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October 20, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: Catawba Nuclear Station
Docket Nos. 50-413 and 50-414

Dear Mr. Denton:

Attached herewith are twenty (20) copies of Revision 9 to Duke Power Company's report, "An Analysis of Hydrogen Control Measures at McGuire Nuclear Station". This revision consists of an Appendix which provides the necessary technical information to establish the applicability of the McGuire report to Catawba Nuclear Station.

The following specific information is included in the Appendix:

1. A discussion of the applicability of previously submitted technical information to Catawba.

2. Confirmatory analysis of containment response using CLASIX with initial conditions and assumptions identical to the base case analysis performed for McGuire.

3. Assessment of equipment survivability at Catawba based on comparison between the qualification profiles used at McGuire and Catawba.

It is our conclusion that the report, "An Analysis of Hydrogen Control Measures at McGuire Nuclear Station", supplemented by the information provided in this submittal, establishes the basis for the acceptability of the hydrogen control measures at Catawba.

You will note that certain figures in the Appendix are to be supplied later. These figures are Duke drawings which are in the process of being revised to reflect the changes made in the instrumentation, control, and power distribution of the Hydrogen Mitigation System as a result of our recent commitment to provide remote operation and control room indication of system status. We expect new revisions of these drawings to be available December 1, 1983 and will distribute the missing figures to you at that time.

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Please advise if there are any further questions regarding this matter.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

ROS/php

Attachments

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
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Appendix A

Applicability to Catawba Nuclear Station

Section 1A

INTRODUCTION

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1.0A Introduction

The document entitled "An Analysis of Hydrogen Control Measures at McGuire Nuclear Station" was issued in three volumes in October, 1981. Subsequent revisions to this document have been issued to keep the information current and to document responses to NRC questions. As a result of this information, approval was granted by NRC of the hydrogen mitigation system at McGuire in supplement 7 to the McGuire Safety Analysis Report, NUREG-0422.

The Catawba Nuclear station of Duke Power Company, because the design of its containment building and associated systems is virtually identical to that of McGuire, will utilize hydrogen control measures which are identical to those used at McGuire and described in the main body of the report on hydrogen control measures for McGuire, hereinafter called the "Red Book."

1.1A Applicability of McGuire Information

The following information is provided concerning the specific applicability of the information in the Red Book to Catawba Nuclear Station.

Section 1.0 - Applicable in its entirity.

Section 2.0 - Applicable in its entirity.

Section 3.0 - The text description of the hydrogen mitigation system is applicable to Catawba, but new tables and figures are included in this Appendix.

Section 4.0 - The general discussion of containment response and sensitivities is applicable to Catawba. The results of a confirmatory analysis performed for Catawba using the latest version of CLASIX is reported in this appendix.

Section 5.0 - The methods of assessment of equipment survivability are identical between units. A new section has been included in this Appendix to document the survivability of Catawba equipment not identical to that used in similar applications at McGuire.

Section 6.0 - Applicable in its entirity.

Section 7.0 - Applicable in its entirity.

Section 3.0A

DESCRIPTION OF PERMANENT HYDROGEN MITIGATION SYSTEM

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3.1A Introduction

The hydrogen mitigation system used at Catawba is identical to that used at McGuire, except for minor differences in terminal box designation and igniter location. The design basis and system description are unchanged from McGuire, and the methods of operation and testing will also be identical to those used at McGuire.

The following tables and figures are provided in this section which provide specific information related to Catawba:

Table 3.1A-1 provides the same information on igniter locations at Table 3.4-1 does for McGuire.

Figure 3.4-1 is applicable to both Catawba and McGuire and is not repeated in the appendix.

Figure 3.1A-1 (Catawba drawing CNEE-0165-02.01) is the equivalent of Figure 3.4-2.

Figures 3.1A-2 through 3.1A-5 provide a schematic representation of igniter locations in the Catawba containment building.

These figures are analogous to Figures 3.4-3 through 3.4-6 for McGuire.

Figure 3.1A-6 shows the power distribution, control, and indication for the Hydrogen Mitigation System for Catawba. It is analogous to figure 3.4-7 for McGuire.

Figure 3.1A-7 shows the specific igniter assignments in the various strings inside containment, illustrating the separation and redundancy in the system. This figure is analogous to Figure 3.4-9 for McGuire.

Table 3.1A-1

Hydrogen Igniter Locations

Term. Box No.	Room; Area	Elevation	Azimuth
1EHM0001	incore instr. tunnel	547	94°
1EHM0002	incore instr. tunnel	547	86°
1EHM0003	lower cont. pipe tunnel	562	92°
1EHM0004	lower cont. pipe tunnel	562	88°
1EHM0005	lower cont. pipe tunnel	562	178°
1EHM0006	lower cont. pipe tunnel	562	182°
1EHM0007	lower cont. pipe tunnel	562	277°
1EHM0008	lower cont. pipe tunnel	562	273°
1EHM0009	lower cont. pipe tunnel	562	5°
1EHM0010	lower cont. pipe tunnel	562	8°
1EHM0011	lower containment	590	326°
1EHM0012	lower containment	590	326°
1EHM0013	fan/accumulator room	601	324°
1EHM0014	fan/accumulator room	601	324°
1EHM0015	top of S/G enclosure	643	335°
1EHM0016	top of S/G enclosure	643	339°
1EHM0017	lower containment	590	2°
1EHM0018	lower containment	590	6°
1EHM0019	fan/accumulator room	601	42°
1EHM0020	fan/accumulator room	601	42°
1EHM0021	top of S/G enclosure	643	18°
1EHM0022	top of S/G enclosure	643	22°
1EHM0023	fan/accumulator room	590	53°
1EHM0024	fan/accumulator room	590	53°
1EHM0025	fan/accumulator room	590	214°
1EHM0026	fan/accumulator room	590	214°
1EHM0027	air return fan discharge	590	245°
1EHM0028	air return fan discharge	590	243°
1EHM0029	incore instr. seal table area	590	91°
1EHM0030	incore instr. seal table area	590	96°
1EHM0031	reactor vessel cavity	602	22°
1EHM0032	reactor vessel cavity	602	158°
1EHM0033	top of PZR enclosure	641	114°
1EHM0034	top of PZR enclosure	641	114°
1EHM0035	lower containment	590	145°
1EHM0036	lower containment	590	145°

Term. Box No.	Room; Area	Elevation	Azimuth
1EHM0037	fan/accumulator room	601	121°
1EHM0038	fan/accumulator room	601	121°
1EHM0039	top of S/G enclosure	643	161°
1EHM0040	top of S/G enclosure	643	165°
1EHM0041	lower containment	590	172°
1EHM0042	lower containment	590	176°
1EHM0043	fan/accumulator room	601	216°
1EHM0044	fan/accumulator room	601	216°
1EHM0045	top of S/G enclosure	643	206°
1EHM0046	top of S/G enclosure	643	210°
1EHM0047	ice condenser	666	232°
1EHM0048	ice condenser	666	321°
1EHM0049	ice condenser	666	11°
1EHM0050	ice condenser	666	34°
1EHM0051	ice condenser	666	59°
1EHM0052	ice condenser	666	84°
1EHM0053	ice condenser	666	108°
1EHM0054	ice condenser	666	133°
1EHM0055	ice condenser	666	157°
1EHM0056	ice condenser	666	183°
1EHM0057	ice condenser	666	206°
1EHM0058	ice condenser	666	232°
1EHM0059	upper containment dome	714	318°
1EHM0060	upper containment dome	714	310°
1EHM0061	upper containment dome	714	49°
1EHM0062	upper containment dome	714	57°
1EHM0063	upper containment dome	714	140°
1EHM0064	upper containment dome	714	132°
1EHM0065	upper containment dome	714	218°
1EHM0066	upper containment dome	714	226°
1EHM0067	lower containment	557	85°
1EHM0068	lower containment	557	85°
1EHM0069	midelevation upper containment	649	140°
1EHM0070	midelevation upper containment	649	220°
1EHM0071	midelevation upper containment	649	320°
1EHM0072	midelevation upper containment	649	40°

Figure 3.1A-1

(Later)

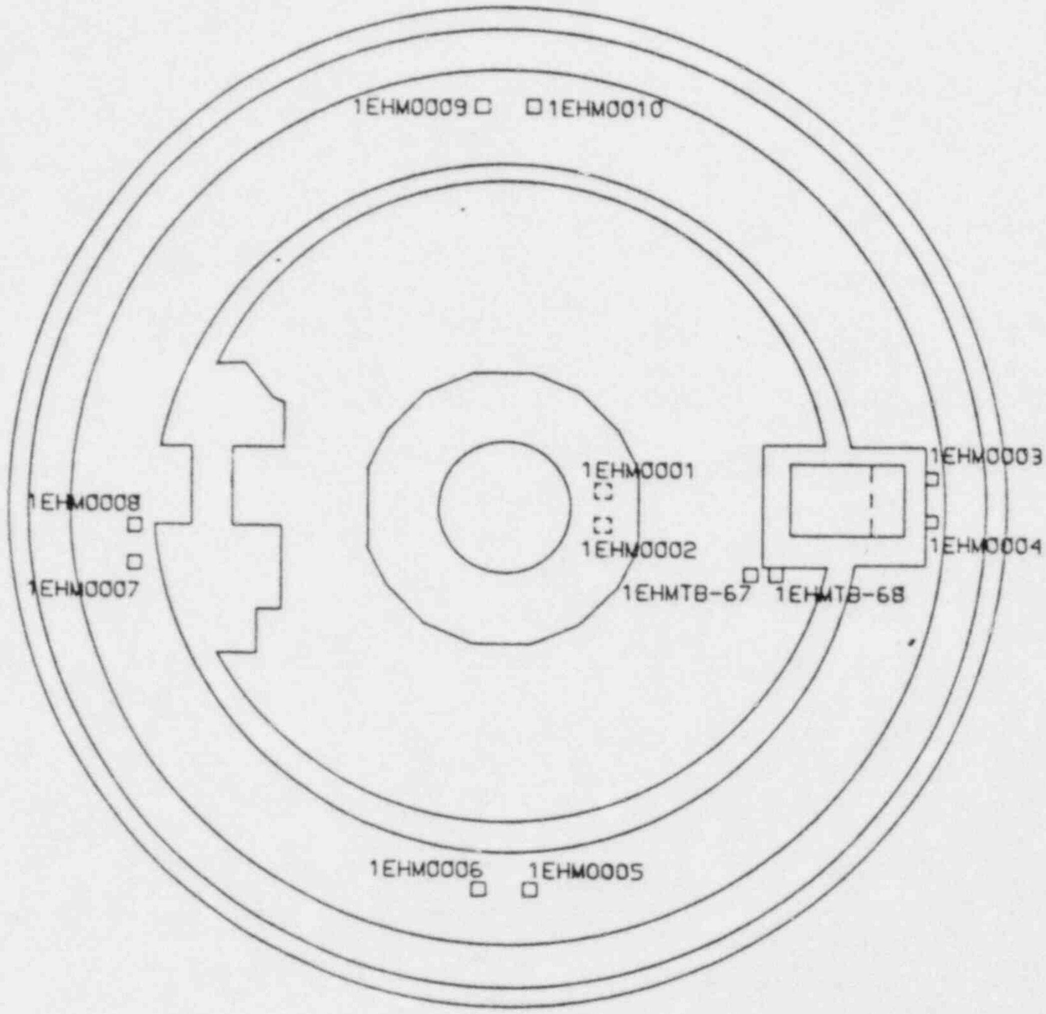

Figure 3.1A-2

CATAWBA CONTAINMENT - SECTION AT EL 565

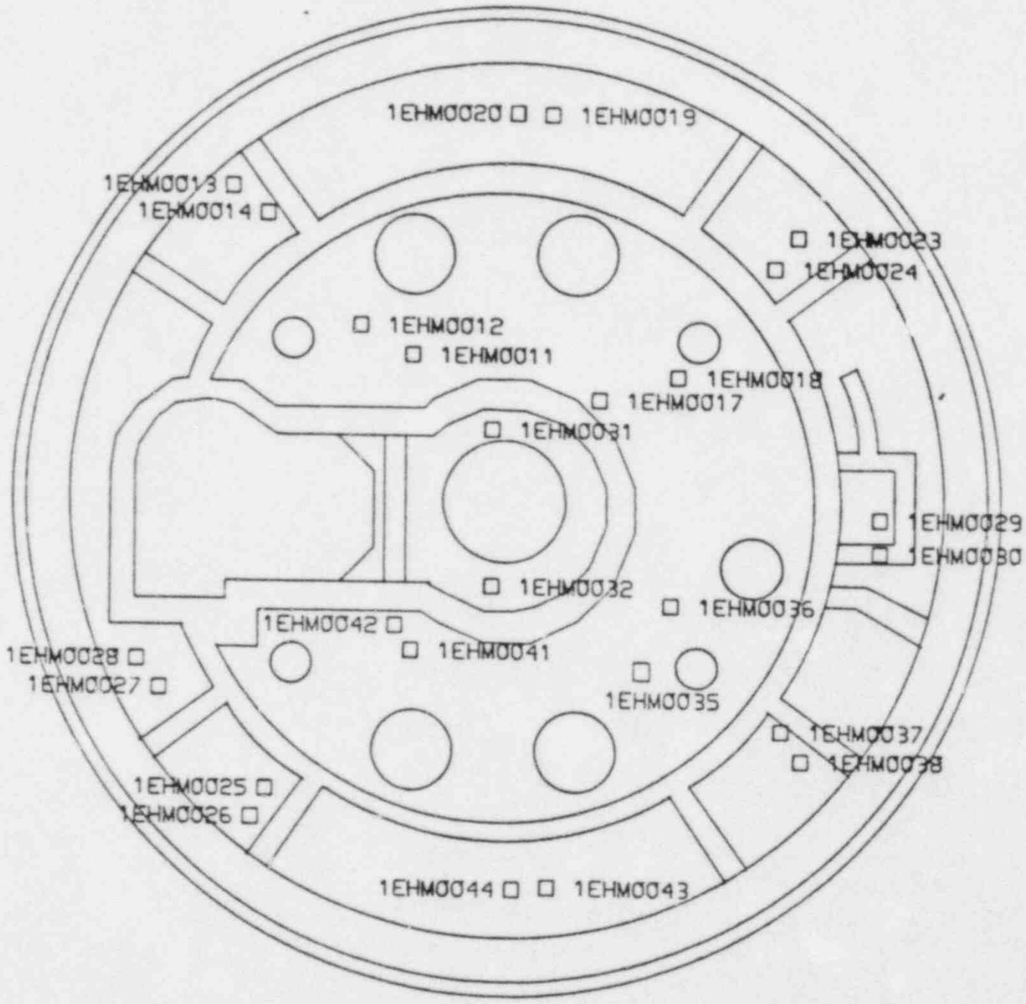

Figure 3.1A-3

CATAWBA CONTAINMENT - SECTION AT EL605

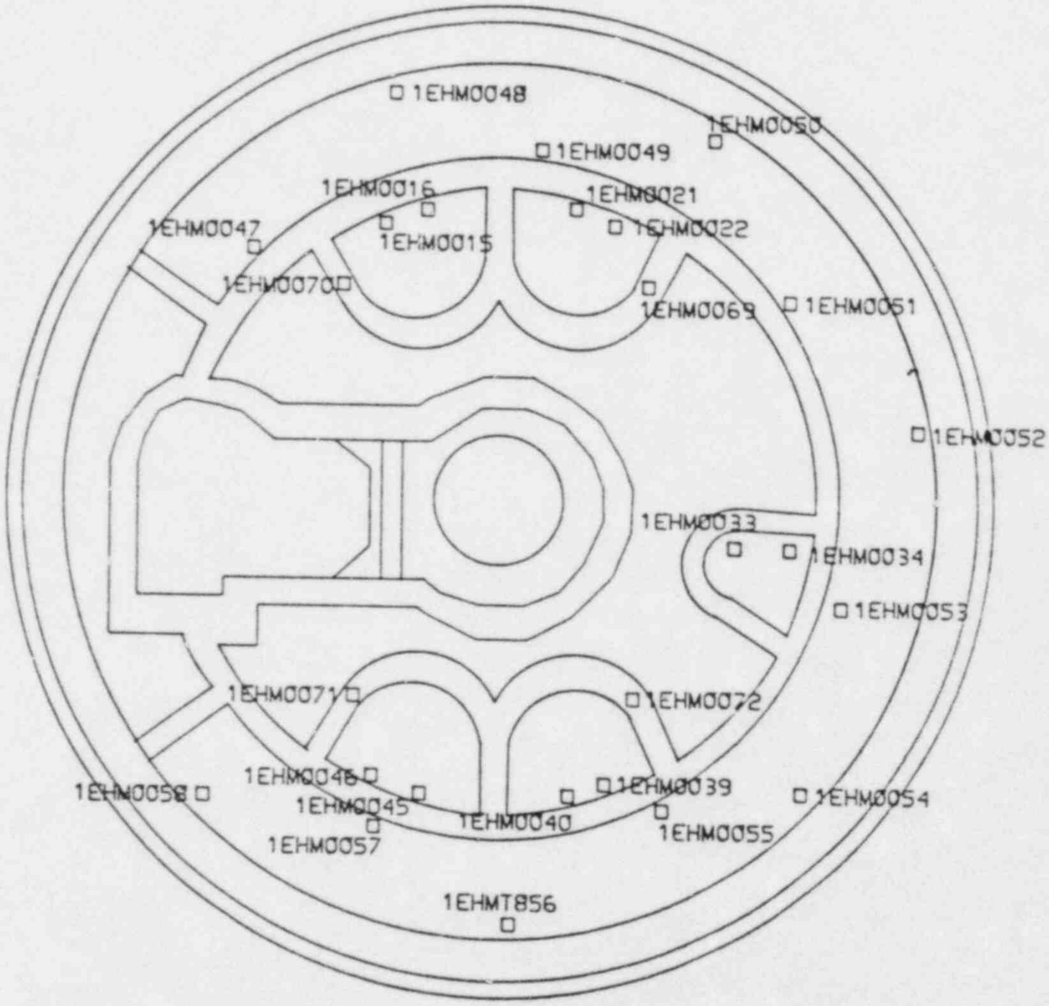

Figure 3.1A-4

CATAWBA CONTAINMENT - SECTION AT EL668

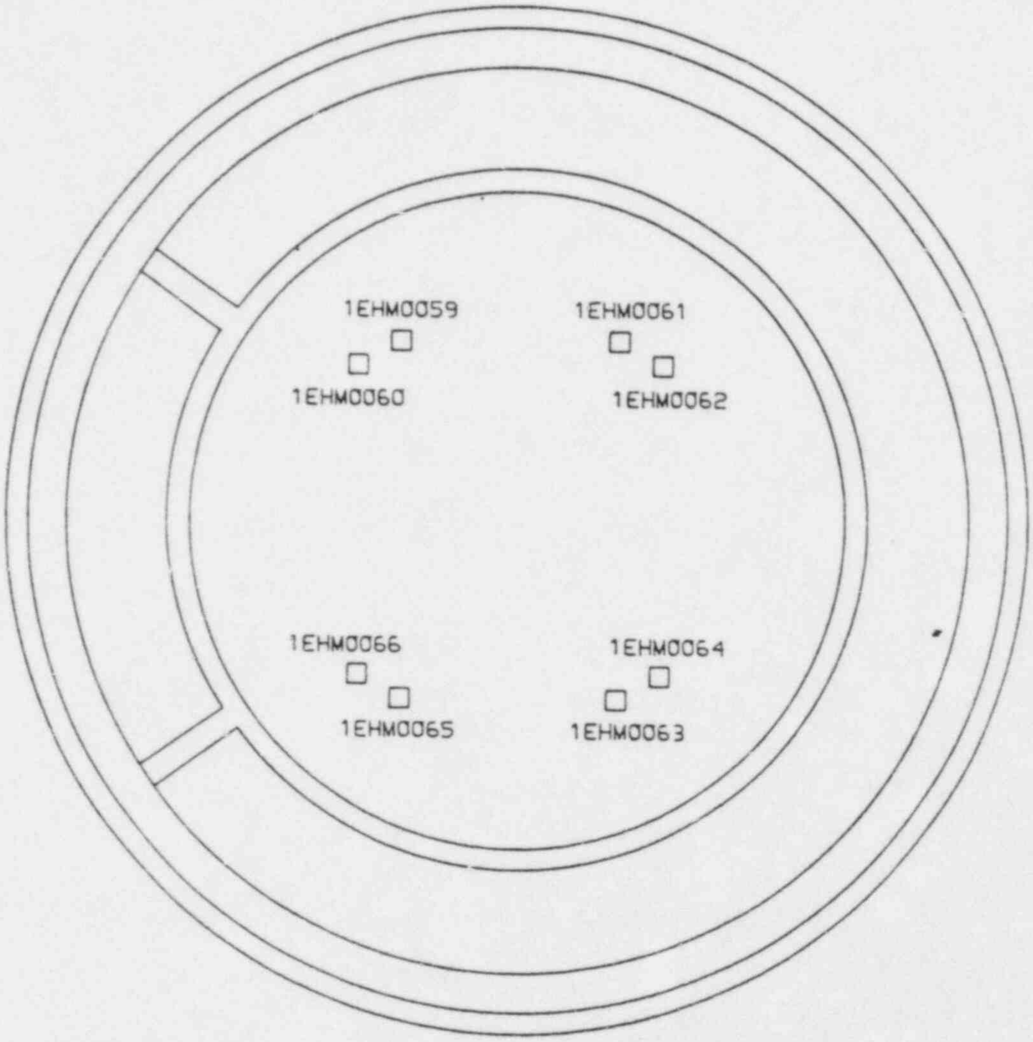

Figure 3.1A-5

CATAWBA CONTAINMENT-SECTION AT EL 721

Figure 3.1A-6

(Later)

Figure 3.1A-7

(Later)

Section 4.0A

ANALYSIS OF CONTAINMENT RESPONSE TO HYDROGEN RELEASE AND COMBUSTION

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4.1A Introduction

The Catawba containment building is virtually identical to that of McGuire. It is expected, therefore, that the response of the Catawba containment building would also be identical to that of McGuire. It was concluded that a CLASIX model of the Catawba containment should be made and some confirmatory analysis performed as a comparison with similar analysis done for McGuire. This analysis was undertaken for two reasons:

1. The TMD model of Catawba used by Westinghouse for analysis of the containment response to LOCA had some minor differences when compared with that used for McGuire. These differences concern the allocation of system volume among the various compartments (the overall containment volume used was identical to that used at McGuire) and in the heat sink structure details. The TMD model of Catawba is discussed on the Catawba FSAR, Section 6.2 . The parameters presented in the FSAR were used to develop the CLASIX model.
2. Several corrections have been made to CLASIX based on the NRC review and subsequent evaluation by the users of the code. These changes consisted mainly of corrections in the heat transfer models for radiation and convection and in the flow path logic for propagating flames. An analysis of Catawba using the corrected version of CLASIX provides some verification of the effects of the corrections on the analysis performed previously for McGuire.

4.2A Selection of Analysis Conditions

Since this analysis of Catawba using CLASIX was intended to be used for comparison with similar analysis performed for McGuire, it was decided to use the base case conditions reported in Section 4.4 as the underlying assumptions concerning the characteristics of the hydrogen burn. The burn times selected were consistent with flame speeds of approximately six feet/second, with ignition at 8.5% hydrogen by volume and burn completion of 100%. Note that implicit in these assumptions are the following conservatisms:

1. No credit is taken for any hydrogen consumption before the volumetric content reaches 8.5%. This is unrealistically conservative based on many recent test results and results in a large rate of energy input to the containment.

2. Burn times, while based on flame speeds of six feet/second, assume simultaneous ignition at all igniter sites and propagation in all directions. For example, the burn time for the upper plenum of the ice condenser is seven seconds. These conservative assumptions, combined with the conservatism of no burning until 8.5%, result in high burning rates for hydrogen. In the upper plenum, this burn rate is approximately 6 lbm/sec. It can be concluded that a burn rate in excess of this rate is unlikely, if the more realistic assumptions of ignition at 6-6.5% hydrogen were used, even if the flame speed may have been underpredicted at 6 ft/sec.

Tables 4.2A-1 through 4.2A-16 contain the CLASIX parameters used for the Catawba analysis.

4.3A Results of Analysis

The results of the Catawba analysis are illustrated in Figures 4.3A-1 through 4.3A-14. Hydrogen is consumed in a series of burns in the lower compartment and ice condenser upper plenum. There are six lower compartment burns and 31 upper plenum burns. The maximum pressure response in containment occurs at t = 4967 seconds when simultaneous burns are occurring in the two compartments. This maximum pressure is 27.84 psia, well below the containment design pressure of 30.0 psia. This may be compared to a maximum pressure of 27.6 psia found during analysis conducted for McGuire and described in Section 4.4. Note also that six lower compartment burns were also found in the McGuire analysis, and these six burns were used as a basis for establishing boundary conditions for survivability of lower containment equipment. The McGuire analysis showed fewer burns in the upper plenum, but survivability of the equipment in this area was not based on a specific number of burns, therefore the previous analysis for McGuire is applicable to Catawba.

Total hydrogen consumption by the series of burns is 1022 lbm, compared with 1032 lbm for the McGuire analysis. Peak temperatures reached during hydrogen burning for Catawba are 1221°F in the lower compartment and 1513°F in the upper plenum. Peak temperatures for McGuire are 1328°F and 1526°F respectively. The results of the analysis are summarized in Table 4.3A-1, which may be compared to Table 4.4-1 for McGuire.

4.4A Conclusions

Despite the slight modeling differences between Catawba and McGuire, the base case analysis which considers burning at six feet/second is essentially the same for the two units. The Catawba analysis shows greater response for the overall transient, but the difference is minor and probably due to the smaller number of heat sinks modeled for Catawba. There is also a larger quantity of hydrogen consumed in the upper plenum at Catawba when compared with McGuire resulting in a somewhat larger energy input into the model of the upper part of the ice condenser and somewhat greater ice melt. This is due to the increased flow through the ice condenser because modeled flow areas were slightly larger for Catawba. It can be concluded that there are no significant differences in the analysis results for the two plants when identical transients are analyzed.

Since the results of the McGuire CLASIX analysis were used to assist in establishing temperature boundary conditions for equipment survivability analysis, the temperatures profiles for Catawba were compared with those from the McGuire analysis. It was noted that for each case the McGuire analysis bounds the temperature profiles for Catawba. This can also be concluded by noting that each lower compartment burn in Catawba consumed slightly less hydrogen than that of McGuire, and the overall peak temperatures are lower in the regions of interest. It can therefore be concluded that the Catawba analysis supports the use of the temperature boundary conditions generated for McGuire for assessment of equipment survivability at Catawba.

Table 4.2A-1

Catawba CLASIX Input

MARCH Reactor Coolant Mass and Energy Release Rates

S2D Sequence

Time (seconds)	H_2O Mass Release Rate (lbm/sec)	H_2O Energy Release Rate (Btu/sec)
0.0	197.2	1.157×10^5
2172	190.5	1.097×10^5
2478	44.85	5.230×10^4
3180	53.53	6.547×10^4
3804	34.82	4.262×10^4
4428	21.40	2.842×10^4
4752	48.42	5.558×10^4
5700	19.42	2.182×10^4
6012	14.07	1.583×10^4
6960	5.253	5.989×10^3
7062	4.718	5.388×10^3
7206	4.060	4.693×10^3

Table 4.2A-2

Catawba CLASIX Input

MARCH Hydrogen Generation Rates and Temperatures

<u>S2D Sequence</u>

Time (seconds)	H_2 Mass Release Rate (lbm/sec)	H_2 Temperature (F)
0.0	0.0	61
3480	0.0	61
3804	0.0413	67
4116	0.260	1582
4428	0.740	795
4752	1.07	771
5700	0.430	612
6330	0.223	555
6648	0.160	535
6960	0.117	519
8070	0.0367	519

Table 4.2A-3

Catawba CLASIX Input

MARCH Fission Product Energy Release Rates

S2D Sequence

Time (seconds)	Energy Release Rate (Btu/sec)
0.0	0.0
3810	0.0
4116	1803
4428	4800
4752	6708
5376	7000
7080	7135

Table 4.2A-4

Catawba CLASIX Input

Burn Parameters

	Lower Compartment	Ice Condenser Lower Plenum	Ice Condenser Upper Plenum	Upper Compartment	Dead Ended Region
Hydrogen v/F for Ignition	0.085	0.99**	0.085	0.085	0.085
Hydrogen v/F for Propagation	0.085	0.085	0.085	0.085	0.085
Hydrogen Fraction Burned	1.0	1.0	1.0	1.0	1.0
Minimum Oxygen v/F for Ignition	0.05	0.05	0.05	0.05	0.05
Minimum Oxygen v/F to Support Combustion	0.0	0.0	0.0	0.0	0.0
Burn Time (sec)*	9	6	7	13	7

*Based on a flame speed of 6 ft/sec.

**There are no ignition sources in this compartment

Table 4.2A-5

Catawba CLASIX Input

Compartment Initial Conditions

	Lower Compartment	Ice Condenser Lower Plenum	Ice Condenser Upper Plenum	Upper Compartment	Dead Ended Region
Volume (ft^3)	217400	24200	47000	670000	127600
Temperature (F)	100	32	32	75	100
O_2 Pressure (psia)	3.08	3.12	3.12	3.11	3.08
N_2 Pressure (psia)	11.63	11.78	11.78	11.75	11.63
H_2O Pressure (psia)	0.28	0.09	0.09	0.13	0.28

Table 4.2A-6

Catawba CLASIX Input

Flow Path Parameters

	LC-LP	LP-UP	UP-UC	UC-LC	DE-LC
Minimum Flow Area (ft^2)	**	**	**	3.0	229
Flow Loss Coefficient	1.16	1.04	1.43	1.5	5.1
Burn Propagation Delay Time (sec)*	9	6	1	9	9

*Based on a flame speed of 6 ft/sec.
**Function of door opening.

Table 4.2A-7

Catawba CLASIX Input

Ice Bed Parameters

Parameter	Value
Initial Ice Mass	2.46×10^6 lbm
Initial Ice Heat Transfer Area	2.96×10^5 ft^2
Heat of Fusion of Ice	150 Btu/lbm
Flow Loss Coefficient	0.0
Initial Net Free Gas Volume	86300 ft^3

Table 4.2A-8

Catawba CLASIX Input

Ice Condenser Door Parameters

Lower Inlet Doors	
Maximum Opening Angle	55°
Minimum Differential Pressure for Maximum Opening	0.0206 psi
Maximum Flow Area	840 ft^2
Bypass Flow Area	0
Intermediate Deck Doors	
Maximum Opening Angle	89°
Minimum Differential Pressure for Maximum Opening	[illegible]5.5 psi
Maximum Flow Area	982.5 ft^2
Bypass Flow Area	20 ft^2
Top Deck Doors	
Maximum Opening Angle	89°
Minimum Differential Pressure for Maximum Opening	1.15 psi
Maximum Flow area	2003 ft^2
Bypass Flow Area	20 ft^2
Minimum Differential Pressure to Initiate Door Opening	0.005 psi

Table 4.2A-9

Catawba CLASIX Input

Air Return Fan/Hydrogen Skimmer System Parameters

Parameter	Value
Air Return Fan Flow Rate	60000 cfm
Hydrogen Skimmer Fan Flow Rate	6000 cfm
Initiation Time	694 sec*

*Initiated 10 minutes after the containment reaches 3.0 psig pressure.

Table 4.2A-10

Catawba CLASIX Input

Spray System Parameters

Parameter	Value
Drop Diameter	0.0268 in
Drop Fall Time	10 sec
Flow Rate	6800 gpm
Temperature	125 F
Drop Film Coefficient	20 Btu/hr ft^2 F
Initiation Time	124 sec*

*Initiated 30 seconds after the containment reaches 3.0 psig pressure.

Table 4.2A-11

Catawba CLASIX Input

Radiant Heat Transfer Beam Length

Compartment	Beam Length (ft)
Lower Compartment	25.0
Ice Condenser Lower Plenum	8.5
Ice Condenser Upper Plenum	8.5
Upper Compartment	59.0
Dead Ended Region	8.5

Table 4.2A-12

Catawba CLASIX Input

Material Dependent Passive Heat Sink Parameters

Parameter	Material	Value
Emmissivity	Concrete	0.9
	Carbon Steel	0.9
	Paint	0.9
Thermal Conductivity (Btu/hr ft F)	Paint on Steel	0.2
	Paint on Concrete	0.0833
	Paint on Concrete*	0.09
	Concrete	26.0
	Carbon Steel	26.0
	Insulation	0.25
Volumetric Heat Capacity (Btu/ft^3 F)	Paint on Steel	0.7
	Paint on Concrete	28.4
	Paint on Concrete*	0.7
	Concrete	28.0
	Concrete$^+$	28.8
	Carbon Steel	54.0
	Carbon Steel$^+$	56.4
	Insulation	0.645
Exit Heat Transfer Coefficient (Btu/hr ft^2 F)	Paint to Steel or Concrete	10^4
	Concrete to Concrete	10^8
	Steel to Insulation	10
	Insulation to Steel or Concrete	0.7
	Last Layer Adiabatic Wall	0

*Applies only to wall in Table and wall in Table

$^+$Applies only to walls in the ice condenser.

Table 4.2A-13

Catawba CLASIX Input

Upper Compartment Passive Heat Sinks

CLASIX Wall Number	Description	Initial Wall Temperature (F)	Surface Area (ft^2)	Layer Number	Number of Nodes	Layer Material	Layer Thickness (ft)
1	Part of the polar crane wall, containment shell, and miscellaneous steel	120	13720	1	2	paint	0.001
				2	5	carbon steel	0.0247
2	Part of the polar crane wall, containment shell, and miscellaneous steel	120	21590	1	2	paint	0.001
				2	30	carbon steel	0.61
3	Part of the polar crane wall	120	14770	1	2	paint	0.0083
				2	12	concrete	1.361
4	Part of the refueling canal and miscellaneous concrete	120	4031	1	2	paint	0.00133
				2	12	concrete	1.304
5	Miscellaneous steel lining	120	5760	1	4	carbon steel	0.0078
6	Upper compartment platforms	120	6831	1	10	galvanized steel	0.0183

Table 4.2A-14

Catawba CLASIX Input

<u>Lower Compartment Passive Heat Sinks</u>

CLASIX Wall Number	Description	Initial Wall Temperature (F)	Surface Area (ft^2)	Layer Number	Number of Nodes	Layer Material	Layer Thickness (ft)
7	Miscellaneous concrete	120	2209	1	2	paint	0.00131
				2	10	concrete	1.000
9	Platforms	120	2000	1	4	carbon steel	0.00783
10	Miscellaneous concrete	120	14800	1	2	paint	0.00083
				2	13	concrete	1.384
11	Miscellaneous concrete	120	10360	1	2	paint	.00083
				2	27	concrete	2.752
12	Reactor Cavity	120	4544	1	2	paint	.00083
				2	80	concrete	8.042
13	Miscellaneous steel	120	15740	1	2	paint	.001000
				2	25	carbon steel	.05220
14	Miscellaneous steel	120	219.8	1	2	paint	.00100
				2	100	carbon steel	.333

Table 4.2A-15

Catawba CLASIX Input

Ice Condenser Lower Plenum Passive Heat Sinks

CLASIX Wall Number	Description	Initial Wall Temperature (F)	Surface Area (ft^2)	Layer Number	Number of Nodes	Layer Material	Layer Thickness (ft)
15	Ice Baskets	32	180628	1	3	carbon steel	0.00663
16	Lattice Frames and support structure	32	105300	1	11	carbon steel	0.0217
18	Ice Condenser Floor	32	3336	1	2	paint	.00512
				2	8	concrete	0.948
19	Containment Wall Panels and Containment Shell	32	16240	1	3	carbon steel	0.00521
				2	8	insulation	0.948
				3	31	stainless steel	0.625
20	Crane Wall Panels and Crane Wall	32	11097	1	3	carbon steel	0.00521
				2	8	insulation	0.948
				3	9	concrete	1.0

Table 4.2A-16

Catawba CLASIX Input

Ice Condenser Upper Plenum Passive Heat Sinks

CLASIX Wall Number	Description	Initial Wall Temperature (F)	Surface Area (ft^2)	Layer Number	Number of Nodes	Layer Material	Layer Thickness (ft)
8	Containment Wall Panels and Containment Shell	32	2860	1	3	carbon steel	0.00521
				2	8	insulation	0.948
				3	31	stainless steel	0.0625
17	Crane Wall Panels and Crane Wall	32	1955	1	3	carbon steel	0.00521
				2	8	insulation	0.948
				3	9	concrete	1.0

Table 4.3A-1

Catawba CLASIX Results Summary

Flame Speed - 6 ft/sec

Basic Transient

Number of burns	LC	6
	UP	31
Magnitude of burns (lbm)	LC	60-100
	UP	18-20
Total H_2 burned (lbm)		1022
H_2 remaining (lbm)		516
Peak temperature (F)	LC	1221.5
	LP	275
	UP	1513
	UC	180
	DE	287
Peak pressure (psig)	LC	12.7
	LP	12.5
	UP	12.84
	UC	12.2
	DE	12.7
Ice remaining (lbm)		3.56×10^5

LC - Lower Compartment

LP - Lower Ice Condenser Plenum

UP - Upper Ice Condenser Plenum

UC - Upper Compartment

DE - Dead-Ended Regions (Accumulator Rooms, etc.)

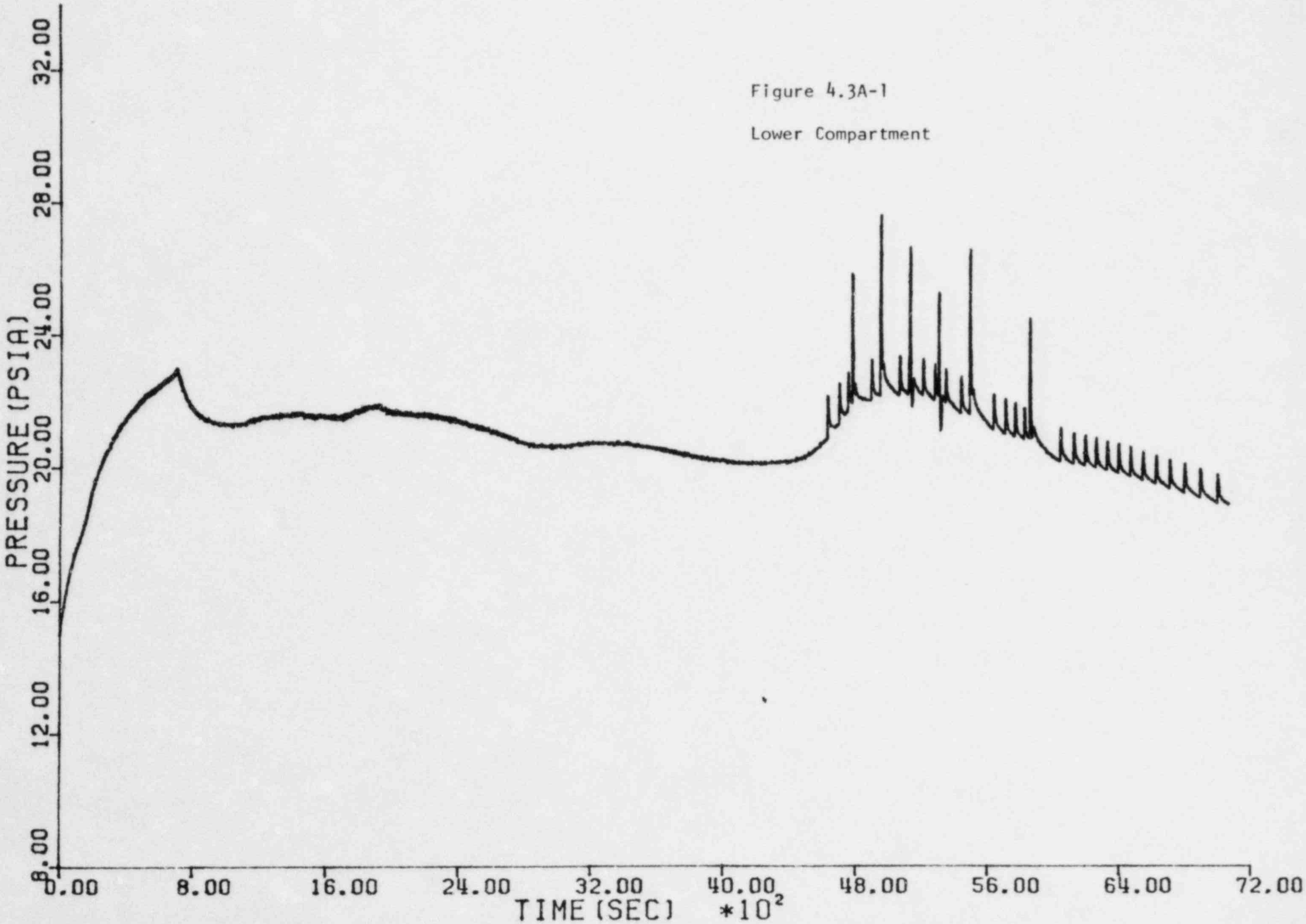


Figure 4.3A-1

Lower Compartment

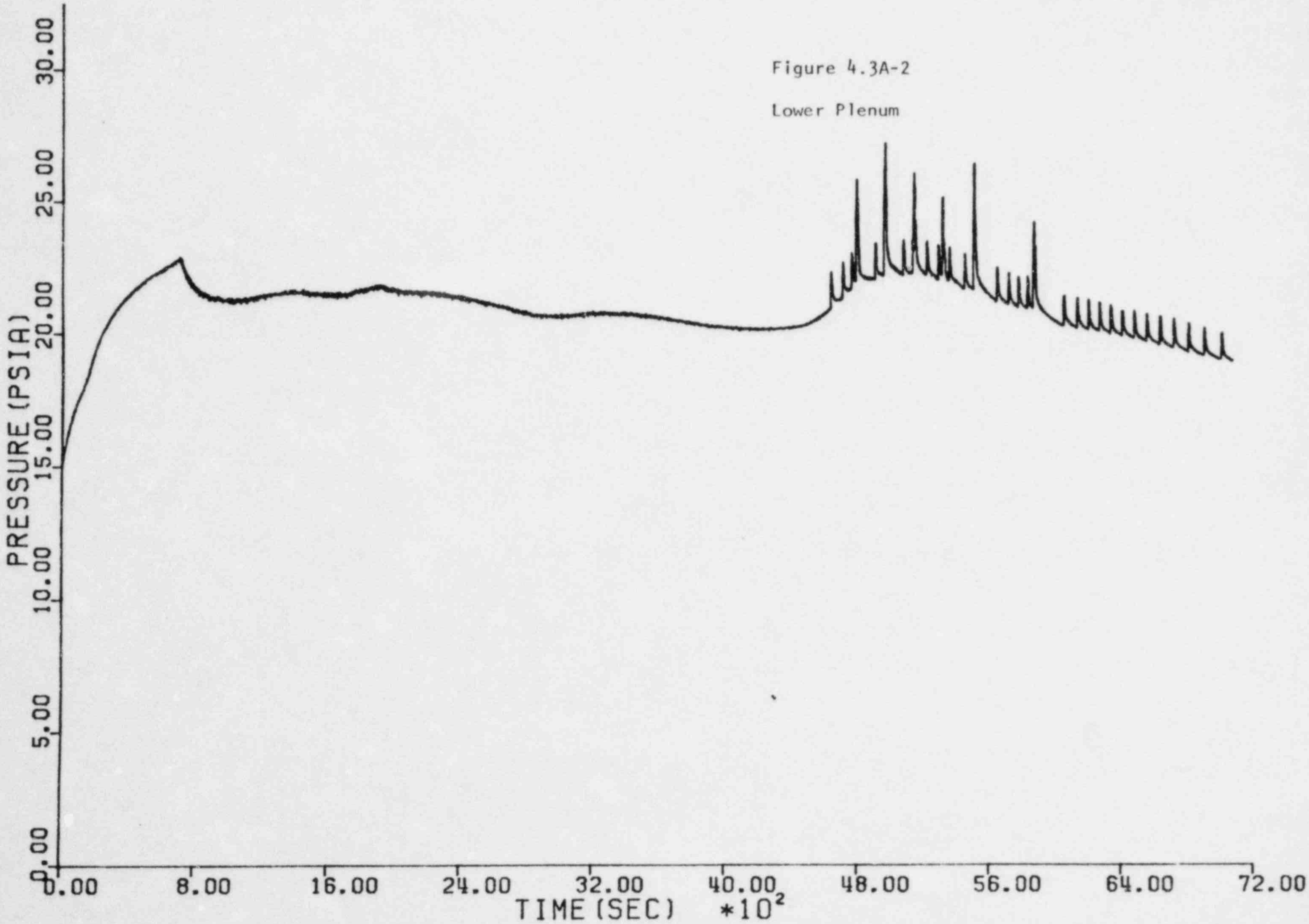


Figure 4.3A-2
Lower Plenum
PRESSURE (PSIA)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
0.00
8.00
16.00
24.00
32.00
40.00
48.00
56.00
64.00
72.00
TIME (SEC) *10²

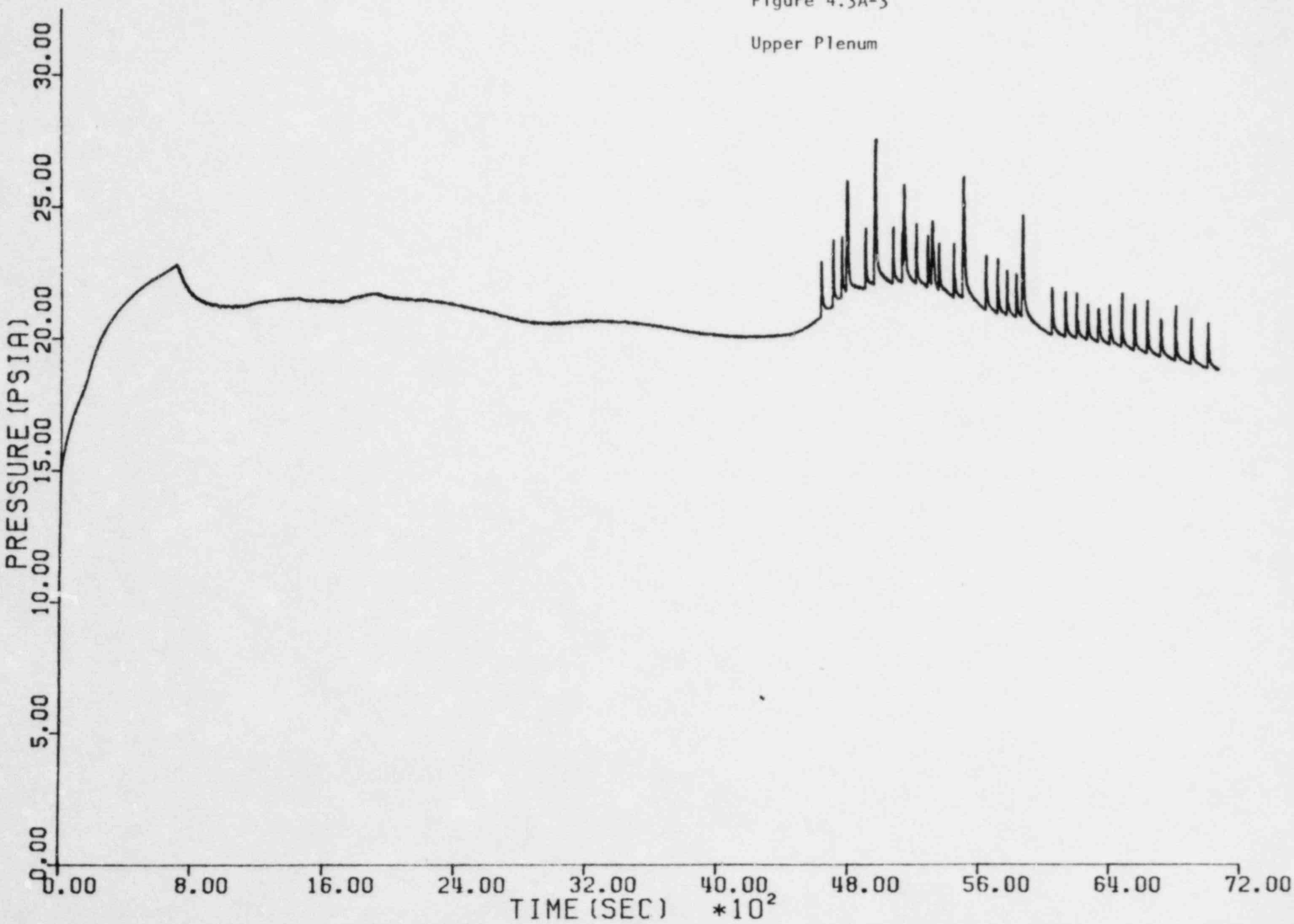


Figure 4.3A-3

Upper Plenum

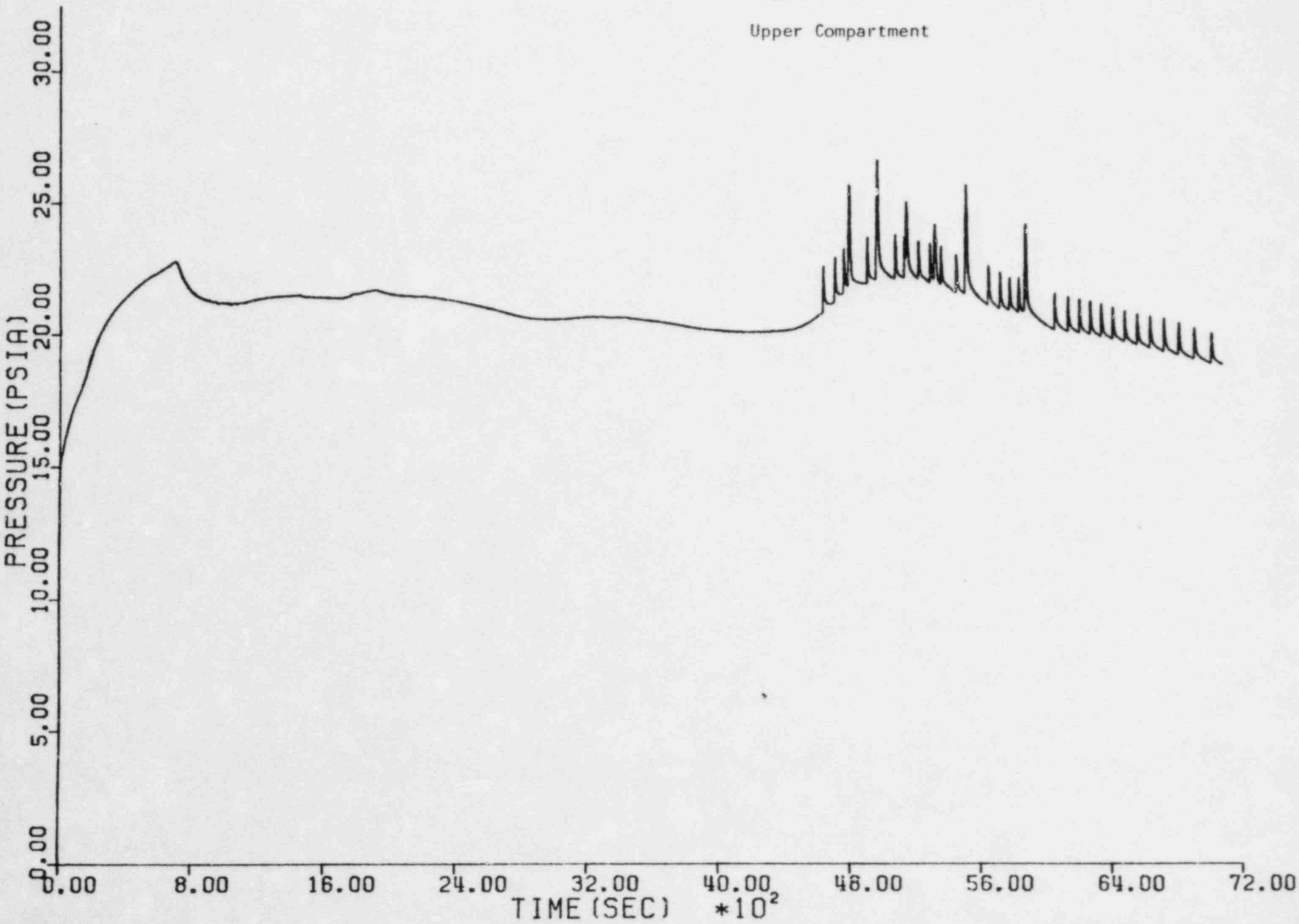


Figure 4.3A-4

Upper Compartment

Figure 4.3A-5

Deadended Compartment

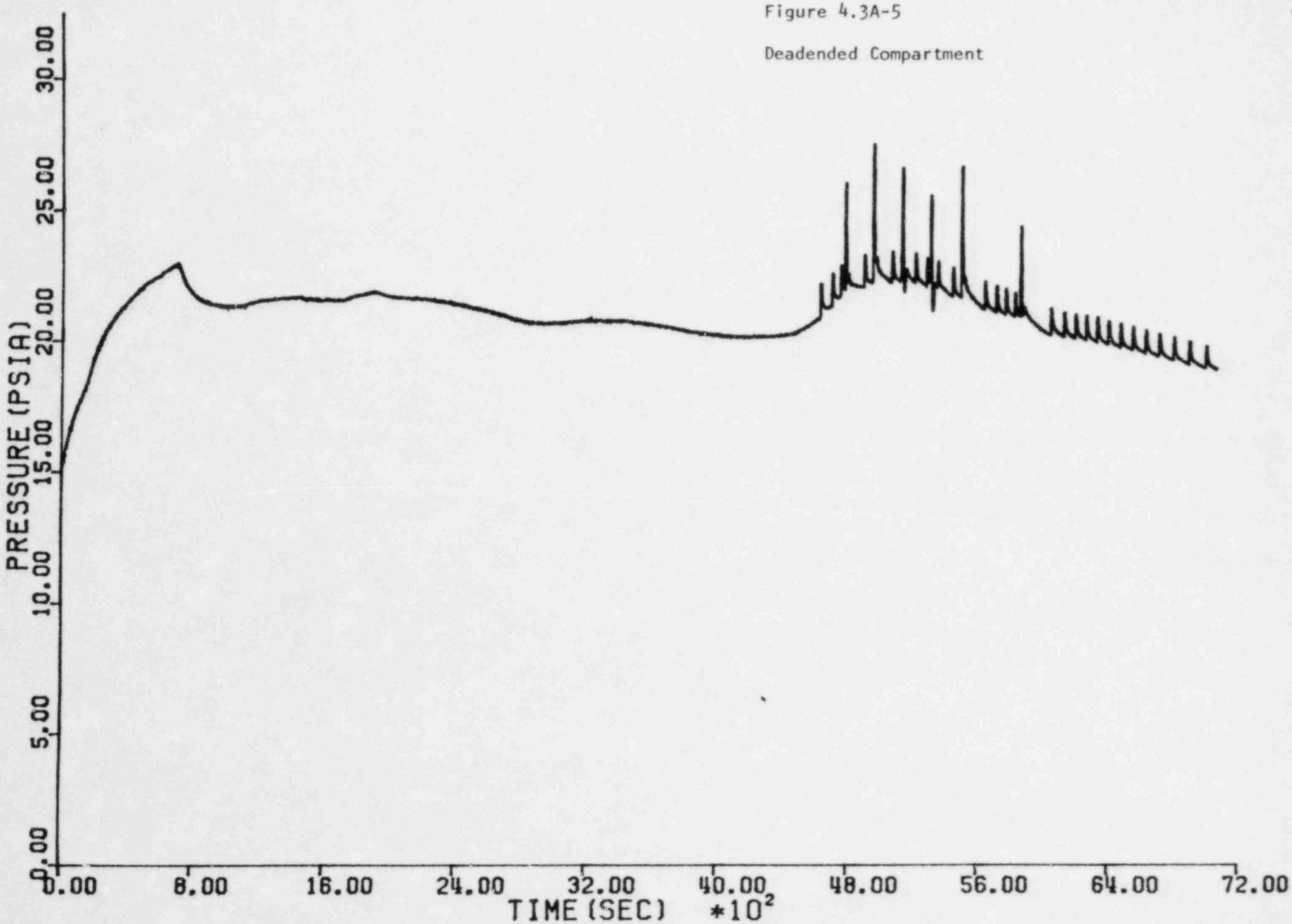
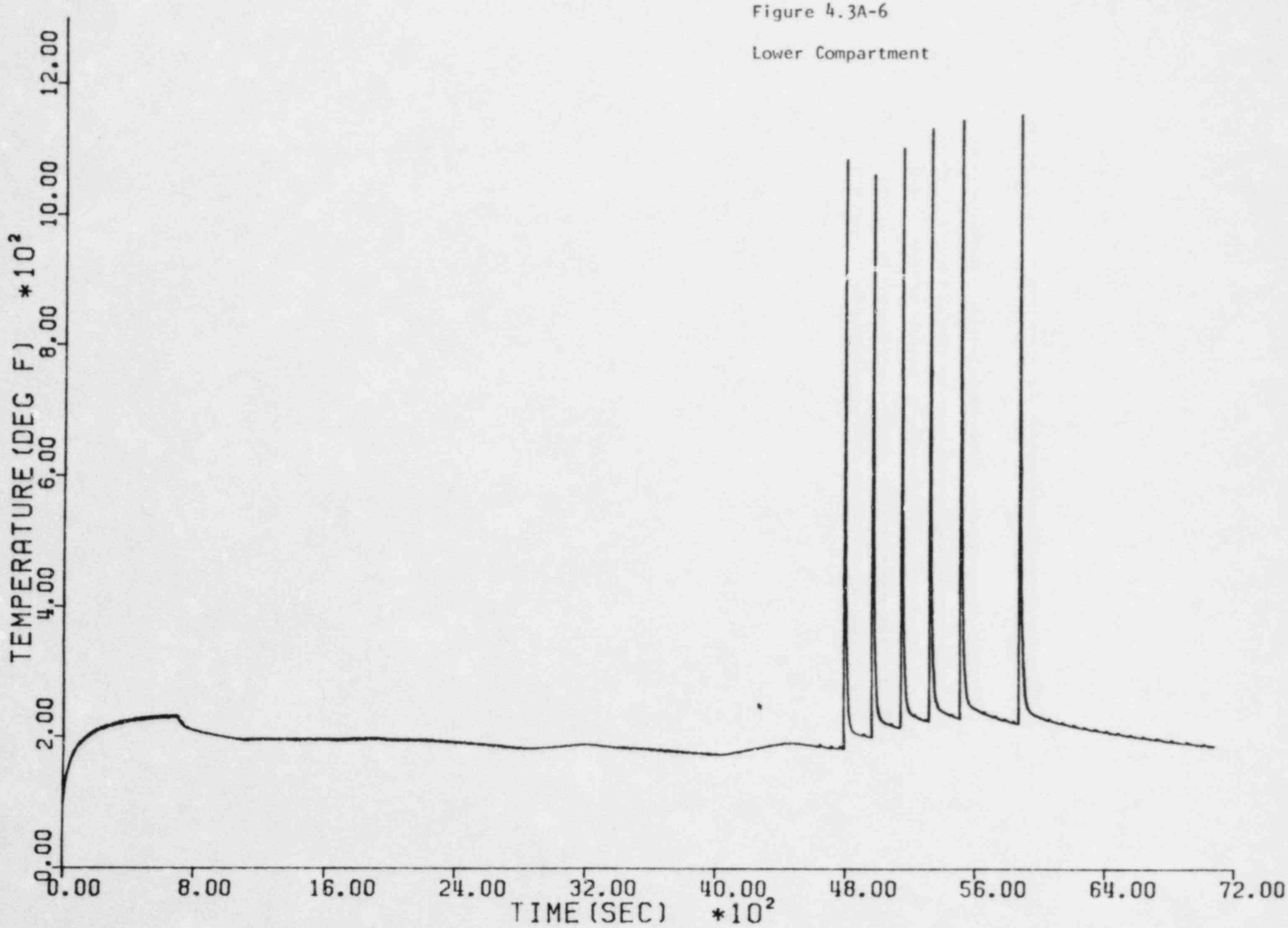


Figure 4.3A-6

Lower Compartment



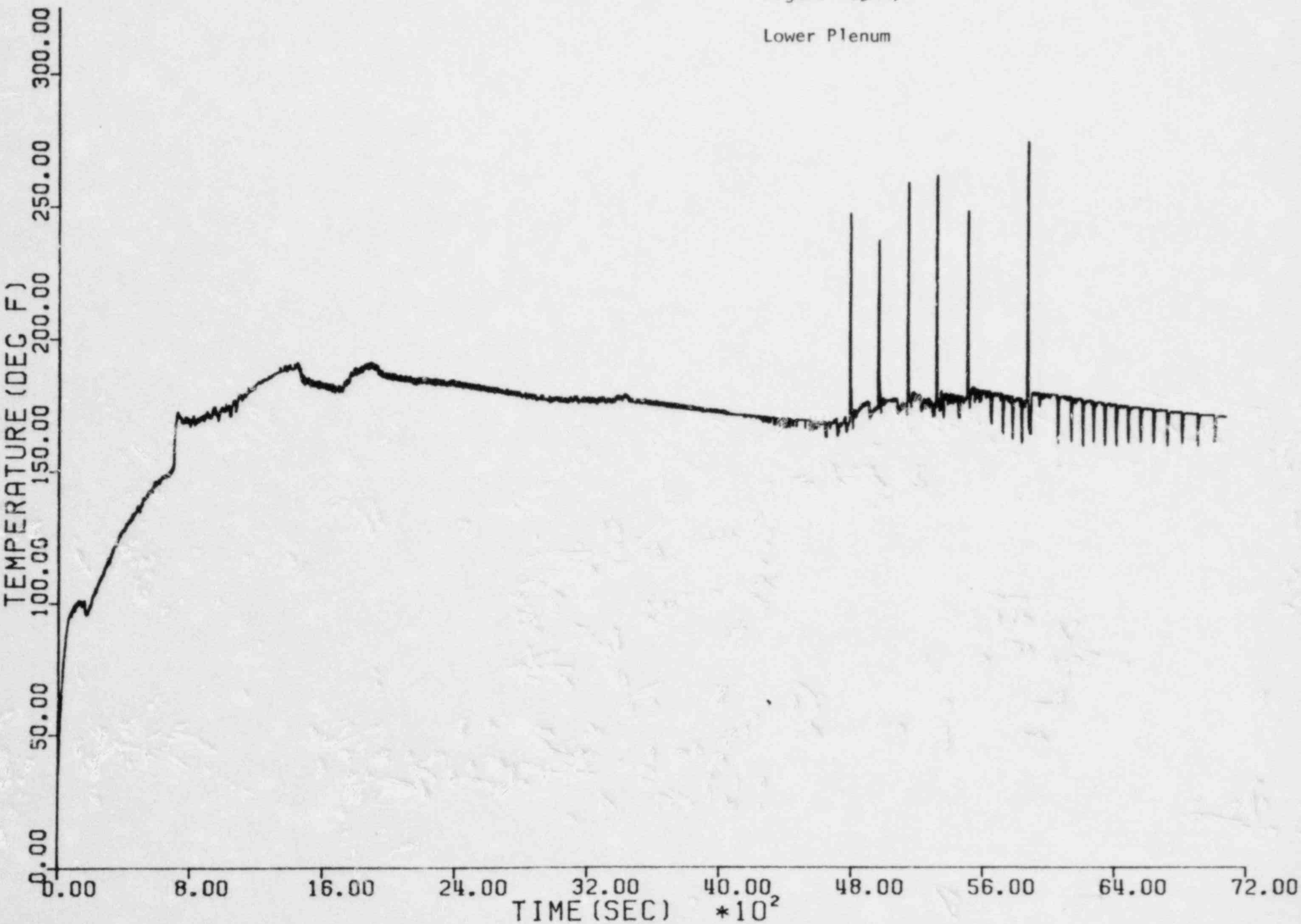


Figure 4.3A-7

Lower Plenum

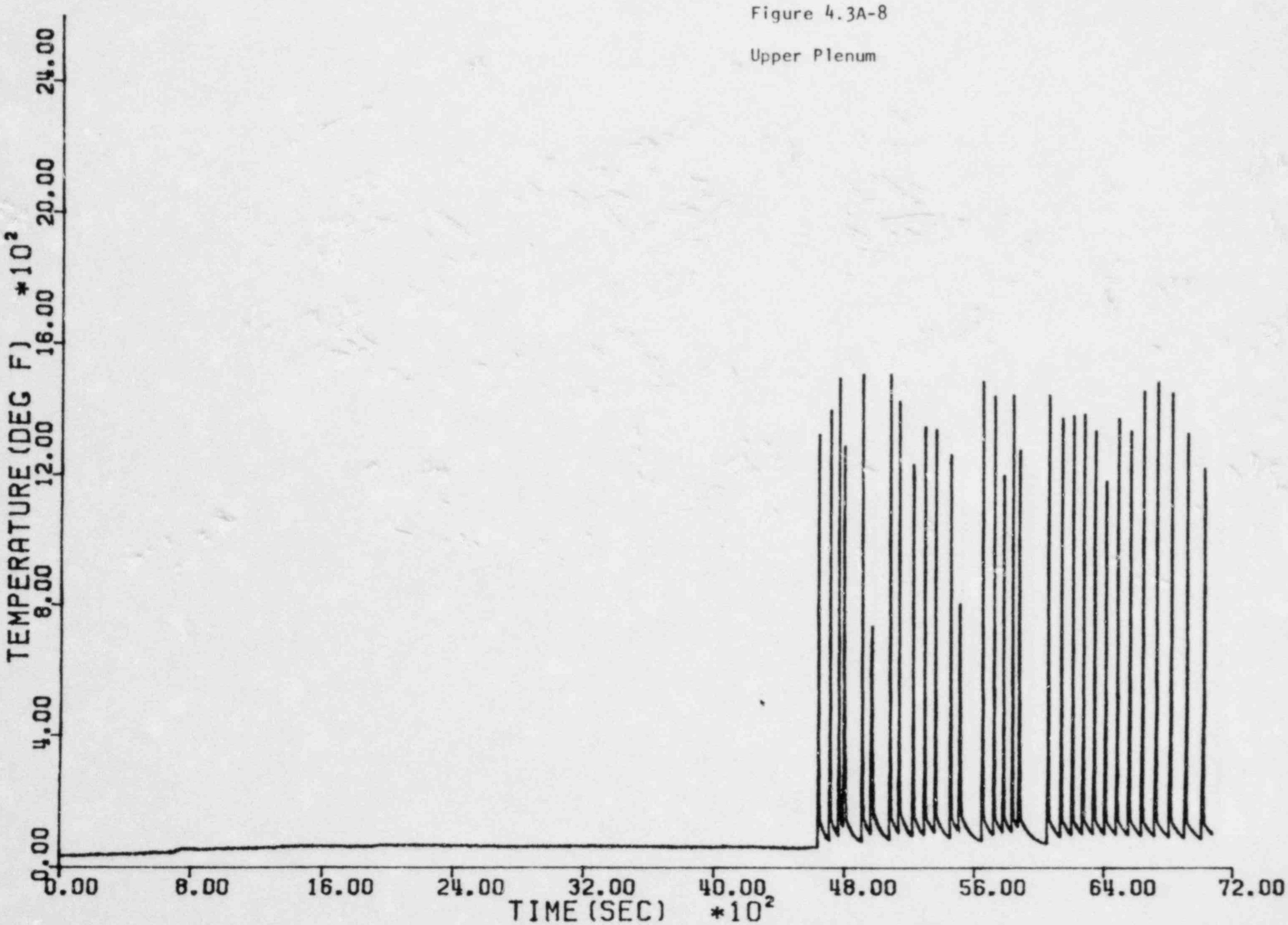


Figure 4.3A-8
Upper Plenum
TEMPERATURE (DEG F) *10²
0.00
4.00
8.00
12.00
16.00
20.00
24.00
0.00
8.00
16.00
24.00
32.00
40.00
48.00
56.00
64.00
72.00
TIME (SEC) *10²

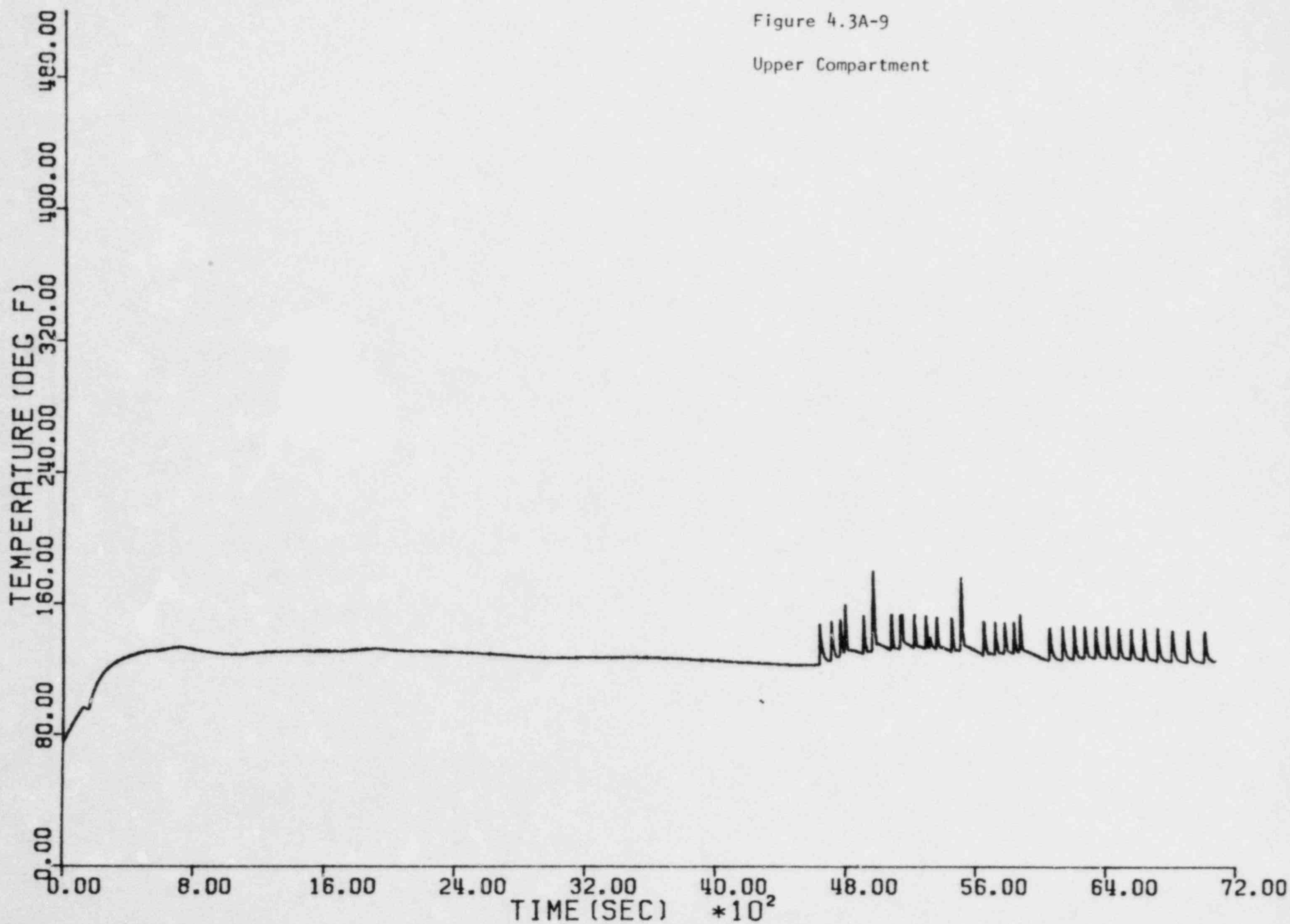


Figure 4.3A-9
Upper Compartment
TEMPERATURE (DEG F)
0.00
80.00
160.00
240.00
320.00
400.00
480.00
0.00
8.00
16.00
24.00
32.00
40.00
48.00
56.00
64.00
72.00
TIME (SEC) *10^2

Figure 4.3A-10

Deadended Compartment

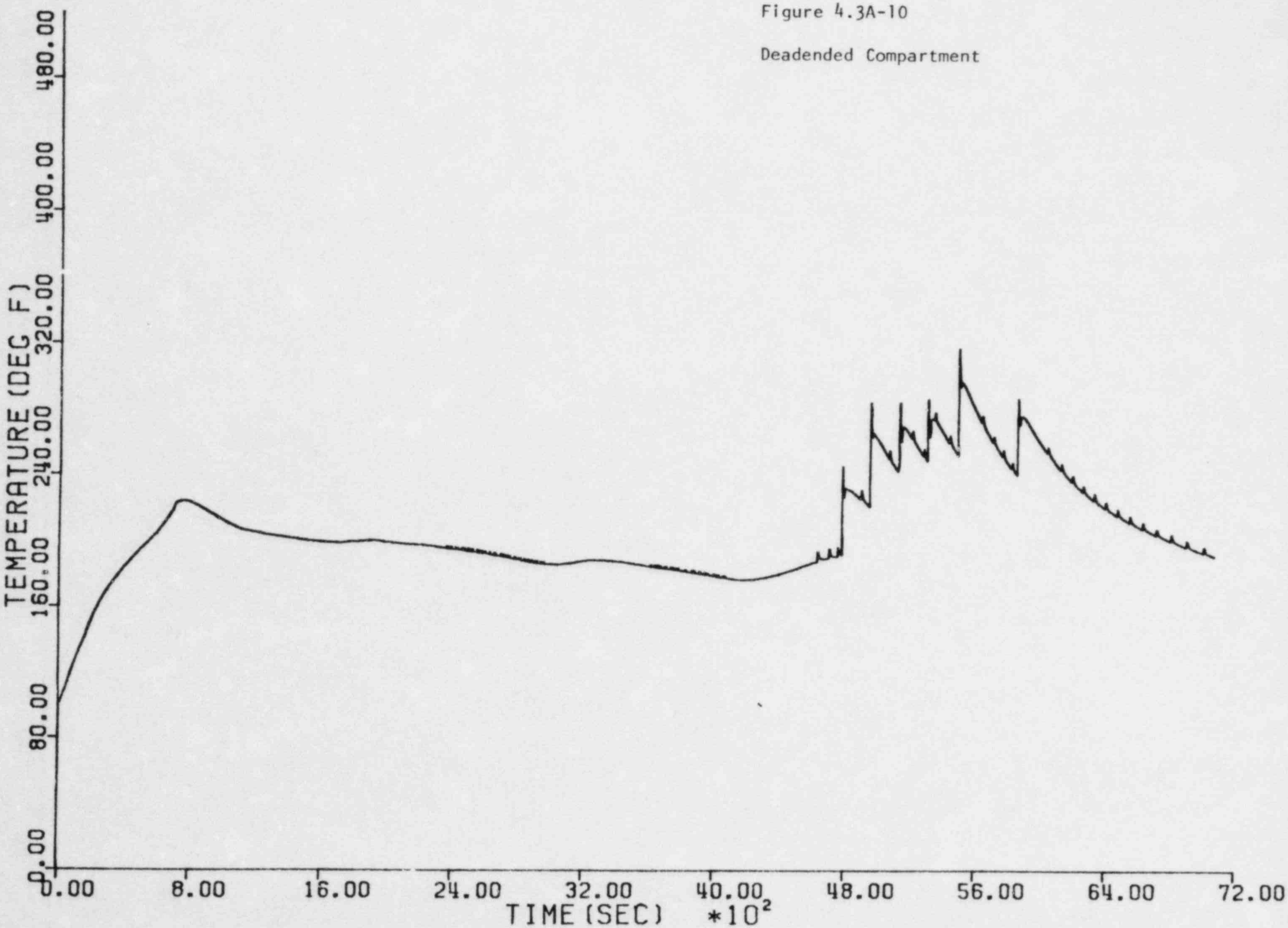


Figure 4.3A-11

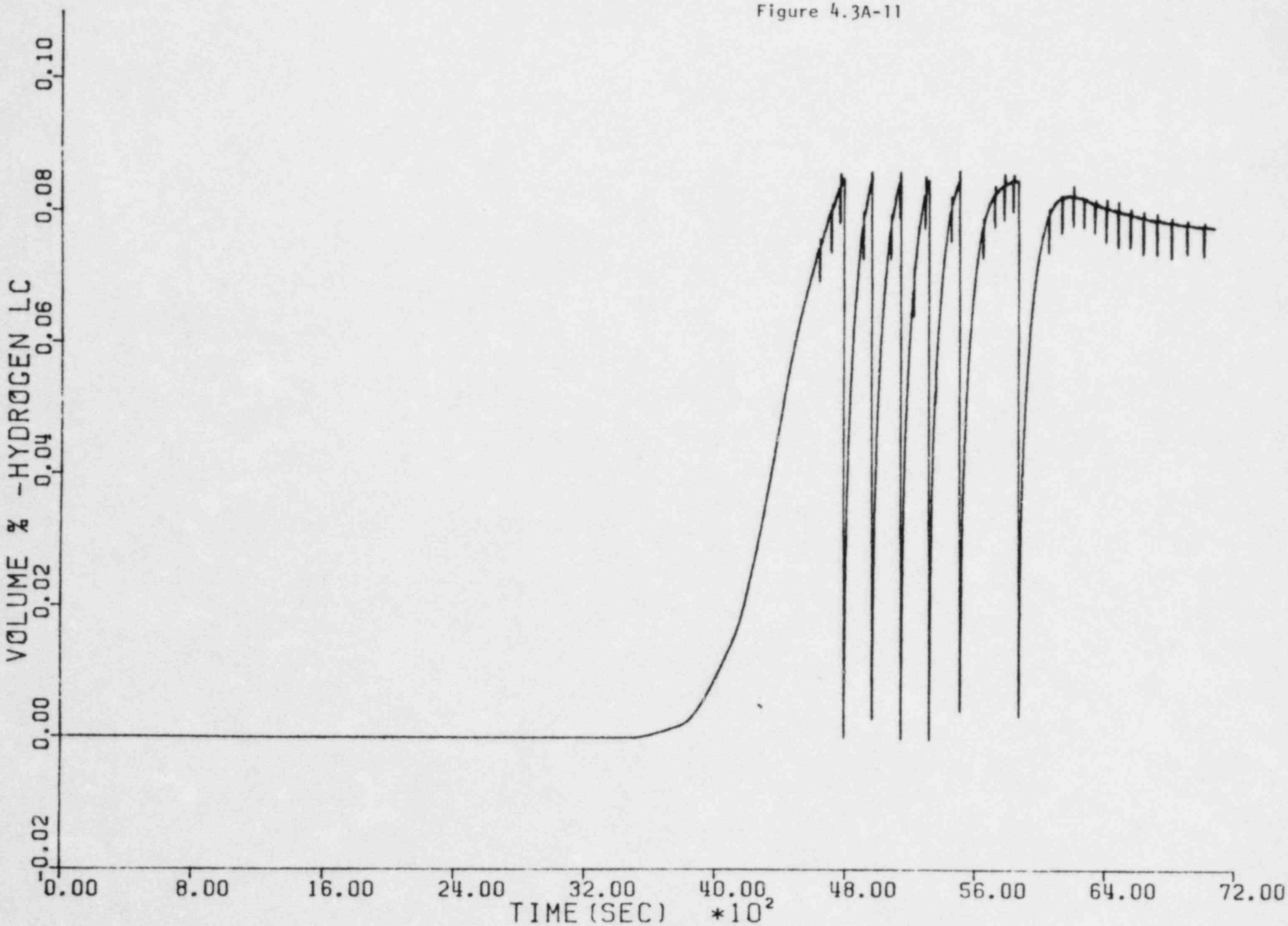


Figure 4.3A-12

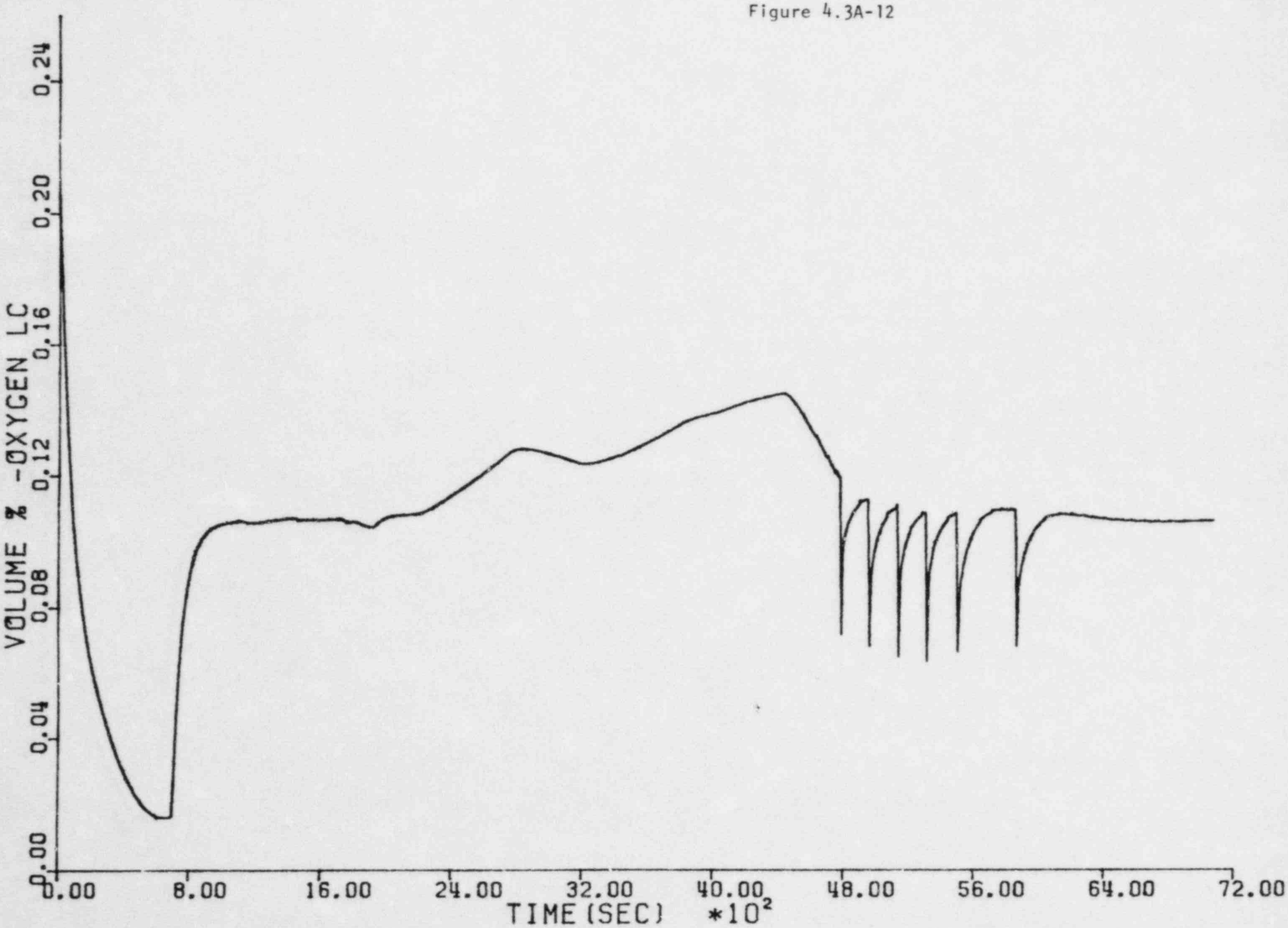


Figure 4.3A-13

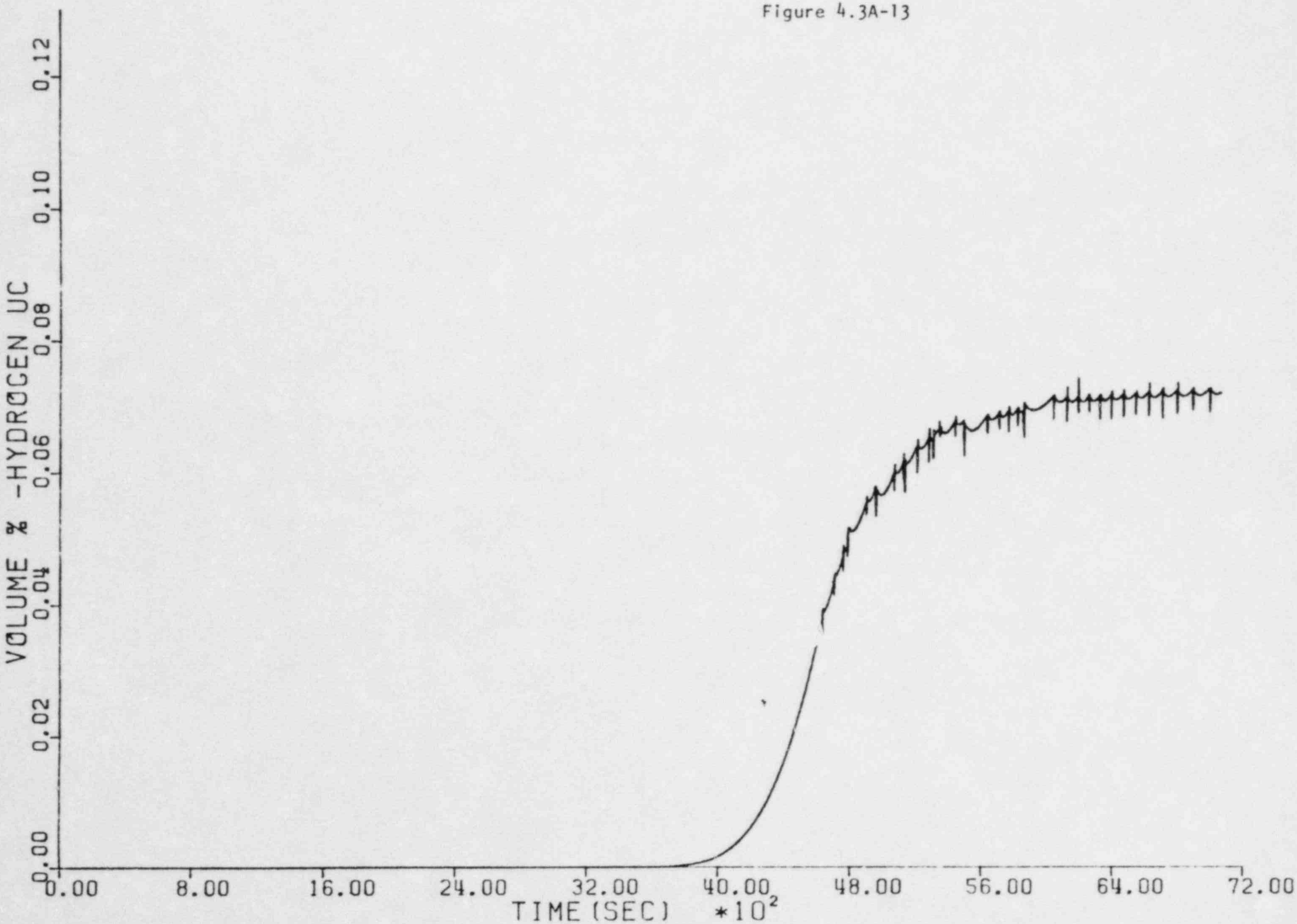
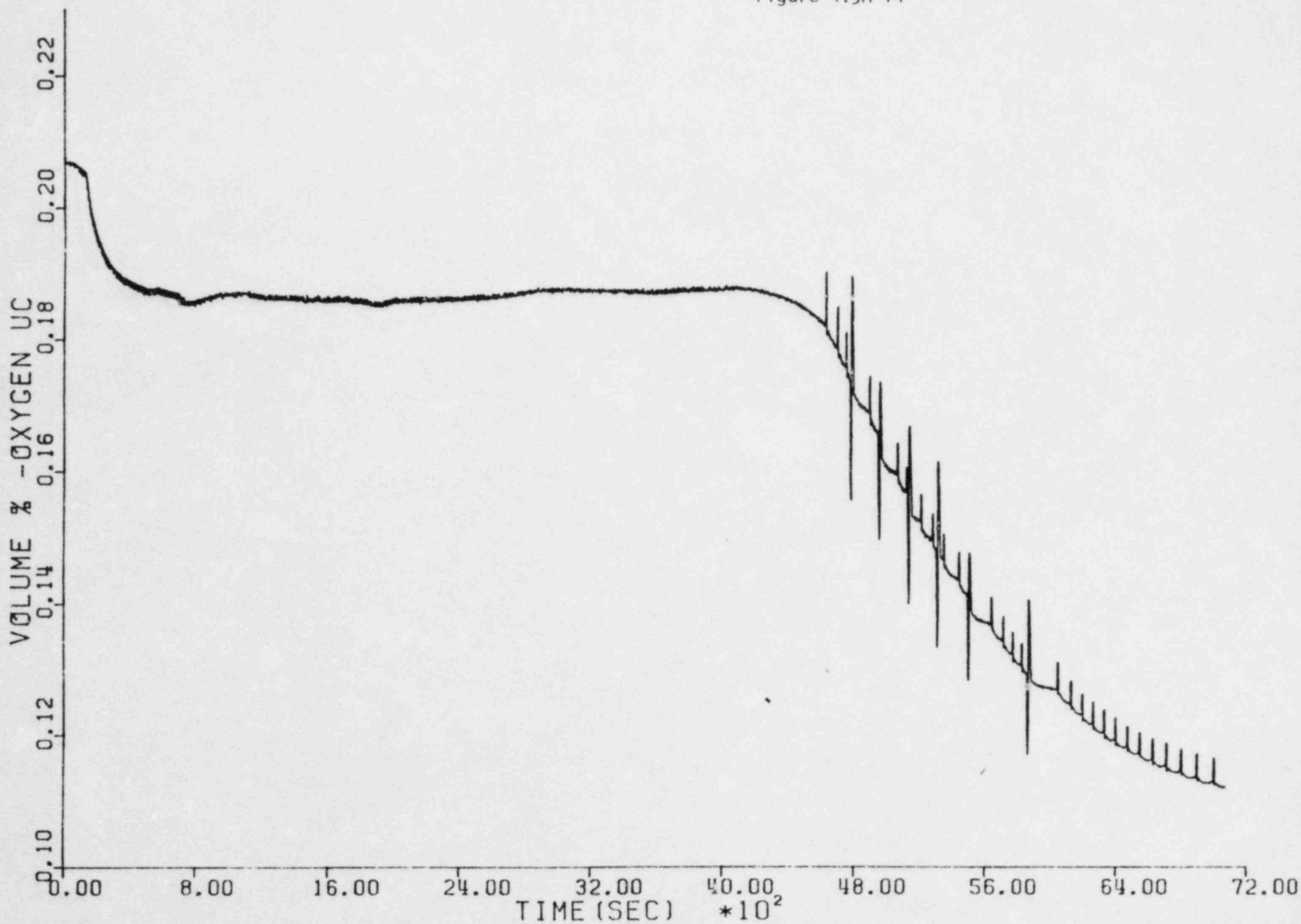


Figure 4.3A-14



Section 5.0A

EQUIPMENT SURVIVABILITY

Table of Contents

5.0A Equipment Survivability

5.1A Introduction

The survivability of the vital equipment used at McGuire was shown in Section 5.0 by analysis, test, and comparison with equipment qualification data. Equipment used in similar applications at Catawba differs, in some cases, from that at McGuire. The discussion in this section will consider each item individually, compare it to the item used at McGuire, and present the basis for its survivability. Note that the steam generator water level transmitters do not appear on the list of essential equipment inside containment at Catawba, as these transmitters at Catawba are located outside of containment, in the annulus.

5.2A Equipment Identical between Stations

For the following equipment, identical models are used at McGuire and Catawba:

- pressurizer water level transmitter
- Duke supplied reactor coolant loop RTD cable
- containment air return fan
- hydrogen skimmer fan

The survivability of this equipment was established for McGuire in Section 5.0, amplified by additional information given in response to NRC questions, Section 7.0. On that basis, the survivability of the above equipment is ensured for Catawba.

5.3A Equipment Not Identical between Stations

The remainder of the items on this list of essential equipment are not identical between Catawba and McGuire. This equipment has for Catawba been qualified to the same or more severe accident profiles as used for McGuire. These items are discussed specifically in the following subsections.

5.3.1A Reactor Coolant Loop RTD's and Integral Cables

As discussed in Section 5.4, of concern in assessing the hydrogen burn survivability of the reactor coolant loop RTD's is the integral cable. The RTD itself is located in a well and subject to a continuous temperature by conduction from the reactor coolant loop far higher than the temperature it will reach as a result of hydrogen burning. The survivability of the McGuire RTD integral cable was established based on analysis and test. The RdF(NSSS)21205 RTD's used at Catawba were qualified using a more severe accident profile than that used for the Rosemont 176KS RTD's used at McGuire. The peak temperature profile is in excess of 400°F for the Catawba RTD compared with 332°F for McGuire. The additional margin available in the cable used at Catawba thus ensures its survivability in the hydrogen burn environment.

5.3.2A Core Exit Thermocouple Cables

The core exit thermocouple cables at Catawba are mineral insulated and have been LOCA qualified to a temperature of 389°F. This is higher than the LOCA qualification temperature of 346°F for the core exit thermocouple cable at McGuire. It may be concluded that this cable will survive on the basis of this comparison and the discussion in Section 5.4.2.4.

5.3.3A Electric Hydrogen Recombiners

Both McGuire and Catawba have electric hydrogen recombiners manufactured by Westinghouse Sturdevant. Model A is used at McGuire and Model B is used at Catawba, with the difference being a slightly lower qualification temperature for Catawba (288°F) as compared to McGuire (309°F). Because the electric hydrogen recombiner is itself a significant source of energy and heat when it is operating, this difference is not considered significant. In addition, no hydrogen is burned in the upper compartment, so the effect of hydrogen burning on the recombiners need not be considered.

5.3.4A Reactor Vessel Head Vent Valves

The Limitorque motor operated valves used at Catawba have been LOCA tested to approximately the same temperature as that used for the Target Rock solenoid valves used at McGuire. In addition, the motor operated valves are much more massive and will exhibit less response to the transient hydrogen flames. It may therefore be concluded that the reactor vessel head vent valves will survive hydrogen burning.

5.3.5A Pressurizer PORV

The Valcor solenoid valves used at Catawba were qualified to approximately the same LOCA temperature as that used for the ASCO solenoid valves used in McGuire. It may be concluded that the pressurizer PORV controls will survive hydrogen burning. The pressurizer PORV itself at both stations is a large air operated valve for which hydrogen burning will not represent a concern.

5.3.6A Pressurizer PORV Block Valves

The Rotork actuator used at McGuire and the Limitorque actuator used at Catawba are LOCA qualified to approximately the same temperature. These massive electric motor operators are not affected significantly by hydrogen burning, and it may therefore be concluded that the PORV block valve will survive hydrogen burning.

5.4A Conclusions

The basis for the conclusion that essential equipment at McGuire will survive hydrogen burning was given in Section 5.0. In Section 5.0A, the basis for survivability of essential equipment in Catawba is demonstrated based on the conclusions drawn for McGuire. As was stated in Section 5.0, the equipment most susceptible to large temperature rises due to hydrogen burning is the cabling associated with essential instrumentation. For Catawba, this cabling has been qualified to more severe accident profiles than at McGuire. More massive equipment for which the effects of hydrogen burning are less has been qualified for essentially the same conditions at both stations. Survivability of essential equipment at Catawba is thus ensured.