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SUBJECT: Forwards S&W Calculations PX-60012-2, MS-2155-0 & PX-60160-0 in support of review of final rept on downcomer design reanalysis.

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N M NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/301 PLAINFIELD ROAD, SYRACUSE, N.Y. 13212/TELEPHONE (315) 474-1511

August 28, 1987
(NMP2L 1070)

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Re: Nine Mile Point Unit 2
Docket No. 50-410
NPF-69

Gentlemen:

By letter dated May 15, 1987 (NMP2L-1035), Niagara Mohawk submitted a final report on Downcomer Design Reanalysis for Nine Mile Point Unit 2. In order to complete the review of this report, members of the Nuclear Regulatory Commission staff requested that Niagara Mohawk submit the detailed design calculations which support this reanalysis. Therefore, please find enclosed the following calculations:

1. Stone & Webster Engineering Corporation Calculation No. PX-60012-2, which supercedes Revision 1 submitted on January 23, 1986.

2. Stone & Webster Engineering Corporation Calculation No. MS-2155-0, which re-evaluates the safety relief valve (SRV) and condensation oscillation (C.O.) load definitions and also supplements Calculation No. MS-1869-2 submitted on January 23, 1986.

3. Stone & Webster Engineering Corporation Calculation No. PX-60160-0 (Plant Specific Condensation Oscillation Loads).

These three (3) calculations should be reviewed along with Stone & Webster Engineering Corporation Calculation Nos. MS-1869-2 and MS-2053-0, submitted to the Nuclear Regulatory Commission on January 23, 1986 (NMP2L-0590).

Very truly yours,

NIAGARA MOHAWK POWER CORPORATION

CVMangan
C. V. Mangan
Senior Vice President

PEF/pns
3627G
Enclosure
xc: Regional Administrator, Region I
Mr. R. A. Capra, Director
Ms. M. F. Haughey, Project Manager (2 copies)
Mr. W. A. Cook, Resident Inspector

A001
1/1

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

A 5010.64 (FRONT) NOTED MAR 20 1986 T.J. Milosheraky Rev 1 TOTAL PAGES = 56

CLIENT & PROJECT	PAGE 1 OF 31 AND 3A, 3B, 6A, 19A, 19B, 20A, 20B, 20C, 20D, 26A, 30A AND 14 P# ATTACHMENTS
NIAGARA MOHAWK POWER CORP. — NMP2	

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (√)
DOWNCOMER RESPONCE TO SRV AIR BUBBLE LOAD (FSI)	☑ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER				
J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12177	NP(E)...	PX-60012		

* APPROVALS – SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (√)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
ORIGINAL PREPARED BY: V. CHANDRA	ORIGINAL REVIEWED BY: T. H. CHONG	ORIGINAL IND. REVIEWED BY: T. H. CHONG	0	—		✓
D. Bhargava 1/19/86	J. S. Hsieh J.S. HSIEH 1-19-86	D. Wang 1-19-86 D. WANG	1	0		✓
Approved by Warren Wang WARREN WANG			1/22/86			
D Bhargava 5/5/87	V. J. Shah 5-5-87	Y. Ben Nagi 5/5/87	2	1		✓
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8709030097

STATEMENT OF REVIEW
CALCULATION NUMBER 12177.08-PX-60012

This calculation has been reviewed in accordance with EMAG-CH-41- and was found to be adequate. The method of review was: (circle appropriate items)

a. Comparison with a similar calculation (number _________.)

b. Alternate calculation or simplified approach.

c. Number by number check.

T. H. Camp 12/10/79
NONINDEPENDENT REVIEWER /DATE

The statement below applies to Nuclear Safety Related QA Category I calculations only.

This calculation has been INDEPENDENTLY reviewed in accordance with EMAG-CH-41- and was found to be adequate. The method of review was: (circle appropriate items)

a. Comparison with prequalified methods and assumptions ____________________.
(prequalified document number(s))

b. Addressing the key questions appearing in Attachment 6.3 of EAP 3.1, Rev.

Tex Henry Camp 12/13/79
INDEPENDENT REVIEWER /DATE

REVISON STATUS TABLE

CALCULATION NO. Px-60012
JOB ORDER NO. 12177.08

7730

REV NO.	PAGE NO.	REASON	REVISOR/DATE	NON-INDEPENDENT REVIEWER/DATE	INDEPENDENT REVIEWER/DATE	APPROVAL/DATE
1	–	GENERAL Replace References 7&9 with correct reference, run analysis with new input data, void previous computer runs. Changed Page numbers.	D Bhargava 1-19-86	J. S. Hsieh 1-19-86	D. Wang 1-19-86	Wener Wang 1/22/86
		SPECIFIC				
	1	CHANGE STATUS FROM PRELIMINARY TO FINAL.				
	3A	ADD				
	4, 5	REVISE TABLE OF CONTENTS				
	19	Delete Paragraph as marked.				
	19A	ADD NEW PAGE				
	20	VOID PAGE				
	20	REVISED PAGE 20				
	20A	ADD NEW PAGE				
	21, 22, 23	Minor changes as marked and Deletion as marked				
	24	VOID				
	25	VOID				
	25	REVISED PAGE 25				
	26	VOID				
	26A	ADD				

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1	28	Delete Ref 7 & 9	(Contd.)			
	29	DELETE REF 11-20 ADD REF. 22-25				
	30,31,3[illegible]	VOID				
	30,31	REVISED PAGES				
	1A-4A	ADD - PROGRAM VERIF.				
	1C-1CC	[illegible]				
2	—	GENERAL: Add new references, run analysis for new input data, changed Page Numbers SPECIFIC:	D Bhargava 5/5/87	V [illegible] 5/5/87	M. [illegible] 5/5/87	
	4, 5	Revise table of contents				
	6A	Add introduction for Rev 2.				
	7	Clarification for Assumption 2.				
	19B	ANALYSIS WITH NEW SRV LOADS.				

REVISON STATUS TABLE

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CALCULATION NO. PX - 60012 Rev 2
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2	20B 20C 20D	ANALYSIS WITH NEW SRV LOADS.	CONTD.			
	26	Changed table No. from 4 to 6.				
	26A	SUMMARY OF RESULTS FOR REV. 2				
	29	REFERENCES ADDED FOR REV. 2				
	30A	COMPUTER LOG.				
	31	MICROFICHE				

CALCULATION SHEET

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STONE & WEBSTER ENGINEERING CORPORATION

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VIJAY CHANDRA 01 AUG 1979	J.H.G 12/10/79	J.H.G 12/10/79

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I.)	1/2

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[illegible]

[illegible]

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VIJAY CHANDRA 01 AUG 1979	J.K.G 12/10/79	JKG 1·/1· ..

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I)	1/2

REV. 1

1. INTRODUCTION:

THE DISCHARGE OF WATER AND AIR FROM A SRV LINE AFTER ACTUATION OF A MAINSTEAM SRV INDUCES OSCILLATORY FLOW IN THE SUPPRESSION POOL DUE TO OSCILLATIONS OF AIR BUBBLE. THIS POOL MOTION EXERTS LOAD ON PIPING SUBMERGED IN THE POOL. THE SRV AIRBUBBLE SUBMERGED STRUCTURE LOADS WERE CALCULATED IN REFERENCE [1]*. BUT, IN [1] THE DOWCOMER WAS ASSUMED RIGID. AFTER APPLYING THESE LOADS ON DOWNCOMERS IT WAS DISCOVERED THAT DOWNCOMER VELOCITY IS SIGNIFICANT (ABOUT 6 ft./Sec. PEAK). IN THE PRESENT CALCULATION THE LOADS ARE NOT CALCULATED. RATHER, THE COUPLED BUBBLE, WATER AND DOWNCOMER RESPONSE EQUATIONS ARE SOLVED SIMULTANEOUSLY TO GIVE DOWNCOMER DEFLECTION AND STRESS.

2. PURPOSE:

THE DOWNCOMER PEAK STRESSES CALCULATED HERE WOULD BE COMBINED WITH STRESSES DUE TO OTHER EVENTS TO ASSESS THE TOTAL STRESS IN THE DOWNCOMER. THE PRIMARY OBJECTIVE IS TO ILLUSTRATE EFFECT OF FLUID DAMPING.

* THE NUMBERS IN THE SQUARE BRACKETS CORRESPOND TO THE ENTRY NUMBER IN THE LIST OF REFERENCES.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 6A
12177	EMD - MECH. SEC.	12177.08-PX-6002-	Rev 2	of 31

INTRODUCTION (FOR REV 2) :

THE LOAD DEFINITION FOR SRV LOADINGS TO BE USED FOR COMBINING IN THE FAULTED CONDITION (SEE REF. 26) WAS REVISED IN REF. 27. THIS LOAD DEFINITION IS FOR A SINGLE SRV ACTUATION, AND THE DOWNCOMER RESPONSES FROM IT ARE TO BE COMBINED WITH BASIC CO, AND SSE LOADS. THIS REVISION CALCULATES DOWNCOMER RESPONSES FROM THE REVISED SRV LOAD DEFINITION.

THE PREVIOUS SINGLE SRV LOAD DEFINITION WAS CONSERVATIVE, AND THE DOWNCOMER RESPONSES WERE HIGHER. HOWEVER, THE PREVIOUS ANALYSIS (FROM REV 1 OF THIS CALC.) IS STILL VALID FOR OTHER SRV EVENTS. THUS, IN THE UPSET AND EMERGENCY CONDITION LOAD COMBINATIONS; AND IN THE FAULTED CONDITION COMBINATION THAT INCLUDES SSE, SRV AND CHUGGING; THE PREVIOUSLY CALCULATED DOWNCOMER RESPONES WILL BE USED.

THE METHOD USED IN THIS REVISION IS IDENTICAL TO THE METHOD USED IN REV 0 AND REV. 1 OF THIS CALCULATION; EXCEPT ASSUMPTION 2. of P. 7 IS NOT USED IN THIS REVISION. THIS IS BECAUSE THE BUBBLE PRESSURE/LOADS ARE DIRECTLY AVAILABLE FROM REF. 27.

[illegible]

3. ASSUMPTIONS:

1. THE AIR BUBBLE IS ASSUMED CENTERED AT ELEVATION 190 ft. (DOWNCOMER TIP) AND TOUCHING THE DOWNCOMER.

Rev 2 | * 2. THE BUBBLE INSTANTANEOUS OVER PRESSURE IS $1.5 * \frac{11}{19}$ * (KKB WALL PRESSURE DATA) [2,3]. THE FACTOR 1.5 IS USED TO CONVERT KKB WALL PRESSURE TO NMP#2 WALL PRESSURE. $\frac{11}{19}$ IS THE RATIO OF DEPTHS OF DOWNCOMER TIP TO A POINT 6 ft ABOVE THE BASEMAT.

3. THE BUBBLE INITIAL RADIUS IS 5 ft. [3].

4. THE ACCELERATION FIELD AT THE GEOMETRIC CENTER OF THE DOWNCOMER TIP IS EVALUATED USING RAYLEIGH BUBBLE EQUATION. EQUATION (A 38) OF [4].

6. THE HORIZONTAL ACCELERATION PROFILE IS LINEAR OVER THE SUBMERGED LENGTH OF DOWNCOMER AND IS ZERO AT THE FREE SURFACE.

7. THE VELOCITY PROFILE OF FLUID IS OBTAINED USING EQUATION (A-66) OF [4] BUT CONSIDERING ONLY ONE NEGATIVE IMAGE TO SIMULATE FREE SURFACE. THE FACTOR USED IN EQUATION (A 67) OF [4] IS ASSUMED EQUAL TO 1.

Rev 2 | * This assumption is not applicable to analysis performed in Rev. 2.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

8. INTERFERENCE EFFECTS ON HYDRODYNAMIC MASS AND STANDARD DRAG ARE IGNORED. (BUT NOT ON ACCELERATION [illegible])

9. THE DOWNCOMER IS MODELLED AS A SINGLE DEGREE OF FREEDOM SYSTEM HAVING A NATURAL FREQUENCY OF THE FUNDAMENTAL MODE OF VIBRATIONS.

4. NOMENCLATURE:

a = DOWNCOMER OUTSIDE RADIUS (ft.)

b = DOWNCOMER POSITION AFTER DEFLECTION (ft.)

C = DOWNCOMER STRUTURAL DAMPING COFFICIENT (LBF. Sec/ft)

C_D = STANDARD DRAG COEFFICIENT

C_M = INVISCID DRAG (INERTIA) COEFFICIENT

d = OUTSIDE DIAMETER OF DOWNCOMER (ft) = $2a$

f = DISTANCE BETWEEN DOWNCOMER TIP CENTER AND BUBBLE = $R+a$ (ft.)

k = DOWNCOMER STIFFNESS BASED ON TIP DEFLECTION (LBF/ft)

K = KEULEGAN-CARPENTER NUMBER $[U_m T/D]$

ℓ = SUBMERGED LENGTH OF DOWNCOMER. (ft.)

ℓ_d = TOTAL LENGTH OF DOWNCOMER (ft.)

m = EQUIVALENT MASS OF DOWNCOMER (SLUG)

m_H = HYDRODYNAMIC MASS OF DOWNCOMER (SLUG)

P = (BUBBLE PRESSURE — UNDISTURBED HYDROSTATIC PRESSURE) (LBF/ft^2)

R = BUBBLE RADIUS (ft.)

R_e = REYNOLDS NUMBER $\left(\frac{U_m d}{\nu}\right)$

S = VERTICAL POSITION ALONG SUBMERGED LENGTH (ft)

t = TIME (Sec.)

T = PERIOD OF OSCILLATION (Sec.)

u = X-COMPONENT OF FLUID VELOCITY (ft/Sec)

U_S = X-COMPONENT OF FLUID VELOCITY AT CYLINDER SURFACE (ft/Sec)

U_M = PEAK VALUE OF (U−V) DURING OSCILLATIONS (ft/Sec.)

U = EQUIVALENT UNIFORM FLUID VELOCITY

V_{sp} = PEAK VELOCITY OF SINGLE D.O.F. SYSTEM WITHOUT FLUID DAMPING (ft/sec)

V_{mp} = AVERAGE OF PEAK VELOCITY OF SUBMERGED NODES OF MULTI D.O.F. SYSTEM (ft/sec)

v = y-COMPONENT OF FLUID VELOCITY (ft/sec.)

v_s = y-COMPONENT OF FLUID VELOCITY AT CYLINDER SURFACE (ft/sec)

V = CYLINER VELOCITY = $\dot{b}$ (ft/sec.)

$V_s = \sqrt{u_s^2 + v_s^2}$ (ft/sec.)

x = x-COORDINATE (ft)

x_s = x-COORDINATE AT CYLINDER SURFACE (ft)

y = y-COORDINATE (ft.)

y_s = y-COORDINATE AT CYLINDER SURFACE (ft.)

Z = SECTION MODULUS (ft^3)

α = VELOCITY MULTIPLIER TO SINGLE D.O.F. SYSTEM = $\frac{V_{mp}}{V_{sp}}$

θ = ANGULAR COORDINATE MEASURED FROM CYLINDER CENTER (RAD.), ALSO A DUMMY VARIABLE

ϕ = VELOCITY POTENTIAL (ft^2/sec.), ALSO A DUMMY VARIABLE

ν = KINEMATIC VISCOSITY OF WATER (ft^2/sec.)

ρ = DENSITY OF WATER (SLUG/ft^3)

δ_{max} = PEAK DEFLECTION OF THE SINGLE D.O.F. SYSTEM (ft.)

ω = UNDAMPED FUNDAMENTAL NATURAL FREQUENCY

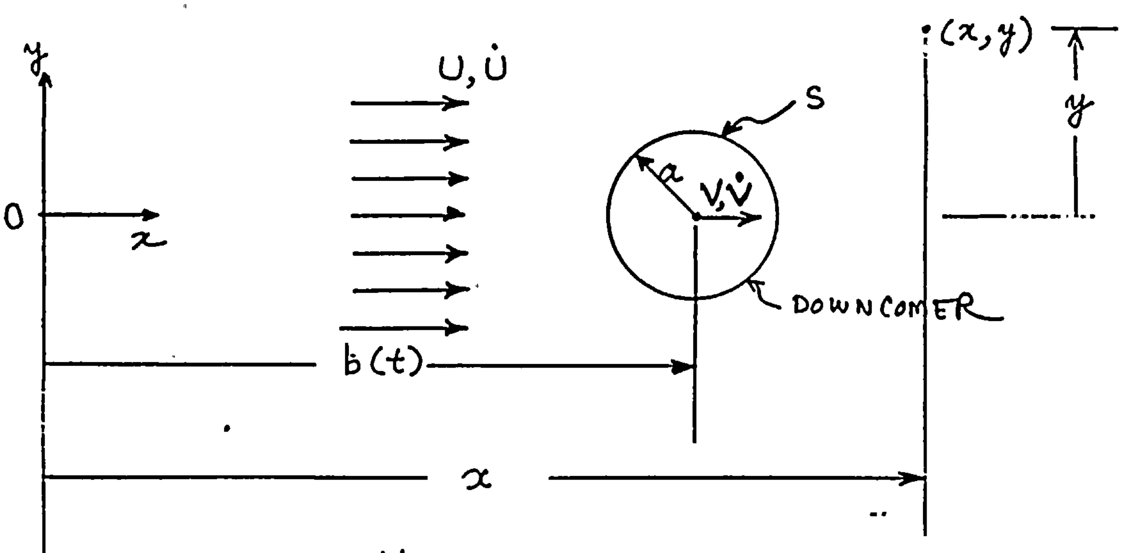
5. ANALYSIS:

THE INLINE FORCE ON A STATIONARY CYLINDER IN PARALLEL CROSS FLOW IS GIVEN BY [5]

$$F = \tfrac{1}{2} C_D \, \ell \, d \, \rho \, |U| U + \frac{\pi}{4} C_M \, \ell \, d^2 \rho \frac{dU}{dt} \qquad (1)$$

IN AN INVISCID FLUID C_M CAN BE EVALUATED ON PURELY THEORETICAL GROUNDS AND IT IS 2. [4]. BUT, IF THE CYLINDER IT SELF IS ACCELERATING THEN THE INVISCID FORCE {SECOND TERM IN (1)} WOULD BE MODIFIED. IT IS DERIVED IN SECTION 5.1.

5.1 INVISCID DRAG ON AN ACCELERATING CYLINDER IN AN UNSTEADY FLOW



$$V = \dot{b}(t) = \frac{db}{dt}$$

PLAN VIEW

THE VELOCITY POTENTIAL FOR A MOVING CYLINDER IN A PARALLEL STREAM OF FLUID IS

$$\phi = Ux + \frac{(U-V)a^2(x-b)}{(x-b)^2+y^2}$$

$$u = \frac{\partial \phi}{\partial x} = U + \frac{(U-V)a^2[y^2-(x-b)^2]}{[y^2+(x-b)^2]^2}$$

$$v = \frac{\partial \phi}{\partial y} = -\frac{2(U-V)a^2(x-b)y}{[(x-b)^2+y^2]^2}$$

IF SUBSCRIPT 'S' DENOTES THE SURFACE OF THE CYLINDER, THEN

$$x_s - b = a\cos\theta \quad , \quad y_s = a\sin\theta$$

$$\therefore u_s = U + \frac{(U-V)a^2\,[a^2\sin^2\theta - a^2\cos^2\theta]}{a^4} = U + (U-V)(\sin^2\theta - \cos^2\theta)$$

$$= U - (U-V)\cos 2\theta$$

$$v_s = -\frac{2(U-V)a^2\,a\cos\theta\,a\sin\theta}{a^4} = -(U-V)\sin 2\theta$$

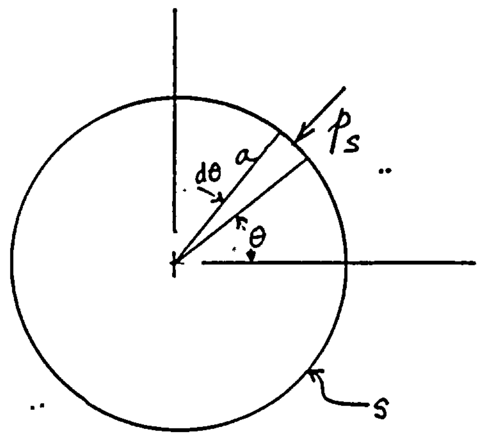
Let $V_s^2 = u_s^2 + v_s^2 = U^2 + (U-V)^2 - 2U(U-V)\cos 2\theta$

$$= U^2 + (U-V)^2 - 2U(U-V)(1 - 2\sin^2\theta)$$

APPLYING BERNOULLI'S EQUATION AT THE CYLINDER SURFACE, ONE OBTAINS

$$\left(\frac{\partial\phi}{\partial t}\right)_s + \frac{V_s^2}{2} + \frac{p_s}{\rho} = f(t)$$

THE INVISCID FLUID LOAD ON THE CYLINDER IS GIVEN BY



$$2\int_0^{\pi} -p_s \, a \, d\theta \, l \cos\theta$$

$$= +2al\rho\int_0^{\pi}\left[\left(\frac{\partial\phi}{\partial t}\right)_s + \frac{V_s^2}{2} - f(t)\right]\cos\theta \, d\theta$$

$$= +2al\rho\int_0^{\pi}\left(\frac{\partial\phi}{\partial t}\right)_s \cos\theta \, d\theta$$

$$\frac{\partial\phi}{\partial t} = \dot{U}x + \frac{(\dot{U}-\dot{V})a^2(x-b)}{(x-b)^2+y^2} + \frac{(U-V)a^2(-\dot{b})}{(x-b)^2+y^2}$$

$$+ \frac{(U-V)a^2(x-b)\,2(x-b)\dot{b}}{\left[(x-b)^2+y^2\right]^2}$$

$$\left(\frac{\partial\phi}{\partial t}\right)_s = \dot{U}(b+a\cos\theta) + (\dot{U}-\dot{V})a\cos\theta - V(U-V)$$

$$\pm 2(U-V)V\cos^2\theta$$

[illegible]

∴ INVISCID FORCE ON THE CYLINDER

$$= +\, 2 a l \rho \int_0^{\pi} a \cos\theta \,(2\dot{U} - \dot{V}) \cos\theta \, d\theta$$

$$= +\, 2 a^2 l \rho (2\dot{U} - \dot{V}) \int_0^{\pi} \left(\frac{1 + \cos 2\theta}{2} \right) d\theta$$

$$= \pi a^2 l \rho \,(2\dot{U} - \dot{V}) = \frac{\pi}{4} d^2 l \rho \,(2\dot{U} - \dot{V})$$

GENERALIZING THE EXPLANATION GIVEN IN [5,6] THE IN-LINE FORCE ON A MOVING CYLINDER WOULD BE GIVEN BY (2).

$$F = \frac{1}{2} C_D l d \rho \,|U - V|\,(U - V) + \frac{\pi}{4}(C_M - 1) d^2 l \rho (\dot{U} - \dot{V}) + \frac{\pi}{4} d^2 l \rho \dot{U} \quad (2) \quad [21]$$

AND THEN THE CYCLE AVERAGED VALUES OF C_D AND C_M CAN BE OBTAINED FROM [5] IF K AND R_e ARE BASED ON THE <u>PEAK RELATIVE VELOCITY</u>.

5.2 EQUATION OF MOTION OF A SINGLE DEGREE OF FREEDOM SYSTEM WITH FLUID DAMPING.

IF A DOWNCOMER CAN BE REPRESENTED AS A SINGLE DEGREE OF FREEDOM SYSTEM THEN ITS EQUATION OF MOTION IS GIVEN BY (3)

$$m\ddot{b} + c\dot{b} + kb = \frac{\pi}{4}(C_M - 1) d^2 l \rho (\dot{U} - \dot{V}) + \frac{\pi}{4} d^2 l \rho \dot{U} + \frac{1}{2} C_D l d \rho \,|U - V|\,(U - V) \quad [21] \quad (3)$$

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STONE & WEBSTER ENGINEERING CORPORATION

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VIJAY CHANDRA 27 JULY 1979	J.H.G. 12/10/79	JHG 12/...

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I.)	1/2

SUBSTITUTING $C_M = 2$ IN THE HYDRODYNAMIC MASS EXPRESSION WE GET, $\frac{\pi}{4}(C_m-1)\, d^2 l \rho \dot{V} = \frac{\pi}{4} d^2 l \rho \dot{V} = m_H \ddot{b}$

THUS THE INTEFERENCE EFFECT ON HYDRODYNAMIC MASS IS IGNORED. ∴ EQUATION (3) TRANSFORMS TO (4).

$$(m + m_H)\ddot{b} + c\dot{b} + kb = \frac{\pi}{4} C_M d^2 l \rho \dot{U} + \frac{1}{2} C_D l d \rho |U-\dot{b}|(U-\dot{b}) \qquad (4)$$

SINCE $C_m \geq 2$ IT IS MADE EQUAL TO 2 ONLY IN HYDRODYNAMIC MASS TERM FOR CONSERVATISM.

5.3 DETERMINATION OF FLOW FIELD:

ACCORDING TO [3] THE FLUID OVERPRESSURE PROFILE DUE TO SRV ACTUATION IS FLAT OVER 6 ft. FROM BASEMAT AND DROPS LINEARLY TO ZERO AT THE FREE SURFACE. IF THE BUBBLE IS ASSUMED TO BE LOCATED AT THE ELEVATION OF DOWNCOMER TIP (190 ft.) THEN ITS PRESSURE WOULD BE $1.5 * \frac{11}{19}$ * (KKB WALL OVERPRESSURE) (SEE ASSUMPTION 2 AND FIGURE 1)*

THE RAYLEIGH BUBBLE EQUATION FOR A SINGLE SPHERICAL BUBBLE IN AN INFINITE FLUID IS [4]

$$R\ddot{R} + \frac{3}{2}\dot{R}^2 = \frac{P}{\rho} \qquad (5)$$

THE INITIAL CONDITIONS ARE

$R(0) = 5$ ft , $\dot{R}(0) = 0$ ft/sec.

$P = \frac{1.5 * 11}{19}$ * KKB WALL OVERPRESSURE. (LBF/ft²)

* PRESSURE TRACE 35 WITH TIME AXIS MULTIPLIED BY 1.8 IS USED HERE BECAUSE THIS PRODUCES LARGEST STRESS FOR EMPTY DOWNCOMER [7].

CALCULATION SHEET STONE & WEBSTER ENGINEERING CORPORATION

▲5010.61

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DOWN COMER RESPONSE TO SRV AIRBUBBLE LOAD (F.S.I.)	1/2

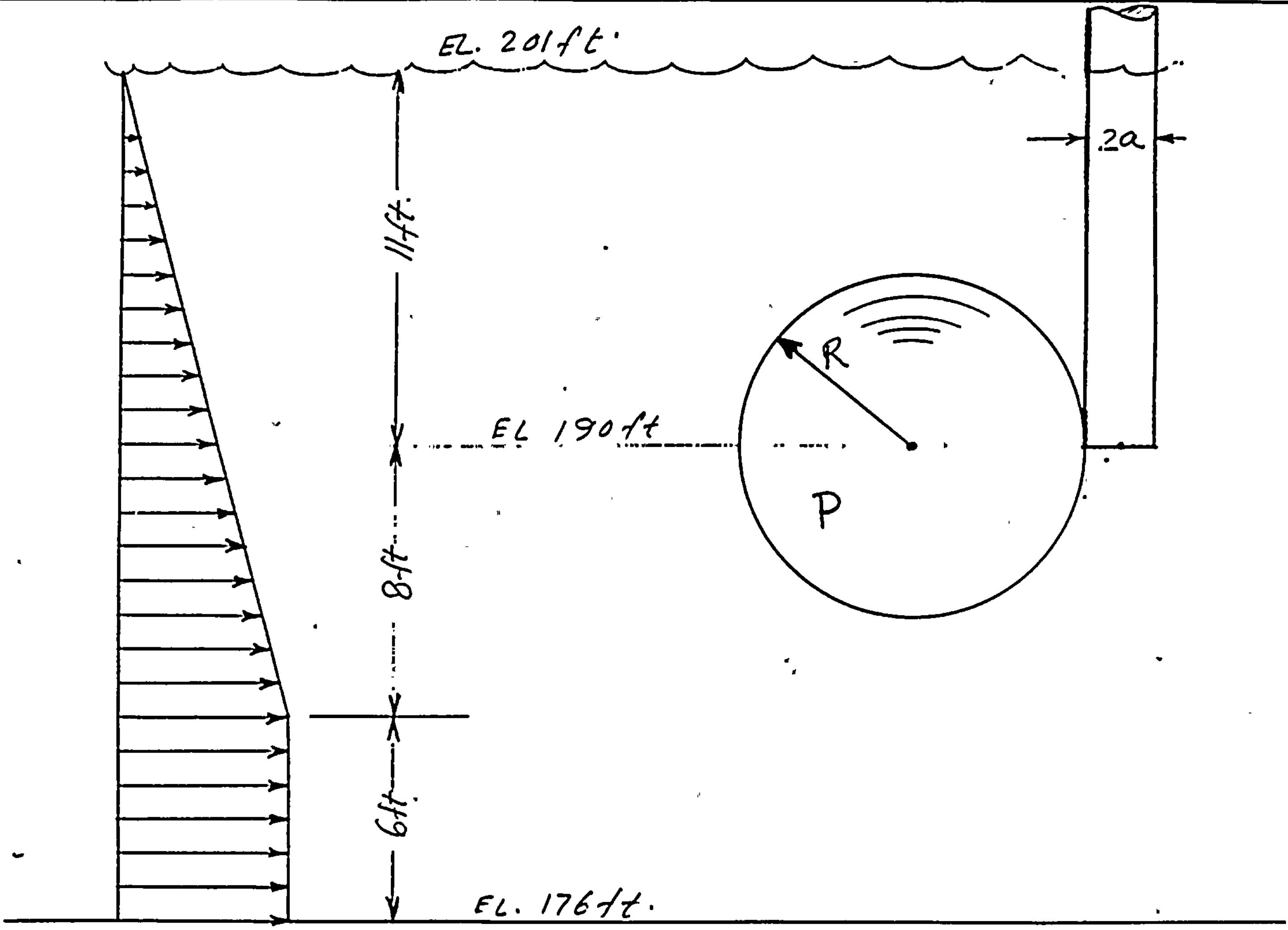


FIGURE 1. FLUID OVERPRESSURE PROFILE DURING SRV ACTUATION. BUBBLE CENTER IS ASSUMED AT DOWNCOMER TIP ELEVATION.

∴ FLUID ACCELERATION AT THE GEOMETRIC CENTER OF THE

$$\ddot{TIP} = \frac{\frac{d}{dt}(R^2\dot{R})}{(R+a)^2}$$, ASSUMING THAT BUBBLE REMAINS

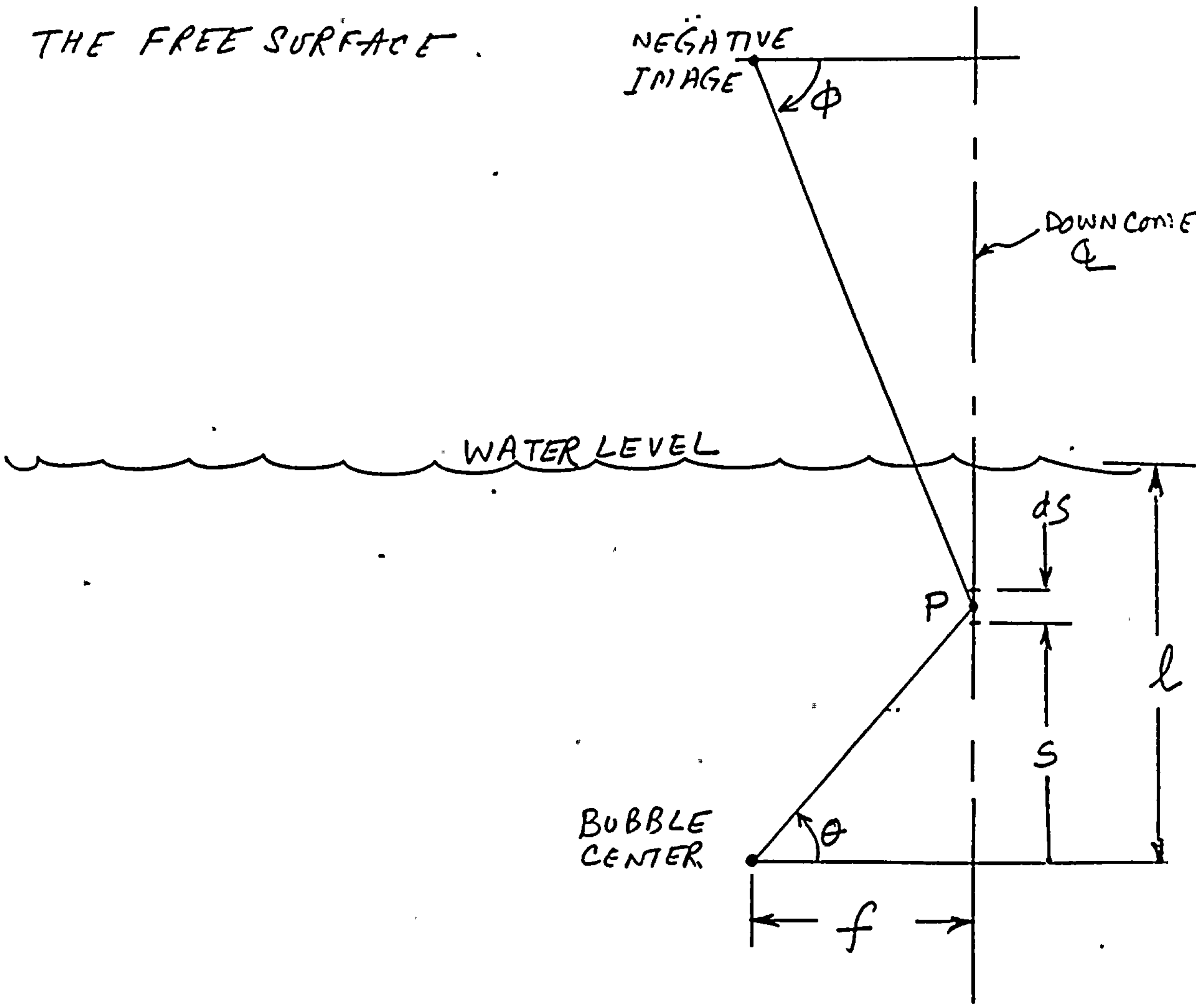
IN CONTACT WITH DOWNCOMER ALL THE TIME.

IT IS ALSO ASSUMED THAT DUE TO FREE SURFACE EFFECT THE FLUID ACCELERATION PROFILE IS LINEAR ALONG THE SUBMERGED LENGTH OF DOWNCOMER.

$\therefore$ EFFECTIVE FLUID ACCELERATION $= \dfrac{\frac{d}{dt}(R^2\dot{R})}{2(R+a)^2}$

$$= \frac{R^2\ddot{R} + 2R\dot{R}^2}{2(R+a)^2} = \dot{U} \qquad (6)$$

TO EVALUATE THE AVERAGE FLUID VELOCITY ALONG THE SUBMERGED LENGTH A NEGATIVE IMAGE WAS CONSIDERED ABOVE THE FREE SURFACE.



∴ HORIZONTAL COMPONENT OF FLUID VELOCITY AT POINT 'P'

$$= \frac{R^2 \dot{R} \cos\theta}{s^2+f^2} - \frac{R^2 \dot{R} \cos\phi}{(2\ell-s)^2+f^2}$$

∴ AVERAGE FLUID VELOCITY

$$= \frac{R^2\dot{R}}{\ell}\int_0^{\ell}\left[\frac{\cos\theta}{s^2+f^2} - \frac{\cos\phi}{(2\ell-s)^2+f^2}\right] ds$$

$s = f\tan\theta$

$ds = f\sec^2\theta\, d\theta$

$2\ell - s = f\tan\phi$

$ds = -f\sec^2\phi\, d\phi$

$$= \frac{R^2\dot{R}}{\ell}\left[\int_0^{\tan^{-1}(\frac{\ell}{f})} \frac{\cos\theta . f\sec^2\theta\, d\theta}{f^2\sec^2\theta} + \int_{\tan^{-1}(\frac{2\ell}{f})}^{\tan^{-1}(\frac{\ell}{f})} \frac{\cos\phi\, f\sec^2\phi\, d\phi}{f^2\sec^2\phi}\right]$$

$$= \frac{R^2\dot{R}}{f\ell}\left[\int_0^{\tan^{-1}(\frac{\ell}{f})}\cos\theta\, d\theta + \int_{\tan^{-1}(\frac{2\ell}{f})}^{\tan^{-1}(\frac{\ell}{f})}\cos\phi\, d\phi\right]$$

$$= \frac{R^2\dot{R}}{f\ell}\left[\frac{\ell}{\sqrt{\ell^2+f^2}} + \frac{\ell}{\sqrt{\ell^2+f^2}} - \frac{2\ell}{\sqrt{(2\ell)^2+f^2}}\right]$$

$$= \frac{2R^2\dot{R}}{f}\left[\frac{1}{\sqrt{\ell^2+f^2}} - \frac{1}{\sqrt{(2\ell)^2+f^2}}\right]$$

$$= \frac{2R^2\dot{R}}{f^2}\left[\left\{1+\left(\frac{\ell}{f}\right)^2\right\}^{-.5} - \left\{1+\left(\frac{2\ell}{f}\right)^2\right\}^{-.5}\right]$$

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SINCE THE BUBBLE IS ASSUMED IN CONTACT WITH THE DOWNCOMER

$$f = R + a$$

∴ AVERAGE HORIZONTAL FLUID VELOCITY ALONG THE DOWNCOMER CENTERLINE IS

$$\frac{2R^2\dot{R}}{(R+a)^2}\left[\left\{1+\left(\frac{\ell}{R+a}\right)^2\right\}^{-0.5} - \left\{1+\left(\frac{2\ell}{R+a}\right)^2\right\}^{-0.5}\right] \qquad (7)$$

$$= U$$

EXPRESSIONS OF U AND $\dot{U}$ AS GIVEN BY EQUATIONS (7) AND (6) WERE USED IN EQUATION 4.

5.4. MODELING OF DOWNCOMER AS A SINGLE DEGREE OF FREEDOM SYSTEM

REV 1

IT IS SEEN FROM REFERENCE [7] THAT ALMOST ALL THE RESPONSE IS CONTRIBUTED BY THE FIRST MODE AND THERFORE THE DOWNCOMER CAN BE MODELED AS A SINGLE DEGREE OF FREEDOM SYSTEM HAVING A FREQUENCY EQUAL TO THE FUNDAMENTAL MODE FREQUENCY OF THE MULTI DEGREE OF FREEDOM SYSTEM

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5.4 MODELLING OF DOWNCOMER RESPONSE AS A SINGLE DEGREE OF FREEDOM SYSTEM :

For the worst load case, i.e. trace 35 time-factor 1.8, the moment obtained from Reference 22 are :

Model A1* - 1% structural damping - Mom. = 2220 Kip-in
" A0* — 1% " " - Mom. = 3614 Kip-in
" A0* — 2% " " — Mom = 3178 Kip-in

* The description of these models is provided in Refer. 22.

The parameters for a SDOF model (stiffness, mass, damping, frequency) are also obtained from Ref. 22. It is initially assumed that the SDOF model having a frequency the same as the first mode of the MDOF model will yield the same moments as the moment obtained from the Multi DOF model. This assumption is verified below in section 5.5.

The moments from SDOF model will be obtained as follows :

M = (Max Displ from computer output) x stiffness x effective length.

The stiffness obtained from Ref 22 is 12867 lb/ft, and the effective length from Ref 22 is 524.25 inches.

$\therefore M = \Delta x(ft) \times 6745.5$ K-in

5.4 A MODELLING OF DOWNCOMER AS A SINGE DEGREE OF FREEDOM SYSTEM :

FOR THE TWO NEW LOAD CASES, I.E. TRACE KTG 11.1, TIME FACTOR 0.51, AND TRACE 12.1, TIME FACTOR 0.48 WHICH ARE OBTAINED FROM REF. 27 ; MOMENTS ARE OBTAINED FROM A MULTI-DEGREE OF FREEDOM ANALYTICAL MODEL AT THE DOWNCOMER FIXED END (REF. 26). THESE ARE :

MODEL AO, 2% DAMP., KTG11.1, MOM. = 1344.9 K-IN.

MODEL AO, 2% DAMP., KTG12.1 MOM. = 1335.5 K-IN.

THE DESCRIPTION OF THESE MODELS IS PROVIDED IN REF. 26. REF. 22 PROVIDES THE PARAMETERS FOR A SDOF MODEL (STIFFNESS, MASS, DAMPING.)
IT IS INITIALLY ASSUMED THAT THE SDOF MODEL HAVING THE SAME FREQUENCY AS THE FIRST MODE OF THE MDOF MODEL WILL YIELD THE SAME MOMENTS AS THE MOMENTS OBTAINED FROM THE MULTI DOF MODEL. THIS ASSUMPTION IS VERIFIED BELOW IN SECTION 5.5A.

THE MOMENTS FROM THE SDOF MODEL WILL BE OBTAINED AS FOLLOWS :

M = (Max. Displ. from computer output) x stiffness x effective length

THE STIFFNESS FROM REF. 22 IS 12867 lb/ft, effective length is 524.25"

$\therefore$ M = Δx (ft) x 6745.5 K-in.

5.5 COMPARISON OF RESPONSE OF SINGLE AND MULTI DEGREE OF FREEDOM SYSTEM WITHOUT FLUID DAMPING :

The equivalence between SDOF and Mult DOF models without fluid damping is established. This verifies the validity of the method presented in this calculation. The moments are compared below

CASE	Moment - k-in KWU Method with Multi DOF (Ref 22)	Moment - k-in Present method with SDOF, no fluid damp
Model A1 - 1% Struct. damp	2220	.3213x6745.5 = 2167 - RUN 1
Model A0 - 1% " "	3614	.5179x6745.5 = 3494 - RUN 2
Model A0 - 2% " "	3178	.4579x6745.5 = 3089 - RUN 3

(TABLE 1)

Since the moments from the two models are about the same, it is concluded that the downcomer response is predominantly from its first mode.

From Ref. 22, the average velocity (based on the squared average, since the fluid damping is proportional to the square of velocity) of submerged nodes is listed below. It is compared to the velocity of SDOF models with no fluid damping :

	MDOF Vel. - Ref 22 (in/sec)	SDOF Vel (No fl. damp.) (in/sec)
Model A1 - 1% damp	31.7	3.202x12 = 38.42 - Run 1
Model A0 - 1% "	62.49	6.164x12 = 73.97 - Run 2
Model A0 - 2% "	53.84	5.363x12 = 64.36 - Run 3

(TABLE 2)

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The above table implies that the SDOF system moves faster than the Multi DOF system. Since the fluid damping depends on velocity, the structure velocity in the fluid damping term will be multiplied by the following factors (velocity ratio):

	(TABLE 3)	Velocity ratio
Model A1 — 1% damp	31.7/38.42 =	0.83
Model A0 — 1% "	62.49/73.97 =	0.84
Model A0 — 2% "	53.84/64.36 =	0.83

These ratios are used as velocity correction factors in the computer runs. The results are tabulated in Table 4, summary of results section.

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5.5 B **RESPONSE OF SINGLE AND MULTI DOF SYSTEMS — WITH AND WITHOUT FLUID DAMPING :**

THE 2 TABLES THAT FOLLOW PROVIDE THE DOWNCOMER RESPONSES USING MDOF - STARDYNE RESULTS FROM REF. 26, AND SDOF RESPONSES WITH AND WITHOUT FLUID DAMPING.

SINCE THE RESULTS FROM MDOF & SDOF ANALYSES ARE COMPARABE, THE VALIDITY OF THE METHOD IS VERIFIED.

THE TABLES ALSO PROVIDE THE CALCULATION OF FINAL RESPONSES. THE VELOCITY CORRECTION FACTORS ARE LISTED IN THESE TABLES.

BOTH TABLES ARE FOR DOWNCOMER MODEL AO, WITH 2% STRUCTURAL DAMPING. THE FIRST TABLE IS FOR SRV KTG TRACE 11.1 TIME FACTOR 0.51. THE SECOND TABLE IS FOR TRACE KTG 12.1, TIME FACTOR 0.48.

IT IS NOTED THAT SECTION 5.7 IS NOT RECALCULATED IN THIS REVISION. C_D OF 0.7 IS ASSUMED TO BE VALID FOR THE REVISED LOAD CASES. THIS IS REASONABLE, SINCE THE REDUCTION IN DOWNCOMER RESPONSES DUE TO FLUID DAMPING IS MINIMAL.

NOTE ALSO THAT IN THE FSI ANALYSIS (I.E. RUN # C112) THE RESPONSES ARE CALCULATED ONLY UPTO 0.9 SEC. WHEREAS THE TOTAL DURATION OF THE FORCING FUNCTION IS SOMEWHAT HIGHER. THIS IS JUSTIFIED BECAUSE, BASED ON GILNET RUN # 145 OF REF. 26, THE MAXIMUM DOWNCOMER RESPONSES OCCUR BEFORE 0.9 SEC. THEREFORE, RESPONSES AFTER 0.9 SEC IN THE FSI ANALYSIS WILL BE LOWER THAN THE MAXIMUM.

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<u>DOWNCOMER MODEL AO – 2% DAMP</u> ($\omega_n = 1.9385$ Hz.)

SRV KTG 11.1 – TIME FACTOR 0.51.

(MAX LOAD INPUT $= 0.647681 \times 2088.55 \times \frac{11}{19} \times 0.5 \times 11.0$

$= 4307.3$ lbs)

	MDOF STARDYNE GILNET (RUN #145) OF Rev. 26	SDOF – w/o FSI – CSMP (RUN #6112)	SDOF – ~~w/o~~ WITH FSI – CSMP* (RUN #6112)	<u>FINAL RESPONSE</u>
TIP DEFLECTION (IN.)	2.36	2.4	2.36	2.32
VELOCITY (IN/SEC)	25.78 (Average)	33.38	—	—
VELOCITY CORR. FACTOR α	—	—	$\frac{25.78}{33.38} = .772$	—
MOMENT (KIP-IN)	1344.9	1350.3	1329.8	$\frac{1329.8}{1350.3} \times 1344.9 = 1324.5$
STRESS (KSI)	8.31	8.34	8.21	8.20

* <u>Note</u>: Run #6112 does not include $\alpha = .772$ the responses are interpolated between two values of α to yield the above results.

<u>Table. 4.</u>

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DOWNCOMER MODEL A0 - 2% DAMPING

SRV KTG 12.1 - TIME FACTOR 0.48.

MAX. INPUT LOAD = $.518963 \times 2088.55 \times \frac{11}{19} \times .5 \times 11 = 3451.3$ lbs.

	(GILNET RUN # 96 OF REF. 26) MDOF STARDYNE	(RUN #9908) SDOF - W/O FSI - CSMP	(RUN #9908) SDOF - WITH FSI - CSMP *	FINAL RESPONSE
TIP DEFLECTION	2.34"	2.5"	2.39"	2.24"
VELOCITY	31.46 in/sec (Average)	40.71 in/sec	-	-
VEL. CORRECTION FACTOR - α	-	-	0.773 (31.46/40.71)	-
MOMENT (K-IN)	1335.5	1404.6	1341.4 (extrapolated for α = .773)	$1335.5 \times \frac{1341.4}{1404.6}$ = 1275.4
STRESS (KSI)	8.25	8.68	8.29	7.9

* Note: Run # 9908 does not include α = .773. The responses are interpolated to yield the above results.

TABLE 5

SINCE ALL THREE STRESSES ARE VERY CLOSE TO EACH OTHER, ONE WOULD CONCLUDE THAT THE PRESENT METHOD IS EQUIVALENT TO KWU METHOD AND HAS AN ADDITIONAL ADVANTAGE OF INCLUDING FLUID DAMPING.

REV 1

FROM [7], THE PEAK VELOCITIES OF THE 6 SUBMERGED NODES ARE 51.9, 55.6, 59.3, 63.76, 68.23, AND 72.7 in/sec. THE AVERAGE OF THESE VELOCITIES IS 5.16 ft/sec. BUT, THE PEAK VELOCITY FOR A SINGLE DEGREE OF FREEDOM SYSTEM WITHOUT FLUID DAMPING IS 6.52 ft/sec [9]. THIS IMPLIES THAT THE SINGLE DEGREE OF FREEDOM SYSTEM MOVES FASTER THAN THE MULTIDEGREE OF FREEDOM SYSTEM. SINCE THE FLUID DAMPING DEPENDS ON VELOCITY THE STRUCTURE VELOCITY IN THE FLUID DAMPING TERM HAS BEEN MULTIPLIED BY A FACTOR $\frac{5.037}{7.073} \approx 0.712 = \alpha$.
THIS FACTOR WOULD CHANGE FROM CASE TO CASE ~~AND~~ IS LISTED IN TABLE 1 ON PAGE 24 FOR ALL CASES ANALYZED.

5.6. NRC CORRECTION FACTORS:

ACCORDING TO [10], A BUBBLE ASYMMETRY FACTOR OF 1.1 SHOULD BE APPLIED TO FLUID VELOCITY AND ACCELERATION AND INTERFERENCE EFFECTS SHOULD BE CONSIDERED ON C_M AND C_D. BASED ON FIGURE 5. OF REFERENCE [6] $C_M = 2.3$ FOR THE MIDDLE CYLINDER.

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EQUATION (4) THUS TRANSFORMS TO

$$(m+m_H)\ddot{b} + c\dot{b} + kb = 1.1 * \frac{\pi}{4} * 2.3 d^2 l \rho \dot{U}$$
$$+ \frac{1}{2} C_D l d \rho \left| 1.1 U - \alpha \dot{b} \right| (1.1 U - \alpha \dot{b}) \quad (8)$$

WHERE $\alpha = 0.791$ FOR DOWNCOMERS WITHOUT ANY WATER INSIDE THEM. AND HAVING 1% STRUCTURAL DAMPING.

5.7. <u>EVALUATION OF LIFT AND DRAG COEFFICIENTS:</u>

ACCORDING TO [8] IF $\frac{U_m T}{D}$ IS LESS THAN 4 THEN THE LIFT FORCE IS NEGLIGIBLE IF THE REYNOLDS NUMBER IS LESS THAN 50,000. BUT ACCORDING TO [5] C_L DECREASES WITH INCREASING REYNOLDS NUMBER. HENCE IT CAN BE CONCLUDED THAT IF $\frac{U_m T}{D} < 4$ SUFFICIENT TO SAY THAT LIFT FORCE IS NEGLIGIBLE. SINCE THE EXPERIMENTS DESCRIBED IN [5,8] WERE CONDUCTED FOR STATIONARY CYLINDERS THEIR RESULTS CAN BE UTILIZED IF U_m (THE PEAK FLUID VELOCITY) IS REPLACED BY THE PEAK RELATIVE VELOCITY.

REV 1

FROM [9] [24] THE PEAK RELATIVE VELOCITY FOR AN EMPTY DOWNCOMER WITHOUT FLUID DAMPING IS ≈ 7.4 6.6 ft/sec AND THE PERIOD T ≈ 0.524 Sec.

SINCE $d = 2$ ft.

$$\therefore \frac{U_m T}{d} = \frac{7.4 \;\; 6.6 * 0.524}{2} = 1.939 \;\; 1.7 < 4.$$

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FROM FIGURES 11 AND 12 OF [5] $C_m \approx 2$ FOR A SINGLE CYLINDER, REYNOLDS NUMBER GREATER THAN 10,000. THE VALUE OF REYNOLDS NUMBER FOR DOWNCOMER OSCILLATIONS

REV 1 WITHOUT FLUID DAMPING IS $\approx \frac{6.6\ (7.4) * 2}{10^{-5}} = 13.2\ (14.8) * 10^5$.

THE PEAK REYNOLDS NUMBER OF THE DOWNCOMER WITH FLUID DAMPING ($C_D = 0.8$) IS ABOUT $\frac{5.8 * 2}{10^{-5}} \approx 11.6 * 10^5$.

THEREFORE THE VALUE OF $C_m = 2$ IS JUSTIFIED FOR A SINGLE CYLINDER AND 2.3 FOR MULTIPLE CYLINDERS [6].

REV 1 SINCE OUR $\frac{U_m T}{d}$ IS ABOUT 1.7 (1.94) AND THE LOWEST VALUE OF $\frac{U_m T}{d}$ IN [5] IS 6, AN EXTRAPOLATION IS NEEDED. IT SEEMS THAT FOR $11.6 * 10^5 \leq R_e \leq 13.2\ (14.8) * 10^5$ AND $\frac{U_m T}{d} \approx 1.7\ (1.94)$, C_D WOULD BE ABOUT 0.7. (THE VALUE OF C_m IS INSENSITIVE TO VALUE OF C_D WHEN $0.7 < C_D < .8$)

5.8 INPUT DATA

THE INPUT DATA USED FOR VARIOUS CASES IS GIVEN

REV 1 BELOW AND IN TABLE 1 ON PAGE 20A (24) AND WAS OBTAINED FROM ~~[7]~~ [22]

DOWNCOMER LENGTH = 45.688 ft. = l_d

DOWNCOMER O.D. = 2 ft. = d

DRAG COEFFICIENT = 0.7 [5] = C_D

REV 1 FOLLOWING IS THE LIST OF CASES ANALYZED ~~[7]~~ [22]

CASE				
1.	UNSTIFFEND DOWNCOMER,	WITHOUT WATER AND	1%	DAMPING
2.	" "	" "	2%	"
3.	" "	WITH WATER AND	1%	"
~~4.~~	~~STIFFENED "~~	~~WITHOUT "~~	~~1%~~	~~"~~
~~5.~~	~~" "~~	~~" "~~	~~2%~~	~~"~~
~~6.~~	~~" "~~	~~WITH "~~	~~1%~~	~~"~~

REV 1

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6. RESULTS

The results are the solution of equation 8 for various cases as described in section 5.8. The downcomer tip peak deflection and fixed end max. moment with and without fluid damping are summarized in Table 4 on P. 26A.

The peak deflection is obtained from the computer outputs. The max. moment is related to fixed end moment by the following formula:

$$\text{Moment} = \delta \times K \times l_d$$

The fixed end moment for other loading conditions (other than SRV) is calculated in the detailed stress report, Reference 22.

As expected, the effect of fluid damping is significant only when the structural velocity is significantly higher than fluid velocity.

REV.2

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TABLE ~~(4)~~ 6

SINGE D.O.F. DEFLECTIONS AND FIXED END MOMENTS

CASE #	Filled or Empty Down F=Filled E=Empty	Struct. Damp & Model & Freq.	MAX DEFLECTION X_1 WITH FLUID DAMPING (Ft)	(M') MOMENT-Kip-in $X_1 \times 6745.5$	(K) Correction Factor = Moment from MDOF / Moment from SDOF (w/o Fluid damp)	FINAL MOMENT; = M' x K.
1	F	.1% A1 1.55 Hz	.3078	2076	$\frac{2220}{2167}$ = 1.0244	2126
2	E	1% A0 1.938 Hz	.4046	2729	$\frac{3614}{3494}$ = 1.0345	2822
3	E	2% A0 1.938 Hz	.3843	2592	$\frac{3178}{3089}$ = 1.0288	2667

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SUMMARY OF RESULTS FOR REV 2

FROM SECTION 5.5B, Pages 20B and 20C, THE MAXIMUM DOWNCOMER RESPONSES DUE TO A SINGLE SRV EVENT, WHICH IS TO BE COMBINED IN THE FAULTED 1 CASE OF THE LOAD COMBINATION IN REF. 26 (I.E. WITH CO & SSE) ARE :

TIP DEFLECTION = 2.32"

MOMENT AT FIXED END = 1324.5 KIP-IN

STRESS = 8.2 KSI

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7. CONCLUSION AND RECOMMENDATIONS:

THE EFFECT OF FLUID DAMPING IS SIGNIFICANT IN THOSE CASES WHERE STRUCTURE VELOCITY IS QUITE HIGH COMPARED TO FLUID VELOCITY.

A MORE PRECISE ANALYSIS CAN BE DONE BY REPRESENTING THE DOWNCOMER AS A MULTI DEGREE OF FREEDOM SYSTEM. OR, IF A SINGLE DEGREE OF FREEDOM ANALYSIS IS PERFORMED THEN K AND M MUST BE SO CHOSEN THAT THE SYSTEM NATURAL FREQUENCY AND PEAK VELOCITIES DO NOT CHANGE. IN THE PRESENT ANALYSIS ONLY FREQUENCY WAS MATCHED AND THE PEAK VELOCITY OF A SINGLE D.O.F. SYSTEM IS CONSIDERABLY HIGHER THAN PEAK VELOCITY OF THE SUBMERGED PART OF DOWNCOMER. BY DOING THIS THE USE OF FACTOR α CAN BE AVOIDED AND SOME CONSERVATISM MIGHT BE REMOVED.

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VIJAY CHANDRA 26 JULY 1979	J.H.G. 17/10/79	JHG

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (FSI)	1/2

8. LIST OF REFERENCES

1. S&W CALCULATION, NO. 12177·08-PX-60000, DATED 02 MAY 1977, PREPARED BY V. CHANDRA, ENTITLED "SRV JET AND BUBBLE SUBMERGED STRUCTURE LOADS ON DOWNCOMERS".

2. KKB WALL PRESSURE DIGITIZED DATA, TRACES 35, 76, AND 82. S&W FILE NO. BC 7811220003.

3. "SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 AND 2, DESIGN ASSESSMENT REPORT VOLUME 1, SECTION 4·1·3·7 PREPARED BY P.P.&L., ALLENTOWN, PA.

4. F.J. MOODY, L.C. CHOW, L.E. LASHER, "ANALYTICAL MODEL FOR ESTIMATING DRAG FORCES ON RIGID SUBMERGED STRUCTURES CAUSED BY LOCA AND SAFETY RELIEF VALVE RAMSHEAD AIR DISCHARGES." GENERAL ELECTRIC REPORT NO. NEDO-21471, 77 NED 245, CLASS 1, SEPTEMBER 1977.

5. T. SARPKAYA, "IN-LINE AND TRANSVERSE FORCES ON CYLINDERS IN OSCILLATORY FLOW AT HIGH REYNOLDS NUMBERS", JOURNAL OF SHIP RESEARCH, VOL. 21, NO. 4, DEC. 1977, pp 200-216.

6. C. DALTON AND R.A. HELFINSTINE, "POTENTIAL FLOW PAST A GROUP OF CIRCULAR CYLINDERS", TRANSACTIONS OF THE ASME, JOURNAL OF BASIC ENGINEERING, DECEMBER 1971, pp 636-642.

REV 1 7. S&W CALCULATION NO. 12177-NM(C)-MS1270, ENTITLED "DOWNCOMER ANALYSIS", PREPARED BY C.C. LEE AND D. BHARGAVA. UNCHECKED AT THIS TIME.

8. T. SARPKAYA, "FORCES ON CYLINDERS AND SPHERES IN A SINUSOIDALLY OSCILLATING FLUID", TRANSACTION OF THE ASME, JOURNAL OF APPLIED MECHANICS, MARCH 1975 pp. 32-37.

REV 1 9. COMPUTER RUN NO. R0745C17, JOB NO. 544, DT. 06 AUG 1979.

10. MARK II CONTAINMENT LEAD PLANT PROGRAM LOAD EVALUATION AND ACCEPTANCE CRITERIA, NUREG-0487, U.S.N.R.C., OCTOBER 1978, pp. III-131, III-134.

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STONE & WEBSTER ENGINEERING CORPORATION

J.O./W.O./CALCULATION NO.	REVISION	PAGE
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PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
VIJAY CHANDRA 01 AUG. 1979	J.H.G. 12/10/79	JHG 12/[illegible]

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I.)	1/2

REV 1

11. COMPUTER RUN NO. R0745C62, JOB NO. 1345, DATED 25 JULY 1979.
12. COMPUTER RUN NO. R0745C28, JOB NO. 1871, DATED 02 AUG 1979
13. COMPUTER RUN NO. R0745C48, JOB NO. 369, DATED 03 AUG 1979
14. COMPUTER RUN NO. R0745C87, JOB NO. 486, DATED 06 AUG. 1979
15. COMPUTER RUN NO R0745C52, JOB NO. 1408, DATED 06 AUG. 1979
16. COMPUTER RUN NO. R0745C72, JOB NO. 1841, DATED 06 AUG 1979
17. COMPUTER RUN NO. R0745C17, JOB NO. 837, DATED 07 AUG. 1979.
18. COMPUTER RUN NO. R0745C21, JOB NO. 1101, DATED 07 AUG. 1979
19. COMPUTER RUN NO. R0745C28, JOB NO. 1443, DATED 07 AUG. 1979
20. COMPUTER RUN NO. R0745C61, JOB NO. 61, DATED 08 AUG. 1979
21. R.D. BLEVINS, "FLOW INDUCED VIBRATIONS". VAN NOSTRAND REINHOLD, 1977, p. 122

REV 1

22. S&W CALCULATION NO 12177-NM(C)-MS-1869 REV 2 – "DOWNCOMER ANALYSIS AND FATIGUE EVALUATION" – DATED 1/22/86
23. COMPUTER RUN #1, JOB 3034, DATED 1/18/86
24. COMPUTER RUN #2, JOB 3024, DATED 1/18/86
25. COMPUTER RUN #3, JOB 3037, DATED 1/18/86

REV 2

26. SWEC CALC. NO. 12177-NM(C)-MS-2US – "DOWNCOMER ANALYSIS FOR REVISED HYDRODYNAMIC LOADS" DATED 5/5/87
27. SWEC. CALC. NO. 12177-NP(C)-PX 60161 – "SRV BUBBLE LOAD ON DOWNCOMER – SINGLE SRV ACTUATION" DATED 5/5/87.

PAGE

ENGINEERING MECHANICS DIVISION
COMPUTER LOG
****

CALCULATION NUMBER: 12177-PX-60012 Rev 1 S&H COMP. AUTH# 1486 CHARGE NUMBER: *** OTHER: ____

PROGRAM NAME	LIBRARY REF. NUMBER	VERSION / LEVEL	RUN NO.	JOB SUBMITTAL NUMBER	FICHE LOC SECT	FICHE LOC PAGE	PREPARED BY: NAME	PREPARED BY: DATE	COMPUTER USED **	COMMENTS OTHER PERTINENT INFORMATION
CSMP			1	3034			D. Bhargava	1/18/86	SWEC	Model A1 - 1% struct damp Run with & w/o fluid damp
CSMP			2	3024			D. Bhargava	1/18/86	SWEC	Model A0 - 1% struct damp with and w/o fluid damp
CSMP			3	3033			D. Bhargava	1/18/86	SWEC	Model A0 - 1% struct. damp with & w/o fluid damp.

* = COMPUTER GENERATED JOB SUBMITTAL NUMBER ABOVE COMPUTER RUNS CHECKED BY : B. [illegible] 1-18-86
** = COMPUTER USED (SWEC OR OTHER)
*** = IF OTHER THAN SWEC COMPUTER IS USED

CALC PX-60012 REV 1

RUN NUMBER LOG

CALCULATION NO. 12177-PX-60012, REV 2
JOB ORDER NO. 12177

7728

RUN NO.	PROGRAM NAME	JOB NO.	C (4) NO.	DATE	FI-CHE (3)	ATS NAME				DISK OUTPUT NAME	(1)	OUTPUT TAPE			CPU TIME (MIN)	DESCRIPTION
						INPUT	(1)	OUTPUT	(1)			NUMBER	(2)	NAME		
4	CSMP	6112	01	3/28/87	Y	—		—		—		—		—		SRV KTG 11.1, T.F. = .51 CSMP-SDOF MODEL.
5	CSMP	7908	01	3/26/87	Y	—		—		—		—		—		SRV KTG 12.1, T.F. = .48 CSMP-SDOF MODEL.

(1) CHECK WHEN DESTROYED
(2) CHECK WHEN RELEASED

(3) PLACE Y WHEN GENERATED AND * WHEN FILED OR DISPOSED OF
(4) C NUMBER APPEARING ON JOB CARD (RYYYYC$\boxed{XX}$)

ENG-ch-41
Attachment 14.5

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 1A
12177	EMD	PX-60012 Rev 1		

ATTACHMENT 1

- LISTING OF COMPUTER PROGRAM
- CSMP PROGRAM VERIFICATION.

[illegible]

Listing for Run #2

```
/      : PRINT CH
/*   INFO REGION=280K,TIME=2
//SRV  EXEC  CSMPX
//X.FT06F001 DD SYSOUT=A
//X.SYSIN DD * ,
TITLE KWU-GE HYBRID WITH FSI: SRV LOAD ON DOWNCOMER
FUNCTION PKWU=(0.0,0.0),...
 (0.144,  0.0 ),(0.153,  0.0 ),(0.162,   0.0 ),(0.171,  0.90),...
 (0.180,  3.80),(0.189,  6.00),(0.198,   4.90),(0.207,  3.60),...
 (0.216,  3.10),(0.225,  4.10),(0.234,   4.30),(0.243,  2.40),...
 (0.252, -1.80),(0.261, -3.10),(0.270,  -3.80),(0.279, -1.00),...
 (0.288,  4.00),(0.297, 13.10),(0.306,  27.30),(0.315, 30.60),...
 (0.324, 26.90),(0.333, 18.50),(0.342,  10.00),(0.351,  4.70),...
 (0.360, -2.10),(0.369, -4.90),(0.378,  -7.90),(0.387,-11.00),...
 (0.396,-12.10),(0.405,-13.00),(0.414,-13.10 ),(0.423,-12.40),...
 (0.432,-11.80),(0.441,-11.90),(0.450,-11.60 ),(0.459,-11.40),...
 (0.468,-10.90),(0.477, -9.70),(0.486, -8.10 ),(0.495, -6.60),...
 (0.504, -5.00),(0.513, -3.30),(0.522, -1.10 ),(0.531,  0.00),...
 (0.540,  1.30),(0.549,  2.00),(0.558,  2.00 ),(0.567,  2.00),...
 (0.576,  2.30),(0.585,  2.50),(0.594,  3.10 ),(0.603,  2.50),...
 (0.612,  2.60),(0.621,  2.10),(0.630,  1.90 ),(0.639,  1.10),...
 (0.648,  1.30),(0.657,  0.90),(0.666,  1.00 ),(0.675,  0.00),...
 (0.684, -0.20),(0.693, -1.00),(0.702, -0.80 ),(0.711, -1.10),...
 (0.720, -0.70),(0.729, -0.90),(0.738, -1.20 ),(0.747, -0.70),...
 (0.756,  0.00),(0.765,  1.80),(0.774,  2.90 ),(0.783,  3.20),...
 (0.792,  4.10),(0.801,  4.60),(0.810,  4.60 ),(0.819,  2.90),...
 (0.828,  2.40),(0.837,  2.10),(0.846,  1.20 ),(0.855,  0.70),...
 (0.864,  1.10),(0.873,  1.00),(0.882,  0.80 ),(0.891,  0.00),...
 (0.900, -0.30),(0.909,  0.10),(0.918,  0.30 ),(0.927,  0.80),...
 (0.936,  1.10),(0.945,  0.80),(0.954,  0.40 ),(0.963,  1.00),...
 (0.972,  1.10),(0.981,  1.10),(0.990,  1.70 ),(0.999,  1.80),...
 (1.008,  2.00),(1.017,  1.90),(1.026,  1.50 ),(1.035,  0.90),...
 (1.044,  0.00),(1.053, -0.70),(1.062, -1.40 ),(1.071, -2.00),...
 (1.080, -2.50),(1.089, -3.00),(1.098, -3.10 ),(1.107, -2.90),...
 (1.116, -2.90),(1.125, -2.00),(1.134, -0.70 ),(1.143,  2.90),...
 (1.152,  4.10),(1.161,  3.30),(1.170,  2.40 ),(1.179,  1.50),...
 (1.188,  0.90),(1.197,  0.70),(1.206,  0.50 ),(1.215,  1.60),...
 (1.224,  2.80),(1.233,  2.00),(1.242,  1.10 ),(1.251,  2.50),...
 (1.260,  2.00),(1.269,  2.00),(1.278,  2.10 ),(1.287,  2.30),...
 (1.296,  2.80),(1.305,  2.90),(1.314,  2.20 ),(1.323,  1.80),...
 (1.332,  1.10),(1.341,  1.20),(1.350,  0.70 ),(1.359,  1.00),...
 (1.368,  0.10),(1.377,  0.70),(1.386,  0.70 ),(1.395,  1.00),...
 (1.404,  0.00),(1.413, -0.40),(1.422, -1.00 ),(1.431, -0.90),...
 (1.440,  0.90),(1.449,  1.40),(1.458,  1.00 ),(1.467,  0.00),...
 (1.476, -1.00),(1.485,  0.00),(1.494,  0.30 ),(1.503,  0.60),...
 (1.512, -0.70),(1.521, -0.30),(1.530, -0.40 ),(1.539, -0.90),....
 (1.548, -1.20),(1.557, -1.90),(1.566, -2.10 ),(1.575, -2.50),...
 (1.584, -4.00),(1.593, -2.80),(1.602, -2.60 ),(1.611, -3.70),...
 (1.620, -6.50),(1.629, -8.00),(1.638, -8.90 ),(1.647, -6.00),...
 (1.656, -5.50),(1.665, -4.90),(1.674, -3.90 ),(1.683, -3.40),...
 (1.692, -3.00),(1.700,  0.00),(3.000,  0.00 )
PARAMETER ALP=(0.0,.83,1.0)
CONSTANT K=12867., H=86.78, DAMP=1.0, CD=0.7,...
         RHOL=1.94, A=1.0, L=11.0
INITIAL
 C=0.02*DAMP*(K*H)**0.5
INCON   RZ=5.0, RDZ=0.0, XDZ=0.0, XZ=0.0
DYNAMIC
P=AFGEN(PKWU,TIME)
PBMPIN=45.33*P
```

P 2A

Listi Run #2 (contd.)

```
R      *PIN/RHOL-1.5*RD**2)/R
RD=INTGRL(RDZ,RDD)
R=INTGRL(RZ,RD)
PROCEDURE AVACC,AVVEL = AA(R,RD,RDD,L,A)
AVVEL=2.*R**2*RD*((1.+(L/(R+A))**2)**(-.5)-(1.+(2.*L/(R+A))**2)**...
 (-.5))/(R+A)**2
AVACC=(R**2*RDD+2.*R*RD**2)/(2.*(R+A)**2)
  IF (TIME .GT. 1.7) AVVEL=0.
  IF (TIME .GT. 1.7) AVACC = 0.
ENDPROCEDURE
  XDD=(1.1*3.14*2.3*A*A*L*RHOL*AVACC + ...
     CD*A*L*RHOL*(1.1*AVVEL-ALP*XD)*...
     ABS(1.1*AVVEL-ALP*XD)-H*X-C*XD)/H
  XD=INTGRL(XDZ,XDD)
  X=INTGRL(XZ,XD)
  VMXD=AVVEL-XD
  PRINT X,XD,XDD,R,RD,RDD,P,AVVEL,AVACC
  TIMER FINTIM=2.7, PRDEL=.100, OUTDEL=.009
  RANGE X,XD,XDD,R,RD,RDD,P,AVVEL,AVACC,VMXD
TERMINAL
END
STOP
/*
//
```

3A

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 4A
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12177	EMD	PX-60012		

VERIFICATION OF CSMD ONE-TIME USAGE COMPUTER PROGRAM

THIS PROGRAM IS VERIFIED IF THE RESULT FROM THE PROGRAM AGREES WITH THE VALUE OBTAINED BY MANUAL COMPUTATION AS FOLLOWING:

THE GENERAL EQUATION IS

$$X_{DD} = (1.1 \times 3.14 * 2.3 \times A^2 \times L * RHOL * AVACC + CD * A * L * RHOL * (1.1 * AVVEL - A\varphi * XD) * |(1.1 * AVVEL - A\varphi * XD)| - K * X - C * XD) / M$$

& $\begin{cases} K = 1287 \\ M = 86.78 \\ DAMP = 1.0 \\ CD = 0.7 \end{cases}$ $\begin{cases} RHOL = 1.94 \\ A = 1.0 \\ L = 11.0 \\ C = 0.02 * DAMP * (K * M)^{1/2} = 21.13384 \end{cases}$

FROM COMPUTER RUN 001, 2024 (1/19/86) AT

$A\varphi = 0.83$ & $T = 1.6$ (RANDOMLY)

$X = -0.25107$

$XD = -3.3556$

$AVVEL = 0.69611$

$AVACC = -3.1855$

SUBSTITUTES THESE VALUES INTO ABOVE EQUATION, YIELDS:

$$X_{DD_H} = [1.1 \times 3.14 * 2.3 \times 1.0^2 \times 11 \times 1.94 \times (-3.1855) + 0.7 \times 1. \times 11. \times 1.94 * (1.1 \times 0.69611 - 0.83 \times (-3.3556)) * |(1.1 \times 0.6911 - 0.83 \times (-3.3556))| - 1287 * (-0.25107) - 21.13384 * (-3.3556)] / 86.78$$

$= \underline{33.991}$

COMPUTER RESULT $- X_{DDC} = 33.992$

SINCE THESE TWO VALUES AGREE QUITE WELL, THE SUBJECT PROGRAM IS THUS CONFIRMED.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

A 5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 1B
12177	EMD	PX-60012		

ATTACHMENT 2

VOID PAGES

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION DISTRIBUTION LIST

PROJECT NAME NMP#2

CALCULATION TITLE DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I.)

J.O.# or W.O.# 12177.08 CALCULATION# -PX-60012 REVISION# 00

BK79123/0002
G1.00 - ~~Rev 0~~
REV 1

PREPARING GROUP SUPERVISOR / LEAD ENGINEER

NAME T.Y. CHOW / A. LUONG.
LOCATION 3G / 6B
GROUP/PROJECT PIPESTRESS / NMP#2

DISTRIBUTION BY OFF-PROJECT STAFF GROUP

NAME	LOCATION	GROUP/PROJECT
VIJAY CHANDRA	3G	PIPE STRESS STAFF
DIVAKAR BHARGAVA	3G	MECHANICAL STAFF.

DISTRIBUTION BY PROJECT

NAME	LOCATION	GROUP/PROJECT
C.S.LAI	6B1	PSAS/NMP2
EM 4.3.6	5Y	Records Mgmnt NMP2

VOID

[illegible]

BK79123/0002-G1.00 · REV.0

STONE & WEBSTER ENGINEERING CORPORATION

ENGINEERING MECHANICS DIVISION

PIPE STRESS STAFF SECTION

CLIENT NIAGARA MOHAWK LOCATION NMP#2 JOB NO. 12177.08

CALCULATION NO. 12177.08-PX-60012 REV ~~00~~ 1

TITLE DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I.)

EQUIPMENT/SYSTEM CODE CLASS 2

NUCLEAR SAFETY RELATED YES ☒ NO ☐

QA CATEGORY 1

VOID

PREPARED BY VIJAY CHANDRA DATE 03 AUG. 1979

REVIEWED BY T.H. Chong (T.H. CHONG) DATE 12/10/79
NON-INDEPENDENT

REVIEWED BY T.H. Chong (T.H. CHONG) DATE 12/13/79
INDEPENDENT

APPROVED BY T.N. Chou DATE 12/14/79
TITLE Supervisor

CALC. STATUS: ☒ PRELIMINARY REV 1 ☒ FINAL REV 1

THE STIFFNESS OF SINGLE DEGREE OF FREEDOM SYSTEM WAS DEFINED IN TERMS OF TIP DISPLACEMENT.

10

5.5. <u>COMPARISON OF RESPONSE OF SINGLE AND MULTIDEGREE OF FREEDOM SYSTEM WITHOUT FLUID DAMPING.</u>

THE EQUIVALENCE BETWEEN SINGLE AND MULTIDEGREE OF FREEDOM MODELS WITHOUT FLUID DAMPING HAS BEEN ESTABLISHED. THE LOADS CALCULATED IN [1] WERE USED FOR THESE TWO CASES. TO VERIFY THE VALIDITY OF THE METHOD PRESENTED IN THIS CALCULATION THE DOWNCOMER FIXED END STRESS WAS ALSO CALCULATED WITHOUT FLUID DAMPING USING THIS METHOD.

FOLLOWING ARE PEAK STRESSES OF ABOVE THREE CASES WITHOUT FLUID DAMPING AND INCLUDING THE HYDRODYNAMIC MASS BUT EXCLUDING THE MASS OF THE WATER WITHIN THE DOWNCOMER.

KWU METHOD LOAD WITH MULTI D.O.F. = 21.8 KSI [7]

KWU METHOD LOAD WITH SINGLE D.O.F. = 22.3 KSI [7]

PRESENT METHOD WITH SINGLE D.O.F. = 22.5 KSI *

* THIS NUMBER WAS OBTAINED AS FOLLOWS:

FROM [9], THE PEAK DISPLACEMENT IS 0.591 ft.

THE STIFFNESS IS 11264 LBF/ft [7]

THE DOWNCOMER LENGTH = 45.688 ft. [7]

∴ FIXED END MOMENT = 11264 × 0.591 × 45.688 LBF.ft

∴ SECTION MODULUS = 161.9 in^3 [7]

∴ STRESS = 22.54 KSI.

TABLE 1. INPUT DATA

CASE NO. (*)	TOTAL EFFECTIVE MASS, ($m+m_H$) (SLUG) [7]	STIFF-NESS K [7] (LBF/ft.)	STRUCTURAL DAMPING (%)	V_{mp} [7] (ft/sec.)	V_{sp} (ft/sec.)	$\alpha = \frac{V_{mp}}{V_{sp}}$	FIXED END SECTION MODULUS, Z (ft^3) [7]	ω [7] HZ.
1	76.0	11264	1	5.037	7.073 [9]	0.712	0.0937	1.9376
2	76.0	11264	2	4.447	5.916 [12]	0.752	0.0937	1.9376
3	118.9	11264	1	2.647	3.664 [9]	0.722	0.0937	1.549
4	81.14	14890	1	4.171	5.836 [13]	0.715	0.1804	2.156
5	81.14	14890	2	3.905	5.593 [13]	0.698	0.1804	2.156
6	123.15	14890	1	3.429	4.650 [14]	0.737	0.1804	1.7506

* SEE PAGE 23 FOR DESCRIPTION

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STONE & WEBSTER ENGINEERING CORPORATION
J.O./W.O./CALCULATION NO. 12177.08-PX-60012-1
PAGE 24a/32
PREPARER/DATE VIJAY CHANDRA 02 AUG 1979
REVIEWER/CHECKER/DATE 12/10/79
INDEPENDENT REVIEWER/DATE
REVISION
SUBJECT/TITLE DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I.)
QA CATEGORY/CODE CLASS 1/2

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CALCULATION SHEET

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STONE & WEBSTER ENGINEERING CORPORATION

J.O./W.O./CALCULATION NO.	REVISION	PAGE
12177.08 - PX- 60012 - 1		~~25~~ / 32 6B

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
VIJFY/CPF NDRP 02 AUG 1979	J.H.G. 8/10/79	J.H.G 12/12/79

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I.)	1/2

6. RESULTS:

REV 1

~~THE RESULTS ARE THE SOLUTIONS OF EQUATION (8) FOR VARIOUS CASES DESCRIBED IN SECTION 5.8. THE DOWNCOMER TIP PEAK DEFLECTION AND FIXED END PEAK STRESS WITH AND WITHOUT FLUID DAMPING ARE SUMMARIZED IN TABLE 2 ON PAGE. 26:.~~

~~THE PEAK DEFLECTION IS OBTAINED FROM THE COMPUTER OUT PUT. THE PEAKSTRESS IS RELATED~~ TO FIXED END STRESS BY THE FOLLOWING FORMULA.

$$\text{FIXED END STRESS} = \frac{\delta * k * l_d}{z}.$$

THE FIXED END PEAK STRESS IS NOT NECESSARILY THE HIGHEST STRESS FOR STIFFENED DOWNCOMER. THE STRESSES HAVE BEEN CALCULATED TO ASSESS THE EFFECT OF FLUID DAMPING. REFERENCE [7] SHOULD BE USED FOR DETAILED STRESS REPORT.

AS EXPECTED THE EFFECT OF FLUID DAMPING IS SIGNIFICANT ONLY WHEN THE STRUCTURAL VELOCITY IS SIGNIFICANTLY HIGHER THAN FLUID VELOCITY. THE HIGHEST REDUCTION IN STRESS WAS OBTAINED IN CASE 1 AND IS 4.79 KSI.

CALCULATION SHEET

A501061

STONE & WEBSTER ENGINEERING CORPORATION

PREPARER/DATE: VIJAY CHANDRA 07 AUG 1979

J.O./W.O./CALCULATION NO.: 12177.08-PX-60012-1

REVIEWER/CHECKER/DATE: [illegible] 12/10/79

INDEPENDENT REVIEWER/DATE: [illegible]

REVISION

PAGE: 26 of 32

SUBJECT/TITLE: DOWNCOMER RESPONSE TO SRV AIR BUBBLE LOAD (F.S.I.)

QA CATEGORY/CODE CLASS: 1/2

7B

TABLE 2.

SINGLE D.O.F. DEFLECTION AND FIXED END STRESS

CASE NO.	FILLED OR EMPTY DOWNCOMER F= FILLED E = EMPTY	STRUCTURAL DAMPING (%)	STIFFENED OR UNSTIFFENED DOWNCOMER. S: STIFF. U: UNSTIFF.	WITHOUT FLUID DAMPING		WITH FLUID DAMPING		$(m+m_H)$	K.	ω
				PEAK DEFLECTION (ft.)	FIXED END STRESS (KSI)	PEAK DEFLECTION (ft.)	FIXED END STRESS (KSI)	(SLUG)	(LBF/ft.)	(HZ.)
1	E	1	U	0.5910 [9]	22.54	0.4655 [15]	17.75	76.0	11264	1.9376
2	E	2	U	0.5227 [12]	19.94	0.4371 [20]	16.67	76.0	11264	1.9376
3	F	1	U	0.3667 [9]	13.99	0.3517 [16]	13.41	118.9	11264	1.549
4	E	1	S	0.4359 [13]	11.42	0.4108 [17]	10.76	81.14	14890	2.156
5	E	2	S	0.4178 [13]	10.94	0.3998 [19]	10.47	81.14	14890	2.156
6	F	1	S	0.4296 [14]	11.25	0.3858 [18]	10.10	123.15	14890	1.750

Rev 1

COMPUTER LOG

9.
7729

VOID

S & W AUTH. NO. 0745 CALCULATION NO. 12177.08-Px-60012
CDC CHARGE NO. JOB ORDER NO. 12177.08

REV 1

RUN NO.	JOB NO. *	FICHE LOC.		PREPARED BY		REVIEWED BY		COMP. **	COMMENTS
		PAGE	SECT	SIGNATURE	DATE	SIGNATURE	DATE		
R0745 C17	544			Vijay chandra.	06 AUG 1979	J. H. Clurp	12/14/79	S&W	NO FLUID DAMPING 1% STR. DAMPING EMPTY AND FULL DOWN COMER
R0745 C62	1345			Vijay chandra.	25 JULY 1979	J. H. Clurp	12/14/79	S&W	CD = 0.3, 0.5, 0.8, 1% EMPTY DOWN COMER.
R0745 C28	1871			Vijay chandra.	02 AUG 1979	J. H. Clurp	12/14/79	S&W.	CD=0, M = 76 SLUGS K=11264 LBF/ft, DAMP = 2%
R0745 C48.	363			Vijay chandra.	03 AUG 1979	J. H. Clurp	12/14/79	S&W	CD=0, M = 81.14 slugs K = 14890 LBF/ft. DAMP=1.2%
R0745 C87	486			Vijay chandra.	06 AUG 1979	J. H. Clurp	12/14/79	S&W	CD=0, M = 123.15 SLUGS K = 14890 LBF/ft, DAMP = 1%.
R0745 C52	1408			Vijay chandra.	06 AUG 1979	J. H. Clurp	12/14/79	S&W	CD=0.7, 1% DAMP, M=76 slugs K = 11264, ALP = 0.712
R0745 C72	1841			Vijay chandra.	06 AUG 1979	J. H. Clurp	12/14/79	S&W	CD=0.7, 1%, M = 118.95 slugs K = 11264 LBF/ft., ALP = 0.722
R0745 C17	837			Vijay chandra.	07 AUG 1979	J. H. Clurp	12/14/79	S&W	CD=0.7, 1%, M=81.14 slugs K = 14890 LBF/ft, ALP= 0.715
R0745 C21	1101			Vijay chandra.	07 AUG 1979	J. H. Clurp	12/14/79	S&W	CD=0.7, 1%, M = 123.15 slugs K=14890 LBF/ft, ALP = 0.737
R0745 C28	1443			Vijay chandra.	07 AUG 1979	J. H. Clurp	12/14/79	S&W	CD=0.7, 2% M = 81.14 slugs K=14890 LBF/ft, ALP = 0.698
R0745 C61	61			Vijay chandra.	08 AUG 1979	J. H. Clurp	12/14/79	S&W	CD=0.7, 2%, M=76 slugs. K=11264 LBF/ft, ALP = .152

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* COMPUTER GENERATED JOB NUMBER

** COMPUTER USED (S & W OR CDC)

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[illegible]

[illegible]

```
//R0745C61 JOB CH,V.CHANDRA.,HSGLEVEL=1
/*JOBINFO R=230K,T=1,PHONE=3734
//CSMP3 EXEC CSMPX
//X.COMPRINT DD DUMMY,DISP=(NEW,DELETE)
//X.SYSPRINT DD DUMMY,DISP=(NEW,DELETE)
TITLE MKU-GE HYBRID WITH FSI; LOAD ON DOWNCOMER
FUNCTION PMKU=(0.0,0.0),...
 (0.144,  0.0 ),(0.153,  0.0 ),(0.162,  0.0 ),(0.171,  0.90),...
 (0.180,  3.80),(0.189,  6.00),(0.198,  4.90),(0.207,  3.60),...
 (0.216,  3.10),(0.225,  4.10),(0.234,  4.30),(0.243,  2.40),...
 (0.252, -1.80),(0.261, -3.10),(0.270, -3.80),(0.279, -1.00),...
 (0.288,  4.00),(0.297, 13.10),(0.306, 27.30),(0.315, 30.60),...
 (0.324, 26.90),(0.333, 18.50),(0.342, 10.00),(0.351,  4.70),...
 (0.360, -0.10),(0.369, -4.90),(0.378, -7.90),(0.387,-11.00),...
 (0.396,-12.10),(0.405,-13.00),(0.414,-13.10),(0.423,-12.40),...
 (0.432,-11.80),(0.441,-11.90),(0.450,-11.60),(0.459,-11.40),...
 (0.468,-10.90),(0.477, -9.70),(0.486, -8.10),(0.495, -6.60),...
 (0.504, -5.00),(0.513, -3.30),(0.522, -1.10),(0.531,  0.0 ),...
 (0.540,  1.30),(0.549,  2.00),(0.558,  2.00),(0.567,  2.00),...
 (0.576,  2.30),(0.585,  2.50),(0.594,  3.10),(0.603,  2.50),...
 (0.612,  2.60),(0.621,  2.10),(0.630,  1.90),(0.639,  1.10),...
 (0.648,  1.30),(0.657,  0.90),(0.666,  1.00),(0.675,  0.0 ),...
 (0.684, -0.20),(0.693, -1.00),(0.702, -0.80),(0.711, -1.10),...
 (0.720, -0.70),(0.729, -0.90),(0.738, -1.20),(0.747, -0.70),...
 (0.756,  0.0 );(0.765,  1.80),(0.774,  2.90),(0.783,  3.20),...
 (0.792,  4.10),(0.801,  4.60),(0.810,  4.60),(0.819,  2.90),...
 (0.828,  2.40),(0.837,  2.10),(0.846,  1.20),(0.855,  0.70),...
 (0.864,  1.10),(0.873,  1.00),(0.882,  0.80),(0.891,  0.0 ),...
 (0.900, -0.30),(0.909,  0.10),(0.918,  0.30),(0.927,  0.80),...
 (0.936,  1.10),(0.945,  0.80),(0.954,  0.40),(0.963,  1.00),...
 (0.972,  1.10),(0.981,  1.10),(0.990,  1.70),(0.999,  1.80),...
 (1.008,  2.00),(1.017,  1.90),(1.026,  1.50),(1.035,  0.90),...
 (1.044,  0.0 ),(1.053, -0.70),(1.062, -1.40),(1.071, -2.00),...
 (1.080, -2.50),(1.089, -3.00),(1.098, -3.10),(1.107, -2.90),...
 (1.116, -2.90),(1.125, -2.00),(1.134, -0.70),(1.143,  2.90),...
 (1.152,  4.10),(1.161,  3.30),(1.170,  2.40),(1.179,  1.50),...
 (1.188,  0.90),(1.197,  0.70),(1.206,  0.50),(1.215,  1.60),...
 (1.224,  2.80),(1.233,  2.00),(1.242,  1.10),(1.251,  2.50),...
 (1.260,  2.00),(1.269,  2.00),(1.278,  2.10),(1.287,  2.30),...
 (1.296,  2.80),(1.305,  2.90),(1.314,  2.20),(1.323,  1.80),...
 (1.332,  1.10),(1.341,  1.20),(1.350,  0.70),(1.359,  1.00),...
 (1.368,  0.10),(1.377,  0.70),(1.386,  0.70),(1.395,  1.00),...
 (1.404,  0.0 ),(1.413, -0.40),(1.422, -1.00),(1.431, -0.90),...
 (1.440,  0.90),(1.449,  1.40),(1.458,  1.00),(1.467,  0.0 ),...
 (1.476, -1.00),(1.485,  0.0 ),(1.494,  0.30),(1.503,  0.60),...
 (1.512, -0.70),(1.521, -0.30),(1.530, -0.40),(1.539, -0.90),...
 (1.548, -1.20),(1.557, -1.90),(1.566, -2.10),(1.575, -2.50),...
 (1.584, -4.00),(1.593, -2.80),(1.602, -2.60),(1.611, -3.70),...
 (1.620, -6.50),(1.629, -8.00),(1.638, -8.90),(1.647, -6.00),...
 (1.656, -5.50),(1.665, -4.90),(1.674, -3.90),(1.683, -3.40),...
(1.692,-3.),(1.7,0.),(3.,0.)
PARAMETER K=11264.,M= 76.00,DAMP=2.,ALP=.752
CONSTANT RHOL=1.94,A=1.,L=11.,CD=.7
INITIAL
C=0.02*(K*M)**0.5*DAMP
INCON RZ=5.,RDZ=0.,XDZ=0.,XZ=0.
```

COMPUTER PROGRAM LISTING OF RUN R0745C61, 08 AUG. 1979 [20]

VOID

REV 1

12177.08-PX-60012

REV. 1

```
DYNAMIC
P=AFGEN(PKHU,TIME)
PBHPIN=45.33*P
RDD=(PBHPIN/RHOL-1.5*RD**2)/R
RD=INTGRL(RDZ,RDD)
R=INTGRL(RZ,RD)
PROCEDURE AVACC,AVVEL = AA(R,RD,RDD,L,A)
AVVEL=2.*R**2*RD*((1.+(L/(R+A))**2)**(-.5)-(1.+(2.*L/(R+A))**2)**...
  (-.5))/(R+A)**2
AVACC=(R**2*RDD+2.*R*RD**2)/(2.*(R+A)**2)
  IF (TIME .GT. 1.7) AVVEL=0.
  IF (TIME .GT. 1.7) AVACC = 0.
ENDPROCEDURE
XDD=(1.1*3.14*2.3*A*A*L*RHOL*AVACC + CD*A*L*RHOL*(1.1*AVVEL-ALP*XD)*...
   ABS(1.1*AVVEL-ALP*XD)-K*X-C*XD)/M
XD=INTGRL(XDZ,XDD)
X=INTGRL(XZ,XD)
VHXD=AVVEL - XD
PRINT X,XD,XDD,R,RD,RDD,P   ,AVVEL,AVACC
TIMER FINTIM=2.700,PRDEL=.009,OUTDEL=.009
RANGE X,XD,XDD,R,RD,RDD,P,AVVEL,AVACC,VHXD
TERMINAL
END
STOP
/*
```

VOID
REV 1

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12177.08-PX-60012
REV. 1

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 32
NIAGARA MOHAWK - NMP2	

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (✓)
DOWNCOMER ANALYSIS FOR REVISED HYDRODYNAMIC LOADS.	☒ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER

J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12177.28	EMD/EQS	MS-2155	—	52A

* APPROVALS – SIGNATURE & DATE N. Repogno 5/5/87

PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓) YES	NO
Bidyut Wiyogi 5/5/87	Divakar Bhuyan 5/5/87	Divakar Bhuyan 5/5/87	0	Supplements Calc. No. MS-1869 Rev 2.		✓

DISTRIBUTION *

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	DOC. CONTROL	5 YL.			

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 2
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12177.28	EMD	MS-2155	N/A	

2. TABLE OF CONTENTS

3. R[illegible]VISION STATUS TABLE

PAGE NO. 3
CALCULATION NO. 12177.28-NM(1)-MS-215F
JOB ORDER NO. 12127.28

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REV NO.	PAGE NO.	REASON	REVISION/DATE	NON-INDEPENDENT REVIEWER/DATE	INDEPENDENT REVIEWER/DATE	APPROVAL/DATE

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE
12177.28	EMD	MS-2155	N/A	4

4. INTRODUCTION/ BACKGROUND :

PREVIOUS LOAD DEFINITIONS OF SRV AND CO WHICH WERE USED IN DOWNCOMER ANALYSIS (REF. 1) WERE CONSERVATIVE. TO ADDRESS NRC'S CONCERNS (REF. 2) THE GOVERNING SRV AND CO LOADS ON DOWNCOMERS WERE REEVALUATED AND REDUCED IN CONFORMANCE WITH THE ACCEPTANCE CRITERIA OF REF. 3 AND 4.

5. OBJECTIVE :

THE OBJECTIVE OF THIS CALCULATION IS TO SUMMARIZE AND DOCUMENT DOWNCOMER ANALYSIS RESUTS BASED ON REVISED SRV AND CO LOADS (REF. 6,7 AND 8). THE REANALYSIS UTILIZED THE SAME ANALYTICAL METHOD AS THE ORIGINAL CALCULATION (REF. 1) THE LOADS AND THE DOWNCOMER STRESSES FOR THE UPSET AND THE EMERGENCY LOADING CONDITIONS WHICH WERE PREVIOUSLY ACCEPTABLE TO THE NRC (REF. 2), HAVE NOT BEEN REVISED. THIS REVISED ANALYSIS ONLY UPDATED THE DOWNCOMER RESPONSES DUE TO THE FAULTED LOAD COMBINATIONS.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

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CALCULATION IDENTIFICATION NUMBER				PAGE 5
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12177.28	EMD	MS-2155	N/A	

6. ASSUMPTIONS:

SAME AS IN REFERENCE 1.

7. COMPUTER PROGRAM IDENTIFICATION:

1. ST-330 STARDYNE - CDC PUBLIC DOMAIN PROGRAM FEB 01/84 H LEVEL.
2. CSMP (CONTINUOUS SYSTEM MODELING PROGRAM-3) - ONE TIME USAGE PROGRAM TO ESTABLISH RESPONSE OF 1 DOF SYSTEM. PROGRAM LISTING IS INCLUDED IN THE ATTACHMENT-1.

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 6
12177.28	EMD	MS-2155	N/A	

8. METHOD :

THIS CALCULATION USES THE SAME MATHEMATICAL MODEL OF THE DOWNCOMER AND SAME ANALYTICAL METHOD AS USED IN THE ORIGINAL CALCULATION (REF. 1). THE ONLY CHANGES ARE THE SRV AND CO INPUT LOADING. DOCUMENTED IN REF. 6 THRU 8. THE SAME TIME HISTORY ANALYSIS IS DONE FOR THE DOWNCOMER USING 'STARDYNE' COMPUTER CODE. AS IN REF. 1 ; IN ADDITION TO THAT A SINGLE DEGREE OF FREEDOM (SDOF) MODEL IS ESTABLISHED TO ACCOUNT FOR THE FLUID STRUCTURE INTERACTION DURING SRV (REF. 5) & CO LOAD EVENT. A DETAILED DESCRIPTION OF THE ANALYTICAL MODEL CAN BE OBTAINED IN REF. 1.

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO. 12177.28	DIVISION & GROUP EMD	CALCULATION NO. MS-2155	OPTIONAL TASK CODE N/A	PAGE 7

9. DESIGN INPUT:

9.1 DOWNCOMER DATA:

BASED ON REF. 1 THE DOWNCOMER PROPERTIES ARE AS FOLLOWS:

MATERIAL = SA 312 TP 304

SIZE = 24" SCH. 20 PIPE

ID = 23.25"

OD = 24.00"

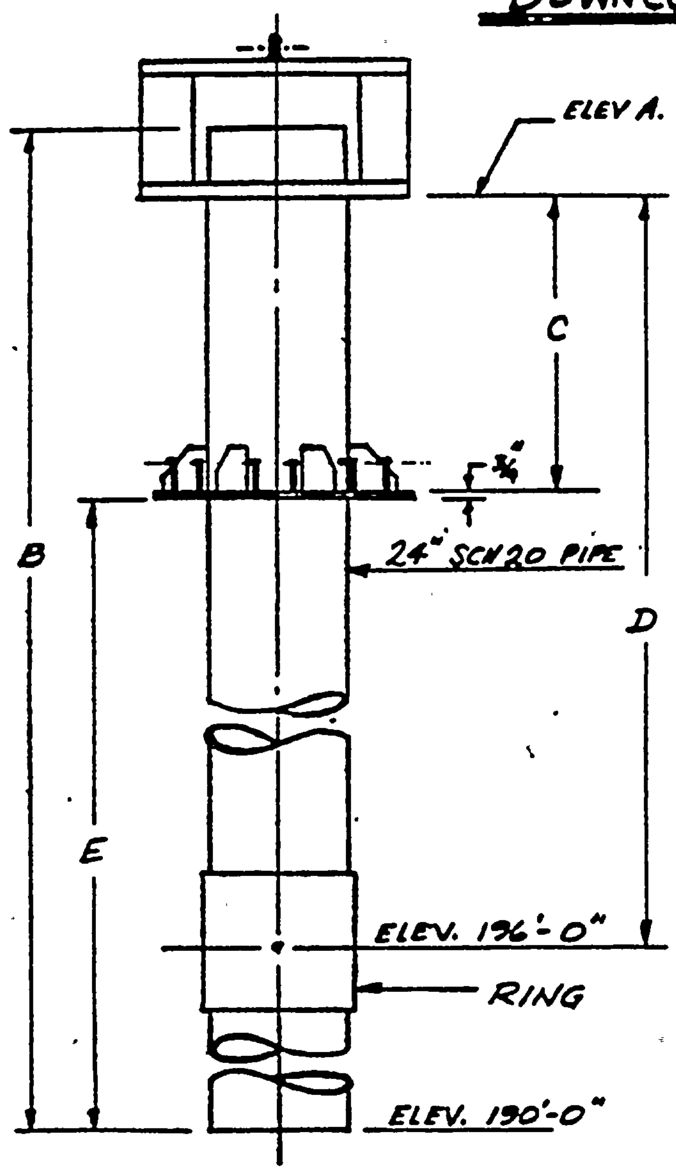
AREA OF CROSS SECTION = 27.83 in^2

SECTION MODULUS = 161.9 in^3

LENGTHS OF THE DOWNCOMERS VARY ACCORDING TO FIG. 1.

[illegible]

DOWNCOMER GEOMETRY



24" SCH 20 PIPE (REF 1)

WALL THICKNESS	0.375 IN.
I.D.	23.250 IN.
I.D. AREA	425.00 $IN.^2$
A (METAL)	27.83 IN^2
WEIGHT/FT. (AUSTENITIC)	96.51 LB/FT.
WEIGHT/FT. (WATER)	183.80 LB/FT.
MOMENT OF INERTIA	1942.0 IN^4
SECTION MODULUS	161.9 IN^3

RING (REF 1)

I.D.	24.0 IN.
O.D.	25.0 IN.
WALL THICKNESS	0.5 IN.
A (METAL)	38.48 $IN.^2$
WEIGHT/FT	133.46 LB/FT.
DENSITY	0.289 LB/IN^3

DETAIL	ELEV. A	B	C	D ±1/2"	E ±1/2"	QTY
AB	240'-0"	51'-0 3/16"	4'-3"	44'-0"	45'-8 1/4"	115
AC	232'-0"	45'-0 3/16"	8'-1 1/2"	36'-0"	38'-9 1/4"	8

(REF 1)

NOTE: AB DENOTES DOWNCOMERS IN THE ANNULUS POOL.
AC DENOTES DOWNCOMERS IN THE PEDESTAL POOL.

Fig. 1

9.2 - DESIGN LOAD/EVENT COMBINATIONS AND ACCEPTANCE CRITERIA

THE LOAD/EVENT COMBINATIONS AND ACCEPTANCE CRITERIA FOR THE DOWNCOMER ANALYSIS ARE BASED ON TABLE 6A.2-1 OF NMP-2 FSAR (REF. 7). IN SECTION 9.3, THE DESIGN LOADINGS OF SRV AND CO ARE CONSERVATIVELY ENVELOPED TO SIMPLIFY THE ANALYSIS.

THE TWENTY-THREE (23) EVENT COMBINATIONS IN TABLE 6A.2-1 (REF. 7) ARE REDUCED TO THE FOLLOWING FOUR (4) GOVERNING EVENT/LOAD COMBINATIONS FOR THE DOWNCOMER ANALYSIS:

UPSET CONDITION

$N + OBE + SRV$ (1.)

EMERGENCY CONDITION

$N + OBE + SRV + SBA/IBA_{CHUG}$ (2.)

FAULTED CONDITION

FAULTED 1. - $N + SSE + SRV + CO$ (3)

FAULTED 2. - $N + SSE + SRV + IBA/DBA_{CHUG}$ (4)

CALCULATION IDENTIFICATION NUMBER				PAGE 10
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12177.28	EMD/EQS	MS-2155		

9.2 - DESIGN LOAD COMBINATIONS AND ACCEPTANCE CRITERIA (Con't)

THESE FOUR GOVERNING LOAD COMBINATIONS ARE EXPANDED, INCLUDING THE COMPONENTS OF SEISMIC, SRV, AND LOCA LOADINGS THAT ARE USED FOR THE ANALYSIS, AS FOLLOWS:

UPSET CONDITION

$$N + \sqrt{(OBEI + OBES)^2 + (SRVS + SRVI)^2} \qquad (1A)$$

EMERGENCY CONDITION

$$N + \sqrt{(OBEI + OBES)^2 + (SRVS + SRVI)^2 + \left(\sqrt{CHUG_{LAT}^2 + CHUG_{SS}^2} + CHUG_I\right)^2} \qquad (2A)$$

FAULTED CONDITION

FAULTED 1.

$$N + \sqrt{(SSEI + SSES)^2 + (SRVS_{ONE} + SRVI)^2 + (CO_I + CO_{SS})^2} \text{ - SEE NOTE 1} \qquad (3A)$$

FAULTED 2.

$$N + \sqrt{(SSEI + SSES)^2 + (SRVS + SRVI)^2 + \left(\sqrt{CHUG_{LAT}^2 + CHUG_{SS}^2} + CHUG_I\right)^2} \qquad (4A)$$

WHERE:

CO_I = CO INERTIA LOAD
CO_{SS} = SUBMERGED STRUCTURE LOAD
N = NORMAL OPERATING LOADS (PRESSURE, DEADWEIGHT, THERMAL)
OBEI = OBE INERTIA LOAD
OBES = OBE SLOSHING LOAD
SSEI = SSE INERTIA LOAD
SSES = SSE SLOSHING LOAD
SRVS = SRV SUBMERGED STRUCTURE BUBBLE LOAD
SRVI = SRV INERTIA LOAD
$CHUG_{LAT}$ = CHUGGING LATERAL LOAD
$CHUG_{SS}$ = CHUGGING SUBMERGED STRUCTURE LOAD
$CHUG_I$ = CHUGGING INERTIA LOAD

NOTE 1: $SRVS_{ONE}$ IS THE SRV SUBMERGED STRUCTURE LOAD FROM A SINGLE SRV ACTUATION, TO MEET SINGLE FAILURE CRITERIA. ALL OTHER "SRV" IS THE ENVELOPE OF SRV_{ONE}, SRV_{ASYM}, SRV_{ADS}, AND SRV_{ALL}.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

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9.2 - DESIGN LOAD COMBINATIONS AND ACCEPTANCE CRITERIA (Con't)

THE LOADING COMBINATIONS IN EQ. (1A.) THROUGH (4A.) ARE USED FOR THE DOWNCOMER ANALYSIS TO MEET THE REQUIREMENTS OF THE FOLLOWING:

(1) - CLASS 2 PIPING ANALYSIS IN ACCORDANCE WITH NC-3600 OF THE ASME CODE, SECTION III. (REF. 10)

(2.) - FUNCTIONAL CAPABILITY ANALYSIS IN ACCORDANCE WITH THE NRC REGULATORY POSITION IN REFERENCE 11 AND NEDO-21985 (REF. 12)

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲ 5010.65

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J.O. OR W.O. NO. 12177.28	DIVISION & GROUP EMD/E&S	CALCULATION NO. MS-2155	OPTIONAL TASK CODE N/A	

9.3 <u>DYNAMIC LOADING INPUT</u>:

REFERENCES FOR INPUT SRV AND CO LOADS ARE AS FOLLOWS:

(1) SRV - SUBMERGED STRUCTURE LOADING - REF. 8

(2) CO - SUBMERGED STRUCTURE LOADING - REF. 6, 7.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

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12177.28	EMD	MS-2155	N/A	

10. CONCLUSIONS:

FOLLOWING TABLES IN SUMMARY OF RESULTS SECTION SHOW THAT AS A RESULT OF THE REVISED SRV AND CO LOADS THERE IS A GREATER MARGIN BETWEEN THE CALCULATED FAULTED-1 STRESS AND THE ALLOWABLE. THE REVISED MAXIMUM STRESS UNDER FAULTED-1 CONDITION IS REDUCED TO 25.18 KSI FROM THE ORIGINAL VALUE OF 30.34 KSI OBTAINED IN REF. 1. FAULTED-2 CONDITION THEREFORE BECOMES THE GOVERNING LOAD COMBINATION.

THE STRESSES DUE TO SRV AND CO LOADS EVALUATED IN THIS CALCULATION ARE SMALLER THAN THOSE IN REF. 1 AND THE EQUIVALENT STRESS CYCLES DUE TO THESE EVENTS ARE EXPECTED TO BE ABOUT THE SAME AS THOSE EVALUATED IN REF. 1. IN ADDITION, THE CUMMULATIVE USAGE FACTOR (C.U.F.) IN REF. 1 WAS CALCULATED TO BE ONLY 0.182. THEREFORE, UNDER THE REDUCED SRV AND CO LOADING THE REVISED C.U.F. IS EXPECTED TO BE LESS THAN 0.182 AND WELL BELOW UNITY.

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CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO. 12177.28	DIVISION & GROUP EMD	CALCULATION NO. MS-2155	OPTIONAL TASK CODE N/A	PAGE 14

11. RESULTS SUMMARY

UNITS IN IN-KIPS

TABLE (1) - DOWNCOMER MOMENT RESPONSE SUMMARY (MODEL A0, A1)

	LOAD CASES	UPSET CONDITION MODEL (A1) W_n = 1.55 HZ	EMERGENCY CONDITION MODEL (A0) W_n = 1.94 HZ.	FAULTED CONDITION MODEL (A0) W_n = 1.94 HZ
SEISMIC INERTIA AND SLOSHING	(a.) OBE	1320.5	1177.0	—
	(b.) SSE	—	—	2341.0
SRV	(a) SRV SS LOAD	2126.0	2822.0	1324.5 FAULTED 1 2667.0 FAULTED 2 (SEE PG 25)
	(b) SRV ARS	49.2	49.2	33.0
LOCA	a.) CO SS LOAD	N/A	N/A	2937.4
	b.) CO ARS	N/A	N/A	109.40
	a.) CHUG. LAT. LOAD	N/A	1567.8	1375.0
	b.) CHUG. SS LOAD	N/A	1490.0	1422.3
	c.) CHUG. ARS	N/A	187.9	144.9
	AP ARS	N/A	N/A	48.0
TOTAL COMBINED MOMENT		2544.6	3892.6	4076.6 FAULTED 1 [illegible] FAULTED 2

A 5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 15
12177.28	EMD	MS-2155	N/A	

RESULTS SUMMARY (con't)

TABLE (2) - DOWNCOMER ASME CODE CLASS 2 STRESS SUMMARY (MODEL A0, A1)

UNITS IN KSI

LOAD CASES		UPSET CONDITION MODEL (A1) ω_n = 1.55 Hz	EMERGENCY CONDITION MODEL (A0) ω_n = 1.94 Hz	FAULTED CONDITION MODEL (A0) ω_n = 1.94 Hz
SEISMIC INERTIA AND SLOSHING	(a) OBE	8.56	7.63	—
	(b.) SSE	—	—	15.18
SRV	a.) SRV SS LOAD	13.79	18.30	8.61 FAULTED 1 17.30 FAULTED 2
	b.) SRV ARS	0.32	0.32	0.21
LOCA	a.) CO SS LOAD	N/A	N/A	19.06
	b.) CO ARS	N/A	N/A	0.71
	a.) CHUG. LAT. LOAD	N/A	10.16	8.92
	b.) CHUG. SS LOAD	N/A	9.66	9.22
	c.) CHUG. ARS	N/A	1.22	0.94
	AP ARS	N/A	N/A	0.31
TOTAL COMBINED STRESS		16.50	25.24	26.44 FAULTED 1 26.96 FAULTED 2
ASME ALLOWABLE		21.36	29.66	[illegible] FAULTED 1 39.55 FAULTED 2

RESULTS SUMMARY (Con't'd)

TABLE (3) DOWNCOMER FUNCTIONAL CAPABILITY STRESS SUMMARY

UNITS IN KSI

	LOAD CASES	UPSET CONDITION MODEL (A1) Wn=1.55 HZ	EMERGENCY CONDITION MODEL (AO) Wn=1.94 HZ	FAULTED CONDITION MODEL (AO) Wn=1.94 HZ
	SEISMIC INERTIA AND SLOSHING (a) OBE	8.16	7.27	-
	(b) SSE	-	-	14.46
SRV	(a) SRV SS LOAD	13.13	17.43	8.2 FAULTED 1 16.48 FAULTED 2
SRV	(b) SRV ARS	0.30	0.30	0.20
LOCA	(a) CO SS LOAD	N/A	N/A	18.15
LOCA	(b) CO ARS	N/A	N/A	0.68
LOCA	(a) CHUG LAT. LOAD	N/A	9.68	8.49
LOCA	(b) CHUG SS LOAD	N/A	9.20	8.79
LOCA	(c) CHUG ARS	N/A	1.16	0.90
LOCA	AP ARS	N/A	N/A	0.30
	TOTAL COMBINED STRESS	15.72	24.04	25.18 FAULTED 1 25.68 FAULTED 2
	FUNCTIONAL CAPABILITY ALLOWABLE	34.35	30.17 @330°F	31.26 FAULTED 1 30.17 FAULTED 2

RESULTS SUMMARY (con't)

TABLE (4) - DOWNCOMER TIP DEFLECTIONS

LOAD CASES		UPSET CONDITION MODEL (A1)		EMERGENCY CONDITION MODE (A0)		FAULTED CONDITION MODEL (A0)	
SEISMIC INERTIA AND SLOSHING							
	a.) OBE	2.71"	JOB 1235/1218	2.13"	JOB 1239/1007	—	—
	b.) SSE	—	—	—	—	4.27"	JOB 1211/783
SRV	(a.) KWU AIR BUBBLE	3.69"	REF. 19	4.86"	REF. 19	4.61 2.32"	REF. 5/FAULTED2 REF. 5/FAULTED1
	(b.) SRV_I (ARS)	.004"	JOB # 365	.004"	JOB # 623	.005"	JOB # 623
LOCA	(a.) COSS LOAD	—		—		4.81	PAGE 22
	(b.) CO_I (ARS)	—		—		0.01"	JOB # 337
	(a.) CHUG. LAT LOAD	—		1.52"	JOB # 57	1.48"	JOB # 57
	(b.) CHUG. SS LOAD	—		1.48"	JOB # 1247	1.46"	JOB # 1544
	(c.) $CHUG_I$ (ARS)	—		0.13	JOB # 327	0.10"	JOB # 327
COMBINED DEFLECT. (SRSS)		4.58"		5.77"		6.98"	FAULTED 2

NOTES: 1. THE RELATIONSHIP BETWEEN THE DOWNCOMER TIP DEFLECTIONS AND STRESS IS A DIRECT ONE, IF THE DOWNCOMER IS ACTIVATED IN ITS FIRST MODE. THIS IS THE CASE FOR THE SRV AIR BUBBLE LOAD AND THE CO SUBMERGED STRUCTURE LOAD.
FOR THE OTHER LOAD CASES, HIGHER DOWNCOMER MODES ALSO CONTRIBUTE TO ITS RESPONSE. THUS, THE RATIO OF TIP DEFLECTION TO STRESS WOULD BE SMALLER, COMPARED TO THE SITUATION WHEN ONLY THE FIRST MODE GOVERNS.
2. REFERRED JOB NUMBERS ARE FROM REF. 1

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CALCULATION SHEET

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CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 18
12177·28	EMD	MS-2155	N/A	

3. EXCEPT THE SUBMERGED STRUCTURE LOADS FOR SRV AND CO ALL OTHER NUMBERS IN THESE TABLES ARE FROM REF. 1.

4. THE CALCULATED STRESSES (NOT ALLOWABLES) IN TABLE.2 ARE 5% HIGHER THAN THE STRESSES IN TABLE.3. (REF. 1)

5. THE STRESSES IN TABLE.3 ARE OBTAINED BY DIVIDING THE BENDING MOMENTS OF TABLE.1 BY DOWNCOMER SECTION MODULUS.

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CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 19
12177.28	EMD	MS-2155	N/A	

12. REFERENCES :

1. SWEC CALCULATION " DOWNCOMER ANALYSIS AND FATIGUE EVALUATION" - 12177.08-NM(C)-MS1869-2 DATED 1-22-86

2. NUREG-1047 " SAFETY EVALUATION REPORT RELATED TO THE OPERATION OF NINE MILE POINT NUCLEAR STATION UNIT NO. 2", SUPPLEMENT 3, DATED JULY 1986.

3. NUREG-0802 " SAFETY/ RELIEF VALVE QUENCHER LOADS: EVALUATION FOR BWR MARK II AND III CONTAINMENTS", OCTOBER, 1982.

4. NUREG-0808 " MARK II CONTAINMENT PROGRAM LOAD EVALUATION AND ACCEPTANCE CRITERIA.", AUGUST 1981

5. SWEC CALCULATION " DOWNCOMER RESPONSES TO SRV AIR BUBBLE LOAD (FSI)" - 12177-NM(C)-PX 600012 REV. 2. DATED 5/5/87

6. SWEC CALCULATION " CO LOAD ON DOWNCOMERS BASED ON NMP2 PLANT SPECIFIC CO LOAD " - 12177-NP(C)-PX-60160 REV. O. DATED 5/5/87

7. NINE MILE PT. 2 FSAR & DESIGN ASSESSMENT REPORT, APP. 6A.

8. SWEC. CALC. "SRV BUBBLE LOAD ON DOWNCOMER - SINGLE SRV ACTUATION". DATED 5/5/87 12177-NP(C)- PX 60161 REV. O. DATED 5/5/87.

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12177·28	EMD	MS-2155	N/A	

9. BLANK

*10. ASME SEC. III DIV. 1 1977 EDITION, INCLUDING 1978 SUMMER ADDENDA.

11. USNRC MEMO TO R.L. TEDESCO, DIVISION OF LICENSING FROM J.P. KNIGHT, DIVISION OF ENGINEERING, "EVALUATION OF TOPICAL REPORT PIPING FUNCTIONAL CAPABILITY CRITERIA," DATED 7/17/1980.

12. NEDO-21985, SEPT. 1978 "FUNCTIONAL CAPABILITY CRITERIA FOR ESSENTIAL MARK II PIPING."

* INORDER TO EVALUATE STRESSES FOR ALL SERVICE LEVELS (A, B, C&D) THE ALLOWABLES AND REQUIREMENTS OF ASME SEC III, SUBSECTION NC, OF THE 1977 ED. WAS USED. THESE REQUIREMENTS ARE MORE STRINGENT THAN THE 1974 EDITION AND ADDENDA DATED 6/30/74 TO 6/30/76. 1977 ED. IS CONSISTENT WITH REF. 12 TO EVALUATE FUNCTIONAL CAPABILITY.

13. ANALYSIS:

SRV SUBMERGED STRUCTURE LOAD:

THE SRV SUBMERGED STRUCTURE LOADS ON DOWNCOMER DUE TO SRV AIRBUBBLE OSCILLATION ARE DISCUSSED IN REF. A FLUID STRUCTURE INTERACTION SDOF MODEL WAS DEVELOPED TO ACCOUNT FOR THE EFFECT OF FLUID DAMPING. THE RESULTANT MOMENT FROM REF. 5 IS SHOWN IN THE FOLLOWING TABLE (HIGHER OF THE TWO CASES ANALYZED I.E. SRV KTG 11.1 AND 12.1).

MODEL	PLANT CONDITION	RESULTANT MOMENT
A_0	FAULTED 1	1324.5 IN-KIPS.

RESULTS OF BOTH SDOF CSMP MODEL (REF. 5) AND MULTIDEGREE OF FREEDOM (MDOF) STARDYNE MODEL ARE USED FOR THE CALCULATION OF SRV SS LOAD. RESULTS OF MDOF STARDYNE MODEL IS INCLUDED HERE. MOMENTS FROM THE MDOF RUN ARE AS FOLLOWS:

MODEL	CASE	DAMPING	MOMENT
A_0	KTG 11.1	2%	1344.9 IN-KIP
A_0	KTG 12.1	2%	1335.5 IN-KIP

DETERMINATION OF AVERAGE VELOCITY FOR SRV KTG 11.1, TIME FACTOR = 0.51

MODEL A_0 - 2% DAMPING

REF. GILNET # 145 DATED 3/28/87

JOINT NO.	JOINT DISPLACEMENT (in)	JOINT VELOCITY MAX (IN / SEC)	ASSOCIATED LENGTH-ΔL (ft)	$VEL^2 \times \Delta L$
1	2.357	30.23	1.0	913.9
2		28.52	2.0	1626.8
3		26.83	2.0	1439.7
4		25.18	1.833	1162.4
5		23.83	1.6667	946.5
6		22.51	1.6667	844.5
7		21.25	0.8333	376.3

$$\sum_{1}^{7} VEL^2 \times \Delta L = 7310.0$$

$\therefore$ AVERAGE VELOCITY $= \sqrt{\frac{\sum VEL^2 \times \Delta L}{L}} = \sqrt{\frac{7310}{11}}$

$= 25.78$ in/sec.

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DETERMINATION OF AVERAGE VELOCITY FOR SRV KTG12.1

MODEL A_0 - 2% DAMPING

REF. GILNET # 96 DATED 3/25/87

JOINT No.	JOINT DISPL. MAX (INCH)	JOINT VELOCITY MAX (INCH/SEC.)	ASSOCIATED LENGTH - ΔL (FT)	$VEL^2 \times \Delta L$
1	2.34	37.24	1	1386.8
2	2.2	35.06	2	2458.4
3	2.05	32.89	2	2163.5
4	1.91	30.71	1.833	1729.0
5	1.79	28.91	1.6667	1393.0
6	1.67	27.11	1.6667	1224.9
7	1.55	25.32	0.8333	534.3

$$\sum_{1}^{7} VEL^2 \times \Delta L = 10889.9$$

$$\therefore \text{AV. VELOCITY} = \sqrt{\frac{\sum VEL^2 \times \Delta L}{L}} = \sqrt{\frac{10889.9}{11}}$$

$$= 31.46 \text{ INCH/SEC}$$

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12177.28	EMD	MS-2155	N/A	

CO SUBMERGED STRUCTURE LOAD:

THE CO LOADS ON THE SUBMERGED PORTION OF THE DOWNCOMER WERE OBTAINED FROM REF. 6,7, IN THE FORM OF LOAD VS TIME. THESE LOADS WERE APPLIED ON A SINGLE DEGREE OF FREEDOM SYSTEM SIMULATING THE DOWNCOMER FREQUENCY AND THE MAXIMUM MOMENT AT FIXED END OF THE DOWNCOMER WERE CALCULATED. OUT OF TEN LOADING CASES ONLY ONE CASE (CO-RUN 12) WAS SELECTED TO BE THE GOVERNING CASE. THE RESULTS ARE:

CO RUN NO #	MOMENT	REFERENCE
3	1211.5	JOB 1811
7	2072.6	JOB 997
9	1465.6	JOB 1870
10	1762.4	JOB 1899
12	3443.81	JOB 922
14	1744.25	JOB 2017
22	1622.7	JOB 2039
24	1070.25	JOB 2067
27	2404.[illegible]	JOB 1058
28	1203.3	JOB 2073

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12177.28	EMD	MS-2155	N/A	

ONCE THE GOVERNING LOADING CASE WAS ESTABLISHED, THE EFFECT OF FLUID DAMPING WAS DETERMINED BY SDOF CSMP MODEL. THE METHODOLOGY IS SIMILAR TO WHAT IS USED FOR SRV (REF. 5). AVERAGE VELOCITY AND VELOCITY CORRECTION FACTOR WERE DETERMINED BY A STARDYNE COMPUTER RUN.

DETERMINATION OF AVERAGE VELOCITY FOR CO- CASE 12

MODEL. A_0 - 2% DAMPING

REF. GILNET # 143 DATED 3/28/87

JOINT NO.	JOINT DISPL. MAX (INCH)	JOINT VELOCITY MAX (INCH/SEC)	ASSOCIATED LENGTH-ΔL (Ft)	$VEL^2 \times \Delta L$
1	6.08	75.3	1.0	5670.1
2	5.7	69.4	2.0	9632.7
3	5.33	63.9	2.0	8166.4
4	4.95	59.80	1.833	6554.9
5	4.64	56.39	1.6667	5299.8
6	4.33	53.10	1.6667	4699.4
7	4.03	49.93	0.8333	2077.4

$$\sum_{1}^{7} VEL^2 \times \Delta L = 42100.7$$

$$\therefore \text{AV. VEL.} = \sqrt{\frac{42100.7}{11}} = 61.87 \text{ inch/sec.}$$

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 27
12177.28	EMD	NS-2155	N/A	

DERIVATION OF FINAL RESPONSE USING SDOF AND MDOF RESULTS:

CASE NO.	ITEM	MDOF STARDYNE RUN # 143	SDOF W/O FSI JOB #7230	SDOF WITH FSI JOB# 7230	FINAL RESPONSE
12	TIP DEFL. (IN)	6.08	6.12	4.84	4.81 INCH
	AV. VEL. (IN/S)	61.87	74.1	VEL. CORR. FACTOR = $\frac{61.87}{74.1}$ = 0.83	47.89 IN/SEC
	MOMENT (K.IN)	3705.6	3435.5	2723.3	2937.4 IN-KIP
	STRESS (KSI)	22.89	21.22	16.82	18.15 KSI

[FINAL TIP DEFLECTION $= 4.84 \times \frac{6.08}{6.12} = 4.81$ INCH.

MOMENT $= 2723.3 \times \frac{3705.6}{3435.5} = 2937.4$ INKIP

VELOCITY $= 57.7 \times \frac{61.87}{74.1} = 47.89$ IN/SEC]

14.

Note: Some micro[illegible] may have different calc. #. They should be read as MS-2155.

COMPUTER LOG

7729

S & W AUTH. NO. 3092 CALCULATION NO. MS-2155
CDC CHARGE NO. 3092 JOB ORDER NO. 12177.28

RUN NO. OR GILNET #	JOB NO. *	FICHE LOC. PAGE	FICHE LOC. SECT	PREPARED BY SIGNATURE	PREPARED BY DATE	REVIEWED BY SIGNATURE	REVIEWED BY DATE	COMP. **	COMMENTS
	1053	32	1	Niyogi	3/16/87	DBhargava	4/14/87	S&W	Co - Run 27
	922		2	Niyogi	3/16/87				Co - Run 12
	997		3	Niyogi	3/16/87				Co - Run 7
	1811		4	Niyogi	4/14/87				Co - Run 3
145	AMFGBOB		14	Niyogi	3/28/87			CDC	SRV - KTG 11.1
	1870		5	Niyogi	"			S&W	Co - Run 9
	1899		6	Niyogi	"				Co - Run 10
	2017		7	Niyogi	"				Co - Run 14
	2039		8	Niyogi	"				Co - Run 22
	2062		9	Niyogi	"				Co - Run 24
	2073		10	Niyogi	"				Co - Run 28
24	AMFG ASG		11	Niyogi	3/28/87			CDC	Gilnet # 143 Stardyne
	7230		12	Niyogi	3/29/87			S&W	Co - Run 12 - FSI
96	AMFG 6XK		13	Niyogi	3/25/87			CDC	SRV - KTG 12.1

* COMPUTER GENERATED JOB NUMBER ** COMPUTER USED (S&W OR CDC)

Attachment 14.1

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[illegible]

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ATTACMENT - 1

```
CONTINUOUS SYSTEM MODELING PROGRAM  III   V1M1   TRANSLATOR   ***

T...c 1DOF DCMER ANAL.CO-WITH FLUID DAMP-MAX RES?-CASE27
        PARAMETER ALP=(0.0,.8352,1.0)
        SYSTEM NPOINT=19100
INITIAL
        CONSTANT PI=3.14159265,...
        RHO=1.94,RAD=1.0,L=11.,CD=.7,...
        M=105.487
NOSORT
        IF(ALP.GT.0.3) GO TO 110
        K=14609.52
        C=42.27
101     FORMAT(2E13.5)
        READ(35,101)TINI,PINI
        P=PINI
        T=0.00
        TEST=T
        CALL FGLOAD(CO4T,T,P)
        PMAX=0.0
102     READ(35,101,END=104)T,P
        IF(PMAX.LE.ABS(P))PMAX=ABS(P)
        T=T-TINI
        IF(T.LE.TEST)GO TO 102
        TEST=T
        CALL FGLOAD(CO4T,T,P)
        GO TO 102
104     TFIN=T+TINI
        TF1=T+.001
        TF2=T+1.0
        CALL FGLOAD(CO4T,TF1,0.0)
        CALL FGLOAD(CO4T,TF2,0.0)
        WRITE(6,106)TFIN,P
        WRITE(6,108)PMAX
106     FORMAT(1H1,'  FINAL TIME=',F8.4,'  FINAL PRESSURE=',F8.4)
108     FORMAT(1X,'MAX PRESSURE=',F8.4)
110     CONTINUE
DYNAMIC
RANGE X,NOM
PRINT X,NOM
METHOD RKSFX
TIMER FINTIM=9.00,DELT=.004,PRDEL=0.5
FUNCTION CO4T
       AVACC=AFGEN(CO4T,TIME)*(2751.0/8.8964)/(2.*PI*RAD**2*L*RHO)
       AVVEL=INTGRL(0.0,AVACC)
       XDD=(2.*PI*RAD**2*L*RHO*AVACC+CD*RAD*L*RHO*...
       (AVVEL-ALP*XD)*ABS(AVVEL-ALP*XD)-K*X-C*XD)/M
       XD=INTGRL(0.,XDD)
       X=INTGRL(0.,XD)
       VMXD=AVVEL-XD
       NOM=X*7366.84
       TERMINAL
       END
       STOP

OUTPUT VARIABLE SEQUENCE
ZZ1000 K      C      P      T      TEST   PMAX   PMAX   T      TEST
TFIN   TF1    TF2    AVACC  AVVEL  XDD    XD     (      VMXD   NOM

****PARAMETERS NOT INPUT OR OUTPUTS NOT AVAILABLE TO SORT SECTION***SET TO ZERO***
```

LISTING OF THE CSMP SDOF PROGRAM W/O FLUID STRUCTURE INTERACTION

12177-28-NM(c)-MS-255 P.30

```
[illegible]NTINUOUS SYSTEM MODELING PROGRAM  III   V1M1   TRANSLAT[illegible]

TITLE 100F OCHER ANAL.CO-WITH FLUID DAMP-MAX RESP-CASE12
        PARAMETER ALP=(0.0,.75,.77,.8,.82,.85,.9,.95,1.0)
        SYSTEM NPOINT=19100
INITIAL
        CONSTANT PI=3.14159265,...
        RHO=1.94,RAD=1.0,L=11.,CD=.7,...
        M=105.544
NOSORT
        IF(ALP.GT.0.3) GO TO 110
        K=14609.52
        C=42.27
101     FORMAT(2E13.5)
        READ(35,101)TINI,PINI
        P=PINI
        T=0.00
        TEST=T
        CALL FGLOAD(CO4T,T,P)
        PMAX=0.0
102     READ(35,101,END=104)T,P
        IF(PMAX.LE.ABS(P))PMAX=ABS(P)
        T=T-TINI
        IF(T.LE.TEST)GO TO 102
        TEST=T
        CALL FGLOAD(CO4T,T,P)
        GO TO 102
104     TFIN=T+TINI
        TF1=T+.001
        TF2=T+1.0
        CALL FGLOAD(CO4T,TF1,0.0)
        CALL FGLOAD(CO4T,TF2,0.0)
        WRITE(6,106)TFIN,P
        WRITE(6,108)PMAX
106     [illegible](1H1,'  FINAL TIME=',F8.4,'  FINAL PRESSURE=',F8.4)
[illegible]     [illegible]1X,'MAX PRESSURE=',F8.4)
[illegible]
[illegible]
[illegible]STRESS
[illegible]STRESS
[illegible]
[illegible].00,DELT=.001,PRDEL=0.5
[illegible]
        [illegible]FGEN(CO4T,TIME)*(2366.0/PMAX)/(2.*PI*RAD**2*L*RHO)
        [illegible]NTGRL(0.0,AVACC)
        [illegible]*PI*RAD**2*L*RHO*AVACC+CD*RAD*L*RHO*...
        [illegible]ALP*XD)*ABS(AVVEL-ALP*XD)-K*X-C*XD)/M
        [illegible]RL(0.,XDD)
        [illegible]L(0.,XD)
        [illegible]VEL-XD
        [illegible]366.84
        [illegible]MOM/161.9
        [illegible]
        [illegible]
        [illegible]

[illegible]E SEQUENCE
[illegible]   C      P      T      TEST   PMAX   PMAX   T      TEST
[illegible]   TF2    AVACC  AVVEL  XDD    XD     X      VMXD   MOM
[illegible]
```

LISTING OF THE CSMP SDOF PROGRAM WITH FLUID STRUCTURE INTERACTION

12177-28-NM(c)-MS-2155

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

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CLIENT & PROJECT	PAGE 1 OF 78 + 65 PAGES ATTACHMENTS
NIAGRA MOHAWK POWER CO/NINE MILE POINT - UNIT 2	

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (✓)
CONDENSATION OSCILLATION LOADS ON DOWNCOMERS BASED ON NMP2 PLANT SPECIFIC CO LOAD	☒ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER

J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12177.28	NP(C)	PX-60.160-0		

* APPROVALS - SIGNATURE & DATE Tuengli Wang 5/5/87

PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION * REQUIRED (✓) YES	NO
V. J. Shah 4/28/87	M. BenNagi 4/29/87	Louis Nich May 5 1987	NEW			✓

DISTRIBUTION*

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)			NMP2 SEG	R. CASSELLA	
GROUP RECORD	Y. S. SUN/3G		NMP2 E.Q.	D. BHARGAVA/5G	
NMP2 MECH.	N. RAPAGNANI/5G				
PIPE STRESS	C. WOLLACK/5G				

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CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO. 12177.28	DIVISION & GROUP NP(C)	CALCULATION NO. PX-60160-0	OPTIONAL TASK CODE	PAGE 2

REF.

STATEMENT OF REVIEW

This calculation has been reviewed in accordance with CHOC EMDM 82-12 and was found to be adequate. The method of review was: (list the appropriate items)

a. Review of Calculation

b. Comparison with a similar previous calculation

1. M. BEN-NAGI 4/29/87 a 0
REVIEWER DATE METHOD REV.

2. ______
REVIEWER DATE METHOD REV.

3. ______
REVIEWER DATE METHOD REV.

The statement below applies to Nuclear Safety Related QA Category I calculations only.

This calculation has been INDEPENDENTLY reviewed in accordance with CHOC EMDM 82-12 and was found to be adequate.

a. Comparison with prequalified method and assumptions ______
(prequalified document number(s))

b. Addressing the key questions appearing in EAP-5.3, and EAP-3.1 (latest revisions)

1. LOUIS C. NIGH [signature] 5/5/87 2 0
INDEPENDENT REVIEWER DATE METHOD REV.

2. ______
INDEPENDENT REVIEWER DATE METHOD REV.

3. ______
INDEPENDENT REVIEWER DATE METHOD REV.

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1.0 OBJECTIVE

The purpose of this calculation is to provide submerged structure loads on:

- [ ] SRV discharge line and quencher
- [x] Downcomers
- [ ] SRV vent lines
- [ ] Piping supports
- [ ] Miscellaneous (discharge and suction lines with strainer) piping

due to:

- [ ] LOCA bubble
- [ ] SRV bubble
- [x] Condensation oscillation
- [ ] Chugging
- [ ] Seismic sloshing
- [ ] Pool swell and fall back
- [ ] LOCA jet

These loads are to be applied to the structures for response assessment.

In this calculation NMP2 plant specific CO Loads defined by G.E. (Ref. 12) based on maximum pool temperature limit of 130°F is used. Number of downcomers has been revised from 119 to 113 (Ref. 3) to agree with plant As built configuration.

Loads on downcomers due to Generic CO Loads for Mark II containment (Ref. 8) were generated in Stone & Webster calculation 12177.08-NP(C)-PX-60052-1 (Ref. 18)

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[illegible]

2. INTRODUCTION

Loss of coolant accident (LOCA) is a design basis event for boiling water reactor (BWR) nuclear power plants. Following a large break accident, the drywell pressure will increase rapidly due to the steam or hot water released from the high energy line break. For a Mark II plant, such as NMP2, the pressurized air-steam mixture will be purged through the vertical downcomer into the suppression pool, where the steam content will be condensed. First, the suppression pool will swell and the drywell air purged into the wetwell. High steam mass flux with some residual air blow down will occur following the pool swell and fall back. Initially, the steam mass flux will be high enough to prevent the steam-water interface from reentering into the downcomer. The dynamic pressure oscillation resulted from the oscillating steam-water interface may generate dynamic loading on the containment as well as on structures submerged in the suppression pool, the load is called the condensation oscillation load. As the blow down continues, the steam mass flux as well the air content are further reduced, eventually the steam condensation becomes unstable and water reentry into the downcomer will take place. This phase of the blowdown is characterized by cyclic steam bubble formation and collapse at the downcomer tip, the phenomenon is called chugging. Chugging also generates dynamic loads on containment and submerged structures. Test series 5200 was conducted at the temporary tall tank test condensation oscillation (4TCO) test facility at General Electric Company to investigate the CO phenomena. The Mark II generic CO and Chugging load definitions were derived from the CO and Chugging test data obtained from this test series respectively.

4TCO test matrix was constructed in such a way as to envelop all the possible LOCA conditions, which covers different reactor models, nuclear steam supply and coolant systems, and different suppression pool temperature operating ranges for all Mark II plants; it was also constructed with the smallest pool area per downcomer for all Mark II plants so as to obtain conservative dynamic pressure measurement. These conservatisms were noted and acknowledged by the NRC (Ref. 8 & 19). In particular, it was found that the transition from CO to chugging can be defined in terms of pool temperature. The generic Mark II CO load definition did not take credit for both the pool size and the pool temperature effect in defining the CO load, however, the NRC allows individual plants to take credit of these effects (Ref. 19).

[illegible]

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2. INTRODUCTION (CONT'D)

A pool temperature transient calculation has been performed (Ref. 21), it was found that the maximum anticipated bulk pool temperature at the transition from CO to chugging for NMP2 following a DBA event is 119 degrees Fahrenheit. Allowing for additional margin, a 130 degree temperature limit was established to define bounding portions of the 4TCO test data used for the NMP2 CO load definition. General Electric Company defined the CO load for NMP2 based on a pool temperature limit of 130 degrees Fahrenheit (Ref 12). This means that 4TCO test data that are outside the operating temperature limit are excluded from the data base. This approach involves the compilation of 4TCO data below 130 degrees, generating a power spectral density (PSD) envelop of this data, and developing a number of new 4TCO time history segments to match the new PSD envelop. The bounding 4TCO time history segments are used in this calculation to calculate the submerged structure load on downcomers.

This calculation uses the same model and analytical method as the original calculation (Ref 18), which calculated the submerged structure load for downcomers in NMP2 pool using the generic Mark II CO load definition time segments. The only change made in this calculation was the bounding time history segments. The bounding time segments for NMP2 CO time segments were presented in Table 3, along with the generic Mark II CO load bounding time segments for reference.

3.0 ASSUMPTIONS

1. The flow in the suppression pool is incompressible, irrotational, and inviscid.

2. The pool boundaries are rigid and water surface remains stationary.

3. Flow field perturbations due to the presence of submerged structures within the pool are negligible.

4. The incident flow is approximately uniform in the vicinity of a structure so Morrison's equation [5.1.1] is applicable.

$$F = 1/2 \quad C_D A_X \, U \, |U| \; + C_m \rho \; VS \, \frac{du}{dt}$$

Where: ρ = Density of water

C_D = Standard drag coefficient

A_X = Projected area normal to the flow field

U = Velocity

VS = Structure volume

C_m = Inertia (acceleration drag) coefficient

5. For CO, chugging, and LOCA bubble load calculation, method of images (MOI) is used by approximating the annular pool geometry with the rectangular box in three ways (Figures 1-3), and cylindrical pool is approximated by a rectangular box shown in Figure 4.

6. The hydrodynamic interaction between annular and cylindrical pools through the vent holes is negligible.

7. Drag volume for a finite cylinder in axial flow is conservatively approximated by a disk and the displaced volume.

8. Structures are rigid and small compared with the characteristic length of hydrodynamic disturbances; the fluid-structure interaction effect is negligible.

9. CO SOURCES ARE APPROXIMATED A POINT SOURCES.

10. THE DENSITY OF WATER (ρ) AT 70°F (1.94 SLUGS/CU FT) IS USED IN THE LOAD CALCULATION.

[illegible]

[illegible]

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4.0 METHOD

Calculation of the submerged structure load on downcomer during the CO phase of a LOCA event is performed in 3 steps. First, the volumetric flow field caused by the condensation oscillation of the steam bubble is calculated from the dynamic pressure traces, then the flow field and the induced drag loads are calculated for the target downcomer. Procedure to calculate the volumetric source is described in section 4.1, that of the flow field and the drag load calculation are described in section 4.2.

4.1 Calculation of the CO source strength

The bottom center pressure data at the 4TCO tank were provided by GE (Ref. 13). These data represented the actual pressure reading during a simulated LOCA blow down event, the data consists of hydrostatic pressure increase as a result of the wetwell airspace pressure increase in addition to the dyanmic pressure corresponding to the CO phenomena. Since only the dynamic pressure will induce drag loads on the submerged structures, trend removal was performed in reference 22 to extract the dynamic pressure for the bounding time segments of NMP2 CO load definition. Table 1 provides the data set names for the trend removed pressure data for the bounding time segments and its associated 4TCO run number and time periods.

The volumetric source strength, SDOT, is related to the dynamic pressure oscillation, P, in according to the following equation (Ref. 1):

$$\text{SDOT} = \dot{S} = P\,/\,\rho\, f(r) \quad [\text{ft}^3\ /\text{sec}^2]$$

where ρ = water density [slug/ft^3]

$f(r)$ = 4TCO tank constant [ft^{-1}]

t = time [sec]

The volumetric source SS, which is the volumetric flow produced by the steam bubble oscillation, can then be obtained by integration.

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$$SS = \int_0^t (P / \rho f(r))\ dt \qquad [ft^3/sec]$$

The quantities SDOT and SS are computed from the dynamic pressure traces using the IBM simulation language CSMP (Ref. 23).

Since the 4TCO test matrix was constructed to simulate the Mark II plants' LOCA blow down conditions, it is expected that the inferred CO sources from the above equations using the 4TCO tank constant are applicable to Mark II plants, NMP2 in particular.

[illegible]

4.0 METHOD (continued)

4.2 Flow field and drag load calculation

Flow field in the suppression pool is calculated by the computer program SSLOAD (Ref. 11). This program solves the Poisson's equation with point sources using the method of images (MOI) (Ref. 20). Since MOI is applicable only to flat boundaries; the annular pool is modelled as a parrallelpipe. Three rectangular boxes are constructed to approximate the suppression pool as shown in Figures 1-3. Flow fields and drag loads are calculated for each of the three rectangular boxes, the box that produces the most conservative load are presented as the design load. The number of images used in the vertical, radial, and circumferential directions are 22, 11, and 3 , respectively.

CO sources are approximated as point sources at one foot below the the downcomer tip, where the steam-water interface is expected to be located. One source is assigned to each downcomer, and all source are assumed to have the same source strength.

Since the CO sources are not expected to be oscillating exactly in phase, the flow field is calculated with the worst phasing assigned to the CO sources. That is, a time delay is assigned to half the pool so that the peak negative pressure within the fundamental CO period coincide with the peak positive pressure of the other half pool. The pool is divided at the location of the target downcomer.

A sensitivity study was performed to locate the downcomer that would experience the highest load. Downcomer 43 (Fig. 4) in the annular pool was found to be the worst case location. Flow field and drag load calculation were then calculated for this downcomer.

Once the flow field is known, the submerged structure load is calculated using the Morrison's equation described on page 8 (Ref. 20).

Adjustment are made for interference effects and unsteady flow effects on the drag coefficients.

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Method 1 - The pool is approximated by unwrapping one-half of annular pool and transforming it into a rectangular box with the shown dimensions.

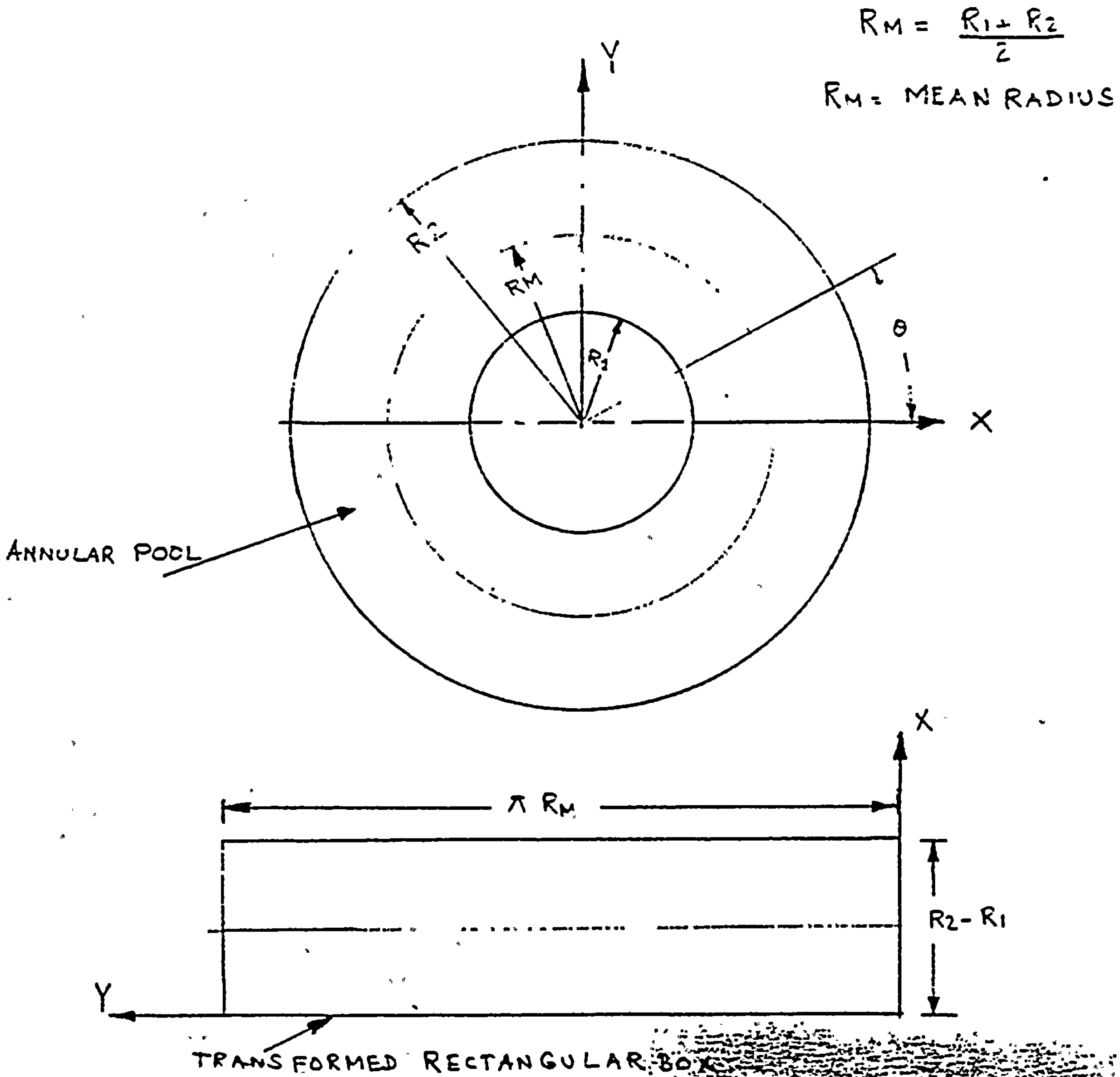

FIGURE - 1

Method 2 - The pool is approximated by a rectangular box to circumscribe one-half of annular pool.

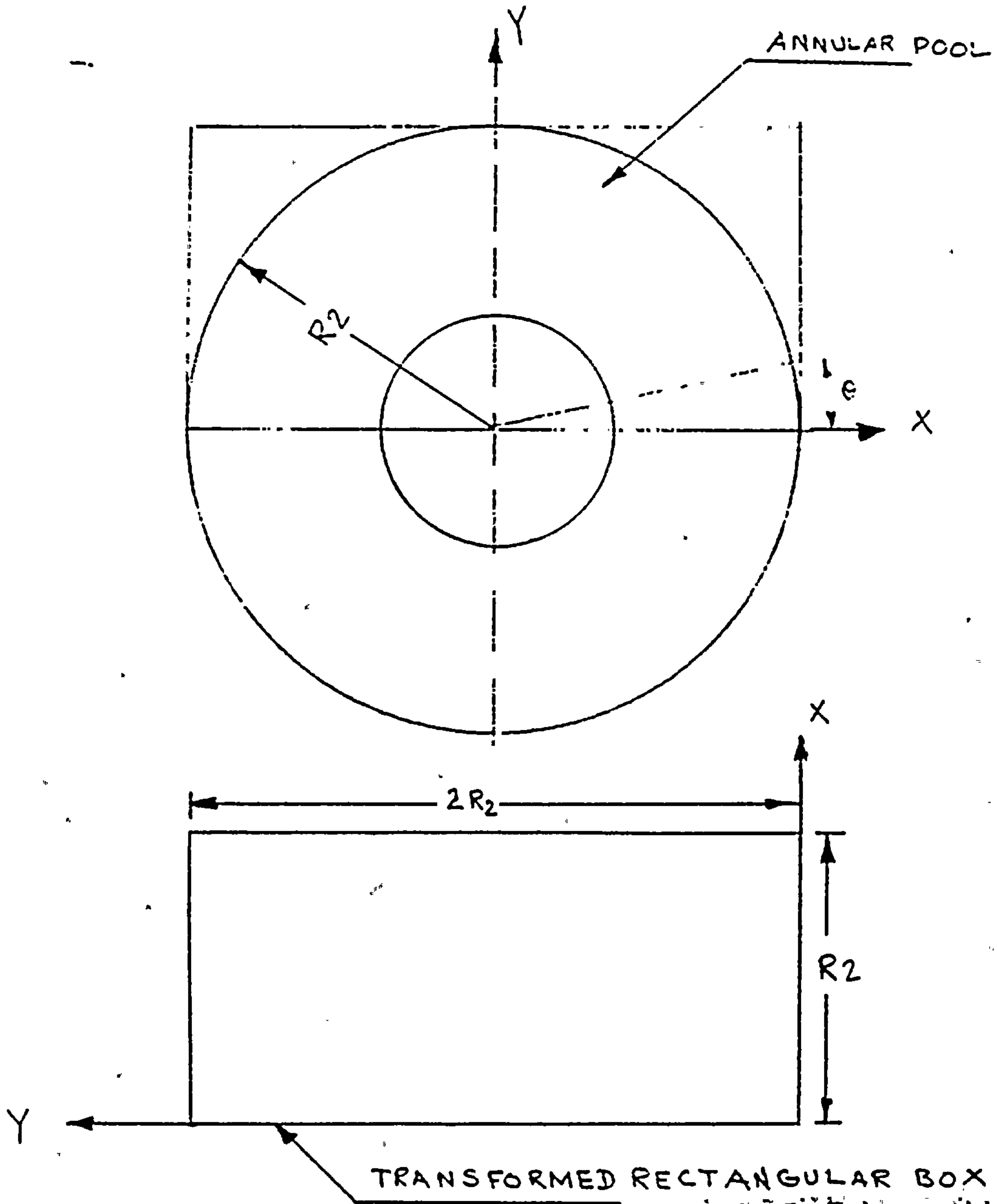

FIGURE - 2

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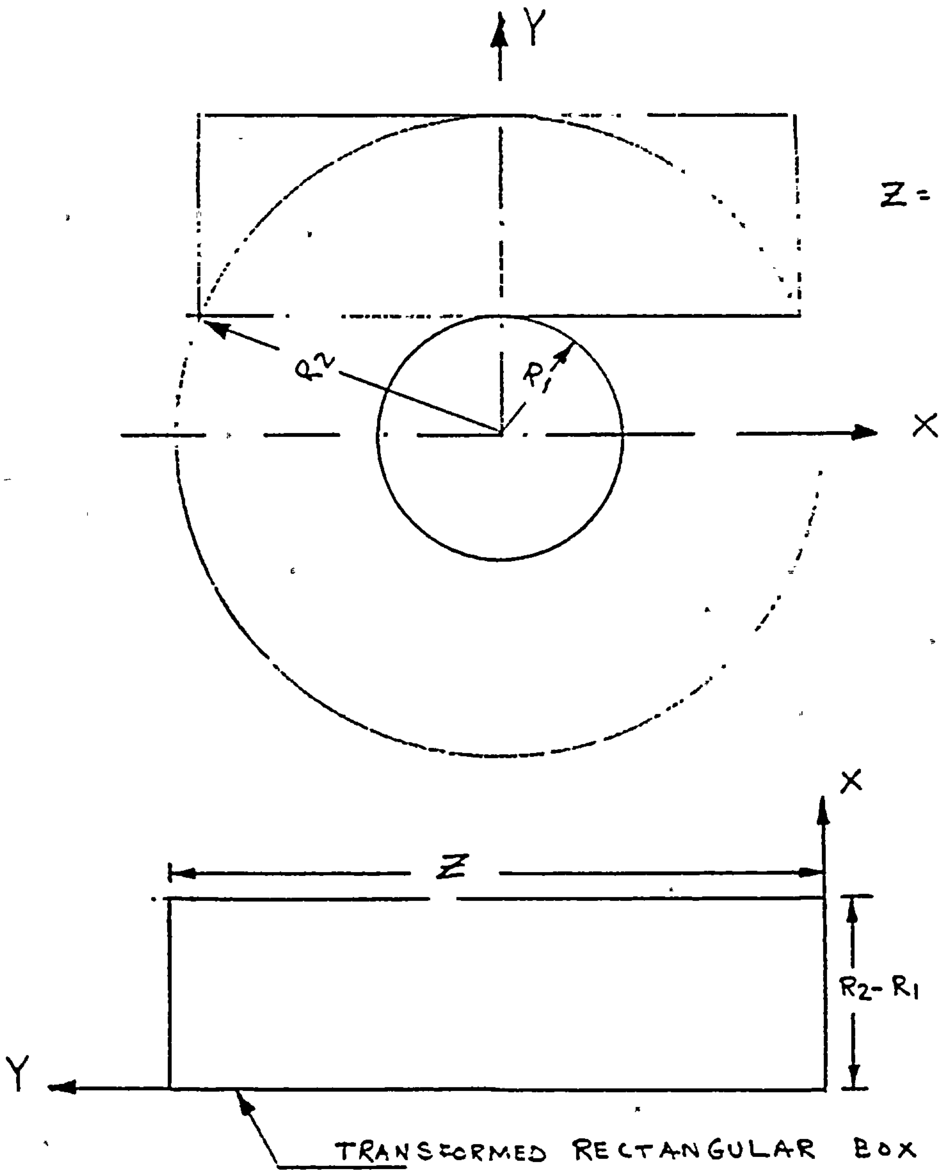
Method 3 - The pool is approximated by a rectangular box with the shown dimensions (tangent rectangle).



$$Z = 2\left[(R_2)^2 + (R_1)^2\right]^{1/2}$$

FIGURE - 3

4. METHOD (CONT'D) ...

ELEV. - 240'-0"

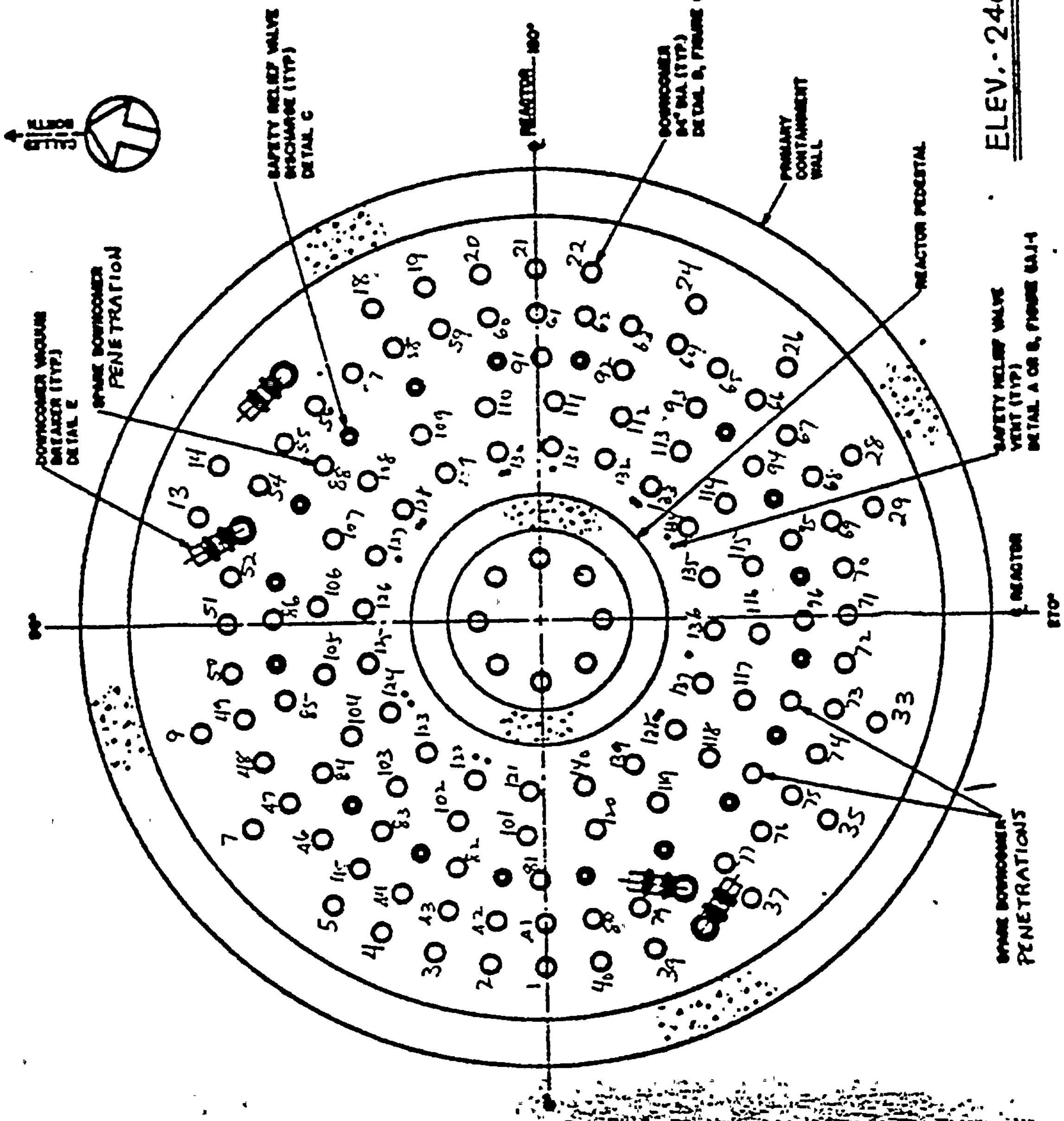


FIG. 4 DOWNCOMER ARRANGMENT

BASED ON REF. 2 & 3

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3. METHOD (CONT'D)

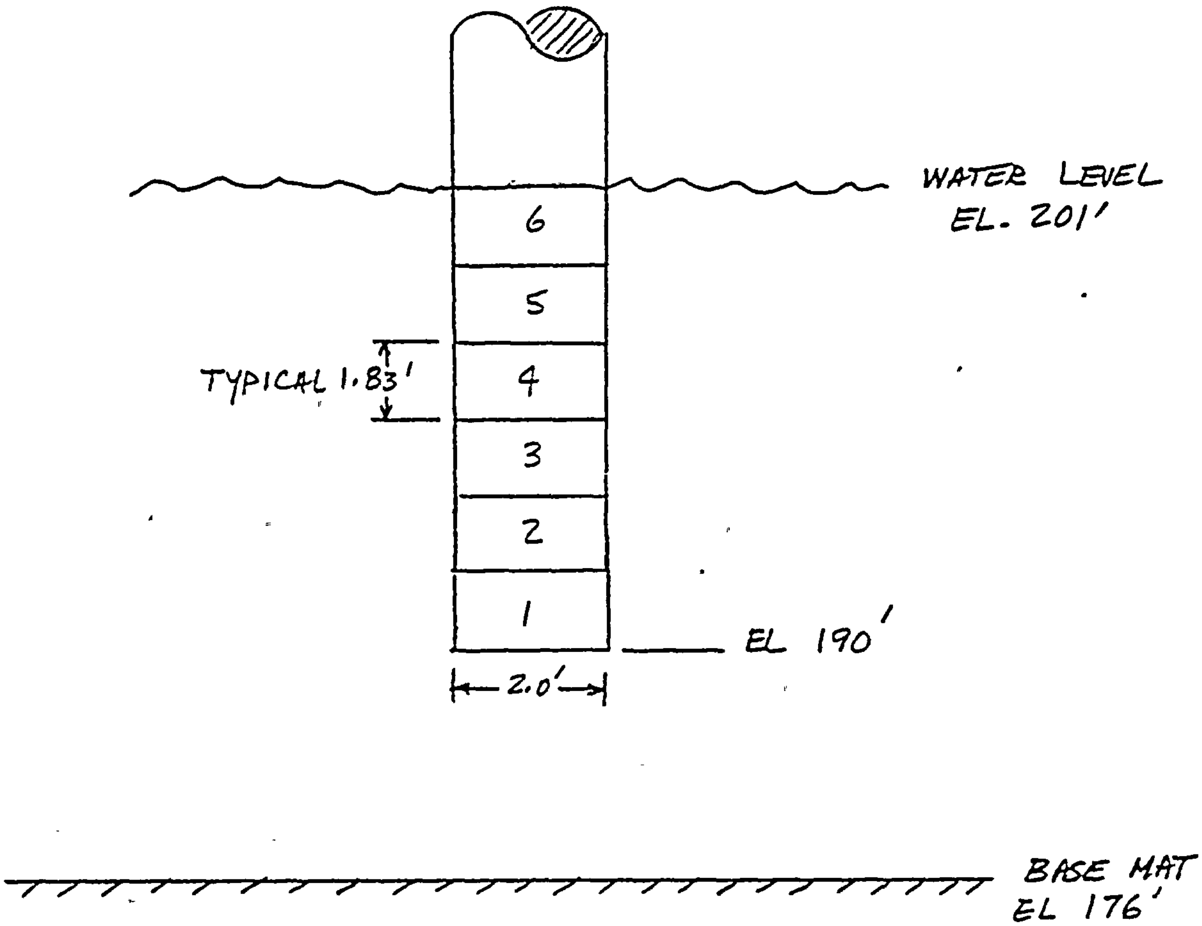

FIGURE 5

DOWNCOMER SEGMENTATION

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TABLE 1 NMP2 CO PRESSURE TIME HISTORY

4TCO RUN #	NMP2 CO LOAD TIME PERIOD (SEC)	DATA SET NAME Δ (PRESSURE TIME HISTORY)	REMARK
3	5-7, 12-15, 16-18	GECO031.ST307.T0507	5-7 SEC CONTROLLING+
4	6-8, 10-12*	#	10-12 SEC CONTROLLING+
5	19-21*	#	
7	12-16, 18-21	GECO071.ST307.T1216	12-16 SEC CONTROLLING+
8	5-7*	#	
9	10-13	GECO091.ST307.T1013	
10	20-22, 26-30	GECO101.ST307.T2630	26-30 SEC CONTROLLING+
12	17-21	GECO121.ST307.T1721	
14	25-35	GECO141.ST307.T2535	
15	25-27, 29-48**	#	31-48 SEC CONTROLLING+
22	11-13	GECO221.ST307.T1113	
23	5-7*	#	
24	6-10	GECO241.ST307.T0610	
27	12-18	GECO271.ST307.T1218	
28	12-14	GECO281.ST307.T1214	

* SAME AS THE GENERIC CO LOAD TIME PERIOD

** GENERIC CO LOAD TIME PERIOD IS FROM 31 TO 48 SEC. HOWEVER AT THE DOWNCOMER FREQUENCY OF 1.94 HZ THE RESPONSE SPECTRUM REMAINS UNCHANGED

\# SAME AS CALCULATION PX 60052-1

\+ BASED ON THE RESPONSE SPECTRUM COMPARISON AT THE DOWNCOMER FREQUENCY OF 1.94 HZ

Δ DATA SET FROM REF. 22

4. METHOD (CONT'D)

TABLE 2

BOUNDING TIME PERIODS FOR NMP2 CO LOADS

Run	Time Periods (sec)
03	05-07, 12-15, 16-18
04	06-08, 10-12
05	19-21
07	12-16, 18-21
08*	05-07
09	10-13
10	20-22, 26-30
12	17-21
14	25-35
15	25-27, 29-48
22	11-13
23	05-07
24*	06-10
27	12-18
28	12-14

*Includes one additional second of data after Tpool = 130°F
Pool Temperature equals 135 F at end of CO period.

[illegible]

[illegible]

4. METHOD (CONT'D)

TABLE 3

COMPARISON OF BOUNDING TIME PERIODS
FOR NMP2 AND GENERIC MARK II CO LOAD

Run	Generic Mark II CO Load Time Periods (sec)	NMP2 CO Load Time Periods (sec)
03	13-15	05-07, 12-15, 16-18
04	10-12	06-08, 10-12
05	19-21	19-21
07	--	12-16, 18-21
08	05-07	05-07
09	10-23	10-13
10	28-30	20-22, 26-30
12	21-25	17-21
14	25-31	25-35
15	31-48	25-27, 29-48
22	13-21	11-13
23	05-07	05-07
24	12-14	06-10
25	32-41	--
26	16-24, 32-36	--
27	16-34	12-18
28	17-19	12-14

5.0 DESIGN INPUT

5.1 The following design input is used for computer program SSLOAD

5.1.1 Input file 10 (Geometric Input)

Radius of inner wall of pool (RPDSTL) = 14.167 ft [Ref. 2]

Radius of outer wall of pool (RWALL) = 45.5 ft [Ref. 3]

Elevation of bottom of pool (ELBSMT) = 176.0 ft ["]

Elevation of surface of water in the pool (ELHWL) = 201.0 ft ["]

No of substructure in the structure = 1 (DC 43)

Standard drag coefficient (CD) = 1.452 [Ref. 4]

Acceleration drag coefficient (CM) = 2.2 [Ref. 4]

Coefficient of Lift (CL) = 0.0

Fluid density (RHO) (D.C. # 43) = 1.94 slug/ft^3

No of segment of substructure (NS) = 6

Drawing angle of one end of substructure (ASTR) = 18°

Radial location of first end of substructure (RSTR) = 34.5 ft

Elevation of first end of substructure (ELSTR) = 190 ft

Drawing angle of other end of substructure (ASTR) = 18°

Radial location of second end of substructure (RSTR) = 34.5 ft

Elevation of second end of substructure (ELSTR) = 201.0 ft

Diameter of cross section of substructure (DIAMTR) = 2.0 ft

5. DESIGN INPUT (CONT'D)

5.1.2 Input file 70 (interference effects on CM)
Based on Ref. 11.

No. of interfering structures (NINT) = 8

Radius of structure (A1) = 1.0 ft

Radial location of structure (R1) = 34.5 ft

Angular location of structure (AZ1) = 18°

Number of terms in series solution to be used (NTERMS) = 3

Radius of interfering structure (A2) (ft) 1.0 1.0 1.0 1.0
1.0 1.0 1.0 1.0

Radial location of interfering structure (R2) ft 39.5 39.5 39.5 34.5
34.5 29.5 29.5 29.5

Angular location of interfering structure (AZ2) deg. 9.0 18.0 27.0 9.0
27.0 4.5 22.5 40.5

5.1.3 Input file 80 (source locations)

Modify drag coefficient for interference (FACINT) = Yes

No. of radial locations of sources (NRING) = 5

Radial location of source ring (RRING) ft.	39.5	34.5	29.5	24.5	19.5
Drawing offset angle for first source in ring (TZERO) deg.	0.0	0.0	1.0	4.5	4.5
Angular Spacing of Sources (DT) deg.	9.0	9.0	18.0	18.0	18.0

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5. DESIGN INPUT (CONT'D)

5.1.3 (Cont'd)

Source indicator (NDUMMY). Missing downcomers.

6, 8, 10, 11, 12, 15, 16, 17, 23, 25, 27, 30, 31, 32, 34,

36, 38, 53, 78, 87, 88, 89, 90, 97, 98, 99. 100 (See fig. 4)
[Ref. 2,3]

No of images to be used in the I direction

11 in Radial, (X), 3 in Circumferential (Y)
and 22 in axial (Z)

K factor, Source is considered as point source = 1

Elevation of source (ELCDMR) = 189.0 ft.

No. of time steps the source definition changes = 1
for a given location (NTIME)

Sources do not have the same strength = 0
(IPHASE)

Print Intermediate Results = 1.
(IPRINT)

5.1.4 Input file 90 (Source Information)

Time Step label (TIME) = Identified as Run No.

Radius of Source (JB) = 1.0 ft.

Source Strength of (JB) = See table on next page

Derivative of Source strength = See table on next page
of (JB)

5. DESIGN INPUT (CONT'D)

5.1.4 (cont'd)

SOURCE TERMS FOR SSLOAD (CSMP Results).

RUN No. TIME (sec.)	SS (FT^3/sec)	SDOT (FT^3/sec^2) Max. +ve Max. -ve
3	-5.0	206.0
05-07	-13.0	-75.0
7		
12-16	-2.50	144.0
	-7.50	-198.0
7		
18-21	-5.0	135.0
	-11.0	-135.0
9	-5.4	84.0
10-13	-7.0	-120.0
10	-4.0	322.0
26-30	-6.0	-160.0
12	-9.0	174.4
17-21	-12.4	-210.4
14	-2.0	146.0
25-35	-0.0	-188.0
22	8.8	115.0
11-13	1.4	-180.0
24	4.95	104.0
6-10	4.35	-108.0
27	-4.0	232.0
12-18	-10.6	-96.0
28	-1.875	140.0
12-14	-4.375	-103.75

6.0 LIST OF REFERENCES:

1. G.E. Report NEDE-23610, "Analytical Model for Estimating Drag Forces On Rigid Submerged structures caused by Condensation Oscillation and Chugging". June 1978

2. S. & W. Drawing No. 12177-EM-2B-17, dt. 7-28-86, EM-2J-17 dt 7-28-86

3. NMP2 E & DCR No. P11820C, dt 4-1-83, P12991 dt. 8-13-84

4. SECTION 5.3.21, Amendment 13 of Zimmer DAR, Appendix Dated Oct. 1980

5. NOT USED

6. Sarpkaya, T., "Forces on Cylinders and Spheres in a Sinusoidally Oscillating Fluid.", Transation of the ASME, March 1975, pp. 32-37.

7. S & W Calculation No. 12177.08-Px-60039. "Chugging Submerged structure load on downcomer" Jan. 1986.

8. G.E. Report, Generic Condensation Oscillation Load Definition Report, NEDE-24288-P, CLASS III, Nov. 1980

9. G.E. Report, 4T Condensation Oscillation Test Program Final Test Report, NEDE 24811-P, CLASS III, May 1980.

10. Op. Cit., G.E. Report NEDO-23610, Appendix B, page B-1, June 1978.

11. S & W program "SSLOAD" VERSION 00/1.00 ME-229, Nov. 1985

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6.0 LIST OF REFERENCES (CONT'D)

12 G.E Report "Plant Unique Assessement of the 4TCO Data For Nine Mile Point 2" February 1987. SWEC File NO. NESS 16.820-5040 REV.A. (SW FILE NO.)

13. "Transmittal of 4TCO Raw Data Tapes for NMP2 CO Load Definition" From S. Mintz of (GE) To M. Dunk/T. Wang (S&W) Dated Feb 12, 1987. (ATTACH. F)

14. Stone & Webster Computer Program ST-307 "BASE LINE CORRECTION AND INTEGRATION (INTBSL)" 6/79.

15. Navin C. Nigam and Paul C. Jennings, "Digital Calculation of Response Spectra from Strong Motion Earthquake Records", C.I.T. Earthquake Engineering Research Laboratory, Pasadena, California, June 1968.

16. Stone & Webster Calculation 12177.08-EMD/MECH-MS-1869-2 "DOWNCOMER ANALYSIS AND FATIGUE EVALUATION", Jan. 86.

17. MARK II CONTAINMENT FORCING FUNCTION INFORMATION REPORT (DFFR), NEDO-21061. Sept. 1976

18. STONE & WEBSTER CALCULATION NO. 12177.08-NP(C)-PX-60052-1, CONDENSATION OSCILLATION LOADS ON DOWNCOMERS FOR POINT SOURCE. DATED 1/21/86.

19. NUREG 0808 "MARK II Containment Program Load Evaluation and Acceptance Criteria, August 1981

[illegible]

[illegible]

[illegible]

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20 ANALYTICAL MODEL FOR ESTIMATING DRAG FORCES ON RIGID SUBMERGED STRUCTURES CAUSED BY LOCA AND RAMSHEAD AIR DISCHARGES. NEDO-21471. Sept. 1977

21. S&W CALCULATION NO. 12177-ES-121 Rev 0 "LARGE BREAK ACCIDENT ANALYSIS FOR FSAR SECTION 6.2.1.1" Dated Dec. 1982

22. S&W CALCULATION 12177.28-NP(C)-PX-60159-0 "TREND REMOVAL FOR 4T CO DATA", May 1987

23. CONTINUOUS SYSTEM MODELING PROGRAM III (CSMP III) PROGRAM NUMBER 5734-X59, IBM PUBLICATION SH19-7001-3, Fourth Edition DEC. 1975.

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7.0 RESULT SUMMARY:

In order to determine submerged structure load on downcomer, a CSMP program was developed to generate source strength (SS), and time derivative of source strength (SDOT) from the wall pressure time history (P4TCO) based on Ref 1

Since phasing of the bubble source has not been established, a worst case phasing has been assigned that maximizes the load on downcomer. For annular pool, several downcomer locations were analyzed as shown in attachment A. The maximum load on the annular pool downcomer was determined to be on the downcomer no. 43 located at 18.0° azimuth and 34.5 ft radius. The loads on downcomer in pedestal pool are always lower than annular pool, as seen in Calc. PX-60052-1, Ref. 18 Therefore, loads on pedestal pool were not generated. Loads on downcomer in pedestal pool from Ref. 18 is included as attachment C for comparison purpose.

7.0 RESULT SUMMARY (CONT'D)

The total no. of load cases specified by Ref. 12 are 21 (See table 1). From these 21 load cases, loads were generated for 10 cases, they are

3 (5-7 Sec.), 7 (12-16 Sec.), 9 (10-13 Sec.), 10 (26-30 Sec.)
12 (17-21 Sec.), 14 (25-35 Sec.), 22 (11-13 Sec.), 24 (6-10 Sec.)
27 (12-18 Sec.), 28 (12-14 Sec.).

The selection of these 10 load cases is based on the following

(1) For multiple time segment, one time segment is selected based on pressure response spectra comparison at downcomer frequency of 1.94 Hz.

(2) For the load definition same as generic loads (Ref. 18), stresses were evaluated in Ref. 16. There is no need to repeat the load calculation.

Comparison of response spectra is given in Attach E.

The pressure time history (P4TCO) shown on Pages 40-72, will follow the acceleration flow field time history, because the flow is incompressible. These time histories (See table on page 29 for storage location) should be normalized so that the maximum load given on page 29 corresponds to maximum pressure.

7.0 RESULT SUMMARY (CONT'D)

CO SUBMERGED STRUCTURE LOAD ON DOWNCOMER

4TCO RUN #	NMP2 CO LOAD TIME PERIOD (SEC)	MAXIMUM LOAD (LBF)	DATA SET NAME (PRESSURE TIME HISTORY)	MAXIMUM PRESSURE (PSI)	REMARK
3	5-7, 12-15, 16-18	2360.8	GEC0031.ST307.T0507	8.08	5-7 SEC CONTROLLING+
4	6-8, 10-12*	906.39#	#	#	10-12 SEC CONTROLLING+
5	19-21*	1538.3#	#	#	
7	12-16, 18-21	2867.0	GEC0071.ST307.T1216	8.10	12-16 SEC CONTROLLING+
8	5-7*	3451.6#	#	#	
9	10-13	1709.0	GEC0091.ST307.T1013	4.54	
10	20-22, 26-30	4033.0	GEC0101.ST307.T2630	12.37	26-30 SEC CONTROLLING+
12	17-21	3223.0	GEC0121.ST307.T1721	7.98	
14	25-35	2796.0	GEC0141.ST307.T2535	8.07	
15	25-27, 29-48**	4219.53#	#	#	31-48 SEC CONTROLLING+
22	11-13	2478.0	GEC0221.ST307.T1113	6.77	
23	5-7*	6538.58#	#	#	
24	6-10	1774.0	GEC0241.ST307.T0610	4.23	
27	12-18	2751.0	GEC0271.ST307.T1218	8.88	
28	12-14	2074.0	GEC0281.ST307.T1214	5.31	

* SAME AS THE GENERIC CO LOAD TIME PERIOD

** GENERIC CO LOAD TIME PERIOD IS FROM 31 TO 48 SEC. HOWEVER AT THE DOWNCOMER FREQUENCY OF 1.94 HZ THE RESPONSE SPECTRUM REMAINS UNCHANGED

\# SAME AS CALCULATION PX 60052-1

\+ BASED ON THE RESPONSE SPECTRUM COMPARISON AT THE DOWNCOMER FREQUENCY OF 1.94 HZ

7. RESULTS SUMMARY (CONT'D)

12177.28-NP(C)-PX-60160-0

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

	CARTESIAN COORDINATES					CYLINDRICAL COORDINATES			
SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	329.61	732.67	0.0	803.40	162.00	-87.06	-798.67	0.0	803.40
2	252.87	554.27	0.0	609.23	162.00	-69.22	-605.28	0.0	609.23
3	181.99	395.07	0.0	434.97	162.00	-50.99	-431.97	0.0	434.97
4	122.28	263.95	0.0	290.90	162.00	-34.73	-288.82	0.0	290.90
5	70.51	151.65	0.0	167.23	162.00	-20.19	-166.01	0.0	167.23
6	23.05	49.47	0.0	54.57	162.00	-6.63	-54.17	0.0	54.57
TOTAL	980.30	2147.08	0.0	2360.31		-268.83	-2344.92	0.0	2360.31

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

	CARTESIAN COORDINATES					CYLINDRICAL COORDINATES			
SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

7. RESULTS SUMMARY (CONT'D)

12177.28-NP(C)- PX-60160-0

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	343.16	914.20	0.0	976.48	162.00	-43.86	-975.49	0.0	976.48
2	265.62	690.45	0.0	739.78	162.00	-39.26	-738.74	0.0	739.78
3	193.89	491.05	0.0	527.95	162.00	-32.65	-526.94	0.0	527.95
4	131.96	327.57	0.0	353.15	162.00	-24.27	-352.31	0.0	353.15
5	76.72	188.07	0.0	203.12	162.00	-14.85	-202.57	0.0	203.12
6	25.18	61.35	0.0	66.32	162.00	-4.99	-66.13	0.0	66.32
TOTAL	1036.52	2672.69	0.0	2866.78		-159.87	-2862.18	0.0	2866.78

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

***C.O. LOAD ON DOWNCOMERS PX-60052-2, RUN 07,12-16 SEC. *** PAGE____

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

	CARTESIAN COORDINATES					CYLINDRICAL COORDINATES			
SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	343.16	914.20	0.0	976.48	162.00	-43.86	-975.49	0.0	976.48
2	265.62	690.45	0.0	739.78	162.00	-39.26	-738.74	0.0	739.78
3	193.89	491.05	0.0	527.95	162.00	-32.65	-526.94	0.0	527.95
4	131.96	327.57	0.0	353.15	162.00	-24.27	-352.31	0.0	353.15
5	76.72	188.07	0.0	203.12	162.00	-14.85	-202.57	0.0	203.12
6	25.18	61.35	0.0	66.32	162.00	-4.99	-66.13	0.0	66.32
TOTAL	1036.52	2672.69	0.0	2866.78		-159.87	-2862.18	0.0	2866.78

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

	CARTESIAN COORDINATES					CYLINDRICAL COORDINATES			
SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

7. RESULTS SUMMARY (CONT'D)

12177.28-NP(C)-PX-60160-0

7. RESULTS SUMMARY (CONT'D)

12177.28-NP(C)-PX-60160-0

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
	CARTESIAN COORDINATES				CYLINDRICAL COORDINATES				
1	203.41	545.03	0.0	581.75	162.00	-25.03	-581.21	0.0	581.75
2	157.55	411.74	0.0	440.85	162.00	-22.60	-440.27	0.0	440.85
3	115.09	292.90	0.0	314.70	162.00	-18.95	-314.12	0.0	314.70
4	78.38	195.41	0.0	210.55	162.00	-14.15	-210.07	0.0	210.55
5	45.59	112.22	0.0	121.12	162.00	-8.68	-120.81	0.0	121.12
6	14.97	36.61	0.0	39.55	162.00	-2.92	-39.45	0.0	39.55
TOTAL	614.98	1593.91	0.0	1708.52		-92.33	-1705.94	0.0	1708.52

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
	CARTESIAN COORDINATES				CYLINDRICAL COORDINATES				
1									
2									
3									
4									
5									
6									
TOTAL									

7. RESULTS SUMMARY (CONT'D)

12177.28-NP(C)-PX-60160-0

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	547.31	1257.17	0.0	1371.14	162.00	-132.03	-1364.77	0.0	1371.14
2	420.74	951.91	0.0	1040.74	162.00	-105.99	-1035.33	0.0	1040.74
3	303.69	678.92	0.0	743.75	162.00	-79.03	-739.54	0.0	743.75
4	204.61	453.84	0.0	497.83	162.00	-54.35	-494.86	0.0	497.83
5	118.21	260.90	0.0	286.42	162.00	-31.80	-284.65	0.0	286.42
6	38.68	85.16	0.0	93.53	162.00	-10.47	-92.99	0.0	93.53
TOTAL	1633.24	3687.90	0.0	4033.43		-413.66	-4012.10	0.0	4033.42

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

7. RESULTS SUMMARY (CONT'D)

12177.28-NPC(C)-PX-60160-0

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	392.22	1024.76	0.0	1097.25	162.00	-56.36	-1095.80	0.0	1097.25
2	303.41	774.29	0.0	831.62	162.00	-49.28	-830.16	0.0	831.62
3	221.18	550.95	0.0	593.69	162.00	-40.10	-592.33	0.0	593.69
4	150.35	367.66	0.0	397.21	162.00	-29.37	-396.12	0.0	397.21
5	87.35	211.14	0.0	228.50	162.00	-17.83	-227.80	0.0	228.50
6	28.66	68.89	0.0	74.61	162.00	-5.97	-74.37	0.0	74.61
TOTAL	1183.17	2997.69	0.0	3222.88		-198.91	-3216.59	0.0	3222.88

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

7. RESULTS SUMMARY (CONT'D)

12177.28-NPC-PX-60160-0

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	337.61	889.60	0.0	951.51	162.00	-46.18	-950.38	0.0	951.51
2	261.26	672.32	0.0	721.30	162.00	-40.71	-720.15	0.0	721.30
3	190.60	478.46	0.0	515.03	162.00	-33.41	-513.94	0.0	515.03
4	129.65	319.32	0.0	344.64	162.00	-24.62	-343.76	0.0	344.64
5	75.36	183.41	0.0	198.29	162.00	-14.99	-197.72	0.0	198.29
6	24.73	59.85	0.0	64.76	162.00	-5.02	-64.56	0.0	64.76
TOTAL	1019.20	2602.96	0.0	2795.52		-164.95	-2790.52	0.0	2795.52

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

7. RESULTS SUMMARY (CONT'D)

12177.28-NP(C)-PX-60160-0

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	292.56	792.46	0.0	844.74	162.00	-33.35	-844.08	0.0	844.74
2	226.38	598.08	0.0	639.49	162.00	-30.48	-638.76	0.0	639.49
3	165.31	425.05	0.0	456.07	162.00	-25.87	-455.33	0.0	456.07
4	112.56	283.37	0.0	304.90	162.00	-19.49	-304.28	0.0	304.90
5	65.46	162.62	0.0	175.30	162.00	-12.00	-174.89	0.0	175.30
6	21.48	53.03	0.0	57.21	162.00	-4.04	-57.07	0.0	57.21
TOTAL	883.74	2314.60	0.0	2477.71		-125.22	-2474.41	0.0	2477.71

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	220.55	562.03	0.0	603.76	162.00	-36.08	-602.68	0.0	603.75
2	170.36	424.93	0.0	457.81	162.00	-30.71	-456.78	0.0	457.81
3	123.93	302.55	0.0	326.95	162.00	-24.37	-326.04	0.0	326.95
4	84.09	201.99	0.0	218.79	162.00	-17.56	-218.09	0.0	218.79
5	48.80	116.03	0.0	125.88	162.00	-10.55	-125.44	0.0	125.88
6	16.00	37.87	0.0	41.11	162.00	-3.52	-40.96	0.0	41.11
TOTAL	663.73	1645.40	0.0	1774.29		-122.78	-1769.97	0.0	1774.29

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

7. RESULTS SUMMARY (CONT'D)

12177.28-NP(C)-PX-60160-0

7. RESULTS SUMMARY (CONT'D)

12177.28-NP(C)-PX-60160-0

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	379.87	855.12	0.0	935.70	162.00	-97.02	-930.66	0.0	935.70
2	291.66	647.17	0.0	709.86	162.00	-77.39	-705.63	0.0	709.86
3	210.14	461.44	0.0	507.03	162.00	-57.26	-503.79	0.0	507.03
4	141.35	308.37	0.0	339.22	162.00	-39.13	-336.96	0.0	339.22
5	81.56	177.21	0.0	195.08	162.00	-22.81	-193.74	0.0	195.08
6	26.67	57.82	0.0	63.68	162.00	-7.50	-63.23	0.0	63.68
TOTAL	1131.24	2507.14	0.0	2750.57		-301.12	-2734.00	0.0	2750.57

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

	CARTESIAN COORDINATES					CYLINDRICAL COORDINATES			
SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	267.65	652.71	0.0	705.45	162.00	-52.85	-703.47	0.0	705.45
2	206.31	493.72	0.0	535.09	162.00	-43.64	-533.31	0.0	535.09
3	149.57	351.74	0.0	382.22	162.00	-33.55	-380.74	0.0	382.22
4	101.17	234.93	0.0	255.79	162.00	-23.62	-254.70	0.0	255.79
5	58.60	134.99	0.0	147.16	162.00	-14.02	-146.49	0.0	147.16
6	19.20	44.05	0.0	48.05	162.00	-4.64	-47.83	0.0	48.05
TOTAL	802.49	1912.14	0.0	2073.76		-172.32	-2066.54	0.0	2073.76

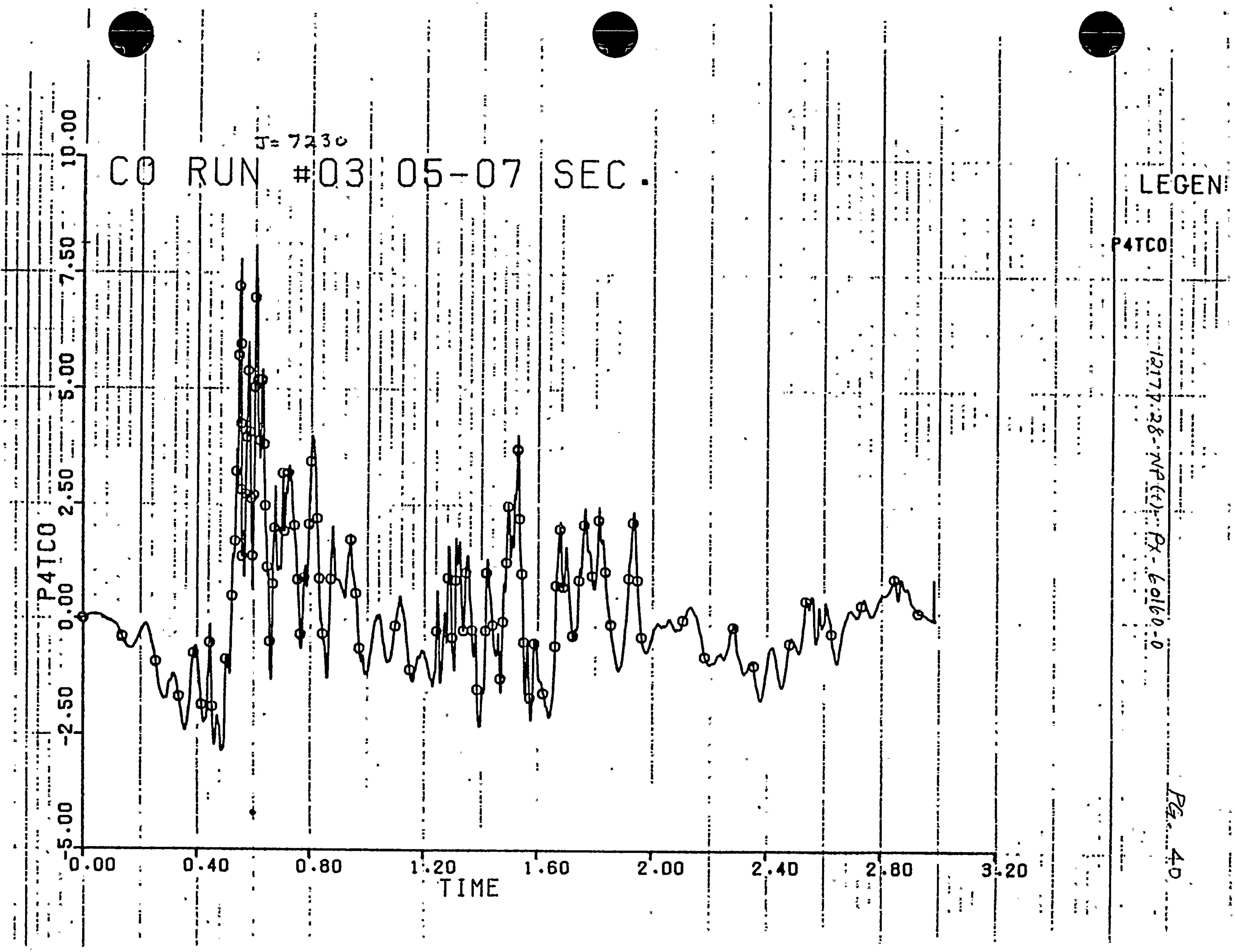
*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

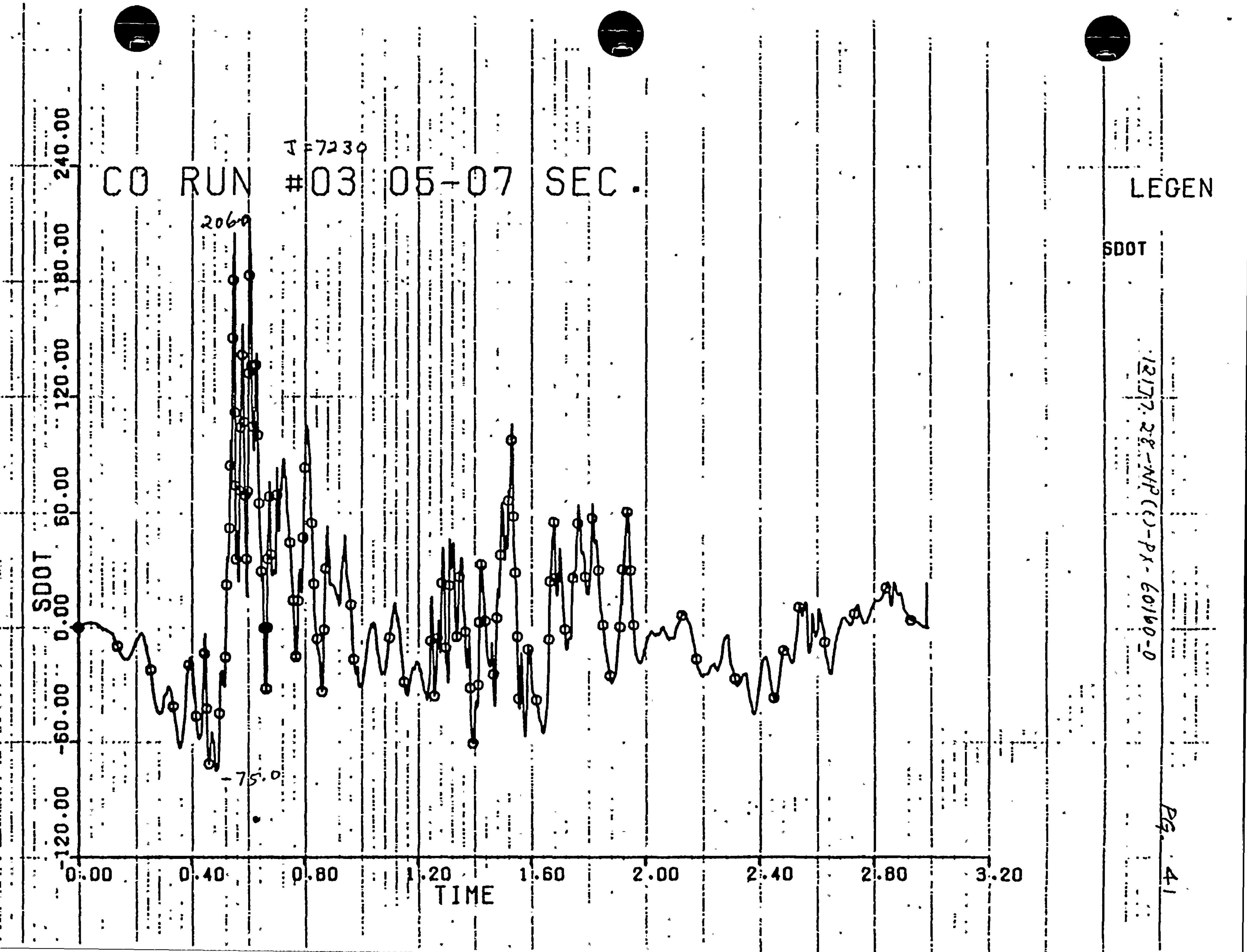
	CARTESIAN COORDINATES					CYLINDRICAL COORDINATES			
SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

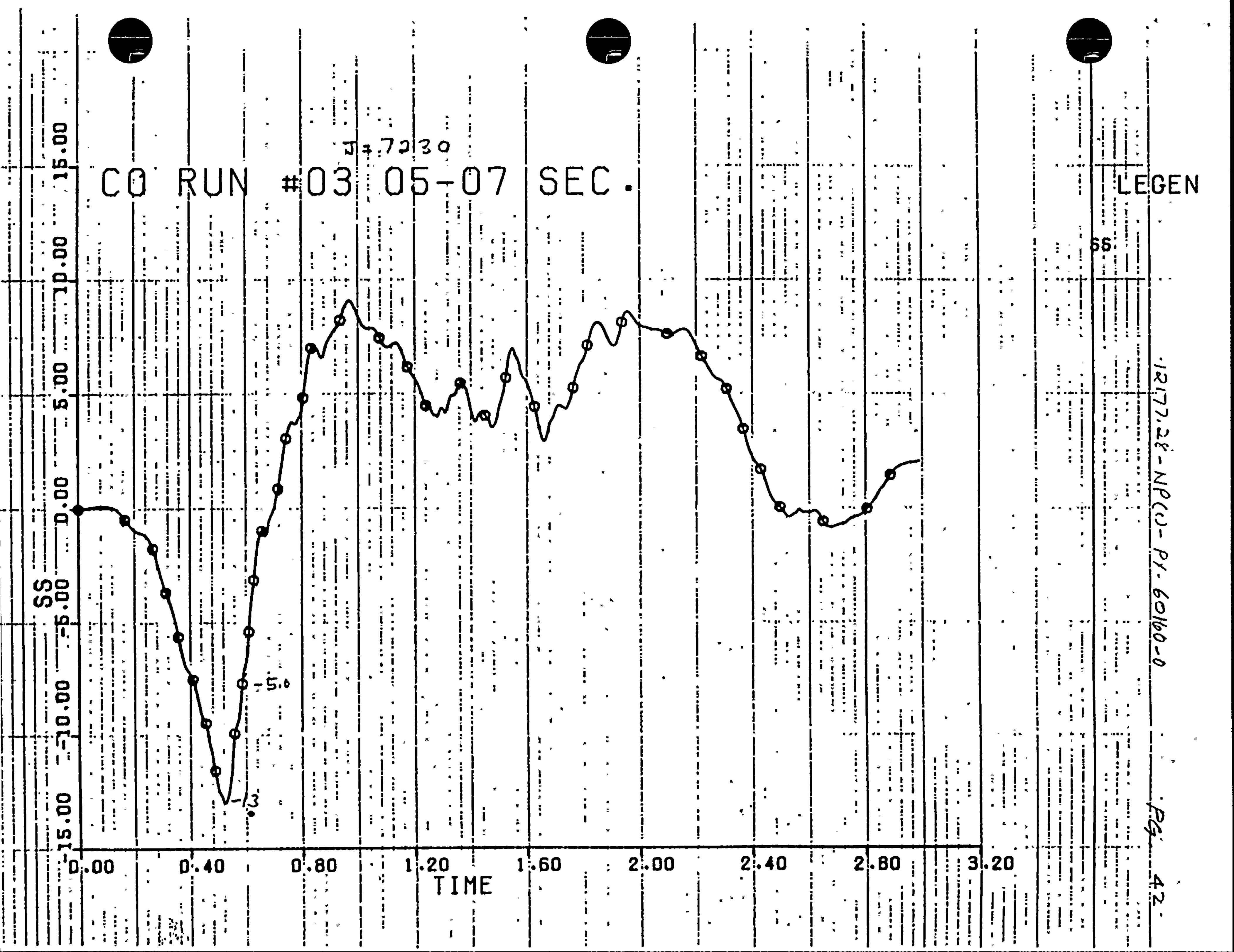
7. RESULTS SUMMARY (CONT'D)

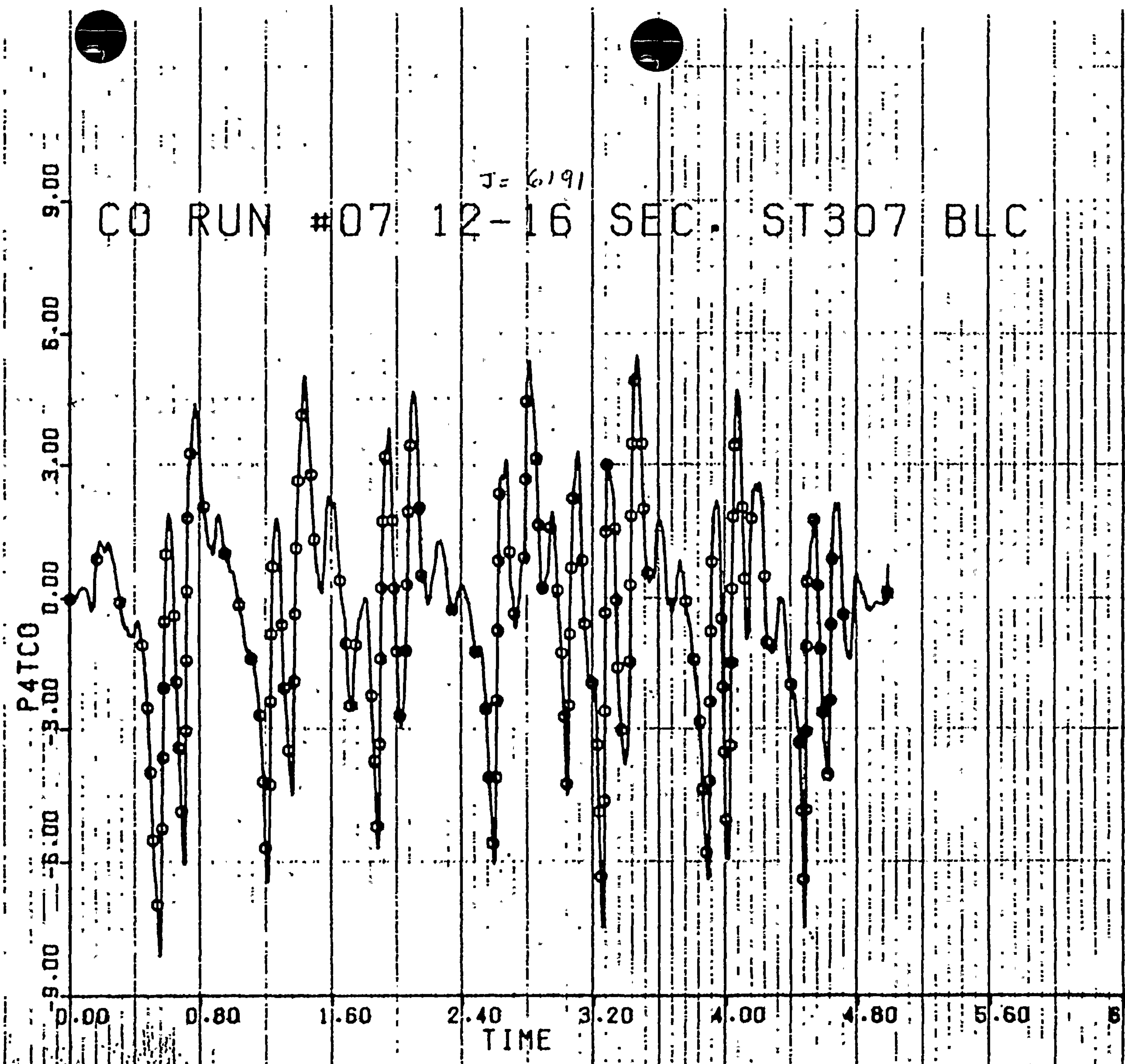
12177.28 - NP(C) - PX-60160-0


J= 7230
CO RUN #03 05-07 SEC.
LEGEN
P4TCO
P4TCO
10.00
7.50
5.00
2.50
0.00
-2.50
-5.00
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
TIME
12177.28-NP(t)-PX-6060-0

Pg. 40


CO RUN #03 05-07 SEC.
J=7230
2060
-75.0
SDOT
TIME
240.00
180.00
120.00
60.00
0.00
-60.00
-120.00
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
LEGEN
SDOT
12177-28-NP(1)-PX-60160-0
Pg. 41


J = 7230
CO RUN #03 05-07 SEC.
LEGEN
SS
SS
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
TIME
-5.0
-13
12177.28-NP(U)-PY-60160-0
PG. 42

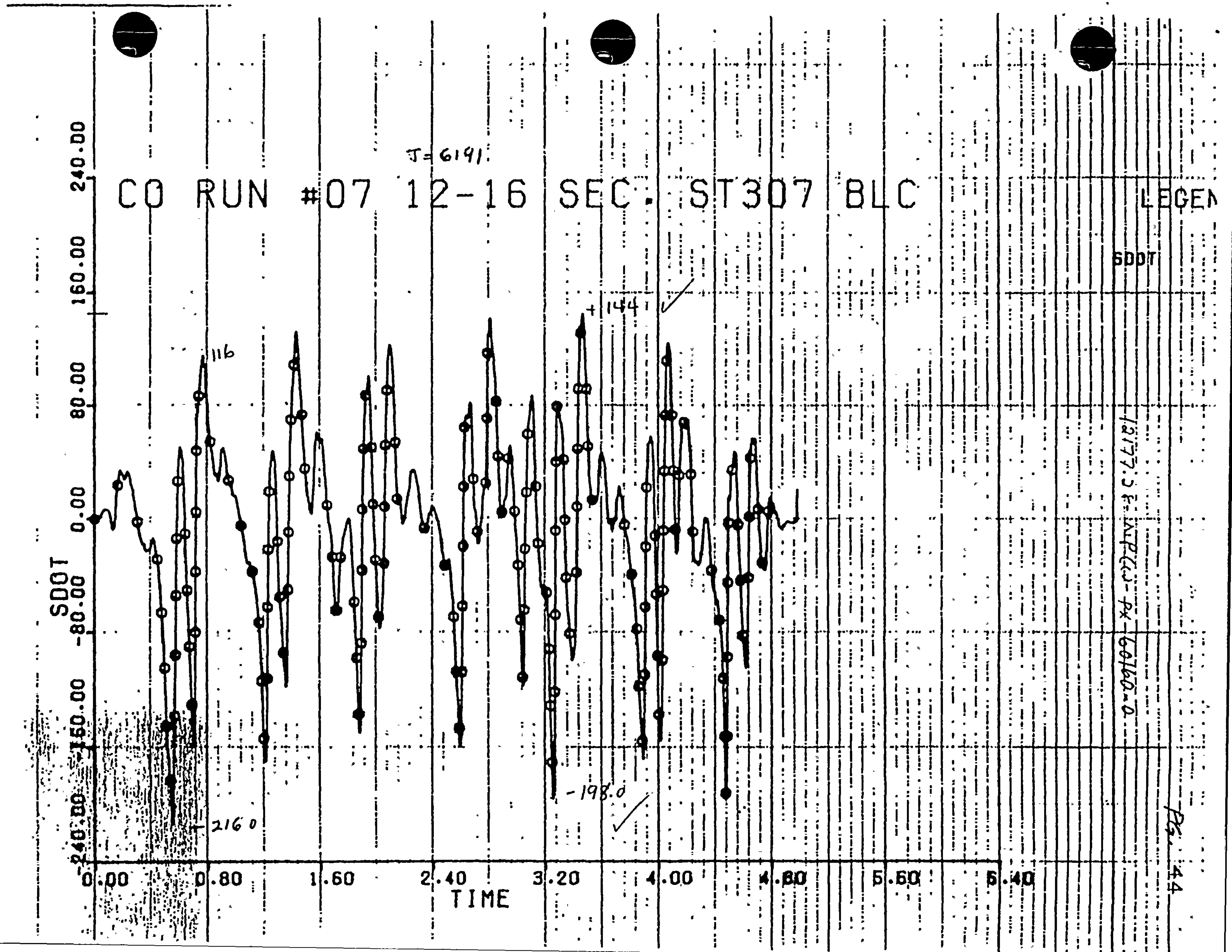


LEGE

P4TCO

12177:28-NP(C)-PX-60160-0

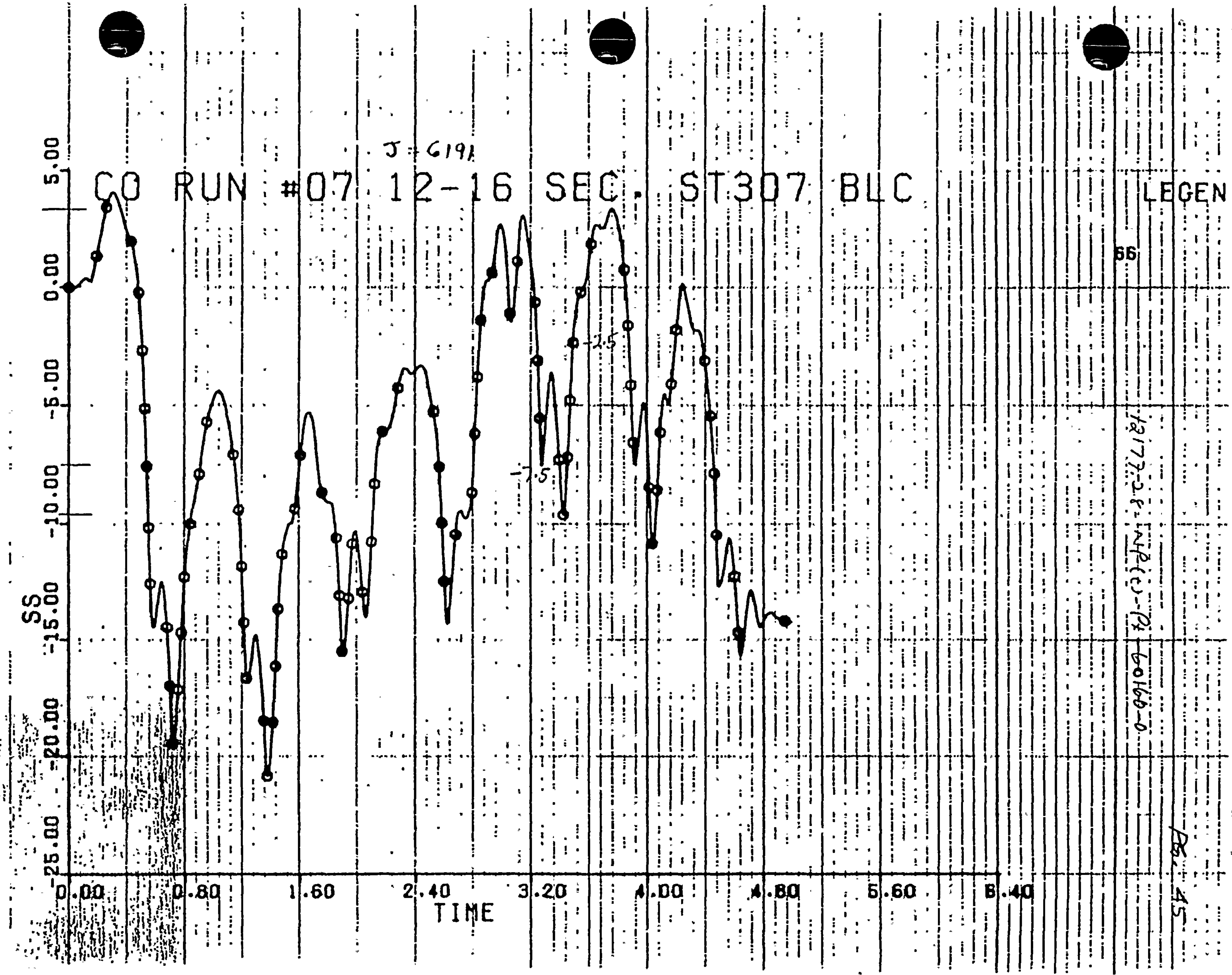
PG. 43



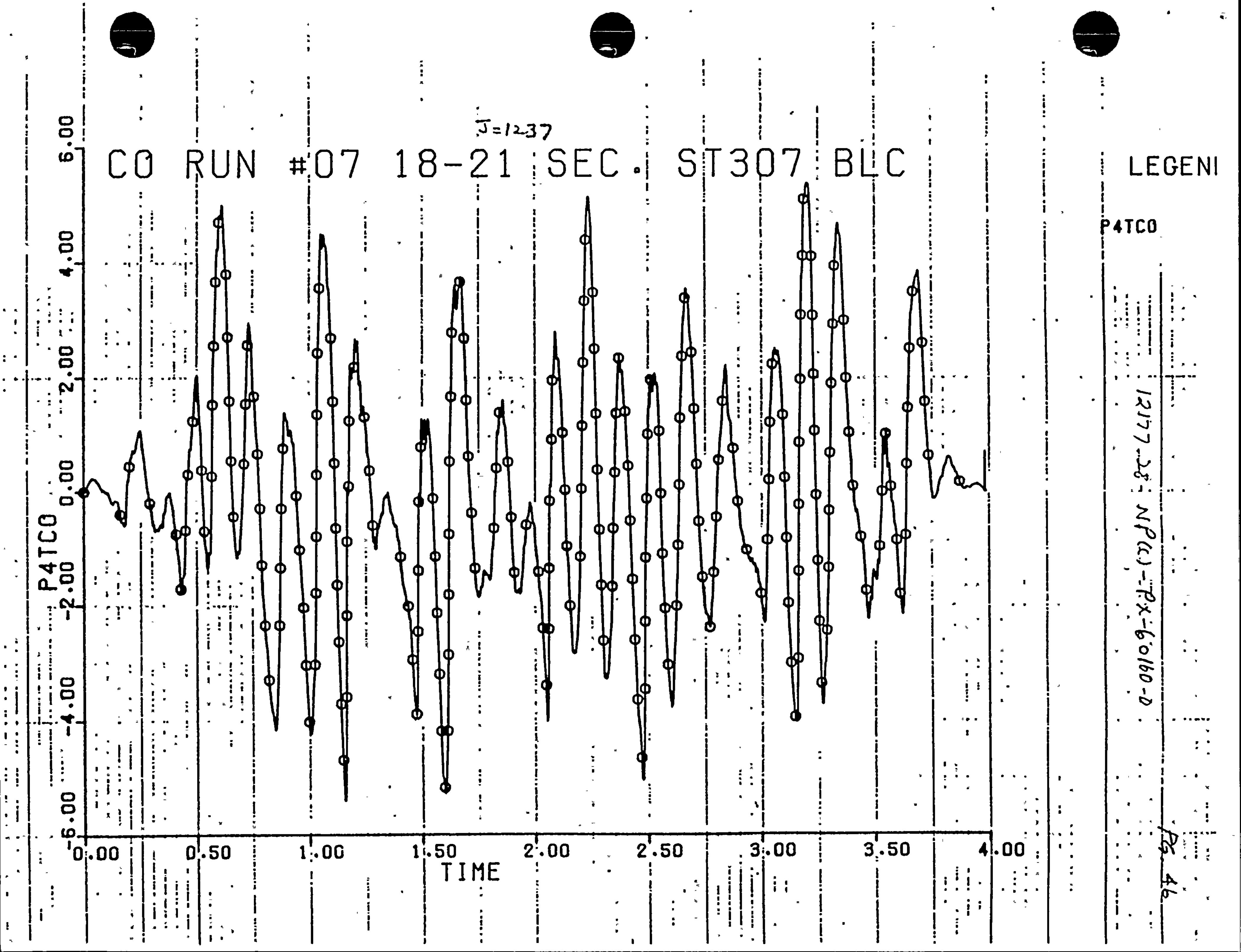
CO RUN #07 12-16 SEC. ST307 BLC
LEGEN
SDOT
J= 6191
116
+144
-198.0
216 0
240.00
160.00
80.00
0.00
-80.00
-160.00
-240.00
SDOT
0.00
0.80
1.60
2.40
3.20
4.00
4.80
5.60
6.40
TIME
Pg. 44

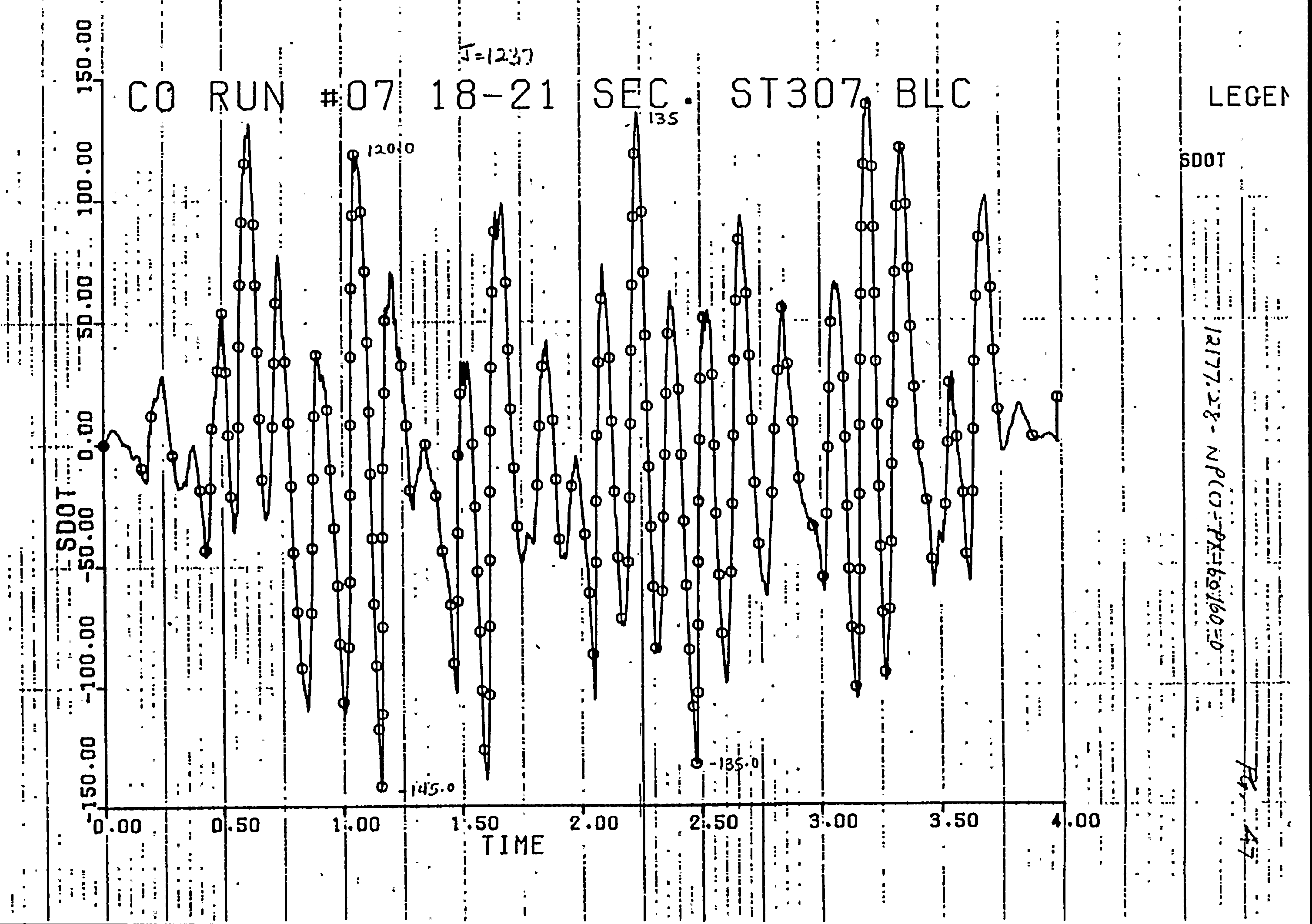
[illegible] [illegible]

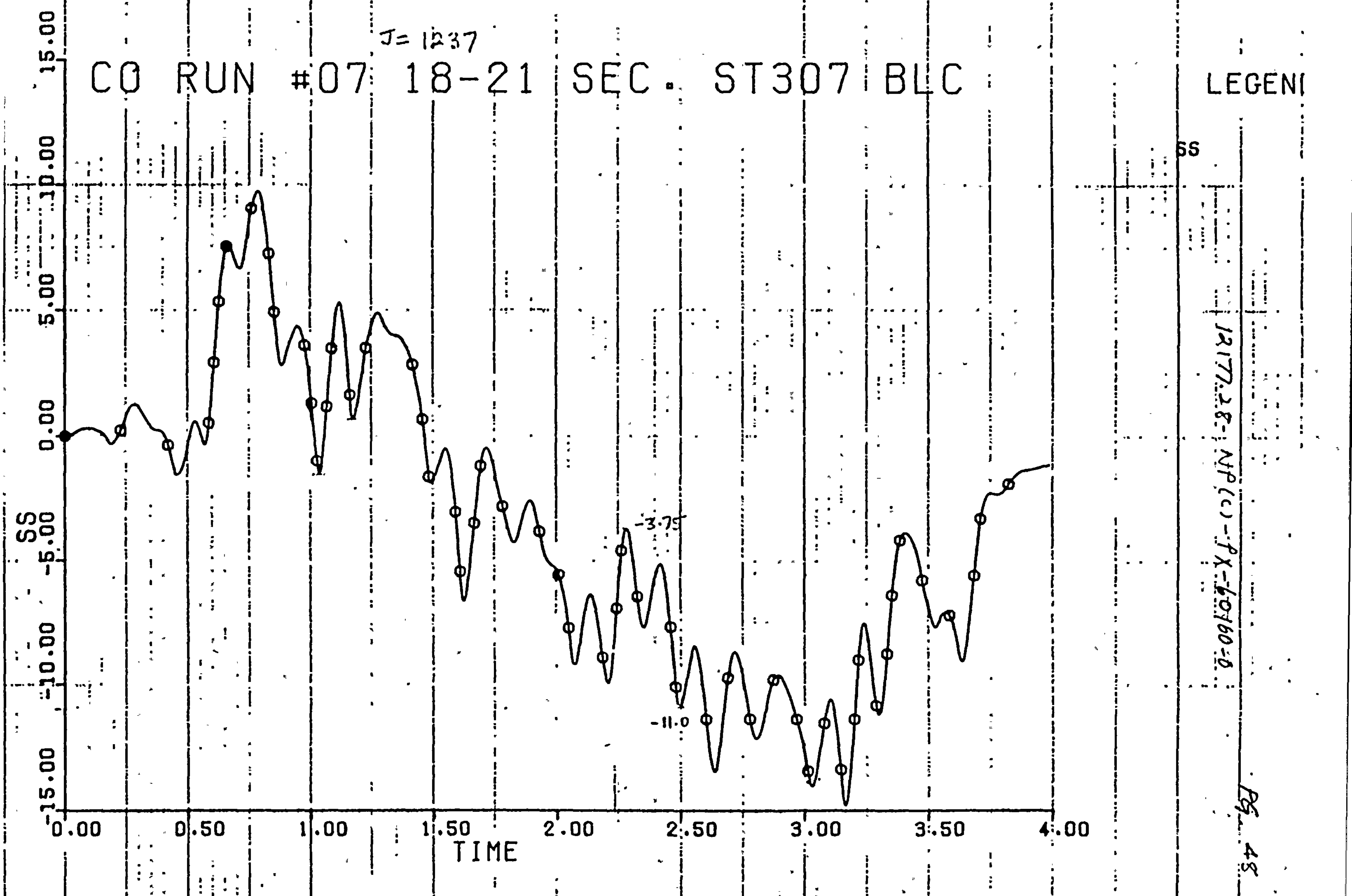
[illegible] [illegible]

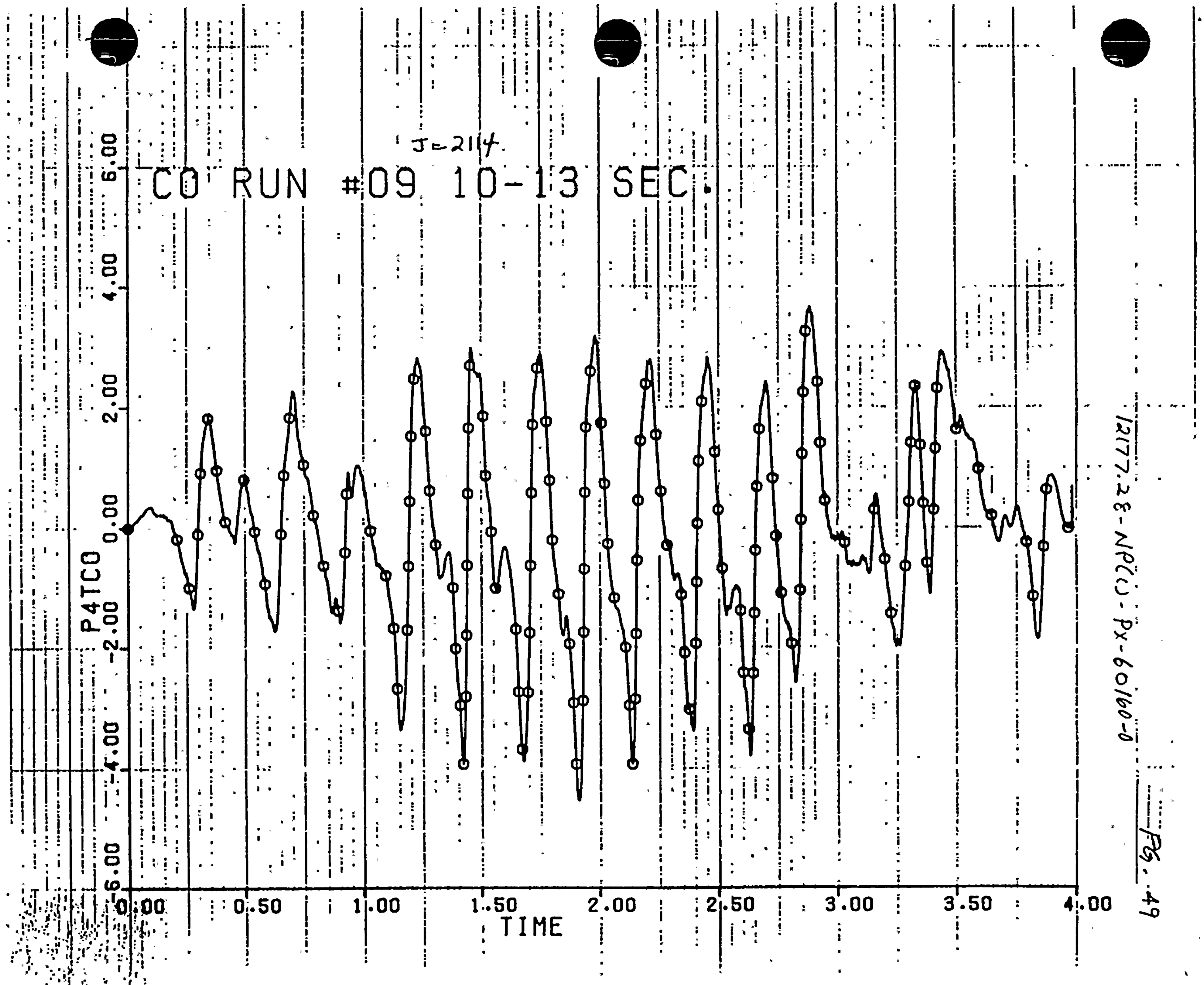

CO RUN #07 12-16 SEC. ST307 BLC
LEGEN
J = 6191
SS
5.00
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
TIME
0.00
0.80
1.60
2.40
3.20
4.00
4.80
5.60
6.40
-2.5
-7.5
66

Pg. 45

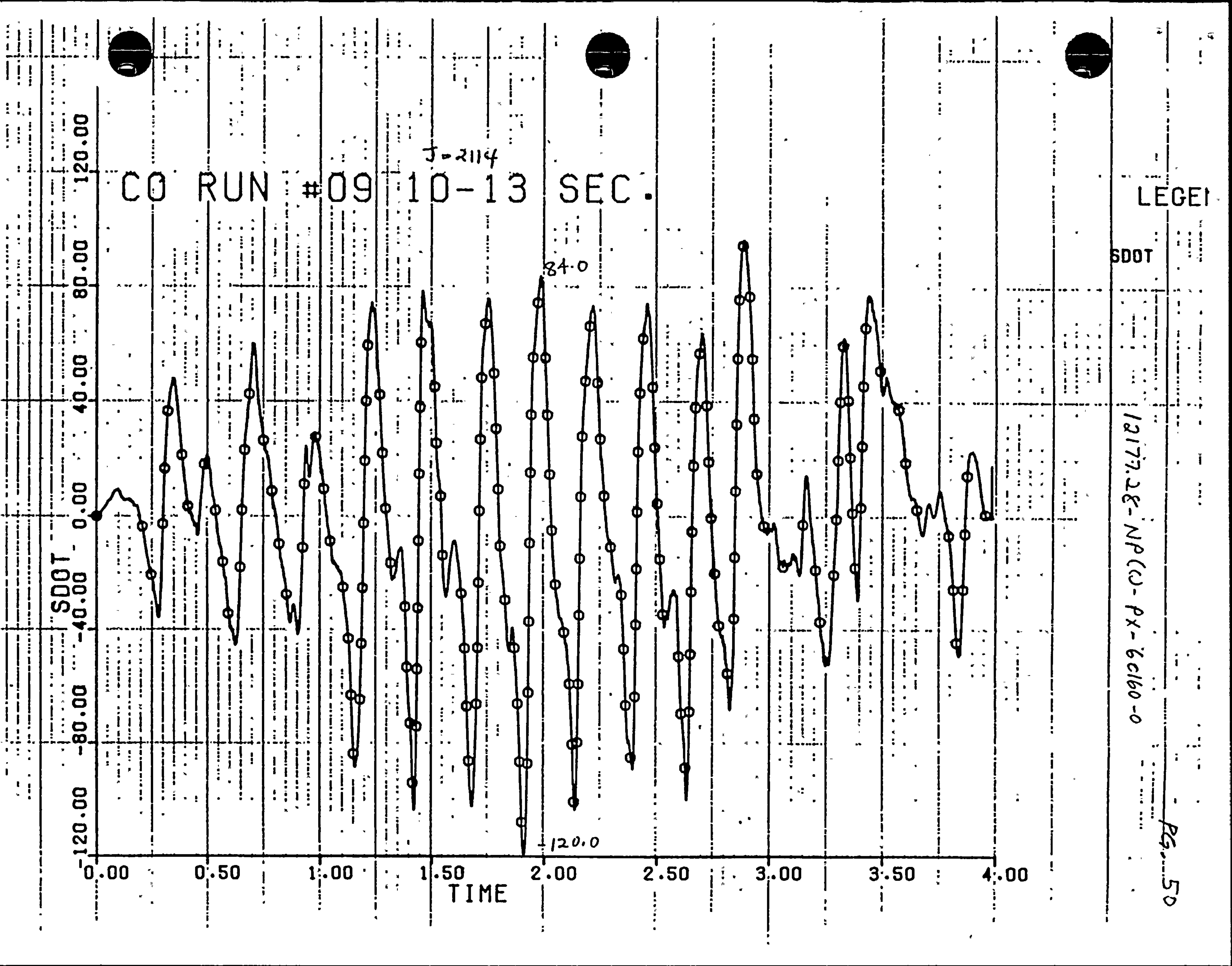

J=1237
CO RUN #07 18-21 SEC. ST307 BLC
LEGENI
P4TCO
P4TCO
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
TIME
12177-58-NP(c)-PX-60160-0
Pg. 46


CO RUN #07 18-21 SEC. ST307 BLC
J=1237
135
120.0
145.0
-135.0
LEGEN
SDOT
SDOT
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
TIME

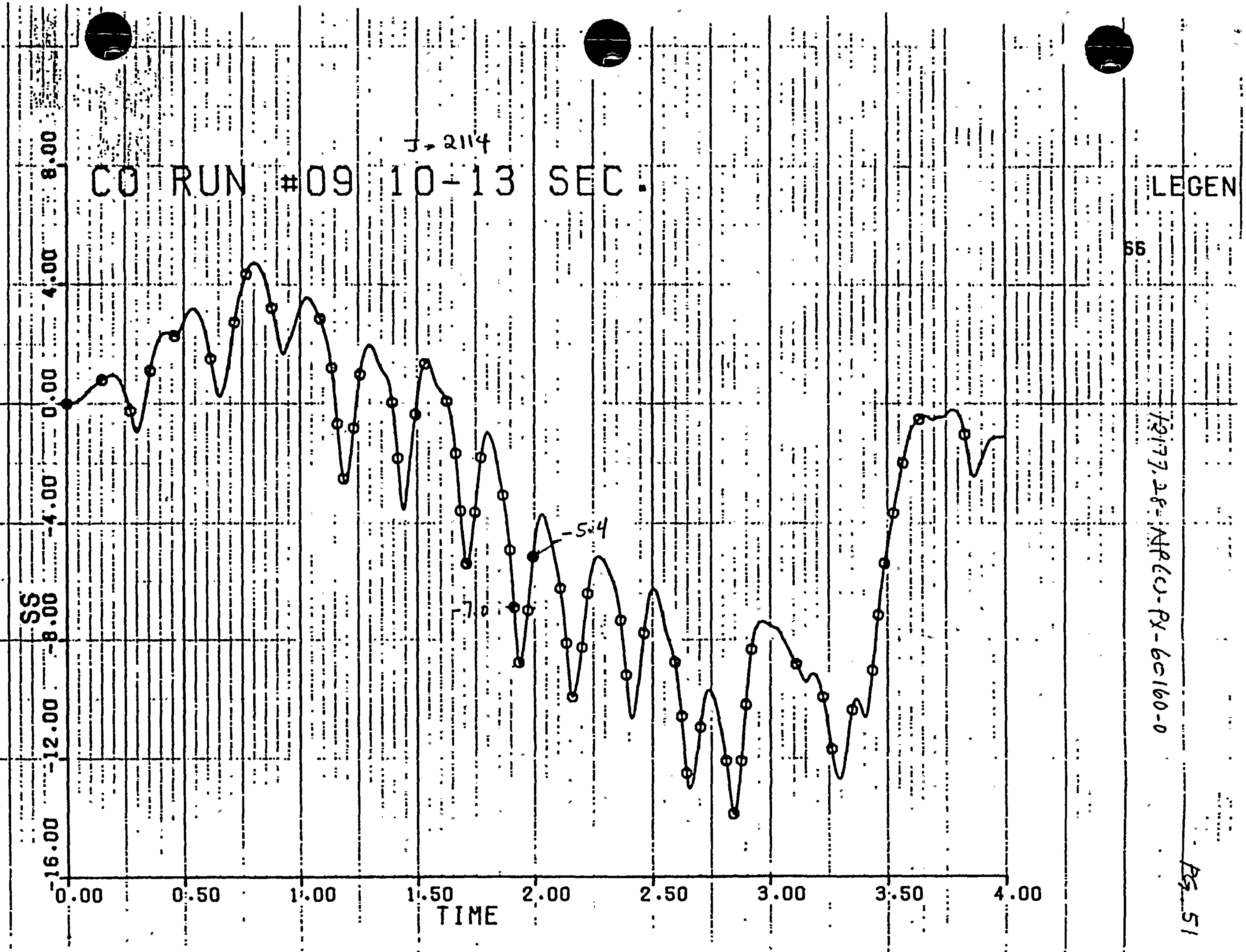

J= 1237
CO RUN #07 18-21 SEC. ST307 BLC
LEGEN[
SS
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
SS
-3.75
-11.0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
TIME
12177.28-NP(c)-FX-60960-0
Pg. 48

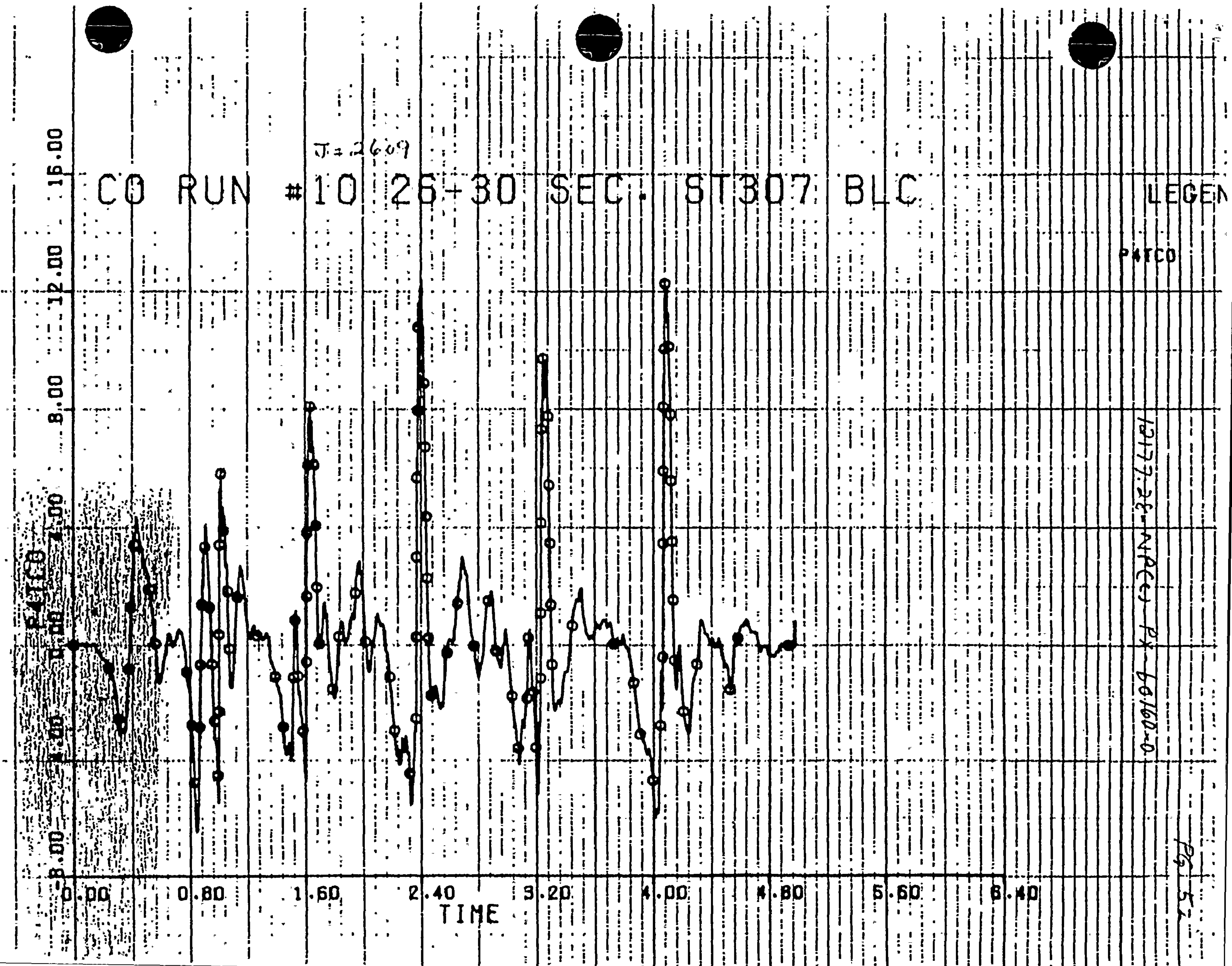

J=2114
CO RUN #09 10-13 SEC.
P4TCO
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
TIME
12177-28-NP(C)-PX-60160-0
FIG. 49

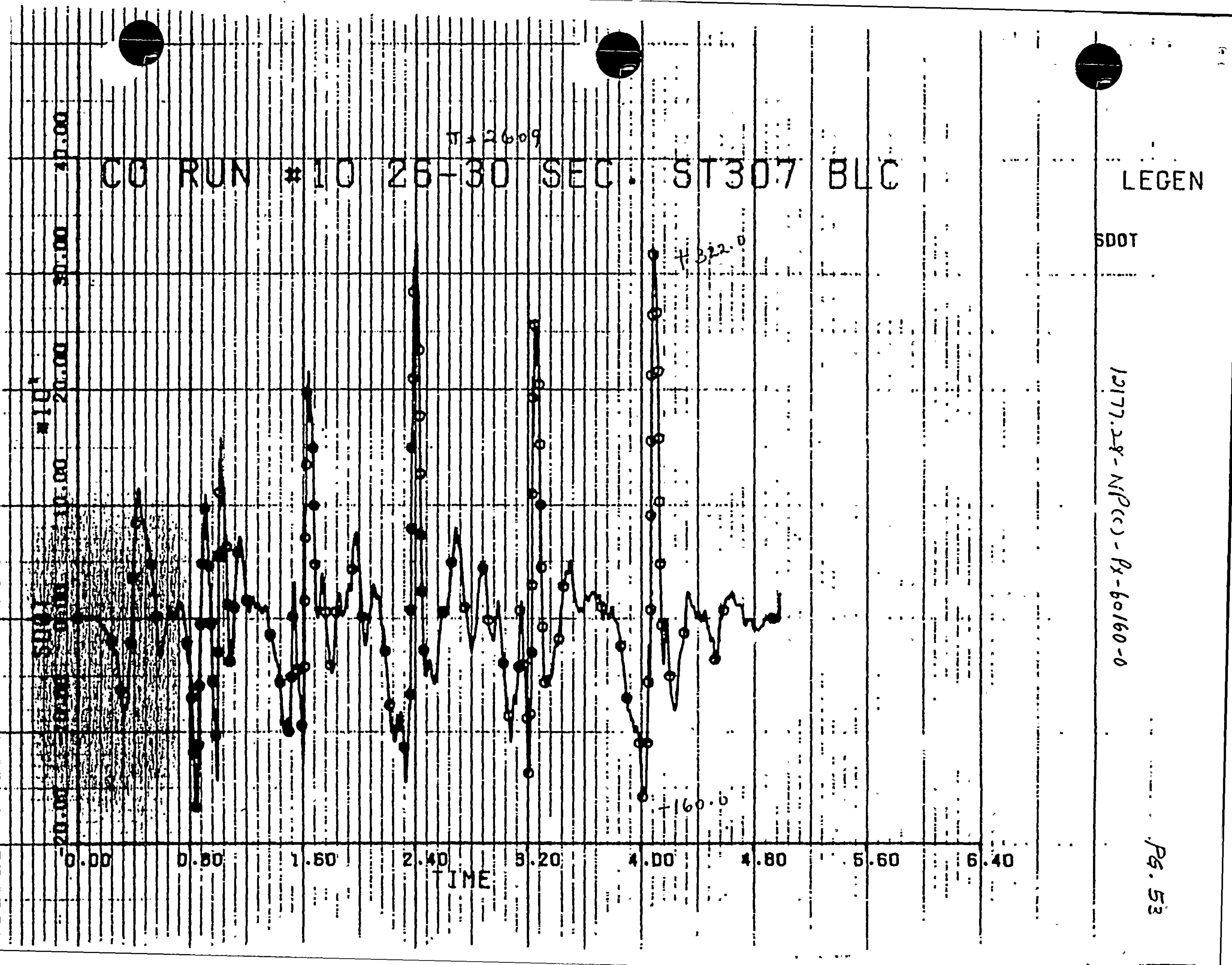
[illegible]

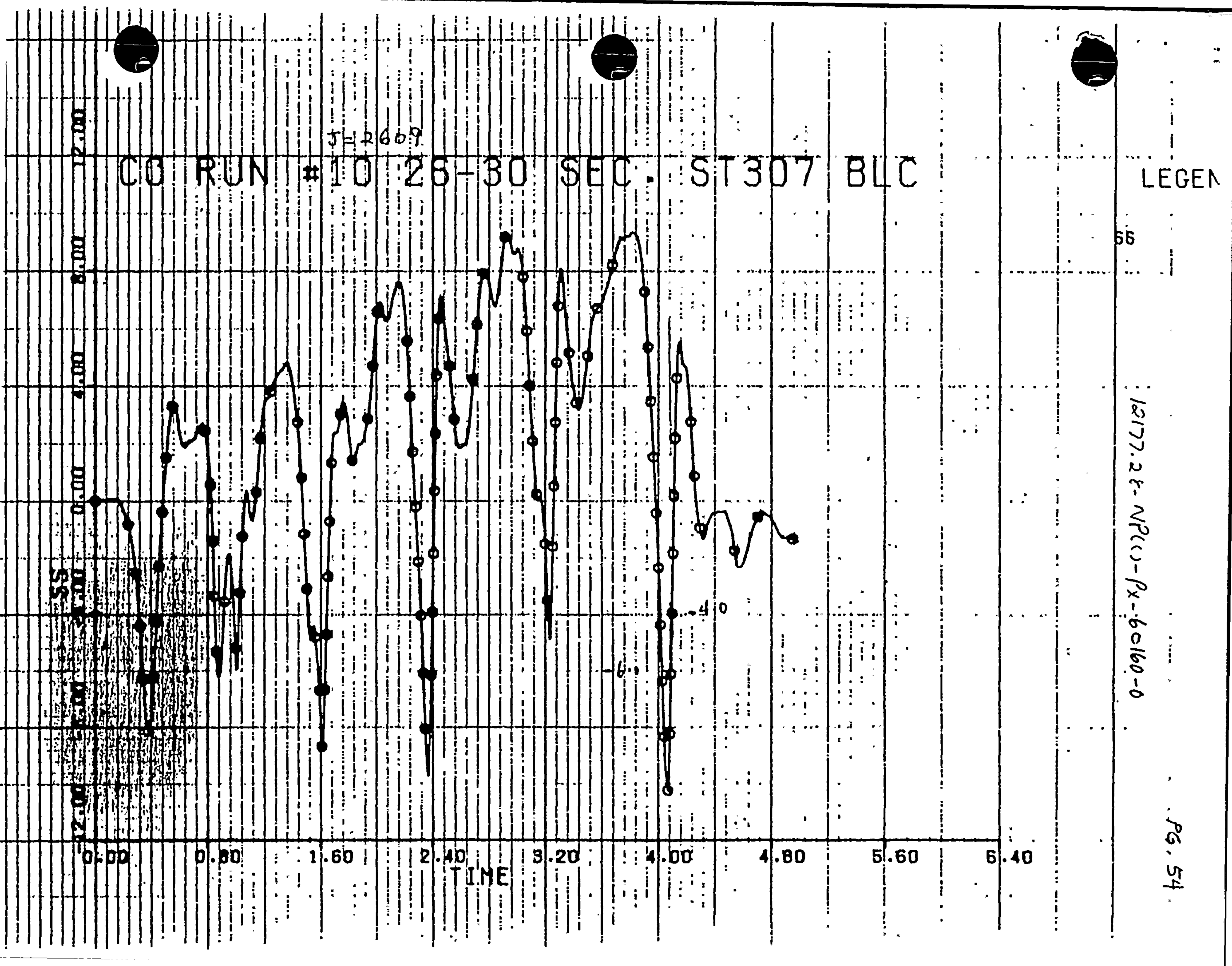


CO RUN #09 10-13 SEC.
J=2114
LEGEI
SDOT
84.0
-120.0
SDOT
120.00
80.00
40.00
0.00
-40.00
-80.00
-120.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
TIME
12177.28-NP(J)-PX-6C160-0
PG. 50

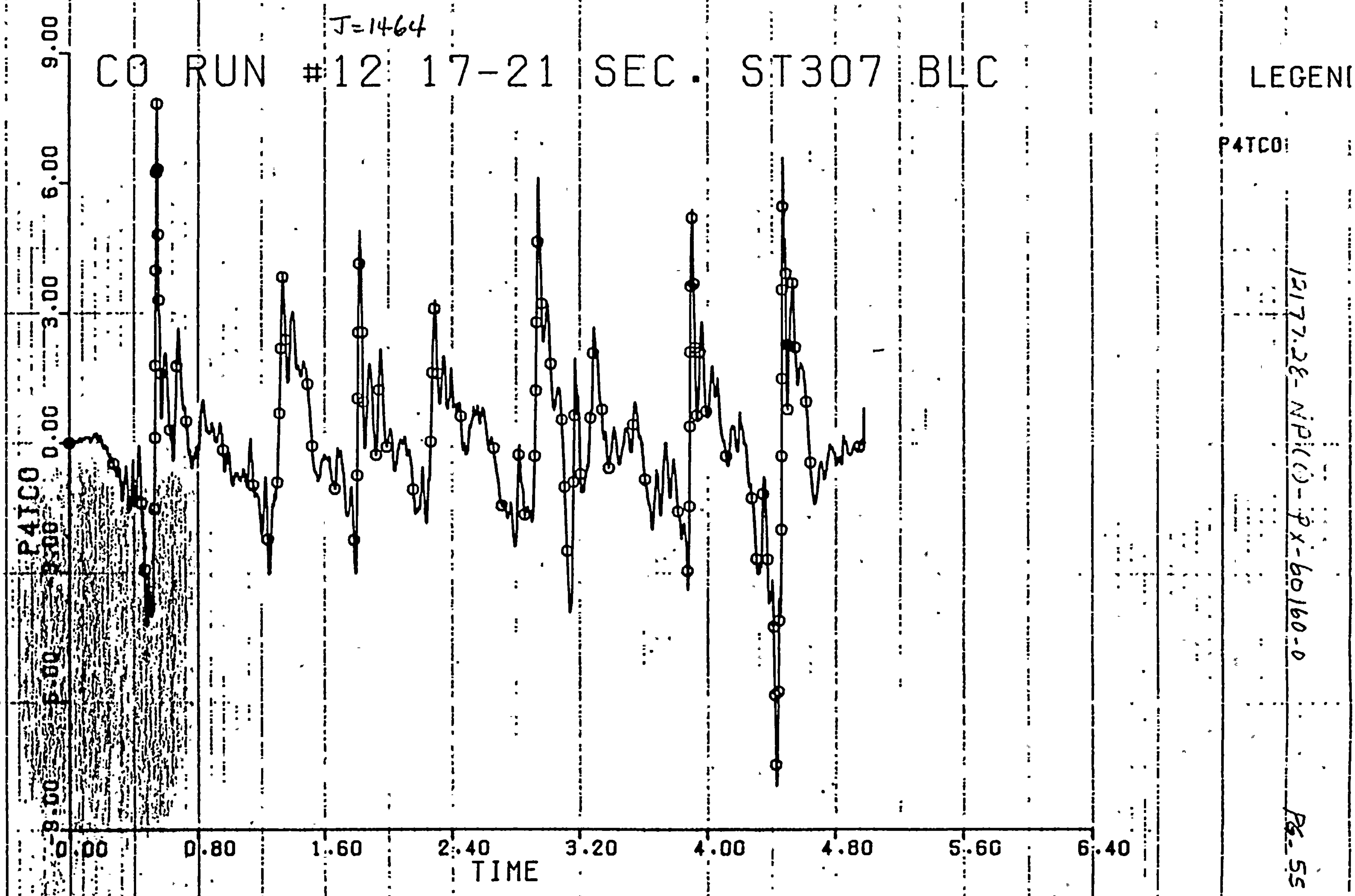

J-2114
CO RUN #09 10-13 SEC.
LEGEN
SS
8.00
4.00
0.00
-4.00
-8.00
-12.00
-16.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
TIME
-5.4
-7.0
12177-28-AR(U)-RX-60160-0


J = 2609
CO RUN #10 26-30 SEC. ST307 BLC
LEGEN
PATCO
16.00
12.00
8.00
4.00
0.00
0.00
0.80
1.60
2.40
3.20
4.00
4.80
5.60
6.40
TIME


CG RUN #10 26-30 SEC. ST307 BLC
LEGEN
SDOT
SDOT *10¹
30.00
20.00
10.00
0.00
0.80
1.60
2.40
3.20
4.00
4.80
5.60
6.40
TIME
+322.0
+160.0
1217.28-NP(c)-Rx-60160-0
Pg. 53

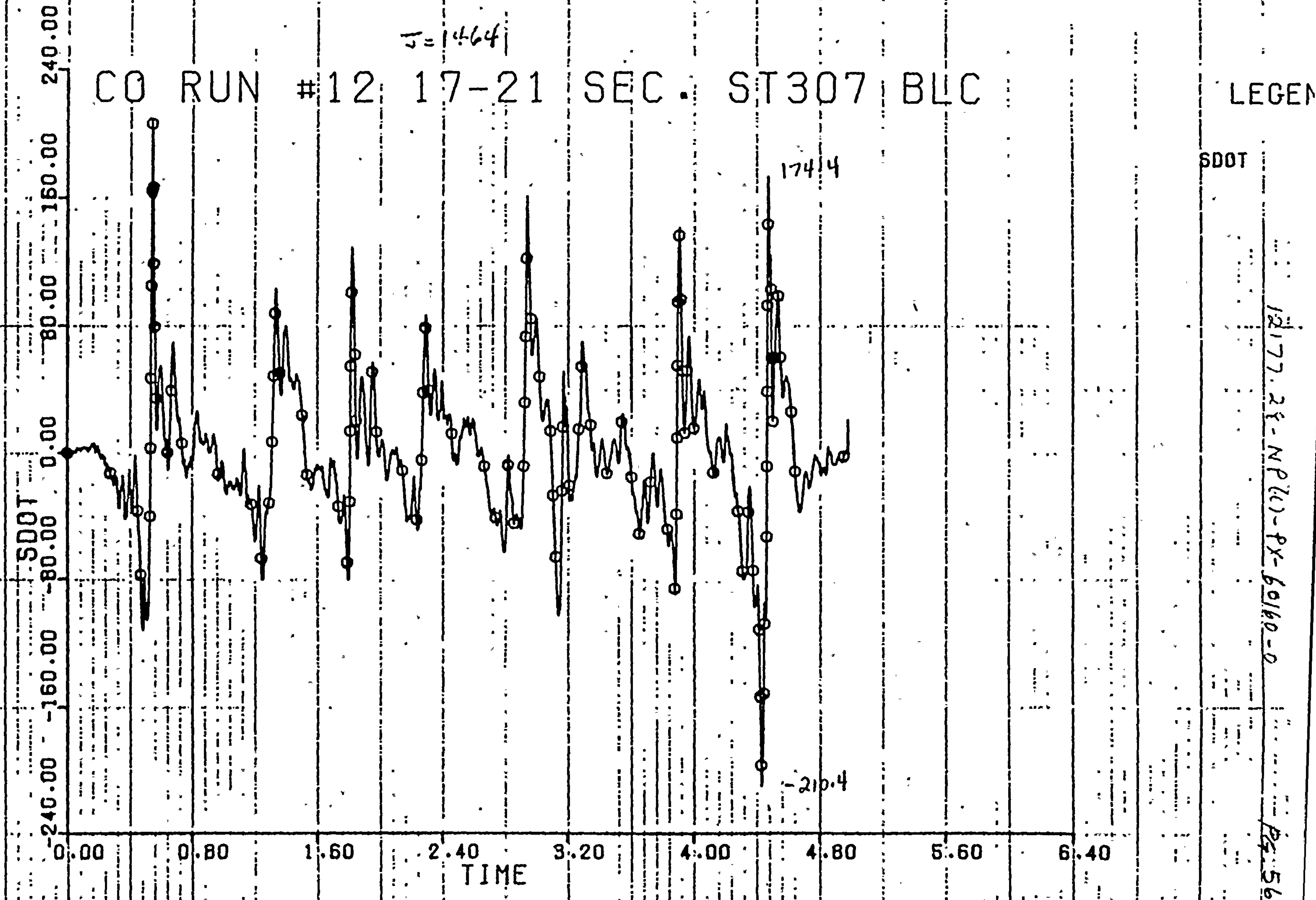


J=2669
CO RUN #10 26-30 SEC. ST307 BLC
LEGEN
SS
12.00
8.00
4.00
0.00
TIME
0.00
0.80
1.60
2.40
3.20
4.00
4.80
5.60
6.40
12177.28-NP(1)-Px-60160-0
PG. 54

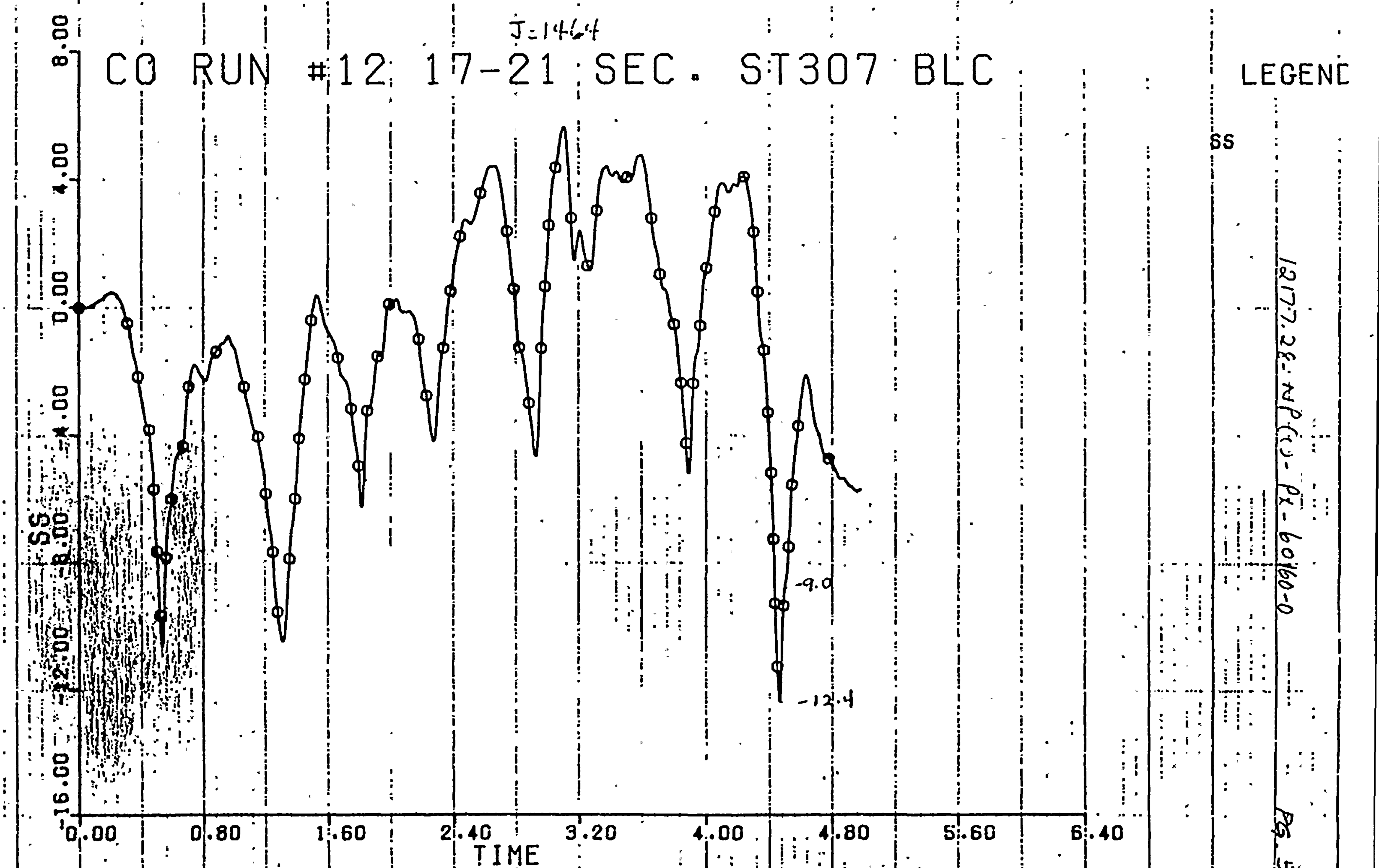


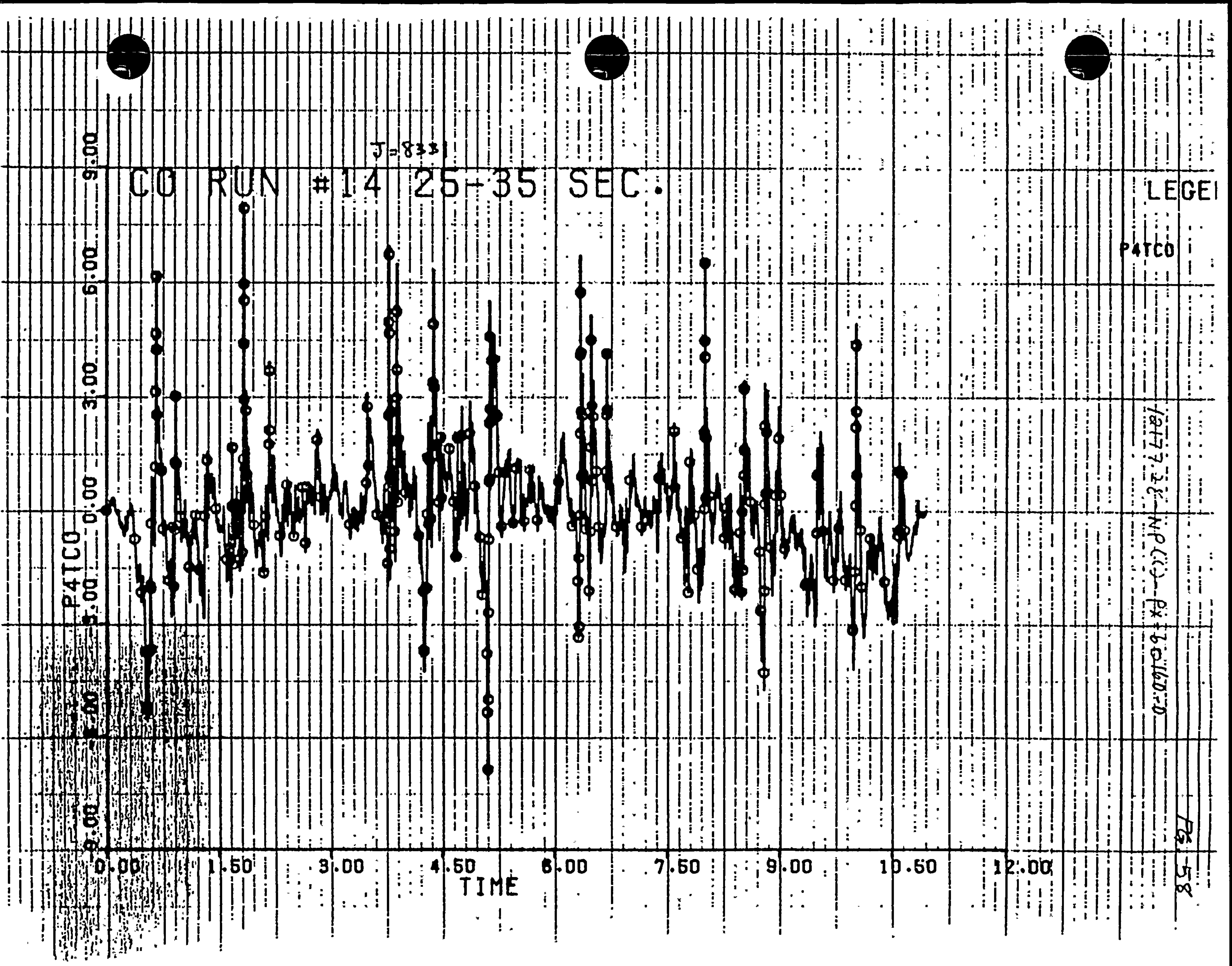
12177.28-NP(()-Px-60160-0

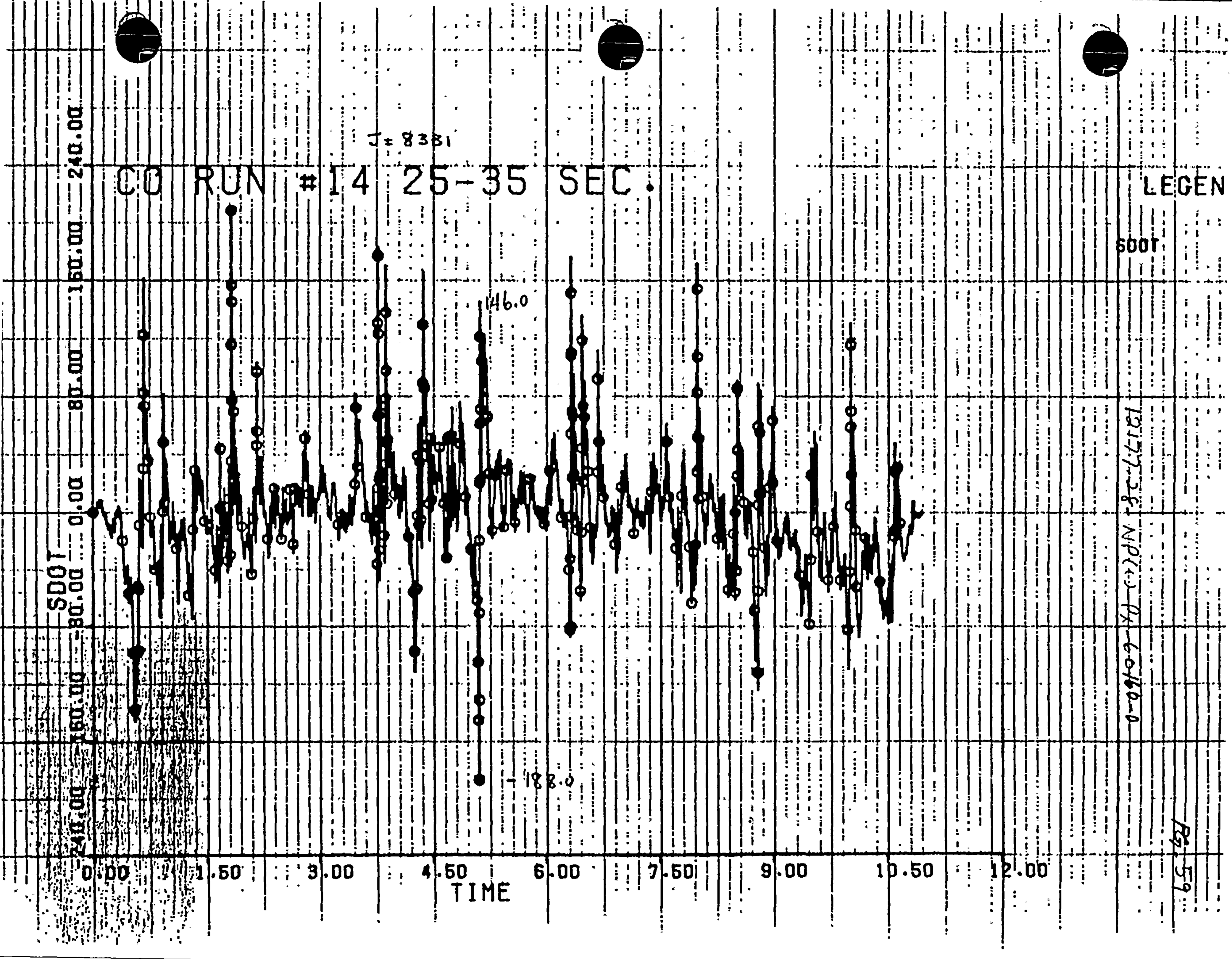
Pg. 55

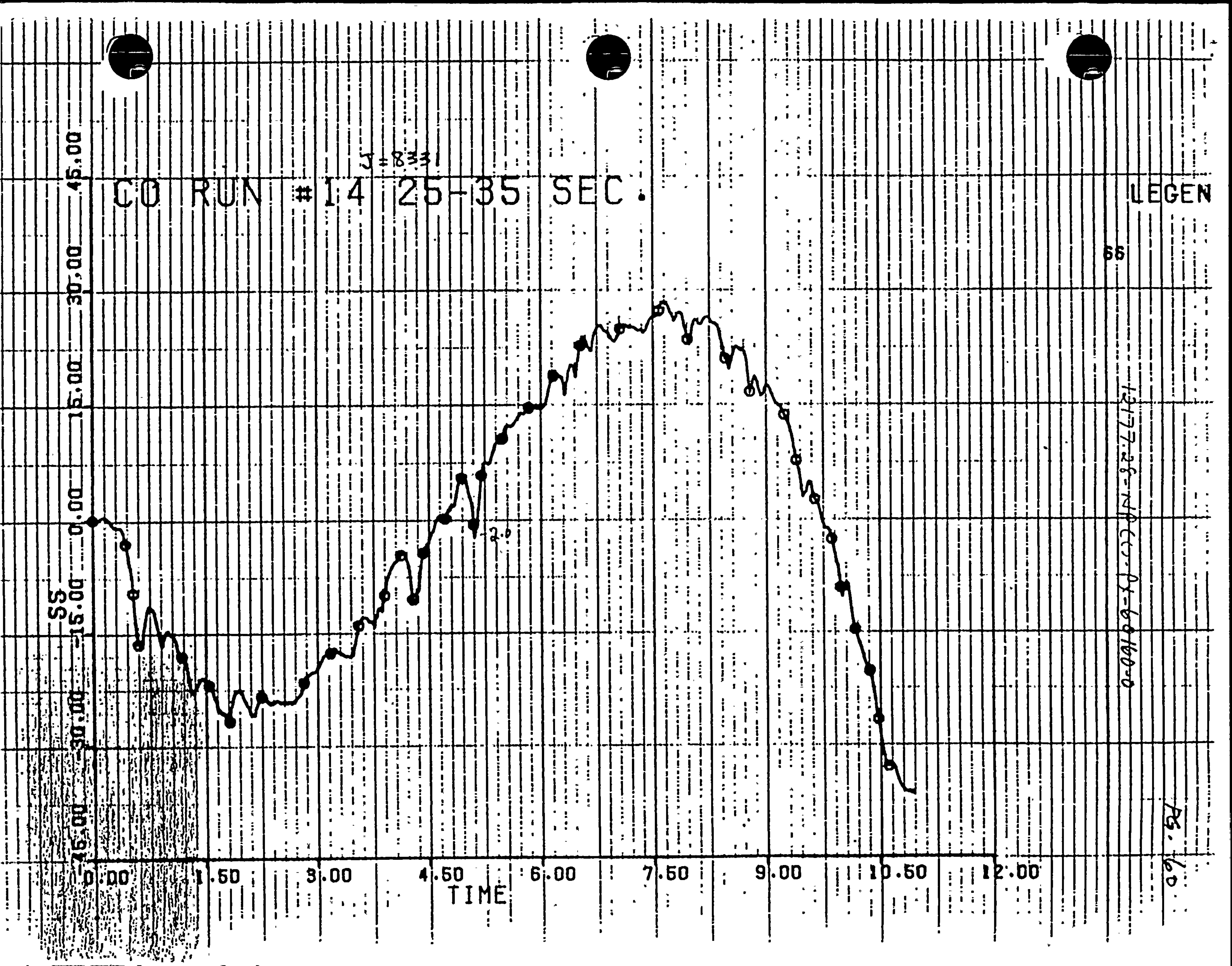


J=1464
CO RUN #12 17-21 SEC. ST307 BLC
LEGEN
SDOT
174.4
-210.4
SDOT
240.00
160.00
80.00
0.00
-80.00
-160.00
-240.00
0.00
0.80
1.60
2.40
3.20
4.00
4.80
5.60
6.40
TIME
12177.2Y-NP(L)-PX-60160-0
Pg. 56

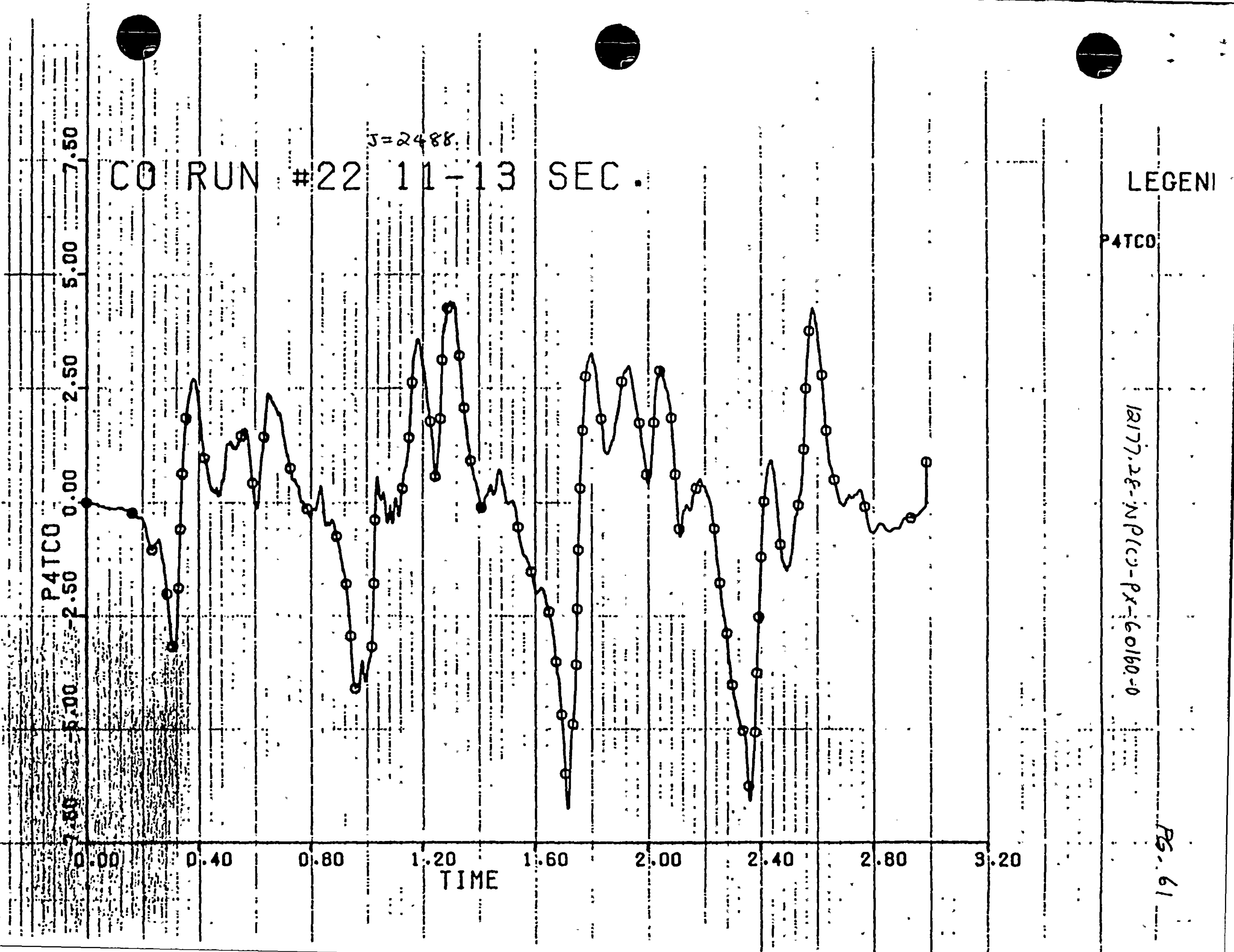

J=1464
CO RUN #12 17-21 SEC. ST307 BLC
LEGEND
SS
-9.0
-12.4
SS
8.00
4.00
0.00
-4.00
-8.00
-12.00
-16.00
0.00
0.80
1.60
2.40
3.20
4.00
4.80
5.60
6.40
TIME

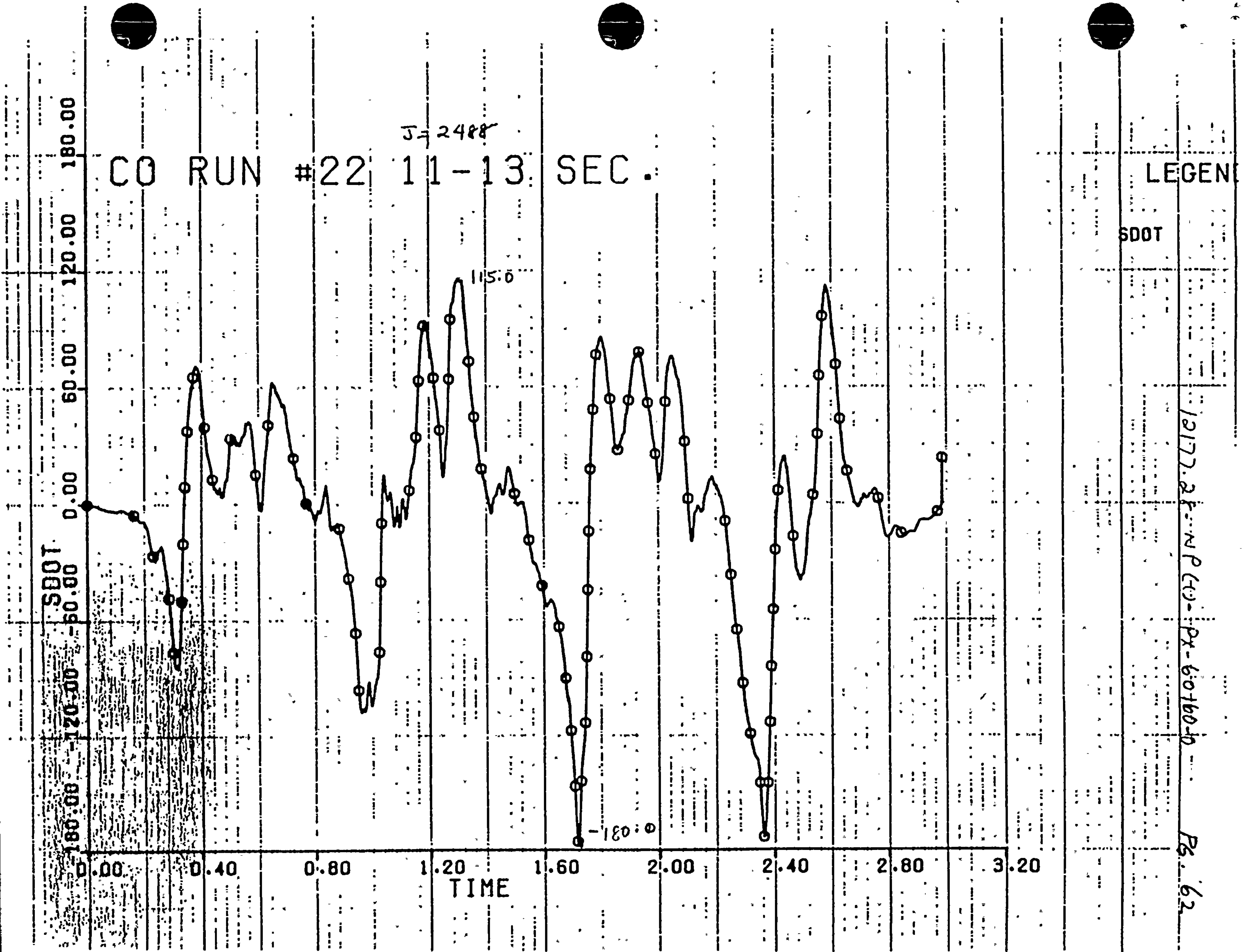

J=8331
CO RUN #14 25-35 SEC.
LEGE
P4TCO
P4TCO
TIME
9.00
6.00
3.00
0.00
0.00
1.50
3.00
4.50
6.00
7.50
9.00
10.50
12.00


J= 8381
CO RUN #14 25-35 SEC.
LEGEN
SDOT
146.0
-188.0
SDOT
240.00
160.00
80.00
0.00
-80.00
-160.00
-240.00
0.00
1.50
3.00
4.50
6.00
7.50
9.00
10.50
12.00
TIME
Pg. 59

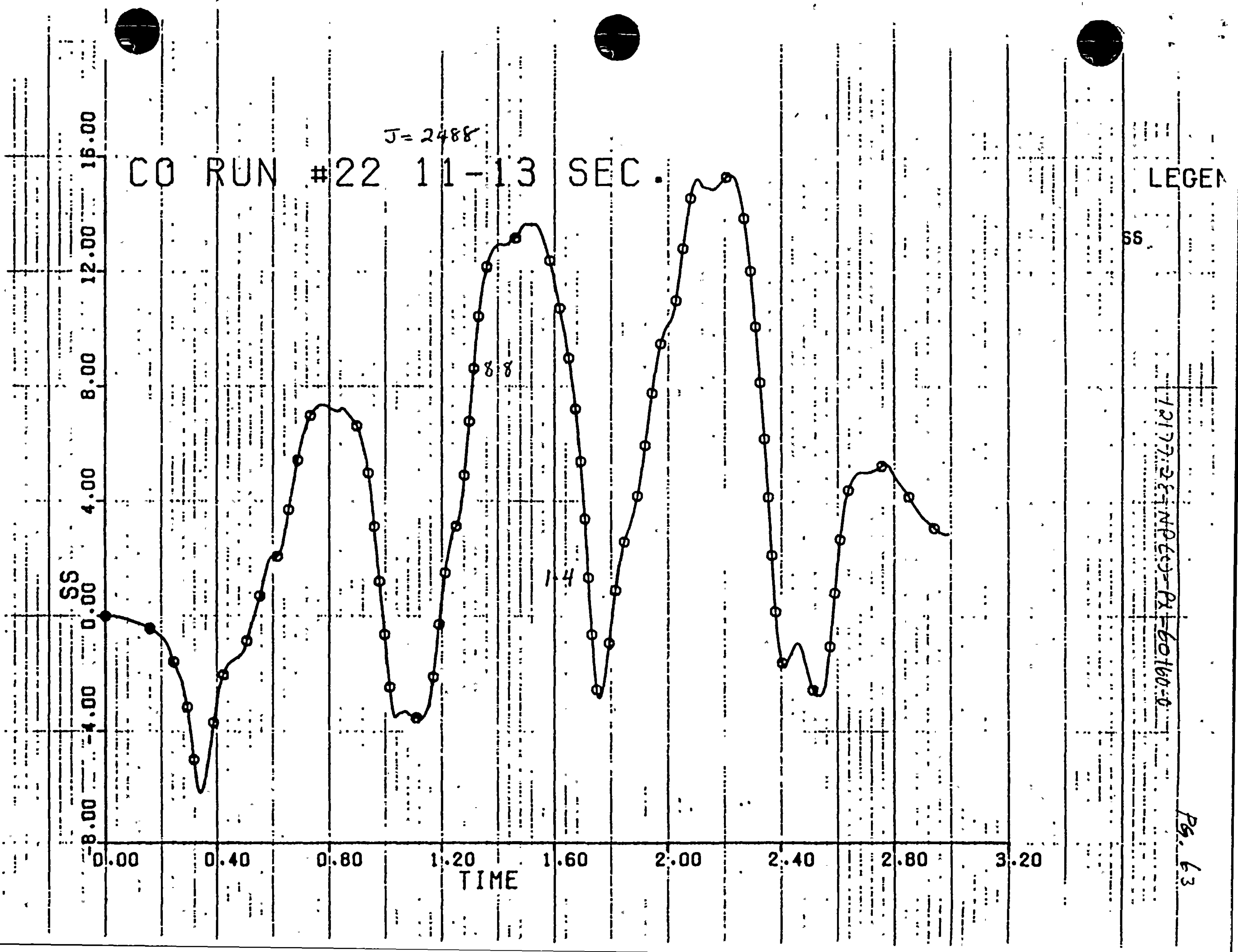


J=8331
CO RUN #14 25-35 SEC.
LEGEN
66
SS
45.00
30.00
15.00
0.00
-15.00
-30.00
-45.00
0.00
1.50
3.00
4.50
6.00
7.50
9.00
10.50
12.00
TIME
-2.0
Pg. 60

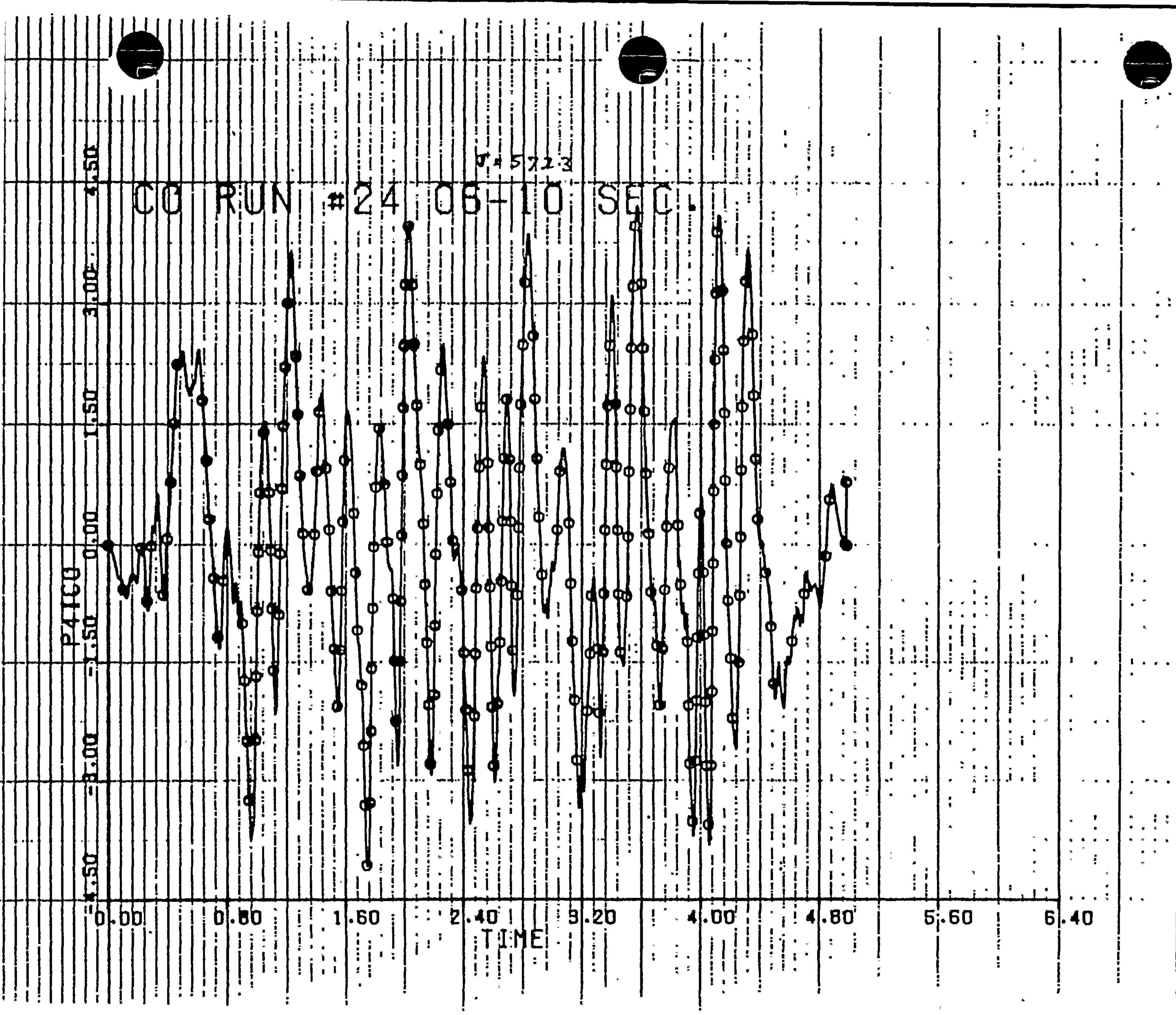

J=2488.
CO RUN #22 11-13 SEC.
LEGENI
P4TCO
P4TCO
7.50
5.00
2.50
0.00
-2.50
-5.00
-7.50
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
TIME
1217.3E-NP(C)-PX-60160-0
Pg. 61



12177.2F-NP(+)-PX-60760-0 — Pg. 62



CO RUN #22 11-13 SEC.
J = 2488
LEGEN
SS
SS
16.00
12.00
8.00
4.00
0.00
-4.00
-8.00
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
TIME
8.8
1.4
Pg. 63

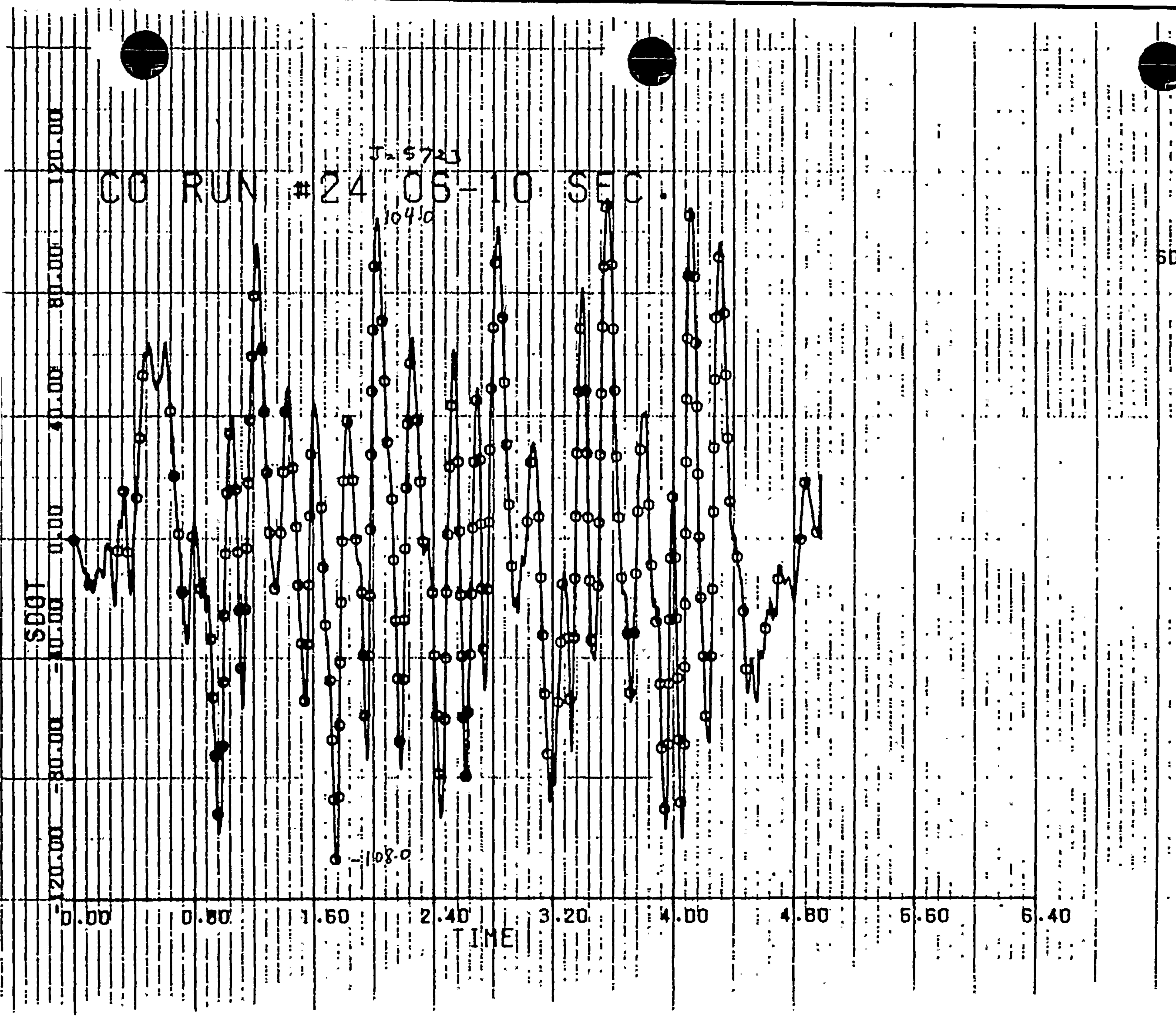


LEGEI

P4TCO

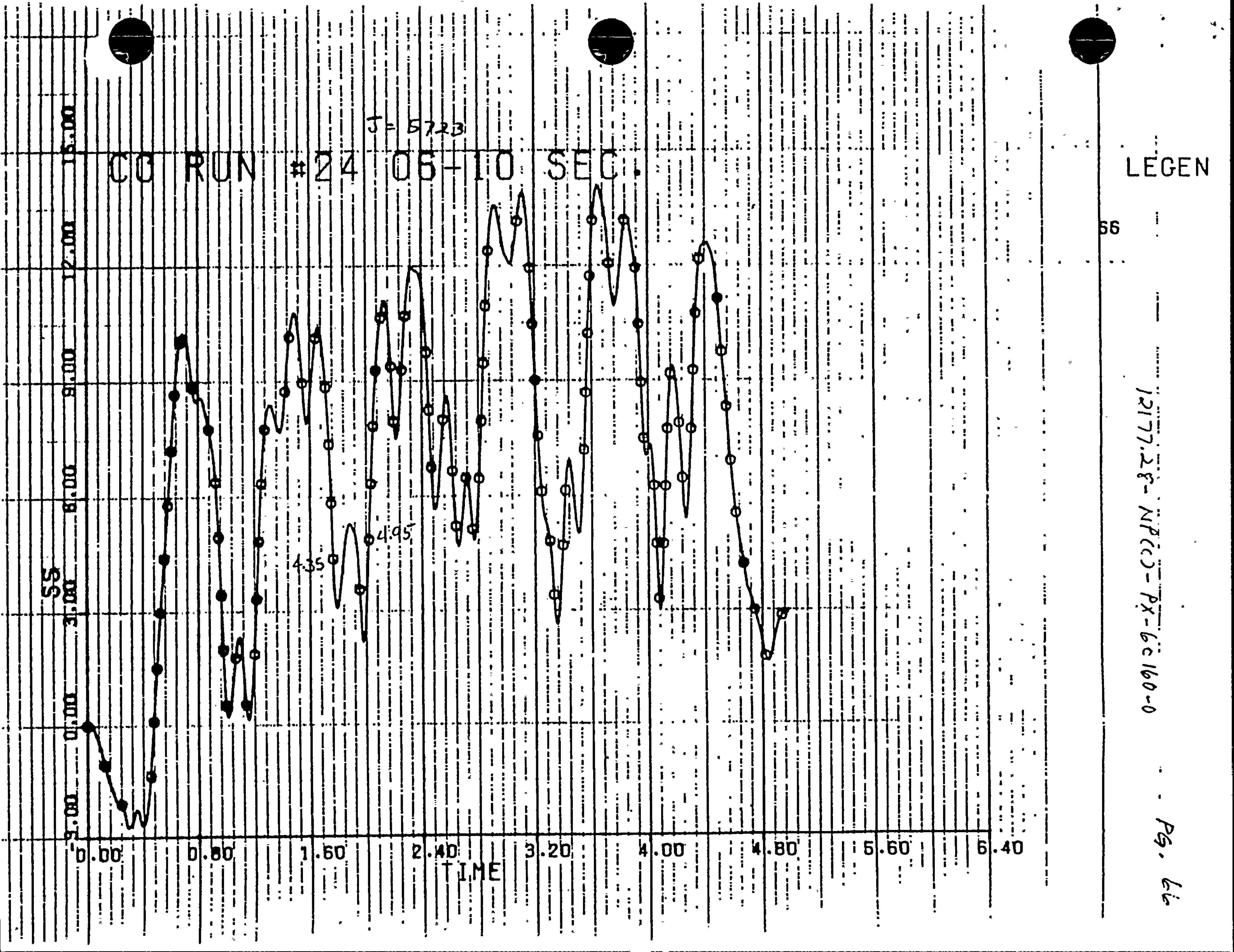
12177.28-NP(1)-PX-60160-0

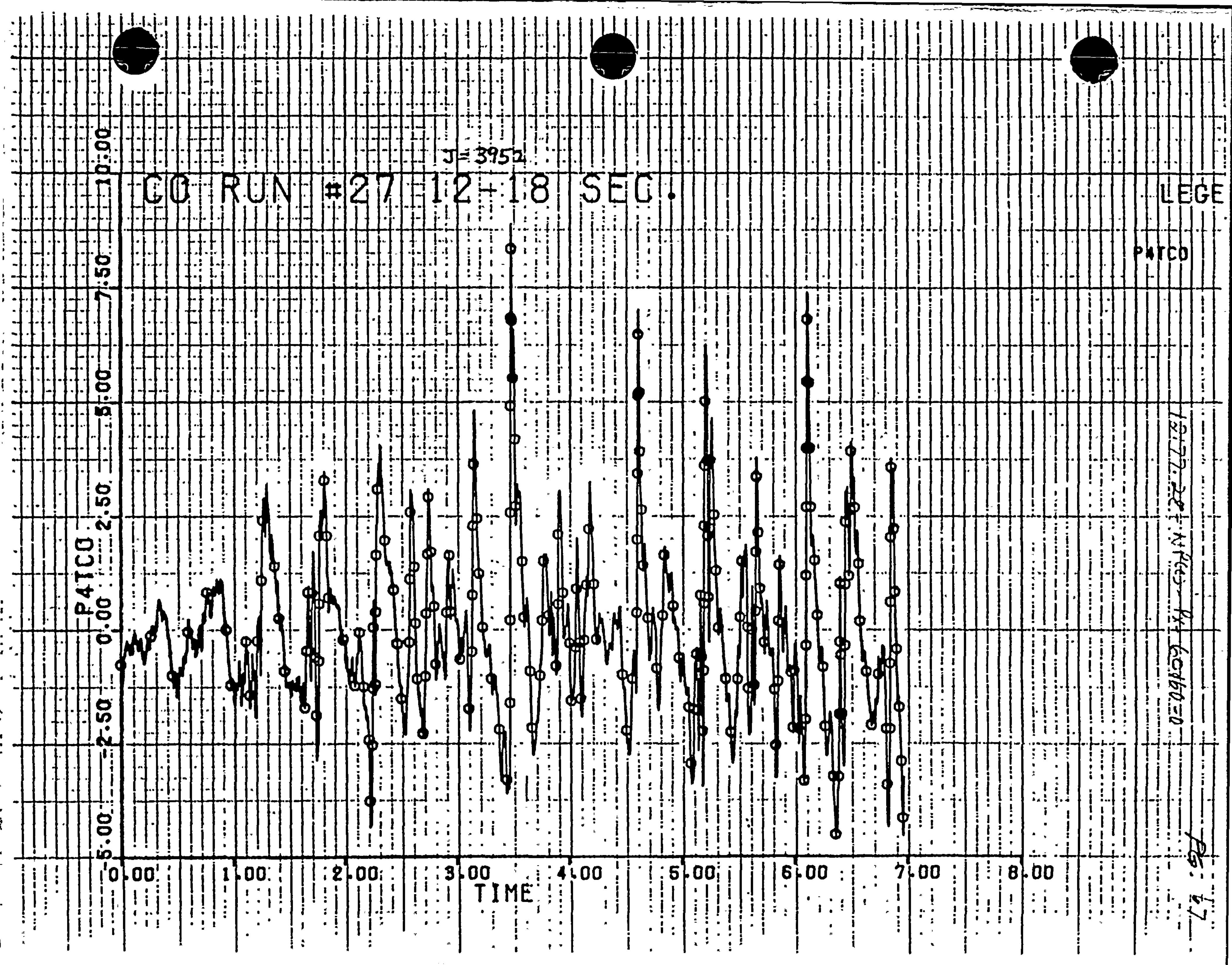
Pg. 64

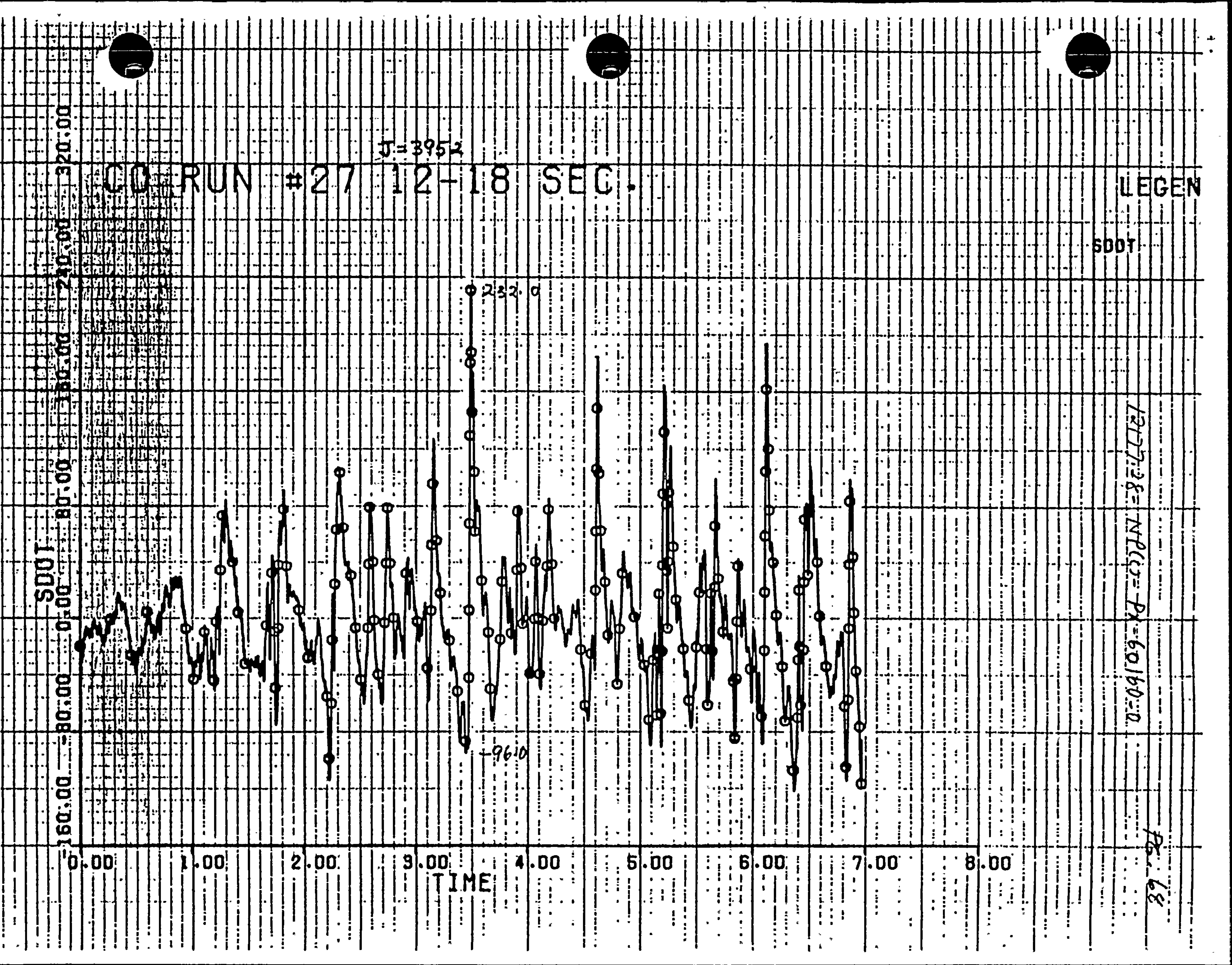


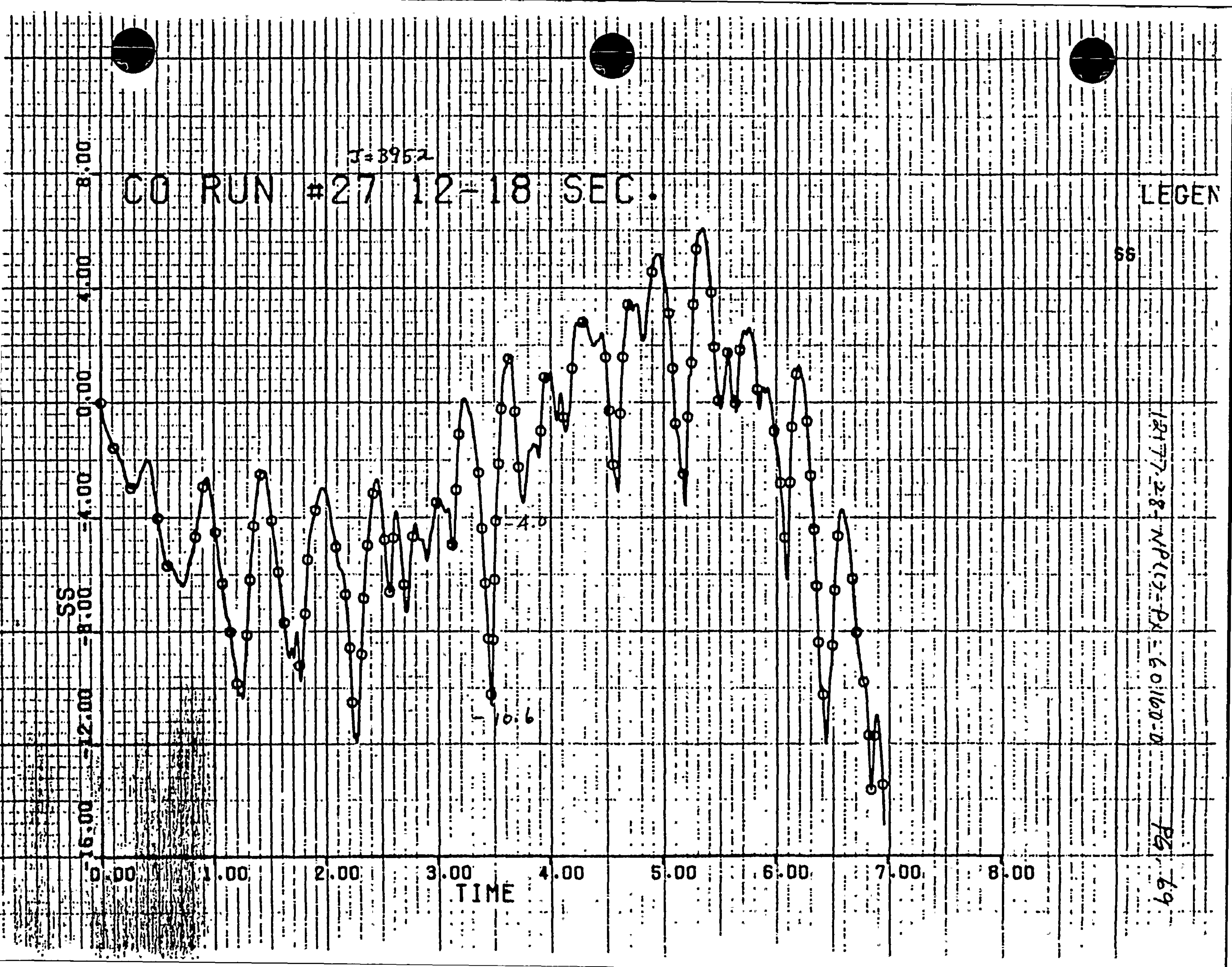
12177.2E-NP(U)-PX-60160-0

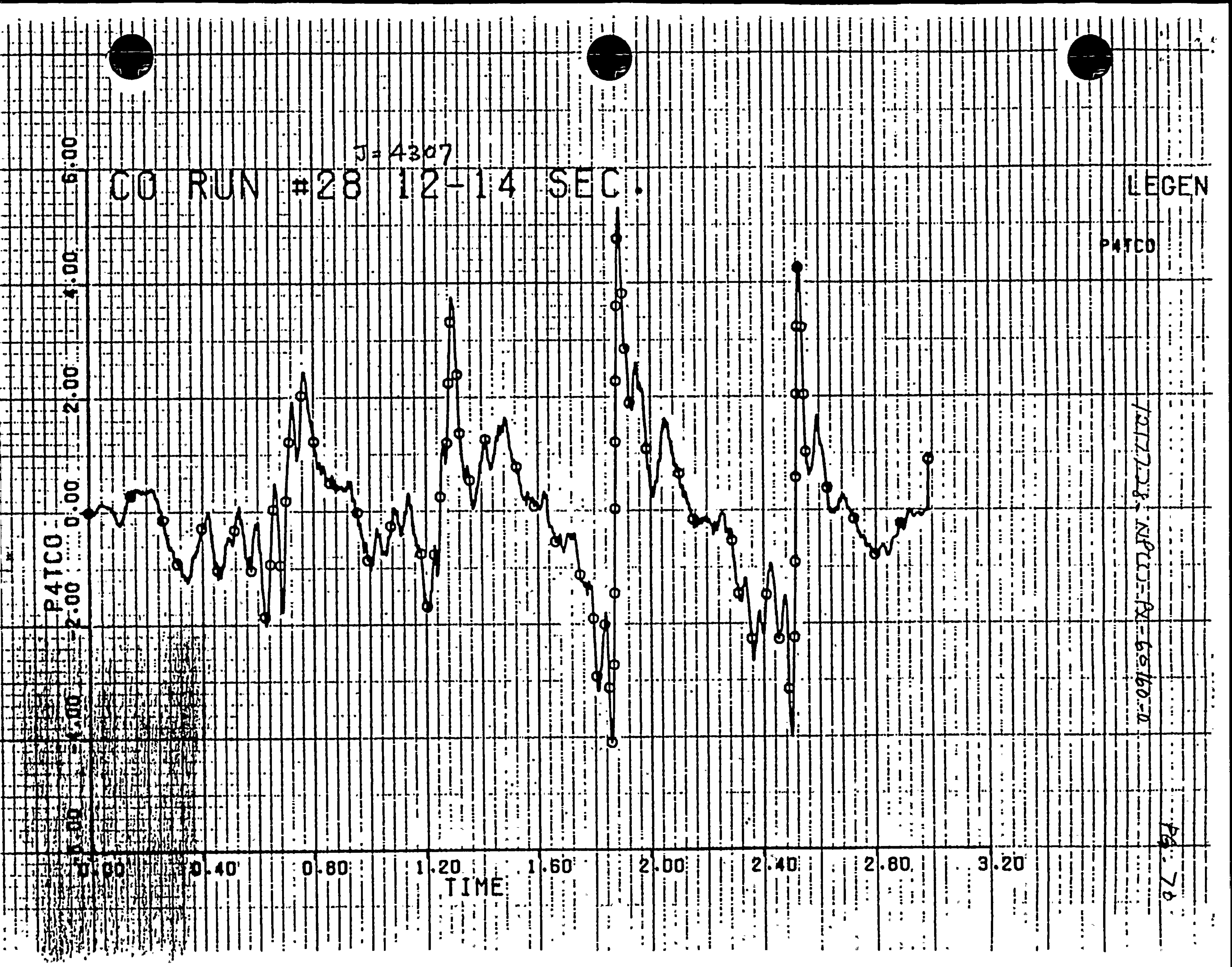
Pg. 65


J = 5723
CO RUN #24 05-10 SEC.
LEGEN
SS
15.00
12.00
9.00
6.00
3.00
0.00
-3.00
0.00
0.80
1.60
2.40
3.20
4.00
4.80
5.60
6.40
TIME
4.35
4.95
12177.28-NP(C)-PX-6C160-0
Pg. 66

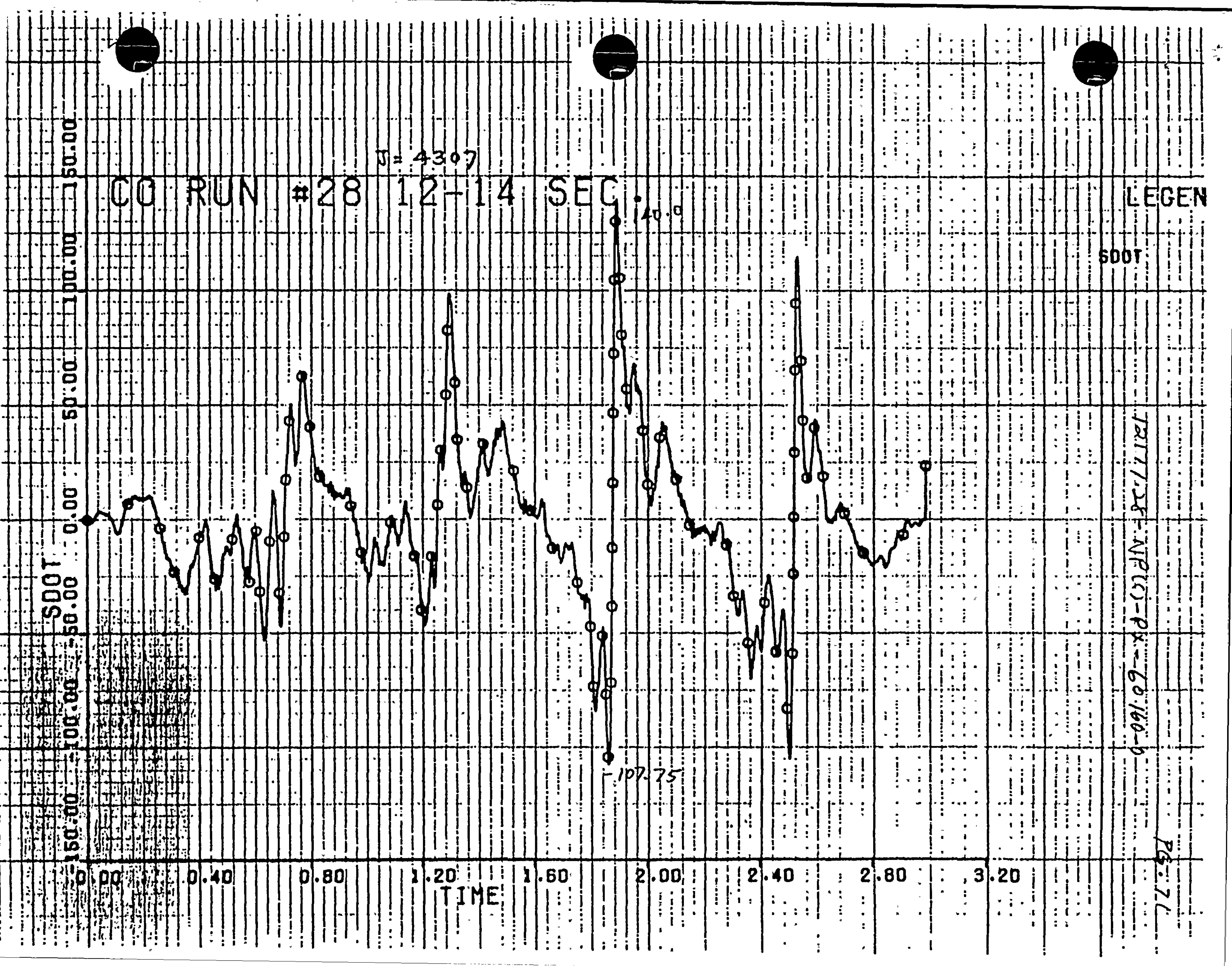

J=3952
CG RUN #27 12-18 SEC.
LEGE
P4TCO
P4TCO
10.00
7.50
5.00
2.50
0.00
-2.50
-5.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
TIME
Pg. 17


J=3952
CO RUN #27 12-18 SEC.
LEGEN
SDOT
232.0
-96.10
SDOT
320.00
240.00
160.00
80.00
0.00
-80.00
-160.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
TIME
RUN 27-28 NP(1)= PK 60160-0
Pg. 63

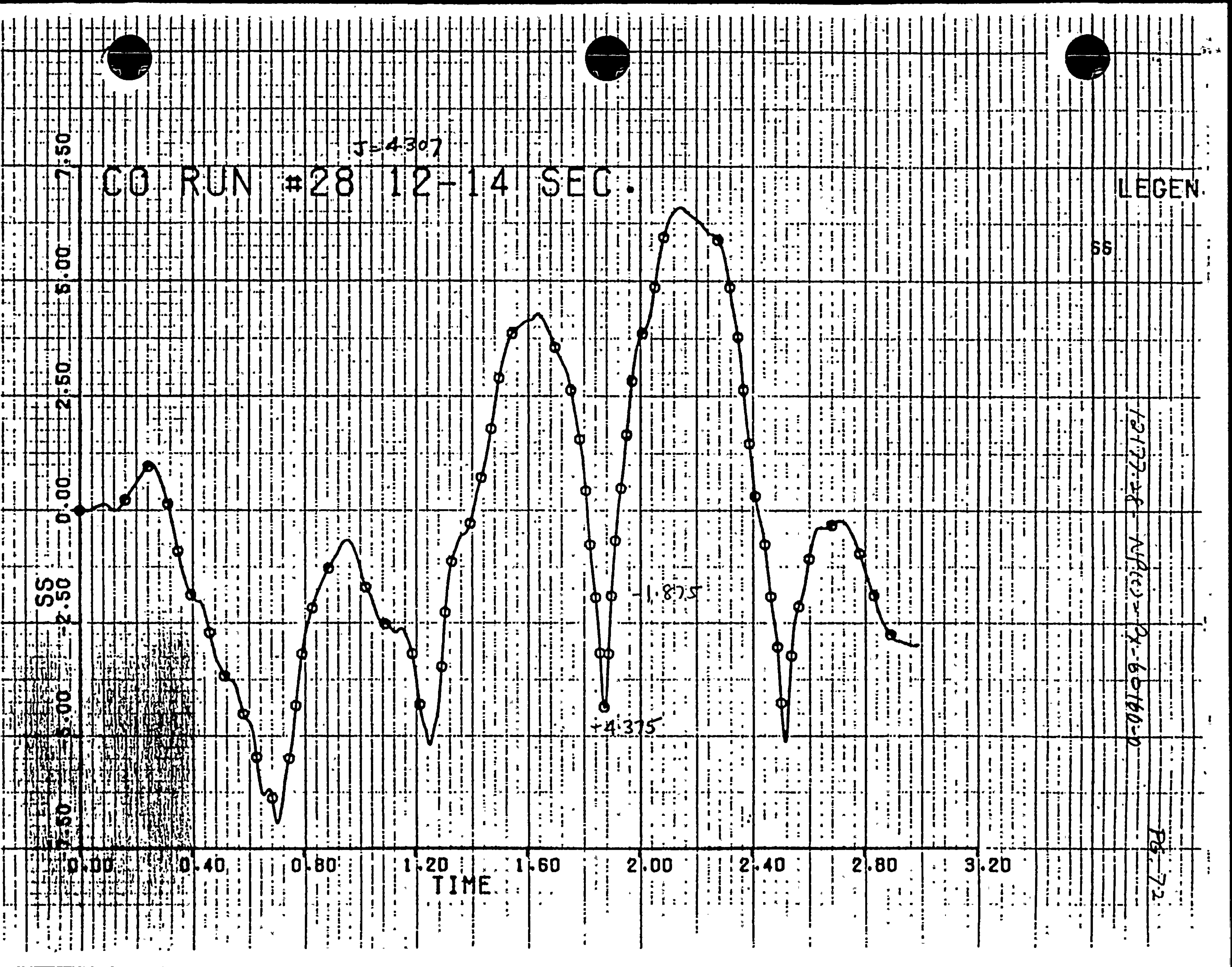

J=3952
CO RUN #27 12-18 SEC.
LEGEN
SS
SS
8.00
4.00
0.00
-4.00
-8.00
-12.00
-16.00
-4.0
-10.6
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
TIME
12177.28 NP(17)=Px=0.01607.0
Pg. 69



J=4307
CO RUN #28 12-14 SEC.
LEGEN
P4TCO
P4TCO
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
TIME


J= 4307
CO RUN #28 12-14 SEC.
140.0
LEGEN
SOOT
-107.75
SOOT
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
TIME

[illegible]


J=4307
CO RUN #28 12-14 SEC.
LEGEN.
SS
SS
7.50
5.00
2.50
0.00
-2.50
-5.00
-7.50
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.80
3.20
TIME
-1.875
+4.375
Pg. 72

8.0

COMPUTER LOG

S & W AUTH. NO. 0201
CDC CHARGE NO. ____________
CALCULATION NO: NPC(C)-PX-60160-0
JOB ORDER NO. 12177.28

RUN NO.	JOB NO. *	FICHE LOC. PAGE	FICHE LOC. SECT	PREPARED BY SIGNATURE	PREPARED BY DATE	REVIEWED BY SIGNATURE	REVIEWED BY DATE	COMP. **	COMMENTS
036	7230	76	90	V. J. Shah	2/25/87	M. Ben Nagi	4/25/87	S&W	CSMP FOR SS & SDOT RUN 3 5-7 Sec.
077	6191	76		V. J. Shah	2/20/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 7 12-16 Sec.
017	1237	76		V. J. Shah	2/19/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 7 18-21 Sec
095	2114	76		V. J. Shah	2/26/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 9 10-13 Sec.
017	2609	76		V. J. Shah	2/19/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 10 26-30 Sec.
018	1464	76		V. J. Shah	2/19/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 12 17-21 Sec.
44	8331	76		V. J. Shah	3/18/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 14 25-35 Sec.
225	2488	76		V. J. Shah	2/26/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 22 11-13 Sec.
145	5728	76		V. J. Shah	2/27/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 24 6-10 Sec.
275	3952	76		V. J. Shah	3/3/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 27 12-18 Sec.
285	[illegible]	[illegible]		V. J. Shah	3/3/87	M. Ben Nagi	4/25/87		CSMP FOR SS & SDOT RUN 28 12-14 Sec.

* COMPUTER GENERATED JOB NUMBER

** COMPUTER USED (S&W OR CDC)

8.0

COMPUTER LOG

S & W AUTH. NO. 0201 CALCULATION NO: ·NP(·)-PX-60160-0
CDC CHARGE NO. JOB ORDER NO. 12177 28

RUN NO.	JOB NO. *	FICHE LOC. PAGE	FICHE LOC. SECT	PREPARED BY SIGNATURE	PREPARED BY DATE	REVIEWED BY SIGNATURE	REVIEWED BY DATE	COMP. **	COMMENTS
005	8374	77	9.0	V J Shah	3/4/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, RUN # 3 5-7 Sec.
003	8240	77		V. J. Shah	3/4/87	M. Bey Nagi	4/25/87	S&W	SSLOAD Run #7 12-16 Sec.
004	8302	77		V. J Shah	3/4/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run #7 18-21 Sec.
006	8474	77		V. J. Shah	3/4/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run # 9 10-13 Sec.
002	7483	77		V. J Shah	3/4/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run #10 26-30 Sec.
001	7368	77		V. J Shah	3/4/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run # 12 17-21 Sec.
145	1861	77		V. J Shah	3/19/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run # 14 25-35 Sec.
007	[illegible]	77		V. J. Shah	3/4/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run # 22 11-13 Sec.
00[illegible]	[illegible]	77		V. J Shah	3/5/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run # 24 6-10 Sec.
00[illegible]	[illegible]	77		V. J. Shah	3/5/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run # 27 12-18 Sec.
010	[illegible]	77		V. J Shah	3/5/87	M. Bey Nagi	4/25/87	S&W	SSLOAD, Run # 28 12-14 Sec.

* COMPUTER GENERATED JOB NUMBER

** COMPUTER USED (S&W OR CDC)

8.0

COMPUTER LOG

S&W AUTH. NO. 0201 CALCULATION NO: NP(1)-PX-60160-0
CDC CHARGE NO. JOB ORDER NO. 12177.28

RUN NO.	JOB NO. *	FICHE LOC. PAGE	FICHE LOC. SECT	PREPARED BY SIGNATURE	PREPARED BY DATE	REVIEWED BY SIGNATURE	REVIEWED BY DATE	COMP. **	COMMENTS
TS1	6074	78	9.0	V. J. Shah	2/27/87	M. Beg Nagi	4/21/87	S&W	SENSITIVITY STUDY D.C.# 41
TS2	6217	78		V J Shah	2/27/87	M. Beg Nagi	4/21/87		" " D.C. # 1
TS3	9331	78		V. J. Shah	3/2/87	M. Beg Nagi	4/21/87		" " D.C.# 83
TS4	9387	78		V. J Shah	3/2/87	M. Beg Nagi	4/21/87		" " D.C.# 103
TS5	412	78		V. J. Shah	3/2/87	M. Beg Nagi	4/21/87		" " D.C.# 123
TS6	465	78		V. J. Shah	3/2/87	M. Beg Nagi	4/21/87		" " D.C. # 93
TS7	1130	78		V. J. Shah	3/2/87	M. Beg Nagi	4/21/87		" " D.C.# 43
TS8	1239	78		V. J. Shah	3/2/87	M. Beg Nagi	4/21/87		" " D.C. # 112
144	2920	78		V J Shah	4/22/87	M. Beg Nagi	4/22/87	S&W	Verification Run for CSMP, Attach B

* COMPUTER GENERATED JOB NUMBER

** COMPUTER USED (S&W OR CDC)

F75

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲ 5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE A1
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12177.28	NP(C)	PX-60/60-0	N/A.	

ATTACHMENT-A, SENSIVITY STUDY.

To determine the downcomer experiencing maximum load, 8 different annular pool downcomers (DC #s 1, 41, 43, 83, 103, 94, 112 and 123) were used in SSLOAD program with co load from Run #12, 17-21 Sec. The maximum load occurs on downcomer #43 (See Fig 4).

***C.O. LOAD ON DOWNCOMER 1 PX-60052-2 ,RUN 12,17-21 SEC. *** PAGE______

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	-104.01	1039.87	0.0	1045.05	180.00	104.01	-1039.87	0.0	1045.05
2	-56.76	781.71	0.0	783.77	180.00	56.77	-781.71	0.0	783.77
3	-24.95	554.83	0.0	555.39	180.00	24.95	-554.83	0.0	555.39
4	-9.15	370.35	0.0	370.46	180.00	9.15	-370.34	0.0	370.46
5	-2.69	212.98	0.0	213.00	180.00	2.69	-212.98	0.0	213.00
6	-0.46	69.56	0.0	69.56	180.00	0.46	-69.56	0.0	69.56
TOTAL	-197.97	3029.29	0.0	3037.23		197.98	-3029.29	0.0	3037.22

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

13177.22-NF(C)-FX-60160-0

ATTACHMENT-A

A2

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	47.31	1046.00	0.0	1047.07	180.00	-47.30	-1046.00	0.0	1047.07
2	40.95	789.01	0.0	790.07	180.00	-40.94	-789.01	0.0	790.07
3	32.62	561.19	0.0	562.14	180.00	-32.62	-561.19	0.0	562.14
4	23.35	374.74	0.0	375.47	180.00	-23.35	-374.74	0.0	375.47
5	13.90	215.41	0.0	215.86	180.00	-13.90	-215.41	0.0	215.86
6	4.61	70.32	0.0	70.47	180.00	-4.61	-70.32	0.0	70.47
TOTAL	162.74	3056.68	0.0	3061.08		-162.73	-3056.68	0.0	3061.08

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

12-7.25- NPC(-PX-60166-0

ATTACHMENT-A

***C.O. LOAD ON DOWNCOMER #43 PX-60052-2 ,RUN 12,17-21 SEC.   ***   PAGE______

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

	CARTESIAN COORDINATES					CYLINDRICAL COORDINATES			
SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	392.22	1024.76	0.0	1097.25	162.00	-56.36	-1095.80	0.0	1097.25
2	303.41	774.29	0.0	831.62	162.00	-49.28	-830.16	0.0	831.62
3	221.18	550.95	0.0	593.69	162.00	-40.10	-592.33	0.0	593.69
4	150.35	367.66	0.0	397.21	162.00	-29.37	-396.12	0.0	397.21
5	87.35	211.14	0.0	228.50	162.00	-17.83	-227.80	0.0	228.50
6	28.66	68.89	0.0	74.61	162.00	-5.97	-74.37	0.0	74.61
TOTAL	1183.17	2997.69	0.0	3222.88		-198.91	-3216.59	0.0	3222.88

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

	CARTESIAN COORDINATES					CYLINDRICAL COORDINATES			
SEGMENT NUMBER	X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

1277.22-NP(C)-PI-60160-0

ATTACHMENT-A

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	434.96	607.28	0.0	746.98	143.00	18.10	-746.76	0.0	746.98
2	363.83	508.32	0.0	625.11	143.00	15.35	-624.92	0.0	625.11
3	283.05	391.79	0.0	483.34	143.00	9.73	-483.25	0.0	483.34
4	200.46	274.36	0.0	339.79	143.00	5.02	-339.75	0.0	339.79
5	119.15	161.70	0.0	200.85	143.00	2.15	-200.84	0.0	200.85
6	39.49	53.35	0.0	66.38	143.00	0.57	-66.37	0.0	66.38
TOTAL	1440.94	1996.80	0.0	2462.45		50.93	-2461.90	0.0	2462.45

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

1217.2F-NF(1)-PX-60/60-0

ATTACHMENT-A

A5

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	406.69	551.92	0.0	685.57	139.50	49.19	-683.81	0.0	685.57
2	345.65	454.74	0.0	571.19	139.50	32.50	-570.26	0.0	571.19
3	271.52	348.95	0.0	442.14	139.50	20.16	-441.68	0.0	442.14
4	193.32	244.79	0.0	311.92	139.50	11.98	-311.69	0.0	311.92
5	115.27	144.66	0.0	184.97	139.50	6.30	-184.86	0.0	184.97
6	38.26	47.81	0.0	61.23	139.50	1.95	-61.20	0.0	61.23
TOTAL	1370.72	1792.86	0.0	2257.04		122.07	-2253.51	0.0	2257.03

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

13177.28-NP(1)-PX-60160-0

ATTACHMENT-A

***C.O. LOAD ON DOWNCOMER 894 PX-60052-2 ,RUN 12,17-21 SEC. *** PAGE______

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	659.59	500.00	0.0	827.69	305.00	-31.25	827.10	0.0	827.69
2	549.12	403.29	0.0	681.31	305.00	-15.39	681.13	0.0	681.31
3	421.83	302.36	0.0	519.00	305.00	-5.72	518.97	0.0	519.00
4	294.89	208.31	0.0	361.04	305.00	-1.50	361.04	0.0	361.04
5	173.65	121.70	0.0	212.05	305.00	-0.09	212.05	0.0	212.05
6	57.27	40.00	0.0	69.86	305.00	0.08	69.86	0.0	69.86
TOTAL	2156.36	1575.66	0.0	2670.94		-53.88	2670.19	0.0	2670.94

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

12177.28-NP(L)-FX-60160-0

ATTACHMENT-A

A7

***C.O. LOAD ON DOWNCOMER #112 PX-60052-2 ,RUN 12,17-21 SEC. *** PAGE____

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	CYLINDRICAL COORDINATES SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	547.98	520.48	0.0	755.76	337.50	307.08	690.56	0.0	755.76
2	409.35	453.99	0.0	607.95	337.50	199.83	574.17	0.0	607.95
3	279.79	369.31	0.0	459.35	337.50	119.08	493.65	0.0	459.35
4	182.97	262.63	0.0	320.08	337.50	68.53	312.66	0.0	320.08
5	103.87	157.56	0.0	188.72	337.50	35.67	185.31	0.0	188.72
6	33.72	52.42	0.0	62.33	337.50	11.09	61.39	0.0	62.33
TOTAL	1552.67	1811.38	0.0	2394.19		741.29	2247.69	0.0	2394.19

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	CYLINDRICAL COORDINATES SEGMENT ANGLE(DEG)	RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

13177.28-NP(1)-PX-60160-0

ATTACHMENT A

3E

*** DRAG LOAD SUMMARY ***

DRAG LOADS NORMAL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1	453.62	348.26	0.0	571.89	139.50	-118.76	-559.43	0.0	571.89
2	360.20	317.06	0.0	479.86	139.50	-67.98	-475.03	0.0	479.86
3	268.78	263.52	0.0	376.42	139.50	-33.24	-374.95	0.0	376.42
4	185.84	194.41	0.0	268.94	139.50	-15.05	-268.52	0.0	268.94
5	109.19	118.24	0.0	160.94	139.50	-6.24	-160.82	0.0	160.94
6	36.03	39.59	0.0	53.53	139.50	-1.68	-53.50	0.0	53.53
TOTAL	1413.66	1281.08	0.0	1911.59		-242.95	-1892.24	0.0	1911.58

*** DRAG LOAD SUMMARY ***

DRAG LOADS PARALLEL TO THE SEGMENT AXIS (LBF)

SEGMENT NUMBER	CARTESIAN COORDINATES X	Y	Z	RESULTANT	SEGMENT ANGLE(DEG)	CYLINDRICAL COORDINATES RADIAL	TANGENTIAL	VERTICAL	RESULTANT
1									
2									
3									
4									
5									
6									
TOTAL									

1217.28-NP(C)-PX-60160-0

ATTACHMENT-A

A9

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE B1
J.O. OR W.O. NO. 12177.28	DIVISION & GROUP NP(L)	CALCULATION NO. PX-60160-0	OPTIONAL TASK CODE	

ATTACHMENT B

COMPUTER PROGRAM CSMP IS VERIFIED BY COMPARING THE COMPUTER OUTPUT RESULTS LISTED ON PAGE B3 TO THE MANUAL INTEGRATION RESULTS FOR TEN TIME STEPS LISTED ON PAGE B2. THE PROGRAM IS VERIFIED SINCE BOTH RESULTS ARE IDENTICAL.

ATTACHMENT B

FROM PAGE 9 , $\dot{S} = \dfrac{P_{WALL}}{\rho\, f(\gamma)}$

$$\dot{S} = \frac{144}{2.82 \times 1.94} P_{4TCO} = 26.32156 \times P_{4TCO} = A \times P_{4TCO}$$

$$m = SLOPE = \frac{1}{2}(\dot{S}_n + \dot{S}_{n-1}) = \frac{SS_n - SS_{n-1}}{\Delta T}$$

$$SS_n = SS_{n-1} + m\,\Delta T$$

n	ΔT	P_{4TCO}	$A \times P_{4TCO}$ * " $\dot{S}$ "	$m = \frac{\dot{S}_n + \dot{S}_{n-1}}{2}$	$m\,\Delta T$ (10^{-4})	SS_n* (10^{-4})
0	0.001	-2.3283×10^{-10}	-6.1284×10^{-9}	—	—	0.0
1	↓	-1.4705×10^{-3}	-3.8706×10^{-2}	-1.9353×10^{-2}	0.19353	-0.19353
2		-2.9155×10^{-3}	-7.6741×10^{-2}	-5.7723×10^{-2}	0.57723	-0.77076
3		-4.3349×10^{-3}	-1.1410×10^{-1}	-9.5421×10^{-2}	0.95421	-1.72500
4		-5.6092×10^{-3}	-1.4764×10^{-1}	-1.3087×10^{-1}	1.30872	-3.03370
5		-6.9482×10^{-3}	-1.8289×10^{-1}	-1.6527×10^{-1}	1.6527	-4.6863
6		-8.2622×10^{-3}	-2.1747×10^{-1}	-2.0018×10^{-1}	2.0618	-6.6882
7		-9.1314×10^{-3}	-2.4035×10^{-1}	-2.2891×10^{-1}	2.2891	-8.9773
8		-1.0096×10^{-2}	-2.6574×10^{-1}	-2.5305×10^{-1}	2.5305	-11.5080
9		-1.2056×10^{-2}	-3.1733×10^{-1}	-2.9154×10^{-1}	2.9154	-14.4230
10	↓	-1.3271×10^{-2}	-3.4931×10^{-1}	-3.3332×10^{-1}	3.3332	-17.7560

* VALUES ARE COMPARED TO COMPUTER RESULTS ON PAGE B3

[illegible]

P TIME HISTORY RUN #14 25-35 SEC.

TIME	SS	SDOT	P4TCO
.0	.0	-6.1285E-09	-2.3283E-10
1.000000D-03	-1.9353E-05	-3.8706E-02	-1.4705E-03
2.000000D-03	-7.7076E-05	-7.6741E-02	-2.9155E-03
3.000000D-03	-1.7250E-04	-.11410	-4.3349E-03
4.000000D-03	-3.0337E-04	-.14764	-5.6092E-03
5.000000D-03	-4.6863E-04	-.18289	-6.9482E-03
6.000000D-03	-6.6881E-04	-.21747	-8.2622E-03
7.000000D-03	-8.9773E-04	-.24035	-9.1314E-03
8.000000D-03	-1.1508E-03	-.26574	-1.0096E-02
9.000000D-03	-1.4423E-03	-.31733	-1.2056E-02
1.000000D-02	-1.7756E-03	-.34931	-1.3271E-02
1.100000D-02	-2.1493E-03	-.39803	-1.5122E-02
1.200000D-02	-2.5493E-03	-.40190	-1.5269E-02
1.300000D-02	-2.9658E-03	-.43120	-1.6382E-02
1.400000D-02	-3.4058E-03	-.44881	-1.7051E-02
1.500000D-02	-3.8860E-03	-.51159	-1.9436E-02
1.600000D-02	-4.4121E-03	-.54059	-2.0538E-02
1.700000D-02	-4.9602E-03	-.55554	-2.1106E-02
1.800000D-02	-5.5363E-03	-.59674	-2.2671E-02
1.900000D-02	-6.1541E-03	-.63890	-2.4273E-02
2.000000D-02	-6.8067E-03	-.66625	-2.5312E-02
2.100000D-02	-7.4780E-03	-.67639	-2.5697E-02
2.200000D-02	-8.1671E-03	-.70173	-2.6660E-02
2.300000D-02	-8.8721E-03	-.70834	-2.6911E-02
2.400000D-02	-9.5921E-03	-.73171	-2.7799E-02
2.500000D-02	-1.0335E-02	-.75448	-2.8664E-02
2.600000D-02	-1.1101E-02	-.77670	-2.9508E-02
2.700000D-02	-1.1910E-02	-.84097	-3.1950E-02
2.800000D-02	-1.2740E-02	-.81936	-3.1129E-02
2.900000D-02	-1.3581E-02	-.86274	-3.2777E-02
3.000000D-02	-1.4430E-02	-.83605	-3.1763E-02
3.100000D-02	-1.5276E-02	-.85461	-3.2468E-02
3.200000D-02	-1.6152E-02	-.89785	-3.4111E-02
3.300000D-02	-1.7072E-02	-.94215	-3.5794E-02
3.400000D-02	-1.8037E-02	-.98745	-3.7515E-02
3.500000D-02	-1.9033E-02	-1.0061	-3.8225E-02
3.600000D-02	-2.0049E-02	-1.0243	-3.8915E-02
3.700000D-02	-2.1067E-02	-1.0127	-3.8473E-02
3.800000D-02	-2.2058E-02	-.96892	-3.6811E-02
3.900000D-02	-2.3034E-02	-.98308	-3.7349E-02
4.000000D-02	-2.3976E-02	-.90199	-3.4268E-02
4.100000D-02	-2.4900E-02	-.94508	-3.5905E-02
4.200000D-02	-2.5834E-02	-.92291	-3.5063E-02
4.300000D-02	-2.6813E-02	-1.0345	-3.9301E-02
4.400000D-02	-2.7905E-02	-1.1503	-4.3700E-02
4.500000D-02	-2.9080E-02	-1.1992	-4.5559E-02
4.600000D-02	-3.0304E-02	-1.2492	-4.7459E-02
4.700000D-02	-3.1597E-02	-1.3374	-5.0809E-02
4.800000D-02	-3.2942E-02	-1.3524	-5.1381E-02
4.900000D-02	-3.4263E-02	-1.2896	-4.8993E-02
5.000000D-02	-3.5519E-02	-1.2231	-4.6467E-02

RESULTS OF CSMP COMPUTER PROGRAM

ATTACHMENT B

12177.28-NPC(?)-PX-60160-0

TH[illegible]S BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE WALLS. [illegible]OOL
THE [illegible]IZE IS 20.250 20.250 25.000 TIME= 1.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-5.833	-54.27	7.000	3.142	13.000	0.0
2	2	1.000	2.183	49.31	7.000	2.356	13.000	45.000
3	3	1.000	2.183	49.31	7.000	1.571	13.000	90.000
4	4	1.000	2.183	49.31	7.000	0.785	13.000	135.000
5	5	1.000	2.183	49.31	7.000	0.0	13.000	180.000
6	6	1.000	-5.833	-54.27	7.000	5.498	13.000	225.000
7	7	1.000	-5.833	-54.27	7.000	4.712	13.000	270.000
8	8	1.000	-5.833	-54.27	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 1.000 SECONDS *********

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.21	-0.37	0.30	0.52	-2.76	-4.72	13.41	14.48
2	-0.16	-0.27	-0.18	0.37	-2.08	-3.52	3.55	5.41
3	-0.11	-0.19	-0.30	0.37	-1.46	-2.42	1.58	3.24
4	-0.07	-0.12	-0.34	0.37	-0.96	-1.56	0.84	2.02
5	-0.04	-0.07	-0.37	0.37	-0.55	-0.87	0.50	1.14
6	-0.01	-0.02	-0.37	0.38	-0.18	-0.28	0.35	0.49

CAL. No. 12177.03-PX-60052
(C.O. Load on pedestal: pool downcomers)

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 1.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.21	-0.37	0.0	0.42	-2.76	-4.72	0.0	5.46
2	-0.16	-0.27	0.0	0.32	-2.08	-3.52	0.0	4.08
3	-0.11	-0.19	0.0	0.22	-1.46	-2.42	0.0	2.83
4	-0.07	-0.12	0.0	0.14	-0.96	-1.56	0.0	1.83
5	-0.04	-0.07	0.0	0.08	-0.55	-0.87	0.0	1.03
6	-0.01	-0.02	0.0	0.03	-0.18	-0.28	0.0	0.33

********* DRAGS AT TIME = 1.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-0.46	-0.81	0.0	0.93	-71.32	-121.96	0.0	141.28	-71.79	-122.77	0.0	142.22
2	-0.26	-0.45	0.0	0.52	-53.67	-90.94	0.0	105.60	-53.94	-91.39	0.0	106.12
3	-0.13	-0.21	0.0	0.25	-37.73	-62.59	0.0	73.09	-37.86	-62.81	0.0	73.34
4	-0.05	-0.09	0.0	0.10	-24.89	-40.35	0.0	47.41	-24.94	-40.44	0.0	47.51
5	-0.02	-0.03	0.0	0.03	-14.17	-22.59	0.0	26.67	-14.19	-22.62	0.0	26.70
6	-0.00	-0.00	0.0	0.00	-4.61	-7.20	0.0	8.61	-4.61	-7.28	0.0	8.61
TOTAL	-0.93	-1.59	0.0	1.84	-206.40	-345.71	0.0	402.65	-207.33	-347.30	0.0	404.50

*** K-FACTORS AT TIME = 1.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-60160-0

C1

T... BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HALL ... OOL
THE ... ZE IS 20.250 20.250 25.000 TIME= 2.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-2.850	-52.51	7.000	3.142	13.000	0.0
2	2	1.000	0.951	50.01	7.000	2.356	13.000	45.000
3	3	1.000	0.951	50.01	7.000	1.571	13.000	90.000
4	4	1.000	0.951	50.01	7.000	0.785	13.000	135.000
5	5	1.000	0.951	50.01	7.000	0.0	13.000	180.000
6	6	1.000	-2.850	-52.51	7.000	5.498	13.000	225.000
7	7	1.000	-2.850	-52.51	7.000	4.712	13.000	270.000
8	8	1.000	-2.850	-52.51	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 2.000 SECONDS *********

CAL. NO. 12177.05-PX-60052
(C.O. Load on pedestal
not downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.10	-0.17	0.11	0.23	-2.73	-4.67	13.81	14.83
2	-0.08	-0.13	-0.11	0.19	-2.06	-3.48	3.85	5.58
3	-0.05	-0.09	-0.16	0.19	-1.44	-2.40	1.87	3.37
4	-0.04	-0.06	-0.18	0.20	-0.95	-1.54	1.13	2.14
5	-0.02	-0.03	-0.19	0.20	-0.54	-0.86	0.79	1.29
6	-0.01	-0.01	-0.20	0.20	-0.18	-0.28	0.65	0.73

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 2.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.10	-0.17	0.0	0.20	-2.73	-4.67	0.0	5.41
2	-0.08	-0.13	0.0	0.15	-2.06	-3.48	0.0	4.04
3	-0.05	-0.09	0.0	0.10	-1.44	-2.40	0.0	2.80
4	-0.04	-0.06	0.0	0.07	-0.95	-1.54	0.0	1.81
5	-0.02	-0.03	0.0	0.04	-0.54	-0.86	0.0	1.02
6	-0.01	-0.01	0.0	0.01	-0.18	-0.28	0.0	0.33

********* DRAGS AT TIME = 2.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-0.10	-0.18	0.0	0.21	-70.65	-120.64	0.0	139.81	-70.75	-120.83	0.0	140.02
2	-0.06	-0.10	0.0	0.12	-53.15	-89.97	0.0	104.50	-53.20	-90.08	0.0	104.62
3	-0.03	-0.05	0.0	0.06	-37.36	-61.94	0.0	72.33	-37.39	-61.98	0.0	72.39
4	-0.01	-0.02	0.0	0.02	-24.64	-39.93	0.0	46.92	-24.65	-39.95	0.0	46.94
5	-0.00	-0.01	0.0	0.01	-14.03	-22.35	0.0	26.39	-14.04	-22.36	0.0	26.40
6	-0.00	-0.00	0.0	0.00	-4.56	-7.20	0.0	8.52	-4.56	-7.20	0.0	8.52
TOTAL	-0.21	-0.36	0.0	0.41	-204.38	-342.03	0.0	398.47	-204.59	-342.39	0.0	398.88

*** K-FACTORS AT TIME = 2.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

12177.28-NPC(S)-PX-60160-0

ATTACHMENT C

[illegible]

...S BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HALL ... POOL
TH... IZE IS 20.250 20.250 25.000 TIME= 3.00

BUBBLE INDEX	DOWNCOMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-2.932	-90.97	7.000	3.142	13.000	0.0
2	2	1.000	2.297	82.88	7.000	2.356	13.000	45.000
3	3	1.000	2.297	82.88	7.000	1.571	13.000	90.000
4	4	1.000	2.297	82.88	7.000	0.785	13.000	135.000
5	5	1.000	2.297	82.88	7.000	0.0	13.000	180.000
6	6	1.000	-2.932	-90.97	7.000	5.498	13.000	225.000
7	7	1.000	-2.932	-90.97	7.000	4.712	13.000	270.000
8	8	1.000	-2.932	-90.97	7.000	3.927	13.000	315.000

######### VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 3.000 SECONDS #########

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.14	-0.24	0.59	0.65	-4.63	-7.92	22.56	24.35
2	-0.10	-0.18	0.13	0.24	-3.48	-5.90	5.98	9.10
3	-0.07	-0.12	0.03	0.15	-2.45	-4.06	2.68	5.45
4	-0.05	-0.08	-0.01	0.09	-1.62	-2.62	1.44	3.40
5	-0.03	-0.04	-0.02	0.06	-0.92	-1.47	0.86	1.93
6	-0.01	-0.01	-0.03	0.03	-0.30	-0.47	0.62	0.89

CAL. NO. 12177.03-PX-60052
C.C.O. Load on backside of pool downcomers)

######### VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 3.000 SECONDS #########

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.14	-0.24	0.0	0.28	-4.63	-7.92	0.0	9.17
2	-0.10	-0.18	0.0	0.21	-3.48	-5.90	0.0	6.85
3	-0.07	-0.12	0.0	0.14	-2.45	-4.06	0.0	4.74
4	-0.05	-0.08	0.0	0.09	-1.62	-2.62	0.0	3.08
5	-0.03	-0.04	0.0	0.05	-0.92	-1.47	0.0	1.73
6	-0.01	-0.01	0.0	0.02	-0.30	-0.47	0.0	0.56

######### DRAGS AT TIME = 3.000 SECONDS #########

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-0.20	-0.34	0.0	0.40	-119.71	-204.68	0.0	237.12	-119.91	-205.02	0.0	237.52
2	-0.11	-0.19	0.0	0.22	-90.08	-152.62	0.0	177.22	-90.20	-152.81	0.0	177.44
3	-0.05	-0.09	0.0	0.11	-63.33	-105.05	0.0	122.66	-63.39	-105.14	0.0	122.77
4	-0.02	-0.04	0.0	0.04	-41.77	-67.72	0.0	79.57	-41.80	-67.76	0.0	79.61
5	-0.01	-0.01	0.0	0.01	-23.79	-37.92	0.0	44.76	-23.79	-37.93	0.0	44.77
6	-0.00	-0.00	0.0	0.00	-7.73	-12.21	0.0	14.45	-7.73	-12.21	0.0	14.45
TOTAL	-0.40	-0.67	0.0	0.78	-346.42	-580.20	0.0	675.79	-346.82	-580.87	0.0	676.57

H-FACTORS AT TIME = 3.000 SECONDS
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C
12177.28-NPC(C)-PX-60160-0

C3

TH[illegible] HAS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE WALL [illegible] POOL
TH[illegible] SIZE IS 20.250 20.250 25.000 TIME= 4.00

BUBBLE INDEX	DOWNCOMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-2.515	-96.80	7.000	3.142	13.000	0.0
2	2	1.000	25.325	285.54	7.000	2.356	13.000	45.000
3	3	1.000	25.325	285.54	7.000	1.571	13.000	90.000
4	4	1.000	25.325	285.54	7.000	0.785	13.000	135.000
5	5	1.000	25.325	285.54	7.000	0.0	13.000	180.000
6	6	1.000	-2.515	-96.80	7.000	5.498	13.000	225.000
7	7	1.000	-2.515	-96.80	7.000	4.712	13.000	270.000
8	8	1.000	-2.515	-96.80	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 4.000 SECONDS *********

CAL. No. 12177.03-PX-60352

(C.O. Load on Pedestal and downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.76	-1.24	9.03	9.15	-10.38	-17.21	96.02	98.10
2	-0.57	-0.94	4.33	4.47	-7.75	-12.90	42.07	44.68
3	-0.40	-0.65	3.52	3.60	-5.43	-8.90	32.34	33.98
4	-0.26	-0.42	3.24	3.27	-3.58	-5.73	28.93	29.71
5	-0.15	-0.23	3.12	3.13	-2.04	-3.21	27.41	27.67
6	-0.05	-0.07	3.07	3.07	-0.66	-1.03	26.79	26.82

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 4.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.76	-1.24	0.0	1.46	-10.38	-17.21	0.0	20.10
2	-0.57	-0.94	0.0	1.09	-7.75	-12.90	0.0	15.04
3	-0.40	-0.65	0.0	0.76	-5.43	-8.90	0.0	10.42
4	-0.26	-0.42	0.0	0.49	-3.58	-5.73	0.0	6.76
5	-0.15	-0.23	0.0	0.28	-2.04	-3.21	0.0	3.80
6	-0.05	-0.07	0.0	0.09	-0.66	-1.03	0.0	1.23

********* [illegible] AT TIME = 4.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-5.80	-9.44	0.0	11.08	-268.32	-445.12	0.0	519.74	-274.12	-454.56	0.0	530.82
2	-3.23	-5.32	0.0	6.22	-200.28	-333.48	0.0	389.00	-203.51	-338.80	0.0	395.22
3	-1.56	-2.54	0.0	2.99	-140.29	-230.02	0.0	269.43	-141.05	-232.56	0.0	272.41
4	-0.67	-1.06	0.0	1.26	-92.55	-148.25	0.0	174.77	-93.22	-149.31	0.0	176.03
5	-0.21	-0.33	0.0	0.40	-52.76	-82.94	0.0	98.30	-52.98	-83.27	0.0	98.69
6	-0.02	-0.03	0.0	0.04	-17.16	-26.70	0.0	31.74	-17.18	-26.73	0.0	31.78
TOTAL	-11.49	-18.74	0.0	21.98	-771.37	-1266.51	0.0	1482.97	-782.86	-1285.24	0.0	1504.95

*** K-FACTORS AT TIME = 4.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-60/60-0

C4

46

[illegible]

T… HAS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HAL… …E POOL
T… SIZE IS 20.250 20.250 25.000 TIME= 5.00

BUBBLE INDEX	DOWNCOMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-13.095	-304.37	7.000	3.142	13.000	0.0
2	2	1.000	11.576	223.39	7.000	2.356	13.000	45.000
3	3	1.000	11.576	223.39	7.000	1.571	13.000	90.000
4	4	1.000	11.576	223.39	7.000	0.785	13.000	135.000
5	5	1.000	11.576	223.39	7.000	0.0	13.000	100.000
6	6	1.000	-13.095	-304.37	7.000	5.498	13.000	225.000
7	7	1.000	-13.095	-304.37	7.000	4.712	13.000	270.000
8	8	1.000	-13.095	-304.37	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 5.000 SECONDS *********

CAL. NO. 12177.03-PX-60052…
(C.O. Load on Pedestal
Pool downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.66	-1.12	3.12	3.38	-14.00	-24.08	55.80	62.37
2	-0.49	-0.84	0.80	1.26	-10.55	-17.94	10.27	23.21
3	-0.35	-0.58	0.33	0.75	-7.42	-12.34	0.92	14.43
4	-0.23	-0.37	0.16	0.46	-4.90	-7.96	-2.67	9.72
5	-0.13	-0.21	0.08	0.26	-2.79	-4.46	-4.36	6.83
6	-0.04	-0.07	0.04	0.09	-0.91	-1.44	-5.06	5.34

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 5.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.66	-1.12	0.0	1.30	-14.00	-24.08	0.0	27.86
2	-0.49	-0.84	0.0	0.97	-10.55	-17.94	0.0	20.81
3	-0.35	-0.58	0.0	0.67	-7.42	-12.34	0.0	14.40
4	-0.23	-0.37	0.0	0.44	-4.90	-7.96	0.0	9.34
5	-0.13	-0.21	0.0	0.25	-2.79	-4.46	0.0	5.26
6	-0.04	-0.07	0.0	0.08	-0.91	-1.44	0.0	1.70

********* DRAGS AT TIME = 5.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-4.44	-7.60	0.0	8.80	-362.03	-622.73	0.0	720.31	-366.47	-630.32	0.0	729.11
2	-2.50	-4.23	0.0	4.91	-272.88	-463.90	0.0	538.20	-275.37	-468.13	0.0	543.12
3	-1.22	-2.02	0.0	2.35	-191.98	-319.17	0.0	372.46	-193.20	-321.19	0.0	374.81
4	-0.52	-0.84	0.0	0.99	-126.63	-205.76	0.0	241.61	-127.15	-206.61	0.0	242.60
5	-0.17	-0.27	0.0	0.31	-72.09	-115.22	0.0	135.91	-72.25	-115.49	0.0	136.23
6	-0.02	-0.03	0.0	0.03	-23.42	-37.12	0.0	43.89	-23.44	-37.14	0.0	43.92
TOTAL	-8.85	-14.98	0.0	17.40	-1049.02	-1763.89	0.0	2052.38	-1057.87	-1778.87	0.0	2069.78

*** H-FACTORS AT TIME = 5.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-60160-0

C5

TH[illegible]AS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HALL [illegible]POOL
[illegible]IZE IS 20.250 20.250 25.000 TIME= 6.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-13.157	-152.57	7.000	3.142	13.000	0.0
2	2	1.000	5.436	329.23	7.000	2.356	13.000	45.000
3	3	1.000	5.436	329.23	7.000	1.571	13.000	90.000
4	4	1.000	5.436	329.23	7.000	0.785	13.000	135.000
5	5	1.000	5.436	329.23	7.000	0.0	13.000	100.000
6	6	1.000	-13.157	-152.57	7.000	5.498	13.000	225.000
7	7	1.000	-13.157	-152.57	7.000	4.712	13.000	270.000
8	8	1.000	-13.157	-152.57	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 6.000 SECONDS *********

CAL. NO. 12177.05-PX-60052
(C.O. Load on Pedestal Load Downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.49	-0.85	0.87	1.31	-13.02	-21.75	107.25	110.21
2	-0.37	-0.63	-0.32	0.80	-9.74	-16.28	44.45	48.33
3	-0.26	-0.44	-0.59	0.78	-6.82	-11.22	32.92	35.44
4	-0.17	-0.28	-0.70	0.77	-4.50	-7.23	28.82	30.06
5	-0.10	-0.16	-0.75	0.78	-2.57	-4.05	26.98	27.41
6	-0.03	-0.05	-0.78	0.78	-0.83	-1.30	26.23	26.28

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 6.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.49	-0.85	0.0	0.98	-13.02	-21.75	0.0	25.35
2	-0.37	-0.63	0.0	0.73	-9.74	-16.28	0.0	18.96
3	-0.26	-0.44	0.0	0.51	-6.82	-11.22	0.0	13.13
4	-0.17	-0.28	0.0	0.33	-4.50	-7.23	0.0	8.52
5	-0.10	-0.16	0.0	0.19	-2.57	-4.05	0.0	4.79
6	-0.03	-0.05	0.0	0.06	-0.83	-1.30	0.0	1.55

********* DRAGS AT TIME = 6.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-2.49	-4.36	0.0	5.02	-336.62	-562.39	0.0	655.44	-339.11	-566.75	0.0	660.46
2	-1.41	-2.42	0.0	2.80	-251.74	-420.87	0.0	490.41	-253.15	-423.28	0.0	493.21
3	-0.69	-1.15	0.0	1.34	-176.48	-290.15	0.0	339.61	-177.17	-291.30	0.0	340.95
4	-0.29	-0.48	0.0	0.56	-116.43	-107.02	0.0	220.30	-116.72	-187.50	0.0	220.86
5	-0.09	-0.15	0.0	0.18	-66.35	-104.64	0.0	123.91	-66.45	-104.79	0.0	124.08
6	-0.01	-0.02	0.0	0.02	-21.58	-33.69	0.0	40.01	-21.58	-33.70	0.0	40.02
TOTAL	-4.99	-8.57	0.0	9.92	-969.20	-1598.76	0.0	1869.66	-974.19	-1607.33	0.0	1879.58

*** H-FACTORS AT TIME = 6.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-60160-0

C6

43

HAS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HALL POOL
TH SIZE IS 20.250 20.250 25.000 TIME= 7.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-11.374	-259.65	7.000	3.142	13.000	0.0
2	2	1.000	6.689	391.31	7.000	2.356	13.000	45.000
3	3	1.000	6.689	391.31	7.000	1.571	13.000	90.000
4	4	1.000	6.689	391.31	7.000	0.785	13.000	135.000
5	5	1.000	6.689	391.31	7.000	0.0	13.000	180.000
6	6	1.000	-11.374	-259.65	7.000	5.498	13.000	225.000
7	7	1.000	-11.374	-259.65	7.000	4.712	13.000	270.000
8	8	1.000	-11.374	-259.65	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 7.000 SECONDS *********

CAL. NO. 12177.03-PX-60052
(C.O. Load on pedestal
pool downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.48	-0.83	1.48	1.76	-17.49	-29.49	120.86	125.63
2	-0.36	-0.61	0.08	0.72	-13.11	-22.03	45.08	51.86
3	-0.25	-0.42	-0.21	0.54	-9.20	-15.18	30.78	35.53
4	-0.17	-0.27	-0.33	0.46	-6.07	-9.79	25.59	28.06
5	-0.10	-0.15	-0.39	0.43	-3.46	-5.48	23.23	24.12
6	-0.03	-0.05	-0.41	0.41	-1.12	-1.76	22.27	22.36

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 7.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.48	-0.83	0.0	0.95	-17.49	-29.49	0.0	34.20
2	-0.36	-0.61	0.0	0.71	-13.11	-22.03	0.0	25.64
3	-0.25	-0.42	0.0	0.49	-9.20	-15.18	0.0	17.75
4	-0.17	-0.27	0.0	0.32	-6.07	-9.79	0.0	11.51
5	-0.10	-0.15	0.0	0.18	-3.46	-5.48	0.0	6.48
6	-0.03	-0.05	0.0	0.06	-1.12	-1.76	0.0	2.09

********* DRAGS AT TIME = 7.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-2.37	-4.09	0.0	4.73	-452.20	-762.46	0.0	886.47	-454.56	-766.56	0.0	891.20
2	-1.33	-2.28	0.0	2.64	-339.01	-569.76	0.0	662.99	-340.34	-572.04	0.0	665.63
3	-0.65	-1.08	0.0	1.26	-237.93	-392.55	0.0	459.03	-238.58	-393.63	0.0	460.29
4	-0.28	-0.45	0.0	0.53	-156.95	-253.03	0.0	297.76	-157.23	-253.49	0.0	298.29
5	-0.09	-0.14	0.0	0.17	-89.42	-141.62	0.0	167.48	-89.51	-141.76	0.0	167.65
6	-0.01	-0.01	0.0	0.02	-29.07	-45.60	0.0	54.08	-29.08	-45.62	0.0	54.09
TOTAL	-4.73	-8.06	0.0	9.35	-1304.57	-2165.03	0.0	2527.81	-1309.30	-2173.09	0.0	2537.15

*** K-FACTORS AT TIME = 7.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

12177.28-NPC(S)-PX-60160-0

ATTACHMENT C

C7

[illegible] HAS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HAL[illegible] POOL
THE [illegible] SIZE IS 20.250 20.250 25.000 TIME= 8.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-7.922	-202.13	7.000	3.142	13.000	0.0
2	2	1.000	3.916	216.37	7.000	2.356	13.000	45.000
3	3	1.000	3.916	216.37	7.000	1.571	13.000	90.000
4	4	1.000	3.916	216.37	7.000	0.785	13.000	135.000
5	5	1.000	3.916	216.37	7.000	0.0	13.000	180.000
6	6	1.000	-7.922	-202.13	7.000	5.498	13.000	225.000
7	7	1.000	-7.922	-202.13	7.000	4.712	13.000	270.000
8	8	1.000	-7.922	-202.13	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 8.000 SECONDS *********

CAL. NO. 12177.03-PX-60052
(C.O. Load on Pedestal pool downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.31	-0.54	0.76	0.98	-11.18	-19.02	61.88	65.70
2	-0.24	-0.40	-0.08	0.47	-8.40	-14.19	19.12	25.25
3	-0.17	-0.28	-0.26	0.41	-5.90	-9.77	10.77	15.70
4	-0.11	-0.18	-0.33	0.39	-3.89	-6.30	7.67	10.66
5	-0.06	-0.10	-0.37	0.39	-2.22	-3.53	6.24	7.50
6	-0.02	-0.03	-0.38	0.38	-0.72	-1.14	5.65	5.80

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 8.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.31	-0.54	0.0	0.63	-11.18	-19.02	0.0	22.06
2	-0.24	-0.40	0.0	0.47	-8.40	-14.19	0.0	16.49
3	-0.17	-0.28	0.0	0.32	-5.90	-9.77	0.0	11.42
4	-0.11	-0.18	0.0	0.21	-3.89	-6.30	0.0	7.41
5	-0.06	-0.10	0.0	0.12	-2.22	-3.53	0.0	4.17
6	-0.02	-0.03	0.0	0.04	-0.72	-1.14	0.0	1.35

********* DRAGS AT TIME = 8.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-1.01	-1.76	0.0	2.03	-289.00	-491.91	0.0	570.52	-290.02	-493.67	0.0	572.55
2	-0.57	-0.98	0.0	1.13	-217.21	-367.04	0.0	426.50	-217.78	-368.02	0.0	427.63
3	-0.28	-0.47	0.0	0.54	-152.62	-252.72	0.0	295.23	-152.90	-253.10	0.0	295.77
4	-0.12	-0.19	0.0	0.23	-100.67	-162.91	0.0	191.51	-100.79	-163.10	0.0	191.74
5	-0.04	-0.06	0.0	0.07	-57.33	-91.20	0.0	107.73	-57.37	-91.26	0.0	107.80
6	-0.00	-0.01	0.0	0.01	-18.63	-29.37	0.0	34.78	-18.64	-29.38	0.0	34.79
TOTAL	-2.03	-3.47	0.0	4.02	-835.48	-1395.15	0.0	1626.27	-837.51	-1398.62	0.0	1630.28

*** K-FACTORS AT TIME = 8.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-6060-0

C8

50

Th[...]AS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE WALL [...] POOL
[...]SIZE IS 20.250 20.250 25.000 TIME= 9.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-6.070	-181.23	7.000	3.142	13.000	0.0
2	2	1.000	4.359	298.28	7.000	2.356	13.000	45.000
3	3	1.000	4.359	298.28	7.000	1.571	13.000	90.000
4	4	1.000	4.359	298.28	7.000	0.785	13.000	135.000
5	5	1.000	4.359	298.28	7.000	0.0	13.000	180.000
6	6	1.000	-6.070	-181.23	7.000	5.498	13.000	225.000
7	7	1.000	-6.070	-181.23	7.000	4.712	13.000	270.000
8	8	1.000	-6.070	-181.23	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 9.000 SECONDS *********

CAL. No. 12177.05-PX-6005-2
(C.O. Load on podostrol pool downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.28	-0.48	1.08	1.21	-12.90	-21.70	93.54	96.88
2	-0.21	-0.35	0.19	0.45	-9.67	-16.22	36.01	40.66
3	-0.15	-0.24	0.00	0.28	-6.78	-11.18	25.24	28.42
4	-0.10	-0.16	-0.07	0.20	-4.47	-7.21	21.35	22.98
5	-0.06	-0.09	-0.10	0.14	-2.55	-4.03	19.59	20.17
6	-0.02	-0.03	-0.11	0.12	-0.83	-1.30	18.87	18.93

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 9.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.28	-0.48	0.0	0.55	-12.90	-21.70	0.0	25.25
2	-0.21	-0.35	0.0	0.41	-9.67	-16.22	0.0	18.88
3	-0.15	-0.24	0.0	0.28	-6.78	-11.18	0.0	13.07
4	-0.10	-0.16	0.0	0.18	-4.47	-7.21	0.0	8.48
5	-0.06	-0.09	0.0	0.10	-2.55	-4.03	0.0	4.77
6	-0.02	-0.03	0.0	0.03	-0.83	-1.30	0.0	1.54

********* DRAGS AT TIME = 9.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-0.79	-1.36	0.0	1.57	-333.59	-561.16	0.0	652.82	-334.38	-562.52	0.0	654.40
2	-0.45	-0.76	0.0	0.88	-249.93	-419.49	0.0	488.30	-250.38	-420.25	0.0	489.18
3	-0.22	-0.36	0.0	0.42	-175.36	-289.06	0.0	338.09	-175.58	-209.42	0.0	338.52
4	-0.09	-0.15	0.0	0.18	-115.68	-186.32	0.0	219.31	-115.77	-186.47	0.0	219.49
5	-0.03	-0.05	0.0	0.06	-65.91	-104.27	0.0	123.36	-65.94	-104.32	0.0	123.41
6	-0.00	-0.00	0.0	0.01	-21.43	-33.57	0.0	39.83	-21.43	-33.58	0.0	39.89
TOTAL	-1.58	-2.68	0.0	3.11	-961.90	-1593.88	0.0	1861.72	-963.47	-1596.56	0.0	1864.83

K-FACTORS AT TIME = 9.000 SECONDS
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

12177.28-NP(C)-PX-6060-0
ATTACHMENT C

C9

51

TH... HAS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HALL... POOL
THE SIZE IS 20.250 20.250 25.000 TIME= 10.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-10.769	-197.62	7.000	3.192	13.000	0.0
2	2	1.000	8.269	212.76	7.000	2.356	13.000	45.000
3	3	1.000	8.269	212.76	7.000	1.571	13.000	90.000
4	4	1.000	8.269	212.76	7.000	0.785	13.000	135.000
5	5	1.000	8.269	212.76	7.000	0.0	13.000	100.000
6	6	1.000	-10.769	-197.62	7.000	5.498	13.000	225.000
7	7	1.000	-10.769	-197.62	7.000	4.712	13.000	270.000
8	8	1.000	-10.769	-197.62	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 10.000 SECONDS *********

	VELOCITY(FT/SEC)				ACCELERATION(FT/SEC**2)			
SEGMENT NO.	X	Y	Z	RESULTANT	X	Y	Z	RESULTANT
1	-0.51	-0.87	2.11	2.33	-10.96	-18.65	60.94	64.67
2	-0.38	-0.65	0.43	0.86	-8.24	-13.92	18.92	24.89
3	-0.27	-0.45	0.09	0.53	-5.79	-9.58	10.71	15.50
4	-0.18	-0.29	-0.04	0.34	-3.82	-6.18	7.67	10.56
5	-0.10	-0.16	-0.11	0.22	-2.17	-3.46	6.26	7.48
6	-0.03	-0.05	-0.13	0.14	-0.71	-1.11	5.68	5.83

CAL. NO. 12177.08-PX-60052

(C.O. Load on pedestal pool downcomers)

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 10.000 SECONDS *********

	NORMAL VELOCITY(FT/SEC)				NORMAL ACCELERATION(FT/SEC**2)			
SEGMENT NO.	X	Y	Z	RESULTANT	X	Y	Z	RESULTANT
1	-0.51	-0.87	0.0	1.00	-10.96	-18.65	0.0	21.63
2	-0.38	-0.65	0.0	0.75	-8.24	-13.92	0.0	16.17
3	-0.27	-0.45	0.0	0.52	-5.79	-9.58	0.0	11.20
4	-0.18	-0.29	0.0	0.34	-3.82	-6.18	0.0	7.26
5	-0.10	-0.16	0.0	0.19	-2.17	-3.46	0.0	4.08
6	-0.03	-0.05	0.0	0.06	-0.71	-1.11	0.0	1.32

********* DRAGS AT TIME = 10.000 SECONDS *********

	VELOCITY DRAG (LBF)				ACCELERATION DRAG (LBF)				TOTAL DRAG (LBF)			
SEGMENT NO.	X	Y	Z	RESULTANT	X	Y	Z	RESULTANT	X	Y	Z	RESULTANT
1	-2.64	-4.53	0.0	5.24	-283.42	-482.33	0.0	559.43	-286.06	-486.06	0.0	564.68
2	-1.49	-2.52	0.0	2.93	-213.01	-359.91	0.0	418.22	-214.49	-362.43	0.0	421.14
3	-0.72	-1.20	0.0	1.40	-149.67	-247.80	0.0	289.49	-150.39	-249.01	0.0	290.90
4	-0.31	-0.50	0.0	0.59	-98.72	-159.74	0.0	107.79	-99.03	-160.25	0.0	109.38
5	-0.10	-0.16	0.0	0.19	-56.22	-89.43	0.0	105.63	-56.32	-89.59	0.0	105.82
6	-0.01	-0.02	0.0	0.02	-18.27	-28.00	0.0	34.11	-18.28	-20.82	0.0	34.13
TOTAL	-5.26	-8.93	0.0	10.37	-819.31	-1368.01	0.0	1594.67	-824.58	-1376.94	0.0	1605.09

*** H-FACTORS AT TIME = 10.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

12177-NP(C)-PX-60160-0

ATTACHMENT C

C10

52

[illegible]

Th... HAS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE WALL ... POOL
... SIZE IS 20.250 20.250 25.000 TIME= 11.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-1.335	-135.03	7.000	3.142	13.000	0.0
2	2	1.000	34.826	593.52	7.000	2.356	13.000	45.000
3	3	1.000	34.826	593.52	7.000	1.571	13.000	90.000
4	4	1.000	34.826	593.52	7.000	0.785	13.000	135.000
5	5	1.000	34.826	593.52	7.000	0.0	13.000	180.000
6	6	1.000	-1.335	-135.03	7.000	5.498	13.000	225.000
7	7	1.000	-1.335	-135.03	7.000	4.712	13.000	270.000
8	8	1.000	-1.335	-135.03	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 11.000 SECONDS *********

CAL. NO. 12177.08-PX-60052
(C.D. Load on pedestal
pool downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-1.00	-1.61	12.60	12.74	-19.87	-32.71	205.18	208.72
2	-0.74	-1.21	6.17	6.33	-14.80	-24.53	94.01	98.27
3	-0.52	-0.84	5.06	5.16	-10.36	-16.93	74.28	76.89
4	-0.34	-0.54	4.69	4.73	-6.83	-10.91	67.46	68.68
5	-0.19	-0.30	4.52	4.54	-3.90	-6.10	64.44	64.85
6	-0.06	-0.10	4.46	4.46	-1.27	-1.96	63.22	63.27

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 11.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-1.00	-1.61	0.0	1.90	-19.87	-32.71	0.0	38.27
2	-0.74	-1.21	0.0	1.42	-14.80	-24.53	0.0	28.65
3	-0.52	-0.84	0.0	0.98	-10.36	-16.93	0.0	19.85
4	-0.34	-0.54	0.0	0.64	-6.83	-10.91	0.0	12.87
5	-0.19	-0.30	0.0	0.36	-3.90	-6.10	0.0	7.24
6	-0.06	-0.10	0.0	0.12	-1.27	-1.96	0.0	2.34

********* DRAGS AT TIME = 11.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-9.81	-15.89	0.0	18.67	-513.70	-845.77	0.0	989.55	-523.51	-861.66	0.0	1008.22
2	-5.45	-8.95	0.0	10.48	-382.68	-634.41	0.0	740.89	-388.13	-643.36	0.0	751.37
3	-2.64	-4.29	0.0	5.03	-267.80	-437.82	0.0	513.23	-270.44	-442.11	0.0	518.26
4	-1.13	-1.79	0.0	2.12	-176.69	-282.17	0.0	332.92	-177.82	-283.96	0.0	335.04
5	-0.36	-0.56	0.0	0.67	-100.75	-157.82	0.0	187.24	-101.11	-158.38	0.0	187.91
6	-0.04	-0.06	0.0	0.07	-32.77	-50.79	0.0	60.45	-32.81	-50.85	0.0	60.52
TOTAL	-19.43	-31.54	0.0	37.05	-1474.39	-2408.78	0.0	2824.27	-1493.82	-2440.32	0.0	2861.32

H-FACTORS AT TIME = 11.000 SECONDS
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

12177.28-NPC(C)-PX-60160-0
ATTACHMENT C

[illegible] AS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HALI [illegible] POOL
TI [illegible] SIZE IS 20.250 20.250 25.000 TIME= 12.00

BUBBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-9.389	-180.51	7.000	3.142	13.000	0.0
2	2	1.000	16.363	168.91	7.000	2.356	13.000	45.000
3	3	1.000	16.363	168.91	7.000	1.571	13.000	90.000
4	4	1.000	16.363	168.91	7.000	0.785	13.000	135.000
5	5	1.000	16.363	168.91	7.000	0.0	13.000	180.000
6	6	1.000	-9.389	-180.51	7.000	5.498	13.000	225.000
7	7	1.000	-9.389	-180.51	7.000	4.712	13.000	270.000
8	8	1.000	-9.389	-180.51	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 12.000 SECONDS *********

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.69	-1.16	5.18	5.35	-9.31	-15.90	46.39	49.91
2	-0.52	-0.87	2.03	2.27	-7.00	-11.86	12.68	18.72
3	-0.36	-0.60	1.44	1.61	-4.92	-8.16	5.99	11.26
4	-0.24	-0.39	1.23	1.31	-3.25	-5.26	3.47	7.09
5	-0.14	-0.22	1.14	1.17	-1.85	-2.95	2.31	4.17
6	-0.04	-0.07	1.10	1.10	-0.60	-0.95	1.82	2.14

CAL. NO. 12177.05-PX-60052
(C.O. LOAD ON Pedestal pool downcomers)

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 12.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.69	-1.16	0.0	1.36	-9.31	-15.90	0.0	18.43
2	-0.52	-0.87	0.0	1.01	-7.00	-11.86	0.0	13.77
3	-0.36	-0.60	0.0	0.70	-4.92	-8.16	0.0	9.53
4	-0.24	-0.39	0.0	0.46	-3.25	-5.26	0.0	6.18
5	-0.14	-0.22	0.0	0.26	-1.85	-2.95	0.0	3.48
6	-0.04	-0.07	0.0	0.08	-0.60	-0.95	0.0	1.12

********* DRAGS AT TIME = 12.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-4.88	-8.20	0.0	9.54	-240.72	-411.27	0.0	476.54	-245.60	-419.47	0.0	486.08
2	-2.74	-4.59	0.0	5.34	-181.11	-306.69	0.0	356.18	-183.84	-311.28	0.0	361.52
3	-1.33	-2.19	0.0	2.56	-127.31	-211.11	0.0	246.53	-128.64	-213.30	0.0	249.09
4	-0.57	-0.92	0.0	1.08	-83.98	-136.09	0.0	159.92	-84.54	-137.01	0.0	160.99
5	-0.18	-0.29	0.0	0.34	-47.82	-76.19	0.0	89.96	-48.00	-76.48	0.0	90.30
6	-0.02	-0.03	0.0	0.04	-15.54	-24.54	0.0	29.05	-15.56	-24.57	0.0	29.08
TOTAL	-9.72	-16.21	0.0	18.90	-696.47	-1165.90	0.0	1358.16	-706.18	-1182.11	0.0	1377.06

*** H-FACTORS AT TIME = 12.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-60160-0

C12

54

AS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE WALL POOL
TH SIZE IS 20.250 20.250 25.000 TIME= 13.00

BUBBLE INDEX	DOWNCOMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-6.243	-173.27	7.000	3.142	13.000	0.0
2	2	1.000	5.714	325.11	7.000	2.356	13.000	45.000
3	3	1.000	5.714	325.11	7.000	1.571	13.000	90.000
4	4	1.000	5.714	325.11	7.000	0.785	13.000	135.000
5	5	1.000	5.714	325.11	7.000	0.0	13.000	180.000
6	6	1.000	-6.243	-173.27	7.000	5.498	13.000	225.000
7	7	1.000	-6.243	-173.27	7.000	4.712	13.000	270.000
8	8	1.000	-6.243	-173.27	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 13.000 SECONDS *********

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.32	-0.54	1.56	1.68	-13.44	-22.53	104.00	107.26
2	-0.24	-0.41	0.42	0.63	-10.06	-16.85	41.66	46.05
3	-0.17	-0.28	0.19	0.38	-7.05	-11.61	30.10	33.02
4	-0.11	-0.18	0.10	0.24	-4.65	-7.49	25.96	27.42
5	-0.06	-0.10	0.06	0.13	-2.65	-4.19	24.09	24.60
6	-0.02	-0.03	0.05	0.06	-0.86	-1.35	23.33	23.39

CAL. NO. 12177.08-PX-60052
(C.O. Load on pedestal pool downcomers)

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 13.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.32	-0.54	0.0	0.63	-13.44	-22.53	0.0	26.23
2	-0.24	-0.41	0.0	0.47	-10.06	-16.85	0.0	19.62
3	-0.17	-0.28	0.0	0.33	-7.05	-11.61	0.0	13.59
4	-0.11	-0.18	0.0	0.21	-4.65	-7.49	0.0	8.81
5	-0.06	-0.10	0.0	0.12	-2.65	-4.19	0.0	4.96
6	-0.02	-0.03	0.0	0.04	-0.86	-1.35	0.0	1.60

********* DRAG AT TIME = 13.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-1.04	-1.78	0.0	2.07	-347.45	-582.50	0.0	678.25	-348.49	-584.28	0.0	680.32
2	-0.59	-0.99	0.0	1.15	-260.08	-435.67	0.0	507.40	-260.67	-436.67	0.0	508.55
3	-0.29	-0.47	0.0	0.55	-182.41	-300.29	0.0	351.35	-182.69	-300.76	0.0	351.90
4	-0.12	-0.20	0.0	0.23	-120.33	-193.55	0.0	227.91	-120.45	-193.75	0.0	228.14
5	-0.04	-0.06	0.0	0.07	-68.57	-108.31	0.0	128.19	-68.61	-108.37	0.0	128.26
6	-0.00	-0.01	0.0	0.01	-22.29	-34.87	0.0	41.39	-22.30	-34.88	0.0	41.40
TOTAL	-2.08	-3.52	0.0	4.09	-1001.13	-1655.19	0.0	1934.48	-1003.21	-1658.71	0.0	1938.57

*** H-FACTORS AT TIME = 13.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-60160-0

C13

[illegible]

AS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HAL POOL
T SIZE IS 20.250 20.250 25.000 TIME= 14.00

BUBBLE INDEX	DOWNCOMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-10.624	-273.24	7.000	3.142	13.000	0.0
2	2	1.000	7.488	476.26	7.000	2.356	13.000	45.000
3	3	1.000	7.488	476.26	7.000	1.571	13.000	90.000
4	4	1.000	7.488	476.26	7.000	0.785	13.000	135.000
5	5	1.000	7.488	476.26	7.000	0.0	13.000	180.000
6	6	1.000	-10.624	-273.24	7.000	5.498	13.000	225.000
7	7	1.000	-10.624	-273.24	7.000	4.712	13.000	270.000
8	8	1.000	-10.624	-273.24	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 14.000 SECONDS *********

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.48	-0.83	1.83	2.07	-20.18	-33.90	150.71	155.79
2	-0.36	-0.62	0.30	0.78	-15.12	-25.35	59.10	66.06
3	-0.25	-0.42	-0.01	0.49	-10.60	-17.47	42.02	46.73
4	-0.17	-0.27	-0.14	0.35	-6.99	-11.26	35.88	38.25
5	-0.10	-0.15	-0.19	0.26	-3.99	-6.30	33.10	33.93
6	-0.03	-0.05	-0.22	0.23	-1.30	-2.03	31.97	32.06

CAL. No. 12177.08-PX-60052
(C.O. Load on Pedestal
pool downcomers.)

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 14.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.48	-0.83	0.0	0.96	-20.18	-33.90	0.0	39.45
2	-0.36	-0.62	0.0	0.71	-15.12	-25.35	0.0	29.51
3	-0.25	-0.42	0.0	0.49	-10.60	-17.47	0.0	20.43
4	-0.17	-0.27	0.0	0.32	-6.99	-11.26	0.0	13.26
5	-0.10	-0.15	0.0	0.18	-3.99	-6.30	0.0	7.46
6	-0.03	-0.05	0.0	0.06	-1.30	-2.03	0.0	2.41

********* DRAG AT TIME = 14.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-2.38	-4.11	0.0	4.75	-521.90	-876.62	0.0	1020.22	-524.29	-880.73	0.0	1024.97
2	-1.34	-2.28	0.0	2.65	-390.86	-655.47	0.0	763.16	-392.20	-657.75	0.0	765.81
3	-0.65	-1.09	0.0	1.27	-274.19	-451.72	0.0	528.42	-274.85	-452.81	0.0	529.69
4	-0.28	-0.45	0.0	0.53	-180.88	-291.17	0.0	342.77	-181.16	-291.62	0.0	343.31
5	-0.09	-0.14	0.0	0.17	-103.06	-162.94	0.0	192.80	-103.15	-163.08	0.0	192.97
6	-0.01	-0.01	0.0	0.02	-33.51	-52.46	0.0	62.25	-33.52	-52.48	0.0	62.27
TOTAL	-4.76	-8.09	0.0	9.39	-1504.41	-2490.38	0.0	2909.63	-1509.17	-2498.47	0.0	2919.01

*** H-FACTORS AT TIME = 14.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177-28-NP(C)-PX-60160-0

C14

56

[illegible]

BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE HALL OL
TI E IS 20.250 20.250 25.000 TIME= 15.00

BUBBLE INDEX	DOWNCOMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-1.613	-103.24	7.000	3.142	13.000	0.0
2	2	1.000	4.744	123.65	7.000	2.356	13.000	45.000
3	3	1.000	4.744	123.65	7.000	1.571	13.000	90.000
4	4	1.000	4.744	123.65	7.000	0.785	13.000	135.000
5	5	1.000	4.744	123.65	7.000	0.0	13.000	180.000
6	6	1.000	-1.613	-103.24	7.000	5.498	13.000	225.000
7	7	1.000	-1.613	-103.24	7.000	4.712	13.000	270.000
8	8	1.000	-1.613	-103.24	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 15.000 SECONDS *********

CAL. NO. 12177.03-PX-60052

CC.O. Load on pedestal pool downcomers)

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.17	-0.29	1.59	1.63	-6.07	-10.30	36.40	38.31
2	-0.13	-0.21	0.70	0.74	-4.56	-7.69	12.14	15.08
3	-0.09	-0.15	0.54	0.56	-3.20	-5.30	7.46	9.70
4	-0.06	-0.10	0.48	0.49	-2.11	-3.41	5.74	7.01
5	-0.03	-0.05	0.45	0.46	-1.20	-1.91	4.95	5.44
6	-0.01	-0.02	0.44	0.45	-0.39	-0.62	4.62	4.68

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 15.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.17	-0.29	0.0	0.33	-6.07	-10.30	0.0	11.96
2	-0.13	-0.21	0.0	0.25	-4.56	-7.69	0.0	8.94
3	-0.09	-0.15	0.0	0.17	-3.20	-5.30	0.0	6.19
4	-0.06	-0.10	0.0	0.11	-2.11	-3.41	0.0	4.01
5	-0.03	-0.05	0.0	0.06	-1.20	-1.91	0.0	2.26
6	-0.01	-0.02	0.0	0.02	-0.39	-0.62	0.0	0.73

********* DRAG AT TIME = 15.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-0.30	-0.50	0.0	0.58	-156.99	-266.37	0.0	309.19	-157.29	-266.86	0.0	309.77
2	-0.17	-0.28	0.0	0.33	-117.89	-198.85	0.0	231.17	-118.06	-199.13	0.0	231.49
3	-0.08	-0.13	0.0	0.16	-82.80	-136.94	0.0	160.03	-82.89	-137.08	0.0	160.19
4	-0.03	-0.06	0.0	0.07	-54.62	-88.28	0.0	103.81	-54.65	-88.33	0.0	103.87
5	-0.01	-0.02	0.0	0.02	-31.11	-49.41	0.0	58.39	-31.12	-49.43	0.0	58.41
6	-0.00	-0.00	0.0	0.00	-10.11	-15.91	0.0	18.85	-10.11	-15.91	0.0	18.86
TOTAL	-0.60	-0.98	0.0	1.15	-453.52	-755.76	0.0	881.44	-454.11	-756.74	0.0	882.58

*** M-FACTORS AT TIME = 15.000 SECONDS ***

1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-60160-0

C15

[illegible]

****** VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME [illegible]00 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY (FT/SEC) X	Y	Z	RESULTANT	NORMAL ACC[illegible] (FT/SEC**2) X	Y	Z	RESULTANT
1	-0.17	-0.29	0.0	0.33	-6.07	-10.30	0.0	11.96
2	-0.13	-0.21	0.0	0.25	-4.56	-7.69	0.0	8.94
3	-0.09	-0.15	0.0	0.17	-3.20	-5.30	0.0	6.19
4	-0.06	-0.10	0.0	0.11	-2.11	-3.41	0.0	4.01
5	-0.03	-0.05	0.0	0.06	-1.20	-1.91	0.0	2.26
6	-0.01	-0.02	0.0	0.02	-0.39	-0.62	0.0	0.73

********* DRAGS AT TIME = 15.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-0.30	-0.50	0.0	0.58	-156.99	-266.37	0.0	309.19	-157.29	-266.86	0.0	309.77
2	-0.17	-0.28	0.0	0.33	-117.89	-198.85	0.0	231.17	-118.06	-199.13	0.0	231.49
3	-0.08	-0.13	0.0	0.16	-82.80	-136.94	0.0	160.03	-82.88	-137.08	0.0	160.19
4	-0.03	-0.06	0.0	0.07	-54.62	-88.28	0.0	103.81	-54.65	-88.33	0.0	103.87
5	-0.01	-0.02	0.0	0.02	-31.11	-49.41	0.0	58.39	-31.12	-49.43	0.0	58.41
6	-0.00	-0.00	0.0	0.00	-10.11	-15.91	0.0	18.85	-10.11	-15.91	0.0	18.86
TOTAL	-0.60	-0.98	0.0	1.15	-453.52	-755.76	0.0	881.49	-454.11	-756.74	0.0	882.58

*** H-FACTORS AT TIME = 15.000 SECONDS ***

1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

SEGMENT NO.	NORMAL VELOCITY (FT/SEC) X	Y	Z	RESULTANT	NORMAL [illegible] X	Y	Z	RESULTANT
1	-0.45	-0.77	0.0	0.89	-17.36	-29.14	0.0	33.92
2	-0.34	-0.58	0.0	0.67	-13.00	-21.79	0.0	25.37
3	-0.24	-0.40	0.0	0.46	-9.12	-15.02	0.0	17.57
4	-0.16	-0.26	0.0	0.30	-6.02	-9.68	0.0	11.40
5	-0.09	-0.14	0.0	0.17	-3.43	-5.42	0.0	6.41
6	-0.03	-0.05	0.0	0.05	-1.11	-1.74	0.0	2.07

********* DRAGS AT TIME = 16.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-2.10	-3.59	0.0	4.16	-448.99	-753.49	0.0	877.12	-451.09	-757.08	0.0	881.28
2	-1.18	-2.00	0.0	2.32	-336.18	-563.47	0.0	656.14	-337.36	-565.47	0.0	658.46
3	-0.57	-0.95	0.0	1.11	-235.81	-388.35	0.0	454.33	-236.38	-309.30	0.0	455.44
4	-0.25	-0.40	0.0	0.47	-155.56	-250.32	0.0	294.71	-155.80	-250.71	0.0	295.18
5	-0.08	-0.13	0.0	0.15	-88.64	-140.08	0.0	165.77	-88.72	-140.20	0.0	165.91
6	-0.01	-0.01	0.0	0.02	-28.82	-45.10	0.0	53.52	-28.83	-45.11	0.0	53.54
TOTAL	-4.19	-7.08	0.0	8.23	-1293.98	-2140.80	0.0	2501.59	-1298.17	-2147.88	0.0	2509.81

*** H-FACTORS AT TIME = 16.000 SECONDS ***

1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

ATTACHMENT C

12177.28-NP(C)-PX-60160-0

C.16

58

OL HAS BEEN APPROXIMATED BY A RECTANGLE TANGENT TO THE Y THE POOL
OL SIZE IS 20.250 20.250 25.000 TIME= 17.

DOUBLE INDEX	DOWNCOMMER INDEX	SOURCE RADIUS	SOURCE STRENGTH	SDOT	RADIAL LOCATION	ANGULAR LOCATION	AXIAL LOCATION	DRAWING ANGLE
1	1	1.000	-8.547	-156.91	7.000	3.142	13.000	0.0
2	2	1.000	3.323	287.56	7.000	2.356	13.000	45.000
3	3	1.000	3.323	287.56	7.000	1.571	13.000	90.000
4	4	1.000	3.323	287.56	7.000	0.785	13.000	135.000
5	5	1.000	3.323	287.56	7.000	0.0	13.000	180.000
6	6	1.000	-8.547	-156.91	7.000	5.498	13.000	225.000
7	7	1.000	-8.547	-156.91	7.000	4.712	13.000	270.000
8	8	1.000	-8.547	-156.91	7.000	3.927	13.000	315.000

********* VELOCITIES AND ACCELERATIONS AT GEOMETRIC CENTERS OF SEGMENTS AT TIME = 17.000 SECONDS *********

SEGMENT NO.	VELOCITY(FT/SEC) X	Y	Z	RESULTANT	ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.31	-0.54	0.49	0.80	-11.98	-20.09	91.68	94.62
2	-0.24	-0.40	-0.25	0.53	-8.97	-15.03	36.98	40.46
3	-0.17	-0.28	-0.41	0.53	-6.29	-10.36	26.23	28.90
4	-0.11	-0.18	-0.48	0.53	-4.15	-6.68	22.56	23.89
5	-0.06	-0.10	-0.52	0.53	-2.36	-3.74	20.90	21.36
6	-0.02	-0.03	-0.53	0.53	-0.77	-1.20	20.22	20.27

CAL. NO. 12177.03-PX-60052

(C.O. Load on Pedestal pool downcomers)

********* VELOCITIES AND ACCELERATIONS NORMAL TO SEGMENT AT TIME = 17.000 SECONDS *********

SEGMENT NO.	NORMAL VELOCITY(FT/SEC) X	Y	Z	RESULTANT	NORMAL ACCELERATION(FT/SEC**2) X	Y	Z	RESULTANT
1	-0.31	-0.54	0.0	0.63	-11.98	-20.09	0.0	23.39
2	-0.24	-0.40	0.0	0.47	-8.97	-15.03	0.0	17.50
3	-0.17	-0.28	0.0	0.32	-6.29	-10.36	0.0	12.12
4	-0.11	-0.18	0.0	0.21	-4.15	-6.68	0.0	7.86
5	-0.06	-0.10	0.0	0.12	-2.36	-3.74	0.0	4.42
6	-0.02	-0.03	0.0	0.04	-0.77	-1.20	0.0	1.43

********* DRAGS AT TIME = 17.000 SECONDS *********

SEGMENT NO.	VELOCITY DRAG (LBF) X	Y	Z	RESULTANT	ACCELERATION DRAG (LBF) X	Y	Z	RESULTANT	TOTAL DRAG (LBF) X	Y	Z	RESULTANT
1	-1.02	-1.78	0.0	2.05	-309.75	-519.61	0.0	604.93	-310.77	-521.39	0.0	606.98
2	-0.57	-0.99	0.0	1.14	-231.90	-388.60	0.0	452.54	-232.47	-389.59	0.0	453.68
3	-0.28	-0.47	0.0	0.55	-162.65	-267.83	0.0	313.35	-162.93	-268.30	0.0	313.90
4	-0.12	-0.20	0.0	0.23	-107.30	-172.63	0.0	203.26	-107.42	-172.83	0.0	203.49
5	-0.04	-0.06	0.0	0.07	-61.14	-96.61	0.0	114.33	-61.18	-96.67	0.0	114.40
6	-0.00	-0.01	0.0	0.01	-19.88	-31.10	0.0	36.91	-19.88	-31.11	0.0	36.92
TOTAL	-2.03	-3.49	0.0	4.04	-892.63	-1476.39	0.0	1725.33	-894.66	-1479.88	0.0	1729.37

*** K-FACTORS AT TIME = 17.000 SECONDS ***
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000

12177.28-NP(C)-PX-60160-0

ATTACHMENT C

C17

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```
//        VJS-SOURCE1:198
/        REGION=640K,TIME=2,DRIVES=1
/      S PEN=.3MM,INK=CARBON,PAPER=11,GRID,TIME=30MIN
/*ROUTE    PRINT   CH
/*FICHE TITLE1='12177-PX 60052-2 COFSI SOURCE RUN'
/*FICHE TITLE2=' SOURCE, V.J.SHAH CHOC/3G'
/*FICHE ORIGS=3
/*FICHE COPIES=3
/*FICHE ORIGTO=1 RECORD RETENTION CENTER- 1 ORIG
/*FICHE ORIGTO=2 V.J.SHAH, CHOC/3G
/*FICHE COPIESTO=3 V.J.SHAH CHOC/3G
//CALCOMP EXEC CSMPX,LINKMEM=CTLCDS,MODEL=SOURCE,
//  TIME.X=(2,0),REGION.X=650K
//X.FT08F001 DD SYSOUT=(R,RFF1)
//X.COMPRINT DD DUMMY,DISP=(NEW,DELETE)
//X.SYSPRINT DD DUMMY,DISP=(NEW,DELETE)
//X.FT06F001 DD SYSOUT=(R,RFF1)
//X.FT35F001 DD UNIT=DISK,DSN=GEC0031.ST307.T0507,
// DISP=SHR
//X.PLOTTAPE DD SYSOUT=P
//X.SYSIN DD *
FIXED IBUF,J,I
/      DIMENSION IBUF(2000),PI(5)
TITLE PRESSURE TIME HISTORY RUN #03 05-07 SEC.
       SYSTEM NPOINT=40000
INITIAL
       INCON  SWITCH=0.0
       A=144./(1.94*2.82)
NOSORT
       IF(SWITCH.EQ.2.) CALL FINISH
101    FORMAT(2E13.5)
       T=0.00
       PMAX=0.
       PMIN=0.
200    READ(35,101) TINI,PINI
       P=PINI
       TEST=T
       CALL FGLOAD(CO4T,T,P)
102    READ(35,101,END=104) T,P
201    IF(PMAX.LE.P) PMAX=P
       IF(PMIN.GE.P) PMIN=P
       T=T-TINI
       IF(T.LE.TEST) GO TO 102
       TEST=T
       CALL FGLOAD(CO4T,T,P)
300    CONTINUE
       GO TO 102
104    REWIND 35
       TF1=T+.001
       TF2=T+1.0
       CALL FGLOAD(CO4T,TF1,0.0)
       CALL FGLOAD(CO4T,TF2,0.0)
       PABS=PMAX
       IF(ABS(PMIN).GT.PABS)PABS=ABS(PMIN)
       WRITE(6,106)T,P
       WRITE(6,108)PMAX,PMIN,PABS
106    FORMAT(1H1,...
       '  FINAL TIME=',F8.4,'  FINAL PRESSURE=',F8.4)
108    FORMAT(1X,'MAX PRESSURE=',F8.4,'  MIN PRESSURE=',F8.4,...
       '  MAX ABS PRESSURE=',F8.4,'  MAX LOAD(IBF)=',F9.2)
```

12177.28-NP(C)-PX-60160-0

ATTACHMENT D

INPUT LISTING

CSMP TO CALCULATE SS AND SDOT

D1

INPUT LISTING (CONT'D)

12177-28-M(C)-PX-60160-0

ATTACHMENT D

```
11'     NTINUE
D'
FL      N CO4T
        P4TCO=AFGEN(CO4T,TIME)
        SDOT=A*P4TCO
        SS=INTGRL(0.,SDOT)
METHOD RKS
TIMER FINTIM=3.00,DELT=.001,PRDEL=0.1,OUTDEL=0.001
FINISH TIME=T
RANGE SS,SDOT,P4TCO
PRINT SS,SDOT,P4TCO
TERMINAL
     NOSORT
  CALL OUTPUT
*   *
*   *
*   *
     IF(SWITCH.EQ.2.)GO TO 999
     IF(SWITCH.EQ.1.)GO TO 998
     IF(SWITCH.EQ.0.)GO TO 997
     GO TO 1000
999  CALL PLOT(0.,0.,999)
     GO TO 1000
997  CALL PLOTS(IBUF,2000)
      SWITCH=1.
998   CONTINUE
1000  CONTINUE
  PAGE XYPLOT,HEIGHT=6.,WIDTH=8.
LABEL CO RUN #03 05-07 SEC.
OUTPUT TIME,SS
OUTPUT TIME,SDOT
OUTPUT TIME,P4TCO
*   *
*   *
END
*   *
*   *
RESET
INCON  SWITCH=2.0
FINISH SWITCH=2.0
END
STOP
/*
```

D2

12177.28-NP(C)-PX-60160-0

ATTACHMENT D

INPUT LISTING (CONT'D)

SSLOAD (TYPICAL)

```
/*J[illegible]EGION=700K,TIME=1
/*R [illegible]INT CH
//*. [illegible]E   VJS-SSLOAD3:198
/*FICHE  TITLE1='12177.28-NP(C)-PX-60052-2,005,CO LOAD ON D.C.'
/*FICHE  TITLE2='3/24/87,ME=229,V00,L00,V.J.SHAH/CHOC 3G'
/*FICHE  ORIGS=3
/*FICHE  COPIES=3
/*FICHE  ORIGTO=RECORD RETENTION CENTER -1 ORG
/*FICHE  ORIGTO=2 V.J.SHAH CHOC/3G
/*FICHE  COPIESTO=3 V.J.SHAH,CHOC/3G
//HOI    EXEC    PGM=SSLOAD,REGION=500K,TIME=5
//STEPLIB DD  DSN=ME229.V00L00.LOAD,DISP=SHR
//FT06F001  DD  SYSOUT=(R,RFF1),DCB=PRINT1
//FT10F001  DD  *
C.O. LOAD ON DOWNCOMERS   PX-60052-2, RUN 03,05-07 SEC.
 14.167   45.5   176.   201.
 1   1.452  2.2        0.0      1.94
 6     18.0     34.5      190.0     18.0   34.5    201.    2.0
/*
//FT70F001  DD *
8  1.0    34.5    18.0    3
1.0   39.5       9.0
1.0   39.5      18.0
1.0   39.5      27.0
1.0   34.5       9.0
1.0   34.5      27.0
1.0   29.5       4.5
1.0   29.5      22.5
1.0   29.5      40.5
/*
//FT80F001  DD *
YES
5
39.5   34.5    29.5   24.5    19.5
0.0     0.0     1.0    4.5     4.5
9.0     9.0    18.0   18.0    18.0
00000101011100111000001010100111010101000000000000000010000000000000000
00000001000000001111000000111100000000000000000000000000000000000000000
11     3     22     1    169.
1 [illegible]
/*
//FT90F001  DD *
[illegible]00    206.00
[illegible]00    206.00
[illegible]00    206.00
[illegible]00    -75.00
[illegible]3.00  -75.00
[illegible]3.00  -75.00
3.[illegible]3.00  -75.00
[illegible]3.00  -75.00
[illegible]3.00  -75.00
[illegible]00    -75.00
[illegible]00    -75.00
[illegible]00    -75.00
[illegible]00    -75.00
3.[illegible]3.00  -75.00
3.[illegible].00   206.00
3.0 1.0 [illegible]5.00   206.00
3.0 1.0 -5.00   206.00
3.0 1.0 -5.00   206.00
```

D3

12177.28-NP(C)-PX-60160-0 D4

ATTACHMENT D

INPUT LISTING (CONT'D)

3.0	[illegible]	-5.00	206.00
3.0	[illegible]	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-13.00	-75.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
3.0	1.0	-5.00	206.00
[illegible]	[illegible]	[illegible]	-75.00
[illegible]	[illegible]	[illegible]	-75.00
[illegible]	[illegible]	[illegible]	-75.00
[illegible]	[illegible]	[illegible]	-75.00
[illegible]	[illegible]	[illegible]	-75.00
[illegible]	[illegible]	[illegible]	-75.00
[illegible]	[illegible]	[illegible]	206.00
[illegible]	[illegible]	[illegible]	206.00
[illegible]	[illegible]	[illegible]	206.00
[illegible]	[illegible]	[illegible]	206.00
[illegible]	[illegible]	[illegible]	206.00
[illegible]	[illegible]	-13.00	-75.00
[illegible]	[illegible]	-13.00	-75.00
[illegible]	[illegible]	-13.00	-75.00
[illegible]	[illegible]	-13.00	-75.00

12177.28-NP(C)-PX-60160-0 D5

ATTACHMENT D

INPUT LISTING (CONT'D)

```
3.0 [illegible] -13.00 -75.00
3.[illegible] -13.00 -75.00
3.[illegible] -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -13.00 -75.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
3.0 1.0 -5.00 206.00
/*
```

[illegible]

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲ 5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE E1
12177.28	NP(C)	PX-60160-0		

ATTACHMENT E

COMPARISON OF PRESSURE RESPONSE SPECTRA FOR MULTIPLE TIME SEGMENT.

AMPLIFIED RESPONSE SPECTRUM

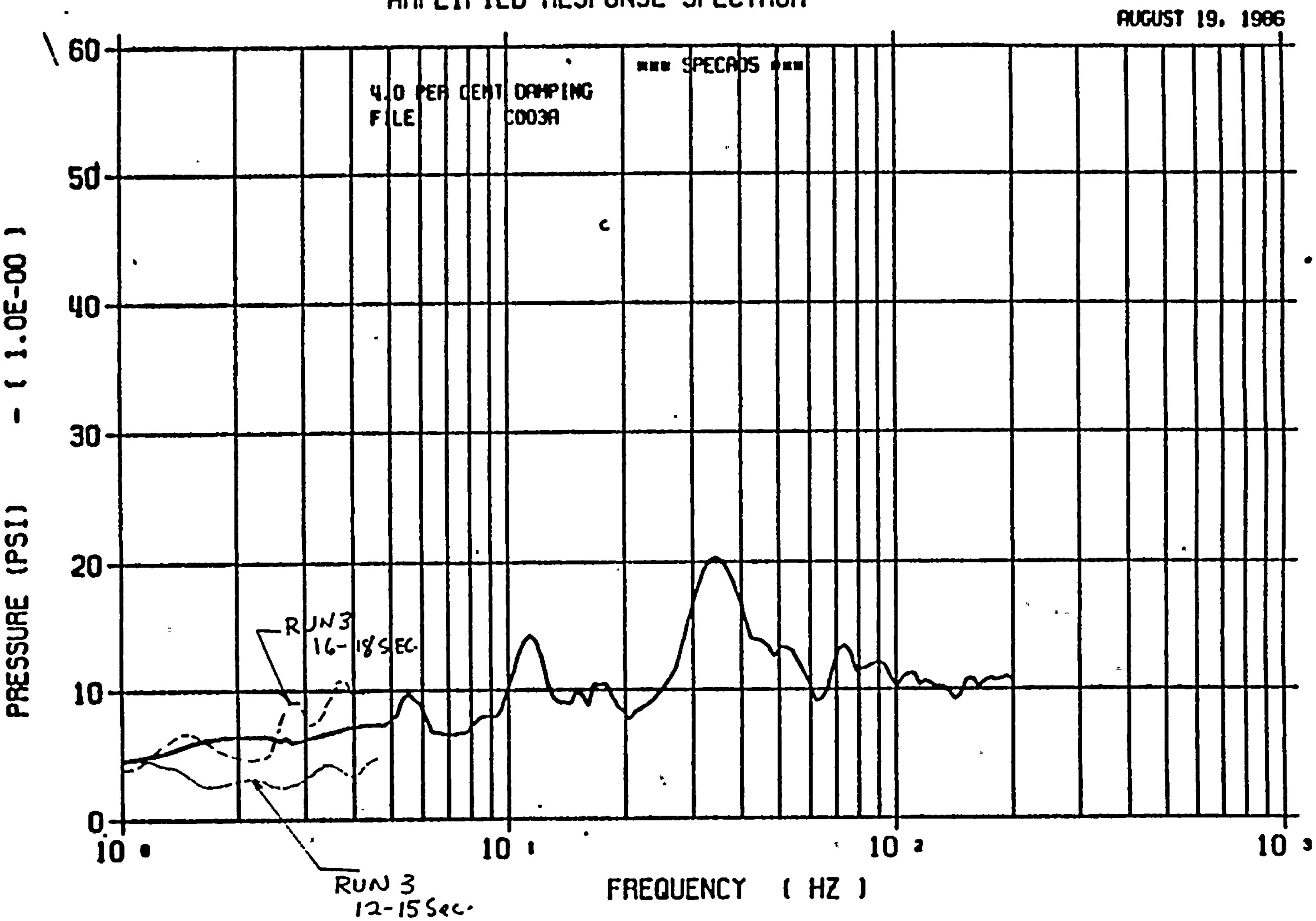


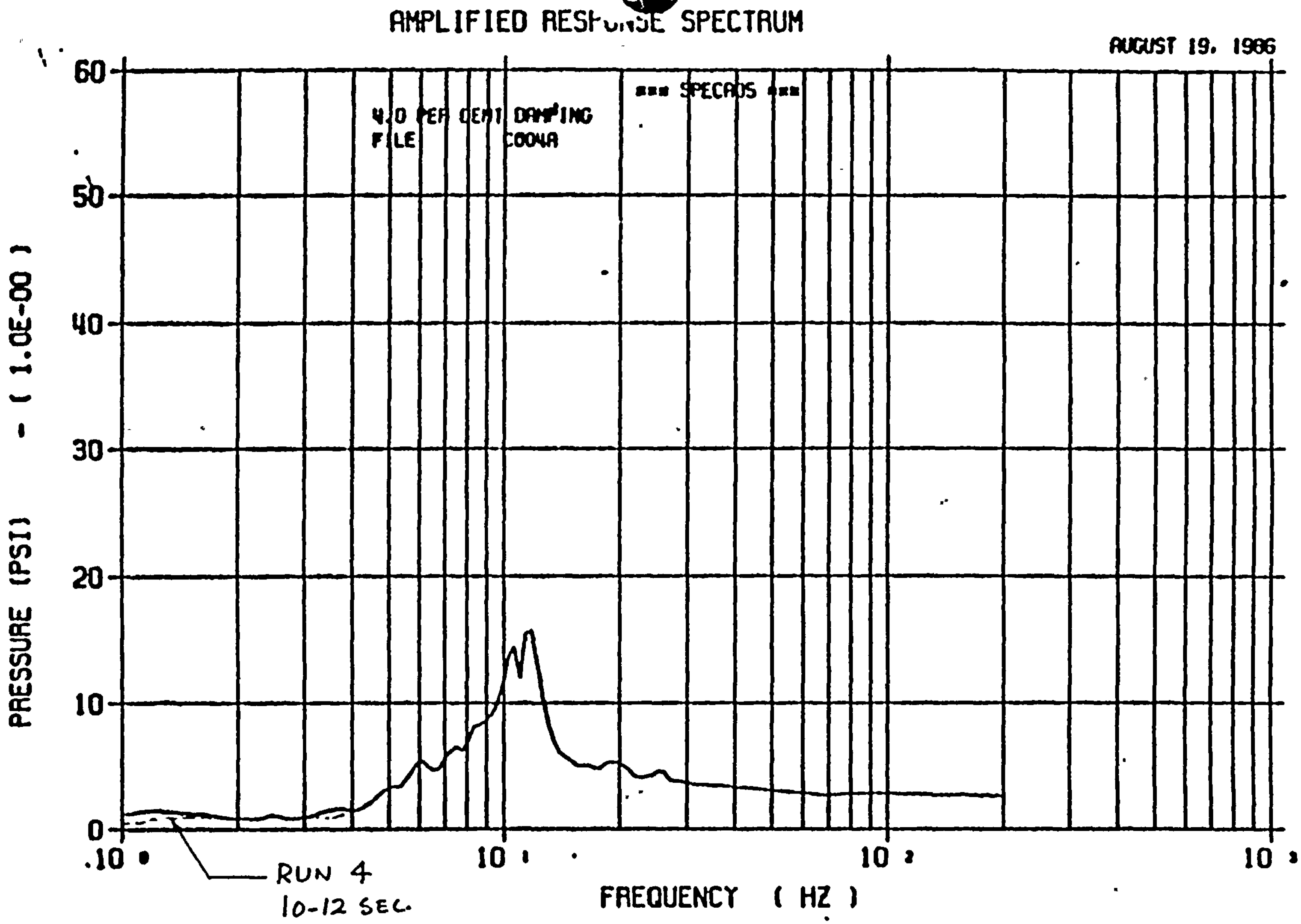
Figure A-1 Pressure Response Spectra for the BCP Time History Selected for 4TCO Run 3, 5 to 7 Seconds.

FROM REF. 6.12

12177.28-NP(L)-PX-60160-D

ATTACHMENT E

E2



PL 1

Figure A-4 Pressure Response Spectra for the BCP Time History Selected for 4TCO Run 4, 6 to 8 Seconds.

FROM REF 6.12

12177.28-NF(C)-PX-6060-0
ATTACHMENT E (CONT'D)

E3

12177.28-NP(C)-FX-60160-0
ATTACHMENT E (CONT'D)

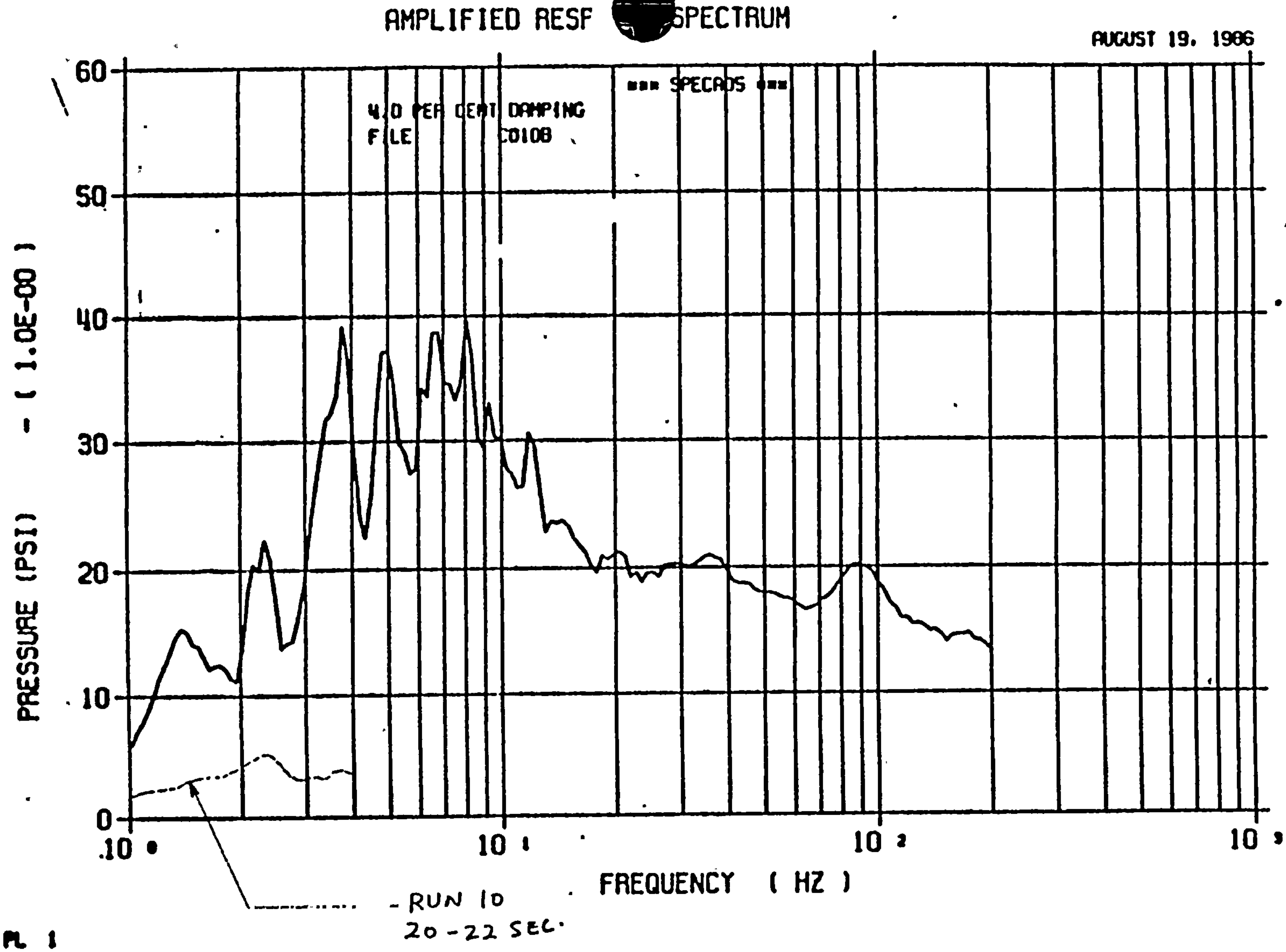
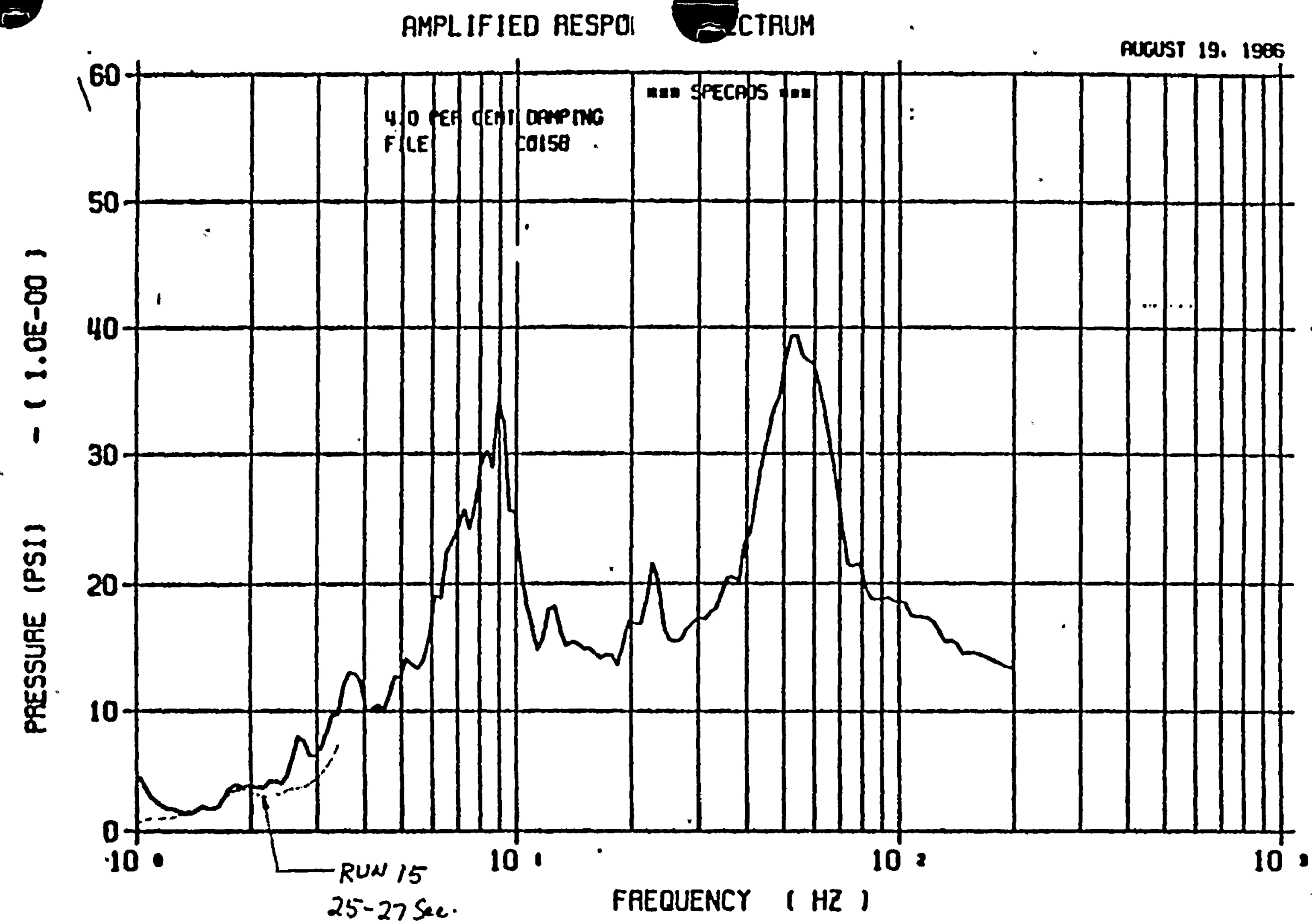


Figure A-12 Pressure Response Spectra for the BCP Time History Selected for 4TCO Run 10, 26 to 30 Seconds.

FROM REF. 6.12



PL. 1

Figure A-16 Pressure Response Spectra for the BCA Time History Selected for 4TCO Run 15, 29 to 48 Seconds.

FROM REF. 6.12

12177.28-NP(C)-PX-6C(?)0-0
ATTACHMENT E

E5

12177.28-NP(1)-PX-60160-0 F1

ATTACHMENT-F

Feb. 12, 1987

To : M. Durka / T. L. Wang (Stone and Webster)

From : /S. Mintz (General Electric Co.)

Subject : Transmittal of 4TCO Raw Data Tapes for NMP2 CO Load Definition

The enclosed tapes contain the raw 4TCO pressure data for the 4TCO runs identified in the NMP2 CO load definition. For each of these runs pressure data begins at 0. seconds. and end well beyond the end times defined for the load definition time periods. Additional tapes would be required to send the total recorded data for these runs. To expedite transmittal these were not included, however if necessary these can be provided upon request.

The CO load definition for NMP2 has been redefined, elinminating Run 21 which included chugging pressure data. Additionally the load definition time periods with associated pool temperatures higher than 130 F have been identified. Table 1 contains the NMP2 CO load definition time periods. The time periods contained in the transmitted raw data tapes are given in Table 2.
The CO data is written in 9-track, 1600 BPI EBCDIC format. there are 5 tapes, the contents and attributes are given in Table 3. There are two end of file marks (EOF) at the end of each file. Each data record has a format of 2E15.7. The first word is time, the second word pressure. Each data record occurs at .001 second intervals.

Contents;

Table 1 : NMP2 CO Load Definition Time Periods

Table 2 : Time periods in tranmitted tapes

Table 3 : Contents of EBCDIC tapes

First 0.05 seconds of data for each run on file

Five tapes with 4TCO data

S Mintz

S. Mintz
Plant Analysis Services (GE)

1217728-NP(1)-PX-60160-0 F2

TABLE 1

Bounding Time Periods
For NMP-2 CO Load

RUN	TIME PERIODS (SEC)
03	05-07, 12-15, 16-18
04	06-08, 10-12
05	19-21
07	12-16, 18-21
08*	05-07 *
09	10-13
10	20-22, 26-30
12	17-21
14	25-35
15	25-27, 29-48
22	11-13
23	05-07
24*	06-10 *
27	12-18
28	12-14

* one second additional data after $t_{pool} > 150°F$

TABLE 2

Transmitted Time Periods for NMP-2 CO Load

RUN	TIME PERIOD (SEC)
03	0-30
04	0-33
05	0-33
07	0-40
08	0-32
09	0-33
10	0-33
12	0-33
14	0-40
15	0-60
22	0-33
23	0-32
24	0-33
27	0-33
28	0-33

12177.28 - NP(1)-PX-60160-0 F4

TABLE 3

CONTENTS OF EBCDIC TAPES

REEL	FILE	RUNS	TIMES (SEC)
47190	1	3	0-30
	2	4	0-33
	3	5	0-33
02200	1	7	0-40
	2	8	0-32
	3	9	0-33
41602	1	10	0-33
	2	12	0-33
	3	14	0-20
	4	14	20-40
43303	1	15	0-30
	2	15	30-60
	3	22	0-33
28624	1	23	0-32
	2	24	0-33
	3	27	0-33
	4	28	0-33

TABLE 3

FILE	1	VOLUME	VSN 40204
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 03 0-30 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	29876		
NUMBER OF BLOCKS	1494		

EOF

FILE	2	INPUT VOLUME	VSN 38041
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 04 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	32864		
NUMBER OF BLOCKS	1644		

EOF

FILE	3	INPUT VOLUME	VSN 38971
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 05 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	32864		
NUMBER OF BLOCKS	1644		

EOF

EOF

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F5

TABLE 3

FI.	1	... UT VOLUME	VSN 36183
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 07 0-40 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	39835		
NUMBER OF BLOCKS	1992		

EOF

FILE	2	INPUT VOLUME	VSN 47049
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 08 0-32 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	31868		
NUMBER OF BLOCKS	1594		

EOF

FILE	3	INPUT VOLUME	VSN 48940
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 09 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	32835		
NUMBER OF BLOCKS	1642		

EOF

EOF

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F6

TABLE 3

FILE	1	INPUT VOLUME	VSN 39153
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 10 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	39835		
NUMBER OF BLOCKS	1992		

EOF

FILE	2	INPUT VOLUME	VSN 36603
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 12 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	32864		
NUMBER OF BLOCKS	1644		

EOF

FILE	3	INPUT VOLUME	VSN 33586
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 14 0-20 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	19918		
NUMBER OF BLOCKS	996		

EOF

FILE	4	INPUT VOLUME	VSN 42405
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 14 20-40 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	19917		
NUMBER OF BLOCKS	996		

EOF

EOF

12177.28-NP(c)-Px-6060-0

F7

TABLE 3

FILE	1	INPUT VOLUME	VSN 14919
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 15 0-30 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	29876		
NUMBER OF BLOCKS	1494		

EOF

FILE	2	INPUT VOLUME	VSN 20233
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 15 30-60 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	29876		
NUMBER OF BLOCKS	1494		

EOF

FILE	3	INPUT VOLUME	VSN 34901
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 22 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	32864		
NUMBER OF BLOCKS	1644		

EOF

EOF

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38

FIL...	1	INPUT VOLUME	VSN 08062
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 23 0-32 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	31868		
NUMBER OF BLOCKS	1594		

EOF

FILE	2	INPUT VOLUME	VSN 42756
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 24 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	32864		
NUMBER OF BLOCKS	1644		

EOF

FILE	3	INPUT VOLUME	VSN 47690
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 27 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	32864		
NUMBER OF BLOCKS	1644		

EOF

FILE	4	INPUT VOLUME	VSN 03172
RECORDING MEDIUM	9-TRACK	CONTENT	4TCO RUN 28 0-33 SEC
LABELS	NONE		
DENSITY, BPI	1600		
CHARACTER SET	EBCDIC		
LOGICAL RECORD LENGTH, BYTES	80		
BLOCK SIZE, BYTES	1600		
NUMBER OF LOGICAL RECORDS	32864		
NUMBER OF BLOCKS	1644		

EOF

EOF

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F9

6T 01 02 13.035 VOLUME 47190 FILE 1 4TCO RUN 0 EC E 2

O RUN 03 L SEC

.	0.1103985E 01
.1125000E-02	0.1103985E 01
.2125025E-02	0.1074147E 01
.3125012E-02	0.1089066E 01
.4124999E-02	0.1074147E 01
.5125016E-02	0.1059228E 01
.6125003E-02	0.1074147E 01
.7125020E-02	0.1029391E 01
.8125007E-02	0.1074147E 01
.9125024E-02	0.1074147E 01
.1012501E-01	0.1044310E 01
.1112503E-01	0.1074147E 01
.1212502E-01	0.1074147E 01
.1312500E-01	0.1059228E 01
.1412502E-01	0.1089066E 01
.1512501E-01	0.1059228E 01
.1612502E-01	0.1089066E 01
.1712501E-01	0.1103985E 01
.1812503E-01	0.1103985E 01
.1912501E-01	0.1103985E 01
.2012500E-01	0.1089066E 01
.2112502E-01	0.1059228E 01
.2212501E-01	0.1089066E 01
.2312502E-01	0.1044310E 01
.2412501E-01	0.1074147E 01
.2512503E-01	0.1074147E 01
.2612501E-01	0.1059228E 01
.2712500E-01	0.1089066E 01
.2812502E-01	0.1059228E 01
.2912500E-01	0.1059228E 01
.3012502E-01	0.1074147E 01
.3125000E-01	0.1044310E 01
.3225002E-01	0.1059228E 01
.3325000E-01	0.1089066E 01
.3425002E-01	0.1089066E 01
.3525001E-01	0.1103985E 01
.3625003E-01	0.1089066E 01
.3725001E-01	0.1089066E 01
.3825000E-01	0.1118903E 01
.3925002E-01	0.1103985E 01
.4025000E-01	0.1089066E 01
.4125002E-01	0.1059228E 01
.4225001E-01	0.9995536E 00
.4325002E-01	0.9697162E 00
.4425001E-01	0.9398788E 00
.4525000E-01	0.9249601E 00
.4625002E-01	0.9697162E 00
.4725000E-01	0.9846349E 00
.4825002E-01	0.1029391E 01
.4925001E-01	0.1089066E 01
.5025002E-01	0.1118903E 01
.5125001E-01	0.1118903E 01
.5225003E-01	0.1148741E 01
.5325001E-01	0.1074147E 01
.5425000E-01	0.1074147E 01
.5525002E-01	0.1029391E 01

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F10

O RUN 04 3 SEC

.	-0.4923175E 00
.1000017E-02	-0.5072362E 00
.2000004E-02	-0.5221549E 00
.3000021E-02	-0.4923175E 00
.4000008E-02	-0.4773987E 00
.4999995E-02	-0.4773987E 00
.6000012E-02	-0.5221549E 00
.6999999E-02	-0.5072362E 00
.8000016E-02	-0.4923175E 00
.9000003E-02	-0.5072362E 00
.1000002E-01	-0.5072362E 00
.1100001E-01	-0.4773987E 00
.1199999E-01	-0.5221549E 00
.1300001E-01	-0.4923175E 00
.1400000E-01	-0.5072362E 00
.1500002E-01	-0.5072302E 00
.1600000E-01	-0.4773987E 00
.1700002E-01	-0.4773987E 00
.1800001E-01	-0.4773987E 00
.1899999E-01	-0.4773987E 00
.2000001E-01	-0.4923175E 00
.2100000E-01	-0.4923175E 00
.2200001E-01	-0.5072362E 00
.2300000E-01	-0.5221549E 00
.2400002E-01	-0.5221549E 00
.2500001E-01	-0.5221549E 00
.2599999E-01	-0.5221549E 00
.2700001E-01	-0.5221549E 00
.2800000E-01	-0.5072362E 00
.2912501E-01	-0.4923175E 00
.3012502E-01	-0.4923175E 00
.3112501E-01	-0.4923175E 00
.3212500E-01	-0.4923175E 00
.3312501E-01	-0.4923175E 00
.3412500E-01	-0.5072362E 00
.3512502E-01	-0.5072302E 00
.3612500E-01	-0.5072362E 00
.3712502E-01	-0.5072362E 00
.3812501E-01	-0.4773987E 00
.3912500E-01	-0.4773987E 00
.4012501E-01	-0.4773987E 00
.4112500E-01	-0.4773987E 00
.4212502E-01	-0.4773987E 00
.4312500E-01	-0.5072362E 00
.4412502E-01	-0.5221549E 00
.4512501E-01	-0.5072302E 00
.4612499E-01	-0.5072362E 00
.4712501E-01	-0.5072362E 00
.4812500E-01	-0.5072362E 00
.4912502E-01	-0.4923175E 00
.5012500E-01	-0.4773987E 00
.5112502E-01	-0.4923175E 00
.5212501E-01	-0.4923175E 00
.5312499E-01	-0.4773987E 00
.5412501E-01	-0.4773987E 00
.5512500E-01	-0.4773987E 00

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F11

CO RUN 05 0 EC

.	0.1342684E 01
.1000002E-02	0.1342684E 01
.2000000E-02	0.1327765E 01
.3000002E-02	0.1327765E 01
.4000001E-02	0.1312847E 01
.5000003E-02	0.1312847E 01
.6000001E-02	0.1297928E 01
.7000003E-02	0.1283009E 01
.8000001E-02	0.1312847E 01
.9000003E-02	0.1312847E 01
.1000000E-01	0.1342684E 01
.1100000E-01	0.1342684E 01
.1200000E-01	0.1342684E 01
.1300000E-01	0.1342684E 01
.1400000E-01	0.1357603E 01
.1500000E-01	0.1357603E 01
.1600000E-01	0.1342684E 01
.1700000E-01	0.1312847E 01
.1800000E-01	0.1342684E 01
.1900000E-01	0.1312847E 01
.2000000E-01	0.1342684E 01
.2100000E-01	0.1342684E 01
.2200000E-01	0.1312847E 01
.2300000E-01	0.1297928E 01
.2400000E-01	0.1297928E 01
.2500000E-01	0.1283009E 01
.2600000E-01	0.1312847E 01
.2700000E-01	0.1312847E 01
.2812500E-01	0.1342684E 01
.2912500E-01	0.1357603E 01
.3012500E-01	0.1342684E 01
.3112500E-01	0.1342684E 01
.3212500E-01	0.1342684E 01
.3312500E-01	0.1342684E 01
.3412500E-01	0.1342684E 01
.3512500E-01	0.1342684E 01
.3612500E-01	0.1312847E 01
.3712500E-01	0.1327765E 01
.3812500E-01	0.1312847E 01
.3912500E-01	0.1327765E 01
.4012500E-01	0.1342684E 01
.4112500E-01	0.1327765E 01
.4212500E-01	0.1342684E 01
.4312500E-01	0.1342684E 01
.4412500E-01	0.1297928E 01
.4512500E-01	0.1312847E 01
.4612500E-01	0.1283009E 01
.4712500E-01	0.1268090E 01
.4812500E-01	0.1253172E 01
.4912500E-01	0.1268090E 01
.5012500E-01	0.1253172E 01
.5112500E-01	0.1268090E 01
.5212500E-01	0.1283009E 01
.5312500E-01	0.1283009E 01
.5412500E-01	0.1268090E 01
.5512500E-01	0.1283009E 01

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F12

4TCO RUN 0. 40 SEC

0.	0.1447115E 01
0.9999275E-03	0.1447115E 01
0.1999974E-02	0.1432196E 01
0.3000021E-02	0.1432196E 01
0.3999948E-02	0.1432196E 01
0.4999995E-02	0.1447115E 01
0.5999923E-02	0.1462034E 01
0.6999969E-02	0.1476952E 01
0.8000016E-02	0.1462034E 01
0.8999944E-02	0.1462034E 01
0.9999990E-02	0.1462034E 01
0.1099992E-01	0.1476952E 01
0.1199996E-01	0.1462034E 01
0.1300001E-01	0.1447115E 01
0.1399994E-01	0.1462034E 01
0.1499999E-01	0.1447115E 01
0.1600003E-01	0.1447115E 01
0.1699996E-01	0.1462034E 01
0.1800001E-01	0.1447115E 01
0.1899993E-01	0.1432196E 01
0.1999998E-01	0.1432196E 01
0.2100003E-01	0.1417278E 01
0.2199996E-01	0.1432196E 01
0.2300000E-01	0.1432196E 01
0.2412498E-01	0.1432196E 01
0.2512503E-01	0.1432196E 01
0.2612495E-01	0.1432196E 01
0.2712500E-01	0.1447115E 01
0.2812493E-01	0.1462034E 01
0.2912498E-01	0.1462034E 01
0.3012502E-01	0.1462034E 01
0.3112495E-01	0.1447115E 01
0.3212500E-01	0.1432196E 01
0.3312492E-01	0.1432196E 01
0.3412497E-01	0.1447115E 01
0.3512502E-01	0.1432196E 01
0.3612494E-01	0.1[illegible]02106E 01
0.3712499E-01	0.1402196E 01
0.3812492E-01	0.1447115E 01
0.3912497E-01	0.1447115E 01
0.4012501E-01	0.1402034E 01
0.4112[illegible]E-01	0.1[illegible]62034E 01
0.4212499E-01	0.1[illegible]02034E 01
0.4312491E-01	0.1476952E 01
0.4412[illegible]E-01	0.1447115E 01
0.4512501E-01	0.1432196E 01
0.4612[illegible]E-01	0.1402359E 01
0.4712498E-01	0.1357603E 01
0.4812503E-01	0.1357603E 01
0.4912[illegible]E-01	0.1372521E 01
0.5012500E-01	0.1372521E 01
0.5112493E-01	0.1[illegible]07440E 01
0.5212496E-01	0.1402359E 01
0.5312502E-01	0.1432196E 01
0.5425000E-01	0.1447115E 01
0.5524993E-01	0.1476952E 01

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F13

393T 01 02 15.556 VOLUME 02200 FILE 2 4TCO RUN 08 SEC E 111

TCO RUN 08 \ SEC

0.	0.9697162E 00
0.1000017E-02	0.9547975E 00
0.2000004E-02	0.9547975E 00
0.3000021E-02	0.9547975E 00
0.4000006E-02	0.9697162E 00
0.5000025E-02	0.9697162E 00
0.6000012E-02	0.9547975E 00
0.6999999E-02	0.9547975E 00
0.8000016E-02	0.9398788E 00
0.9000003E-02	0.9398788E 00
0.1000002E-01	0.9547975E 00
0.1100001E-01	0.9547975E 00
0.1200002E-01	0.9547975E 00
0.1300001E-01	0.9547975E 00
0.1400000E-01	0.9846349E 00
0.1500002E-01	0.9697162E 00
0.1612502E-01	0.9547975E 00
0.1712501E-01	0.9547975E 00
0.1812500E-01	0.9697162E 00
0.1912501E-01	0.9697162E 00
0.2012500E-01	0.9697162E 00
0.2112502E-01	0.9547975E 00
0.2212501E-01	0.9398788E 00
0.2312502E-01	0.9249601E 00
0.2412501E-01	0.9100414E 00
0.2512500E-01	0.9249601E 00
0.2612501E-01	0.9547975E 00
0.2712500E-01	0.9547975E 00
0.2812502E-01	0.9697162E 00
0.2912501E-01	0.9846349E 00
0.3012502E-01	0.9846349E 00
0.3112501E-01	0.9697162E 00
0.3212500E-01	0.9697162E 00
0.3312501E-01	0.9398788E 00
0.3412500E-01	0.9547975E 00
0.3512502E-01	0.9547975E 00
0.3612500E-01	0.9846349E 00
0.3712502E-01	0.9995536E 00
0.3812501E-01	0.9846349E 00
0.3912503E-01	0.9995536E 00
0.4012501E-01	0.9697162E 00
0.4112500E-01	0.9398788E 00
0.4212502E-01	0.9398788E 00
0.4312500E-01	0.9100414E 00
0.4412502E-01	0.8951227E 00
0.4512501E-01	0.8802039E 00
0.4625002E-01	0.8951227E 00
0.4725000E-01	0.9249601E 00
0.4825002E-01	0.9547975E 00
0.4925001E-01	0.9697162E 00
0.5025002E-01	0.9995536E 00
0.5125001E-01	0.9846349E 00
0.5225000E-01	0.9697162E 00
0.5325001E-01	0.9398788E 00
0.5425000E-01	0.8802039E 00
0.5525002E-01	0.8503665E 00

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F14

TCO RUN 09 .3 SEC

0.	0.7011794E 00
0.9999946E-03	0.7310168E 00
0.1999997E-02	0.7160981E 00
0.2999999E-02	0.7310168E 00
0.4000001E-02	0.7459355E 00
0.4999995E-02	0.7310168E 00
0.5999997E-02	0.7011794E 00
0.6999999E-02	0.7011794E 00
0.7999994E-02	0.7160981E 00
0.8999996E-02	0.7011794E 00
0.9999998E-02	0.7011794E 00
0.1100000E-01	0.7011794E 00
0.1199999E-01	0.7310168E 00
0.1300000E-01	0.7011794E 00
0.1400000E-01	0.7160981E 00
0.1500000E-01	0.7310168E 00
0.1600000E-01	0.6862607E 00
0.1700000E-01	0.7160981E 00
0.1800000E-01	0.7459355E 00
0.1899999E-01	0.7310168E 00
0.2000000E-01	0.7011794E 00
0.2100000E-01	0.7310168E 00
0.2200000E-01	0.7011794E 00
0.2312500E-01	0.7011794E 00
0.2412499E-01	0.7011794E 00
0.2512500E-01	0.6862607E 00
0.2612500E-01	0.6862607E 00
0.2712500E-01	0.7011794E 00
0.2812500E-01	0.6862607E 00
0.2912500E-01	0.6862607E 00
0.3012500E-01	0.7160981E 00
0.3112499E-01	0.7160981E 00
0.3212500E-01	0.7011794E 00
0.3312500E-01	0.7160981E 00
0.3412500E-01	0.7310168E 00
0.3512499E-01	0.7459355E 00
0.3612500E-01	0.7459355E 00
0.3712500E-01	0.7310168E 00
0.3812500E-01	0.7310168E 00
0.3912500E-01	0.7459355E 00
0.4012500E-01	0.7608543E 00
0.4112500E-01	0.7459355E 00
0.4212499E-01	0.7459355E 00
0.4312500E-01	0.7011794E 00
0.4412500E-01	0.6415046E 00
0.4512500E-01	0.6116671E 00
0.4612499E-01	0.6116671E 00
0.4712500E-01	0.6415046E 00
0.4812500E-01	0.6862607E 00
0.4912500E-01	0.6713420E 00
0.5012500E-01	0.7459355E 00
0.5112500E-01	0.7757730E 00
0.5212500E-01	0.8056104E 00
0.5325000E-01	0.8354479E 00
0.5424999E-01	0.8056104E 00
0.5525000E-01	0.7757730E 00

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F15

4TCO RUN 10 0-33 SEC

0.	0.9100414E 00
0.9999871E-03	0.9100414E 00
0.2000004E-02	0.8951227E 00
0.2999991E-02	0.8652852E 00
0.3999978E-02	0.8652852E 00
0.5124966E-02	0.8951227E 00
0.6125003E-02	0.8951227E 00
0.7124990E-02	0.8802039E 00
0.8124977E-02	0.8802039E 00
0.9124994E-02	0.8652852E 00
0.1012499E-01	0.8652852E 00
0.1112500E-01	0.8802039E 00
0.1212499E-01	0.8652852E 00
0.1312500E-01	0.8802039E 00
0.1412490E-01	0.8802039E 00
0.1512498E-01	0.8951227E 00
0.1612498E-01	0.8802039E 00
0.1712498E-01	0.8802039E 00
0.1812500E-01	0.8652852E 00
0.1912498E-01	0.8802039E 00
0.2012497E-01	0.8802039E 00
0.2112502E-01	0.8802039E 00
0.2212501E-01	0.8951227E 00
0.2312499E-01	0.8802039E 00
0.2412498E-01	0.8652852E 00
0.2512497E-01	0.8205291E 00
0.2612501E-01	0.8503665E 00
0.2712500E-01	0.8354478E 00
0.2812499E-01	0.8354478E 00
0.2912498E-01	0.8652852E 00
0.3012498E-01	0.8802039E 00
0.3112501E-01	0.8802039E 00
0.3212500E-01	0.8652852E 00
0.3312498E-01	0.9249601E 00
0.3412497E-01	0.9100414E 00
0.3525001E-01	0.8652852E 00
0.3625000E-01	0.8652852E 00
0.3724998E-01	0.8652852E 00
0.3824997E-01	0.8652852E 00
0.3925002E-01	0.8802039E 00
0.4025000E-01	0.8802039E 00
0.4124999E-01	0.8802039E 00
0.4224998E-01	0.8652852E 00
0.4324996E-01	0.8056104E 00
0.4425001E-01	0.8205291E 00
0.4525000E-01	0.7757730E 00
0.4624999E-01	0.7608543E 00
0.4724997E-01	0.7459355E 00
0.4825002E-01	0.7608543E 00
0.4925001E-01	0.7608543E 00
0.5024999E-01	0.8354478E 00
0.5124993E-01	0.8652852E 00
0.5224997E-01	0.9100414E 00
0.5325001E-01	0.9846349E 00
0.5425000E-01	0.1044310E 01
0.5524999E-01	0.1074147E 01

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F16

4TCO RUN 12 0-33 SEC

0.	0.1118903E 01
0.9999871E-03	0.1103985E 01
0.2000004E-02	0.1103985E 01
0.3125012E-02	0.1089066E 01
0.4124999E-02	0.1089066E 01
0.5125016E-02	0.1089066E 01
0.6125003E-02	0.1103985E 01
0.7124990E-02	0.1103985E 01
0.8125007E-02	0.1103985E 01
0.9124994E-02	0.1133822E 01
0.1012501E-01	0.1148741E 01
0.1112500E-01	0.1103985E 01
0.1212502E-01	0.1103985E 01
0.1312500E-01	0.1074147E 01
0.1412499E-01	0.1118903E 01
0.1512501E-01	0.1118903E 01
0.1612499E-01	0.1133822E 01
0.1712501E-01	0.1089066E 01
0.1812500E-01	0.1089066E 01
0.1912501E-01	0.1103985E 01
0.2012500E-01	0.1089066E 01
0.2112499E-01	0.1074147E 01
0.2212501E-01	0.1074147E 01
0.2312499E-01	0.1089066E 01
0.2412501E-01	0.1089066E 01
0.2512500E-01	0.1103985E 01
0.2612501E-01	0.1103985E 01
0.2712500E-01	0.1103985E 01
0.2812499E-01	0.1103985E 01
0.2912501E-01	0.1074147E 01
0.3012499E-01	0.1103985E 01
0.3112501E-01	0.1089066E 01
0.3212500E-01	0.1118903E 01
0.3325000E-01	0.1118903E 01
0.3424999E-01	0.1103985E 01
0.3525001E-01	0.1089066E 01
0.3625000E-01	0.1074147E 01
0.3725001E-01	0.1074147E 01
0.3825000E-01	0.1074147E 01
0.3925002E-01	0.1089066E 01
0.4025000E-01	0.1118903E 01
0.4124999E-01	0.1118903E 01
0.4225001E-01	0.1163659E 01
0.4324999E-01	0.1148741E 01
0.4425001E-01	0.1163659E 01
0.4525000E-01	0.1118903E 01
0.4625002E-01	0.1074147E 01
0.4725000E-01	0.1059228E 01
0.4824999E-01	0.1044310E 01
0.4925001E-01	0.1014472E 01
0.5024999E-01	0.1014472E 01
0.5125001E-01	0.1044310E 01
0.5225000E-01	0.1074147E 01
0.5325001E-01	0.1089066E 01
0.5425000E-01	0.1103985E 01
0.5524999E-01	0.1163659E 01

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F17

[illegible]

TCO RUN 14 SEC

0.2000087E 02	0.3003137E 02
0.2000187E 02	0.2992693E 02
0.2000287E 02	0.2989710E 02
0.2000388E 02	0.2983742E 02
0.2000487E 02	0.2989710E 02
0.2000587E 02	0.2998661E 02
0.2000688E 02	0.3016563E 02
0.2000787E 02	0.3034466E 02
0.2000887E 02	0.3055352E 02
0.2000987E 02	0.3080714E 02
0.2001087E 02	0.3106076E 02
0.2001187E 02	0.3134421E 02
0.2001300E 02	0.3165750E 02
0.2001400E 02	0.3194098E 02
0.2001500E 02	0.3229901E 02
0.2001600E 02	0.3267198E 02
0.2001700E 02	0.3310462E 02
0.2001800E 02	0.3349251E 02
0.2001900E 02	0.3368645E 02
0.2002000E 02	0.3364169E 02
0.2002100E 02	0.3326873E 02
0.2002200E 02	0.3259738E 02
0.2002300E 02	0.3180637E 02
0.2002400E 02	0.3110551E 02
0.2002500E 02	0.3055352E 02
0.2002600E 02	0.3021029E 02
0.2002700E 02	0.3009104E 02
0.2002800E 02	0.3016563E 02
0.2002900E 02	0.3031482E 02
0.2003000E 02	0.3047893E 02
0.2003100E 02	0.3062811E 02
0.2003200E 02	0.3070271E 02
0.2003300E 02	0.3074740E 02
0.2003400E 02	0.3073254E 02
0.2003500E 02	0.3068779E 02
0.2003600E 02	0.3064303E 02
0.2003700E 02	0.3062811E 02
0.2003800E 02	0.3064303E 02
0.2003900E 02	0.3074746E 02
0.2004000E 02	0.3079222E 02
0.2004100E 02	0.3085169E 02
0.2004200E 02	0.3097124E 02
0.2004312E 02	0.3110551E 02
0.2004412E 02	0.3123978E 02
0.2004513E 02	0.3137405E 02
0.2004612E 02	0.3146356E 02
0.2004712E 02	0.3146356E 02
0.2004813E 02	0.3135913E 02
0.2004912E 02	0.3125470E 02
0.2005012E 02	0.3118011E 02
0.2005112E 02	0.3110551E 02
0.2005212E 02	0.3103092E 02
0.2005312E 02	0.3092649E 02
0.2005412E 02	0.3080681E 02
0.2005512E 02	0.3079222E 02
0.2005612E 02	0.3074740E 02

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F18

4TCO RUN 14 0-20 SEC

0.	0.1969270E 01
0.9999871E-03	0.1939432E 01
0.2000004E-02	0.1909595E 01
0.2999991E-02	0.1909595E 01
0.4000008E-02	0.1894676E 01
0.4999995E-02	0.1909595E 01
0.5999982E-02	0.1939432E 01
0.6999999E-02	0.1939432E 01
0.7999986E-02	0.1939432E 01
0.9000003E-02	0.1954351E 01
0.1012501E-01	0.1969270E 01
0.1112500E-01	0.1984189E 01
0.1212499E-01	0.1969270E 01
0.1312500E-01	0.1969270E 01
0.1412499E-01	0.1924514E 01
0.1512501E-01	0.1984189E 01
0.1612499E-01	0.1969270E 01
0.1712501E-01	0.1939432E 01
0.1812500E-01	0.1939432E 01
0.1912498E-01	0.1939432E 01
0.2012500E-01	0.1939432E 01
0.2112499E-01	0.1939432E 01
0.2212501E-01	0.1954351E 01
0.2312499E-01	0.1939432E 01
0.2412501E-01	0.1969270E 01
0.2512500E-01	0.1954351E 01
0.2612498E-01	0.1969270E 01
0.2712500E-01	0.1969270E 01
0.2812499E-01	0.1969270E 01
0.2912501E-01	0.1984189E 01
0.3012499E-01	0.1984189E 01
0.3112501E-01	0.1984189E 01
0.3212500E-01	0.1969270E 01
0.3312498E-01	0.1969270E 01
0.3412500E-01	0.1954351E 01
0.3512499E-01	0.1969270E 01
0.3612500E-01	0.1924514E 01
0.3712499E-01	0.1894676E 01
0.3812501E-01	0.1939432E 01
0.3912500E-01	0.1939432E 01
0.4025000E-01	0.1954351E 01
0.4124999E-01	0.1969270E 01
0.4225001E-01	0.1984189E 01
0.4324999E-01	0.1999107E 01
0.4425001E-01	0.1984189E 01
0.4525000E-01	0.1984189E 01
0.4624999E-01	0.1954351E 01
0.4725000E-01	0.1939432E 01
0.4824999E-01	0.1924514E 01
0.4925001E-01	0.1939432E 01
0.5024999E-01	0.1894676E 01
0.5125001E-01	0.1894676E 01
0.5225000E-01	0.1894676E 01
0.5324998E-01	0.1924514E 01
0.5425000E-01	0.1924514E 01
0.5524999E-01	0.1969270E 01

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F19

4TCO RUN 15 .0 SEC

0.	0.2386994E 01
0.1000017E-02	0.2386994E 01
0.2000004E-02	0.2401912E 01
0.3000021E-02	0.2401912E 01
0.4124999E-02	0.2401912E 01
0.5125016E-02	0.2401912E 01
0.6125003E-02	0.2386994E 01
0.7125020E-02	0.2386994E 01
0.8125007E-02	0.2372075E 01
0.9125024E-02	0.2386994E 01
0.1012501E-01	0.2357156E 01
0.1112500E-01	0.2357156E 01
0.1212502E-01	0.2386994E 01
0.1312500E-01	0.2342238E 01
0.1412502E-01	0.2342238E 01
0.1512501E-01	0.2327319E 01
0.1612502E-01	0.2386994E 01
0.1712501E-01	0.2342238E 01
0.1812503E-01	0.2386994E 01
0.1912501E-01	0.2386994E 01
0.2012500E-01	0.2401912E 01
0.2112502E-01	0.2386994E 01
0.2212501E-01	0.2386994E 01
0.2312502E-01	0.2372075E 01
0.2412501E-01	0.2342238E 01
0.2512503E-01	0.2357156E 01
0.2612501E-01	0.2342238E 01
0.2712500E-01	0.2342238E 01
0.2812502E-01	0.2357156E 01
0.2912501E-01	0.2386994E 01
0.3012502E-01	0.2357156E 01
0.3112501E-01	0.2386994E 01
0.3212503E-01	0.2386994E 01
0.3312501E-01	0.2372075E 01
0.3425002E-01	0.2386994E 01
0.3525001E-01	0.2386994E 01
0.3625003E-01	0.2386994E 01
0.3725001E-01	0.2401912E 01
0.3825000E-01	0.2416831E 01
0.3925002E-01	0.2386994E 01
0.4025000E-01	0.2386994E 01
0.4125002E-01	0.2386994E 01
0.4225001E-01	0.2386994E 01
0.4325002E-01	0.2386994E 01
0.4425001E-01	0.2342238E 01
0.4525000E-01	0.2297461E 01
0.4625002E-01	0.2307644E 01
0.4725000E-01	0.2237607E 01
0.4825002E-01	0.2282563E 01
0.4925001E-01	0.2012400E 01
0.5025002E-01	0.2386994E 01
0.5125001E-01	0.2386394E 01
0.5225003E-01	0.2448869E 01
0.5325001E-01	0.2476506E 01
0.5425000E-01	0.2506343E 01
0.5525002E-01	0.2461587E 01

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F21

4TCO RUN 15 30-60 SEC

0.3000036E 02	0.2661498E 02
0.3000137E 02	0.2640612E 02
0.3000237E 02	0.2625693E 02
0.3000337E 02	0.2619726E 02
0.3000438E 02	0.2625693E 02
0.3000538E 02	0.2642104E 02
0.3000638E 02	0.2667466E 02
0.3000738E 02	0.2697303E 02
0.3000850E 02	0.2728632E 02
0.3000950E 02	0.2745043E 02
0.3001050E 02	0.2752502E 02
0.3001150E 02	0.2753994E 02
0.3001250E 02	0.2755486E 02
0.3001350E 02	0.2748027E 02
0.3001450E 02	0.2737583E 02
0.3001550E 02	0.2737583E 02
0.3001650E 02	0.2743551E 02
0.3001750E 02	0.2746535E 02
0.3001850E 02	0.2736092E 02
0.3001950E 02	0.2734600E 02
0.3002050E 02	0.2736092E 02
0.3002150E 02	0.2722665E 02
0.3002250E 02	0.2710730E 02
0.3002350E 02	0.2692827E 02
0.3002450E 02	0.2676417E 02
0.3002550E 02	0.2655331E 02
0.3002650E 02	0.2630169E 02
0.3002750E 02	0.2604607E 02
0.3002850E 02	0.2585413E 02
0.3002950E 02	0.2571986E 02
0.3003050E 02	0.2563035E 02
0.3003150E 02	0.2569002E 02
0.3003250E 02	0.2591380E 02
0.3003350E 02	0.2640612E 02
0.3003450E 02	0.2709238E 02
0.3003550E 02	0.2801734E 02
0.3003650E 02	0.[illegible]94230E 02
0.3003750E 02	0.2934510E 02
0.3003863E 02	0.[illegible]18100E 02
0.3003962E 02	0.2866771E 02
0.3004062E 02	0.2855884E 02
0.3004162E 02	0.2867376E 02
0.3004263E 02	0.2922575E 02
0.3004363E 02	0.3007612E 02
0.3004463E 02	0.3103092E 02
0.3004562E 02	0.3159763E 02
0.3004662E 02	0.3156799E 02
0.3004762E 02	0.3113535E 02
0.3004862E 02	0.3064303E 02
0.3004960E 02	0.3021039E 02
0.3005063E 02	0.3004628E 02
0.3005163E 02	0.3000153E 02
0.3005262E 02	0.3004628E 02
0.3005362E 02	0.2998661E 02
0.3005462E 02	0.2977775E 02
0.3005560E 02	0.2983742E 02

4TCO RUN 22 0 SEC

0.	0.7459355E 00
0.9999871E-03	0.7310168E 00
0.1999974E-02	0.7011794E 00
0.2999961E-02	0.7160981E 00
0.3999949E-02	0.6802607E 00
0.4999995E-02	0.7459355E 00
0.6124973E-02	0.7608543E 00
0.7124960E-02	0.7459355E 00
0.8124948E-02	0.7608543E 00
0.9124991E-02	0.7459355E 00
0.1012498E-01	0.7459355E 00
0.1112497E-01	0.7608543E 00
0.1212496E-01	0.7459355E 00
0.1312500E-01	0.7459355E 00
0.1412499E-01	0.7310168E 00
0.1512498E-01	0.7608543E 00
0.1612496E-01	0.7459355E 00
0.1712495E-01	0.7459355E 00
0.1812500E-01	0.7459355E 00
0.1912498E-01	0.7310168E 00
0.2012497E-01	0.7011794E 00
0.2112496E-01	0.7011794E 00
0.2212501E-01	0.7160981E 00
0.2312499E-01	0.7459355E 00
0.2412498E-01	0.7310168E 00
0.2512497E-01	0.7160981E 00
0.2612495E-01	0.7608543E 00
0.2712500E-01	0.7459355E 00
0.2812499E-01	0.7310168E 00
0.2912498E-01	0.7459355E 00
0.3012496E-01	0.7459355E 00
0.3112495E-01	0.7459355E 00
0.3212500E-01	0.7459355E 00
0.3312498E-01	0.7508543E 00
0.3412497E-01	0.7459355E 00
0.3512496E-01	0.7160981E 00
0.3625000E-01	0.6802007E 00
0.3724998E-01	0.6802607E 00
0.3824997E-01	0.7011794E 00
0.3924995E-01	0.7459355E 00
0.4025000E-01	0.7608543E 00
0.4124998E-01	0.7459355E 00
0.4224996E-01	0.7459355E 00
0.4324998E-01	0.7459355E 00
0.4424995E-01	0.7310168E 00
0.4525000E-01	0.7310168E 00
0.4624999E-01	0.6713420E 00
0.4724997E-01	0.6415046E 00
0.4824990E-01	0.5967484E 00
0.4924995E-01	0.5816297E 00
0.5024999E-01	0.5669110E 00
0.5124998E-01	0.5718671E 00
0.5224997E-01	0.6654233E 00
0.5324996E-01	0.7011794E 00
0.5425000E-01	0.7608543E 00
0.5524998E-01	0.8205291E 00

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F22

TCO RUN 23 2 SEC

0.	0.9995536E 00
0.1000047E-02	0.9846349E 00
0.2000034E-02	0.9846349E 00
0.3000021E-02	0.9697162E 00
0.4000008E-02	0.9846349E 00
0.5000055E-02	0.9995536E 00
0.6000042E-02	0.9846349E 00
0.7000029E-02	0.9846349E 00
0.8000016E-02	0.9697162E 00
0.9000003E-02	0.9398788E 00
0.1000005E-01	0.9547975E 00
0.1100004E-01	0.9398788E 00
0.1200002E-01	0.9846349E 00
0.1300001E-01	0.9547975E 00
0.1400000E-01	0.9547975E 00
0.1500005E-01	0.9846349E 00
0.1600003E-01	0.9846349E 00
0.1700002E-01	0.9995536E 00
0.1812500E-01	0.9995536E 00
0.1912504E-01	0.9697162E 00
0.2012503E-01	0.9697162E 00
0.2112502E-01	0.9547975E 00
0.2212501E-01	0.9547975E 00
0.2312505E-01	0.9697162E 00
0.2412504E-01	0.9547975E 00
0.2512503E-01	0.9398788E 00
0.2612501E-01	0.9547975E 00
0.2712500E-01	0.9249601E 00
0.2812505E-01	0.9398788E 00
0.2912503E-01	0.9846349E 00
0.3012502E-01	0.9995536E 00
0.3112501E-01	0.1014472E 01
0.3212506E-01	0.1029391E 01
0.3312504E-01	0.9995536E 00
0.3412503E-01	0.1014472E 01
0.3512502E-01	0.9697162E 00
0.3612500E-01	0.9846349E 00
0.3712505E-01	0.9846349E 00
0.3812504E-01	0.9846349E 00
0.3912503E-01	0.1014472E 01
0.4012501E-01	0.1029391E 01
0.4112500E-01	0.9995536E 00
0.4212505E-01	0.9846349E 00
0.4312503E-01	0.9846349E 00
0.4412502E-01	0.9547975E 00
0.4512501E-01	0.9547975E 00
0.4612505E-01	0.9249601E 00
0.4712504E-01	0.8802039E 00
0.4825002E-01	0.8951227E 00
0.4925001E-01	0.8951227E 00
0.5025005E-01	0.9100414E 00
0.5125004E-01	0.8951227E 00
0.5225003E-01	0.8951227E 00
0.5325001E-01	0.9249601E 00
0.5425000E-01	0.9697162E 00
0.5525005E-01	0.1014472E 01

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TCO RUN 24 0 SEC

0.	0.5967484E 00
0.1000002E-02	0.5669110E 00
0.2000004E-02	0.5669110E 00
0.3000006E-02	0.5818297E 00
0.4000008E-02	0.5818297E 00
0.5125001E-02	0.6116671E 00
0.6125003E-02	0.5669110E 00
0.7125005E-02	0.6265859E 00
0.8125007E-02	0.6265859E 00
0.9125009E-02	0.6116671E 00
0.1012501E-01	0.6265859E 00
0.1112501E-01	0.5967484E 00
0.1212500E-01	0.6116671E 00
0.1312500E-01	0.6116671E 00
0.1412500E-01	0.6265859E 00
0.1512501E-01	0.6116671E 00
0.1612501E-01	0.6265859E 00
0.1712501E-01	0.6116671E 00
0.1812501E-01	0.5818297E 00
0.1912501E-01	0.5669110E 00
0.2012500E-01	0.5818297E 00
0.2112500E-01	0.5967484E 00
0.2212501E-01	0.5967484E 00
0.2312501E-01	0.5818297E 00
0.2412501E-01	0.5967484E 00
0.2512501E-01	0.6415046E 00
0.2612501E-01	0.6265859E 00
0.2712500E-01	0.6265859E 00
0.2812500E-01	0.6265859E 00
0.2912501E-01	0.5967484E 00
0.3012501E-01	0.6116671E 00
0.3112501E-01	0.6265859E 00
0.3212501E-01	0.5818297E 00
0.3312501E-01	0.5669110E 00
0.3412500E-01	0.5967484E 00
0.3525001E-01	0.5967484E 00
0.3625001E-01	0.5967484E 00
0.3725001E-01	0.6265859E 00
0.3825001E-01	0.6415046E 00
0.3925000E-01	0.6415046E 00
0.4025000E-01	0.6265859E 00
0.4125001E-01	0.6265859E 00
0.4225001E-01	0.6265859E 00
0.4325001E-01	0.6116671E 00
0.4425001E-01	0.5669110E 00
0.4525001E-01	0.5370738E 00
0.4625000E-01	0.5519923E 00
0.4725000E-01	0.5519923E 00
0.4825000E-01	0.5669110E 00
0.4925001E-01	0.6265859E 00
0.5025001E-01	0.6265859E 00
0.5125001E-01	0.6415046E 00
0.5225001E-01	0.6713420E 00
0.5325001E-01	0.6265859E 00
0.5425000E-01	0.6116671E 00
0.5525000E-01	0.6116671E 00

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4TCO RUN 27 3 SEC

0.	0.3919984E 00
0.9999871E-03	0.3919984E 00
0.1999974E-02	0.4150571E 00
0.3000021E-02	0.3458809E 00
0.4000008E-02	0.3458809E 00
0.4999995E-02	0.3919984E 00
0.5999982E-02	0.3228222E 00
0.6999969E-02	0.3458809E 00
0.8000016E-02	0.3919984E 00
0.9000003E-02	0.3919984E 00
0.9999990E-02	0.3919984E 00
0.1099998E-01	0.4150571E 00
0.1199996E-01	0.4150571E 00
0.1300001E-01	0.4150571E 00
0.1400000E-01	0.4150571E 00
0.1499999E-01	0.3919984E 00
0.1599997E-01	0.4150571E 00
0.1700002E-01	0.3919984E 00
0.1800001E-01	0.3919984E 00
0.1899999E-01	0.3458809E 00
0.2012497E-01	0.3919984E 00
0.2112502E-01	0.4150571E 00
0.2212501E-01	0.3228222E 00
0.2312499E-01	0.3919984E 00
0.2412498E-01	0.3919984E 00
0.2512497E-01	0.3458809E 00
0.2612501E-01	0.3458809E 00
0.2712500E-01	0.4381158E 00
0.2812499E-01	0.4381158E 00
0.2912498E-01	0.4150571E 00
0.3012498E-01	0.4150571E 00
0.3112501E-01	0.4150571E 00
0.3212500E-01	0.3919984E 00
0.3312498E-01	0.3689397E 00
0.3412497E-01	0.2997635E 00
0.3512502E-01	0.3458809E 00
0.3612500E-01	0.3228222E 00
0.3712499E-01	0.3228222E 00
0.3812498E-01	0.3458809E 00
0.3912497E-01	0.3458809E 00
0.4012501E-01	0.3919984E 00
0.4112500E-01	0.3919984E 00
0.4212499E-01	0.3919984E 00
0.4312497E-01	0.3919984E 00
0.4412502E-01	0.3919984E 00
0.4512501E-01	0.3458809E 00
0.4612499E-01	0.3458809E 00
0.4712498E-01	0.3228222E 00
0.4812497E-01	0.2997635E 00
0.4912502E-01	0.3228222E 00
0.5024999E-01	0.3228222E 00
0.5124998E-01	0.3228222E 00
0.5224997E-01	0.3919984E 00
0.5325001E-01	0.4150571E 00
0.5425000E-01	0.4150571E 00
0.5524999E-01	0.4150571E 00

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4TCO RUN 28 SEC

0.	0.5072920E 00
0.9999871E-03	0.4842333E 00
0.2000004E-02	0.4381158E 00
0.2999991E-02	0.4842333E 00
0.3999978E-02	0.4611746E 00
0.4999995E-02	0.4611746E 00
0.5999982E-02	0.5072920E 00
0.6999999E-02	0.5072920E 00
0.7999986E-02	0.5072920E 00
0.9000003E-02	0.5072920E 00
0.9999990E-02	0.5072920E 00
0.1099998E-01	0.5072920E 00
0.1199999E-01	0.4611746E 00
0.1299998E-01	0.4842333E 00
0.1400000E-01	0.4842333E 00
0.1499999E-01	0.4611746E 00
0.1600000E-01	0.4381158E 00
0.1699999E-01	0.4611746E 00
0.1800001E-01	0.5072920E 00
0.1899999E-01	0.4842333E 00
0.1999998E-01	0.4381158E 00
0.2100000E-01	0.5072920E 00
0.2199998E-01	0.5072920E 00
0.2300000E-01	0.5303508E 00
0.2399999E-01	0.4842333E 00
0.2512500E-01	0.4842333E 00
0.2612498E-01	0.4842333E 00
0.2712500E-01	0.4611746E 00
0.2812499E-01	0.4150571E 00
0.2912501E-01	0.4842333E 00
0.3012499E-01	0.4611746E 00
0.3112498E-01	0.4611746E 00
0.3212500E-01	0.4842333E 00
0.3312498E-01	0.4842333E 00
0.3412500E-01	0.4611746E 00
0.3512499E-01	0.4150571E 00
0.3612500E-01	0.4611746E 00
0.3712499E-01	0.4611746E 00
0.3812498E-01	0.4611746E 00
0.3912500E-01	0.5072920E 00
0.4012498E-01	0.5303508E 00
0.4112500E-01	0.5303508E 00
0.4212499E-01	0.5072920E 00
0.4312500E-01	0.4611746E 00
0.4412499E-01	0.4611746E 00
0.4512498E-01	0.4150571E 00
0.4612499E-01	0.4150571E 00
0.4712498E-01	0.3919984E 00
0.4812500E-01	0.3919984E 00
0.4912499E-01	0.3919984E 00
0.5012500E-01	0.3458809E 00
0.5112498E-01	0.0009397E 00
0.5212501E-01	0.3919984E 00
0.5312499E-01	0.4150571E 00
0.5412498E-01	0.4842333E 00
0.5524999E-01	0.5303508E 00

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