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AUTH.NAME AUTHOR AFFILIATION
ALEXICH,M.P. Indiana & Michigan Electric Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards Rev 0 to Technical Rept TR-5364-3, "Analysis of Pressurizer Safety valve Discharge Piping Sys,...," Vols 1 & 2 & Rev 0 to Technical Rept TR-5364-4,Vols 1 & 2,per NUREG-0737,Item II.D.1.
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INDIANA & MICHIGAN ELECTRIC COMPANY

P.O. BOX 16631
COLUMBUS, OHIO 43216

December 15, 1983
AEP:NRC:0585D

Donald C. Cook Nuclear Plant Unit Nos. 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
NUREG-0737, Item II.D.1
PWR RELIEF AND SAFETY VALVE TEST PROGRAM

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

References: (1) Letter No. AEP:NRC:0585C dated July 9, 1982
(2) Letter from Mr. S.A. Varga, NRC, dated March 14, 1983
(3) Letter No. AEP:NRC:0585G dated October 14, 1983

Dear Mr. Denton:

This letter and its Attachment concerns the plant specific evaluation of the Relief (PORV) and Safety Valves (SV) and the related discharge piping analysis for the Donald C. Cook Nuclear Plant as detailed in Reference (1). It is submitted in compliance with the requirements of item II.D.1 of NUREG-0737. In Reference (3) we requested an extension to the submittal date of July 1, 1983 noted in Reference (2) for the plant specific evaluation up to December 15, 1983. The following are the Indiana & Michigan Electric Company's responses as applicable to the Donald C. Cook Nuclear Plant, Unit Nos. 1 and 2.

This document has been prepared following Corporate procedures which incorporate a reasonable set of controls to insure its accuracy and completeness prior to signature by the undersigned.

Very truly yours,

M. P. Alexich
Vice President

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MPA/cam
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ATTACHMENT TO AEP:NRC:0585D

Item 1 Plant Specific Reports for Safety & Relief Valve (SV/PORV) Qualification.

The Pressurizer Power Operated Relief Valves (PORV) at Cook Plant are Masoneilan relief valves, Model #38-20721. These valves are the same as those tested in the EPRI valve test program. The Masoneilan valve's performance was acceptable under various transient conditions performed during the test.

We have reviewed the EPRI test results, and the D. C. Cook Nuclear Plant specific piping system analysis performed by Teledyne Engineering Services (TES) and conclude that the valves tested represent the relief valves design installed at D. C. Cook Plant, and that the conditions tested by EPRI envelope the range of expected operating and accident conditions including the use of PORV's to mitigate cold overpressurization for the D. C. Cook Plant; and therefore, it is concluded that the PORV's at the D. C. Cook Nuclear Plant are qualified as required by Item II.D.1 of NUREG-0737 for plant specific applications.

The Pressurizer Safety Valves (SV) at Cook Plant are Crosby Model #HB-BP-86-6M6 equipped with loop seals upstream of the valves. This model type valve was tested at the Combustion Engineering test facility in Windsor, Connecticut. The tests were conducted both with a water and without a water loop seal. The tests confirmed the ability of the safety valves to open and close under their expected operating fluid conditions. It is concluded from these tests that the SV's are qualified as required by Item II.D.1 of NUREG-0737 for plant specific applications.

Westinghouse Electric Corporation has completed the study to evaluate the overall operability of the safety valves and the effect of safety valve performance on the system overpressurization and has issued WCAP-10105. The above WCAP Report was submitted to the NRC by Westinghouse Owner's Group letter No. WOG-77 dated 7/27/82.

The as-built piping analysis performed by Teledyne Engineering Services for the D. C. Cook Plant, with the loop seal configuration, indicated that the inlet and discharge piping and supports would be overstressed for the accident condition loads (SV thermal transients and SV shock) and that the loading was beyond that envelope tested under the EPRI program. To mitigate this overstress concern, Indiana & Michigan Electric Company has decided to drain the water in the safety valve loop seals as noted in Reference (3) of the cover letter. A design modification was initiated to drain each of the (3) pressurizer safety valve loop seals to the pressurizer and to install drain lines to each of the loop seals. This modification has been completed in both Units.

Based on the EPRI SV test program report, Westinghouse evaluation report WCAP 10105, TES piping evaluation report, and our review of the above reports, we conclude that the safety valves and the associated discharge piping system are qualified for the plant specific applications in the drained loop seal configuration.

Item 2: Plant Specific Submittal for Piping and Supports Evaluation.

Teledyne Engineering Services (TES) has completed the plant specific PORV/SV discharge piping analyses for the Donald C. Cook Nuclear Plant. The mathematical model consists of the discharge piping from the pressurizer up to the Pressurizer Relief Tank, including the relief and safety valves. The analyses consisted of thermal hydraulic analyses using RELAP-5/MOD 1 computer code to generate hydrodynamic data for control volumes of each segment of the pipe. This is then input into REPIPE Computer code to derive the force time histories on the piping system, one for the inlet junction and the other for the outlet junction. SAP2SAP then combines the two force time histories into one. The stress analyses of the piping system were performed using TMRSAP computer code. The stress analyses of the as-built piping system indicated that the discharge piping system was overloaded for the safety valve transient followed by the seal water discharge through the discharge piping. The calculated stresses in the piping and its supports exceeded the allowable limits. To eliminate this concern, an analysis was performed without water in the loop seals. This analysis with the dry loop seal showed that the loads and stresses are within the allowable limits for the piping system and supports with a few exceptions. For Unit No. 1, TES results indicate that the loads on eight pipe supports exceed the design loads as shown on the original as-built support drawings and for Unit No. 2, twenty-four supports exceed the design loads. A reanalysis of these supports for the increased loads was performed by AEPSC and it was determined that: 1) for Unit No. 1, six supports were found to be adequate to resist the revised loads and only two supports needed modifications; and 2) for Unit No. 2, seventeen supports were found to be adequate to resist the revised loads while seven supports needed modifications. A design modification was initiated to modify these supports. All supports requiring modification have been reworked and are now capable of carrying the revised loading. The following TES reports of the piping analysis using the drained loop seal are attached:

Unit No. 1; Technical Report TR-5364-3, Volumes 1 and 2
Unit No. 2; Technical Report TR-5364-4, Volumes 1 and 2.

The TES evaluation also showed that the safety valve accelerations due to the SV transient shock condition exceeded the vertical allowable of 2g's by less than 1g. However, we were informed by Westinghouse, who is the safety valve supplier, that the valves have been successfully seismically tested for 4g-vertical and 6g-horizontal accelerations. Based on the above information, we conclude that the acceleration on the SVs during an SV transient are within the test acceleration values and are acceptable.

References:

1) EPRI PORV/SV Test Program Reports as identified in our letter No. AEP:NRC:0585B dated April 7, 1982.

2) Westinghouse WCAP-10105, "Review of Pressurizer Safety Valve Performance as observed in the EPRI Safety and Relief Valve Test Program," dated June, 1982. (Non-proprietary)

3) Teledyne Reports TR-5364-1, Rev. 0, Books 1,2,3, of 15
TR-5364-2, Rev. 0, Books 1,2 of 10
TR-5364-3, Rev. 0, Books 1,2 of 3
TR-5364-4, Rev. 0, Books 1,2 of 3

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TECHNICAL REPORT

TECHNICAL REPORT TR-5364-3
REVISION 0

BOOK 2 OF 3

DONALD C. COOK NUCLEAR GENERATING PLANT

ANALYSES OF PRESSURIZER SAFETY VALVE DISCHARGE PIPING SYSTEM, WITH DRAINED LOOP SEALS PER NUREG 0737, II.D.1, UNIT 1

JULY 18, 1983

AMERICAN ELECTRIC POWER SERVICE CORPORATION
2 BROADWAY
NEW YORK, NEW YORK 10004

TECHNICAL REPORT TR-5364-3
REVISION 0

BOOK 2 OF 3

DONALD C. COOK NUCLEAR GENERATING STATION

ANALYSIS OF PRESSURIZER SAFETY VALVE DISCHARGE PIPING SYSTEM, WITH DRAINED LOOP SEALS PER NUREG 0737, II. D.1, UNIT 1

JULY 18, 1983

TELEDYNE ENGINEERING SERVICES

130 SECOND AVENUE
WALTHAM, MASSACHUSETTS 02254
617-890-3350

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5.0 STRUCTURAL ANALYSIS

Thermal and force/time history analyses were performed for the drained loop seal condition of the pressurizer safety and relief valve discharge piping using the TMRSAP computer program; a modified version of SAPIV. The computer model used was based on TES isometric drawing E-5763, Revision 3, which is shown in Section 7.0. In general, the structural analysis was done in accordance with AEP letter dated November 29, 1982 from Mr. Sam Ulan of AEP to Mr. L.B. Semprucci of TES (Reference 1) and AEP letter dated March 15, 1983 from Mr. Sam Ulan of AEP to Mr. Pat Harrison of TES (Reference 11).

For the drained loop seal analysis, it was not necessary to reanalyze the deadweight, normal thermal, PORV transient thermal, OBE seismic and DBE seismic conditions. The as-built analysis of the pressurizer safety and relief valve discharge piping, contained in TES Technical Report TR-5364-1, Revision 0 (Reference 2), should be referenced for all analytical results for the above conditions. This report contains the results for the SV transient thermal condition and the SV transient shock force time/history analysis. The emergency condition is shown to be acceptable, per this report, except as noted in Sections 6.2 and 6.3.2, for a drained loop seal condition. The normal and upset conditions were shown to be acceptable per the as-built analysis and report (Reference 2). The draining of the loop seals will not adversely affect the analysis of the normal and upset conditions.

5.1 SV Transient Thermal Analysis

Thermal analysis was performed for the SV transient condition. The temperature distribution was obtained from the RELAP5 output, as shown in Section 4.9. Throughout this report, thermal case 1 refers to normal operation, thermal case 2 to PORV operation, and thermal case 3 to SV operation.

Boundary displacements were calculated for the quench tank nozzle, pressurizer nozzles, and support 1-GRC-R-616, which connects to the pressurizer.

5.2 Transient Shock Analysis

Based on the results obtained from the RELAP5 analysis, presented in Section 4, the SV transient shock analysis was performed. The analysis was calculated at one millisecond intervals for a length of .65 seconds. All loads peaked previous to .65 seconds, indicating that the analysis was performed for a sufficient length of time.

6.0 ANALYTICAL RESULTS

Section 6.0 contains all analytical results relative to emergency conditions. That is, stress equations C1, C2 and C3 (as defined in Reference 1), support loads for all restraints, valve accelerations for DBE seismic and SV transient shock conditions, nozzle loads and valve end moments. For easier reference, the results presented in Section 6.0 include loadings for all conditions with deadweight, normal thermal, PORV transient thermal, OBE seismic, and DBE seismic results being taken from TES Technical Report TR-5364-1, Revision 0.

6.1 Stress Summary

Stress calculations were based on the 1967 Edition of the ANSI B31.1 Code (Reference 13), the AEP letter dated November 29, 1982 (Reference 1), and the AEP letter dated March 15, 1983 (Reference 11). For this report, stress combinations C1, C2 and C3 are presented, TES Technical Report TR-5364-1 should be referenced for A1, A2, B1, B2 and B3 stresses. Stress combinations C1, C2 and C3 are as follows:

C1 normal pressure stress + deadweight stress + DBE stress $\leq 1.8\ S_h$

C2 SV transient pressure stress + SV transient weight stress + SV transient shock stress $\leq 1.8\ S_h$

C3 SV transient thermal stress range $\leq 1.25\ S_c + .25\ S_h$

The stresses presented conservatively consider all moments to be intensified, although B31.1 allows for intensification factors to be omitted in the torsional direction.

Allowable stresses for stress combinations C1, C2 and C3, were obtained by using the maximum temperature the piping experienced during the SV transient event to determine S_h. The value of S_c was based on 70°F per Reference 10. A summary of allowable stresses for the emergency condition is given in Table 6.1-1.

Section 119.6.1 of the B31.1 Code indicates that the thermal range stress calculations shall be based on the range between the minimum and maximum temperature. Stresses for the maximum range of thermal moments, due to all thermal conditions considered, were analyzed and found to be satisfactory.

Stresses were calculated as follows:

Pressure

$$\frac{Pd^2}{D^2-d^2}$$

Deadweight

$$\frac{.75i\ M_A}{Z}$$

Thermal

$$\frac{i\ M_C}{Z}$$

Seismic

$$\frac{.75i\ M_B}{Z}$$

Force/Time History

$$\frac{.75i\ M_D}{Z}$$

where:

d = inside diameter of pipe
D = outside diameter of pipe
i = intensification factor
M_A = resultant moment due to deadweight loadings
M_B = resultant moment due to seismic loadings
M_C = range of resultant moments due to thermal loadings
M_D = resultant moment due to force/time history analysis
Z = section modulus

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TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 13 JULY 1983
D. C. COOK UNIT 1
SUMMARY OF ALLOWABLES

BY JWB DATE 7-13-83
CHKD Dmd DATE 7/13/83
SHEET NO._____ OF __________

TABLE 6.1-1
SUMMARY OF ALLOWABLES

MAIN RISER

NODES	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
1 THRU 44	SA-358-316 CL 1	394	16336
46 THRU 72	"	422	16234
74 THRU 142	"	435	16195
200 THRU 206	"	452	16144
260 THRU 295	SA-312-304	452	14742

SRV LOOPS

NODES LOOP C	NODES LOOP B	NODES LOOP A	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
98 THRU 109	144 THRU 156	208 THRU 216	SA-312-304	445	14770
110 THRU 1140	157 THRU 163	220 THRU 2230	"	460	14710
115	165	225	"	460	11740 *
120	170	229	SA-376-316	670	11480 *
122 THRU 138	172 THRU 185	233 THRU 244	"	670	16000

NOTE; LOOP C REFERS TO THE SRV LOOP CONTAINING VALVE SV-45C THIS NOTATION IS TYPICAL OF LOOPS B AND A ALSO.
* ALLOWABLE AS PER NOTE (6),TABLE A-1 OF B 31.1.0, 1967 CODE.

PORV LOOP 151

NODES	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
610	SA-312-304	600	14350
615 THRU 625	"	923	13508
630	"	653	14300
635 THRU 665	SA-376-304	653	14300

NOTE: PORV LOOP 151 REFERS TO THE PORV LOOP CONTAINING VALVES NMO-151 AND NRV-151. THIS IS TYPICAL OF LOOPS 152 AND 153.

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TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 13 JULY 1983
D. C. COOK UNIT 1
SUMMARY OF ALLOWABLES

BY DWB DATE 7-13-83
CHKD DMD DATE 7/13/83
SHEET NO.____ OF ____

TABLE 6.1-1 (Cont)

PORV LOOP 153

NODES	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
560 THRU 555	SA-312-304	500	14550
550 THRU 533	"	567	14416
530 THRU 525	"	933	13468
515	"	653	14300
510 THRU 450	SA-376-304	653	14300
440 THRU 750	SA-376-316	653	16000

PORV LOOP 152

NODES	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
300 THRU 325	SA-312-304	500	14550
335 THRU 340	"	600	14350
350	"	700	14200
355 THRU 375	"	816	13952
380 THRU 385	"	960	13220
390	"	653	14300
400 THRU 431	SA-376-304	653	14300

6.1.1 Equation C-1 Stresses

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DONALD C. COOK
UNIT #1
PROJECT 5364

BY: Dmd DATE: 7/12/83
CHECKED BY: CMA DATE: 7-12-83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
1	0	.1	.2	.3 YZ	29.4
4		.9	1.3	2.2 YZ	
6		.3	.8	1.1 YZ	
7		.2	.3	.5 YZ	
8		.1	.2	.3 YZ	
10		.2	.3	.5 YZ	
12		.5	.7	1.2 YZ	
18		.4	.2	.6 YZ	
30		.4	.3	.7 YZ	
32		.7	.4	1.1 YZ	
33		.4	.1	.5 YZ	
34		.4	.2	.6 YZ	
36		.5	.2	.7 YZ	
38		.2	.5	.7 YZ	
40		.2	.4	.6 YZ	
42		.1	.2	.3 YZ	
44		.2	.3	.5 YZ	
46		.2	.3	.5 YZ	29.2
48		.1	.2	.3 YZ	
50		.2	.4	.6 YZ	

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ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMD DATE: 7/12/83
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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
52	0	.3	.5	.8 YZ	29.2
56	↓	.4	.4	.8 XY	↓
58		.4	.4	.8 XY	
60		.3	.4	.7 YZ	
62		.4	.3	.7 XY	
66		.2	.4	.6 YZ	
68		.2	.4	.6 YZ	
70		.2	.3	.5 YZ	
72		.1	.6	.7 YZ	
74		.3	.3	.6 XY	
76		.2	.3	.5 XY	
80		.3	.3	.6 XY	
82		.5	.4	.9 XY	
83		.2	.3	.5 XY	
84		.5	.4	.9 XY	
86		.3	.3	.6 XY	
88		.3	.3	.6 XY	
90		.5	.4	.9 XY	
93		.4	.3	.7 XY	
97R	↓	.8	.6	1.4 XY	↓

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DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMD DATE: 7/12/83
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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
97R	0	.7	.7	1.4 XY	29.2
195		.5	.4	.9 XY	
142R		.7	.6	1.3 XY	
142R		.6	.7	1.3 XY	
200		.4	.4	.8 XY	29.1
206R		.3	.6	.9 XY	
206R		.3	.4	.7 XY	
260		1.0	1.3	2.3 XY	26.5
280		1.5	3.2	4.7 XY	
285		4.5	2.2	6.7 XY	
290		5.3	3.0	8.3 XY	
295B		3.7	2.5	6.2 XY	
97B		.7	1.8	2.5 XY	26.6
98		.8	.6	1.4 XY	
99		.7	.7	1.4 XY	
100		.4	1.1	1.5 XY	
102		.3	1.4	1.7 XY	
103		.3	1.7	2.0 XY	
104		.8	3.1	3.9 XY	
106		1.0	3.3	4.3 XY	

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UNIT #1
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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
108	0	.6	2.0	2.6 XY	26.6
109		.9	2.0	2.9 XY	26.6
110		1.2	2.3	3.5 XY	26.5
112		.5	4.3	4.8 XY	
114		1.2	4.5	5.7 XY	
1140		.7	2.6	3.3 XY	
115		.7	2.7	3.4 XY	21.1
120	3.5	.9	.7	5.1 YZ	20.7
122		1.1	4.3	8.9 XY	28.8
124		.9	5.1	9.5 XY	
126		.9	5.1	9.5 XY	
128		.7	4.5	8.7 XY	
130		.6	2.8	6.9 XY	
132		.9	2.1	6.5 YZ	
134		1.0	2.3	6.8 YZ	
136		1.2	2.8	7.5 YZ	
138		1.3	2.7	7.5 YZ	
142B	0	.6	1.2	1.8 YZ	26.6
144		.4	.7	1.1 YZ	26.6
146		.2	1.2	1.4 YZ	26.6

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DONALD C. COOK
UNIT #1
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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
148	0	.3	1.8	2.1 YZ	26.6
150		1.0	3.6	4.6 YZ	26.6
152		1.4	3.9	5.3 YZ	26.6
156		.8	2.3	3.1 YZ	26.6
157		1.1	2.0	3.1 YZ	26.5
158		1.3	2.0	3.3 YZ	
160		.7	3.5	4.2 YZ	
162		1.2	3.7	4.9 YZ	
163		.7	2.2	2.9 YZ	
165		.7	2.2	2.9 YZ	21.1
170	3.5	.9	.6	5.0 XY	20.7
172		1.0	4.0	8.5 YZ	28.8
174		.8	4.7	9.0 YZ	
176		.8	4.7	9.0 YZ	
178		.5	4.2	8.2 YZ	
180		.5	2.6	6.6 YZ	
181		.8	2.0	6.3 YZ	
182		.9	2.0	6.4 XY	
184		1.1	2.4	7.0 XY	
185		1.2	2.4	7.1 XY	

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DONALD C. COOK
UNIT #1
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BY: DMD DATE: 7/12/83
CHECKED BY: CMA DATE: 7-12-83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
206B	0	1.1	2.2	3.3 XY	26.6
208		.3	1.6	1.9 XY	
214		1.0	3.5	4.5 XY	
216		1.5	3.8	5.3 XY	
220		1.3	1.4	2.7 XY	26.5
222		.6	2.3	2.9 XY	
223		1.0	2.4	3.4 XY	
2230		.6	1.4	2.0 XY	
225		.6	1.4	2.0 XY	21.1
229	3.5	.7	.7	4.9 XY	20.7
233		.8	3.4	7.7 XY	28.8
234		.5	3.7	7.7 XY	
235		.5	3.7	7.7 XY	
236		.3	3.1	6.9 XY	
237		.2	2.2	5.9 XY	
238		.7	1.8	6.0 XY	
240		.8	1.9	6.2 XY	
242		1.1	2.2	6.8 YZ	
244		1.1	2.2	6.8 YZ	
295R	0	3.2	2.0	5.2 YZ	26.2

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TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
560	0	9.9	5.5	15.4 YZ	26.2
555		5.6	2.7	8.3 YZ	26.2
550		3.5	6.6	10.1 YZ	25.9
545		3.7	13.5	17.2 YZ	
540		3.8	15.5	19.3 YZ	
536		3.7	11.6	15.3 YZ	
535		4.1	10.8	14.9 YZ	
534		4.7	9.8	14.5 YZ	
533		5.6	13.0	18.6 YZ	
530		6.4	11.2	17.6 YZ	24.2
529		4.2	8.4	12.6 YZ	24.2
525		4.6	8.5	13.1 YZ	25.7
510	2.9	3.0	5.6	11.5 XY	
505		2.5	6.0	11.4 XY	
490		1.7	6.6	11.2 XY	
485		2.8	5.8	11.5 YZ	
480		2.7	5.8	11.4 YZ	
475		2.5	5.8	11.2 YZ	
465		4.2	5.6	12.7 YZ	
460		2.7	6.4	12.0 YZ	

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TELEDYNE
ENGINEERING SERVICES

DONALD. C. COOK
UNIT #1
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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
450	2.9	5.0	8.2	16.1 YZ	25.7
440	4.1	5.4	8.1	17.6 YZ	28.8
435 R		3.4	4.8	12.3 XY	
435 R		1.1	8.3	13.5 YZ	
575		3.5	5.4	13.0 YZ	
585		5.5	6.8	16.4 YZ	
590		6.3	5.7	16.1 YZ	
595		7.0	6.3	17.4 YZ	
600 R	3.5	2.1	2.0	7.6 YZ	
600 R		2.5	2.4	8.4 YZ	
668		2.6	2.4	8.5 YZ	
670		2.6	2.4	8.5 YZ	
675		2.9	2.3	8.7 YZ	
680		2.9	2.3	8.7 YZ	
690		2.6	1.8	7.9 XY	
700		2.1	1.7	7.3 XY	
710		1.1	2.0	6.6 XY	
715		.8	2.3	6.6 XY	
717		.5	2.7	6.7 XY	
720		.4	2.9	6.8 XY	

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TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
725	3.5	.4	3.0	6.9 XY	28.8
750	3.5	.3	3.8	7.6 XY	28.8
295 R	0	2.7	2.9	5.6 YZ	26.2
300		5.2	5.6	10.8 YZ	
310		4.1	5.0	9.1 YZ	
320		2.8	5.3	8.1 YZ	
325		1.6	5.9	7.5 YZ	
335R		1.2	6.3	7.5 YZ	25.8
335R		2.9	7.3	10.2 YZ	25.8
340		4.7	11.7	16.4 YZ	25.8
350		2.8	9.1	11.9 YZ	25.6
355		1.0	6.6	7.6 YZ	25.1
360		1.9	5.1	7.0 YZ	
365		3.1	6.1	9.2 YZ	
370		3.7	4.2	7.9 YZ	
375		3.6	3.1	6.7 YZ	
380		3.4	4.8	8.2 YZ	23.8
382		2.4	4.0	6.4 YZ	23.8
385		2.5	4.4	6.9 YZ	25.7
400	2.9	1.7	7.7	12.3 YZ	25.7

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ENGINEERING SERVICES

DONALD C. COOK
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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
405	2.9	2.1	8.0	13.0 YZ	25.7
420		2.6	10.2	15.7 YZ	
429		4.1	11.8	18.8 YZ	
430		4.6	12.5	20.0 YZ	
431		4.7	12.6	20.2 YZ	
435 B		5.0	15.1	23.0 YZ	
335 B	0	3.0	9.0	12.0 YZ	25.8
610		3.6	8.5	12.1 YZ	25.8
615		3.5	8.2	11.7 YZ	24.3
620		2.6	6.2	8.8 YZ	24.3
625		2.8	6.5	9.3 YZ	25.7
635	2.9	2.9	5.5	11.3 YZ	
645		3.7	5.1	11.7 YZ	
657		3.8	5.9	12.6 YZ	
660		3.2	6.7	12.8 YZ	
665		3.2	6.8	12.9 YZ	
600 B		3.0	8.8	14.7 YZ	

6.1.2 Equation C-2 Stresses

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DONALD C. COOK
UNIT #1
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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
1	.4	.1	2.1	2.6	29.4
4	1.6	.9	16.4	18.9	
6		.3	8.9	10.8	
7		.2	4.4	6.2	
8		.1	2.6	4.3	
10		.2	5.3	7.1	
12		.5	8.7	10.8	
18		.4	3.9	5.9	
30		.4	5.3	7.3	
32		.7	4.3	6.6	
33		.4	2.1	4.1	
34		.4	2.0	4.0	
36		.5	2.4	4.5	
38		.2	7.3	9.1	
40		.2	5.9	7.7	
42		.1	3.2	4.9	
44		.2	6.5	8.3	
46	2.2	.2	6.1	8.5	29.2
48	2.2	.1	2.9	5.2	29.2
50	2.2	.2	6.1	8.5	29.2

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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
52	2.2	.3	7.9	10.4	29.2
56		.4	7.5	10.1	
58		.4	7.3	9.9	
60		.3	6.3	8.8	
62		.4	5.5	8.1	
66		.2	10.0	12.4	
68		.2	8.6	11.0	
70		.2	6.7	9.1	
72		.1	8.0	10.3	
74	2.6	.3	7.1	10.0	
76		.2	3.9	6.7	
80		.3	4.5	7.4	
82		.5	7.1	10.2	
83		.2	3.6	6.4	
84		.5	6.9	10.0	
86		.3	5.3	8.2	
88		.3	4.7	7.6	
90		.5	6.7	9.8	
93		.4	4.9	7.9	
97R		.8	3.5	6.9	

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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
97R	2.6	.7	3.9	7.2	29.2
195		.5	2.8	5.9	
142R		.7	4.3	7.6	
142R		.6	4.5	7.7	
200	3.1	.4	2.9	6.4	29.1
206R		.3	3.4	6.8	
206R		.3	2.8	6.2	
260		1.0	8.6	12.7	26.5
280	2.2	1.5	4.1	7.8	
285		4.5	1.9	8.6	
290		5.3	1.7	9.2	
295B		3.7	1.5	7.4	
97B	2.1	.7	9.2	12.0	26.6
98		.8	3.9	6.8	
99		.7	4.9	7.7	
100		.4	5.3	7.8	
102		.3	5.3	7.7	
103		.3	2.4	4.8	
104		.8	3.2	6.1	
106		1.0	4.4	7.5	

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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
108	2.1	.6	2.6	5.3	26.6
109	2.1	.9	4.3	7.3	26.6
110	2.4	1.2	2.5	6.1	26.5
112		.5	4.8	7.7	
114		1.2	6.3	9.9	
1140		.7	3.7	6.8	
115		.7	3.7	6.8	21.1
120	4.0	.9	2.5	7.4	20.7
122		1.1	2.4	7.5	28.8
124		.9	1.7	6.6	
125		.9	1.7	6.6	
126		.9	1.7	6.6	
128		.7	1.8	6.5	
130		.6	2.1	6.7	
132		.9	2.2	7.1	
134		1.0	2.2	7.2	
136		1.2	3.4	8.6	
138		1.3	3.5	8.8	
142B	2.1	.6	6.6	9.3	26.6
144	2.1	.4	4.0	6.5	26.6

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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
146	2.1	.2	3.2	5.5	26.6
148		.3	1.7	4.1	
150		1.0	2.6	5.7	
152		1.4	3.1	6.6	
156		.8	2.0	4.9	
157	2.4	1.1	2.8	6.3	26.5
158		1.3	1.7	5.4	
160		.7	2.9	6.0	
162		1.2	4.6	8.2	
163		.7	2.7	5.8	
165		.7	2.7	5.8	21.1
170	4.0	.9	2.8	7.7	20.7
172		1.0	2.4	7.4	28.8
174		.8	1.8	6.6	
175		.8	1.8	6.6	
176		.8	1.8	6.6	
178		.5	1.2	5.7	
180		.5	1.8	6.3	
181		.8	2.7	7.5	
182		.9	2.7	7.6	

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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
184	4.0	1.1	3.1	8.2	28.8
185	4.0	1.2	3.1	8.3	28.8
206B	2.1	1.1	8.6	11.8	26.6
208		.3	1.9	4.3	
214		1.0	3.7	6.8	
216		1.5	5.1	8.7	
220	2.4	1.3	2.6	6.3	26.5
222		.6	6.0	9.0	
223		1.0	6.3	9.7	
2230		.6	3.7	6.7	
225		.6	3.7	6.7	21.1
229	4.0	.7	3.0	7.7	20.7
233		.8	2.3	7.1	28.8
234		.5	1.8	6.3	
232		.5	1.7	6.2	
235		.5	1.7	6.2	
236		.3	1.1	5.4	
237		.2	2.0	6.2	
238		.7	2.3	7.0	
240		.8	2.4	7.2	

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DONALD C. COOK
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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
242	4.0	1.1	3.0	8.1	28.8
244	4.0	1.1	3.0	8.1	28.8
295R	2.1	3.2	1.7	7.0	26.2
560	3.5	9.9	4.9	18.3	26.2
555	2.3	5.6	5.2	13.1	26.2
550	4.0	3.5	3.4	10.9	25.9
545		3.7	2.7	10.4	
540		3.8	4.4	12.2	
536		3.7	3.5	11.2	
535		4.1	3.4	11.5	
534		4.7	3.5	12.2	
533		5.6	4.7	14.3	
530	1.5	6.4	4.0	11.9	24.2
529		4.2	6.3	12.0	24.2
525		4.6	8.7	14.8	25.7
510	2.9	3.0	9.1	15.0	
505		2.5	8.8	14.2	
490		1.7	5.0	9.6	
485		2.8	4.3	10.0	
480		2.7	4.5	10.1	

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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
475	2.9	2.5	4.1	9.5	25.7
465		4.2	4.9	12.0	
460		2.7	1.7	7.3	
450		5.0	3.6	11.5	
440	4.1	5.4	3.3	12.8	28.8
435R	4.7	3.4	2.6	10.7	
435R	4.7	1.1	2.3	8.1	
575	4.1	3.5	2.4	10.0	
585		5.5	2.5	12.1	
590		6.3	1.7	12.1	
595		7.0	3.6	14.7	
600R	4.0	2.1	1.4	7.5	
600R	4.0	2.5	.8	7.3	
668	3.5	2.6	.8	6.9	
670		2.6	.8	6.9	
675		2.9	1.0	7.4	
680		2.9	1.0	7.4	
690		2.6	1.7	7.8	
700		2.1	1.4	7.0	
710		1.1	1.8	6.4	

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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
715	3.5	.8	2.0	6.3	28.8
717		.5	.7	4.7	
720		.4	1.1	5.0	
725		.4	1.5	5.4	
750		.3	3.2	7.0	
295R		2.7	1.5	7.7	26.2
300		5.2	2.6	11.3	
310	2.7	4.1	3.5	10.3	
320		2.8	4.3	9.8	
325		1.6	4.2	8.5	
335R		1.2	5.5	9.4	25.8
335R		2.9	3.4	9.0	
340	6.2	4.7	4.5	15.4	
350	10.3	2.8	3.2	16.3	25.6
355	1.5	1.0	5.8	8.3	25.1
360		1.9	4.6	8.0	
365		3.1	5.7	10.3	
370		3.7	3.9	9.1	
375		3.6	6.5	11.6	
380		3.4	10.5	15.4	23.8

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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
382	1.5	2.4	7.9	11.8	23.8
385	1.5	2.5	7.9	11.9	25.7
400	2.9	1.7	6.6	11.2	
405		2.1	6.5	11.5	
420		2.6	4.2	9.7	
429		4.1	2.6	9.6	
430		4.6	2.7	10.2	
431		4.7	2.8	10.4	
435B		5.0	3.7	11.6	
335B	5.1	3.0	9.0	17.1	25.8
610	5.1	3.6	7.0	15.7	25.8
615	1.5	3.5	6.3	11.3	24.3
620		2.6	6.1	10.2	24.3
625		2.8	12.9	17.2	25.7
635	2.9	2.9	8.0	13.8	
645		3.7	5.4	12.0	
657		3.8	4.8	11.5	
660		3.2	5.3	11.4	
665		3.2	5.1	11.2	
600B		3.0	5.5	11.4	

6.1.3 Equation C-3 Stresses

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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
1	0	27.5
4	2.4	
6	1.6	
7	.6	
8	.5	
10	.9	
12	.4	
18	.3	
30	1.3	
32	.9	
33	.3	
34	.3	
36	.2	
38	2.3	
40	2.5	
42	.9	
44	2.5	
46	3.2	
48	1.3	
50	3.7	

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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
52	3.6	27.5
56	1.2	
58	1.2	
60	1.9	
62	2.3	
66	1.3	
68	1.2	
70	1.2	
72	.9	
74	2.1	
76	2.1	
80	2.0	
82	1.9	
83	.7	
84	1.9	
86	2.0	
88	2.0	
90	2.1	
93	.8	
97R	1.7	

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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
97R	2.1	27.5
195	1.0	
142 R	1.9	
142 R	2.1	
200	.9	
206 R	1.6	
206 R	1.8	
260	2.9	27.1
280	10.9	
285	5.2	
290	5.4	
295 B	4.5	
97B	2.2	
98	1.3	
99	1.1	
100	.9	
102	.5	
103	.1	
104	.7	
106	.8	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364- 3
Revision 0

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DmD DATE: 7/12/83
CHECKED BY: DMB DATE: 7-12-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
108	.4	27.1
109	.3	
110	.5	
112	1.5	
114	1.5	
1140	.6	
115	.6	26.4
120	.2	26.3
122	.2	27.4
124	.3	
126	.3	
128	.3	
130	.2	
132	.2	
134	.2	
136	.1	
138	.1	
142B	2.8	27.1
144	1.6	
146	1.4	

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TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: Dmd DATE: 7/12/83
CHECKED BY: [illegible] DATE: 7-12-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
148	1.0	27.1
150	1.6	
152	1.0	
156	.4	
157	.5	
158	1.1	
160	2.6	
162	3.1	
163	1.4	
165	1.4	26.4
170	.5	26.3
172	.2	27.4
174	.2	
176	.2	
178	.4	
180	.5	
181	.5	
182	.5	
184	.5	
185	.4	

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TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DmD DATE: 7/12/83
CHECKED BY: AMB DATE: 7-12-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
108	.4	27.1
109	.3	
110	.5	
112	1.5	
114	1.5	
1140	.6	
115	.6	26.4
120	.2	26.3
122	.2	27.4
124	.3	
126	.3	
128	.3	
130	.2	
132	.2	
134	.2	
136	.1	
138	.1	
142B	2.8	27.1
144	1.6	
146	1.4	

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UNIT #1
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CHECKED BY: DMB DATE: 7-12-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
206B	7.3	27.1
208	3.1	
214	5.2	
216	3.7	
220	1.1	
222	3.6	
223	5.5	
2230	2.4	
225	2.4	26.4
229	1.1	26.3
233	.5	27.4
234	.5	
235	.5	
236	.8	
237	1.2	
238	1.3	
240	1.3	
242	1.2	
244	1.1	
295 R	7.4	27.1

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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
560	15.9	27.1
555	5.3	27.1
550	2.1	27.0
545	5.8	
540	4.5	
536	2.8	
535	3.2	
534	3.8	
533	6.8	
530	8.3	26.8
529	4.5	26.8
525	4.4	27.0
510	2.3	
505	2.1	
490	1.9	
485	1.7	
480	1.7	
475	1.4	
465	2.3	
460	1.7	

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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
450	2.2	27.0
440	2.3	27.0
435 R	1.4	27.4
435 R	2.8	
575	3.0	
585	2.6	
590	3.7	
595	4.5	
600R	1.4	
600R	1.7	
668	1.7	
670	1.9	
675	2.0	
680	1.8	
690	2.1	
700	2.0	
710	1.5	
715	1.6	
717	2.0	
720	2.5	

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CHECKED BY: SMB DATE: 7-12-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
725	2.7	27.4
750	2.8	27.4
295 R	3.1	27.1
300	3.5	
310	1.4	
320	2.8	
325	3.2	
335 R	4.2	27.0
335 R	5.6	
340	7.0	
350	5.3	
355	2.3	26.9
360	2.0	
365	3.0	
370	2.1	
375	2.1	
380	2.8	26.7
382	1.7	26.7
385	2.0	27.0
400	1.6	27.0

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DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMD DATE: 7/12/83
CHECKED BY: AMB DATE: 7-12-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
405	2.3	27.0
420	2.8	
429	3.5	
430	3.7	
431	3.7	
435 B	4.2	
335 B	3.5	
610	5.1	
615	5.6	26.8
620	3.2	26.8
625	3.2	27.0
635	1.9	
645	2.0	
657	2.1	
660	2.2	
665	2.2	
600 B	2.3	

6.2 Support Loads

Support loads are given for each support on the pressurizer relief line piping. Support load combinations were calculated in accordance with Table II of Reference 1. Thermal-1 refers to the normal thermal operating case, thermal-2 refers to the PORV transient thermal condition, and thermal-3 refers to the SV transient thermal loading.

The support load combinations considered are as follows:

D1 deadweight + normal thermal +/- OBE

D2 deadweight + PORV transient thermal +/- $\left[(OBE)^2 + (PORV\ transient\ shock)^2\right]^{1/2}$

E1 deadweight + normal thermal +/- DBE

E2 deadweight + SV transient thermal +/- SV transient shock

The results of the support load combinations indicate that the following supports exceed the load given on the support drawing.

1-GRC-R-585
1-GRC-R-589
1-GRC-R-591
1-GRC-R-601
1-GRC-S-608
1-GRC-R-613
1-GRC-S-614
1-GRC-R-616

Review of these supports to ensure acceptability falls outside of the TES work scope and is, therefore, the responsibility of others.

The support loads given are taken from the TMRSAP computer analysis. The support loads given act on the support. The following explanation details the procedure followed in extracting these support loads.

Four different methods of modeling supports were used in the analysis presented in this report. Constant force supports were modeled using a **FORCE** card. Supports in a global coordinate direction were modeled using a **RESTRAINT** card for deadweight, thermal and seismic analyses and were modeled with a **SPRING** card for force/time history analysis. For any supports not oriented in a global coordinate direction a **FLEX** card was used to represent the support, regardless of the type of analysis being executed. Because of the various methods used, slightly different procedures are used to extract the support loads. In general, there are two tables in the TMRSAP output which are used to obtain support loads: the "Boundary Element Forces/Moments" table and the "Pipe Forces/Moments/ Displacements/Member Global Directions" table. The former table is used for supports modeled using **FLEX** or **SPRING** cards and the latter for supports modeled using a **FORCE** or **RESTRAINT** card.

In the "Boundary Element Forces/Moments" table (see Figure 6.2-1), support loads can be extracted directly and are given in pounds in the direction indicated by the **SPRING** or **FLEX** card. The supports in this table are referenced only by the "element number" and, therefore, the "Boundary Elements" table (see Figure 6.2-2) must be used to determine which element number corresponds to which support.

The "Pipe Forces/Moments/Displacements/Member Global Direction" table (see Figure 6.2-3) gives the global forces on the x, y, and z directions for each TMR node number. Note that the SAP node number is internally generated by the program and does not correspond to the node number input. To show equilibrium between the "j" and "i" ends of a node, the force at the "i" end of the node is subtracted from the force at the "j" end of the node. The only exception to this procedure is when a **RESTRAINT** card is used. the **RESTRAINT** card instructs the program to change the sign at the "i" end of the node and to generate a reaction on the pipe at that node. Therefore, the support load is obtained by adding the "j" and "i" forces together and then flipping the sign in order to generate the reaction on the support, instead of the reaction on the pipe.

The following list gives all of the possible combinations of analysis type, support type and support orientation encountered on TES Project 5364 and refers to the appropriate detailed explanation which follows.

	Analysis Type	Support Type	Support Orientation	Modeling	Explanation
1.	deadweight	constant force	global	FORCE	A
2.	deadweight	rigid	global	RESTRAINT	B
3.	deadweight	rigid	skewed	FLEX	C
4.	thermal	rigid	global	RESTRAINT	B
5.	thermal	rigid	skewed	FLEX	C
6.	seismic	rigid	global	RESTRAINT	D
7.	seismic	rigid	skewed	FLEX	E
8.	seismic	snubber	global	RESTRAINT	D
9.	seismic	snubber	skewed	FLEX	E
10.	f/t history	rigid	global	SPRING	F
11.	f/t history	rigid	skewed	FLEX	F
12.	f/t history	snubber	global	SPRING	F
13.	f/t history	snubber	skewed	FLEX	F

A The load for a constant force support modeled with a FORCE card is obtained by subtracting the force at the "i" end of the appropriate node from the force at the "j" end in the "Pipe Forces/Moments/Displacements/Member Global Directions" table. The resulting sign and magnitude indicates the force on the pipe and should agree with the value entered on the FORCE card. To determine the load on the support, the sign obtained from the TMRSAP output should be flipped.

B In deadweight and thermal analyses, rigid supports orientated in a global coordinate direction were modeled using a **RESTRAINT** card. The support load for this case is obtained by adding the x, y, or z forces at the "i" and "j" ends of the appropriate node. The resulting sign must then be flipped to obtain the reaction on the support, as opposed to the reaction on the pipe.

C Skewed supports modeled with **FLEX** cards in deadweight and thermal analyses require a two step process in determining the support load. The **FLEX** card generates a boundary element and the first step is to determine which boundary element number corresponds to which support. This can be done by looking in the "Boundary Elements" table which lists the boundary element number and the node at which that element is modeled. Once the boundary element number has been determined, then the "Boundary Element Forces/Moments" table is used to extract the support load. The load from this table acts along the direction of the support as input by the analyst. This axial (relative to the support) force can then be broken down into the appropriate global components.

An alternative method would be to follow the procedure outlined in B above to determine the force in each appropriate component direction.

D The procedure for global rigid and snubber supports in seismic analysis is similar to procedure B. One difference is that seismic output has no signs since it is assumed that all forces can act + or -. Therefore, rather than flipping the sign of the support load obtained a +/- is applied.

Procedure D is followed for the x, y, and z shock directions and then the x and y loads are combined by the SRSS method as are the loads for the y and z shock directions. The greater value is then listed on the support load summary sheet.

E Skewed supports in seismic are the same as skewed supports in deadweight and thermal except that again the boundary element force extracted must be considered +/-. Since no signs are carried in the TMRSAP output of a seismic analysis, it is not recommended to use the alternative method given under C when extracting support loads from a seismic run.

F In a force/time history analysis, no **RESTRAINT** cards are used; **FLEX** cards are used to represent skewed supports and **SPRING** cards are used to represent global supports. Both of these techniques generate boundary elements and therefore, the procedure is essentially the same as that described in C above. The only difference is that the "Boundary Element Forces/Moments" table does not list a single value but rather a table of times and forces (see Figure 6.2-4). At the end of this table, the maximum absolute positive and negative values are given. The maximum absolute value is conservatively used with a +/- applied.

Figure 6.2-1

BOUNDARY ELEMENT FORCES/MOMENTS

ELEMENT NUMBER	LOAD CASE	FORCE	MOMENT
1	1	-0.24511E+05	.[illegible]E+0[illegible]
2	1	0.22[illegible]4E+04	0.00000E+00
3	1	0.38934E+04	[illegible].00[illegible]0E+0[illegible]

53 0 [illegible] 0 0 0 0
B O U N D A [illegible] E L E M E N T S

ELEMENT TYPE = 7
NUMBER OF ELEMENTS = 7

ELEMENT LOAD CASE MULTIPLIERS

CASE(A)	CASE(B)	CASE(C)	CASE(D)
1.0000	0.0000	0.0000	0.0000

ELEM. NO.	NODE (N) SAP	NODE (N) TNR	NODES DEFINING CONSTRAINT DIRECTION (NI) SAP	(NI) TNR	(NJ) SAP	(NJ) TNR	(NK) SAP	(NK) TNR	(NL) SAP	(NL) TNR	CODE KD	CODE KR	GENERATION CODE (KN)	SPECIFIED DISPLACEMENT	SPECIFIED ROTATION	SPRING RATE
1	31	250	47	411	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
2	32	260	48	412	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
3	20	300	49	413	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
4	20	300	50	414	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
5	16	360	51	415	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
6	4	390	52	416	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
7	4	390	53	417	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08

Figure 6.2-2

PIPE CES/MOMENTS/DISPLACEMENTS/ PER GLOBAL DIRECTIONS
(MAXIMUM ABSOLUTE VALUES)

ELEM. NO.	ELEM. TYPE	STATION	NODE SAP	NODE THR	FX	FY	FZ	MX	MY	MZ	DX	DY	DZ
18	TANGENT	END-I	34	256	22.	1.	100.	25.	435.	45.	0.4501	0.0165	0.0013
		END-J	32	260	22.	1.	100.	44.	680.	45.	0.6616	0.0000	0.0014
19	TANGENT	END-I	32	260	16.	4.	100.	44.	680.	45.	0.6616	0.0000	0.0014
		END-J	30	265	16.	4.	100.	33.	956.	45.	0.6765	0.0261	0.0016
20	BEND	END-I	30	265	16.	3.	100.	33.	956.	45.	0.6765	0.0261	0.0016
		END-J	28	270	100.	3.	16.	44.	699.	44.	0.6475	0.0380	0.0599
21	TANGENT	END-I	28	270	16.	3.	99.	44.	699.	44.	0.6475	0.0380	0.0599
		END-J	26	275	16.	3.	99.	44.	552.	43.	0.6475	0.0596	0.2268
22	BEND	END-I	26	275	13.	2.	97.	44.	552.	43.	0.6475	0.0596	0.2268
		END-J	24	280	97.	2.	13.	46.	668.	47.	0.6318	0.0630	0.2477
23	TANGENT	END-I	24	280	13.	2.	95.	47.	668.	46.	0.6318	0.0630	0.2477
		END-J	23	282	13.	2.	95.	54.	542.	46.	0.4360	0.0626	0.2479
24	TANGENT	END-I	23	282	12.	1.	91.	54.	542.	46.	0.4360	0.0626	0.2479
		END-J	22	284	12.	1.	91.	54.	473.	46.	0.2867	0.0466	0.2480
25	TANGENT	END-I	22	284	14.	2.	88.	54.	473.	46.	0.2867	0.0466	0.2480
		END-J	21	286	14.	2.	88.	39.	264.	46.	0.1775	0.0271	0.2481
26	TANGENT	END-I	21	286	21.	3.	84.	39.	264.	46.	0.1775	0.0271	0.2481
		END-J	20	300	21.	3.	84.	90.	450.	46.	0.0000	0.0000	0.2482
27	TANGENT	END-I	20	300	20.	4.	82.	90.	450.	46.	0.0000	0.0000	0.2482
		END-J	19	302	20.	4.	82.	43.	235.	46.	0.1939	0.0211	0.2483
28	TANGENT	END-I	19	302	14.	3.	81.	43.	235.	46.	0.1939	0.0211	0.2483
		END-J	18	304	14.	3.	81.	63.	489.	46.	0.3502	0.0327	0.2484
29	TANGENT	END-I	18	304	6.	2.	82.	63.	489.	46.	0.3502	0.0327	0.2484
		END-J	17	306	6.	2.	82.	92.	538.	46.	0.4062	0.0298	0.2485
30	TANGENT	END-I	17	306	8.	3.	85.	92.	538.	46.	0.4062	0.0298	0.2485
		END-J	16	360	8.	3.	85.	103.	376.	46.	0.3323	0.0000	0.2485
31	TANGENT	END-I	16	360	14.	19.	89.	103.	376.	46.	0.3323	0.0000	0.2485
		END-J	15	362	14.	19.	89.	277.	104.	46.	0.2988	0.0415	0.2486
32	TANGENT	END-I	15	362	11.	18.	92.	277.	104.	46.	0.2988	0.0415	0.2486
		END-J	14	365	11.	18.	92.	568.	82.	46.	0.5053	0.0152	0.2486
33	BEND	END-I	14	365	6.	17.	28.	568.	82.	46.	0.5053	0.0152	0.2486
		END-J	13	370	6.	26.	17.	538.	62.	100.	0.5114	0.0083	0.2459
34	TANGENT	END-I	13	370	6.	17.	27.	538.	100.	62.	0.5114	0.0083	0.2459
		END-J	12	372	6.	17.	27.	140.	100.	106.	0.3314	0.0083	0.2778

Figure 6.2-3

Figure 6.2-4

T I M E   H I S T O R Y   R E S P O N S E

ELEMENT TYPE (B O U N D A R Y) / / / OUTPUT SET = 1

ELEMENT NUMBER - (*STRESS COMPONENT*) RMS-MOMENT

TIME	1-BDRY-F	1-BDRY-M	2-BDRY-F	2-BDRY-M	3-BDRY-F	3-BDRY-M
0,00400	1,811E-04	0,000E+00	-9,004E-06	0,000E+00	8,244E-04	0,000E+00
0,00800	1,110E-03	0,000E+00	-1,193E-04	0,000E+00	1,069E-02	0,000E+00
0,01200	-1,072E-01	0,000E+00	-4,511E-04	0,000E+00	4,126E-02	0,000E+00
0,01600	-3,488E-01	0,000E+00	-3,053E-02	0,000E+00	3,861E-02	0,000E+00
0,02000	1,800E-01	0,000E+00	1,596E-01	0,000E+00	-8,165E-02	0,000E+00
0,02400	-7,737E-02	0,000E+00	1,823E-01	0,000E+00	-2,535E-01	0,000E+00
0,02800	1,728E-01	0,000E+00	6,121E-02	0,000E+00	-3,761E-01	0,000E+00
0,03200	1,868E-02	0,000E+00	-4,704E-02	0,000E+00	-4,345E-01	0,000E+00
0,03600	8,303E-02	0,000E+00	-6,699E-02	0,000E+00	-4,068E-01	0,000E+00
0,04000	-1,794E-01	0,000E+00	-3,910E-02	0,000E+00	-2,884E-01	0,000E+00
0,04400	2,759E-01	0,000E+00	6,603E-03	0,000E+00	-1,039E-01	0,000E+00
0,04800	2,457E-02	0,000E+00	-5,933E-02	0,000E+00	9,523E-02	0,000E+00
0,05200	7,131E-03	0,000E+00	-1,880E-01	0,000E+00	2,276E-01	0,000E+00
0,05600	1,515E-01	0,000E+00	-1,719E-01	0,000E+00	2,817E-01	0,000E+00
0,06000	-1,835E-01	0,000E+00	-6,527E-02	0,000E+00	3,237E-01	0,000E+00
0,06400	-1,508E-02	0,000E+00	4,264E-02	0,000E+00	4,100E-01	0,000E+00
0,06800	1,658E-02	0,000E+00	1,165E-01	0,000E+00	5,146E-01	0,000E+00
0,07200	-7,581E-02	0,000E+00	1,042E-01	0,000E+00	5,542E-01	0,000E+00
0,07600	1,043E-01	0,000E+00	4,836E-02	0,000E+00	5,423E-01	0,000E+00
[illegible]	-4,064E-02	0,000E+00	-1,728E-02	0,000E+00	5,671E-01	0,000E+00
[illegible]	[illegible]805E-01	0,000E+00	-6,959E-02	0,000E+00	6,079E-01	0,000E+00
[illegible]	[illegible]	0,000E+00	-5,292E-03	0,000E+00	5,329E-01	0,000E+00
[illegible]	[illegible]	[illegible]	7,707E-02	0,000E+00	2,765E-01	0,000E+00
[illegible]	[illegible]	[illegible]	-2,265E-02	0,000E+00	-4,502E-02	0,000E+00
0.50400	[illegible]	[illegible]	[illegible]	0,000E+00	-2,737E-01	0,000E+00
0.50800	-1.168E+00	[illegible]	[illegible]	[illegible]	-3,964E-01	0,000E+00
0.51200	-2.605E+00	[illegible]	[illegible]	[illegible]	-4.903E-01	0,000E+00
0.51600	-3.554E+00	0,000E+00	[illegible]	[illegible]	[illegible]	0,000E+00
0.52000	-3.967E+00	0,000E+00	1.59[illegible]	[illegible]	[illegible]	[illegible]
0.52400	-3.900E+00	0,000E+00	2,337E+00	[illegible]	[illegible]	[illegible]
0.52800	-3.543E+00	0,000E+00	2,862E+00	[illegible]	[illegible]	[illegible]
0.53200	-3.090E+00	0,000E+00	2,886E+00	0,000E+00	[illegible]	[illegible]
0.53600	-2.656E+00	0,000E+00	2,284E+00	0,000E+00	2,304E+01	[illegible]
0.54000	-2.227E+00	0,000E+00	1,166E+00	0,000E+00	2.073E+01	[illegible]
0.54400	-1,692E+00	0,000E+00	-1,756E-01	0,000E+00	1.679E+01	0,000E+00
0.54800	-9,205E-01	0,000E+00	-1,390E+00	0,000E+00	1.174E+01	0,000E+00
0.55200	1.430E-01	0,000E+00	-2,213E+00	0,000E+00	6,136E+00	0,000E+00
0.55600	1.426E+00	0,000E+00	-2,556E+00	0,000E+00	4,727E-01	0,000E+00
0.56000	2,740E+00	0,000E+00	-2,511E+00	0,000E+00	-4,841E+00	0,000E+00
0.56400	3.846E+00	0,000E+00	-2,296E+00	0,000E+00	-9,419E+00	0,000E+00
0.56800	4,528E+00	0,000E+00	-2,159E+00	0,000E+00	-1,767E+01	0,000E+00
0.57200	4.669E+00	0,000E+00	-2,265E+00	0,000E+00	-1.481E+01	0,000E+00
0.57600	4.266E+00	0,000E+00	-2,609E+00	0,000E+00	-1.499E+01	0,000E+00
0.58000	3,517E+00	0,000E+00	-3,000E+00	0,000E+00	-1,337E+01	0,000E+00
0.58400	2,560E+00	0,000E+00	-3,149E+00	0,000E+00	-1,015E+01	0,000E+00
0.58800	1,595E+00	0,000E+00	-2,807E+00	0,000E+00	-5,731E+00	0,000E+00
0.59200	7,256E-01	0,000E+00	-1,892E+00	0,000E+00	-5,898E-01	0,000E+00
0.59600	-4,067E-02	0,000E+00	-5.237E-01	0,000E+00	4.776E+00	0,000E+00
0.60000	-7,607E-01	0,000E+00	1,011E+00	0,000E+00	9,925E+00	0,000E+00

MAXIMUM ABSOLUTE VALUES

MAXIMUM	4.847E+00	0.000E+00	4,913E+00	0.000E+00	2,960E+01	0.000E+00
TIME	4,400E-01	0.000E+00	3,480E-01	0,000E+00	4,880E-01	0.000E+00

MAX/MIN VALUES

MAXIMUM	4,669E+00	0.000E+00	4,913E+00	0,000E+00	7.329E+01	0.000E+00
TIME	5,720E-01	0,000E+00	3.480E-01	0,000E+00	5.320E-01	0.000E+00
MINIMUM	-4.847E+00	0.000E+00	-3,809E+00	0,000E+00	-2.960E+01	0,000E+00
TIME	4.400E-01	0.000E+00	4,000E-01	0,000E+00	4,880E-01	0.000E+00

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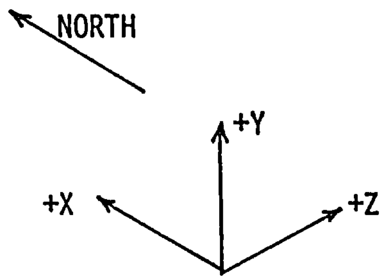
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: AMB DATE: 7-12-83
CHECKED BY: DmD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-585
NODE NUMBER 33

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	.002	-.001	-60					
THERMAL-1	—	-.153	.069	2060					
THERMAL-2	—	-.045	-.393	-180					
THERMAL-3	—	.001	-.558	-1115					
SEISMIC-OBE	—	±0	±.013	±221					
SEISMIC-DBE	—	±.001	±.021	±376					
BLOWDOWN-SV	—	+.014 -.013	+.253 -.238	±18490					
BLOWDOWN-PORV	—	±0	±.005	±423					

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+2221 -717		
EMERGENCY	+17315 -19665		

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	15571		
DESIGN (-)	16613		

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE Greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

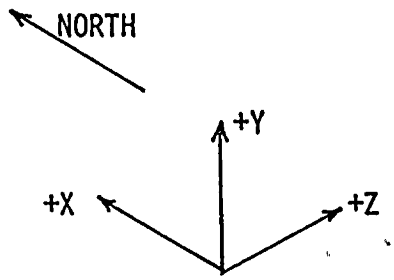
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-586
NODE NUMBER 36

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	0	—	-.001		-1020				
THERMAL-1	.002	—	.118		2170				
THERMAL-2	.037	—	-.377		370				
THERMAL-3	.046	—	-.557		-400				
SEISMIC-OBE	±0	—	±.013		±143				
SEISMIC-DBE	±0	—	±.021		±254				
BLOWDOWN-SV	+.019 -.010	—	+.255 -.229		±5035				
BLOWDOWN-PORV	±0	—	±.006		±201				

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		+1293 -1163	
EMERGENCY		+3615 -6455	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)		5856	
DESIGN (-)		7621	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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SUPPORT LOAD SUMMARY SHEET

BY: DWB DATE: 7-12-83

CHECKED BY: DMD DATE: 7/13/83

DONALD C. COOK
UNIT #1
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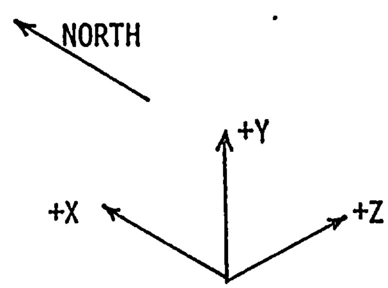
GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-587

NODE NUMBER 42

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.006	-.016	.003						
THERMAL-1	-.266	.855	.296						
THERMAL-2	.140	.329	-.326						
THERMAL-3	.280	.095	-.567						
SEISMIC-OBE	±.004	±0	±.011		±170				
SEISMIC-DBE	±.006	±0	±.018		±281				
BLOWDOWN-SV	+.111 -.096	±0	+.221 -.229		±10950				
BLOWDOWN-PORV	+.008 -.006	±0	+.014 -.010		±324				

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET		+366 -366	
EMERGENCY		±10950	

	SUPPORT DRAWING LOADS		
	FX	FY	FZ
DESIGN (+)		12009	
DESIGN (-)		12009	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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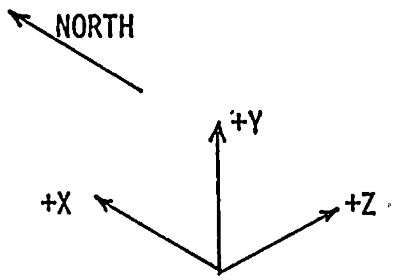
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-588
NODE NUMBER 48

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.009	-.021	.004		-426				
THERMAL-1	-.419	1.08	.218						
THERMAL-2	.151	.453	-.324						
THERMAL-3	.355	.172	-.534						
SEISMIC-OBE	±.006	±.004	±.010						
SEISMIC-DBE	±.010	±.008	±.016						
BLOWDOWN-SV	+.204 -.170	+.116 -.154	+.219 -.173						
BLOWDOWN-PORV	+.013 -.011	+.007 -.008	+.016 -.010						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-426	
EMERGENCY		-426	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		426	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE — THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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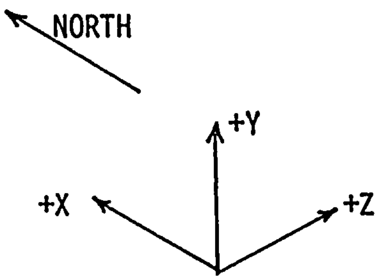
DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-589
NODE NUMBER 66

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	-.008	—	70		50			
THERMAL-1	—	2.26	—	-1360		-1119			
THERMAL-2	—	.964	—	390		100			
THERMAL-3	—	.394	—	1096		605			
SEISMIC-OBE	—	±.002	—	±284		±384			
SEISMIC-DBE	—	±.004	—	±466		±637			
BLOWDOWN-SV	—	+.124 -.101	—	±4249		±14240			
BLOWDOWN-PORV	—	+.005 -.006	—	±161		±623			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	+786 -1574		+882 -1453
EMERGENCY	+5415 -3083		+14895 -13585

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)	5595		10170
DESIGN (-)	4246		10089

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE Greater* THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

* EXCEPT FOR +/- FX

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UNIT #1
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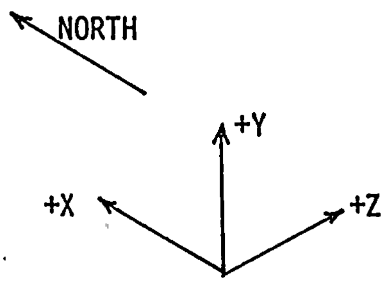
BY: SMB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-590
NODE NUMBER 70

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	0	-.008	-.001		-1200				
THERMAL-1	-.027	2.26	-.022						
THERMAL-2	-.018	1.03	-.015						
THERMAL-3	-.015	.491	-.012						
SEISMIC-OBE	±.004	±.002	±.002						
SEISMIC-DBE	±.006	±.005	±.007						
BLOWDOWN-SV	+.039 -.034	+.124 -.101	+.069 -.071						
BLOWDOWN-PORV	±.004	+.005 -.006	+.004 -.006						

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		-1200	
EMERGENCY		-1200	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		1200	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ________ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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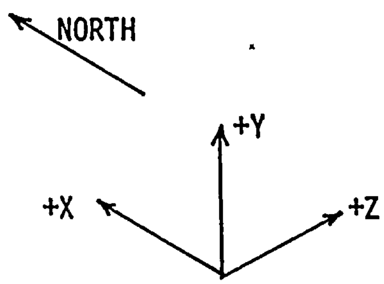
BY: DMB DATE: 7-12-83

CHECKED BY: DMD DATE: 7/13/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-591

NODE NUMBER 83

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	-.007	—	-60		50			
THERMAL-1	—	2.30	—	-210		-140			
THERMAL-2	—	1.74	—	-150		-10			
THERMAL-3	—	1.49	—	-95		14			
SEISMIC-OBE	—	±.002	—	±276		±218			
SEISMIC-DBE	—	±.003	—	±468		±364			
BLOWDOWN-SV	—	+.089 -.063	—	±4318		±6080			
BLOWDOWN-PORV	—	+.006 -.005	—	±354		±331			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+239 -659		+436 -356
EMERGENCY	+4163 -4473		+6144 -6016

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	1935		5348
DESIGN (-)	2257		5339

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE Greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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SUPPORT LOAD SUMMARY SHEET

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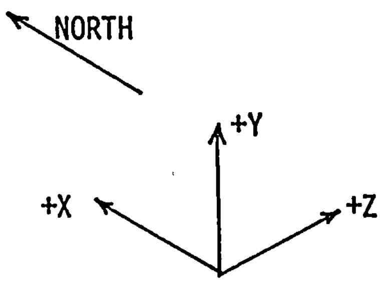
GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-592
NODE NUMBER 1140

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.034	.032	-.076						
THERMAL-1	-.185	2.82	.185						
THERMAL-2	-.207	2.83	.161						
THERMAL-3	-.227	2.86	.149						
SEISMIC-OBE	±.228	±0	±.055		±1280				
SEISMIC-DBE	±.397	±0	±.091		±2122				
BLOWDOWN-SV	+.042 -.061	±0	+.071 -.069		±5647				
BLOWDOWN-PORV	+.003 -.002	±0	±.002		±142				

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		±1288	
EMERGENCY		±5647	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)		20531	
DESIGN (-)		20531	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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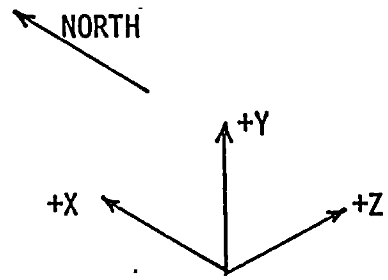
GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-593

NODE NUMBER 111

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.002	.068	-.036		-1067				
THERMAL-1	-.113	2.81	.144						
THERMAL-2	-.183	2.78	.185						
THERMAL-3	-.213	2.75	.222						
SEISMIC-OBE	±.171	±.016	±.042						
SEISMIC-DBE	±.298	±.028	±.070						
BLOWDOWN-SV	+.080 -.104	+.035 -.020	+.083 -.094						
BLOWDOWN-PORV	±.006	±.001	+.004 -.005						

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		-1067	
EMERGENCY		-1067	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		1067	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ____ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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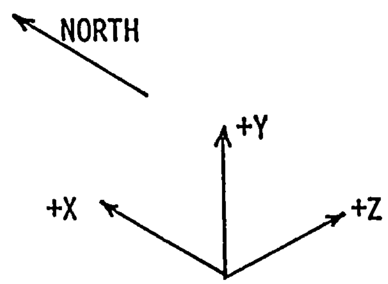

MARK NUMBER 1-GRC-S-594
NODE NUMBER 163

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.076	.030	-.006						
THERMAL-1	.178	2.78	.218						
THERMAL-2	.110	2.81	.249						
THERMAL-3	.059	2.85	.272						
SEISMIC-OBE	±.056	±0	±.202		±1131				
SEISMIC-DBE	±.097	±0	±.350		±1872				
BLOWDOWN-SV	+.065 -.080	±0	+.054 -.055		±5769				
BLOWDOWN-PORV	±.001	±0	±.002		±162				

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		±1143	
EMERGENCY		±5769	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)		19734	
DESIGN (-)		19734	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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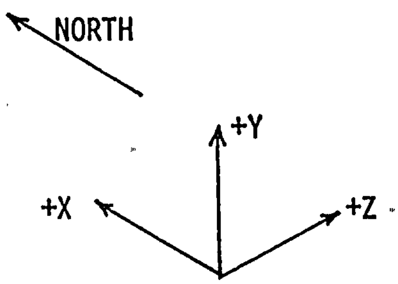

MARK NUMBER 1-GRC-C-595
NODE NUMBER 159

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.050	.062	.008		-1074				
THERMAL-1	.167	2.76	.159						
THERMAL-2	.123	2.76	.241						
THERMAL-3	.109	2.77	.289						
SEISMIC-OBE	±.046	±.014	±.175						
SEISMIC-DBE	±.079	±.023	±.303						
BLOWDOWN-SV	+.058 -.074	+.026 -.018	+.073 -.064						
BLOWDOWN-PORV	±.001	±.001	±.003						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-1074	
EMERGENCY		-1074	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		1074	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ________ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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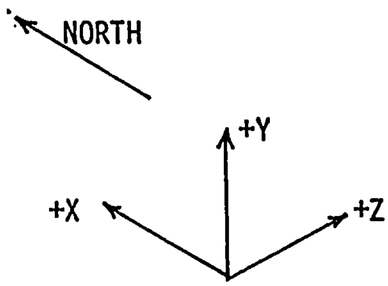

MARK NUMBER 1-GRC-S-596
NODE NUMBER 2230

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.009	.015	.050						
THERMAL-1	.391	2.66	-.271						
THERMAL-2	.323	2.75	-.105						
THERMAL-3	.274	2.82	.017						
SEISMIC-OBE	±.127	±0	±.099		±1052				
SEISMIC-DBE	±.217	±0	±.168		±1734				
BLOWDOWN-SV	+.052 -.071	±0	+.080 -.064		±5052				
BLOWDOWN-PORV	±.003	±0	±.003		± 206				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		±1072	
EMERGENCY		±5052	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		11811	
DESIGN (-)		11811	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

Technical Report
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Revision 0

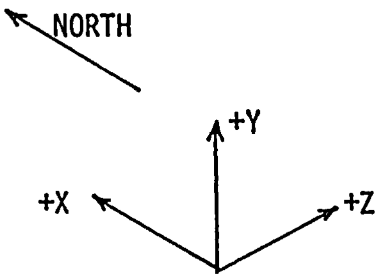
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-597
NODE NUMBER 221

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.001	.036	.027		-1025				
THERMAL-1	.283	2.57	-.216						
THERMAL-2	.253	2.63	-.078						
THERMAL-3	.239	2.68	.002						
SEISMIC-OBE	±.094	±.013	±.071						
SEISMIC-DBE	±.160	±.022	±.122						
BLOWDOWN-SV	+.060 -.077	+.029 -.030	+.072 -.049						
BLOWDOWN-PORV	+.005 -.006	±.002	+.003 -.002						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-1025	
EMERGENCY		-1025	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		1025	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ________ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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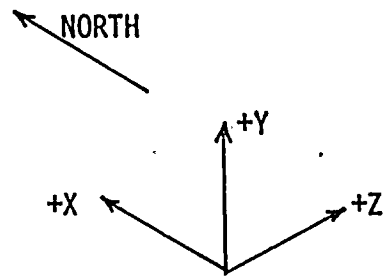
DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: Dmb DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-598
NODE NUMBER 108

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.053	.049	.086						
THERMAL-1	.035	2.79	.105						
THERMAL-2	-.202	2.59	.193						
THERMAL-3	-.308	2.41	.248						
SEISMIC-OBE	±.021	±.006	±.017	±37		±46			
SEISMIC-DBE	±.034	±.010	±.027	±61		±76			
BLOWDOWN-SV	+.189 -.189	+.020 -.011	+.151 -.154	±1723		±2146			
BLOWDOWN-PORV	±.022	±.001	+.017 -.018	±58		±72			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	±69		±85
EMERGENCY	±1723		±2146

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	2763		4152
DESIGN (-)	2763		4152

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
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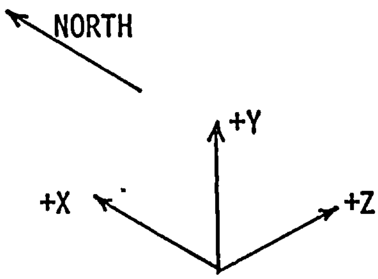
GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-599
NODE NUMBER 156

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.052	.045	.014						
THERMAL-1	.155	2.75	.066						
THERMAL-2	-.014	2.60	.274						
THERMAL-3	-.074	2.47	.386						
SEISMIC-OBE	±.001	±.009	±.008	±97	±17	±12			
SEISMIC-DBE	±.002	±.016	±.015	±122	±29	±20			
BLOWDOWN-SV	+.009 -.007	+.016 -.010	+.072 -.063	±2522	±440	±299			
BLOWDOWN-PORV	±.001	±0	+.007 -.008	±97	±17	±12			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	±137	±24	±17
EMERGENCY	±2522	±440	±299

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	3610		545
DESIGN (-)	3610		545

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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ENGINEERING SERVICES

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DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
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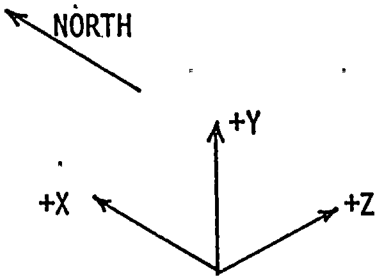
GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-600
NODE NUMBER 195

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	-.003	—	100		-120			
THERMAL-1	—	2.34	—	-1110		1830			
THERMAL-2	—	2.30	—	-720		1470			
THERMAL-3	—	2.29	—	-436		858			
SEISMIC-OBE	—	±.001	—	±376		±269			
SEISMIC-DBE	—	±.002	—	±599		±436			
BLOWDOWN-SV	—	+.038 -.026	—	±3008		±8605			
BLOWDOWN-PORV	—	±.002	—	±458		±718			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+476 -1386		+2117 -389
EMERGENCY	+2672 -3344		+9343 -7867

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	6179		20488
DESIGN (-)	7047		19475

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

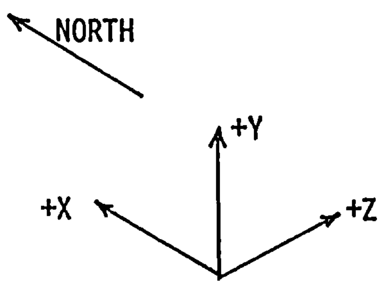
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-601
NODE NUMBER 280

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	-.003	—	-320		720			
THERMAL-1	—	2.36	—	300		-1050			
THERMAL-2	—	2.63	—	1320		-2700			
THERMAL-3	—	2.73	—	1595		-2830			
SEISMIC-OBE	—	±.001	—	±642		±308			
SEISMIC-DBE	—	±.001	—	±983		±424			
BLOWDOWN-SV	—	+.037 -.026	—	±1649		±1943			
BLOWDOWN-PORV	—	±.002	—	±698		±265			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+1948 -962		+1028 -2386
EMERGENCY	+2924 -1303		+1144 -4053

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	8757		2740
DESIGN (-)	1223		1106

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater* THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

*except for +FX & +FZ

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TELEDYNE
ENGINEERING SERVICES

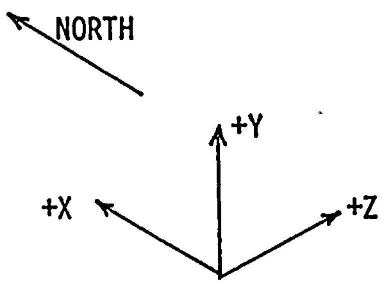
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 7-12-83

CHECKED BY: DMD DATE: 7/13/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-602

NODE NUMBER 668

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.104	.001	-.043		-1159				
THERMAL-1	.422	3.19	-.176						
THERMAL-2	.311	3.24	-.172						
THERMAL-3	.296	3.25	-.182						
SEISMIC-OBE	±.141	±.047	±.088						
SEISMIC-DBE	±.209	±.072	±.128						
BLOWDOWN-SV	+.040 -.024	±.035	±.025						
BLOWDOWN-PORV	+.099 -.127	+.059 -.040	+.085 -.062						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-1159	
EMERGENCY		-1159	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		1159	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE —— THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

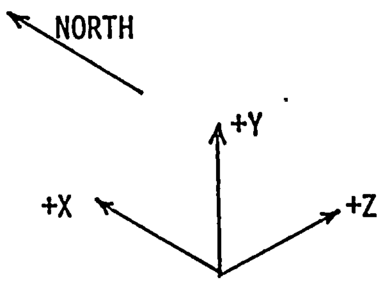
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-603
NODE NUMBER 585

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.103	.211	-.042	-121		-298			
THERMAL-1	.168	3.33	-.067	-173		-428			
THERMAL-2	.056	3.37	-.023	-270		-650			
THERMAL-3	.042	3.39	-.018	-277		-684			
SEISMIC-OBE	±.141	±.077	±.057	±614		±1519			
SEISMIC-DBE	±.208	±.106	±.086	±855		±2117			
BLOWDOWN-SV	+.041 -.022	+.072 -.055	+.009 -.016	±505		±1250			
BLOWDOWN-PORV	+.099 -.128	+.045 -.044	+.053 -.040	±511		±1266			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+493 -1190		+1221 -2925
EMERGENCY	+734 -1149		+1819 -2843

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	1560		3863
DESIGN (-)	1833		4540

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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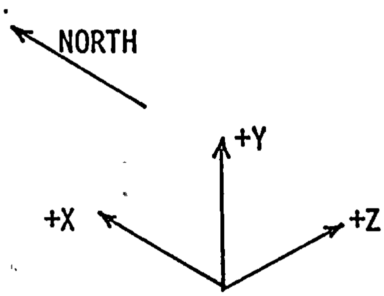
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DmD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-604
NODE NUMBER 450

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.052	.816	-.075						
THERMAL-1	.120	3.36	.334						
THERMAL-2	.106	3.52	.445						
THERMAL-3	.122	3.58	.474						
SEISMIC-OBE	±.093	±0	±.202		±653				
SEISMIC-DBE	±.127	±0	±.293		±952				
BLOWDOWN-SV	+.030 -.027	±0	+.031 -.035		±861				
BLOWDOWN-PORV	+.059 -.058	±0	+.150 -.147		±868				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		±1086	
EMERGENCY		±952	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		1629	
DESIGN (-)		1629	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

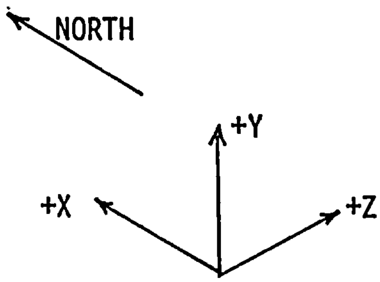
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-605
NODE NUMBER 465

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.039	1.22	-.053	673		-507			
THERMAL-1	.402	3.20	.534	-414		312			
THERMAL-2	.470	3.59	.630	-530		400			
THERMAL-3	.492	3.72	.655	-563		424			
SEISMIC-OBE	±.138	±.362	±.182	±680		±512			
SEISMIC-DBE	±.199	±.487	±.263	±1021		±769			
BLOWDOWN-SV	+.023 -.024	+.087 -.083	±.030	±1738		±1310			
BLOWDOWN-PORV	+.100 -.105	+.138 -.167	+.132 -.137	±1217		±918			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	+1537 -1251		+944 -1158
EMERGENCY	+1848 -1628		+1227 -1393

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	2286		2337
DESIGN (-)	3150		1635

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

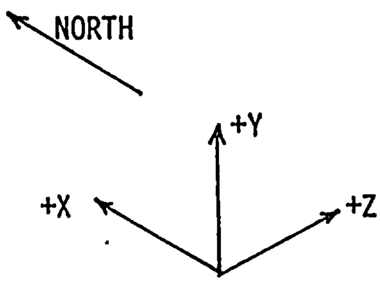
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-606
NODE NUMBER 485

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.043	1.25	-.050		-811				
THERMAL-1	.608	3.02	.514						
THERMAL-2	.699	3.57	.571						
THERMAL-3	.720	3.75	.602						
SEISMIC-OBE	±.167	±.523	±.160						
SEISMIC-DBE	±.243	±.704	±.216						
BLOWDOWN-SV	±.029	+.084 -.066	+.032 -.039						
BLOWDOWN-PORV	+.123 -.131	+.194 -.231	+.101 -.104						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-811	
EMERGENCY		-811	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		811	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE — THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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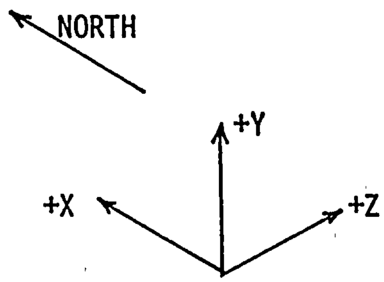
SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DmD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-607
NODE NUMBER 529

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.065	.465	-.105		-658				
THERMAL-1	.819	2.54	.039						
THERMAL-2	.879	3.28	.006						
THERMAL-3	.898	3.49	.011						
SEISMIC-OBE	±.122	±.045	±.122						
SEISMIC-DBE	±.177	±.085	±.165						
BLOWDOWN-SV	+.031 -.034	+.013 -.017	+.011 -.013						
BLOWDOWN-PORV	+.085 -.098	+.028 -.031	+.025 -.024						

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		-658	
EMERGENCY		-658	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		658	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE — THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

TELEDYNE
ENGINEERING SERVICES

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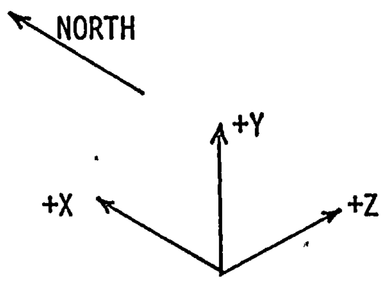
DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 7-12-83
CHECKED BY: Dmd DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-608

NODE NUMBER 534

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.093	.373	-.064						
THERMAL-1	.758	2.46	-.010						
THERMAL-2	.863	3.21	-.046						
THERMAL-3	.914	3.41	-.054						
SEISMIC-OBE	±.110	±0	±.064		±639				
SEISMIC-DBE	±.160	±0	±.087		±876				
BLOWDOWN-SV	+.033 -.038	±0	+.009 -.007		±1658				
BLOWDOWN-PORV	+.084 -.087	±0	+.018 -.020		±1025				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		±1208	
EMERGENCY		±1658	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		1288	
DESIGN (-)		1288	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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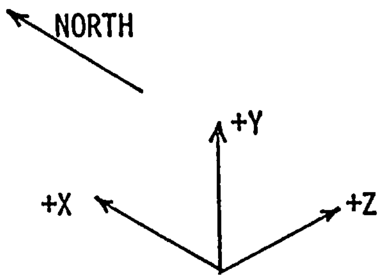
DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 7-12-83
CHECKED BY: DMD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-609
NODE NUMBER 536

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.129	.373	—			-280			
THERMAL-1	.691	2.46	—			10			
THERMAL-2	.821	3.18	—			900			
THERMAL-3	.875	3.38	—			980			
SEISMIC-OBE	±.106	±0	—			±527			
SEISMIC-DBE	±.154	±0	—			±711			
BLOWDOWN-SV	+.043 -.044	+.001 -.002	—			±1191			
BLOWDOWN-PORV	+.087 -.079	±.001	—			±518			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET			+1359 -807
EMERGENCY			+1891 -991

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			2543
DESIGN (-)			1916

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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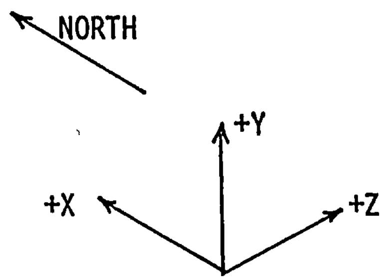
DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 7-12-83
CHECKED BY: DmD DATE: 7/13/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-610
NODE NUMBER 620

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.098	.404	-.057		-783				
THERMAL-1	.258	3.08	.376						
THERMAL-2	.104	3.37	.310						
THERMAL-3	.050	3.45	.245						
SEISMIC-OBE	±.055	±.027	±.151						
SEISMIC-DBE	±.088	±.041	±.219						
BLOWDOWN-SV	+.057 -.052	+.058 -.063	+.075 -.081						
BLOWDOWN-PORV	+.054 -.056	+.023 -.029	+.136 -.094						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-783	
EMERGENCY		-783	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		783	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ______ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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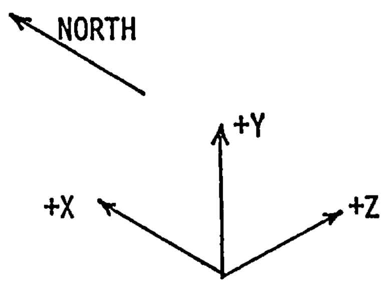
GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-611
NODE NUMBER 431

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.063	.693	-.066		-930				
THERMAL-1	.137	3.34	.250						
THERMAL-2	.108	3.48	.344						
THERMAL-3	.120	3.54	.369						
SEISMIC-OBE	±.081	±.017	±.173						
SEISMIC-DBE	±.111	±.027	±.251						
BLOWDOWN-SV	+.027 / -.027	+.021 / -.019	+.025 / -.028						
BLOWDOWN-PORV	+.055 / -.042	+.015 / -.017	+.128 / -.127						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-930	
EMERGENCY		-930	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		930	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE — THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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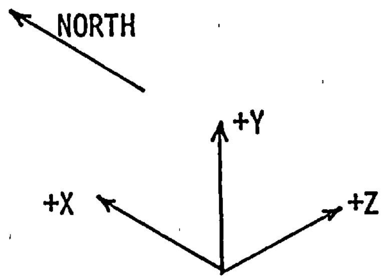

MARK NUMBER 1-GRC-C-612
NODE NUMBER 382

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.113	.918	-.085		-638				
THERMAL-1	.569	3.08	.425						
THERMAL-2	.698	3.46	.455						
THERMAL-3	.769	3.60	.464						
SEISMIC-OBE	±.219	±.650	±.119						
SEISMIC-DBE	±.316	±.874	±.172						
BLOWDOWN-SV	+.035 -.047	+.020 -.021	+.027 -.028						
BLOWDOWN-PORV	+.157 -.124	+.125 -.093	+.073 -.092						

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		-638	
EMERGENCY		-638	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		638	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ______
THAN THE LOAD SHOWN
ON THE SUPPORT DRAWING

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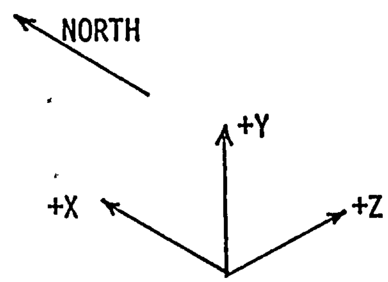

MARK NUMBER 1-GRC-R-613
NODE NUMBER 360

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.049	.928	.039	-136		171			
THERMAL-1	.500	3.08	.397	-78		97			
THERMAL-2	.638	3.40	.508	-220		280			
THERMAL-3	.709	3.48	.564	-311		391			
SEISMIC-OBE	±.204	±.625	±.162	±276		±347			
SEISMIC-DBE	±.292	±.843	±.232	±407		±512			
BLOWDOWN-SV.	+.074 -.089	+.039 -.034	+.058 -.070	±257		±323			
BLOWDOWN-PORV	+.153 -.123	+.133 -.087	+.120 -.098	±296		±312			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+140 -761		+960 -176
EMERGENCY	+271 -704		+885 -341

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	772		670
DESIGN (-)	787		658

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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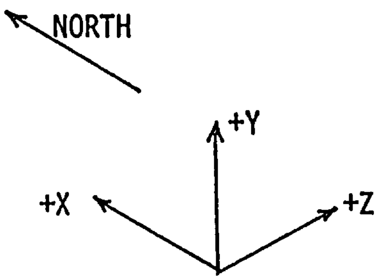

MARK NUMBER 1-GRC-S-614

NODE NUMBER 325

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.011	.380	.041						
THERMAL-1	.181	3.02	.423						
THERMAL-2	-.008	3.28	.341						
THERMAL-3	-.073	3.33	.269						
SEISMIC-OBE	±.027	±.041	±.192	±99	±368	±73			
SEISMIC-DBE	±.045	±.058	±.277	±156	±580	±115			
BLOWDOWN-SV	+.082 -.094	+.037 -.040	+.082 -.089	±738	±2754	±546			
BLOWDOWN-PORV	+.042 -.033	+.026 -.030	+.158 -.110	±295	±1101	±218			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	±311	±1161	±230
EMERGENCY	±738	±2754	±546

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	288	953	104
DESIGN (-)	288	953	104

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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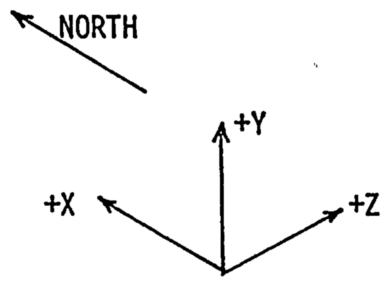

MARK NUMBER 1-GRC-C-615
NODE NUMBER 101

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.085	.065	.037		-142				
THERMAL-1	.082	2.66	.036						
THERMAL-2	-.099	2.46	.277						
THERMAL-3	-.122	2.31	.394						
SEISMIC-OBE	±.018	±.023	±.004						
SEISMIC-DBE	±.029	±.038	±.007						
BLOWDOWN-SV	+.144 -.137	+.166 -.168	+.046 -.039						
BLOWDOWN-PORV	±.015	±.010	±.004						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-142	
EMERGENCY		-142	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		142	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ______ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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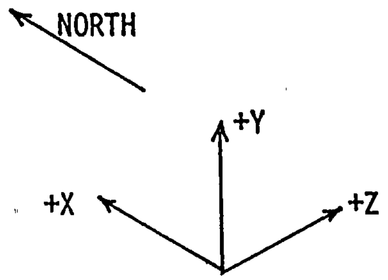

MARK NUMBER 1-GRC-R-616

NODE NUMBER 203

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.004	0	-.002		-1950				
THERMAL-1	.013	2.35	-.003		1451				
THERMAL-2	-.016	2.35	.023		1490				
THERMAL-3	-.024	2.35	.038		977				
SEISMIC-OBE	±.003	±0	±.002		±606				
SEISMIC-DBE	±.004	±0	±.002		±947				
BLOWDOWN-SV	±.028	±0	+.018 -.019		±23460				
BLOWDOWN-PORV	+.003 -.004	±0	±.002		±1070				

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		+770 -2556	
EMERGENCY		+22487 -24433	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)		3272	
DESIGN (-)		8315	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

6.3 Valve Accelerations

Valve accelerations are presented in this section for the DBE seismic condition and the SV transient shock condition. The DBE seismic accelerations are taken directly from TR-5364-1, Revision 0 and are presented in this report since the DBE event constitutes an emergency condition. The horizontal allowable was taken as 3g and the vertical allowable as 2g based on the attachments to AEP letter dated September 16, 1982 from Mr. J. L. Williams of AEP to Mr. L. B. Semprucci of TES (Reference 14). For the seismic condition, the resultant horizontal acceleration was compared against the 3g allowable.

The vertical acceleration values of valves SV-45A, SV-45B, SV-45C, NMO-151, NRV-151 and NRV-153, exceed the 2g criteria. The horizontal acceleration values of valves NMO-152 and NMO-153, exceed the 3g criteria. However, TES was informed per Reference 12 that the NMO and NRV series valves can accept valve accelerations up to 6g in any direction. Since it is not in the work scope of this project to qualify the SV valves for vertical accelerations over 2g, this task is assumed to be the responsibility of American Electric Power Service Corporation and will not be further addressed other than to report the acceleration values in Section 6.3.2.

6.3.1 DBE Seismic Accelerations

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VALVE NO.		NMO-151			NMO-152			NMO-153		
NODE NO.		651			411			496		
		ACCELERATION			ACCELERATION			ACCELERATION		
		A_x	A_y	A_z	A_x	A_y	A_z	A_x	A_y	A_z
SHOCK DIRECTION	X	.76	.41	.41	.73	.36	.56	.67	.93	.61
	Y	.17	.15	.15	.27	.25	.24	.24	.33	.34
	Z	.36	.27	.66	.70	.52	.69	.51	.64	.78
SRSS RESULTS	A_{xT}	.86g			1.05g			.88g		
	A_{yT}	.51g			.68g			1.18g		
	A_{zT}	.79g			.92g			1.05g		

	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE
VERTICAL A_{yT}	.51g	2g	.68g	2g	1.18g	2g
HORIZONTAL *	1.17g	3g	1.40g	3g	1.37g	3g

* HORIZONTAL ACCELERATION = $\sqrt{(A_{xT})^2 + (A_{zT})^2}$

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VALVE NO.		SV-45A			SV-45B			SV-45C		
NODE NO.		2260			1660			1170		
		ACCELERATION			ACCELERATION			ACCELERATION		
		A_x	A_y	A_z	A_x	A_y	A_z	A_x	A_y	A_z
SHOCK DIRECTION	X	.99	.13	.88	.96	.16	.46	1.46	.10	.24
	Y	.05	.02	.05	.05	.02	.04	.04	.01	.04
	Z	.84	.15	.82	.51	.11	1.35	.29	.17	1.09
SRSS RESULTS	A_{xT}	1.30g			1.09 g			1.49 g		
	A_{yT}	.20 g			.20 g			.20 g		
	A_{zT}	1.20 g			1.43g			1.12g		

	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE
VERTICAL A_{yT}	.2g	2g	.20g	2g	.20g	2g
HORIZONTAL *	1.77g	3g	1.80g	3g	1.86g	3g

$$* \text{ HORIZONTAL ACCELERATION} = \sqrt{(A_{xT})^2 + (A_{zT})^2}$$

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VALVE NO.		NRV-151			NRV-152			NRV-153		
NODE NO.		631			391			516		
		ACCELERATION			ACCELERATION			ACCELERATION		
		A_x	A_y	A_z	A_x	A_y	A_z	A_x	A_y	A_z
SHOCK DIRECTION	X	.93	.32	.34	1.16	.60	.84	.97	.42	.67
	Y	.17	.14	.16	.46	.51	.35	.26	.14	.51
	Z	.54	.30	1.24	1.21	1.00	1.08	.51	.30	1.02
SRSS RESULTS	A_{xT}	1.09g			1.74g			1.13g		
	A_{yT}	.46g			1.27g			.53g		
	A_{zT}	1.30g			1.41g			1.32g		

	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE
VERTICAL A_{yT}	.46g	2g	1.27g	2g	.53g	2g
HORIZONTAL *	1.69g	3g	2.24g	3g	1.74g	3g

* HORIZONTAL ACCELERATION = $\sqrt{(A_{xT})^2 + (A_{zT})^2}$

6.3.2 SV Transient Shock Valve Accelerations

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VALVE ACCELERATIONS

VALVE	SV-45A			SV-45B		
NODE NUMBER	2260			1660		
VALVE WEIGHT	685 lbs			685 lbs		
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	887	1608	958	1088	1760	769
ACCELERATION	1.295g	2.347	1.399	1.588	2.569	1.123
ALLOWABLE	3g	2g	3g	3g	2g	3g

VALVE	SV-45C					
NODE NUMBER	1170					
VALVE WEIGHT	685 lbs					
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	819	1372	1865			
ACCELERATION	1.196	2.003	2.723			
ALLOWABLE	3g	2g	3g			

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VALVE ACCELERATIONS

VALVE	NMO-151			NMO-152		
NODE NUMBER	651			411		
VALVE WEIGHT	400 lbs			400 lbs		
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	908	879	1130	1122	551	1428
ACCELERATION	2.270	2.198	2.825	2.805	1.378	3.570
ALLOWABLE	3g	2g	3g	3g	2g	3g

VALVE	NMO-153					
NODE NUMBER	496					
VALVE WEIGHT	400 lbs					
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	1981	804	1018			
ACCELERATION	4.953	2.010	2.545			
ALLOWABLE	3g	2g	3g			

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VALVE ACCELERATIONS

VALVE	NRV-151			NRV-152		
NODE NUMBER	631			391		
VALVE WEIGHT	480 lbs			480 lbs		
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	1439	2105	458	600	616	588
ACCELERATION	2.998	4.385	.954	1.250	1.283	1.225
ALLOWABLE	3g	2g	3g	3g	2g	3g

VALVE	NRV-153					
NODE NUMBER	516					
VALVE WEIGHT	480 lbs					
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	952	1071	997			
ACCELERATION	1.983	2.231	2.077			
ALLOWABLE	3g	2g	3g			

6.4 Nozzle Loads

Forces and moments for the four pressurizer nozzles and the quench tank nozzles are given in this section for all loading conditions. The directions indicated represent the load on the appropriate nozzle.

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NOZZLE LOAD SUMMARY SHEET

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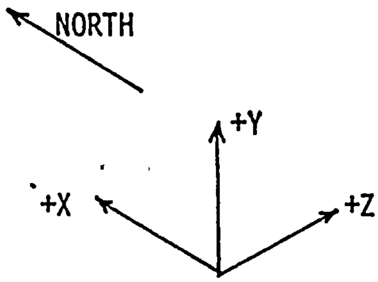

NODE NUMBER 1

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	0	-1000	-20	-1200	-870	20090
THERMAL-1	—	—	—	-450	340	1479	31540	62080	121840
THERMAL-2	—	—	—	-20	80	10	-8120	-9000	33650
THERMAL-3	—	—	—	+176	-16	-600	-22369	-38588	-4376
SEISMIC-OBE	—	—	—	±50	±147	±510	±7676	±18535	±6030
SEISMIC-DBE	—	—	—	±94	±259	±840	±12681	±30687	±10427
BLOWDOWN-SV	—	—	—	±15134	±16673	±10794	±161391	±379873	±272163
BLOWDOWN-PORV	—	—	—	±495	±10369	±222	±3854	±1814	±8140

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

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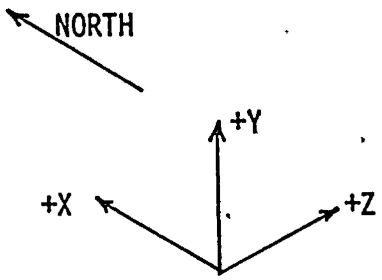

NODE NUMBER 750

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	-100	470	250	9220	-1790	-3810
THERMAL-1	—	—	—	820	-579	170	17250	4720	-83830
THERMAL-2	—	—	—	390	-50	400	33520	9870	-45740
THERMAL-3	—	—	—	+321	+103	+434	+35474	+11143	-39421
SEISMIC-OBE	—	—	—	±375	±500	±389	±19183	±26696	±34854
SEISMIC-DBE	—	—	—	±527	±806	±537	±26283	±38635	±52040
BLOWDOWN-SV	—	—	—	±1564	±1922	±1090	±35180	±26501	±46682
BLOWDOWN-PORV	—	—	—	±2083	±2803	±886	±36134	±37970	±81181

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

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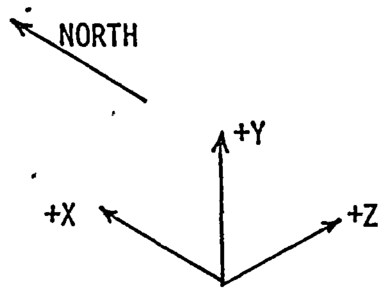


NODE NUMBER 244

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	20	-1040	60	18230	-950	-11150
THERMAL-1	—	—	—	-140	-2069	-690	-28480	26920	-64200
THERMAL-2	—	—	—	-260	-1180	-120	-19920	10250	-39240
THERMAL-3	—	—	—	-293	-448	+241	-11881	+194	-17805
SEISMIC-OBE	—	—	—	±611	±921	±501	±10864	±10964	±20444
SEISMIC-DBE	—	—	—	±1031	±1523	±852	±18491	±18177	±33944
BLOWDOWN-SV	—	—	—	±2230	±3985	±1460	±44943	±31261	±48836
BLOWDOWN-PORV	—	—	—	±94	±105	±130	±3725	±1966	±3188

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

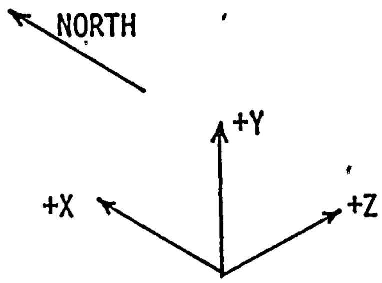
TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: CMA DATE: 7-12-83
CHECKED BY: DMD DATE: 7/12/83

GLOBAL COORDINATE SYSTEM



NODE NUMBER 185

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1				-50	-910	0	13930	440	16830
THERMAL-1				360	-820	-440	20890	22100	-17600
THERMAL-2				80	-430	-100	7080	5680	-12980
THERMAL-3				-94	-114	+108	-2499	-3431	-7145
SEISMIC-OBE				±681	±1191	±810	±24668	±13523	±7006
SEISMIC-DBE				±1132	±1982	±1401	±40909	±22405	±12079
BLOWDOWN-SV				±1616	±4578	±2023	±51700	±36387	±43219
BLOWDOWN-PORV				±77	±113	±75	±2215	±1205	±2071

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

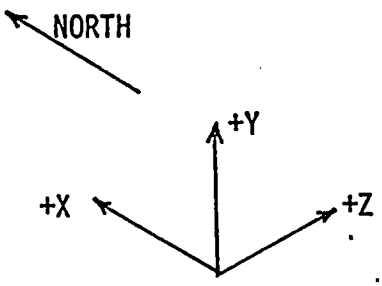
TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: CMA DATE: 7-12-83
CHECKED BY: DMD DATE: 7/12/83

GLOBAL COORDINATE SYSTEM



NODE NUMBER 138

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	-20	-880	-60	-10330	850	21360
THERMAL-1	—	—	—	400	-480	-30	15060	15000	12520
THERMAL-2	—	—	—	150	-280	30	6850	4950	3270
THERMAL-3	—	—	—	-5	-102	+59	+636	-279	-1913
SEISMIC-OBE	—	—	—	±920	±1350	±820	±16050	±15834	±23448
SEISMIC-DBE	—	—	—	±1600	±2241	±1361	±26601	±26287	±38971
BLOWDOWN-SV	—	—	—	±1779	±4810	±1756	±40295	±31889	±59681
BLOWDOWN-PORV	—	—	—	±127	±187	±50	±995	±1598	±2876

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

6.5 Valve Loads

Section 6.5 gives the moments on each end of all valves in the piping system for all loading conditions. The moments reported are those acting on the pipe at the point where the valve and pipe meet.

VALVE END MOMENTS

Donald C. Cook
Unit #1
Project 5364

BY: DmD DATE: 7/13/83
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VALVE NUMBER SV-45C

NODE	115			120		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	5364	-2369	-1525	16095	-2363	-5536
THERMAL-1	-1913	-3627	-20154	-8605	-9858	-10136
THERMAL-2	2673	23	-4907	-2185	-2115	-514
THERMAL-3	4463	932	3437	1853	1332	3928
SEISMIC OBE	± 2418	± 3067	± 12929	± 6421	± 1098	± 5189
SEISMIC DBE	± 4087	± 5324	± 22508	± 10645	± 1821	± 8610
BLOWDOWN PORV	± 1858	± 806	± 2460	± 1460	± 793	± 1894
BLOWDOWN SV	± 27996	± 9547	± 22864	± 46416	± 15645	± 30346

VALVE NUMBER SV-45B

NODE	165			170		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	2426	-1606	-5606	3252	-1550	-16289
THERMAL-1	-16818	-3639	-13166	-9819	-11254	6586
THERMAL-2	-246	-1464	596	1062	-3237	9045
THERMAL-3	9071	-1215	7982	6945	649	8091
SEISMIC OBE	± 10449	± 3248	± 2078	± 2403	± 1044	± 6396
SEISMIC DBE	± 18079	± 5616	± 3593	± 4037	± 1730	± 10582
BLOWDOWN PORV	± 1117	± 544	± 849	± 1046	± 706	± 911
BLOWDOWN SV	± 17315	± 5012	± 24084	± 13943	± 11172	± 53865

UNITS: INCH-POUNDS

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TELEDYNE
ENGINEERING SERVICES

VALVE END MOMENTS

Donald C. Cook
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BY: DMD DATE: 7/13/83
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VALVE NUMBER SV-45A

NODE	225			229		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	-2525	-909	-4675	-10304	-269	-7910
THERMAL-1	-17623	-4471	6022	24503	-11620	18857
THERMAL-2	3133	-3765	12510	22174	-8404	16514
THERMAL-3	15561	-4420	14412	17577	-6815	12405
SEISMIC OBE	± 4649	± 2775	± 4870	± 6046	± 1853	± 4509
SEISMIC DBE	± 7941	± 4736	± 8259	± 10129	± 3152	± 7664
BLOWDOWN PORV	± 1064	± 904	± 2528	± 672	± 511	± 1856
BLOWDOWN SV	± 19916	± 10927	± 30894	± 49933	± 6192	± 30219

VALVE NUMBER ______

NODE						
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT						
THERMAL-1						
THERMAL-2						
THERMAL-3						
SEISMIC OBE						
SEISMIC DBE						
BLOWDOWN PORV						
BLOWDOWN SV						

UNITS: INCH-POUNDS

VALVE END MOMENTS

Donald C. Cook
Unit #1
Project 5364

BY: DMD DATE: 7/13/83
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VALVE NUMBER NRV-153

NODE	525			510		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	-5959	3595	-4701	-6710	2225	-6561
THERMAL-1	2852	-4053	1999	2961	-3923	2271
THERMAL-2	3932	-3806	4366	3673	-3767	3725
THERMAL-3	3833	-4667	5361	3470	-4749	4461
SEISMIC OBE	±9951	±5546	±1702	±4646	±4981	±9759
SEISMIC DBE	±13438	±7551	±2527	±7165	±6806	±15305
BLOWDOWN PORV	±3998	±2113	±9683	±7039	±4021	±11669
BLOWDOWN SV	±7455	±3995	±13986	±21087	±6173	±26192

VALVE NUMBER NMO-153

NODE	505			490		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	-6204	562	-5309	-4760	-784	-2629
THERMAL-1	3094	-3766	2600	3202	-3636	2866
THERMAL-2	3358	-3723	2946	3105	-3682	2317
THERMAL-3	3028	-4852	3368	2672	-4929	2485
SEISMIC OBE	±4753	±5126	±10677	±8361	±7712	±9107
SEISMIC DBE	±7196	±7003	±16578	±9231	±6785	±17895
BLOWDOWN PORV	±8354	±6186	±12386	±4807	±6132	±13195
BLOWDOWN SV	±17121	±13584	±27482	±5018	±11157	±13487

UNITS: INCH-POUNDS

VALVE END MOMENTS

Donald C. Cook
Unit #1
Project 5364

BY: DMD DATE: 7/13/83
CHECKED BY: CMA DATE: 7-13-83

VALVE NUMBER NRV-152

NODE	385			400		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	-347	595	-4480	1429	-1879	-5198
THERMAL-1	-400	1634	89	-704	-37	212
THERMAL-2	-1418	-1618	78	-1374	-3349	60
THERMAL-3	-1065	-3366	-585	-906	-5164	-650
SEISMIC OBE	±4646	±2854	±1240	±9380	±4125	±12514
SEISMIC DBE	±6450	±4457	±1972	±14835	±6030	±18821
BLOWDOWN PORV	±4233	±1847	±3336	±11543	±3164	±12310
BLOWDOWN SV	±13121	±3453	±5578	±15870	±4992	±16260

VALVE NUMBER NMO-152

NODE	405			420		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	76	-4888	-4650	-2685	-7312	-3174
THERMAL-1	-1073	-2072	361	-1371	-3709	481
THERMAL-2	-1319	-5455	38	-1275	-7152	20
THERMAL-3	-713	-7349	-728	-557	-9112	-791
SEISMIC OBE	±10544	±4509	±13030	±14271	±6013	±16190
SEISMIC DBE	±16123	±6182	±19393	±21126	±8564	±23806
BLOWDOWN PORV	±10442	±5391	±11858	±10039	±4745	±9527
BLOWDOWN SV	±14504	±11200	±16034	±8965	±12461	±7035

UNITS: INCH-POUNDS

VALVE END MOMENTS

Donald C. Cook
Unit #1
Project 5364

BY: Dmd DATE: 7/13/83
CHECKED BY: CMA DATE: 7-13-83

VALVE NUMBER NRV-151

NODE	625			635		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	5091	-575	670	7219	42	5939
THERMAL-1	7775	1660	4472	5328	-3428	-1588
THERMAL-2	5387	-3196	2717	4882	-5146	1466
THERMAL-3	3981	-4171	1420	4024	-4476	1528
SEISMIC OBE	±5763	±4843	±2129	±9577	±4397	±4585
SEISMIC DBE	±8659	±7323	±3281	±14592	±6809	±7333
BLOWDOWN PORV	±3207	±2431	±8262	±8007	±4980	±17493
BLOWDOWN SV	±4138	±2699	±23225	±13956	±5788	±24454

VALVE NUMBER NMO-151

NODE	645			657		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	8389	790	8832	8022	1396	9243
THERMAL-1	2349	-9618	-8955	-47	-14606	-14900
THERMAL-2	4267	7517	-55	3772	-9431	-1283
THERMAL-3	4078	-4845	1660	4120	-5146	1766
SEISMIC OBE	±9728	±2722	±3576	±11289	±3684	±3669
SEISMIC DBE	±14704	±3880	±5836	±17293	±5411	±5967
BLOWDOWN PORV	±9321	±8307	±15478	±7523	±7192	±8935
BLOWDOWN SV	±14821	±9889	±15344	±10734	±9903	±10734

UNITS: INCH-POUNDS

7.0 DRAWINGS

8.0 REFERENCES

1. Letter from Mr. S. Ulan of AEP to Mr. L. B. Semprucci of TES, dated November 29, 1982.

2. Teledyne Engineering Services Technical Report TR-5364-1.

3. Crosby Valve and Gage Company Drawing No. H-51688, Revision A.

4. Technical Paper #410 by Crane.

5. Westinghouse Electric Company, Drawing No. 110E272.

6. ITI Report, "Evaluation of RELAP5/MOD1 for Calculation of Safety and Relief Valve Discharge Piping Hydrodynamic Loads," February 1982. Prepared by Intermountain Technologies.

7. Review of Pressurizer Safety Valve Performance as observed in the EPRI Safety and Relief Valve Test Program. WCAP-10105.

8. ASME Code NB7000, Section III.

9. Teledyne Engineering Services Technical Proposal PR-5653, dated May 14, 1981.

10. TES letter 5364-44, dated May 28, 1983 from Mr. P. D. Harrison of TES to Mr. Sam Ulan of AEP.

8.0 REFERENCES (Continued)

11. Letter from Mr. S. Ulan of AEP to Mr. P. D. Harrison of TES, dated March 15, 1983.

12. Letter from Mr. Sam Ulan of AEP to Mr. P. D. Harrison of TES, dated May 26, 1983.

13. 1967 Edition of USAS B31.1 Power Piping Code.

14. Letter from Mr. J. L. Williams of AEP to Mr. L. B. Semprucci of TES, dated September 16, 1982.

15. EPRI Power Safety and Relief Valve Test Program Guide for Application of Valve Test Program results to Plant-Specific Evaluations. Interim Report, July 1982 (Research Project V102).

AMERICAN ELECTRIC POWER SERVICE CORPORATION
2 BROADWAY
NEW YORK, NEW YORK 10004

TECHNICAL REPORT TR-5364-4
REVISION 0

BOOK 2 OF 3

DONALD C. COOK NUCLEAR GENERATING STATION

ANALYSIS OF PRESSURIZER SAFETY VALVE DISCHARGE PIPING SYSTEM, WITH DRAINED LOOP SEALS PER NUREG 0737, II. D.1, UNIT 2

JULY 18, 1983

TELEDYNE ENGINEERING SERVICES

130 SECOND AVENUE
WALTHAM, MASSACHUSETTS 02254
617-890-3350

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5.0 STRUCTURAL ANALYSIS

Thermal and force/time history analyses were performed for the drained loop seal condition of the pressurizer safety and relief valve discharge piping using the TMRSAP computer program; a modified version of SAPIV. The computer model used was based on TES isometric drawing E-5761, Revision 2, which is shown in Section 7.0. In general, the structural analysis was done in accordance with AEP letter dated November 29, 1982 from Mr. Sam Ulan of AEP to Mr. L.B. Semprucci of TES (Reference 1) and AEP letter dated March 15, 1983 from Mr. Sam Ulan of AEP to Mr. Pat Harrison of TES (Reference 11).

For the drained loop seal analysis, it was not necessary to reanalyze the deadweight, normal thermal, PORV transient thermal, OBE seismic and DBE seismic conditions. The as-built analysis of the pressurizer safety and relief valve discharge piping, contained in TES Technical Report TR-5364-2, Revision 0 (Reference 2), should be referenced for all analytical results for the above conditions. This report contains the results for the SV transient thermal condition and the SV transient shock force time/history analysis. The emergency condition is shown to be acceptable, per this report, except as noted in Sections 6.2 and 6.3.2, for a drained loop seal condition. The normal and upset conditions were shown to be acceptable per the as-built analysis and report (Reference 2). The draining of the loop seals will not adversely affect the analysis of the normal and upset conditions.

5.1 SV Transient Thermal Analysis

Thermal analysis was performed for the SV transient condition. The temperature distribution was obtained from the RELAP5 output, as shown in Section 4.9. Throughout this report, thermal case 1 refers to normal operation, thermal case 2 to PORV operation, and thermal case 3 to SV operation.

Boundary displacements were calculated for the quench tank nozzle, pressurizer nozzles, and support 2-GRC-R-616, which connects to the pressurizer.

5.2 Transient Shock Analysis

Based on the results obtained from the RELAP5 analysis, presented in Section 4, the SV transient shock analysis was performed. The analysis was calculated at one millisecond intervals for a length of .65 seconds. All loads peaked previous to .65 seconds, indicating that the analysis was performed for a sufficient length of time.

6.0 ANALYTICAL RESULTS

Section 6.0 contains all analytical results relative to emergency conditions. That is, stress equations C1, C2 and C3 (as defined in Reference 1), support loads for all restraints, valve accelerations for DBE seismic and SV transient shock conditions, nozzle loads and valve end moments. For easier reference, the results presented in Section 6.0 include loadings for all conditions with deadweight, normal thermal, PORV transient thermal, OBE seismic, and DBE seismic results being taken from TES Technical Report TR-5364-2, Revision 0.

6.1 Stress Summary

Stress calculations were based on the 1967 Edition of the ANSI B31.1 Code (Reference 13), the AEP letter dated November 29, 1982 (Reference 1), and the AEP letter dated March 15, 1983 (Reference 11). For this report, stress combinations C1, C2 and C3 are presented, TES Technical Report TR-5364-2 should be referenced for A1, A2, B1, B2 and B3 stresses. Stress combinations C1, C2 and C3 are as follows:

C1 normal pressure stress + deadweight stress + DBE stress $\leq 1.8\ S_h$

C2 SV transient pressure stress + SV transient weight stress + SV transient shock stress $\leq 1.8\ S_h$

C3 SV transient thermal stress range $\leq 1.25\ S_c + .25\ S_h$

The stresses presented conservatively consider all moments to be intensified, although B31.1 allows for intensification factors to be omitted in the torsional direction.

Allowable stresses for stress combinations C1, C2 and C3, were obtained by using the maximum temperature the piping experienced during the SV transient event to determine S_h. The value of S_c was based on 70°F per Reference 10. A summary of allowable stresses for the emergency condition is given in Table 6.1-1.

Section 119.6.1 of the B31.1 Code indicates that the thermal range stress calculations shall be based on the range between the minimum and maximum temperature. Stresses for the maximum range of thermal moments, due to all thermal conditions considered, were analyzed and found to be satisfactory.

Stresses were calculated as follows:

Pressure

$$\frac{Pd^2}{D^2-d^2}$$

Deadweight

$$\frac{.75i\ M_A}{Z}$$

Thermal

$$\frac{i\ M_C}{Z}$$

Seismic

$$\frac{.75i\ M_B}{Z}$$

Force/Time History

$$\frac{.75i\ M_D}{Z}$$

where:

d = inside diameter of pipe
D = outside diameter of pipe
i = intensification factor
M_A = resultant moment due to deadweight loadings
M_B = resultant moment due to seismic loadings
M_C = range of resultant moments due to thermal loadings
M_D = resultant moment due to force/time history analysis
Z = section modulus

TELEDYNE ENGINEERING SERVICES

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PROJECT: 5364 14 JULY 1983
D. C. COOK UNIT 2
SUMMARY OF ALLOWABLES

BY DMB DATE 7-14-83
CHKD Smd DATE 7/15/83
SHEET NO. ____ OF ____

TABLE 6.1-1

PORV LOOP 151

NODES	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
230	SA-312-304	447	14762
286 THRU 288	"	600	14350
290	"	760	14080
292 THRU 318	"	653	14294
320 THRU 342	SA-376-316	653	16000

PORV LOOP 152

NODES	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
240 THRU 402	SA-312-304	800	14000
404 THRU 344	"	864	13780
346	"	653	14300
350 THRU 356	SA-376-304	653	14300

PORV LOOP 153

NODES	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
232 THRU 236	SA-312-304	440	14790
238 THRU 239	"	560	14430
240 THRU 244	"	800	14000
246 THRU 261	"	890	13650
259 THRU 262	"	956	13292
266 THRU 284	SA-376-304	653	14300

NOTE: PORV LOOP 151 REFERS TO THE PORV LOOP CONTAINING VALVES NMO-151 AND NRV-151. THIS IS TYPICAL OF LOOPS 152 AND 153.

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 14 JULY 1983
D. C. COOK UNIT 2
SUMMARY OF ALLOWABLES

BY DMB DATE 7-14-83
CHKD DMD DATE 7/15/83
SHEET NO.____ OF ____

TABLE 6.1-1 (Cont)

MAIN RISER

NODES	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
2 THRU 24	SA-358-316 CL 1	388	16372
26 THRU 36	•	409	16273
38 THRU 51	•	421	16237
52 THRU 71	•	432	16204
72 THRU 219	•	440	16180
222 THRU 230	SA-312-304	440	14790

LOOPS

NODES LOOP C	NODES LOOP B	NODES LOOP A	MATERIAL	TEMPERATURE (°F)	Sh (PSI)
72 THRU 82	126 THRU 136	176 THRU 190	SA-312-304	440	14790
84 THRU 96	138 THRU 146		•	445	14770
98	148	195	•	464	14694
103	152	196	•	464	11706 *
107	156	200	SA-376-316	672	11468 *
108 THRU 124	158 THRU 174	202 THRU 218	SA-376-316	672	16000

NOTE: LOOP C REFERS TO SRV LOOP CONTAINING VALVE SV-45C THIS IS TYPICAL OF LOOPS B AND A ALSO.
* ALLOWABLE AS PER NOTE (6),TABLE A-1 OF B 31.1.0, 1967 CODE.

6.1.1 Equation C-1 Stresses

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
2	0	0	0	0	29.5
4		.3	.3	.6 XY	
6		.4	.1	.5 XY	
7		.2	.1	.3 XY	
8		.3	0	.3 XY	
10		.7	.1	.8 XY	
12		1.0	.1	1.1 XY	
14		.5	.1	.6 XY	
16		.6	.1	.7 XY	
18		1.1	.2	1.3 XY	
20		1.5	.3	1.8 YZ	
21		.8	.1	.9 YZ	
24		.8	.1	.9 YZ	
26		.8	.5	1.3 YZ	29.3
28		.9	.4	1.3 YZ	
32		.5	.1	.6 XY	
33		.9	.3	1.2 XY	
34		1.0	.3	1.3 XY	
36		1.0	.3	1.3 XY	
38		.9	.3	1.2 XY	29.2

DONALD C. COOK
UNIT #2
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BY: CMA DATE: 7-13-83
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STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
40	0	.4	.4	.8 XY	29.2
42		.3	.5	.8 XY	
44		.9	.4	1.3 YZ	
46		1.3	.3	1.6 XY	
48		.6	.5	1.1 YZ	
49		.6	.4	1.0 YZ	
50		.6	.3	.9 XY	
51		.4	.5	.9 XY	
52		.4	.3	.7 XY	
54		.2	.3	.5 YZ	
56		.4	.2	.6 YZ	
58		.6	.4	1.0 XY	
60		.3	.2	.5 XY	
62		.6	.4	1.0 XY	
64		.4	.4	.8 XY	
66		.3	.3	.6 XY	
68		.3	.4	.7 XY	
70		.2	.5	.7 YZ	
71		.3	.7	1.0 YZ	
72R		.4	1.2	1.6 YZ	26.6

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TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
72R	0	.6	1.3	1.9 YZ	26.6
73		.4	.9	1.3 YZ	
126R		.6	1.2	1.8 YZ	
126R		.6	1.4	2.0 YZ	
127		.4	.8	1.2 YZ	
176R		.3	.8	1.1 YZ	
176R		.2	.6	.8 YZ	
219		.4	1.8	2.2 YZ	
222		1.5	4.4	5.9 YZ	27.1
224		2.9	3.2	6.1 YZ	
226		2.6	3.9	6.5 YZ	
228		1.3	3.0	4.3 YZ	26.8
230R		.9	3.8	4.7 YZ	
230R		1.6	1.8	3.4 YZ	
232		3.0	3.6	6.6 YZ	
234		2.9	3.6	6.5 YZ	
236		2.0	3.4	5.4 YZ	
238		1.3	6.3	7.6 XY	26.0
240R		1.1	6.9	8.0 XY	25.2
240R		1.3	4.4	5.7 YZ	25.2

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
242	0	2.0	5.4	7.4 YZ	25.2
244		1.6	4.0	5.6 YZ	25.2
246		1.2	4.1	5.3 YZ	24.8
248		1.1	6.0	7.1 YZ	
250		1.5	7.9	9.4 YZ	
252		1.8	11.4	13.2 YZ	
258		1.7	12.7	14.4 YZ	
259		1.5	11.3	12.8 YZ	23.9
257		2.6	15.1	17.7 YZ	
260		1.3	11.6	12.9 YZ	
262		2.9	8.2	11.1 YZ	
266	2.9	3.0	3.1	9.0 YZ	25.7
268		3.6	3.7	10.2 YZ	
272		3.5	4.6	11.0 YZ	
274		2.7	4.2	9.8 YZ	
276		3.1	4.1	10.1 YZ	
278		3.4	4.3	10.6 YZ	
279		3.4	4.3	10.6 YZ	
280		2.2	6.9	12.0 YZ	
282		1.6	7.5	12.0 YZ	

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
284B	2.9	.9	10.0	13.8 YZ	25.7
72B	0	2.0	1.9	3.9 XY	26.6
74		1.0	1.2	2.2 XY	
76		.6	.8	1.4 XY	
78		.3	.7	1.0 XY	
80		.3	.4	.7 XY	
82		.4	.6	1.0 YZ	
84		.4	1.0	1.4 YZ	
86		.3	1.1	1.4 YZ	
88		1.2	2.2	3.4 YZ	
90		1.5	2.4	3.9 YZ	
92		.9	1.5	2.4 YZ	
97		1.0	1.7	2.7 YZ	
94		1.2	2.2	3.4 YZ	
100		.3	2.3	2.6 YZ	
96		.5	4.1	4.6 YZ	
98		.8	4.2	5.0 YZ	26.4
103		.5	2.5	3.0 YZ	21.1
107	3.5	.7	.7	4.9 XY	20.6
108	3.5	.8	3.8	8.1 YZ	28.8

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: SMS DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
110	3.5	.6	4.4	8.5 YZ	28.8
111		.6	4.4	8.5 YZ	
112		.6	4.4	8.5 YZ	
114		.3	3.9	7.7 YZ	
116		.3	2.4	6.2 YZ	
118		.6	2.0	6.1 YZ	
120		.7	2.0	6.2 YZ	
122		1.0	2.2	6.7 XY	
124		1.0	2.2	6.7 XY	
126B	0	.7	1.7	2.4 XY	26.6
128		.4	.7	1.1 XY	
130		.4	.5	.9 YZ	
132		.4	.7	1.1 XY	
134		.2	1.2	1.4 XY	
136		.2	1.8	2.0 XY	
138		1.0	3.4	4.4 XY	
140		1.4	3.6	5.0 XY	
142		.8	2.2	3.0 XY	
143		.9	2.2	3.1 XY	
144		1.1	2.3	3.4 XY	

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
145	0	.3	2.4	2.7 XY	26.6
146		.6	5.6	6.2 XY	26.6
148		1.0	5.7	6.7 XY	26.4
152		.5	2.6	3.1 XY	21.1
156	3.5	.8	.8	5.1 YZ	20.6
158		.9	4.2	8.6 XY	28.8
160		.7	5.0	9.2 XY	
161		.7	5.0	9.2 XY	
162		.7	5.0	9.2 XY	
164		.5	4.4	8.4 XY	
166		.5	2.7	6.7 XY	
168		.8	2.0	6.3 XY	
170		.9	2.1	6.5 YZ	
172		1.2	2.5	7.2 YZ	
174		1.2	2.5	7.2 YZ	
176B	0	.7	1.2	1.9 YZ	26.6
178		.6	.7	1.3 YZ	
180		.3	1.4	1.7 YZ	
182		.3	2.2	2.5 YZ	
184		.9	4.2	5.1 YZ	

TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
186	0	1.3	4.3	5.6 YZ	26.6
187		.9	2.1	3.0 YZ	
188		1.0	1.9	2.9 YZ	
192		.3	1.8	2.1 YZ	
190		.5	3.2	3.7 YZ	
195		1.0	3.1	4.1 YZ	26.4
196		.6	1.9	2.5 YZ	21.1
200	3.5	.8	.8	5.1 XY	20.6
202		.9	3.8	8.2 YZ	28.8
204		.6	4.4	8.5 YZ	
205		.6	4.4	8.5 YZ	
206		.6	4.4	8.5 YZ	
208		.3	3.9	7.7 YZ	
210		.3	2.4	6.2 YZ	
212		.7	1.9	6.1 YZ	
214		.8	2.0	6.3 XY	
216		1.1	2.3	6.9 XY	
218		1.1	2.3	6.9 XY	
230B	0	3.2	15.0	18.2 YZ	26.6
286	0	6.4	10.1	16.5 YZ	25.8

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TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA/PDH DATE: 7-15-83
CHECKED BY: SmS DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
288	0	6.7	9.2	15.9 YZ	25.8
290	0	3.6	7.5	11.1 YZ	25.3
292	0	3.9	8.3	12.2 YZ	25.7
296	2.9	2.1	6.3	11.3 YZ	
298		1.4	5.6	9.9 YZ	
302		1.8	6.3	11.0 YZ	
304		2.5	6.1	11.5 YZ	
306		2.0	6.1	11.0 YZ	
308		1.7	6.4	11.0 YZ	
310		1.3	6.2	10.4 YZ	
312		3.2	5.3	11.4 YZ	
314		.9	4.2	8.0 YZ	
316		1.1	4.1	8.1 YZ	
318	4.1	5.6	3.3	13.0 XY	
320R		4.3	2.4	10.8 XY	28.8
320R		3.1	2.4	9.6 YZ	
322		3.3	2.6	10.0 YZ	
324		3.1	2.5	9.7 YZ	
325		3.1	2.5	9.7 YZ	
326		2.7	2.9	9.7 YZ	

TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
328	4.1	2.5	2.7	9.3 YZ	28.8
330		2.4	2.5	9.1 YZ	
332		2.6	3.3	10.0 YZ	
334	3.5	.8	1.0	5.3 YZ	
336		.7	1.1	5.3 YZ	
284R		.7	.9	5.1 YZ	
284R		.6	1.3	5.4 YZ	
338		.4	1.3	5.2 YZ	
339		.6	1.7	5.8 YZ	
340		.7	1.8	6.0 YZ	
342		.8	1.7	6.0 YZ	
240B	0	1.3	11.8	13.1 XY	25.2
241		1.3	9.1	10.4 XY	
402		3.5	7.0	10.5 XY	
404		4.7	9.2	13.9 XY	24.8
344		3.5	8.1	11.6 XY	24.8
346		.9	6.9	7.8 XY	25.7
350	2.9	.7	5.4	9.0 XY	
352		.9	4.7	8.5 XY	
356		.4	5.3	8.6 XY	

TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CMA DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	DBE STRESS (KSI)	EQUATION C1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
320B	2.9	3.1	7.0	13.0 XY	28.8

6.1.2 Equation C-2 Stresses

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-13-83
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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
2	.4	0	1.3	1.7	29.5
4	1.5	.3	7.6	9.4	
6		.4	3.4	5.3	
7		.2	1.7	3.4	
8		.3	1.3	3.1	
10		.7	3.2	5.4	
12		1.0	3.6	6.1	
14		.5	3.0	5.0	
16		.6	3.9	6.0	
18		1.1	7.8	10.4	
20		1.5	7.6	10.6	
21		.8	4.2	6.5	
24		.8	4.2	6.5	
26	1.9	.8	7.2	9.9	29.3
28		.9	5.6	8.4	
32		.5	3.0	5.4	
33		.9	6.0	8.8	
34		1.0	5.0	7.9	
36		1.0	5.0	7.9	
38	2.2	.9	6.0	9.1	29.2

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: LMB DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
40	2.2	.4	7.0	9.6	29.2
42		.3	6.8	9.3	
44		.9	6.0	9.1	
46		1.3	4.8	8.3	
48		.6	5.2	8.0	
49		.6	4.6	7.4	
50		.6	4.6	7.4	
51		.4	6.1	8.7	
52	2.5	.4	4.8	7.7	
54		.2	2.2	4.9	
56		.4	3.4	6.3	
58		.6	6.0	9.1	
60		.3	3.0	5.8	
62		.6	6.0	9.1	
64		.4	4.0	6.9	
66		.3	3.4	6.2	
68		.3	5.8	8.6	
70		.2	3.6	6.3	
71		.3	3.1	5.9	
72R	2.7	.4	5.3	8.4	26.6

TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
72R	2.7	.6	5.4	8.7	26.6
73		.4	4.0	7.1	
126R		.6	5.7	9.0	
126R		.6	6.5	9.8	
127		.4	6.4	9.5	
176R		.3	3.9	6.9	
176R		.2	3.6	6.5	
219		.4	11.2	14.3	
222	2.0	1.5	7.3	10.8	27.1
224		2.9	8.0	12.9	
226		2.6	5.0	9.6	
228		1.3	5.4	8.7	26.8
230R		.9	6.5	9.4	
230R		1.6	3.1	6.7	
232		3.0	5.6	10.6	
234	1.5	2.9	5.5	9.9	
236	1.5	2.0	4.0	7.5	
238	4.5	1.3	5.4	11.2	26.0
240R	1.8	1.1	6.0	8.9	25.2
240R	1.8	1.3	4.1	7.2	25.2

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DATE: 7-13-83
CHECKED BY: DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
242	1.8	2.0	5.9	9.7	25.2
244	1.5	1.6	3.5	6.6	25.2
246		1.2	2.0	4.7	24.8
248		1.1	2.3	4.9	
250		1.5	3.0	6.0	
252		1.8	1.4	4.7	
258		1.7	3.0	6.2	
259		1.5	2.5	5.5	23.9
257		2.6	3.3	7.4	
260		1.3	3.1	5.9	
262		2.9	4.3	8.7	
266	2.9	3.0	3.0	8.9	25.7
268		3.6	2.9	9.4	
272		3.5	1.7	8.1	
274		2.7	1.2	6.8	
276		3.1	1.0	7.0	
278		3.4	.8	7.1	
279		3.4	.8	7.1	
280		2.2	1.4	6.5	
282		1.6	1.3	5.8	

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 7-13-83
CHECKED BY: [illegible] DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
284B	2.9	.9	3.3	7.1	25.7
72B	2.0	2.0	6.3	10.3	26.6
74		1.0	5.6	8.6	
76		.6	3.4	6.0	
78		.3	8.5	10.8	
80		.3	3.8	6.1	
82		.4	4.7	7.1	
84	2.1	.4	3.2	5.7	
86		.3	3.5	5.9	
88		1.2	3.1	6.4	
90		1.5	3.6	7.2	
92		.9	2.2	5.2	
97		1.0	4.1	7.2	
94		1.2	2.2	5.5	
100		.3	2.2	4.6	
96		.5	4.6	7.2	
98	2.5	.8	4.1	7.4	26.4
103	2.5	.5	2.5	5.5	21.1
107	4.1	.7	2.9	7.7	20.6
108	4.1	.8	2.0	6.9	28.8

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TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: AMB DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
110	4.1	.6	2.1	6.8	28.8
111		.6	2.1	6.8	
112		.6	2.1	6.8	
114		.3	1.8	6.2	
116		.3	2.1	6.5	
118		.6	2.5	7.2	
120		.7	2.6	7.4	
122		1.0	3.1	8.2	
124		1.0	3.1	8.2	
126B	2.1	.7	10.0	12.8	26.6
128	2.0	.4	4.7	7.1	
130		.4	3.2	5.6	
132		.4	2.6	5.0	
134		.2	3.0	5.2	
136		.2	1.8	4.0	
138	2.1	1.0	4.8	7.9	
140		1.4	6.8	10.3	
142		.8	4.1	7.0	
143		.9	2.4	5.4	
144		1.1	1.4	4.6	

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 7-13-83
CHECKED BY: [illegible] DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
145	2.1	.3	2.2	4.6	26.6
146	2.1	.6	3.3	6.0	26.6
148	2.5	1.0	3.1	6.6	26.4
152	2.5	.5	1.5	4.5	21.1
156	4.1	.8	2.3	7.2	20.6
158		.9	2.0	7.0	28.8
160		.7	1.6	6.4	
161		.7	1.6	6.4	
162		.7	1.6	6.4	
164		.5	1.2	5.8	
166		.5	1.7	6.3	
168		.8	2.8	7.7	
170		.9	3.0	8.0	
172		1.2	3.5	8.8	
174		1.2	3.5	8.8	
176B	2.1	.7	6.2	9.0	26.6
178	2.0	.6	3.0	5.6	
180		.3	4.6	6.9	
182		.3	1.4	3.7	
184	2.0	.9	1.7	4.6	

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-13-83
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STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
186	2.0	1.3	2.6	5.9	26.6
187		.9	2.3	5.2	
188		1.0	1.8	4.8	
192		.3	3.4	5.7	
190		.5	4.6	7.1	
195	2.5	1.0	3.7	7.2	26.4
196	2.5	.6	2.3	5.4	21.1
200	4.1	.8	2.8	7.7	20.6
202		.9	2.3	7.3	28.8
204		.6	1.8	6.5	
205		.6	1.8	6.5	
206		.6	1.8	6.5	
208		.3	1.3	5.7	
210		.3	2.1	6.5	
212		.7	2.8	7.6	
214		.8	3.1	8.0	
216		1.1	3.9	9.1	
218		1.1	3.9	9.1	
230B	1.4	3.2	12.7	17.3	26.6
286	5.1	6.4	8.8	20.3	25.8

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TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: AMB DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
288	5.1	6.7	7.8	19.6	25.8
290	1.5	3.6	6.4	11.5	25.3
292	7.4	3.9	7.3	18.6	25.7
296	2.9	2.1	6.9	11.9	
298		1.4	7.0	11.3	
302		1.8	6.5	11.2	
304		2.5	5.9	11.3	
306		2.0	4.8	9.7	
308		1.7	4.0	8.6	
310		1.3	3.9	8.1	
312		3.2	4.1	10.2	
314		.9	2.7	6.5	
316		1.1	2.5	6.5	
318	4.1	5.6	2.6	12.3	
320R		4.3	2.3	10.7	28.8
320R		3.1	1.9	9.1	
322		3.3	1.8	9.2	
324		3.1	1.7	8.9	
325		3.1	1.7	8.9	
326		2.7	2.1	8.9	

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
328	4.1	2.5	2.1	8.7	28.8
330		2.4	2.0	8.5	
332		2.6	2.5	9.2	
334	3.5	.8	.8	5.1	
336		.7	1.0	5.2	
284R		.7	.9	5.1	
284R		.6	1.0	5.1	
338		.4	.8	4.7	
339		.6	1.2	5.3	
340		.7	1.4	5.6	
342		.8	1.4	5.7	
240B	1.5	1.3	6.7	9.5	25.2
241		1.3	3.1	5.9	
402		3.5	2.9	7.9	
404		4.7	3.8	10.0	24.8
344		3.5	4.7	9.7	24.8
346	7.4	.9	3.4	11.7	25.7
350	2.9	.7	6.7	10.3	
352		.9	6.2	10.0	
356		.4	4.8	8.1	

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-13-83
CHECKED BY: Smd DATE: 7/15/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
320B	2.9	3.1	4.3	10.3	28.8

6.1.3 Equation C-3 Stresses

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DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-13-83
CHECKED BY: CMA DATE: 7-14-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
2	.3	27.5
4	2.9	
6	2.2	
7	.8	
8	.6	
10	1.3	
12	.5	
14	.4	
16	.9	
18	2.4	
20	1.0	
21	.4	
24	.4	
26	2.4	
28	2.6	
32	.9	
33	2.5	
34	3.3	
36	3.7	
38	3.6	

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMB DATE: 7-13-83
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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
40	1.4	27.5
42	1.2	
44	1.5	
46	1.8	
48	1.2	
49	1.2	
50	1.2	
51	.9	
52	1.9	
54	1.8	
56	1.7	
58	1.6	
60	.6	
62	1.6	
64	1.8	
66	2.1	
68	2.3	
70	1.5	
71	2.3	
72R	5.1	27.1

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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
72R	4.7	27.1
73	2.1	
126R	3.3	
126R	2.8	
127	1.3	
176R	1.6	
176R	2.4	
219	2.9	
222	22.0	27.2
224	8.3	
226	13.6	
228	5.7	
230R	8.4	
230R	7.7	
232	10.8	
234	10.6	
236	6.5	
238	14.1	27.0
240R	14.8	26.9
240R	14.7	26.9

DONALD C. COOK
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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
242	12.6	26.9
244	3.8	
246	11.5	
248	9.9	
250	17.7	
252	8.8	
258	6.8	
259	6.6	26.8
257	11.8	
260	10.8	
262	5.7	
266	3.3	27.0
268	4.1	
272	5.0	
274	5.9	
276	6.3	
278	6.4	
279	6.3	
280	4.1	
282	3.4	

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BY: [illegible] DATE: 7-13-83
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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
284 B	2.8	27.0
72 B	6.8	27.1
74	2.7	
76	7.0	
78	8.9	
80	7.9	
82	3.5	
84	3.8	
86	2.8	
88	5.1	
90	4.3	
92	1.9	
97	1.9	
94	3.0	
100	3.1	
96	7.1	
98	7.7	
103	3.4	26.4
107	1.4	26.3
108	.9	27.4

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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
110	.9	27.4
111	.8	
112	.9	
114	1.0	
116	1.3	
118	1.5	
120	1.5	
122	1.5	
124	1.4	
126B	2.6	27.1
128	1.7	
130	1.6	
132	1.4	
134	1.0	
136	.5	
138	.7	
140	.6	
142	.2	
143	.4	
144	.8	

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-13-83
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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
145	1.0	27.1
146	2.9	
148	3.1	
152	1.1	26.4
156	.4	26.4
158	.3	27.4
160	.3	
161	.3	
162	.3	
164	.4	
166	.4	
168	.4	
170	.3	
172	.3	
174	.2	
176B	4.4	27.1
178	2.3	
180	1.9	
182	1.6	
184	3.3	

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 7-13-83
CHECKED BY: [illegible] DATE: 7/15/83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
186	2.3	27.1
187	.7	
188	1.8	
192	1.9	
190	4.3	
195	5.2	
196	2.3	26.4
200	.8	26.3
202	.1	27.4
204	.3	
205	.2	
206	.3	
208	.4	
210	.6	
212	.7	
214	.7	
216	.7	
218	.6	
230B	3.5	27.1
286	3.3	27.0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 7-13-83
CHECKED BY: DMD DATE: 7/15/83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
288	3.0	27.0
290	1.6	
292	1.6	
296	.9	
298	.9	
302	.8	
304	.8	
306	.8	
308	.8	
310	.8	
312	1.1	
314	1.2	
316	1.4	
318	1.6	
320R	1.0	27.4
320R	2.8	
322	2.0	
324	3.6	
325	3.0	
326	5.0	

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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
328	5.0	27.4
330	4.5	
332	5.2	
334	1.7	
336	2.2	
284 R	2.1	
284 R	2.1	
338	4.0	
339	5.4	
340	5.8	
342	5.3	
240B	17.0	26.9
241	1.9	
402	5.0	
404	9.0	
344	16.2	
346	8.3	27.0
350	3.9	
352	3.0	
356	2.7	

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UNIT #2
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STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
320B.	3.7	27.4

6.2 Support Loads

Support loads are given for each support on the pressurizer relief line piping. Support load combinations were calculated in accordance with Table II of Reference 1. Thermal-1 refers to the normal thermal operating case, thermal-2 refers to the PORV transient thermal condition, and thermal-3 refers to the SV transient thermal loading.

The support load combinations considered are as follows:

D1 deadweight + normal thermal +/- OBE

D2 deadweight + PORV transient thermal +/- $\left[(\mathrm{OBE})^2 + (\mathrm{PORV\ transient\ shock})^2\right]^{1/2}$

E1 deadweight + normal thermal +/- DBE

E2 deadweight + SV transient thermal +/- SV transient shock

The results of the support load combinations indicate that the following supports exceed the load given on the support drawing. Review of these supports to ensure acceptability falls outside of the TES work scope and is, therefore, the responsibility of others.

2-GRC-R-585	2-GRC-R-586
2-GRC-S-609	2-GRC-R-607
2-GRC-S-587	2-GRC-S-611
2-GRC-R-589	2-GRC-R-612
2-GRC-R-591	2-GRC-R-614
2-GRC-S-594	2-GRC-S-624
2-GRC-S-596	2-GRC-S-626
2-GRC-S-598	2-GRC-S-629
2-GRC-S-599	2-GRC-S-630
2-GRC-R-600	2-GRC-S-631
2-GRC-R-601	2-GRC-S-632
2-GRC-R-605	2-GRC-R-633

The support loads given are taken from the TMRSAP computer analysis. The support loads given act on the support. The following explanation details the procedure followed in extracting these support loads.

Four different methods of modeling supports were used in the analysis presented in this report. Constant force supports were modeled using a **FORCE** card. Supports in a global coordinate direction were modeled using a **RESTRAINT** card for deadweight, thermal and seismic analyses and were modeled with a **SPRING** card for force/time history analysis. For any supports not oriented in a global coordinate direction a **FLEX** card was used to represent the support, regardless of the type of analysis being executed. Because of the various methods used, slightly different procedures are used to extract the support loads. In general, there are two tables in the TMRSAP output which are used to obtain support loads: the "Boundary Element Forces/Moments" table and the "Pipe Forces/Moments/Displacements/Member Global Directions" table. The former table is used for supports modeled using **FLEX** or **SPRING** cards and the latter for supports modeled using a **FORCE** or **RESTRAINT** card.

In the "Boundary Element Forces/Moments" table (see Figure 6.2-1), support loads can be extracted directly and are given in pounds in the direction indicated by the **SPRING** or **FLEX** card. The supports in this table are referenced only by the "element number" and, therefore, the "Boundary Elements" table (see Figure 6.2-2) must be used to determine which element number corresponds to which support.

The "Pipe Forces/Moments/Displacements/Member Global Direction" table (see Figure 6.2-3) gives the global forces on the x, y, and z directions for each TMR node number. Note that the SAP node number is internally generated by the program and does not correspond to the node number input. To show equilibrium between the "j" and "i" ends of a node, the force at the "i" end of the node is subtracted from the force at the "j" end of the node. The only exception to this procedure is when a **RESTRAINT** card is used. the **RESTRAINT** card instructs the program to change the sign at the "i" end of the node and to generate a reaction on the pipe at that node. Therefore, the support load is obtained by adding the "j" and "i" forces together and then flipping the sign in order to generate the reaction on the support, instead of the reaction on the pipe.

The following list gives all of the possible combinations of analysis type, support type and support orientation encountered on TES Project 5364 and refers to the appropriate detailed explanation which follows.

	Analysis Type	Support Type	Support Orientation	Modeling	Explanation
1.	deadweight	constant force	global	FORCE	A
2.	deadweight	rigid	global	RESTRAINT	B
3.	deadweight	rigid	skewed	FLEX	C
4.	thermal	rigid	global	RESTRAINT	B
5.	thermal	rigid	skewed	FLEX	C
6.	seismic	rigid	global	RESTRAINT	D
7.	seismic	rigid	skewed	FLEX	E
8.	seismic	snubber	global	RESTRAINT	D
9.	seismic	snubber	skewed	FLEX	E
10.	f/t history	rigid	global	SPRING	F
11.	f/t history	rigid	skewed	FLEX	F
12.	f/t history	snubber	global	SPRING	F
13.	f/t history	snubber	skewed	FLEX	F

A The load for a constant force support modeled with a FORCE card is obtained by subtracting the force at the "i" end of the appropriate node from the force at the "j" end in the "Pipe Forces/Moments/Displacements/Member Global Directions" table. The resulting sign and magnitude indicates the force on the pipe and should agree with the value entered on the FORCE card. To determine the load on the support, the sign obtained from the TMRSAP output should be flipped.

B In deadweight and thermal analyses, rigid supports orientated in a global coordinate direction were modeled using a RESTRAINT card. The support load for this case is obtained by adding the x, y, or z forces at the "i" and "j" ends of the appropriate node. The resulting sign must then be flipped to obtain the reaction on the support, as opposed to the reaction on the pipe.

C Skewed supports modeled with FLEX cards in deadweight and thermal analyses require a two step process in determining the support load. The FLEX card generates a boundary element and the first step is to determine which boundary element number corresponds to which support. This can be done by looking in the "Boundary Elements" table which lists the boundary element number and the node at which that element is modeled. Once the boundary element number has been determined, then the "Boundary Element Forces/Moments" table is used to extract the support load. The load from this table acts along the direction of the support as input by the analyst. This axial (relative to the support) force can then be broken down into the appropriate global components.

An alternative method would be to follow the procedure outlined in B above to determine the force in each appropriate component direction.

D The procedure for global rigid and snubber supports in seismic analysis is similar to procedure B. One difference is that seismic output has no signs since it is assumed that all forces can act + or -. Therefore, rather than flipping the sign of the support load obtained a +/- is applied.

Procedure D is followed for the x, y, and z shock directions and then the x and y loads are combined by the SRSS method as are the loads for the y and z shock directions. The greater value is then listed on the support load summary sheet.

E Skewed supports in seismic are the same as skewed supports in deadweight and thermal except that again the boundary element force extracted must be considered +/-. Since no signs are carried in the TMRSAP output of a seismic analysis, it is not recommended to use the alternative method given under C when extracting support loads from a seismic run.

F In a force/time history analysis, no RESTRAINT cards are used; FLEX cards are used to represent skewed supports and SPRING cards are used to represent global supports. Both of these techniques generate boundary elements and therefore, the procedure is essentially the same as that described in C above. The only difference is that the "Boundary Element Forces/Moments" table does not list a single value but rather a table of times and forces (see Figure 6.2-4). At the end of this table, the maximum absolute positive and negative values are given. The maximum absolute value is conservatively used with a +/- applied.

Figure 6.2-1

B O U N D A R Y   E L E M E N T   F O R C E S / M O M E N T S

ELEMENT NUMBER	LOAD CASE	FORCE	MOMENT
1	1	-0.24511E+05	[illegible]
2	1	0.22004E+04	0.00000E+00
3	1	0.38934E+04	[illegible]

53 0 0 0 0 0 0

BOUNDARY ELEMENTS

ELEMENT TYPE = 7
NUMBER OF ELEMENTS = 7

ELEMENT LOAD CASE MULTIPLIERS

CASE(A)	CASE(B)	CASE(C)	CASE(D)
1.0000	0.0000	0.0000	0.0000

ELEM. NO.	NODE (N) SAP	NODE (N) TMR	NODES DEFINING CONSTRAINT DIRECTION (NI) SAP	(NI) TMR	(NJ) SAP	(NJ) TMR	(NK) SAP	(NK) TMR	(NL) SAP	(NL) TMR	CODE KD	CODE KR	GENERATION CODE (KN)	SPECIFIED DISPLACEMENT	SPECIFIED ROTATION	SPRING RATE
1	31	250	47	411	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
2	32	260	48	412	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
3	20	300	49	413	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
4	20	300	50	414	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
5	16	360	51	415	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
6	4	390	52	416	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08
7	4	390	53	417	0	0	0	0	0	0	1	0	0	0.0000E+00	0.0000E+00	0.1000E+08

Figure 6.2-2

PIPE [illegible]CES/MOMENTS/DISPLACEMENTS/[illegible]MBER GLOBAL DIRECTIONS
(MAXIMUM ABSOLUTE VALUES)

ELEM. NO.	ELEM. TYPE	STATION	NODE SAP	NODE THR	FX	FY	FZ	MX	MY	MZ	DX	DY	DZ
18	TANGENT	END-I	34	256	22.	1.	100.	25.	435.	45.	0.4501	0.0165	0.0013
		END-J	32	260	22.	1.	100.	44.	680.	45.	0.6616	0.0000	0.0014
19	TANGENT	END-I	32	260	16.	4.	100.	44.	680.	45.	0.6616	0.0000	0.0014
		END-J	30	265	16.	4.	100.	33.	956.	45.	0.6765	0.0261	0.0016
20	BEND	END-I	30	265	16.	3.	100.	33.	956.	45.	0.6765	0.0261	0.0016
		END-J	28	270	100.	3.	16.	44.	699.	44.	0.6475	0.0380	0.0599
21	TANGENT	END-I	28	270	16.	3.	99.	44.	699.	44.	0.6475	0.0380	0.0599
		END-J	26	275	16.	3.	99.	44.	552.	43.	0.6475	0.0596	0.2268
22	BEND	END-I	26	275	13.	2.	97.	44.	552.	43.	0.6475	0.0596	0.2268
		END-J	24	280	97.	2.	13.	46.	668.	47.	0.6318	0.0630	0.2477
23	TANGENT	END-I	24	280	13.	2.	95.	47.	668.	46.	0.6318	0.0630	0.2477
		END-J	23	282	13.	2.	95.	54.	542.	46.	0.4360	0.0626	0.2479
24	TANGENT	END-I	23	282	12.	1.	91.	54.	542.	46.	0.4360	0.0626	0.2479
		END-J	22	284	12.	1.	91.	54.	473.	46.	0.2867	0.0466	0.2480
25	TANGENT	END-I	22	284	14.	2.	88.	54.	473.	46.	0.2867	0.0466	0.2480
		END-J	21	286	14.	2.	88.	39.	264.	46.	0.1775	0.0271	0.2481
26	TANGENT	END-I	21	286	21.	3.	84.	39.	264.	46.	0.1775	0.0271	0.2481
		END-J	20	300	21.	3.	84.	90.	450.	46.	0.0000	0.0000	0.2482
27	TANGENT	END-I	20	300	20.	4.	62.	90.	450.	46.	0.0000	0.0000	0.2482
		END-J	19	302	20.	4.	62.	43.	235.	46.	0.1939	0.0211	0.2483
28	TANGENT	END-I	19	302	14.	3.	81.	43.	235.	46.	0.1939	0.0211	0.2483
		END-J	18	304	14.	3.	81.	63.	489.	46.	0.3502	0.0327	0.2484
29	TANGENT	END-I	18	304	6.	2.	82.	63.	489.	46.	0.3502	0.0327	0.2484
		END-J	17	306	6.	2.	82.	92.	538.	46.	0.4062	0.0298	0.2485
30	TANGENT	END-I	17	306	8.	3.	85.	92.	538.	46.	0.4062	0.0298	0.2485
		END-J	16	360	8.	3.	85.	103.	376.	46.	0.3323	0.0000	0.2485
31	TANGENT	END-I	16	360	14.	19.	89.	103.	376.	46.	0.3323	0.0000	0.2485
		END-J	15	362	14.	19.	89.	277.	104.	46.	0.2988	0.0415	0.2486
32	TANGENT	END-I	15	362	11.	18.	92.	277.	104.	46.	0.2988	0.0415	0.2486
		END-J	14	365	11.	18.	92.	568.	82.	46.	0.5053	0.0152	0.2486
33	BEND	END-I	14	365	6.	17.	28.	568.	82.	46.	0.5053	0.0152	0.2486
		END-J	13	370	6.	26.	17.	538.	62.	100.	0.5114	0.0083	0.2459
34	TANGENT	END-I	13	370	6.	17.	27.	538.	100.	62.	0.5114	0.0083	0.2459
		END-J	12	372	6.	17.	27.	140.	100.	106.	0.3314	0.0083	0.2778

Figure 6.2-3

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Figure 6.2-4

T I M E H I S T O R Y R E S P O N S E

ELEMENT TYPE (B O U N D A R Y) / / / OUTPUT SET = 1

ELEMENT NUMBER - (*STRESS COMPONENT*) RMS-MOMEN

TIME	1-BDRY-F	1-BDRY-M	2-BDRY-F	2-BDRY-M	3-BDRY-F	3-BDRY-M
0.00400	1.811E-04	0.000E+00	-9.004E-06	0.000E+00	8.244E-04	0.000E+00
0.00800	1.110E-03	0.000E+00	-1.193E-04	0.000E+00	1.069E-02	0.000E+00
0.01200	-1.072E-01	0.000E+00	-4.511E-04	0.000E+00	4.126E-02	0.000E+00
0.01600	-3.488E-01	0.000E+00	3.053E-02	0.000E+00	3.861E-02	0.000E+00
0.02000	1.800E-01	0.000E+00	1.596E-01	0.000E+00	-8.165E-02	0.000E+00
0.02400	-7.732E-02	0.000E+00	1.823E-01	0.000E+00	-2.535E-01	0.000E+00
0.02800	1.728E-01	0.000E+00	6.121E-02	0.000E+00	-3.761E-01	0.000E+00
0.03200	1.888E-02	0.000E+00	-4.704E-02	0.000E+00	-4.345E-01	0.000E+00
0.03600	8.303E-02	0.000E+00	-6.699E-02	0.000E+00	-4.068E-01	0.000E+00
0.04000	-1.794E-01	0.000E+00	-3.910E-02	0.000E+00	-2.864E-01	0.000E+00
0.04400	2.759E-01	0.000E+00	6.603E-03	0.000E+00	-1.039E-01	0.000E+00
0.04800	2.457E-02	0.000E+00	-5.933E-02	0.000E+00	9.523E-02	0.000E+00
0.05200	7.131E-03	0.000E+00	-1.880E-01	0.000E+00	2.276E-01	0.000E+00
0.05600	1.515E-01	0.000E+00	-1.719E-01	0.000E+00	2.817E-01	0.000E+00
0.06000	-1.835E-01	0.000E+00	-6.527E-02	0.000E+00	3.237E-01	0.000E+00
0.06400	-1.508E-02	0.000E+00	4.264E-02	0.000E+00	4.100E-01	0.000E+00
0.06800	1.658E-02	0.000E+00	1.185E-01	0.000E+00	5.146E-01	0.000E+00
0.07200	-7.581E-02	0.000E+00	1.042E-01	0.000E+00	5.542E-01	0.000E+00
0.07600	1.043E-01	0.000E+00	4.836E-02	0.000E+00	5.423E-01	0.000E+00
[illegible]	-4.064E-02	0.000E+00	-1.728E-02	0.000E+00	5.671E-01	0.000E+00
[illegible]	[illegible]	0.000E+00	-6.959E-02	0.000E+00	6.079E-01	0.000E+00
[illegible]	[illegible]	0.000E+00	-5.292E-03	0.000E+00	5.329E-01	0.000E+00
[illegible]	[illegible]	[illegible]	7.707E-02	0.000E+00	2.765E-01	0.000E+00
[illegible]	[illegible]	[illegible]	[illegible]	0.000E+00	-4.502E-02	0.000E+00
0.50400	[illegible]	[illegible]	[illegible]	0.000E+00	-2.737E-01	0.000E+00
0.50800	-1.168E+00	[illegible]	[illegible]	[illegible]	-3.964E-01	0.000E+00
0.51200	-2.605E+00	[illegible]	[illegible]	[illegible]	-4.903E-01	0.000E+00
0.51600	-3.554E+00	0.000E+00	[illegible]	[illegible]	[illegible]	0.000E+00
0.52000	-3.967E+00	0.000E+00	[illegible]	[illegible]	[illegible]	[illegible]
0.52400	-3.900E+00	0.000E+00	2.337E+00	[illegible]	[illegible]	[illegible]
0.52800	-3.543E+00	0.000E+00	2.862E+00	[illegible]	[illegible]	[illegible]
0.53200	-3.090E+00	0.000E+00	2.886E+00	0.000E+00	[illegible]	[illegible]
0.53600	-2.656E+00	0.000E+00	2.284E+00	0.000E+00	2.304E+01	[illegible]
0.54000	-2.227E+00	0.000E+00	1.166E+00	0.000E+00	2.073E+01	[illegible]
0.54400	-1.692E+00	0.000E+00	-1.756E-01	0.000E+00	1.679E+01	0.000E+00
0.54800	-9.205E-01	0.000E+00	-1.390E+00	0.000E+00	1.174E+01	0.000E+00
0.55200	1.430E-01	0.000E+00	-2.213E+00	0.000E+00	6.136E+00	0.000E+00
0.55600	1.426E+00	0.000E+00	-2.556E+00	0.000E+00	4.727E-01	0.000E+00
0.56000	2.740E+00	0.000E+00	-2.511E+00	0.000E+00	-4.841E+00	0.000E+00
0.56400	3.846E+00	0.000E+00	-2.296E+00	0.000E+00	-9.419E+00	0.000E+00
0.56800	4.528E+00	0.000E+00	-2.159E+00	0.000E+00	-1.267E+01	0.000E+00
0.57200	4.609E+00	0.000E+00	-2.265E+00	0.000E+00	-1.461E+01	0.000E+00
0.57600	4.266E+00	0.000E+00	-2.609E+00	0.000E+00	-1.499E+01	0.000E+00
0.58000	3.517E+00	0.000E+00	-3.000E+00	0.000E+00	-1.337E+01	0.000E+00
0.58400	2.506E+00	0.000E+00	-3.149E+00	0.000E+00	-1.015E+01	0.000E+00
0.58800	1.595E+00	0.000E+00	-2.807E+00	0.000E+00	-5.731E+00	0.000E+00
0.59200	7.256E-01	0.000E+00	-1.892E+00	0.000E+00	-5.898E-01	0.000E+00
0.59600	-4.067E-02	0.000E+00	-5.237E-01	0.000E+00	4.776E+00	0.000E+00
0.60000	-7.607E-01	0.000E+00	1.011E+00	0.000E+00	9.925E+00	0.000E+00

MAXIMUM ABSOLUTE VALUES

MAXIMUM	4.847E+00	0.000E+00	4.913E+00	0.000E+00	2.960E+01	0.000E+00
TIME	4.400E-01	0.000E+00	3.480E-01	0.000E+00	4.880E-01	0.000E+00

MAX/MIN VALUES

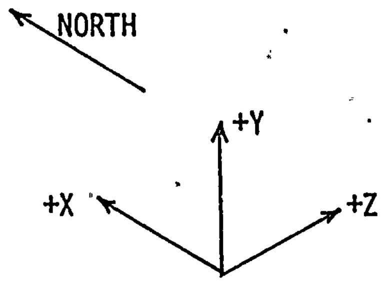
MAXIMUM	4.609E+00	0.000E+00	4.913E+00	0.000E+00	2.329E+01	0.000E+00
TIME	5.720E-01	0.000E+00	3.480E-01	0.000E+00	5.320E-01	0.000E+00
MINIMUM	-4.847E+00	0.000E+00	-3.809E+00	0.000E+00	-2.960E+01	0.000E+00
TIME	4.400E-01	0.000E+00	4.000E-01	0.000E+00	4.880E-01	0.000E+00

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: AWB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-585
NODE NUMBER 16

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEAD WEIGHT-1	—	.019	.001	-20					
THERMAL-1	—	-.161	.027	-1860					
THERMAL-2	—	-.035	-.377	350					
THERMAL-3	—	.015	-.510	+1239					
SEISMIC-OBE	—	±.001	±.001	±202					
SEISMIC-DBE	—	±.002	±.002	±351					
BLOWDOWN-SV	—	+.028 -.031	+.056 -.092	±17820					
BLOWDOWN-PORV	—	±.001	±.002	±377					

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+758 -2082		
EMERGENCY	+19039 -16601		

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	397.		
DESIGN (-)	4132		

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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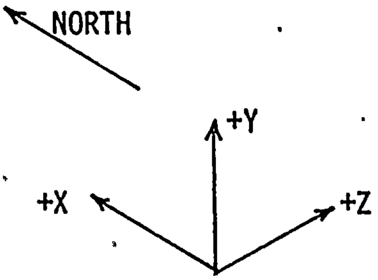
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-14-83
CHECKED BY: DmD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-586
NODE NUMBER 24

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEAD WEIGHT-1	-.003	—	.006		-1170				
THERMAL-1	-.034	—	.067		1700				
THERMAL-2	-.067	—	-.400		241				
THERMAL-3	-.067	—	-.557		-363				
SEISMIC-OBE	±.001	—	±0		±111				
SEISMIC-DBE	±.001	—	±0		±201				
BLOWDOWN-SV	+.036 -.054	—	+.024 -.029		±4425				
BLOWDOWN-PORV	±.002	—	±0		±110				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		+641 -1281	
EMERGENCY		+2892 -5958	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		479	
DESIGN (-)		3890	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 7-14-83
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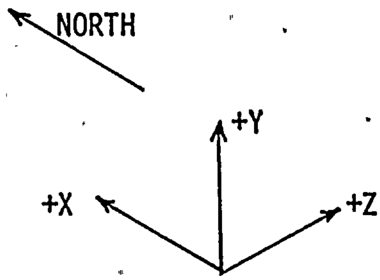
DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-587
NODE NUMBER 32

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.036	-.129	.028						
THERMAL-1	-.226	1.01	.276						
THERMAL-2	-.203	.370	-.330						
THERMAL-3	-.349	.107	-.556						
SEISMIC-OBE	±.004	±0	±.007		±134				
SEISMIC-DBE	±.007	±0	±.011		±237				
BLOWDOWN-SV	+.105 -.131	±0	+.232 -.156		±12460				
BLOWDOWN-PORV	+.007 -.008	±0	+.014 -.012		±257				

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		±290	
EMERGENCY		±12460	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)		1037	
DESIGN (-)		1037	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

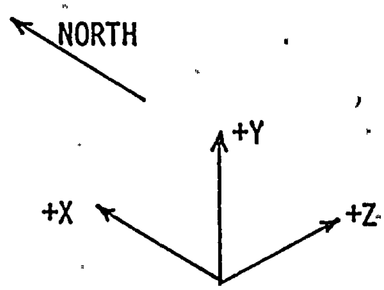
TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: JMB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-589
NODE NUMBER 48

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
[illegible]EIGHT-1	—	.004	—	-30		20			
THERMAL-1	—	2.27	—	1150		-770			
THERMAL-2	—	.985	—	-399		246			
THERMAL-3	—	.454	—	-1009		662			
SEISMIC-OBE	—	±.007	—	±254		±380			
SEISMIC-DBE	—	±.011	—	±427		±662			
BLOWDOWN-SV	—	+.126 -.085	—	±3795		±6636			
BLOWDOWN-PORV	—	+.006 -.005	—	±170		±537			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+1374 -735		+924 -1130
EMERGENCY	+2756 -4834		+7318 -5954

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	3236		4144
DESIGN (-)	615		5682

U[illegible] DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING
EXCEPT FOR + Fx

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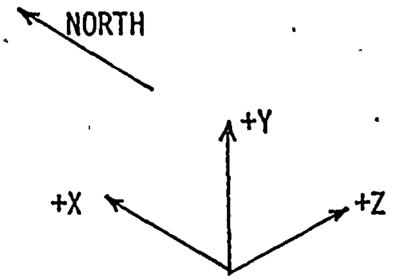
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DWB DATE: 7-14-83
CHECKED BY: DmD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-590
NODE NUMBER 50

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
EIGHT-1	-.001	.004	-.010		-3281				
THERMAL-1	.024	2.27	-.023						
THERMAL-2	.018	1.06	-.017						
THERMAL-3	.017	.555	-.014						
SEISMIC-OBE	±.004	±.011	±.003						
SEISMIC-DBE	±.007	±.004	±.005						
BLOWDOWN-SV	+.040 -.036	+.125 -.085	+.068 -.074						
BLOWDOWN-PORV	±.002	+.006 -.005	+.006 -.007						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-3281	
EMERGENCY		-3281	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		3281	

U
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ______ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

TELEDYNE ENGINEERING SERVICES

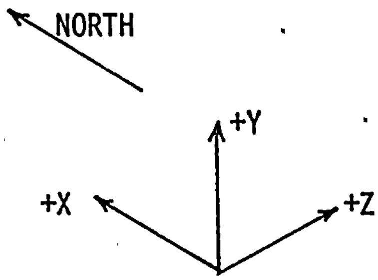
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 7-14-83

CHECKED BY: DMD DATE: 7/15/83

DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-591

NODE NUMBER 60

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	—	-.001	—	30		-70			
THERMAL-1	—	2.31	—	180		-500			
THERMAL-2	—	1.76	—	-219		-211			
THERMAL-3	—	1.53	—	-427		-118			
SEISMIC-OBE	—	±.007	—	±272		±241			
SEISMIC-DBE	—	±.011	—	±447		±417			
BLOWDOWN-SV	—	+.100 -.072	—	±3498		±6075			
BLOWDOWN-PORV	—	+.004 -.005	—	±392		±764			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+482 -666		+522 -1084
EMERGENCY	+3101 -3895		+5887 -6263

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	1566		1044
DESIGN (-)	972		657

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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SUPPORT LOAD SUMMARY SHEET

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UNIT #2
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BY: DMB DATE: 7-14-83
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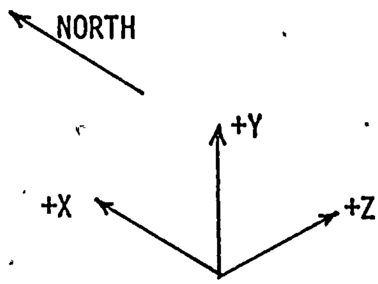
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-592
NODE NUMBER 101

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
D[illegible]EIGHT-1	-.036	.024	-.023						
THERMAL-1	.224	2.82	-.116						
THERMAL-2	.263	2.79	-.152						
THERMAL-3	.292	2.78	-.164						
SEISMIC-OBE	±.101	±0	±.144		±800				
SEISMIC-DBE	±.176	±0	±.250		±1324				
BLOWDOWN-SV	+.074 -.069	±0	+.052 -.086		±3964				
BLOWDOWN-PORV	±.001	±0	±.001		±95				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		±806	
EMERGENCY		±3964	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		5301	
DESIGN (-)		5301	

U[illegible] DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

BY: AWB DATE: 7-14-83
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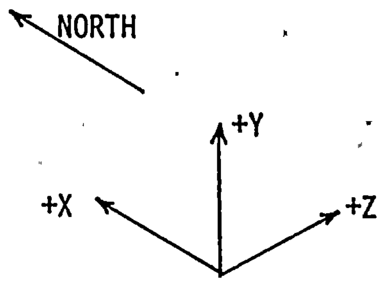
DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-593

NODE NUMBER 99

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	-.035	.038	-.019		-1054				
THERMAL-1	.215	2.80	-.107						
THERMAL-2	.290	2.74	-.161						
THERMAL-3	.340	2.71	-.173						
SEISMIC-OBE	±.104	±.004	±.148						
SEISMIC-DBE	±.182	±.007	±.258						
BLOWDOWN-SV	+.083 -.074	±.021	+.071 -.104						
BLOWDOWN-PORV	±.001	±.001	+.002 -.001						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-1054	
EMERGENCY		-1054	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		1054	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ______ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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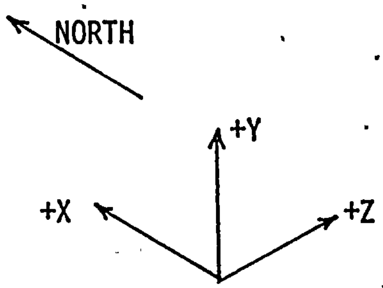
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-14-83
CHECKED BY: Dmd DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-594
NODE NUMBER 149

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.023	.027	-.047						
THERMAL-1	.160	2.81	.166						
THERMAL-2	.206	2.81	.154						
THERMAL-3	.231	2.82	.157						
SEISMIC-OBE	±.192	±0	±.047		±1100				
SEISMIC-DBE	±.332	±0	±.078		±1820				
BLOWDOWN-SV	+.056 -.045	±0	+.058 -.053		±4497				
BLOWDOWN-PORV	±.002	±0	±.002		±142				

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		±1109	
EMERGENCY		±4497	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)		4479	
DESIGN (-)		4479	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE essentially the same as ~~THAN~~ THE LOAD SHOWN ON THE SUPPORT DRAWING

SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 7-14-83
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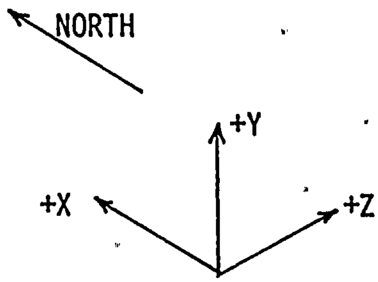
DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-595

NODE NUMBER 147

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.012	.045	-.035		-1072				
THERMAL-1	.135	2.79	.142						
THERMAL-2	.206	2.79	.176						
THERMAL-3	.234	2.78	.207						
SEISMIC-OBE	±.173	±.007	±.040						
SEISMIC-DBE	±.299	±.012	±.068						
BLOWDOWN-SV	+.069 -.054	+.015 -.014	+.053 -.046						
BLOWDOWN-PORV	±.002	±.001	±.002						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-1072	
EMERGENCY		-1072	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		1072	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ________ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

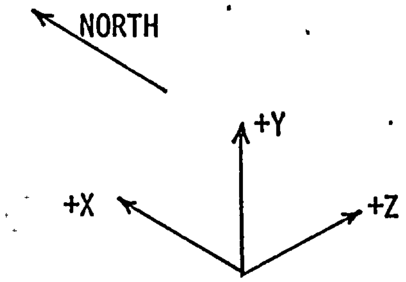
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-14-83
CHECKED BY: DmD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-596
NODE NUMBER 193

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	.045	.024	-.003						
THERMAL-1	-.177	2.76	.187						
THERMAL-2	-.081	2.80	.248						
THERMAL-3	-.040	2.82	.283						
SEISMIC-OBE	±.045	±0	±.167		±997				
SEISMIC-DBE	±.075	±0	±.286		±1646				
BLOWDOWN-SV	+.073 -.063	±0	+.046 -.044		±4853				
BLOWDOWN-PORV	±.001	±0	+.002 -.003		±93				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		±1001	
EMERGENCY		±4853	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		4218	
DESIGN (-)		4218	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

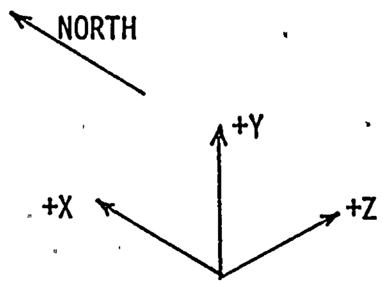
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: AMB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-597
NODE NUMBER 189

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	.041	.044	-.005		-983				
THERMAL-1	-.175	2.72	.145						
THERMAL-2	-.104	2.75	.247						
THERMAL-3	-.084	2.78	.300						
SEISMIC-OBE	±.044	±.009	±.167						
SEISMIC-DBE	±.072	±.015	±.285						
BLOWDOWN-SV	+.070 -.062	+.026 -.020	+.049 -.051						
BLOWDOWN-PORV	±.001	±.001	+.002 -.004						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-983	
EMERGENCY		-983	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		983	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ______ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

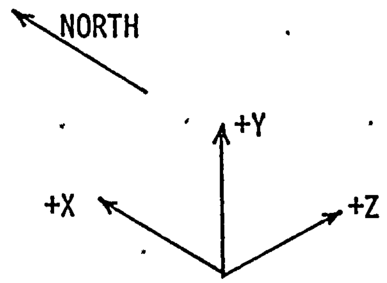
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: AMB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-598
NODE NUMBER 95

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
D[illegible]EIGHT-1	.016	.030	.002						
THERMAL-1	.085	2.81	-.131						
THERMAL-2	-.103	2.59	-.445						
THERMAL-3	-.177	2.41	-.586						
SEISMIC-OBE	±.007	±.003	±.006	±121	±131	±191			
SEISMIC-DBE	±.012	±.005	±.011	±209	±226	±330			
BLOWDOWN-SV	+.122 -.075	±.013	+.041 -.080	±903	±976	±1428			
BLOWDOWN-PORV	±.004	±.001	+.003 -.002	±45	±49	±72			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	±129	±140	±204
EMERGENCY	±903	±976	±1428

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	731	823	1223
DESIGN (-)	731	823	1223

U[illegible]
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

Technical Report
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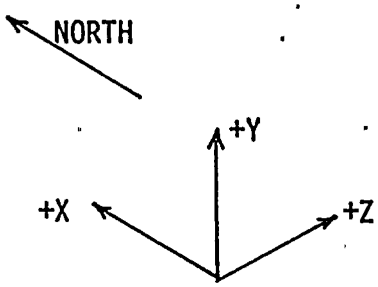
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: AMB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-599
NODE NUMBER 141

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEAD WEIGHT-1	-.020	.028	.042						
THERMAL-1	.114	2.80	.039						
THERMAL-2	.301	2.64	.142						
THERMAL-3	.361	2.50	.192						
SEISMIC-OBE	±.010	±.006	±.004	±85	±42	±62			
SEISMIC-DBE	±.017	±.011	±.007	±145	±73	±106			
BLOWDOWN-SV	+.033 -.029	+.012 -.010	+.025 -.021	±1772	±887	±1295			
BLOWDOWN-PORV	±.002	±.001	+.001 -.002	±68	±34	±50			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	±109	±54	±80
EMERGENCY	±1772	±887	±1295

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	422		573
DESIGN (-)	422		573

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

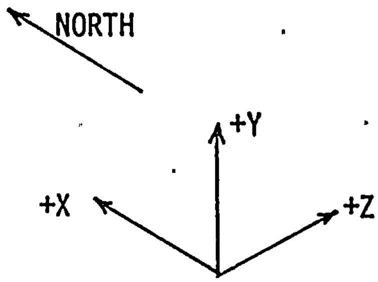
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-14-83
CHECKED BY: DmD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-600
NODE NUMBER 73

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	-.002	—	-180		-170			
THERMAL-1	—	2.35	—	2060		2030			
THERMAL-2	—	2.32	—	1742		252			
THERMAL-3	—	2.31	—	1647		-533			
SEISMIC-OBE	—	±.005	—	±362		±517			
SEISMIC-DBE	—	±.008	—	±573		±873			
BLOWDOWN-SV	—	+.056 -.037	—	±3874		±14230			
BLOWDOWN-PORV	—	+.003 -.002	—	±327		±1006			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	+2242 -542		+2377 -1049
EMERGENCY	+5341 -2407		+13527 -14933

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	981		3659
DESIGN (-)	2395		1997

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

Technical Report
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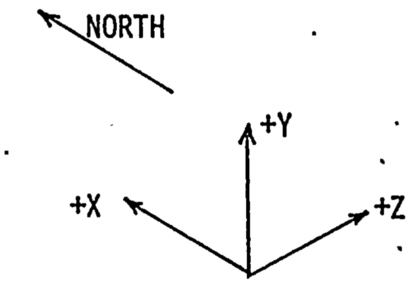
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-14-83
CHECKED BY: SmS DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-601
NODE NUMBER 222

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	-.002	—	530		370			
THERMAL-1	—	2.37	—	-1769		-2000			
THERMAL-2	—	2.62	—	-5054		-2181			
THERMAL-3	—	2.70	—	-6497		-2133			
SEISMIC-OBE	—	±.006	—	±701		±392			
SEISMIC-DBE	—	±.009	—	±1092		±632			
BLOWDOWN-SV	—	+.051 -.035	—	±14350		±2031			
BLOWDOWN-PORV	—	+.003 -.002	—	±352		±254			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	+1231 -5308		+762 -2278
EMERGENCY	+8383 -20317		+1002 -3794

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	8751		2740
DESIGN (-)	1223		1106

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

EXCEPT +Fx & +Fz

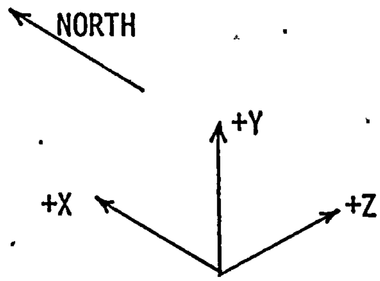
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DWB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-602
NODE NUMBER 290

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
[illegible]EIGHT-1	-.030	.077	.056		-798				
THERMAL-1	-.523	2.71	-.508						
THERMAL-2	-.574	3.15	-.502						
THERMAL-3	-.619	3.24	-.494						
SEISMIC-OBE	±.077	±.010	±.147						
SEISMIC-DBE	±.123	±.016	±.234						
BLOWDOWN-SV	+.085 -.081	+.019 -.017	+.120 -.199						
BLOWDOWN-PORV	+.017 -.024	+.011 -.009	+.025 -.017						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-798	
EMERGENCY		-798	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		798	

U[illegible]: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ______ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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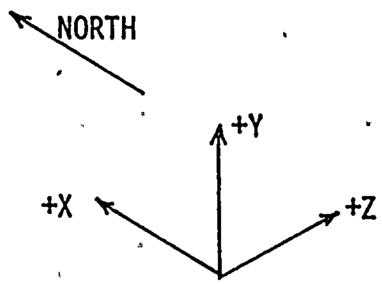
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: AMB DATE: 7-14-83
CHECKED BY: Dmd DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-605
NODE NUMBER 326

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	.120	—	170		-30			
THERMAL-1	—	3.36	—	-2220		3530			
THERMAL-2	—	3.36	—	-1381		3692			
THERMAL-3	—	3.36	—	-549		2917			
SEISMIC-OBE	—	±.013	—	±714		±1095			
SEISMIC-DBE	—	±.012	—	±1117		±1718			
BLOWDOWN-SV	—	+.022 -.023	—	±1036		±1289			
BLOWDOWN-PORV	—	+.014 -.012	—	±2305		±1683			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	+1202 -3624		+5670 -1125
EMERGENCY	+1287 -3167		+5218 -1748

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	2972		2412
DESIGN (-)	1313		5851

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater* THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

*except for $+F_x$ & $-F_z$

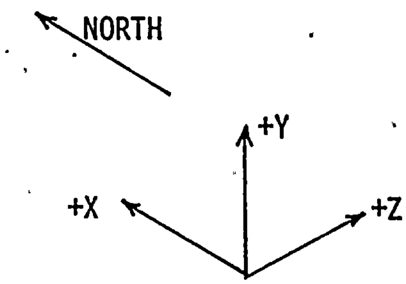
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DWB DATE: 7-14-83
CHECKED BY: DmD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-606

NODE NUMBER 316

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEAD WEIGHT-1	-.023	.235	.021		-634				
THERMAL-1	.076	3.67	-.282						
THERMAL-2	.093	3.66	-.253						
THERMAL-3	.102	3.61	-.266						
SEISMIC-OBE	±.032	±.064	±.051						
SEISMIC-DBE	±.050	±.102	±.080						
BLOWDOWN-SV	+.025 -.027	+.083 -.074	+.043 -.049						
BLOWDOWN-PORV	+.015 -.018	+.046 -.031	+.029 -.035						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-634	
EMERGENCY		-634	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		634	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ______ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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TELEDYNE ENGINEERING SERVICES

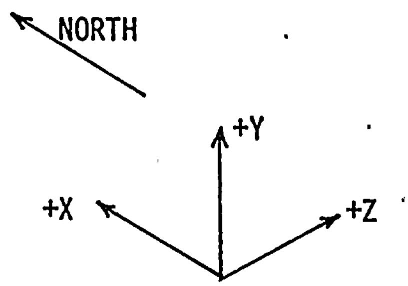
SUPPORT LOAD SUMMARY SHEET

BY: AMB DATE: 7-14-83

CHECKED BY: DMD DATE: 7/15/83

DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-607

NODE NUMBER 312

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	-.002	.452	.031	-1069		-36			
THERMAL-1	.023	3.69	-.582	3205		109			
THERMAL-2	.020	3.73	-.559	1095		37			
THERMAL-3	.020	3.65	-.574	-80		-3			
SEISMIC-OBE	±.001	±.049	±.041	±950		±32			
SEISMIC-DBE	±.001	±.077	±.064	±1470		±50			
BLOWDOWN-SV	±.001	+.068 -.056	+.041 -.046	±1316		±45			
BLOWDOWN-PORV	±.001	+.047 -.020	+.026 -.029	±1617		±55			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	+3086 -2019		+105 -68
EMERGENCY	+3606 -2539		+123 -86

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	2146		340
DESIGN (-)	5245		720

UNITS:
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less* THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

* except for +Fx

TELEDYNE ENGINEERING SERVICES

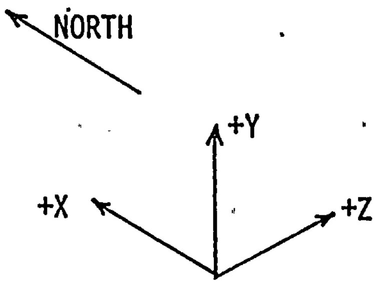
SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: AMB DATE: 7-14-83

CHECKED BY: Dmd DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-608

NODE NUMBER 304

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.026	.361	.047		-858				
THERMAL-1	-.185	3.30	-.669						
THERMAL-2	-.242	3.50	-.628						
THERMAL-3	-.278	3.49	-.625						
SEISMIC-OBE	±.051	±.004	±.082						
SEISMIC-DBE	±.081	±.006	±.130						
BLOWDOWN-SV	+.054 -.048	±.014	+.060 -.063						
BLOWDOWN-PORV	+.021 -.022	+.008 -.010	+.022 -.018						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-858	
EMERGENCY		-858	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		858	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ________ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

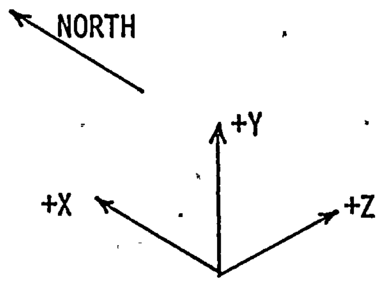
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: JMB DATE: 7-14-83
CHECKED BY: DmD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-609
NODE NUMBER 306

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	-.024	.420	.042						
THERMAL-1	-.114	3.42	-.693						
THERMAL-2	-.170	3.57	-.652						
THERMAL-3	-.204	3.54	-.653						
SEISMIC-OBE	±.043	±0	±.064		±333				
SEISMIC-DBE	±.069	±0	±.101		±516				
BLOWDOWN-SV	+.047 -.042	±.00	+.053 -.054		±1034				
BLOWDOWN-PORV	±.021	±0	+.024 -.021		±687				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		±763	
EMERGENCY		±1034	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		560	
DESIGN (-)		560	

UNITS:
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

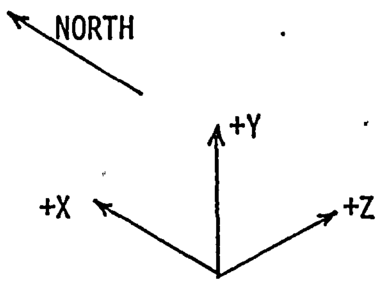
TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

BY: SMB DATE: 7-14-83
CHECKED BY: DmD DATE: 7/15/83

DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-610
NODE NUMBER 274

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
[illegible]EIGHT-1	-.031	.029	-.041		-637				
THERMAL-1	-.430	3.23	.187						
THERMAL-2	-.390	3.27	-.078						
THERMAL-3	-.374	3.28	-.267						
SEISMIC-OBE	±.108	±.011	±.281						
SEISMIC-DBE	±.160	±.019	±.417						
BLOWDOWN-SV	+.010 -.009	+.014 -.013	+.026 -.023						
BLOWDOWN-PORV	+.026 -.027	+.021 -.023	+.046 -.045						

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		-637	
EMERGENCY		-637	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		637	

U[illegible]
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ________ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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TELEDYNE
ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 7-14-83
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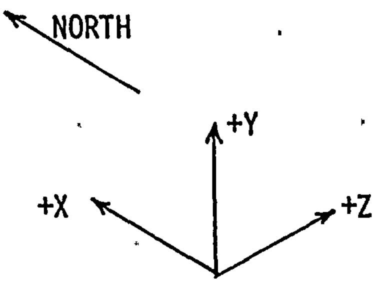
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-611
NODE NUMBER 248

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
[illegible]EIGHT-1	.045	.340	.050						
THERMAL-1	.093	3.36	-.193						
THERMAL-2	.070	3.61	.014						
THERMAL-3	.047	3.69	.159						
SEISMIC-OBE	±.010	±.016	±.049	± 26	± 184	± 62			
SEISMIC-DBE	±.016	±.023	±.073	± 41	± 286	± 96			
BLOWDOWN-SV	+.012 -.017	+.007 -.008	+.018 -.021	±123	±869	±291			
BLOWDOWN-PORV	+.021 -.018	+.008 -.009	+.016 -.017	±160	±1124	±376			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	±162	±1139	±381
EMERGENCY	±123	±869	±291

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	79	550	184
DESIGN (-)	79	550	184

U[illegible]
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
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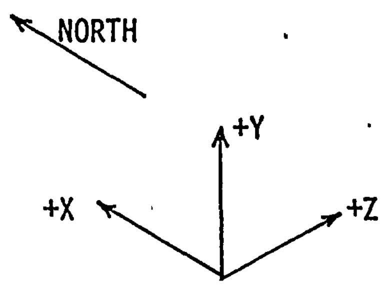
SUPPORT LOAD SUMMARY SHEET

BY: AMB DATE: 7-14-83
CHECKED BY: DmD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-612
NODE NUMBER 258

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	.341	—	-210		30			
THERMAL-1	—	3.30	—	1629		-2820			
THERMAL-2	—	3.65	—	-338		-152			
THERMAL-3	—	3.82	—	-1612		1834			
SEISMIC-OBE	—	±.023	—	±605		±1211			
SEISMIC-DBE	—	±.035	—	±915		±1792			
BLOWDOWN-SV	—	+.011 -.012	—	±1041		±493			
BLOWDOWN-PORV	—	+.010 -.009	—	±873		±669			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	+2024 -1610		+1262 -4001
EMERGENCY	+2334 -2863		+2357 -4582

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	3141		4894
DESIGN (-)	1105		1768

UNITS:
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less * THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

* EXCEPT -Fx & -Fz

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SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
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BY: DMB DATE: 7-14-83
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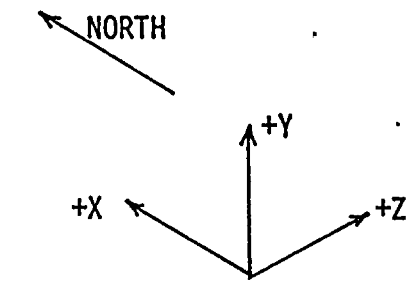
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-613
NODE NUMBER 261

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	-.014	.333	-.015		-720				
THERMAL-1	-.037	3.29	.057						
THERMAL-2	-.028	3.65	-.011						
THERMAL-3	-.020	3.84	-.060						
SEISMIC-OBE	±.006	±.022	±.022						
SEISMIC-DBE	±.009	±.033	±.032						
BLOWDOWN-SV	±.003	±.011	±.005						
BLOWDOWN-PORV	+.007 -.009	+.010 -.007	±.005						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-720	
EMERGENCY		-720	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		720	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE — THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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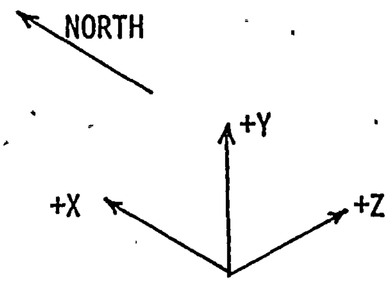
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-614
NODE NUMBER 238

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	.018	.198	.041	371		-157			
THERMAL-1	-.118	3.34	-.437	-2147		912			
THERMAL-2	-.183	3.42	-.440	3293		-1398			
THERMAL-3	0.223	3.37	-.542	5983		-2540			
SEISMIC-OBE	±.015	±.004	±.038	±720		±306			
SEISMIC-DBE	±.023	±.006	±.057	±1076		±457			
BLOWDOWN-SV	+.016 -.015	+.005 -.009	+.038 -.034	±859		±365			
BLOWDOWN-PORV	+.010 -.014	±.002	+.024 -.031	±670		±284			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	+4648 -2496		+1061 -1972
EMERGENCY	+7213 -2852		+1212 -3062

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	1264		3962
DESIGN (-)	9331		538

UNITS:
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE LESS *
THAN THE LOAD SHOWN
ON THE SUPPORT DRAWING

*except for +Fx, & -Fz

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DONALD C. COOK
UNIT #2
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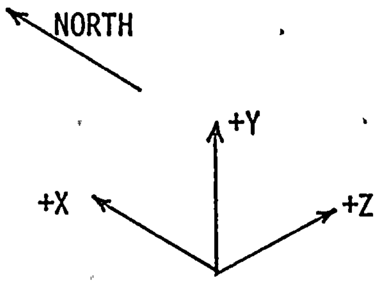
BY: DMB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-616
NODE NUMBER 129

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	-.004	0	.001		-276				
THERMAL-1	.012	2.35	-.006		-558				
THERMAL-2	.063	2.35	.041		-8				
THERMAL-3	.077	2.35	.064		3				
SEISMIC-OBE	±.002	±0	±.005		±1753				
SEISMIC-DBE	±.003	±0	±.008		±2789				
BLOWDOWN-SV	+.030 -.023	±0	+.023 -.024		±14520				
BLOWDOWN-PORV	±.003	±0	±.002		±754				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		+1624 -2587	
EMERGENCY		+14247 -14793	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		36947	
DESIGN (-)		37502	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE less THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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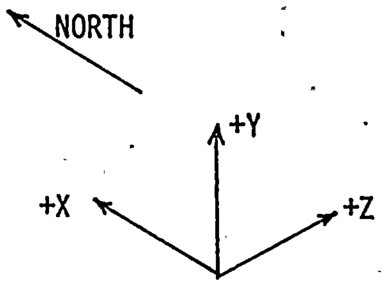
SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: JWB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-624
NODE NUMBER 22

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.008	-.003	.006						
THERMAL-1	-.069	-.003	.065						
THERMAL-2	-.074	-.009	-.429						
THERMAL-3	-.069	-.011	-.593						
SEISMIC-OBE	±.001	±0	±0	±7		±75			
SEISMIC-DBE	±.002	±.001	±0	±11		±122			
BLOWDOWN-SV	+.063 -.096	+.011 -.010	+.024 -.030	±2001		±22571			
BLOWDOWN-PORV	±.003	±0	±0	±18		±199			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	±19		±213
EMERGENCY	±2001		±22571

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			1429
DESIGN (-)			1429

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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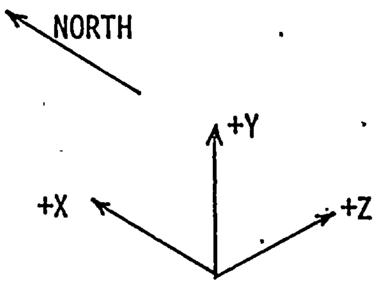
CHECKED BY: Dmd DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GBC-S-626
NODE NUMBER 402

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEAD WEIGHT-1	-.017	.210	.013						
THERMAL-1	-.270	3.39	-.599						
THERMAL-2	-.171	3.51	-.575						
THERMAL-3	-.176	3.51	-.632						
SEISMIC-OBE	±.048	±0	±.039		±291				
SEISMIC-DBE	±.082	±0	±.060		±503				
BLOWDOWN-SV	+.042 -.031	±0	+.030 -.023		±707				
BLOWDOWN-PORV	+.016 -.020	±0	+.018 -.026		±1396				

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		±1426	
EMERGENCY		±707	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)		945	
DESIGN (-)		945	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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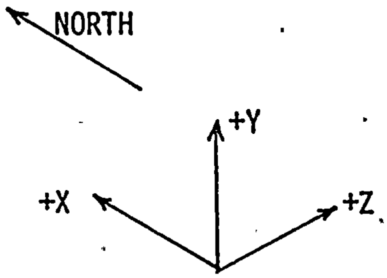
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-627
NODE NUMBER 400

DESIGN LOADINGS	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.005	.202	.022		-732				
THERMAL-1	-.238	3.38	-.530						
THERMAL-2	-.183	3.51	-.494						
THERMAL-3	-.207	3.49	-.544						
SEISMIC-OBE	±.032	±.014	±.037						
SEISMIC-DBE	±.053	±.024	±.057						
BLOWDOWN-SV	+.035 -.030	+.010 -.006	+.030 -.034						
BLOWDOWN-PORV.	+.012 -.018	±.004	+.022 -.028						

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET		-732	
EMERGENCY		-732	

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)			
DESIGN (-)		732	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE ____ THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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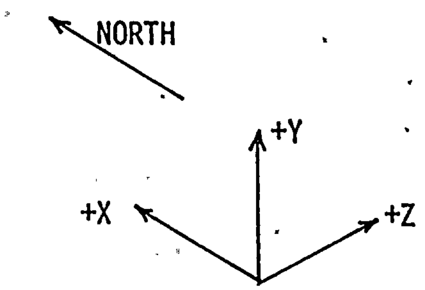
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-629
NODE NUMBER 228

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	.018	.013	.036						
THERMAL-1	-.279	2.47	-.252						
THERMAL-2	-.500	2.91	-.309						
THERMAL-3	-.608	3.03	-.325						
SEISMIC-OBE	±.044	±0	±.084		±1766				
SEISMIC-DBE	±.068	±0	±.133		±2808				
BLOWDOWN-SV	+.086 -.071	±0	+.139 -.221		±8037				
BLOWDOWN-PORV	+.015 -.022	±0	+.025 -.019		±1025				

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		±2042	
EMERGENCY		±8037	

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)		5943	
DESIGN (-)		5943	

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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DONALD C. COOK
UNIT #2
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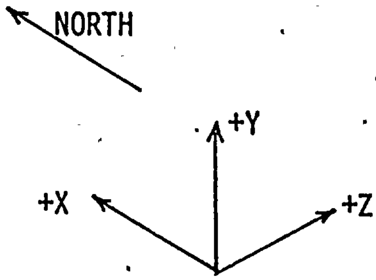
BY: SMB DATE: 7-14-83
CHECKED BY: DMD DATE: 7/15/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2GRC-S-630
NODE NUMBER 182

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	-.028	.030	.005						
THERMAL-1	.003	2.65	.030						
THERMAL-2	.072	2.55	.280						
THERMAL-3	.066	2.47	.376						
SEISMIC-OBE	±.008	±.009	±.005	±56		±88			
SEISMIC-DBE	±.013	±.014	±.008	±95		±150			
BLOWDOWN-SV	+.095 -.067	+.032 -.031	+.059 -.041	±1018		±1609			
BLOWDOWN-PORV	+.005 -.007	±.002	+.003 -.005	±98		±155			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	±113		±178
EMERGENCY	±1018		±1609

SUPPORT DRAWING LOADS	FX	FY	FZ
DESIGN (+)	339		404
DESIGN (-)	339		404

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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DONALD C. COOK
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BY: DWB DATE: 7-14-83
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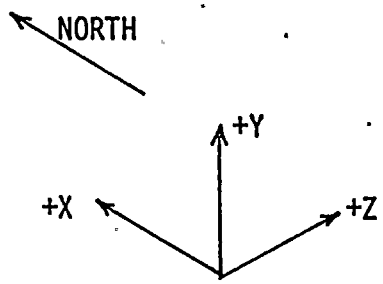
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-631
NODE NUMBER 132

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
D[illegible]EIGHT-1	-.023	-.005	.002						
THERMAL-1	.080	2.48	.009						
THERMAL-2	.080	2.40	.230						
THERMAL-3	.047	2.35	.311						
SEISMIC-OBE	±.002	±.025	±.002	±107		±84			
SEISMIC-DBE	±.003	±.043	±.003	±184		±146			
BLOWDOWN-SV	+.035 -.016	+.240 -.258	+.039 -.018	±2834		±2245			
BLOWDOWN-PORV	+.001 -.002	+.021 -.020	+.001 -.002	±183		±145			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	±212		±168
EMERGENCY	±2834		±2245

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	681		811
DESIGN (-)	681		811

U[illegible] DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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BY: [illegible] DATE: 7-14-83
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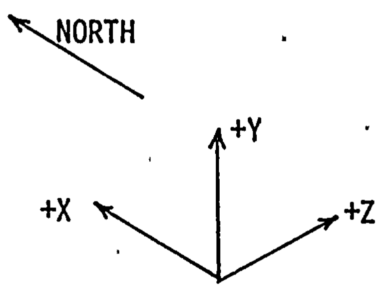
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-632
NODE NUMBER 78

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	.001	-.058	-.001						
THERMAL-1	.084	2.43	.002						
THERMAL-2	.093	2.27	.197						
THERMAL-3	.054	2.20	.270						
SEISMIC-OBE	±.002	±.038	±.002	±224		±184			
SEISMIC-DBE	±.002	±.065	±.003	±384		±316			
BLOWDOWN-SV	+.046 -.020	+.126 -.131	+.038 -.021	±6051		±4977			
BLOWDOWN-PORV	±.002	+.009 -.006	±.002	±168		±138			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	±280		±230
EMERGENCY	±6051		±4977

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	2500		3167
DESIGN (-)	2500		3167

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

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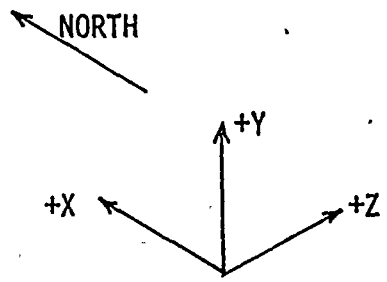
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-633
NODE NUMBER 84

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.003	-.051	-.003	46		40			
THERMAL-1	.106	2.68	-.120	73		64			
THERMAL-2	.276	2.32	-.312	1207		1060			
THERMAL-3	.306	2.10	-.344	1650		1450			
SEISMIC-OBE	±.002	±.053	±.003	±284		±249			
SEISMIC-DBE	±.004	±.085	±.005	±488		±429			
BLOWDOWN-SV	+.056 -.034	+.147 -.173	+.040 -.066	±2145		±1883			
BLOWDOWN-PORV	±.002	+.008 -.006	+.003 -.002	±96		±84			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	+1553 -238		+1363 -209
EMERGENCY	+3841 -449		+3373 -393

	SUPPORT DRAWING LOADS		
	FX	FY	FZ
DESIGN (+)	1984		1495
DESIGN (-)	4210		3173

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TES COMBINED LOADS ARE greater* THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

* except for +Fz & +Fx

6.3 Valve Accelerations

Valve accelerations are presented in this section for the DBE seismic condition and the SV transient shock condition. The DBE seismic accelerations are taken directly from TR-5364-2, Revision 0 and are presented in this report since the DBE event constitutes an emergency condition. The horizontal allowable was taken as 3g and the vertical allowable as 2g based on the attachments to AEP letter dated September 16, 1982 from Mr. J. L. Williams of AEP to Mr. L. B. Semprucci of TES (Reference 14). For the seismic condition, the resultant horizontal acceleration was compared against the 3g allowable.

The vertical acceleration values of valves SV-45A, SV-45C, NRV-151, and NRV-153 exceed the 2g criteria. The horizontal acceleration values of valves NMO-151 and NMO-153, exceed the 3g criteria. However, TES was informed per Reference 12 that the NMO and NRV series valves can accept valve accelerations up to 6g in any direction. Since it is not in the work scope of this project to qualify the SV valves for vertical accelerations over 2g, this task is assumed to be the responsibility of American Electric Power Service Corporation and will not be further addressed other than to report the acceleration values in Section 6.3.2.

6.3.1 DBE Seismic Accelerations

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ENGINEERING SERVICES

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BY: DMD DATE: 7/15/83
CHECKED BY: DMB DATE: 7-15-83

VALVE NO.		SV-45A			SV-45B			SV-45C		
NODE NO.		1980			1540			105		
		ACCELERATION			ACCELERATION			ACCELERATION		
		A_x	A_y	A_z	A_x	A_y	A_z	A_x	A_y	A_z
SHOCK DIRECTION	X	1.02	.16	.41	1.47	.19	.34	.82	.12	.80
	Y	.04	.02	.05	.06	.03	.05	.06	.03	.06
	Z	.42	.20	1.34	.34	.16	1.07	.81	.14	1.05
SRSS RESULTS	A_{xT}	1.10 g			1.51 g			1.15 g		
	A_{yT}	.26 g			.25 g			.19 g		
	A_{zT}	1.40 g			1.12 g			1.32 g		

	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE
VERTICAL A_{yT}	.26 g	2 g	.25 g	2 g	.19 g	2 g
HORIZONTAL *	1.78 g	3 g	1.88 g	3 g	1.75 g	3 g

* HORIZONTAL ACCELERATION = $\sqrt{(A_{xT})^2 + (A_{zT})^2}$

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VALVE NO.		NMO-151			NMO-152			NMO-153		
NODE NO.		301			355			271		
		ACCELERATION			ACCELERATION			ACCELERATION		
		A_x	A_y	A_z	A_x	A_y	A_z	A_x	A_y	A_z
SHOCK DIRECTION	X	.35	.19	.39	.78	.35	.40	.54	.39	.90
	Y	.17	.09	.11	.16	.16	.08	.11	.12	.19
	Z	.50	.24	.91	.49	.26	.35	.51	.19	1.14
SRSS RESULTS	A_{xT}	.63 g			.93 g			.75 g		
	A_{yT}	.32 g			.46 g			.45 g		
	A_{zT}	1.00 g			.54 g			1.46 g		

	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE
VERTICAL A_{yT}	.32 g	2 g	.46 g	2 g	.45 g	2 g
HORIZONTAL *	1.18 g	3 g	1.07 g	3 g	1.65 g	3 g

* HORIZONTAL ACCELERATION = $\sqrt{(A_{xT})^2 + (A_{zT})^2}$

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VALVE NO.		NRV-151			NRV-152			NRV-153		
NODE NO.		295			349			265		
		ACCELERATION			ACCELERATION			ACCELERATION		
		A_x	A_y	A_z	A_x	A_y	A_z	A_x	A_y	A_z
SHOCK DIRECTION	X	.54	.18	.69	1.40	.19	.75	.62	.31	.91
	Y	.13	.08	.12	.12	.09	.19	.22	.10	.13
	Z	.86	.22	1.53	.72	.14	.53	.49	.18	1.26
SRSS RESULTS	A_{xT}	1.02 g			1.58 g			.82 g		
	A_{yT}	.30 g			.25 g			.37 g		
	A_{zT}	1.69 g			.94 g			1.56 g		

	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE	ACCEL.	ALLOWABLE
VERTICAL A_{yT}	.30 g	2 g	.25 g	2 g	.37 g	2 g
HORIZONTAL *	1.97 g	3 g	1.84 g	3 g	1.76 g	3 g

* HORIZONTAL ACCELERATION = $\sqrt{(A_{xT})^2 + (A_{zT})^2}$

6.3.2 SV Transient Shock Valve Accelerations

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VALVE ACCELERATIONS

VALVE	SV-45A			SV-45B		
NODE NUMBER	1980			1540		
VALVE WEIGHT	685 LBS			685 LBS		
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	1099	1866	621	610	1317	930
ACCELERATION	1.60g	2.72g	.91g	.89g	1.92g	1.36g
ALLOWABLE	3g	2g	3g	3g	2g	3g

VALVE	SV-45C					
NODE NUMBER	105					
VALVE WEIGHT	685 LBS					
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	2048	1374	1142			
ACCELERATION	2.99g	2.01g	1.67g			
ALLOWABLE	3g	2g	3g			

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VALVE ACCELERATIONS

VALVE	NMO-151			NMO-152		
NODE NUMBER	301			355		
VALVE WEIGHT	400 LBS			400 LBS		
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	1211	688	1179	1334	549	700
ACCELERATION	3.03g	1.72g	2.95g	3.34g	1.37g	1.75g
ALLOWABLE	3g	2g	3g	3g	2g	3g

VALVE	NMO-153					
NODE NUMBER	271					
VALVE WEIGHT	400 LBS					
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	472	555	510			
ACCELERATION	1.18g	1.39g	1.28g			
ALLOWABLE	3g	2g	3g			

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VALVE ACCELERATIONS

VALVE	NRV-151			NRV-152		
NODE NUMBER	295			349		
VALVE WEIGHT	480 LBS			480 LBS		
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	969	992	639	633	359	987
ACCELERATION	2.02g	2.07g	1.33g	1.32g	.75g	2.06g
ALLOWABLE	3g	2g	3g	3g	2g	3g

VALVE	NRV-153					
NODE NUMBER	265					
VALVE WEIGHT	480 LBS					
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	451	988	365			
ACCELERATION	.94g	2.06g	.76g			
ALLOWABLE	3g	2g	3g			

6.4 Nozzle Loads

Forces and moments for the four pressurizer nozzles and the quench tank nozzles are given in this section for all loading conditions. The directions indicated represent the load on the appropriate nozzle.

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NOZZLE LOAD SUMMARY SHEET

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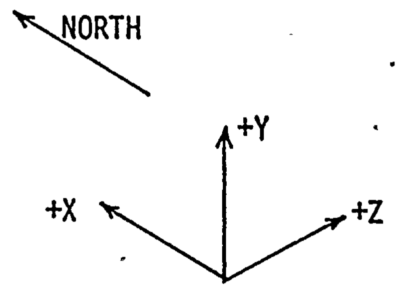
GLOBAL COORDINATE SYSTEM



NODE NUMBER 2

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	70	-950	50	-2580	-3220	-6470
THERMAL-1	—	—	—	460	590	1150	53470	-41790	-117040
THERMAL-2	—	—	—	-120	180	-110	-310	23990	-27730
THERMAL-3	—	—	—	-364	33	-620	-19856	49646	9035
SEISMIC-OBE	—	—	—	± 36	± 94	± 50	± 795	±1565	±4116
SEISMIC-DBE	—	—	—	± 58	± 166	± 85	±1329	±2599	±7133
BLOWDOWN-SV	—	—	—	±12557	±10225	±6496	±97053	±173671	±234442
BLOWDOWN-PORV	—	—	—	±351	± 117	± 104	± 1569	±3272	±5446

UNITS:
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TELEDYNE
ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

DONALD C. COOK
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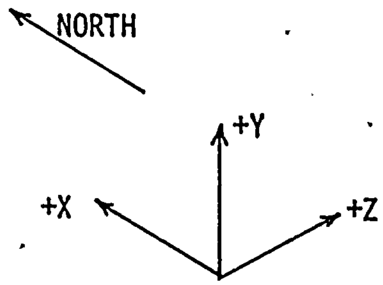
GLOBAL COORDINATE SYSTEM



NODE NUMBER 124

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	—	—	—	-60	-980	0	-19300	-1010	-2569
THERMAL-1	—	—	—	-180	-320	150	-160	-5150	-13550
THERMAL-2	—	—	—	-230	-200	-40	7220	11740	-16410
THERMAL-3	—	—	—	-234	-85	-149	10644	18825	-16004
SEISMIC-OBE	—	—	—	±591	±852	±701	±16243	±13095	±17376
SEISMIC-DBE	—	—	—	±1063	±1406	±1213	±28151	±21905	±28949
BLOWDOWN-SV	—	—	—	±1992	±4110	±1968	±52996	±30819	±38148
BLOWDOWN-PORV	—	—	—	±29	±55	±45	±1716	±823	±766

U DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

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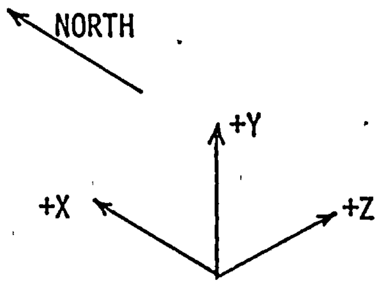
GLOBAL COORDINATE SYSTEM



NODE NUMBER 174

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
DEAD WEIGHT-1	—	—	—	0	-910	-40	-7530	-800	-20980
THERMAL-1	—	—	—	-380	-490	-110	16750	-10960	-7250
THERMAL-2	—	—	—	-70	-270	20	6460	-950	790
THERMAL-3	—	—	—	75	-112	75	817	3155	3642
SEISMIC-OBE	—	—	—	±891	±1210	±790	±15309	±16045	±22664
SEISMIC-DBE	—	—	—	±1542	±1991	±1300	±25318	±26549	±39163
BLOWDOWN-SV	—	—	—	±1855	±3812	±1588	±39888	±34638	±68139
BLOWDOWN-PORV	—	—	—	±57	±78	±56	±1212	±1081	±2519

UNITS: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

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NOZZLE LOAD SUMMARY SHEET

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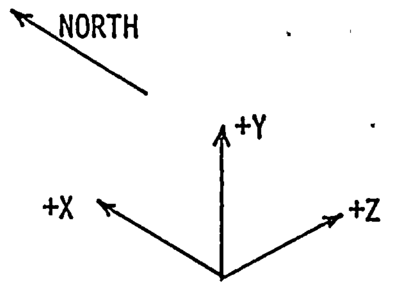
GLOBAL COORDINATE SYSTEM



NODE NUMBER 218

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	△X	△Y	△Z	FX	FY	FZ	MX	MY	MZ
[illegible]EIGHT-1	—	—	—	40	-989	-10	15160	-250	-13760
THERMAL-1	—	—	—	-270	-860	-579	21990	-21679	24070
THERMAL-2	—	—	—	90	-400	-60	4940	-970	15200
THERMAL-3	—	—	—	266	-106	185	-3757	8410	8655
SEISMIC-OBE	—	—	—	± 740	± 1100	± 780	±22610	±14193	±7406
SEISMIC-DBE	—	—	—	± 1221	± 1821	± 1331	±37426	±23445	±12649
BLOWDOWN-SV	—	—	—	± 1916	± 3991	± 1946	±71402	±36879	±44569
BLOWDOWN-PORV	—	—	—	± 57	± 86	± 56	±1725	±1000	±1503

U[illegible]
DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

TELEDYNE
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NOZZLE LOAD SUMMARY SHEET

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BY: AMB DATE: 7-15-83
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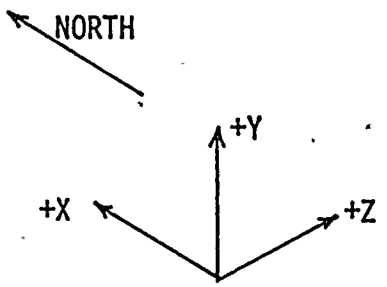
GLOBAL COORDINATE SYSTEM



NODE NUMBER 342

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	ΔX	ΔY	ΔZ	FX	FY	FZ	MX	MY	MZ
WEIGHT-1	—	—	—	310	-170	10	1330	4320	-13070
THERMAL-1	—	—	—	70	-60	-1150	-81270	38800	29390
THERMAL-2	—	—	—	40	450	-1159	-97290	31640	26650
THERMAL-3	—	—	—	-87	630	-1027	-96885	25749	29629
SEISMIC-OBE	—	—	—	±182	±284	±241	±15557	±12931	±10248
SEISMIC-DBE	—	—	—	±294	±477	±393	±23938	±19320	±15588
BLOWDOWN-SV	—	—	—	±608	±854	±536	±22610	±10856	±20905
BLOWDOWN-PORV	—	—	—	±650	±6248	±554	±19815	±5301	±17464

: DISPLACEMENTS : INCHES
FORCES : POUNDS
MOMENTS : INCH-POUNDS

6.5 Valve Loads

Section 6.5 gives the moments on each end of all valves in the piping system for all loading conditions. The moments reported are those acting on the pipe at the point where the valve and pipe meet.

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VALVE END MOMENTS

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VALVE NUMBER SV-45A

NODE	196			200		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	2532	988	4853	3242	1046	14021
THERMAL-1	-22224	2773	4017	-12742	12244	-14350
THERMAL-2	2172	1696	-9635	2836	2570	-14309
THERMAL-3	12702	1852	-15648	9257	-1368	-12535
SEISMIC OBE	±8522	±3675	±1779	±2077	±1291	±8896
SEISMIC DBE	±14573	±6280	±2978	±3497	±2148	±14684
BLOWDOWN PORV	±882	±285	±597	±917	±730	±854
BLOWDOWN SV	±15641	±5675	±16144	±18332	±8701	±53593

VALVE NUMBER SV-45B

NODE	152			156		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	3963	1343	99	13948	1588	5144
THERMAL-1	-6572	1225	14663	-11581	7505	4517
THERMAL-2	2055	-1423	-1573	-2199	-544	-4628
THERMAL-3	5055	-1920	-7651	2088	-3491	-7054
SEISMIC OBE	±3762	±3713	±12031	±6927	±906	±6495
SEISMIC DBE	±6504	±6423	±20814	±11460	±1507	±10755
BLOWDOWN PORV	±375	±196	±419	±812	±685	±460
BLOWDOWN SV	±13439	±4024	±9469	±43216	±8612	±21143

UNITS: INCH-POUNDS

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VALVE END MOMENTS

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VALVE NUMBER SV-45C

NODE	103			107		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	1798	819	-3676	7708	1492	-10836
THERMAL-1	5555	299	9505	-650	3946	9948
THERMAL-2	-8372	-10721	18035	-9908	-8612	16182
THERMAL-3	-15796	-14223	21464	-14056	-13327	18220
SEISMIC OBE	± 9863	± 2919	± 7704	± 7041	± 746	± 4154
SEISMIC DBE	± 17131	± 5077	± 13374	± 11679	± 1244	± 6881
BLOWDOWN PORV	± 620	± 130	± 564	± 750	± 557	± 706
BLOWDOWN SV	± 16794	± 5651	± 19111	± 37040	± 21524	± 45449

VALVE NUMBER ______

NODE						
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT						
THERMAL-1						
THERMAL-2						
THERMAL-3						
SEISMIC OBE						
SEISMIC DBE						
BLOWDOWN PORV						
BLOWDOWN SV						

UNITS: INCH-POUNDS

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VALVE END MOMENTS

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VALVE NUMBER NRV-151

NODE	292			296		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	1305	1338	6933	1460	1690	6549
THERMAL-1	6579	1741	-6163	6375	-2570	-5656
THERMAL-2	4729	213	-2379	4594	-1096	-2044
THERMAL-3	2754	-792	-795	2688	-764	-630
SEISMIC OBE	±7008	±6142	±1983	±7941	±7814	±6151
SEISMIC DBE	±11146	±9772	±3029	±12646	±12433	±9834
BLOWDOWN PORV	±3576	±1129	±7671	±7647	±2661	±13478
BLOWDOWN SV	±12537	±5119	±11965	±14712	±10942	±19470

VALVE NUMBER NMO-151

NODE	298			302		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	2967	2084	2817	4660	2428	-2677
THERMAL-1	6141	-7464	-5077	5941	-11682	-4581
THERMAL-2	4439	-2581	-1662	4307	-3862	-1334
THERMAL-3	2612	-732	-441	2546	-704	-280
SEISMIC OBE	±8219	±6296	±4674	±11359	±3818	±4451
SEISMIC DBE	±13090	±10021	±7504	±18076	±6171	±7081
BLOWDOWN PORV	±8087	±5021	±10421	±4703	±5603	±8713
BLOWDOWN SV	±12997	±17238	±18650	±13560	±16039	±9346

UNITS: INCH-POUNDS

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VALVE END MOMENTS

Donald C. Cook
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BY: DWB DATE: 7-15-83
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VALVE NUMBER NRV-152

NODE	346			350		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	809	-275	1382	-2482	-389	54
THERMAL-1	11080	5888	4243	10447	1662	3988
THERMAL-2	15352	1300	9007	12609	-1039	7899
THERMAL-3	12306	-2944	8347	9281	-4256	7126
SEISMIC OBE	±3106	±4196	±5116	±4329	±5260	±7278
SEISMIC DBE	±5275	±7312	±8915	±7257	±9160	±12551
BLOWDOWN PORV	±7740	±1096	±4492	±8822	±2339	±7346
BLOWDOWN SV	±5610	±3958	±3866	±21646	±4190	±16609

VALVE NUMBER NMO-152

NODE	352			356		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	-3004	-546	-157	-1051	-660	109
THERMAL-1	9575	-4166	3635	8954	-8322	3385
THERMAL-2	8824	-4264	6371	6133	-6576	5286
THERMAL-3	5108	-6065	5441	2140	-7367	4245
SEISMIC OBE	±3712	±3372	±7236	±3792	±1538	±9170
SEISMIC DBE	±6252	±5827	±12497	±6515	±2534	±15906
BLOWDOWN PORV	±10489	±5586	±5966	±14880	±6371	±6195
BLOWDOWN SV	±14256	±14015	±14477	±6680	±13034	±9226

UNITS: INCH-POUNDS

VALVE END MOMENTS

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Unit #2
Project 5364

BY: DMB DATE: 7-15-83
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VALVE NUMBER NRV-153

NODE	262			266		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	3490	-224	-3953	5265	-41	-8350
THERMAL-1	-9400	-7895	-8140	-10151	-6228	-6280
THERMAL-2	1198	-3818	-996	2002	-2637	-2988
THERMAL-3	9074	-1424	4999	10675	-528	1034
SEISMIC OBE	± 9149	± 770	± 4255	± 4528	± 2963	± 4959
SEISMIC DBE	± 13560	± 1221	± 6318	± 7296	± 4435	± 8120
BLOWDOWN PORV	± 2573	± 1296	± 7121	± 6328	± 1946	± 13676
BLOWDOWN SV	± 3521	± 1978	± 7888	± 9405	± 2148	± 6211

VALVE NUMBER NMO-153

NODE	268			272		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	6007	180	-10184	6196	360	-9360
THERMAL-1	-11065	-4200	-4020	-11800	-2566	-2196
THERMAL-2	2981	-1202	-5409	3768	-42	-7363
THERMAL-3	12624	558	-3786	14191	1438	-7675
SEISMIC OBE	± 3722	± 6476	± 2187	± 7515	± 6167	± 2910
SEISMIC DBE	± 5692	± 9605	± 3625	± 11152	± 9150	± 4402
BLOWDOWN PORV	± 5957	± 2541	± 11249	± 4781	± 2193	± 12104
BLOWDOWN SV	± 7894	± 4486	± 6526	± 2400	± 4274	± 3811

UNITS: INCH-POUNDS

7.0 DRAWINGS

8.0 REFERENCES

1. Letter from Mr. S. Ulan of AEP to Mr. L. B. Semprucci of TES, dated November 29, 1982.

2. Teledyne Engineering Services Technical Report TR-5364-2.

3. Crosby Valve and Gage Company Drawing No. H-51688, Revision A.

4. Technical Paper #410 by Crane.

5. Westinghouse Electric Company, Drawing No. 110E272.

6. ITI Report, "Evaluation of RELAP5/MOD1 for Calculation of Safety and Relief Valve Discharge Piping Hydrodynamic Loads," February 1982. Prepared by Intermountain Technologies.

7. Review of Pressurizer Safety Valve Performance as observed in the EPRI Safety and Relief Valve Test Program. WCAP-10105.

8. ASME Code NB7000, Section III.

9. Teledyne Engineering Services Technical Proposal PR-5653, dated May 14, 1981.

10. TES letter 5364-44, dated May 28, 1983 from Mr. P. D. Harrison of TES to Mr. Sam Ulan of AEP.

8.0 REFERENCES (Continued)

11. Letter from Mr. S. Ulan of AEP to Mr. P. D. Harrison of TES, dated March 15, 1983.

12. Letter from Mr. Sam Ulan of AEP to Mr. P. D. Harrison of TES, dated May 26, 1983.

13. 1967 Edition of USAS B31.1 Power Piping Code.

14. Letter from Mr. J. L. Williams of AEP to Mr. L. B. Semprucci of TES, dated September 16, 1982.

15. EPRI Power Safety and Relief Valve Test Program Guide for Application of Valve Test Program results to Plant-Specific Evaluations. Interim Report, July 1982 (Research Project V102).

AMERICAN ELECTRIC POWER SERVICE CORPORATION
2 BROADWAY
NEW YORK, NEW YORK 10004

TECHNICAL REPORT TR-5364-4
REVISION 0

BOOK 1 OF 3

DONALD C. COOK NUCLEAR GENERATING STATION

ANALYSIS OF PRESSURIZER SAFETY VALVE DISCHARGE PIPING SYSTEM, WITH DRAINED LOOP SEALS PER NUREG 0737, II. D.1, UNIT 2

JULY 18, 1983

TELEDYNE ENGINEERING SERVICES

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617-890-3350

TELEDYNE ENGINEERING SERVICES

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1.0 INTRODUCTION

American Electric Power Service Corporation (AEPSC), purchase order number 02676-820-1N, authorized Teledyne Engineering Services (TES) to analyze the Pressurizer Safety/Relief Valve Discharge Piping per NRC NUREG-0737, Item II. D.1 for the Donald C. Cook Nuclear Power Plant, Unit #2.

This activity was performed in accordance with the TES Quality Assurance program which meets the requirements of 10CFR50, Appendix B, and ANSI N45.2.11 as interpreted by Regulatory Guide 1.64, Revision 2.

The scope of work for this effort is described in detail in Teledyne Engineering Services Technical Proposal PR-5653 (Reference 9), dated May 14, 1981 and modified as stated in AEPSC letter dated November 29, 1982, from Mr. Sam Ulan (AEPSC) to Mr. L. B. Semprucci (TES); in AEPSC letter from Mr. Sam Ulan (AEPSC) to Mr. P. D. Harrison (TES) dated March 15, 1983 (References 1 and 11) and in TES letter 5364-44 from Mr. P. D.Harrison (TES) to Mr. S. Ulan (AEPSC) dated May 28, 1983 (Reference 10).

The majority of the analysis was performed after the receipt of AEPSC letters dated November 29, 1982 and March 15, 1983 (References 1 and 11), which were issued after more complete information was available from the EPRI data.

This analysis was performed using large digital computer programs supplemented with any necessary hand calculations. The RELAP5 MOD1 Cycle 14 computer program was used to do the thermal fluid transient analysis. The structural analysis, for all loading conditions, was done utilizing the TMRSAP computer program.

The size of the pressurizer safety/relief valve discharge piping system was so large that the computer models, for both RELAP and TMRSAP, strained the limits of the programs. This condition necessitated multiple RELAP runs in order to execute the thermal fluid transient analysis for the appropriate length of time. For the structural analysis it was necessary to expand the core of the TMRSAP program in order to avoid an overconservative overlap analysis.

2.0 CONCLUSIONS

The analysis performed by TES on the Pressurizer Safety/Relief Valve Discharge Piping System with the Safety Valve loop seal drained, indicates that all criteria of NRC NUREG-0737, Item II.D.1 are met, with the following qualifications:

1) Valve accelerations due to the SV transient shock condition for valves SV-45A and SV-45C exceed the vertical allowable of 2g's (Reference 14). The accelerations exceed the allowable by less than 1g and, therefore, it is TES's opinion that these valve accelerations are acceptable. However, setting the criteria of acceptance of these accelerations is out of the TES work scope and is, therefore, the responsibility of others.

2) The supports listed below exceed the loads given on the As-Built support drawings (see Section 6.2). These support loads, while exceeding the previous loads, do so in most cases by a small percentage. However, acceptance of these loads is out of the TES work scope and is the responsibility of others.

2-GRC-R-585	2-GRC-R-605
2-GRC-R-586	2-GRC-S-609
2-GRC-S-587	2-GRC-S-611
2-GRC-R-589	2-GRC-S-624
2-GRC-R-591	2-GRC-S-626
2-GRC-S-596	2-GRC-S-629
2-GRC-S-598	2-GRC-S-630
2-GRC-S-599	2-GRC-S-631
2-GRC-R-600	2-GRC-S-632
2-GRC-R-601	2-GRC-R-633

This report documents that the safety/relief valve discharge piping for Unit 2 is acceptable for emergency conditions assuming drained loop seals. TES Technical Report TR-5364-2, Revision 0 (Reference 2), which is based on the as-built condition, documents the acceptability of the system for normal and upset conditions. Draining the loop seals will not affect the normal and upset conditions.

The purpose of the loop seals was to protect the safety valves from leaking by keeping free hydrogen and high temperatures away from the valve seats. It should be noted that while draining the loop seals relieves the overwhelming stress on the discharge system, see Technical Report TR-5364-2, Revision 0 (Reference 2), it also leaves the valve seats unprotected and, therefore, susceptible to leaking. While it is beyond the responsibility of TES, this condition can result in serious consequences and should be investigated.

Support load summary sheets have been included in this report for all supports and supercede the loads reported in TR-5364-2.

3.0 SYSTEM DESCRIPTION/DISCUSSION

The Pressurizer Safety/Relief Valve Discharge Piping System consists of all of the piping from the pressurizer nozzles, down to the sparger in the quench tank. This information is depicted on TES drawing E-5761, Revision 2, generated from AEP drawings 2-GRC-22, sheets 1 and 2; 2-GRC-23, sheets 1, 2 and 3; 2-GRC-24; 2-GRC-25; 2-5435-26; 2-GRC-27; 2-5435-8; 2-RC-22, sheets 1 and 2; 2-RC-23, sheets 1, 2, and 3; 2-RC-24; 2-RC-25; 2-RC-26; and 2-RC-27.

The "Discharge" piping constitutes a very large system resulting in a large computer model. The size and geometrical complexity, which is due mainly to the sweeping curves around the pressurizer, complicates the modification effort in addition to causing longer run times.

Modification of this complex system, to attempt to secure satisfactory "Safety Valve Discharge" results, is limited to draining the SV loop seals. Heating the loop seals is not a viable "fix" because of the size of the loops. These long loops contain sufficient quantity of water such that on SV Discharge, the water seal does not "flash" completely enough to reduce the very high loads caused by the water slug. Modification to the support system is also a poor option because of the very limited space in the annulus around the pressurizer, which makes construction very difficult.

4.0 THERMAL FLUIDS ANALYSIS

4.1 Introduction

The following thermodynamic fluid analysis determines the fluid forces which act on the pressurizer safety valve discharge piping of the American Electric Power Service Corporation (AEPSC) Donald C. Cook Nuclear Power Plant, Unit 2. These forces are generated by the sudden opening of the pressurizer safety valves during one of the pressurizer transients described in the AEP letter of November 29, 1982 to TES (Reference 1).

These fluid forces and the resulting loads and stresses on the piping system became of increased concern as a result of the incident at Three Mile Island. Following this incident, the NRC issued NUREG 0578 and NUREG 0737, which required that each utility determine the effect of safety/ relief valve operation upon the valve and the discharge piping. An elaborate program involving both testing and analysis was established under the general management of the Electric Power Research Institute (EPRI). The EPRI program included intensive testing of safety and relief valves as well as a full scale safety valve test facility, built at Combustion Engineering in Connecticut.

Simultaneously, an analytical program was initiated to choose and test a computer program which would predict the fluid forces; RELAP5 MOD1 was chosen. RELAP5 MOD1 is the latest in the family of RELAP programs developed at the Idaho National Engineering Laboratory.

The D.C. Cook Units 1 and 2 pressurizer safety valves have "Cold Loop Seals". A "Cold Loop Seal" is a subcooled slug of water trapped between the safety valve seat and the pressurizer nozzle by a loop of piping. The function of this slug of water is to prevent the safety valve from leaking, this is accomplished by keeping free hydrogen away from, and maintaining reduced temperatures at the valve seat. While the loop seal provides a benefit, it also has a serious drawback. When the safety valve opens, the loop seal is shot through the discharge piping with tremendous force. In TES Technical Report TR-5364-1, TES performed a fluid analysis to determine the magnitude of the loads applied

to the discharge piping by the propulsion of the cold loop seal. These loads were calculated to be greater than 100,000 lbf for a single safety valve discharge. The simultaneous discharge of the pressurizer's three safety valves with loop seals could result in loads of over 300,000 lbs.

As explained in TR-5364-1, TES also performed a sensitivity study to determine if raising the loop seal temperature (by electrical trace heating) would reduce the loads. Increasing the loop seal temperature did lower the loads somewhat, however, a significant reduction was not obtained. It was then suggested that the loop seal should be drained so that when the safety valves operated, they would discharge steam only.

This report presents the analysis for the steam discharge that was performed for the Unit 2 pressurizer safety valves. The maximum fluid force calculated in this analysis is 24,000 lbf for simultaneous discharge of all three safety valves. It can be seen that draining the loop seals provides a significant force reduction.

In this analysis, as before, TES has used RELAP5 MOD1 version 2.11 as it is made available through Control Data Corp with a post-processor, REPIPE version 3.10, which calculates the fluid forces. This version of RELAP5 MOD1 is identified by the following computer job control language at Control Data Corporation:

```
BEGIN, RELAP5, R5M2, INPUT=INPUTFILE, SCM=377000B
```

The computer analysis procedure for the thermal analysis portion is included in Appendix A.

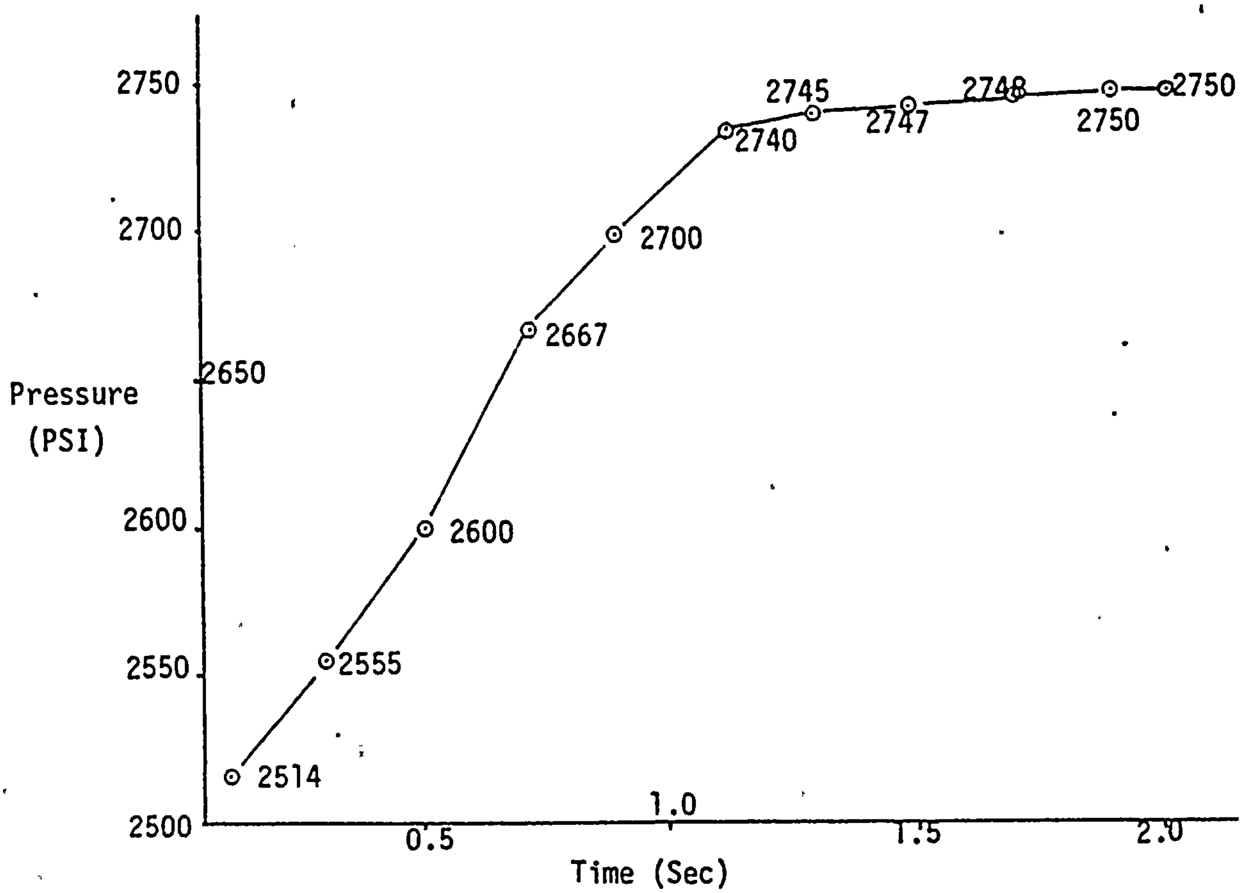
RELAP5 calculates hydrodynamic data for control volumes in each segment of pipe. REPIPE then takes this data and defines two force time histories for each segment, one set for inlet junction forces and the other for outlet junction forces. A TES generated program, SAP2SAP, adds these force time histories. Finally, one force-time history for each segment of axial, unbalanced loads is analyzed structurally.

4.2 RELAP Model

4.2.1 The D.C. Cook pressurizer was modeled as a single time dependent volume with the following transient condition as specified by the AEPSC, November 29, 1982 letter to Mr. L.B. Semprucci, pages 1-7 (Reference 1):

Safety Valves

Pressure Time History (in the pressurizer)



These are the same safety valve pressure boundary conditions that were used in analyzing the quarter model cold loop seal case of TR-5364-1 (Reference 2).

4.2.2 Safety valves were modeled as RELAP junctions emulating Crosby HB-BP-86 valves (Reference 3) with orifice areas of 0.01897 Ft^2 and a valve opening time of 0.010 seconds.

Valve orifice areas were calculated using the Crosby Valve and Gage Company Drawing No. H-51688, Revision A (Reference 3) provided by AEP, and RELAP (Run ID BAICDRO) implementing rated flows. Calculated values are included in Section 4.6 and Figure 4.6.1.

4.2.3 Discharge piping was modeled from all safety and power operated relief valves to the quench tank. This discharge piping included the following pipe sizes:

3 inch, 12 inch	SCH 40
4 inch, 6 inch	SCH 40S
4 inch	SCH 120
3 inch, 6 inch	SCH 160

Friction factors for long and short radius elbows and reducers were taken from technical paper #410 by Crane (Reference 4). Calculations of these frictional losses are included in Appendix A. The discharge piping is defined in segments of straight sections from; elbow to elbow, valve to elbow, etc.

4.2.4 The Quench Tank was modeled in two parts, the sparger and the tank itself, using cylindrical volumes containing water and air. The quench tank volumes were taken from Westinghouse Dwg. No. 110E272 (Reference 5).

The sparger for D.C. Cook is a perforated pipe submerged in water within the quench tank as indicated in Figure 4.2.1. It is represented in RELAP as a pipe similarly submerged and of equal volume.

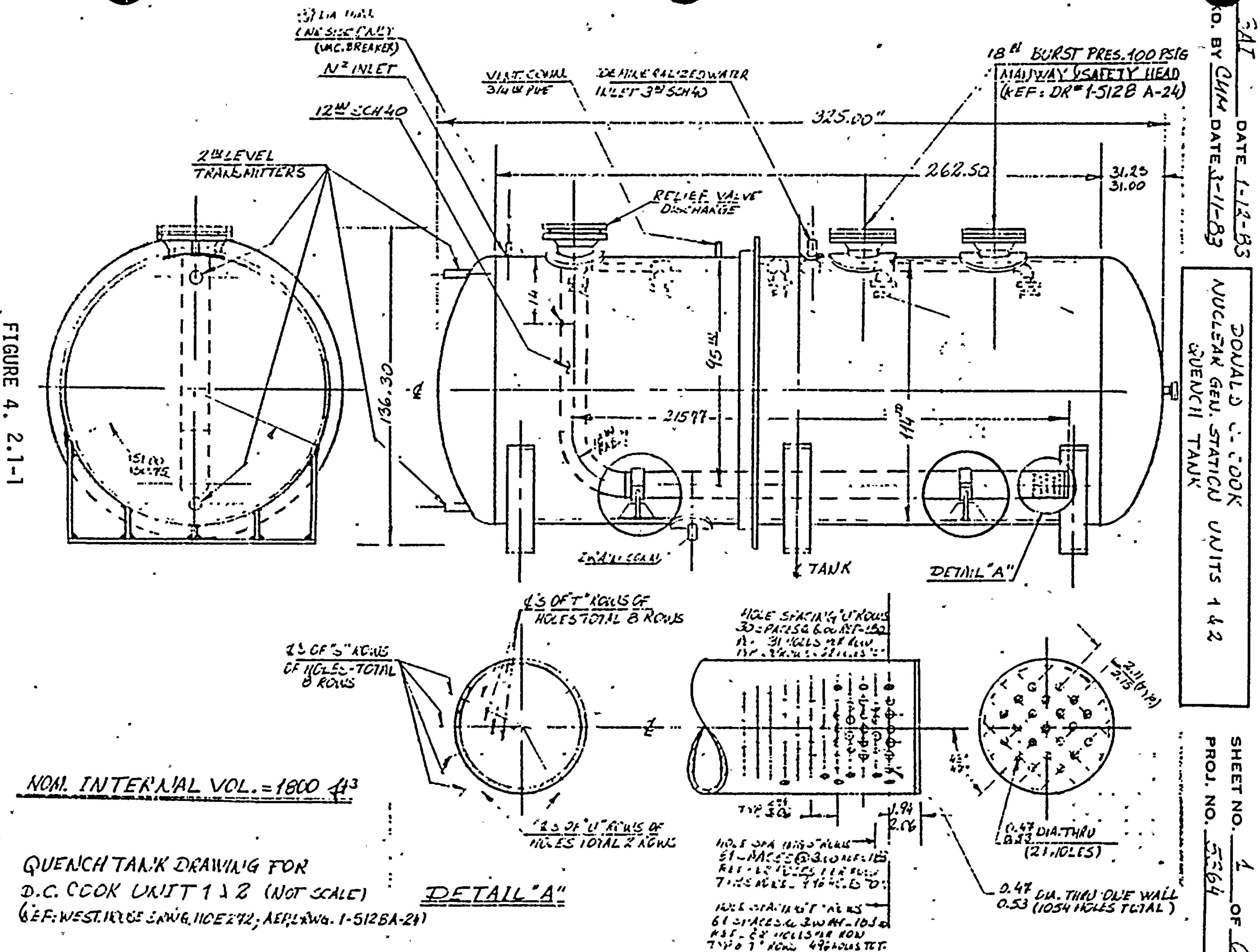

TELEDYNE ENGINEERING SERVICES
DONALD C. COOK
NUCLEAR GEN. STATION UNITS 1 & 2
QUENCH TANK
SHEET NO. 1 OF 6
PROJ. NO. 5364
BY SAT DATE 1-12-83
CKD. BY CUM DATE 3-11-83
18" BURST PRES. 100 PSIG
MANWAY & SAFETY HEAD
(REF: DR# 1-512B A-24)
VENT CONN. 3/4" PIPE
DEMINERALIZED WATER INLET 3" SCH 40
N2 INLET
12" SCH 40
2" LEVEL TRANSMITTERS
RELIEF VALVE DISCHARGE
325.00"
262.50
31.25
31.00
136.30
95
215.77
TANK
DRAIN CONN.
DETAIL "A"
HOLE SPACING "U" ROWS
HOLES TOTAL 8 ROWS
HOLES TOTAL 2 ROWS
0.47 DIA. THRU
0.53
(21 HOLES)
0.47 DIA. THRU ONE WALL
0.53 (1054 HOLES TOTAL)
1.94
2.06
NOM. INTERNAL VOL. = 1800 ft³
QUENCH TANK DRAWING FOR
D.C. COOK UNIT 1 & 2 (NOT SCALE)
REF: WEST. DWG. 110E272; AEP DWG. 1-512BA-24

FIGURE 4. 2.1-1

TELEDYNE ENGINEERING SERVICES

BY BAT DATE 1-17-83 CHKD. BY CNM DATE 3-11-83	DONALD C. COOK NUCLEAR GEN. STATION UNITS 1&2 RELAP5 QUENCH TANK MODELING	SHEET NO. 2 OF 6 PROJ. NO. 5364

RELAP5 MODEL OF THE QUENCH TANK

REMARKS:

1. QUENCHTANK WAS MODELED AS A SERIES OF "PIPE COMPONENTS" WITH APPROPRIATE FLOW AREAS AND LOSS COEFFICIENTS

2. WATER LEVEL IN THE QUENCH TANK IS AT THE SAME HEIGHT AS THE WATER LEVEL IN THE SPARGER

3. THE SECTION OF THE SPARGER WITH DISCHARGE HOLES WAS MODELED AS A PIPE WITH ITS LENGTH EQUAL TO THE LENGTH OF THE SPARGER WITH THE TOTAL NUMBER OF HOLE AREAS EQUAL TO FLOW AREA OF THE SPARGER (REF. DETAIL DRW"A")

4. RUPTURE DISCS WERE MODELED AS A TRIP VALVE WHICH OPENS AT THE BURST PRESSURE OF 100 psig.

5. VACUUM BREAKER HOLE WITH DIA. = 0.25 - 0.31^{IN} AND LOCATED 14 INCHES FROM THE TOP OF THE QUENCH TANK WAS IGNORED IN THE MODELING.

V = NOMINAL INTERNAL VOLUME OF THE TANK = 1800 ft^3 (W.H. Dr.# 110 E272)

TANK IS 82% FULL OF WATER. (REF. TELECON LBS WITH SAM ULAN DATED 1-14-83.)

V_1 = WATER VOLUME IN THE QUENCH TANK = 1476 ft^3

V_2 = AIR VOLUME IN THE QUENCH TANK = 324 ft^3

FIGURE 4.2.7-2

TELEDYNE ENGINEERING SERVICES

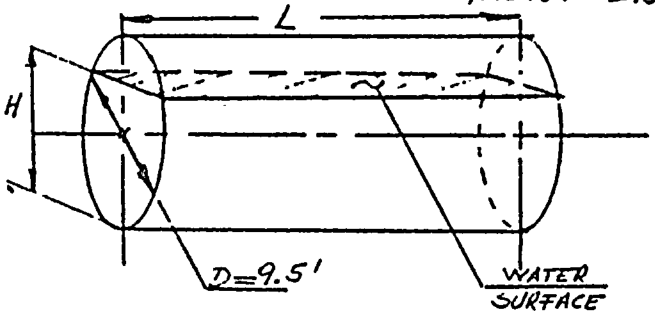
BY 3AT DATE 1-17-83
CKD. BY CMM DATE 3-11-83

DONALD C. COOK
NUCLEAR GEN. STATION UNITS 1 & 2
RELAP5 QUENCH TANK MODELING

SHEET NO. 3 OF 6
PROJ. NO. 5364

IF QUENCH TANK IS A CYLINDER WITH $D = 114$ IN INSIDE DIA.

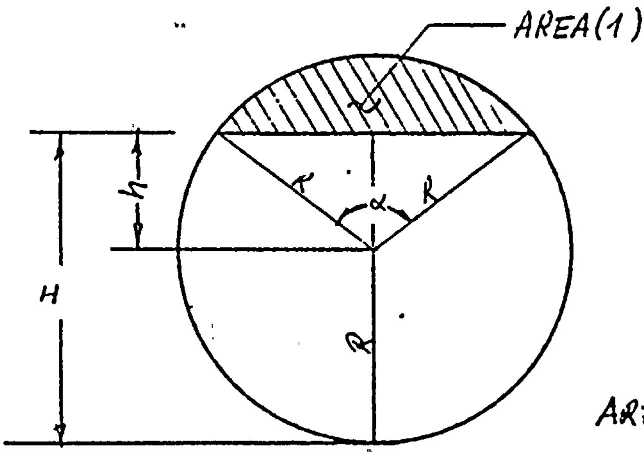
THEN: LENGTH $L = \dfrac{V}{\left(\frac{D}{2}\right)^2 \pi}$



$$L = \frac{1800}{\left(\frac{9.5}{2}\right)^2 \pi}$$

$$L = 25.3943 \text{ ft}$$

H- HEIGHT OF THE WATER LEVEL FROM BOTTOM OF THE TANK



$$AREA(1) = \frac{R^2}{2}(\hat{\alpha} - \sin\alpha) \quad \text{EQN} - 1$$

WHERE: $\hat{\alpha}$; IN RADIANS

α ; IN DEGREES

$$AREA(1) = \frac{\text{AIR VOLUME}}{\text{HEIGHT OF CYL.}} = \frac{V_2}{L} = \frac{324}{25.3943}$$

$$AREA(1) = 12.7588 \text{ ft}^2$$

SUBSTITUTING INTO EQN 1

$$12.7588 = \frac{22.5625}{2}(\hat{\alpha} - \sin\alpha)$$

$$13.1310 = \hat{\alpha} - \sin\alpha$$

BY TRIAL AND ERROR:

$\alpha \approx 116.5°$

FIGURE 4.2.1-3

BY BAI DATE 1-17-83
CHKD. BY CMM DATE 3-11-83

DONALD C. COOK
NUCLEAR GEN. STATION UNITS 1 & 2
RELAP5 QUENCH TANK MODELING

SHEET NO. 4 OF 6
PROJ. NO. 5364

$$h = R \cos\frac{\alpha}{2}$$

$$h = 4.75 \cos\frac{116.5}{2}$$

$$h = 2.4995$$

$$H = h + R = 4.75 + 2.4995$$

$H \approx 87^{IN} = 7.25$ ft HEIGHT OF WATER SURFACE FROM THE BOTTOM OF THE QUENCH TANK.

$D - H = 27^{IN} = 2.25$ ft FROM THE TOP OF THE QUENCH TANK TO THE WATER SURFACE.

FROM WATER SURFACE TO THE CENTER OF THE HORIZANTAL SECTION OF THE SPARGER $\approx 68^{IN} = 5.6667$ ft

HEIGHT OF WATER LEVEL IN QUENCH TANK MODEL MUST BE ALSO $= 5.6667$ ft

VOLUME OF WATER IN QUENCH TANK $= 1476$ ft^3

SURFACE AREA BETWEEN WATER AND AIR $= \frac{1476}{5.6667} = 260.4706$ ft^2

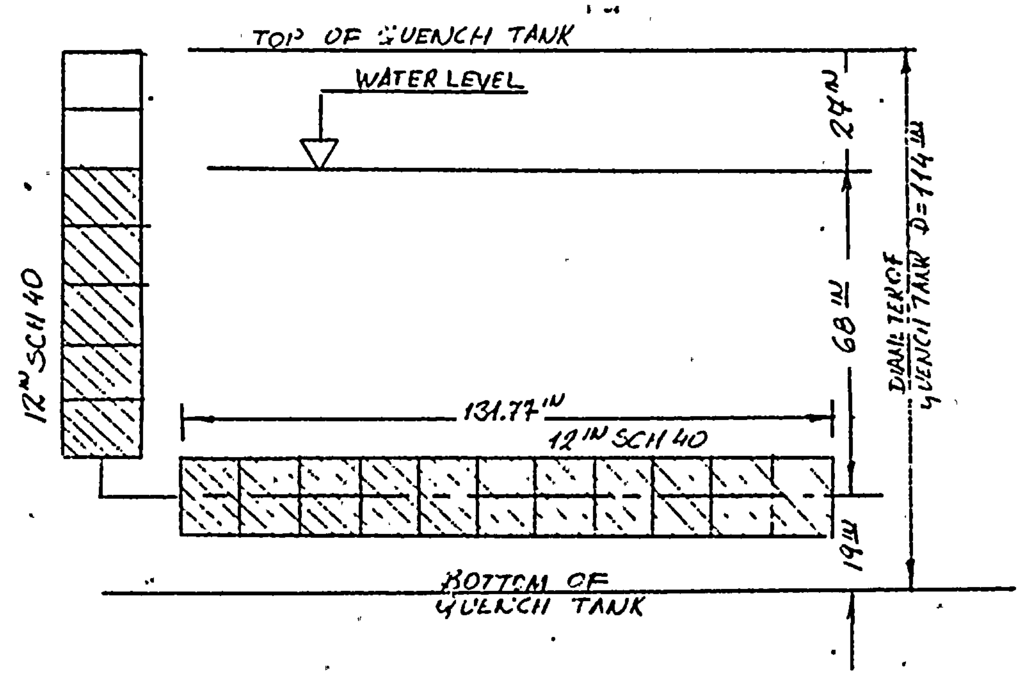
VOLUME OF AIR IN QUENCH TANK $= 324$ ft^3

HEIGHT OF AIR VOLUME IN RELAP MODEL $= \frac{324}{260.4706} = 1.2439$ ft

FIGURE 4.2.1-4

FIGURE 4.2.1-5

SPARGER MODELING



AREA OF EACH HOLE ON SPARGER SIDE = 0.1963 in² = 0.0014 ft²

TOTAL FLOW AREA OF ALL THE SIDE HOLES = 1054 x 0.0014 = 1.4368 ft²

FLOW AREA OF 12 in SCH40 PIPE = 0.7773 ft²

ALL THE HOLES ARE DISTRIBUTED EVENLY @ 183 in LENGTH FROM THE TIP OF THE SPARGER

AREA RATIOS $= \frac{0.7773}{1.4368} = 0.541$ REPRESENTS THE SECTION OF THE SPARGER WHICH INCLUDES ALL THE HOLES WITH THE TOTAL AREAS EQUAL TO THE FLOW AREA OF THE 12" SCH40 PIPE.

$1 - 0.541 = .459$

$183 \times 0.459 = 83.9977 \approx 84.0'' = 7$ ft THE LENGTH WHICH MUST BE EXCLUDED FROM THE TIP

TOTAL LENGTH OF HORIZONTAL SECTION = 215.77 in (REF DRW ON Page 1)

THIS LENGTH IN RELAP MODEL = $215.77 - 84 = 131.77 \approx 11$ ft

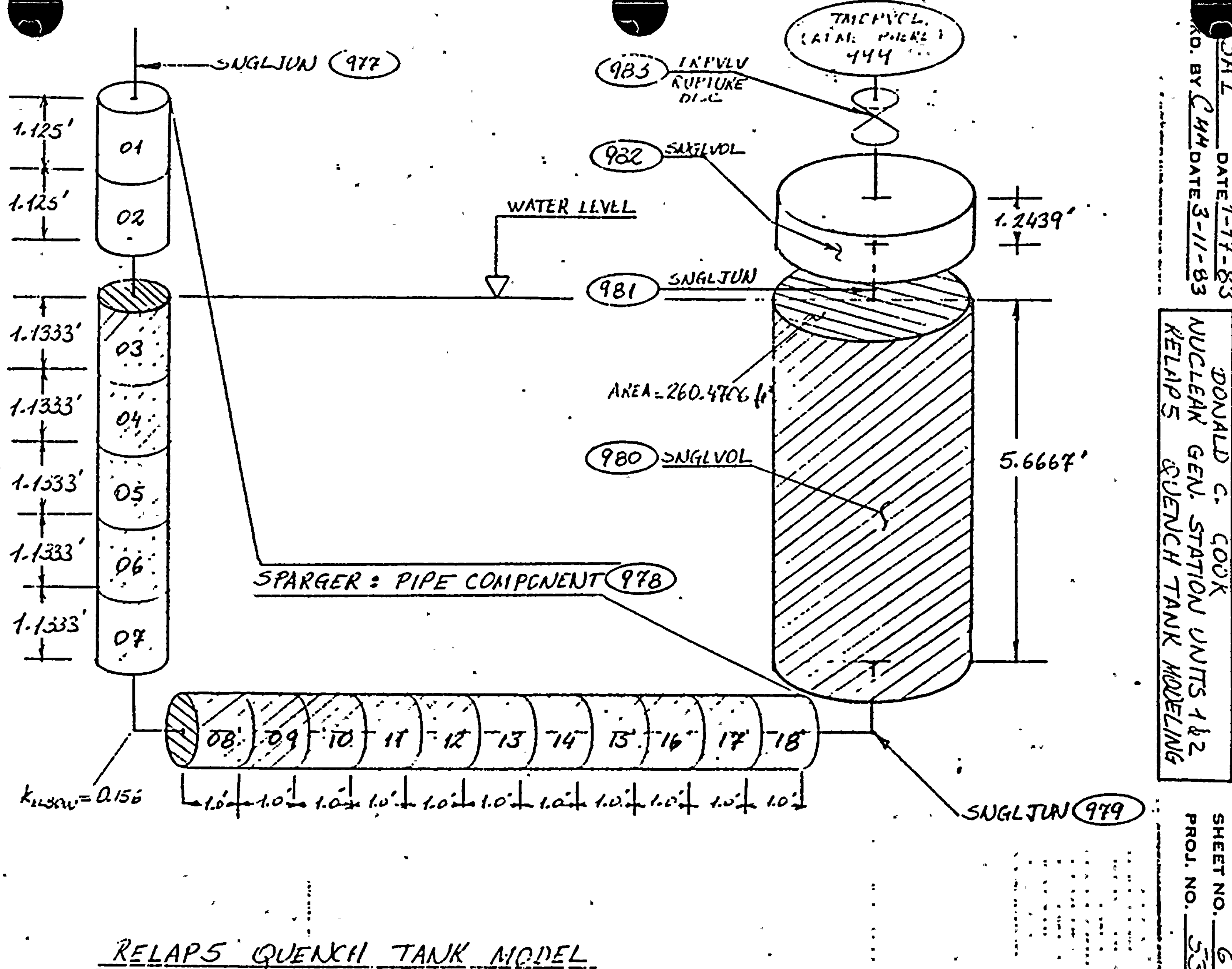

TELEDYNE ENGINEERING SERVICES
DATE 1-17-83
DATE 3-11-83
DONALD C. COOK NUCLEAR GEN. STATION UNITS 1 & 2
RELAP5 QUENCH TANK MODELING
SHEET NO. 6 OF 6
PROJ. NO. 5364
SNGLJUN 977
983 TMDPVLV RUPTURE DISC
TMDPVOL (ATM. PRESS.) 444
982 SNGLVOL
1.2439'
WATER LEVEL
981 SNGLJUN
AREA = 260.4706 ft²
980 SNGLVOL
5.6667'
1.125'
1.125'
01
02
1.1333'
1.1333'
1.1333'
1.1333'
1.1333'
03
04
05
06
07
SPARGER : PIPE COMPONENT 978
08 09 10 11 12 13 14 15 16 17 18
1.0' 1.0' 1.0' 1.0' 1.0' 1.0' 1.0' 1.0' 1.0' 1.0' 1.0'
SNGLJUN 979
RELAP5 QUENCH TANK MODEL

FIGURE 4.2.1-6

4.3 RELAP Model Control Volumes

The "Evaluation of RELAP5/MOD1 for Calculation of Safety/Relief Valve Discharge Piping Hydrodynamic Loads" report prepared by Intermountain Technologies Inc. (Reference 6) recommends using ten or more control volumes per bounded segment when modeling valve discharge piping for RELAP5, while avoiding significant control volume length differences to preserve pressure wave shapes. The ten control volume criteria recommended by ITI was adhered to by TES in all cases, except in piping arcs and in segments less than three feet in length. The D.C. Cook discharge piping is modeled using as few as one control volume per segment (pipe segments with lengths less than 0.5 feet) and up to thirty-two control volumes per segment.

Arc modeling for Unit 2 is represented in Figure 4.3.1. All arcs for Unit 2 were modeled in RELAP as having no fluid losses. Essentially, RELAP calculates these as straight sections of pipe. REPIPE, however, distributes the calculated forces to pre-assigned node points matching the TES structural models.

Average control volume lengths used for the D.C. Cook RELAP Unit 2 model were:

Pipe Size	Average C.V. Length
3 inch SCH 160	0.5264 feet
6 inch SCH 160	0.5019 feet
4 inch SCH 40S	0.5056 feet
6 inch SCH 40S	0.8871 feet
12 inch SCH 40	0.8526 feet
3 inch SCH 40	0.4744 feet
4 inch SCH 120	0.4471 feet

The schematic of the discharge system modeled in RELAP for the SV Unit 2 model is represented in Figure 4.7.1.

Quench Tank modeling was achieved using twenty control volumes and twenty junctions. Eighteen volumes comprise the sparger model while the remaining two are single volumes modeling the water and air spaces of the quench tank. The water and air volumes as determined from Westinghouse Dwg. No. 110E272 (Reference 5) were input to RELAP to insure proper quenching capacity. Eighteen control volumes forming the sparger are initially 88% full of water representing a submerged pipe. The discharge holes were modeled as a single hole with an area of .7773 $ft.^2$ at a point on the sparger where the sum of the small hole areas equal the 12 inch schedule 40 discharge area.

Finally, the tank rupture disk is modeled as a pressure actuated valve placed on the air volume and set to blow out at 100 psig discharging to atmosphere. Figure 4.2.1 represents the D.C. Cook Unit 1 and 2 Quench Tanks. Pressure in the air volume of the quench tank never exceeded 30 psia during the Unit 2 SV transient case of steam and drained loop seals RELAP5 run for 0.5 seconds.

BY JMM DATE 1-17-83
CHKD. BY CJC DATE 2-17-83

RELAP MODEL 1/4 MODEL
ARC 1 LEVEL 669'-2" UNIT 2

SHEET NO. 1 OF 1
PROJ. NO. 5364

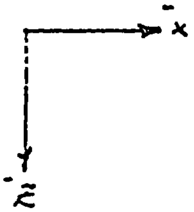
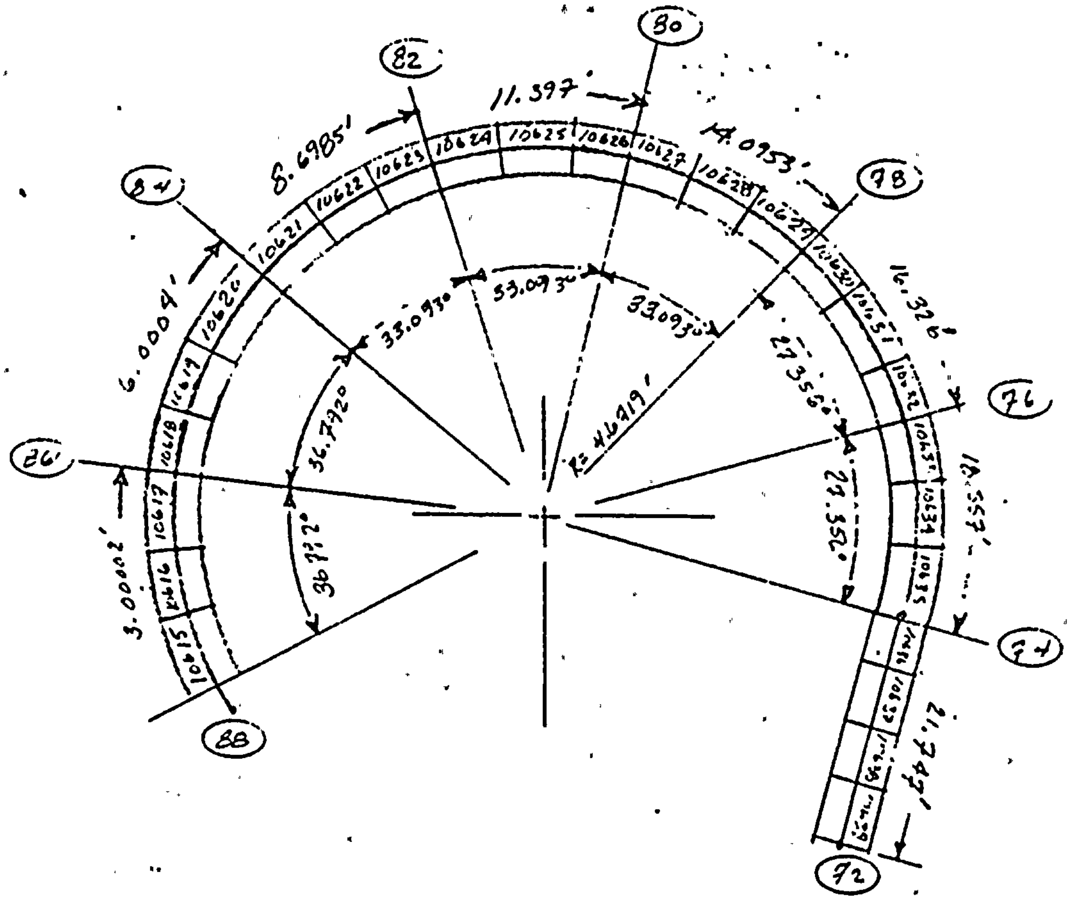


FIGURE 4.3.1-1

REF: JBM CALC
12-31-81



COMPONENT 106 6IN PIPE SCH 40S.
VOLUMES 10615 → 10639

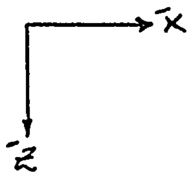
TELEDYNE ENGINEERING SERVICES

BY HM DATE 1-17-83
CHKD. BY CJC DATE 2-17-83

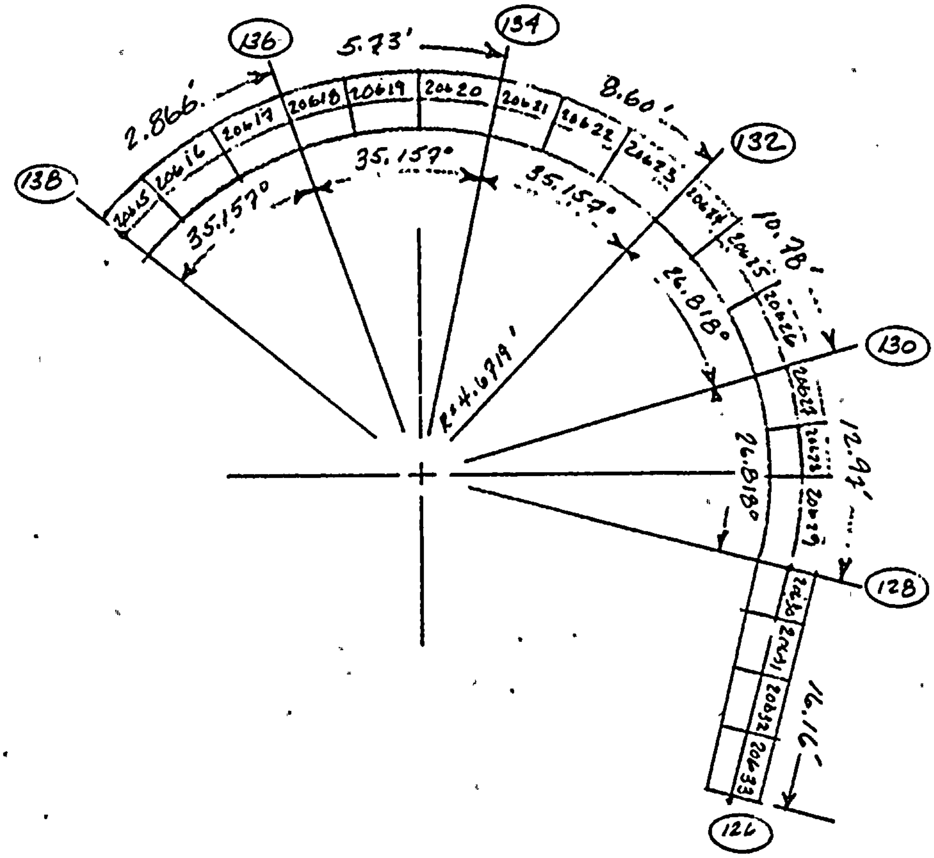
RELAP MODEL
ARC 2 LEVEL 670'-10" UNIT 2

SHEET NO. 1 OF 1
PROJ. NO. 5364

FIGURE 4.3.1-2



REF VBM CALC 12-31-81



COMPONENT 206
VOLUMES 20615 → 20633

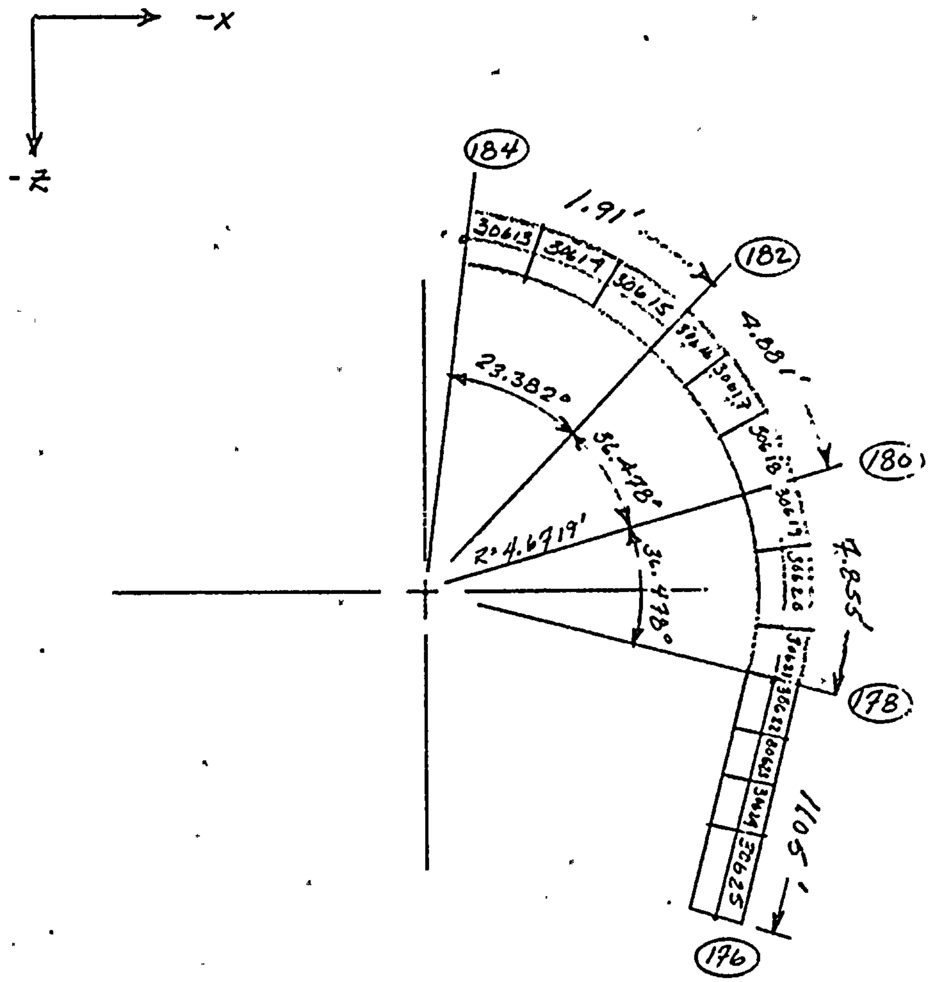
UM DATE 1-17-83
CHKD. BY CJC DATE 2-17-83

RELAP MODEL
ARC 3 LEVEL 672'-6" UNIT 2

SHEET NO. 1 OF 1
PROJ. NO. 5364

FIGURE 4.3.1-3

REF: JBM CALC
12-31-81



COMPONENT - 306

VOLUMES - 30613 → 30625

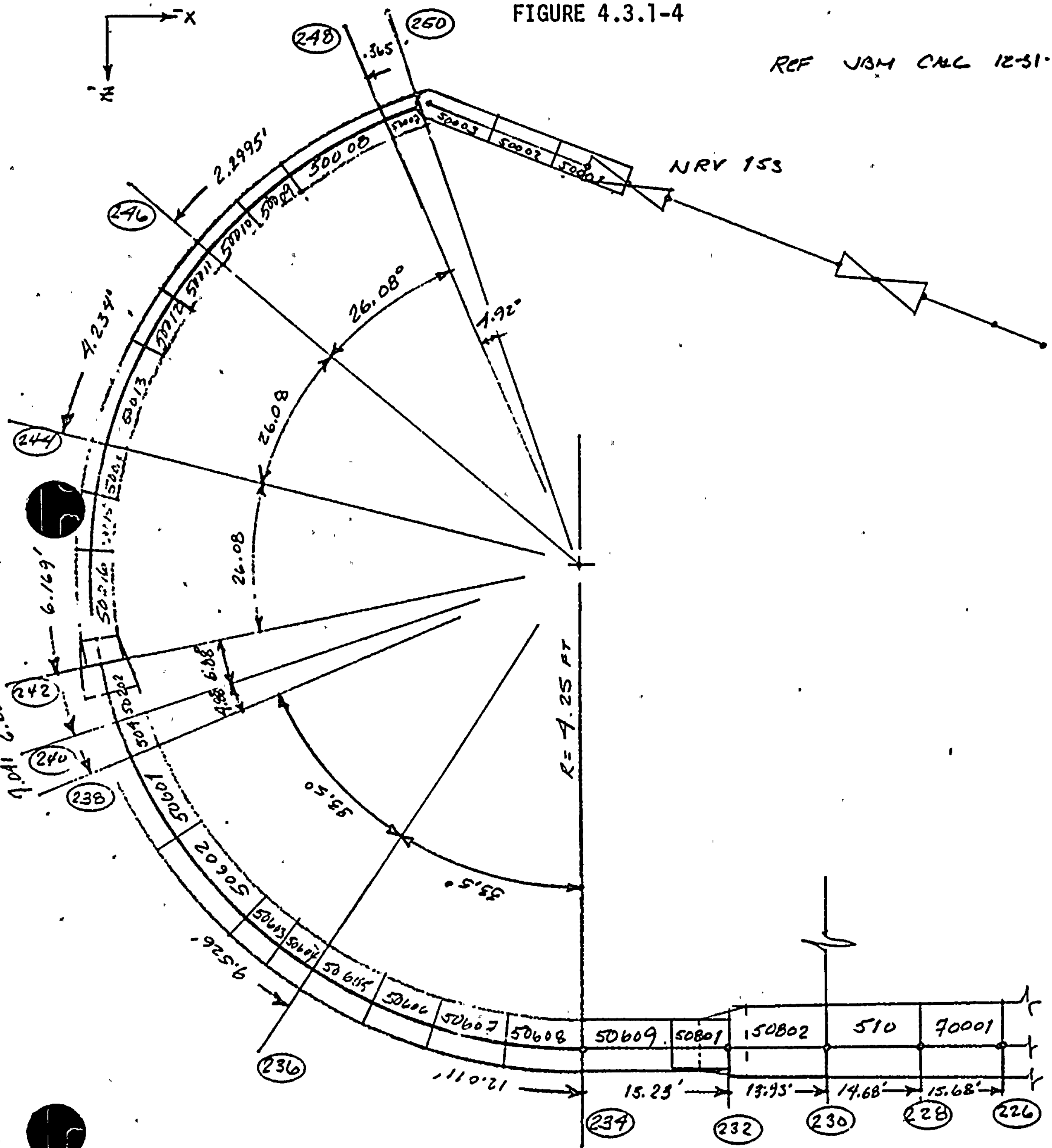
[illegible]MM DATE 1-14-83
CHKD. BY CJC DATE 2-17-83

RELAP MODEL ARC B.
ARC LEVEL 684'-9" UNIT 2

SHEET NO. 1 OF 1
PROJ. NO. 5364

FIGURE 4.3.1-4

REF JBM CALC 12-31-81



ELEVATION Δ = 0.5" - NEGLIGIBLE

4.4 Valve Flow Rate Calculation

The following values were used in valve modeling considerations:

Valve Type	TES Flow[2] Rate Calculated LBM/HR	Max Rating[1] For Steam @ 3% Accum.	Actual Bore Area (IN^2)	Opening Time (Sec)
Crosby Safety Relief Valve	452,393	435,000	3.6 in^2	0.010 (Ref. 15)

1 The maximum rating for steam at 3% accumulation value is from the Crosby Valve and Gage Safety Valve Drawing No. H-51688, Revision A (Reference 3).

2 Flow rate at 2500 psig plus 3% accumulation.

The valve flow rates normally used by TES in the RELAP analysis of the SVs would be a 15% increase in the ASME rated flow: 10% to consider the ASME underating of the theoretical flow and 5% to cover tolerances. However, in this particular case, Westinghouse has provided AEPSC with a summary of the EPRI flow rate tests of the Crosby 6M6 safety valve (Reference 7). Also, see Figure 4.4.1-4. A comparison was made in an effort to achieve a more realistic flow rate. The flow rate chosen which most closely bounds the test data is the following ASME flow rate. All calculations are included as Figure 4.4.1.

$W_T = 51.5\ AP$ Napier's Eq.

ASME rated flow:

$$W_R = 51.5A\ (1.03P + 14.7)(.9)(.966)C \qquad \text{(Ref. 8)}$$

where:

W_T = theoretical flow

W_R = rated flow

coefficients:

1.03 - applies 3% accumulation

0.966 - valve flow coefficient

0.9 - represents theoretical flow rate reduced 10% to equal ASME rating

C = 1.0771 calculated on Figure 4.4.1-2 following.

TELEDYNE ENGINEERING SERVICES

BY BAI	DATE 2-4-83	CROSBY 6M6 VALVE	SHEET NO. 1 OF 3
CHKD. BY CMM	DATE 2-10-83	RELAP5 MODEL FLOW AREA CALCULATIONS	PROJ. NO. 5364

FIGURE 4.4.1-1

REF: 1. ASME SEC III N.B.-7731.1 & N.B.-7734.2 (1980)

2. CROSBY 6M6 MODEL: HB-BP-86 VALVE DRAWING No: H-51688 REV. A

3. WESTINGHOUSE REPORT WCAP-10105
"REVIEW OF PRESSURIZER SAFETY VALVE PERFORMANCE AS OBSERVED IN THE EPRI SAFETY AND RELIEF VALVE TEST PROGRAM"

4. TES TELECON WITH MR. DAVE TIEBAULT FROM CROSBY DATED 2-4-83

CROSBY 6M6 VALVE PROPERTIES

MANUFACTURER	: CROSBY VALVE & GAGE CO.
TYPE	: SPRING LOADED SAFETY VALVE
MODEL NO	: HB-BP-86 6M6
DRAWING NO.	: H-51688 REV. A
BORE AREA (A_R)	: 3.644 in^2
DESIGN SET PRESS. (P_{SET})	: 2485 psig
DISCHARGE COEF. (K_D)	: 0.966

CALCULATION OF MAX. FLOW RATE (w_R)

THE FOLLOWING ASSUMPTIONS AND CONSIDERATIONS ARE MADE IN DETERMINING w_R FOR RELAP5 MODEL

1. IN THE FOLLOWING CALCULATIONS A CONSTANT SET PRESSURE IS USED TO CALCULATE A FLOW AREA FOR THE RELAP5 MODEL AND DOES NOT NECESSARILY REPRESENT PRESSURIZER INPUT CONDITIONS

2. THERE ARE VARIOUS EQUATIONS AND EXPERIMENTAL RESULTS YIELDING DIFFERENT FLOW RATES. ALL OF THESE ARE PRESENTED IN THE PROCEDING PAGE. A FLOW RATE WAS SELECTED SUCH THAT IT WOULD BE CONSERVATIVE. IF COMPARED WITH TEST DATA BUT IT WOULD STILL BE REALISTIC.

TELEDYNE ENGINEERING SERVICES

BY [redacted] DATE 2-4-83
CHKD. BY CMM DATE 2-10-83

CROSBY 6M6 VALVE
RELAP5 MODEL FLOW AREA CALCULATIONS

SHEET NO. 2 OF 3
PROJ. NO. 5364

FIGURE 4.4.1-2

VARIOUS FLOW RATES FOR 6M6 CROSBY VALVE FROM DIFFERENT SOURCES

1. FLOW RATE BY USING EQN. $\left.w_R\right)_1 = 51.5 \times A_R (1.03 P_{SET} + 14.7) K_D$

WHERE $A_R = 3.644$ in²
$P_{SET} = 2485$ psig
$K_D = 0.966$

$\left.w_R\right)_1 = 466\,674$ lb/hr

2. FLOW RATE BY USING EQN. $\left.w_R\right)_2 = 51.5 \times A_R (1.03 P_{SET} + 14.7) K_D (0.9)$
FACTOR: 0.9 TAKES INTO ACCOUNT MANUFACTURING TOLERANCES

(ASME. FLOW RATE FROM OLD EQN) $\left.w_R\right)_2 = 420\,006$ lb/hr

3. FLOW RATE BY USING EQN. $\left.w_R\right)_3 = 51.5 \times A_R (1.03 P_{SET} + 14.7)(0.9)$

HERE $K_D = 1.0$
(THIS IS THE VALUE PRESENTED ON 6M6 DRWG. (REF.2) AS $w_{R_3} \simeq 435\,000$ lb/hr) $\left.w_R\right)_3 = 434788$ lb/hr

4. FLOW RATE BY USING EQN. $\left.w_R\right)_4 = 51.5 \times A_R (1.03 P_{SET} + 14.7) C \times K_D$
(THIS IS THE NEW ASME EQN. WITHOUT MANUFACTURING TOLERANCES)

$C = \dfrac{0.1906\ P_{SET} - 1000}{0.2292\ P_{SET} - 1061}$ $\quad C = 1.07711$

$\left.w_{R}\right)_4 = 502\,659$ lb/hr

5. FLOW RATE BY USING EQN $\left.w_R\right)_5 = 51.5 A_R (1.03 P_{SET} + 14.7) C \times K_D \times 0.9$
$C = 1.07711$

(FACTOR OF 0.9 INCLUDES MANUFACTURING TOLERANCES) $\left.w_R\right)_5 = 452\,393$ lb/hr

6. MAXIMUM TESTED FLOW RATE (REF.3)

$\left.w_R\right)_6 \cong 444\,000$ lb/hr

TELEDYNE ENGINEERING SERVICES

BY BAI DATE 2-4-83
CHKD. BY CMM DATE 2-10-83

CROSBY 6M6 VALVE
RELAP5 MODEL FLOW AREA CALCULATIONS

SHEET NO. 3 OF 3
PROJ. NO. 5364

FIGURE 4.4.1-3

IN RELAP5 MODEL FOR THE 6M6 CROSBY VALVE $W_R) = 452393$ lb/hr WAS USED BASED ON ASSUMPTION 2 AT PAGE 1.

$$W_R = 452\,393 \text{ lb/hr} = 125.66 \text{ lb/sec}$$

USING THE COMPUTER RUN BAICDRØ

VALVE FULL OPEN AREA IN THE RUN BAICDRØ = 0.0232 ft²
FLOW RATE @ 80% OPENING = 122.99 lb/sec
FLOW RATE @ 90% OPENING = 138.01 lb/sec

RELAP5 FLOW AREA WHICH DELIVERS $W_R = 125.66$ lb/sec IS CALCULATED BY INTERPOLATION

$$A_{FLOW} = \left[0.8 + 0.1\,\frac{125.66 - 122.99}{138.01 - 122.99}\right](0.0232)$$

$A_{FLOW} = 0.01897$ ft²

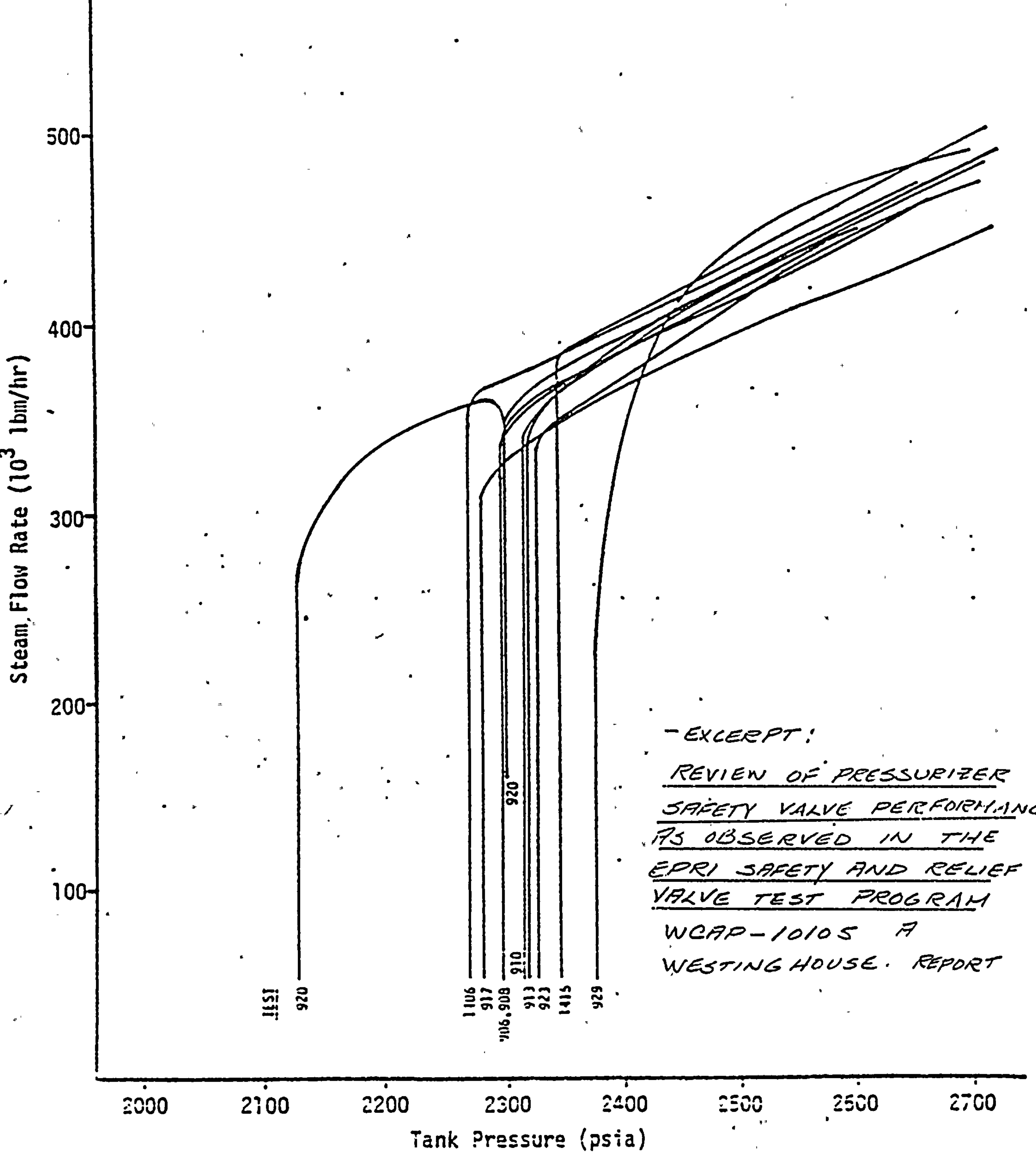
∴ CROSBY 6M6 RELAP5 MODEL FLOW AREA = 0.01897 ft²

FIGURE 4.4.1-4

FIGURE 3-5

STEAM DISCHARGE CYCLE (STABLE)

CROSBY 6M6



- EXCERPT:
REVIEW OF PRESSURIZER SAFETY VALVE PERFORMANCE AS OBSERVED IN THE EPRI SAFETY AND RELIEF VALVE TEST PROGRAM
WCAP-10105 A
WESTINGHOUSE REPORT

4.5 RELAP Plots

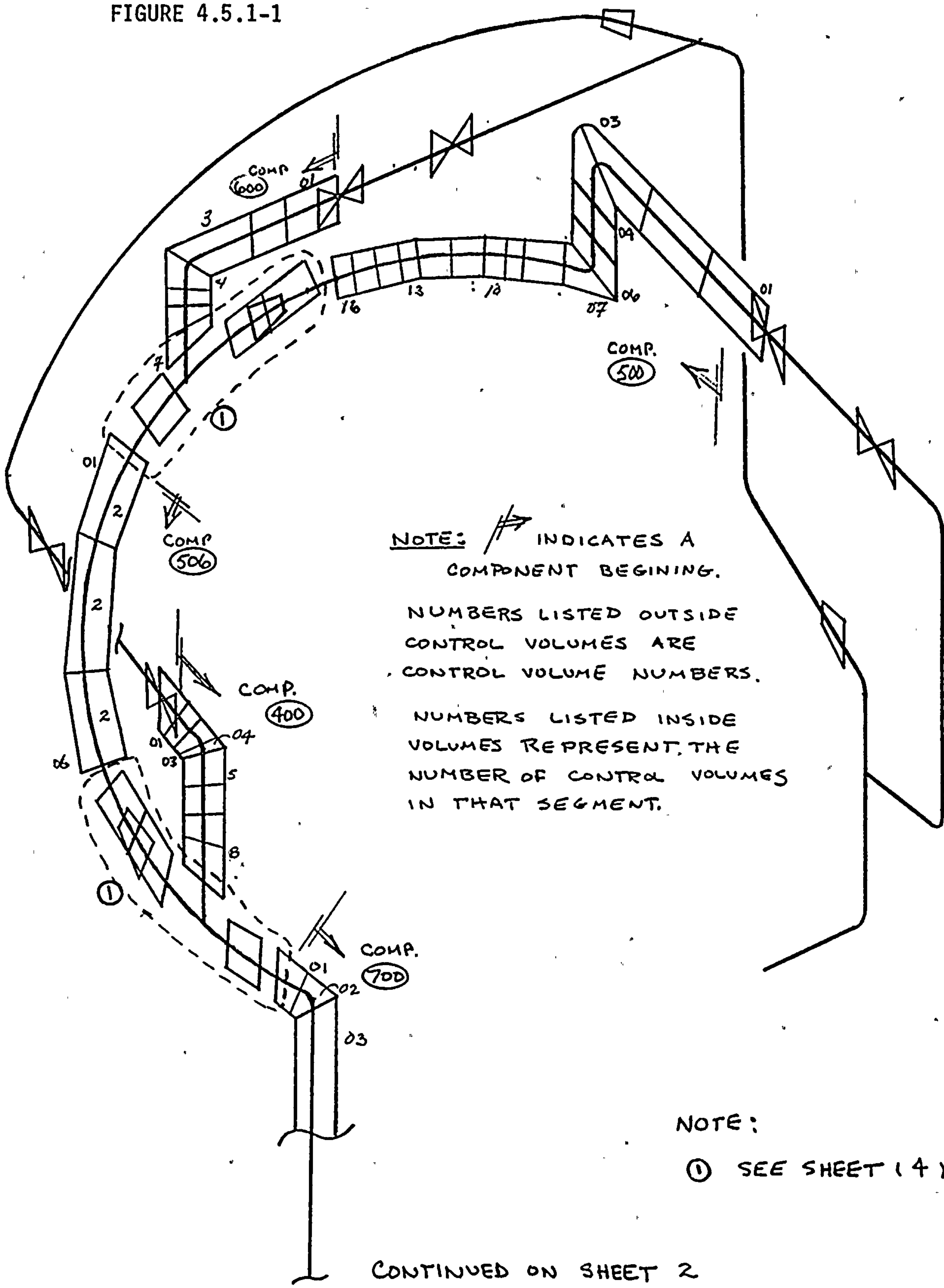
The following plots represent RELAP mass flows, pressures and qualities at various points along the discharge piping. The ordinate axis may not always be correct; many times multipliers will be off (CDC is aware of this problem in RELAP). However, the plots do depict trends accurately and are calculated and reported in RELAP every 0.001 seconds. Correct peaks and times at which they occur are listed with each trace. A RELAP volume schematic precedes the plot set for the transient steam case.

BY CJC DATE 3-11-83
CHKD. BY CLM DATE 3-11-83

RELAP MODEL SCHEMATIC
UNIT 2 PORV SECTION

SHEET NO. 1 OF 6
PROJ. NO. 5364

FIGURE 4.5.1-1



NOTE: INDICATES A COMPONENT BEGINING.

NUMBERS LISTED OUTSIDE CONTROL VOLUMES ARE CONTROL VOLUME NUMBERS.

NUMBERS LISTED INSIDE VOLUMES REPRESENT THE NUMBER OF CONTROL VOLUMES IN THAT SEGMENT.

NOTE:

① SEE SHEET (4)

CONTINUED ON SHEET 2

Technical Report
TR-5364-4
Revision 0

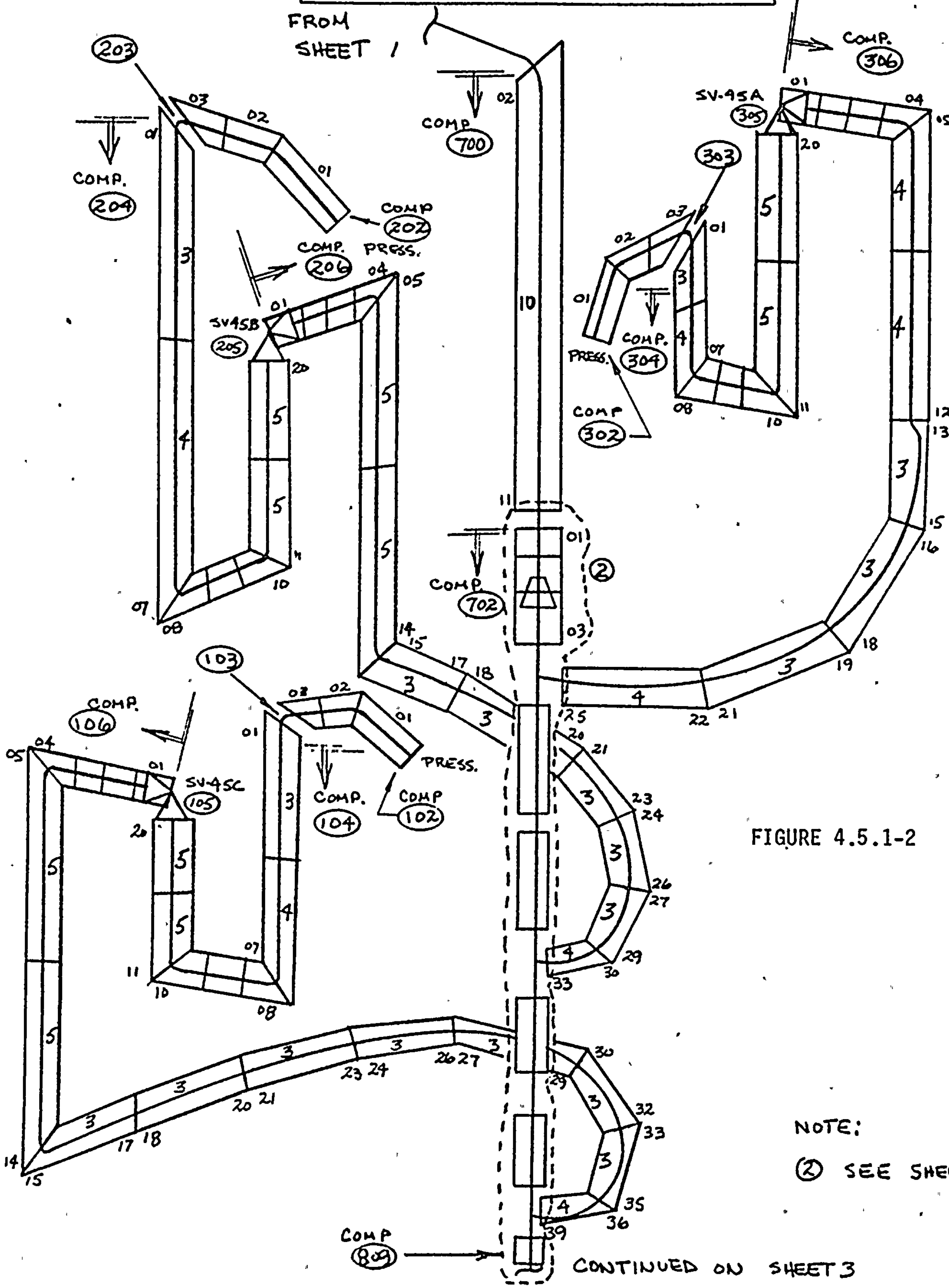
TELEDYNE ENGINEERING SERVICES

PORV MODEL

BY CJC DATE 3-11-83
CHKD. BY CMM DATE 3-11-83

RELAP MODEL SCHEMATIC
UNIT2 SRV SECTION

SHEET NO. 2 OF 6
PROJ. NO. 5364



CONTINUED ON SHEET 3

FIGURE 4.5.1-2

NOTE:

② SEE SHEET (5)

TELEDYNE ENGINEERING SERVICES

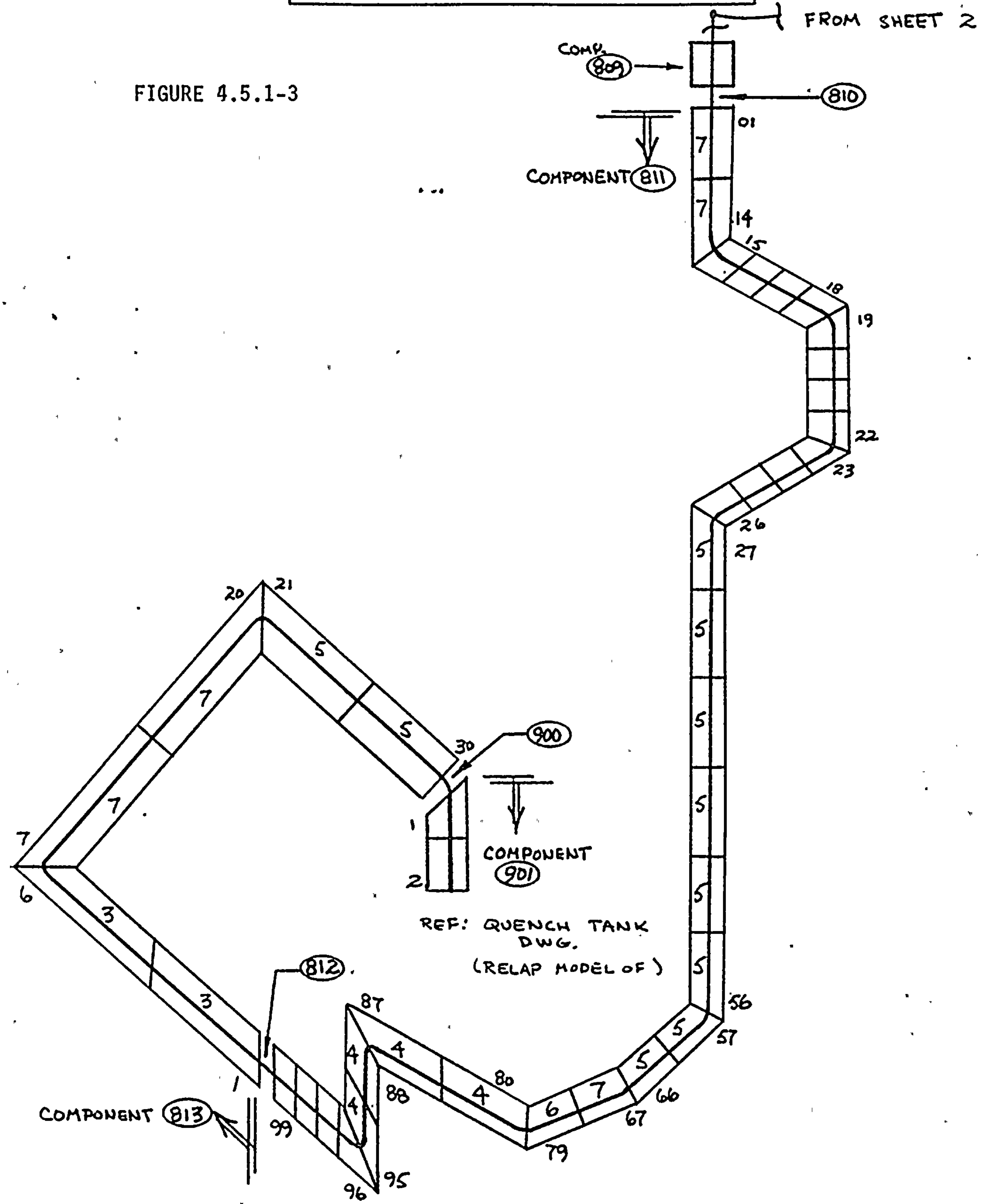
PORV MODEL

BY CJC DATE 3-11-83
CHKD. BY CNM DATE 3-11-83

RELAP MODEL SCHEMATIC
UNIT 2 12" DWNSTRM. SECTION

SHEET NO. 3 OF 6
PROJ. NO. 5364

FIGURE 4.5.1-3



TELEDYNE ENGINEERING SERVICES

BY CMM DATE 1-19-83
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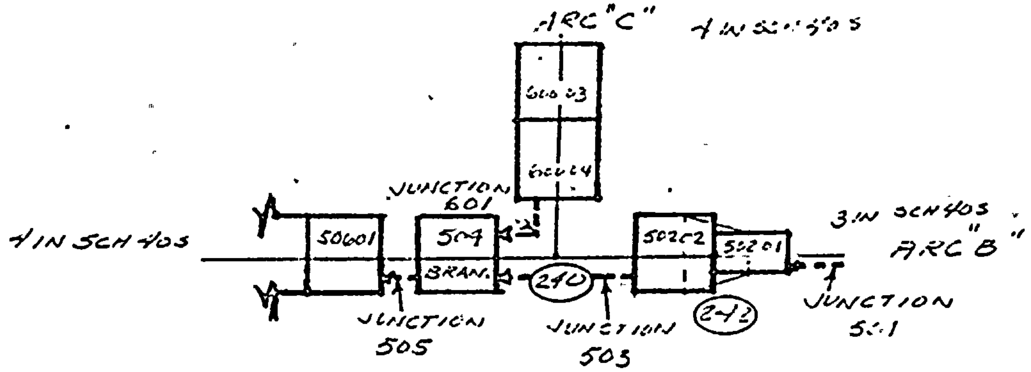
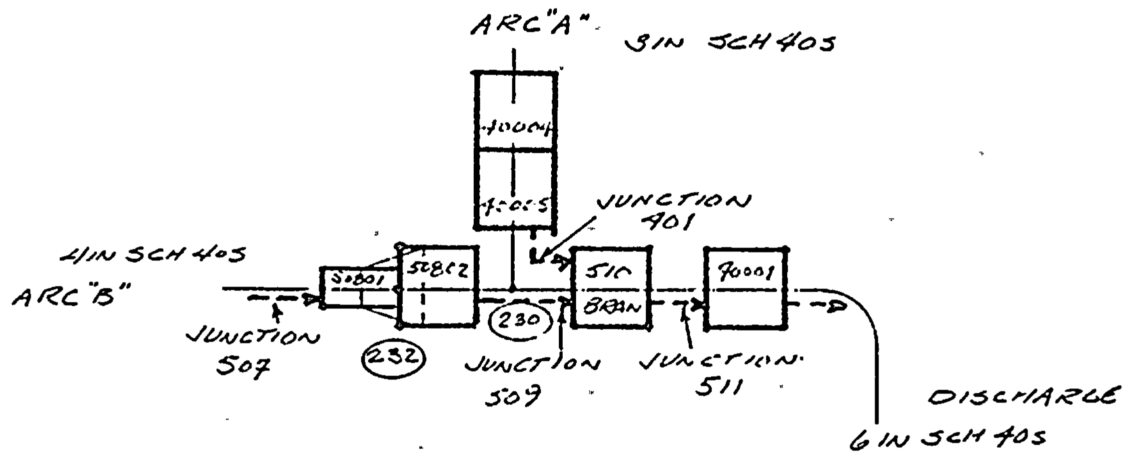
4-27

RELAP5 MODEL
UNIT 2 BRANCHES & TEES.

SHEET NO. 4 OF 6
PROJ. NO. 5364



INTERSECTION OF ARCS B & C 4 IN x 3 IN TEE (SCH 40S)

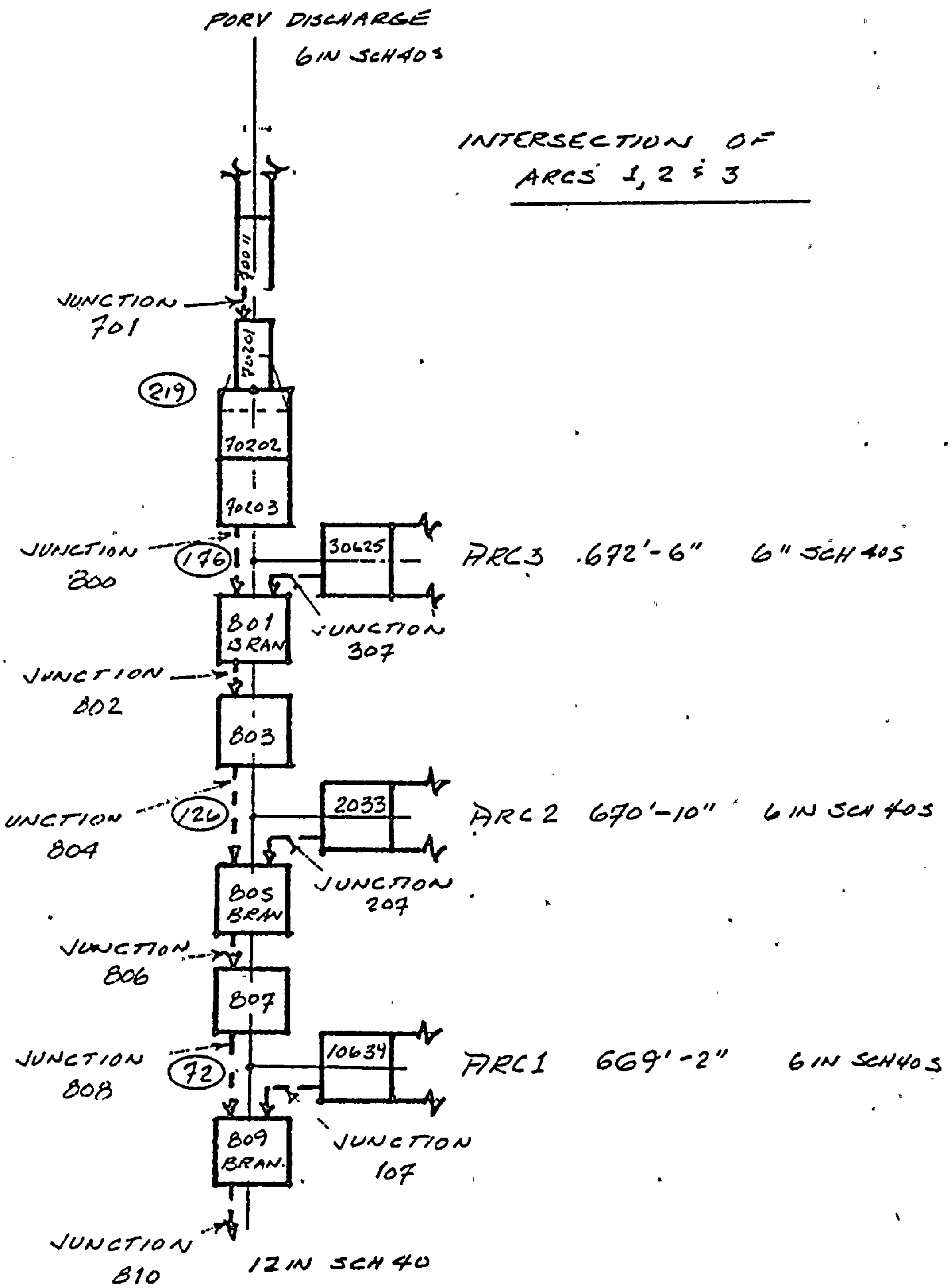


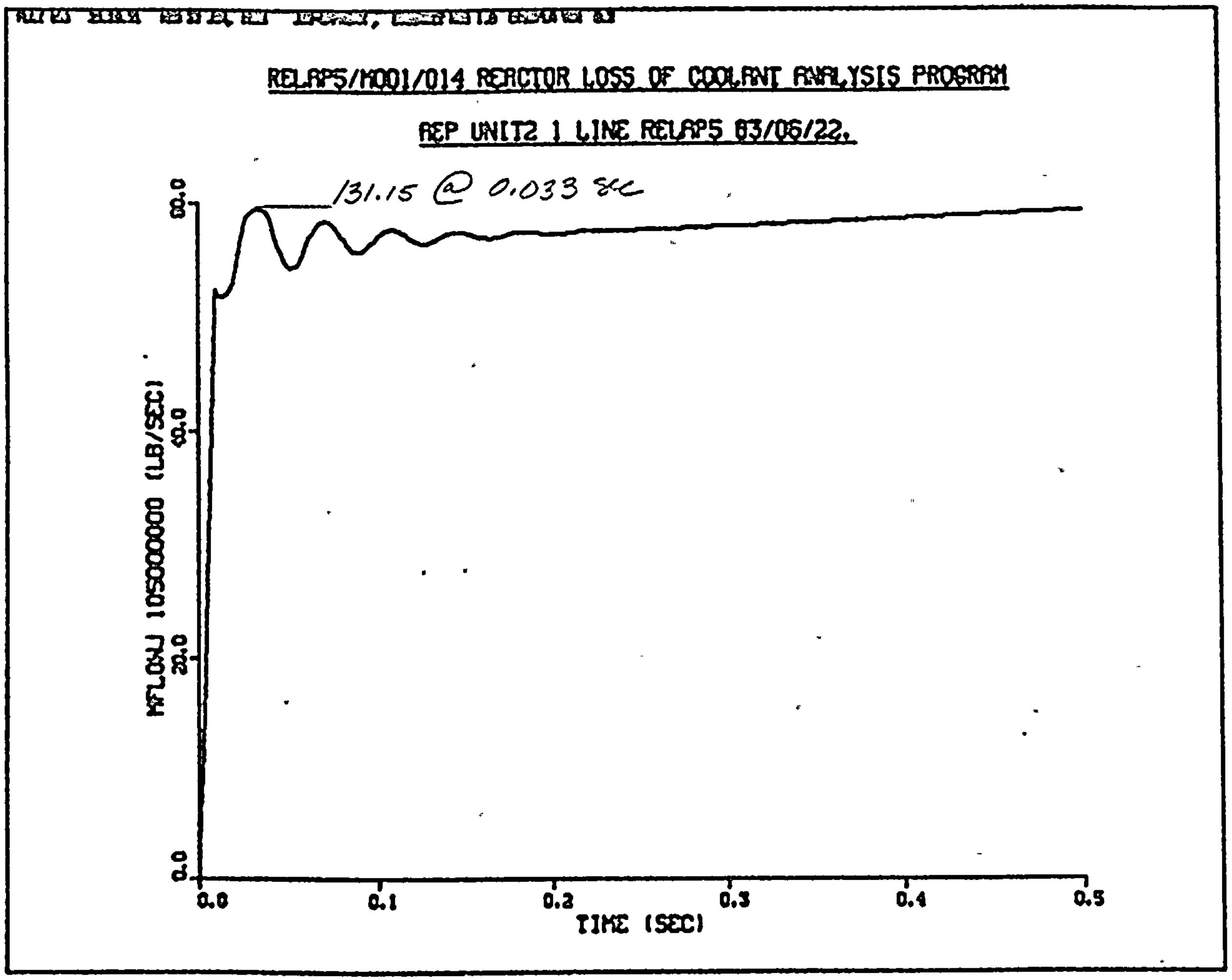
INTERSECTION OF ARCS B & A 3 IN x 6 IN TEE (SCH 40S)

FIGURE 4.5.1-4

BY CMM DATE 1-19-83	RELAP5 MODEL	SHEET NO. 5 OF 6
CHKD. BY CJC DATE 2-17-83	UNIT2 BRANCHES & TEES	PROJ. NO. 5364

FIGURE 4.5.1-5





TELEDYNE
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BY KJG DATE 6-22-83

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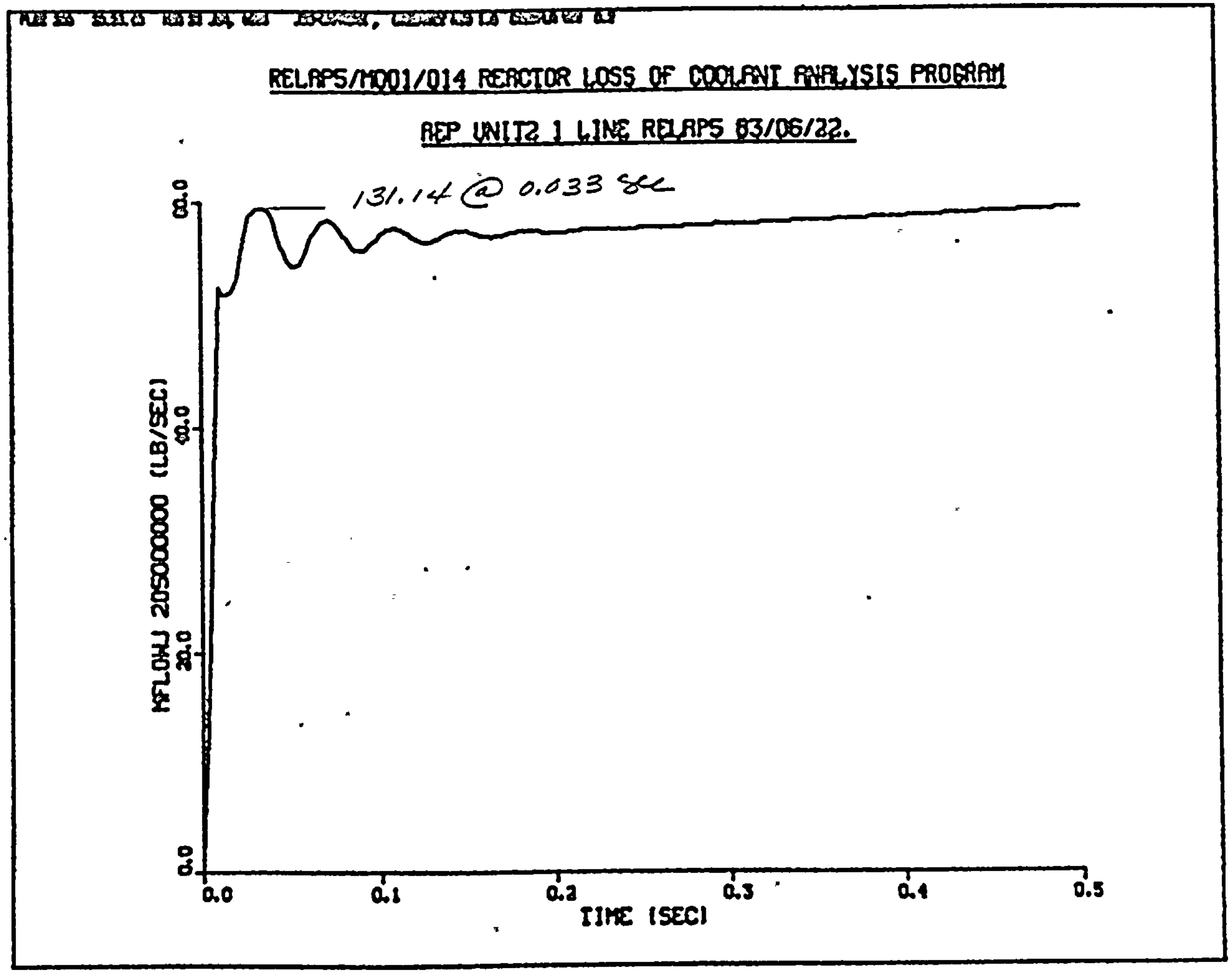

TELEDYNE ENGINEERING SERVICES

BY KJG DATE 6-22-83

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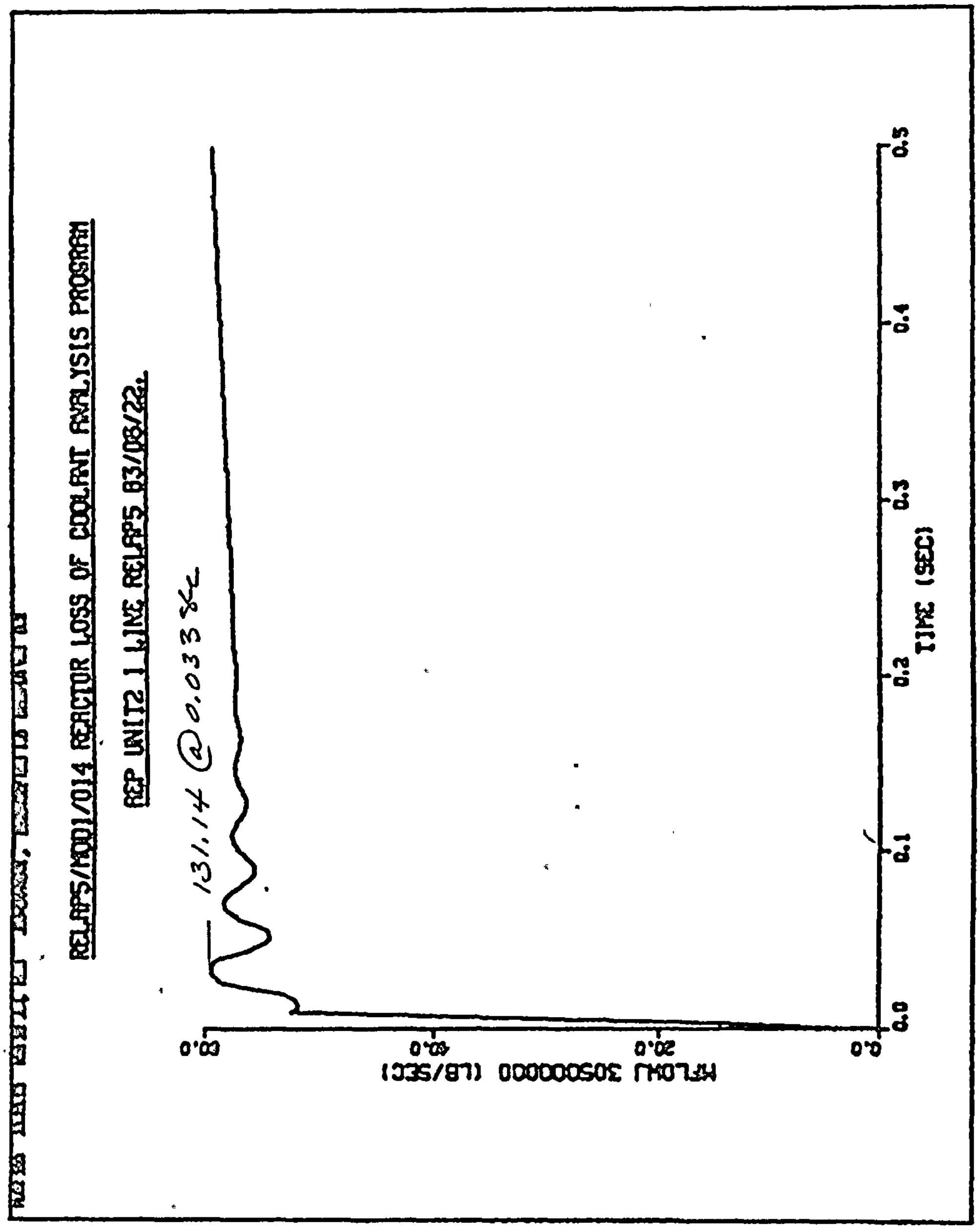
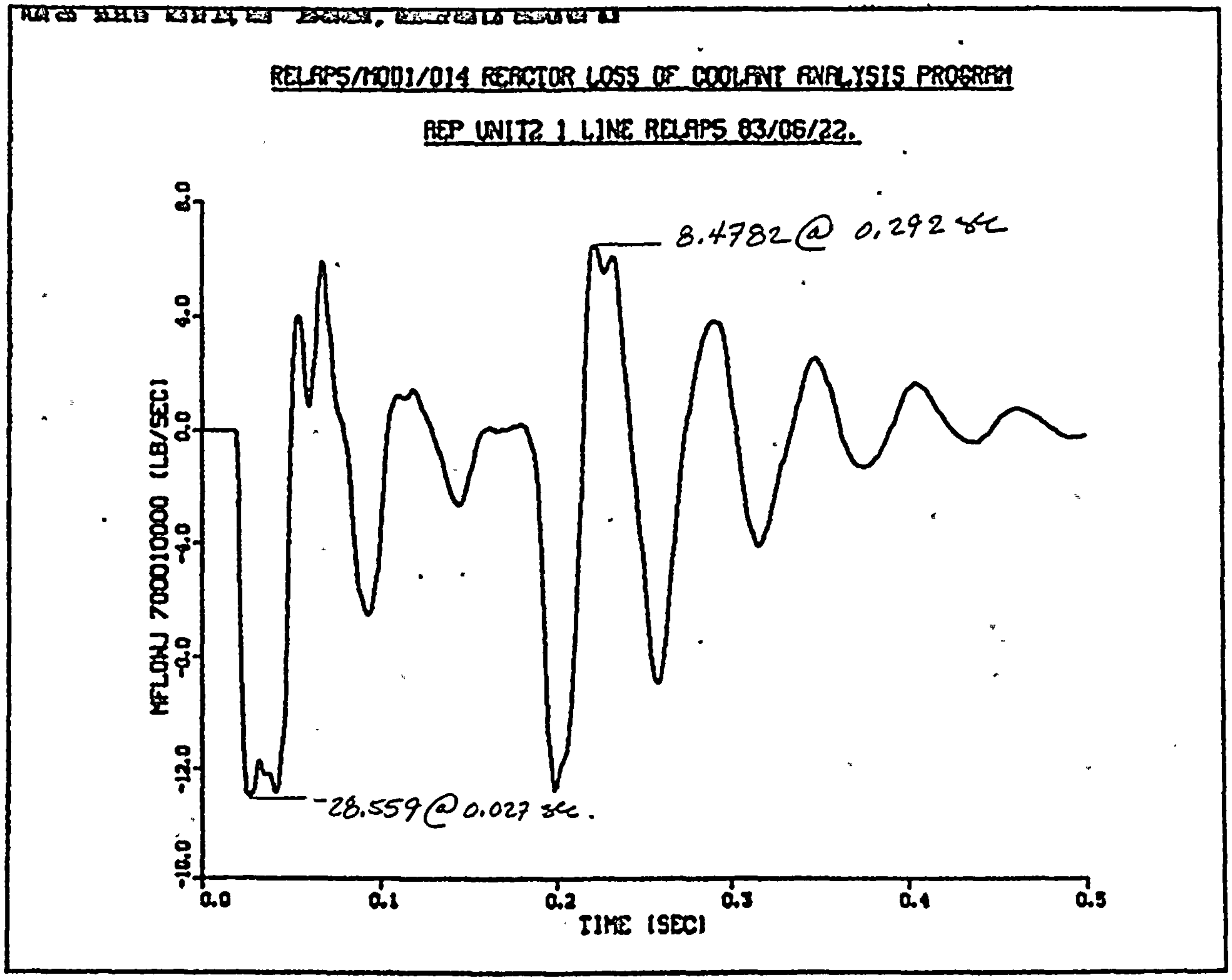
TELEDYNE
ENGINEERING SERVICES

BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83





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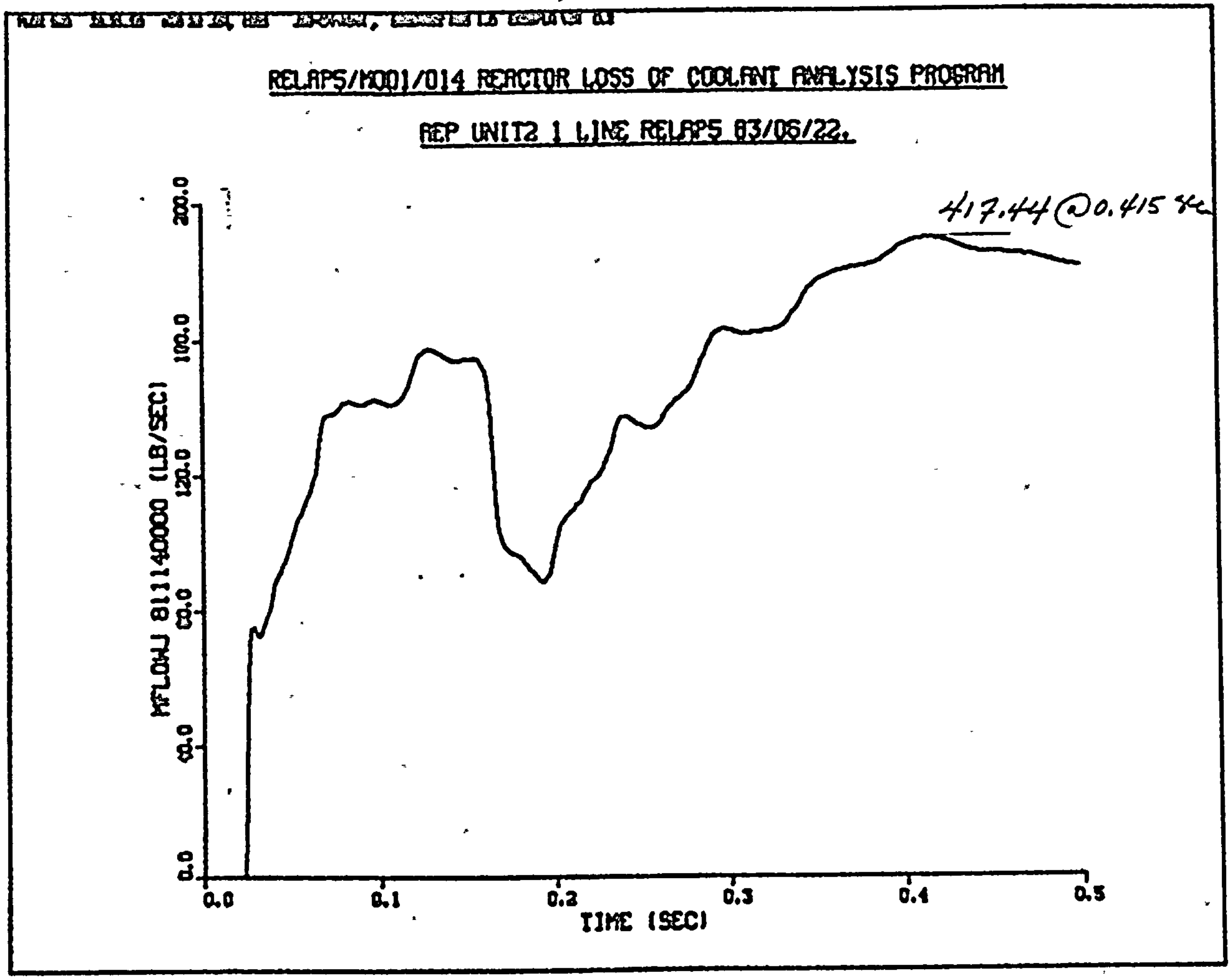

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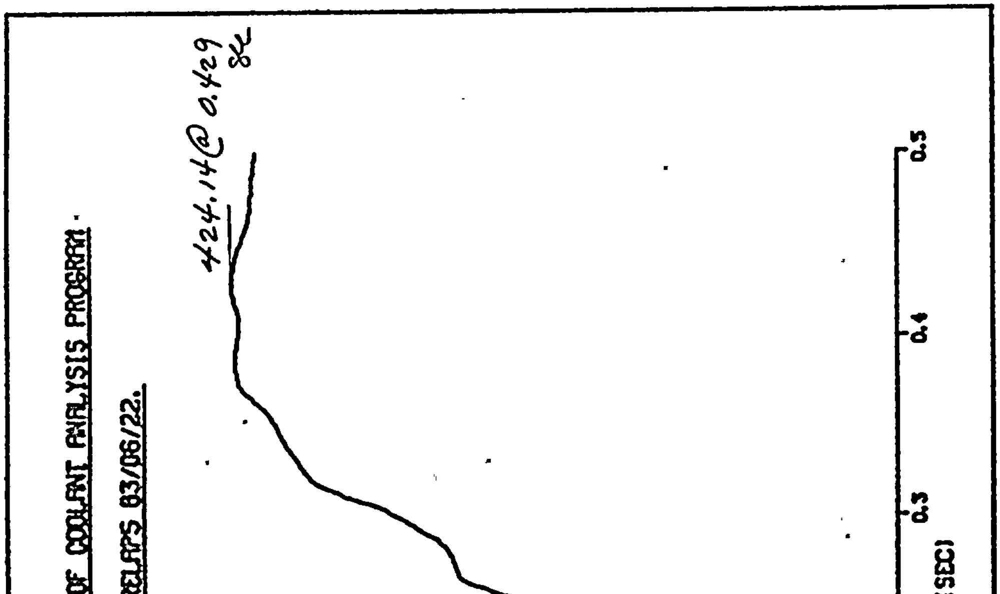
BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83



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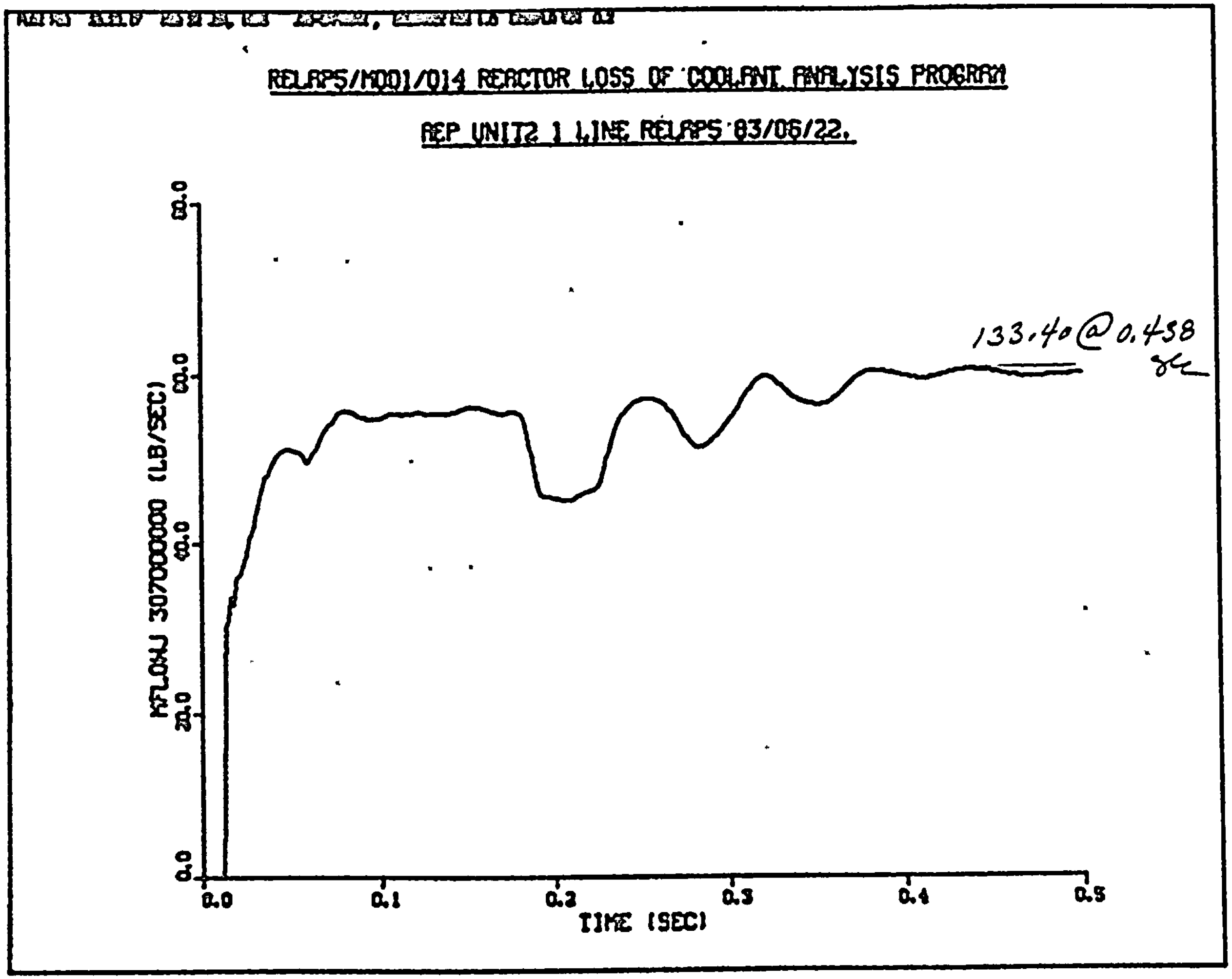

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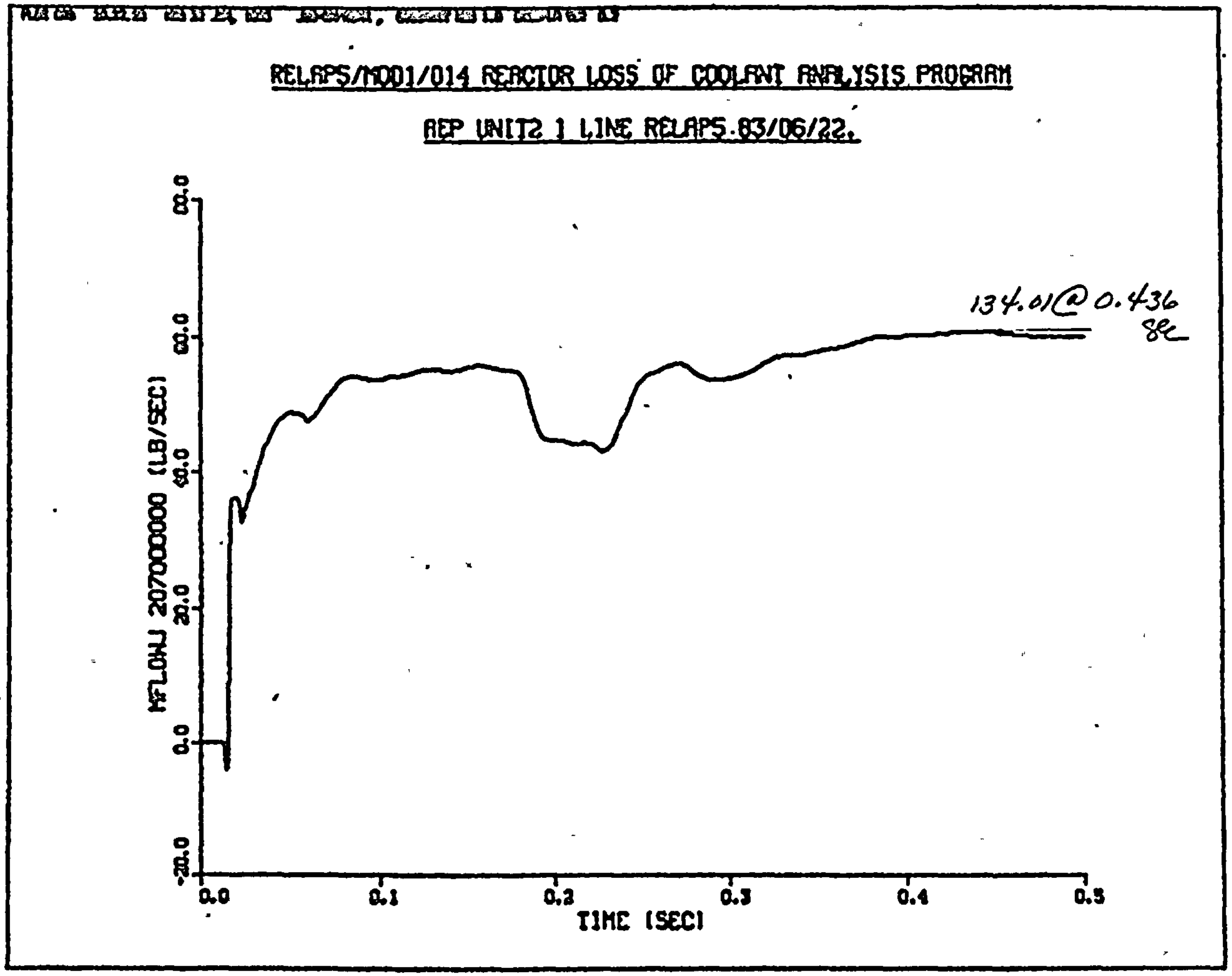

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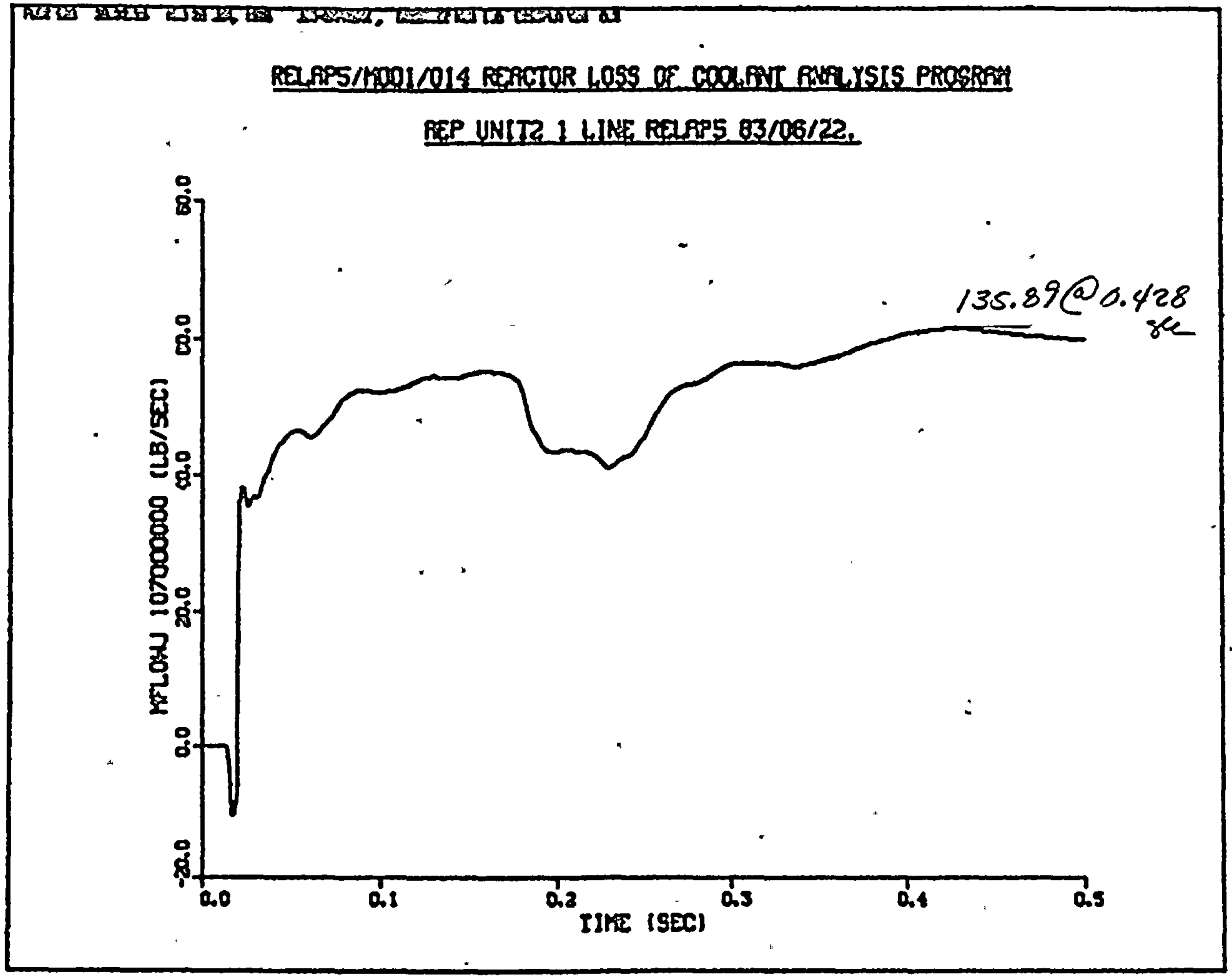

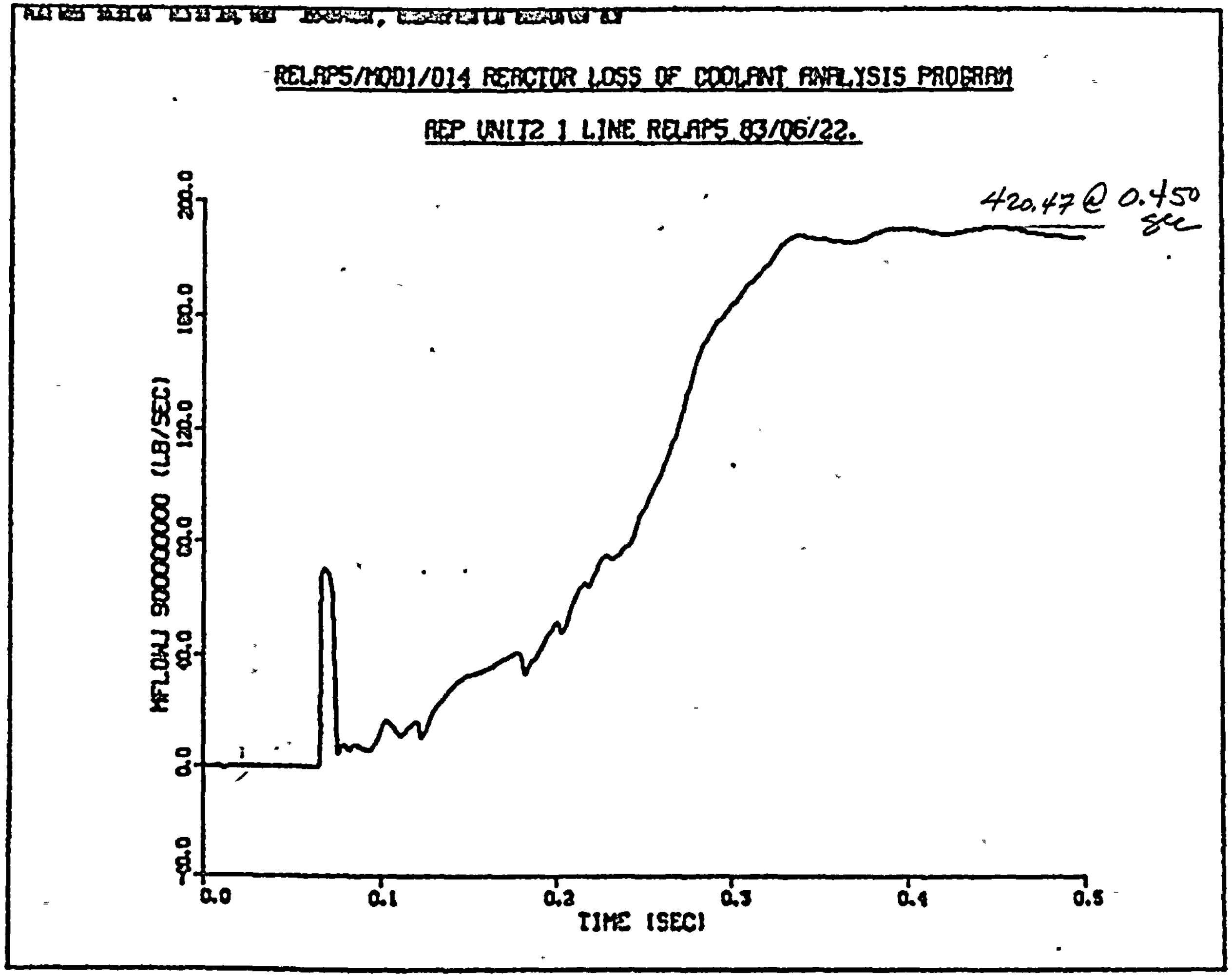

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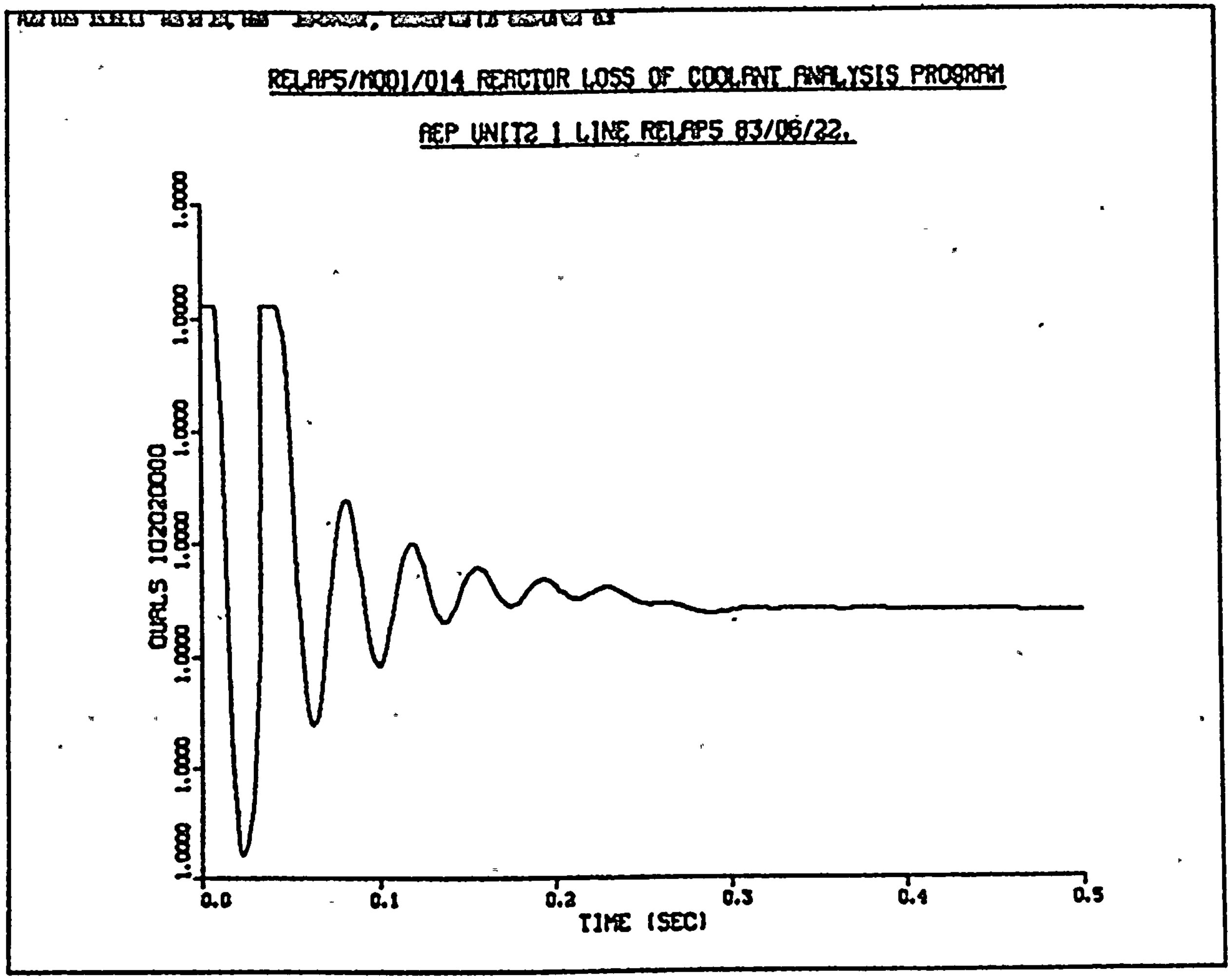

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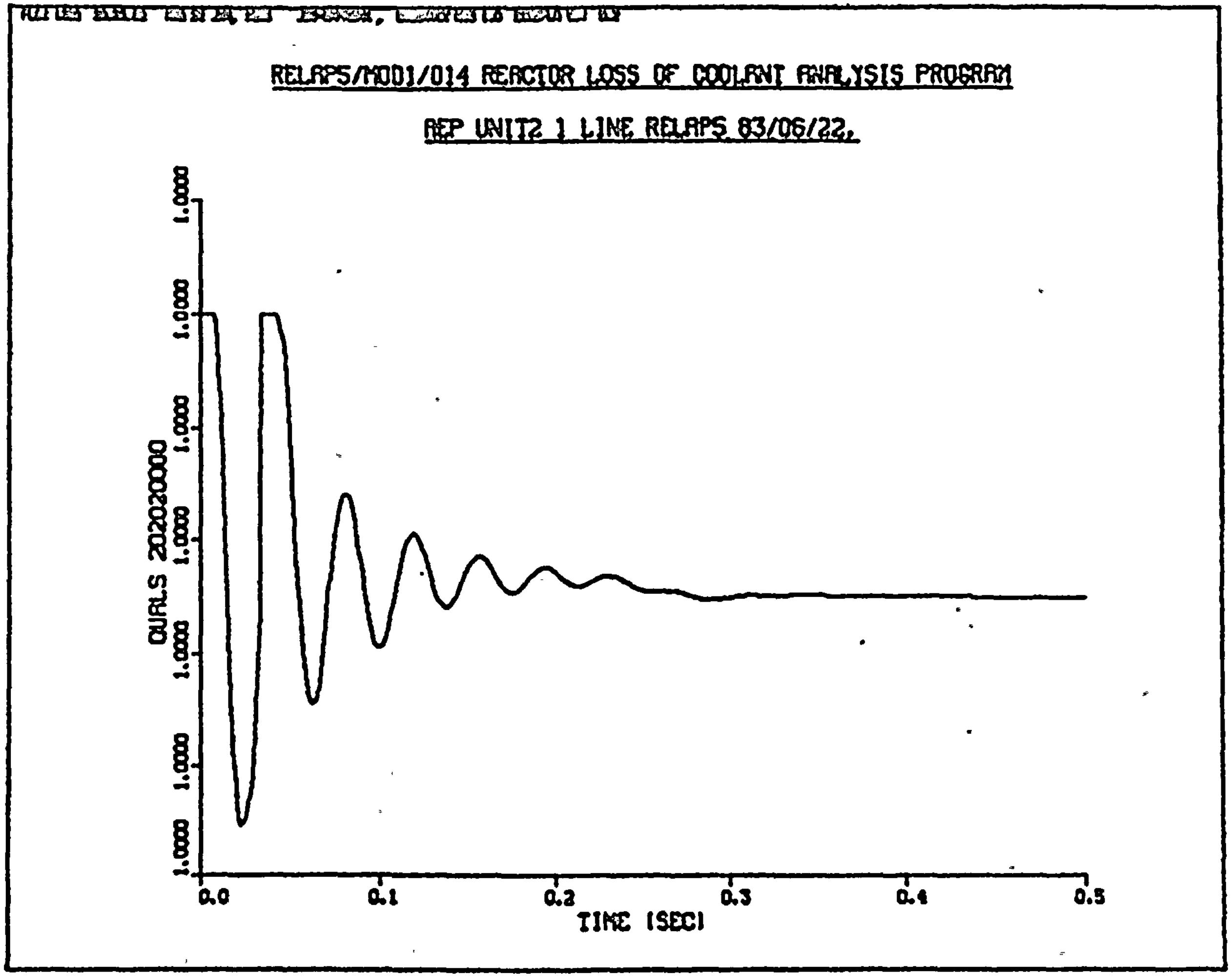

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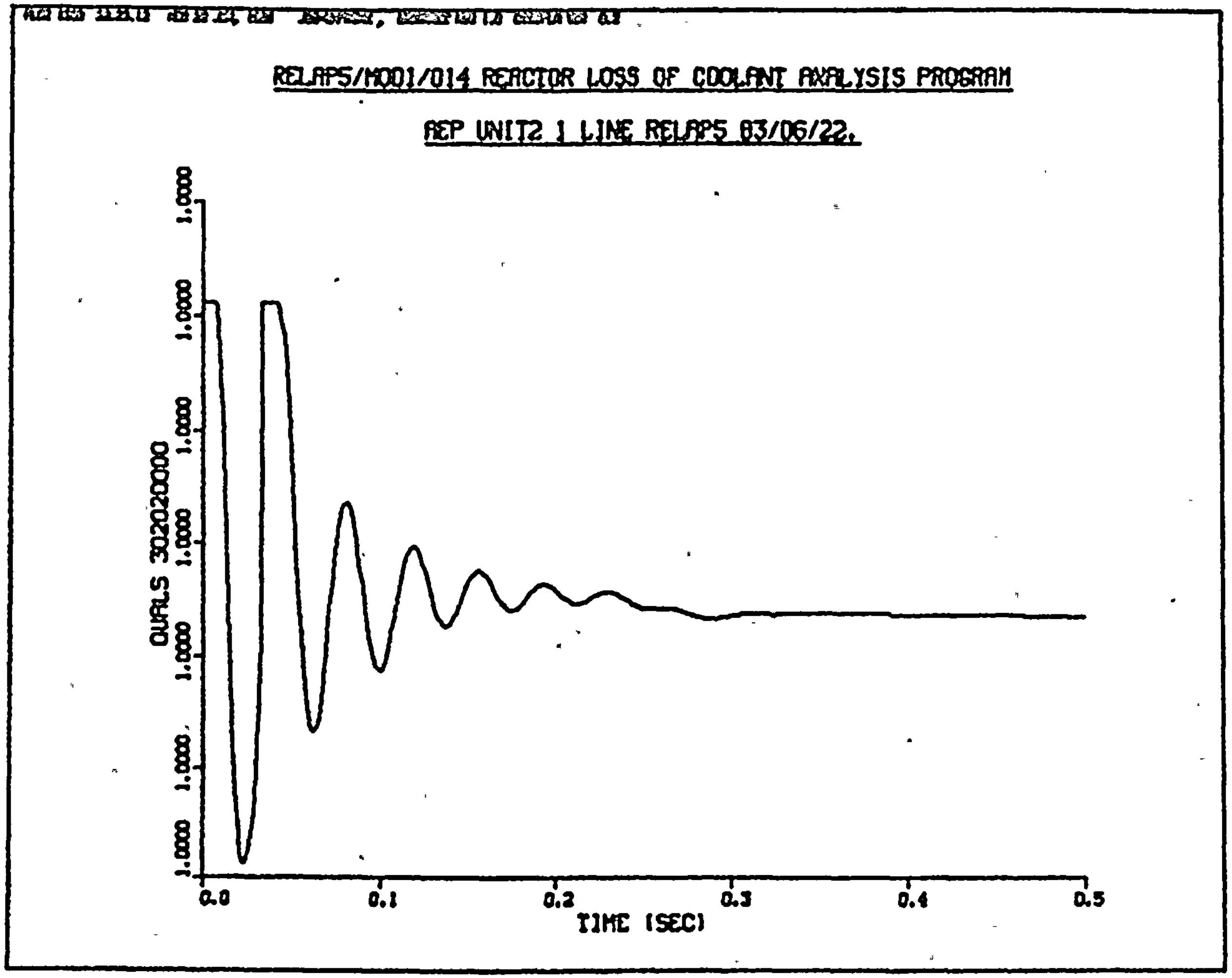

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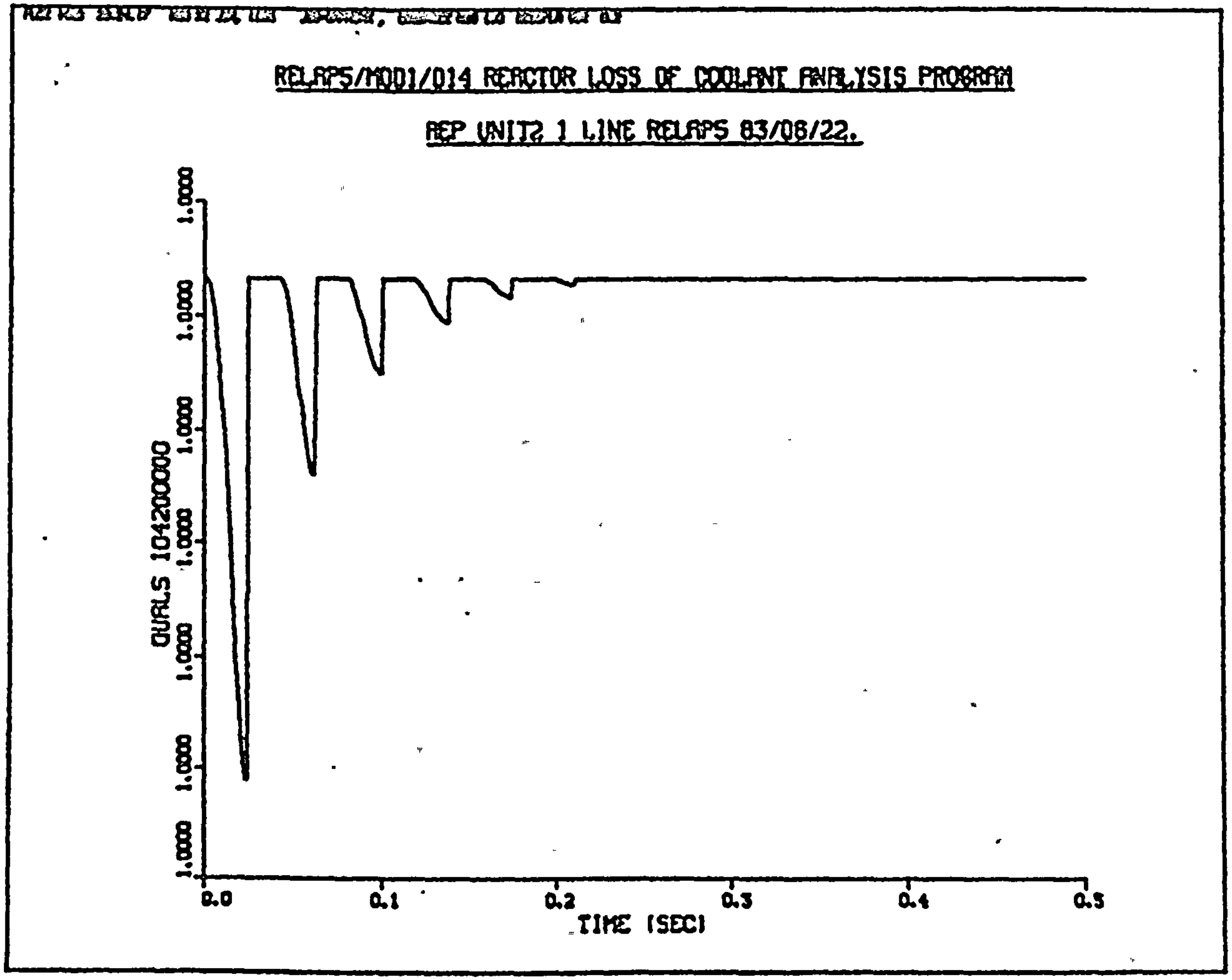

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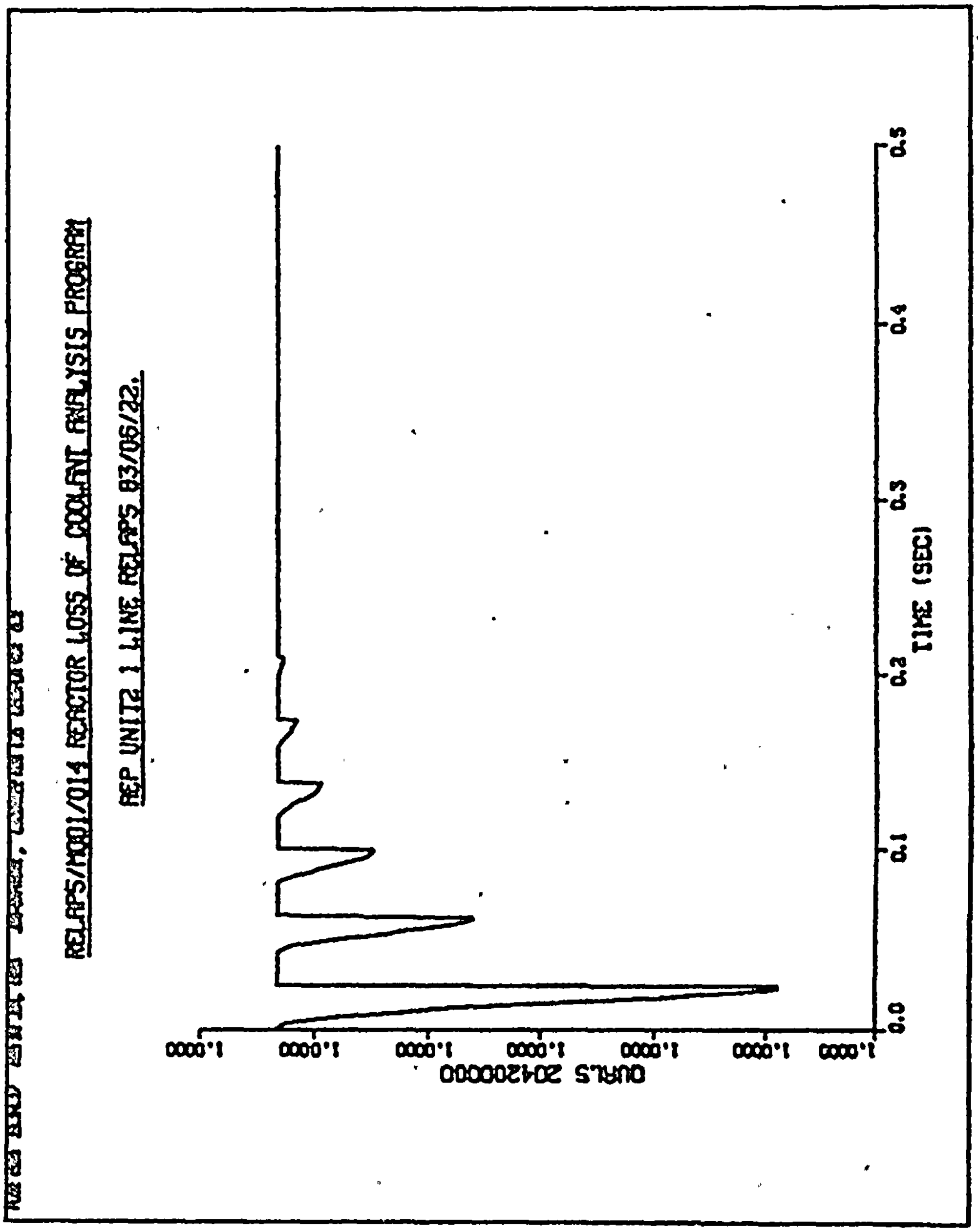

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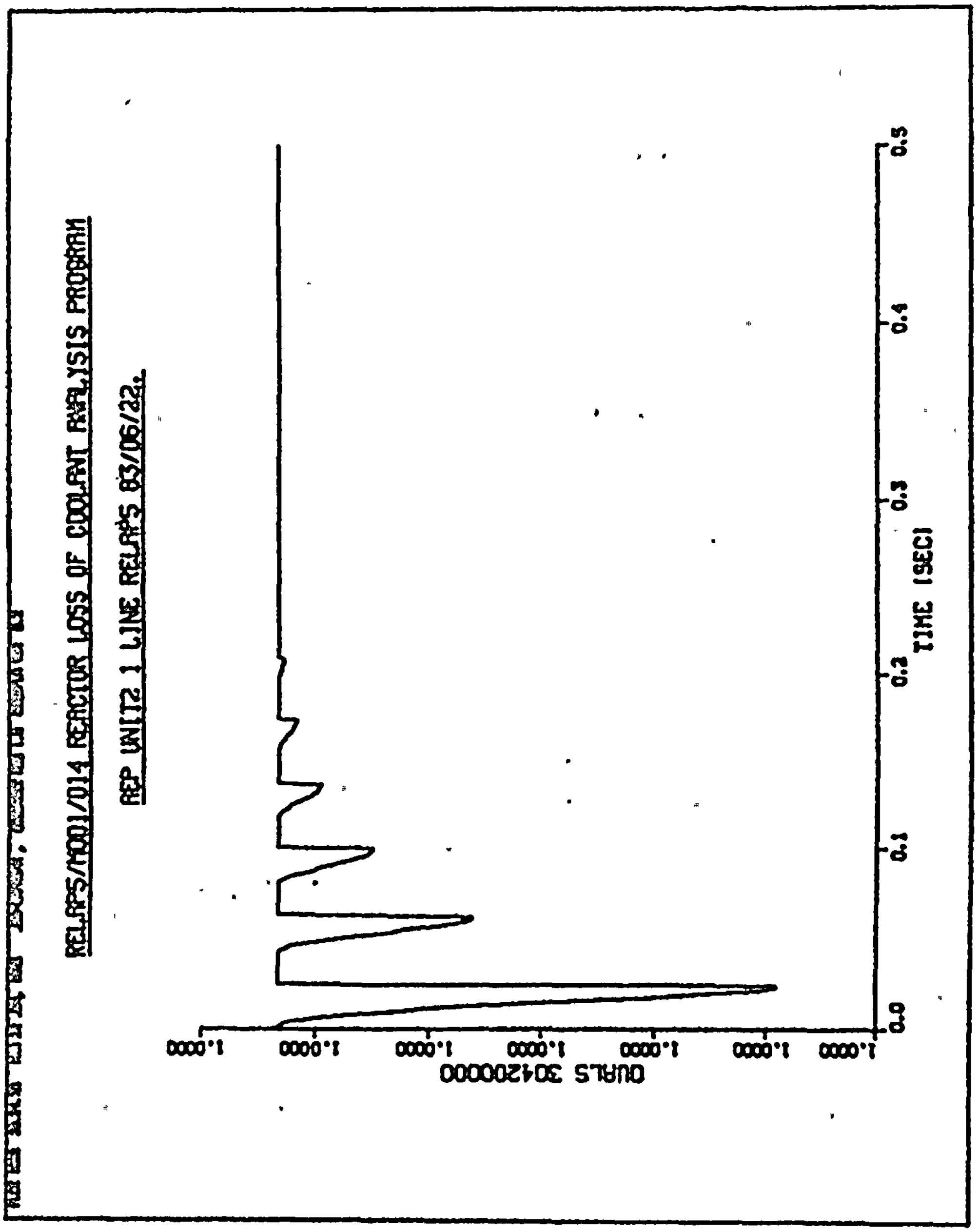

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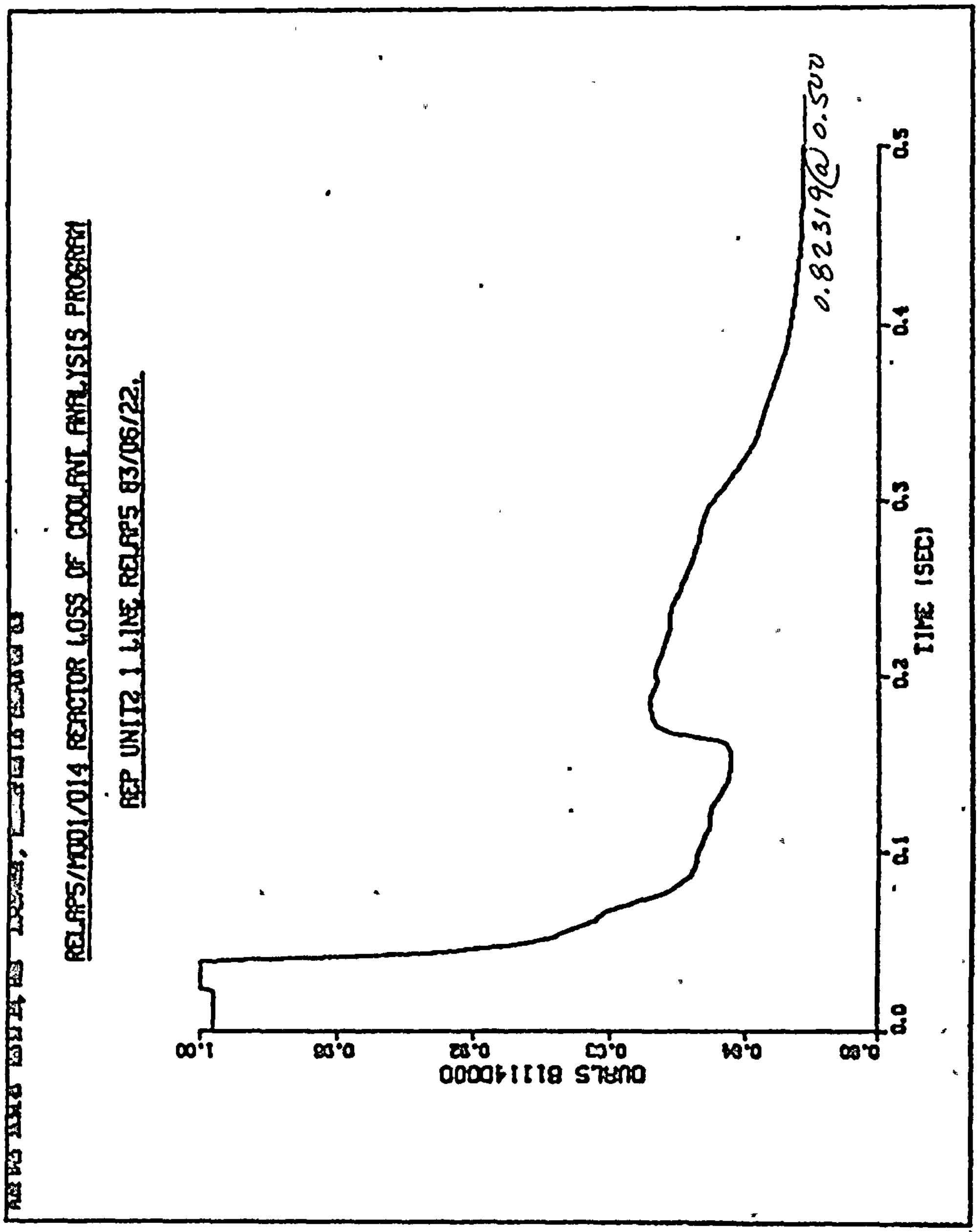

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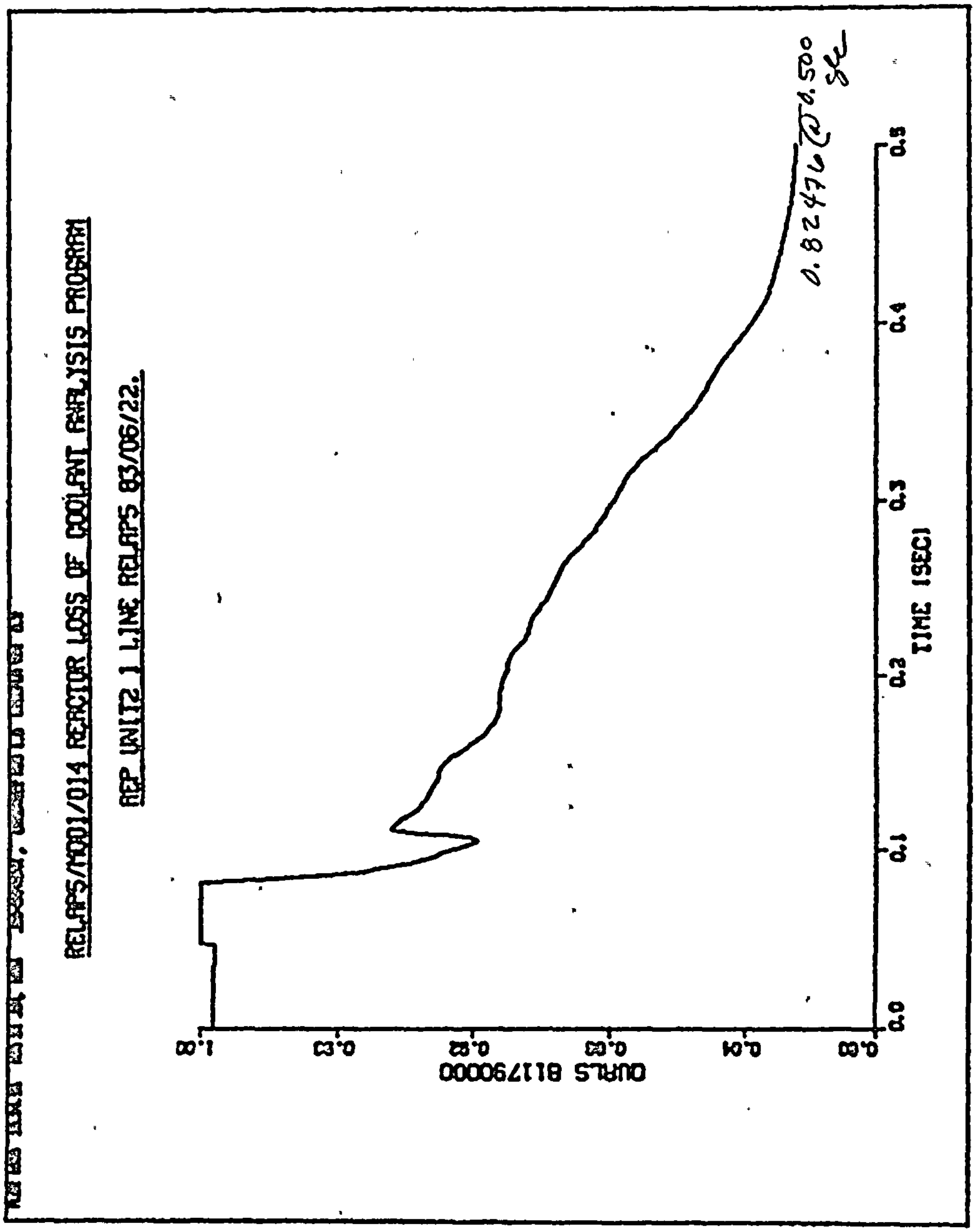

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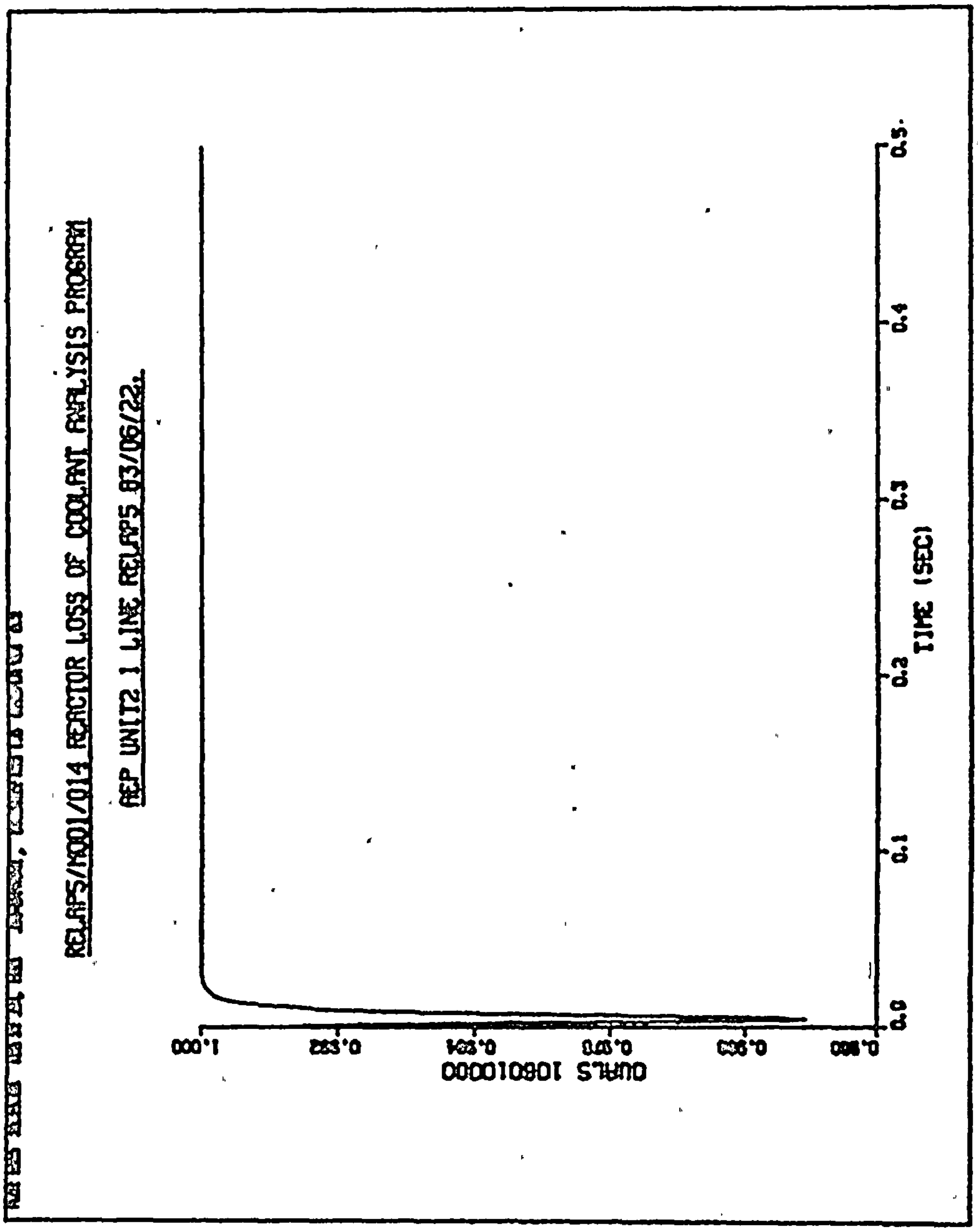

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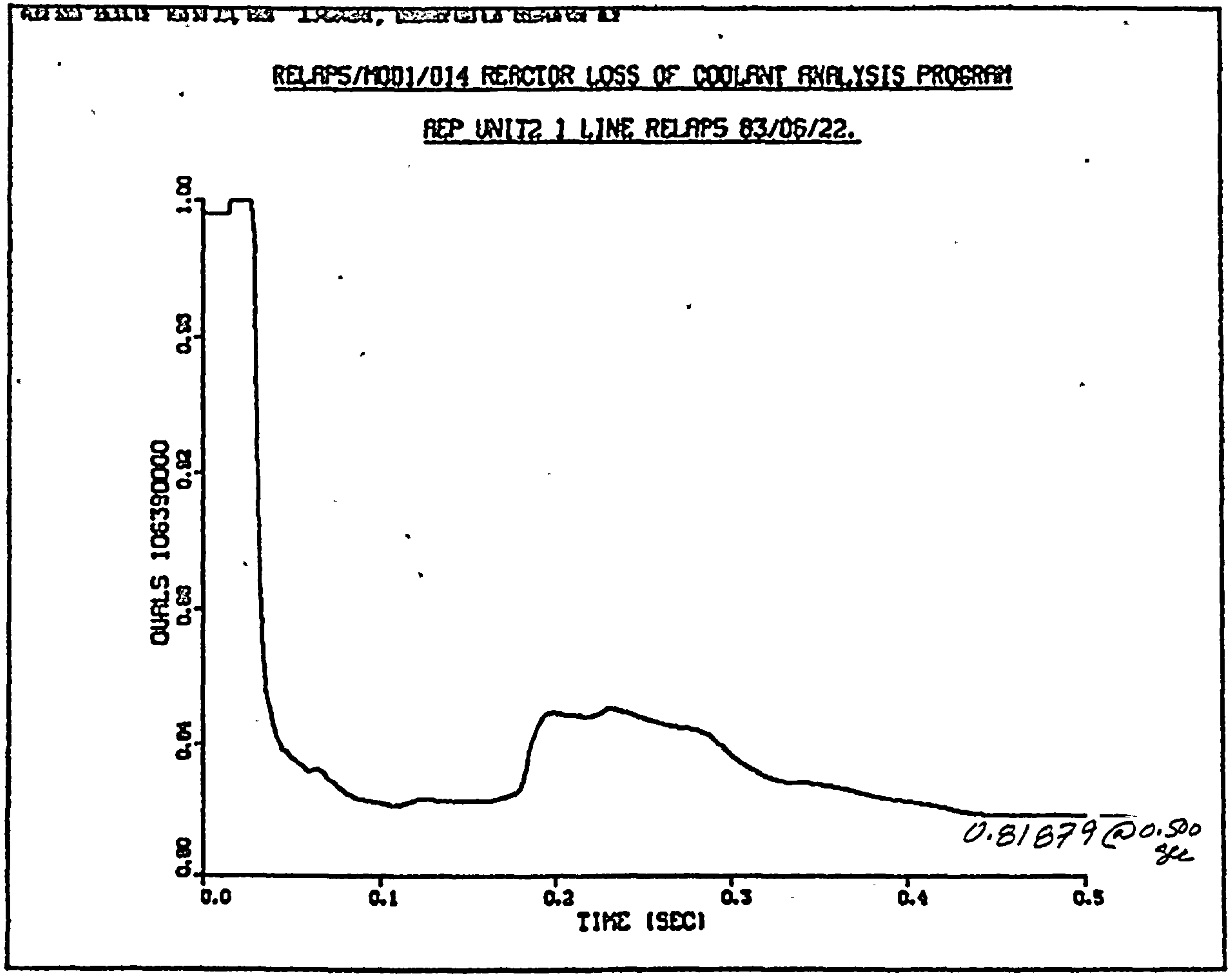

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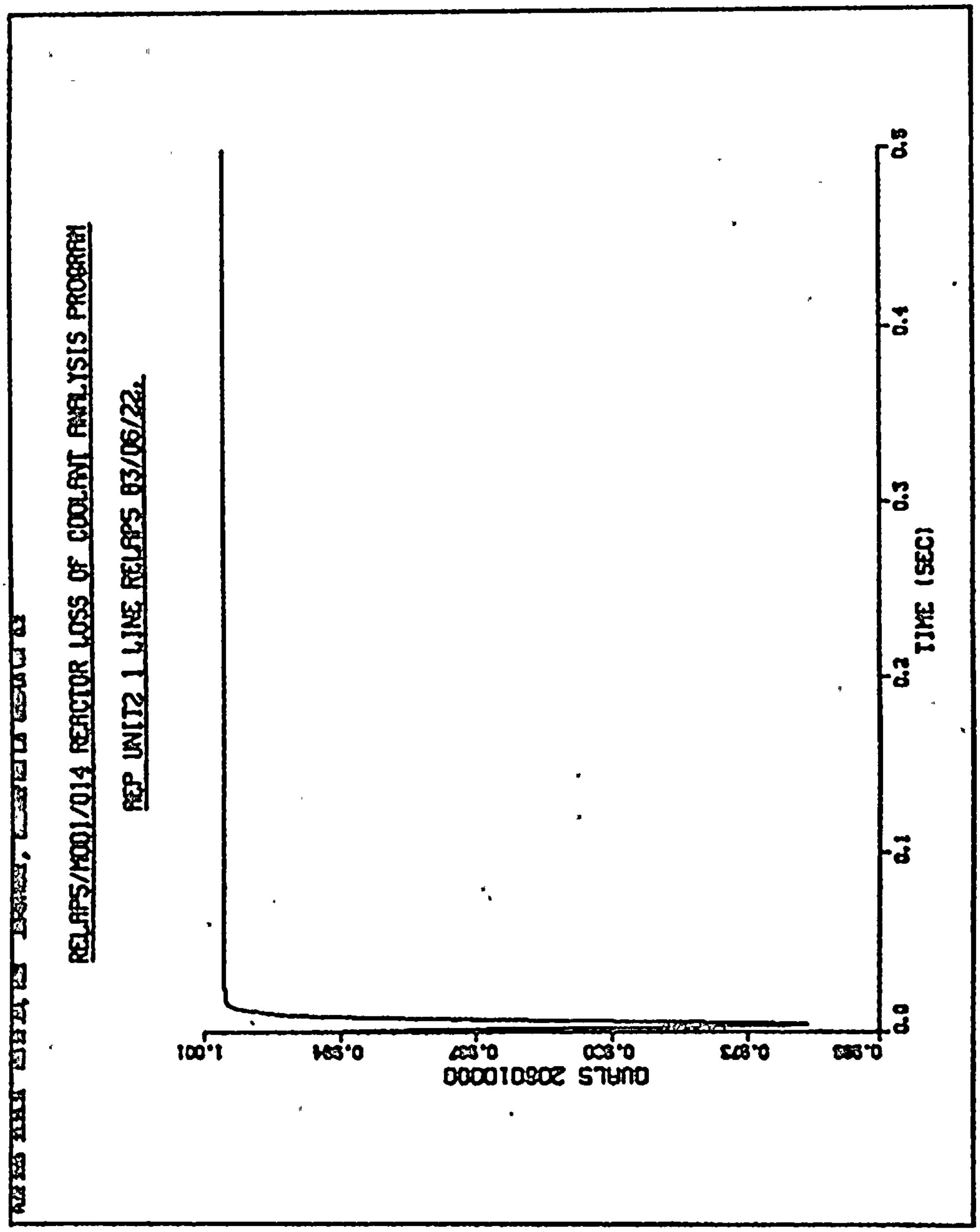

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ENGINEERING SERVICES

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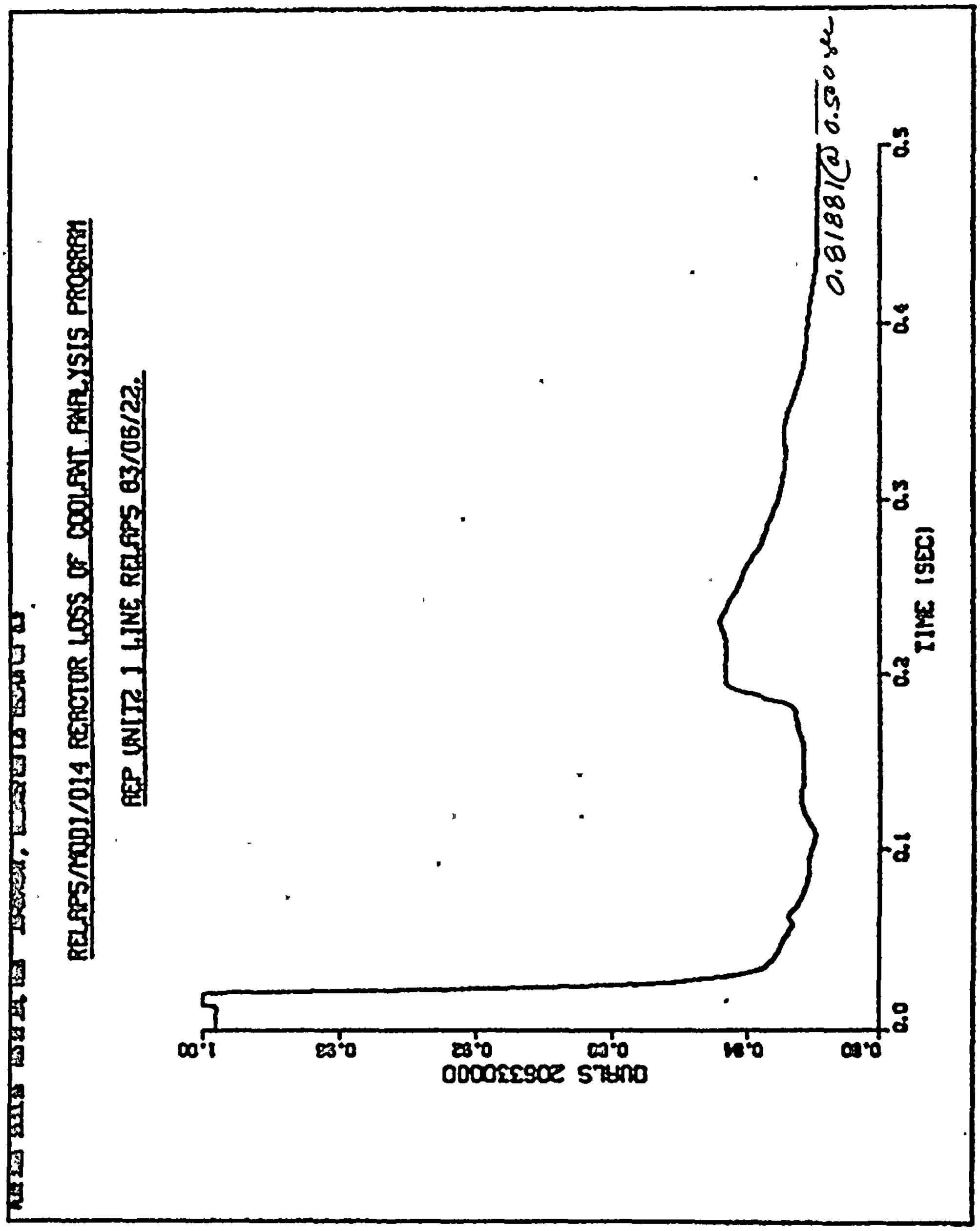

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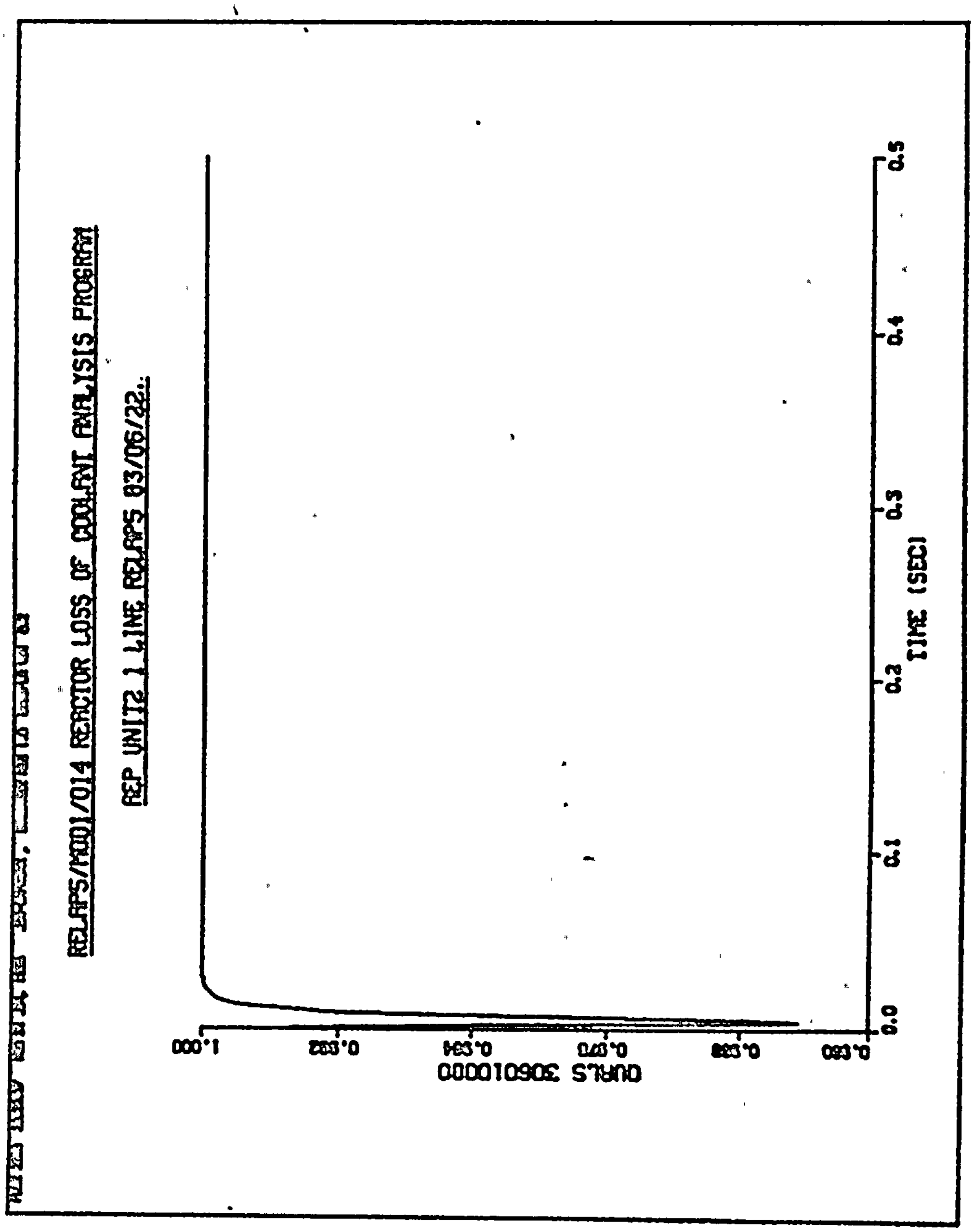
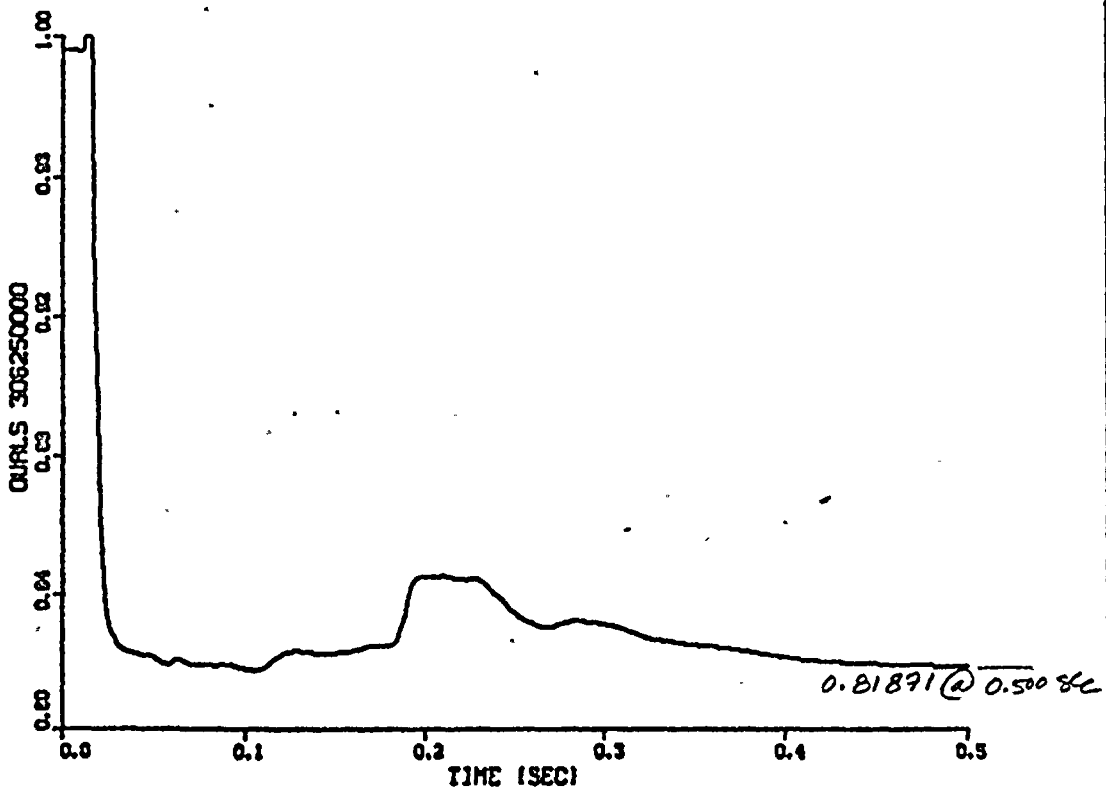


RELAPS/MOD1/014 REACTOR LOSS OF COOLANT ANALYSIS PROGRAM

AEP UNIT2 1 LINE RELAPS 83/06/22.



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ENGINEERING SERVICES

BY KJG DATE 6-22-83
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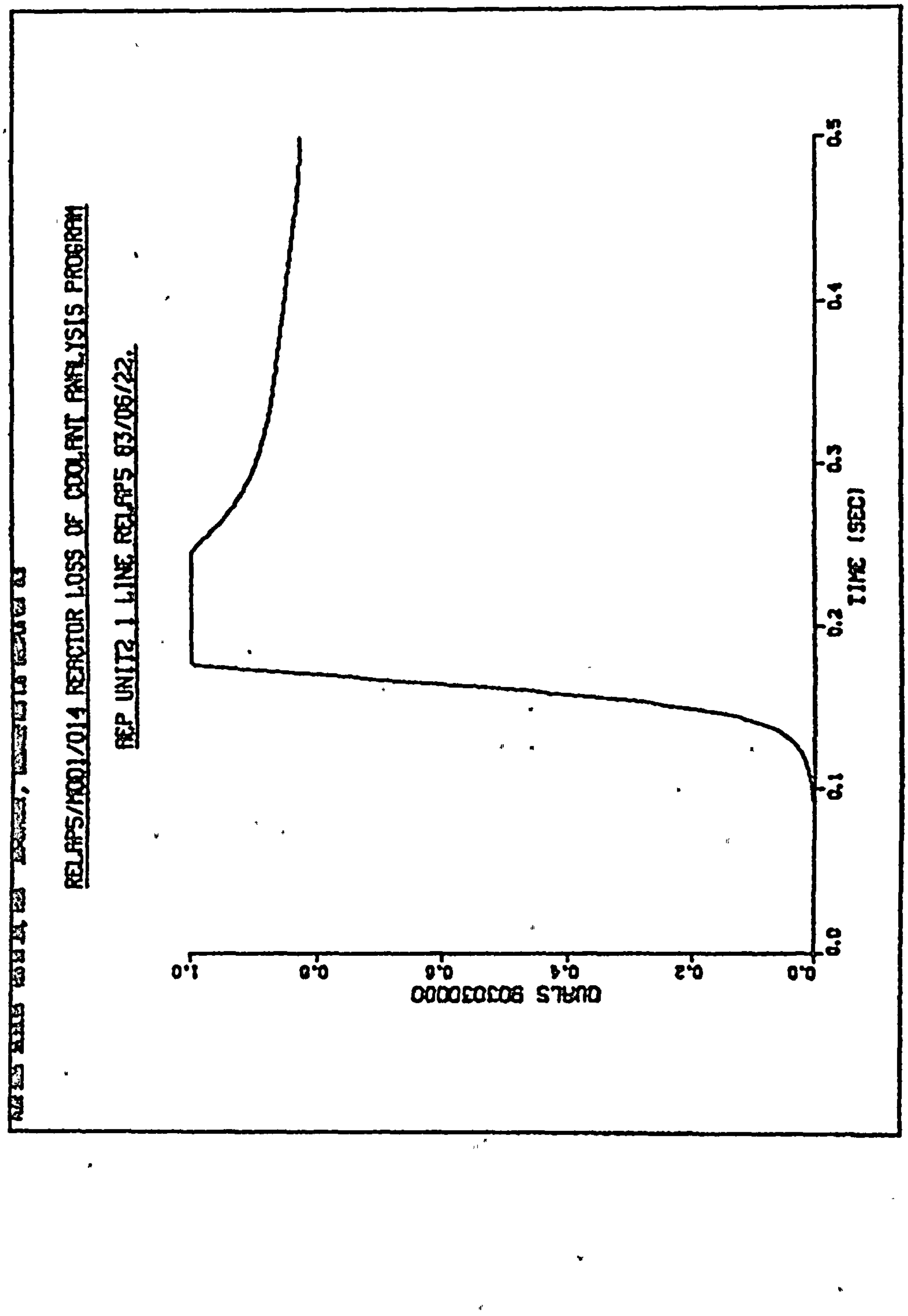

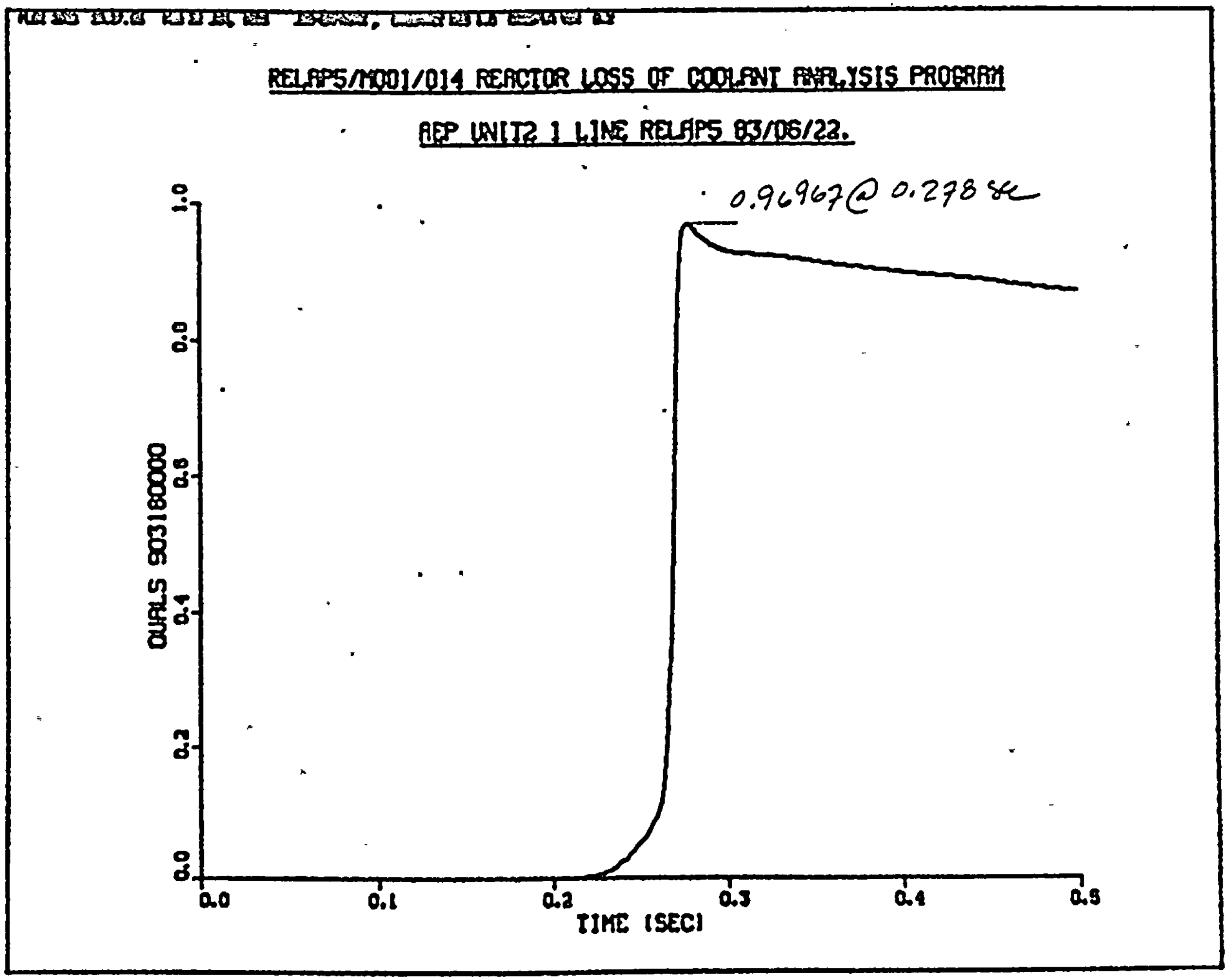

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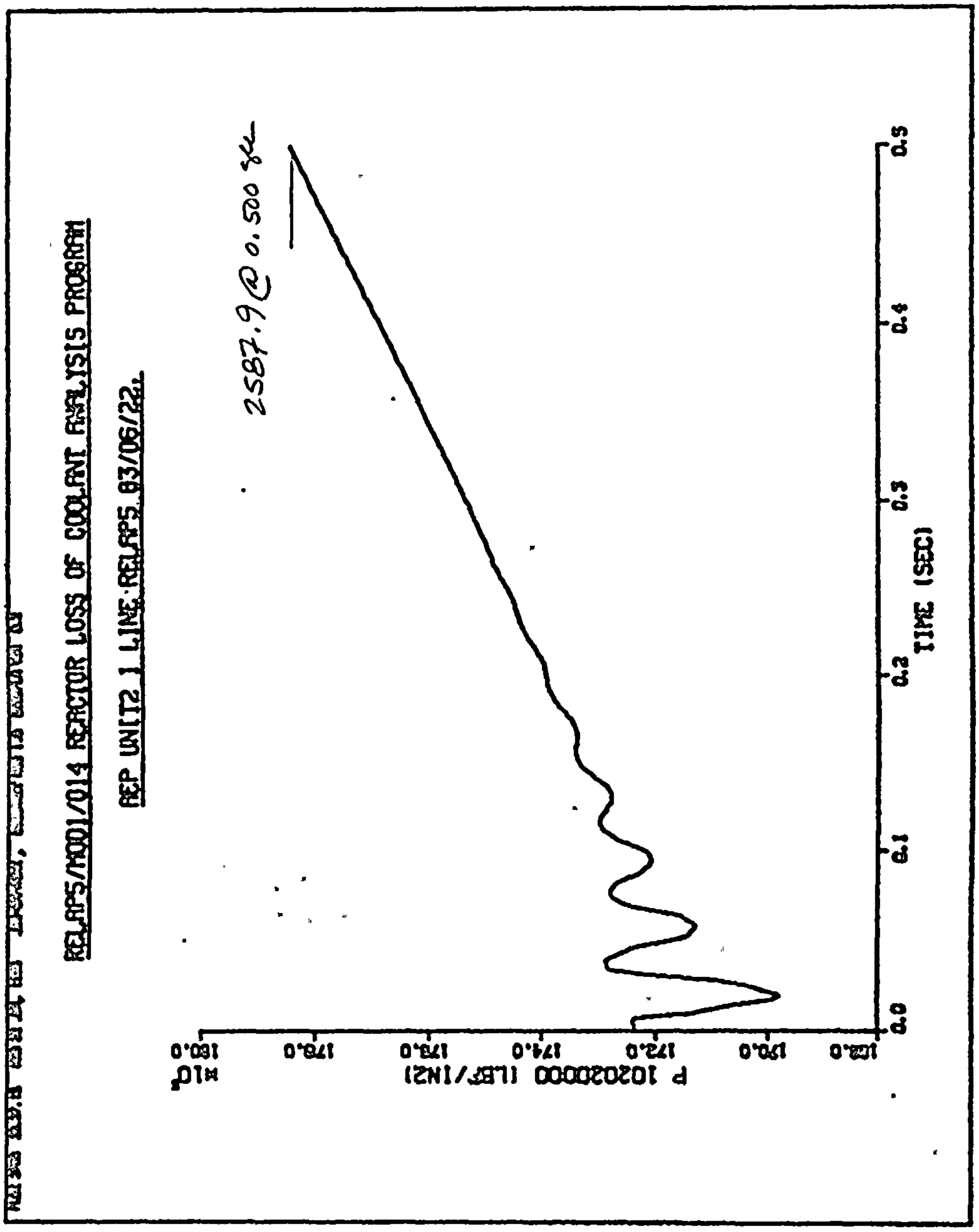
TELEDYNE ENGINEERING SERVICES

BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83



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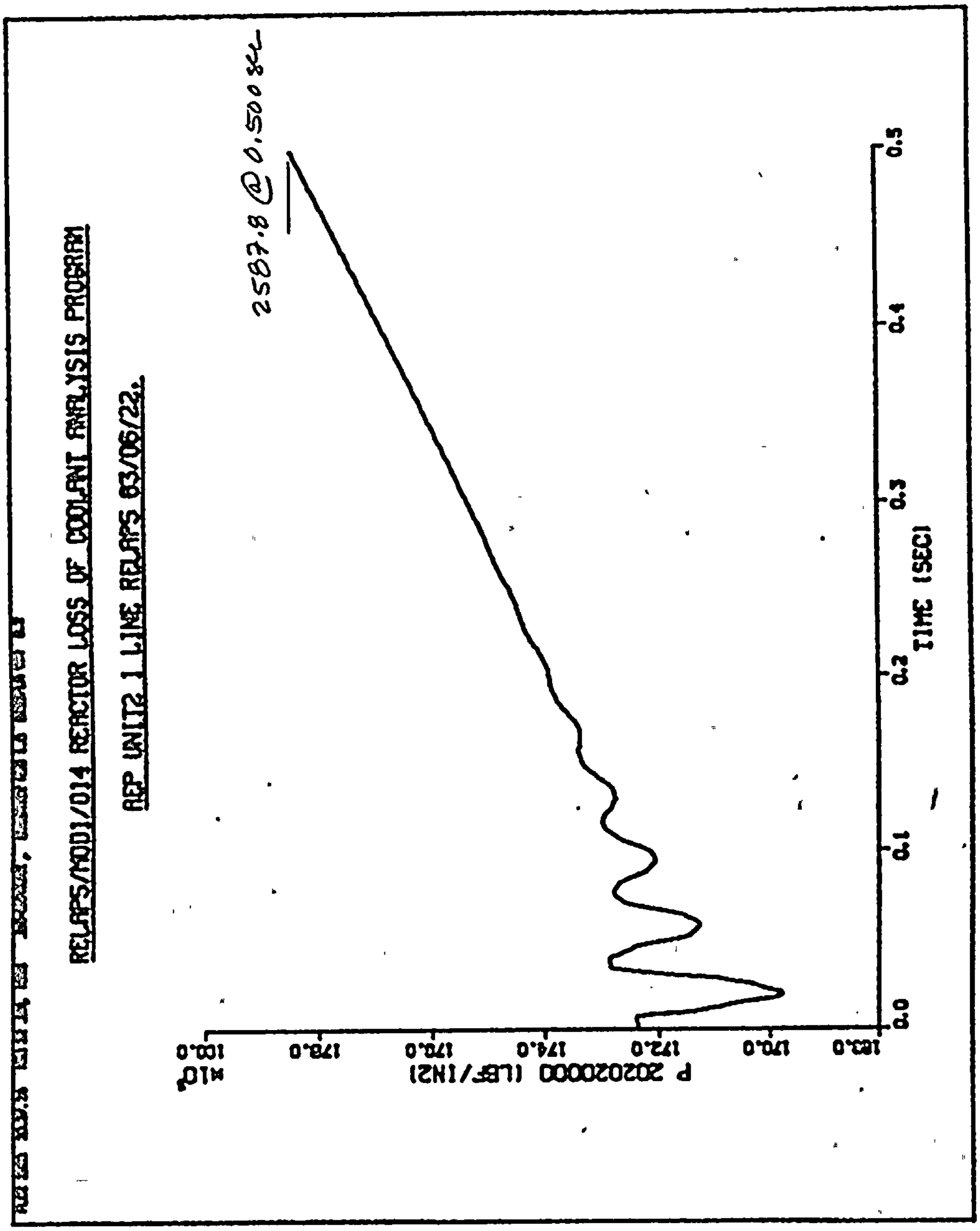
ENGINEERING SERVICES

BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83



TELEDYNE ENGINEERING SERVICES

BY KJG DATE 6-22-83
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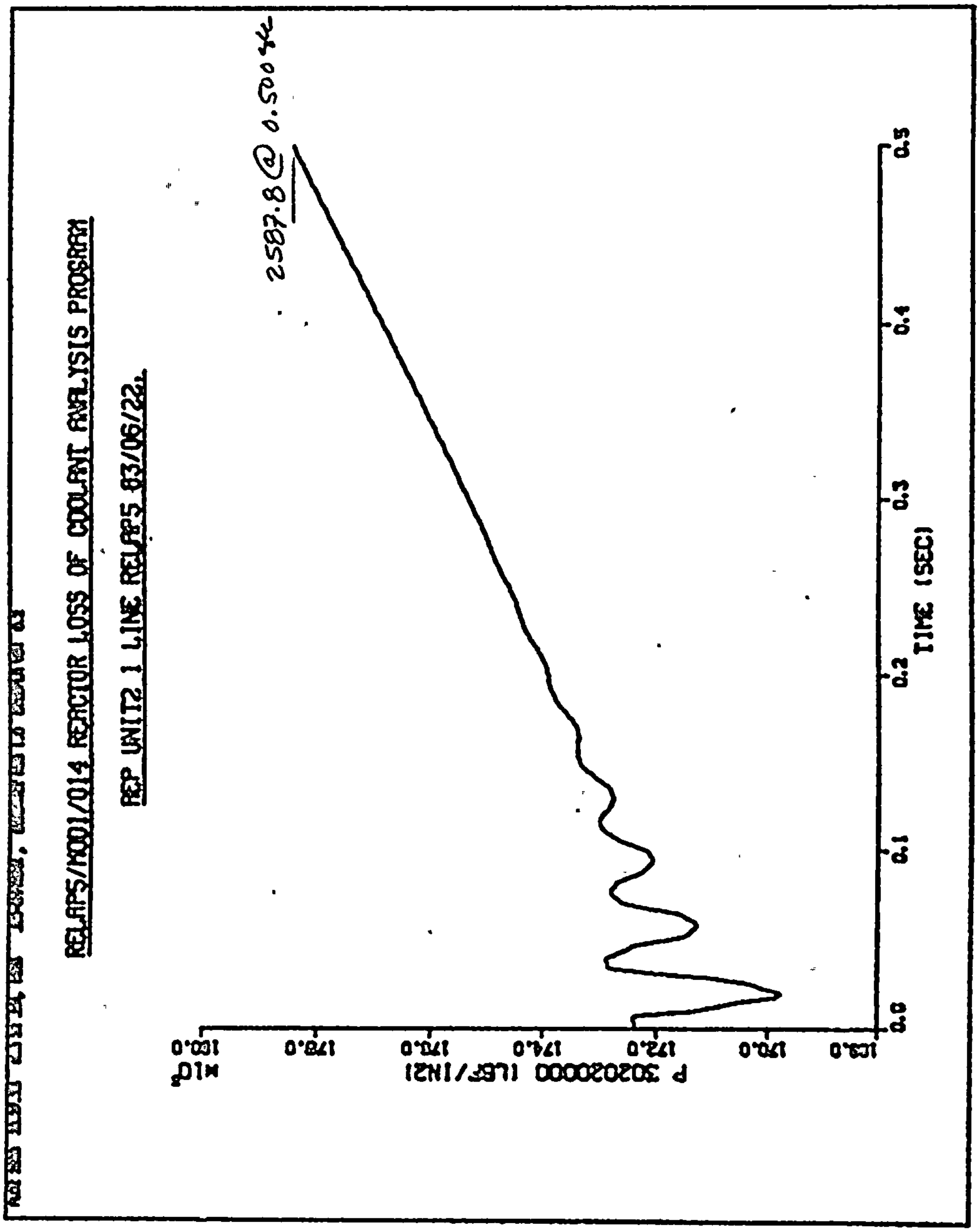

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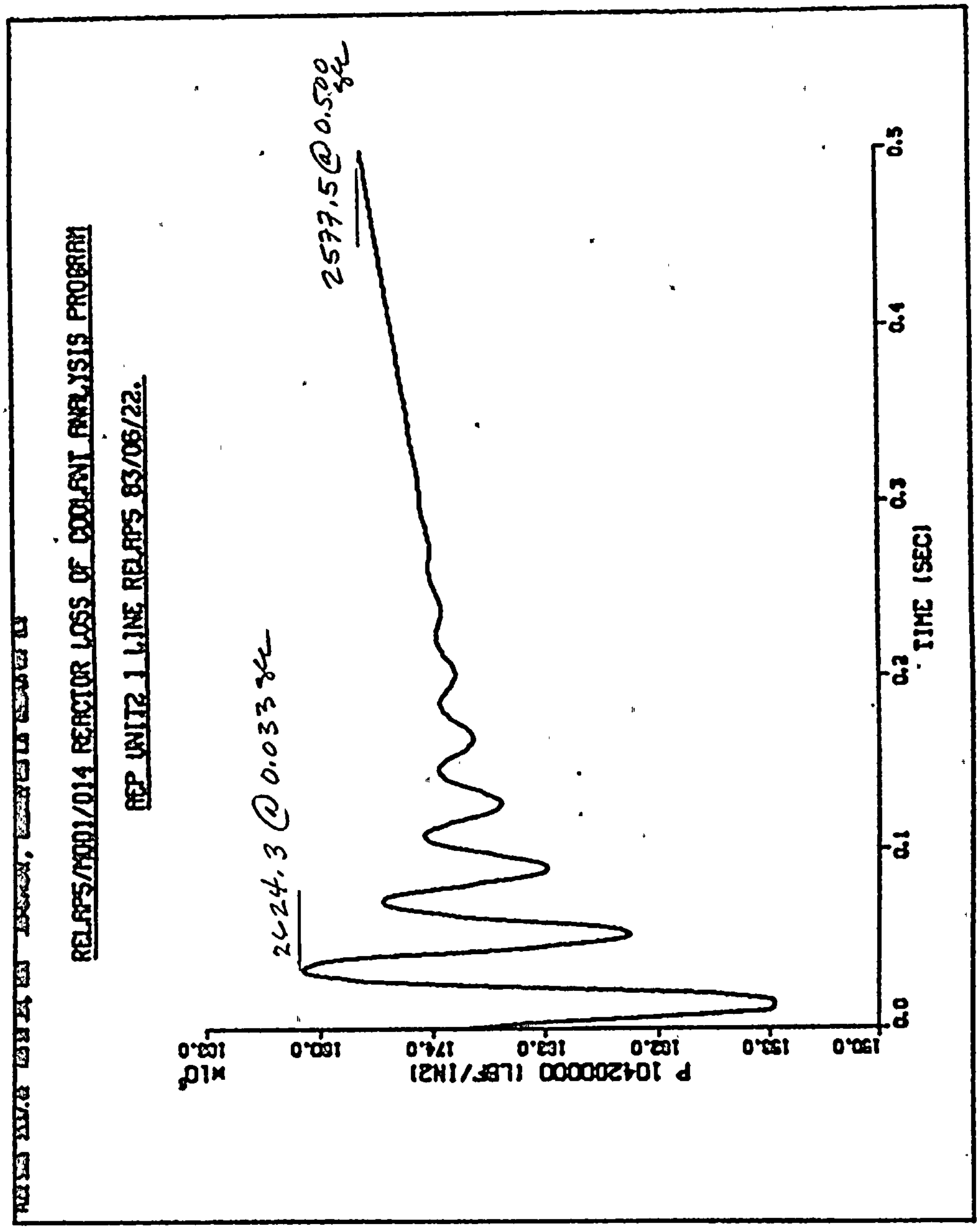
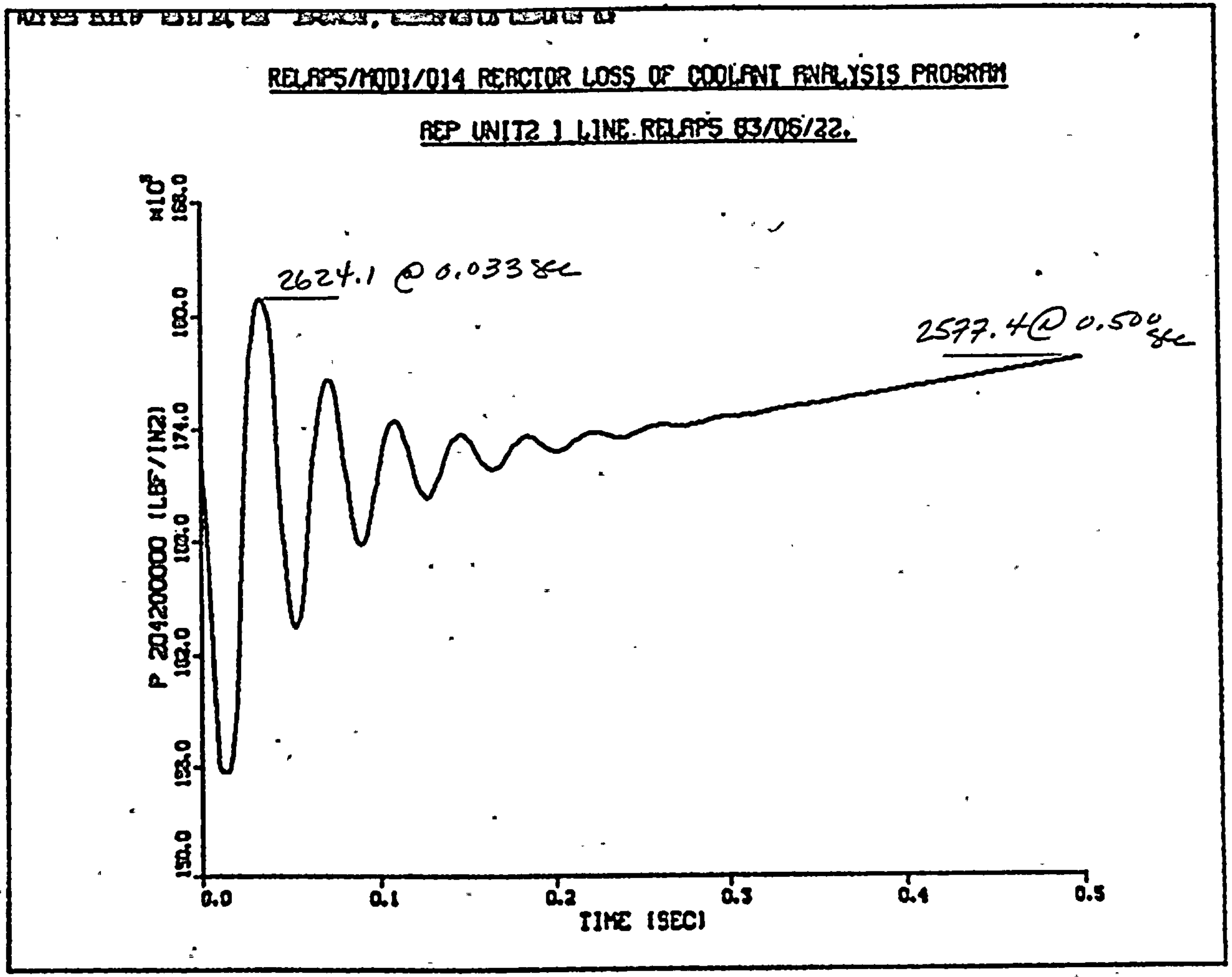


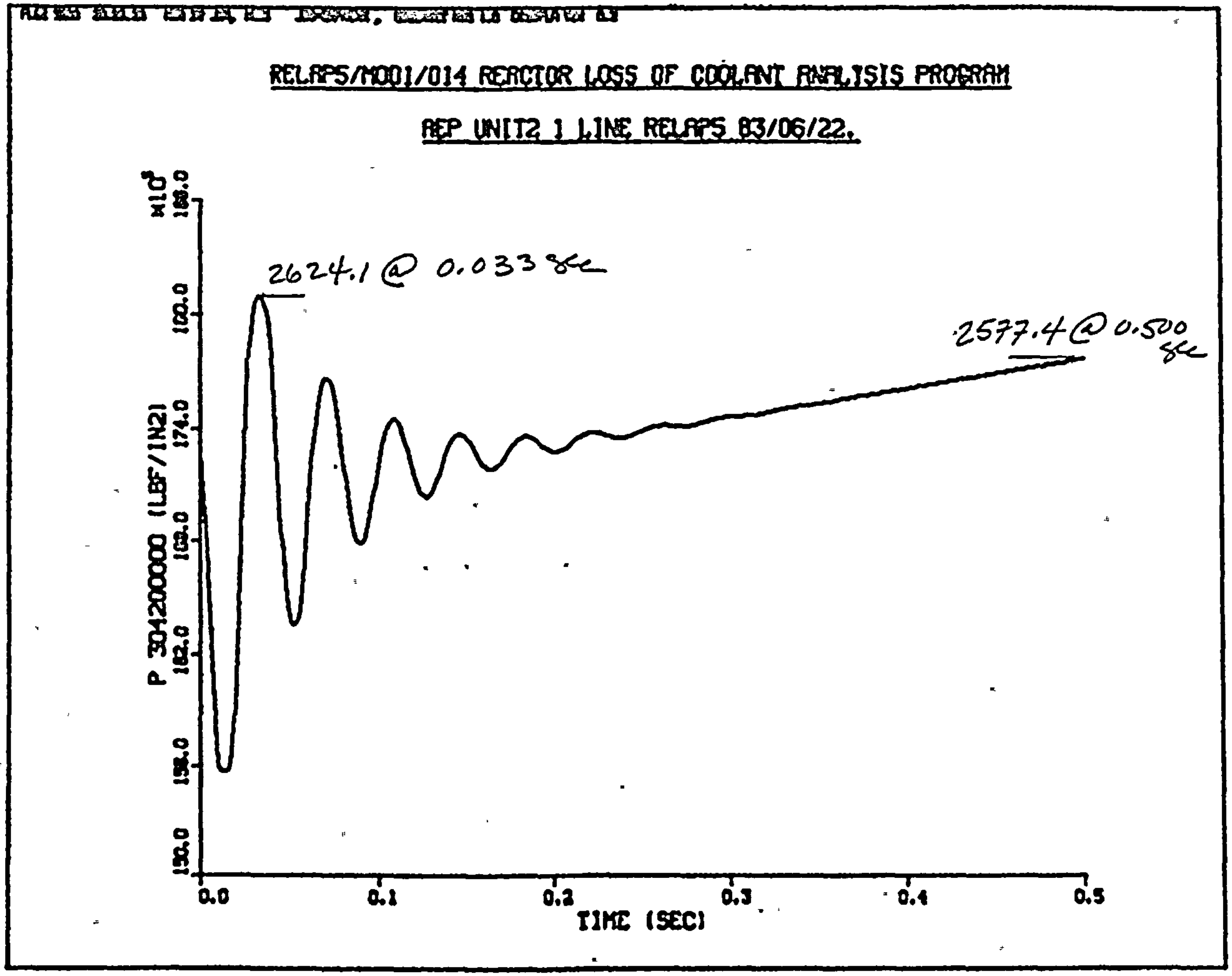
BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83



TELEDYNE ENGINEERING SERVICES

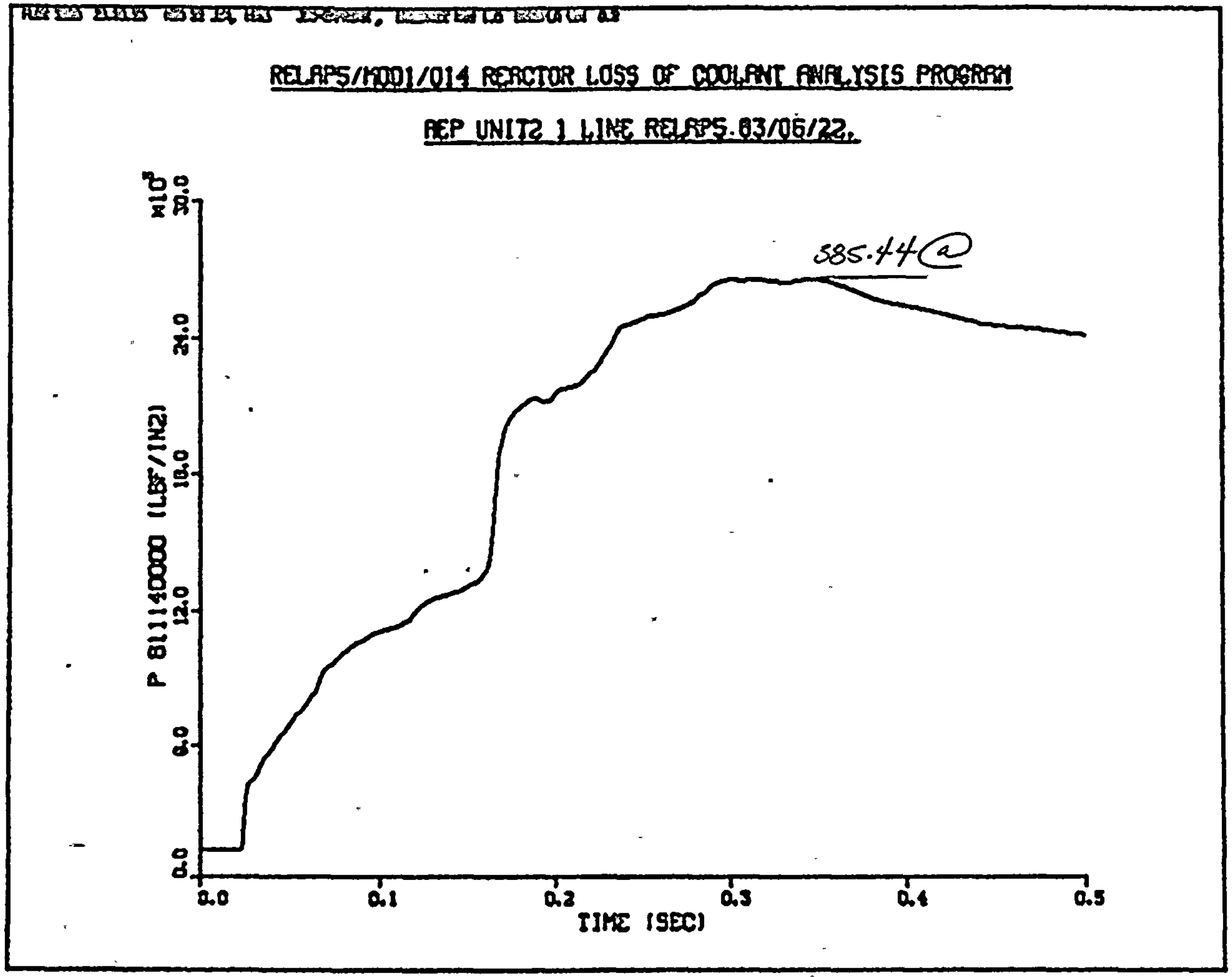
BY KJG DATE 6-22-83

CHKD. BY CMM DATE 6-27-83



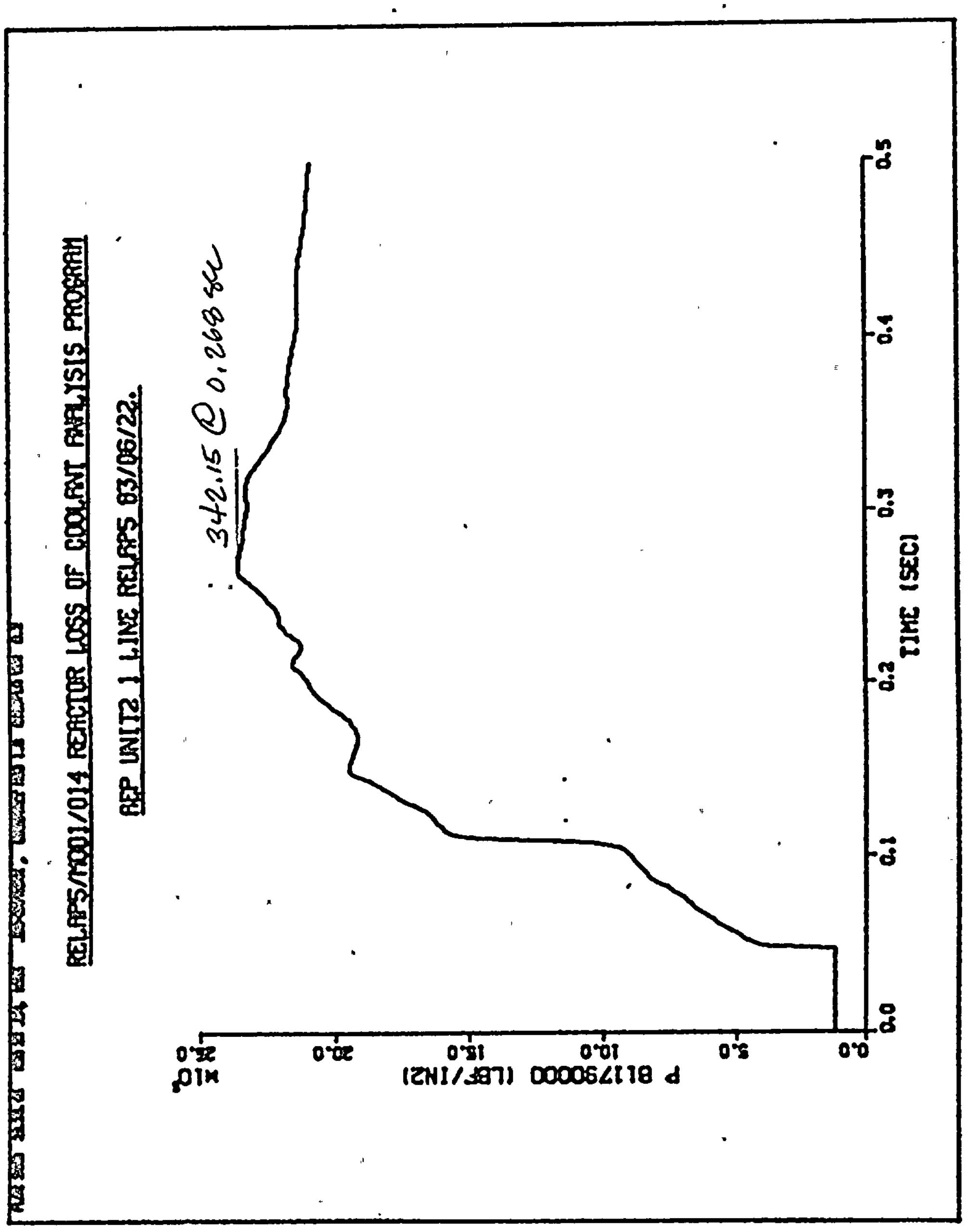
TELEDYNE
ENGINEERING SERVICES

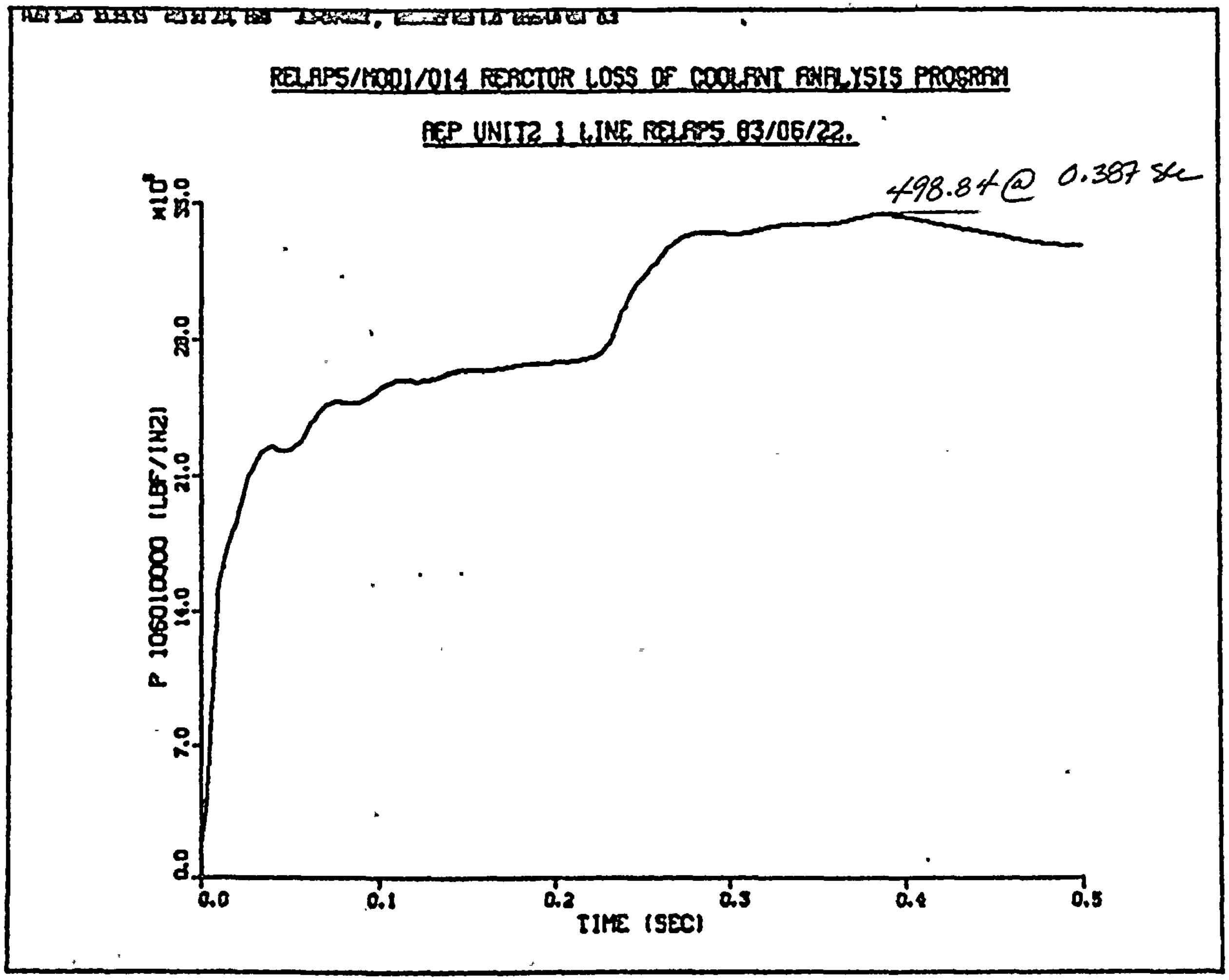
BY KJG DATE 6-22-83
CHKD. BY [illegible] DATE 6-27-83



TELEDYNE
ENGINEERING SERVICES

BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83



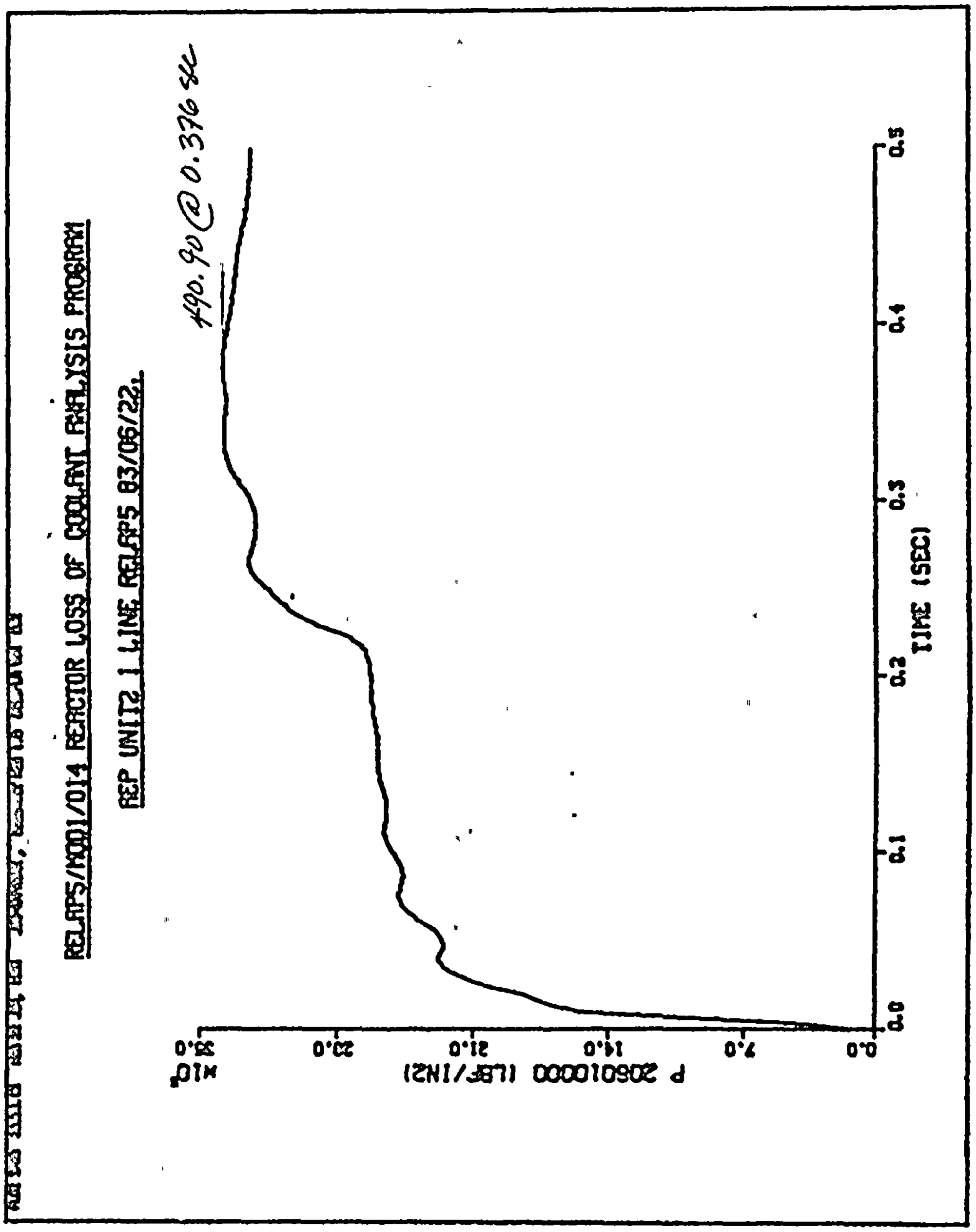


TELEDYNE ENGINEERING SERVICES

BY KJG DATE 6-22-83

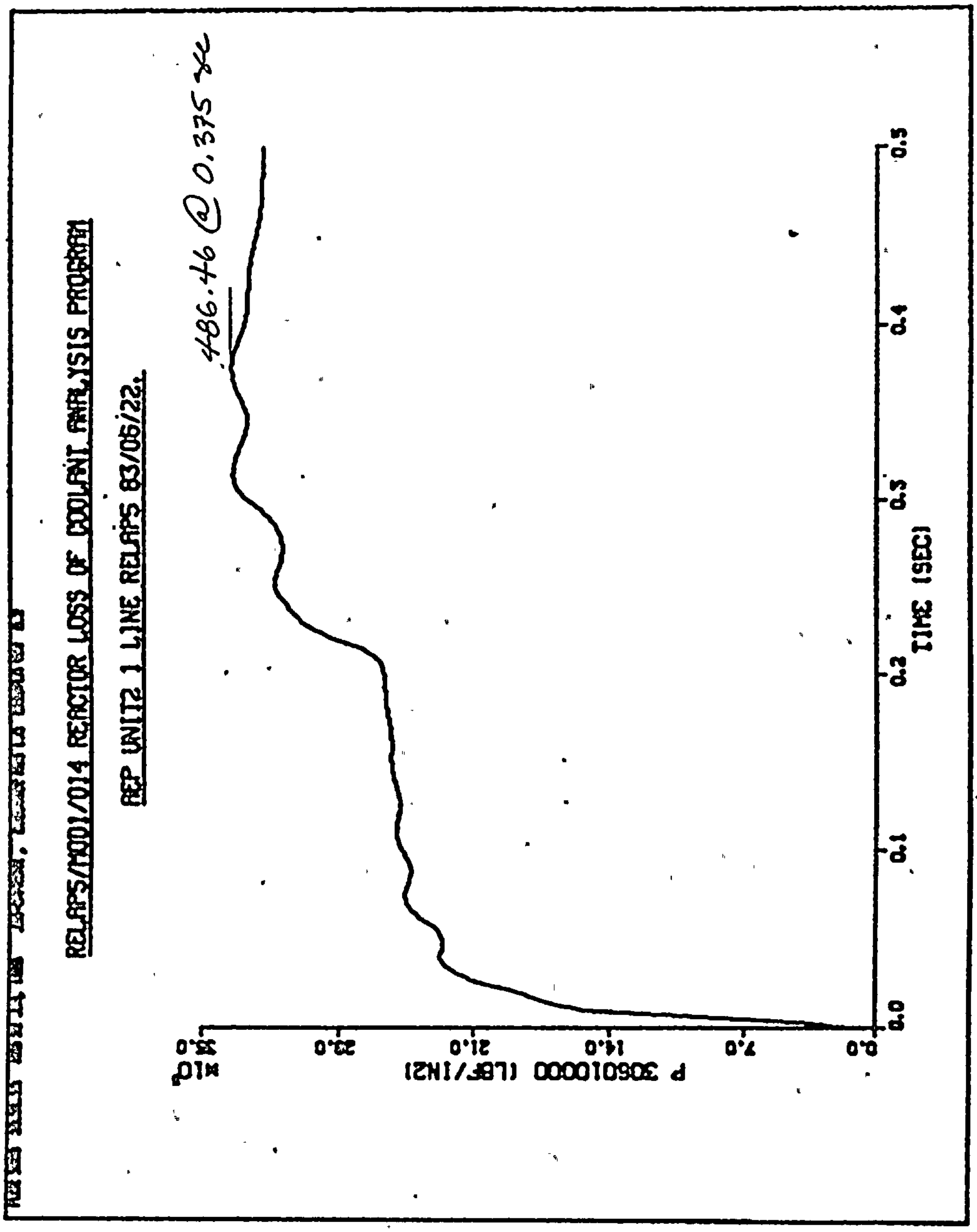
CHKD. BY CMY DATE 6-27-83

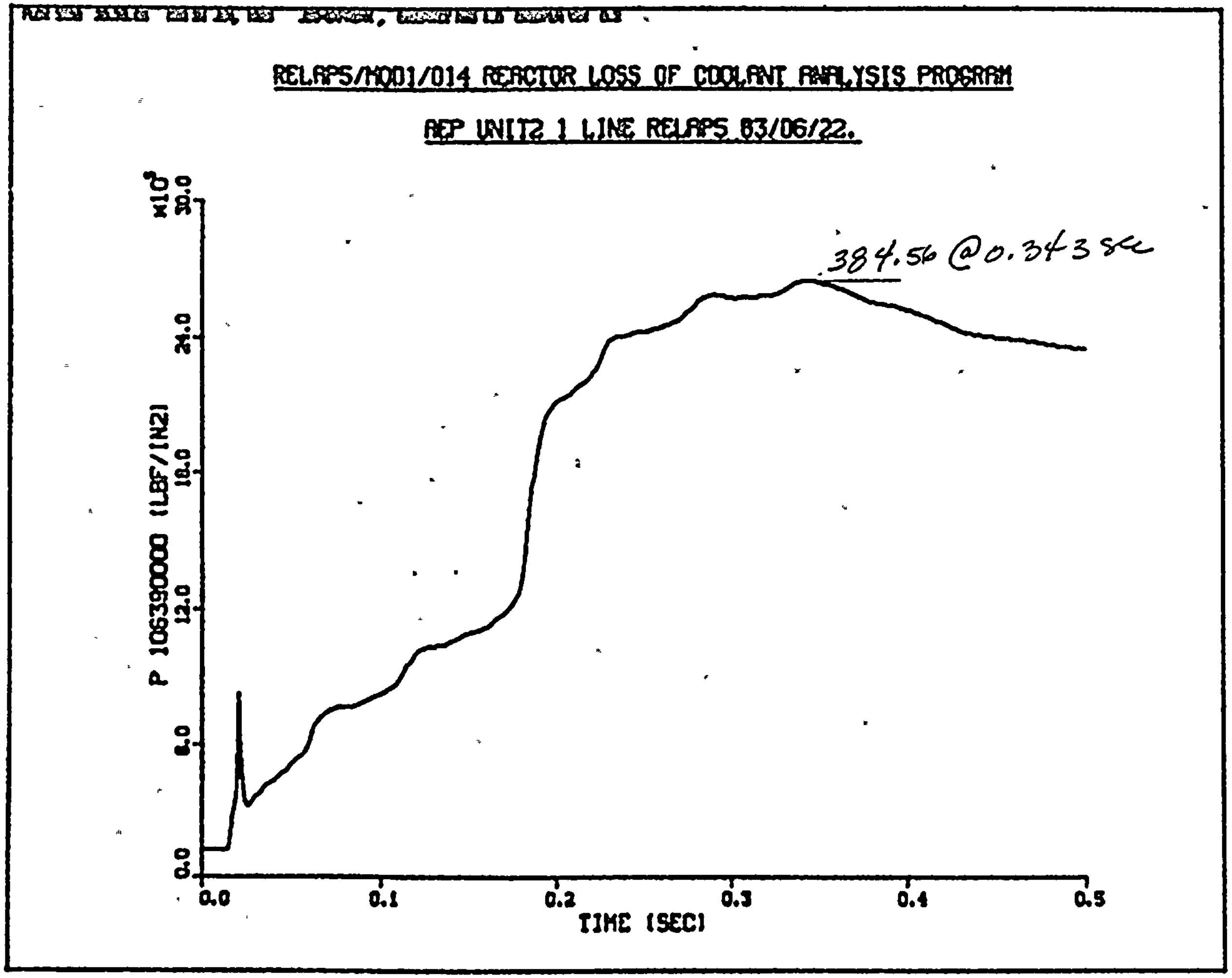
BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83



TELEDYNE
ENGINEERING SERVICES

BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83

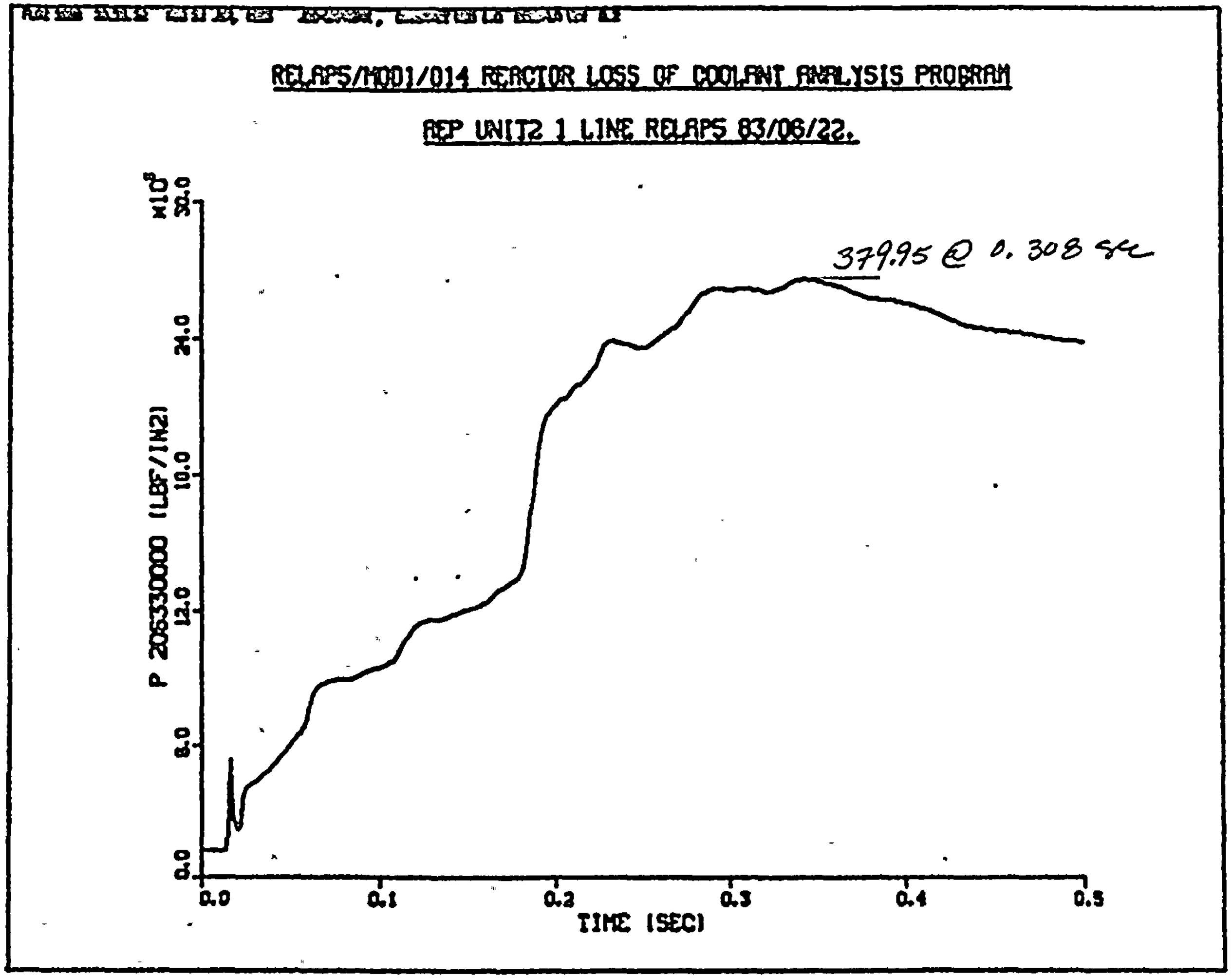




TELEDYNE ENGINEERING SERVICES

BY KJG DATE 6-22-83

CHKD. BY [illegible] DATE 6-27-83



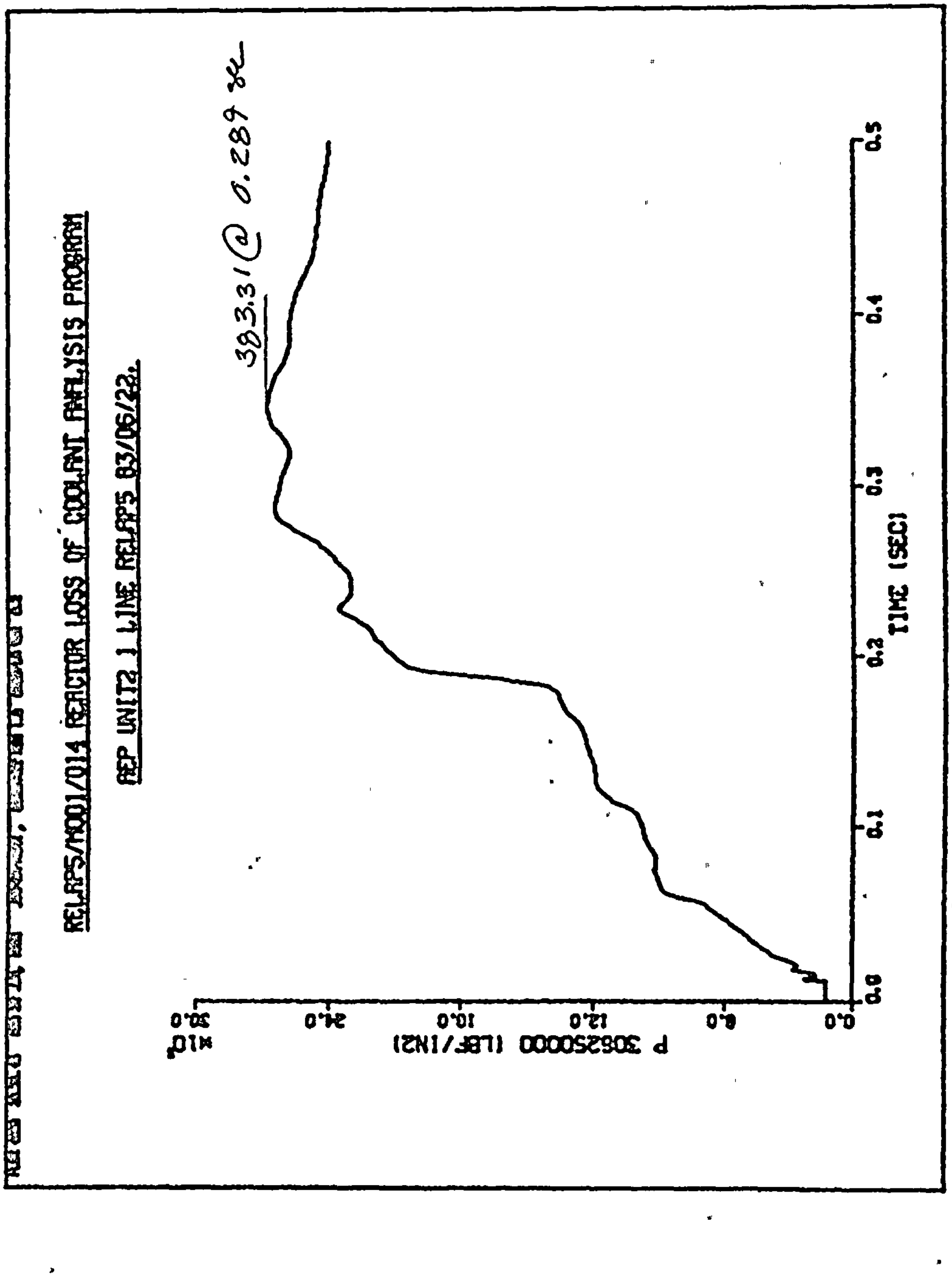
TELEDYNE ENGINEERING SERVICES

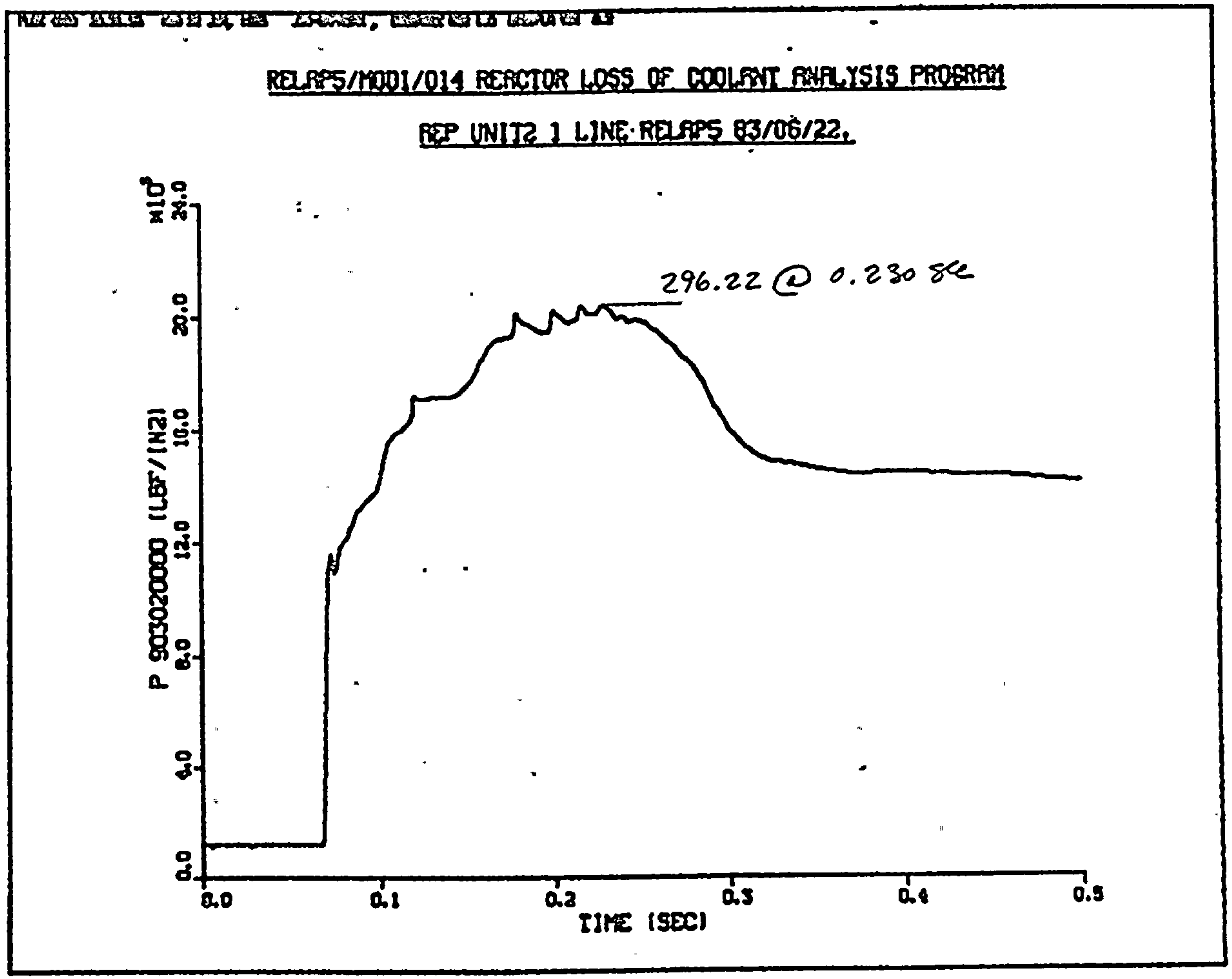
BY KJG DATE 6-22-83

CHKD. BY CMM DATE 6-27-83

TELEDYNE
ENGINEERING SERVICES

BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83





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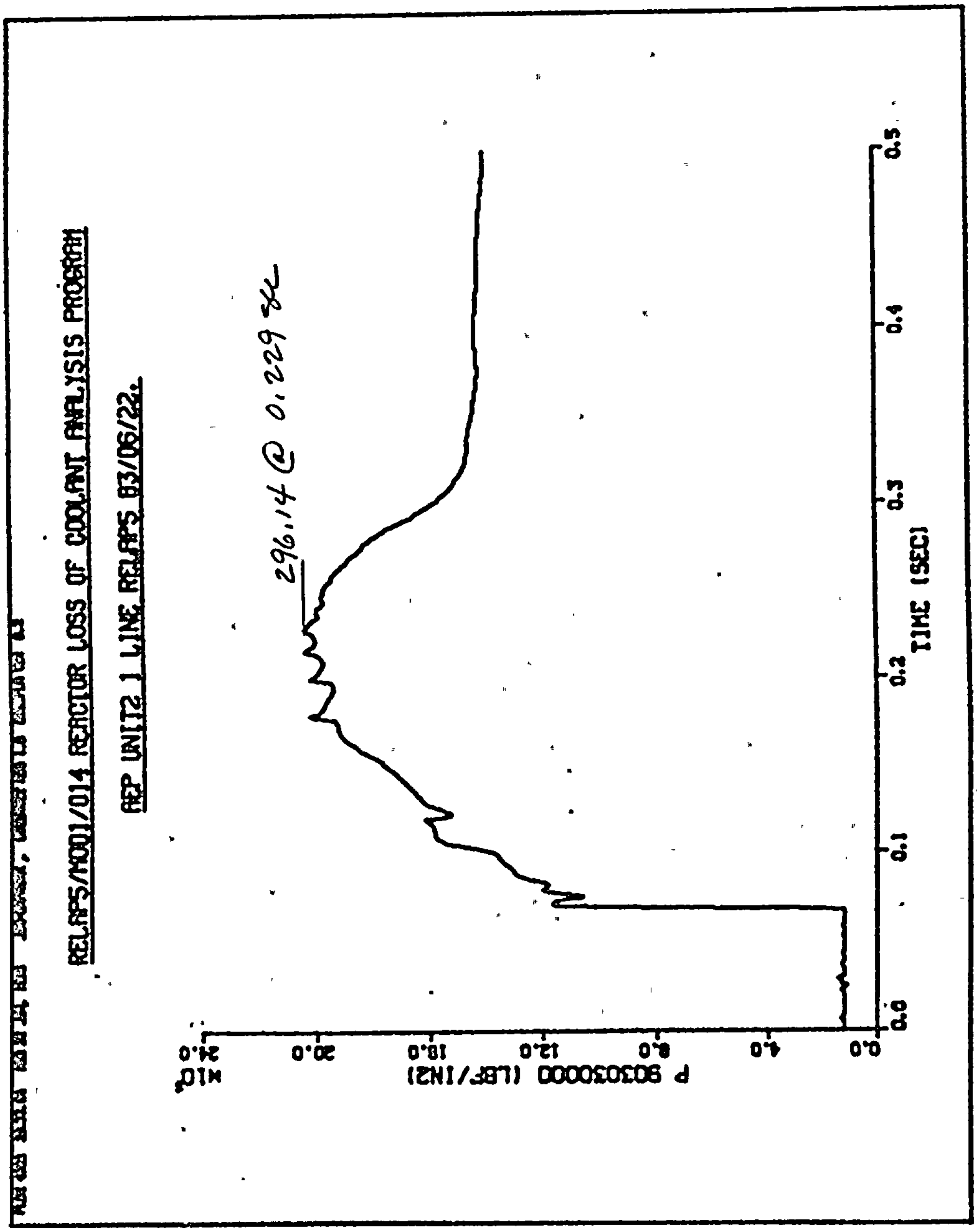
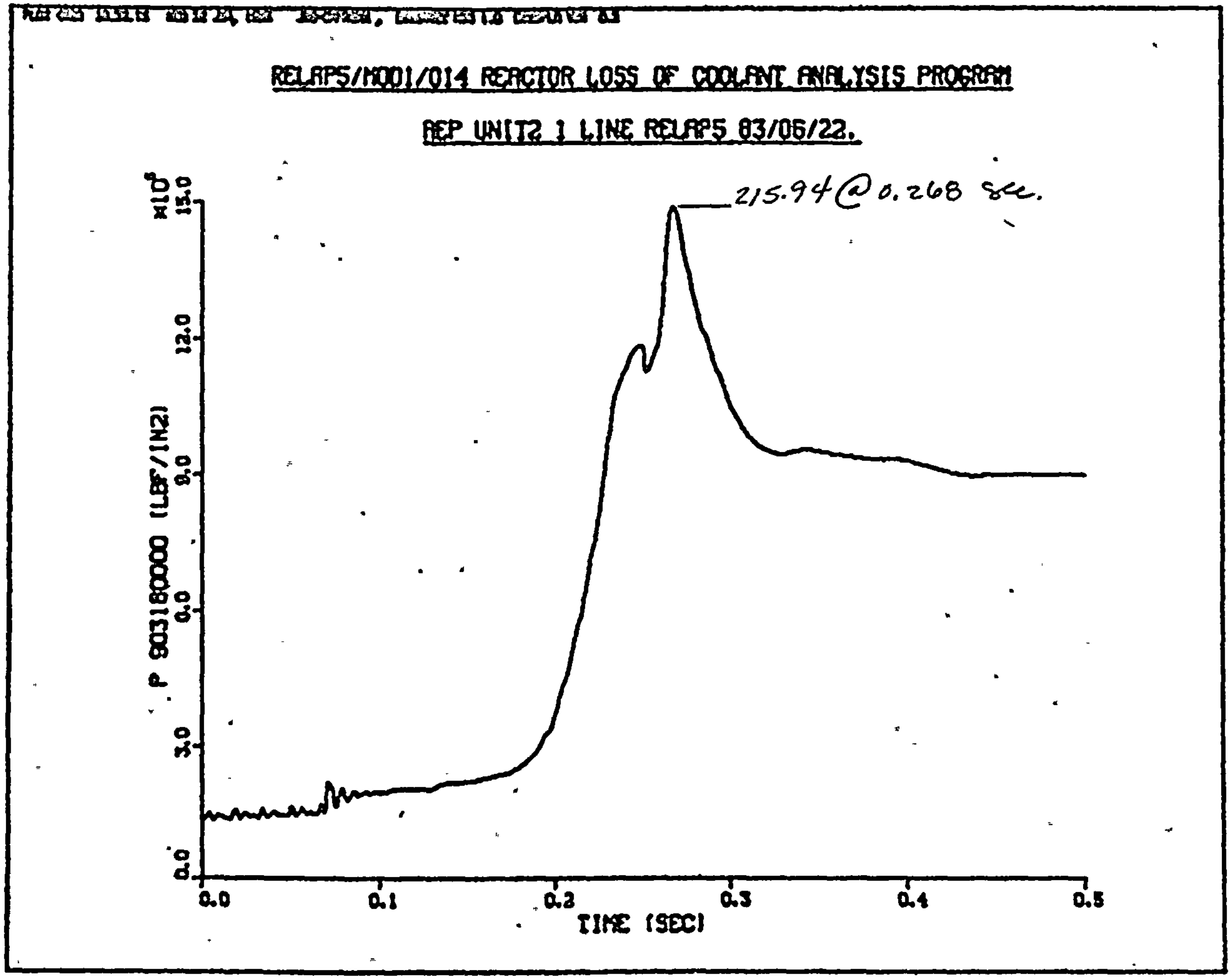
BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83

TELEDYNE
ENGINEERING SERVICES

BY KJG DATE 6-22-83
CHKD. BY CMM DATE 6-27-83





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BY KJG DATE 6-22-83
CHKD. BY CMW DATE 6-27-83

4.6 Force Time History Plots

The following are force versus time plots for each pipe segment at a node point described by the structural model. A drawing indicating force placement precedes the set. Since the force time histories were plotted after balancing and merging(i.e. SAP2SAP and MERGE), each plot is unbalanced force versus time from 0.0 to 0.5 seconds. Unit 2 has 67 pipe segments and correspondingly 67 force time histories.

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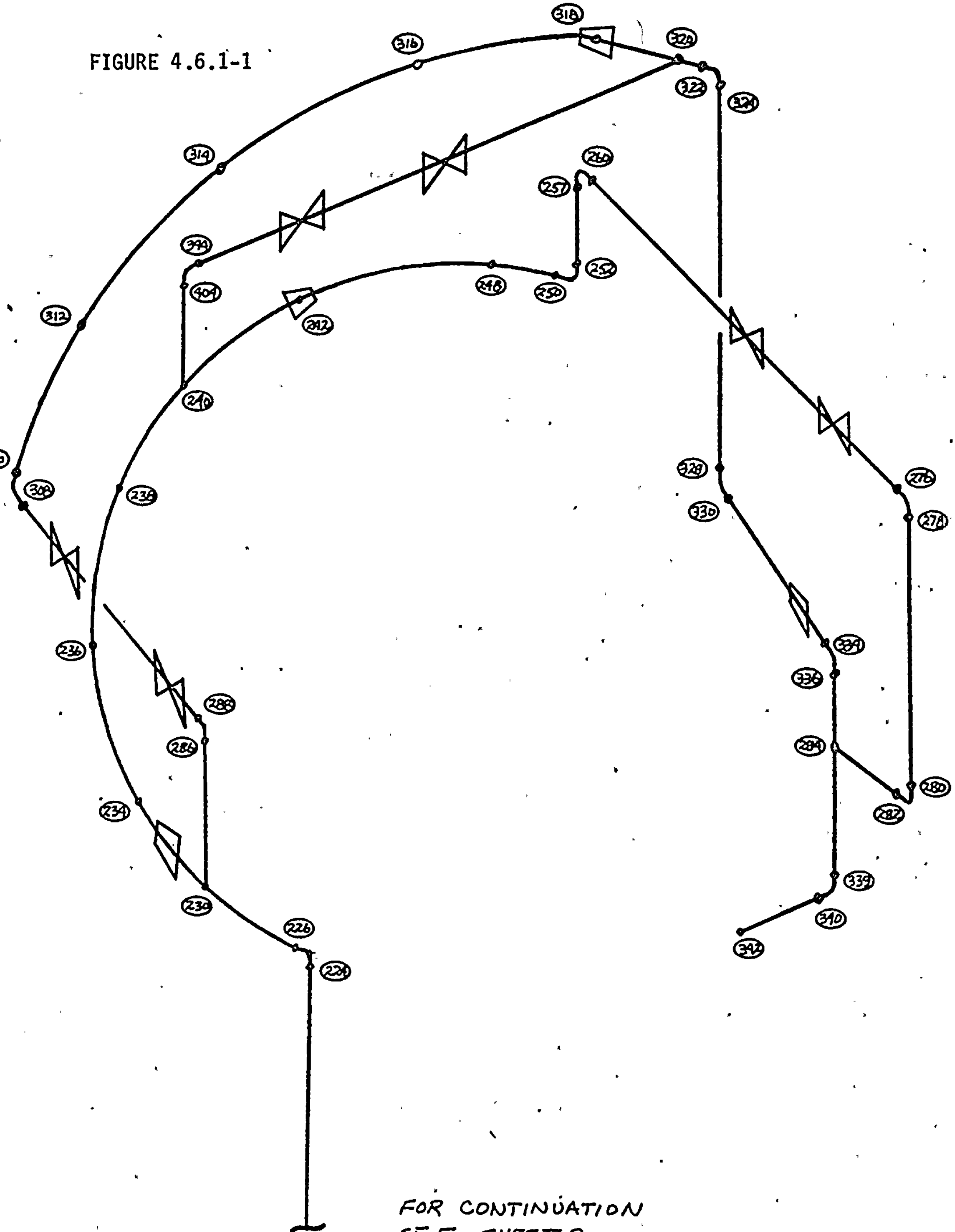
BY CJC DATE 3-11-83
CHKD. BY CHM DATE 3-11-83

UNIT 2 STRUCTURAL NODE POINTS
PORV SECTION

SHEET NO. 1 OF 3
PROJ. NO. 5364

FIGURE 4.6.1-1



FOR CONTINUATION
SEE SHEET 2

TELEDYNE ENGINEERING SERVICES

BY CJC DATE 3-11-83
CHKD. BY CMM DATE 3-11-83

UNIT 2 STRUCTURAL NODE POINTS
SRV SECTION

SHEET NO. 2 OF 3
PROJ. NO. 5364

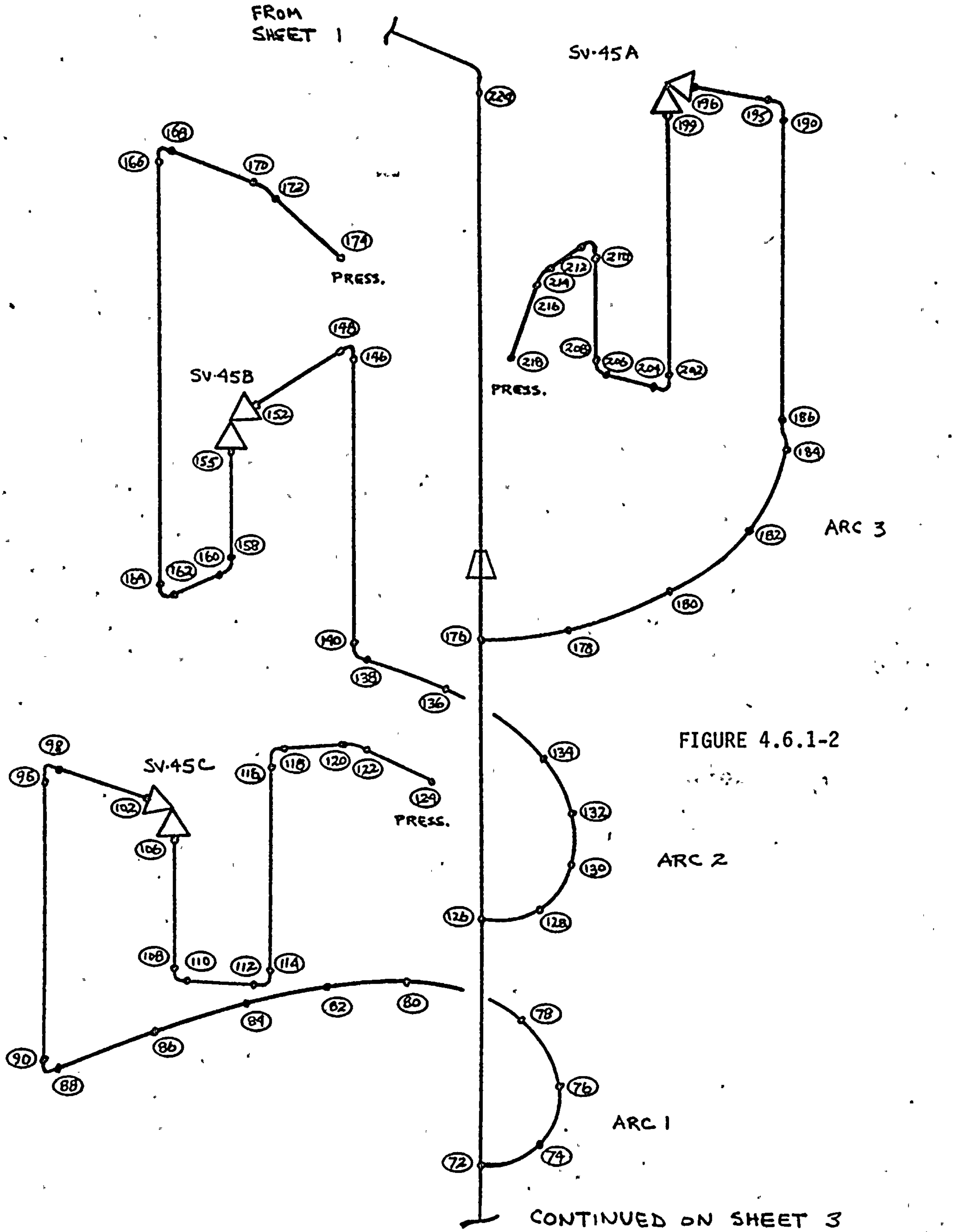


FIGURE 4.6.1-2

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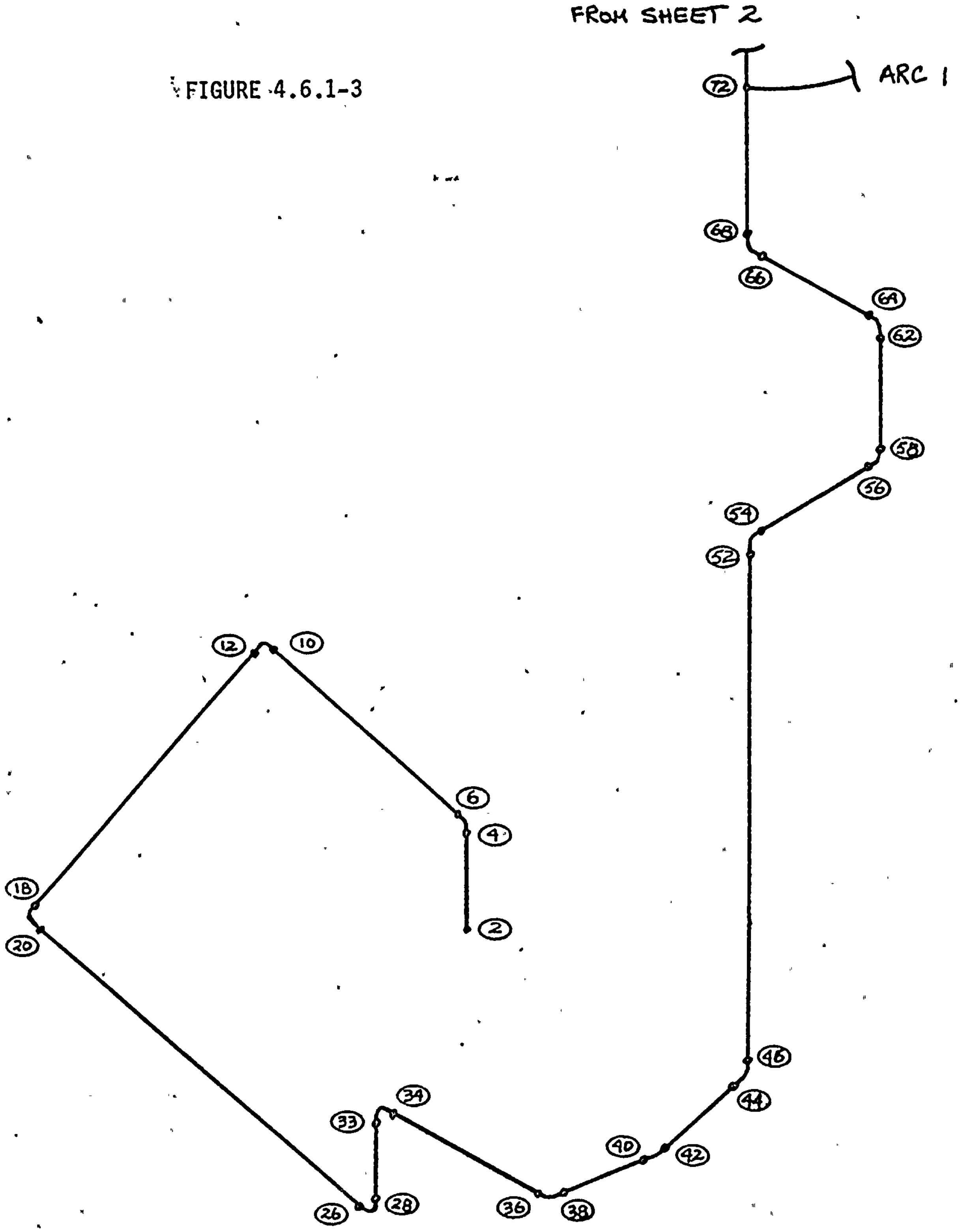
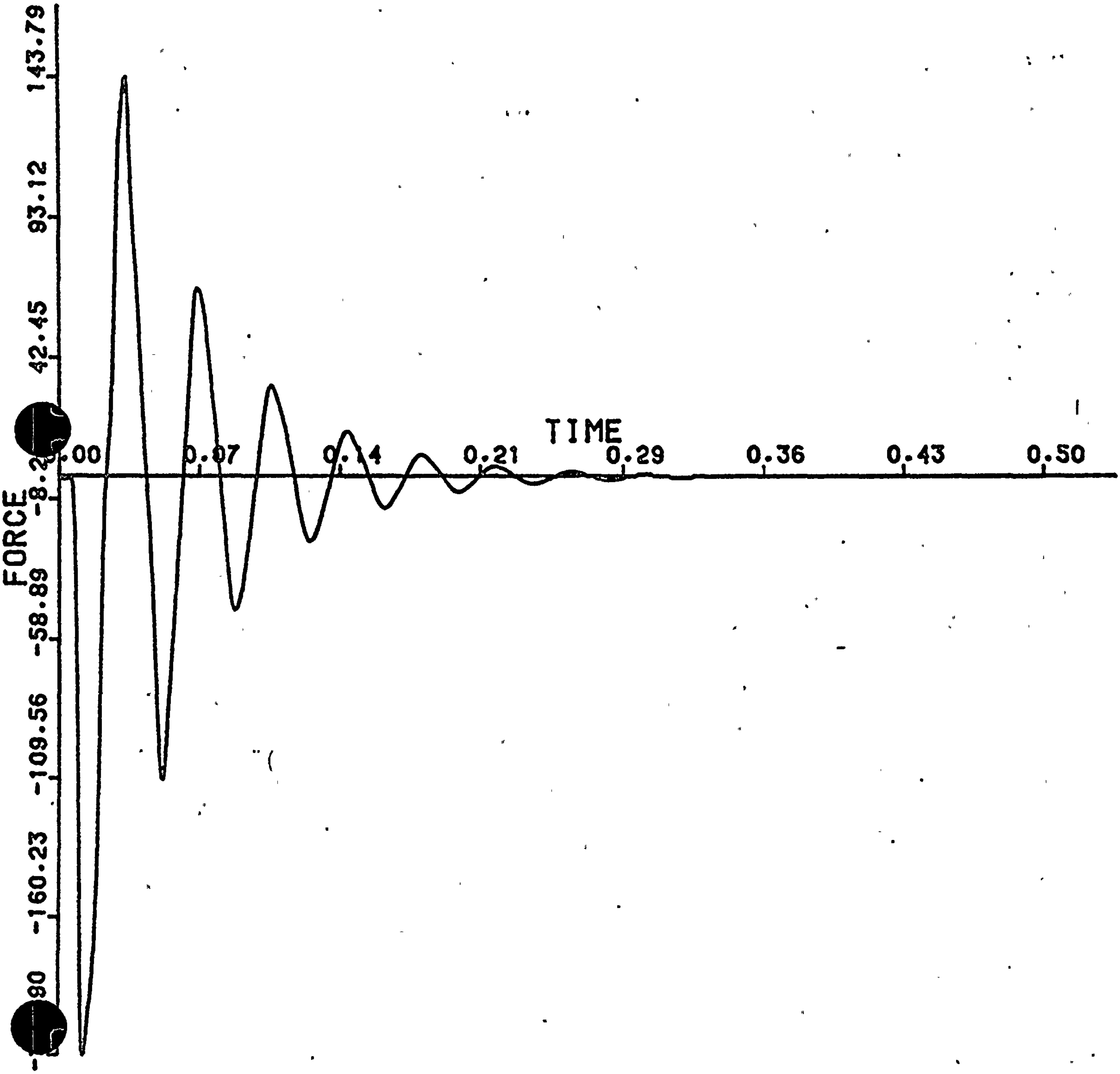
BY CJC DATE 3-11-83	UNIT 2 STRUCTURAL NODE POINTS	SHEET NO. 3 OF 3	
CHKD. BY CHM DATE 3-11-83	12" DWNSTRM. SECTION	PROJ. NO. 5364	

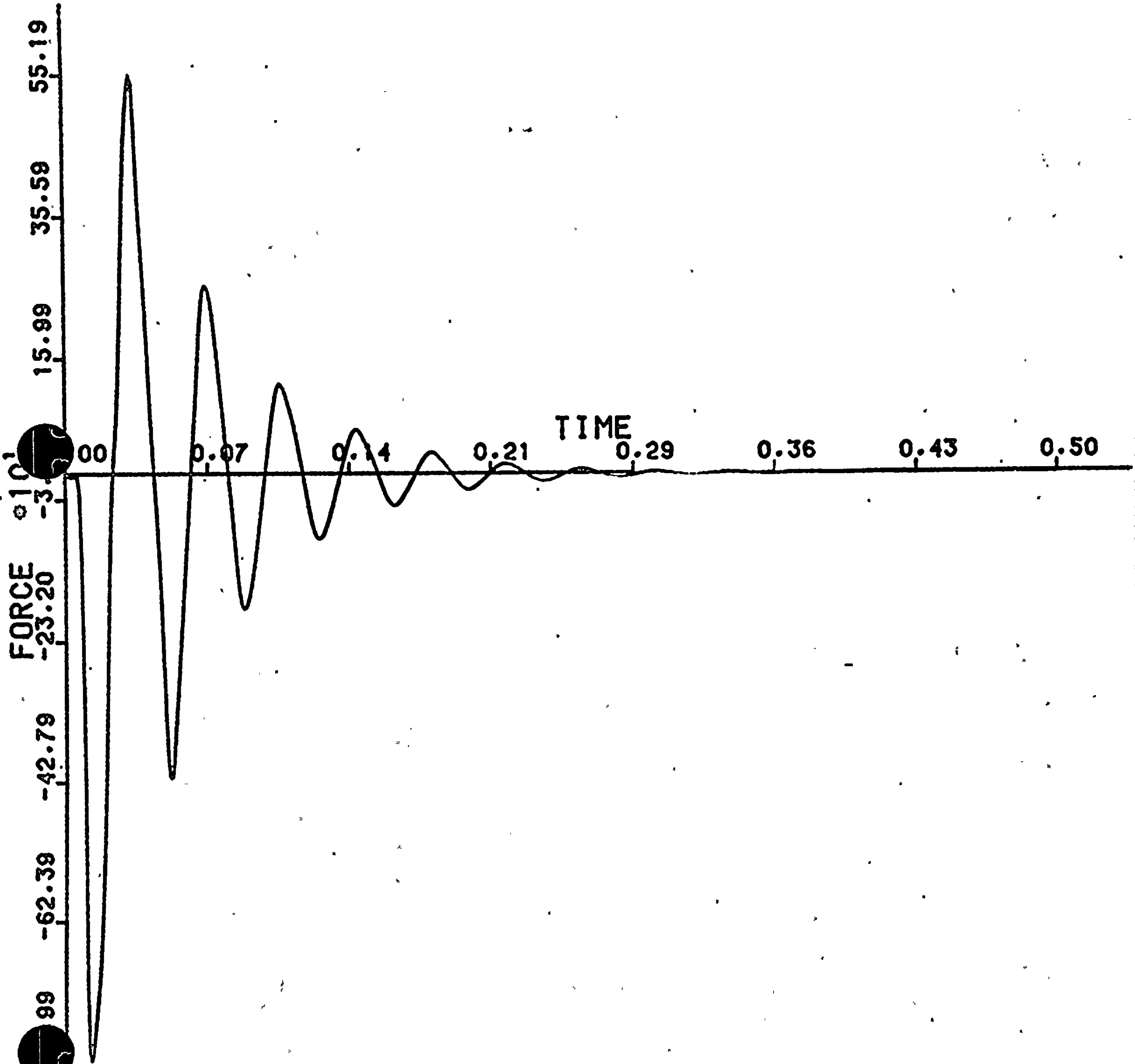
FIGURE 4.6.1-3

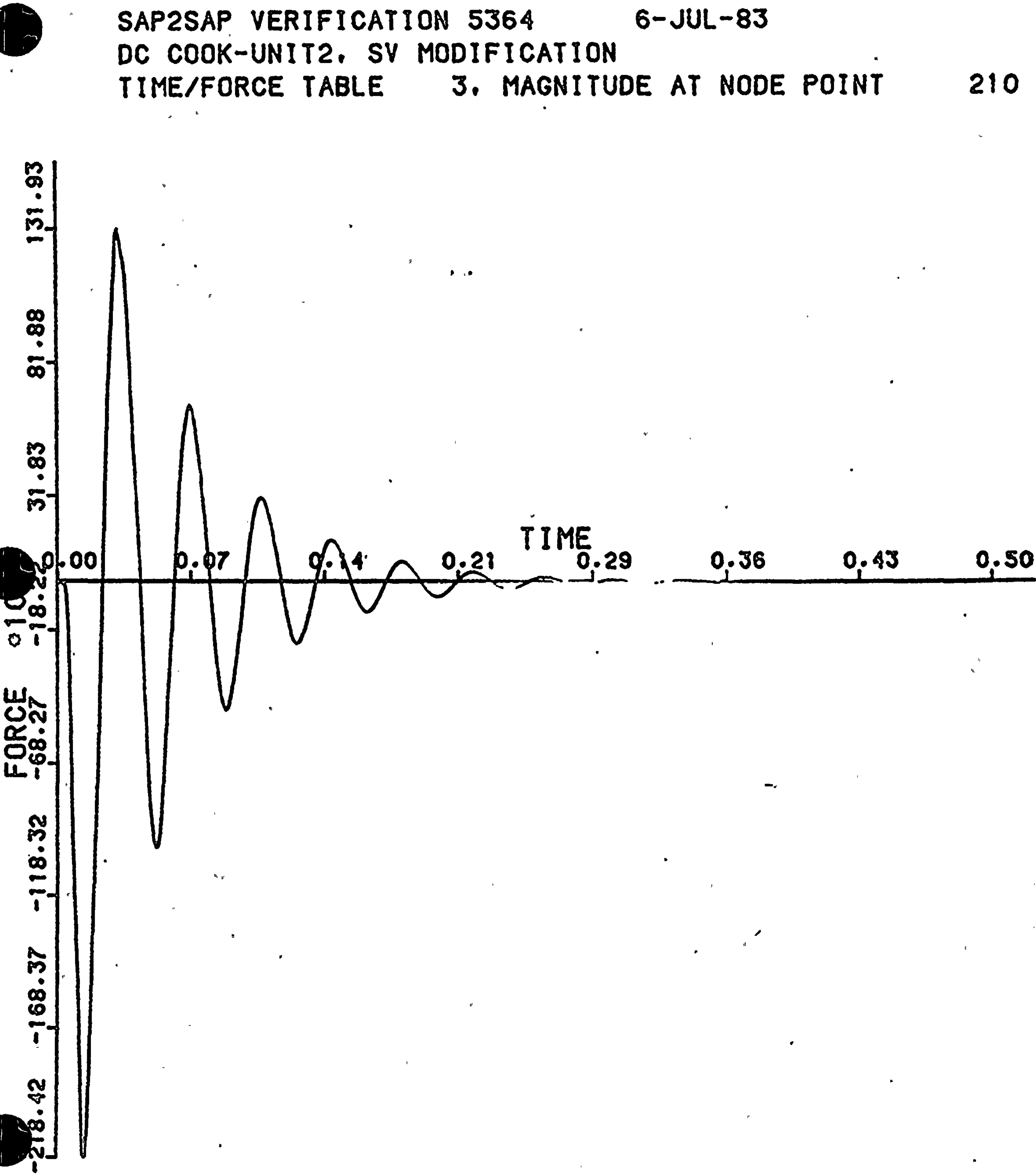


SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 1, MAGNITUDE AT NODE POINT 216



SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 2, MAGNITUDE AT NODE POINT 214




SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 3, MAGNITUDE AT NODE POINT 210
TIME
0.00
0.07
0.14
0.21
0.29
0.36
0.43
0.50
FORCE *10
131.93
81.88
31.83
-18.22
-68.27
-118.32
-168.37
-218.42

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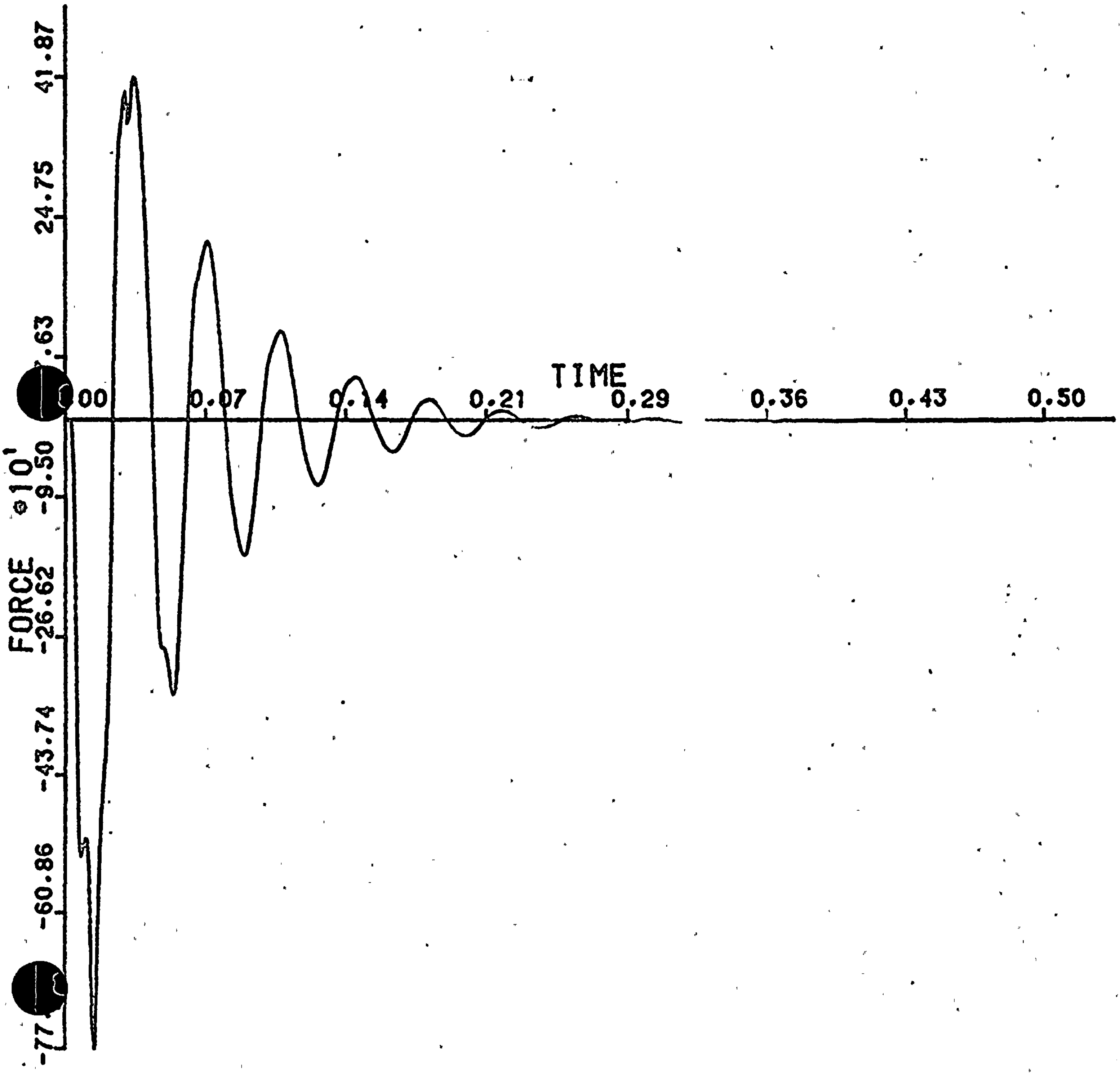
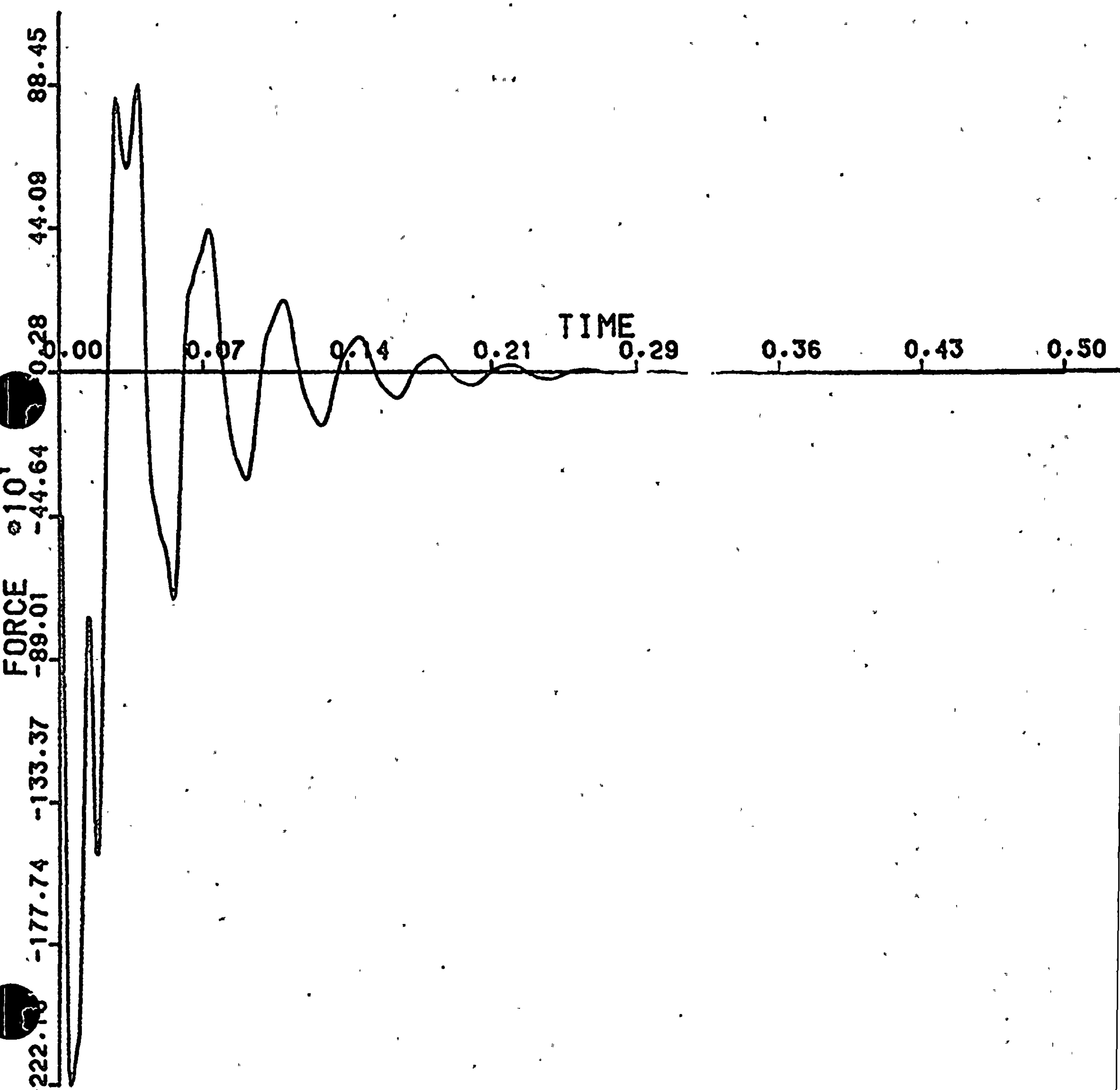
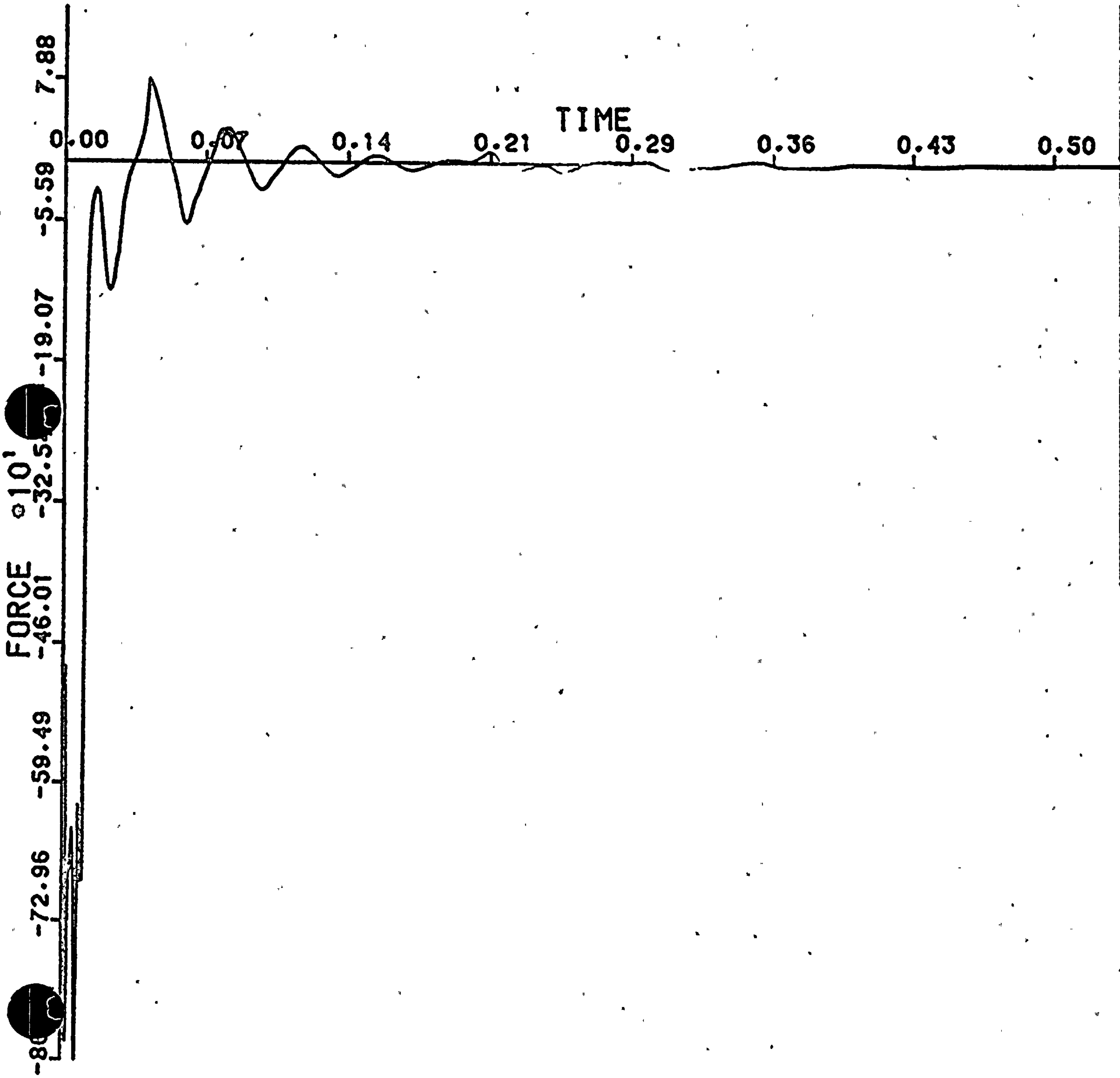
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 4, MAGNITUDE AT NODE POINT 205



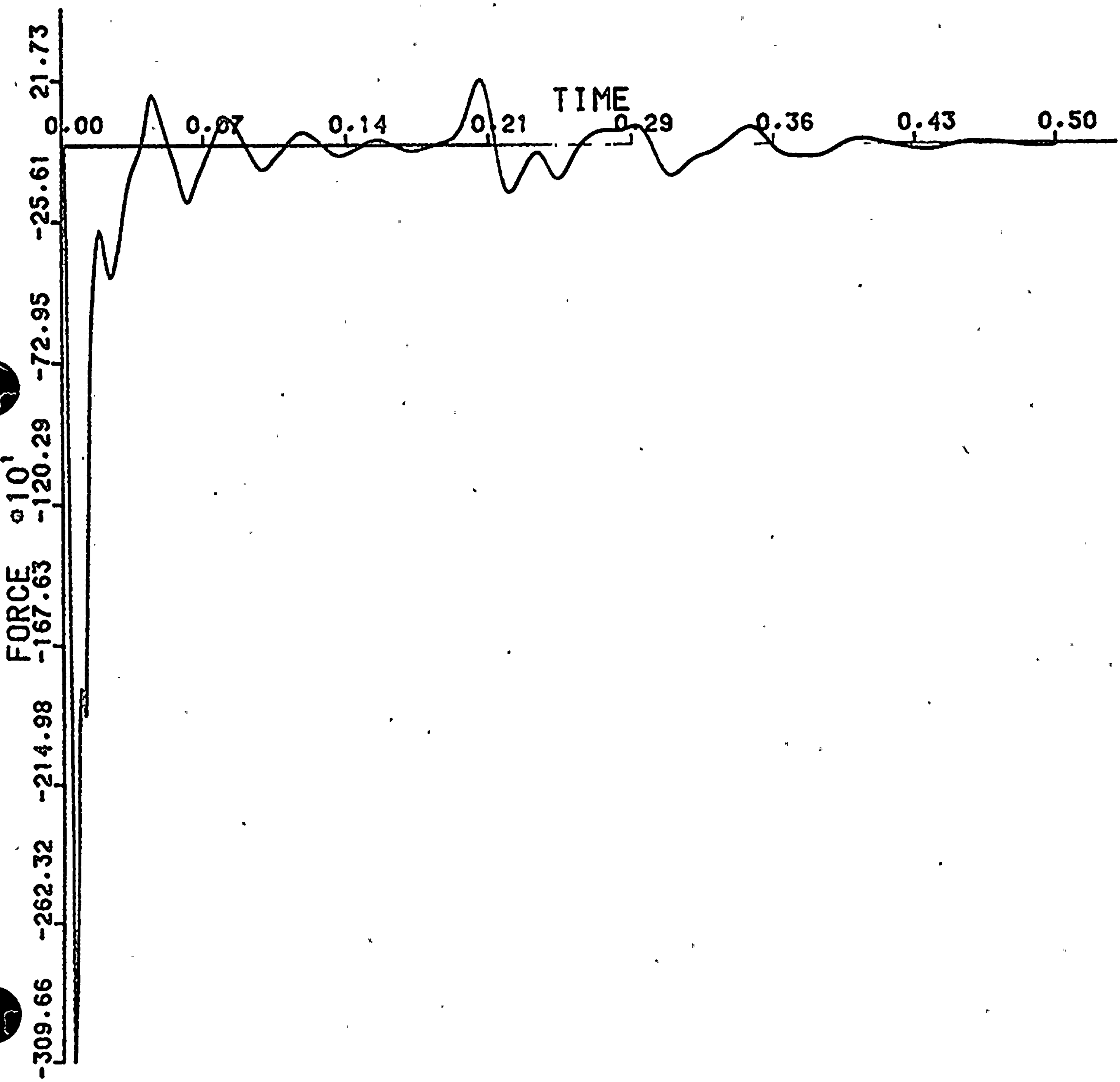
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 5, MAGNITUDE AT NODE POINT 202



SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 6, MAGNITUDE AT NODE POINT 196



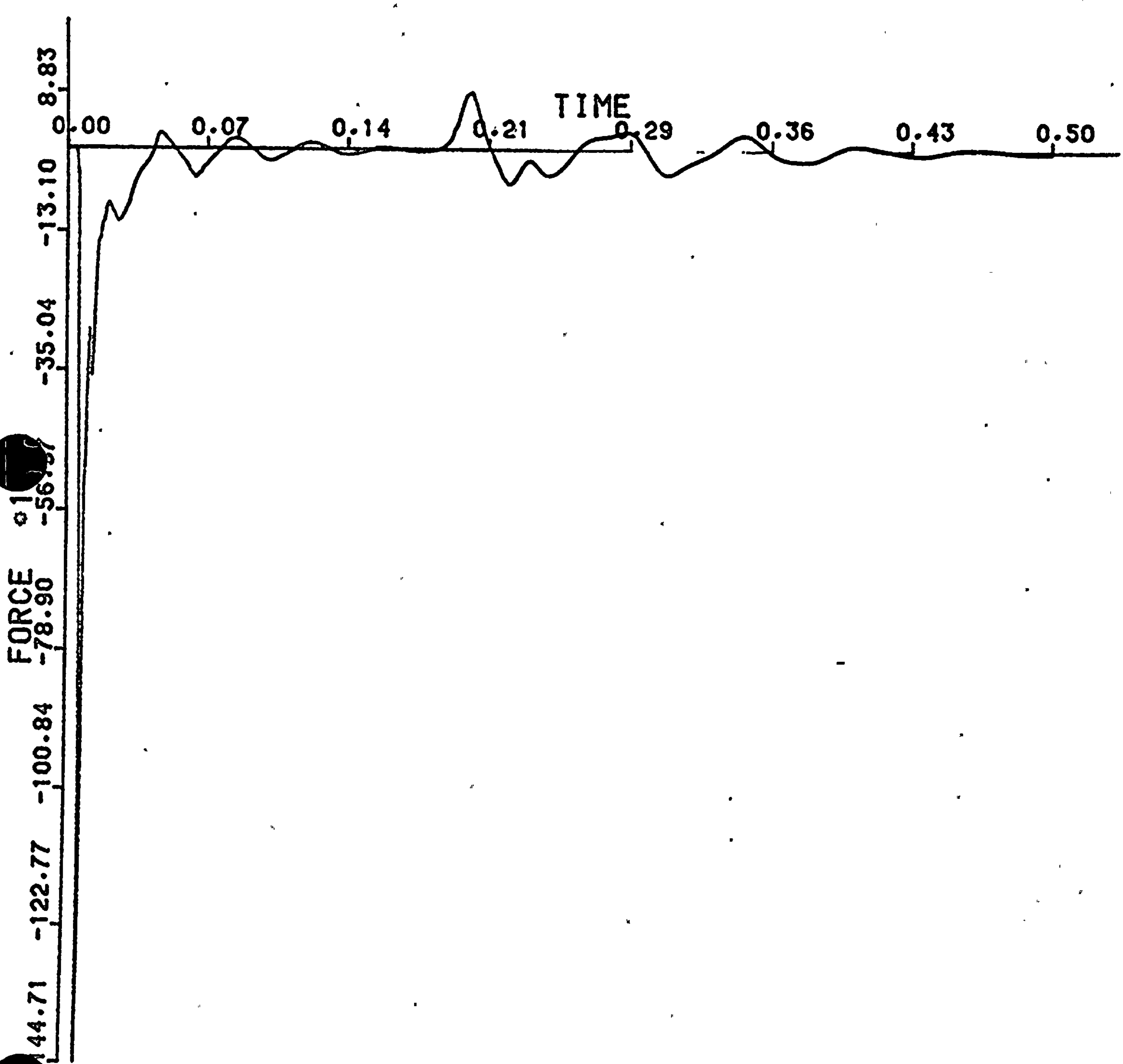
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 7, MAGNITUDE AT NODE POINT 187



SAP2SAP VERIFICATION 5364 6-JUL-83

DC COOK-UNIT2, SV MODIFICATION

TIME/FORCE TABLE 8, MAGNITUDE AT NODE POINT 184



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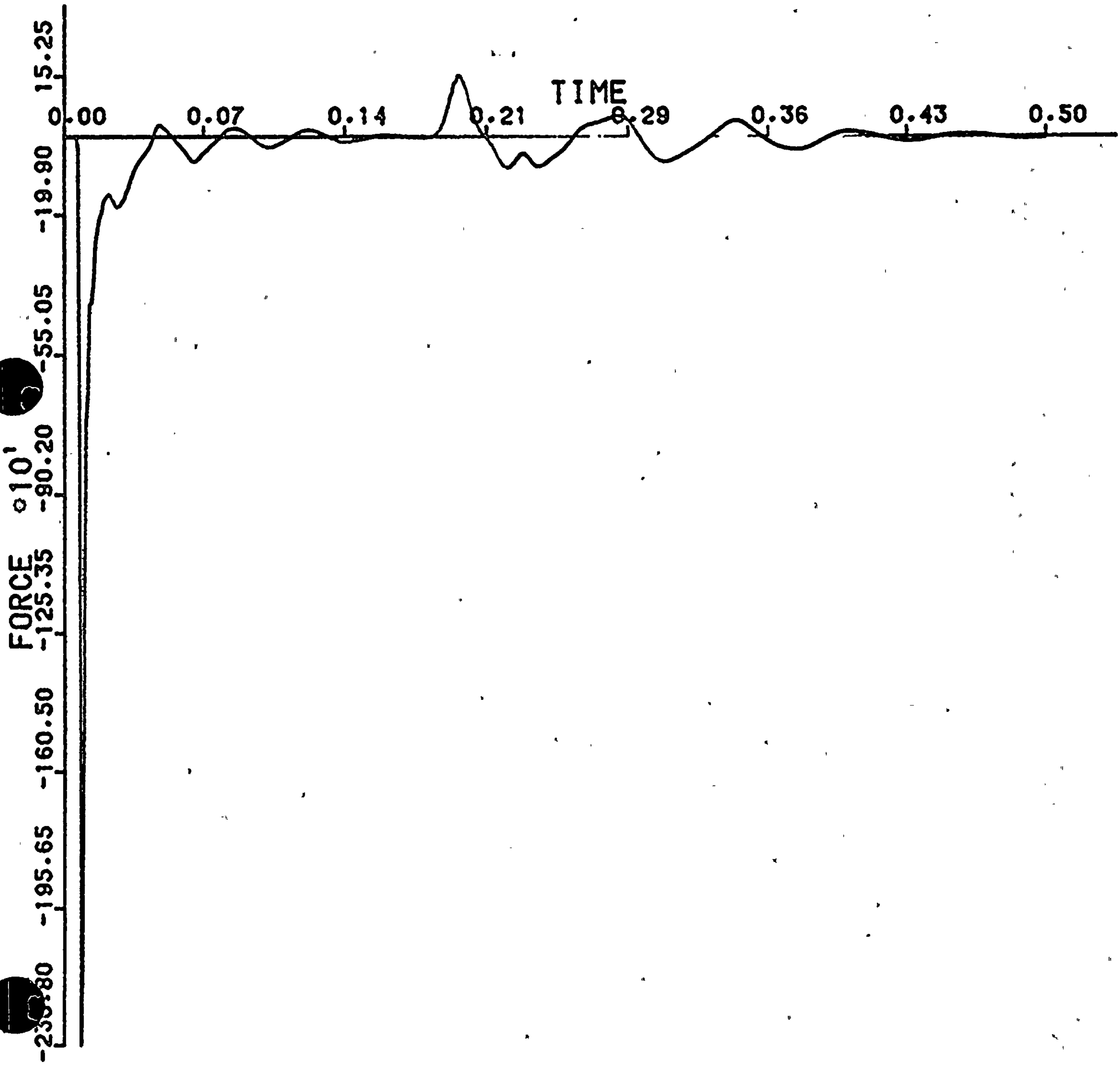
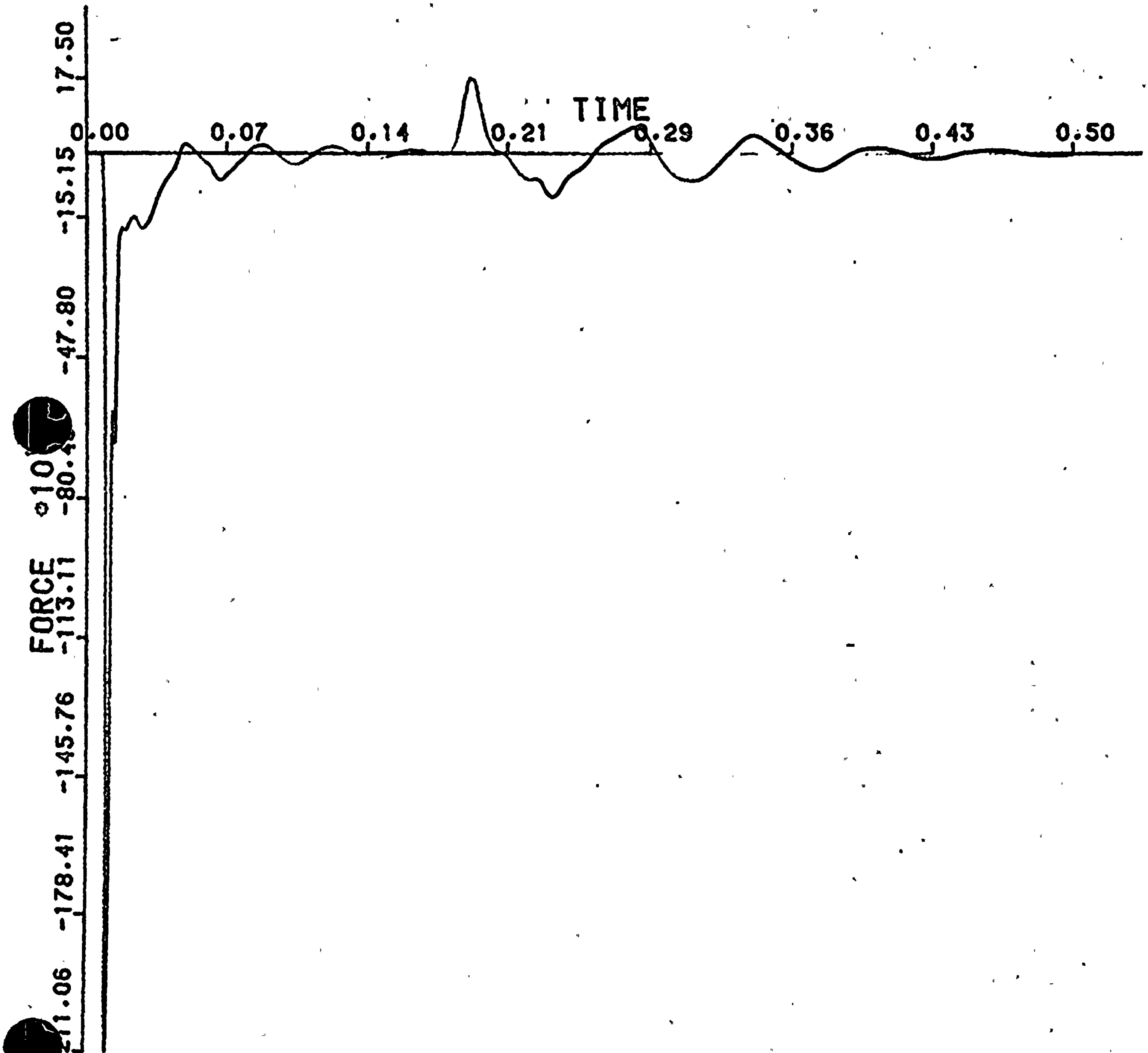
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 9, MAGNITUDE AT NODE POINT 182



SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2. SV MODIFICATION
TIME/FORCE TABLE 10. MAGNITUDE AT NODE POINT 180



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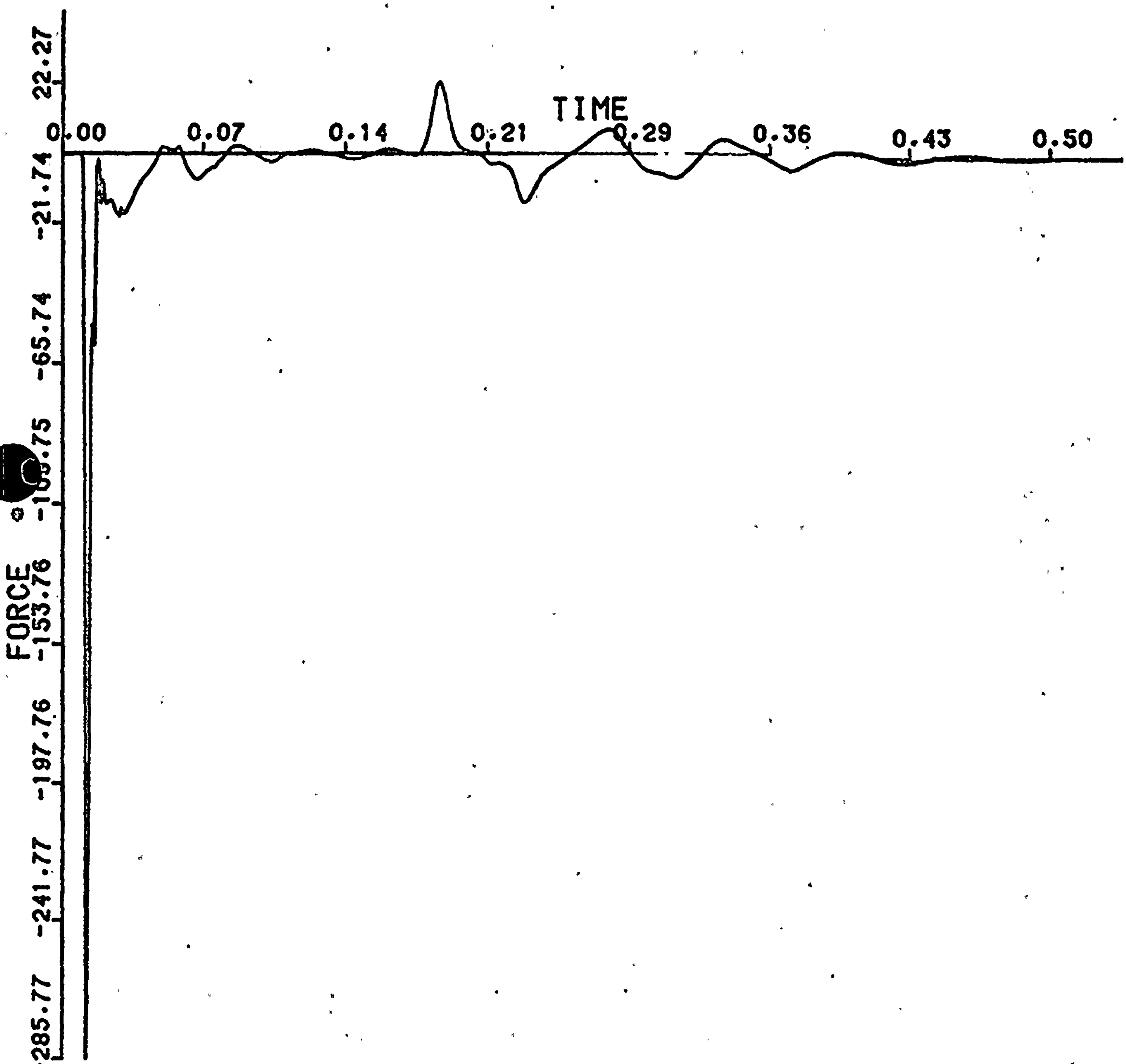
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 11, MAGNITUDE AT NODE POINT 178



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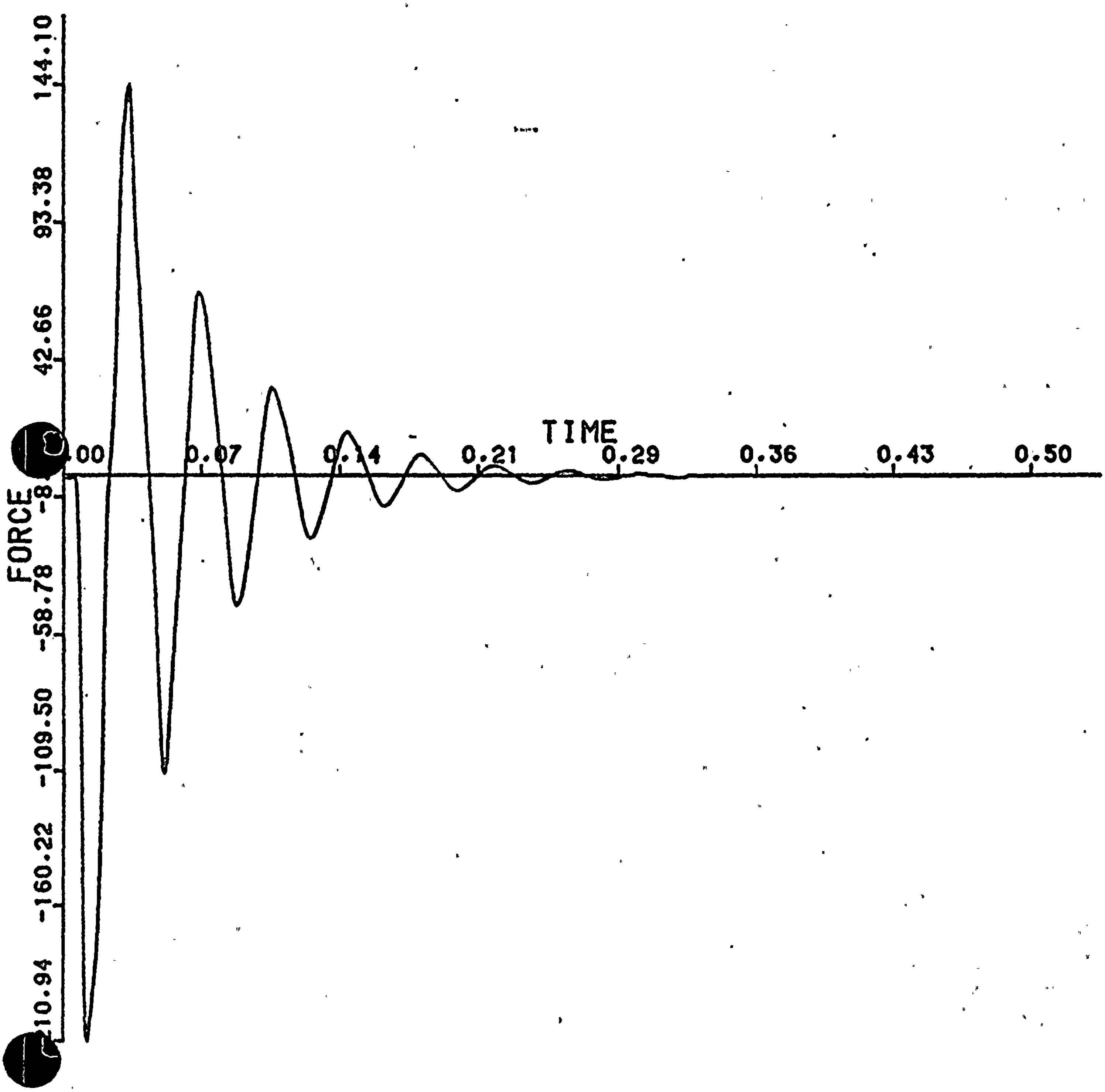
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 12, MAGNITUDE AT NODE POINT 172



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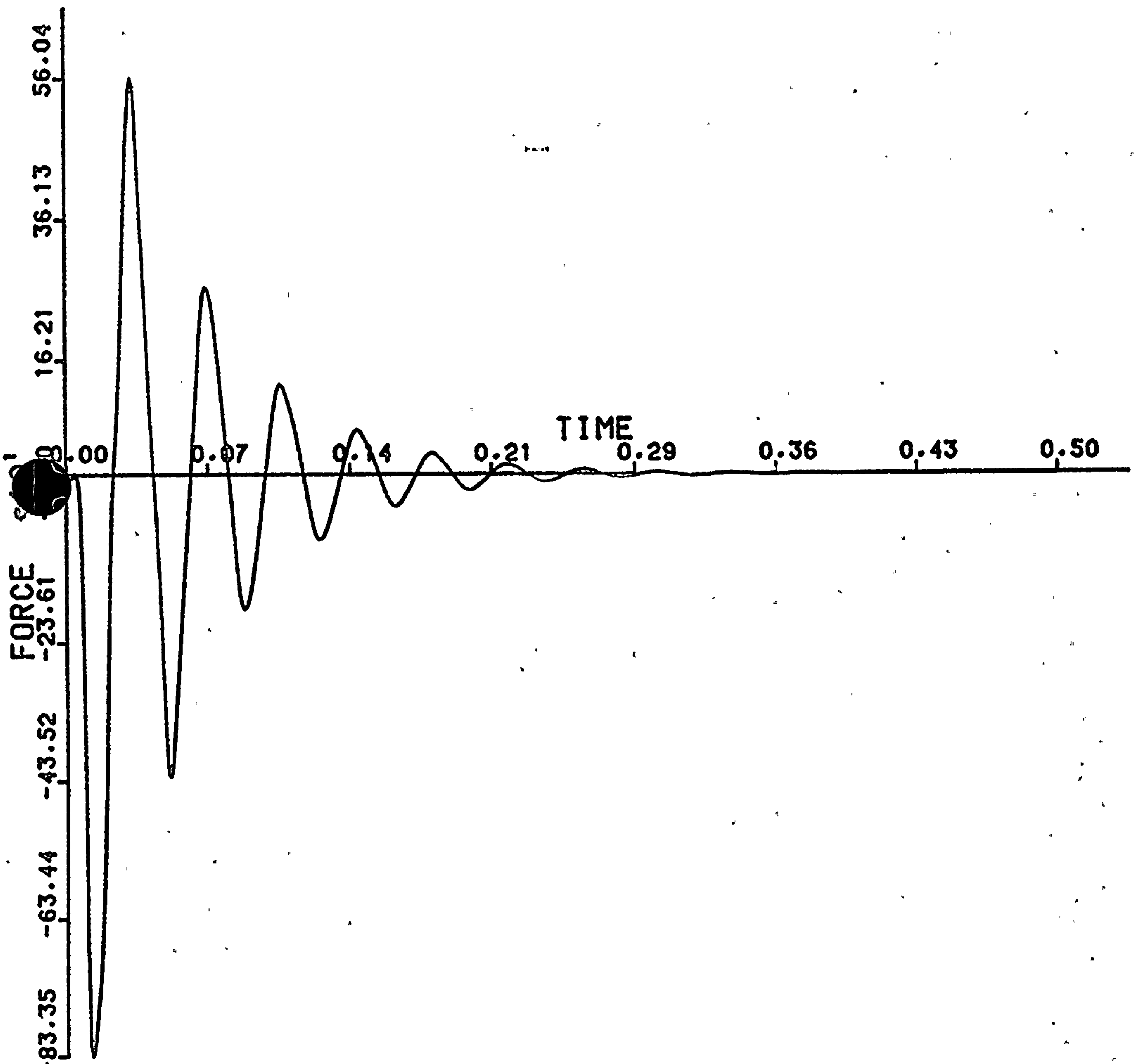
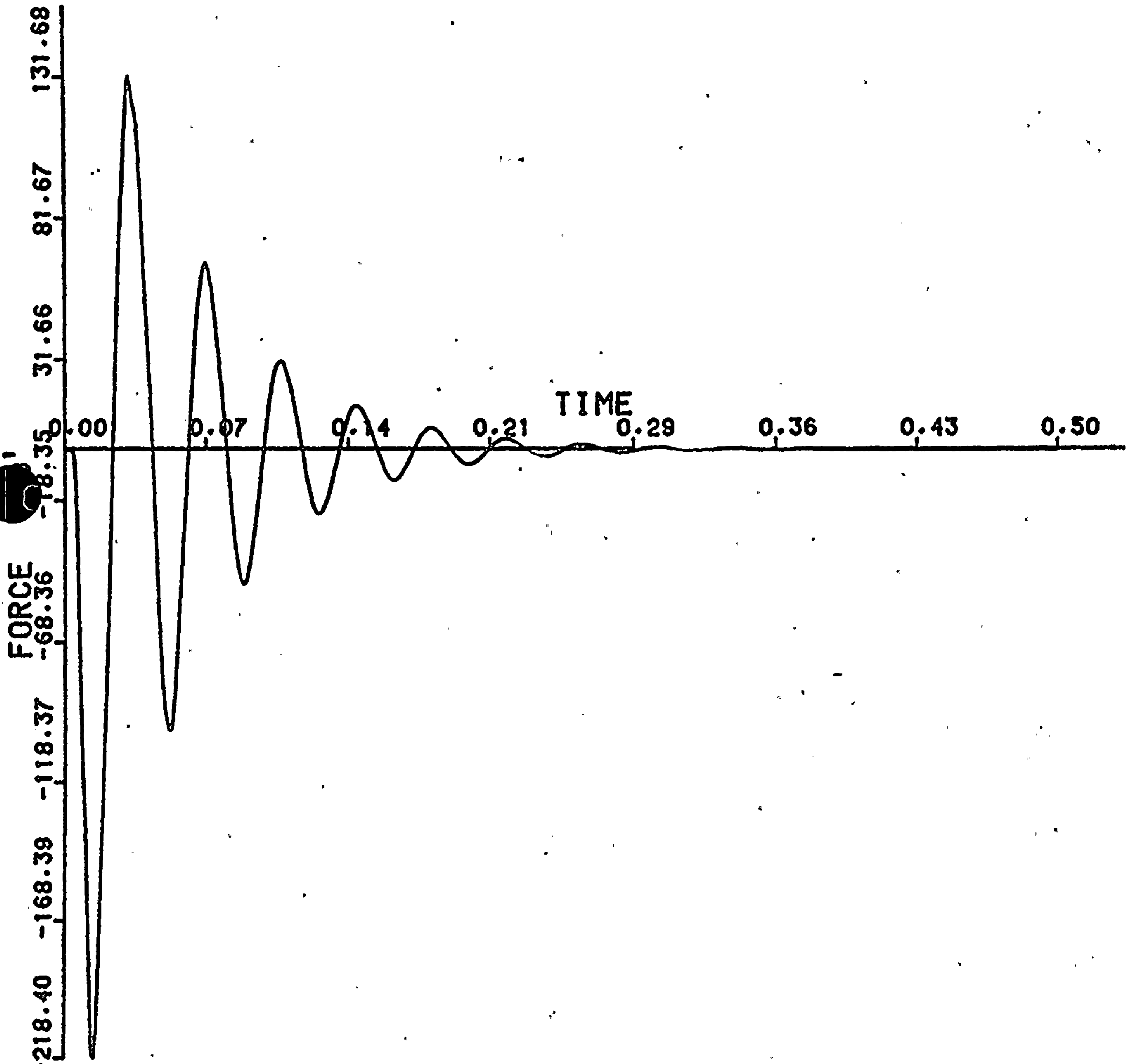
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 13, MAGNITUDE AT NODE POINT 170



SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 14, MAGNITUDE AT NODE POINT 166



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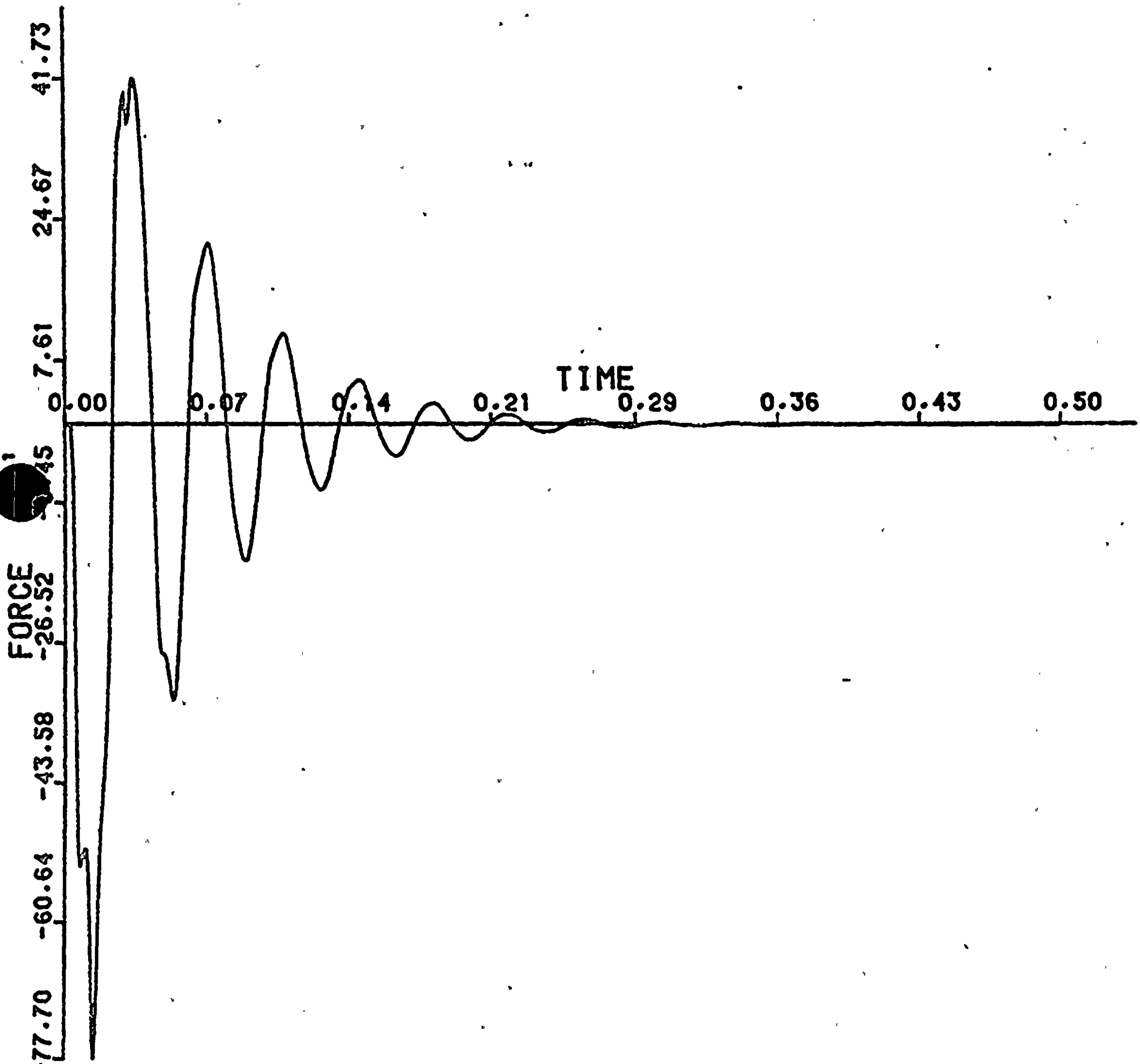
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 15, MAGNITUDE AT NODE POINT 161



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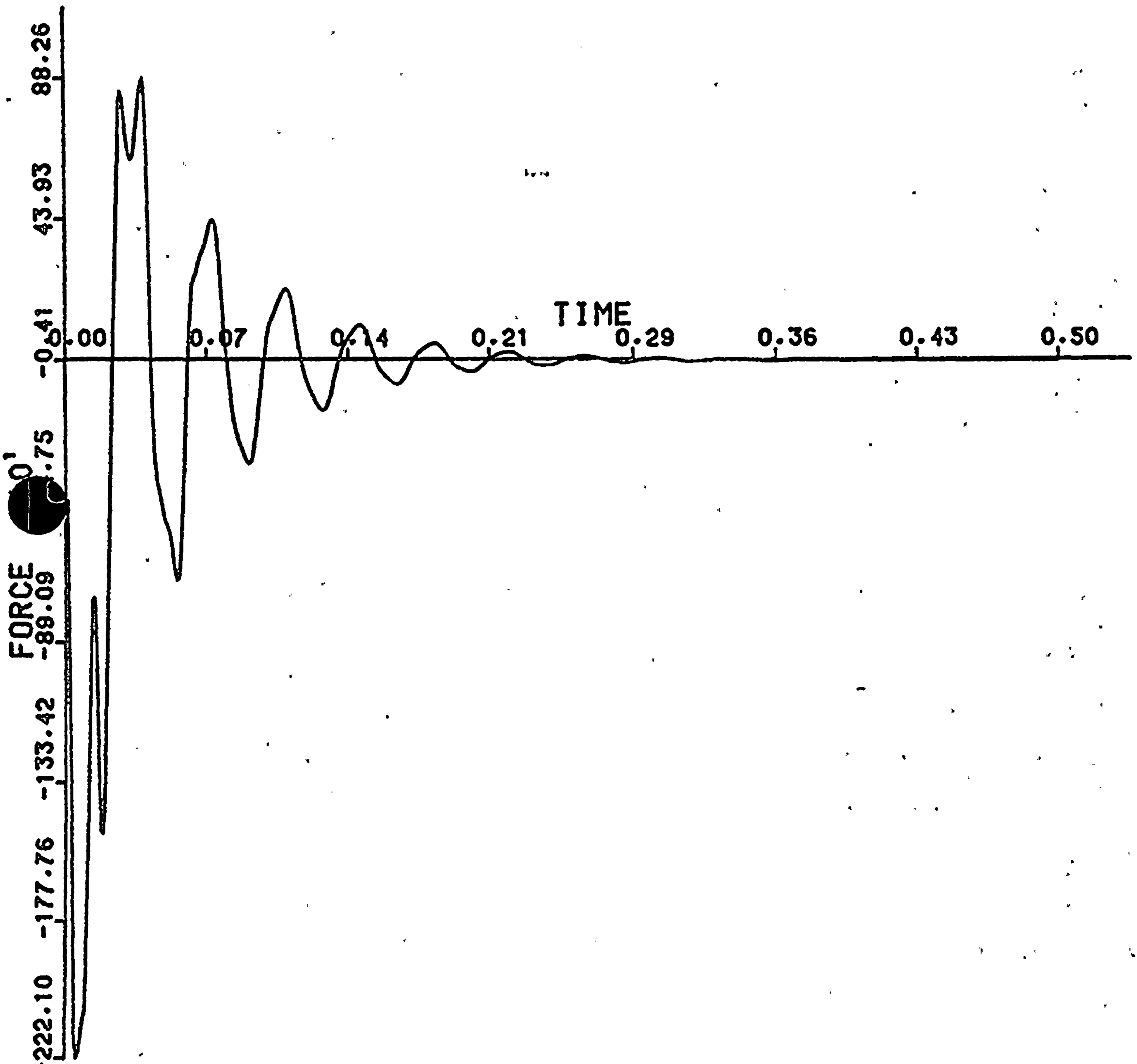
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 16, MAGNITUDE AT NODE POINT 158



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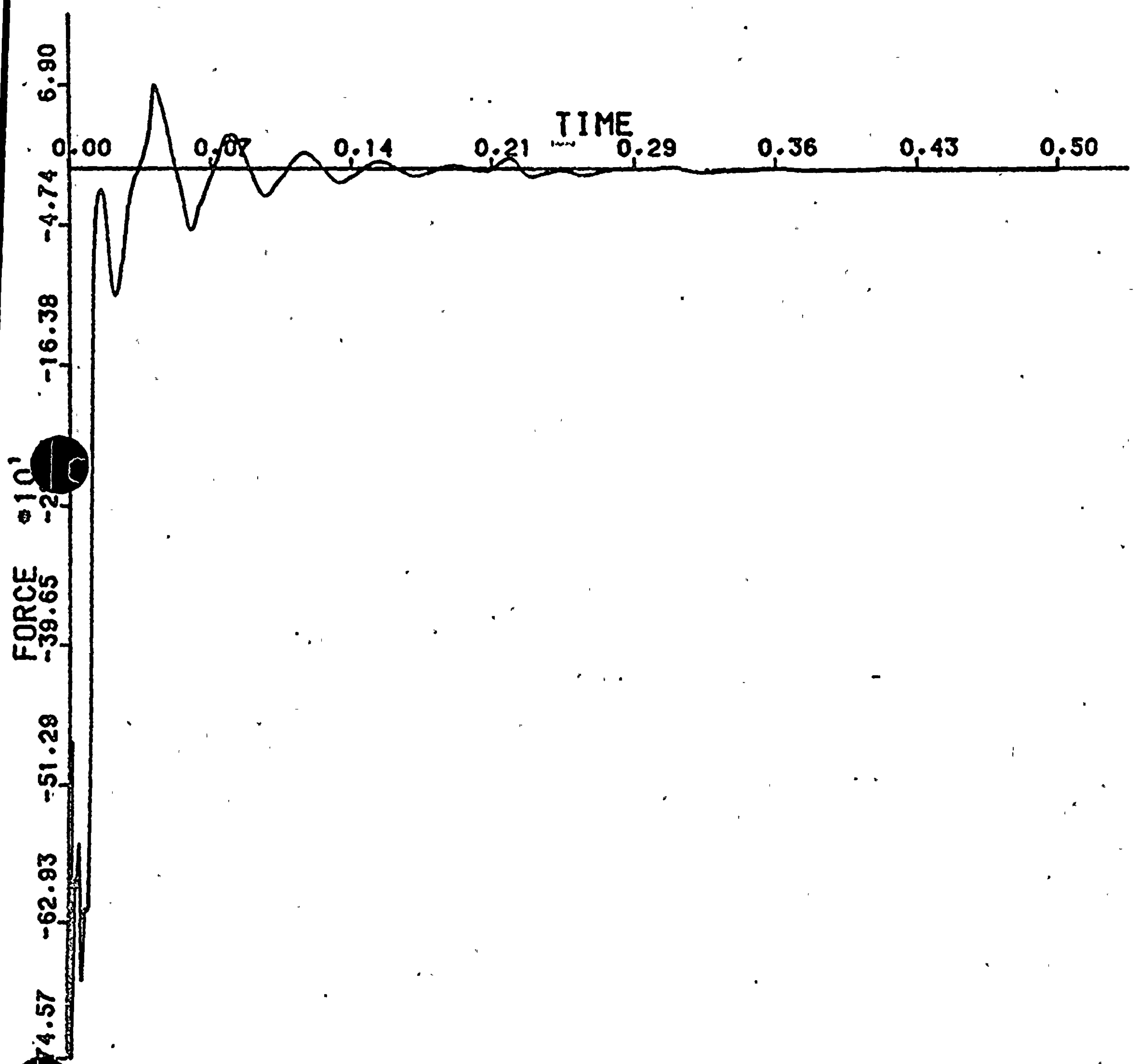
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 17, MAGNITUDE AT NODE POINT 152



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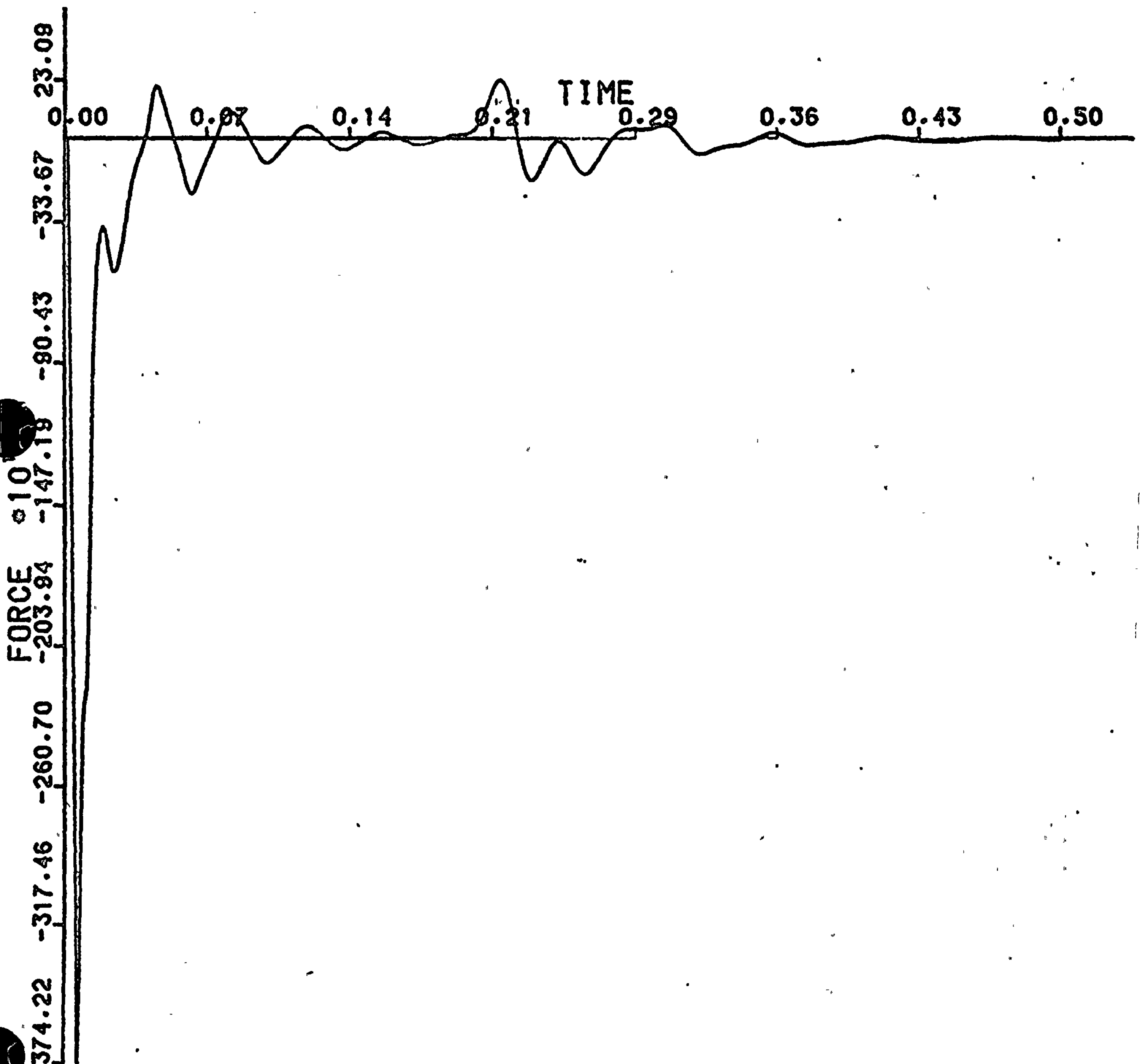
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 18, MAGNITUDE AT NODE POINT 143



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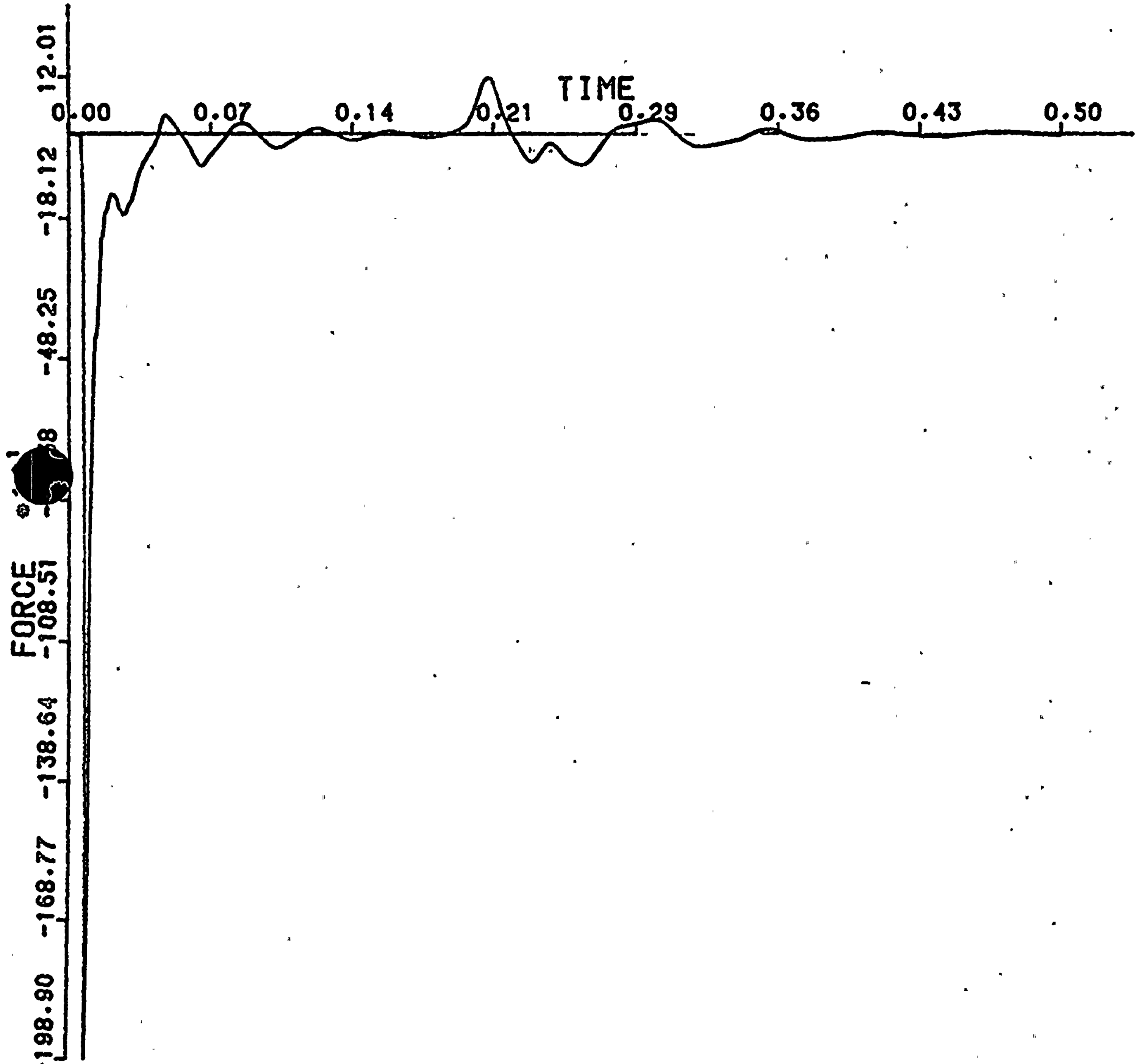
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 19, MAGNITUDE AT NODE POINT 138



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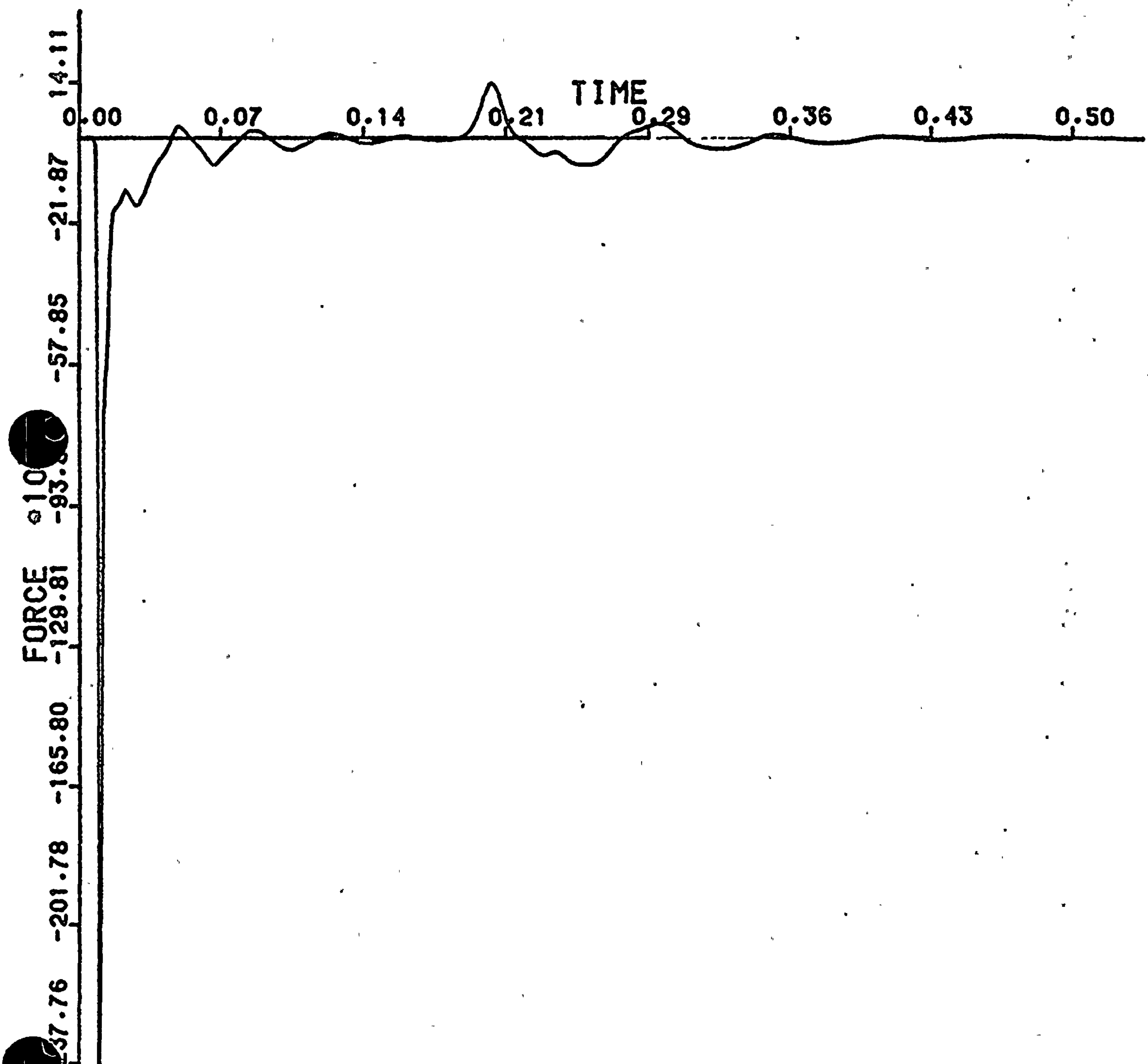
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 20, MAGNITUDE AT NODE POINT 136



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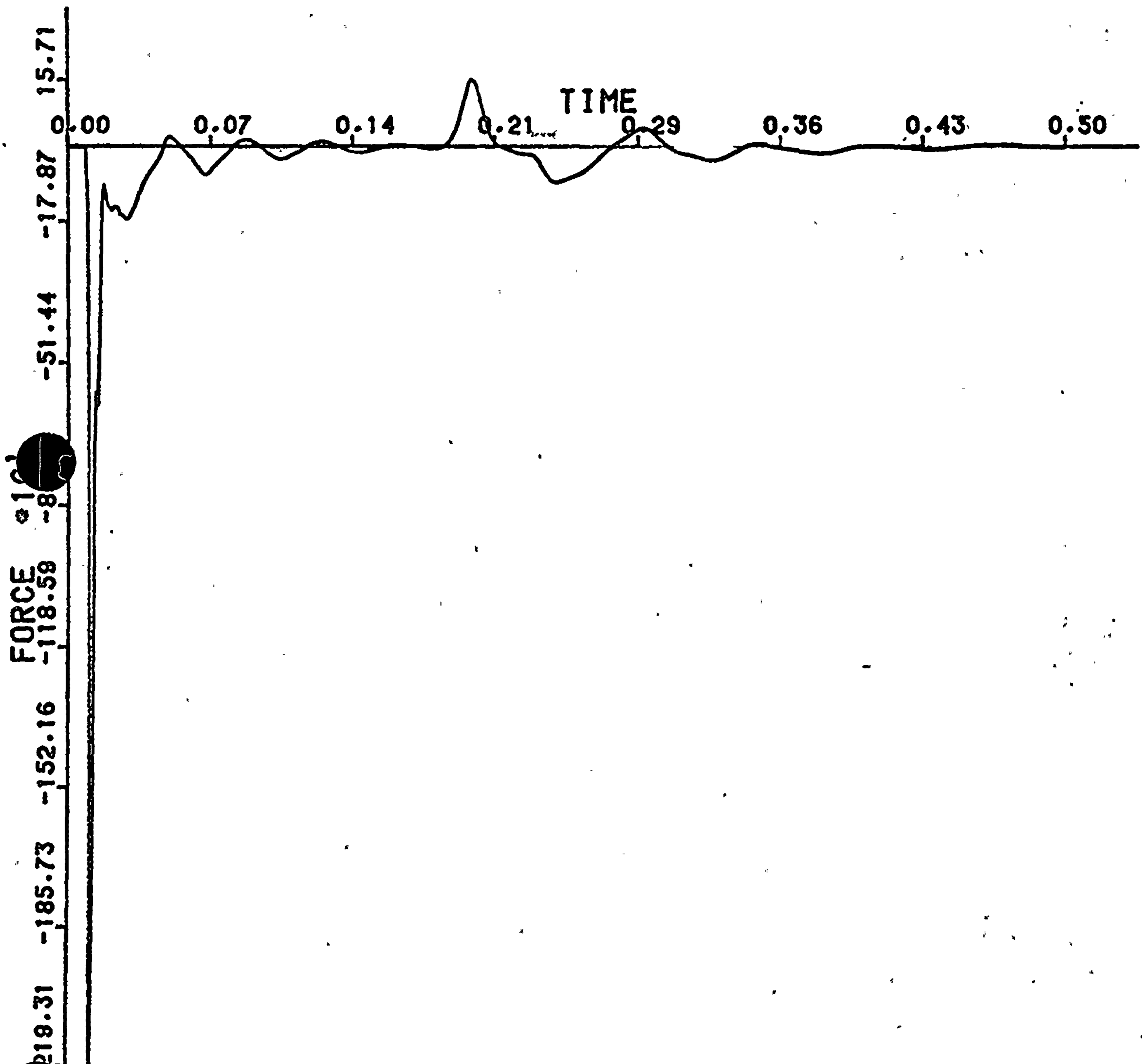
DC COOK-UNIT2. SV MODIFICATION
TIME/FORCE TABLE 21. MAGNITUDE AT NODE POINT 134



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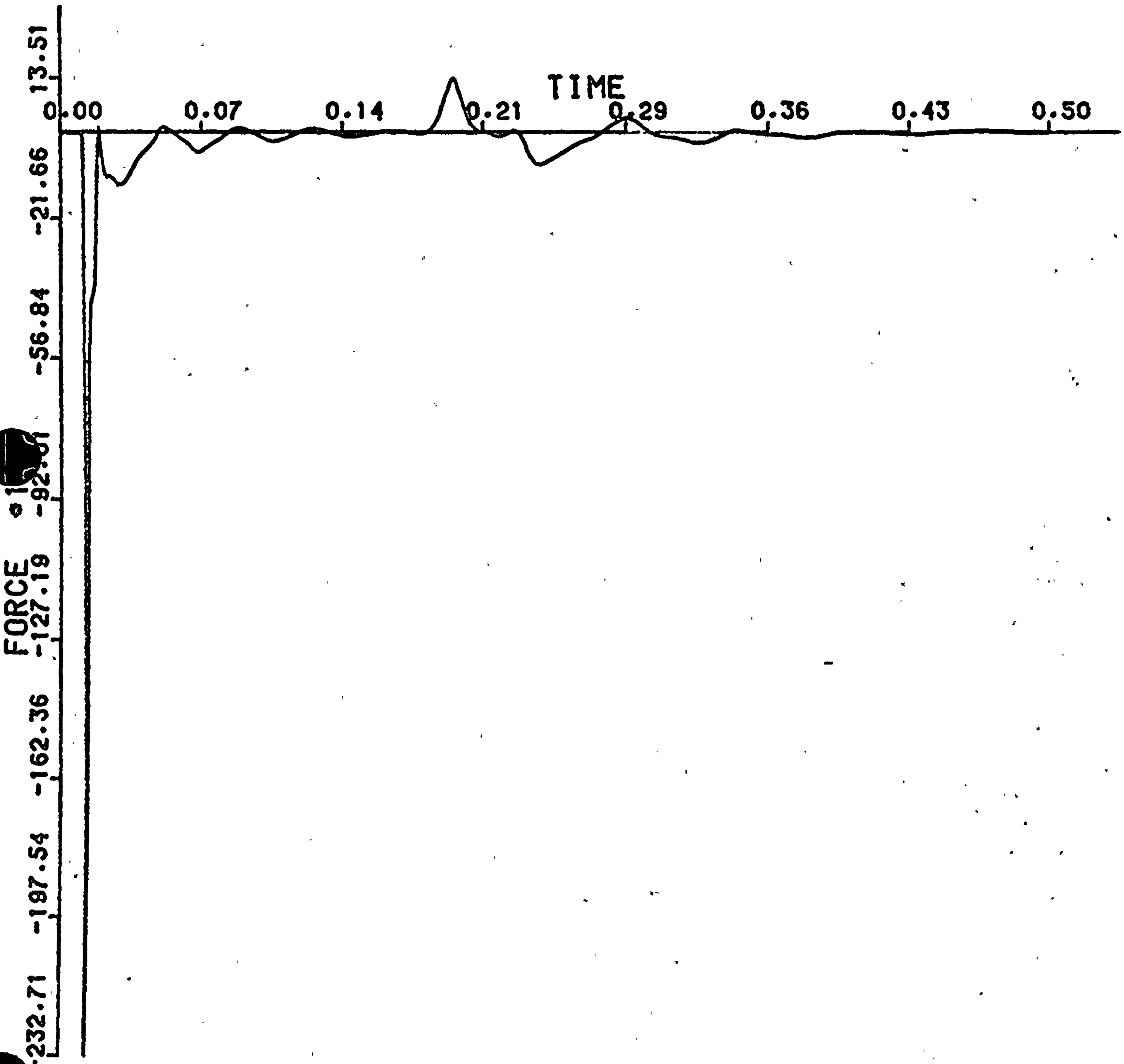
DC COOK-UNIT2, SV MODIFICATION

TIME/FORCE TABLE 22, MAGNITUDE AT NODE POINT 132



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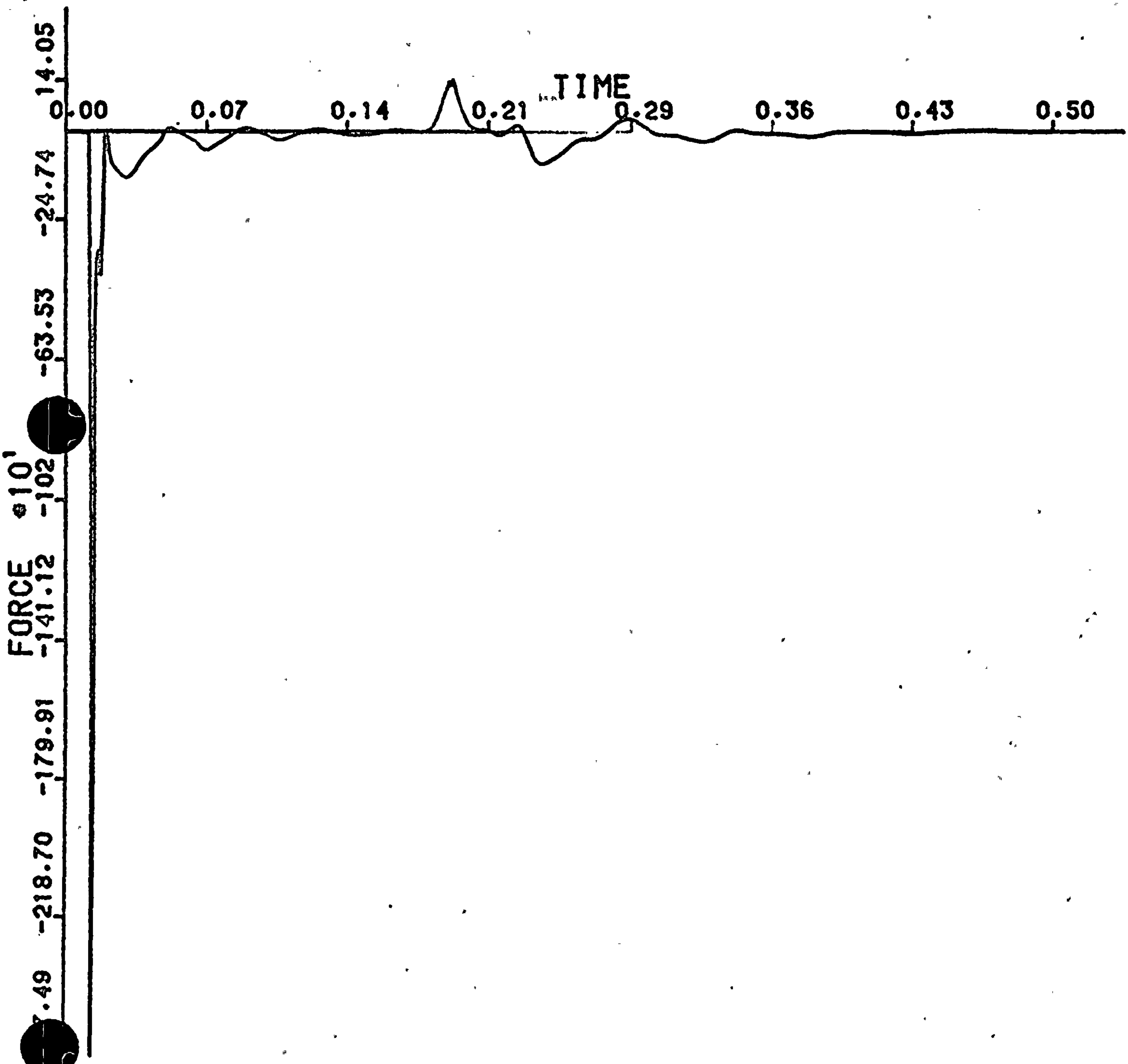
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 23, MAGNITUDE AT NODE POINT 130



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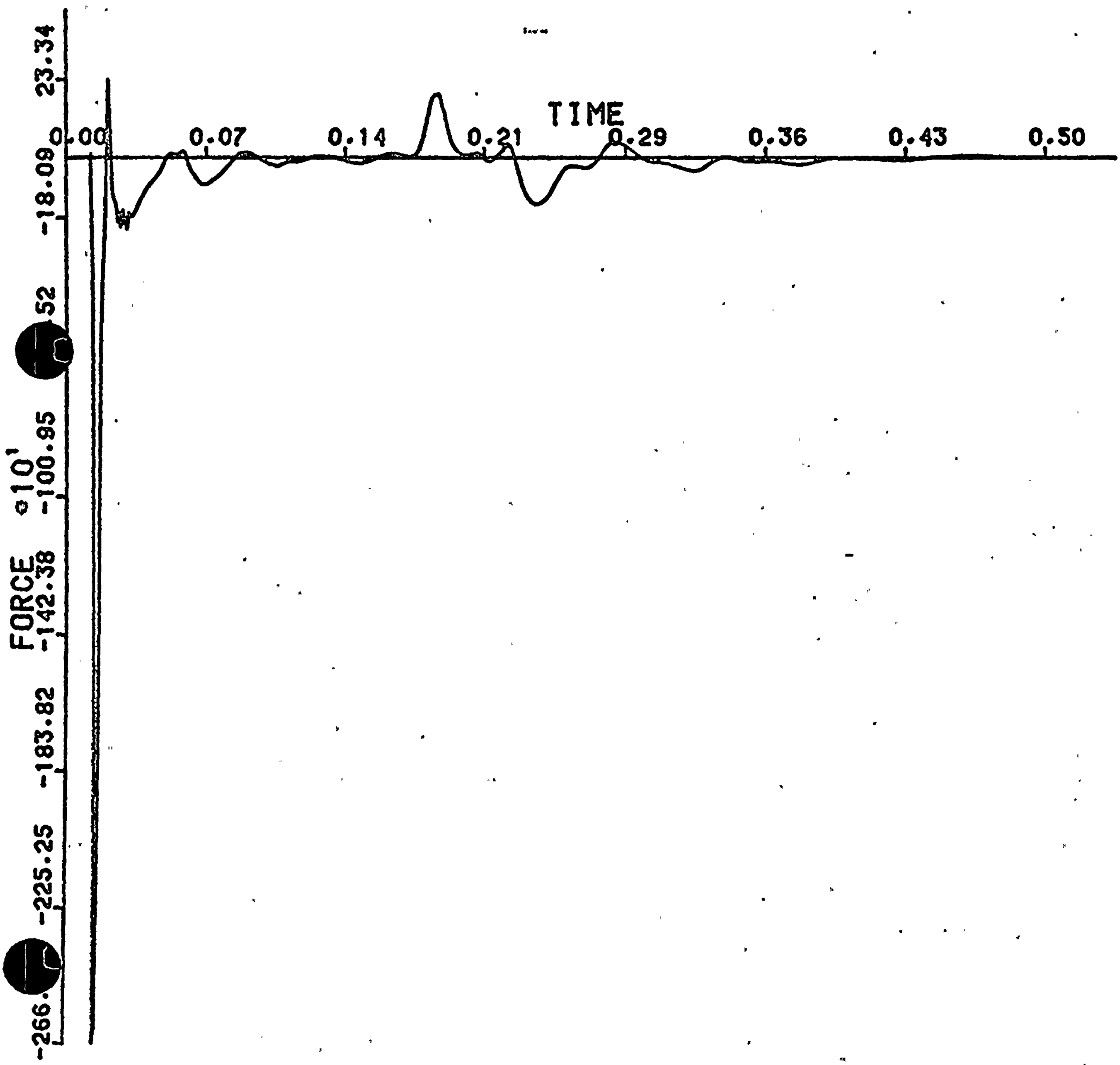
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 24, MAGNITUDE AT NODE POINT 128



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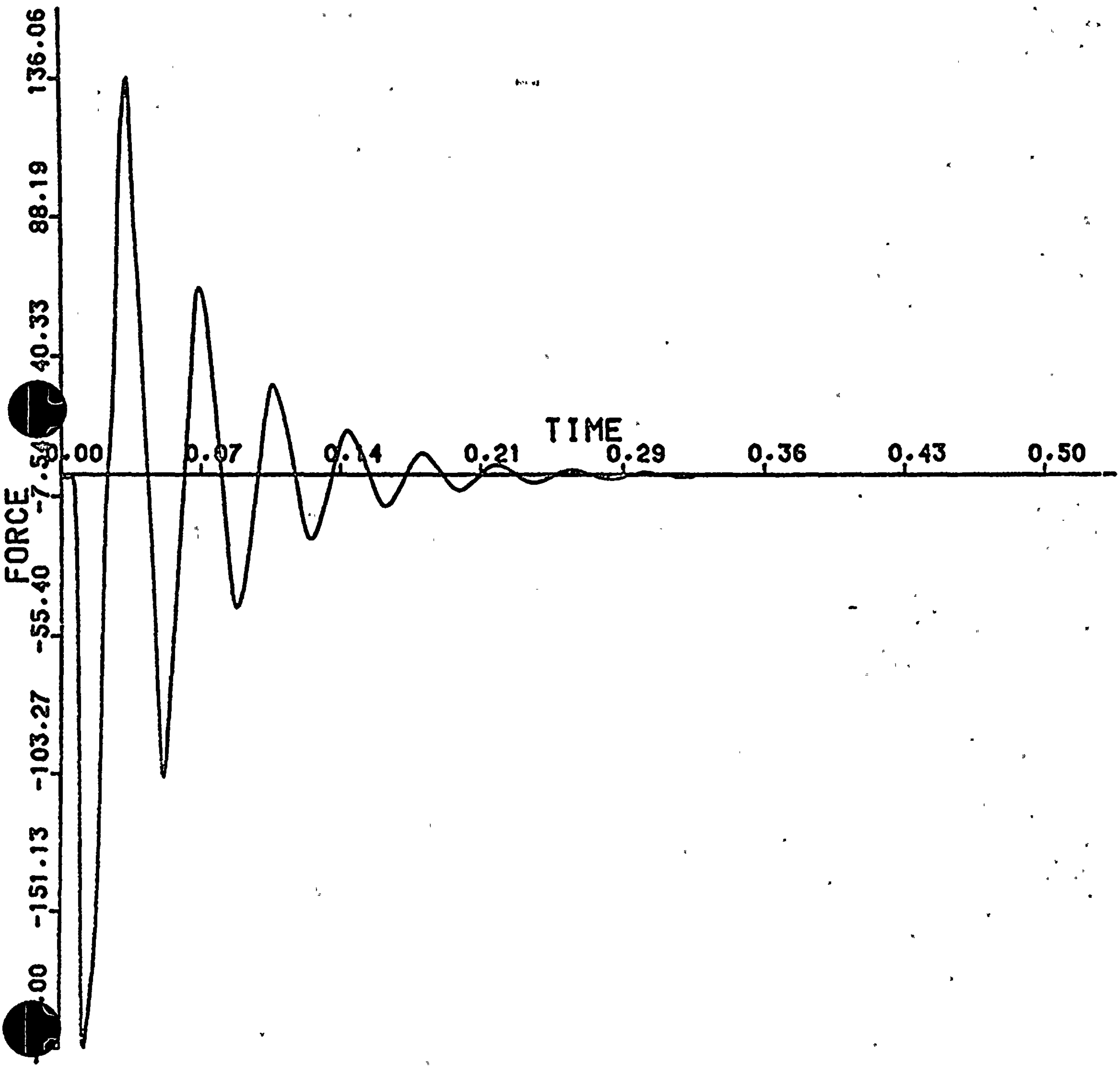
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2. SV MODIFICATION
TIME/FORCE TABLE 25. MAGNITUDE AT NODE POINT 122



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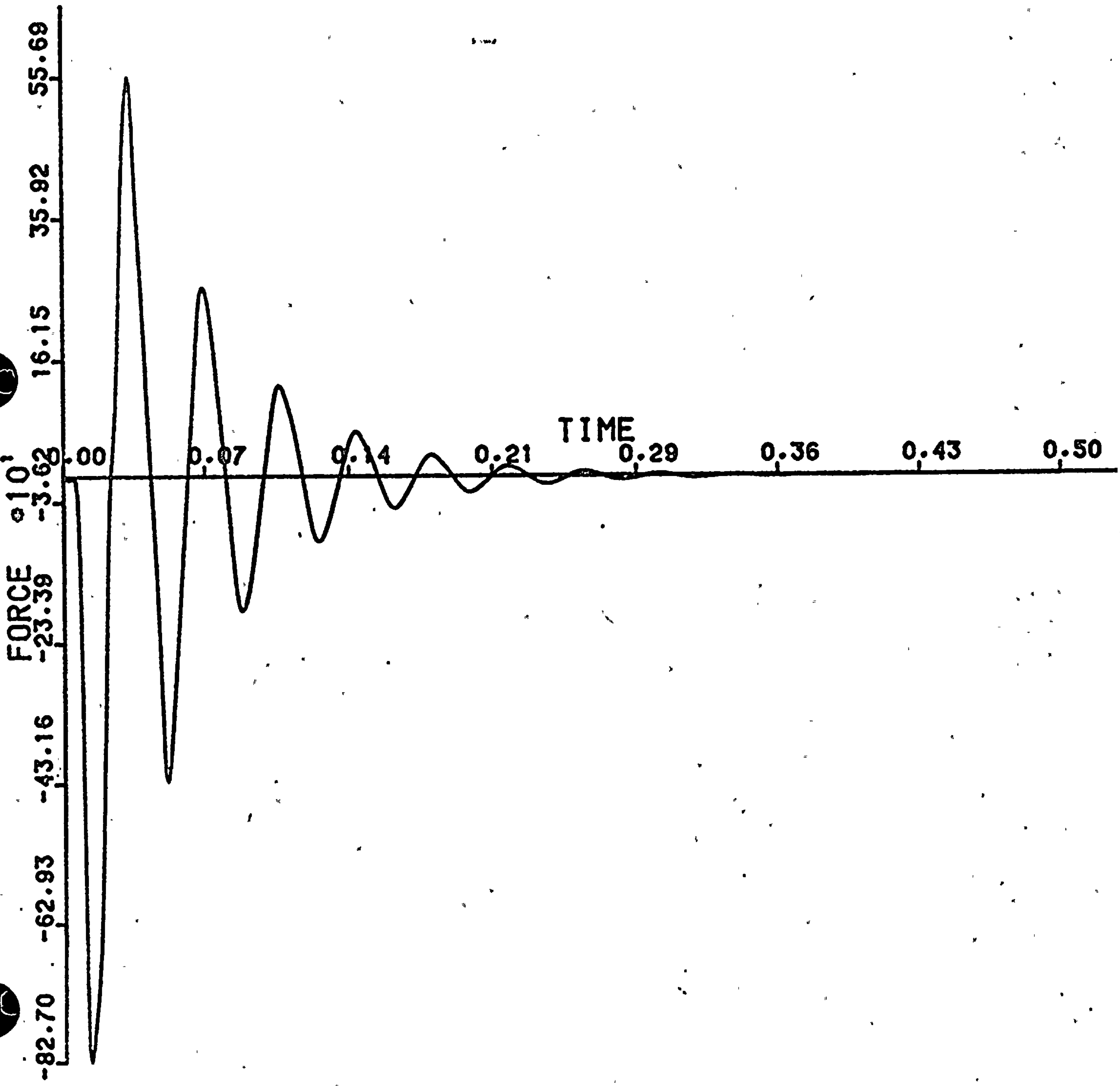
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 26, MAGNITUDE AT NODE POINT 120



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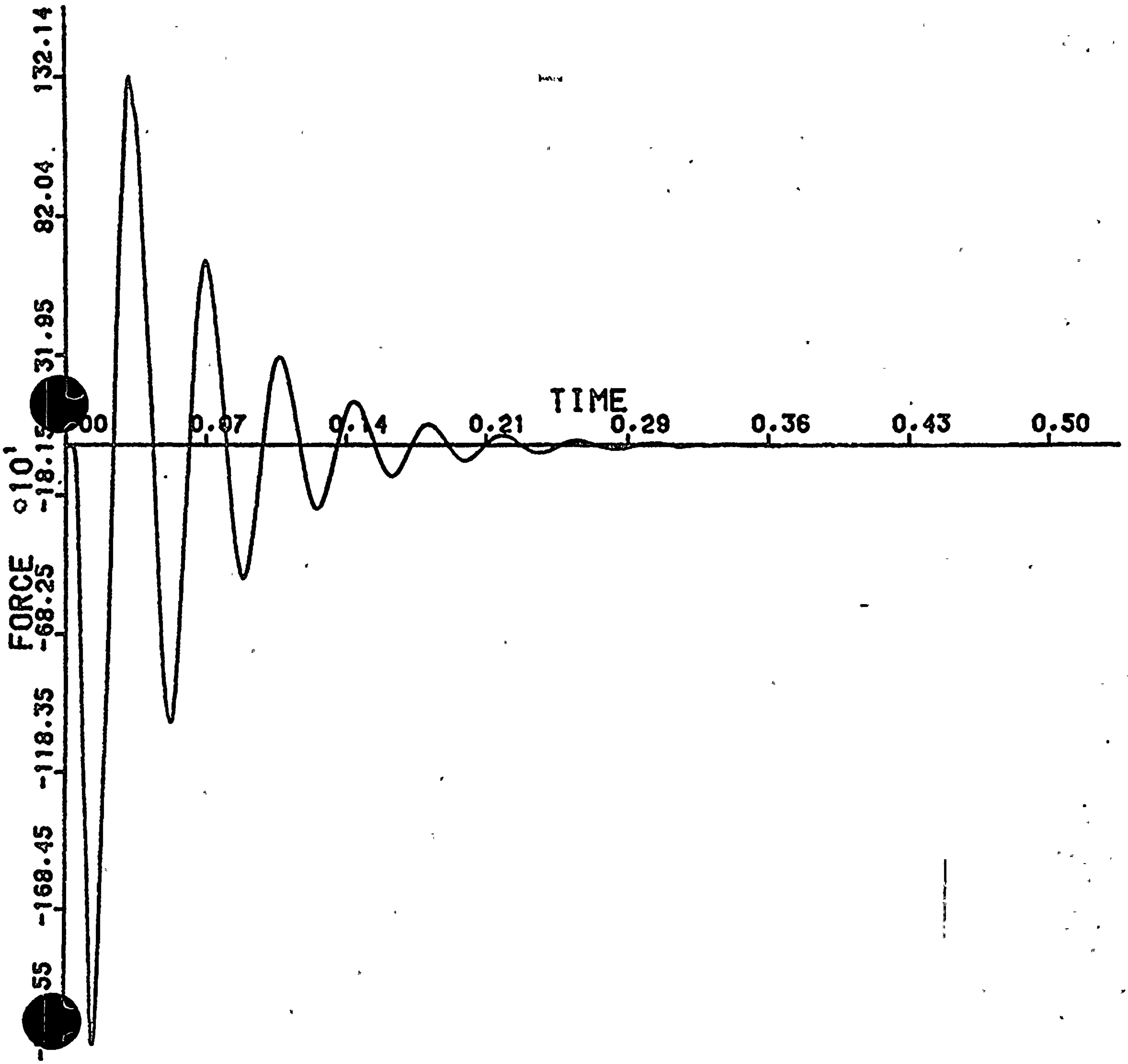
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 27, MAGNITUDE AT NODE POINT 116



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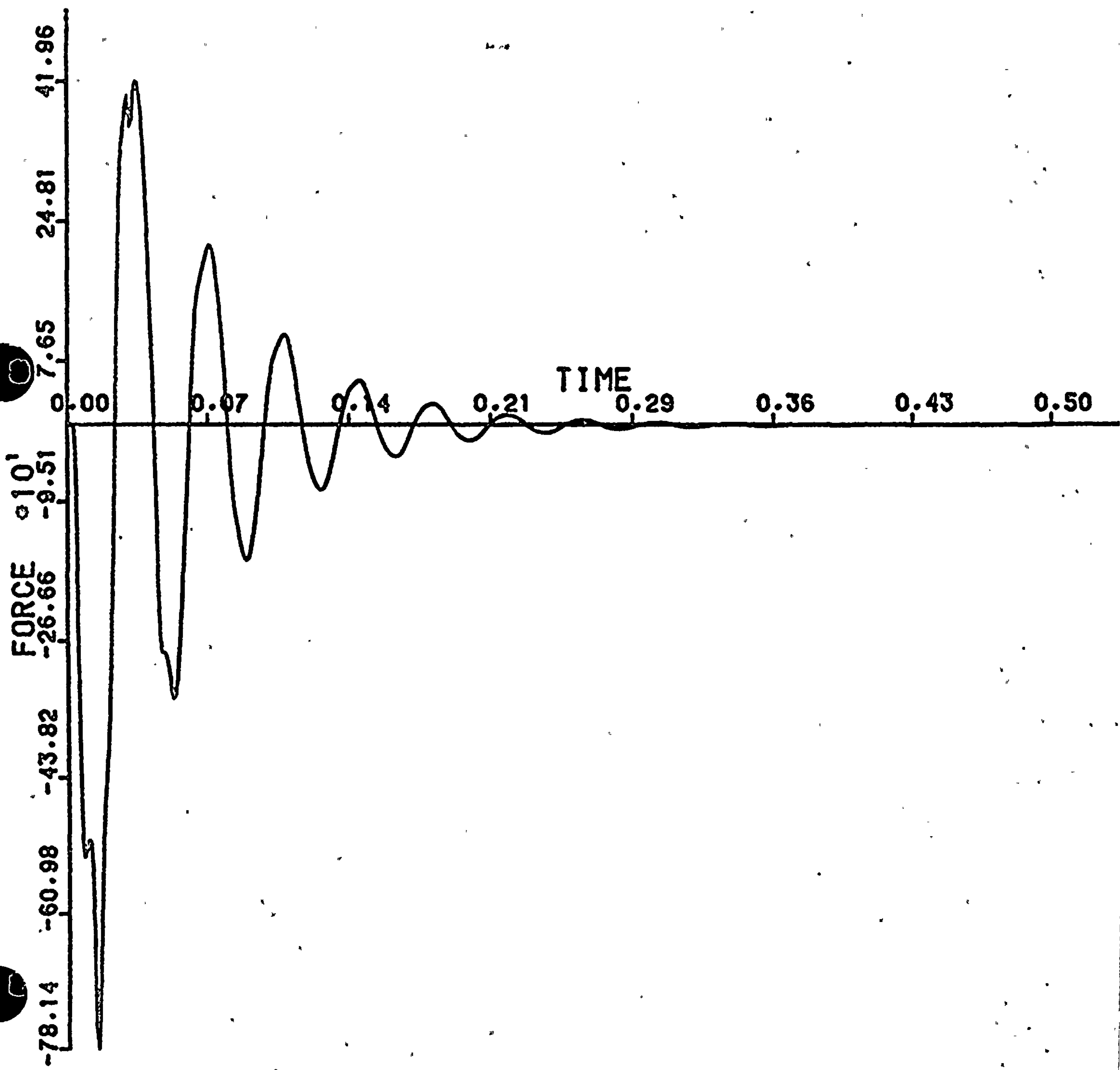
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 28, MAGNITUDE AT NODE POINT 111



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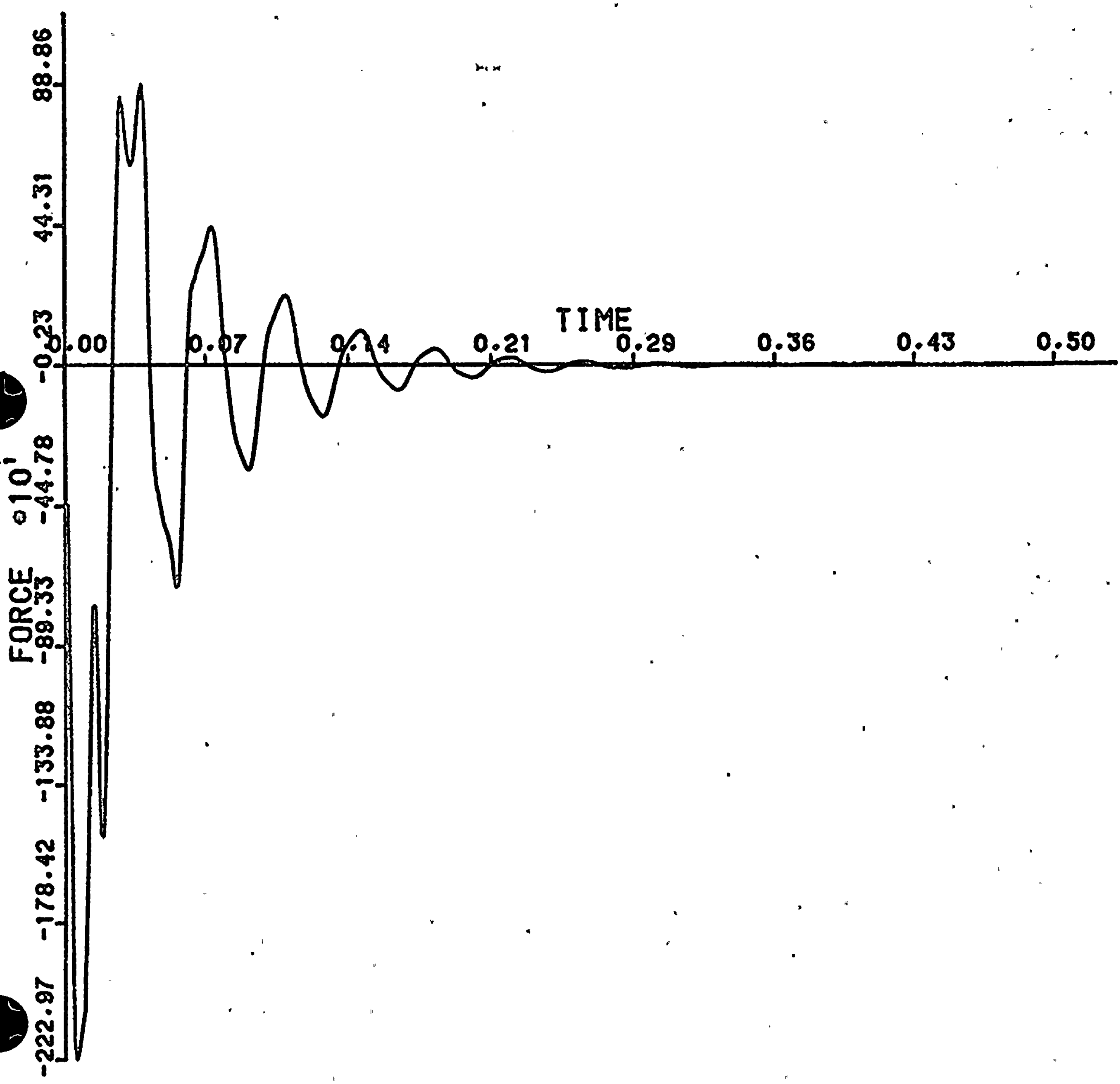
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 29, MAGNITUDE AT NODE POINT 107



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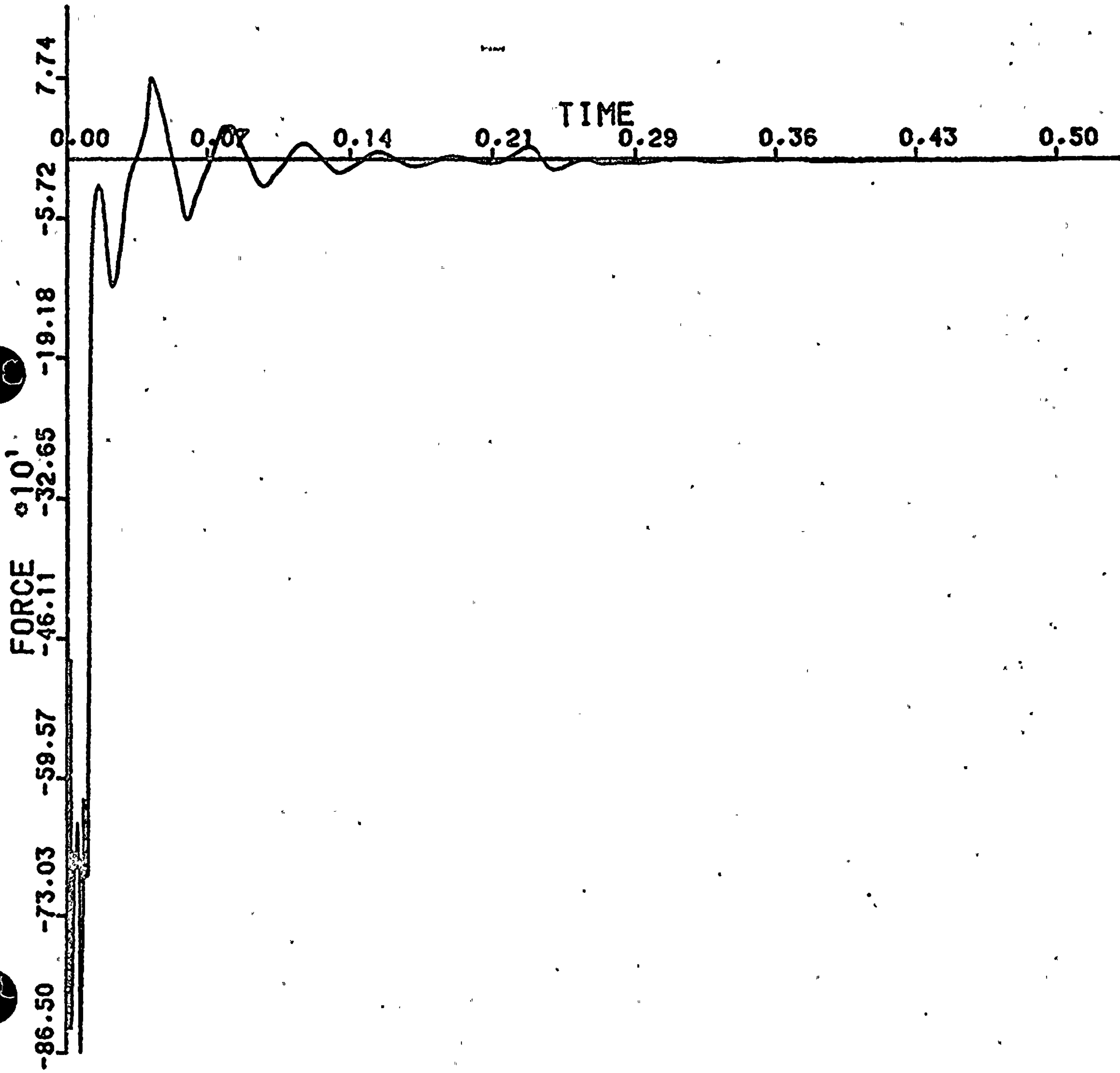
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 30, MAGNITUDE AT NODE POINT 103



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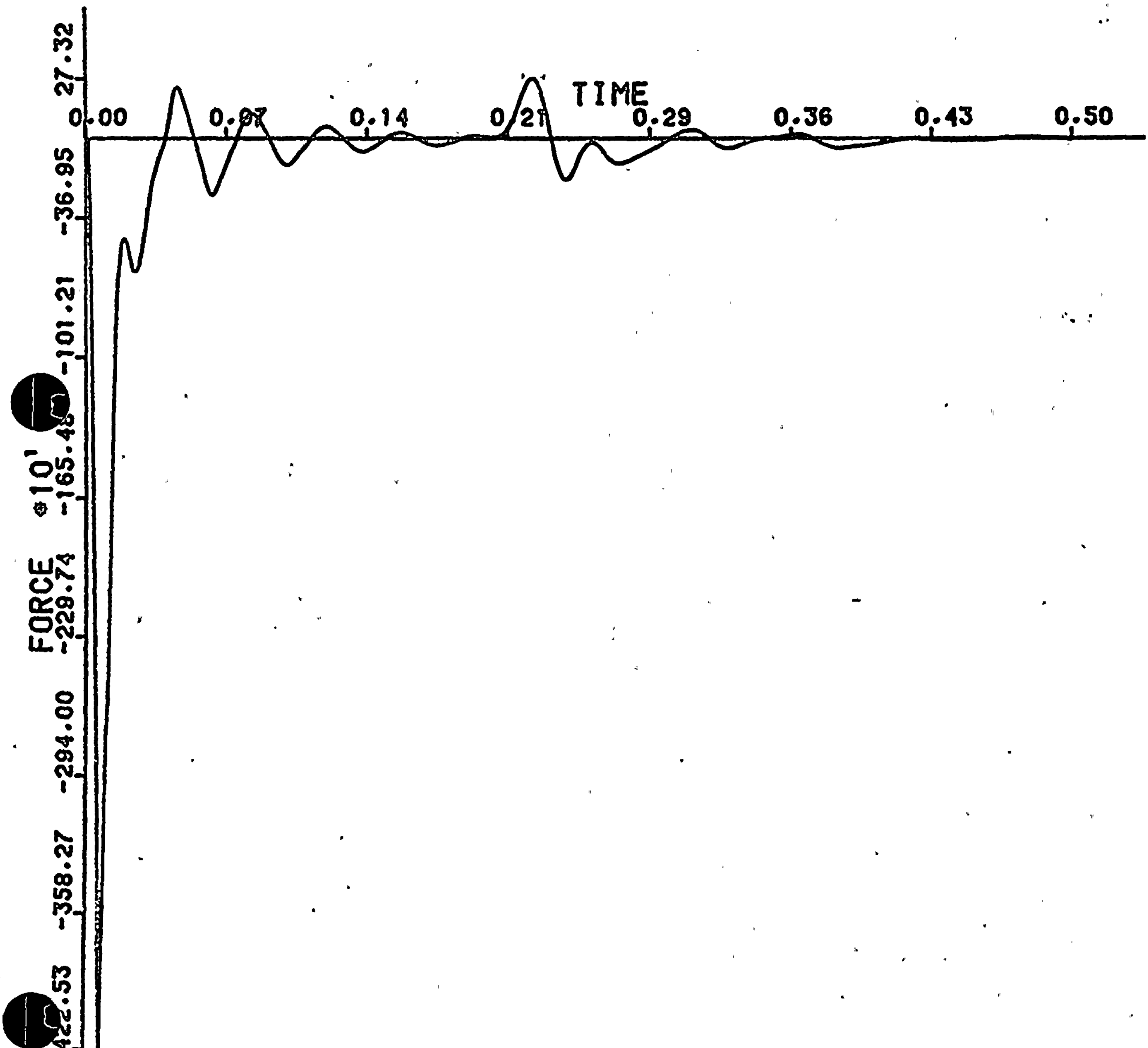
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 31, MAGNITUDE AT NODE POINT 97



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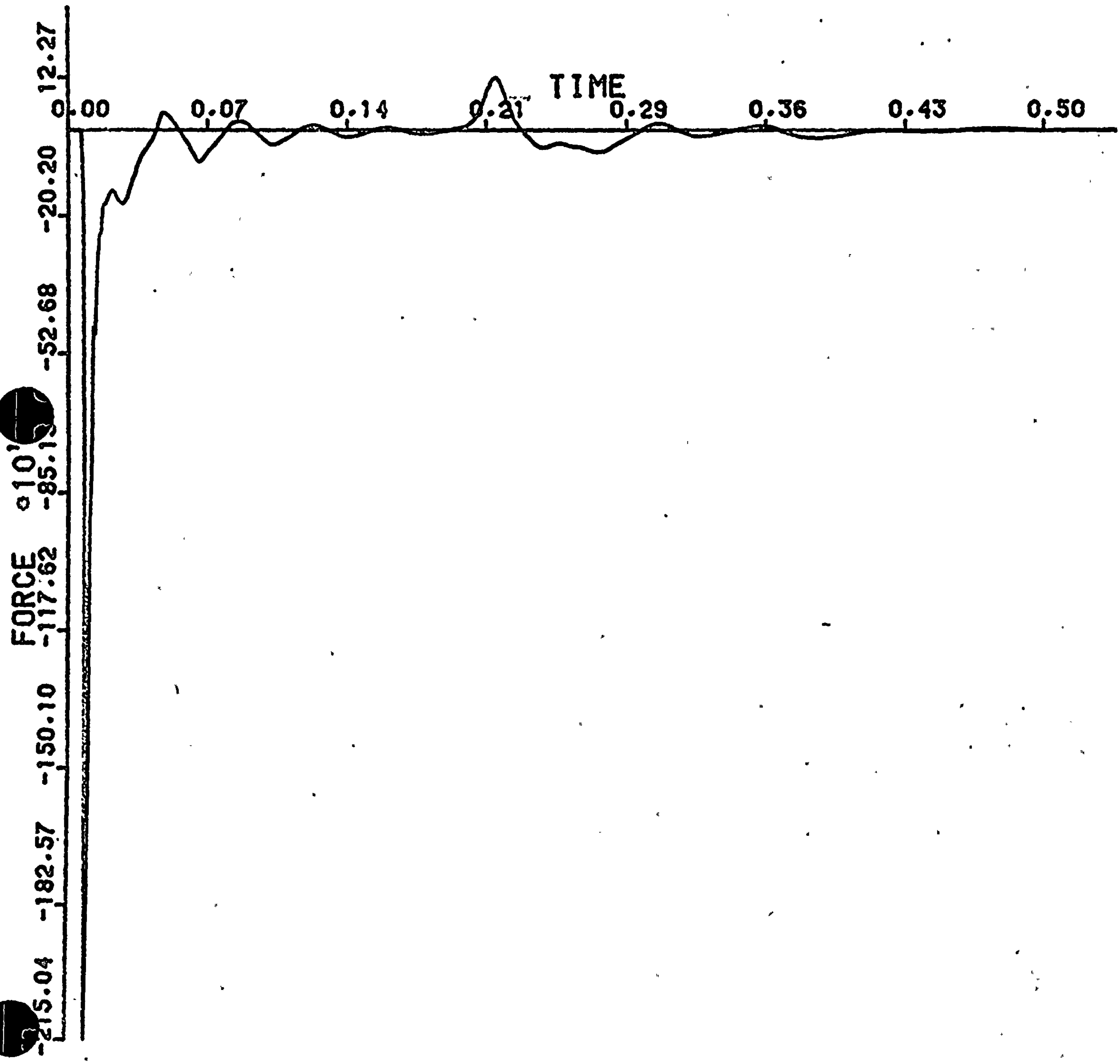
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 32, MAGNITUDE AT NODE POINT 88



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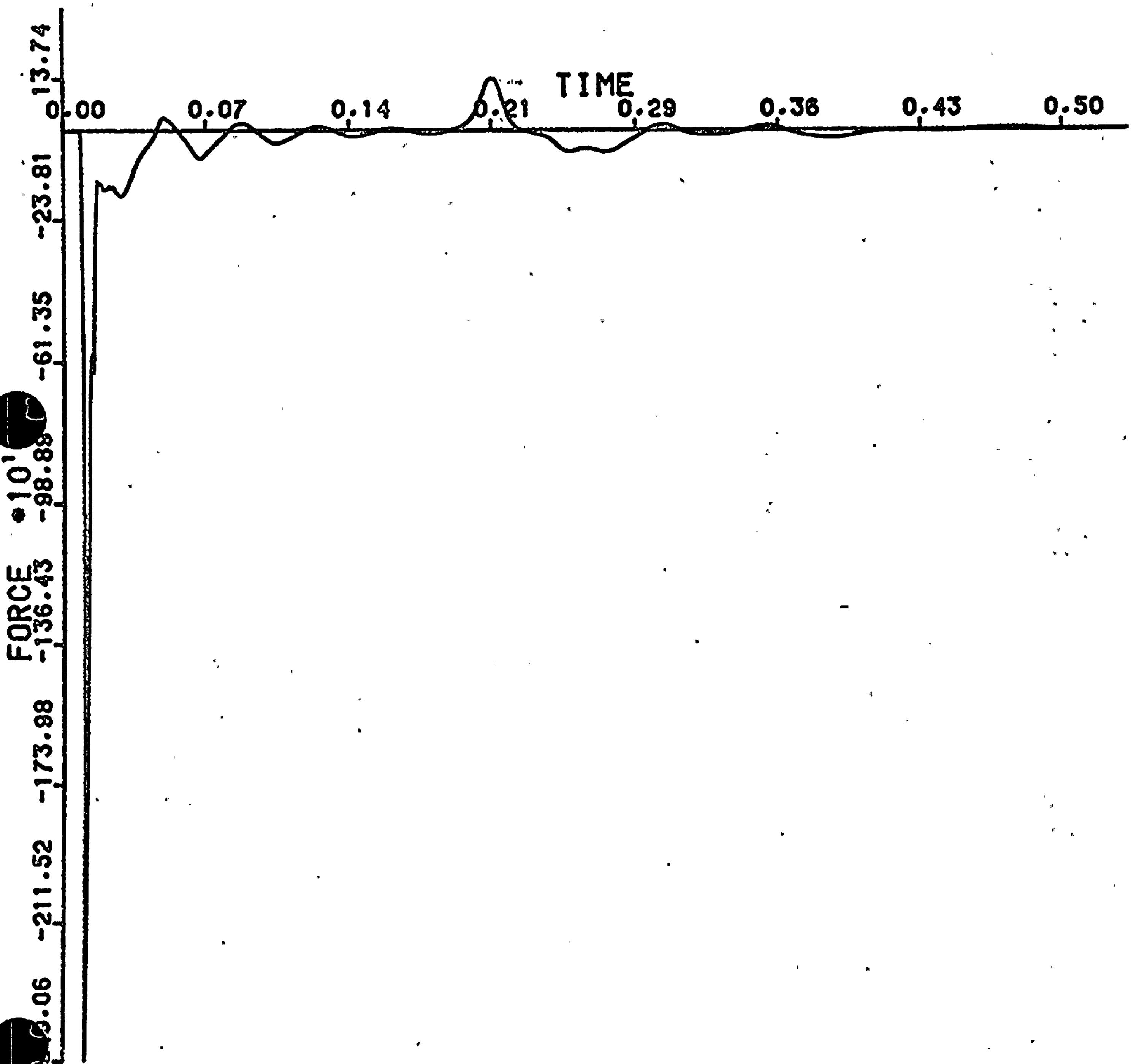
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 33, MAGNITUDE AT NODE POINT 86



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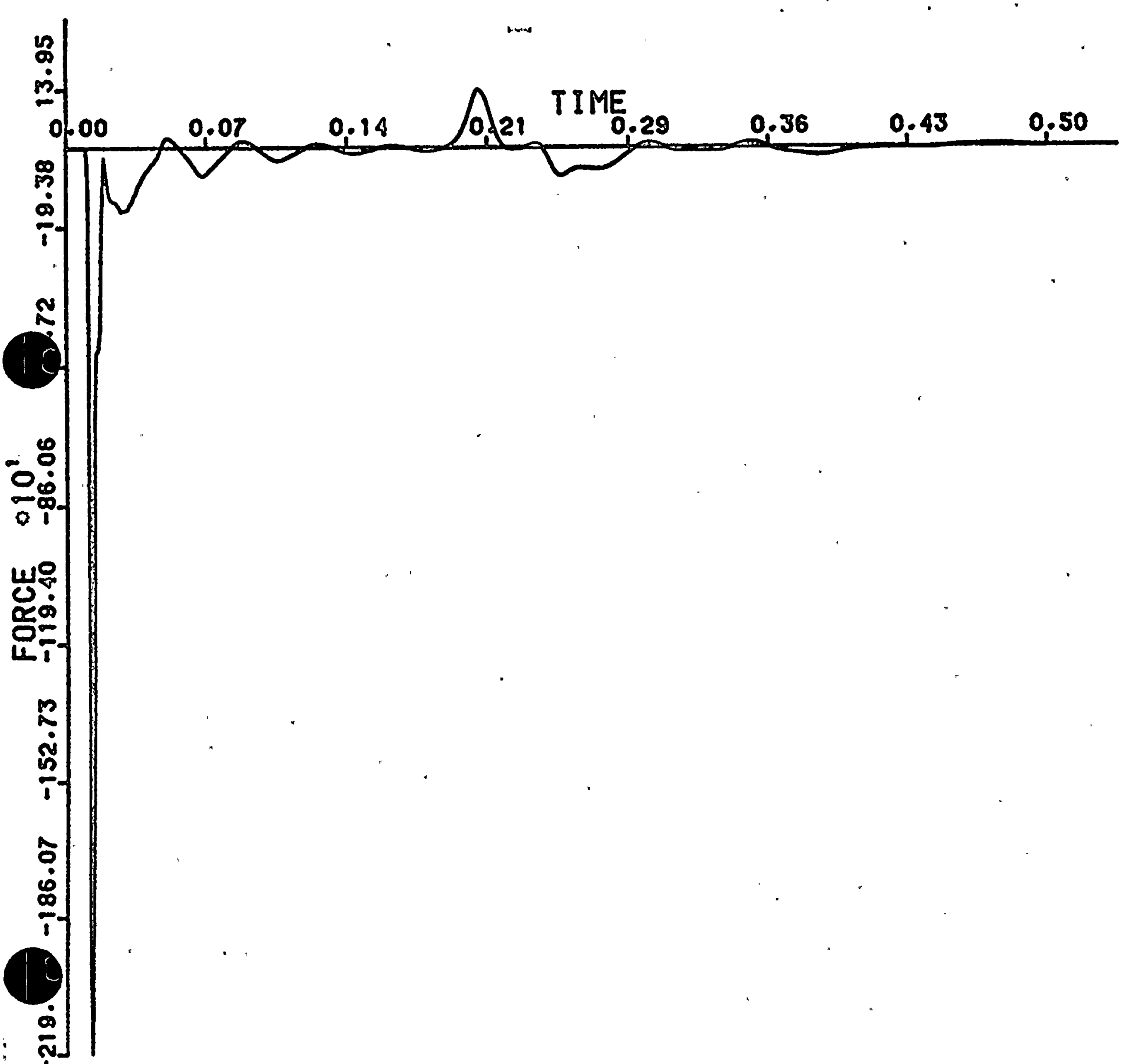
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 34, MAGNITUDE AT NODE POINT 84



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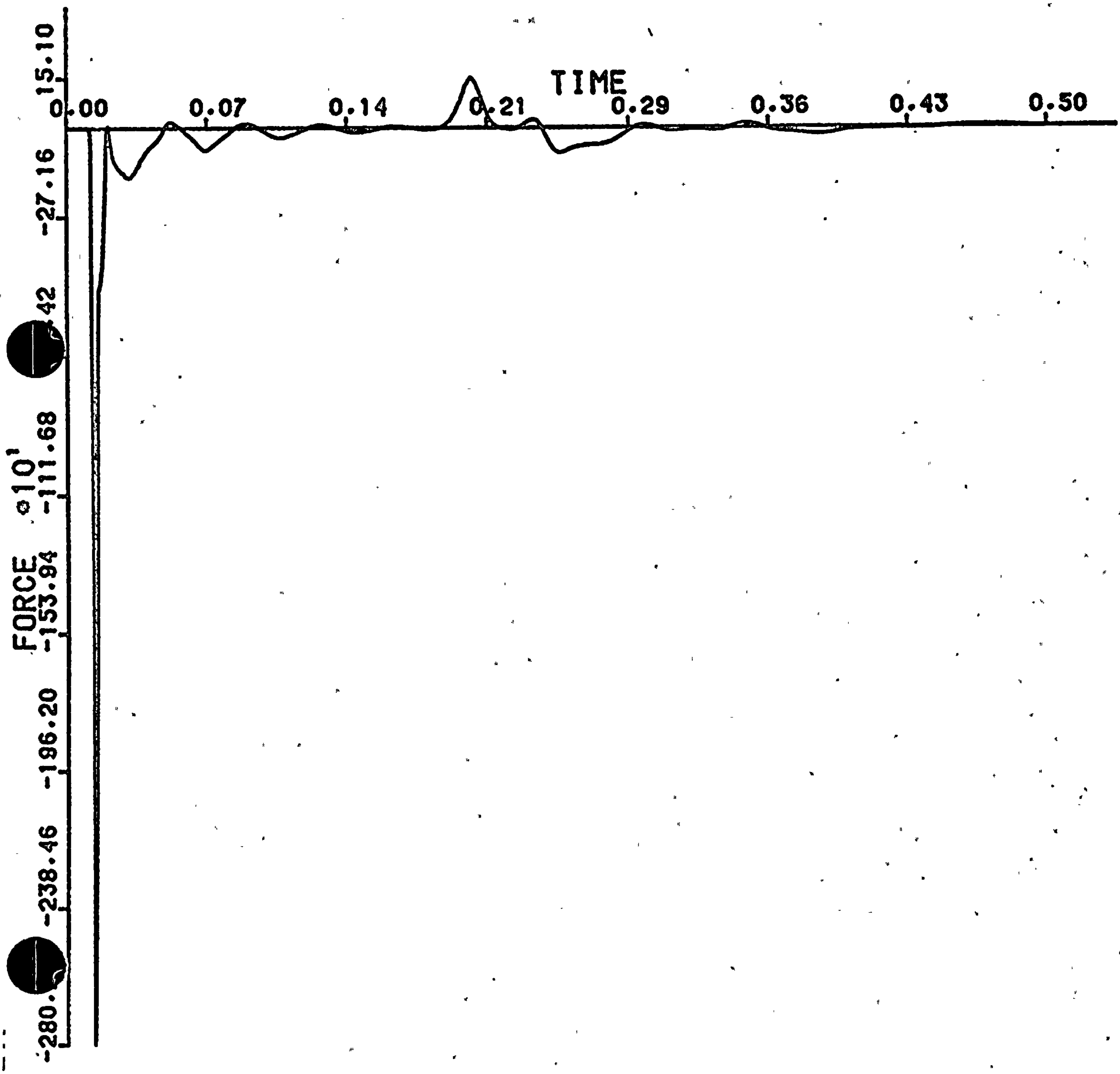
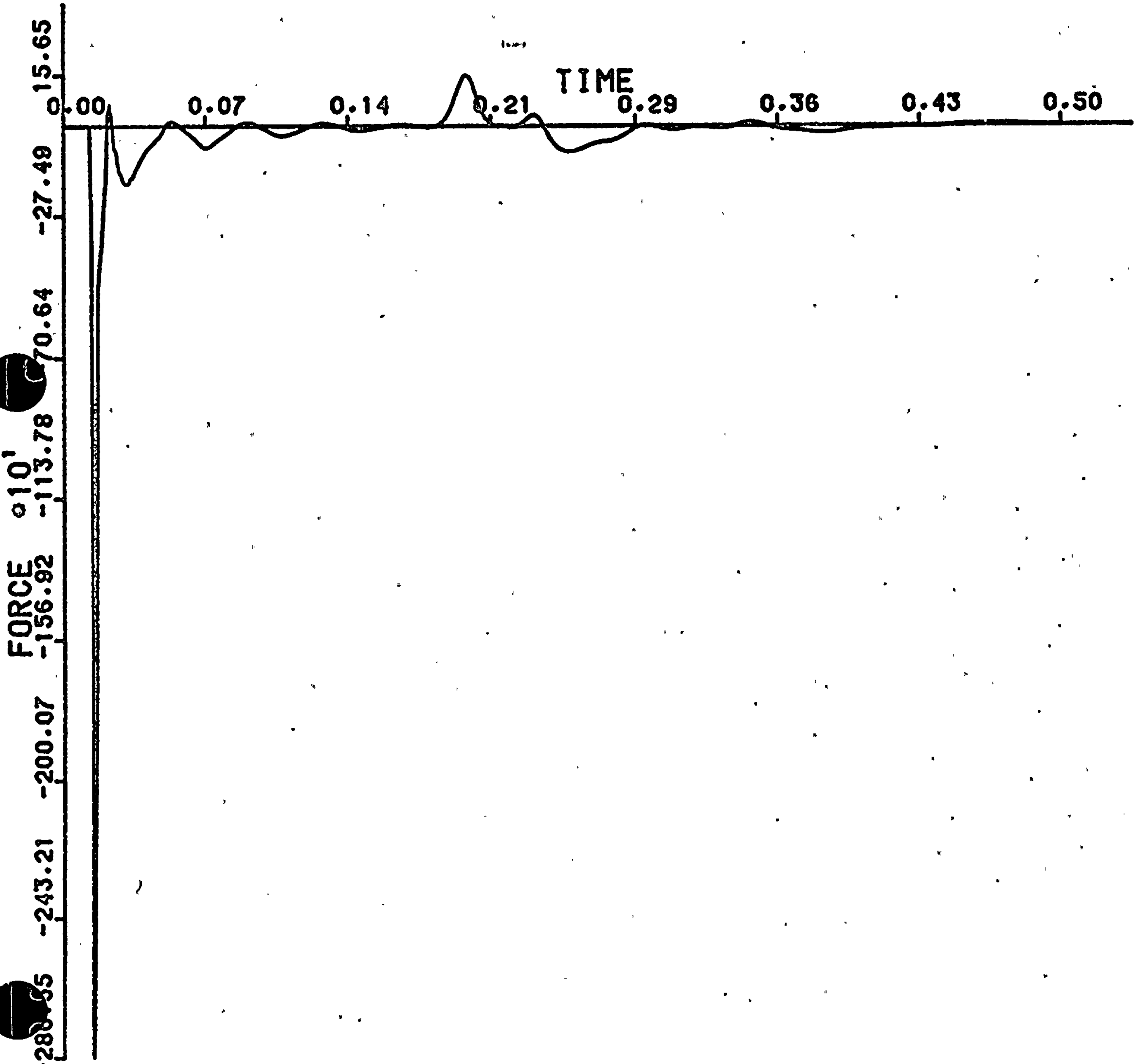
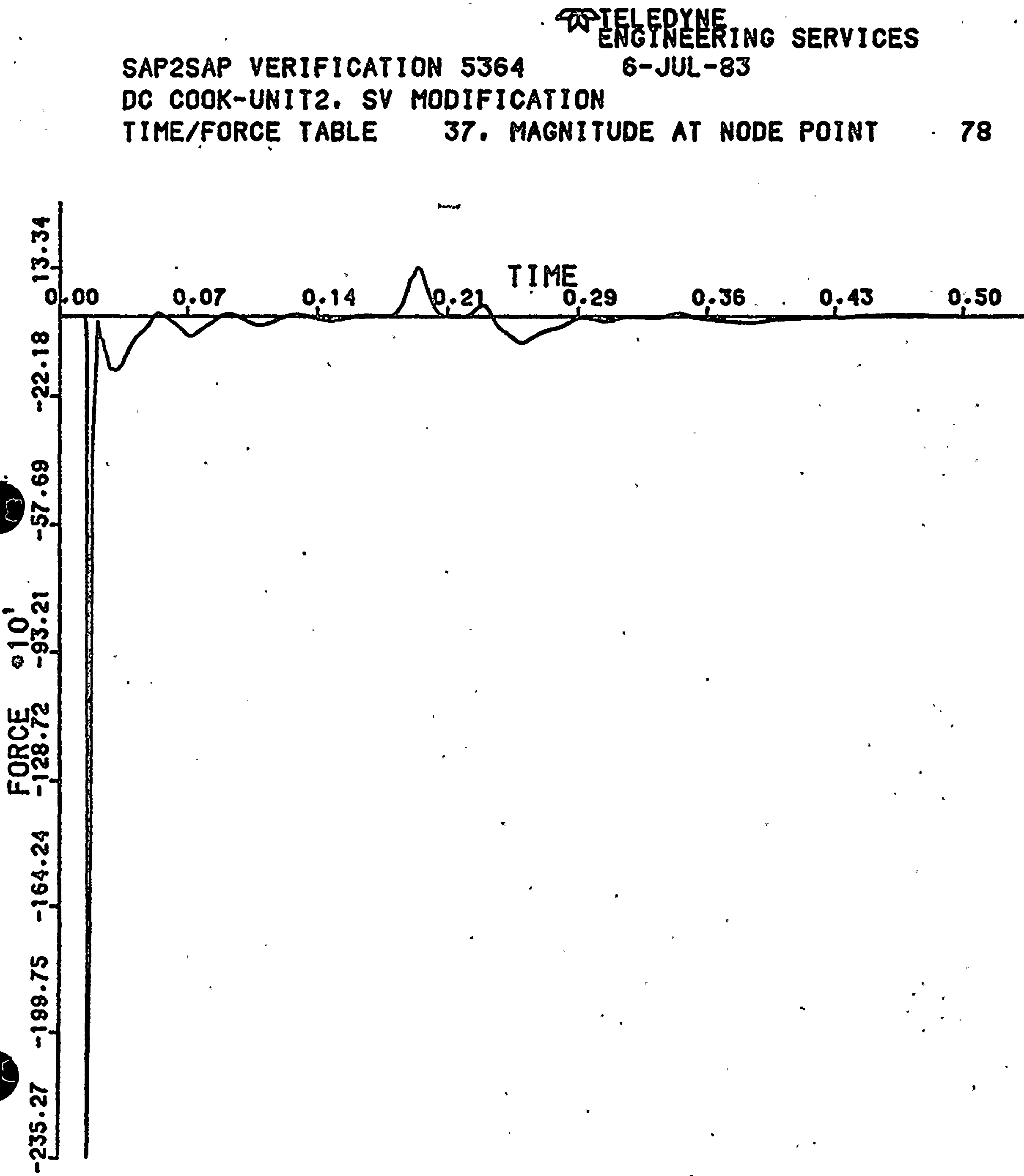
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 35, MAGNITUDE AT NODE POINT 82



TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 36, MAGNITUDE AT NODE POINT 80




TELEDYNE ENGINEERING SERVICES
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 37, MAGNITUDE AT NODE POINT 78
TIME
0.00
0.07
0.14
0.21
0.29
0.36
0.43
0.50
FORCE *10¹
13.34
-22.18
-57.69
-93.21
-128.72
-164.24
-199.75
-235.27

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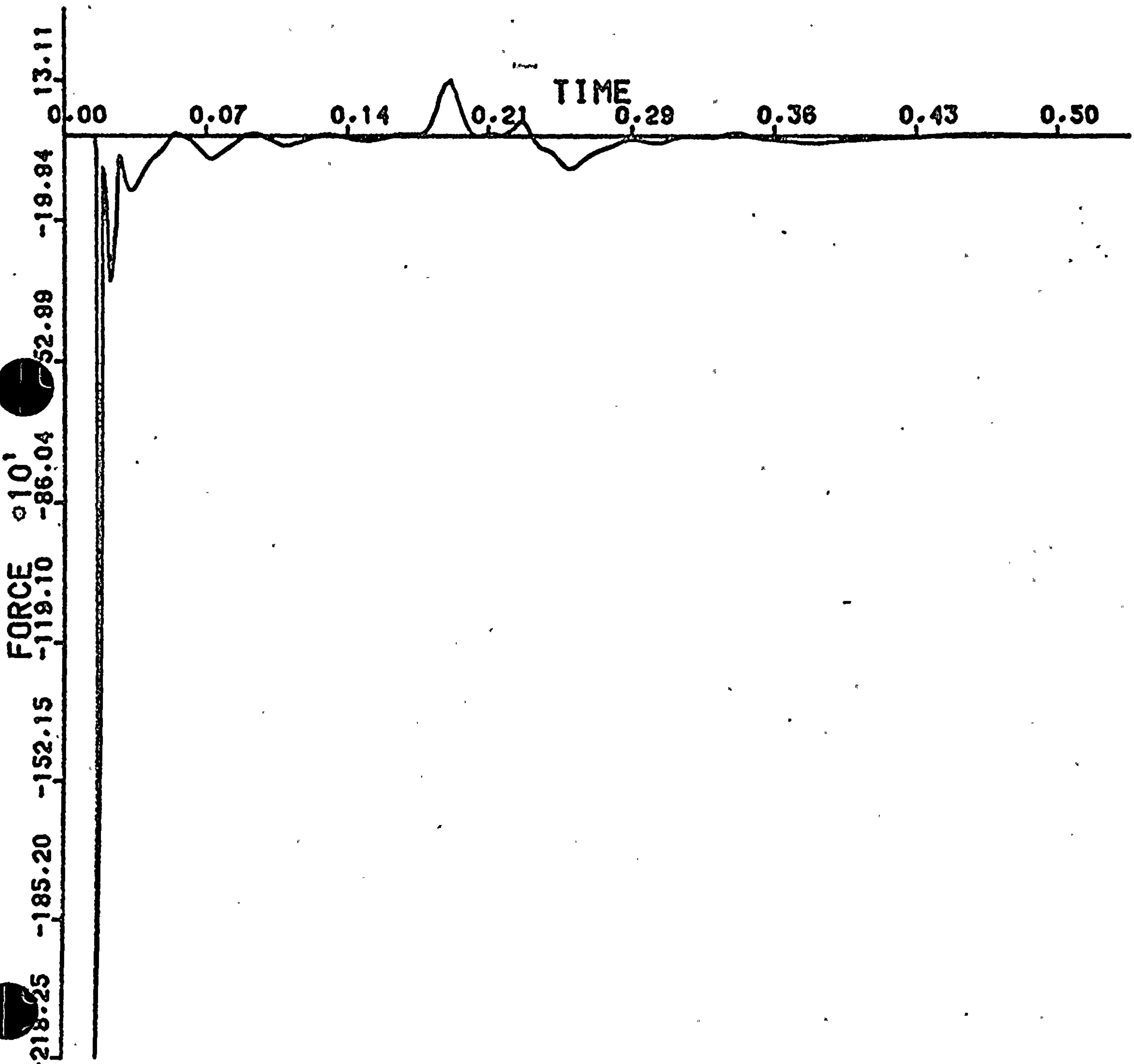
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 38, MAGNITUDE AT NODE POINT 76



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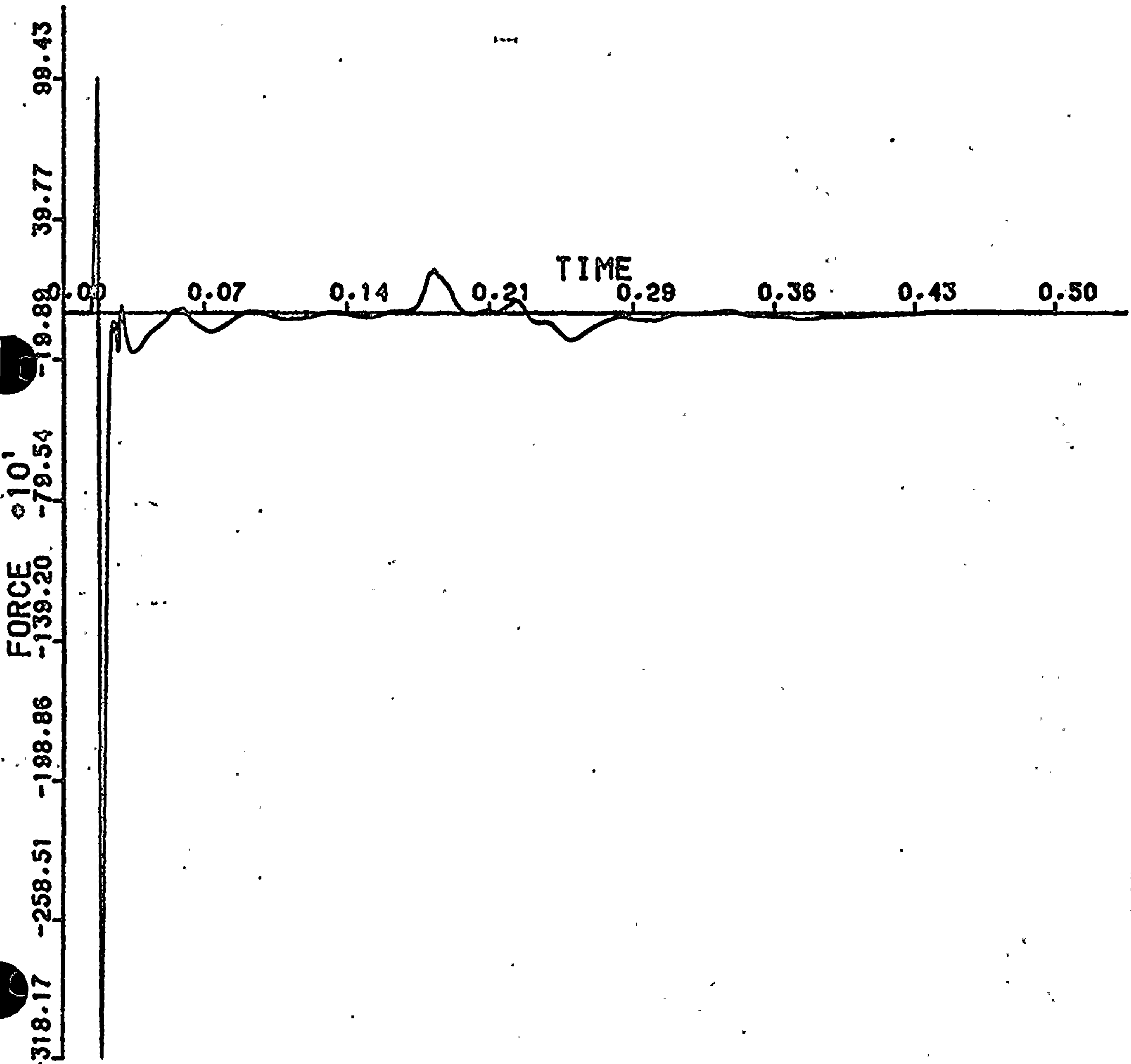
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 39, MAGNITUDE AT NODE POINT 74



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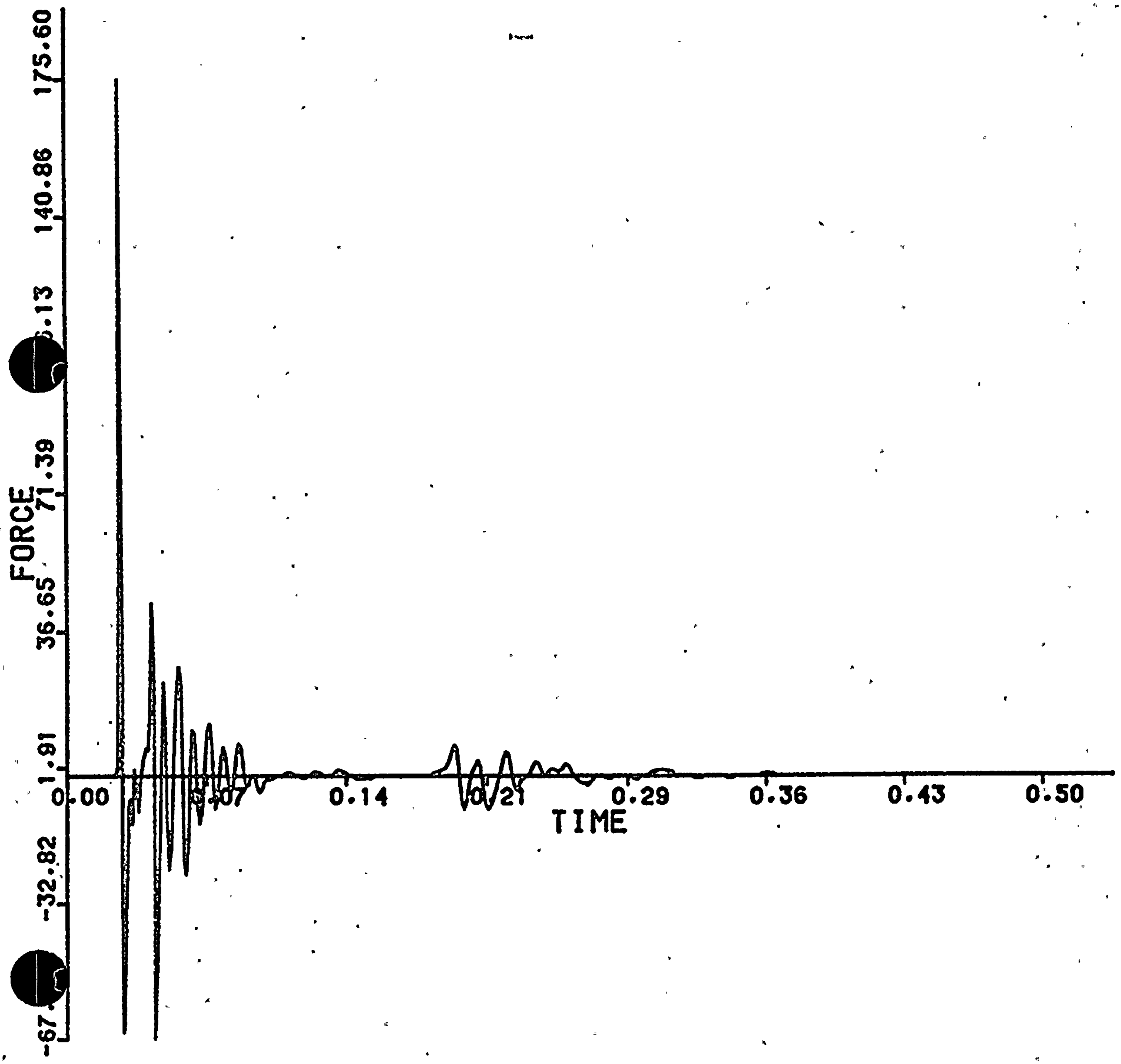
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 40, MAGNITUDE AT NODE POINT 346



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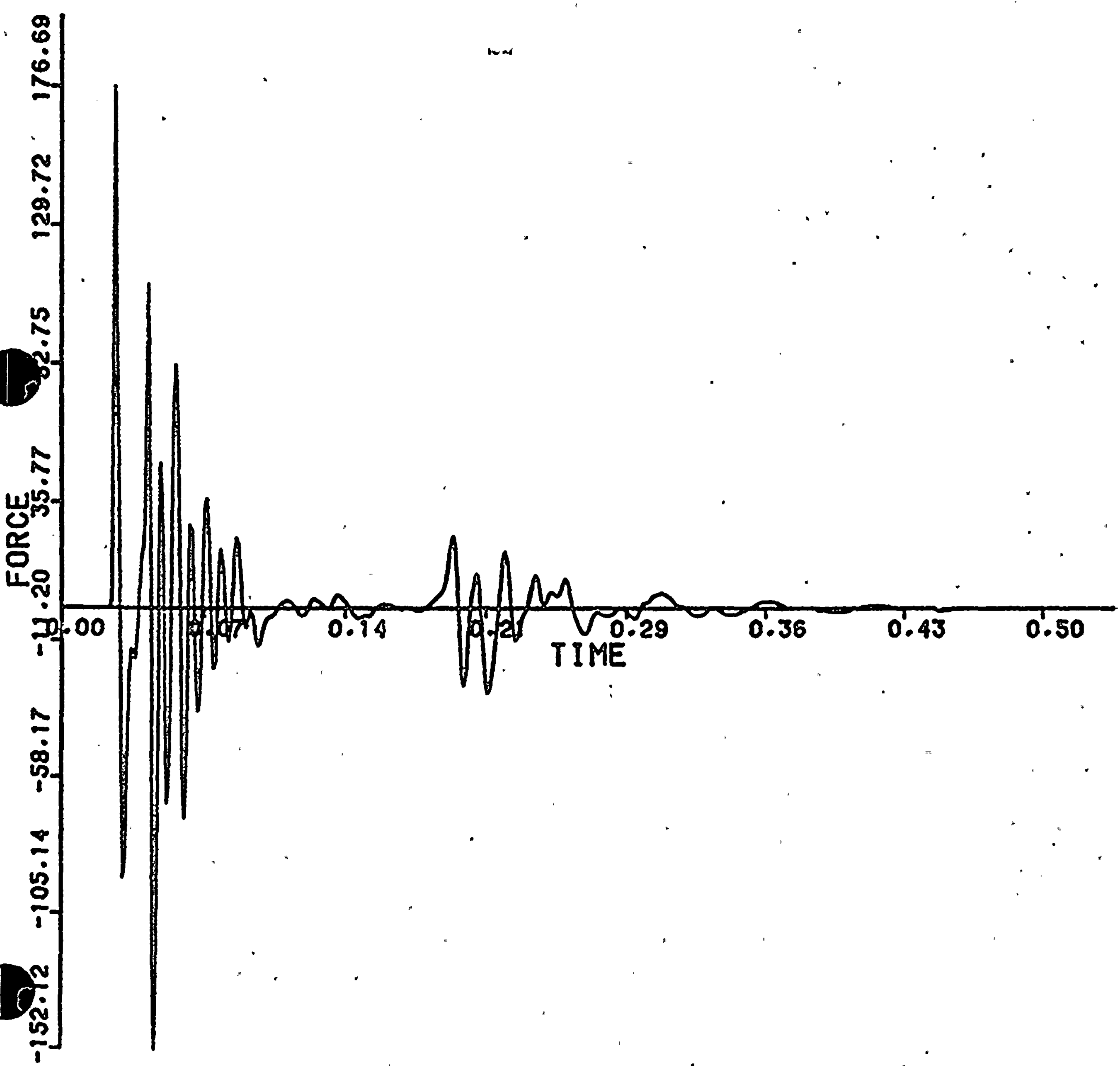
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 41, MAGNITUDE AT NODE POINT 404



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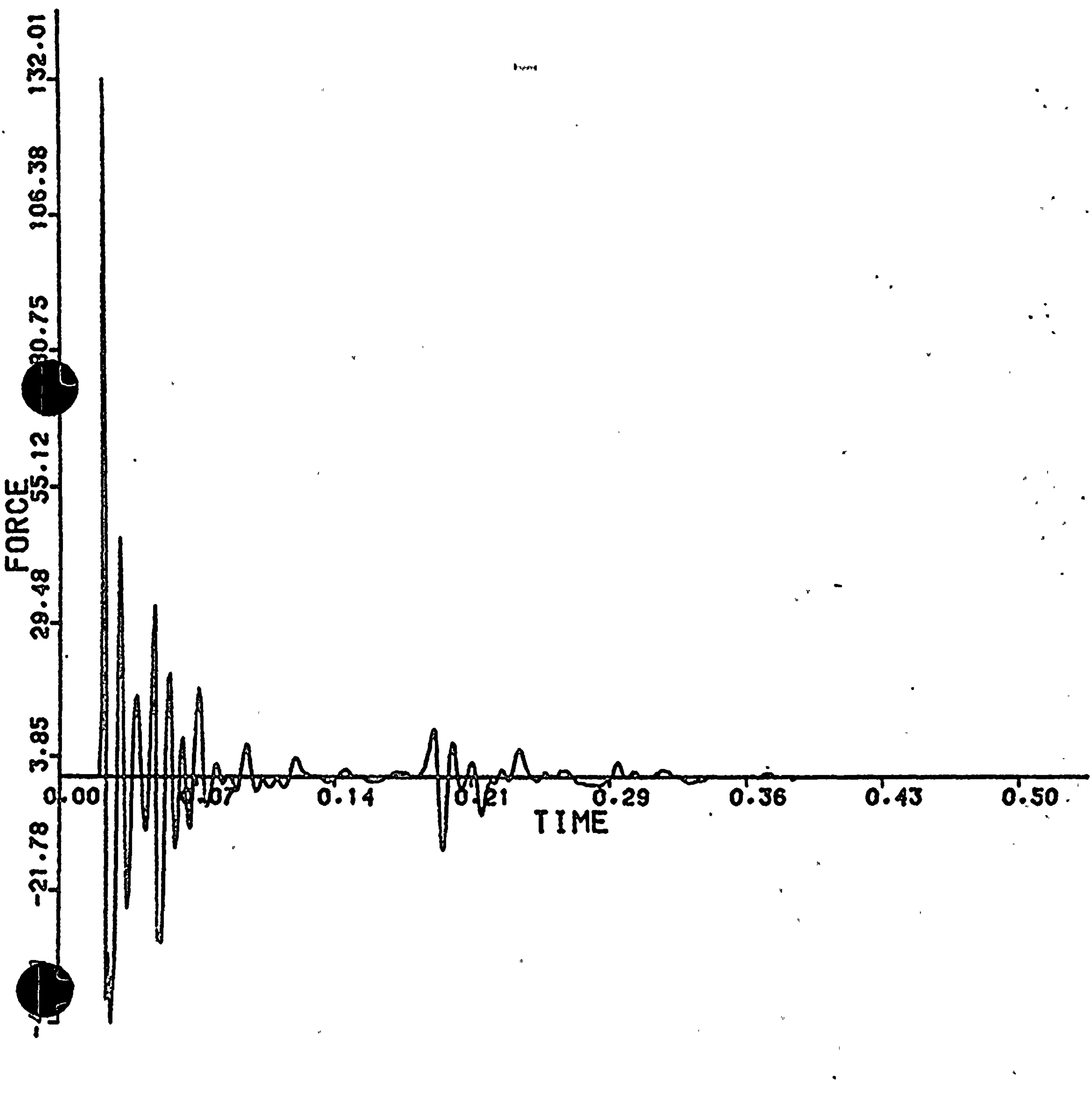
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 42, MAGNITUDE AT NODE POINT 290



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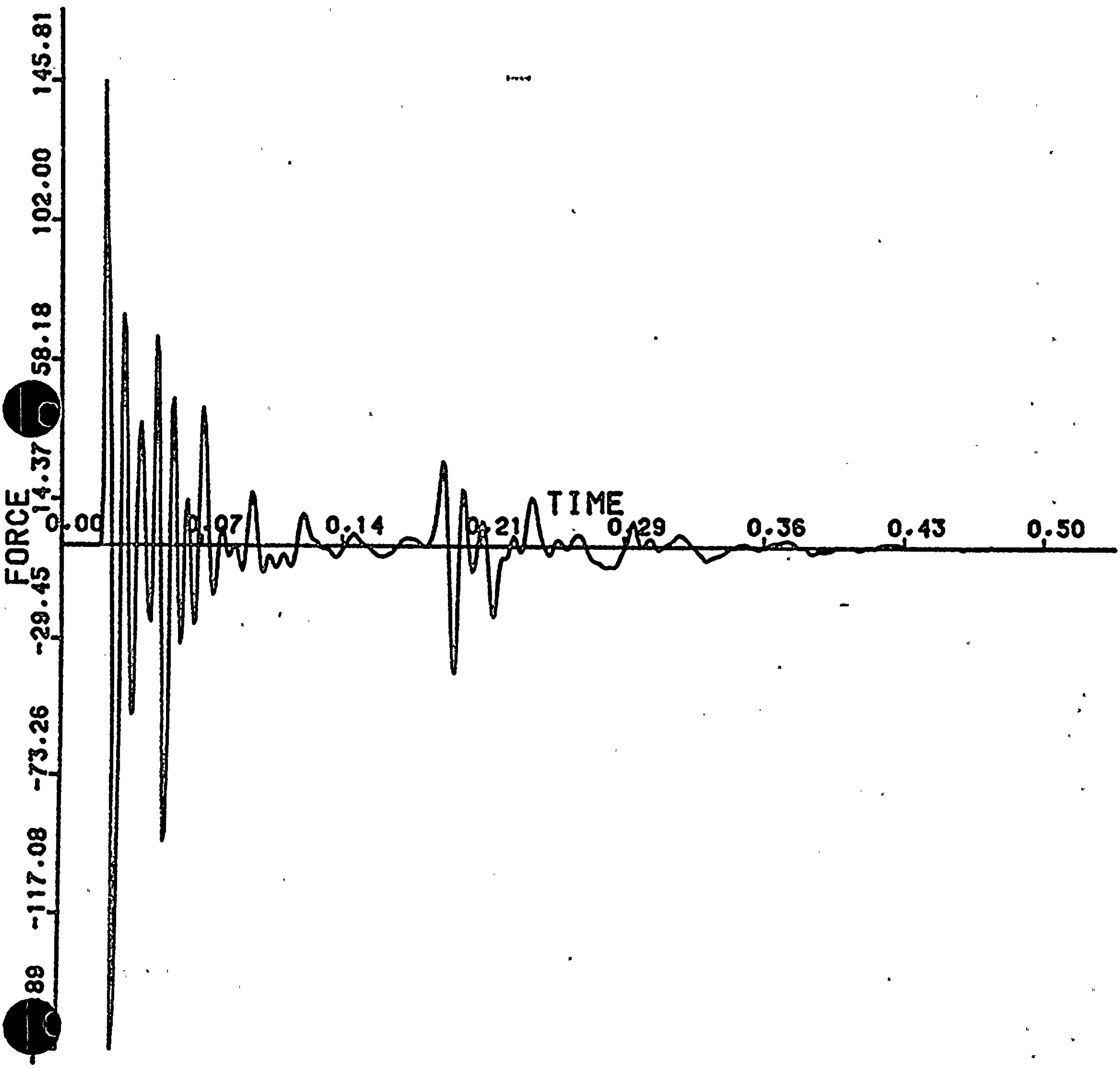
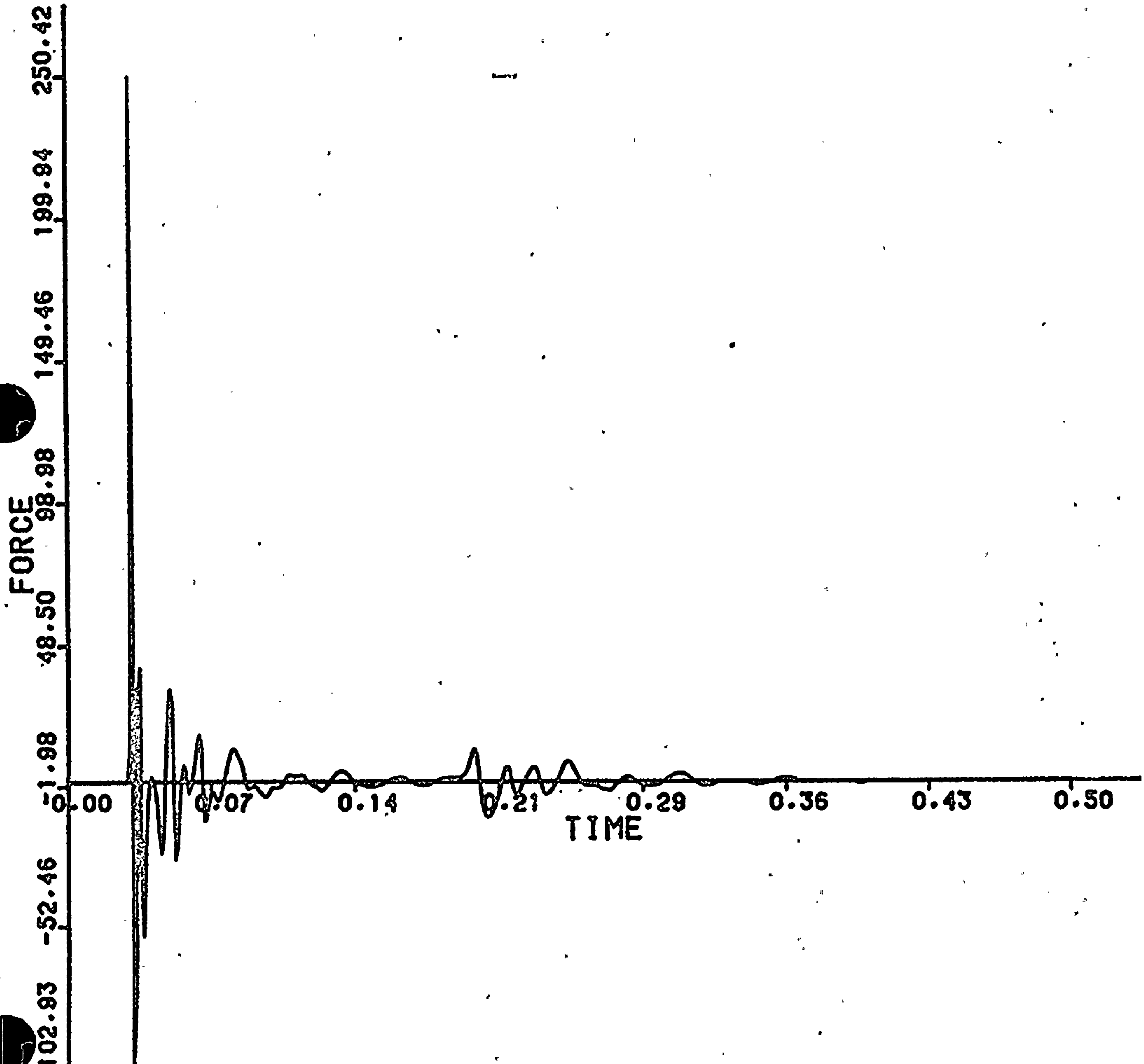
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 43, MAGNITUDE AT NODE POINT 286



TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 44. MAGNITUDE AT NODE POINT 262



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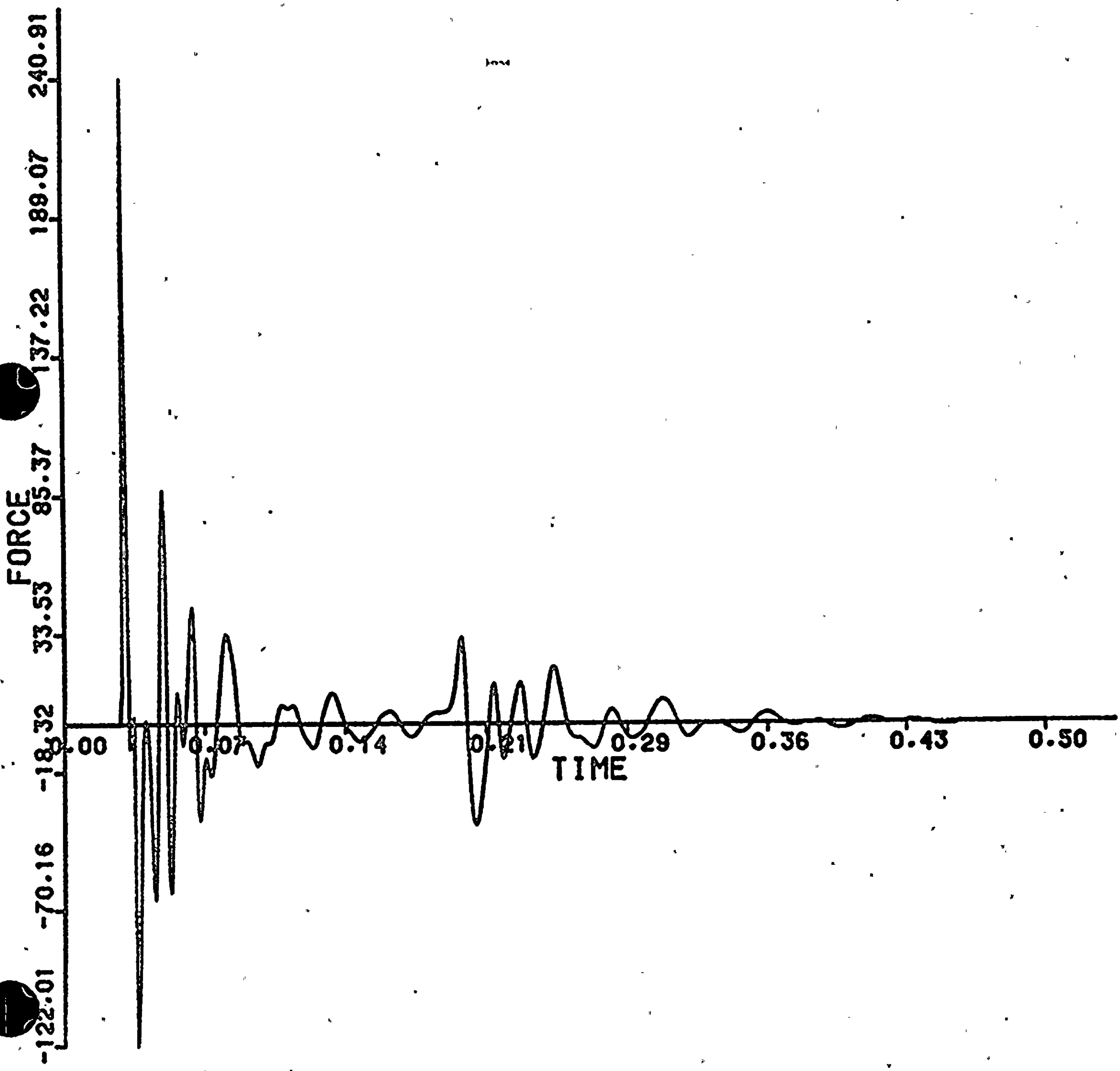
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 45, MAGNITUDE AT NODE POINT 258



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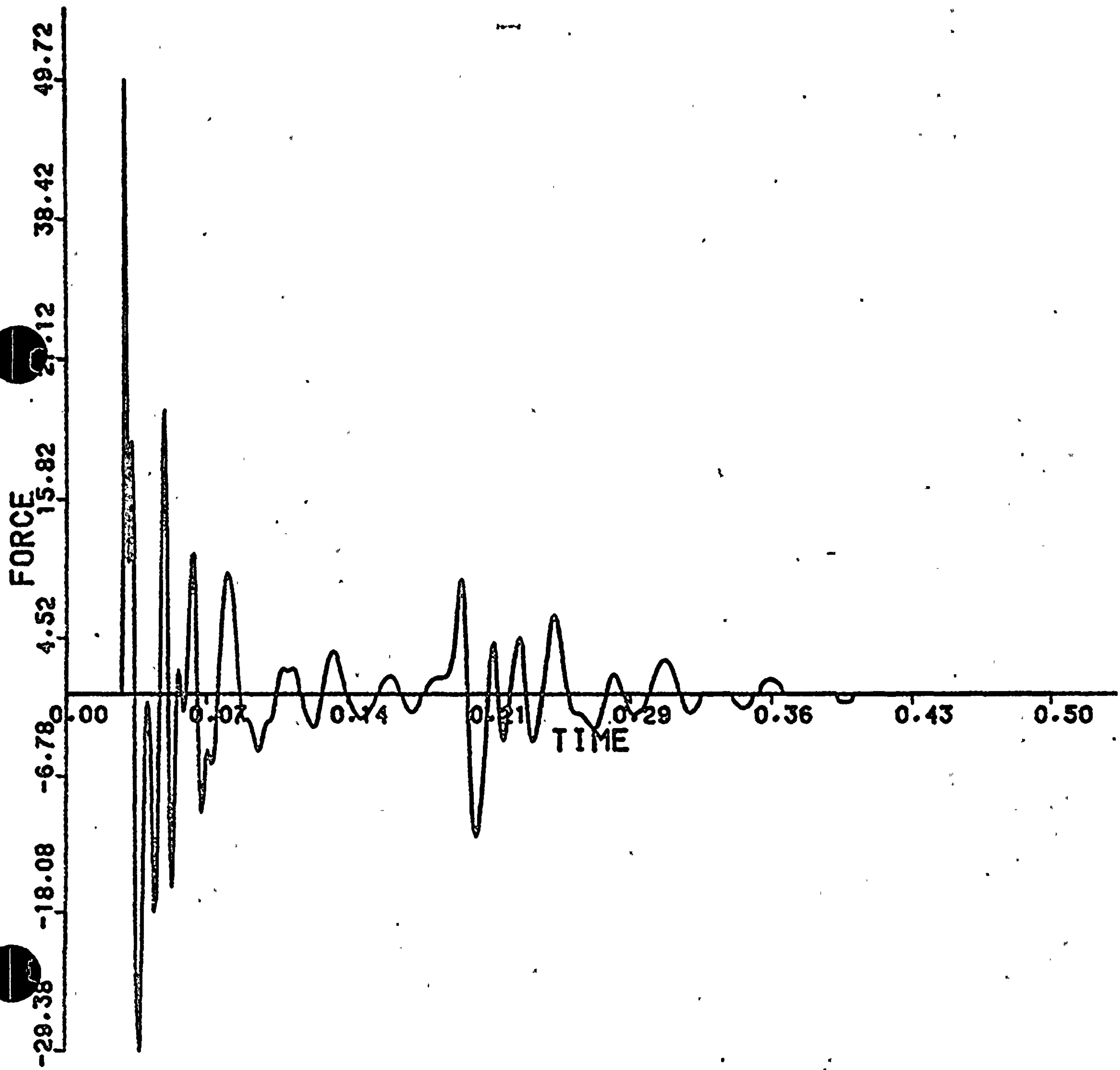
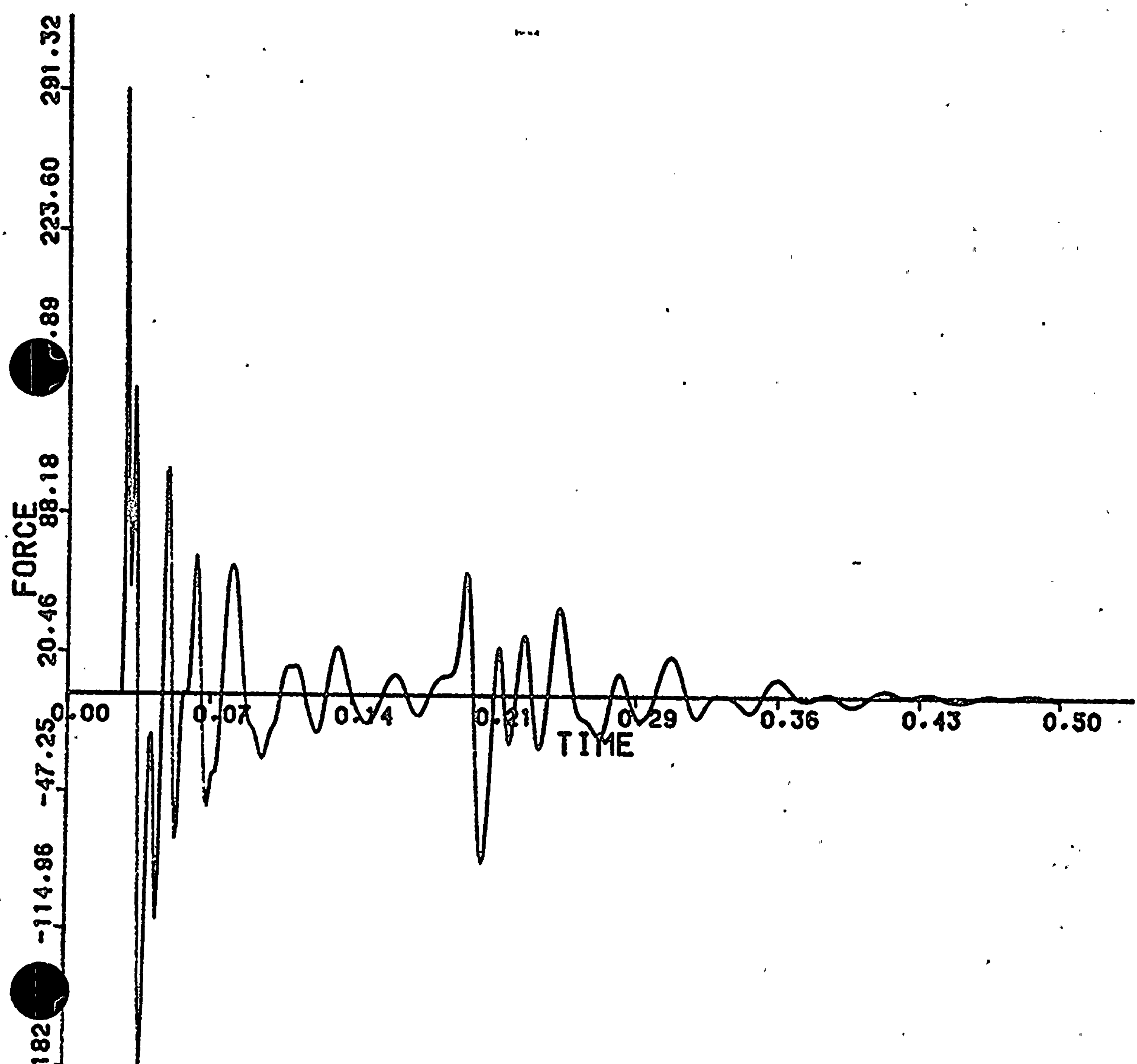
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 46, MAGNITUDE AT NODE POINT 250



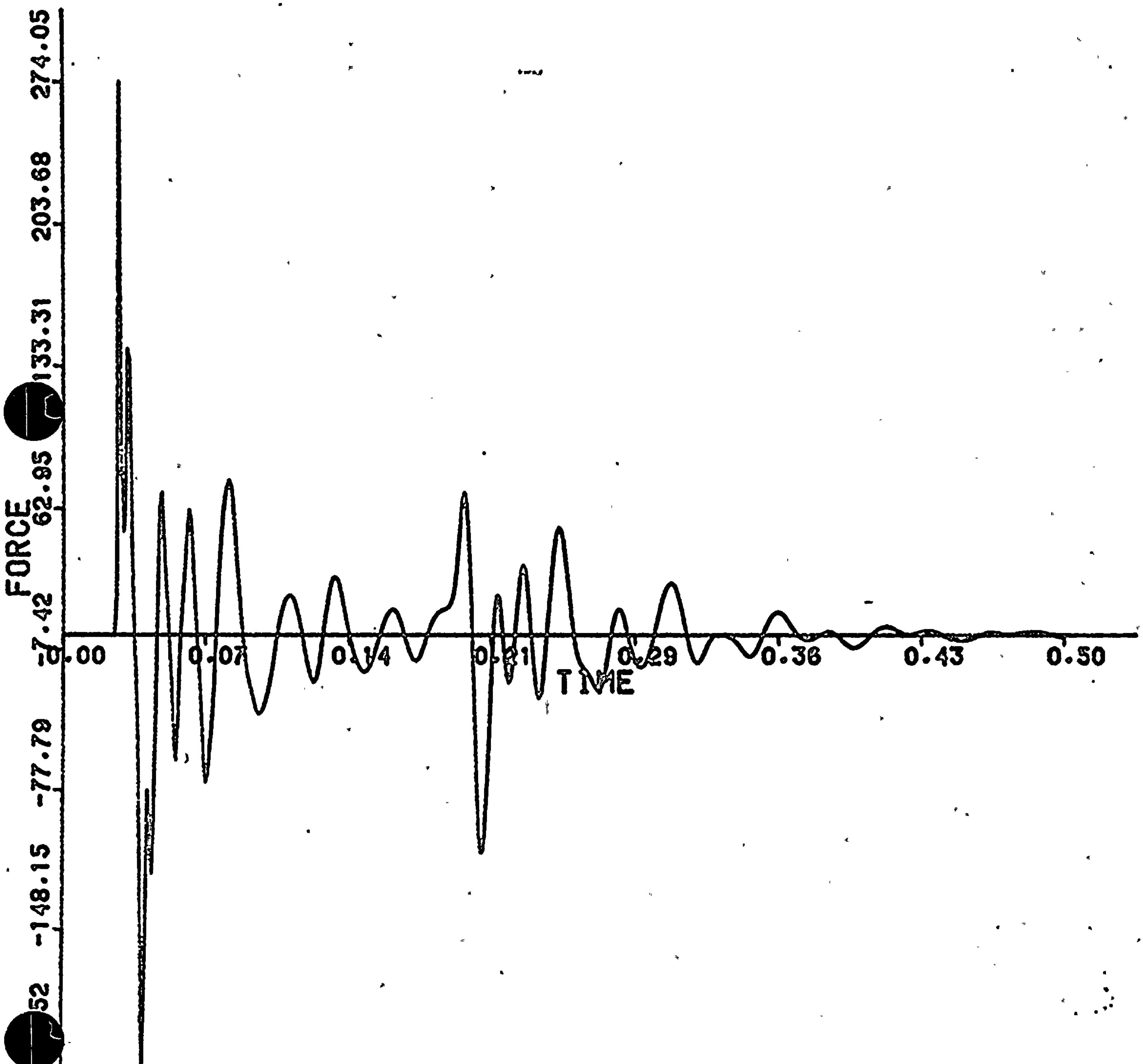
TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 47, MAGNITUDE AT NODE POINT 248



TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 48, MAGNITUDE AT NODE POINT 246



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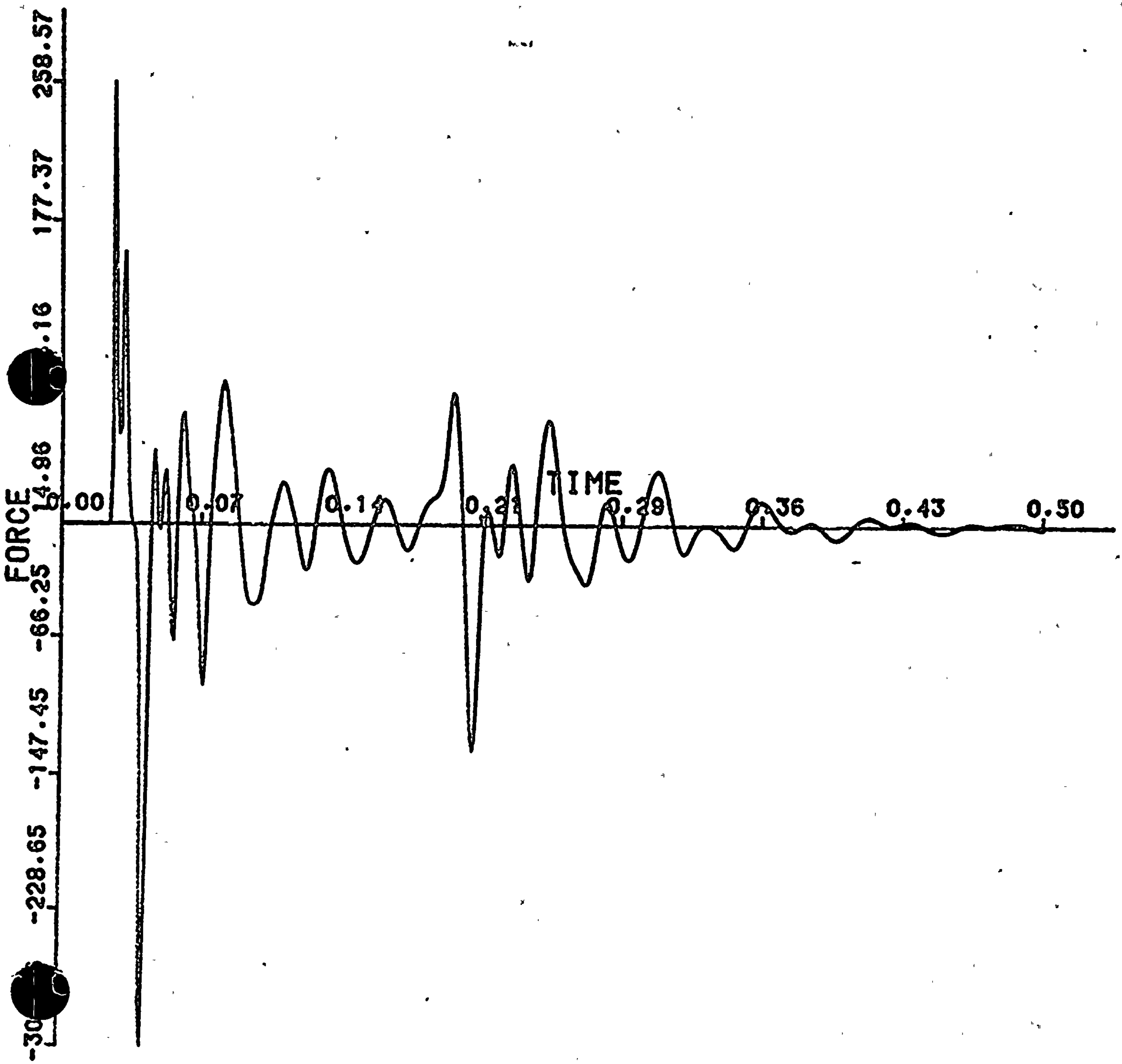
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 49, MAGNITUDE AT NODE POINT 244



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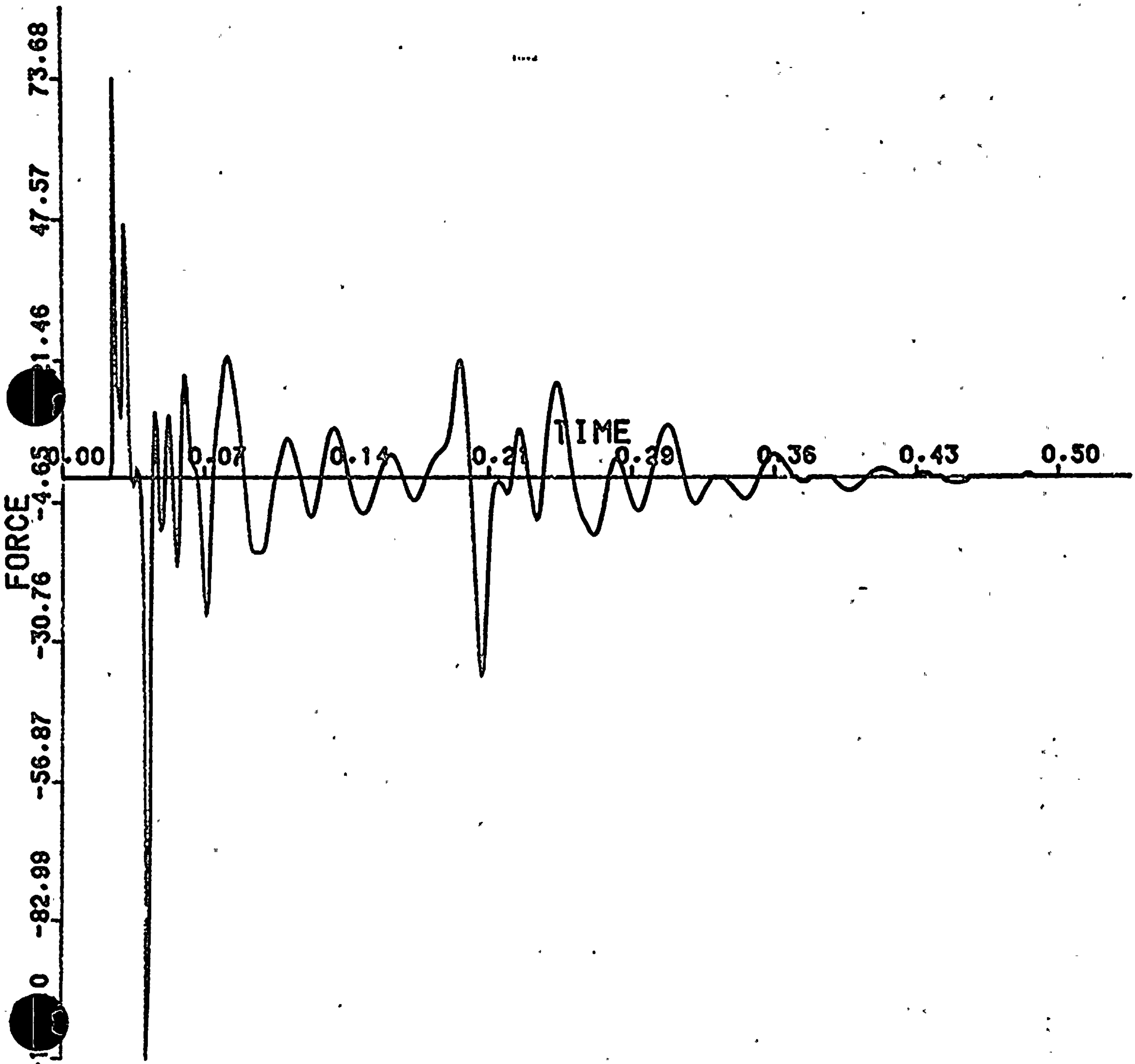
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 50, MAGNITUDE AT NODE POINT 242



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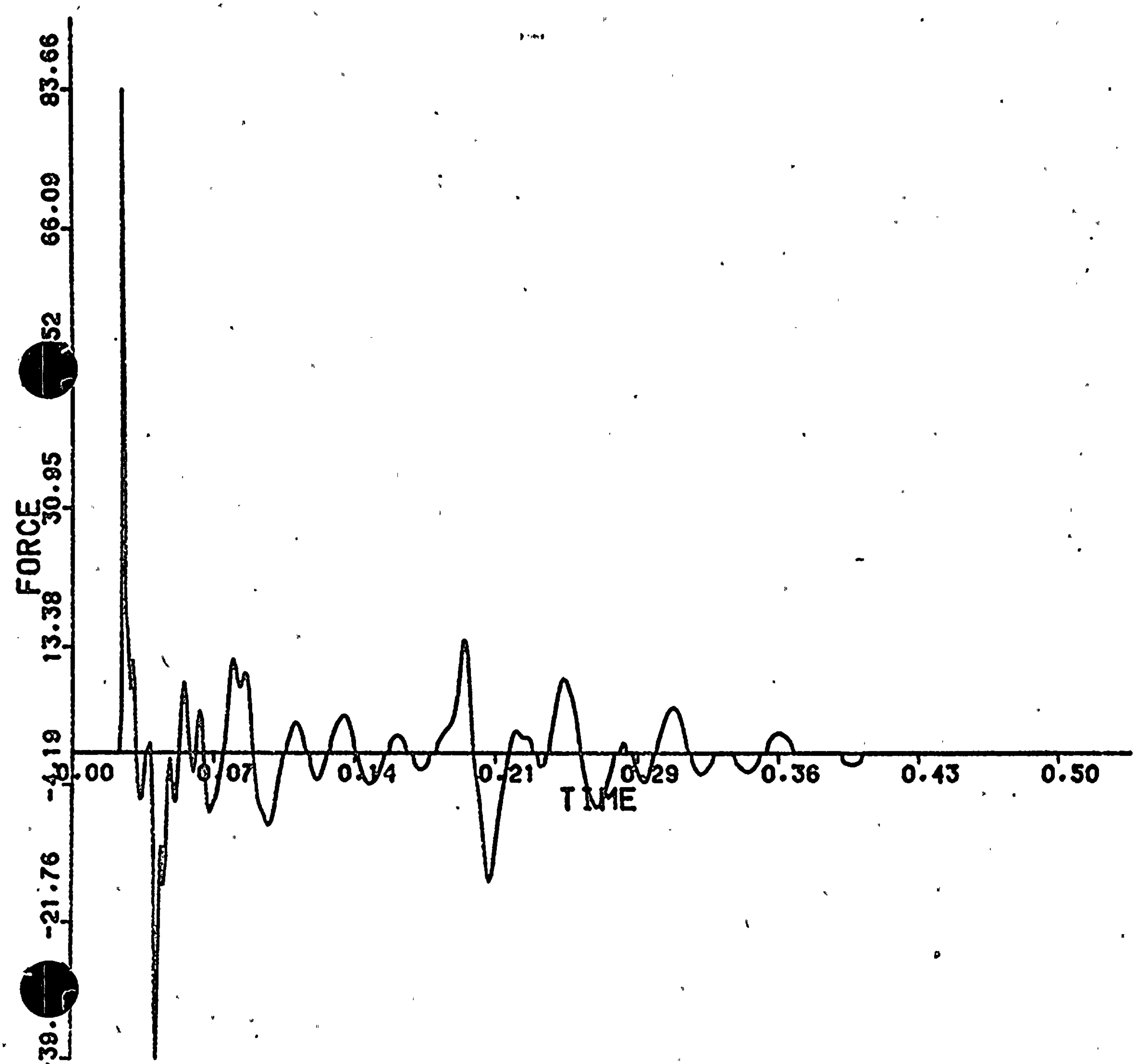
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 51, MAGNITUDE AT NODE POINT 240



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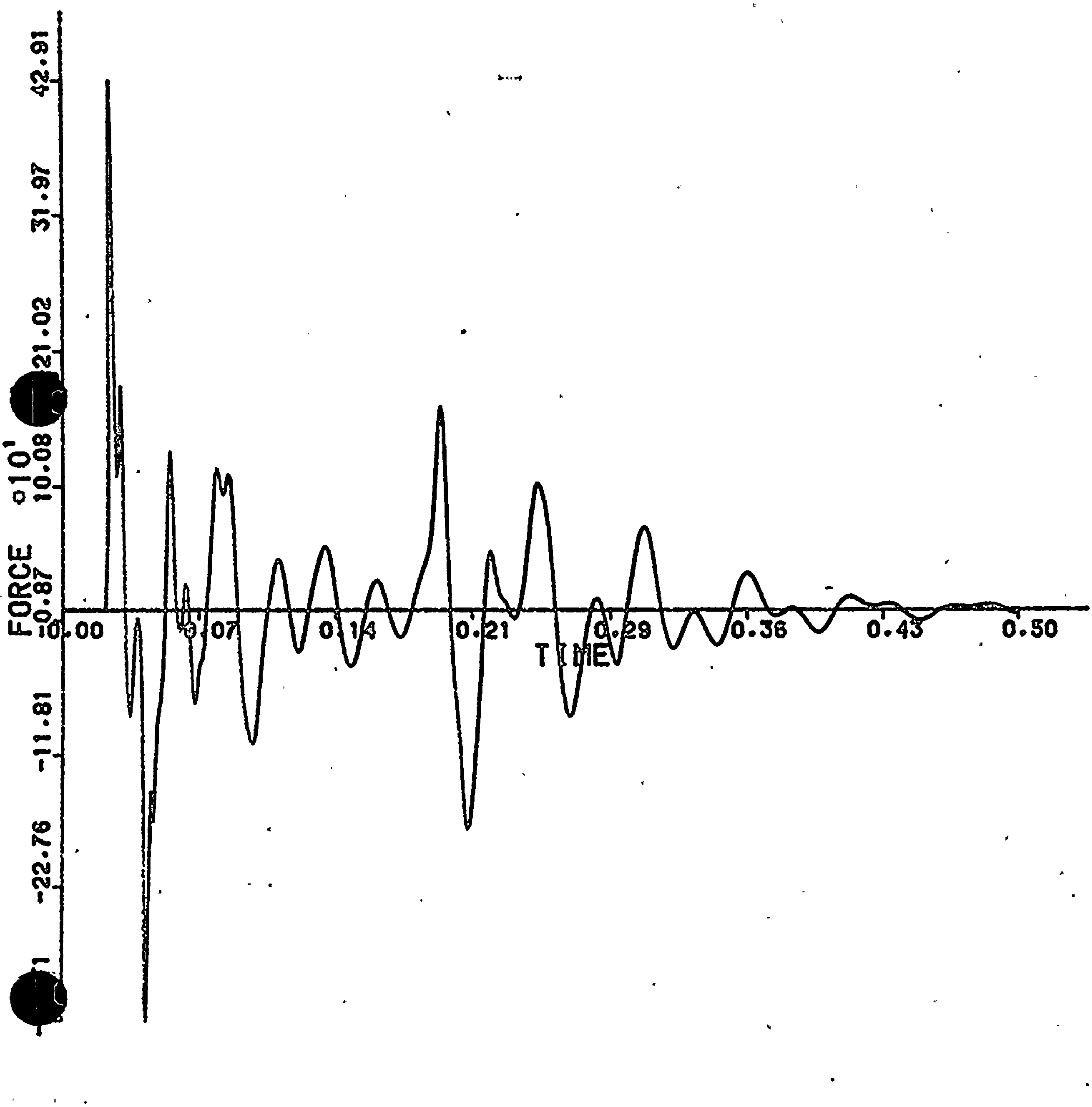
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 52, MAGNITUDE AT NODE POINT 238



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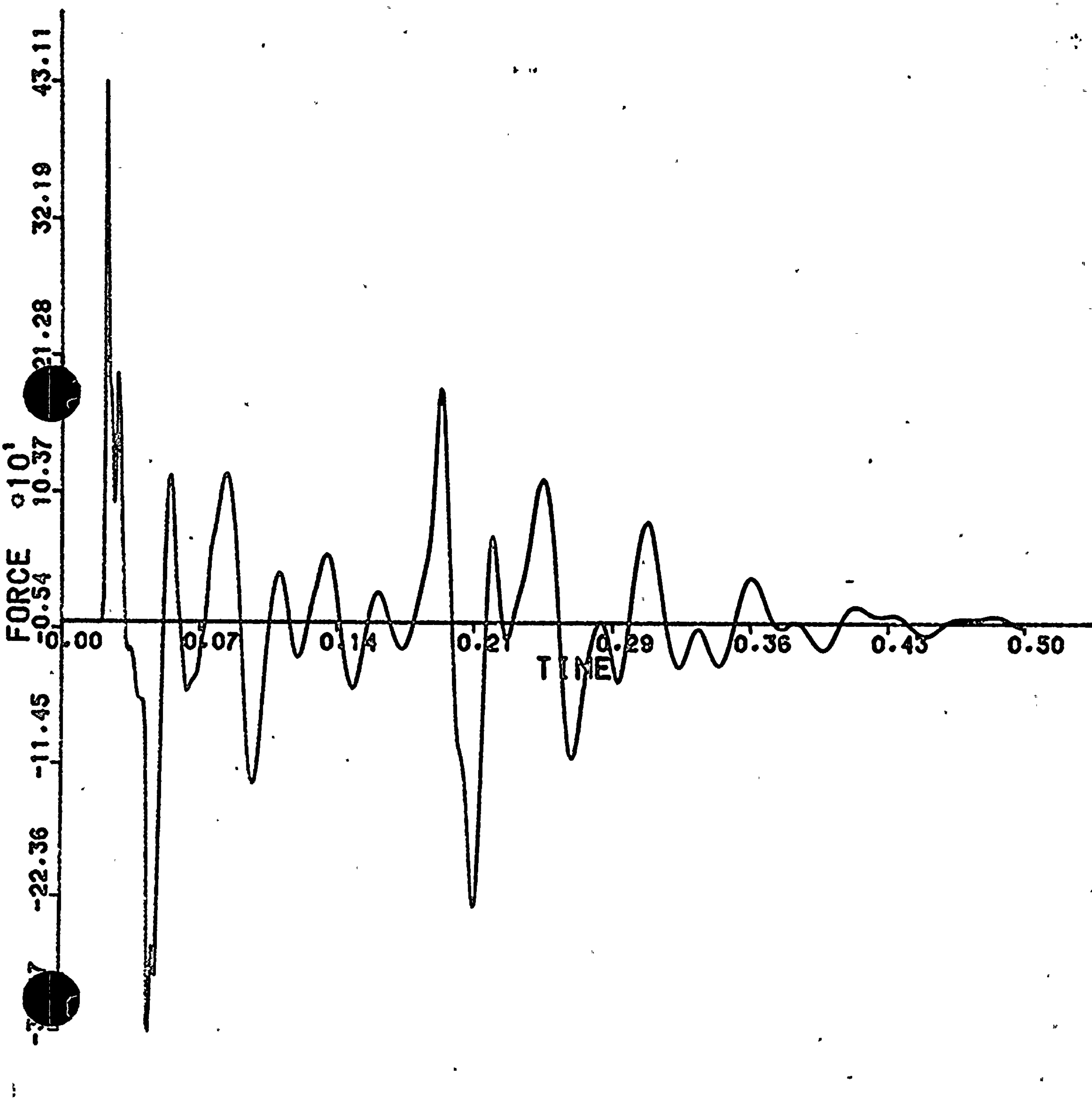
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 53, MAGNITUDE AT NODE POINT 236



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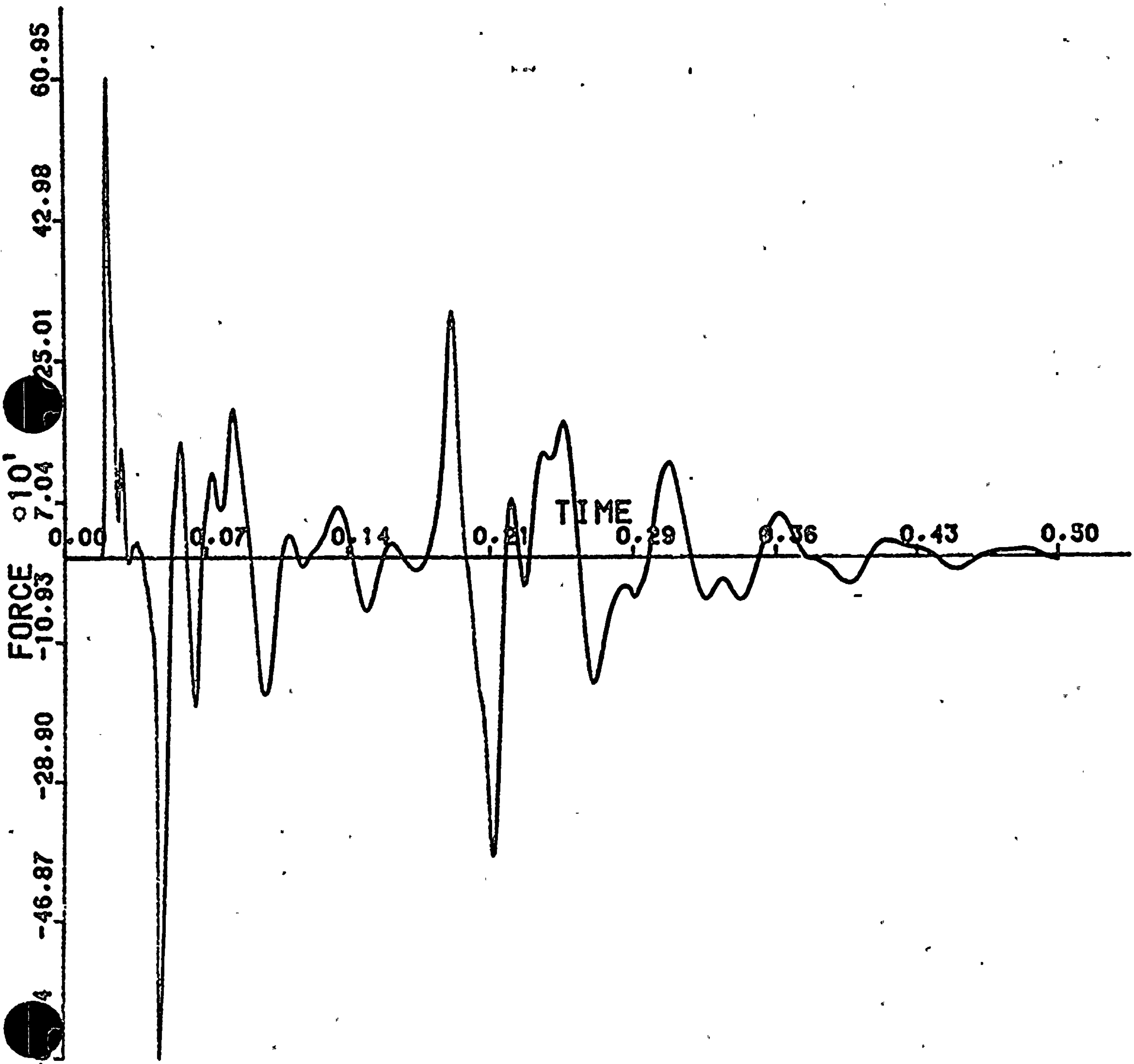
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 54, MAGNITUDE AT NODE POINT 234



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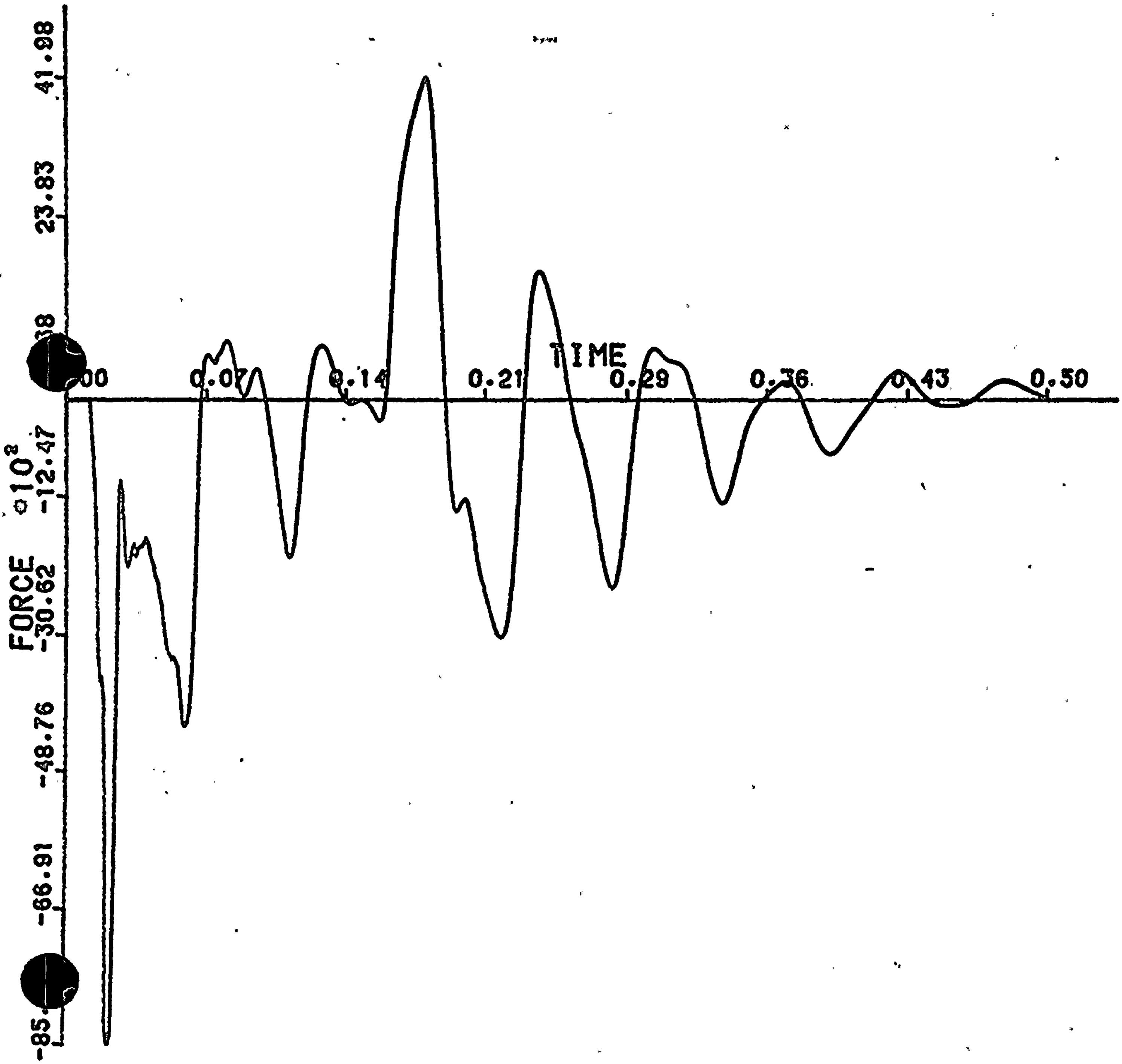
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 55 , MAGNITUDE AT NODE POINT 73



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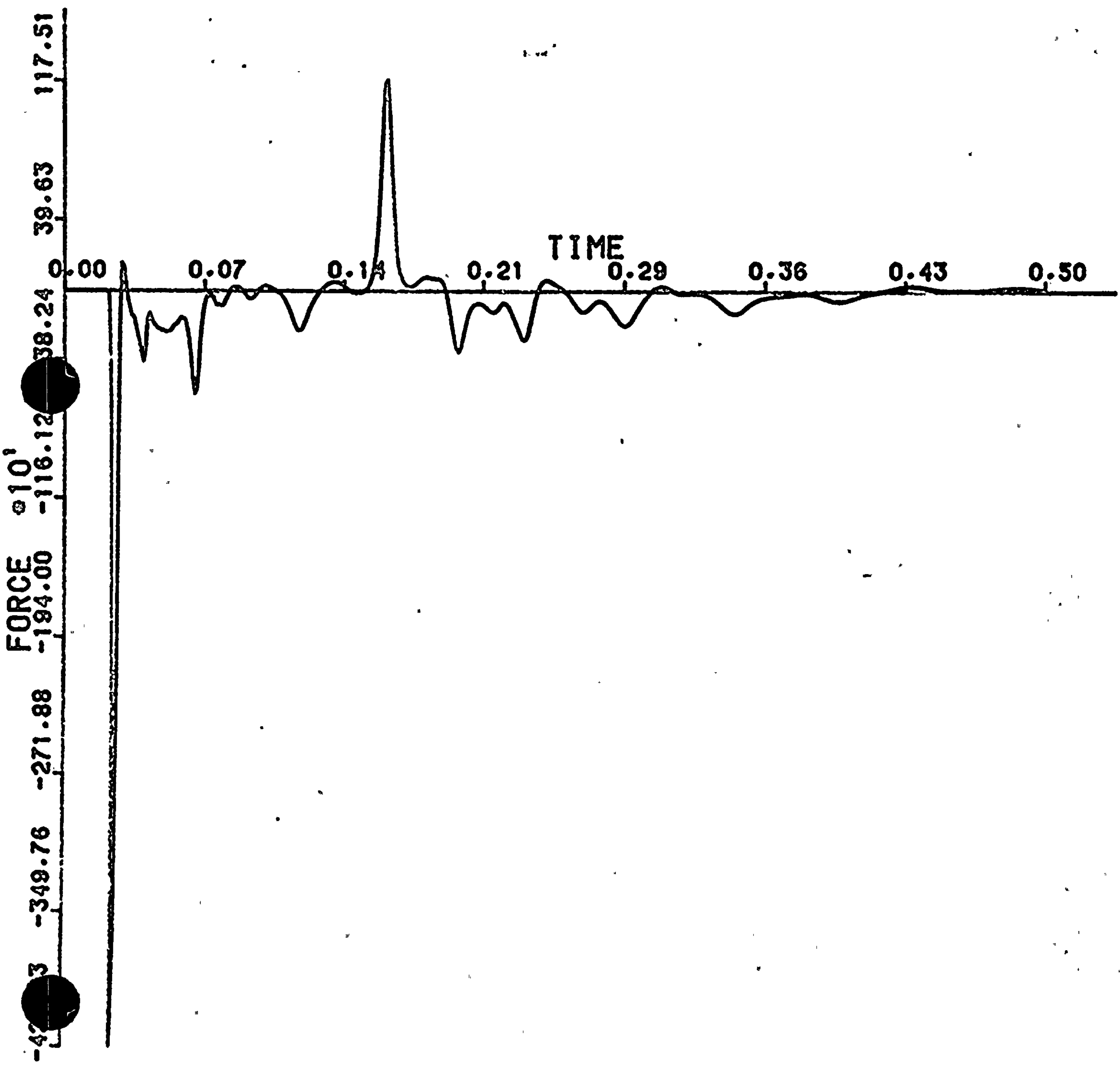
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 56 , MAGNITUDE AT NODE POINT 66



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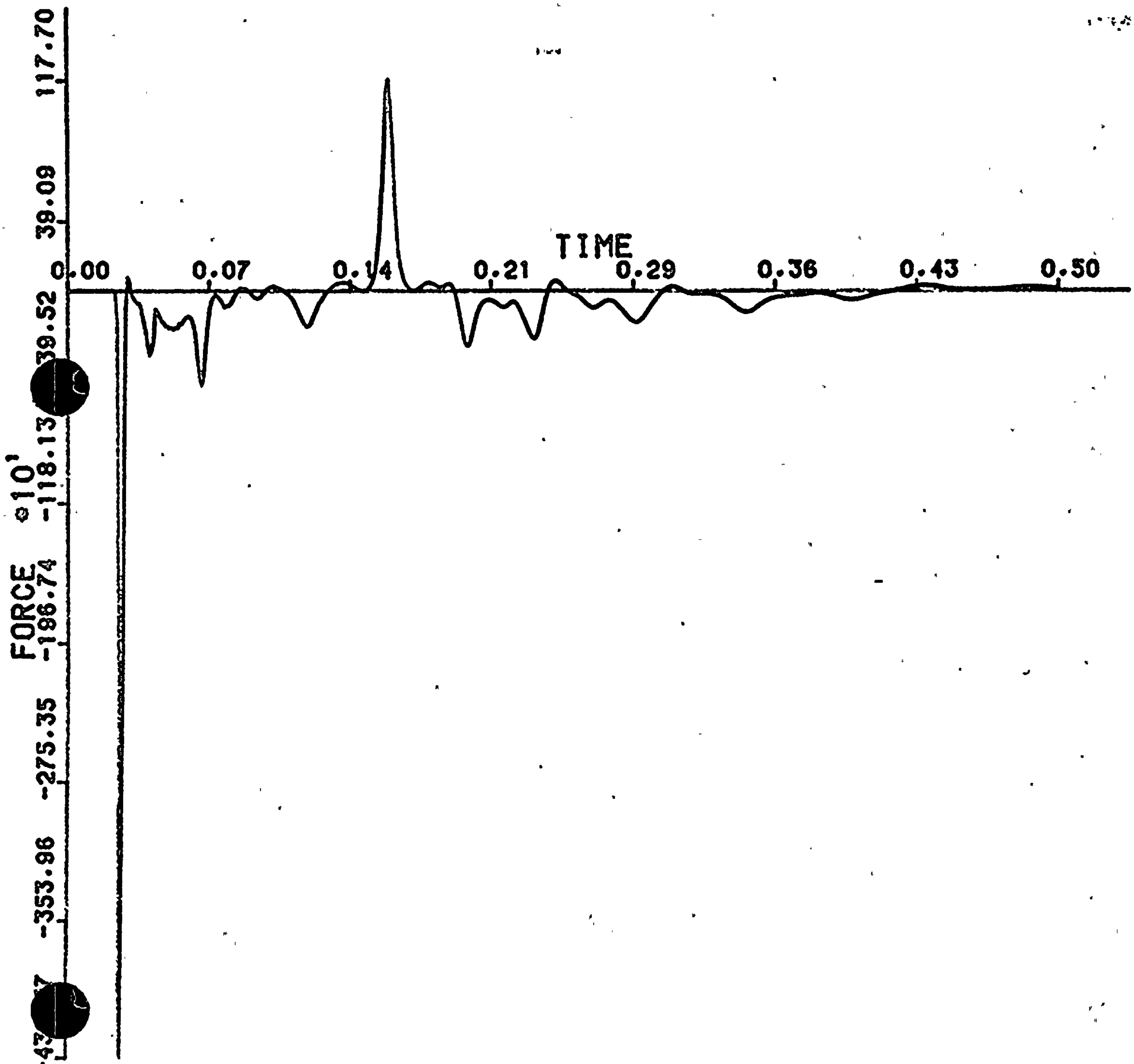
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 57 , MAGNITUDE AT NODE POINT 60



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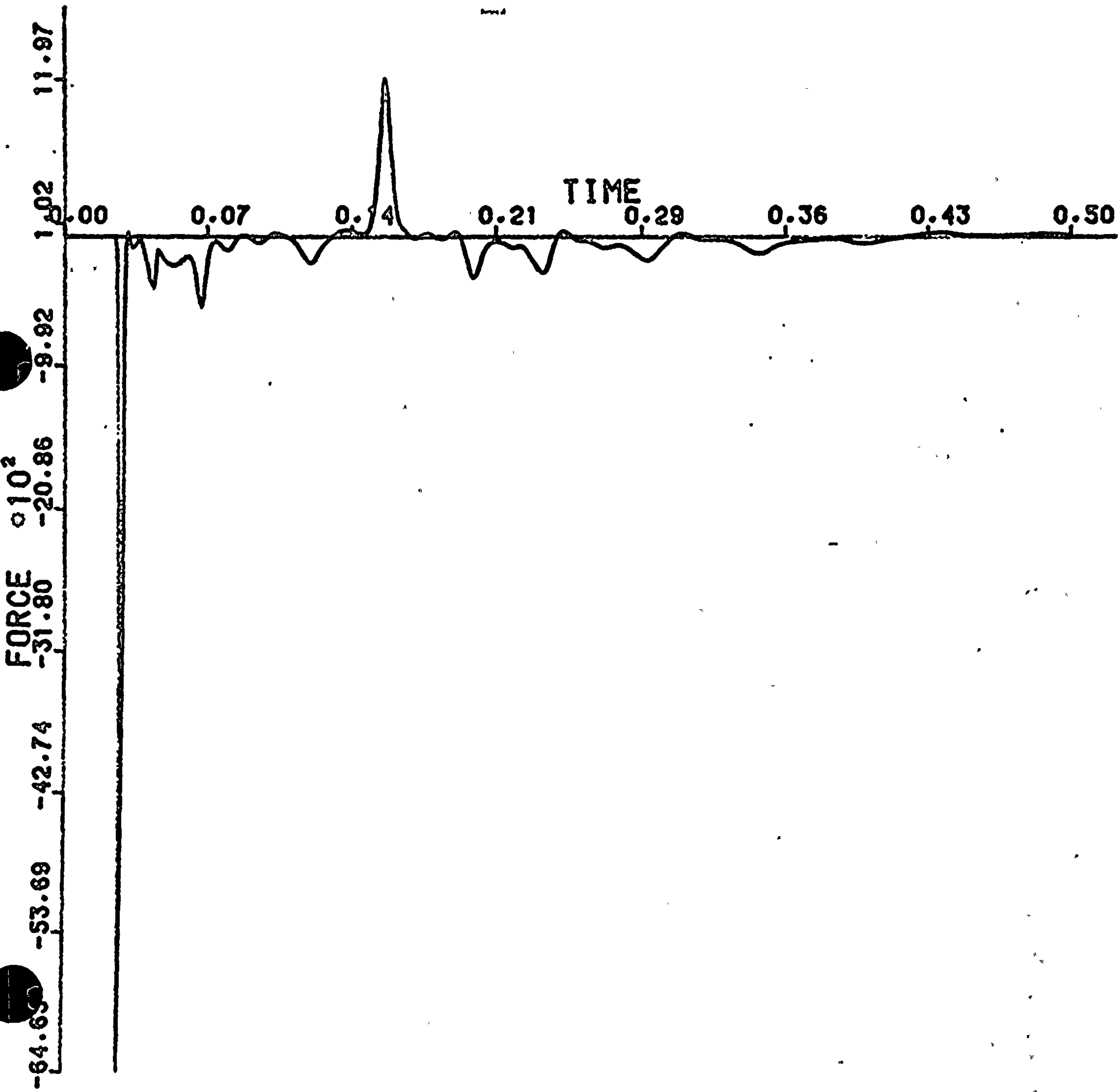
SAP2SAP VERIFICATION 5364 6-JUL-83

DC COOK-UNIT2, SV MODIFICATION

TIME/FORCE TABLE 58 , MAGNITUDE AT NODE POINT 56



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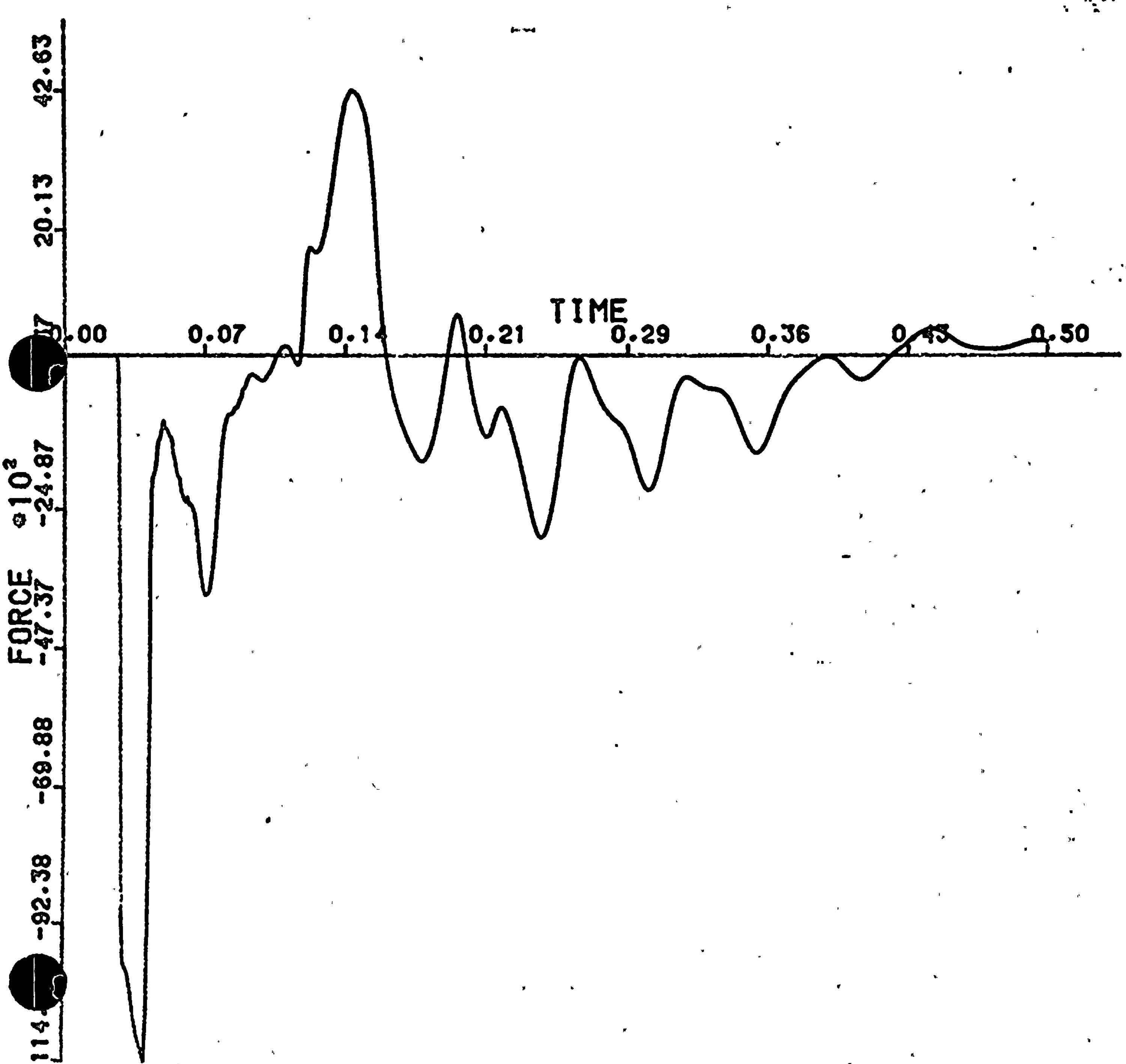
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 59 , MAGNITUDE AT NODE POINT 48



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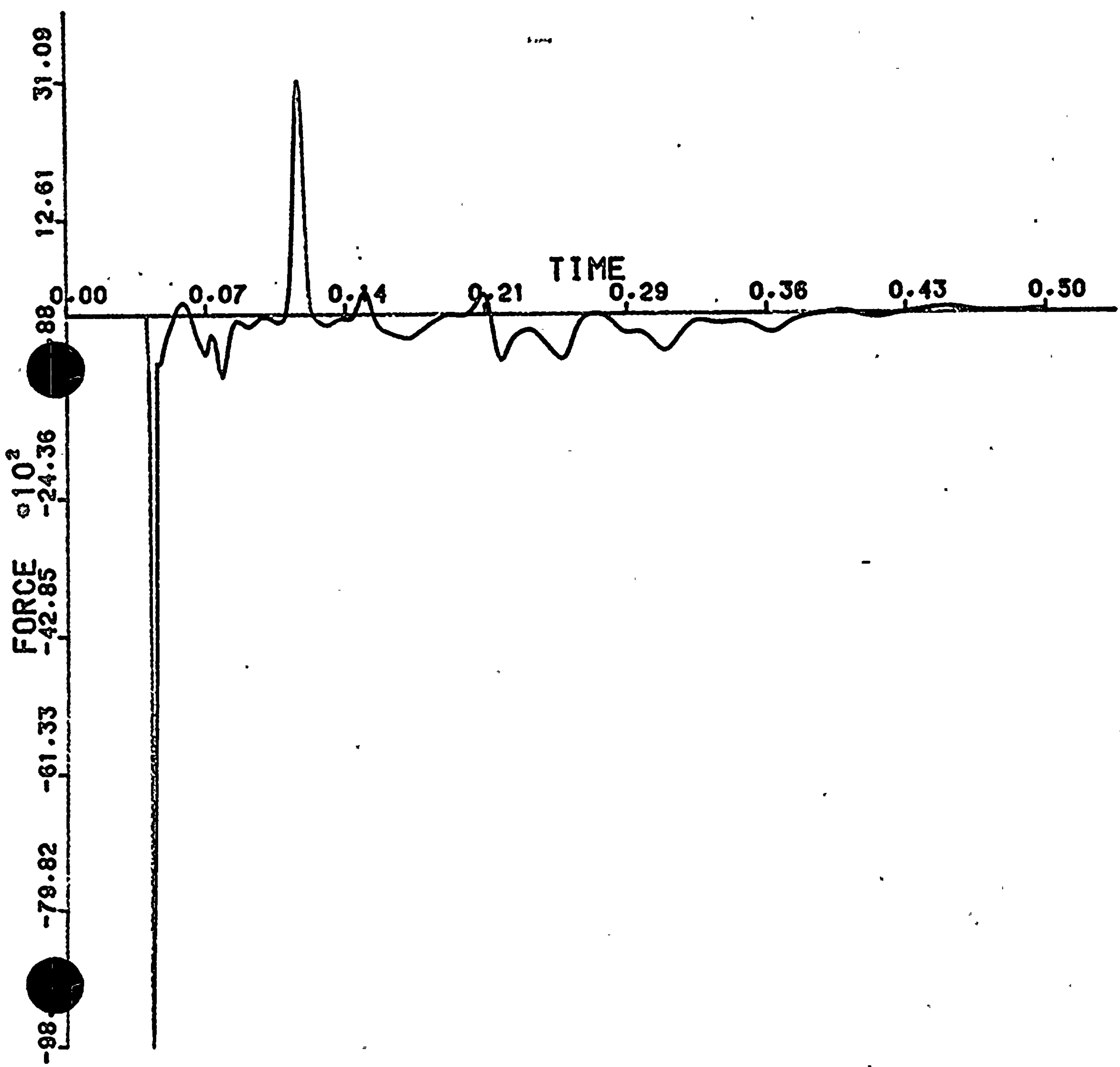
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 60 , MAGNITUDE AT NODE POINT 44



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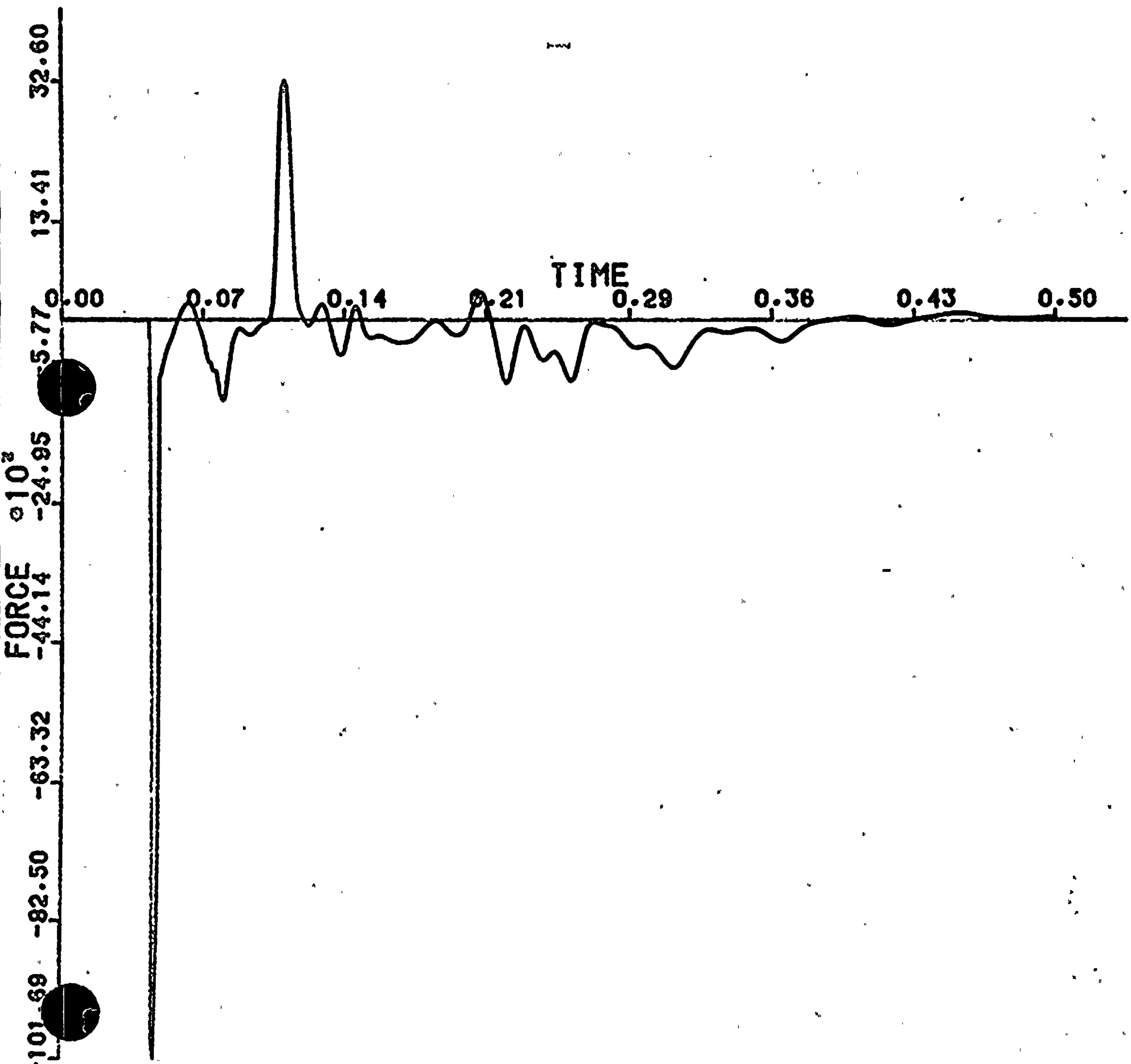
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 61 , MAGNITUDE AT NODE POINT 40



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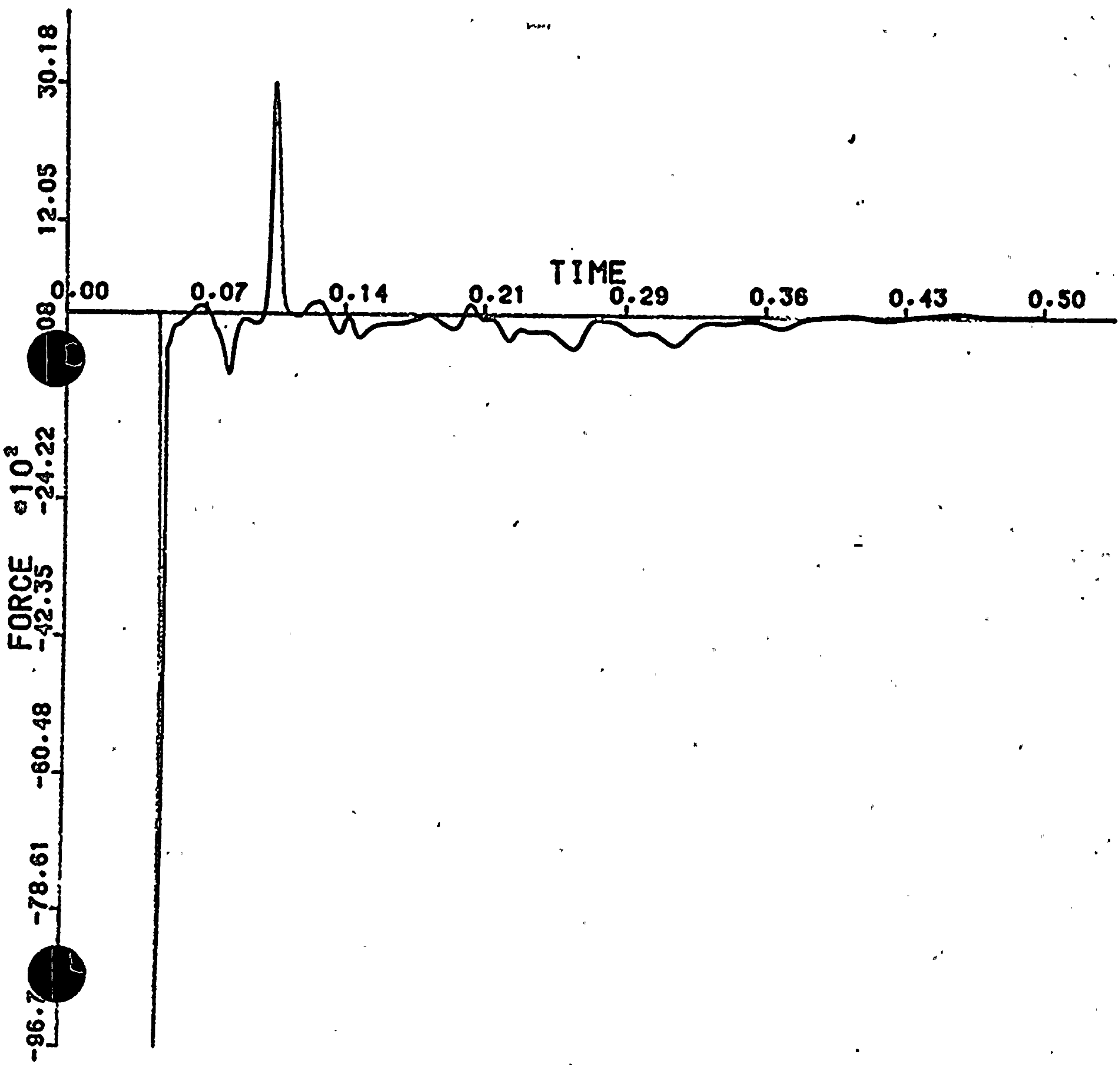
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2. SV MODIFICATION
TIME/FORCE TABLE 62 . MAGNITUDE AT NODE POINT 36



[illegible]

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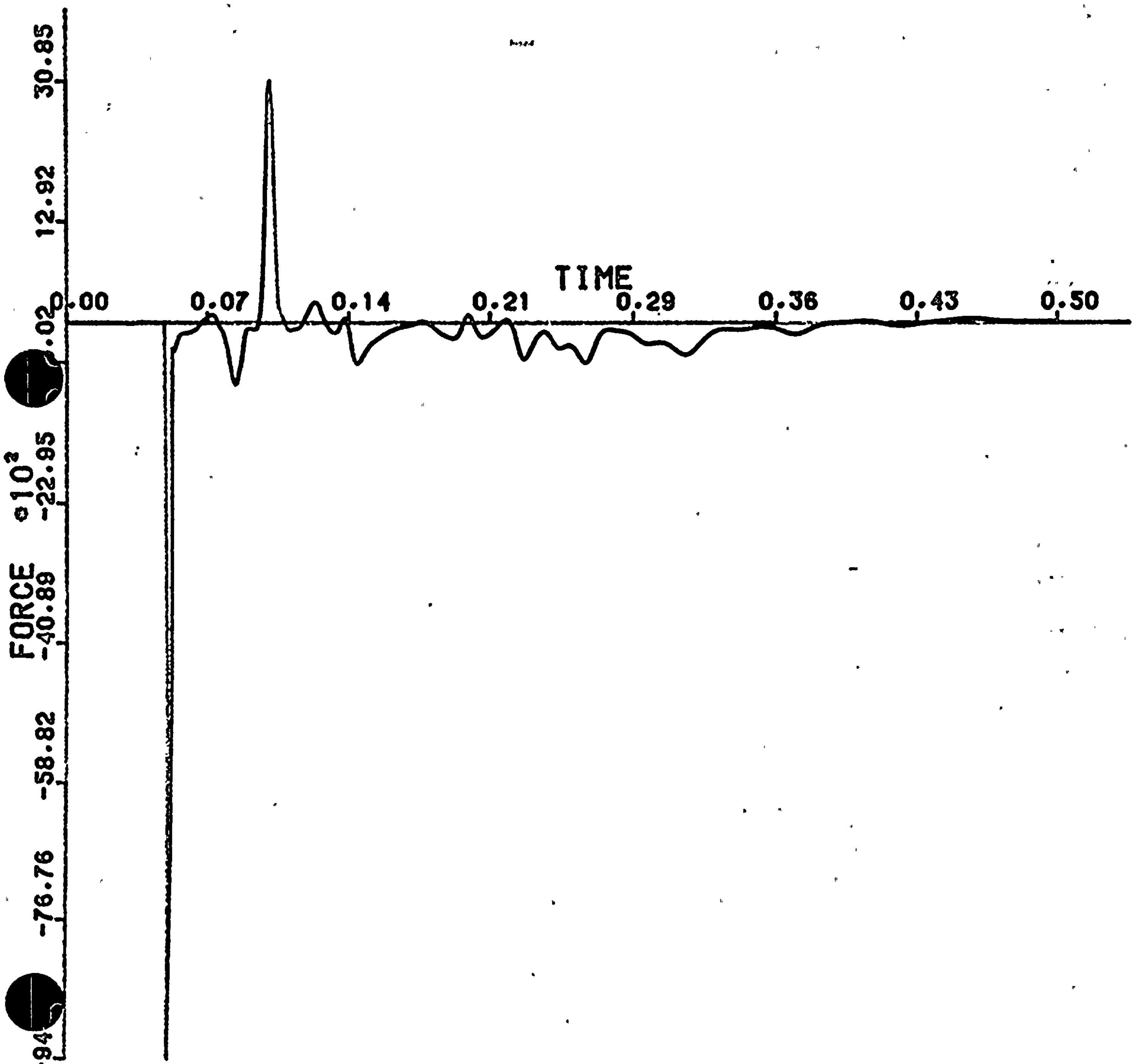
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 63 , MAGNITUDE AT NODE POINT 35



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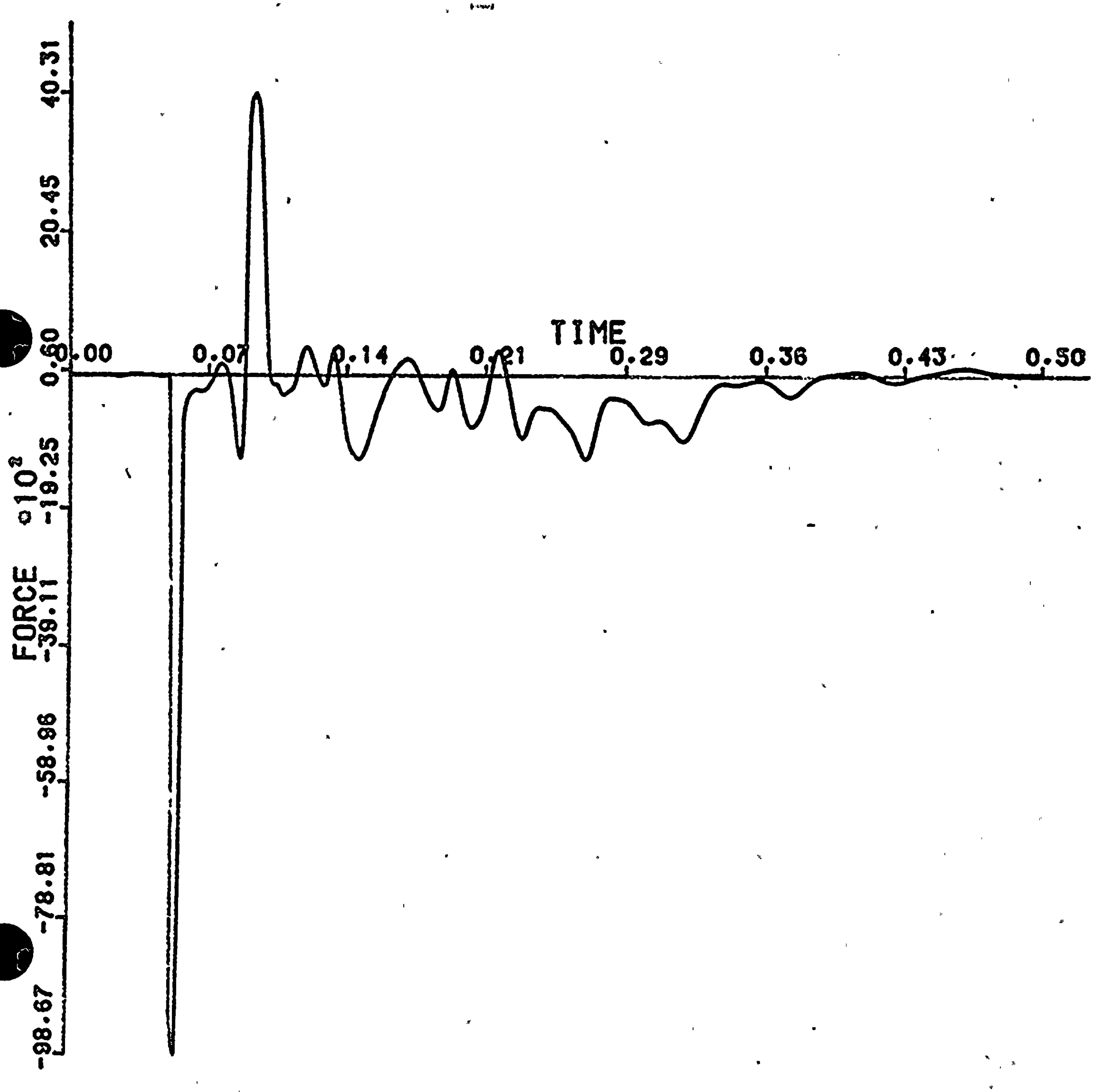
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 64, MAGNITUDE AT NODE POINT 24



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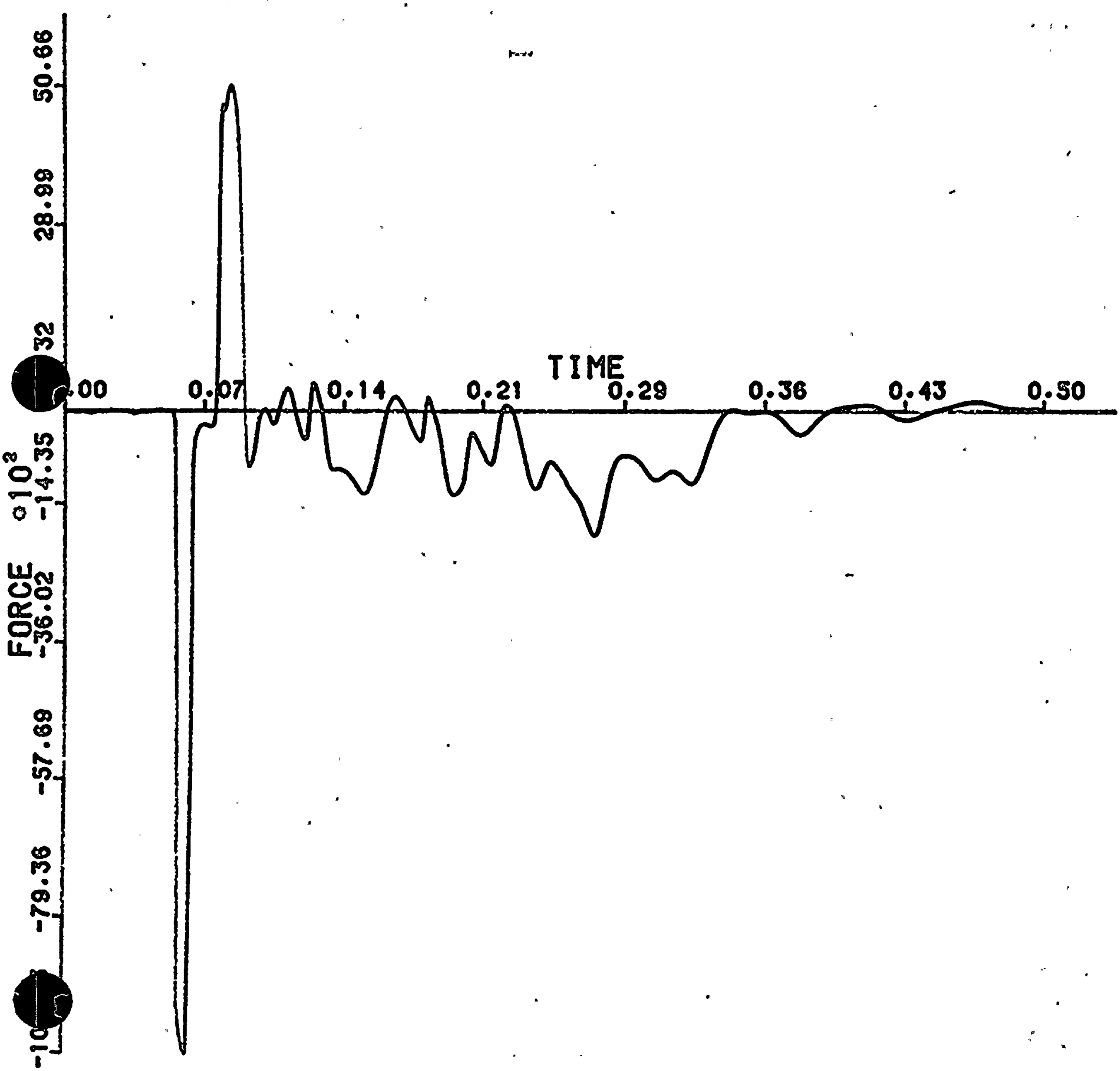
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 65, MAGNITUDE AT NODE POINT 14



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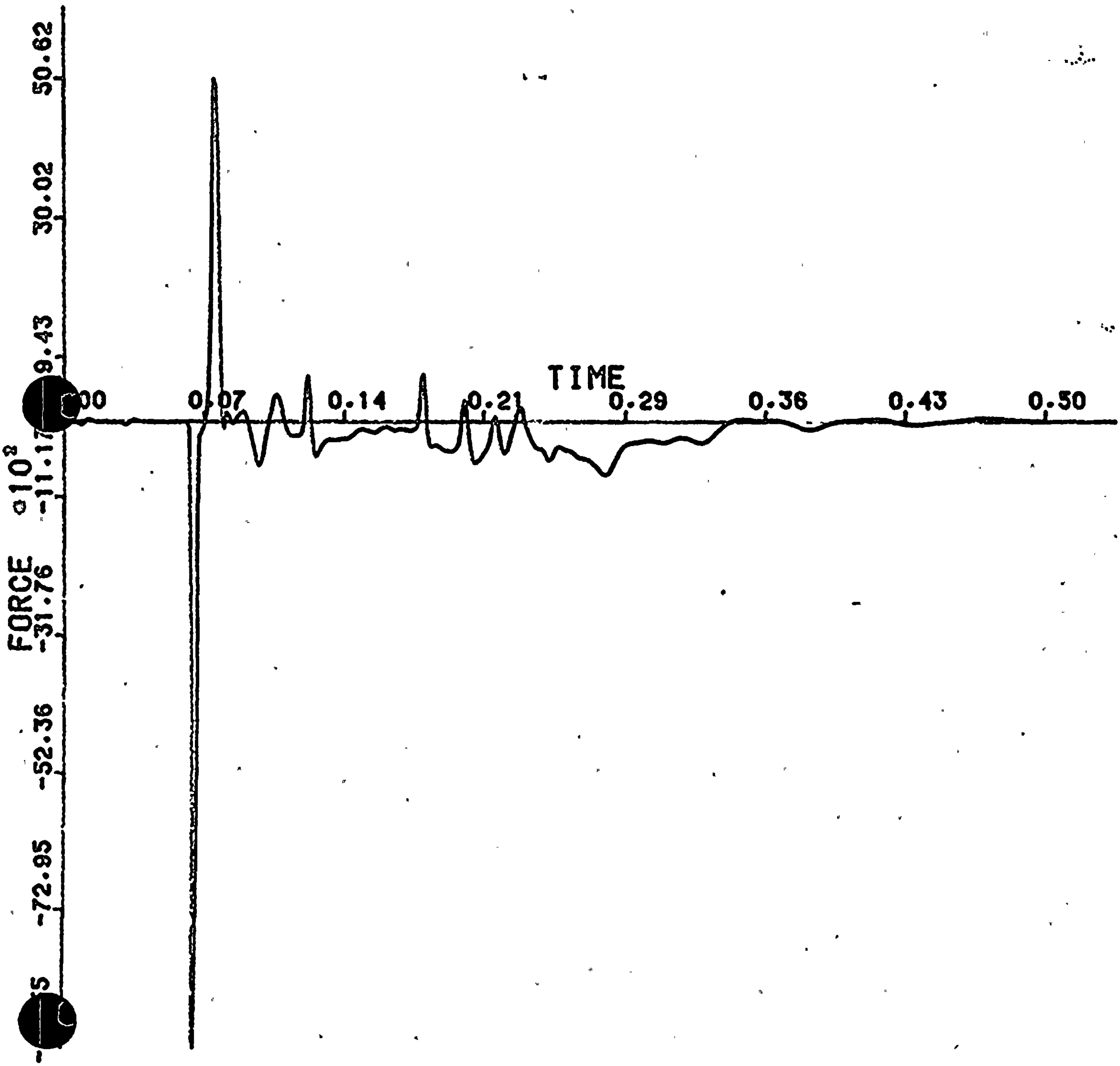
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 66, MAGNITUDE AT NODE POINT 8



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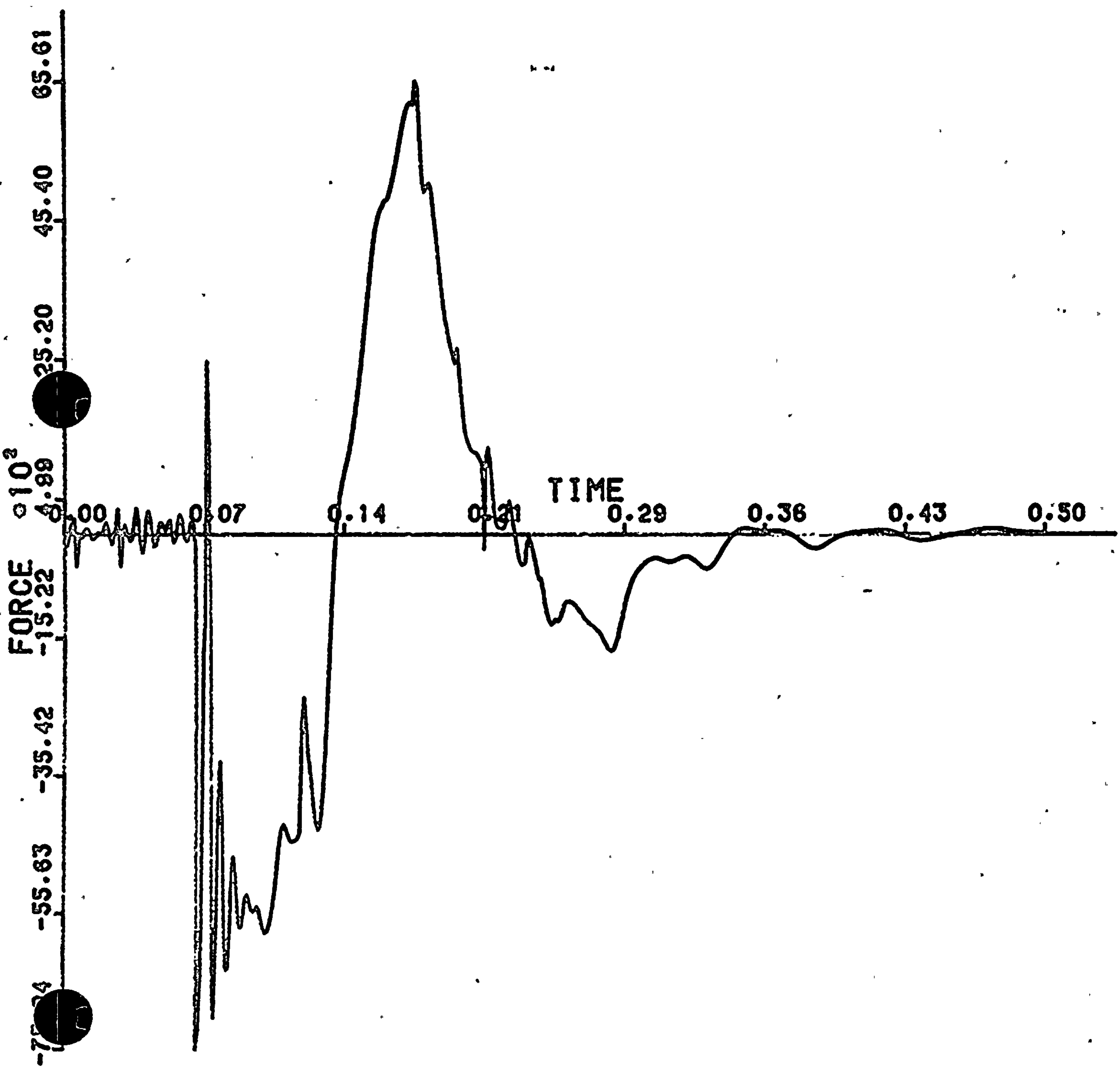
SAP2SAP VERIFICATION 5364 6-JUL-83
DC COOK-UNIT2, SV MODIFICATION
TIME/FORCE TABLE 67, MAGNITUDE AT NODE POINT 4



4.7 RELAP Input

Included here is the RELAP5 MOD1 input listing for the transient steam case.

The SV model has:

- 387 volumes
- 386 junctions

Heat structures were not included in the RELAP model because of the program capacity. Including heat structures would have further reduced the number of available control volumes. This is a conservative assumption, ITI (Reference 6) showed higher loads were computed without heat structures.

LISTING OF INPUT DATA FOR CASE 1

```
=AEP UNIT2  1 LINE  RELAP5
*  AEP  D.C. COOK UNIT2
*  DISCHRAGE PIPING
*  THIS IS THE NUMBERING SYSTEM FOR UNIT2S' RELAP MODEL
*  WHERE COMPONENTS NUMBERED IN THE:
*          100'S ARE VALVE SV-45C AND ARC 1 LEVEL  669'-2"
*          200'S ARE VALVE SV-45B AND ARC 2 LEVEL  670'-10"
*          300'S ARE VALVE SV-45A ARN ARC 3 LEVEL  672'-6"
*          400'S ARE PORV NRV-151 AND ARC "A"
*          500'S ARE PORV NRV-153 AND ARC "B"
*          600'S ARE PORV NRV-152 AND ARC "C"
*          700'S ARE 6" DISCHARGE PIPING
*          800'S ARE 12" DISCH.
*          900'S QUENCH TANK PORTION
*          999  ATMOSPHERE
100 NEW TRANSNT
101 RUN
102 BRITISH BRITISH
104 NOACTION
*
*************************************
*          TIME STEP CONTROL        *
*************************************
*
201  0.500  1.0-7  2.0-4  11001  5  50  250
*
**************************************
*             MINOR EDITS          . *
**************************************
*
*
*
301   MFLOWJ   105000000
302   MFLOWJ   205000000
303   MFLOWJ   305000000
304   MFLOWJ   700010000
305   MFLOWJ   811140000
306   MFLOWJ   811790000
307   MFLOWJ   307000000
308   MFLOWJ   207000000
309   MFLOWJ   107000000
310   MFLOWJ   900000000
*
311   QUALS   102020000
312   QUALS   202020000
313   QUALS   302020000
314   QUALS   104200000
315   QUALS   204200000
316   QUALS   304200000
317   QUALS   811140000
318   QUALS   811790000
319   QUALS   106010000
320   QUALS   106390000
321   QUALS   206010000
322   QUALS   206330000
323   QUALS   306010000
```

BY KJG. DATE 6-22-83
CHKD. BY CMM DATE 6-27-83

```
2020    811680000,811690000,811700000,811710000,811720000
2121    811730000,811740000,811750000,811760000,811770000
2022    811780000,811790000,811800000,811810000,811820000
2023    811830000,811840000,811850000,811860000,811870000
2024    811880000,811890000,811900000,811910000,811920000
2025    811930000,811940000,811950000,811960000,811970000
2026    811980000,811990000,813010000,813020000,813030000
2027    813040000,813050000,813060000,813070000,813080000
2028    813090000,813100000,813110000,813120000,813130000
2029    813140000,813150000,813160000,813170000,813180000
2030    813190000,813200000,813210000,813220000,813230000
2031    813240000,813250000,813260000,813270000,813280000
2032    813290000,813300000,901010000,901020000,903010000
2033    903020000,903030000,903040000,903050000,903060000
2034    903070000,903080000
*
*
*
*
*
*
***********************************
*             TRIPS               *
***********************************
*
501  P  907010000  GT  NULL  0  114.7  L  *QUENCH TANK BLOW OUT PATCH
503  TIME  0  GE NULL 0  0.0     L  *  VALVE OPEN
504  TIME  0  GE  NULL  0  5.0  L  *  VALVE CLOSED
600  504
*
*****************************************************
*           ****************************           *
*           * HYDRODYNAMIC COMPONENTS *            *
*           ****************************           *
*****************************************************
*
*
*
*********************************************
*    SAFETY VALVES DISCHARGE SECTION        *
*********************************************
*
*
*
************************************************************
*    SAFETY VALVE-45C  DISCHARGING AT ELEV. 669'-2"  ARC  1    *
************************************************************
*
*
*******************
* PRESSURIZER  #1 *
*******************
*
1000000  "PRESS1"  TMDPVOL
1000101  0.0  20.0  500.0  0.0  0.0  0.0  0.00005  0.0  11
1000200  2
1000201  0.0  2500.0  1.0  0.1  2514.0  1.0  0.3  2555.0  1.0  0.5  2600.0  1.0
1000202  0.7  2687.0  1.0  0.9  2700.0  1.0  1.1  2740.0  1.0  1.3  2745.0  1.0
```

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```
324  QUALS  306250000
325  QUALS  903030000
326  QUALS  903180000
*
327  P        102020000
328  P        202020000
329  P        302020000
330  P        104200000
331  P        204200000
332  P        304200000
333  P        811140000
334  P        811790000
335  P        106010000
336  P        106390000
337  P        206010000
338  P        206330000
339  P        306010000
340  P        306250000
341  P        903020000
342  P        903030000
343  P        903180000
*
*
*
*
*
*
***************************************************
**                                              **
**         FORCE  CARDS  FOR  REPIPE             **
**                                              **
***************************************************
*
*
*
*
*
*  MAIN DISHCHARGE PIPING
*
2001    5,161
2002    700020000,700030000,700040000,700050000
2003    700060000,700070000,700080000,700090000,700100000
2004    700110000,700120000,702010000,702020000,702030000
2005    306250000,801010000,803010000,206330000,805010000
2006    807010000,106390000,809010000,811010000,811020000
2007    811030000,811040000,811050000,811060000,811070000
2008    811080000,811090000,811100000,811110000,811120000
2009    811130000,811140000,811150000,811160000,811170000
2010    811180000,811190000,811200000,811210000,811220000
2011    811230000,811240000,811250000,811260000,811270000
2012    811280000,811290000,811300000,811310000,811320000
2013    811330000,811340000,811350000,811360000,811370000
2014    811380000,811390000,811400000,811410000,811420000
2015    811430000,811440000,811450000,811460000,811470000
2016    811480000,811490000,811500000,811510000,811520000
2017    811530000,811540000,811550000,811560000,811570000
2018    811580000,811590000,811600000,811610000,811620000
2019    811630000,811640000,811650000,811660000,811670000
```

```
1000203  1.5  2747.0  1.0  1.7  2748.0  1.0  1.9  2750.0  1.0  2.0  2750.0  1.0
*
*  LOOP SEAL GEOMETRY
*
1010000  "LPSL1"  SNGLJUN
1010101  100000000  102000000  0.0  0.0  0.0  1000  * THIS IS A SHORT RADIUS ELBOW LEAVING
1010201  1  0.0  0.0  0.0
*
1020000     "LPSL1"  PIPE
1020001     3
1020101     0.1465     3
1020301     0.299      1
1020302     0.6237     3
1020401     0.0        3
1020601     43.        1
1020602     0.0        3
1020801     0.000151  0.0    3
1020901     0.0877    0.0877     1
1020902     0.0       0.0        2
1021001     00         3
1021101     1000       2
1021201     2  2500.   1.0  0.0  0.0   3
1021300     1
1021301     0.0  0.0  0.0     2
*
1030000  "LPSL1"  SNGLJUN
1030101  102010000  104000000  0.0  0.1836  0.1836  1000
1030201  1  0.0  0.0  0.0
*
1040000  "LPSL1"  PIPE
1040001  20
1040101  0.1465  20
1040301  0.50  10
1040302  0.6214  20
1040401  0.0  20
1040601  -90.0  7
1040602  0.0  10
1040603  90.0  20
1040801  0.000151  0.0  20
1040901  0.0  0.0  6
1040902  0.1836  0.1836  7
1040903  0.0  0.0  9
1040904  0.1836  0.1836  10
1040905  0.0  0.0  19
1041001  00  20
1041101  1000  19
1041201  2  2500.0  1.0  0.0  0.0  20
1041300  1
1041301  0.0  0.0  0.0  19
*
*
*********************************
*   SV-45C  CROSBY 6M6          *
*********************************
*
*
1050000  "SRV1"  VALVE
1050101  104010000  106000000  0.01897  0.0  0.0  0100
```

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```
1050201  1  0.0  0.0  0.0
1050300  MTRVLV
1050301  503  504  100.0  0.0  *  CROSBY 6M6  OPENING IN 10 MSEC
**
*  DISCHARGE PIPING
**
1060000  "DISCHA1"  PIPE
1060001  39
1060101  0.20069  39
1060301  0.526  4
1060302  1.094  14
* ARC STARTS HERE LEVEL 669-2"
1060303  1.000  20
1060304  0.8994  29
1060305  0.7436  35
* ARC ENDS
1060310  0.7980  39
1060401  0.0  39
1060601  0.0  4
1060602  -90.0  14
1060603  0.0  39
1060801  0.000152  0.0  39
1060901  0.0  0.0  3
1060902  0.1800  0.1800  4
1060903  0.0  0.0  13
1060904  0.1800  0.1800  14
1060905  0.0  0.0  38
1061001  00  39
1061101  1000  38
1061201  4  17.7  120.0  0.93424  0.0  39
1061300  1
1061301  0.0  0.0  0.0  38
*
1070000  "DISCHA1"  SNGLJUN
1070101  106010000  809000000  0.0  0.1560  0.1560  1000  *LOSSES FOR A 12 IN ELBOW
1070201  1  0.0  0.0  0.0
*
*
*
*******************************************************
*         MAIN DISCHARGE  12" HEADER TO QUENCH TANK        *
*******************************************************
*
*
*
8090000  "DISCHA1"  BRANCH
8090001  0
8090101  0.77708  0.5  0.0  0.0  -90.0  -0.5  0.000169  0.0  00
8090200  4  17.7  120.0  0.93424  0.0  0.0
*
8100000  "DISCHA1"  SNGLJUN
8100101  809010000  811000000  0.0  0.0  0.0  1000
8100201  1  0.0  0.0  0.0
*
8110000  "DISCH1A"  PIPE
8110001  99
8110101  0.7771  99
8110301  1.039  14
```

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```
8110302  0.52995  18
8110303  0.5  22
8110304  0.52995  26
8110305  0.95729  56
8110306  0.475  66
8110307  0.49359  79
8110308  0.46875  87
8110309  0.50  95
8110310  0.95  99
8110401  0.0  99
8110601  -90.0  14
8110602  -45.0  18
8110603  -90.0  22
8110604  -45.0  26
8110605  -90.0  56
8110606  0.0  87
8110607  -90.0  95
8110608  0.0  99
8110801  0.000169  0.0  99
8110901  0.0  0.0  13
8110902  0.078  0.078  14
8110903  0.0  0.0  17
8110904  0.078  0.078  18
8110905  0.0  0.0  21
8110906  0.078  0.078  22
8110907  0.0  0.0  25
8110908  0.078  0.078  26
8110909  0.0  0.0  55
8110910  0.156  0.156  56
8110911  0.0  0.0  65
8110912  0.026  0.026  66
8110913  0.0  0.0  78
8110914  0.13  0.13  79
8110915  0.0  0.0  86
8110916  0.156  0.156  87
8110917  0.0  0.0  94
8110918  0.156  0.156  95
8110919  0.0  0.0  98
8111001  00  99
8111101  1000  98
8111201  4  17.7  120.0  0.93424  0.0  99
8111300  1
8111301  0.0  0.0  0.0  98
*
8120000  "DISCHA1"  SNGLJUN
8120101  811010000  813000000  0.0  0.0  0.0  1000
8120201  1  0.0  0.0  0.0
*
8130000  "DISCHA1" PIPE
8130001  30
8130101  0.7771  30
8130301  0.95  6
8130302  1.0  20
8130303  0.5  30
8130401  0.0  30
8130601  0.0  30
8130801  0.000169  0.0  30
8130901  0.0  0.0  5
```


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```
8130902  0.156  0.156  6
8130903  0.0  0.0  19
8130904  0.156  0.156  20
8130905  0.0  0.0  29
8131001  00  30
8131101  1000  29
8131201  4  17.7  120.0  0.93424  0.0  30
8131300  1
8131301  0.0  0.0  0.0  29
*
*
*
*****************************************************
*         SAFETY VALVE 45B AT ELEV. 670'-10" ARC 2    *
*****************************************************
*
*
*
******************
* PRESSURIZER #2 *
******************
*
*
2000000   "PRESS2"  TMDPVOL
2000101  0.0 20.0 500.0 0.0 0.0 0.0 0.00005 0.0 11
2000200  2
2000201  0.0  2500.0  1.0  0.1  2514.0  1.0  0.3  2555.0  1.0  0.5  2600.0  1.0
2000202  0.7  2667.0  1.0  0.9  2700.0  1.0  1.1  2740.0  1.0  1.3  2745.0  1.0
2000203  1.5  2747.0  1.0  1.7  2748.0  1.0  1.9  2750.0  1.0  2.0  2750.0  1.0
*
*  LOOP  SEAL  GEOMETRY  #2 SRV
*
2010000    "LPSL2" SNGLJUN
2010101    200000000  202000000  0.0 0.0  0.0 1000  *THIS IS A SHORT RADIUS ELBOW  LEAVE 0
2010201    1  0.0  0.0  0.0
*
2020000    "LPSL2"  PIPE
2020001    3
2020101    0.1465     3
2020301    0.317      1
2020302    0.6289     3
2020401    0.0        3
2020601    46.        1
2020602    0.0        3
2020801    0.000151  0.0   3
2020901    0.09388   0.09388    1
2020902    0.0       0.0     2
2021001    00         3
2021101    1000       2
2021201    2  2500.   1.0  0.0  0.0   3
2021300    1
2021301    0.0  0.0  0.0    2
*
2030000    "LPSL2"  SNGLJUN
2030101   202010000  204000000   0.0  0.1836  0.1836  1000
2030201    1  0.0  0.0 0.0
*
2040000    "LPSL2"   PIPE
```

```
2040001   20
2040101   0.1465     20
2040301   0.5        10
2040302   0.6188      20
2040401   0.0        20
2040601   -90.0       7
2040602   0.0        10
2040603   90.0       20
2040801   0.000151 0.0  20
2040901   0.0  0.0    6
2040902  0.1836  0.1836  7
2040903   0.0 0.0     9
2040904  0.1836  0.1836      10
2040905   0.0 0.0    19
2041001   00  20
2041101   1000   19
2041201  2  2500.0  1.0  0.0  0.0  20
2041300   1
2041301   0.0 0.0 0.0 19
*
*
*****************************
*   SV-45B  CROSBY 6M6      *
*****************************
*
*
2050000   "SRV2"  VALVE
2050101   204010000  206000000  0.01897  0.0 0.0 0100
2050201   1 0.0 0.0 0.0
2050300   MTRVLV
2050301   503  504  100.0  0.0  * CROSBY 6M6 OPENING IN 10 MSEC.
**
*   DISCHARGE  PIPING
**
2060000   "DISCHA2"  PIPE
2060001   33
2060101   0.20069    33
2060301   0.4635      4
2060302   0.927      14
*ARC  STARTS  LEVEL  670'-10"
2060303   0.955      23
2060304   0.727      29
2060308   0.7980     33
2060401   0.0        33
2060601   0.0         4
2060602   -90.       14
2060603   0.0        33
2060801   0.000152  0.0   33
2060901   0.0  0.0  3
2060902  0.1800  0.1800      4
2060903   0.0  0.0  13
2060904  0.1800  0.1800      14
2060905   0.0  0.0  32
2061001     00       33
2061101   1000   32
2061201   4  17.7  120.0  0.93424  0.0  33
2061300   1
2061301   0.0  0.0  0.0  32
```

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cor

```
*
**************************************************
*    SAFETY VALVE 45A AT ELEV. 672'-6" ARC 3     *
**************************************************
*
*
*
*******************
* PRESSURIZER #3 *
*******************
*
3000000  "PRESS3"    TMDPVOL
3000101   0.0  20.0  500.0  0.0  0.0  0.0  0.00005  0.0  11
3000200   2
3000201   0.0  2500.0  1.0  0.1  2514.0  1.0  0.3  2555.0  1.0  0.5  2600.0  1.0
3000202  0.7  2667.0  1.0  0.9  2700.0  1.0  1.1  2740.0  1.0  1.3  2745.0  1.0
3000203  1.5  2747.0  1.0  1.7  2748.0  1.0  1.9  2750.0  1.0  2.0  2750.0  1.0
*
*   LOOP SEAL GEOMETRY #3  SRV
*
3010000  "LPSL3"  SNGLJUN
3010101   300000000  302000000  0.0 0.0 0.0  1000  *  THIS IS A SHORT RADIUS ELBOW WE WILL
3010201   1  0.0  0.0  0.0
*
3020000    "LPSL2"  PIPE
3020001    3
3020101    0.1465     3
3020301    0.317      1
3020302    0.6185     3
3020401    0.0        3
3020601    46.        1
3020602    0.0        3
3020801    0.000151  0.0   3
3020901    0.09388   0.09388    1
3020902    0.0       0.0       2
3021001    00        3
3021101    1000      2
3021201    2  2500.   1.0  0.0  0.0   3
3021300    1
3021301    0.0  0.0  0.0    2
*
3030000 "LPSL3" SNGLJUN
3030101   302010000  304000000  0.0  0.1836  0.1836  1000
3030201   1  0.0  0.0  0.0
*
3040000    "LPSL3"  PIPE
3040001   20
3040101   0.1465    20
3040301   0.5       10
3040302   0.6188     20
3040401   0.0       20
3040601   -90.0    7
3040602   0.0      10
3040603   90.0    20
3040801   0.000151  0.0  20
3040901   0.0  0.0  6
3040902  0.1836  0.1836        7
3040903   0.0  0.0  9
```

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```
3040904  0.1836  0.1836   10
3040905   0.0  0.0 19
3041001   00  20
3041101   1000  19
3041201  2  2500.0  1.0  0.0  0.0  20
3041300   1
3041301   0.0  0.0  0.0  19
*
*
****************************
*    SV-45A CROSBY 6M6     *
****************************
*
*
3050000    "SRV3"  VALVE
3050101    304010000  306000000  0.01897  0.0  0.0  0100
3050201    1  0.0  0.0  0.0
3050300   MTRVLV
3050301    503  504  100.0  0.0  * CROSBY 6M6 OPENING IN 10 MSEC
**
*   DISCHARGE PIPING
**
3060000    "DISCHA3"  PIPE
3060001    25
3060101    0.20069  25
3060301    0.526     4
3060302    0.969    12
*   ARC  STARTS  LEVEL  672'-6"
3060303    0.636    15
3060304    0.991    18
3060305    0.991    21
3060306    0.799    25
*   ARC ENDS
3060401    0.0   25
3060601    0.0       4
3060602    -90.0    12
3060603    0.0      25
3060801    0.000152  0.0  25
3060901    0.0  0.0   3
3060902  0.1800  0.1800    4
3060903    0.0  0.0  11
3060904  0.1800  0.1800    12
3060905    0.0  0.0  24
3061001    00  25
3061101   1000  24
3061201    4  17.7  120.0  0.83424  0.0  25
3061300    1
3061301    0.0  0.0 0.0  24
*
*
*
*
******************************************
*          PORV  PIPING                  *
******************************************
*
*
*
```

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```
5000000   "PORVB"   PIPE
5000001   16
5000101   0.05132   16    *  3 IN  SCH40S
5000301   0.497   3
5000302   0.556   6
*      ARC STARTS LEVEL 684' 9"
5000303   0.365      7   *
5000304   0.6448   13
5000305   0.53217     16
5000401   0.0   16
5000601   0.0     3
5000602   -90.0   6
5000603   0.0     16
5000801   0.000153   0.0   16
5000901   0.0        0.0         2
5000902   0.2088   0.2088    3
5000903   0.0        0.0         5
5000904   0.2088   0.2088    6
5000905   0.0        0.0        15
5001001   00   16
5001101   1000   15
5001201   4   17.7   120.0   0.93424   0.0   16
5001300   1
5001301   0.0   0.0   0.0   15
*
5010000   "PORVB"   SNGLJUN   *   THIS JUNCTION IS ON ARC B
5010101   500010000   502000000   0.0   0.0   0.0   1000
5010201   1   0.0 0.0 0.0 0.0
*
5020000   "PORVB"   PIPE   * REDUCER ON ARC B 3IN X4IN
5020001   2
5020101   0.05132     1    *   3IN SCH40S
5020102   0.08840     2    *   4IN SCH40S
5020301   0.3385    1
5020302   0.511      2
5020401   0.0   2
5020601   0.0   2
5020801   0.000153   0.0   1
5020802   0.000134   0.0   2
5020901   0.0544   0.0399   1
5021001   00   2
5021101   1000   1
5021201   4   17.7   120.0 0.93424   0.0   2
5021300   1
5021301   0.0   0.0   0.0   1
*
*
5030000   "PORVB"   SNGLJUN   * ON ARC B
5030101   502010000   504000000   0.0   0.0   0.0   1000
5030201   1   0.0   0.0   0.0
*
5040000   "PORVB"   BRANCH   *   ON ARC B @ 242
5040001   0
5040101   0.0884   0.361 0.0   0.0   0.0   0.0   0.000134   0.0   00
5040200   4   17.7   120.0   0.93424   0.0   0.0
*
5050000   "PORVB"   SNGLJUN     * ON ARC B
5050101   504010000   506000000   0.0   0.0   0.0   1000
```

```
5050201   1  0.0  0.0  0.0
*
5060000   "PORVB" PIPE   *  ON ARC B
5060001   9
5060101   0.0884   9
5060301   0.6211   8
5060302   0.6398    9
5060401   0.0  9
5060601   0.0  9
5060801   0.000134  0.0  9
5060901   0.0  0.0  8
5061001   00  9
5061101   1000  8
5061201   4  17.7  120.0  0.93424  0.0  9
5061300   1
5061301   0.0  0.0  0.0  8
*
5070000   "PORVB"  SNGLJUN
5070101   506010000  508000000  0.0  0.0  0.0  1000
5070201   1  0.0  0.0  0.0
*
5080000   "PORVB" PIPE  *  REDUCER ON ARC B 4IN X 8IN
5080001   2
5080101   0.0884  1
5080102   0.20069   2
5080301   0.5792  2
5080401   0.0  2
5080601   0.0  2
5080801   0.000134  0.0  1
5080802   0.000152  0.0  2
5080901   0.1483  0.0815  1
5081001   00  2
5081101   1000  1
5081201   4  17.7  120.0  0.93424  0.0  2
5081300   1
5081301   0.0  0.0  0.0  1
*
5090000   "PORVB" SNGLJUN   * ON ARC B
5090101   508010000  510000000  0.0  0.0  0.0 1000
5090201   1  0.0  0.0  0.0
*
5100000   "PORVB" BRANCH   * ON ARC B @ 232
5100001   0
5100101   0.20069 0.75  0.0  0.0  0.0  0.0  0.000152  0.0  00
5100200   4  17.7  120.0  0.93424  0.0  0.0
*
5110000   "PORVB" SNGLJUN   *  ON ARC B
5110101   510010000  700000000    0.0  0.0 0.0  1000
5110201   1  0.0  0.0  0.0
*
4000000   "PORVA"  PIPE   * 3IN SCH40S
4000001   8
4000101   0.05132   8
4000301   0.4141    4
4000302   0.4375    8
4000401   0.0  8
4000601   0.0  4
4000602   -90.0  8
```

```
4000801   0.000153  0.0  8
4000901   0.0  0.0  3
4000902   0.2088  0.2088  4
4000903   0.0  0.0  7
4001001   00  8
4001101   1000  7
4001201   4  17.7  120.0  0.93424  0.0  8
4001300   1
4001301   0.0  0.0  0.0  7
*
4010000   "PORVAB" SNGLJUN
4010101   400010000  510000000   0.0  0.1800  0.1800  1000
4010201   1  0.0  0.0  0.0
*
6000000   "PORVC"  PIPE
6000001   7
6000101   0.05132 7  * 3IN SCH40
6000301   0.4722    3
6000302   0.4375    7
6000401   0.0  7
6000601   0.0  3
6000602   -90.0  7
6000801   0.000153  0.0  7
6000901   0.0  0.0  2
6000902   0.2088  0.2088  3
6000903   0.0  0.0  6
6001001   00  7
6001101   1000  6
6001201   4  17.7  120.0  0.93424  0.0  7
6001300   1
6001301   0.0  0.0  0.0  6
*
6010000   "PORVBC" SNGLJUN
6010101   600010000  504000000  0.0  0.1832  0.1832  1000
6010201   1  0.0  0.0  0.0
*
7000000   "PORVBD"  PIPE   *  DOWNSTREAM OF ARCS
7000001   12
7000101   0.20069   12
7000301   0.50  2
7000302   1.0333   12
7000401   0.0  12
7000601   0.0   2
7000602   -90.  12
7000801   0.000152  0.0   12
7000901   0.0    0.0    1
7000902   0.1800  0.1800  2
7000903   0.0       0.0      11
7001001   00   12
7001101   1000   11
7001201   4  17.7  120.0  0.93424  0.0  12
7001300   1
7001301   0.0  0.0  0.0  11
*
7010000   "PORVD"  SNGLJUN
7010101   700010000  702000000  0.0  0.0  0.0  1000
7010201   1  0.0  0.0  0.0
*
```

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```
*
*
*
*
*****************************************************
**                                                 **
**          MAIN ARC CONNECTIONS                   **
**                                                 **
*****************************************************
*
*
*
*
7020000   "PORVD"  PIPE   * REDUCER 6 X12IN ABOVE SRV ARCS INTERSECTION W/ DISCH
7020001   3
7020101   0.20069  1
7020102   .77708   3
7020301   0.75  1
7020302   0.5833  3
7020401   0.0  3
7020601   -90.0  3
7020801   0.000152  0.0  1
7020802   0.000169  0.0  3
7020901   0.4930  0.2045  1
7020902   0.0       0.0      2
7021001   00  3
7021101   1000  2
7021201   4  17.7  120.0  0.93424  0.0  3
7021300   1
7021301   0.0  0.0  0.0  2
*
8000000   "PORVD"  SNGLJUN
8000101   702010000  801000000  0.0  0.0  0.0  1000
8000201   1  0.0  0.0  0.0
*
3070000   "PORVD3"  SNGLJUN
3070101   306010000  801000000  0.0  0.156  0.156  1000 * 12 IN ELBOW LOSSES
3070201   1  0.0  0.0  0.0
*
8010000   "PORVD"  BRANCH   *  CONNECTS ARC3 W/ DISCH
8010001   0
8010101   0.77708  0.5  0.0  0.0  -90.  -0.5  0.000169  0.0  00
8010200   4  17.7  120.0  0.93424  0.0 0.0
*
8020000   "PORVD"  SNGLJUN
8020101   801010000  803000000  0.0  0.0  0.0  1000
8020201   1  0.0  0.0 0.0
*
8030000   "PORVD"  SNGLVOL
8030101   0.77708  1.1667  0.0  0.0 -90.  -1.1667  0.000169  0.0  00
8030200   4  17.7  120.0 0.93424  0.0  0.0
*
8040000   "PORVD"  SNGLJUN
8040101   803010000  805000000  0.0  0.0  0.0 1000
8040201   1  0.0  0.0  0.0
*
2070000   "PORVD"  SNGLJUN
```


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```
2070101   206010000  805000000  0.0  0.156  0.156  1000 * 12 IN ELBOW LOSSES
2070201   1  0.0  0.0  0.0
*
8050000   "PORVD"  BRANCH   * CONNECTS  ARC2 W/ DISCH
8050001   0
8050101   0.77708  0.5  0.0  0.0  -90.  -0.5  0.000169 0.0 00
8050200   4  17.7  120.0  0.93424  0.0  0.0
*
8060000   "PORVD"  SNGLJUN
8060101   805010000  807000000   0.0  0.0  0.0  1000
8060201   1  0.0  0.0  0.0
*
8070000   "PORVD"  SNGLVOL
8070101   0.77708  1.1667 0.0 0.0 -90. -1.1667 0.000169 0.0 00
8070200   4  17.7  120.0  0.93424  0.0  0.0
*
8080000   "PORVD"  SNGLJUN
8080101   807010000  809000000  0.0  0.0  0.0  1000
8080201   1  0.0  0.0  0.0
*
9000000  "QTANKD"  SNGLJUN
9000101  813010000  901000000  0.0  0.1560  0.1560  1000
9000201  1  0.0  0.0  0.0
*
9010000  "QTANKD"  PIPE
9010001  2
9010101  0.77708  2
9010301  1.02083  2
9010401  0.0  2
9010601  -90.0  2
9010801  0.000169  0.0  2
9010901  0.0  0.0  1
9011001  00  2
9011101  1000  1
9011201  4  17.7  120.0  0.93424  0.0  2
9011300  1
9011301  0.0  0.0  0.0  1
*
*************************
**                     **
**    QUENCH   TANK    **
**                     **
*************************
*
9020000   "QTANK-IN"  SNGLJUN
9020101   901010000  903000000  0.  0.  0.   1000
9020201   1   0.  0.   0.
**
*   SPARGER  12 IN SCH40  PIPE
**
9030000   "SPARGER"  PIPE
*    NO OF VOLUMES
9030001   18
*    FLOW AREA
9030101   0.7773      18
*    VOL. LENGTHS
9030301   1.125       2
9030302   1.1333      7
```

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```
9030303   1.0        18
*     VOL. VOLS.
9030401   0.0        18
*
*     VERTICAL ANGLES
9030601  -90.         7
9030602   0.0        18
*     PIPE  ROUGHNESS
9030801   1.69-4     0.0        18
*     JUNCTION  LOSS COEFF.
9030901   0.0        0.0        6
9030902   0.156      0.156      7
9030903   0.0        0.0        17
*     VOL. CONTROL FLAG
9031001   00         18
*     JUN. CONTROL FLAG
9031101   1000       17
*     INITIAL COND.
9031201   4    17.7    120.    0.93424    0.   2
9031202   3    17.7    120.    0.0        0.   18
*          JUN. INITIAL COND.
9031300   1
9031301   0.0  0.0  0.0       17
**
*     SPARGER   EXIT
**
9040000 "EXIT" SNGLJUN
9040101   903010000   905000000    0.0    1.0    1.0    1000
9040201   1    0.    0.    0.
**
*          WATER  VOL.
**
9050000   "QT. WATER" SNGLVOL
9050101   260.4706   5.6667   0.0   0.0   90.   5.6667  0.003  0.0   01
9050200   3    17.7       120.
**
*          INTERFACE
**
9060000   "INTERFACE"  SNGLJUN
9060101   905010000  907000000   0.0    0.0    0.0    1000
9060201   1    0.0  0.0  0.0
**
*          AIR  VOLUME
**
9070000   "QT.AIR"   SNGLVOL
9070101   260.4706   1.2439    0.0   0.0   90.   1.2439  0.003  0.0  01
9070200   4    17.7    120.    0.93424
**
*          RUPTURE DISC
**
9080000   "RUP.DISC"   VALVE
9080101   907010000    999000000     1.77  0.   0.    1100
9080201   1    0.    0.    0.
9080300   TRPVLV
9080301   501          *     VALVE OPENING TRIP
**
*     PIPE  OUTSIDE  ENVIRONMENT
**
```

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```
9990000   "ATMOSPHERE"   TMDPVOL
9990101   10000.   10000.   0.0  0.0  0.0  0.0  .00001  0.0  11
9990200   4
9990201   0.0  14.7  120.  0.91907
*
*
*
*
*         ***************************
*         *                          *
*         *        PLOT   CARDS      *
*         *                          *
*         ***************************
*
*
*
20300100  MFLOWJ   105000000
20300200  MFLOWJ   205000000
20300300  MFLOWJ   305000000
20300400  MFLOWJ   700010000
20300500  MFLOWJ   811140000
20300600  MFLOWJ   811790000
20300700  MFLOWJ   307000000
20300800  MFLOWJ   207000000
20300900  MFLOWJ   107000000
20301000  MFLOWJ   900000000
*
20301100  QUALS   102020000
20301200  QUALS   202020000
20301300  QUALS   302020000
20301400  QUALS   104200000
20301500  QUALS   204200000
20301600  QUALS   304200000
20301700  QUALS   811140000
20301800  QUALS   811790000
20301900  QUALS   106010000
20302000  QUALS   106390000
20302100  QUALS   206010000
20302200  QUALS   206330000
20302300  QUALS   306010000
20302400  QUALS   306250000
20302500  QUALS   903030000
20302600  QUALS   903180000
*
20302700  P        102020000
20302800  P        202020000
20302900  P        302020000
20303000  P        104200000
20303100  P        204200000
20303200  P        304200000
20303300  P        811140000
20303400  P        811790000
20303500  P        106010000
20303600  P        106390000
20303700  P        206010000
20303800  P        206330000
20303900  P        306010000
20304000  P        306250000
```


COPI

```
985   20304100  P       903020000
986   20304200  P       903030000
987   20304300  P       903180000
988   *
989   *
990   *
991   *
992   *
993   *
994   .END OF CASE
```

4.8 REPIPE Input

These are input listings of Control Data Corporation's RELAP post-processor, REPIPE. Each set represents direction cosines of the RELAP model as well as structural node assignments. On the Unit 2 SV model, it was necessary to break up the model in two sections, of approximately equal size, because of REPIPE's size limitations.

Input Set	Model Section
4.8.1	A
4.8.2	B

4.8.1 REPIPE Input - Section A

```
$PI
INLI   3,KBLOCK=300,KPIPE=13,KPLOT(1)=0,KWAVE=1,
KPRINT=-1,KPNV=1,KSTEP=3,
NDROPV=700020000,306250000,206330000,106390000,903080000$
224    700020000  0.0 -1.0  0.0/
224    700030000  0.0 -1.0  0.0/
224    700040000  0.0 -1.0  0.0/
224    700050000  0.0 -1.0  0.0/
224    700060000  0.0 -1.0  0.0/
224    700070000  0.0 -1.0  0.0/
224    700080000  0.0 -1.0  0.0/
224    700090000  0.0 -1.0  0.0/
224    700100000  0.0 -1.0  0.0/
224    700110000  0.0    -1.0    0.0/
224    701000000  0.0 -1.0  0.0/
224    702010000  0.0 -1.0  0.0/
224    702020000  0.0 -1.0  0.0/
224    800000000  0.0 -1.0  0.0/
224    307000000  0.0    -1.0    0.0/
224    802000000  0.0 -1.0  0.0/
224    804000000  0.0 -1.0  0.0/
224     207000000  0.0    -1.0    0.0/
224    806000000  0.0 -1.0  0.0/
224    808000000  0.0 -1.0  0.0/
224    107000000  0.0    -1.0    0.0/
224    810000000  0.0 -1.0  0.0/
224    811010000  0.0 -1.0  0.0/
224    811020000  0.0 -1.0  0.0/
224    811030000  0.0 -1.0  0.0/
224    811040000  0.0 -1.0  0.0/
224    811050000  0.0 -1.0  0.0/
224    811060000  0.0 -1.0  0.0/
224    811070000  0.0 -1.0  0.0/
224    811080000  0.0 -1.0  0.0/
224    811090000  0.0 -1.0  0.0/
224    811100000  0.0 -1.0  0.0/
224    811110000  0.0 -1.0  0.0/
224    811120000  0.0 -1.0  0.0/
224    811130000  0.0 -1.0  0.0/
68    -700030000  0.0 -1.0  0.0/
68    -700040000  0.0 -1.0  0.0/
68    -700050000  0.0 -1.0  0.0/
68    -700060000  0.0 -1.0  0.0/
68    -700070000  0.0 -1.0  0.0/
68    -700080000  0.0 -1.0  0.0/
68    -700090000  0.0 -1.0  0.0/
68    -700100000  0.0 -1.0  0.0/
68    -700110000  0.0    -1.0    0.0/
68    -701000000  0.0 -1.0  0.0/
68    -702010000  0.0 -1.0  0.0/
68    -702020000  0.0 -1.0  0.0/
68    -800000000  0.0 -1.0  0.0/
68    -802000000  0.0 -1.0  0.0/
68    -804000000  0.0 -1.0  0.0/
68    -806000000  0.0 -1.0  0.0/
68    -808000000  0.0 -1.0  0.0/
68    -810000000  0.0 -1.0  0.0/
68    -811010000  0.0 -1.0  0.0/
68    -811020000  0.0 -1.0  0.0/
68    -811030000  0.0 -1.0  0.0/
68    -811040000  0.0 -1.0  0.0/
68    -811050000  0.0 -1.0  0.0/
68    -811060000  0.0 -1.0  0.0/
COPI
```

BY KJG DATE 6·23·83

CHKD. BY CMM DATE 6·29·83

68	[illegible]1070000	0.0	-1.0	0.0/
68	[illegible]1080000	0.0	-1.0	0.0/
68	-811090000	0.0	-1.0	0.0/
68	-811100000	0.0	-1.0	0.0/
68	-811110000	0.0	-1.0	0.0/
68	-811120000	0.0	-1.0	0.0/
68	-811130000	0.0	-1.0	0.0/
68	-811140000	0.0	-1.0	0.0/
66	811140000	-.236	-.707	.667/
66	811150000	-.236	-.707	.667/
66	811160000	-.236	-.707	.667/
66	811170000	-.236	-.707	.667/
64	-811150000	-.236	-.707	.667/
64	-811160000	-.236	-.707	.667/
64	-811170000	-.236	-.707	.667/
64	-811180000	-.236	-.707	.667/
62	811180000	0.0	-1.0	0.0/
62	811190000	0.0	-1.0	0.0/
62	811200000	0.0	-1.0	0.0/
62	811210000	0.0	-1.0	0.0/
58	-811190000	0.0	-1.0	0.0/
58	-811200000	0.0	-1.0	0.0/
58	-811210000	0.0	-1.0	0.0/
58	-811220000	0.0	-1.0	0.0/
56	811220000	.236	-.707	-.667/
56	811230000	.236	-.707	-.667/
56	811240000	.236	-.707	-.667/
56	811250000	.236	-.707	-.667/
54	-811230000	.236	-.707	-.667/
54	-811240000	.236	-.707	-.667/
54	-811250000	.236	-.707	-.667/
54	-811260000	.236	-.707	-.667/
52	811260000	0.0	-1.0	0.0/
52	811270000	0.0	-1.0	0.0/
52	811280000	0.0	-1.0	0.0/
52	811290000	0.0	-1.0	0.0/
52	811300000	0.0	-1.0	0.0/
52	811310000	0.0	-1.0	0.0/
52	811320000	0.0	-1.0	0.0/
52	811330000	0.0	-1.0	0.0/
52	811340000	0.0	-1.0	0.0/
52	811350000	0.0	-1.0	0.0/
52	811360000	0.0	-1.0	0.0/
52	811370000	0.0	-1.0	0.0/
52	811380000	0.0	-1.0	0.0/
52	811390000	0.0	-1.0	0.0/
52	811400000	0.0	-1.0	0.0/
52	811410000	0.0	-1.0	0.0/
52	811420000	0.0	-1.0	0.0/
52	811430000	0.0	-1.0	0.0/
52	811440000	0.0	-1.0	0.0/
52	811450000	0.0	-1.0	0.0/
52	811460000	0.0	-1.0	0.0/
52	811470000	0.0	-1.0	0.0/
52	811480000	0.0	-1.0	0.0/
52	811490000	0.0	-1.0	0.0/
52	811500000	0.0	-1.0	0.0/
52	811510000	0.0	-1.0	0.0/
52	811520000	0.0	-1.0	0.0/
52	811530000	0.0	-1.0	0.0/
52	811540000	0.0	-1.0	0.0/
52	811550000	0.0	-1.0	0.0/
46	-811270000	0.0	-1.0	0.0/

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46	[illegible]280000	0.0	-1.0	0.0/
46	[illegible]1290000	0.0	-1.0	0.0/
46	-811300000	0.0	-1.0	0.0/
46	-811310000	0.0	-1.0	0.0/
46	-811320000	0.0	-1.0	0.0/
46	-811330000	0.0	-1.0	0.0/
46	-811340000	0.0	-1.0	0.0/
46	-811350000	0.0	-1.0	0.0/
46	-811360000	0.0	-1.0	0.0/
46	-811370000	0.0	-1.0	0.0/
46	-811380000	0.0	-1.0	0.0/
46	-811390000	0.0	-1.0	0.0/
46	-811400000	0.0	-1.0	0.0/
46	-811410000	0.0	-1.0	0.0/
46	-811420000	0.0	-1.0	0.0/
46	-811430000	0.0	-1.0	0.0/
46	-811440000	0.0	-1.0	0.0/
46	-811450000	0.0	-1.0	0.0/
46	-811460000	0.0	-1.0	0.0/
46	-811470000	0.0	-1.0	0.0/
46	-811480000	0.0	-1.0	0.0/
46	-811490000	0.0	-1.0	0.0/
46	-811500000	0.0	-1.0	0.0/
46	-811510000	0.0	-1.0	0.0/
46	-811520000	0.0	-1.0	0.0/
46	-811530000	0.0	-1.0	0.0/
46	-811540000	0.0	-1.0	0.0/
46	-811550000	0.0	-1.0	0.0/
46	-811560000	0.0	-1.0	0.0/
44	811560000	0.0	0.0	-1.0/
44	811570000	0.0	0.0	-1.0/
44	811580000	0.0	0.0	-1.0/
44	811590000	0.0	0.0	-1.0/
44	811600000	0.0	0.0	-1.0/
44	811610000	0.0	0.0	-1.0/
44	811620000	0.0	0.0	-1.0/
44	811630000	0.0	0.0	-1.0/
44	811640000	0.0	0.0	-1.0/
44	811650000	0.0	0.0	-1.0/
42	-811570000	0.0	0.0	-1.0/
42	-811580000	0.0	0.0	-1.0/
42	-811590000	0.0	0.0	-1.0/
42	-811600000	0.0	0.0	-1.0/
42	-811610000	0.0	0.0	-1.0/
42	-811620000	0.0	0.0	-1.0/
42	-811630000	0.0	0.0	-1.0/
42	-811640000	0.0	0.0	-1.0/
42	-811650000	0.0	0.0	-1.0/
42	-811660000	0.0	0.0	-1.0/
40	811660000	.259	0.0	-.966/
40	811670000	.259	0.0	-.966/
40	811680000	.259	0.0	-.966/
40	811690000	.259	0.0	-.966/
40	811700000	.259	0.0	-.966/
40	811710000	.259	0.0	-.966/
40	811720000	.259	0.0	-.966/
40	811730000	.259	0.0	-.966/
40	811740000	.259	0.0	-.966/
40	811750000	.259	0.0	-.966/
40	811760000	.259	0.0	-.966/
40	811770000	.259	0.0	-.966/
40	811780000	.259	0.0	-.966/
38	-811670000	.259	0.0	-.966/

COPI

38	[illegible]680000	.259	0.0	-.966/
38	[illegible]690000	.259	0.0	-.966/
38	-811700000	.259	0.0	-.966/
38	-811710000	.259	0.0	-.966/
38	-811720000	.259	0.0	-.966/
38	-811730000	.259	0.0	-.966/
38	-811740000	.259	0.0	-.966/
38	-811750000	.259	0.0	-.966/
38	-811760000	.259	0.0	-.966/
38	-811770000	.259	0.0	-.966/
38	-811780000	.259	0.0	-.966/
38	-811790000	.259	0.0	-.966/
36	811790000	1.0	0.0	0.0/
36	811800000	1.0	0.0	0.0/
36	811810000	1.0	0.0	0.0/
36	811820000	1.0	0.0	0.0/
36	811830000	1.0	0.0	0.0/
36	811840000	1.0	0.0	0.0/
36	811850000	1.0	0.0	0.0/
36	811860000	1.0	0.0	0.0/
34	-811800000	1.0	0.0	0.0/
34	-811810000	1.0	0.0	0.0/
34	-811820000	1.0	0.0	0.0/
34	-811830000	1.0	0.0	0.0/
34	-811840000	1.0	0.0	0.0/
34	-811850000	1.0	0.0	0.0/
34	-811860000	1.0	0.0	0.0/
34	-811870000	1.0	0.0	0.0/
33	811870000	0.0	-1.0	0.0/
33	811880000	0.0	-1.0	0.0/
33	811890000	0.0	-1.0	0.0/
33	811900000	0.0	-1.0	0.0/
33	811910000	0.0	-1.0	0.0/
33	811920000	0.0	-1.0	0.0/
33	811930000	0.0	-1.0	0.0/
33	811940000	0.0	-1.0	0.0/
28	-811880000	0.0	-1.0	0.0/
28	-811890000	0.0	-1.0	0.0/
28	-811900000	0.0	-1.0	0.0/
28	-811910000	0.0	-1.0	0.0/
28	-811920000	0.0	-1.0	0.0/
28	-811930000	0.0	-1.0	0.0/
28	-811940000	0.0	-1.0	0.0/
28	-811950000	0.0	-1.0	0.0/
26	811950000	1.0	0.0	0.0/
26	811960000	1.0	0.0	0.0/
26	811970000	1.0	0.0	0.0/
26	811980000	1.0	0.0	0.0/
26	812000000	1.0	0.0	0.0/
26	813010000	1.0	0.0	0.0/
26	813020000	1.0	0.0	0.0/
26	813030000	1.0	0.0	0.0/
26	813040000	1.0	0.0	0.0/
26	813050000	1.0	0.0	0.0/
20	-811960000	1.0	0.0	0.0/
20	-811970000	1.0	0.0	0.0/
20	-811980000	1.0	0.0	0.0/
20	-812000000	1.0	0.0	0.0/
20	-813010000	1.0	0.0	0.0/
20	-813020000	1.0	0.0	0.0/
20	-813030000	1.0	0.0	0.0/
20	-813040000	1.0	0.0	0.0/
20	-813050000	1.0	0.0	0.0/

COPI

20	[illegible]060000	1.0	0.0	0.0/
18	[illegible]3060000	0.0	0.0	1.0/
18	813070000	0.0	0.0	1.0/
18	813080000	0.0	0.0	1.0/
18	813090000	0.0	0.0	1.0/
18	813100000	0.0	0.0	1.0/
18	813110000	0.0	0.0	1.0/
18	813120000	0.0	0.0	1.0/
18	813130000	0.0	0.0	1.0/
18	813140000	0.0	0.0	1.0/
18	813150000	0.0	0.0	1.0/
18	813160000	0.0	0.0	1.0/
18	813170000	0.0	0.0	1.0/
18	813180000	0.0	0.0	1.0/
18	813190000	0.0	0.0	1.0/
12	-813070000	0.0	0.0	1.0/
12	-813080000	0.0	0.0	1.0/
12	-813090000	0.0	0.0	1.0/
12	-813100000	0.0	0.0	1.0/
12	-813110000	0.0	0.0	1.0/
12	-813120000	0.0	0.0	1.0/
12	-813130000	0.0	0.0	1.0/
12	-813140000	0.0	0.0	1.0/
12	-813150000	0.0	0.0	1.0/
12	-813160000	0.0	0.0	1.0/
12	-813170000	0.0	0.0	1.0/
12	-813180000	0.0	0.0	1.0/
12	-813190000	0.0	0.0	1.0/
12	-813200000	0.0	0.0	1.0/
10	813200000	-1.0	0.0	0.0/
10	813210000	-1.0	0.0	0.0/
10	813220000	-1.0	0.0	0.0/
10	813230000	-1.0	0.0	0.0/
10	813240000	-1.0	0.0	0.0/
10	813250000	-1.0	0.0	0.0/
10	813260000	-1.0	0.0	0.0/
10	813270000	-1.0	0.0	0.0/
10	813280000	-1.0	0.0	0.0/
10	813290000	-1.0	0.0	0.0/
6	-813210000	-1.0	0.0	0.0/
6	-813220000	-1.0	0.0	0.0/
6	-813230000	-1.0	0.0	0.0/
6	-813240000	-1.0	0.0	0.0/
6	-813250000	-1.0	0.0	0.0/
6	-813260000	-1.0	0.0	0.0/
6	-813270000	-1.0	0.0	0.0/
6	-813280000	-1.0	0.0	0.0/
6	-813290000	-1.0	0.0	0.0/
6	-900000000	-1.0	0.0	0.0/
4	900000000	0.0	-1.0	0.0/
4	901010000	0.0	-1.0	0.0/
4	902000000	0.0	-1.0	0.0/
4	903010000	0.0	-1.0	0.0/
4	903020000	0.0	-1.0	0.0/
4	903030000	0.0	-1.0	0.0/
4	903040000	0.0	-1.0	0.0/
4	903050000	0.0	-1.0	0.0/
4	903060000	0.0	-1.0	0.0/
2	-901010000	0.0	-1.0	0.0/
2	-902000000	0.0	-1.0	0.0/
2	-903010000	0.0	-1.0	0.0/
2	-903020000	0.0	-1.0	0.0/
2	-903030000	0.0	-1.0	0.0/

COP1

```
2   [illegible]0000   0.0   -1.0   0.0/
2   [illegible]50000   0.0   -1.0   0.0/
2   -903060000   0.0   -1.0   0.0/
2   -903070000   0.0   -1.0   0.0/
99999/
 $STEPS TSTEP(1)=0.001,0.500,-1,-1$
```

4.8.2 REPIPE Input - Section B

```
$P
INLINE=3,KBLOCK=300,KPIPE=13,KPLOT(1)=0,KWAVE=1,
KPRINT=-1,KPNV=1,KSTEP=3,
NDROPV=700030000,100010000,
809010000,200010000,805010000,300010000,801010000$
218    301000000   .4044  .7193  .5648/
216   -302010000   .4044  .7193  .5648/
214    302010000   .582  0.0  .813/
214    302020000   .582  0.0  .813/
212   -302020000   .582  0.0  .813/
212   -303000000   .582  0.0  .813/
210    303000000   0.0 -1.0  0.0/
210    304010000   0.0 -1.0  0.0/
210    304020000   0.0 -1.0  0.0/
210    304030000   0.0 -1.0  0.0/
210    304040000   0.0 -1.0  0.0/
210    304050000   0.0 -1.0  0.0/
210    304060000   0.0 -1.0  0.0/
208   -304010000   0.0 -1.0  0.0/
208   -304020000   0.0 -1.0  0.0/
208   -304030000   0.0 -1.0  0.0/
208   -304040000   0.0 -1.0  0.0/
208   -304050000   0.0 -1.0  0.0/
208   -304060000   0.0 -1.0  0.0/
208   -304070000   0.0 -1.0  0.0/
206    304070000  -.896  0.0  .444/
206    304080000  -.896  0.0  .444/
206    304090000  -.896  0.0  .444/
204   -304080000  -.896  0.0  .444/
204   -304090000  -.896  0.0  .444/
204   -304100000  -.896  0.0  .444/
202    304100000   0.0  1.0  0.0/
202    304110000   0.0  1.0  0.0/
202    304120000   0.0  1.0  0.0/
202    304130000   0.0  1.0  0.0/
202    304140000   0.0  1.0  0.0/
202    304150000   0.0  1.0  0.0/
202    304160000   0.0  1.0  0.0/
202    304170000   0.0  1.0  0.0/
202    304180000   0.0  1.0  0.0/
202    304190000   0.0  1.0  0.0/
200   -304110000   0.0  1.0  0.0/
200   -304120000   0.0  1.0  0.0/
200   -304130000   0.0  1.0  0.0/
200   -304140000   0.0  1.0  0.0/
200   -304150000   0.0  1.0  0.0/
200   -304160000   0.0  1.0  0.0/
200   -304170000   0.0  1.0  0.0/
200   -304180000   0.0  1.0  0.0/
200   -304190000   0.0  1.0  0.0/
200   -305000000   0.0  1.0  0.0/
198    305000000  -.997  0.0  .071/
198    306010000  -.997  0.0  .071/
198    306020000  -.997  0.0  .071/
198    306030000  -.997  0.0  .071/
195   -306010000  -.997  0.0  .071/
195   -306020000  -.997  0.0  .071/
195   -306030000  -.997  0.0  .071/
195   -306040000  -.997  0.0  .071/
190    306040000   0.0 -1.0  0.0/
190    306050000   0.0 -1.0  0.0/
190    306060000   0.0 -1.0  0.0/
190    306070000   0.0 -1.0  0.0/
```

BY KJG DATE 6-27-83
CHKD. BY CMM DATE 6-30-83

```
190  [illegible]8080000   0.0 -1.0  0.0/
190  [illegible]06090000  0.0 -1.0  0.0/
190    306100000   0.0 -1.0  0.0/
190    306110000   0.0 -1.0  0.0/
186   -306050000   0.0 -1.0  0.0/
186   -306060000   0.0 -1.0  0.0/
186   -306070000   0.0 -1.0  0.0/
186   -306080000   0.0 -1.0  0.0/
186   -306090000   0.0 -1.0  0.0/
186   -306100000   0.0 -1.0  0.0/
186   -306110000   0.0 -1.0  0.0/
186   -306120000   0.0 -1.0  0.0/
184    306120000  -.935  0.0 -.352/
184    306130000  -.935  0.0 -.352/
184    306140000  -.935  0.0 -.352/
18201 -306130000  -.935  0.0 -.352/
18201 -306140000  -.935  0.0 -.352/
18201 -306150000  -.935  0.0 -.352/
18202  306150000  -.635  0.0 -.772/
18202  306160000  -.635  0.0 -.772/
18202  306170000  -.635  0.0 -.772/
18001 -306160000  -.635  0.0 -.772/
18001 -306170000  -.635  0.0 -.772/
18001 -306180000  -.635  0.0 -.772/
18002  306180000  -.052  0.0 -.9987/
18002  306190000  -.052  0.0 -.9987/
18002  306200000  -.052  0.0 -.9987/
17801 -306190000  -.052  0.0 -.9987/
17801 -306200000  -.052  0.0 -.9987/
17801 -306210000  -.052  0.0 -.9987/
17802  306210000   .264  0.0 -.9645/
17802  306220000   .264  0.0 -.9645/
17802  306230000   .264  0.0 -.9645/
17802  306240000   .264  0.0 -.9645/
176   -306220000   .264  0.0 -.9645/
176   -306230000   .264  0.0 -.9645/
176   -306240000   .264  0.0 -.9645/
176   -307000000   .264  0.0 -.9645/
174    201000000   .681   .719  -.138/
172   -202010000   .681   .719  -.138/
170    202010000   .980  0.0 -.198/
170    202020000   .980  0.0 -.198/
168   -202020000   .980  0.0 -.198/
168   -203000000   .980  0.0 -.198/
166    203000000   0.0 -1.0  0.0/
166    204010000   0.0 -1.0  0.0/
166    204020000   0.0 -1.0  0.0/
166    204030000   0.0 -1.0  0.0/
166    204040000   0.0 -1.0  0.0/
166    204050000   0.0 -1.0  0.0/
166    204060000   0.0 -1.0  0.0/
164   -204010000   0.0 -1.0  0.0/
164   -204020000   0.0 -1.0  0.0/
164   -204030000   0.0 -1.0  0.0/
164   -204040000   0.0 -1.0  0.0/
164   -204050000   0.0 -1.0  0.0/
164   -204060000   0.0 -1.0  0.0/
164   -204070000   0.0 -1.0  0.0/
162    204070000   .091  0.0   .996/
162    204080000   .091  0.0   .996/
162    204090000   .091  0.0   .996/
160   -204080000   .091  0.0   .996/
160   -204090000   .091  0.0   .996/
```
COPI

160	[illegible]100000	.091	0.0	.998/
158	[illegible]100000	0.0	1.0	0.0/
158	204110000	0.0	1.0	0.0/
158	204120000	0.0	1.0	0.0/
158	204130000	0.0	1.0	0.0/
158	204140000	0.0	1.0	0.0/
158	204150000	0.0	1.0	0.0/
158	204160000	0.0	1.0	0.0/
158	204170000	0.0	1.0	0.0/
158	204180000	0.0	1.0	0.0/
158	204190000	0.0	1.0	0.0/
158	-204110000	0.0	1.0	0.0/
156	-204120000	0.0	1.0	0.0/
156	-204130000	0.0	1.0	0.0/
156	-204140000	0.0	1.0	0.0/
156	-204150000	0.0	1.0	0.0/
156	-204160000	0.0	1.0	0.0/
156	-204170000	0.0	1.0	0.0/
156	-204180000	0.0	1.0	0.0/
156	-204190000	0.0	1.0	0.0/
156	-205000000	0.0	1.0	0.0/
152	205000000	-0.4181	0.0	0.9084/
152	206010000	-0.4181	0.0	0.9084/
152	206020000	-0.4181	0.0	0.9084/
152	206030000	-0.4181	0.0	0.9084/
148	-206010000	-0.4181	0.0	0.9084/
148	-206020000	-0.4181	0.0	0.9084/
148	-206030000	-0.4181	0.0	0.9084/
148	-206040000	-0.4181	0.0	0.9084/
146	206040000	0.0	-1.0	0.0/
146	206050000	0.0	-1.0	0.0/
146	206060000	0.0	-1.0	0.0/
146	206070000	0.0	-1.0	0.0/
146	206080000	0.0	-1.0	0.0/
146	206090000	0.0	-1.0	0.0/
146	206100000	0.0	-1.0	0.0/
146	206110000	0.0	-1.0	0.0/
146	206120000	0.0	-1.0	0.0/
146	206130000	0.0	-1.0	0.0/
140	-206050000	0.0	-1.0	0.0/
140	-206060000	0.0	-1.0	0.0/
140	-206070000	0.0	-1.0	0.0/
140	-206080000	0.0	-1.0	0.0/
140	-206090000	0.0	-1.0	0.0/
140	-206100000	0.0	-1.0	0.0/
140	-206110000	0.0	-1.0	0.0/
140	-206120000	0.0	-1.0	0.0/
140	-206130000	0.0	-1.0	0.0/
140	-206140000	0.0	-1.0	0.0/
138	206140000	-.806	0.0	.591/
138	206150000	-.806	0.0	.591/
138	206160000	-.806	0.0	.591/
13601	-206150000	-.806	0.0	.591/
13601	-206160000	-.806	0.0	.591/
13601	-206170000	-.806	0.0	.591/
13602	206170000	-.9998	0.0	.0191/
13602	206180000	-.9998	0.0	.0191/
13602	206190000	-.9998	0.0	.0191/
13401	-206180000	-.9998	0.0	.0191/
13401	-206190000	-.9998	0.0	.0191/
13401	-206200000	-.9998	0.0	.0191/
13402	206200000	-.829	0.0	-.560/
13402	206210000	-.829	0.0	-.560/

com

```
13402 [illegible]0000  -.829  0.0 -.560/
13201 -[illegible]0000  -.829  0.0 -.560/
13201 -206220000  -.829  0.0 -.560/
13201 -206230000  -.829  0.0 -.560/
13202  206230000  -.422  0.0 -.907/
13202  206240000  -.422  0.0 -.907/
13202  206250000  -.422  0.0 -.907/
13001 -206240000  -.422  0.0 -.907/
13001 -206250000  -.422  0.0 -.907/
13001 -206260000  -.422  0.0 -.907/
13002  206260000   .032  0.0  .9995/
13002  206270000   .032  0.0  .9995/
13002  206280000   .032  0.0  .9995/
12801 -206270000   .032  0.0  .9995/
12801 -206280000   .032  0.0  .9995/
12801 -206290000   .032  0.0  .9995/
12802  206290000   .264  0.0 -.9645/
12802  206300000   .264  0.0 -.9645/
12802  206310000   .264  0.0 -.9645/
12802  206320000   .264  0.0 -.9645/
126   -206300000   .264  0.0 -.9645/
126   -206310000   .264  0.0 -.9645/
126   -206320000   .264  0.0 -.9645/
126   -207000000   .264  0.0 -.9645/
124    101000000  .161  .682 -.713/
122   -102010000  .161  .682 -.713/
120    102010000  .221  0.0  -.975/
120    102020000  .221  0.0  -.975/
118   -102020000  .221  0.0  -.975/
118   -103000000  .221  0.0  -.975/
116    103000000  0.0  -1.0  0.0/
116    104010000  0.0  -1.0  0.0/
116    104020000  0.0  -1.0  0.0/
116    104030000  0.0  -1.0  0.0/
116    104040000  0.0  -1.0  0.0/
116    104050000  0.0  -1.0  0.0/
116    104060000  0.0  -1.0  0.0/
114   -104010000  0.0  -1.0  0.0/
114   -104020000  0.0  -1.0  0.0/
114   -104030000  0.0  -1.0  0.0/
114   -104040000  0.0  -1.0  0.0/
114   -104050000  0.0  -1.0  0.0/
114   -104060000  0.0  -1.0  0.0/
114   -104070000  0.0  -1.0  0.0/
112    104070000  .927  0.0  .375/
112    104080000  .927  0.0  .375/
112    104090000  .927  0.0  .375/
110   -104080000  .927  0.0  .375/
110   -104090000  .927  0.0  .375/
110   -104100000  .927  0.0  .375/
108    104100000  0.0  1.0  0.0/
108    104110000  0.0  1.0  0.0/
108    104120000  0.0  1.0  0.0/
108    104130000  0.0  1.0  0.0/
108    104140000  0.0  1.0  0.0/
108    104150000  0.0  1.0  0.0/
108    104160000  0.0  1.0  0.0/
108    104170000  0.0  1.0  0.0/
108    104180000  0.0  1.0  0.0/
108    104190000  0.0  1.0  0.0/
106   -104110000  0.0  1.0  0.0/
106   -104120000  0.0  1.0  0.0/
106   -104130000  0.0  1.0  0.0/
```

[illegible]	104140000	0.0	1.0	0.0/
[illegible]	104150000	0.0	1.0	0.0/
106	-104160000	0.0	1.0	0.0/
106	-104170000	0.0	1.0	0.0/
106	-104180000	0.0	1.0	0.0/
106	-104190000	0.0	1.0	0.0/
106	-105000000	0.0	1.0	0.0/
102	105000000	.717	0.0	.697/
102	106010000	.717	0.0	.697/
102	106020000	.717	0.0	.697/
102	106030000	.717	0.0	.697/
98	-106010000	.717	0.0	.697/
98	-106020000	.717	0.0	.697/
98	-106030000	.717	0.0	.697/
98	-106040000	.717	0.0	.697/
96	106040000	0.0	-1.0	0.0/
96	106050000	0.0	-1.0	0.0/
96	106060000	0.0	-1.0	0.0/
96	106070000	0.0	-1.0	0.0/
96	106080000	0.0	-1.0	0.0/
96	106090000	0.0	-1.0	0.0/
96	106100000	0.0	-1.0	0.0/
96	106110000	0.0	-1.0	0.0/
96	106120000	0.0	-1.0	0.0/
96	106130000	0.0	-1.0	0.0/
90	-106050000	0.0	-1.0	0.0/
90	-106060000	0.0	-1.0	0.0/
90	-106070000	0.0	-1.0	0.0/
90	-106080000	0.0	-1.0	0.0/
90	-106090000	0.0	-1.0	0.0/
90	-106100000	0.0	-1.0	0.0/
90	-106110000	0.0	-1.0	0.0/
90	-106120000	0.0	-1.0	0.0/
90	-106130000	0.0	-1.0	0.0/
90	-106140000	0.0	-1.0	0.0/
88	106140000	.265	0.0	.964/
88	106150000	.265	0.0	.964/
88	106160000	.265	0.0	.964/
8601	-106150000	.265	0.0	.964/
8601	-106160000	.265	0.0	.964/
8601	-106170000	.265	0.0	.964/
8602	106170000	.389	0.0	.921/
8602	106180000	.389	0.0	.921/
8602	106190000	.389	0.0	.921/
8401	-106180000	.389	0.0	.921/
8401	-106190000	.389	0.0	.921/
8401	-106200000	.389	0.0	.921/
8402	106200000	-.846	0.0	.533/
8402	106210000	-.846	0.0	.533/
8402	106220000	-.846	0.0	.533/
8201	-106210000	-.846	0.0	.533/
8201	-106220000	-.846	0.0	.533/
8201	-106230000	-.846	0.0	.533/
8202	106230000	-.999	0.0	-.016/
8202	106240000	-.999	0.0	-.016/
8202	106250000	-.999	0.0	-.016/
8001	-106240000	-.999	0.0	-.016/
8001	-106250000	-.999	0.0	-.016/
8001	-106260000	-.999	0.0	-.016/
8002	106260000	-.829	0.0	-.559/
8002	106270000	-.829	0.0	-.559/
8002	106280000	-.829	0.0	-.559/
7801	-106270000	-.829	0.0	-.559/

```
780[illegible]3280000  -.829  0.0 -.559/
7801 [illegible]06290000  -.829  0.0 -.559/
7802   106290000  -.481  0.0 -.877/
7802   106300000  -.481  0.0 -.877/
7802   106310000  -.481  0.0 -.877/
7601  -106300000  -.481  0.0 -.877/
7601  -106310000  -.481  0.0 -.877/
7601  -108320000  -.481  0.0 -.877/
7602   106320000   .028  0.0 -.9998/
7602   106330000   .028  0.0 -.9998/
7602   106340000   .028  0.0 -.9998/
7401  -106330000   .028  0.0 -.9998/
7401  -106340000   .028  0.0 -.9998/
7401  -106350000   .028  0.0 -.9998/
7402   106350000   .264  0.0 -.965/
7402   106360000   .264  0.0 -.965/
7402   106370000   .264  0.0 -.965/
7402   106380000   .264  0.0 -.965/
72    -106360000   .264  0.0 -.965/
72    -106370000   .264  0.0 -.965/
72    -106380000   .264  0.0 -.965/
72    -107000000   .264  0.0 -.965/
346    599000000  0.3746  0.0  -0.9272/
346     600010000  .3746  0.0  -0.9272/
346     600020000  .3746  0.0  -0.9272/
344    -600010000  0.3746   0.0   -0.9272/
344    -600020000  .3746  0.0  -0.9272/
344    -600030000  .3747  0.0  -.9272/
404     600030000  0.0 -1.0  0.0/
404     600040000   0.0      -1.0     0.0/
404     600050000   0.0      -1.0     0.0/
404     600060000   0.0      -1.0     0.0/
240    -600040000  0.0 -1.0  0.0/
240     -600050000   0.0      -1.0     0.0/
240     -600060000   0.0      -1.0     0.0/
240    -601000000  0.0 -1.0  0.0/
292     399000000  -0.927   0.0    -0.3751/
292     400010000  -.927  0.0 -.375/
292     400020000  -.927  0.0 -.375/
292     400030000  -.927  0.0 -.375/
288    -400010000   -0.927   0.0   -0.3751/
288    -400020000  -.927  0.0 -.375/
288    -400030000  -.927  0.0 -.375/
288     -400040000    -.927     0.0     -.3751/
286     400040000  0.0 -1.0  0.0/
286     400050000  0.0 -1.0  0.0/
286     400060000   0.0      -1.0     0.0/
286     400070000   0.0      -1.0     0.0/
230    -400050000  0.0 -1.0  0.0/
230     -400060000   0.0      -1.0     0.0/
230     -400070000   0.0      -1.0     0.0/
230    -401000000  0.0 -1.0  0.0/
262     499000000  0.927    0.0    0.3751/
262     500010000  .927  0.0  .375/
262     500020000  .927  0.0  .375/
260    -500010000   0.927   0.0   0.3751/
260    -500020000  .927  0.0  .375/
260    -500030000  .927  0.0  .375/
257     500030000  0.0 -1.0  0.0/
257     500040000  0.0 -1.0  0.0/
257     500050000  0.0 -1.0  0.0/
252    -500040000  0.0 -1.0  0.0/
252    -500050000  0.0 -1.0  0.0/
```

```
2[illegible] -500060000  0.0 -1.0  0.0/
25[illegible] 500060000  .7559  0.0  -0.6547/
24801 -500070000  .7559  0.0  -0.6547/
24802  500070000  .7170  0.0  -0.6971/
24802  500080000  .7170  0.0  -0.6971/
24802    500090000    .7170  0.0  -0.6971/
24601 -500080000  .7170  0.0  -0.6971/
24601 -500090000  .7170  0.0  -0.6971/
24601    -500100000    .7170  0.0  -0.6971/
24602  500100000  .3736  0.0  -0.9276/
24602    500110000    .3736  0.0  -0.9276/
24602    500120000    .3736  0.0  -0.9276/
24401 -500110000  .3736  0.0  -0.9276/
24401      -500120000     .3736  0.0  -0.9276/
24401      -500130000     .3736  0.0  -0.9276/
24402  500130000  -.028  0.0  -0.9998/
24402  500140000  -.028  0.0  -0.9996/
24402  500150000   -.028   0.0   -.9998/
24402  501000000  -.028  0.0  -0.9996/
24201 -500140000  -.028  0.0  -0.9998/
24201 -500150000   -.028   0.0   -.9998/
24201 -501000000  -.028  0.0  -0.9996/
24201 -502010000  -.028  0.0  -0.9996/
24202  502010000  -.253  0.0 -.967/
24001 -503000000  -.253  0.0 -.967/
24002  503000000  -.351  0.0 -.938/
24002  601000000  -.351   0.0    -.936/
23801 -505000000  -.351  0.0 -.936/
23802  505000000  -.639  0.0 -.769/
23802  506010000  -.639  0.0 -.769/
23802  506020000  -.639  0.0 -.769/
23802    506030000    -.639   0.0   -.769/
23601 -506010000  -.639  0.0 -.769/
23601 -506020000  -.639  0.0 -.769/
23601 -506030000  -.639  0.0 -.769/
23601      -506040000     -.639   0.0 . -.769/
23602       506040000     -.958    0.0     -.288/
23602       506050000     -.958    0.0     -.288/
23602  506060000  -.958  0.0 -.288/
23602  506070000  -.958  0.0 -.288/
23401 -506050000  -.958  0.0 -.288/
23401 -506060000  -.958  0.0 -.288/
23401 -506070000    -.958   0.0    -.288/
23401 -506080000    -.958   0.0    -.288/
23402  506080000  -.9999  0.0 -.01745/
23402  507000000  -.9999  0.0 -.01745/
23402  508010000  -.9999  0.0 -.01745/
23402  509000000    -.9999   0.0    -.01745/
23402  401000000    -.9999   0.0    -.01745/
23402  511000000    -.9999   0.0    -.01745/
23402  700010000  -0.9999  0.0  -0.01745/
226 -507000000  -.9999  0.0 -.01745/
226 -508010000  -.9999  0.0 -.01745/
226 -509000000  -.9999  0.0 -.01745/
226   -511000000  -.9999  0.0 -.01745/
226   -700010000  -.9999  0.0 -.01745/
226  -700020000  -0.9999  0.0  -0.01745/
99999/
 $STEPS TSTEP(1)=0.001,0.500,-1,-1$
```


COPI

4.9 APPENDIX A

TELEDYNE ENGINEERING SERVICES

BY SM DATE 8-24-82
CHKD. BY SGC DATE 8-25-82
[illegible] 6-1-83

AMERICAN ELECTRIC POWER
DC. COOK UNITS 1 & 2
PIPE PROPERTIES

SHEET NO. 1 OF 1
PROJ. NO. 5364

PIPE PROPERTIES

SIZE	SCHEDULE	I. D. (in.)	FLOW AREA (ft^2)	FRICTION FACTOR f	ϵ/d	ROUGHNESS ϵ (ft)	* K_{ELBOW} $12f$
3"	40	3.068	.05132	.0174	.0006	1.53×10^{-4}	.2088
3"	160	2.624	.03757	.0181	.0007	1.53×10^{-4}	.2172
4"	40	4.026	.08840	.0161	.0004	1.34×10^{-4}	.1932
4"	120	3.624	.07160	.0162	.00044	1.33×10^{-4}	.1944
6"	40	6.065	.20069	.015	.0003	1.52×10^{-4}	.1800
6"	160	5.189	.14653	.0153	.00035	1.51×10^{-4}	.1836
12"	40	11.938	.77708	.013	.00017	1.69×10^{-4}	.1560

* RESISTANCE DUE TO BEND ONLY FOR 1.5d BENDS

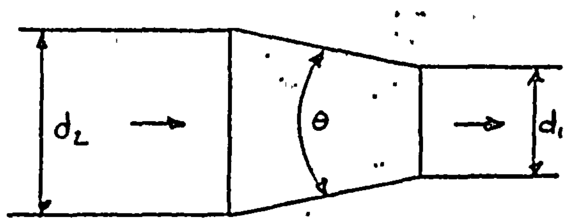
REF: CRANE TECHNICAL PAPER No. 410

TELEDYNE ENGINEERING SERVICES

BY JBM DATE 12-8-82
CHKD. BY JEV DATE 12-8-82
JBJ 6-1-83

AMERICAN ELECTRIC POWER
D.C. COOK UNITS 1 & 2
LOSSES IN REDUCERS

SHEET NO. 1 OF 1
PROJ. NO. 5364



$\beta = \frac{d_1}{d_2}$

IF : $\theta \leq 45°$

FORWARD LOSS COEFFICIENTS

$K = 0.8 \left(\sin \frac{\theta}{2}\right)(1-\beta^2)$

REVERSE LOSS COEFFICIENTS

$K = 2.6 \left(\sin \frac{\theta}{2}\right)(1-\beta^2)^2$

SIZE	d_1	d_2	β	θ	K, FORWARD	K, REVERSE
12" SCH 40 × 6" SCH 40S	6.065"	11.938"	.5080	40.3°	.2045	.4930
6" SCH 40S × 4" SCH 40S	4.026"	6.065	.6638	21°	.0815	.1483
4" SCH 40S × 3" SCH 40	3.068"	4.026"	.7620	13.66°	.0399	.0544
3" SCH 160 × 4" SCH 120	2.624"	3.624"	.7241	14.25°	.0472	.0730
4" SCH 120 × 6" SCH 160	3.624"	5.189"	.6984	16.19°	.0577	.0961
6" SCH 40S × 3" SCH 40	3.068"	6.065"	.5059	30.48°	.1565	.3784

REFERENCE: CRANE TECHNICAL PAPER 410 p. A-26

K IS TAKEN WITH RESPECT TO THE SMALLER DIAMETER PIPE.

TELEDYNE ENGINEERING SERVICES

BY JMH DATE 5-24-83
CHKD. BY [illegible] DATE 5-26-83

NON-CONDENSIBLE GAS QUALITY CALCULATION FOR INITIAL COND. UNITS 1 & 2

SHEET NO. 1 OF 1
PROJ. NO. 5364

FOR INITIAL CONDITIONS OF:

$P_T = 17.7$ psia

$T = 120°$ F $\quad$ from $P_v = 1.6924$ psia

SPECIFIC HUMIDITY $\quad \gamma = \dfrac{M_w}{M_a} = \dfrac{\text{MASS OF WATER VAPOR}}{\text{MASS OF AIR}} = \dfrac{V_a}{V_w}$

$$\gamma = \frac{R_a T / P_a}{R_w T / P_w} = 0.622 \frac{P_w}{P_a}$$

$$\gamma = 0.622 \frac{1.6924 \text{ psia}}{16.008 \text{ psia}}$$

$$\gamma = 0.06576$$

NONCONDENSIBLE GAS (AIR) QUALITY $= 1 - \gamma = 0.93424$

TELEDYNE ENGINEERING SERVICES

BY CHM DATE 7-14-83
CHKD. BY LBS DATE 7-14-83

UNIT 2 TEMPERATURE DISTRUBUTION SV MOD

THE FOLLOWING TEMPERATURE DISTRIBUTION (PAGE 5 OF 5) IS EXTRACTED FROM THE RELAP RUN FOR STRUCTURAL PURPOSES. THE PRECEDING PLOTS (1-3) SHOW TEMPERATURE VERSUS TIME AT SOME POINTS ON THE DISCHARGE TO CONFER THE TIME AT WHICH MAXIMUM TEMPERATURE VALUES OCCURED. THAT TIME WAS USED TO ESTIMATE MAXIMUMS FOR ALL OTHER POINTS ON THE DISCHARGE PIPING YIELDING THE VALUES ON PAGE 4.

THE FOLLOWING CONDITIONS APPLY TO THESES TEMPERATURES:

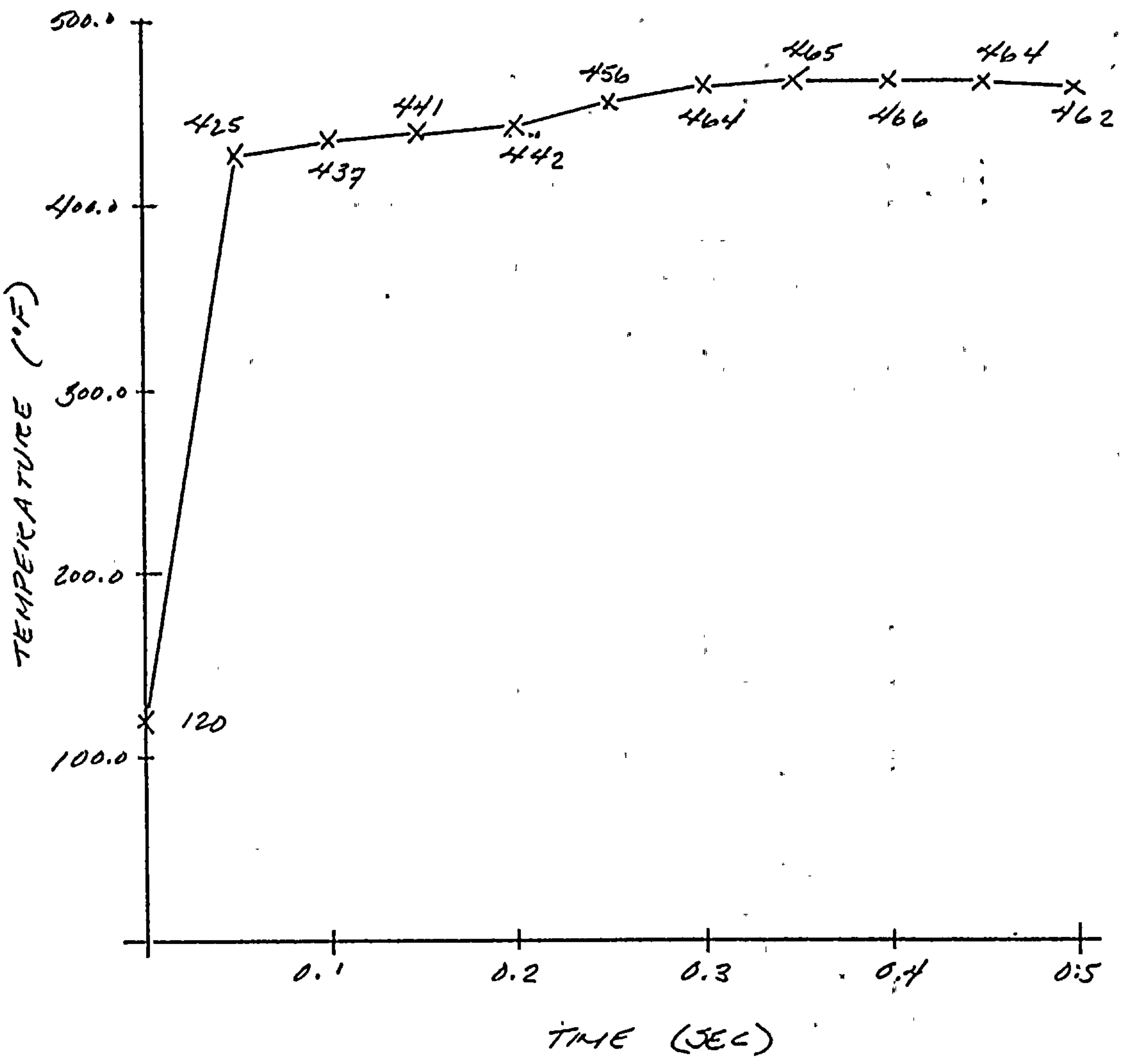
1. THESE ARE STEAM TEMPERATURES NOT PIPE WALL TEMPERATURES.
2. THE PIPE WALL TEMPERATURES WILL LAG THESE TEMPS. BY SEVERAL SECONDS.
3. THE PIPE WALL TEMPS MAY EQUAL THE STEAM TEMPS. IN MAGNITUDE BUT WILL NEVER EXCEED THESE TEMPS.
4. THE RELAP ANALYSIS ASSUMED THE PIPE WALL TO BE ADIABATIC THEREFORE THESE STEAM TEMPS. REPRESENT A CONSERVATIVE UPPER BOUND.

TELEDYNE ENGINEERING SERVICES

BY CMM DATE 7-5-83
CHKD. BY KJG DATE 7-6-83

UNIT 2 SV MODIFICATION
TEMPERATURE DISTRIBUTION

SHEET NO. 2 OF 6
PROJ. NO. 5364



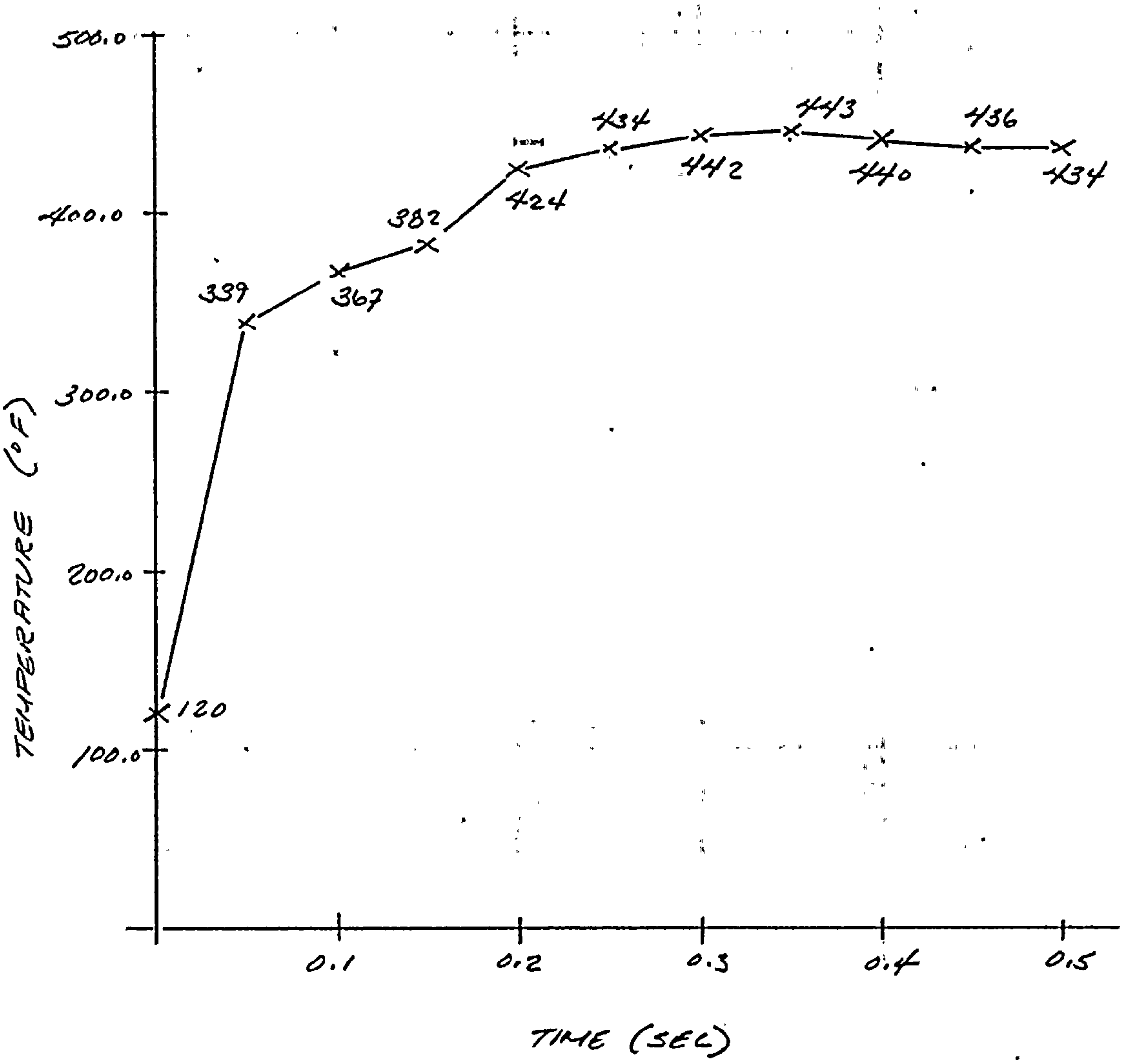
RELAP5 RUN - BHFRIHX
CONTROL VOLUME - 10601

TELEDYNE ENGINEERING SERVICES

BY CMM DATE 7-5-83
CHKD. BY BTG DATE 7-6-83

UNIT 2 SV MODIFICATION
TEMPERATURE DISTRIBUTION

SHEET NO. 3 OF 6
PROJ. NO. 5364



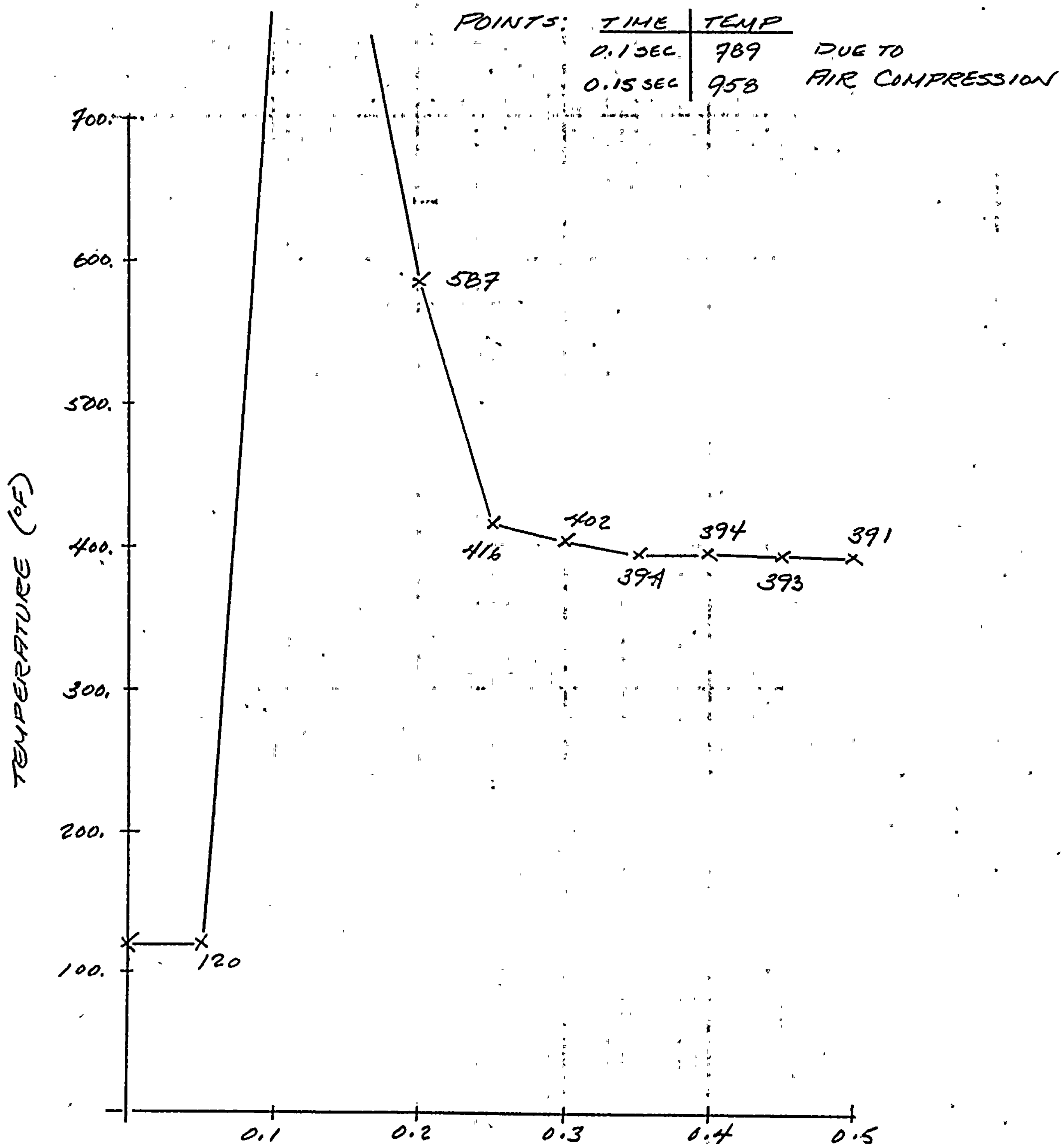
RELAP5 RUN - BHFR1HX
CONTROL VOLUME - 80901

TELEDYNE ENGINEERING SERVICES

Y CMM DATE 7-5-83
CHKD. BY KJG DATE 7-6-83

UNIT 2 SV MODIFICATION
TEMPERATURE DISTRIBUTION

SHEET NO. 4 OF 6
PROJ. NO. 5364



RELAPS RUN - 8HFRIHX
CONTROL VOLUME-81330

BY CMM DATE 7-5-83
CHKD. BY KJG DATE 7-6-83

UNIT 2 SV MODIFICATION
TEMPERATURE DISTRIBUTION

SHEET NO. 5 OF 6
PROJ. NO. 5364

THE PRECEEDING PLOT SET DETERMINES THE 0.4 SEC POINT TO BE THE APPROXIMATE OCCURANCE OF PEAK TEMPERATURES.

STRUCTURAL NODE POINT	RELAPS CONTROL VOLUME	EQUILIBRIUM TEMP @ 0.4 SEC FROM RELAPS RUN - BHFRIHX (°F)
404	60004	863.6
230	51001	446.5
262	50001	955.6 *
246	50011	896.3 *
219	70201	447.6
206	30409	671.6
196	30601	462.3
180	30618	440.6
160	20409	671.6
152	20601	464.3
136	20617	443.7
111	10409	671.6
103	10601	466.5
84	10620	444.5
72	80901	440.1
52	81127	431.9
38	81179	420.7
24	81305	408.9
10	81321	397.5
2	90102	388.1
238	50603	560
290	40002	760 *

TELEDYNE ENGINEERING SERVICES

BY CMM DATE 7-5-83
CHKD. BY LBS DATE 7-15-83

UNIT2 SV MODIFICATION
TEMPERATURE DISTRIBUTION

SHEET NO. 6 OF 6
PROJ. NO. 5364

* THESE TEMPERATURES REPRESENT THE EFFECT OF ADIABATIC COMPRESSION OF THE N_2 IN THE DISCHARGE LINE WHICH IS TRAPPED AGAINST THE CLOSED PORV'S. THE RELAP PROGRAM DOES NOT ADEQUATELY REPRESENT THE MIXING BETWEEN THE STREAM AND N_2 AT THESE POINTS. THEREFORE THIS IS AN UPPER BOUND OF THE ACTUAL TEMPERATURE. IN THE PHYSICAL SYSTEM MORE MIXING WOULD OCCUR AND THESE TEMPERATURES WOULD BE QUICKLY DISSIPATED.