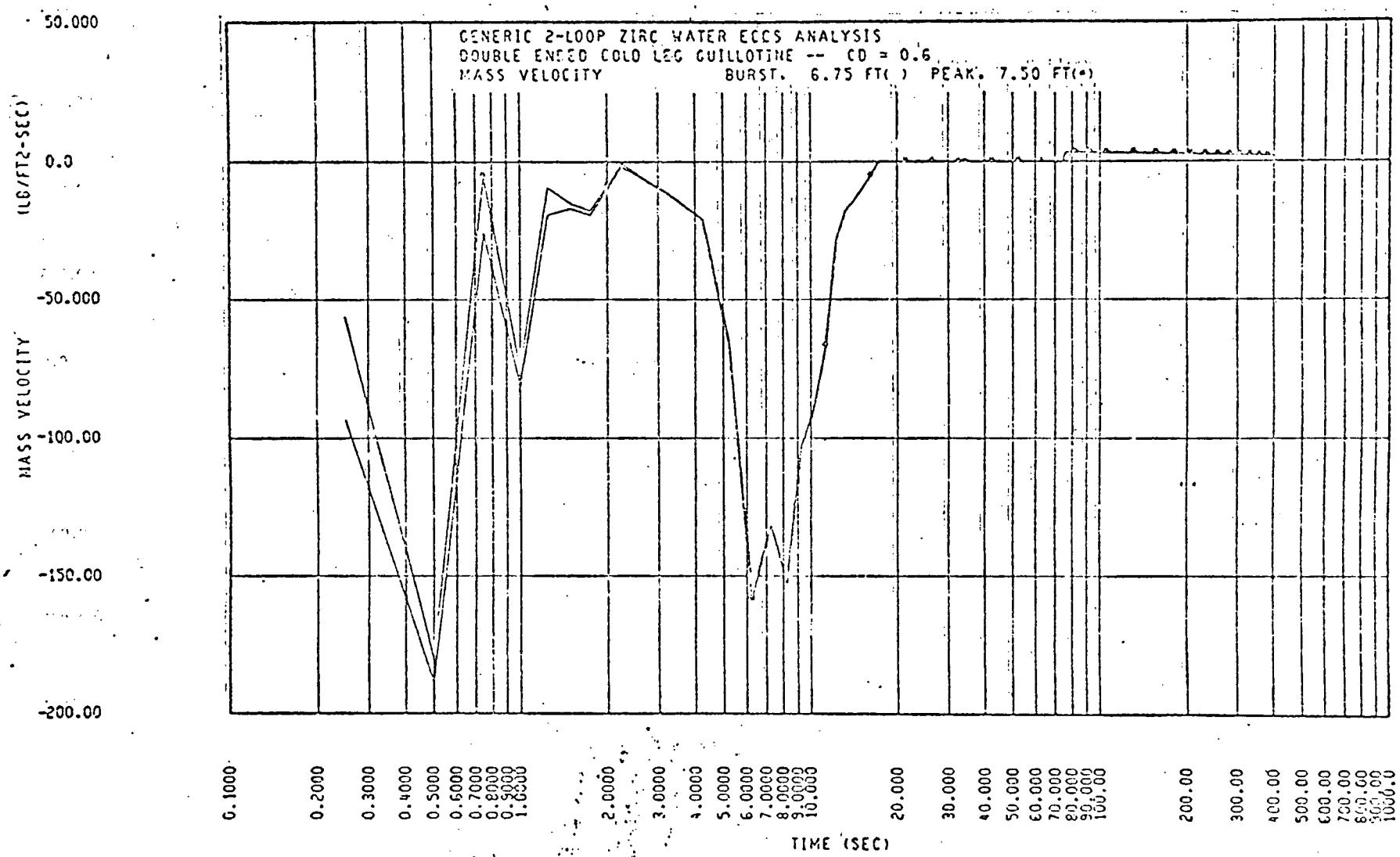

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
MASS VELOCITY BURST. 6.75 FT( ) PEAK. 7.50 FT(*)
MASS VELOCITY (LB/FT2-SEC)
50.000
0.0
-50.000
-100.00
-150.00
-200.00
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
0.8000
0.9000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.0
TIME (SEC)

FIGURE 2b

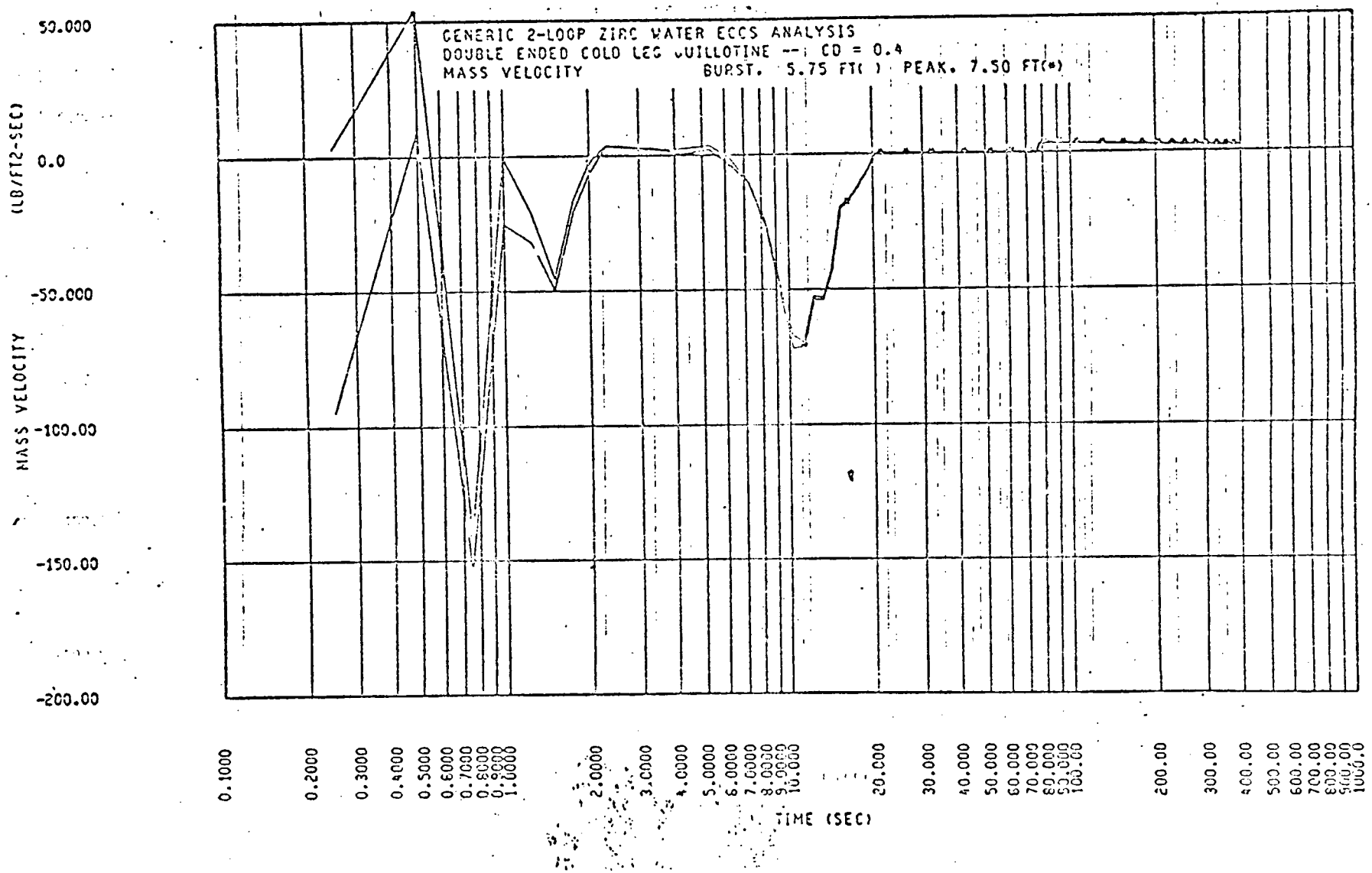

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE --; CD = 0.4
MASS VELOCITY
BURST. 5.75 FT( ) PEAK. 7.50 FT(*)
MASS VELOCITY (LB/FT2-SEC)
50.000
0.0
-50.000
-100.00
-150.00
-200.00
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
0.7000
0.8000
0.9000
1.0000
2.0000
3.0000
4.0000
5.0000
6.0000
7.0000
8.0000
9.0000
10.000
20.000
30.000
40.000
50.000
60.000
70.000
80.000
90.000
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.0
TIME (SEC)

FIGURE 2c

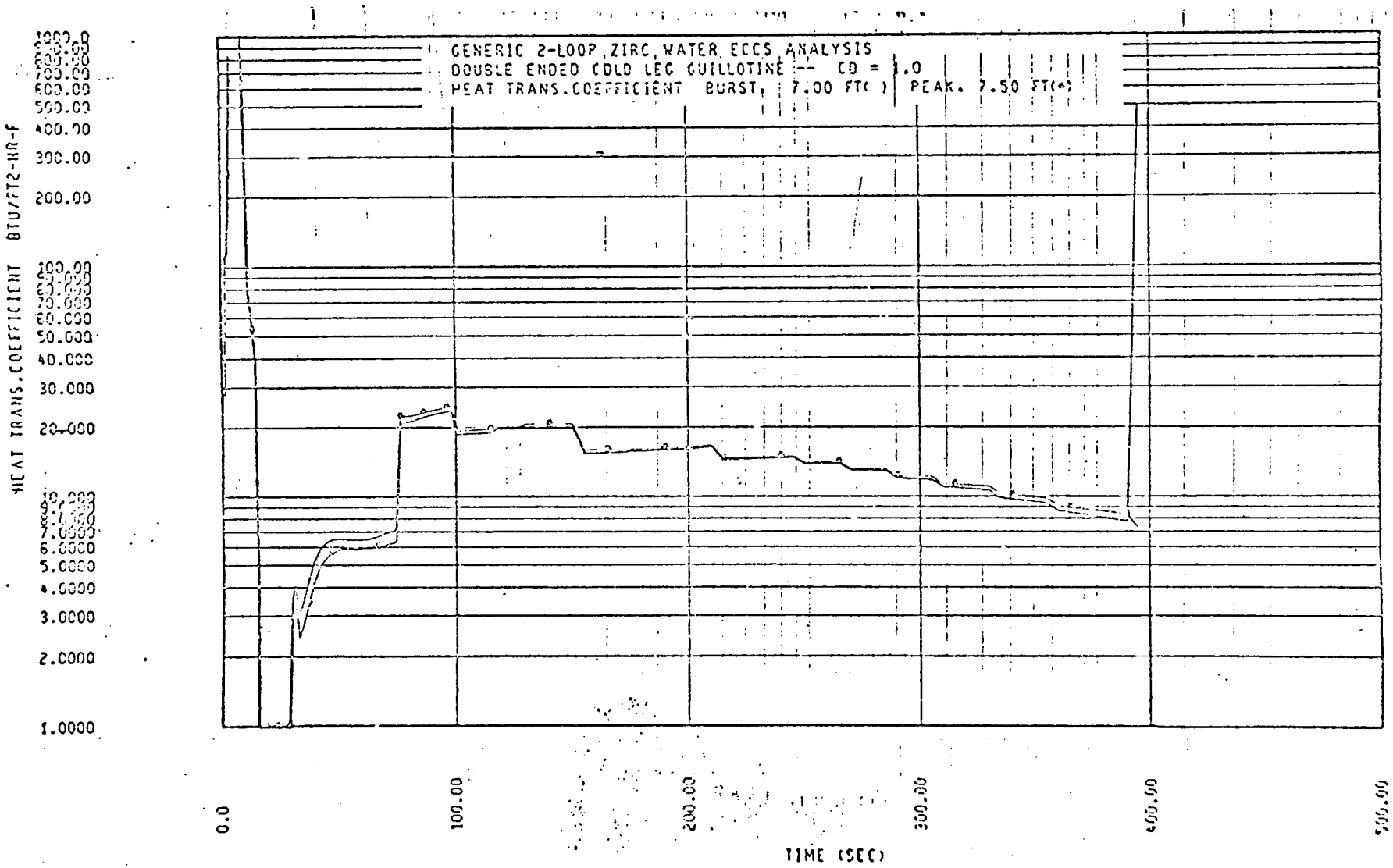

GENERIC 2-LOOP,ZIRC,WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
HEAT TRANS.COEFFICIENT BURST, 7.00 FT( ) PEAK. 7.50 FT(*)
HEAT TRANS.COEFFICIENT BTU/FT2-HR-F
1000.0
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
90.000
80.000
70.000
60.000
50.000
40.000
30.000
20.000
10.000
9.0000
8.0000
7.0000
6.0000
5.0000
4.0000
3.0000
2.0000
1.0000
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 3a

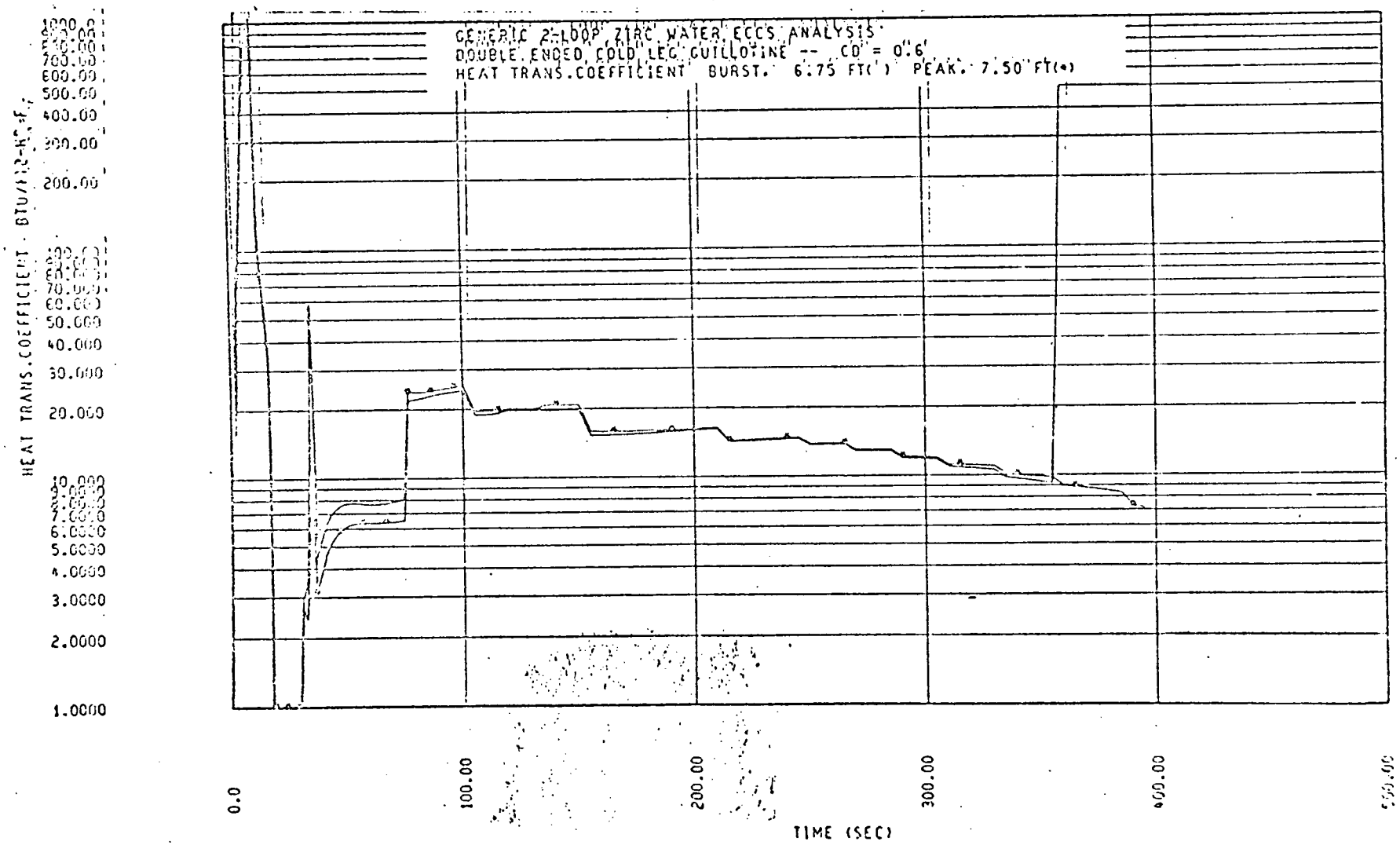

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
HEAT TRANS.COEFFICIENT BURST. 6.75 FT( ) PEAK. 7.50 FT(*)
HEAT TRANS.COEFFICIENT - BTU/FT2-HR-F
1000.0
700.00
600.00
500.00
400.00
300.00
200.00
100.00
70.000
60.000
50.000
40.000
30.000
20.000
10.000
7.0000
6.0000
5.0000
4.0000
3.0000
2.0000
1.0000
0.0
100.00
200.00
300.00
400.00
TIME (SEC)

FIGURE 3b

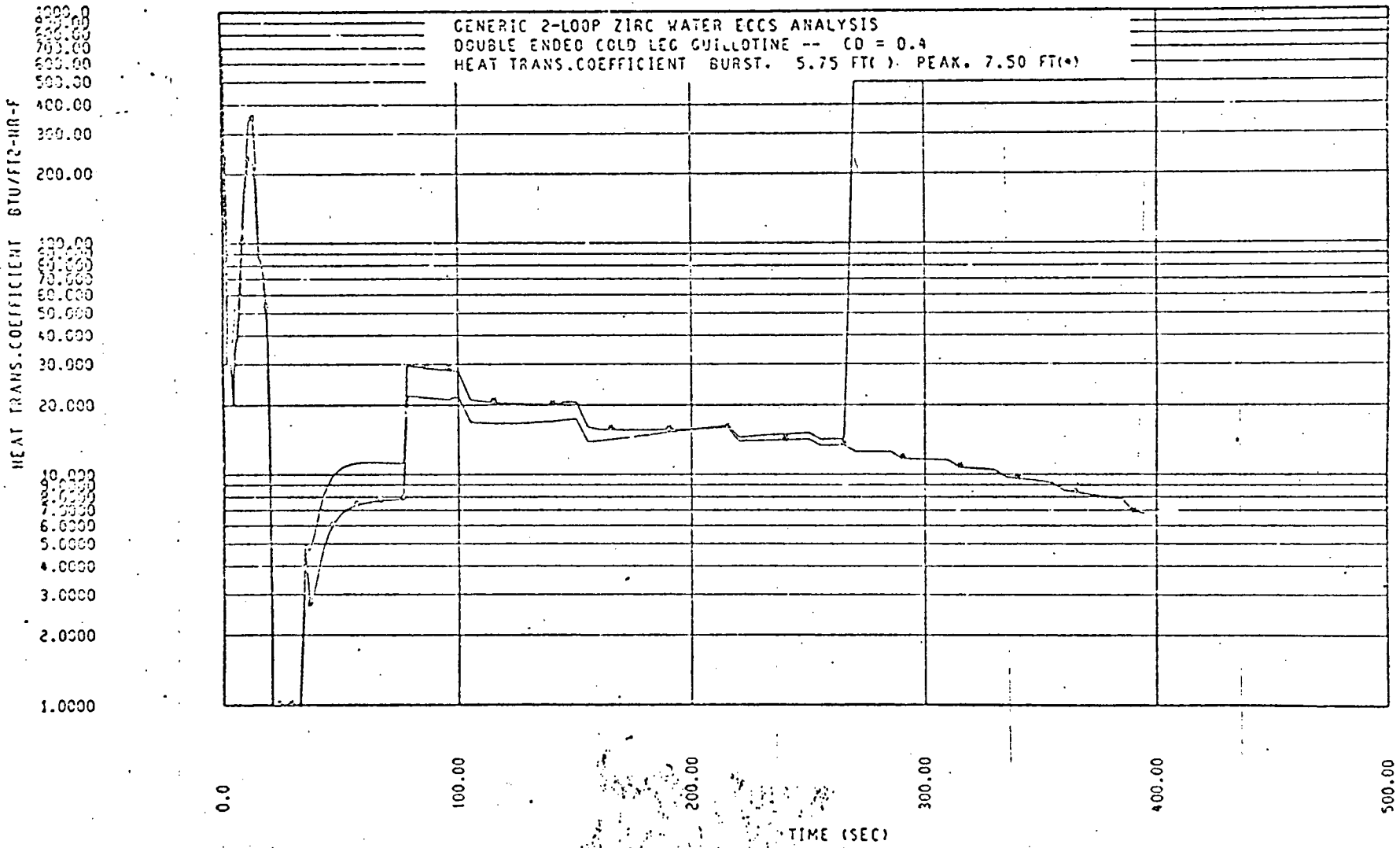

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
HEAT TRANS.COEFFICIENT BURST. 5.75 FT( ). PEAK. 7.50 FT(•)
HEAT TRANS.COEFFICIENT BTU/FT2-HR-F
400.00
300.00
200.00
20.000
10.000
6.0000
5.0000
4.0000
3.0000
2.0000
1.0000
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 3c

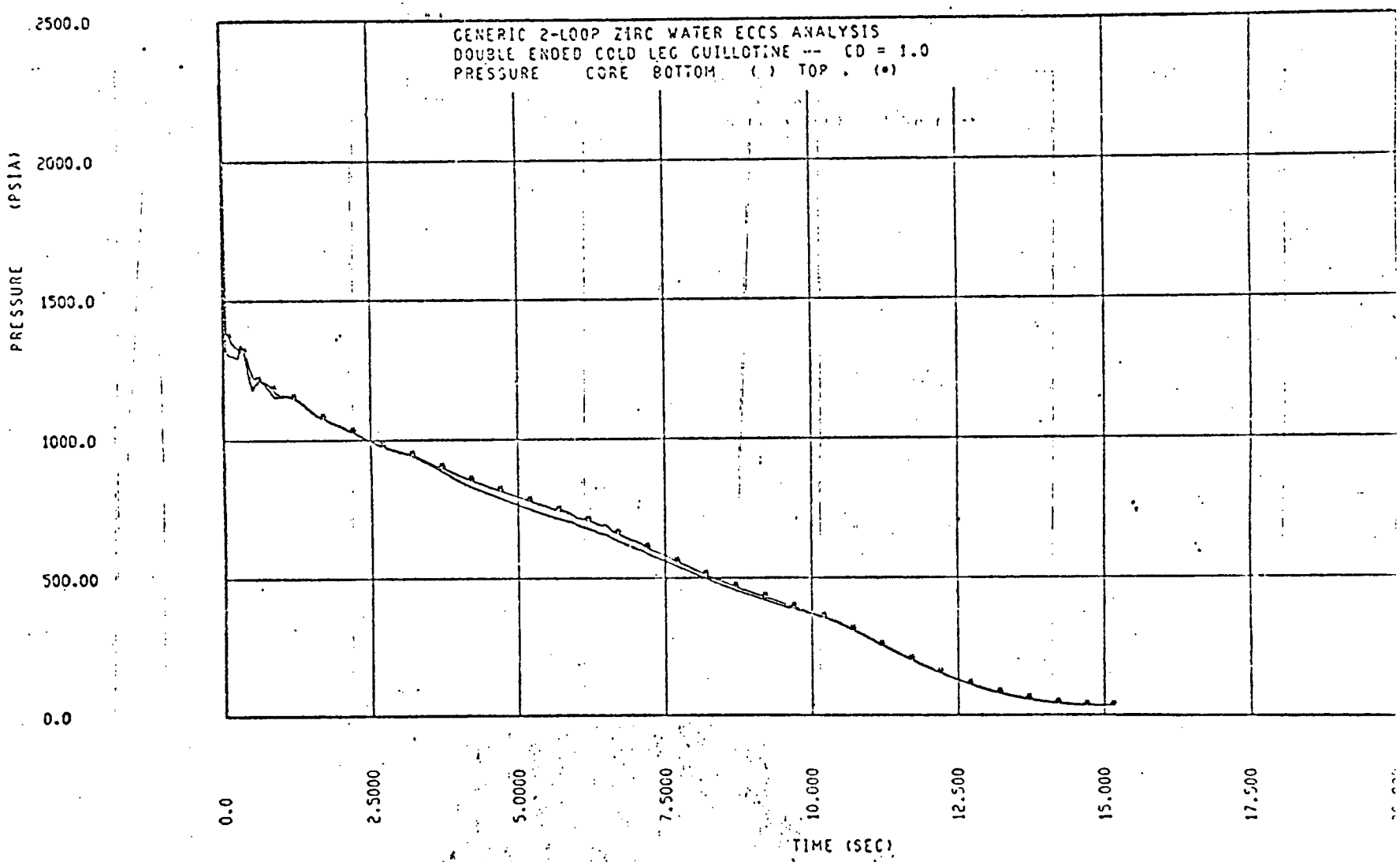

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
PRESSURE CORE BOTTOM ( ) TOP . (*)
PRESSURE (PSIA)
2500.0
2000.0
1500.0
1000.0
500.00
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
TIME (SEC)

FIGURE 4a

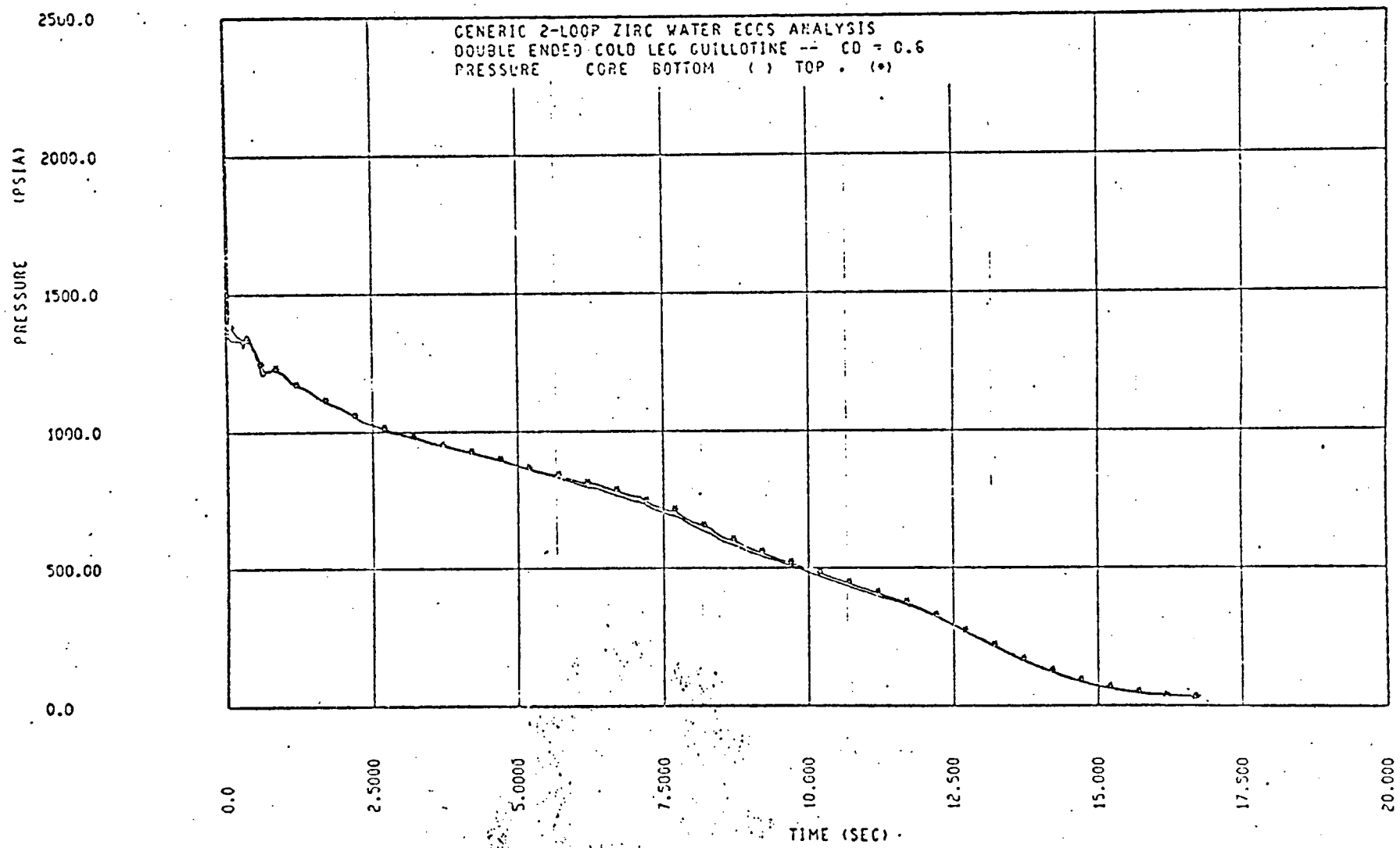

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
PRESSURE CORE BOTTOM ( ) TOP . (•)
PRESSURE (PSIA)
2500.0
2000.0
1500.0
1000.0
500.00
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 4b

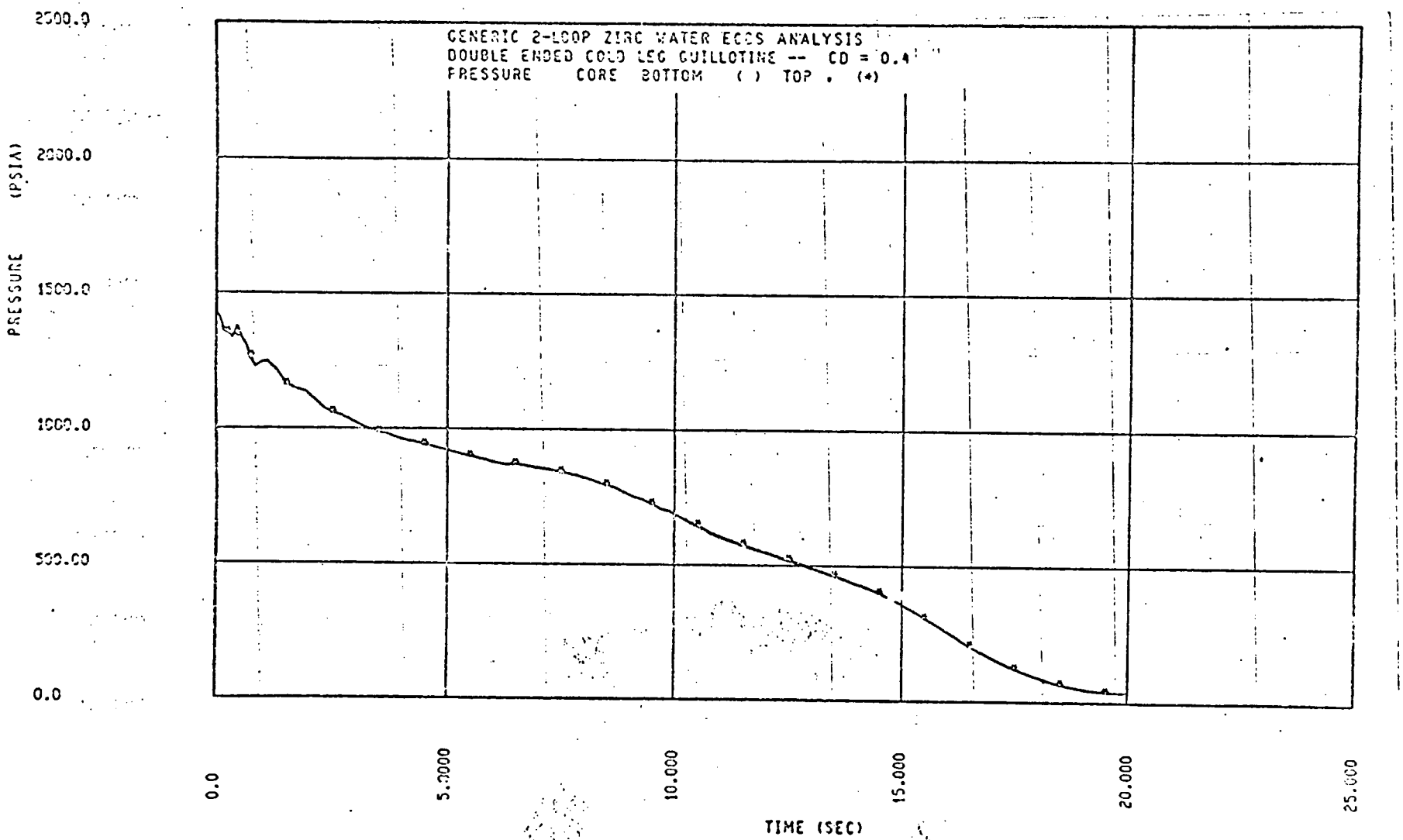

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
PRESSURE CORE BOTTOM ( ) TOP . (+)
PRESSURE (PSIA)
2500.0
2000.0
1500.0
1000.0
500.00
0.0
0.0
5.0000
10.000
15.000
20.000
25.000
TIME (SEC)

FIGURE 4c

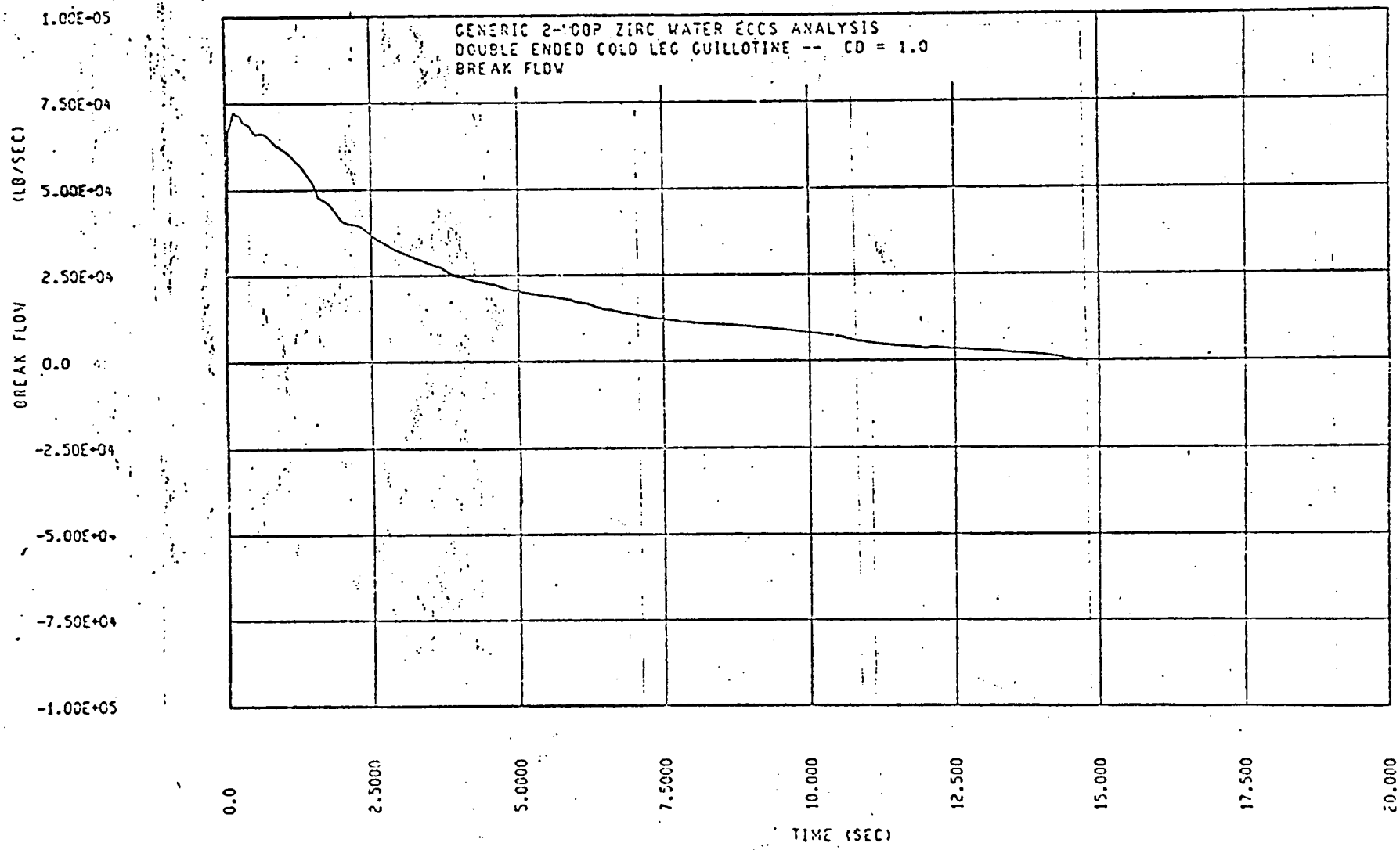

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
BREAK FLOW
BREAK FLOW (LB/SEC)
1.00E+05
7.50E+04
5.00E+04
2.50E+04
0.0
-2.50E+04
-5.00E+04
-7.50E+04
-1.00E+05
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 5a

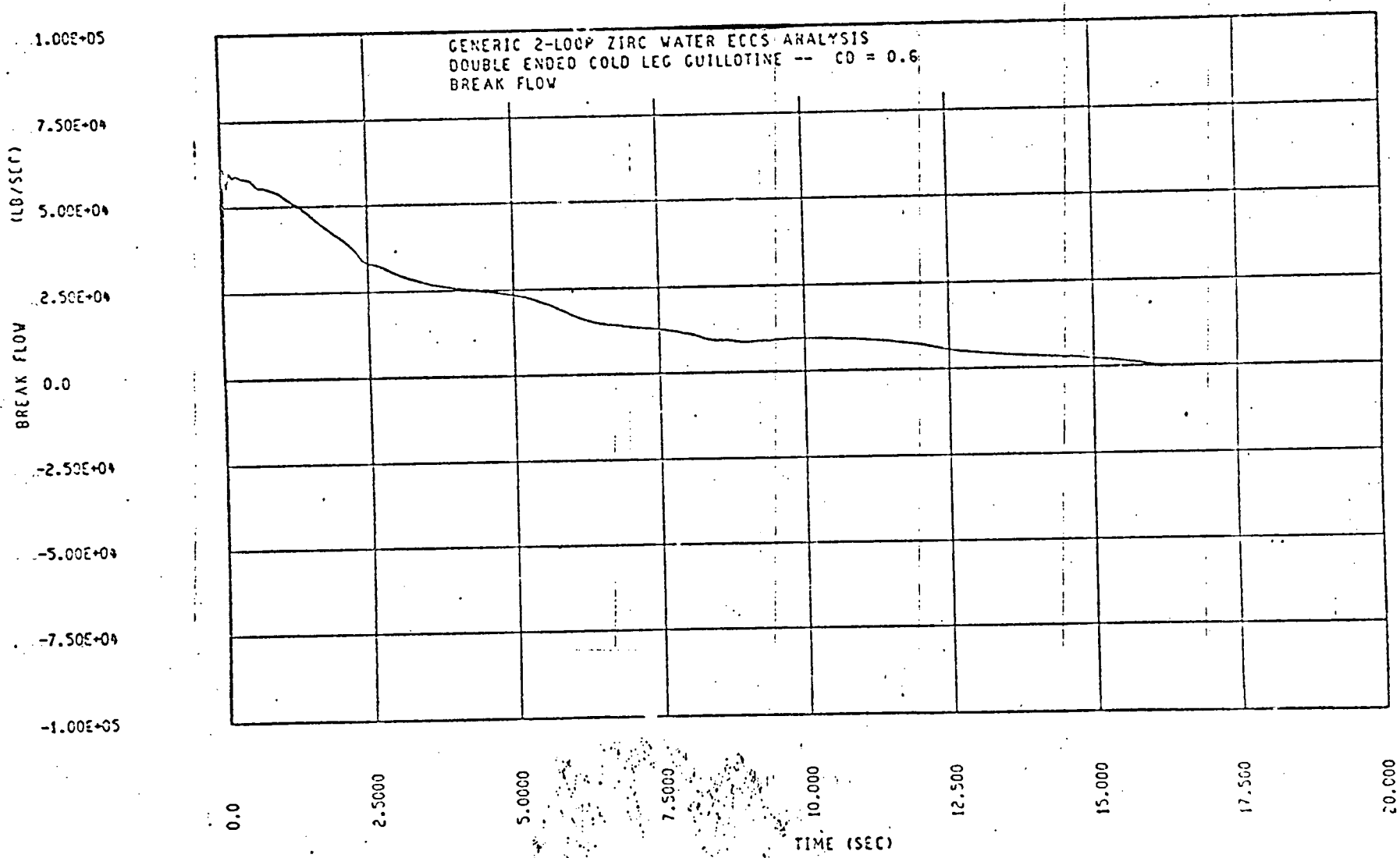

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
BREAK FLOW
BREAK FLOW (LB/SEC)
1.00E+05
7.50E+04
5.00E+04
2.50E+04
0.0
-2.50E+04
-5.00E+04
-7.50E+04
-1.00E+05
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 5b

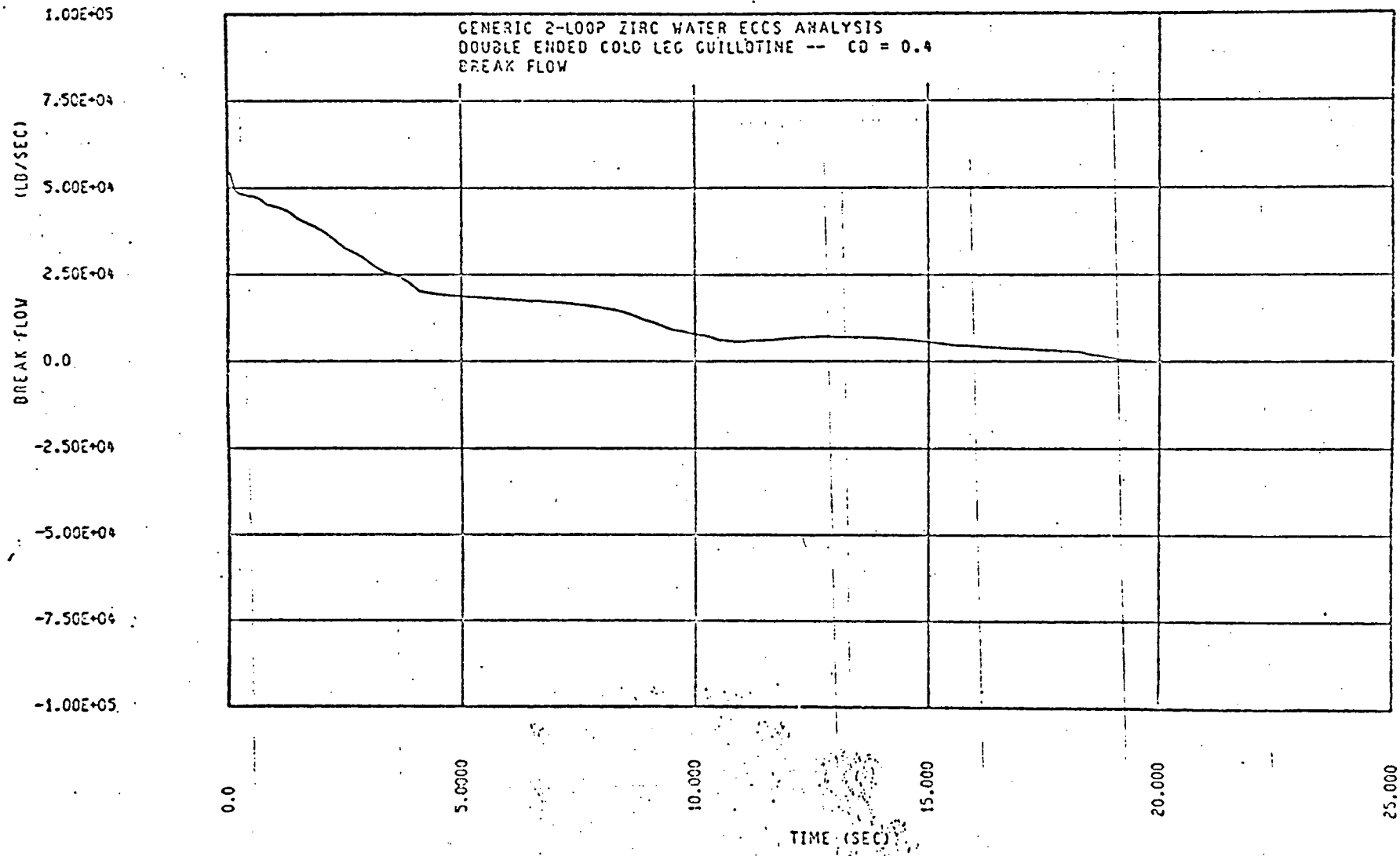

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
BREAK FLOW
BREAK FLOW (LB/SEC)
1.00E+05
7.50E+04
5.00E+04
2.50E+04
0.0
-2.50E+04
-5.00E+04
-7.50E+04
-1.00E+05
0.0
5.0000
10.000
15.000
20.000
25.000
TIME (SEC)

FIGURE 5c

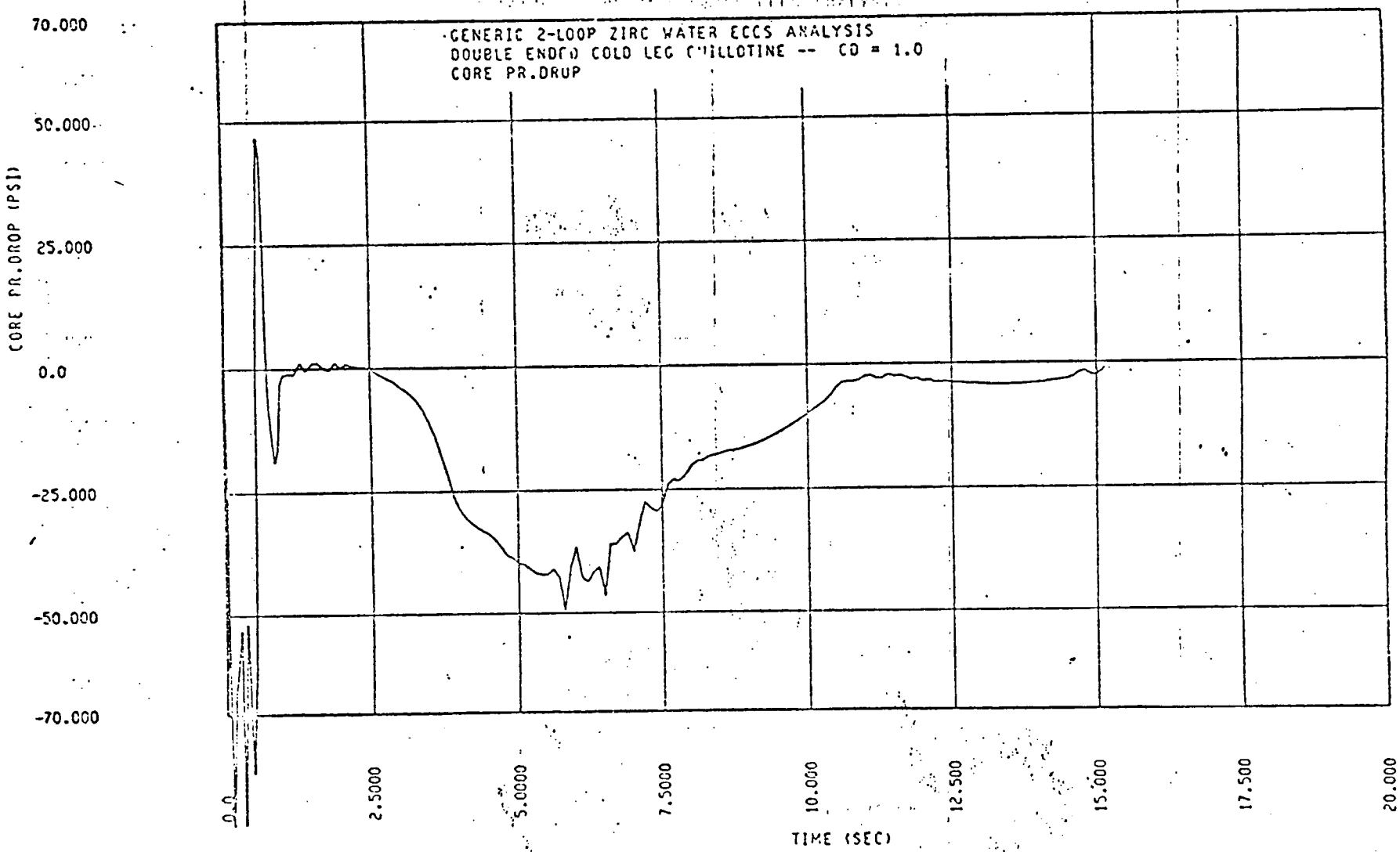

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
CORE PR.DROP
CORE PR.DROP (PSI)
70.000
50.000
25.000
0.0
-25.000
-50.000
-70.000
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 6a

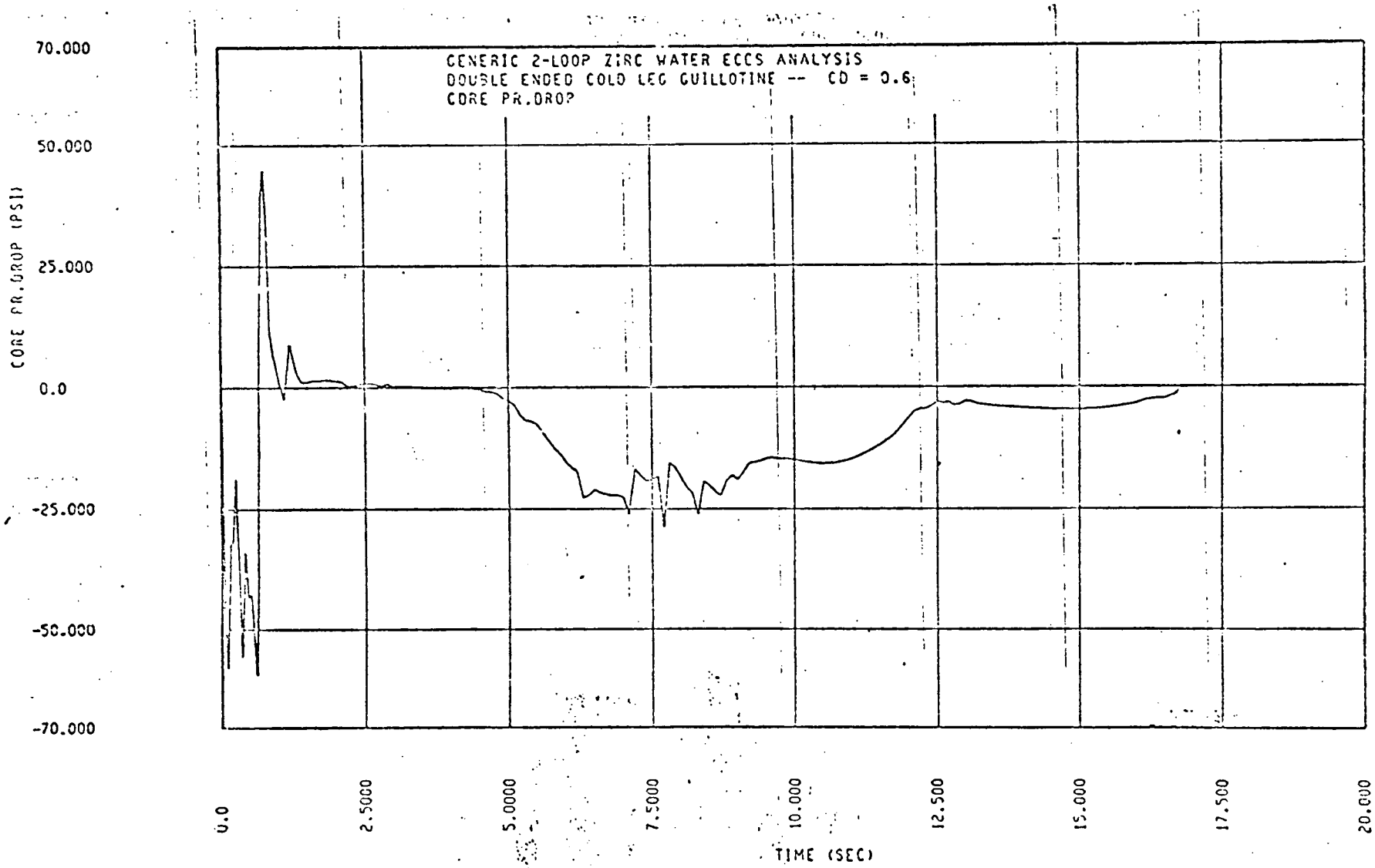

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
CORE PR.DROP
CORE PR.DROP (PSI)
70.000
50.000
25.000
0.0
-25.000
-50.000
-70.000
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 6b

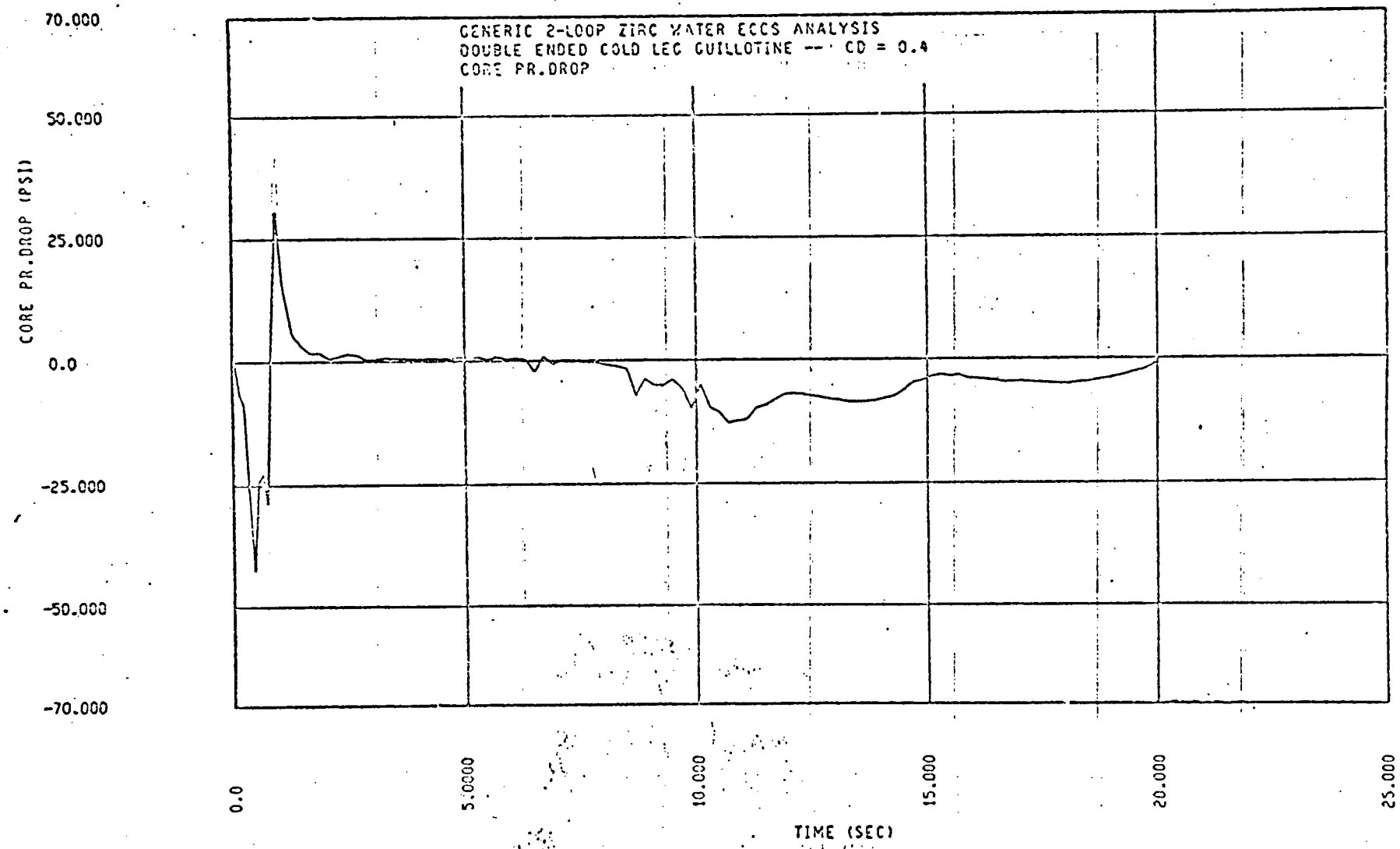

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
CORE PR.DROP
70.000
50.000
25.000
0.0
-25.000
-50.000
-70.000
CORE PR.DROP (PSI)
0.0
5.0000
10.000
15.000
20.000
25.000
TIME (SEC)

FIGURE 6 C

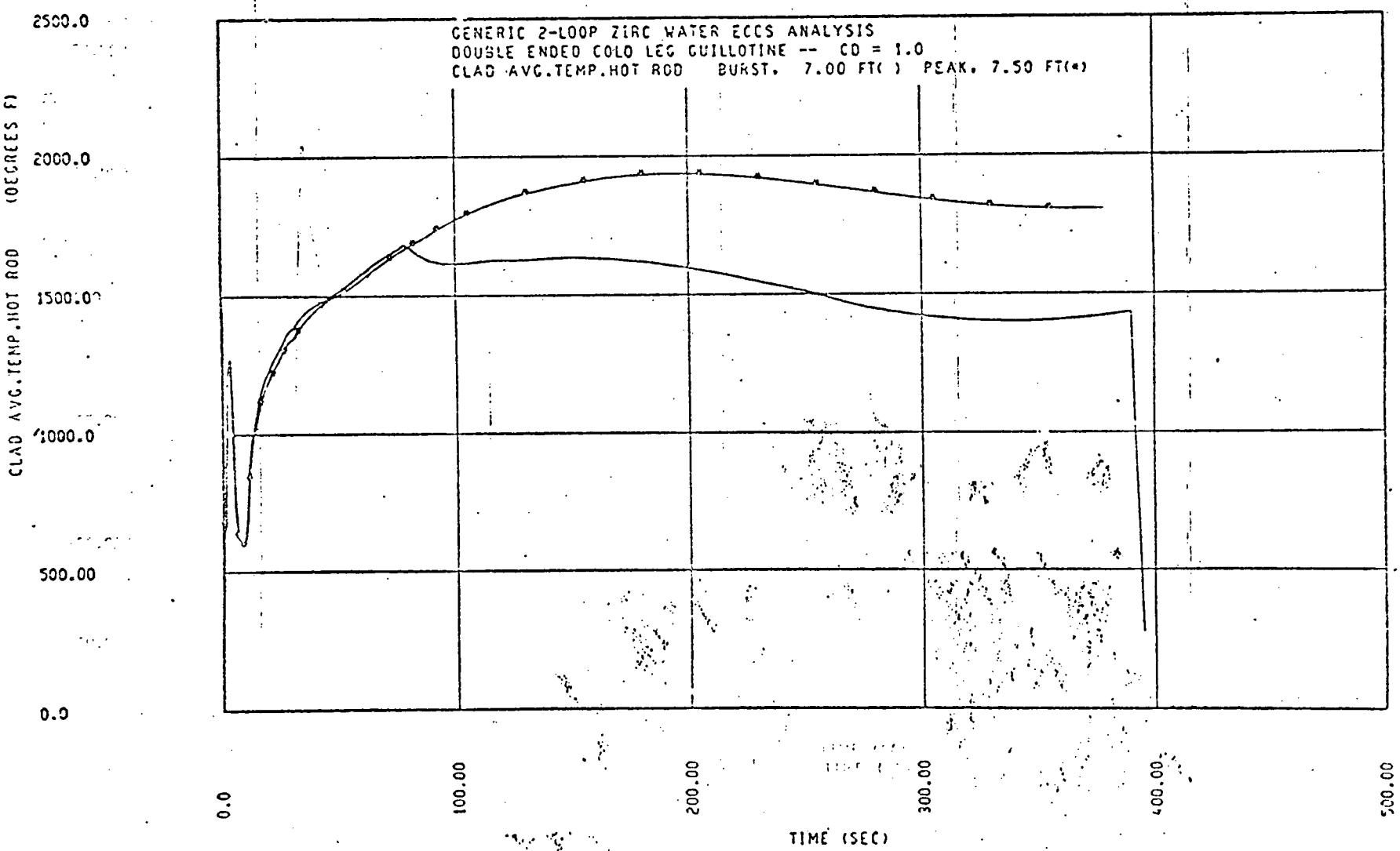

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
CLAD AVG.TEMP.HOT ROD BURST. 7.00 FT( ) PEAK. 7.50 FT(*)
CLAD AVG.TEMP.HOT ROD (DEGREES F)
2500.0
2000.0
1500.0
1000.0
500.00
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 7a

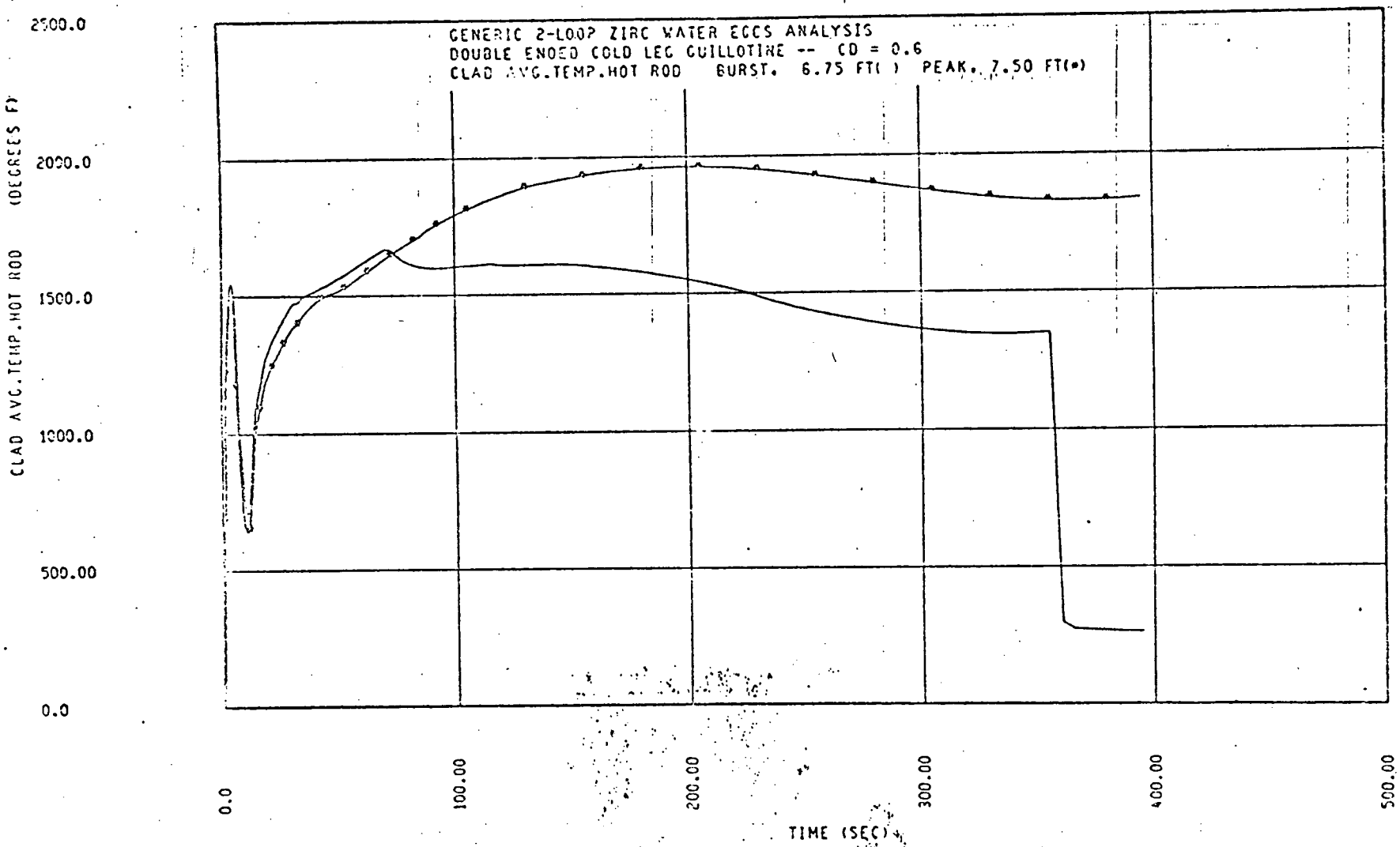

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
CLAD AVG.TEMP.HOT ROD BURST. 6.75 FT( ) PEAK. 7.50 FT(•)
CLAD AVG.TEMP.HOT ROD (DEGREES F)
2500.0
2000.0
1500.0
1000.0
500.00
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 7b

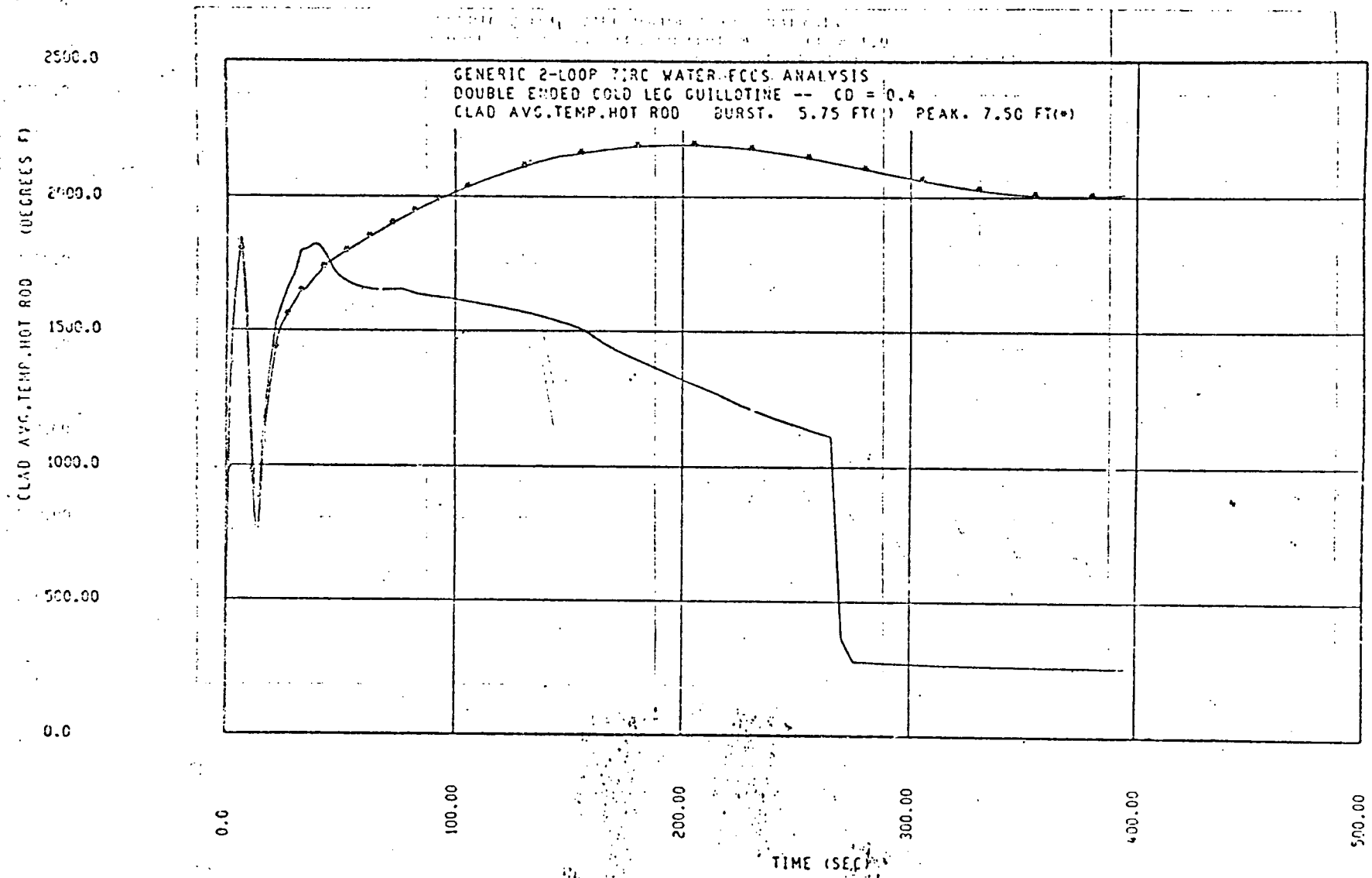

GENERIC 2-LOOP TIRC WATER FCCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
CLAD AVG.TEMP.HOT ROD BURST. 5.75 FT(*) PEAK. 7.50 FT(*)
CLAD AVG.TEMP.HOT ROD (DEGREES F)
2500.0
2000.0
1500.0
1000.0
500.00
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 7c

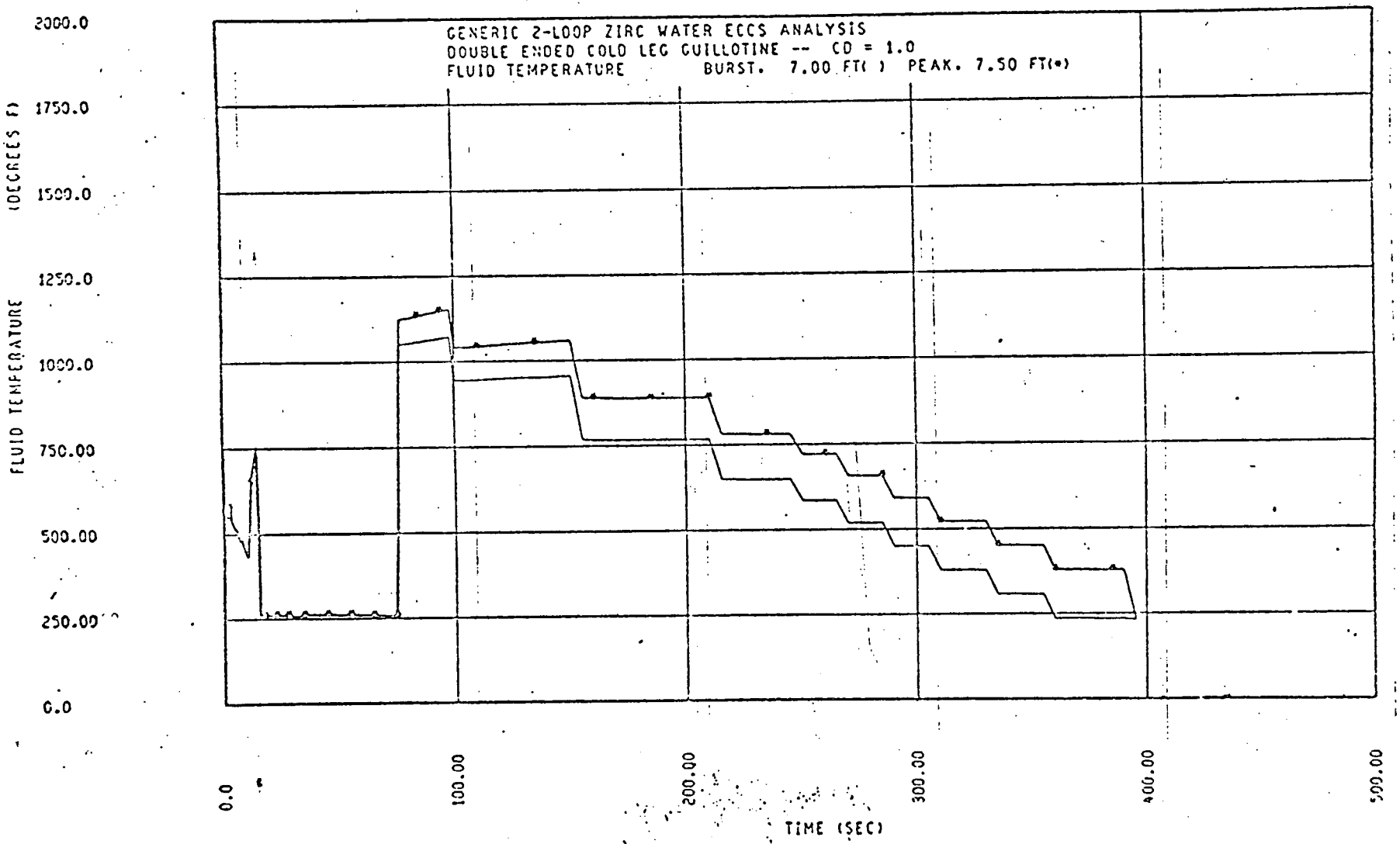

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
FLUID TEMPERATURE BURST. 7.00 FT( ) PEAK. 7.50 FT(*)
FLUID TEMPERATURE (DEGREES F)
2000.0
1750.0
1500.0
1250.0
1000.0
750.00
500.00
250.00
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 8a

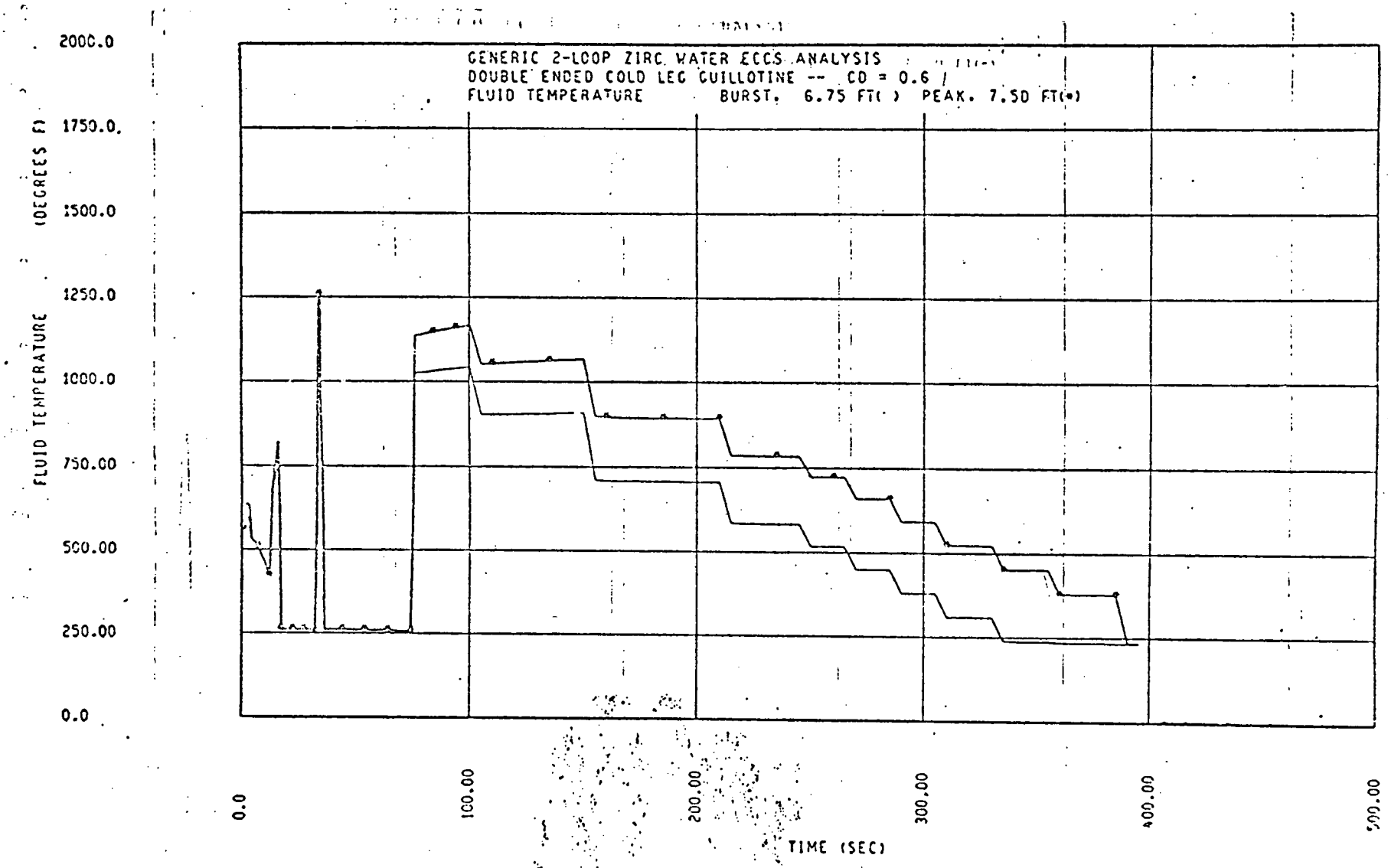

GENERIC 2-LOOP ZIRC. WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6 /
FLUID TEMPERATURE BURST, 6.75 FT( ) PEAK, 7.50 FT(•)
FLUID TEMPERATURE (DEGREES F)
2000.0
1750.0
1500.0
1250.0
1000.0
750.00
500.00
250.00
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 8b

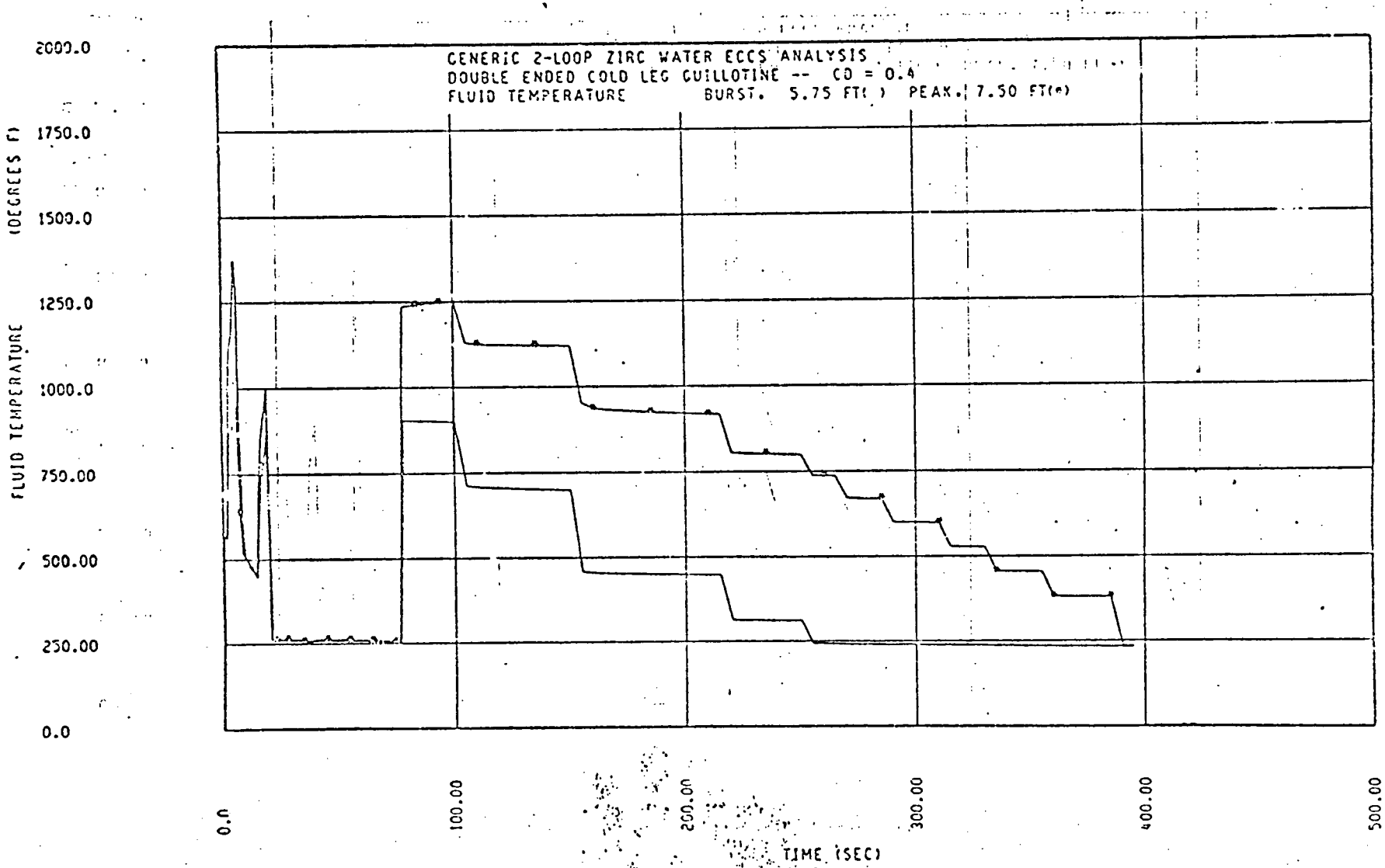

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
FLUID TEMPERATURE BURST. 5.75 FT( ) PEAK. 7.50 FT(*)
FLUID TEMPERATURE (DEGREES F)
2000.0
1750.0
1500.0
1250.0
1000.0
750.00
500.00
250.00
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 8c

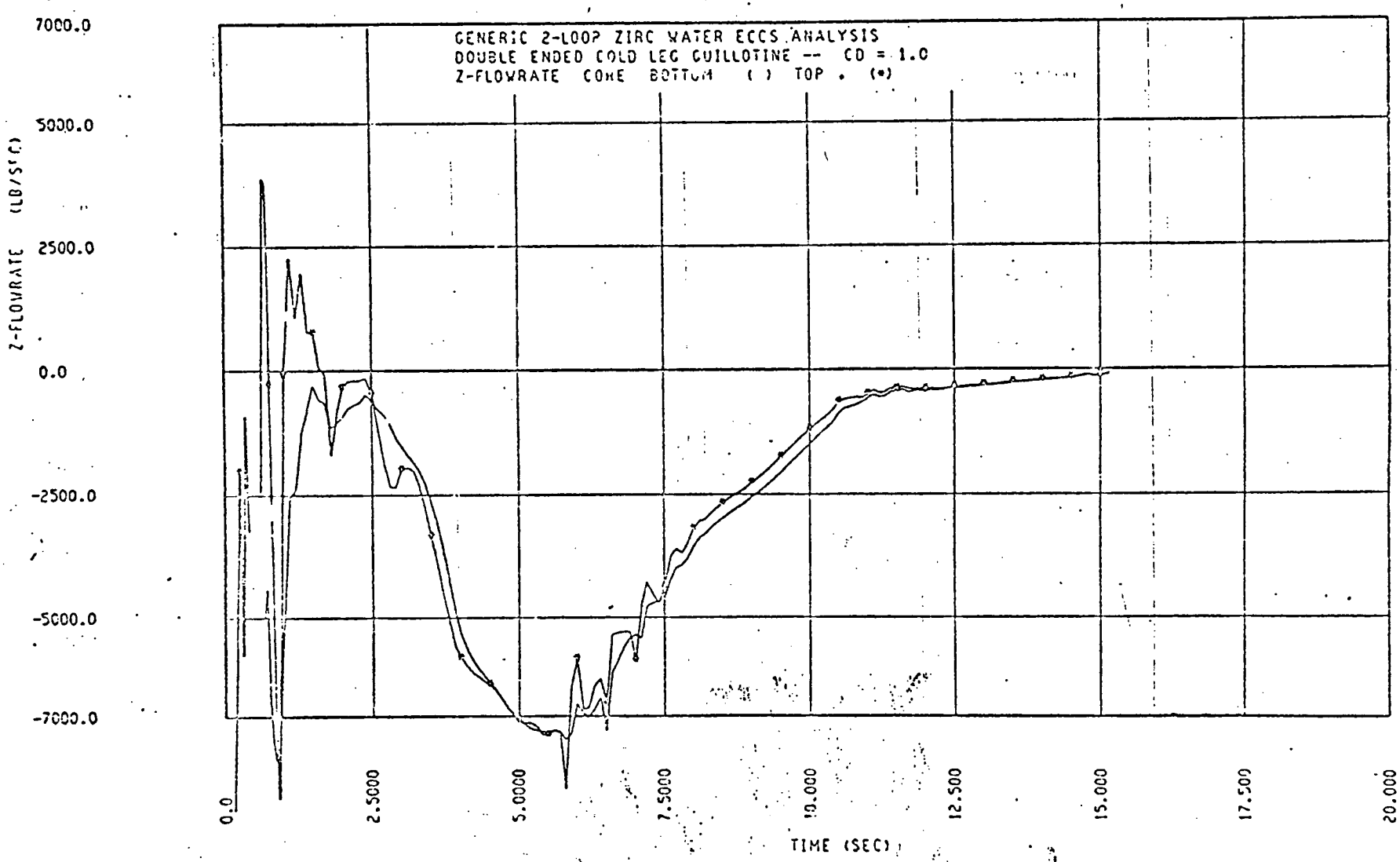

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
Z-FLOWRATE CORE BOTTOM ( ) TOP . (•)
Z-FLOWRATE (LB/SEC)
7000.0
5000.0
2500.0
0.0
-2500.0
-5000.0
-7000.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 9-a

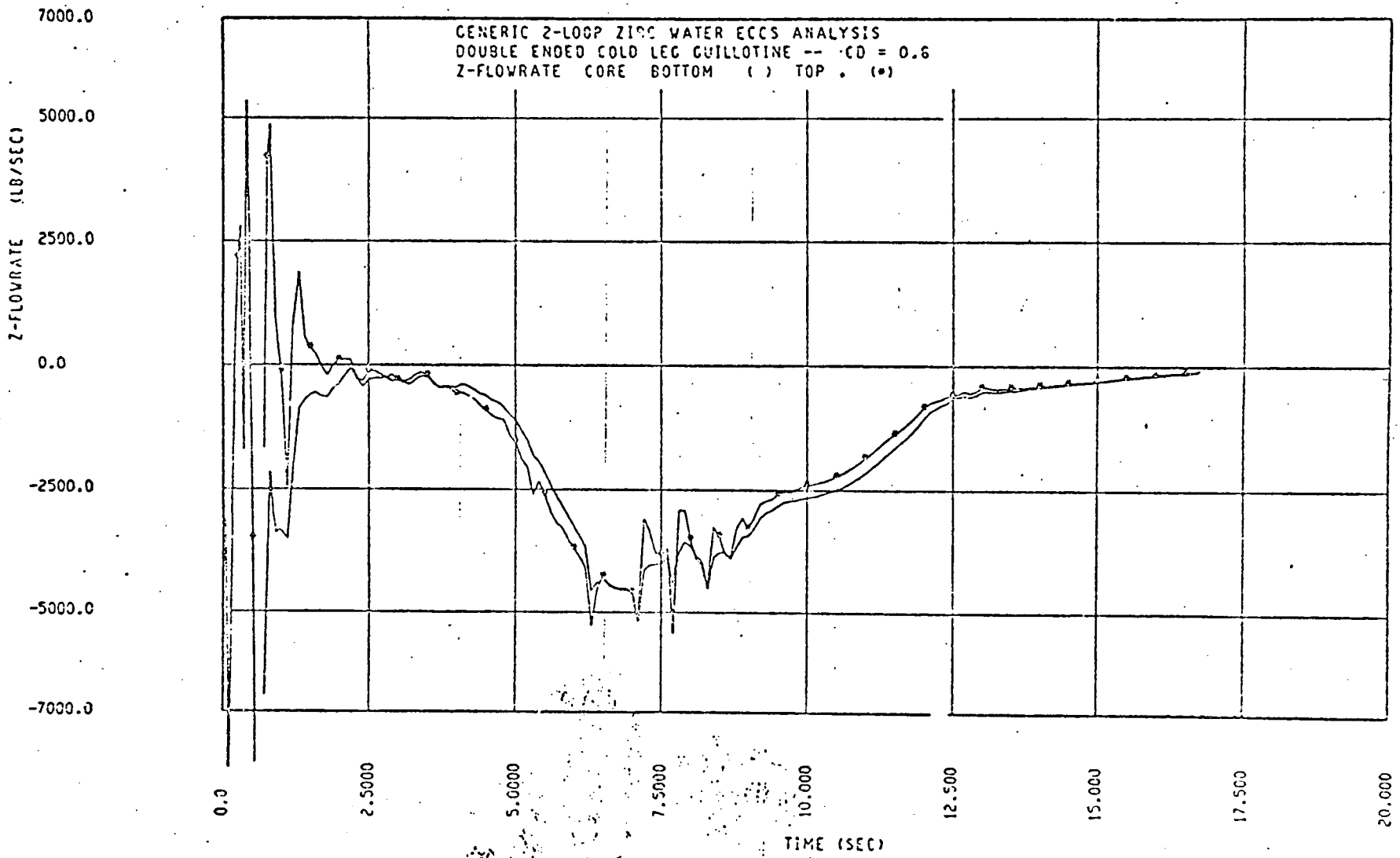

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
Z-FLOWRATE CORE BOTTOM ( ) TOP . (*)
Z-FLOWRATE (LB/SEC)
7000.0
5000.0
2500.0
0.0
-2500.0
-5000.0
-7000.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 9-6

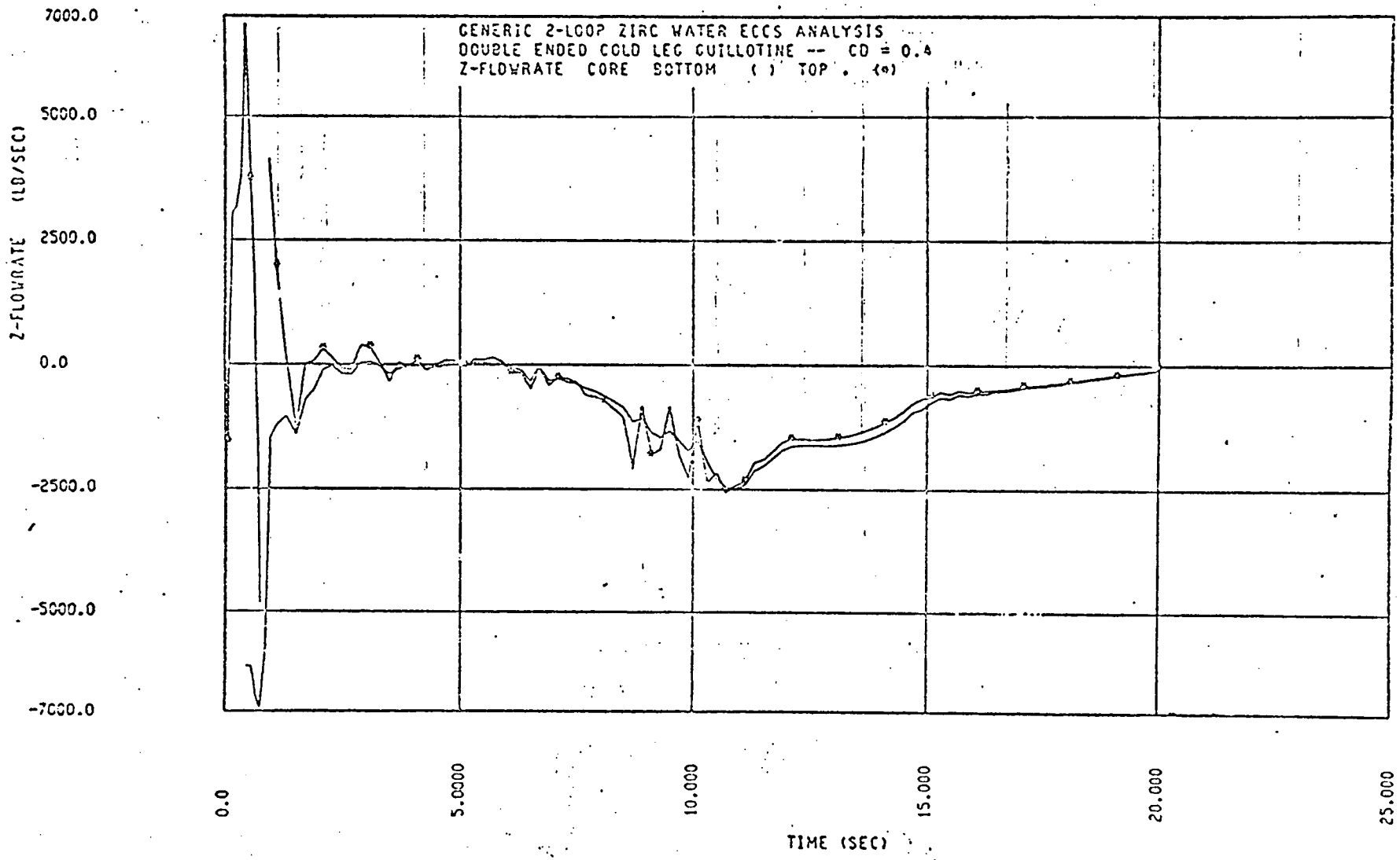

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
Z-FLOWRATE CORE BOTTOM ( ) TOP . (*)
7000.0
5000.0
2500.0
0.0
-2500.0
-5000.0
-7000.0
Z-FLOWRATE (LB/SEC)
0.0
5.0000
10.000
15.000
20.000
25.000
TIME (SEC)

FIGURE 9-c

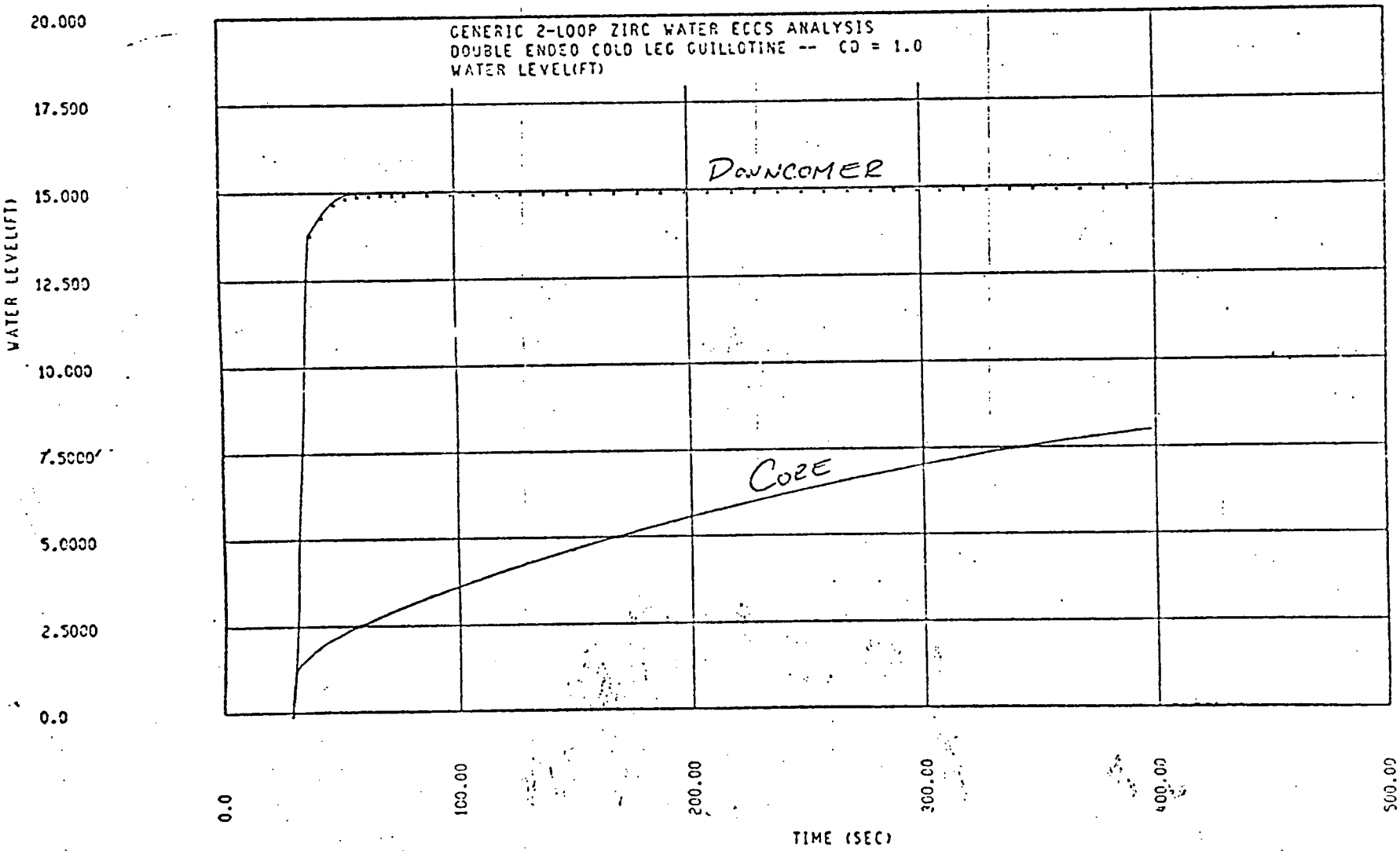

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
WATER LEVEL(FT)
DOWNCOMER
CORE
WATER LEVEL(FT)
20.000
17.500
15.000
12.500
10.000
7.5000
5.0000
2.5000
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 10-a

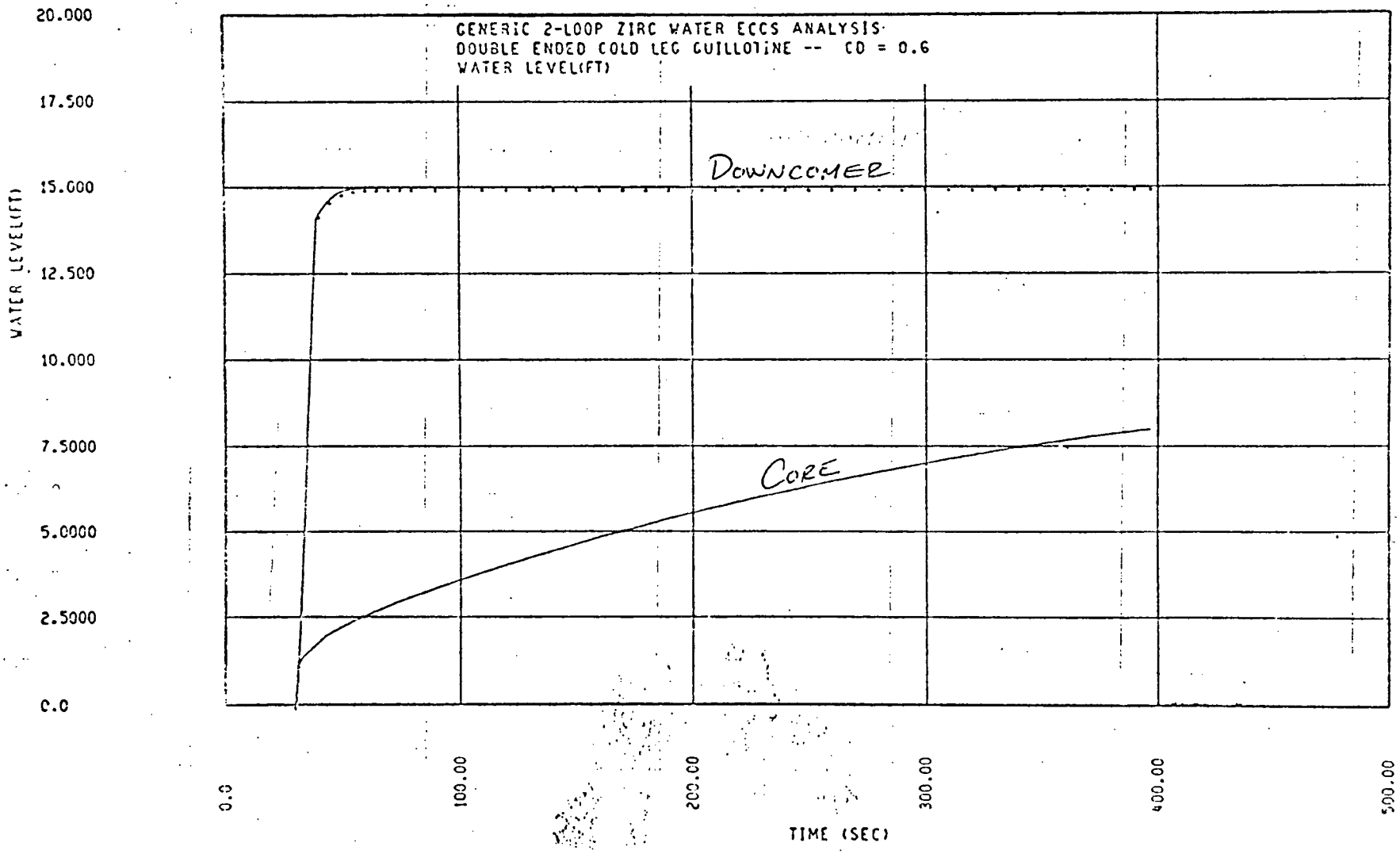

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
WATER LEVEL(FT)
DOWNCOMER
CORE
WATER LEVEL(FT)
20.000
17.500
15.000
12.500
10.000
7.5000
5.0000
2.5000
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 10-b

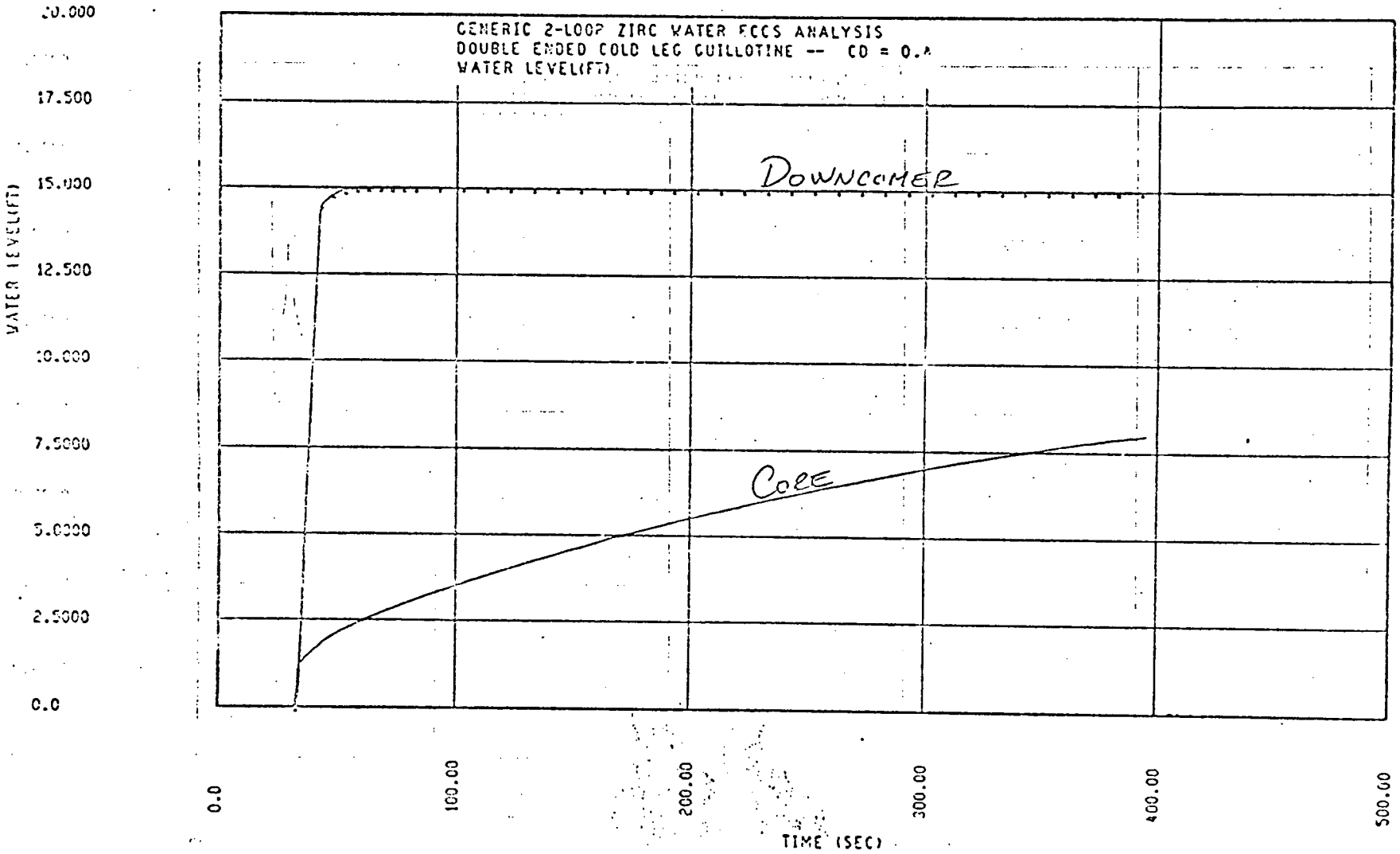

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.8
WATER LEVEL(FT)
20.000
17.500
15.000
12.500
10.000
7.5000
5.0000
2.5000
0.0
WATER LEVEL(FT)
DOWNCOMER
CORE
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 10-C

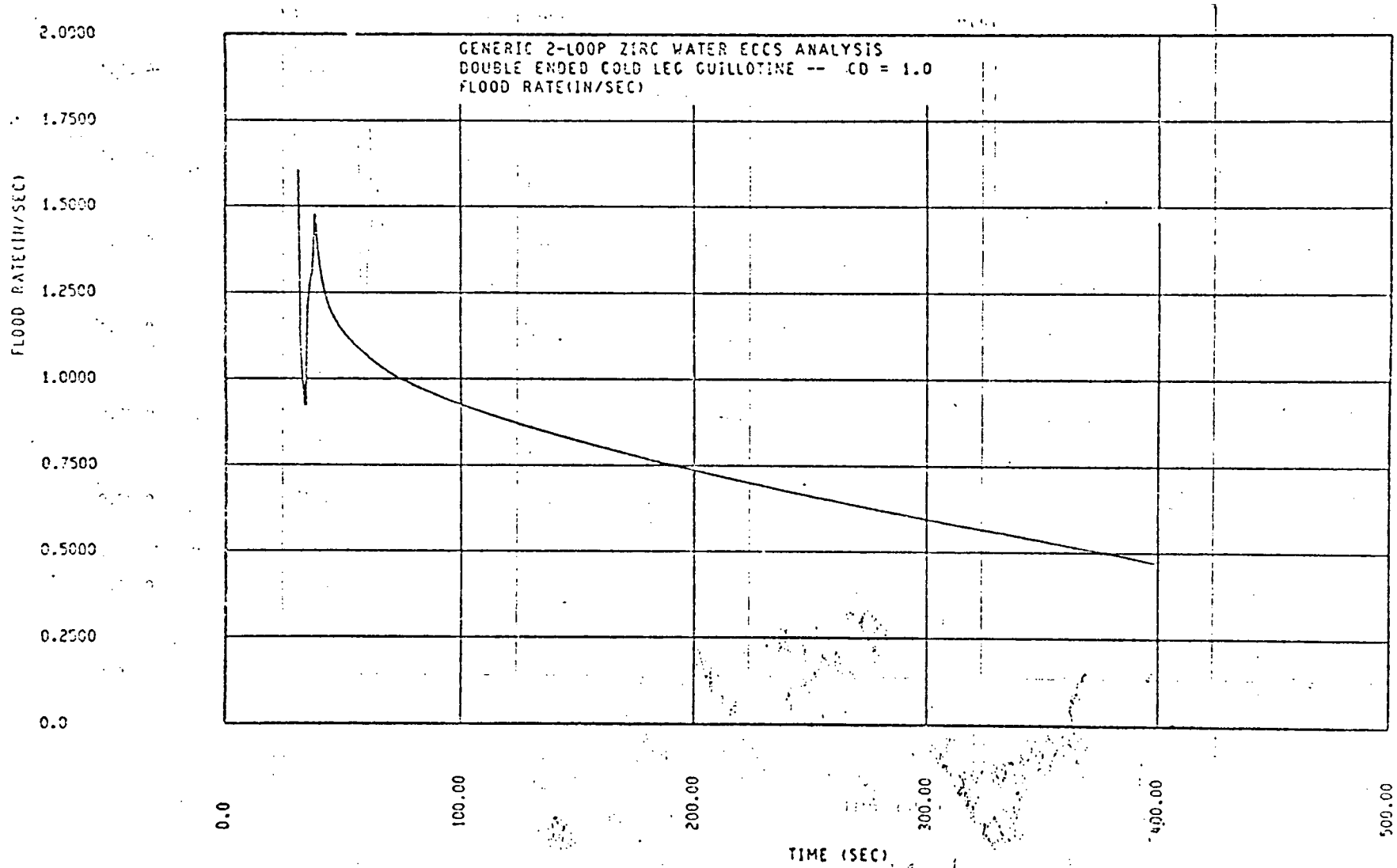

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
FLOOD RATE(IN/SEC)
FLOOD RATE(IN/SEC)
2.0000
1.7500
1.5000
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 11-a

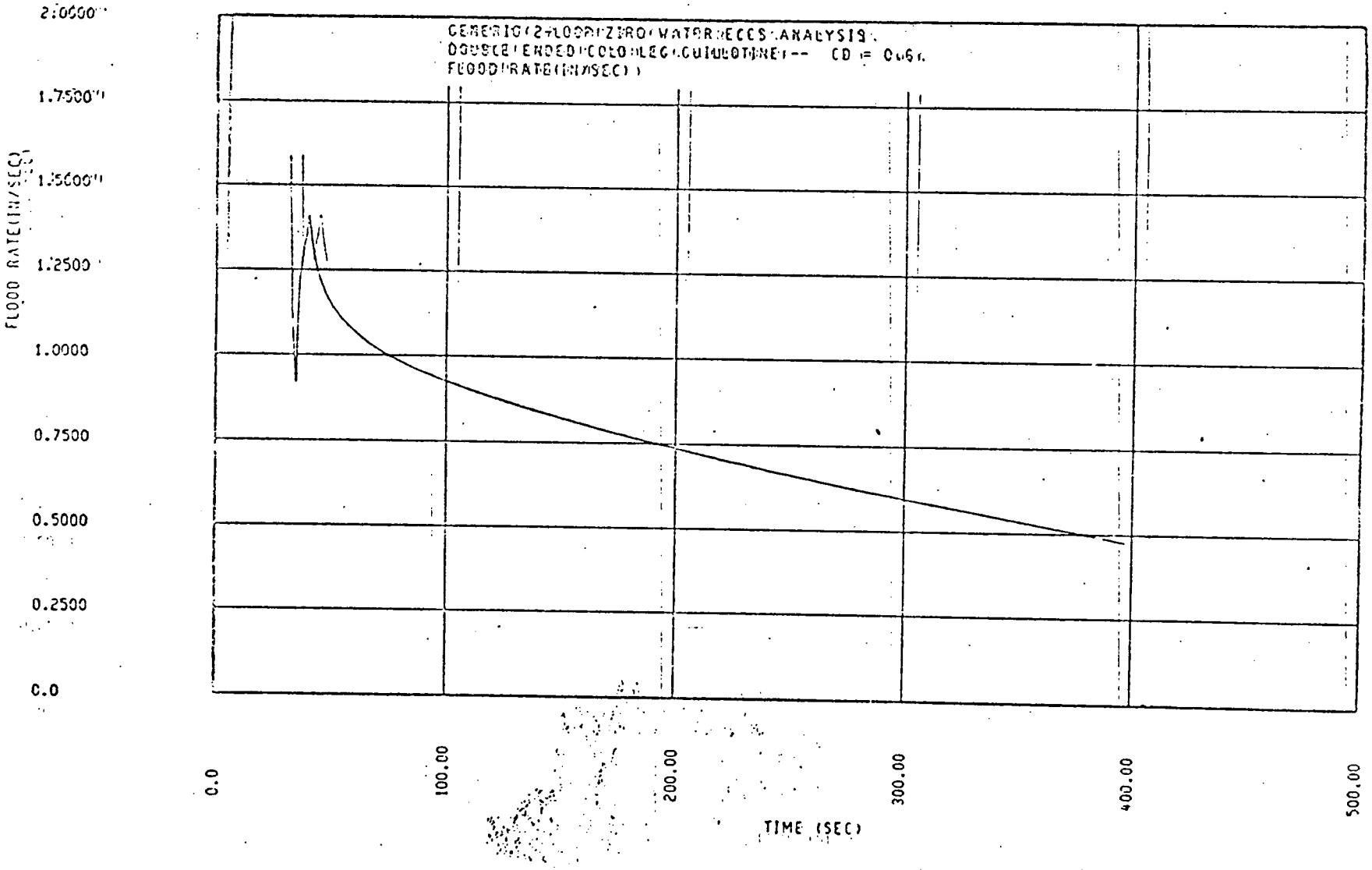

GENERIC (2-LOOP) ZERO WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
FLOOD RATE (IN/SEC)
2.0000
1.7500
1.5000
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
FLOOD RATE (IN/SEC)
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 11-b

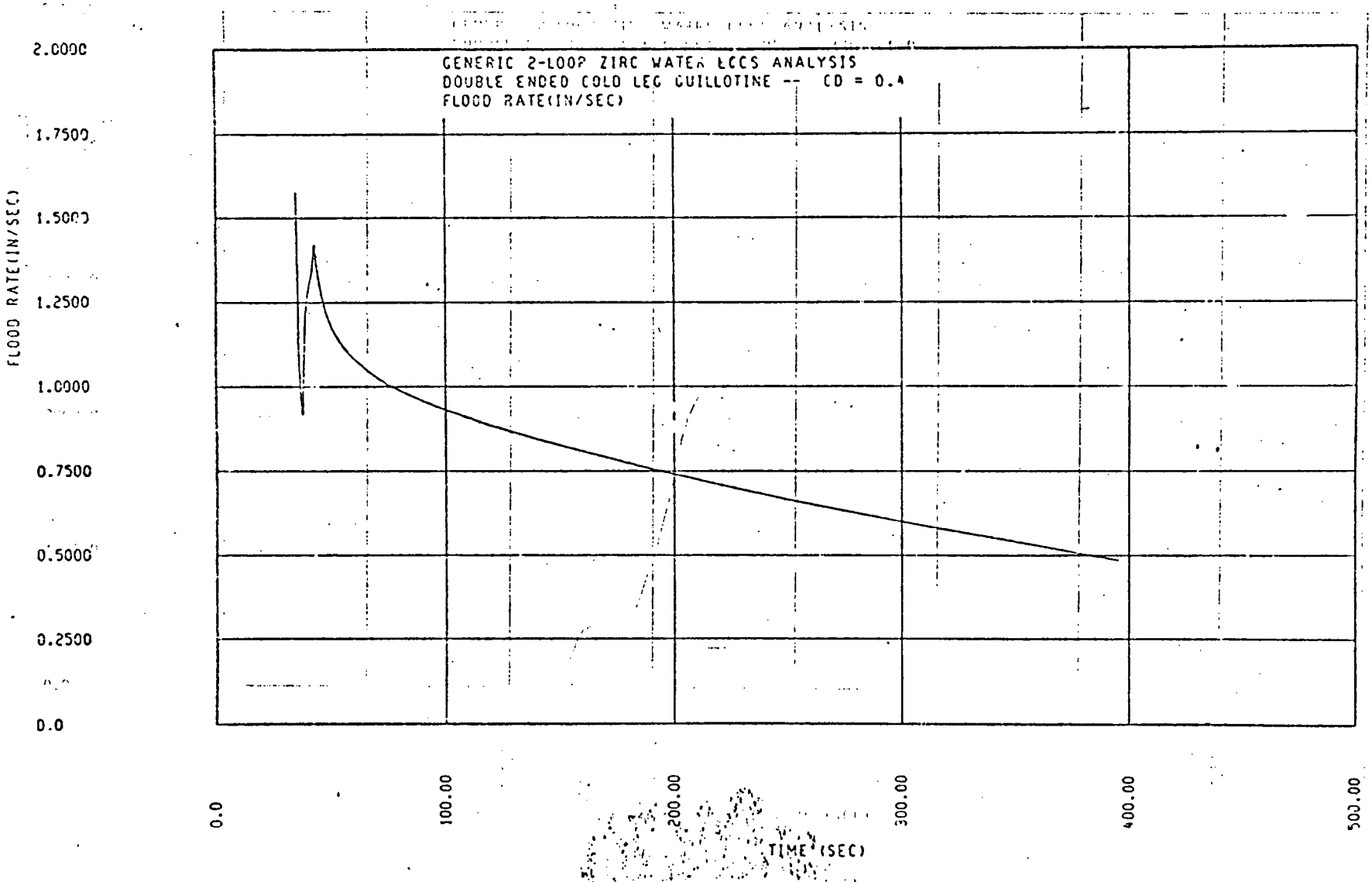

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.8
FLOOD RATE(IN/SEC)
FLOOD RATE(IN/SEC)
2.0000
1.7500
1.5000
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
100.00
200.00
300.00
400.00
500.00
TIME (SEC)

FIGURE 11-C

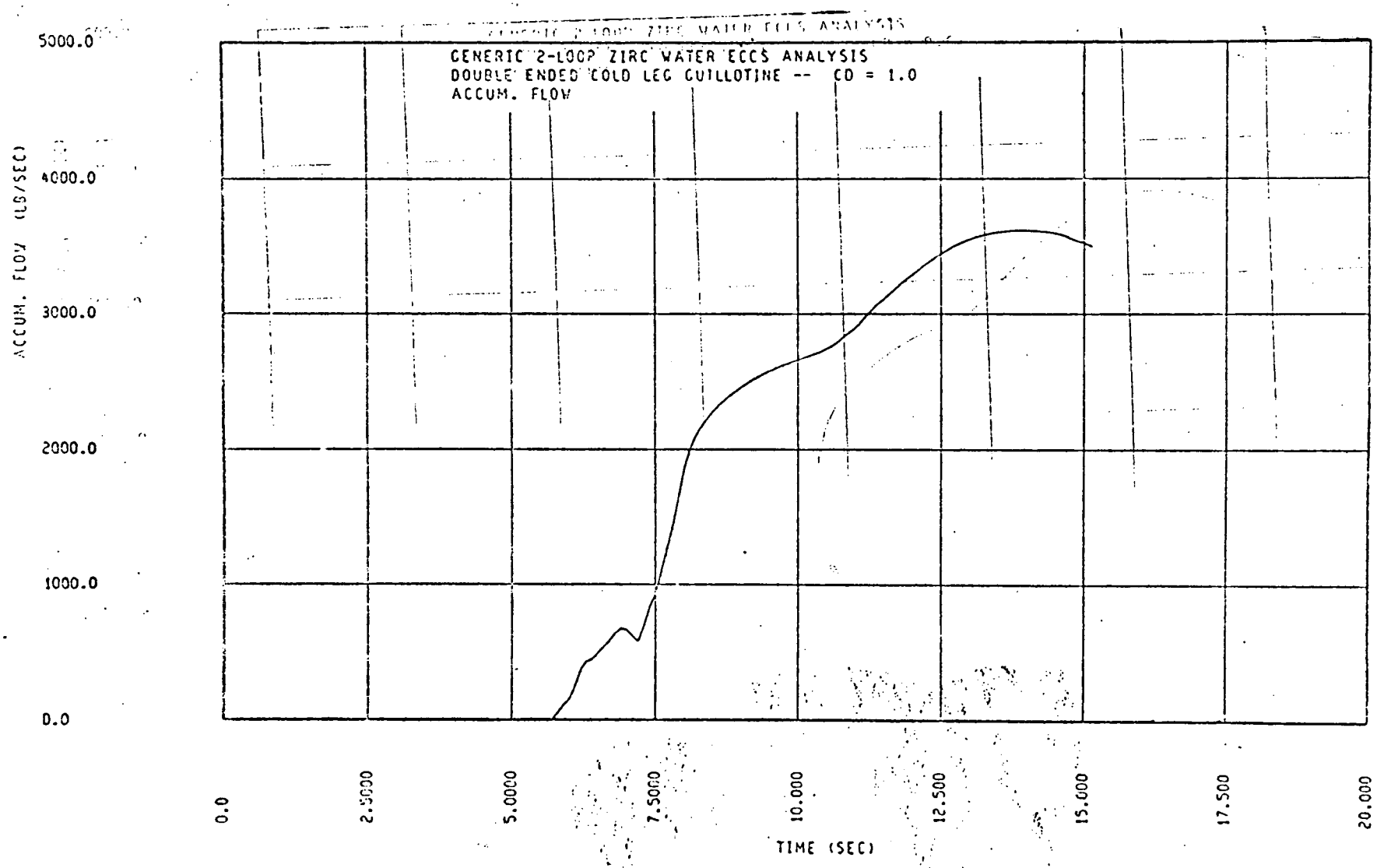

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
ACCUM. FLOW
ACCUM. FLOW (LB/SEC)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 12-a

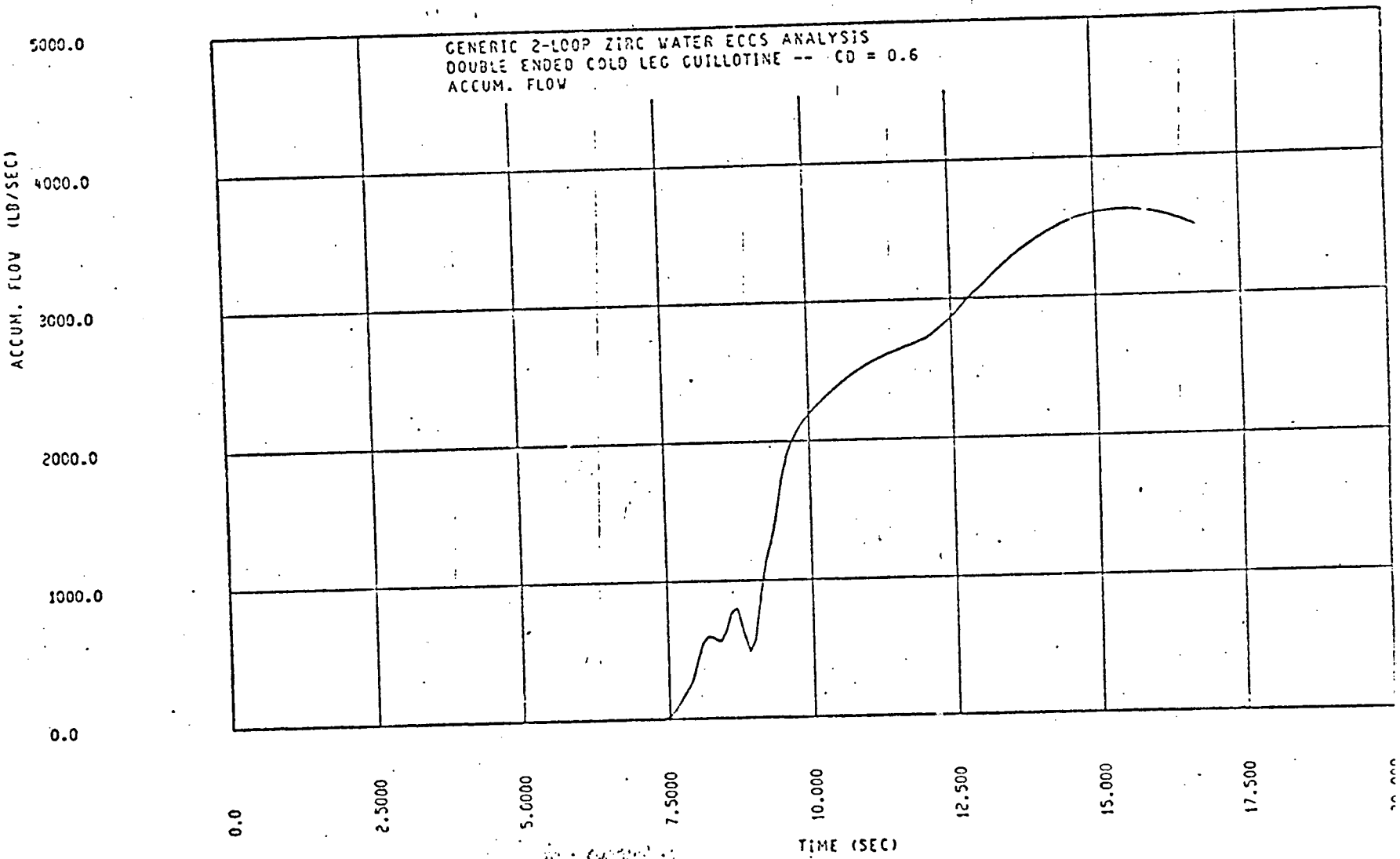

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
ACCUM. FLOW
ACCUM. FLOW (LB/SEC)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
TIME (SEC)

FIGURE 12-b

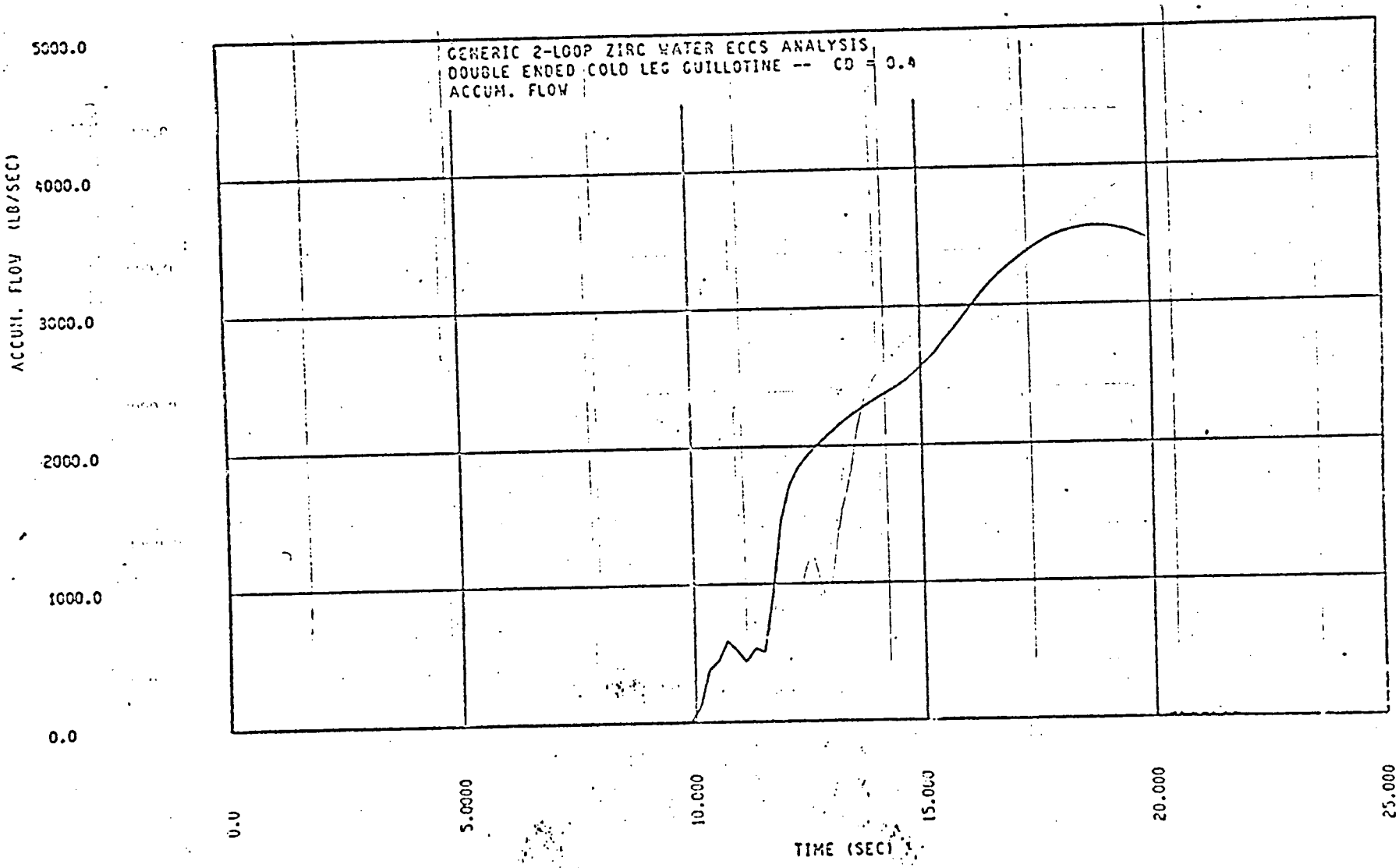

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
ACCUM. FLOW
ACCUM. FLOW (LB/SEC)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
5.0000
10.000
15.000
20.000
25.000
TIME (SEC)

FIGURE 12-C

K·E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 1320

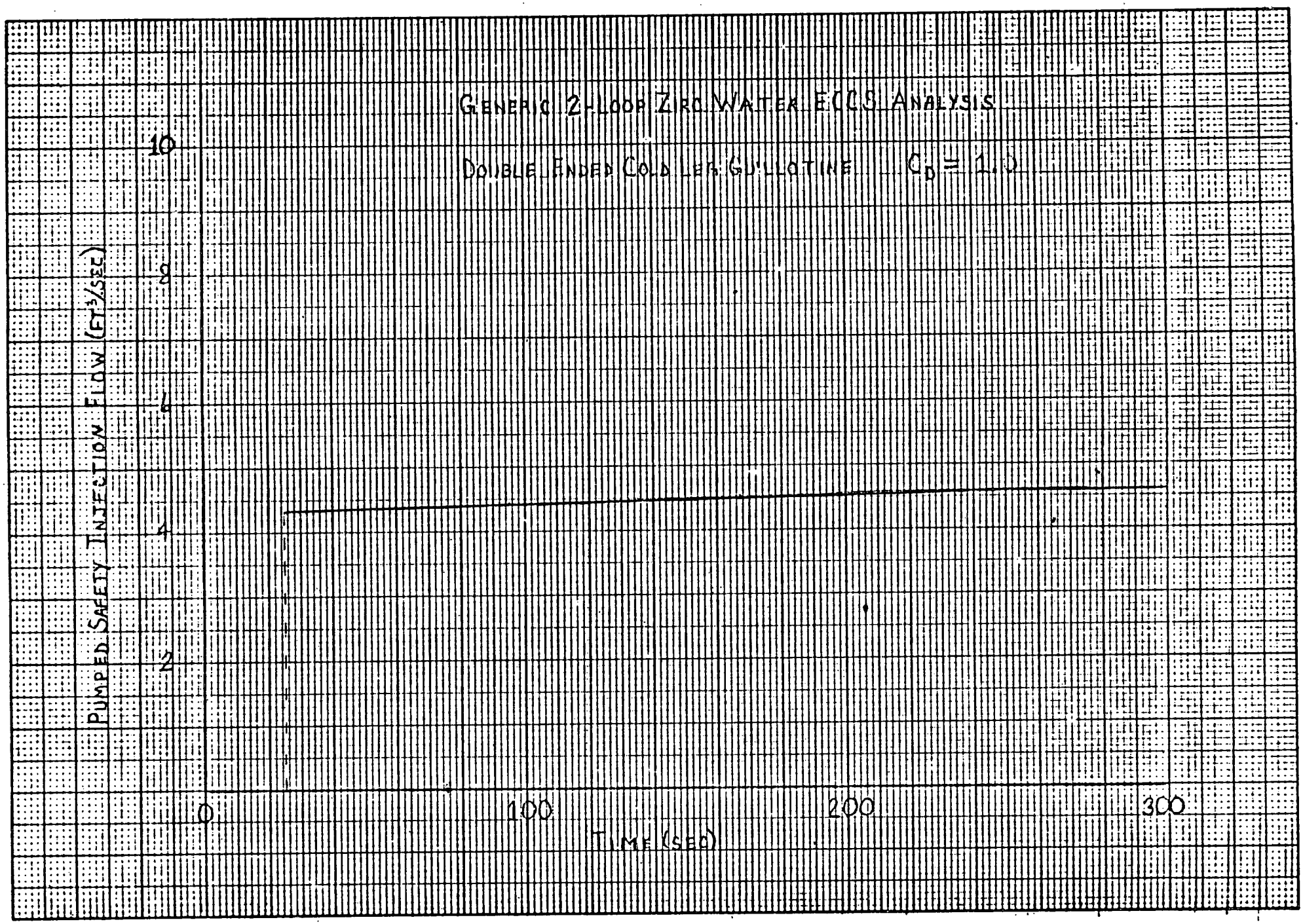


FIGURE 13-a

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 1320

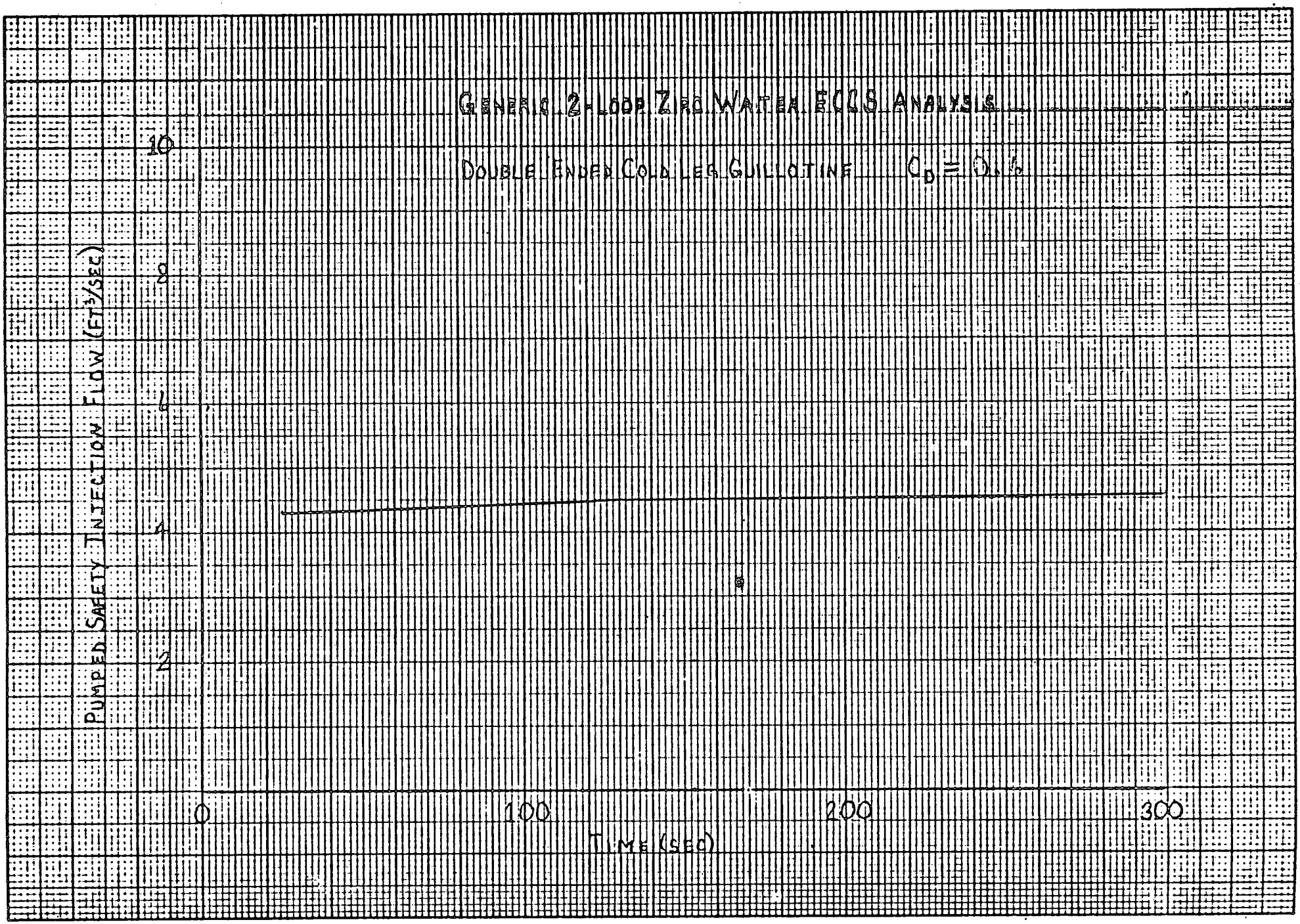


FIGURE 13-6

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1320

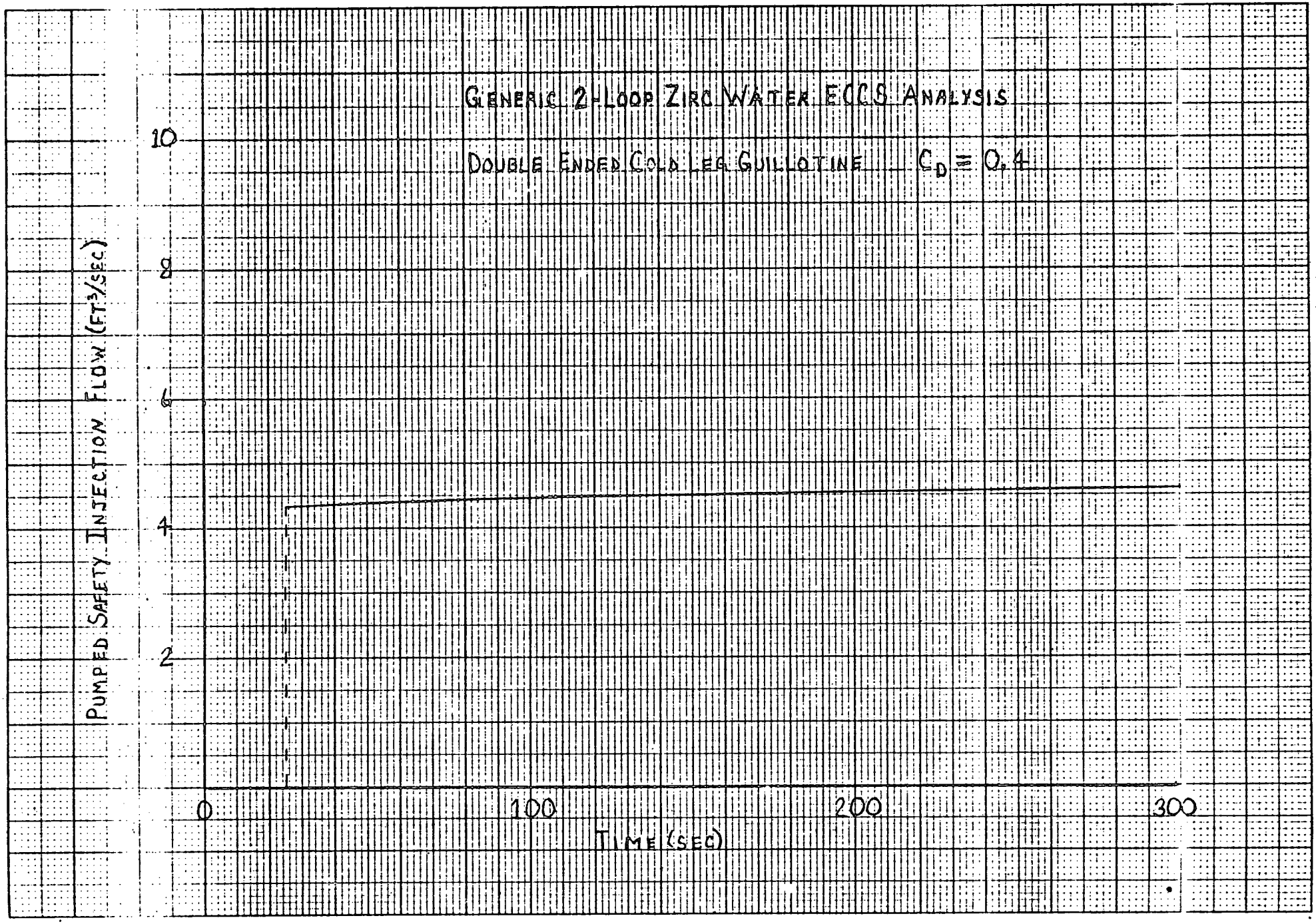


FIGURE 13-6

K•E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1320

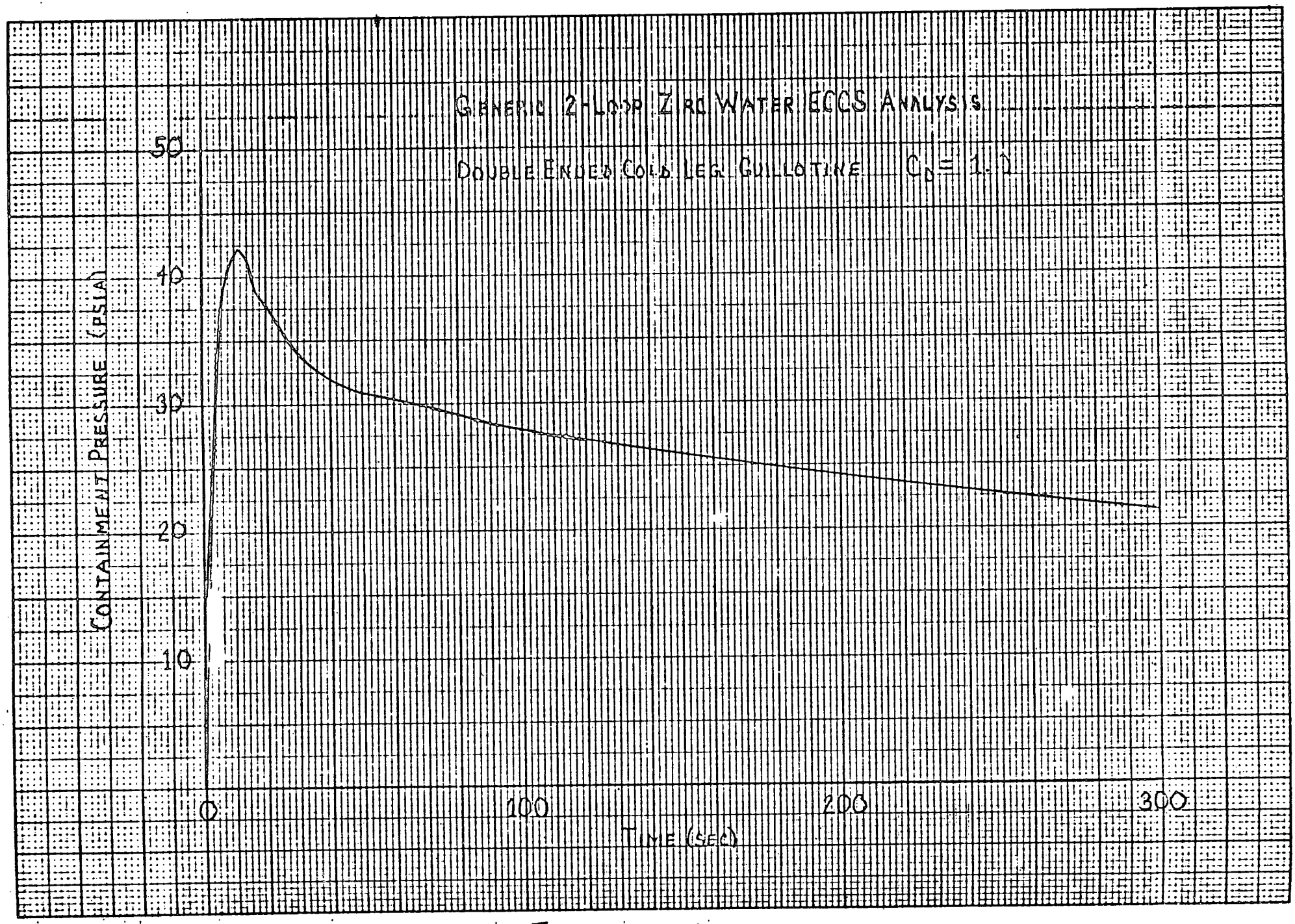


FIGURE 14-a

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1320

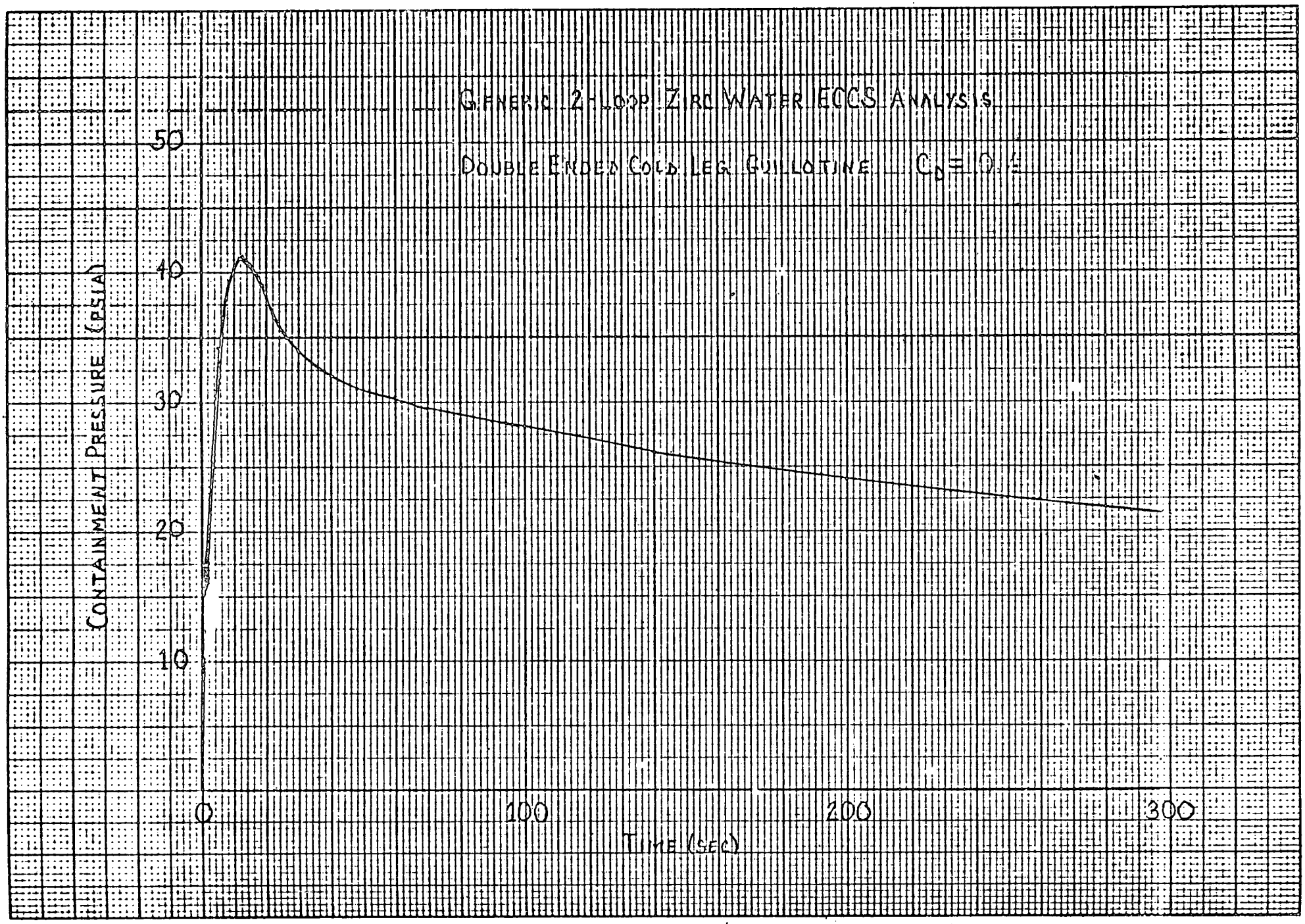


FIGURE 14-b

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1320

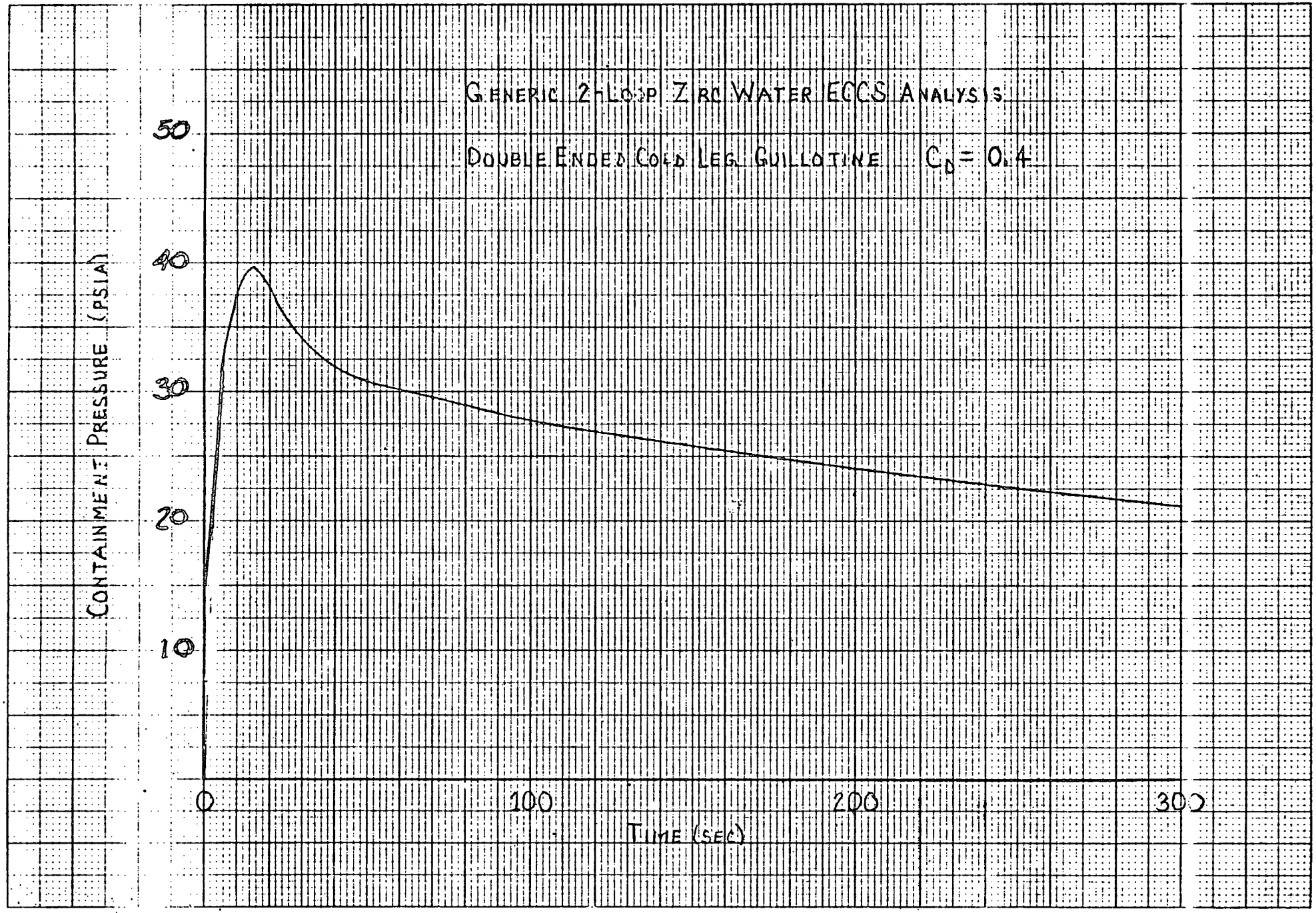


FIGURE 14-c

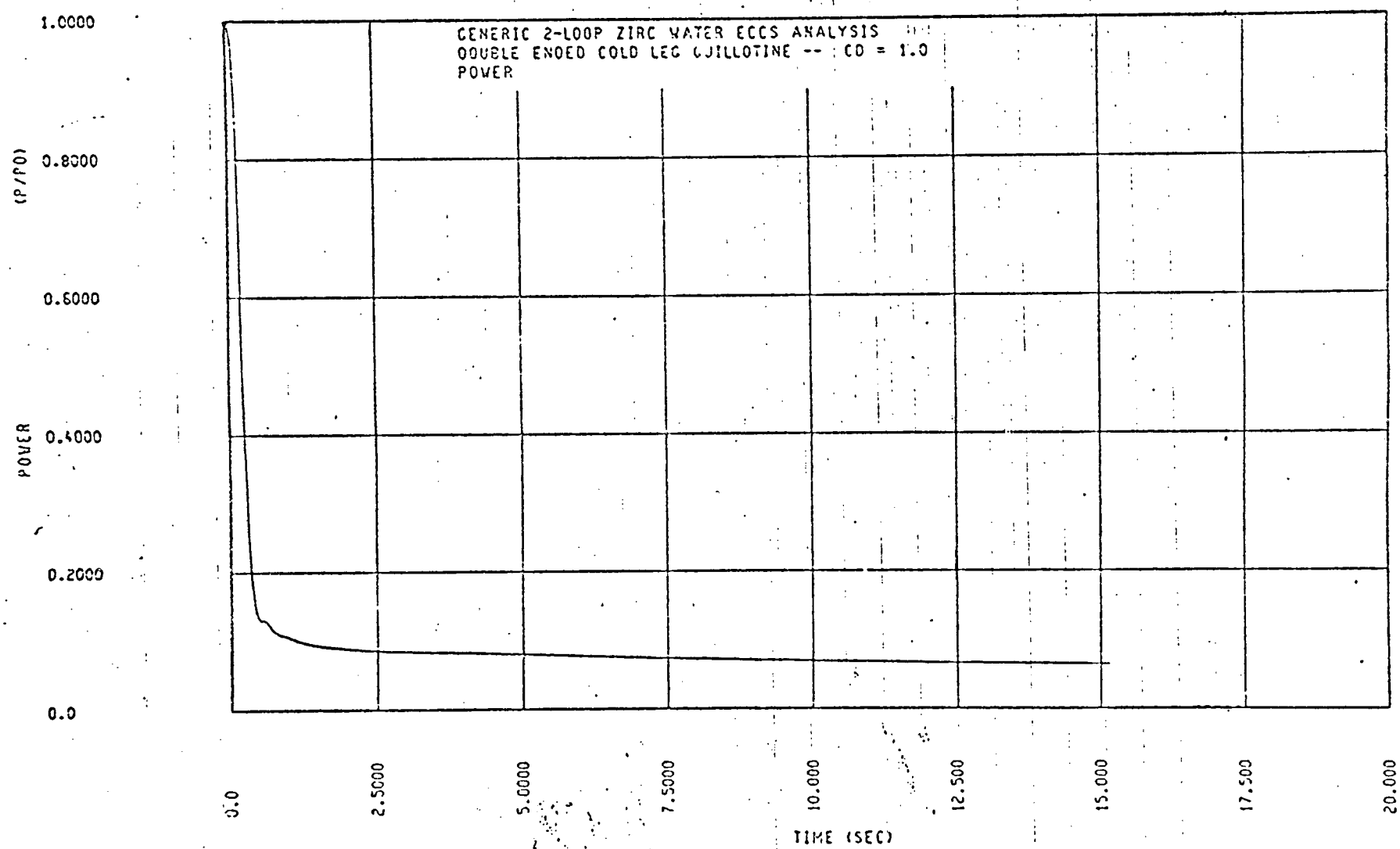

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 1.0
POWER
POWER (P/PO)
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 15-a

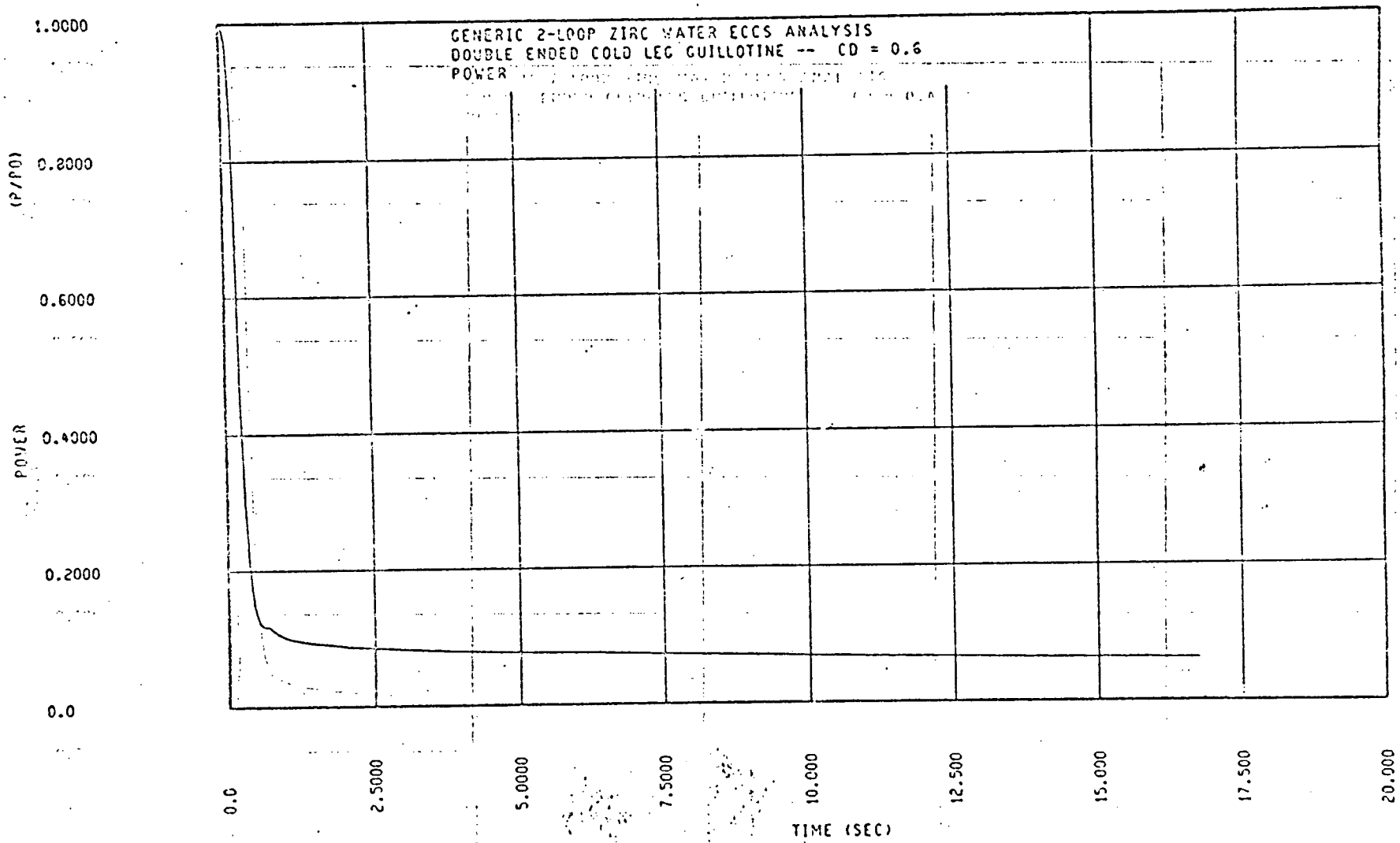

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.6
POWER
POWER (P/P0)
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
2.5000
5.0000
7.5000
10.000
12.500
15.000
17.500
20.000
TIME (SEC)

FIGURE 15-b

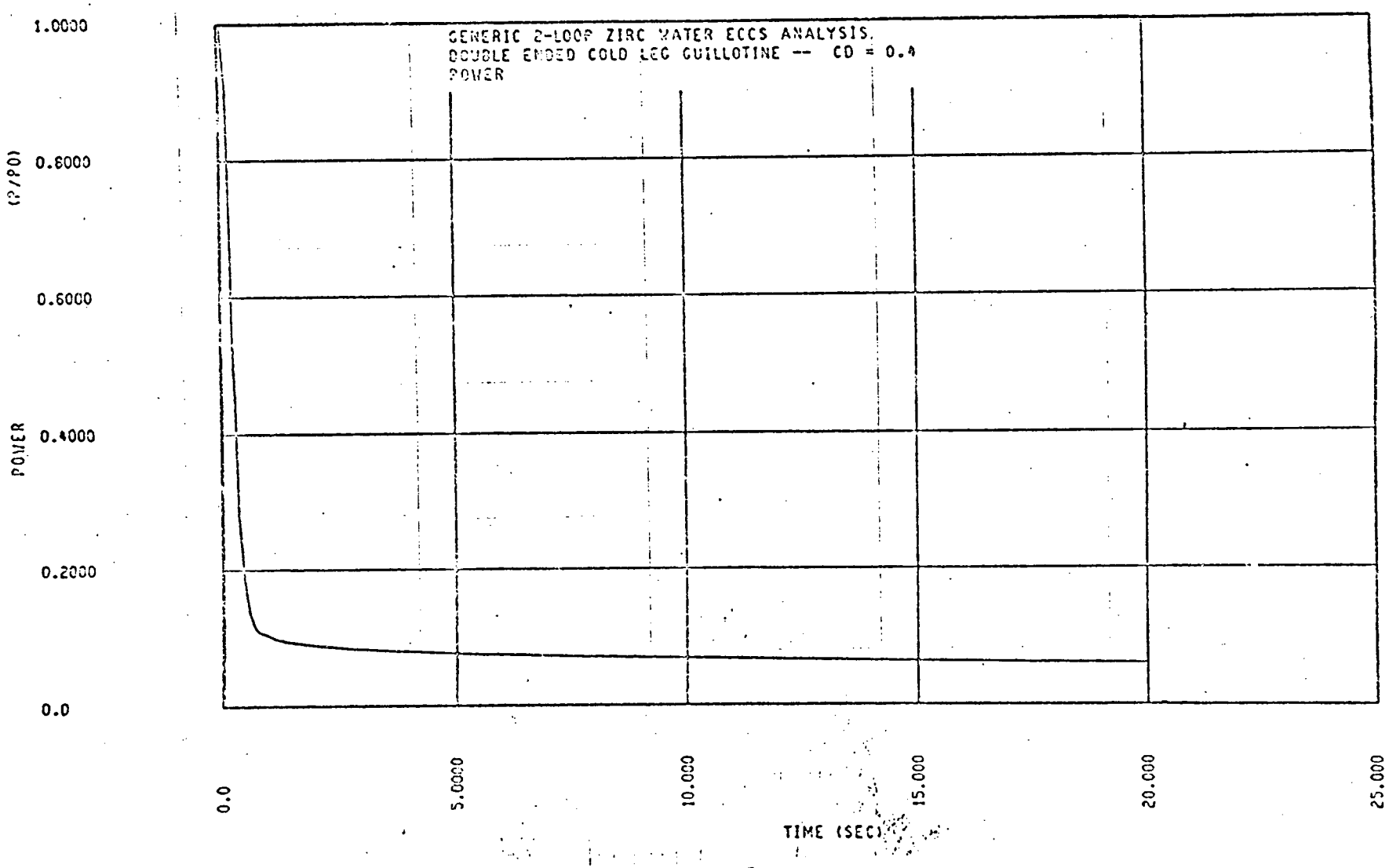

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS.
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
POWER
POWER (P/P0)
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
5.0000
10.000
15.000
20.000
25.000
TIME (SEC)

FIGURE 15-c

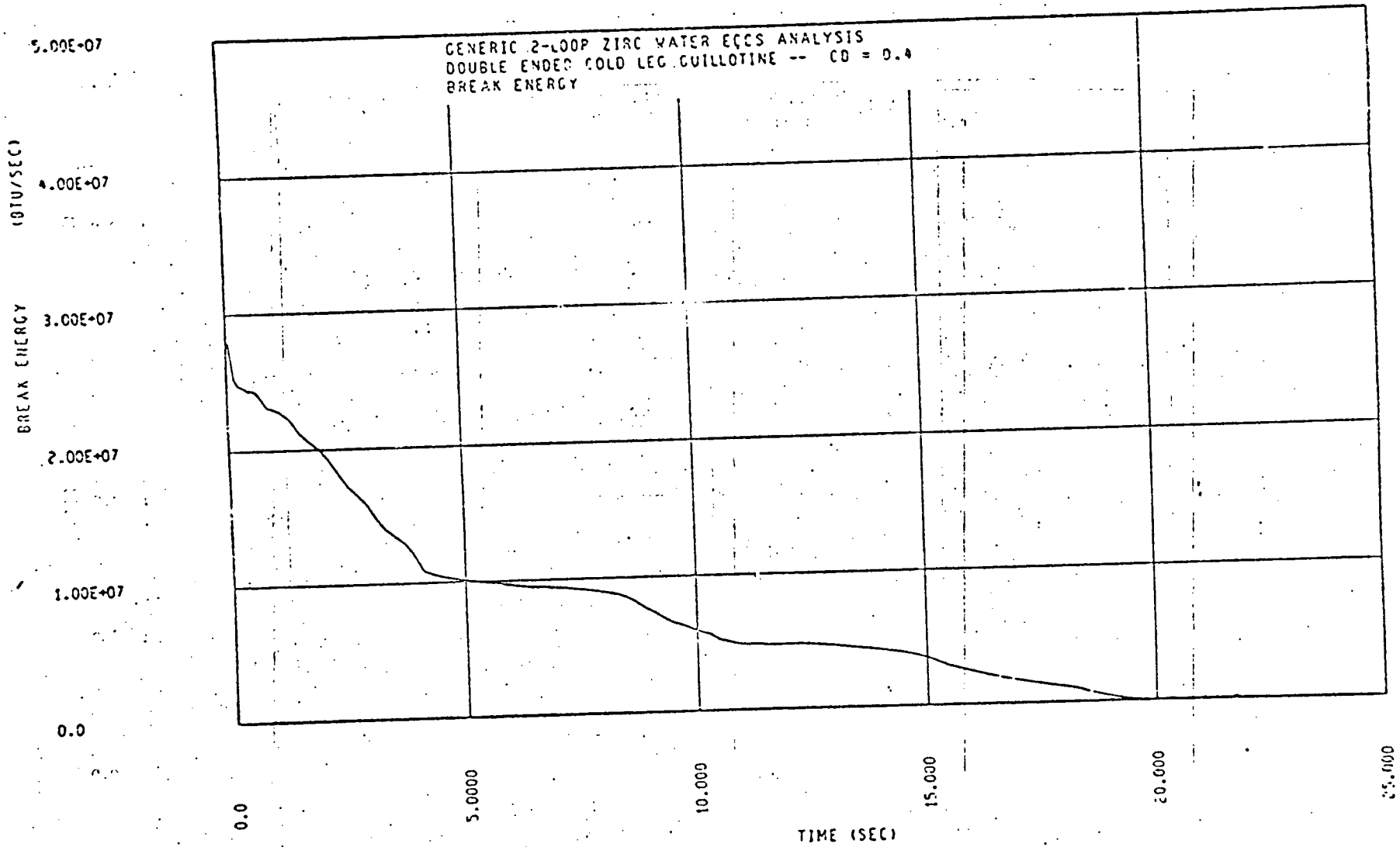

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE -- CD = 0.4
BREAK ENERGY
BREAK ENERGY (BTU/SEC)
5.00E+07
4.00E+07
3.00E+07
2.00E+07
1.00E+07
0.0
0.0
5.0000
10.000
15.000
20.000
25.000
TIME (SEC)

FIGURE 16

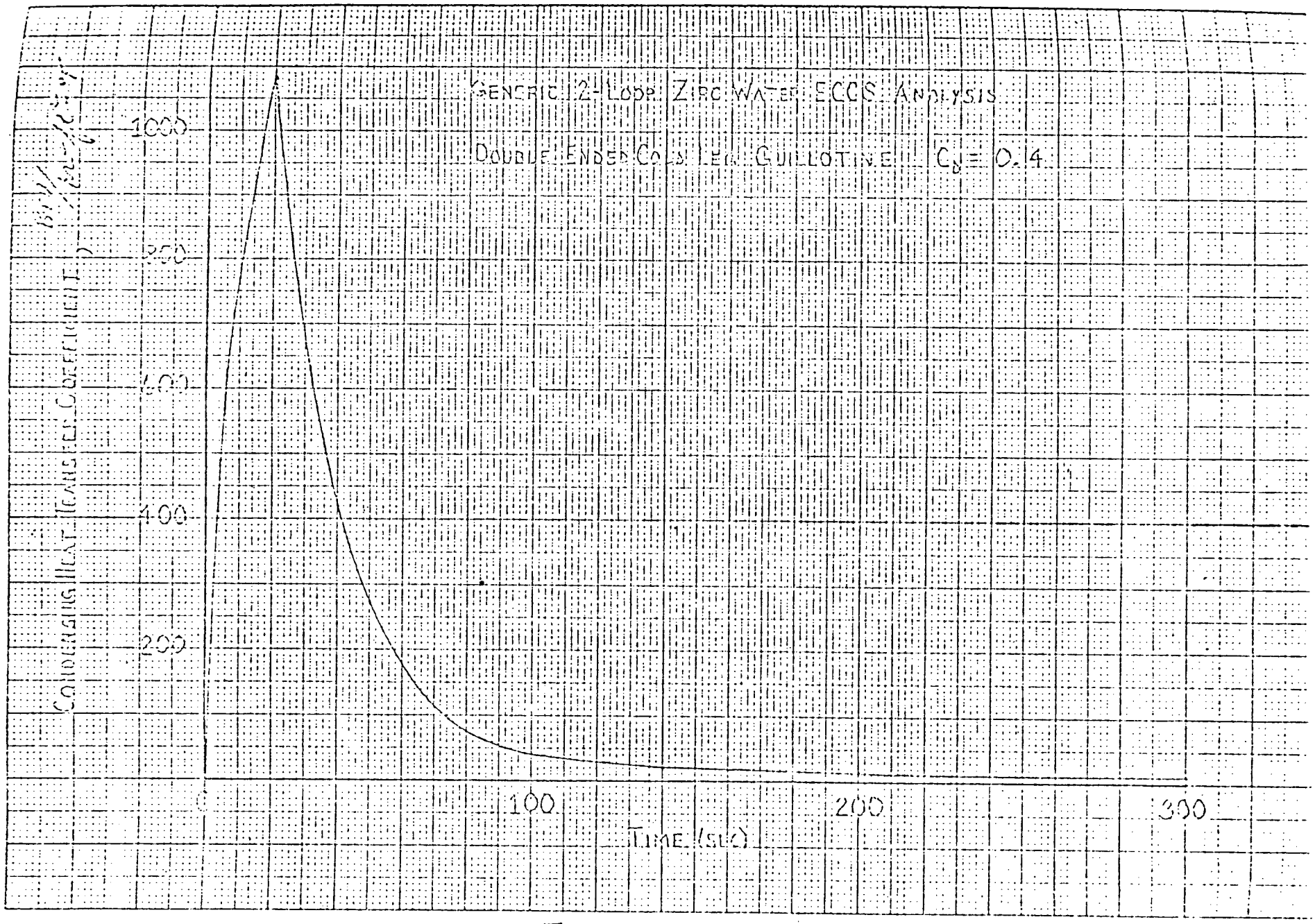

GENERIC 2-LOOP ZIRC WATER ECCS ANALYSIS
DOUBLE ENDED COLD LEG GUILLOTINE $C_d = 0.4$
CONDENSING HEAT TRANSFER COEFFICIENT
1000
800
600
400
200
0
100
200
300
TIME (SEC)

FIGURE 17