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ALEXICH, M. P. Indiana & Michigan Electric Co.
RECIP. NAME RECIPIENT AFFILIATION
DENTON, H. R. Office of Nuclear Reactor Regulation, Director (post 851125

SUBJECT: Forwards response to BJ Youngblood 860402 request for addl info re NUREG-0737, TMI Action Item II.D.1 on relief & safety valve testing. Responses to Questions 3 & 4d postponed until addl info provided by NRC.
SEE RMTS

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INDIANA & MICHIGAN ELECTRIC COMPANY

P.O. BOX 16631
COLUMBUS, OHIO 43216

July 30, 1986
AEP:NRC:0585I

Donald C. Cook Nuclear Plant Unit Nos. 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
RESPONSE TO NRC, REQUEST FOR ADDITIONAL INFORMATION REGARDING TMI ACTION ITEM II.D.1 ON RELIEF AND SAFETY VALVE TESTING

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

References:

1. EPRI PWR Safety and Relief Valve Test Program Guide for Application of Valve Test Program Results to Plant-Specific Evaluations, Revision 2, Interim Report, July, 1982.

2. EPRI PWR Safety and Relief Valve Test Program Safety and Relief Valve Test Report, EPRI NP-2628-SR, Dec., 1982.

3. M. P. Alexich, Indiana & Michigan Electric Co., letter to H. R. Denton, NRC, "Donald C. Cook Nuclear Plant Units 1 and 2, NUREG-0737, Item II.D.1, PWR Relief and Safety Valve Test Program," AEP:NRC:0585D, December 15, 1983.

4. M. P. Alexich, Indiana & Michigan Electric Co., letter to H. R. Denton, NRC, "Response to NRC, Request for Additional Information Regarding Testing of the Pressurizer Safety and Relief Valves, Donald C. Cook Nuclear Plant, Units 1 and 2," AEP:NRC:0585H, July 15, 1985.

Dear Mr. Denton:

This letter and its attachments respond to B. J. Youngblood's letter of April 2, 1986, which requested additional information regarding TMI Action Item II.D.1 on relief and safety valve testing. Six questions were to be addressed, but in discussions with your staff, it was agreed that response to Questions 3 and 4d would be postponed until after additional information is provided to us by your staff. This letter and its attachments respond to the remaining questions in Mr. Youngblood's letter, as applicable to the Donald C. Cook Nuclear Plant, Units 1 and 2.

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The attachments to this letter contain the following information:

Attachment 1: Response to the questions in Mr. Youngblood's letter.
Attachment 2: Teledyne input on Question 4a.
Attachment 3: Teledyne input on Questions 4b and 4c.
Attachment 4: Stress analysis results for Question 5c.
Attachment 5: Westinghouse Report V-EC-108 related to Question 6.

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

Very truly yours,

M. P. Alexich
Vice President

7/20/86

cm

Attachments

cc: (w/o attachments)
John E. Dolan
W. G. Smith, Jr. - Bridgman
R. C. Callen
G. Bruchmann
G. Charnoff
NRC Resident Inspector - Bridgman

ATTACHMENT 1 TO AEP:NRC:0585I

RESPONSE TO NRC REGARDING

REQUEST FOR ADDITIONAL INFORMATION

ON RELIEF AND SAFETY VALVE TESTING

Question 1: Safety Valve Inlet Pressure Drop

"The licensee gave the pressure drop values through the inlet piping as 14.4 psi for the plant specific safety valve and 15.8 psi for applicable EPRI test valve. These pressure drop values appear to be extremely low, when compared with the pressure drop values listed in Table B-3 of Reference 1 for various EPRI valve inlet configurations. Please verify the pressure drop values given previously. Present a recalculation of the total pressure drops through the inlet piping of D. C. Cook Units 1 and 2 safety valves and the applicable EPRI inlet piping arrangement. The total pressure drop should include both the frictional and accoustic [sic] wave components evaluated under steam conditions."

Response 1:

The previous calculation considered only the frictional component of inlet piping pressure drop. The pressure drop was recalculated using the method given in Reference 1, Appendix B. This method includes both frictional and acoustic wave components evaluated during both valve opening and closing. The results of the calculations are shown in the following table. The ΔP values for the EPRI test were taken from Table B-3 of Appendix B in Reference 1.

INLET PIPING PRESSURE DROP (psi)

	Cook Plant			EPRI Test
	Frictional Component	Acoustic Wave Component	Total ΔP	
Valve Opening	12.1	216.1	228.2	263
Valve Closing	5.8	146.8	152.6	181

The above results are based on the transient ΔP which is the controlling ΔP. Steady-state ΔP is the same as the frictional component given in the above table.

It is observed by comparison of the Cook Plant and EPRI test inlet piping pressure drop that the Cook Plant ΔP is lower than the EPRI inlet piping ΔP. Since the Cook Plant pressurizer safety valves (PSVs) do not utilize loop seals, steam discharge conditions noted in Appendix B of Reference 1 are applicable to the Cook Plant. Therefore, the performance of the Cook Plant pressurizer safety valves can be evaluated based on the performance of the EPRI tested valve, Crosby 6M6.

Question 2: Safety Valve Backpressure

"EPRI Test No. 1411, which was selected as a representative test of the D. C. Cook safety valve, showed that the maximum backpressure developed at the outlet of the test valve was 245 psia. The backpressure for the D. C. Cook safety valve was not given in the submittal. Please provide the predicted value of the maximum backpressure developed at the outlet of the D. C. Cook Units 1 and 2 safety valves in order to verify whether the plant specific pressure drop is bounded by the EPRI test."

Response 2:

Safety valve backpressure was calculated based on the procedure given in Reference 1, Appendix A. The approach assumes simultaneous discharge of all safety valves or all PORVs. Since Cook Plant PSVs do not utilize loop seals, the calculation was done only for steam conditions. Maximum pressurizer relief tank pressure (100 psig) was assumed. The backpressures were calculated using the actual discharge piping geometry and a two-phase homogeneous flow model. The Unit 2 piping geometry was used since it is slightly longer than that in Unit 1.

The homogeneous flow model considers the two phases to flow as a single phase possessing mean fluid properties. It provides more accurate pressure drop estimates for dispersed flow in the higher mass velocity ranges (2000 - 2500 Kg/M^2 sec). The following assumptions are implicit in the model:

a) Entropy remains constant as fluid flows along the line.
b) Steam and water velocities are equal.
c) Steam and water are in thermodynamic equilibrium.
d) There is no dissipation of mechanical energy at the steam and water interface.
e) Suitably defined single-phase friction factor for two-phase flow was used.

The results of the calculations are shown in the following table:

Flow per Safety Valve (lb/hr)	Flow per PORV (lb/hr)	Total Flowrate (lb/hr)	Predicted Safety Valve Backpressure (psia) SV-45A	SV-45B	SV-45C
458,000*	0	1,374,000	438.2	431.9	430.0
0	179,000	537,000	192.6	192.6	192.6

* This value is specified in Table B-1 of Reference 1.

Two EPRI "steam" tests (903 and 1411) were conducted on the Crosby 6M6 valve as shown in Table 3.5.1.b, Reference 2. Test 903 was conducted at high backpressure (665 psia) and Test 1411 at low backpressure (245 psia). Since the Cook valves maximum predicted backpressure (438 psia) is above that of Test 1411, this test is not applicable for demonstrating valve operability. Test 903, while conducted at sufficiently high backpressure, is also not applicable, since the valve ring settings were not representative of the ring settings on the Cook valves.

However, another test (929), which was a "loop seal" test, can be used as a basis for demonstrating satisfactory valve performance on steam at high backpressure. Test 929 was conducted on a valve with ring settings representative of the Cook valves and at high backpressure (710 psia). Although the valve chattered during this test as the water in the loop seal was expelled, the valve "stabilized on steam," (Note (4), Table 3.5.1.c in Reference 2). Therefore, it is concluded that the Crosby 6M6 valve operability on steam at high backpressure (710 psia) was demonstrated by Test 929. Since the Cook Plant PSV predicted maximum backpressure (438 psia) is enveloped by EPRI Test 929, Cook Plant PSV valve operability was demonstrated.

Question 3: (Awaiting further NRC clarification)

Question 4: Safety Valve and PORV Piping Stress Analysis

a. "Reference 4 indicates that details of the piping stress analysis for PORV discharge cases are contained in the Teledyne Reports TR-5364-1 and TR-5364-2. Our record shows that the above reports have not been submitted for review by the licensee. Please provide copies of the above reports so that the piping analysis pertinent to PORV discharge can be reviewed.

b. In the thermal hydraulic analysis of the piping discharge conditions, the computer codes REPIPE/SAP2SAP were used to calculate the fluid force time histories from RELAP5 analysis results. Provide verification of the REPIPE/SAP2SAP codes by showing that these codes produce accurate results for similar problems.

c. The licensee presented a verification of the structural analysis code, TMRSAP, using assumed force time histories in the form of ramp functions to represent the fluid forces exerted on the piping model (Question 16, Reference 4). In order to demonstrate that the computer code produces accurate results for the valve discharge problem analyzed, similar piping model and fluid forces must be used. The ramp shape force histories used in the verification problem does not realistically represent the type of fluid forces in a safety valve/PORV discharge event. Therefore, present a verification of the TMRSAP code using fluid forces representative of the valve discharge conditions."

Response 4a:

Included as Attachment 2 to this submittal are the Teledyne Reports requested by Question 4a.

Response 4b and 4c:

Included as Attachment 3 to this submittal is the response from Teledyne Engineering Services regarding the REPIPE/SAP2SAP codes and the TMRSAP code discussed in Questions 4b and 4c.

Question 4d: (Awaiting further NRC clarification)

Question 5: Piping Support Stresses

"The Teledyne stress report indicates that a number of pipe supports (8 in Unit 1 and 24 in Unit 2) exceeded their design loads. Subsequent reanalysis performed by the licensee concluded that, with the exception of a few supports which required modifications, the rest of the supports were found to be adequate to resist the revised loads. Since the licensee did not provide any detail concerning the reanalysis, a review of the support adequacy cannot be performed. Therefore provide the following information required for the evaluation.

a. Identify the governing code and standards used for support design.

b. List the load combination equations used including all the operation conditions as suggested in the EPRI Guide for Plant Specific Evaluations (Reference 2). Also specify the allowable stress limit applicable to each condition.

c. Provide a comparison of the worst case support stresses (or loads) with the applicable allowable stress limits (or allowable loads) and identify the load combinations associated with the worst stresses. These data should be presented for the questionable supports indicated in the Teledyne stress report."

Response 5a:

The governing codes and standards used for support design are as follows:

1. American Institute for Steel Construction (AISC) Code for auxiliary steel
2. Manufacturers Standardization Society (M.S.S.)-SP-58 for commercial pipe hanger attachments
3. Power Piping USAS B.31.1-1967 - for pipe integral attachments

Response 5b:

The load combination equations for normal and upset conditions are:

D_1 = Normal (Weight Load) + Normal (Thermal Range Load) ± OBE Load

D_2 = PORV Transient (Weight Load) + PORV Transient (Thermal Range Load) $\pm\sqrt{(\text{OBE})^2 \text{ Load} + (\text{PORV Trans.})^2 \text{ Shock Load}}$

The load summation shall not provide support component stress greater than 100% of that permitted by 5a.

The load combination equations for emergency conditions are:

E_1 = Normal (Weight Load) + Normal (Thermal Range Load) ± DBE Load

E_2 = SV Transient (Weight Load) + SV Transient (Thermal Range Load) ± SV Transient (Shock Load)

The load summation shall not produce support component stress greater than 133% of that permitted by 5a.

Additionally, 90% of yield stress shall not be exceeded.

Response 5c:

A tabulated summary for comparing the worst-case support stresses with the applicable stress limits for the supports identified in the Teledyne Stress Report is provided in Attachment 4. For three items noted in Attachment 4, stress comparisons will be made after as-built information is obtained from the plant.

Question 6: Valve Accelerations

"The licensee stated in Reference 3 that the Teledyne analysis showed that the maximum vertical acceleration of the D. C. Cook safety valve resulting from a piping discharge transient exceeded the design allowable of 2 g by less than 1 g. The licensee contended that these valves were successfully tested in the Westinghouse seismic test to 4 g in the vertical direction. Therefore, the predicted acceleration for the D. C. Cook valves, although exceeding the design allowable, would still be acceptable. However, the licensee did not provide any details of the test and its findings. Since NUREG-0737, Item II.D.I requires that the valve operability must be demonstrated for operating and transient conditions, the operability of the valves under the predicted g loadings must be assured. Therefore, provide a discussion of the seismic test performed by Westinghouse to demonstrate that the operability of the safety valve will not be impaired under the predicted acceleration level."

Response 6:

In the December 15, 1983, submittal, Reference 3, it was stated that "we were informed by Westinghouse... that the valves have been successfully seismically test for 4 g - vertical and 6 g - horizontal accelerations." That statement was based on a September 1, 1983, letter from Westinghouse, which stated: "The specified seismic accelerations under which the valve successfully completed seismic testing were 4 g - vertical and 6 g - horizontal."

In response to Question 6, Westinghouse informed us that upon further investigation, they learned from Crosby that the valve seismically tested was a forged valve design and not the cast version. Since Westinghouse supplied Cook Plant with cast valves, the seismic tests referred to above may not be directly applicable to the Cook PSVs.

However, a seismic analysis was performed for the cast version of the valve based on 4 g - vertical and 6 g - horizontal seismic accelerations. The analysis and results are contained in Crosby Valve and Gage Company Report No. EC-310, dated March, 1977, which is a proprietary report. Westinghouse did prepare and submit to us a summary of the report, V-EC-108, attached for reference (Attachment 5). The results of the seismic analysis showed a maximum stress in the valve body of 5058 psi (allowable = 18,700 psi) and a maximum stress in the valve bonnet of 5720 psi (allowable = 17,400 psi). The evaluation showed that the "valve remains structurally sound and maintains full operational capabilities" for the 4 g - vertical and 6 g - horizontal seismic conditions. Since the predicted maximum vertical acceleration of the Cook PSVs in the Teledyne analysis was less than 3 g, and the Crosby seismic analysis concludes that the valve maintains full operational capability under 4 g - vertical acceleration, it is concluded that the operability of the Cook PSV will not be impaired by the predicted acceleration level. It should be noted that the predicted maximum horizontal acceleration of the Cook PSVs in the Teledyne analysis was within the design allowable of 3 g, and hence within the tested value of 6 g, and is therefore acceptable.

ATTACHMENT 2

TO

AEP:NRC:0585I

TELEDYNE INPUT (QUESTION 4a)

ATTACHMENT 3

TO

AEP:NRC:0585I

TELEDYNE INPUT (QUESTIONS 4b AND 4c)

TELEDYNE
ENGINEERING SERVICES

130 SECOND AVENUE

WALTHAM, MASSACHUSETTS 02254-9195

(617) 890-3350 TWX (710) 324-7508

July 9, 1986
5364-73

American Electric Power Service Corp.
1 Riverside Plaza
Columbus, OH, 43216-6631

Attention: Mr. Osman Yasin

Subject: REPIPE Verification

Dear Gentlemen,

The REPIPE computer program is a Control Data Corporation (CDC) proprietary program. It is made available to the public on a fee basis. CDC is a Teledyne Engineering Services (TES) Approved Vendor. This means that TES quality assurance engineers have audited the CDC quality assurance program and have found it to meet our standards.

TES used the REPIPE version 3.10 computer program in the execution of Technical Reports TR-5364-1, 2, 3 and 4.

This program was used with the understanding that CDC had tested the program under their QA procedures. CDC QA records have been reviewed in the safety-related library for REPIPE version 3.10 as installed on KHE in April, 1983. Quality assurance testing was performed per the CDC SRQA program at that time. Test results are on file as lifetime records.

Very truly yours,

TELEDYNE ENGINEERING SERVICES

Lenin B. Semprucci

Lenin B. Semprucci
Principal Engineer

LBS:mld
cc: D. Messinger (TES)
R. Berks (TES)

TELEDYNE
ENGINEERING SERVICES

130 SECOND AVENUE

WALTHAM, MASSACHUSETTS 02254-9195

(617) 890-3350 TWX (710) 324-7508

June 5, 1986
5364-17

American Electric Power Service Corp.
1 Riverside Plaza
Columbus, OH, 43216-6631

Attn: Mr. J. L. Williams
Section Manager

Subject: D. C. Cook Nuclear Plant
NRC Questions Related to TMI Action Item II.D.1 on Relief and Safety Valve Testing, File No. DC-D-0353.36M

Ref: AEPSC letter dated 5/29/86 from Osman Yasin to L. B. Semprucci

Dear Sirs,

Enclosed you will find our response to NRC Questions 4b and 4c. Copies of Technical Reports TR-5364-1 and TR-5364-2 books 1, 2 and 3 are also enclosed as requested in Question 4a.

If there are any questions please call me at (617) 890-3350.

Very truly yours,

TELEDYNE ENGINEERING SERVICES

Lenin B. Semprucci
Principal Engineer

LBS:mld
cc: J.A. DiBello (AEPSC)
M.J. Noronha (AEPSC)
O. Yasin (AEPSC)
R. Wray (TES)
R.H. Berks (TES)
D.F. Landers (TES)

In response to question 4b which states:

> In the thermal hydraulic analysis of the piping discharge conditions, the computer codes REPIPE/SAP2SAP were used to calculate the fluid force time histories from RELAP5 analysis results. Provide verification of the REPIPE/SAP2SAP codes by showing that these codes produce accurate results for similar problems.

The REPIPE computer code is maintained and serviced by Control Data Corporation. Verification of REPIPE's capacity to develope a force time history from RELAP5 mod 1 is provided by Control Data Corporation.

SAP2SAP is a TES generated program which reformats SAP force time history files. SAP2SAP was used on the D.C. Cook force time history files generated by REPIPE for the following reasons.

The REPIPE program generates force time histories from RELAP output in SAP format. For each straight pipe segment in which a force time history occurs REPIPE assigns the positive force to the structural node at one end of the pipe segment and the negative force to the structural node at the other end. This requires two structural nodes associated with two force time history tables for every straight pipe segment. The D.C. Cook structural model was so big that the number of structural nodes with force time histories exceeded the capacity of the program. Therefore the SAP2SAP program was used to reduce the number of structural nodes being loaded by adding the force time histories of the nodes at each end of a pipe segment and replace the two force time histories with a single force time history applied to one structural node on the pipe segment.

The SAP2SAP program is simply an "arithimetic" program providing the user with several options. The program is independent of the valve discharge problem.

NRC question 4C states:

> The licensee presented a verification of the structural analysis code, TMRSAP, using assumed force time histories in the form of ramp functions to represent the fluid forces exerted on the piping model (Question 16, Reference 1). In order to demonstrate that the computer code produces accurate results for the valve discharge problem analyzed, similar piping model and fluid forces must be used. The ramp shape force time histories used in the verification problem does not realistically represent the type of fluid forces found in a safety valve PORV discharge event. Therefore, present a verification of the TMRSAP code using fluid forces representative of the valve discharge conditions.

In response to question 4C, TES provides the following:

The verification problem used by TES realistically represents the fluid forces found in a safety valve/PORV discharge event. This is evident by a comparison of the TES verification fluid loads with those used in the EPRI/CE Test Program (Ref. 2) shown in the following figures.

Figures 4-8, 4-10 and 4-12, from Ref. 2, illustrate the fluid loads (shown as solid lines) and the structural response (shown in dashed lines) corresponding to test #1411 of the EPRI/CE safety valve tests performed in response to NUREG 0737. We call your attention to the fluid loads (the structural response is not in question). It can be seen that these fluid loads are a ramp up to a peak value followed by a ramp down to the no load position.

Figures 3, 4, 5 and 6 present the fluid forces used in the TES verification problem. It can be seen that TES's verification fluid forces ramp up to a peak value and then ramp down to the no load position as do those in the EPRI/CE program. The TES verification problem geometry is not identical to the EPRI/CE test geometry (see figures 1 and 2), therefore one would not expect the magnitude and duration of the forces to be identical. The point is that the forces are similar in general configuration and therefore representative of the valve discharge problem.

The NRC reviewer's concern may be due to a misunderstanding of the TES forcing function.

The TES fluid forcing function as presented in the verification problem is a <u>total elbow</u> load. The forcing function presented in the EPRI/CE problem are <u>net segment</u> loads (known as unbalanced forces, or wave forces). The net segment load is the difference in the elbow loads at either end of the pipe segment. In order to compare the TES forcing function with the EPRI/CE forcing function, one must take the difference in the total elbow loads bounding each segment. This has been done in figures 3, 4, 5 and 6. Now it can be seen that the TES forcing function is indeed representative of the EPRI/CE forcing function.

It must be further pointed out that the method by which TMRSAP (or any dynamic program) solves a force time history problem is independent of the form of the forcing function. The analyst inputs the forcing function as a table of load versus time. Whether the function is a ramp, series of ramps or any arbitrary function doesn't matter to the program. The same equations are being solved with each time step. What is important is that the analyst chose the time steps properly.

As additional information on January 7-11, 1985, NRC personnel conducted an inspection at our facility in Waltham, Massachusetts (NRC Inspection Report and Docket No. 99900513/85-01 dated July 11, 1985). The purpose of this inspection was to review our Quality Assurance Program in the areas of computer code verification, computer code error handling procedures, and pipe support design calculations.

Regarding computer program verification, the following is an excerpt from the Report:

> "The development and verification of the computer program TMRSAP, which is used by TES in the design of safety-related items was reviewed during this inspection. Technical Engineering Procedures TEP-1-005, Application Computer Program Development, was reviewed and utilized throughout the inspection of TMRSAP.
>
> The computer code TMRSAP, which was developed internally by TES, is used for static and dynamic analysis of linear piping systems. It employs a finite element solution technique with a library consisting of curved and straight pipe elements, and a boundary element for simulation of pipe restraints. TMRSAP provides capability for analysis of such static loading as deadweight, thermal, and pressure elongation loadings. Capabilities for dynamic analysis include response spectrum and time history (both modal and direct) analysis. Solution methods include Gaussian elimination for static solutions, and determinant search for subspace iteration for the modal dynamic solutions. Direct integration is performed with the Wilson-θ-method.
>
> TES verified TMRSAP by a comparison of the output of 22 verification problem solutions with either the results of hand calculations or the output of other computer codes (STARDYNE, EPIPE, ANSYS, and ADLPIPE). During this inspection all verification problems were reviewed. Although the verification of this code was done according to a general design control procedure (Section 3.0 of the TES Quality Assurance Manual), it was found to meet the requirements of the latest TES procedure controlling computer code verification (TES-1-005), with one exception. The exception was that the source code listing and computation outputs were not included in the verification

manual. However, the computation output includes a source code listing that was clearly identified in the verification manual and was readily available at the TES office. No violations or nonconformances were identified during this part of the inspection."

TELEDYNE ENGINEERING SERVICES

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RESPONSE TO NRC QUESTIONS

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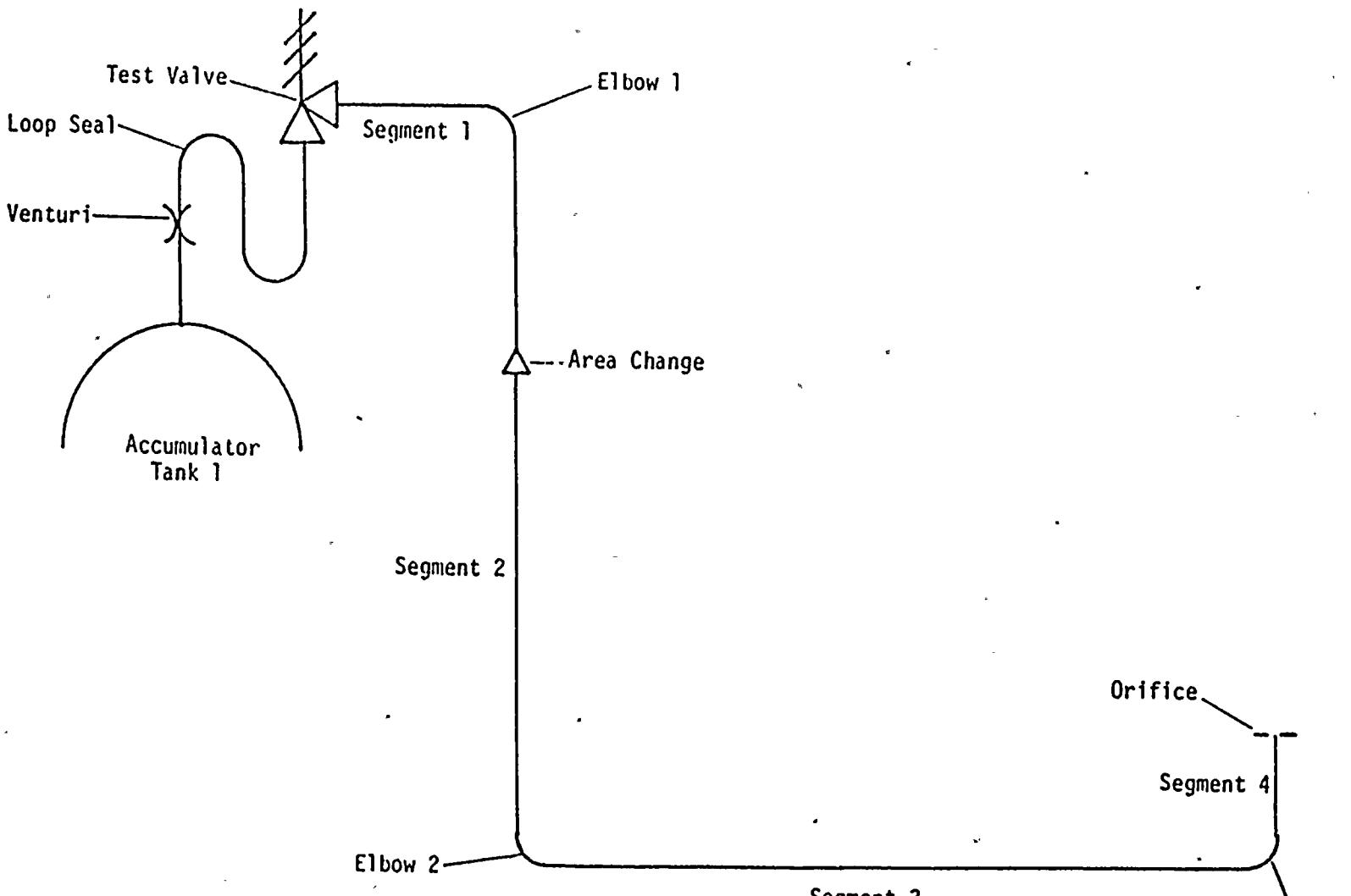

EPRI/CE SAFETY VALVE TEST GEOMETRY

FIG 1

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RESPONSE TO NRC QUESTIONS

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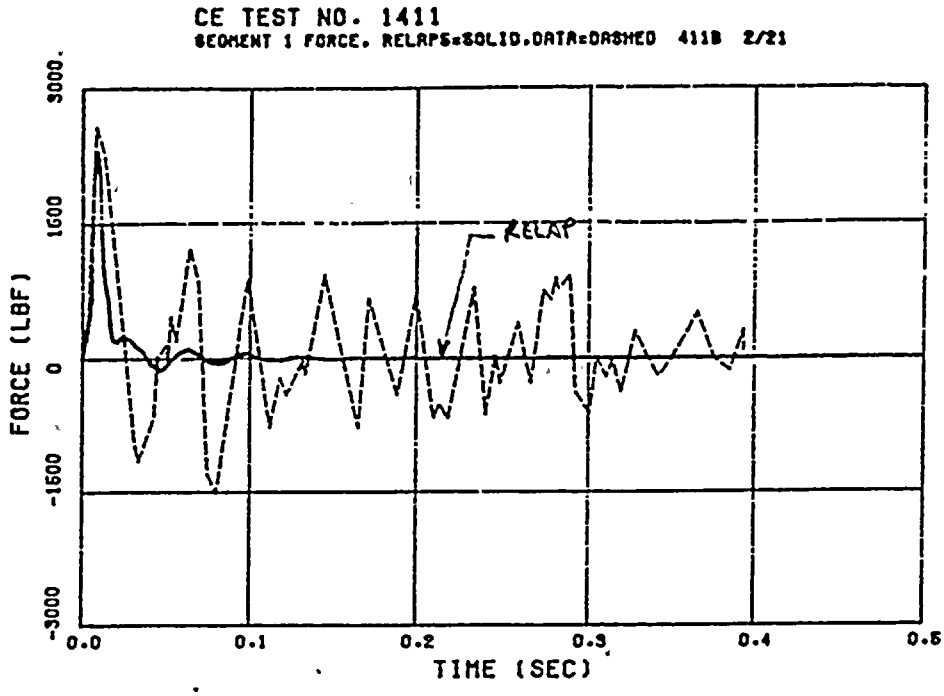
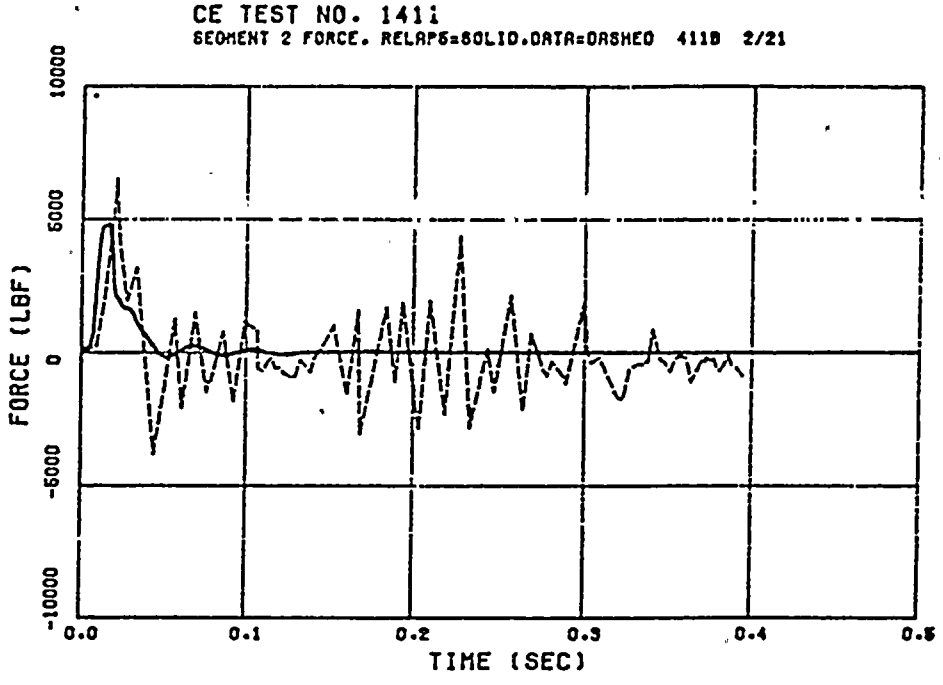


(REF 2)

Figure 4-8. Comparison Plot of RELAP5/MOD1-Calculated Segment 1 Force with Experimental Data, Test 1411.



(REF 2)

Figure 4-10. Comparison Plot of RELAP5/MOD1-Calculated Segment 2 Force with Experimental Data, Test 1411.

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RESPONSE TO NRC QUESTIONS

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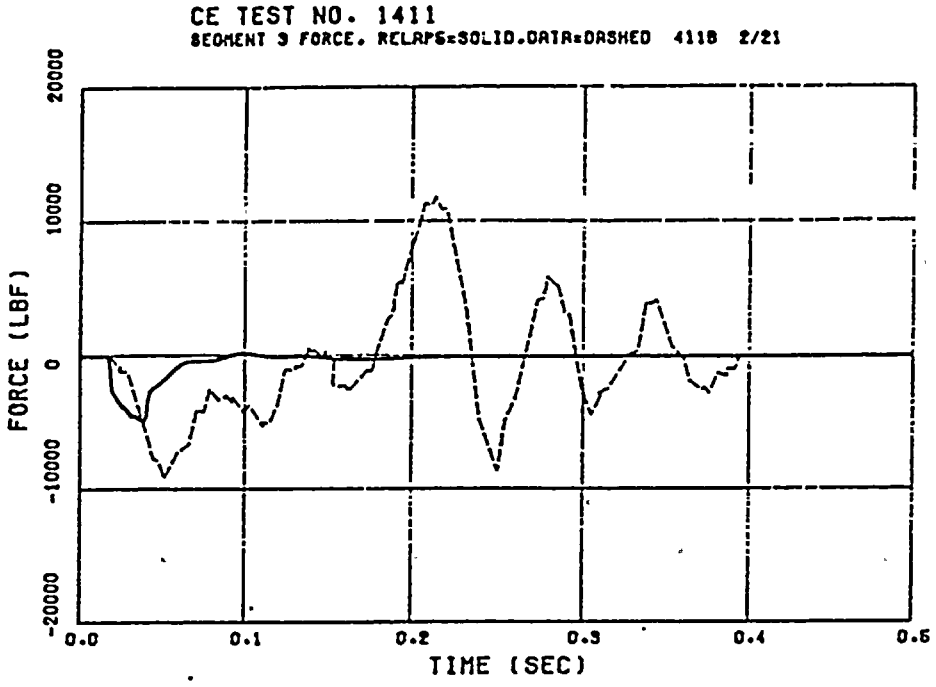

Figure 4-12. Comparison Plot of RELAP5/MOD1-Calculated Segment 3 Force with Experimental Data, Test 1411.

:(REF 2)

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RESPONSE TO NRC QUESTIONS

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TES VERIFICATION MODEL

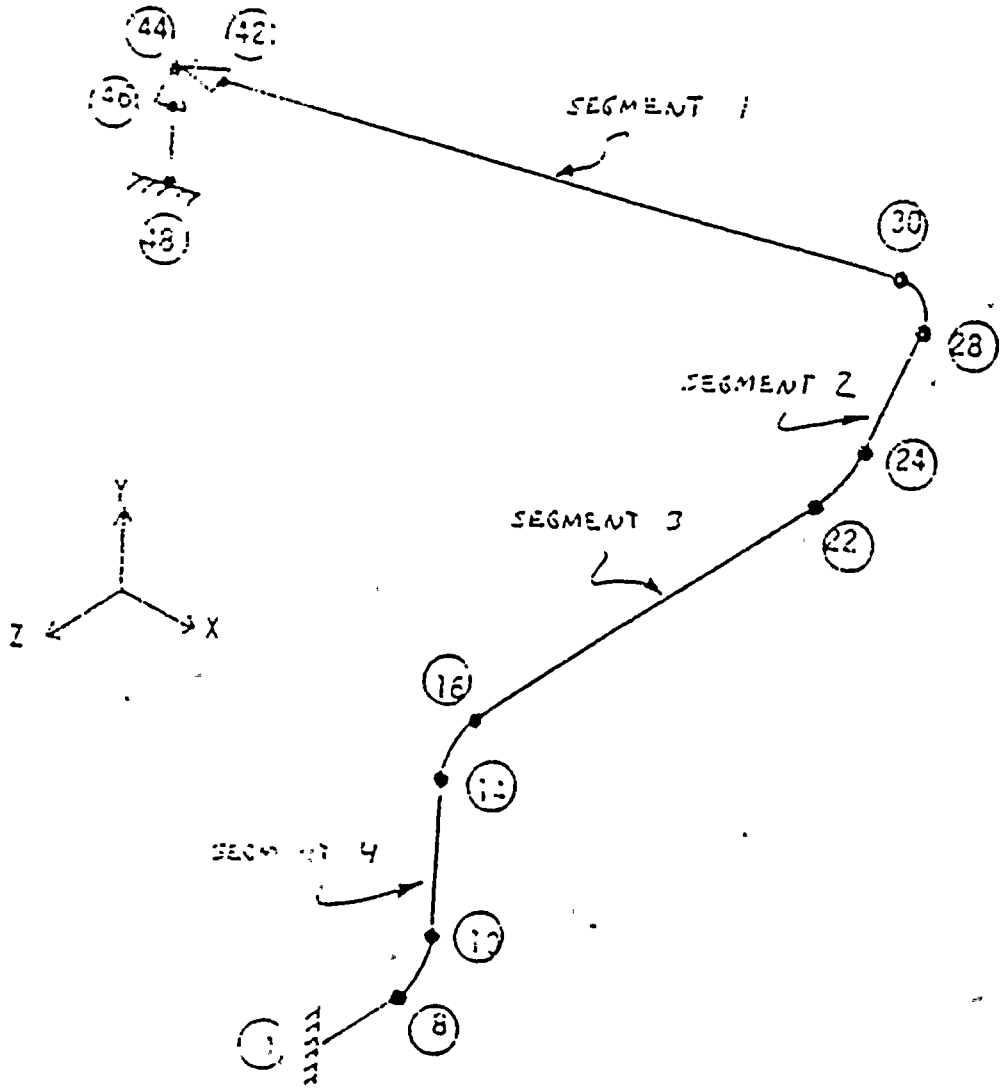

FIG 2.0

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RESPONSE TO NRC QUESTIONS

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PROJ. NO. 5764

NET SEGMENT LOAD

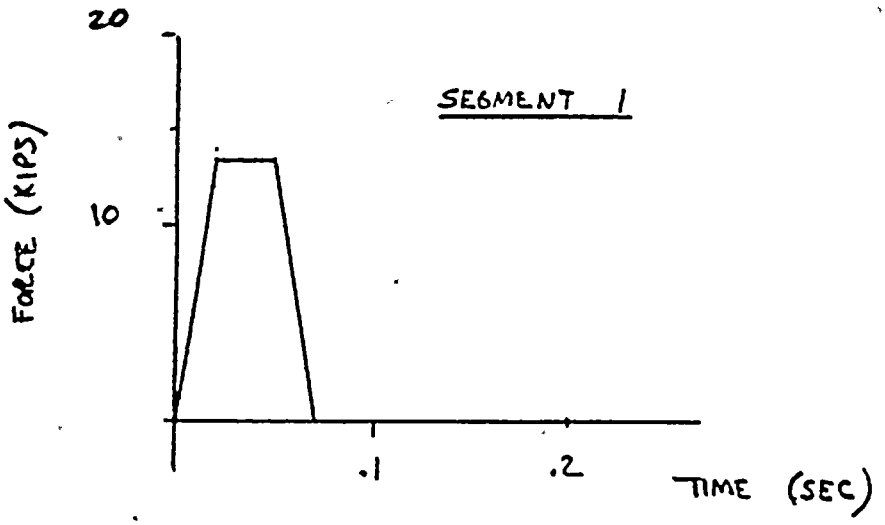

FIG 3.0

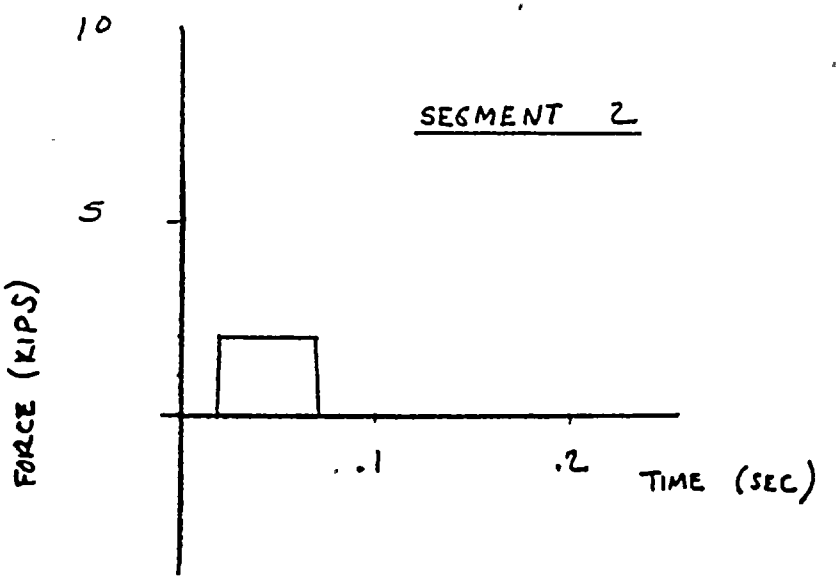

FIG. 4.0

TELEDYNE ENGINEERING SERVICES

BY LRS DATE 6-5-86
CHKD. BY ____ DATE ____

RESPONSE TO NRC QUESTIONS

SHEET NO. ____ OF ____
PROJ. NO. 5364

NET SEGMENT LOAD

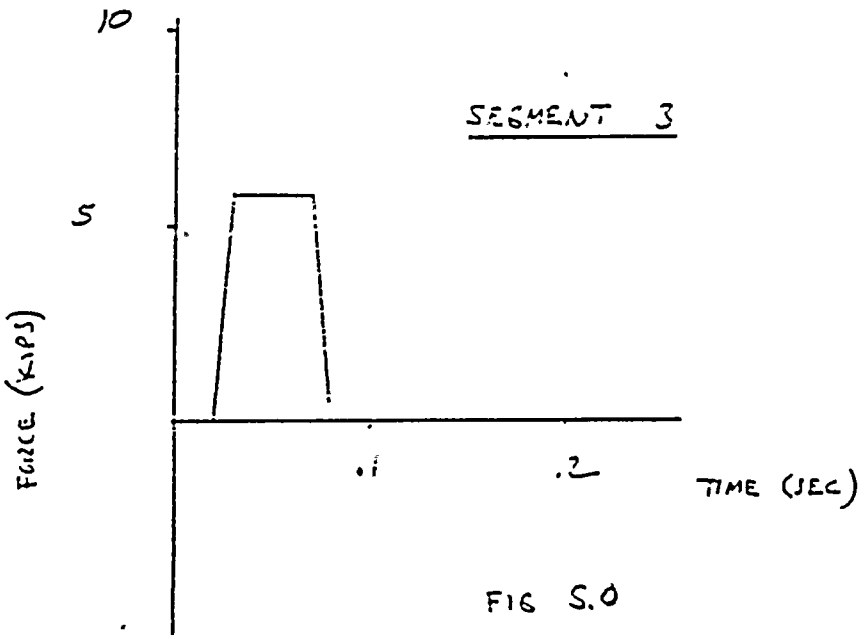

FIG 5.0

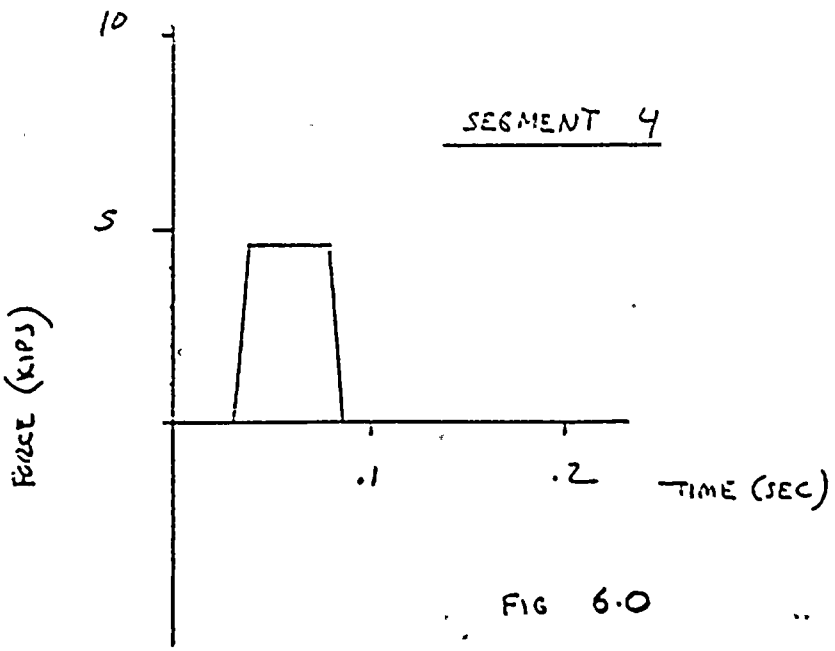

FIG 6.0

REFERENCES

1. M.P. Alexich, Indiana & Michigan Electric Co., letter to M.R. Denton, NRC, "Response to NRC Request for Additional Information Regarding Testing of the Pressurizer Safety and Relief Valves, Donald C. Cook Nuclear Plant, Units 1 and 2," AEP:NRC:0585H, July 15, 1985.

2. Application of RELAP5/MOD1 for calculation of Safety and Relief Valve Discharge Piping Hydrodynamic Loads, EPRI NP-2479, Project V102-28, Final Report, December 1982.

ATTACHMENT 4

TO

AEP:NRC:0585I

PIPING SUPPORT STRESS ANALYSIS

RESPONSE TO NRC QUESTION 5c
PORV/SV DISCHARGE ANALYSIS

UNIT NO. 1

Hanger Mark Number	Catalog Items Actual Load / Allow Load	Structural Steel Members Actual Stress/Allow Stress Axial +Bending	Shear	Weld	Expansion Bolts	Remarks
1-GRC-R585	0.94	NA	NA	0.32	1.43*	Before Modification
	0.94	.98	0.18	0.32	0.45	After Modification
1-GRC-R589	NA	0.57	0.32	0.74	0.68*	No Modification
1-GRC-R591	0.72	0.60	0.33	0.40	NA	No Modification
1-GRC-R601	0.72	0.22	0.14	0.18	NA	No Modification
1-GRC-R608	0.42	NA	NA	0.22	NA	No Modification
1-GRC-R613	NA	0.27	0.08	0.39	NA	No Modification
1-GRC-S614	0.73	NA	NA	0.26	NA	No Modification
1-GRC-R616	NA	1.09	0.41	1.67	NA	Before Modification
	NA	0.98	0.41	0.76	NA	After Modification

* Based on "Teledyne Engineering Services" allowable expansion anchor loads.

RESPONSE TO NRC QUESTION 5c
PORV/SV DISCHARGE ANALYSIS

UNIT NO. 2

Hanger Mark Number	Catalog Items Actual Load / Allow Load	Structural Steel Members Actual Stress/Allow Stress Axial +Bending	Shear	Weld	Expansion Bolts	Remarks
2-GRC-R585	NA	0.72	0.71	0.12	4.58*	Before Modification
	NA	0.72	0.71	0.08	0.99	After Modification
2-GRC-R586	SEE NOTE					Before Modification
	0.56	0.39	0.37	0.48	NA	After Modification
2-GRC-R587	3.12	1.07	0.56	0.96	NA	Before Modification
	0.53	0.44	0.40	0.19	NA	After Modification
2-GRC-R591	0.98	0.42	0.31	0.36	NA	Before Modification
	0.35	0.83	0.25	0.36	NA	After Modification
2-GRC-R600	1.07	0.87	0.06	0.72	NA	Before Modification
	NA	0.65	0.10	0.39	NA	After Modification

Note: Hanger 2-GRC-R586 was analyzed by Structural Design because it had to be relocated due to a field interference. Therefore, no calculations were performed for the "Before Modification" condition.

RESPONSE TO NRC QUESTION 5c
PORV/SV DISCHARGE ANALYSIS

UNIT NO. 2

Hanger Mark Number	Catalog Items Actual Load / Allow Load	Structural Steel Members Actual Stress/Allow Stress Axial +Bending	Shear	Weld	Expansion Bolts	Remarks
2-GRC-R601	3.83	0.95	0.85	0.81	NA	Before Modification
	0.79	0.95	0.85	0.83	NA	After Modification
2-GRC-R624	5.66	NA	NA	1.11	NA	Before Modification
	0.62	NA	NA	0.57	NA	After Modification
2-GRC-S629	0.58	0.37	0.35	0.35	NA	No Modification
2-GRC-S631	0.93	NA	NA	0.11	0.91*	No Modification
2-GRC-S632	0.57	0.90	NA	0.19	1.85*	Before Modification
	0.57	0.95	NA	0.10	0.98	After Modification

* Based on "Teledyne Engineering Services" allowable loads on expansion anchors.

RESPONSE TO NRC QUESTION 5c
PORV/SV DISCHARGE ANALYSIS

UNIT NO. 2

Hanger Mark Number	Catalog Items Actual Load / Allowable Load	Structural Steel Members Actual Stress/Allowable Stress Axial +Bending	Shear	Weld	Expansion Bolts	Remarks
2-GRC-S-594	0.33	0.37	0.23	0.45	NA	No Modification
2-GRC-S-596	0.35	0.074	0.11	*	0.58	No Modification
2-GRC-S-598	0.54	NA	NA	0.05	NA	No Modification
2-GRC-S-599	0.657	NA	NA	0.27	NA	No Modification
2-GRC-R-605	NA	0.156	NA	NA	NA	No Modification
2-GRC-R-607	NA	0.38	0.11	0.13	NA	No Modification
2-GRC-R-609	0.29	0.11	0.045	0.13	NA	No Modification

* Comparison of actual stress and allowable stress will be made after as-built information from the plant is obtained.

RESPONSE TO NRC QUESTION 5c
PORV/SV DISCHARGE ANALYSIS

UNIT NO. 2

Hanger Mark Number	Catalog Items Actual Load / Allowable Load	Structural Steel Members Actual Stress/Allowable Stress Axial +Bending	Shear	Weld	Expansion Bolts	Remarks
2-GRC-R589	NA	.38	.18	.56	.45	No Modification
2-GRC-S611	.41	NA	NA	.11	NA	No Modification
2-GRC-R612	NA	.243	.357	.32	*	No Modification
2-GRC-R614	NA	.44	.3	*	NA	No Modification
2-GRC-S626	.48	.07	NA	.12	NA	No Modification
2-GRC-S630	.64	.04	NA	.07	NA	No Modification
2-GRC-R633	NA	.73	.26	.24	.94	No Modification

* Comparison of actual stress and allowable stress will be made after as-built information from the plant is obtained.

ATTACHMENT 5

TO

AEP:NRC:0585I

WESTINGHOUSE REPORT V-EC-108 (QUESTION 6)

Westinghouse Electric Corporation
Power Systems

Energy Systems
Service Division

Box 355
Pittsburgh Pennsylvania 15230-0355

RECEIVED
JUN 9 1986
P.&V

AEP-86-592

June 5, 1986

Mr. J. D. Hoffman
Piping & Valves Section
American Electric Power Service Corporation
One Riverside Plaza
Columbus, Ohio 43216

American Electric Power Service Corporation
D. C. Cook Units 1 and 2
Summary of Pressurizer Safety Valve Seismic Evaluation

Dear Mr. Hoffman:

Enclosed please find a copy of the subject seismic evaluation as per your request. This summary was previously telecopied to you to give you an advance copy.

This mailing completes your request. Please call me if I can be of further service.

Very truly yours,

H. C. Walls, Manager
Mid-America Area
Projects Department

CAS/lee
7138f

cc: M. Marrocco

Calculation: V-EC-108 Rev. 0
File: 70502/220/5

SUMMARY OF SEISMIC EVALUATION
- PRESSURIZER SAFETY VALVE -
6RV58MSB
DONALD C. COOK UNITS 1 AND 2

Reference:
1. Westinghouse Equipment Specification No. 676279 Rev. 2, Spec. Sheet 1
2. Crosby Report No. EC-310 Rev. 0 (File: 70502/220/5)

Summary Prepared By: E. M. Petrosky Date 5/8/86
E. M. Petrosky

Summary Reviewed By: T J Matty Date 5/8/86
T. J. Matty

Westinghouse Electric Corporation
Power Systems Division
P.O. Box 355
Pittsburgh, PA 15230

1.0 INTRODUCTION AND EQUIPMENT DESCRIPTION

The object of the evaluation was to demonstrate the structural integrity and operability of the 6RV58MSB under loading due to 6g horizontal and 4g vertical seismic accelerations.

Both the valve body and bonnet were analyzed as pressurized thick-walled cylinders.

The 6RV58MSB is a 6 inch safety valve per Crosby Drawing H-51688. The valve has design conditions of 2500 psia at 650°F and is designed per ANSI-B-16.5. Its location numbers are 8010 A, B, and C.

2.0 METHODS OF QUALIFICATION

The valve body and bonnet of the 6RV58MSB were modeled as thick walled pressurized cylinders. Forces due to the seismic accelerations were applied to the center of gravity of the valve. Using conventional analyses, stresses were determined for the minimum cross section areas.

Although the 6RV58MSB was designed and built to ANSI-B-16.5, the stress criteria of the ASME Boiler and Pressure Vessel Code, Section III, were used as the basis for establishing allowable stress levels. Allowable stresses were set at or below yield to preclude any permanent deformations to the valve while simultaneously subjected to seismic and normal operating loads.

The valve body and bonnet were modeled as thick walled pressurized cylinders subjected to pressure, seismic and operational loading. Stresses were calculated using classical formulae. The maximum stresses in body and bonnet were less than the allowable stresses.

The valve satisfies the requirements that the minimum section modulus and minimum cross sectional metal area are greater than those of the connected piping. This assures that stresses in the valve body will be less than those in the connected piping at the piping-to-valve interface. By then limiting stresses in the piping due to pressure plus dead weight plus thermal plus seismic to less than yielded it is assured that the state of stress in the valve body will be elastic therefore precluding any permanent deformations in the valves for this conservative loading combination. These requirements assure that the structural integrity and operability of the valve will not be compromised by externally applied piping loads.

3.0 NATURAL FREQUENCY

The natural frequency of the 6RV58MSB was determined using a single-degree-of-freedom model with a single lumped mass at the center of gravity of the valve. The model conservatively assumes that the equivalent body and bonnet cylinders have dimensions equal to their minimum cross sections. The minimum natural frequency was found to be 216 Hz.

4.0 SUMMARY OF RESULTS

A. Valve Body: Maximum Stress - 5058 psi
Allowable Stress - 18,7000 psi

Bonnet: Maximum Stress - 5720 psi
Allowable Stress - 17,400 psi

B. The natural frequency of the valve assembly is greater than 33 Hz.

C. There are no appurtenances on the 6RV58MSB requiring qualification in order to demonstrate structural integrity and operability.

5.0 CONCLUSION

This evaluation shows that the 6RV58MSB valve remains structurally sound and maintains full operational capabilities for the conditions subjected.

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TECHNICAL REPORT TR-5364-2
REVISION 0

BOOK 2 OF 10

DONALD C. COOK NUCLEAR GENERATING PLANT

ANALYSIS OF PRESSURIZER SAFETY/RELIEF VALVES DISCHARGE PIPING SYSTEM PER NUREG 0737, II.D.1, UNIT 2

8608060048

JUNE 10, 1983

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

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TECHNICAL REPORT TR-5364-2
REVISION 0

BOOK 2 OF 10

DONALD C. COOK NUCLEAR GENERATING STATION

ANALYSIS OF PRESSURIZER SAFETY/RELIEF VALVES DISCHARGE PIPING SYSTEM PER NUREG 0737, II. D.1, UNIT 2

JUNE 10, 1983

TELEDYNE ENGINEERING SERVICES

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

TABLE OF CONTENTS

			PAGE
1.0	INTRODUCTION	Book 1 of 10	1-1
2.0	CONCLUSIONS		2-1
3.0	SYSTEM DESCRIPTION/DISCUSSION		3-1
4.0	THERMAL FLUIDS ANALYSIS		4-1
	4.1 Introduction		4-1
	4.2 RELAP Model		4-3
	4.2.1 Pressurizer Conditions		4-3
	4.2.2 Valve Modeling		4-4
	4.2.3 Discharge Piping		4-11
	4.2.4 Quench Tank		4-11
	4.3 RELAP Model Control Volumes		4-12
	4.4 Quarter Model		4-19
	4.5 Unit 2 PORV Model		4-20
	4.6 Valve Flow Rate Calculation		4-23
	4.6.1 SV Flow Rate		4-24
	4.6.2 PORV Flow Rate		4-25
	4.7 RELAP Plots		4-28
	4.7.1 Unit 2 - 400° Solid Liquid Case		4-29
	4.7.2 Quarter Model - Cold Loop Seal/Steam Case		4-113
	4.8 Force Time History Plots		4-129
	4.8.1 Unit 2 - 400° Solid Liquid Case		4-130
	4.8.2 Quarter Model - Cold Loop Seal/Steam Case		4-201
	4.9 RELAP Input	Book 2 of 10	4-229
	4.9.1 PORV Solid 400° Liquid		4-230
	4.9.2 PORV Solid 400° Liquid Restart		4-250

[illegible]

TABLE OF CONTENTS
(Continued)

		PAGE
4.10	REPIPE Input	4-260
4.10.1	Model Section A PORV Unit 2	4-261
4.10.2	Model Section B PORV Unit 2	4-271
4.10.3	Quarter Model	4-278
4.11	APPENDIX A	4-286
5.0	STRUCTURAL ANALYSIS	5-1
5.1	Deadweight Analysis	5-2
5.2	Thermal Analysis	5-2
5.3	Seismic Analysis	5-2
5.4	Force/Time History Analysis	5-3
5.4.1	PORV Transient	5-3
5.4.2	SV Transient	5-4
6.0	ANALYTICAL RESULTS	6-1
6.1	Stress Summary	6-1
6.1.1	Equation A-1 Stresses	6-6
6.1.2	Equation A-2 Stresses	6-18
6.1.3	Equation B-1 Stresses	6-30
6.1.4	Equation B-2 Stresses	6-42
6.1.5	Equation B-3 Stresses	6-54
6.1.6	Equation C-1 Stresses	6-66
6.1.7	Equation C-2 Stresses	6-78
6.1.8	Equation C-3 Stresses	6-83
6.2	Support Loads	6-88
6.3	Valve Accelerations	6-125
6.3.1	DBE Seismic Valve Accelerations	6-126
6.3.2	PORV Transient Shock and SV Transient Shock Valve Accelerations	6-130
6.4	Nozzle Loads	6-134
6.5	Valve Loads	6-140
6.6	Miscellaneous Calculations	6-146
6.6.1	Thermal Boundary Displacements	6-147
6.6.2	OBE Spectra	6-153
6.6.3	DBE Spectra	6-160
7.0	DRAWINGS	7-1
8.0	REFERENCES	8-1

TABLE OF CONTENTS
(Continued)

9.0 COMPUTER ANALYSIS

9.1	RELAP/REPIPE Input	Book 3 of 10
9.2	Deadweight, Thermal Input/Output	Book 4 of 10
9.3	OBE Seismic X-Y Input/Output	Book 5 of 10
9.4	OBE Seismic Y-Z Input/Output	Book 6 of 10
9.5	DBE Seismic X-Y Input/Output	Book 7 of 10
9.6	DBE Seismic Y-Z Input/Output	Book 8 of 10
9.7	PORV Transient Shock Input	Book 9 of 10
9.8	SV Quarter Model Transient Shock Input	Book 10 of 10

REMOVED

4.9 RELAP Input

The RELAP5 MOD1 input listings are included for each of the transient conditions.

Input Listing	Transient Case
4.9.1	PORV Solid 400° Liquid 0-400 msec
4.9.2	PORV Solid 400° Liquid Restart 400-600 msec
4.9.3	SV Cold Loop Seal (Quarter Model)

The PORV model has:

- 411 volumes
- 412 junctions
- 7 tee branches

The SRV model has:

- 190 volumes
- 191 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 18) showed higher loads were computed without heat structures.

4.9.1 PORV Solid 400° Liquid

ABOVE

LISTING OF INPUT DATA FOR CASE 1

```
    1   =AEP UNIT2  1 LINE  RELAP5
    2   *
    3   *
    4   *
    5   *
    6   *
    7   *          ************************************************
    8   *          ************************************************
    9   *          **                                            **
   10   *          **       UNIT 2 PORV MODEL,  SOLID CASE       **
   11   *          **                                            **
   12   *          ************************************************
   13   *          ************************************************
   14   *
   15   *
   16   *
   17   *
   18   *
   19   *
   20   *  AEP  D.C. COOK UNIT2
   21   *  DISCHRAGE PIPING
   22   *  THIS IS THE NUMBERING SYSTEM FOR UNIT2S' RELAP MODEL
   23   *  WHERE COMPONENTS NUMBERED IN THE:
   24   *        100'S ARE VALVE SV-45C AND ARC 1 LEVEL  669'-2"
   25   *        200'S ARE VALVE SV-45B AND ARC 2 LEVEL  670'-10"
   26   *        300'S ARE VALVE SV-45A ARN ARC 3 LEVEL  672'-6"
   27   *        400'S ARE PORV NRV-151 AND ARC "A"
   28   *        500'S ARE PORV NRV-153 AND ARC "B"
   29   *        600'S ARE PORV NRV-152 AND ARC "C"
   30   *        700'S ARE 6" DISCHARGE PIPING
   31   *        800'S ARE 12" DISCH.
   32   *        900'S QUENCH TANK PORTION
   33   *        999  ATMOSPHERE
   34   100 NEW TRANSNT
   35   101 RUN
   36   102 BRITISH BRITISH
   37   104 NOACTION
   38   *
   39   ***************************************
   40   *         TIME STEP CONTROL           *
   41   ***************************************
   42   *
   43   201  0.400  1.0-7  2.0-4  11001  5  50  250
   44   *
   45   ***************************************
   46   *           MINOR EDITS               *
   47   ***************************************
   48   *
   49   301  MFLOWJ  415000000
   50   302  MFLOWJ  490000000
   51   303  MFLOWJ  493000000
   52   304  MFLOWJ  388000000
   53   305  MFLOWJ  811140000
   54   306  MFLOWJ  811790000
   55   307  MFLOWJ  307000000
   56   308  MFLOWJ  207000000
```

BY KJG DATE 5-17-83

CHKD. BY CMM DATE 6-2-83

TELEDYNE ENGINEERING SERVICES

230V.

```
   57    309  MFLOWJ  107000000
   58    *
   59    310  QUALS   400010000
   60    311  QUALS   500010000
   61    312  QUALS   600010000
   62    313  QUALS   410210000
   63    314  QUALS   485270000
   64    315  QUALS   492110000
   65    316  QUALS   389010000
   66    317  QUALS   811140000
   67    318  QUALS   811790000
   68    319  QUALS   106010000
   69    320  QUALS   106390000
   70    321  QUALS   206010000
   71    322  QUALS   206330000
   72    323  QUALS   306010000
   73    324  QUALS   306250000
   74    *
   75    325  P       400010000
   76    326  P       500010000
   77    327  P       600010000
   78    328  P       410210000
   79    329  P       485270000
   80    330  P       492110000
   81    331  P       389010000
   82    332  P       811140000
   83    333  P       811790000
   84    334  P       106010000
   85    335  P       106390000
   86    336  P       206010000
   87    337  P       206330000
   88    338  P       306010000
   89    339  P       306250000
   90    *
   91    *
   92    *
   93    *
   94    *
   95    ************************************************
   96    **                                            **
   97    **         FORCE  CARDS  FOR  REPIPE          **
   98    **                                            **
   99    ************************************************
  100    *
  101    *    *******   ARC 2, ELEVATION 670' 10",  SV-458   ******
  102    *
  103    2001    5,151
  104    2002    206010000,206020000,206030000,206040000,206050000
  105    2003    206060000,206070000,206080000,206090000,206100000
  106    2004    206110000,206120000,206130000,206140000,206150000
  107    2005    206160000,206170000,206180000,206190000,206200000
  108    2006    206210000,206220000,206230000,206240000,206250000
  109    2007    206260000,206270000,206280000,206290000,206300000
  110    2008    206310000,206320000,206330000
  111    *
  112    *
  113    *
  114    *
```


TELEDYNE
ENGINEERING SERVICES

```
*      ****   FIRST C.V. DOWNSTREAM OF THE ARC   ****
*
*
2010   805010000
*
*
*
*
*      *****  12 INCH DISCHARGE DOWN TO THE QUENCH TANK  *****
*
*
2020   811190000,811200000,811210000,811220000,811230000
2021   811240000,811250000,811260000,811270000,811280000
2022   811290000,811300000,811310000,811320000,811330000
2023   811340000,811350000,811360000,811370000,811380000
2024   811390000,811400000,811410000,811420000,811430000
2025   811440000,811450000,811460000,811470000,811480000
2026   811490000,811500000,811510000,811520000,811530000
2027   811540000,811550000,811560000,811570000,811580000
2028   811590000,811600000,811610000,811620000,811630000
2029   811640000,811650000,811660000,811670000,811680000
2030   811690000,811700000,811710000,811720000,811730000
2031   811740000,811750000,811760000,811770000,811780000
2032   811790000,811800000,811810000,811820000,811830000
2033   811840000,811850000,811860000,811870000,811880000
2034   811890000,811900000,811910000,811920000,811930000
2035   811940000,811950000,811960000,811970000,811980000
2036   811990000,811180000
*
2040   813010000,813020000,813030000,813040000,813050000
2041   813060000,813070000,813080000,813090000,813100000
2042   813110000,813120000,813130000,813140000,813150000
2043   813160000,813170000,813180000,813190000,813200000
2044   813210000,813220000,813230000,813240000,813250000
2045   813260000,813270000,813280000,813290000,813300000
*
*
*
*      ******   PIPE DOWN INTO THE QUENCH TANK  ****
*
*
2050   901010000,901020000,903010000,903020000
2051   903030000
*
*
*
*
*
*
*
*
*      *****   PIPING UPSTREAM OF PORV NRV - 153  *****
*
*
*
*
```

```
*
*
*
*
*
**********************************
*          TRIPS                 *
**********************************
*
501  P  907010000  GT  NULL  0  114.7  L  *QUENCH TANK BLOW OUT PATCH
502  TIME  0  GT NULL 0  1.5  L  * JOB TERMINATION TRIP
503  TIME  0  GE NULL 0  0.0    L  *  VALVE OPEN
504  TIME  0  GE  NULL  0  5.0  L  *  VALVE CLOSED
600  502
*
*****************************************************
*          ***************************              *
*          * HYDRODYNAMIC COMPONENTS *              *
*          ***************************              *
*****************************************************
*
3850000  "PRESS4"  TMDPVOL
3850101  0.0  20.0  500.0   0.0  0.0  0.0  0.00005  0.0  11
3850200  3
3850201  0.0  2349.7  400.0  0.8  2420.0  400.0  1.2  2498.7  400.0
*
*        ************************************
*        *   PORV UPSTREAM PIPING           *
*        ************************************
*
*
3860000  "NOZ"  SNGLJUN
3860101  385000000  387000000  0.0  0.0  0.0  1100
3860201  1  0.0  0.0  0.0
*
*    6 INCH SCH.  160 PIPE
*
3870000  "PORVU"  PIPE
3870001  12
3870101  0.14653  12
3870301  0.328  1
3870302  0.5227  12
3870401  0.0  12
3870601  42.733  1
3870602  90.0  12
3870801  0.000151  0.0  12
3870901  0.0964  0.0964  1
3870902  0.0  0.0  11
3871001  00  12
3871101  1000  11
3871201  3  2349.7  400.0  0.0  0.0  12
3871300  1
3871301  0.0  0.0  0.0  11
*
3880000  "PORVU"  SNGLJUN
3880101  387010000  389000000  0.0  0.0  0.0  1000
3880201  1  0.0  0.0  0.0
*
```


TELEDYNE ENGINEERING SERVICES

```
*   6 X 6 X 3 INCH REDUCING TEE
*
3890000  "PORVU"  BRANCH
3890001  0
3890101  0.14653  0.25  0.0  0.0  90.0  0.25  0.000151  0.0  00
3890200  3  2349.7  400.0  0.0  0.0  0.0
*
4980000  "PORVU"  SNGLJUN
4980101  389010000  410000000  0.0  0.1836  0.1836  1000
4980201  1  0.0  0.0  0.0
*
*   3 INCH SCH. 160 PIPING
*
4100000  "PORV"  PIPE
4100001  21
4100101  0.03757  17
4100102  0.03387  18
4100103  0.0265  19
4100104  0.01912  20
4100105  0.01175  21
4100301  0.5  5
4100302  0.5278  11
4100303  0.5313  17
4100304  0.2657  21
4100401  0.0  21
4100601  0.0  5
4100602  90.0  11
4100603  0.0  21
4100801  0.000153  0.0  21
4100901  0.0  0.0  4
4100902  0.2172  0.2172  5
4100903  0.0  0.0  10
4100904  0.2172  0.2172  11
4100905  0.0  0.0  20
4101001  00  21
4101101  1000  20
4101201  3  2349.7  400.0  0.0  0.0  21
4101300  1
4101301  0.0  0.0  0.0  20
*
*   PORV VALVE NRV - 153
*
4150000  "PORV153"  VALVE
4150101  410010000  500000000  0.00806  0.0  0.0  0100
4150201  1  0.0  0.0  0.0
4150300  MTRVLV
4150301  503  504  1.0  0.0
*
4200000  "PORV"  SNGLJUN
4200101  389010000  425000000  0.0  0.0  0.0  1000
4200201  1  0.0  0.0  0.0
*
*     6  INCH  SCH.  160  PIPING
*
4250000  "PORV"  PIPE
4250001  5
4250101  0.1465  5
4250301  0.3889  3
```


TELEDYNE
ENGINEERING SERVICES

```
4250302  0.375  5
4250401  0.0  5
4250601  90.0  3
4250602  0.0  5
4250801  0.000151  0.0  5
4250901  0.0  0.0  2
4250902  0.1836  0.1836  3
4250903  0.0  0.0  4
4251001  00  5
4251101  1000  4
4251201  3  2349.7  400.0  0.0  0.0  5
4251300  1
4251301  0.0  0.0  0.0  4
*
4300000  "PORV"  SNGLJUN
4300101  425010000  435000000  0.0  0.0  0.0  1000
4300201  1  0.0  0.0  0.0
*
*     6 INCH   X 4 INCH    REDUCER
*
4350000  "PORV"  PIPE
4350001  2
4350101  0.1465  1
4350102  0.0716  2
4350301  0.2292  2
4350401  0.0  2
4350601  0.0  2
4350801  0.000151  0.0  1
4350802  0.000133  0.0  2
4350901  0.0577  0.0961  1
4351001  00  2
4351101  1000  1
4351201  3  2349.7  400.0  0.0  0.0  2
4351300  1
4351301  0.0  0.0  0.0  1

*
4400000  "PORV"  SNGLJUN
4400101  435010000  445000000  0.0  0.0  0.0  1000
4400201  1  0.0  0.0  0.0
*
*    4  INCH  SCH.  120  PIPING
*
4450000  "PORV"  PIPE
4450001  10
4450101  0.0716  10
4450301  0.35833  5
4450302  0.5  10
4450401  0.0  10
4450601  0.0  5
4450602  90.0  9
4450603  0.0  10
4450801  0.000133  0.0  10
4450901  0.0  0.0  4
4450902  0.1944  0.1944  5
4450903  0.0  0.0  8
4450904  0.1944  0.1944  9
4451001  00  10
```

```
 347    4451101  1000  9
 348    4451201  3  2349.7  400.0  0.0  0.0  10
 349    4451300  1
 350    4451301  0.0  0.0  0.0  9
 351    *
 352    4500000  "PORV"  SNGLJUN
 353    4500101  445010000  455000000  0.0  0.0  0.0  1000
 354    4500201  1  0.0  0.0  0.0
 355    *
 356    *     4 X 4 X 3  INCH REDUCING BRANCH
 357    *
 358    4550000  "PORV"  BRANCH
 359    4550001  0
 360    4550101  0.0716  0.5  0.0  0.0  0.0  0.0  0.000133  0.0. 00
 361    4550200  3  2349.7  400.0  0.0  0.0  0.0
 362    *
 363    4600000   "PORV"   SNGLJUN
 364    4600101  455010000  465000000  0.0  0.0  0.0  1000
 365    4600201  1  0.0  0.0  0.0
 366    *
 367    *    4  INCH  SCH.  120  PIPING
 368    *
 369    4650000  "PORV"  PIPE
 370    4650001  3
 371    4650101  0.0716    3
 372    4650301  0.25  3
 373    4650401  0.0  3
 374    4650601  0.0  3
 375    4650801  0.000133  0.0  3
 376    4650901  0.0  0.0  2
 377    4651001  00  3
 378    4651101  1000  2
 379    4651201  3  2349.7  400.0  0.0  0.0  3
 380    4651300  1
 381    4651301  0.0  0.0  0.0  2
 382    *
 383    4700000  "PORV"  SNGLJUN
 384    4700101  465010000  475000000  0.0  0.0  0.0  1000
 385    4700201  1  0.0  0.0  0.0
 386    *
 387    *    4 INCH  X  3 INCH   REDUCER
 388    *
 389    4750000  "PORV"  PIPE
 390    4750001  2
 391    4750101  0.0716  1
 392    4750102  0.0376  2
 393    4750301  0.1667  2
 394    4750401  0.0  2
 395    4750601  0.0  2
 396    4750801  0.000133  0.0  1
 397    4750802  0.000153  0.0  2
 398    4750901  0.0472  0.0730  1
 399    4751001  00  2
 400    4751101  1000  1
 401    4751201  3  2349.7  400.0  0.0  0.0  2
 402    4751301  0.0  0.0  0.0  1
 403    *
 404    4800000  "PORV"  SNGLJUN
```

```
4800101  475010000  485000000  0.0  0.0  0.0  1000
4800201  1  0.0  0.0  0.0
*
*   3  INCH  SCH.  160  PIPING
*
4850000  "PORV"  PIPE
4850001  27
4850101  0.0376  23
4850102  0.0339  24
4850103  0.0266  25
4850104  0.0192  26
4850105  0.0118  27
4850301  0.4375  4
4850302  0.4690  12
4850303  0.500  15
4850304  0.368  16
4850305  0.367  17
4850306  0.5405  23
4850307  0.41937  27
4850401  0.0  27
4850601  0.0  27
4850801  0.000153  0.0  27
4850901  0.0  0.0  26
4851001  00  27
4851101  1000  26
4851201  3  2349.7  400.0  0.0  0.0  27
4851300  1
4851301  0.0  0.0  0.0  26
*
*    PORV  VALVE  NRV - 151
*
4900000  "PORV"  VALVE
4900101  485010000  400000000  0.00806  0.0  0.0  0100
4900201  1  0.0  0.0  0.0
4900300  MTRVLV
4900301  503  504  1.0  0.0
*
4910000  "PORV"  SNGLJUN
4910101  455010000  492000000  0.0  0.095  0.095  1000
4910201  1  0.0  0.0  0.0
*
*   3  INCH  SCH.  160  PIPING
*
4920000  "PORV"  PIPE
4920001  11
4920101  0.0376  7
4920102  0.0339  8
4920103  0.0266  9
4920104  0.0192  10
4920105  0.0118  11
4920301  0.4881  7
4920302  0.4792  11
4920401  0.0  11
4920601  0.0  11
4920801  0.000153  0.0  11
4920901  0.0  0.0  10
4921001  00  11
4921101  1000  10
```

```
4921201  3  2349.7  400.0  0.0  0.0  11
4921300  1
4921301  0.0  0.0  0.0  10
*
*   PORV  VALVE  NRV - 152
*
4930000  "PORV"  VALVE
4930101  492010000  600000000  0.00806  0.0  0.0  0100
4930201  1  0.0  0.0  0.0
4930300  MTRVLV
4930301  503  504  1.0  0.0
*
*
*********************************************
*    SAFETY VALVES DISCHARGE SECTION        *
*********************************************
*
*
*
*****************************************************************
*    SAFETY VALVE-45C  DISCHARGING AT ELEV. 669'-2"  ARC  1     *
*****************************************************************
*
*
**
*  DISCHARGE PIPING
*
*  6  INCH  SCH.  40  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
1060306  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  0.9284  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      *
*******************************************************
*
*
*     12  X  12  X  6  INCH  REDUCING TEE
*
*     CONNECTS  SRV  PIPING  TO  MAIN  DISCHARGE
*
*
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  0.9284
*
8100000  "DISCHA1"  SNGLJUN
8100101  809010000  811000000  0.0  0.0  0.0  1000
8100201  1  0.0  0.0  0.0
*
*     12   INCH  SCH.  40  DISCHARGE PIPING
*
8110000  "DISCH1A"  PIPE
8110001  99
8110101  0.7771  99
8110301  1.039  14
8110302  0.53025  18
8110303  0.5  22
8110304  0.53025  26
8110305  0.9875  56
8110306  0.475  66
8110307  0.49359  79
8110308  0.46875  87
8110309  0.50  95
8110310  0.875  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  0.158  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  99
8111001  00  99
8111101  1000  98
8111201  4  17.7  120.0  0.9284  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
*
*    12  INCH  SCH.  40  DISCHARGE  PIPING
*
8130000  "DISCHA1" PIPE
8130001  30
8130101  0.7771  30
8130301  0.875  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
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  0.9284  0.0  30
8131300  1
8131301  0.0  0.0  0.0  29
*
*
*
**************************************************
*        SAFETY VALVE 458 AT ELEV. 670'-10" ARC 2    *
**************************************************
*
*
*
**
*   DISCHARGE  PIPING
*
*  6  INCH  SCH.  40  PIPING
**
2060000   "DISCHA2"  PIPE
2060001   33
2060101   0.20069    33
2060301   0.4635     4
```


TELEDYNE
ENGINEERING SERVICES

```
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  0.9284  0.0  33
2061300   1
2061301   0.0  0.0  0.0  32
*
**************************************************
*    SAFETY VALVE 45A AT ELEV. 672'-6" ARC 3     *
**************************************************
*
*
*
**
*   DISCHARGE PIPING
*
*    6  INCH  SCH.  40  PIPING
**
3060000   "DISCHA3"  PIPE
3060001   25
3060101   0.20069  25
3060301   0.526      4
3060302   0.969     12
*   ARC  STARTS  LEVEL  672'-6"
3060303   0.635     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  0.9284  0.0  25
3061300   1
3061301   0.0  0.0 0.0  24
```


TELEDYNE
ENGINEERING SERVICES

```
*
*
*
*
*****************************************
*         PORV  PIPING                  *
*****************************************
*
*
*   PIPING  DOWNSTREAM  OF  VALVE  NRV - 153
*
*   3  INCH  SCH.  40  PIPING
*
*
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    0.5892   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  0.9284  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
*
*   4  INCH  X  3  INCH  DIFFUSER
*
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   2
5020401   0.0  2
5020601   0.0  2
5020801   0.000153  0.0  1
5020802   0.000134  0.0  2
5020901   0.0399  0.0544  1
5021001   00  2
5021101   1000  1
5021201   4  17.7  120.0 0.9284  0.0  2
```


TELEDYNE ENGINEERING SERVICES

```
  753    5021300   1
  754    5021301   0.0  0.0  0.0  1
  755    *
  756    *
  757    5030000   "PORVB"  SNGLJUN  * ON ARC B
  758    5030101   502010000  504000000  0.0  0.0  0.0  1000
  759    5030201   1  0.0  0.0  0.0
  760    *
  761    *    4  X  4  X  3  INCH  BRANCH
  762    *
  763    5040000   "PORVB"  BRANCH  *  ON ARC B @ 242
  764    5040001   0
  765    5040101   0.0884  0.361  0.0  0.0  0.0  0.0  0.000134  0.0  00
  766    5040200   4  17.7  120.0  0.9284  0.0  0.0
  767    *
  768    5050000   "PORVB"  SNGLJUN    * ON ARC B
  769    5050101   504010000  506000000  0.0  0.0  0.0  1000
  770    5050201   1  0.0  0.0  0.0
  771    *
  772    *    4  INCH  SCH.  40  PIPING
  773    *
  774    5060000  "PORVB" PIPE   *  ON ARC B
  775    5060001   9
  776    5060101   0.0884   9
  777    5060301   0.6211   8
  778    5060302   0.7607    9
  779    5060401   0.0  9
  780    5060601   0.0  9
  781    5060801   0.000134  0.0  9
  782    5060901  0.0  0.0  8
  783    5061001   00  9
  784    5061101   1000  8
  785    5061201   4  17.7  120.0  0.9284  0.0  9
  786    5061300   1
  787    5061301   0.0  0.0  0.0  8
  788    *
  789    5070000   "PORVB"  SNGLJUN
  790    5070101   506010000  508000000  0.0  0.0  0.0  1000
  791    5070201   1  0.0  0.0  0.0
  792    *
  793    *    4  INCH  X  6  INCH  DIFFUSER
  794    *
  795    5080000   "PORVB" PIPE
  796    5080001   2
  797    5080101   0.0884  1
  798    5080102   0.20069   2
  799    5080301   0.5792  2
  800    5080401   0.0  2
  801    5080601   0.0  2
  802    5080801   0.000134  0.0  1
  803    5080802   0.000152  0.0  2
  804    5080901   0.1483  0.0815  1
  805    5081001   00  2
  806    5081101   1000  1
  807    5081201   4  17.7  120.0  0.9284  0.0  2
  808    5081300   1
  809    5081301   0.0  0.0  0.0  1
  810    *
```

```
811   5090000   "PORVB" SNGLJUN   * ON ARC B
812   5090101   508010000  510000000  0.0  0.0  0.0 1000
813   5090201   1  0.0  0.0  0.0
814   *
815   *   6  X  6  X  3  INCH REDUCING  TEE
816   *
817   5100000   "PORVB" BRANCH    * ON ARC B @ 232
818   5100001   0
819   5100101   0.20069 0.25  0.0  0.0 -0.0  0.0  0.000152  0.0  00
820   5100200   4  17.7  120.0  0.9284  0.0  0.0
821   *
822   5110000   "PORVB" SNGLJUN   *  ON ARC B
823   5110101  510010000  700000000     0.0  0.0 0.0  1000
824   5110201   1  0.0  0.0  0.0
825   *
826   *    PIPING  DOWNSTREAM  OF  VALVE  NRV - 151
827   *
828   *    3  INCH  SCH.  40  PIPING
829   *
830   4000000   "PORVA"  PIPE
831   4000001   8
832   4000101   0.05132  8
833   4000301   0.4141   4
834   4000302   0.4375   8
835   4000401   0.0  8
836   4000601   0.0  4
837   4000602   -90.0 8
838   4000801   0.000153  0.0  8
839   4000901   0.0  0.0  3
840   4000902   0.2088  0.2088  4
841   4000903  0.0  0.0  7
842   4001001   00  8
843   4001101   1000  7
844   4001201   4  17.7  120.0  0.9284  0.0  8
845   4001300   1
846   4001301   0.0  0.0  0.0  7
847   *
848   4010000   "PORVAB" SNGLJUN
849   4010101   400010000  510000000   0.0  0.1800  0.1800  1000
850   4010201   1  0.0  0.0  0.0
851   *
852   *    DOWNSTREAM  PIPING  FROM  VALVE  NRV - 152
853   *
854   *    3  INCH  SCH.  40  PIPING
855   *
856   6000000   "PORVC"  PIPE
857   6000001   7
858   6000101   0.05132 7
859   6000301   0.4722    3
860   6000302   0.4375   7
861   6000401   0.0  7
862   6000601   0.0  3
863   6000602   -90.0  7
864   6000801   0.000153  0.0  7
865   6000901   0.0  0.0  2
866   6000902   0.2088  0.2088  3
867   6000903   0.0  0.0  6
868   6001001   00  7
```

```
6001101   1000  6
6001201   4  17.7  120.0  0.9284  0.0  7
6001300   1
6001301   0.0  0.0  0.0  6
*
6010000   "PORVBC" SNGLJUN
6010101   600010000  504000000  0.0  0.1932  0.1932  1000
6010201   1  0.0  0.0  0.0
*
*    MAIN  HEADER  DOWNSTREAM  OF  PORV  PIPING
*
7000000   "PORVBD"  PIPE
7000001   12
7000101   0.20069  12
7000301   0.75  2
7000302   1.075  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  0.9284  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
*
*
*
*
**********************************************************
**                                                      **
**          MAIN ARC CONNECTIONS                        **
**                                                      **
**********************************************************
*
*
*
*    12 INCH  X  6 INCH   DIFFUSER ABOVE SRV ARCS ON MAIN DISCHARGE
*
*
*
7020000   "PORVD"  PIPE
7020001   3
7020101   0.20069  1
7020102   .77708   3
7020301   0.75  1
7020302   0.375  3
7020401   0.0  3
7020601   -90.0  3
7020801   0.000152  0.0  1
```

```
927    7020802   0.000169  0.0  3
928    7020901   0.4930  0.2045  1
929    7020902   0.0     0.0     2
930    7021001   00  3
931    7021101   1000  2
932    7021201   4  17.7  120.0  0.9284  0.0  3
933    7021300   1
934    7021301   0.0  0.0  0.0  2
935    *
936    8000000   "PORVD"  SNGLJUN
937    8000101   702010000  801000000  0.0  0.0  0.0  1000
938    8000201   1  0.0  0.0  0.0
939    *
940    3070000   "PORVD3"  SNGLJUN
941    3070101   306010000  801000000  0.0  0.156  0.156  1000 * 12 IN ELBOW LOSSES
942    3070201   1  0.0  0.0  0.0
943    *
944    *   12  X  12  X  6  INCH REDUCING TEE CONNECTS ARC WITH DISCHARGE
945    *
946    8010000  "PORVD"  BRANCH
947    8010001   0
948    8010101   0.77708  0.5  0.0  0.0  -90.  -0.5  0.000169  0.0  00
949    8010200   4  17.7  120.0  0.9284  0.0 0.0
950    *
951    8020000   "PORVD"  SNGLJUN
952    8020101   801010000  803000000  0.0  0.0  0.0  1000
953    8020201   1  0.0  0.0 0.0
954    *
955    8030000   "PORVD"  SNGLVOL
956    8030101   0.77708  1.1667  0.0  0.0 -90.  -1.1667  0.000169  0.0  00
957    8030200   4  17.7  120.0 0.9284  0.0  0.0
958    *
959    8040000   "PORVD"  SNGLJUN
960    8040101   803010000  805000000  0.0  0.0  0.0 1000
961    8040201   1  0.0  0.0  0.0
962    *
963    2070000   "PORVD"  SNGLJUN
964    2070101   206010000  805000000  0.0  0.156  0.156  1000 * 12 IN ELBOW LOSSES
965    2070201   1  0.0  0.0  0.0
966    *
967    *  12 X12 X 6 INCH REDUCING TEE. CONNECTS SRV ARC WITH DISCHARGE PIPING.
968    *
969    8050000   "PORVD"  BRANCH
970    8050001   0
971    8050101   0.77708  0.5  0.0  0.0  -90.  -0.5  0.000169 0.0 00
972    8050200   4  17.7  120.0  0.9284  0.0  0.0
973    *
974    8060000   "PORVD"  SNGLJUN
975    8060101   805010000  807000000   0.0  0.0  0.0  1000
976    8060201   1  0.0  0.0  0.0
977    *
978    8070000   "PORVD"  SNGLVOL
979    8070101   0.77708  1.1667 0.0 0.0 -90. -1.1667 0.000169 0.0 00
980    8070200   4  17.7  120.0  0.9284  0.0  0.0
981    *
982    8080000   "PORVD"  SNGLJUN
983    8080101   807010000  809000000  0.0  0.0  0.0  1000
984    8080201   1  0.0  0.0  0.0
```


TELEDYNE ENGINEERING SERVICES

```
*
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  1.0833  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  0.9284  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
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.   0.9284   0.   2
```

```
1043    9031202   3    17.7   120.    0.0       0.    18.
1044    *         JUN. INITIAL COND.
1045    9031300   1
1046    9031301   0.0  0.0  0.0       17
1047    **
1048    *    SPARGER   EXIT
1049    **
1050    9040000 "EXIT" SNGLJUN
1051    9040101   903010000   905000000    0.0    1.0   1.0     0100
1052    9040201   1    0.     0.     0.
1053    **
1054    *         WATER  VOL.
1055    **
1056    9050000  "QT. WATER" SNGLVOL
1057    9050101   260.4706   5.6667   0.0   0.0   90.  5.6667  0.003  0.0   01
1058    9050200   3    17.7      120.
1059    **
1060    *         INTERFACE
1061    **
1062    9060000   "INTERFACE"  SNGLJUN
1063    9060101   905010000  907000000   0.0    0.0    0.0    1000
1064    9060201   1    0.0  0.0  0.0
1065    **
1066    *         AIR  VOLUME
1067    **
1068    9070000   "QT.AIR"  SNGLVOL
1069    9070101   260.4706  1.2439    0.0   0.0   90.   1.2439  0.003  0.0  01
1070    9070200   4    17.7   120.    0.9284
1071    **
1072    *         RUPTURE DISC
1073    **
1074    9080000   "RUP.DISC"  VALVE
1075    9080101   907010000   999000000     1.77  0.  0.   1100
1076    9080201   1    0.   0.   0.
1077    9080300   TRPVLV
1078    9080301   501       *    VALVE OPENING TRIP
1079    **
1080    *    PIPE  OUTSIDE  ENVIRONMENT
1081    **
1082    9990000   "ATMOSPHERE"   TMDPVOL
1083    9990101   10000.     10000.     0.0  0.0  0.0  0.0  .00001  0.0  11
1084    9990200   4
1085    9990201   0.0  17.7  120.  0.9284
1086    .END OF CASE
```


TELEDYNE
ENGINEERING SERVICES

4.9.2 PORV Solid 400° Liquid Restart

LISTING OF INPUT DATA FOR CASE 1

```
    1    =THIS RESTARS RELAP 3 PORVS OPENING ON SOLID WATER UNIT2 RED
    2    *
    3    100 RESTART TRANSNT
    4    101 RUN
    5    *
    6    103 2000
    7    104 NOACTION
    8    201 0.600  1.-7 2.-4 11001 5 50 250
    9    *
   10    *
   11    * MINOR EDITS
   12    *
   13    301  MFLOWJ  415000000
   14    302  MFLOWJ  490000000
   15    303  MFLOWJ  493000000
   16    304  MFLOWJ  388000000
   17    305  MFLOWJ  811140000
   18    306  MFLOWJ  811790000
   19    307  MFLOWJ  307000000
   20    308  MFLOWJ  207000000
   21    309  MFLOWJ  107000000
   22    *
   23    310  QUALS  400010000
   24    311  QUALS  500010000
   25    312  QUALS  600010000
   26    313  QUALS  410210000
   27    314  QUALS  485270000
   28    315  QUALS  492110000
   29    316  QUALS  389010000
   30    317  QUALS  811140000
   31    318  QUALS  811790000
   32    319  QUALS  106010000
   33    320  QUALS  106390000
   34    321  QUALS  206010000
   35    322  QUALS  206330000
   36    323  QUALS  306010000
   37    324  QUALS  306250000
   38    *
   39    325  P       400010000
   40    326  P       500010000
   41    327  P       600010000
   42    328  P       410210000
   43    329  P       485270000
   44    330  P       492110000
   45    331  P       389010000
   46    332  P       811140000
   47    333  P       811790000
   48    334  P       106010000
   49    335  P       106390000
   50    336  P       206010000
   51    337  P       206330000
   52    338  P       306010000
   53    339  P       306250000
   54    *
   55    2001    5,151
   56    2002    206010000,206020000,206030000,206040000,206050000
```

BY KJG DATE 5-20-83

CHKD. BY [illegible] DATE 6-2-83

TELEDYNE
ENGINEERING SERVICES

```
   57    2003    206060000,206070000,206080000,206090000,206100000
   58    2004    206110000,206120000,206130000,206140000,206150000
   59    2005    206160000,206170000,206180000,206190000,206200000
   60    2006    206210000,206220000,206230000,206240000,206250000
   61    2007    206260000,206270000,206280000,206290000,206300000
   62    2008    206310000,206320000,206330000
   63    *
   64    *
   65    *
   66    *
   67    *      ****   FIRST C.V. DOWNSTREAM OF THE ARC    ****
   68    *
   69    *
   70    2010    805010000
   71    *
   72    *
   73    *
   74    *
   75    *      *****  12 INCH DISCHARGE DOWN TO THE QUENCH TANK   *****
   76    *
   77    *
   78    2020    811190000,811200000,811210000,811220000,811230000
   79    2021    811240000,811250000,811260000,811270000,811280000
   80    2022    811290000,811300000,811310000,811320000,811330000
   81    2023    811340000,811350000,811360000,811370000,811380000
   82    2024    811390000,811400000,811410000,811420000,811430000
   83    2025    811440000,811450000,811460000,811470000,811480000
   84    2026    811490000,811500000,811510000,811520000,811530000
   85    2027    811540000,811550000,811560000,811570000,811580000
   86    2028    811590000,811600000,811610000,811620000,811630000
   87    2029    811640000,811650000,811660000,811670000,811680000
   88    2030    811690000,811700000,811710000,811720000,811730000
   89    2031    811740000,811750000,811760000,811770000,811780000
   90    2032    811790000,811800000,811810000,811820000,811830000
   91    2033    811840000,811850000,811860000,811870000,811880000
   92    2034    811890000,811900000,811910000,811920000,811930000
   93    2035    811940000,811950000,811960000,811970000,811980000
   94    2036    811990000,811180000
   95    *
   96    2040    813010000,813020000,813030000,813040000,813050000
   97    2041    813060000,813070000,813080000,813090000,813100000
   98    2042    813110000,813120000,813130000,813140000,813150000
   99    2043    813160000,813170000,813180000,813190000,813200000
  100    2044    813210000,813220000,813230000,813240000,813250000
  101    2045    813260000,813270000,813280000,813290000,813300000
  102    *
  103    *
  104    *
  105    *      ******   PIPE DOWN INTO THE QUENCH TANK  ****
  106    *
  107    *
  108    2050    901010000,901020000,903010000,903020000
  109    2051    903030000
  110    *
  111    *
  112    *
  113    3880000  "PORVU"  SNGLJUN
  114    3880101  387010000  389000000  0.0  0.0  0.0  1000
```


TELEDYNE
ENGINEERING SERVICES

```
115     3880201  1  0.0  0.0  0.0
116     20300100  MFLOWJ  4.15000000
117     20300200  MFLOWJ  493000000
118     20300300  MFLOWJ  490000000
119     20300400  MFLOWJ  388000000
120     20300500  MFLOWJ  811140000
121     20300600  MFLOWJ  811790000
122     20300700  MFLOWJ  307000000
123     20300800  MFLOWJ  207000000
124     20300900  MFLOWJ  107000000
125     *
126     20301000  QUALS  400010000
127     20301100  QUALS  500010000
128     20301200  QUALS  600010000
129     20301300  QUALS  410210000
130     20301400  QUALS  485270000
131     20301500  QUALS  492110000
132     20301600  QUALS  389010000
133     20301700  QUALS  811140000
134     20301800  QUALS  811790000
135     20301900  QUALS  106010000
136     20302000  QUALS  106390000
137     20302100  QUALS  206010000
138     20302200  QUALS  206330000
139     20302300  QUALS  306010000
140     20302400  QUALS  306250000
141     *
142     20302500  P       400010000
143     20302600  P       500010000
144     20302700  P       600010000
145     20302800  P       410210000
146     20302900  P       485270000
147     20303000  P       492110000
148     20303100  P       389010000
149     20303200  P       811140000
150     20303300  P       811790000
151     20303400  P       106010000
152     20303500  P       106390000
153     20303600  P       206010000
154     20303700  P       206330000
155     20303800  P       306010000
156     20303900  P       306250000
157     *
158     .END
```

4.9.3 SV Cold Loop Seal (Quarter Model)

LISTING OF INPUT DATA FOR CASE 1

```
    1   =AEP UNIT2 1 LINE RELAP5
    2   100 NEW TRANSNT
    3   101 RUN
    4   102 BRITISH BRITISH
    5   104 NOACTION
    6   * TIME STEP CONTROL
    7   *
    8   201  0.6000  1.0-7  2.0-4  11001  5  25  250
    9   * MINOR EDITS
   10   *
   11   301  QUALS  007010000
   12   302  QUALS  005200000
   13   303  QUALS  013200000
   14   304  P      005200000
   15   305  P      007010000
   16   308  P      007380000
   17   307  MFLOWJ 006000000
   18   308  MFLOWJ 005070000
   19   309  MFLOWJ 014000000
   20   310  P      007140000
   21   311  P      011560000
   22   312  P      013300000
   23   313  MFLOWJ 007140000
   24   314  MFLOWJ 007380000
   25   315  MFLOWJ 011560000
   26   *
   27   *
   28  2001  5,192,001010000,003010000,005010000
   29  2002  005020000,005030000,005040000,005050000,005060000
   30  2003  005070000,005080000,005090000,005100000,005110000
   31  2004  005120000,005130000,005140000,005150000,005160000
   32  2005  005170000,005180000,005190000,005200000,007010000
   33  2006  007020000,007030000,007040000,007050000,007060000,007070000
   34  2007  007080000,007090000,007100000,007110000,007120000
   35  2008  007130000,007140000,007150000,007160000,007170000
   36  2009  007180000,007190000,007200000,007210000,007220000
   37  2010  007230000,007240000,007250000,007260000,007270000
   38  2011  007280000,007290000,007300000,007310000,007320000
   39  2012  007330000,007340000,007350000,007360000,007370000
   40  2013  007380000,007390000,009010000,011010000,011020000
   41  2014  011030000,011040000,011050000,011060000,011070000
   42  2015  011080000,011090000,011100000,011110000,011120000
   43  2016  011130000,011140000,011150000,011160000,011170000
   44  2017  011180000,011190000,011200000,011210000,011220000
   45  2018  011230000,011240000,011250000,011260000,011270000
   46  2019  011280000,011290000,011300000,011310000,011320000
   47  2020  011330000,011340000,011350000,011360000,011370000
   48  2021  011380000,011390000,011400000,011410000,011420000
   49  2022  011430000,011440000,011450000,011460000,011470000
   50  2023  011480000,011490000,011500000,011510000,011520000
   51  2024  011530000,011540000,011550000,011560000,011570000
   52  2025  011580000,011590000,011600000,011810000,011820000
   53  2026  011830000,011840000,011850000,011860000,011870000
   54  2027  011880000,011890000,011700000,011710000,011720000
   55  2028  011730000,011740000,011750000,011760000,011770000
   56  2029  011780000,011790000,011800000,011810000,011820000
```

BY CLM DATE 2-9-83

CHKD. BY LGS DATE 2-9-83

TELEDYNE ENGINEERING SERVICES

```
2030  011830000,011840000,011850000,011860000,011870000
2031  011880000,011890000,011900000,011910000,011920000
2032  011930000,011940000,011950000,011960000,011970000
2033  011980000,011990000,013010000,013020000,013030000
2034  013040000,013050000,013060000,013070000,013080000
2035  013090000,013100000,013110000,013120000,013130000
2036  013140000,013150000,013160000,013170000,013180000
2037  013190000,013200000,013210000,013220000,013230000
2038  013240000,013250000,013260000,013270000,013280000
2039  013290000,013300000,015010000
*
*TRIPS
*
502  TIME  0  GT NULL 0  1.500  L  * JOB TERMINATION TRIP
503  TIME  0  GE NULL 0  0.0    L  * VALVE OPEN
504  TIME  0  GE  NULL  0  5.0  L  * VALVE CLOSED
600  502
*
*  HYDRODYNAMIC COMPONENTS
*
*
* PRESSURIZER
*
0010000  "PRESS1"  TMDPVOL
0010101  0.0  20.0  500.0  0.0  0.0  0.0  0.00005  0.0  11
0010200  2
0010201  0.0  2500.0  1.0  0.1  2514.0  1.0  0.3  2555.0  1.0  0.5  2600.0  1.0
0010202  0.7  2687.0  1.0  0.9  2700.0  1.0  1.1  2740.0  1.0  1.3  2745.0  1.0
0010203  1.5  2747.0  1.0  1.7  2748.0  1.0  1.9  2750.0  1.0  2.0  2750.0  1.0
0010204  2.5  2750.0  1.0
*
*  LOOP SEAL GEOMETRY
*
0020000  "LPSL"  SNGLJUN
0020101  001000000  003000000  0.0  0.0  0.0  1000  * THIS IS A SHORT RADIUS ELBOW LEAVING
0020201  1  0.0  0.0  0.0
*
0030000  "LPSL" SNGLVOL
0030101  0.1465  1.0  0.0  90.0  0.0  0.0  0.000151  0.0  00
0030200    2  2500.0  1.0
*
0040000  "LPSL"  SNGLJUN
0040101  003010000  005000000  0.0  0.1838  0.1838  1000
0040201  1  0.0  0.0  0.0
*
0050000  "LPSL"  PIPE
0050001  20
0050101  0.1465  20
0050301  0.50  10
0050302  0.574  20
0050401  0.0  20
0050601  -90.0  7
0050602  0.0  10
0050603  90.0  20
0050801  0.000151  0.0  20
0050901  0.0  0.0  6
0050902  0.1838  0.1838  7
0050903  0.0  0.0  9
```

```
0050904  0.1838  0.1838  10
0050905  0 0  0.0  19
0051001  00  20
0051101  1000  19
0051201  3  2500.0  584.4  0.0  0.0  1
0051202  3  2500.0  451.1  0.0  0.0  2
0051203  3  2500.0  352.1  0.0  0.0  3
0051204  3  2500.0  276.8  0.0  0.0  4
0051205  3  2500.0  218.1  0.0  0.0  5
0051206  3  2500.0  169.3  0.0  0.0  8
0051207  3  2500.0  141.1  0.0  0.0  20
0051300  1
0051301  0.0  0.0  0.0  19
*
*****************************
*  VALVE  6M8  CROSBY SAFETY
*****************************
0060000  "SRV"  VALVE
0060101  005010000  007000000  0.022  0.0  0.0  0100
0060201  1  0.0  0.0  0.0
0060300  MTRVLV
0060301  503  504  100.0  0.0  *  CROSBY 6M8  OPENING IN 10 MSEC
*
*  DISCHARBE PIPING
0070000  "DISCHA1"  PIPE
0070001  39
0070101  0.20069  39
0070301  0.526  4
0070302  1.094  14
* ARC STARTS HERE LEVEL 669-2"
0070303  0.94167  17
0070304  0.942  20
0070305  0.8425  23
0070306  0.844  26
0070307  0.8433  29
0070308  0.8333  32
0070309  0.8333  35
* ARC ENDS
0070310  0.91750  39
0070401  0.0  39
0070601  0.0  4
0070602  -90.0  14
0070603  0.0  39
0070801  0.000152  0.0  39
0070901  0.0  0.0  3
0070902  0.1800  0.1800  4
0070903  0.0  0.0  13
0070904  0.1800  0.1800  14
0070905  0 0  0.0  38
0071001  00  39
0071101  1000  38
0071201  4  14.7  120.0  0.9284  0.0  39
0071300  1
0071301  0.0  0.0  0.0  38
*
0080000  "DISCHA1"  SNGLJUN
0080101  007010000  009000000  0.0  0.1560  0.1560  1000  *LOSSES FOR A 12 IN ELBOW
0080201  1  0.0  0.0  0.0
```

```
    *
    * INPUT A BRANCH HERE FOR A COMPLETE MODEL
    *
0090000  "DISCHA1"  SNGLVOL
0090101  0.7771  0.5  0.0  0.0  -90.0  -0.5  0.000169  0.0  00
0090200  4  14.7  120.0  0.9284
    *
0100000  "DISCHA1"  SNGLJUN
0100101  009010000  011000000  0.0  0.0  0.0  1000
0100201  1  0.0  0.0  0.0
    *
0110000  "DISCH1A"  PIPE
0110001  99
0110101  0.7771  99
0110301  1.039  14
0110302  0.53025  18
0110303  0.5  22
0110304  0.53025  26
0110305  0.9875  58
0110306  0.475  68
0110307  0.49359  79
0110308  0.46875  87
0110309  0.51172  95
0110310  0.85  99
0110401  0.0  99
0110601  -90.0  14
0110602  -45.0  18
0110603  -90.0  22
0110604  -45.0  26
0110605  -90.0  58
0110606  0.0  87
0110607  -90.0  95
0110608  0.0  99
0110801  0.000169  0.0  99
0110901  0.0  0.0  13
0110902  0.078  0.078  14
0110903  0.0  0.0  17
0110904  0.078  0.078  18
0110905  0.0  0.0  21
0110906  0.078  0.078  22
0110907  0.0  0.0  25
0110908  0.078  0.078  26
0110909  0.0  0.0  55
0110910  0.156  0.156  56
0110911  0.0  0.0  65
0110912  0.156  0.156  66
0110913  0.0  0.0  78
0110914  0.156  0.156  79
0110915  0.0  0.0  86
0110916  0.156  0.156  87
0110917  0.0  0.0  94
0110918  0.156  0.156  95
0110919  0.0  0.0  98
0111001  00  99
0111101  1000  98
0111201  4  14.7  120.0  0.9284  0.0  99
0111300  1
0111301  0.0  0.0  0.0  98
```


TELEDYNE ENGINEERING SERVICES

```
*
0120000  "DISCHA1"  SNGLJUN
0120101  011010000  013000000  0.0  0.0  0.0  1000
0120201  1  0.0  0.0  0.0
*
0130000  "DISCHA1" PIPE
0130001  30
0130101  0.7771  30
0130301  0.95  8
0130302  1.0  20
0130303  0.5  30
0130401  0.0  30
0130601  0.0  30
0130801  0.000169  0.0  30
0130901  0.0  0.0  5
0130902  0.156  0.156  8
0130903  0.0  0.0  19
0130904  0.156  0.156  20
0130905  0.0  0.0  29
0131001  00  30
0131101  1000  29
0131201  4  14.7  120.0  0.9284  0.0  30
0131300  1
0131301  0.0  0.0  0.0  29
*
0140000  "DISCH1A"  SNGLJUN
0140101  013010000  015000000  0.0  0.0  0.0  0100
0140201  1  0.0  0.0  0.0
*
0150000  "ATMOS"  TMDPVOL
0150101  10000.0  10000.0  0.0  0.0  0.0  0.0  0.00001  0.0  11
0150200  4
0150201  0.0  14.7  120.0  0.9284
*
* PLOT CARDS
*
20300100  QUALS  007010000
20300200  QUALS  005200000
20300300  QUALS  013200000
20300400  P      005200000
20300500  P      007010000
20300600  P      007380000
20300700  MFLOWJ 006000000
20300800  MFLOWJ 005070000
20300900  MFLOWJ 014000000
20301000  P    007140000
20301100  P    011560000
20301200  P    013300000
20301300  MFLOWJ  007140000
20301400   MFLOWJ  007380000
20301500  MFLOWJ  011560000
.END OF CASE
```


TELEDYNE ENGINEERING SERVICES

4.10 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 PORV model, it was necessary to break up the model in two sections because of REPIPE's size limitations.

Input Set	Model Section
4.10.1	A
4.10.2	B
4.10.3	Quarter Model

4.10.1 Model Section A PORV Unit 2

```
$PIPES
 INLINE=3,KBLOCK=200,KPIPE=10,KPLOT(1)=1,KWAVE=1,
 KPRINT=-1,KPNV=1,KSTEP=3,
 NDROPV=385010000,206330000,811190000$
342    386000000    -0.3710    0.6786    0.6340/
340    -387010000   -0.3710    0.6786    0.6340/
339    387010000     0.0   1.0   0.0/
339    387020000     0.0   1.0   0.0/
339    387030000     0.0   1.0   0.0/
339    387040000     0.0   1.0   0.0/
339    387050000    0.0   1.0   0.0/
339    387060000    0.0   1.0   0.0/
339    387070000    0.0   1.0   0.0/
339    387080000    0.0   1.0   0.0/
339    387090000    0.0   1.0   0.0/
339    387100000    0.0   1.0   0.0/
339    387110000    0.0   1.0   0.0/
339    388000000    0.0   1.0   0.0/
339    420000000    0.0   1.0   0.0/
339    425010000    0.0   1.0   0.0/
339    425020000    0.0   1.0   0.0/
336   -387020000    0.0   1.0   0.0/
336   -387030000    0.0   1.0   0.0/
336   -387040000    0.0   1.0   0.0/
336   -387050000    0.0   1.0   0.0/
336   -387060000    0.0   1.0   0.0/
336   -387070000    0.0   1.0   0.0/
336   -387080000    0.0   1.0   0.0/
336   -387090000    0.0   1.0   0.0/
336   -387100000    0.0   1.0   0.0/
336   -387110000   0.0   1.0   0.0/
336   -388000000    0.0    1.0    0.0/
336   -420000000    0.0    1.0    0.0/
336  -498000000  0.0  1.0  0.0/
336   -425010000    0.0    1.0    0.0/
336   -425020000    0.0    1.0    0.0/
336   -425030000    0.0    1.0    0.0/
334    425030000    0.7844      0.0    0.6202/
334    425040000    0.7844      0.0    0.6202/
334    430000000    0.7844      0.0    0.6202/
330   -425040000    0.7844      0.0    0.6202/
330   -430000000    0.7844      0.0    0.6202/
330   -435010000    0.7844      0.0    0.6202/
334   435010000   0.7844      0.0    0.6202/
334   440000000   0.7844      0.0    0.6202/
334   445010000   0.7844      0.0    0.6202/
334   445020000   0.7844      0.0    0.6202/
334   445030000   0.7844      0.0    0.6202/
334   445040000   0.7844      0.0    0.6202/
330   -440000000    0.7844      0.0    0.6202/
330   -445010000    0.7844      0.0    0.6202/
330   -445020000    0.7844      0.0    0.6202/
330   -445030000    0.7844      0.0    0.6202/
330   -445040000    0.7844      0.0    0.6202/
330   -445050000    0.7844      0.0    0.6202/
328    445050000    0.0    1.0    0.0/
328    445060000    0.0    1.0    0.0/
328    445070000    0.0    1.0    0.0/
328    445080000    0.0    1.0    0.0/
```

BY KJG DATE 5-21-83

CHKD. BY MR DATE 5/24/83

```
324   -445060000     0.0     1.0     0.0/
324   -445070000     0.0     1.0     0.0/
324   -445080000     0.0     1.0     0.0/
324   -445090000     0.0     1.0     0.0/
322    445090000    0.9138     0.0    -0.4062/
322    450000000    0.9138     0.0    -0.4062/
322    460000000    0.9138     0.0    -0.4062/
322    465010000    0.9138     0.0    -0.4062/
322    465020000    0.9138     0.0    -0.4062/
322    470000000    0.9138     0.0    -0.4062/
318   -450000000    0.9138     0.0    -0.4062/
318   -460000000    0.9138     0.0    -0.4062/
318   -491000000  0.9138  0.0    -0.4062/
318   -465010000    0.9138     0.0    -0.4062/
318   -465020000    0.9138     0.0    -0.4062/
318    -470000000    0.9138     0.0    -0.4062/
318   -475010000    0.9138     0.0    -0.4062/
3181   475010000    0.8212     0.0    -0.5707/
3181   480000000    0.8212     0.0    -0.5707/
3181   485010000    0.8212     0.0    -0.5707/
3181   485020000    0.8212     0.0    -0.5707/
3181   485030000    0.8212     0.0    -0.5707/
316   -480000000    0.8212     0.0    -0.5707/
316   -485010000    0.8212     0.0    -0.5707/
316   -485020000    0.8212     0.0    -0.5707/
316   -485030000    0.8212     0.0    -0.5707/
316   -485040000    0.8212     0.0    -0.5707/
3161   485040000     0.5557     0.0    -0.8314/
3161   485050000     0.5557     0.0    -0.8314/
3161   485060000     0.5557     0.0    -0.8314/
3161   485070000     0.5557     0.0    -0.8314/
314   -485050000     0.5557     0.0    -0.8314/
314   -485060000     0.5557     0.0    -0.8314/
314   -485070000     0.5557     0.0    -0.8314/
314   -485080000     0.5557     0.0    -0.8314/
3141   485080000    0.2178     0.0    -0.9760/
3141   485090000    0.2178     0.0    -0.9760/
3141   485100000    0.2178     0.0    -0.9760/
3141   485110000    0.2178     0.0    -0.9760/
312   -485090000    0.2178     0.0    -0.9760/
312   -485100000    0.2178     0.0    -0.9760/
312   -485110000    0.2178     0.0    -0.9760/
312   -485120000    0.2178     0.0    -0.9760/
3121   485120000   -0.1543     0.0    -0.9880/
3121   485130000   -0.1543     0.0    -0.9880/
3121   485140000   -0.1543     0.0    -0.9880/
3121   485150000   -0.1543     0.0    -0.9880/
310   -485130000   -0.1543     0.0    -0.9880/
310   -485140000   -0.1543     0.0    -0.9880/
310   -485150000   -0.1543     0.0    -0.9880/
310   -485160000   -0.1543     0.0    -0.9880/
3101    485160000   -0.9272   -0.0262   -0.3745/
308    485170000   -0.9272   -0.0262   -0.3745/
308    485180000   -0.9272   -0.0262   -0.3745/
308    485190000   -0.9272   -0.0262   -0.3745/
308    485200000   -0.9272   -0.0262   -0.3745/
308    485210000   -0.9272   -0.0262   -0.3745/
308    485220000   -0.9272   -0.0262   -0.3745/
308    485230000   -0.9272   -0.0262   -0.3745/
308    485240000   -0.9272   -0.0262   -0.3745/
```

```
308    485250000    -0.9272    -0.0262    -0.3745/
308    485260000    -0.9272    -0.0262    -0.3745/
3081   -485170000   -0.9272    -0.0262    -0.3745/
294    -485180000   -0.9272    -0.0262    -0.3745/
294    -485190000   -0.9272    -0.0262    -0.3745/
294    -485200000   -0.9272    -0.0262    -0.3745/
294    -485210000   -0.9272    -0.0262    -0.3745/
294    -485220000   -0.9272    -0.0262    -0.3745/
294    -485230000   -0.9272    -0.0262    -0.3745/
294    -485240000   -0.9272    -0.0262    -0.3745/
294    -485250000   -0.9272    -0.0262    -0.3745/
294    -485260000   -0.9272    -0.0262    -0.3745/
294    -490000000   -0.9272    -0.0262    -0.3745/
292    490000000    -0.9272    -0.0262    -0.3745/
292    400010000    -0.9272    -0.0262    -0.3745/
292    400020000    -0.9272    -0.0262    -0.3745/
292    400030000    -0.9272    -0.0262    -0.3745/
288    -400010000   -0.9272    -0.0262    -0.3745/
288    -400020000   -0.9272    -0.0262    -0.3745/
288    -400030000   -0.9272    -0.0262    -0.3745/
288    -400040000   -0.9272    -0.0262    -0.3745/
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/
320    491000000    0.3746    0.0185    -0.9272/
320    492010000    0.3746    0.0185    -0.9272/
320    492020000    0.3746    0.0185    -0.9272/
320    492030000    0.3746    0.0185    -0.9272/
320    492040000    0.3746    0.0185    -0.9272/
320    492050000    0.3746    0.0185    -0.9272/
320    492060000    0.3746    0.0185    -0.9272/
320    492070000    0.3746    0.0185    -0.9272/
320    492080000    0.3746    0.0185    -0.9272/
320    492090000    0.3746    0.0185    -0.9272/
320    492100000    0.3746    0.0185    -0.9272/
348    -492010000   0.3746    0.0185    -0.9272/
348    -492020000   0.3746    0.0185    -0.9272/
348    -492030000   0.3746    0.0185    -0.9272/
348    -492040000   0.3746    0.0185    -0.9272/
348    -492050000   0.3746    0.0185    -0.9272/
348    -492060000   0.3746    0.0185    -0.9272/
348    -492070000   0.3746    0.0185    -0.9272/
348    -492080000   0.3746    0.0185    -0.9272/
348    -492090000   0.3746    0.0185    -0.9272/
348    -492100000   0.3746    0.0185    -0.9272/
348    -493000000   0.3746    0.0185    -0.9272/
346    493000000    0.3746    0.0185    -0.9272/
346    600010000    0.3746    0.0185    -0.9272/
346    600020000    0.3746    0.0185    -0.9272/
344    -600010000   0.3746    0.0185    -0.9272/
344    -600020000   0.3746    0.0185    -0.9272/
344    -600030000   0.3746    0.0185    -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/
2402    -600050000     0.0     -1.0     0.0/
2402    -600060000     0.0     -1.0     0.0/
2402    -601000000     0.0     -1.0     0.0/
284     498000000    -0.9272     0.0     -0.3746/
284     410010000    -0.9272     0.0     -0.3746/
284     410020000    -0.9272     0.0     -0.3746/
284     410030000    -0.9272     0.0     -0.3746/
284     410040000    -0.9272     0.0     -0.3746/
282    -410010000    -0.9272     0.0     -0.3746/
282    -410020000    -0.9272     0.0     -0.3746/
282    -410030000    -0.9272     0.0     -0.3746/
282    -410040000    -0.9272     0.0     -0.3746/
282    -410050000    -0.9272     0.0     -0.3746/
280     410050000     0.0      1.0      0.0/
280     410060000     0.0      1.0      0.0/
280     410070000     0.0      1.0      0.0/
280     410080000     0.0      1.0      0.0/
280     410090000     0.0      1.0      0.0/
280     410100000     0.0      1.0      0.0/
278    -410060000     0.0      1.0      0.0/
278    -410070000     0.0      1.0      0.0/
278    -410080000     0.0      1.0      0.0/
278    -410090000     0.0      1.0      0.0/
278    -410100000     0.0      1.0      0.0/
278    -410110000     0.0      1.0      0.0/
276     410110000    0.9270    -0.0218     0.3745/
276     410120000    0.9270    -0.0218     0.3745/
276     410130000    0.9270    -0.0218     0.3745/
276     410140000    0.9270    -0.0218     0.3745/
276     410150000    0.9270    -0.0218     0.3745/
276     410160000    0.9270    -0.0218     0.3745/
276     410170000    0.9270    -0.0218     0.3745/
276     410180000    0.9270    -0.0218     0.3745/
276     410190000    0.9270    -0.0218     0.3745/
276     410200000    0.9270    -0.0218     0.3745/
264    -410120000    0.9270    -0.0218     0.3745/
264    -410130000    0.9270    -0.0218     0.3745/
264    -410140000    0.9270    -0.0218     0.3745/
264    -410150000    0.9270    -0.0218     0.3745/
264    -410160000    0.9270    -0.0218     0.3745/
264    -410170000    0.9270    -0.0218     0.3745/
264    -410180000    0.9270    -0.0218     0.3745/
264    -410190000    0.9270    -0.0218     0.3745/
264    -410200000    0.9270    -0.0218     0.3745/
264    -415000000    0.9270    -0.0218     0.3745/
262     415000000    0.9270    -0.0218     0.3745/
262     500010000    0.9270    -0.0218     0.3745/
262     500020000    0.9270    -0.0218     0.3745/
260    -500010000    0.9270    -0.0218     0.3745/
260    -500020000    0.9270    -0.0218     0.3745/
260    -500030000    0.9270    -0.0218     0.3745/
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/
252    -500060000     0.0     -1.0     0.0/
250     500060000     0.7559     0.0     -0.6547/
```

```
248    -500070000     0.7559     0.0     -0.6547/
2481    500070000     0.7170     0.0     -0.6971/
2481    500080000     0.7170     0.0     -0.6971/
2481    500090000     0.7170     0.0     -0.6971/
246    -500080000     0.7170     0.0     -0.6971/
246    -500090000     0.7170     0.0     -0.6971/
246    -500100000     0.7170     0.0     -0.6971/
2461    500100000     0.3736     0.0     -0.9276/
2461    500110000     0.3736     0.0     -0.9276/
2461    500120000     0.3736     0.0     -0.9276/
244    -500110000     0.3736     0.0     -0.9276/
244    -500120000     0.3736     0.0     -0.9276/
244    -500130000     0.3736     0.0     -0.9276/
2441    500130000     0.0282     0.0     -0.9996/
2441    500140000     0.0282     0.0     -0.9996/
2441    500150000     0.0282     0.0     -0.9996/
2441    501000000     0.0282     0.0     -0.9996/
242    -500140000     0.0282     0.0     -0.9996/
242    -500150000     0.0282     0.0     -0.9996/
242    -501000000     0.0282     0.0     -0.9996/
242    -502010000     0.0282     0.0     -0.9996/
2421    502010000    -0.2531     0.0     -0.9674/
240    -503000000    -0.2531     0 0     -0.9674/
2401    503000000    -0.3508     0.0     -0.9364/
2401   601000000  -0.3508  0.0  -0.9364/
238    -505000000    -0.3508     0.0     -0.9364/
2381    505000000     -0.6395     0.0     -0.7688/
2381    506010000     -0.6395     0.0     -0.7688/
2381    506020000     -0.6395     0.0     -0.7688/
2381    506030000     -0.6395     0.0     -0.7688/
236    -506010000     -0.6395     0.0     -0.7688/
236    -506020000     -0.6395     0.0     -0.7688/
236    -506030000     -0.6395     0.0     -0.7688/
236    -506040000     -0.6395     0.0     -0.7688/
2361    506040000     -0.9576     0.0     -0.2882/
2361    506050000     -0.9576     0.0     -0.2882/
2361    506060000     -0.9576     0.0     -0.2882/
2361    506070000     -0.9576     0.0     -0.2882/
234    -506050000     -0.9576     0.0     -0.2882/
234    -506060000     -0.9576     0.0     -0.2882/
234    -506070000     -0.9576     0.0     -0.2882/
234    -506080000     -0.9576     0.0     -0.2882/
2341    506080000     -0.9998     0.0     -0.0175/
2341    507000000     -0.9998     0.0     -0.0175/
2341    508010000     -0.9998     0.0     -0.0175/
2341    509000000     -0.9998     0.0     -0.0175/
2341    511000000     -0.9998     0.0     -0.0175/
226    -507000000     -0.9998     0.0     -0.0175/
226    -508010000     -0.9998     0.0     -0.0175/
226    -509010000     -0.9998     0.0     -0.0175/
226    -511000000     -0.9998     0.0     -0.0175/
226    -700010000     -0.9998     0.0     -0.0175/
224    700010000    0.0    -1.0    0.0/
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/
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/
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    -700020000     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/
68    -811070000     0.0     -1.0     0.0/
68    -811080000     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/
```

```
 68     811140000    -0.2356    -0.7071    0.6667/
 66     811150000    -0.2356    -0.7071    0.6667/
 66     811160000    -0.2356    -0.7071    0.6667/
 66     811170000    -0.2356    -0.7071    0.6667/
 64    -811150000    -0.2356    -0.7071    0.6667/
 64    -811160000    -0.2356    -0.7071    0.6667/
 64    -811170000    -0.2356    -0.7071    0.6667/
 64    -811180000    -0.2356    -0.7071    0.6667/
198  305000000  -0.9975   0.0  0.0709/
198     306010000   -0.9975    0.0    0.0709/
198     306020000   -0.9975    0.0    0.0709/
198     306030000   -0.9975    0.0    0.0709/
195  -306010000  -0.9975  0.0  0.0709/
195    -306020000   -0.9975    0.0    0.0709/
195    -306030000   -0.9975    0.0    0.0709/
195    -306040000   -0.9975    0.0    0.0709/
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/
190     306080000    0.0     -1.0     0.0/
190     306090000    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    -0.9359     0.0     -0.3523/
184     306130000    -0.9359     0.0     -0.3523/
184     306140000    -0.9359     0.0     -0.3523/
182    -306130000    -0.9359     0.0     -0.3523/
182    -306140000    -0.9359     0.0     -0.3523/
182    -306150000    -0.9359     0.0     -0.3523/
1821    306150000    -0.6354     0.0     -0.7722/
1821    306160000    -0.6354     0.0     -0.7722/
1821    306170000    -0.6354     0.0     -0.7722/
180    -306160000    -0.6354     0.0     -0.7722/
180    -306170000    -0.6354     0.0     -0.7722/
180    -306180000    -0.6354     0.0     -0.7722/
1801   306180000    -0.0516     0.0     -0.9987/
1801   306190000    -0.0516     0.0     -0.9987/
1801   306200000    -0.0516     0.0     -0.9987/
178   -306190000    -0.0516     0.0     -0.9987/
178   -306200000    -0.0516     0.0     -0.9987/
178   -306210000    -0.0516     0.0     -0.9987/
1781   306210000    0.2639     0.0     -0.9645/
1781   306220000    0.2639     0.0     -0.9645/
1781   306230000    0.2639     0.0     -0.9645/
1781   306240000    0.2639     0.0     -0.9645/
176   -306220000    0.2639     0.0     -0.9645/
176   -306230000    0.2639     0.0     -0.9645/
176   -306240000    0.2639     0.0     -0.9645/
176   -307000000    0.2639     0.0     -0.9645/
104   105000000  0.7169  0.0  0.6972/
104    106010000    0.7169     0.0     0.6972/
```

```
104    106020000     0.7169     0.0     0.6972/
104    106030000     0.7169     0.0     0.6972/
98   -106010000  0.7169  0.0  0.6972/
98    -106020000     0.7169     0.0     0.6972/
98    -106030000     0.7169     0.0     0.6972/
98    -106040000     0.7169     0.0     0.6972/
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     0.2657     0.0     0.9641/
88     106150000     0.2657     0.0     0.9641/
88     106160000     0.2657     0.0     0.9641/
86    -106150000     0.2657     0.0     0.9641/
86    -106160000     0.2657     0.0     0.9641/
86    -106170000     0.2657     0.0     0.9641/
861    106170000    -0.3889     0.0     0.9213/
861    106180000    -0.3889     0.0     0.9213/
861    106190000    -0.3889     0.0     0.9213/
84    -106180000    -0.3889     0.0     0.9213/
84    -106190000    -0.3889     0.0     0.9213/
84    -106200000    -0.3889     0.0     0.9213/
841    106200000    -0.8464     0.0     0.5326/
841    106210000    -0.8464     0.0     0.5326/
841    106220000    -0.8464     0.0     0.5326/
82    -106210000    -0.8464     0.0     0.5326/
82    -106220000    -0.8464     0.0     0.5326/
82    -106230000    -0.8464     0.0     0.5326/
821    106230000    -0.9999     0.0     0.0162/
821    106240000    -0.9999     0.0     0.0162/
821    106250000    -0.9999     0.0     0.0162/
80    -106240000    -0.9999     0.0     0.0162/
80    -106250000    -0.9999     0.0     0.0162/
80    -106260000    -0.9999     0.0     0.0162/
801    106260000    -0.8289     0.0    -0.5595/
801    106270000    -0.8289     0.0    -0.5595/
801    106280000    -0.8289     0.0    -0.5595/
78    -106270000    -0.8289     0.0    -0.5595/
78    -106280000    -0.8289     0.0    -0.5595/
78    -106290000    -0.8289     0.0    -0.5595/
781    106290000    -0.4813     0.0    -0.8768/
781    106300000    -0.4813     0.0    -0.8766/
781    106310000    -0.4813     0.0    -0.8766/
76    -106300000    -0.4813     0.0    -0.8768/
```

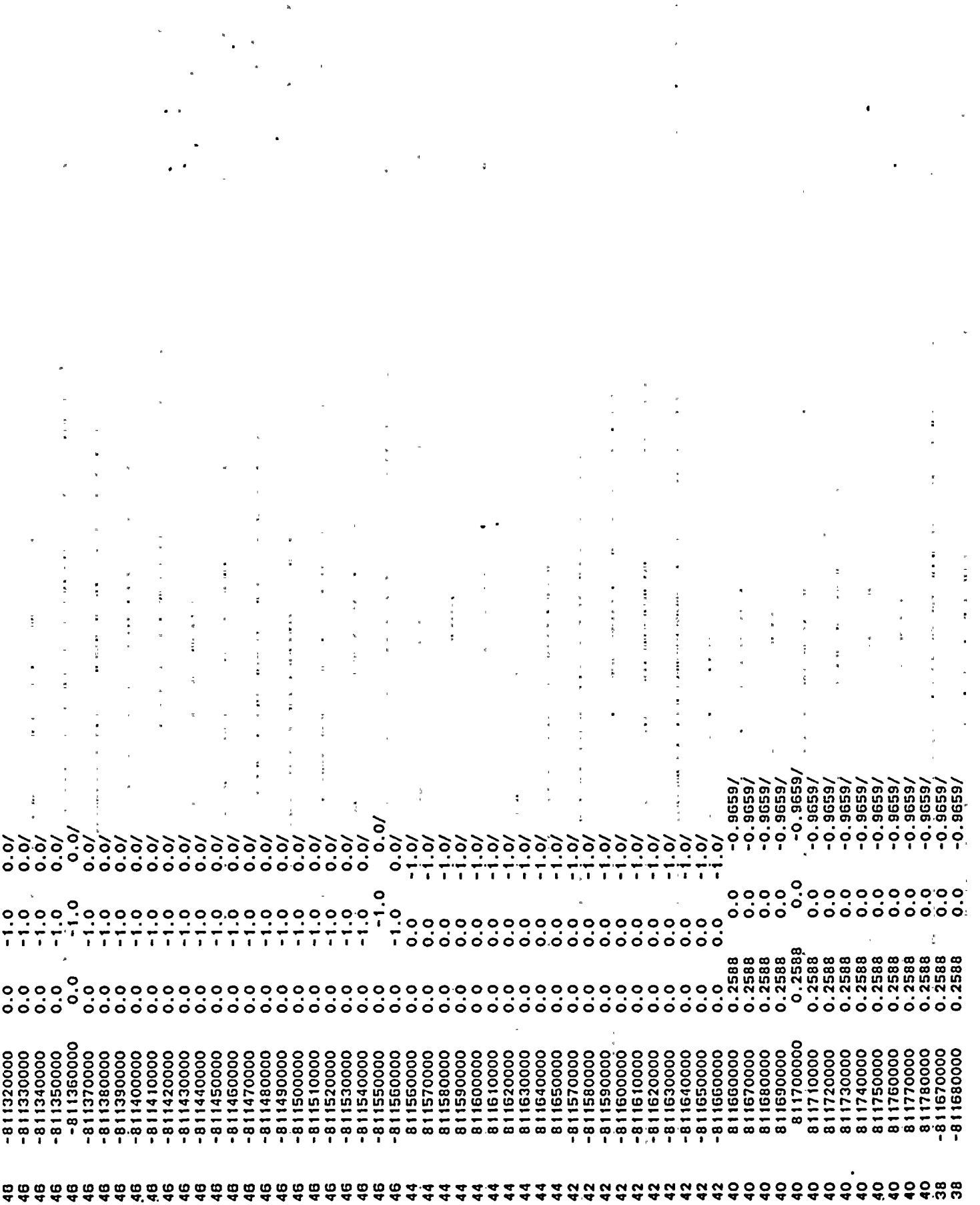
```
76     -106310000     -0.4813     0.0     -0.8766/
76     -106320000     -0.4813     0.0     -0.8766/
761     106320000     -0.2356    -0.7071     0.6667/
761     106330000     -0.2356    -0.7071     0.6667/
761     106340000     -0.2356    -0.7071     0.6667/
74     -106330000     -0.2356    -0.7071     0.6667/
74     -106340000     -0.2356    -0.7071     0.6667/
74     -106350000     -0.2356    -0.7071     0.6667/
741     106350000     0.2639     0.0     -0.9645/
741     106360000     0.2639     0.0     -0.9645/
741     106370000     0.2639     0.0     -0.9645/
741     106380000     0.2639     0.0     -0.9645/
72      -106360000     0.2639     0.0     -0.9645/
72      -106370000     0.2639     0.0     -0.9645/
72      -106380000     0.2639     0.0     -0.9645/
72      -107000000     0.2639     0.0     -0.9645/
99999/
 $STEPS TSTEP(1)=0.001,0.200,-1,-1$
```

4.10.2 Model Section B PORV Unit 2

```
$PIPES
 INLINE=3,KBLOCK=200,KPIPE=10,KPLOT(1)=1,KWAVE=1,
 KPRINT=-1,KPNV=1,KSTEP=3,
 NDROPV=206010000,903030000,805010000,811180000$
154   206010000    -0.4181    0.0    0.9084/
154  206020000    -0.4181    0.0    0.9084/
154   206030000    -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    -0.8064    0.0    0.5913/
138   206150000    -0.8064    0.0    0.5913/
138   206160000    -0.8064    0.0    0.5913/
136  -206150000    -0.8064    0.0    0.5913/
136  -206160000    -0.8064    0.0    0.5913/
136  -206170000    -0.8064    0.0    0.5913/
1361  206170000    -0.9998    0.0    0.0191/
1361  206180000    -0.9998    0.0    0.0191/
1361  206190000    -0.9998    0.0    0.0191/
134  -206180000    -0.9998    0.0    0.0191/
134  -206190000    -0.9998    0.0    0.0191/
134  -206200000    -0.9998    0.0    0.0191/
1341  206200000    -0.8285    0.0    -0.5599/
1341  206210000    -0.8285    0.0    -0.5599/
1341  206220000    -0.8285    0.0    -0.5599/
132  -206210000    -0.8285    0.0    -0.5599/
132  -206220000    -0.8285    0.0    -0.5599/
132  -206230000    -0.8285    0.0    -0.5599/
1321  206230000    -0.4217    0.0    -0.9067/
1321  206240000    -0.4217    0.0    -0.9067/
1321  206250000    -0.4217    0.0    -0.9067/
130  -206240000    -0.4217    0.0    -0.9067/
130  -206250000    -0.4217    0.0    -0.9067/
130  -206260000    -0.4217    0.0    -0.9067/
1301  206260000    0.0323    0.0    -0.9995/
1301  206270000    0.0323    0.0    -0.9995/
1301  206280000    0.0323    0.0    -0.9995/
128  -206270000    0.0323    0.0    -0.9995/
128  -206280000    0.0323    0.0    -0.9995/
```

BY KJG DATE 5-21-83
CHKD. BY MIL DATE 5-26-83

```
128  -206290000    0.0323     0.0     -0.8995/
1281  206290000    0.2639     0.0     -0.9645/
1281  206300000    0.2639     0.0     -0.9645/
1281  206310000    0.2639     0.0     -0.9645/
1231  206320000    0.2639     0.0     -0.9645/
126  -206300000    0.2639     0.0     -0.9645/
126  -206310000    0.2639     0.0     -0.9645/
126  -206320000    0.2639     0.0     -0.9645/
126  -207000000    0.2639     0.0     -0.9645/
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/
58     811220000    0.2356    -0.7071    -0.6667/
56     811230000    0.2356    -0.7071    -0.6667/
56     811240000    0.2356    -0.7071    -0.6667/
56     811250000    0.2356    -0.7071    -0.6667/
54    -811230000    0.2356    -0.7071    -0.6667/
54    -811240000    0.2356    -0.7071    -0.6667/
54    -811250000    0.2356    -0.7071    -0.6667/
54    -811260000    0.2356    -0.7071    -0.6667/
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/
46    -811280000    0.0     -1.0      0.0/
46    -811290000    0.0     -1.0      0.0/
46    -811300000    0.0     -1.0      0.0/
46    -811310000    0.0     -1.0      0.0/
```



```
38    -811690000    0.2588    0.0    -0.9659/
38    -811700000    0.2588    0.0    -0.9659/
38    -811710000    0.2588    0.0    -0.9659/
38    -811720000    0.2588    0.0    -0.9659/
38    -811730000    0.2588    0.0    -0.9659/
38    -811740000    0.2588    0.0    -0.9659/
38    -811750000    0.2588    0.0    -0.9659/
38    -811760000    0.2588    0.0    -0.9659/
38    -811770000    0.2588    0.0    -0.9659/
38    -811780000    0.2588    0.0    -0.9659/
38    -811790000    0.2588    0.0    -0.9659/
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/
20    -813060000     1.0     0.0     0.0/
18     813060000     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     -813300000    -1.0     0.0     0.0/
4      900000000     0.0    -1.0     0.0/
4     901010000     0.0    -1.0     0.0/
4     901020000     0.0    -1.0     0.0/
4     902000000     0.0    -1.0     0.0/
4     903010000     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/
```

```
 $STEPS TSTEP(1)=0.001,1.0,-1,-1$
 99999/
```

4.10.3 Quarter Model

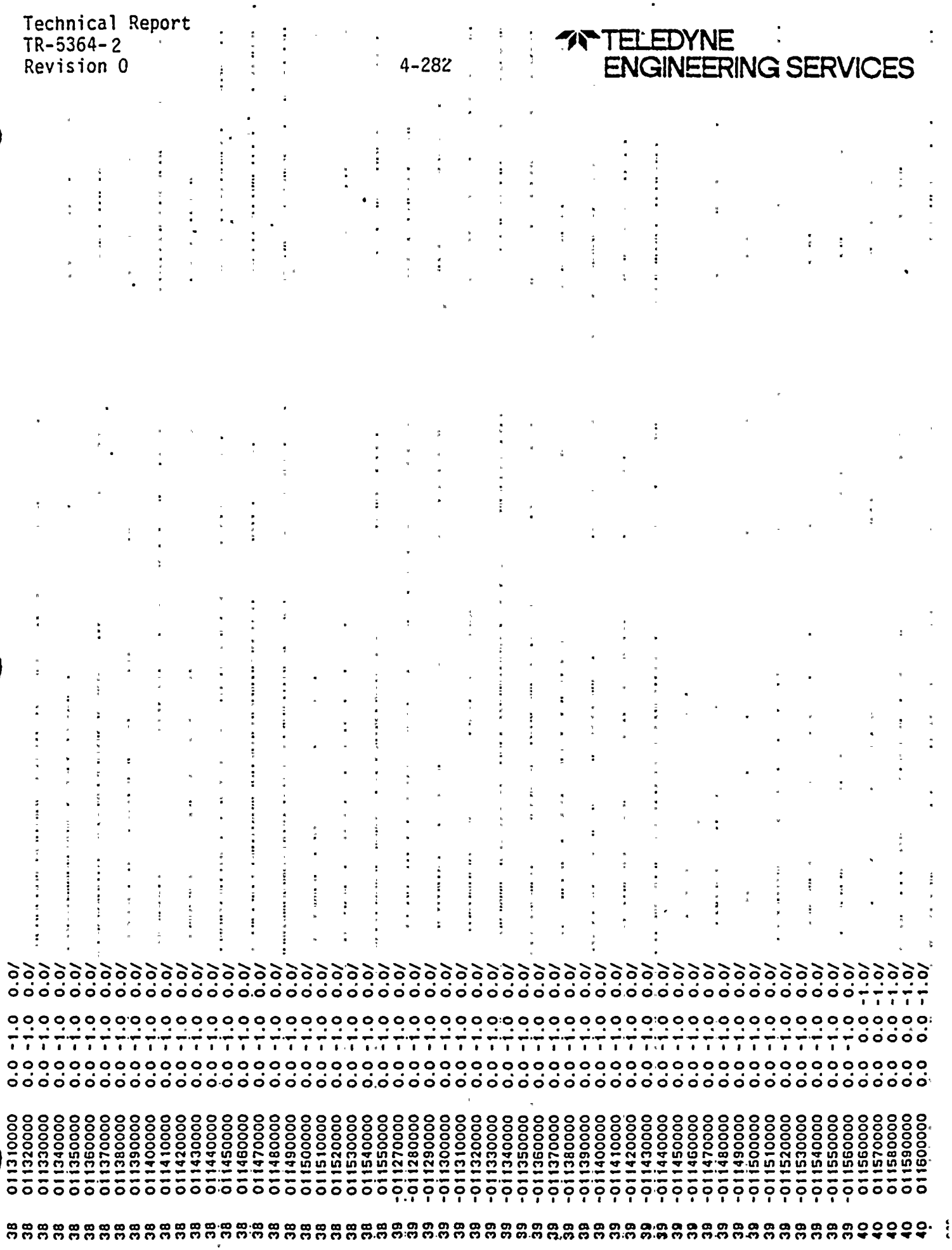
```
$PIPES
 INLINE=3,KBLOCK=601,KPIPE=0,KPLOT(1)=1,KWAVE=1,
 KPRINT=-1,KPNV=1,KSTEP=3,NDROPV=1010000,15010000$
1    002000000   -1.0  0.0  0.0/
2   -004000000   -1.0  0.0  0.0/
3    004000000    0.0  -1.0  0.0/
3    005010000    0.0 -1.0  0.0/
3    005020000    0.0 -1.0  0.0/
3    005040000    0.0 -1.0  0.0/
3    005050000    0.0 -1.0  0.0/
3    005060000    0.0 -1.0  0.0/
4   -005010000    0.0 -1.0  0.0/
4   -005020000    0.0 -1.0  0.0/
4   -005030000    0.0 -1.0  0.0/
4   -005040000    0.0 -1.0  0.0/
4   -005050000    0.0 -1.0  0.0/
4   -005060000    0.0 -1.0  0.0/
4   -005070000    0.0 -1.0  0.0/
5    005070000   -1.0  0.0  0.0/
5    005080000   -1.0  0.0  0.0/
5    005090000   -1.0  0.0  0.0/
6   -005080000   -1.0  0.0  0.0/
6   -005090000   -1.0  0.0  0.0/
6   -005100000   -1.0  0.0  0.0/
7    005100000    0.0  1.0  0.0/
7    005110000    0.0  1.0  0.0/
7    005120000    0.0  1.0  0.0/
7    005130000    0.0  1.0  0.0/
7    005140000    0.0  1.0  0.0/
7    005150000    0.0  1.0  0.0/
7    005160000    0.0  1.0  0.0/
7    005170000    0.0  1.0  0.0/
7    005180000    0.0  1.0  0.0/
7    005190000    0.0  1.0  0.0/
8   -005110000    0.0  1.0  0.0/
8   -005120000    0.0  1.0  0.0/
8   -005130000    0.0  1.0  0.0/
8   -005140000    0.0  1.0  0.0/
8   -005150000    0.0  1.0  0.0/
8   -005160000    0.0  1.0  0.0/
8   -005170000    0.0  1.0  0.0/
8   -005180000    0.0  1.0  0.0/
8   -005190000    0.0  1.0  0.0/
8   -008000000    0.0  1.0  0.0/
9    008000000   -1.0  0.0  0.0/
9    007010000   -1.0  0.0  0.0/
9    007020000   -1.0  0.0  0.0/
9    007030000   -1.0  0.0  0.0/
10  -007010000   -1.0  0.0  0.0/
10  -007020000   -1.0  0.0  0.0/
10  -007030000   -1.0  0.0  0.0/
10  -007040000   -1.0  0.0  0.0/
11   007040000    0.0 -1.0  0.0/
11   007050000    0.0 -1.0  0.0/
11   007060000    0.0 -1.0  0.0/
11   007070000    0.0 -1.0  0.0/
11   007080000    0.0 -1.0  0.0/
11   007090000    0.0 -1.0  0.0/
11   007100000    0.0 -1.0  0.0/
11   007110000    0.0 -1.0  0.0/
```

BY CMM DATE 2-9-83

CHKD. BY LOS DATE 2-9-83

```
11  007120000    0 0 -1.0   0.0/
11  007130000    0.0 -1.0   0.0/
12 -007050000    0.0 -1.0   0.0/
12 -007060000    0.0 -1.0   0.0/
12 -007070000    0.0 -1.0   0.0/
12 -007080000    0.0 -1.0   0.0/
12 -007090000    0.0 -1.0   0.0/
12 -007100000    0.0 -1.0   0.0/
12 -007110000    0.0 -1.0   0.0/
12 -007120000    0.0 -1.0   0.0/
12 -007130000    0.0 -1.0   0.0/
12 -007140000    0.0 -1.0   0.0/
14   007140000   -.258   0.0 -.966/
14   007150000   -.258   0.0 -.966/
14   007160000   -.258   0.0 -.966/
15  -007150000   -.258   0.0 -.966/
15  -007160000   -.258   0.0 -.966/
15  -007170000   -.258   0.0 -.966/
16   007170000    .337   0.0 -.942/
16   007180000    .337   0.0 -.942/
16   007190000    .337   0.0 -.942/
17  -007180000    .337   0.0 -.942/
17  -007190000    .337   0.0 -.942/
17  -007200000    .337   0.0 -.942/
18   007200000    .793   0.0 -.609/
18   007210000    .793   0.0 -.609/
18   007220000    .793   0.0 -.609/
19  -007210000    .793   0.0 -.609/
19  -007220000    .793   0 0 -.609/
19  -007230000    .793   0.0 -.609/
20   007230000    .994   0.0 -.1132/
20   007240000    .994   0.0 -.1132/
20   007250000    .994   0.0 -.1132/
21  -007240000    .994   0.0 -.1132/
21  -007250000    .994   0.0 -.1132/
21  -007260000    .994   0 0 -.1132/
22   007260000    .910   0.0  .415/
22   007270000    .910   0.0  .415/
22   007280000    .910   0.0  .415/
23  -007270000    .910   0.0  .415/
23  -007280000    .910   0.0  .415/
23  -007290000    .910   0.0  .415/
24   007290000    .555   0.0  .8321/
24   007300000    .555   0.0  .8321/
24   007310000    .555   0.0  .8321/
25  -007300000    .555   0.0  .8321/
25  -007310000    .555   0.0  .8321/
25  -007320000    .555   0.0  .8321/
26   007320000   .0183   0 0 .9998/
26   007330000   .0183   0.0 .9998/
26   007340000   .0183   0.0 .9998/
27  -007330000   .0183   0.0 .9998/
27  -007340000   .0183   0.0 .9998/
27  -007350000   .0183   0.0 .9998/
28   007350000   -.264   0.0  .965/
28   007360000   -.264   0.0  .965/
28   007370000   -.264   0.0  .965/
28   007380000   -.264   0.0  .965/
29  -007360000   -.264   0.0  .965/
29  -007370000   -.264   0.0  .965/
```

```
29  -007380000   -.264  0.0   .965/
29  -008000000   -.264  0.0   .965/
30   008000000    0.0 -1.0   0.0/
30   010000000    0.0 -1.0   0.0/
30   011010000    0.0 -1.0   0.0/
30   011020000    0.0 -1.0   0.0/
30   011030000    0.0 -1.0   0.0/
30   011040000    0.0 -1.0   0.0/
30   011050000    0.0 -1.0   0.0/
30   011060000    0.0 -1.0   0.0/
30   011070000    0.0 -1.0   0.0/
30   011080000    0.0 -1.0   0.0/
30   011090000    0.0 -1.0   0.0/
30   011100000    0.0 -1.0   0.0/
30   011110000    0.0 -1.0   0.0/
30   011120000    0.0 -1.0   0.0/
30   011130000    0.0 -1.0   0.0/
31  -010000000    0.0 -1.0   0.0/
31  -011010000    0.0 -1.0   0.0/
31  -011020000    0.0 -1.0   0.0/
31  -011030000    0.0 -1.0   0.0/
31  -011040000    0.0 -1.0   0.0/
31  -011050000    0.0 -1.0   0.0/
31  -011060000    0.0 -1.0   0.0/
31  -011070000    0.0 -1.0   0.0/
31  -011080000    0.0 -1.0   0.0/
31  -011090000    0.0 -1.0   0.0/
31  -011100000    0.0 -1.0   0.0/
31  -011110000    0.0 -1.0   0.0/
31  -011120000    0.0 -1.0   0.0/
31  -011130000    0.0 -1.0   0.0/
31  -011140000    0.0 -1.0   0.0/
32   011140000    .316 -.707 -.948/
32   011150000    .316 -.707 -.948/
32   011160000    .316 -.707 -.948/
32   011170000    .316 -.707 -.948/
33  -011150000    .316 -.707 -.948/
33  -011160000    .316 -.707 -.948/
33  -011170000    .316 -.707 -.948/
33  -011180000    .316 -.707 -.948/
34   011180000    0.0 -1.0   0.0/
34   011190000    0.0 -1.0   0.0/
34   011200000    0.0 -1.0   0.0/
34   011210000    0.0 -1.0   0.0/
35  -011200000    0.0 -1.0   0.0/
35  -011210000    0.0 -1.0   0.0/
35  -011220000    0.0 -1.0   0.0/
36   011220000   -.316 -.707  .948/
36   011230000   -.316 -.707  .948/
36   011240000   -.316 -.707  .948/
36   011250000   -.316 -.707  .948/
37  -011230000   -.316 -.707  .948/
37  -011240000   -.316 -.707  .948/
37  -011250000   -.316 -.707  .948/
37  -011260000   -.316 -.707  .948/
38   011260000    0.0 -1.0   0.0/
38   011270000    0.0 -1.0   0.0/
38   011280000    0.0 -1.0   0.0/
38   011290000    0.0 -1.0   0.0/
38   011300000    0.0 -1.0   0.0/
```



```
40   011610000    0.0   0.0  -1.0/
40   011620000    0.0   0.0  -1.0/
40   011630000    0.0   0.0  -1.0/
40   011640000    0.0   0.0  -1.0/
40   011650000    0.0   0.0  -1.0/
41  -011570000    0.0   0.0  -1.0/
41  -011580000    0.0   0.0  -1.0/
41  -011590000    0.0   0 0  -1.0/
41  -011600000    0.0   0.0  -1.0/
41  -011610000    0.0   0.0  -1.0/
41  -011620000    0.0   0.0  -1.0/
41  -011630000    0.0   0.0  -1.0/
41  -011640000    0.0   0.0  -1.0/
41  -011650000    0.0   0.0  -1.0/
41  -011660000    0.0   0.0  -1.0/
42   011660000   -.259   0.0   .966/
42   011670000   -.259   0.0   .966/
42   011680000   -.259   0.0   .966/
42   011690000   -.259   0.0   .966/
42   011700000   -.259   0.0   .966/
42   011710000   -.259   0.0   .966/
42   011720000   -.259   0.0   .966/
42   011730000   -.259   0.0   .966/
42   011740000   -.259   0.0   .966/
42   011750000   -.259   0 0   .966/
42   011760000   -.259   0.0   .966/
42   011770000   -.259   0.0   .966/
42   011780000   -.259   0.0   .966/
43  -011670000   -.259   0.0   .966/
43  -011680000   -.259   0.0   .966/
43  -011690000   -.259   0.0   .966/
43  -011700000   -.259   0.0   .966/
43  -011710000   -.259   0.0   .966/
43  -011720000   -.259   0.0   .966/
43  -011730000   -.259   0.0   .966/
43  -011740000   -.259   0.0   .966/
43  -011750000   -.259   0.0   .966/
43  -011760000   -.259   0.0   .966/
43  -011770000   -.259   0.0   .966/
43  -011780000   -.259   0.0   .966/
43  -011790000   -.259   0.0   .966/
44   011790000   -1.0   0.0   0.0/
44   011800000   -1.0   0.0   0.0/
44   011810000   -1.0   0.0   0.0/
44   011820000   -1.0   0.0   0.0/
44   011830000   -1.0   0.0   0.0/
44   011840000   -1.0   0.0   0.0/
44   011850000   -1.0   0.0   0.0/
44   011860000   -1.0   0.0   0.0/
45  -011800000   -1.0   0.0   0.0/
45  -011810000   -1.0   0.0   0.0/
45  -011820000   -1.0   0.0   0.0/
45  -011830000   -1.0   0.0   0.0/
45  -011840000   -1.0   0.0   0.0/
45  -011850000   -1.0   0.0   0.0/
45  -011860000   -1.0   0.0   0.0/
45  -011870000   -1.0   0.0   0.0/
46   011870000    0.0  -1.0   0.0/
46   011880000    0.0  -1.0   0.0/
46   011890000    0.0  -1.0   0.0/
```

```
 48   011900000    0.0 -1.0  0.0/
 48   011910000    0.0 -1.0  0.0/
 48   011920000    0.0 -1.0  0.0/
 48   011930000    0.0 -1.0  0.0/
 48   011940000    0.0 -1.0  0.0/
 47  -011880000    0.0 -1.0  0.0/
 47  -011890000    0.0 -1.0  0.0/
 47  -011900000    0.0 -1.0  0.0/
 47  -011910000    0.0 -1.0  0.0/
 47  -011920000    0.0 -1.0  0.0/
 47  -011930000    0.0 -1.0  0.0/
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 48   011960000   -1.0  0.0  0.0/
 48   011970000   -1.0  0.0  0.0/
 48   011980000   -1.0  0.0  0.0/
 48   011990000   -1.0  0.0  0.0/
 48   012000000   -1.0  0.0  0.0/
 48   013010000   -1.0  0.0  0.0/
 48   013020000   -1.0  0.0  0.0/
 48   013030000   -1.0  0.0  0.0/
 48   013040000   -1.0  0.0  0.0/
 48   013050000   -1.0  0.0  0.0/
 49  -011960000   -1.0  0.0  0.0/
 49  -011970000   -1.0  0.0  0.0/
 49  -011980000   -1.0  0.0  0.0/
 49  -011990000   -1.0  0.0  0.0/
 49  -012000000   -1.0  0.0  0.0/
 49  -013010000   -1.0  0.0  0.0/
 49  -013020000   -1.0  0.0  0.0/
 49  -013030000   -1.0  0.0  0.0/
 49  -013040000   -1.0  0.0  0.0/
 49  -013050000   -1.0  0.0  0.0/
 49  -013060000   -1.0  0.0  0.0/
 50   013060000    0.0  0.0 -1.0/
 50   013070000    0.0  0.0 -1.0/
 50   013080000    0.0  0.0 -1.0/
 50   013090000    0.0  0.0 -1.0/
 50   013100000    0.0  0.0 -1.0/
 50   013110000    0.0  0.0 -1.0/
 50   013120000    0.0  0.0 -1.0/
 50   013130000    0.0  0.0 -1.0/
 50   013140000    0.0  0.0 -1.0/
 50   013150000    0.0  0.0 -1.0/
 50   013160000    0.0  0.0 -1.0/
 50   013170000    0.0  0.0 -1.0/
 50   013180000    0.0  0.0 -1.0/
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 51  -013090000    0.0  0.0 -1.0/
 51  -013100000    0.0  0.0 -1.0/
 51  -013110000    0.0  0.0 -1.0/
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 51  -013130000    0.0  0.0 -1.0/
 51  -013140000    0.0  0.0 -1.0/
 51  -013150000    0.0  0.0 -1.0/
 51  -013160000    0.0  0.0 -1.0/
 51  -013170000    0.0  0.0 -1.0/
```

```
51   -013180000    0.0   0.0 -1.0/
51   -013190000    0.0   0.0 -1.0/
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52    013220000    1.0   0.0  0.0/
52    013230000    1.0   0.0  0.0/
52    013240000    1.0   0.0  0.0/
52    013250000    1.0   0.0  0.0/
52    013260000    1.0   0.0  0.0/
52    013270000    1.0   0.0  0.0/
52    013280000    1.0   0.0  0.0/
52    013290000    1.0   0.0  0.0/
53   -013210000    1.0   0.0  0.0/
53   -013220000    1.0   0.0  0.0/
53   -013230000    1.0   0.0  0.0/
53   -013240000    1.0   0.0  0.0/
53   -013250000    1.0   0.0  0.0/
53   -013260000    1.0   0.0  0.0/
53   -013270000    1.0   0.0  0.0/
53   -013280000    1.0   0.0  0.0/
53   -013290000    1.0   0.0  0.0/
53   -014000000   1.0   0.0   0.0/
99999/
 $STEPS TSTEP(1)=0.001,0.600$
```

4.11 APPENDIX A

TELEDYNE ENGINEERING SERVICES

BY SH DATE 8-24-92
CHKD. BY SGC DATE 8-25-92
SH 6-1-93

AMERICAN ELECTRIC POWER
D.C. 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} * 12 f
1"	40	3.068	.05132	.0174	.0006	1.53×10^{-4}	.2028
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

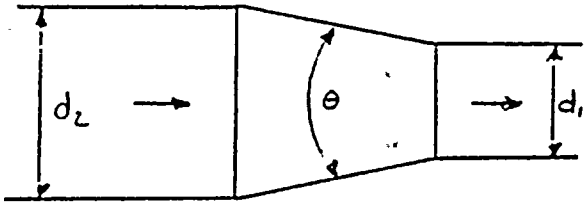
REF: CRANE TECHNICAL PAPER No. 410

TELEDYNE ENGINEERING SERVICES

BY JBM DATE 12-8-82
CHKD. BY JEY DATE 12-8-82 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 x 6" SCH 40S	6.065"	11.938"	.5080	40.3°	.2045	.4930
6" SCH 40S x 4" SCH 40S	4.026"	6.065"	.6638	21°	.0815	.1483
4" SCH 40S x 3" SCH 40	3.068"	4.026"	.7620	13.66°	.0399	.0544
3" SCH 160 x 4" SCH 120	2.624"	3.624"	.7241	14.25°	.0472	.0730
4" SCH 120 x 6" SCH 160	3.624"	5.189"	.6984	16.19°	.0577	.0961
6" SCH 40S x 3" SCH 40	3.068"	6.065"	.5059	30.48°	.1565	.3784

REFERENCE: CRANE TECHNICAL PAPER 410 p. A-26

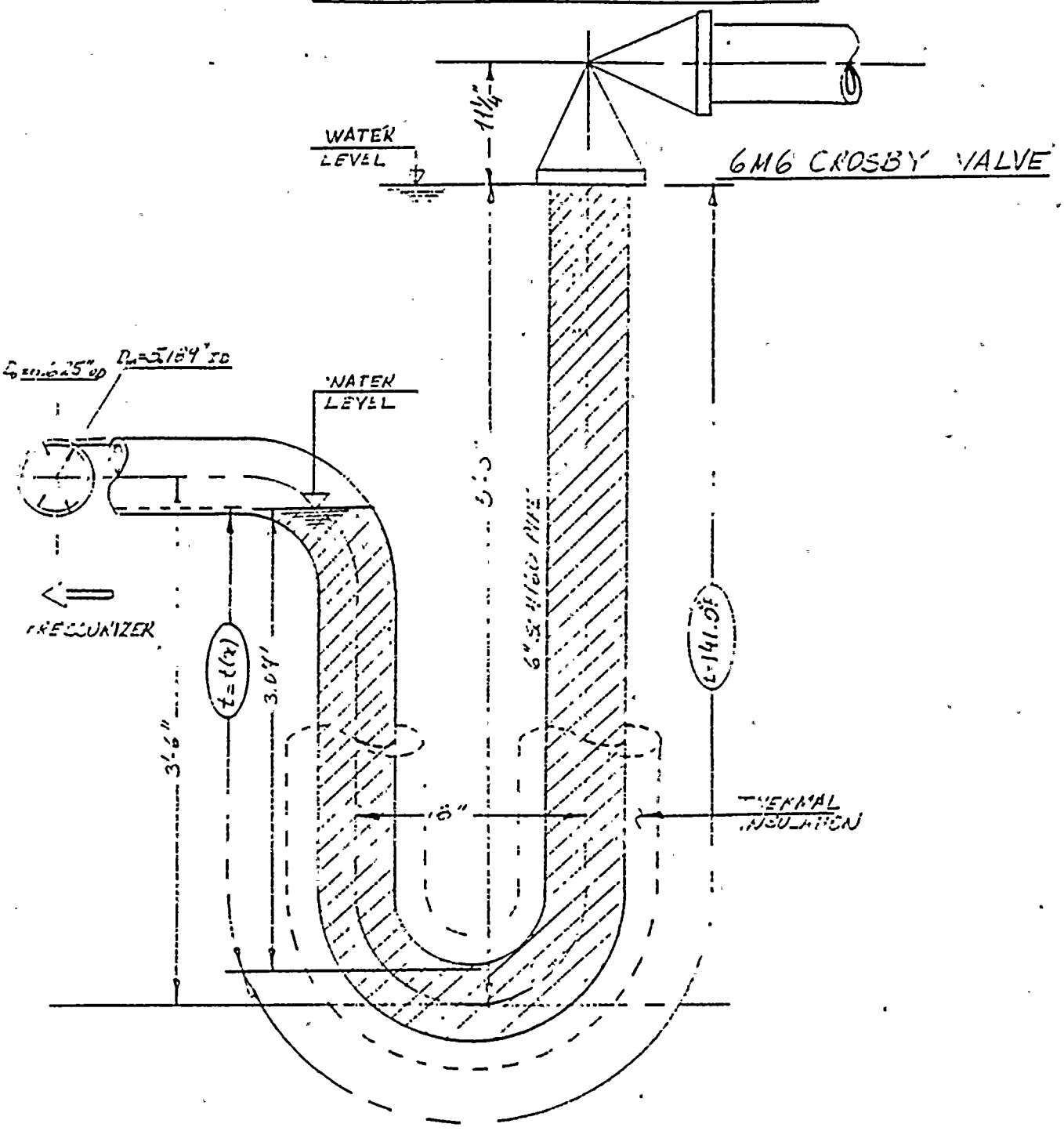
K IS TAKEN WITH RESPECT TO THE SMALLER DIAMETER PIPE.

TELEDYNE ENGINEERING SERVICES

BY BAT DATE 12-17-82
CHKD. BY ____ DATE ____

AEP D.C. COOK UNIT 1
SV LINE LOOP SEAL TEMP DISTRIBUTION

SHEET NO. 1 OF 12
PROJ. NO. 5364



INDICATES TEMPERATURE VARIATIONS IN LOOP SEAL (REF. TEXT)

D.C. COOK UNIT 1
SAFETY VALVE LINE LOOP SEAL
GEOMETRY

TELEDYNE ENGINEERING SERVICES

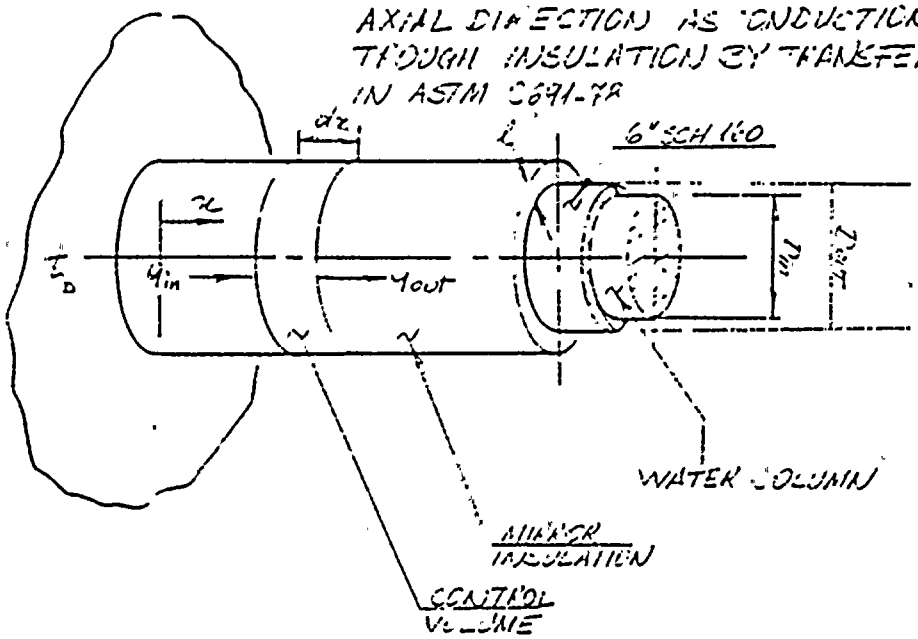
BY SAT DATE 12-17-82
CHKD. BY ___ DATE ___

A E P D.C. COOK UNIT 1
SV LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 2 OF 12
PROJ. NO. 5364

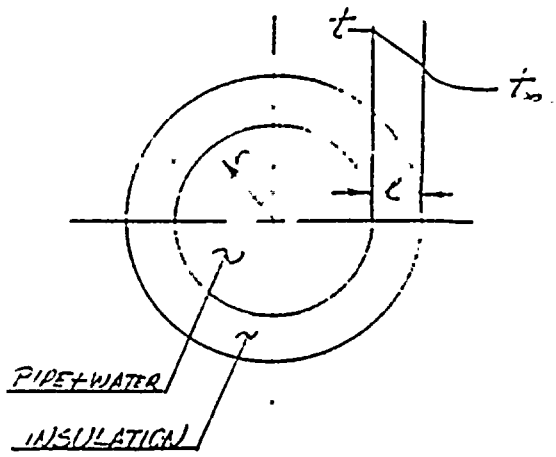
DERIVATION OF ENERGY EQUATION

ASSUMPTION 1: LOOP SEAL PIPING IS MODELED AS STRAIGHT PIPE WITH FINITE LENGTH WITH BOUNDARY CONDITIONS DESCRIBED BELOW. HEAT IS TRANSFERED BOTH IN AXIAL DIRECTION AS CONDUCTION AND IN RADIAL DIRECTION THROUGH INSULATION BY TRANSFERENCE EQUATION AS DESCRIBED IN ASTM C691-78



PIPE MODEL

ASSUMPTION 2: TEMPERATURE ACROSS CROSS-SECTION OF THE PIPE INCLUDING WATER AND WALL IS CONSTANT.



q_{in} (CONDUCTED INTO ELEMENT) $= -[(KA)_{PIPE} + (KA)_{water}] \frac{dt}{dx}$

$q_{in} = -(KA)_{eff} \frac{dt}{dx}$ WHERE $(KA)_{eff} = (KA)_{pipe} + (KA)_{water}$

q_{out} (CONDUCTED OUT OF ELEMENT) $= q_{in} + \Delta q$

$q_{out} = -\left[(KA)_{eff} \frac{dt}{dx} + \frac{d}{dx}\left(-KA_{eff} \frac{dt}{dx}\right) dx\right]$

TEMPERATURE DISTRIBUTION ACROSS THE CROSS-SECTION OF PIPE

BY SAT DATE 12-17-82
CHKD. BY YM DATE 12-2-82

AEP D.C.COOK UNIT 1
SV LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 3 OF 12
PROJ. NO. 5364

$(KA)_{eff}$ = EQUIVALENT THERMAL CONDUCTANCE OF PIPE IN AXIAL DIRECTION)

t = TEMPERATURE AS A FUNCTION OF x

q_s (TRANSFERED OUT OF SURFACE OF THE PIPE) = $T_r A_s (t_{in} - t_\infty)$

(REF: ASTM C591-78)

WHERE: A_s = SURFACE AREA OF PIPE $(ft^2) = \pi D_o dx$

t_{in} = TEMPERATURE OF PIPE + WATER (ASSUMED EQUAL)

t_∞ = PIPE ENVIRONMENT TEMPERATURE = 120 °F

T_r = THERMAL TRANSFERENCE $\frac{BTU}{hr\text{-}ft^2\text{-}F}$

ENERGY EQUATION FOR THE CONTROL VOLUME

$$q_{in} = q_{out} + q_s$$

$$-(kA)_{eff} \frac{dt}{dx} = \left\{-(kA)_{eff} \frac{dt}{dx} + \frac{d}{dx}\left[-kA)_{eff} \frac{dt}{dx}\right] dx\right\} + T_r \pi D_o dx (t - t_\infty)$$

$$(KA)_{eff} \frac{d^2t}{dx^2} = T_r \pi D_o (t - t_\infty)$$

LET $\theta = t - t_\infty$ THEN $\frac{d\theta}{dx} = \frac{dt}{dx}$ AND $\frac{d^2\theta}{dx^2} = \frac{d^2t}{dx^2}$

LET $m^2 = \frac{T_r \pi D_o}{(KA)_{eff}}$

THEREFORE:

$$\frac{d^2\theta}{dx^2} = m^2 \theta$$

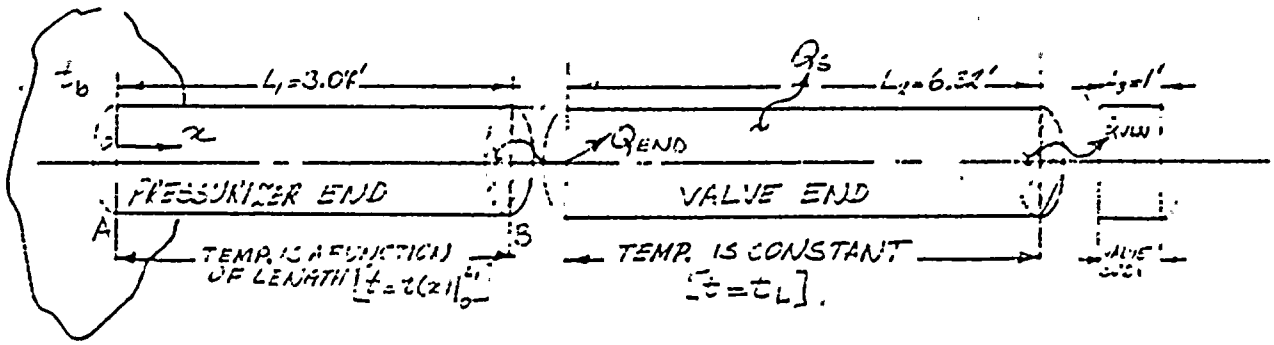
$$\theta = C_1 e^{mx} + C_2 e^{-mx}$$

$$\boxed{t = C_1 e^{mx} + C_2 e^{-mx} + 120}$$

EQUATION-(1)
GENERAL TEMPERATURE DISTRIBUTION EQN.

BY SAF DATE 12-20-82 | AEP D. C. COOK UNIT 1 | SHEET NO. 4 OF 12
CHKD. BY WM DATE 1-7-83 | S.V. LINE LOOP SEAL TEMP. DISTRIBUTION | PROJ. NO. 5364

ASSUMPTIONS. TEMPERATURE VARIES ONLY IN THE PRESSURIZER END OF THE LOOP SEAL AND REMAINS CONSTANT AT THE VALVE END OF THE LOOP SEAL. THIS IS DUE TO THE CIRCULATION OF WATER IN THE VALVE END OF LOOP SEAL BECAUSE OF NATURAL CONVECTION (REF. PAGE 1 OF THIS ANALYSIS).



LOOP SEAL MODEL

BOUNDARY CONDITIONS FOR EQN 1

1- $x = 0$ $\quad t = t_0 = 660\,^{\circ}F$ (SAT. STEAM TEMP. @ 2500 psia)

2- $x = 3.04$ ft $\quad -(kA)_{eff} \left.\dfrac{dt}{dx}\right|_{x=3.04} = Q_{END}$

$$-(kA)_{eff}\left[mC_1 e^{mx} - mC_2 e^{-mx}\right] = Q_{END} \quad \text{EQN. (2)}$$

C_1 AND C_2 ARE FOUND FROM EQN. 1 AND EQN. 2

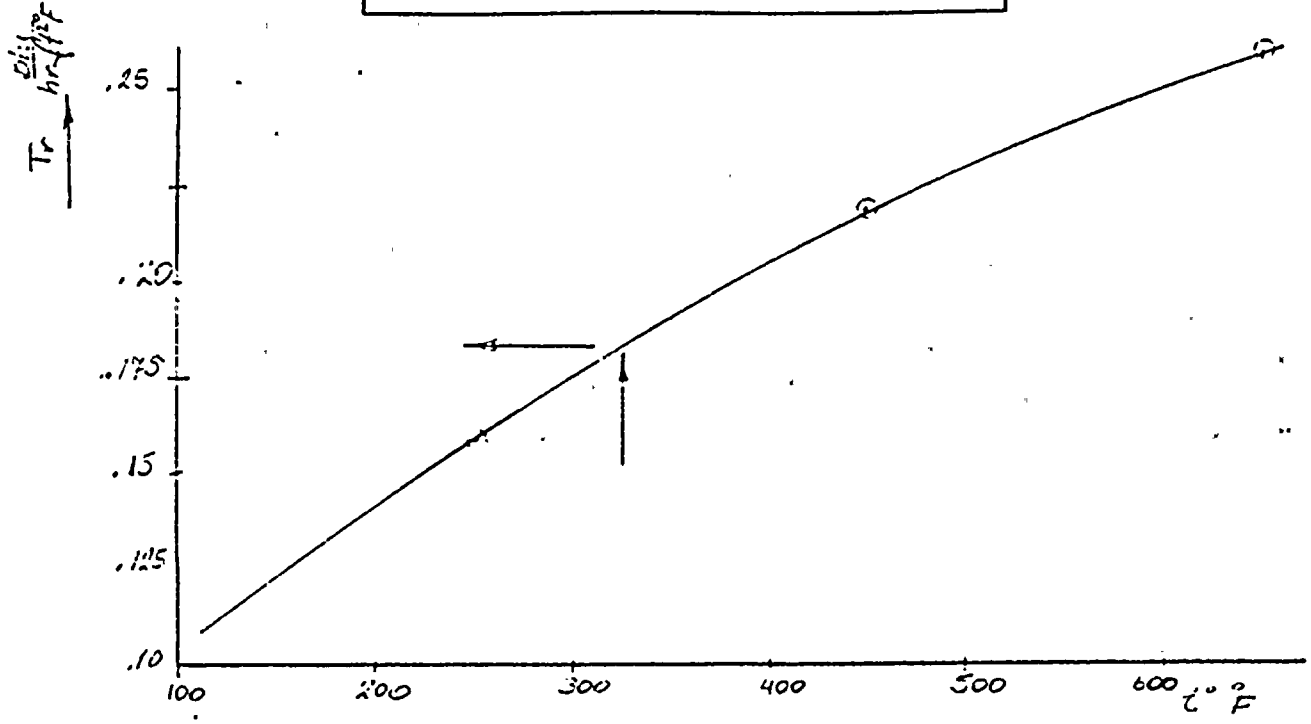
T_r (TRANSMISSIVITY) IS A FUNCTION OF TEMPERATURE AND FROM THE TELECON BETWEEN "TEC" AND "DIAMOND POWER" DATED (12-15-82)

T_r $\frac{BTU}{hr\,ft^2\,^{\circ}F}$	TEMP °F
0.254	650
0.219	450
0.158	250

BY SAI DATE 12-20-82
CHKD. BY [illegible] DATE 1-3-83

AEP D.C. COOK UNIT 1
S.V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 5 OF 12
PROJ. NO. 5364



PLOT OF TRANSMISSIVITY VS TEMPERATURE FROM DATA ON TELECON BETWEEN "TES" AND "DIAMOND POWER" DATED (12-16-82).

ASSUMED AVERAGE FLUID TEMPERATURE = 325 °F

FROM PLOT $T_r = 0.16 \frac{Btu}{hr\,ft^2\,°F}$ @ $t = 325$ °F

$$(KA)_{eff} = (KA)_{PIPE} + (KA)_{WATER}$$

$A_{PIPE} = 13.22\ in^2$

$A_{WATER} = 21.1\ in^2$

ESTIMATED AVERAGE VALUES

$K_{PIPE} \simeq 7.9 \frac{Btu}{hr\text{-}ft\text{-}°F}$ (REF*: PIPE MAT. SPECT. SCCPM104GCS PROVIDED BY AEP AND ASME III BOILER & PRESSURE VESSEL CODE)

$K_{WATER} = 0.38 \frac{Btu}{hr\text{-}ft\text{-}°F}$ (REF: HEAT TRANSFER, J.P. HOLMAN Fig 1.5 FIRST EDITION)

$$(KA)_{eff} = 0.98 \frac{Btu\text{-}ft}{hr\text{-}°F}$$

(*NOTE: PIPE IS MADE OF ASTM A-376 GRADE TP316 SEAMLESS AUSTENITIC STEEL)

BY SAI DATE 12-21-82
CHKD. BY MM DATE 1-7-83

AEP D.C. COOK UNIT 1
S.V. LINE LOOPSEAL TEMP. DISTRIBUTION

SHEET NO. 5 OF 12
PROJ. NO. 5364

ASSUME $t = 145°F$ AT VALVE END OF LOOPSEAL

$$Q_{END} = Q_S + Q_{VLV} \quad \ldots\ldots$$

Q_S = HEAT LOSS ACROSS INSULATION FROM VALVE END OF LOOP-SEAL

$$Q_S = T_r A_S (t_L - t_\infty) \quad \ldots\ldots$$

WHERE $A_S = D_o \pi L_2$ SURFACE AREA OF VALVE END OF LOOPSEAL

$T_r = 0.120 \frac{Btu}{ft^2 hr\ F}$ @ 145°F (FROM PLOT AT PAGES OF THIS ANALYSIS)

(NOTE: DIFFERENT T_r IS USED IN EQN. 1 AND Q_S SINCE MEAN TEMPERATURES ARE DIFFERENT)

$$Q_S = (0.120)(0.55 \times \pi \times 6.32)[145 - 120]$$

$$Q_S = 32.76 \frac{Btu}{hr}$$

VALVE END HEAT LOSS IS ASSUMED AS HEAT FLOWING TROUGH A SOLID VALVE BODY WITH $L_3 = 1'$ EQUIVALENT LENGTH AND D_o DIAMETER.

$$Q_{VLV} = (kA)_{steel} \frac{t_L - t_\infty}{L_3}$$

$$Q_{VLV} = (7.9)(0.24) \frac{145 - 120}{1.0}$$

$$Q_{VLV} = 47.28 \frac{Btu}{hr}$$

$$Q_{END} = Q_S + Q_{VLV}$$

$$Q_{END} = 80.04 \frac{Btu}{hr}$$

BY SAI DATE 12-21-82
CHKD. BY [illegible] DATE 1-7-83

AEP D.C. COOK UNIT 1
S.V LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 7 OF 12
PROJ. NO. 5564

TEMPERATURE DISTRIBUTION EQUATION @ $0 < x < L_1 = 3.07$

$$t = C_1 e^{mx} + C_2 e^{-mx} + 120$$

SOLVE FOR C_1 AND C_2 USING BOUNDARY CONDITIONS:

$x = 0 \qquad t = t_b = 668\ ^\circ F$ BOUNDARY CON. 1

$$-(kA)_{4"} \left.\frac{dt}{dx}\right|_{x=L_1} = Q_{END}$$ BOUNDARY CON. 2

$$-m \times 0.76 \left[C_1 e^{mL_1} - C_2 e^{-mL_1}\right] = 80.04$$

$$m = \left[\frac{T_r \pi D_o}{(kA)_{4"}}\right]^{1/2}$$

$$m = \left[\frac{0.1 \times 3.7 \times 0.65}{0.76}\right]^{1/2}$$

$$m = 0.64$$

SUBSTITUTING BOUNDARY CONDITIONS:

FROM B.C. 1 $\quad C_1 e^{0.64(0)} + C_2 e^{-0.64(0)} = 548$ _____ EQN (2)

FROM B.C. 2 $\quad -C_1 e^{0.64L_1} + C_2 e^{-0.64L_1} = k_1 [Q_s + Q_{VLV}]$ _____ EQN (3)

AFTER SUBSTITUTING

$$C_1 - C_2 = 548$$

$$-7.13 C_1 + 0.14 C_2 = 160.08$$

TWO EQUATIONS WITH TWO UNKNOWNS AFTER SOLVING

$C_1 = -11.5$ AND $C_2 = 559.50$

BY SAT DATE 12-21-82
CHKD. BY [illegible] DATE [illegible]

AEP D. C. COOK UNIT 1
S.V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 3 OF 12
PROJ. NO. 5364

TEMPERATURE DISTRIBUTION EQUATION BECOMES

$t = -11.5\, e^{0.64x} + 559.5\, e^{-0.64x} + 120$ @ $0 < x < 3.07$

CHECKING ASSUMED $t = t_L = 145°$ @ $x = 3.07$

PROCEDURE: FIND $A(t)$ BY SUBSTITUTING $x = 3.07$ AND COMPARE THIS (t) BY ASSUMED $t = 145°F$

$t = -11.5\, e^{(0.64)(3.07)} + 554.5\, e^{-(0.64)(3.07)} + 120$

$t_{TOTAL} = 115.44\ °F < t_{ASS} = 145°F$

ASSUME: $T = t_L = 135°F$

EQNS (2) AND (3) BECOMES:

$$\begin{cases} C_1 + C_2 = 548 \\ -7.13\, C_1 + 0.14\, C_2 = 96.20 \end{cases}$$

$Q_{INV} = 28.44$ BTU/HR
$Q_S = .436$ BTU/HR
$Q_{END} = 20.0$

AFTER SOLVING

$C_1 = -2.68$

$C_2 = 550.68$ AND TEMP DISTRIBUTION:

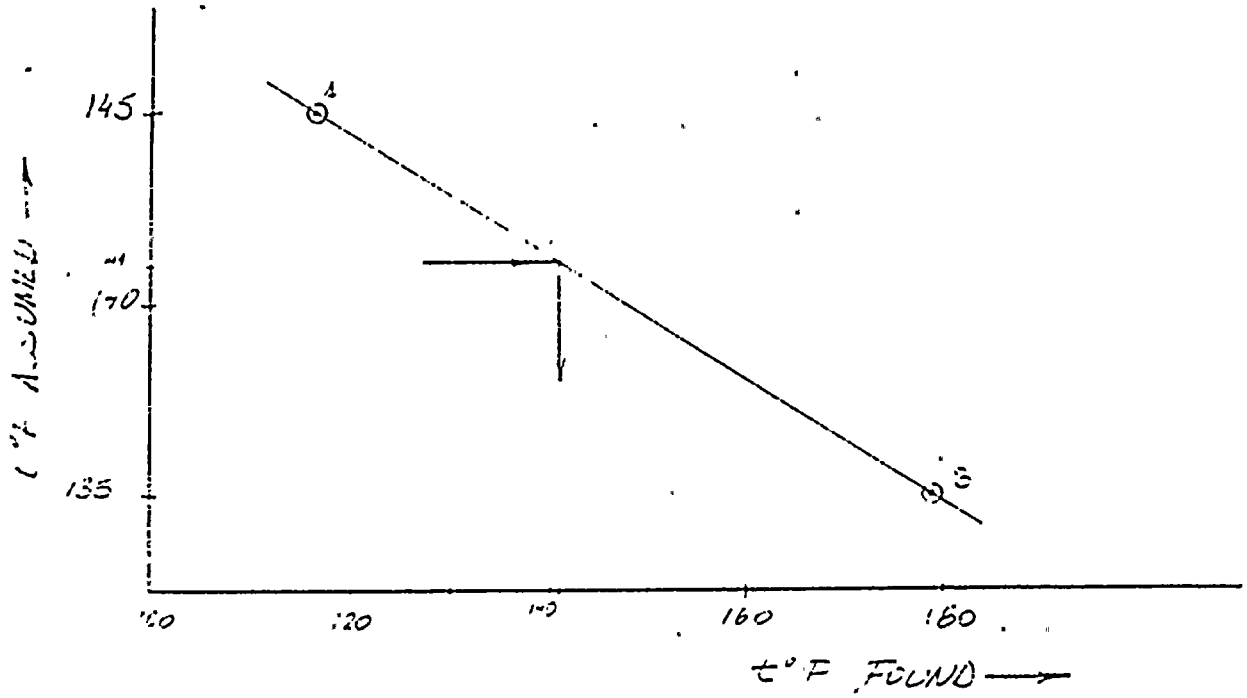
$t = -2.68\, e^{0.64x} + 550.68\, e^{-0.64x} + 120$

@ $x = 3.07$ $t_{TOTAL} = 178.08\ °F > t_{ASS} = 135°F$

BY SAT DATE 12-21-82
CHKD. BY [illegible] DATE [illegible]

A E P S. C. COOK UNIT 1
S. V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 9 OF 12
PROJ. NO. 5364



AFTER PLOTING t_{ass} VS. t_{FOUND} AND BY VISUAL INTERPOLATION
(PROCEDURE: FIND $t_{ass} = t_{FOUND}$ ON LINE A-B)
WE'N $t_{ass} = 141\ °F$

SUBSTITUTING $t_{ass} = 141\ °F$ INTO EQN (2) AND EQN (3)

$$Q_3 = 417.52 \ \frac{Btu}{hr}$$

$$Q_{VLV} = 39.32 \ \frac{Btu}{hr}$$

$$Q_{END} = 378.34 \ Btu/hr$$

$$\begin{cases} C_1 + C_2 = 548 \\ -7.13C_1 + 0.14C_2 = 184.67 \end{cases}$$

$$C_1 = -7.97 \qquad C_2 = 555.97$$

$$t = -7.97\,e^{0.64x} + 555.97\,e^{-0.64x} + 120$$

@ $x = 3.07$; $t_{FOUND} = 141.08\ °F \approx t_{ass} = 141.00$

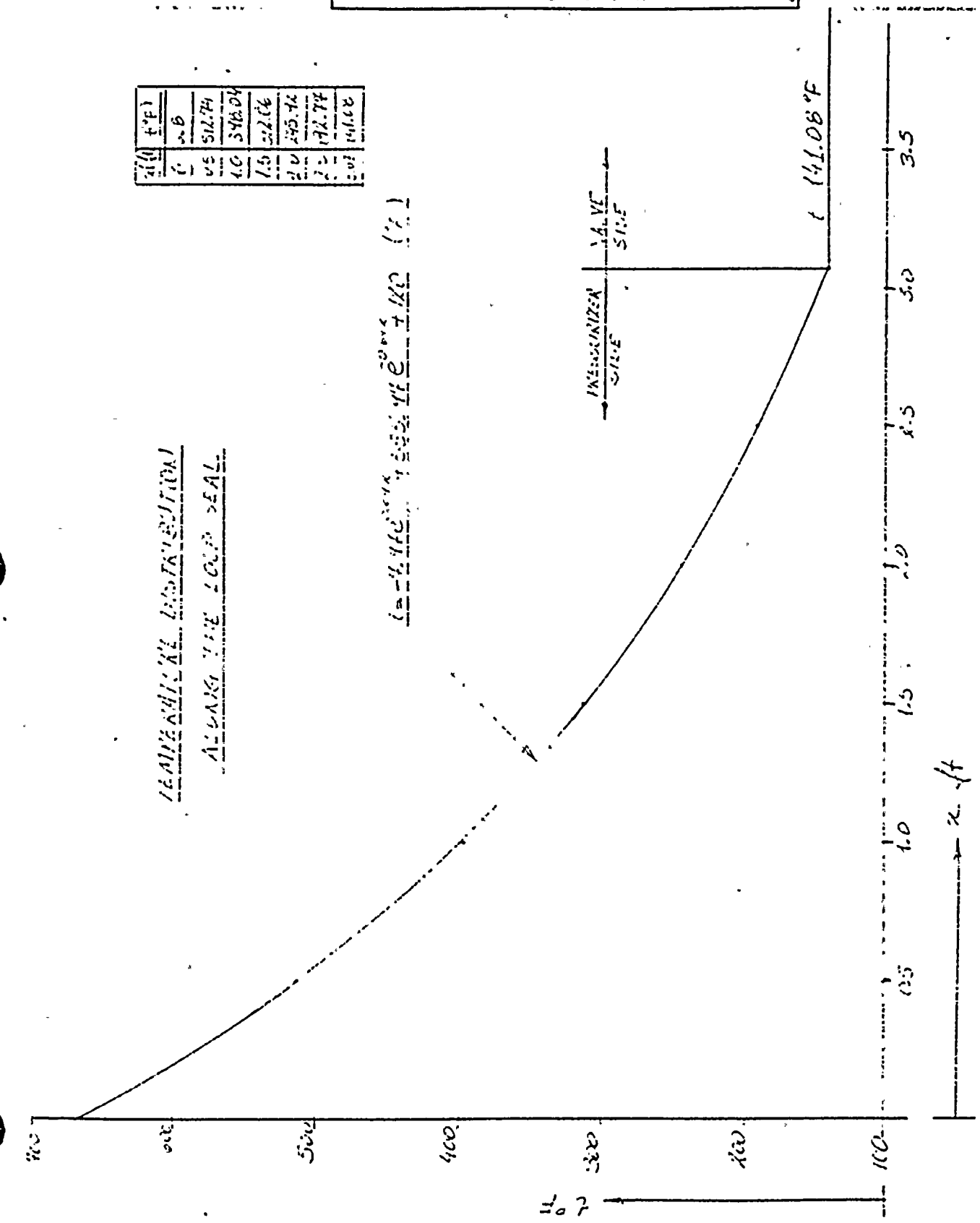
TELEDYNE ENGINEERING SERVICES

BY SAT DATE 12-21-83
CHKD. BY [illegible] DATE [illegible]

A E P [illegible]
S. V. LINE [illegible] SEAL TEMP. DISTRIBUTION

SHEET NO. 10 OF 12
PROJ. NO. 5364

TIME (HR)	TEMP (°F)
0	70
0.5	91.74
1.0	109.04
1.5	122.66
2.0	133.74
2.5	142.74
3.0	149.82



TELEDYNE ENGINEERING SERVICES

BY BAT DATE 12-21-82
CHKD. BY [illegible] DATE [illegible]

AEP D.C. COOK UNIT 1
S.V. LINE LOOP SEAL TEMP. DISTRIBUTION

CHECKING $T_r = 0.181 \frac{Btu}{hr\,ft^2\,°F}$ FOR $T_{AVE} = 325°F$ (PAGE 5)

AREA UNDER $t = t(x)$ CURVE @ $0 < x < L_1 = 3.07'$

$$AREA = \int_0^{L_1} t(x)\,dx$$

$$= \int_0^{L_1} \left[-4.47 e^{(0.64)x} + 555.47 e^{-(.64)x} + 120\right] dx$$

$$= -\frac{6.97}{.64} e^{0.64x}\Big|_{x=0}^{3.07} - \frac{555.47}{0.64} e^{-(.64)x}\Big|_{x=0}^{3.07} + 120x\Big|_{x=0}^{3.07}$$

$$= (-88.63 + 12.45) - (121.75 - 868.70) + (368.4)$$

$$AREA = 1038.91 \text{ °F-ft}$$

$$t_{AVE} = \frac{1038.91}{3.07}$$

$t_{AVE} = 338.42°F$ — 4% DIFFERENCE FROM THE ASSUMED $t_{AVE} = 325°F$ WHICH IS ACCEPTABLE

Technical Report
TR-5364-2
Revision 0

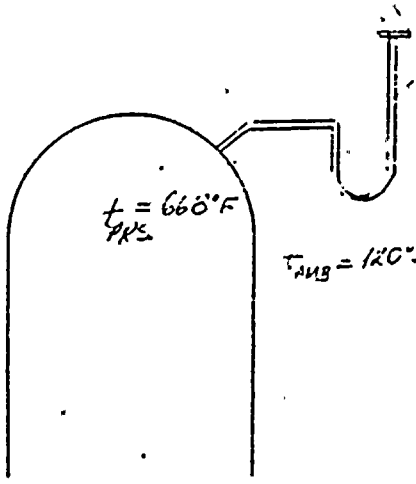
TELEDYNE ENGINEERING SERVICES

BY SAJ DATE 12-22-82
CHKD. BY ____ DATE ____

AEP D. C. COOK UNIT 1
C.V. LINE LOOPSEAL TEMP. DISTRIBUTION

SHEET NO. 12 OF 12
PROJ. NO. 5364

CHEKING THE RADIATION EFFECTS ON LOOP SEAL BY TAKING CONSERVATIVE VALUES FOR THE WORST CASE



ASSUME THE LOOPSEAL AS LUMPED VOL.

AVERAGE TEMPERATURE OF LOOP SEAL

$$t_{AVE}\Big)_{LS} = \frac{\rho A_1 C_p (338.42) + \rho A_2 C_p (141.08)}{\rho A_1 C_p + \rho A_2 C_p} = 205.6$$

t_{AVE} = 205.60°F = 665.60 °R

L_1 = 5.07'

L_2 = 6.32'

WHERE ρ : DENSITY
A : CROSS-SECTIONAL AREA
C_p : HEAT CAPACITY

FROM PAGE 5 T_f = .145 $\frac{Btu}{hr\,ft^2}$ @ t = 212.41 °F

$$\frac{q}{A} = (.145)(205.6 - 120) = 12.41 \frac{Btu}{hr\,ft^2}$$

T_s – SURFACE TEMP. OF LOOP SEAL

USING NEWTON'S LAW OF COOLING, $h = 5 \frac{Btu}{hr\,°F\,ft^2}$

$$12.41 = 5(T_s - 120)$$

$$T_s = 122.48°F$$

PRESSURIZER :

MAX. HEAT LOSS FROM PRESSURIZER $\frac{q}{A} = 80 \frac{Btu}{ft^2\,hr}$ (REF. METALLIC INSULATION AEP SPEC. NO. ECCS6102GCS

t_p SURFACE TEMP. OF PRESSURIZER $80 = 5(t_p - 120)$

$$t_p = 136°$$

ASSUMING : RADIATION SHAPE FACTORS = 0.5
EMISSIVITY $\epsilon \leq$ 0.03 (SINCE SURFACES ARE MIRROR)
(REF: MARKS MECH. ENG. HANDBOOK 9th EDITION)

STEFAN-BOLTZMANN CONST. $\sigma = 0.1714 \times 10^{-8} \frac{Btu}{hr\,ft^2\,°R^4}$

$$\frac{q}{A}\Big)_{RAD} = \sigma \epsilon F_2 (T_p^4 - T_s^4) = (0.03)(0.5)(.1714 \times 10^{-8})[596^4 - 582^4]$$

$$\frac{q}{A}\Big)_{RAD} = 0.294 \frac{Btu}{hr\,ft^2}$$

RADIATION HEAT TRANSFER HAS NEGLIGIBLE EFFECT ON LOOP SEAL TEMP. DISTRIBUTION

TELEDYNE ENGINEERING SERVICES

BY CMM DATE 1-11-82
CHKD. BY KG DATE 5-24-83

TEMPERATURE DISTRIBUTION DETERMINATION - UNIT 2

SHEET NO. 1 OF 1
PROJ. NO. 5364

USING THE EQUATION:

$$t = -7.97e^{0.64x} + 555.97e^{-0.64x} + 120\ (^{\circ}F).$$

WHERE x = AXIAL DISTANCE AWAY FROM PRESSURIZED ALONG HOOP SEAL

ACCURATE $0 \leq x \leq 3.07$ (FT)

FOR VALUES $x > 3.07$ $t = 141.08\ ^{\circ}F$

REF: SAI HAND CALC. 5-22-82

CONTROL VOLUME	x VALUE (FT)	t (DETERMINED) (°F)
501	0.25	534.4
502	0.75	451.1
503	1.25	352.1
504	1.75	276.8
505	2.25	218.2
506	2.75	169.3
507	3.25	141.1
↓		
520	VALVE	↓

TELEDYNE ENGINEERING SERVICES

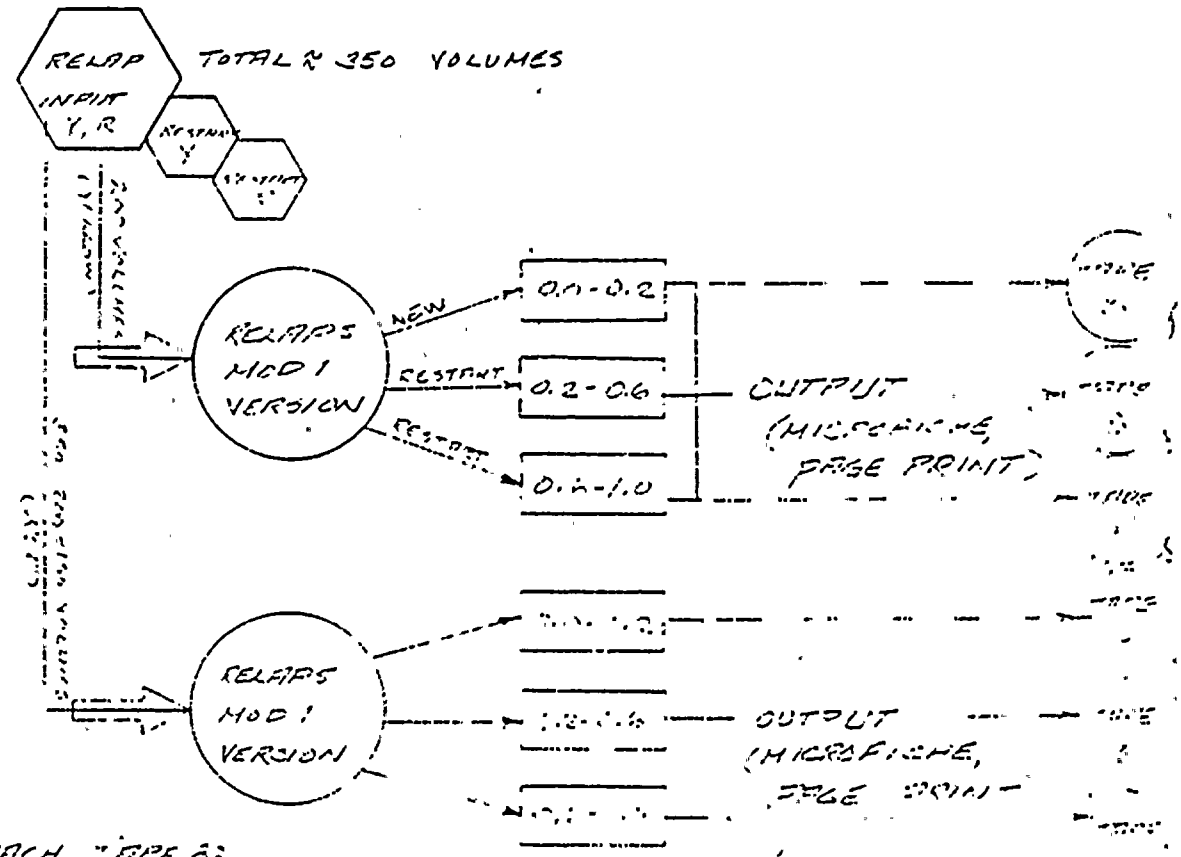
BY JMM DATE 5-4-83
CHKD. BY KG DATE 5-24-83

COMPUTER USAGE FOR THERMAL ANALYSIS

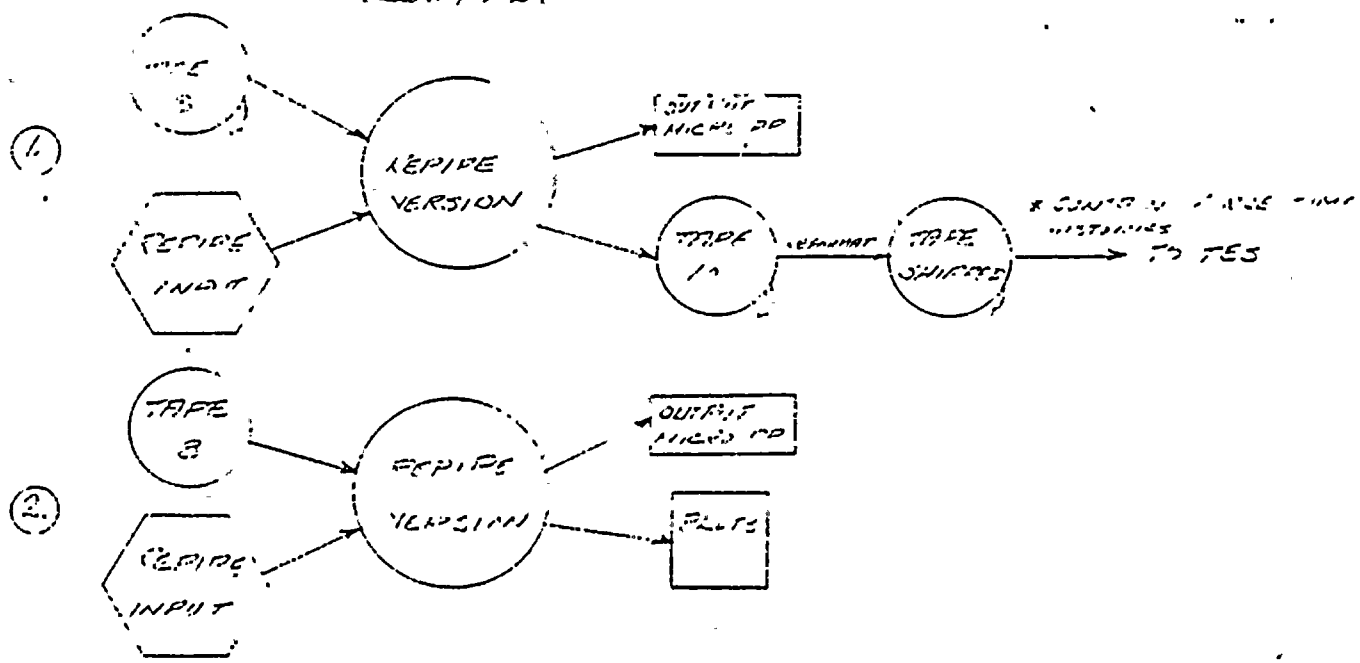
SHEET NO. 1 OF 2
PROJ. NO. 5364

TRANSIENTS:

1. LOOPSEAL, SATURATED) STEAM CASE @ COC
2. SOLID 400° WATER CASE



IN EACH TAPE 6: FOLLOWING.

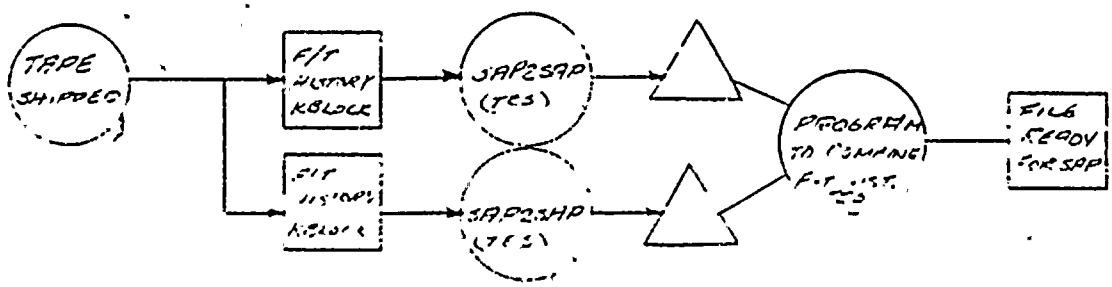


TELEDYNE ENGINEERING SERVICES

BY JHH DATE 5-4-83
CHKD. BY KJG DATE 5-24-83

COMPUTER USAGE FOR THERMAL ANALYSIS.

SHEET NO. 2 OF 2
PROJ. NO. 5364



TELEDYNE ENGINEERING SERVICES

BY QMM DATE 3-28-83
CHKD. BY KJC DATE 5-9-83

PORV UNIT 1 BOUNDARY CONDITIONS

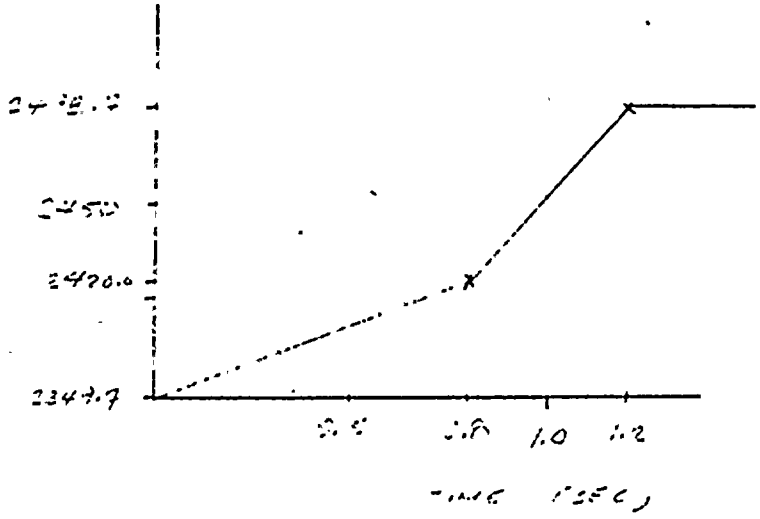
SHEET NO. 1 OF 1
PROJ. NO. 5364

(1.) VALVE OPENING TIME, PORV : 1.0 SEC

MARSONEILAN : REF :

(TIME) REF : TABLE 4.5.2-1 FSAR 4.53 EIPSI SAFETY RELIEF VALVE TEST REPORT (CP-V102)

(2.) PRESSURIZER CONDITIONS :



REF : REF LETTER TO NRC 11-29-82 , CURVE #5 OF 6

(3.) VALVE FLOW AREA CALCULATED KNOWING TIME FLOW RATE = 197,700 LBM/HR. REF: FSAR 4.53 EIPSI SAFETY AND RELIEF VALVE TEST REPORT (CP-V102) AND RUN RECORD AREA = 0.00806 FT²

(4.) QUALITY USED IN UPSTREAM PIPING TO SIMULATE CONDENSATE SEE RUG CALC

TELEDYNE ENGINEERING SERVICES

BY JMM DATE 5-24-83
CHKD. BY KG DATE 5-24-83

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 $\quad P_v$ = 1.693 psia

SPECIFIC HUMIDITY $\quad Y = \frac{M_N}{M_a} = \frac{\text{MASS OF WATER VAPOR}}{\text{MASS OF AIR}} = \frac{V_a}{V_N}$

$$Y = \frac{R_a T / P_a}{R_{UIT}/P_N} = 1.122 \frac{P_N}{P_a}$$

$$Y = 0.622 \frac{1.693 \text{ psia}}{16.008 \text{ psia}}$$

$$Y = 0.065761$$

NONCONDENSIBLE GAS (AIR) QUALITY = 1 − Y = 0.73424

5.0 STRUCTURAL ANALYSIS

Deadweight, thermal, seismic and force/time history analyses were performed for 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 included 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 2) and AEP letter dated March 15, 1983 from Mr. Sam Ulan of AEP to Mr. Pat Harrison of TES (Reference 3). Section 6.0 contains all of the results for the analyses performed.

Only the piping shown on drawing E-5761 was included in the analysis. Branch lines not in the scope of work were decoupled in accordance with the procedure outlined in TES letter 5364-21 dated February 2, 1983 (Reference 8); that is if the moment of inertia of the main run of pipe is greater than or equal to 40 times the moment of inertia of the branch, the branch line was decoupled.

Valve drawing 88405-1 listed the weight of valves NMO-151, 152 and 153 as being 352 pounds and this value was used by TES in the deadweight and seismic analyses. However, per Reference 7, TES was informed by AEP that the valve weight was actually 400 pounds. TES reran the deadweight and seismic analyses and determined that the net result of the valve weight change was negligible. Since pipe stresses and support loads had already been extracted and calculated based on the 352 pound valve weight, it was decided not to revise the deadweight and seismic analyses. The valve weight was changed to 400 pounds prior to executing the PORV transient shock analysis.

5.1 Deadweight Analysis

The effects of pipe weight, water weight and insulation weight were considered in the deadweight analysis. In addition, concentrated weights were located wherever branch lines were decoupled, at flanges, and at valve cg's. The weights used for decoupled branch lines were calculated in accordance with the procedure defined in TES letter 5364-25, dated February 14, 1983 (Reference 9). Per Reference 3, only the normal operating deadweight case was analyzed.

A summary of the weights and forces applied in the deadweight analysis are shown in Table 5-1.

5.2 Thermal Analysis

Three thermal cases were analyzed; normal operation, PORV operation, and SV operation. Temperature distributions for the PORV and SV cases were obtained from the RELAP5 output. Throughout this report, thermal case 1 refers to normal operation, thermal case 2 refers to PORV operation, and thermal case 3 refers to SV operation. Results of thermal case 3 are given only for the nodes, supports, and valves which are part of the quarter model, described in Section 2.

Boundary displacements were calculated for the quench tank nozzle, pressurizer nozzles and support 1-GRC-R-616, which connects to the pressurizer, for all thermal conditions analyzed. These calculations are shown in Section 6.6.

5.3 Seismic Analysis

Seismic analysis was performed for both the operating basis earthquake (OBE) and design basis earthquake (DBE). For each of these conditions, two analyses were made; one considering response spectra applied in the X and Y directions and one considering response spectra applied in the Y and Z directions. All seismic values reported in Section 6 are based (per node) on the analysis direction yielding the larger results.

For the OBE analysis, the horizontal spectra was obtained by enveloping Containment Crane Wall Figures for elevations 651'-3", 663'-4", 675'-4" and 687'-6". The figures used were based on .5% equipment damping and 2% structural damping. Prior to enveloping the figures, the peaks of each curve were broadened +/-15%, in accordance with NRC Regulatory Guide 1.122.

For the vertical direction Containment Base Slab, elevation 597'6" was used with .5% equipment damping and 2% structural damping. The peaks of this curve were also broadened +/-15% and two-thirds of the value obtained from the figure was used in the spectra.

For the DBE analysis, the spectra for the horizontal and vertical directions were obtained in the same manner as for the OBE analysis; except that 5% structural damping was used rather than 2%.

The procedures described above are in accordance with the November 29, 1982 letter from AEP (Reference 2) and TES letter 5364-33, dated April 8, 1983 (Reference 10).

The figures used and spectra obtained are detailed in Section 6.6.

5.4 Force/Time History Analysis

5.4.1 PORV Transient

Two potential PORV transients exist, condensate and solid water. Based on a preliminary analysis, of Unit 1, it was determined that the solid water case was the dominating condition throughout the piping system, therefore, only the solid water case was analyzed for Unit 2.

The solid water analysis was performed at one millisecond intervals for a length of one second. All loads peaked previous to one second, indicating that the analysis was performed for a sufficient length of time.

5.4.2. SV Transient

A quarter model analysis was performed for the SV transient shock condition. This analysis, which considered the opening of valve SV-45C only, resulted in catastrophic failure of the piping system. For economic reasons, it was decided that no further evaluation of the SV transient shock condition would be considered until the system was modified.

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 — 8 JUNE 1983
D. C. COOK UNIT 2
DEADWEIGHT DATA — TABLE 5-1

BY DMB DATE 6-8-83
CHKD DMB DATE 6/8/83
SHEET NO. ____ OF ____

MAIN RISER

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
2	12" SCH. 40	34.748 *	(P) I W
4 THRU 176	12" SCH. 40	4.458	(P) I W
219 THRU 230	6" SCH. 40S	1.582	(P) I W

* FLANGE WEIGHT DISTRIBUTED OVER 2.042' ADDED TO PIPE WEIGHT.

APPLIED FORCES

NODE	FORCE LBS.
50	3281

NOTE: APPLIED FORCES REPRESENT THE SETTINGS OF CONSTANT FORCE SUPPORTS AT THE NODES INDICATED. ALL FORCES ARE APPLIED IN THE +Y GLOBAL DIRECTION.

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
1000	122
1001	20
1005	12

SRV LOOP C (REFERS TO SRV LOOP CONTAINING VALVE SV-45C, THIS NOTATION IS TYPICAL OF LOOPS B AND A ALSO.)

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
72 THRU 97	6" SCH. 40S	1.582	(P) I W
94 THRU 103	6" SCH. 40S	2.632	(P) (I) W
107 THRU 116	6" SCH. 160	5.575	(P) (I) (W)
118 THRU 124	6" SCH. 160	4.904	(P) (I) W

APPLIED FORCES

NODE	FORCE LBS.
99	1054

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
102	81
105	685
1006	164

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364
D. C. COOK UNIT 2
DEADWEIGHT DATA

8 JUNE 1983

TABLE 5-1 Cont.

BY DMB DATE 6-8-83
CHKD DMD DATE 6/8/83
SHEET NO. ____ OF ____

SRV LOOP B

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
126 THRU 143	6" SCH. 40S	1.582	(P) I W
144 THRU 152	6" SCH. 40S	2.632	(P) (I) W
156 THRU 166	6" SCH. 160	5.575	(P) (I) (W)
168 THRU 174	6" SCH. 160	4.904	(P) (I) W

APPLIED FORCES

NODE	FORCE LBS.
147	1072

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
153	81
1540	685
155	164
1007	14

SRV LOOP A

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
176 THRU 187	6" SCH. 40S	1.582	(P) I W
188 THRU 196	6" SCH. 40S	2.632	(P) (I) W
200 THRU 210	6" SCH. 160	5.575	(P) (I) (W)
212 THRU 218	6" SCH. 160	4.904	(P) (I) W

APPLIED FORCES

NODE	FORCE LBS.
189	983

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
197	81
1980	685
199	164
1008	14

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 8 JUNE 1983
D. C. COOK UNIT 2
DEADWEIGHT DATA TABLE 5-1 Cont.

BY DMB DATE 6-8-83
CHKD DmD DATE 6/8/83
SHEET NO. ____ OF ____

PORV LOOP 151 (REFERS TO PORV LOOP CONTAINING VALVES NMO-151 AND NRV-151, THIS NOTATION IS TYPICAL OF LOOPS 152 AND 153 ALSO.)

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
230	3" SCH. 40S	.632	(P) I W
286 THRU 292	3" SCH. 40S	1.190	(P) (I) W
296 THRU 308	3" SCH. 160	1.948	(P) (I) (W)
310 THRU 316	3" SCH. 160	1.753	(P) (I) W
318 THRU 330	4" SCH. 120	2.200	(P) (I) W
332 THRU 342	6" SCH. 160	4.825	(P) (I) W

APPLIED FORCES

NODE	FORCE LBS.
290	798
304	858
316	634

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
295	480
301	400
1003	14
1002	14

TECHNICAL REPORT TR - 5364 - 2
REV. NO. 0

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 — 8 JUNE 1983
D. C. COOK UNIT 2
DEADWEIGHT DATA — TABLE 5-1 Cont.

BY DMB DATE 6-8-83
CHKD DMB DATE 6/8/83
SHEET NO. ____ OF ____

PORV LOOP 152

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
240 THRU 402	3" SCH. 40S	.632	(P) I W
404 THRU 346	3" SCH. 40S	1.190	(P) (I) W
350 THRU 320	3" SCH. 160	1.948	(P) (I) (W)

APPLIED FORCES

NODE	FORCE LBS.
400	732

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
349	480
355	400

PORV LOOP 153

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
232 THRU 240	4" SCH. 40S	.899	(P) I W
242 THRU 259	3" SCH. 40S	.632	(P) I W
257 THRU 262	3" SCH. 40S	1.190	(P) (I) W
266 THRU 276	3" SCH. 160	1.948	(P) (I) (W)
278 THRU 284	3" SCH. 160	1.772	(P) (I) W

APPLIED FORCES

NODE	FORCE LBS.
261	720
274	637

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
265	480
271	400
1004	14

6.0 ANALYTICAL RESULTS

6.1 Stress Summary

Stress calculations were based on the 1967 Edition of the ANSI B31.1 Code (Reference 11), the AEP letter dated November 29, 1982 (Reference 2), and the AEP letter dated March 15, 1983 (Reference 3). These stress combinations were performed:

A1 normal pressure stress + deadweight stress $\leq S_h$

A2 normal thermal stress range $\leq (1.25\ S_c + .25\ S_h)$

B1 normal pressure stress + deadweight stress + OBE stress $\leq 1.2\ S_h$

B2 PORV transient pressure stress + deadweight stress + $\left[(\text{OBE stress})^2 + (\text{PORV transient shock stress})^2\right]^{1/2} \leq 1.2\ S_h$

B3 PORV transient thermal stress range $\leq 1.25\ S_c + .25\ S_h$

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

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

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

Stresses were not calculated for equation A3 since all node points passed the equation A2 stress criteria with the exception of node 230B. For this node, equation A3 stress was calculated and was less than the allowable. Stresses for equations C2 and C3 are presented only for those nodes that are part of the quarter model.

The TMRPASS computer program was used, when possible, to aid in the stress calculations. The program; however, does not allow for intensification factors to be omitted in the torsional direction as does the B31.1 code, therefore, at any intensified nodes, the torsional moments are intensified.

Allowable stresses were obtained by using the maximum temperature experienced during any loading case to determine S_h. The value of S_c was based on 70°F per Reference 2. A summary of the allowable stresses 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. The worst thermal moments due to all conditions considered were reviewed 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

TECHNICAL REPORT TR - 5364 - 2
REV. NO. 0

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 3 JUNE 1983
D. C. COOK UNIT 2
SUMMARY OF ALLOWABLES TABLE 6.1-1

BY DMD DATE 6-3-83
CHKD DMD DATE 6/3/83
SHEET NO. ____ OF ____

MAIN RISER

NODES	MATERIAL	TEMPERATURE (F)	Sh (PSI)
2 THRU 24	SA-358-316 CL 1	430	16210
26 THRU 36	"	326	16744
38 THRU 51	"	337	16678
52 THRU 71	"	354	16576
72 THRU 219	"	348	16612
222 THRU 226	SA-312-304	380	15070
228 THRU 230	"	413	14898

SRV LOOPS

NODES LOOP C	NODES LOOP B	NODES LOOP A	MATERIAL	TEMPERATURE (F)	Sh (PSI)
72 THRU 82	126 THRU 136	176 THRU 182	SA-312-304	348	15262
84 THRU 92	138 THRU 143	184 THRU 187	"	370	15130
97 THRU 96	144 THRU 146	188 THRU 190	"	430	14830
98	148	195	"	460	14710
103	152	196	"	460	11740 *
107	156	200	SA-376-316	653	11600 *
108 THRU 124	158 THRU 174	202 THRU 218	SA-376-316	653	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.

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 3 JUNE 1983
D. C. COOK UNIT 2
SUMMARY OF ALLOWABLES TABLE 6.1-1 Cont.

BY DMB DATE 6-3-83
CHKD DMS DATE 6/3/83
SHEET NO. ____ OF ____

PORV LOOP 151

NODES	MATERIAL	TEMPERATURE (F)	Sh (PSI)
230	SA-312-304	413	14898
286 THRU 290	"	480	14630
292 THRU 318	"	653	14300
320 THRU 342	SA-376-316	653	16000

PORV LOOP 152

NODES	MATERIAL	TEMPERATURE (F)	Sh (PSI)
340 THRU 344	SA-312-304	480	14630
346	SA-312-304	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	413	14898
238 THRU 260	SA-312-304	480	14630
262	SA-312-304	653	14300
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.

6.1.1 Equation A-1 Stresses

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SmS DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
2	0	0	0	16.2
4		.3	.3	
6		.4	.4	
7		.2	.2	
8		.3	.3	
10		.7	.7	
12		1.0	1.0	
14		.5	.5	
16		.6	.6	
18		1.1	1.1	
20		1.5	1.5	
21		.8	.8	
24		.8	.8	
26		.8	.8	16.7
28		.9	.9	
32		.5	.5	
33		.9	.9	
34		1.0	1.0	
36		1.0	1.0	
38		.9	.9	16.7

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/4/83

CHECKED BY: _____ DATE: _____

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
40	0	.4	.4	16.7
42		.3	.3	
44		.9	.9	
46		1.3	1.3	
48		.6	.6	
49		.6	.6	
50		.6	.6	
51		.4	.4	
52		.4	.4	16.6
54		.2	.2	
56		.4	.4	
58		.6	.6	
60		.3	.3	
62		.6	.6	
64		.4	.4	
66		.3	.3	
68		.3	.3	
70		.2	.2	
71		.3	.3	
72R		.4	.4	16.6

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
72R	0	.6	.6	16.6
73		.4	.4	
126R		.6	.6	
126R		.6	.6	
127		.4	.4	
176R		.3	.3	
176R		.2	.2	
219		.4	.4	
222		1.5	1.5	15.1
224		2.9	2.9	
226		2.6	2.6	
228		1.3	1.3	14.9
230R		.9	.9	
230R		1.6	1.6	
232		3.0	3.0	
234		2.9	2.9	
236		2.0	2.0	
238		1.3	1.3	14.6
240R		1.1	1.1	
240R		1.3	1.3	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMB DATE: 5/4/83
CHECKED BY: RWB DATE: 5-4-83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
242	0	2.0	2.0	14.6
244		1.6	1.6	
246		1.2	1.2	
248		1.1	1.1	
250		1.5	1.5	
252		1.8	1.8	
258		1.7	1.7	
259		1.5	1.5	
257		2.6	2.6	
260		1.3	1.3	
262		2.9	2.9	14.3
266	2.9	3.0	5.9	
268		3.6	6.5	
272		3.5	6.4	
274		2.7	5.6	
276		3.1	6.0	
278		3.4	6.3	
279		3.4	6.3	
280		2.2	5.1	
282		1.6	4.5	

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMS DATE: 5/4/83
CHECKED BY: DWB DATE: 5-4-83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
284B	2.9	.9	3.8	14.3
72B	0	2.0	2.0	15.3
74		1.0	1.0	
76		.6	.6	
78		.3	.3	
80		.3	.3	
82		.4	.4	
84		.4	.4	15.1
86		.3	.3	
88		1.2	1.2	
90		1.5	1.5	
92		.9	.9	
97		1.0	1.0	14.8
94		1.2	1.2	
100		.3	.3	
96		.5	.5	
98		.8	.8	14.7
103		.5	.5	11.7
107	3.5	.7	4.2	11.6
108	3.5	.8	4.3	16.0

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DWB DATE: 5-4-83
CHECKED BY: DMS DATE: 5/4/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
110	3.5	.6	4.1	16.0
111		.6	4.1	
112		.6	4.1	
114		.3	3.8	
116		.3	3.8	
118		.6	4.1	
120		.7	4.2	
122		1.0	4.5	
124		1.0	4.5	
126B	0	.7	.7	15.3
128		.4	.4	
130		.4	.4	
132		.4	.4	
134		.2	.2	
136		.2	.2	
138		1.0	1.0	15.1
140		1.4	1.4	
142		.8	.8	
143		.9	.9	
144		1.1	1.1	14.8

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5-4-83
CHECKED BY: DMS DATE: 5/4/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
145	0	.3	.3	14.8
146		.6	.6	14.8
148		1.0	1.0	14.7
152		.5	.5	11.7
156	3.5	.8	4.3	11.6
158		.9	4.4	16.0
160		.7	4.2	
161		.7	4.2	
162		.7	4.2	
164		.5	4.0	
166		.5	4.0	
168		.8	4.3	
170		.9	4.4	
172		1.2	4.7	
174		1.2	4.7	
176 B	0	.7	.7	15.3
178		.6	.6	
180		.3	.3	
182		.3	.3	
184		.9	.9	15.1

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5-4-83
CHECKED BY: SmS DATE: 5/4/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
186	0	1.3	1.3	15.1
187		.9	.9	15.1
188		1.0	1.0	14.8
192		.3	.3	
190		.5	.5	
195		1.0	1.0	14.7
196		.6	.6	11.7
200	3.5	.8	4.3	11.6
202		.9	4.4	16.0
204		.6	4.1	
205		.6	4.1	
206		.6	4.1	
208		.3	3.8	
210		.3	3.8	
212		.7	4.2	
214		.8	4.3	
216		1.1	4.6	
218		1.1	4.6	
230B	0	3.2	3.2	14.9
286	0	6.4	6.4	14.6

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
288	0	6.7	6.7	14.6
290	↓	3.6	3.6	14.6
292	↓	3.9	3.9	14.3
296	2.9	2.1	5.0	↓
298	↓	1.4	4.3	↓
302	↓	1.8	4.7	↓
304	↓	2.5	5.4	↓
306	↓	2.0	4.9	↓
308	↓	1.7	4.6	↓
310	↓	1.3	4.2	↓
312	↓	3.2	6.1	↓
314	↓	.9	3.8	↓
316	↓	1.1	4.0	↓
318	4.1	5.6	9.7	↓
320R	↓	4.3	8.4	16.0
320R	↓	3.1	7.2	↓
322	↓	3.3	7.4	↓
324	↓	3.1	7.2	↓
325	↓	3.1	7.2	↓
326	↓	2.7	6.8	↓

TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
328	4.1	2.5	6.6	16.0
330	↓	2.4	6.5	↓
332	↓	2.6	6.7	↓
334	3.5	.8	4.3	↓
336	↓	.7	4.2	↓
284R	↓	.7	4.2	16.0
284R	↓	.6	4.1	↓
338	↓	.4	3.9	↓
339	↓	.6	4.1	↓
340	↓	.7	4.2	↓
342	↓	.8	4.3	↓
240B	0	1.3	1.3	14.6
241	↓	1.3	1.3	↓
402	↓	3.5	3.5	↓
404	↓	4.7	4.7	↓
344	↓	3.5	3.5	↓
346	↓	.9	.9	14.3
350	2.9	.7	3.6	↓
352	↓	.9	3.8	↓
356	↓	.4	3.3	↓

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DmS DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
320B	2.9	3.1	6.0	16.0

6.1.2 Equation A-2 Stresses

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/4/83
CHECKED BY: RMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
2	.7	27.6
4	7.2	
6	6.7	
7	2.5	
8	2.6	
10	7.4	
12	8.2	
14	3.2	
16	3.7	
18	10.1	
20	8.8	
21	3.3	
24	3.3	
26	5.4	27.7
28	7.2	
32	2.7	
33	7.4	
34	9.2	
36	10.4	
38	10.7	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SHS DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
40	9.8	27.7
42	9.9	
44	12.0	
46	11.9	
48	2.6	
49	2.5	
50	2.3	
51	1.4	
52	2.8	
54	2.8	
56	2.8	
58	2.9	
60	1.1	
62	2.9	
64	2.8	
66	2.9	
68	3.1	
70	1.1	
71	1.1	
72R	2.3	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMS DATE: 5/4/83

CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
72 R	2.2	27.7
73	1.1	
126R	1.7	
126R	2.1	
127	.6	
176R	.9	
176R	2.8	
219	4.5	
222	10.3	27.2
224	12.2	
226	10.2	
228	4.5	
230R	7.5	
230R	2.5	
232	3.0	
234	2.9	
236	3.3	
238	7.2	27.1
240R	8.7	
240R	12.1	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
242	9.8	27.1
244	11.2	
246	16.7	
248	13.2	
250	23.5	
252	14.2	
258	9.5	
259	9.2	
257	16.4	
260	15.2	
262	8.1	27.0
266	4.2	
268	3.9	
272	3.8	
274	3.9	
276	4.0	
278	4.2	
279	4.1	
280	5.1	
282	5.3	

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SmS DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
284 B	6.4	27.0
72 B	4.3	27.3
74	2.5	
76	2.2	
78	1.9	
80	1.8	
82	2.1	
84	2.5	27.2
86	2.4	
88	5.0	
90	4.6	
92	1.9	
97	.6	27.1
94	.9	
100	1.0	
96	2.2	
98	2.8	
103	1.2	26.4
107	.5	26.4
108	.5	27.4

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
110	.7	27.4
111	.6	
112	.7	
114	.8	
116	.8	
118	.8	
120	.8	
122	.8	
124	.7	
126 B	6.8	27.3
128	3.0	
130	2.5	
132	2.5	
134	2.8	
136	2.9	
138	6.7	27.2
140	6.3	
142	2.6	
143	.9	
144	1.0	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
145	1.5	27.1
146	4.7	27.1
148	5.4	27.1
152	1.8	26.4
156	1.7	26.4
158	.9	27.4
160	1.2	↓
161	1.1	
162	1.2	
164	1.4	
166	1.3	
168	1.2	
170	1.2	
172	1.2	
174	1.1	
176B	10.0	27.3
178	4.5	27.3
180	3.5	27.3
182	3.3	27.3
184	7.9	27.2

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMS DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
186	7.4	27.2
187	.6	27.2
188	2.0	27.1
192	2.2	27.1
190	4.9	27.1
195	5.8	27.1
196	2.6	26.4
200	1.2	26.4
202	1.8	27.4
204	2.4	↓
205	2.2	
206	2.4	
208	2.7	
210	2.4	
212	2.2	
214	2.2	
216	2.2	
218	2.0	
230B	29.6*	27.2
286	6.9	27.1

* EQUATION A3 STRESS IS 32.8 < 42.1 = 1.25 ($S_C + S_H$)
∴ node 230B stress IS acceptable

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMS DATE: 5/4/83
CHECKED BY: DMG DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
288	10.3	27.1
290	5.3	27.1
292	5.0	27.0
296	2.8	
298	3.4	
302	4.3	
304	4.6	
306	5.6	
308	6.6	
310	5.4	
312	6.9	
314	1.7	
316	2.3	
318	1.7	
320R	1.5	27.4
320R	2.7	
322	2.3	
324	3.6	
325	3.0	
326	5.9	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMS DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
328	6.2	27.4
330	5.6	
332	6.3	
334	2.1	
336	2.6	
284 R	2.4	27.4
284 R	2.7	
338	3.9	
339	5.3	
340	5.6	
342	5.1	
240 B	15.3	27.1
241	5.7	
402	6.3	
404	11.2	
344	14.2	
346	7.2	27.0
350	3.5	
352	3.4	
356	3.9	

TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
320B	6.5	27.4

6.1.3 Equation B-1 Stresses

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SmB DATE: 5/4/83
CHECKED BY: CMB DATE: 5-9-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
2	0	0	0	0	19.5
4		.3	.2	.5 XY	
6		.4	0	.4 XY	
7		.2	0	.2 XY	
8		.3	0	.3 XY	
10		.7	.1	.8 XY	
12		1.0	0	1.0 XY	
14		.5	.1	.6 XY	
16		.6	0	.6 XY	
18		1.1	.1	1.2 XY	
20		1.5	.2	1.7 XY	
21		.8	0	.8 YZ	
24		.8	0	.8 YZ	
26		.8	.3	1.1 YZ	20.1
28		.9	.2	1.1 XY YZ	
32		.5	.1	.6 XY	
33		.9	.2	1.1 XY	
34		1.0	.1	1.1 XY	
36		1.0	.1	1.1 XY	
38		.9	.2	1.1 XY	20.0

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
40	0	.4	.2	.6 XY	20.0
42		.3	.3	.6 XY	
44		.9	.2	1.1 YZ	
46		1.3	.2	1.5 XY	
48		.6	.3	.9 YZ	
49		.6	.2	.8 YZ	
50		.6	.2	.8 XY	
51		.4	.3	.7 XY	
52		.4	.2	.6 XY YZ	19.9
54		.2	.1	.3 YZ	
56		.4	.1	.5 YZ	
58		.6	.2	.8 XY	
60		.3	.1	.4 XY	
62		.6	.2	.8 XY	
64		.4	.2	.6 XY	
66		.3	.2	.5 XY	
68		.3	.2	.5 XY	
70		.2	.3	.5 YZ	
71		.3	.4	.7 YZ	
72R		.4	.8	1.2 YZ	19.9

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
72R	0	.6	.8	1.4 YZ	19.9
73		.4	.6	1.0 YZ	
126R		.6	.8	1.4 YZ	
126R		.6	.9	1.5 YZ	
127		.4	.5	.9 YZ	
176R		.3	.5	.8 YZ	
176R		.2	.4	.6 YZ	
219		.4	1.1	1.5 YZ	
222		1.5	2.8	4.3 YZ	18.1
224		2.9	2.0	4.9 YZ	
226		2.6	2.5	5.1 YZ	
228		1.3	1.9	3.2 YZ	17.9
230R		.9	2.4	3.3 YZ	
230R		1.6	2.1	3.7 YZ	
232		3.0	2.3	5.3 YZ	
234		2.9	2.3	5.2 YZ	
236		2.0	2.2	4.2 YZ	
238		1.3	3.7	5.0 XY	17.6
240R		1.1	4.0	5.1 XY	
240R		1.3	2.9	4.2 YZ	

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
242	0	2.0	3.5	5.5 YZ	17.6
244		1.6	2.6	4.2 YZ	
246		1.2	2.8	4.0 YZ	
248		1.1	4.0	5.1 YZ	
250		1.5	5.3	6.8 YZ	
252		1.8	7.7	9.5 YZ	
258		1.7	8.6	10.3 YZ	
259		1.5	7.6	9.1 YZ	
257		2.6	10.2	12.8 YZ	
260		1.3	7.8	9.1 YZ	
262		2.9	5.5	8.4 YZ	17.2
266	2.9	3.0	2.3	9.2 XY	
268		3.6	2.4	8.9 YZ	
272		3.5	3.1	9.5 YZ	
274		2.7	2.9	8.5 YZ	
276		3.1	2.8	8.8 YZ	
278		3.4	2.9	9.2 YZ	
279		3.4	2.9	9.2 YZ	
280		2.2	4.7	9.8 YZ	
282		1.6	5.1	9.6 YZ	

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMB DATE: 5/4/83
CHECKED BY: DWB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
284B	2.9	.9	6.7	10.5 YZ	17.2
72B	0	2.0	1.1	3.1 XY	18.3
74		1.0	.7	1.7 XY	
76		.6	.5	1.1 XY	
78		.3	.4	.7 XY	
80		.3	.2	.5 XY	
82		.4	.3	.7 YZ	
84		.4	.6	1.0 YZ	18.2
86		.3	.7	1.0 YZ	
88		1.2	1.2	2.4 YZ	
90		1.5	1.4	2.9 YZ	
92		.9	.8	1.7 YZ	
97		1.0	.9	1.9 YZ	17.8
94		1.2	1.3	2.5 YZ	
100		.3	1.3	1.6 YZ	
96		.5	2.3	2.8 YZ	
98		.8	2.4	3.2 YZ	17.7
103		.5	1.4	1.9 YZ	14.1
107	3.5	.7	.4	4.6 XY	13.9
108	3.5	.8	2.2	6.5 YZ	19.2

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
110	3.5	.6	2.5	6.6 YZ	19.2
111		.6	2.5	6.6 YZ	
112		.6	2.5	6.6 YZ	
114		.3	2.2	6.0 YZ	
116		.3	1.4	5.2 YZ	
118		.6	1.2	5.3 YZ	
120		.7	1.2	5.4 YZ	
122		1.0	1.3	5.8 XY	
124		1.0	1.3	5.8 XY	
126B	0	.7	1.0	1.7 XY	18.3
128		.4	.4	.8 XY	
130		.4	.3	.7 YZ	
132		.4	.4	.8 XY	
134		.2	.7	.9 XY	
136		.2	1.0	1.2 XY	
138		1.0	2.0	3.0 XY	18.2
140		1.4	2.1	3.5 XY	
142		.8	1.3	2.1 XY	
143		.9	1.3	2.2 XY	
144		1.1	1.3	2.4 XY	17.8

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SHD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
145	0	.3	1.4	1.7 xy	17.8
146	↓	.6	3.2	3.8 xy	17.8
148	↓	1.0	3.3	4.3 xy	17.7
152	↓	.5	1.5	2.0 xy	14.1
156	3.5	.8	.5	4.8 yz	13.9
158	↓	.9	2.5	6.9 xy	19.2
160	↓	.7	2.9	7.1 xy	↓
161	↓	.7	2.9	7.1 xy	↓
162	↓	.7	2.9	7.1 xy	↓
164	↓	.5	2.5	6.5 xy	↓
166	↓	.5	1.5	5.5 xy	↓
168	↓	.8	1.2	5.5 yz	↓
170	↓	.9	1.3	5.7 yz	↓
172	↓	1.2	1.5	6.2 yz	↓
174	↓	1.2	1.5	6.2 yz	↓
176B	0	.7	.7	1.4 yz	18.3
178	↓	.6	.4	1.0 yz	↓
180	↓	.3	.8	1.1 yz	↓
182	↓	.3	1.3	1.6 yz	↓
184	↓	.9	2.5	3.4 yz	18.2

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMB DATE: 5/4/83
CHECKED BY: DWB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
186	0	1.3	2.5	3.8 YZ	18.2
187		.9	1.2	2.1 YZ	18.2
188		1.0	1.1	2.1 YZ	17.8
192		.3	1.1	1.4 YZ	17.8
190		.5	1.9	2.4 YZ	17.8
195		1.0	1.9	2.9 YZ	17.7
196		.6	1.1	1.7 YZ	14.1
200	3.5	.8	.5	4.8 XY	13.9
202		.9	2.2	6.6 YZ	19.2
204		.6	2.6	6.7 YZ	
205		.6	2.6	6.7 YZ	
206		.6	2.6	6.7 YZ	
208		.3	2.3	6.1 YZ	
210		.3	1.4	5.2 YZ	
212		.7	1.1	5.3 XY	
214		.8	1.2	5.5 XY	
216		1.1	1.4	6.0 XY	
218		1.1	1.4	6.0 XY	
230B	0	3.2	9.5	12.7 YZ	17.9
286	0	6.4	6.3	12.7 YZ	17.6

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
288	0	6.7	5.8	12.5 YZ	17.6
290	↓	3.6	4.7	8.3 YZ	17.6
292	↓	3.9	5.2	9.1 YZ	17.2
296	2.9	2.1	4.0	9.0 YZ	↓
298	↓	1.4	3.5	7.8 YZ	↓
302	↓	1.8	4.0	8.7 YZ	↓
304	↓	2.5	3.8	9.2 YZ	↓
306	↓	2.0	3.8	8.7 YZ	↓
308	↓	1.7	4.0	8.6 YZ	↓
310	↓	1.3	3.9	8.1 YZ	↓
312	↓	3.2	3.4	9.5 YZ	↓
314	↓	.9	2.6	6.4 YZ	↓
316	↓	1.1	2.6	6.6 YZ	↓
318	4.1	5.6	1.9	11.6 XY	↓
320R	↓	4.3	1.4	9.8 XY	19.2
320R	↓	3.1	1.5	8.7 YZ	↓
322	↓	3.3	1.6	9.0 YZ	↓
324	↓	3.1	1.6	8.8 YZ	↓
325	↓	3.1	1.6	8.8 YZ	↓
326	↓	2.7	1.9	8.7 YZ	↓

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMB DATE: 4/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
328	4.1	2.5	1.7	8.3 YZ	17.2
330	↓	2.4	1.7	8.2 YZ	19.2
332	↓	2.6	2.1	8.8 YZ	↓
334	3.5	.8	.6	4.9 YZ	↓
336	↓	.7	.7	4.9 YZ	↓
284R	↓	.7	.6	4.8 YZ	19.2
284R	↓	.6	.8	4.9 YZ	↓
338	↓	.4	.9	4.8 YZ	↓
339	↓	.6	1.1	5.2 YZ	↓
340	↓	.7	1.2	5.4 YZ	↓
342	↓	.8	1.1	5.4 YZ	↓
240B	0	1.3	6.9	8.2 XY	17.6
241	↓	1.3	5.4	6.7 XY	↓
402	↓	3.5	4.0	7.5 XY	↓
404	↓	4.7	5.3	10.0 XY	↓
344	↓	3.5	4.7	8.2 XY	↓
346	↓	.9	4.0	4.9 XY	17.2
350	2.9	.7	3.1	6.7 XY	↓
352	↓	.9	2.7	6.5 XY	↓
356	↓	.4	3.1	6.4 XY	↓

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/4/83
CHECKED BY: JWB DATE: 5-4-83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
320B	2.9	3.1	4.0	10.0 XY	19.2

6.1.4 Equation B-2 Stresses

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 6/8/83
CHECKED BY: [illegible] DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
2	.6	0	0	0	.6	19.5
4	↓	.3	.2	.1	1.1	↓
6		.4	0	0	1.0	
7		.2	0	0	.8	
8		.3	0	0	.9	
10		.7	.1	0	1.4	
12		1.0	0	0	1.6	
14		.5	.1	.1	1.2	
16		.6	0	.1	1.3	
18		1.1	.1	.1	1.8	
20	↓	1.5	.2	.1	2.3	
21	.7	.8	0	.1	1.6	
24	↓	.8	0	.1	1.6	↓
26		.8	.3	.2	1.9	20.1
28		.9	.2	.1	1.8	↓
32		.5	.1	.1	1.3	
33		.9	.2	.1	1.8	
34		1.0	.1	.1	1.8	
36		1.0	.1	.1	1.8	↓
38	↓	.9	.2	.1	1.8	20.0

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMD DATE: 6/8/83
CHECKED BY: RWB DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
40	.7	.4	.2	.2	1.4	20.0
42		.3	.3	.2	1.4	
44		.9	.2	.2	1.9	
46		1.3	.2	.1	2.2	
48		.6	.3	.4	1.8	
49		.6	.2	.4	1.7	
50		.6	.2	.4	1.7	
51		.4	.3	.5	1.7	
52		.4	.2	.2	1.4	19.9
54		.2	.1	.1	1.0	
56		.4	.1	.1	1.2	
58		.6	.2	.2	1.6	
60		.3	.1	.2	1.2	
62		.6	.2	.2	1.6	
64		.4	.2	.2	1.4	
66		.3	.2	.2	1.3	
68		.3	.2	.2	1.3	
70		.2	.3	.3	1.3	
71		.3	.4	.2	1.4	
72R	.9	.4	.8	.2	2.1	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 6/8/83

CHECKED BY: DMB DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
72R	.9	.6	.8	.2	2.3	19.9
73	↓	.4	.6	.2	1.9	↓
126R		.6	.8	.2	2.3	
126R		.6	.9	.2	2.4	
127		.4	.5	.3	1.9	
176R		.3	.5	.2	1.7	
176R		.2	.4	.1	1.5	
219	↓	.4	1.1	.6	2.6	↓
222	1.0	1.5	2.8	.9	5.4	18.1
224	1.0	2.9	2.0	.6	6.0	↓
226	1.0	2.6	2.5	.4	6.1	↓
228	1.5	1.3	1.9	.5	4.8	17.9
230R	1.5	.9	2.4	.8	4.9	↓
230R	1.5	1.6	2.1	.5	5.3	
232	1.5	3.0	2.3	1.1	7.0	
234	1.1	2.9	2.3	1.0	6.5	
236	1.1	2.0	2.2	1.3	5.7	↓
238	2.3	1.3	3.7	1.7	7.7	17.6
240R	2.3	1.1	4.0	1.2	7.6	↓
240R	2.3	1.3	2.9	1.2	6.7	↓

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 6/8/83
CHECKED BY: DMC DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
242	2.3	2.0	3.5	1.3	8.0	17.6
244		1.6	2.6	1.8	7.1	
246		1.2	2.8	2.2	7.1	
248		1.1	4.0	1.8	7.8	
250		1.5	5.3	1.8	9.4	
252		1.8	7.7	1.4	11.9	
258		1.7	8.6	2.4	12.9	
259		1.5	7.6	2.8	11.9	
257		2.6	10.2	2.8	15.5	
260		1.3	7.8	2.5	11.8	
262	2.9	2.9	5.5	3.9	12.5	17.2
266		3.0	2.3	4.5	11.0	
268		3.6	2.4	3.7	10.9	
272		3.5	3.1	4.0	11.5	
274		2.7	2.9	1.3	8.8	
276		3.1	2.8	1.1	9.0	
278		3.4	2.9	1.3	9.5	
279		3.4	2.9	1.3	9.5	
280		2.2	4.7	1.7	10.1	
282		1.6	5.1	1.3	9.8	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: BmS DATE: 6/8/83
CHECKED BY: JWC DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
2848	2.9	.9	6.7	4.4	11.8	17.2
72B	.7	2.0	1.1	.3	3.8	18.3
74		1.0	.7	.2	2.4	
76		.6	.5	.2	1.8	
78		.3	.4	.3	1.5	
80		.3	.2	.2	1.3	
82		.4	.3	.2	1.5	
84	.3	.4	.6	.2	1.3	18.2
86		.3	.7	.1	1.3	
88		1.2	1.2	.1	2.7	
90		1.5	1.4	.1	3.2	
92		.9	.8	.2	2.0	
97		1.0	.9	.2	2.2	17.8
94		1.2	1.3	.1	2.8	
100		.3	1.3	.1	1.9	
96		.5	2.3	.1	3.1	
98	.1	.8	2.4	.1	3.3	17.7
103	.1	.5	1.4	.1	2.0	14.1
107	3.5	.7	.4	0	4.6	13.9
108	3.5	.8	2.2	0	6.5	19.2

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 6/8/83
CHECKED BY: DMC DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
110	3.5	.6	2.5	0	6.6	19.2
111		.6	2.5	0	6.6	
112		.6	2.5	0	6.6	
114		.3	2.2	0	6.0	
116		.3	1.4	0	5.2	
118		.6	1.2	.1	5.3	
120		.7	1.2	.1	5.4	
122		1.0	1.3	.1	5.8	
124		1.0	1.3	.1	5.8	
126 B	.7	.7	1.0	.6	2.6	18.3
128		.4	.4	.4	1.7	
130		.4	.3	.2	1.5	
132		.4	.4	.2	1.5	
134		.2	.7	.2	1.6	
136		.2	1.0	.2	1.9	
138	.3	1.0	2.0	.2	3.3	18.2
140		1.4	2.1	.3	3.8	
142		.8	1.3	.3	2.4	
143		.9	1.3	.2	2.5	
144		1.1	1.3	.1	2.7	17.8

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SmS DATE: 6/8/83
CHECKED BY: KWC DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
145	.3	.3	1.4	.1	2.0	17.8
146	.3	.6	3.2	.1	4.1	17.8
148	.1	1.0	3.3	.1	4.4	17.7
152	.1	.5	1.5	.1	2.1	14.1
156	3.5	.8	.5	.1	4.8	13.9
158	↓	.9	2.5	.1	6.9	19.2
160		.7	2.9	0	7.1	↓
161		.7	2.9	.1	7.1	
162		.7	2.9	.1	7.1	
164		.5	2.5	0	6.5	
166		.5	1.5	.1	5.5	
168		.8	1.2	.1	5.5	
170		.9	1.3	.1	5.7	
172		1.2	1.5	.1	6.2	
174	↓	1.2	1.5	.1	6.2	↓
176B	.7	.7	.7	.3	2.2	18.3
178	↓	.6	.4	.2	1.7	↓
180		.3	.8	.5	1.9	
182	↓	.3	1.3	.1	2.3	↓
184	.3	.9	2.5	.1	3.7	18.2

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 6/8/83
CHECKED BY: JMC DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
186	.3	1.3	2.5	.1	4.1	18.2
187		.9	1.2	.1	2.4	18.2
188		1.0	1.1	.1	2.4	17.8
192		.3	1.1	.1	1.7	17.8
190		.5	1.9	.1	2.7	17.8
195	.1	1.0	1.9	.1	3.0	17.7
196	.1	.6	1.1	.1	1.8	14.1
200	3.5	.8	.5	.1	4.8	13.9
202		.9	2.2	.1	6.6	19.2
204		.6	2.6	.1	6.7	
205		.6	2.6	.1	6.7	
206		.6	2.6	.1	6.7	
208		.3	2.3	.1	6.1	
210		.3	1.4	.1	5.2	
212		.7	1.1	.1	5.3	
214		.8	1.2	.1	5.5	
216		1.1	1.4	.1	6.0	
218		1.1	1.4	.1	6.0	
230B	1.9	3.2	9.5	3.1	15.1	17.9
286	1.9	6.4	6.3	1.3	14.7	17.6

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6/8/83
CHECKED BY: DKB DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
288	1.9	6.7	5.8	1.2	14.5	17.6
290	1.9	3.6	4.7	2.8	11.0	17.6
292	1.9	3.9	5.2	4.6	12.7	17.2
296	2.9	2.1	4.0	4.2	10.8	
298		1.4	3.5	3.4	9.2	
302		1.8	4.0	2.9	9.6	
304		2.5	3.8	2.4	9.9	
306		2.0	3.8	2.4	9.4	
308		1.7	4.0	1.7	8.9	
310		1.3	3.9	1.3	8.3	
312		3.2	3.4	4.0	11.3	
314		.9	2.6	1.5	6.8	
316		1.1	2.6	2.5	7.6	
318	4.1	5.6	1.9	2.3	12.7	
320R		4.3	1.4	1.9	10.8	19.2
320R		3.1	1.5	2.3	9.9	
322		3.3	1.6	2.0	10.0	
324		3.1	1.6	1.2	9.2	
325		3.1	1.6	1.2	9.2	
326		2.7	1.9	2.5	9.9	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMS DATE: 6/8/83
CHECKED BY: DMC DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
328	4.1	2.5	1.7	2.3	9.5	17.2
330	4.1	2.4	1.7	2.1	9.2	19.2
332	4.1	2.6	2.1	2.1	9.7	
334	3.5	.8	.6	.6	5.1	
336		.7	.7	.7	5.2	
284R		.7	.6	.9	5.3	
284R		.6	.8	.9	5.3	
338		.4	.9	.4	4.9	
339		.6	1.1	.7	5.4	
340		.7	1.2	1.2	5.9	
342	↓	.8	1.1	1.2	5.9	↓
240B	1.9	1.3	6.9	1.9	10.4	17.6
241		1.3	5.4	1.4	8.8	
402		3.5	4.0	1.5	9.7	
404		4.7	5.3	1.5	12.1	
344		3.5	4.7	1.8	10.4	↓
346	↓	.9	4.0	4.8	9.0	17.2
350	2.9	.7	3.1	2.8	7.8	
352	2.9	.9	2.7	3.6	8.3	
356	2.9	.4	3.1	4.7	8.9	↓

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 6/8/83
CHECKED BY: DMB DATE: 6-8-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
320 B	2.9	3.1	4.0	3.7	11.4	19.2

6.1.5 Equation B-3 Stresses

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [signature] DATE: 5-31-83
CHECKED BY: [signature] DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
2	.2	27.6
4	2.1	
6	2.3	
7	.8	
8	.9	
10	2.4	
12	2.5	
14	.9	
16	1.0	
18	2.7	
20	2.7	
21	1.0	
24	1.0	
26	1.8	27.7
28	1.7	
32	.6	
33	1.7	
34	2.0	
36	2.2	
38	2.3	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5-31-83
CHECKED BY: DMB DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
40	2.3	27.7
42	2.3	
44	2.6	
46	3.2	
48	1.4	
49	1.4	
50	1.3	
51	.7	
52	.6	
54	.5	
56	.5	
58	.4	
60	.2	
62	.4	
64	.5	
66	.7	
68	1.0	
70	1.0	
71	1.6	
72 R	3.6	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [signature] DATE: 5-31-83
CHECKED BY: [signature] DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
72R	3.8	27.7
73	1.7	
126R	2.6	
126R	3.3	
127	1.1	
176R	1.3	
176R	2.4	
219	2.7	
222	18.3	27.2
224	5.0	
226	6.8	
228	2.8	
230R	4.0	
230R	6.1	
232	8.8	
234	8.7	
236	6.0	
238	7.3	27.1
240R	8.2	
240R	6.9	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [signature] DATE: 5-31-83
CHECKED BY: [signature] DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
242	8.0	27.1
244	5.9	
246	2.8	
248	2.4	
250	4.3	
252	4.9	
258	3.0	
259	2.8	
257	5.0	
260	4.4	
262	2.3	27.0
266	1.4	
268	2.0	
272	2.6	
274	3.1	
276	3.4	
278	3.3	
279	3.3	
280	1.9	
282	1.5	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: CSYKE DATE: 5-31-83
CHECKED BY: DMD DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
284 B	1.2	27.0
72 B	4.1	27.3
74	2.6	
76	5.6	
78	6.8	
80	5.8	
82	2.6	
84	3.6	27.2
86	2.8	
88	5.0	
90	4.3	
92	1.8	
97	1.5	27.1
94	2.2	
100	2.3	
96	5.1	
98	5.8	
103	2.6	26.4
107	1.1	26.4
108	.7	27.4

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 5-31-83
CHECKED BY: [illegible] DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
110	.7	27.4
111	.6	
112	.7	
114	.8	
116	1.1	
118	1.2	
120	1.2	
122	1.2	
124	1.1	
126 B	4.3	27.3
128	2.4	
130	2.1	
132	1.7	
134	1.1	
136	.8	
138	1.9	27.2
140	2.2	
142	.9	
143	.7	
144	.5	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [signature] DATE: 5-31-83
CHECKED BY: [signature] DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
145	.5	27.1
146	1.4	
148	1.0	
152	.3	26.4
156	.3	26.4
158	.5	27.4
160	.6	
161	.5	
162	.6	
164	.6	
166	.5	
168	.4	
170	.4	
172	.4	
174	.3	
176B	6.3	27.3
178	3.3	
180	2.4	
182	1.3	
184	2.3	27.2

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DKB DATE: 5-31-83
CHECKED BY: DMD DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
186	2.0	27.2
187	.6	27.2
188	.7	27.1
192	.7	
190	1.6	
195	2.5	
196	1.1	26.4
200	.7	26.4
202	.7	27.4
204	.8	
205	.7	
206	.8	
208	1.0	
210	1.1	
212	1.0	
214	1.0	
216	.9	
218	.8	
230 B	8.0	27.2
286	3.5	27.1

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [signature] DATE: 5-31-83
CHECKED BY: [signature] DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
288	5.5	27.1
290	3.0	27.1
292	2.9	27.0
296	1.6	
298	1.7	
302	1.8	
304	1.9	
306	2.1	
308	2.4	
310	2.0	
312	2.3	
314	1.0	
316	1.9	
318	1.8	
320R	.8	27.4
320R	2.7	
322	1.3	
324	3.9	
325	3.2	
326	6.1	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [signature] DATE: 5-31-83
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STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
328	6.2	27.4
330	5.4	
332	6.0	
334	2.0	
336	2.4	
284 R	2.3	
284 R	2.3	
338	4.0	
339	5.5	
340	5.9	
342	5.4	↓
240 B	20.0	27.1
241	2.3	
402	5.8	
404	10.4	
344	18.9	↓
346	9.7	27.0
350	4.6	
352	3.6	
356	3.2	↓

TELEDYNE
ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DWE DATE: 5-31-83
CHECKED BY: SMD DATE: 5/31/83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE KSI	ALLOWABLE STRESS (KSI)
320 B	3.9	27.4

6.1.6 Equation C-1 Stresses

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: BMD DATE: 5/5/83
CHECKED BY: DWB DATE: 5-5-83

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	29.2
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	30.1
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	30.0

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMB DATE: 5/5/83
CHECKED BY: JMB DATE: 5-5-83

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	30.0
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		.9	.5	.9 XY	↓
52		.4	.3	.7 XY	29.8
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	29.9

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMB DATE: 5/5/83
CHECKED BY: DMB DATE: 5-6-83

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	29.9
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	26.3
240R		1.1	6.9	8.0 XY	
240R		1.3	4.4	5.7 YZ	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMD DATE: 5/5/83
CHECKED BY: SMB DATE: 5-6-83

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	26.3
244		1.6	4.0	5.6 YZ	
246		1.2	4.1	5.3 YZ	
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	
257		2.6	15.1	17.7 YZ	
260		1.3	11.6	12.9 YZ	
262		2.9	8.2	11.1 YZ	25.7
266	2.9	3.0	3.1	9.0 YZ	
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	

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/5/83
CHECKED BY: DMB DATE: 5-6-83

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	27.5
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	27.2
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	26.7
94		1.2	2.2	3.4	YZ	26.7
100		.3	2.3	2.6	YZ	26.7
96		.5	4.1	4.6	YZ	26.7
98		.8	4.2	5.0	YZ	26.5
103		.5	2.5	3.0	YZ	21.1
107	3.5	.7	.7	4.9	XY	21.0
108	3.5	.8	3.8	8.1	YZ	28.8

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMS DATE: 5/5/83
CHECKED BY: DVB DATE: 5-6-83

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	27.5
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	27.2
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	26.7

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMS DATE: 5/5/83
CHECKED BY: DMB DATE: 5-6-83

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	26.7
146		.6	5.6	6.2	XY	26.7
148		1.0	5.7	6.7	XY	26.5
152		.5	2.6	3.1	XY	21.1
156	3.5	.8	.8	5.1	YZ	20.9
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	27.5
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	27.2

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMD DATE: 5/5/83
CHECKED BY: DMB DATE: 5-6-83

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	27.2
187		.9	2.1	3.0 yz	27.2
188		1.0	1.9	2.9 yz	26.7
192		.3	1.8	2.1 yz	26.7
190		.5	3.2	3.7 yz	26.7
195		1.0	3.1	4.1 yz	26.5
196		.6	1.9	2.5 yz	21.1
200	3.5	.8	.8	5.1 xy	20.9
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	
230 B	0	3.2	15.0	18.2 yz	26.8
286	0	6.4	10.1	16.5 yz	26.3

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMD DATE: 5/5/83
CHECKED BY: RWB DATE: 5-6-83

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	26.3
290	0	3.6	7.5	11.1 YZ	26.3
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	↓

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMS DATE: 5/5/83
CHECKED BY: DMB DATE: 5-6-83

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	↓
284F	↓	.7	.9	5.1 YZ	28.8
284F	↓	.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	↓
240E	0	1.3	11.8	13.1 XY	26.3
241	↓	1.3	9.1	10.4 XY	↓
402	↓	3.5	7.0	10.5 XY	↓
404	↓	4.7	9.2	13.9 XY	↓
344	↓	3.5	8.1	11.6 XY	↓
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	↓

Technical Report
TR-5364-2
Revision 0

TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: BMD DATE: 5/5/83
CHECKED BY: DWC DATE: 5-6-83

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

6.1.7 Equation C-2 Stresses

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DWB DATE: 5-18-83
CHECKED BY: DHB DATE: 5/18/83

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	5.4	5.8	29.2
4	↓	.3	39.7	40.4	↓
6		.4	20.3	21.1	
7		.2	10.0	10.6	
8		.3	6.9	7.6	
10		.7	16.7	17.8	
12		1.0	18.8	20.2	
14		.5	13.1	14.0	
16		.6	28.1	29.1	
18		1.1	56.8	58.3	
20		1.5	32.9	34.8	
21	↓	.8	16.2	17.4	↓
24	.7	.8	16.8	18.3	30.1
26	↓	.8	77.5	79.0	↓
28		.9	55.9	57.5	
32		.5	19.8	21.0	
33		.9	40.	41.6	
34		1.0	40.4	42.1	
36	↓	1.0	41.1	42.8	↓
38	.8	.9	59.6	61.3	30.0

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHD DATE: 5-18-83
CHECKED BY: SHD DATE: May 18, 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	.8	.4	56.3	57.5	30.0
42		.3	55.3	56.4	
44		.9	54.3	56.0	
46		1.3	48.7	50.8	
48		.6	59.2	60.6	
49		.6	51.2	52.6	
50		.6	44.4	45.8	
51	↓	.4	64.3	65.5	↓
52	1.0	.4	93.6	95.0	29.8
54		.2	59.1	60.3	
56		.4	24.2	25.6	
58		.6	51.2	52.8	
60		.3	28.2	29.5	
62		.6	54.0	55.6	
64		.4	40.6	42.0	
66		.3	27.8	29.1	
68		.3	37.5	38.8	
70		.2	32.9	34.1	
71	↓	.3	15.6	16.9	↓
72R	.9	.4	36.3	37.6	29.9

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 5-18-83
CHECKED BY: [illegible] DATE: 5/18/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
72B	.7	2.0	74.	76.7	27.5
74		1.0	48.3	50.0	
76		.6	106.1	107.4	
78		.3	194.4	195.4	
80		.3	146.9	147.9	
82	↓	.4	201.3	202.4	↓
84	.9	.4	53.4	54.7	27.2
86		.3	49.0	50.2	
88		1.2	49.1	51.2	
90		1.5	97.3	99.7	
92	↓	.9	75.0	76.8	↓
97	1.8	1.0	69.0	71.8	26.7
94		1.2	59.5	62.5	
100		.3	62.5	64.6	
96	↓	.5	101.5	103.8	↓
98	2.4	.8	114.2	117.4	26.5
103	2.4	.5	67.2	70.1	21.1
107	3.5	.7	32.5	36.7	21.0
108	3.5	.8	23.5	27.8	28.8
110	3.5	.6	30.9	35.0	28.8

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5-18-83
CHECKED BY: DHS DATE: 5/18/83

STRESS SUMMARY - EQUATION C2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	SV TRANSIENT SHOCK STRESS (KSI)	EQUATION C2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
111	3.5	.6	30.9	35.0	28.8
112	↓	.6	30.9	35.0	↓
114		.3	26.1	29.9	
116		.3	47.7	51.5	
118		.6	83.6	87.7	
120		.7	87.1	91.3	
122		1.0	89.9	94.4	
124		1.0	89.9	94.4	

6.1.8 Equation C-3 Stresses

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: BMB DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
2	.2	27.6
4	1.9	
6	2.1	
7	.8	
8	.8	
10	2.1	
12	2.1	
14	.8	
16	.9	
18	2.5	
20	2.4	
21	.9	
24	.9	"
26	1.8	27.7
28	1.6	
32	.6	
33	1.6	
34	1.8	
36	2.1	
38	2.1	"

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
40	1.9	27.7
42	1.9	
44	2.1	
46	2.7	
48	1.4	
49	1.3	
50	1.3	
51	.7	
52	.8	
54	.7	
56	.7	
58	.6	
60	.2	
62	.6	
64	.7	
66	.9	
68	1.1	
70	.9	
71	1.4	
72R	3.2	

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 5/4/83
CHECKED BY: MG DATE: 5-4-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS) (KSI)	ALLOWABLE STRESS (KSI)
72B	4.1	27.3
74	2.1	
76	5.0	
78	6.1	
80	5.3	
82	2.3	
84	3.0	27.2
86	2.2	
88	3.9	
90	3.2	
92	1.4	
97	1.3	27.1
94	2.2	
100	2.2	
96	5.1	
98	5.6	
103	2.5	26.4
107	1.0	26.4
108	.6	27.4
110	.6	27.4

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SMD DATE: 5/4/83
CHECKED BY: DMB DATE: 5-4-83

STRESS SUMMARY - EQUATION C3

NODE #	SV TRANSIENT THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
111	.5	27.4
112	.6	
114	.7	
116	.9	
118	1.0	
120	1.1	
122	1.1	
124	1.0	

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, Reference 2. Combination E2 was only considered for those supports that are part of the quarter model. Thermal-1 refers to the normal thermal operating case and thermal-2 refers to the PORV transient thermal loading and thermal-3 refers to SV transient thermal condition.

The support load combinations considered are as follows:

D1 = deadweight + normal thermal +/- OBE

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

E1 = deadweight + normal thermal +/- DBE

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

Technical Report
TR-5364-2
Revision 0

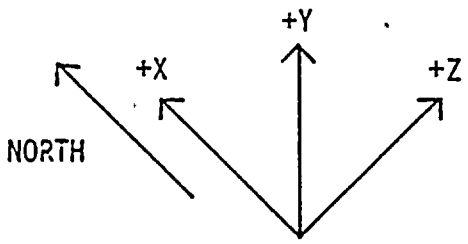
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 6-9-83
CHECKED BY: [illegible] DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-585

NODE NUMBER 16

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1		.019	.001	-20					
THERMAL-1		-.161	.027	-1860					
THERMAL-2		-.035	-.377	350					
THERMAL-3		-.029	-.377	493					
SEISMIC-OBE		±.001	±.001	±202					
SEISMIC-DBE		±.002	±.002	±351					
BLOWDOWN-SRV		+.266 -.264	+.292 -.464	±76790					
BLOWDOWN-PORV		±.001	±.002	±377					

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	+758 -3082		
EMERGENCY	+77263 -76317		

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)	4132		
DESIGN (-)	347		

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

For normal/upset conditions TES combined loads are less for +FX and greater for -FX. For the emergency condition TES loads are greater.

Technical Report
TR-5364-2
Revision 0

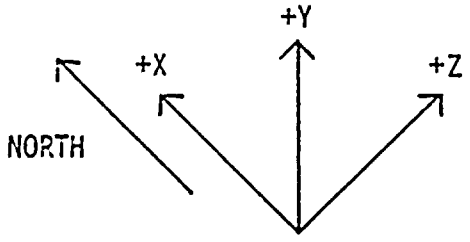
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DNB DATE: 6-9-83
CHECKED BY: DMB DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-586

NODE NUMBER 24

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.003		.006		-1170				
THERMAL-1	-.034		.067		1700				
THERMAL-2	-.061		-.400		241				
THERMAL-3	-.051		-.362		139				
SEISMIC-OBE	±.001		0		± 111				
SEISMIC-DBE	±.001		0		± 201				
BLOWDOWN-SRV	+.261 -.373		+.064 -.062		±25780				
BLOWDOWN-PORV	±.002		± 0		± 110				

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		+641 -1281	
EMERGENCY		+24749 -26811	

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)		3890	
DESIGN (-)		479	

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

For normal/upset conditions TES combined loads are less for +FY and greater for -FY. For the emergency condition TES combined loads are greater.

Technical Report
TR-5364-2
Revision 0

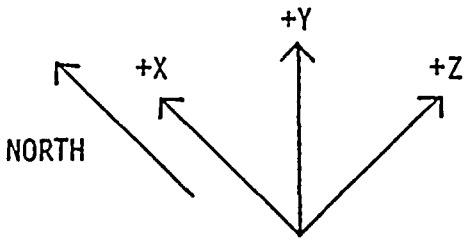
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 6-9-83
CHECKED BY: DMB DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-587

NODE NUMBER 32

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.036	-.129	.028						
THERMAL-1	.226	1.01	.276						
THERMAL-2	-.203	.370	-.330						
THERMAL-3	-.186	.330	-.330						
SEISMIC-OBE	±.004	0	±.007		±134				
SEISMIC-DBE	±.007	0	±.011		±237				
BLOWDOWN-SRV	+1.307 -1.491	〃	+1.522 -1.398		±5145o				
BLOWDOWN-PORV	±.007 .003	〃	+.014 -.012		±257				

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		±290	
EMERGENCY		±5145o	

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

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

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING FOR THE NORMAL/UPSET CONDITIONS AND GREATER FOR THE EMERGENCY CONDITION.

Technical Report
TR-5364-2
Revision 0

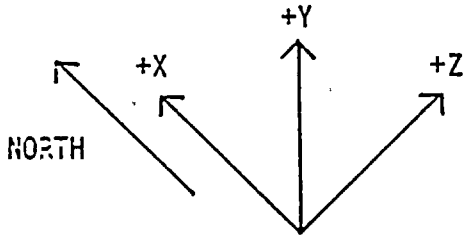
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: SDH3 DATE: 6-9-83
CHECKED BY: SMS DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-589

NODE NUMBER 48

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1		.004		-30		20			
THERMAL-1		2.27		1150		-770			
THERMAL-2		.985		-399		246			
THERMAL-3		.904		-501		333			
SEISMIC-OBE		±.007		±254		±380			
SEISMIC-DBE		±.011		±427		±662			
BLOWDOWN-SRV		+.758 -.786		±45110		±75580			
BLOWDOWN-PORV		+.006 -.005		±170		±537			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+1374 -735		+924 -1130
EMERGENCY	+44579 -45641		+75933 -75227

SUPPORT DRAWING LOADS			
	FX	FY	FZ
DESIGN (+)	615		5682
DESIGN (-)	5236		4144

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

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING FOR THE NORMAL/UPSET CONDITIONS AND GREATER FOR THE EMERGENCY CONDITION.

TELEDYNE ENGINEERING SERVICES

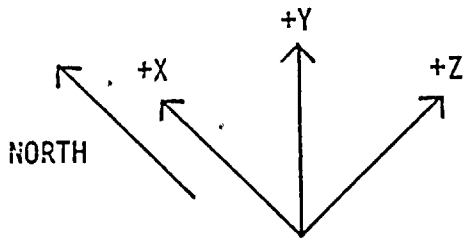
SUPPORT LOAD SUMMARY SHEET

BY: [illegible] DATE: 6-9-83

CHECKED BY: [illegible] DATE: 6/9/83

DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-590

NODE NUMBER 50

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.001	.004	-.010		3281				
THERMAL-1	.024	2.27	-.023						
THERMAL-2	.018	1.06	-.017						
THERMAL-3	.019	.980	-.017						
SEISMIC-OBE	±.004	±.011	±.003						
SEISMIC-DBE	±.007	±.004	±.005						
BLOWDOWN-SRV	+.341 -.314	+.752 -.784	+.712 -.573						
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 (+)		3281	
DESIGN (-)			

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

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

Technical Report
TR-5364-2
Revision 0

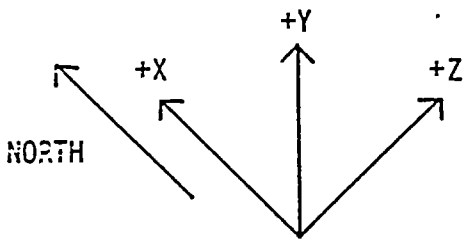
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

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
DEADWEIGHT-1		-.001		30		-70			
THERMAL-1		2.31		180		-500			
THERMAL-2		1.76		-219		-211			
THERMAL-3		1.72		-171		-238			
SEISMIC-OBE		±.007		±272		±247			
SEISMIC-OBE		±.011		±447		±417			
BLOWDOWN-SRV		+.405 -.526		±39540		±73540			
BLOWDOWN-PORV		+.004 -.005		±392		±764			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	+482 -666		+522 -1084
EMERGENCY	+39399 -39681		+73232 -73848

SUPPORT DRAWING LOADS

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

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

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING FOR THE NORMAL/UPSET CONDITIONS AND GREATER FOR THE EMERGENCY CONDITION.

Technical Report
TR-5364-2
Revision 0

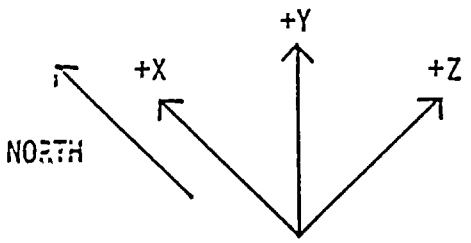
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-592

NODE NUMBER 101

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.036	.024	-.023						
THERMAL-1	.224	2.82	-.116						
THERMAL-2	.263	2.79	-.152						
THERMAL-3	.269	2.79	-.151						
SEISMIC-OBE	±.101	0	±.144		±800				
SEISMIC-DBE	±.176	0	±.250		±1324				
BLOWDOWN-SRV	+.455 -.369	0	+.409 -.461		±55600				
BLOWDOWN-PORV	±.001	0	±.001		± 95				

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		±806	
EMERGENCY		±55600	

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)		5301	
DESIGN (-)		5301	

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

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING FOR THE NORMAL/UPSET CONDITION AND GREATER FOR THE EMERGENCY CONDITION.

Technical Report
TR-5364-2
Revision 0

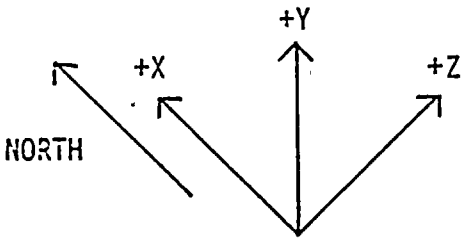
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 6-9-83
CHECKED BY: [illegible] DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-593

NODE NUMBER 99

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.035	.038	-.019		1054				
THERMAL-1	.215	2.80	-.107						
THERMAL-2	.290	2.74	-.161						
THERMAL-3	.309	2.73	-.146						
SEISMIC-OBE	±.104	±.004	±.148						
SEISMIC-DBE	±.132	±.007	±.258						
BLOWDOWN-SRV	+.760 -.617	+.308 -.299	+.499 -.728						
BLOWDOWN-PORV	±.001	±.001	+.002 -.001						

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		+1054	
EMERGENCY		+1054	

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)		1054	
DESIGN (-)			

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

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

Technical Report
TR-5364-2
Revision 0

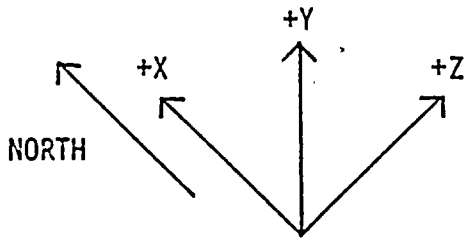
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: CMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-594

NODE NUMBER 149

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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	—	—	—						
SEISMIC-OBE	±.192	0	±.047		±1100				
SEISMIC-DBE	±.332	0	±.078		±1820				
BLOWDOWN-SRV	—	—	—		—				
BLOWDOWN-PORV	±.002	0	±.002		±142				

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		±1109	
EMERGENCY		±1820	

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)		4479	
DESIGN (-)		4479	

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

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

Technical Report
TR-5364-2
Revision 0

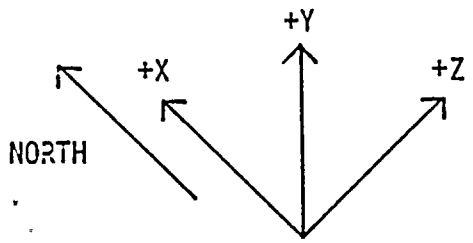
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMS DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-595

NODE NUMBER 147

DESIGN LOADINGS										
	DISPLACEMENTS			FORCES			MOMENTS			
	X	Y	Z	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	—	—	—						
SEISMIC-OBE	±.173	±.007	±.040						
SEISMIC-DBE	±.299	±.012	±.068						
BLOWDOWN-SRV	—	—	—						
BLOWDOWN-PORV	±.002	±.001	±.002						

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

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

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

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

Technical Report
TR-5364-2
Revision 0

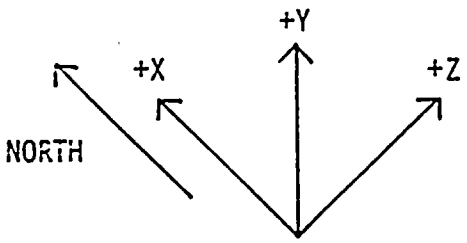
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

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
DEADWEIGHT-1	.045	.024	-.003						
THERMAL-1	-.177	2.76	.187						
THERMAL-2	-.081	2.80	.248						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.045	0	±.167		±997				
SEISMIC-OBE	±.075	0	±.286		±1646				
BLOWDOWN-SRV	—	—	—		—				
BLOWDOWN-PORV	±.001	0	+.002 -.003		±93				

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		±1001	
EMERGENCY		±1646	

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)		4218	
DESIGN (-)		4218	

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

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

Technical Report
TR-5364-2
Revision 0

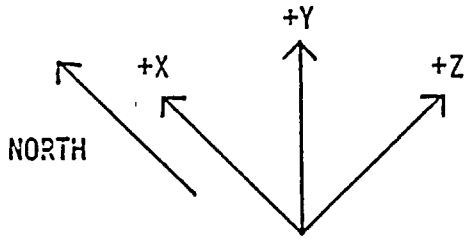
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-597

NODE NUMBER 189

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.041	.044	-.005		983				
THERMAL-1	-.175	2.72	.145						
THERMAL-2	-.104	2.75	.247						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.044	±.009	±.167						
SEISMIC-DBE	±.072	±.015	±.285						
BLOWDOWN-SRV	—	—	—						
BLOWDOWN-PORV	±.001	±.001	±.002 −.004						

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

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

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

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

Technical Report
TR-5364-2
Revision 0

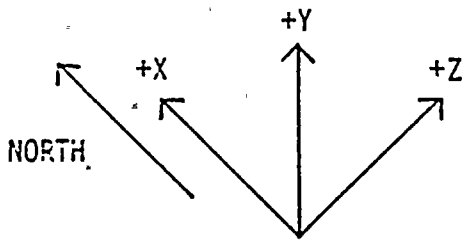
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-598

NODE NUMBER 95

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.016	.030	.002						
THERMAL-1	.085	2.81	-.131						
THERMAL-2	-.103	2.59	-.445						
THERMAL-3	-.096	2.74	-.435						
SEISMIC-OBE	±.007	±.003	±.006	±121	±131	±191			
SEISMIC-OBE	±.012	±.005	±.011	±209	±226	±330			
BLOWDOWN-SRV	+3.39 -3.28	+.166 -.173	+1.99 -1.48	±34425	±37195	±54455			
BLOWDOWN-PORV	±.004	±.001	+.003 -.002	±45	±49	±72			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	±129	±140	±204
EMERGENCY	±34425	±37195	±54455

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)	731	823	1223
DESIGN (-)	731	823	1223

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

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING FOR THE NORMAL/UPSET CONDITIONS AND GREATER FOR THE EMERGENCY CONDITION.

Technical Report
TR-5364-2
Revision 0

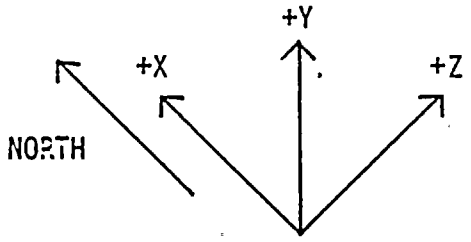
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-599

NODE NUMBER 141

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.020	.028	.042						
THERMAL-1	.114	2.80	.039						
THERMAL-2	.301	±.64	.142						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.010	±.006	±.004	±85	±42	±62			
SEISMIC-DBE	±.017	±.011	±.007	±145	±73	±106			
BLOWDOWN-SRV	—	—	—	—	—	—			
BLOWDOWN-PORV	±.002	±.001	+.001 −.002	±68	±34	±50			

TES COMBINED LOADS	FX	FY	FZ
NORMAL/UPSET	±109	±54	±80
EMERGENCY	±145	±73	±106

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

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

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

Technical Report
TR-5364-2
Revision 0

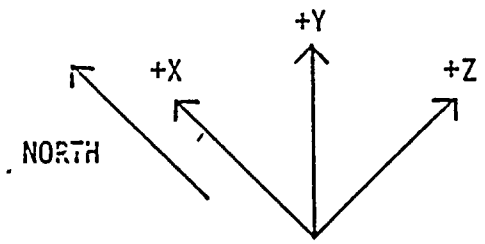
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-600

NODE NUMBER 73

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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		—		—		—			
SEISMIC-OBE		±.005		±362		±517			
SEISMIC-DBE		±.008		±573		±872			
BLOWDOWN-SRV		—		—		—			
BLOWDOWN-PORV		+.003 -.002		±327		±1006			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	+2242 -642		+2377 -1049
EMERGENCY	+1453 -753		+2732 -1042

SUPPORT DRAWING LOADS

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

LESS (-Fx, -Fz)

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

TES COMBINED LOADS ARE GREATER (+Fx, +Fz) THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

Technical Report
TR-5364-2
Revision 0

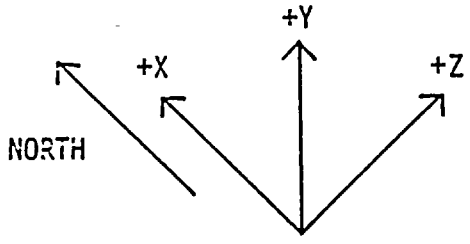
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMS DATE: 6-9-83
CHECKED BY: DMS DATE: 6/9/83

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		—		—		—			
SEISMIC-OBE		±.006		±701		±392			
SEISMIC-DBE		±.009		±1092		±632			
BLOWDOWN-SRV		—		—		—			
BLOWDOWN-PORV		+.003 −.002		±352		±254			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+1231 −5308		+762 −2278
EMERGENCY	+1622 −2331		+1002 −2262

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

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

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

* EXCEPT IN + FX

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

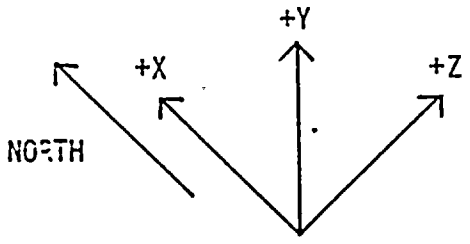
SUPPORT LOAD SUMMARY SHEET

BY: DNB DATE: 6-9-83

CHECKED BY: DMB DATE: 6/9/83

DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-602

NODE NUMBER 290

DESIGN LOADINGS										
	DISPLACEMENTS			FORCES			MOMENTS			
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.030	.077	.056		798				
THERMAL-1	-.523	2.71	-.508						
THERMAL-2	-.574	3.15	-.502						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.077	±.010	±.147						
SEISMIC-DBE	±.123	.016	.234						
BLOWDOWN-SRV	—	—	—						
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 (+)		798	
DESIGN (-)			

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

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

Technical Report
TR-5364-2
Revision 0

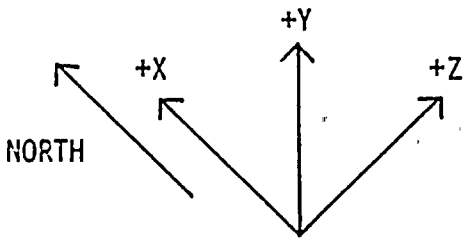
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DNB DATE: 6-9-83
CHECKED BY: D.M.D DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-605

NODE NUMBER 326

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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		—		—		—			
SEISMIC-OBE		±.013		±714		±1095			
SEISMIC-DBE		±.012		±1117		±1718			
BLOWDOWN-SRV		—		—		—			
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 (+)	1313		5851
DESIGN (-)	2972		2412

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

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

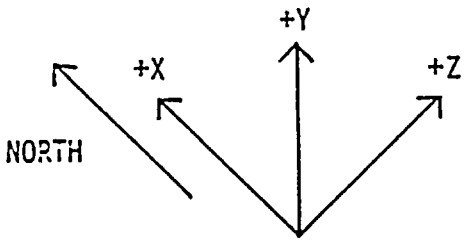
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMS DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-606

NODE NUMBER 316

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.023	.235	.021		634				
THERMAL-1	.076	3.67	-.282						
THERMAL-2	.093	3.66	-.253						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.032	±.064	±.051						
SEISMIC-DBE	±.050	±.102	±.080						
BLOWDOWN-SRV	—	—	—						
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 (+)		634	
DESIGN (-)			

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

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

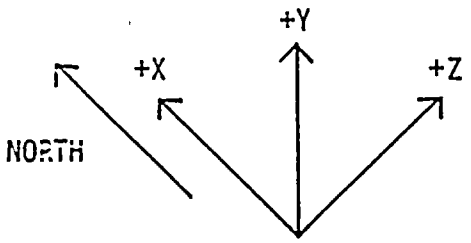
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-607

NODE NUMBER 312

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.002	.452	.031	-1069		-36			
THERMAL-1	.023	3.69	-.582	3205		109			
THERMAL-2	.020	3.73	-.559	1095		37			
THERMAL-3	—	—	—	—		—			
SEISMIC-OBE	±.001	±.049	±.041	±950		± 32			
SEISMIC-OBE	±.001	±.077	±.064	±1470		± 50			
BLOWDOWN-SRV	—	—	—	—		—			
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 (+)	5245		720
DESIGN (-)	2146		340

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

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

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

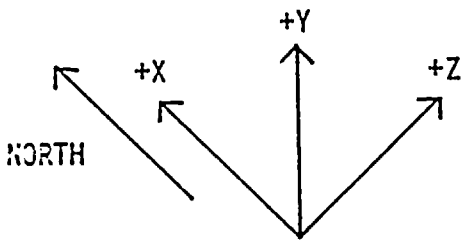
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 6-9-83

CHECKED BY: DMS DATE: 6/9/83

DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-608

NODE NUMBER 304

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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	—	—	—						
SEISMIC-OBE	±.051	±.004	±.082						
SEISMIC-DBE	±.081	±.006	±.130						
BLOWDOWN-SRV	—	—	—						
BLOWDOWN-PORV	+.021 −.022	+.008 −.010	+.022 −.018						

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET		+858	
EMERGENCY		+353	

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

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

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

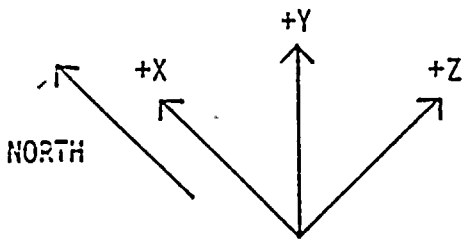
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DNB DATE: 6-9-83
CHECKED BY: DmD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-609

NODE NUMBER 306

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.024	.420	.042						
THERMAL-1	-.114	3.42	-.693						
THERMAL-2	-.170	3.57	-.652						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.043	0	±.064		±333				
SEISMIC-DBE	±.069	0	±.101		±516				
BLOWDOWN-SRV	—	—	—		—				
BLOWDOWN-PORV	±.021	0	+.024 -.021		±687				

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		±763	
EMERGENCY		±516	

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

Technical Report
TR-5364-2
Revision 0

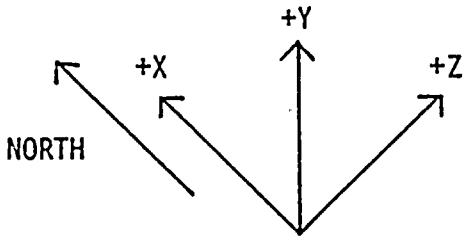
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 6-9-83
CHECKED BY: [illegible] DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-610

NODE NUMBER 274

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.031	.029	-.041		637				
THERMAL-1	-.430	3.23	.187						
THERMAL-2	-.390	3.27	-.078						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.108	±.011	±.281						
SEISMIC-DBE	±.160	±.019	±.417						
BLOWDOWN-SRV	—	—	—						
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 (+)		637	
DESIGN (-)			

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

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

Technical Report
TR-5364-2
Revision 0

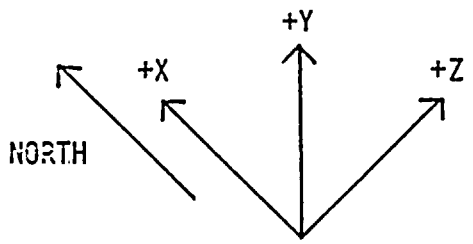
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: SMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-611

NODE NUMBER 248

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.045	.340	.050						
THERMAL-1	.093	3.36	-.193						
THERMAL-2	.070	3.61	.014						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.010	±.016	±.049	± 26	± 184	± 62			
SEISMIC-DBE	±.016	±.025	±.073	± 41	± 286	± 96			
BLOWDOWN-SRV	—	—	—	—	—	—			
BLOWDOWN-PORV	+.021 −.018	+.008 −.009	+.016 −.017	± 160	± 1134	± 376			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	± 162	± 1139	± 381
EMERGENCY	± 41	± 286	± 96

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)	79	550	184
DESIGN (-)	79	550	184

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

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

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

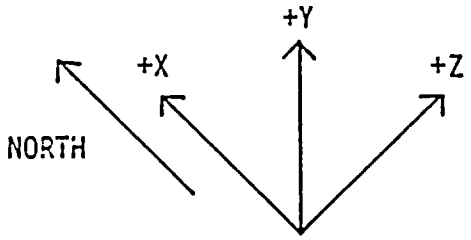
SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 6-9-83

CHECKED BY: [illegible] DATE: 6/9/83

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		-21		30			
THERMAL-1		3.30		162		-2820			
THERMAL-2		3.65		-35		-152			
THERMAL-3		—		—		—			
SEISMIC-OBE		±.023		±60		±1211			
SEISMIC-OBE		±.035		±910		±1792			
BLOWDOWN-SRV		—		—		—			
BLOWDOWN-PORV		+.010 -.009		±873		±669			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+2024 −1610		+1262 −4001
EMERGENCY	+2329 −1120		+1822 −4582

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

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

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

Technical Report
TR-5364-2
Revision 0

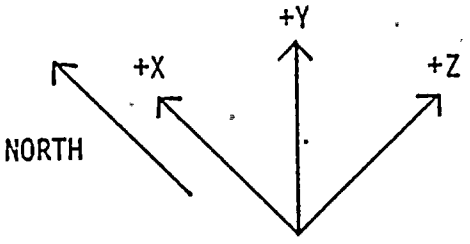
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-613

NODE NUMBER 261

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.014	.233	-.015		720				
THERMAL-1	-.037	3.29	.057						
THERMAL-2	-.028	3.65	-.011						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.006	±.022	±.022						
SEISMIC-DBE	±.009	±.033	±.032						
BLOWDOWN-SRV	—	—	—						
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 (+)		720	
DESIGN (-)			

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

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

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
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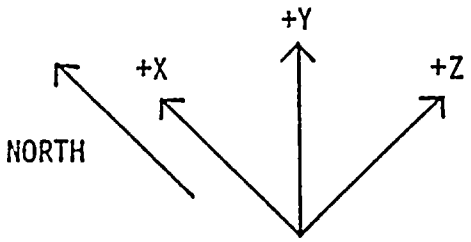
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-614

NODE NUMBER 238

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.018	.198	.041	371.		-157			
THERMAL-1	-.118	3.34	-.437	-2147		912			
THERMAL-2	-.183	3.42	-.440	-3293		-1393			
THERMAL-3	—	—	—	—		—			
SEISMIC-OBE	±.015	±.004	±.038	±720		±306			
SEISMIC-DBE	±.023	±.006	±.057	±1076		±457			
BLOWDOWN-SRV	—	—	—	—		—			
BLOWDOWN-PORV	+.010 -.014	±.002	+.024 -.031	±670		±284			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	+4648 -2496		±1061 -1972
EMERGENCY	+1447 -2852		+1212 -614

SUPPORT DRAWING LOADS

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

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

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

Technical Report
TR-5364-2
Revision 0

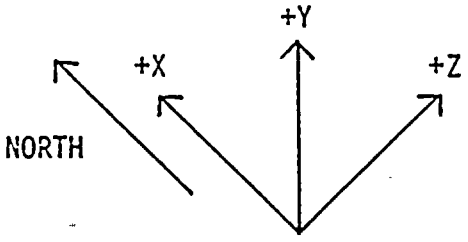
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-R-616

NODE NUMBER 129

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.004	0	.001		-276				
THERMAL-1	.012	2.35	-.006		-558				
THERMAL-2	.063	2.35	.041		-8				
THERMAL-3	—	—	—		—				
SEISMIC-OBE	±.002		±.005		±1753				
SEISMIC-OBE	±.003		±.008		±2789				
BLOWDOWN-SRV	—		—		—				
BLOWDOWN-PORV	±.003		±.002		±754				

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		+1624 -2587	
EMERGENCY		+2513 -3623	

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)		37502	
DESIGN (-)		36947	

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

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

Technical Report
TR-5364-2
Revision 0

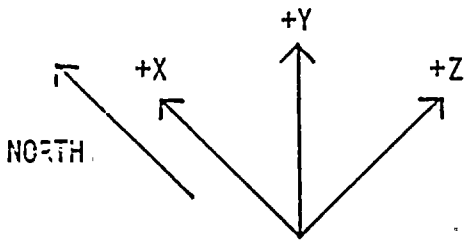
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

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	-.059	-.009	-.387						
SEISMIC-OBE	±.001	0	0	±7		±15			
SEISMIC-OBE	±.002	±.001	0	±11		±122			
BLOWDOWN-SRV	+.737 −.675	+.088 −.084	+.065 −.063	±40292		±3572			
BLOWDOWN-PORV	±.003	0	±0	±18		±199			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	±19		±213
EMERGENCY	±40292		±3572

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)			1429
DESIGN (-)			1429

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

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING FOR THE NORMAL/UPSET CONDITIONS AND GREATER FOR THE EMERGENCY CONDITION.

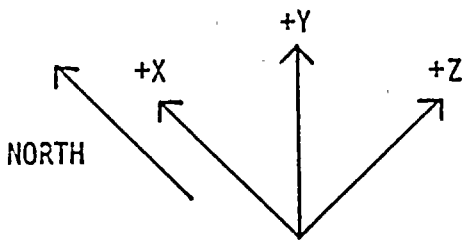
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-626

NODE NUMBER 402

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.017	.210	.013						
THERMAL-1	-.270	3.39	-.599						
THERMAL-2	-.171	3.51	-.575						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.048	0	±.039		±291				
SEISMIC-DBE	±.082	0	±.060		±503				
BLOWDOWN-SRV	—	—	—		—				
BLOWDOWN-PORV	+.016 −.020	0	+.018 −.026		±1396				

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		±1426	
EMERGENCY		±503	

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

Technical Report
TR-5364-2
Revision 0

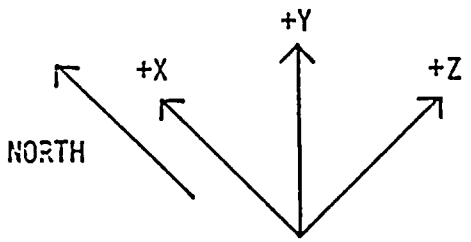
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [signature] DATE: 6-9-83
CHECKED BY: DMS DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-C-627

NODE NUMBER 400

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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	—	—	—						
SEISMIC-OBE	±.032	±.014	±.037						
SEISMIC-DBE	±.053	±.024	±.057						
BLOWDOWN-SRV	—	—	—						
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 (+)		732	
DESIGN (-)			

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

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

Technical Report
TR-5364-2
Revision 0

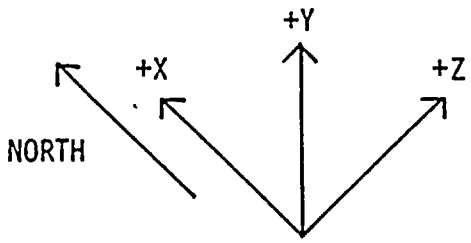
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-629

NODE NUMBER 228

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.018	.013	.036						
THERMAL-1	-.279	2.47	-.252						
THERMAL-2	-.500	2.91	-.309						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.044		±.084		±1766				
SEISMIC-DBE	±.068		±.133		±2808				
BLOWDOWN-SRV	—		—		—				
BLOWDOWN-PORV	+.015 -.022		+.025 -.019		±1025				

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET		±2042	
EMERGENCY		±2808	

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)		5943	
DESIGN (-)		5943	

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

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

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

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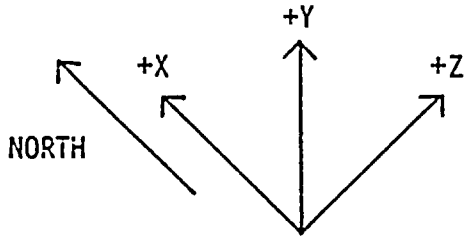
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-630

NODE NUMBER 182

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.028	.030	.005						
THERMAL-1	.003	2.65	.030						
THERMAL-2	.072	2.55	.280						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.008	±.009	±.005	±56		±88			
SEISMIC-OBE	±.013	±.014	±.008	±95		±150			
BLOWDOWN-SRV	—	—	—	—		—			
BLOWDOWN-PORV	+.005 −.007	±.002	+.003 −.005	±98		±155			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	±113		±178
EMERGENCY	±95		±150

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)	339		404
DESIGN (-)	339		404

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

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

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

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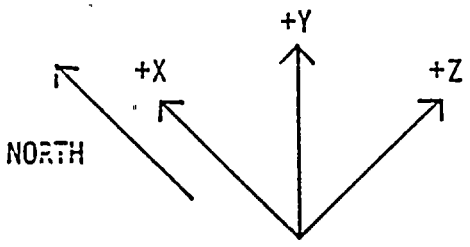

MARK NUMBER 2-GRC-S-631

NODE NUMBER 132

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.023	-.005	.002						
THERMAL-1	.080	2.48	.009						
THERMAL-2	.080	2.40	.230						
THERMAL-3	—	—	—						
SEISMIC-OBE	±.002	±.025	±.002	±107		±84			
SEISMIC-DBE	±.003	±.043	±.003	±184		±146			
BLOWDOWN-SRV	—	—	—						
BLOWDOWN-PORV	+.001 −.002	+.021 −.020	+.001 −.002	±183		±145			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	±212		±168
EMERGENCY	±184		±146

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)	681		811
DESIGN (-)	681		811

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

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Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHB DATE: 6-9-83
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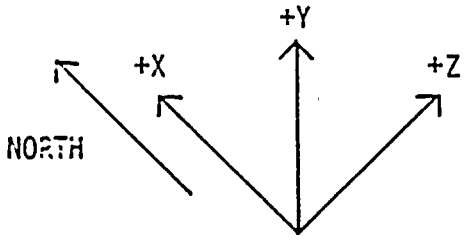
GLOBAL COORDINATE SYSTEM



MARK NUMBER 2-GRC-S-632

NODE NUMBER 78

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.001	-.058	-.001						
THERMAL-1	.084	2.43	.002						
THERMAL-2	.093	2.27	.197						
THERMAL-3	.035	2.25	.182						
SEISMIC-OBE	±.002	±.038	±.002	±224		±184			
SEISMIC-OBE	±.002	±.065	±.003	±384		±316			
BLOWDOWN-SRV	+.268 −.312	+1.14 −1.24	+.384 −.441	±128356		±105579			
BLOWDOWN-PORV	±.002	+.009 −.006	±.002	±168		±138			

TES COMBINED LOADS

	FX	FY	FZ
NORMAL/UPSET	±280		±230
EMERGENCY	±128356		±105579

SUPPORT DRAWING LOADS

	FX	FY	FZ
DESIGN (+)	2500		3167
DESIGN (-)	2500		3167

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

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING FOR THE NORMAL/UPSET CONDITIONS AND GREATER FOR THE EMERGENCY CONDITION.

Technical Report
TR-5364-2
Revision 0

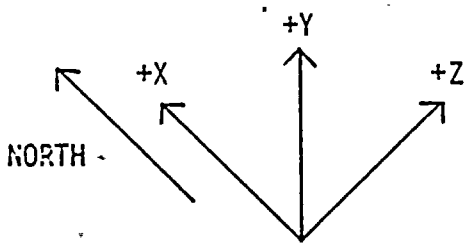
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 6-9-83
CHECKED BY: DMD DATE: 6/9/83

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	3.32	-.312	1207		1060			
THERMAL-3	.213	2.20	-.240	1136		998			
SEISMIC-OBE	±.002	±.053	±.003	±284		±249			
SEISMIC-DBE	±.004	±.085	±.005	±488		±429			
BLOWDOWN-SRV	+1.43 -1.63	+.890 -.883	+2.02 -1.82	±102123		±89665			
BLOWDOWN-PORV	±.002	+.003 -.006	+.003 -.002	∓96		±84			

TES COMBINED LOADS			
	FX	FY	FZ
NORMAL/UPSET	+1553 -238		+1363 -209
EMERGENCY	+103305 -100941		+90703 -88627

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

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

TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING FOR THE NORMAL/UPSET CONDITIONS AND GREATER FOR THE EMERGENCY CONDITION.

6.3 Valve Accelerations

Valve accelerations were calculated for all valves due to the DBE seismic condition and the PORV transient shock condition. In addition, the acceleration of valve SV-45C was calculated for the SV transient shock condition since this valve is part of the quarter model. 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 12). For the seismic accelerations, the resultant horizontal acceleration was compared against the 3g allowable. Weights for valves NMO-151, 152 and 153 were taken as 352 pounds, in determining the seismic acceleration, since this is the value used in the seismic analysis, see Section 5.0.

For the PORV transient shock accelerations, the updated valve weight of 400 pounds was used in both the analysis and the acceleration calculations. It should be noted that valves NRV-151, NRV-152, NRV-153, NMO-151, NMO-152 and NMO-153 all fail the vertical acceleration criteria of 2g and valves NMO-151, 152 and 153 exceed the horizontal acceleration criteria of 3g. These values are considered acceptable per reference 7 (see Section 2.0).

The acceleration of valve SV-45C for the SV transient shock condition exceeds all criteria by a large margin, which further indicates the failure of the system during emergency conditions.

6.3.1 DBE Seismic Valve Accelerations

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5/12/83
CHECKED BY: [illegible] DATE: 5-12-83

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 = $\sqrt{(A_{XT})^2 + (A_{ZT})^2}$

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DHD DATE: 5/12/83
CHECKED BY: DHK DATE: 5-12-83

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	.17	.39	.78	.35	.40	.54	.37	.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 = $\sqrt{(A_{xT})^2 + (A_{zT})^2}$

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

TELEDYNE ENGINEERING SERVICES

BY: DMD DATE: 5/12/83
CHECKED BY: DWK DATE: 5-13-83

VALVE NO.		NRV-151			NRV-152			NRV-153		
NODE NO.		295			341			365		
		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	.61	1.40	.19	.75	.62	.31	.91
	Y	.13	.33	.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 PORV Transient Shock and SV Transient Shock Valve Accelerations

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMS DATE: 8 June 83
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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)	36	56	49	41	47	53
ACCELERATION	.05g	.08g	.07g	.06g	.07g	.08g
ALLOWABLE	3 g	2 g	3 g	3 g	2 g	3 g

VALVE	SV-45C			SV-45C *		
NODE NUMBER	105			105		
VALVE WEIGHT	685 LBS			685 LBS		
DIRECTION	X	Y	Z	X	Y	Z
FORCE (LBS)	27	34	21	19469	21145	8192
ACCELERATION	.04 g	.05g	.03g	28.4g	30.9g	12.0g
ALLOWABLE	3 g	2 g	3 g	3g	2g	3g

* ACCELERATIONS ARE THE RESULTS OF THE SV TRANSIENT SHOCK CONDITION FROM THE QUARTER MODEL ANALYSIS. ALL OTHER VALVE ACCELERATIONS IN THIS SECTION RESULT FROM THE PORV TRANSIENT SHOCK CONDITION.

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMS DATE: 8 JUNE 83
CHECKED BY: DMB DATE: 8 June 83

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)	1413	891	633	636	1248	1498
ACCELERATION	3.53g	2.23g	1.58g	1.59g	3.12g	3.75g
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)	1554	1156	632			
ACCELERATION	3.89g	2.89g	1.58g			
ALLOWABLE	3g	2g	3g			

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 8 JUNE 83
CHECKED BY: DMB DATE: 8 June 83

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)	597	1003	234	346	1754	647
ACCELERATION	1.24g	2.09g	.49g	.72g	3.65g	1.35g
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)	555	1123	222			
ACCELERATION	1.16g	2.34g	.46g			
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 each loading condition analyzed.

TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

BY: DMD DATE: 6/8/83

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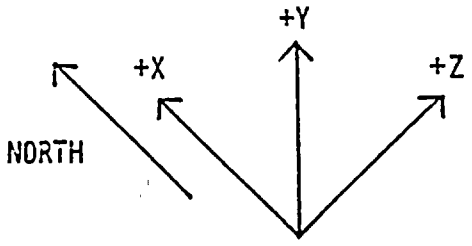
DONALD C. COOK
UNIT #2
PROJECT 5364

GLOBAL COORDINATE SYSTEM



NODE NUMBER 2

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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	—	—	—	-160	170	-200	-2360	25980	-22200
SEISMIC-OBE	—	—	—	±36	±94	±50	±795	±1565	±4116
SEISMIC-DBE	—	—	—	±58	±166	±85	±1329	±2599	±7133
BLOWDOWN-SRV	—	—	—	±32019	±19725	±27766	±351784	±958752	±973166
BLOWDOWN-PORV	—	—	—	±351	±117	±104	±1569	±3272	±5446

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

TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

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DONALD C. COOK
UNIT #2
PROJECT 5364

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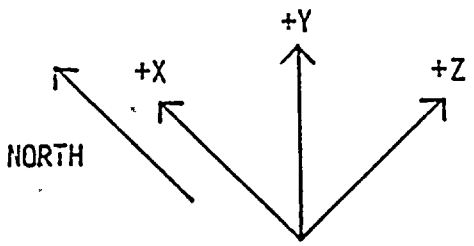

NODE NUMBER 124

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-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	—	—	—	-200	-100	-80	6990	11450	-13570
SEISMIC-OBE	—	—	—	±591	±852	±701	±16243	±13095	±17376
SEISMIC-DBE	—	—	—	±1003	±1406	±1213	±28151	±21905	±28949
BLOWDOWN-SRV	—	—	—	±14971	±33325	±52119	±1674445	±559538	±419711
BLOWDOWN-PORV	—	—	—	±29	±55	±45	±1716	±823	±766

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

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

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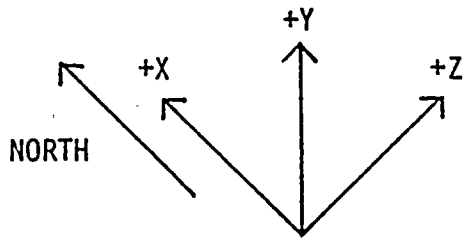
GLOBAL COORDINATE SYSTEM



NODE NUMBER 174

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	0	-910	-40	-7530	-800	-20980
THERMAL-1	—	—	—	-380	-490	-110	16750	-10860	-7250
THERMAL-2	—	—	—	-70	-270	20	6460	-950	790
SEISMIC-OBE	—	—	—	±891	±1210	±790	±15309	±16045	±22664
SEISMIC-OBE	—	—	—	±1542	±1991	±1300	±25318	±26549	±39163
BLOWDOWN-SRV	—	—	—	—	—	—	—	—	—
BLOWDOWN-PORV	—	—	—	±57	±78	±56	±1212	±1081	±2519

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

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

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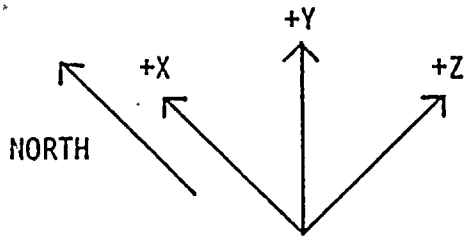
GLOBAL COORDINATE SYSTEM



NODE NUMBER 218

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	40	-989	-10	15160	-250	-13760
THERMAL-1	—	—	—	-270	-860	-579	21990	-21679	24070
THERMAL-2	—	—	—	90	-400	-60	4940	-970	15200
SEISMIC-OBE	—	—	—	±740	±1100	±780	±22610	±14193	±7406
SEISMIC-OBE	—	—	—	±1221	±1821	±1331	±37426	±23445	±12649
BLOWDOWN-SRV	—	—	—	—	—	—	—	—	—
BLOWDOWN-PORV	—	—	—	±57	±86	±56	±1725	±1000	±1503

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

Technical Report
TR-5364-2
Revision 0

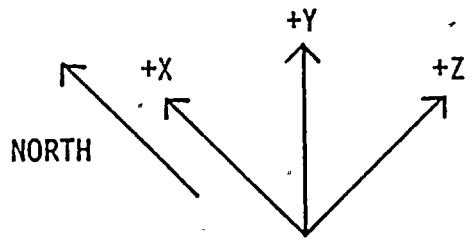
TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMD DATE: 6/8/83
CHECKED BY: DMB DATE: 6-8-83

GLOBAL COORDINATE SYSTEM



NODE NUMBER 342

	DESIGN LOADINGS								
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	310	-170	10	1330	4320	-13070
THERMAL-1	—	—	—	70	-60	-1150	-87270	33800	29390
THERMAL-2	—	—	—	40	450	-1159	-97290	31640	26650
SEISMIC-OBE	—	—	—	±182	±284	±241	±15557	±12931	±10248
SEISMIC-DBE	—	—	—	±294	±477	±393	±23938	±19320	±15538
BLOWDOWN-SRV	—	—	—	—	—	—	—	—	—
BLOWDOWN-PORV	—	—	—	±650	±6248	±554	±19815	± 5301	± 17464

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 each loading condition analyzed.

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

VALVE END MOMENTS

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [signature] DATE: 6-8-83

CHECKED BY: DMS DATE: 6/8/83

VALVE NUMBER SV-45A

NODE NUMBER	196			200		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	2532	938	4853	3242	1046	14021
THERMAL 1	-22224	2773	4017	-12742	12244	-14350
THERMAL 2	2172	1696	-9635	2836	2570	-14309
SEISMIC OBE	±8522	±3675	±1779	±2077	±1291	±8896
SEISMIC DBE	±14573	±6280	±2978	±3497	±2148	±14684
BLOWDOWN PORV	±882	±285	±597	±917	±730	±854

VALVE NUMBER _____

NODE NUMBER						
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT						
THERMAL 1						
THERMAL 2						
SEISMIC OBE						
SEISMIC DBE						
BLOWDOWN PORV						

UNITS: INCH-POUNDS

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

VALVE END MOMENTS

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 6-8-83
CHECKED BY: DmD DATE: 6/8/83

VALVE NUMBER SV-45B

NODE NUMBER	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	—	—	—	—	—	—
SEISMIC OBE	±3762	±3713	±12031	±6927	± 906	±6495
SEISMIC DBE	±6504	± 6423	±20814	±11460	± 1507	±10755
BLOWDOWN PORV	± 375	±196	±419	±872	±685	±460

VALVE NUMBER SV-45C

NODE NUMBER	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	-9678	-9073	17487	-9336	-7745	14976
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 SRV	±433358	±84761	±502148	±391070	±255572	±578093

UNITS: INCH-POUNDS

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

VALVE END MOMENTS

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: DMB DATE: 5-27-83
CHECKED BY: DMB DATE: 5/27/83

VALVE NUMBER NRV-151

NODE NUMBER	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
SEISMIC OBE	±7008	±6142	±1983	±7941	±7814	±6151
SEISMIC DBE	±11146	±9772	±3029	±12646	±12433	±9834
BLOWDOWN PORV	±3576	±1129	±7671	±7647	±2661	±13478

VALVE NUMBER NMO-151

NODE NUMBER	298			302		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	2967	2084	2817	4660	2428	-2677
THERMAL 1	6141	-7454	-5077	5941	-11682	-4531
THERMAL 2	4439	-2581	-1662	4307	-3862	-1334
SEISMIC OBE	±8219	±6296	±4674	±11359	±3878	±4451
SEISMIC DBE	±13090	±10021	±7504	±18076	±6171	±7087
BLOWDOWN PORV	±8087	±5021	±10421	±4703	±5603	±8713

UNITS: INCH-POUNDS

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

VALVE END MOMENTS

DONALD C. COOK
UNIT #2
PROJECT 5364

BY: [illegible] DATE: 5-27-83
CHECKED BY: DMD DATE: 5/27/83

VALVE NUMBER NRV-152

NODE NUMBER	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
SEISMIC OBE	±3106	±4196	±5116	±4329	±5260	±7278
SEISMIC DBE	±5275	±7312	±8915	±7257	±9160	±12551
BLOWDOWN PORV	±7740	±1096	±4492	±8822	±2339	±7346

VALVE NUMBER NMO-152

NODE NUMBER	352			356		
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT	-3004	-546	-157	-1057	-660	109
THERMAL 1	9575	-4166	3635	8954	-3322	3385
THERMAL 2	8824	-4264	6371	6133	-6576	5286
SEISMIC OBE	±3712	±3372	±7236	±3792	±1538	±9170
SEISMIC DBE	±6252	±5827	±12497	±6515	±2534	±15906
BLOWDOWN PORV	±10489	±5586	±5966	±14880	±6371	±6195

UNITS: INCH-POUNDS

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision 0

VALVE END MOMENTS

BY: [illegible] DATE: 5-27-83

CHECKED BY: [illegible] DATE: 5/27/83

DONALD C. COOK
UNIT #2
PROJECT 5364

VALVE NUMBER NRV-153

NODE NUMBER	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
SEISMIC OBE	± 9149	± 770	± 4255	± 4528	± 2963	± 4959
SEISMIC DBE	± 13560	± 1221	± 6318	± 7296	± 4435	± 8120
BLOWDOWN PORV	± 2573	± 1296	± 7121	± 6328	± 1946	± 13676

VALVE NUMBER NMO-153

NODE NUMBER	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
SEISMIC OBE	± 3722	± 6476	± 2187	± 7515	± 6167	± 2910
SEISMIC DBE	± 5692	± 9605	± 3625	± 11152	± 9150	± 4402
BLOWDOWN PORV	± 5957	± 2541	± 11249	± 4781	± 2193	± 12104

UNITS: INCH-POUNDS

6.6 Miscellaneous Calculations

6.6.1 Thermal Boundary Displacements

Technical Report
TR-5364-2
Revision Q

TELEDYNE ENGINEERING SERVICES

BY DMD DATE 4/8/83
CHKD. BY [illegible] DATE 4-18-83

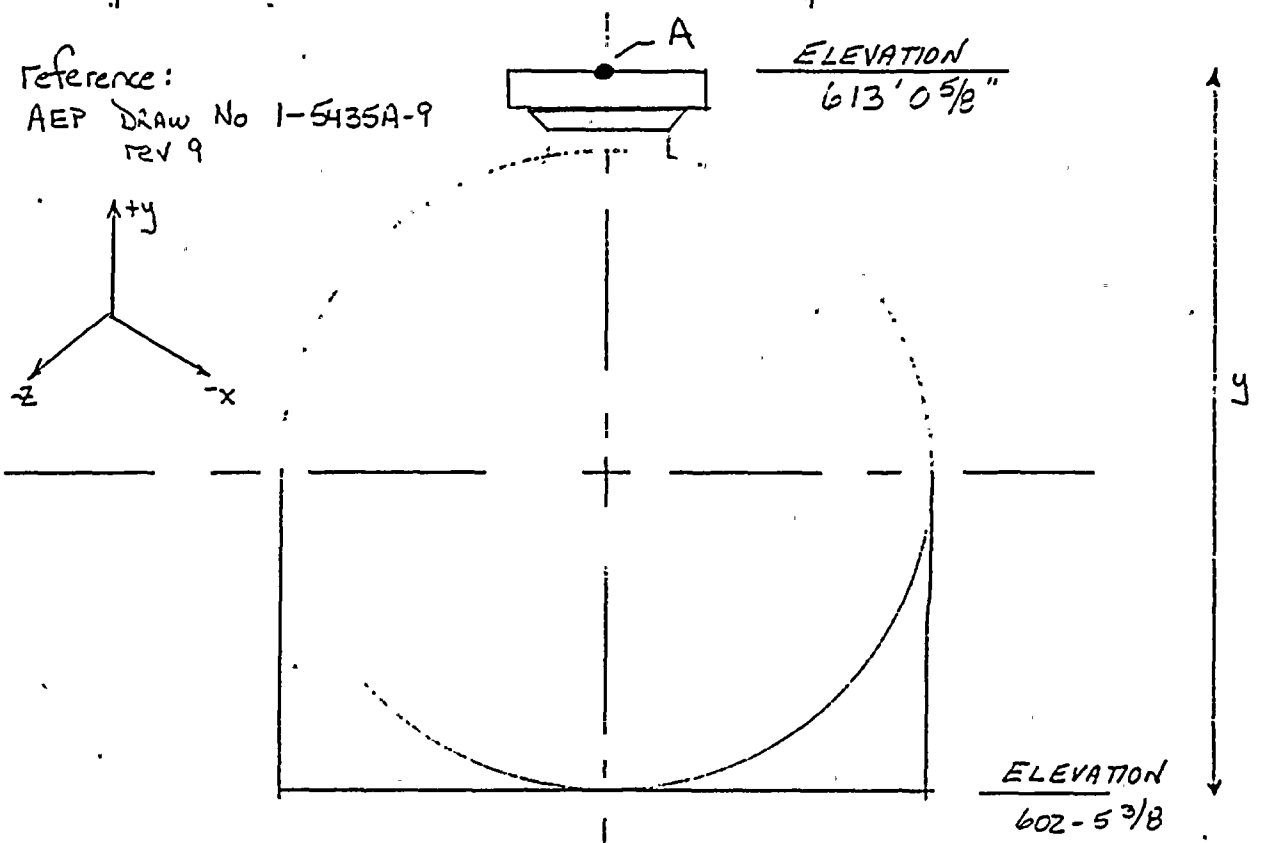
THERMAL BOUNDARY DISPLACEMENTS NORMAL THERMAL CONDITION

SHEET NO. 1 OF
PROJ. NO. 5364

UNITS I & Z

Temperature @ Quench Tank = 85°F (per AEP letter dated 11/29/82)

Reference:
AEP Draw No 1-5435A-9
rev 9



Want displacements at point A

$$y = 613'-0\,5/8'' - 602-5\,3/8' = 10'-7\,1/4 = 10.604'$$

x movement = z movement = 0 since nozzle is at ℄ of Q-tank

y movement = $\alpha \Delta t \ell$

$\alpha = 6.135 \times 10^{-6}$ in/in/°F (for ferritic carbon steel)
$\Delta t = 15°F$ (85-70)
$\ell = 10.604' = 127.248''$

$\Delta y = 6.135 \times 10^{-6} \times 15 \times 127.248 = .0117''$

Summary $\Delta x = 0$ $\Delta y = +.0117''$ $\Delta z = 0$

TELEDYNE ENGINEERING SERVICES

BY DMD DATE 4/12/83
CHKD. BY [illegible] DATE 4-[illegible]-83

α, ΔT Values Units 1 & 2

SHEET NO. 1 OF ____
PROJ. NO. 5364

temperature $\Rightarrow$ 653°F

$\Delta T = 653 - 70 = 583$

for austentic stainless steel $\alpha_{650} = 9.87 \times 10^{-6}$

$\alpha_{700} = 9.93 \times 10^{-6}$

$\alpha_{700} - \alpha_{650} = 9.93 - 9.87 = .06$

$\therefore \frac{.06}{50^\circ} = \frac{x}{3^\circ}$ $x = .0036$

$\alpha_{653} = 9.87 + .0036 = 9.8736 \times 10^{-6}$

temperature = 85°

$\Delta T = 85 - 70 = 15^\circ$

for austentic stainless steel $\alpha_{70} = 9.11 \times 10^{-6}$

$\alpha_{100} = 9.16 \times 10^{-6}$

$\alpha_{100} - \alpha_{70} = 9.16 - 9.11 = .05$

$\frac{.05}{30} = \frac{x}{15} \Rightarrow x = .025$

$\alpha_{85} = 9.11 + .025 = 9.135 \times 10^{-6}$

TELEDYNE ENGINEERING SERVICES

BY DMD. DATE 4/12/83
CHKD. BY [illegible] DATE [illegible]

Thermal Boundary Displacements
Normal Thermal Condition

SHEET NO. 2 OF ____
PROJ. NO. 5364

Temperature of Pressurizer = 653°F (per AEP letter dated 11/29/82)

references ① AEP DRAW No 1-5435-8 rev 8
② (W) DRAW No 1097 J56 sheet 1 of 2
③ AEP DRAW No 1-5436-8

per reference ② dimension from base of pressurizer to SRV & PORV nozzles is :

$$635.5 - (52.00 - 35.06) = 618.56''$$

Δy will be same for all four nozzles since the elevations are the same.

$\alpha_{583°} = 7.3366 \times 10^{-6}$ in/in/°F for carbon steel @ 653°

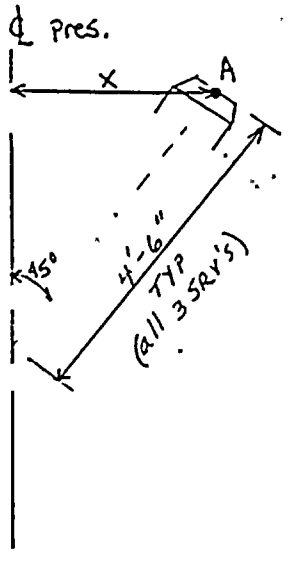
$l = 618.56''$

$\Delta t = 653 - 70 = 583$

$$\Delta y = + \alpha \Delta t l = 7.3366 \times 10^{-6} \times 618.56'' \times 583°F = 2.6457''$$

radial growth

per section "G-7" of ref 3



$$\frac{\sin 90}{4.5} = \frac{\sin 45}{x}$$

$x = 3.182' = 38.1838''$

note: this page of calculations is the same for both units since the pressurizer & nozzle dimensions are essentially identical

TELEDYNE ENGINEERING SERVICES

BY: DMD DATE: 4/13/83
CHKD. BY: DMB DATE: 4-13-83

Thermal Boundary Displacements
Normal Thermal Condition

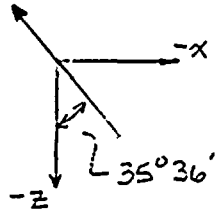
SHEET NO. 3 OF ____
PROJ. NO. 5.364

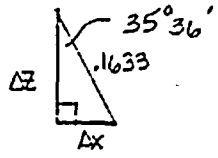
UNIT 2

Radial $\Delta = 7.3366 \times 10^{-6} \times 583 \times 38.1838 = .1633''$

determine X & Z Components for radial Δ for each SRV valve nozzle

Valve SV-45A



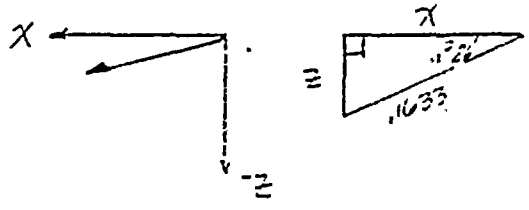


$$\frac{\sin 90}{.1633} = \frac{\sin 35°36'}{\Delta X} = \frac{\cos 35°36'}{\Delta Z}$$

$\Delta X = +.0951$

$\Delta Z = +.1328$

Valve SV-45B

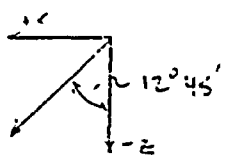


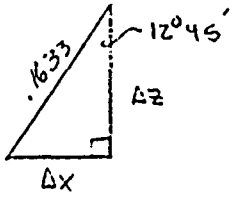
$$\frac{\sin 90}{.1633} = \frac{\sin 110°26'}{-\Delta Z} = \frac{\cos 110°26'}{\Delta X}$$

$\Delta X = +.1601$

$\Delta Z = -.0324$

Valve SV-45C





$$\frac{\sin 90}{.1633} = \frac{\sin 12°45'}{\Delta X} = \frac{\cos 12°45'}{-\Delta Z}$$

$\Delta X = +.0360$

$\Delta Z = -.1593$

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

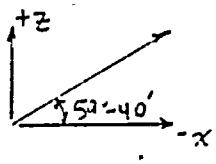
BY DMB DATE 4/13/83
CHKD. BY DMB DATE 4-13-83

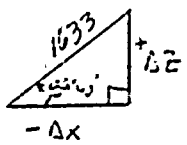
Thermal Boundary Displacements
Normal Thermal Condition

SHEET NO. 4 OF ____
PROJ. NO. 5364

UNIT 2

PORV Relief Line





$$\frac{\sin 90}{.1633} = \frac{\sin 59°40'}{+\Delta Z} = \frac{\cos 59°40'}{-\Delta X}$$

$\Delta X = -.0825$
$\Delta Z = +.1409$

for the 4 pressurizer nozzles the following displacements will be inserted.

node 218 (Valve SV-45A)
$\Delta X = +.0951"$
$\Delta y = +2.6457"$
$\Delta z = +.1328"$

node 174 (SV-45B)
$\Delta X = +.1601"$
$\Delta y = +2.6457"$
$\Delta z = -.0324"$

node 124 (SV-45C)
$\Delta X = +.0360"$
$\Delta y = +2.6457"$
$\Delta z = -.1593"$

node 342 (PORV Relief)
$\Delta X = -.0825"$
$\Delta y = +2.6457"$
$\Delta z = +.1409"$

6.6.2 OBE Spectra

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-2
Revision
BY BMD DATE 4/8/83
CHKD. BY BMB DATE 4/8/83

Response Spectra

SHEET NO. 1 OF
PROJ. NO. 5364

OBE Analysis

for both Units 1 & 2 the attached spectra curves indicate that Containment CRANE WALL elevation 667'-6" governs for all frequencies. Therefore the horizontal (X & Z) response spectra for OBE analysis is

f	g
.5	.10
1.0	.30
1.2	.50
1.7	5.0
2.3	5.0
3.6	1.10
5.0	.90
10.0	.60
21.0	.42
50.0	.42

VERTICAL

The vertical, OBE response, per the attached spectra, is:

f	g
.5	.04
1.0	.13
1.22	.20
1.70	1.33
2.30	1.33
3.10	.62
5.00	.62
10.0	.23
22.0	.12
50.0	.12

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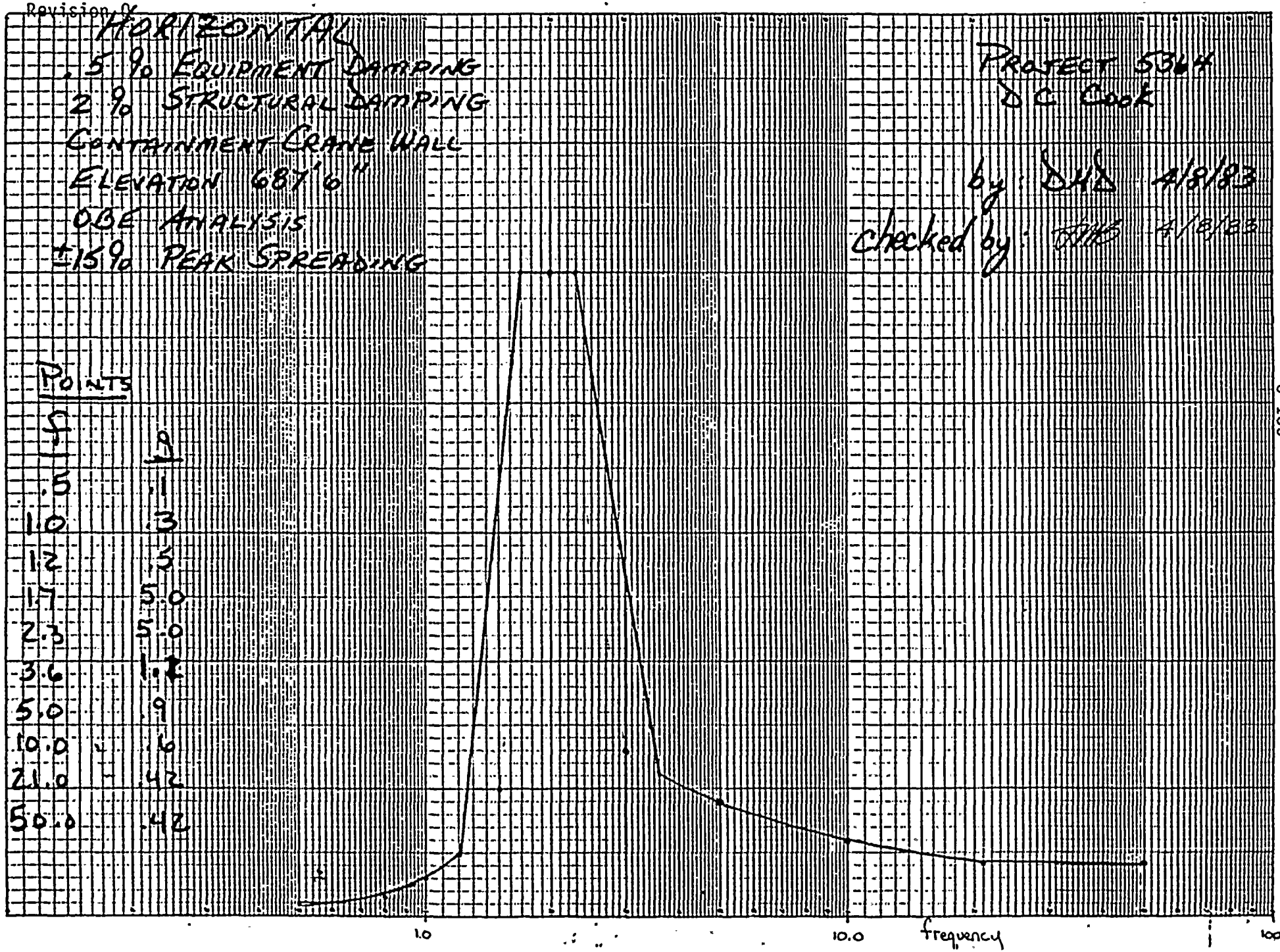
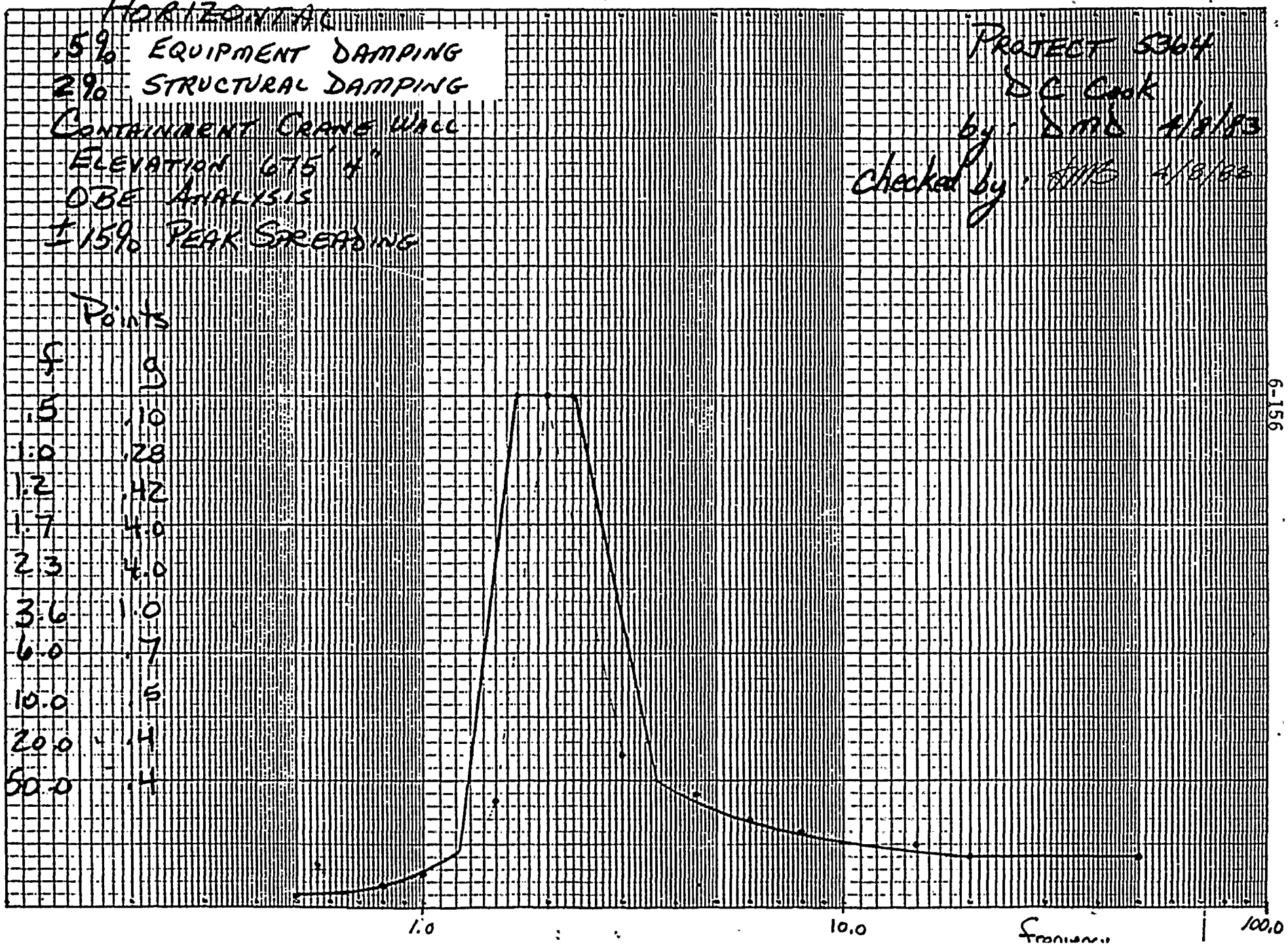
HORIZONTAL
.5 % EQUIPMENT DAMPING
2 % STRUCTURAL DAMPING
CONTAINMENT CRANE WALL
ELEVATION 687'6"
OBE ANALYSIS
±15% PEAK SPREADING

PROJECT 5364
D C COOK
by: DHA 4/8/83
Checked by: [illegible] 4/8/83

POINTS	SF	D
1	.5	.11
2	1.0	.13
3	1.2	.5
4	1.7	5.0
5	2.3	5.0
6	3.6	1.1
7	5.0	.9
8	10.0	.6
9	21.0	.42
	50.0	.42




HORIZONTAL
.5% EQUIPMENT DAMPING
2% STRUCTURAL DAMPING
CONTAINMENT CRANE WHCC
ELEVATION 675'-4"
OBE ANALYSIS
±15% PEAK SPREADING
PROJECT 5364
DC Cook
by: DMB 4/8/83
Checked by: [illegible] 4/8/83
Points
4 .9
5 1.0
1.0 .28
1.2 .42
1.7 4.0
2.3 4.0
3.6 1.0
6.0 .7
10.0 .5
20.0 .4
50.0 .4
9
5
4
3
2
1
1.0
10.0
100.0
Frequency
6-156

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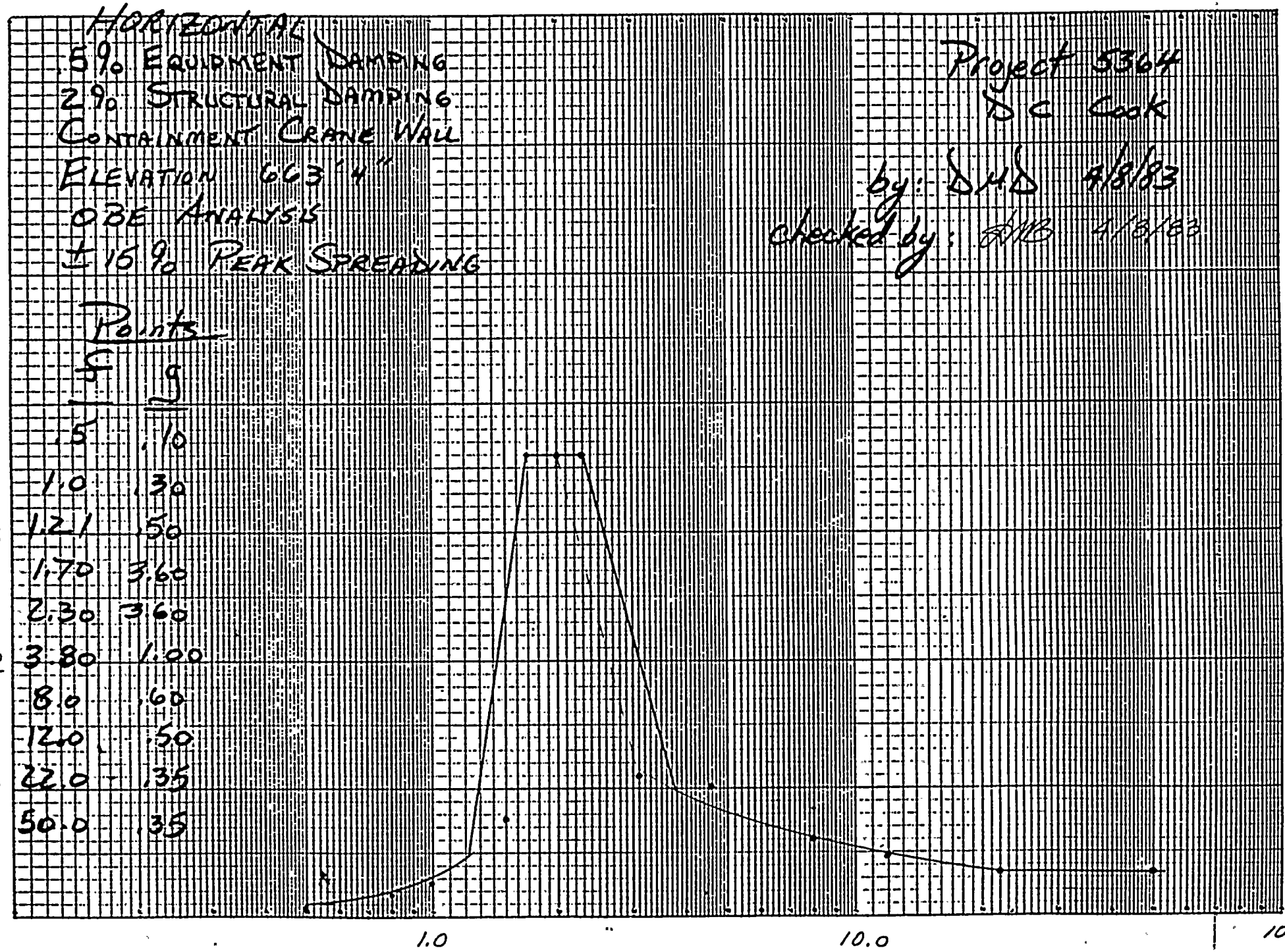

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HORIZONTAL

.5% Equipment Damping

2% Structural Damping

Containment Crane Wall

Elevation 651'3"

OBE Analysis

± 15% Peak Spreading

Project 5364

DC Cook

by: DMD 4/8/83

checked by: [illegible] 4/8/83

Points

f	g
.5	.09
1.0	.30
1.22	.45
1.7	.33
2.3	.33
3.45	1.05
5.0	.80
8.0	.60
15.0	.40
20.0	.32
50.0	.32

g

4

3

2

1

1.0

10.0

Frequency

10c

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VERTICAL

.5% EQUIPMENT DAMPING

2% STRUCTURAL DAMPING

CONTAINMENT BASE SLAB

ELEVATION 587' 6"

OBE ANALYSIS

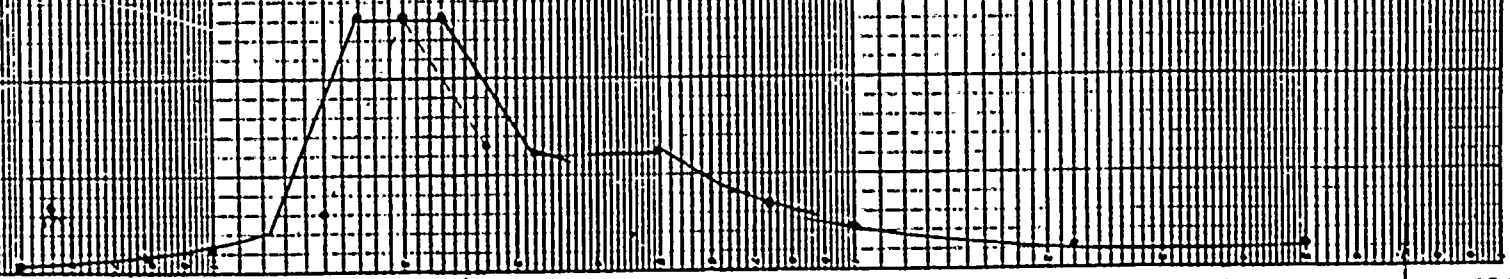
± 15% PEAK SPREADING

Project 5364
DC Cook
by: SMD 4/8/83
checked by: [illegible] 4/8/83

Points

f	g
1.5	.04
1.0	.13
1.22	.20
1.7	1.33
2.3	1.33
3.1	.62
5.0	.62
10.0	.23
22.0	.12
50.0	.12

Note: accelerations shown are 2/3 of values from response spectra



6.6.3 DBE Spectra

Technical Report
TR-5364-2
Revision 0

TELEDYNE ENGINEERING SERVICES

BY DMD DATE 4/11/83
CHKD. BY [illegible] DATE 4/12-83

RESPONSE SPECTRA

SHEET NO. 1 OF ____
PROJ. NO. 5364

DBE Analysis

per the attached figures, enveloping CONTAINMENT CRANE WALL ELEVATIONS 651.3, 663.3, 675.3 & 687.5 results in the following DBE horizontal spectra for both Units 1 & 2

freq ↑	g ↓
.5	.19
1.0	.50
1.18	.70
1.7	5.2
2.3	5.2
3.15	2.6
3.65	1.46
6.0	1.40
7.0	1.15
10.0	1.0
17.0	.72
50.0	.72

VERTICAL

The Vertical DBE response for Units 1 & 2, per the attached spectra, is:

f	g
.5	.11
1.0	.25
1.18	.33
1.70	1.40
2.30	1.40
3.42	.80
6.00	.80
10.0	.43
15.0	.28
25.0	.20
50.0	.20

[redacted]

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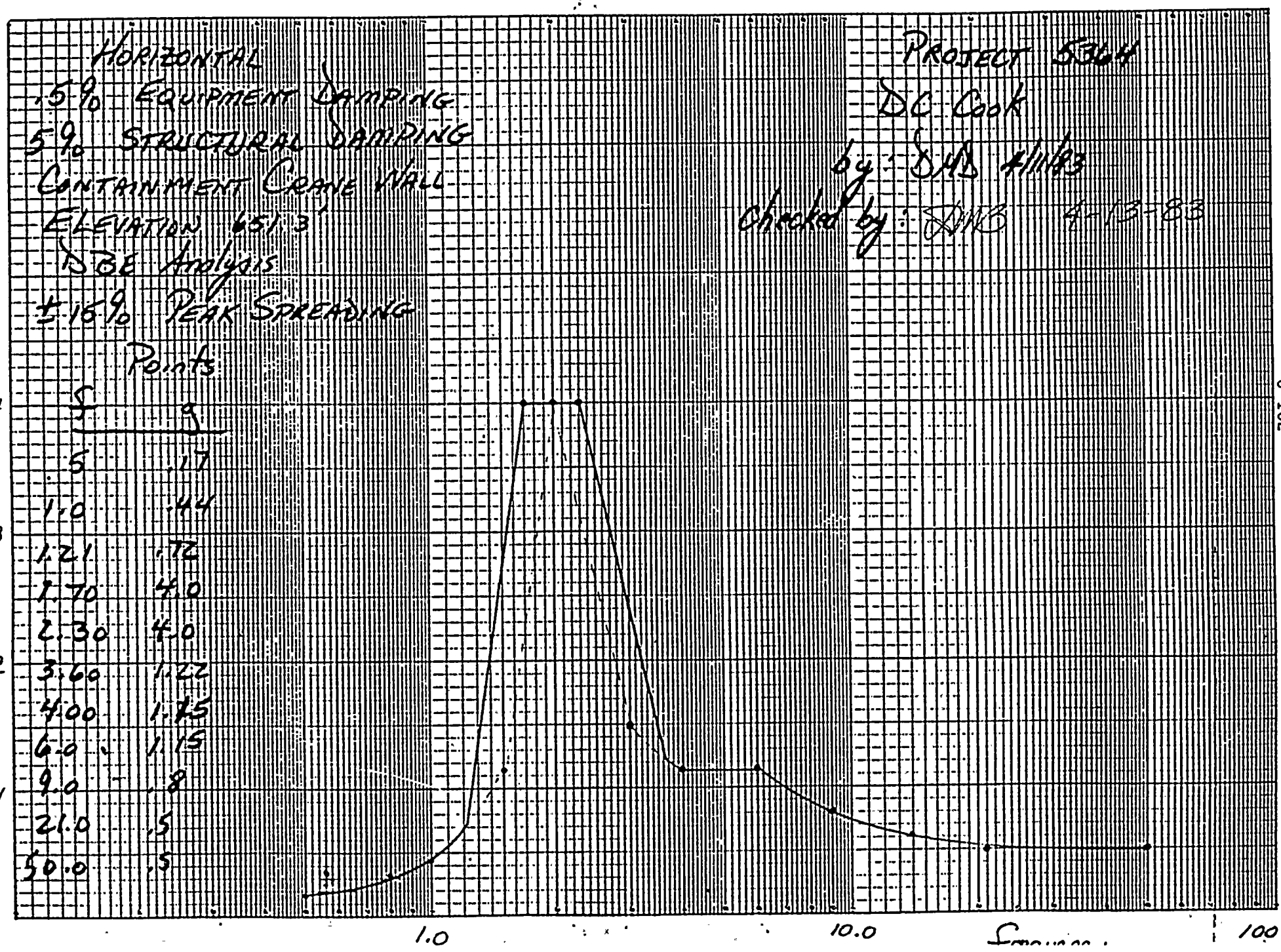
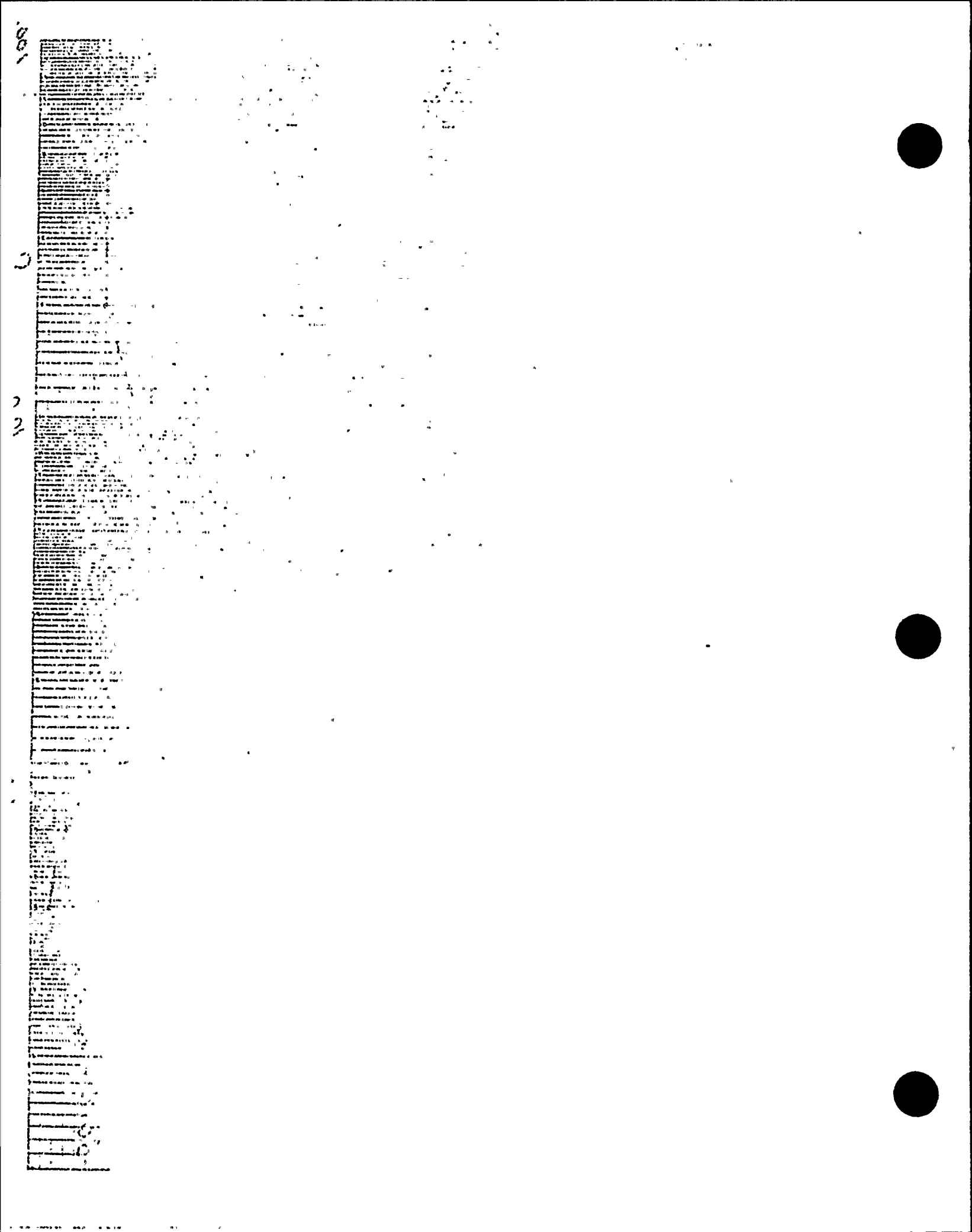




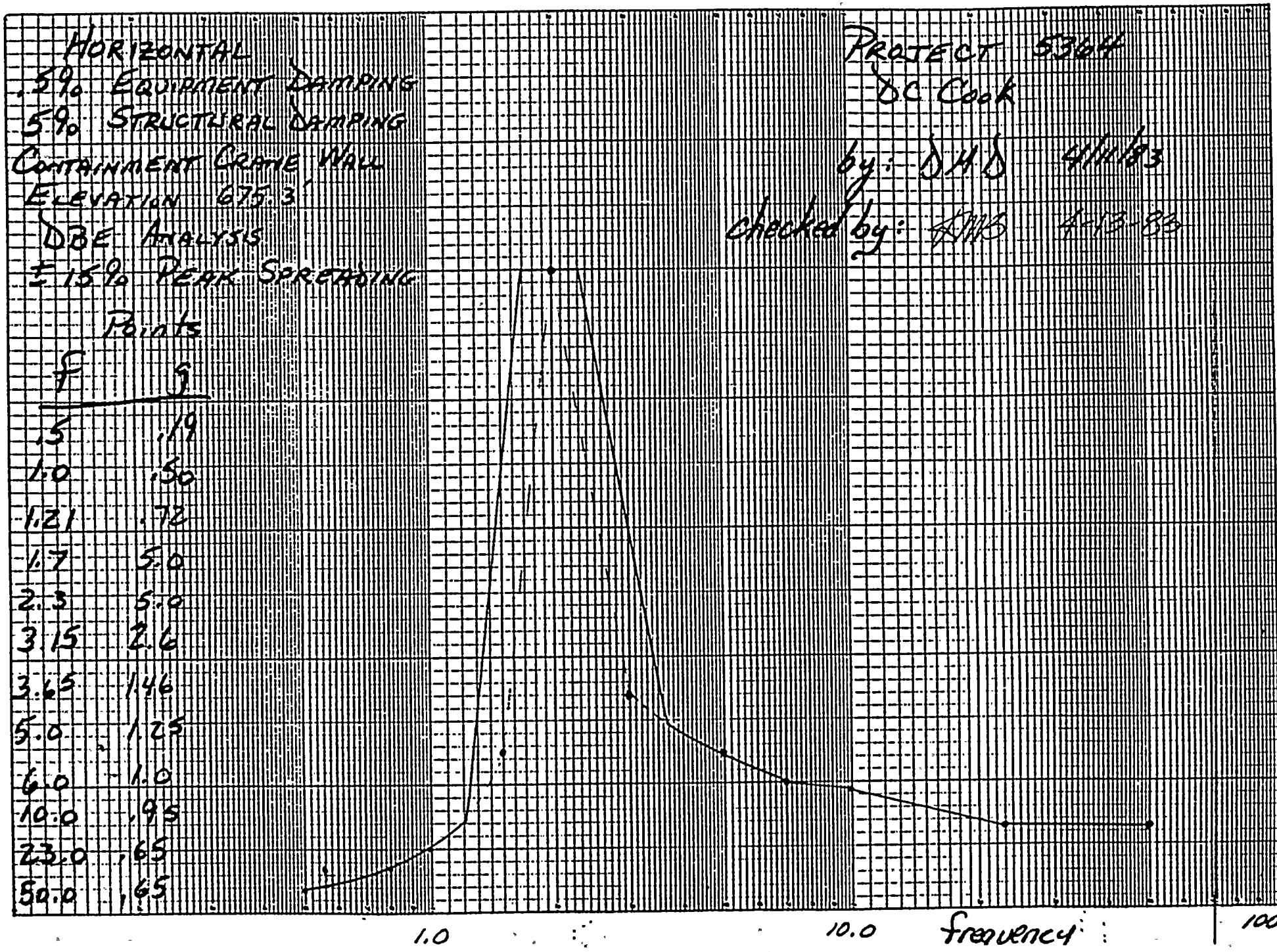
GRAPH PAPER ®
PRINTED IN U.S.A.

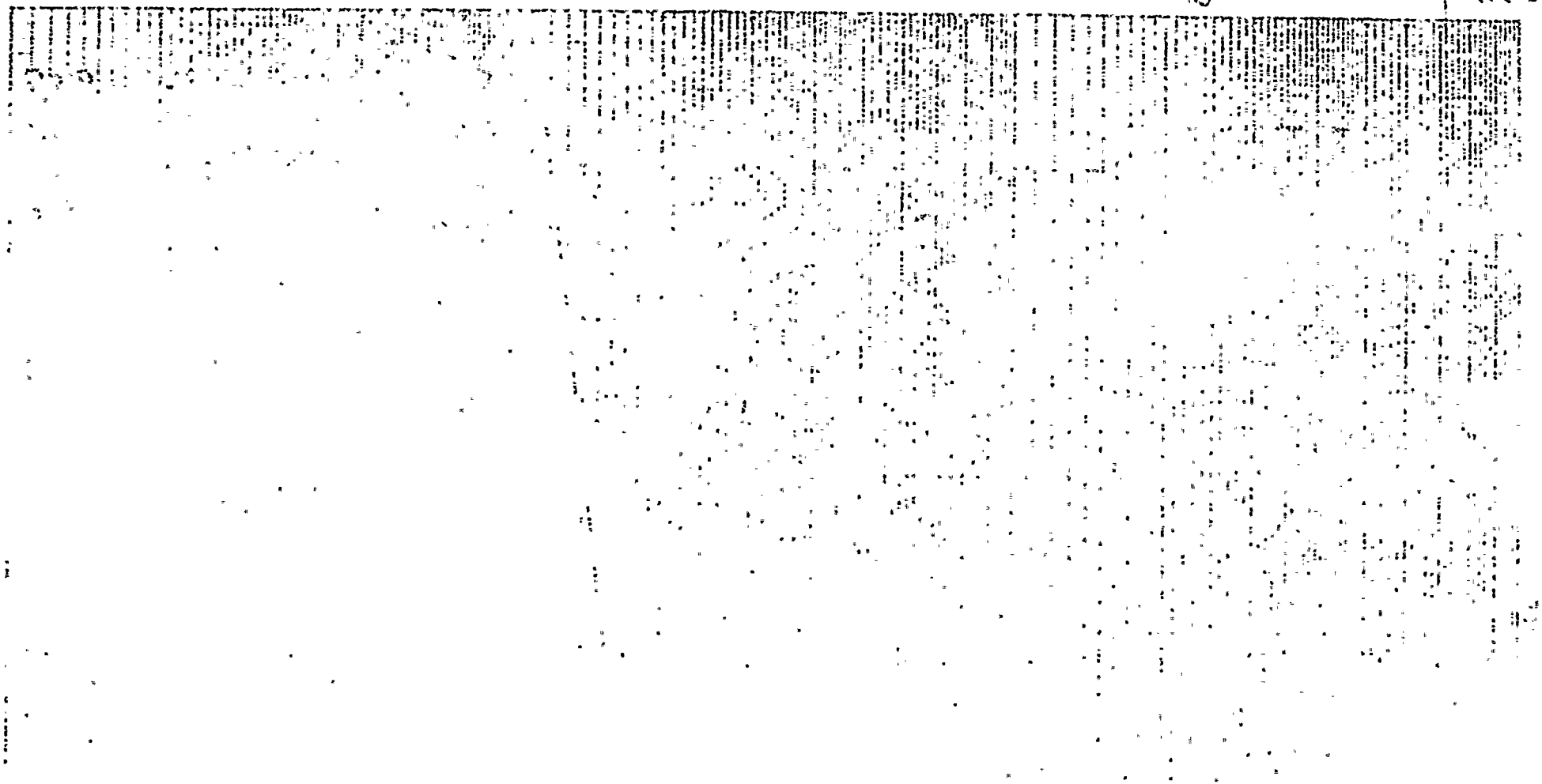
HORIZONTAL
.5% EQUIPMENT DAMPING
5% STRUCTURAL DAMPING
CONTAINMENT CRANE WALL
ELEVATION 663.3
↑ BE Analysis
± 15% PEAK SPREADING

PROJECT 5364
DC Cook
by DMD 4/1/83
Checked by [illegible] 4-13-83

Points	g
.5	.18
1.0	.46
1.2	.70
1.7	4.6
2.3	4.6
3.65	1.48
5.0	1.25
7.0	1.15
10.0	.90
20.0	.60
50.0	.60

[redacted]


HORIZONTAL
.5% EQUIPMENT DAMPING
5% STRUCTURAL DAMPING
CONTAINMENT CRANE WALL
ELEVATION 675.3'
DBE ANALYSIS
±15% PEAK SPREADING
Points
PROJECT 5364
DC Cook
by: DHS 4/14/83
checked by: [illegible] 4-13-83
F S
.5 .19
1.0 .50
1.21 .72
1.7 5.0
2.3 5.0
3.15 2.6
3.65 1.46
5.0 1.25
6.0 1.0
10.0 .95
23.0 .65
50.0 .65
1.0
10.0
frequency
100.0
6-164



GRAPH PAPER
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HORIZONTAL
.5% EQUIPMENT DAMPING
5% STRUCTURAL DAMPING
CONTAINMENT CRANE WALL
ELEVATION 687'-6"
DBE ANALYSIS
± 16% PEAK SPREADING

PROJECT 5364
D C Cook
by DMS 4/11/83
checked by: [illegible] 4-13-85

Freq	g
.5	.18
1.0	.50
1.18	.70
1.7	5.2
2.3	5.2
3.15	1.76
6.0	1.4
10.0	1.0
17.0	.72
50.0	.72

1.0 10.0 100.0

[redacted]

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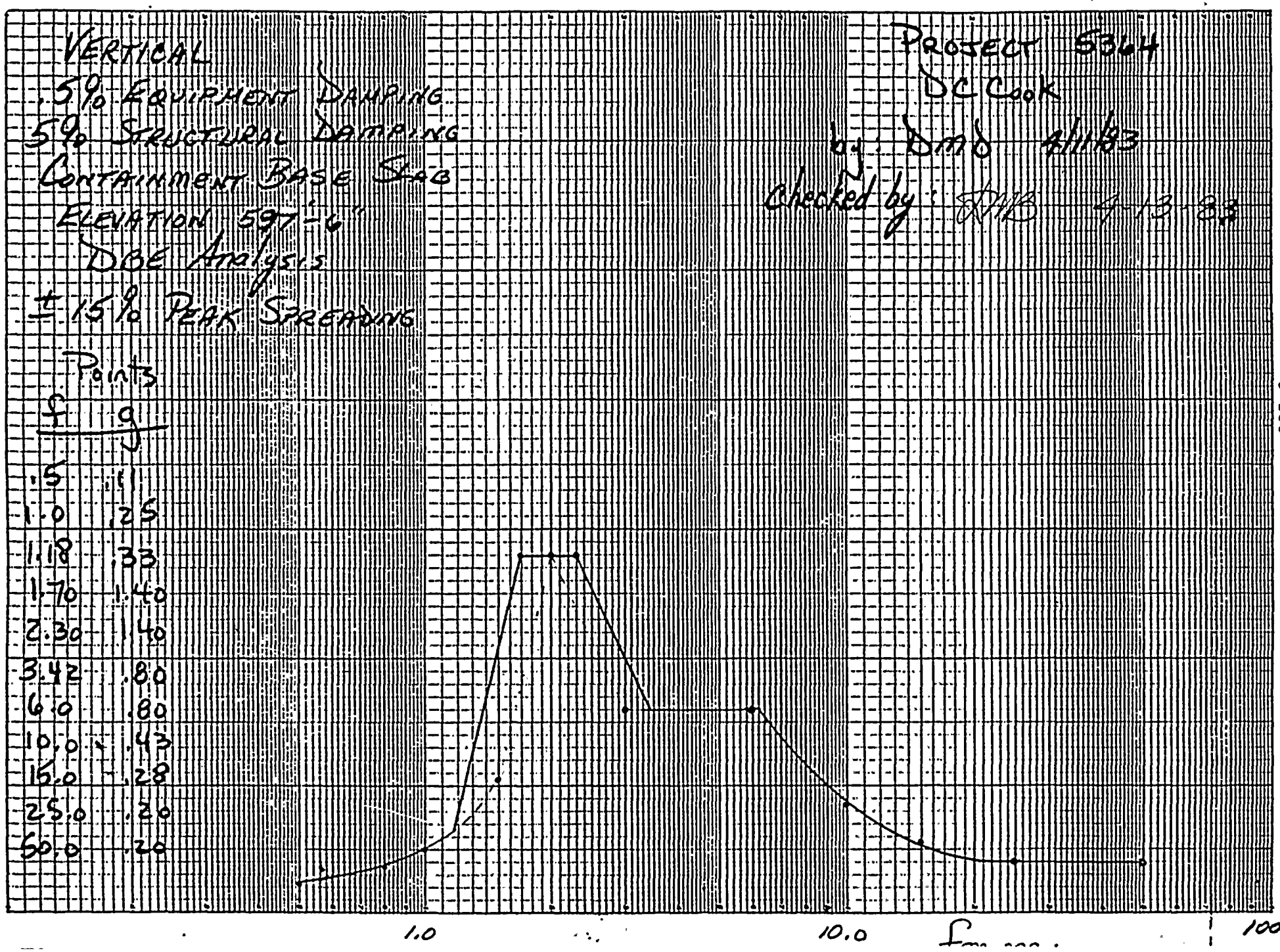

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7.0 DRAWINGS

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

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6. TES Technical Report TR-5364-1, Donald C. Cook Nuclear Generating Station, "Analysis of Pressurizer Safety Valves/Relief Valves Discharge Piping Systems per NUREG 0737, II.D.1, Unit 1.

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8. TES letter 5364-21, dated February 2, 1983 from Mr. P. D. Harrison of TES to Mr. Sam Ulan of AEP.

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DATE 6.13.86

TELEDYNE
ENGINEERING SERVICES

TECHNICAL REPORT

TECHNICAL REPORT TR-5364-2
REVISION 0

BOOK 3 OF 10

DONALD C. COOK NUCLEAR GENERATING PLANT

ANALYSIS OF PRESSURIZER SAFETY/RELIEF VALVES DISCHARGE PIPING SYSTEM PER NUREG 0737, II.D.1, UNIT 2

8608060048

JUNE 10, 1983

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

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TECHNICAL REPORT TR-5364-2
REVISION 0

BOOK 3 OF 10

DONALD C. COOK NUCLEAR GENERATING STATION

ANALYSIS OF PRESSURIZER SAFETY/RELIEF VALVES DISCHARGE PIPING SYSTEM PER NUREG 0737, II. D.1, UNIT 2

JUNE 10, 1983

Section 9.1.1 RELAP Input

9.1.1.1 PORV Solid 400° Liquid
9.1.1.2 PORV Solid 400° Liquid Restart
9.1.1.3 SV Cold Loop Seal (Quarter Model)

Section 9.1.2 REPIPE Input

9.1.2.1 Unit 2 - Model Section A
9.1.2.2 Unit 2 - Model Section B
9.1.2.3 Unit 2 - Quarter Model

TELEDYNE ENGINEERING SERVICES

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

TELEDYNE ENGINEERING SERVICES

TABLE OF CONTENTS

			PAGE
1.0	INTRODUCTION	Book 1 of 10	1-1
2.0	CONCLUSIONS		2-1
3.0	SYSTEM DESCRIPTION/DISCUSSION		3-1
4.0	THERMAL FLUIDS ANALYSIS		4-1
4.1	Introduction		4-1
4.2	RELAP Model		4-3
4.2.1	Pressurizer Conditions		4-3
4.2.2	Valve Modeling		4-4
4.2.3	Discharge Piping		4-11
4.2.4	Quench Tank		4-11
4.3	RELAP Model Control Volumes		4-12
4.4	Quarter Model		4-19
4.5	Unit 2 PORV Model		4-20
4.6	Valve Flow Rate Calculation		4-23
4.6.1	SV Flow Rate		4-24
4.6.2	PORV Flow Rate		4-25
4.7	RELAP Plots		4-28
4.7.1	Unit 2 - 400° Solid Liquid Case		4-29
4.7.2	Quarter Model - Cold Loop Seal/Steam Case		4-113
4.8	Force Time History Plots		4-129
4.8.1	Unit 2 - 400° Solid Liquid Case		4-130
4.8.2	Quarter Model - Cold Loop Seal/Steam Case		4-201
4.9	RELAP Input	Book 2 of 10	4-229
4.9.1	PORV Solid 400° Liquid		4-230
4.9.2	PORV Solid 400° Liquid Restart		4-250

TABLE OF CONTENTS
(Continued)

		PAGE
4.10	REPIPE Input	4-260
4.10.1	Model Section A PORV Unit 2	4-261
4.10.2	Model Section B PORV Unit 2	4-271
4.10.3	Quarter Model	4-278
4.11	APPENDIX A	4-286
5.0	STRUCTURAL ANALYSIS	5-1
5.1	Deadweight Analysis	5-2
5.2	Thermal Analysis	5-2
5.3	Seismic Analysis	5-2
5.4	Force/Time History Analysis	5-3
5.4.1	PORV Transient	5-3
5.4.2	SV Transient	5-4
6.0	ANALYTICAL RESULTS	6-1
6.1	Stress Summary	6-1
6.1.1	Equation A-1 Stresses	6-6
6.1.2	Equation A-2 Stresses	6-18
6.1.3	Equation B-1 Stresses	6-30
6.1.4	Equation B-2 Stresses	6-42
6.1.5	Equation B-3 Stresses	6-54
6.1.6	Equation C-1 Stresses	6-66
6.1.7	Equation C-2 Stresses	6-78
6.1.8	Equation C-3 Stresses	6-83
6.2	Support Loads	6-88
6.3	Valve Accelerations	6-125
6.3.1	DBE Seismic Valve Accelerations	6-126
6.3.2	PORV Transient Shock and SV Transient Shock Valve Accelerations	6-130
6.4	Nozzle Loads	6-134
6.5	Valve Loads	6-140
6.6	Miscellaneous Calculations	6-146
6.6.1	Thermal Boundary Displacements	6-147
6.6.2	OBE Spectra	6-153
6.6.3	DBE Spectra	6-160
7.0	DRAWINGS	7-1
8.0	REFERENCES	8-1

TABLE OF CONTENTS
(Continued)

9.0 COMPUTER ANALYSIS

9.1	RELAP/REPIPE Input	Book 3 of 10
9.2	Deadweight, Thermal Input/Output	Book 4 of 10
9.3	OBE Seismic X-Y Input/Output	Book 5 of 10
9.4	OBE Seismic Y-Z Input/Output	Book 6 of 10
9.5	DBE Seismic X-Y Input/Output	Book 7 of 10
9.6	DBE Seismic Y-Z Input/Output	Book 8 of 10
9.7	PORV Transient Shock Input	Book 9 of 10
9.8	SV Quarter Model Transient Shock Input	Book 10 of 10

Section 9.1.1

RELAP Input

9.1.1.1 PORV Solid 400 Liquid

21	308	MILFORD	3031005DC
22	301	MILFORD	3031003D3
24	306	MILFORD	8111AC069
23	302	MILFORD	8111H0D0C
25	304	MILFORD	[illegible]

LISTING OF INPUT DATA FOR CASE 1

```
=AEP UNIT2  1 LINE  RELAP5
*
*
*
*
*
*          ************************************************
*          ************************************************
*          **                                            **
*          **       UNIT 2 PORV MODEL,  SOLID CASE       **
*          **                                            **
*          ************************************************
*          ************************************************
*
*
*
*
*
*  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  0.400  1.0-7  2.0-4  11001  5  50  250
*
****************************************
*           MINOR EDITS                *
****************************************
*
301  MFLOWJ  415000000
302  MFLOWJ  490000000
303  MFLOWJ  493000000
304  MFLOWJ  388000000
305  MFLOWJ  811140000
306  MFLOWJ  811790000
307  MFLOWJ  307000000
308  MFLOWJ  207000000
```

BY KJG DATE 5-17-83
CHKD. BY [illegible] DATE 6-2-83

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```
 57    309  MFLOWJ  107000000
 58    *
 59    310  QUALS  400010000
 60    311  QUALS  500010000
 61    312  QUALS  600010000
 62    313  QUALS  410210000
 63    314  QUALS  485270000
 64    315  QUALS  492110000
 65    316  QUALS  389010000
 66    317  QUALS  811140000
 67    318  QUALS  811790000
 68    319  QUALS  106010000
 69    320  QUALS  106390000
 70    321  QUALS  206010000
 71    322  QUALS  206330000
 72    323  QUALS  306010000
 73    324  QUALS  306250000
 74    *
 75    325  P       400010000
 76    326  P       500010000
 77    327  P       600010000
 78    328  P       410210000
 79    329  P       485270000
 80    330  P       492110000
 81    331  P       389010000
 82    332  P       811140000
 83    333  P       811790000
 84    334  P       106010000
 85    335  P       106390000
 86    336  P       206010000
 87    337  P       206330000
 88    338  P       306010000
 89    339  P       306250000
 90    *
 91    *
 92    *
 93    *
 94    *
 95    ************************************************
 96    **                                            **
 97    **         FORCE  CARDS  FOR  REPIPE          **
 98    **                                            **
 99    ************************************************
100    *
101    *    *******   ARC 2, ELEVATION 670' 10",  SV-45B   ******
102    *
103    2001    5,151
104    2002    206010000,206020000,206030000,206040000,206050000
105    2003    206060000,206070000,206080000,206090000,206100000
106    2004    206110000,206120000,206130000,206140000,206150000
107    2005    206160000,206170000,206180000,206190000,206200000
108    2006    206210000,206220000,206230000,206240000,206250000
109    2007    206260000,206270000,206280000,206290000,206300000
110    2008    206310000,206320000,206330000
111    *
112    *
113    *
114    *
```

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```
*      ****   FIRST C.V. DOWNSTREAM OF THE ARC    ****
*
*
2010    805010000
*
*
*
*
*      *****  12 INCH DISCHARGE DOWN TO THE QUENCH TANK   *****
*
*
2020    811190000,811200000,811210000,811220000,811230000
2021    811240000,811250000,811260000,811270000,811280000
2022    811290000,811300000,811310000,811320000,811330000
2023    811340000,811350000,811360000,811370000,811380000
2024    811390000,811400000,811410000,811420000,811430000
2025    811440000,811450000,811460000,811470000,811480000
2026    811490000,811500000,811510000,811520000,811530000
2027    811540000,811550000,811560000,811570000,811580000
2028    811590000,811600000,811610000,811620000,811630000
2029    811640000,811650000,811660000,811670000,811680000
2030    811690000,811700000,811710000,811720000,811730000
2031    811740000,811750000,811760000,811770000,811780000
2032    811790000,811800000,811810000,811820000,811830000
2033    811840000,811850000,811860000,811870000,811880000
2034    811890000,811900000,811910000,811920000,811930000
2035    811940000,811950000,811960000,811970000,811980000
2036    811990000,811180000
*
2040    813010000,813020000,813030000,813040000,813050000
2041    813060000,813070000,813080000,813090000,813100000
2042    813110000,813120000,813130000,813140000,813150000
2043    813160000,813170000,813180000,813190000,813200000
2044    813210000,813220000,813230000,813240000,813250000
2045    813260000,813270000,813280000,813290000,813300000
*
*
*
*      ******   PIPE DOWN INTO THE QUENCH TANK  ****
*
*
2050    901010000,901020000,903010000,903020000
2051    903030000
*
*
*
*
*
*
*
*
*      *****   PIPING UPSTREAM OF PORV NRV - 153   *****
*
*
*
*
*
```

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```
330
338
338
33A
```

```
*
*
*
*
*
**********************************
*           TRIPS                *
**********************************
*
501  P  907010000  GT  NULL  0  114.7  L  *QUENCH TANK BLOW OUT PATCH
502  TIME  0  GT NULL 0  1.5  L  * JOB TERMINATION TRIP
503  TIME  0  GE NULL 0  0.0    L  *  VALVE OPEN
504  TIME  0  GE  NULL  0  5.0  L  *  VALVE CLOSED
600  502
*
*****************************************************
*          ****************************             *
*          * HYDRODYNAMIC COMPONENTS *             *
*          ****************************             *
*****************************************************
*
3850000  "PRESS4"  TMDPVOL
3850101  0.0  20.0  500.0   0.0  0.0  0.0  0.00005  0.0  11
3850200  3
3850201  0.0  2349.7  400.0  0.8  2420.0  400.0  1.2  2498.7  400.0
*
*         ************************************
*         *   PORV UPSTREAM PIPING           *
*         ************************************
*
*
3860000  "NOZ"  SNGLJUN
3860101  385000000  387000000  0.0  0.0  0.0  1100
3860201  1  0.0  0.0  0.0
*
*    6 INCH SCH.  160 PIPE
*
3870000  "PORVU"  PIPE
3870001  12
3870101  0.14653  12
3870301  0.328  1
3870302  0.5227  12
3870401  0.0  12
3870601  42.733  1
3870602  90.0  12
3870801  0.000151  0.0  12
3870901  0.0964  0.0964  1
3870902  0.0  0.0  11
3871001  00  12
3871101  1000  11
3871201  3  2349.7  400.0  0.0  0.0  12
3871300  1
3871301  0.0  0.0  0.0  11
*
3880000  "PORVU"  SNGLJUN
3880101  387010000  389000000  0.0  0.0  0.0  1000
3880201  1  0.0  0.0  0.0
*
```

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```
580   4520301  0'288a  2
581   4522101  0 1252  1
582   4580001  2
```

```
231     *   6 X 6 X 3 INCH REDUCING TEE
232     *
233     3890000  "PORVU"  BRANCH
234     3890001  0
235     3890101  0.14653  0.25  0.0  0.0  90.0  0.25  0.000151  0.0  00
236     3890200  3  2349.7  400.0  0.0  0.0  0.0
237     *
238     4980000  "PORVU"  SNGLJUN
239     4980101  389010000  410000000  0.0  0.1836  0.1836  1000
240     4980201  1  0.0  0.0  0.0
241     *
242     *   3 INCH SCH. 160 PIPING
243     *
244     4100000  "PORV"  PIPE
245     4100001  21
246     4100101  0.03757  17
247     4100102  0.03387  18
248     4100103  0.0265  19
249     4100104  0.01912  20
250     4100105  0.01175  21
251     4100301  0.5  5
252     4100302  0.5278  11
253     4100303  0.5313  17
254     4100304  0.2657  21
255     4100401  0.0  21
256     4100601  0.0  5
257     4100602  90.0  11
258     4100603  0.0  21
259     4100801  0.000153  0.0  21
260     4100901  0.0  0.0  4
261     4100902  0.2172  0.2172  5
262     4100903  0.0  0.0  10
263     4100904  0.2172  0.2172  11
264     4100905  0.0  0.0  20
265     4101001  00  21
266     4101101  1000  20
267     4101201  3  2349.7  400.0  0.0  0.0  21
268     4101300  1
269     4101301  0.0  0.0  0.0  20
270     *
271     *   PORV VALVE NRV - 153
272     *
273     4150000  "PORV153"  VALVE
274     4150101  410010000  500000000  0.00806  0.0  0.0  0100
275     4150201  1  0.0  0.0  0.0
276     4150300  MTRVLV
277     4150301  503  504  1.0  0.0
278     *
279     4200000  "PORV"  SNGLJUN
280     4200101  389010000  425000000  0.0  0.0  0.0  1000
281     4200201  1  0.0  0.0  0.0
282     *
283     *     6  INCH  SCH.  160  PIPING
284     *
285     4250000  "PORV"  PIPE
286     4250001  5
287     4250101  0.1465  5
288     4250301  0.3889  3
```

TELEDYNE ENGINEERING SERVICES

```
  289    4250302  0.375  5
  290    4250401  0.0  5
  291    4250601  90.0  3
  292    4250602  0.0  5
  293    4250801  0.000151  0.0  5
  294    4250901  0.0  0.0  2
  295    4250902  0.1836  0.1836  3
  296    4250903  0.0  0.0  4
  297    4251001  00  5
  298    4251101  1000  4
  299    4251201  3  2349.7  400.0  0.0  0.0  5
  300    4251300  1
  301    4251301  0.0  0.0  0.0  4
  302    *
  303    4300000  "PORV"  SNGLJUN
  304    4300101  425010000  435000000  0.0  0.0  0.0  1000
  305    4300201  1  0.0  0.0  0.0
  306    *
  307    *      6 INCH   X 4 INCH    REDUCER
  308    *
  309    4350000  "PORV"  PIPE
  310    4350001  2
  311    4350101  0.1465  1
  312    4350102  0.0716  2
  313    4350301  0.2292  2
  314    4350401  0.0  2
  315    4350601  0.0  2
  316    4350801  0.000151  0.0  1
  317    4350802  0.000133  0.0  2
  318    4350901  0.0577  0.0961  1
  319    4351001  00  2
  320    4351101  1000  1
  321    4351201  3  2349.7  400.0  0.0  0.0  2
  322    4351300  1
  323    4351301  0.0  0.0  0.0  1
  324
  325    *
  326    4400000  "PORV"  SNGLJUN
  327    4400101  435010000  445000000  0.0  0.0  0.0  1000
  328    4400201  1  0.0  0.0  0.0
  329    *
  330    *    4  INCH  SCH.  120  PIPING
  331    *
  332    4450000  "PORV"  PIPE
  333    4450001  10
  334    4450101  0.0716  10
  335    4450301  0.35833  5
  336    4450302  0.5  10
  337    4450401  0.0  10
  338    4450601  0.0  5
  339    4450602  90.0  9
  340    4450603  0.0  10
  341    4450801  0.000133  0.0  10
  342    4450901  0.0  0.0  4
  343    4450902  0.1944  0.1944  5
  344    4450903  0.0  0.0  8
  345    4450904  0.1944  0.1944  9
  346    4451001  00  10
```

TELEDYNE ENGINEERING SERVICES

```
347   4451101  1000  9
348   4451201  3  2349.7  400.0  0.0  0.0  10
349   4451300  1
350   4451301  0.0  0.0  0.0  9
351   *
352   4500000  "PORV"  SNGLJUN
353   4500101  445010000  455000000  0.0  0.0  0.0  1000
354   4500201  1  0.0  0.0  0.0
355   *
356   *     4 X 4 X 3  INCH REDUCING BRANCH
357   *
358   4550000  "PORV"  BRANCH
359   4550001  0
360   4550101  0.0716  0.5  0.0  0.0  0.0  0.0  0.000133  0.0  00
361   4550200  3  2349.7  400.0  0.0  0.0  0.0
362   *
363   4600000   "PORV"   SNGLJUN
364   4600101  455010000  465000000  0.0  0.0  0.0  1000
365   4600201  1  0.0  0.0  0.0
366   *
367   *    4  INCH  SCH.  120  PIPING
368   *
369   4650000  "PORV"  PIPE
370   4650001  3
371   4650101  0.0716    3
372   4650301  0.25  3
373   4650401  0.0  3
374   4650601  0.0  3
375   4650801  0.000133  0.0  3
376   4650901  0.0  0.0  2
377   4651001  00  3
378   4651101  1000  2
379   4651201  3  2349.7  400.0  0.0  0.0  3
380   4651300  1
381   4651301  0.0  0.0  0.0  2
382   *
383   4700000  "PORV"  SNGLJUN
384   4700101  465010000  475000000  0.0  0.0  0.0  1000
385   4700201  1  0.0  0.0  0.0
386   *
387   *    4 INCH  X  3 INCH   REDUCER
388   *
389   4750000  "PORV"  PIPE
390   4750001  2
391   4750101  0.0716  1
392   4750102  0.0376  2
393   4750301  0.1667  2
394   4750401  0.0  2
395   4750601  0.0  2
396   4750801  0.000133  0.0  1
397   4750802  0.000153  0.0  2
398   4750901  0.0472  0.0730  1
399   4751001  00  2
400   4751101  1000  1
401   4751201  3  2349.7  400.0  0.0  0.0  2
402   4751301  0.0  0.0  0.0  1
403   *
404   4800000  "PORV"  SNGLJUN
```

TELEDYNE ENGINEERING SERVICES

```
405    4800101  475010000  485000000  0.0  0.0  0.0  1000
406    4800201  1  0.0  0.0  0.0
407    *
408    *   3  INCH  SCH.  160  PIPING
409    *
410    4850000  "PORV"  PIPE
411    4850001  27
412    4850101  0.0376  23
413    4850102  0.0339  24
414    4850103  0.0266  25
415    4850104  0.0192  26
416    4850105  0.0118  27
417    4850301  0.4375  4
418    4850302  0.4690  12
419    4850303  0.500  15
420    4850304  0.368  16
421    4850305  0.367  17
422    4850306  0.5405  23
423    4850307  0.41937  27
424    4850401  0.0  27
425    4850601  0.0  27
426    4850801  0.000153  0.0  27
427    4850901  0.0  0.0  26
428    4851001  00  27
429    4851101  1000  26
430    4851201  3  2349.7  400.0  0.0  0.0  27
431    4851300  1
432    4851301  0.0  0.0  0.0  26
433    *
434    *    PORV  VALVE  NRV - 151
435    *
436    4900000  "PORV"  VALVE
437    4900101  485010000  400000000  0.00806  0.0  0.0  0100
438    4900201  1  0.0  0.0  0.0
439    4900300  MTRVLV
440    4900301  503  504  1.0  0.0
441    *
442    4910000  "PORV"  SNGLJUN
443    4910101  455010000  492000000  0.0  0.095  0.095  1000
444    4910201  1  0.0  0.0  0.0
445    *
446    *   3  INCH  SCH.  160  PIPING
447    *
448    4920000  "PORV"  PIPE
449    4920001  11
450    4920101  0.0376  7
451    4920102  0.0339  8
452    4920103  0.0266  9
453    4920104  0.0192  10
454    4920105  0.0118  11
455    4920301  0.4881  7
456    4920302  0.4792  11
457    4920401  0.0  11
458    4920601  0.0  11
459    4920801  0.000153  0.0  11
460    4920901  0.0  0.0  10
461    4921001  00  11
462    4921101  1000  10
```

TELEDYNE ENGINEERING SERVICES

```
463   4921201  3  2349.7  400.0  0.0  0.0  11
464   4921300  1
465   4921301  0.0  0.0  0.0  10
466   *
467   *   PORV  VALVE  NRV - 152
468   *
469   4930000  "PORV"  VALVE
470   4930101  492010000  600000000  0.00805  0.0  0.0  0100
471   4930201  1  0.0  0.0  0.0
472   4930300  MTRVLV
473   4930301  503  504  1.0  0.0
474   *
475   *
476   ********************************************
477   *    SAFETY VALVES DISCHARGE SECTION       *
478   ********************************************
479   *
480   *
481   *
482   ************************************************************
483   *    SAFETY VALVE-45C  DISCHARGING AT ELEV. 669'-2"  ARC  1   *
484   ************************************************************
485   *
486   *
487   **
488   *  DISCHARGE PIPING
489   *
490   *  6  INCH  SCH.  40  PIPING
491   **
492   1060000  "DISCHA1"  PIPE
493   1060001  39
494   1060101  0.20069  39
495   1060301  0.526  4
496   1060302  1.094  14
497   * ARC STARTS HERE LEVEL 669-2"
498   1060303  1.000  20
499   1060304  0.8994  29
500   1060305  0.7436  35
501   * ARC ENDS
502   1060306  0.7980  39
503   1060401  0.0  39
504   1060601  0.0  4
505   1060602  -90.0  14
506   1060603  0.0  39
507   1060801  0.000152  0.0  39
508   1060901  0.0  0.0  3
509   1060902  0.1800  0.1800  4
510   1060903  0.0  0.0  13
511   1060904  0.1800  0.1800  14
512   1060905  0.0  0.0  38
513   1061001  00  39
514   1061101  1000  38
515   1061201  4  17.7  120.0  0.9284  0.0  39
516   1061300  1
517   1061301  0.0  0.0  0.0  38
518   *
519   1070000  "DISCHA1"  SNGLJUN
520   1070101  106010000  809000000  0.0  0.1560  0.1560  1000  *LOSSES FOR A 12 IN ELBOW
```

TELEDYNE ENGINEERING SERVICES

```
1070201  1  0.0  0.0  0.0
*
*
*
*******************************************************
*       MAIN DISCHARGE  12" HEADER TO QUENCH TANK     *
*******************************************************
*
*
*    12  X  12  X  6  INCH  REDUCING TEE
*
*    CONNECTS  SRV  PIPING  TO  MAIN  DISCHARGE
*
*
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  0.9284
*
8100000  "DISCHA1"  SNGLJUN
8100101  809010000  811000000  0.0  0.0  0.0  1000
8100201  1  0.0  0.0  0.0
*
*    12   INCH  SCH.  40  DISCHARGE PIPING
*
8110000  "DISCH1A"  PIPE
8110001  99
8110101  0.7771  99
8110301  1.039  14
8110302  0.53025  18
8110303  0.5  22
8110304  0.53025  26
8110305  0.9875  56
8110306  0.475  66
8110307  0.49359  79
8110308  0.46875  87
8110309  0.50  95
8110310  0.875  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
```

TELEDYNE ENGINEERING SERVICES

```
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  0.9284  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
*
*     12  INCH  SCH.  40  DISCHARGE  PIPING
*
8130000  "DISCHA1" PIPE
8130001  30
8130101  0.7771  30
8130301  0.875  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
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  0.9284  0.0  30
8131300  1
8131301  0.0  0.0  0.0  29
*
*
*
*****************************************************
*        SAFETY VALVE 458 AT ELEV. 670'-10" ARC 2   *
*****************************************************
*
*
*
**
*   DISCHARGE  PIPING
*
*  6  INCH  SCH.  40  PIPING
**
2060000   "DISCHA2"  PIPE
2060001   33
2060101   0.20069   33
2060301   0.4635     4
```

TELEDYNE ENGINEERING SERVICES

```
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  0.9284  0.0  33
2061300   1
2061301   0.0  0.0  0.0  32
*
**************************************************
*    SAFETY VALVE 45A AT ELEV. 672'-6" ARC 3     *
**************************************************
*
*
*
**
*   DISCHARGE PIPING
*
*    6  INCH  SCH.  40  PIPING
**
3060000   "DISCHA3"  PIPE
3060001   25
3060101   0.20069  25
3060301   0.526     4
3060302   0.969     12
*   ARC  STARTS  LEVEL  672'-6"
3060303   0.635     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  0.9284  0.0  25
3061300   1
3061301   0.0  0.0 0.0  24
```

TELEDYNE ENGINEERING SERVICES

```
695    *
696    *
697    *
698    *
699    ****************************************
700    *         PORV  PIPING                 *
701    ****************************************
702    *
703    *
704    *   PIPING  DOWNSTREAM  OF  VALVE  NRV - 153
705    *
706    *   3  INCH  SCH.  40  PIPING
707    *
708    *
709    5000000   "PORVB"   PIPE
710    5000001   16
711    5000101   0.05132  16   *  3 IN  SCH40S
712    5000301   0.497  3
713    5000302   0.556  6
714       *   ARC  STARTS  LEVEL  684'-9"
715    5000303   0.365    7  *
716    5000304   0.6448  13
717    5000305    0.5892   16
718    5000401   0.0  16
719    5000601   0.0    3
720    5000602   -90.0  6
721    5000603   0.0   16
722    5000801   0.000153  0.0  16
723    5000901   0.0      0.0      2
724    5000902   0.2088   0.2088   3
725    5000903   0.0      0.0      5
726    5000904   0.2088   0.2088   6
727    5000905   0.0      0.0     15
728    5001001  00  16
729    5001101   1000  15
730    5001201   4  17.7  120.0  0.9284  0.0  16
731    5001300   1
732    5001301   0.0  0.0  0.0  15
733    *
734    5010000   "PORVB"  SNGLJUN   *  THIS JUNCTION IS ON ARC B
735    5010101   500010000  502000000  0.0  0.0  0.0  1000
736    5010201   1  0.0 0.0 0.0
737    *
738    *   4  INCH  X  3  INCH  DIFFUSER
739    *
740    5020000   "PORVB"  PIPE  * REDUCER ON ARC B 3IN X4IN
741    5020001   2
742    5020101   0.05132   1   *  3IN SCH40S
743    5020102   0.08840   2   *  4IN SCH40S
744    5020301   0.3385   2
745    5020401   0.0  2
746    5020601   0.0  2
747    5020801   0.000153  0.0  1
748    5020802   0.000134  0.0  2
749    5020901   0.0399  0.0544  1
750    5021001   00  2
751    5021101   1000  1
752    5021201   4  17.7  120.0 0.9284  0.0  2
```

TELEDYNE ENGINEERING SERVICES

```
753   5021300   1
754   5021301   0.0  0.0  0.0  1
755   *
756   *
757   5030000   "PORVB"  SNGLJUN  * ON ARC B
758   5030101   502010000  504000000  0.0  0.0  0.0  1000
759   5030201   1  0.0  0.0  0.0
760   *
761   *   4  X  4  X  3  INCH  BRANCH
762   *
763   5040000   "PORVB"  BRANCH  *  ON ARC B @ 242
764   5040001   0
765   5040101   0.0884  0.361 0.0  0.0  0.0  0.0  0.000134  0.0  00
766   5040200   4  17.7  120.0  0.9284  0.0  0.0
767   *
768   5050000   "PORVB"  SNGLJUN    * ON ARC B
769   5050101   504010000  506000000  0.0  0.0  0.0  1000
770   5050201   1  0.0  0.0  0.0
771   *
772   *    4  INCH  SCH.  40  PIPING
773   *
774   5060000  "PORVB" PIPE   *  ON ARC B
775   5060001   9
776   5060101   0.0884   9
777   5060301   0.6211   8
778   5060302   0.7607    9
779   5060401   0.0  9
780   5060601   0.0  9
781   5060801   0.000134  0.0  9
782   5060901  0.0  0.0  8
783   5061001   00  9
784   5061101   1000  8
785   5061201   4  17.7  120.0  0.9284  0.0  9
786   5061300   1
787   5061301   0.0  0.0  0.0  8
788   *
789   5070000   "PORVB"  SNGLJUN
790   5070101   506010000  508000000  0.0  0.0  0.0  1000
791   5070201   1  0.0  0.0  0.0
792   *
793   *    4  INCH  X  6  INCH  DIFFUSER
794   *
795   5080000   "PORVB" PIPE
796   5080001   2
797   5080101   0.0884  1
798   5080102   0.20069   2
799   5080301   0.5792  2
800   5080401   0.0  2
801   5080601   0.0  2
802   5080801   0.000134  0.0  1
803   5080802   0.000152  0.0  2
804   5080901   0.1483  0.0815  1
805   5081001   00  2
806   5081101   1000  1
807   5081201   4  17.7  120.0  0.9284  0.0  2
808   5081300   1
809   5081301   0.0  0.0  0.0  1
810   *
```

TELEDYNE ENGINEERING SERVICES

```
811   5090000   "PORVB" SNGLJUN   * ON ARC B
812   5090101   508010000  510000000  0.0  0.0  0.0 1000
813   5090201   1  0.0  0.0  0.0
814   *
815   *   6  X  6  X  3  INCH REDUCING  TEE
816   *
817   5100000   "PORVB" BRANCH   * ON ARC B @ 232
818   5100001   0
819   5100101   0.20069 0.25  0.0  0.0  0.0  0.0  0.000152  0.0  00
820   5100200   4  17.7  120.0  0.9284  0.0  0.0
821   *
822   5110000   "PORVB" SNGLJUN   *  ON ARC B
823   5110101  510010000  700000000     0.0  0.0 0.0  1000
824   5110201   1  0.0  0.0  0.0
825   *
826   *    PIPING  DOWNSTREAM  OF  VALVE  NRV - 151
827   *
828   *    3  INCH  SCH.  40  PIPING
829   *
830   4000000   "PORVA"  PIPE
831   4000001   8
832   4000101   0.05132  8
833   4000301   0.4141   4
834   4000302   0.4375   8
835   4000401   0.0  8
836   4000601   0.0  4
837   4000602   -90.0 8
838   4000801   0.000153  0.0  8
839   4000901   0.0  0.0  3
840   4000902   0.2088  0.2088  4
841   4000903  0.0  0.0  7
842   4001001   00  8
843   4001101   1000  7
844   4001201   4  17.7  120.0  0.9284  0.0  8
845   4001300   1
846   4001301   0.0  0.0  0.0   7
847   *
848   4010000   "PORVAB" SNGLJUN
849   4010101   400010000  510000000   0.0  0.1800  0.1800  1000
850   4010201   1  0.0  0.0  0.0
851   *
852   *    DOWNSTREAM  PIPING  FROM  VALVE  NRV - 152
853   *
854   *    3  INCH  SCH.  40  PIPING
855   *
856   6000000   "PORVC"  PIPE
857   6000001   7
858   6000101   0.05132 7
859   6000301   0.4722    3
860   6000302   0.4375   7
861   6000401   0.0  7
862   6000601   0.0  3
863   6000602   -90.0  7
864   6000801   0.000153  0.0  7
865   6000901   0.0  0.0  2
866   6000902   0.2088  0.2088  3
867   6000903   0.0  0.0  6
868   6001001   00  7
```

TELEDYNE ENGINEERING SERVICES

```
6001101   1000  6
6001201   4  17.7  120.0  0.9284  0.0  7
6001300   1
6001301   0.0  0.0  0.0  6
*
6010000   "PORVBC" SNGLJUN
6010101   600010000  504000000  0.0  0.1932  0.1932  1000
6010201   1  0.0  0.0  0.0
*
*    MAIN  HEADER  DOWNSTREAM  OF  PORV  PIPING
*
7000000   "PORVBD"  PIPE
7000001   12
7000101   0.20069  12
7000301   0.75  2
7000302   1.075  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  0.9284  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
*
*
*
*
**********************************************
**                                          **
**         MAIN ARC CONNECTIONS             **
**                                          **
**********************************************
*
*
*
*    12 INCH  X  6 INCH   DIFFUSER ABOVE SRV ARCS ON MAIN DISCHARGE
*
*
*
7020000   "PORVD"  PIPE
7020001   3
7020101   0.20069  1
7020102   .77708   3
7020301   0.75  1
7020302   0.375  3
7020401   0.0  3
7020601   -90.0  3
7020801   0.000152  0.0  1
```

TELEDYNE ENGINEERING SERVICES

```
927   7020802  0.000169  0.0  3
928   7020901  0.4930  0.2045  1
929   7020902  0.0     0.0     2
930   7021001  00  3
931   7021101  1000  2
932   7021201  4  17.7  120.0  0.9284  0.0  3
933   7021300  1
934   7021301  0.0  0.0  0.0  2
935   *
936   8000000  "PORVD"  SNGLJUN
937   8000101  702010000  801000000  0.0  0.0  0.0  1000
938   8000201  1  0.0  0.0  0.0
939   *
940   3070000  "PORVD3"  SNGLJUN
941   3070101  306010000  801000000  0.0  0.156  0.156  1000 * 12 IN ELBOW LOSSES
942   3070201  1  0.0  0.0  0.0
943   *
944   *   12  X  12  X  6  INCH REDUCING TEE CONNECTS ARC WITH DISCHARGE
945   *
946   8010000  "PORVD"  BRANCH
947   8010001  0
948   8010101  0.77708  0.5  0.0  0.0  -90.  -0.5  0.000169  0.0  00
949   8010200  4  17.7  120.0  0.9284  0.0 0.0
950   *
951   8020000  "PORVD"  SNGLJUN
952   8020101  801010000  803000000  0.0  0.0  0.0  1000
953   8020201  1  0.0  0.0 0.0
954   *
955   8030000  "PORVD"  SNGLVOL
956   8030101  0.77708  1.1667  0.0  0.0 -90.  -1.1667  0.000169  0.0  00
957   8030200  4  17.7  120.0 0.9284  0.0  0.0
958   *
959   8040000  "PORVD"  SNGLJUN
960   8040101  803010000  805000000  0.0  0.0  0.0 1000
961   8040201  1  0.0  0.0  0.0
962   *
963   2070000  "PORVD"  SNGLJUN
964   2070101  206010000  805000000  0.0  0.156  0.156  1000 * 12 IN ELBOW LOSSES
965   2070201  1  0.0  0.0  0.0
966   *
967   *  12 X12 X 6 INCH REDUCING TEE. CONNECTS SRV ARC WITH DISCHARGE PIPING.
968   *
969   8050000  "PORVD"  BRANCH
970   8050001  0
971   8050101  0.77708  0.5  0.0  0.0  -90.  -0.5  0.000169 0.0 00
972   8050200  4  17.7  120.0  0.9284  0.0  0.0
973   *
974   8060000  "PORVD"  SNGLJUN
975   8060101  805010000  807000000   0.0  0.0  0.0  1000
976   8060201  1  0.0  0.0  0.0
977   *
978   8070000  "PORVD"  SNGLVOL
979   8070101  0.77708  1.1667 0.0 0.0 -90. -1.1667 0.000169 0.0 00
980   8070200  4  17.7  120.0  0.9284  0.0  0.0
981   *
982   8080000  "PORVD"  SNGLJUN
983   8080101  807010000  809000000  0.0  0.0  0.0  1000
984   8080201  1  0.0  0.0  0.0
```

TELEDYNE ENGINEERING SERVICES

```
*
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  1.0833  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  0.9284  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
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.   0.9284   0.   2
```

TELEDYNE ENGINEERING SERVICES

```
1043    9031202   3    17.7   120.    0.0       0.   18
1044    *         JUN. INITIAL COND.
1045    9031300   1
1046    9031301   0.0  0.0  0.0       17
1047    **
1048    *    SPARGER   EXIT
1049    **
1050    9040000 "EXIT" SNGLJUN
1051    9040101   903010000   905000000    0.0    1.0   1.0     0100
1052    9040201   1    0.     0.     0.
1053    **
1054    *         WATER  VOL.
1055    **
1056    9050000  "QT. WATER" SNGLVOL
1057    9050101   260.4706   5.6667   0.0   0.0   90.  5.6667  0.003  0.0   01
1058    9050200   3    17.7       120.
1059    **
1060    *         INTERFACE
1061    **
1062    9060000   "INTERFACE"  SNGLJUN
1063    9060101   905010000  907000000   0.0    0.0    0.0    1000
1064    9060201   1    0.0  0.0  0.0
1065    **
1066    *         AIR  VOLUME
1067    **
1068    9070000   "QT.AIR"  SNGLVOL
1069    9070101   260.4706  1.2439    0.0   0.0   90.   1.2439  0.003  0.0  01
1070    9070200   4    17.7   120.    0.9284
1071    **
1072    *         RUPTURE DISC
1073    **
1074    9080000   "RUP.DISC"  VALVE
1075    9080101   907010000   999000000      1.77  0.  0.   1100
1076    9080201   1    0.   0.   0.
1077    9080300   TRPVLV
1078    9080301   501        *    VALVE OPENING TRIP
1079    **
1080    *    PIPE  OUTSIDE  ENVIRONMENT
1081    **
1082    9990000   "ATMOSPHERE"   TMDPVOL
1083    9990101   10000.    10000.    0.0  0.0  0.0  0.0  .00001  0.0  11
1084    9990200   4
1085    9990201   0.0  17.7  120.  0.9284
1086    .END OF CASE
```

TELEDYNE ENGINEERING SERVICES

9.1.1.2 PORV Solid 400 Liquid Restart

LISTING OF INPUT DATA FOR CASE 1

```
    1  =THIS RESTARS RELAP 3 PORVS OPENING ON SOLID WATER UNIT2 RED
    2  *
    3  100 RESTART TRANSNT
    4  101 RUN
    5  *
    6  103 2000
    7  104 NOACTION
    8  201 0.600  1.-7 2.-4 11001 5 50 250
    9  *
   10  *
   11  * MINOR EDITS
   12  *
   13  301  MFLOWJ  415000000
   14  302  MFLOWJ  490000000
   15  303  MFLOWJ  493000000
   16  304  MFLOWJ  388000000
   17  305  MFLOWJ  811140000
   18  306  MFLOWJ  811790000
   19  307  MFLOWJ  307000000
   20  308  MFLOWJ  207000000
   21  309  MFLOWJ  107000000
   22  *
   23  310  QUALS  400010000
   24  311  QUALS  500010000
   25  312  QUALS  600010000
   26  313  QUALS  410210000
   27  314  QUALS  485270000
   28  315  QUALS  492110000
   29  316  QUALS  389010000
   30  317  QUALS  811140000
   31  318  QUALS  811790000
   32  319  QUALS  106010000
   33  320  QUALS  106390000
   34  321  QUALS  206010000
   35  322  QUALS  206330000
   36  323  QUALS  306010000
   37  324  QUALS  306250000
   38  *
   39  325  P       400010000
   40  326  P       500010000
   41  327  P       600010000
   42  328  P       410210000
   43  329  P       485270000
   44  330  P       492110000
   45  331  P       389010000
   46  332  P       811140000
   47  333  P       811790000
   48  334  P       106010000
   49  335  P       106390000
   50  336  P       206010000
   51  337  P       206330000
   52  338  P       306010000
   53  339  P       306250000
   54  *
   55  2001    5,151
   56  2002    206010000,206020000,206030000,206040000,206050000
```

BY KJG DATE 5-20-83

CHKD. BY [illegible] DATE 6-2-83

TELEDYNE ENGINEERING SERVICES

```
    57    2003    206060000,206070000,206080000,206090000,206100000
    58    2004    206110000,206120000,206130000,206140000,206150000
    59    2005    206160000,206170000,206180000,206190000,206200000
    60    2006    206210000,206220000,206230000,206240000,206250000
    61    2007    206260000,206270000,206280000,206290000,206300000
    62    2008    206310000,206320000,206330000
    63    *
    64    *
    65    *
    66    *
    67    *     ****   FIRST C.V. DOWNSTREAM OF THE ARC    ****
    68    *
    69    *
    70    2010    805010000
    71    *
    72    *
    73    *
    74    *
    75    *      *****  12 INCH DISCHARGE DOWN TO THE QUENCH TANK   *****
    76    *
    77    *
    78    2020    811190000,811200000,811210000,811220000,811230000
    79    2021    811240000,811250000,811260000,811270000,811280000
    80    2022    811290000,811300000,811310000,811320000,811330000
    81    2023    811340000,811350000,811360000,811370000,811380000
    82    2024    811390000,811400000,811410000,811420000,811430000
    83    2025    811440000,811450000,811460000,811470000,811480000
    84    2026    811490000,811500000,811510000,811520000,811530000
    85    2027    811540000,811550000,811560000,811570000,811580000
    86    2028    811590000,811600000,811610000,811620000,811630000
    87    2029    811640000,811650000,811660000,811670000,811680000
    88    2030    811690000,811700000,811710000,811720000,811730000
    89    2031    811740000,811750000,811760000,811770000,811780000
    90    2032    811790000,811800000,811810000,811820000,811830000
    91    2033    811840000,811850000,811860000,811870000,811880000
    92    2034    811890000,811900000,811910000,811920000,811930000
    93    2035    811940000,811950000,811960000,811970000,811980000
    94    2036    811990000,811180000
    95    *
    96    2040    813010000,813020000,813030000,813040000,813050000
    97    2041    813060000,813070000,813080000,813090000,813100000
    98    2042    813110000,813120000,813130000,813140000,813150000
    99    2043    813160000,813170000,813180000,813190000,813200000
   100    2044    813210000,813220000,813230000,813240000,813250000
   101    2045    813260000,813270000,813280000,813290000,813300000
   102    *
   103    *
   104    *
   105    *      ******   PIPE DOWN INTO THE QUENCH TANK  ****
   106    *
   107    *
   108    2050    901010000,901020000,903010000,903020000
   109    2051    903030000
   110    *
   111    *
   112    *
   113    3880000  "PORVU"  SNGLJUN
   114    3880101  387010000  389000000  0.0  0.0  0.0  1000
```

TELEDYNE ENGINEERING SERVICES

```
  115     3880201  1  0.0  0.0  0.0
  116     20300100  MFLOWJ  415000000
  117     20300200  MFLOWJ  493000000
  118     20300300  MFLOWJ  490000000
  119     20300400  MFLOWJ  388000000
  120     20300500  MFLOWJ  811140000
  121     20300600  MFLOWJ  811790000
  122     20300700  MFLOWJ  307000000
  123     20300800  MFLOWJ  207000000
  124     20300900  MFLOWJ  107000000
  125     *
  126     20301000  QUALS  400010000
  127     20301100  QUALS  500010000
  128     20301200  QUALS  600010000
  129     20301300  QUALS  410210000
  130     20301400  QUALS  485270000
  131     20301500  QUALS  492110000
  132     20301600  QUALS  389010000
  133     20301700  QUALS  811140000
  134     20301800  QUALS  811790000
  135     20301900  QUALS  106010000
  136     20302000  QUALS  106390000
  137     20302100  QUALS  206010000
  138     20302200  QUALS  206330000
  139     20302300  QUALS  306010000
  140     20302400  QUALS  306250000
  141     *
  142     20302500  P       400010000
  143     20302600  P       500010000
  144     20302700  P       600010000
  145     20302800  P       410210000
  146     20302900  P       485270000
  147     20303000  P       492110000
  148     20303100  P       389010000
  149     20303200  P       811140000
  150     20303300  P       811790000
  151     20303400  P       106010000
  152     20303500  P       106390000
  153     20303600  P       206010000
  154     20303700  P       206330000
  155     20303800  P       306010000
  156     20303900  P       306250000
  157     *
  158     .END
```

TELEDYNE ENGINEERING SERVICES

9.1.1.3 SV Cold Loop Seal (Quarter Model)

LISTING OF INPUT DATA FOR CASE 1

```
    1  *AEP UNIT2  1 LINE  RELAP5
    2   100 NEW TRANSNT
    3   101 RUN
    4   102 BRITISH BRITISH
    5   104 NOACTION
    6   * TIME STEP CONTROL
    7   *
    8   201  0.6000  1.0-7  2.0-4  11001  5  25  250
    9   * MINOR EDITS
   10   *
   11   301  QUALS  007010000
   12   302  QUALS  005200000
   13   303  QUALS  013200000
   14   304  P      005200000
   15   305  P      007010000
   16   306  P      007380000
   17   307  MFLOWJ 006000000
   18   308  MFLOWJ 005070000
   19   309  MFLOWJ 014000000
   20   310  P      007140000
   21   311  P      011560000
   22   312  P      013300000
   23   313  MFLOWJ 007140000
   24   314  MFLOWJ 007380000
   25   315  MFLOWJ 011560000
   26   *
   27   *
   28   2001  5,192,001010000,003010000,005010000
   29   2002  005020000,005030000,005040000,005050000,005060000
   30   2003  005070000,005080000,005090000,005100000,005110000
   31   2004  005120000,005130000,005140000,005150000,005160000
   32   2005  005170000,005180000,005190000,005200000,007010000
   33   2006  007020000,007030000,007040000,007050000,007060000,007070000
   34   2007  007080000,007090000,007100000,007110000,007120000
   35   2008  007130000,007140000,007150000,007160000,007170000
   36   2009  007180000,007190000,007200000,007210000,007220000
   37   2010  007230000,007240000,007250000,007260000,007270000
   38   2011  007280000,007290000,007300000,007310000,007320000
   39   2012  007330000,007340000,007350000,007360000,007370000
   40   2013  007380000,007390000,009010000,011010000,011020000
   41   2014  011030000,011040000,011050000,011060000,011070000
   42   2015  011080000,011090000,011100000,011110000,011120000
   43   2016  011130000,011140000,011150000,011160000,011170000
   44   2017  011180000,011190000,011200000,011210000,011220000
   45   2018  011230000,011240000,011250000,011260000,011270000
   46   2019  011280000,011290000,011300000,011310000,011320000
   47   2020  011330000,011340000,011350000,011360000,011370000
   48   2021  011380000,011390000,011400000,011410000,011420000
   49   2022  011430000,011440000,011450000,011460000,011470000
   50   2023  011480000,011490000,011500000,011510000,011520000
   51   2024  011530000,011540000,011550000,011560000,011570000
   52   2025  011580000,011590000,011600000,011610000,011620000
   53   2026  011630000,011640000,011650000,011660000,011670000
   54   2027  011680000,011690000,011700000,011710000,011720000
   55   2028  011730000,011740000,011750000,011760000,011770000
   56   2029  011780000,011790000,011800000,011810000,011820000
```

BY CLM DATE 2-9-83

CHKD. BY LGS DATE 2-9-83

TELEDYNE ENGINEERING SERVICES

```
    2030  011830000,011840000,011850000,011860000,011870000
    2031  011880000,011890000,011900000,011910000,011920000
    2032  011830000,011940000,011950000,011960000,011970000
    2033  011980000,011990000,013010000,013020000,013030000
    2034  013040000,013050000,013060000,013070000,013080000
    2035  013090000,013100000,013110000,013120000,013130000
    2036  013140000,013150000,013160000,013170000,013180000
    2037  013190000,013200000,013210000,013220000,013230000
    2038  013240000,013250000,013260000,013270000,013280000
    2039  013280000,013300000,015010000
*
*TRIPS
*
502  TIME  0  GT NULL 0  1.500  L  * JOB TERMINATION TRIP
503  TIME  0  GE NULL 0  0.0    L  *  VALVE OPEN
504  TIME  0  GE  NULL  0  5.0  L  *  VALVE CLOSED
600  502
*
*  HYDRODYNAMIC COMPONENTS
*
*
*
* PRESSURIZER
*
0010000  "PRESS1"  TMDPVOL
0010101  0.0  20.0  500.0  0.0  0.0  0.0  0.00005  0.0  11
0010200  2
0010201  0.0  2500.0  1.0  0.1  2514.0  1.0  0.3  2555.0  1.0  0.5  2600.0  1.0
0010202  0.7  2687.0  1.0  0.9  2700.0  1.0  1.1  2740.0  1.0  1.3  2745.0  1.0
0010203  1.5  2747.0  1.0  1.7  2748.0  1.0  1.9  2750.0  1.0  2.0  2750.0  1.0
0010204  2.5  2750.0  1.0
*
*  LOOP SEAL GEOMETRY
*
0020000  "LPSL"  SNGLJUN
0020101  001000000  003000000  0.0  0.0  0.0  1000  * THIS IS A SHORT RADIUS ELBOW LEAVING
0020201  1  0.0  0.0  0.0
*
0030000  "LPSL" SNGLVOL
0030101  0.1465  1.0  0.0  90.0  0.0  0.0  0.000151  0.0  00
0030200    2  2500.0  1.0
*
0040000  "LPSL"  SNGLJUN
0040101  003010000  005000000  0.0  0.1838  0.1838  1000
0040201  1  0.0  0.0  0.0
*
0050000  "LPSL"  PIPE
0050001  20
0050101  0.1465  20
0050301  0.50  10
0050302  0.574  20
0050401  0.0  20
0050801  -90.0  7
0050602  0.0  10
0050603  90.0  20
0050801  0.000151  0.0  20
0050901  0.0  0.0  8
```

```
0050904  0.1838  0.1838  10
0050905  0.0  0.0  19
0051001  00  20
0051101  1000  19
0051201  3  2500.0  584.4  0.0  0.0  1
0051202  3  2500.0  451.1  0.0  0.0  2
0051203  3  2500.0  352.1  0.0  0.0  3
0051204  3  2500.0  276.8  0.0  0.0  4
0051205  3  2500.0  218.1  0.0  0.0  5
0051206  3  2500.0  169.3  0.0  0.0  8
0051207  3  2500.0  141.1  0.0  0.0  20
0051300  1
0051301  0.0  0.0  0.0  19
*
*****************************
*  VALVE  6M8  CROSBY SAFETY
*****************************
0060000  "SRV"  VALVE
0060101  005010000  007000000  0.022  0.0  0.0  0100
0060201  1  0.0  0.0  0.0
0060300  MTRVLV
0060301  503  504  100.0  0.0  *  CROSBY 6M8  OPENING IN 10 MSEC
*
*  DISCHARGE PIPING
0070000  "DISCHA1"  PIPE
0070001  38
0070101  0.20069  38
0070301  0.526  4
0070302  1.094  14
* ARC STARTS HERE LEVEL 689-2"
0070303  0.84187  17
0070304  0.942  20
0070305  0.8425  23
0070306  0.844  26
0070307  0.8433  29
0070308  0.8333  32
0070309  0.8333  35
* ARC ENDS
0070310  0.91750  38
0070401  0.0  38
0070601  0.0  4
0070602  -90.0  14
0070603  0.0  38
0070801  0.000152  0.0  38
0070901  0.0  0.0  3
0070902  0.1800  0.1800  4
0070903  0.0  0.0  13
0070904  0.1800  0.1800  14
0070905  0.0  0.0  38
0071001  00  38
0071101  1000  38
0071201  4  14.7  120.0  0.9284  0.0  38
0071300  1
0071301  0.0  0.0  0.0  38
*
0080000  "DISCHA1"  SNGLJUN
0080101  007010000  009000000  0.0  0.1580  0.1580  1000  *LOSSES FOR A 12 IN ELBOW
```

TELEDYNE ENGINEERING SERVICES

```
*
* INPUT A BRANCH HERE FOR A COMPLETE MODEL
*
0090000  "DISCHA1"  SNGLVOL
0090101  0.7771  0.5  0.0  0.0  -90.0  -0.5  0.000169  0.0  00
0090200  4  14.7  120.0  0.9284
*
0100000  "DISCHA1"  SNGLJUN
0100101  009010000  011000000  0.0  0.0  0.0  1000
0100201  1  0.0  0.0  0.0
*
0110000  "DISCHA"  PIPE
0110001  99
0110101  0.7771  99
0110301  1.039  14
0110302  0.53025  18
0110303  0.5  22
0110304  0.53025  26
0110305  0.9875  58
0110306  0.475  68
0110307  0.49359  79
0110308  0.46875  87
0110309  0.51172  95
0110310  0.95  99
0110401  0.0  99
0110601  -90.0  14
0110602  -45.0  18
0110603  -90.0  22
0110604  -45.0  26
0110605  -90.0  58
0110606  0.0  87
0110607  -90.0  95
0110608  0.0  99
0110801  0.000169  0.0  99
0110901  0.0  0.0  13
0110902  0.078  0.078  14
0110903  0.0  0.0  17
0110904  0.078  0.078  18
0110905  0.0  0.0  21
0110906  0.078  0.078  22
0110907  0.0  0.0  25
0110908  0.078  0.078  26
0110909  0.0  0.0  55
0110910  0.156  0.156  58
0110911  0.0  0.0  65
0110912  0.156  0.156  66
0110913  0.0  0.0  78
0110914  0.156  0.156  79
0110915  0.0  0.0  86
0110916  0.156  0.156  87
0110917  0.0  0.0  94
0110918  0.156  0.156  95
0110919  0.0  0.0  98
0111001  00  99
0111101  1000  98
0111201  4  14.7  120.0  0.9284  0.0  99
0111300  1
```

TELEDYNE ENGINEERING SERVICES

```
231   *
232   0120000  "DISCHA1"  SNGLJUN
233   0120101  011010000  013000000  0.0  0.0  0.0  1000
234   0120201  1  0.0  0.0  0.0
235   *
236   0130000  "DISCHA1" PIPE
237   0130001  30
238   0130101  0.7771  30
239   0130301  0.85  8
240   0130302  1.0  20
241   0130303  0.5  30
242   0130401  0.0  30
243   0130601  0.0  30
244   0130801  0.000169  0.0  30
245   0130901  0.0  0.0  5
246   0130902  0.156  0.156  8
247   0130903  0.0  0.0  19
248   0130904  0.156  0.156  20
249   0130905  0.0  0.0  29
250   0131001  00  30
251   0131101  1000  29
252   0131201  4  14.7  120.0  0.9284  0.0  30
253   0131300  1
254   0131301  0.0  0.0  0.0  29
255   *
256   0140000  "DISCH1A"  SNGLJUN
257   0140101  013010000  015000000  0.0  0.0  0.0  0100
258   0140201  1  0.0  0.0  0.0
259   *
260   0150000  "ATMOS"  TMDPVOL
261   0150101  10000.0  10000.0  0.0  0.0  0.0  0.0  0.00001  0.0  11
262   0150200  4
263   0150201  0.0  14.7  120.0  0.9284
264   *
265   * PLOT CARDS
266   *
267   20300100  QUALS  007010000
268   20300200  QUALS  005200000
269   20300300  QUALS  013200000
270   20300400  P      005200000
271   20300500  P      007010000
272   20300600  P      007380000
273   20300700  MFLOWJ 006000000
274   20300800  MFLOWJ 005070000
275   20300900  MFLOWJ 014000000
276   20301000  P    007140000
277   20301100  P    011560000
278   20301200  P    013300000
279   20301300  MFLOWJ  007140000
280   20301400   MFLOWJ  007380000
281   20301500  MFLOWJ  011680000
282   .END OF CASE
```

TELEDYNE ENGINEERING SERVICES

Section 9.1.2

REPIPE Input

9.1.2.1 Unit 2 - Model Section A

```
 $PIPES
 INLINE=3,KBLOCK=200,KPIPE=10,KPLOT(1)=1,KWAVE=1,
 KPRINT=-1,KPNV=1,KSTEP=3,
 NDROPV=385010000,206330000,811190000$
342     386000000     -0.3710     0.6786     0.6340/
340     -387010000     -0.3710     0.6786     0.6340/
339     387010000      0.0    1.0    0.0/
339     387020000      0.0    1.0     0.0/
339     387030000      0.0    1.0     0.0/
339     387040000      0.0    1.0     0.0/
339     387050000      0.0    1.0     0.0/
339     387060000      0.0    1.0     0.0/
339     387070000      0.0    1.0     0.0/
339     387080000      0.0    1.0     0.0/
339     387090000      0.0    1.0     0.0/
339     387100000      0.0    1.0     0.0/
339     387110000      0.0    1.0     0.0/
339     388000000      0.0    1.0     0.0/
339     420000000      0.0    1.0     0.0/
339     425010000      0.0    1.0     0.0/
339     425020000      0.0    1.0     0.0/
336    -387020000      0.0    1.0     0.0/
336    -387030000      0.0    1.0     0.0/
336    -387040000      0.0    1.0     0.0/
336    -387050000      0.0    1.0     0.0/
336    -387060000      0.0    1.0     0.0/
336    -387070000      0.0    1.0     0.0/
336    -387080000      0.0    1.0     0.0/
336    -387090000      0.0    1.0     0.0/
336    -387100000      0.0    1.0     0.0/
336    -387110000    0.0    1.0    0.0/
336    -388000000      0.0     1.0     0.0/
336    -420000000      0.0     1.0     0.0/
336   -498000000  0.0  1.0  0.0/
336    -425010000      0.0     1.0     0.0/
336    -425020000      0.0     1.0     0.0/
336    -425030000      0.0     1.0     0.0/
334     425030000      0.7844      0.0     0.6202/
334     425040000      0.7844      0.0     0.6202/
334     430000000      0.7844      0.0     0.6202/
330    -425040000      0.7844      0.0     0.6202/
330    -430000000      0.7844      0.0     0.6202/
330    -435010000      0.7844      0.0     0.6202/
334    435010000     0.7844      0.0     0.6202/
334    440000000     0.7844      0.0     0.6202/
334    445010000     0.7844      0.0     0.6202/
334    445020000     0.7844      0.0     0.6202/
334    445030000     0.7844      0.0     0.6202/
334    445040000     0.7844      0.0     0.6202/
330    -440000000     0.7844      0.0     0.6202/
330    -445010000     0.7844      0.0     0.6202/
330    -445020000     0.7844      0.0     0.6202/
330    -445030000     0.7844      0.0     0.6202/
330    -445040000     0.7844      0.0     0.6202/
330    -445050000     0.7844      0.0     0.6202/
328     445050000      0.0     1.0     0.0/
328     445060000      0.0     1.0     0.0/
328     445070000      0.0     1.0     0.0/
328     445080000      0.0     1.0     0.0/
```

BY KJG DATE 5-21-03

CHKD. BY MR DATE 5/21/03

TELEDYNE
ENGINEERING SERVICES

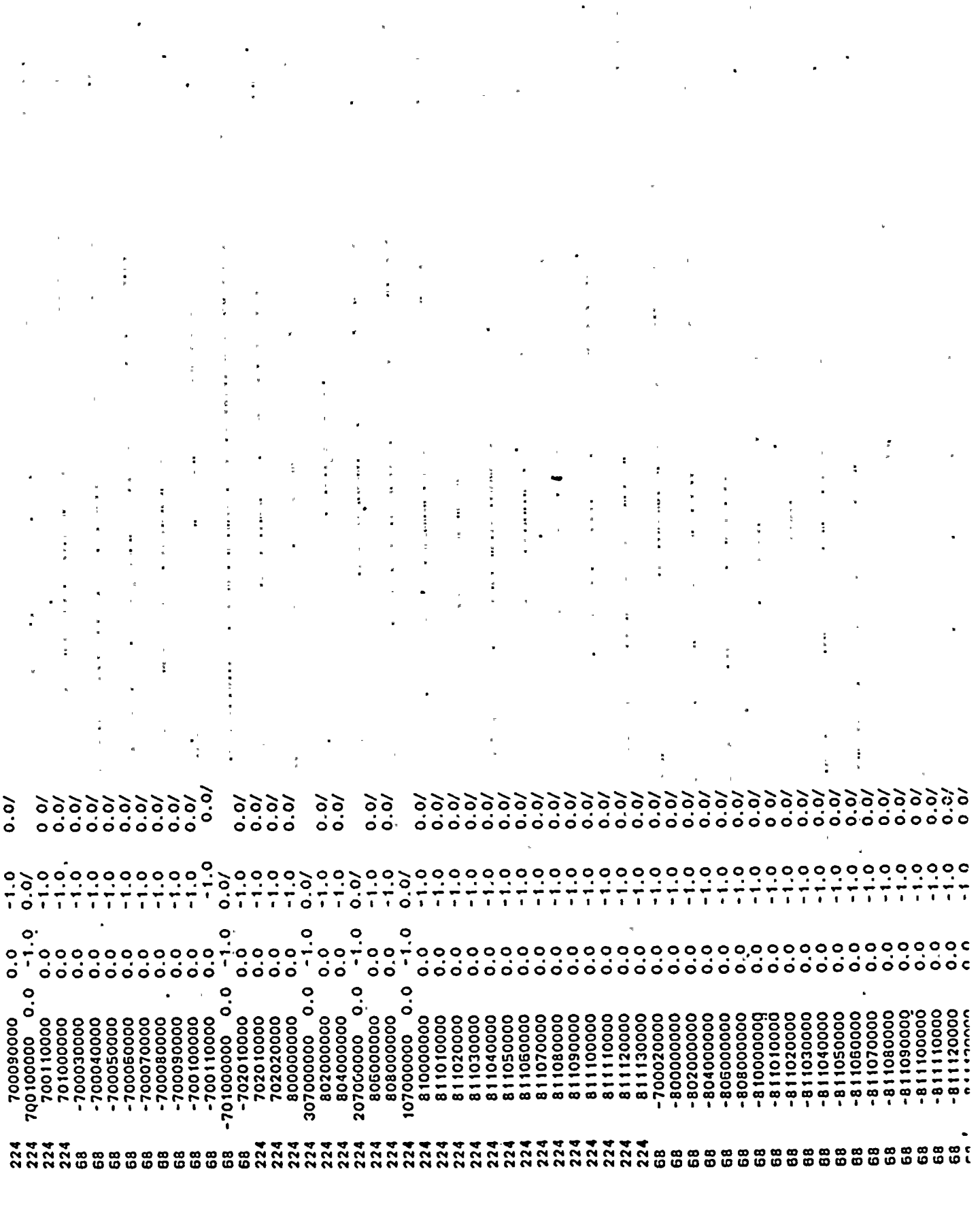
```
324   -445060000     0.0     1.0     0.0/
324   -445070000     0.0     1.0     0.0/
324   -445080000     0.0     1.0     0.0/
324   -445090000     0.0     1.0     0.0/
322    445090000     0.9138    0.0     -0.4062/
322    450000000     0.9138    0.0     -0.4062/
322    460000000     0.9138    0.0     -0.4062/
322    465010000     0.9138    0.0     -0.4062/
322    465020000     0.9138    0.0     -0.4062/
322    470000000     0.9138    0.0     -0.4062/
318   -450000000     0.9138    0.0     -0.4062/
318   -460000000     0.9138    0.0     -0.4062/
318   -491000000  0.9138  0.0    -0.4062/
318   -465010000     0.9138    0.0     -0.4062/
318   -465020000     0.9138    0.0     -0.4062/
318    -470000000     0.9138     0.0     -0.4062/
318   -475010000     0.9138    0.0     -0.4062/
3181   475010000     0.8212    0.0     -0.5707/
3181   480000000     0.8212    0.0     -0.5707/
3181   485010000     0.8212    0.0     -0.5707/
3181   485020000     0.8212    0.0     -0.5707/
3181   485030000     0.8212    0.0     -0.5707/
316   -480000000     0.8212    0.0     -0.5707/
316   -485010000     0.8212    0.0     -0.5707/
316   -485020000     0.8212    0.0     -0.5707/
316   -485030000     0.8212    0.0     -0.5707/
316   -485040000     0.8212    0 0     -0.5707/
3161   485040000      0.5557     0.0      -0.8314/
3161   485050000      0.5557     0.0      -0.8314/
3161   485060000      0.5557     0.0      -0.8314/
3161   485070000      0.5557     0.0      -0.8314/
314   -485050000      0.5557     0.0      -0.8314/
314   -485060000      0.5557     0.0      -0.8314/
314   -485070000      0.5557     0.0      -0.8314/
314   -485080000      0.5557     0.0      -0.8314/
3141   485080000     0.2178     0.0     -0.9760/
3141   485090000     0.2178     0.0     -0.9760/
3141   485100000     0.2178     0.0     -0.9760/
3141   485110000     0.2178     0.0     -0.9760/
312   -485090000     0.2178     0.0     -0.9760/
312   -485100000     0.2178     0.0     -0.9760/
312   -485110000     0.2178     0.0     -0.9760/
312   -485120000     0.2178     0.0     -0.9760/
3121   485120000     -0.1543     0.0      -0.9880/
3121   485130000     -0.1543     0.0      -0.9880/
3121   485140000     -0.1543     0.0      -0.9880/
3121   485150000     -0.1543     0.0      -0.9880/
310   -485130000     -0.1543     0.0      -0.9880/
310   -485140000     -0.1543     0.0      -0.9880/
310   -485150000     -0.1543     0.0      -0.9880/
310   -485160000     -0.1543     0.0      -0.9880/
3101    485160000     -0.9272      -0.0262      -0.3745/
308    485170000     -0.9272     -0.0262     -0.3745/
308    485180000     -0.9272     -0.0262     -0.3745/
308    485190000     -0.9272     -0.0262     -0.3745/
308    485200000     -0.9272     -0.0262     -0.3745/
308    485210000     -0.9272     -0.0262     -0.3745/
308    485220000     -0.9272     -0.0262     -0.3745/
308    485230000     -0.9272     -0.0262     -0.3745/
       485240000     -0.9272     -0.0262     -0.3745/
```

```
308    485250000    -0.9272    -0.0262    -0.3745/
308    485260000    -0.9272    -0.0262    -0.3745/
3081   -485170000   -0.9272    -0.0262    -0.3745/
294    -485180000   -0.9272    -0.0262    -0.3745/
294    -485190000   -0.9272    -0.0262    -0.3745/
294    -485200000   -0.9272    -0.0262    -0.3745/
294    -485210000   -0.9272    -0.0262    -0.3745/
294    -485220000   -0.9272    -0.0262    -0.3745/
294    -485230000   -0.9272    -0.0262    -0.3745/
294    -485240000   -0.9272    -0.0262    -0.3745/
294    -485250000   -0.9272    -0.0262    -0.3745/
294    -485260000   -0.9272    -0.0262    -0.3745/
294    -490000000   -0.9272    -0.0262    -0.3745/
292     490000000   -0.9272    -0.0262    -0.3745/
292     400010000   -0.9272    -0.0262    -0.3745/
292     400020000   -0.9272    -0.0262    -0.3745/
292     400030000   -0.9272    -0.0262    -0.3745/
288    -400010000   -0.9272    -0.0262    -0.3745/
288    -400020000   -0.9272    -0.0262    -0.3745/
288    -400030000   -0.9272    -0.0262    -0.3745/
288    -400040000   -0.9272    -0.0262    -0.3745/
288     400040000    0.0     -1.0     0.0/
288     400050000    0.0     -1.0     0.0/
288     400060000    0.0     -1.0     0.0/
288     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/
320     491000000    0.3746     0.0185    -0.9272/
320     492010000    0.3746     0.0185    -0.9272/
320     492020000    0.3746     0.0185    -0.9272/
320     492030000    0.3746     0.0185    -0.9272/
320     492040000    0.3746     0.0185    -0.9272/
320     492050000    0.3746     0.0185    -0.9272/
320     492060000    0.3746     0.0185    -0.9272/
320     492070000    0.3746     0.0185    -0.9272/
320     492080000    0.3746     0.0185    -0.9272/
320     492090000    0.3746     0.0185    -0.9272/
320     492100000    0.3746     0.0185    -0.9272/
348    -492010000    0.3746     0.0185    -0.9272/
348    -492020000    0.3746     0.0185    -0.9272/
348    -492030000    0.3746     0.0185    -0.9272/
348    -492040000    0.3746     0.0185    -0.9272/
348    -492050000    0.3746     0.0185    -0.9272/
348    -492060000    0.3746     0.0185    -0.9272/
348    -492070000    0.3746     0.0185    -0.9272/
348    -492080000    0.3746     0.0185    -0.9272/
348    -492090000    0.3746     0.0185    -0.9272/
348    -492100000    0.3746     0.0185    -0.9272/
348    -493000000    0.3746     0.0185    -0.9272/
348     493000000    0.3746     0.0185    -0.9272/
346     600010000    0.3746     0.0185    -0.9272/
346     600020000    0.3746     0.0185    -0.9272/
344    -600010000    0.3746     0.0185    -0.9272/
344    -600020000    0.3746     0.0185    -0.9272/
344    -600030000    0.3746     0.0185    -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/
2402    -600050000    0.0     -1.0     0.0/
2402    -600060000    0.0     -1.0     0.0/
2402    -601000000    0.0     -1.0     0.0/
284     498000000   -0.9272    0.0    -0.3746/
284     410010000   -0.9272    0.0    -0.3746/
284     410020000   -0.9272    0.0    -0.3746/
284     410030000   -0.9272    0.0    -0.3746/
284     410040000   -0 9272    0.0    -0.3746/
282    -410010000   -0.9272    0.0    -0.3746/
282    -410020000   -0.9272    0.0    -0.3746/
282    -410030000   -0.9272    0.0    -0.3746/
282    -410040000   -0.9272    0.0    -0.3746/
282    -410050000   -0.9272    0.0    -0.3746/
280     410050000    0.0      1.0     0.0/
280     410060000    0.0      1.0     0.0/
280     410070000    0.0      1.0     0.0/
280     410080000    0.0      1.0     0.0/
280     410090000    0.0      1.0     0.0/
280     410100000    0.0      1.0     0.0/
278    -410060000    0.0      1.0     0.0/
278    -410070000    0.0      1.0     0.0/
278    -410080000    0.0      1.0     0.0/
278    -410090000    0.0      1.0     0.0/
278    -410100000    0.0      1.0     0.0/
278    -410110000    0.0      1.0     0.0/
276     410110000   0.9270   -0.0218    0.3745/
276     410120000   0.9270   -0.0218    0.3745/
278     410130000   0.9270   -0.0218    0.3745/
278     410140000   0.9270   -0.0218    0.3745/
278     410150000   0.9270   -0.0218    0.3745/
276     410160000   0.9270   -0.0218    0.3745/
278     410170000   0.9270   -0.0218    0.3745/
278     410180000   0.9270   -0.0218    0.3745/
278     410190000   0.9270   -0.0218    0.3745/
278     410200000   0.9270   -0.0218    0.3745/
264    -410120000   0.9270   -0.0218    0.3745/
264    -410130000   0.9270   -0.0218    0.3745/
264    -410140000   0.9270   -0.0218    0.3745/
264    -410150000   0.9270   -0.0218    0.3745/
264    -410160000   0.9270   -0.0218    0.3745/
264    -410170000   0.9270   -0.0218    0.3745/
264    -410180000   0.9270   -0.0218    0.3745/
264    -410190000   0.9270   -0.0218    0.3745/
264    -410200000   0.9270   -0.0218    0.3745/
264    -415000000   0.9270   -0.0218    0.3745/
262     415000000   0.9270   -0.0218    0.3745/
262     500010000   0.9270   -0 0218    0.3745/
262     500020000   0.9270   -0.0218    0.3745/
260    -500010000   0.9270   -0.0218    0.3745/
260    -500020000   0.9270   -0.0218    0.3745/
260    -500030000   0.9270   -0.0218    0.3745/
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/
252    -500060000    0.0     -1.0     0.0/
250     500060000   0.7559     0.0    -0.6547/
```

```
248    -500070000    0 7559    0.0    -0.6547/
2481    500070000    0.7170    0.0    -0.6971/
2481    500080000    0.7170    0.0    -0.6971/
2481    500090000    0.7170    0.0    -0.6971/
246    -500080000    0.7170    0.0    -0.6971/
246    -500090000    0.7170    0.0    -0.6971/
246    -500100000    0.7170    0.0    -0.6971/
2461    500100000    0.3736    0.0    -0.9276/
2461    500110000    0.3736    0.0    -0.9276/
2461    500120000    0.3736    0.0    -0.9276/
244    -500110000    0.3736    0.0    -0.9276/
244    -500120000    0.3736    0.0    -0.9276/
244    -500130000    0.3736    0.0    -0.9276/
2441    500130000    0.0282    0.0    -0.9996/
2441    500140000    0.0282    0.0    -0.9996/
2441    500150000    0.0282    0.0    -0.9996/
2441    501000000    0.0282    0.0    -0.9996/
242    -500140000    0.0282    0.0    -0.9996/
242    -500150000    0.0282    0.0    -0.9996/
242    -501000000    0.0282    0.0    -0.9996/
242    -502010000    0.0282    0.0    -0.9996/
2421    502010000   -0.2531    0.0    -0.9674/
240    -503000000   -0.2531    0 0    -0.9674/
2401    503000000   -0.3508    0 0    -0.9364/
2401   601000000  -0.3508  0.0  -0.9364/
238    -505000000   -0.3508    0.0    -0.9364/
2381    505000000   -0.6395    0.0    -0.7688/
2381    506010000   -0.6395    0.0    -0.7688/
2381    506020000   -0.6395    0.0    -0.7688/
2381    506030000   -0.6395    0.0    -0.7688/
236    -506010000   -0.6395    0.0    -0.7688/
236    -506020000   -0 6395    0.0    -0.7688/
236    -506030000   -0.6395    0.0    -0.7688/
236    -506040000   -0.6395    0.0    -0.7688/
2361    506040000   -0.9576    0.0    -0.2882/
2361    506050000   -0.9576    0.0    -0.2882/
2361    506060000   -0.9576    0.0    -0.2882/
2361    506070000   -0.9576    0.0    -0.2882/
234    -506050000   -0.9576    0.0    -0.2882/
234    -506060000   -0.9576    0.0    -0.2882/
234    -506070000   -0.9576    0.0    -0.2882/
234    -506080000   -0.9576    0.0    -0.2882/
2341    506080000   -0.9998    0.0    -0.0175/
2341    507000000   -0.9998    0.0    -0.0175/
2341    508010000   -0.9998    0 0    -0.0175/
2341    509000000   -0.9998    0.0    -0.0175/
2341    511000000   -0.9998    0.0    -0.0175/
226    -507000000   -0.9998    0.0    -0.0175/
226    -508010000   -0.9998    0.0    -0.0175/
226    -509010000   -0.9998    0.0    -0.0175/
226    -511000000   -0.9998    0.0    -0.0175/
226    -700010000   -0.9998    0.0    -0.0175/
224    700010000    0.0    -1.0    0.0/
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/
```

TELEDYNE
ENGINEERING SERVICES



```
 68     811140000     -0.2356     -0.7071     0.6667/
 68     811150000     -0.2356     -0.7071     0.6667/
 68     811160000     -0.2356     -0.7071     0.6667/
 66     811170000     -0.2356     -0.7071     0.6667/
 64    -811150000     -0.2356     -0.7071     0.6667/
 64    -811160000     -0.2356     -0.7071     0.6667/
 64    -811170000     -0.2356     -0.7071     0.6667/
 64    -811180000     -0.2356     -0.7071     0.6667/
198   305000000  -0.9975   0.0   0.0709/
198     306010000     -0.9975     0.0     0.0709/
198     306020000     -0.9975     0.0     0.0709/
198     306030000     -0.9975     0.0     0.0709/
195    -306010000  -0.9975  0.0   0.0709/
195    -306020000     -0.9975     0 0     0.0709/
195    -306030000     -0.9975     0 0     0.0709/
195    -306040000     -0.9975     0.0     0.0709/
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/
190     306080000      0.0     -1.0     0.0/
190     306090000      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     -0.9359      0.0     -0.3523/
184     306130000     -0.9359      0.0     -0.3523/
184     306140000     -0.9359      0.0     -0.3523/
182    -306130000     -0.9359      0.0     -0.3523/
182    -306140000     -0.9359      0.0     -0.3523/
182    -306150000     -0.9359      0.0     -0.3523/
1821    306150000     -0.6354      0.0     -0.7722/
1821    306160000     -0.6354      0.0     -0.7722/
1821    306170000     -0.6354      0.0     -0.7722/
180    -306160000     -0.6354      0.0     -0.7722/
180    -306170000     -0.6354      0.0     -0.7722/
180    -306180000     -0.6354      0.0     -0.7722/
1801    306180000     -0.0516      0.0     -0.9987/
1801    306190000     -0.0516      0.0     -0.9987/
1801    306200000     -0.0516      0.0     -0.9987/
178    -306190000     -0.0516      0.0     -0.9987/
178    -306200000     -0.0516      0.0     -0.9987/
178    -306210000     -0.0516      0.0     -0.9987/
1781    306210000      0.2639      0.0     -0.9645/
1781    306220000      0.2639      0.0     -0.9645/
1781    306230000      0.2639      0.0     -0.9645/
1781    306240000      0.2639      0.0     -0.9645/
176    -306220000      0.2639      0.0     -0.9645/
176    -306230000      0.2639      0.0     -0.9645/
176    -306240000      0.2639      0.0     -0.9645/
176    -307000000      0.2639      0.0     -0.9645/
104    105000000   0.7169   0.0   0.6972/
104     106010000      0.7169      0.0     0.6972/
```

```
104   106020000    0.7169    0 0    0.6972/
104   106030000    0.7169    0.0    0.6972/
98  -106010000  0.7169  0.0  0.6972/
98  -106020000    0.7169    0.0    0.6972/
98  -106030000    0.7169    0.0    0.6972/
98  -106040000    0.7169    0.0    0.6972/
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    0.2657    0.0    0.9641/
88    106150000    0.2657    0 0    0.9641/
88    106160000    0.2657    0.0    0.9641/
86  -106150000    0.2657    0.0    0.9641/
86  -106160000    0.2657    0.0    0.9641/
86  -106170000    0.2657    0.0    0.9641/
861   106170000   -0.3889    0.0    0.9213/
861   106180000   -0.3889    0.0    0.9213/
861   106190000   -0.3889    0 0    0.9213/
84  -106180000   -0.3889    0.0    0.9213/
84  -106190000   -0.3889    0.0    0.9213/
84  -106200000   -0.3889    0 0    0.9213/
841   106200000   -0.8464    0.0    0.5326/
841   106210000   -0.8464    0.0    0.5326/
841   106220000   -0.8464    0.0    0.5326/
82  -106210000   -0.8464    0.0    0.5326/
82  -106220000   -0.8464    0.0    0.5326/
82  -106230000   -0.8464    0.0    0.5326/
821   106230000   -0.9999    0.0    0.0162/
821   106240000   -0.9999    0.0    0.0162/
821   106250000   -0.9999    0.0    0.0162/
80  -106240000   -0.9999    0.0    0.0162/
80  -106250000   -0.9999    0.0    0.0162/
80  -106260000   -0.9999    0.0    0.0162/
801   106260000   -0.8289    0.0   -0.5595/
801   106270000   -0.8289    0.0   -0.5595/
801   106280000   -0.8289    0.0   -0.5595/
78  -106270000   -0.8289    0.0   -0.5595/
78  -106280000   -0.8289    0.0   -0.5595/
78  -106290000   -0.8289    0.0   -0.5595/
781   106290000   -0.4813    0.0   -0.8766/
781   106300000   -0.4813    0.0   -0.8766/
781   106310000   -0.4813    0.0   -0.8766/
78  -106300000   -0.4813    0.0   -0.8766/
```

```
76     -106310000     -0.4813     0.0     -0.8766/
76     -106320000     -0.4813     0.0     -0.8766/
761     106320000     -0.2356    -0.7071     0.6667/
761     106330000     -0.2356    -0.7071     0.6667/
761     106340000     -0.2356    -0.7071     0.6667/
74     -106330000     -0.2356    -0.7071     0.6667/
74     -106340000     -0.2356    -0.7071     0.6667/
74     -106350000     -0.2356    -0.7071     0.6667/
741     106350000     0.2639     0.0     -0.9645/
741     106360000     0.2639     0.0     -0.9645/
741     106370000     0.2639     0.0     -0.9645/
741     106380000     0.2639     0.0     -0.9645/
72     -106360000     0.2639     0.0     -0.9645/
72     -106370000     0.2639     0.0     -0.9645/
72     -106380000     0.2639     0.0     -0.9645/
72     -107000000     0.2639     0.0     -0.9645/
99999/
 $STEPS TSTEP(1)=0.001,0.200,-1,-1$
```

9.1.2.2 Unit 2 - Model Section B

```
$PIPES
INLINE=3,KBLOCK=200,KPIPE=10,KPLOT(1)=1,KWAVE=1,
KPRINT=-1,KPNV=1,KSTEP=3,
NDROPV=206010000,903030000,805010000,811180000$
154    206010000     -0.4181     0.0     0.9084/
154   206020000     -0.4181     0.0     0.9084/
154    206030000     -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     -0.8064     0.0     0.5913/
138    206150000     -0.8064     0.0     0.5913/
138    206160000     -0.8064     0.0     0.5913/
136   -206150000     -0.8064     0.0     0.5913/
136   -206160000     -0.8064     0.0     0.5913/
136   -206170000     -0.8064     0.0     0.5913/
1361   206170000     -0.9998     0.0     0.0191/
1361   206180000     -0.9998     0.0     0.0191/
1361   206190000     -0.9998     0.0     0.0191/
134   -206180000     -0.9998     0.0     0.0191/
134   -206190000     -0.9998     0.0     0.0191/
134   -206200000     -0.9998     0.0     0.0191/
1341   206200000     -0.8285     0.0     -0.5599/
1341   206210000     -0.8285     0.0     -0.5599/
1341   206220000     -0.8285     0.0     -0.5599/
132   -206210000     -0.8285     0.0     -0.5599/
132   -206220000     -0.8285     0.0     -0.5599/
132   -206230000     -0.8285     0.0     -0.5599/
1321   206230000     -0.4217     0.0     -0.9067/
1321   206240000     -0.4217     0.0     -0.9067/
1321   206250000     -0.4217     0.0     -0.9067/
130   -206240000     -0.4217     0.0     -0.9067/
130   -206250000     -0.4217     0.0     -0.9067/
130   -206260000     -0.4217     0.0     -0.9067/
1301   206260000     0.0323     0.0     -0.9995/
1301   206270000     0.0323     0.0     -0.9995/
1301   206280000     0.0323     0.0     -0.9995/
128   -206270000     0.0323     0.0     -0.9995/
128   -206280000     0.0323     0.0     -0.9995/
```

BY KJG DATE 5-21-83

CHKD. BY MIL DATE 5-26-83

TELEDYNE ENGINEERING SERVICES

```
128  -206290000    0.0323     0.0     -0.9995/
1281  206290000    0.2639     0.0     -0.9645/
1281  206300000    0.2639     0.0     -0.9645/
1281  206310000    0.2639     0.0     -0.9645/
1231  206320000    0.2639     0.0     -0.9645/
126  -206300000    0.2639     0.0     -0.9645/
126  -206310000    0.2639     0.0     -0.9645/
126  -206320000    0.2639     0.0     -0.9645/
126  -207000000    0.2639     0.0     -0.9645/
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    0.2356    -0.7071    -0.6667/
56    811230000    0.2356    -0.7071    -0.6667/
56    811240000    0.2356    -0.7071    -0.6667/
56    811250000    0.2356    -0.7071    -0.6667/
54   -811230000    0.2356    -0.7071    -0.6667/
54   -811240000    0.2356    -0.7071    -0.6667/
54   -811250000    0.2356    -0.7071    -0.6667/
54   -811260000    0.2356    -0.7071    -0.6667/
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/
46   -811280000     0.0     -1.0      0.0/
46   -811290000     0.0     -1.0      0.0/
46   -811300000     0.0     -1.0      0.0/
46   -811310000     0.0     -1.0      0.0/
```

TELEDYNE
ENGINEERING SERVICES

38	-8.1180000	0.5258	[illegible]	-0.0255
39	-8.1070000	0.5281	[illegible]	-0.[illegible]
40				

```
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    0.2588     0.0     -0.9659/
40     811670000    0.2588     0.0     -0.9659/
40     811680000    0.2588     0.0     -0.9659/
40     811690000    0.2588     0.0     -0.9659/
40      811700000    0.2588     0.0     -0.9659/
40     811710000    0.2588     0.0     -0.9659/
40     811720000    0.2588     0.0     -0.9659/
40     811730000    0.2588     0.0     -0.9659/
40     811740000    0.2588     0.0     -0.9659/
40     811750000    0.2588     0.0     -0.9659/
40     811760000    0.2588     0.0     -0.9659/
40     811770000    0.2588     0.0     -0.9659/
40     811780000    0.2588     0.0     -0.9659/
38    -811670000    0.2588     0.0     -0.9659/
38    -811680000    0.2588     0.0     -0.9659/
```

TELEDYNE
ENGINEERING SERVICES

30 -813030000 1.0 0.0 0.0
30 -813030000 1.0 0.0 0.0
30 -813030000 1.0 0.0 0.0

```
38    -811690000    0.2588    0.0    -0.9659/
38    -811700000    0.2588    0.0    -0.9659/
38    -811710000    0.2588    0.0    -0.9659/
38    -811720000    0.2588    0.0    -0.9659/
38    -811730000    0.2588    0.0    -0.9659/
38    -811740000    0.2588    0.0    -0.9659/
38    -811750000    0.2588    0.0    -0.9659/
38    -811760000    0.2588    0.0    -0.9659/
38    -811770000    0.2588    0.0    -0.9659/
38    -811780000    0.2588    0.0    -0.9659/
38    -811790000    0.2588    0.0    -0.9659/
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/
28     811950000    1.0    0.0    0.0/
28     811960000    1.0    0.0    0.0/
28     811970000    1.0    0.0    0.0/
26     811980000    1.0    0.0    0.0/
26     812000000    1.0    0.0    0.0/
28     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/
```

TELEDYNE
ENGINEERING SERVICES

[illegible]	-.803050000	0.0	[illegible]
[illegible]	-.803010000	[illegible]	[illegible]

```
20    -813040000     1.0     0.0     0.0/
20    -813050000     1.0     0.0     0.0/
20    -813060000     1.0     0.0     0.0/
18     813060000     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     -813300000    -1.0     0.0     0.0/
4      900000000     0.0    -1.0     0.0/
4     901010000     0.0    -1.0     0.0/
4     901020000     0.0    -1.0     0.0/
4     902000000     0.0    -1.0     0.0/
4     903010000     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/
```

TELEDYNE
ENGINEERING SERVICES

```
99999/
 $STEPS TSTEP(1)=0.001,1.0,-1,-1$
```

TELEDYNE
ENGINEERING SERVICES

9.1.2.3 Unit 2 - Quarter Model

(3)

```
$PIPES
INLINE=3,KBLOCK=601,KPIPE=0,KPLOT(1)=1,KWAVE=1,
KPRINT=-1,KPNV=1,KSTEP=3,NDROPV=1010000,15010000$
1    002000000    -1.0   0.0   0.0/
2   -004000000    -1.0   0.0   0.0/
3    004000000     0.0  -1.0   0.0/
3    005010000     0.0  -1.0   0.0/
3    005020000     0.0  -1.0   0 0/
3    005040000     0.0  -1.0   0.0/
3    005050000     0.0  -1.0   0.0/
3    005060000     0.0  -1.0   0.0/
4   -005010000     0.0  -1.0   0.0/
4   -005020000     0.0  -1.0   0.0/
4   -005030000     0.0  -1.0   0.0/
4   -005040000     0.0  -1.0   0.0/
4   -005050000     0.0  -1.0   0.0/
4   -005060000     0.0  -1.0   0.0/
4   -005070000     0.0  -1.0   0.0/
5    005070000    -1.0   0.0   0.0/
5    005080000    -1.0   0.0   0.0/
5    005090000    -1.0   0.0   0.0/
6   -005080000    -1.0   0.0   0.0/
6   -005090000    -1.0   0.0   0.0/
6   -005100000    -1.0   0.0   0.0/
7    005100000     0.0   1.0   0.0/
7    005110000     0.0   1.0   0.0/
7    005120000     0.0   1.0   0.0/
7    005130000     0.0   1.0   0.0/
7    005140000     0.0   1.0   0.0/
7    005150000     0.0   1.0   0.0/
7    005160000     0.0   1.0   0.0/
7    005170000     0.0   1.0   0.0/
7    005180000     0.0   1.0   0.0/
7    005190000     0.0   1.0   0.0/
8   -005110000     0.0   1.0   0.0/
8   -005120000     0.0   1.0   0.0/
8   -005130000     0.0   1.0   0.0/
8   -005140000     0.0   1.0   0.0/
8   -005150000     0.0   1.0   0.0/
8   -005160000     0.0   1.0   0.0/
8   -005170000     0.0   1.0   0.0/
8   -005180000     0.0   1.0   0.0/
8   -005190000     0.0   1.0   0.0/
8   -008000000     0.0   1.0   0.0/
9    008000000    -1.0   0.0   0.0/
9    007010000    -1.0   0.0   0.0/
9    007020000    -1.0   0.0   0.0/
9    007030000    -1.0   0.0   0.0/
10  -007010000    -1.0   0.0   0.0/
10  -007020000    -1.0   0.0   0.0/
10  -007030000    -1.0   0.0   0.0/
10  -007040000    -1.0   0.0   0.0/
11   007040000     0.0  -1.0   0.0/
11   007050000     0.0  -1.0   0.0/
11   007080000     0.0  -1.0   0.0/
11   007070000     0.0  -1.0   0.0/
11   007080000     0.0  -1.0   0.0/
11   007090000     0.0  -1.0   0.0/
```

BY CHH DATE 2-9-83

CHKD. BY LOS DATE 2-9-83

```
11  007120000    0.0 -1.0  0.0/
11  007130000    0.0 -1.0  0.0/
12 -007050000    0.0 -1.0  0.0/
12 -007060000    0.0 -1.0  0.0/
12 -007070000    0.0 -1.0  0.0/
12 -007080000    0.0 -1.0  0.0/
12 -007090000    0.0 -1.0  0.0/
12 -007100000    0.0 -1.0  0.0/
12 -007110000    0.0 -1.0  0.0/
12 -007120000    0.0 -1.0  0.0/
12 -007130000    0.0 -1.0  0.0/
12 -007140000    0.0 -1.0  0.0/
14   007140000   -.258  0.0 -.966/
14   007150000   -.258  0.0 -.966/
14   007160000   -.258  0.0 -.966/
15  -007150000   -.258  0.0 -.966/
15  -007160000   -.258  0.0 -.966/
15  -007170000   -.258  0.0 -.966/
16   007170000    .337  0.0 -.942/
16   007180000    .337  0.0 -.942/
16   007190000    .337  0.0 -.942/
17  -007180000    .337  0.0 -.942/
17  -007190000    .337  0.0 -.942/
17  -007200000    .337  0.0 -.942/
18   007200000    .793  0.0 -.609/
18   007210000    .793  0.0 -.609/
18   007220000    .793  0.0 -.609/
19  -007210000    .793  0.0 -.609/
19  -007220000    .793  0.0 -.609/
19  -007230000    .793  0.0 -.609/
20   007230000    .994  0.0 -.1132/
20   007240000    .994  0.0 -.1132/
20   007250000    .994  0.0 -.1132/
21  -007240000    .994  0.0 -.1132/
21  -007250000    .994  0.0 -.1132/
21  -007260000    .994  0.0 -.1132/
22   007260000    .910  0.0  .415/
22   007270000    .910  0.0  .415/
22   007280000    .910  0.0  .415/
23  -007270000    .910  0.0  .415/
23  -007280000    .910  0.0  .415/
23  -007290000    .910  0.0  .415/
24   007290000    .555  0.0  .8321/
24   007300000    .555  0.0  .8321/
24   007310000    .555  0.0  .8321/
25  -007300000    .555  0.0  .8321/
25  -007310000    .555  0.0  .8321/
25  -007320000    .555  0.0  .8321/
26   007320000   .0183  0.0 .9998/
26   007330000   .0183  0.0 .9998/
26   007340000   .0183  0.0 .9998/
27  -007330000   .0183  0.0 .9998/
27  -007340000   .0183  0.0 .9998/
27  -007350000   .0183  0.0 .9998/
28   007350000   -.264  0.0  .965/
28   007360000   -.264  0.0  .965/
28   007370000   -.264  0.0  .965/
28   007380000   -.264  0.0  .965/
28  -007360000   -.264  0.0  .965/
```

```
29  -007380000   -.284   0.0   .965/
29  -008000000   -.264   0.0   .965/
30   008000000    0.0  -1.0   0.0/
30   010000000    0.0  -1.0   0.0/
30   011010000    0.0  -1.0   0.0/
30   011020000    0.0  -1.0   0.0/
30   011030000    0.0  -1.0   0.0/
30   011040000    0.0  -1.0   0.0/
30   011050000    0.0  -1.0   0.0/
30   011060000    0.0  -1.0   0.0/
30   011070000    0.0  -1.0   0.0/
30   011080000    0.0  -1.0   0.0/
30   011090000    0.0  -1.0   0.0/
30   011100000    0.0  -1.0   0.0/
30   011110000    0.0  -1.0   0.0/
30   011120000    0.0  -1.0   0.0/
30   011130000    0.0  -1.0   0.0/
31  -010000000    0.0  -1.0   0.0/
31  -011010000    0.0  -1.0   0.0/
31  -011020000    0.0  -1.0   0.0/
31  -011030000    0.0  -1.0   0.0/
31  -011040000    0.0  -1.0   0.0/
31  -011050000    0.0  -1.0   0.0/
31  -011060000    0.0  -1.0   0.0/
31  -011070000    0.0  -1.0   0.0/
31  -011080000    0.0  -1.0   0.0/
31  -011090000    0.0  -1.0   0.0/
31  -011100000    0.0  -1.0   0.0/
31  -011110000    0.0  -1.0   0.0/
31  -011120000    0.0  -1.0   0.0/
31  -011130000    0.0  -1.0   0.0/
31  -011140000    0.0  -1.0   0.0/
32   011140000    .316  -.707  -.948/
32   011150000    .316  -.707  -.948/
32   011160000    .316  -.707  -.948/
32   011170000    .316  -.707  -.948/
33  -011150000    .316  -.707  -.948/
33  -011160000    .316  -.707  -.948/
33  -011170000    .316  -.707  -.948/
33  -011180000    .316  -.707  -.948/
34   011180000    0.0  -1.0   0.0/
34   011190000    0.0  -1.0   0.0/
34   011200000    0.0  -1.0   0.0/
34   011210000    0.0  -1.0   0.0/
35  -011200000    0.0  -1.0   0.0/
35  -011210000    0.0  -1.0   0.0/
35  -011220000    0.0  -1.0   0.0/
36   011220000   -.316  -.707   .948/
36   011230000   -.316  -.707   .948/
36   011240000   -.316  -.707   .948/
36   011250000   -.316  -.707   .948/
37  -011230000   -.316  -.707   .948/
37  -011240000   -.316  -.707   .948/
37  -011250000   -.316  -.707   .948/
37  -011260000   -.316  -.707   .948/
38   011260000    0.0  -1.0   0.0/
38   011270000    0.0  -1.0   0.0/
38   011280000    0.0  -1.0   0.0/
38   011290000    0.0  -1.0   0.0/
```

```
40  01120000   0.0  0.0 -1.0\
30  01120000   0.0  0.0 -1.0\
20  01120000   0.0  0.0 -1.0\
10  01120000   0.0  0.0 -1.0\
```

```
38   011310000    0.0 -1.0  0.0/
38   011320000    0.0 -1.0  0.0/
38   011330000    0.0 -1.0  0.0/
38   011340000    0.0 -1.0  0.0/
38   011350000    0.0 -1.0  0.0/
38   011360000    0.0 -1.0  0.0/
38   011370000    0.0 -1.0  0.0/
38   011380000    0.0 -1.0  0.0/
38   011390000    0.0 -1.0  0.0/
38   011400000    0.0 -1.0  0.0/
38   011410000    0.0 -1.0  0.0/
38   011420000    0.0 -1.0  0.0/
38   011430000    0.0 -1.0  0.0/
38   011440000    0.0 -1.0  0.0/
38   011450000    0.0 -1.0  0.0/
38   011460000    0.0 -1.0  0.0/
38   011470000    0.0 -1.0  0.0/
38   011480000    0.0 -1.0  0.0/
38   011490000    0.0 -1.0  0.0/
38   011500000    0.0 -1.0  0.0/
38   011510000    0.0 -1.0  0.0/
38   011520000    0.0 -1.0  0.0/
38   011530000    0.0 -1.0  0.0/
38   011540000    0.0 -1.0  0.0/
38   011550000    0.0 -1.0  0.0/
39  -011270000    0.0 -1.0  0.0/
39  -011280000    0.0 -1.0  0.0/
39  -011290000    0.0 -1.0  0.0/
39  -011300000    0.0 -1.0  0.0/
39  -011310000    0.0 -1.0  0.0/
39  -011320000    0.0 -1.0  0.0/
39  -011330000    0.0 -1.0  0.0/
39  -011340000    0.0 -1.0  0.0/
39  -011350000    0.0 -1.0  0.0/
39  -011360000    0.0 -1.0  0.0/
39  -011370000    0.0 -1.0  0.0/
39  -011380000    0.0 -1.0  0.0/
39  -011390000    0.0 -1.0  0.0/
39  -011400000    0.0 -1.0  0.0/
39  -011410000    0.0 -1.0  0.0/
39  -011420000    0.0 -1.0  0.0/
39  -011430000    0.0 -1.0  0.0/
39  -011440000    0.0 -1.0  0.0/
39  -011450000    0.0 -1.0  0.0/
39  -011460000    0.0 -1.0  0.0/
39  -011470000    0.0 -1.0  0.0/
39  -011480000    0.0 -1.0  0.0/
39  -011490000    0.0 -1.0  0.0/
39  -011500000    0.0 -1.0  0.0/
39  -011510000    0.0 -1.0  0.0/
39  -011520000    0.0 -1.0  0.0/
39  -011530000    0.0 -1.0  0.0/
39  -011540000    0.0 -1.0  0.0/
39  -011550000    0.0 -1.0  0.0/
39  -011560000    0.0 -1.0  0.0/
40   011560000    0.0  0.0 -1.0/
40   011570000    0.0  0.0 -1.0/
40   011580000    0.0  0.0 -1.0/
40   011590000    0.0  0.0 -1.0/
```

```
40   011610000    0.0   0.0  -1.0/
40   011620000    0.0   0.0  -1.0/
40   011630000    0.0   0.0  -1.0/
40   011640000    0.0   0.0  -1.0/
40   011650000    0.0   0.0  -1.0/
41  -011570000    0.0   0.0  -1.0/
41  -011580000    0.0   0.0  -1.0/
41  -011590000    0.0   0.0  -1.0/
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41  -011610000    0.0   0.0  -1.0/
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41  -011630000    0.0   0.0  -1.0/
41  -011640000    0.0   0.0  -1.0/
41  -011650000    0.0   0.0  -1.0/
41  -011660000    0.0   0.0  -1.0/
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42   011670000  -.259    0.0   .966/
42   011680000  -.259    0.0   .966/
42   011690000  -.259    0.0   .966/
42   011700000  -.259    0.0   .966/
42   011710000  -.259    0.0   .966/
42   011720000  -.259    0.0   .966/
42   011730000  -.259    0.0   .966/
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42   011750000  -.259    0.0   .966/
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44   011820000  -1.0     0.0   0.0/
44   011830000  -1.0     0.0   0.0/
44   011840000  -1.0     0.0   0.0/
44   011850000  -1.0     0.0   0.0/
44   011860000  -1.0     0.0   0.0/
45  -011800000  -1.0     0.0   0.0/
45  -011810000  -1.0     0.0   0.0/
45  -011820000  -1.0     0.0   0.0/
45  -011830000  -1.0     0.0   0.0/
45  -011840000  -1.0     0.0   0.0/
45  -011850000  -1.0     0.0   0.0/
45  -011860000  -1.0     0.0   0.0/
45  -011870000  -1.0     0.0   0.0/
46   011870000   0.0    -1.0   0.0/
```

```
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48   011920000    0.0 -1.0  0.0/
48   011930000    0.0 -1.0  0.0/
48   011940000    0.0 -1.0  0.0/
47  -011880000    0.0 -1.0  0.0/
47  -011890000    0.0 -1.0  0.0/
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47  -011910000    0.0 -1.0  0.0/
47  -011920000    0.0 -1.0  0.0/
47  -011930000    0.0 -1.0  0.0/
47  -011940000    0.0 -1.0  0.0/
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48   011970000   -1.0  0.0  0.0/
48   011980000   -1.0  0.0  0.0/
48   011990000   -1.0  0.0  0.0/
48   012000000   -1.0  0.0  0.0/
48   013010000   -1.0  0.0  0.0/
48   013020000   -1.0  0.0  0.0/
48   013030000   -1.0  0.0  0.0/
48   013040000   -1.0  0.0  0.0/
48   013050000   -1.0  0.0  0.0/
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49  -012000000   -1.0  0.0  0.0/
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49  -013040000   -1.0  0.0  0.0/
49  -013050000   -1.0  0.0  0.0/
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50   013080000    0.0  0.0 -1.0/
50   013090000    0.0  0.0 -1.0/
50   013100000    0.0  0.0 -1.0/
50   013110000    0.0  0.0 -1.0/
50   013120000    0.0  0.0 -1.0/
50   013130000    0.0  0.0 -1.0/
50   013140000    0.0  0.0 -1.0/
50   013150000    0.0  0.0 -1.0/
50   013160000    0.0  0.0 -1.0/
50   013170000    0.0  0.0 -1.0/
50   013180000    0.0  0.0 -1.0/
50   013190000    0.0  0.0 -1.0/
51  -013070000    0.0  0.0 -1.0/
51  -013080000    0.0  0.0 -1.0/
51  -013090000    0.0  0.0 -1.0/
51  -013100000    0.0  0.0 -1.0/
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51  -013160000    0.0  0.0 -1.0/
```

```
51   -013180000   0.0   0.0  -1.0/
51   -013190000   0.0   0.0  -1.0/
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52    013240000   1.0   0.0   0.0/
52    013250000   1.0   0.0   0.0/
52    013260000   1.0   0.0   0.0/
52    013270000   1.0   0.0   0.0/
52    013280000   1.0   0.0   0.0/
52    013290000   1.0   0.0   0.0/
53   -013210000   1.0   0.0   0.0/
53   -013220000   1.0   0.0   0.0/
53   -013230000   1.0   0.0   0.0/
53   -013240000   1.0   0.0   0.0/
53   -013250000   1.0   0.0   0.0/
53   -013260000   1.0   0.0   0.0/
53   -013270000   1.0   0.0   0.0/
53   -013280000   1.0   0.0   0.0/
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53   -014000000   1.0   0.0   0.0/
99999/
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TECHNICAL REPORT TR-5364-1 M
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BOOK 2 OF 15

DONALD C. COOK NUCLEAR GENERATING PLANT

ANALYSIS OF PRESSURIZER SAFETY/RELIEF VALVES DISCHARGE PIPING SYSTEM PER NUREG 0737, II.D.1, UNIT 1

JUNE 6, 1983

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

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TECHNICAL REPORT TR-5364-1
REVISION 0

BOOK 2 OF 15

DONALD C. COOK NUCLEAR GENERATING STATION

ANALYSIS OF PRESSURIZER SAFETY/RELIEF VALVES DISCHARGE PIPING SYSTEM PER NUREG 0737, II. D.1, UNIT 1

JUNE 6, 1983

TELEDYNE ENGINEERING SERVICES
130 SECOND AVENUE
WALTHAM, MASSACHUSETTS 02254
617-890-3350

TABLE OF CONTENTS

			PAGE
1.0	INTRODUCTION	Book 1 of 15	1-1
2.0	CONCLUSIONS		2-1
3.0	SYSTEM DESCRIPTION/DISCUSSION		3-1
4.0	THERMAL FLUIDS ANALYSIS		4-1
	4.1 Introduction		4-1
	4.2 RELAP Model		4-3
	4.2.1 Pressurizer Conditions		4-3
	4.2.2 Valve Modeling		4-4
	4.2.3 Discharge Piping		4-5
	4.2.4 Quench Tank		4-5
	4.3 RELAP Model Control Volumes		4-16
	4.4 Quarter Model		4-26
	4.5 Unit 1 PORV Model		4-36
	4.5.1 Condensate Modeled Case		4-36
	4.5.2 PORV Modeled Transient		4-36
	4.6 Valve Flow Rate Calculation		4-40
	4.6.1 SV Flow Rate		4-41
	4.6.2 PORV Flow Rate		4-42
	4.7 RELAP Plots		4-45
	4.7.1 Unit 1 - Condensate/Steam Case		4-46
	4.7.2 Unit 1 - 400° Solid Liquid Case		4-166
	4.7.3 Quarter Model - Cold Loop Seal/Steam Case		4-244
	4.8 Force Time History Plots	Book 2 of 15	4-260
	4.8.1 Unit 1 - Condensate/Steam Case		4-261
	4.8.2 Unit 1 - 400° Solid Liquid Case		4-320
	4.8.3 Quarter Model - Cold Loop Seal/Steam Case		4-392
	4.9 RELAP Input		4-420
	4.9.1 PORV Condensate/Steam		4-421
	4.9.2 Condensate/Steam Restart		4-439
	4.9.3 PORV Solid 400° Liquid		4-448
	4.9.4 PORV Solid 400° Liquid Restart		4-467
	4.9.5 SV Cold Loop Seal (Quarter Model)		4-472

TABLE OF CONTENTS
(Continued)

			PAGE
4.10	REPIPE Input		4-478
4.10.1	Unit 1 - Model Section A		4-479
4.10.2	Unit 1 - Model Section B		4-489
4.10.3	Unit 2 - (Quarter Model)		4-496
4.11	APPENDIX A		
5.0	STRUCTURAL ANALYSIS	Book 3 of 15	5-1
5.1	Deadweight Analysis		5-2
5.2	Thermal Analysis		5-2
5.3	Seismic Analysis		5-2
5.4	Force/Time History Analysis		5-7
5.4.1	PORV Transient		5-7
5.4.2	SV Transient		5-8
6.0	ANALYTICAL RESULTS		6-1
6.1	Stress Summary		6-1
6.1.1	Equation A-1 Stresses		6-6
6.1.2	Equation A-2 Stresses		6-17
6.1.3	Equation B-1 Stresses		6-28
6.1.4	Equation B-2 Stresses		6-39
6.1.5	Equation B-3 Stresses		6-50
6.1.6	Equation C-1 Stresses		6-61
6.2	Support Loads		6-72
6.3	Valve Accelerations		6-105
6.3.1	DBE Seismic Valve Accelerations		6-106
6.3.2	PORV Transient Shock Valve Accelerations		6-110
6.4	Nozzle Loads		6-114
6.5	Valve Loads		6-120
6.6	Miscellaneous Calculations		6-126
6.6.1	Thermal Boundary Displacements		6-127
6.6.2	OBE Spectra		6-133
6.6.3	DBE Spectra		6-140
7.0	DRAWINGS		7-1
8.0	REFERENCES		8-1

TABLE OF CONTENTS
(Continued)

9.0 COMPUTER ANALYSIS

9.1	RELAP/REPIPE Input	Book 4 of 15
9.2	Deadweight/Thermal Input/Output	Book 5 of 15
9.3	OBE Seismic X-Y Input/Output	Books 6, 7 of 15
9.4	OBE Seismic Y-Z Input/Output	Books 8, 9 of 15
9.5	DBE Seismic X-Y Input/Output	Books 10, 11 of 15
9.6	DBE Seismic Y-Z Input/Output	Books 12, 13 of 15
9.7	PORV Transient Shock Input	Books 14, 15 of 15

4.8 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 each set (Unit 1, Unit 2). 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 0.6 seconds. The problem was run to 0.6 seconds because all significant forces in the area of concern (piping about the PORV's) had diminished in this time.

Unit 1 (PORV)	71 segments
Quarter Model	26 segments

Plot Set		Transient
4.8.1	Unit 1	Condensate/Steam Case (75% of model)
4.8.2	Unit 1	400° Solid Liquid Case
4.8.3	Quarter Model	Cold Loop Seal/Steam Case

4.8.1 Unit 1 - Condensate/Steam Case (75% of model)

BY RBM DATE 4-14-83
CHKD. BY LBS DATE 4-14-83

UNIT 1 STRUCTURAL NODE POINTS
PORV SECTION

SHEET NO. 1 OF 3
PROJ. NO. 5364

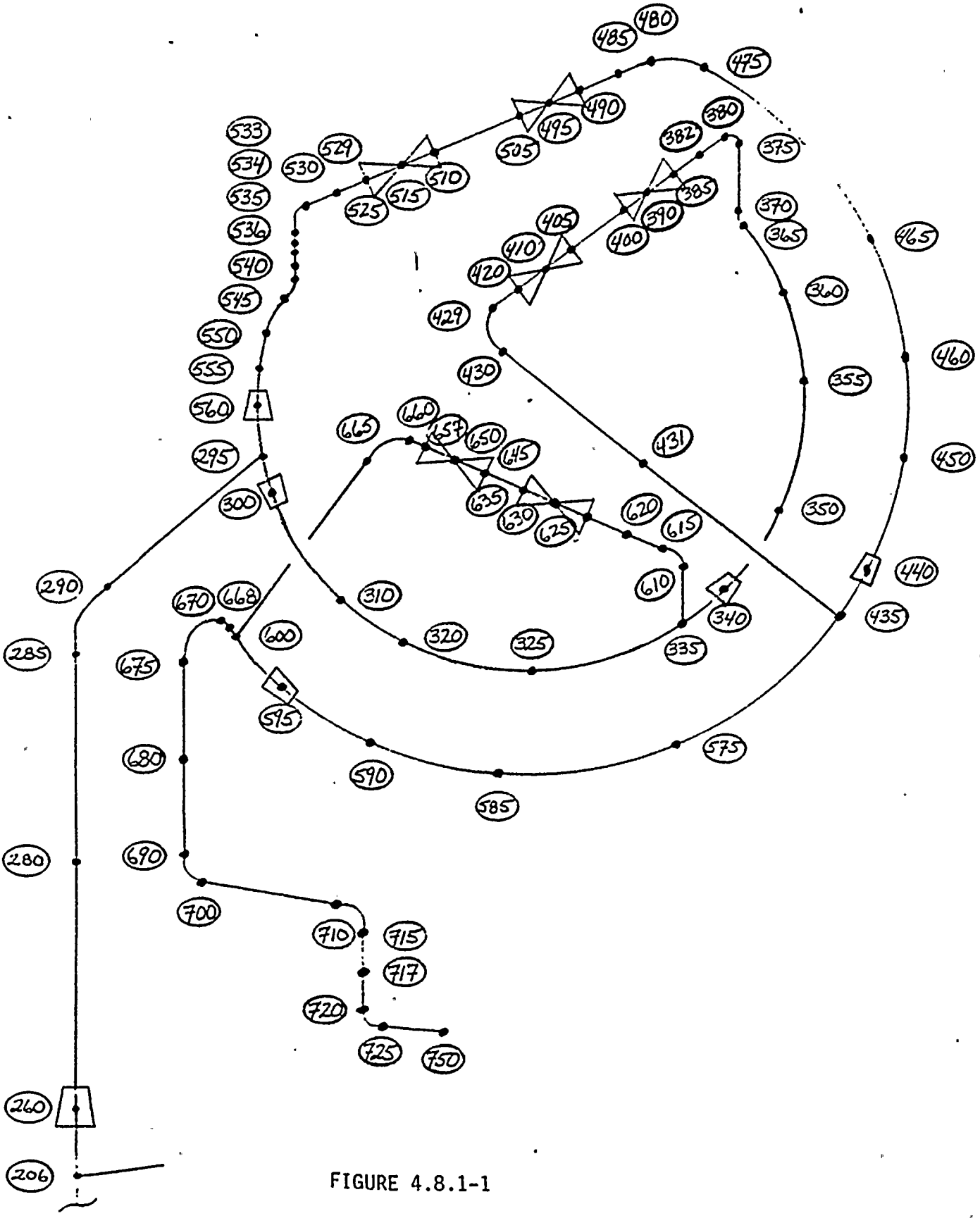

FIGURE 4.8.1-1

BY RAM DATE 4-14-83
CHKD. BY LBS DATE 4-14-83

UNIT 1 STRUCTURAL NODES POINTS
MAIN ARCS

SHEET NO. 2 OF 3
PROJ. NO. 5364

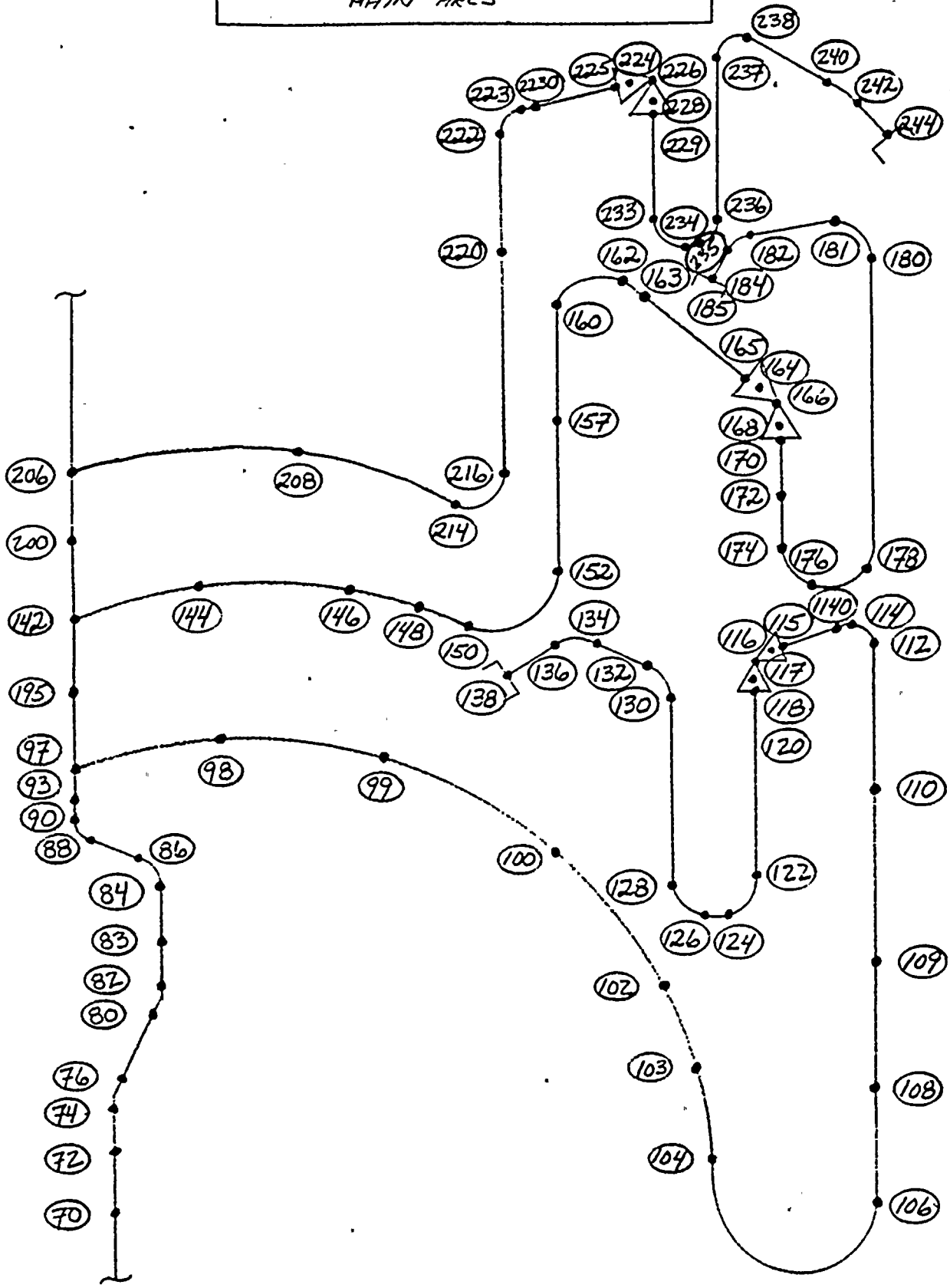

FIGURE 4.8.1-2

BY RAH DATE 4-14-83
CHKD. BY LBS DATE 4-14-83

UNIT 1 STRUCTURAL NODE POINTS
DOWNSTREAM (12 IN)

SHEET NO. 3 OF 3
PROJ. NO. 5364

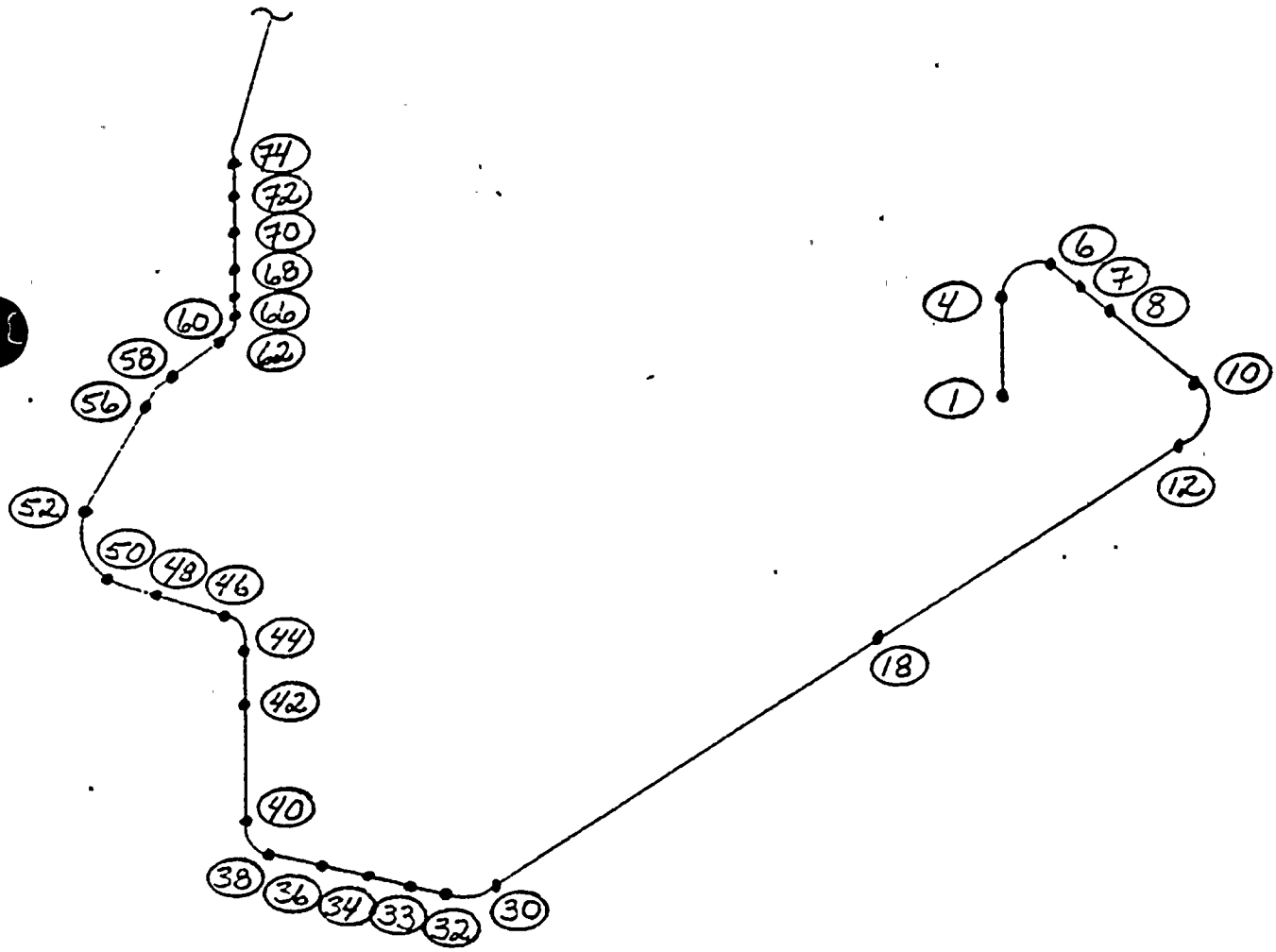

FIGURE 4.8.1-3

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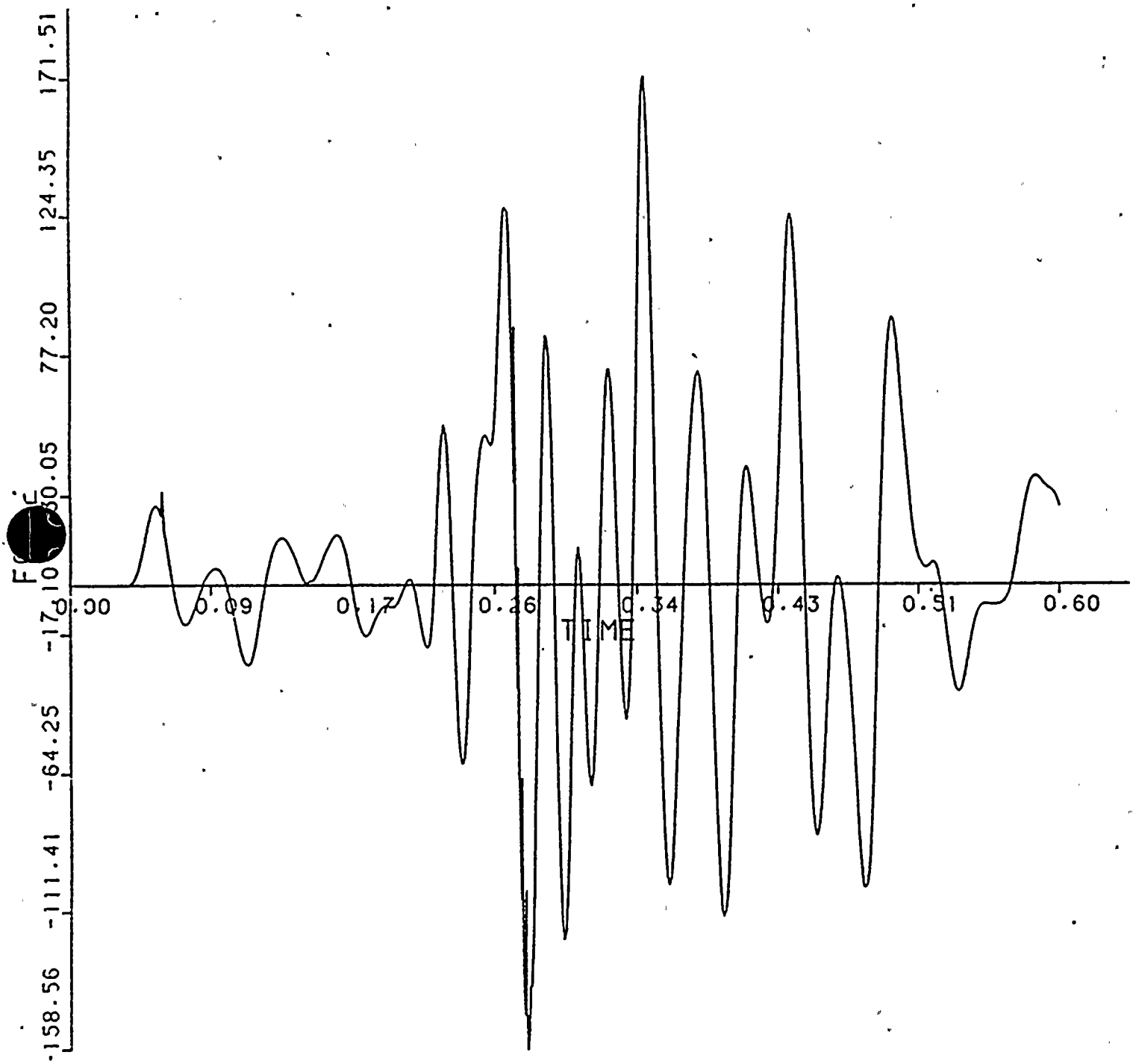
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 1, MAGNITUDE AT NODE POINT 109



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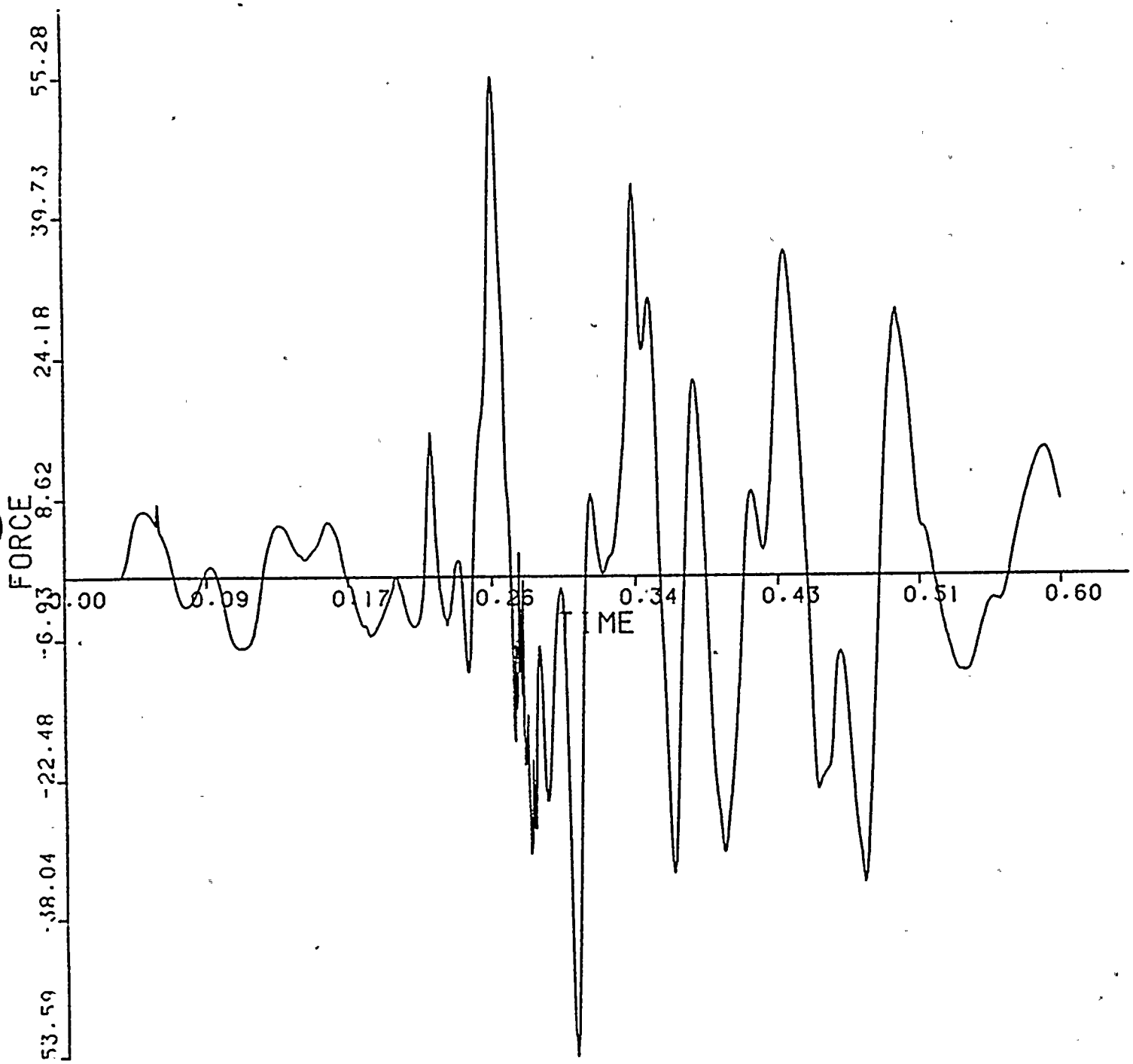
YELLOW LOOP SEAL - YELLPSL.TMP

TIME/FORCE TABLE 2. MAGNITUDE AT NODE POINT 104



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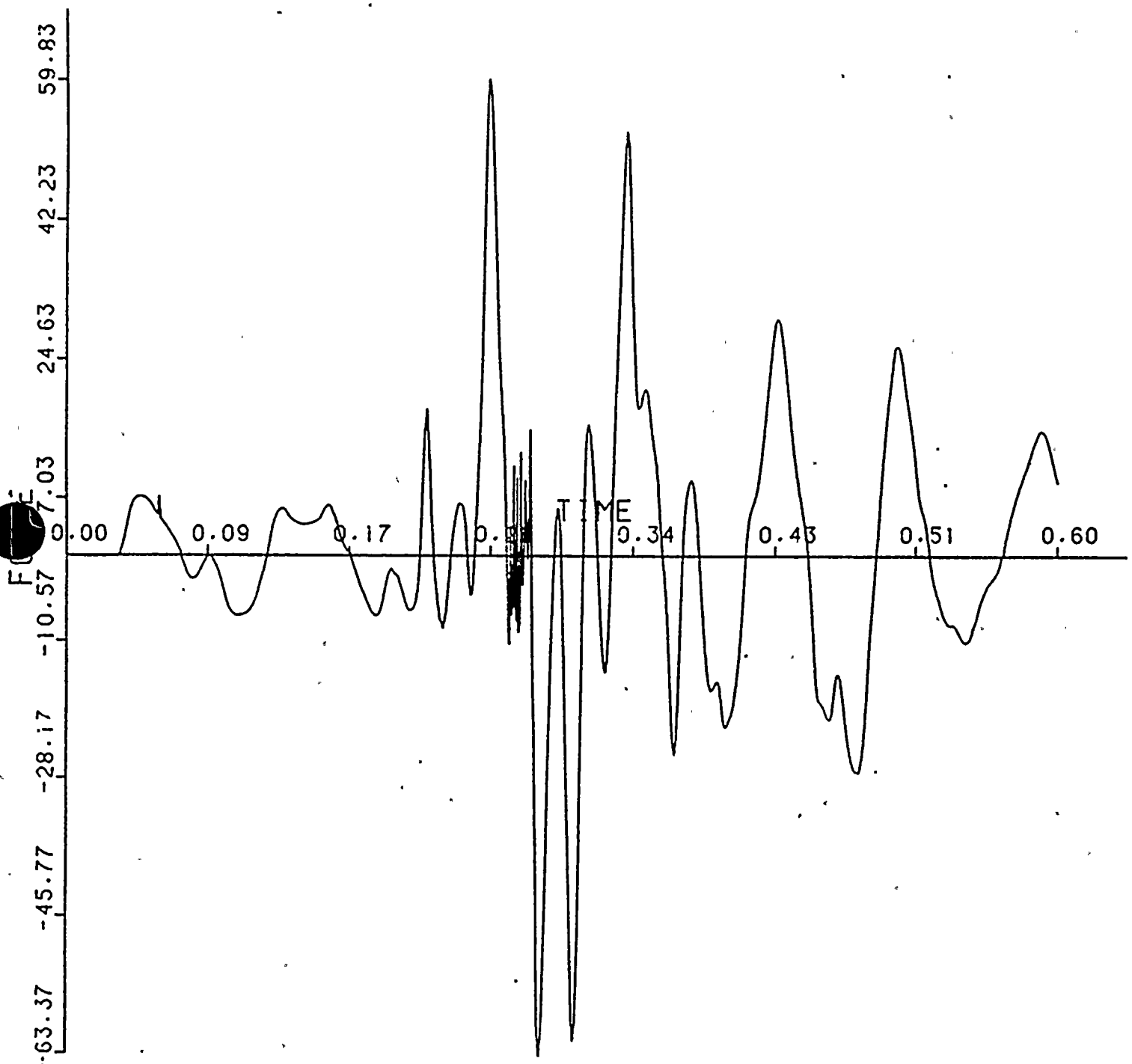
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 3, MAGNITUDE AT NODE POINT 103



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TR-5364-1
Revision 0

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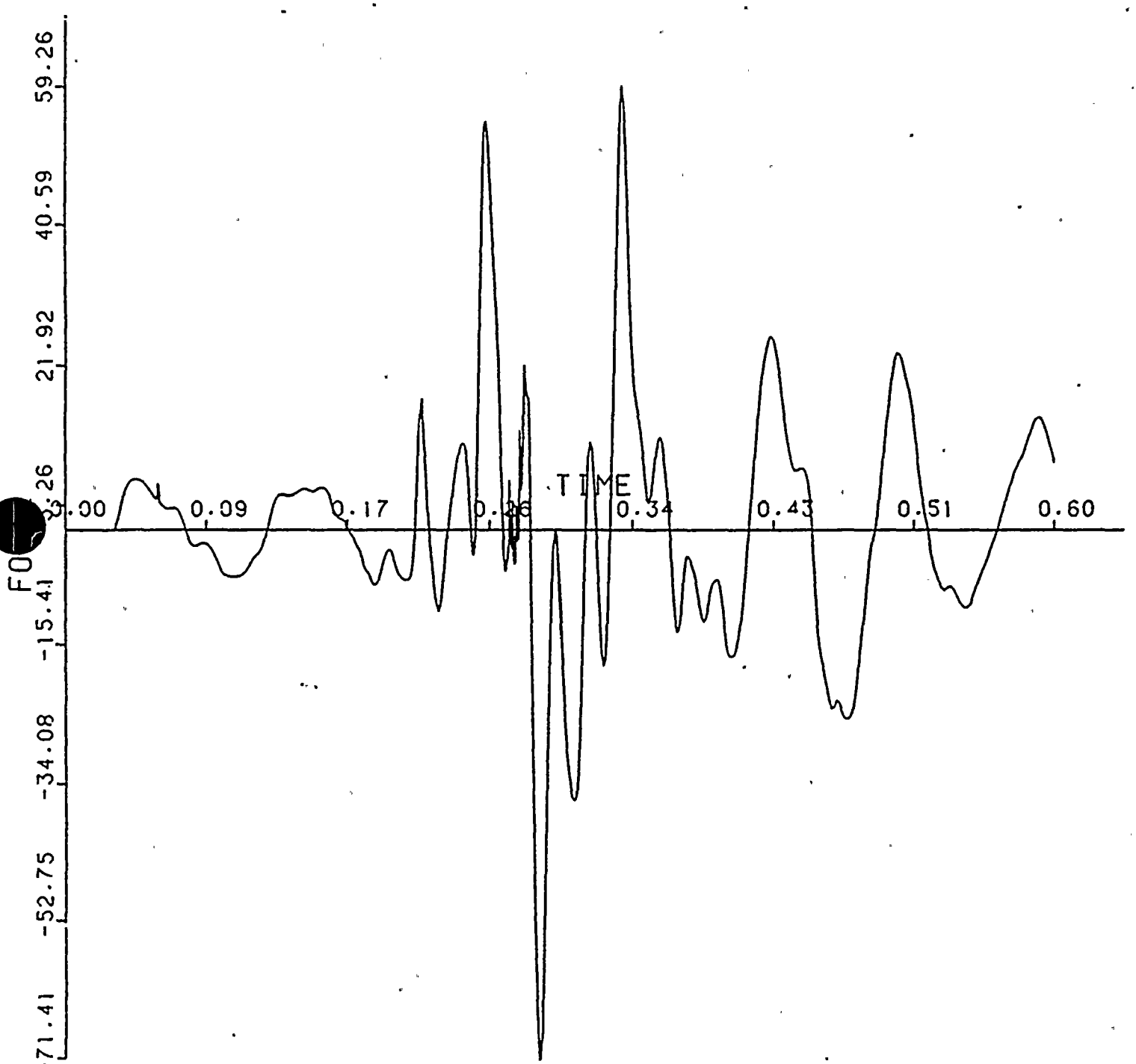
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 4. MAGNITUDE AT NODE POINT 102



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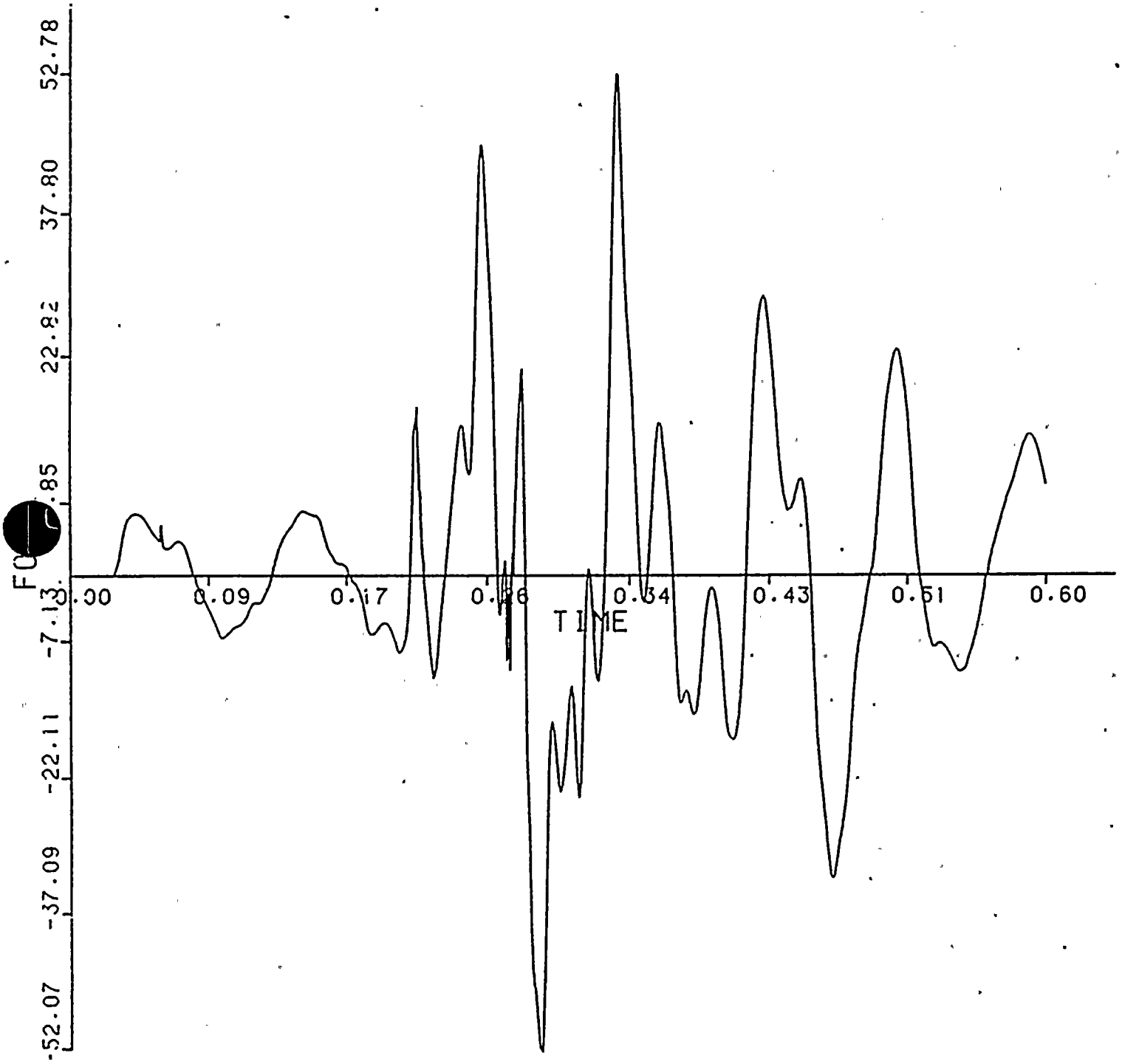
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 5, MAGNITUDE AT NODE POINT 100



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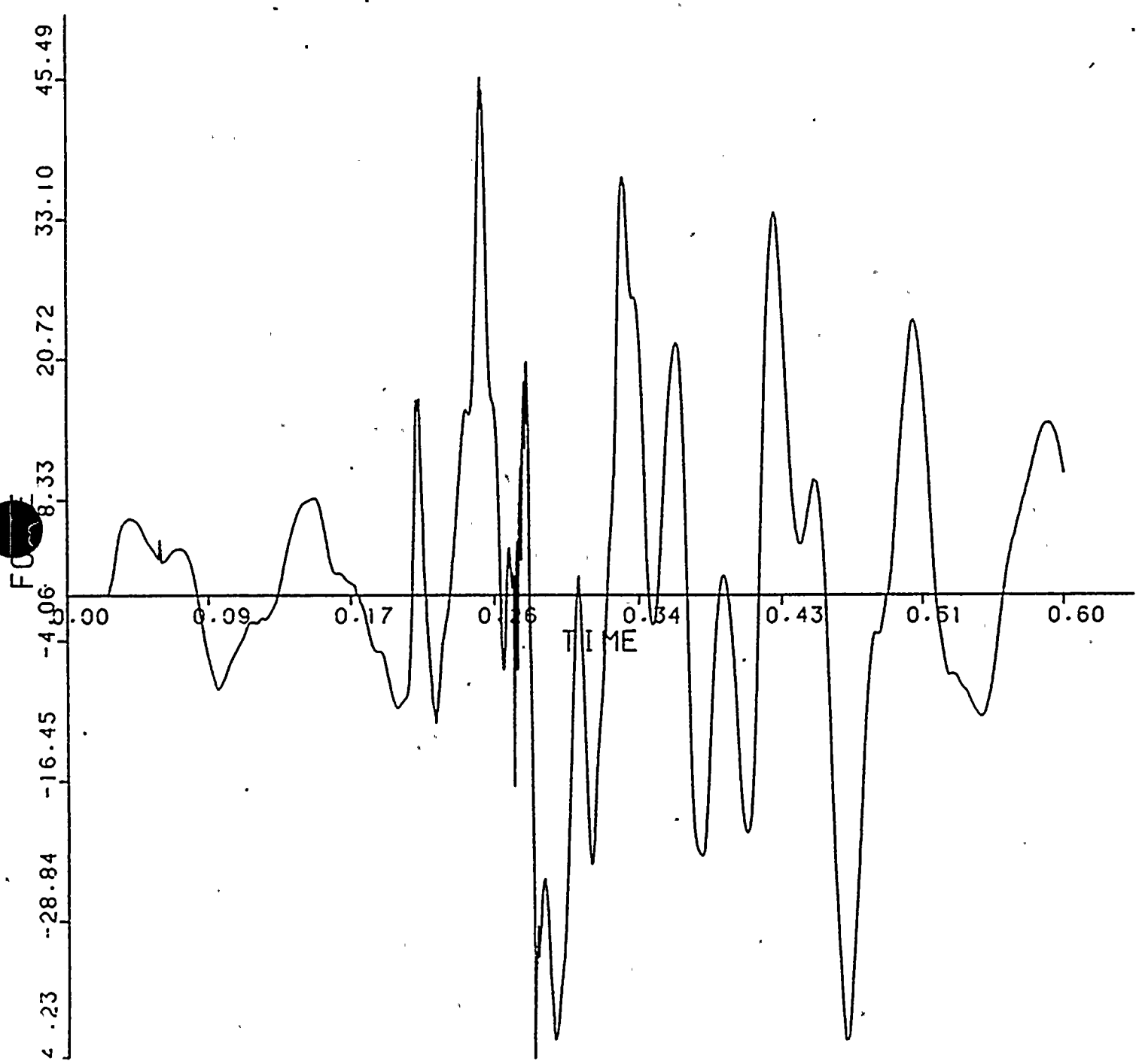
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 6. MAGNITUDE AT NODE POINT 99



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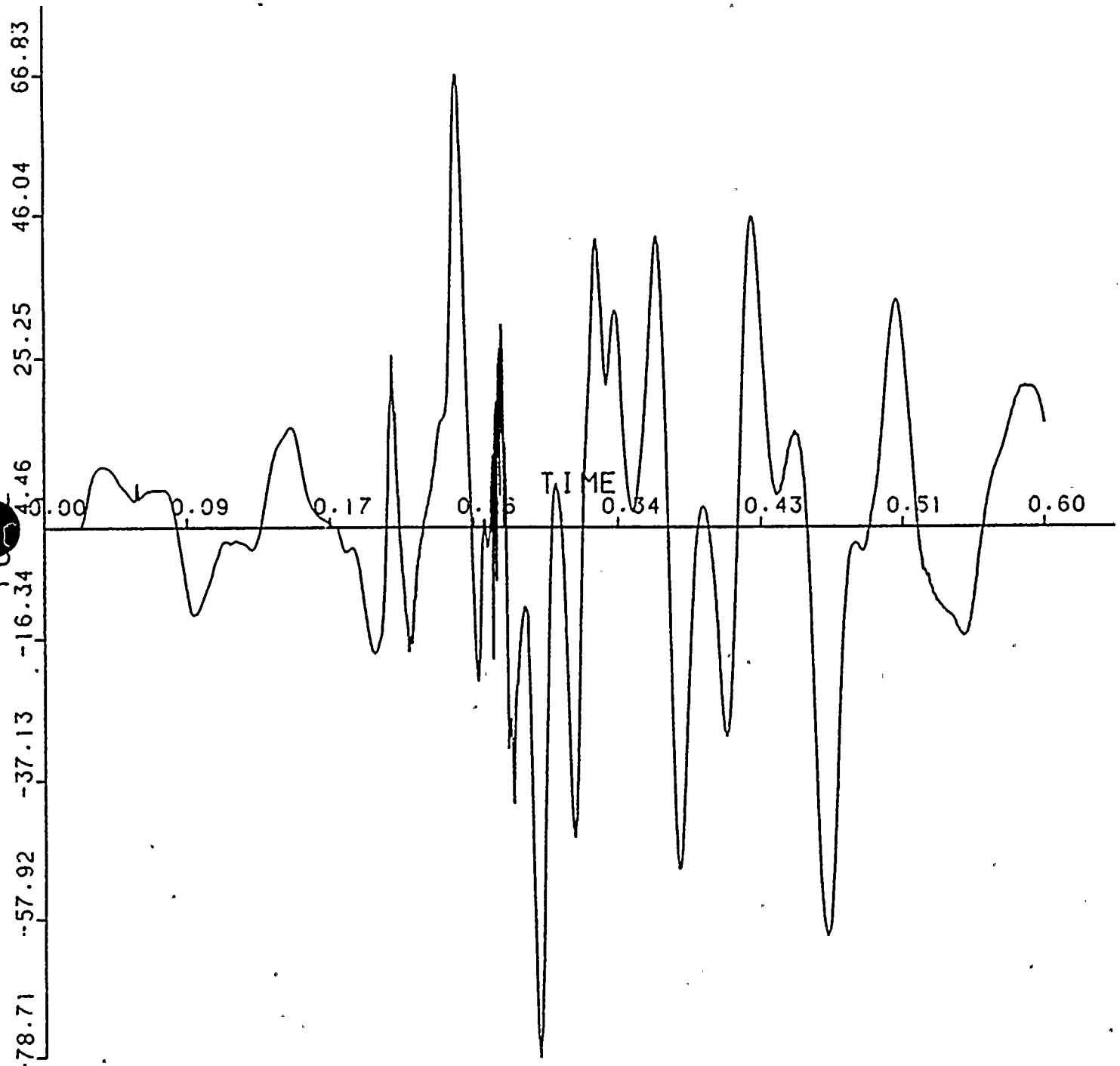
SAP4SAP VERIFICATION 5364 12 MAY 83

YELLOW LOOP SEAL - YELLPSL.IMP
TIME/FORCE TABLE 7, MAGNITUDE AT NODE POINT . 98



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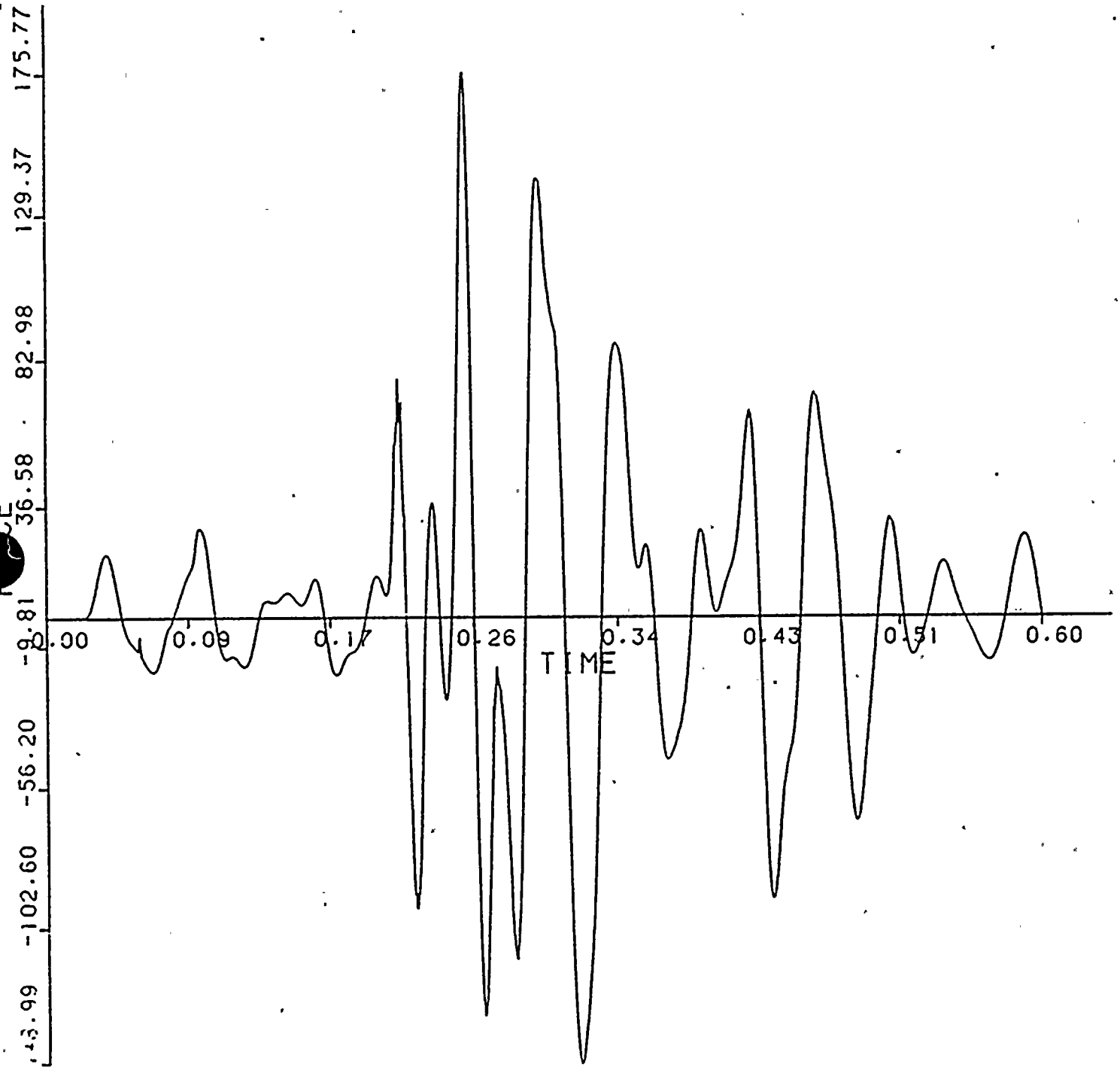
YELLOW LOOP SEAL - YELLPSL.TMP

TIME/FORCE TABLE 8. MAGNITUDE AT NODE POINT 216



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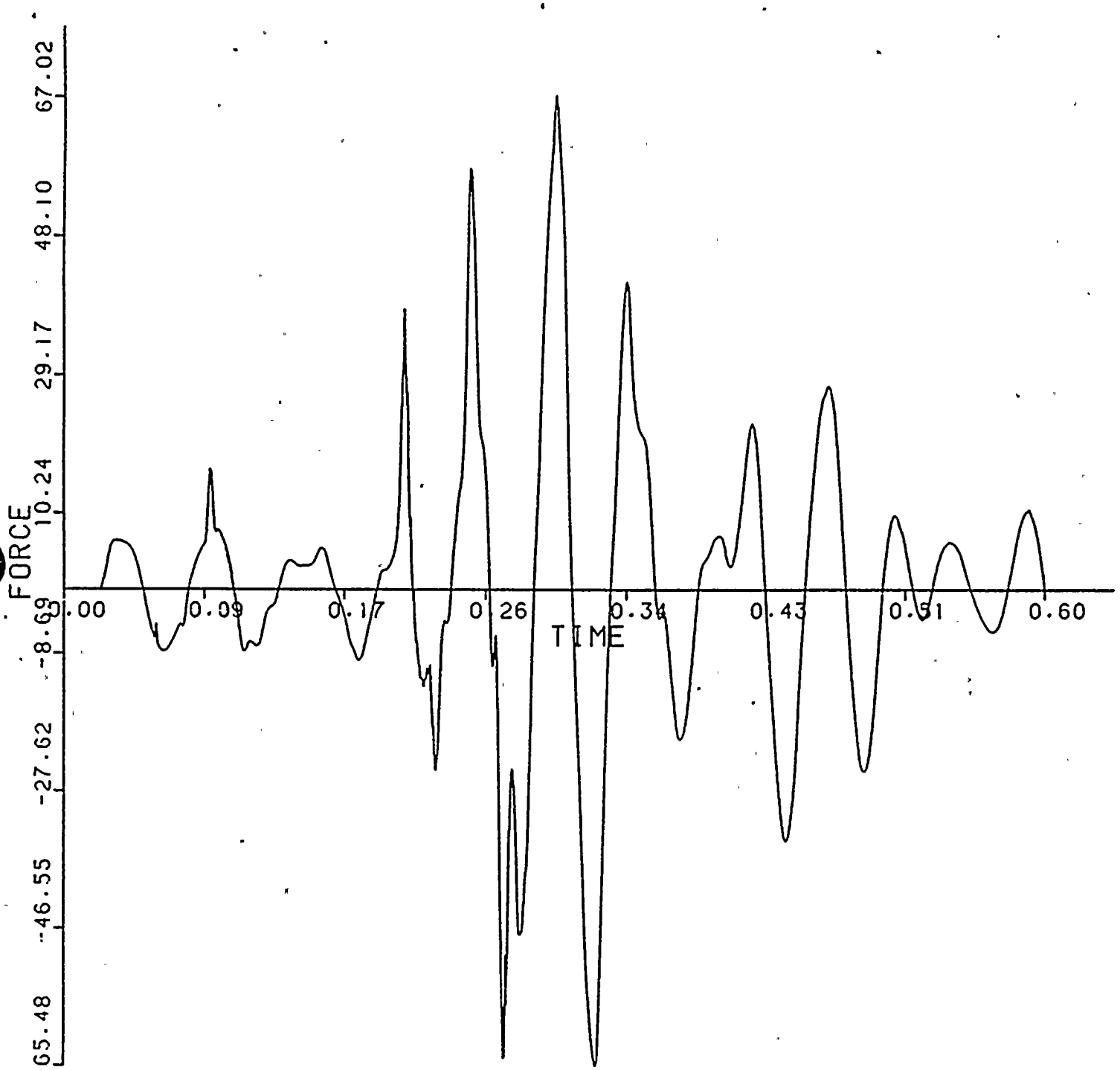
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 9. MAGNITUDE AT NODE POINT 214



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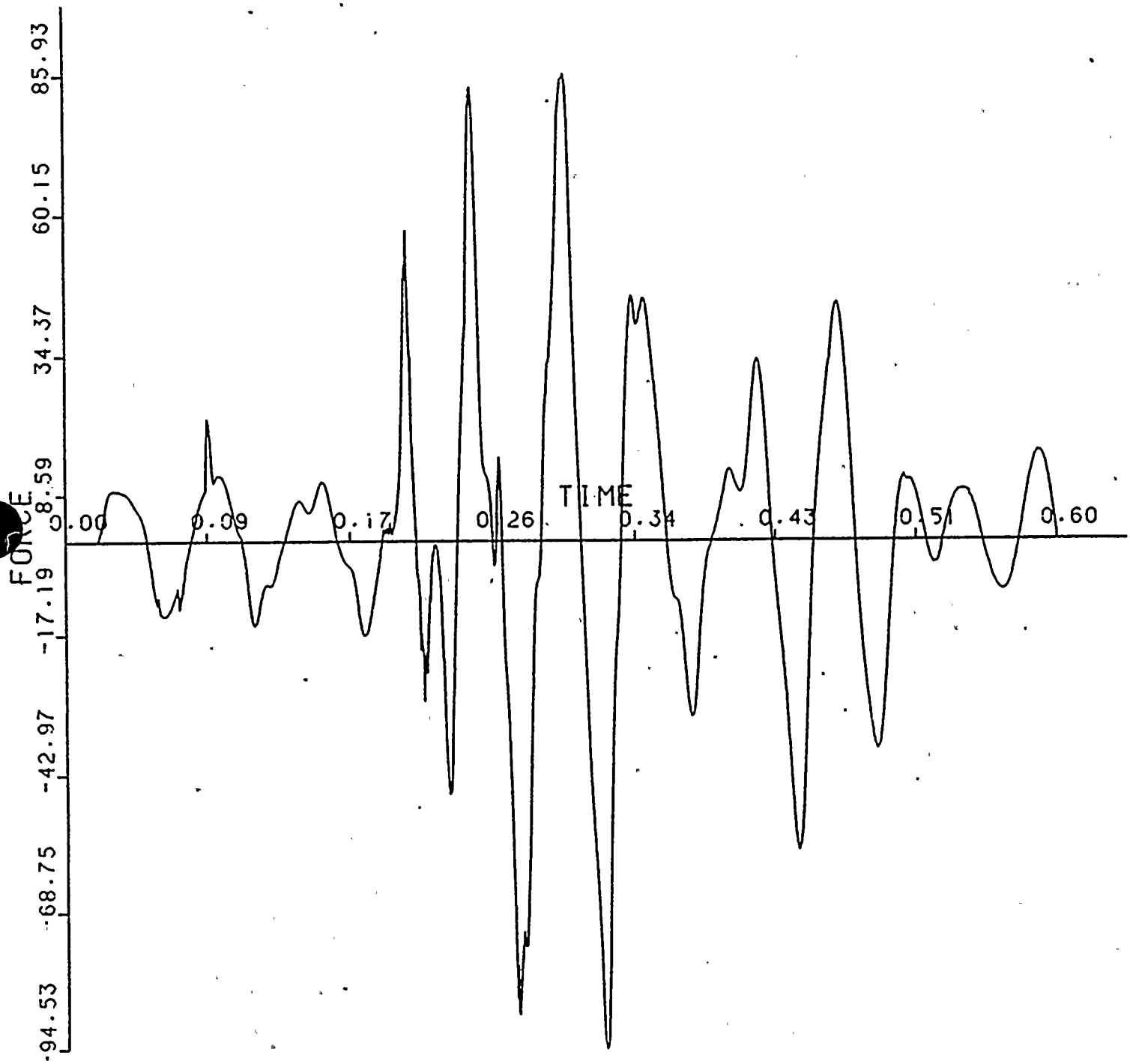
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 10. MAGNITUDE AT NODE POINT 208



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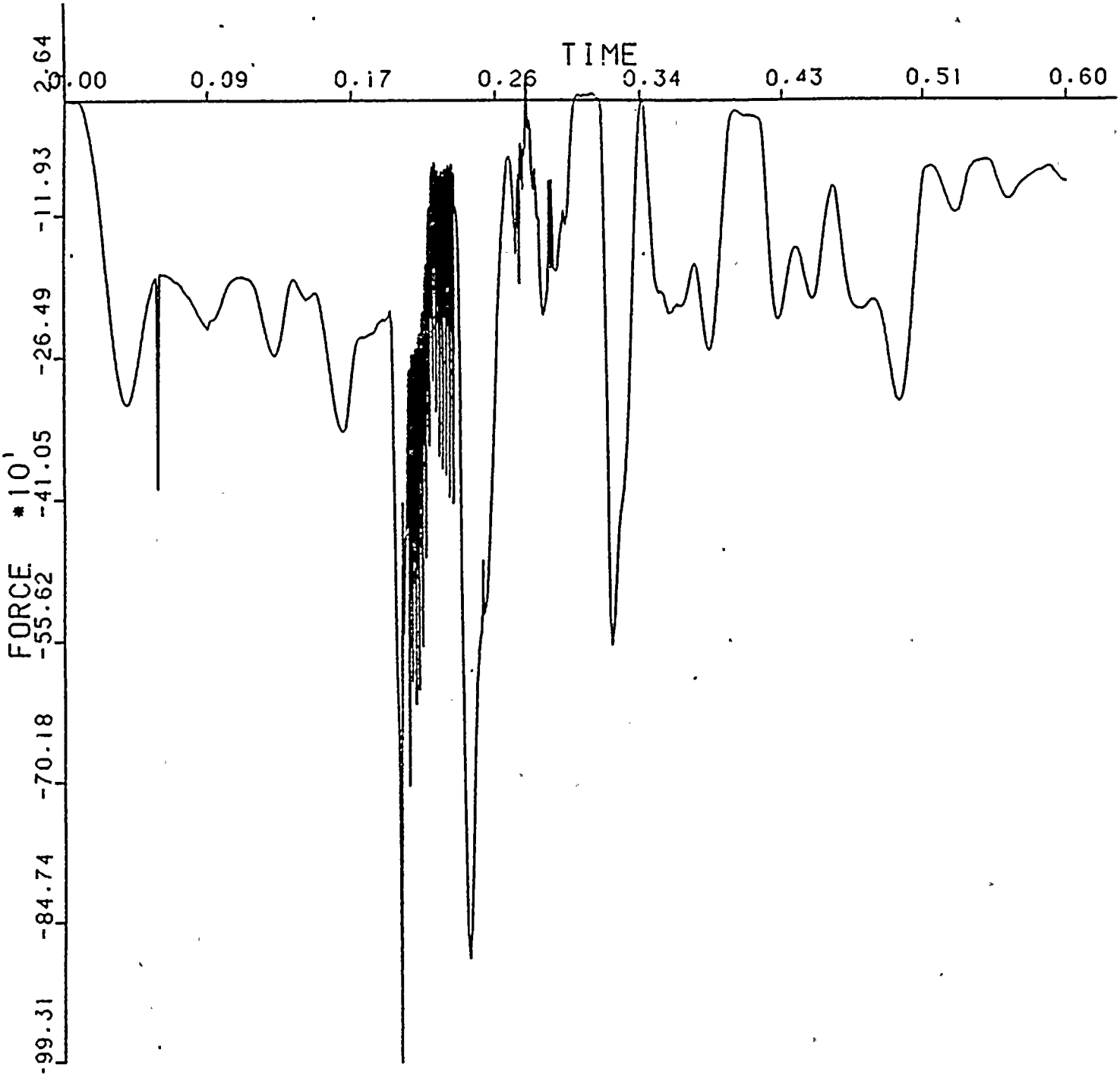
YELLOW LOOP SEAL - YELLPSL.TMP

TIME/FORCE TABLE 11. MAGNITUDE AT NODE POINT 280



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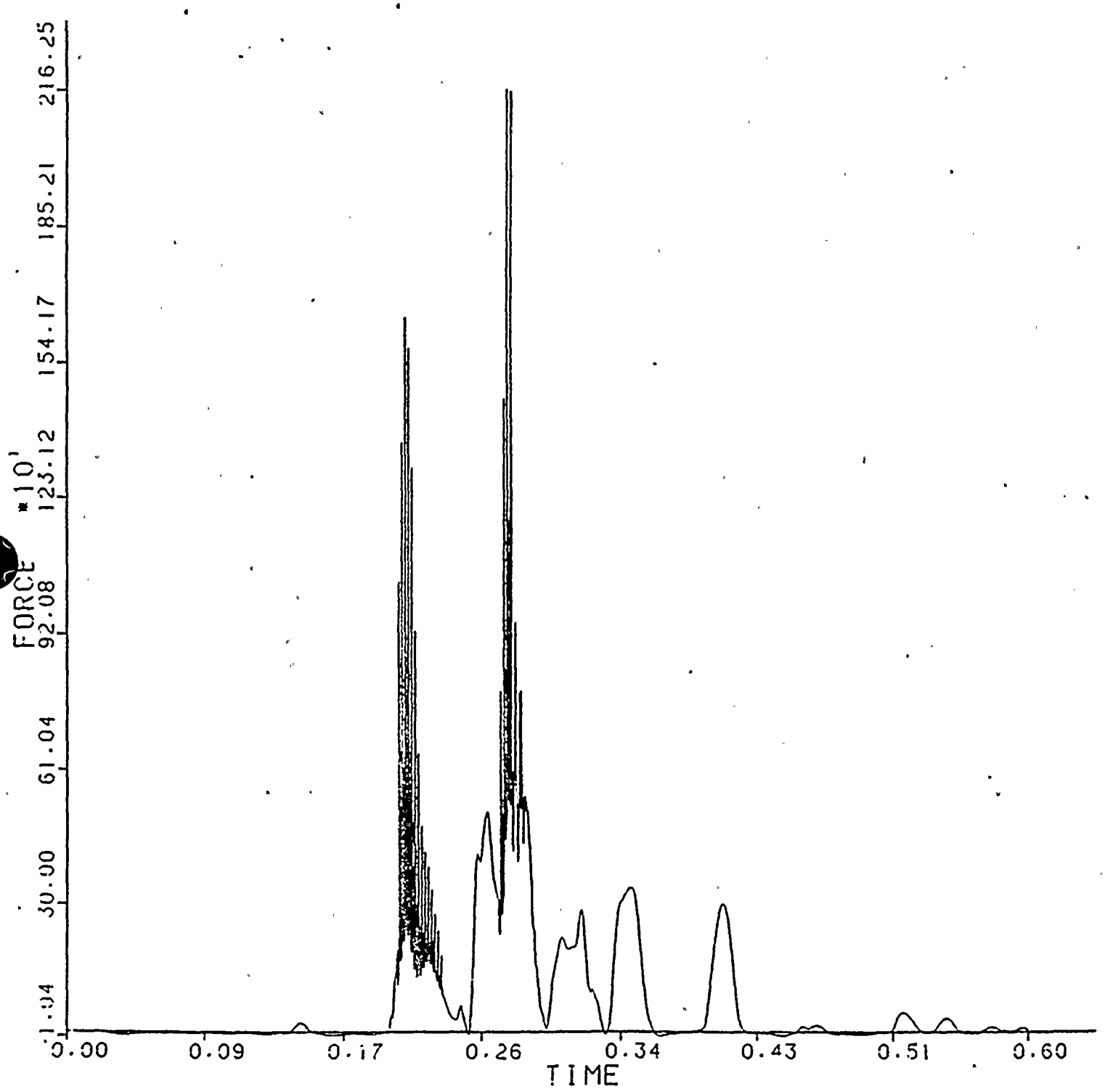
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 12. MAGNITUDE AT NODE POINT 142



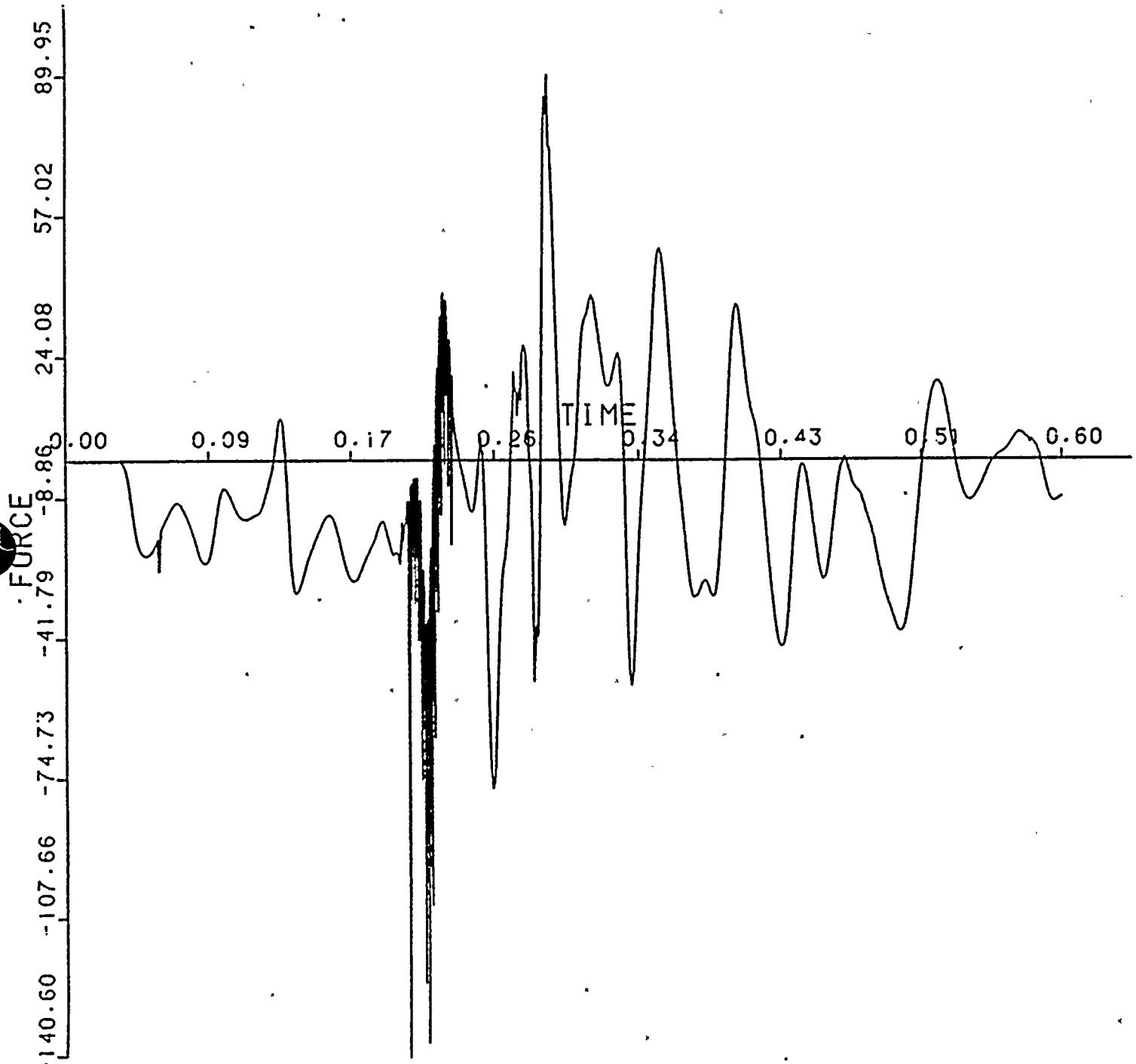
DONE BY: MR DATE: 5-12-83
CHKD BY: MR DATE: 5-12-83

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83

YELLOW LOOP SEAL - YELLPSL.TMP

TIME/FORCE TABLE 13. MAGNITUDE AT NODE POINT 88



DONE BY: MR DATE: 5-12-83

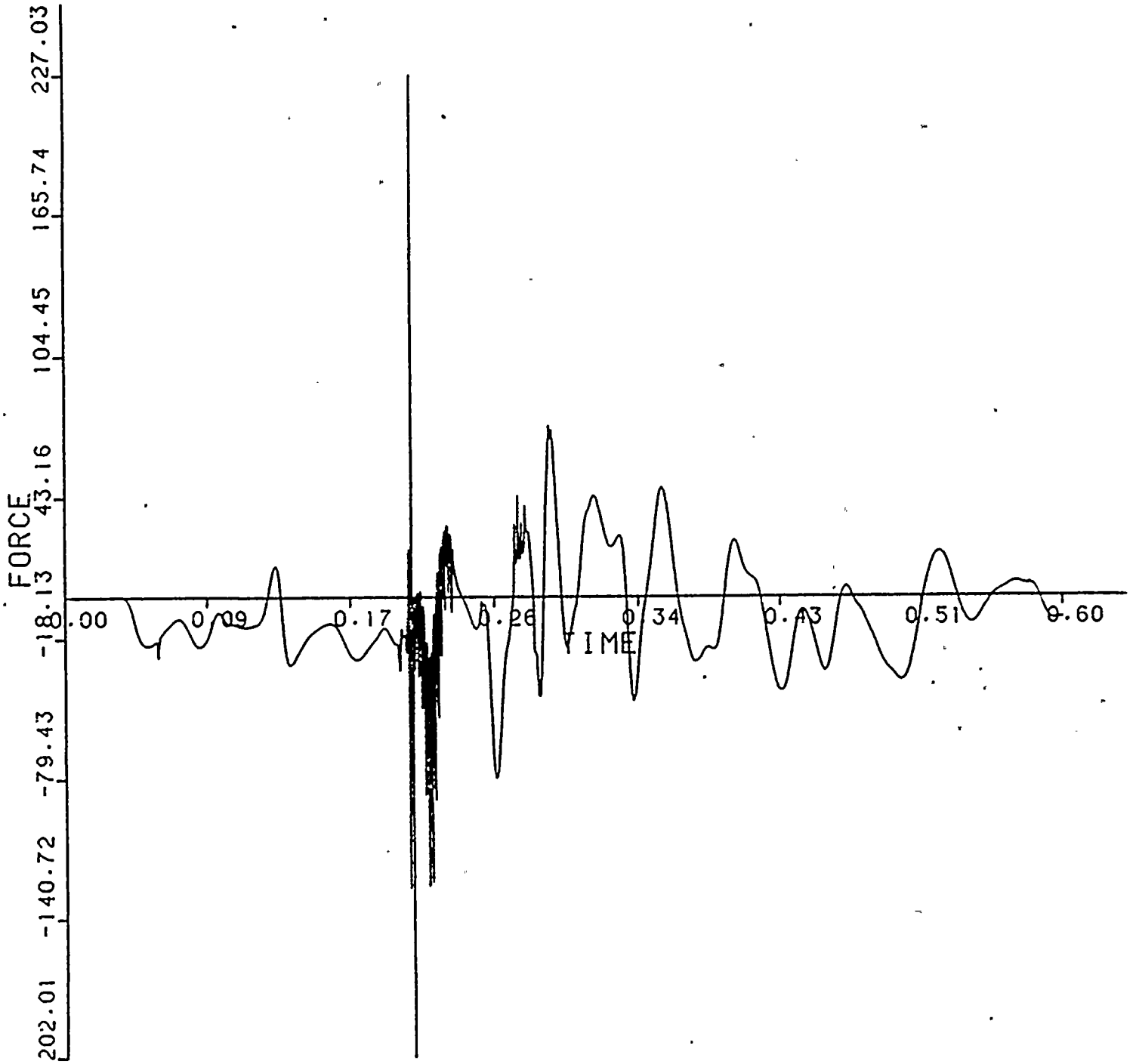
CHKD BY: MLL DATE: 5-12-83

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83

YELLOW LOOP SEAL - YELLPSL.TMP

TIME/FORCE TABLE 14, MAGNITUDE AT NODE POINT 83

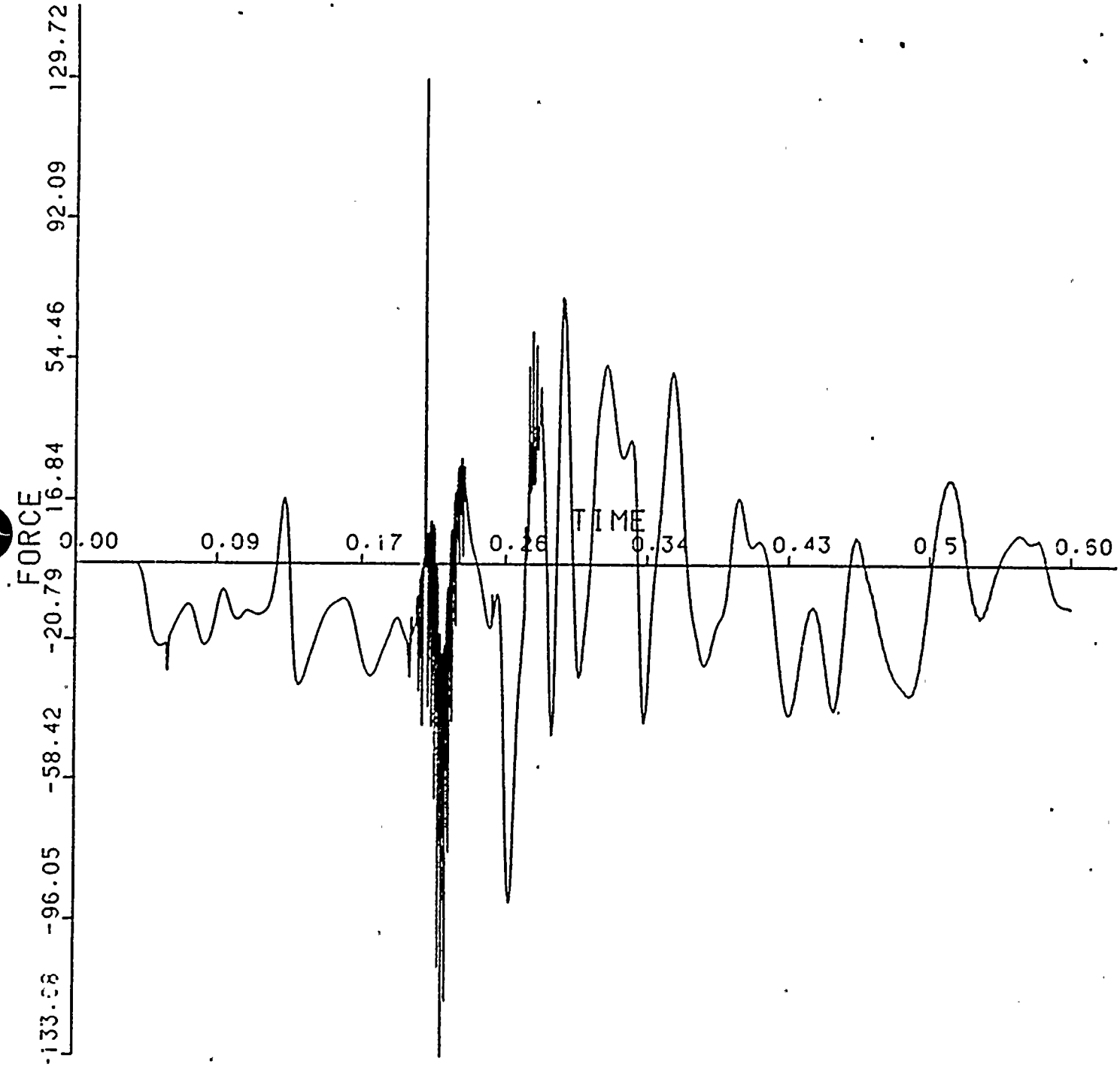


DONE BY: AK DATE: 5-12-83

CHKD BY: AK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
.TIME/FORCE TABLE 15. MAGNITUDE AT NODE POINT 80



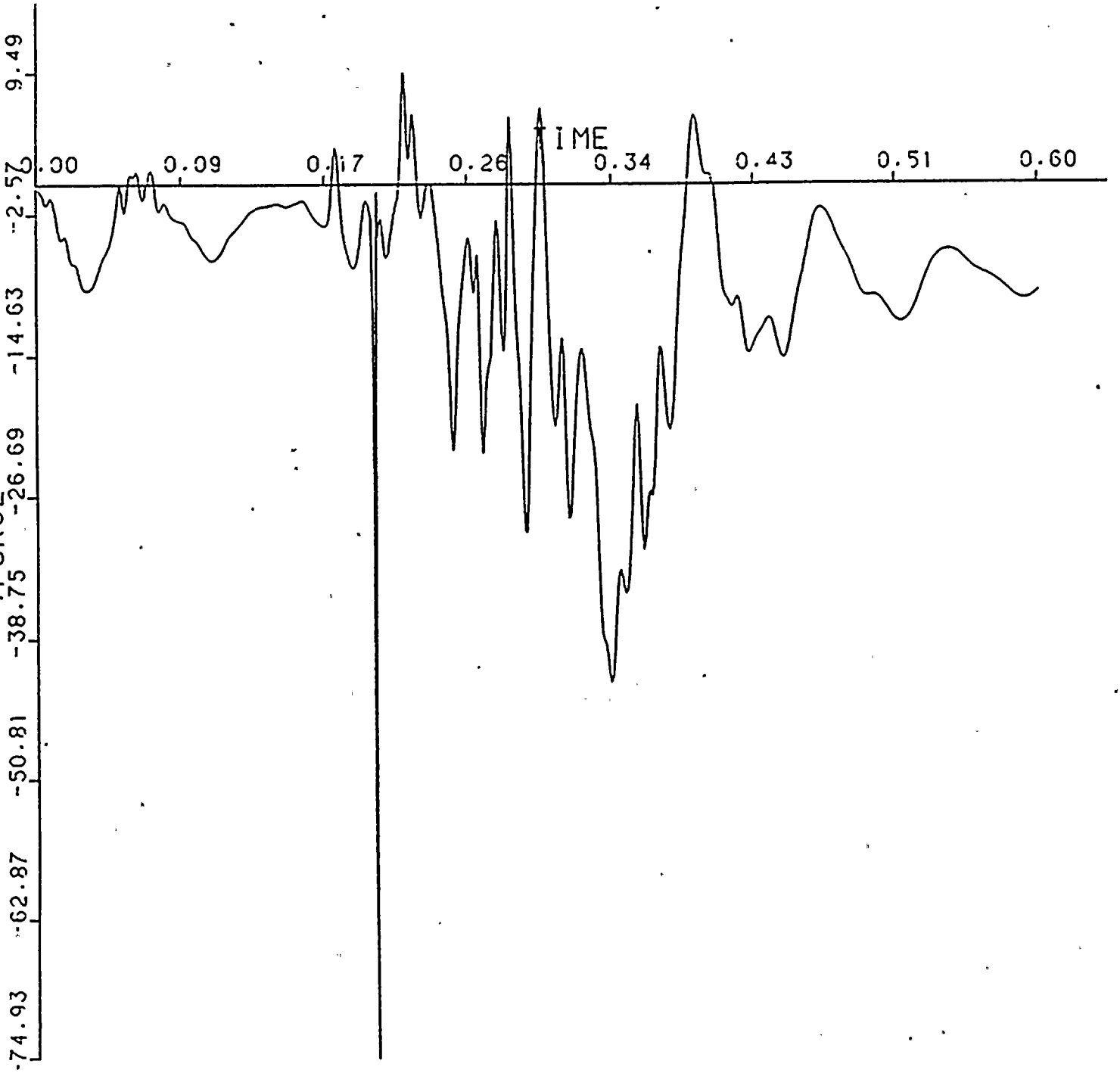
DONE BY: MK DATE: 5-12-83
CHKD BY: WL DATE: 5-13-83

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83

YELLOW LOOP SEAL - YELLPSL.TMP

TIME/FORCE TABLE 16, MAGNITUDE AT NODE POINT 725



DONE BY: MK DATE: 5-12-83

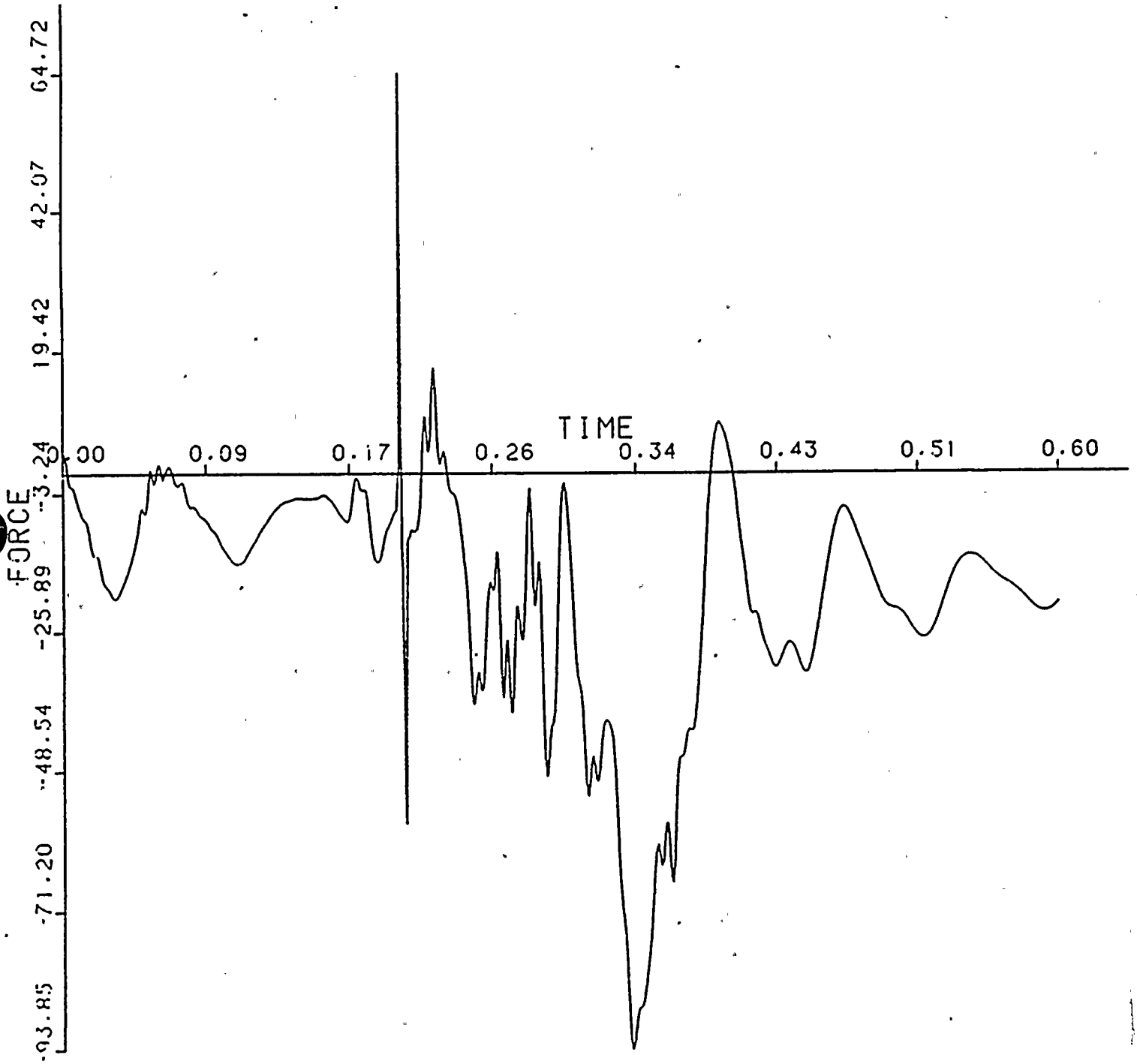
CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP/SAP VERIFICATION [illegible] MAY 83

YELLOW LOOP SEAL YELLOW LOOP

[illegible] 717



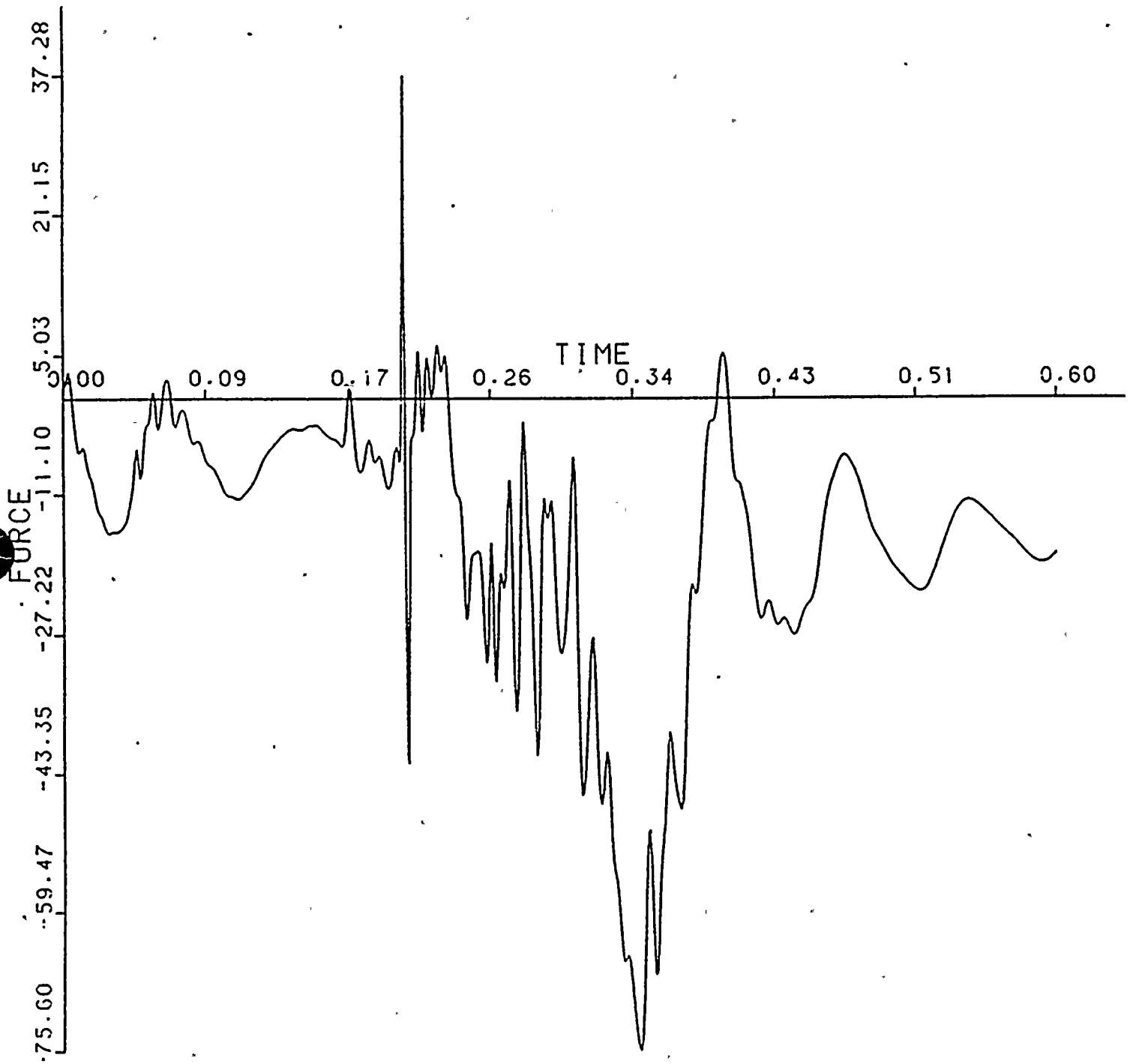
DONE BY: MK DATE: 5-12-83
CHKD BY: [illegible] DATE: 5-12-83

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83

YELLOW LOOP SEAL - YELLPSL.TMP

TIME/FORCE TABLE 18. MAGNITUDE AT NODE POINT 710

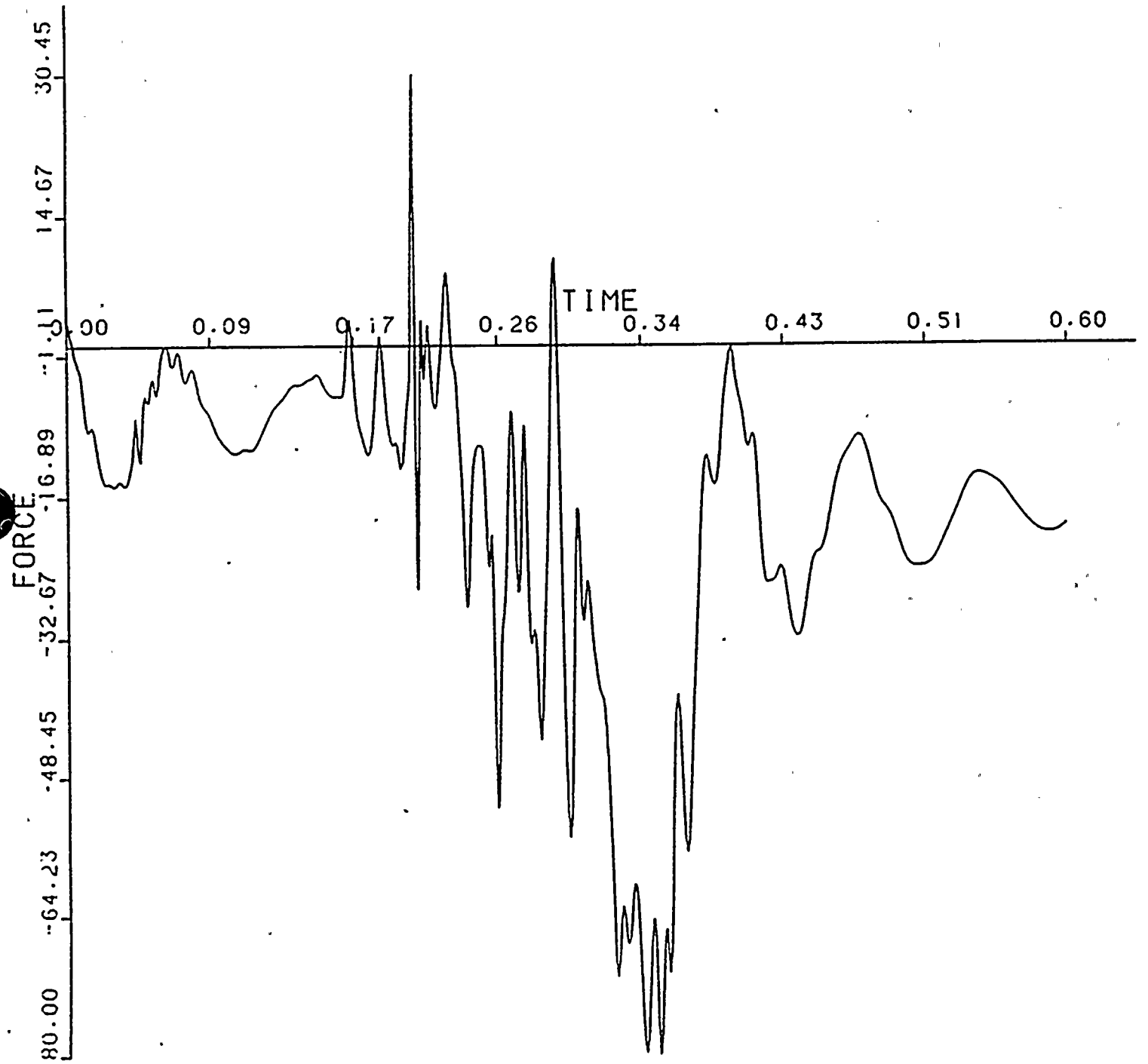


DONE BY: AK DATE: 5-12-83

CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 19. MAGNITUDE AT NODE POINT 680

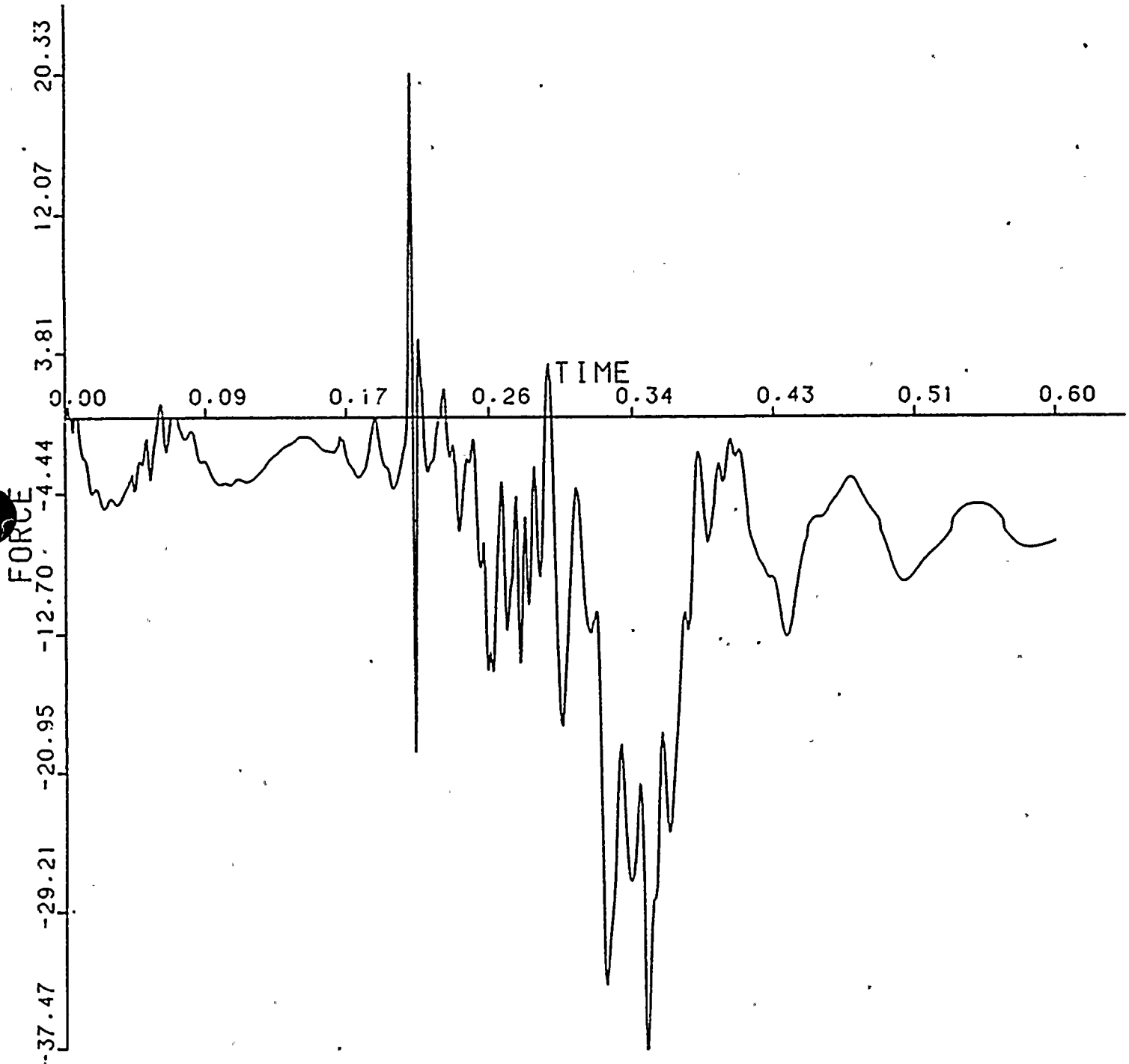


DONE BY: MK DATE: 5-12-83
CHKD BY: WL DATE: 5-12-83

Technical Report
TR-5364-1
Revision 0

TELEDYNE
ENGINEERING SERVICES

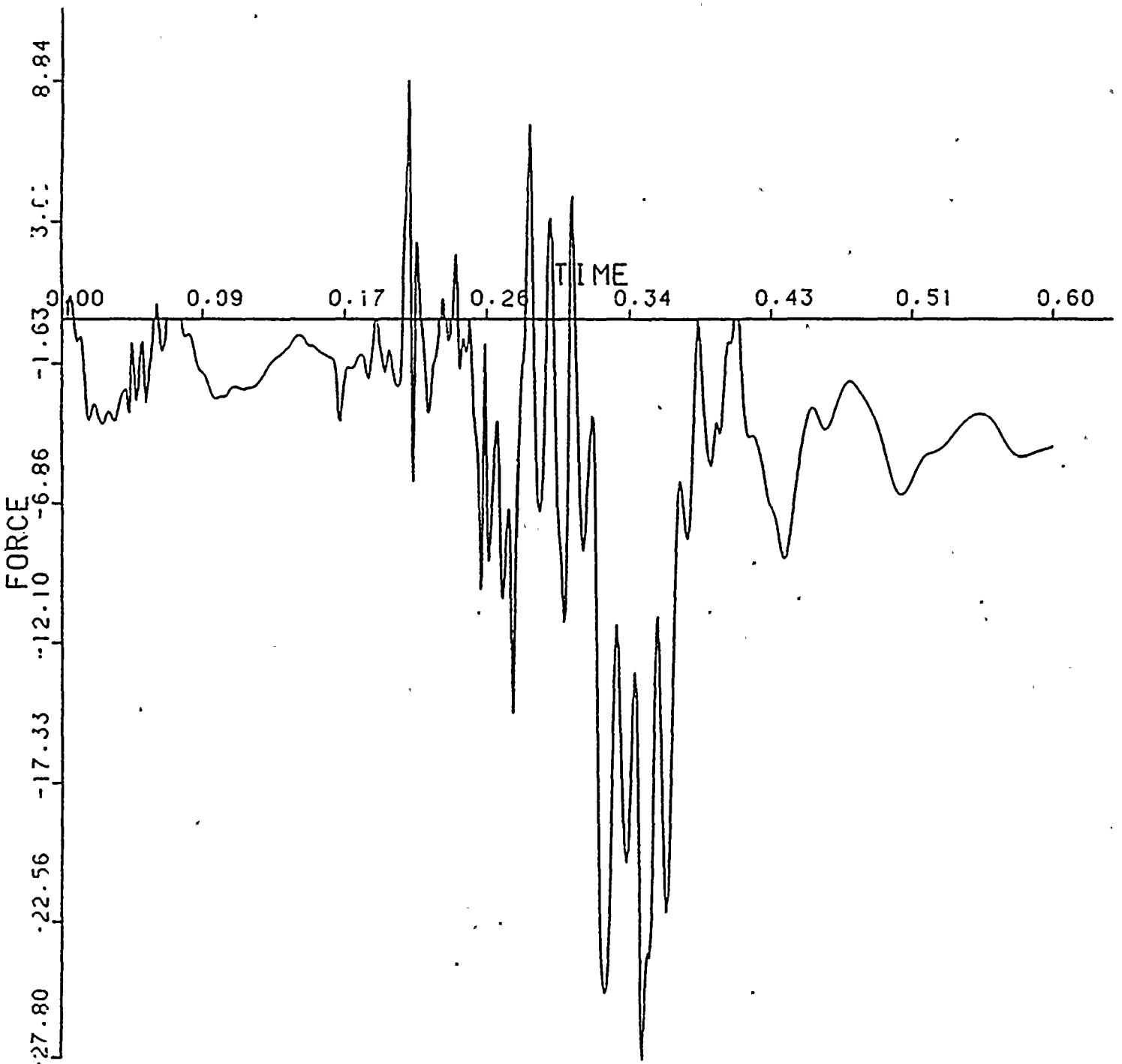
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 20, MAGNITUDE AT NODE POINT 600



DONE BY: MC DATE: 5-12-83
CHKD BY: MC DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

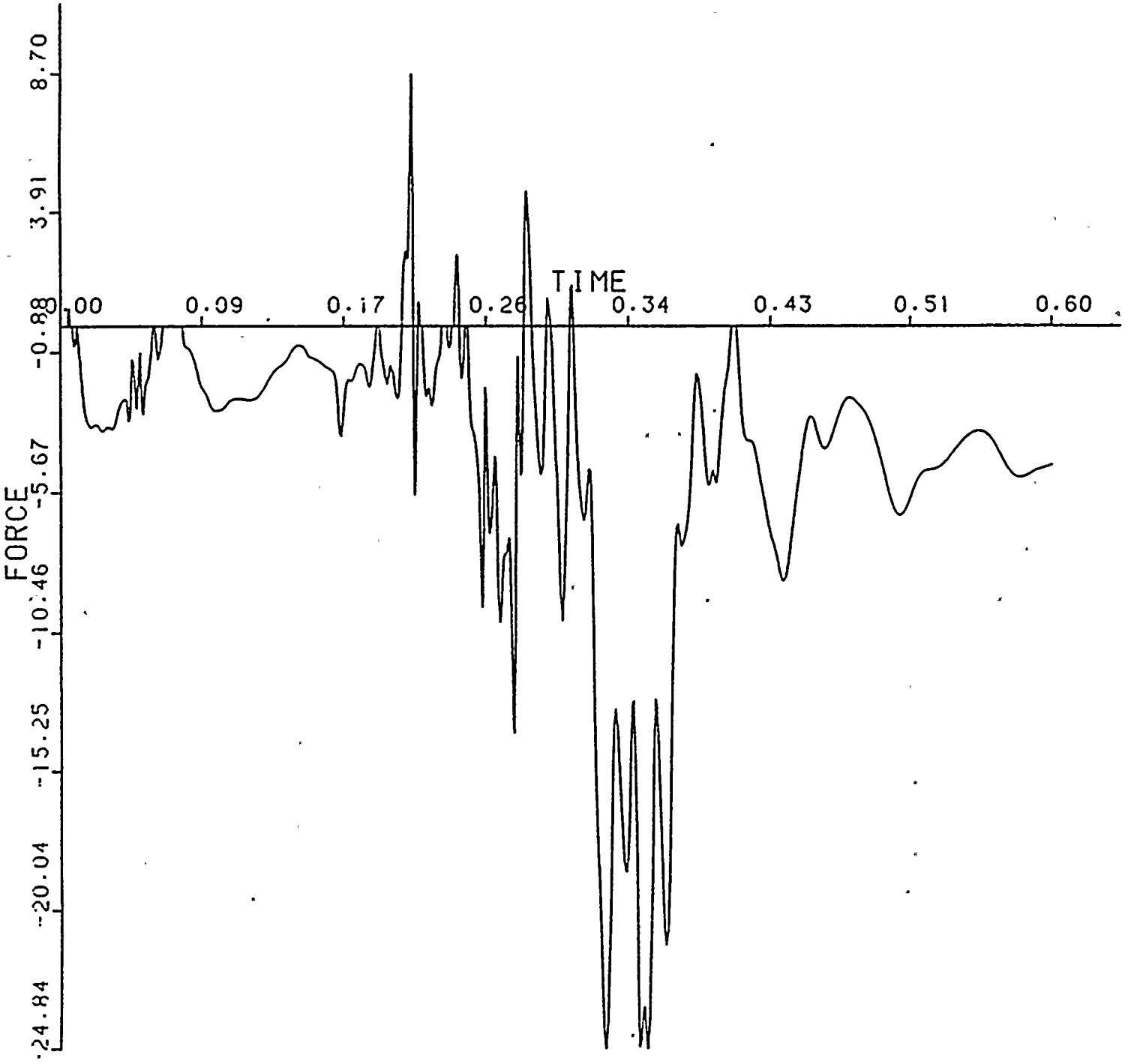
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 21. MAGNITUDE AT NODE POINT 590



DONE BY: MR DATE: 5-12-83
CHKD BY: MM DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 22. MAGNITUDE AT NODE POINT 585

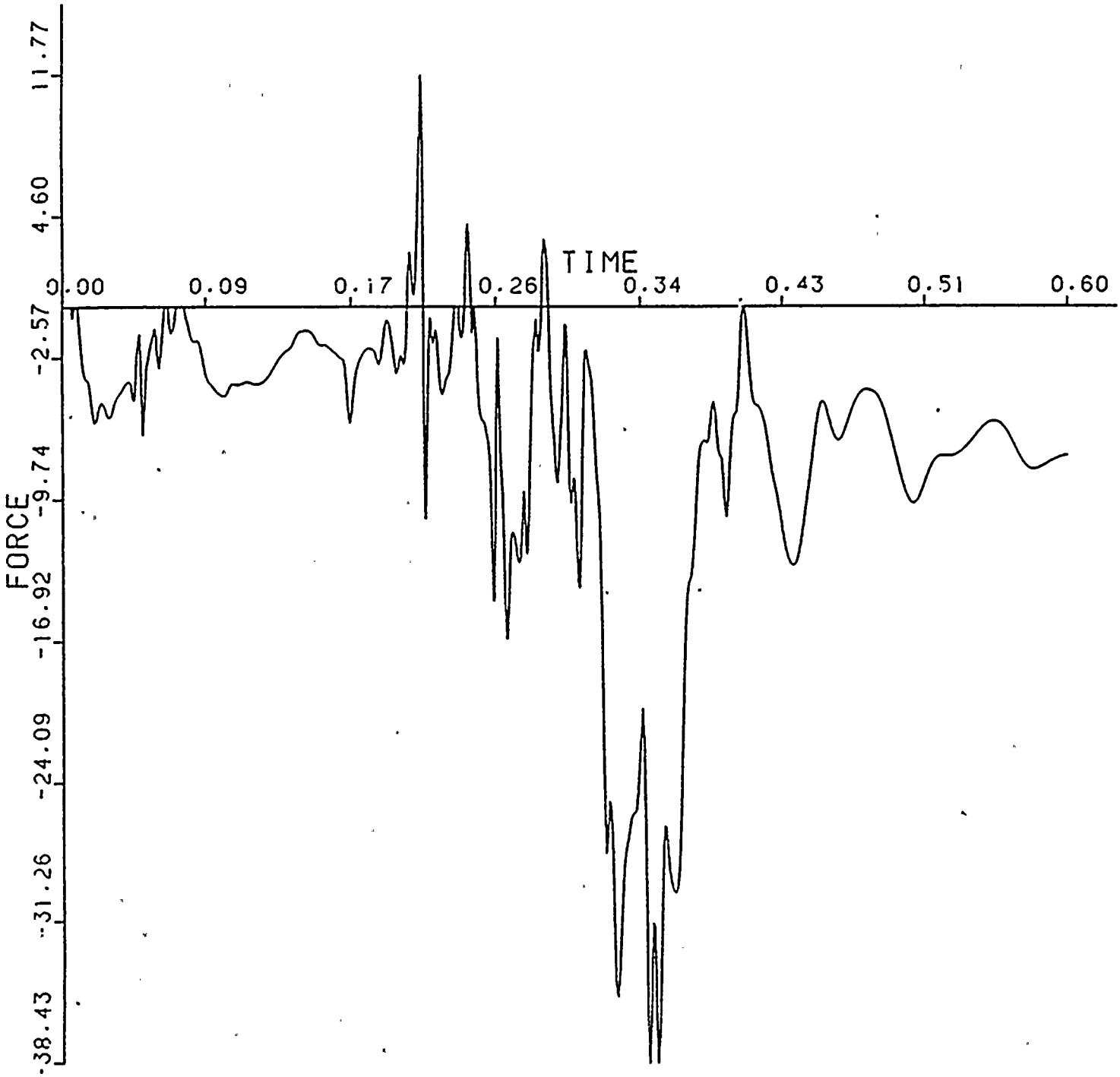


DONE BY: MC DATE: 5-12-83
CHKD BY: MC DATE: 5-12-83

Technical Report
TR-5364-1
Revision 0

ANATECH
ENGINEERING SERVICES

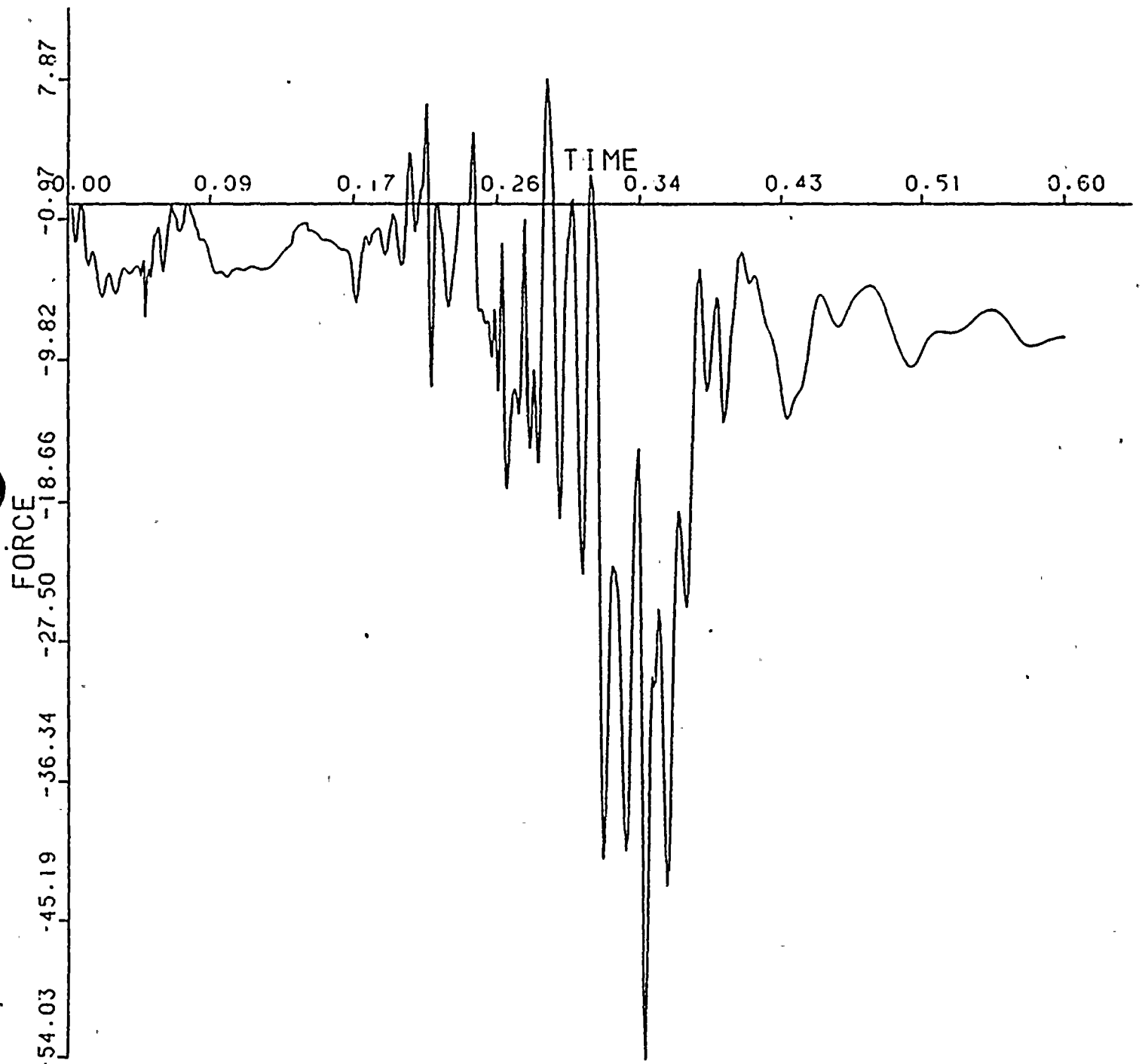
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 23, MAGNITUDE AT NODE POINT 575



DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 24, MAGNITUDE AT NODE POINT 435



DONE BY: MK DATE: 5-12-83
CHKD BY: LL DATE: 5-13-83

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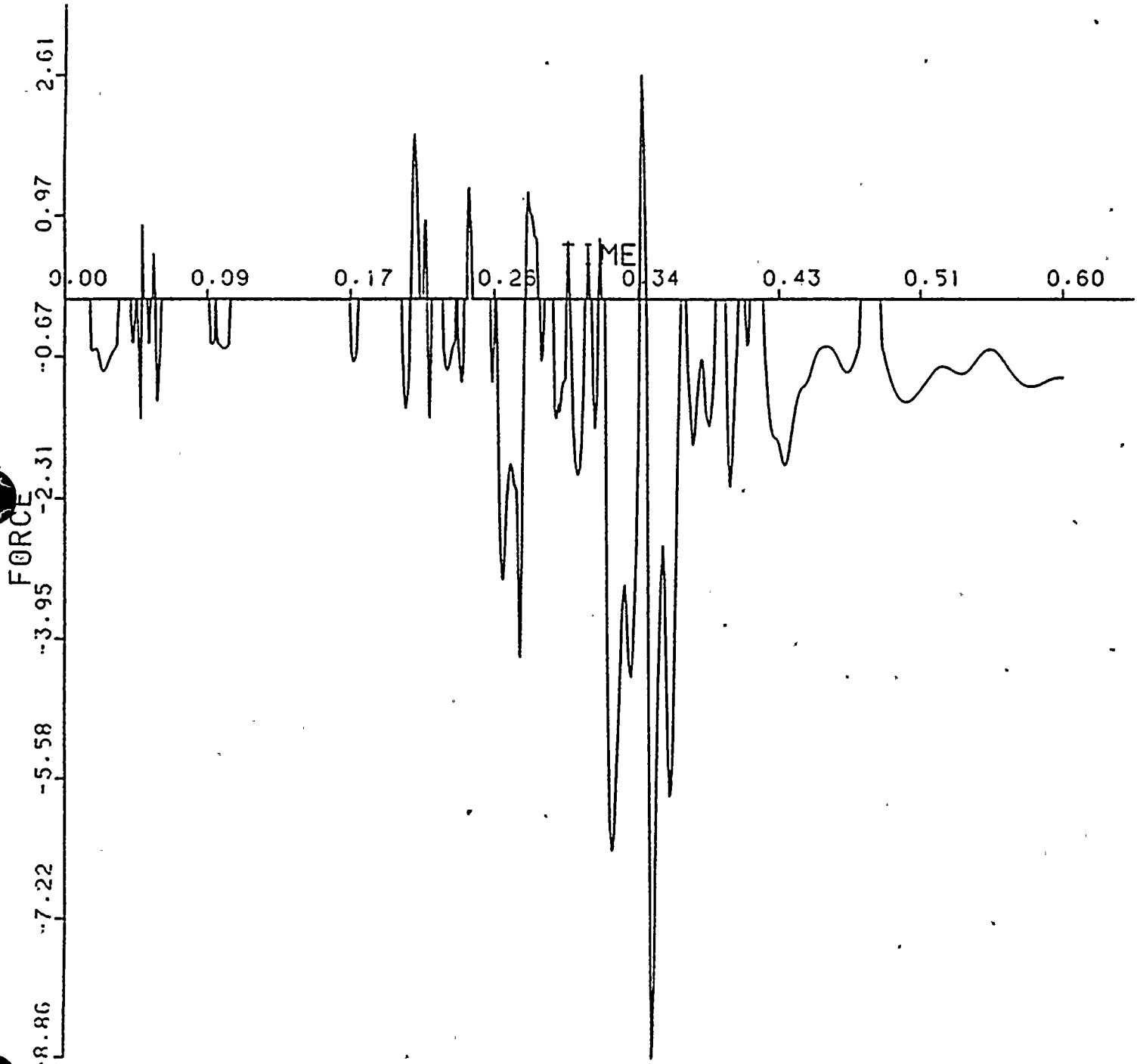
ENGINEERING SERVICES

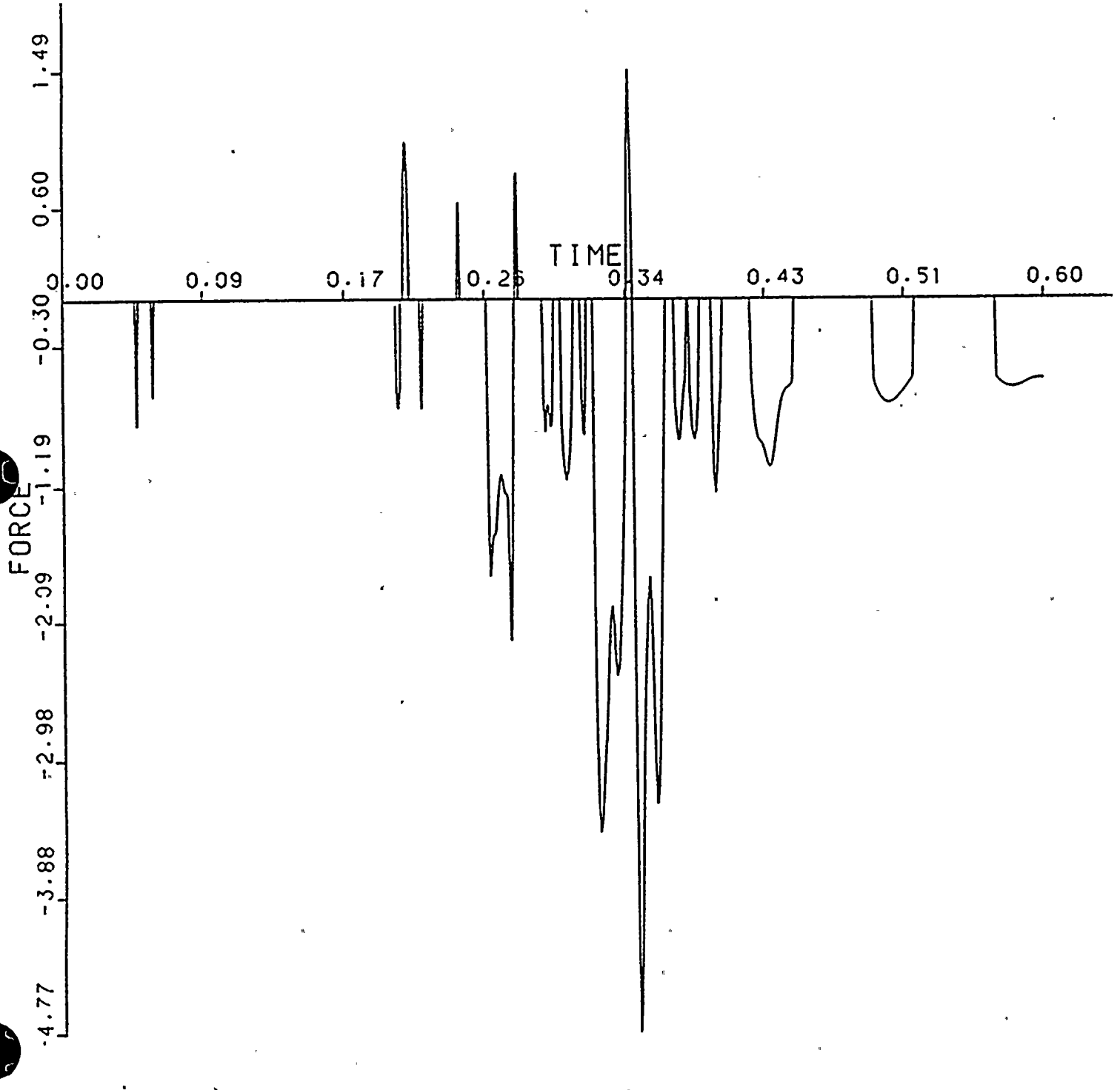
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 25. MAGNITUDE AT NODE POINT 440



DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

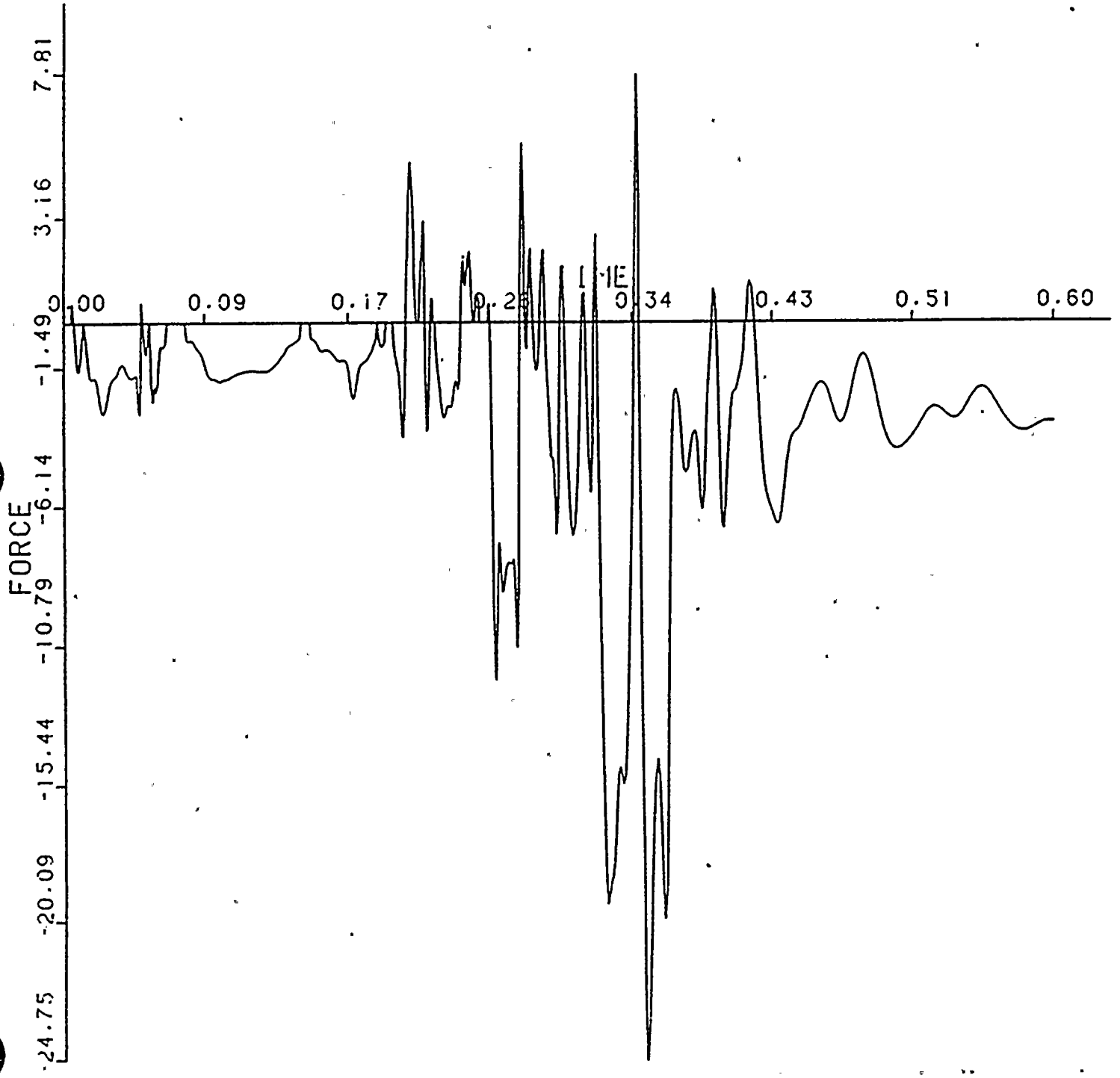
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 26. MAGNITUDE AT NODE POINT 450



DONE BY: MR DATE: 5-12-83
CHKD BY: WL DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 27. MAGNITUDE AT NODE POINT. 460



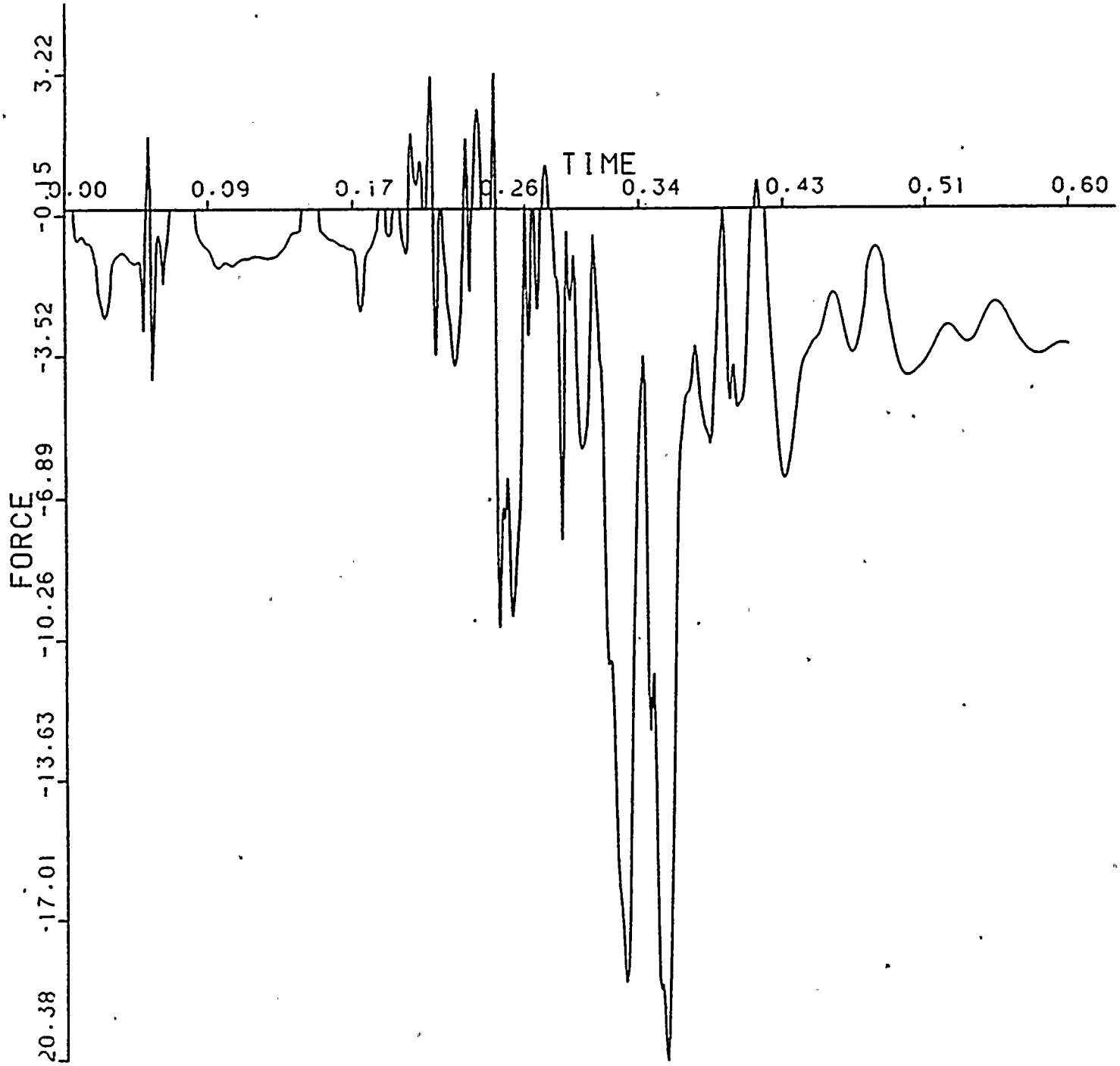
DONE BY: MK DATE: 5-12-83
CHKD BY: LL DATE: 5-12-83

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83

YELLOW LOOP SEAL - YELLPSL.TMP

TIME/FORCE TABLE 28. MAGNITUDE AT NODE POINT . 465

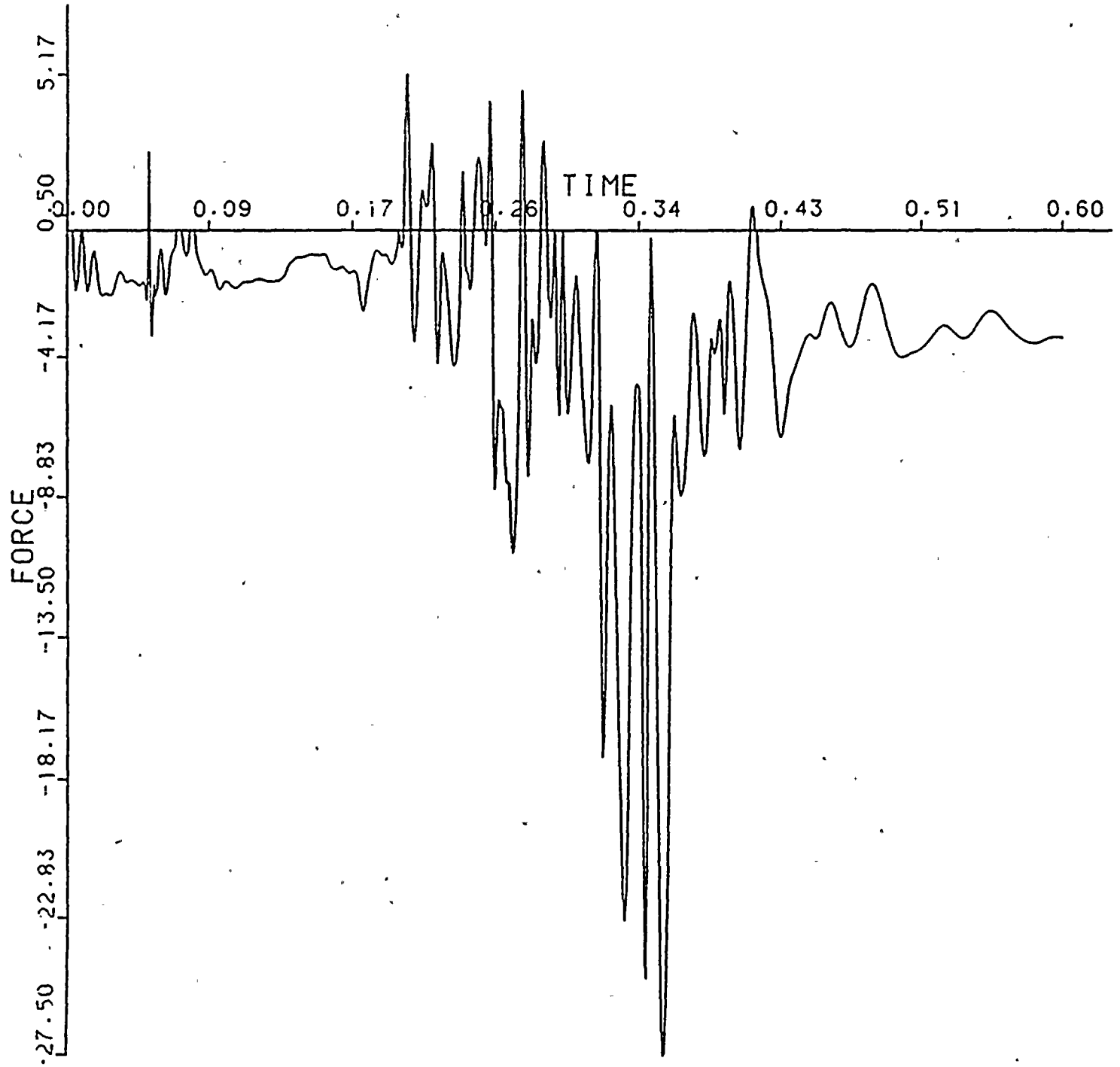


DONE BY: MR DATE: 5-12-83

CHKD BY: MR DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 29. MAGNITUDE AT NODE POINT 475

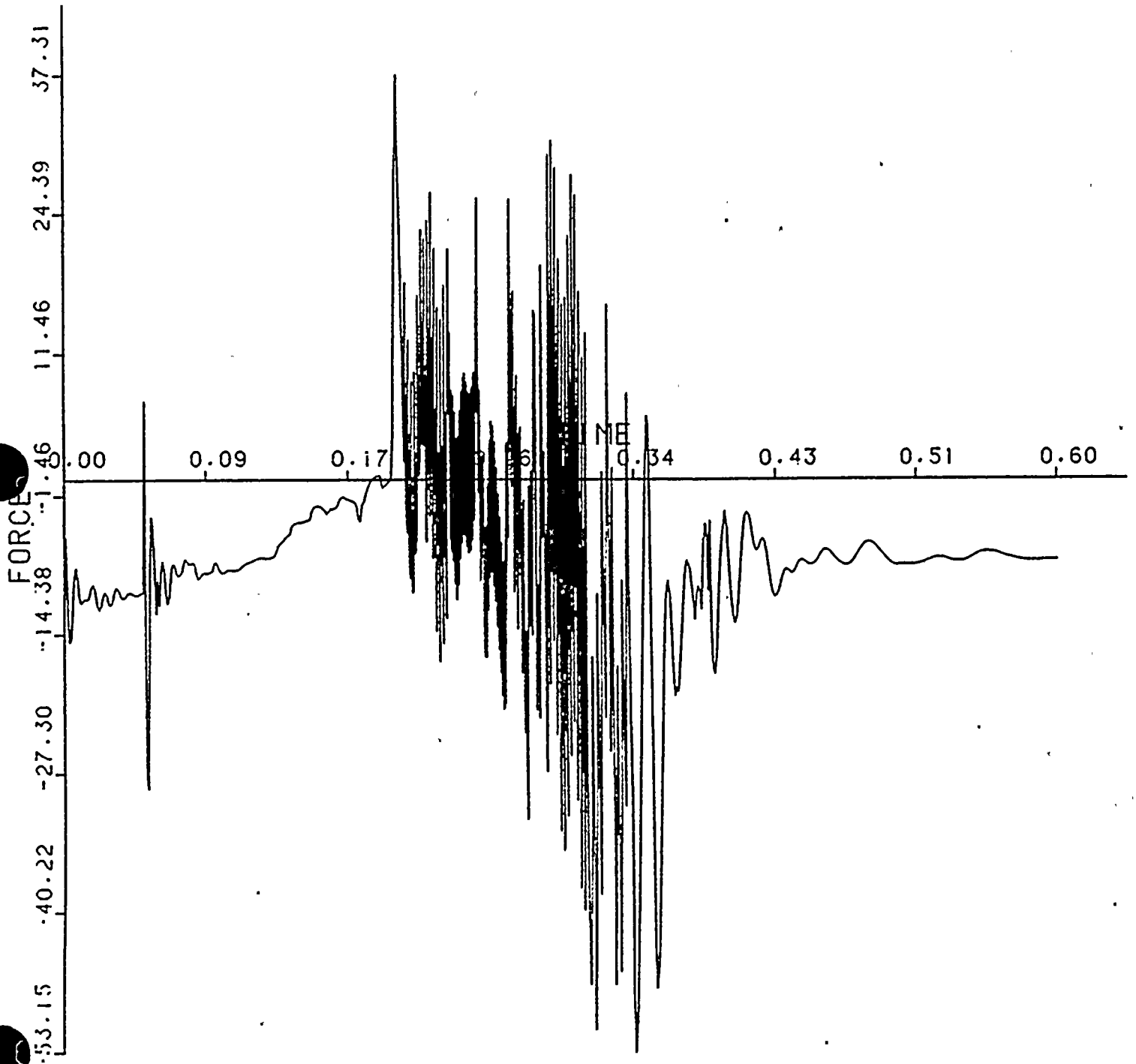


DONE BY: MR DATE: 5-12-83
CHKD BY: MR DATE: 5-12-83

Technical Report
TR-5364-1
Revision 0

TELEDYNE
ENGINEERING SERVICES

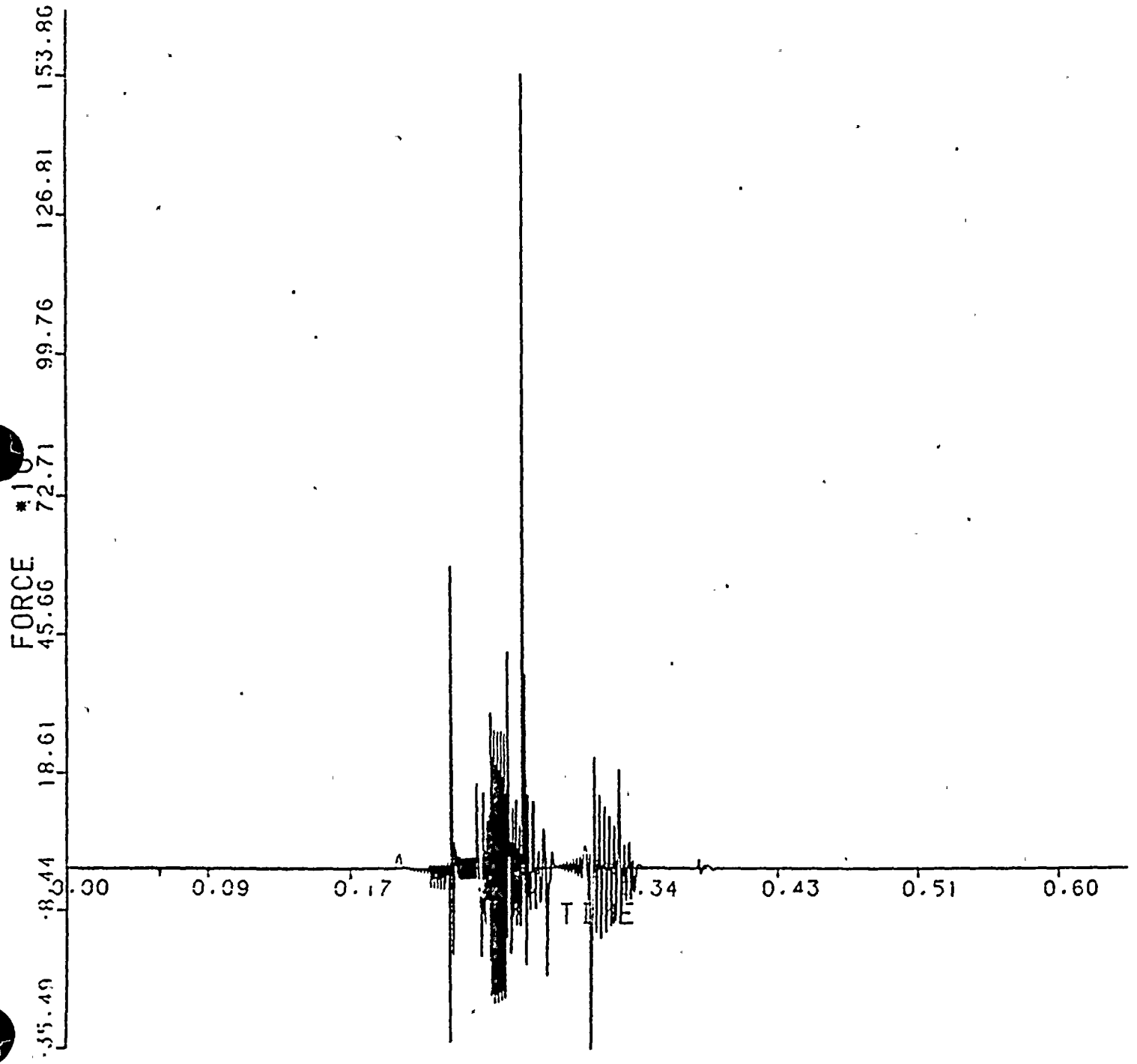
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 30, MAGNITUDE AT NODE POINT 485



DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

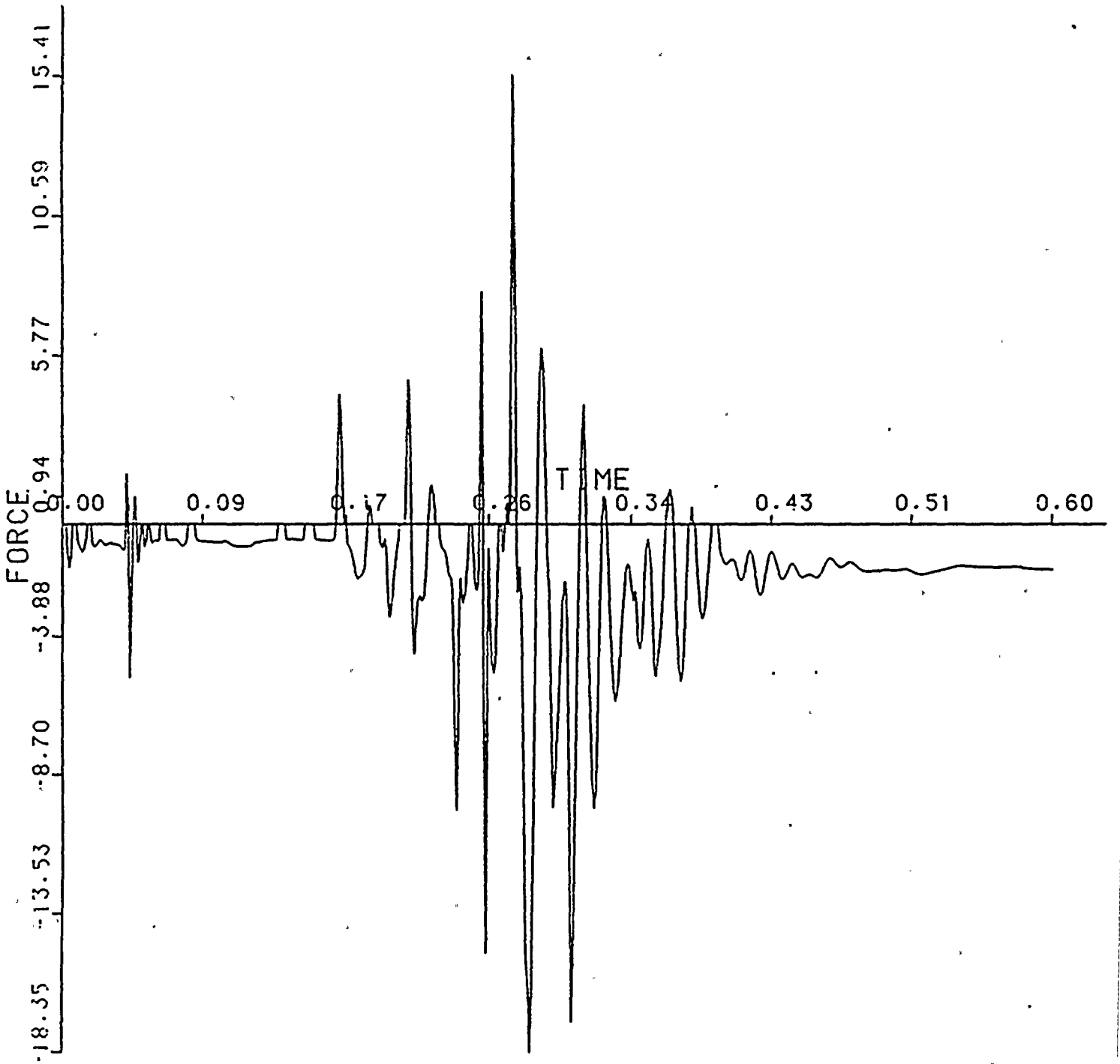
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 31. MAGNITUDE AT NODE POINT 529



DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

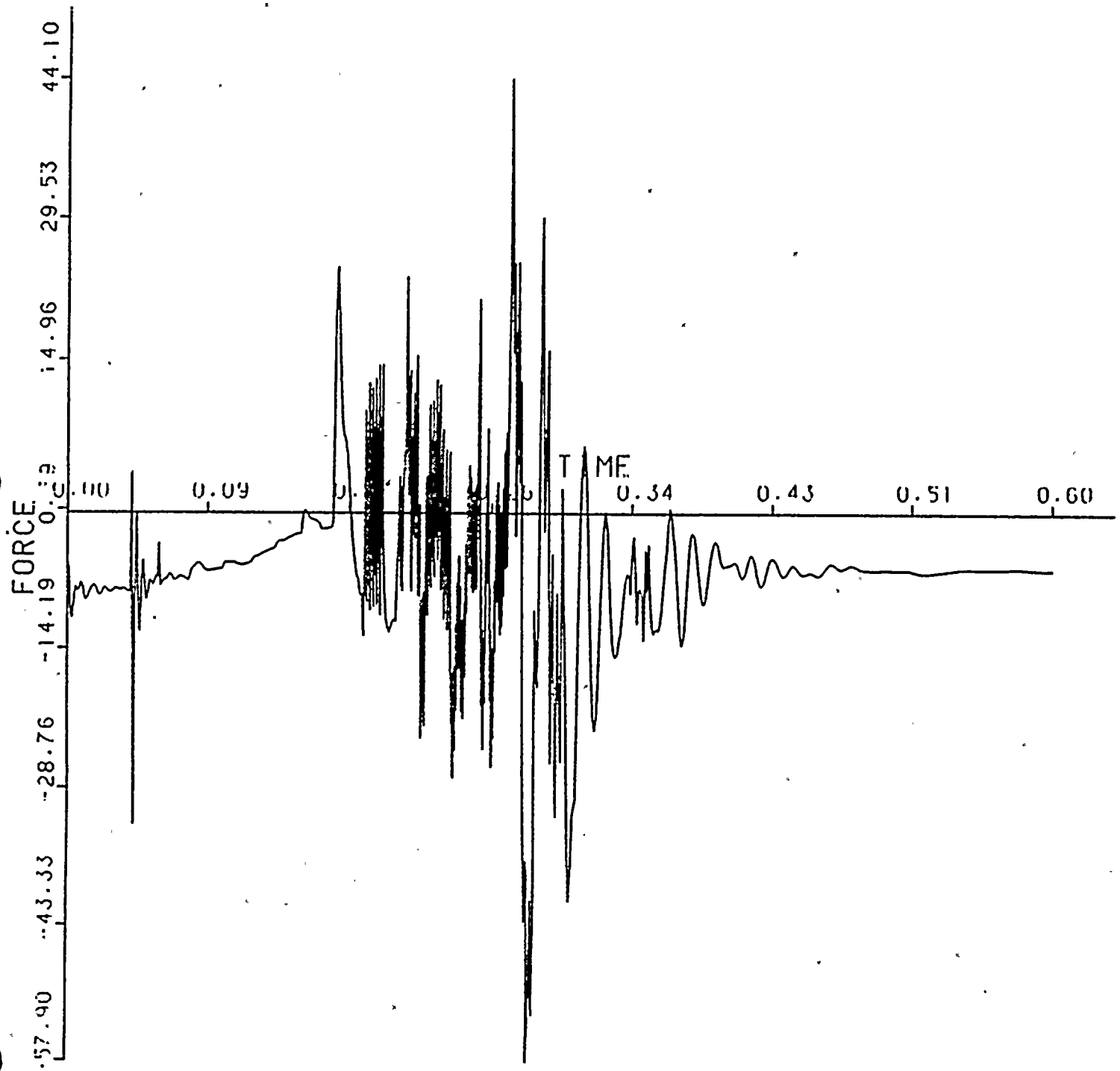
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 32, MAGNITUDE AT NODE POINT 665



DONE BY: MC DATE: 5-12-83
CHKD BY: MC DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 33. MAGNITUDE AT NODE POINT 657

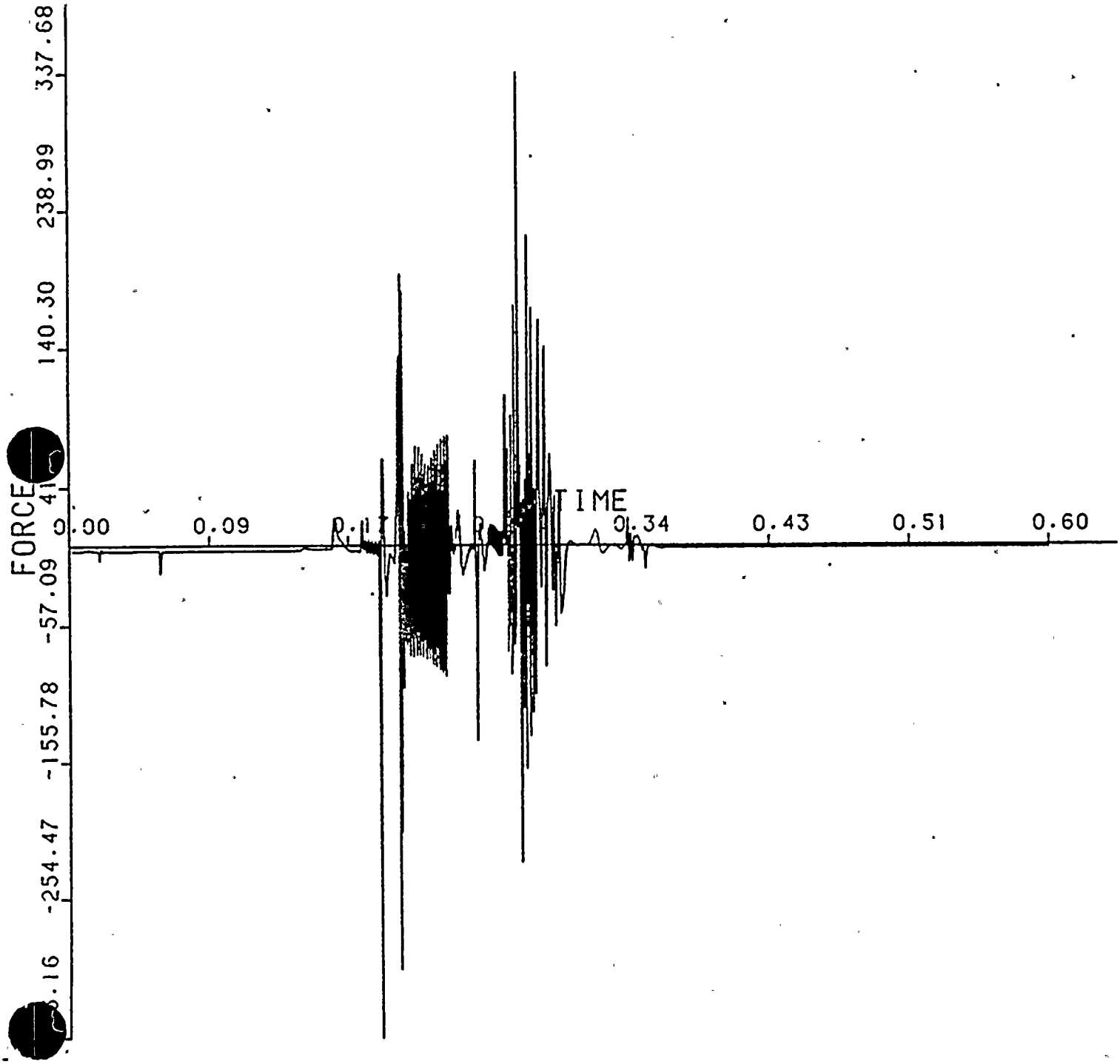


DONE BY: MR DATE: 5-12-83
CHKD BY: MR DATE: 5-12-83

Technical Report
TR-5364-1
Revision 0

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 34, MAGNITUDE AT NODE POINT 620

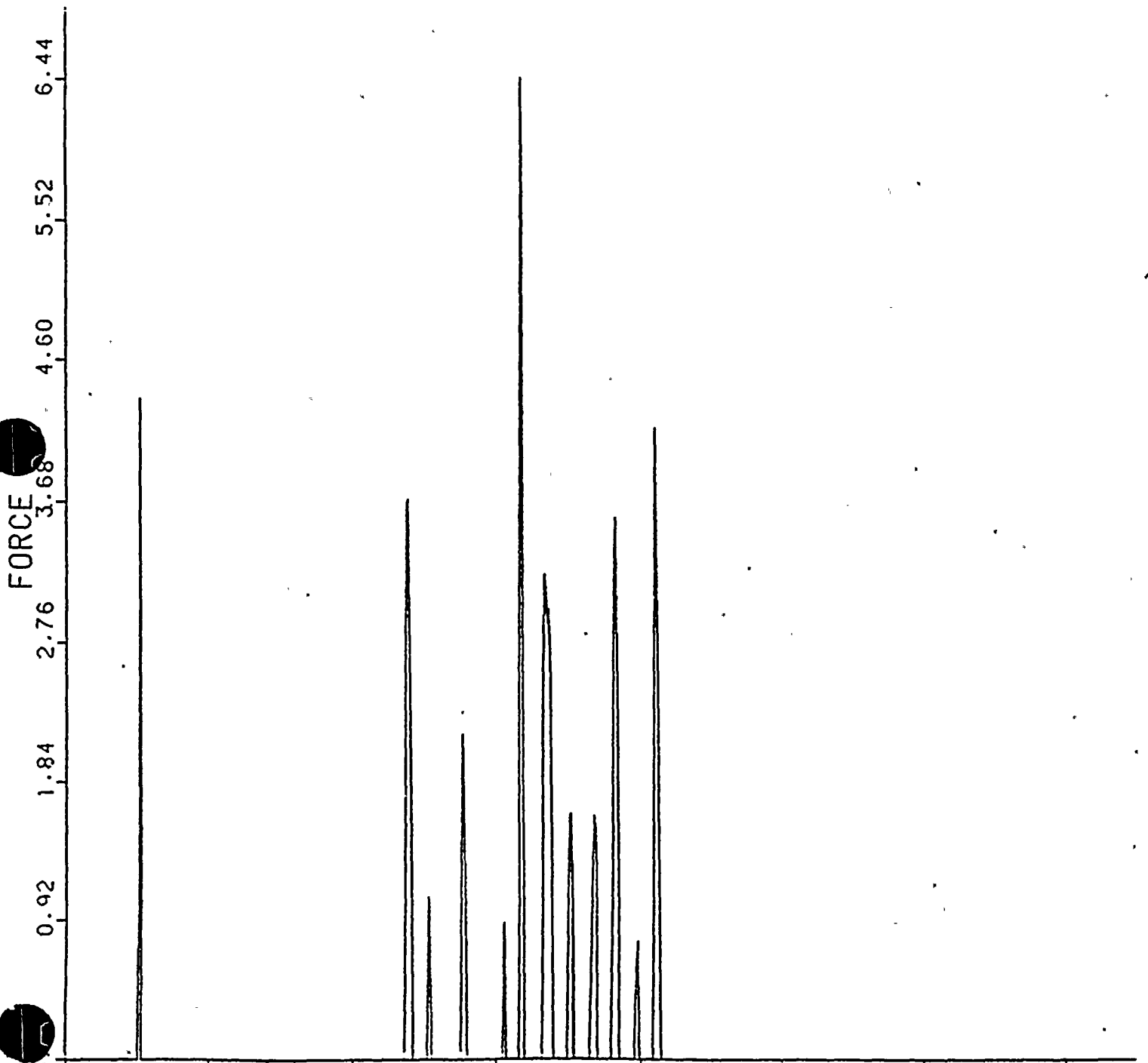


DONE BY: AR DATE: 5-12-83
CHKD BY: WL DATE: 5-12-83

Technical Report
TR-5364-1
Revision 0

ILLINOIS
ENGINEERING SERVICES

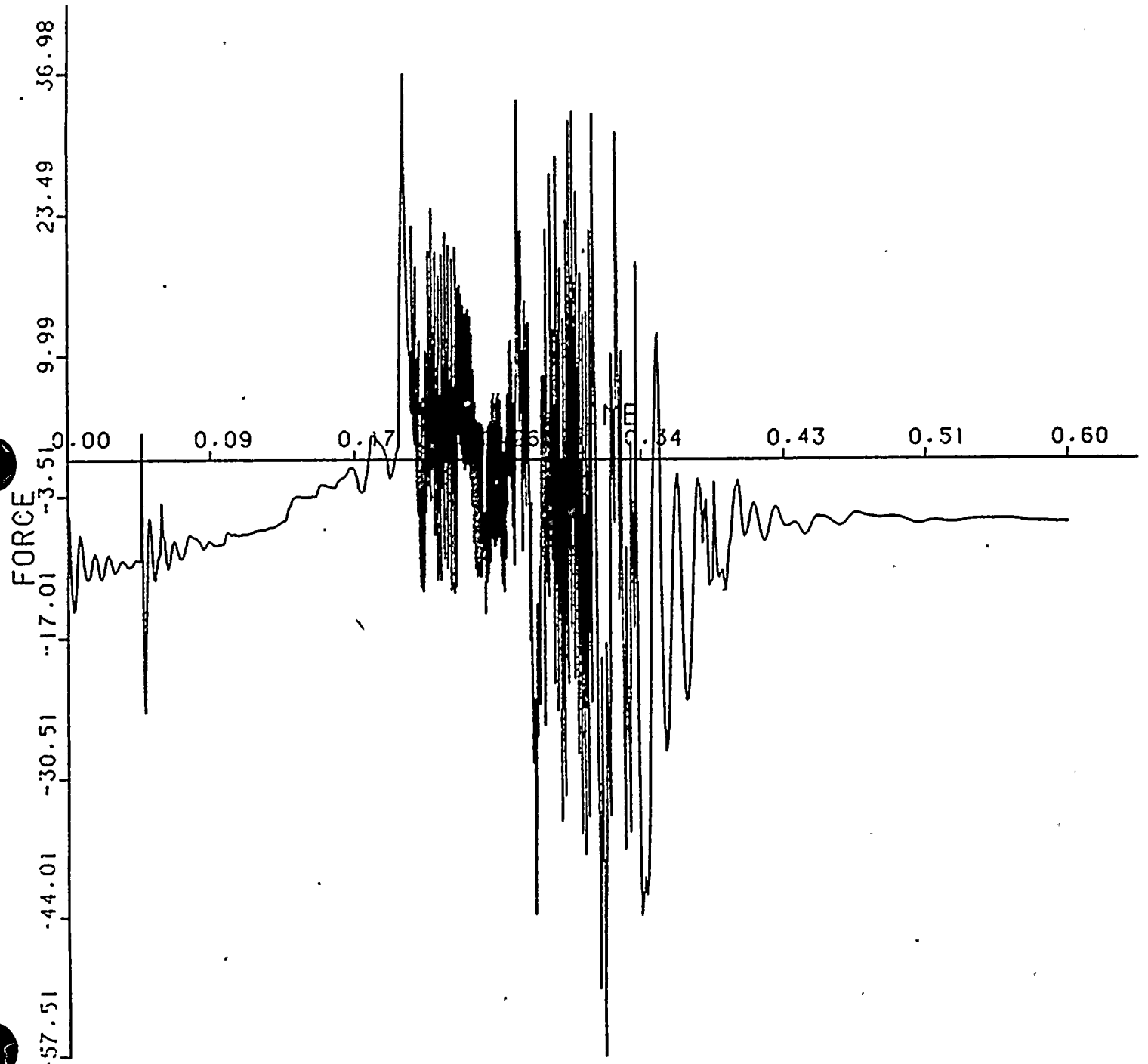
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 35. MAGNITUDE AT NODE POINT 431



DONE BY: [illegible] DATE: 5/12/83
CHKD BY: [illegible] DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 36, MAGNITUDE AT NODE POINT 405

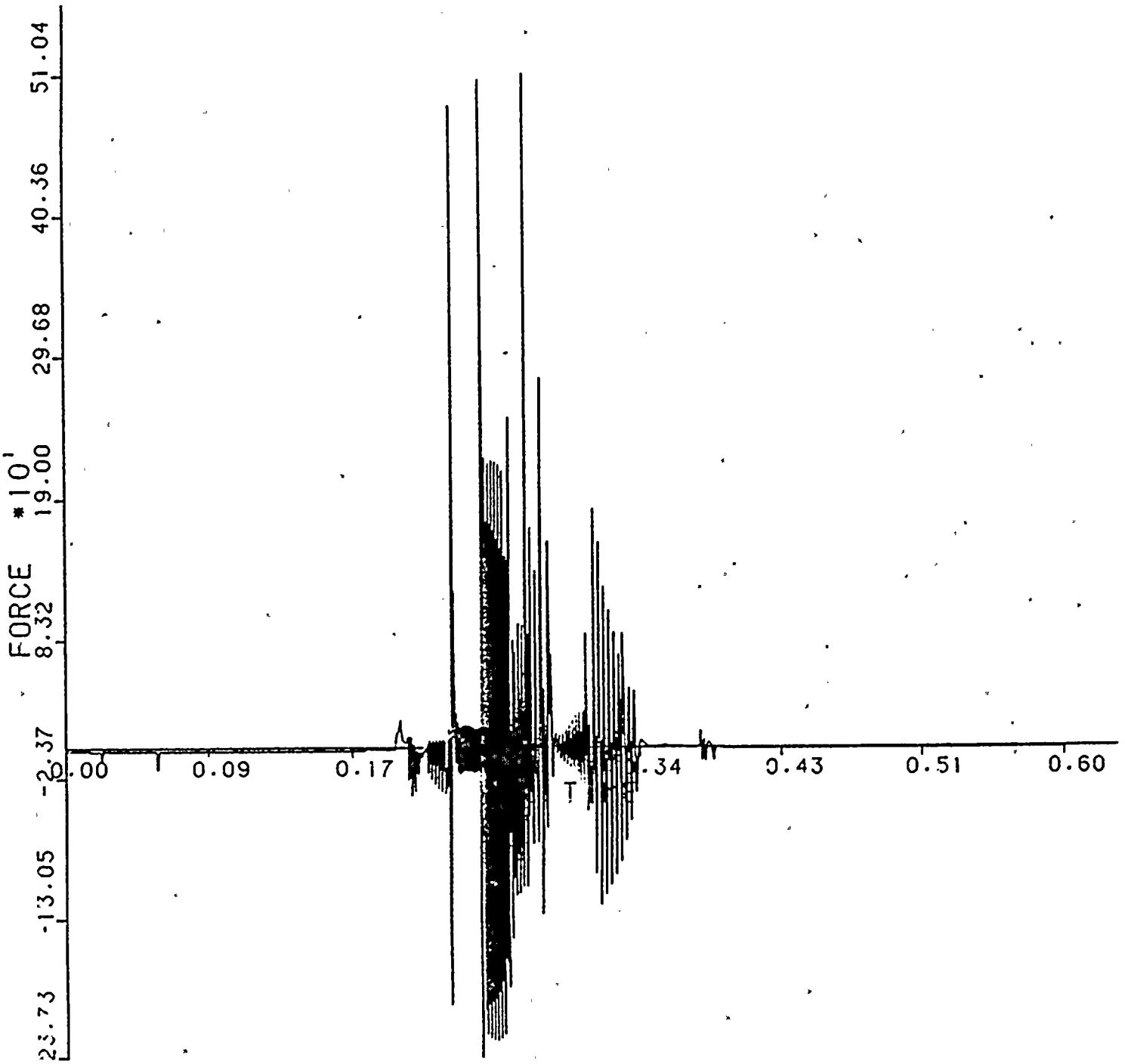


DONE BY: ML DATE: 5-12-83
CHKD BY: ML DATE: 5-12-83

Tecnnical Report
TR-5364-1
Revision 0

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 37, MAGNITUDE AT NODE POINT 382



DONE BY: [illegible] DATE: 5-12-83
CHKD BY: [illegible] DATE: 5-12-83

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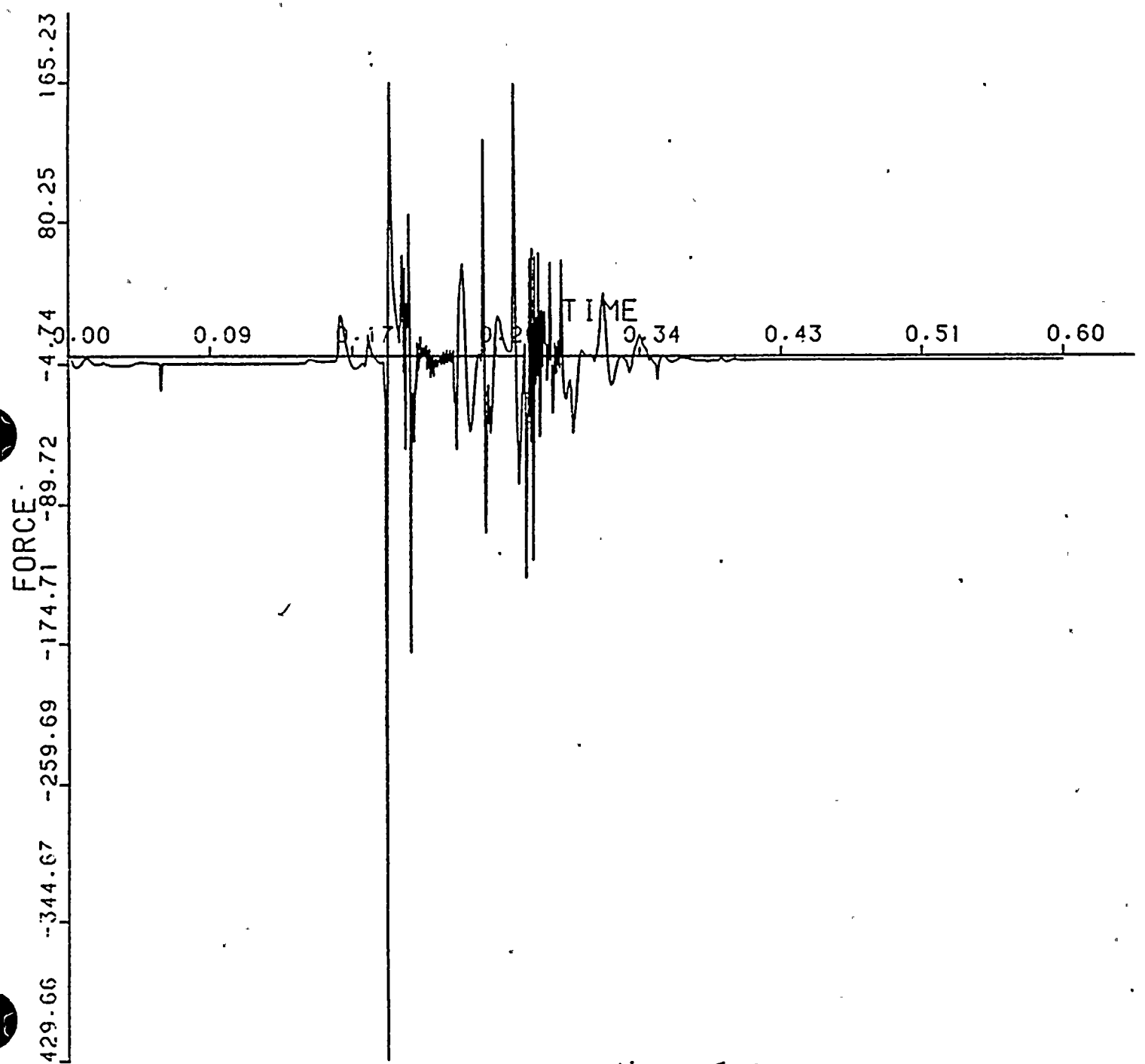
ENGINEERING SERVICES

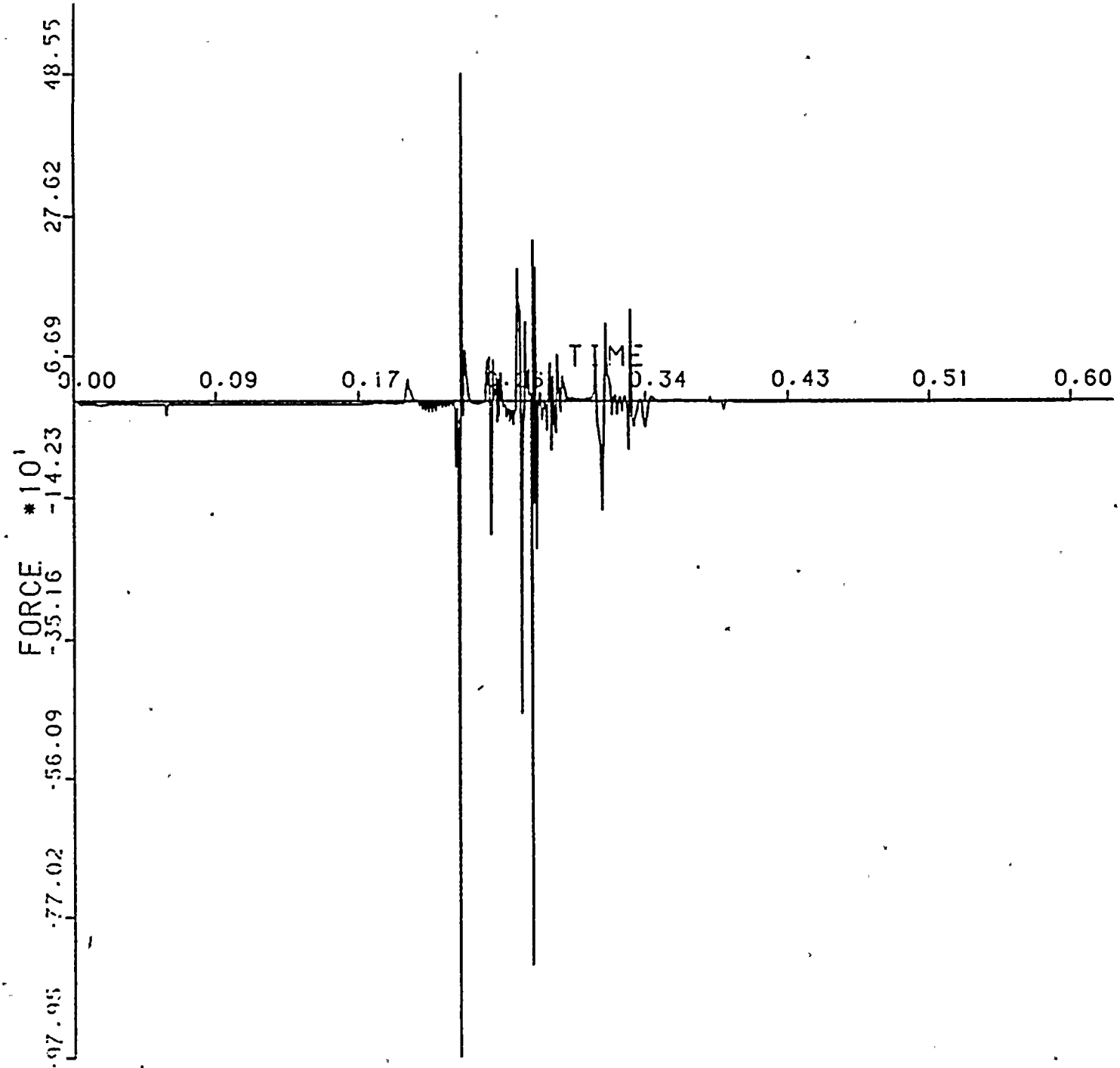
CAP/SAP VERIFICATION 5364 17 MAY 83
YELLOW LOOP SEAL YELLPSI.INP
TIME/FORCE TABLE 38. MAGNITUDE AT NODE POINT 610



DONE BY: MK DATE: 5-12-83
CHKD BY: MZ DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 39. MAGNITUDE AT NODE POINT 535

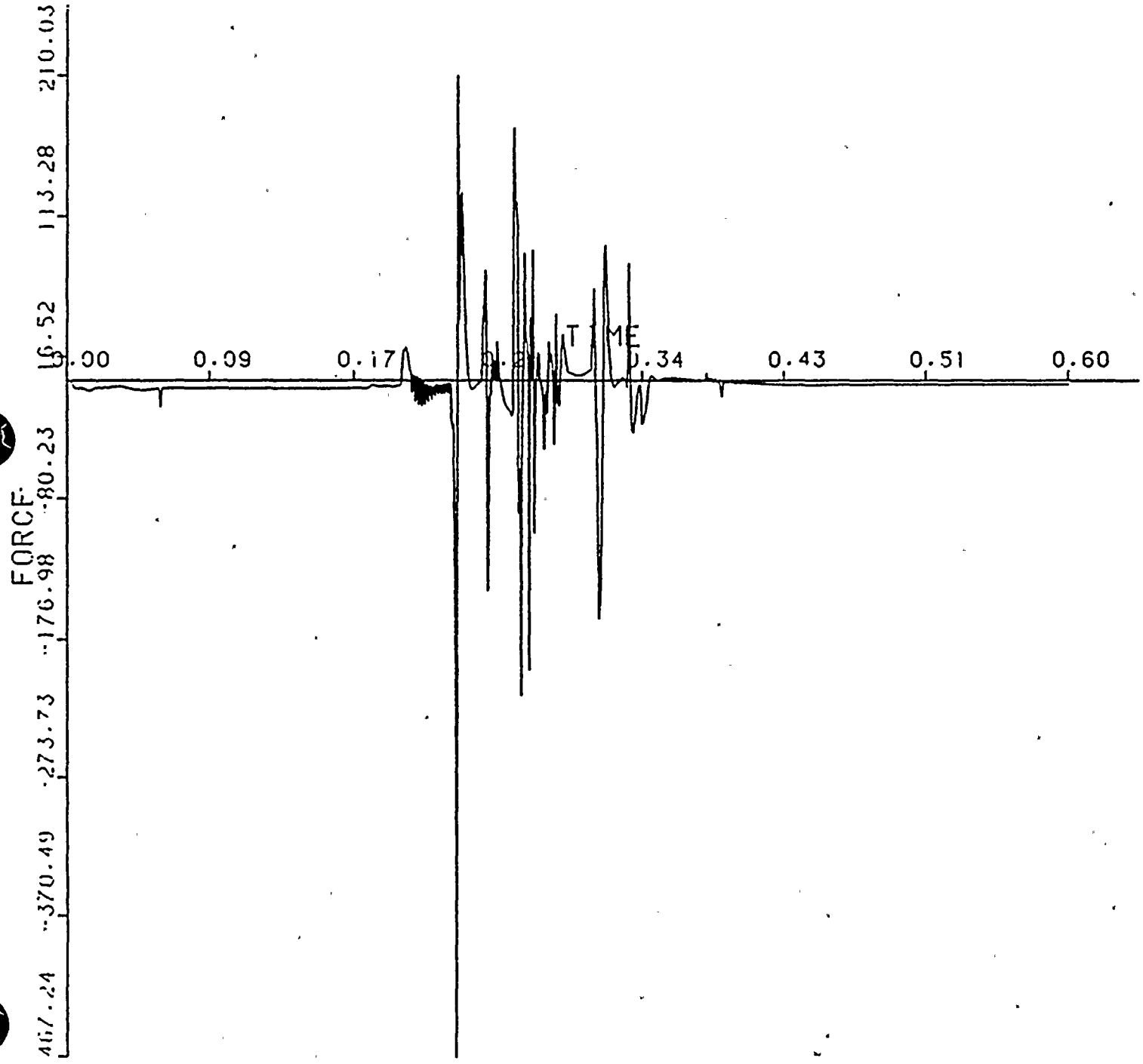


DONE BY: MR DATE: 5-12-83
CHKD BY: MR DATE: 5-12-83

Tecnnical Report
TR-5364-1
Revision 0

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 40. MAGNITUDE AT NODE POINT 545



DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

Technical Report
TR-5364-1
Revision C

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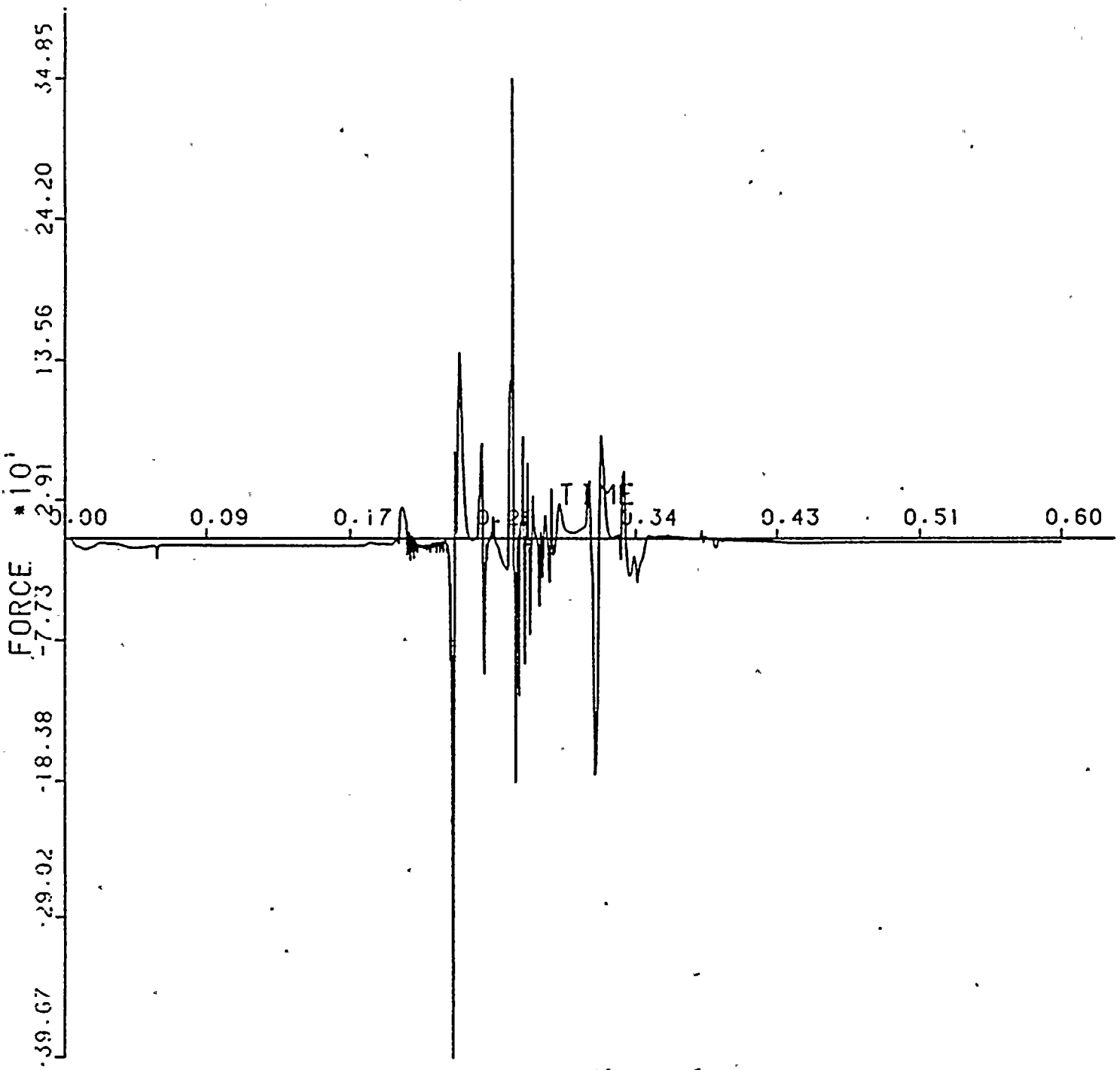
ENGINEERING SERVICES

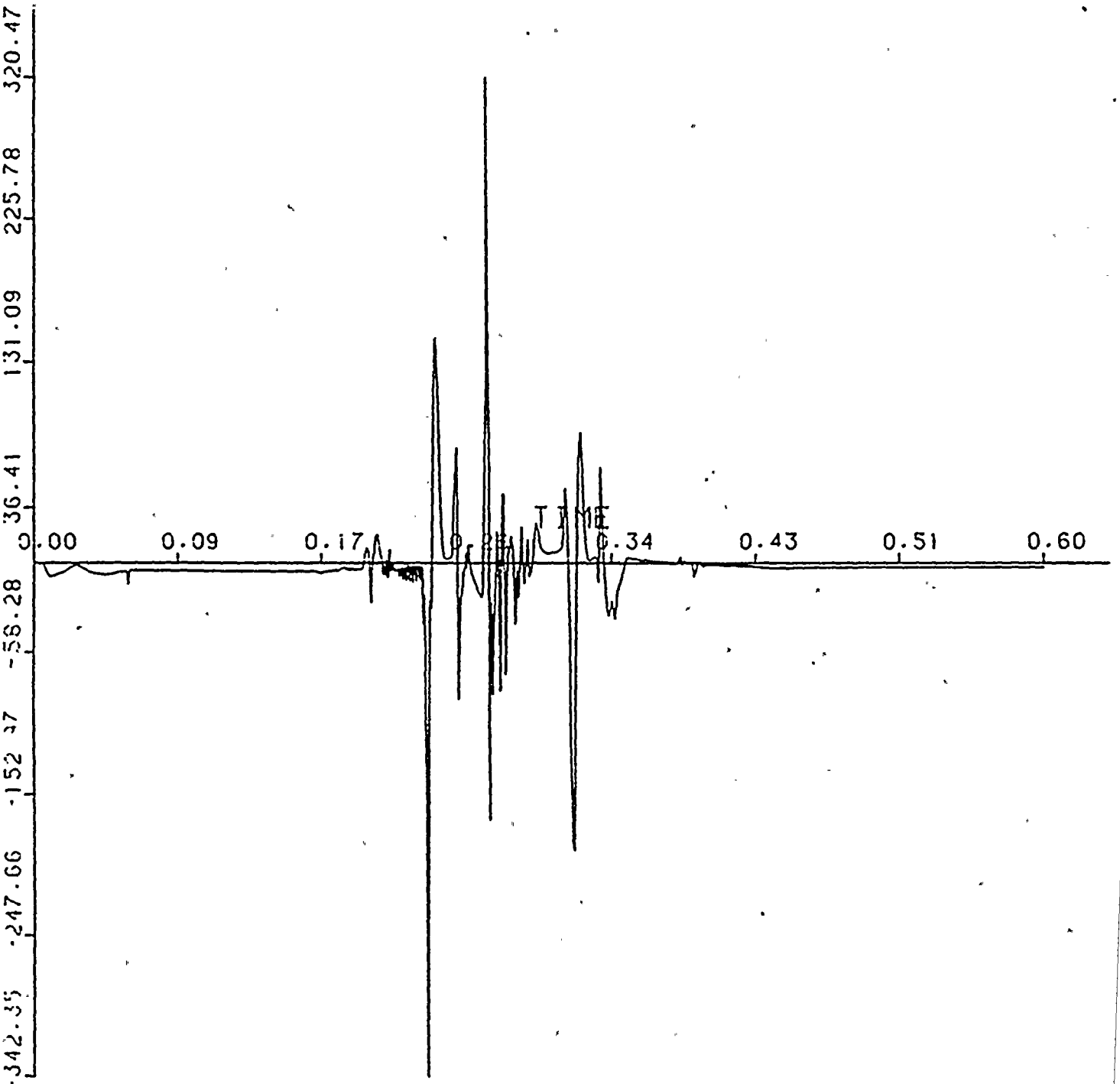
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 41, MAGNITUDE AT NODE POINT 550



DONE BY: MR DATE: 5-12-83
CHKD BY: ML DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

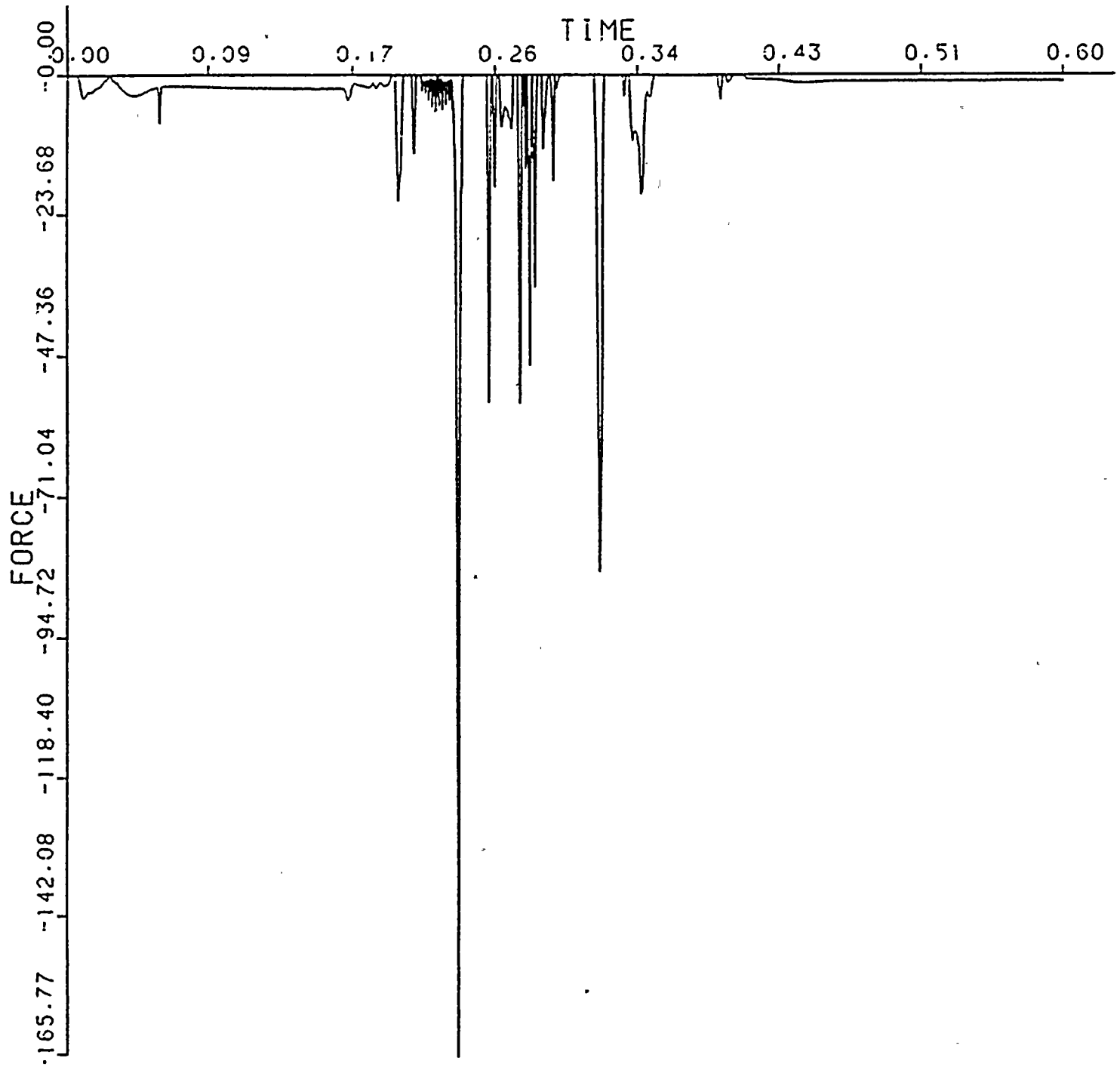
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 42. MAGNITUDE AT NODE POINT '555



DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

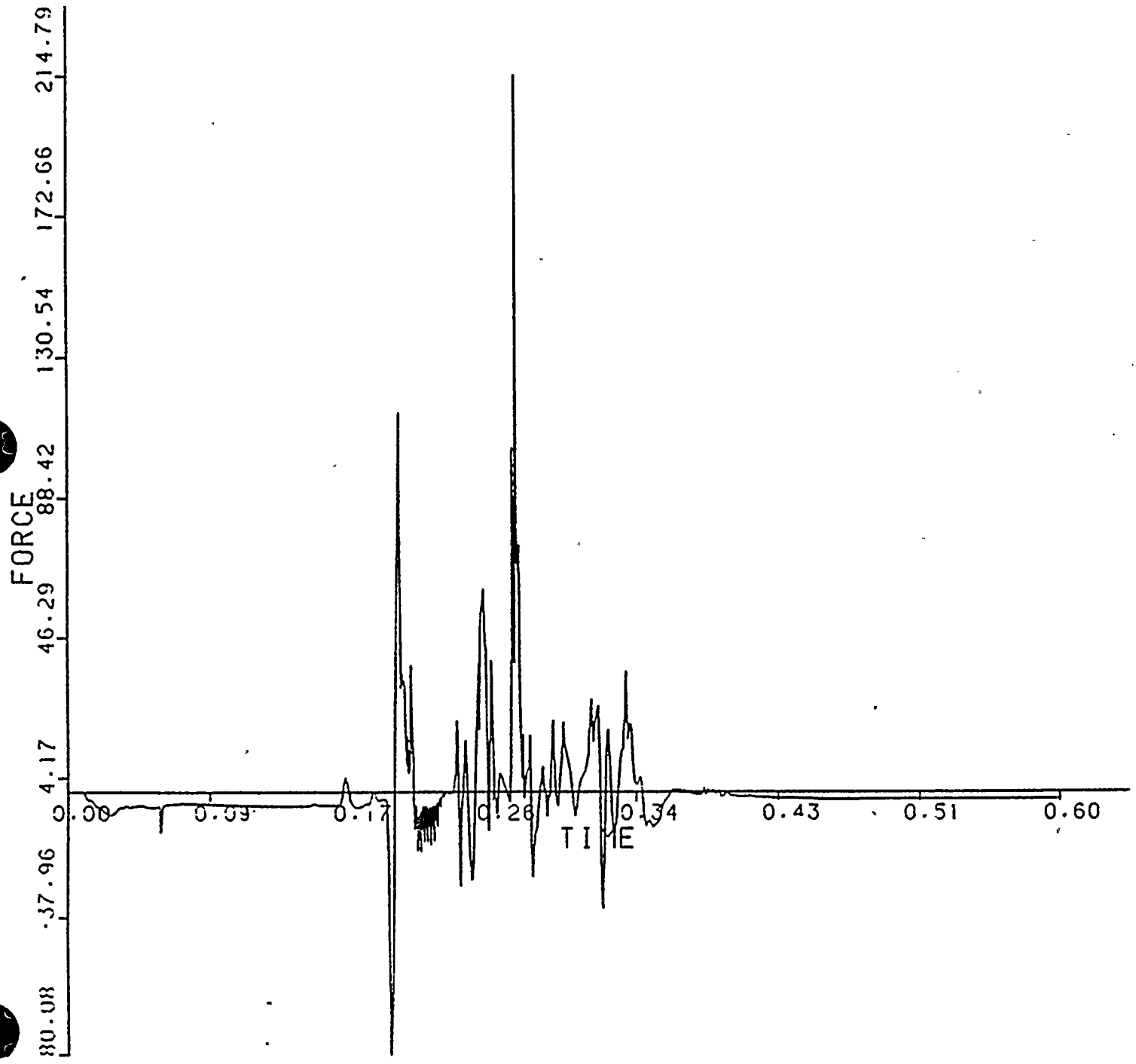
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 43. MAGNITUDE AT NODE POINT 560



DONE BY: MK DATE: 5-12-83
CHKD BY: MM DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 44. MAGNITUDE AT NODE POINT 300



DONE BY: HK DATE: 5-12-83
CHKD BY: MM DATE: 5-12-83

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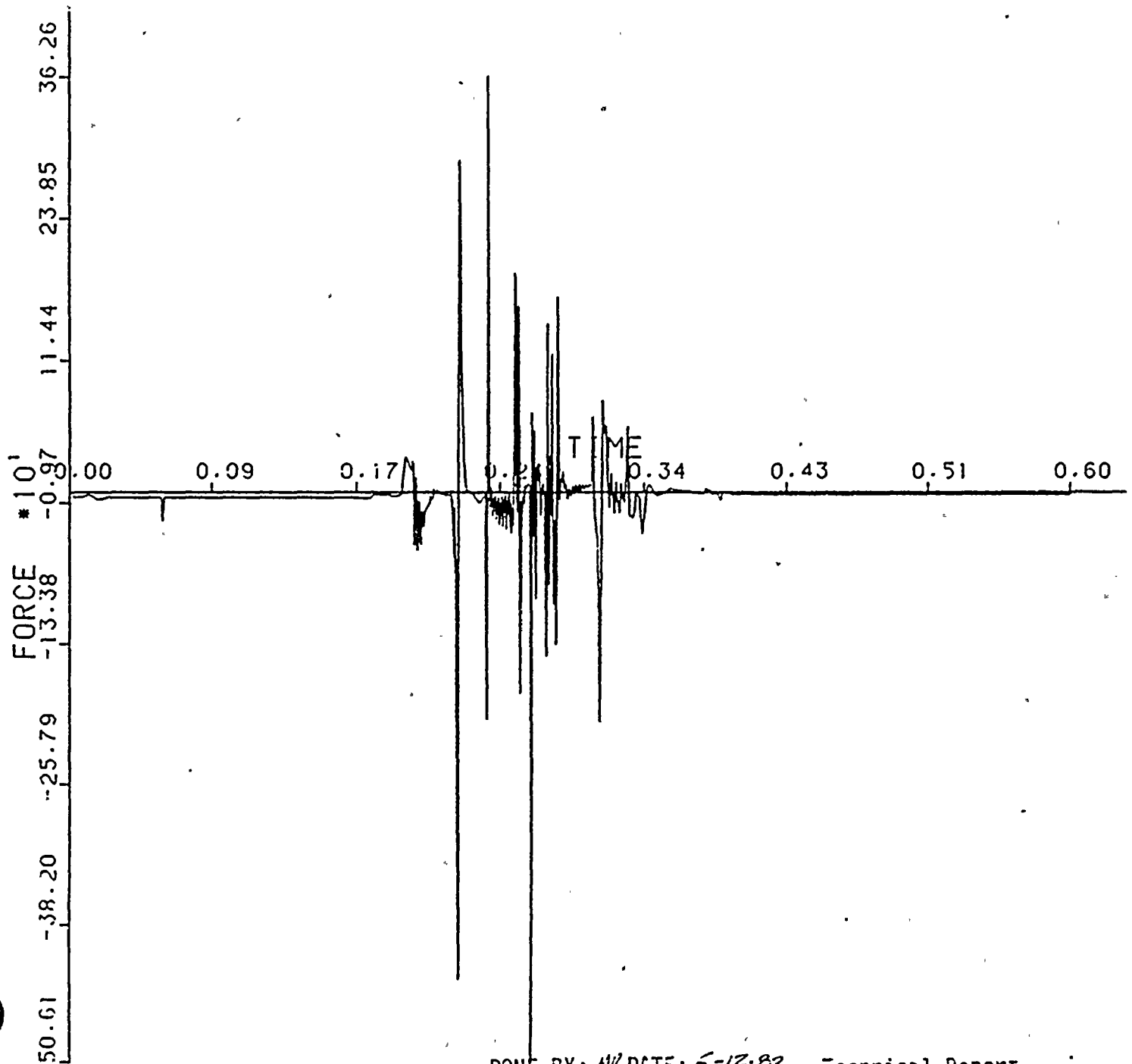
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 45, MAGNITUDE AT NODE POINT 375



DONE BY: MR DATE: 5-12-83
CHKD BY: MR DATE: 5-12-83

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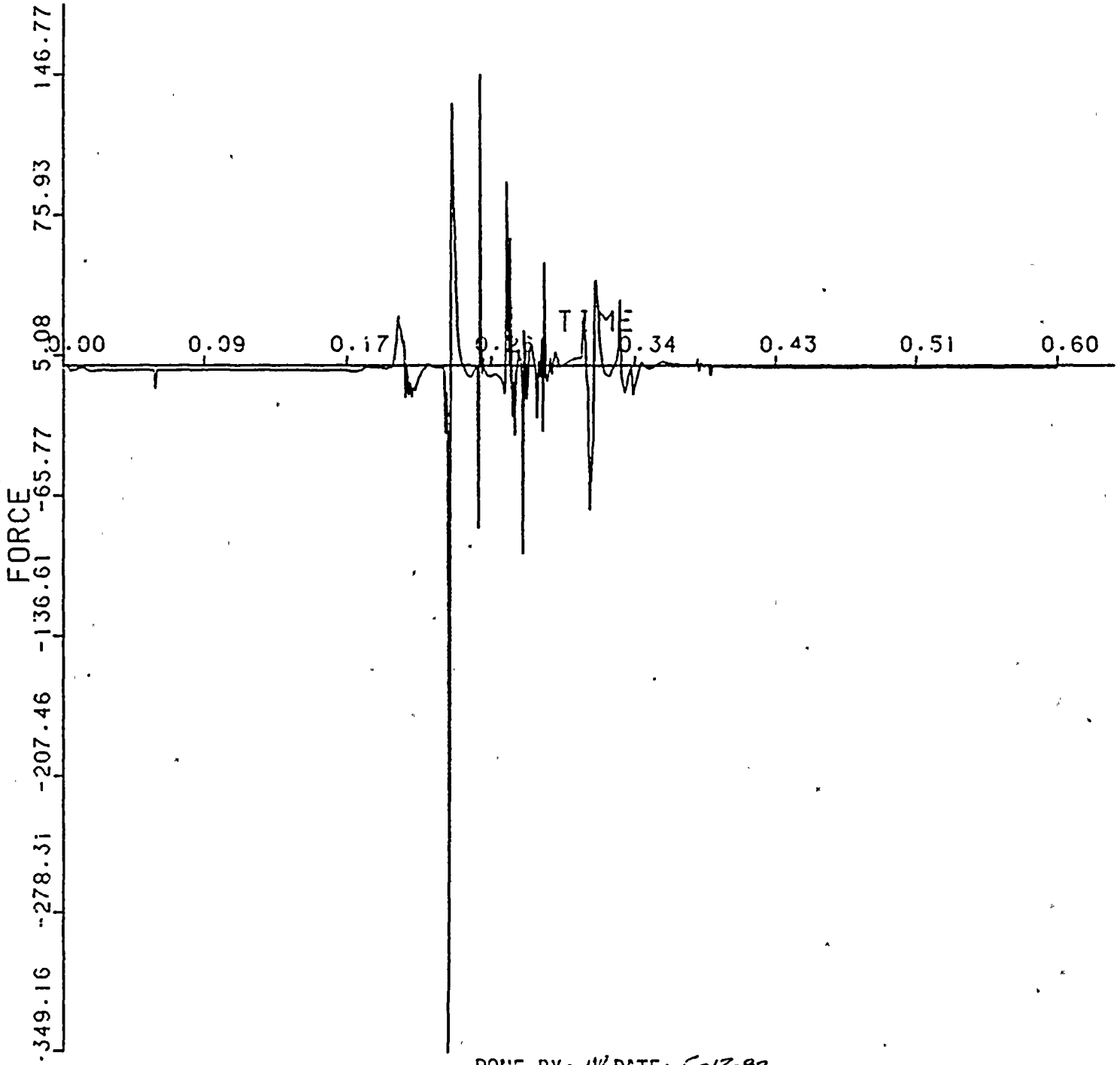
ENGINEERING SERVICES

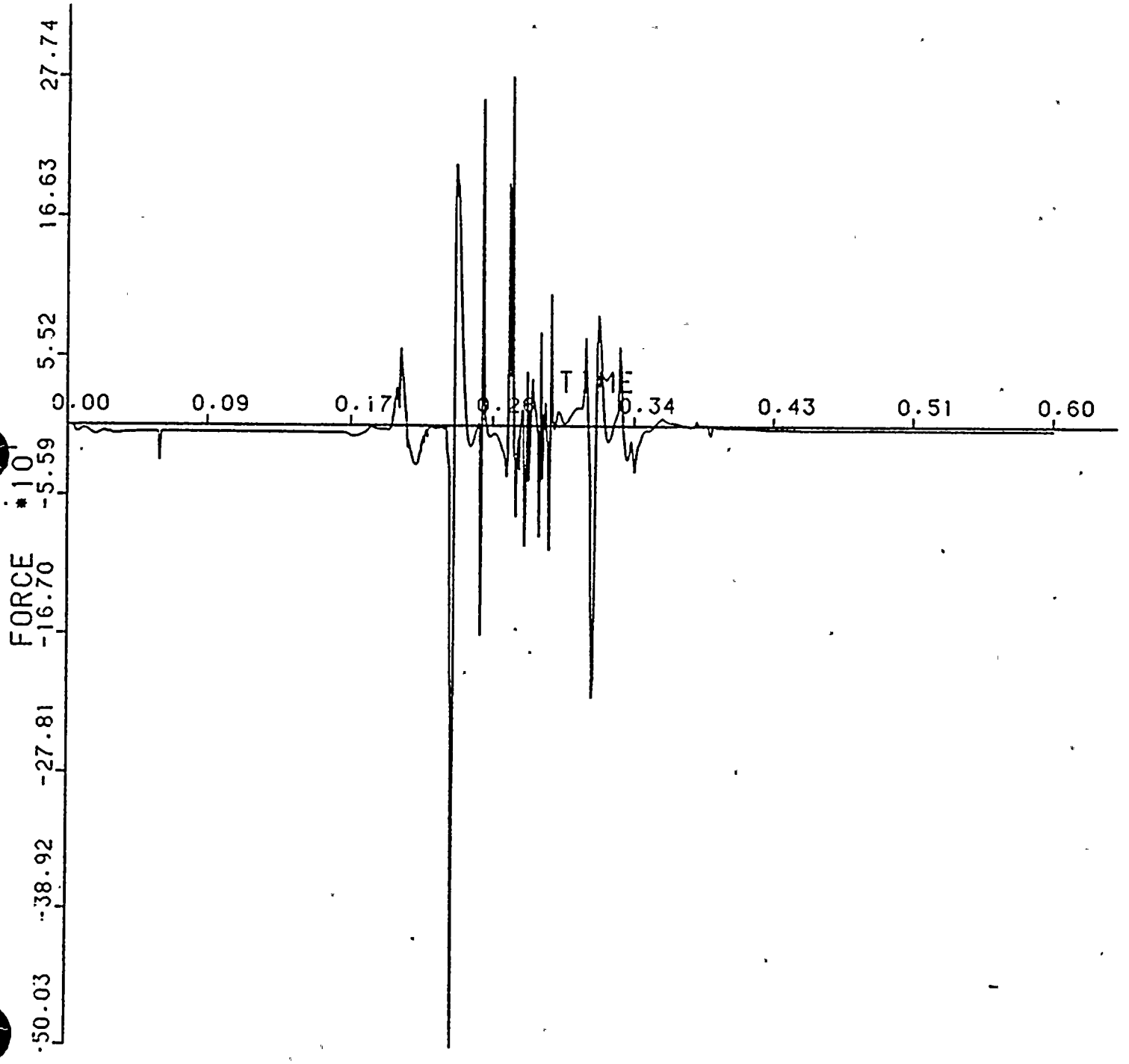
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 46. MAGNITUDE AT NODE POINT 365



DONE BY: AK DATE: 5-12-83
CHKD BY: AK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

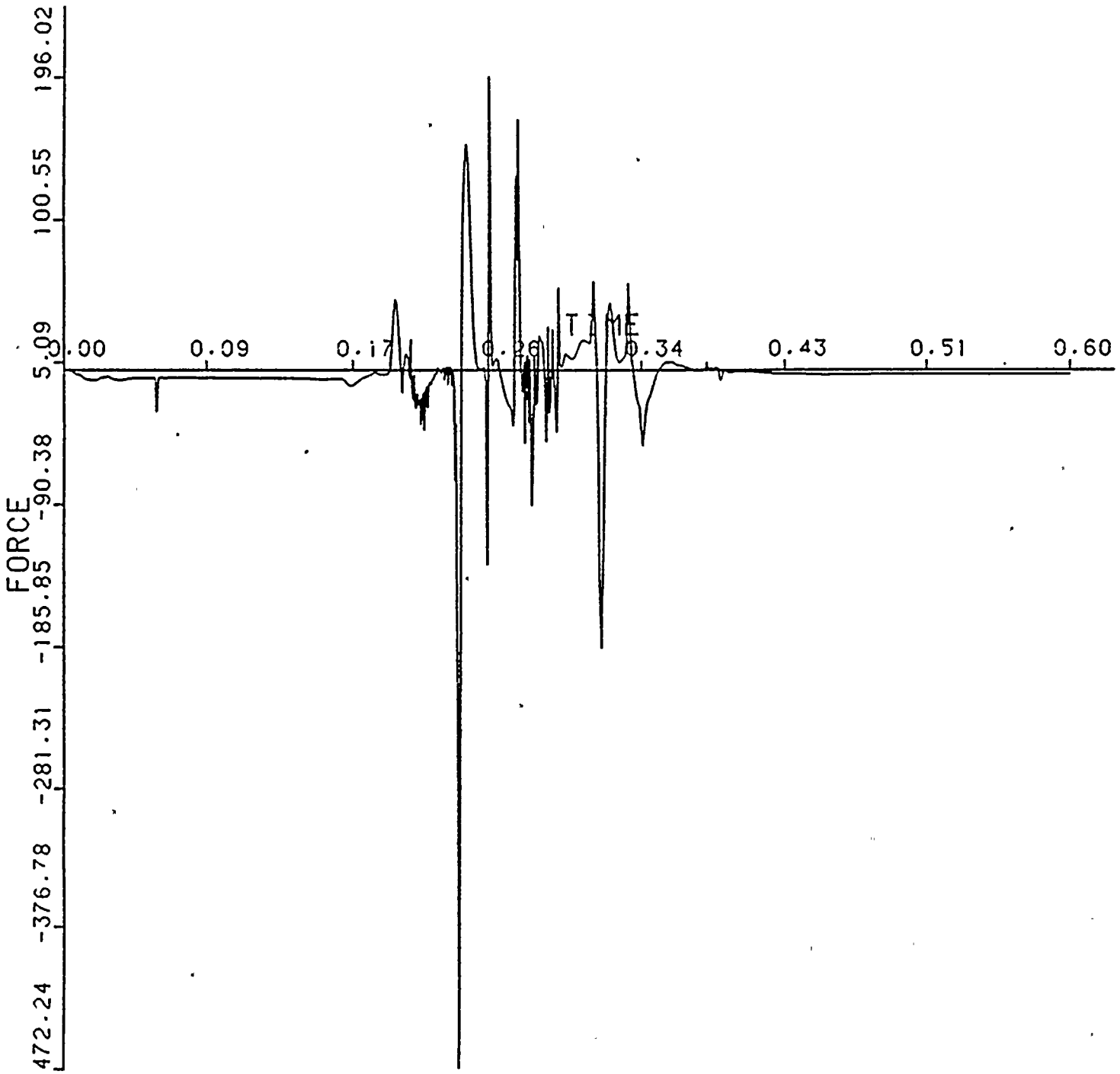
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE , 47, MAGNITUDE AT NODE POINT 360



DONE BY: MA DATE: 5-12-83
CHKD BY: MA DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 48. MAGNITUDE AT NODE POINT 355

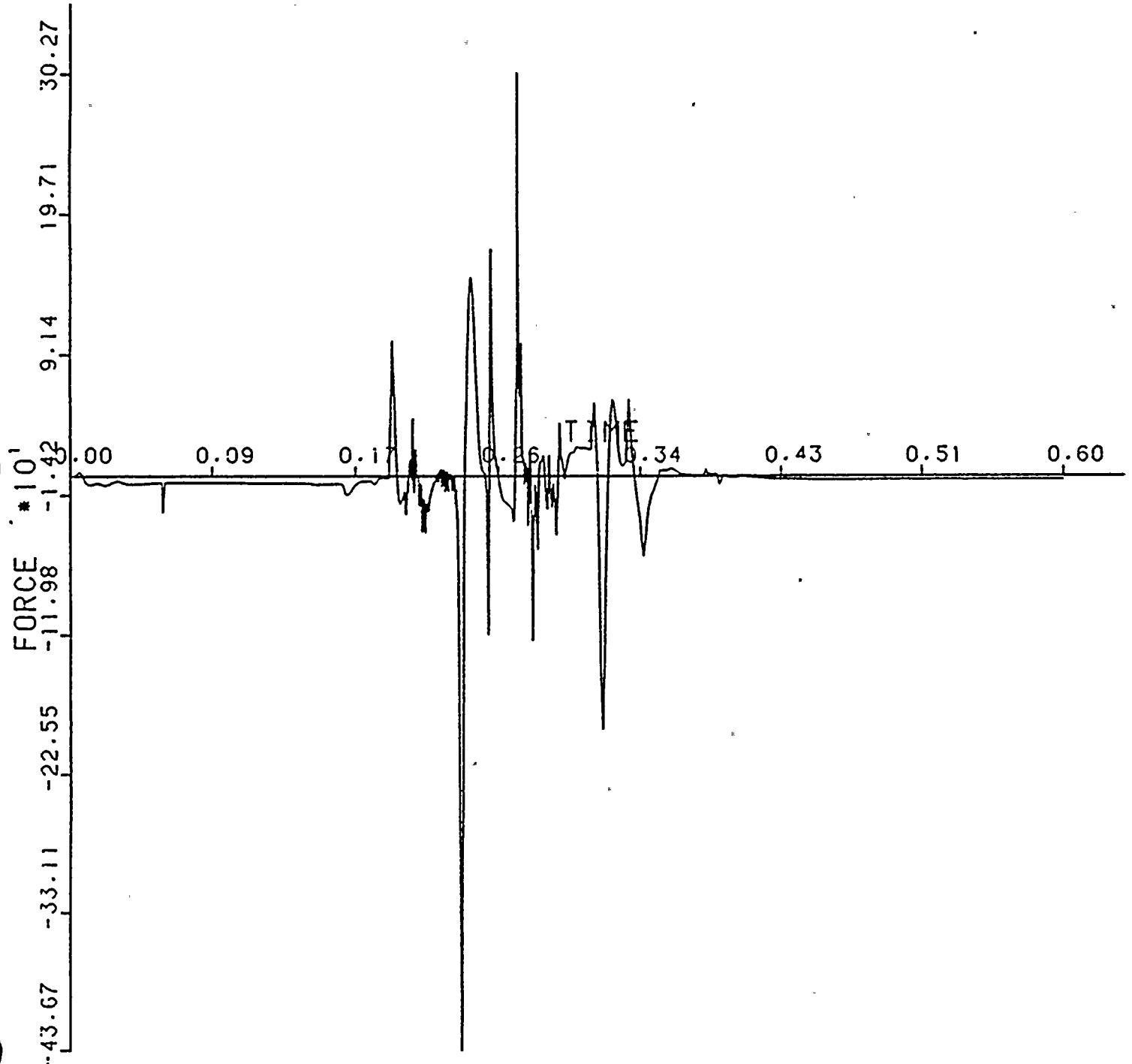


DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

Technical Report
TR-5364-1
Revision 0

TELEDYNE
ENGINEERING SERVICES

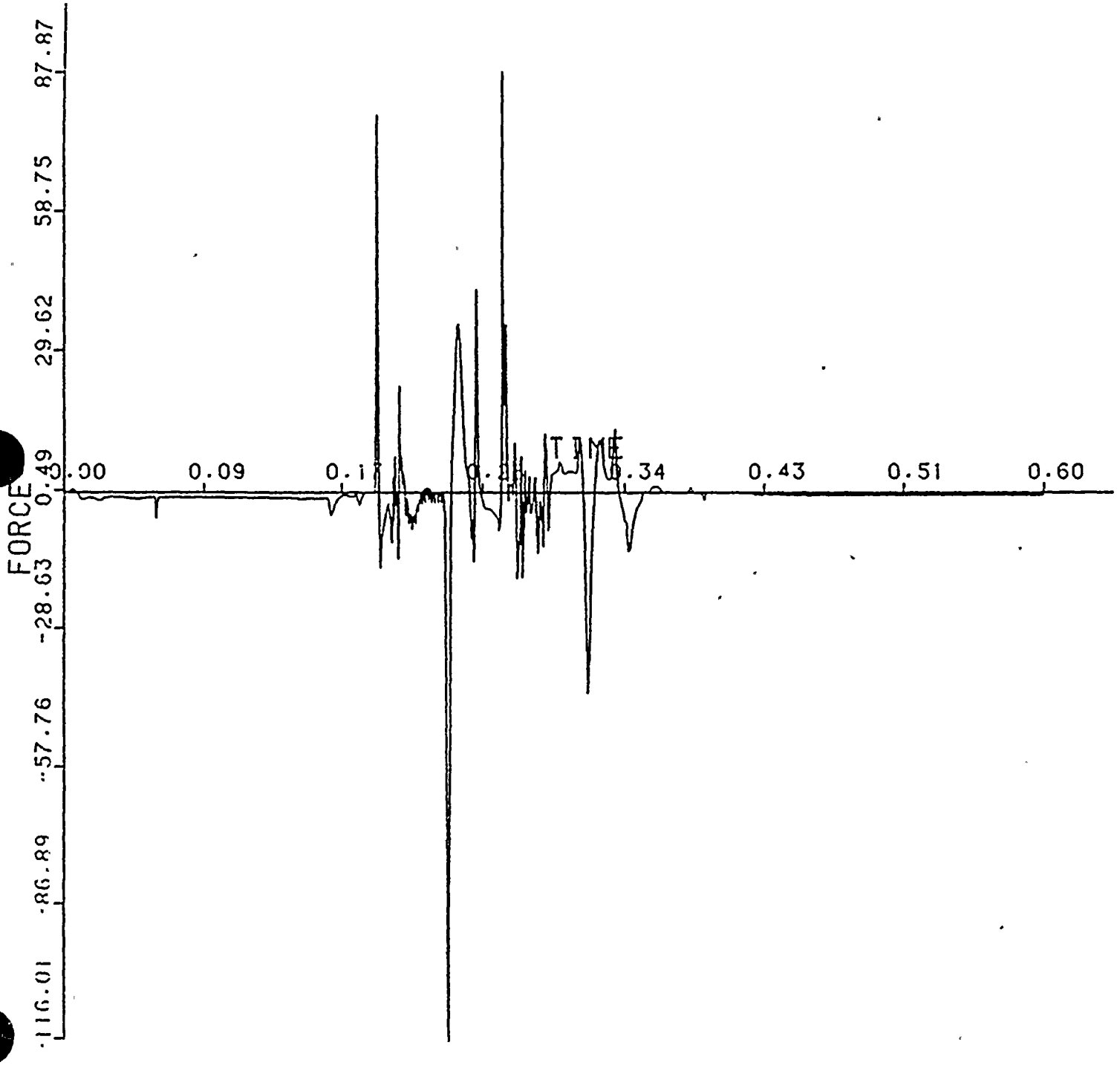
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 49. MAGNITUDE AT NODE POINT 350



DONE BY: MR DATE: 5-12-83
CHKD BY: MD DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

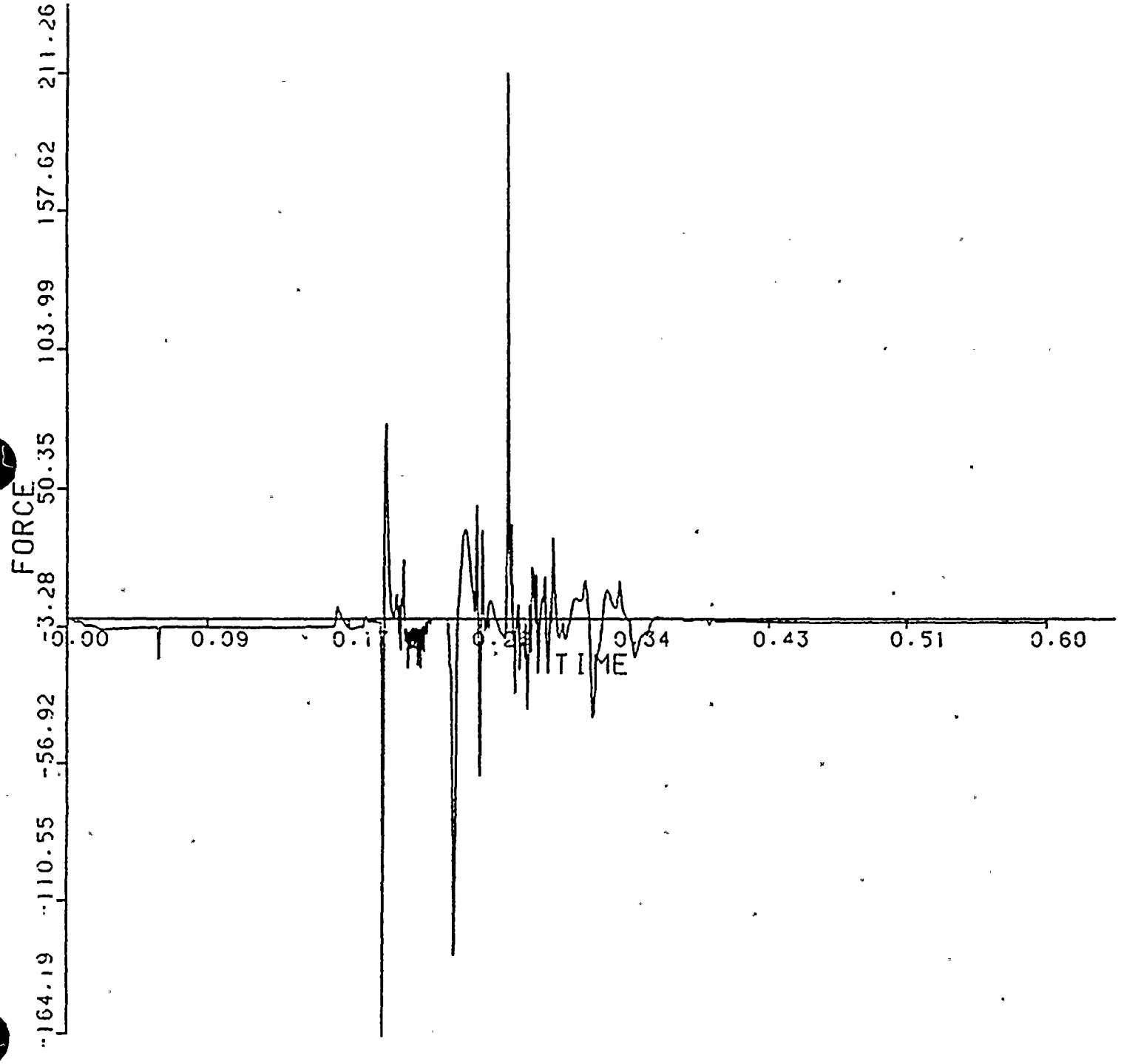
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 50. MAGNITUDE AT NODE POINT 340



DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

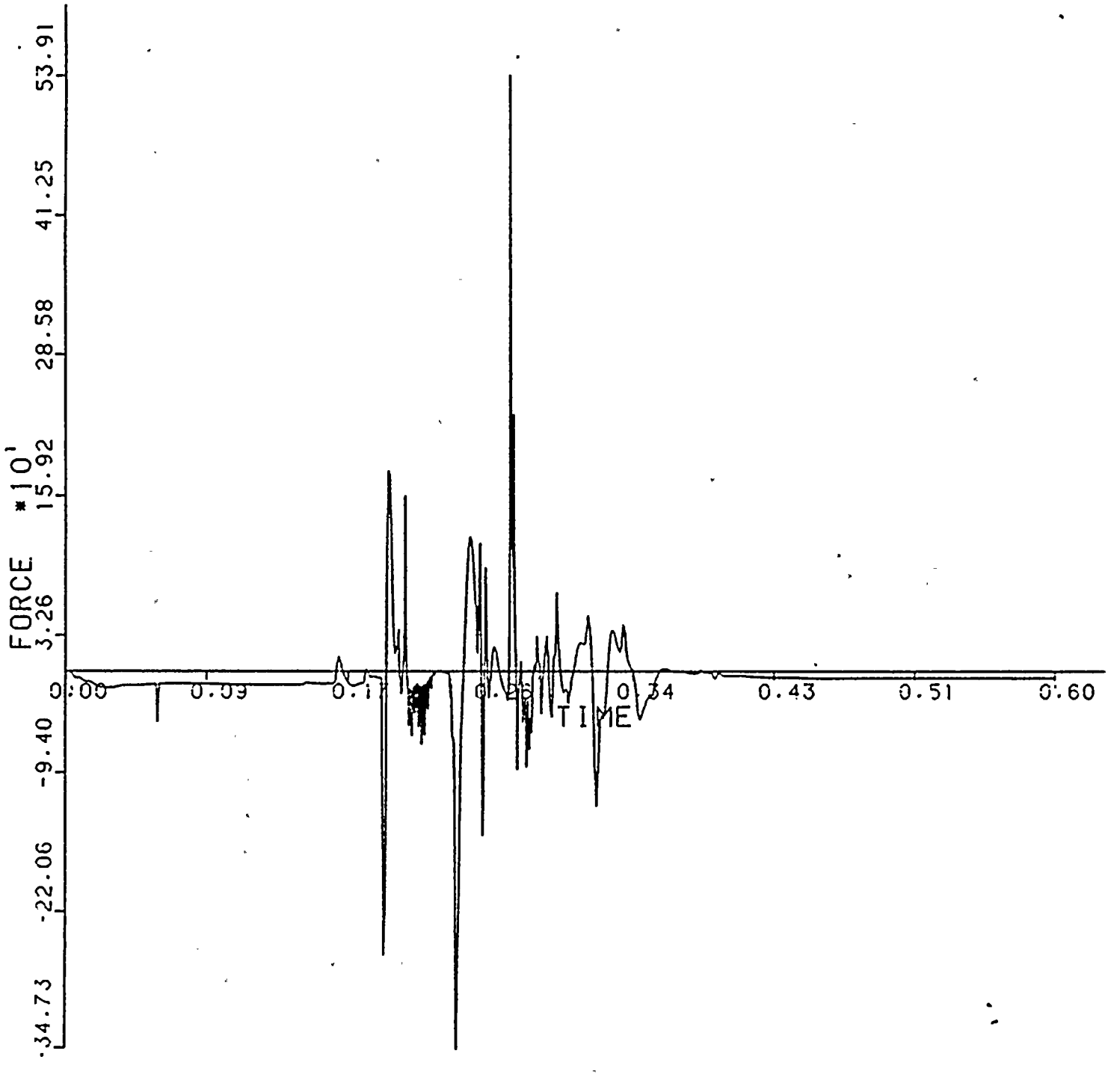
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 51. MAGNITUDE AT NODE POINT 335



DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

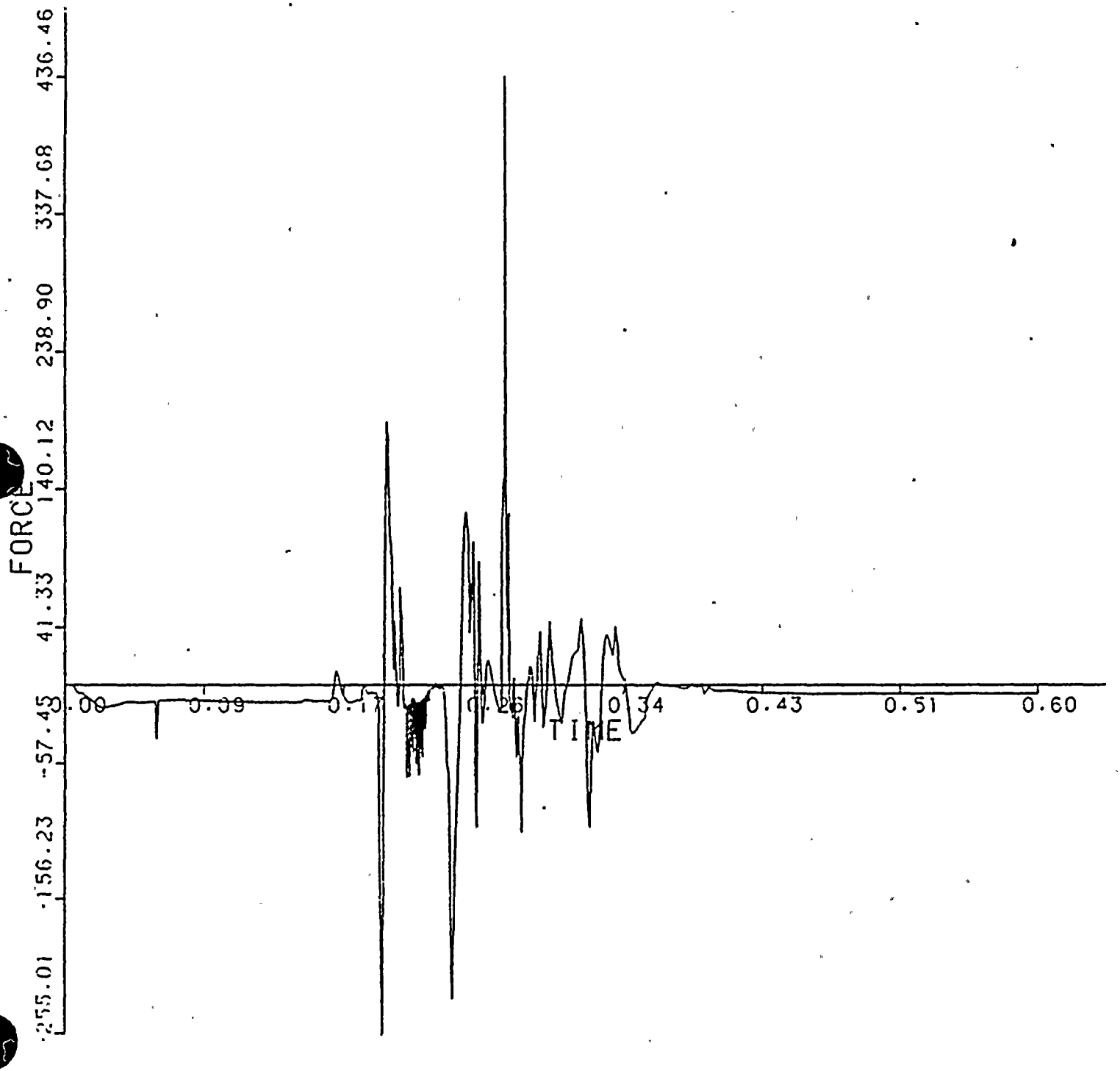
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE ·52, MAGNITUDE AT NODE POINT 325



DONE BY: MR DATE: 5-12-83
CHKD BY: MR DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE '53. MAGNITUDE AT NODE POINT 320

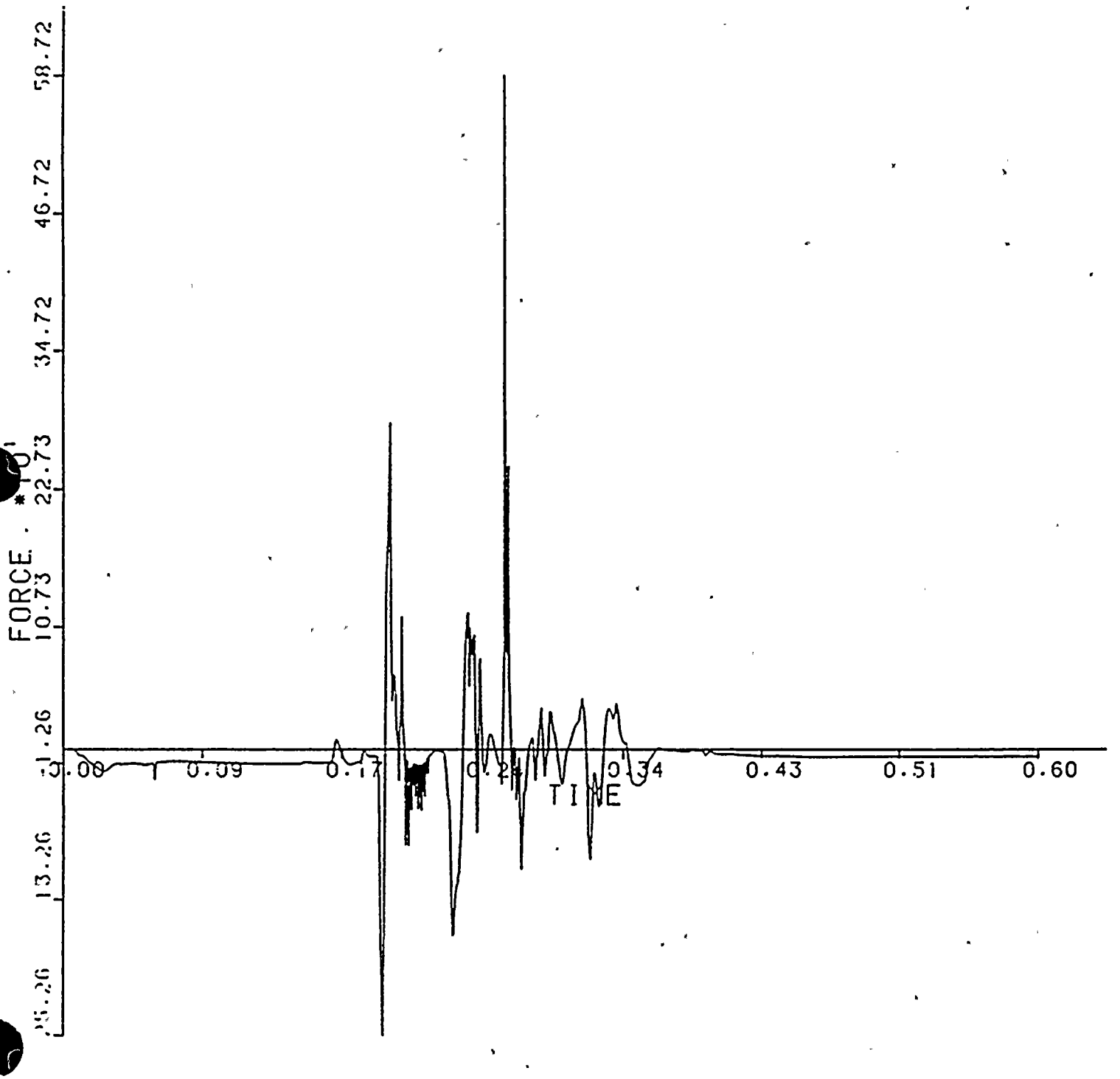


DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

Technical Report
TR-5364-1
Revision 0

TELEDYNE
ENGINEERING SERVICES

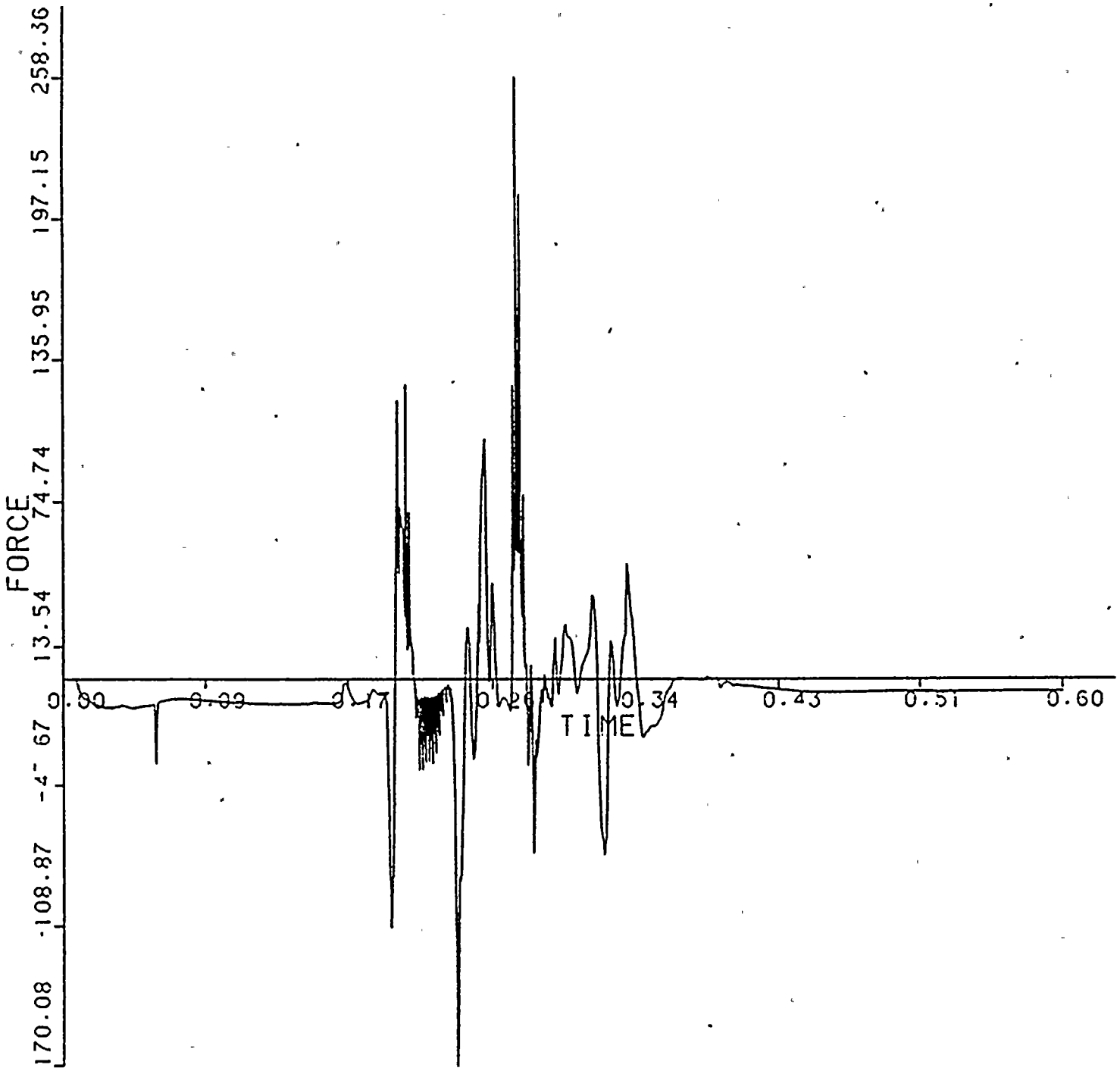
SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 54. MAGNITUDE AT NODE POINT 310



DONE BY: MK DATE: 5-12-83
CHKD BY: LL DATE: 5-12-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 12-MAY-83
YELLOW LOOP SEAL - YELLPSL.TMP
TIME/FORCE TABLE 55, MAGNITUDE AT NODE POINT 295



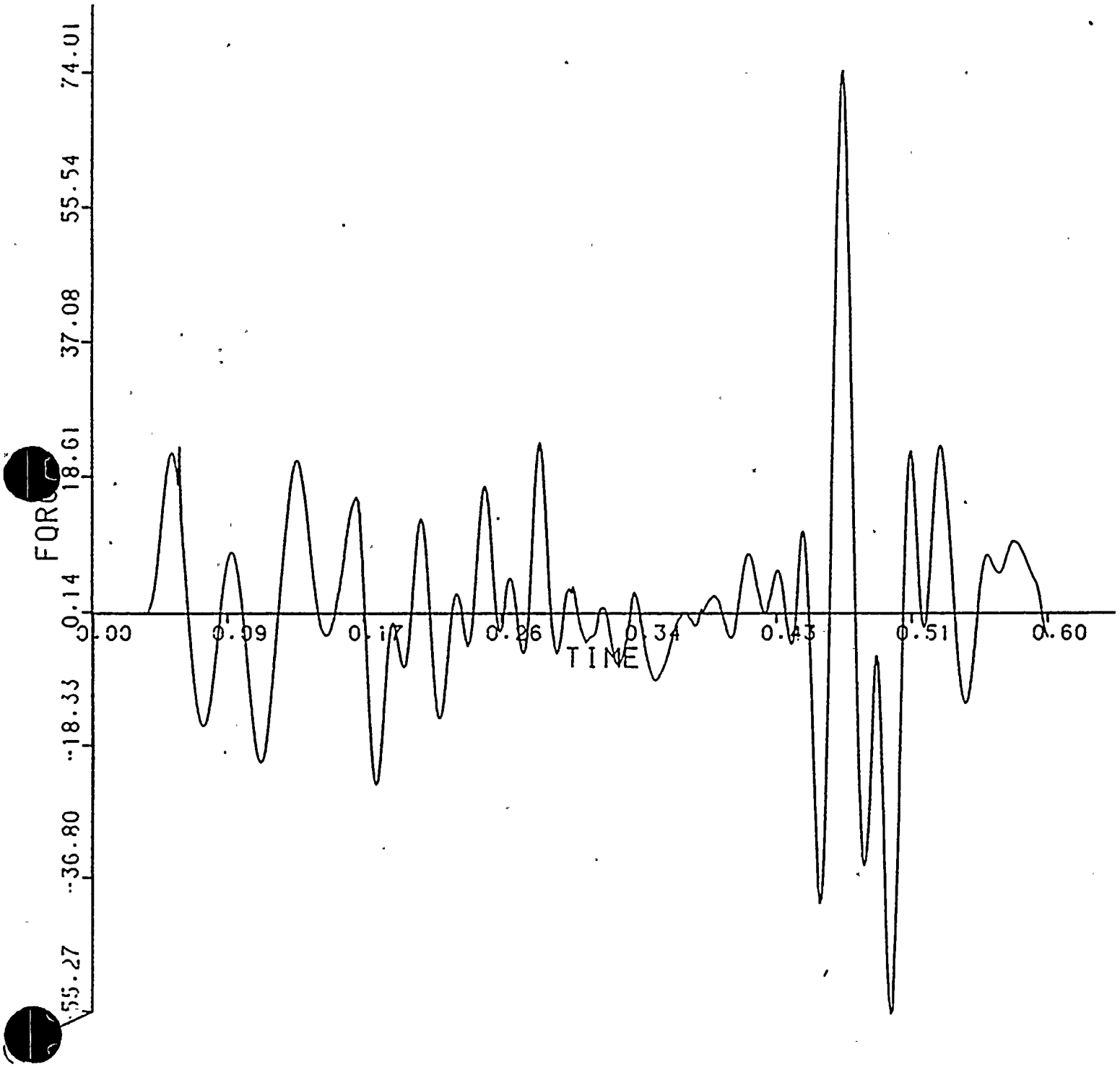
DONE BY: MK DATE: 5-12-83
CHKD BY: MK DATE: 5-12-83

Technical Report
TR-5364-1
Revision 0

4.8.2 Unit 1 - 400° Solid Liquid Case

FIELDYNE
ENGINEERING SERVICES

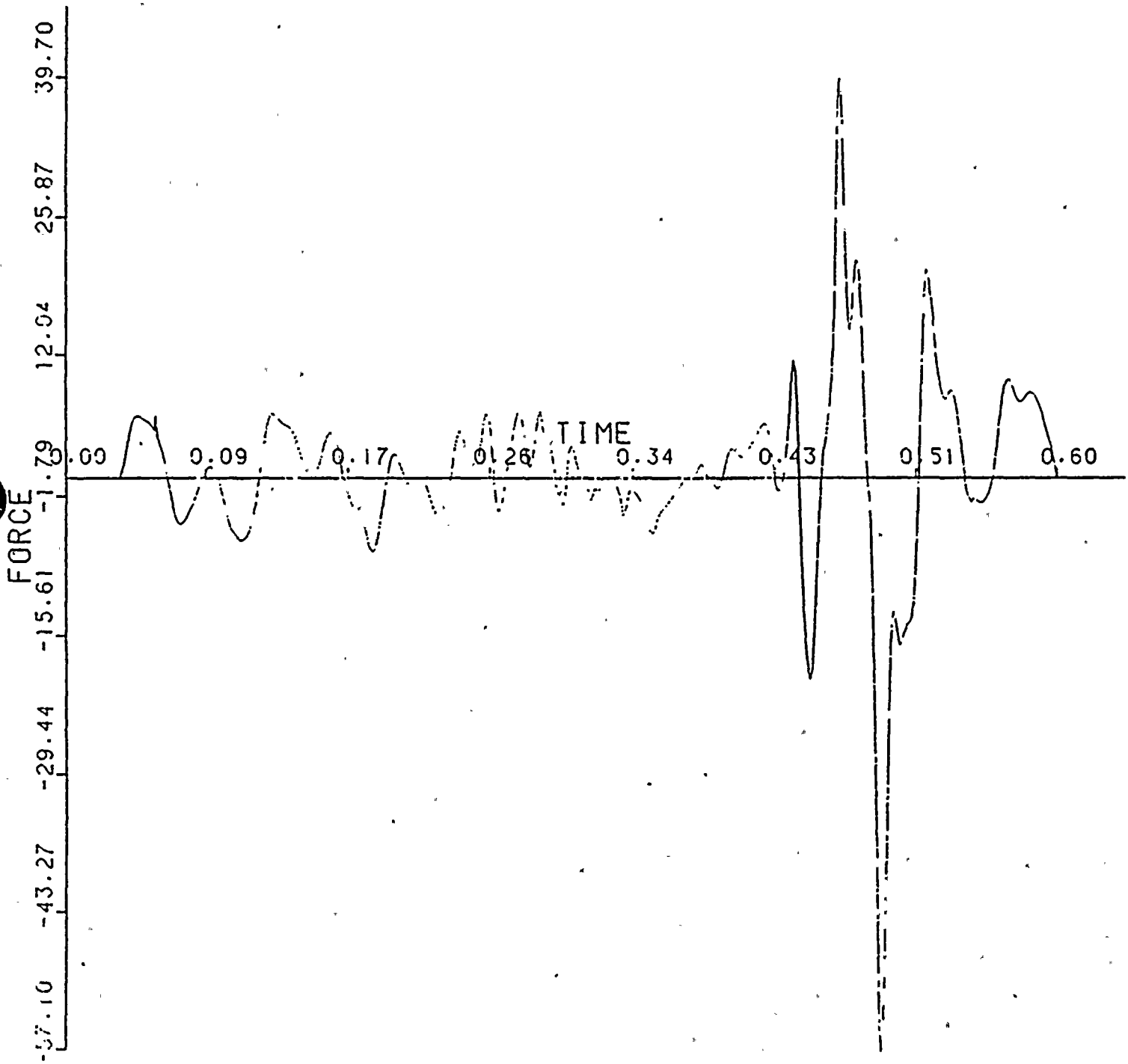
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 1, MAGNITUDE AT NODE POINT .109



DONE BY: MZ DATE: 5-23-83
CHKD BY: MA DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

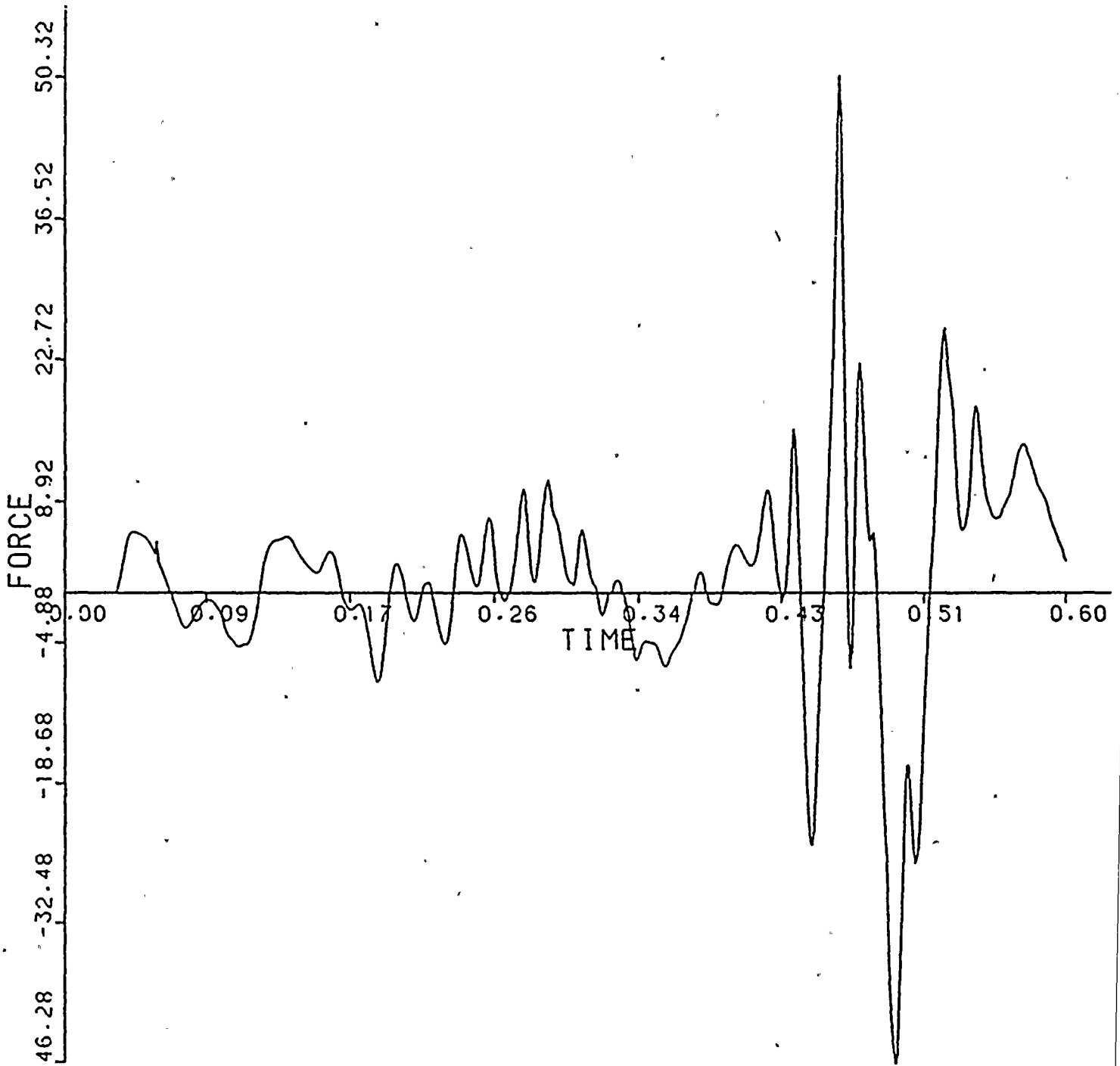
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 2, MAGNITUDE AT NODE POINT 104



DONE BY: MR DATE: 5/23/83
CHKD BY: JM DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 3, MAGNITUDE AT NODE POINT 103



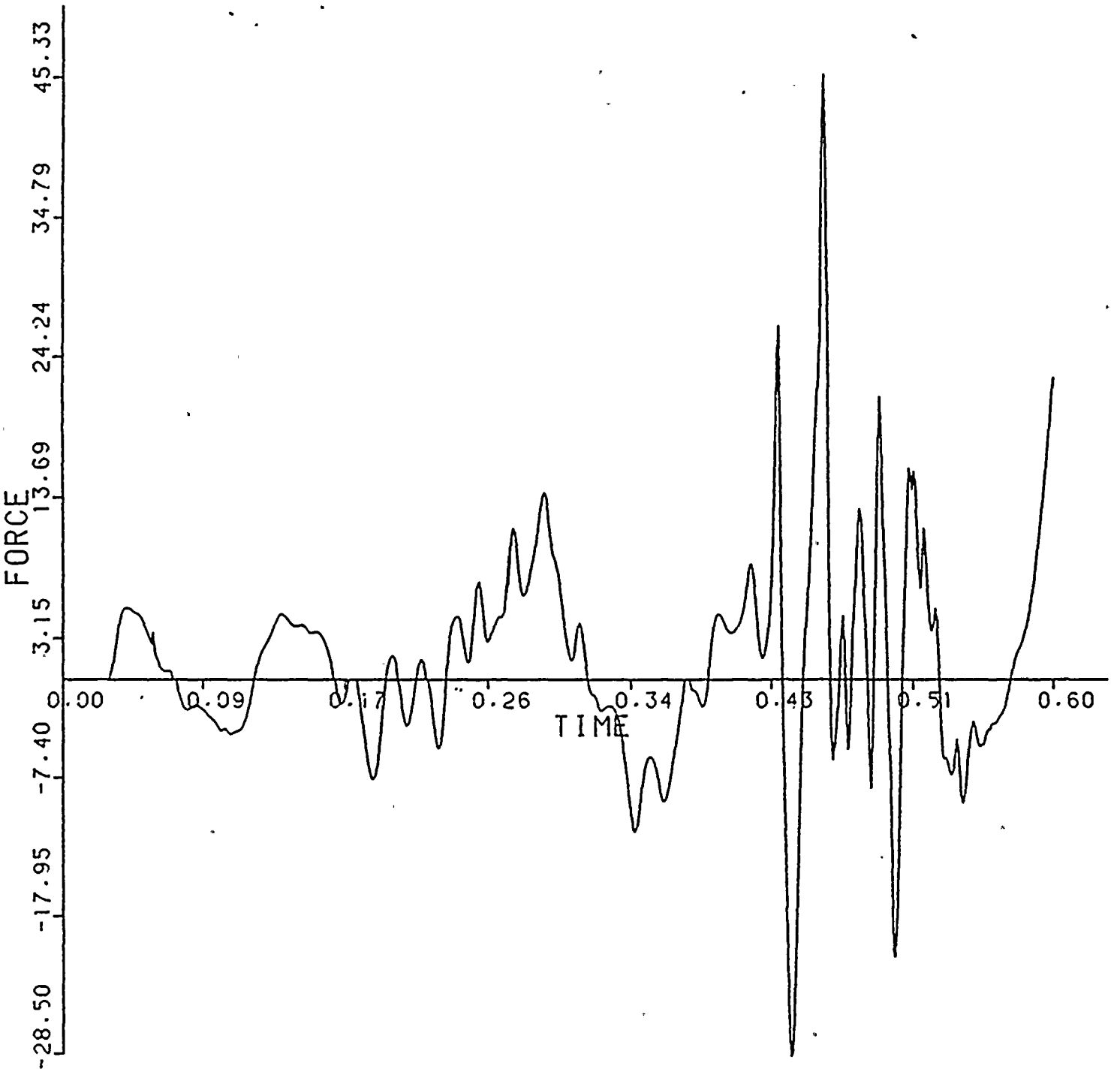
DONE BY: MR DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83

YEL-RED SOLID UNIT 1, 0-600 MS

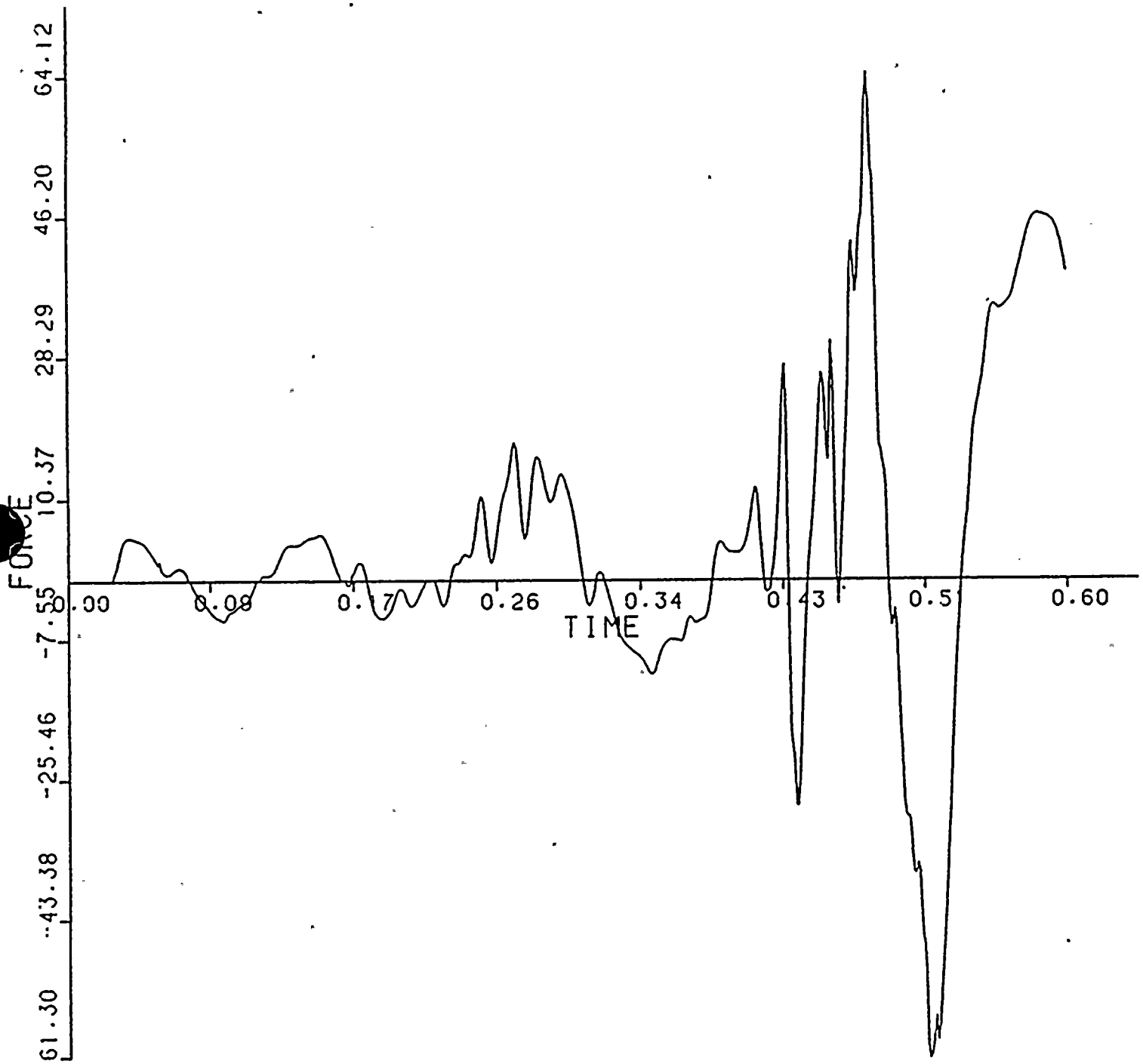
TIME/FORCE TABLE 4, MAGNITUDE AT NODE POINT 102



DONE BY: MR DATE: 5-23-83

CHKD BY: JM DATE: 5-23-83

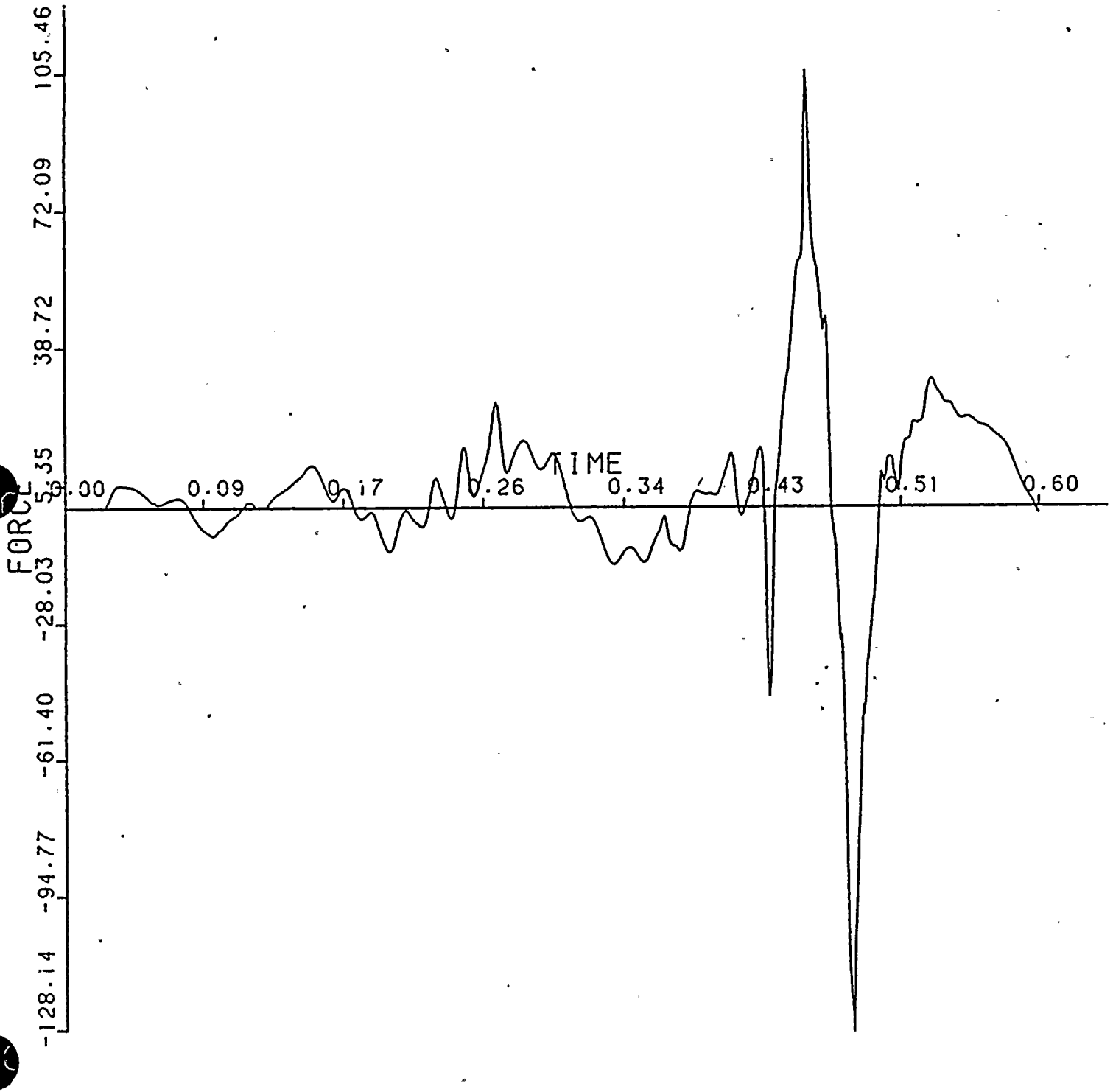
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 5, MAGNITUDE AT NODE POINT . 100



DONE BY: MZ DATE: 5-23-83
CHKD BY: MA DATE: 5-23-83

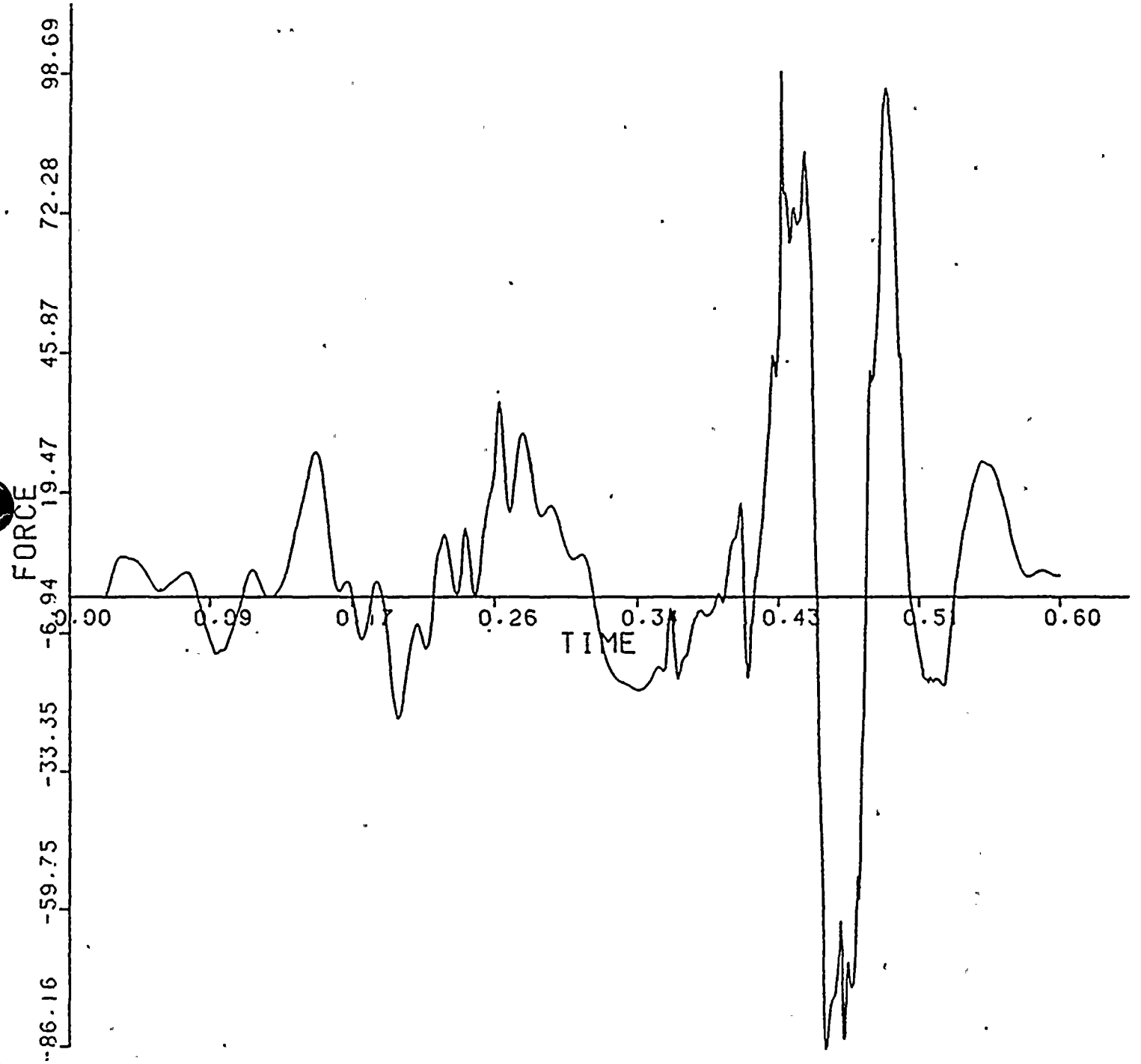
TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 6, MAGNITUDE AT NODE POINT 99



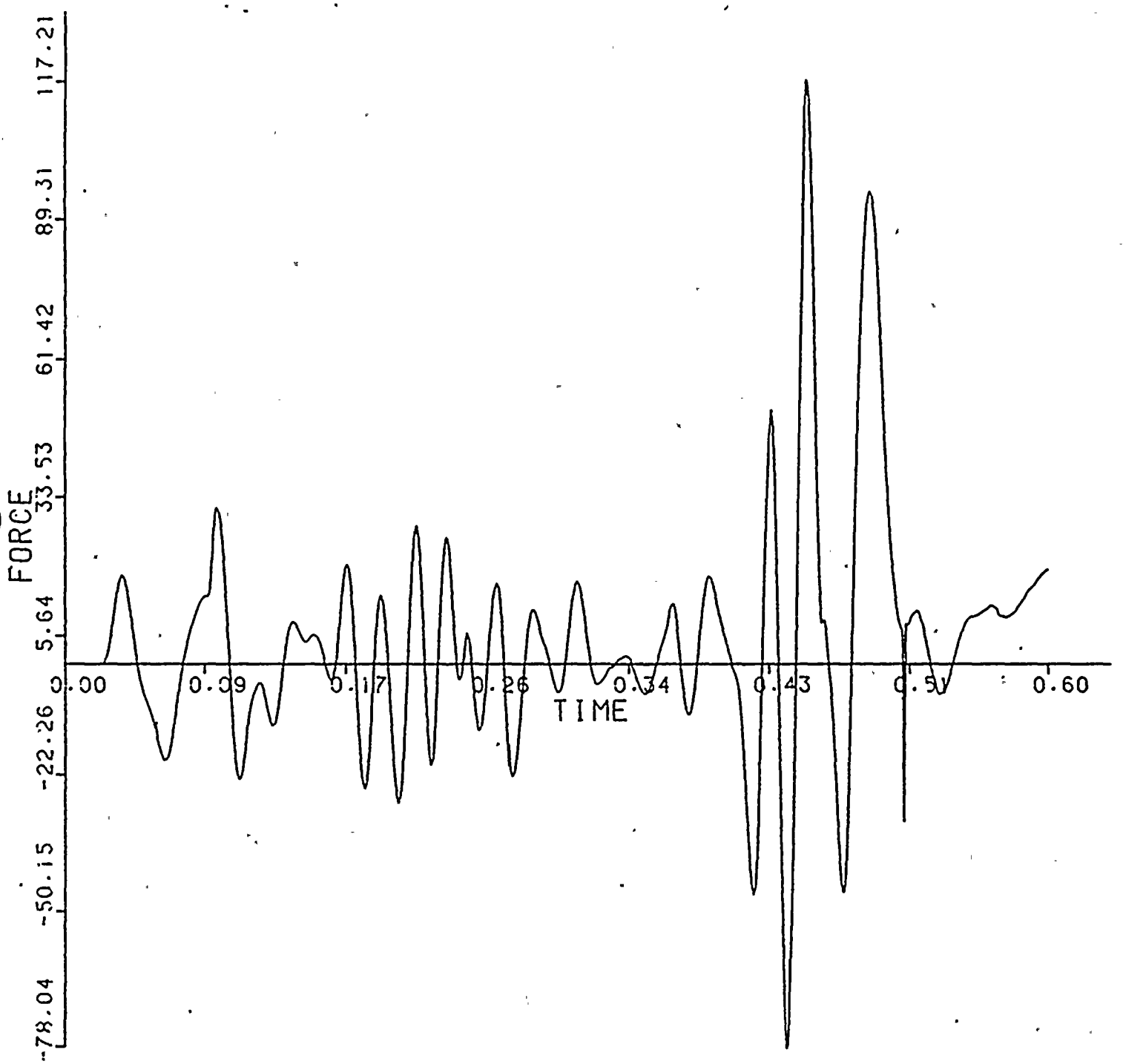
DONE BY: MZ DATE: 5-25-83
CHKD BY: JM DATE: 5-25-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 7, MAGNITUDE AT NODE POINT 98



DONE BY: MZ DATE: 5-23-83
CHKD BY: JM DATE: 5-25-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 8, MAGNITUDE AT NODE POINT 216



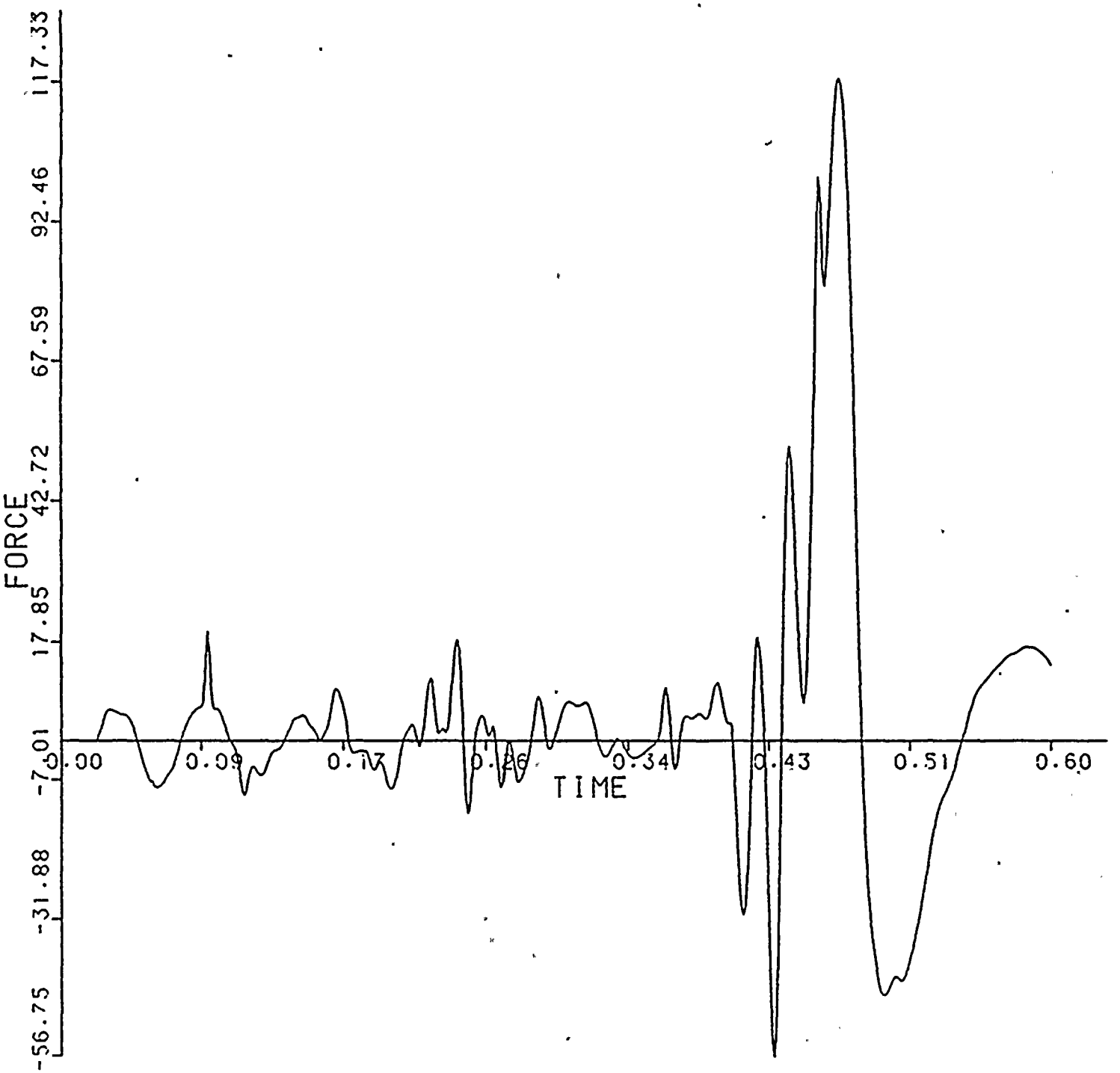
DONE BY: MZ DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83

YEL-RED SOLID UNIT 1, 0-600 MS

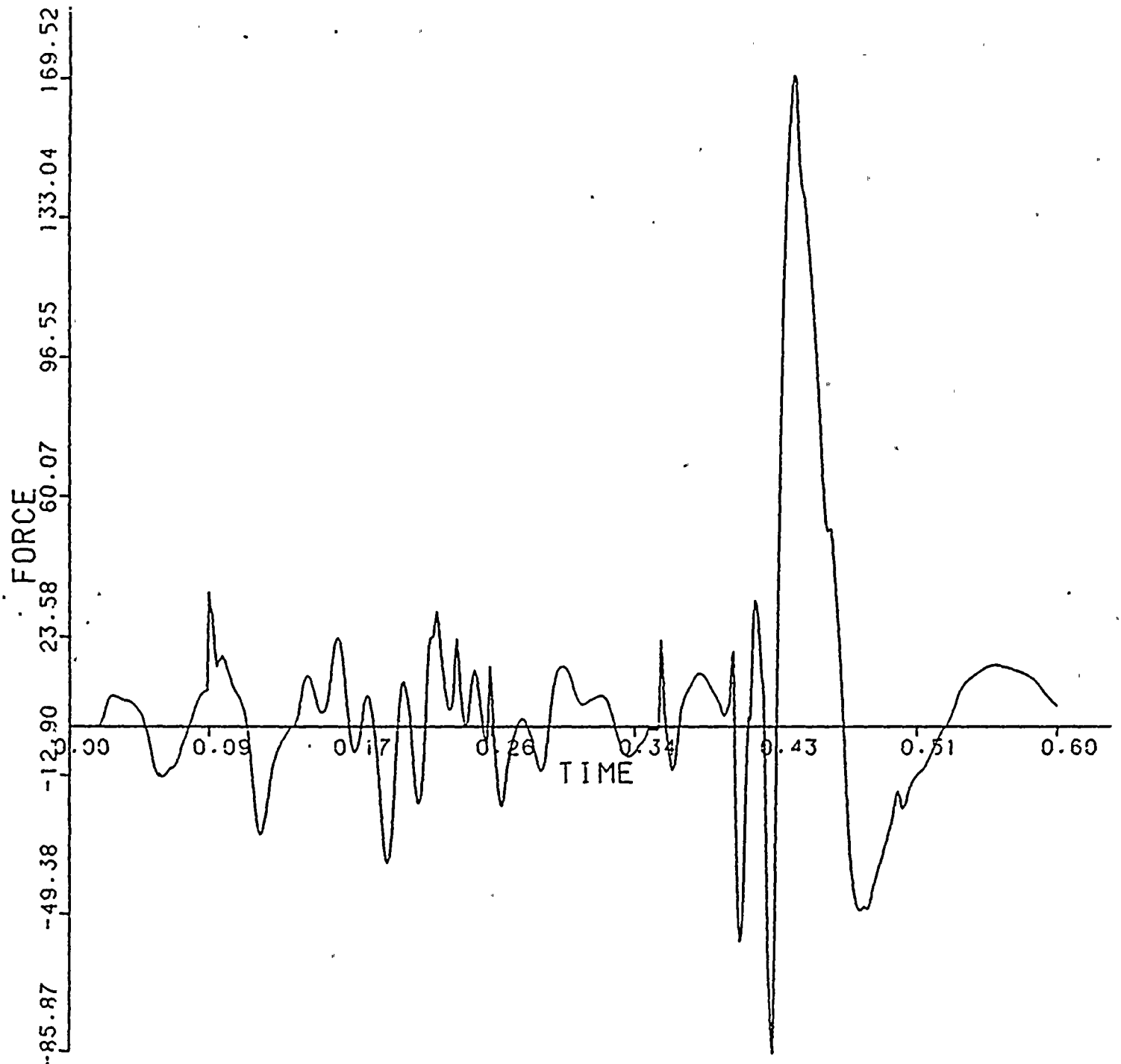
TIME/FORCE TABLE 9. MAGNITUDE AT NODE POINT 214



DONE BY: MC DATE: 5-23-83

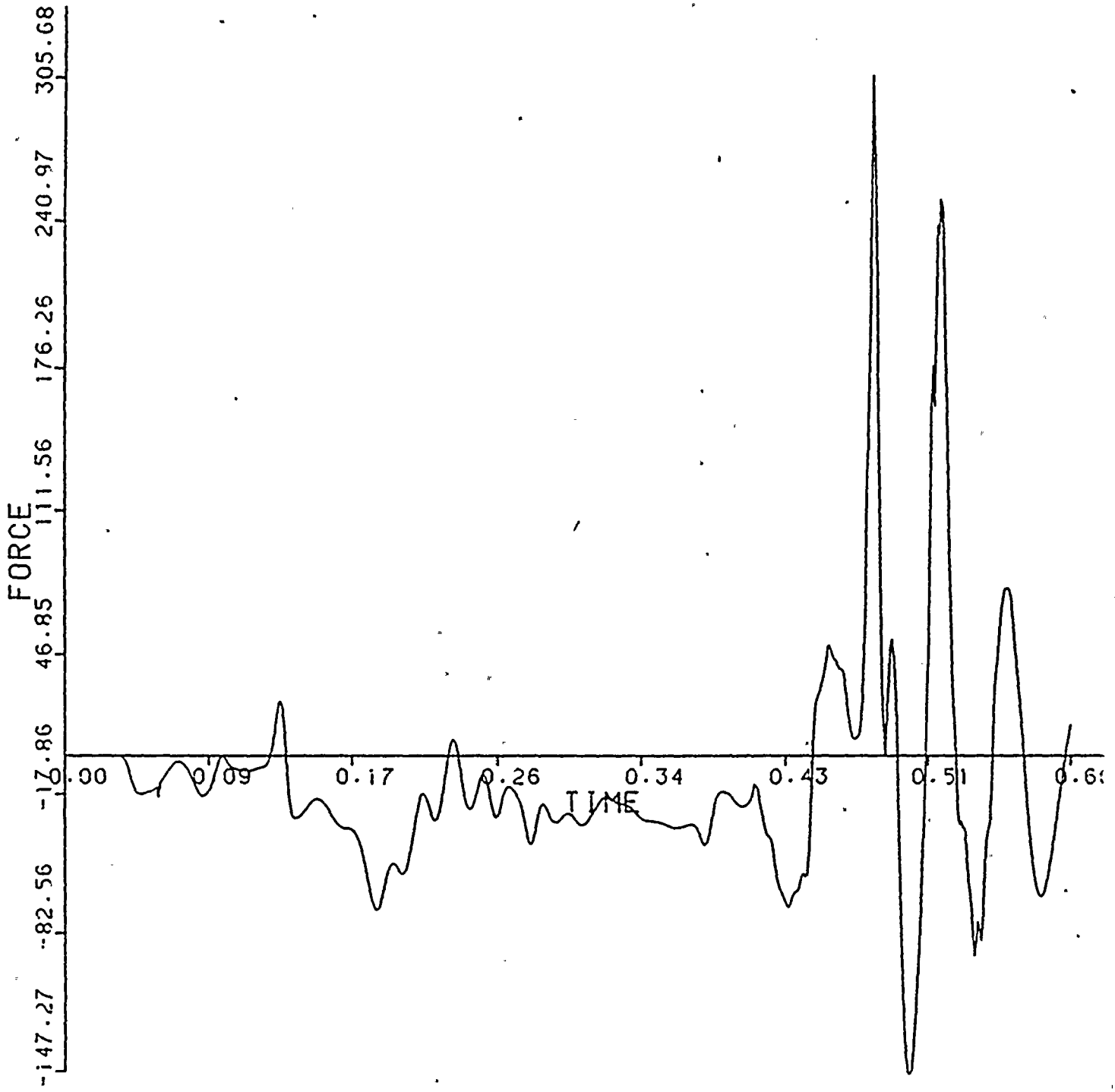
CHKD BY: [illegible] DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 10. MAGNITUDE AT NODE POINT 208



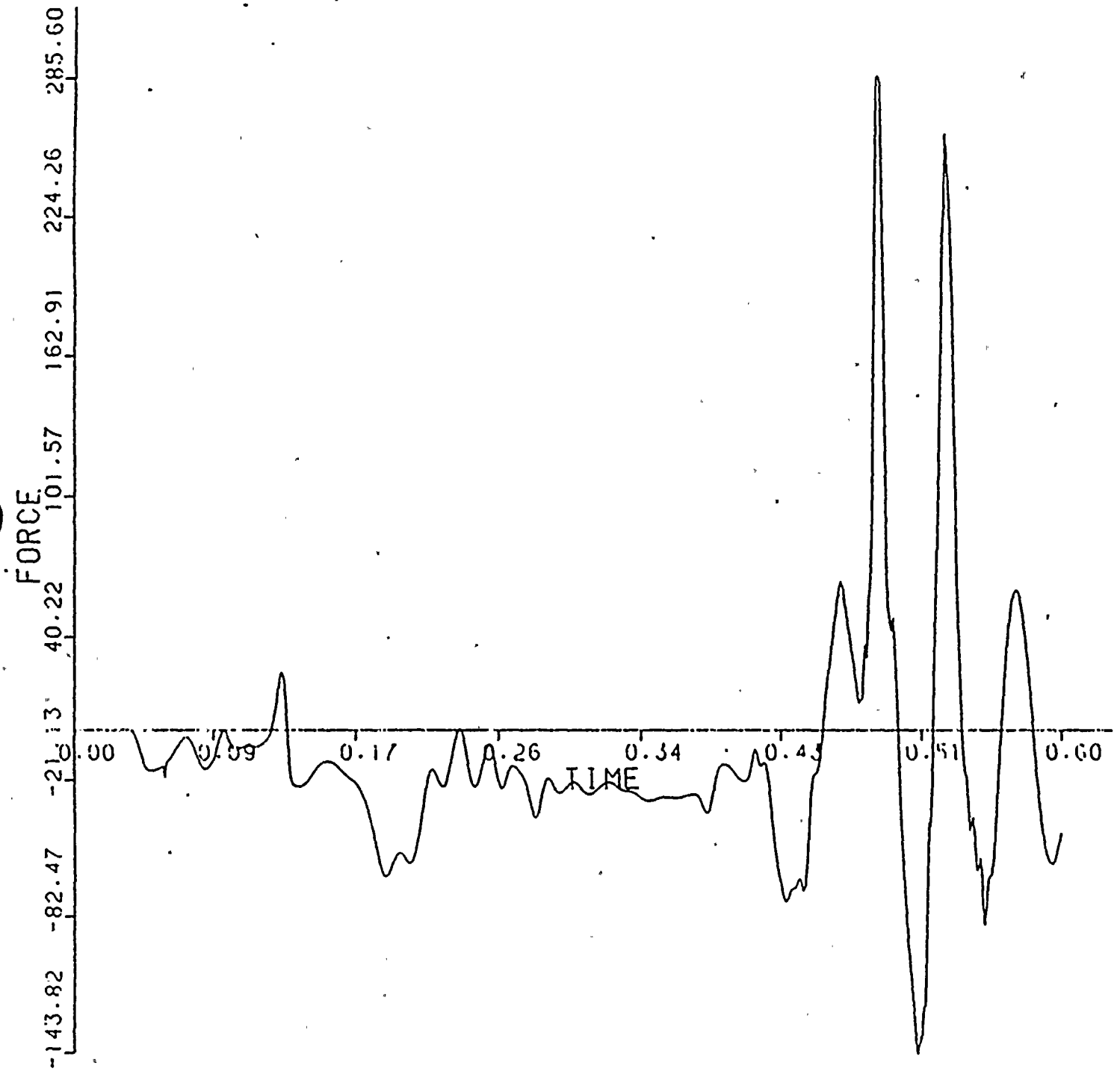
DONE BY: MR DATE: 5-12-83
CHKD BY: [illegible] DATE: 5-25-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 11, MAGNITUDE AT NODE POINT 88



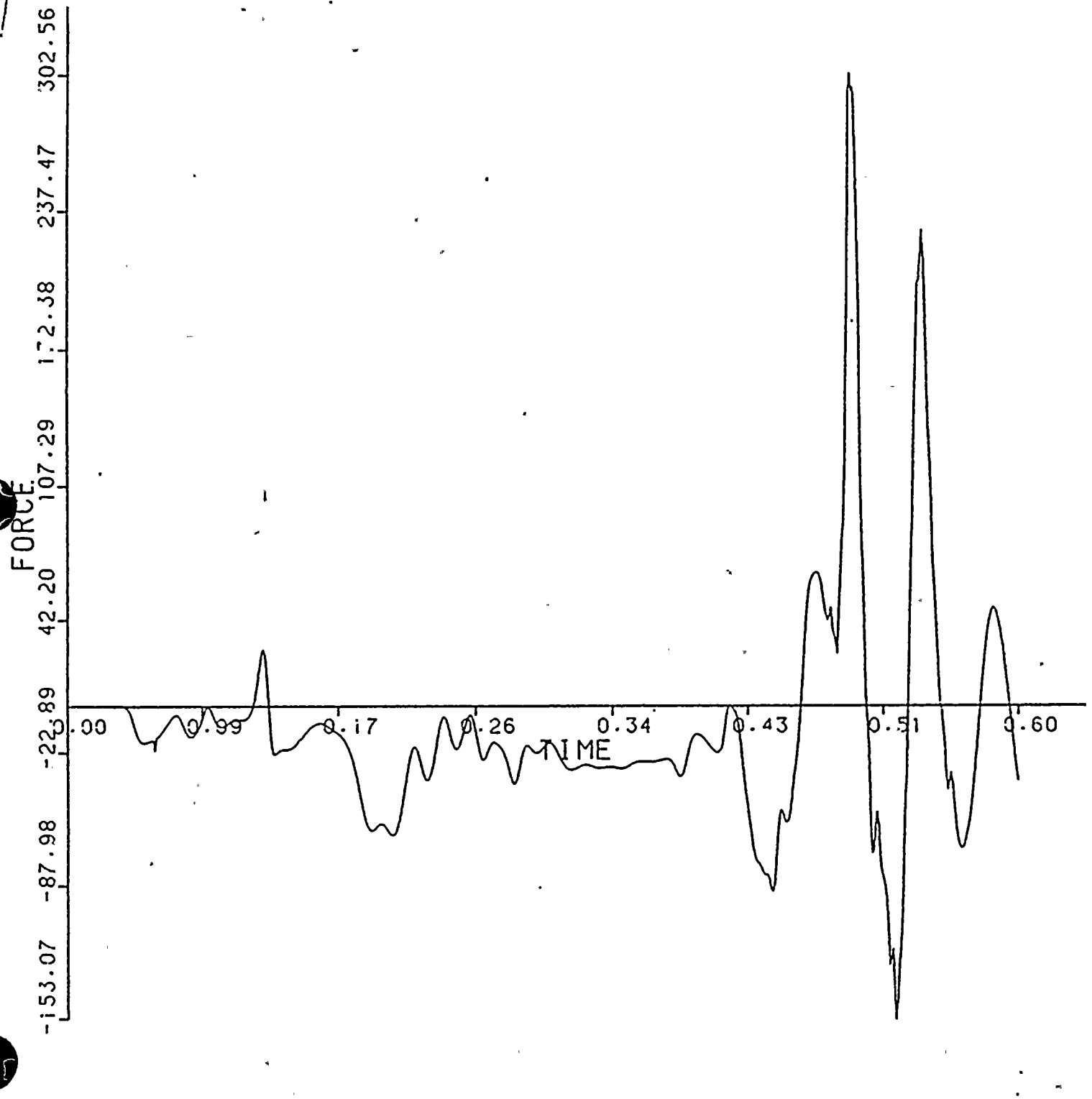
DONE BY: MR DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 12, MAGNITUDE AT NODE POINT 83



DONE BY: MC DATE: 5-23-83
CHKD BY: MM DATE: 5-23-83

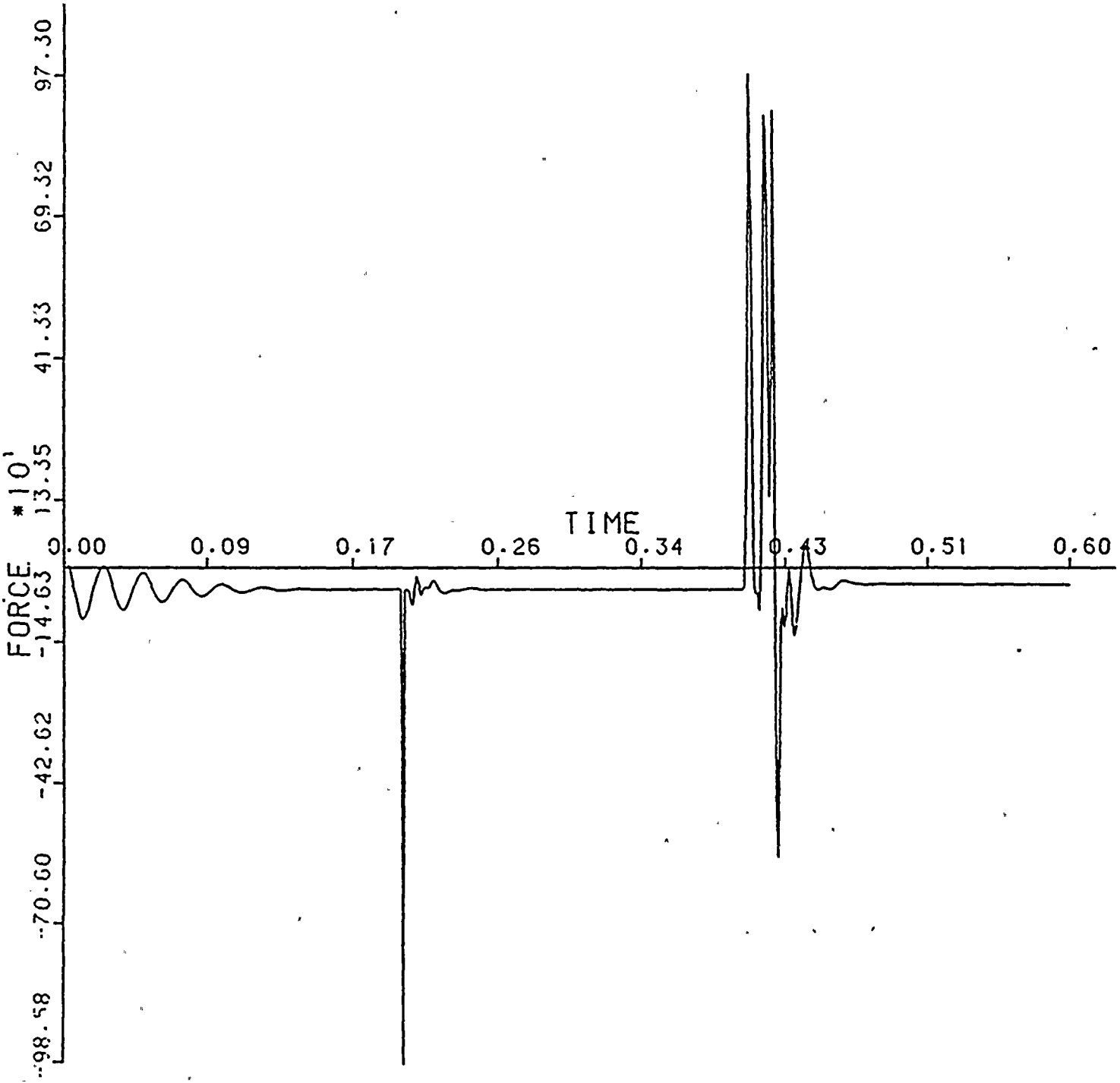
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 13, MAGNITUDE AT NODE POINT 80,



DONE BY: MZ DATE: 5 JUN 85
CHK'D BY: JM DATE: 6-6-85

TELEDYNE
ENGINEERING SERVICES

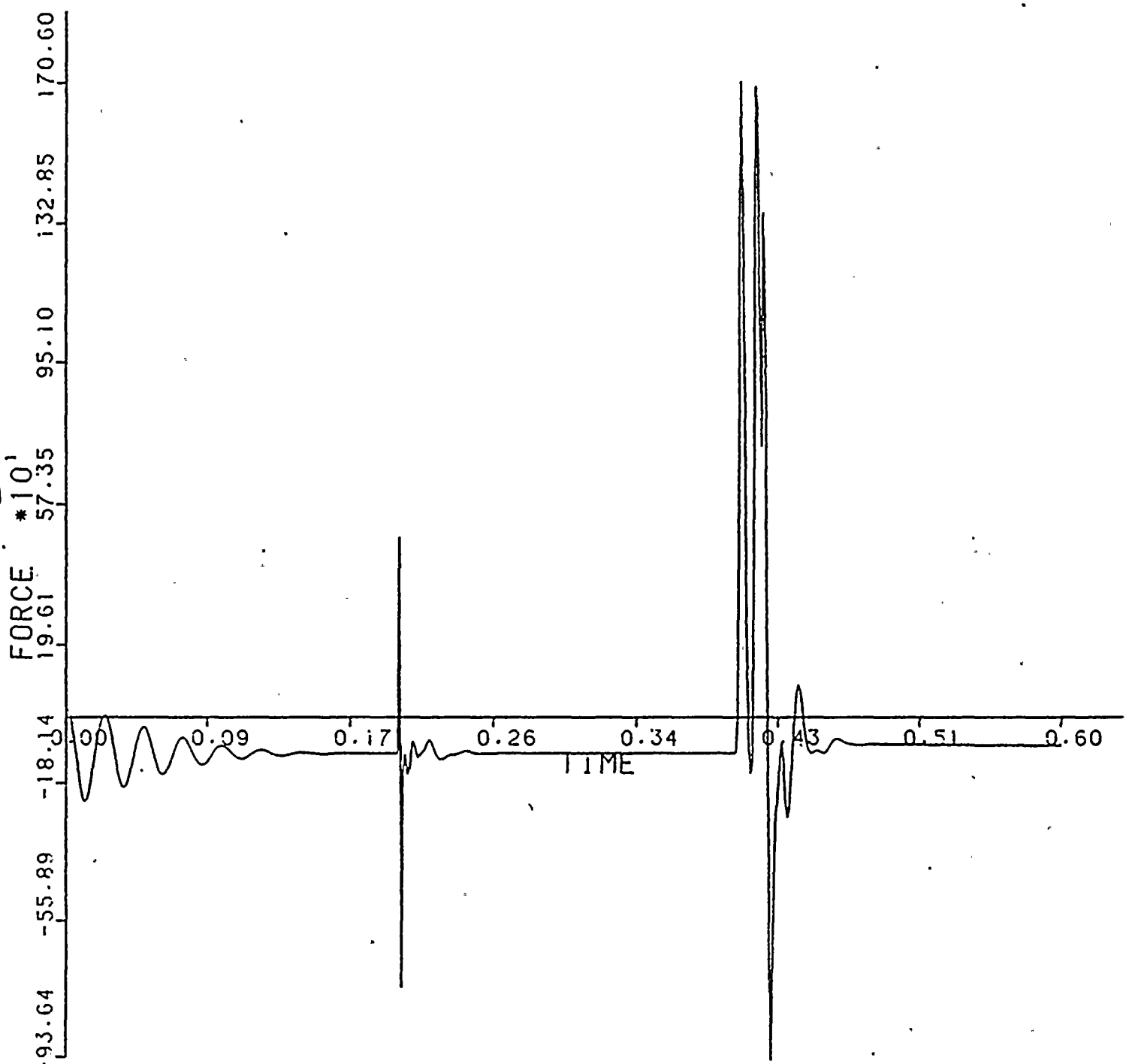
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 14, MAGNITUDE AT NODE POINT 725



DONE BY: WZ DATE: 5-23-83
CHKD BY: JM DATE: 5-25-83

TELEDYNE
ENGINEERING SERVICES

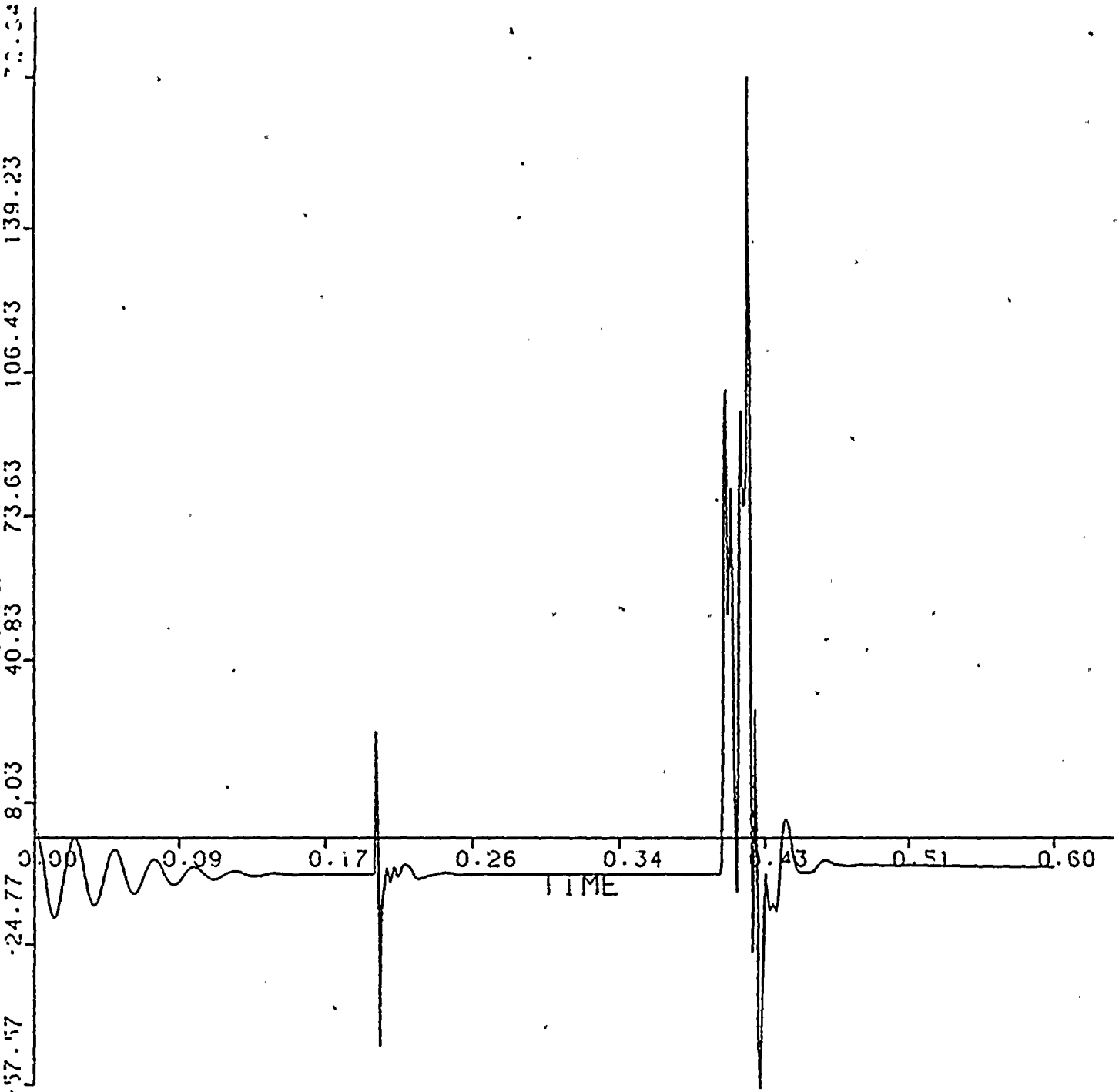
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 15. MAGNITUDE AT NODE POINT 717



DONE BY: [illegible] DATE: [illegible]
CHKD BY: [illegible] DATE: [illegible]

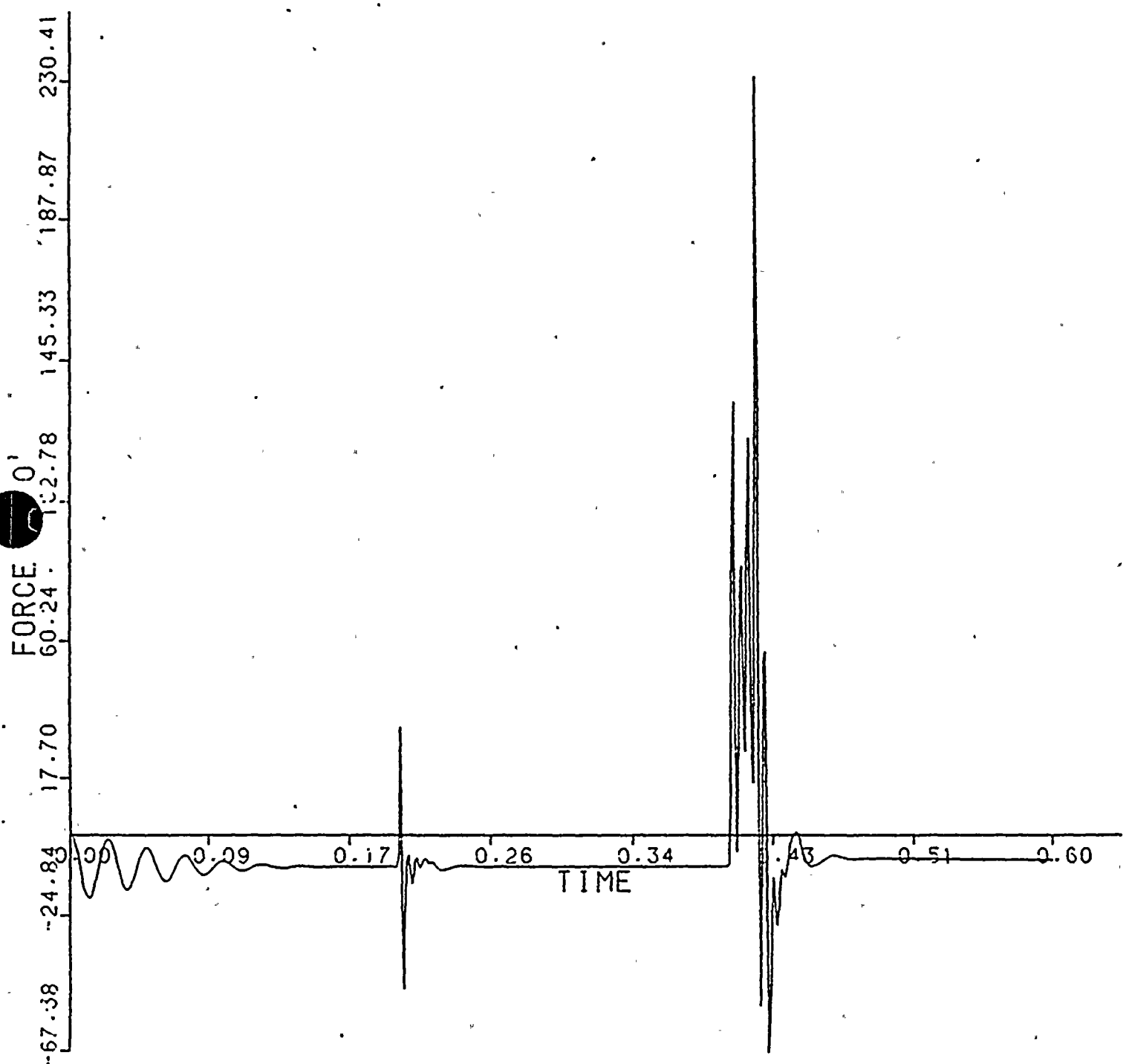
TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 16. MAGNITUDE AT NODE POINT 710



DONE BY: MZ DATE: 5-[illegible]
CHKD BY: [illegible] DATE: [illegible]

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 17. MAGNITUDE AT NODE POINT 680



DONE BY: MJ DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

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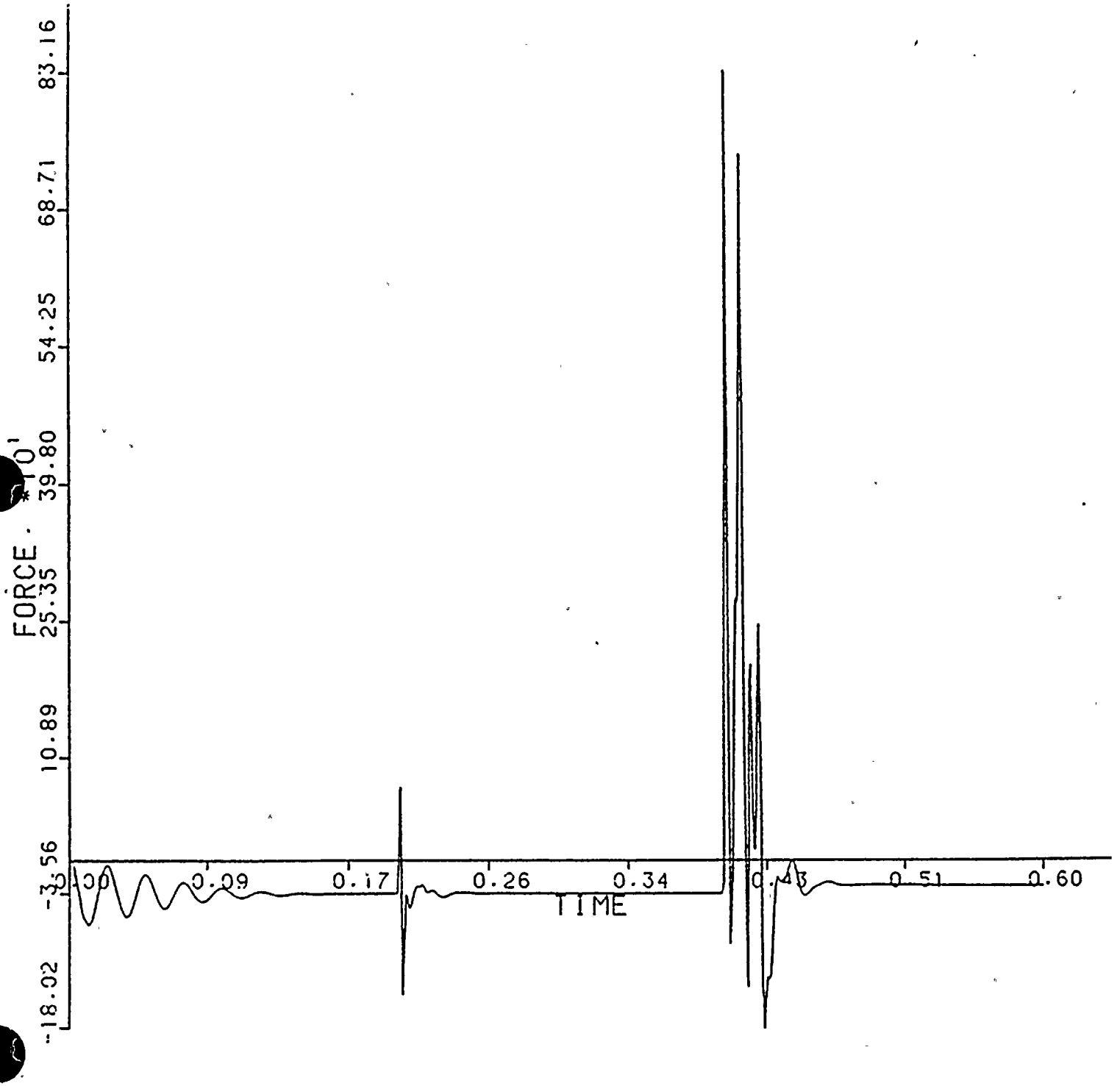
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE . 18, MAGNITUDE AT NODE POINT 600



DONE BY: MD DATE: 5-23-83
CHKD BY: MA DATE: 5-23-83

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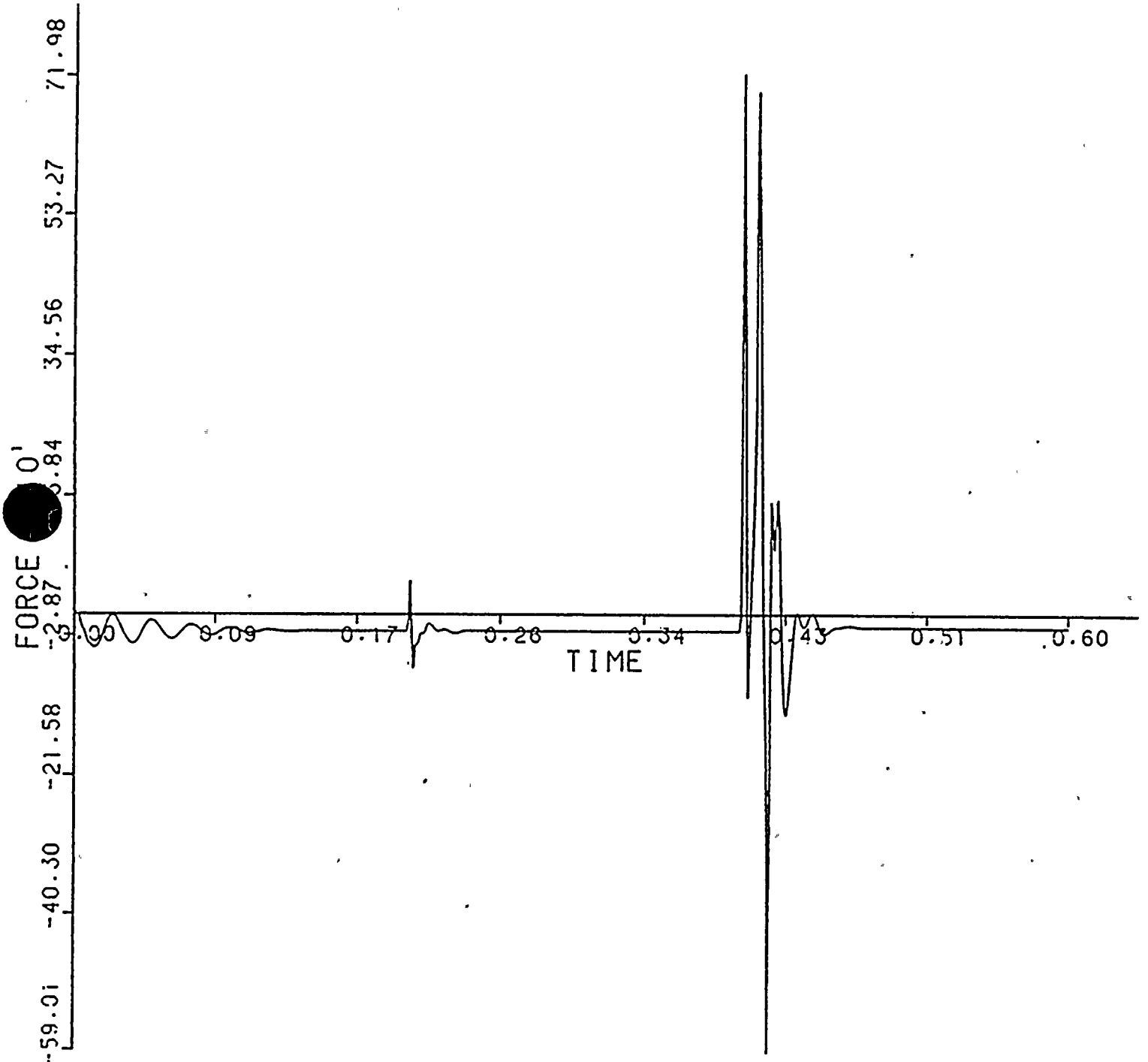
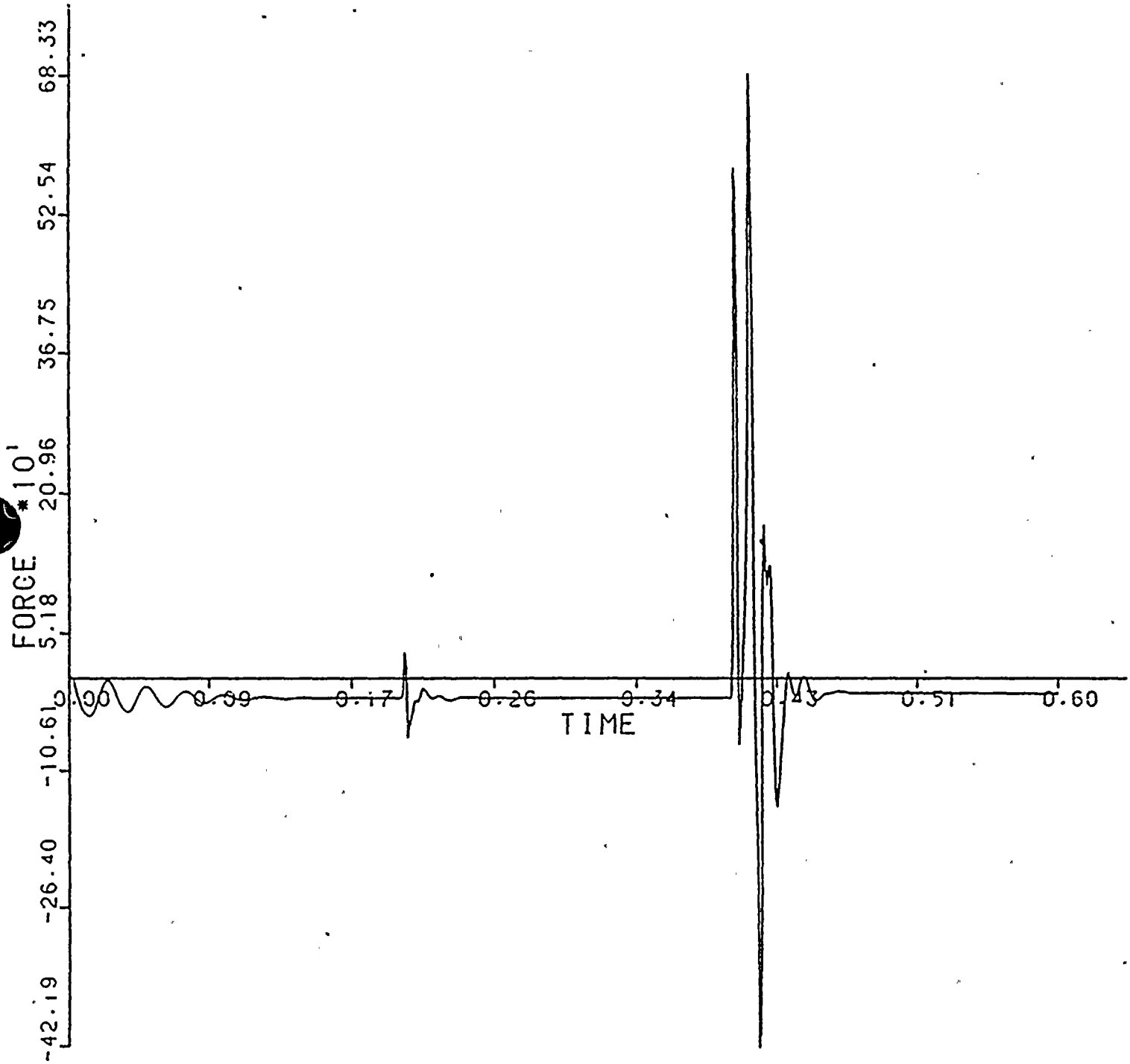
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID,UNIT 1, 0-600 MS
TIME/FORCE TABLE 19, MAGNITUDE AT NODE POINT 590



DONE BY: MZ DATE: 5/24/83
CHKD BY: JM DATE: 5-25-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 20, MAGNITUDE AT NODE POINT 585



DONE BY: DATE:
CHKD BY: DATE:

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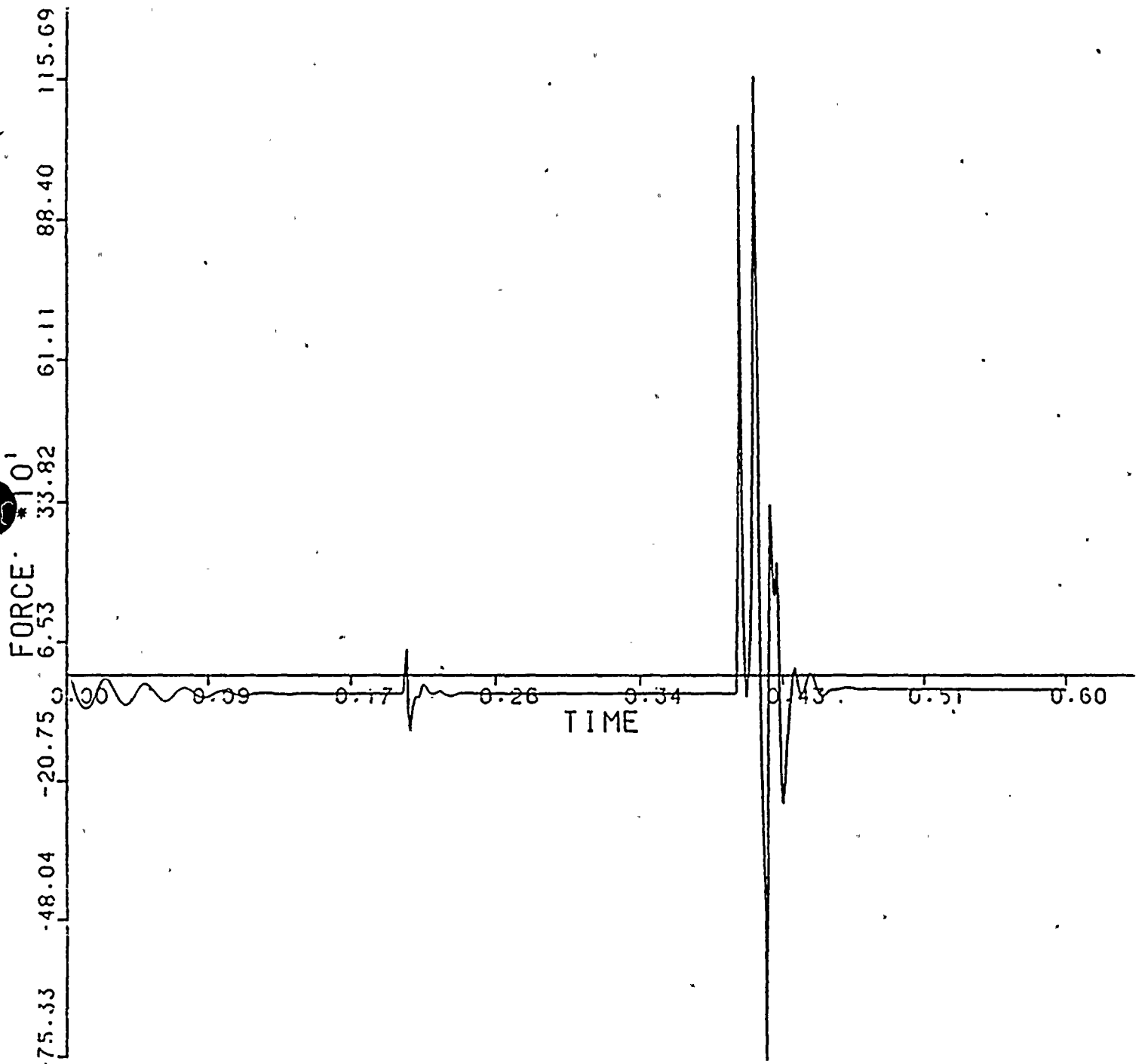
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 21. MAGNITUDE AT NODE POINT 575



DONE BY: MC DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

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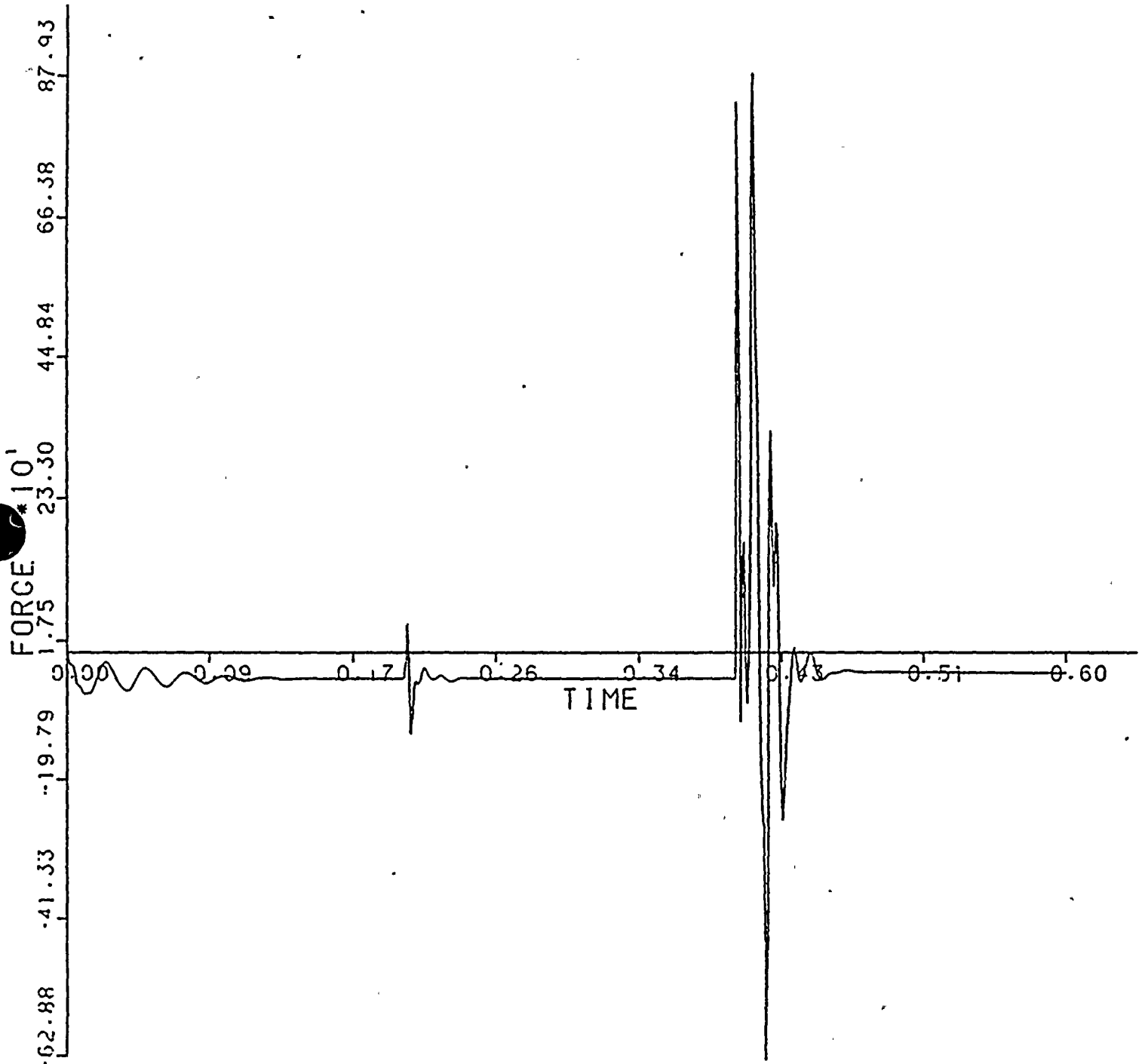
ENGINEERING SERVICES

4-342

SAP2SAP VERIFICATION 5364 23-MAY-83

YEL-RED SOLID UNIT 1, 0-600 MS

TIME/FORCE TABLE 22, MAGNITUDE AT NODE POINT 435

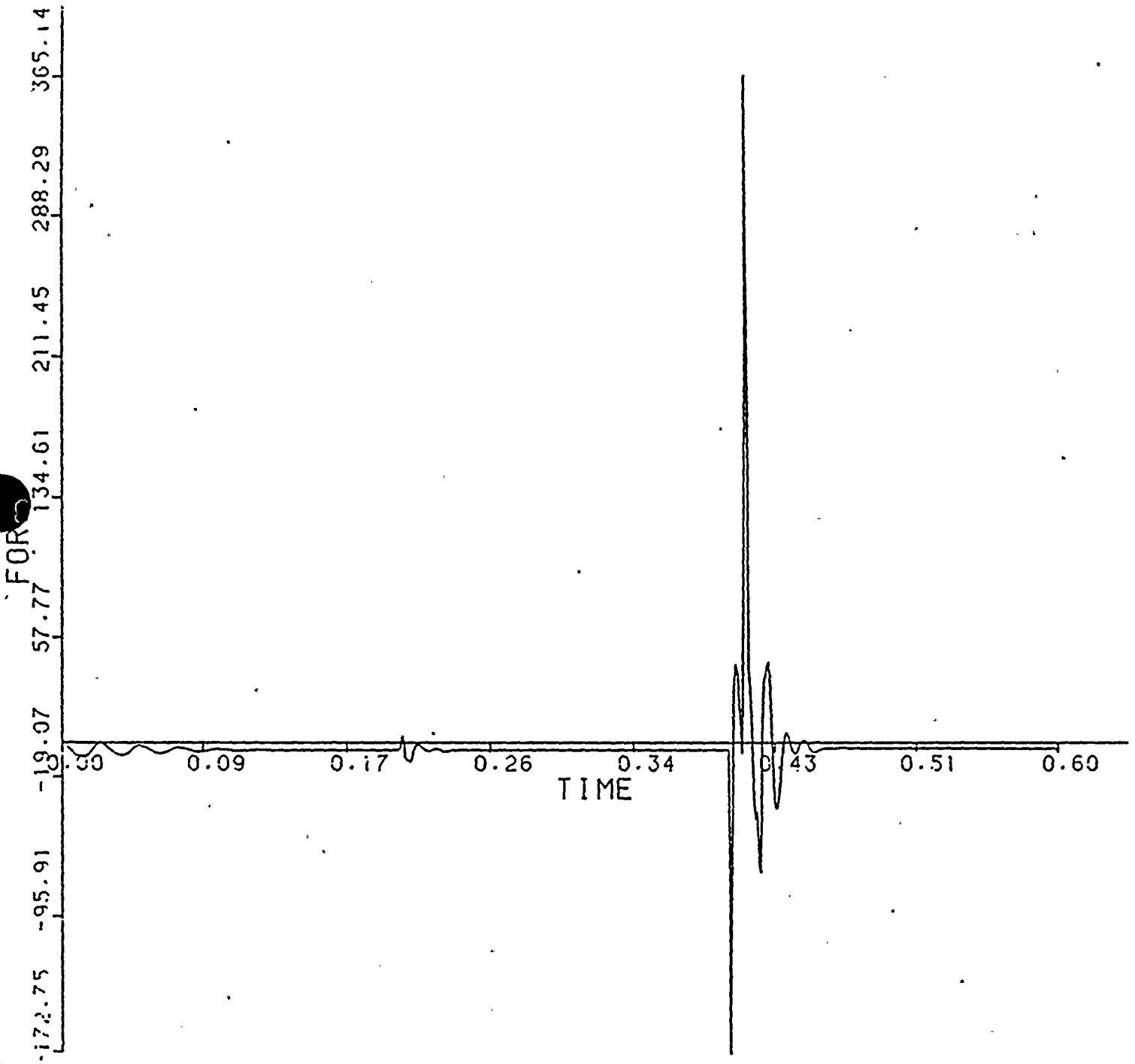


DONE BY: [illegible] DATE: [illegible]

CHKD BY: [illegible] DATE: [illegible]

TELEDYNE
ENGINEERING SERVICES

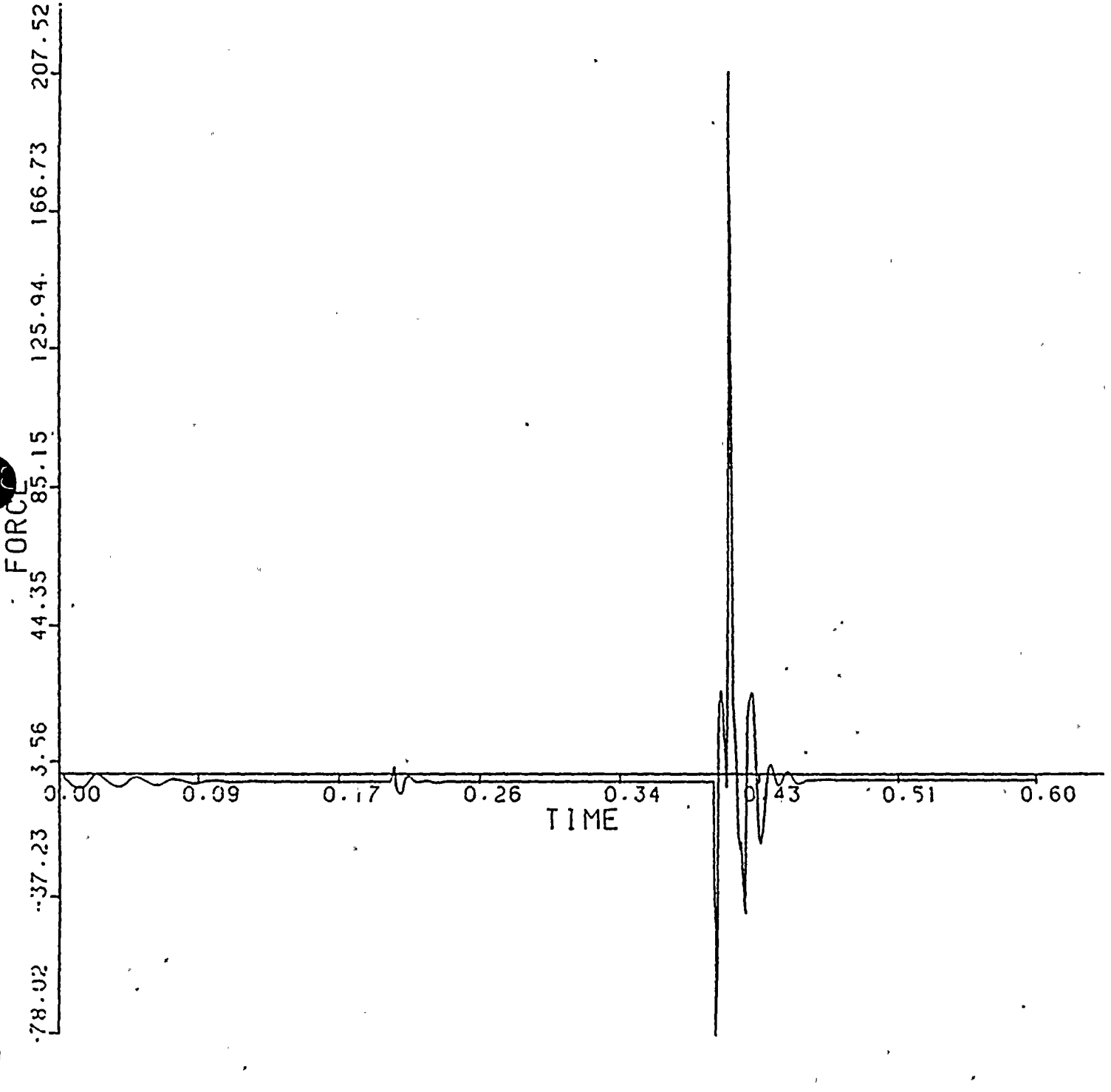
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 23, MAGNITUDE AT NODE POINT 440



DONE BY: VZ DATE: 5-23-83
CHKD BY: JJ DATE: 5-25-83

TELEDYNE
ENGINEERING SERVICES

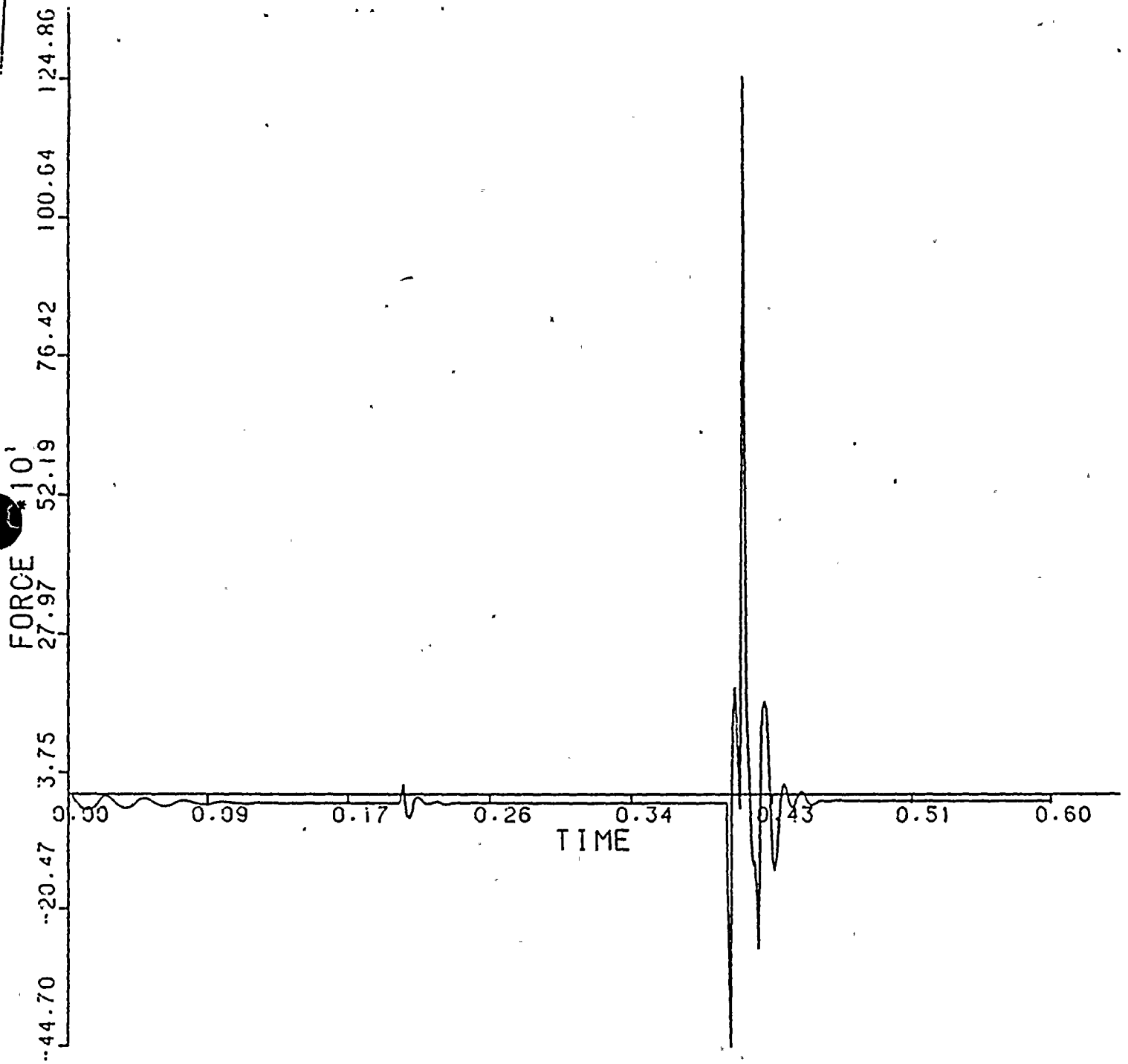
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 24, MAGNITUDE AT NODE POINT 450



DONE BY: MD DATE: 5-23-83
CHKD BY: M DATE: 5-23-83

TELEDYNE ENGINEERING SERVICES

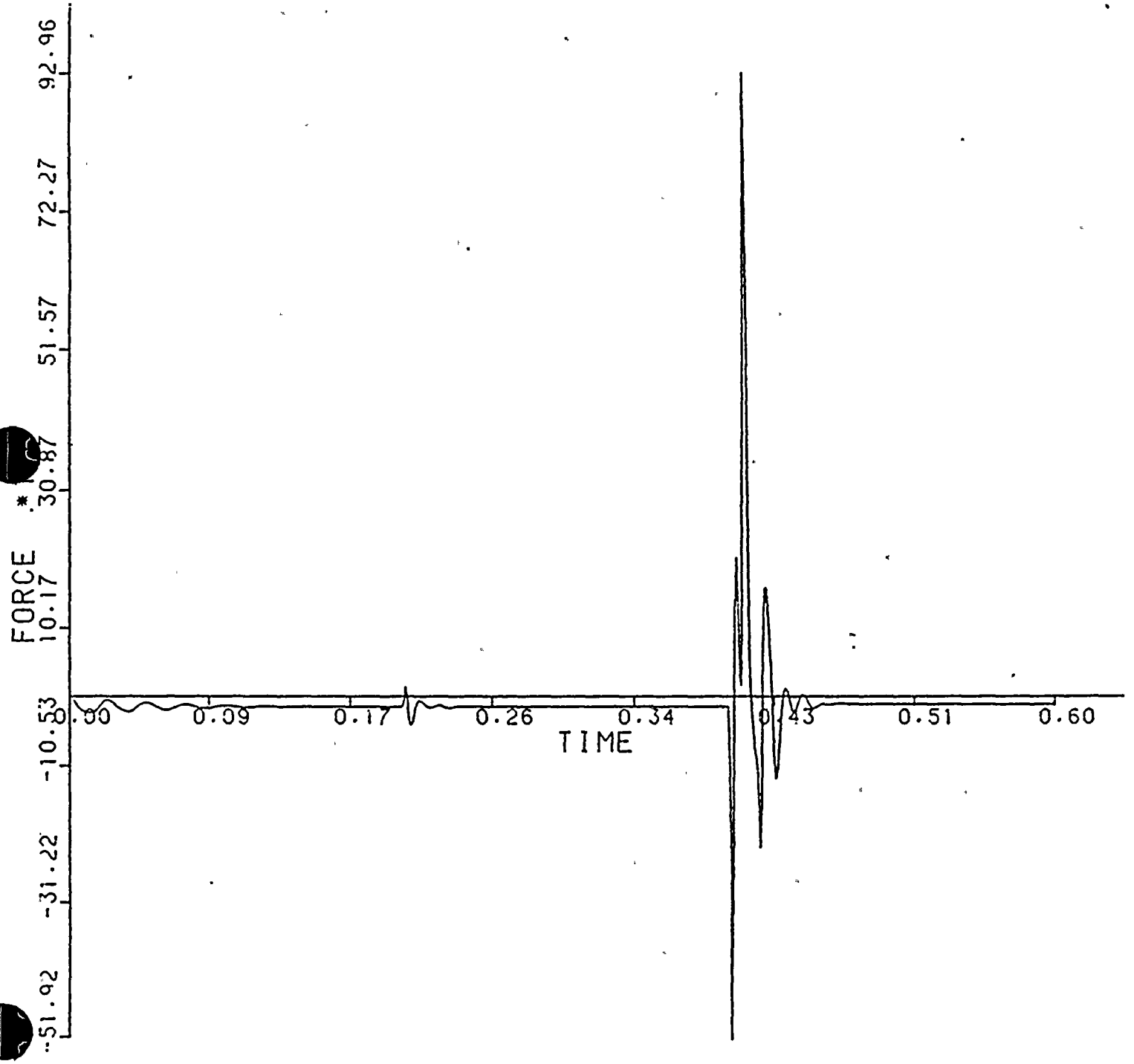
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 25, MAGNITUDE AT NODE POINT 460



DONE BY: _____ DATE: _____
CHKD BY: _____ DATE: _____

TELEDYNE
ENGINEERING SERVICES

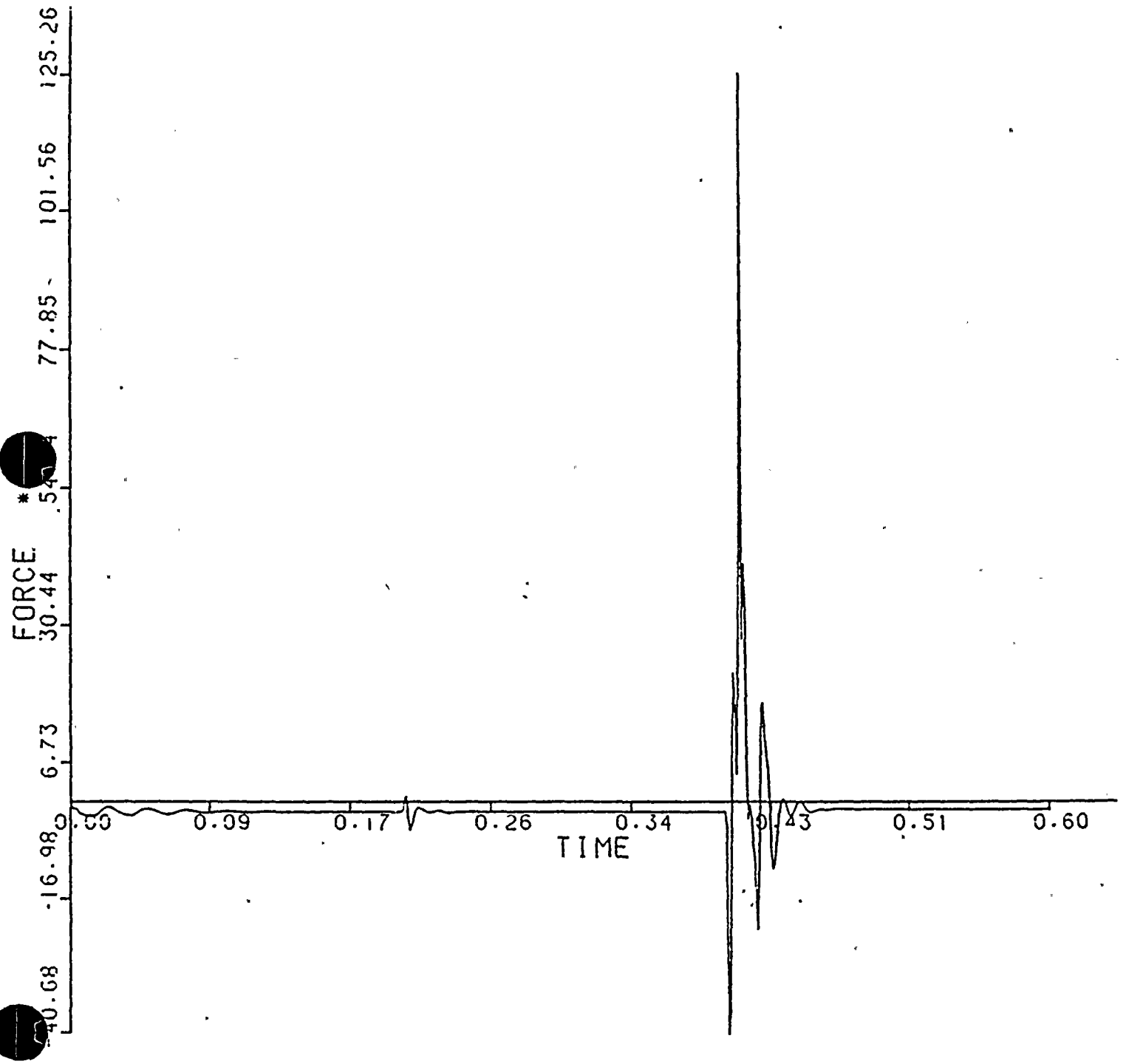
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 26, MAGNITUDE AT NODE POINT 465



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

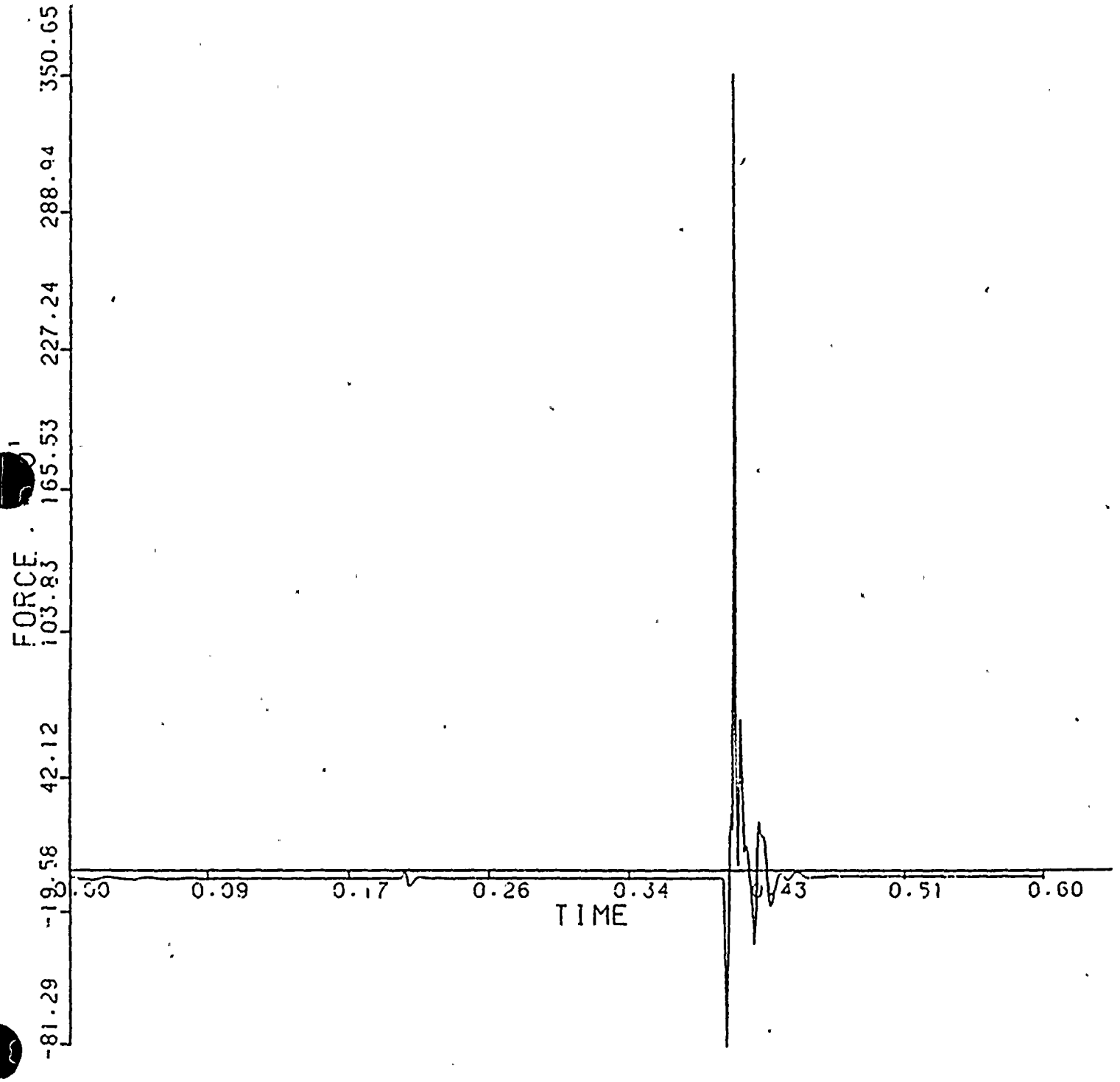
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 27, MAGNITUDE AT NODE POINT 475



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

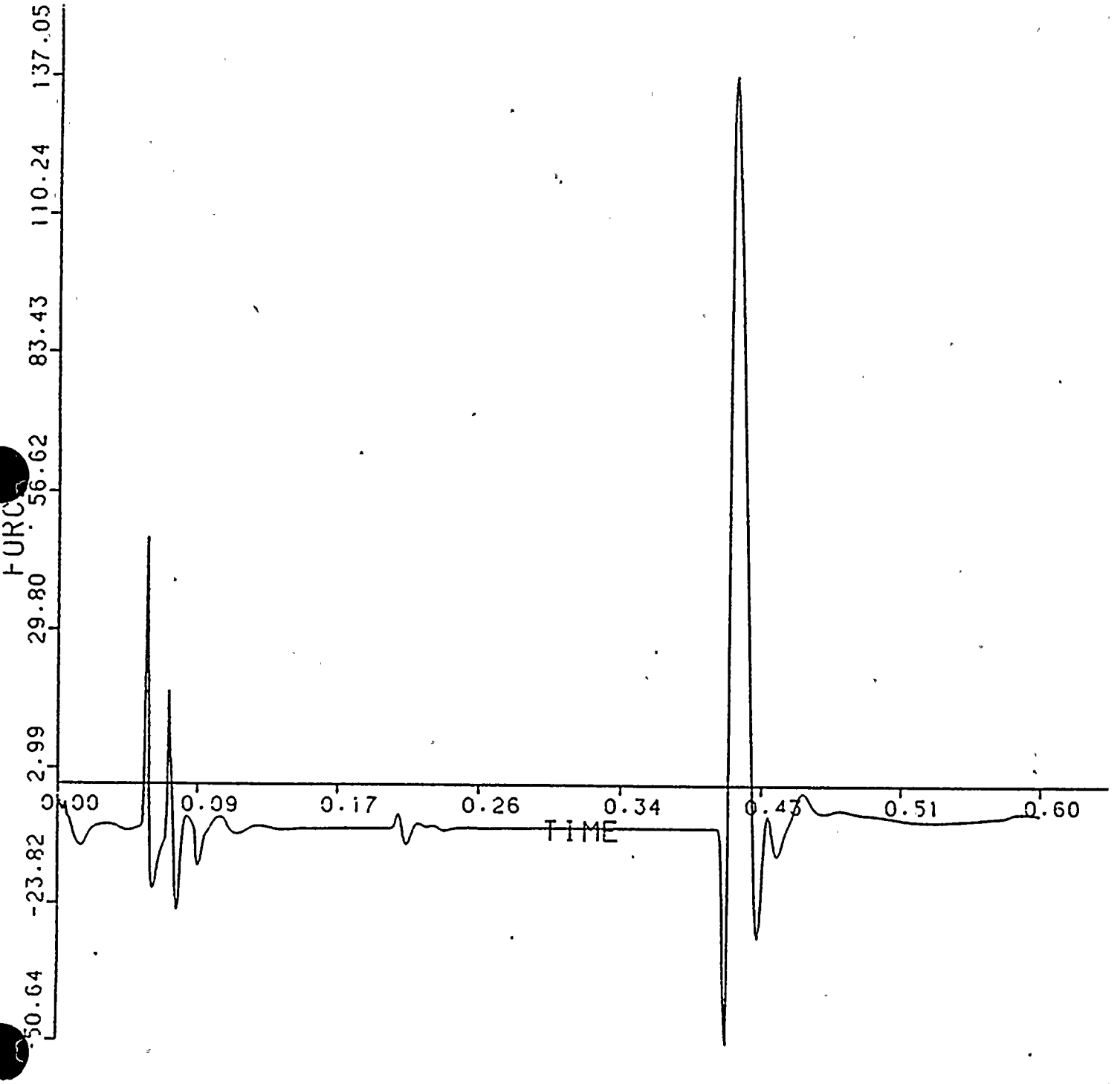
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 28. MAGNITUDE AT NODE POINT 485



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

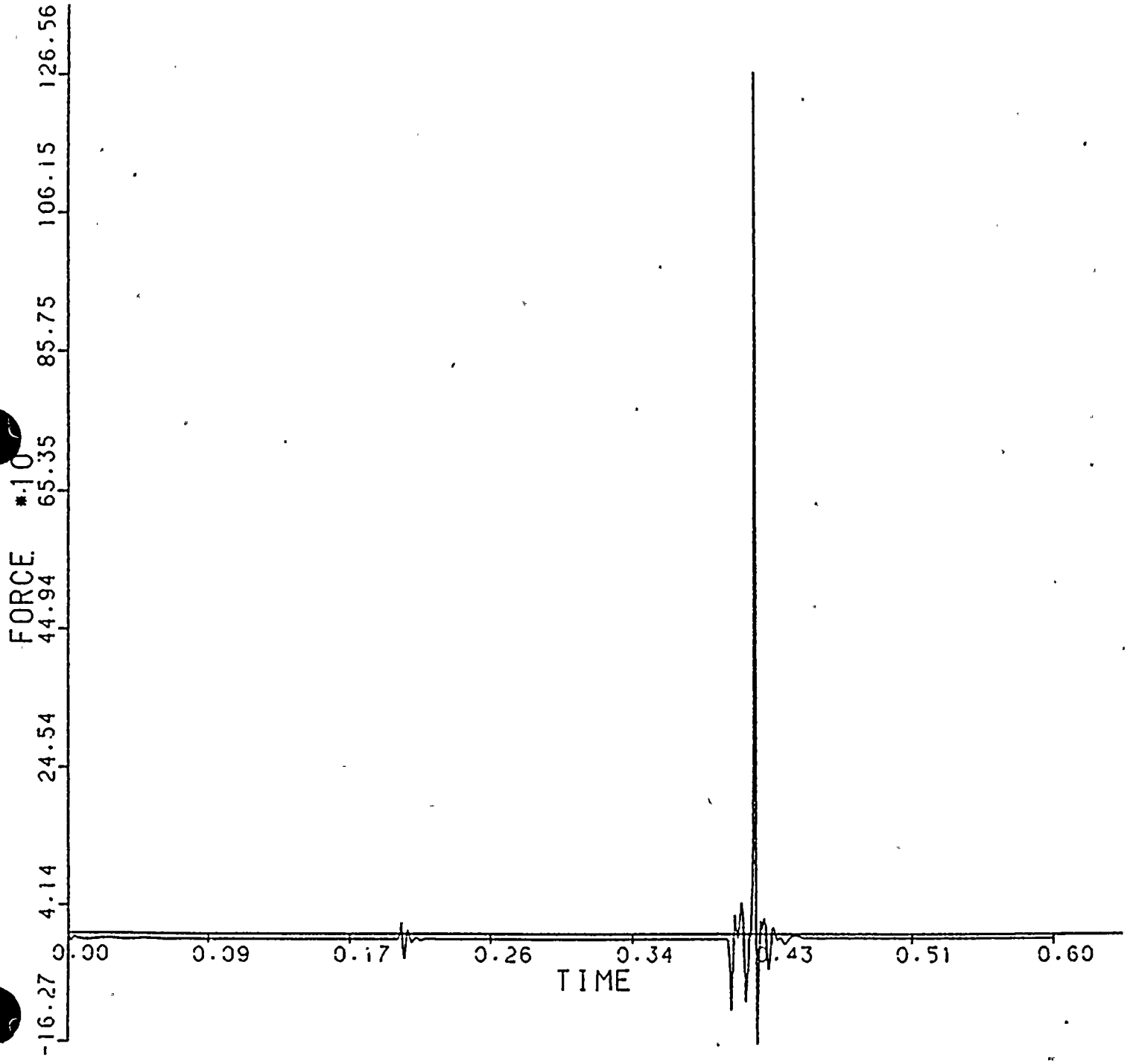
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 29. MAGNITUDE AT NODE POINT 529



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

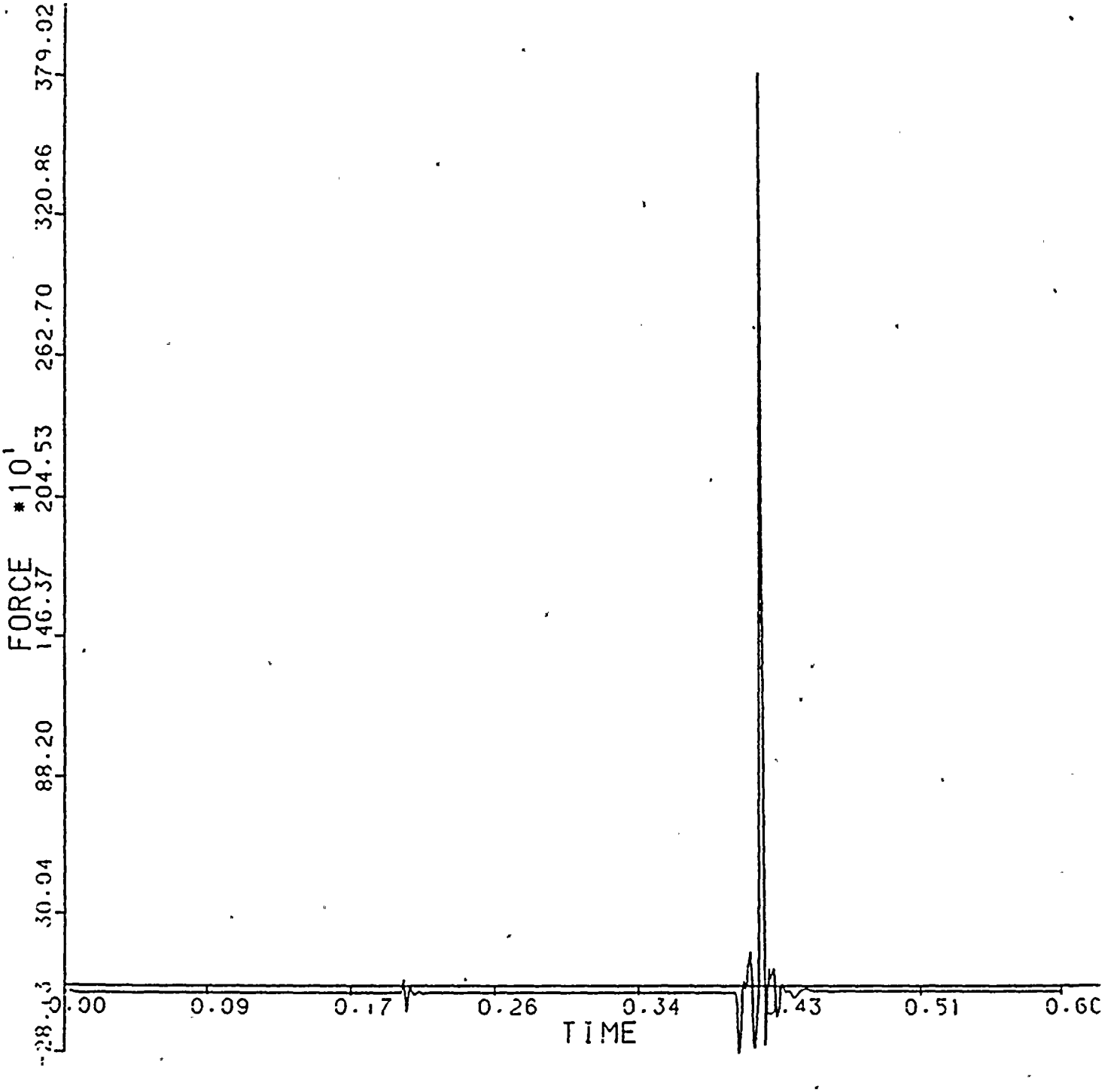
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 30, MAGNITUDE AT NODE POINT 665



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

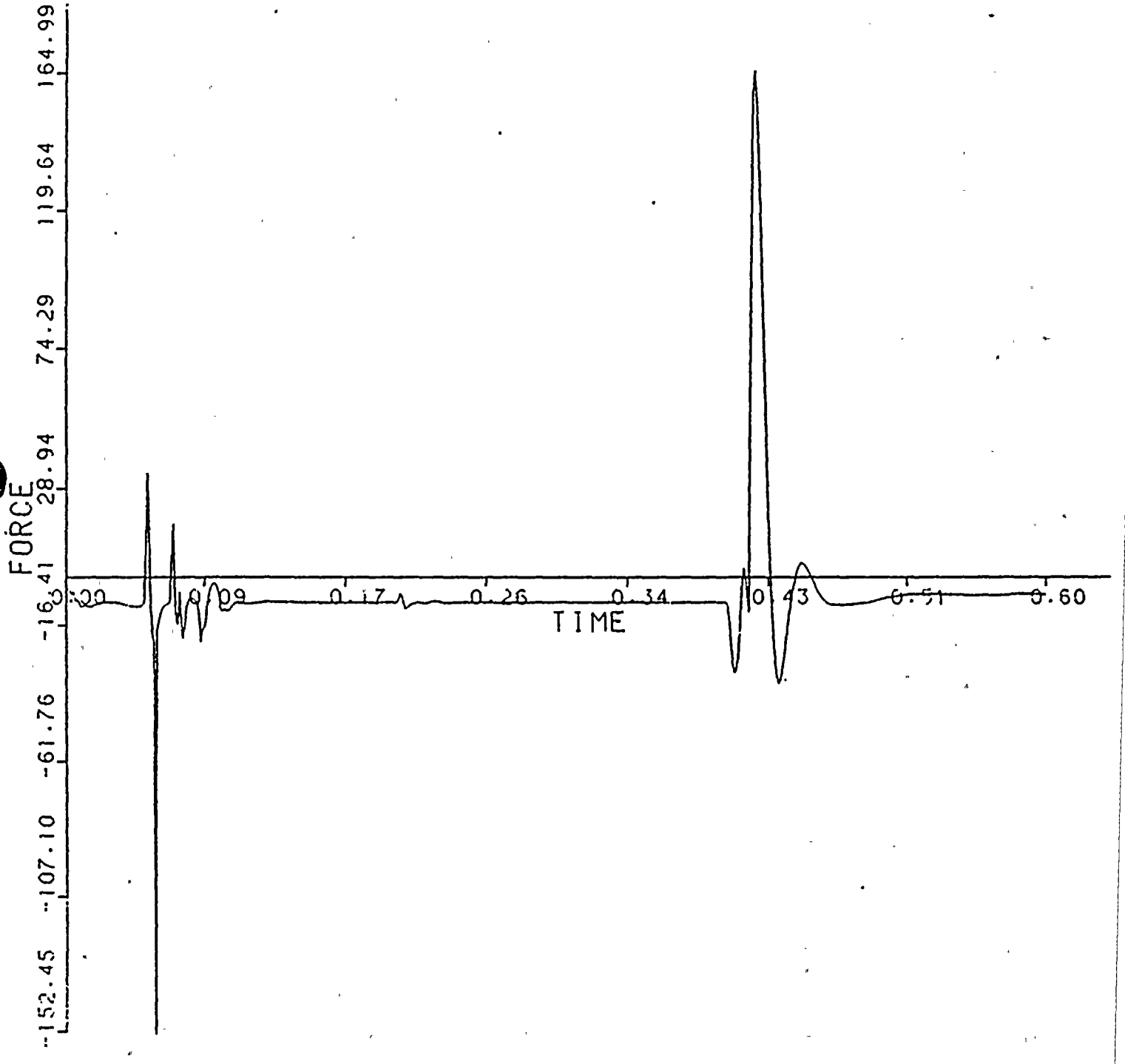
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 31, MAGNITUDE AT NODE POINT 657



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

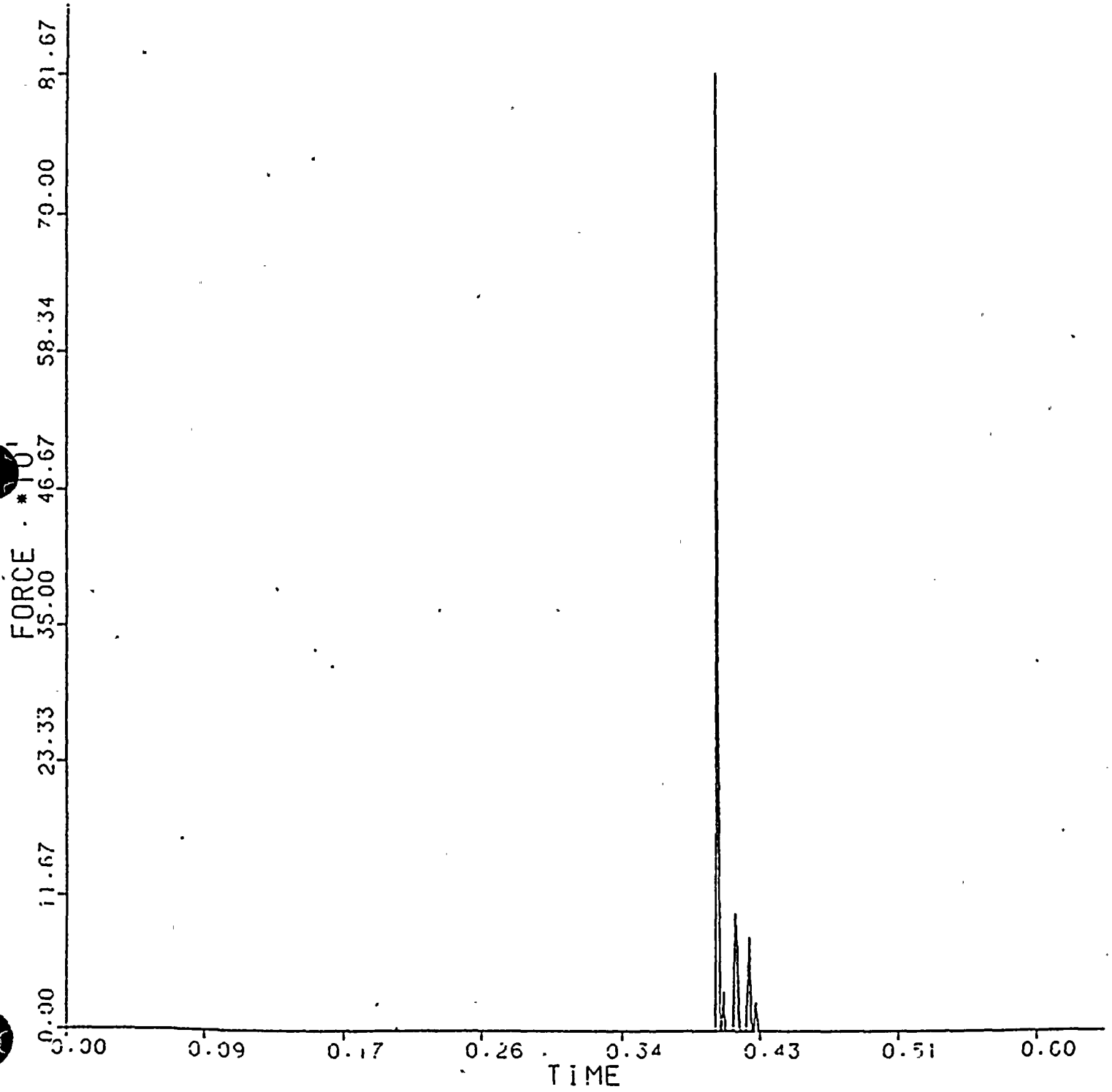
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE, 32, MAGNITUDE AT NODE POINT 620



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

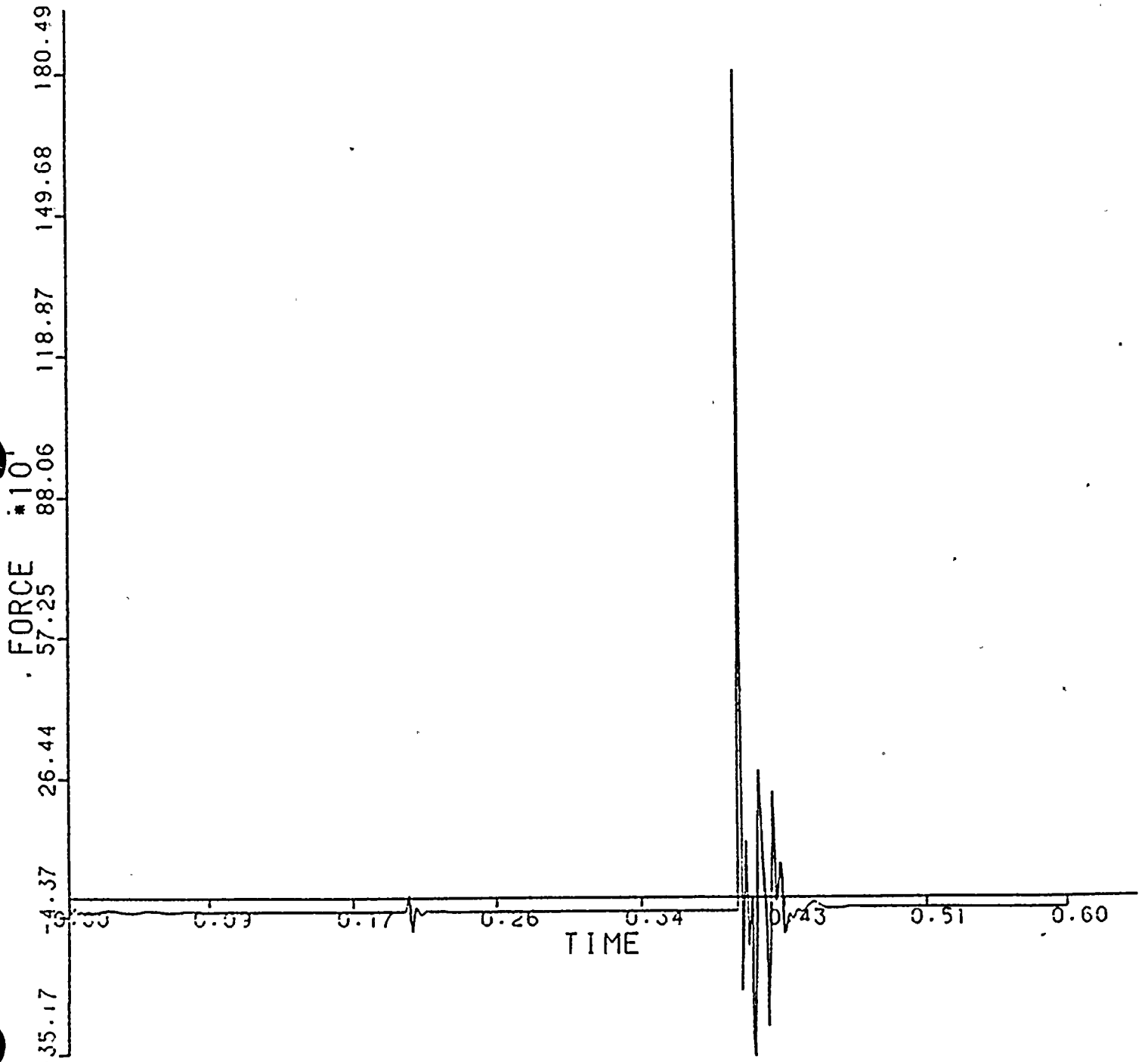
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 33. MAGNITUDE AT NODE POINT 431



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

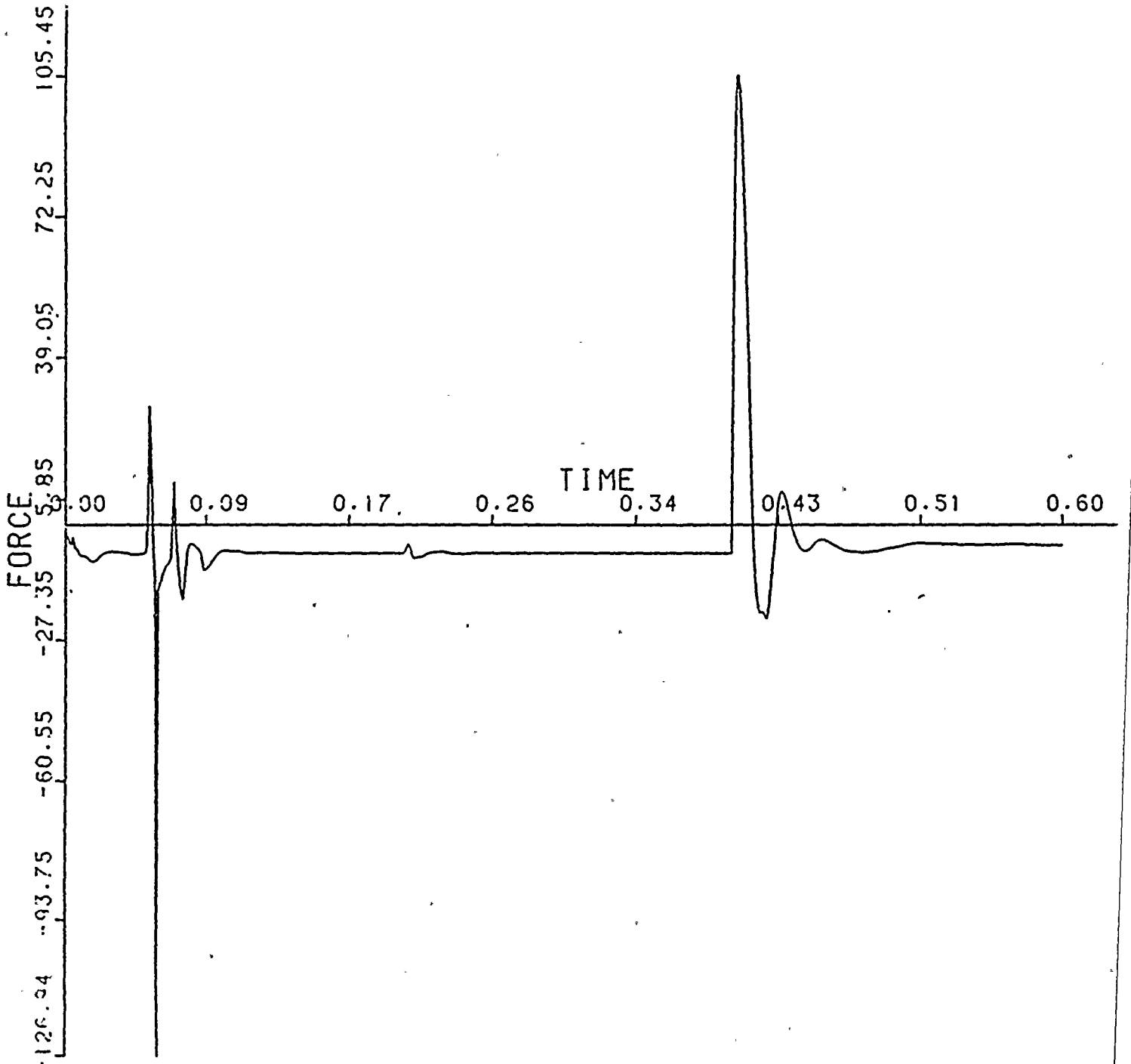
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 34, MAGNITUDE AT NODE POINT 405



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

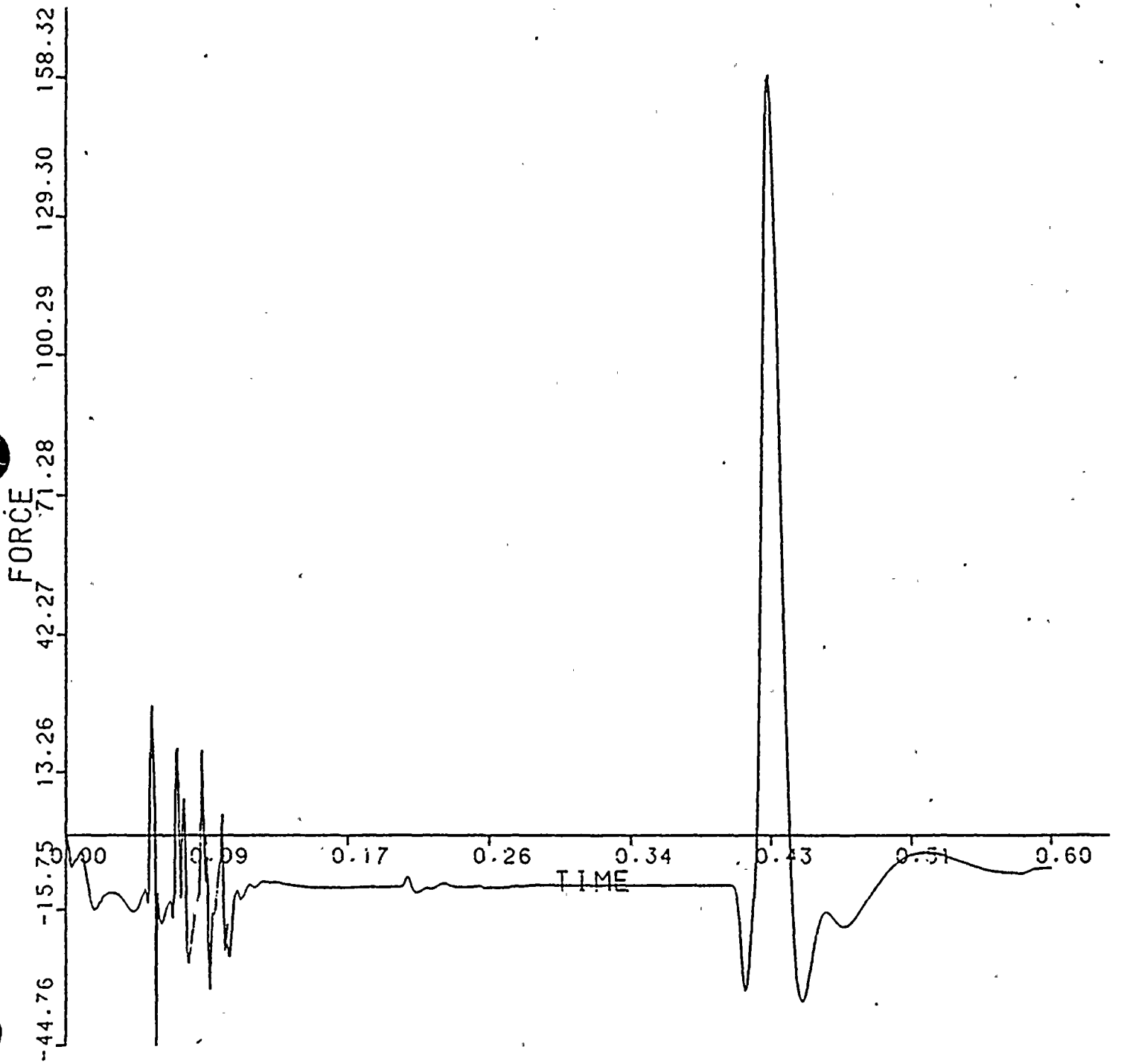
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 35. MAGNITUDE AT NODE POINT 382



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

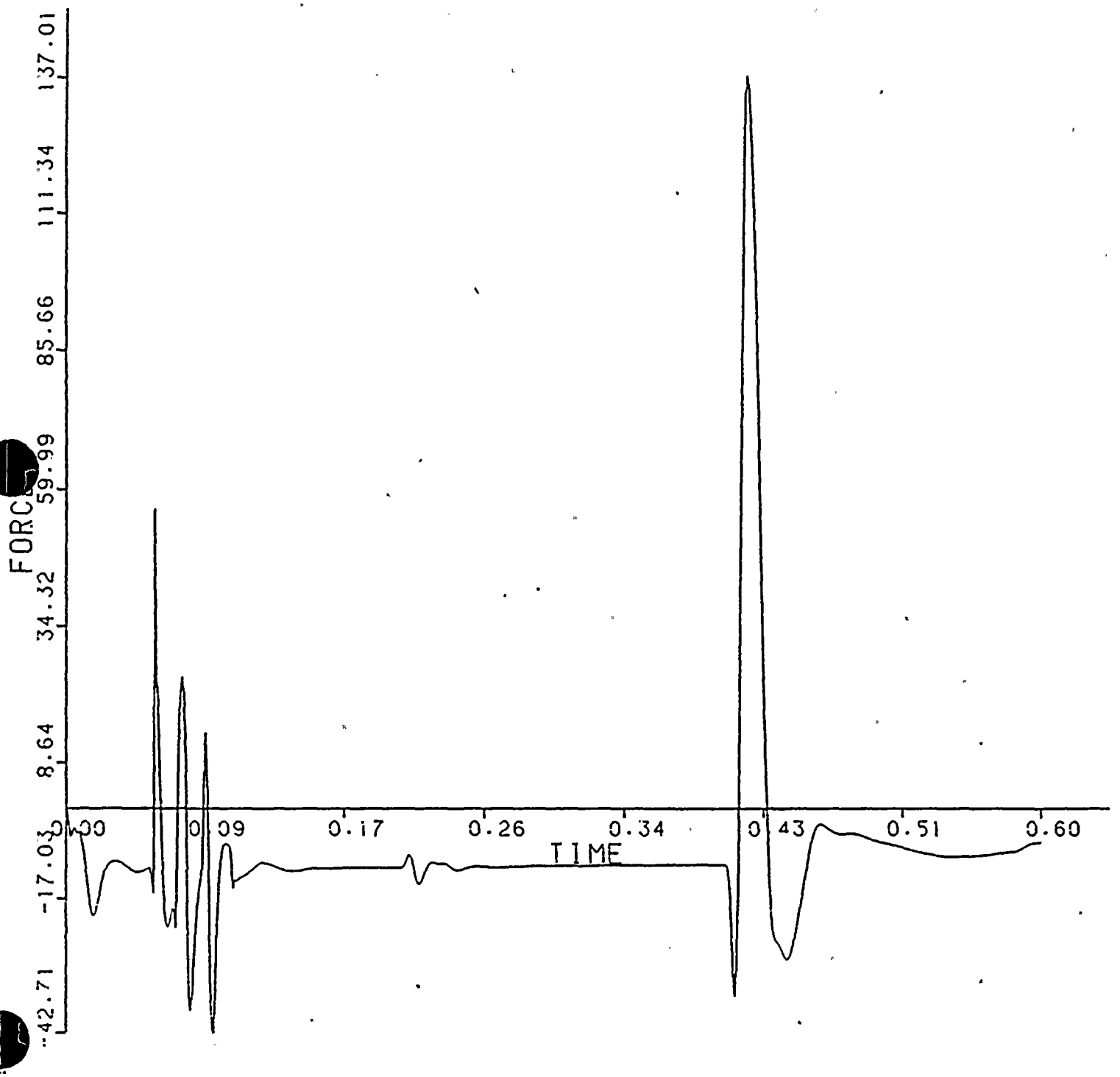
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 36, MAGNITUDE AT NODE POINT 610



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

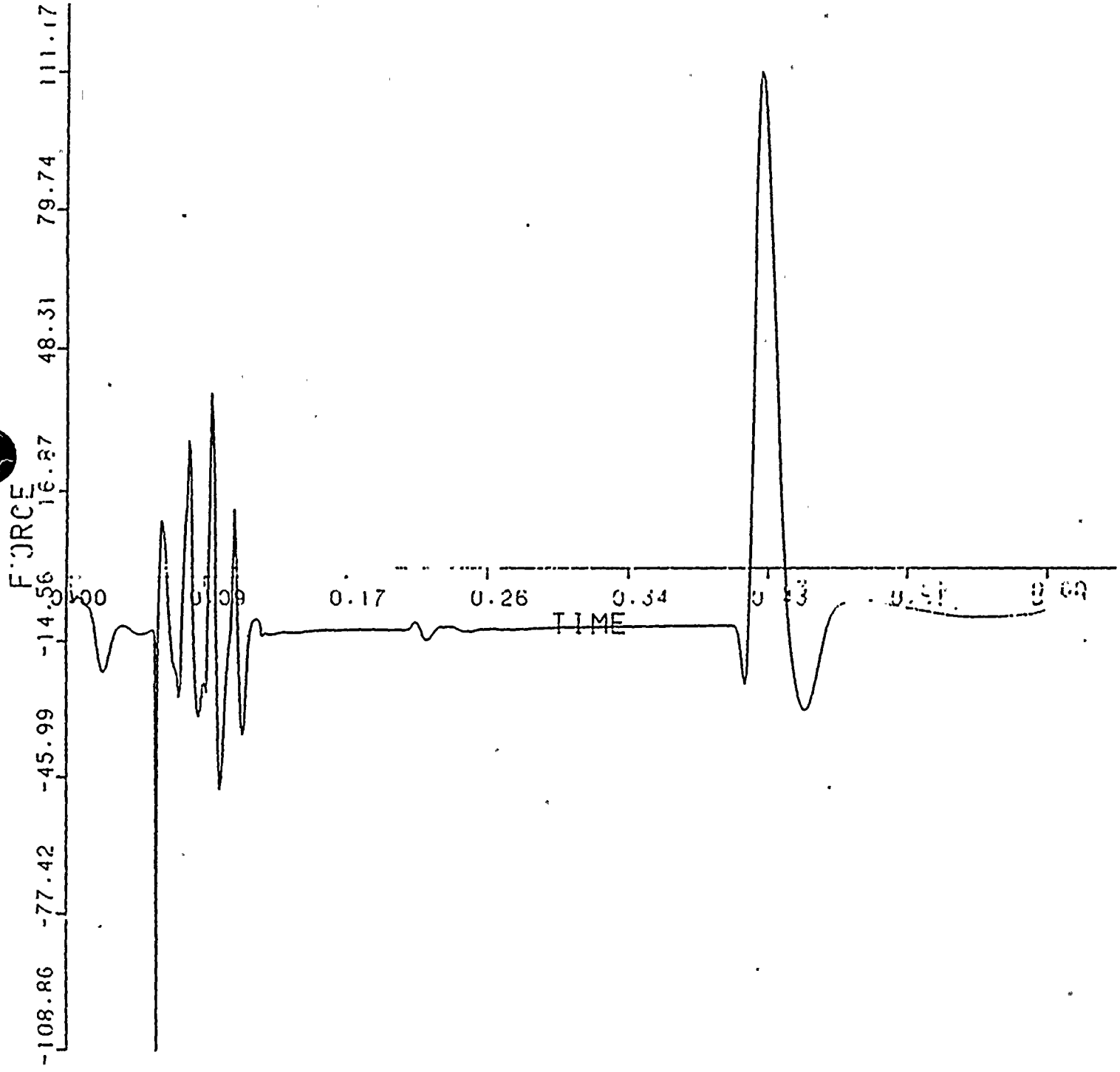
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 37. MAGNITUDE AT NODE POINT 535



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

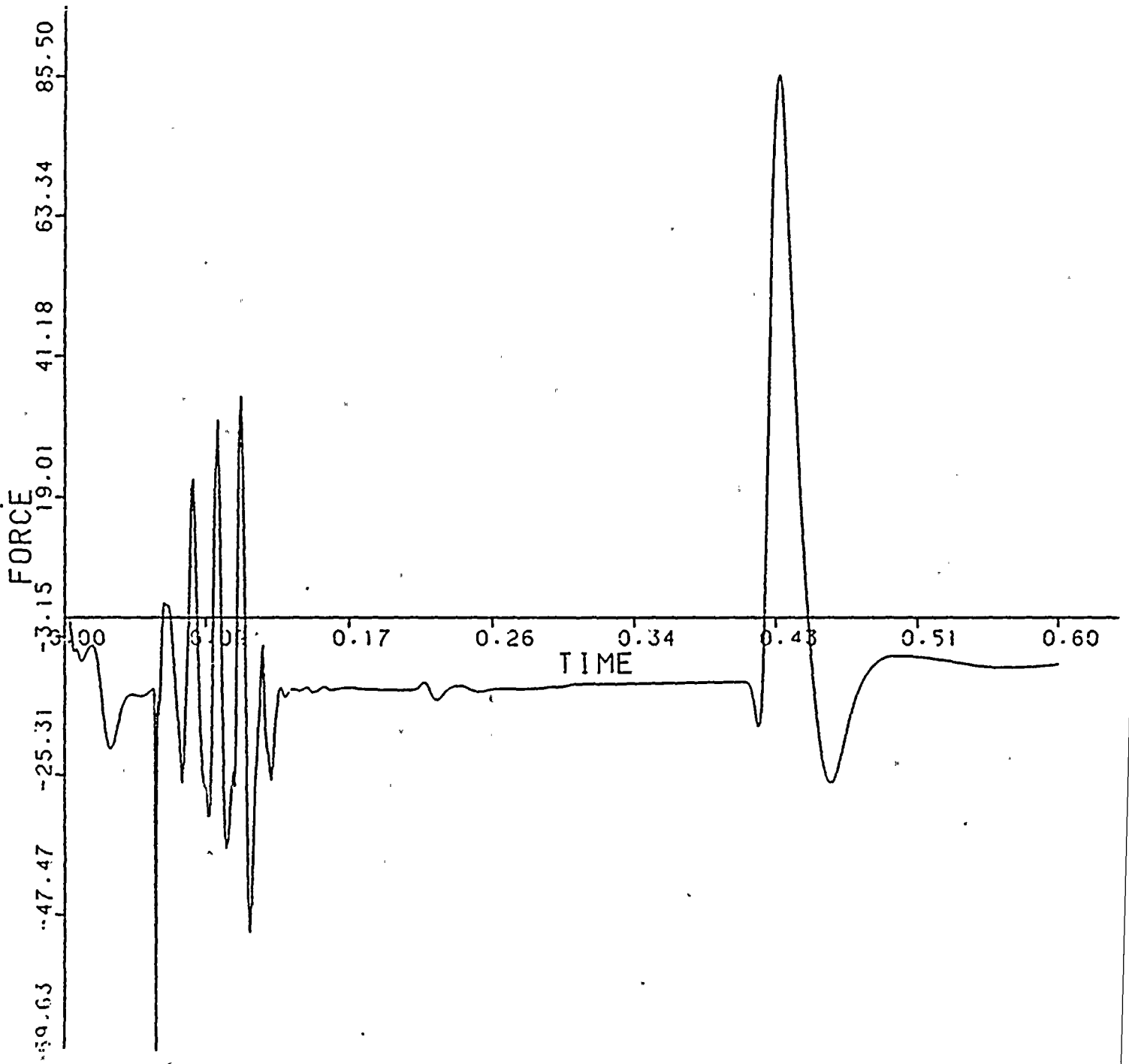
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 38, MAGNITUDE AT NODE POINT 545



DONE BY: MZ DATE: 5-23-83
CHKD BY: [illegible] DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

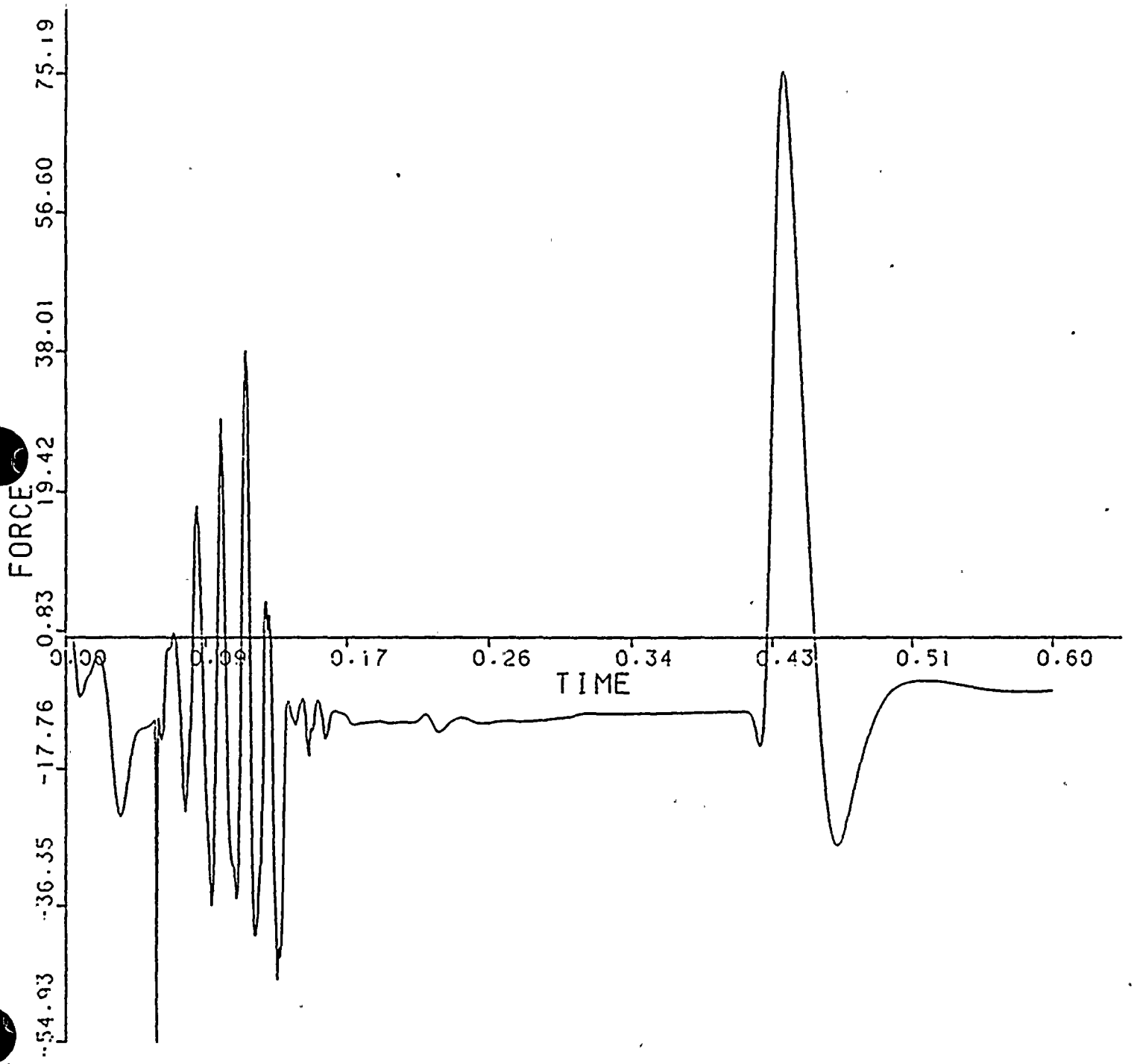
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 39. MAGNITUDE AT NODE POINT 550



DONE BY: MZ DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

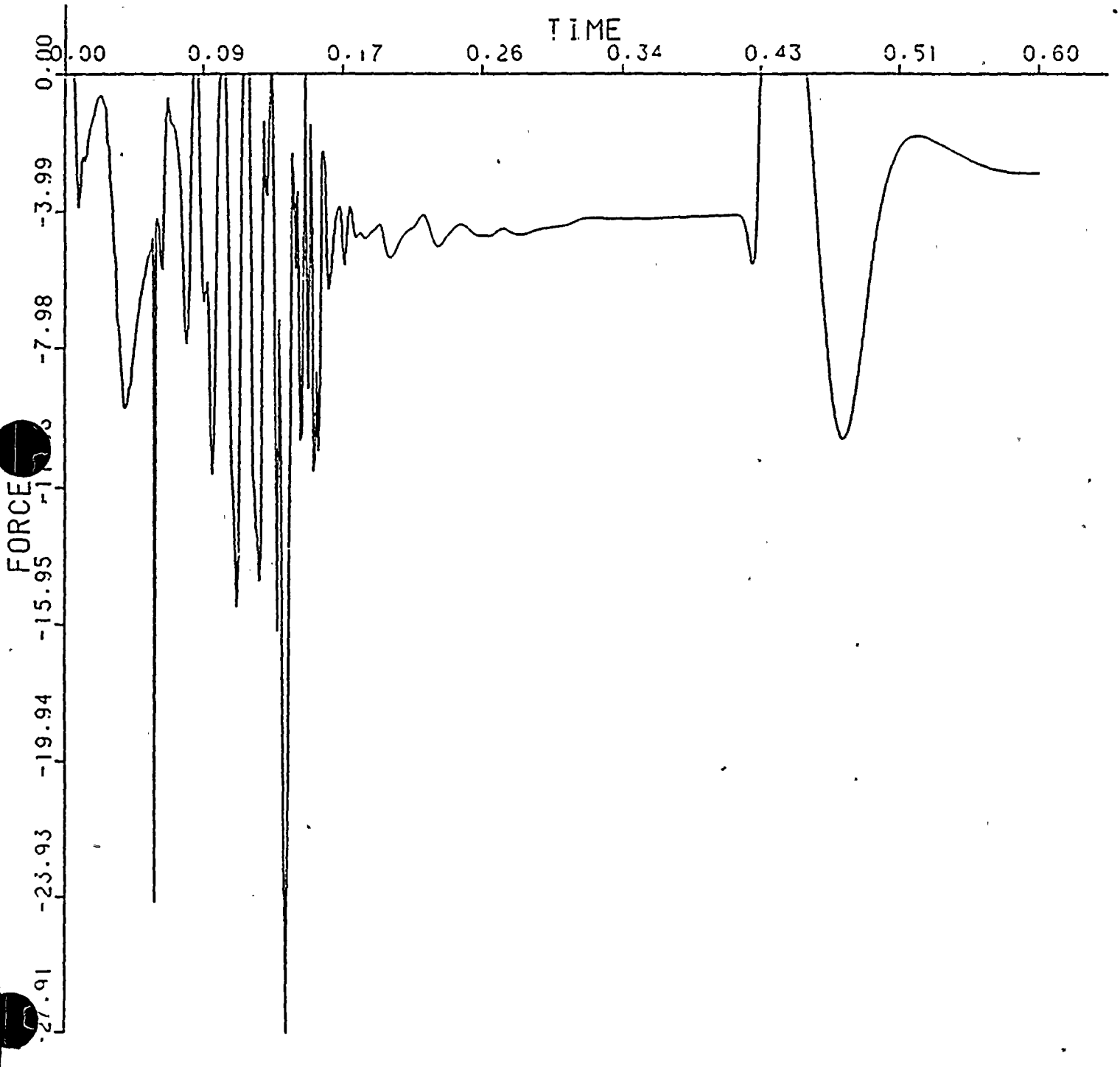
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 40. MAGNITUDE AT NODE POINT 555



DONE BY: MZ DATE: 5-23-83
CHKD BY: MM DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

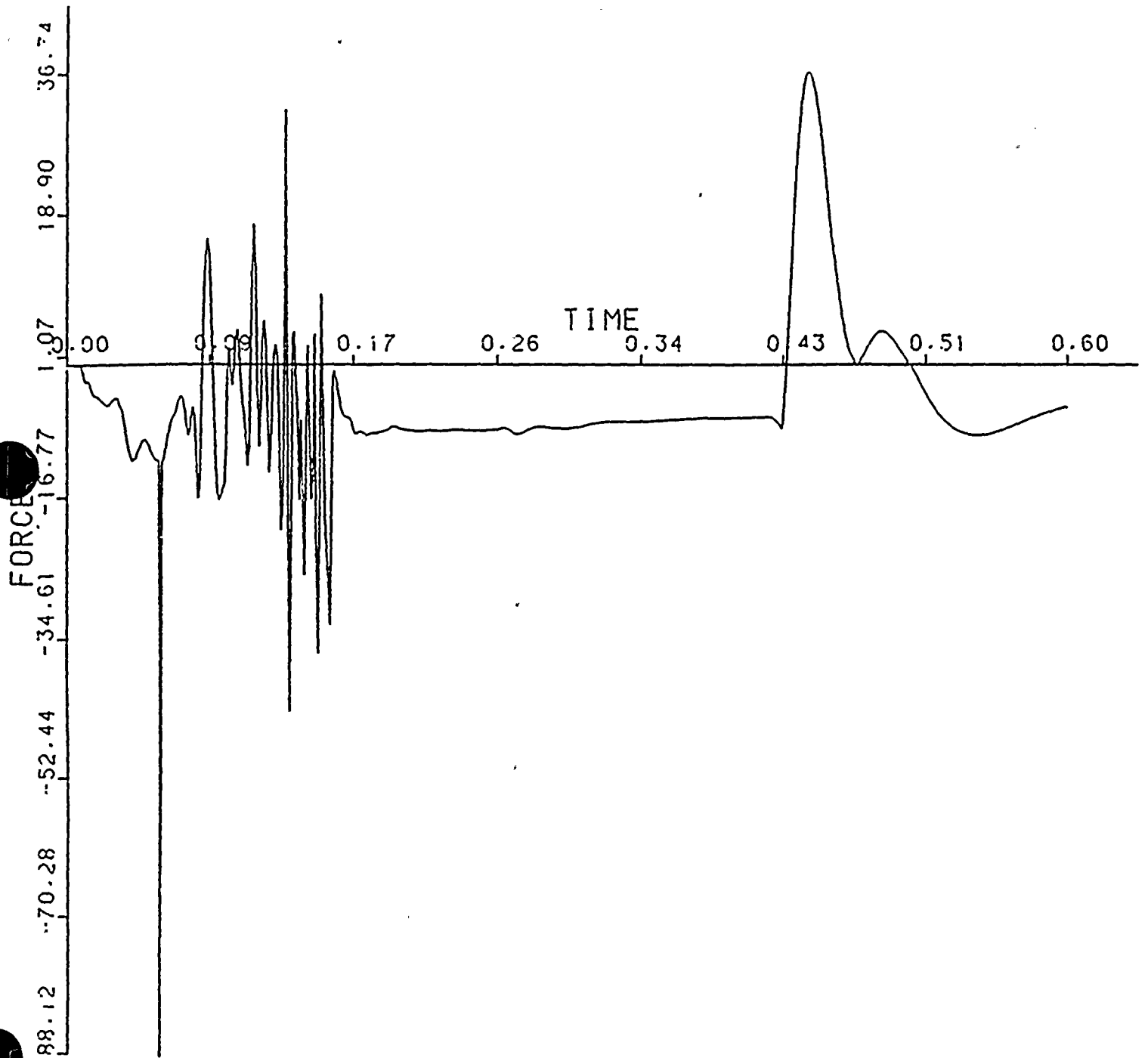
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 41, MAGNITUDE AT NODE POINT 560



DONE BY: MZ DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

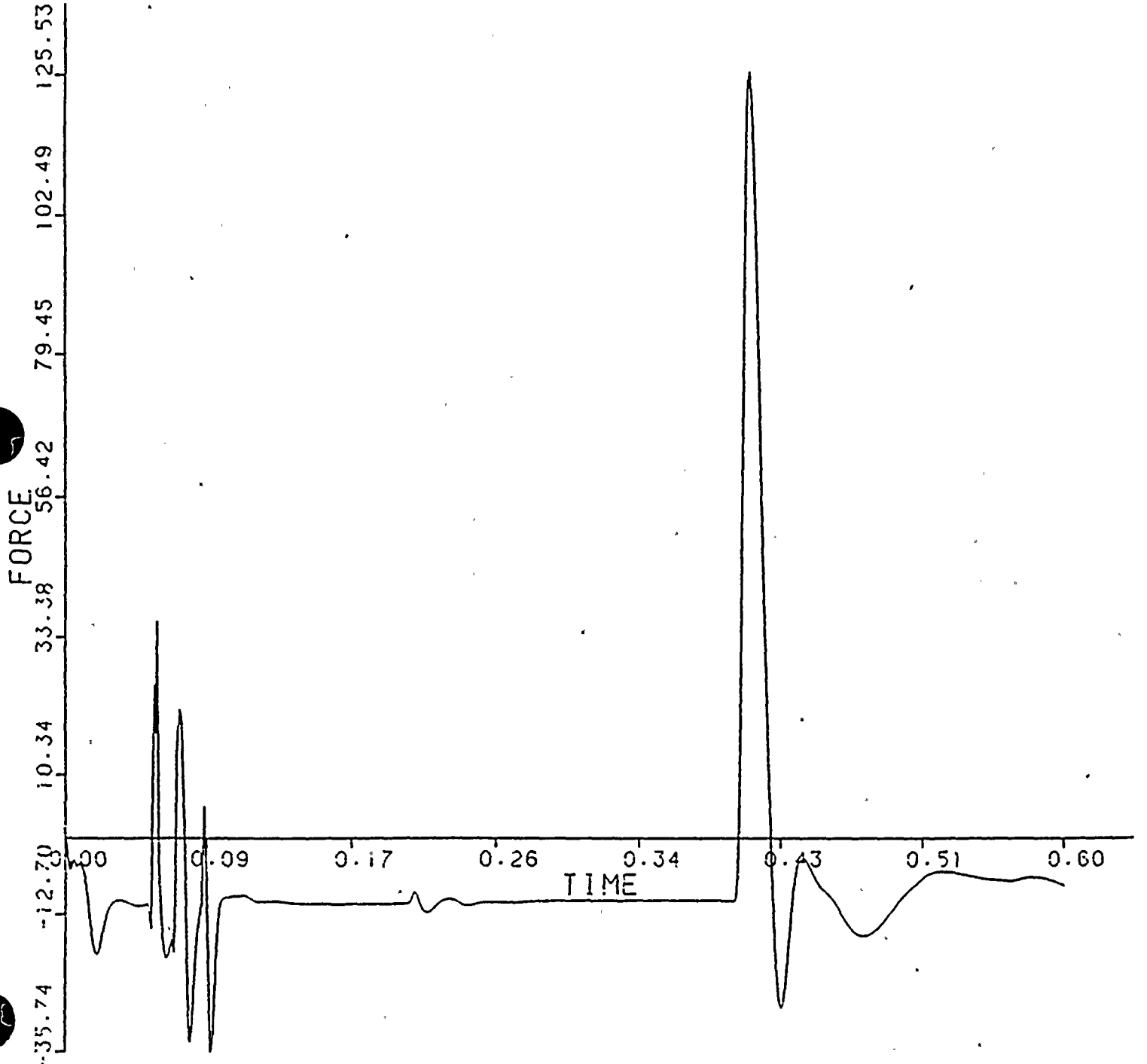
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 42, MAGNITUDE AT NODE POINT 300



DONE BY: MR DATE: 5-23-83
CHKD BY: [illegible] DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23 MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 43, MAGNITUDE AT NODE POINT 375



DONE BY: MR DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

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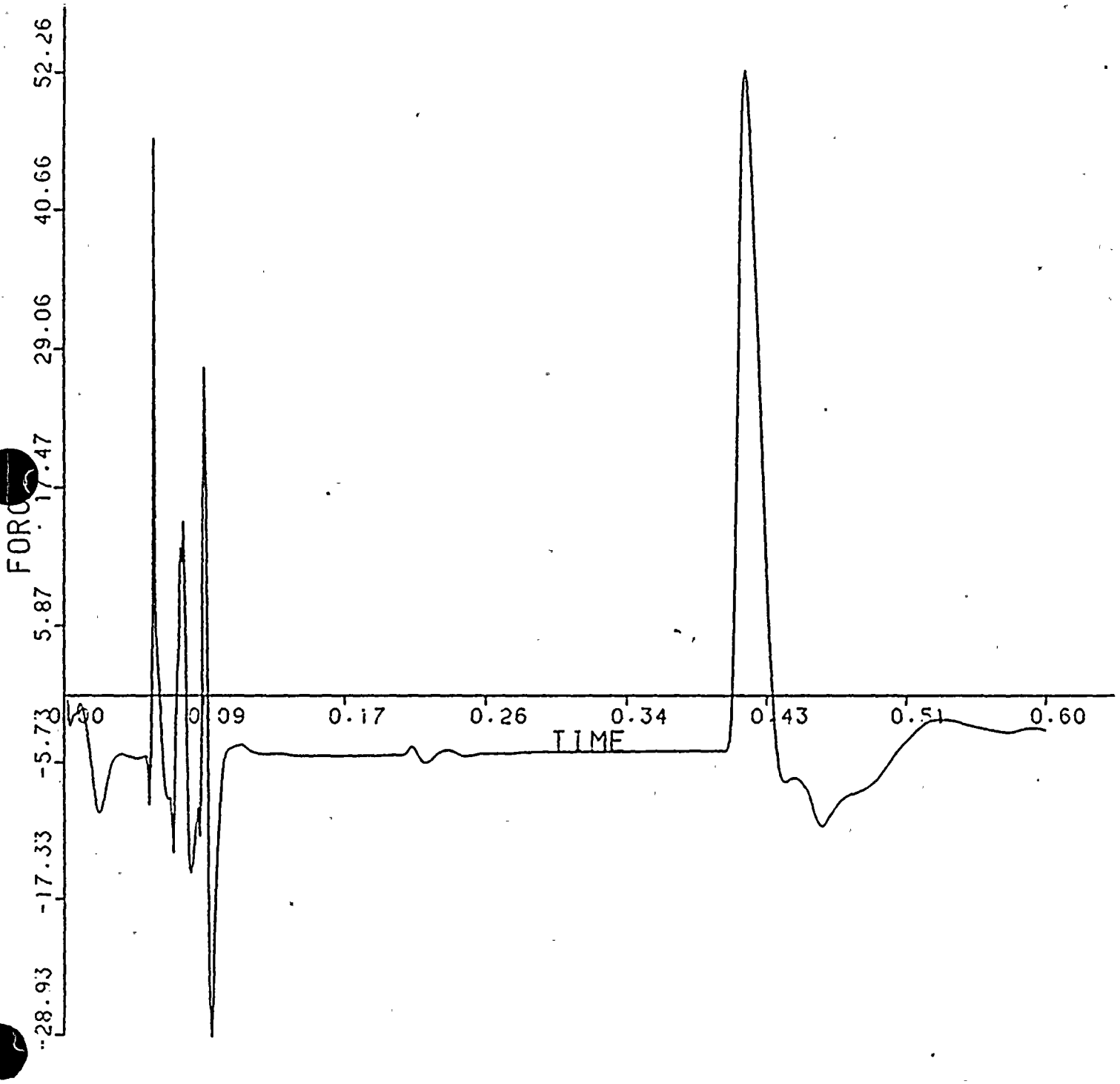
ENGINEERING SERVICES

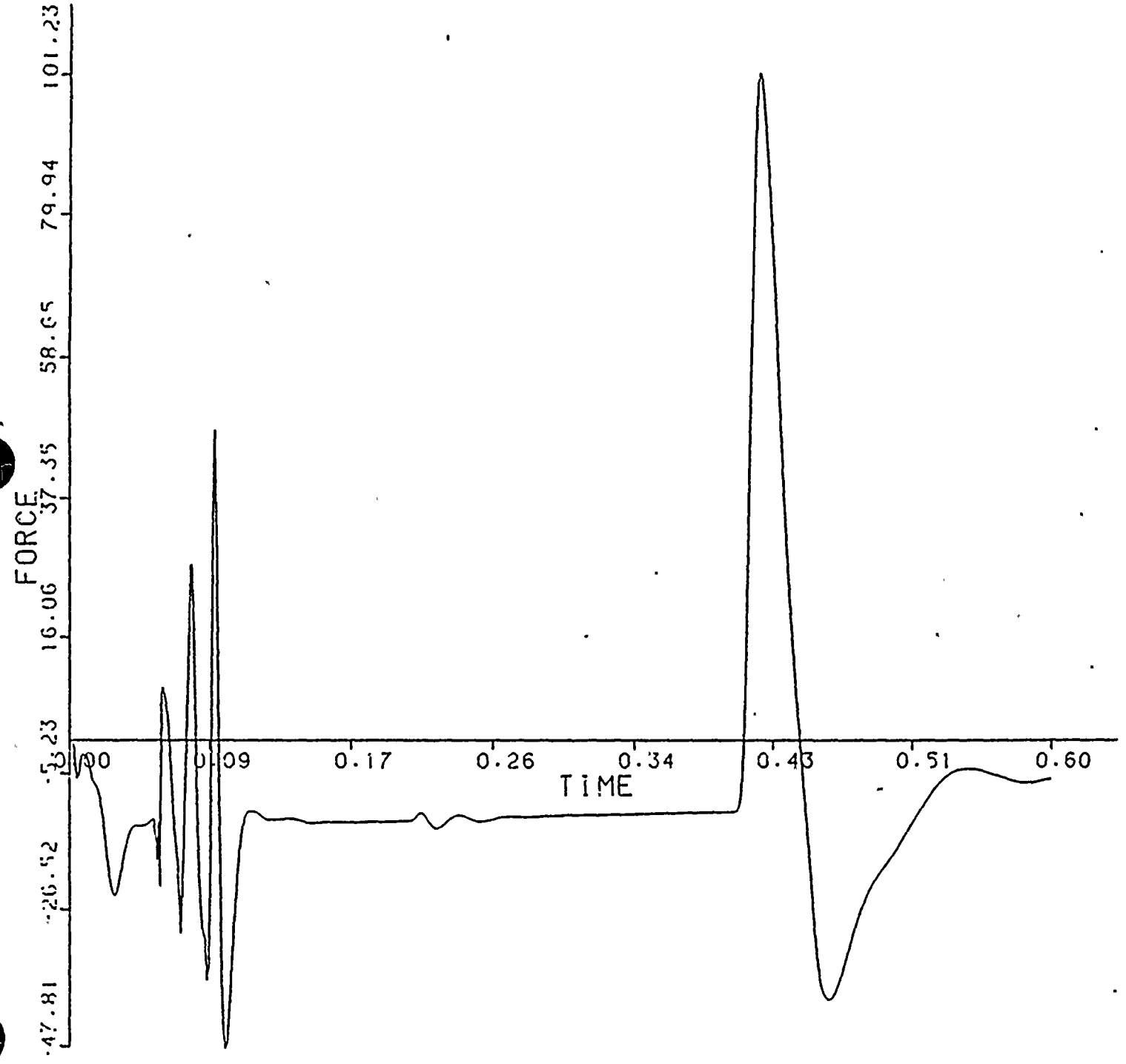
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 44, MAGNITUDE AT NODE POINT 365



DONE BY: MR DATE: 5-23-83
CHKD BY: MM DATE: 5-23-83

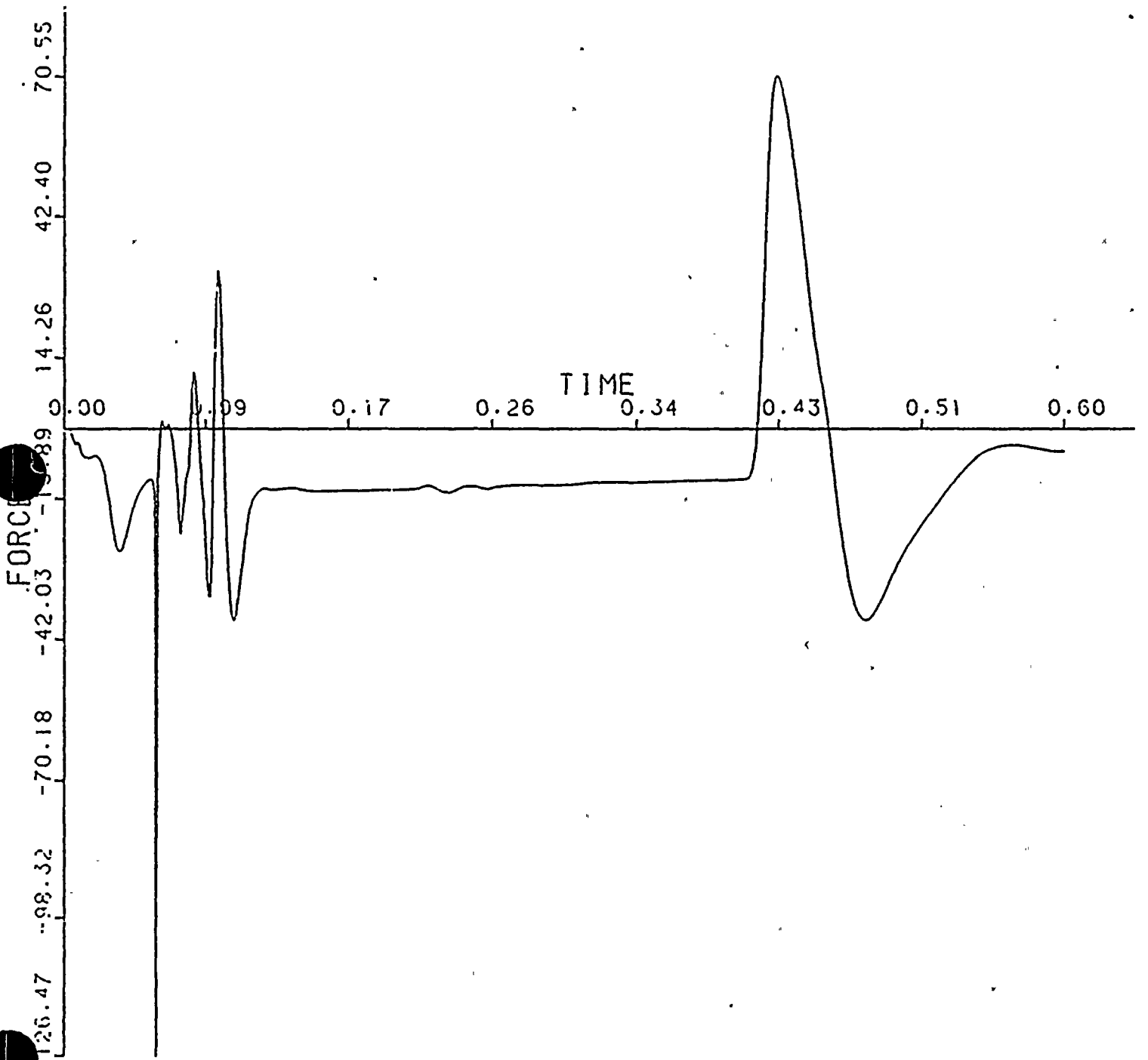
TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23 MAY 83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 45, MAGNITUDE AT NODE POINT 360



DONE BY: [illegible] DATE: [illegible]
CHKD BY: [illegible] DATE: [illegible]

SAP2SAP VERIFICATION 5364 23-MAY 93
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 46, MAGNITUDE AT NODE POINT 355.



DONE BY: MZ DATE: 5-24-93
CHKD BY: JM DATE: 5-25-93

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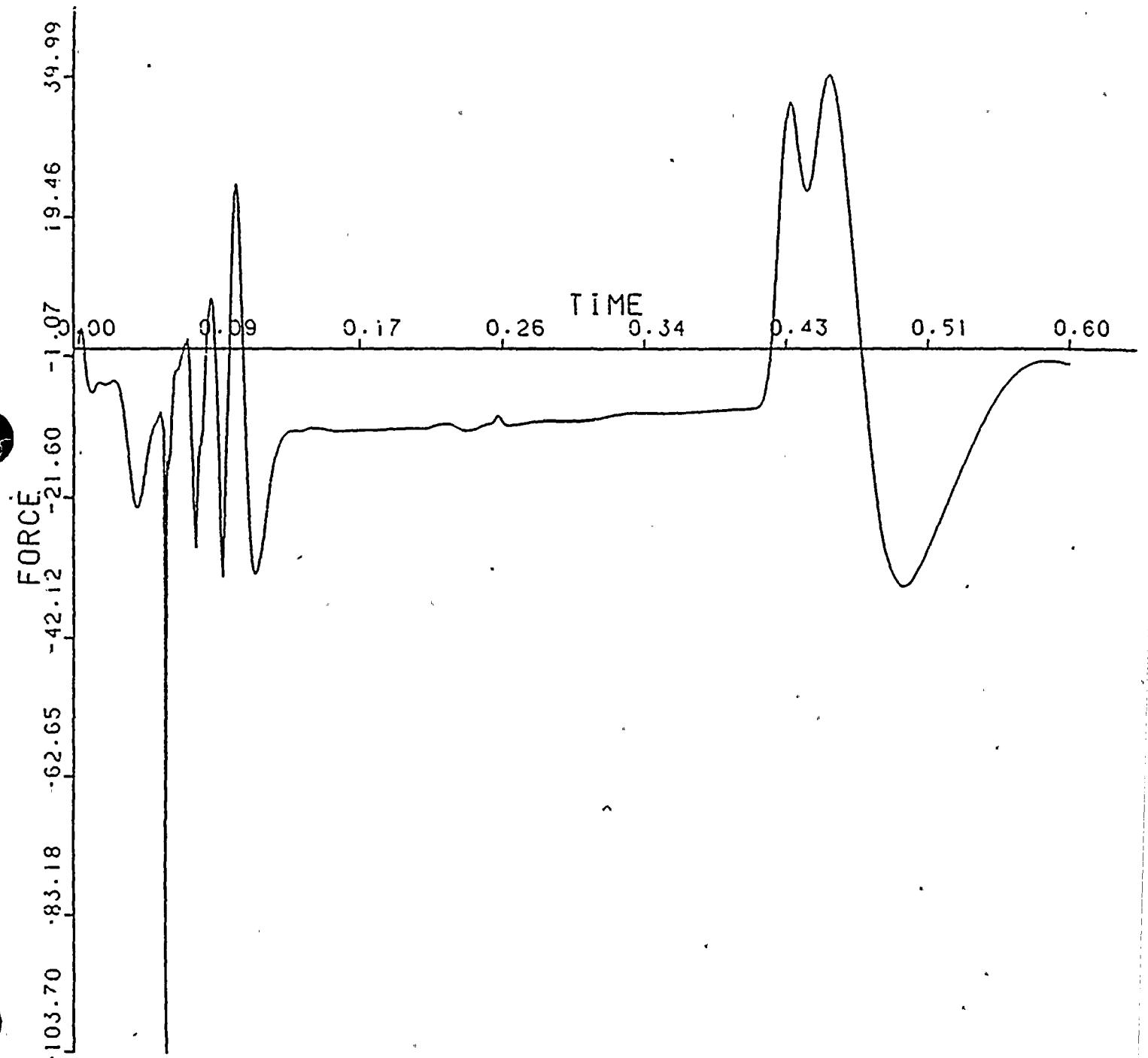
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 47, MAGNITUDE AT NODE POINT 350



DONE BY: [illegible] DATE: [illegible]
CHKD BY: [illegible] DATE: [illegible]

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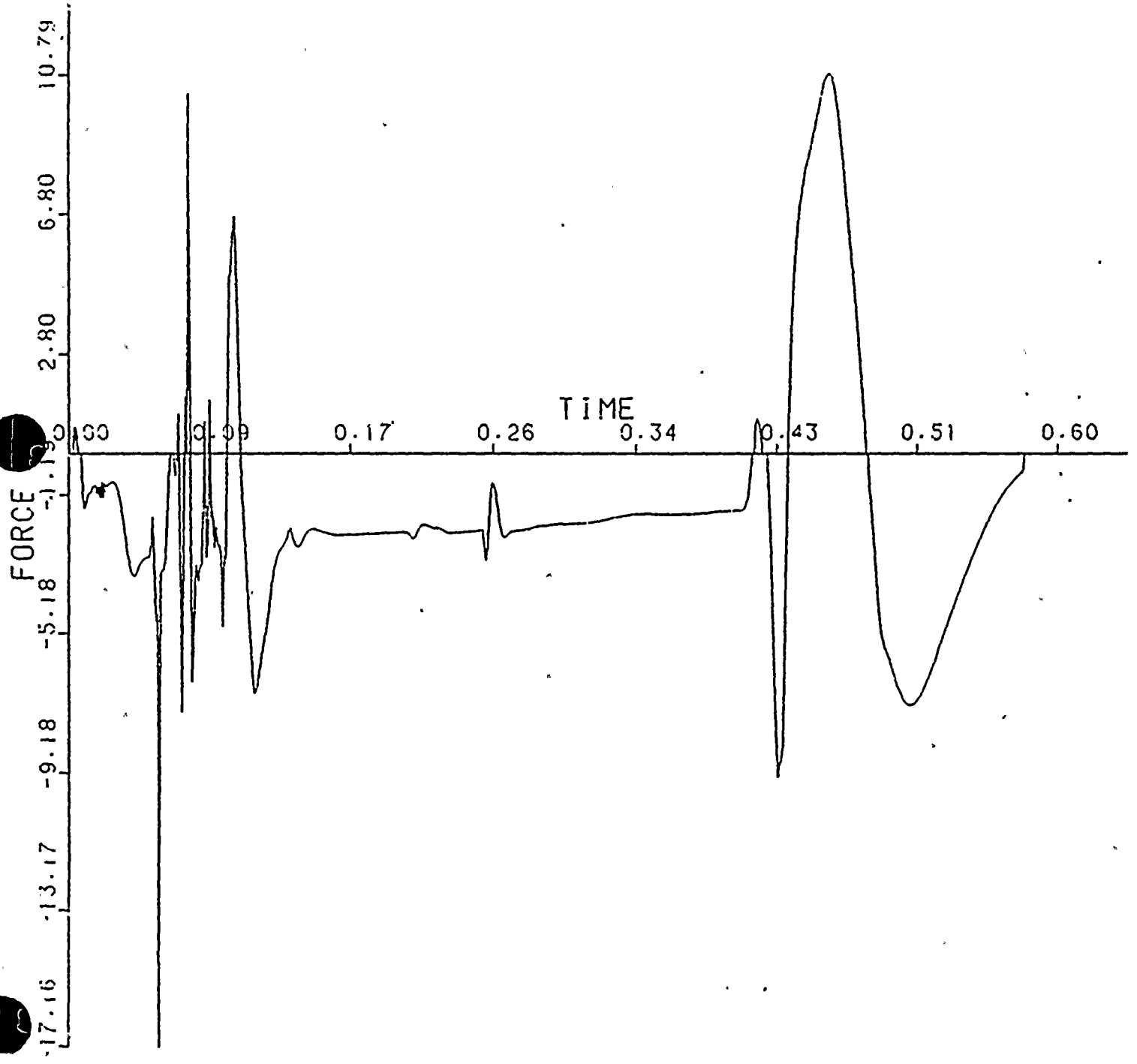
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 48. MAGNITUDE AT NODE POINT 340



DONE BY: MR DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

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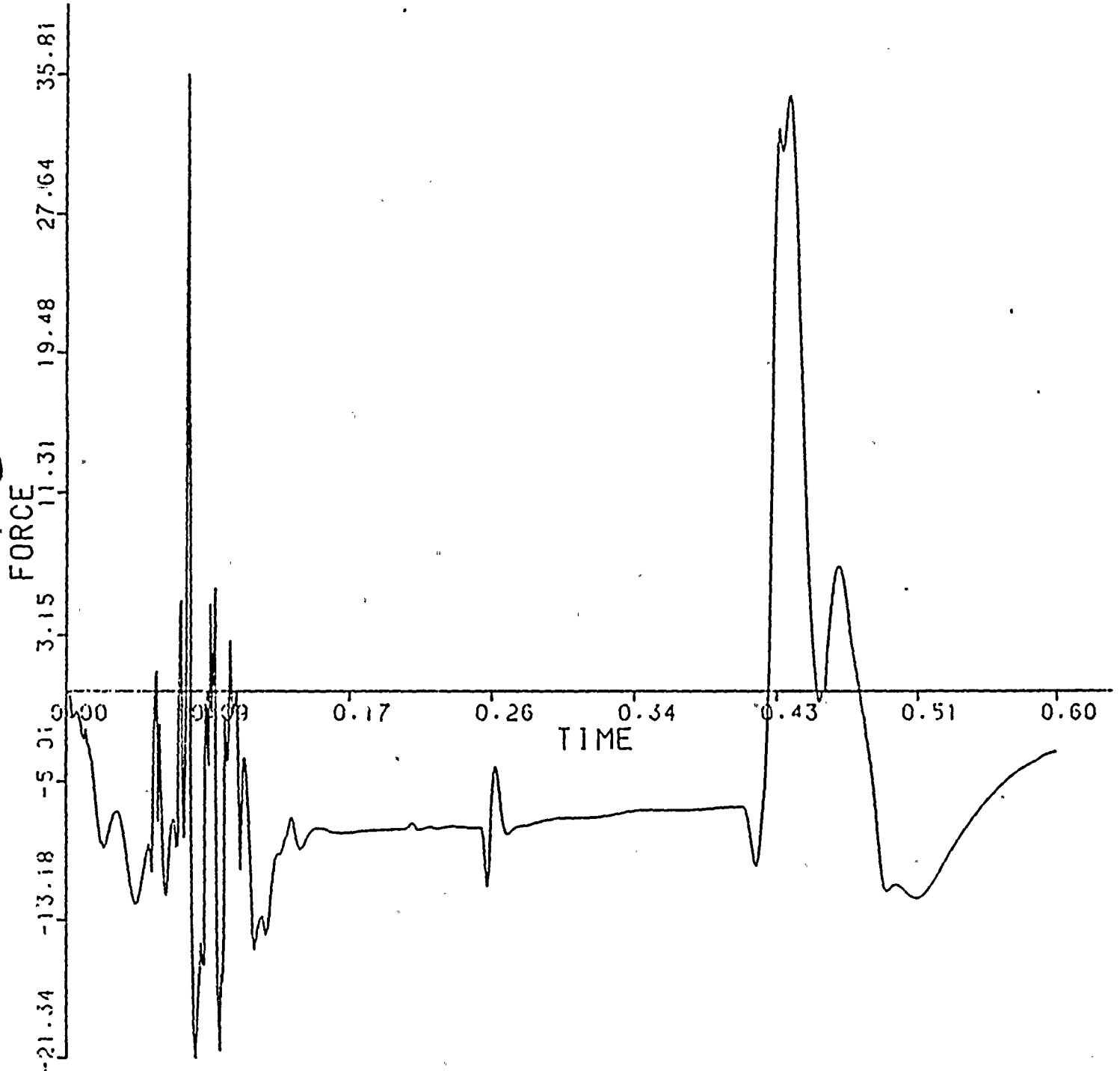
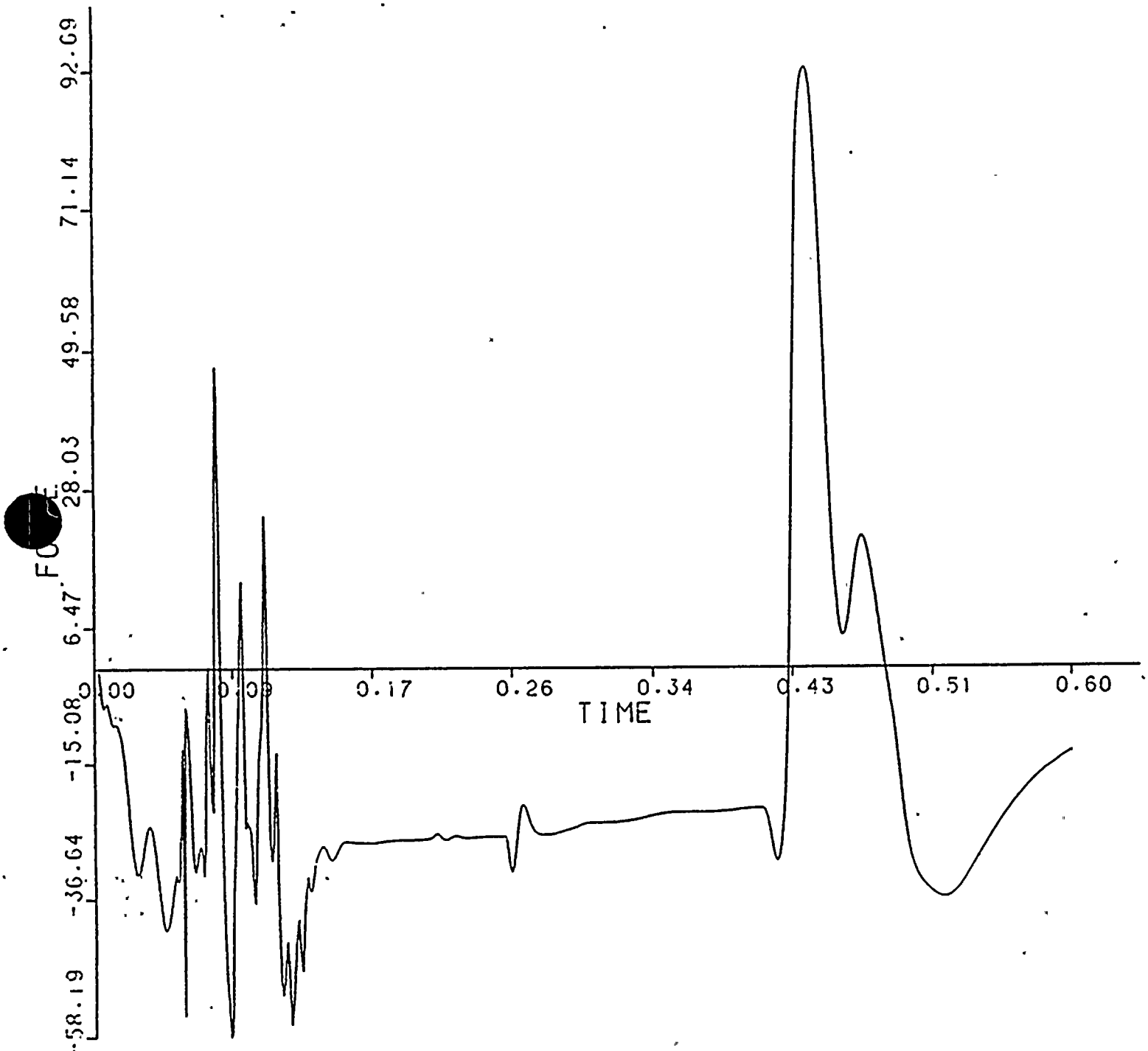
ENGINEERING SERVICES

SAP2SAP VERIFICAIION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 49, MAGNITUDE AT NODE POINT 335



DONE BY: MZ DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE . 50, MAGNITUDE AT NODE POINT 325



DONE BY: MC DATE: 5-25-83
CHKD BY: MM DATE: 5-25-83

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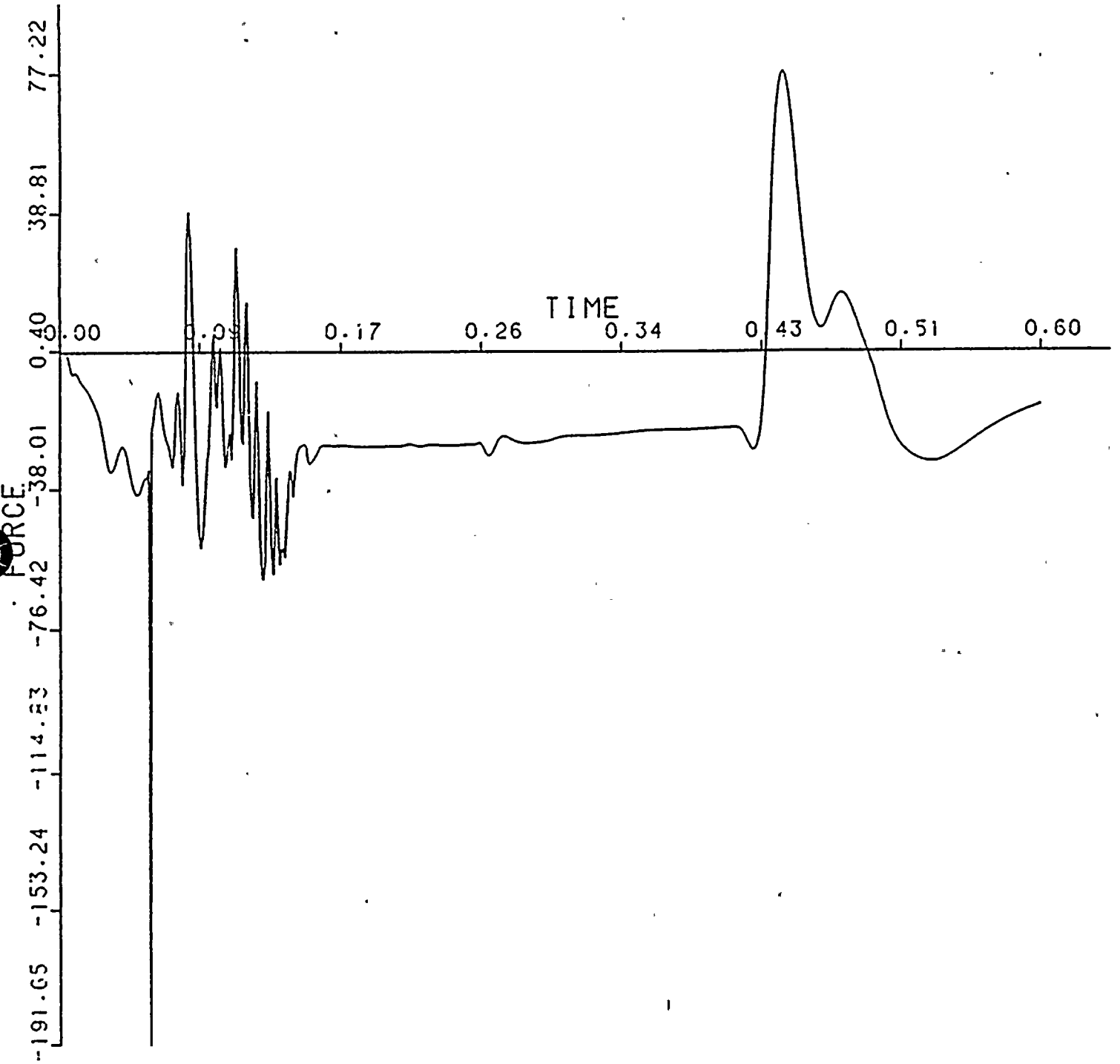
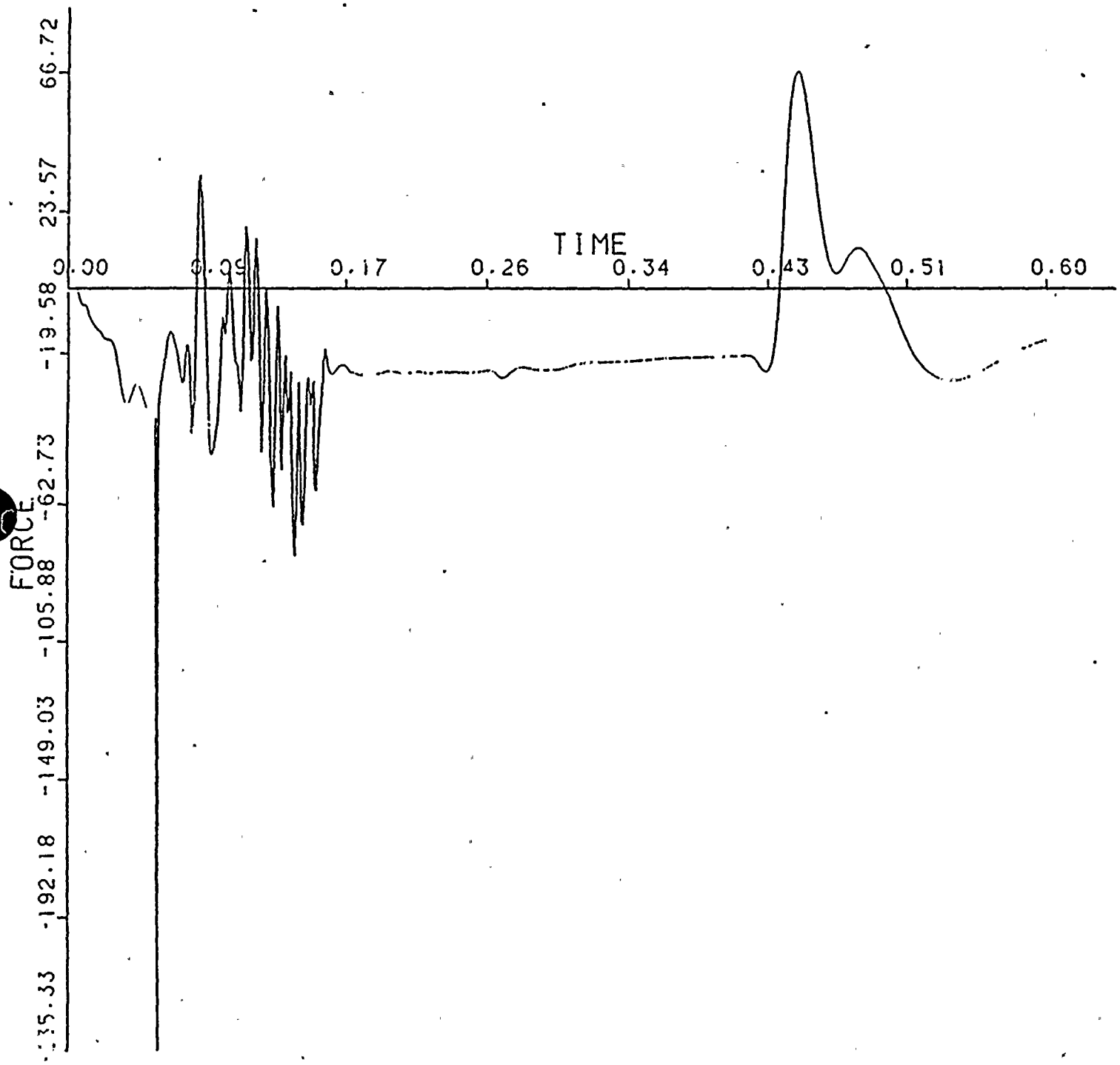
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 51. MAGNITUDE AT NODE POINT 320



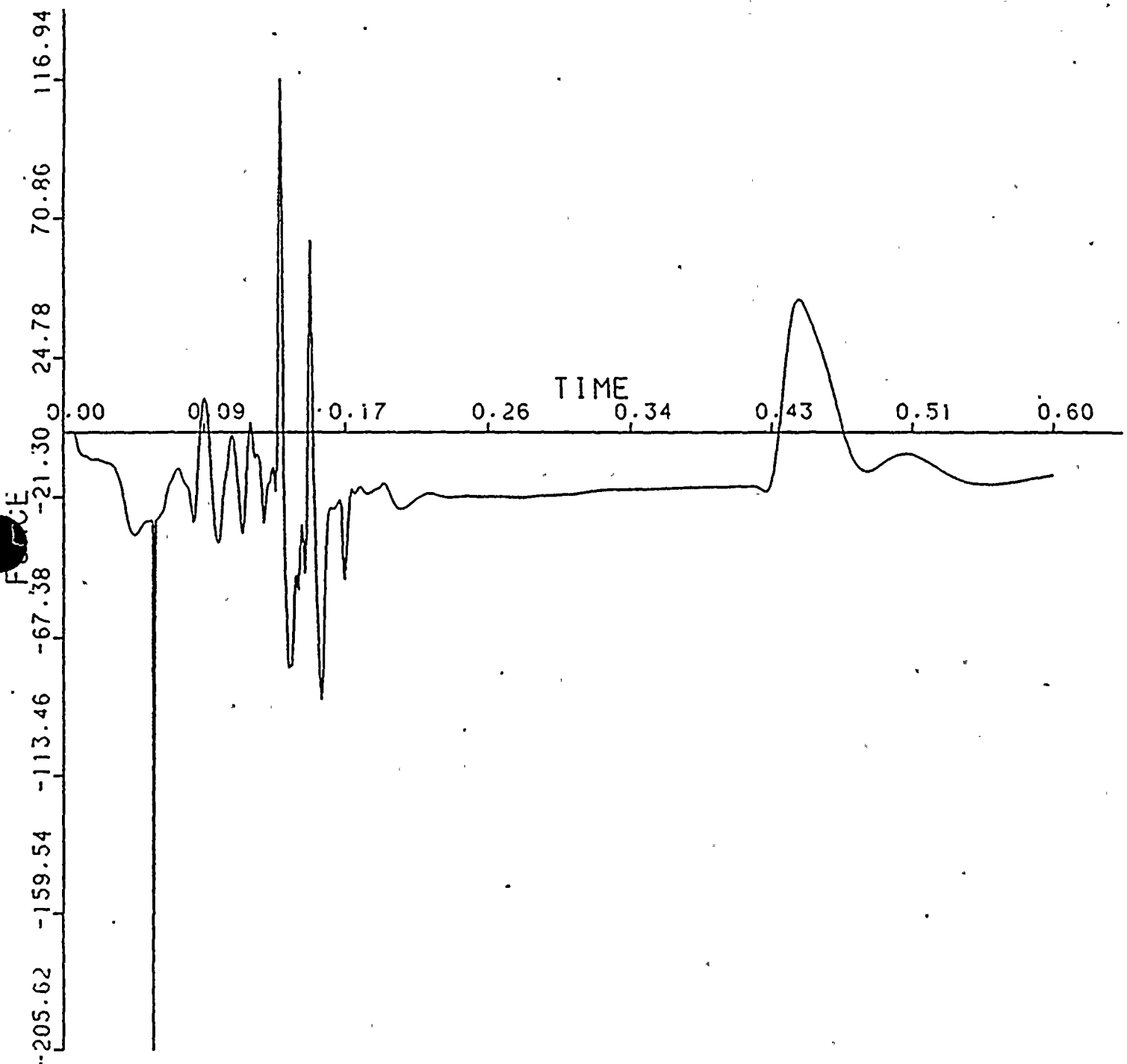
DONE BY: MD DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 52. MAGNITUDE AT NODE POINT 310



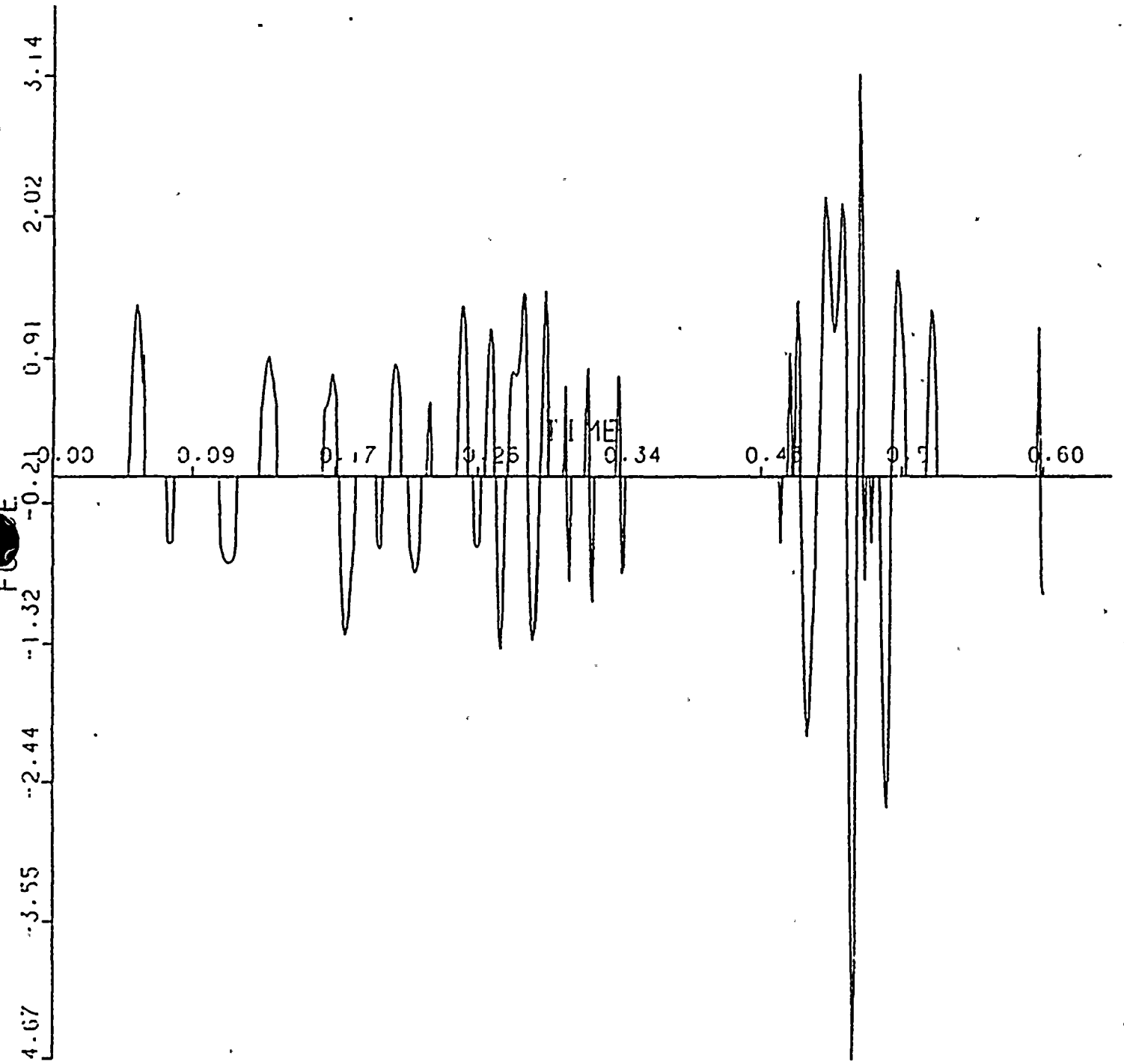
DONE BY: MR DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 53, MAGNITUDE AT NODE POINT 295



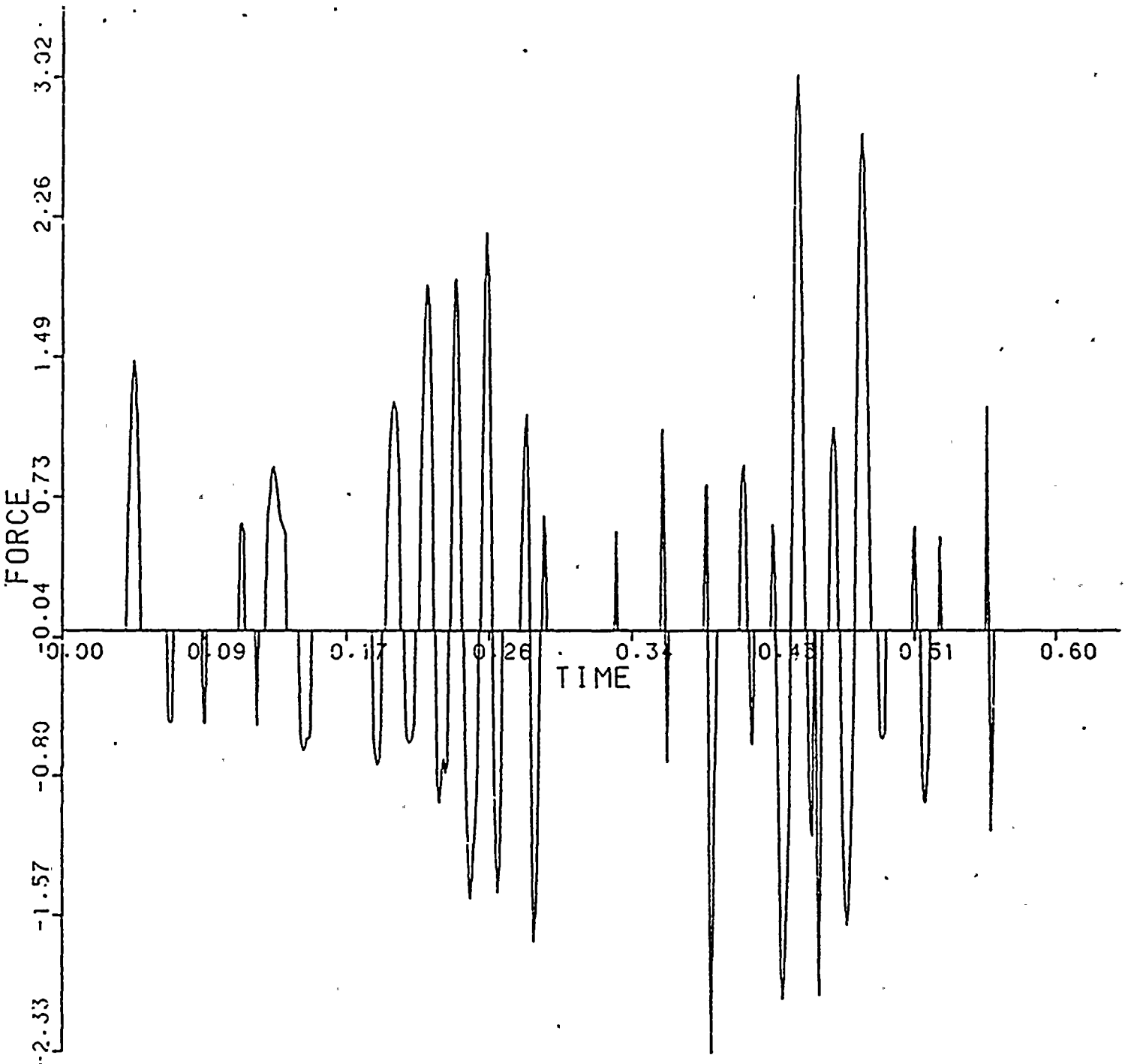
DONE BY: MC DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 54, MAGNITUDE AT NODE POINT 114



DONE BY: VR DATE: 5-23-83
CHKD BY: DM DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED. SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 55, MAGNITUDE AT NODE POINT 162

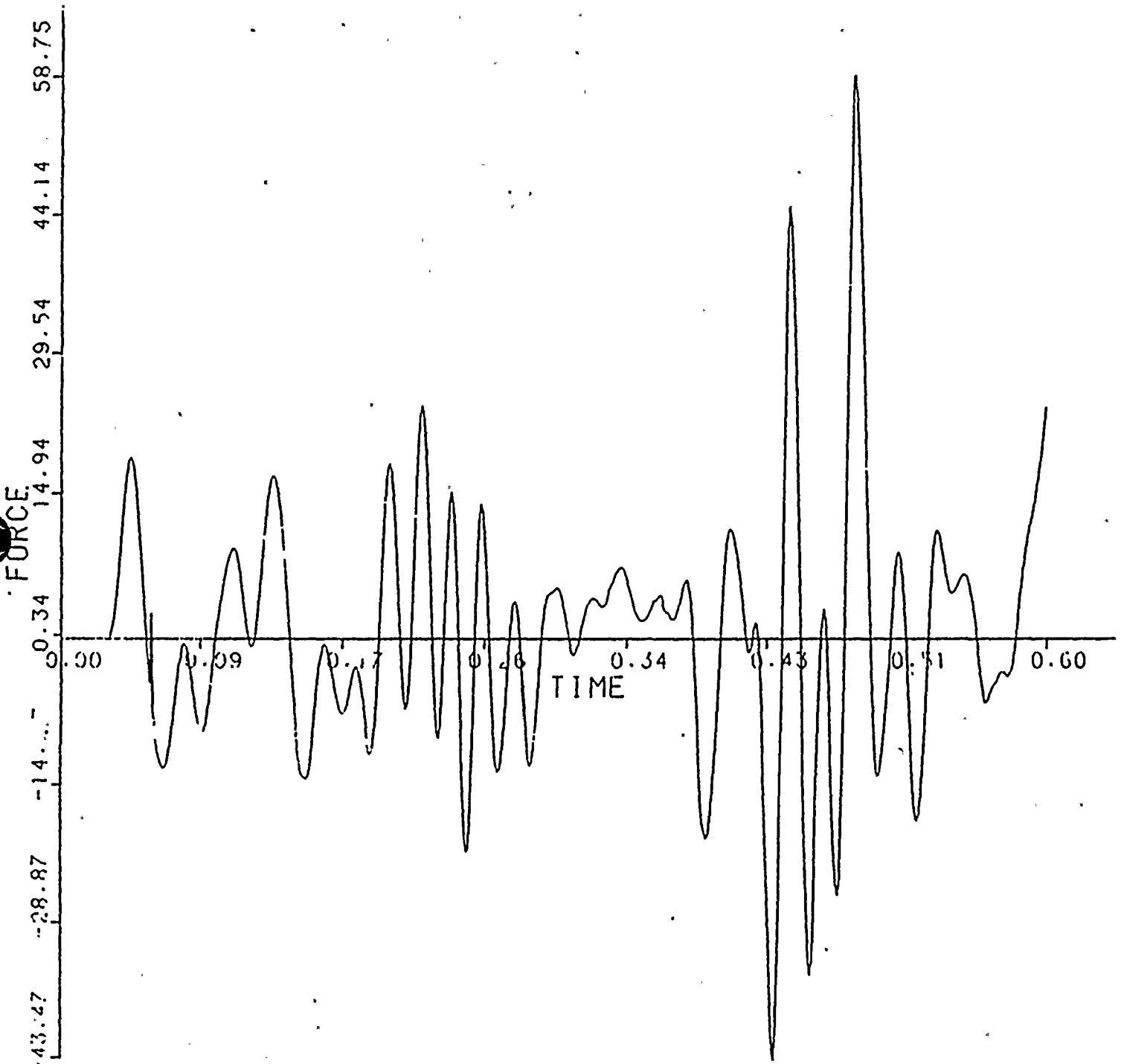


DONE BY: VC DATE: 5-23-83
CHKD BY: JM DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83

YEL-RED SOLID UNIT 1, 0.600 MS

TIME/FORCE TABLE 56. MAGNITUDE AT NODE POINT 157



DONE BY: [illegible] DATE: [illegible]

CHKD BY: [illegible] DATE: [illegible]

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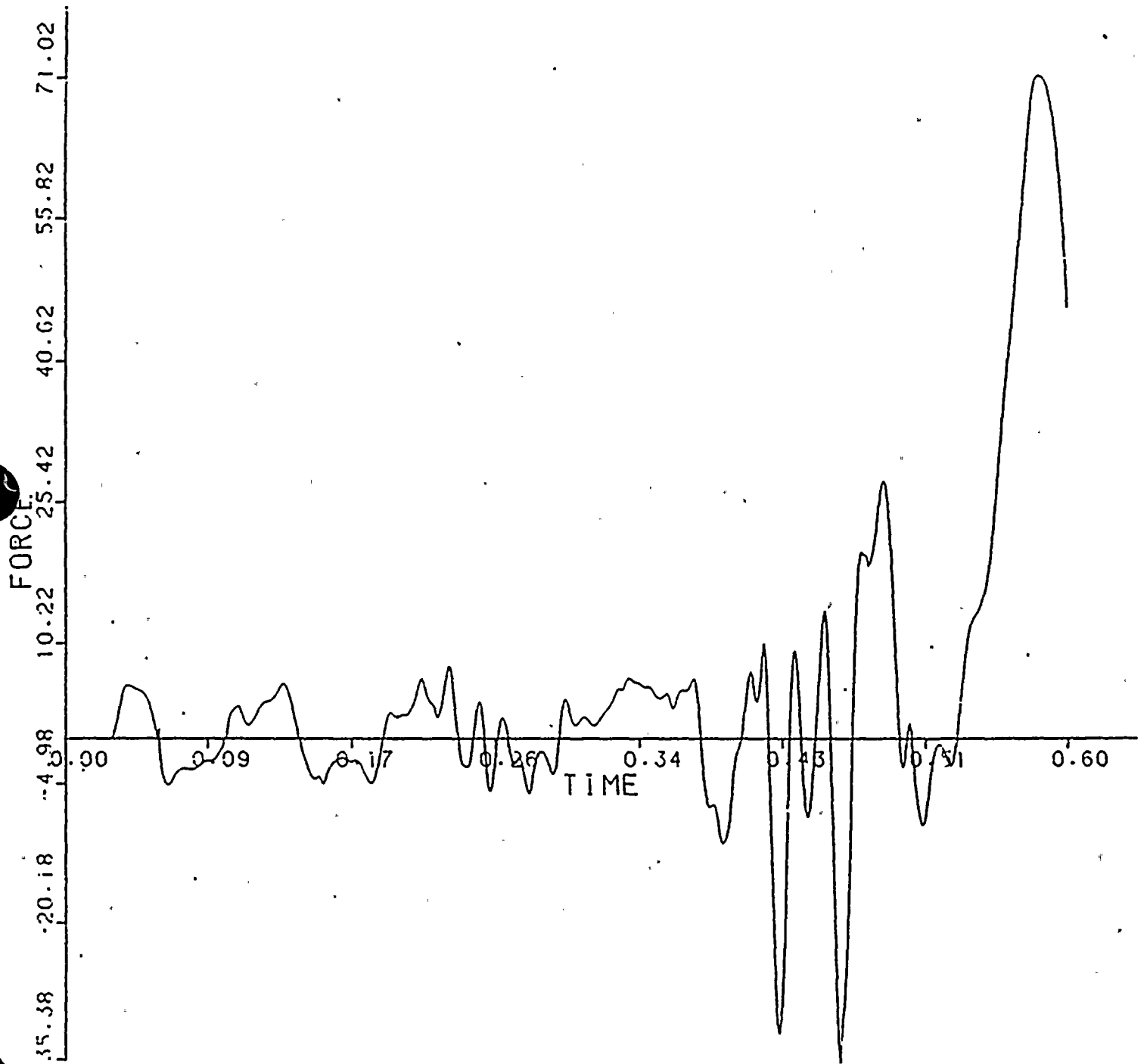
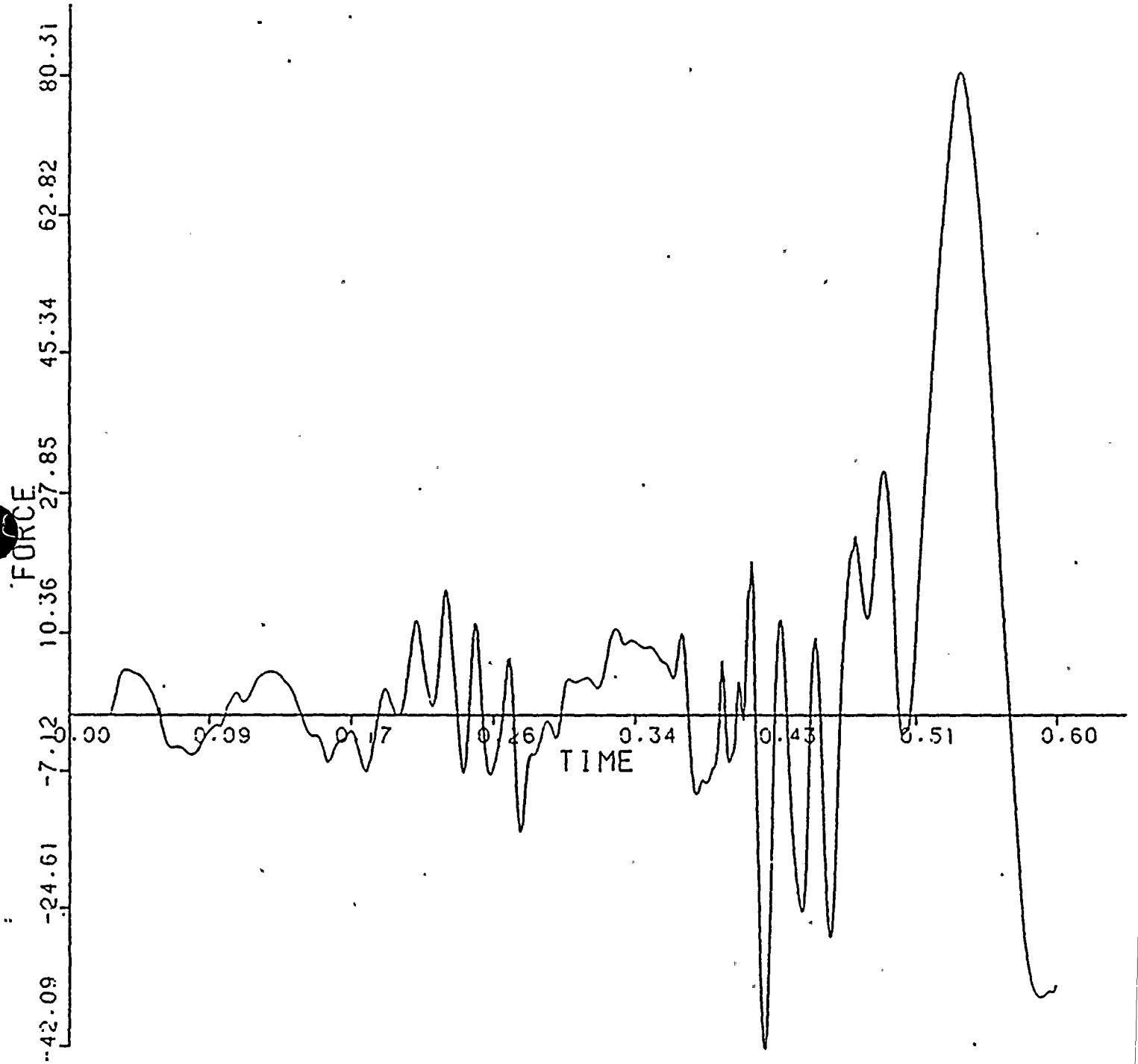
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 57, MAGNITUDE AT NODE POINT 150



DONE BY: WZ DATE: 5-23-83
CHKD BY: MM DATE: 5-23-83

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 58, MAGNITUDE AT NODE POINT 148



DONE BY: [illegible] DATE: [illegible]
CHKD BY: [illegible] DATE: [illegible]

TELEDYNE
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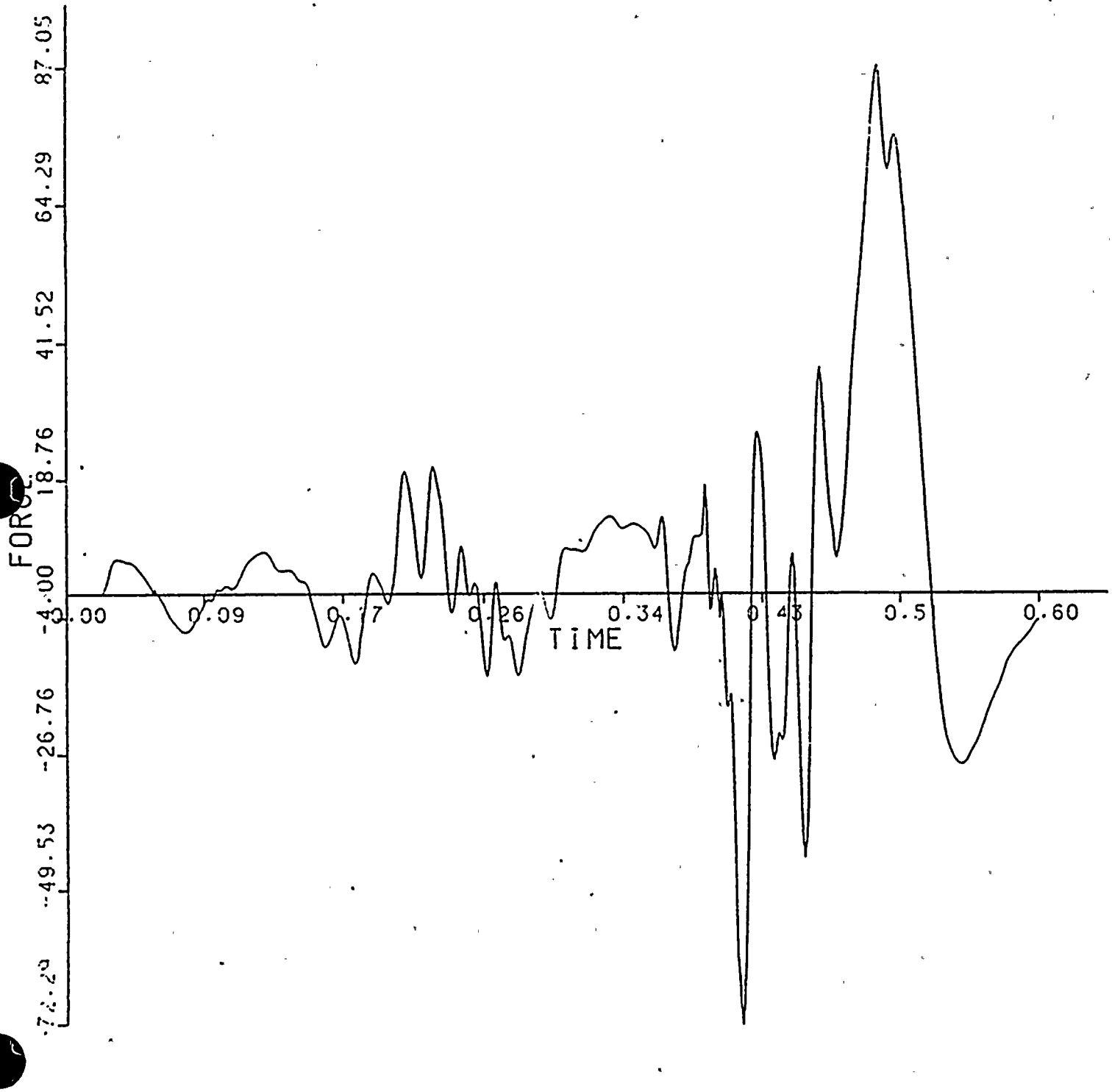
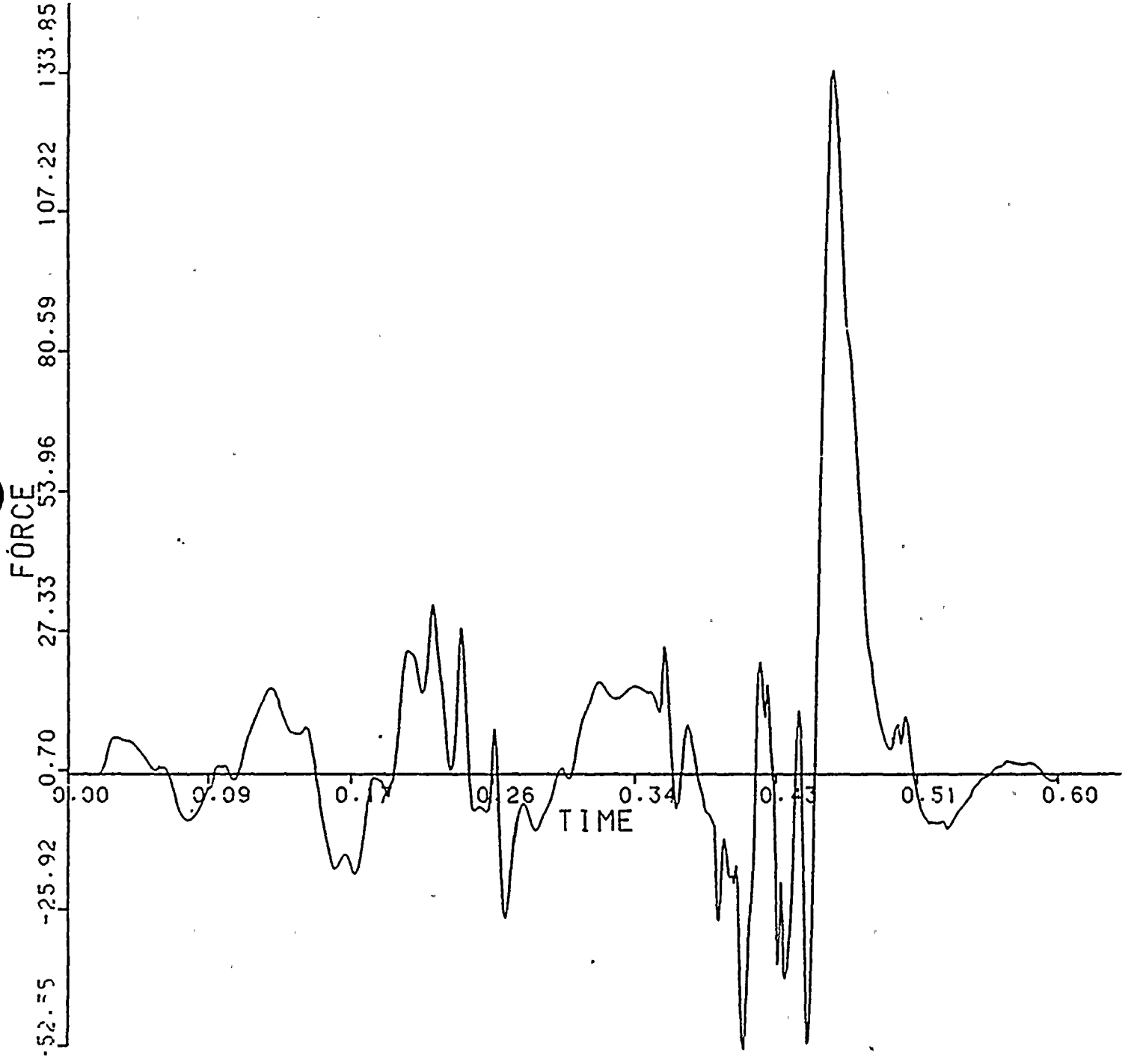
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 59, MAGNITUDE AT NODE POINT 146



DONE BY: [illegible] DATE: [illegible]
CHKD BY: [illegible] DATE: [illegible]

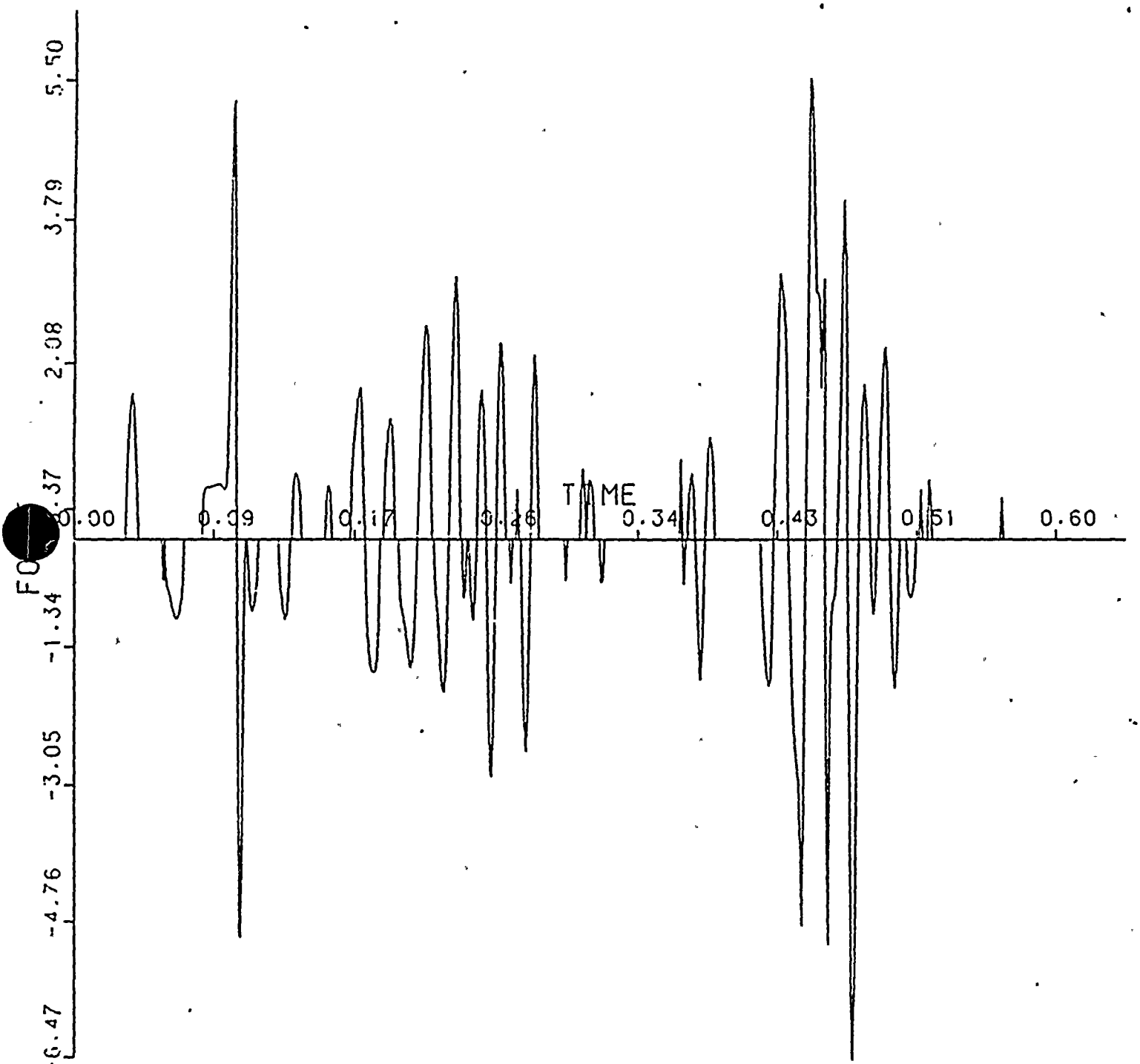
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 60, MAGNITUDE AT NODE POINT 144



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE ENGINEERING SERVICES
4-381

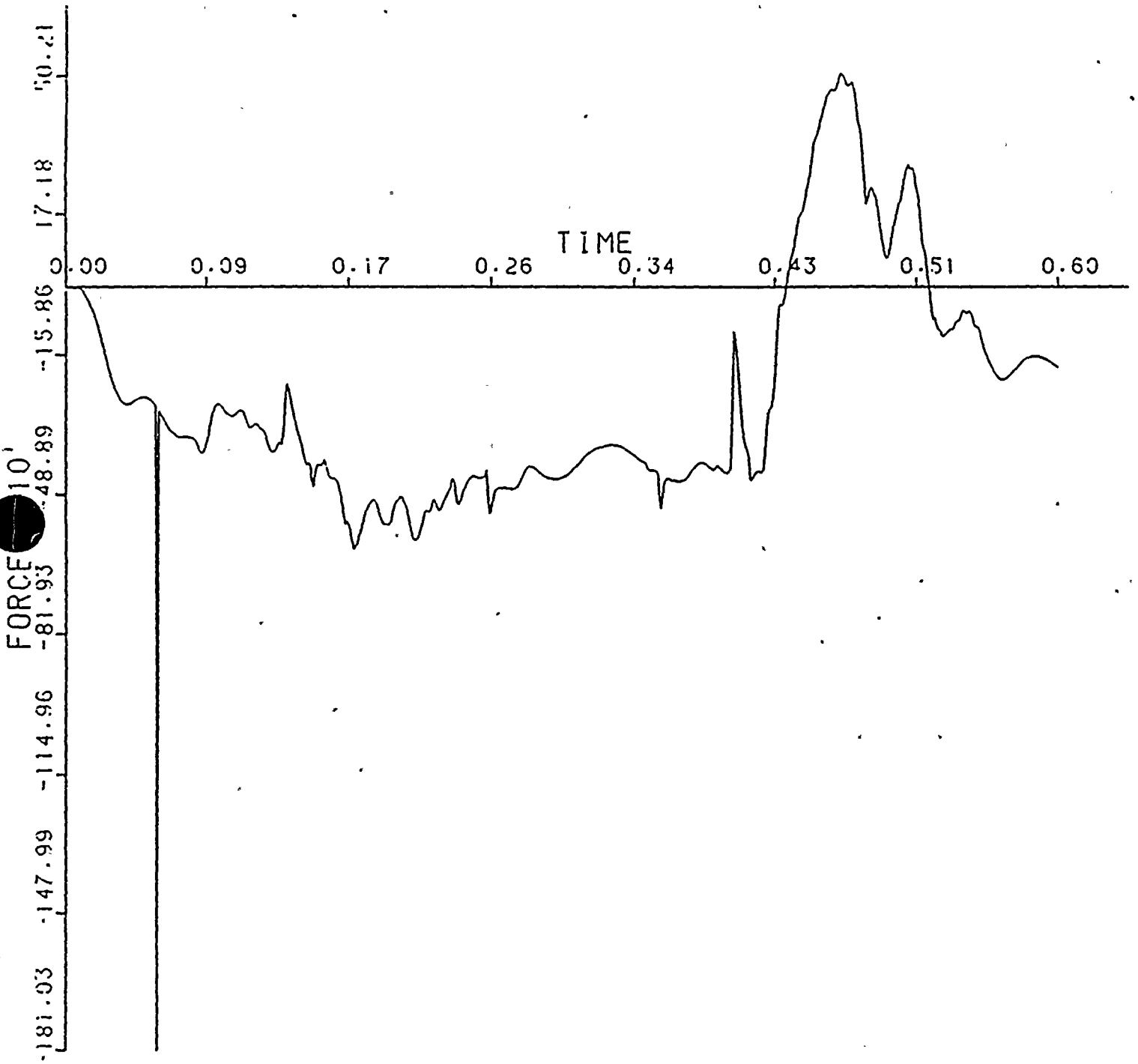
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 61, MAGNITUDE AT NODE POINT 223



DONE BY: [illegible] DATE: [illegible]
CHKD BY: [illegible] DATE: [illegible]

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 62. MAGNITUDE AT NODE POINT 260



DONE BY: MZ DATE: 5.24.83
CHKD BY: JM DATE: 5-25-83

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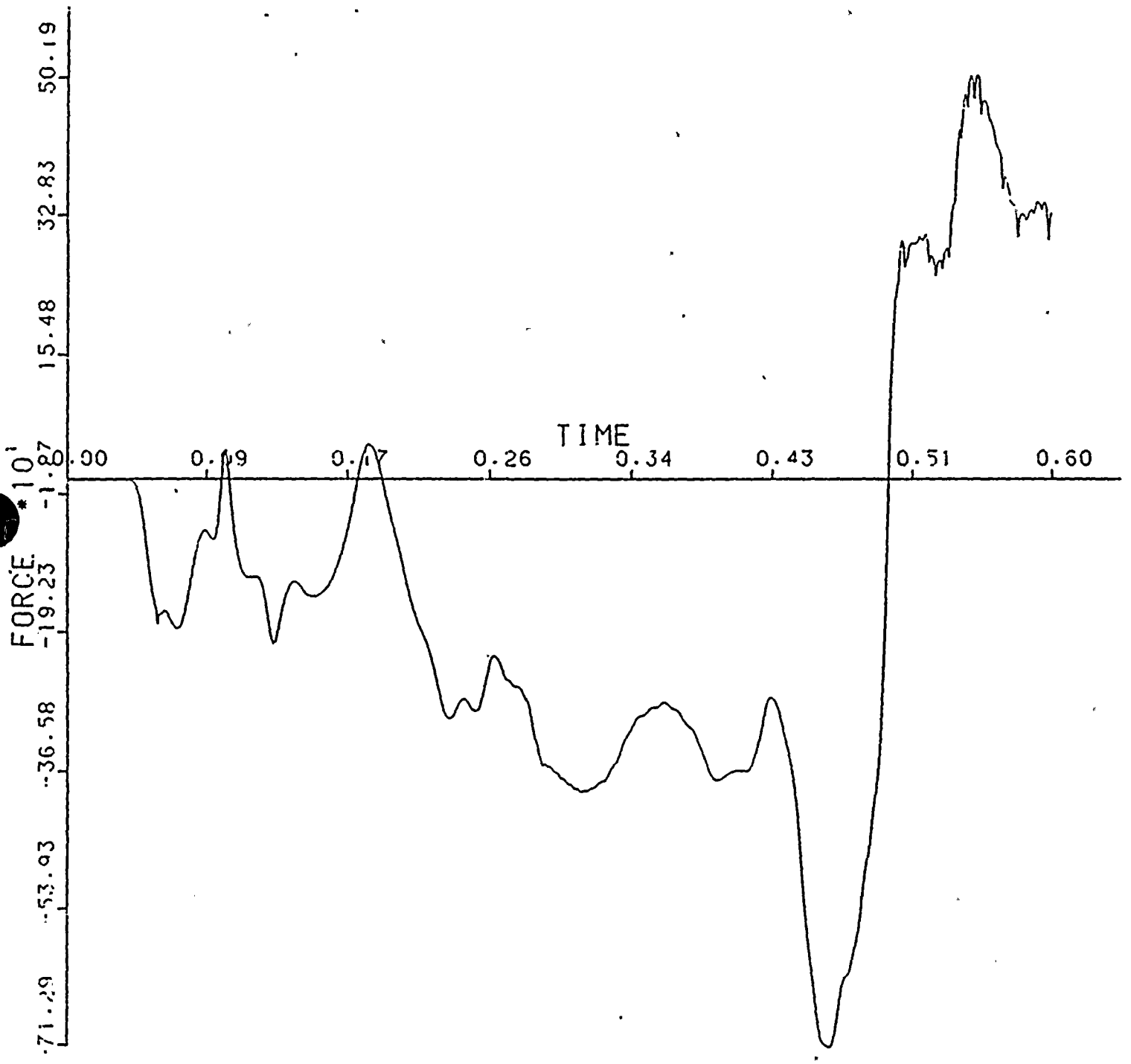
SAP2SAP VERIFICATION 5364 23-MAY-83

YFL-RFD SOLID UNIT 1, 0-600 MS

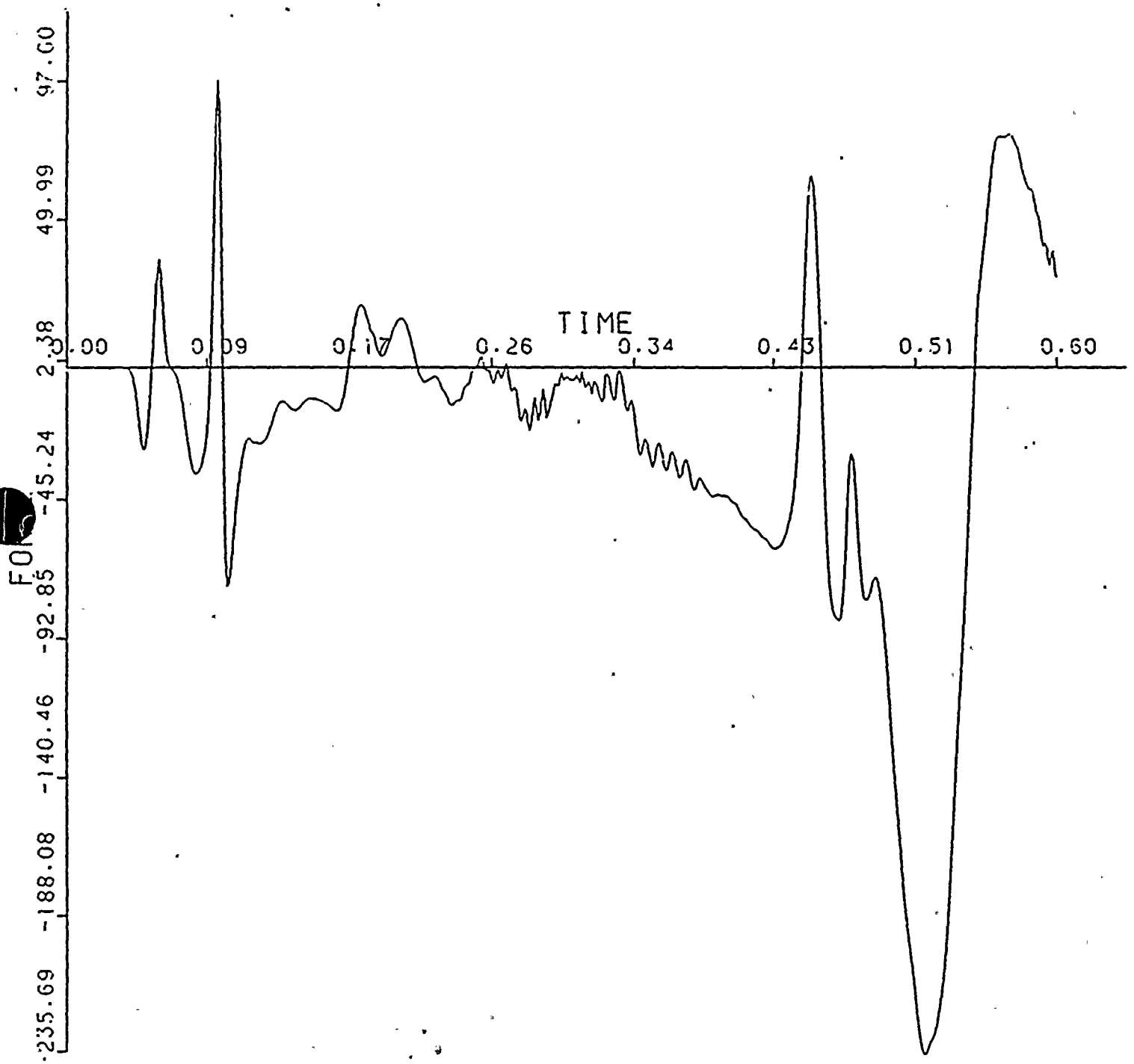
TIME/FORCE TABLE G.S. MAGNITUDE AT NODE POINT GR



DONE BY: MR DATE: 5/24/83

CHKD BY: [illegible] DATE: 5-23-83

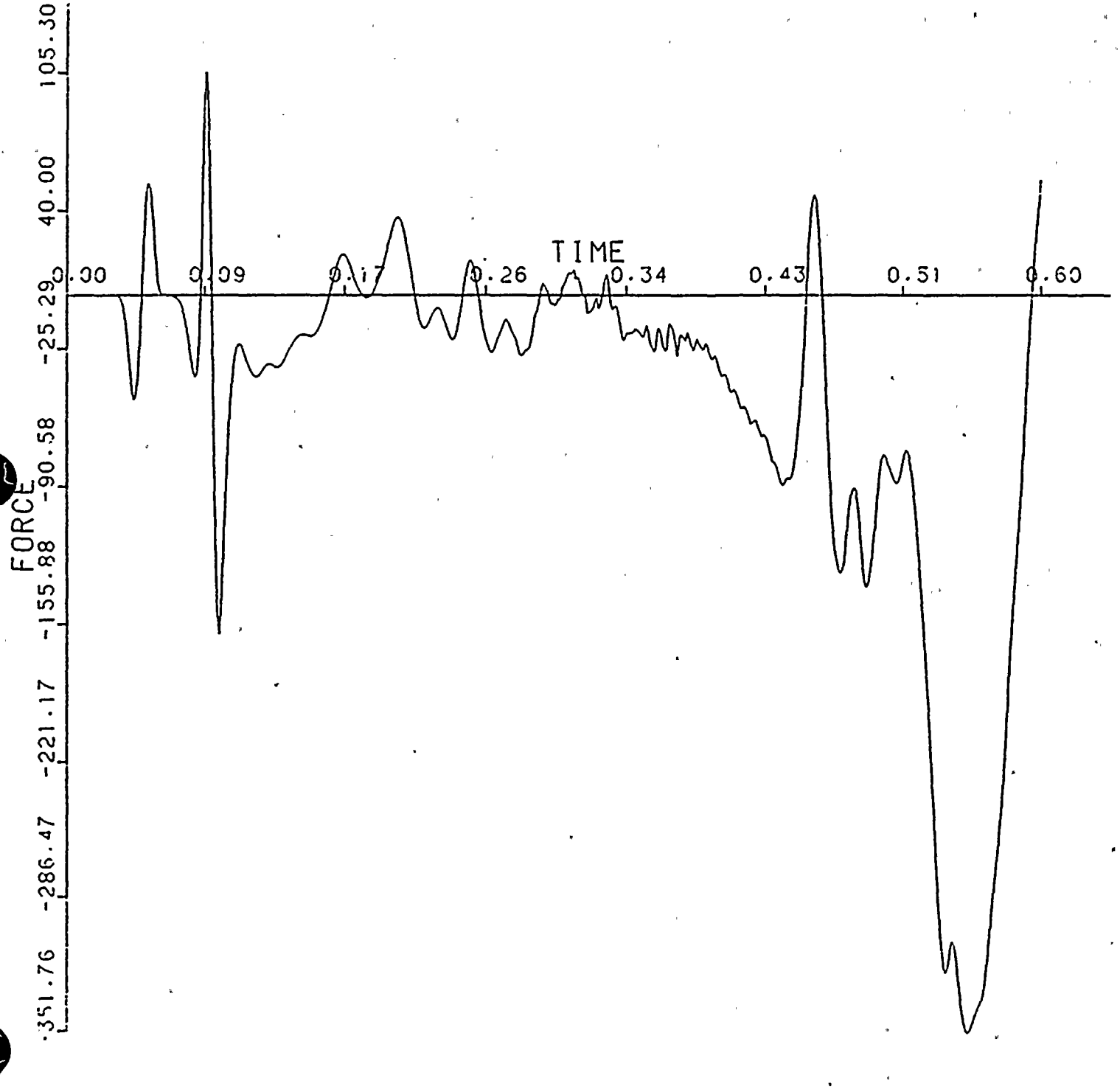
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 64. MAGNITUDE AT NODE POINT 58



DONE BY: MR DATE: 5/24/83
CHKD BY: JM DATE: 5-27-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YIELD SOLID UNIT 1, 0.600 MS
TIME/FORCE TABLE 65, MAGNITUDE AT NODE POINT 65



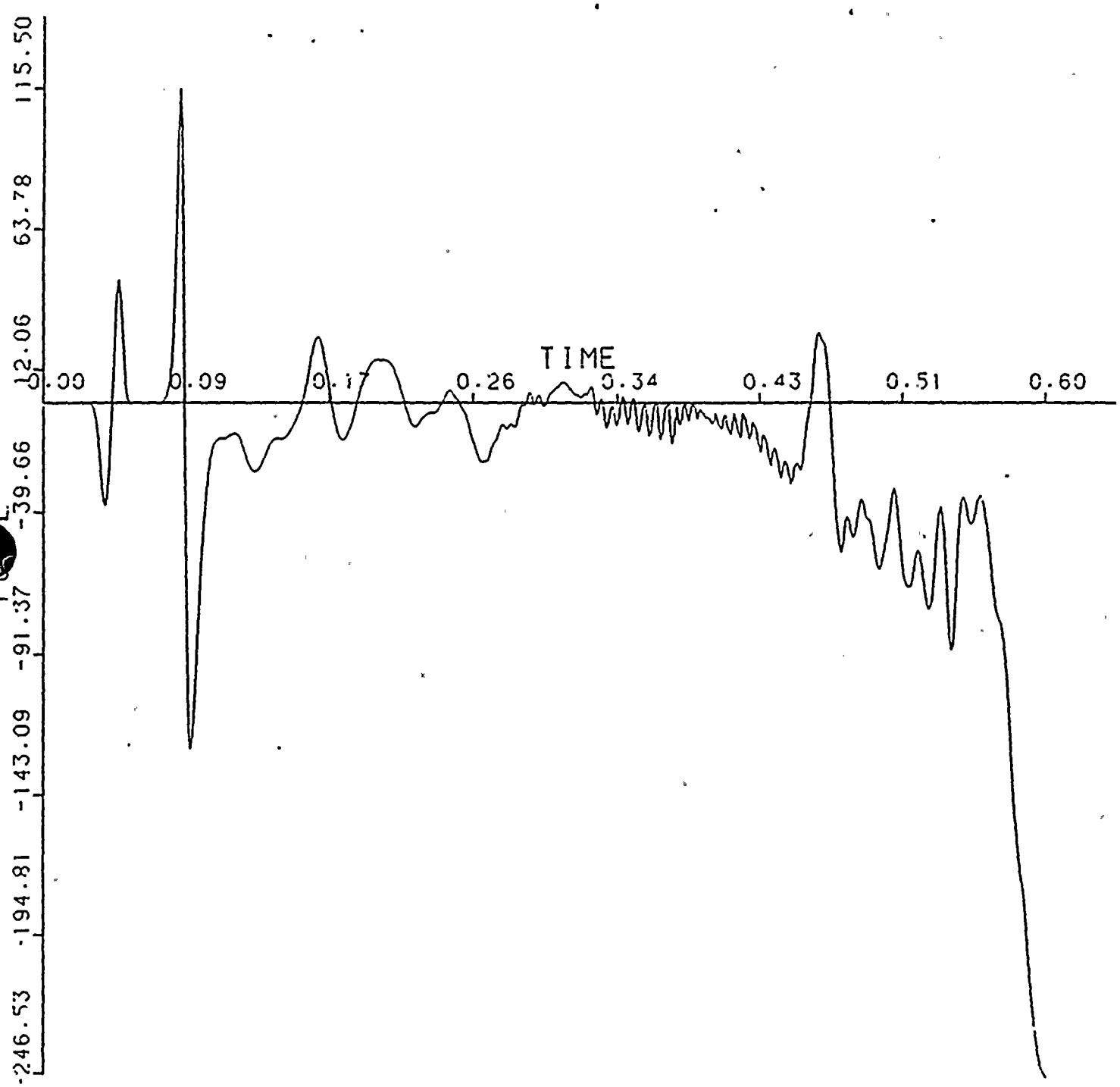
DONE BY: MC DATE: 5/24/83
CHKD BY: JH DATE: 5-25-83

ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83

YEL-RED SOLID UNIT 1, 0-600 MS

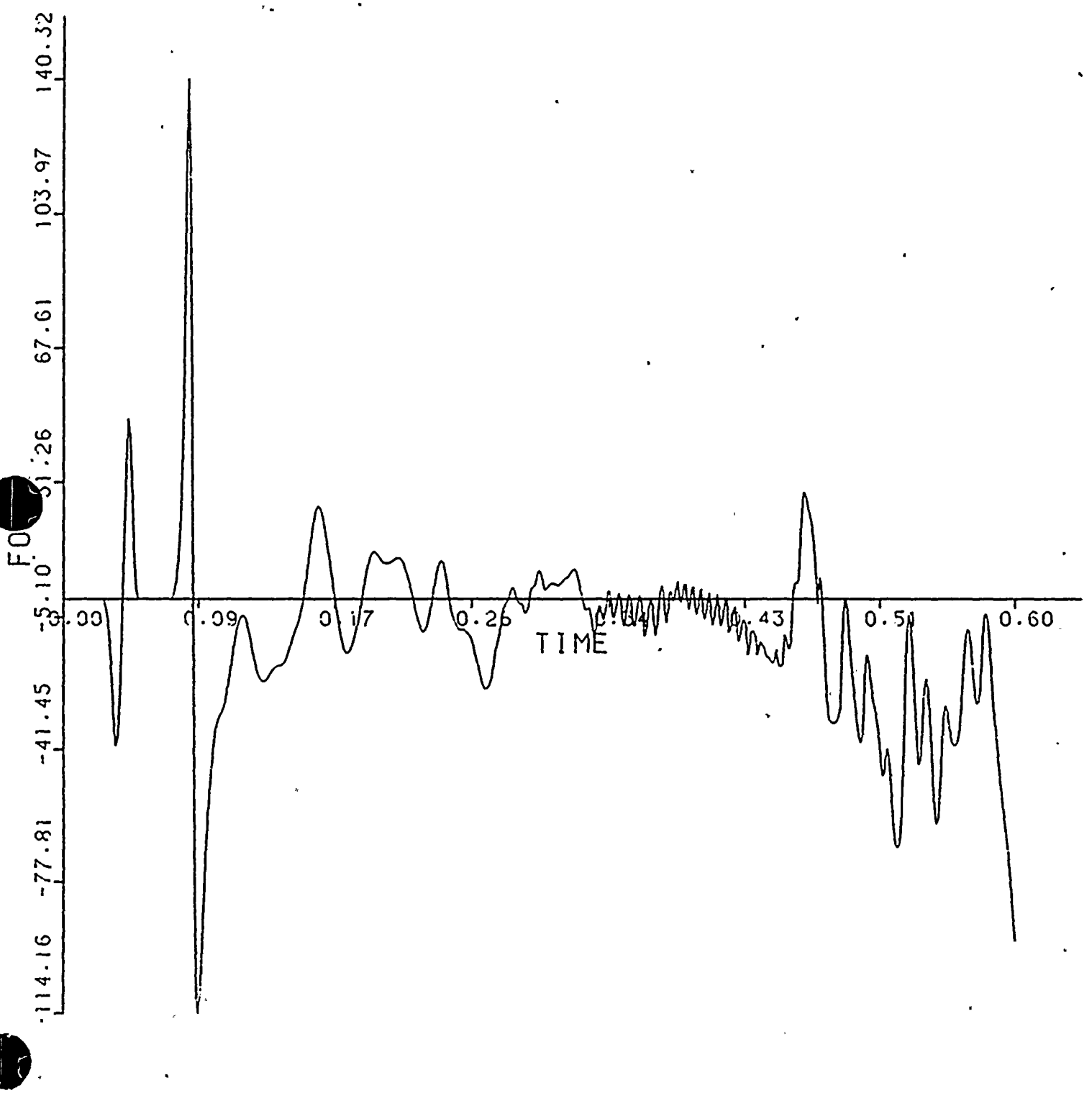
TIME/FORCE TABLE 66, MAGNITUDE AT NODE POINT 48



DONE BY: MR DATE: 5/24/83

CHKD BY: [illegible] DATE: 5-23-83

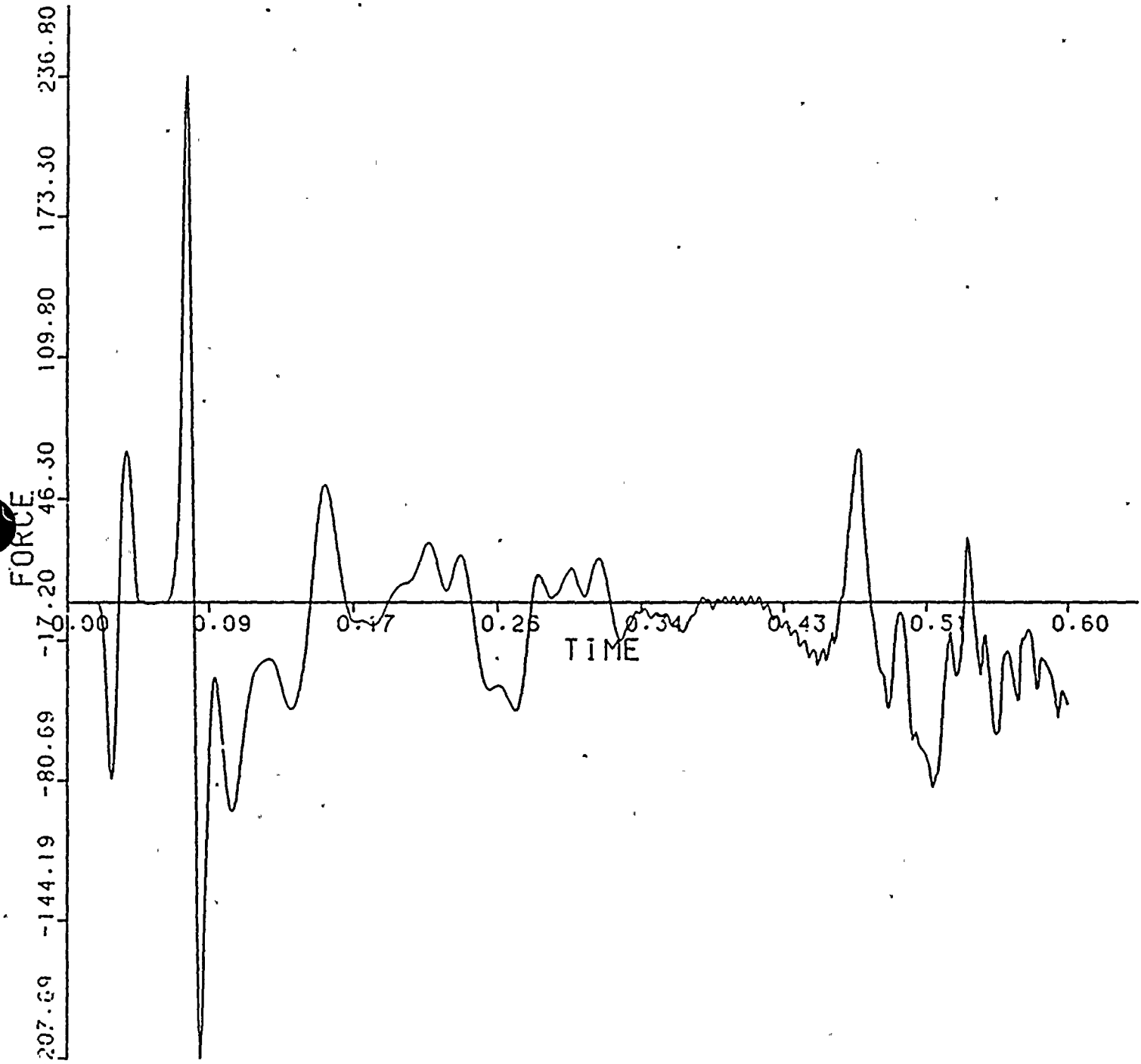
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 67, MAGNITUDE AT NODE POINT 40



DONE BY: MR DATE: 5/24/83
CHKD BY: [illegible] DATE: 5-25-83

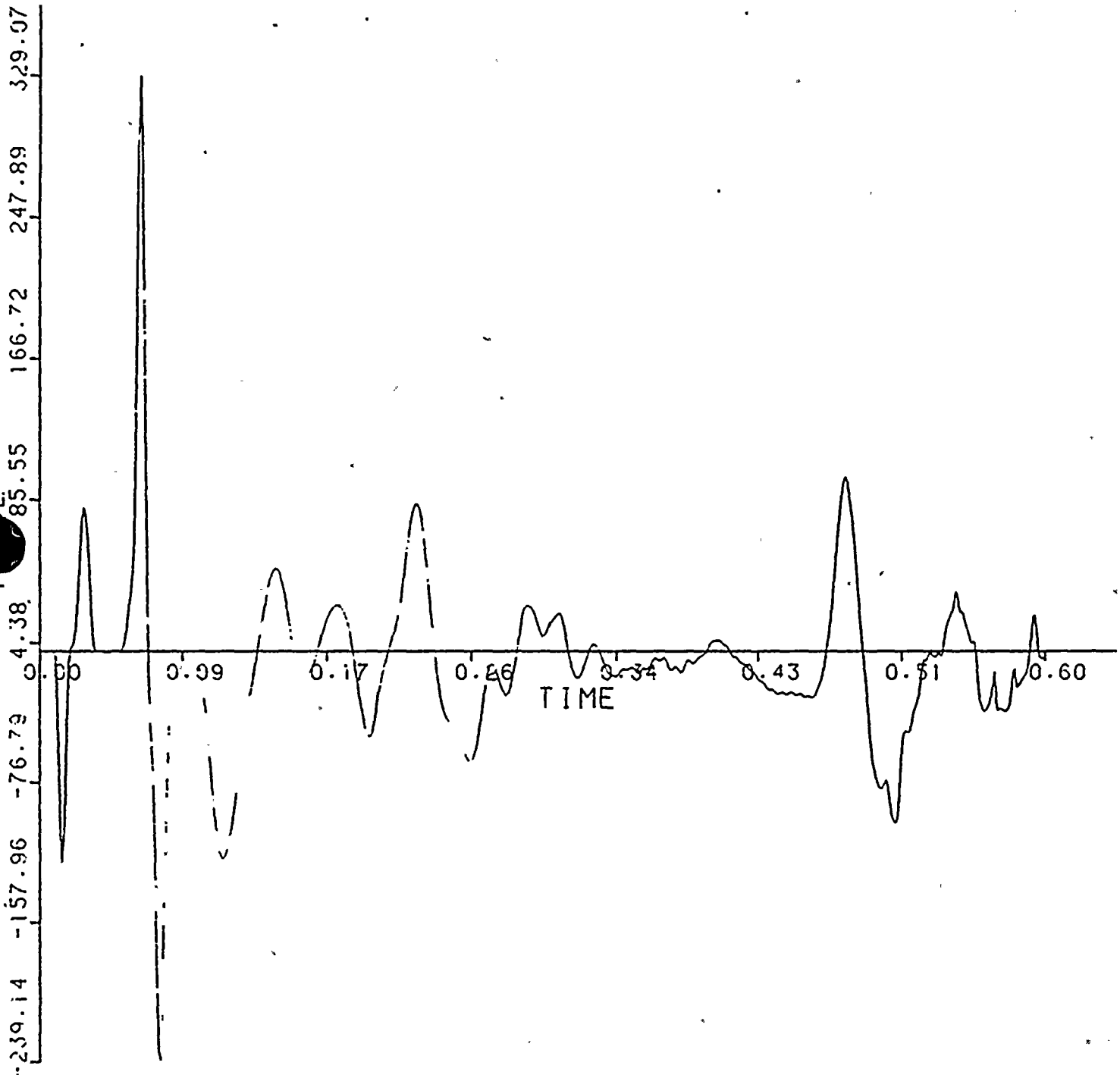
TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 68, MAGNITUDE AT NODE POINT 34



DONE BY: MR DATE: 5/25/83
CHKD BY: JH DATE: 5-23-83

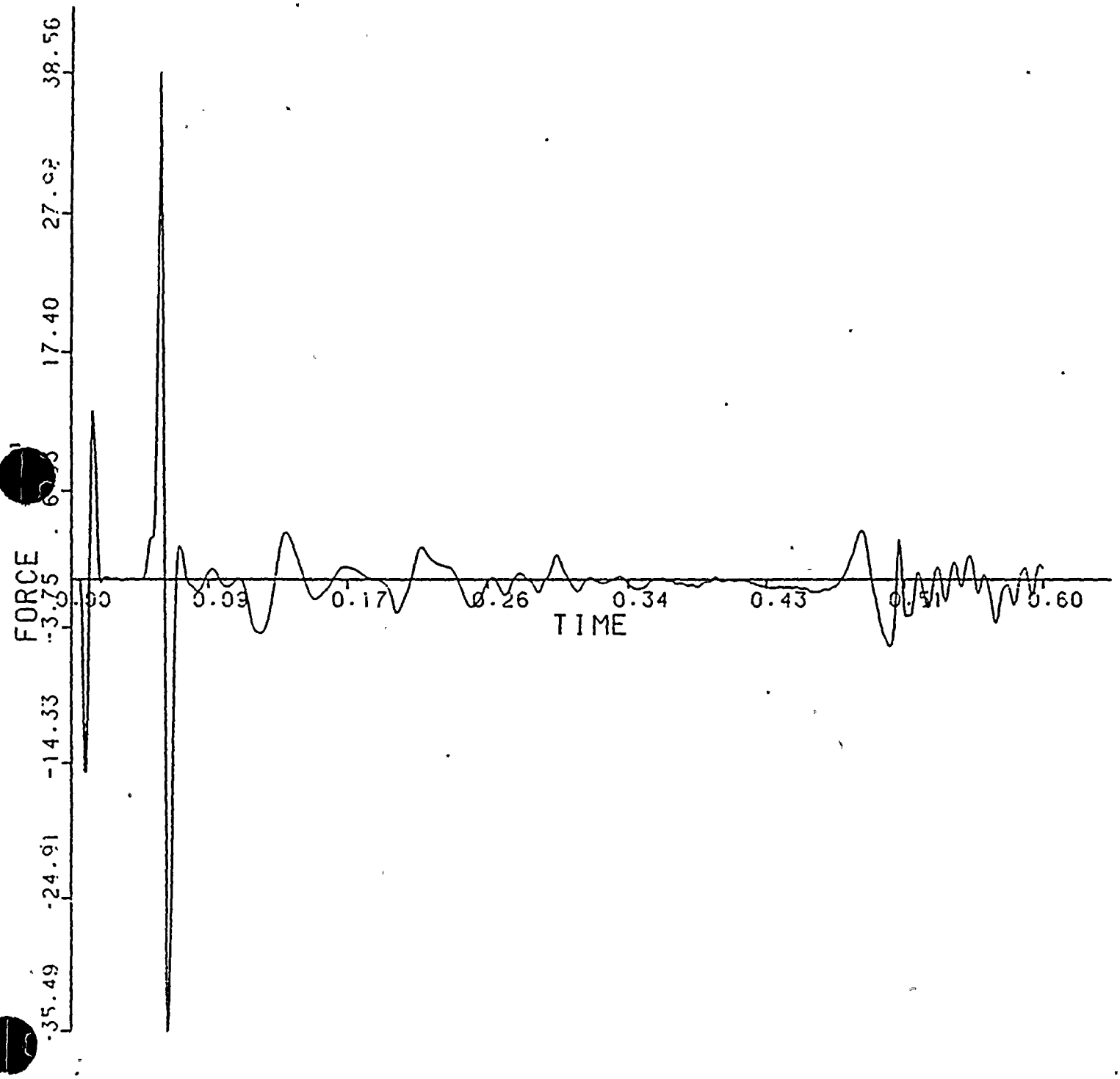
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1. 0-600 MS
TIME/FORCE TABLE 69. MAGNITUDE AT NODE POINT 18



DONE BY: MR DATE: 5/24/83
CHKD BY: CM DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

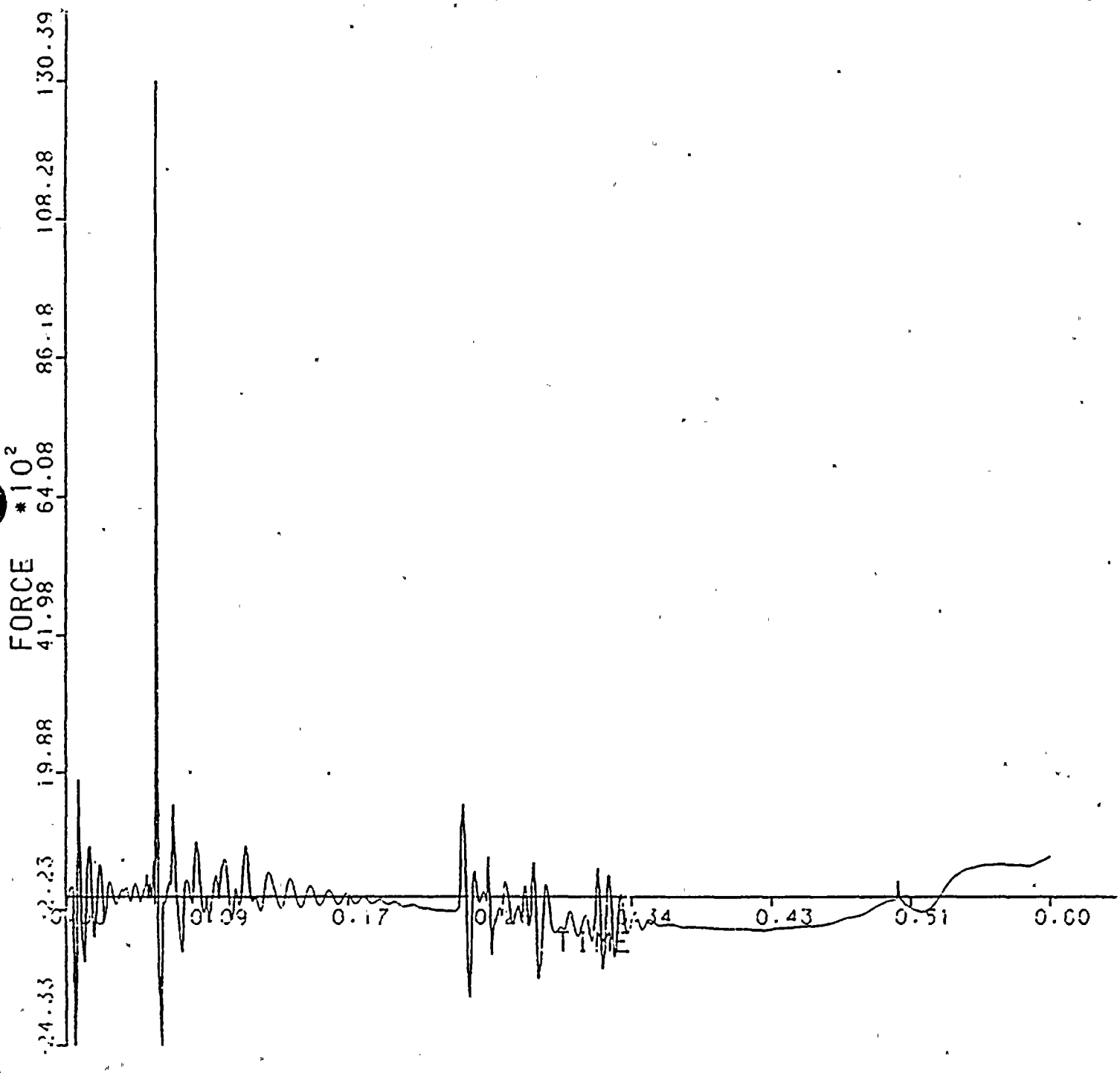
SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 70. MAGNITUDE AT NODE POINT 8



DONE BY: MR DATE: 5/24/83
CHKD BY: [illegible] DATE: 5-23-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 23-MAY-83
YEL-RED SOLID UNIT 1, 0-600 MS
TIME/FORCE TABLE 71, MAGNITUDE AT NODE POINT 4



DONE BY: MR DATE: 5/24/83
CHKD BY: CM DATE: 5-27-83

4.8.3 Quarter Model - Cold Loop Seal/Steam Case

BY CMM DATE 3-16-83
CHKD. BY KYG DATE 5-24-83

1/4 MODEL LENGTHS & NODES (SRV) ANALYSIS

SHEET NO. 1 OF 1
PROJ. NO. 5364

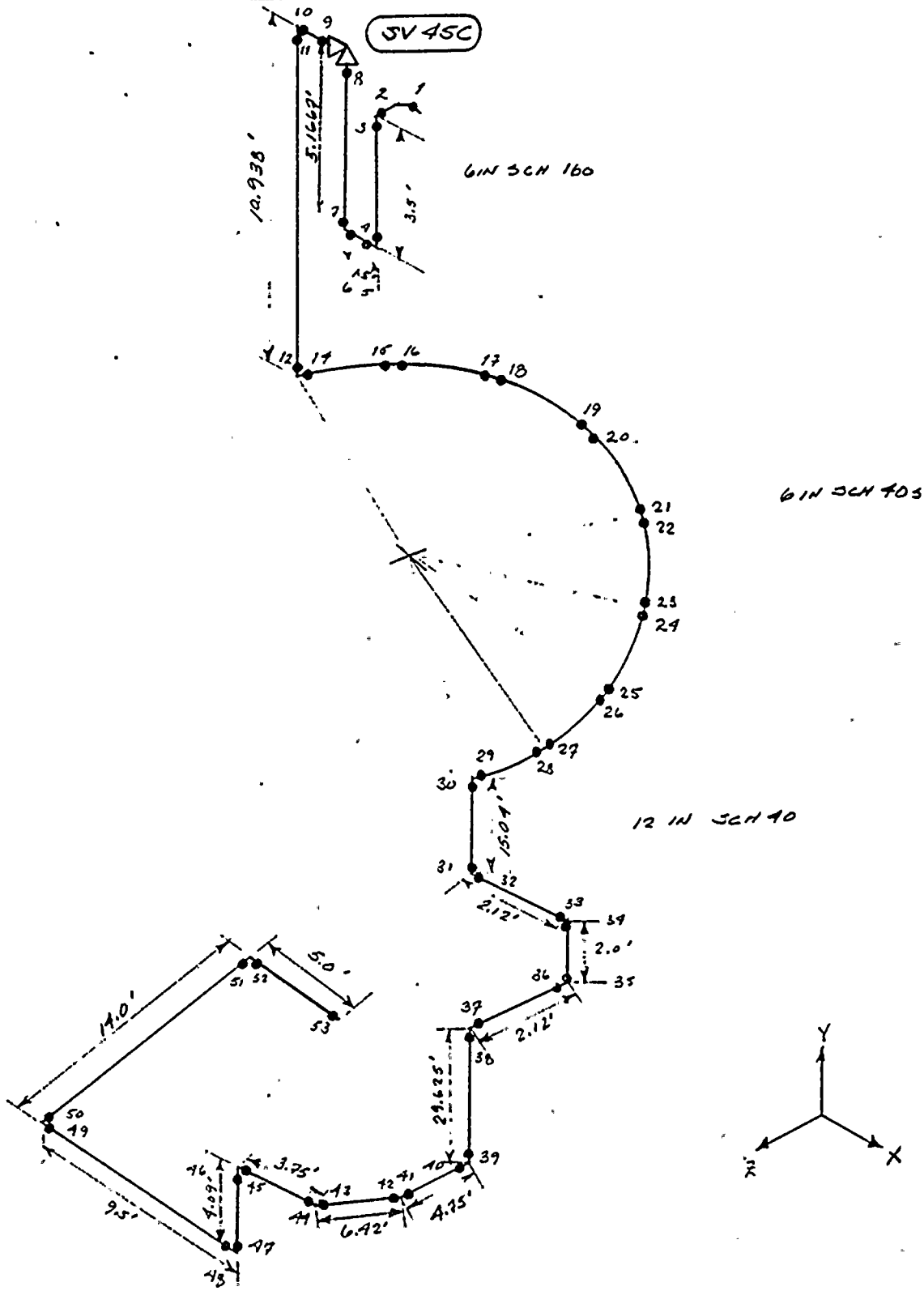


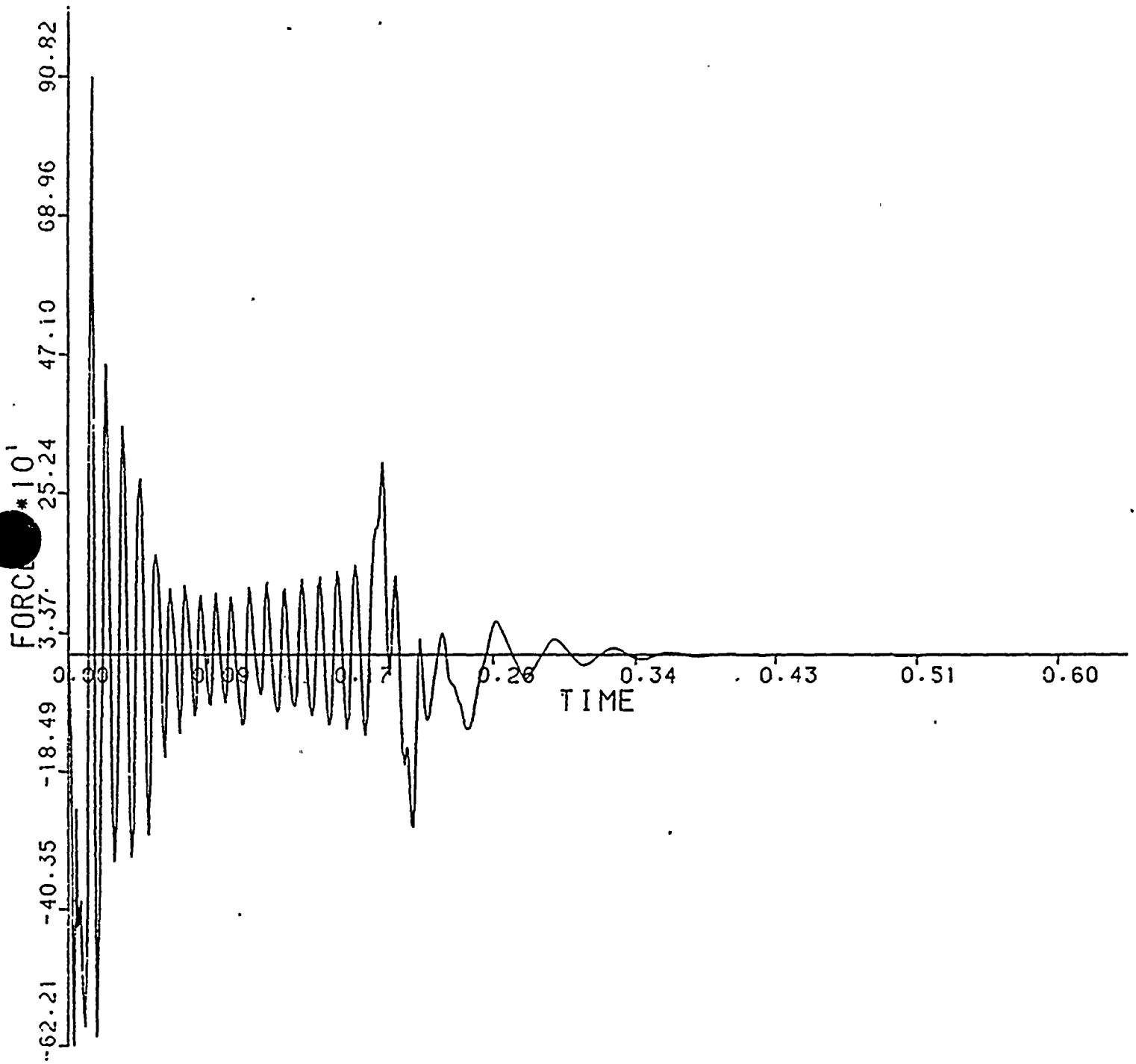
FIGURE 4.8.2-1

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83

QUARTER MODEL UNIT 2 LOOPSEAL

TIME/FORCE TABLE 1. MAGNITUDE AT NODE POINT 118



DONE BY: [illegible] DATE: 5-26-83

CHKD BY: [illegible] DATE: 5-27-83

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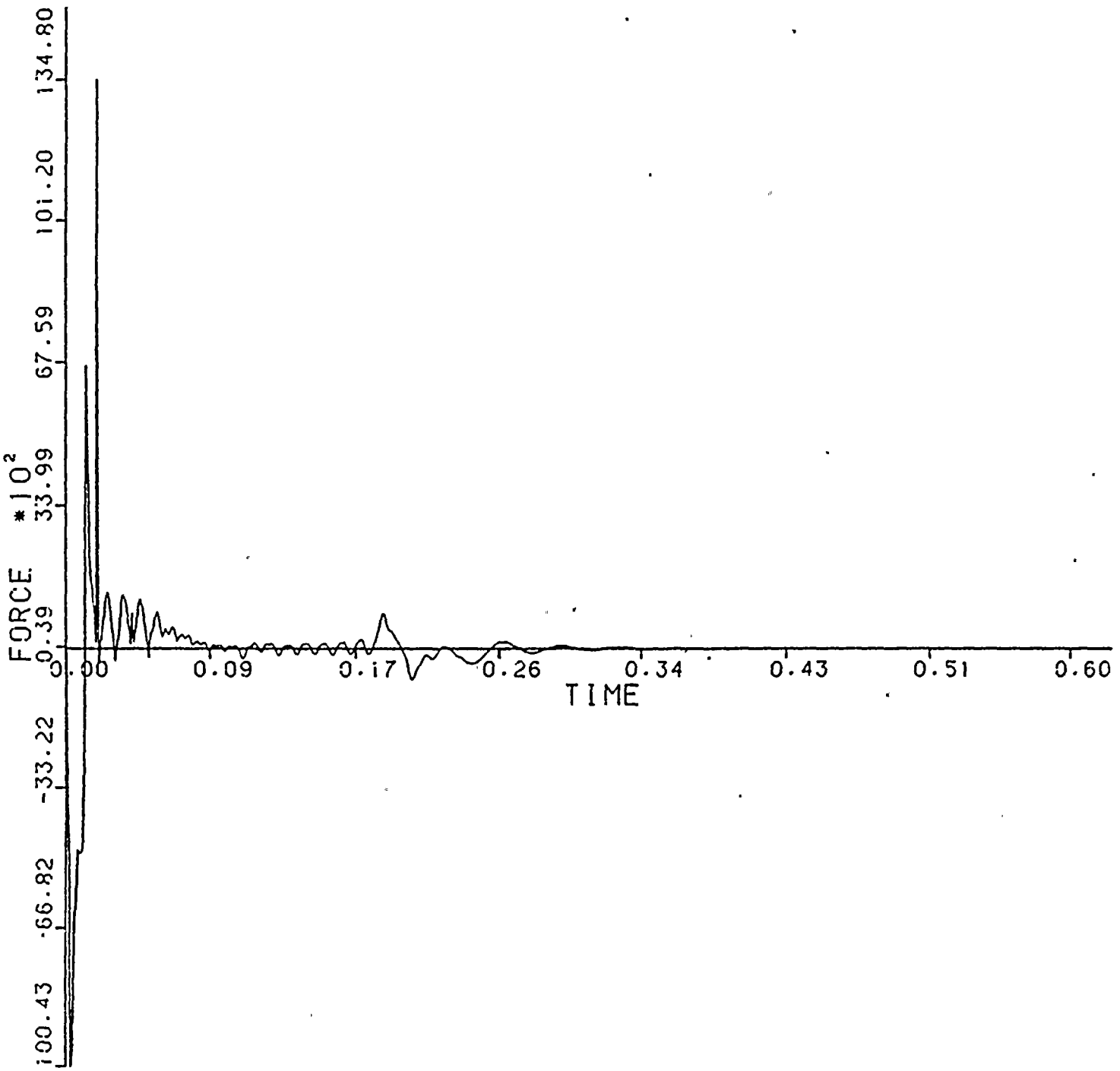
ENGINEERING SERVICES

CAP/SAP VERIFICATION 5364 24 MAY 83
QUARTER MODEL UNIT 2 LOAD 1A1
TIME FORCE TABLE 2: MAGNITUDE AT NODE POINT 114



DONE BY: DATE: 5-26-83
CHKD BY: DATE: 5-27-83

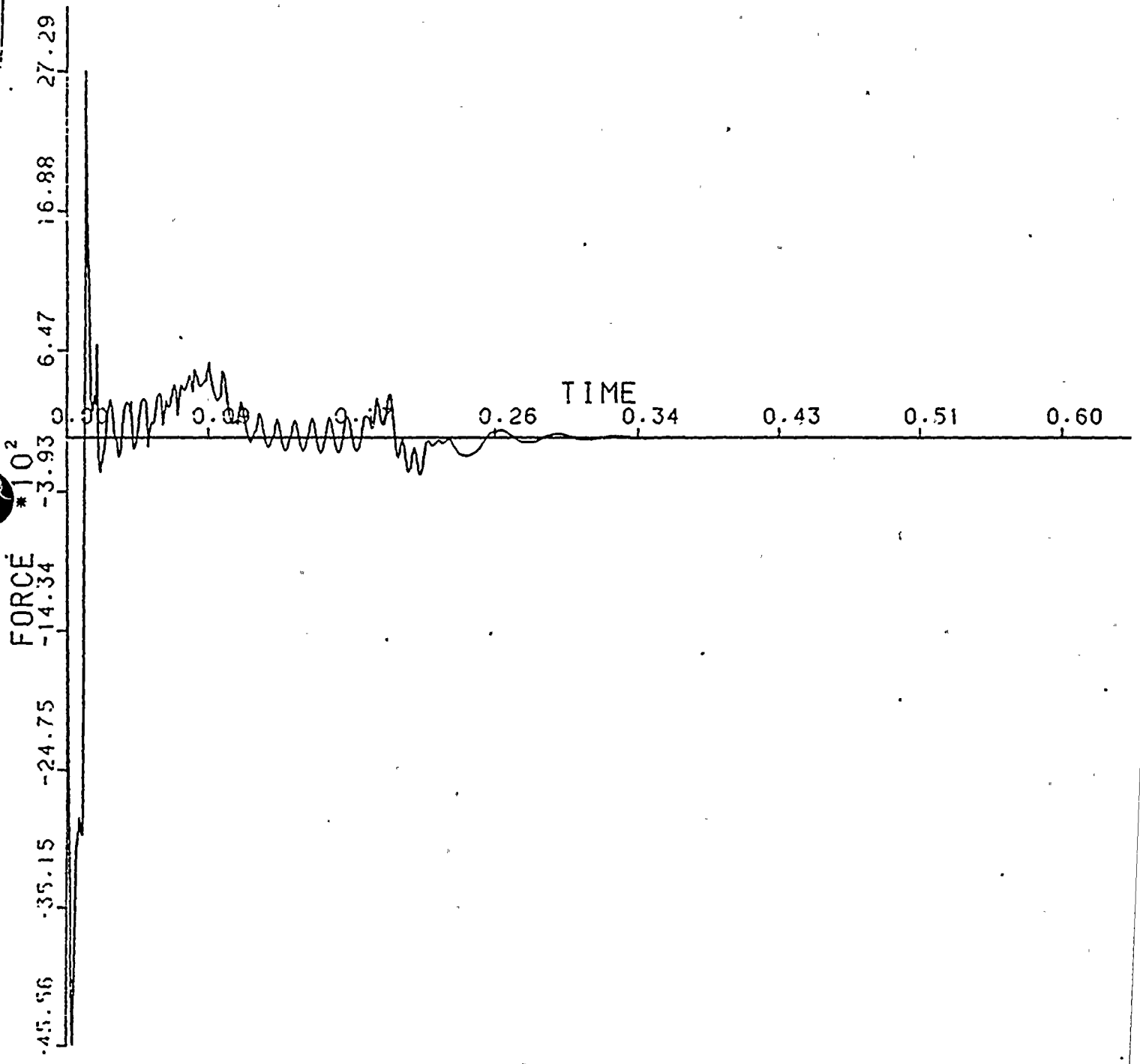
Technical Report
TR-5364-1
Revision 0

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83

QUARTER MODEL UNIT 2 LOOPSEAL

TIME/FORCE TABLE 3. MAGNITUDE AT NODE POINT 111



DONE BY: [illegible] DATE: 5-26-83

CHKD BY: [illegible] DATE: 5-27-83

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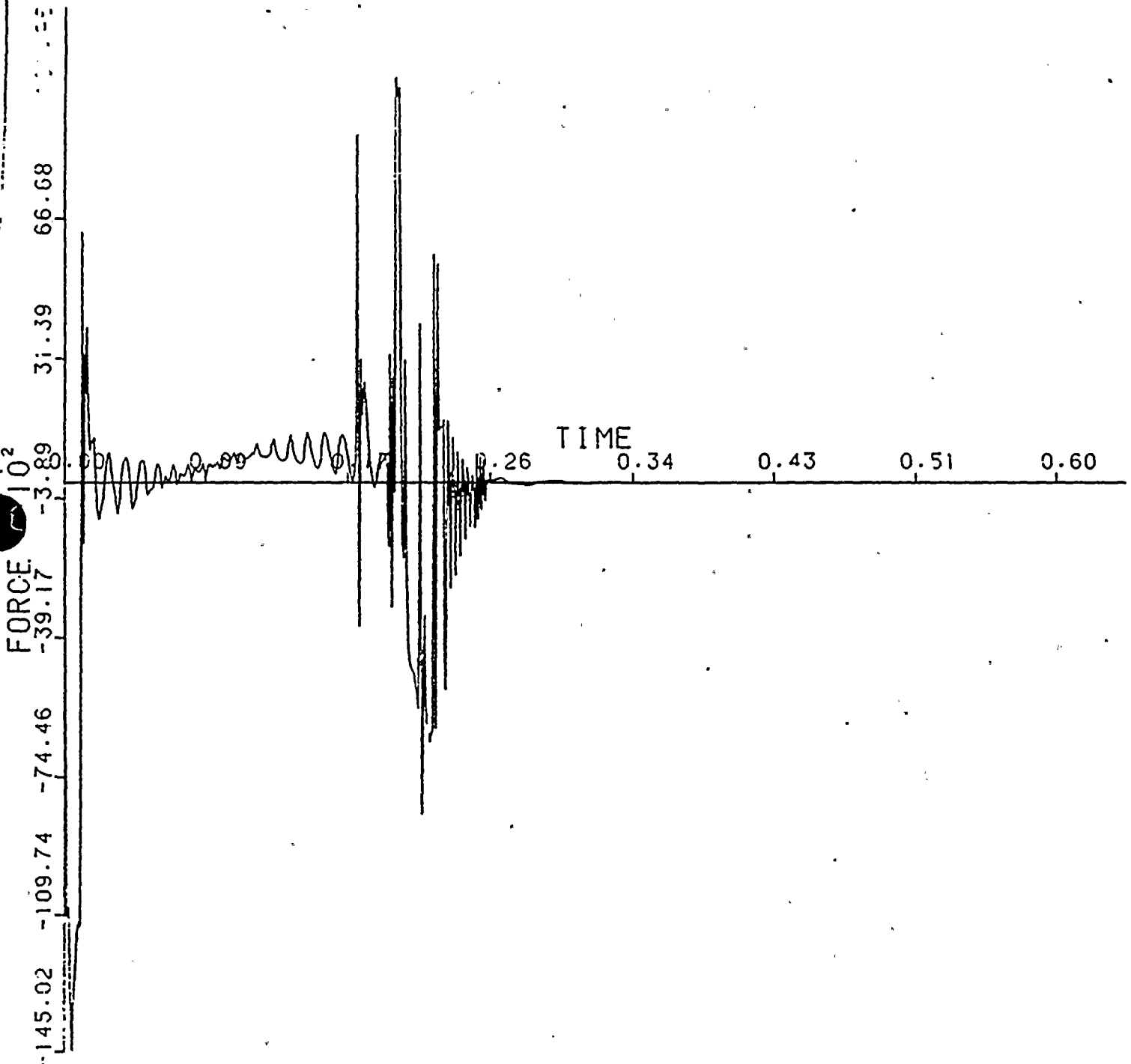
SAP2SAP VERIFICATION 5364 24-MAY-83

QUARTER MODEL UNIT 2 LOOPSEAL

TIME/FORCE TABLE 4, MAGNITUDE AT NODE POINT 107



DONE BY: DATE:

CHKD BY: DATE:

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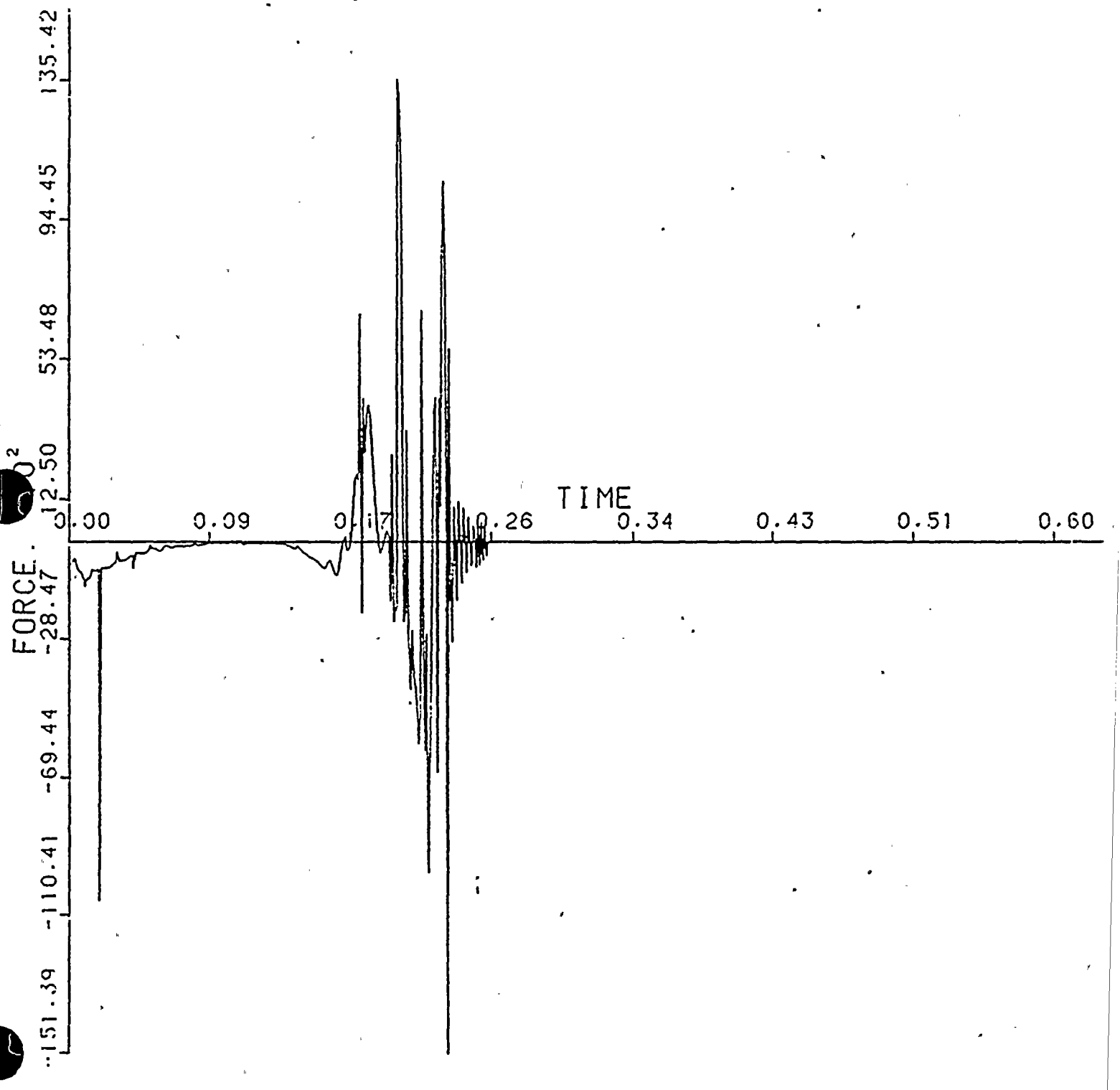
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 5, MAGNITUDE AT NODE POINT 98



DONE BY: DATE: 5-28-83
CHKD BY: DATE: 5-27-83

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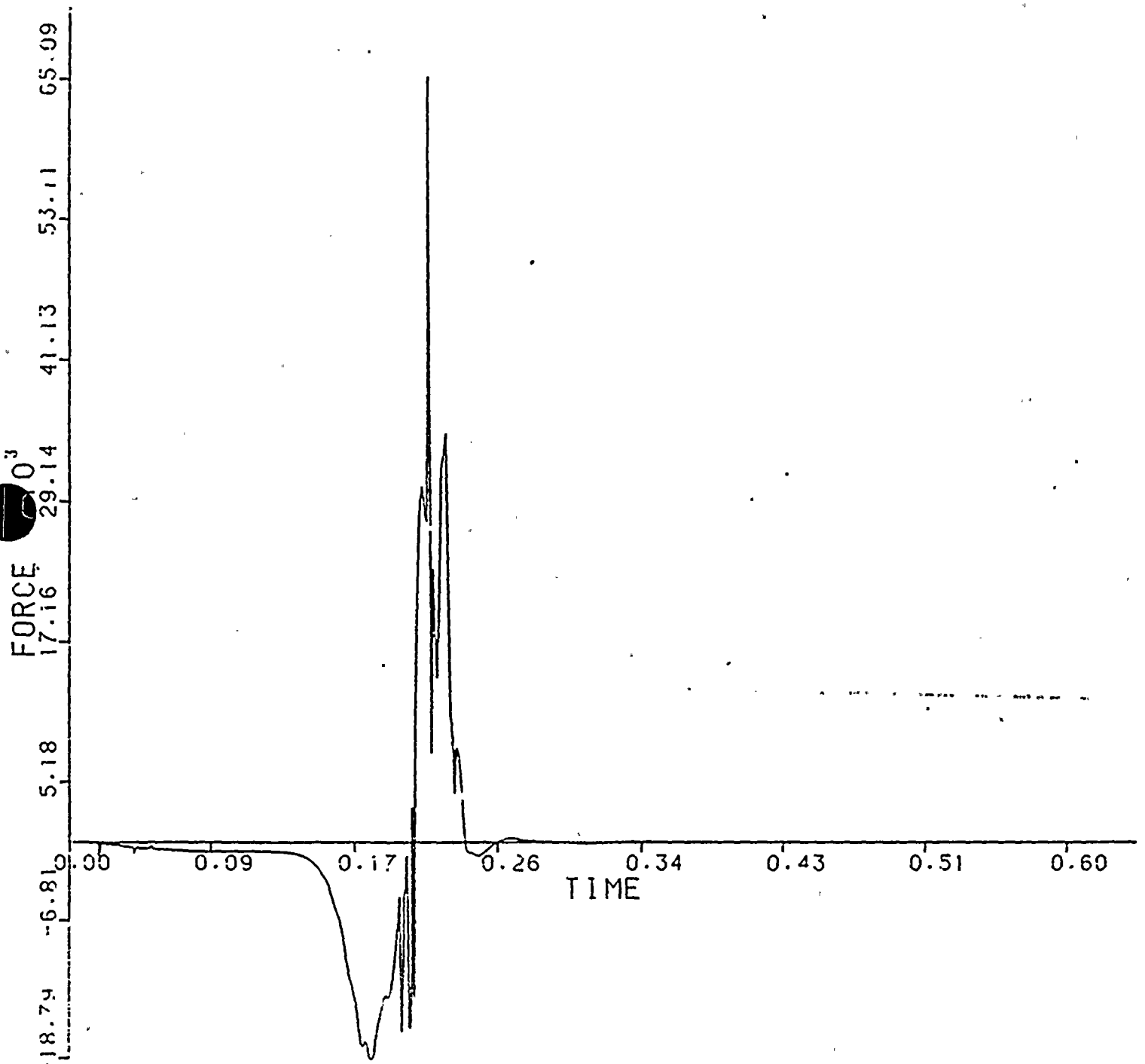
ENGINEERING SERVICES

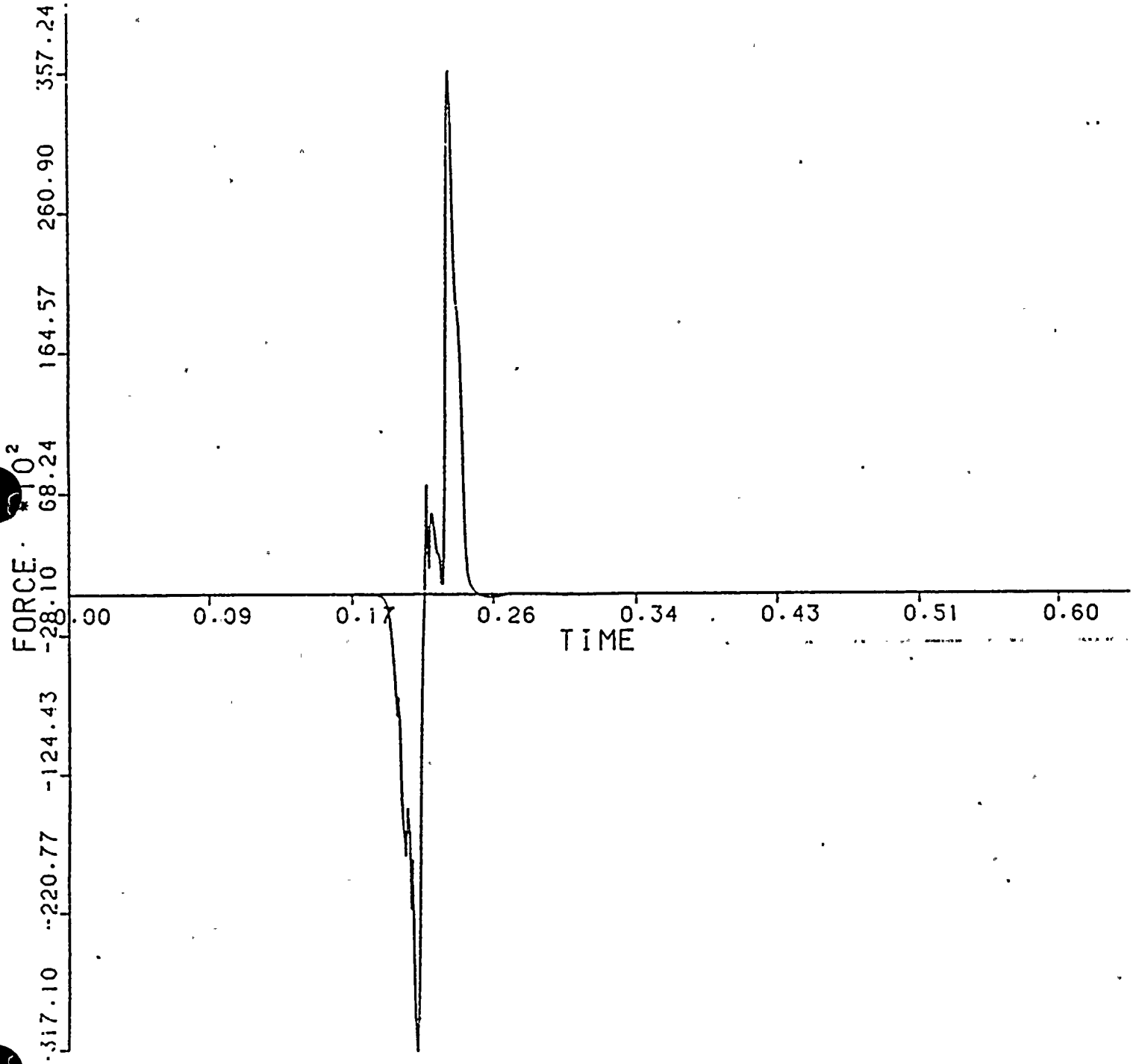
SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE · 6. MAGNITUDE AT NODE POINT 90



DONE BY: [illegible] DATE: [illegible]
CHKD BY: [illegible] DATE: [illegible]

TELEDYNE ENGINEERING SERVICES
24-MAY-83

SAP2SAP VERIFICATION 5364
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 7. MAGNITUDE AT NODE POINT 88



DONE BY: DATE: 5-26-83
CHKD BY: DATE: 5-27-83

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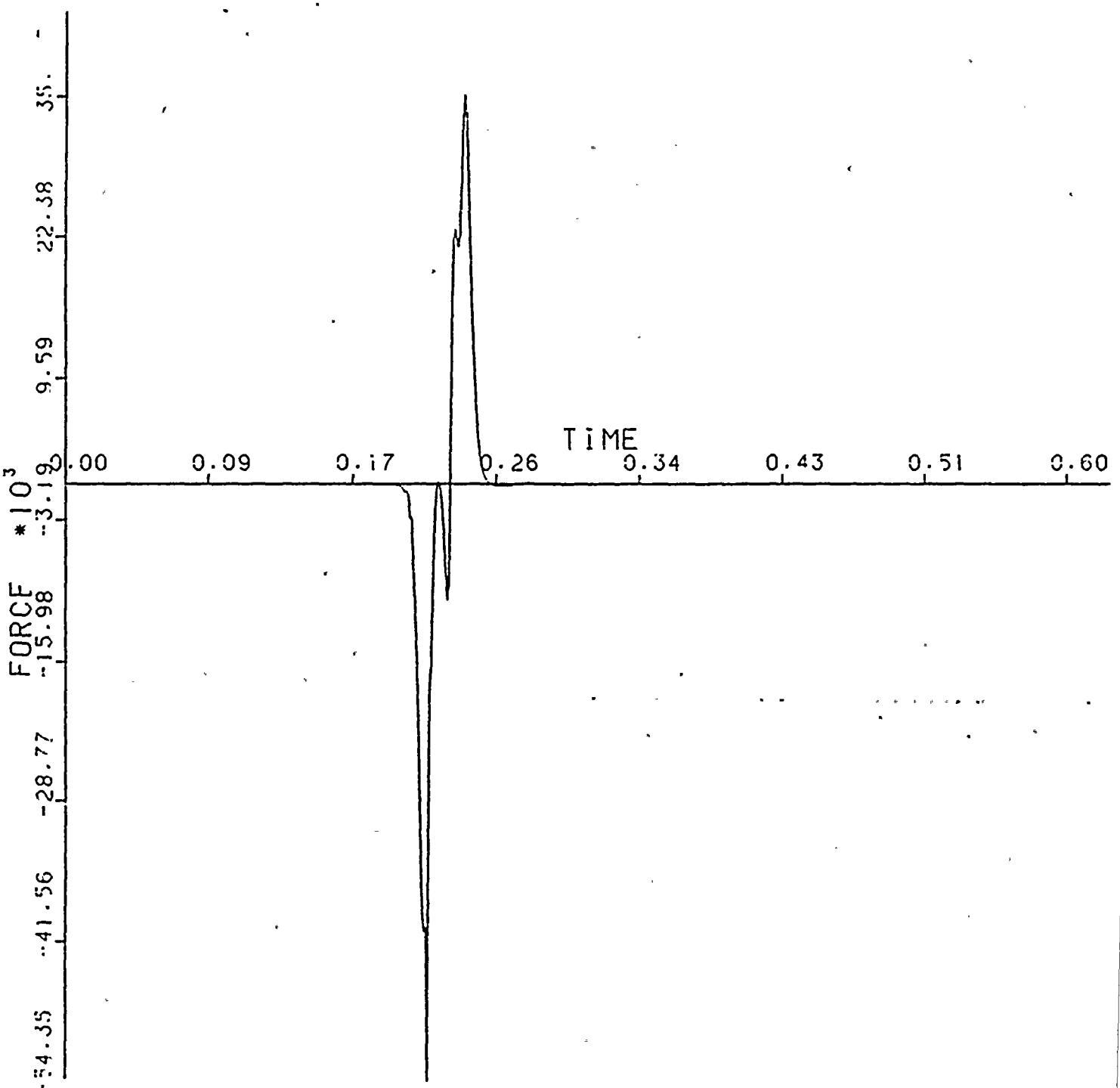
SAP2SAP VERIFICATION 5364 24-MAY-83

QUARTER MODEL UNIT 2 LOOPSEAL

TIME/FORCE TABLE 8, MAGNITUDE AT NODE POINT 86



DONE BY: DATE:

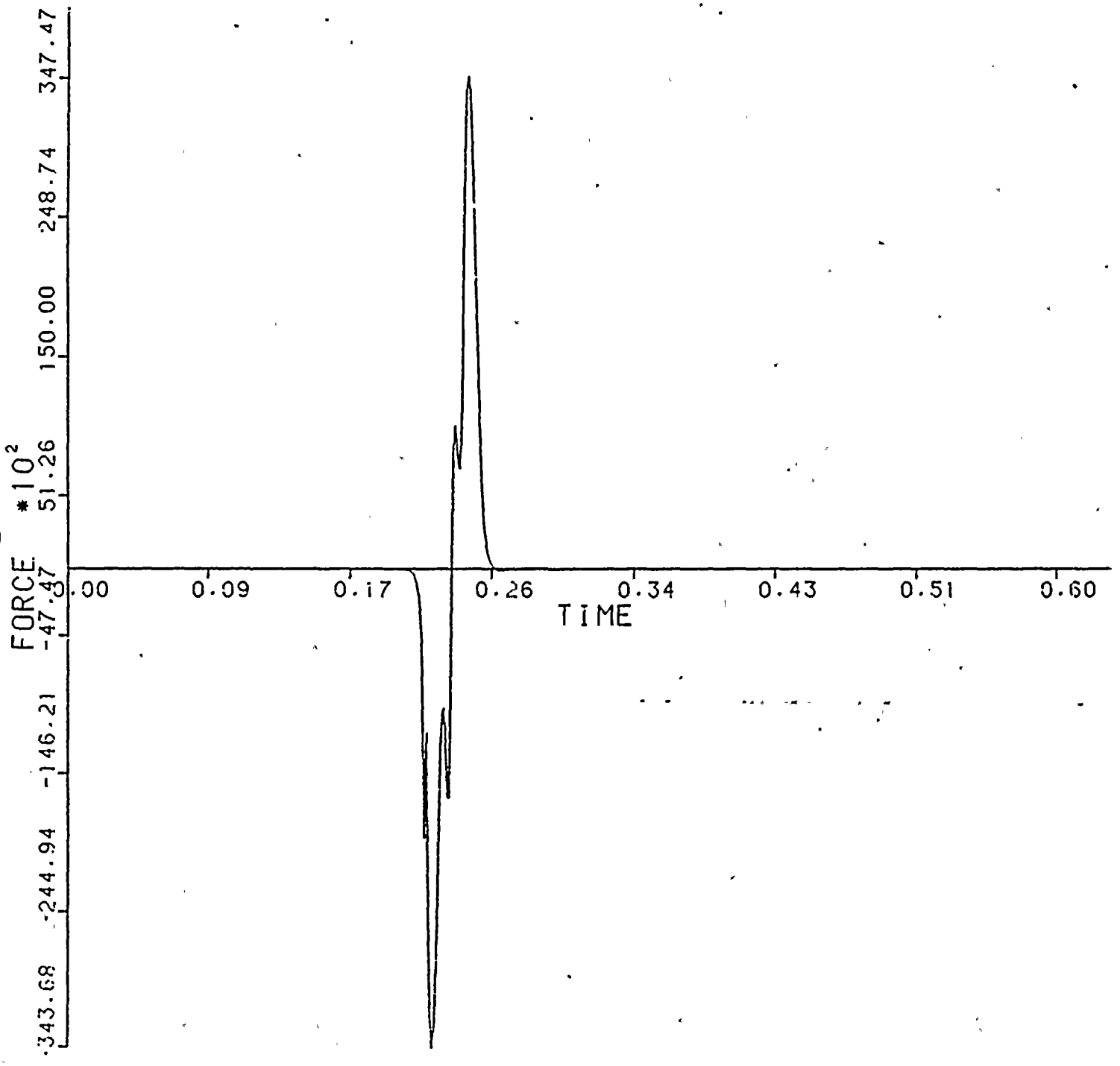
CHKD BY: DATE:

TELEDYNE ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83

QUARTER MODEL UNIT 2 LOOPSEAL

TIME/FORCE TABLE 9. MAGNITUDE AT NODE POINT 84



DONE BY: DATE: 5-26-83

CHKD BY: DATE: 5-27-83

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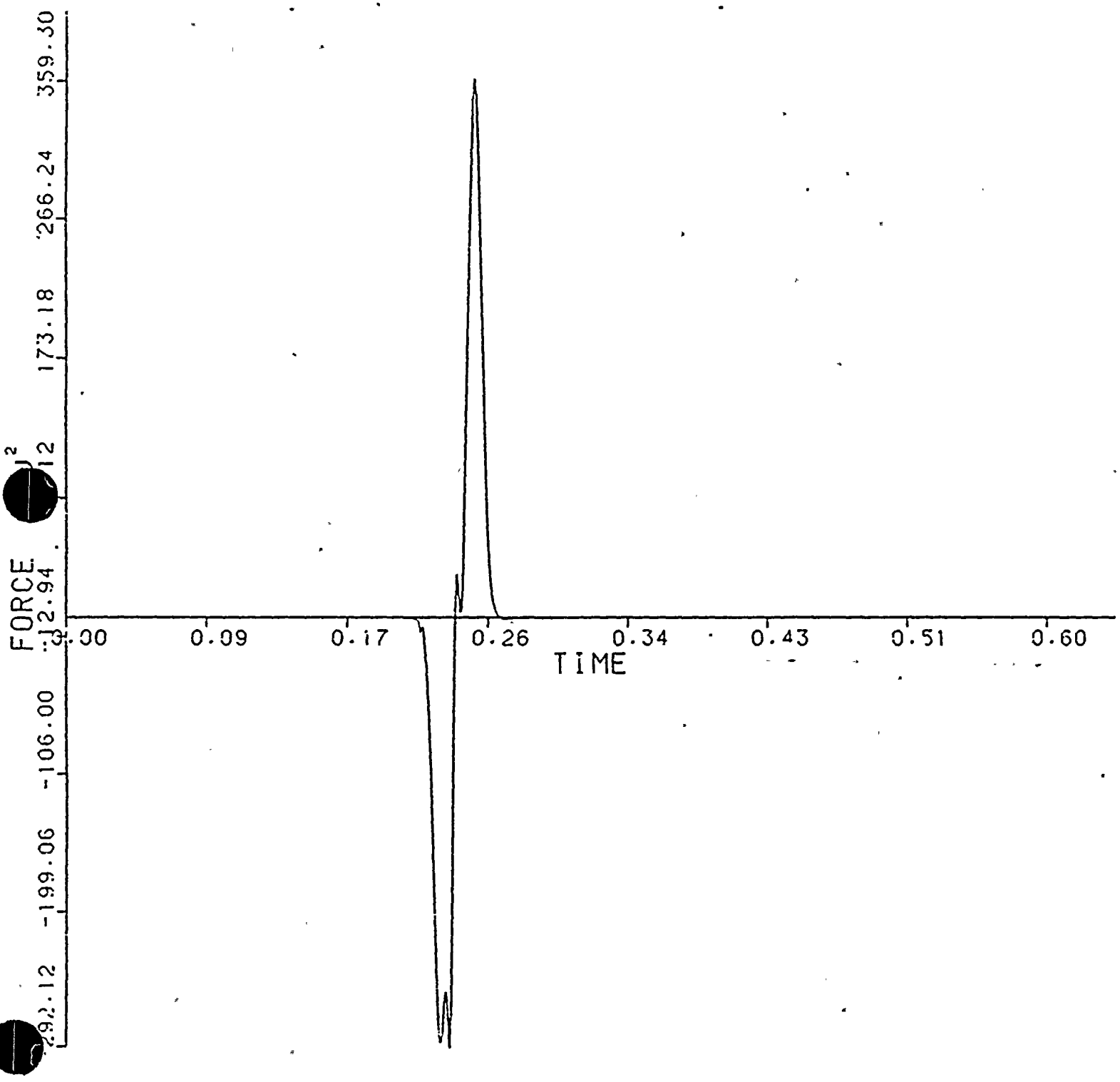
SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 10, MAGNITUDE AT NODE POINT 82



DONE BY: DATE:
CHKD BY: DATE:

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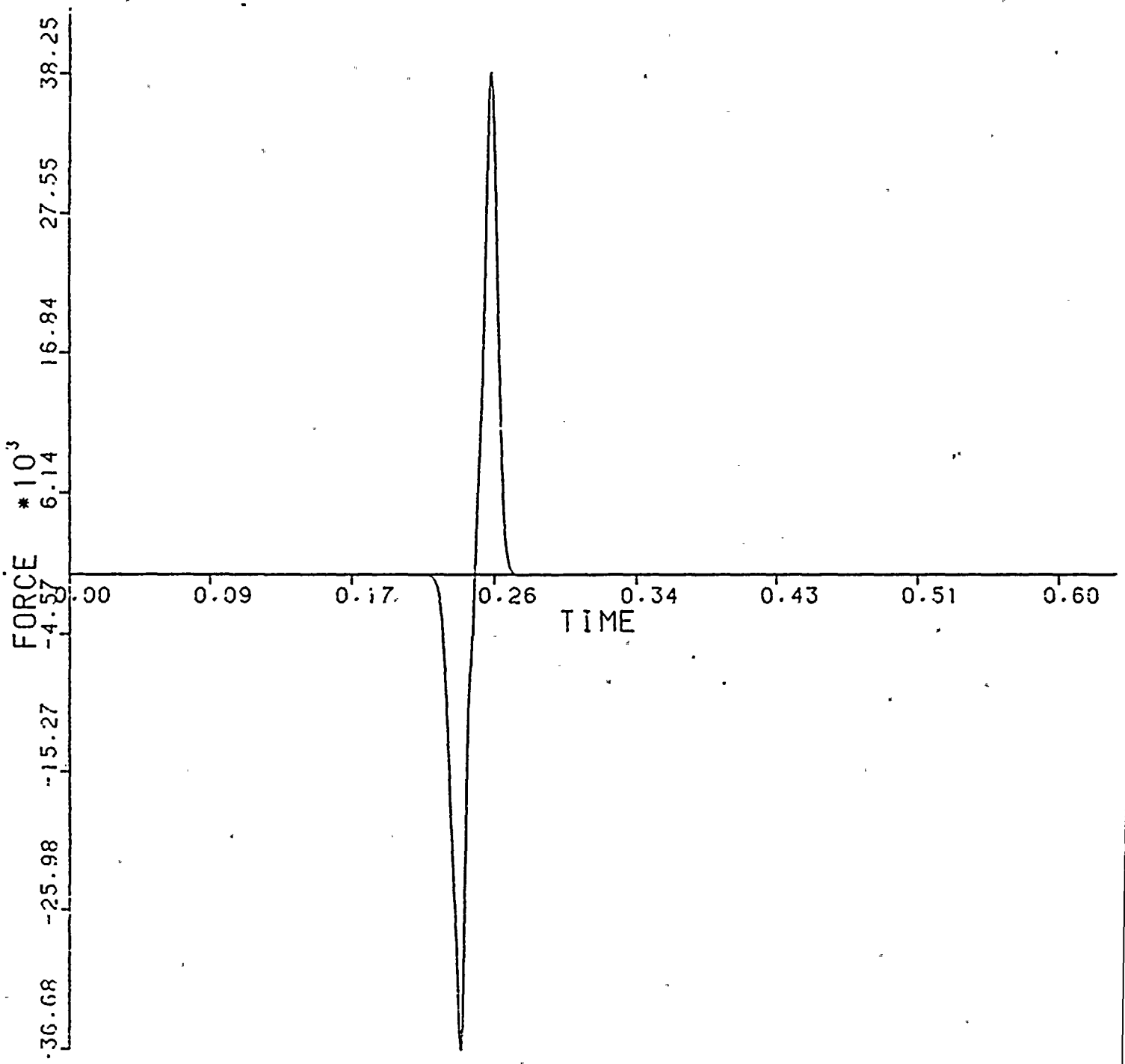
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 11. MAGNITUDE AT NODE POINT 80



DONE BY: DATE: 5-26-83
CHKD BY: DATE: 5-27-83

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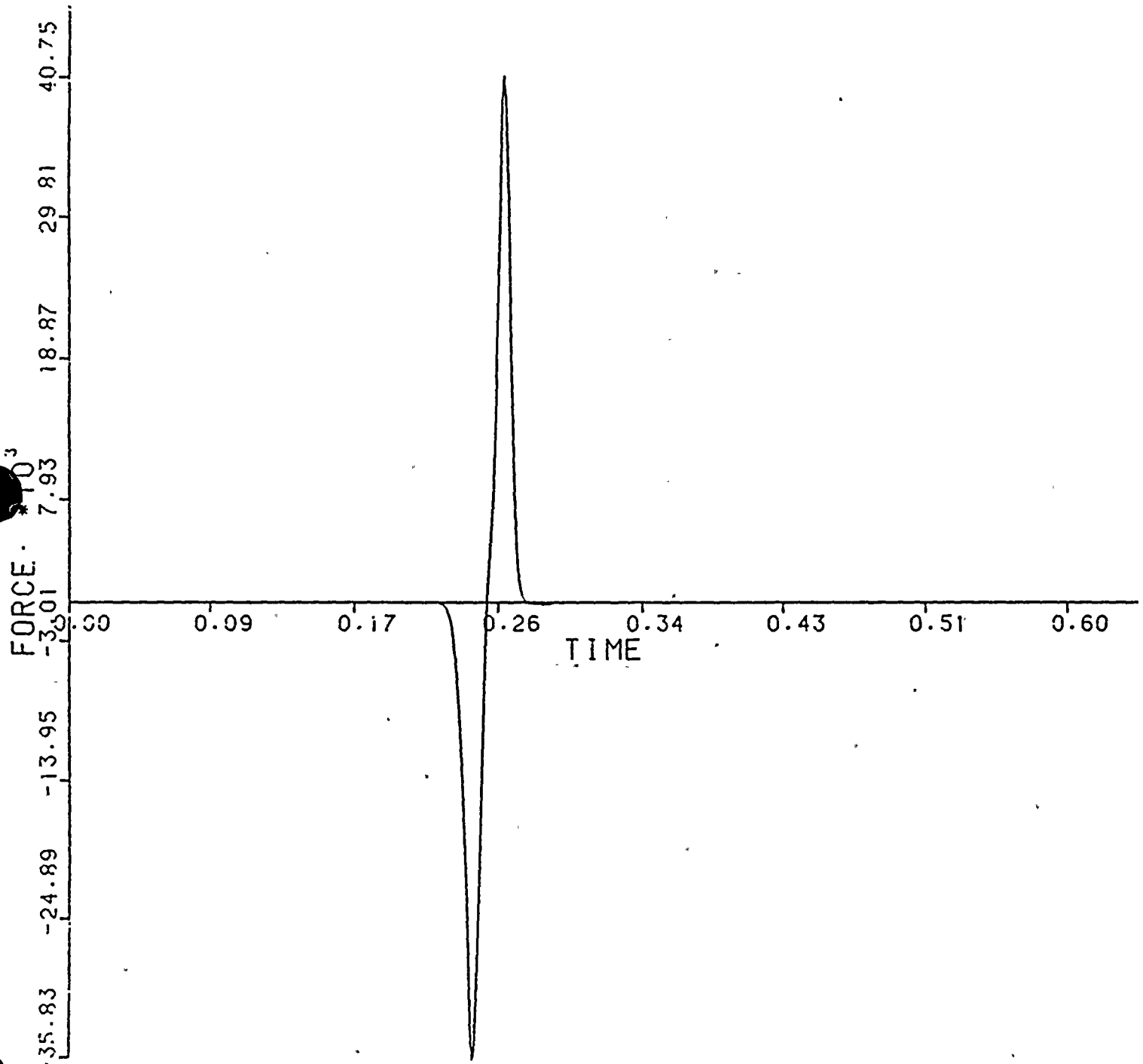
ENGINEERING SERVICES

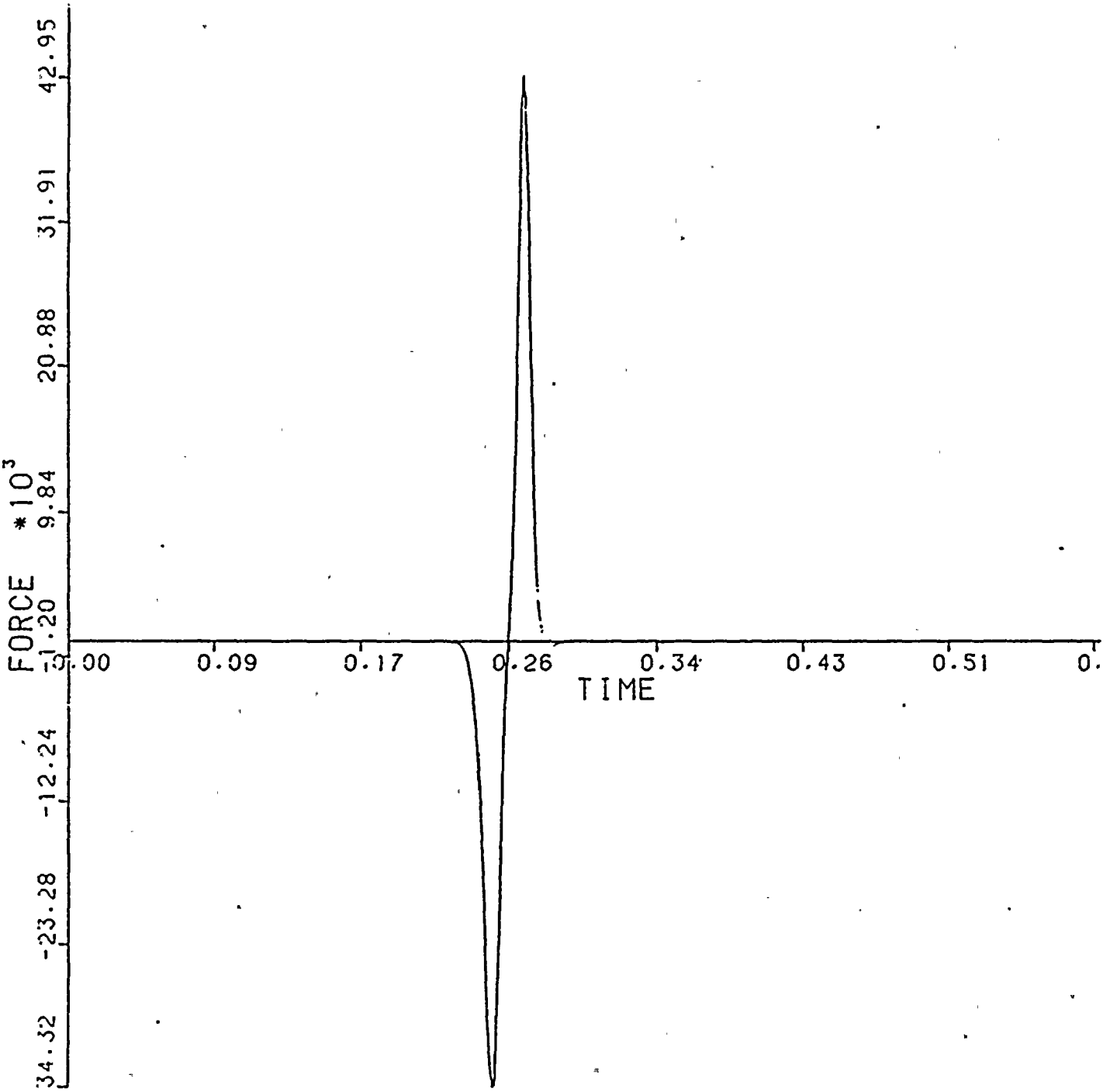
SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 12. MAGNITUDE AT NODE POINT 78



DONE BY: DATE: 5-26-83
CHKD BY: DATE: 5-27-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 13. MAGNITUDE AT NODE POINT 7



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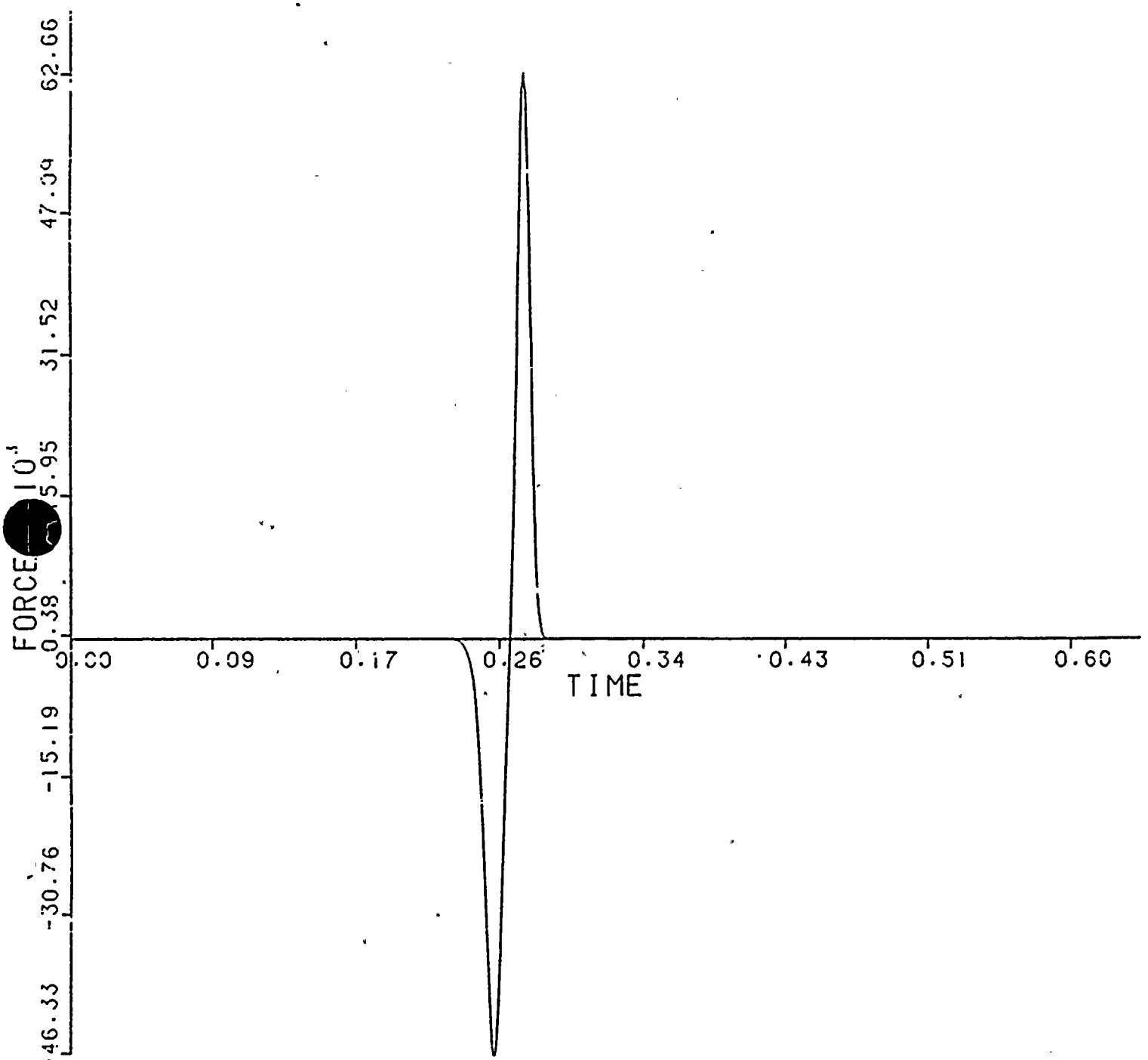
Technical Report
TR-5364-1
Revision 0

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE.TABLE 14, MAGNITUDE AT NODE POINT 74



DONE BY: DATE: 5-26-83
CHKD BY: DATE: 5-27-83

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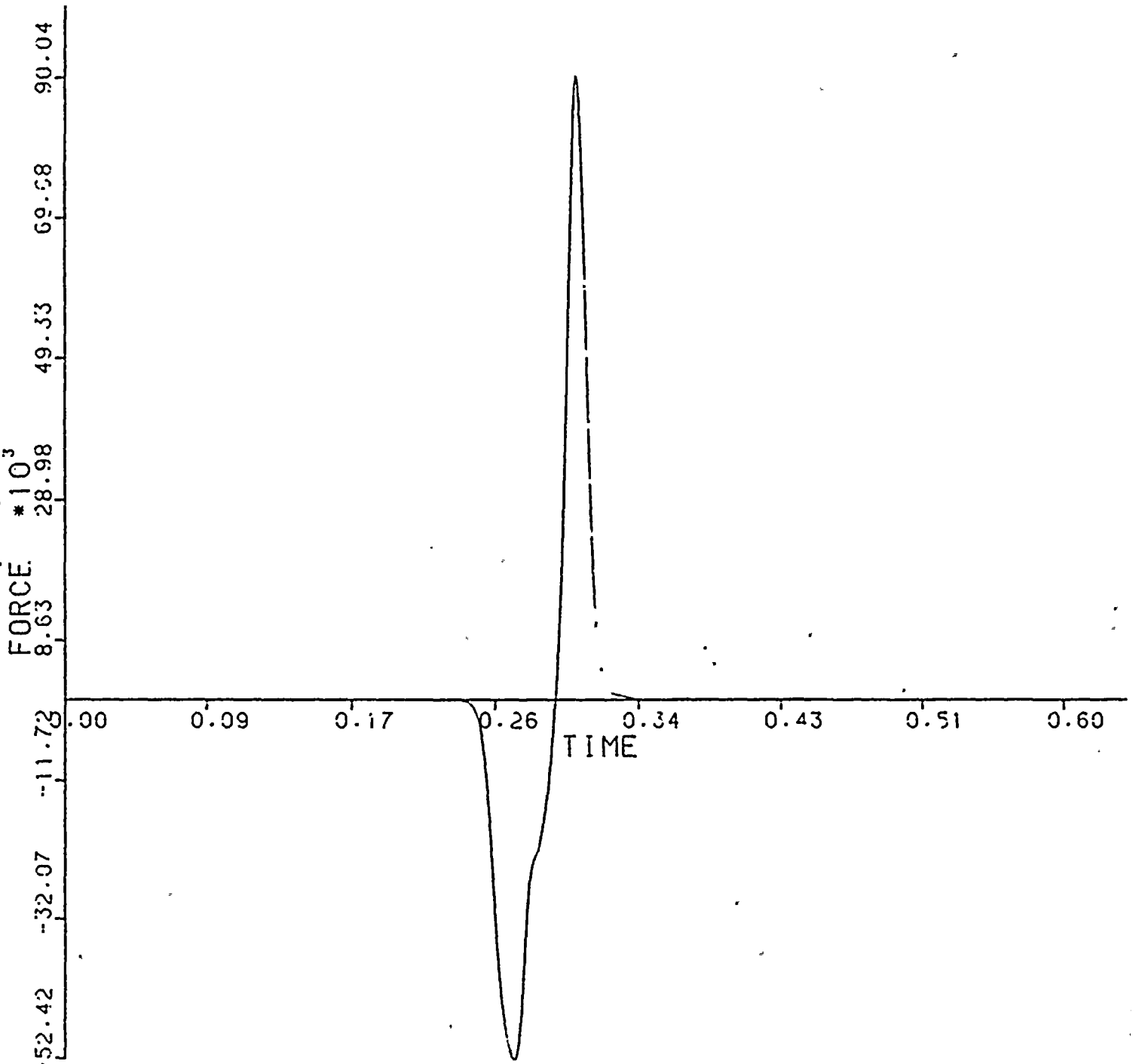
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 15. MAGNITUDE AT NODE POINT 70



DONE BY: DATE: 5-26-83
CHKD BY: DATE: 5-27-83

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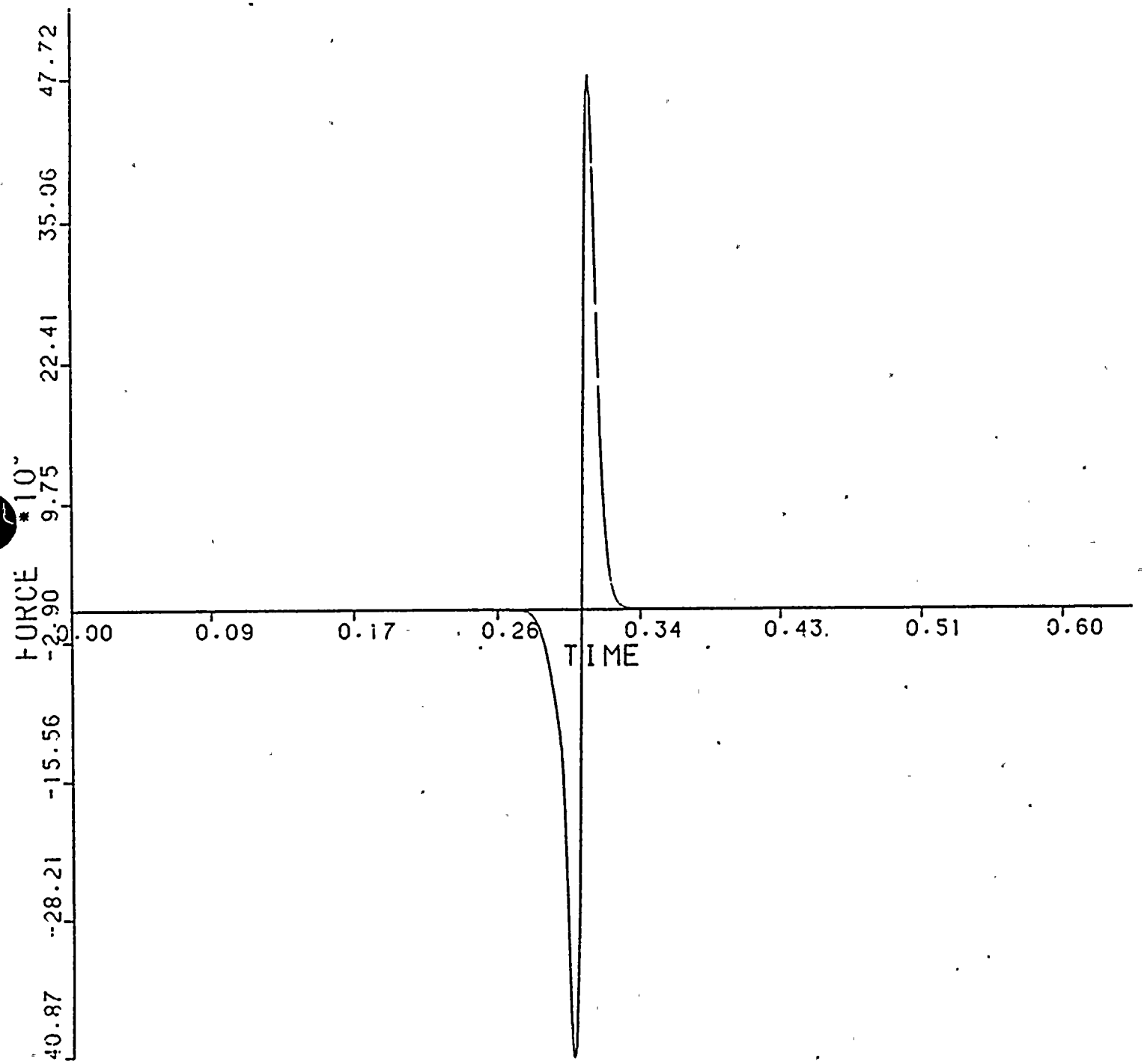
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 16, MAGNITUDE AT NODE POINT 64



DONE BY: [illegible] DATE: 5-26-83
CHKD BY: [illegible] DATE: 5-27-83

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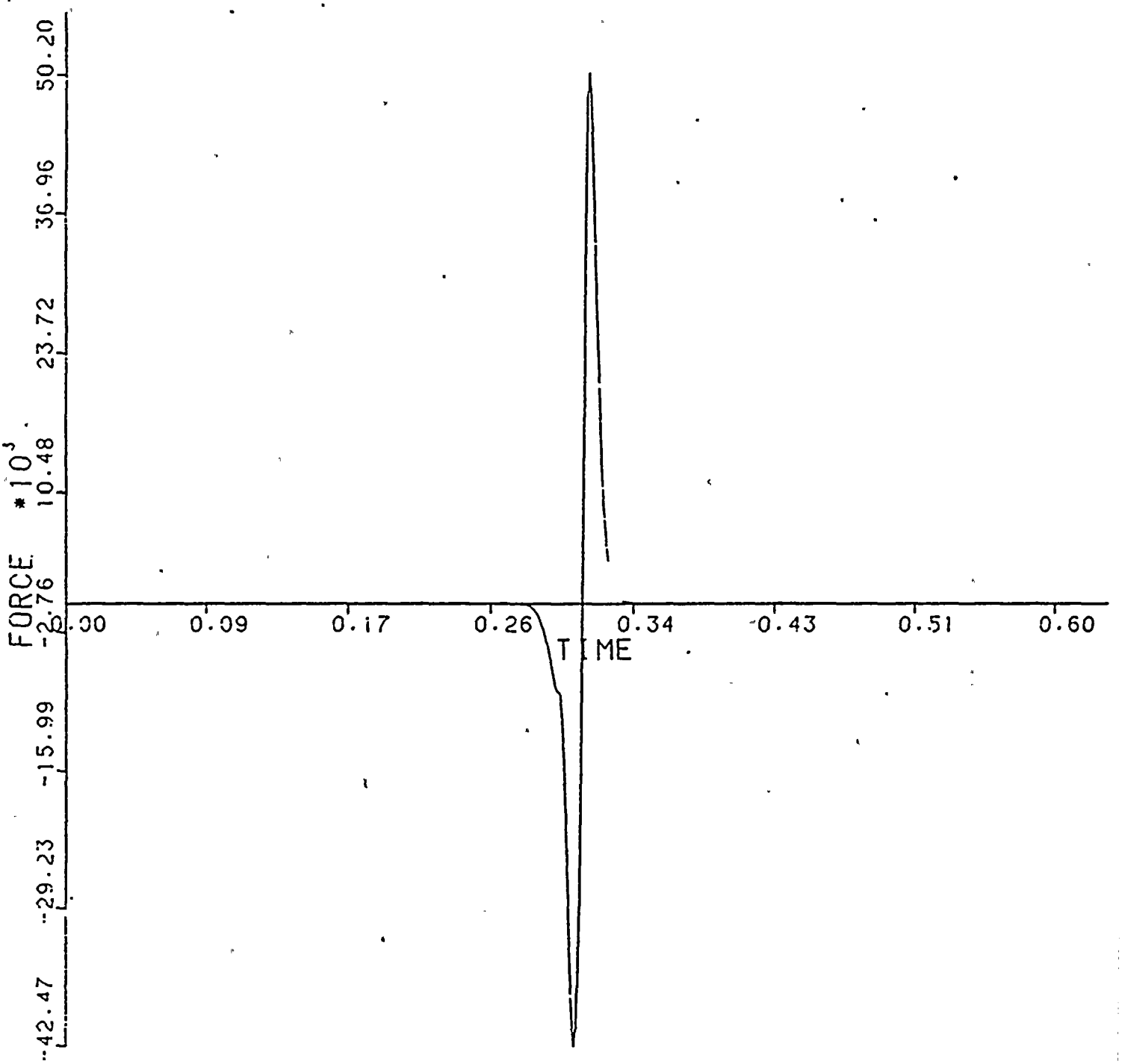
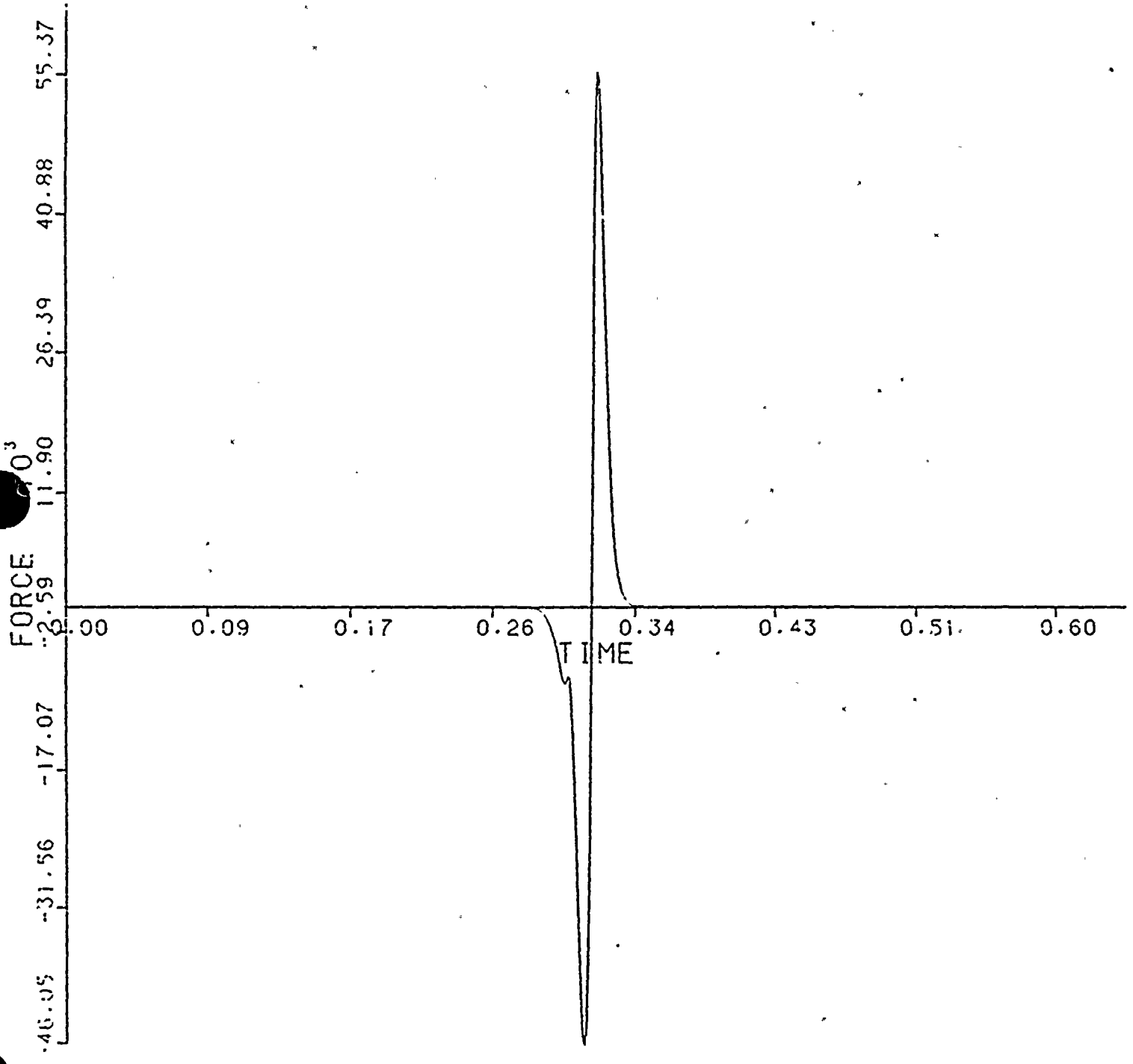
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 17. MAGNITUDE AT NODE POINT 60



DONE BY: JHA DATE: 5-26-83
CHKD BY: KTG DATE: 5-27-83

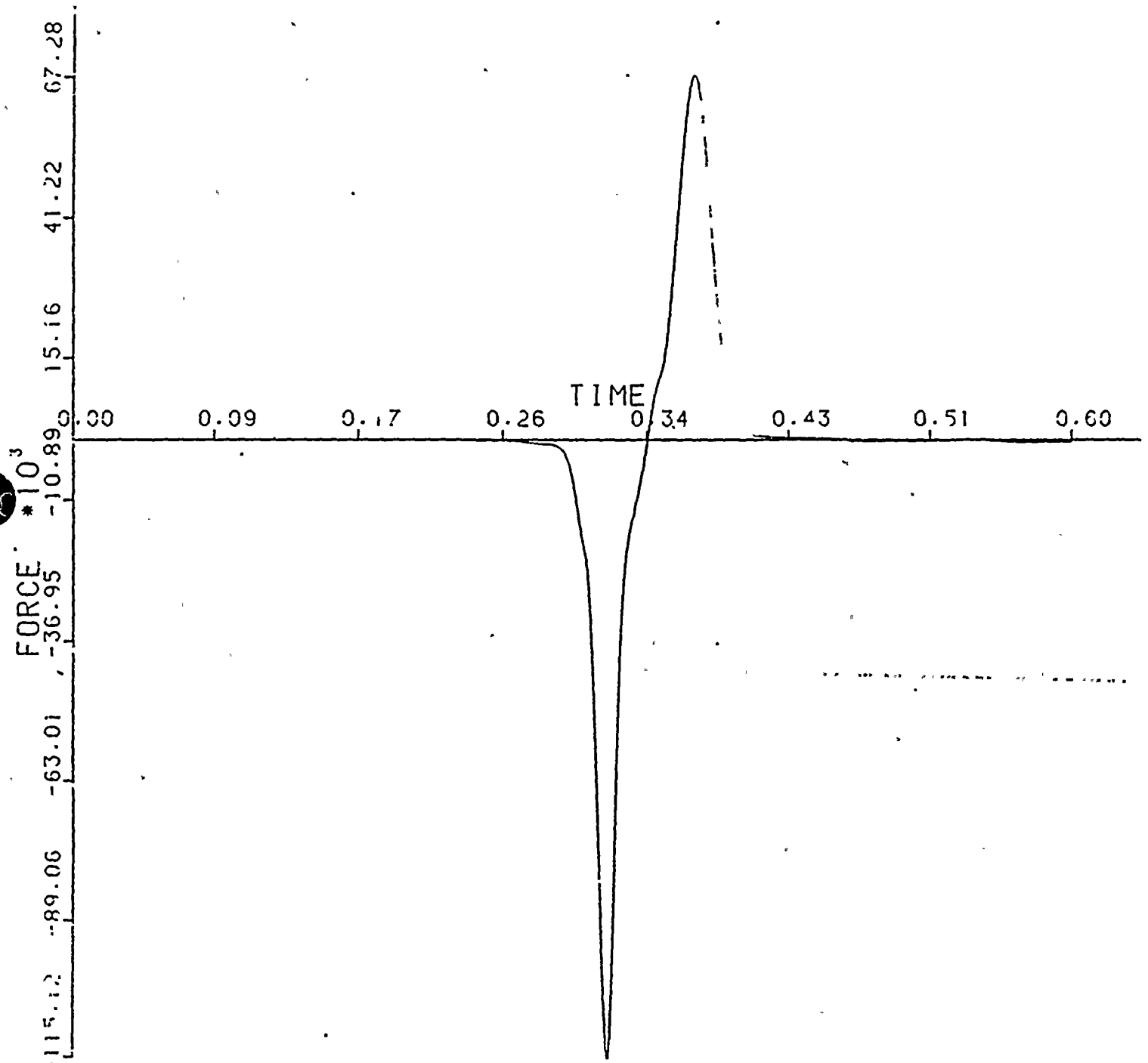
SAP2SAP VERIFICATION 5364 . 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 18. MAGNITUDE AT NODE POINT 54



DONE BY: DATE: 5-26-83
CHKD BY: DATE: 5-27-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 19. MAGNITUDE AT NODE POINT 48



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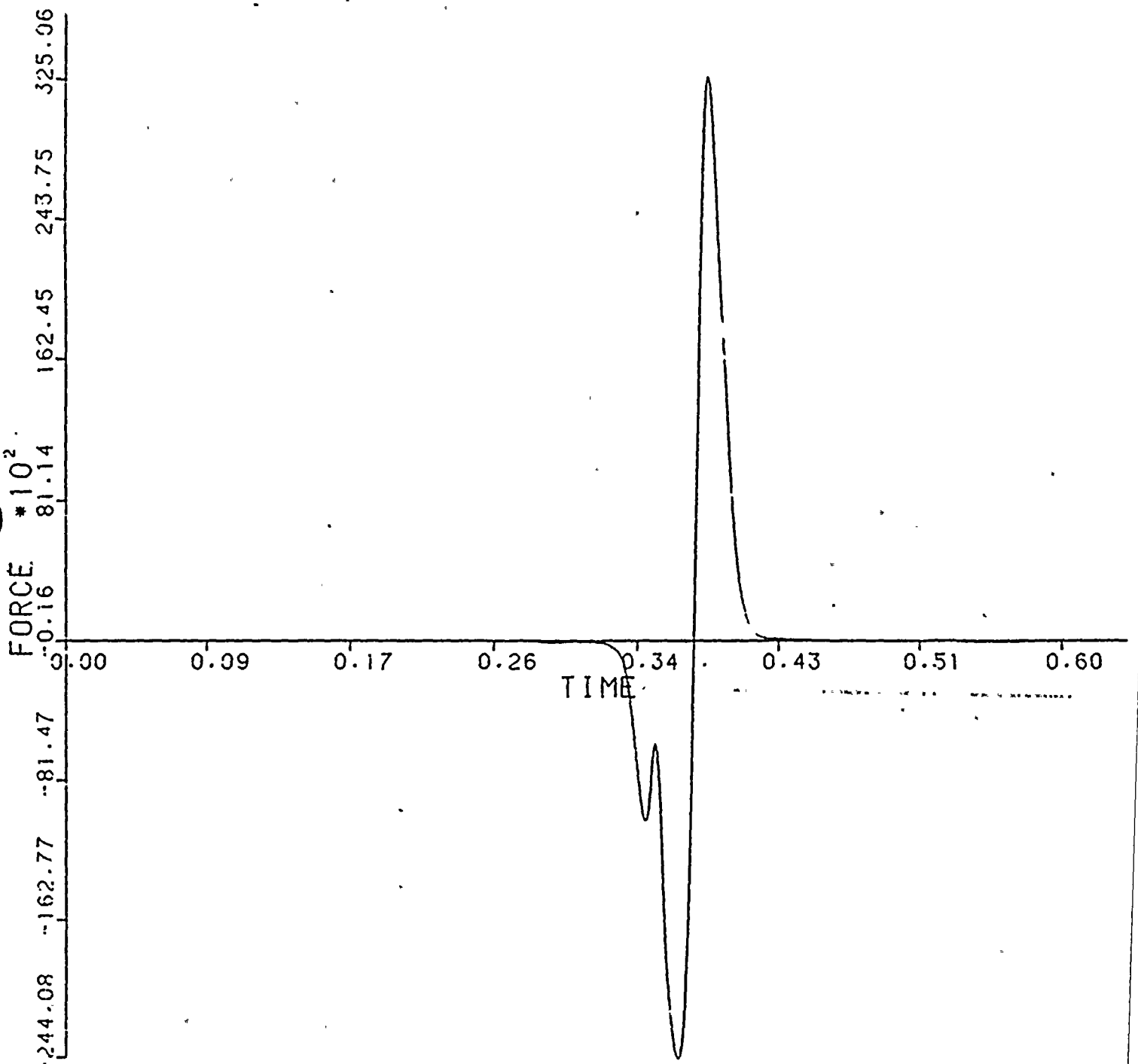
CHKD BY: [illegible] DATE: [illegible]

TELEDYNE
ENGINEERING SERVICES

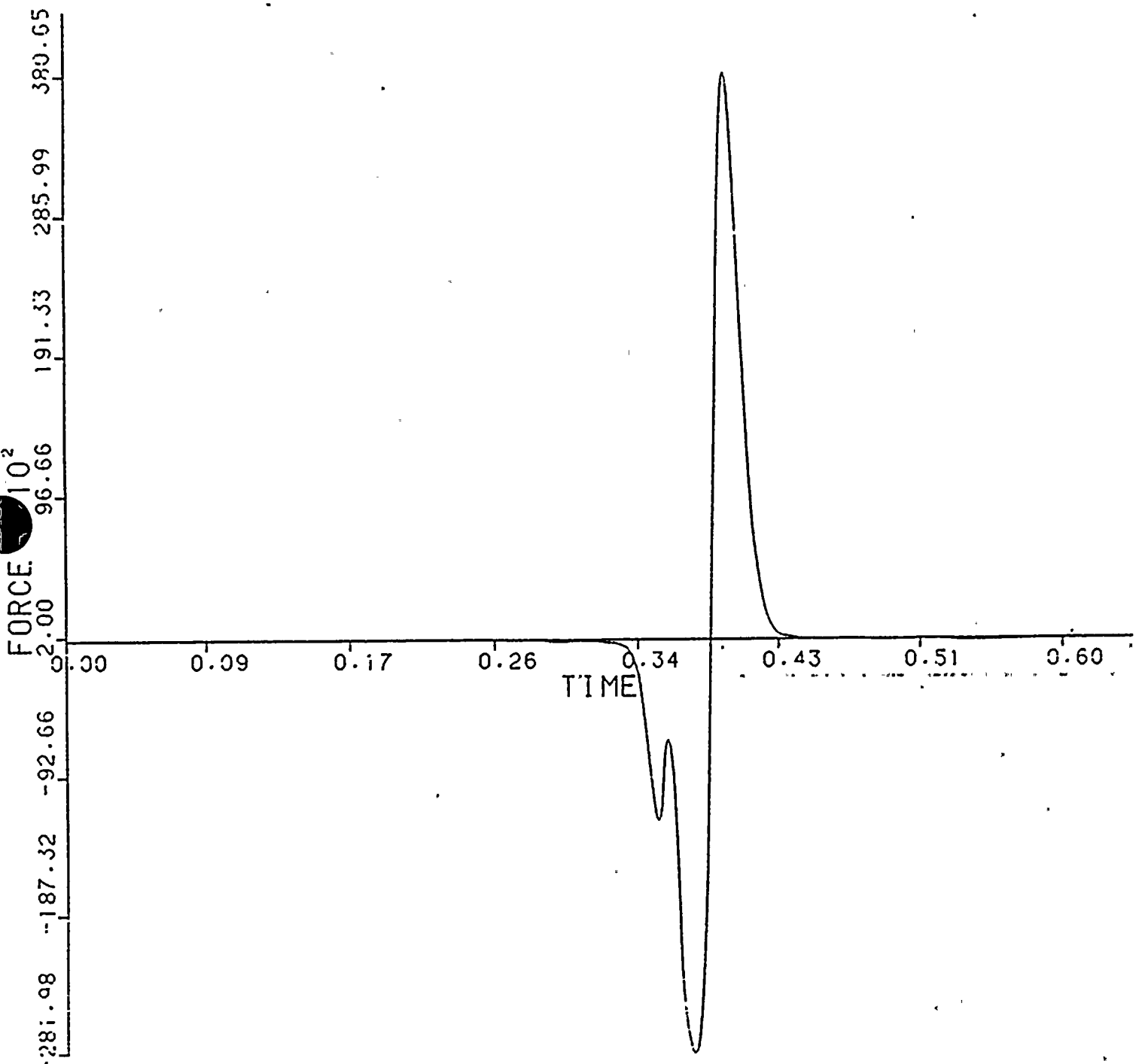
SAP2SAP VERIFICATION 5364 24-MAY-93
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 20. MAGNITUDE AT NODE POINT 42



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-93
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 21, MAGNITUDE AT NODE POINT 38



DONE BY: DATE:
CHKD BY: DATE:

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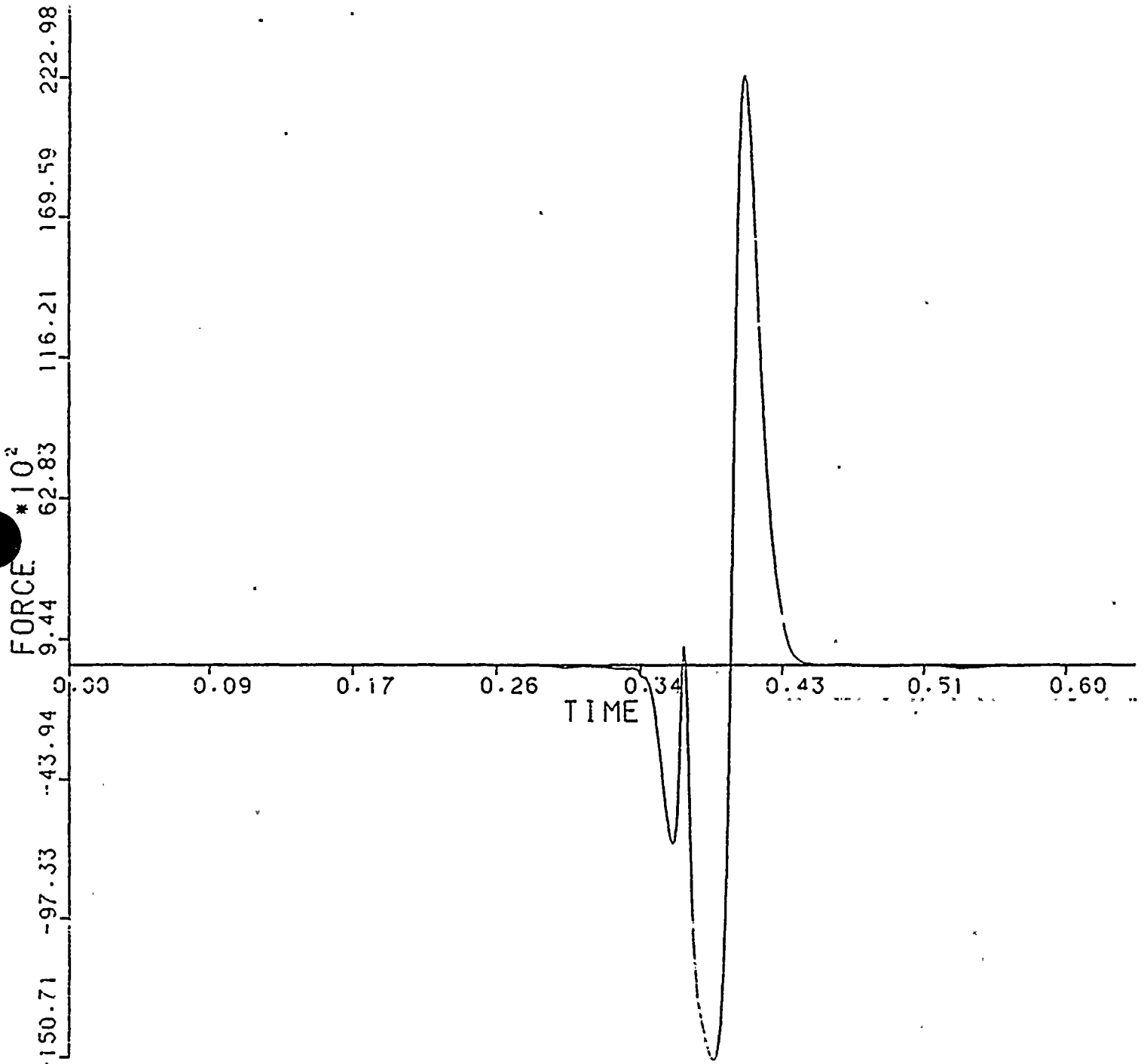
ENGINEERING SERVICES

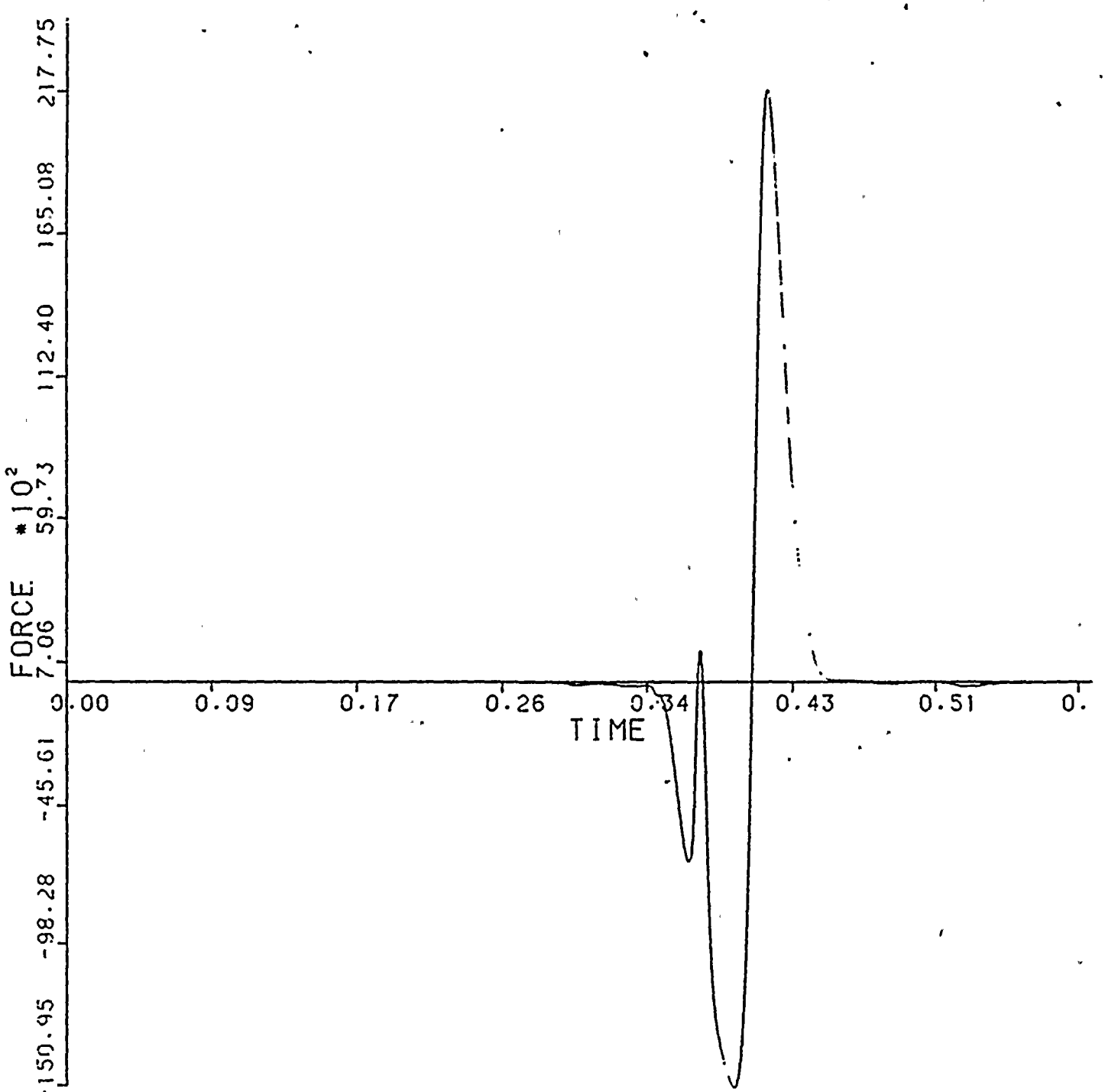
SAP_SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 22. MAGNITUDE AT NODE POINT 34



DONE BY: DATE:
CHKD BY: DATE:

TELEDYNE ENGINEERING SERVICES

SAP/SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 23. MAGNITUDE AT NODE POINT 32



DONE BY: DATE:
CHKD BY: DATE:

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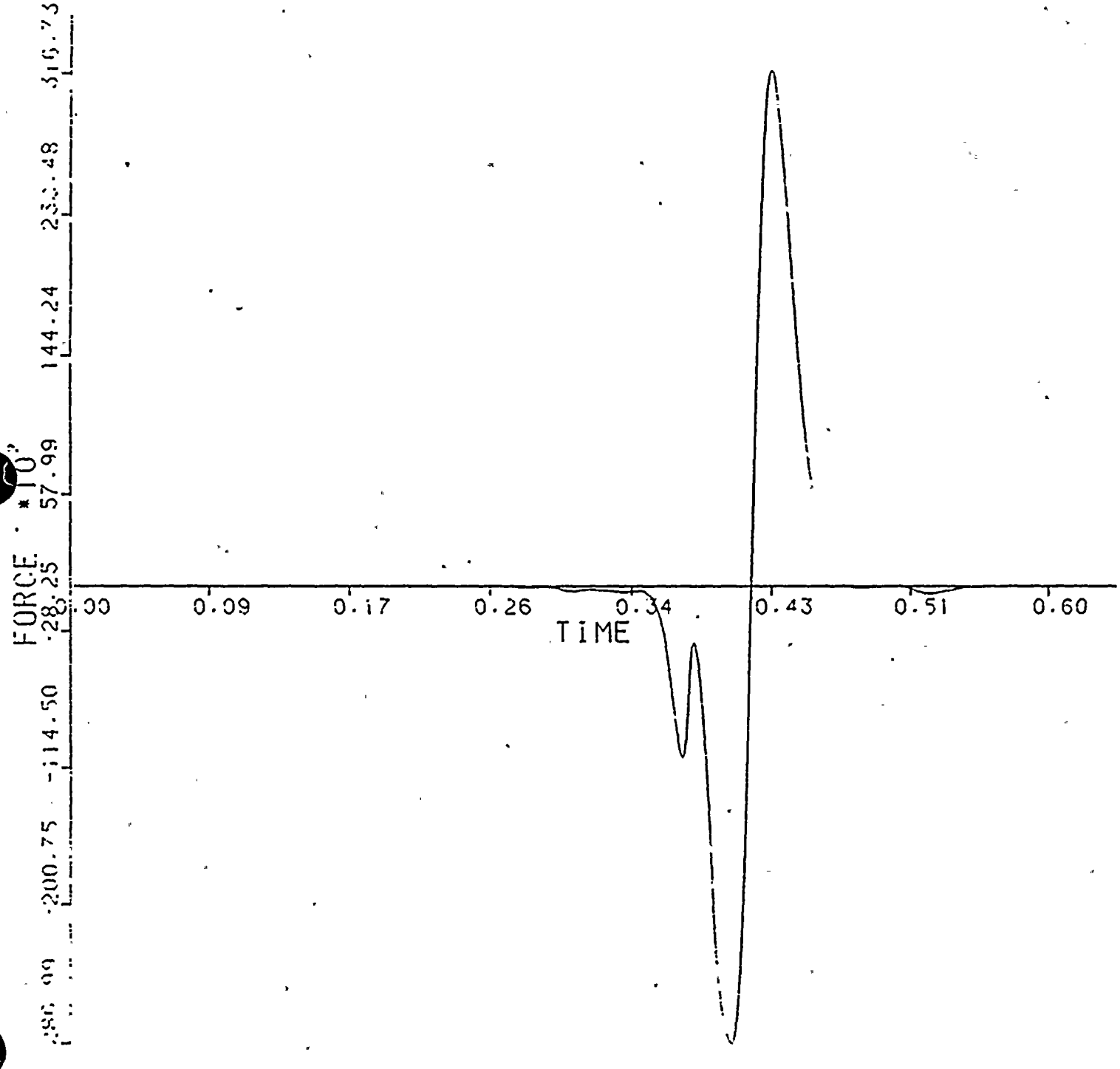
SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 24, MAGNITUDE AT NODE POINT 21



DONE BY: DATE:
CHKD BY: DATE:

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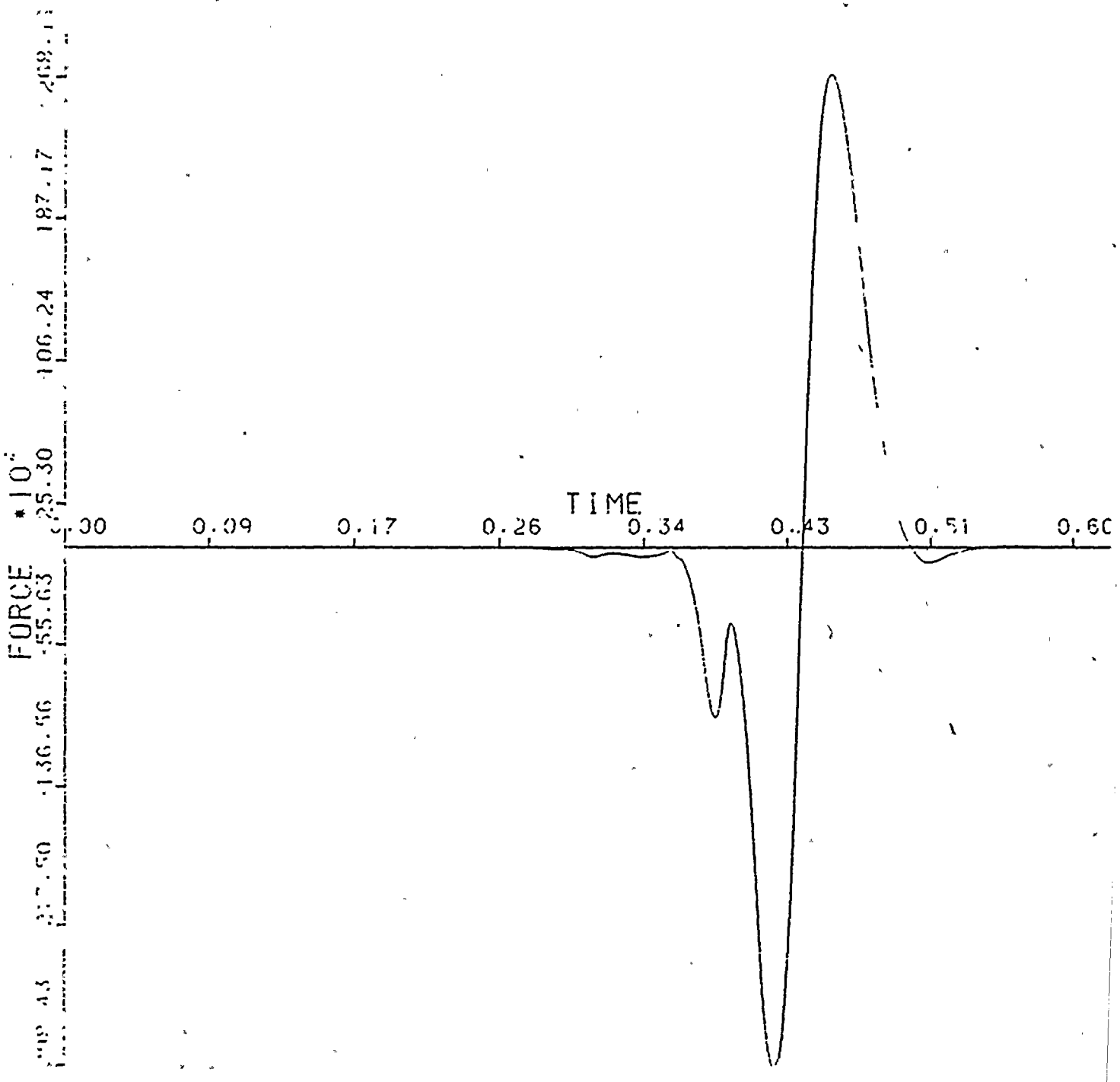
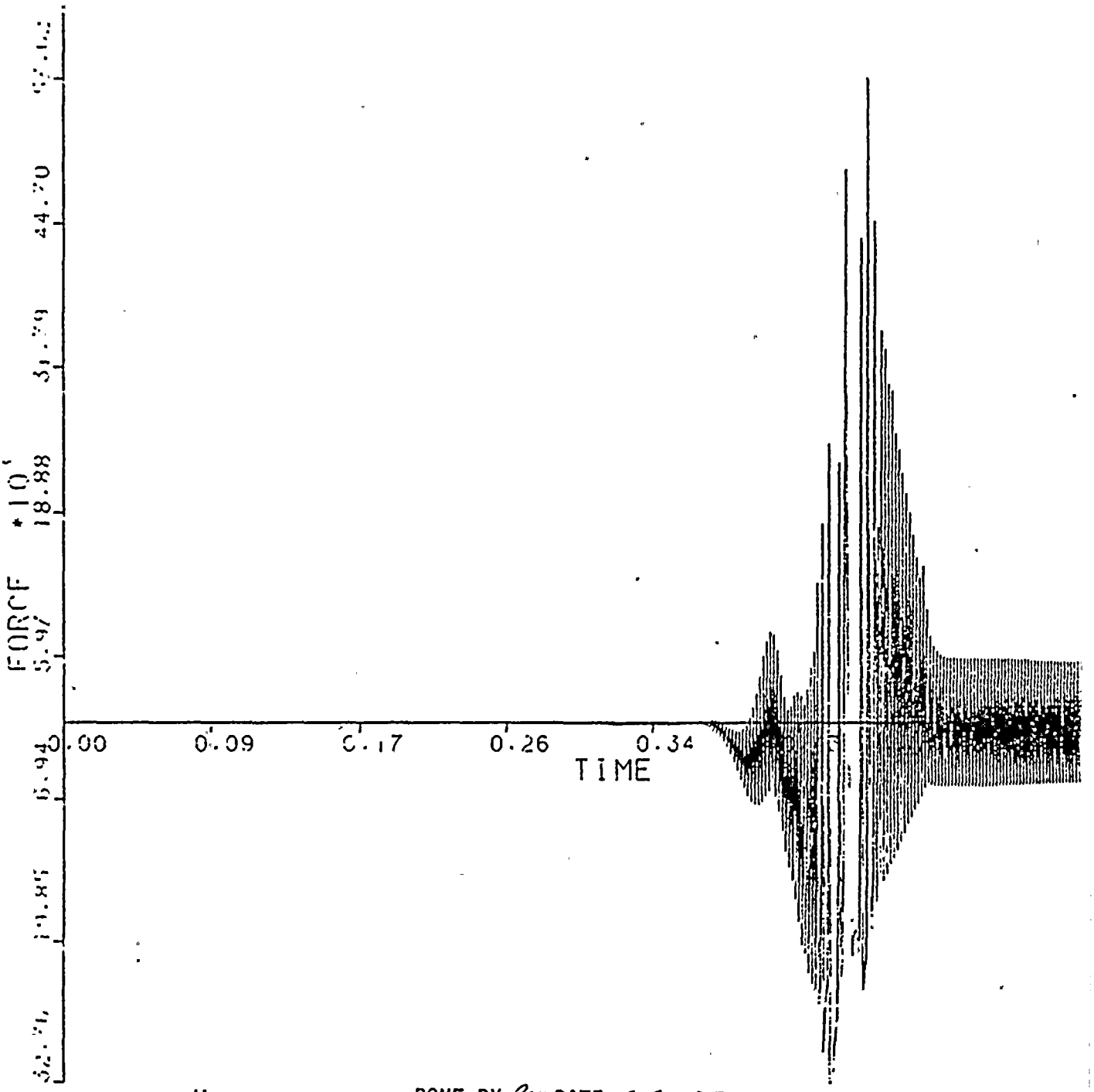
SAP2SAP VERIFICATION 5364 24-MAY-83
QUARTER MODEL UNIT 2 LOOPSEAL
TIME SHOCK LOAD ... MAGNITUDE AT NODE POINT 12



DONE BY: CHL DATE: 5-26-83
CHKD BY: ET DATE: 5-27-83

TELEDYNE
ENGINEERING SERVICES

SAP2SAP VERIFICATION 5364 24-MAY-83.
QUARTER MODEL UNIT 2 LOOPSEAL
TIME/FORCE TABLE 26, MAGNITUDE AT NODE POINT



DONE BY: DATE: 5-26-83
CHKD BY: DATE: 5-27-83

4.9 RELAP Input

The RELAP5 MOD1 input listings are included for each of the transient conditions.

Input Listing	Unit	Transient Case
4.9.1	1	PORV Condensate/Steam 0-200 msec
4.9.2	1	Condensate/Steam Restart 200-400 msec 400-600 msec
4.9.3	1	PORV Solid 400° Liquid 0-200 msec
4.9.4	1	PORV Solid 400° Liquid Restart 200-600 msec
4.9.5	2	SV Cold Loop Seal (Quarter Model)

The PORV model has:

- 396 volumes
- 397 junctions
- 7 tee branches

The SRV model has:

- 190 volumes
- 191 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 18) showed higher loads were computed without heat structures.

4.9.1 PORV Condensate/Steam

LISTING OF INPUT DATA FOR CASE 1

```
    1   =D.C.COOK UNIT1 PORV OPEN
    2   *
    3   *  DISCHARGE PIPING
    4   *  THIS IS THE NUMBERING SYSTEM FOR UNIT1'S RELAP MODEL
    5   *  WHERE COMPONENTS NUMBERED IN THE:
    6   *        100'S ARE VALVE SV-45C AND ARC 1 LEVEL  669'-2"
    7   *        200'S ARE VALVE SV-45B AND ARC 2 LEVEL  670'-10"
    8   *        300'S ARE VALVE SV-45A ARN ARC 3 LEVEL  672'-8"
    9   *        400'S ARE PORV NRV-151 AND ARC "A"
   10   *        500'S ARE PORV NRV-153 AND ARC "B"
   11   *        600'S ARE PORV NRV-152 AND ARC "C"
   12   *        700'S AND 800'S ARE 6" AND 12" MAIN DISCHARGE PIPING
   13   *        900'S QUENCH TANK PORTION
   14   *        999  ATMOSPHERE
   15   *
   16   *
   17   *
   18   100      NEW  TRANSNT
   19   101       RUN
   20   102       BRITISH   BRITISH
   21   104      NOACTION
   22   *
   23   ********************************************
   24   *     TIME STEP CONTROL                    *
   25   ********************************************
   26   *
   27   201       0.200,1.-7,2.-4,11001,5,50,250
   28   *
   29   *
   30   ********************************************
   31   *          MINOR EDITS                     *
   32   ********************************************
   33   *
   34   301  MFLOWJ  410000000
   35   302  MFLOWJ  510000000
   36   303  MFLOWJ  610000000
   37   304  MFLOWJ  402000000
   38   305  MFLOWJ  811140000
   39   306  MFLOWJ  811570000
   40   307  MFLOWJ  308000000
   41   308  MFLOWJ  208000000
   42   309  MFLOWJ  108000000
   43   *
   44   310  QUALS   411010000
   45   311  QUALS   511010000
   46   312  QUALS   611010000
   47   313  QUALS   409260000
   48   314  QUALS   509120000
   49   315  QUALS   609110000
   50   316  QUALS   401280000
   51   317  QUALS   811140000
   52   318  QUALS   811570000
   53   319  QUALS   307010000
   54   320  QUALS   307180000
   55   321  QUALS   207010000
   58   322  QUALS   207260000
```

BY CMM DATE 4-12-83

CHKD. BY RM DATE 4-20-83

TELEDYNE ENGINEERING SERVICES

```
    323  QUALS  107010000
    324  QUALS  107330000
    *
    325  P      411010000
    326  P      511010000
    327  P      611010000
    328  P      409260000
    329  P      509120000
    330  P      609110000
    331  P      401280000
    332  P      811140000
    333  P      811570000
    334  P      307010000
    335  P      307180000
    336  P      207010000
    337  P      207260000
    338  P      107010000
    339  P      107330000
    *
    *
    ****************************************
    *  FORCE CARDS  FOR REPIPE             *
    ****************************************
    *
    ********************************************************************
    *THIS RELAP RUN INCLUDES FORCE CARDS OF THE MAIN HEADER, DOWNSTREAM
    *DISCHARGE TOWARDS THE QUENCH TANK AS WELL AS THE SEGEMENTS DOWNSTREAM
    *OF THE SAFETY VALVES AND ARC "2" ENTIRE MODEL
    ********************************************************************
    *
    *
    *****ARC-2*****
    *
    *
2001  5,178,207010000,207020000,207030000,207040000,207050000
2019  207060000,207070000,207080000,207090000,207100000
2020  207110000,207120000,207130000,207140000,207150000
2021  207160000,207170000,207180000,207190000,207200000
2022  207210000,207220000,207230000,207240000,207250000
2023  207260000,307010000,307020000,307030000,307040000
2024  307050000,107010000,107020000,107030000,107040000
2025  107050000
    *
    *  MAIN HEADER 6 BY 12 IN
    *
2033  703020000,703030000,703040000,703050000,703060000
2034  703070000,703080000,703090000,703100000,703110000
2035  703120000,703130000,703140000,801010000,803010000
2036  805010000,807010000,703010000
2037  809010000,811010000,811020000,811030000,811040000
2038  811050000,811060000,811070000,811080000,811090000
2039  811100000,811110000,811120000,811130000,811140000
2040  811150000,307180000,107330000
2042  811260000
    *
    *
    *  MAIN DISHARGE DOWSTREAM TOWARDS QUENCH TANK
    *
```


TELEDYNE ENGINEERING SERVICES

```
  115    2013 811270000,811280000,811290000,811300000,811310000
  116    2014 811320000,811330000,811340000,811350000,811360000
  117    2015 811370000,811380000,811390000,811400000,811410000
  118    2016 811420000,811430000,811440000,811450000,811460000
  119    2017 811470000,811480000,811490000,811500000,811510000
  120    2018 811520000,811530000,811540000,811550000,811560000
  121    2043 811570000,811580000,811590000,811600000,811610000
  122    2044 811620000,811630000,811640000,811650000,811660000
  123    2045 811670000,811680000,811690000,811700000,811710000
  124    2046 811720000,811730000,811740000,811750000,811760000
  125    2047 811770000,811780000,811790000,811800000,811810000
  126    2048 811820000,811830000,811840000,811850000,811860000
  127    2049 811870000,811880000,811890000,811900000,811910000
  128    2026 811920000,811930000,811940000,811950000,811960000
  129    2027 811970000,813010000,813020000,813030000,813040000
  130    2028 813050000,813060000,813070000,813080000,813090000
  131    2029 813100000,813110000,813120000,813130000,813140000
  132    2030 813150000,813160000,813170000,813180000,813190000
  133    2031 813200000,813210000,813220000,813230000,813240000
  134    2032 813250000,813260000,978010000,978020000,978030000
  135    2050  978040000,978050000,978060000,978070000,978080000
  136    *
  137    ****************************************
  138    *          TRIPS                       *
  139    ****************************************
  140    *
  141    *
  142    501  TIME  0 GE NULL 0  0.0  L   * VALVE OPENING TRIP
  143    502  TIME  0 GE NULL  0  5.0  L   *  JOB TERMINATION TRIP
  144    515  P  982010000  GE  NULL 0 114.7  L *  QUENCH TANK RUPTURE PRESS.
  145    600       502
  146    *
  147    ************************************************************
  148    *         ************************************        *
  149    *         *  HYDRODYNAMIC COMPONENTS         *        *
  150    *         ************************************        *
  151    ************************************************************
  152    *
  153    *
  154    *        PRESSURIZER   COMPONENT
  155    3990000     "PRESS"   TMDPVOL
  156    3990101  0.0  20.0  500.0  0.0  0.0  0.0  0.00005  0.0  11
  157    3990200  2
  158    3990201  0.0  2349.7  1.0  0.8  2420.0  1.0  1.2  2498.7  1.0
  159    *
  160    4000000     "PORV"  SNGLJUN
  161    4000101     399000000  401000000  0.0  0.0  0.0  1100
  162    4000201     1   0.0  0.0  0.0
  163    *
  164    4010000     "PORV"  PIPE
  165    4010001     28
  166    4010101     0.1465     28
  167    4010301     .4375      4
  168    4010302     .5104      12
  169    4010303     .5         19
  170    4010304     .5         27
  171    4010305  0.72  28
  172    4010401     0.0      28
```


TELEDYNE ENGINEERING SERVICES

```
 173  4010601  45.      4
 174  4010602  90.        12
 175  4010603  0.0     19
 176  4010604  90.     27
 177  4010605  0.0  28
 178  4010801  1.51E-4   0.0  28
 179  4010901  0.0       0.0     3
 180  4010902  .092      .092    4
 181  4010903  0.0       0.0     11
 182  4010904  .1836     .1836   12
 183  4010905  0.0       0.0     18
 184  4010906  .1836     .1836   19
 185  4010907  0.0       0.0     28
 186  4010908  0.1836  0.1836  27
 187  4011001  00      28
 188  4011101  1000      27
 189  4011201  2  2349.7  1.0  0.0  0.0  28
 190  4011300  1
 191  4011301  0.0  0.0  0.0     27
 192  *
 193  4020000  "PORV"  SNGLJUN
 194  4020101  401010000  403000000  0.0  0.0  0.0  1000
 195  4020201  1  0.0  0.0  0.0
 196  *
 197  4030000  "PORV"  BRANCH
 198  4030001  0
 199  4030101  0.1465  0.5  0.0  0.0  0.0  0.0  1.51E-4  0.0  00
 200  4030200  2  2349.7  1.0  0.0  0.0  0.0
 201  *
 202  4040000  "PORV"  SNGLJUN
 203  4040101  403010000  405000000  0.1465  0.0  0.0  1000
 204  4040201  1  0.0  0.0  0.0
 205  *
 206  4050000  "PORV"  PIPE
 207  4050001  16
 208  4050101  0.1465    1
 209  4050102  0.0716   16
 210  4050301  0.698  1
 211  4050302  0.471  7
 212  4050303  0.451  16
 213  4050401  0.0      16
 214  4050601  0.0      16
 215  4050801  1.51E-4   0.0  1
 216  4050802  1.33E-4   0.0   16
 217  4050901  0.0577  0.0961  1
 218  4050902  0.0  0.0  15
 219  4051001  00      16
 220  4051101  1000      15
 221  4051201  2  2349.7  1.0  0.0  0.0  16
 222  4051300  1
 223  4051301  0.0  0.0  0.0       15
 224  *
 225  4060000  "PORV"  SNGLJUN
 226  4060101  405010000  407000000  0.0  0.0  0.0  1000
 227  4060201  1  0.0  0.0  0.0
 228  *
 229  4070000  "PORV"  BRANCH
 230  4070001  0
```


TELEDYNE ENGINEERING SERVICES

```
  231  4070101   0.0716   0.451  0.0  0.0  0.0  0.0  1.33E-4  0.0  00
  232  4070200  2  2349.7  1.0  0.0  0.0  0.0
  233  *
  234  4080000   "PORV"   SNGLJUN
  235  4080101   407010000  409000000  0.0  0.0  0.0  1000
  236  4080201   1  0.0  0.0  0.0
  237  *
  238  4090000   "PORV"   PIPE
  239  4090001   26
  240  4090101   0.0716      1
  241  4090102   0.03757     22
  242  4090103   0.03388     23
  243  4090104   0.02650     24
  244  4090105   0.01912     25
  245  4090106   0.01175     26
  246  4090301   0.53        1
  247  4090302   .30         2
  248  4090303  0.493  10
  249  4090304   0.55       14
  250  4090305   0.510      22
  251  4090306  0.255    26
  252  4090401   0.0        26
  253  4090601   0.0        26
  254  4090801   1.33E-4   0.0      1
  255  4090802   1.53E-4   0.0      26
  256  4090901   0.0       0.0      13
  257  4090902   0.585     0.585    14
  258  4090903   0.0       0.0      25
  259  4091001   00        28
  260  4091102  1000  25
  261  4091201  2  2349.7  1.0  0.0  0.0  17
  262  4091202  2  2349.7  0.0  0.0  0.0  28
  263  4091300   1
  264  4091301   0.0  0.0  0.0      25
  265  *
  266  4100000   "PORV151"   VALVE
  267  4100101   409010000  411000000  0.00808  0.0  0.0  0100
  268  4100201   1  0.0  0.0  0.0
  269  4100300   MTRVLV
  270  4100301   501  502  1.0  0.0
  271  *
  272  5080000   "PORV"  SNGLJUN
  273  5080101   407010000  509000000  0.0  0.2172  0.2172  1000
  274  5080201   1  0.0  0.0  0.0
  275  *
  276  5090000   "PORV"  PIPE
  277  5090001   12
  278  5090101   0.03757     8
  279  5090102  0.03388     9
  280  5090103   0.02650     10
  281  5090104   0.01912     11
  282  5090105    0.01175     12
  283  5090301   0.4089      2
  284  5090302   0.5078      8
  285  5090303    0.2539      12
  286  5090401   0.0         12
  287  5090601   0.0         12
  288  5090801   1.53E-4   0.0    12
```

```
 289   5090901  0.0  0.0  1
 290   5090902  0.2172   0.2172 2
 291   5090903  0.0      0.0    11
 292   5091001  00     12
 293   5091101  1000     11
 294   5091201  2  2349.7  1.0  0.0  0.0  3
 295   5091202  2  2349.7  0.0  0.0  0.0  12
 296   5091300  1
 297   5091301  0.0  0.0  0.0    11
 298   *
 299   5100000  "PORV152"  VALVE
 300   5100101  509010000  511000000  0.00806  0.0  0.0  0100
 301   5100201  1   0.0  0.0  0.0
 302   5100300  MTRVLV
 303   5100301  501  502  1.0  0.0
 304   *
 305   6080000  "PORV"  SNGLJUN
 306   6080101  403010000  609000000  0.0  0.1836  0.1836  1000
 307   6080201  1   0.0  0.0  0.0
 308   *
 309   6090000  "PORV"  PIPE
 310   6090001  11
 311   6090101  0.03757    7
 312   6090102  0.03388    8
 313   6090103  0.02650    9
 314   6090104  0.01912    10
 315   6090105  0.01175    11
 316   6090301  0.4089     2
 317   6090302  0.5699     7
 318   6090303  .2850      11
 319   6090401  0.0        11
 320   6090601  0.0        11
 321   6090801  1.53E-4    0.0    11
 322   6090901  0.0  0.0  1
 323   6090902  0.2172   0.2172   2
 324   6090903  0.0      0.0    10
 325   6091001  00       11
 326   6091101  1000       10
 327   6091201  2  2349.7  1.0  0.0  0.0  4
 328   6091202  2  2349.7  0.0  0.0  0.0  11
 329   6091300  1
 330   6091301  0.0  0.0  0.0  10
 331   *
 332   6100000  "PORV153"  VALVE
 333   6100101  609010000  611000000  0.00806  0.0  0.0  0100
 334   6100201  1   0.0 0.0  0.0
 335   6100300  MTRVLV
 336   6100301  501  502  1.0     0.0
 337   ***************************************
 338   *
 339   *   VALVE DOWNSTREAM PIPING
 340   1070000  "DWNSTRM#1"  PIPE
 341   1070001     33
 342   *
 343   1070101  0.20069      33
 344   *
 345   1070301  0.5261        4
 346   1070302  0.9943       15
```

```
 347   1070303   0.9132          21
 348   1070304   0.8472          30
 349   1070305   1.085           33
 350   *
 351   1070401   0.0             33
 352   *
 353   1070601   0.0              4
 354   1070602   -90.            15
 355   1070603   0.0             33
 356   *
 357   1070801   1.52-4   0.     33
 358   1070901   0.0       0.0    3
 359   1070902   0.18      0.18   4
 360   1070903   0.0       0.0   14
 361   1070904   0.18      0.18  15
 362   1070905   0.0       0.0   32
 363   *
 364   1071001   00         33
 365   1071101   1000      32
 366   *
 367   1071201   4   17.7   120.   0.9284   0.   33
 368   *
 369   1071300   1
 370   1071301   0.0  0.0  0.0  32
 371   *
 372   *
 373   *
 374   *
 375   ***************************************************************
 376   *
 377   *    VALVE DOWNSTREAM PIPING
 378   2070000   "DWNSTRM#2"   PIPE
 379   *
 380   2070001                 26
 381   2070101   0.20069       26
 382   *
 383   2070301   0.5261         4
 384   2070302   0.9271        14
 385   2070303   0.8852        23
 386   2070304   1.085         28
 387   *
 388   2070401   0.0           26
 389   *
 390   2070601   0.0            4
 391   2070602   -90.          14
 392   2070603   0.0           28
 393   *
 394   2070801   1.52-4   0.   28
 395   *
 396   2070901   0.0       0.0    3
 397   2070902   0.18      0.18   4
 398   2070903   0.0       0.0   13
 399   2070904   0.18      0.18  14
 400   2070905   0.0       0.0   25
 401   *
 402   2071001   00          28
 403   *
 404   2071101   1000        25
```

```
*
2071201   4   17.7   120.   0.9284   0.   26
*
2071300   1
2071301   0.0  0.0  0.0  25
*
*
*****************************************************************
*
*    VALVE DOWNSTREAM PIPING
3070000   "DWNSTRM#3"   PIPE
3070001   18
*
3070101   0.20069   18
*
3070301   0.5261     4
3070302   1.0339    12
3070303   0.801     15
3070304   1.085     18
*
3070401   0.0       18
*
3070601   0.0        4
3070602   -90.      12
3070603   0.0       18
*
3070801   1.52-4   0.   18
*
3070901   0.0       0.0       3
3070902   0.18      0.18      4
3070903   0.0       0.0      11
3070904   0.18      0.18     12
3070905   0.0       0.0      17
*
3071001   00        18
3071101   1000      17
*
3071201   4   17.7   120.   0.9284   0.   18
*
3071300   1
3071301   0.0  0.0  0.0       17
*
*
*********************************************
*     PORV DISCHARGE SECTION                *
*********************************************
*
*
*******************************************************
*   PORV NRV-151 DISCHARGE LINE ARC "A"               *
*******************************************************
*
*
4110000   "PORV1"   PIPE
4110001        19
*
4110101   0.05132   17
4110102   0.20069   19
```


TELEDYNE ENGINEERING SERVICES

```
*
4110301   0.3724      4
4110302   0.3802      8
4110303   0.561       17
4110304   0.349       19
*
4110401   0.0         19
*
4110601   0.0         4
4110602   -90.        8
4110603   0.0         19
*
4110801   1.53-4 .0 17
4110802   1.52-4 .0 19
*
4110901   0.0         0.0         3
4110902   0.2088      0.2088      4
4110903   0.0         0.0         7
4110904   0.2088      0.2088      8
4110905   0.0         0.0         16
4110906   0.3784      0.1565      17
4110907   0.0         0.0         18
*
4111001   00          19
4111101   1000        18
*
4111201   4   17.7   120.   0.9284  0.0   19
*
4111300   1
4111301   0.0  0.0  0.0   18
*
4120000   "ENTERMAIN"  SNGLJUN
4120101   411010000  701000000  0.0  0.1800  0.1800  1100
4120201   1   0.0  0.0  0.0
*
*
*****************************************************
*   PORV NRV-153 DISCHARGE LINE ARC "B"             *
*****************************************************
*
*
*
5110000   "PORV2LINE"  PIPE
5110001          19
*
5110101   0.05132    18
5110102   0.08840    19
*
5110301   0.4303     3
5110302   0.3620     7
5110303   0.3529        9
5110304   0.6058     18
5110305   0.371      19
*
5110401   0.0        19
*
5110601   0.0        3
5110602   -90.       7
```


TELEDYNE ENGINEERING SERVICES

```
   5110603   0.0         19
*
   5110801   1.53-4  .0  18
   5110802   1.34-4  .0  19
*
   5110901   0.0         0.0         2
   5110902   0.2088      0.2088      3
   5110903   0.0         0.0         6
   5110904   0.2088      0.2088      7
   5110905   0.0         0.0         17
   5110908   0.0544      0.0399      18
*
   5111001   00          19
*
   5111101   1000        18
*
   5111201   4  17.7  120.  0.9284  0.0  19
*
   5111300   1
   5111301   0.0  0.0  0.0  18
*
   5120000   "JUNC."   SNGLJUN
   5120101   511010000  513000000  0.0  0.0  0.0  1000
   5120201   1  0.0  0.0  0.0
*
*
*
   5130000   "4X4X3TEE"   BRANCH
   5130001   0
   5130101   0.08840  0.3524  0.0 0.0 0.0 0.0  1.34-4  0.0   00
   5130200   4  17.7  120.  0.9284  0.0  0.0
*
*
   5140000   "4IN JUNC"  SNGLJUN
   5140101   513010000  515000000  0.0  0.0  0.0   1000
   5140201   1  0.0  0.0  0.0
*
   5150000   "4INSCH40"  PIPE
   5150001             12
*
   5150101   0.0884    10
   5150102   0.20069   12
*
   5150301   0.3524    1
   5150302   0.6963    10
   5150303   0.349     12
*
   5150401   0.0       12
*
   5150601   0.0       12
*
   5150801   1.34-4 0.0   10
   5150802   1.52-4  0.0   12
*
   5150901   0.0         0.0         9
   5150902   0.1483      0.0815      10
   5150903   0.0         0.0         11
*
```

```
5151001   00        12
*
5151101   1000      11
*
5151201   4  17.7  120.  0.9284  0.0   12
*
5151300   1
5151301   0.0  0.0  0.0   11
*
5160000   "ENTERMAIN"  SNGLJUN
5160101   515010000  701000000  0.0  0.0  0.0   1000
5160201   1  0.0  0.0  0.0
*
*
*****************************************************
*   PORV NRV-152 DISCHARGE LINE  ARC "C"            *
*****************************************************
*
*
*
6110000   "PORVDISC3"  PIPE
6110001             8
*
6110101   0.05132   8
*
6110301   0.3723    4
6110302   0.3648    8
*
6110401   0.0       8
*
6110601   0.0       4
6110602   -90.      8
*
6110801   1.53-4 .0 8
*
6110901   0.0       0.0       3
6110902   0.211     0.211     4
6110903   0.0       0.0       7
*
6111001   00        8
6111101   1000      7
*
6111201   4  17.7  120.  0.9284  0.0   8
*
6111300   1
6111301   0.0  0.0  0.0   7
*
6120000   "PORVLINE"   SNGLJUN
6120101   611010000  513000000  0.0  0.0  0.0   1000
6120201   1  0.0  0.0  0.0
*
*****************************************
*   MAIN DISCHARGE LINE SECTION         *
*****************************************
*
*
*    MAIN DISCHARGE LINE
7010000   "ENTERMAIN"    BRANCH
```

```
7010001  0
7010101  0.20069  0.7035 0.0 0.0 0.0 0.0 1.52-4 0.0  00
7010200  4    17.7  120.  0.9284  0.0  0.0
*
7020000  "MAINLINE"  SNGLJUN
7020101  701010000  703000000 0.0  0.0  0.0  1000
7020201  1    0.0  0.0  0.0
*
7030000  "MAINLINE"  PIPE
*
7030001        14
*
7030101  0.20069   12
7030102  0.77708   14  * 12 IN LINE STARTS HERE
*
7030301  0.7035    1
7030302  1.0076    12
7030303  0.5834    14  * 12 IN LINE STARTS HERE
*
7030401  0.0       14
*
7030601  0.0       1
7030602  -90.      14
*
7030801    1.52-4    0.     12
7030802  1.69-4  0.   14
*
7030901  0.180     0.180     1
7030902  0.0       0.0       11
7030903  0.493     0.2045    12
7030904  0.0       0.0       13
*
7031001  00        14
7031101  1000      13
*
7031201  4   17.7   120.   0.9284   0.0   14
*
7031300  1
7031301  0.0  0.0  0.0   13
*
*
7040000  "MAINLINE"  SNGLJUN
7040101  703010000  801000000   0.0  0.0  0.0   1000
7040201  1   0.0  0.0  0.0
*
3080000  "CON.1"  SNGLJUN
3080101  307010000  801000000   0.0  0.1560  0.1560  1000
3080201  1   0.0  0.0  0.0
*
*
*
*
*
*    CONNECTION  TO MAIN LINE AT ELEV. 672'-6"
*
*
8010000  "12-BRANC1"   BRANCH
8010001  0
```


TELEDYNE ENGINEERING SERVICES

```
8010101  0.77708  0.8334  0.0  0.0 -90. -0.8334  1.69-4  0.0  00
8010200  4  17.7  120.  0.9284  0.0  0.0
*
8020000  "MAINLINE"  SNGLJUN
8020101  801010000  803000000  0.0  0.0  0.0  1000
8020201  1  0.0  0.0  0.0
*
8030000  "MAINLINE"  SNGLVOL
8030101  0.77708  0.8334  0.0  0.0 -90.  -0.8334  1.69-4  0.0  00
8030200  4  17.7  120.  0.9284  0.0  0.0
*
*    CONNECTION TO MAIN LINE AT ELEV. 670'-10"
*
*
8040000  "MAINLINE"  SNGLJUN
8040101  803010000  805000000  0.0  0.0  0.0  1000
8040201  1  0.0  0.0  0.0
*
2080000  "CON.2"  SNGLJUN
2080101  207010000  805000000  0.0  0.1560  0.1560  1000
2080201  1  0.0  0.0  0.0
*
8050000  "MAINBR.3"  BRANCH
8050001  0
8050101  0.77708  0.8334 0.0 0.0 -90. -0.8334  1.69-4  0.0  00
8050200  4  17.7  120.  0.9284  0.0  0.0
*
8060000  "MAINLINE"  SNGLJUN
8060101  805010000  807000000  0.0  0.0  0.0  1000
8060201  1  0.0  0.0  0.0
*
8070000  "MAINLINE"  SNGLVOL
8070101  0.77708  0.8334  0.0  0.0 -90.  -0.8334  1.69-4  0.0  00
8070200  4  17.7  120.  0.9284  0.0  0.0
*
*
*    CONNECTION TO MAIN LINE AT ELEV. 669'-2"
*
*
*
8080000  "MAINLINE"  SNGLJUN
8080101  807010000  809000000  0.0  0.0  0.0  1000
8080201  1  0.0  0.0  0.0
*
1080000  "CON.3"  SNGLJUN
1080101  107010000  809000000  0.0  0.1560  0.1560  1000
1080201  1  0.0  0.0  0.0
*
8090000  "MAINBR4"  BRANCH
8090001  0
8090101  0.77708  0.8334  0.0 0.0 -90. -0.8334  1.69-4  0.0  00
8090200  4  17.7  120.  0.9284 0.0  0.0
*
8100000  "MAINLINE"  SNGLJUN
8100101  809010000  811000000  0.0  0.0  0.0  1000
8100201  1  0.0  0.0  0.0
*
*
```


TELEDYNE ENGINEERING SERVICES

```
   753   8110000  "MAINLINE"  PIPE
   754   *
   755   8110001              97
   756   *
   757   8110101  0.77708     97
   758   *
   759   8110301  1.0149      14
   760   8110302  0.5303      18
   761   8110303  0.5         22
   762   8110304  0.5303      26
   763   8110305  0.9908      56
   764   8110306  0.5         64
   765   8110307  0.8750      72
   766   8110308  0.5104      80
   767   8110309  0.5000      88
   768   8110310  1.0558      97
   769   *
   770   8110401  0.0         97
   771   *
   772   8110601  -90.        14
   773   8110602  -45.        18
   774   8110603  -90.        22
   775   8110604  -45.        26
   776   8110605  -90.        56
   777   8110606  0.0         80
   778   8110607  -90.        88
   779   8110608  0.0         97
   780   *
   781   8110801  1.69-4   0.  97
   782   *
   783   8110901  0.0         0.0         13
   784   8110902  0.078       0.078       14
   785   8110903  0.0         0.0         17
   786   8110904  0.078       0.078       18
   787   8110905  0.0         0.0         21
   788   8110906  0.078       0.078       22
   789   8110907  0.0         0.0         25
   790   8110908  0.078       0.078       26
   791   8110909  0.0         0.0         55
   792   8110910  0.156       0.156       56
   793   8110911  0.0         0.0         63
   794   8110912  0.026       0.026       64
   795   8110913  0.0         0.0         71
   796   8110914  0.13        0.13        72
   797   8110915  0.0         0.0         79
   798   8110916  0.156       0.156       80
   799   8110917  0.0         0.0         87
   800   8110918  0.156       0.156       88
   801   8110919  0.0         0.0         96
   802   *
   803   8111001  00          97
   804   *
   805   8111101  1000        96
   806   *
   807   8111201  4  17.7  120.  0.9296  0.0     97
   808   *
   809   8111300  1
   810   8111301  0.0  0.0  0.0     96
```


TELEDYNE ENGINEERING SERVICES

```
*
*
8120000  "MAINDISC"  SNGLJUN
8120101  811010000  813000000  0.0  0.156  0.156  1000
8120201  1  0.0  0.0  0.0
*
8130000  "MAINLINE"  PIPE
*
8130001              26
*
8130101  0.77708     26
*
8130301  1.0         14
8130302  0.5         24
8130303  1.20833     26
*
8130401  0.0         26
*
8130601  0.0         24
8130602  -90.        26
*
8130801  1.69-4      0.  28
*
8130901  0.0         0.0         13
8130902  0.156       0.156       14
8130903  0.0         0.0         23
8130904  0.156       0.156       24
8130905  0.0         0.0         25
*
8131001  00          28
*
8131101  1000        25
*
8131201  4  17.7  120.  0.9284  0.0  28
*
8131300  1
8131301  0.0  0.0  0.0         25
*
*
*
*****************************************
*     QUENCH TANK                       *
*****************************************
*
*
*
9770000  "QTANK-IN"  SNGLJUN
9770101  813010000  978000000  0.  0.  0.  1000
9770201  1  0.  0.  0.
*
*    SPARGER  12 IN SCH40  PIPE
*
9780000  "SPARGER"  PIPE
*    NO OF VOLUMES
9780001  18
*    FLOW AREA
9780101  0.7773      18
*    VOL. LENGTHS
```


TELEDYNE ENGINEERING SERVICES

```
9780301   1.125      2
9780302   1.1333     7
9780303   1.0        18
*    VOL. VOLS.
9780401   0.0        18
*
*   VERTICAL ANGLES
9780601   -90.       7
9780602   0.0        18
*    PIPE  ROUGHNESS
9780801   1.69-4     0.0        18
*    JUNCTION  LOSS COEFF.
9780901   0.0        0.0        6
9780902   0.156      0.156      7
9780903   0.0        0.0        17
*    VOL. CONTROL FLAG
9781001   00         18
*    JUN. CONTROL FLAG
9781101   1000       17
*    INITIAL COND.
9781201   4    17.7   120.    0.9284    0.    2
9781202   3    17.7   120.    0.0       0.    18
*         JUN. INITIAL COND.
9781300   1
9781301   0.0  0.0  0.0        17
*    SPARGER   EXIT
9790000 "EXIT" SNGLJUN
9790101   978010000   980000000    0.0    1.0   1.0      1100
9790201   1    0.     0.     0.
*         QUENCH TANK
*
*         WATER  VOL.
9800000 "QT. WATER" SNGLVOL
9800101   260.4706   5.6667   0.0   0.0   90.   5.6667  0.003  0.0   01
9800200   3    17.7       120.
*         INTERFACE
9810000   "INTERFACE"  SNGLJUN
9810101   980010000  982000000   0.0    0.0    0.0     1000
9810201   1    0.0   0.0   0.0
*         AIR  VOLUME
9820000   "QT.AIR"  SNGLVOL
9820101   260.4706  1.2439    0.0   0.0   90.   1.2439  0.003  0.0  01
9820200   4    17.7   120.    0.9284
*
*         RUPTURE DISC
9830000   "RUP.DISC"  VALVE
9830101   982010000   999000000      1.77  0.  0.    1100
9830201   1    0.    0.    0.
9830300   TRPVLV
9830301   515        *    VALVE OPENING TRIP
*
*
*****************************************
*    PIPE OUTSIDE ENVIROMENT            *
*****************************************
*
*
9990000   "ATMOSPHERE"    TMDPVOL
```


TELEDYNE ENGINEERING SERVICES

```
 927   9990101  10000.   10000.   0.0  0.0  0.0  0.0  .00001  0.0  11
 928   9990200  4
 929   9990201  0.0  17.7  120.  0.9284
 930   *
 931   *
 932   ****************************************
 933   *  PLOT CARDS                          *
 934   ****************************************
 935   *
 936   *
 937   *
 938   20300100  MFLOWJ  410000000
 939   20300200  MFLOWJ  510000000
 940   20300300  MFLOWJ  610000000
 941   20300400  MFLOWJ  402000000
 942   20300500  MFLOWJ  811140000
 943   20300600  MFLOWJ  811570000
 944   20300700  MFLOWJ  308000000
 945   20300800  MFLOWJ  208000000
 946   20300900  MFLOWJ  108000000
 947   *
 948   20301000  QUALS  411010000
 949   20301100  QUALS  511010000
 950   20301200  QUALS  611010000
 951   20301300  QUALS  409240000
 952   20301400  QUALS  509100000
 953   20301500  QUALS  609090000
 954   20301600  QUALS  401280000
 955   20301700  QUALS  811140000
 956   20301800  QUALS  811570000
 957   20301900  QUALS  307010000
 958   20302000  QUALS  307180000
 959   20302100  QUALS  207010000
 960   20302200  QUALS  207260000
 961   20302300  QUALS  107010000
 962   20302400  QUALS  107330000
 963   *
 964   20302500  P      411010000
 965   20302600  P      511010000
 966   20302700  P      611010000
 967   20302800  P      409240000
 968   20302900  P      509100000
 969   20303000  P      609090000
 970   20303100  P      401280000
 971   20303200  P      811140000
 972   20303200  P      811570000
       CARD ABOVE IS REPLACEMENT CARD.
 973   20303400  P      307010000
 974   20303500  P      307180000
 975   20303600  P      207010000
 976   20303700  P      207260000
 977   20303800  P      107010000
 978   20303900  P      107330000
 979   *
 980   *
 981   *
 982   *
 983   . END OF CASE
```

4.9.2 Condensate/Steam Restart

LISTING OF INPUT DATA FOR CASE 1

```
    1  =THIS RESTARTS RELAP,3PORVS OPENING ON LOOPSEALS UP/DWN 2 ARCS
    2  *
    3  100  RESTART TRANSNT
    4  101  RUN
    5  *
    6  103 1102
    7  104  NOACTION
    8  201  0.600  1.-7  2.-4  11001  5  50  250
    9  *
   10  *  MINOR EDITS
   11  *
   12  301  MFLOWJ  410000000
   13  302  MFLOWJ  510000000
   14  303  MFLOWJ  610000000
   15  304  MFLOWJ  402000000
   16  305  MFLOWJ  811140000
   17  306  MFLOWJ  811570000
   18  307  MFLOWJ  308000000
   19  308  MFLOWJ  208000000
   20  309  MFLOWJ  108000000
   21  *
   22  310  QUALS  411010000
   23  311  QUALS  511010000
   24  312  QUALS  611010000
   25  313  QUALS  409260000
   26  314  QUALS  509120000
   27  315  QUALS  609110000
   28  316  QUALS  401280000
   29  317  QUALS  811140000
   30  318  QUALS  811570000
   31  319  QUALS  307010000
   32  320  QUALS  307180000
   33  321  QUALS  207010000
   34  322  QUALS  207260000
   35  323  QUALS  107010000
   36  324  QUALS  107330000
   37  *
   38  325  P      411010000
   39  326  P      511010000
   40  327  P      611010000
   41  328  P      409260000
   42  329  P      509120000
   43  330  P      609110000
   44  331  P      401280000
   45  332  P      811140000
   46  333  P      811570000
   47  334  P      307010000
   48  335  P      307180000
   49  336  P      207010000
   50  337  P      207260000
   51  338  P      107010000
   52  339  P      107330000
   53  *
   54  *
   55  *
   56  4000000  "PORV"  SNGLJUN
```

BY CWM DATE 4-14-83

CHKD. BY JBM DATE 4-20-83

TELEDYNE ENGINEERING SERVICES

```
    4000101  399000000  401000000  0.0  0.0  0.0  1100
    4000201  1  0.0  0.0  0.0
    ****************************************
    *  FORCE CARDS  FOR REPIPE             *
    ****************************************
    *
    ************************************************************************
    * THIS RELAP RUN INCLUDES ENTIRE ARCS 1 AND 3, PORV UPSTREAM AND
    * DOWN AS WELL AS THE MAIN HEADER AND SOME DISHCHARGE PIPING
    ************************************************************************
    *
    *
    *****ARC-1*****
    *
    *
    2001  5,247,509110000,509120000,609100000,107040000
    2002  107050000,107060000,107070000,107080000,107090000
    2003  107100000,107110000,107120000,107130000,107140000
    2004  107150000,107160000,107170000,107180000,107190000
    2005  107200000,107210000,107220000,107230000,107240000
    2006  107250000,107260000,107270000,107280000,107290000
    2007  107300000,107310000,107320000,107330000
    *
    *
    *****ARC-2*****
    *
    *
    *
    *****ARC-3*****
    *
    *
    2014  609110000,409250000,409260000,307040000
    2015  307050000,307060000,307070000,307080000,307090000
    2016  307100000,307110000,307120000,307130000,307140000
    2017  307150000,307160000 307170000,307180000
    *
    *
    *
    *
    ***   PORV'S  DOWNSTREAM   ***
    *
    *
    *
    2046 611010000,611020000,611030000,611040000,611050000
    2047 611060000,611070000,611080000,511010000,511020000
    2048 511030000,511040000,511050000,511060000,511070000
    2049 511080000,511090000,511100000,511110000,511120000
    2050 511130000,511140000,511150000,511160000,511170000
    2051 511180000,511190000,513010000,515010000,515020000
    2052 515030000,515040000,515050000,515060000,515070000
    2053 515080000,515090000,515100000,515110000,515120000
    2054 411010000,411020000,411030000,411040000,411050000
    2055 411060000,411070000,411080000,411090000,411100000
    2056 411110000,411120000,411130000,411140000,411150000
    2057 411160000,411170000,411180000,411190000,701010000
    2058 703010000
    *
```

```
115   *
116   *****MAIN DISCHARGE LINE*****
117   *
118   *
119   2018  703020000,703030000,703040000,703050000,703060000
120   2019  703070000,703080000,703090000,703100000,703110000
121   2020  703120000,703130000,703140000,801010000,803010000
122   2021  805010000,807010000
123   2022  809010000,811010000,811020000,811030000,811040000
124   2023  811050000,811060000,811070000,811080000,811090000
125   2024  811100000,811110000,811120000,811130000,811140000
126   2025  811150000,811160000,811170000,811180000,811190000
127   2026  811200000,811210000,811220000,811230000,811240000
128   2027  811250000,811260000,811270000
129   *
130   *
131   ***  PORV UPSTREAM  ***
132   *
133   *
134   2028  399010000,401010000,401020000,401030000,401040000
135   2029  401050000,401060000,401070000,401080000,401090000
136   2030  401100000,401110000,401120000,401130000,401140000
137   2031  401150000,401160000,401170000,401180000,401190000
138   2032  401200000,401210000,401220000,401230000,401240000
139   2033  401250000,401260000,401270000,401280000,403010000
140   2034  405010000,405020000,405030000,405040000,405050000
141   2035  405060000,405070000,405080000,405090000,405100000
142   2036  405110000,405120000,405130000,405140000,405150000
143   2037  405160000,407010000,409010000,409020000,409030000
144   2038  409040000,409050000,409060000,409070000,409080000
145   2039  409090000,409100000,409110000,409120000,409130000
146   2040  409140000,409150000,409160000,409170000,409180000
147   2041  409190000,409200000,409210000,409220000,409230000
148   2042  409240000,609010000,609020000,609030000,609040000
149   2043  609050000,609060000,609070000,609080000,609090000
150   2044  509010000,509020000,509030000,509040000,509050000
151   2045  509060000,509070000,509080000,509090000,509100000
152   *
153   *
154   ****************************************
155   *  PLOT CARDS                          *
156   ****************************************
157   *
158   *
159   *
160   20300100  MFLOWJ  410000000
161   20300200  MFLOWJ  510000000
162   20300300  MFLOWJ  610000000
163   20300400  MFLOWJ  402000000
164   20300500  MFLOWJ  811140000
165   20300600  MFLOWJ  811570000
166   20300700  MFLOWJ  308000000
167   20300800  MFLOWJ  208000000
168   20300900  MFLOWJ  108000000
169   *
170   20301000  QUALS  411010000
171   20301100  QUALS  511010000
172   20301200  QUALS  611010000
```

```
  173   20301300  QUALS   409240000
  174   20301400  QUALS   509100000
  175   20301500  QUALS   609090000
  176   20301600  QUALS   401280000
  177   20301700  QUALS   811140000
  178   20301800  QUALS   811570000
  179   20301900  QUALS   307010000
  180   20302000  QUALS   307180000
  181   20302100  QUALS   207010000
  182   20302200  QUALS   207260000
  183   20302300  QUALS   107010000
  184   20302400  QUALS   107330000
  185   *
  186   20302500  P       411010000
  187   20302600  P       511010000
  188   20302700  P       611010000
  189   20302800  P       409240000
  190   20302900  P       509100000
  191   20303000  P       609090000
  192   20303100  P       401280000
  193   20303200  P       811140000
  194   20303300  P       811570000
  195   20303400  P       307010000
  196   20303500  P       307180000
  197   20303600  P       207010000
  198   20303700  P       207260000
  199   20303800  P       107010000
  200   20303900  P       107330000
  201   *
  202   *
  203   *
  204   *
  205   . END OF CASE
```

LISTING OF INPUT DATA FOR CASE 1

```
    1  =THIS RESTARTS RELAP,3PORVS OPENING ON LOOPSEALS UP/DWN 2 ARCS
    2  *
    3  100  RESTART TRANSNT
    4  101  RUN
    5  *
    6  103 3791
    7  104  NOACTION
    8  201  1.0  1.-7  2.-4  11001  5  50  250
    9  *
   10  *  MINOR EDITS
   11  *
   12  301  MFLOWJ  410000000
   13  302  MFLOWJ  510000000
   14  303  MFLOWJ  610000000
   15  304  MFLOWJ  402000000
   16  305  MFLOWJ  811140000
   17  306  MFLOWJ  811570000
   18  307  MFLOWJ  308000000
   19  308  MFLOWJ  208000000
   20  309  MFLOWJ  108000000
   21  *
   22  310  QUALS  411010000
   23  311  QUALS  511010000
   24  312  QUALS  611010000
   25  313  QUALS  409260000
   26  314  QUALS  509120000
   27  315  QUALS  609110000
   28  316  QUALS  401280000
   29  317  QUALS  811140000
   30  318  QUALS  811570000
   31  319  QUALS  307010000
   32  320  QUALS  307180000
   33  321  QUALS  207010000
   34  322  QUALS  207260000
   35  323  QUALS  107010000
   36  324  QUALS  107330000
   37  *
   38  325  P      411010000
   39  326  P      511010000
   40  327  P      611010000
   41  328  P      409260000
   42  329  P      509120000
   43  330  P      609110000
   44  331  P      401280000
   45  332  P      811140000
   46  333  P      811570000
   47  334  P      307010000
   48  335  P      307180000
   49  336  P      207010000
   50  337  P      207260000
   51  338  P      107010000
   52  339  P      107330000
   53  *
   54  *
   55  *
   56  4000000  "PORV"  SNGLJUN
```

BY CMM DATE 4-14-83

CHKD. BY JRM DATE 4-20-83

TELEDYNE ENGINEERING SERVICES

```
4000101  399000000  401000000  0.0  0.0  0.0  1100
4000201  1  0.0  0.0  0.0
*****************************************
*  FORCE CARDS  FOR REPIPE              *
*****************************************
*
*************************************************************************
* THIS RELAP RUN INCLUDES ENTIRE ARCS 1 AND 3, PORV UPSTREAM AND
* DOWN AS WELL AS THE MAIN HEADER AND SOME DISHCHARGE PIPING
*************************************************************************
*
*
*****ARC-1*****
*
*
2001  5,247,509110000,509120000,609100000,107040000
2002  107050000,107060000,107070000,107080000,107090000
2003  107100000,107110000,107120000,107130000,107140000
2004  107150000,107160000,107170000,107180000,107190000
2005  107200000,107210000,107220000,107230000,107240000
2006  107250000,107260000,107270000,107280000,107290000
2007  107300000,107310000,107320000,107330000
*
*
*****ARC-2*****
*
*
*
*****ARC-3*****
*
*
2014  609110000,409250000,409260000,307040000
2015  307050000,307060000,307070000,307080000,307090000
2016  307100000,307110000,307120000,307130000,307140000
2017  307150000,307160000 307170000,307180000
*
*
*
*
***   PORV'S  DOWNSTREAM   ***
*
*
2046 611010000,611020000,611030000,611040000,611050000
2047 611060000,611070000,611080000,511010000,511020000
2048 511030000,511040000,511050000,511060000,511070000
2049 511080000,511090000,511100000,511110000,511120000
2050 511130000,511140000,511150000,511160000,511170000
2051 511180000,511190000,513010000,515010000,515020000
2052 515030000,515040000,515050000,515060000,515070000
2053 515080000,515090000,515100000,515110000,515120000
2054 411010000,411020000,411030000,411040000,411050000
2055 411060000,411070000,411080000,411090000,411100000
2056 411110000,411120000,411130000,411140000,411150000
2057 411160000,411170000,411180000,411190000,701010000
2058 703010000
*
```

```
*
*****MAIN DISCHARGE LINE*****
*
*
2018  703020000,703030000,703040000,703050000,703060000
2019  703070000,703080000,703090000,703100000,703110000
2020  703120000,703130000,703140000,801010000,803010000
2021  805010000,807010000
2022  809010000,811010000,811020000,811030000,811040000
2023  811050000,811060000,811070000,811080000,811090000
2024  811100000,811110000,811120000,811130000,811140000
2025  811150000,811160000,811170000,811180000,811190000
2026  811200000,811210000,811220000,811230000,811240000
2027  811250000,811260000,811270000
*
*
***  PORV UPSTREAM  ***
*
*
2028  399010000,401010000,401020000,401030000,401040000
2029  401050000,401060000,401070000,401080000,401090000
2030  401100000,401110000,401120000,401130000,401140000
2031  401150000,401160000,401170000,401180000,401190000
2032  401200000,401210000,401220000,401230000,401240000
2033  401250000,401260000,401270000,401280000,403010000
2034  405010000,405020000,405030000,405040000,405050000
2035  405060000,405070000,405080000,405090000,405100000
2036  405110000,405120000,405130000,405140000,405150000
2037  405160000,407010000,409010000,409020000,409030000
2038  409040000,409050000,409060000,409070000,409080000
2039  409090000,409100000,409110000,409120000,409130000
2040  409140000,409150000,409160000,409170000,409180000
2041  409190000,409200000,409210000,409220000,409230000
2042  409240000,609010000,609020000,609030000,609040000
2043  609050000,609060000,609070000,609080000,609090000
2044  509010000,509020000,509030000,509040000,509050000
2045  509060000,509070000,509080000,509090000,509100000
*
*
****************************************
*  PLOT CARDS                          *
****************************************
*
*
*
20300100  MFLOWJ  410000000
20300200  MFLOWJ  510000000
20300300  MFLOWJ  610000000
20300400  MFLOWJ  402000000
20300500  MFLOWJ  811140000
20300600  MFLOWJ  811570000
20300700  MFLOWJ  308000000
20300800  MFLOWJ  208000000
20300900  MFLOWJ  108000000
*
20301000  QUALS  411010000
20301100  QUALS  511010000
20301200  QUALS  611010000
```


TELEDYNE ENGINEERING SERVICES

```
  173    20301300  QUALS  409240000
  174    20301400  QUALS  509100000
  175    20301500  QUALS  609090000
  176    20301600  QUALS  401280000
  177    20301700  QUALS  811140000
  178    20301800  QUALS  811570000
  179    20301900  QUALS  307010000
  180    20302000  QUALS  307180000
  181    20302100  QUALS  207010000
  182    20302200  QUALS  207260000
  183    20302300  QUALS  107010000
  184    20302400  QUALS  107330000
  185    *
  186    20302500  P      411010000
  187    20302600  P      511010000
  188    20302700  P      611010000
  189    20302800  P      409240000
  190    20302900  P      509100000
  191    20303000  P      609090000
  192    20303100  P      401280000
  193    20303200  P      811140000
  194    20303300  P      811570000
  195    20303400  P      307010000
  196    20303500  P      307180000
  197    20303600  P      207010000
  198    20303700  P      207260000
  199    20303800  P      107010000
  200    20303900  P      107330000
  201    *
  202    *
  203    *
  204    *
  205    . END OF CASE
```


TELEDYNE ENGINEERING SERVICES

4.9.3 PORV Solid 400° Liquid

LISTING OF INPUT DATA FOR CASE 1

```
    1  =D.C.COOK UNIT1 PORV OPEN
    2  *
    3  *  DISCHARGE PIPING
    4  *  THIS IS THE NUMBERING SYSTEM FOR UNIT1'S RELAP MODEL
    5  *  WHERE COMPONENTS NUMBERED IN THE:
    6  *        100'S ARE VALVE SV-45C AND ARC 1 LEVEL  669'-2"
    7  *        200'S ARE VALVE SV-45B AND ARC 2 LEVEL  670'-10"
    8  *        300'S ARE VALVE SV-45A ARN ARC 3 LEVEL  672'-6"
    9  *        400'S ARE PORV NRV-151 AND ARC "A"
   10  *        500'S ARE PORV NRV-153 AND ARC "B"
   11  *        600'S ARE PORV NRV-152 AND ARC "C"
   12  *        700'S AND 800'S ARE 6" AND 12" MAIN DISCHARGE PIPING
   13  *        900'S QUENCH TANK PORTION
   14  *        999  ATMOSPHERE
   15  *
   16  *
   17  *
   18  100      NEW  TRANSNT
   19  101       RUN
   20  102       BRITISH   BRITISH
   21  104      NOACTION
   22  *
   23  ********************************************
   24  *      TIME STEP CONTROL                   *
   25  ********************************************
   26  *
   27  201       0.200,1.-7,2.-4,11001,5,50,250
   28  *
   29  *
   30  ********************************************
   31  *          MINOR EDITS                     *
   32  ********************************************
   33  *
   34  301  MFLOWJ  410000000
   35  302  MFLOWJ  510000000
   36  303  MFLOWJ  610000000
   37  304  MFLOWJ  402000000
   38  305  MFLOWJ  811140000
   39  306  MFLOWJ  811570000
   40  307  MFLOWJ  308000000
   41  308  MFLOWJ  208000000
   42  309  MFLOWJ  108000000
   43  *
   44  310  QUALS   411010000
   45  311  QUALS   511010000
   46  312  QUALS   611010000
   47  313  QUALS   409260000
   48  314  QUALS   509120000
   49  315  QUALS   609110000
   50  316  QUALS   401280000
   51  317  QUALS   811140000
   52  318  QUALS   811570000
   53  319  QUALS   307010000
   54  320  QUALS   307180000
   55  321  QUALS   207010000
   56  322  QUALS   207260000
```

BY CMM DATE 4-21-83

CHKD. BY KJG DATE 5-20-83

TELEDYNE ENGINEERING SERVICES

```
    323  QUALS  107010000
    324  QUALS  107330000
    *
    325  P      411010000
    326  P      511010000
    327  P      611010000
    328  P      409260000
    329  P      509120000
    330  P      609110000
    331  P      401280000
    332  P      811140000
    333  P      811570000
    334  P      307010000
    335  P      307180000
    336  P      207010000
    337  P      207260000
    338  P      107010000
    339  P      107330000
    *
    *
    ****************************************
    *  FORCE CARDS  FOR REPIPE             *
    ****************************************
    *
    ********************************************************************************
    * THIS RELAP RUN INCLUDES ENTIRE ARCS 1 AND 3, PORV UPSTREAM AND
    * DOWN AS WELL AS THE MAIN HEADER AND SOME DISHCHARGE PIPING
    ********************************************************************************
    *
    *
    *****ARC-1*****
    *
    *
    2001  5,247,509110000,509120000,609100000,107040000
    2002  107050000,107060000,107070000,107080000,107090000
    2003  107100000,107110000,107120000,107130000,107140000
    2004  107150000,107160000,107170000,107180000,107190000
    2005  107200000,107210000,107220000,107230000,107240000
    2006  107250000,107260000,107270000,107280000,107290000
    2007  107300000,107310000,107320000,107330000
    *
    *
    *****ARC-2*****
    *
    *
    *
    *****ARC-3*****
    *
    *
    2014  609110000,409250000,409260000,307040000
    2015  307050000,307060000,307070000,307080000,307090000
    2016  307100000,307110000,307120000,307130000,307140000
    2017  307150000,307160000 307170000,307180000
    *
    *
    *
    *
```

```
*** PORV'S DOWNSTREAM ***
*
*
*
2046 611010000,611020000,611030000,611040000,611050000
2047 611060000,611070000,611080000,511010000,511020000
2048 511030000,511040000,511050000,511060000,511070000
2049 511080000,511090000,511100000,511110000,511120000
2050 511130000,511140000,511150000,511160000,511170000
2051 511180000,511190000,513010000,515010000,515020000
2052 515030000,515040000,515050000,515060000,515070000
2053 515080000,515090000,515100000,515110000,515120000
2054 411010000,411020000,411030000,411040000,411050000
2055 411060000,411070000,411080000,411090000,411100000
2056 411110000,411120000,411130000,411140000,411150000
2057 411160000,411170000,411180000,411190000,701010000
2058 703010000
*
*
*****MAIN DISCHARGE LINE*****
*
*
2018 703020000,703030000,703040000,703050000,703060000
2019 703070000,703080000,703090000,703100000,703110000
2020 703120000,703130000,703140000,801010000,803010000
2021 805010000,807010000
2022 809010000,811010000,811020000,811030000,811040000
2023 811050000,811060000,811070000,811080000,811090000
2024 811100000,811110000,811120000,811130000,811140000
2025 811150000,811160000,811170000,811180000,811190000
2026 811200000,811210000,811220000,811230000,811240000
2027 811250000,811260000,811270000
*
*
*** PORV UPSTREAM ***
*
*
2028 399010000,401010000,401020000,401030000,401040000
2029 401050000,401060000,401070000,401080000,401090000
2030 401100000,401110000,401120000,401130000,401140000
2031 401150000,401160000,401170000,401180000,401190000
2032 401200000,401210000,401220000,401230000,401240000
2033 401250000,401260000,401270000,401280000,403010000
2034 405010000,405020000,405030000,405040000,405050000
2035 405060000,405070000,405080000,405090000,405100000
2036 405110000,405120000,405130000,405140000,405150000
2037 405160000,407010000,409010000,409020000,409030000
2038 409040000,409050000,409060000,409070000,409080000
2039 409090000,409100000,409110000,409120000,409130000
2040 409140000,409150000,409160000,409170000,409180000
2041 409190000,409200000,409210000,409220000,409230000
2042 409240000,609010000,609020000,609030000,609040000
2043 609050000,609060000,609070000,609080000,609090000
2044 509010000,509020000,509030000,509040000,509050000
2045 509060000,509070000,509080000,509090000,509100000
*
*
**************************************
```

```
*          TRIPS                *
*****************************************
*
*
501  TIME  0 GE NULL 0  0.0  L   * VALVE OPENING TRIP
502  TIME  0 GE NULL  0  5.0  L   *  JOB TERMINATION TRIP
515  P  982010000  GE  NULL 0 114.7   L *  QUENCH TANK RUPTURE PRESS.
600      502
*
*************************************************************
*          ***************************************          *
*          *  HYDRODYNAMIC COMPONENTS          *          *
*          ***************************************          *
*************************************************************
*
*
*          PRESSURIZER   COMPONENT
3990000     "PRESS"   TMDPVOL
3990101  0.0  20.0  500.0  0.0  0.0  0.0  0.00005  0.0  11
3990200  3
3990201  0.0  2349.7  400.0  0.8  2420.0  400.0  1.2  2498.7  400.0
*
4000000     "PORV"  SNGLJUN
4000101     399000000  401000000  0.0  0.0  0.0  1100
4000201     1   0.0  0.0  0.0
*
4010000     "PORV"  PIPE
4010001     28
4010101     0.1465     28
4010301     .4375      4
4010302     .5104      12
4010303     .5         19
4010304     .5         27
4010305  0.72  28
4010401     0.0      28
4010601     45.      4
4010602     90.        12
4010603     0.0     19
4010604     90.     27
4010605  0.0  28
4010801     1.51E-4    0.0  28
4010901     0.0        0.0      3
4010902     .092       .092     4
4010903     0.0        0.0      11
4010904     .1836      .1836    12
4010905     0.0        0.0      18
4010906     .1836      .1836    19
4010907     0.0        0.0      26
4010908  0.1836  0.1836  27
4011001     00      28
4011101     1000      27
4011201  3  2349.7  400.0  0.0  0.0  28
4011300     1
4011301     0.0  0.0  0.0     27
*
4020000     "PORV"  SNGLJUN
4020101     401010000  403000000  0.0  0.0  0.0  1000
4020201     1   0.0  0.0  0.0
```


TELEDYNE ENGINEERING SERVICES

```
231  *
232  4030000  "PORV"  BRANCH
233  4030001  0
234  4030101  0.1465  0.5  0.0  0.0  0.0  0.0  1.51E-4  0.0  00
235  4030200  3  2349.7  400.0  0.0  0.0  0.0
236  *
237  4040000  "PORV"  SNGLJUN
238  4040101  403010000  405000000  0.1465  0.0  0.0  1000
239  4040201  1  0.0  0.0  0.0
240  *
241  4050000  "PORV"  PIPE
242  4050001  16
243  4050101  0.1465  1
244  4050102  0.0718  16
245  4050301  0.698  1
246  4050302  0.471  7
247  4050303  0.451  16
248  4050401  0.0  16
249  4050601  0.0  16
250  4050801  1.51E-4  0.0  1
251  4050802  1.33E-4  0.0  16
252  4050901  0.0577  0.0961  1
253  4050902  0.0  0.0  15
254  4051001  00  16
255  4051101  1000  15
256  4051201  3  2349.7  400.0  0.0  0.0  16
257  4051300  1
258  4051301  0.0  0.0  0.0  15
259  *
260  4060000  "PORV"  SNGLJUN
261  4060101  405010000  407000000  0.0  0.0  0.0  1000
262  4060201  1  0.0  0.0  0.0
263  *
264  4070000  "PORV"  BRANCH
265  4070001  0
266  4070101  0.0718  0.451  0.0  0.0  0.0  0.0  1.33E-4  0.0  00
267  4070200  3  2349.7  400.0  0.0  0.0  0.0
268  *
269  4080000  "PORV"  SNGLJUN
270  4080101  407010000  409000000  0.0  0.0  0.0  1000
271  4080201  1  0.0  0.0  0.0
272  *
273  4090000  "PORV"  PIPE
274  4090001  26
275  4090101  0.0716  1
276  4090102  0.03757  22
277  4090103  0.03388  23
278  4090104  0.02650  24
279  4090105  0.01912  25
280  4090106  0.01175  26
281  4090301  0.53  1
282  4090302  .30  2
283  4090303  0.493  10
284  4090304  0.55  14
285  4090305  0.510  22
286  4090306  0.255  26
287  4090401  0.0  26
288  4090601  0.0  26
```

```
  289    4090801    1.33E-4    0.0       1
  290    4090802    1.53E-4    0.0       26
  291    4090901    0.0        0.0       13
  292    4090902    0.585      0.585     14
  293    4090903    0.0        0.0       25
  294    4091001    00         28
  295    4091102    1000       25
  296    4091201    3  2349.7  400.0  0.0  0.0  28
  297    4091300    1
  298    4091301    0.0  0.0  0.0  25
  299    *
  300    4100000    "PORV151"  VALVE
  301    4100101    409010000  411000000  0.00806  0.0  0.0  0100
  302    4100201    1  0.0  0.0  0.0
  303    4100300    MTRVLV
  304    4100301    501  502  1.0  0.0
  305    *
  306    5080000    "PORV"  SNGLJUN
  307    5080101    407010000  509000000  0.0  0.2172  0.2172  1000
  308    5080201    1  0.0  0.0  0.0
  309    *
  310    5090000    "PORV"  PIPE
  311    5090001    12
  312    5090101    0.03757    8
  313    5090102    0.03388    9
  314    5090103    0.02650    10
  315    5090104    0.01912    11
  316    5090105    0.01175    12
  317    5090301    0.4089     2
  318    5090302    0.5078     8
  319    5090303    0.2539     12
  320    5090401    0.0        12
  321    5090601    0.0        12
  322    5090801    1.53E-4    0.0       12
  323    5090901    0.0  0.0  1
  324    5090902    0.2172     0.2172    2
  325    5090903    0.0        0.0       11
  326    5091001    00         12
  327    5091101    1000       11
  328    5091201    3  2349.7  400.0  0.0  0.0  12
  329    5091300    1
  330    5091301    0.0  0.0  0.0  11
  331    *
  332    5100000    "PORV152"  VALVE
  333    5100101    509010000  511000000  0.00806  0.0  0.0  0100
  334    5100201    1  0.0  0.0  0.0
  335    5100300    MTRVLV
  336    5100301    501  502  1.0  0.0
  337    *
  338    6080000    "PORV"  SNGLJUN
  339    6080101    403010000  609000000  0.0  0.1838  0.1838  1000
  340    6080201    1  0.0  0.0  0.0
  341    *
  342    6090000    "PORV"  PIPE
  343    6090001    11
  344    6090101    0.03757    7
  345    6090102    0.03388    8
  346    6090103    0.02650    9
```


TELEDYNE ENGINEERING SERVICES

```
  347   6090104  0.01912    10
  348   6090105  0.01175    11
  349   6090301   0.4089     2
  350   6090302   0.5699     7
  351   6090303    .2850    11
  352   6090401   0.0       11
  353   6090601   0.0       11
  354   6090801   1.53E-4   0.0   11
  355   6090901  0.0  0.0  1
  356   6090902   0.2172   0.2172   2
  357   6090903   0.0      0.0    10
  358   6091001   00      11
  359   6091101   1000     10
  360   6091201  3  2349.7  400.0  0.0  0.0  0.0   11
  361   6091300   1
  362   6091301   0.0  0.0  0.0  10
  363   *
  364   6100000   "PORV153"  VALVE
  365   6100101   609010000  611000000  0.00808  0.0  0.0  0100
  366   6100201   1    0.0 0.0  0.0
  367   6100300   MTRVLV
  368   6100301   501  502   1.0     0.0
  369   ********************************************
  370   *
  371   *    VALVE  DOWNSTREAM  PIPING
  372   1070000   "DWNSTRM#1"   PIPE
  373   1070001       33
  374   *
  375   1070101   0.20069       33
  376   *
  377   1070301   0.5281         4
  378   1070302   0.9943        15
  379   1070303   0.9132        21
  380   1070304   0.8472        30
  381   1070305   1.085         33
  382   *
  383   1070401   0.0           33
  384   *
  385   1070601   0.0            4
  386   1070602   -90.          15
  387   1070603   0.0           33
  388   *
  389   1070801   1.52-4   0.   33
  390   1070901   0.0      0.0      3
  391   1070902   0.18     0.18     4
  392   1070903   0.0      0.0     14
  393   1070904   0.18     0.18    15
  394   1070905   0.0      0.0     32
  395   *
  396   1071001   00       33
  397   1071101   1000     32
  398   *
  399   1071201   4   17.7   120.   0.9284   0.   33
  400   *
  401   1071300   1
  402   1071301   0.0  0.0  0.0  32
  403   *
  404   *
```


TELEDYNE ENGINEERING SERVICES

```
*
*
*************************************************************************
*
*    VALVE DOWNSTREAM PIPING
2070000   "DWNSTRM#2"   PIPE
*
2070001              28
2070101  0.20069     28
*
2070301   0.5261     4
2070302   0.9271     14
2070303   0.8852     23
2070304   1.085      28
*
2070401   0.0        26
*
2070601   0.0        4
2070602   -90.       14
2070603   0.0        26
*
2070801   1.52-4   0.    26
*
2070901   0.0        0.0        3
2070902   0.18       0.18       4
2070903   0.0        0.0        13
2070904   0.18       0.18       14
2070905   0.0        0.0        25
*
2071001   00         26
*
2071101   1000       25
*
2071201   4   17.7   120.   0.9284   0.   26
*
2071300   1
2071301   0.0  0.0  0.0  25
*
*
*************************************************************************
*
*    VALVE DOWNSTREAM PIPING
3070000   "DWNSTRM#3"   PIPE
3070001   18
*
3070101   0.20069    18
*
3070301   0.5261     4
3070302   1.0339     12
3070303   0.801      15
3070304   1.085      18
*
3070401   0.0        18
*
3070601   0.0        4
3070602   -90.       12
3070603   0.0        18
*
```

```
3070801   1.52-4   0.     18
*
3070901   0.0      0.0      3
3070902   0.18     0.18     4
3070903   0.0      0.0     11
3070904   0.18     0.18    12
3070905   0.0      0.0     17
*
3071001   00       18
3071101   1000     17
*
3071201   4   17.7   120.   0.9284   0.    18
*
3071300   1
3071301   0.0  0.0  0.0      17
*
*
*********************************************
*     PORV DISCHARGE SECTION                *
*********************************************
*
*
*************************************************************
*   PORV NRV-151 DISCHARGE LINE ARC "A"                     *
*************************************************************
*
*
4110000   "PORV1"  PIPE
4110001        19
*
4110101   0.05132   17
4110102   0.20069   19
*
4110301   0.3724    4
4110302   0.3802    8
4110303   0.561     17
4110304   0.349     19
*
4110401   0.0       19
*
4110601   0.0       4
4110602   -90.      8
4110603   0.0       19
*
4110801   1.53-4  .0  17
4110802   1.52-4  .0  19
*
4110901   0.0       0.0      3
4110902   0.2088    0.2088   4
4110903   0.0       0.0      7
4110904   0.2088    0.2088   8
4110905   0.0       0.0     16
4110906   0.3784    0.1565  17
4110907   0.0       0.0     18
*
4111001   00        19
4111101   1000      18
*
```


TELEDYNE ENGINEERING SERVICES

```
4111201   4   17.7   120.   0.9284   0.0   19
*
4111300   1
4111301   0.0  0.0  0.0   18
*
4120000   "ENTERMAIN"   SNGLJUN
4120101   411010000   701000000   0.0   0.1800   0.1800   1100
4120201   1   0.0   0.0   0.0
*
*
*****************************************************
*   PORV NRV-153 DISCHARGE LINE ARC "B"             *
*****************************************************
*
*
*
5110000   "PORV2LINE"   PIPE
5110001           19
*
5110101   0.05132   18
5110102   0.08840   19
*
5110301   0.4303    3
5110302   0.3620    7
5110303   0.3529    9
5110304   0.6058    18
5110305   0.371     19
*
5110401   0.0       19
*
5110601   0.0       3
5110602   -90.      7
5110603   0.0       19
*
5110801   1.53-4  .0  18
5110802   1.34-4  .0  19
*
5110901   0.0       0.0       2
5110902   0.2088    0.2088    3
5110903   0.0       0.0       6
5110904   0.2088    0.2088    7
5110905   0.0       0.0       17
5110906   0.0544    0.0399    18
*
5111001   00        19
*
5111101   1000      18
*
5111201   4   17.7   120.   0.9284   0.0   19
*
5111300   1
5111301   0.0  0.0  0.0   18
*
5120000   "JUNC."   SNGLJUN
5120101   511010000   513000000   0.0   0.0   0.0   1000
5120201   1   0.0   0.0   0.0
*
*
```

```
   579    *
   580    5130000   "4X4X3TEE"   BRANCH
   581    5130001   0
   582    5130101   0.08840  0.3524  0.0 0.0 0.0 0.0  1.34-4  0.0    00
   583    5130200   4  17.7  120.  0.9284  0.0  0.0
   584    *
   585    *
   586    5140000   "4IN JUNC"  SNGLJUN
   587    5140101   513010000  515000000  0.0  0.0  0.0    1000
   588    5140201   1  0.0  0.0  0.0
   589    *
   590    5150000   "4INSCH40"  PIPE
   591    5150001             12
   592    *
   593    5150101   0.0884    10
   594    5150102   0.20069   12
   595    *
   596    5150301   0.3524    1
   597    5150302   0.6983    10
   598    5150303   0.349     12
   599    *
   600    5150401   0.0       12
   601    *
   602    5150601   0.0       12
   603    *
   604    5150801   1.34-4 0.0   10
   605    5150802   1.52-4  0.0    12
   606    *
   607    5150901   0.0       0.0       9
   608    5150902   0.1483    0.0815    10
   609    5150903   0.0       0.0       11
   610    *
   611    5151001   00        12
   612    *
   613    5151101   1000      11
   614    *
   615    5151201   4  17.7  120.  0.9284  0.0   12
   616    *
   617    5151300   1
   618    5151301   0.0  0.0  0.0   11
   619    *
   620    5160000   "ENTERMAIN"  SNGLJUN
   621    5160101   515010000  701000000  0.0  0.0  0.0    1000
   622    5160201   1  0.0  0.0  0.0
   623    *
   624    *
   625    ******************************************************
   626    *   PORV NRV-152 DISCHARGE LINE  ARC "C"             *
   627    ******************************************************
   628    *
   629    *
   630    *
   631    6110000   "PORVDISC3"  PIPE
   632    6110001             8
   633    *
   634    6110101   0.05132   8
   635    *
   636    6110301   0.3723    4
```

```
  637   6110302   0.3846    8
  638   *
  639   6110401   0.0       8
  640   *
  641   6110601   0.0       4
  642   6110602   -90.      8
  643   *
  644   6110801   1.53-4 .0 8
  645   *
  646   6110901   0.0       0.0       3
  647   6110902   0.211     0.211     4
  648   6110903   0.0       0.0       7
  649   *
  650   6111001   00        8
  651   6111101   1000      7
  652   *
  653   6111201   4  17.7   120.   0.9284  0.0   8
  654   *
  655   6111300   1
  656   6111301   0.0  0.0  0.0   7
  657   *
  658   6120000   "PORVLINE"    SNGLJUN
  659   6120101   611010000  513000000  0.0  0.0  0.0   1000
  660   6120201   1  0.0  0.0  0.0
  661   *
  662   ********************************************
  663   *   MAIN DISCHARGE LINE SECTION            *
  664   ********************************************
  665   *
  666   *
  667   *    MAIN  DISCHARGE  LINE
  668   7010000    "ENTERMAIN"     BRANCH
  669   7010001   0
  670   7010101   0.20069  0.7035 0.0 0.0 0.0 0.0 1.52-4 0.0  00
  671   7010200   4     17.7   120.  0.9284  0.0   0.0
  672   *
  673   7020000   "MAINLINE"   SNGLJUN
  674   7020101   701010000  703000000 0.0  0.0  0.0   1000
  675   7020201   1     0.0  0.0  0.0
  676   *
  677   7030000   "MAINLINE"   PIPE
  678   *
  679   7030001         14
  680   *
  681   7030101   0.20069    12
  682   7030102   0.77708    14   * 12 IN LINE STARTS HERE
  683   *
  684   7030301   0.7035     1
  685   7030302   1.0076     12
  686   7030303   0.5834     14    * 12 IN LINE STARTS HERE
  687   *
  688   7030401   0.0        14
  689   *
  690   7030601   0.0        1
  691   7030602   -90.       14
  692   *
  693   7030801    1.52-4     0.     12
  694   7030802   1.69-4  0.   14
```


TELEDYNE ENGINEERING SERVICES

```
695    *
696    7030901   0.180      0.180      1
697    7030902   0.0        0.0        11
698    7030903   0.493      0.2045     12
699    7030904   0.0        0.0        13
700    *
701    7031001   00         14
702    7031101   1000       13
703    *
704    7031201   4   17.7   120.   0.9284   0.0   14
705    *
706    7031300   1
707    7031301   0.0  0.0  0.0   13
708    *
709    *
710    7040000   "MAINLINE"  SNGLJUN
711    7040101   703010000  801000000   0.0  0.0  0.0   1000
712    7040201   1   0.0  0.0  0.0
713    *
714    3080000   "CON.1"  SNGLJUN
715    3080101   307010000  801000000   0.0  0.1560  0.1560  1000
716    3080201   1   0.0  0.0  0.0
717    *
718    *
719    *
720    *
721    *
722    *    CONNECTION  TO MAIN LINE AT ELEV. 672'-6"
723    *
724    *
725    8010000   "12-BRANC1"   BRANCH
726    8010001   0
727    8010101   0.77708  0.8334  0.0  0.0 -90.  -0.8334  1.69-4  0.0  00
728    8010200   4   17.7  120.  0.9284  0.0  0.0
729    *
730    8020000   "MAINLINE"  SNGLJUN
731    8020101   801010000  803000000  0.0  0.0  0.0   1000
732    8020201   1   0.0  0.0  0.0
733    *
734    8030000   "MAINLINE"  SNGLVOL
735    8030101   0.77708  0.8334  0.0  0.0 -90.  -0.8334  1.69-4  0.0  00
736    8030200   4  17.7  120.  0.9284  0.0  0.0
737    *
738    *    CONNECTION TO MAIN LINE AT ELEV. 670'-10"
739    *
740    *
741    8040000   "MAINLINE"  SNGLJUN
742    8040101   803010000  805000000  0.0  0.0  0.0   1000
743    8040201   1   0.0  0.0  0.0
744    *
745    2080000   "CON.2"   SNGLJUN
746    2080101   207010000  805000000  0.0  0.1560  0.1560   1000
747    2080201   1   0.0  0.0  0.0
748    *
749    8050000   "MAINBR.3"  BRANCH
750    8050001   0
751    8050101   0.77708  0.8334 0.0 0.0 -90.  -0.8334  1.69-4  0.0  00
752    8050200   4   17.7  120.  0.9284  0.0  0.0
```


TELEDYNE ENGINEERING SERVICES

```
753   *
754   8060000  "MAINLINE"  SNGLJUN
755   8060101  805010000  807000000  0.0  0.0  0.0  1000
756   8060201  1  0.0  0.0  0.0
757   *
758   8070000  "MAINLINE"  SNGLVOL
759   8070101  0.77708  0.8334  0.0  0.0 -90.  -0.8334  1.69-4  0.0  00
760   8070200  4  17.7  120.  0.9284  0.0  0.0
781   *
762   *
763   *   CONNECTION TO MAIN LINE AT ELEV. 669'-2"
764   *
765   *
766   *
767   8080000  "MAINLINE"  SNGLJUN
768   8080101  807010000  809000000  0.0  0.0  0.0  1000
769   8080201  1  0.0  0.0  0.0
770   *
771   1080000  "CON.3"  SNGLJUN
772   1080101  107010000  809000000  0.0  0.1560  0.1560  1000
773   1080201  1  0.0  0.0  0.0
774   *
775   8090000  "MAINBR4"  BRANCH
776   8090001  0
777   8090101  0.77708  0.8334  0.0 0.0 -90. -0.8334  1.69-4  0.0  00
778   8090200  4  17.7  120.  0.9284 0.0  0.0
779   *
780   8100000  "MAINLINE"  SNGLJUN
781   8100101  809010000  811000000  0.0  0.0  0.0  1000
782   8100201  1  0.0  0.0  0.0
783   *
784   *
785   8110000  "MAINLINE"  PIPE
786   *
787   8110001          97
788   *
789   8110101  0.77708  97
790   *
791   8110301  1.0149  14
792   8110302  0.5303  18
793   8110303  0.5  22
794   8110304  0.5303  26
795   8110305  0.9908  56
796   8110306  0.5  64
797   8110307  0.8750  72
798   8110308  0.5104  80
799   8110309  0.5000  88
800   8110310  1.0556  97
801   *
802   8110401  0.0  97
803   *
804   8110601  -90.  14
805   8110602  -45.  18
806   8110603  -90.  22
807   8110604  -45.  26
808   8110605  -90.  56
809   8110606  0.0  80
810   8110607  -90.  88
```


TELEDYNE ENGINEERING SERVICES

```
  811    8110608   0.0          97
  812    *
  813    8110801   1.69-4    0.   97
  814    *
  815    8110901   0.0          0.0          13
  816    8110902   0.078        0.078        14
  817    8110903   0.0          0.0          17
  818    8110904   0.078        0.078        18
  819    8110905   0.0          0.0          21
  820    8110906   0.078        0.078        22
  821    8110907   0.0          0.0          25
  822    8110908   0.078        0.078        26
  823    8110909   0.0          0.0          55
  824    8110910   0.156        0.156        56
  825    8110911   0.0          0.0          63
  826    8110912   0.026        0.026        64
  827    8110913   0.0          0.0          71
  828    8110914   0.13         0.13         72
  829    8110915   0.0          0.0          79
  830    8110916   0.156        0.156        80
  831    8110917   0.0          0.0          87
  832    8110918   0.156        0.156        88
  833    8110919   0.0          0.0          96
  834    *
  835    8111001   00           97
  836    *
  837    8111101   1000         96
  838    *
  839    8111201   4  17.7  120.  0.9298  0.0      97
  840    *
  841    8111300   1
  842    8111301   0.0  0.0  0.0    96
  843    *
  844    *
  845    8120000   "MAINDISC"  SNGLJUN
  846    8120101   811010000  813000000  0.0  0.156  0.156  1000
  847    8120201   1  0.0  0.0  0.0
  848    *
  849    8130000   "MAINLINE"  PIPE
  850    *
  851    8130001              26
  852    *
  853    8130101   0.77708    26
  854    *
  855    8130301   1.0          14
  856    8130302   0.5        24
  857    8130303   1.20833      26
  858    *
  859    8130401   0.0          26
  860    *
  861    8130601   0.0          24
  862    8130602   -90.         26
  863    *
  864    8130801   1.69-4    0.   26
  865    *
  866    8130901   0.0          0.0          13
  867    8130902   0.156        0.156        14
  868    8130903   0.0          0.0          23
```

```
8130904   0.158     0.158     24
8130905   0.0       0.0       25
*
8131001   00        26
*
8131101   1000      25
*
8131201   4  17.7  120.  0.9284 0.0  28
*
8131300   1
8131301   0.0  0.0  0.0       25
*
*
*
*****************************************
*     QUENCH TANK                       *
*****************************************
*
*
*
9770000   "QTANK-IN"  SNGLJUN
9770101   813010000  978000000  0.  0.  0.    1000
9770201   1    0.  0.   0.
*
*    SPARGER  12 IN SCH40  PIPE
*
9780000   "SPARGER"  PIPE
*    NO OF VOLUMES
9780001   18
*    FLOW AREA
9780101   0.7773    18
*    VOL. LENGTHS
9780301   1.125     2
9780302   1.1333    7
9780303   1.0       18
*    VOL. VOLS.
9780401   0.0       18
*
*    VERTICAL ANGLES
9780601   -90.      7
9780602   0.0       18
*    PIPE  ROUGHNESS
9780801   1.69-4    0.0       18
*    JUNCTION  LOSS COEFF.
9780901   0.0       0.0       6
9780902   0.158     0.158     7
9780903   0.0       0.0       17
*    VOL. CONTROL FLAG
9781001   00        18
*    JUN. CONTROL FLAG
9781101   1000      17
*    INITIAL COND.
9781201   4    17.7   120.    0.9284    0.   2
9781202   3    17.7   120.    0.0       0.   18
*         JUN. INITIAL COND.
9781300   1
9781301   0.0  0.0  0.0       17
*    SPARGER   EXIT
```

```
9790000 "EXIT" SNGLJUN
9790101  978010000  980000000    0.0    1.0    1.0      1100
9790201  1    0.     0.     0.
*        QUENCH TANK
*
*        WATER  VOL.
9800000  "QT. WATER" SNGLVOL
9800101  260.4708   5.6667   0.0    0.0    90.   5.6667  0.003  0.0    01
9800200  3    17.7      120.
*        INTERFACE
9810000  "INTERFACE"  SNGLJUN
9810101  980010000  982000000   0.0    0.0    0.0    1000
9810201  1    0.0  0.0  0.0
*        AIR  VOLUME
9820000  "QT.AIR"  SNGLVOL
9820101  260.4706  1.2439    0.0    0.0    90.    1.2439  0.003  0.0  01
9820200  4    17.7   120.     0.9284
*
*        RUPTURE DISC
9830000  "RUP.DISC"  VALVE
9830101  982010000   999000000      1.77  0.   0.    1100
9830201  1    0.    0.    0.
9830300  TRPVLV
9830301  515       *     VALVE OPENING TRIP
*
*
*****************************************
*    PIPE OUTSIDE ENVIROMENT            *
*****************************************
*
*
9990000   "ATMOSPHERE"    TMDPVOL
9990101   10000.     10000.     0.0  0.0  0.0  0.0  .00001  0.0  11
9990200   4
9990201   0.0  17.7  120.  0.9284
*
*
*****************************************
*  PLOT CARDS                           *
*****************************************
*
*
*
20300100  MFLOWJ  410000000
20300200  MFLOWJ  510000000
20300300  MFLOWJ  610000000
20300400  MFLOWJ  402000000
20300500  MFLOWJ  811140000
20300600  MFLOWJ  811570000
20300700  MFLOWJ  308000000
20300800  MFLOWJ  208000000
20300900  MFLOWJ  108000000
*
20301000  QUALS  411010000
20301100  QUALS  511010000
20301200  QUALS  611010000
20301300  QUALS  409240000
20301400  QUALS  509100000
```


TELEDYNE ENGINEERING SERVICES

```
  985   20301500  QUALS  609090000
  986   20301600  QUALS  401280000
  987   20301700  QUALS  811140000
  988   20301800  QUALS  811570000
  989   20301900  QUALS  307010000
  990   20302000  QUALS  307180000
  991   20302100  QUALS  207010000
  992   20302200  QUALS  207260000
  993   20302300  QUALS  107010000
  994   20302400  QUALS  107330000
  995   *
  996   20302500  P      411010000
  997   20302600  P      511010000
  998   20302700  P      611010000
  999   20302800  P      409240000
 1000   20302900  P      509100000
 1001   20303000  P      609090000
 1002   20303100  P      401280000
 1003   20303200  P      811140000
 1004   20303200  P      811570000
        CARD ABOVE IS REPLACEMENT CARD.
 1005   20303400  P      307010000
 1006   20303500  P      307180000
 1007   20303600  P      207010000
 1008   20303700  P      207260000
 1009   20303800  P      107010000
 1010   20303900  P      107330000
 1011   *
 1012   *
 1013   *
 1014   *
 1015   . END OF CASE
```

4.9.4 PORV Solid 400° Liquid Restart

LISTING OF INPUT DATA FOR CASE 1

```
    1   =THIS RESTARTS RELAP,3PORVS OPENING ON LOOPSEALS UP/DWN 2 ARCS
    2   *
    3   100  RESTART TRANSNT
    4   101  RUN
    5   *
    6   103 1010
    7   104  NOACTION
    8   201  0.600  1.-7  2.-4  11001  5  50  250
    9   *
   10   *  MINOR EDITS
   11   *
   12   301  MFLOWJ  410000000
   13   302  MFLOWJ  510000000
   14   303  MFLOWJ  610000000
   15   304  MFLOWJ  402000000
   16   305  MFLOWJ  811140000
   17   306  MFLOWJ  811570000
   18   307  MFLOWJ  308000000
   19   308  MFLOWJ  208000000
   20   309  MFLOWJ  108000000
   21   *
   22   310  QUALS  411010000
   23   311  QUALS  511010000
   24   312  QUALS  611010000
   25   313  QUALS  409260000
   26   314  QUALS  509120000
   27   315  QUALS  609110000
   28   316  QUALS  401280000
   29   317  QUALS  811140000
   30   318  QUALS  811570000
   31   319  QUALS  307010000
   32   320  QUALS  307180000
   33   321  QUALS  207010000
   34   322  QUALS  207260000
   35   323  QUALS  107010000
   36   324  QUALS  107330000
   37   *
   38   325  P      411010000
   39   326  P      511010000
   40   327  P      611010000
   41   328  P      409260000
   42   329  P      509120000
   43   330  P      609110000
   44   331  P      401280000
   45   332  P      811140000
   46   333  P      811570000
   47   334  P      307010000
   48   335  P      307180000
   49   336  P      207010000
   50   337  P      207260000
   51   338  P      107010000
   52   339  P      107330000
   53   *
   54   *
   55   *
   56   4000000  "PORV"  SNGLJUN
```

BY CMM DATE 5-13-83

CHKD. BY KJG DATE 5-13-83

TELEDYNE ENGINEERING SERVICES

```
4000101  399000000  401000000  0.0  0.0  0.0  1100
4000201  1  0.0  0.0  0.0
*****************************************
*  FORCE CARDS  FOR REPIPE              *
*****************************************
*
*************************************************************************
* THIS RELAP RUN INCLUDES ENTIRE ARCS 1 AND 3, PORV UPSTREAM AND
* DOWN AS WELL AS THE MAIN HEADER AND SOME DISHCHARGE PIPING
*************************************************************************
*
*
*****ARC-1*****
*
*
2001  5,247,509110000,509120000,609100000,107040000
2002  107050000,107060000,107070000,107080000,107090000
2003  107100000,107110000,107120000,107130000,107140000
2004  107150000,107160000,107170000,107180000,107190000
2005  107200000,107210000,107220000,107230000,107240000
2006  107250000,107260000,107270000,107280000,107290000
2007  107300000,107310000,107320000,107330000
*
*
*****ARC-2*****
*
*
*
*
*****ARC-3*****
*
*
2014  609110000,409250000,409260000,307040000
2015  307050000,307060000,307070000,307080000,307090000
2016  307100000,307110000,307120000,307130000,307140000
2017  307150000,307160000 307170000,307180000
*
*
*
*
***   PORV'S  DOWNSTREAM   ***
*
*
*
2046 611010000,611020000,611030000,611040000,611050000
2047 611060000,611070000,611080000,511010000,511020000
2048 511030000,511040000,511050000,511060000,511070000
2049 511080000,511090000,511100000,511110000,511120000
2050 511130000,511140000,511150000,511160000,511170000
2051 511180000,511190000,513010000,515010000,515020000
2052 515030000,515040000,515050000,515060000,515070000
2053 515080000,515090000,515100000,515110000,515120000
2054 411010000,411020000,411030000,411040000,411050000
2055 411060000,411070000,411080000,411090000,411100000
2056 411110000,411120000,411130000,411140000,411150000
2057 411160000,411170000,411180000,411190000,701010000
2058 703010000
*
```

```
*
*****MAIN DISCHARGE LINE*****
*
*
2018  703020000,703030000,703040000,703050000,703060000
2019  703070000,703080000,703090000,703100000,703110000
2020  703120000,703130000,703140000,801010000,803010000
2021  805010000,807010000
2022  809010000,811010000,811020000,811030000,811040000
2023  811050000,811060000,811070000,811080000,811090000
2024  811100000,811110000,811120000,811130000,811140000
2025  811150000,811160000,811170000,811180000,811190000
2026  811200000,811210000,811220000,811230000,811240000
2027  811250000,811260000,811270000
*
*
***  PORV UPSTREAM  ***
*
*
2028  399010000,401010000,401020000,401030000,401040000
2029  401050000,401060000,401070000,401080000,401090000
2030  401100000,401110000,401120000,401130000,401140000
2031  401150000,401160000,401170000,401180000,401190000
2032  401200000,401210000,401220000,401230000,401240000
2033  401250000,401260000,401270000,401280000,403010000
2034  405010000,405020000,405030000,405040000,405050000
2035  405060000,405070000,405080000,405090000,405100000
2036  405110000,405120000,405130000,405140000,405150000
2037  405160000,407010000,409010000,409020000,409030000
2038  409040000,409050000,409060000,409070000,409080000
2039  409090000,409100000,409110000,409120000,409130000
2040  409140000,409150000,409160000,409170000,409180000
2041  409190000,409200000,409210000,409220000,409230000
2042  409240000,809010000,809020000,809030000,809040000
2043  809050000,809060000,809070000,809080000,809090000
2044  509010000,509020000,509030000,509040000,509050000
2045  509060000,509070000,509080000,509090000,509100000
*
*
*****************************************
*  PLOT CARDS                           *
*****************************************
*
*
*
20300100  MFLOWJ  410000000
20300200  MFLOWJ  510000000
20300300  MFLOWJ  610000000
20300400  MFLOWJ  402000000
20300500  MFLOWJ  811140000
20300600  MFLOWJ  811570000
20300700  MFLOWJ  308000000
20300800  MFLOWJ  208000000
20300900  MFLOWJ  108000000
*
20301000  QUALS  411010000
20301100  QUALS  511010000
20301200  QUALS  611010000
```

```
   173    20301300  QUALS   409240000
   174    20301400  QUALS   509100000
   175    20301500  QUALS   609090000
   176    20301600  QUALS   401280000
   177    20301700  QUALS   811140000
   178    20301800  QUALS   811570000
   179    20301900  QUALS   307010000
   180    20302000  QUALS   307180000
   181    20302100  QUALS   207010000
   182    20302200  QUALS   207260000
   183    20302300  QUALS   107010000
   184    20302400  QUALS   107330000
   185    *
   186    20302500  P       411010000
   187    20302600  P       511010000
   188    20302700  P       611010000
   189    20302800  P       409240000
   190    20302900  P       509100000
   191    20303000  P       609090000
   192    20303100  P       401280000
   193    20303200  P       811140000
   194    20303300  P       811570000
   195    20303400  P       307010000
   196    20303500  P       307180000
   197    20303600  P       207010000
   198    20303700  P       207260000
   199    20303800  P       107010000
   200    20303900  P       107330000
   201    *
   202    *
   203    *
   204    *
   205    . END OF CASE
```

4.9.5 SV Cold Loop Seal (Quarter Model)

LISTING OF INPUT DATA FOR CASE 1

```
    1  =AEP UNIT2  1 LINE  RELAP5
    2  100 NEW TRANSNT
    3  101 RUN
    4  102 BRITISH BRITISH
    5  104 NOACTION
    6  * TIME STEP CONTROL
    7  *
    8  201  0.6000  1.0-7  2.0-4  11001  5  25  250
    9  * MINOR EDITS
   10  *
   11  301  QUALS  007010000
   12  302  QUALS  005200000
   13  303  QUALS  013200000
   14  304  P      005200000
   15  305  P      007010000
   16  306  P      007380000
   17  307  MFLOWJ 006000000
   18  308  MFLOWJ 005070000
   19  309  MFLOWJ 014000000
   20  310  P      007140000
   21  311  P      011560000
   22  312  P      013300000
   23  313  MFLOWJ 007140000
   24  314  MFLOWJ 007380000
   25  315  MFLOWJ 011560000
   26  *
   27  *
   28  2001  5,192,001010000,003010000,005010000
   29  2002  005020000,005030000,005040000,005050000,005060000
   30  2003  005070000,005080000,005090000,005100000,005110000
   31  2004  005120000,005130000,005140000,005150000,005160000
   32  2005  005170000,005180000,005190000,005200000,007010000
   33  2006  007020000,007030000,007040000,007050000,007060000,007070000
   34  2007  007080000,007090000,007100000,007110000,007120000
   35  2008  007130000,007140000,007150000,007160000,007170000
   36  2009  007180000,007190000,007200000,007210000,007220000
   37  2010  007230000,007240000,007250000,007260000,007270000
   38  2011  007280000,007290000,007300000,007310000,007320000
   39  2012  007330000,007340000,007350000,007360000,007370000
   40  2013  007380000,007390000,009010000,011010000,011020000
   41  2014  011030000,011040000,011050000,011060000,011070000
   42  2015  011080000,011090000,011100000,011110000,011120000
   43  2016  011130000,011140000,011150000,011160000,011170000
   44  2017  011180000,011190000,011200000,011210000,011220000
   45  2018  011230000,011240000,011250000,011260000,011270000
   46  2019  011280000,011290000,011300000,011310000,011320000
   47  2020  011330000,011340000,011350000,011360000,011370000
   48  2021  011380000,011390000,011400000,011410000,011420000
   49  2022  011430000,011440000,011450000,011460000,011470000
   50  2023  011480000,011490000,011500000,011510000,011520000
   51  2024  011530000,011540000,011550000,011560000,011570000
   52  2025  011580000,011590000,011600000,011610000,011620000
   53  2026  011630000,011640000,011650000,011660000,011670000
   54  2027  011680000,011690000,011700000,011710000,011720000
   55  2028  011730000,011740000,011750000,011760000,011770000
   56  2029  011780000,011790000,011800000,011810000,011820000
```

BY CMM DATE 2-9-83
CHKD. BY LPS DATE 2-9-83

Technical Report TR-5364-1 Revision 0
TELEDYNE ENGINEERING SERVICES

```
    2030  011830000,011840000,011850000,011860000,011870000
    2031  011880000,011890000,011900000,011910000,011920000
    2032  011930000,011940000,011950000,011960000,011970000
    2033  011980000,011990000,013010000,013020000,013030000
    2034  013040000,013050000,013060000,013070000,013080000
    2035  013090000,013100000,013110000,013120000,013130000
    2036  013140000,013150000,013160000,013170000,013180000
    2037  013190000,013200000,013210000,013220000,013230000
    2038  013240000,013250000,013260000,013270000,013280000
    2039  013290000,013300000,015010000
*
*TRIPS
*
502  TIME  0  GT NULL 0  1.500  L  * J08 TERMINATION TRIP
503  TIME  0  GE NULL 0  0.0    L  *  VALVE OPEN
504  TIME  0  GE  NULL  0  5.0  L  *  VALVE CLOSED
600  502
*
* HYDRODYNAMIC COMPONENTS
*
*
* PRESSURIZER
*
0010000  "PRESS1"  TMDPVOL
0010101  0.0  20.0  500.0  0.0  0.0  0.0  0.00005  0.0  11
0010200  2
0010201  0.0  2500.0  1.0  0.1  2514.0  1.0  0.3  2555.0  1.0  0.5  2600.0  1.0
0010202  0.7  2667.0  1.0  0.9  2700.0  1.0  1.1  2740.0  1.0  1.3  2745.0  1.0
0010203  1.5  2747.0  1.0  1.7  2748.0  1.0  1.9  2750.0  1.0  2.0  2750.0  1.0
0010204  2.5  2750.0  1.0
*
*  LOOP SEAL GEOMETRY
*
0020000  "LPSL"  SNGLJUN
0020101  001000000  003000000  0.0  0.0  0.0  1000  * THIS IS A SHORT RADIUS ELBOW LEAVING
0020201  1  0.0  0.0  0.0
*
0030000  "LPSL" SNGLVOL
0030101  0.1465  1.0  0.0  90.0  0.0  0.0  0.000151  0.0  00
0030200    2  2500.0  1.0
*
0040000  "LPSL"  SNGLJUN
0040101  003010000  005000000  0.0  0.1838  0.1838  1000
0040201  1  0.0  0.0  0.0
*
0050000  "LPSL"  PIPE
0050001  20
0050101  0.1465  20
0050301  0.50  10
0050302  0.574  20
0050401  0.0  20
0050601  -90.0  7
0050602  0.0  10
0050603  90.0  20
0050801  0.000151  0.0  20
0050901  0.0  0.0  8
0050902  0.1838  0.1838  7
0050903  0.0  0.0  8
```


Technical Report TR-5364-1 Revision 0
TELEDYNE ENGINEERING SERVICES

```
0050904  0.1838  0.1838  10
0050905  0.0  0.0  19
0051001  00  20
0051101  1000  19
0051201  3  2500.0  584.4  0.0  0.0  1
0051202  3  2500.0  451.1  0.0  0.0  2
0051203  3  2500.0  352.1  0.0  0.0  3
0051204  3  2500.0  276.8  0.0  0.0  4
0051205  3  2500.0  218.1  0.0  0.0  5
0051206  3  2500.0  169.3  0.0  0.0  8
0051207  3  2500.0  141.1  0.0  0.0  20
0051300  1
0051301  0.0  0.0  0.0  19
*
*****************************
*  VALVE  6M6  CROSBY SAFETY
*****************************
0060000  "SRV"  VALVE
0060101  005010000  007000000  0.022  0.0  0.0  0100
0060201  1  0.0  0.0  0.0
0060300  MTRVLV
0060301  503  504  100.0  0.0  *  CROSBY 6M6  OPENING IN 10 MSEC
*
*  DISCHARBE PIPING
0070000  "DISCHA1"  PIPE
0070001  39
0070101  0.20069  39
0070301  0.528  4
0070302  1.094  14
* ARC STARTS HERE LEVEL 669-2"
0070303  0.94167  17
0070304  0.942  20
0070305  0.8425  23
0070306  0.844  26
0070307  0.8433  29
0070308  0.8333  32
0070309  0.8333  35
* ARC ENDS
0070310  0.91750  39
0070401  0.0  39
0070601  0.0  4
0070602  -90.0  14
0070603  0.0  39
0070801  0.000152  0.0  39
0070901  0.0  0.0  3
0070902  0.1800  0.1800  4
0070903  0.0  0.0  13
0070904  0.1800  0.1800  14
0070905  0.0  0.0  38
0071001  00  39
0071101  1000  38
0071201  4  14.7  120.0  0.9284  0.0  39
0071300  1
0071301  0.0  0.0  0.0  38
*
0080000  "DISCHA1"  SNGLJUN
0080101  007010000  008000000  0.0  0.1560  0.1560  1000  *LOSSES FOR A 12 IN ELBOW
0080201  1  0.0  0.0  0.0
```


TELEDYNE ENGINEERING SERVICES

COPI

```
*
* INPUT A BRANCH HERE FOR A COMPLETE MODEL
*
0090000  "DISCHA1"  SNGLVOL
0090101  0.7771  0.5  0.0  0.0  -90.0  -0.5  0.000169  0.0  00
0090200  4  14.7  120.0  0.9284
*
0100000  "DISCHA1"  SNGLJUN
0100101  009010000  011000000  0.0  0.0  0.0  1000
0100201  1  0.0  0.0  0.0
*
0110000  "DISCH1A"  PIPE
0110001  99
0110101  0.7771  99
0110301  1.039  14
0110302  0.53025  18
0110303  0.5  22
0110304  0.53025  28
0110305  0.9875  58
0110306  0.475  68
0110307  0.49359  79
0110308  0.46875  87
0110309  0.51172  95
0110310  0.95  99
0110401  0.0  99
0110601  -90.0  14
0110602  -45.0  18
0110603  -90.0  22
0110604  -45.0  28
0110605  -90.0  58
0110606  0.0  87
0110607  -90.0  95
0110608  0.0  99
0110801  0.000169  0.0  89
0110901  0.0  0.0  13
0110902  0.078  0.078  14
0110903  0.0  0.0  17
0110904  0.078  0.078  18
0110905  0.0  0.0  21
0110906  0.078  0.078  22
0110907  0.0  0.0  25
0110908  0.078  0.078  26
0110909  0.0  0.0  55
0110910  0.156  0.156  56
0110911  0.0  0.0  65
0110912  0.156  0.156  66
0110913  0.0  0.0  78
0110914  0.156  0.156  78
0110915  0.0  0.0  86
0110916  0.156  0.156  87
0110917  0.0  0.0  94
0110918  0.156  0.156  95
0110919  0.0  0.0  98
0111001  00  99
0111101  1000  98
0111201  4  14.7  120.0  0.9284  0.0  99
0111300  1
0111301  0.0  0.0  0.0  98
```

```
231   *
232   0120000  "DISCHA1"  SNGLJUN
233   0120101  011010000  013000000  0.0  0.0  0.0  1000
234   0120201  1  0.0  0.0  0.0
235   *
236   0130000  "DISCHA1" PIPE
237   0130001  30
238   0130101  0.7771  30
239   0130301  0.95  8
240   0130302  1.0  20
241   0130303  0.5  30
242   0130401  0.0  30
243   0130601  0.0  30
244   0130801  0.000169  0.0  30
245   0130901  0.0  0.0  5
246   0130902  0.156  0.156  8
247   0130903  0.0  0.0  19
248   0130904  0.156  0.156  20
249   0130905  0.0  0.0  29
250   0131001  00  30
251   0131101  1000  29
252   0131201  4  14.7  120.0  0.9284  0.0  30
253   0131300  1
254   0131301  0.0  0.0  0.0  29
255   *
256   0140000  "DISCH1A"  SNGLJUN
257   0140101  013010000  015000000  0.0  0.0  0.0  0100
258   0140201  1  0.0  0.0  0.0
259   *
260   0150000  "ATMOS"  TMDPVOL
261   0150101  10000.0  10000.0  0.0  0.0  0.0  0.0  0.00001  0.0  11
262   0150200  4
263   0150201  0.0  14.7  120.0  0.9284
264   *
265   * PLOT CARDS
266   *
267   20300100  QUALS  007010000
268   20300200  QUALS  005200000
269   20300300  QUALS  013200000
270   20300400  P      005200000
271   20300500  P      007010000
272   20300600  P      007380000
273   20300700  MFLOWJ 008000000
274   20300800  MFLOWJ 005070000
275   20300900  MFLOWJ 014000000
276   20301000  P    007140000
277   20301100  P    011560000
278   20301200  P    013300000
279   20301300  MFLOWJ  007140000
280   20301400   MFLOWJ  007380000
281   20301500  MFLOWJ  011560000
282   .END OF CASE
```

4.10 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 1 PORV model, it was necessary to break up the model in two sections because of REPIPE's size limitations.

Input Set	Model Section	Unit
4.10.1	A	1
4.10.2	B	1
4.10.3	-	2 (Quarter Model)

4.10.1 Unit 1 - Model Section A

```
$PIPES
INLINE=10,KBLOCK=280,KPIPE=10,KPLOT(1)=1,KWAVE=1,
KPRINT=-1,KPNV=1,KSTEP=3,
NDROPV=399010000,811270000,307040000,107040000,805010000,611010000,
511010000,411010000,609110000,509120000,409260000$
 112     107040000  0.      -1.0     0./
 112     107050000  0.      -1.0     0./
 112     107060000  0.      -1.0     0./
 112     107070000  0.      -1.0     0./
 112     107080000  0.      -1.0     0./
 112     107090000  0.      -1.0     0./
 112     107100000  0.      -1.0     0./
 112     107110000  0.      -1.0     0./
 112     107120000  0.      -1.0     0./
 112     107130000  0.      -1.0     0./
 112     107140000  0.      -1.0     0./
 108    -107050000  0.      -1.0     0./
 108    -107060000  0.      -1.0     0./
 108    -107070000  0.      -1.0     0./
 108    -107080000  0.      -1.0     0./
 108    -107090000  0.      -1.0     0./
 108    -107100000  0.      -1.0     0./
 108    -107110000  0.      -1.0     0./
 108    -107120000  0.      -1.0     0./
 108    -107130000  0.      -1.0     0./
 108    -107140000  0.      -1.0     0./
 108    -107150000  0.      -1.0     0./
 104     107150000  0.7723  0.       0.6353/
 104     107160000  0.7723  0.       0.6353/
 104     107170000  0.7723  0.       0.6353/
10301   -107160000  0.7723  0.       0.6353/
10301   -107170000  0.7723  0.       0.6353/
10301   -107180000  0.7723  0.       0.6353/
10302    107180000  0.9948  0.       0.1018/
10302    107190000  0.9948  0.       0.1018/
10302    107200000  0.9948  0.       0.1018/
10201   -107190000  0.9948  0.       0.1018/
10201   -107200000  0.9948  0.       0.1018/
10201   -107210000  0.9948  0.       0.1018/
10202    107210000  0.8945  0.      -0.4470/
10202    107220000  0.8945  0.      -0.4470/
10202    107230000  0.8945  0.      -0.4470/
10001   -107220000  0.8945  0.      -0.4470/
10001   -107230000  0.8945  0.      -0.4470/
10001   -107240000  0.8945  0.      -0.4470/
10002    107240000  0.8454  0.      -0.5342/
10002    107250000  0.8454  0.      -0.5342/
10002    107260000  0.8454  0.      -0.5342/
 9901   -107250000  0.8454  0.      -0.5342/
 9901   -107260000  0.8454  0.      -0.5342/
 9901   -107270000  0.8454  0.      -0.5342/
 9902    107270000  0.0195  0.      -0.9998/
 9902    107280000  0.0195  0.      -0.998/
 9902    107290000  0.0195  0.      -0.998/
 9801   -107280000  0.0195  0.      -0.998/
 9801   -107290000  0.0195  0.      -0.998/
 9801   -107300000  0.0195  0.      -0.998/
 9802    107300000 -0.2497  0.      -0.9683/
 9802    107310000 -0.2497  0.      -0.9683/
 9802    107320000 -0.2497  0.      -0.9683/
```

BY CHM DATE 4-26-83

CHKD. BY MR DATE 4-26-83

TELEDYNE ENGINEERING SERVICES

```
97  -107310000  -0.2497   0.    -0.9683/
97  -107320000  -0.2497   0.    -0.9683/
97  -108000000  -0.2497   0.    -0.9683/
222    307040000    0.      -1.0     0./
222    307050000    0.      -1.0     0./
222    307060000    0.      -1.0     0./
222    307070000    0.      -1.0     0./
222    307080000    0.      -1.0     0./
222    307090000    0.      -1.0     0./
222    307100000    0.      -1.0     0./
222    307110000    0.      -1.0     0./
216   -307050000    0.      -1.0     0./
216   -307060000    0.      -1.0     0./
216   -307070000    0.      -1.0     0./
216   -307080000    0.      -1.0     0./
216   -307090000    0.      -1.0     0./
216   -307100000    0.      -1.0     0./
216   -307110000    0.      -1.0     0./
216   -307120000    0.      -1.0     0./
214    307120000   0.0047   0.    -0.99999/
214    307130000   0.0047   0.    -0.99999/
214    307140000   0.0047   0.    -0.99999/
20801   -307130000   0.0047   0.    -0.99999/
20801   -307140000   0.0047   0.    -0.99999/
20801   -307150000   0.0047   0.    -0.99999/
20802    307150000  -0.2497   0.    -0.9683/
20802    307160000  -0.2497   0.    -0.9683/
20802    307170000  -0.2497   0.    -0.9683/
208     -307160000  -0.2497   0.    -0.9683/
208     -307170000  -0.2497   0.    -0.9683/
208     -308000000  -0.2497   0.    -0.9683/
285      703010000    0.      -1.0     0./
285      703020000    0.      -1.0     0./
285      703030000    0.      -1.0     0./
285      703040000    0.      -1.0     0./
285      703050000    0.      -1.0     0./
285      703060000    0.      -1.0     0./
285      703070000    0.      -1.0     0./
285      703080000    0.      -1.0     0./
285      703090000    0.      -1.0     0./
285      703100000    0.      -1.0     0./
285      703110000    0.      -1.0     0./
260      703120000    0.      -1.0     0./
260      703130000    0.      -1.0     0./
260      704000000    0.      -1.0     0./
260      802000000    0.      -1.0     0./
260      804000000  0.0   -1.0   0.0/
260      806000000  0.0   -1.0   0.0/
260      808000000    0.      -1.0     0./
260      810000000    0.      -1.0     0./
260      811010000    0.      -1.0     0./
260      811020000    0.      -1.0     0./
260      811030000    0.      -1.0     0./
260      811040000    0.      -1.0     0./
260      811050000    0.      -1.0     0./
260      811060000    0.      -1.0     0./
260      811070000    0.      -1.0     0./
260      811080000    0.      -1.0     0./
260      811090000    0.      -1.0     0./
260      811100000    0.      -1.0     0./
```


TELEDYNE ENGINEERING SERVICES

```
750   401010000   0.6890   0.7071   -0.1591/
750   401020000   0.6890   0.7071   -0.1591/
750   401030000   0.6890   0.7071   -0.1591/
725  -401010000   0.6890   0.7071   -0.1591/
725  -401020000   0.6890   0.7071   -0.1591/
725  -401030000   0.6890   0.7071   -0.1591/
725  -401040000   0.6890   0.7071   -0.1591/
720   401040000   0.0      1.0      0.0/
720   401050000   0.0      1.0      0.0/
720   401060000   0.0      1.0      0.0/
720   401070000   0.0      1.0      0.0/
720   401080000   0.0      1.0      0.0/
720   401090000   0.0      1.0      0.0/
720   401100000   0.0      1.0      0.0/
720   401110000   0.0      1.0      0.0/
715  -401050000   0.0      1.0      0.0/
715  -401060000   0.0      1.0      0.0/
715  -401070000   0.0      1.0      0.0/
715  -401080000   0.0      1.0      0.0/
715  -401090000   0.0      1.0      0.0/
715  -401100000   0.0      1.0      0.0/
715  -401110000   0.0      1.0      0.0/
715  -401120000   0.0      1.0      0.0/
710   401120000   1.0      0.0      0.0/
710   401130000   1.0      0.0      0.0/
710   401140000   1.0      0.0      0.0/
710   401150000   1.0      0.0      0.0/
710   401160000   1.0      0.0      0.0/
710   401170000   1.0      0.0      0.0/
710   401180000   1.0      0.0      0.0/
700  -401130000   1.0      0.0      0.0/
700  -401140000   1.0      0.0      0.0/
700  -401150000   1.0      0.0      0.0/
700  -401160000   1.0      0.0      0.0/
700  -401170000   1.0      0.0      0.0/
700  -401180000   1.0      0.0      0.0/
700  -401190000   1.0      0.0      0.0/
690   401190000   0.0      1.0      0.0/
690   401200000   0.0      1.0      0.0/
690   401210000   0.0      1.0      0.0/
690   401220000   0.0      1.0      0.0/
690   401230000   0.0      1.0      0.0/
690   401240000   0.0      1.0      0.0/
690   401250000   0.0      1.0      0.0/
690   401260000   0.0      1.0      0.0/
675  -401200000   0.0      1.0      0.0/
675   -401210000  0.0      1.0      0.0/
675  -401220000   0.0      1.0      0.0/
675   -401230000  0.0      1.0      0.0/
675   -401240000  0.0      1.0      0.0/
675   -401250000  0.0      1.0      0.0/
675   -401260000  0.0      1.0      0.0/
675   -401270000  0.0      1.0      0.0/
670   401270000  -0.935    0.0     -0.3561/
670   402000000  -0.935    0.0     -0.3561/
670   404000000  -0.935    0.0     -0.3561/
595  -402000000  -0.935    0.0     -0.3561/
595  -404000000  -0.935    0.0     -0.3561/
595  -405010000  -0.935    0.0     -0.3561/
8951  405010000  -.9994    0.0     -.0341/
```


TELEDYNE
ENGINEERING SERVICES

```
260       811110000     0.       -1.0      0./
260       811120000     0.       -1.0      0./
260       811130000     0.       -1.0      0./
2601       -703020000     0.       -1.0      0./
2601       -703030000     0.       -1.0      0./
2601       -703040000     0.       -1.0      0./
2601       -703050000     0.       -1.0      0./
2601       -703060000     0.       -1.0      0./
2601       -703070000     0.       -1.0      0./
2601       -703080000     0.       -1.0      0./
2601       -703090000     0.       -1.0      0./
2601       -703100000     0.       -1.0      0./
2601       -703110000     0.       -1.0      0./
2601       -703120000     0.       -1.0      0./
90       -703130000     0.       -1.0      0./
90       -704000000     0.       -1.0      0./
90       -802000000     0.       -1.0      0./
90       -804000000   0.0    -1.0   0.0/
90       -805000000   0.0    -1.0   0.0/
90       -808000000     0.       -1.0      0./
90       -810000000     0.       -1.0      0./
90       -811010000     0.       -1.0      0./
90       -811020000     0.       -1.0      0./
90       -811030000     0.       -1.0      0./
90       -811040000     0.       -1.0      0./
90       -811050000     0.       -1.0      0./
90       -811060000     0.       -1.0      0./
90       -811070000     0.       -1.0      0./
90       -811080000     0.       -1.0      0./
90       -811090000     0.       -1.0      0./
90       -811100000     0.       -1.0      0./
90       -811110000     0.       -1.0      0./
90       -811120000     0.       -1.0      0./
90       -811130000     0.       -1.0      0./
90       -811140000     0.       -1.0      0./
88        811140000    -0.6667   -0.7071    0.2356/
88        811150000    -0.6667   -0.7071    0.2356/
88        811160000    -0.6667   -0.7071    0.2356/
88        811170000    -0.6667   -0.7071    0.2356/
86      -811150000    -0.6667   -0.7071    0.2356/
86      -811160000    -0.6667   -0.7071    0.2356/
86      -811170000    -0.6667   -0.7071    0.2356/
86      -811180000    -0.6667   -0.7071    0.2356/
84        811180000     0.       -1.0       0./
84        811190000     0.       -1.0       0./
84        811200000     0.       -1.0       0./
84        811210000     0.       -1.0       0./
82      -811190000     0.       -1.0       0./
82      -811200000     0.       -1.0       0./
82      -811210000     0.       -1.0       0./
82      -811220000     0.       -1.0       0./
80        811220000    -0.2356   -0.7071   -0.6667/
80        811230000    -0.2356   -0.7071   -0.6667/
80        811240000    -0.2356   -0.7071   -0.6667/
80        811250000    -0.2356   -0.7071   -0.6667/
78      -811230000    -0.2356   -0.7071   -0.6667/
78      -811240000    -0.2356   -0.7071   -0.6667/
78      -811250000    -0.2356   -0.7071   -0.6667/
78      -811260000    -0.2356   -0.7071   -0.6667/
750    400000000   0.6890  0.7071  -0.1591/
```


TELEDYNE
ENGINEERING SERVICES

```
5951  405020000  -.9994     0.0     -.0341/
5951  405030000  -.9994     0.0     -.0341/
590  -405020000  -.9994     0.0     -.0341/
590  -405030000  -.9994     0.0     -.0341/
590  -405040000  -.9994     0.0     -.0341/
5901  405040000  -.9703     0.0      .2420/
5901  405050000  -.9703     0.0      .2420/
5901  405060000  -.9703     0.0      .2420/
585  -405050000  -.9703     0.0      .2420/
585  -405060000  -.9703     0.0      .2420/
585  -405070000  -.9703     0.0      .2420/
5851  405070000  -.8217     0.0      .570/
5851  405080000  -.8217     0.0      .570/
5851  405090000  -.8217     0.0      .570/
5851  405100000  -.8217     0.0      .570/
5851  405110000  -.8217     0.0      .570/
575  -405080000  -.8217     0.0      .570/
575  -405090000  -.8217     0.0      .570/
575  -405100000  -.8217     0.0      .570/
575  -405110000  -.8217     0.0      .570/
575  -405120000  -.8217     0.0      .570/
5751  405120000  -.4962     0.0      .8682/
5751  405130000  -.4962     0.0      .8682/
5751  405140000  -.4962     0.0      .8682/
5751  405150000  -.4962     0.0      .8682/
5751  406000000  -.4962     0.0      .8682/
435  -405130000  -.4962     0.0      .8682/
435  -405140000  -.4962     0.0      .8682/
435  -405150000  -.4962     0.0      .8682/
435  -406000000  -.4962     0.0      .8682/
435  -408000000  -.4962     0.0      .8682/
4351  408000000  -.24165     0.0     .97036/
440  -409010000  -.24165     0.0     .97036/
4401  409010000  -.1623   0.0   .9867/
450  -409020000  -.1623   0.0   .9867/
4501  409020000  .0623   0.0   .9981/
4501  409030000  .0623   0.0   .9981/
4501  409040000  .0623   0.0   .9981/
4501  409050000  .0623   0.0   .9981/
460  -409030000  .0623   0.0   .9981/
460  -409040000  .0623   0.0   .9981/
460  -409050000  .0623   0.0   .9981/
460  -409060000  .0623   0.0   .9981/
4601  409060000  .4362   0.0   .8999/
4601  409070000  .4362   0.0   .8999/
4801  409080000  .4362   0.0   .8999/
4001  409090000  .4362   0.0   .8999/
465  -409070000  .4362   0.0   .8999/
465  -409080000  .4362   0.0   .8999/
465  -409090000  .4362   0.0   .8999/
465  -409100000  .4362   0.0   .8999/
4651  409100000  .76   0.0   .6500/
4651  409110000  .76   0.0   .6500/
4651  409120000  .76   0.0   .6500/
4651  409130000  .76   0.0   .6500/
475  -409110000  .76   0.0   .6500/
475  -409120000  .76   0.0   .6500/
475  -409130000  .76   0.0   .6500/
475  -409140000  .76   0.0   .6500/
480  409140000  0.9263  -0.044  -.3742/
```

```
480  409150000  0.9263  -0.044  -.3742/
480  409160000  0.9263  -0.044  -.3742/
480  409170000  0.9263  -0.044  -.3742/
480  409180000  0.9263  -0.044  -.3742/
480  409190000  0.9263  -0.044  -.3742/
480  409200000  0.9263  -0.044  -.3742/
480  409210000  0.9263  -0.044  -.3742/
480  409220000  0.9263  -0.044  -.3742/
480  409230000  0.9263  -0.044  -.3742/
480  409240000  0.9263  -0.044  -.3742/
525  411010000  0.9263  -0.044  -.3742/
525  411020000  0.9263  -0.044  -.3742/
525  411030000  0.9263  -0.044  -.3742/
510 -409150000  0.9263  -0.044  -.3742/
510 -409160000  0.9263  -0.044  -.3742/
510 -409170000  0.9263  -0.044  -.3742/
510 -409180000  0.9263  -0.044  -.3742/
510 -409190000  0.9263  -0.044  -.3742/
510 -409200000  0.9263  -0.044  -.3742/
510 -409210000  0.9263  -0.044  -.3742/
510  -409220000  0.9263  -0.044  -.3742/
510  -409230000  0.9263  -0.044  -.3742/
510  -409240000  0.9263  -0.044  -.3742/
510  -409250000  0.9263  -0.044  -.3742/
530  -411020000  0.9263  -0.044  -.3742/
530  -411030000  0.9263  -0.044  -.3742/
530 -411040000  0.9263  -0.044  -.3742/
600      608000000   -0.292     -0.0464     0.9563/
600      609010000   -0.292     -0.0464     0.9563/
665     -609010000   -0.292     -0.0464     0.9563/
665     -609020000   -0.292     -0.0464     0.9563/
660      609020000   -0.9262     -0.0464     0.3742/
660      609030000   -0.9262     -0.0464     0.3742/
660      609040000   -0.9262     -0.0464     0.3742/
660      609050000   -0.9262     -0.0464     0.3742/
660      609060000   -0.9262     -0.0464     0.3742/
660      609070000   -0.9262     -0.0464     0.3742/
660      609080000   -0.9262     -0.0464     0.3742/
680      609090000   -0.9262     -0.0464   0.3742/
625      611010000   -0.9262     -0.0464     0.3742/
625      611020000   -0.9262     -0.0464     0.3742/
625      611030000   -0.9262     -0.0464     0.3742/
635     -609030000   -0.9262     -0.0464     0.3742/
635     -609040000   -0.9262     -0.0464     0.3742/
635     -609050000   -0.9262     -0.0464     0.3742/
635     -609060000   -0.9262     -0.0464     0.3742/
635     -609070000   -0.9262     -0.0464     0.3742/
635     -609080000   -0.9262     -0.0464     0.3742/
635     -609090000   -0.9262     -0.0464   0.3742/
635     -609100000  -0.9262     -0.0464   0.3742/
615     -611020000   -0.9262     -0.0464     0.3742/
615     -611030000   -0.9262     -0.0464     0.3742/
615     -611040000   -0.9262     -0.0464     0.3742/
435      508000000    0.9670  -0.2548  0.0/
435      509010000    0.9670  -0.2548  0.0/
430     -509010000    0.9670  -0.2548  0.0/
430     -509020000    0.9670  -0.2548  0.0/
429      509020000    0.3745    -0.0292     0.9268/
429      509030000    0.3745    -0.0292     0.9268/
429      509040000    0.3745    -0.0292     0.9268/
```


TELEDYNE ENGINEERING SERVICES

```
429     509050000     0.3745     -0.0292        0.9268/
429     509060000     0.3745     -0.0292        0.9268/
429     509070000     0.3745     -0.0292        0.9268/
429     509080000     0.3745     -0.0292        0.9268/
429     509090000     0.3745     -0.0292        0.9268/
429    509100000    0.3745     -0.0292     0.9268/
385     511010000     0.3745     -0.0292        0.9268/
385     511020000     0.3745     -0.0292        0.9268/
400    -509030000     0.3745     -0.0292        0.9268/
400    -509040000     0.3745     -0.0292        0.9268/
400    -509050000     0.3745     -0.0292        0.9268/
400    -509060000     0.3745     -0.0292        0.9268/
400    -509070000     0.3745     -0.0292        0.9268/
400    -509080000     0.3745     -0.0292        0.9268/
400    -509090000     0.3745     -0.0292        0.9268/
400    -509100000   0.3745     -0.0292     0.9268/
400    -509110000   0.3745     -0.0292     0.9268/
380    -511020000     0.3745     -0.0292        0.9268/
380    -511030000     0.3745     -0.0292        0.9268/
610     611040000     0.0 -1.0   0.0/
610     611050000     0.0 -1.0   0.0/
610     611060000     0.0 -1.0   0.0/
610     611070000     0.0 -1.0   0.0/
335    -611050000     0.0 -1.0   0.0/
335    -611060000     0.0 -1.0   0.0/
335    -611070000     0.0 -1.0   0.0/
335    -612000000     0.0 -1.0   0.0/
535     411040000     0.0 -1.0   0.0/
535     411050000     0.0 -1.0   0.0/
535     411060000     0.0 -1.0   0.0/
535     411070000     0.0 -1.0   0.0/
540    -411050000     0.0 -1.0   0.0/
540    -411060000     0.0 -1.0   0.0/
540    -411070000     0.0 -1.0   0.0/
540    -411080000     0.0 -1.0   0.0/
545     411080000     .285   0.0 -.9585/
545     411090000     .285   0.0 -.9585/
545     411100000     .285   0.0 -.9585/
55001  -411090000     .285   0.0 -.9585/
55001  -411100000     .285   0.0 -.9585/
55001  -411110000     .285   0.0 -.9585/
55002   411110000    -.107   0.0 -.9943/
55002   411120000    -.107   0.0 -.9943/
55002   411130000    -.107   0.0 -.9943/
55501  -411120000    -.107   0.0 -.9943/
55501  -411130000    -.107   0.0 -.9943/
55501  -411140000    -.107   0.0 -.9943/
55502   411140000    -.483   0.0 -.876/
55502   411150000    -.483   0.0 -.876/
55502   411160000    -.483   0.0 -.876/
56001  -411150000    -.483   0.0 -.876/
56001  -411160000    -.483   0.0 -.876/
56001  -411170000    -.483   0.0 -.876/
56002   411170000    -.7064   0.0 -.7078/
56002   411180000    -.7064   0.0 -.7078/
295    -411180000    -.7064   0.0 -.7078/
295    -412000000    -.7064   0.0 -.7078/
375     511030000     0.0 -1.0   0.0/
375     511040000     0.0 -1.0   0.0/
375     511050000     0.0 -1.0   0.0/
```

```
375     511060000     0.0 -1.0  0.0/
370    -511040000     0.0 -1.0  0.0/
370    -511050000     0.0 -1.0  0.0/
370    -511060000     0.0 -1.0  0.0/
370    -511070000     0.0 -1.0  0.0/
365     511070000    -.826  0.0 -.563/
365     511080000    -.826  0.0 -.563/
36001  -511080000    -.826  0.0 -.563/
36001  -511090000    -.826  0.0 -.563/
36002   511090000    -.633  0.0 -.7745/
36002   511100000    -.633  0.0 -.7745/
36002   511110000    -.633  0.0 -.7745/
35501  -511100000    -.633  0.0 -.7745/
35501  -511110000    -.633  0.0 -.7745/
35501  -511120000    -.633  0.0 -.7745/
35502   511120000    -.264  0.0 -.967/
35502   511130000    -.264  0.0 -.967/
35502   511140000    -.264  0.0 -.967/
35001  -511130000    -.264  0.0 -.967/
35001  -511140000    -.264  0.0 -.967/
35001  -511150000    -.264  0.0 -.967/
35002   511150000     .169  0.0 -.9856/
35002   511160000     .169  0.0 -.9856/
35002   511170000     .169  0.0 -.9856/
34001  -511160000     .169  0.0 -.9856/
34001  -511170000     .169  0.0 -.9856/
34001  -511180000     .169  0.0 -.9856/
34002   511180000     .415  0.0 -.9099/
33501  -512000000     .415  0.0 -.9099/
33502   512000000     .525  0.0 -.851/
33502  612000000  0.525  0.0  -0.851/
33502   514000000     .525  0.0 -.851/
32501  -514000000     .525  0.0 -.851/
32501  -515010000     .525  0.0 -.851/
32502   515010000     .773  0.0 -.635/
32502   515020000     .773  0.0 -.635/
32502   515030000     .773  0.0 -.635/
32001  -515020000     .773  0.0 -.635/
32001  -515030000     .773  0.0 -.635/
32001  -515040000     .773  0.0 -.635/
32002   515040000     .981  0.0 -.195/
32002   515050000     .981  0.0 -.195/
32002   515060000     .981  0.0 -.195/
31001  -515050000     .981  0.0 -.195/
31001  -515060000     .981  0.0 -.195/
31001  -515070000     .981  0.0 -.195/
31002   515070000     .957  0.0  .290/
31002   515080000     .957  0.0  .290/
31002   515090000     .957  0.0  .290/
30001  -515080000     .957  0.0  .290/
30001  -515090000     .957  0.0  .290/
30001  -515100000     .957  0.0  .290/
30002   515100000     .812  0.0  .583/
30002   515110000     .812  0.0  .583/
295    -515110000     .812  0.0  .583/
295    -516000000     .812  0.0  .583/
2951    516000000  -0.648  0.0  -.761/
2951    412000000  -0.648  0.0  -.761/
2951    702000000  -0.648  0.0  -.761/
290    -702000000  -0.648  0.0  -.761/
```


TELEDYNE
ENGINEERING SERVICES

```
290  -703010000  -0.648  0.0  -.781/
99999/
 $STEPS TSTEP(1)=0.001,1.0$
```

4.10.2 Unit 1 - Model Section B

```
$PIPES
INLINE=3,KBLOCK=200,KPIPE=10,KPLOT(1)=1,KWAVE=1,
KPRINT=-1,KPNV=1,KSTEP=3,
NDROPV=811260000,307050000,107050000,703010000,811150000,
307180000,107330000,811260000,978080000$
115   105000000   0.3498   0.     0.9368/
115    107010000   0.3498   0.     0.9368/
115    107020000   0.3498   0.     0.9368/
115    107030000   0.3498   0.     0.9368/
114   -107010000   0.3498   0.     0.9368/
114    -107020000   0.3498   0.     0.9368/
114    -107030000   0.3498   0.     0.9368/
114    -107040000   0.3498   0.     0.9368/
164    206000000   0.9966   0.     0.0819/
164    207010000   0.9966   0.     0.0819/
164    207020000   0.9966   0.     0.0819/
164    207030000   0.9966   0.     0.0819/
162   -207010000   0.9966   0.     0.0819/
162   -207020000   0.9966   0.     0.0819/
162   -207030000   0.99660  0.     0.0819/
162   -207040000   0.9966   0.     0.0819/
160    207040000   0.       -1.0   0./
160    207050000   0.       -1.0   0./
160    207060000   0.       -1.0   0./
160    207070000   0.       -1.0   0./
160    207080000   0.       -1.0   0./
160    207090000   0.       -1.0   0./
160    207100000   0.       -1.0   0./
160    207110000   0.       -1.0   0./
160    207120000   0.       -1.0   0./
160    207130000   0.       -1.0   0./
152   -207050000   0.       -1.0   0./
152   -207060000   0.       -1.0   0./
152   -207070000   0.       -1.0   0./
152   -207080000   0.       -1.0   0./
152   -207090000   0.       -1.0   0./
152   -207100000   0.       -1.0   0./
152   -207110000   0.       -1.0   0./
152   -207120000   0.       -1.0   0./
152   -207130000   0.       -1.0   0./
152   -207140000   0.       -1.0   0./
150    207140000    0.9202   0.     -0.3915/
150    207150000    0.9202   0.     -0.3915/
150    207160000    0.9202   0.     -0.3915/
14801  -207150000   0.9202   0.     -0.3915/
14801  -207160000   0.9202   0.     -0.3915/
14801  -207170000   0.9202   0.     -0.3915/
14802   207170000   0.5647   0.     -0.8253/
14802   207180000   0.5647   0.     -0.8253/
14802   207190000   0.5647   0.     -0.8253/
14601  -207180000   0.5647   0.     -0.8253/
14601  -207190000   0.5647   0.     -0.8253/
14601   -207200000   0.5647   0.     -0.8253/
14602    207200000   0.0318   0.     -0.9995/
14602    207210000   0.0318   0.     -0.9995/
14602    207220000   0.0318   0.     -0.9995/
14401   -207210000   0.0318   0.     -0.9995/
14401   -207220000   0.0318   0.     -0.9995/
14401   -207230000   0.0318   0.     -0.9995/
14402    207230000  -0.2497   0.     -0.9683/
```

BY CMM DATE 4-26-83

CHKD. BY MIL DATE 4-26-83

```
14402     207240000  -0.2497    0.   -0.9683/
14402     207250000  -0.2497    0.   -0.9683/
142      -207240000  -0.2497    0.   -0.9683/
142      -207250000  -0.2497    0.   -0.9683/
142      -208000000  -0.2497    0.   -0.9683/
224     306000000  -0.4621   0.     -0.8868/
224     307010000  -0.4621   0.     -0.8868/
224     307020000  -0.4621   0.     -0.8868/
224     307030000  -0.4621   0.     -0.8868/
223    -307010000  -0.4621   0.     -0.8868/
223    -307020000  -0.4621   0.     -0.8868/
223    -307030000  -0.4621   0.     -0.8868/
223    -307040000  -0.4621   0.     -0.8868/
285         703010000    0.       -1.0     0./
285         703020000    0.       -1.0     0./
285         703030000    0.       -1.0     0./
285         703040000    0.       -1.0     0./
285         703050000    0.       -1.0     0./
285         703060000    0.       -1.0     0./
285         703070000    0.       -1.0     0./
285         703080000    0.       -1.0     0./
285         703090000    0.       -1.0     0./
285         703100000    0.       -1.0     0./
285         703110000    0.       -1.0     0./
285         703120000    0.       -1.0     0./
285         703130000    0.       -1.0     0./
285         704000000    0.       -1.0     0./
285  308000000  0.0  -1.0  0.0/
285         802000000    0.       -1.0     0./
285         804000000    0.       -1.0     0./
285  208000000  0.0  -1.0  0.0/
285         806000000    0.       -1.0     0./
285         808000000    0.       -1.0     0./
285  108000000  0.0  -1.0  0.0/
285         810000000    0.       -1.0     0./
285         811010000    0.       -1.0     0./
285         811020000    0.       -1.0     0./
285         811030000    0.       -1.0     0./
285         811040000    0.       -1.0     0./
285         811050000    0.       -1.0     0./
285         811060000    0.       -1.0     0./
285         811070000    0.       -1.0     0./
285         811080000    0.       -1.0     0./
285         811090000    0.       -1.0     0./
285         811100000    0.       -1.0     0./
285         811110000    0.       -1.0     0./
285         811120000    0.       -1.0     0./
285         811130000    0.       -1.0     0./
90        -703020000    0.       -1.0     0./
90        -703030000    0.       -1.0     0./
90       -703040000    0.       -1.0     0./
90       -703050000    0.       -1.0     0./
90       -703060000    0.       -1.0     0./
90       -703070000    0.       -1.0     0./
90       -703080000    0.       -1.0     0./
90       -703090000    0.       -1.0     0./
90       -703100000    0.       -1.0     0./
90       -703110000    0.       -1.0     0./
90       -703120000    0.       -1.0     0./
90       -703130000    0.       -1.0     0./
```


TELEDYNE
ENGINEERING SERVICES

```
90      -704000000     0.       -1.0     0./
90      -802000000     0.       -1.0     0./
90      -804000000     0.       -1.0     0./
90      -806000000     0.       -1.0     0./
90      -808000000     0.       -1.0     0./
90      -810000000     0.       -1.0     0./
90      -811010000     0.       -1.0     0./
90      -811020000     0.       -1.0     0./
90      -811030000     0.       -1.0     0./
90      -811040000     0.       -1.0     0./
90      -811050000     0.       -1.0     0./
90      -811060000     0.       -1.0     0./
90      -811070000     0.       -1.0     0./
90      -811080000     0.       -1.0     0./
90      -811090000     0.       -1.0     0./
90      -811100000     0.       -1.0     0./
90      -811110000     0.       -1.0     0./
90      -811120000     0.       -1.0     0./
90      -811130000     0.       -1.0     0./
90      -811140000     0.       -1.0     0./
74  811260000  0.0  -1.0  0.0/
74     811270000      0.0  -1.0    0.0/
74     811280000      0.0  -1.0    0.0/
74     811290000      0.0  -1.0    0.0/
74     811300000      0.0  -1.0    0.0/
74     811310000      0.0  -1.0    0.0/
74     811320000      0.0  -1.0    0.0/
74     811330000      0.0  -1.0    0.0/
74     811340000      0.0  -1.0    0.0/
74     811350000      0.0  -1.0    0.0/
74     811360000      0.0  -1.0    0.0/
74     811370000      0.0  -1.0    0.0/
74     811380000      0.0  -1.0    0.0/
74     811390000      0.0  -1.0    0.0/
74     811400000      0.0  -1.0    0.0/
74     811410000      0.0  -1.0    0.0/
74     811420000      0.0  -1.0    0.0/
74     811430000      0.0  -1.0    0.0/
74     811440000      0.0  -1.0    0.0/
74     811450000      0.0  -1.0    0.0/
74     811460000      0.0  -1.0    0.0/
74     811470000      0.0  -1.0    0.0/
74     811480000      0.0  -1.0    0.0/
74     811490000      0.0  -1.0    0.0/
74     811500000      0.0  -1.0    0.0/
74     811510000      0.0  -1.0    0.0/
74     811520000      0.0  -1.0    0.0/
74     811530000      0.0  -1.0    0.0/
74     811540000      0.0  -1.0    0.0/
74     811550000      0.0  -1.0    0.0/
82    -811270000      0.0  -1.0    0.0/
82    -811280000      0.0  -1.0    0.0/
82    -811290000      0.0  -1.0    0.0/
82    -811300000      0.0  -1.0    0.0/
82    -811310000      0.0  -1.0    0.0/
82    -811320000      0.0  -1.0    0.0/
82    -811330000      0.0  -1.0    0.0/
82    -811340000      0.0  -1.0    0.0/
82    -811350000      0.0  -1.0    0.0/
82    -811360000      0.0  -1.0    0.0/
```

```
62    -811370000      0.0   -1.0    0.0/
62    -811380000      0.0   -1.0    0.0/
62    -811390000      0.0   -1.0    0.0/
62    -811400000      0.0   -1.0    0.0/
62    -811410000      0.0   -1.0    0.0/
62    -811420000      0.0   -1.0    0.0/
62    -811430000      0.0   -1.0    0.0/
62    -811440000      0.0   -1.0    0.0/
62    -811450000      0.0   -1.0    0.0/
62    -811460000      0.0   -1.0    0.0/
62    -811470000      0.0   -1.0    0.0/
62    -811480000      0.0   -1.0    0.0/
62    -811490000      0.0   -1.0    0.0/
62    -811500000      0.0   -1.0    0.0/
62    -811510000      0.0   -1.0    0.0/
62    -811520000      0.0   -1.0    0.0/
62    -811530000      0.0   -1.0    0.0/
62    -811540000      0.0   -1.0    0.0/
62    -811550000      0.0   -1.0    0.0/
62    -811560000      0.0   -1.0    0.0/
60     811560000      0.0    0.0   -1.0/
60     811570000      0.0    0.0   -1.0/
60     811580000      0.0    0.0   -1.0/
60     811590000      0.0    0.0   -1.0/
60     811600000      0.0    0.0   -1.0/
60     811610000      0.0    0.0   -1.0/
60     811620000      0.0    0.0   -1.0/
60     811630000      0.0    0.0   -1.0/
58    -811570000      0.0    0.0   -1.0/
58    -811580000      0.0    0.0   -1.0/
58    -811590000      0.0    0.0   -1.0/
58    -811600000      0.0    0.0   -1.0/
58    -811610000      0.0    0.0   -1.0/
58    -811620000      0.0    0.0   -1.0/
58    -811630000      0.0    0.0   -1.0/
58    -811640000      0.0    0.0   -1.0/
56     811640000     -.259   0.0   -.966/
58     811650000     -.259   0.0   -.966/
58     811660000     -.259   0.0   -.966/
58     811670000     -.259   0.0   -.966/
58     811680000     -.259   0.0   -.966/
58     811690000     -.259   0.0   -.966/
58     811700000     -.259   0.0   -.966/
58     811710000     -.259   0.0   -.966/
52    -811650000     -.259   0.0   -.966/
52    -811660000     -.259   0.0   -.966/
52    -811670000     -.259   0.0   -.966/
52    -811680000     -.259   0.0   -.966/
52    -811690000     -.259   0.0   -.966/
52    -811700000     -.259   0.0   -.966/
52    -811710000     -.259   0.0   -.966/
52    -811720000     -.259   0.0   -.966/
50     811720000     -1.0    0.0    0.0/
50     811730000     -1.0    0.0    0.0/
50     811740000     -1.0    0.0    0.0/
50     811750000     -1.0    0.0    0.0/
50     811760000     -1.0    0.0    0.0/
50     811770000     -1.0    0.0    0.0/
50     811780000     -1.0    0.0    0.0/
50     811790000     -1.0    0.0    0.0/
```

```
46   -811730000    -1.0    0.0    0.0/
46   -811740000    -1.0    0.0    0.0/
46   -811750000    -1.0    0.0    0.0/
46   -811760000    -1.0    0.0    0.0/
46   -811770000    -1.0    0.0    0.0/
46   -811780000    -1.0    0.0    0.0/
46   -811790000    -1.0    0.0    0.0/
46   -811800000    -1.0    0.0    0.0/
44    811800000     0.0   -1.0    0.0/
44    811810000     0.0   -1.0    0.0/
44    811820000     0.0   -1.0    0.0/
44    811830000     0.0   -1.0    0.0/
44    811840000     0.0   -1.0    0.0/
44    811850000     0.0   -1.0    0.0/
44    811860000     0.0   -1.0    0.0/
44    811870000     0.0   -1.0    0.0/
40   -811810000     0.0   -1.0    0.0/
40   -811820000     0.0   -1.0    0.0/
40   -811830000     0.0   -1.0    0.0/
40   -811840000     0.0   -1.0    0.0/
40   -811850000     0.0   -1.0    0.0/
40   -811860000     0.0   -1.0    0.0/
40   -811870000     0.0   -1.0    0.0/
40   -811880000     0.0   -1.0    0.0/
38    811880000    -1.0    0.0    0.0/
38    811890000    -1.0    0.0    0.0/
38    811900000    -1.0    0.0    0.0/
38    811910000    -1.0    0.0    0.0/
38    811920000    -1.0    0.0    0.0/
38    811930000    -1.0    0.0    0.0/
38    811940000    -1.0    0.0    0.0/
38    811950000    -1.0    0.0    0.0/
38    811960000    -1.0    0.0    0.0/
32   -811890000    -1.0    0.0    0.0/
32   -811900000    -1.0    0.0    0.0/
32   -811910000    -1.0    0.0    0.0/
32   -811920000    -1.0    0.0    0.0/
32   -811930000    -1.0    0.0    0.0/
32   -811940000    -1.0    0.0    0.0/
32   -811950000    -1.0    0.0    0.0/
32   -811960000    -1.0    0.0    0.0/
32   -812000000    -1.0    0.0    0.0/
30    812000000     0.0    0.0    1.0/
30    813010000     0.0    0.0    1.0/
30    813020000     0.0    0.0    1.0/
30    813030000     0.0    0.0    1.0/
30    813040000     0.0    0.0    1.0/
30    813050000     0.0    0.0    1.0/
30    813060000     0.0    0.0    1.0/
30    813070000     0.0    0.0    1.0/
30    813080000     0.0    0.0    1.0/
30    813090000     0.0    0.0    1.0/
30    813100000     0.0    0.0    1.0/
30    813110000     0.0    0.0    1.0/
30    813120000     0.0    0.0    1.0/
30    813130000     0.0    0.0    1.0/
12   -813010000     0.0    0.0    1.0/
12   -813020000     0.0    0.0    1.0/
12   -813030000     0.0    0.0    1.0/
12   -813040000     0.0    0.0    1.0/
```

```
12     -813050000      0.0    0.0    1.0/
12     -813060000      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/
10      813140000      1.0    0.0    0.0/
10      813150000      1.0    0.0    0.0/
10      813160000      1.0    0.0    0.0/
10      813170000      1.0    0.0    0.0/
10      813180000      1.0    0.0    0.0/
10      813190000      1.0    0.0    0.0/
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/
6      -813150000      1.0    0.0    0.0/
6      -813160000      1.0    0.0    0.0/
6      -813170000      1.0    0.0    0.0/
6      -813180000      1.0    0.0    0.0/
6      -813190000      1.0    0.0    0.0/
6      -813200000      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/
4      813240000       0.0   -1.0    0.0/
4      813250000       0.0   -1.0    0.0/
4      977000000  0.0  -1.0  0.0/
4      978010000  0.0  -1.0  0.0/
4      978020000  0.0  -1.0  0.0/
4      978030000  0.0  -1.0  0.0/
4      978040000  0.0  -1.0  0.0/
4      978050000  0.0  -1.0  0.0/
4      978060000  0.0  -1.0  0.0/
1     -813250000       0.0   -1.0    0.0/
1     -977000000       0.0   -1.0    0.0/
1      -978010000  0.0  -1.0  0.0/
1     -978020000  0.0  -1.0  0.0/
1     -978030000  0.0  -1.0  0.0/
1     -978040000  0.0  -1.0  0.0/
1     -978050000  0.0  -1.0  0.0/
1     -978060000  0.0  -1.0  0.0/
1     -978070000  0.0  -1.0  0.0/
99999/
 $STEPS TSTEP(1)=0.001,1.0$
```

4.10.3 Unit 2 - (Quarter Model)

```
$PIPES
INLINE=3,KBLOCK=601,KPIPE=0,KPLOT(1)=1,KWAVE=1,
KPRINT=-1,KPNV=1,KSTEP=3,NOROPV=1010000,15010000$
 1   002000000   -1.0   0.0   0.0/
 2  -004000000   -1.0   0.0   0.0/
 3   004000000    0.0  -1.0   0.0/
 3   005010000    0.0  -1.0   0.0/
 3   005020000    0.0  -1.0   0.0/
 3   005040000    0.0  -1.0   0.0/
 3   005050000    0.0  -1.0   0.0/
 3   005060000    0.0  -1.0   0.0/
 4  -005010000    0.0  -1.0   0.0/
 4  -005020000    0.0  -1.0   0.0/
 4  -005030000    0.0  -1.0   0.0/
 4  -005040000    0.0  -1.0   0.0/
 4  -005050000    0.0  -1.0   0.0/
 4  -005060000    0.0  -1.0   0.0/
 4  -005070000    0.0  -1.0   0.0/
 5   005070000   -1.0   0.0   0.0/
 5   005080000   -1.0   0.0   0.0/
 5   005090000   -1.0   0.0   0.0/
 6  -005080000   -1.0   0.0   0.0/
 6  -005090000   -1.0   0.0   0.0/
 6  -005100000   -1.0   0.0   0.0/
 7   005100000    0.0   1.0   0.0/
 7   005110000    0.0   1.0   0.0/
 7   005120000    0.0   1.0   0.0/
 7   005130000    0.0   1.0   0.0/
 7   005140000    0.0   1.0   0.0/
 7   005150000    0.0   1.0   0.0/
 7   005160000    0.0   1.0   0.0/
 7   005170000    0.0   1.0   0.0/
 7   005180000    0.0   1.0   0.0/
 7   005190000    0.0   1.0   0.0/
 8  -005110000    0.0   1.0   0.0/
 8  -005120000    0.0   1.0   0.0/
 8  -005130000    0.0   1.0   0.0/
 8  -005140000    0.0   1.0   0.0/
 8  -005150000    0.0   1.0   0.0/
 8  -005160000    0.0   1.0   0.0/
 8  -005170000    0.0   1.0   0.0/
 8  -005180000    0.0   1.0   0.0/
 8  -005190000    0.0   1.0   0.0/
 8  -006000000    0.0   1.0   0.0/
 9   006000000   -1.0   0.0   0.0/
 9   007010000   -1.0   0.0   0.0/
 9   007020000   -1.0   0.0   0.0/
 9   007030000   -1.0   0.0   0.0/
10  -007010000   -1.0   0.0   0.0/
10  -007020000   -1.0   0.0   0.0/
10  -007030000   -1.0   0.0   0.0/
10  -007040000   -1.0   0.0   0.0/
11   007040000    0.0  -1.0   0.0/
11   007050000    0.0  -1.0   0.0/
11   007060000    0.0  -1.0   0.0/
11   007070000    0.0  -1.0   0.0/
11   007080000    0.0  -1.0   0.0/
11   007090000    0.0  -1.0   0.0/
11   007100000    0.0  -1.0   0.0/
11   007110000    0.0  -1.0   0.0/
```

BY CHM DATE 2-9-83

CHKD. BY LOS DATE 2-9-83

```
11  007120000    0.0 -1.0  0.0/
11  007130000    0.0 -1.0  0.0/
12 -007050000    0.0 -1.0  0.0/
12 -007060000    0.0 -1.0  0.0/
12 -007070000    0.0 -1.0  0.0/
12 -007080000    0.0 -1.0  0.0/
12 -007090000    0.0 -1.0  0.0/
12 -007100000    0.0 -1.0  0.0/
12 -007110000    0.0 -1.0  0.0/
12 -007120000    0.0 -1.0  0.0/
12 -007130000    0.0 -1.0  0.0/
12 -007140000    0.0 -1.0  0.0/
14  007140000   -.258  0.0 -.966/
14  007150000   -.258  0.0 -.966/
14  007160000   -.258  0.0 -.966/
15 -007150000   -.258  0.0 -.966/
15 -007160000   -.258  0.0 -.966/
15 -007170000   -.258  0.0 -.966/
16  007170000    .337  0.0 -.942/
16  007180000    .337  0.0 -.942/
16  007190000    .337  0.0 -.942/
17 -007180000    .337  0.0 -.942/
17 -007190000    .337  0.0 -.942/
17 -007200000    .337  0.0 -.942/
18  007200000    .793  0.0 -.609/
18  007210000    .793  0.0 -.609/
18  007220000    .793  0.0 -.609/
19 -007210000    .793  0.0 -.609/
18 -007220000    .793  0.0 -.609/
19 -007230000    .793  0.0 -.609/
20  007230000    .994  0.0 -.1132/
20  007240000    .994  0.0 -.1132/
20  007250000    .994  0.0 -.1132/
21 -007240000    .994  0.0 -.1132/
21 -007250000    .994  0.0 -.1132/
21 -007260000    .994  0.0 -.1132/
22  007260000    .910  0.0  .415/
22  007270000    .910  0.0  .415/
22  007280000    .910  0.0  .415/
23 -007270000    .910  0.0  .415/
23 -007280000    .910  0.0  .415/
23 -007290000    .910  0.0  .415/
24  007290000    .555  0.0  .8321/
24  007300000    .555  0.0  .8321/
24  007310000    .555  0.0  .8321/
25 -007300000    .555  0.0  .8321/
25 -007310000    .555  0.0  .8321/
25 -007320000    .555  0.0  .8321/
26  007320000   .0183  0.0  .9998/
26  007330000   .0183  0.0  .9998/
26  007340000   .0183  0.0  .9998/
27 -007330000   .0183  0.0  .9998/
27 -007340000   .0183  0.0  .9998/
27 -007350000   .0183  0.0  .9998/
28  007350000   -.264  0.0  .965/
28  007360000   -.264  0.0  .965/
28  007370000   -.264  0.0  .965/
28  007380000   -.264  0.0  .965/
29 -007360000   -.264  0.0  .965/
29 -007370000   -.264  0.0  .965/
```

```
29  -007380000   -.264   0.0   .965/
29  -008000000   -.264   0.0   .965/
30   008000000    0.0  -1.0   0.0/
30   010000000    0.0  -1.0   0.0/
30   011010000    0.0  -1.0   0.0/
30   011020000    0.0  -1.0   0.0/
30   011030000    0.0  -1.0   0.0/
30   011040000    0.0  -1.0   0.0/
30   011050000    0.0  -1.0   0.0/
30   011060000    0.0  -1.0   0.0/
30   011070000    0.0  -1.0   0.0/
30   011080000    0.0  -1.0   0.0/
30   011090000    0.0  -1.0   0.0/
30   011100000    0.0  -1.0   0.0/
30   011110000    0.0  -1.0   0.0/
30   011120000    0.0  -1.0   0.0/
30   011130000    0.0  -1.0   0.0/
31  -010000000    0.0  -1.0   0.0/
31  -011010000    0.0  -1.0   0.0/
31  -011020000    0.0  -1.0   0.0/
31  -011030000    0.0  -1.0   0.0/
31  -011040000    0.0  -1.0   0.0/
31  -011050000    0.0  -1.0   0.0/
31  -011060000    0.0  -1.0   0.0/
31  -011070000    0.0  -1.0   0.0/
31  -011080000    0.0  -1.0   0.0/
31  -011090000    0.0  -1.0   0.0/
31  -011100000    0.0  -1.0   0.0/
31  -011110000    0.0  -1.0   0.0/
31  -011120000    0.0  -1.0   0.0/
31  -011130000    0.0  -1.0   0.0/
31  -011140000    0.0  -1.0   0.0/
32   011140000    .316  -.707  -.948/
32   011150000    .316  -.707  -.948/
32   011160000    .316  -.707  -.948/
32   011170000    .316  -.707  -.948/
33  -011150000    .316  -.707  -.948/
33  -011160000    .316  -.707  -.948/
33  -011170000    .316  -.707  -.948/
33  -011180000    .316  -.707  -.948/
34   011180000    0.0  -1.0   0.0/
34   011190000    0.0  -1.0   0.0/
34   011200000    0.0  -1.0   0.0/
34   011210000    0.0  -1.0   0.0/
35  -011200000    0.0  -1.0   0.0/
35  -011210000    0.0  -1.0   0.0/
35  -011220000    0.0  -1.0   0.0/
36   011220000   -.316  -.707   .948/
36   011230000   -.316  -.707   .948/
36   011240000   -.316  -.707   .948/
36   011250000   -.316  -.707   .948/
37  -011230000   -.316  -.707   .948/
37  -011240000   -.316  -.707   .948/
37  -011250000   -.316  -.707   .948/
37  -011260000   -.316  -.707   .948/
38   011260000    0.0  -1.0   0.0/
38   011270000    0.0  -1.0   0.0/
38   011280000    0.0  -1.0   0.0/
38   011290000    0.0  -1.0   0.0/
38   011300000    0.0  -1.0   0.0/
```

```
38   011310000    0.0 -1.0  0.0/
38   011320000    0.0 -1.0  0.0/
38   011330000    0.0 -1.0  0.0/
38   011340000    0.0 -1.0  0.0/
38   011350000    0.0 -1.0  0.0/
38   011360000    0.0 -1.0  0.0/
38   011370000    0.0 -1.0  0.0/
38   011380000    0.0 -1.0  0.0/
38   011390000    0.0 -1.0  0.0/
38   011400000    0.0 -1.0  0.0/
38   011410000    0.0 -1.0  0.0/
38   011420000    0.0 -1.0  0.0/
38   011430000    0.0 -1.0  0.0/
38   011440000    0.0 -1.0  0.0/
38   011450000    0.0 -1.0  0.0/
38   011460000    0.0 -1.0  0.0/
38   011470000    0.0 -1.0  0.0/
38   011480000    0.0 -1.0  0.0/
38   011490000    0.0 -1.0  0.0/
38   011500000    0.0 -1.0  0.0/
38   011510000    0.0 -1.0  0.0/
38   011520000    0.0 -1.0  0.0/
38   011530000    0.0 -1.0  0.0/
38   011540000    0.0 -1.0  0.0/
38   011550000    0.0 -1.0  0.0/
39  -011270000    0.0 -1.0  0.0/
39  -011280000    0.0 -1.0  0.0/
39  -011290000    0.0 -1.0  0.0/
39  -011300000    0.0 -1.0  0.0/
39  -011310000    0.0 -1.0  0.0/
39  -011320000    0.0 -1.0  0.0/
39  -011330000    0.0 -1.0  0.0/
39  -011340000    0.0 -1.0  0.0/
39  -011350000    0.0 -1.0  0.0/
39  -011360000    0.0 -1.0  0.0/
39  -011370000    0.0 -1.0  0.0/
39  -011380000    0.0 -1.0  0.0/
39  -011390000    0.0 -1.0  0.0/
39  -011400000    0.0 -1.0  0.0/
39  -011410000    0.0 -1.0  0.0/
39  -011420000    0.0 -1.0  0.0/
39  -011430000    0.0 -1.0  0.0/
39  -011440000    0.0 -1.0  0.0/
39  -011450000    0.0 -1.0  0.0/
39  -011460000    0.0 -1.0  0.0/
39  -011470000    0.0 -1.0  0.0/
39  -011480000    0.0 -1.0  0.0/
39  -011490000    0.0 -1.0  0.0/
39  -011500000    0.0 -1.0  0.0/
39  -011510000    0.0 -1.0  0.0/
39  -011520000    0.0 -1.0  0.0/
39  -011530000    0.0 -1.0  0.0/
39  -011540000    0.0 -1.0  0.0/
39  -011550000    0.0 -1.0  0.0/
39  -011560000    0.0 -1.0  0.0/
40   011560000    0.0  0.0 -1.0/
40   011570000    0.0  0.0 -1.0/
40   011580000    0.0  0.0 -1.0/
40   011590000    0.0  0.0 -1.0/
40   011600000    0.0  0.0 -1.0/
```

```
 40   011610000    0.0   0.0 -1.0/
 40   011620000    0.0   0.0 -1.0/
 40   011630000    0.0   0.0 -1.0/
 40   011640000    0.0   0.0 -1.0/
 40   011650000    0.0   0.0 -1.0/
 41  -011570000    0.0   0.0 -1.0/
 41  -011580000    0.0   0.0 -1.0/
 41  -011590000    0.0   0.0 -1.0/
 41  -011600000    0.0   0.0 -1.0/
 41  -011610000    0.0   0.0 -1.0/
 41  -011620000    0.0   0.0 -1.0/
 41  -011630000    0.0   0.0 -1.0/
 41  -011640000    0.0   0.0 -1.0/
 41  -011650000    0.0   0.0 -1.0/
 41  -011660000    0.0   0.0 -1.0/
 42   011660000   -.259   0.0   .966/
 42   011670000   -.259   0.0   .966/
 42   011680000   -.259   0.0   .966/
 42   011690000   -.259   0.0   .966/
 42   011700000   -.259   0.0   .966/
 42   011710000   -.259   0.0   .966/
 42   011720000   -.259   0.0   .966/
 42   011730000   -.259   0.0   .966/
 42   011740000   -.259   0.0   .966/
 42   011750000   -.259   0.0   .966/
 42   011760000   -.259   0.0   .966/
 42   011770000   -.259   0.0   .966/
 42   011780000   -.259   0.0   .966/
 43  -011670000   -.259   0.0   .966/
 43  -011680000   -.259   0.0   .966/
 43  -011690000   -.259   0.0   .966/
 43  -011700000   -.259   0.0   .966/
 43  -011710000   -.259   0.0   .966/
 43  -011720000   -.259   0.0   .966/
 43  -011730000   -.259   0.0   .966/
 43  -011740000   -.259   0.0   .966/
 43  -011750000   -.259   0.0   .966/
 43  -011760000   -.259   0.0   .966/
 43  -011770000   -.259   0.0   .966/
 43  -011780000   -.259   0.0   .966/
 43  -011790000   -.259   0.0   .966/
 44   011790000   -1.0   0.0   0.0/
 44   011800000   -1.0   0.0   0.0/
 44   011810000   -1.0   0.0   0.0/
 44   011820000   -1.0   0.0   0.0/
 44   011830000   -1.0   0.0   0.0/
 44   011840000   -1.0   0.0   0.0/
 44   011850000   -1.0   0.0   0.0/
 44   011860000   -1.0   0.0   0.0/
 45  -011800000   -1.0   0.0   0.0/
 45  -011810000   -1.0   0.0   0.0/
 45  -011820000   -1.0   0.0   0.0/
 45  -011830000   -1.0   0.0   0.0/
 45  -011840000   -1.0   0.0   0.0/
 45  -011850000   -1.0   0.0   0.0/
 45  -011860000   -1.0   0.0   0.0/
 45  -011870000   -1.0   0.0   0.0/
 46   011870000    0.0  -1.0   0.0/
 46   011880000    0.0  -1.0   0.0/
 46   011890000    0.0  -1.0   0.0/
```


TELEDYNE
ENGINEERING SERVICES

```
 48   011900000    0.0 -1.0  0.0/
 48   011910000    0.0 -1.0  0.0/
 48   011920000    0.0 -1.0  0.0/
 48   011930000    0.0 -1.0  0.0/
 48   011940000    0.0 -1.0  0.0/
 47  -011880000    0.0 -1.0  0.0/
 47  -011890000    0.0 -1.0  0.0/
 47  -011900000    0.0 -1.0  0.0/
 47  -011910000    0.0 -1.0  0.0/
 47  -011920000    0.0 -1.0  0.0/
 47  -011930000    0.0 -1.0  0.0/
 47  -011940000    0.0 -1.0  0.0/
 47  -011950000    0.0 -1.0  0.0/
 48   011950000   -1.0  0.0  0.0/
 48   011960000   -1.0  0.0  0.0/
 48   011970000   -1.0  0.0  0.0/
 48   011980000   -1.0  0.0  0.0/
 48   011990000   -1.0  0.0  0.0/
 48   012000000   -1.0  0.0  0.0/
 48   013010000   -1.0  0.0  0.0/
 48   013020000   -1.0  0.0  0.0/
 48   013030000   -1.0  0.0  0.0/
 48   013040000   -1.0  0.0  0.0/
 48   013050000   -1.0  0.0  0.0/
 49  -011960000   -1.0  0.0  0.0/
 49  -011970000   -1.0  0.0  0.0/
 49  -011980000   -1.0  0.0  0.0/
 49  -011990000   -1.0  0.0  0.0/
 49  -012000000   -1.0  0.0  0.0/
 49  -013010000   -1.0  0.0  0.0/
 49  -013020000   -1.0  0.0  0.0/
 49  -013030000   -1.0  0.0  0.0/
 49  -013040000   -1.0  0.0  0.0/
 49  -013050000   -1.0  0.0  0.0/
 49  -013060000   -1.0  0.0  0.0/
 50   013060000    0.0  0.0 -1.0/
 50   013070000    0.0  0.0 -1.0/
 50   013080000    0.0  0.0 -1.0/
 50   013090000    0.0  0.0 -1.0/
 50   013100000    0.0  0.0 -1.0/
 50   013110000    0.0  0.0 -1.0/
 50   013120000    0.0  0.0 -1.0/
 50   013130000    0.0  0.0 -1.0/
 50   013140000    0.0  0.0 -1.0/
 50   013150000    0.0  0.0 -1.0/
 50   013160000    0.0  0.0 -1.0/
 50   013170000    0.0  0.0 -1.0/
 50   013180000    0.0  0.0 -1.0/
 50   013190000    0.0  0.0 -1.0/
 51  -013070000    0.0  0.0 -1.0/
 51  -013080000    0.0  0.0 -1.0/
 51  -013090000    0.0  0.0 -1.0/
 51  -013100000    0.0  0.0 -1.0/
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 51  -013120000    0.0  0.0 -1.0/
 51  -013130000    0.0  0.0 -1.0/
 51  -013140000    0.0  0.0 -1.0/
 51  -013150000    0.0  0.0 -1.0/
 51  -013160000    0.0  0.0 -1.0/
 51  -013170000    0.0  0.0 -1.0/
```

```
  51  -013180000    0.0   0.0 -1.0/
  51  -013190000    0.0   0.0 -1.0/
  51  -013200000    0.0   0.0 -1.0/
  52   013200000    1.0   0.0  0.0/
  52   013210000    1.0   0.0  0.0/
  52   013220000    1.0   0.0  0.0/
  52   013230000    1.0   0.0  0.0/
  52   013240000    1.0   0.0  0.0/
  52   013250000    1.0   0.0  0.0/
  52   013260000    1.0   0.0  0.0/
  52   013270000    1.0   0.0  0.0/
  52   013280000    1.0   0.0  0.0/
  52   013290000    1.0   0.0  0.0/
  53  -013210000    1.0   0.0  0.0/
  53  -013220000    1.0   0.0  0.0/
  53  -013230000    1.0   0.0  0.0/
  53  -013240000    1.0   0.0  0.0/
  53  -013250000    1.0   0.0  0.0/
  53  -013260000    1.0   0.0  0.0/
  53  -013270000    1.0   0.0  0.0/
  53  -013280000    1.0   0.0  0.0/
  53  -013290000    1.0   0.0  0.0/
  53  -014000000    1.0   0.0  0.0/
99999/
  $STEPS TSTEP(1)=0.001,0.600$
```


TELEDYNE
ENGINEERING SERVICES

4.11 APPENDIX A

TELEDYNE ENGINEERING SERVICES

BY JBM DATE 8-24-82
CHKD. BY SGC DATE 8-25-82
JCK 6-1-83

AMERICAN ELECTRIC POWER
D.C. 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} 12 f
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

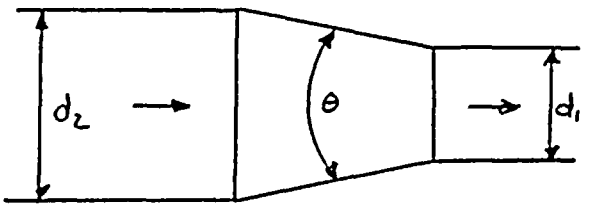
REF: CRANE TECHNICAL PAPER No. 410

TELEDYNE ENGINEERING SERVICES

BY JBM DATE 12-8-82
CHKD. BY JEY DATE 12-8-82 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: $\theta \leq 45^\circ$

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 x 6" SCH 40S	6.065"	11.938"	.5080	40.3°	.2045	.4930
6" SCH 40S x 4" SCH 40S	4.026"	6.065"	.6638	21°	.0815	.1483
4" SCH 40S x 3" SCH 40	3.068"	4.026"	.7620	13.66°	.0399	.0544
3" SCH 160 x 4" SCH 120	2.624"	3.624"	.7241	14.25°	.0472	.0730
4" SCH 120 x 6" SCH 160	3.624"	5.189"	.6984	16.19°	.0577	.0961
6" SCH 40S x 3" SCH 40	3.068"	6.065"	.5059	30.48°	.1565	.3784

REFERENCE: CRANE TECHNICAL PAPER 410 p. A-26

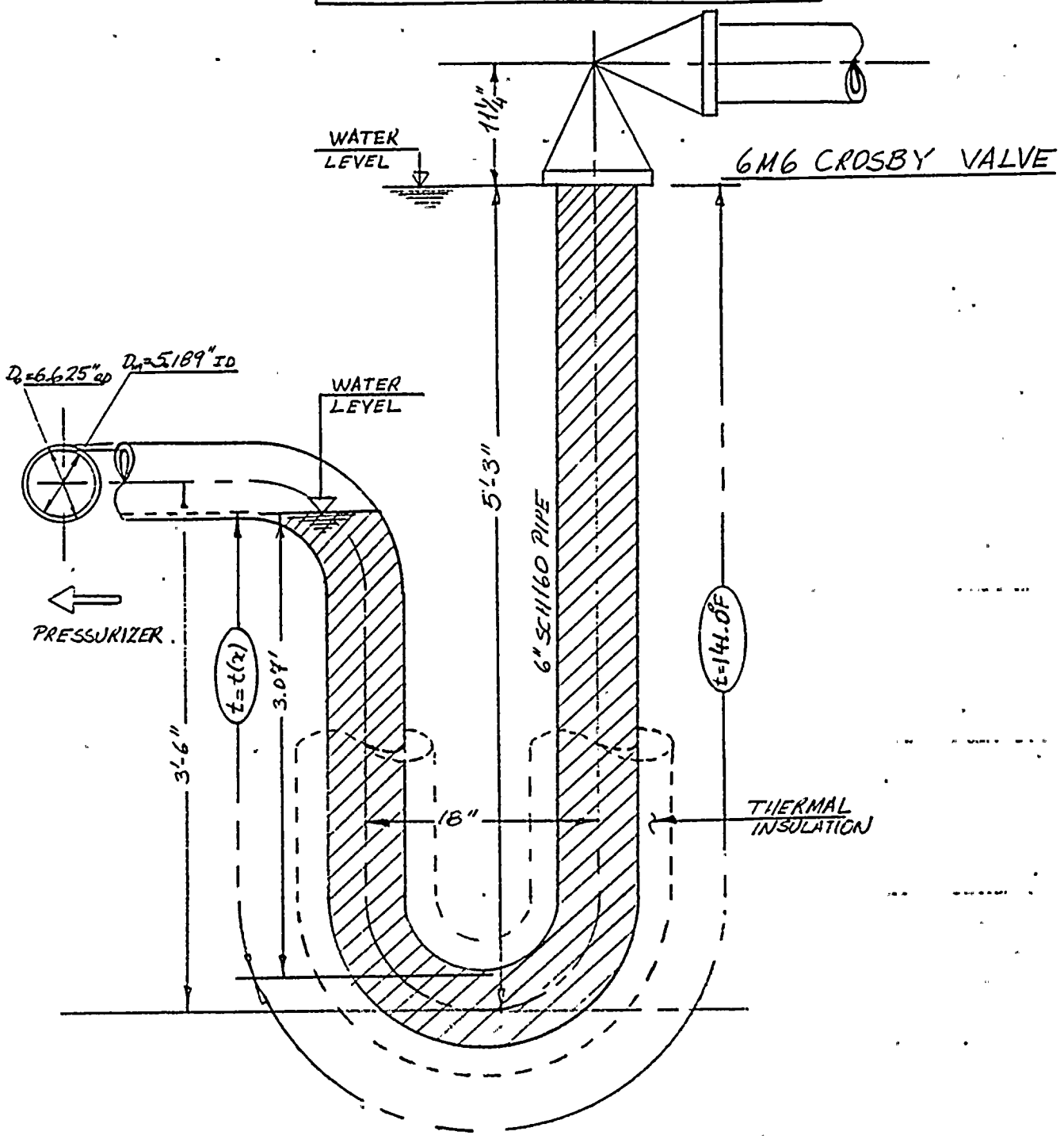
K IS TAKEN WITH RESPECT TO THE SMALLER DIAMETER PIPE.

TELEDYNE ENGINEERING SERVICES

BY BAT DATE 12-17-82
CHKD. BY JNM DATE 1-7-83

AEP D.C. COOK UNIT 1
SV LINE LOOP SEAL TEMP DISTRIBUTION

SHEET NO. 1 OF 12
PROJ. NO. 5364



INDICATES TEMPERATURE VARIATIONS IN LOOP SEAL (REF. TEXT)

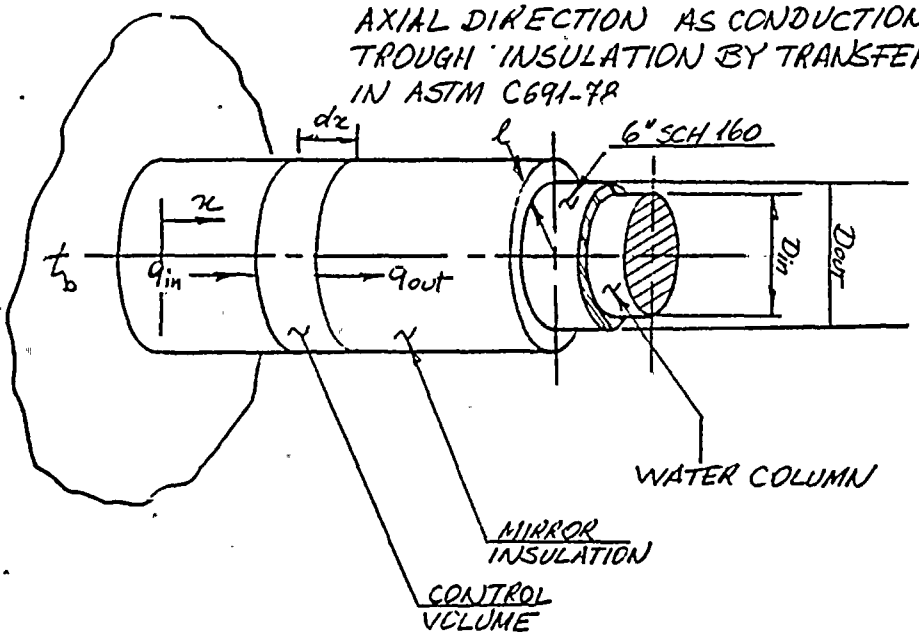
D.C. COOK UNIT 1
SAFETY VALVE LINE_LOOP SEAL
GEOMETRY

BY BAI DATE 12-17-82
CHKD. BY CHK DATE 1-7-83

A E P D.C. COOK UNIT 1
SV LINE LOOP SEAL TEMP. DISTRIBUTION

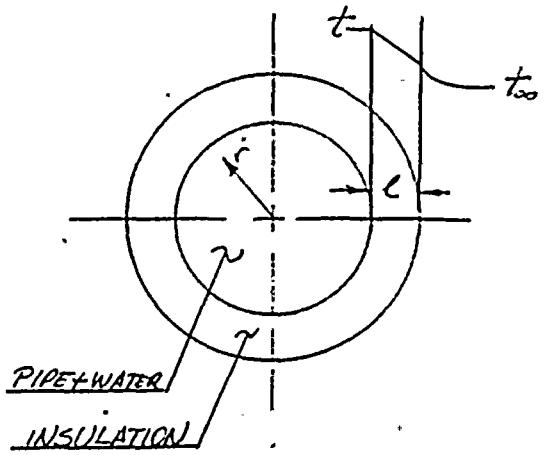
DERIVATION OF ENERGY EQUATION

ASSUMPTION 1: LOOP SEAL PIPING IS MODELED AS STRAIGHT PIPE WITH FINITE LENGTH WITH BOUNDARY CONDITIONS DESCRIBED BELOW. HEAT IS TRANSFERED BOTH IN AXIAL DIRECTION AS CONDUCTION AND IN RADIAL DIRECTION TROUGH INSULATION BY TRANSFERENCE EQUATION AS DESCRIBED IN ASTM C691-78



PIPE MODEL

ASSUMPTION 2: TEMPERATURE ACROSS CROSS-SECTION OF THE PIPE INCLUDING WATER AND WALL IS CONSTANT.



q_{in} (CONDUCTED INTO ELEMENT) $= \left[(KA)_{PIPE} + (KA)_{water}\right] \frac{dt}{dx}$

$q_{in} = -(KA)_{eff} \frac{dt}{dx}$ WHERE $(KA)_{eff} = (kA)_{pipe} + (kA)_{water}$

q_{out} (CONDUCTED OUT OF ELEMENT) $= q_{in} + \Delta q$

$q_{out} = \left[-(KA)_{eff} \frac{dt}{dx} + \frac{d}{dx}\left(-KA_{eff} \frac{dt}{dx}\right) dx\right]$

TEMPERATURE DISTRIBUTION ACROSS THE CROSS-SECTION OF PIPE

BY BAT DATE 12-17-82
CHKD. BY JHM DATE 1-7-83

AEP D.C.COOK UNIT 1
SV LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 3 OF 12
PROJ. NO. 5364

$(KA)_{eff}$ = EQUIVALENT THERMAL CONDUCTANCE OF PIPE IN AXIAL DIRECTION

t = TEMPERATURE AS A FUNCTION OF x

q_s (TRANSFERED OUT OF SURFACE OF THE PIPE) $= T_r A_s (t_{in} - t_\infty)$

(REF: ASTM C691-78)

WHERE: A_s = SURFACE AREA OF PIPE $(ft^2) = \pi D_o dx$

t_{in} = TEMPERATURE OF PIPE & WATER (ASSUMED EQUAL)

t_∞ = PIPE ENVIROMENT TEMPERATURE = 120 °F

T_r = THERMAL TRANSFERENCE $\frac{Btu}{hr\text{-}ft^2\text{-}F}$

ENERGY EQUATION FOR THE CONTROL VOLUME

$$q_{in} = q_{out} + q_s$$

$$-(kA)_{eff}\frac{dt}{dx} = \left\{-(kA)_{eff}\frac{dt}{dx} + \frac{d}{dx}\left[-(kA)_{eff}\frac{dt}{dx}\right]dx\right\} + T_r \pi D_o dx (t - t_\infty)$$

$$(KA)_{eff}\frac{d^2t}{dx^2} = T_r \pi D_o (t - t_\infty)$$

LET $\theta = t - t_\infty$ THEN $\frac{d\theta}{dx} = \frac{dt}{dx}$ AND $\frac{d^2\theta}{dx^2} = \frac{d^2t}{dx^2}$

LET $m^2 = \frac{T_r \pi D_o}{(KA)_{eff}}$

THEREFORE:

$$\frac{d^2\theta}{dx^2} = m^2\theta$$

$$\theta = C_1 e^{mx} + C_2 e^{-mx}$$

$$\boxed{t = C_1 e^{mx} + C_2 e^{-mx} + 120}$$

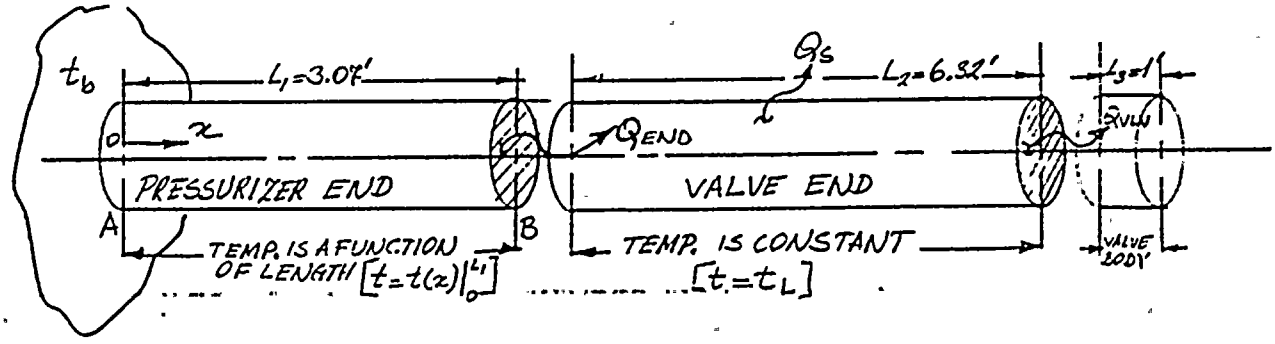
EQUATION-(1)
GENERAL TEMPERATURE DISTRIBUTION EQN.

BY BAT DATE 12-20-82
CHKD. BY MH DATE 1-7-83

AEP D. C. COOK UNIT 1
S.V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 4 OF 12
PROJ. NO. 5364

ASSUMPTION 3.- TEMPERATURE VARIES ONLY IN THE PRESSURIZER END OF THE LOOP SEAL AND REMAINS CONSTANT AT THE VALVE END OF THE LOOP SEAL. THIS IS DUE TO THE CIRCULATION OF WATER IN THE VALVE END OF LOOP SEAL BECAUSE OF NATURAL CONVECTION (REF. PAGE 1 OF THIS ANALYSIS)



LOOP SEAL MODEL

BOUNDARY CONDITIONS FOR EQN 1

1- $x = 0$ $\quad t = t_b = 668\,^\circ F$ (SAT. STEAM TEMP. @ 2500 psia)

2- $x = 3.07$ ft $\quad -(kA)_{eff}\left.\frac{dt}{dx}\right|_{x=3.07} = Q_{END}$

$$-(kA)_{eff}\left[mC_1 e^{mx} - mC_2 e^{-mx}\right] = Q_{END} \quad \text{EQN. (2)}$$

C_1 AND C_2 ARE FOUND FROM EQN. 1 AND EQN. 2

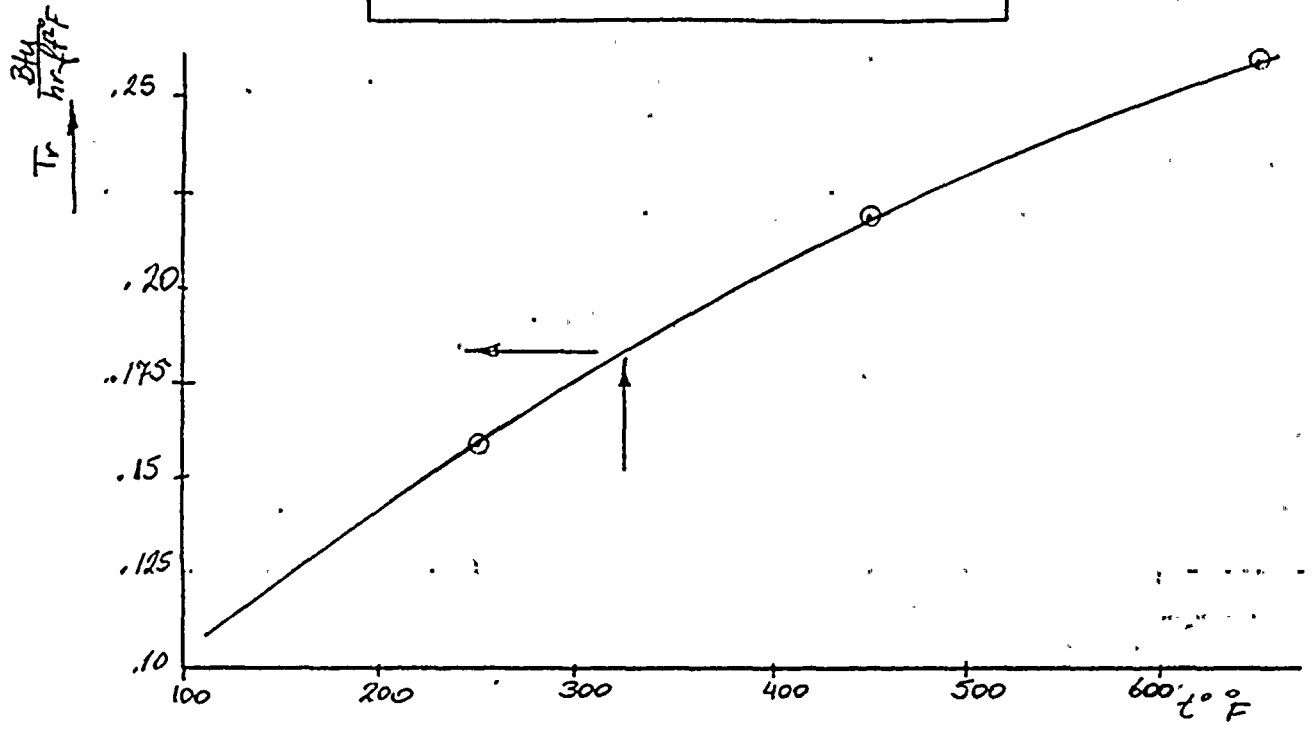
T_f ('TRANSMISSIVITY') IS A FUNCTION OF TEMPERATURE AND FROM THE TELECON BETWEEN "TES" AND "DIAMOND POWER" DATED (12-16-82)

T_f $\frac{Btu}{hr\,ft^2\,F.}$	TEMP °F
0.259	650
0.219	450
0.758	250

BY BAI DATE 12-20-82
CHKD. BY CMM DATE 1-7-83

AEP D.C. COOK UNIT 1
S.V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 5 OF 12
PROJ. NO. 5364



PLOT OF TRANSMISSIVITY VS TEMPERATURE FROM DATA ON TELECON BETWEEN "TES" AND "DIAMOND POWER" DATED (12-16-82).

ASSUMED AVERAGE FLUID TEMPERATURE = 325°F

FROM PLOT $T_r = 0.182 \frac{Btu}{hr\,ft^2\,°F}$ @ $t = 325°F$

$$(KA)_{eff} = (KA)_{PIPE} + (KA)_{WATER}$$

$A_{PIPE} = 13.22\ in^2$

$A_{WATER} = 21.1\ in^2$

ESTIMATED AVERAGE VALUES

$K_{PIPE} \simeq 7.9 \frac{Btu}{hr-ft-°F}$ (REF:* PIPE MAT. SPECT DCCPM104QCS PROVIDED BY AEP AND ASME III BOILER & PRESSURE VESSEL CODE)

$K_{WATER} = 0.38 \frac{Btu}{hr-ft-°F}$ (REF: HEAT TRANSFER; J. P. HOLMAN Fig 1.5 FIRST EDITION)

$$(KA)_{eff} = 0.78 \frac{Btu-ft}{hr-°F}$$

(*NOTE: PIPE IS MADE OF ASTM A-376 GRADE TP316 SEAMLESS AUSTENITIC STEEL)

BY BAI DATE 12-21-82
CHKD. BY CMM DATE 1-7-83

AEP D.C. COOK UNIT 1
S.V. LINE LOOPSEAL TEMP. DISTRIBUTION

SHEET NO. 6 OF 12
PROJ. NO. 5364

ASSUME $t = 145°F$ AT VALVE END OF LOOPSEAL

$$Q_{END} = Q_S + Q_{VLV}$$

Q_S = HEAT LOSS ACROSS INSULATION FROM VALVE END OF LOOP-SEAL

$$Q_S = T_r A_S (t_L - t_\infty)$$

WHERE $A_S = D_o \pi L_2$ SURFACE AREA OF VALVE END OF LOOPSEAL

$T_r = 0.120 \frac{Btu}{ft^2 \cdot hr \cdot F}$ @ 145°F (FROM PLOT AT PAGES OF THIS ANALYSIS)

(NOTE: DIFFERENT T_r IS USED IN EQN. 1 AND Q_S SINCE MEAN TEMPERATURES ARE DIFFERENT)

$$Q_S = (0.120)(0.55 \times \pi \times 6.32)[145 - 120]$$

$$Q_S = 32.76 \frac{Btu}{hr}$$

VALVE END HEAT LOSS IS ASSUMED AS HEAT FLOWING TROUGH A SOLID VALVE BODY WITH $L_3 = 1'$ EQUIVALENT LENGTH AND D_o DIAMETER.

$$Q_{VLV} = (kA)_{steel} \frac{t_L - t_\infty}{L_3}$$

$$Q_{VLV} = (7.9)(6.24) \frac{145 - 120}{1.0}$$

$$Q_{VLV} = 47.28 \frac{Btu}{hr}$$

$$Q_{END} = Q_S + Q_{VLV}$$

$$Q_{END} = 80.04 \frac{Btu}{hr}$$

BY BAI DATE 12-21-82
CHKD. BY JHM DATE 1-7-83

A EP D.C. COOK UNIT 1
S.V LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 7 OF 12
PROJ. NO. 5364

TEMPERATURE DISTRIBUTION EQUATION @ $0 < x < L_1 = 3.07$

$$t = C_1 e^{mx} + C_2 e^{-mx} + 120$$

SOLVE FOR C_1 AND C_2 USING BOUNDARY CONDITIONS:

$x = 0 \qquad t = t_b = 668\ °F$ BOUNDARY CON. 1

$$-(kA)_{eff} \left.\frac{dt}{dx}\right|_{x=L_1} = Q_{END}$$ BOUNDARY CON. 2

$$-m \times 0.78 \left[C_1 e^{mL_1} - C_2 e^{-mL_1}\right] = 80.04$$

$$m = \left[\frac{T_r \pi D_o}{(KA)_{eff}}\right]^{1/2}$$

$$m = \left[\frac{0.182 \cdot \pi \cdot 0.55}{0.78}\right]^{1/2}$$

$$m = 0.64$$

SUBSTITUTING BOUNDARY CONDITIONS:

FROM B.C. 1 $\quad C_1 e^{0.64(0)} + C_2 e^{-0.64(0)} = 548$ ——— EQN. (2)

FROM BC. 2 $\quad -C_1 e^{0.64L_1} + C_2 e^{-0.64L_1} = (2.)[Q_s + Q_{VU}]$ ——— EQN. (3)

AFTER SUBSTITUTING

$$C_1 + C_2 = 548$$

$$-7.13\, C_1 + 0.14\, C_2 = 160.08$$

TWO EQUATIONS WITH TWO UNKNOWNS. AFTER SOLVING

$C_1 = -11.5$ AND $C_2 = 559.50$

BY BAT DATE 12-21-82
CHKD. BY CHM DATE 1-7-83

AEP D. C. COOK UNIT 1
S.V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 8 OF 12
PROJ. NO. 5364

TEMPERATURE DISTRIBUTION EQUATION BECOMES

$$t = -11.5\, e^{0.64x} + 559.5\, e^{-0.64x} + 120 \qquad @ \quad 0 < x < 3.07$$

CHECKING ASSUMED $t = t_L = 145°$ @ $x = 3.07$ ft

PROCEDURE: FIND $A(t)$ BY SUBSTITUTING $x = 3.07$ AND COMPORE THIS (t) BY ASSUMED $t = 145°F$

$$t = -11.5\, e^{(0.64)(3.07)} + 559.5\, e^{-(0.64)(3.07)} + 120$$

$$t_{found} = 116.44\ °F < t_{ass} = 145°F$$

ASSUME: $t = t_L = 135°F$

EQNS (2) AND (3) BECOMES:

$$\begin{cases} C_1 + C_2 = 54.8 \\ -7.13\, C_1 + 0.14\, C_2 = 96.20 \end{cases}$$

$Q_{VLV} = 28.44$ Btu/hr
$Q_S = 19.66$ Btu/hr
$Q_{END} = 48.10$

AFTER SOLVING

$C_1 = -2.68$

$C_2 = 550.68$ AND TEMP. DISTRIBUTION:

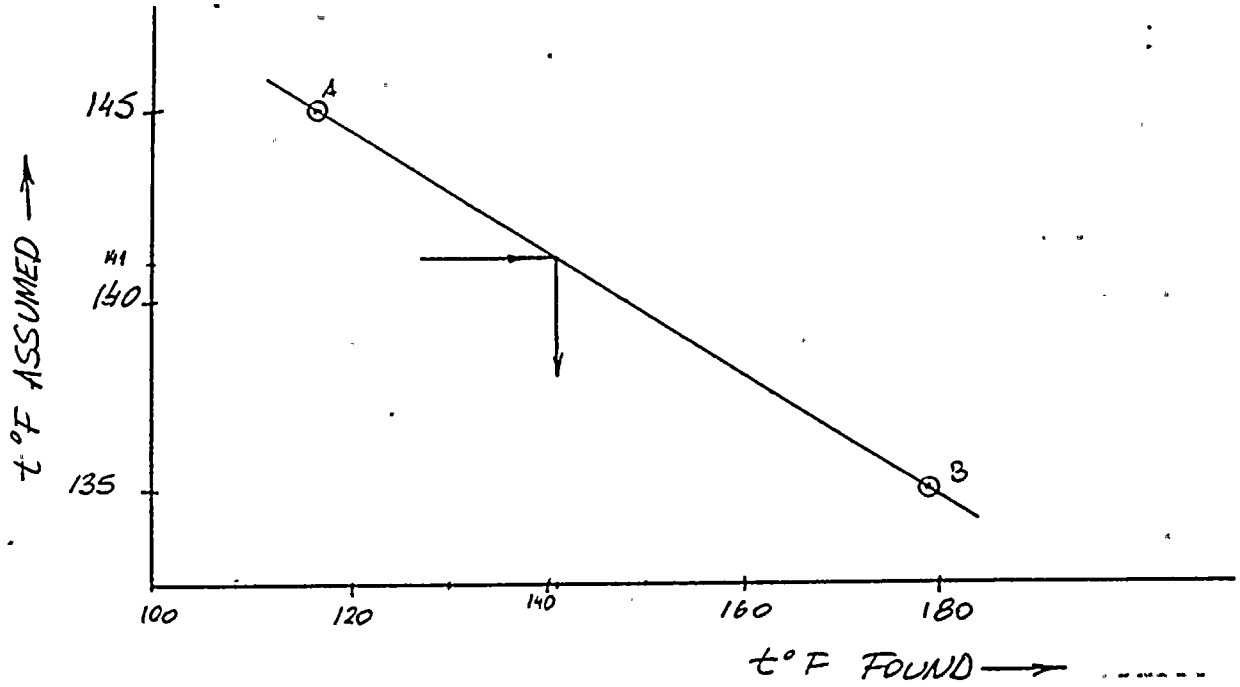
$$t = -2.68\, e^{0.64x} + 550.68\, e^{-0.64x} + 120$$

@ $x = 3.07$ $t_{found} = 178.08\ °F > t_{ass} = 135°F$

BY BAI DATE 12-21-82
CHKD. BY CLM DATE 1-7-83

A EP D. C. COOK UNIT 1
S. V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 9 OF 12
PROJ. NO. 5364



AFTER PLOTING t_{ass} VS. t_{FOUND} AND BY VISUAL INTERPOLATION
(PROCEDURE: FIND $t_{ass} = t_{FOUND}$ ON LINE A-B)
NEW $t_{ass} = 141\ ^\circ F$

SUBSTITUTING $t_{ass} = 141\ ^\circ F$, INTO EQN (2) AND EQN (3)

$$Q_S = 27.52\ \frac{Btu}{hr}$$

$$Q_{VLV} = 39.82\ \frac{Btu}{hr}$$

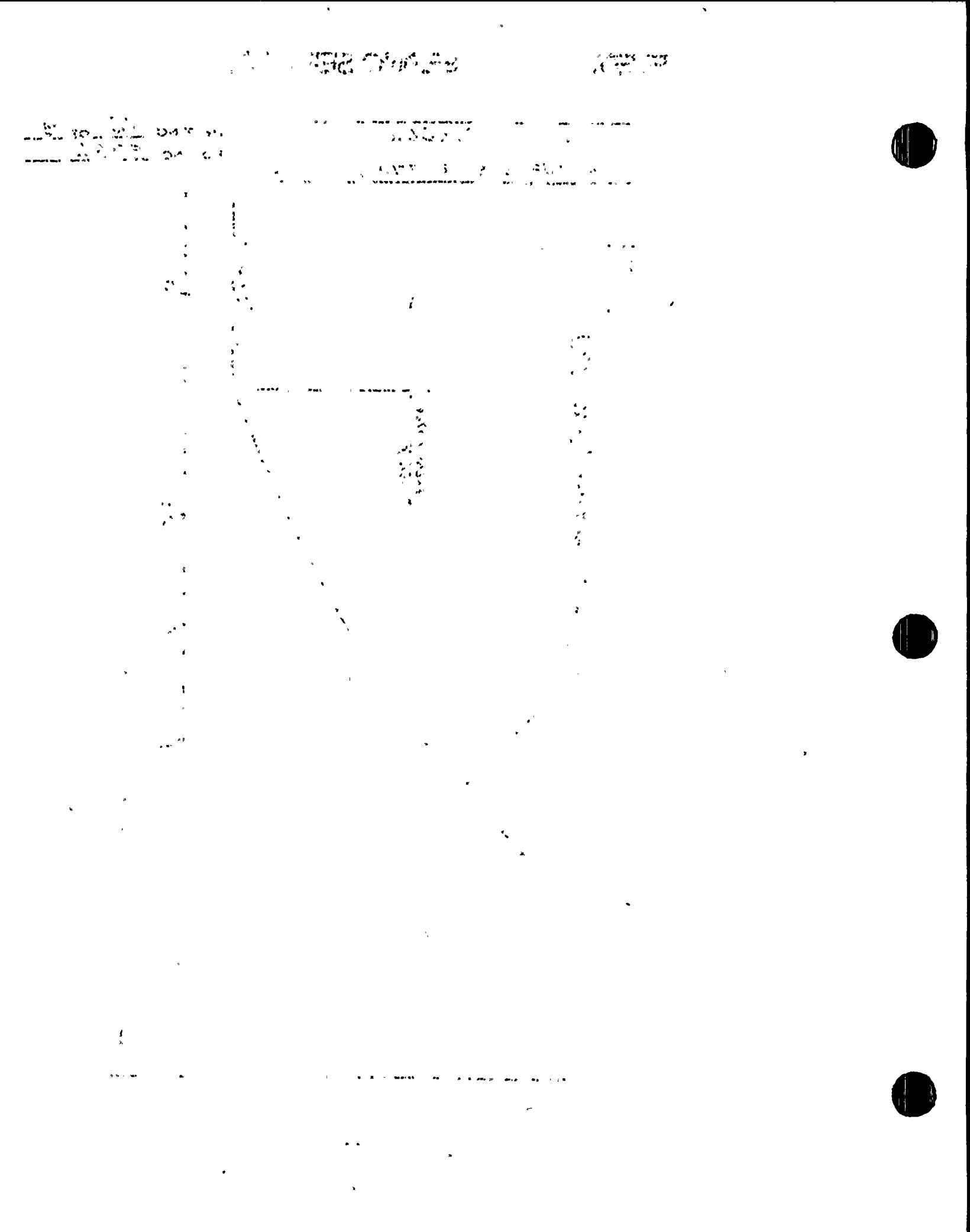
$$Q_{END} = 67.34\ Btu/hr$$

$$\begin{cases} C_1 + C_2 = 548 \\ -7.13C_1 + 0.14C_2 = 134.67 \end{cases}$$

$$C_1 = -7.97 \qquad C_2 = 555.97$$

$$t = -7.97e^{0.64x} + 555.97e^{-0.64x} + 120$$

@ $x = 3.07$; $t_{FOUND} = 141.08\ ^\circ F \approx t_{ass} = 141.00$



TELEDYNE ENGINEERING SERVICES

BY BAT DATE 12-21-83
CHKD. BY [illegible] DATE 1-7-83

AEP D.C. COOK
S.V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 10 OF 12
PROJ. NO. 5364

Z(ft)	t(°F)
0	668
0.5	512.74
1.0	398.04
1.5	312.06
2.0	245.92
2.5	192.77
3.07	141.08

TEMPERATURE DISTRIBUTION
ALONG THE LOOP SEAL

$t = -7.9 e^{0.64z} + 555.9 e^{-0.64z} + 120$ (F)

$t = 141.08$ °F

PRESSURIZER SIDE — VALVE SIDE

z ft

0.5 1.0 1.5 2.0 2.5 3.0 3.5

100 200 300 400 500 600 700

t °F

TELEDYNE ENGINEERING SERVICES

BY BAI DATE 12-21-82
CHKD. BY CUM DATE 1-7-83

AEP D.C. COOK UNIT 1
S.V. LINE LOOP SEAL TEMP. DISTRIBUTION

SHEET NO. 11 OF 12
PROJ. NO. 5364

CHECKING $T_r = 0.182 \frac{Btu}{hr\,ft^2\,°F}$ FOR $T_{AVE} = 325°F$ (PAGE 5)

AREA UNDER $t = t(x)$ CURVE @ $0 < x < L_1 = 3.07'$

$$AREA = \int_0^{L_1} t(x)\,dx$$

$$= \int_0^{L_1} \left[-7.97 e^{(0.64)x} + 555.97 e^{-(.64)x} + 120\right] dx$$

$$= -\frac{7.97}{0.64} e^{0.64x}\Big|_{x=0}^{3.07} - \frac{555.97}{0.64} e^{-(.64)x}\Big|_{x=0}^{3.07} + 120x\Big|_{x=0}^{3.07}$$

$$= (-88.83 + 12.45) - (121.78 - 868.70) + (368.4)$$

$$AREA = 1038.94\ °F\,ft$$

$$t_{AVE} = \frac{1038.94}{3.07}$$

$t_{AVE} = 338.42°F$ 4% DIFFERENCE FROM THE ASSUMED $t_{AVE} = 325°F$ WHICH IS ACCEPTABLE

Technical Report
TR-5364-1
Revision 0

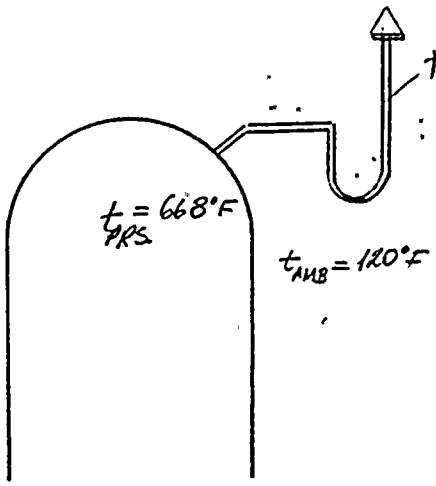
TELEDYNE ENGINEERING SERVICES

BY BAI DATE 12-22-82
CHKD. BY MM DATE 1-7-83

AEP D. C. COOK UNIT 1
S.V. LINE LOOPSEAL TEMP. DISTRIBUTION

SHEET NO. 12 OF 12
PROJ. NO. 5364

CHEKING THE RADIATION EFFECTS ON LOOP SEAL BY TAKING CONSERVATIVE VALUES FOR THE WORST CASE



ASSUME THE LOOPSEAL AS LUMPED VOL.

AVERAGE TEMPERATURE OF LOOP SEAL .....

$$t_{AVE}\Big|_{L.S} = \frac{C_p A L_1 (338.42) + C_p A L_2 (141.08)}{C_p A (L_1 + L_2)} = 205.6$$

$t_{AVE} = 205.60°F = 665.60°R$ $\quad L_1 = 3.07'$

WHERE = ρ : DENSITY
A : CROSS-SECTIONAL AREA $\quad L_2 = 6.32'$
C_p : HEAT CAPACITY

FROM PAGE 5 $T_r = .145 \frac{Btu}{hr\,ft^2 °F}$ @ $t = 212.71°F$

$$\frac{q}{A} = (.145)(205.6 - 120) = 12.41 \frac{Btu}{hr\,ft^2}$$

T_s – SURFACE TEMP. OF LOOP SEAL USING NEWTON'S LAW OF COOLING & $h = 5 \frac{Btu}{hr\,°F\,ft^2}$

$12.41 = 5(T_s - 120)$

$t_s = 122.48°F$

PRESSURIZER :

MAX. HEAT LOSS FROM PRESSURIZER $\frac{q}{A} = 80 \frac{Btu}{ft^2 °F\,hr}$ (REF: METALLIC INSULATION AEP SPEC. NO. DCCSG102QCS

t_p SURFACE TEMP. OF PRESSURIZER $\quad 80 = 5(t_p - 120)$

$t_p = 136°$

ASSUMING : RADIATION SHAPE FACTORS = 0.5
EMISSIVITY $\epsilon \cong 0.03$ (SINCE SURFACES ARE MIRROR)
(REF: MARKS MECH. ENG. HANDBOOK 6th EDITION)

STEFAN-BOLTZMANN CONST. $\sigma = 0.1714 \times 10^{-8} \frac{Btu}{hr\,ft^2 R^4}$

$$\frac{q}{A}\Big)_{RAD} = \sigma \epsilon F_{12} (T_p^4 - T_s^4) = (0.03)(0.5)(.1714 \times 10^{-8})[596^4 - 582^4]$$

$$\frac{q}{A}\Big)_{RAD} = 0.294 \frac{Btu}{hr\text{-}ft^2}$$

RADIATION HEAT TRANSFER HAS NEGLIGIBLE EFFECT ON LOOP SEAL TEMP. DISTRIBUTION

TELEDYNE ENGINEERING SERVICES

BY CHM DATE 1-11-82
CHKD. BY KJG DATE 5-24-83

TEMPERATURE DISTRIBUTION DETERMINATION - UNIT 2

SHEET NO. 1 OF 1
PROJ. NO. 5364

USING THE EQUATION:

$$t = -7.97e^{0.64x} + 355.97e^{-0.64x} + 120 \ (^{\circ}F).$$

WHERE x = AXIAL DISTANCE AWAY FROM PRESSURIZER ALONG LOOP SEAL

ACCURATE $0 \leq x \leq 3.07$ (FT)

FOR VALUES $x > 3.07$ $t = 141.08\ ^{\circ}F$

REF: BAI HAND CALC 12-22-82

CONTROL VOLUME	x VALUE (FT)	t (DETERMINED) ($^{\circ}F$)
501	0.25	584.4
502	0.75	451.1
503	1.25	352.1
504	1.75	276.8
505	2.25	218.1
506	2.75	169.3
507 ↓	3.25	141.1 ↓
520	VALVE	

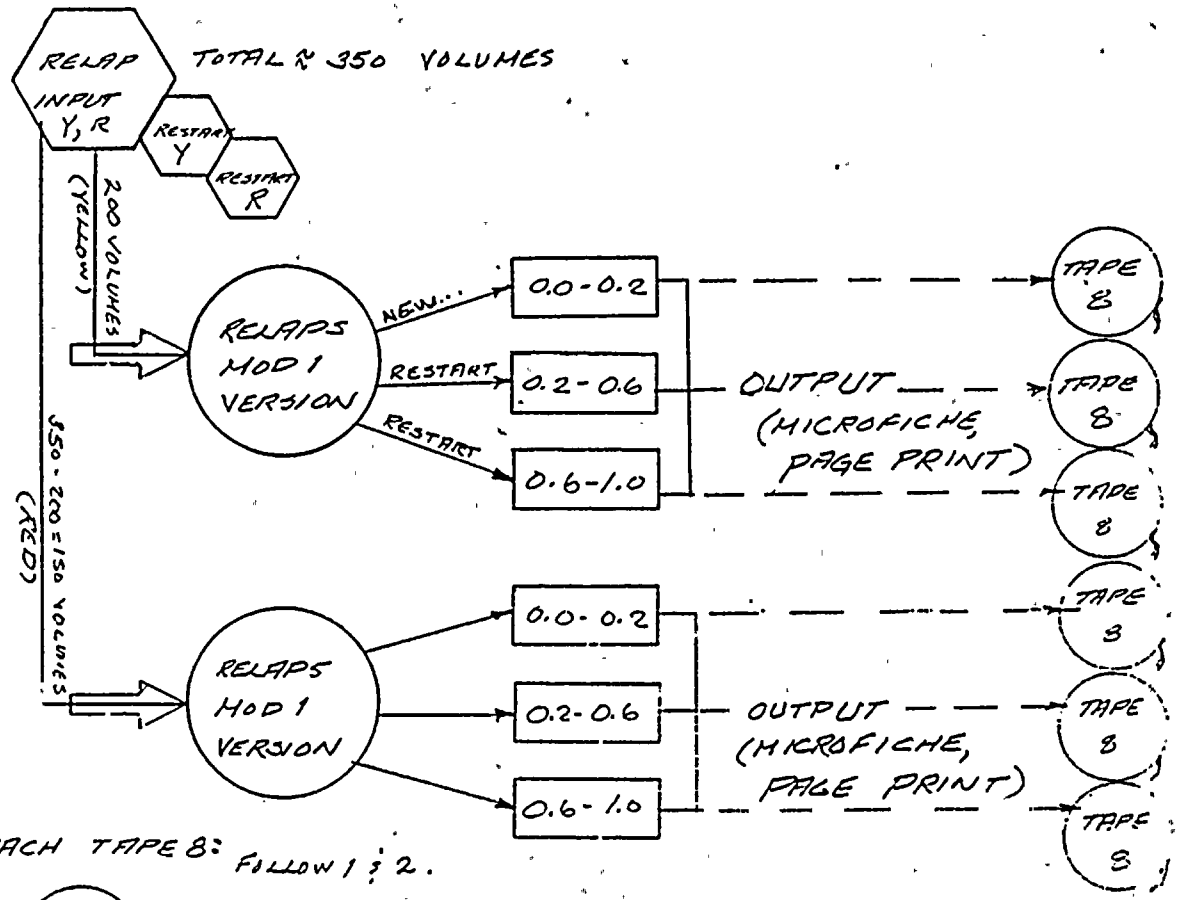
BY CHM DATE 5-4-83
CHKD. BY KG DATE 5-24-83

COMPUTER USAGE FOR THERMAL ANALYSIS

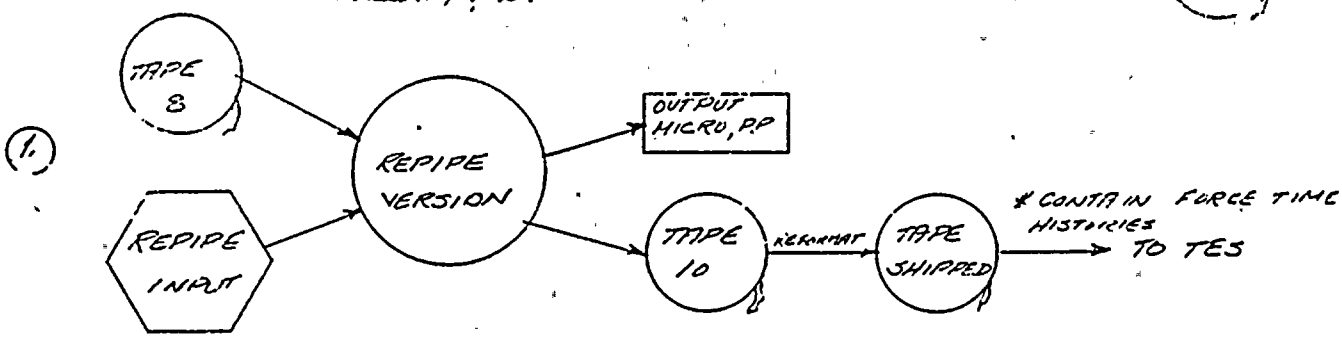
SHEET NO. 1 OF 2
PROJ. NO: 5364

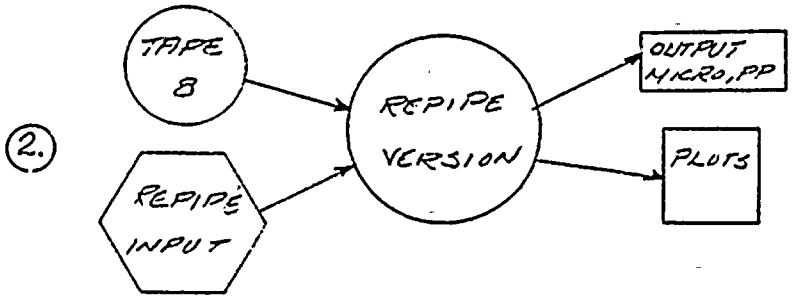
TRANSIENTS:

1. LOOPSEAL (SATURATED) STEAM CASE @CDC
2. SOLID 400° WATER CASE



FOR EACH TAPE 8: FOLLOW 1 & 2.

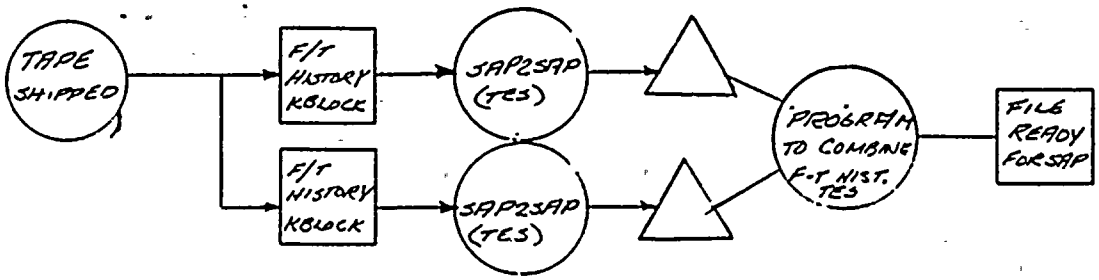


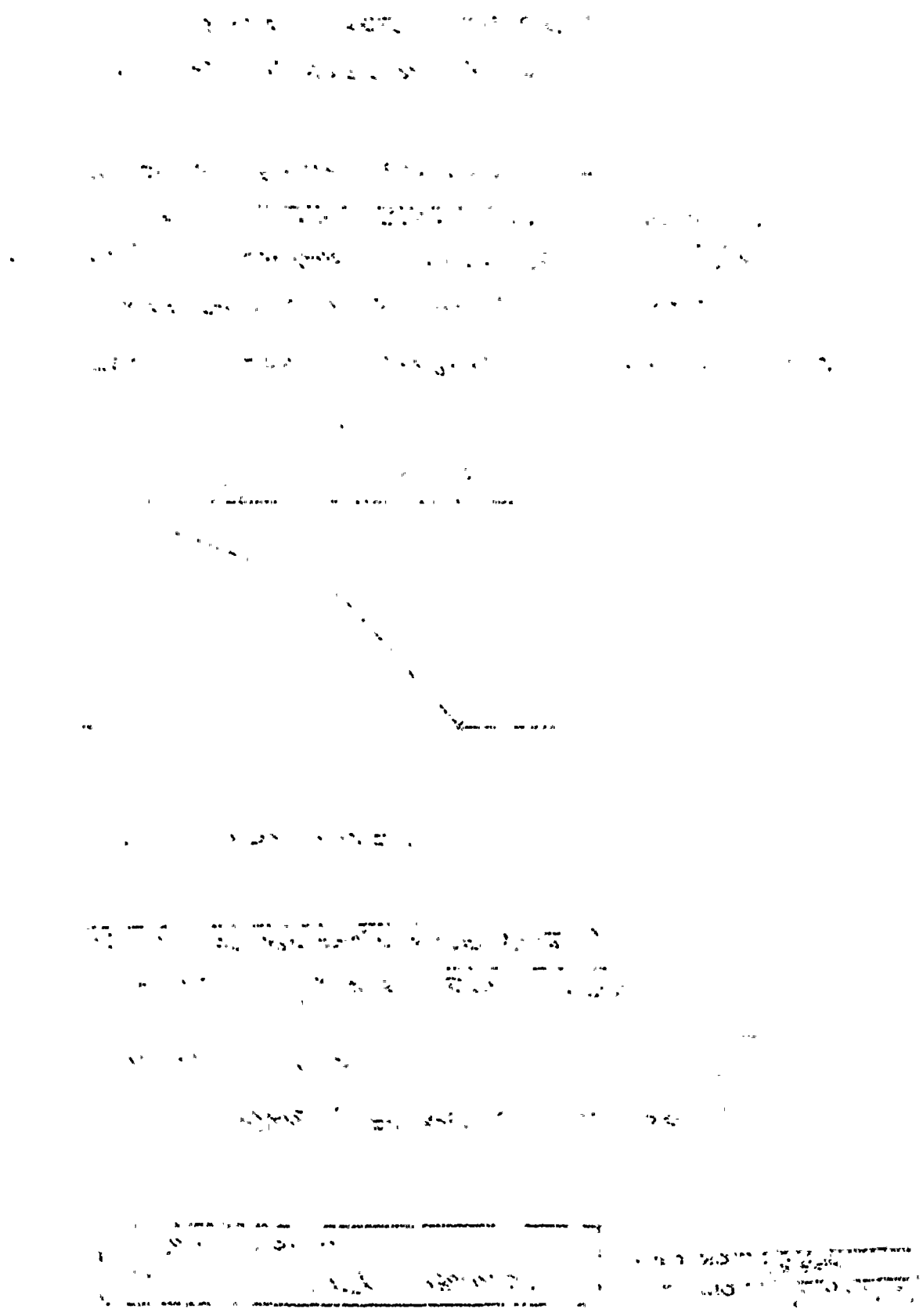


BY CHM DATE 5-4-83
CHKD. BY KJG DATE 5-24-83

COMPUTER USAGE FOR THERMAL ANALYSIS.

SHEET NO. 2 OF 2
PROJ. NO. 5364





TELEDYNE ENGINEERING SERVICES

BY CHM DATE 3-28-83
CHKD. BY KK DATE 5-9-83

PORV UNIT 1 BOUNDARY CONDITIONS

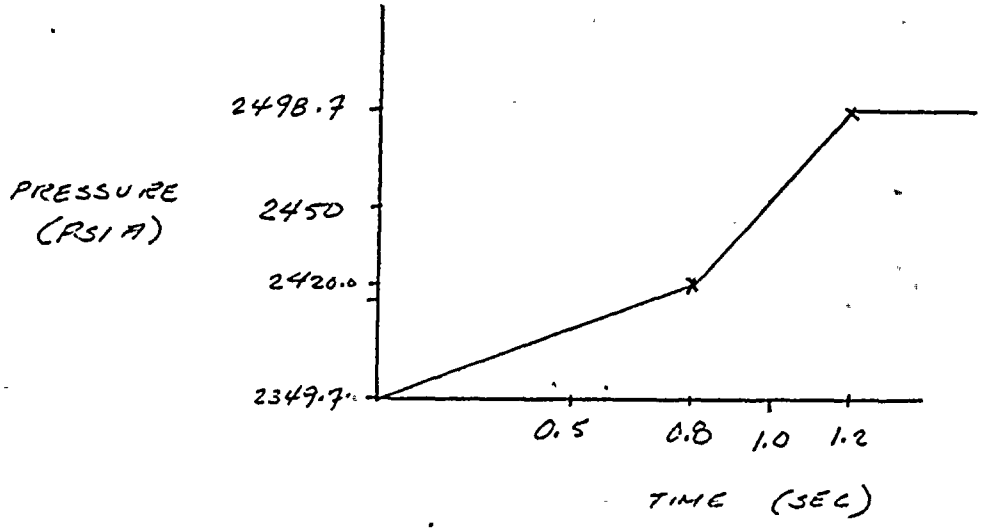
SHEET NO. 1 OF 1
PROJ. NO. 5364

(1.) VALVE OPENING TIME, PORV : 1.0 SEC

MASONEILAN : REF :

(TIME) REF : TABLE 4.5.2-1 PG 4-50 EPRI SAFETY & RELIEF VALVE TEST REPORT (RP-V102)

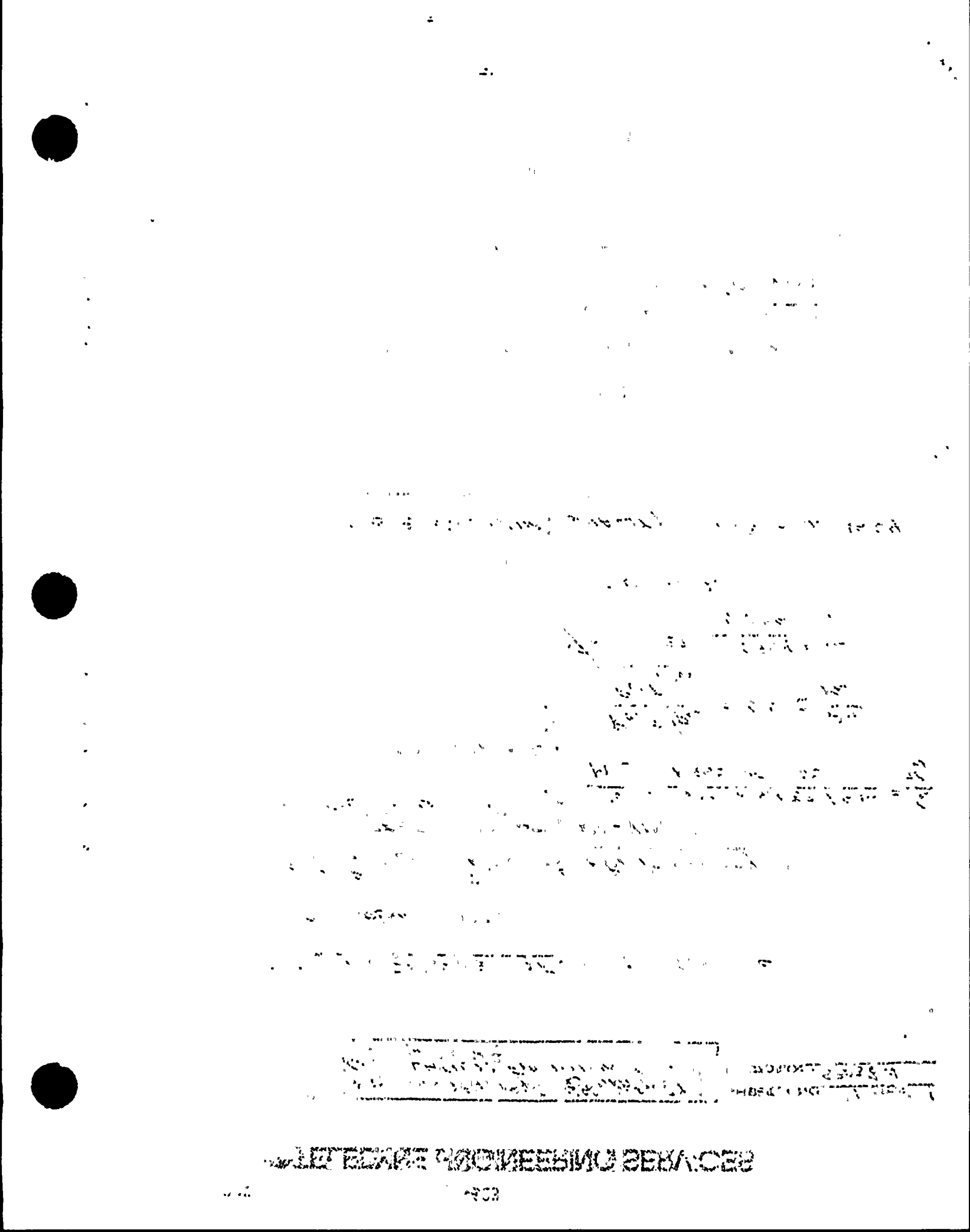
(2.) PRESSURIZER CONDITIONS :



REF : AEP LETTER TO NRC 11-29-82 / CURVE PG 6 OF 7

(3) VALVE FLOW AREA CALCULATED KNOWING ASME FLOW RATE = 199,000 lbm/HR. REF: PG 4-53 EPRI SAFETY AND RELIEF VALVE TEST REPORT (RP-V102) AND RUN BAICORE AREA = 0.00806 FT^2

(4.) QUALITY USED IN UPSTREAM PIPING TO SIMULATE CONDENSATE SEE NUG CALC



TELEDYNE ENGINEERING SERVICES

BY CHM 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 $\qquad P_v = 1.6924$ psia

SPECIFIC HUMIDITY $\gamma = \frac{M_w}{M_a} = \frac{\text{MASS OF WATER VAPOR}}{\text{MASS OF AIR}} = \frac{V_a}{V_w}$

$$\gamma = \frac{R_a T / P_a}{R_w T / P_w} = 0.622 \frac{P_w}{P_a}$$

$$\gamma = 0.622 \frac{1.6924 \text{ psia}}{16.008 \text{ psia}}$$

$$\gamma = 0.06576$$

NONCONDENSIBLE GAS (AIR) QUALITY $= 1 - \gamma = 0.93424$

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TECHNICAL REPORT TR-5364-1
REVISION 0

BOOK 3 OF 15

DONALD C. COOK NUCLEAR GENERATING PLANT

ANALYSIS OF PRESSURIZER SAFETY/RELIEF VALVES DISCHARGE PIPING SYSTEM PER NUREG 0737, II.D.1, UNIT 1

JUNE 6, 1983

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

TECHNICAL REPORT TR-5364-1
REVISION 0

BOOK 3 OF 15

DONALD C. COOK NUCLEAR GENERATING STATION

ANALYSIS OF PRESSURIZER SAFETY/RELIEF VALVES DISCHARGE PIPING SYSTEM PER NUREG 0737, II. D.1, UNIT 1

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JUNE 6, 1983

TELEDYNE ENGINEERING SERVICES

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

SERVICES

TABLE OF CONTENTS

			PAGE
1.0	INTRODUCTION	Book 1 of 15	1-1
2.0	CONCLUSIONS		2-1
3.0	SYSTEM DESCRIPTION/DISCUSSION		3-1
4.0	THERMAL FLUIDS ANALYSIS		4-1
4.1	Introduction		4-1
4.2	RELAP Model		4-3
4.2.1	Pressurizer Conditions		4-3
4.2.2	Valve Modeling		4-4
4.2.3	Discharge Piping		4-5
4.2.4	Quench Tank		4-5
4.3	RELAP Model Control Volumes		4-16
4.4	Quarter Model		4-26
4.5	Unit 1 PORV Model		4-36
4.5.1	Condensate Modeled Case		4-36
4.5.2	PORV Modeled Transient		4-36
4.6	Valve Flow Rate Calculation		4-40
4.6.1	SV Flow Rate		4-41
4.6.2	PORV Flow Rate		4-42
4.7	RELAP Plots		4-45
4.7.1	Unit 1 - Condensate/Steam Case		4-46
4.7.2	Unit 1 - 400° Solid Liquid Case		4-166
4.7.3	Quarter Model - Cold Loop Seal/Steam Case		4-244
4.8	Force Time History Plots	Book 2 of 15	4-260
4.8.1	Unit 1 - Condensate/Steam Case		4-261
4.8.2	Unit 1 - 400° Solid Liquid Case		4-320
4.8.3	Quarter Model - Cold Loop Seal/Steam Case		4-392
4.9	RELAP Input		4-420
4.9.1	PORV Condensate/Steam		4-421
4.9.2	Condensate/Steam Restart		4-439
4.9.3	PORV Solid 400° Liquid		4-448
4.9.4	PORV Solid 400° Liquid Restart		4-467
4.9.5	SV Cold Loop Seal (Quarter Model)		4-472

SERVICES

TABLE OF CONTENTS
(Continued)

			PAGE
4.10	REPIPE Input		4-478
	4.10.1 Unit 1 - Model Section A		4-479
	4.10.2 Unit 1 - Model Section B		4-489
	4.10.3 Unit 2 - (Quarter Model)		4-496
4.11	APPENDIX A		
5.0	STRUCTURAL ANALYSIS	Book 3 of 15	5-1
5.1	Deadweight Analysis		5-2
5.2	Thermal Analysis		5-2
5.3	Seismic Analysis		5-2
5.4	Force/Time History Analysis		5-7
	5.4.1 PORV Transient		5-7
	5.4.2 SV Transient		5-8
6.0	ANALYTICAL RESULTS		6-1
6.1	Stress Summary		6-1
	6.1.1 Equation A-1 Stresses		6-6
	6.1.2 Equation A-2 Stresses		6-17
	6.1.3 Equation B-1 Stresses		6-28
	6.1.4 Equation B-2 Stresses		6-39
	6.1.5 Equation B-3 Stresses		6-50
	6.1.6 Equation C-1 Stresses		6-61
6.2	Support Loads		6-72
6.3	Valve Accelerations		6-105
	6.3.1 DBE Seismic Valve Accelerations		6-106
	6.3.2 PORV Transient Shock Valve Accelerations		6-110
6.4	Nozzle Loads		6-114
6.5	Valve Loads		6-120
6.6	Miscellaneous Calculations		6-126
	6.6.1 Thermal Boundary Displacements		6-127
	6.6.2 OBE Spectra		6-133
	6.6.3 DBE Spectra		6-140
7.0	DRAWINGS		7-1
8.0	REFERENCES		8-1

TABLE OF CONTENTS
(Continued)

9.0 COMPUTER ANALYSIS

9.1	RELAP/REPIPE Input	Book 4 of 15
9.2	Deadweight/Thermal Input/Output	Book 5 of 15
9.3	OBE Seismic X-Y Input/Output	Books 6, 7 of 15
9.4	OBE Seismic Y-Z Input/Output	Books 8, 9 of 15
9.5	DBE Seismic X-Y Input/Output	Books 10, 11 of 15
9.6	DBE Seismic Y-Z Input/Output	Books 12, 13 of 15
9.7	PORV Transient Shock Input	Books 14, 15 of 15

SERVICES

5.0 STRUCTURAL ANALYSIS

Deadweight, thermal, seismic and force/time history analyses were performed for 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 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 2) and AEP letter dated March 15, 1983 from Mr. Sam Ulan of AEP to Mr. Pat Harrison of TES (Reference 3). Section 6.0 contains all of the results for the analyses performed.

Only the piping shown on drawing E-5763 was included in the analysis. Branch lines not in the scope of work were decoupled in accordance with the procedure outlined in TES letter 5364-21 dated February 2, 1983 (Reference 8); that is if the moment of inertia of the main run of pipe is greater than or equal to 40 times the moment of inertia of the branch, the branch line was decoupled.

Valve drawing 88405-1 listed the weight of valves NMO-151, 152 and 153 as being 352 pounds and this value was used by TES in the deadweight and seismic analyses. However, per Reference 7, TES was informed by AEP that the valve weight was actually 400 pounds. TES immediately reran the deadweight and seismic analyses and observed a minor increase in seismic results, which were offset by a decrease in deadweight results. The decrease in deadweight results, in the opinion of TES, indicates the constant force supports near the valves are over supporting the pipe. The net result of the valve weight change was considered negligible and since pipe stresses and support loads had already been extracted and calculated based on the 352 pound valve weight, it was decided not to revise the deadweight and seismic analyses. The valve weight was changed to 400 pounds prior to executing the force/time history analysis.

SERVICES

5.1 Deadweight Analysis

The effects of pipe weight, water weight and insulation weight were considered in the deadweight analysis. In addition, concentrated weights were located wherever branch lines were decoupled, at flanges, and at valve cg's. The weights used for decoupled branch lines were calculated in accordance with the procedure defined in TES letter 5364-25, dated February 14, 1983 (Reference 9). Per Reference 3, only the normal operation deadweight case was analyzed.

A summary of the weights and forces applied in the deadweight analysis are shown in Table 5-1.

5.2 Thermal Analysis

Two thermal cases were analyzed; normal operation and PORV operation. Temperature distributions for the PORV case were obtained from the RELAP5 output. Throughout this report, thermal case 1 refers to normal operation and thermal case 2 refers to PORV operation.

Boundary displacements were calculated for the quench tank nozzle, pressurizer nozzles and support 1-GRC-R-616, which connects to the pressurizer, for both thermal conditions analyzed. These calculations are shown in Section 6.6.

5.3 Seismic Analysis

Seismic analysis was performed for both the operating basis earthquake (OBE) and design basis earthquake (DBE). For each of these conditions, two analyses were made; one considering response spectra applied in the X and Y directions and one considering response spectra applied in the Y and Z directions. The results in Section 6 will be based on the greater of these two analyses for all values reported.

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 6 JUNE 1983
D. C. COOK UNIT 1
DEADWEIGHT DATA TABLE 5-1

BY DMD DATE 6/6/83
CHKD PDA DATE 6/6/83
SHEET NO.____ OF _____

MAIN RISER

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
1	12" SCH. 40	34.748 *	(P) I W
4 THRU 206	12" SCH. 40	4.458	(P) I W
260 THRU 295	6" SCH. 40S	1.582	(P) I W

* FLANGE WEIGHT DISTRIBUTED OVER 2.042' ADDED TO PIPE WEIGHT.

APPLIED FORCES

NODE	FORCE LBS.
48	426
70	1200

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
1000	122
1001	20

NOTE; APPLIED FORCES REPRESENT THE SETTINGS OF CONSTANT FORCE SUPPORTS AT THE NODES INDICATED. ALL FORCES ARE APPLIED IN THE +Y GLOBAL DIRECTION.

SRV LOOP C (REFERS TO SRV LOOP CONTAINING VALVE SV-45C, THIS NOTATION IS TYPIC OF LOOPS B AND A ALSO.)

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
97 THRU 109	6" SCH. 40S	1.582	(P) I W
110 THRU 115	6" SCH. 40S	2.632	(P) (I) W
120 THRU 130	6" SCH. 160	5.575	(P) (I) (W)
132 THRU 138	6" SCH. 160	4.904	(P) (I) W

APPLIED FORCES

NODE	FORCE LBS.
101	142
111	1067

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
116	.81
1170	685.
118	164

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 6 JUNE 1983
D. C. COOK UNIT 1
DEADWEIGHT DATA Table 5-1 (Cont)

BY DMS DATE 6/6/83
CHKD PDH DATE 6/6/83
SHEET NO. ____ OF ____

SRV LOOP B

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
142 THRU 157	6" SCH. 40S	1.582	(P) I W
158 THRU 165	6" SCH. 40S	2.632	(P) (I) W
170 THRU 180	6" SCH. 160	5.575	(P) (I) (W)
181 THRU 185	6" SCH. 160	4.904	(P) (I) W

APPLIED FORCES

NODE	FORCE LBS.
159	1074

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
164	81
1660	685
168	164

SRV LOOP A

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
206 THRU 216	6" SCH. 40S	1.582	(P) I W
220 THRU 225	6" SCH. 40S	2.632	(P) (I) W
229 THRU 237	6" SCH. 160	5.575	(P) (I) (W)
238 THRU 244	6" SCH. 160	4.904	(P) (I) W

APPLIED FORCES

NODE	FORCE LBS.
221	1025

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
224	81
2260	685
228	164

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 6 JUNE 1983
D. C. COOK UNIT 1
DEADWEIGHT DATA Table 5-1 (Cont)

BY Smd DATE 6/6/83
CHKD PDH DATE 6/6/83
SHEET NO. ____ OF ____

PORV LOOP 153 (REFERS TO PORV LOOP CONTAINING VALVES NMO-153 AND NRV-153, THIS NOTATION IS TYPICAL OF LOOPS 152 AND 151 ALSO.)

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER		
295	6" SCH. 40S	1.58	P	I	W
560 THRU 534	3" SCH. 40S	.632	(F)	I	W
533 THRU 525	3" SCH. 40S	1.190	(F)	(I)	W
510 THRU 480	3" SCH. 160	1.948	(F)	(I)	(W)
475 THRU 450	3" SCH. 160	1.753	(F)	(I)	W
440 THRU 590	4" SCH. 120	2.200	(F)	(I)	W
595 THRU 750	6" SCH. 160	4.825	(F)	(I)	W

APPLIED FORCES

NODE	FORCE LBS.
529	658
485	811
668	1159

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
516	480
496	352
1002	14
1003	14

DATE

DATE

OF

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 6 JUNE 1983
D. C. COOK UNIT 1
DEADWEIGHT DATA Table 5-1 (Cont)

BY DMD DATE 6/6/83
CHKD PDH DATE 6/6/83
SHEET NO. ____ OF ____

PORV LOOP 152

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
300 THRU 335	4" SCH. 40S	.899	(P) I W
340 THRU 370	3" SCH. 40S	.632	(P) I W
375 THRU 385	3" SCH. 40S	1.190	(P) (I) W
400 THRU 435	3" SCH. 160	1.948	(P) (I) (W)

APPLIED FORCES

NODE	FORCE LBS.
382	638
431	930

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
391	480
411	352

PORV LOOP 151

NODES	PIPE SIZE	DIST.WEIGHT LBS/IN	CONTENTS PIPE/INSULATION/WATER
335	3" SCH. 40S	.632	(P) I W
610 THRU 625	3" SCH. 40S	1.190	(P) (I) W
635 THRU 660	3" SCH. 160	1.948	(P) (I) (W)

APPLIED FORCES

NODE	FORCE LBS.
620	783

CONCENTRATED WEIGHTS

NODE	WEIGHT LBS.
631	480
651	352

NOTE: THE VALVE WEIGHTS OF 352 LBS. LISTED FOR THE THREE PORV LOOPS I KNOWN TO BE INCORRECT. PER AMENDED INFORMATION, THESE WEIGHTS WERE CHANGED TO 400 LBS. THE 48 LB. DIFFERENCE WAS, HOWEVER, DETERMINED T HAVE NEGLIGIBLE AFFECT ON THE ANALYSIS. (SEE SECTION 5)

For the OBE analysis, the horizontal spectra was obtained by enveloping Containment Crane Wall Figures for elevations 651'-3", 663'-4", 675'-4" and 687'-6". The figures used were based on .5% equipment damping and 2% structural damping. Prior to enveloping the figures, the peaks of each curve were broadened +/-15%, in accordance with NRC Regulatory Guide 1.122.

For the vertical direction Containment Base Slab, elevation 597'6" was used with .5% equipment damping and 2% structural damping. The peaks of this curve were also broadened +/-15% and two-thirds of the value obtained from the figure was used in the spectra.

For the OBE analysis, the spectra were obtained for the horizontal and vertical directions in the same manner as for the horizontal direction; except that 5% structural damping was used rather than 2%.

The procedures described above are in accordance with the November 29, 1982 letter from AEP (Reference 2) and TES letter 5364-33, dated April 8, 1983 (Reference 10).

The peak broadened figures used and spectra obtained are detailed in Section 6.6.

5.4 Force/Time History Analysis

5.4.1 PORV Transient

Two potential PORV transients exist, condensate and solid water. Based on a preliminary analysis by TES, it was determined that the solid water case was the dominating condition throughout the piping system. Based on these results, only the solid water case was analyzed.

The solid water analysis was performed at one millisecond intervals for a length of one second. All loads peaked previous to one second, indicating that the analysis was performed for a sufficient length of time.

5.4.2 SV Transient

The SV transient condition was not analyzed for Unit 1 based on the quarter model SV transient analysis performed for Unit 2. That analysis, which considered the opening of only one SV valve, resulted in catastrophic failure of the piping system. Due to the similarity of the Unit 1 and Unit 2 piping systems, it was considered not justifiable economically to analyze the SV transient for Unit 1 until the system was modified. The results of the 1/4 model SV analysis are given in TES Technical Report TR-5364-2, Revision 0 (Reference 6).

6.0 ANALYTICAL RESULTS

6.1 Stress Summary

Stress calculations were based on the 1967 Edition of the ANSI B31.1 Code (Reference 11), the AEP letter dated November 29, 1982 (Reference 2), and the AEP letter dated March 15, 1983 (Reference 3). The stress combinations performed were:

A1 normal pressure stress + deadweight stress $< S_h$

A2 normal thermal stress range $< (1.25\ S_c + .25\ S_h)$

B1 normal pressure stress + deadweight stress + OBE stress $< 1.2\ S_h$

B2 PORV transient pressure stress + deadweight stress + $\left[(\text{OBE stress})^2 + (\text{PORV transient shock stress})^2\right]^{1/2} < 1.2\ S_h$

B3 PORV transient thermal stress range $< \left(1.25\ S_c + .25\ S_h\right)$

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

Stresses were not calculated for equation A3 since all node points passed the equation A2 stress criteria. The equation C2 stresses were not calculated since the SV transient shock analysis was not performed, based on the Unit 2 Quarter model analysis (see Section 5.4.2). Equation C3 stresses do not exist since TES did not analyze for the SV transient thermal condition, see Section 5.2.

The TMRPASS computer program was used, when possible, to aid in the stress calculations. The program; however, does not allow for intensification factors to be omitted in the torsional direction as does the B31.1 code. Therefore, the stresses presented consider, at any intensified nodes, all moments

to be intensified. For equation B2, three nodes, (540, 533 and 435B), originally failed this more conservative method. In order to not exceed the stress criteria at these nodes, the intensification factor was removed, by hand calculations, in the torsional direction for as many of the loading conditions as necessary. The revised stress values are presented in the appropriate Table.

Allowable stresses were obtained by using the maximum temperature the piping experienced during any loading case to determine Sh. The value of Sc was based on 70°F per Reference 2. A summary of the allowable stresses is given in Table 6.1-1.

Section 119.6.1 of the B31.1 code indicates that the thermal stress range stress calculations shall be based on the range between the minimum and maximum temperature. Neither equation A2 or B3 allows for this criteria, however, the worst thermal moments due to both conditons analyzed, plus the case of no expansion, was 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

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 28 MAY 1983
D. C. COOK UNIT 1
SUMMARY OF ALLOWABLES

BY DMB DATE 5-28-83
CHKD DMB DATE 5/28/83
SHEET NO. ____ OF ____

TABLE 6.1-1

MAIN RISER

NODES	MATERIAL	TEMPERATURE (F)	Sh (PSI)
1 THRU 26	SA-358-316 CL 1	400	16210
32 THRU 52	"	526	16744
56 THRU 72	"	537	16678
74 THRU 93	"	554	16576
97 THRU 206	"	548	16612
260	SA-312-304	548	15262
280 THRU 295	"	550	15070
296 THRU 295	"	410	14898

SRV LOOPS

NODES LOOP C	NODES LOOP B	NODES LOOP A	MATERIAL	TEMPERATURE (F)	Sh (PSI)
99 THRU 100	144 THRU 146	208	SA-312-304	548	15252 *
102 THRU 107	148 THRU 155	214 THRU 216	"	550	15153
110 THRU 112	157 THRU 160	220 THRU 222	"	450	14830
114 THRU 1140	162 THRU 163	223 THRU 2230	"	460	14710
115	165	225	"	460	11740 *
120	170	227	SA-376-316	653	11600 *
122 THRU 138	172 THRU 188	233 THRU 244	SA-376-316	653	13000

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.

TELEDYNE ENGINEERING SERVICES

PROJECT: 5364 28 MAY 1983
D. C. COOK UNIT 1
SUMMARY OF ALLOWABLES

BY DMB DATE 5-28-83
CHKD Dmb DATE 5/28/83
SHEET NO. ____ OF ____

TABLE 6.1-1 (cont.)

PORV LOOP 153

NODES	MATERIAL	TEMPERATURE (F)	Sh (PSI)
560 THRU 555	SA-312-304	413	14898
550 THRU 529	"	480	14630
525 THRU 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 282	SA-312-304	413	14898
305 THRU 390	SA-312-304	653	14300
400 THRU 431	SA-376-304	653	14300

PORV LOOP 151

NODES	MATERIAL	TEMPERATURE (F)	Sh (PSI)
610 THRU 620	SA-312-304	480	14630
625 THRU 630	SA-312-304	653	14300
635 THRU 665	SA-376-304	653	14300

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

6.1.1 Equation A-1 Stresses

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DmD DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
1	0	.1	.1	16.2
4		.9	.9	
6		.3	.3	
7		.2	.2	
8		.1	.1	
10		.2	.2	
12		.5	.5	
18		.4	.4	
30		.4	.4	
32		.7	.7	16.7
33		.4	.4	
34		.4	.4	
36		.5	.5	
38		.2	.2	
40		.2	.2	
42		.1	.1	
44		.2	.2	
46		.2	.2	
48		.1	.1	
50		.2	.2	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DAD DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
52	0	.3	.3	16.7
56		.4	.4	
58		.4	.4	
60		.3	.3	
62		.4	.4	
66		.2	.2	
68		.2	.2	
70		.2	.2	
72		.1	.1	
74		.3	.3	16.6
76		.2	.2	
80		.3	.3	
82		.5	.5	
83		.2	.2	
84		.5	.5	
86		.3	.3	
88		.3	.3	
90		.5	.5	
93		.4	.4	
97R		.8	.8	16.6

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: JMB DATE: 5-3-83
CHECKED BY: SmS DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
97R	0	.7	.7	16.6
195		.5	.5	
142R		.7	.7	
142R		.6	.6	
200		.4	.4	
206R		.3	.3	
206R		.3	.3	↓
260		1.0	1.0	15.3
280		1.5	1.5	15.1
285		4.5	4.5	15.1
290		5.3	5.3	14.9
295B		3.7	3.7	↓
97E		.7	.7	15.3
98		.8	.8	
99		.7	.7	
100		.4	.4	↓
102		.3	.3	15.1
103		.3	.3	
104		.8	.8	
106	↓	1.0	1.0	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 5-3-83
CHECKED BY: DMB DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
108	0	.6	.6	15.1
109		.9	.9	15.1
110		1.2	1.2	14.8
112		.5	.5	14.8
114		1.2	1.2	14.7
1140		.7	.7	14.7
115	↓	.7	.7	11.7
120	3.5	0.9	4.4	11.6
122		1.1	4.6	16.0
124		.9	4.4	
126		.9	4.4	
128		.7	4.2	
130		.6	4.1	
132		.9	4.4	
134		1.0	4.5	
136		1.2	4.7	
138	↓	1.3	4.8	↓
142E	0	.6	.6	15.3
144		.4	.4	
146	↓	.2	.2	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [illegible] DATE: 5-3-83
CHECKED BY: DMB DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
148	0	.3	.3	15.1
150		1.0	1.0	
152		1.4	1.4	
156		.8	.8	↓
157		1.1	1.1	14.8
158		1.3	1.3	
160		.7	.7	↓
162		1.2	1.2	14.7
163		.7	.7	14.7
165	↓	.7	.7	11.7
170	3.5	.9	4.4	11.6
172		1.0	4.5	16.0
174		.8	4.3	
176		.8	4.3	
178		.5	4.0	
180		.5	4.0	
181		.8	4.3	
182		.9	4.4	
184		1.1	4.6	
185	↓	1.2	4.7	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMS DATE: 5-3-83
CHECKED BY: DmS DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
206B	0	1.1	1.1	15.3
208		.3	.3	15.3
214		1.0	1.0	15.1
216		1.5	1.5	15.1
220		1.3	1.3	14.8
222		.6	.6	14.8
223		1.0	1.0	14.7
2230		.6	.6	14.7
225	↓	.6	.6	11.7
229	3.5	.7	4.2	11.6
233		.8	4.3	16.0
234		.5	4.0	
235		.5	4.0	
236		.3	3.8	
237		.2	3.7	
238		.7	4.2	
240		.8	4.3	
242		1.1	4.6	
244	↓	1.1	4.6	↓
295R	0	3.2	3.2	14.9

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [illegible] DATE: 5-3-83
CHECKED BY: DMS DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
560	0	9.9	9.9	14.9
555		5.6	5.6	14.9
550		3.5	3.5	14.6
545		3.7	3.7	
540		3.8	3.8	
536		3.7	3.7	
535		4.1	4.1	
534		4.7	4.7	
533		5.6	5.6	
530		6.4	6.4	
529		4.2	4.2	↓
525	↓	4.6	4.6	14.3
510	2.9	3.0	5.9	
505		2.5	5.4	
490		1.7	4.6	
485		2.8	5.7	
480		2.7	5.6	
475		2.5	5.4	
465		4.2	7.1	
460	↓	2.7	5.6	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [illegible] DATE: 5-3-83
CHECKED BY: DMS DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
450	2.9	5.0	7.9	14.3
440	4.1	5.4	9.5	14.3
435R		3.4	7.5	16.0
435R		1.1	5.2	16.0
575		3.5	7.6	16.0
585		5.5	9.6	
590		6.3	10.4	
595	↓	7.0	11.1	
600R	3.5	2.1	5.6	
600R	3.5	2.5	6.0	
668	3.5	2.6	6.1	
670		2.6	6.1	
675		2.9	6.4	
680		2.9	6.4	
690		2.6	6.1	
700		2.1	5.6	
710		1.1	4.6	
715		.8	4.3	
717		.5	4.0	
720	↓	.4	3.9	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [illegible] DATE: 5-3-83
CHECKED BY: DMD DATE: 5/3/83

STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
725	3.5	.4	3.9	16.0
750	3.5	.3	3.8	16.0
295R	0	2.7	2.7	14.9
300		5.2	5.2	
310		4.1	4.1	
320		2.8	2.8	
325		1.6	1.6	
335R		1.2	1.2	
335R		2.9	2.9	↓
340		4.7	4.7	14.6
350		2.8	2.8	
355		1.0	1.0	
360		1.9	1.9	
365		3.1	3.1	
370		3.7	3.7	
375		3.6	3.6	
380		3.4	3.4	
382		2.4	2.4	↓
385	↓	2.5	2.5	14.3
400	2.9	1.7	4.6	14.3

TELEDYNE
ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
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STRESS SUMMARY - EQUATION A1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	EQUATION A1 STRESS (KSI)	ALLOWABLE STRESS (KSI)
405	2.9	2.1	5.0	14.3
420		2.6	5.5	
429		4.1	7.0	
430		4.6	7.5	
431		4.7	7.6	
435B		5.0	7.9	
335B	0	3.0	3.0	14.9
610		3.6	3.6	14.6
615		3.5	3.5	
620		2.6	2.6	
625		2.8	2.8	14.3
635	2.9	2.9	5.8	
645		3.7	6.6	
657		3.8	6.7	
660		3.2	6.1	
665		3.0	5.9	
600B		3.0	5.9	

6.1.2 Equation A-2 Stresses

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMB DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
1	.7	27.5
4	7.6	
6	6.8	
7	2.5	
8	2.5	
10	7.0	
12	7.6	
18	3.1	
30	9.5	↓
32	8.8	27.6
33	3.3	
34	3.1	
36	3.0	
38	4.6	
40	6.9	
42	2.7	
44	7.2	
46	9.5	
48	3.8	
50	11.2	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [illegible] DATE: 5-3-83
CHECKED BY: DMD DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
52	11.7	27.6
56	11.0	
58	11.3	
60	13.0	
62	12.8	
66	2.5	
68	2.4	
70	2.3	
72	1.2	
74	2.1	
76	2.1	
80	2.3	
82	2.5	
83	.9	
84	2.4	
86	2.2	
88	2.4	
90	2.9	
93	1.4	
97R	3.5	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMS DATE: 5-3-83
CHECKED BY: DMS DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
97 R	2.1	27.6
195	1.1	
142 R	2.8	
142 R	1.7	
200	.8	
206 R	2.2	
206 R	2.8	↓
260	6.0	27.3
280	3.6	27.2
285	8.9	
290	8.3	
295 B	5.8	↓
97 B	7.5	27.3
98	3.1	
99	2.0	
100	1.9	↓
102	2.4	27.2
103	3.0	
104	7.4	
106	7.1	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMS DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
108	3.1	27.2
109	1.0	27.2
110	1.3	27.1
112	4.7	
114	5.3	
1140	2.3	
115	2.3	26.4
120	.8	26.3
122	.8	27.4
124	1.2	
126	1.2	
128	1.4	
130	1.3	
132	1.4	
134	1.4	
136	1.4	
138	1.3	
142B	9.8	27.3
144	3.6	
146	2.3	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 5-3-83
CHECKED BY: DMD DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
148	2.7	27.2
150	8.1	
152	8.3	
156	3.5	↓
157	.6	27.1
158	2.1	
160	5.6	
162	5.6	
163	2.4	↓
165	2.4	26.4
170	.8	26.3
172	1.6	27.4
174	2.2	
176	2.2	
178	2.4	
180	2.0	
181	1.9	
182	1.9	
184	2.0	
185	1.8	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [signature] DATE: 5-3-83
CHECKED BY: [signature] DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
206 B	17.6	27.3
208	4.0	27.3
214	4.6	27.2
216	6.6	27.2
220	2.4	27.1
222	7.5	
223	5.1	
2230	2.2	↓
225	2.2	26.4
229	1.7	26.3
233	3.3	27.4
234	4.5	
235	4.5	
236	5.2	
237	4.6	
238	4.1	
240	4.1	
242	4.2	
244	3.8	↓
295 R	2.9	27.2

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 5-3-83
CHECKED BY: DMD DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
560	7.0	27.2
555	3.8	27.2
550	1.8	27.1
545	4.3	
540	4.6	
536	2.5	
535	2.5	
534	2.6	
533	4.6	
530	5.2	
529	2.9	↓
525	2.9	27.0
510	1.7	
505	1.7	
490	1.7	
485	1.8	
480	1.9	
475	1.7	
465	2.0	
460	1.6	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMS DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
450	2.0	27.0
440	2.1	27.0
435R	1.2	27.4
435R	2.7	
575	2.1	
585	.8	
590	.7	
595	.5	
600R	.1	
600R	1.8	
668	1.8	
670	2.0	
675	1.9	
680	1.7	
690	1.5	
700	1.7	
710	2.0	
715	2.6	
717	3.5	
720	4.2	↓

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 5-3-83
CHECKED BY: DMD DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
725	4.5	27.4
750	4.4	27.4
295 R	4.6	27.2
300	6.1	
310	3.2	
320	2.3	
325	5.5	
335 R	10.0	
335 R	1.7	
340	2.1	27.1
350	2.5	
355	2.8	
360	2.9	
365	5.4	
370	4.8	
375	3.0	
380	2.3	
382	1.1	
385	.9	
400	.2	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMS DATE: 5/3/83

STRESS SUMMARY - EQUATION A2

NODE #	NORMAL THERMAL STRESS (KSI)	ALLOWABLE STRESS (KSI)
405	.7	27.0
420	1.2	
429	1.8	
430	2.1	
431	2.2	
435B	3.0	
335B	15.1	27.2
610	16.3	27.1
615	12.7	
620	6.7	
625	5.0	27.0
635	2.0	
645	4.1	
657	6.5	
660	9.1	
665	10.0	
600B	13.0	

6.1.3 Equation B-1 Stresses

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [signature] DATE: 5-3-83
CHECKED BY: [signature] DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
1	0	.1	.1	.2 (YZ)	19.5
4		.9	.8	1.7 YZ	
6		.3	.5	.8 YZ	
7		.2	.2	.4 YZ	
8		.1	.1	.2 YZ	
10		.2	.2	.4 YZ	
12		.5	.4	.9 YZ	
18		.4	.1	.5 YZ	
30		.4	.2	.6 YZ	
32		.7	.2	.9 YZ	20.1
33		.4	.1	.5 YZ	
34		.4	.2	.6 YZ	
36		.5	.1	.6 YZ	
38		.2	.3	.5 YZ	
40		.2	.2	.4 YZ	
42		.1	.1	.2 YZ	
44		.2	.2	.4 YZ	
46		.2	.2	.4 YZ	
48		.1	.1	.2 YZ	
50		.2	.2	.4 YZ	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DHC DATE: 5-3-83
CHECKED BY: DHS DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
52	0	.3	.3	.6 YZ	20.1
56		.4	.2	.6 XY	20.0
58		.4	.2	.6 XY	
60		.3	.2	.5 YZ	
62		.4	.2	.6 XY	
66		.2	.3	.5 YZ	
68		.2	.2	.4 YZ	
70		.2	.2	.4 YZ	
72		.1	.4	.5 YZ	
74		.3	.1	.4 XY	19.9
76		.2	.2	.4 XY	
80		.3	.2	.5 XY	
82		.5	.2	.7 XY	
83		.2	.2	.4 XY	
84		.5	.2	.7 XY	
86		.3	.2	.5 XY	
88		.3	.2	.5 XY	
90		.5	.2	.7 XY	
93		.4	.2	.6 XY	
97R		.8	.4	1.2 XY	19.9

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [illegible] DATE: 5-3-83
CHECKED BY: [illegible] DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
97R	0	.7	.4	1.1 XY	19.9
195		.5	.3	.8 XY	
142R		.7	.4	1.1 XY	
142R		.6	.4	1.0 XY	
200		.4	.2	.6 XY	
206R		.3	.4	.7 XY	
206R		.3	.3	.6 XY	
260		1.0	.8	1.8 XY	18.3
280		1.5	2.1	3.6 XY	18.1
285		4.5	1.5	6.0 XY	18.1
290		5.3	2.0	7.3 XY	17.9
295B		3.7	1.7	5.4 XY	17.9
97B		.7	1.1	1.8 XY	18.3
98		.8	.3	1.1 XY	
99		.7	.4	1.1 XY	
100		.4	.7	1.1 XY	
102		.3	.8	1.1 XY	18.2
103		.3	1.0	1.3 XY	
104		.8	1.8	2.6 XY	
106		1.0	1.9	2.9 XY	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMS DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
108	0	.6	1.1	1.7 XY	18.2
109		.9	1.2	2.1 XY	18.2
110		1.2	1.3	2.5 XY	17.8
112		.5	2.4	2.9 XY	17.8
114		1.2	2.6	3.8 XY	17.7
1140		.7	1.5	2.2 XY	17.7
115	↓	.7	1.5	2.2 XY	14.1
120	3.5	.9	.4	4.8 YZ	13.9
122		1.1	2.5	7.1 XY	19.2
124		.9	2.9	7.3 XY	
126		.9	2.9	7.3 XY	
128		.7	2.6	6.8 XY	
130		.6	1.6	5.7 XYZ	
132		.9	1.3	5.7 YZ	
134		1.0	1.4	5.9 YZ	
136		1.2	1.7	6.4 YZ	
138	↓	1.3	1.6	6.4 YZ	↓
142B	0	.6	.7	1.3 YZ	18.3
144		.4	.4	.8 XY	
146	↓	.2	.7	.9 YZ	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMD DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
148	0	.3	1.0	1.3 YZ	18.2
150		1.0	2.1	3.1 YZ	
152		1.4	2.2	3.6 YZ	
156		.8	1.4	2.2 YZ	
157		1.1	1.2	2.3 YZ	17.8
158		1.3	1.2	2.5 YZ	
160		.7	2.0	2.7 YZ	
162		1.2	2.1	3.3 YZ	17.7
163		.7	1.3	2.0 YZ	17.7
165		.7	1.3	2.0 YZ	14.1
170	3.5	.9	.3	4.7 XY	13.9
172		1.0	2.3	6.8 YZ	19.2
174		.8	2.7	7.0 YZ	
176		.8	2.7	7.0 YZ	
178		.5	2.4	6.4 YZ	
180		.5	1.5	5.5 YZ	
181		.8	1.1	5.4 XY YZ	
182		.9	1.2	5.6 XY	
184		1.1	1.5	6.1 XY	
185		1.2	1.4	6.1 XY	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DNB DATE: 5-3-83
CHECKED BY: DMD DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
206B	0	1.1	1.3	2.4 XY	18.3
208		.3	1.0	1.3 XY	18.3
214		1.0	2.1	3.1 XY	18.2
216		1.5	2.2	3.7 XY	18.2
220		1.3	.8	2.1 XY	17.8
222		.6	1.3	1.9 XY	17.8
223		1.0	1.4	2.4 XY	17.7
2230		.6	.8	1.4 XY	17.7
225	↓	.6	.8	1.4 XY	14.1
229	3.5	.7	.4	4.6 XY	13.9
233		.8	2.0	6.3 XY	19.2
234		.5	2.2	6.2 XY	
235		.5	2.2	6.2 XY	
236		.3	1.8	5.6 XY	
237		.2	1.3	5.0 XY	
238		.7	1.1	5.3 XY	
240		.8	1.1	5.4 XY	
242		1.1	1.3	5.9 YZ	
244	↓	1.1	1.3	5.9 YZ	↓
295R	0	3.2	1.5	4.7 YZ	17.9

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 5-3-83
CHECKED BY: DHD DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
560	0	9.9	4.1	14.0 YZ	17.9
555		5.6	1.9	7.5 YZ	17.9
550		3.5	4.8	8.3 YZ	17.6
545		3.7	9.9	13.6 YZ	17.6
540		3.8	11.4	15.2 YZ	
536		3.7	8.6	12.3 YZ	
535		4.1	8.0	12.1 YZ	
534		4.7	7.2	11.9 YZ	
533		5.6	9.6	15.2 YZ	
530		6.4	8.2	14.6 YZ	
529		4.2	6.2	10.4 YZ	
525		4.6	6.3	10.9 YZ	17.2
510	2.9	3.0	3.6	9.5 XY	
505		2.5	4.0	9.4 XY	
490		1.7	4.5	9.1 YZ	
485		2.8	4.2	9.9 YZ	
~~480~~		2.7	4.2	9.8 YZ	
475		2.5	4.2	9.6 YZ	
465		4.2	4.1	11.2 YZ	
460		2.7	4.7	10.3 YZ	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [illegible] DATE: 5-3-83
CHECKED BY: [illegible] DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
450	2.9	5.0	5.9	13.8 YZ	17.2
440	4.1	5.4	5.8	15.3 YZ	17.2
435R		3.4	3.3	10.8 YZ	19.2
435R		1.1	6.0	11.2 YZ	
575		3.5	3.9	11.5 YZ	
585		5.5	5.0	14.6 YZ	
590		6.3	4.2	14.6 YZ	
595	↓	7.0	4.5	15.6 YZ	
600R	3.5	2.1	1.5	7.1 YZ	
600R	3.5	2.5	1.7	7.7 YZ	
668		2.6	1.7	7.8 YZ	
670		2.6	1.8	7.9 YZ	
675		2.9	1.6	8.0 YZ	
680		2.9	1.6	8.0 YZ	
690		2.6	1.3	7.4 XY	
700		2.1	1.2	6.8 XY	
710		1.1	1.4	6.0 XY	
715		.8	1.5	5.8 XY	
717		.5	1.8	5.8 XY	
720	↓	.4	1.9	5.8 XY	↓

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DHB DATE: 5-3-83
CHECKED BY: DHB DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
725	3.5	.4	2.0	5.9 XY	19.2
750	3.5	.3	2.7	6.5 XY	19.2
295R	0	2.7	2.1	4.8 YZ	17.9
300		5.2	4.1	9.3 YZ	
310		4.1	3.7	7.8 YZ	
320		2.8	3.8	6.6 YZ	
325		1.6	4.1	5.7 YZ	
335R		1.2	4.4	5.6 YZ	
335R		2.9	5.3	8.1 YZ	↓
340		4.7	8.4	13.1 YZ	17.6
350		2.8	6.5	9.3 YZ	
355		1.0	4.6	5.6 YZ	
360		1.9	3.4	5.3 YZ	
365		3.1	4.1	7.2 YZ	
370		3.7	2.8	6.5 YZ	
375		3.6	2.0	5.6 YZ	
380		3.4	3.3	6.7 YZ	
382		2.4	2.7	5.1 YZ	↓
385	↓	2.5	3.0	5.5 YZ	17.2
400	2.9	1.7	5.1	9.7 YZ	17.2

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMS DATE: 5-3-83
CHECKED BY: DMD DATE: 5/3/83

STRESS SUMMARY - EQUATION B1

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	EQUATION B1-STRESS (KSI)	ALLOWABLE STRESS (KSI)
405	2.9	2.1	5.3	10.3 YZ	17.2
420	↓	2.6	6.9	12.4 YZ	↓
429		4.1	8.1	15.1 YZ	
430		4.6	8.6	16.1 YZ	
431		4.7	8.7	16.3 YZ	
435 B		5.0	10.5	18.4 YZ	19.2
335 B	0	3.0	5.7	8.7 YZ	17.9
610		3.6	5.7	9.3 YZ	17.6
615		3.5	5.5	9.0 YZ	↓
620		2.6	4.2	6.8 YZ	
625		2.8	4.3	7.1 YZ	17.2
635	2.9	2.9	3.5	9.3 YZ	↓
645	↓	3.7	3.4	10.0 YZ	
657		3.8	3.8	10.5 YZ	
660		3.2	4.3	10.4 YZ	
665		3.0	4.5	10.4 YZ	
600 B		3.0	5.7	11.6 YZ	17.2

6.1.4 Equation B-2 Stresses

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMS DATE: 5/23/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
1	.6	.1	.1	0	.8	19.5
4		.9	.8	.3	2.4	
6		.3	.5	2.2	3.2	
7		.2	.2	.1	1.0	
8		.1	.1	.1	.8	
10		.2	.2	.1	1.0	
12		.5	.4	.2	1.5	
18		.4	.1	.1	1.1	
30		.4	.2	.2	1.3	
32	.7	.7	.2	.2	1.7	20.1
33		.4	.1	.1	1.2	
34		.4	.2	.1	1.3	
36		.5	.1	.1	1.3	
38		.2	.3	.5	1.5	
40		.2	.2	.3	1.3	
42		.1	.1	.1	.9	
44		.2	.2	.3	1.3	
46		.2	.2	.2	1.2	
48		.1	.1	.1	.9	
50		.2	.2	.2	1.2	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMD DATE: May 23, 1983
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
52	.7	.3	.3	.3	1.4	20.1
56		.4	.2	.3	1.5	20.0
58		.4	.2	.3	1.5	
60		.3	.2	.4	1.4	
62		.4	.2	.3	1.5	
66		.2	.3	.5	1.5	
68		.2	.2	.4	1.3	
70		.2	.2	.4	1.3	
72		.1	.4	.5	1.4	
74		.3	.1	.3	1.3	19.9
76		.2	.2	.2	1.2	
80		.3	.2	.3	1.4	
82		.5	.2	.5	1.7	
83		.2	.2	.2	1.2	
84		.5	.2	.4	1.6	
86		.3	.2	.2	1.4	
88		.3	.2	.3	1.4	
90		.5	.2	.4	1.6	
93		.4	.2	.4	1.5	
97R	.9	.8	.4	.4	2.3	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: SMD DATE: 5/23/83
CHECKED BY: JMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
97R	.9	.7	.4	.4	2.2	19.9
195		.5	.3	.3	1.8	
142R		.7	.4	.4	2.2	
142R		.6	.4	.4	2.1	
200		.4	.2	.2	1.6	
206R		.3	.4	.3	1.7	
206R		.3	.3	.3	1.6	
260		1.0	.8	.8	3.0	18.3
280	1.0	1.5	2.1	2.1	5.5	18.1
285	1.0	4.5	1.5	1.1	7.4	18.1
290	1.5	5.3	2.0	1.6	9.4	17.9
295B	1.5	3.7	1.7	1.3	7.3	17.9
97B	.3	.7	1.1	.9	2.4	18.3
98		.8	.3	.3	1.5	
99		.7	.4	.5	1.6	
100		.4	.7	.6	1.6	
102		.3	.8	.5	1.5	18.2
103		.3	1.0	.2	1.6	
104		.8	1.8	.2	2.9	
106		1.0	1.9	.3	3.2	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: SMS DATE: 5/23/83

CHECKED BY: SMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
108	.3	.6	1.1	.2	2.0	18.2
109	↓	.9	1.2	.2	2.4	18.2
110	↓	1.2	1.3	.2	2.8	17.8
112	↓	.5	2.4	.5	3.3	17.8
114	.1	1.2	2.6	.6	4.0	17.7
1140	↓	.7	1.5	.3	2.3	17.7
115	↓	.7	1.5	.3	2.3	14.1
120	3.5	.9	.4	.1	4.8	13.9
122	↓	1.1	2.5	.1	7.1	19.2
124	↓	.9	2.9	.1	7.3	↓
126	↓	.9	2.9	.1	7.3	↓
128	↓	.7	2.6	.1	6.8	↓
130	↓	.6	1.6	.1	5.7	↓
132	↓	.9	1.3	.2	5.7	↓
134	↓	1.0	1.4	.2	5.9	↓
136	↓	1.2	1.7	.2	6.4	↓
138	↓	1.3	1.6	.2	6.4	↓
142 B	.7	.6	.7	.6	2.2	18.3
144	↓	.4	.4	.5	1.7	↓
146	↓	.2	.7	.3	1.7	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: SMS DATE: 5/23/83
CHECKED BY: SMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI).	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
148	.3	..3	1.0	.1	1.6	18.2
150		1.0	2.1	.1	3.4	
152		1.4	2.2	.3	3.9	
156		.8	1.4	.2	2.5	
157		1.1	1.2	.1	2.6	17.8
158		1.3	1.2	.1	2.8	
160		.7	2.0	.2	3.0	
162	.1	1.2	2.1	.2	3.4	17.7
163		.7	1.3	.1	2.1	17.7
165		.7	1.3	.1	2.1	14.1
170	3.5	.9	.3	.1	4.7	13.9
172		1.0	2.3	.1	6.8	19.2
174		.8	2.7	.1	7.0	
176		.8	2.7	.1	7.0	
178		.5	2.4	.1	6.4	
180		.5	1.5	.1	5.5	
181		.8	1.1	.1	5.4	
182		.9	1.2	.1	5.6	
184		1.1	1.5	.1	6.1	
185		1.2	1.4	.1	6.1	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DHD DATE: 5/23/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
206B	.7	1.1	1.3	.7	3.3	18.3
208	.7	.3	1.0	.2	2.0	18.3
214	.3	1.0	2.1	.4	3.4	18.2
216	.3	1.5	2.2	.5	4.1	18.2
220	.3	1.3	.8	.2	2.4	17.8
222	.3	.6	1.3	.5	2.3	17.8
223	.1	1.0	1.4	.5	2.6	17.7
2230	.1	.6	.8	.3	1.6	17.7
225	.1	.6	.8	.3	1.6	14.1
229	3.5	.7	.4	.1	4.6	13.9
233	↓	.8	2.0	.1	6.3	19.2
234		.5	2.2	.1	6.2	↓
235		.5	2.2	.1	6.2	
236		.3	1.8	.1	5.6	
237		.2	1.3	.1	5.0	
238		.7	1.1	.2	5.3	
240		.8	1.1	.2	5.4	
242		1.1	1.3	.2	5.9	
244	↓	1.1	1.3	.2	5.9	↓
295R	1.5	3.2	1.5	.9	6.4	17.9

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMD DATE: 5/23/83

CHECKED BY: [illegible] DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
560	1.5	9.9	4.1	2.8	16.4	17.9
555	1.0	5.6	1.9	1.6	9.1	17.9
550	1.9	3.5	4.8	2.0	10.6	17.6
545	↓	3.7	9.9	3.1	16.0	17.6
540		3.8	11.4	3.5	17.6	↓
536		3.7	8.6	2.6	14.6	
535		4.1	8.0	2.4	14.4	
534		4.7	7.2	2.3	14.2	
533		5.6	9.6	3.1	17.5	
530		6.4	8.2	3.0	17.0	
529		4.2	6.2	4.0	13.5	
525		4.6	6.3	5.8	15.1	17.2
510	2.9	3.0	3.6	4.0	11.3	↓
505	↓	2.5	4.0	4.0	11.1	
490		1.7	4.5	4.6	11.0	
485		2.3	4.2	3.0	10.9	
480		2.7	4.2	3.0	10.8	
475		2.5	4.2	2.7	10.4	
465		4.2	4.1	3.3	12.4	
460	↓	2.7	4.7	2.5	10.9	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: BMS DATE: 5/23/83
CHECKED BY: RMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
450	2.9	5.0	5.9	4.3	15.2	17.2
440	4.1	5.4	5.8	4.5	16.8	17.2
435R		3.4	3.3	2.8	11.8	19.2
436R		1.1	6.0	3.1	12.0	
575		3.5	3.9	1.8	11.9	
585		5.5	5.0	2.7	15.3	
590		6.3	4.2	2.0	15.1	
595		7.0	4.5	2.5	16.2	
600R	↓	2.1	1.5	.9	7.9	
600R	3.5	2.5	1.7	.9	7.9	
668		2.6	1.7	1.0	8.1	
670		2.6	1.8	1.1	8.2	
675		2.9	1.6	1.2	8.4	
680		2.9	1.6	1.2	8.4	
690		2.6	1.3	1.1	7.8	
700		2.1	1.2	1.4	7.4	
710		1.1	1.4	2.5	7.5	
715		.8	1.5	2.9	7.6	
717		.5	1.8	1.4	6.3	
720	↓	.4	1.9	2.0	6.7	↓

TELEDYNE ENGINEERING SERVICES

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5/23/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
725	3.5	.4	2.0	2.7	7.3	19.2
750	3.5	.3	2.7	4.6	9.1	19.2
295R	1.5	2.7	2.1	1.3	6.7	17.9
300	1.5	5.2	4.1	2.1	11.3	
310	1.2	4.1	3.7	2.1	9.6	
320	1.2	2.8	3.8	2.9	8.3	
325	1.2	1.6	4.1	3.6	8.3	
335R	2.3	1.2	4.4	3.3	9.0	
335R	2.3	2.9	5.3	1.8	10.8	
340	2.3	4.7	8.4	2.7	15.8	17.6
350	1.9	2.8	6.5	2.0	11.5	
355		1.0	4.6	1.9	7.9	
360		1.9	3.4	1.8	7.6	
365		3.1	4.1	2.4	9.8	
370		3.7	2.8	2.3	9.2	
375		3.6	2.0	2.7	8.9	
380		3.4	3.3	3.5	10.1	
382		2.4	2.7	2.6	9.0	
385		2.5	3.0	2.6	8.4	17.2
400	2.9	1.7	5.1	4.2	11.2	17.2

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: SMD DATE: 5/23/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B2

NODE #	PRESSURE STRESS (KSI)	DEADWEIGHT STRESS (KSI)	OBE STRESS (KSI)	PORV TRANSIENT SHOCK STRESS(KSI)	EQUATION B2 STRESS (KSI)	ALLOWABLE STRESS (KSI)
405	2.9	2.1	5.3	4.0	11.6	17.2
420	↓	2.6	6.9	3.2	13.1	↓
429	↓	4.1	8.1	3.0	15.6	↓
430	↓	4.6	8.6	3.1	16.6	↓
431	↓	4.7	8.7	3.1	16.8	↓
435B	↓	5.0	10.5	3.6	19.0	19.2
335B	2.3	3.0	5.7	5.5	13.2	17.9
610	1.9	3.6	5.7	2.7	11.8	17.6
615	1.9	3.5	5.5	3.2	11.8	↓
620	1.9	2.6	4.2	2.5	9.4	↓
625	1.9	2.8	4.3	4.7	11.1	17.2
635	2.9	2.9	3.5	9.6	16.0	↓
645	↓	3.7	3.4	5.4	13.0	↓
657	↓	3.8	3.8	3.2	11.7	↓
660	↓	3.2	4.3	2.2	10.9	↓
665	↓	3.0	4.5	2.7	11.1	↓
600B	↓	3.0	5.7	5.4	13.8	↓

6.1.5 Equation B-3 Stresses

Technical Report
TR-5364-1
Revision 0

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMD DATE: 5/25/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
1	.2	27.5
4	2.0	
6	2.0	
7	.8	
8	.8	
10	2.2	
12	2.3	
18	.9	
30	2.5	
32	2.5	27.6
33	.9	
34	.9	
36	.9	
38	1.4	
40	1.4	
42	.5	
44	1.4	
46	1.7	
48	.7	
50	2.0	

Technical Report
TR-5364-1
Revision 0

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: SMS DATE: 5/25/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
52	2.2	27.6
56	2.5	
58	2.5	
60	2.9	
62	3.3	
66	1.4	
68	1.3	
70	1.3	
72	.7	
74	.9	
76	.8	
80	.8	
82	.8	
83	.3	
84	.8	
86	.7	
88	.7	
90	.8	
93	.4	
97R	1.2	

1

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: SMS DATE: 5/25/83
CHECKED BY: RWB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
97R	1.6	27.6
195	.8	↓
142R	1.6	↓
142R	2.1	↓
200	.9	↓
206R	1.8	↓
206R	2.5	↓
260	4.3	27.3
280	9.7	27.2
285	6.0	↓
290	5.6	↓
295B	4.7	↓
97B	4.7	27.3
98	2.3	↓
99	1.7	↓
100	1.2	↓
102	1.0	27.2
103	1.2	↓
104	3.3	↓
106	3.3	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMT DATE: 5/25/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
108	1.5	27.2
109	.7	27.2
110	.5	27.1
112	1.7	27.1
114	1.4	27.1
1140	.6	27.1
115	.6	26.4
120	.2	26.3
122	.4	27.4
124	.6	
126	.6	
128	.7	
130	.5	
132	.5	
134	.5	
136	.5	
138	.5	
142 B	6.1	27.3
144	2.8	
146	1.8	

Technical Report
TR-5364-1
Revision 0

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMD DATE: 5/23/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
148	1.0	27.2
150	2.5	
152	2.9	
156	1.2	
157	.5	27.1
158	.3	
160	.7	
162	.4	
163	.2	
165	.2	26.4
170	.5	26.3
172	.8	27.4
174	1.0	
176	1.0	
178	1.2	
180	1.1	
181	.9	
182	.9	
184	.9	
185	.8	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: SMS DATE: 5/25/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
206B	12.1	27.3
208	3.9	27.3
214	4.5	27.2
216	3.7	27.2
220	.5	27.1
222	2.0	27.1
223	3.3	27.1
2230	1.5	27.1
225	1.5	26.4
229	1.5	26.3
233	1.6	27.4
234	2.2	
235	2.2	
236	2.7	
237	2.7	
238	2.6	
240	2.6	
242	2.5	
244	2.3	
295 R	6.3	27.2

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: SmS DATE: 5/25/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
560	13.3	27.2
555	4.1	27.2
550	2.1	27.1
545	5.0	
540	3.9	
536	2.5	
535	2.8	
534	3.3	
533	5.9	
530	7.1	
529	3.9	
525	3.8	27.0
510	2.0	
505	1.8	
490	1.7	
485	1.4	
480	1.4	
475	1.2	
465	2.2	
460	1.5	

Technical Report
TR-5364-1
Revision 0

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: BmS DATE: 5/25/83
CHECKED BY: [illegible] DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
450	2.2	27.0
440	2.3	27.0
435 R	1.4	27.4
435 R	3.0	
575	2.9	
585	1.9	
590	2.7	
595	3.2	
600 R	.9	
600 R	1.5	
668	1.5	
670	1.7	
675	1.8	
680	1.6	
690	1.9	
700	1.9	
710	1.6	
715	1.7	
717	2.3	
720	2.7	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMD DATE: 5/25/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
725	2.9	27.4
750	2.9	27.4
295R	2.1	27.2
300	2.4	
310	.8	
320	2.1	
325	2.8	
335R	4.1	
335R	3.9	
340	4.7	27.1
350	3.1	
355	1.6	
360	1.9	
365	2.9	
370	1.6	
375	.6	
380	1.7	
382	1.0	
385	1.2	
400	1.1	

Technical Report
TR-5364-1
Revision 0

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5/25/83
CHECKED BY: DMB DATE: 5-25-83

STRESS SUMMARY - EQUATION B3

NODE #	PORV TRANSIENT THERMAL STRESS RANGE (KSI)	ALLOWABLE STRESS (KSI)
405	1.7	27.0
420	2.3	
429	2.9	
430	3.1	
431	3.1	
435 B	3.9	
335 B	2.6	27.2
610	6.1	27.1
615	6.8	
620	3.8	
625	3.7	27.0
635	2.2	
645	2.7	
657	3.2	
660	3.8	
665	3.9	
600 B	4.4	

6.1.6 Equation C-1 Stresses

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DHS DATE: 5/3/83

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	29.2
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	30.1
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	
48		.1	.2	.3 YZ	
50	↓	.2	.4	.6 YZ	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: BMB DATE: 5/3/83

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	30.1
56		.4	.4	.8 XY	30.0
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	29.8
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	
.97B	↓	.8	.6	1.4 XY	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: SHD DATE: 5/3/83

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	29.9
195		.5	.4	.9 XY	
142R		.7	.6	1.3 XY	
142R		.6	.7	1.3 XY	
200		.4	.4	.8 XY	
206R		.3	.6	.9 XY	
206R		.3	.4	.7 XY	
260		1.0	1.3	2.3 XY	27.5
280		1.5	3.2	4.7 XY	27.1
285		4.5	2.2	6.7 XY	27.1
290		5.3	3.0	8.3 XY	26.8
295B		3.7	2.5	6.2 XY	26.8
97B		.7	1.8	2.5 XY	27.5
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	27.2
103		.3	1.7	2.0 XY	
104		.8	3.1	3.9 XY	
106		1.0	3.3	4.3 XY	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMS DATE: 5/3/83

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	27.2
109		.9	2.0	2.9 XY	27.2
110		1.2	2.3	3.5 XY	26.7
112		.5	4.3	4.8 XY	26.7
114		1.2	4.5	5.7 XY	26.5
1140		.7	2.6	3.3 XY	26.5
115		.7	2.7	3.4 XY	21.2
120	3.5	.9	.7	5.1 YZ	20.9
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	27.5
144		.4	.7	1.1 YZ	
146		.2	1.2	1.4 YZ	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 5-3-83
CHECKED BY: DMD DATE: 5-3-83

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	27.2
150		1.0	3.6	4.6 YZ	27.2
152		1.4	3.9	5.3 YZ	27.2
156		.8	2.3	3.1 YZ	27.2
157		1.1	2.0	3.1 YZ	26.7
158		1.3	2.0	3.3 YZ	26.7
160		.7	3.5	4.2 YZ	26.7
162		1.2	3.7	4.9 YZ	26.5
163		.7	2.2	2.9 YZ	26.5
165	↓	.7	2.2	2.9 YZ	21.1
170	3.5	.9	.6	5.0 XY	20.9
172		1.0	4.0	8.5 YZ	28.8
174		.8	4.7	9.0 YZ	28.8
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	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: [illegible] DATE: 5-3-83
CHECKED BY: DMS DATE: 5/4/83

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	27.5
208		.3	1.6	1.9 XY	27.5
214		1.0	3.5	4.5 XY	27.2
216		1.5	3.8	5.3 XY	27.2
220		1.3	1.4	2.7 XY	26.7
222		.6	2.3	2.9 XY	26.7
223		1.0	2.4	3.4 XY	26.5
2230		.6	1.4	2.0 XY	26.5
225	↓	.6	1.4	2.0 XY	21.1
229	3.5	.7	.7	4.9 XY	20.9
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	26.8

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMS DATE: 5/4/83

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	26.8
555		5.6	2.7	8.3 YZ	26.8
550		3.5	6.6	10.1 YZ	26.3
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	
529		4.2	8.4	12.6 YZ	
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	↓

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMS DATE: 5/4/83

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	25.7
435R		3.4	4.8	12.3 XY	28.8
435R		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	
600R	3.5	2.1	2.0	7.6 YZ	
600R		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	

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMS DATE: 5/4/83

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
295R	0	2.7	2.9	5.6 YZ	26.8
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	
335R		2.9	7.3	10.2 YZ	
340		4.7	11.7	16.4 YZ	26.3
350		2.8	9.1	11.9 YZ	
355		1.0	6.6	7.6 YZ	
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	
382		2.4	4.0	6.4 YZ	
385		2.5	4.4	6.9 YZ	25.7
400	2.9	1.7	7.7	12.3 YZ	25.7

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-3-83
CHECKED BY: DMD DATE: 5/4/83

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	
435B		5.0	15.1	23.0 YZ	25.7
335B	0	3.0	9.0	12.0 YZ	26.8
610		3.6	8.5	12.1 YZ	26.3
615		3.5	8.2	11.7 YZ	
620		2.6	6.2	8.8 YZ	
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	
600B		3.0	8.8	14.7 YZ	25.7

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, Reference 2. Combination E2 was not considered since the SV analysis was not performed. Thermal-1 refers to the normal thermal operating case and thermal-2 refers to the PORV transient thermal loading.

The support load combinations considered are as follows:

D1 = deadweight + normal thermal +/- OBE

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

E1 = deadweight + normal thermal +/- DBE

TELEDYNE ENGINEERING SERVICES

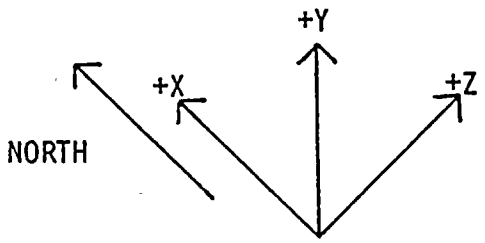
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 5-11-83

CHECKED BY: DMD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-585

NODE NUMBER 33

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	0	.002	∓.001	-60					
THERMAL-1	0	∓.153	.069	2060					
THERMAL-2	0	-.045	-.393	-180					
SEISMIC-OBE	0	0	±.013	± 221.					
SEISMIC-DBE	0	±.001	±.021	± 376.					
BLOWDOWN-SRV									
BLOWDOWN-PORV	0	0	±.005	± 423					

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	+2221 - 717		
EMERGENCY	+2376 -436		

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

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

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

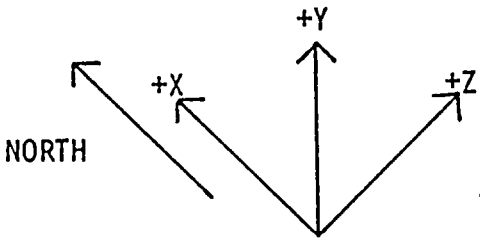
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 5-11-83
CHECKED BY: DnD DATE: 5/26/83

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	0	-.001		-1020				
THERMAL-1	.002	0	.118		+2170				
THERMAL-2	.037	0	-.377		+370				
SEISMIC-OBE	0	0	±.013		±143				
SEISMIC-DBE	0	0	±.021		±254				
BLOWDOWN-SRV									
BLOWDOWN-PORV	0	0	±.006		±201				

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET		+1293 -1163	
EMERGENCY		+1404 -1274	

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

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

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

TELEDYNE ENGINEERING SERVICES

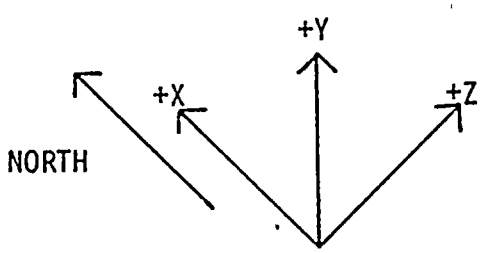
SUPPORT LOAD SUMMARY SHEET

BY: [illegible] DATE: 5-11-83

CHECKED BY: DMS DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

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						
RMAL-1	-.266	.855	.296						
THERMAL-2	.140	.329	-.326						
SEISMIC-OBE	±.004	0	±.011		±170				
SEISMIC-DBE	±.006	0	±.018		±281				
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.008 -.006	0	+.014 -.010		±324				

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET		+ 366 - 366	
EMERGENCY		+ 281 - 281	

	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

TELEDYNE ENGINEERING SERVICES

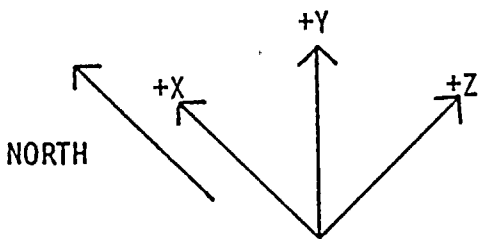
SUPPORT LOAD SUMMARY SHEET

BY: [illegible] DATE: 5-25-83

CHECKED BY: [illegible] DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-588

NODE NUMBER 48

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.009	-.021	.004		426				
[illegible]RMAL-1	-.419	1.08	.218						
THERMAL-2	.151	.453	-.324						
SEISMIC-OBE	±.006	±.004	±.010						
SEISMIC-DBE	±.010	±.008	±.016						
BLOWDOWN-SRV									
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 (+)		426	
DESIGN (-)			

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

TES COMBINED LOADS ARE [illegible] THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

TELEDYNE ENGINEERING SERVICES

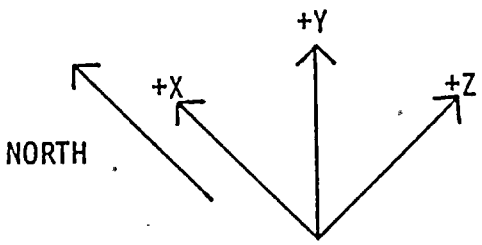
SUPPORT LOAD SUMMARY SHEET

BY: SMS DATE: 5-11-83

CHECKED BY: DMS DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

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	0.	-.008	0	+70		+50			
THERMAL-1	0	2.26	0	-1360		-1119			
THERMAL-2	0	.964	0	+390		+100			
SEISMIC-OBE	0	±.002	0	±284.		±384			
SEISMIC-OBE	0	±.004	0	±466		±637			
BLOWDOWN-SRV									
BLOWDOWN-PORV	0	+.005 -.006	0	±161		±623			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	+786 -1574		+882 -1453
EMERGENCY	+536 -1756		+687 -1706

	SUPPORT DRAWING LOADS		
	FX	FY	FZ
DESIGN (+)	4246		10089
DESIGN (-)	5595		10770

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

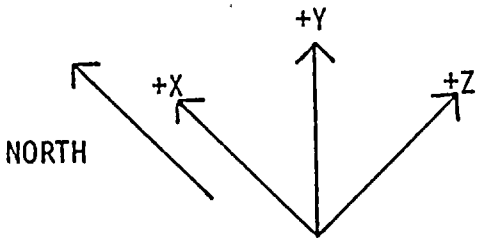
TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-25-83
CHECKED BY: DnD DATE: 5/26/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-590

NODE NUMBER 70

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	0	-.008	-.001		1200				
THERMAL-1	-.027	2.26	-.022						
THERMAL-2	-.018	1.03	-.015						
SEISMIC-OBE	±.004	±.002	±.002						
SEISMIC-DBE	±.006	±.005	±.007						
BLOWDOWN-SRV									
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 (+)		1200	
DESIGN (-)			

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

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

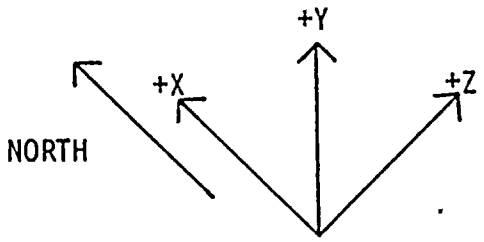
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DHS DATE: 5-11-83
CHECKED BY: DMD DATE: 5/26/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-591

NODE NUMBER 83

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	0	-.007	0	-60		+50			
THERMAL-1	0	2.30	0	-210		-140			
THERMAL-2	0	1.74	0	-150		-10			
SEISMIC-OBE	0	±.002	0	±276		±218			
SEISMIC-DBE	0	±.003	0	±468		±364			
BLOWDOWN-SRV									
BLOWDOWN-PORV	0	+.006 -.005	0	±354		±331			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	+239 -659		+436 -356
EMERGENCY	+408 -738		+414 -454

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

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

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

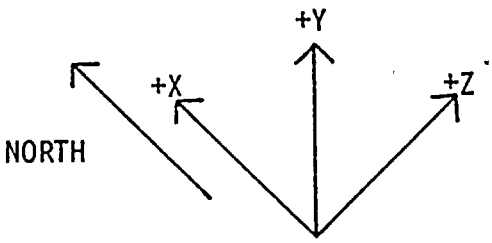
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-11-83
CHECKED BY: DMD DATE: 5/26/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-592

NODE NUMBER 1140

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.034	.032	-.076						
THERMAL-1	-.185	2.82	.185						
THERMAL-2	-.207	2.83	.161						
SEISMIC-OBE	±.228	0	±.055		±1280				
SEISMIC-DBE	±.397	0	±.091		±2122				
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.003 -.002	0	±.002		± 142				

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET		±1288	
EMERGENCY		± 2122	

	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

TELEDYNE ENGINEERING SERVICES

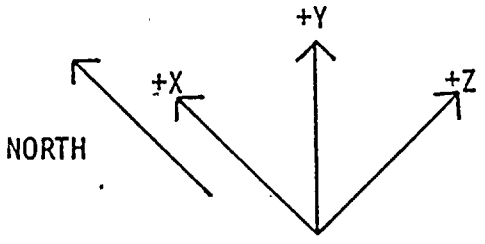
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 5-25-83

CHECKED BY: DMS DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-593

NODE NUMBER 111

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.002	.068	-.036		1067				
THERMAL-1	-.113	2.81	.144						
THERMAL-2	-.182	2.78	.185						
SEISMIC-OBE	±.171	±.016	±.042						
SEISMIC-DBE	±.298	±.028	±.070						
BLOWDOWN-SRV									
BLOWDOWN-PORV	±.006	±.001	+.004 -.005						

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

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

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

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

TELEDYNE ENGINEERING SERVICES

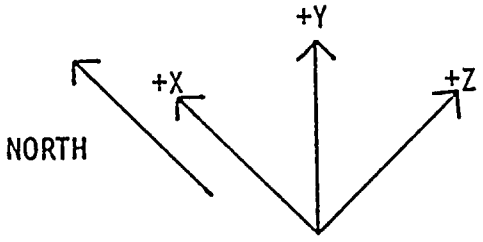
SUPPORT LOAD SUMMARY SHEET

BY: DHB DATE: 5-11-83

CHECKED BY: DMD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



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						
SEISMIC-OBE	±.056	0	±.202		±1131				
SEISMIC-DBE	±.097	0	±.350		±1872				
BLOWDOWN-SRV									
BLOWDOWN-PORV	±.001	0	±.002		±162				

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET		±1143	
EMERGENCY		±1872	

	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

Technical Report
TR-5364-1
Revision 0

6-83

TELEDYNE ENGINEERING SERVICES

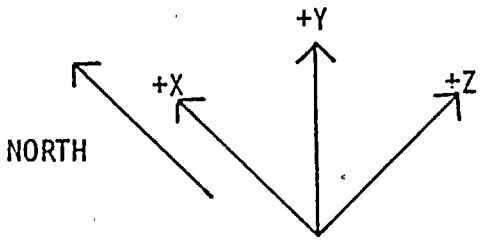
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 5-25-83

CHECKED BY: DMB DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



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						
SEISMIC-OBE	±.046	±.014	±.175						
SEISMIC-DBE	±.079	±.023	±.303						
BLOWDOWN-SRV									
BLOWDOWN-PORV	±.001	±.001	±.003						

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

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

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

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

TELEDYNE ENGINEERING SERVICES

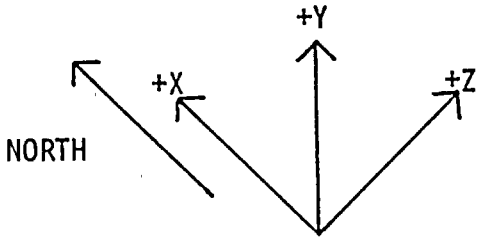
SUPPORT LOAD SUMMARY SHEET

BY: [illegible] DATE: 5-11-83

CHECKED BY: SMD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-596

NODE NUMBER 2230

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	δX	δY	δZ	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.009	.015	.05						
THERMAL-1	.391	2.66	-.271						
THERMAL-2	.323	2.75	-.105						
SEISMIC-OBE	±.127	0	±.099		±1052.				
SEISMIC-OBE	±.217	0	±.168		±1734				
BLOWDOWN-SRV									
BLOWDOWN-PORV	±.003	.0	±.003		± 206				

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET		±1072	
EMERGENCY		±1734	

	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

TELEDYNE ENGINEERING SERVICES

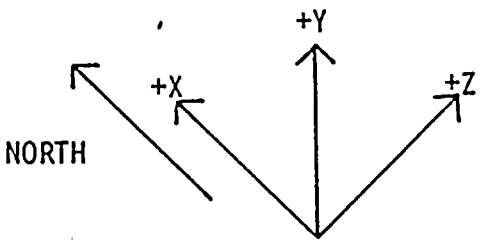
SUPPORT LOAD SUMMARY SHEET

BY: DWB DATE: 5-25-83

CHECKED BY: DnD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-597

NODE NUMBER 221

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.001	.036	.027		1025				
THERMAL-1	.283	2.57	-.216						
THERMAL-2	.253	2.63	-.078						
SEISMIC-OBE	±.094	±.013	±.071						
SEISMIC-DBE	±.160	±.022	±.122						
BLOWDOWN-SRV									
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 (+)		1025	
DESIGN (-)			

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

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

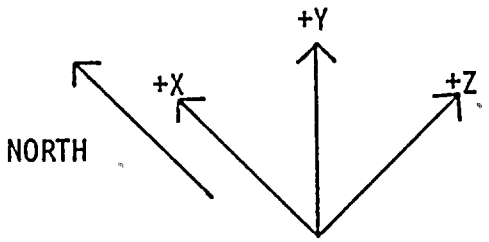
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-20-83
CHECKED BY: DMD DATE: 5/26/83

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						
SEISMIC-OBE	±.021	±.006	±.017	±37		±46			
SEISMIC-DBE	±.034	±.010	±.027	±61		±76			
BLOWDOWN-SRV									
BLOWDOWN-PORV	±.022	±.001	+.017 -.018	±58.		±72.			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	±69		±85
EMERGENCY	±61		±76

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

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

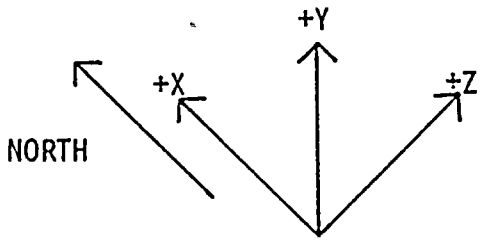
TES COMBINED LOADS ARE LESS THAN THE LOAD SHOWN ON THE SUPPORT DRAWING

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-20-83
CHECKED BY: DMS DATE: 5/26/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-599

NODE NUMBER 156

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.052	.045	.014						
THERMAL-1	.155	2.75	.066						
THERMAL-2	-.014	2.60	.274						
SEISMIC-OBE	±.001	±.009	±.008	±97	± 17	± 12			
SEISMIC-DBE	±.002	±.016	±.015	±166	± 29	± 20			
BLOWDOWN-SRV									
BLOWDOWN-PORV	±.001	0	+.007 −.008	±97	± 17	± 12			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	±137	± 24	± 17
EMERGENCY	±166	± 29	± 20

	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

TELEDYNE ENGINEERING SERVICES

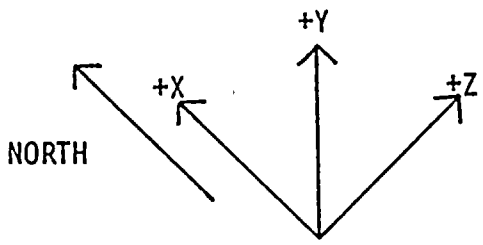
SUPPORT LOAD SUMMARY SHEET

BY: [illegible] DATE: 5-11-83

CHECKED BY: DMD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-600

NODE NUMBER 195

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	0	-.003	0	+100		-120			
THERMAL-1	0	2.34	0	-1110		+1830			
THERMAL-2	0	2.30	0	-720		+1470			
SEISMIC-OBE	0	±.001	0	±376		±269			
SEISMIC-DBE	0	±.002	0	±599		±436			
BLOWDOWN-SRV									
BLOWDOWN-PORV	0	±.002	0	±458		±718			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	+476 -1386		+2117 -389
EMERGENCY	+699 -1609		+2146 -556

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

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

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

TELEDYNE ENGINEERING SERVICES

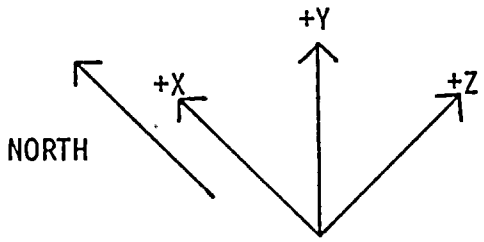
SUPPORT LOAD SUMMARY SHEET

BY: DWB DATE: 5-11-83

CHECKED BY: DMD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

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	0	-.003	0	-320		+720			
THERMAL-1	0	2.36	0	+300		-1050			
THERMAL-2	0	2.63	0	+1320		-2700			
SEISMIC-OBE	0	±.001	0	±642		±308			
SEISMIC-DBE	0	±.001	0	±983		±424			
BLOWDOWN-SRV									
BLOWDOWN-PORV	0	±.002	0	±698		±265			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	+1948 -962		+1028 -2386
EMERGENCY	+963 -1303		+1144 -754

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

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

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

* EXCEPT +Fx LOAD

TELEDYNE ENGINEERING SERVICES

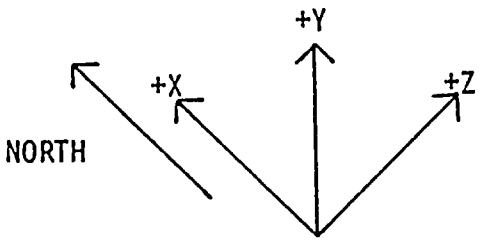
SUPPORT LOAD SUMMARY SHEET

BY: JWB DATE: 5-25-83

CHECKED BY: DMD DATE: 5/26/83

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						
SEISMIC-OBE	±.141	±.047	±.088						
SEISMIC-DBE	±.209	±.072	±.128						
BLOWDOWN-SRV									
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 (+)		1159	
DESIGN (-)			

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

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

TELEDYNE ENGINEERING SERVICES

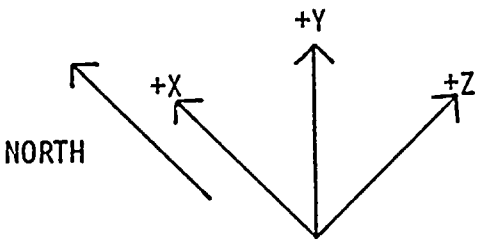
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 5-20-83

CHECKED BY: DmD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-603

NODE NUMBER 585

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.103	.211	-.042	-121		-298			
THERMAL-1	.163	3.33	-.067	-173		-428			
THERMAL-2	.056	3.37	-.023	-270.		-650.			
SEISMIC-OBE	±.141	±.077	±.057	±614		±1519			
SEISMIC-DBE	±.208	±.106	±.085	±855		±2117			
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.099 -.128	+.045 -.044	+.052 -.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 (+)	1833		4540
DESIGN (-)	1560		3863

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

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

TELEDYNE ENGINEERING SERVICES

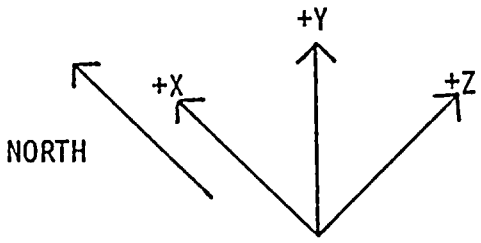
SUPPORT LOAD SUMMARY SHEET

BY: [illegible] DATE: 5-11-83

CHECKED BY: DMD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-604

NODE NUMBER 450

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.052	.816	-.075						
THERMAL-1	.120	3.36	.334						
THERMAL-2	.106	3.52	.445						
SEISMIC-OBE	±.093	0	±.202		∓653.				
SEISMIC-DBE	±.127	0	±.293		∓952.				
BLOWDOWN-SRV									
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

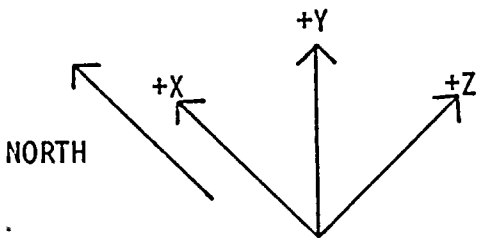
SUPPORT LOAD SUMMARY SHEET

BY: [illegible] DATE: 5-20-83

CHECKED BY: [illegible] DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-605

NODE NUMBER 465

DESIGN LOADINGS

	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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			
SEISMIC-OBE	±.138	±.362	±.182	±680		±512			
SEISMIC-DBE	±.199	±.487	±.263	±1021		±769			
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.100 -.105	+.138 -.167	+.132 -.137	±1217		±918			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	+1537 -1251		+944 -1158
EMERGENCY	+1694 -762		+574 -1276

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

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

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

TELEDYNE ENGINEERING SERVICES

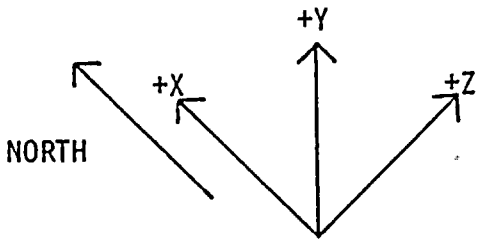
DONALD C. COOK
UNIT #1
PROJECT 5364

SUPPORT LOAD SUMMARY SHEET

BY: RMB DATE: 5-25-83

CHECKED BY: DmD DATE: 5/26/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C1-606

NODE NUMBER 485

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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						
SEISMIC-OBE	±.167	±.523	±.160						
SEISMIC-DBE	±.243	±.704	±.216						
BLOWDOWN-SRV									
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 (+)		811	
DESIGN (-)			

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

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

TELEDYNE ENGINEERING SERVICES

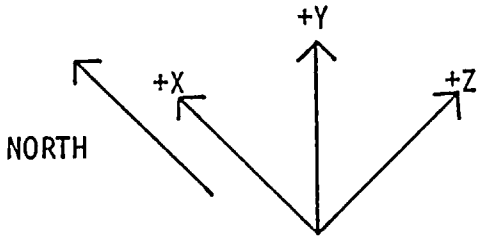
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 5-25-83

CHECKED BY: DmD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

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						
SEISMIC-OBE	±.122	±.045	±.122						
SEISMIC-DBE	±.177	±.085	±.165						
BLOWDOWN-SRV									
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 (+)		658	
DESIGN (-)			

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

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

TELEDYNE ENGINEERING SERVICES

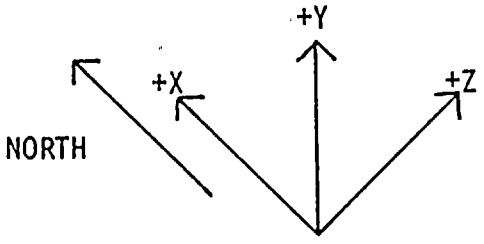
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 5-11-83

CHECKED BY: DMS DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-S-608

NODE NUMBER 534

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.093	.373	-.064						
THERMAL-1	.758	2.46	-.010						
THERMAL-2	.863	3.21	-.046						
SEISMIC-OBE	±.110	0	±.064		±639.				
SEISMIC-DBE	±.160	0	±.087		±876.				
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.084 -.087	0	+.018 -.020		±1025				

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET		±1208	
EMERGENCY		±876	

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

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

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

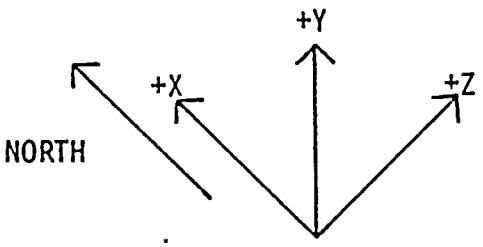
TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: AWB DATE: 5-11-83
CHECKED BY: DmD DATE: 5/26/83

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-R-609

NODE NUMBER 536

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	-.129	.373	0			-280.			
THERMAL-1	.691	2.46	0			+10.			
THERMAL-2	.821	3.18	0			+900.			
SEISMIC-OBE	±.106	0	0			±527.			
SEISMIC-DBE	±.154	0	0			±711.			
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.031 -.079	±.001	0			±518			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET			+1359 -807
EMERGENCY			+441 -991

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

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

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

TELEDYNE ENGINEERING SERVICES

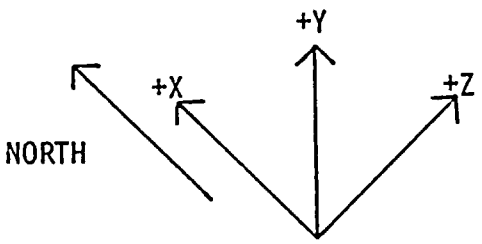
SUPPORT LOAD SUMMARY SHEET

BY: DWB DATE: 5-25-83

CHECKED BY: DMD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-610

NODE NUMBER 620

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.098	.404	-.057		783				
THERMAL-1	.258	3.08	.376						
THERMAL-2	.104	3.37	.310						
SEISMIC-OBE	±.055	±.027	±.151						
SEISMIC-DBE	±.088	±.041	±.219						
BLOWDOWN-SRV									
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 (+)		783	
DESIGN (-)			

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

BY: DWB DATE: 5-25-83

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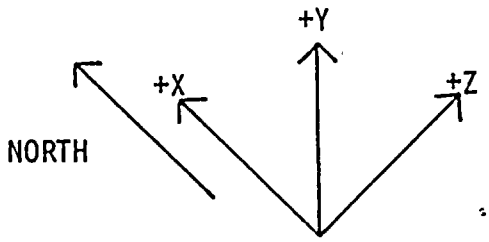
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-611

NODE NUMBER 431

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.063	.693	-.066		930				
THERMAL-1	.137	3.34	.250						
THERMAL-2	.108	3.48	.344						
SEISMIC-OBE	±.081	±.017	±.173						
SEISMIC-OBE	±.111	±.027	±.251						
BLOWDOWN-SRV									
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 (+)		930	
DESIGN (-)			

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

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

TELEDYNE
ENGINEERING SERVICES

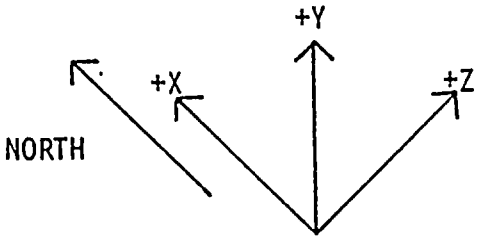
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 5-25-83

CHECKED BY: DMS DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-612

NODE NUMBER 382

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.113	.918	-.085		638				
THERMAL-1	.569	3.08	.425						
THERMAL-2	.698	3.46	.455						
SEISMIC-OBE	±.219	±.650	±.119						
SEISMIC-DBE	±.316	±.874	±.172						
BLOWDOWN-SRV									
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 (+)		638	
DESIGN (-)			

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

BY: DMB DATE: 5-20-83

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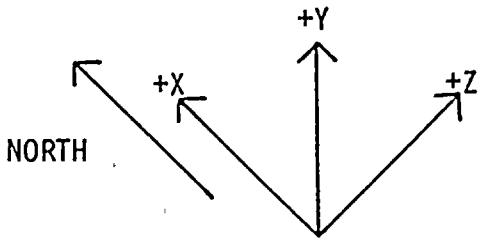
DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRE-R-613

NODE NUMBER 360

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.049	.928	.039	-136		+171			
THERMAL-1	.500	3.08	.397	-78		+97			
THERMAL-2	.658	3.40	.508	-220		+280			
SEISMIC-OBE	±.204	±.625	±.162	±276		±347			
SEISMIC-DBE	±.292	±.843	±.232	±407		±512			
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.152 −.123	+.133 −.087	+.120 −.048	±296		±372			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	+140 −761		+960 −176
EMERGENCY	+271 −621		+780 −341

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

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

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

* EXCEPT + Fz LOAD

TELEDYNE ENGINEERING SERVICES

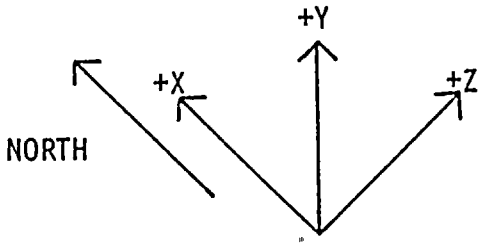
SUPPORT LOAD SUMMARY SHEET

BY: DMB DATE: 5-20-83

CHECKED BY: DmD DATE: 5/26/83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



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						
[illegible]RMAL-1	.181	3.02	.423						
THERMAL-2	-.008	3.28	.341						
SEISMIC-OBE	±.027	±.041	±.192	±99	±368	±73			
SEISMIC-DBE	±.045	±.058	±.277	±156	±580	±115			
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.042 -.033	+.026 -.030	+.158 -.110	±295	±1101	±218			

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET	±311	±1161	±230
EMERGENCY	±156	±580	±115

	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

* EXCEPT -FX LOAD AND -FY LOAD

TELEDYNE ENGINEERING SERVICES

SUPPORT LOAD SUMMARY SHEET

DONALD C. COOK
UNIT #1
PROJECT 5364

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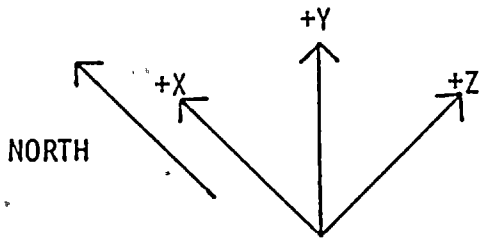
GLOBAL COORDINATE SYSTEM



MARK NUMBER 1-GRC-C-615

NODE NUMBER 101

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	.085	.065	.037		142				
THERMAL-1	.082	2.66	.036						
THERMAL-2	-.099	2.46	.277						
SEISMIC-OBE	±.018	±.023	±.004						
SEISMIC-DBE	±.029	±.038	±.007						
BLOWDOWN-SRV									
BLOWDOWN-PORV	±.015	±.010	±.004						

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

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

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

BY: DMB DATE: 5-20-83

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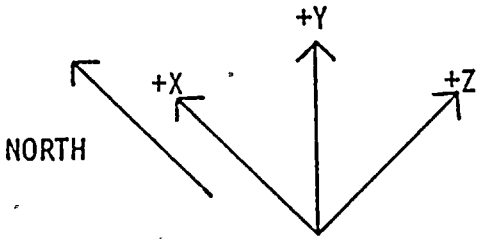
DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



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.				
SEISMIC-OBE	±.003	0	±.002		±606.3				
SEISMIC-DBE	±.004	0	±.002		±946.9				
BLOWDOWN-SRV									
BLOWDOWN-PORV	+.003 -.004	0	±.002		±1070				

	TES COMBINED LOADS		
	FX	FY	FZ
NORMAL/UPSET		+770 -2556	
EMERGENCY		+448 -2897	

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

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

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

6.3 Valve Accelerations

Valve accelerations were calculated for both the DBE seismic condition and the PORV transient shock 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 12). For the seismic acclerations, the resultant horizontal acceleration was compared against the 3g allowable. Weights for valves NMO-151, 152 and 153 were taken as 352 pounds, in determining the seismic acceleration, since this is the value used in the seismic analysis, see Section 5.0.

For the PORV transient shock accelerations, the updated valve weight of 400 pounds was used in both the analysis and the acceleration calculations. It should be noted that valves NRV-151, NRV-152, NMO-151, NMO-152 and NMO-153 all fail the vertical acceleration criteria of 2g (see Section 2.0).

6.3.1 DBE Seismic Valve Accelerations

TELEDYNE ENGINEERING SERVICES

BY: SMJ DATE: 5/12/83

CHECKED BY: [illegible] DATE: [illegible]

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UNIT #1
PROJECT 5364

VALVE NO.		NMO-15			NMO-152			NMO-15		
NODE NO.		651			411			41		
		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	.13	.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}	.86 g			1.05 g			.99 g		
	A_{yT}	.51 g			.68 g			1.18 g		
	A_{zT}	.79 g			.92 g			1.05 g		
		ACCEL.	ALLOWABLE		ACCEL.	ALLOWABLE		ACCEL.	ALLOWABLE	
VERTICAL A_{vT}		.51 g	2 g		.68 g	2 g		1.18 g	2 g	
HORIZONTAL *		1.17 g	3 g		1.40 g	3 g		1.37 g	3 g	

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

Technical Report
TR-5364-1
Revision 0

DONALD C. COOK
UNIT #1
PROJECT 5364

TELEDYNE ENGINEERING SERVICES

BY: DMD DATE: 5/12/83
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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	.3	38	.96	.16	.46	1.46	.10	.24
	Y	.05	02	.05	.05	.02	.04	.04	.01	.04
	Z	.84	.15	32	.51	.11	1.35	.29	.17	1.09
SRSS RESULTS	A_{XT}	1.30 g			1.09 g			1.47 g		
	A_{yT}	.20 g			.20 g			.20 g		
	A_{zT}	1.20 g			1.43 g			1.12 g		

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

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

TELEDYNE ENGINEERING SERVICES

BY: SmS DATE: 5/12/83

CHECKED BY: [illegible] DATE: [illegible]

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UNIT #1
PROJECT 5364

VALVE NO.		NRV-151			NRV-152			NRV-151		
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	.13	.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	1.04	.51	.30	1.02
SRSS RESULTS	A_{xT}	1.09 g			1.74 g			1.13 g		
	A_{yT}	.46 g			1.27 g			.53 g		
	A -	1.30 g			1.41 g			1.32 g		
		ACCEL.	ALLOWABLE		ACCEL.	ALLOWABLE		ACCEL.	ALLOWABLE	
VERTICAL A_{yT}		.46 g	2 g		1.27 g	2 g		.53 g	2 g	
HORIZONTAL *		1.61 g	3 g		2.24 g	3 g		1.74 g	3 g	

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

6.3.2. PORV Transient Shock Valve Accelerations

Technical Report
TR-5364-1
Revision 0

6-111

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-24-83
CHECKED BY: DMD DATE: 5/24/83

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)	48	43	31	32	36	49
ACCELERATION	.07g	.06g	.05g	.05g	.05g	.07g
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)	47	33	41			
ACCELERATION	.07g	.05g	.06g			
ALLOWABLE	3g	2g	3g			

Technical Report
TR-5364-1
Revision 0

6-112

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-24-83
CHECKED BY: DMD DATE: 5/24/83

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)	1116	999	835	783	960	899
ACCELERATION	2.79g	2.50g	2.09g	1.96g	2.40g	2.25g
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)	1194	1083	399			
ACCELERATION	2.99g	2.71g	1.00g			
ALLOWABLE	3g	2g	3g			

Technical Report
TR-5364-1
Revision 0

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-24-83
CHECKED BY: DMD DATE: 5/24/83

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)	658	1579	369	387	766	639
ACCELERATION	1.37g	3.29g	.77g	.81g	1.60g	1.33g
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)	454	1269	307			
ACCELERATION	.95g	2.63g	.64g			
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 each loading condition analyzed.

TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

BY: DMD DATE: 5/26/83

CHECKED BY: DMB DATE: 5-26-83

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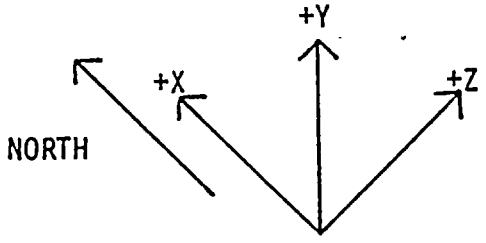
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



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
SEISMIC-OBE	—	—	—	±50	±147	±510	±7676	±18535	±6030
SEISMIC-DBE	—	—	—	±94	±259	±840	±12681	±30537	±10427
BLOWDOWN-SRV									
BLOWDOWN-PORV	—	—	—	±495	±10369	±222	±3354	±1814	±8140

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

TELEDYNE ENGINEERING SERVICES

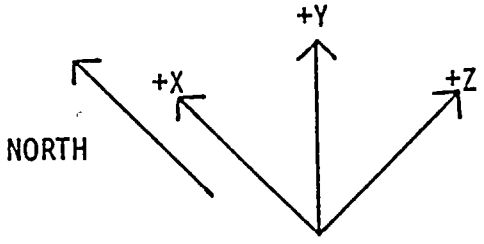
NOZZLE LOAD SUMMARY SHEET

BY: BMB DATE: 5/26/83

CHECKED BY: JMB DATE: 5-26-83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



NODE NUMBER 750

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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
SEISMIC-OBE	—	—	—	±375	±500	±339	±19183	±26696	±34854
SEISMIC-DBE	—	—	—	±527	±806	±537	±26283	±38635	±52040
BLOWDOWN-SRV									
BLOWDOWN-PORV	—	—	—	±2083	±2803	± 886	±36134	± 37970	± 81181

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

TELEDYNE ENGINEERING SERVICES

NOZZLE LOAD SUMMARY SHEET

BY: DMD DATE: 5/26/83

CHECKED BY: DMB DATE: 5-26-83

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UNIT #1
PROJECT 5364

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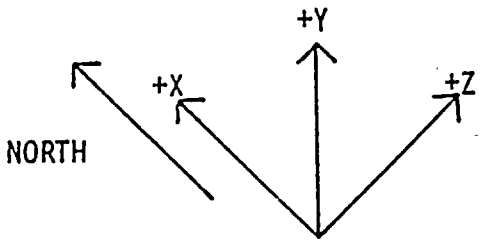


NODE NUMBER 244

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
SEISMIC-OBE	—	—	—	±611	±921	±501	±10864	±10964	±20444
SEISMIC-DBE	—	—	—	±1031	±1523	±852	±18491	±18177	±33944
BLOWDOWN-SRV									
BLOWDOWN-PORV	—	—	—	±94	±105	±130	±3725	±1966	±3188

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

Technical Report
TR-5364-1
Revision 0

6-118

TELEDYNE ENGINEERING SERVICES

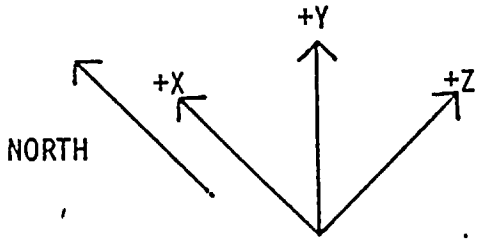
NOZZLE LOAD SUMMARY SHEET

BY: DMD DATE: 5/26/83

CHECKED BY: DMB DATE: 5-26-83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



NODE NUMBER 185

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	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
SEISMIC-OBE	—	—	—	±681	±1191	±810	±24668	±13523	±7006
SEISMIC-DBE	—	—	—	±1132	±1982	±1401	±40909	±22405	±13079
BLOWDOWN-SRV									
BLOWDOWN-PORV	—	—	—	±77	±113	±75	±2215	±1205	±2071

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

Technical Report
TR-5364-1
Revision 0

6-119

TELEDYNE ENGINEERING SERVICES

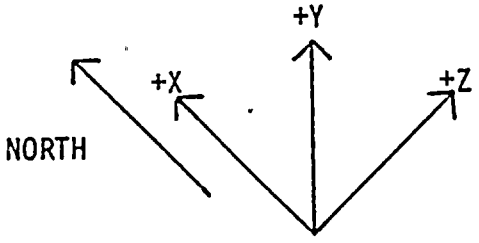
NOZZLE LOAD SUMMARY SHEET

BY: DMD DATE: 5/26/83

CHECKED BY: DMB DATE: 5-26-83

DONALD C. COOK
UNIT #1
PROJECT 5364

GLOBAL COORDINATE SYSTEM



NODE NUMBER 138

DESIGN LOADINGS									
	DISPLACEMENTS			FORCES			MOMENTS		
	X	Y	Z	FX	FY	FZ	MX	MY	MZ
DEADWEIGHT-1	—	—	—	-20	-880	-60	-10330	850	21360
THERMAL-1	—	—	—	400	-430	-30	15060	15000	12520
THERMAL-2	—	—	—	150	-280	30	6850	4950	3270
SEISMIC-OBE	—	—	—	±920	±1350	±820	±16050	±15834	±23448
SEISMIC-DBE	—	—	—	±1600	±2241	±1361	±26601	±26287	±38971
BLOWDOWN-SRV	—	—	—						
BLOWDOWN-PORV	—	—	—	±127	±87	±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 each loading condition analyzed.

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-1
Revision 0

6-121

VALVE END MOMENTS

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-25-83

CHECKED BY: DMS DATE: 5/27/83

VALVE NUMBER SV-45C

NODE NUMBER	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
SEISMIC OBE	±2418	±3067	±12929	±6421	±1098	±5189
SEISMIC DBE	±4087	±5324	±22508	±10645	±1821	±8610
BLOWDOWN PORV	±1858	±806	±2466	±1460	±793	±1894

VALVE NUMBER SV-45B

NODE NUMBER	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
SEISMIC OBE	±10449	±3248	±2078	±2403	±1044	±6396
SEISMIC DBE	±18079	±5616	±3593	±4037	±1730	±10582
BLOWDOWN PORV	±1117	±544	±849	±1046	±706	±911

UNITS: INCH-POUNDS

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-1
Revision 0

6-122
VALVE END MOMENTS

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DWB DATE: 5-25-83
CHECKED BY: SMS DATE: 5/27/83

VALVE NUMBER SV-45A

NODE NUMBER	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
SEISMIC OBE	±4649	±2775	±4870	±6046	±1853	±4509
SEISMIC DBE	±7941	±4736	±8259	±10129	±3152	±7664
BLOWDOWN PORV	±1064	±904	±2528	±672	±511	±1356

VALVE NUMBER _____

NODE NUMBER						
	MX	MY	MZ	MX	MY	MZ
DEADWEIGHT						
THERMAL 1						
THERMAL 2						
SEISMIC OBE						
SEISMIC DBE						
BLOWDOWN PORV						

UNITS: INCH-POUNDS

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-1
Revision 0

6-123

VALVE END MOMENTS

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DNB DATE: 5-25-83

CHECKED BY: DmD DATE: 5/27/83

VALVE NUMBER NRV-153

NODE NUMBER	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
SEISMIC OBE	±9951	±5546	±1702	±4646	±4981	±9759
SEISMIC DBE	±13438	±7551	±2527	±7165	±6806	±15305
BLOWDOWN PORV	±3998	±2113	±9683	±7039	±4021	±11669

VALVE NUMBER NMO-153

NODE NUMBER	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
SEISMIC OBE	±4753	±5126	±10677	±8361	±7712	±9107
SEISMIC DBE	±7196	±7003	±16578	±9231	±6785	±17895
BLOWDOWN PORV	±8354	±6186	±12386	±4807	±6132	±13195

UNITS: INCH-POUNDS

TELEDYNE ENGINEERING SERVICES

Technical Report TR-5364-1
Revision 0

6-124

VALVE END MOMENTS

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-25-83
CHECKED BY: DMD DATE: 5/27/83

VALVE NUMBER NRV-152

NODE NUMBER	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
SEISMIC OBE	±4646	±2854	±1240	±9380	±4125	±12514
SEISMIC DBE	±6450	±4457	±1972	±14835	±6030	±18821
BLOWDOWN PORV	±4233	±1847	±3336	±11543	±3164	±12310

VALVE NUMBER NMO-152

NODE NUMBER	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
SEISMIC OBE	±10544	±4509	±13030	±14271	±6013	±16190
SEISMIC DBE	±16123	±6182	±19393	±21126	±8564	±23806
BLOWDOWN PORV	±10442	±5391	±11858	±10039	±4745	±9527

UNITS: INCH-POUNDS

TELEDYNE ENGINEERING SERVICES

Technical Report
TR-5364-1
Revision 0

6-125

VALVE END MOMENTS

DONALD C. COOK
UNIT #1
PROJECT 5364

BY: DMB DATE: 5-25-83
CHECKED BY: DMD DATE: 5/27/83

VALVE NUMBER NRV-151

NODE NUMBER	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
SEISMIC OBE	±5763	±4843	±2129	±9577	±4397	±4585
SEISMIC DBE	±8659	±7323	±3281	±14592	±6809	±7333
BLOWDOWN PORV	±3907	±2431	±8262	±8007	±4980	±17493

VALVE NUMBER NMO-151

NODE NUMBER	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
SEISMIC OBE	±9728	±2722	±3576	±11289	±3684	±3669
SEISMIC DBE	±14704	±3880	±5836	±17293	±5411	±5967
BLOWDOWN PORV	±9321	±8307	±15478	±7523	±7192	±8935

UNITS: INCH-POUNDS

6.6 Miscellaneous Calculations

6.6.1 Thermal Boundary Displacements

TELEDYNE ENGINEERING SERVICES

BY DMD DATE 4/8/83
CHKD. BY [illegible] DATE 7-1-83

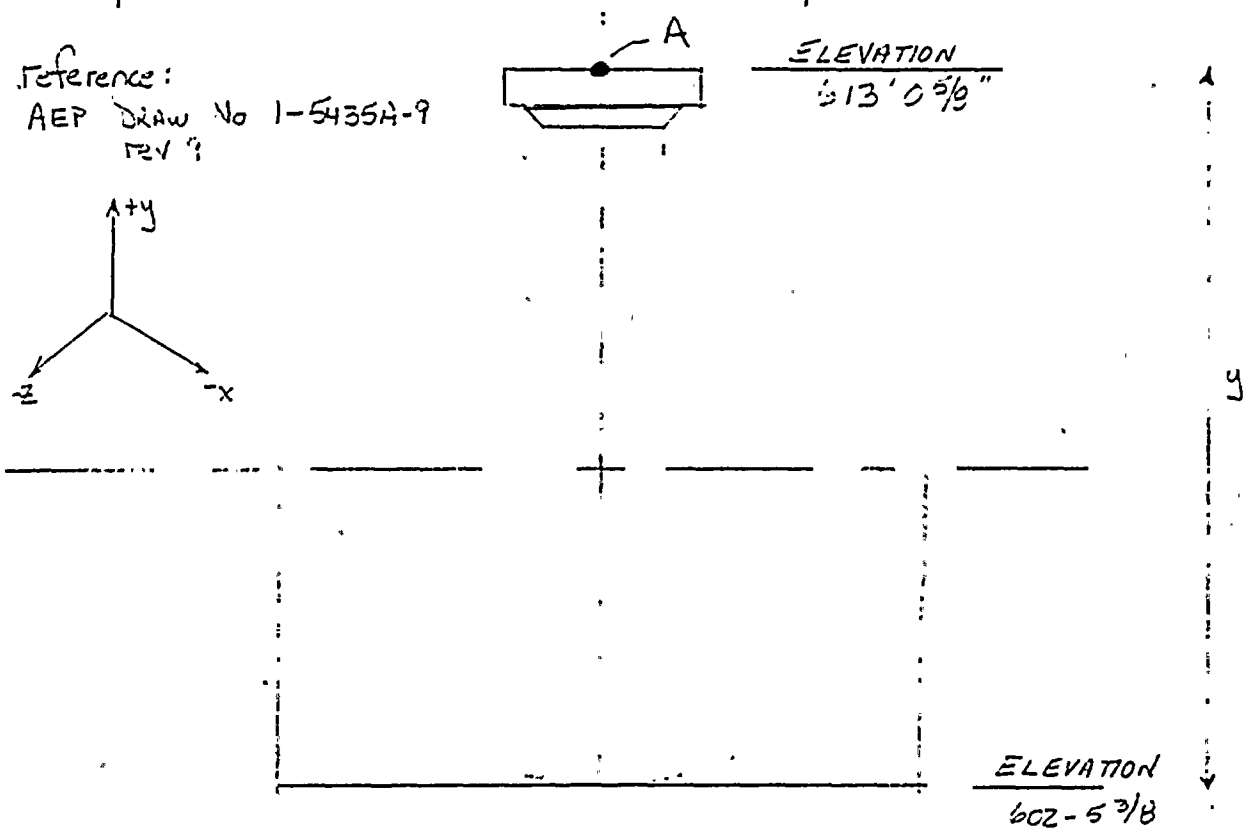
THERMAL BOUNDARY DISPLACEMENT
NORMAL THERMAL CONDITION

SHEET NO. 1 OF
PROJ. NO. 5364

UNITS 1 & 2

Temperature @ Quench Tank = 85°F (per AEP letter dated 11/29/82)

Reference:
AEP Draw No 1-5435A-9
Rev 9



What displacements at point A

$$y = 613'-0\,5/8'' - 602-5\,3/8'' = 10'-7\,1/4 = 10.604'$$

x movement = z movement = 0 since nozzle is at ℄ of Q-tank

y movement = $\alpha \Delta t \ell$

$\alpha = 6.135 \times 10^{-6}$ in/in/°F (for ferritic carbon steel)
$\Delta t = 15°F$ (85-70)
$\ell = 10.604' = 127.248''$

$\Delta y = 6.135 \times 10^{-6} \times 15 \times 127.248 = .0117''$

Summary $\Delta x = 0$ $\Delta y = +.0117''$ $\Delta z = 0$

TELEDYNE ENGINEERING SERVICES

6-129

BY DMD DATE 4/12/83
CHKD. BY [illegible] DATE [illegible]

α, ΔT Values Units 1 & 2

SHEET NO. 1 OF
PROJ. NO. 5364

temperature $\Rightarrow$ 653°F

$\Delta T = 653 - 70 = 583$

for austentic stainless steel $\alpha_{650} = 9.37 \times 10^{-6}$

$\alpha_{700} = 9.93 \times 10^{-6}$

$\alpha_{700} - \alpha_{650} = 9.93 - 9.37 = .06$

$\frac{.06}{50^\circ} = \frac{x}{3^\circ}$ $x = .0036$

$\alpha_{653} = 9.37 + .0036 = 9.3736 \times 10^{-6}$

temperature = 85°

$\Delta T = 85 - 70 = 15^\circ$

for austentic stainless steel $\alpha_{70} = 9.11 \times 10^{-6}$

$\alpha_{100} = 9.16 \times 10^{-6}$

$\alpha_{100} - \alpha_{70} = 9.16 - 9.11 = .05$

$\frac{.05}{30} = \frac{x}{15} \Rightarrow x = .025$

$\alpha_{85} = 9.11 + .025 = 9.135 \times 10^{-6}$

TELEDYNE ENGINEERING SERVICES

6-130

BY DMD DATE 4/12/83
CHKD. BY [illegible] DATE [illegible]

Thermal Boundary Displacements
Normal Thermal Condition

SHEET NO. 2 OF ____
PROJ. NO. 5364

Temperature of Pressurizer = 653°F (per AEP letter dated 11/29/82)

references ① AEP DRAW No 1-5435-8 rev 8
② (W) DRAW No 1097 J56 sheet 1 of 2
③ AEP DRAW No 1-5436-?

per reference ② dimension from base of pressurizer to SRV & PORV nozzles is :

$$635.5 - (52.00 - 35.06) = 618.56"$$

Δy will be same for all four nozzles since the elevations are the same.

$\alpha_{583°} = 7.3366 \times 10^{-6}$ in/in/°F for carbon steel @ 653°

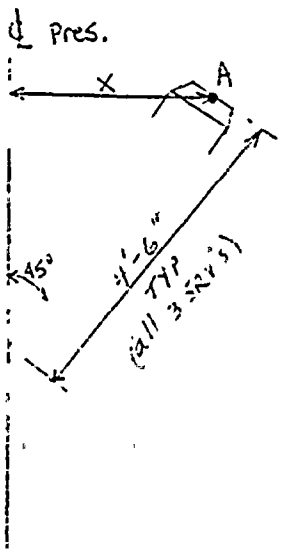
$l = 618.56"$

$\Delta t = 653 - 70 = 583$

$$\Delta y = + \alpha \Delta t l = 7.3366 \times 10^{-6} \times 618.56" \times 583°F = 2.6457"$$

radial growth

per section "G-7" of ref 3



$$\frac{\sin 45}{4.5} = \frac{\sin 45}{x}$$

$x = 3.182' = 38.1838"$

note: this page of calculations is the same for both units since the pressurizer & nozzle dimensions are essentially identical

TELEDYNE ENGINEERING SERVICES

6-131

BY DMD DATE 4/12/83
CHKD. BY. DATE

Thermal Boundary Displacements
Normal Thermal Condition

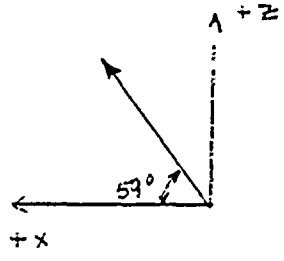
SHEET NO. 3 OF
PROJ. NO. 5364

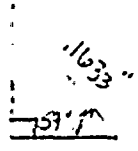
UNIT 1

radial Δ = $7.3366 \times 10^{-6} \times 583 \times 38.1838 = .1633''$

determine X & Z components for radial Δ for each SRV valve

Valve SV-45A

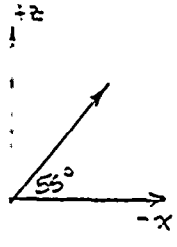


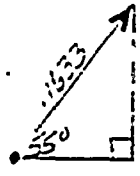


$$\frac{\sin 90}{.1633''} = \frac{\sin 59}{+\Delta Z} = \frac{\cos 59}{+\Delta X}$$

$\Delta X = +.0841''$
$\Delta Z = +.1400''$

Valve SV-45B

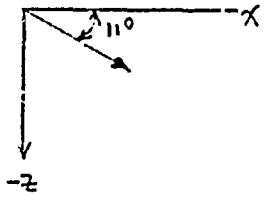


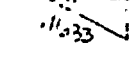


$$\frac{\sin 90}{.1633} = \frac{\sin 55}{-Z} = \frac{\cos 55}{-X}$$

$\Delta X = -.0937$
$\Delta Z = +.1338$

Valve SV-45C





$$\frac{\sin 90}{.1633} = \frac{\sin 11}{-Z} = \frac{\cos 11}{-X}$$

$\Delta X = -.1603$
$\Delta Z = -.0312$

TELEDYNE ENGINEERING SERVICES

6-132

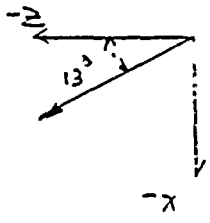
BY DMD. DATE 4/12/83
CHKD. BY [illegible] DATE 4-12-83

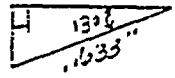
Thermal Boundary Displacements
Normal Thermal Condition

SHEET NO. 4 OF ____
PROJ. NO. 5364

UNIT 1

porv relief line





$$\frac{\sin 90}{.1633} = \frac{\sin 13^\circ}{-\Delta x} = \frac{\cos 13^\circ}{-\Delta z}$$

$\Delta X = -.0367"$
$\Delta Z = -.1591"$

Summary, for the 4 pressurizer nozzles the following displacements will be inserted

node 138 (SV-45C)	$\Delta x = -.1603"$ $\Delta y = +2.6457"$ $\Delta z = -.0312"$	node 185 (SV-45B)	$\Delta x = -.0937"$ $\Delta y = +2.6457"$ $\Delta z = +.1338"$
node 244 (SV-45A)	$\Delta x = +.0841"$ $\Delta y = +2.6457"$ $\Delta z = +.1400"$	node 750 (PORV relief)	$\Delta x = -.0367"$ $\Delta y = +2.6457"$ $\Delta z = -.1591"$

6.6.2 OBE Spectra

TELEDYNE ENGINEERING SERVICES

BY DMD DATE 4/8/83
CHKD. BY DMB DATE 4/8/83

Response Spectra

OBE Analysis

for both Units 1 & 2 the attached spectra curves indicate that Containment CRANE WALL elevation 667'-6" governs for all frequencies. Therefore the horizontal (X & Z) response spectra for OBE analysis is

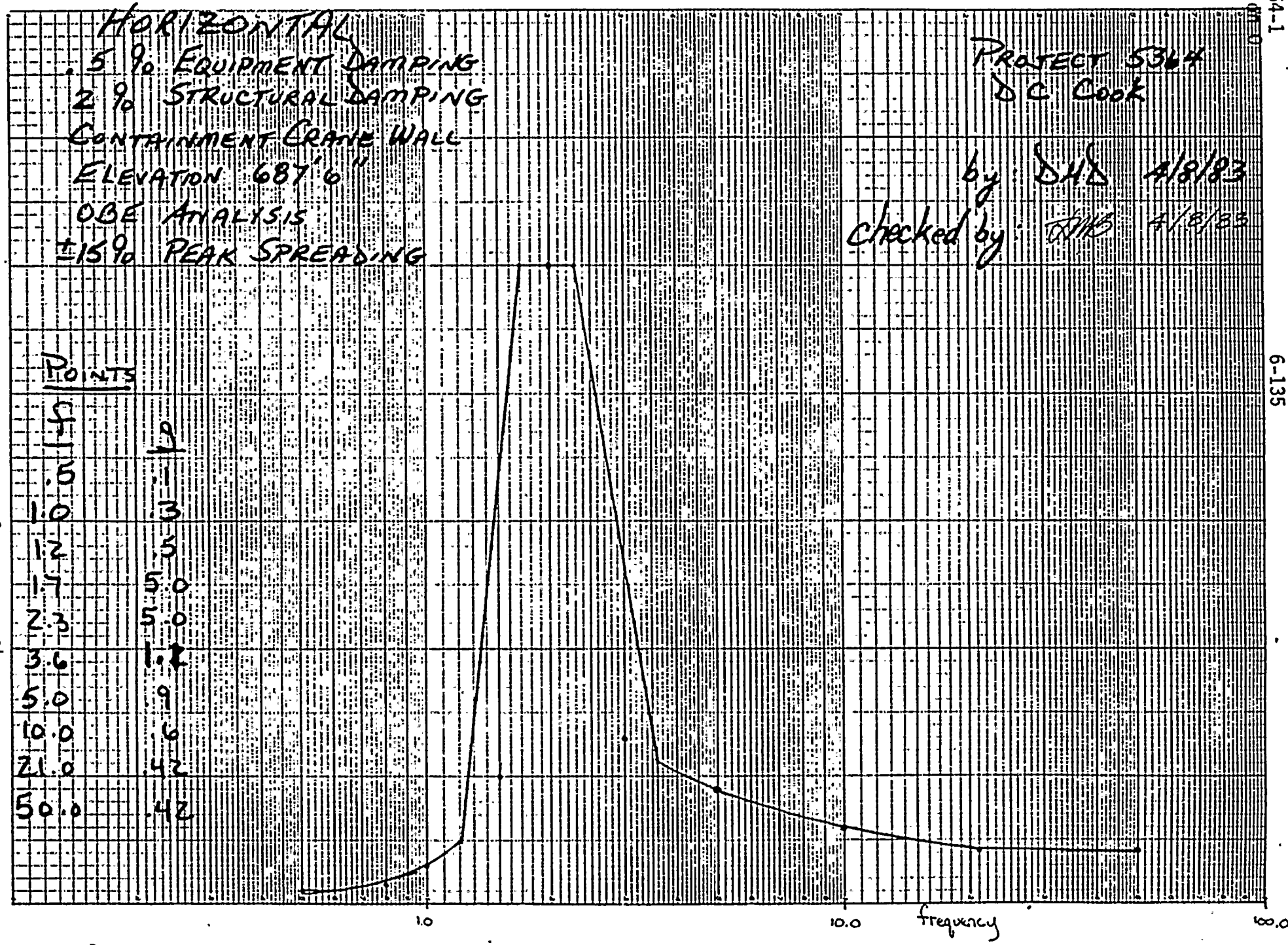
f	g
.5	.10
1.0	.30
1.2	.50
1.7	5.0
2.3	5.0
3.6	1.10
5.0	.10
10.0	.60
21.0	.42
50.0	.42

VERTICAL

The vertical OBE response, per the attached spectra, is:

f	g
.5	.04
1.0	.13
1.22	.20
1.70	1.33
2.30	1.33
3.10	.62
5.00	.62
10.0	.23
22.0	.12
50.0	.12

NO. 31.287-R 10 DIVISIONS PER INCH (10 DIVISIONS) BY THREE 3" 3-INCH CYCLES RATIO RULING. CODEX GRAPH PAPER® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.



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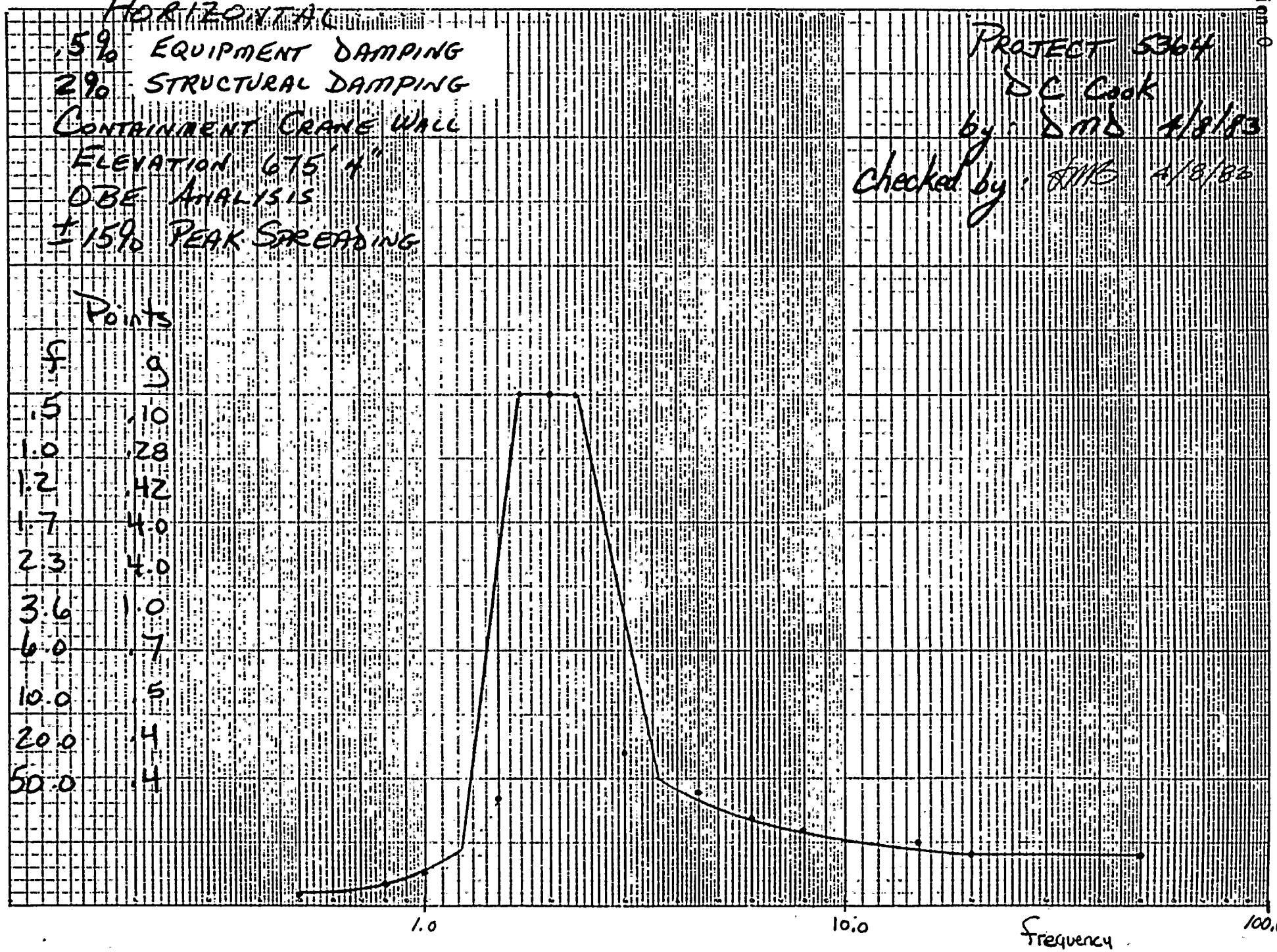
NO. 31,287-R 10 DIVISIONS PER INCH (70 DIVISIONS) BY THREE 3 1/3-INCH CYCLES RATIO RULING. codex GRAPH PAPER® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.



NO. 31,287-R 10 DIVISIONS PER INCH (70 DIVISIONS) BY TWO 3 INCH CYCLES RATIO RULING
Codex GRAPH PAPER
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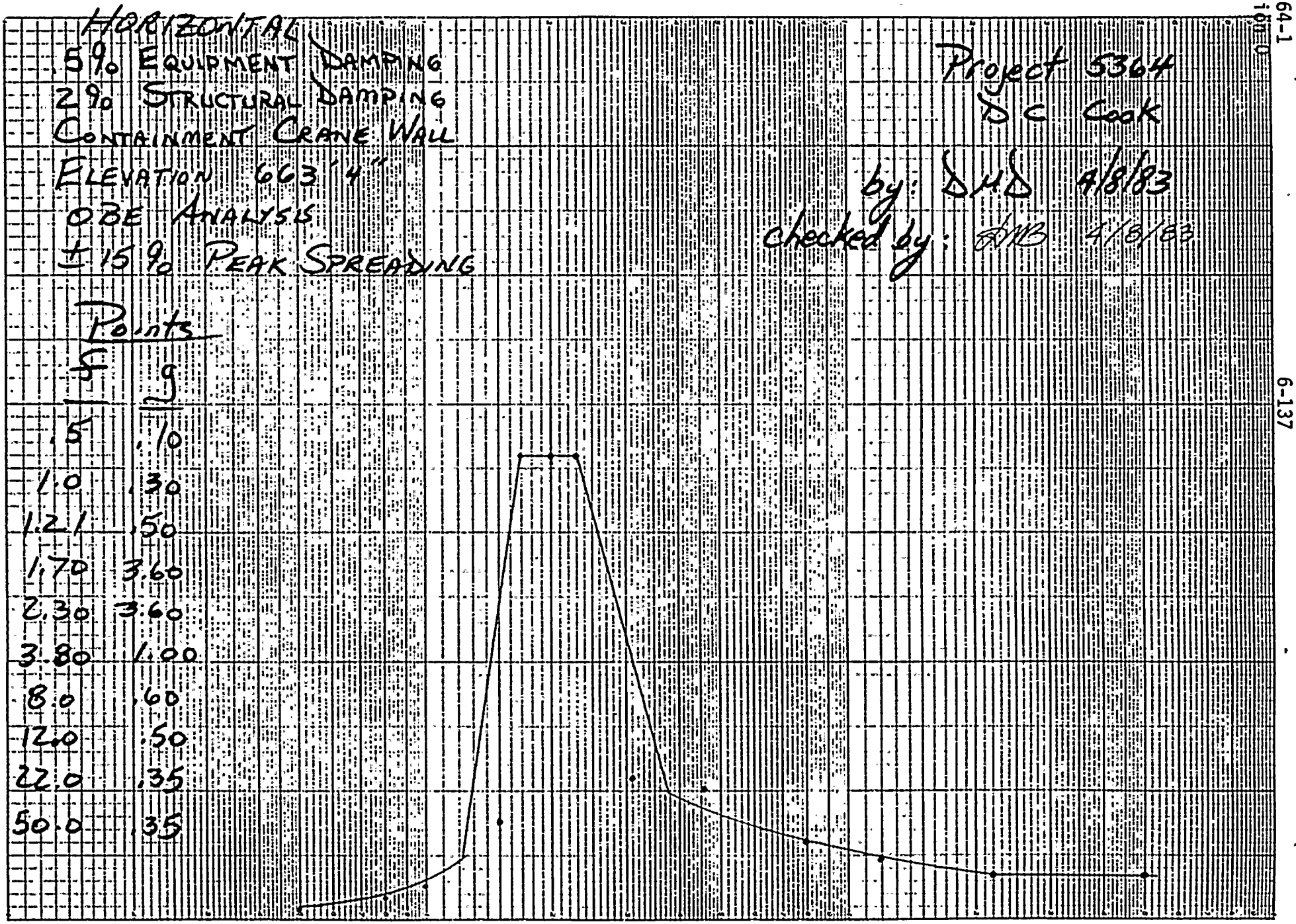
HORIZONTAL
5% EQUIPMENT DAMPING
2% STRUCTURAL DAMPING
CONTAINMENT CRANE WALL
ELEVATION 663'4"
OBE ANALYSIS
± 15% PEAK SPREADING

Project 5364 Cook
by: DHD 4/8/83
checked by: BMB 4/8/83

Points	
f	g
.5	.10
1.0	.30
1.21	.50
1.70	3.60
2.30	3.60
3.80	1.00
8.0	.60
12.0	.50
22.0	.35
50.0	.35



NO. 31,287-R. 10 DIVISIONS PER INCH (70 DIVISIONS) BY THREE 3 1/3-INCH CYCLES RATIO RULING. codex GRAPH PAPER® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

HORIZONTAL

.5 % EQUIPMENT DAMPING

2 % STRUCTURAL DAMPING

CONTAINMENT CRANE WALL

ELEVATION 651' 3"

OBE ANALYSIS

± 15% PEAK SPREADING

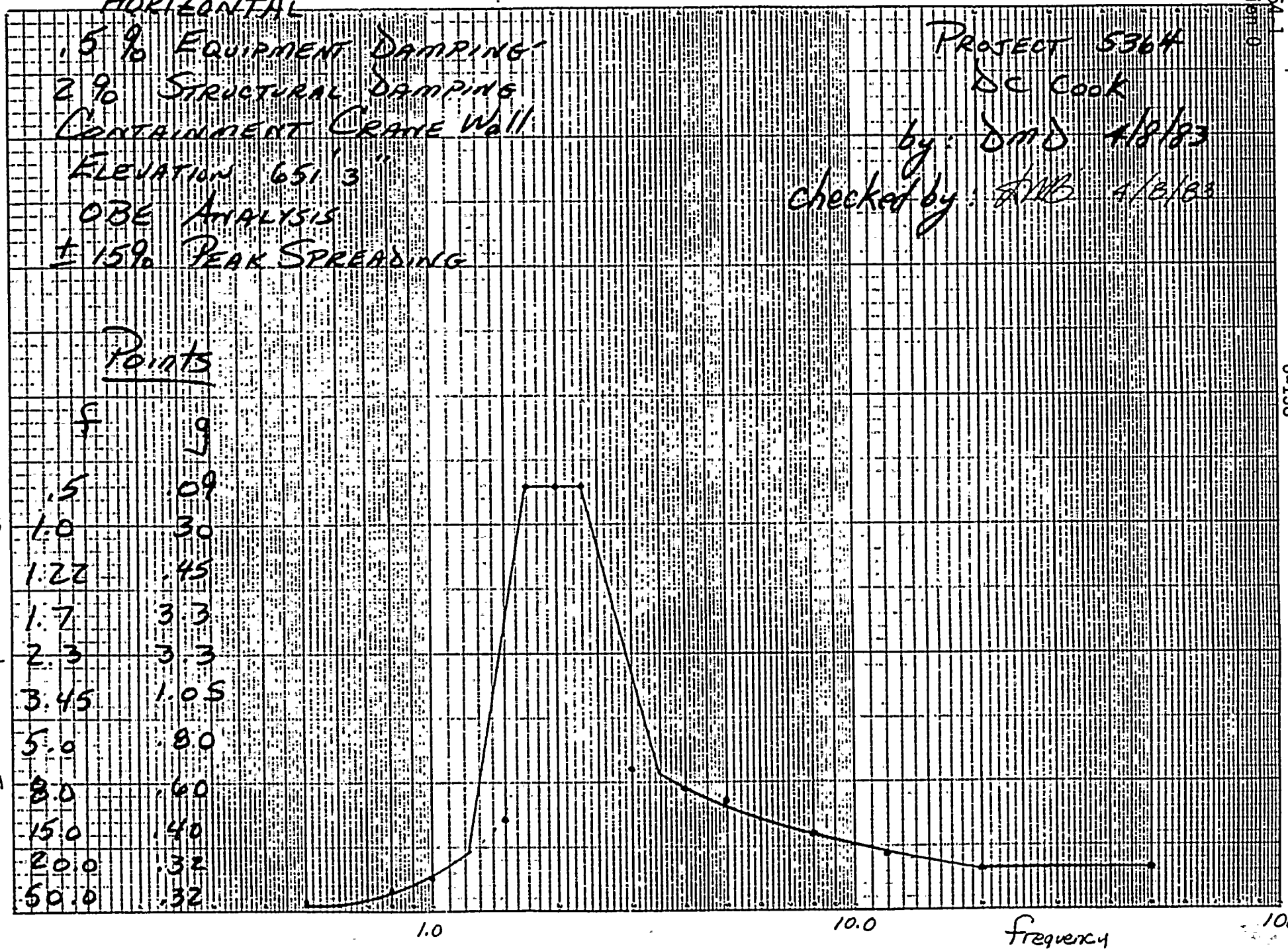
PROJECT 5364

DC COOK

by: DMD 4/8/83

checked by: [illegible] 4/8/83

Points	f
	.07
.5	.09
1.0	.30
1.22	.45
1.7	3.3
2.3	3.3
3.45	1.05
5.0	8.0
8.0	.60
15.0	.40
20.0	.32
50.0	.32



NO. 31.287-R. 10 DIVISIONS PER INCH (70 DIVISIONS) BY THREE 3 1/3-INCH CYCLES RATIO RULING. codex GRAPH PAPER® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

VERTICAL

.5% EQUIPMENT DAMPING

2% STRUCTURAL DAMPING

CONTAINMENT BASE SLAB

ELEVATION 597' 6"

OBE ANALYSIS

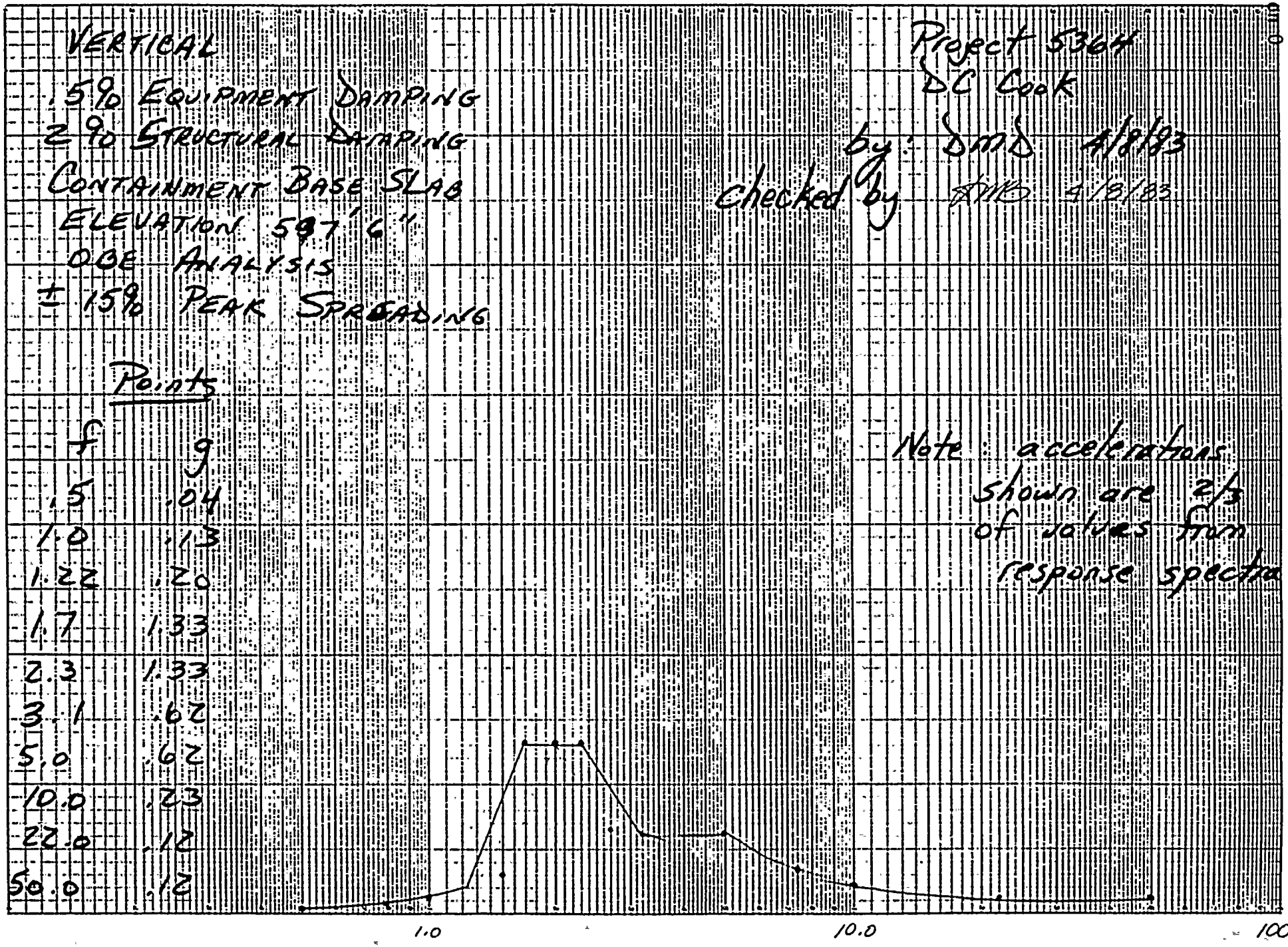
± 15% PEAK SPREADING

Project 5364
DC Cook
by: DMD 4/8/83
Checked by: [illegible] 4/8/83

Points

f	g
.5	.04
1.0	.13
1.22	.20
1.7	1.33
2.3	1.33
3.1	.62
5.0	.62
10.0	.23
22.0	.12
50.0	.12

Note: accelerations shown are 2/3 of values from response spectra



6.6.3 DBE Spectra

TELEDYNE ENGINEERING SERVICES

BY DMD DATE 4/11/83
CHKD. BY [illegible] DATE 4-13-83

RESPONSE SPECTRA

SHEET NO. 1 OF ___
PROJ. NO. 5364

DBE Analysis

per the attached figures, enveloping CONTAINMENT CRANE WALL ELEVATIONS 651.3, 663.3, 675.3 & 687.5 results in the following DBE horizontal spectra for both Units 1 & 2

Freq	g
.5	.19
1.0	.50
1.18	.70
1.7	5.2
2.3	5.2
3.15	2.6
3.65	1.46
6.0	1.40
7.0	1.15
10.0	1.0
17.0	.72
50.0	.72

VERTICAL

The Vertical DBE response for Units 1 & 2, per the attached spectra, is.

f	g
.5	.11
1.0	.25
1.18	.33
1.70	1.40
2.30	1.40
3.42	.80
6.00	.80
10.0	.43
15.0	.28
25.0	.20
50.0	.20

0.001

NO. 31,287-R. 10 DIVISIONS PER INCH (70 DIVISIONS) BY THREE 3 1/3-INCH CYCLES RATIO RULING. codex GRAPH PAPER® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

HORIZONTAL

.5% EQUIPMENT DAMPING

5% STRUCTURAL DAMPING

CONTAINMENT CRANE WALL

ELEVATION 651'

DBE Analysis

±15% PEAK SPREADING

PROJECT 5364

D.C. Cook

by: SAB 4/11/83

checked by: DMB 4-13-83

Points	
5	.17
1.0	.44
1.21	.72
1.70	4.0
2.30	4.0
3.60	1.22
4.00	1.75
6.0	1.15
9.0	.8
21.0	.5
50.0	.5

9 4 3 2 1

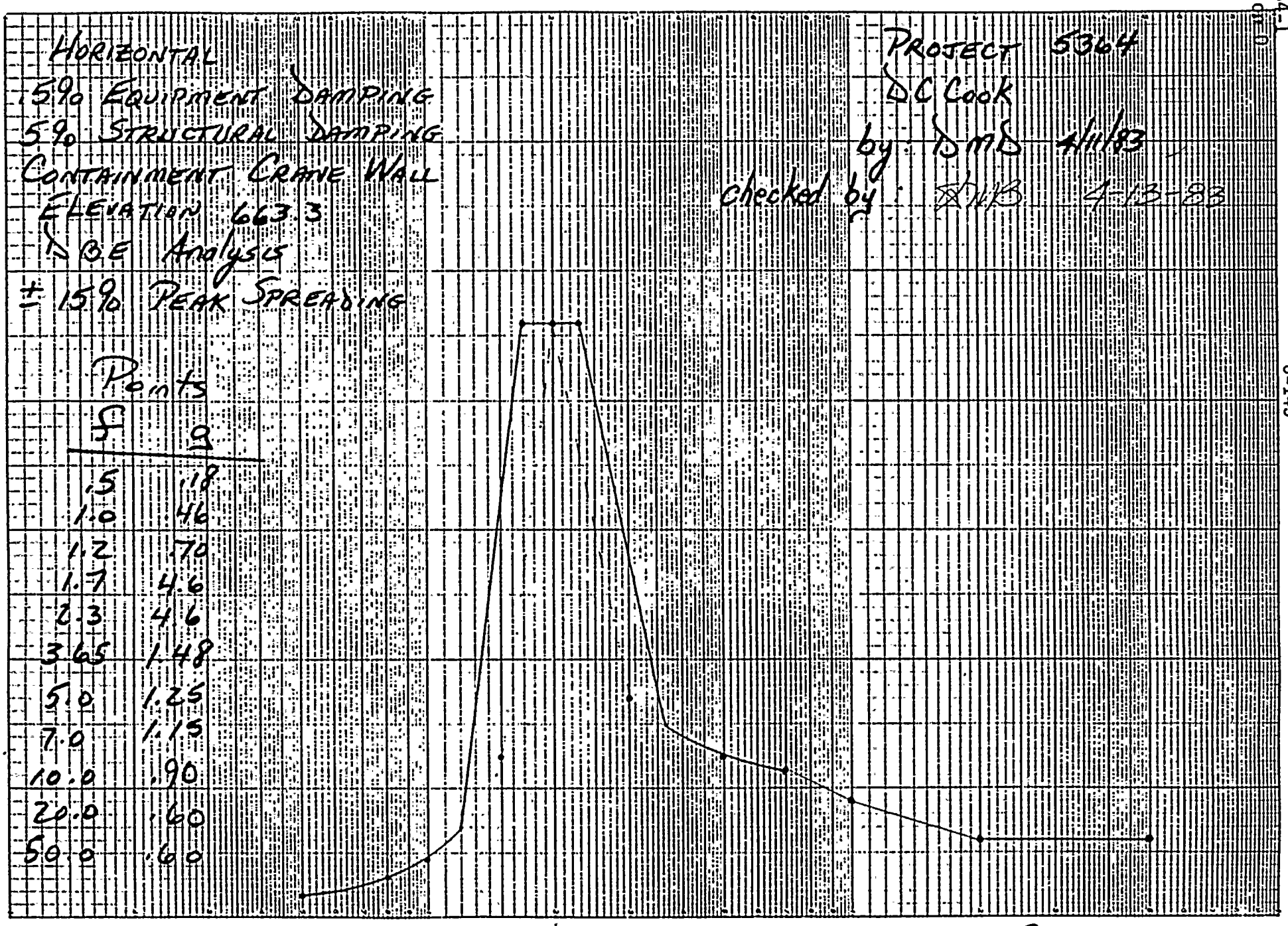
1.0 10.0 100.0 Frequency

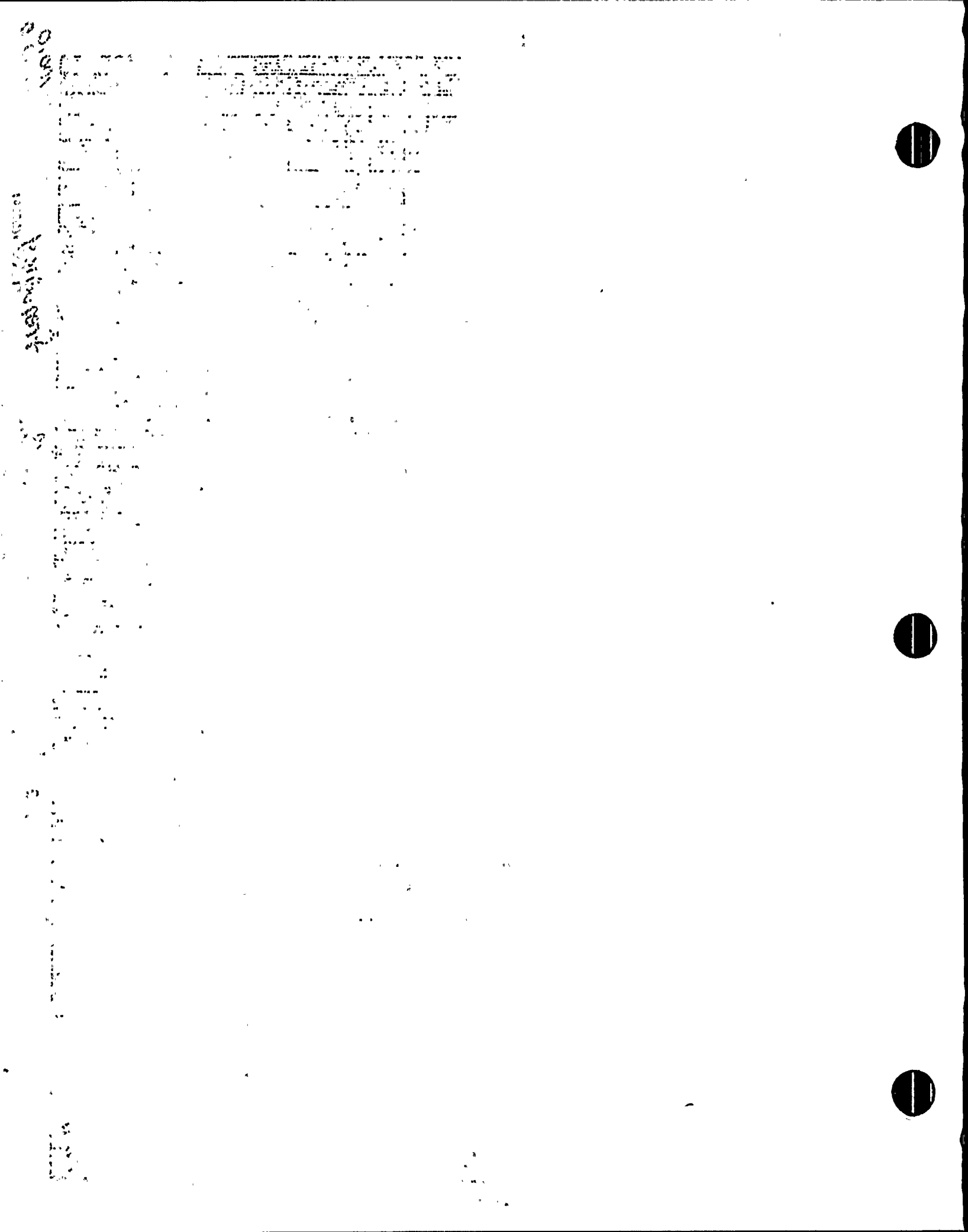
NO. 31,287-R· 10 DIVISIONS PER INCH (70 DIVISIONS) BY THREE 3 1/3-INCH CYCLES RATIO RULING. codex GRAPH PAPER® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

HORIZONTAL
.5% EQUIPMENT DAMPING
5% STRUCTURAL DAMPING
CONTAINMENT CRANE WALL
ELEVATION 663'3"
SSE Analysis
± 15% PEAK SPREADING

PROJECT 5364
DC Cook
by DMB 4/11/83
checked by [illegible] 4-13-83

Points	f	g
	.5	.18
	1.0	.46
	1.2	.70
	1.7	4.6
	2.3	4.6
3	3.65	1.48
	5.0	1.25
	7.0	1.15
	10.0	.90
	20.0	.60
	50.0	.60





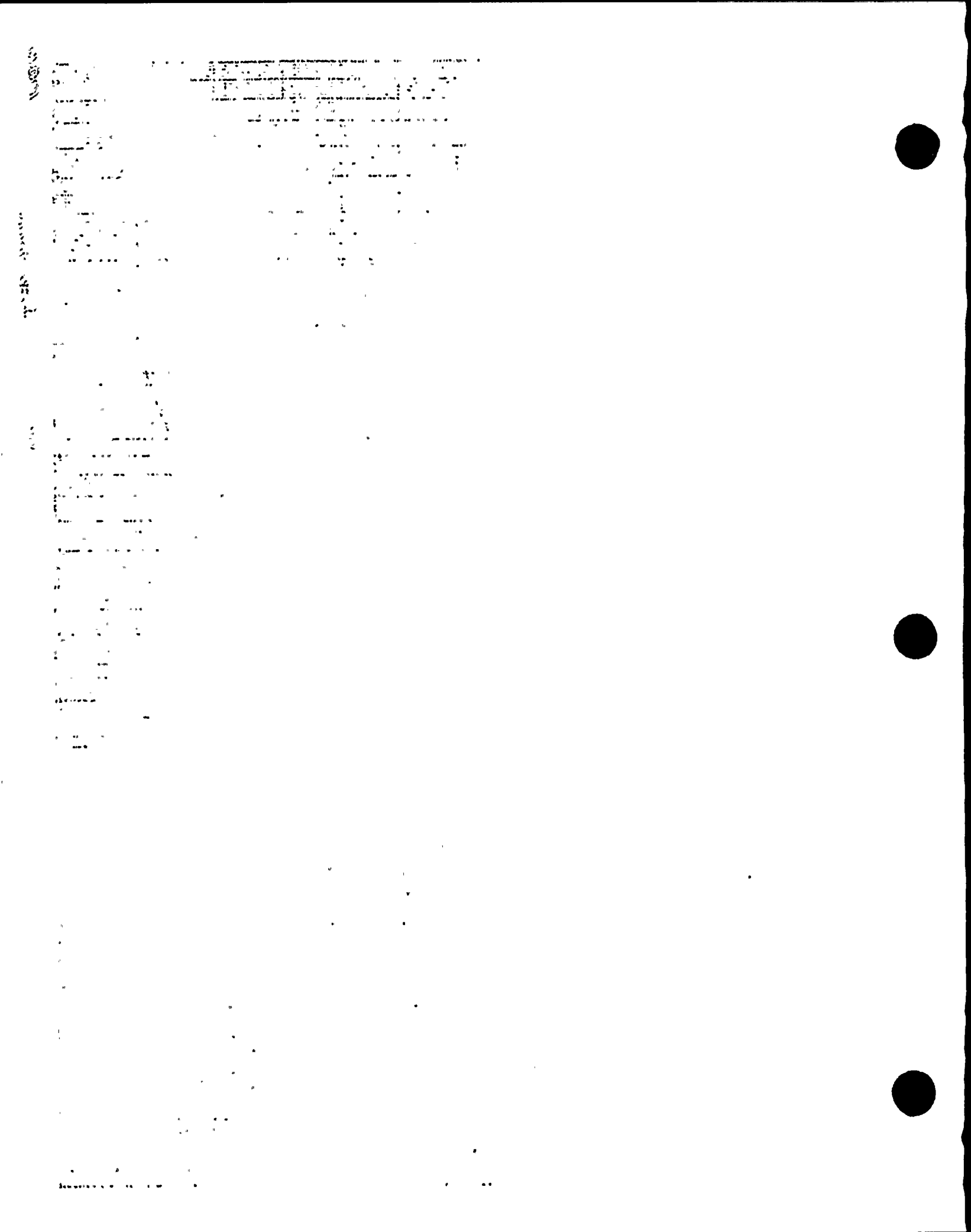
NO. 31,287-R. 10 DIVISIONS PER INCH (70 DIVISIONS) BY THREE 3 1/3-INCH CYCLES RATIO RULING. codex GRAPH PAPER ® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

HORIZONTAL
5% EQUIPMENT DAMPING
5% STRUCTURAL DAMPING
CONTAINMENT CRANE WALL
ELEVATION 675.3'
DBE ANALYSIS
±15% PEAK SPREADING
Points

PROJECT 5364
DC Cook
by: DHD 4/11/83
checked by: RMS 4-13-83

f	g
.5	.19
1.0	.50
1.21	.72
1.7	5.0
2.3	5.0
3.15	2.6
3.65	1.46
5.0	1.25
6.0	1.0
10.0	.95
23.0	.65
50.0	.65

1.0 10.0 frequency 100.0



NO. 31,287-R. 10 DIVISIONS PER INCH (70 DIVISIONS) BY THREE 3 1/2-INCH CYCLES RATIO RULING. codex GRAPH PAPER® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

HORIZONTAL
.5% EQUIPMENT DAMPING
5% STRUCTURAL DAMPING
CONTAINMENT CRANE WALL
ELEVATION 687'-6"
DBE ANALYSIS
± 15% PEAK SPREADING

PROJECT 5364
D.C. Cook
by: DMS 4/11/83
checked by: RMB 4-13-83

Freq	g
.5	.18
1.0	.50
1.18	.70
1.7	5.2
2.3	5.2
3.15	1.76
6.0	.14
10.0	.10
17.0	.72
50.0	.72

1.0 10.0 from one... 100.0

NO. 31,267-R. 10 DIVISIONS PER INCH (10 DIVISIONS) BY THREE 3 INCH CYCLES RATIO NO. INCH. codex GRAPH PAPER® IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062 PRINTED IN U.S.A.

VERTICAL
5% EQUIPMENT DAMPING
5% STRUCTURAL DAMPING
CONTAINMENT BASE SLAB
ELEVATION 597'-6"
DBE Analysis
± 15% PEAK SPREADING

PROJECT 5364
DC COOK
by: DMD 4/11/83
checked by: [illegible] 4-13-83

Points	f	g
	.5	.11
	1.0	.25
	1.18	.33
	1.70	1.40
	2.30	1.40
	3.42	.80
	6.0	.80
	10.0	.43
	15.0	.28
	25.0	.20
	50.0	.20

1.0 10.0 100.0 Frequency

7.0 DRAWINGS

ENGINEERING

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8. TES letter 5364-21, dated February 2, 1983 from Mr. P. D. Harrison of TES to Mr. Sam Ulan of AEP.

9. TES letter 5364-25, dated February 14, 1983 from Mr. P. D. Harrison of TES to Mr. Sam Ulan of AEP.

10. TES letter 5364-33, dated April 8, 1983 from Mr. P. D. Harrison of TES to Mr. Sam Ulan of AEP.

TELEDYNE
INSULATED WIRE

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

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

14. Masoneilan International, Inc. Control Valve Model No. 38-20721, Drawing No. CP1-18-55, Revision H.

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

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17. ASME Code NB7000, Section III.

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