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REVISION 1

MARK I CONTAINMENT PROGRAM PLANT UNIQUE LOAD DEFINITION HOPE CREEK GENERATING STATION: UNIT 1

GENERAL ELECTRIC

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MARK I CONTAINMENT PROGRAM
PLANT-UNIQUE LOAD DEFINITION
HOPE CREEK GENERATING STATION: UNIT 1

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GENERAL ELECTRIC

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CONTENTS

ABSTRACT

This document provides unique definition of specific containment loading conditions that would result from a postulated loss-of-coolant accident in the Hope Creek Generating Station: Unit 1. Transient information is provided for containment pressures and temperatures, vent system thrust, torus vertical loads, vent system pool swell impact loads, and vent header deflector loads. The document has been prepared under the Mark I Containment Program to aid Public Service Electric and Gas in the performance of a containment structural evaluation.

1. INTRODUCTION

This report provides specific transient loading information resulting from a postulated loss-of-coolant (LOCA) accident in the Hope Creek Generating Station Unit 1. This report, in conjunction with the Mark I Containment Load Definition Report, was prepared for Public Service Electric and Gas to use in the structural evaluation of the Mark I Containment system.

The following specific LOCA-related transient information is included:

- Pressure and temperature time histories for the drywell and wetwell
- Vent system thrust loads
- Net vertical pool swell loads and average submerged pressures on the wetwell
- Pool swell impact and drag loads on the vent system
- Vent header deflector loads

Transient information is presented via a series of figures for each of the above areas. An alpha-numeric identification scheme was developed for the figures: the alpha designation denotes the plant of interest; the first three digits of the numeric designation denote the applicable discussion section in the Mark I Containment Program Load Definition Report (NEDO-21888).

Transient conditions presented in this report are results of plant unique testing and/or analysis for specific plant conditions that have been provided or requested by the aforementioned utility. Changes to those specific plant conditions could result in changes to the transient information reported herein. If, after further review of this document, the responsible utility considers that such changes would be appropriate, the document can be modified accordingly.

2. LOCA PRESSURE AND TEMPERATURE TRANSIENTS

This section provides the LOCA-induced pressure and temperature transients for the drywell and wetwell. The initial conditions for which the pressure and temperature responses were evaluated are also presented. Transient conditions are included for the design basis accident (DBA), intermediate break accident (IBA), and small break accident (SBA). The list of applicable figures and tables for this section is given on the following page.

Peak drywell pressure and temperature and the wetwell pressure and temperature at 30 seconds are identified on the DBA containment pressure and temperature plots (Figures 4.1.1-1 and 4.1.1-2).

The peak containment pressures, the containment temperatures at the end of RPV blowdown, and the containment pressures and temperatures at the time of ADS initiation are identified on the IBA and SBA containment pressure and temperature plots (Figures 4.1.2-1, 4.1.2-2, 4.1.3-1, and 4.1.3-2).

HOPE CREEK 1

PLANT-UNIQUE PRESSURE AND TEMPERATURE RESPONSE TABLES AND FIGURES

Figure or Table No.	Title	Applicable Revision No.
Table HC 4.1.1-1	Plant ditions at Instant of DBA Pipe Break	Revision 1
Figure HC 4.1.1-1	DBA Containment Pressure Response	Revision 1
Figure HC 4.1.1-2	DBA Containment Temperature Response	Revision 1
Table HC 4.1.2-1	Plant Conditions at Instant of IBA Pipe Break	Revision 1
Figure HC 4.1.2-1	IBA Containment Pressure Response	Revision 1
Figure HC 4.1.2-2	IBA Containment Temperature Response	Revision 1
Table HC 4.1.3-1	Plant Conditions at Instant of SBA Pipe Break	Revision 1
Figure HC 4.1.3-1	SBA Containment Pressure Response	Revision 1
Figure HC 4.1.3-2	SBA Containment Temperature Response	Revision 1

Table HC 4.1.1-1

PLANT CONDITIONS AT INSTANT OF DBA PIPE BREAK

102% Licensed Power (MWt)	3359
Initial Suppression Pool Temperature (^{o}F)	80.0
Downcomer Submergence (ft)	3.33
Airspace Volume (ft^3)	
Drywell	169,000
Wetwell	133,500
Airspace Pressure (psig)	
Drywell	0.75
Wetwell	0.75

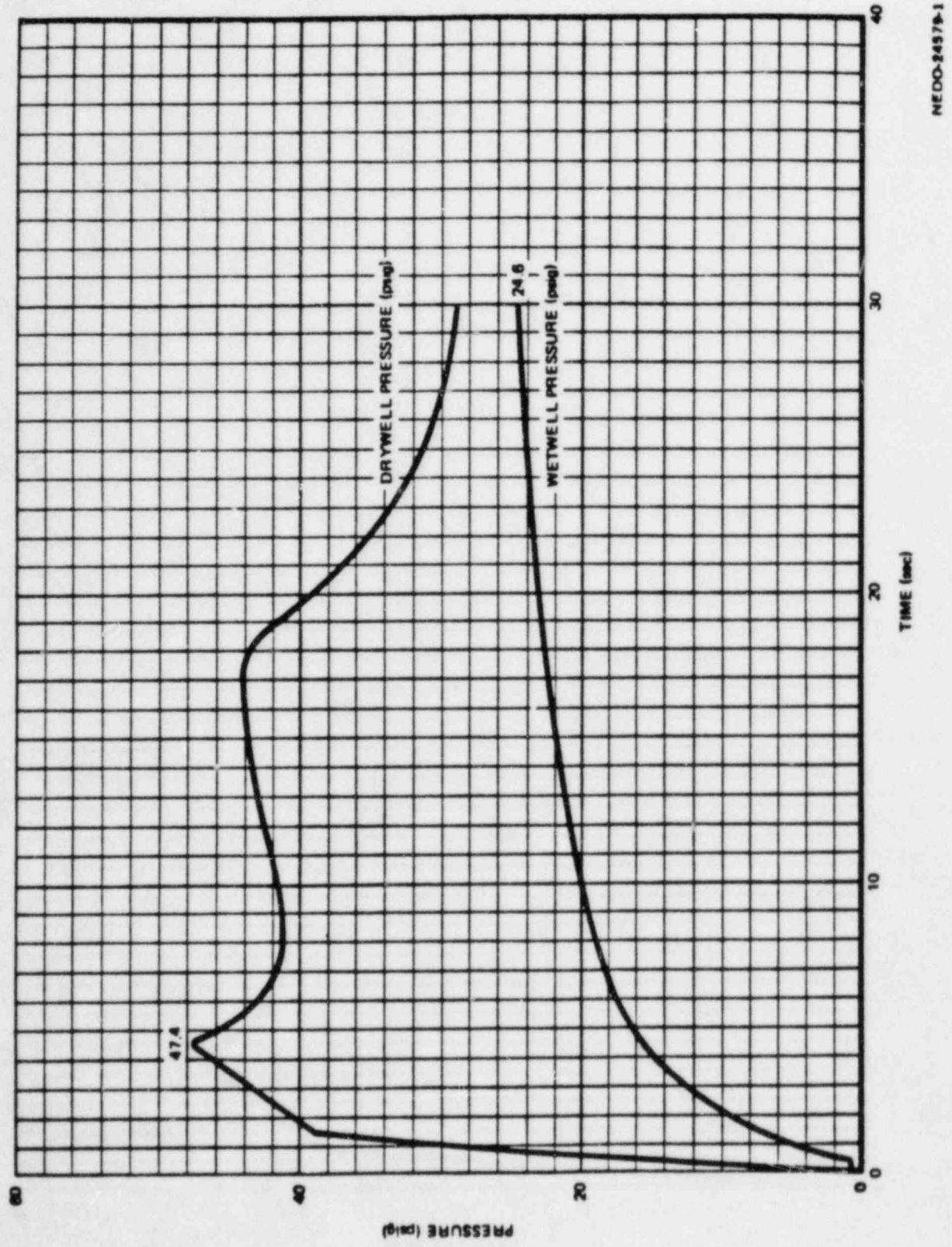


Figure HC 4.1.1-1. DBA Containment Pressure Response

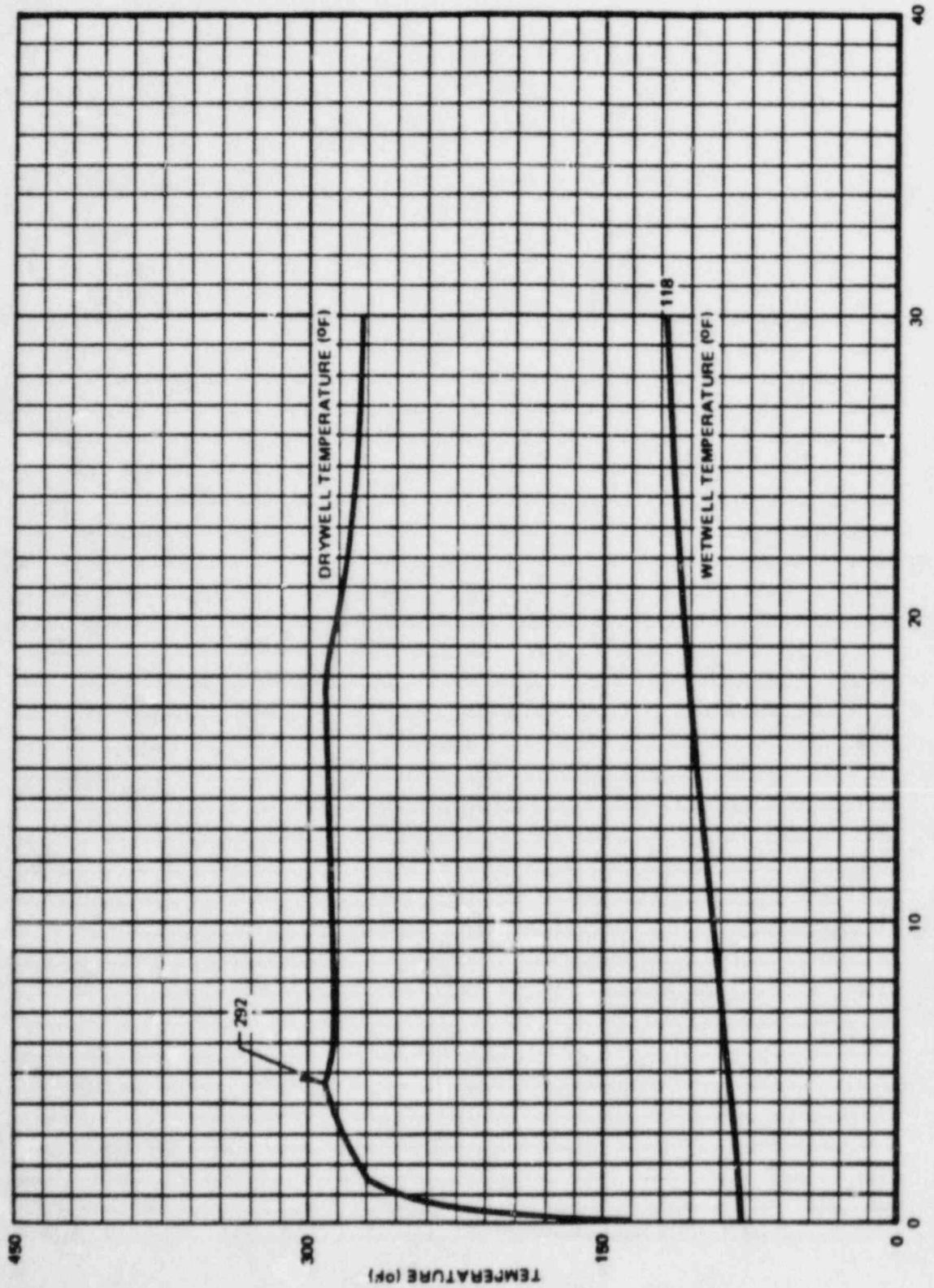


Figure HC 4.1.1-2. DBA Containment Temperature Response

Table HC 4.1.2-1

PLANT CONDITIONS AT INSTANT OF IBA PIPE BREAK

102% Licensed Power (MWt)	3359
Initial Suppression Pool Temperature (^{o}F)	95
Downcomer Submergence (ft)	3.33
Airspace Volume (ft^3)	
Drywell	169,000
Wetwell	133,500
Airspace Pressure (psig)	
Drywell	0.75
Wetwell	0.75

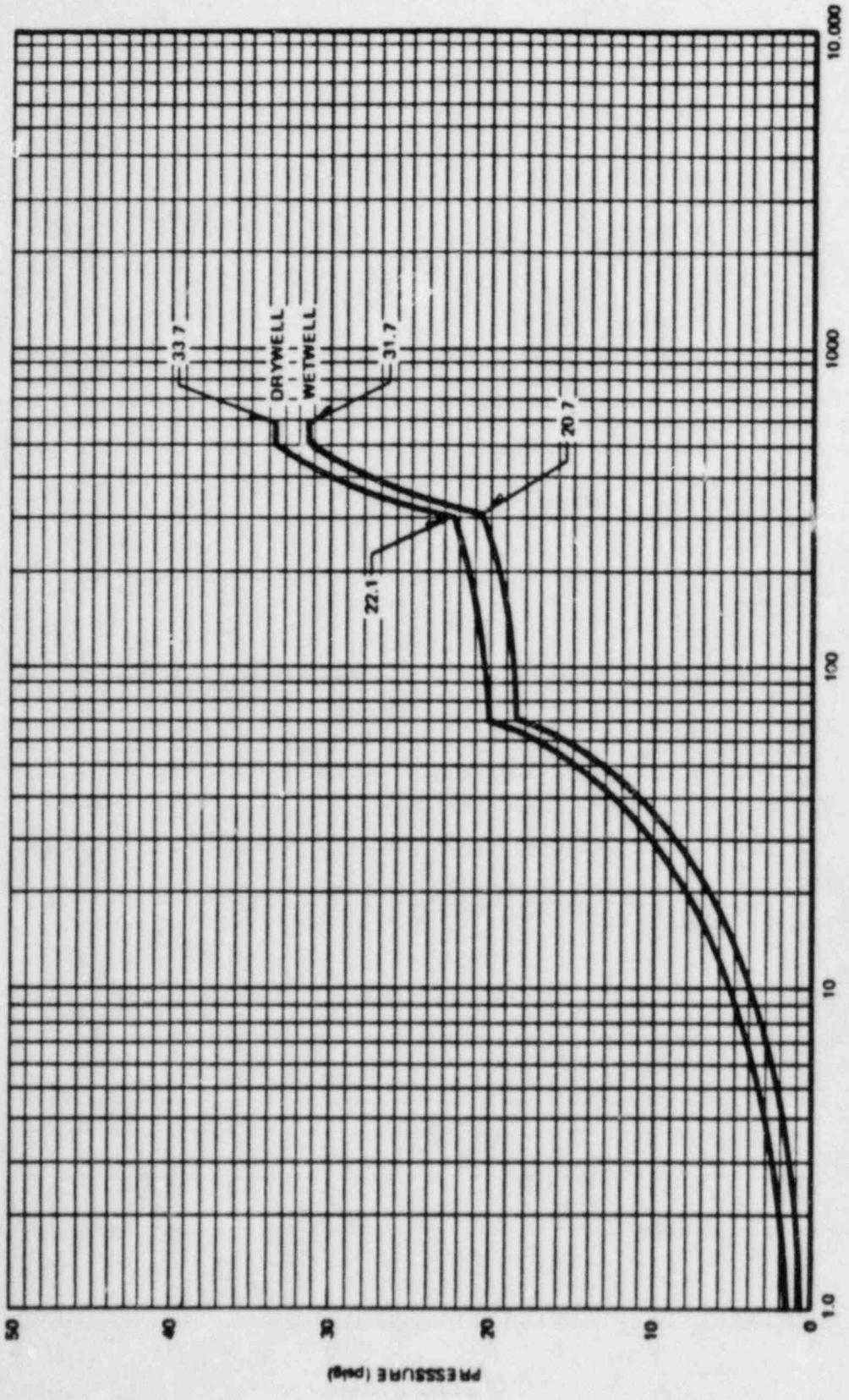


Figure HC 4.1.2-1. IBA Containment Pressure Response

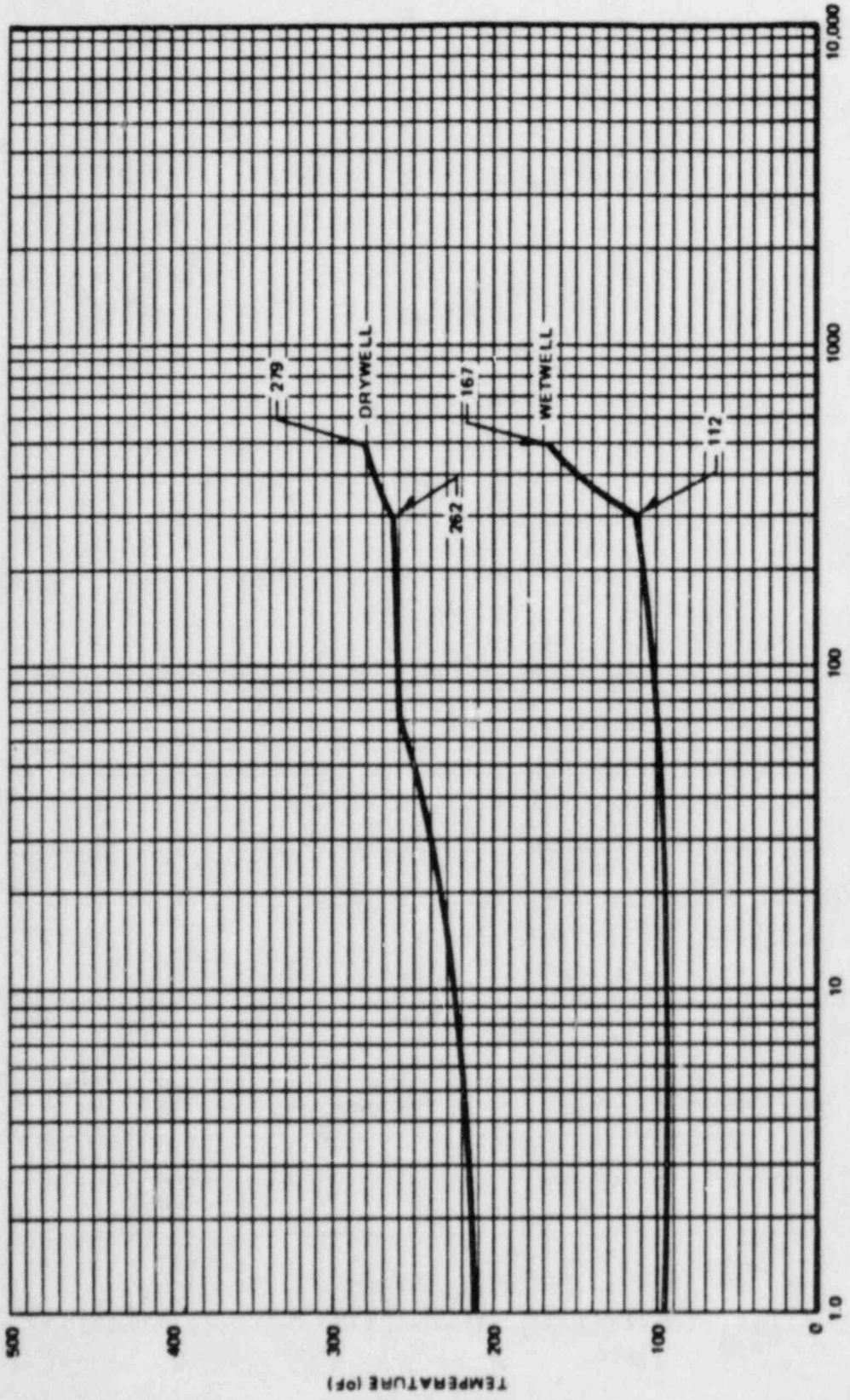


Figure HC 4.1.2-2. IBA Containment Temperature Response

Table HC 4.1.3-1

PLANT CONDITIONS AT INSTANT OF SBA PIPE BREAK

102% Licensed Power (MWt)	3359
Initial Suppression Pool Temperature (^{o}F)	95
Downcomer Submergence (ft)	3.33
Airspace Volume (ft^3)	
Drywell	169,000
Wetwell	133,500
Airspace Pressure (psig)	
Drywell	0.75
Wetwell	0.75

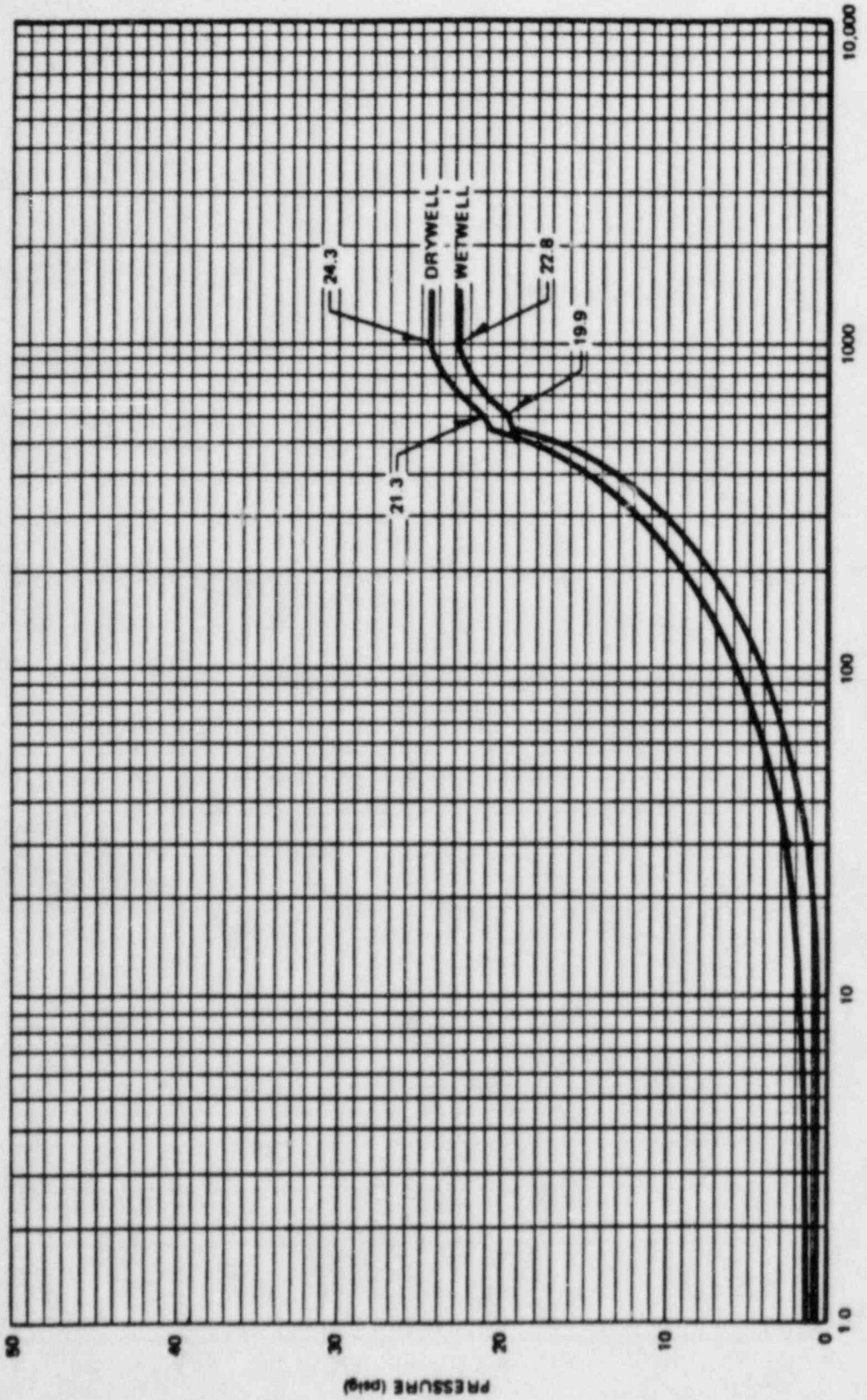


Figure HC 4.1.3-1. SBA Containment Pressure Response

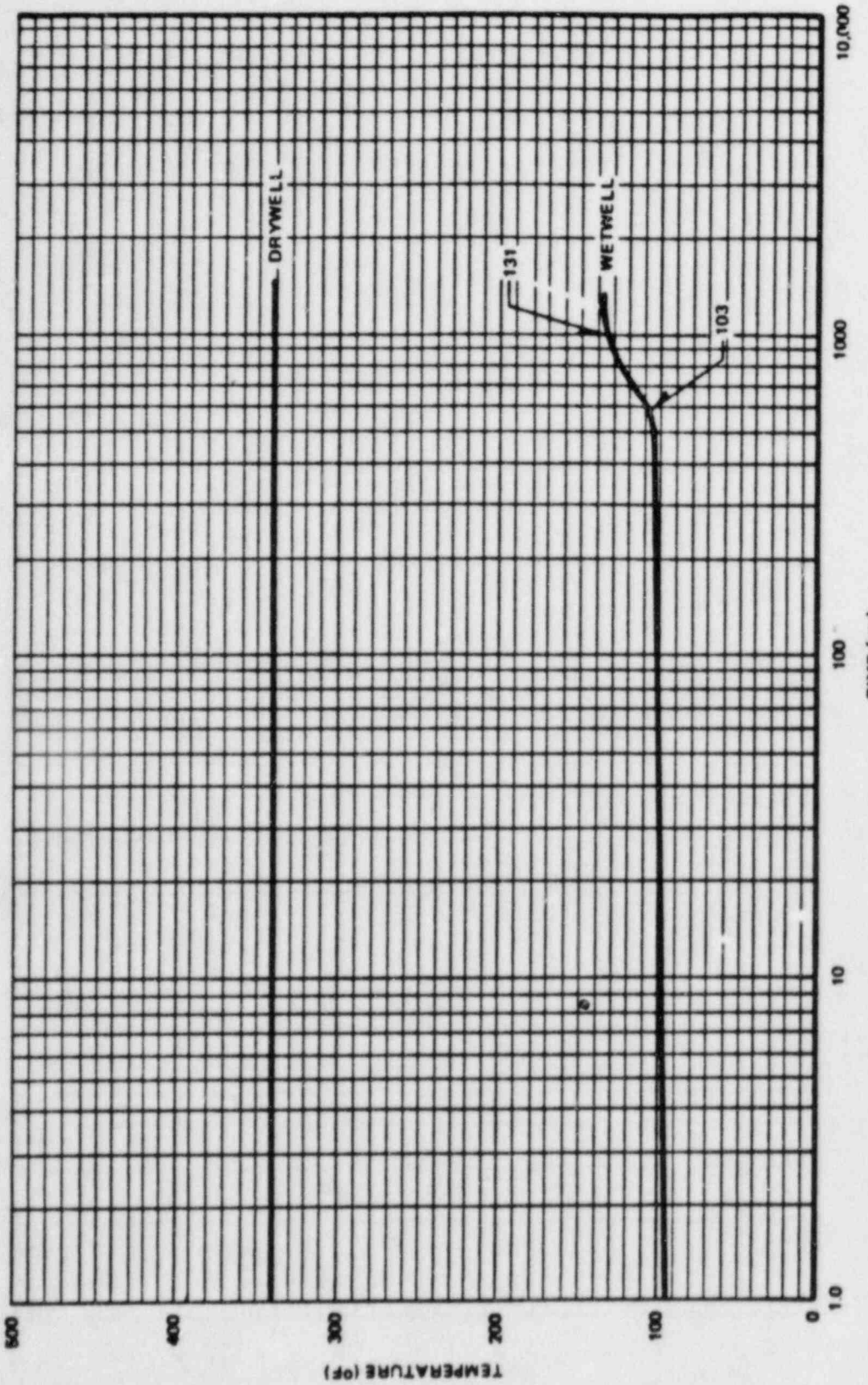


Figure HC 4.1.3-2. SBA Containment Temperature Response

3. DBA VENT SYSTEM THRUST LOADS, ZERO ΔP

This section provides thrust loads for the main vents, vent header, and downcomers resulting from the postulated DBA for plant operation at zero drywell-wetwell pressure differential. The list of applicable figures and tables for this section is given on the following page.

HOPE CREEK 1
PLANT-UNIQUE DBA VENT SYSTEM THRUST LOAD (ZERO ΔP)
TABLES AND FIGURES

Figure or Table No.	Title	Applicable Revision No.
Table HC 4.2-1	Nomenclature for DBA Vent System Thrust Load Section	Revision 1
Table HC 4.2-2	Plant Conditions at Instant of DBA Pipe Break for Thrust Load Calculations (Zero ΔP)	Revision 1
Figure HC 4.2-1	Definition of Positive Thrust Loads	Revision 1
Figure HC 4.2-2	Single Main Vent Forces (0-5 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-3	Vent Header Forces per Mitre Bend (0-5 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-4	Single Downcomer Forces (0-5 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-5	Total and Net Vertical Forces (0-5 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-6	Pressure Time Histories (0-5 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-7	Single Main Vent Forces (0-30 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-8	Vent Header Forces per Mitre Bend (0-30 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-9	Single Downcomer Forces (0-30 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-10	Total and Net Vertical Forces (0-30 sec) (Zero ΔP)	Revision 1
Figure HC 4.2-11	Pressure Time Histories (0-30 sec) (Zero ΔP)	Revision 1

Table HC 4.2-1

NOMENCLATURE FOR DBA VENT SYSTEM THRUST LOAD SECTION

PDW	Drywell pressure
PWW	Wetwell airspace pressure
P1	Main vent pressure
P2	Vent header pressure
P3	Downcomer pressure
F1V1	Vertical force on a single main vent end cap
F1H1	Horizontal force on a single main vent end cap
F1V2	Vertical force on a single main vent mitre bend (applicable to Browns Ferry and Oyster Creek only)
F1H2	Horizontal force on a single main vent mitre bend (applicable to Browns Ferry and Oyster Creek only)
F2V	Vertical force on vent header (per mitre bend)
F2H	Horizontal force on vent header (per mitre bend)
F3V	Vertical force on a single downcomer mitre bend
F3H	Horizontal force on a single downcomer mitre bend
F4V	Vertical force on second mitre bend of a single downcomer (if applicable)
F4H	Horizontal force on second mitre bend of a single downcomer (if applicable)
F1V1T	Total main vent end cap vertical force = F1V1 x number of main vents
F1V2T	Total main vent mitre bend vertical force = F1V2 x number of main vents
F2VT	Total vent header vertical force = F2V x number of vent header mitre bends
F3VT	Total vertical force (first downcomer mitre bend) = F3V x number of downcomers
F4VT	Total vertical force (second downcomer mitre bend) = F4V x number of downcomers
FNETV	FNETV = F1V1T + F1V2T + F2VT + F3VT + F4VT

Table 4.2-1 (Continued)

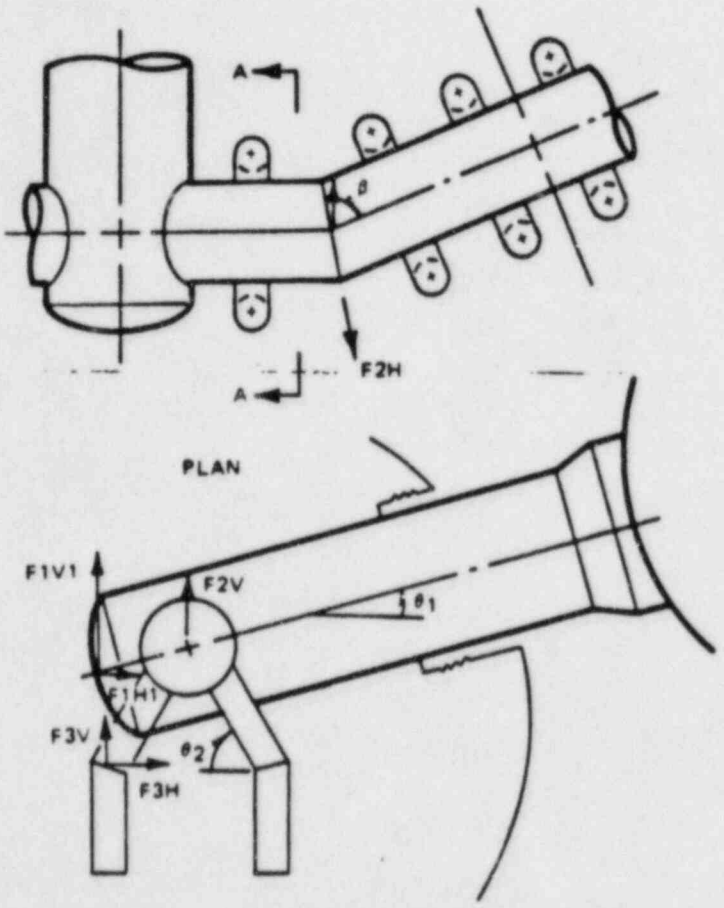
NOMENCLATURE FOR DBA VENT SYSTEM THRUST LOAD SECTION

A_{VH}	Vent header flow area
A_{VP}	Total main vent flow area
A_{DC}	Total downcomer flow area
n_1	Number of main vents
n_2	Number of downcomers
n_3	Number of vent header mitre bends
$\dot{m}_T$	Total mass flow rate
V_1	Fluid velocity in main vent
V_2	Fluid velocity in vent header
V_3	Fluid velocity in downcomer
θ_1	Angle of main vent with horizontal
θ_2	Angle of first downcomer mitre bend with horizontal
θ_3	Angle of second downcomer mitre bend with horizontal
α	Angle of main vent mitre bend with horizontal
β	90° − (vent header mitre bend angle)

Table HC 4.2-2

PLANT CONDITIONS AT INSTANT OF DBA PIPE BREAK
FOR THRUST LOAD CALCULATIONS (ZERO ΔP)

Thermal Power (102% of licensed) (MWt)	3359
Initial Suppression Pool Temperature (^{o}F)	80
Downcomer Submergence (ft)	3.33
Airspace Volume (ft^3)	
Drywell	169,000
Wetwell	133,500
Airspace Pressure (psig)	
Drywell	0.75
Wetwell	0.75



F1V1 = VERTICAL FORCE ON MAIN VENT END CAP
F1H1 = HORIZONTAL FORCE ON MAIN VENT END CAP
F2V = VERTICAL FORCE ON VENT HEADER (PER MITRE BEND)
F2H = HORIZONTAL FORCE ON VENT HEADER (PER MITRE BEND)
F3V = VERTICAL FORCE ON DOWNCOMER MITRE BEND
F3H = HORIZONTAL FORCE ON DOWNCOMER MITRE BEND

FORCES ARE SHOWN IN THEIR ASSUMED POSITIVE DIRECTION

Figure HC 4.2-1. Definition of Positive Thrust Loads

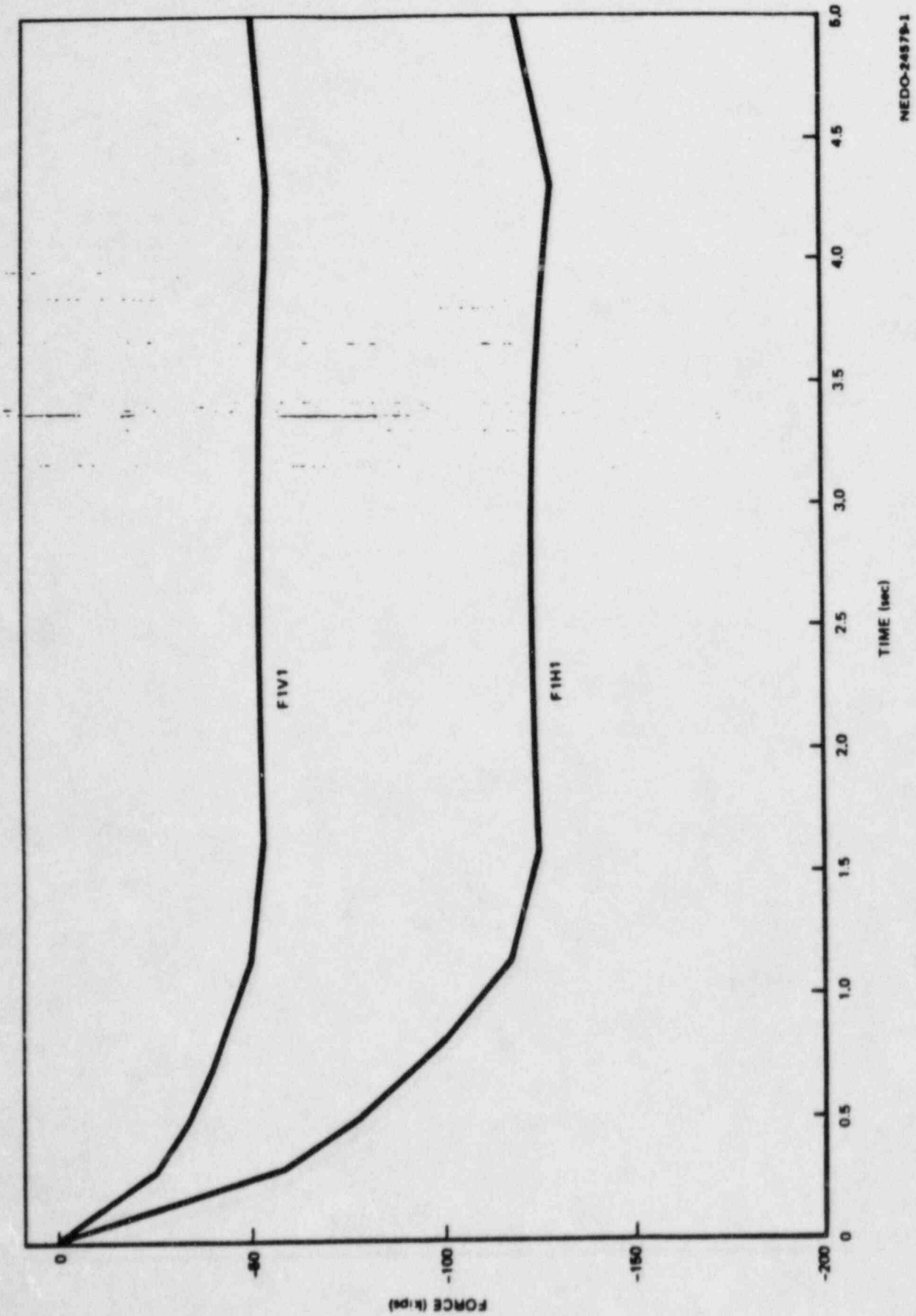


Figure HC 4.2-2. Single Main Vent Forces (0-5 sec) (Zero ΔP)

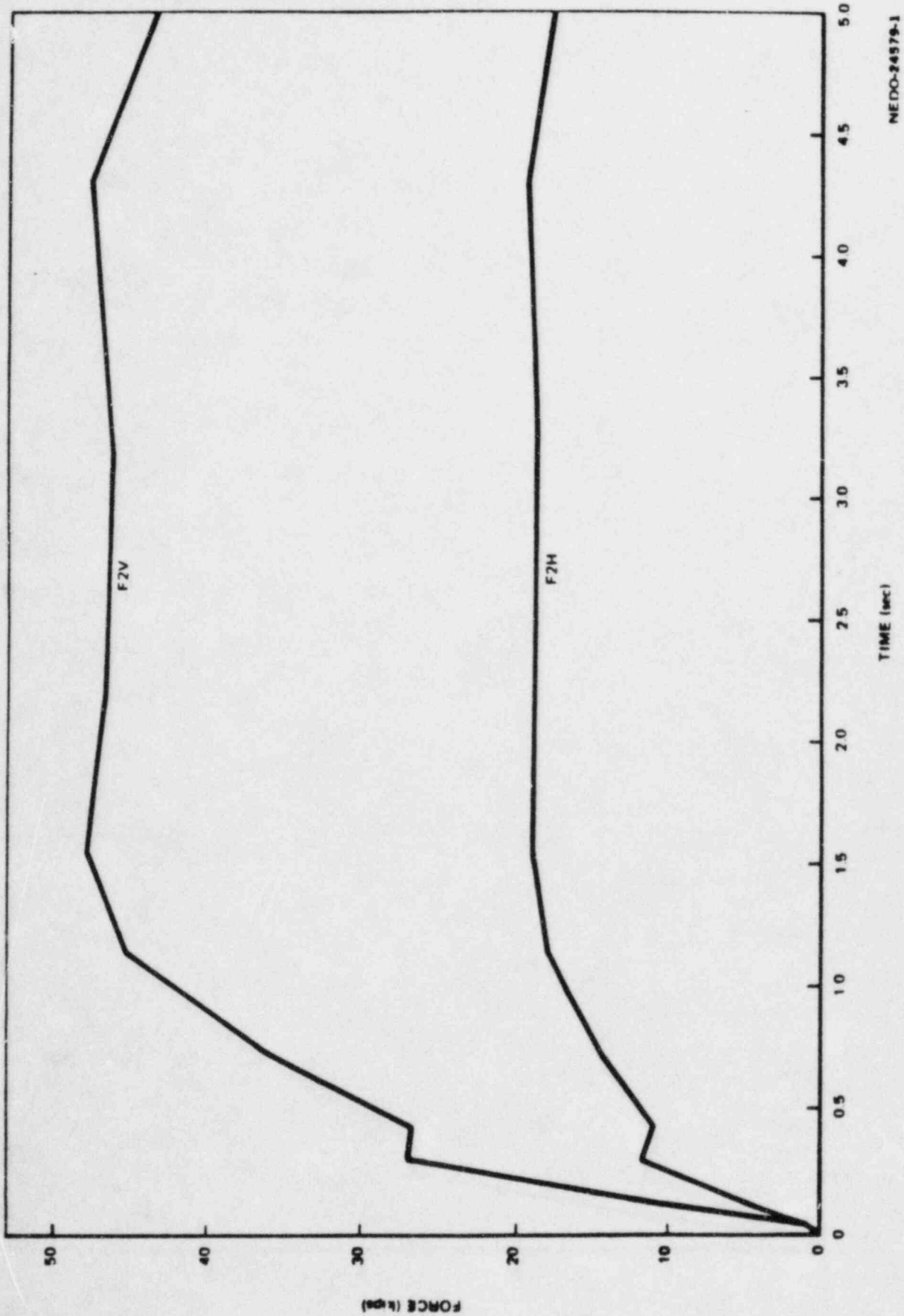


Figure HC 4.2-3. Vent Header Forces Per Mitre Bend (0-5 sec) (Zero ΔP)

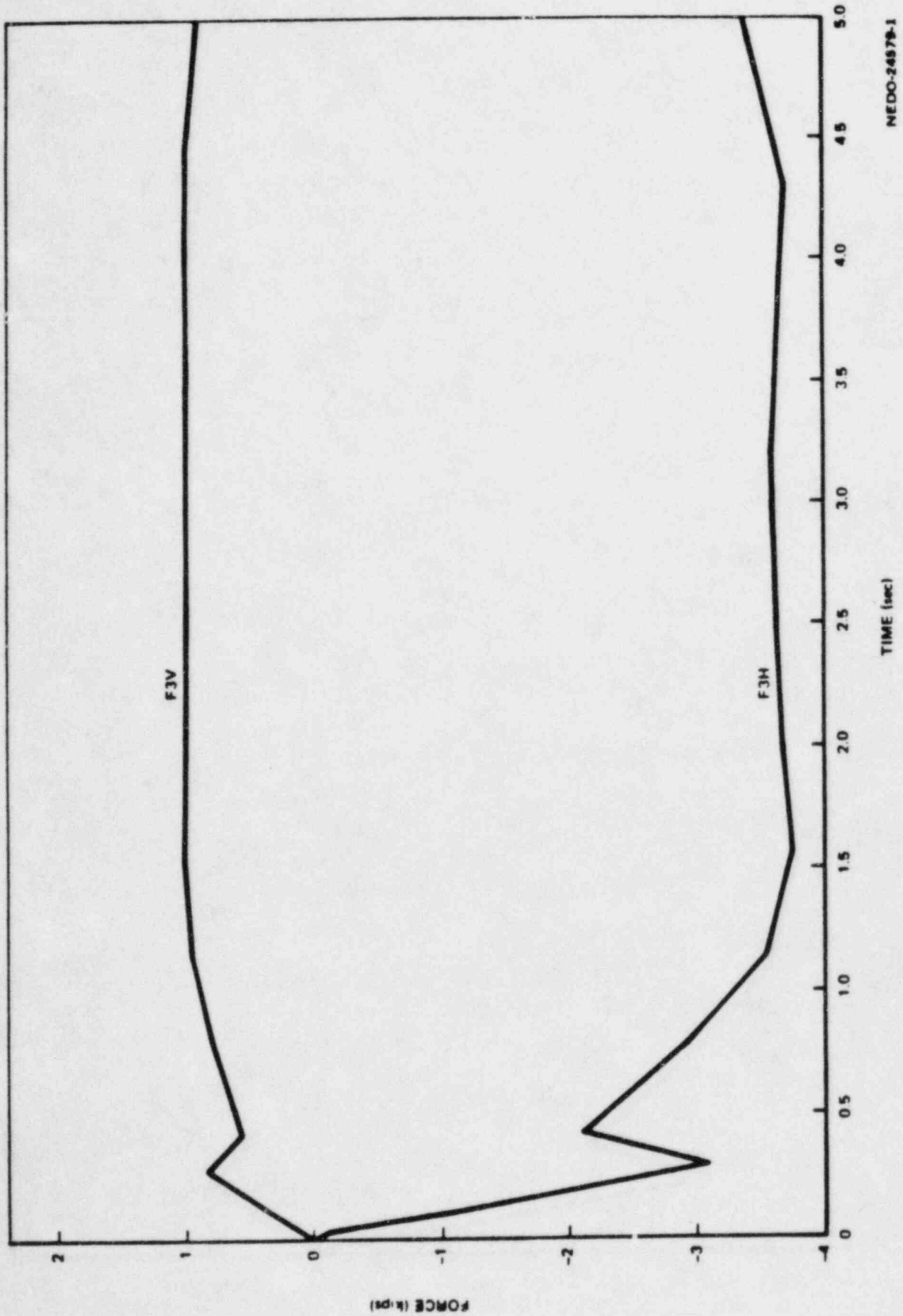


Figure HC 4.2-4. Single Downcomer Forces (0-5 sec) (Zero ΔP)

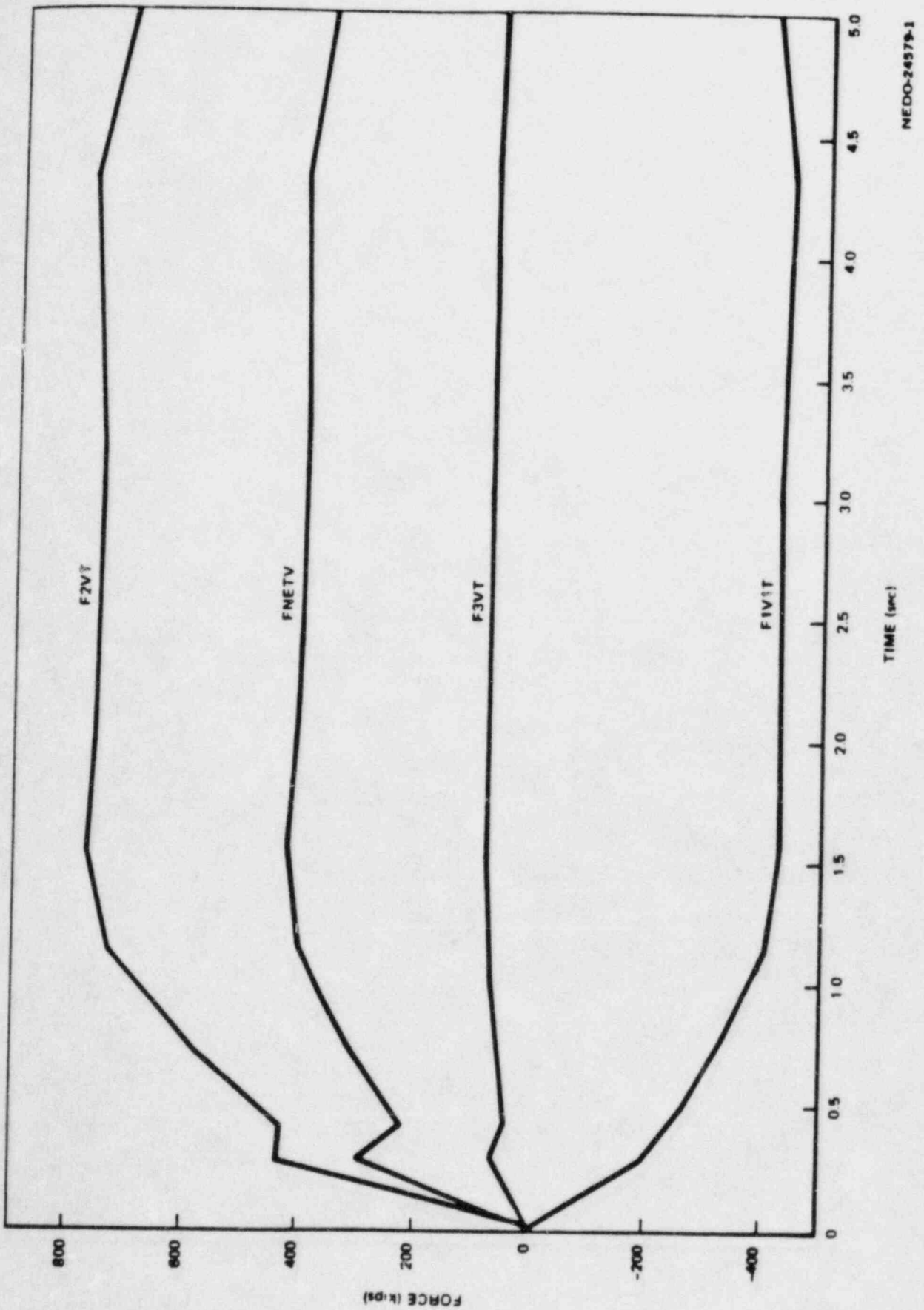


Figure HC 4.2-5. Total and Net Vertical Forces (0-5 sec) (Zero ΔP)

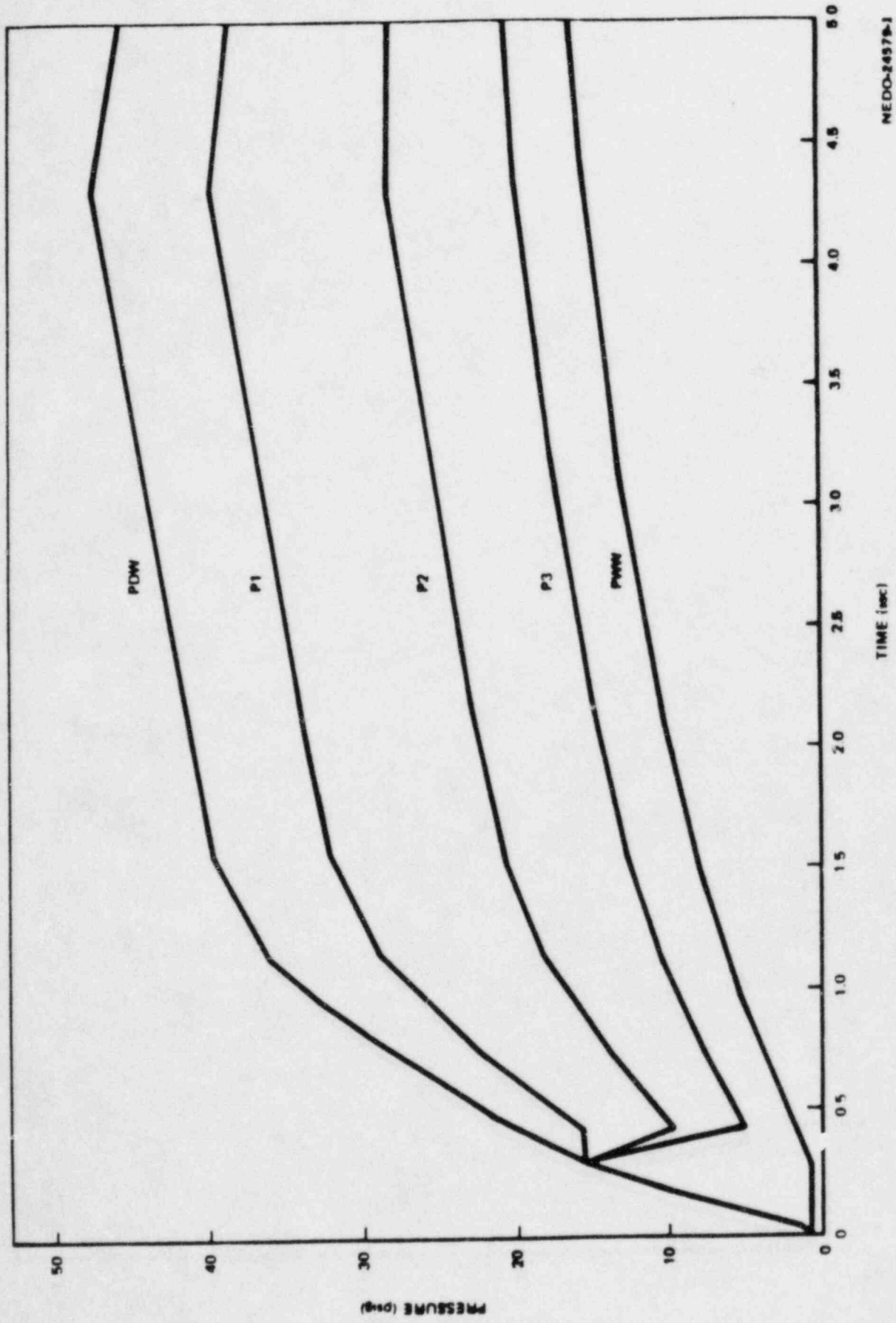


Figure HC 4.2-6. Pressure Time Histories (0-5 sec) (Zero ΔP)

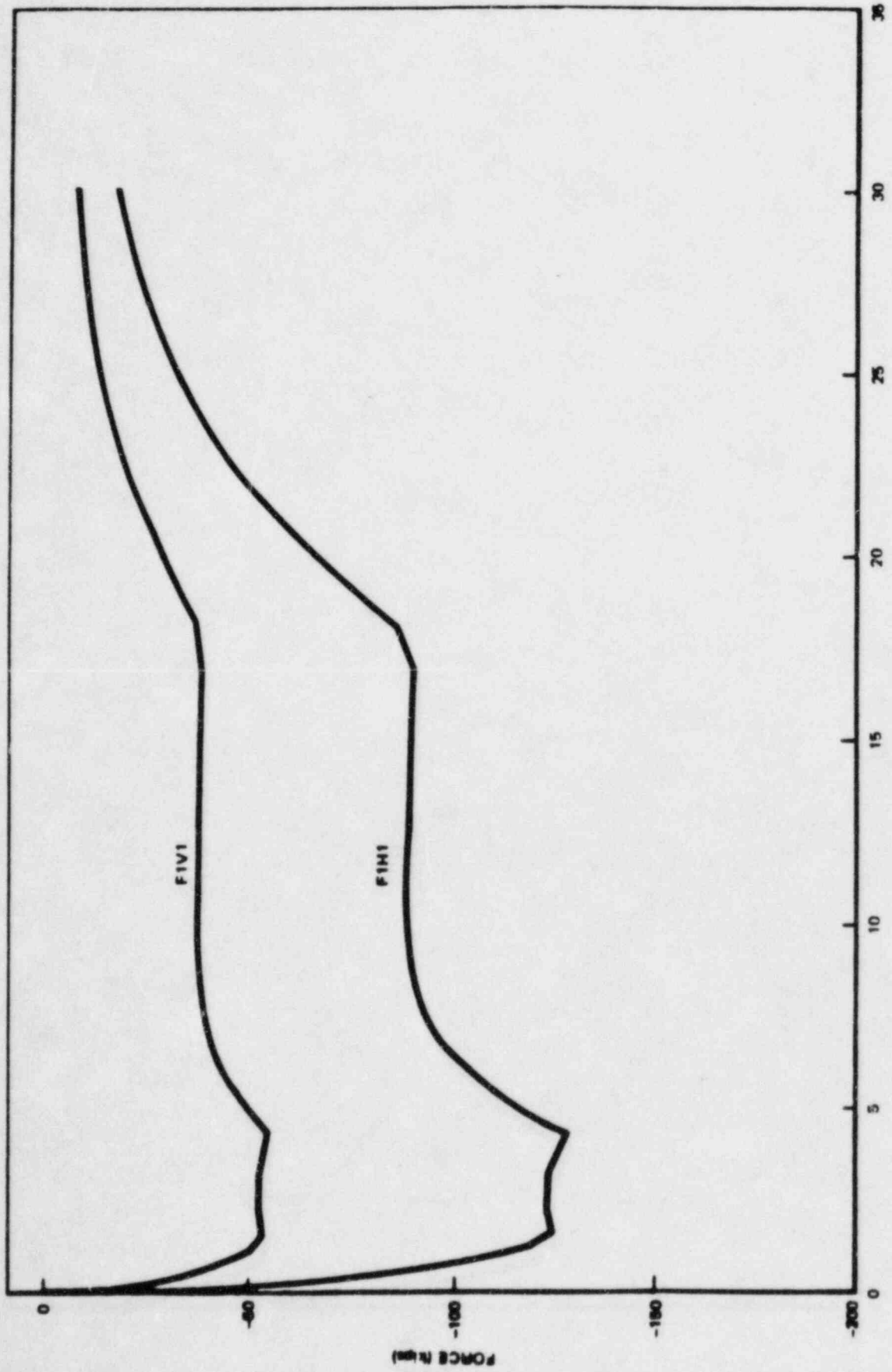


Figure HC 4.2-7. Single Main Vent Forces (0-30 sec) (Zero ΔP)

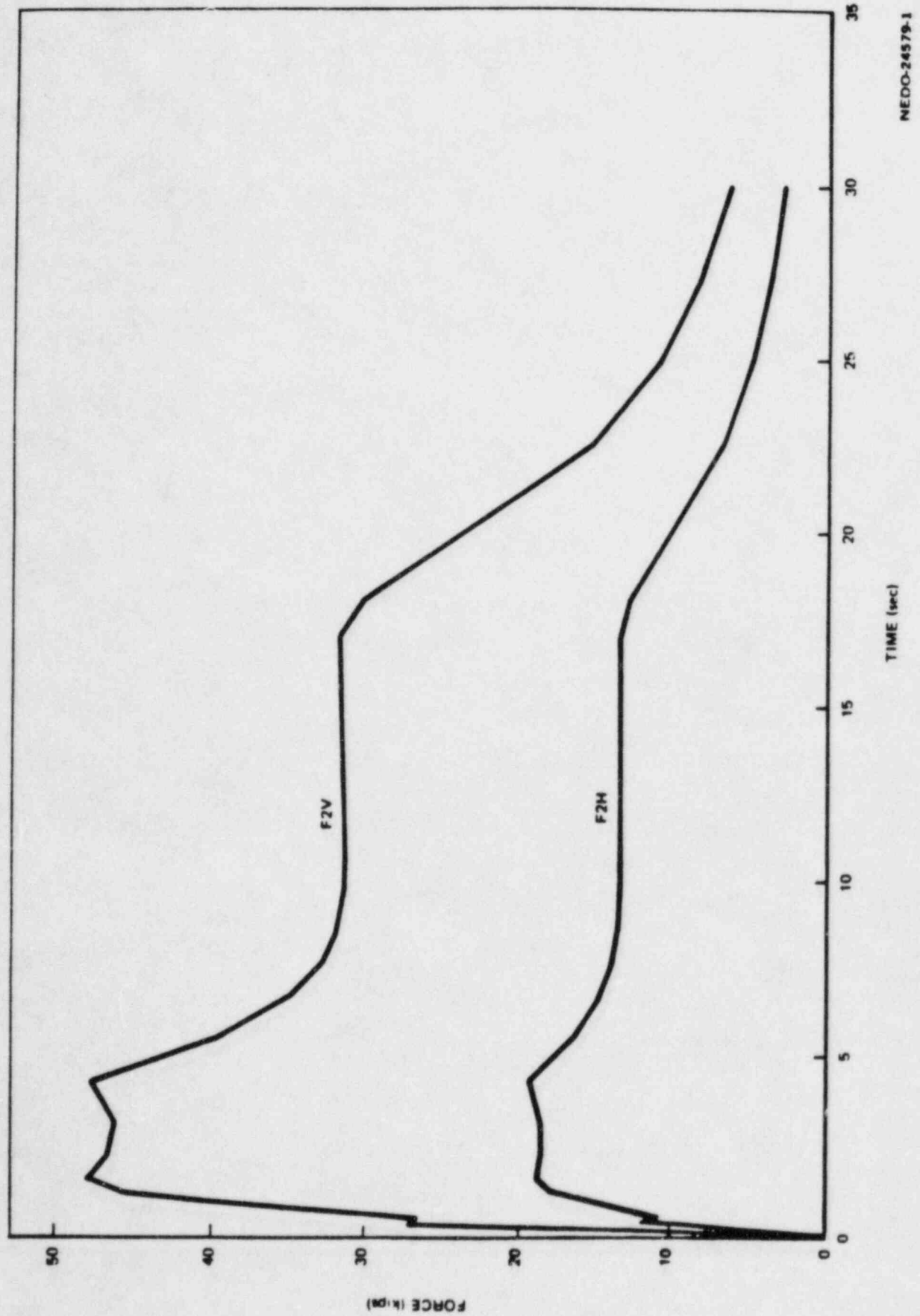


Figure HC 4.2-8. Vent Header Forces per Mitre Bend (0-30 sec) (Zero ΔP)

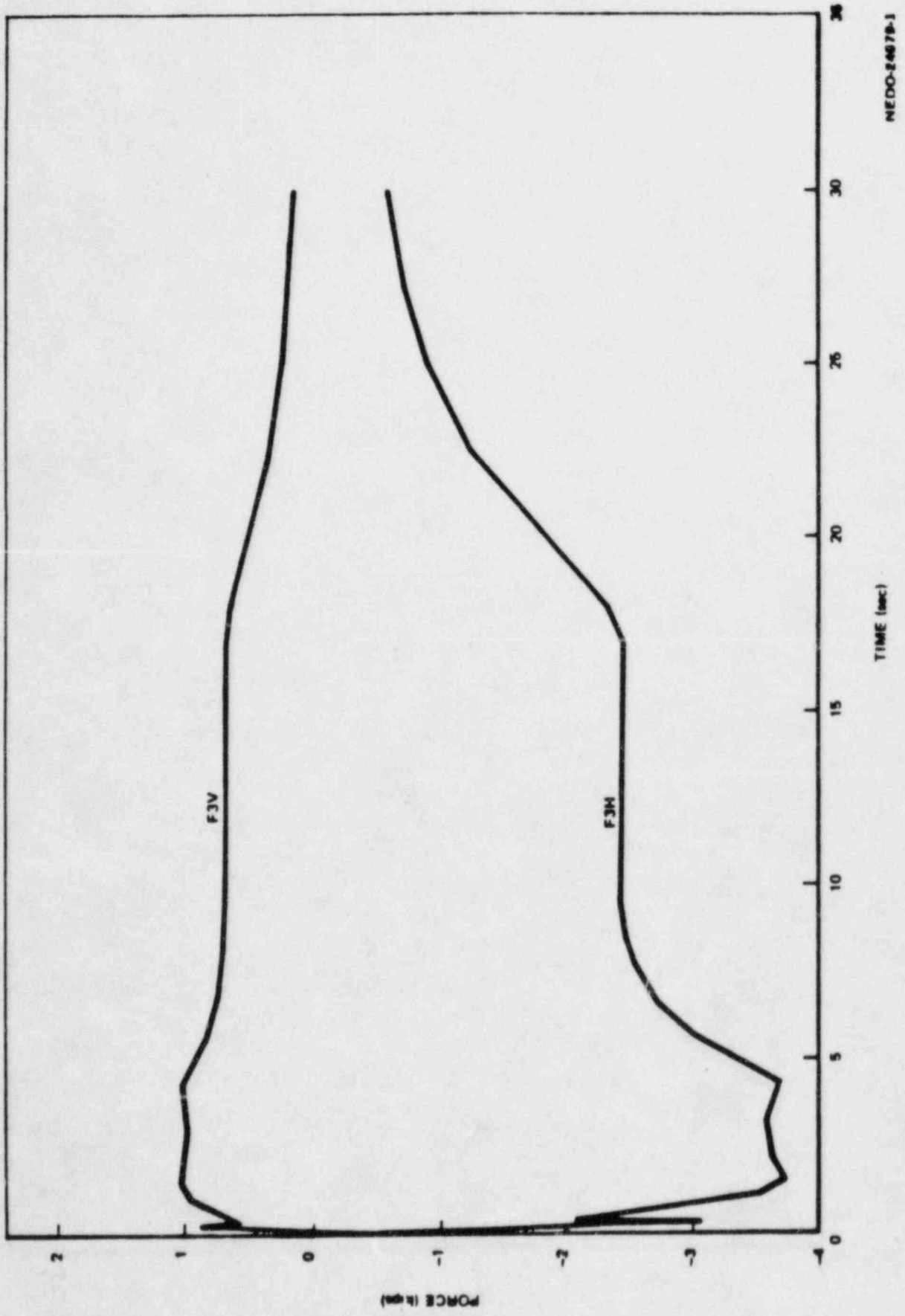


Figure HC 4.2-9. Single Downcomer Forces (0-30 sec) (Zero ΔP)

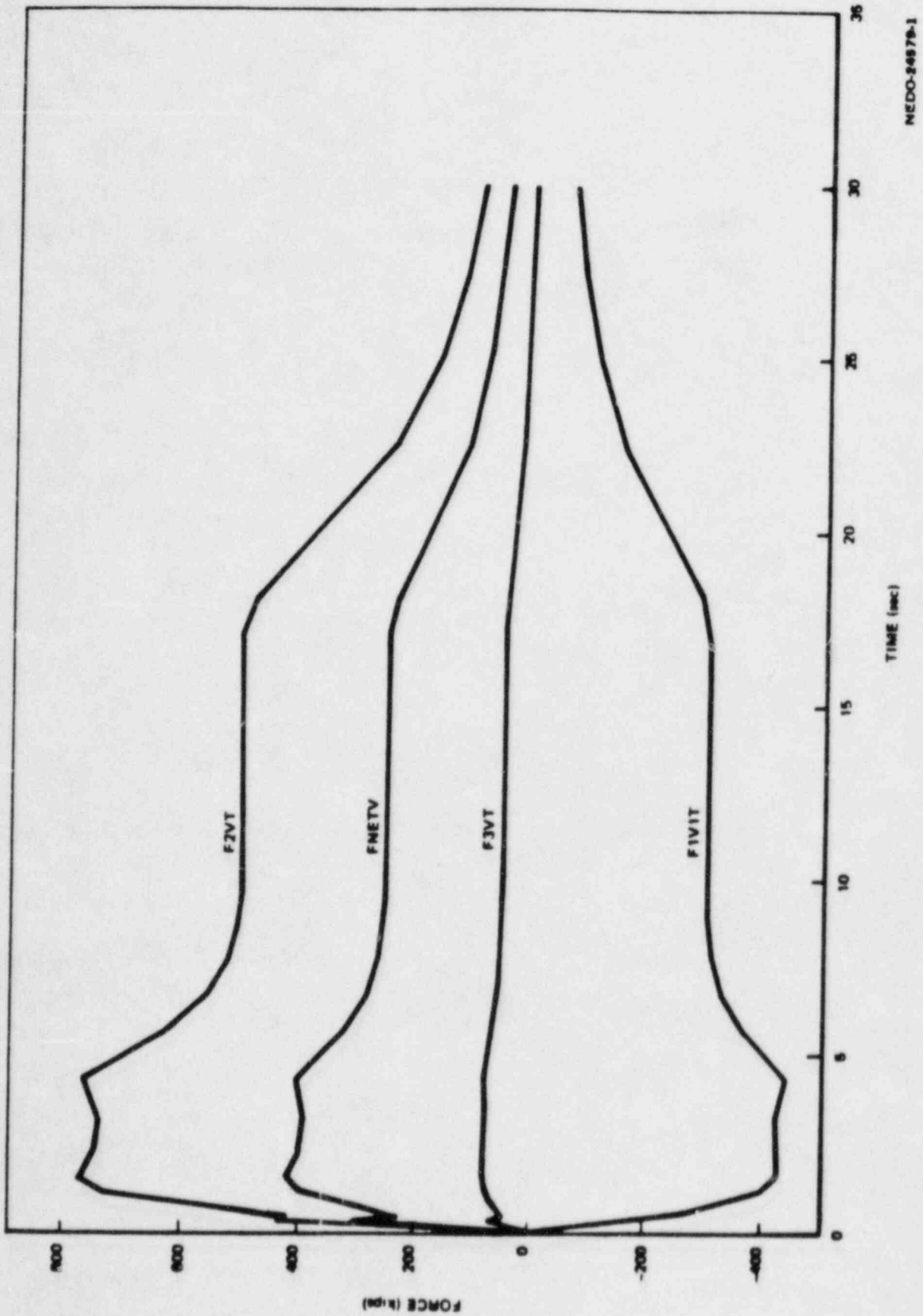


Figure HC 4.2-10. Total and Net Vertical Forces (0-30 sec) (Zero ΔP)

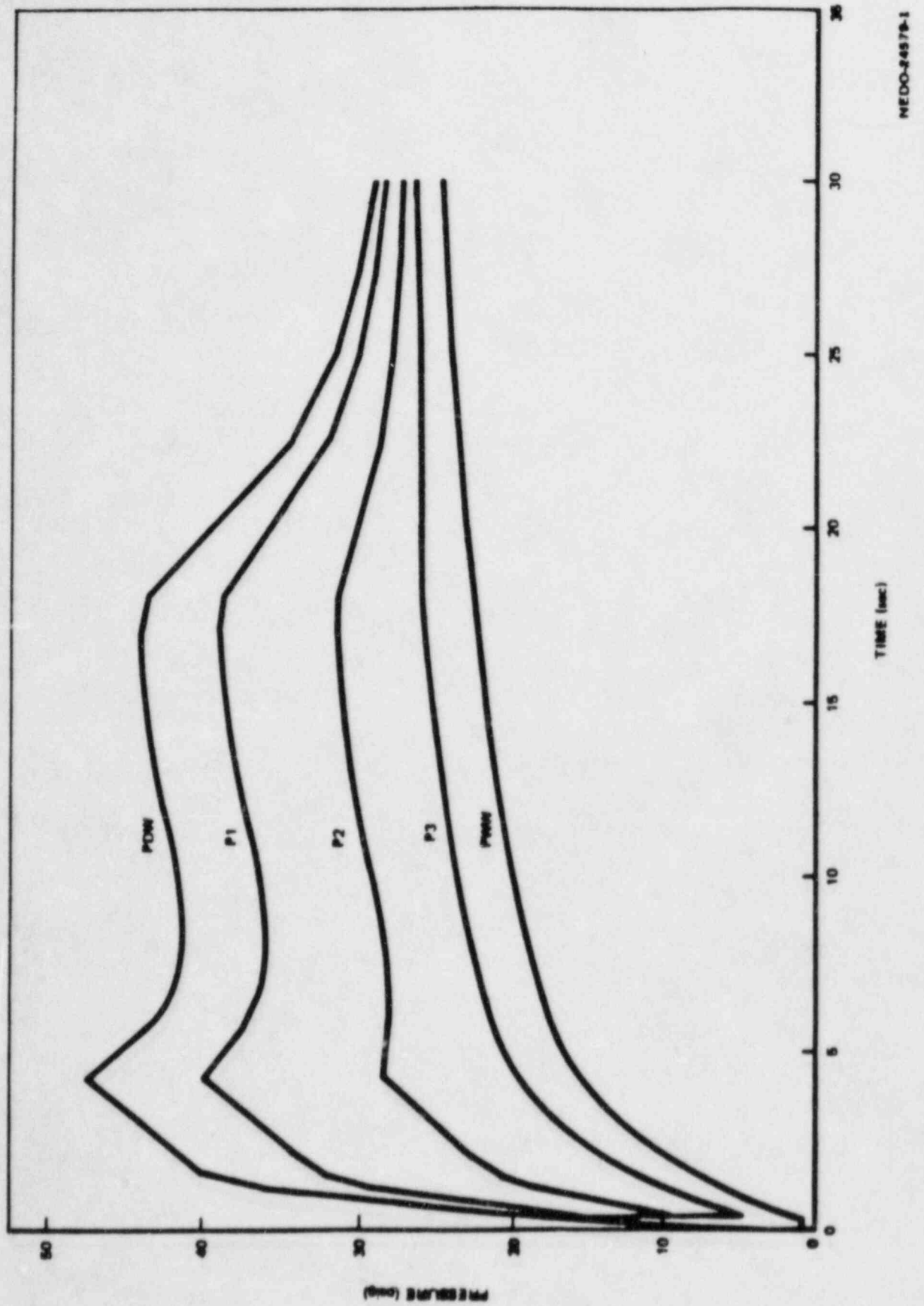


Figure HC 4.2-11. Pressure Time Histories (0-30 sec) (Zero ΔP)

4. POOL SWELL TORUS VERTICAL LOADS

This section provides the net torus vertical load and shell pressure histories resulting from the drywell air purge to the wetwell during the postulated DBA. The list of applicable figures for this section is given on the following page.

HOPE CREEK 1

POOL SWELL TORUS VERTICAL LOADS TABLES AND FIGURES

Figure No.	Title	Applicable Revision No.
Figure HC 4.3.1-1	Net Torus Vertical Load (Zero ΔP)	Revision 1
Figure HC 4.3.2-1	Average Submerged Pressure (Zero ΔP)	Revision 1
Figure HC 4.3.2-2	Torus Air Pressure (Zero ΔP)	Revision 1

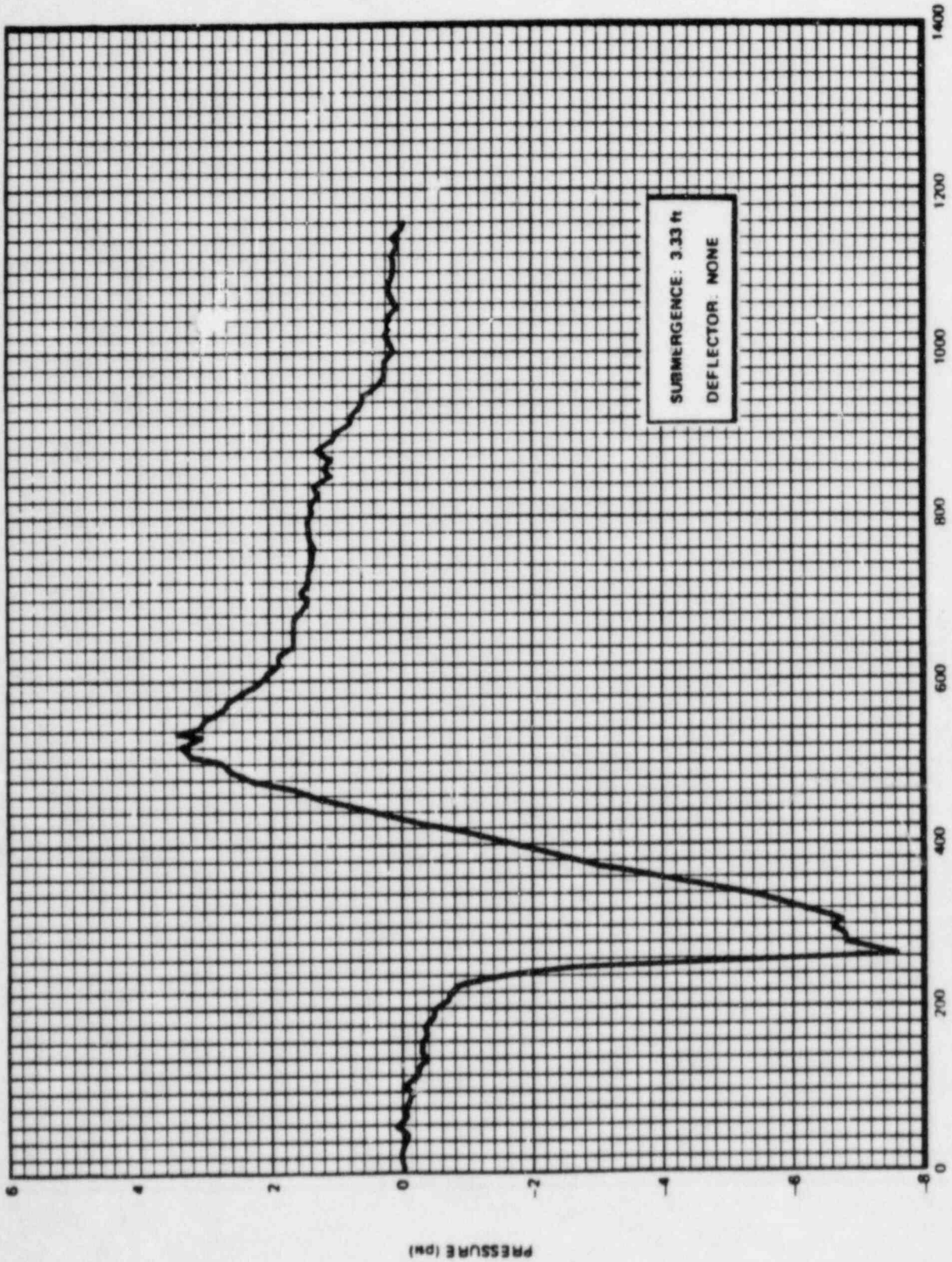


Figure HC 4.3.1-1. Net Torus Vertical Load (Zero ΔP)

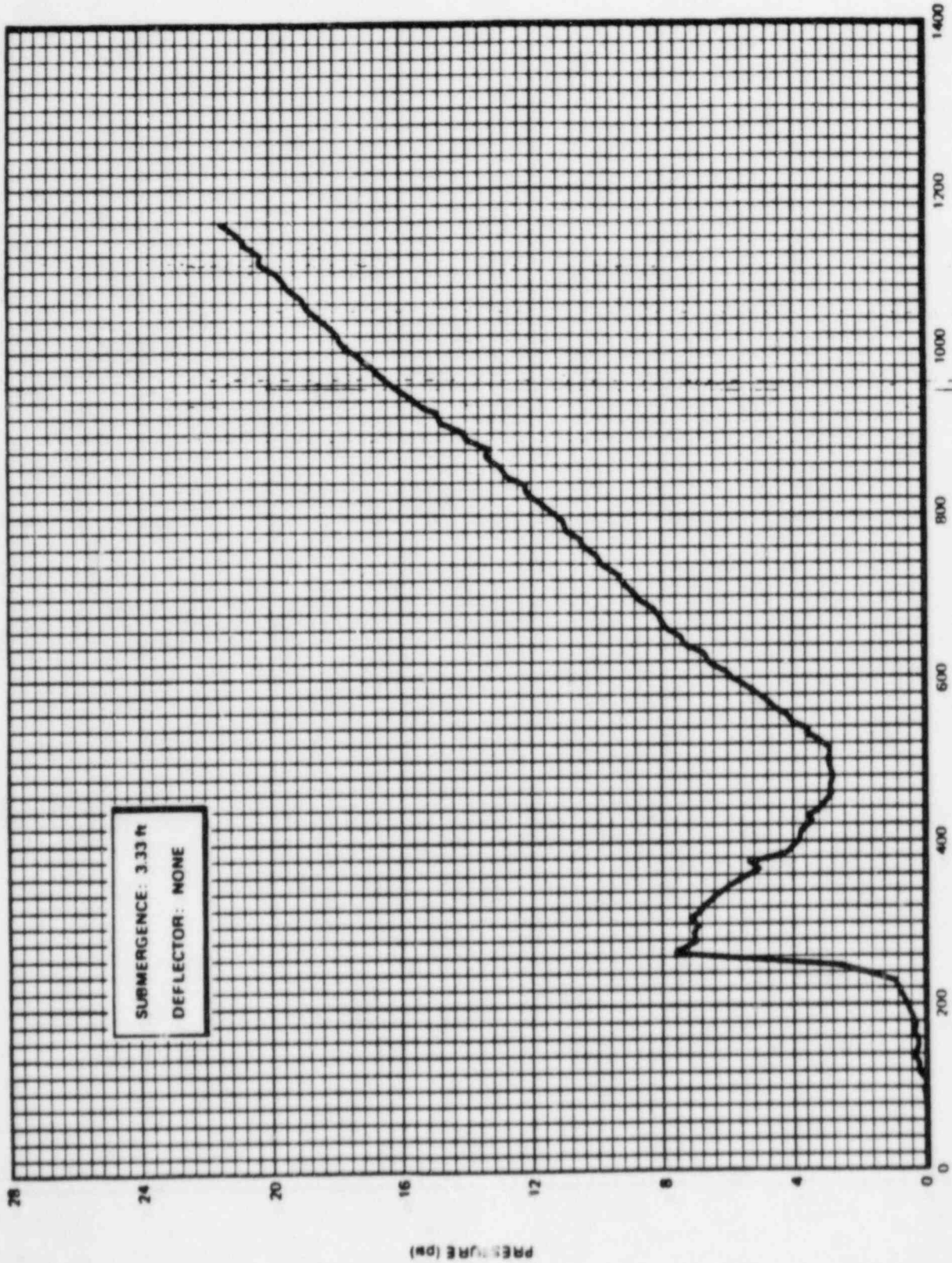


Figure HC 4.3.2-1. Average Submerged Pressure (Zero ΔP)

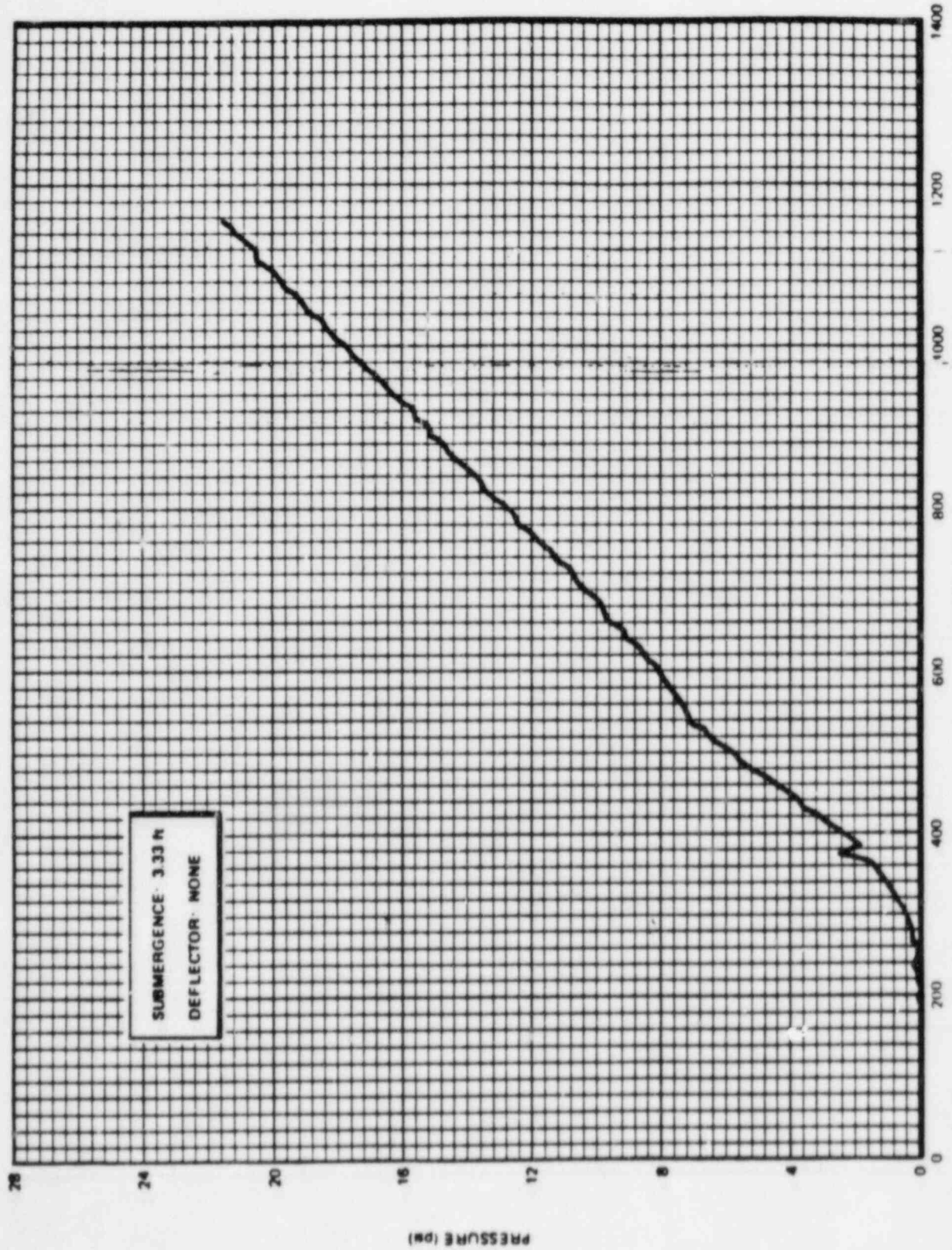


Figure HC 4.3.2-2. Torus Air Pressure (Zero ΔP)

5. POOL SWELL IMPACT AND DRAG LOADS

This section provides the pool swell impact and drag pressures on the vent header as a function of position and time. Also included are the pool swell displacement and velocity distributions for evaluation of impact and drag loads on other structures located above the pool. The list of applicable figures and tables for this section is given on the following page.

HOPE CREEK 1

PLANT-UNIQUE POOL SWELL IMPACT AND DRAG LOAD TABLES AND FIGURES

Figure or Table No.	Title	Applicable Revision No.
Figure HC 4.3.3-1	Location of Impact/Drag Pressure Transients on Header	Revision 1
Table HC 4.3.3-1	Vent Header Local Impact/Drag Pressure Transients (Zero ΔP)	Revision 1
Figure HC 4.3.3-2	Longitudinal Vent Header Impact Velocity Distribution Based on EPRI Main Vent Orifice Test	Revision 1
Figure HC 4.3.3-3	Longitudinal Time Delay Distribution Based on EPRI Main Vent Orifice Test	Revision 1
Figure HC 4.3.3-4	Circumferential Time Delay Distribution (Zero ΔP)	Revision 1
Figure HC 4.3.4-1	Pool Swell Displacement Distribution (Zero ΔP)	Revision 1
Figure HC 4.3.4-2	Pool Swell Velocity Distribution (Zero ΔP)	Revision 1

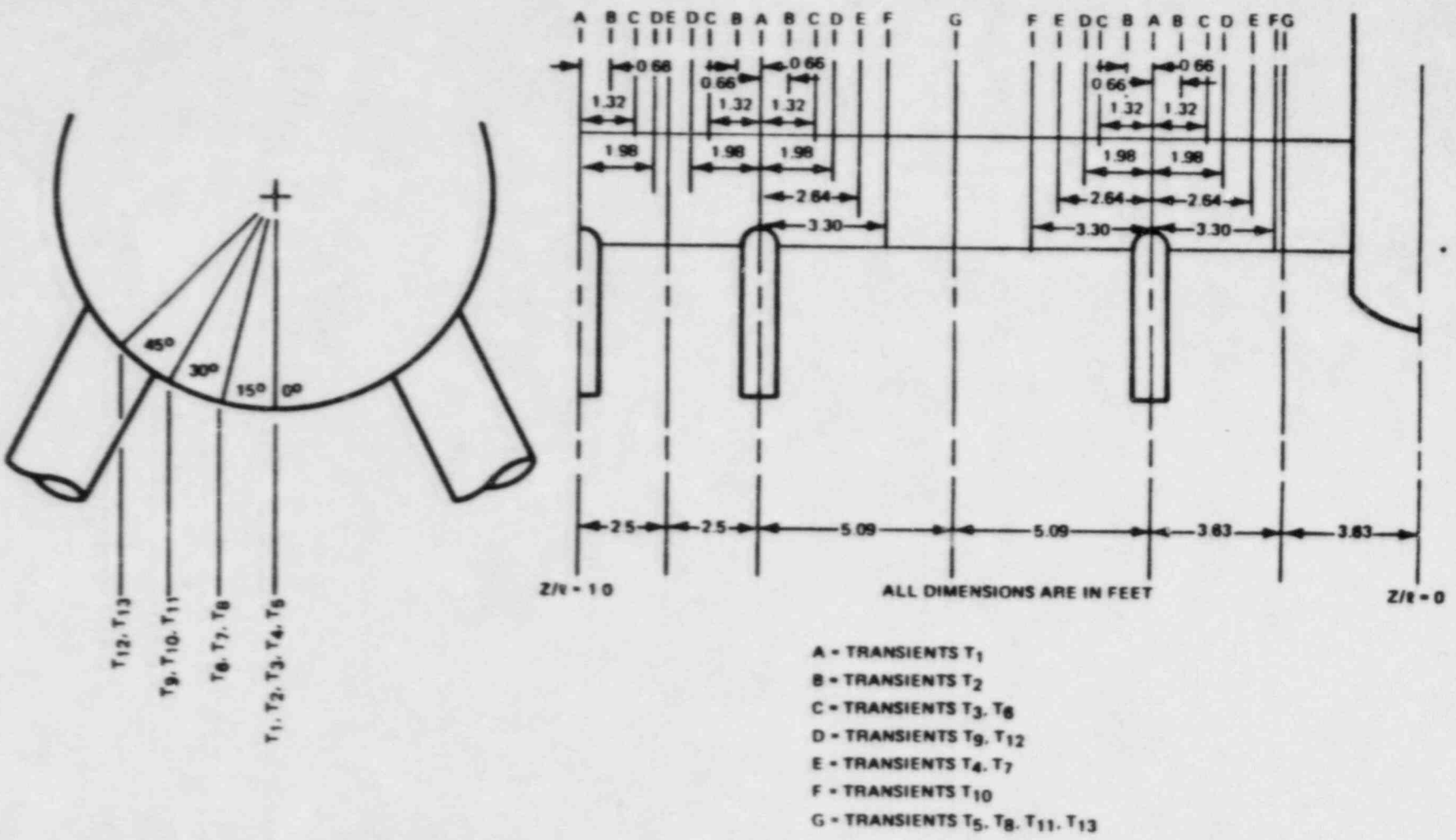


Figure HC 4.3.3-1. Location of Impact/Drag Pressure Transients on Header

Table HC 4.3.3-1

VENT HEADER LOCAL IMPACT/DRAG PRESSURE TRANSIENTS (ZERO ΔP)

Submergence: 3.33 ft - Deflector: None

LOCATION T1

T (MSEC)	P (PSI)
.0000	.0000
3.7825	110.9964
5.3629	19.2675
32.9724	1.2781
129.8405	.0000

LOCATION T2

T (MSEC)	P (PSI)
.0000	.0000
1.0089	86.4973
3.9697	14.7894
37.1802	1.0096
147.4195	.0000

LOCATION T3

T (MSEC)	P (PSI)
.0000	.0000
1.7648	73.2051
5.0796	19.4413
31.2318	1.1446
115.2446	.0000

LOCATION T4

T (MSEC)	P (PSI)
.0000	.0000
2.0147	39.2146
5.8145	15.7925
30.1577	1.1279
129.7742	.0000

LOCATION T5

T (MSEC)	P (PSI)
.0000	.0000
2.7678	48.4591
6.4563	12.6974
27.8508	1.4947
122.2272	.0000

LOCATION T6

T (MSEC)	P (PSI)
.0000	.0000
6.8307	26.9672
14.9476	8.1949
47.7926	.9021
125.5884	.0000

LOCATION T7

T (MSEC)	P (PSI)
.0000	.0000
2.1889	38.6895
7.1372	13.1546
29.8393	1.0749
110.8239	.0000

LOCATION T8

T (MSEC)	P (PSI)
.0000	.0000
2.1689	52.2543
4.9770	13.3529
25.8630	1.2743
126.4270	.0000

LOCATION T9

T (MSEC)	P (PSI)
.0000	.0000
5.1052	18.1601
18.7291	7.1697
32.8730	.9271
112.1954	.0000

LOCATION T10

T (MSEC)	P (PSI)
.0000	.0000
2.3912	25.5096
6.9442	9.9645
24.9185	.8049
107.3402	.0000

LOCATION T11

T (MSEC)	P (PSI)
.0000	.0000
1.6379	19.8920
6.1542	8.1251
27.3527	.5657
112.8516	.0000

LOCATION T12

T (MSEC)	P (PSI)
.0000	.0000
3.2598	9.8717
13.4339	3.9279
38.9334	.1020
104.9937	.0000

LOCATION T13

T (MSEC)	P (PSI)
.0000	.0000
2.2182	6.7498
7.0136	3.8184
27.4789	1.1247
81.3046	.0000

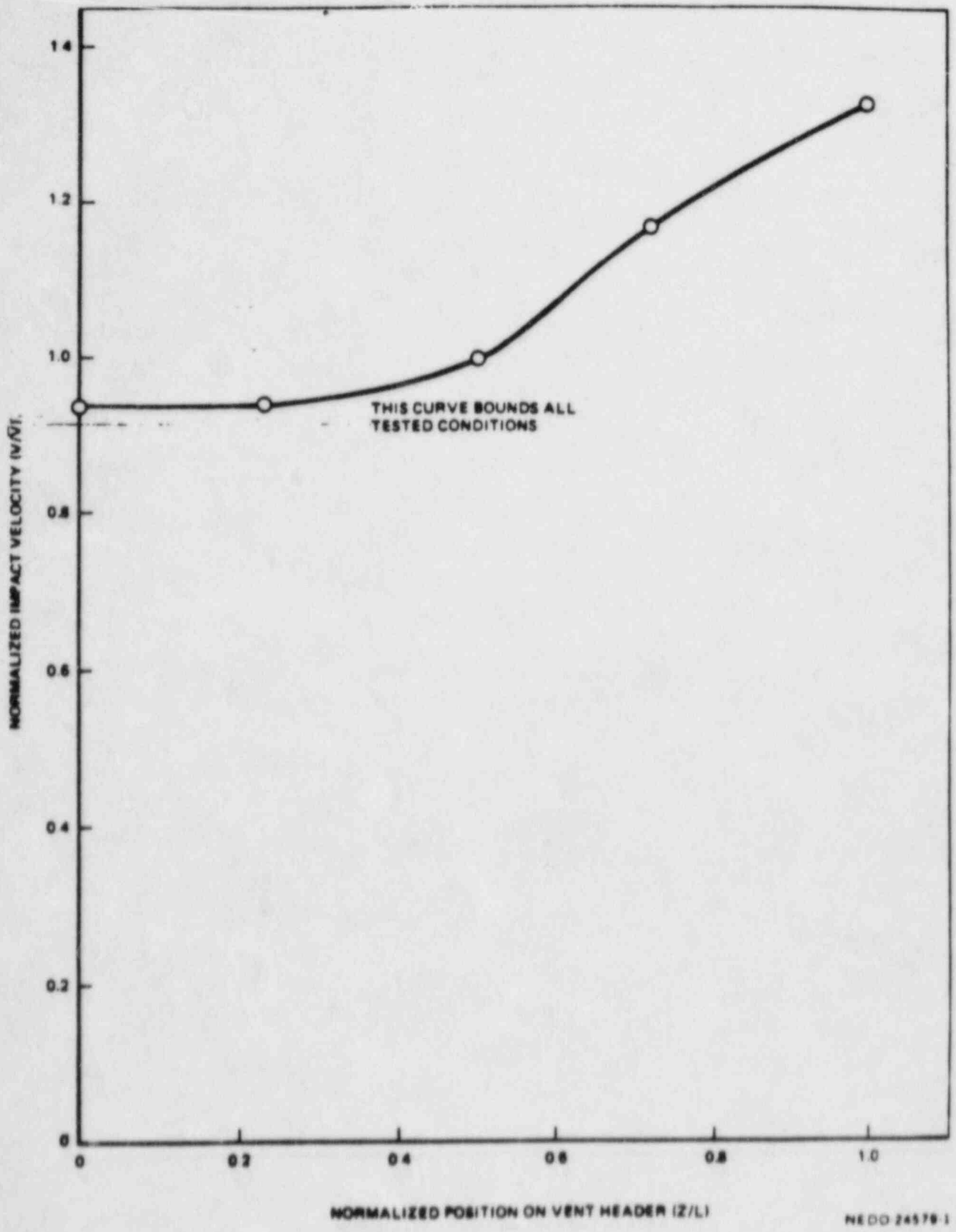


Figure HC 4.3.3-2. Longitudinal Vent Header Impact Velocity Distribution Based on EPRI Main Vent Orifice Test

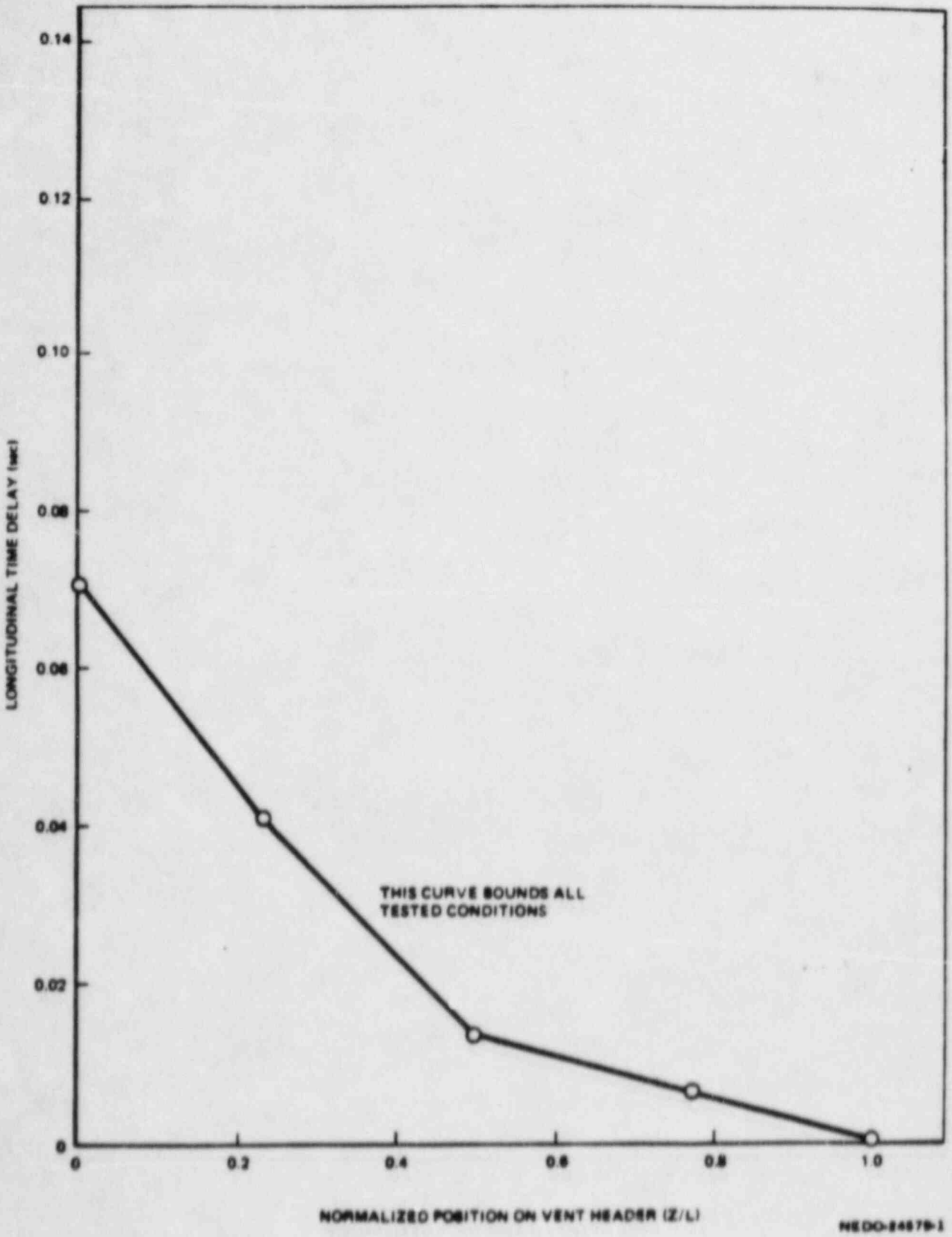


Figure HC 4.3.3-3. Longitudinal Time Delay Distribution Based on EPRI Main Vent Orifice Test

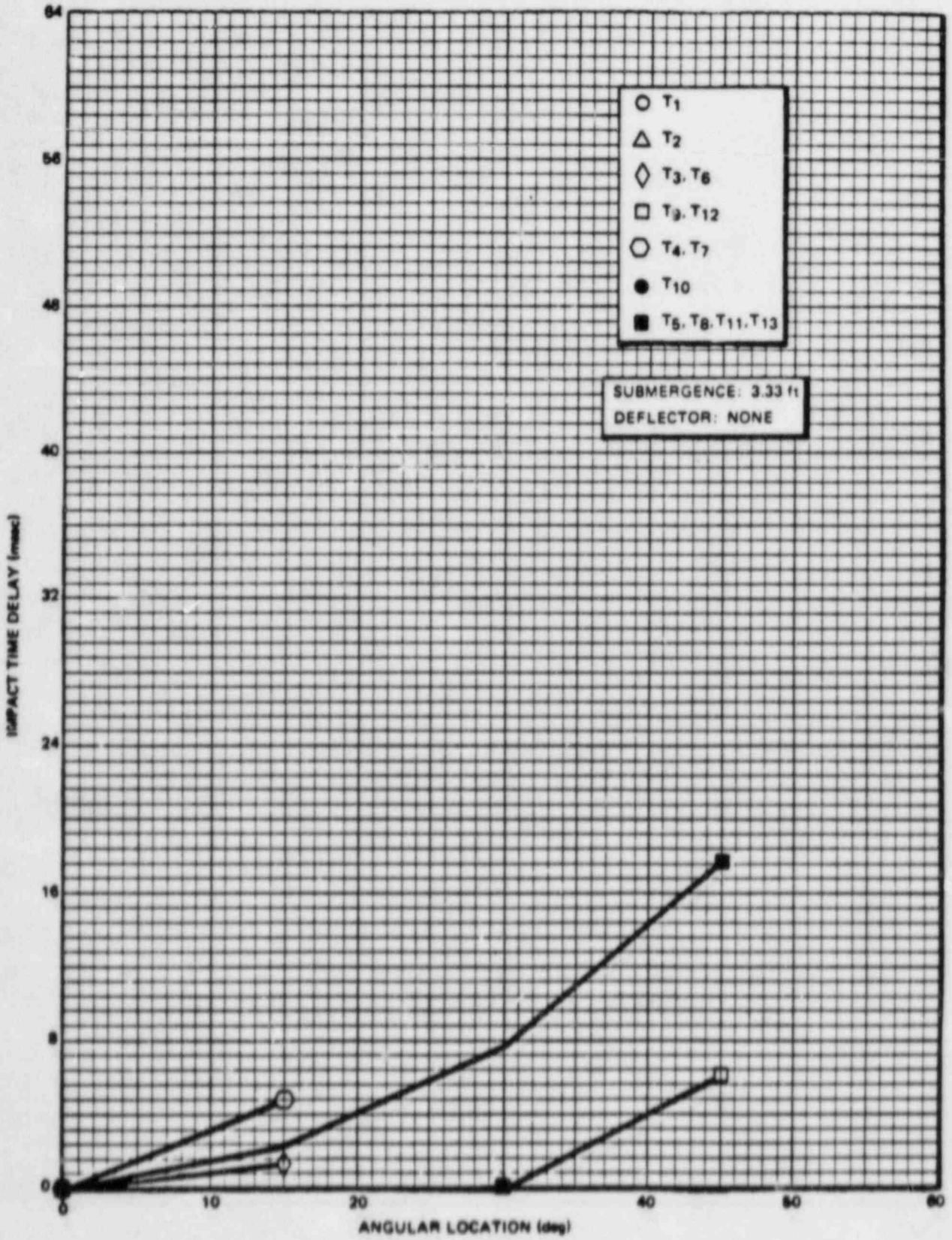


Figure HC 4.3.3-4. Circumferential Time Delay Distribution (Zero ΔP)

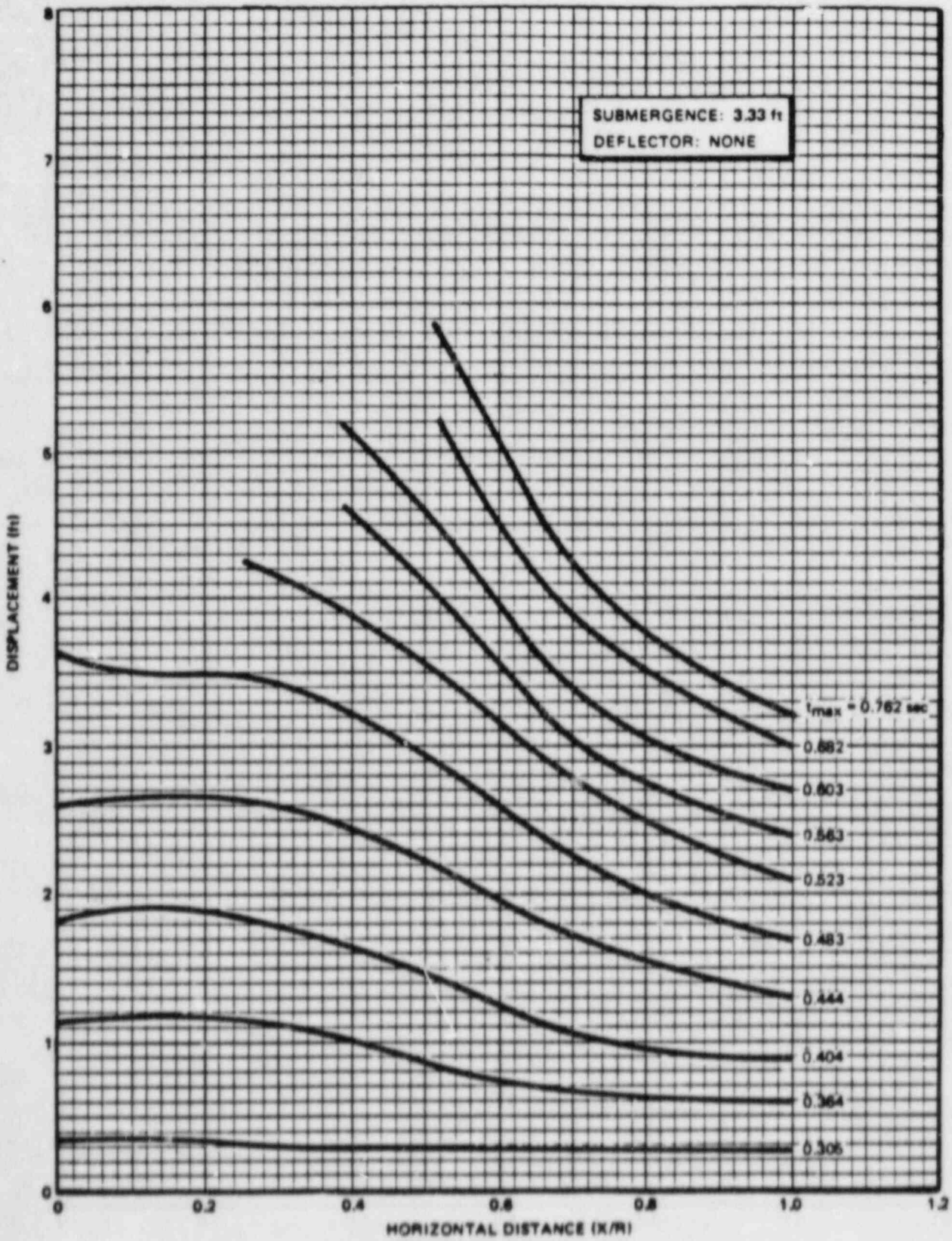


Figure HC 4.3.4-1. Pool Swell Displacement Distribution (Zero ΔP)

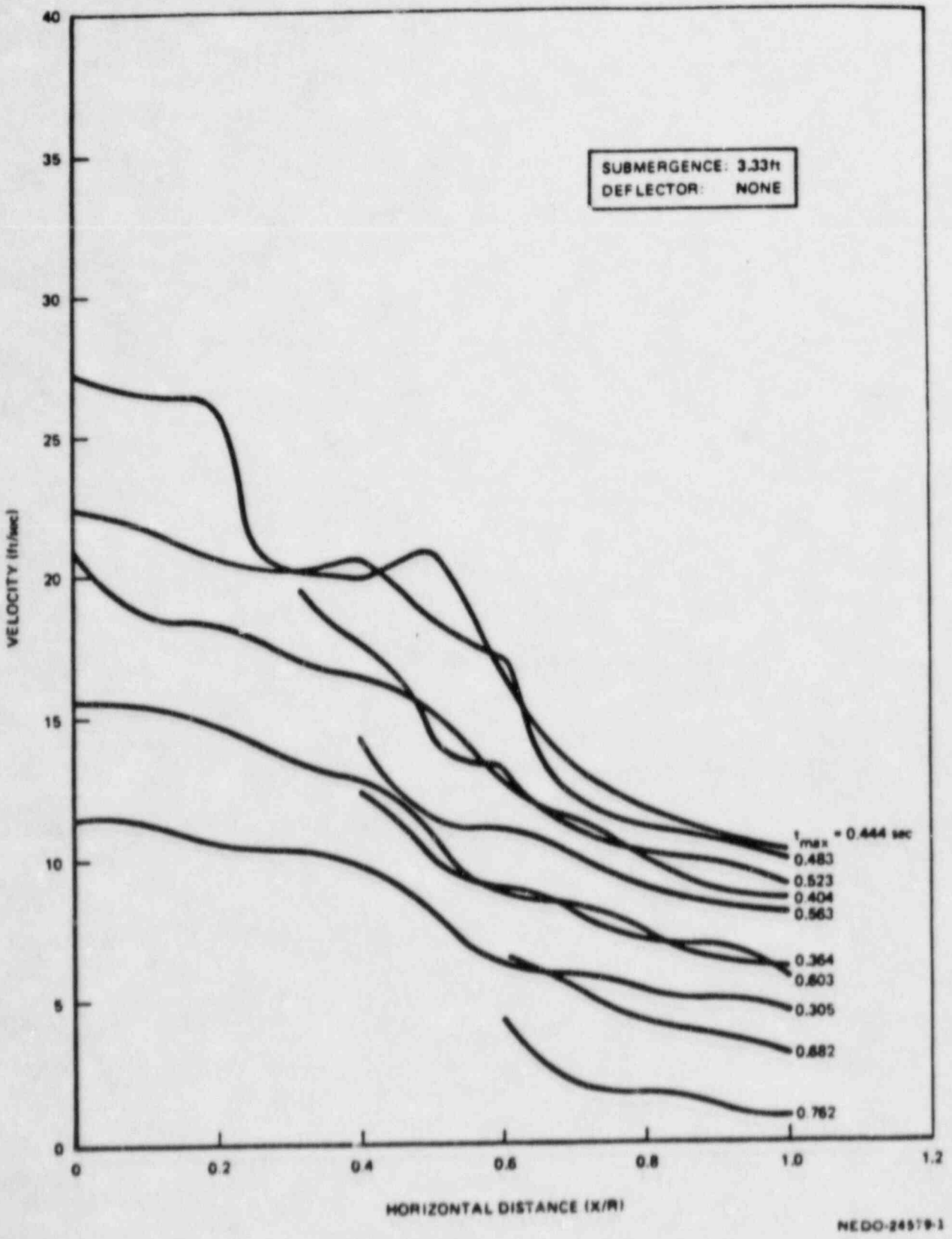


Figure HC 4.3.4-2. Pool Swell Velocity Distribution (Zero ΔP)

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TITLE PAGE

AUTHOR	SUBJECT	TIE NUMBER
Nuclear Services Engineering	Nuclear Science and Technology	82NED004
		DATE: January 1982
TITLE: Mark I Containment Program Plant-Unique Load Definition Hope Creek Generating Station: 1		GE CLASS: I
		GOVERNMENT CLASS:
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SUMMARY

This document provides unique definition of specific containment loading conditions that would result from a postulated loss-of-coolant accident in the Hope Creek Generating Station: Unit 1. Transient information is provided for containment pressures and temperatures, vent system thrust, torus vertical loads, vent system pool swell impact loads, and vent header deflector loads. The document has been prepared under the Mark I Containment Program to aid Public Service Electric and Gas in the performance of a containment structural evaluation.

By cutting out this rectangle and folding in half, the above information can be fitted into a standard card file.

DOCUMENT NUMBER NEDO-24579-1

INFORMATION PREPARED FOR Nuclear Fuel & Services Division

SECTION Nuclear Services Engineering

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NED-914 (6/77)

ATTACHMENT 2

MARK I OWNERS' GROUP CMDOF VALIDATION PROGRAM

REVIEW SUMMARY LETTER

(NUTECH LETTER RHB-85-002,

FROM R. H. BUCHHOLZ TO D. B. VASSALLO (USNRC)

DATED JANUARY 11, 1985)

RSC:db

MP85 27/07 1