DUKE POWER COMPANY
GENERAL OFFICES
422 SOUTH CHURCH STREET
CHARLOTTE, N. C. 28242

P. O. BOX 33189

TELEPHONE: AREA 704
373-4011

February 26, 1985

OGTP-872-N-57

C. H. Berlinger
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: TDI Diesel Generator Owners Group
Request for Additional Information
File: MTS-4086

Dear Mr. Berlinger:

Per a verbal request from your staff during our February 21, 1985 meeting at the Riverbend Nuclear Power Plant, enclosed is a copy of the Riverbend 2800KW crankshaft torsional analysis and the support package for the deletion report on Riverbend component 03-650C.

Should you have questions, please call R. J. Deese at (704) 373-3489.

Very truly yours,

Richard W Borsall

for C. L. Ray, Jr.
Technical Program Director
TDI Diesel Generator Owners Group

CLR/RJD/cr

cc w/attachment: W. W. Laity
J. R. Hamilton

cc w/o attachment: H. R. Denton
J. C. Kammeyer

B031
1/1

MEMORANDUM

TO: John Kammeyer

FROM: Lisa Shusto

DATE: February 25, 1985

RE: Riverbend Torsional Analysis at 2800 kW Load

Enclosed is a copy of the torsional analysis results performed on Riverbend Nuclear Power Plant at a load of 2800 kW. The stresses for each cylinder are summarized and compared with those at a load of 3500 kW in Table 1. The TN values used for both the 3500 kW and 2800 kW analyses are presented in Table 2. If you have any questions, I may be reached at (415) 856-9400.

LMS/gg

Table 1
NOMINAL SHEAR STRESSES AT 450 RPM FOR
DSR-48 13-INCH BY 12-INCH CRANKSHAFT AT RIVERBEND

Location	Amplitude of Nominal Shear Stress (psi)	
	2800 kW	3500 Kw
Between Cylinder No. 1 and Cylinder No. 2	2355	3068
Between Cylinder No. 2 and Cylinder No. 3	2631	3293
Between Cylinder No. 3 and Cylinder No. 4	3873	4842
Between Cylinder No. 4 and Cylinder No. 5	4493	5666
Between Cylinder No. 5 and Cylinder No. 6	5978	7357
Between Cylinder No. 6 and Cylinder No. 7	5272	6191
Between Cylinder No. 7 and Cylinder No. 8	4842	5977
Between Cylinder No. 8 and Flywheel	4799	5903

Table 2

TN VALUES FOR ANALYSES

3500 kW	2800 kW
3.449E+01	2.759E+01
9.193E+01	7.905E+01
1.500E+02	1.280E+02
1.123E+02	9.419E+01
9.775E+01	8.365E+01
7.703E+01	6.595E+01
6.065E+01	5.251E+01
4.804E+01	4.237E+01
3.560E+01	3.187E+01
2.618E+01	2.435E+01
2.083E+01	1.924E+01
1.548E+01	1.465E+01
1.101E+01	1.063E+01
8.478E+00	8.021E+00
6.326E+00	5.801E+00
4.609E+00	4.536E+00
4.012E+00	3.355E+00
2.971E+00	2.688E+00
2.456E+00	2.221E+00
2.046E+00	1.629E+00
1.759E+00	1.524E+00
1.110E+00	9.367E-01
1.130E+00	1.258E+00
9.971E-01	8.272E-01
8.724E-01	6.586E-01

COMPUTER CALCULATION COVER SHEET

PROJECT NO.: PA07596

TASK NO.: DR65

Note: only 2800 KW RUN for Riverbend is attached

VALIDATED COMPUTER CODE:

SHAMS	0005	1
Name	Number	Revision

MAINTAINED AT: Failure Analysis Associates, VAX"/780
2225 East Bayshore Road
Palo Alto, California 94303

DESCRIPTION OF CALCULATION

- REDUCED LOAD - RIVERBEND INPUT

Computer Runs at 2800, 3200, and 3300 KW loads for Shoreham Nuclear Power Plant to determine peak stresses

Computer Runs at ~~2800~~ 3200, 3300 and 3500 KW load for Gulf States Nuclear Power Plant to determine peak stresses

SUBJECT REPORT

TITLE: Memo to John Kuyumjian re: Riverbend Load that Produces Stresses Equal to Those at Shoreham Load of 3300 KW

REPORT NUMBER: _____

DATE: October 18, 1984

Lisa Shemsha	10/11/84	Robert Scott	10/12/84
Engineer	Date	Reviewer	Date

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*                                                                       *
*  S H A F T -- SHAFT HARMONIC ANALYSIS BY MODAL SUPERPOSITION          *
*                                                                       *
*  GULF STATES UTILITIES COMPANY -- RIVERBEND NUCLEAR POWER STATION     *
*  CRANKSHAFT TORSIONAL VIBRATION ANALYSIS OF 13/12 INCH CRANKSHAFT.    *
*                                                                       *
*  AIR START VALVE@AVERAGED OVER 6 FIRINGS                              *
*  FIRING CHARACTERISTICS -- NORMAL                                     *
*                                                                       *
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S T R U C T U R A L   P A R A M E T E R S

JOINT     INERTIA    STIFFNESS

    1  4.8850E+00  6.8226E+07
    2  4.6222E+01  8.4727E+07
    3  4.7922E+01  8.4727E+07
    4  4.7922E+01  8.4727E+07
    5  4.7922E+01  8.4727E+07
    6  4.7922E+01  8.4727E+07
    7  4.7922E+01  8.4727E+07
    8  4.7922E+01  8.4727E+07
    9  5.0149E+01  7.6941E+07
   10  4.2655E+02  3.0972E+08
   11  4.9761E+03  1.4090E+06

N A T U R A L   F R E Q U E N C I E S   A N D   M O D E   S H A P E S

MODE NUMBER     1
NATURAL FREQUENCY =        15.48 RAD/SEC        2.48 HZ      148.86 R.P.M

JOINT  DISPLACEMENT
    1    0.01321
    2    0.01321
    3    0.01321
    4    0.01320
    5    0.01320
    6    0.01319
    7    0.01318
    8    0.01317
    9    0.01316
   10    0.01314
   11    0.01313

MODE NUMBER     2
NATURAL FREQUENCY =       238.54 RAD/SEC       37.97 HZ     2277.90 R.P.M

JOINT  DISPLACEMENT
    1    0.06682
    2    0.06638
    3    0.06388
    4    0.05932
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    5   -0.05286
    6    0.04469
    7    0.03509
    8    0.02435
    9    0.01284
   10    0.00032
   11   -0.00357


MODE NUMBER     3
NATURAL FREQUENCY =      672.38 RAD/SEC        107.01 HZ      6420.78 R.P.M

JOINT  DISPLACEMENT
    1   -0.06343
    2   -0.06007
    3   -0.04199
    4   -0.01317
    5    0.01981
    6    0.04634
    7    0.06181
    8    0.06148
    9    0.04442
   10    0.01437
   11   -0.00230


MODE NUMBER     4
NATURAL FREQUENCY =      920.77 RAD/SEC        146.54 HZ      8792.69 R.P.M

JOINT  DISPLACEMENT
    1   -0.03906
    2   -0.03518
    3   -0.01519
    4    0.01268
    5    0.03356
    6    0.03899
    7    0.02566
    8    0.00007
    9   -0.02556
   10   -0.03966
   11   -0.00334


MODE NUMBER     5
NATURAL FREQUENCY =     1186.71 RAD/SEC        188.87 HZ     11332.23 R.P.M

JOINT  DISPLACEMENT
    1   -0.06399
    2   -0.05344
    3   -0.00248
    4    0.05045
    5    0.06320
    6    0.02560
    7   -0.03238
    8   -0.06457
    9   -0.04533
   10    0.01747
   11   -0.00081


MODE NUMBER     6
NATURAL FREQUENCY =     1573.20 RAD/SEC        250.38 HZ     15022.95 R.P.M
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JOINT	DISPLACEMENT
1	-0.06583
2	-0.04676
3	0.03356
4	0.06690
5	0.00659
6	-0.06294
7	-0.04437
8	0.03632
9	0.06616
10	0.00770
11	0.00028

MODE NUMBER 7
NATURAL FREQUENCY = 1928.90 RAD/SEC 306.99 HZ 18419.63 R.P.M

JOINT	DISPLACEMENT
1	-0.06390
2	-0.03607
3	0.06099
4	0.02970
5	-0.06409
6	-0.02301
7	0.06649
8	0.01606
9	-0.06817
10	0.00439
11	-0.00007

MODE NUMBER 8
NATURAL FREQUENCY = 2229.88 RAD/SEC 354.90 HZ 21293.82 R.P.M

JOINT	DISPLACEMENT
1	-0.05894
2	-0.02462
3	0.07004
4	-0.03228
5	-0.04382
6	0.06788
7	-0.01133
8	-0.05868
9	0.05900
10	-0.00262
11	0.00003

MODE NUMBER 9
NATURAL FREQUENCY = 2461.13 RAD/SEC 391.70 HZ 23502.06 R.P.M

JOINT	DISPLACEMENT
1	-0.04829
2	-0.01404
3	0.05087
4	-0.06990
5	0.04081
6	0.01171
7	-0.05751
8	0.07029
9	-0.04273
10	0.00150
11	-0.00002

MODE NUMBER 10
NATURAL FREQUENCY = 2608.41 RAD/SEC 415.14 HZ 24908.46 R.P.M

JOINT	DISPLACEMENT
1	0.02856
2	0.00581
3	-0.03276
4	-0.05473
5	-0.06841
6	0.07170
7	-0.06411
8	0.04679
9	-0.02238
10	0.00868
11	-0.00081

MODE NUMBER 11
NATURAL FREQUENCY = 3171.40 RAD/SEC 504.74 HZ 30284.69 R.P.M

JOINT	DISPLACEMENT
1	0.34297
2	-0.06091
3	0.01795
4	-0.00529
5	0.00156
6	-0.00046
7	0.00014
8	-0.00004
9	0.00001
10	0.00000
11	0.00000

M O D A L D A M P I N G

MODE	PERCENT
1	0.02500
2	0.02500
3	0.02500
4	0.02500
5	0.02500
6	0.02500
7	0.02500
8	0.02500
9	0.02500
10	0.02500
11	0.02500

NUMBER OF TIME STEPS = 120
CODE FOR GENERAL LOADING = 0
CODE FOR ENGINE ANALYSIS = 1

NUMBER OF CYLINDERS = 8
NUMBER OF STROKES IN CYCLE = 4
CODE FOR V ENGINE = 0
V ANGLE = 0.00 DEGREES

ENGINE SPEED = 450.00 R.P.M.
LEFT BANK TIMING = 0.00 DEGREES
RIGHT BANK TIMING = 0.00 DEGREES

FIRING ORDER

1 4 7 3 8 5 2 6

HARMONIC	PRESSURE COSINE	PRESSURE SINE	INERTIA COSINE	INERTIA SINE
0	6.4800E+03	0.0000E+00		
1	-1.6200E+04	1.0400E+04	-1.3800E-06	5.7900E-08
2	9.1700E+01	2.2500E+04	-1.3800E-06	2.4000E+03
3	-4.1200E+02	-1.7000E+04	-1.3000E-06	1.1400E-08
4	-1.0900E+03	1.5100E+04	-1.3000E-06	-2.1700E+04
5	2.0600E+03	-1.1700E+04	-1.3000E-06	1.8900E-08
6	-2.8000E+03	8.3700E+03	-1.3000E-06	7.5400E+03
7	2.3100E+03	7.4800E+03	-1.3800E-06	2.6500E-08
8	-2.2700E+03	5.1100E+03	-1.3000E-06	-5.7600E+02
9	1.9000E+03	-3.9600E+03	-1.3000E-06	3.4100E-08
10	-1.6700E+03	3.0400E+03	-1.3000E-06	8.3900E+01
11	1.4800E+03	-2.1900E+03	-1.3000E-06	4.1700E-08
12	-1.1700E+03	1.6200E+03	-1.3000E-06	1.1500E+01
13	7.0900E+02	-1.1300E+03	-1.3000E-06	6.9200E-08
14	-2.2500E+02	7.6500E+02	-1.3000E-06	-1.1700E+00
15	6.5200E+02	-9.2000E+02	-1.3000E-06	5.6800E-08
16	-4.8600E+02	3.6100E+02	-1.3000E-06	-2.0400E-01
17	4.2200E+02	-2.4000E+02	-1.3000E-06	6.4400E-08
18	-3.7600E+02	1.3800E+02	-1.3000E-06	1.6700E+02
19	2.4600E+02	-1.2500E+02	-1.3000E-06	7.2000E-08
20	-2.6700E+02	8.5700E+01	-1.3000E-06	3.3900E-03
21	1.6500E+02	-9.5000E+01	-1.3000E-06	7.9600E-08
22	-1.8300E+02	1.3400E+02	-1.3000E-06	-2.3800E-04
23	1.4800E+02	-1.8600E+01	-1.3000E-06	8.7200E-08
24	-8.5600E+01	7.0800E+01	-1.3000E-06	5.4000E-05

CYLINDER LOADING FACTORS

CYLINDER	FACTOR
1	1.000
2	1.000
3	1.000
4	1.000
5	1.000
6	1.000
7	1.000
8	1.000

APPLIED LOAD HARMONICS

COSINE

HARMONIC	JOINT OR MODE 1	2	3	4	5	6	7	8	9	10	11
0	0.000E+00	5.480E+03	5.480E+03	5.480E+03	5.480E+03	5.480E+03	5.480E+03	5.480E+03	5.480E+03	0.000E+00	0.000E+00
1	0.000E+00	-1.020E+04	-1.000E+04	1.428E+04	-1.414E+02	1.414E+02	-1.428E+04	1.000E+04	1.020E+04	0.000E+00	0.000E+00
2	0.000E+00	5.170E+03	-5.170E+03	2.500E+04	-2.500E+04	-2.500E+04	2.500E+04	-5.170E+03	5.170E+03	0.000E+00	0.000E+00
3	0.000E+00	-4.120E+02	-1.700E+04	1.173E+04	1.231E+04	-1.231E+04	-1.173E+04	-1.700E+04	4.120E+02	0.000E+00	0.000E+00
4	0.000E+00	-1.090E+03	-1.090E+03	1.090E+03	1.090E+03	1.090E+03	1.090E+03	-1.090E+03	-1.090E+03	0.000E+00	0.000E+00
5	0.000E+00	2.060E+03	-1.170E+04	-6.817E+03	-9.730E+03	9.730E+03	6.817E+03	1.170E+04	-2.060E+03	0.000E+00	0.000E+00
6	0.000E+00	-2.090E+03	2.090E+03	-1.730E+03	1.730E+03	1.730E+03	-1.730E+03	2.090E+03	-2.090E+03	0.000E+00	0.000E+00
7	0.000E+00	2.310E+03	7.280E+03	-6.781E+03	-3.514E+03	3.514E+03	6.781E+03	-7.280E+03	-2.310E+03	0.000E+00	0.000E+00
8	0.000E+00	-2.270E+03	-2.270E+03	-2.270E+03	-2.270E+03	-2.270E+03	-2.270E+03	-2.270E+03	-2.270E+03	0.000E+00	0.000E+00
9	0.000E+00	1.900E+03	-3.960E+03	1.457E+03	4.144E+03	-4.144E+03	-1.457E+03	3.960E+03	-1.900E+03	0.000E+00	0.000E+00
10	0.000E+00	-1.670E+03	1.670E+03	3.124E+03	-3.124E+03	-3.124E+03	3.124E+03	1.670E+03	-1.670E+03	0.000E+00	0.000E+00
11	0.000E+00	1.480E+03	2.190E+03	2.595E+03	5.020E+02	-5.020E+02	-2.595E+03	-2.190E+03	-1.480E+03	0.000E+00	0.000E+00
12	0.000E+00	-1.170E+03	-1.170E+03	1.170E+03	1.170E+03	1.170E+03	1.170E+03	-1.170E+03	-1.170E+03	0.000E+00	0.000E+00
13	0.000E+00	9.090E+02	-1.130E+03	-1.563E+02	-1.442E+03	1.442E+03	1.563E+02	1.130E+03	-9.090E+02	0.000E+00	0.000E+00
14	0.000E+00	-7.250E+02	7.250E+02	-7.538E+02	7.538E+02	7.538E+02	-7.538E+02	7.250E+02	-7.250E+02	0.000E+00	0.000E+00
15	0.000E+00	6.320E+02	5.200E+02	-8.146E+02	7.920E+01	-7.920E+01	8.146E+02	-5.200E+02	-6.320E+02	0.000E+00	0.000E+00
16	0.000E+00	-4.860E+02	-4.860E+02	-4.860E+02	-4.860E+02	-4.860E+02	-4.860E+02	-4.860E+02	-4.860E+02	0.000E+00	0.000E+00
17	0.000E+00	4.220E+02	-2.400E+02	-1.287E+02	4.681E+02	-4.681E+02	1.287E+02	2.400E+02	-4.220E+02	0.000E+00	0.000E+00
18	0.000E+00	-3.760E+02	3.760E+02	1.390E+02	-1.390E+02	1.390E+02	3.760E+02	-3.760E+02	0.000E+00	0.000E+00	0.000E+00
19	0.000E+00	2.460E+02	1.250E+02	2.623E+02	-8.556E+01	8.556E+01	-2.623E+02	-1.250E+02	-2.460E+02	0.000E+00	0.000E+00
20	0.000E+00	-2.670E+02	-2.670E+02	2.670E+02	2.670E+02	2.670E+02	2.670E+02	-2.670E+02	-2.670E+02	0.000E+00	0.000E+00
21	0.000E+00	1.650E+02	-3.500E+01	9.192E+01	-1.414E+02	1.414E+02	-9.192E+01	3.500E+01	-1.650E+02	0.000E+00	0.000E+00
22	0.000E+00	-1.830E+02	1.830E+02	-1.340E+02	1.340E+02	1.340E+02	-1.340E+02	1.830E+02	-1.830E+02	0.000E+00	0.000E+00
23	0.000E+00	1.480E+02	1.860E+01	-1.178E+02	9.150E+01	-9.150E+01	1.178E+02	-1.860E+01	-1.480E+02	0.000E+00	0.000E+00
24	0.000E+00	-9.560E+01	-9.560E+01	-9.560E+01	-9.560E+01	-9.560E+01	-9.560E+01	-9.560E+01	-9.560E+01	0.000E+00	0.000E+00

SINE

HARMONIC	JOINT OR MODE 1	2	3	4	5	6	7	8	9	10	11
1	0.000E+00	-1.000E+04	1.020E+04	-1.414E+02	-1.428E+04	1.428E+04	1.414E+02	-1.020E+04	1.000E+04	0.000E+00	0.000E+00
2	0.000E+00	2.500E+04	-2.500E+04	-5.170E+03	5.170E+03	-5.170E+03	-2.500E+04	2.500E+04	0.000E+00	0.000E+00	0.000E+00
3	0.000E+00	-1.700E+04	-4.120E+02	-1.231E+04	1.173E+04	-1.173E+04	1.231E+04	4.120E+02	1.700E+04	0.000E+00	0.000E+00
4	0.000E+00	-6.600E+03	-6.600E+03	6.600E+03	6.600E+03	6.600E+03	6.600E+03	-6.600E+03	-6.600E+03	0.000E+00	0.000E+00
5	0.000E+00	-1.170E+04	-2.060E+03	-9.730E+03	6.817E+03	-6.817E+03	9.730E+03	2.060E+03	1.170E+04	0.000E+00	0.000E+00
6	0.000E+00	1.730E+03	-1.730E+03	-2.090E+03	2.090E+03	2.090E+03	-2.090E+03	-1.730E+03	1.730E+03	0.000E+00	0.000E+00
7	0.000E+00	-7.280E+03	2.310E+03	3.514E+03	-6.781E+03	6.781E+03	-3.514E+03	-2.310E+03	7.280E+03	0.000E+00	0.000E+00
8	0.000E+00	4.714E+03	4.714E+03	4.714E+03	4.714E+03	4.714E+03	4.714E+03	4.714E+03	4.714E+03	0.000E+00	0.000E+00
9	0.000E+00	-3.960E+03	-1.900E+03	4.144E+03	-1.457E+03	1.457E+03	-4.144E+03	1.900E+03	3.960E+03	0.000E+00	0.000E+00
10	0.000E+00	3.124E+03	-3.124E+03	1.670E+03	-1.670E+03	-1.670E+03	1.670E+03	-3.124E+03	3.124E+03	0.000E+00	0.000E+00
11	0.000E+00	-2.190E+03	1.480E+03	-5.020E+02	2.595E+03	-2.595E+03	5.020E+02	-1.480E+03	2.190E+03	0.000E+00	0.000E+00
12	0.000E+00	1.532E+03	1.532E+03	-1.532E+03	-1.532E+03	-1.532E+03	-1.532E+03	1.532E+03	1.532E+03	0.000E+00	0.000E+00
13	0.000E+00	-1.130E+03	-9.090E+02	-1.442E+03	1.563E+02	-1.563E+02	1.442E+03	9.090E+02	1.130E+03	0.000E+00	0.000E+00
14	0.000E+00	7.538E+02	-7.538E+02	-7.250E+02	7.250E+02	7.250E+02	-7.250E+02	-7.538E+02	7.538E+02	0.000E+00	0.000E+00
15	0.000E+00	-5.200E+02	6.320E+02	-7.920E+01	-8.146E+02	8.146E+02	7.920E+01	-6.320E+02	5.200E+02	0.000E+00	0.000E+00
16	0.000E+00	3.608E+02	3.608E+02	3.608E+02	3.608E+02	3.608E+02	3.608E+02	3.608E+02	3.608E+02	0.000E+00	0.000E+00
17	0.000E+00	-2.400E+02	-4.220E+02	4.681E+02	1.287E+02	-1.287E+02	-4.681E+02	4.220E+02	2.400E+02	0.000E+00	0.000E+00
18	0.000E+00	1.390E+02	-1.390E+02	3.760E+02	-3.760E+02	-3.760E+02	3.760E+02	-1.390E+02	1.390E+02	0.000E+00	0.000E+00
19	0.000E+00	-1.250E+02	2.460E+02	8.556E+01	2.623E+02	-2.623E+02	-8.556E+01	-2.460E+02	1.250E+02	0.000E+00	0.000E+00
20	0.000E+00	6.570E+01	6.570E+01	-6.570E+01	-6.570E+01	-6.570E+01	-6.570E+01	6.570E+01	6.570E+01	0.000E+00	0.000E+00
21	0.000E+00	-3.500E+01	-1.650E+02	-1.414E+02	-9.192E+01	9.192E+01	1.414E+02	1.650E+02	3.500E+01	0.000E+00	0.000E+00
22	0.000E+00	1.340E+02	-1.340E+02	-1.830E+02	1.830E+02	1.830E+02	-1.830E+02	-1.340E+02	1.340E+02	0.000E+00	0.000E+00
23	0.000E+00	-1.860E+01	1.480E+02	-9.150E+01	-1.178E+02	1.178E+02	9.150E+01	-1.480E+02	1.860E+01	0.000E+00	0.000E+00
24	0.000E+00	7.080E+01	7.080E+01	7.080E+01	7.080E+01	7.080E+01	7.080E+01	7.080E+01	7.080E+01	0.000E+00	0.000E+00

APPLIED LOAD HARMONICS IN NORMAL COORDINATES

COSINE HARMONIC	JOINT OR MODE 1	2	3	4	5	6	7	8	9	10	11
0	5.782E+02	1.969E+03	6.513E+02	1.884E+02	-3.231E+02	3.039E+02	-9.913E+01	1.435E+02	-1.369E+01	-4.721E+01	-2.578E+02
1	-5.952E-01	-5.963E+02	1.044E+03	5.754E+01	6.395E+02	2.759E+03	-1.296E+03	-7.178E+02	-3.595E+02	2.225E+03	3.638E+02
2	-1.469E-01	-1.251E+02	-5.942E+02	-1.105E+03	-1.932E+03	1.711E+03	3.645E+03	-1.573E+03	-5.460E+03	-4.749E+02	-5.637E+02
3	8.406E-01	1.035E+03	-2.931E+03	-4.810E+02	2.493E+03	2.161E+03	-1.869E+02	6.017E+02	6.852E+00	-1.695E+03	2.921E+02
4	3.162E-02	2.672E+01	1.190E+02	2.029E+02	2.972E+02	-1.342E+02	3.954E+01	-7.116E+01	-1.605E+02	-3.872E+00	4.245E+01
5	-5.618E-01	-5.968E+02	1.770E+03	3.037E+02	-1.674E+03	-1.635E+03	1.910E+02	-4.487E+02	-5.879E+00	1.542E+03	-3.186E+02
6	2.901E-02	2.428E+01	1.002E+02	1.555E+02	1.886E+02	-3.098E+01	6.180E+01	6.898E+01	6.999E+02	8.588E+01	1.755E+02
7	2.172E-01	2.184E+02	-3.975E+02	-2.230E+01	-2.605E+02	-1.280E+03	7.951E+02	1.279E+03	-3.511E+01	-8.275E+02	1.989E+01
8	-2.395E+02	-8.158E+02	-2.098E+02	-7.803E+01	1.338E+02	-1.259E+02	4.106E+01	-5.946E+01	5.671E+00	1.956E+01	1.066E+02
9	1.623E-02	4.435E+01	-1.315E+01	4.053E-02	1.513E+01	2.466E+02	-3.407E+02	-1.162E+03	2.022E+02	-3.886E+01	-1.865E+02
10	6.836E-03	5.252E+00	4.799E+00	-3.244E+01	-1.680E+02	3.307E+02	8.753E+02	-2.498E+02	-2.516E+02	1.154E+01	1.121E+02
11	2.239E-01	2.328E+02	-5.911E+02	-8.560E+01	3.578E+02	1.505E+02	2.979E+01	4.769E+01	-1.215E-01	1.056E+02	-6.384E+01
12	3.394E-02	2.868E+01	1.277E+02	2.177E+02	3.190E+02	-1.440E+02	4.244E+01	-7.638E+01	-1.723E+02	-4.157E+00	4.556E+01
13	-9.067E-03	-1.155E+01	7.214E+01	1.838E+01	-1.447E+02	-2.172E+02	4.340E+01	-5.715E+01	-1.033E+00	2.989E+02	-7.776E+01
14	1.062E-02	8.904E+00	3.734E+01	5.927E+01	7.631E+01	-2.287E+01	-6.733E+00	3.433E+01	2.704E+02	3.174E+01	6.185E+01
15	3.524E-02	3.529E+01	-6.156E+01	-3.381E+00	-3.733E+01	-1.579E+02	7.037E+01	2.231E+01	2.459E+01	-1.315E+02	-2.457E+01
16	-5.127E+01	-1.747E+02	-5.776E+01	-1.671E+01	2.865E+01	-2.695E+01	8.791E+00	-1.273E+01	1.214E+00	4.187E+00	2.287E+01
17	1.389E-02	1.381E+01	-2.283E+01	-1.173E+00	-1.139E+01	-2.876E+01	-1.173E+01	-1.158E+02	3.006E+01	-4.989E+01	-2.838E+01
18	3.586E-03	2.954E+00	1.051E+01	1.232E+01	2.091E+00	2.994E+01	9.364E+01	-1.806E+01	4.490E+01	9.747E+00	2.876E+01
19	2.306E-02	2.377E+01	-5.622E+01	-7.375E+00	2.428E+01	-4.883E+00	7.375E+00	-4.204E-01	-1.127E-01	4.015E+01	-1.433E+01
20	7.745E-03	6.545E+00	2.914E+01	4.969E+01	7.281E+01	-3.287E+01	9.686E+00	-1.743E+01	-3.933E+01	-9.486E-01	1.040E+01
21	8.429E-03	8.524E+00	-1.681E+01	-1.540E+00	-1.212E+00	-1.814E+01	6.152E+00	-4.432E+00	-1.216E-01	3.817E+01	-1.147E+01
22	2.476E-03	2.071E+00	8.486E+00	1.301E+01	1.528E+01	-1.334E+00	8.615E+00	4.857E+00	5.814E+01	7.298E+00	1.526E+01
23	6.558E-03	6.551E+00	-1.121E+01	-6.011E-01	-6.363E+00	-2.351E+01	6.162E+00	-1.773E+01	8.155E+00	-2.413E+01	-7.859E+00
24	-1.009E+01	-3.436E+01	-1.136E+01	-3.286E+00	5.636E+00	-5.302E+00	1.729E+00	-2.504E+00	2.388E-01	8.236E-01	4.498E+00

SINE HARMONIC	JOINT OR MODE 1	2	3	4	5	6	7	8	9	10	11
1	-2.549E-01	-2.523E+02	4.005E+02	1.945E+01	1.657E+02	9.214E+01	7.292E+02	3.748E+03	-8.172E+02	8.911E+02	7.646E+02
2	-2.532E-01	-2.092E+02	-7.669E+02	-9.605E+02	-4.271E+02	-1.670E+03	-5.480E+03	9.250E+02	-3.718E+03	-6.996E+02	-1.938E+03
3	-1.106E+00	-1.129E+03	2.439E+03	2.738E+02	-4.667E+02	1.366E+03	-5.931E+02	3.163E+02	1.098E+01	-3.553E+03	1.119E+03
4	1.915E-01	1.618E+02	7.203E+02	1.226E+03	1.800E+03	-8.124E+02	2.394E+02	-6.309E+02	-9.721E+02	-2.345E+01	2.570E+02
5	-8.666E-01	-8.880E+02	1.991E+03	2.394E+02	-5.828E+02	7.182E+02	-3.902E+02	1.557E+02	6.866E+00	-2.277E+03	7.422E+02
6	-1.124E-02	-9.039E+00	-2.412E+01	-6.240E+00	9.297E+01	-2.522E+02	-6.967E+02	1.812E+02	5.439E+01	-2.647E+01	-1.233E+02
7	-2.696E-01	-2.687E+02	4.508E+02	2.361E+01	2.386E+02	7.352E+02	1.936E+01	1.590E+03	-4.760E+02	9.788E+02	4.523E+02
8	4.973E+02	1.694E+03	5.602E+02	1.621E+02	-2.779E+02	2.614E+02	-8.527E+01	1.235E+02	-1.178E+01	-4.061E+01	-2.218E+02
9	-1.985E-01	-1.986E+02	3.435E+02	1.867E+01	2.026E+02	8.121E+02	-3.051E+02	1.624E+02	-1.856E+02	7.361E+02	1.817E+02
10	-4.004E-02	-3.341E+01	-1.345E+02	-2.005E+02	-2.172E+02	-2.593E+01	-2.602E+02	-4.113E+01	-8.813E+02	-1.168E+02	-2.566E+02
11	-5.173E-02	-4.973E+01	4.464E+01	-8.674E+00	1.656E+02	3.678E+02	-9.195E+01	9.429E+01	2.008E+00	-6.027E+02	1.680E+02
12	-4.443E-02	-3.754E+01	-1.671E+02	-2.850E+02	-4.176E+02	1.885E+02	-5.556E+01	9.998E+01	2.256E+02	5.441E+00	-5.964E+01
13	-1.257E-01	-1.301E+02	3.171E+02	4.348E+01	-1.608E+02	-1.945E+01	-3.048E+01	-9.761E+00	3.882E-01	-1.528E+02	6.063E+01
14	-5.570E-03	-4.522E+00	-1.361E+01	-9.175E+00	2.737E+01	-9.524E+01	-2.695E+02	6.640E+01	-9.712E+00	-1.389E+01	-5.488E+01
15	-1.159E-02	-1.143E+01	1.766E+01	8.236E-01	6.276E+00	-8.478E+00	4.808E+01	2.175E+02	-4.485E+01	3.978E+01	4.183E+01
16	3.807E+01	1.297E+02	4.268E+01	1.240E+01	-2.127E+01	2.001E+01	-6.526E+00	9.450E+00	-9.013E-01	-3.108E+00	-1.698E+01
17	-1.707E-02	-1.713E+01	3.037E+01	1.699E+00	1.935E+01	8.929E+01	-4.917E+01	-5.844E+01	-4.120E+00	6.441E+01	4.753E+00
18	-2.876E-03	-2.434E+00	-1.103E+01	-1.941E+01	-3.100E+01	2.264E+01	4.371E+01	-2.224E+01	-9.350E+01	-9.018E+00	-1.331E+01
19	6.613E-03	7.246E+00	-2.585E+01	-5.126E+00	3.324E+01	4.120E+01	-6.887E+00	1.102E+01	1.771E-01	-4.968E+01	1.210E+01
20	-1.906E-03	-1.611E+00	-7.171E+00	-1.223E+01	-1.792E+01	8.088E+00	-2.384E+00	4.289E+00	9.677E+00	2.334E-01	-2.559E+00
21	-1.200E-02	-1.257E+01	3.388E+01	5.270E+00	-2.513E+01	-1.772E+01	4.437E-01	-5.081E+00	-4.096E-02	8.211E+00	-2.539E-01
22	-7.940E-04	-6.338E-01	-1.516E+00	2.508E-01	8.894E+00	-2.120E+01	-5.783E+01	1.547E+01	8.012E+00	-1.783E+00	-9.417E+00
23	1.645E-03	1.674E+00	-3.272E+00	-2.022E-01	-2.667E+00	-1.668E+01	1.426E+01	3.568E+01	-4.518E+00	-6.667E+00	4.054E+00
24	7.470E+00	2.545E+01	8.414E+00	2.434E+00	-4.174E+00	3.926E+00	-1.281E+00	1.854E+00	-1.769E-01	-6.100E-01	-3.331E+00

DISPLACEMENT HARMONICS

COSINE HARMONIC	JOINT OR MODE 1	2	3	4	5	6	7	8	9	10	11
0	3.364E-02	3.364E-02	3.357E-02	3.344E-02	3.325E-02	3.299E-02	3.267E-02	3.228E-02	3.183E-02	3.126E-02	3.111E-02
1	-8.761E-04	-8.761E-04	-7.555E-04	-5.167E-04	-4.463E-04	-3.742E-04	-3.036E-04	-6.434E-05	5.686E-05	5.782E-05	5.802E-05
2	5.617E-06	5.660E-06	-5.498E-05	-5.488E-05	-3.500E-04	-3.496E-04	-5.371E-05	-5.305E-05	8.297E-06	8.950E-06	9.122E-06
3	1.620E-03	1.619E-03	1.617E-03	1.409E-03	1.058E-03	5.583E-04	2.020E-04	-1.623E-05	-3.363E-05	-5.781E-05	-6.292E-05
4	-4.872E-07	-5.318E-07	1.199E-05	3.714E-05	4.959E-05	4.942E-05	3.664E-05	1.118E-05	-1.591E-06	-1.727E-06	-1.785E-06
5	-1.030E-03	-1.029E-03	-1.046E-03	-9.176E-04	-7.032E-04	-3.690E-04	-1.473E-04	-4.716E-06	5.270E-08	3.269E-05	4.034E-05
6	1.347E-05	1.344E-05	3.800E-05	3.737E-05	5.664E-05	5.493E-05	3.227E-05	2.957E-05	1.761E-06	-1.659E-06	-2.457E-06
7	6.046E-04	6.025E-04	5.631E-04	4.287E-04	3.673E-04	3.410E-04	2.680E-04	1.105E-04	3.704E-05	-1.413E-05	-2.623E-05
8	-2.938E-03	-2.925E-03	-2.822E-03	-2.630E-03	-2.353E-03	-1.997E-03	-1.570E-03	-1.080E-03	-5.394E-04	9.973E-05	2.535E-04
9	3.099E-04	3.079E-04	2.741E-04	2.785E-04	2.576E-04	1.802E-04	1.462E-04	1.248E-04	5.315E-05	-2.462E-06	-1.603E-05
10	6.814E-04	6.769E-04	6.717E-04	6.253E-04	5.221E-04	4.389E-04	3.785E-04	2.690E-04	1.311E-04	-3.635E-06	-3.680E-05
11	-1.221E-03	-1.211E-03	-1.174E-03	-1.116E-03	-1.045E-03	-9.399E-04	-7.919E-04	-5.826E-04	-3.250E-04	-7.340E-06	7.226E-05
12	-1.081E-04	-1.070E-04	-8.685E-05	-4.854E-05	-2.179E-05	-7.971E-06	-7.765E-06	-2.112E-05	-1.953E-05	-1.305E-06	3.394E-06
13	4.317E-05	4.275E-05	2.963E-05	2.851E-05	2.797E-05	4.343E-05	4.008E-05	3.341E-05	1.218E-05	3.144E-07	-2.597E-06
14	-2.445E-05	-2.413E-05	-1.372E-05	-1.109E-05	1.063E-06	4.343E-06	-1.455E-06	1.656E-06	-3.981E-06	-4.191E-07	5.344E-07
15	-1.846E-05	-1.819E-05	-2.417E-05	-3.449E-05	-3.275E-05	-2.967E-05	-2.344E-05	-2.513E-05	-1.895E-05	-2.307E-06	2.233E-06
16	1.492E-04	1.466E-04	1.382E-04	1.240E-04	1.054E-04	8.384E-05	6.111E-05	3.913E-05	1.971E-05	2.819E-06	-1.922E-06
17	-1.440E-06	-1.418E-06	-6.292E-06	-7.793E-06	-6.977E-06	-1.098E-05	-8.440E-06	-6.658E-06	-7.009E-06	-1.095E-06	6.355E-07
18	-6.662E-08	-6.513E-06	-1.246E-06	-2.790E-07	-8.825E-07	1.803E-07	2.797E-06	3.516E-06	-5.698E-07	-9.610E-08	4.824E-08
19	1.444E-06	1.413E-06	-1.665E-06	-5.975E-06	-1.267E-05	-1.690E-05	-2.031E-05	-1.840E-05	-1.303E-05	-2.243E-06	1.040E-06
20	-1.614E-05	-1.571E-05	-1.021E-05	-2.584E-07	6.569E-06	9.400E-06	7.876E-06	2.195E-06	-6.041E-07	-1.153E-07	4.360E-08
21	3.430E-06	3.322E-06	7.786E-07	-1.517E-06	-4.718E-06	-5.579E-06	-7.251E-06	-6.715E-06	-5.546E-06	-1.151E-06	3.581E-07
22	-5.446E-06	-5.270E-06	-2.146E-06	-8.797E-07	2.074E-06	3.166E-06	2.232E-06	2.508E-06	2.136E-07	4.366E-08	-1.331E-08
23	3.187E-06	3.081E-06	7.516E-07	-1.891E-06	-2.848E-06	-4.439E-06	-4.207E-06	-4.665E-06	-4.168E-06	-9.174E-07	2.527E-07
24	1.512E-05	1.454E-05	1.251E-05	9.300E-06	5.506E-06	1.832E-06	-1.038E-06	-2.570E-06	-2.481E-06	-5.934E-07	1.457E-07

SINE HARMONIC	JOINT OR MODE 1	2	3	4	5	6	7	8	9	10	11
1	-3.815E-04	-3.815E-04	-2.631E-04	-2.648E-04	-2.647E-04	-9.597E-05	-9.572E-05	-9.700E-05	2.207E-05	2.311E-05	2.332E-05
2	5.177E-06	5.158E-06	-2.900E-04	-2.898E-04	-2.284E-04	-2.273E-04	-2.865E-04	-2.845E-04	1.292E-05	1.541E-05	1.597E-05
3	-1.771E-03	-1.770E-03	-1.564E-03	-1.351E-03	-9.889E-04	-7.634E-04	-3.972E-04	-1.747E-04	4.392E-05	6.384E-05	6.844E-05
4	2.194E-05	2.193E-05	9.975E-05	2.550E-04	3.310E-04	3.274E-04	2.442E-04	8.176E-05	-3.155E-06	-1.082E-05	-1.258E-05
5	-1.680E-03	-1.677E-03	-1.523E-03	-1.331E-03	-1.013E-03	-7.659E-04	-4.330E-04	-2.120E-04	-1.419E-05	5.152E-05	6.677E-05
6	-3.165E-06	-3.147E-06	-2.343E-05	-2.311E-05	2.150E-06	2.582E-06	-2.182E-05	-2.129E-05	-2.046E-07	6.165E-07	8.151E-07
7	-6.635E-04	-6.616E-04	-5.647E-04	-4.874E-04	-4.442E-04	-3.142E-04	-2.600E-04	-1.608E-04	-3.168E-05	1.668E-05	2.813E-05
8	4.693E-03	4.674E-03	4.513E-03	4.209E-03	3.769E-03	3.200E-03	2.514E-03	1.724E-03	8.447E-04	-2.027E-04	-4.531E-04
9	-1.119E-03	-1.114E-03	-1.034E-03	-9.066E-04	-8.051E-04	-6.666E-04	-5.283E-04	-3.277E-04	-1.417E-04	1.589E-05	5.407E-05
10	-1.694E-04	-1.686E-04	-2.004E-04	-1.902E-04	-1.950E-04	-1.746E-04	-1.294E-04	-1.007E-04	-3.254E-05	2.966E-06	1.158E-05
11	6.952E-04	6.902E-04	6.876E-04	6.433E-04	5.822E-04	4.701E-04	3.728E-04	2.571E-04	1.505E-04	-9.522E-07	-3.841E-05
12	1.714E-04	1.699E-04	1.433E-04	9.245E-05	5.548E-05	3.395E-05	2.879E-05	4.030E-05	3.203E-05	1.533E-06	-6.189E-06
13	1.830E-04	1.810E-04	1.829E-04	1.859E-04	1.960E-04	1.939E-04	1.832E-04	1.456E-04	8.933E-05	7.248E-06	-1.408E-05
14	1.270E-05	1.256E-05	2.928E-06	2.009E-06	9.595E-06	7.946E-06	-2.847E-06	-4.870E-06	2.247E-06	2.038E-07	-3.249E-07
15	8.770E-06	8.638E-06	1.401E-05	1.093E-05	8.191E-06	1.459E-05	1.044E-05	4.636E-06	6.100E-06	6.178E-07	-8.189E-07
16	-1.212E-04	-1.193E-04	-1.128E-04	-1.019E-04	-8.733E-05	-7.028E-05	-5.201E-05	-3.391E-05	-1.735E-05	-2.175E-06	2.031E-06
17	3.559E-06	3.485E-06	5.887E-06	1.277E-05	1.301E-05	1.053E-05	8.711E-06	1.165E-05	8.567E-06	1.240E-06	-8.360E-07
18	5.623E-06	5.516E-06	3.302E-06	2.361E-06	-3.277E-06	-4.129E-06	-1.147E-07	-5.632E-07	6.271E-07	9.779E-08	-5.373E-08
19	1.912E-06	1.856E-06	3.004E-06	8.670E-07	-2.395E-06	-8.417E-06	-1.030E-05	-9.852E-06	-5.249E-06	-9.903E-07	3.781E-07
20	3.294E-06	3.236E-06	2.157E-06	1.300E-07	-1.176E-06	-1.658E-06	-1.275E-06	-4.909E-08	4.224E-07	7.349E-08	-2.909E-08
21	-3.672E-06	-3.576E-06	-2.647E-06	5.806E-07	5.392E-06	1.059E-05	1.325E-05	1.248E-05	8.082E-06	1.566E-06	-5.578E-07
22	9.997E-07	9.797E-07	-7.015E-07	-6.959E-07	1.591E-06	1.439E-06	-1.137E-06	-1.390E-06	1.110E-07	2.374E-08	-5.605E-09
23	1.510E-06	1.448E-06	1.322E-06	-7.865E-07	-1.659E-06	-8.532E-07	-1.252E-06	-2.502E-06	-1.547E-06	-3.773E-07	8.680E-08
24	-1.035E-05	-9.982E-06	-8.807E-06	-6.947E-06	-4.710E-06	-2.465E-06	-5.872E-07	6.078E-07	9.138E-07	1.952E-07	-4.904E-08

ORDER	VIBRATION AMPLITUDE (DEGREES)
0.5	0.055
1.0	0.000
1.5	0.138
2.0	0.001
2.5	0.113
3.0	0.001
3.5	0.051
4.0	[illegible]
4.5	0.047
5.0	0.040
5.5	0.081
6.0	0.012
6.5	0.011
7.0	[illegible]
7.5	0.001
8.0	[illegible]
8.5	0.000
9.0	0.000
9.5	0.000
10.0	[illegible]
10.5	0.000
11.0	0.000
11.5	0.000
12.0	0.001

APPLIED LOAD TIME HISTORY

TIME SECONDS	JOINT OR MEMBER 1	2	3	4	5	6	7	8	9	10	11
0.00000	0.000E+00	-0.113E+03	0.440E+02	0.464E+05	-0.179E+05	-0.230E+05	0.152E+05	-0.932E+02	0.567E+03	0.000E+00	0.000E+00
0.00222	0.000E+00	-0.600E+04	-0.312E+04	0.460E+05	-0.134E+05	-0.203E+05	0.191E+05	-0.404E+04	0.241E+05	0.000E+00	0.000E+00
0.00444	0.000E+00	-0.116E+05	-0.637E+04	0.453E+05	-0.827E+04	-0.174E+05	0.219E+05	-0.762E+04	0.480E+05	0.000E+00	0.000E+00
0.00667	0.000E+00	-0.165E+05	-0.965E+04	0.439E+05	-0.261E+04	-0.146E+05	0.236E+05	-0.109E+05	0.660E+05	0.000E+00	0.000E+00
0.00889	0.000E+00	-0.203E+05	-0.128E+05	0.417E+05	0.342E+04	-0.117E+05	0.242E+05	-0.140E+05	0.751E+05	0.000E+00	0.000E+00
0.01111	0.000E+00	-0.225E+05	-0.157E+05	0.389E+05	0.935E+04	-0.916E+04	0.241E+05	-0.170E+05	0.762E+05	0.000E+00	0.000E+00
0.01333	0.000E+00	-0.230E+05	-0.186E+05	0.358E+05	0.145E+05	-0.798E+04	0.235E+05	-0.196E+05	0.724E+05	0.000E+00	0.000E+00
0.01556	0.000E+00	-0.219E+05	-0.213E+05	0.326E+05	0.183E+05	-0.895E+04	0.223E+05	-0.219E+05	0.665E+05	0.000E+00	0.000E+00
0.01778	0.000E+00	-0.196E+05	-0.237E+05	0.290E+05	0.207E+05	-0.120E+05	0.204E+05	-0.237E+05	0.606E+05	0.000E+00	0.000E+00
0.02000	0.000E+00	-0.160E+05	-0.256E+05	0.250E+05	0.216E+05	-0.162E+05	0.180E+05	-0.252E+05	0.553E+05	0.000E+00	0.000E+00
0.02222	0.000E+00	-0.113E+05	-0.267E+05	0.208E+05	0.216E+05	-0.207E+05	0.154E+05	-0.263E+05	0.512E+05	0.000E+00	0.000E+00
0.02444	0.000E+00	-0.584E+04	-0.273E+05	0.166E+05	0.199E+05	-0.249E+05	0.125E+05	-0.268E+05	0.487E+05	0.000E+00	0.000E+00
0.02667	0.000E+00	-0.158E+03	-0.273E+05	0.124E+05	0.165E+05	-0.274E+05	0.953E+04	-0.263E+05	0.475E+05	0.000E+00	0.000E+00
0.02889	0.000E+00	0.536E+04	-0.268E+05	0.830E+04	0.116E+05	-0.258E+05	0.638E+04	-0.246E+05	0.470E+05	0.000E+00	0.000E+00
0.03111	0.000E+00	0.105E+05	-0.253E+05	0.409E+04	0.589E+04	-0.169E+05	0.320E+04	-0.218E+05	0.467E+05	0.000E+00	0.000E+00
0.03333	0.000E+00	0.152E+05	-0.230E+05	-0.932E+02	-0.113E+03	0.567E+03	0.440E+02	-0.179E+05	0.464E+05	0.000E+00	0.000E+00
0.03556	0.000E+00	0.191E+05	-0.203E+05	-0.404E+04	-0.600E+04	0.241E+05	-0.312E+04	-0.134E+05	0.460E+05	0.000E+00	0.000E+00
0.03778	0.000E+00	0.219E+05	-0.174E+05	-0.762E+04	-0.116E+05	0.480E+05	-0.637E+04	-0.827E+04	0.453E+05	0.000E+00	0.000E+00
0.04000	0.000E+00	0.236E+05	-0.146E+05	-0.109E+05	-0.165E+05	0.660E+05	-0.965E+04	-0.261E+04	0.439E+05	0.000E+00	0.000E+00
0.04222	0.000E+00	0.242E+05	-0.117E+05	-0.140E+05	-0.203E+05	0.751E+05	-0.128E+05	0.342E+04	0.417E+05	0.000E+00	0.000E+00
0.04444	0.000E+00	0.241E+05	-0.916E+04	-0.170E+05	-0.225E+05	0.762E+05	-0.157E+05	0.935E+04	0.389E+05	0.000E+00	0.000E+00
0.04667	0.000E+00	0.235E+05	-0.798E+04	-0.196E+05	-0.230E+05	0.724E+05	-0.186E+05	0.145E+05	0.358E+05	0.000E+00	0.000E+00
0.04889	0.000E+00	0.223E+05	-0.895E+04	-0.219E+05	-0.219E+05	0.665E+05	-0.213E+05	0.183E+05	0.326E+05	0.000E+00	0.000E+00
0.05111	0.000E+00	0.204E+05	-0.120E+05	-0.237E+05	-0.196E+05	0.606E+05	-0.237E+05	0.207E+05	0.290E+05	0.000E+00	0.000E+00
0.05333	0.000E+00	0.180E+05	-0.162E+05	-0.252E+05	-0.160E+05	0.553E+05	-0.256E+05	0.218E+05	0.250E+05	0.000E+00	0.000E+00
0.05556	0.000E+00	0.154E+05	-0.207E+05	-0.263E+05	-0.113E+05	0.512E+05	-0.267E+05	0.216E+05	0.208E+05	0.000E+00	0.000E+00
0.05778	0.000E+00	0.125E+05	-0.249E+05	-0.268E+05	-0.584E+04	0.487E+05	-0.273E+05	0.199E+05	0.166E+05	0.000E+00	0.000E+00
0.06000	0.000E+00	0.953E+04	-0.274E+05	-0.263E+05	-0.158E+03	0.475E+05	-0.273E+05	0.165E+05	0.124E+05	0.000E+00	0.000E+00
0.06222	0.000E+00	0.638E+04	-0.258E+05	-0.246E+05	0.536E+04	0.470E+05	-0.268E+05	0.116E+05	0.830E+04	0.000E+00	0.000E+00
0.06444	0.000E+00	0.320E+04	-0.169E+05	-0.218E+05	0.105E+05	0.467E+05	-0.253E+05	0.589E+04	0.409E+04	0.000E+00	0.000E+00
0.06667	0.000E+00	0.440E+02	0.567E+03	-0.179E+05	0.152E+05	0.464E+05	-0.230E+05	-0.113E+03	-0.932E+02	0.000E+00	0.000E+00
0.06889	0.000E+00	-0.312E+04	0.241E+05	-0.134E+05	0.191E+05	0.460E+05	-0.203E+05	-0.600E+04	-0.404E+04	0.000E+00	0.000E+00
0.07111	0.000E+00	-0.637E+04	0.480E+05	-0.827E+04	0.219E+05	0.453E+05	-0.174E+05	-0.116E+05	-0.762E+04	0.000E+00	0.000E+00
0.07333	0.000E+00	-0.965E+04	0.660E+05	-0.261E+04	0.236E+05	0.439E+05	-0.146E+05	-0.165E+05	-0.109E+05	0.000E+00	0.000E+00
0.07556	0.000E+00	-0.128E+05	0.751E+05	0.342E+04	0.242E+05	0.417E+05	-0.117E+05	-0.203E+05	-0.140E+05	0.000E+00	0.000E+00
0.07778	0.000E+00	-0.157E+05	0.762E+05	0.935E+04	0.241E+05	0.389E+05	-0.916E+04	-0.225E+05	-0.170E+05	0.000E+00	0.000E+00
0.08000	0.000E+00	-0.186E+05	0.724E+05	0.145E+05	0.235E+05	0.358E+05	-0.798E+04	-0.230E+05	-0.196E+05	0.000E+00	0.000E+00
0.08222	0.000E+00	-0.213E+05	0.665E+05	0.183E+05	0.223E+05	0.326E+05	-0.895E+04	-0.219E+05	-0.219E+05	0.000E+00	0.000E+00
0.08444	0.000E+00	-0.237E+05	0.606E+05	0.207E+05	0.204E+05	0.290E+05	-0.120E+05	-0.196E+05	-0.237E+05	0.000E+00	0.000E+00
0.08667	0.000E+00	-0.256E+05	0.553E+05	0.218E+05	0.180E+05	0.250E+05	-0.162E+05	-0.160E+05	-0.252E+05	0.000E+00	0.000E+00
0.08889	0.000E+00	-0.267E+05	0.512E+05	0.216E+05	0.154E+05	0.208E+05	-0.207E+05	-0.113E+05	-0.263E+05	0.000E+00	0.000E+00
0.09111	0.000E+00	-0.273E+05	0.487E+05	0.199E+05	0.125E+05	0.166E+05	-0.249E+05	-0.584E+04	-0.268E+05	0.000E+00	0.000E+00
0.09333	0.000E+00	-0.273E+05	0.475E+05	0.165E+05	0.953E+04	0.124E+05	-0.274E+05	-0.158E+03	-0.263E+05	0.000E+00	0.000E+00
0.09556	0.000E+00	-0.268E+05	0.470E+05	0.116E+05	0.638E+04	0.830E+04	-0.258E+05	0.536E+04	-0.246E+05	0.000E+00	0.000E+00
0.09778	0.000E+00	-0.253E+05	0.467E+05	0.589E+04	0.320E+04	0.409E+04	-0.169E+05	0.105E+05	-0.218E+05	0.000E+00	0.000E+00
0.10000	0.000E+00	-0.230E+05	0.464E+05	-0.113E+03	0.440E+02	-0.932E+02	0.567E+03	0.152E+05	-0.179E+05	0.000E+00	0.000E+00
0.10222	0.000E+00	-0.203E+05	0.460E+05	-0.600E+04	-0.312E+04	-0.404E+04	0.241E+05	0.191E+05	-0.134E+05	0.000E+00	0.000E+00
0.10444	0.000E+00	-0.174E+05	0.453E+05	-0.116E+05	-0.637E+04	-0.762E+04	0.480E+05	0.219E+05	-0.827E+04	0.000E+00	0.000E+00
0.10667	0.000E+00	-0.146E+05	0.439E+05	-0.165E+05	-0.965E+04	-0.109E+05	0.660E+05	0.236E+05	-0.261E+04	0.000E+00	0.000E+00
0.10889	0.000E+00	-0.117E+05	0.417E+05	-0.203E+05	-0.128E+05	-0.140E+05	0.751E+05	0.242E+05	0.342E+04	0.000E+00	0.000E+00
0.11111	0.000E+00	-0.916E+04	0.389E+05	-0.225E+05	-0.157E+05	-0.170E+05	0.762E+05	0.241E+05	0.935E+04	0.000E+00	0.000E+00
0.11333	0.000E+00	-0.798E+04	0.358E+05	-0.230E+05	-0.186E+05	-0.196E+05	0.724E+05	0.235E+05	0.145E+05	0.000E+00	0.000E+00
0.11556	0.000E+00	-0.895E+04	0.326E+05	-0.219E+05	-0.213E+05	-0.219E+05	0.665E+05	0.223E+05	0.183E+05	0.000E+00	0.000E+00
0.11778	0.000E+00	-0.120E+05	0.290E+05	-0.196E+05	-0.237E+05	-0.237E+05	0.606E+05	0.204E+05	0.207E+05	0.000E+00	0.000E+00
0.12000	0.000E+00	-0.162E+05	0.250E+05	-0.160E+05	-0.256E+05	-0.252E+05	0.553E+05	0.180E+05	0.218E+05	0.000E+00	0.000E+00
0.12222	0.000E+00	-0.207E+05	0.208E+05	-0.113E+05	-0.267E+05	-0.263E+05	0.512E+05	0.154E+05	0.216E+05	0.000E+00	0.000E+00
0.12444	0.000E+00	-0.249E+05	0.166E+05	-0.584E+04	-0.273E+05	-0.268E+05	0.487E+05	0.125E+05	0.199E+05	0.000E+00	0.000E+00

0.13111	0.000E+00	-0.109E+05	0.409E+04	0.109E+05	-0.253E+05	-0.218E+05	0.467E+05	0.320E+04	0.589E+04	0.000E+00	0.000E+00
0.13333	0.000E+00	0.367E+03	-0.932E+02	0.152E+05	-0.230E+05	-0.179E+05	0.464E+05	0.440E+02	-0.113E+03	0.000E+00	0.000E+00
0.13556	0.000E+00	0.241E+05	-0.404E+04	0.191E+05	-0.203E+05	-0.134E+05	0.460E+05	-0.312E+04	-0.600E+04	0.000E+00	0.000E+00
0.13778	0.000E+00	0.480E+05	-0.762E+04	0.219E+05	-0.174E+05	-0.827E+04	0.453E+05	-0.637E+04	-0.116E+05	0.000E+00	0.000E+00
0.14000	0.000E+00	0.660E+05	-0.109E+05	0.236E+05	-0.146E+05	-0.261E+04	0.439E+05	-0.965E+04	-0.165E+05	0.000E+00	0.000E+00
0.14222	0.000E+00	0.751E+05	-0.140E+05	0.242E+05	-0.117E+05	0.342E+04	0.417E+05	-0.128E+05	-0.203E+05	0.000E+00	0.000E+00
0.14444	0.000E+00	0.762E+05	-0.170E+05	0.241E+05	-0.916E+04	0.935E+04	0.389E+05	-0.157E+05	-0.225E+05	0.000E+00	0.000E+00
0.14667	0.000E+00	0.724E+05	-0.196E+05	0.235E+05	-0.798E+04	0.145E+05	0.358E+05	-0.186E+05	-0.230E+05	0.000E+00	0.000E+00
0.14889	0.000E+00	0.665E+05	-0.219E+05	0.223E+05	-0.895E+04	0.183E+05	0.326E+05	-0.213E+05	-0.219E+05	0.000E+00	0.000E+00
0.15111	0.000E+00	0.606E+05	-0.237E+05	0.204E+05	-0.120E+05	0.207E+05	0.290E+05	-0.237E+05	-0.196E+05	0.000E+00	0.000E+00
0.15333	0.000E+00	0.553E+05	-0.252E+05	0.180E+05	-0.162E+05	0.218E+05	0.250E+05	-0.256E+05	-0.160E+05	0.000E+00	0.000E+00
0.15556	0.000E+00	0.512E+05	-0.263E+05	0.154E+05	-0.207E+05	0.216E+05	0.208E+05	-0.267E+05	-0.113E+05	0.000E+00	0.000E+00
0.15778	0.000E+00	0.487E+05	-0.268E+05	0.125E+05	-0.249E+05	0.199E+05	0.166E+05	-0.273E+05	-0.584E+04	0.000E+00	0.000E+00
0.16000	0.000E+00	0.475E+05	-0.263E+05	0.953E+04	-0.274E+05	0.165E+05	0.124E+05	-0.273E+05	-0.158E+03	0.000E+00	0.000E+00
0.16222	0.000E+00	0.470E+05	-0.246E+05	0.638E+04	-0.258E+05	0.116E+05	0.830E+04	-0.268E+05	0.536E+04	0.000E+00	0.000E+00
0.16444	0.000E+00	0.467E+05	-0.218E+05	0.320E+04	-0.169E+05	0.589E+04	0.409E+04	-0.253E+05	0.105E+05	0.000E+00	0.000E+00
0.16667	0.000E+00	0.464E+05	-0.179E+05	0.440E+02	0.567E+03	-0.113E+03	-0.932E+02	-0.230E+05	0.152E+05	0.000E+00	0.000E+00
0.16889	0.000E+00	0.460E+05	-0.134E+05	-0.312E+04	0.241E+05	-0.600E+04	-0.404E+04	-0.203E+05	0.191E+05	0.000E+00	0.000E+00
0.17111	0.000E+00	0.453E+05	-0.827E+04	-0.637E+04	0.480E+05	-0.116E+05	-0.762E+04	-0.174E+05	0.219E+05	0.000E+00	0.000E+00
0.17333	0.000E+00	0.439E+05	-0.261E+04	-0.965E+04	0.660E+05	-0.165E+05	-0.109E+05	-0.146E+05	0.236E+05	0.000E+00	0.000E+00
0.17556	0.000E+00	0.417E+05	0.342E+04	-0.128E+05	0.751E+05	-0.203E+05	-0.140E+05	-0.117E+05	0.242E+05	0.000E+00	0.000E+00
0.17778	0.000E+00	0.389E+05	0.935E+04	-0.157E+05	0.762E+05	-0.225E+05	-0.170E+05	-0.916E+04	0.241E+05	0.000E+00	0.000E+00
0.18000	0.000E+00	0.358E+05	0.145E+05	-0.186E+05	0.724E+05	-0.230E+05	-0.196E+05	-0.798E+04	0.235E+05	0.000E+00	0.000E+00
0.18222	0.000E+00	0.326E+05	0.183E+05	-0.213E+05	0.665E+05	-0.219E+05	-0.219E+05	-0.895E+04	0.223E+05	0.000E+00	0.000E+00
0.18444	0.000E+00	0.290E+05	0.207E+05	-0.237E+05	0.606E+05	-0.196E+05	-0.237E+05	-0.120E+05	0.204E+05	0.000E+00	0.000E+00
0.18667	0.000E+00	0.250E+05	0.216E+05	-0.256E+05	0.553E+05	-0.160E+05	-0.252E+05	-0.162E+05	0.180E+05	0.000E+00	0.000E+00
0.18889	0.000E+00	0.208E+05	0.216E+05	-0.267E+05	0.512E+05	-0.113E+05	-0.263E+05	-0.207E+05	0.154E+05	0.000E+00	0.000E+00
0.19111	0.000E+00	0.166E+05	0.199E+05	-0.273E+05	0.487E+05	-0.584E+04	-0.268E+05	-0.249E+05	0.125E+05	0.000E+00	0.000E+00
0.19333	0.000E+00	0.124E+05	0.165E+05	-0.273E+05	0.475E+05	-0.158E+03	-0.263E+05	-0.274E+05	0.953E+04	0.000E+00	0.000E+00
0.19556	0.000E+00	0.830E+04	0.116E+05	-0.268E+05	0.470E+05	0.536E+04	-0.246E+05	-0.258E+05	0.638E+04	0.000E+00	0.000E+00
0.19778	0.000E+00	0.409E+04	0.589E+04	-0.253E+05	0.467E+05	0.105E+05	-0.218E+05	-0.169E+05	0.320E+04	0.000E+00	0.000E+00
0.20000	0.000E+00	-0.932E+02	-0.113E+03	-0.230E+05	0.464E+05	0.152E+05	-0.179E+05	0.567E+03	0.440E+02	0.000E+00	0.000E+00
0.20222	0.000E+00	-0.404E+04	-0.600E+04	-0.203E+05	0.460E+05	0.191E+05	-0.134E+05	0.241E+05	-0.312E+04	0.000E+00	0.000E+00
0.20444	0.000E+00	-0.762E+04	-0.116E+05	-0.174E+05	0.453E+05	0.219E+05	-0.827E+04	0.480E+05	-0.637E+04	0.000E+00	0.000E+00
0.20667	0.000E+00	-0.109E+05	-0.165E+05	-0.146E+05	0.439E+05	0.236E+05	-0.261E+04	0.660E+05	-0.965E+04	0.000E+00	0.000E+00
0.20889	0.000E+00	-0.140E+05	-0.203E+05	-0.117E+05	0.417E+05	0.242E+05	0.342E+04	0.751E+05	-0.128E+05	0.000E+00	0.000E+00
0.21111	0.000E+00	-0.170E+05	-0.225E+05	-0.916E+04	0.389E+05	0.241E+05	0.935E+04	0.762E+05	-0.157E+05	0.000E+00	0.000E+00
0.21333	0.000E+00	-0.196E+05	-0.230E+05	-0.798E+04	0.358E+05	0.235E+05	0.145E+05	0.724E+05	-0.186E+05	0.000E+00	0.000E+00
0.21556	0.000E+00	-0.219E+05	-0.219E+05	-0.895E+04	0.326E+05	0.223E+05	0.183E+05	0.665E+05	-0.213E+05	0.000E+00	0.000E+00
0.21778	0.000E+00	-0.237E+05	-0.196E+05	-0.120E+05	0.290E+05	0.204E+05	0.207E+05	0.606E+05	-0.237E+05	0.000E+00	0.000E+00
0.22000	0.000E+00	-0.252E+05	-0.160E+05	-0.162E+05	0.250E+05	0.180E+05	0.218E+05	0.553E+05	-0.256E+05	0.000E+00	0.000E+00
0.22222	0.000E+00	-0.263E+05	-0.113E+05	-0.207E+05	0.208E+05	0.154E+05	0.216E+05	0.512E+05	-0.267E+05	0.000E+00	0.000E+00
0.22444	0.000E+00	-0.268E+05	-0.584E+04	-0.249E+05	0.166E+05	0.125E+05	0.199E+05	0.487E+05	-0.273E+05	0.000E+00	0.000E+00
0.22667	0.000E+00	-0.263E+05	-0.158E+03	-0.274E+05	0.124E+05	0.953E+04	0.165E+05	0.475E+05	-0.273E+05	0.000E+00	0.000E+00
0.22889	0.000E+00	-0.246E+05	0.536E+04	-0.258E+05	0.830E+04	0.638E+04	0.116E+05	0.470E+05	-0.268E+05	0.000E+00	0.000E+00
0.23111	0.000E+00	-0.218E+05	0.105E+05	-0.169E+05	0.409E+04	0.320E+04	0.589E+04	0.467E+05	-0.253E+05	0.000E+00	0.000E+00
0.23333	0.000E+00	-0.179E+05	0.152E+05	0.567E+03	-0.932E+02	0.440E+02	-0.113E+03	0.464E+05	-0.230E+05	0.000E+00	0.000E+00
0.23556	0.000E+00	-0.134E+05	0.191E+05	0.241E+05	-0.404E+04	-0.312E+04	-0.600E+04	0.460E+05	-0.203E+05	0.000E+00	0.000E+00
0.23778	0.000E+00	-0.827E+04	0.219E+05	0.480E+05	-0.762E+04	-0.637E+04	-0.116E+05	0.453E+05	-0.174E+05	0.000E+00	0.000E+00
0.24000	0.000E+00	-0.261E+04	0.236E+05	0.660E+05	-0.109E+05	-0.965E+04	-0.165E+05	0.439E+05	-0.146E+05	0.000E+00	0.000E+00
0.24222	0.000E+00	0.342E+04	0.242E+05	0.751E+05	-0.140E+05	-0.128E+05	-0.203E+05	0.417E+05	-0.117E+05	0.000E+00	0.000E+00
0.24444	0.000E+00	0.935E+04	0.241E+05	0.762E+05	-0.170E+05	-0.157E+05	-0.225E+05	0.389E+05	-0.916E+04	0.000E+00	0.000E+00
0.24667	0.000E+00	0.145E+05	0.235E+05	0.724E+05	-0.196E+05	-0.186E+05	-0.230E+05	0.358E+05	-0.798E+04	0.000E+00	0.000E+00
0.24889	0.000E+00	0.183E+05	0.223E+05	0.665E+05	-0.219E+05	-0.213E+05	-0.219E+05	0.326E+05	-0.895E+04	0.000E+00	0.000E+00
0.25111	0.000E+00	0.207E+05	0.204E+05	0.606E+05	-0.237E+05	-0.237E+05	-0.196E+05	0.290E+05	-0.120E+05	0.000E+00	0.000E+00
0.25333	0.000E+00	0.216E+05	0.180E+05	0.553E+05	-0.252E+05	-0.256E+05	-0.160E+05	0.250E+05	-0.162E+05	0.000E+00	0.000E+00
0.25556	0.000E+00	0.216E+05	0.154E+05	0.512E+05	-0.263E+05	-0.267E+05	-0.113E+05	0.208E+05	-0.207E+05	0.000E+00	0.000E+00
0.25778	0.000E+00	0.199E+05	0.125E+05	0.487E+05	-0.268E+05	-0.273E+05	-0.584E+04	0.166E+05	-0.249E+05	0.000E+00	0.000E+00
0.26000	0.000E+00	0.165E+05	0.953E+04	0.475E+05	-0.263E+05	-0.273E+05	-0.158E+03	0.124E+05	-0.274E+05	0.000E+00	0.000E+00
0.26222	0.000E+00	0.116E+05	0.638E+04	0.470E+05	-0.246E+05	-0.268E+05	0.536E+04	0.830E+04	-0.258E+05	0.000E+00	0.000E+00
0.26444	0.000E+00	0.589E+04	0.320E+04	0.467E+05	-0.219E+05	-0.253E+05	0.105E+05	0.409E+04	-0.169E+05	0.000E+00	0.000E+00

MAXIMUM	0.000E+00	7.621E+04	7.621E+04	7.621E+04	7.621E+04	7.621E+04	7.621E+04	7.621E+04	7.621E+04	0.000E+00	0.000E+00
TIME	2.644E-01	1.444E-01	7.778E-02	2.444E-01	1.778E-01	4.444E-02	1.111E-01	2.111E-01	1.111E-02	2.644E-01	2.644E-01
MINIMUM	0.000E+00	-2.741E+04	-2.741E+04	-2.741E+04	-2.741E+04	-2.741E+04	-2.741E+04	-2.741E+04	-2.741E+04	0.000E+00	0.000E+00
TIME	[illegible]	1.267E-01	6.000E-02	2.267E-01	1.600E-01	2.667E-02	9.333E-02	1.933E-01	2.600E-01	2.644E-01	2.644E-01
RANGE	0.000E+00	1.036E+05	1.036E+05	1.036E+05	1.036E+05	1.036E+05	1.036E+05	1.036E+05	1.036E+05	0.000E+00	0.000E+00

DISPLACEMENT TIME HISTORY

TIME SECONDS	JOINT OR MEMBER 1	2	3	4	5	6	7	8	9	10	11
0.00000	0.308E-01	0.309E-01	0.309E-01	0.311E-01	0.307E-01	0.307E-01	0.309E-01	0.310E-01	0.312E-01	0.314E-01	0.314E-01
0.00222	0.320E-01	0.320E-01	0.321E-01	0.323E-01	0.319E-01	0.317E-01	0.318E-01	0.317E-01	0.317E-01	0.313E-01	0.312E-01
0.00444	0.334E-01	0.333E-01	0.335E-01	0.336E-01	0.333E-01	0.330E-01	0.329E-01	0.325E-01	0.322E-01	0.313E-01	0.310E-01
0.00667	0.346E-01	0.345E-01	0.347E-01	0.349E-01	0.345E-01	0.341E-01	0.338E-01	0.332E-01	0.327E-01	0.312E-01	0.309E-01
0.00889	0.353E-01	0.352E-01	0.354E-01	0.356E-01	0.352E-01	0.347E-01	0.343E-01	0.335E-01	0.329E-01	0.312E-01	0.308E-01
0.01111	0.352E-01	0.352E-01	0.353E-01	0.356E-01	0.353E-01	0.348E-01	0.343E-01	0.335E-01	0.329E-01	0.312E-01	0.308E-01
0.01333	0.343E-01	0.343E-01	0.345E-01	0.348E-01	0.347E-01	0.343E-01	0.339E-01	0.332E-01	0.327E-01	0.312E-01	0.309E-01
0.01556	0.329E-01	0.329E-01	0.331E-01	0.335E-01	0.335E-01	0.333E-01	0.331E-01	0.326E-01	0.324E-01	0.313E-01	0.310E-01
0.01778	0.311E-01	0.311E-01	0.314E-01	0.319E-01	0.321E-01	0.320E-01	0.321E-01	0.319E-01	0.320E-01	0.313E-01	0.312E-01
0.02000	0.296E-01	0.295E-01	0.297E-01	0.303E-01	0.307E-01	0.308E-01	0.311E-01	0.312E-01	0.316E-01	0.314E-01	0.314E-01
0.02222	0.283E-01	0.283E-01	0.285E-01	0.291E-01	0.295E-01	0.298E-01	0.303E-01	0.307E-01	0.314E-01	0.315E-01	0.315E-01
0.02444	0.277E-01	0.277E-01	0.279E-01	0.285E-01	0.289E-01	0.292E-01	0.298E-01	0.303E-01	0.312E-01	0.315E-01	0.316E-01
0.02667	0.279E-01	0.279E-01	0.280E-01	0.285E-01	0.289E-01	0.291E-01	0.297E-01	0.303E-01	0.312E-01	0.316E-01	0.317E-01
0.02889	0.287E-01	0.287E-01	0.286E-01	0.290E-01	0.293E-01	0.295E-01	0.300E-01	0.305E-01	0.313E-01	0.316E-01	0.316E-01
0.03111	0.298E-01	0.298E-01	0.297E-01	0.299E-01	0.300E-01	0.302E-01	0.305E-01	0.308E-01	0.315E-01	0.315E-01	0.315E-01
0.03333	0.310E-01	0.310E-01	0.308E-01	0.309E-01	0.310E-01	0.311E-01	0.312E-01	0.313E-01	0.317E-01	0.314E-01	0.314E-01
0.03556	0.321E-01	0.321E-01	0.319E-01	0.319E-01	0.319E-01	0.321E-01	0.319E-01	0.318E-01	0.319E-01	0.314E-01	0.312E-01
0.03778	0.332E-01	0.332E-01	0.330E-01	0.329E-01	0.329E-01	0.331E-01	0.327E-01	0.324E-01	0.321E-01	0.313E-01	0.311E-01
0.04000	0.343E-01	0.343E-01	0.340E-01	0.339E-01	0.339E-01	0.340E-01	0.334E-01	0.329E-01	0.323E-01	0.312E-01	0.309E-01
0.04222	0.352E-01	0.352E-01	0.349E-01	0.347E-01	0.346E-01	0.347E-01	0.339E-01	0.332E-01	0.325E-01	0.311E-01	0.308E-01
0.04444	0.359E-01	0.359E-01	0.355E-01	0.352E-01	0.351E-01	0.351E-01	0.342E-01	0.335E-01	0.326E-01	0.311E-01	0.308E-01
0.04667	0.360E-01	0.360E-01	0.356E-01	0.353E-01	0.351E-01	0.351E-01	0.342E-01	0.335E-01	0.326E-01	0.312E-01	0.308E-01
0.04889	0.354E-01	0.354E-01	0.351E-01	0.347E-01	0.346E-01	0.347E-01	0.339E-01	0.333E-01	0.325E-01	0.312E-01	0.309E-01
0.05111	0.342E-01	0.342E-01	0.339E-01	0.336E-01	0.336E-01	0.338E-01	0.333E-01	0.329E-01	0.323E-01	0.313E-01	0.310E-01
0.05333	0.325E-01	0.325E-01	0.322E-01	0.321E-01	0.323E-01	0.327E-01	0.324E-01	0.323E-01	0.320E-01	0.314E-01	0.312E-01
0.05556	0.306E-01	0.306E-01	0.304E-01	0.305E-01	0.309E-01	0.314E-01	0.314E-01	0.317E-01	0.317E-01	0.315E-01	0.314E-01
0.05778	0.288E-01	0.288E-01	0.287E-01	0.289E-01	0.296E-01	0.303E-01	0.305E-01	0.310E-01	0.314E-01	0.315E-01	0.316E-01
0.06000	0.275E-01	0.275E-01	0.275E-01	0.279E-01	0.287E-01	0.295E-01	0.299E-01	0.306E-01	0.311E-01	0.316E-01	0.316E-01
0.06222	0.269E-01	0.270E-01	0.270E-01	0.275E-01	0.283E-01	0.292E-01	0.296E-01	0.303E-01	0.309E-01	0.315E-01	0.317E-01
0.06444	0.274E-01	0.274E-01	0.275E-01	0.279E-01	0.287E-01	0.294E-01	0.297E-01	0.303E-01	0.309E-01	0.315E-01	0.316E-01
0.06667	0.288E-01	0.288E-01	0.290E-01	0.292E-01	0.298E-01	0.303E-01	0.303E-01	0.306E-01	0.310E-01	0.314E-01	0.315E-01
0.06889	0.312E-01	0.312E-01	0.314E-01	0.314E-01	0.316E-01	0.317E-01	0.313E-01	0.312E-01	0.312E-01	0.312E-01	0.313E-01
0.07111	0.345E-01	0.345E-01	0.346E-01	0.342E-01	0.340E-01	0.336E-01	0.327E-01	0.320E-01	0.315E-01	0.311E-01	0.310E-01
0.07333	0.381E-01	0.381E-01	0.382E-01	0.375E-01	0.368E-01	0.359E-01	0.344E-01	0.331E-01	0.320E-01	0.310E-01	0.307E-01
0.07556	0.415E-01	0.415E-01	0.415E-01	0.406E-01	0.395E-01	0.381E-01	0.361E-01	0.342E-01	0.326E-01	0.309E-01	0.305E-01
0.07778	0.440E-01	0.440E-01	0.439E-01	0.429E-01	0.415E-01	0.398E-01	0.374E-01	0.351E-01	0.330E-01	0.309E-01	0.304E-01
0.08000	0.450E-01	0.449E-01	0.449E-01	0.438E-01	0.423E-01	0.404E-01	0.380E-01	0.355E-01	0.332E-01	0.309E-01	0.303E-01
0.08222	0.441E-01	0.440E-01	0.441E-01	0.431E-01	0.417E-01	0.399E-01	0.376E-01	0.352E-01	0.331E-01	0.310E-01	0.304E-01
0.08444	0.415E-01	0.415E-01	0.416E-01	0.408E-01	0.397E-01	0.382E-01	0.362E-01	0.344E-01	0.327E-01	0.311E-01	0.307E-01
0.08667	0.377E-01	0.377E-01	0.379E-01	0.375E-01	0.367E-01	0.356E-01	0.343E-01	0.330E-01	0.320E-01	0.312E-01	0.309E-01
0.08889	0.336E-01	0.336E-01	0.340E-01	0.338E-01	0.334E-01	0.328E-01	0.321E-01	0.316E-01	0.313E-01	0.313E-01	0.312E-01
0.09111	0.299E-01	0.300E-01	0.305E-01	0.305E-01	0.305E-01	0.304E-01	0.302E-01	0.303E-01	0.306E-01	0.313E-01	0.315E-01
0.09333	0.276E-01	0.277E-01	0.282E-01	0.284E-01	0.286E-01	0.288E-01	0.289E-01	0.296E-01	0.302E-01	0.314E-01	0.317E-01
0.09556	0.270E-01	0.271E-01	0.276E-01	0.278E-01	0.280E-01	0.283E-01	0.286E-01	0.294E-01	0.302E-01	0.314E-01	0.317E-01
0.09778	0.281E-01	0.281E-01	0.286E-01	0.287E-01	0.288E-01	0.290E-01	0.293E-01	0.299E-01	0.305E-01	0.314E-01	0.316E-01
0.10000	0.304E-01	0.305E-01	0.308E-01	0.307E-01	0.307E-01	0.307E-01	0.308E-01	0.310E-01	0.310E-01	0.313E-01	0.314E-01
0.10222	0.334E-01	0.334E-01	0.336E-01	0.333E-01	0.331E-01	0.329E-01	0.328E-01	0.324E-01	0.318E-01	0.312E-01	0.311E-01
0.10444	0.363E-01	0.363E-01	0.364E-01	0.359E-01	0.355E-01	0.351E-01	0.347E-01	0.338E-01	0.325E-01	0.312E-01	0.308E-01
0.10667	0.385E-01	0.385E-01	0.385E-01	0.379E-01	0.373E-01	0.367E-01	0.362E-01	0.348E-01	0.330E-01	0.311E-01	0.306E-01
0.10889	0.395E-01	0.395E-01	0.394E-01	0.387E-01	0.381E-01	0.374E-01	0.368E-01	0.353E-01	0.333E-01	0.311E-01	0.305E-01
0.11111	0.391E-01	0.390E-01	0.389E-01	0.382E-01	0.376E-01	0.371E-01	0.366E-01	0.351E-01	0.333E-01	0.311E-01	0.306E-01
0.11333	0.372E-01	0.371E-01	0.371E-01	0.365E-01	0.360E-01	0.357E-01	0.355E-01	0.344E-01	0.329E-01	0.311E-01	0.307E-01
0.11556	0.341E-01	0.341E-01	0.342E-01	0.338E-01	0.336E-01	0.336E-01	0.338E-01	0.333E-01	0.324E-01	0.312E-01	0.309E-01
0.11778	0.307E-01	0.307E-01	0.309E-01	0.307E-01	0.309E-01	0.313E-01	0.320E-01	0.320E-01	0.318E-01	0.313E-01	0.312E-01
0.12000	0.276E-01	0.276E-01	0.279E-01	0.280E-01	0.284E-01	0.292E-01	0.303E-01	0.309E-01	0.313E-01	0.314E-01	0.314E-01
0.12222	0.254E-01	0.254E-01	0.258E-01	0.262E-01	0.267E-01	0.278E-01	0.292E-01	0.301E-01	0.309E-01	0.315E-01	0.316E-01
0.12444	0.246E-01	0.246E-01	0.250E-01	0.255E-01	0.261E-01	0.272E-01	0.287E-01	0.298E-01	0.307E-01	0.315E-01	0.317E-01

0.12689	0.267E-01	0.267E-01	0.271E-01	0.275E-01	0.280E-01	0.287E-01	0.299E-01	0.305E-01	0.311E-01	0.315E-01	0.316E-01
0.13111	0.292E-01	0.292E-01	0.294E-01	0.297E-01	0.298E-01	0.303E-01	0.310E-01	0.312E-01	0.314E-01	0.315E-01	0.315E-01
0.13333	0.320E-01	0.320E-01	0.320E-01	0.320E-01	0.318E-01	0.319E-01	0.322E-01	0.319E-01	0.317E-01	0.314E-01	0.313E-01
0.13556	0.348E-01	0.348E-01	0.345E-01	0.342E-01	0.337E-01	0.334E-01	0.333E-01	0.326E-01	0.319E-01	0.312E-01	0.310E-01
0.13778	0.374E-01	0.374E-01	0.368E-01	0.363E-01	0.354E-01	0.348E-01	0.342E-01	0.331E-01	0.321E-01	0.311E-01	0.308E-01
0.14000	0.396E-01	0.396E-01	0.388E-01	0.380E-01	0.369E-01	0.360E-01	0.350E-01	0.336E-01	0.322E-01	0.310E-01	0.307E-01
0.14222	0.413E-01	0.413E-01	0.403E-01	0.394E-01	0.381E-01	0.370E-01	0.358E-01	0.340E-01	0.324E-01	0.309E-01	0.305E-01
0.14444	0.421E-01	0.421E-01	0.411E-01	0.402E-01	0.389E-01	0.376E-01	0.362E-01	0.343E-01	0.325E-01	0.309E-01	0.305E-01
0.14667	0.421E-01	0.421E-01	0.411E-01	0.402E-01	0.390E-01	0.378E-01	0.363E-01	0.344E-01	0.326E-01	0.309E-01	0.305E-01
0.14889	0.411E-01	0.411E-01	0.402E-01	0.395E-01	0.384E-01	0.373E-01	0.359E-01	0.341E-01	0.325E-01	0.310E-01	0.306E-01
0.15111	0.393E-01	0.393E-01	0.385E-01	0.379E-01	0.370E-01	0.362E-01	0.350E-01	0.335E-01	0.322E-01	0.311E-01	0.308E-01
0.15333	0.369E-01	0.369E-01	0.362E-01	0.358E-01	0.351E-01	0.346E-01	0.338E-01	0.327E-01	0.319E-01	0.312E-01	0.310E-01
0.15556	0.343E-01	0.343E-01	0.337E-01	0.334E-01	0.330E-01	0.329E-01	0.325E-01	0.318E-01	0.315E-01	0.313E-01	0.312E-01
0.15778	0.319E-01	0.319E-01	0.314E-01	0.313E-01	0.311E-01	0.313E-01	0.312E-01	0.310E-01	0.311E-01	0.314E-01	0.314E-01
0.16000	0.302E-01	0.302E-01	0.297E-01	0.297E-01	0.297E-01	0.300E-01	0.302E-01	0.304E-01	0.309E-01	0.314E-01	0.315E-01
0.16222	0.294E-01	0.294E-01	0.290E-01	0.289E-01	0.290E-01	0.294E-01	0.297E-01	0.300E-01	0.307E-01	0.314E-01	0.316E-01
0.16444	0.296E-01	0.296E-01	0.292E-01	0.291E-01	0.291E-01	0.294E-01	0.297E-01	0.301E-01	0.307E-01	0.314E-01	0.315E-01
0.16667	0.307E-01	0.307E-01	0.303E-01	0.301E-01	0.301E-01	0.302E-01	0.303E-01	0.305E-01	0.309E-01	0.313E-01	0.314E-01
0.16889	0.326E-01	0.326E-01	0.322E-01	0.319E-01	0.318E-01	0.315E-01	0.313E-01	0.312E-01	0.313E-01	0.312E-01	0.312E-01
0.17111	0.351E-01	0.351E-01	0.346E-01	0.343E-01	0.340E-01	0.332E-01	0.326E-01	0.321E-01	0.317E-01	0.311E-01	0.310E-01
0.17333	0.379E-01	0.379E-01	0.373E-01	0.368E-01	0.364E-01	0.351E-01	0.340E-01	0.330E-01	0.322E-01	0.310E-01	0.307E-01
0.17556	0.404E-01	0.404E-01	0.398E-01	0.390E-01	0.384E-01	0.367E-01	0.352E-01	0.339E-01	0.327E-01	0.310E-01	0.306E-01
0.17778	0.420E-01	0.420E-01	0.413E-01	0.404E-01	0.396E-01	0.377E-01	0.360E-01	0.345E-01	0.330E-01	0.310E-01	0.305E-01
0.18000	0.423E-01	0.423E-01	0.416E-01	0.407E-01	0.398E-01	0.379E-01	0.362E-01	0.346E-01	0.330E-01	0.310E-01	0.305E-01
0.18222	0.411E-01	0.411E-01	0.405E-01	0.396E-01	0.388E-01	0.371E-01	0.355E-01	0.342E-01	0.328E-01	0.310E-01	0.306E-01
0.18444	0.387E-01	0.387E-01	0.382E-01	0.375E-01	0.369E-01	0.355E-01	0.343E-01	0.333E-01	0.324E-01	0.311E-01	0.308E-01
0.18667	0.356E-01	0.355E-01	0.352E-01	0.346E-01	0.343E-01	0.334E-01	0.326E-01	0.321E-01	0.318E-01	0.312E-01	0.311E-01
0.18889	0.323E-01	0.323E-01	0.322E-01	0.318E-01	0.318E-01	0.313E-01	0.309E-01	0.309E-01	0.312E-01	0.313E-01	0.313E-01
0.19111	0.297E-01	0.297E-01	0.297E-01	0.295E-01	0.298E-01	0.296E-01	0.296E-01	0.300E-01	0.307E-01	0.314E-01	0.315E-01
0.19333	0.283E-01	0.283E-01	0.283E-01	0.283E-01	0.288E-01	0.288E-01	0.290E-01	0.295E-01	0.305E-01	0.314E-01	0.316E-01
0.19556	0.282E-01	0.283E-01	0.283E-01	0.284E-01	0.289E-01	0.290E-01	0.291E-01	0.296E-01	0.305E-01	0.314E-01	0.316E-01
0.19778	0.294E-01	0.294E-01	0.295E-01	0.296E-01	0.300E-01	0.300E-01	0.300E-01	0.303E-01	0.308E-01	0.314E-01	0.315E-01
0.20000	0.313E-01	0.314E-01	0.314E-01	0.315E-01	0.318E-01	0.317E-01	0.314E-01	0.314E-01	0.313E-01	0.313E-01	0.313E-01
0.20222	0.335E-01	0.335E-01	0.335E-01	0.336E-01	0.339E-01	0.336E-01	0.330E-01	0.326E-01	0.320E-01	0.313E-01	0.311E-01
0.20444	0.354E-01	0.354E-01	0.354E-01	0.354E-01	0.356E-01	0.352E-01	0.345E-01	0.338E-01	0.326E-01	0.312E-01	0.309E-01
0.20667	0.366E-01	0.366E-01	0.366E-01	0.367E-01	0.368E-01	0.363E-01	0.355E-01	0.346E-01	0.329E-01	0.312E-01	0.307E-01
0.20889	0.368E-01	0.368E-01	0.368E-01	0.370E-01	0.371E-01	0.367E-01	0.359E-01	0.349E-01	0.331E-01	0.311E-01	0.307E-01
0.21111	0.360E-01	0.360E-01	0.360E-01	0.363E-01	0.365E-01	0.362E-01	0.356E-01	0.347E-01	0.329E-01	0.311E-01	0.307E-01
0.21333	0.343E-01	0.343E-01	0.344E-01	0.348E-01	0.352E-01	0.351E-01	0.347E-01	0.341E-01	0.326E-01	0.312E-01	0.308E-01
0.21556	0.321E-01	0.321E-01	0.323E-01	0.328E-01	0.334E-01	0.336E-01	0.335E-01	0.332E-01	0.321E-01	0.312E-01	0.310E-01
0.21778	0.298E-01	0.298E-01	0.302E-01	0.308E-01	0.316E-01	0.321E-01	0.324E-01	0.324E-01	0.317E-01	0.313E-01	0.312E-01
0.22000	0.281E-01	0.281E-01	0.285E-01	0.291E-01	0.301E-01	0.308E-01	0.313E-01	0.316E-01	0.314E-01	0.314E-01	0.314E-01
0.22222	0.271E-01	0.271E-01	0.275E-01	0.282E-01	0.292E-01	0.300E-01	0.307E-01	0.312E-01	0.312E-01	0.315E-01	0.315E-01
0.22444	0.269E-01	0.270E-01	0.274E-01	0.280E-01	0.289E-01	0.298E-01	0.305E-01	0.311E-01	0.311E-01	0.315E-01	0.316E-01
0.22667	0.276E-01	0.276E-01	0.280E-01	0.285E-01	0.293E-01	0.301E-01	0.307E-01	0.313E-01	0.312E-01	0.315E-01	0.316E-01
0.22889	0.289E-01	0.289E-01	0.292E-01	0.295E-01	0.301E-01	0.307E-01	0.312E-01	0.316E-01	0.314E-01	0.315E-01	0.315E-01
0.23111	0.304E-01	0.304E-01	0.306E-01	0.308E-01	0.311E-01	0.314E-01	0.317E-01	0.319E-01	0.315E-01	0.315E-01	0.314E-01
0.23333	0.319E-01	0.319E-01	0.321E-01	0.321E-01	0.321E-01	0.322E-01	0.322E-01	0.322E-01	0.317E-01	0.314E-01	0.313E-01
0.23556	0.333E-01	0.333E-01	0.335E-01	0.334E-01	0.331E-01	0.329E-01	0.326E-01	0.325E-01	0.318E-01	0.313E-01	0.311E-01
0.23778	0.348E-01	0.348E-01	0.349E-01	0.348E-01	0.341E-01	0.336E-01	0.331E-01	0.327E-01	0.319E-01	0.312E-01	0.310E-01
0.24000	0.364E-01	0.364E-01	0.364E-01	0.362E-01	0.352E-01	0.343E-01	0.336E-01	0.331E-01	0.320E-01	0.311E-01	0.308E-01
0.24222	0.380E-01	0.380E-01	0.380E-01	0.376E-01	0.363E-01	0.352E-01	0.342E-01	0.335E-01	0.322E-01	0.310E-01	0.307E-01
0.24444	0.394E-01	0.394E-01	0.393E-01	0.387E-01	0.373E-01	0.359E-01	0.348E-01	0.338E-01	0.324E-01	0.310E-01	0.306E-01
0.24667	0.403E-01	0.403E-01	0.400E-01	0.394E-01	0.378E-01	0.364E-01	0.351E-01	0.341E-01	0.326E-01	0.310E-01	0.306E-01
0.24889	0.404E-01	0.403E-01	0.400E-01	0.393E-01	0.377E-01	0.363E-01	0.350E-01	0.340E-01	0.326E-01	0.311E-01	0.307E-01
0.25111	0.395E-01	0.395E-01	0.391E-01	0.384E-01	0.369E-01	0.356E-01	0.345E-01	0.337E-01	0.324E-01	0.311E-01	0.308E-01
0.25333	0.378E-01	0.378E-01	0.374E-01	0.368E-01	0.355E-01	0.345E-01	0.337E-01	0.330E-01	0.321E-01	0.312E-01	0.310E-01
0.25556	0.356E-01	0.356E-01	0.353E-01	0.349E-01	0.338E-01	0.330E-01	0.326E-01	0.322E-01	0.317E-01	0.313E-01	0.312E-01
0.25778	0.333E-01	0.333E-01	0.332E-01	0.329E-01	0.320E-01	0.316E-01	0.315E-01	0.314E-01	0.313E-01	0.314E-01	0.314E-01
0.26000	0.315E-01	0.315E-01	0.314E-01	0.313E-01	0.307E-01	0.305E-01	0.306E-01	0.308E-01	0.309E-01	0.314E-01	0.315E-01
0.26222	0.304E-01	0.305E-01	0.304E-01	0.304E-01	0.300E-01	0.299E-01	0.302E-01	0.305E-01	0.308E-01	0.314E-01	0.316E-01
0.26444	0.302E-01	0.303E-01	0.303E-01	0.304E-01	0.300E-01	0.300E-01	0.303E-01	0.306E-01	0.308E-01	0.314E-01	0.315E-01

MAXIMUM	4.496E-02	4.491E-02	4.488E-02	4.379E-02	4.234E-02	4.044E-02	3.798E-02	3.550E-02	3.331E-02	3.157E-02	3.173E-02
TIME	8.000E-02	8.000E-02	8.000E-02	8.000E-02	8.000E-02	8.000E-02	8.000E-02	8.000E-02	1.089E-01	2.667E-02	1.267E-01
MINIMUM	2.452E-02	2.455E-02	2.503E-02	2.547E-02	2.612E-02	2.722E-02	2.864E-02	2.940E-02	3.018E-02	3.088E-02	3.034E-02
TIME	1.244E-01	1.244E-01	1.244E-01	1.244E-01	1.244E-01	1.244E-01	9.556E-02	9.556E-02	9.556E-02	7.778E-02	8.889E-02
RANGE	2.044E-02	2.036E-02	1.985E-02	1.832E-02	1.622E-02	1.322E-02	9.335E-03	6.094E-03	3.135E-03	6.949E-04	1.393E-03

MEMBER FORCE TIME HISTORY

TIME SECONDS	JOINT OR MEMBER 1	2	3	4	5	6	7	8	9	10	11
0.00000	-0.789E+03	-0.656E+04	-0.119E+05	0.292E+05	0.627E+04	-0.212E+05	-0.978E+04	-0.128E+05	-0.145E+05	-0.142E+05	0.443E+05
0.00222	-0.345E+03	-0.879E+04	-0.142E+05	0.295E+05	0.140E+05	-0.806E+04	0.962E+04	0.450E+04	0.277E+05	0.275E+05	0.440E+05
0.00444	0.175E+03	-0.101E+05	-0.152E+05	0.314E+05	0.243E+05	0.814E+04	0.313E+05	0.247E+05	0.734E+05	0.730E+05	0.437E+05
0.00667	0.691E+03	-0.108E+05	-0.156E+05	0.330E+05	0.346E+05	0.239E+05	0.509E+05	0.428E+05	0.111E+06	0.110E+06	0.435E+05
0.00889	0.106E+04	-0.116E+05	-0.171E+05	0.316E+05	0.413E+05	0.352E+05	0.641E+05	0.536E+05	0.131E+06	0.129E+06	0.434E+05
0.01111	0.114E+04	-0.132E+05	-0.211E+05	0.254E+05	0.415E+05	0.382E+05	0.671E+05	0.536E+05	0.132E+06	0.129E+06	0.434E+05
0.01333	0.902E+03	-0.156E+05	-0.278E+05	0.141E+05	0.342E+05	0.311E+05	0.585E+05	0.415E+05	0.115E+06	0.113E+06	0.435E+05
0.01556	0.448E+03	-0.182E+05	-0.363E+05	-0.419E+03	0.211E+05	0.150E+05	0.396E+05	0.192E+05	0.866E+05	0.849E+05	0.437E+05
0.01778	-0.774E+02	-0.202E+05	-0.443E+05	-0.153E+05	0.565E+04	-0.601E+04	0.146E+05	-0.900E+04	0.516E+05	0.512E+05	0.439E+05
0.02000	-0.558E+03	-0.206E+05	-0.498E+05	-0.279E+05	-0.868E+04	-0.271E+05	-0.108E+05	-0.373E+05	0.173E+05	0.179E+05	0.442E+05
0.02222	-0.904E+03	-0.187E+05	-0.514E+05	-0.360E+05	-0.190E+05	-0.437E+05	-0.315E+05	-0.601E+05	-0.101E+05	-0.863E+04	0.444E+05
0.02444	-0.102E+04	-0.143E+05	-0.483E+05	-0.379E+05	-0.234E+05	-0.529E+05	-0.440E+05	-0.734E+05	-0.261E+05	-0.238E+05	0.446E+05
0.02667	-0.870E+03	-0.731E+04	-0.405E+05	-0.334E+05	-0.216E+05	-0.533E+05	-0.471E+05	-0.757E+05	-0.293E+05	-0.263E+05	0.446E+05
0.02889	-0.512E+03	0.112E+04	-0.292E+05	-0.243E+05	-0.160E+05	-0.452E+05	-0.413E+05	-0.676E+05	-0.214E+05	-0.181E+05	0.446E+05
0.03111	-0.150E+03	0.923E+04	-0.174E+05	-0.147E+05	-0.107E+05	-0.300E+05	-0.285E+05	-0.514E+05	-0.516E+04	-0.256E+04	0.444E+05
0.03333	0.381E+02	0.154E+05	-0.769E+04	-0.813E+04	-0.904E+04	-0.100E+05	-0.110E+05	-0.297E+05	0.164E+05	0.178E+05	0.442E+05
0.03556	0.260E+02	0.193E+05	-0.938E+03	-0.505E+04	-0.113E+05	0.122E+05	0.874E+04	-0.500E+04	0.408E+05	0.408E+05	0.440E+05
0.03778	-0.731E+01	0.219E+05	0.445E+04	-0.300E+04	-0.142E+05	0.343E+05	0.283E+05	0.202E+05	0.656E+05	0.643E+05	0.438E+05
0.04000	0.109E+03	0.245E+05	0.108E+05	0.100E+04	-0.141E+05	0.537E+05	0.454E+05	0.435E+05	0.879E+05	0.856E+05	0.436E+05
0.04222	0.401E+03	0.275E+05	0.186E+05	0.744E+04	-0.100E+05	0.680E+05	0.575E+05	0.622E+05	0.105E+06	0.102E+06	0.434E+05
0.04444	0.735E+03	0.302E+05	0.260E+05	0.136E+05	-0.471E+04	0.753E+05	0.625E+05	0.737E+05	0.114E+06	0.110E+06	0.434E+05
0.04667	0.949E+03	0.313E+05	0.297E+05	0.158E+05	-0.225E+04	0.744E+05	0.591E+05	0.758E+05	0.113E+06	0.110E+06	0.434E+05
0.04889	0.955E+03	0.301E+05	0.276E+05	0.114E+05	-0.561E+04	0.651E+05	0.471E+05	0.677E+05	0.102E+06	0.996E+05	0.435E+05
0.05111	0.751E+03	0.265E+05	0.196E+05	0.359E+03	-0.154E+05	0.485E+05	0.274E+05	0.500E+05	0.801E+05	0.795E+05	0.437E+05
0.05333	0.371E+03	0.211E+05	0.732E+04	-0.158E+05	-0.300E+05	0.268E+05	0.240E+04	0.252E+05	0.509E+05	0.515E+05	0.440E+05
0.05556	-0.121E+03	0.144E+05	-0.725E+04	-0.345E+05	-0.469E+05	0.352E+04	-0.238E+05	-0.235E+04	0.185E+05	0.201E+05	0.442E+05
0.05778	-0.627E+03	0.740E+04	-0.218E+05	-0.527E+05	-0.623E+05	-0.167E+05	-0.462E+05	-0.276E+05	-0.116E+05	-0.891E+04	0.445E+05
0.06000	-0.104E+04	0.102E+04	-0.336E+05	-0.664E+05	-0.723E+05	-0.294E+05	-0.602E+05	-0.457E+05	-0.341E+05	-0.305E+05	0.446E+05
0.06222	-0.130E+04	-0.432E+04	-0.392E+05	-0.719E+05	-0.733E+05	-0.317E+05	-0.625E+05	-0.533E+05	-0.460E+05	-0.417E+05	0.446E+05
0.06444	-0.144E+04	-0.861E+04	-0.357E+05	-0.662E+05	-0.630E+05	-0.221E+05	-0.518E+05	-0.485E+05	-0.456E+05	-0.415E+05	0.445E+05
0.06667	-0.144E+04	-0.118E+05	-0.214E+05	-0.482E+05	-0.405E+05	-0.671E+02	-0.276E+05	-0.307E+05	-0.322E+05	-0.294E+05	0.443E+05
0.06889	-0.124E+04	-0.133E+05	0.218E+04	-0.190E+05	-0.663E+04	0.338E+05	0.916E+04	0.221E+03	-0.542E+04	-0.478E+04	0.440E+05
0.07111	-0.716E+03	-0.122E+05	0.309E+05	0.179E+05	0.355E+05	0.770E+05	0.564E+05	0.426E+05	0.336E+05	0.319E+05	0.437E+05
0.07333	0.153E+03	-0.835E+04	0.588E+05	0.567E+05	0.805E+05	0.124E+06	0.109E+06	0.921E+05	0.807E+05	0.771E+05	0.433E+05
0.07556	0.119E+04	-0.299E+04	0.803E+05	0.908E+05	0.121E+06	0.167E+06	0.159E+06	0.141E+06	0.128E+06	0.123E+06	0.430E+05
0.07778	0.209E+04	0.142E+04	0.919E+05	0.114E+06	0.150E+06	0.198E+06	0.196E+06	0.178E+06	0.163E+06	0.159E+06	0.428E+05
0.08000	0.257E+04	0.248E+04	0.923E+05	0.123E+06	0.161E+06	0.209E+06	0.210E+06	0.194E+06	0.178E+06	0.174E+06	0.427E+05
0.08222	0.247E+04	-0.106E+04	0.823E+05	0.116E+06	0.153E+06	0.197E+06	0.198E+06	0.182E+06	0.164E+06	0.161E+06	0.429E+05
0.08444	0.180E+04	-0.898E+04	0.639E+05	0.961E+05	0.127E+06	0.165E+06	0.160E+06	0.145E+06	0.123E+06	0.122E+06	0.432E+05
0.08667	0.691E+03	-0.199E+05	0.401E+05	0.664E+05	0.885E+05	0.117E+06	0.103E+06	0.891E+05	0.648E+05	0.649E+05	0.436E+05
0.08889	-0.607E+03	-0.317E+05	0.155E+05	0.335E+05	0.457E+05	0.639E+05	0.410E+05	0.281E+05	0.916E+03	0.237E+04	0.440E+05
0.09111	-0.174E+04	-0.415E+05	-0.446E+04	0.486E+04	0.799E+04	0.166E+05	-0.146E+05	-0.249E+05	-0.540E+05	-0.513E+05	0.444E+05
0.09333	-0.238E+04	-0.468E+05	-0.152E+05	-0.133E+05	-0.168E+05	-0.155E+05	-0.520E+05	-0.584E+05	-0.680E+05	-0.845E+05	0.446E+05
0.09556	-0.236E+04	-0.462E+05	-0.150E+05	-0.182E+05	-0.252E+05	-0.286E+05	-0.642E+05	-0.656E+05	-0.938E+05	-0.905E+05	0.446E+05
0.09778	-0.181E+04	-0.402E+05	-0.574E+04	-0.114E+05	-0.189E+05	-0.245E+05	-0.499E+05	-0.453E+05	-0.702E+05	-0.678E+05	0.445E+05
0.10000	-0.960E+03	-0.309E+05	0.830E+04	0.250E+04	-0.346E+04	-0.918E+04	-0.139E+05	-0.227E+04	-0.222E+05	-0.210E+05	0.442E+05
0.10222	-0.342E+02	-0.206E+05	0.252E+05	0.190E+05	0.156E+05	0.111E+05	0.345E+05	0.532E+05	0.395E+05	0.394E+05	0.438E+05
0.10444	0.849E+03	-0.104E+05	0.408E+05	0.349E+05	0.338E+05	0.310E+05	0.830E+05	0.108E+06	0.101E+06	0.997E+05	0.435E+05
0.10667	0.160E+04	-0.144E+04	0.535E+05	0.476E+05	0.477E+05	0.457E+05	0.119E+06	0.148E+06	0.148E+06	0.146E+06	0.432E+05
0.10889	0.207E+04	0.532E+04	0.612E+05	0.541E+05	0.536E+05	0.504E+05	0.135E+06	0.165E+06	0.172E+06	0.168E+06	0.430E+05
0.11111	0.210E+04	0.803E+04	0.611E+05	0.516E+05	0.476E+05	0.408E+05	0.125E+06	0.155E+06	0.167E+06	0.164E+06	0.431E+05
0.11333	0.161E+04	0.521E+04	0.517E+05	0.384E+05	0.284E+05	0.161E+05	0.942E+05	0.122E+06	0.138E+06	0.135E+06	0.432E+05
0.11556	0.724E+03	-0.300E+04	0.342E+05	0.164E+05	-0.136E+04	-0.203E+05	0.487E+05	0.726E+05	0.918E+05	0.901E+05	0.436E+05
0.11778	-0.310E+03	-0.143E+05	0.123E+05	-0.953E+04	-0.353E+05	-0.608E+05	-0.152E+04	0.180E+05	0.384E+05	0.381E+05	0.439E+05
0.12000	-0.122E+04	-0.261E+05	-0.936E+04	-0.332E+05	-0.658E+05	-0.969E+05	-0.462E+05	-0.313E+05	-0.110E+05	-0.990E+04	0.443E+05
0.12222	-0.179E+04	-0.354E+05	-0.267E+05	-0.494E+05	-0.863E+05	-0.121E+06	-0.768E+05	-0.659E+05	-0.466E+05	-0.444E+05	0.446E+05
0.12444	-0.193E+04	-0.407E+05	-0.371E+05	-0.551E+05	-0.933E+05	-0.129E+06	-0.877E+05	-0.800E+05	-0.624E+05	-0.593E+05	0.447E+05

0.13556	0.175E+03	0.254E+05	0.229E+05	0.435E+05	0.246E+05	0.125E+05	0.596E+05	0.573E+05	0.519E+05	0.522E+05	0.437E+05
0.13778	0.443E+03	0.515E+05	0.465E+05	0.706E+05	0.548E+05	0.476E+05	0.937E+05	0.877E+05	0.763E+05	0.742E+05	0.435E+05
0.14000	0.730E+03	0.719E+05	0.652E+05	0.921E+05	0.799E+05	0.788E+05	0.124E+06	0.114E+06	0.979E+05	0.940E+05	0.432E+05
0.14222	0.102E+04	0.835E+05	0.757E+05	0.105E+06	0.974E+05	0.104E+06	0.148E+06	0.136E+06	0.116E+06	0.112E+06	0.430E+05
0.14444	0.124E+04	0.864E+05	0.774E+05	0.109E+06	0.106E+06	0.120E+06	0.163E+06	0.149E+06	0.128E+06	0.124E+06	0.429E+05
0.14667	0.132E+04	0.832E+05	0.725E+05	0.104E+06	0.104E+06	0.125E+06	0.165E+06	0.150E+06	0.129E+06	0.126E+06	0.430E+05
0.14889	0.123E+04	0.767E+05	0.632E+05	0.935E+05	0.919E+05	0.116E+06	0.154E+06	0.136E+06	0.116E+06	0.113E+06	0.431E+05
0.15111	0.936E+03	0.683E+05	0.509E+05	0.774E+05	0.709E+05	0.964E+05	0.129E+06	0.108E+06	0.892E+05	0.880E+05	0.434E+05
0.15333	0.618E+03	0.587E+05	0.364E+05	0.571E+05	0.435E+05	0.675E+05	0.941E+05	0.695E+05	0.540E+05	0.539E+05	0.437E+05
0.15556	-0.246E+03	0.492E+05	0.214E+05	0.355E+05	0.138E+05	0.347E+05	0.549E+05	0.278E+05	0.162E+05	0.176E+05	0.440E+05
0.15778	-0.870E+03	0.416E+05	0.909E+04	0.166E+05	-0.126E+05	0.394E+04	0.180E+05	-0.110E+05	-0.177E+05	-0.150E+05	0.442E+05
0.16000	-0.126E+04	0.371E+05	0.235E+04	0.415E+04	-0.302E+05	-0.191E+05	-0.107E+05	-0.408E+05	-0.424E+05	-0.387E+05	0.444E+05
0.16222	-0.138E+04	0.357E+05	0.161E+04	-0.948E+03	-0.351E+05	-0.301E+05	-0.269E+05	-0.571E+05	-0.535E+05	-0.497E+05	0.445E+05
0.16444	-0.131E+04	0.360E+05	0.504E+04	-0.628E+03	-0.262E+05	-0.272E+05	-0.284E+05	-0.573E+05	-0.487E+05	-0.454E+05	0.444E+05
0.16667	-0.116E+04	0.369E+05	0.108E+05	0.297E+04	-0.415E+04	-0.104E+05	-0.152E+05	-0.414E+05	-0.279E+05	-0.257E+05	0.442E+05
0.16889	-0.917E+03	0.385E+05	0.188E+05	0.985E+04	0.285E+05	0.181E+05	0.108E+05	-0.118E+05	0.614E+04	0.681E+04	0.439E+05
0.17111	-0.449E+03	0.417E+05	0.304E+05	0.216E+05	0.675E+05	0.543E+05	0.454E+05	0.270E+05	0.484E+05	0.473E+05	0.436E+05
0.17333	-0.287E+03	0.443E+05	0.457E+05	0.383E+05	0.107E+06	0.920E+05	0.824E+05	0.686E+05	0.924E+05	0.896E+05	0.433E+05
0.17556	0.113E+04	0.511E+05	0.621E+05	0.567E+05	0.139E+06	0.124E+06	0.114E+06	0.105E+06	0.131E+06	0.127E+06	0.431E+05
0.17778	0.180E+04	0.537E+05	0.752E+05	0.709E+05	0.157E+06	0.143E+06	0.133E+06	0.128E+06	0.155E+06	0.151E+06	0.429E+05
0.18000	0.206E+04	0.528E+05	0.812E+05	0.756E+05	0.160E+06	0.146E+06	0.134E+06	0.132E+06	0.158E+06	0.155E+06	0.430E+05
0.18222	0.183E+04	0.476E+05	0.783E+05	0.684E+05	0.145E+06	0.132E+06	0.117E+06	0.113E+06	0.138E+06	0.136E+06	0.431E+05
0.18444	0.118E+04	0.387E+05	0.672E+05	0.507E+05	0.118E+06	0.103E+06	0.836E+05	0.746E+05	0.967E+05	0.959E+05	0.434E+05
0.18667	0.230E+03	0.269E+05	0.502E+05	0.257E+05	0.818E+05	0.663E+05	0.415E+05	0.257E+05	0.440E+05	0.443E+05	0.438E+05
0.18889	-0.786E+03	0.144E+05	0.306E+05	-0.129E+04	0.451E+05	0.295E+05	-0.735E+02	-0.230E+05	-0.876E+04	-0.718E+04	0.441E+05
0.19111	-0.159E+04	0.357E+04	0.128E+05	-0.246E+05	0.149E+05	0.122E+04	-0.317E+05	-0.608E+05	-0.504E+05	-0.475E+05	0.444E+05
0.19333	-0.193E+04	-0.331E+04	0.260E+03	-0.393E+05	-0.290E+04	-0.126E+05	-0.465E+05	-0.793E+05	-0.725E+05	-0.691E+05	0.446E+05
0.19556	-0.172E+04	-0.576E+04	-0.575E+04	-0.437E+05	-0.686E+04	-0.105E+05	-0.426E+05	-0.741E+05	-0.706E+05	-0.677E+05	0.446E+05
0.19778	-0.112E+04	-0.504E+04	-0.682E+04	-0.397E+05	-0.525E+02	0.396E+04	-0.236E+05	-0.453E+05	-0.446E+05	-0.429E+05	0.444E+05
0.20000	-0.370E+03	-0.312E+04	-0.584E+04	-0.316E+05	0.121E+05	0.245E+05	0.379E+04	0.169E+04	0.389E+03	0.103E+04	0.441E+05
0.20222	0.331E+03	-0.131E+04	-0.504E+04	-0.233E+05	0.245E+05	0.451E+05	0.326E+05	0.570E+05	0.542E+05	0.540E+05	0.438E+05
0.20444	0.914E+03	-0.102E+03	-0.535E+04	-0.167E+05	0.343E+05	0.613E+05	0.572E+05	0.108E+06	0.104E+06	0.103E+06	0.435E+05
0.20667	0.133E+04	0.509E+02	-0.732E+04	-0.131E+05	0.391E+05	0.700E+05	0.736E+05	0.145E+06	0.138E+06	0.136E+06	0.433E+05
0.20889	0.150E+04	-0.174E+04	-0.119E+05	-0.139E+05	0.368E+05	0.689E+05	0.789E+05	0.159E+06	0.149E+06	0.146E+06	0.432E+05
0.21111	0.131E+04	-0.626E+04	-0.199E+05	-0.207E+05	0.259E+05	0.567E+05	0.715E+05	0.152E+06	0.138E+06	0.135E+06	0.432E+05
0.21333	0.781E+03	-0.132E+05	-0.309E+05	-0.336E+05	0.694E+04	0.345E+05	0.523E+05	0.127E+06	0.110E+06	0.107E+06	0.434E+05
0.21556	0.877E+02	-0.211E+05	-0.424E+05	-0.504E+05	-0.169E+05	0.627E+04	0.253E+05	0.924E+05	0.713E+05	0.697E+05	0.437E+05
0.21778	-0.565E+03	-0.284E+05	-0.517E+05	-0.668E+05	-0.406E+05	-0.224E+05	-0.339E+04	0.560E+05	0.315E+05	0.311E+05	0.440E+05
0.22000	-0.103E+04	-0.336E+05	-0.566E+05	-0.790E+05	-0.594E+05	-0.460E+05	-0.277E+05	0.251E+05	-0.196E+04	-0.128E+04	0.442E+05
0.22222	-0.123E+04	-0.364E+05	-0.560E+05	-0.843E+05	-0.702E+05	-0.604E+05	-0.431E+05	0.506E+04	-0.233E+05	-0.217E+05	0.444E+05
0.22444	-0.116E+04	-0.362E+05	-0.499E+05	-0.818E+05	-0.714E+05	-0.638E+05	-0.477E+05	-0.174E+04	-0.304E+05	-0.277E+05	0.445E+05
0.22667	-0.824E+03	-0.331E+05	-0.388E+05	-0.714E+05	-0.632E+05	-0.569E+05	-0.427E+05	0.324E+04	-0.248E+05	-0.214E+05	0.445E+05
0.22889	-0.383E+03	-0.278E+05	-0.251E+05	-0.536E+05	-0.472E+05	-0.420E+05	-0.310E+05	0.157E+05	-0.111E+05	-0.738E+04	0.444E+05
0.23111	-0.388E+02	-0.222E+05	-0.122E+05	-0.300E+05	-0.261E+05	-0.227E+05	-0.163E+05	0.308E+05	0.583E+04	0.906E+04	0.443E+05
0.23333	0.419E+02	-0.177E+05	-0.242E+04	-0.229E+04	-0.225E+04	-0.182E+04	-0.142E+04	0.454E+05	0.227E+05	0.247E+05	0.441E+05
0.23556	-0.100E+03	-0.143E+05	0.416E+04	0.274E+05	0.228E+05	0.194E+05	0.132E+05	0.591E+05	0.388E+05	0.390E+05	0.439E+05
0.23778	-0.238E+03	-0.102E+05	0.103E+05	0.571E+05	0.484E+05	0.411E+05	0.286E+05	0.733E+05	0.554E+05	0.538E+05	0.436E+05
0.24000	-0.145E+03	-0.379E+04	0.191E+05	0.846E+05	0.734E+05	0.630E+05	0.457E+05	0.890E+05	0.738E+05	0.707E+05	0.434E+05
0.24222	0.223E+03	0.524E+04	0.312E+05	0.108E+06	0.956E+05	0.835E+05	0.635E+05	0.105E+06	0.934E+05	0.896E+05	0.433E+05
0.24444	0.717E+03	0.152E+05	0.443E+05	0.125E+06	0.112E+06	0.994E+05	0.789E+05	0.119E+06	0.111E+06	0.107E+06	0.432E+05
0.24667	0.113E+04	0.237E+05	0.548E+05	0.134E+06	0.121E+06	0.107E+06	0.879E+05	0.126E+06	0.120E+06	0.117E+06	0.432E+05
0.24889	0.131E+04	0.290E+05	0.600E+05	0.135E+06	0.120E+06	0.104E+06	0.871E+05	0.123E+06	0.116E+06	0.114E+06	0.432E+05
0.25111	0.119E+04	0.305E+05	0.588E+05	0.127E+06	0.109E+06	0.907E+05	0.752E+05	0.107E+06	0.969E+05	0.961E+05	0.434E+05
0.25333	0.780E+03	0.282E+05	0.513E+05	0.111E+06	0.899E+05	0.675E+05	0.539E+05	0.807E+05	0.656E+05	0.657E+05	0.437E+05
0.25556	0.157E+03	0.229E+05	0.392E+05	0.910E+05	0.650E+05	0.386E+05	0.274E+05	0.484E+05	0.278E+05	0.291E+05	0.440E+05
0.25778	-0.510E+03	0.157E+05	0.247E+05	0.698E+05	0.397E+05	0.962E+04	0.155E+04	0.167E+05	-0.889E+04	-0.652E+04	0.442E+05
0.26000	-0.101E+04	0.826E+04	0.108E+05	0.516E+05	0.192E+05	-0.133E+05	-0.176E+05	-0.797E+04	-0.370E+05	-0.342E+05	0.444E+05
0.26222	-0.121E+04	0.177E+04	-0.142E+03	0.389E+05	0.693E+04	-0.262E+05	-0.260E+05	-0.215E+05	-0.497E+05	-0.474E+05	0.445E+05
0.26444	-0.111E+04	-0.314E+04	-0.754E+04	0.319E+05	0.319E+04	-0.283E+05	-0.228E+05	-0.226E+05	-0.423E+05	-0.410E+05	0.444E+05

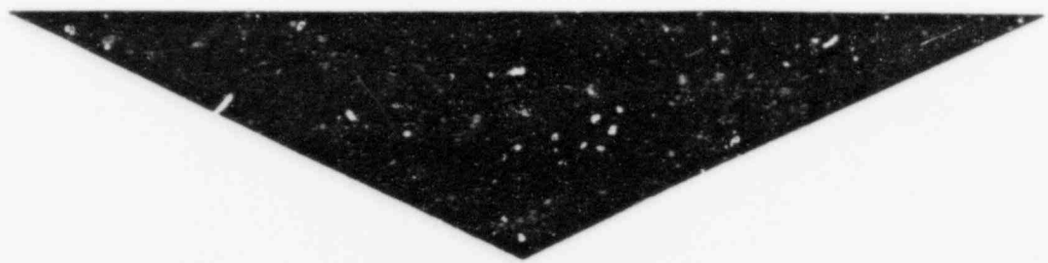
MAXIMUM	2.566E+03	8.638E+04	9.228E+04	1.347E+05	1.608E+05	2.088E+05	2.104E+05	1.938E+05	1.775E+05	1.741E+05	4.471E+04
TIME	8.000E-02	1.444E-01	8.000E-02	2.489E-01	8.000E-02	8.000E-02	8.000E-02	8.000E-02	8.000E-02	8.000E-02	1.267E-01
MINIMUM	-2.376E+03	-4.678E+04	-5.655E+04	-8.432E+04	-9.325E+04	-1.292E+05	-8.774E+04	-7.997E+04	-9.384E+04	-9.050E+04	4.275E+04
TIME	9.333E-02	9.333E-02	2.200E-01	2.222E-01	1.244E-01	1.244E-01	1.244E-01	1.244E-01	9.556E-02	9.556E-02	8.000E-02
RANGE	4.942E+03	1.332E+05	1.488E+05	2.190E+05	2.541E+05	3.381E+05	2.981E+05	2.738E+05	2.714E+05	2.646E+05	1.963E+03

2978

COSINE HARMONIC	JOINT OR MODE 1	2	3	4	5	6	7	8	9	10	11
0	-7.058E-10	5.480E+03	1.096E+04	1.644E+04	2.192E+04	2.740E+04	3.288E+04	3.836E+04	4.384E+04	4.384E+04	4.384E+04
1	-2.200E+00	-1.022E+04	-2.024E+04	-5.964E+03	-6.107E+03	-5.982E+03	-2.027E+04	-1.027E+04	-7.324E+01	-6.318E+01	8.175E+01
2	-2.456E+00	5.138E+03	-8.340E+00	2.500E+04	-3.328E+01	-2.507E+04	-5.569E+01	-5.198E+03	-5.027E+01	-5.306E+01	1.285E+01
3	6.768E+01	1.600E+02	1.762E+04	2.975E+04	4.233E+04	3.019E+04	1.849E+04	1.474E+03	1.838E+03	1.676E+03	-8.866E+01
4	2.589E+00	-1.061E+03	-2.131E+03	-1.054E+03	1.441E+01	1.083E+03	2.157E+03	1.082E+03	1.045E+01	1.781E+01	-2.514E+00
5	-7.823E+01	1.434E+03	-1.084E+04	-1.816E+04	-2.832E+04	-1.878E+04	-1.208E+04	-4.040E+02	-2.511E+03	-2.371E+03	5.684E+01
6	1.435E+00	-2.081E+03	5.344E+01	-1.632E+03	1.445E+02	1.920E+03	2.293E+02	2.356E+03	2.632E+02	2.472E+02	-3.462E+00
7	1.231E+02	3.334E+03	1.139E+04	5.202E+03	2.223E+03	6.185E+03	1.335E+04	6.225E+03	3.938E+03	3.746E+03	-3.696E+01
8	-7.809E+02	-8.688E+03	-1.626E+04	-2.348E+04	-3.018E+04	-3.622E+04	-4.147E+04	-4.581E+04	-4.918E+04	-4.763E+04	3.572E+02
9	1.468E+02	2.861E+03	3.741E+02	1.370E+03	6.564E+03	2.880E+03	1.814E+03	6.067E+03	4.278E+03	4.201E+03	-2.258E+01
10	2.587E+02	4.402E+02	3.935E+03	8.743E+03	7.046E+03	5.126E+03	9.271E+03	1.168E+04	1.037E+04	1.027E+04	-9.186E+01
11	-5.719E+02	-3.189E+03	-4.887E+03	-5.984E+03	-8.949E+03	-1.253E+04	-1.773E+04	-2.183E+04	-2.444E+04	-2.466E+04	1.818E+02
12	-6.497E+01	-1.706E+03	-3.246E+03	-2.266E+03	-1.171E+03	-1.753E+01	1.132E+03	-1.352E+02	-1.402E+03	-1.455E+03	4.782E+00
13	2.427E+01	1.112E+03	9.509E+01	4.520E+01	-1.309E+03	2.838E+02	5.649E+02	1.799E+03	9.131E+02	9.018E+02	-3.659E+00
14	-1.895E+01	-8.817E+02	-2.231E+02	-1.030E+03	-2.779E+02	4.913E+02	-2.635E+02	4.776E+02	-2.741E+02	-2.953E+02	7.530E-01
15	-1.564E+01	-5.068E+02	-8.747E+02	-1.479E+02	-2.618E+02	-5.273E+02	1.432E+02	-5.243E+02	-1.280E+03	-1.406E+03	3.146E+00
16	1.486E+02	7.170E+02	1.198E+03	1.578E+03	1.828E+03	1.925E+03	1.863E+03	1.646E+03	1.299E+03	1.468E+03	-2.787E+00
17	-1.280E+00	4.130E+02	1.272E+02	-6.918E+01	3.393E+02	-2.153E+02	-1.510E+02	2.975E+01	-4.551E+02	-5.359E+02	8.954E-01
18	-8.625E+00	-4.483E+02	-8.194E+01	5.113E+01	-9.005E+01	-2.217E+02	-6.098E+01	3.462E+02	-3.645E+01	-4.470E+01	6.797E-02
19	1.782E+00	2.608E+02	3.651E+02	5.674E+02	3.587E+02	2.886E+02	-1.615E+02	-4.553E+02	-8.299E+02	-1.017E+03	1.466E+00
20	-2.470E+01	-4.660E+02	-8.435E+02	-5.785E+02	-2.399E+02	1.291E+02	4.814E+02	2.371E+02	-3.761E+01	-4.920E+01	6.144E-02
21	6.254E+00	-2.155E+02	-1.945E+02	2.712E+02	7.294E+01	1.417E+02	-4.540E+01	-9.908E+01	-3.382E+02	-4.673E+02	5.046E-01
22	-1.012E+01	-2.647E+02	-1.073E+02	-2.502E+02	-9.259E+01	7.920E+01	-2.341E+01	1.944E+02	1.308E+01	1.764E+01	-1.875E-02
23	6.170E+00	1.973E+02	2.239E+02	8.102E+01	1.349E+02	-1.972E+01	3.883E+01	-4.206E+01	-2.501E+02	-3.624E+02	3.560E-01
24	3.370E+01	1.719E+02	2.720E+02	3.215E+02	3.112E+02	2.432E+02	1.299E+02	-7.561E+00	-1.452E+02	-2.289E+02	2.053E-01

SINE HARMONIC	JOINT OR MODE 1	2	3	4	5	6	7	8	9	10	11
1	-3.735E+00	-1.003E+04	1.440E+02	-3.207E+00	-1.430E+04	-2.092E+01	1.082E+02	-1.009E+04	-7.964E+01	-6.653E+01	3.286E+01
2	1.061E+00	2.501E+04	-1.928E+01	-5.200E+03	-9.351E+01	5.012E+03	-1.684E+02	-2.520E+04	-1.922E+02	-1.726E+02	2.250E+01
3	-5.053E+01	-1.741E+04	-1.810E+04	-3.065E+04	-1.910E+04	-3.103E+04	-1.885E+04	-1.853E+04	-1.532E+03	-1.426E+03	9.643E+01
4	8.846E-01	-6.594E+03	-1.315E+04	-6.441E+03	3.064E+02	7.052E+03	1.376E+04	7.194E+03	5.897E+02	5.465E+02	-1.773E+01
5	-1.685E+02	-1.309E+04	-1.627E+04	-2.697E+04	-2.089E+04	-2.821E+04	-1.873E+04	-1.676E+04	-5.056E+03	-4.723E+03	9.408E+01
6	-1.046E+00	1.718E+03	-2.709E+01	-2.140E+03	-3.664E+01	2.067E+03	-4.418E+01	-1.787E+03	-6.318E+01	-6.152E+01	1.149E+00
7	-1.133E+02	-8.205E+03	-6.554E+03	-3.662E+03	-1.101E+04	-4.594E+03	-8.403E+03	-1.094E+04	-3.721E+03	-3.549E+03	3.964E+01
8	1.090E+03	1.365E+04	2.574E+04	3.734E+04	4.820E+04	5.814E+04	6.694E+04	7.446E+04	8.059E+04	7.754E+04	-6.384E+02
9	-3.367E+02	-6.716E+03	-1.083E+04	-8.598E+03	-1.174E+04	-1.172E+04	-1.699E+04	-1.576E+04	-1.212E+04	-1.182E+04	7.618E+01
10	-5.163E+01	2.697E+03	-8.590E+02	4.047E+02	-1.732E+03	-3.826E+03	-2.433E+03	-5.777E+03	-2.732E+03	-2.668E+03	1.631E+01
11	2.936E+02	2.178E+02	3.757E+03	5.178E+03	9.491E+03	8.252E+03	9.801E+03	9.029E+03	1.165E+04	1.160E+04	-5.412E+01
12	8.899E+01	2.254E+03	4.309E+03	3.132E+03	1.824E+03	4.367E+02	-9.748E+02	7.003E+02	2.347E+03	2.392E+03	-8.720E+00
13	1.184E+02	-1.623E+02	-2.523E+02	-8.584E+02	1.745E+02	9.086E+02	3.187E+03	4.767E+03	6.315E+03	6.605E+03	-1.983E+01
14	7.980E+00	8.164E+02	7.789E+01	-6.427E+02	1.397E+02	9.145E+02	1.714E+02	-6.030E+02	1.572E+02	1.637E+02	-4.577E-01
15	7.662E+00	-4.548E+02	2.604E+02	2.323E+02	-5.424E+02	3.515E+02	4.921E+02	-1.240E+02	4.218E+02	4.450E+02	-1.154E+00
16	-1.118E+02	-5.494E+02	-9.251E+02	-1.231E+03	-1.444E+03	-1.548E+03	-1.534E+03	-1.403E+03	-1.168E+03	-1.303E+03	2.862E+00
17	4.280E+00	-2.035E+02	-5.832E+02	-2.013E+01	2.096E+02	1.545E+02	-2.491E+02	2.614E+02	5.637E+02	6.431E+02	-1.178E+00
18	6.206E+00	1.876E+02	7.970E+01	4.777E+02	7.219E+01	-3.401E+02	3.800E+01	-1.008E+02	4.073E+01	4.693E+01	-7.570E-02
19	3.272E+00	-9.721E+01	1.810E+02	2.764E+02	5.102E+02	1.595E+02	-3.787E+01	-3.900E+02	-3.276E+02	-4.238E+02	5.328E-01
20	3.366E+00	9.146E+01	1.717E+02	1.107E+02	4.086E+01	-3.248E+01	-1.039E+02	-3.995E+01	2.684E+01	3.177E+01	-4.098E-02
21	-5.554E+00	-7.871E+01	-2.735E+02	-4.077E+02	-4.400E+02	-2.261E+02	6.555E+01	3.726E+02	5.014E+02	6.577E+02	-7.859E-01
22	1.162E+00	1.424E+02	-4.799E-01	-1.938E+02	1.287E+01	2.183E+02	2.142E+01	-1.272E+02	6.717E+00	9.088E+00	-7.897E-03
23	3.565E+00	1.070E+01	1.786E+02	7.393E+01	-6.828E+01	3.379E+01	1.059E+02	-8.091E+01	-8.998E+01	-1.438E+02	1.223E-01
24	-2.124E+01	-9.955E+01	-1.576E+02	-1.896E+02	-1.902E+02	-1.591E+02	-1.013E+02	-2.593E+01	5.529E+01	7.565E+01	-6.910E-02

REPORT APPROVAL FORM



1.6.1

FOR INTERNAL USE ONLY

FAILURE ANALYSIS ASSOCIATES

IN-HOUSE REPORT APPROVAL FORM

Communication Title or Subject:

Calculations for Generator Shaft and Bearing for River Bend Nuclear Station Diesel Generator

Communication Number: None Communication Date: -

Project Number: DR-06-03-6506

Task Number (if applicable): _____

Approvals

Craig Hoyles
Task Engineer

Date: 1-21-85

Clifford Wells
Corporate Officer

Date: 2-4-85

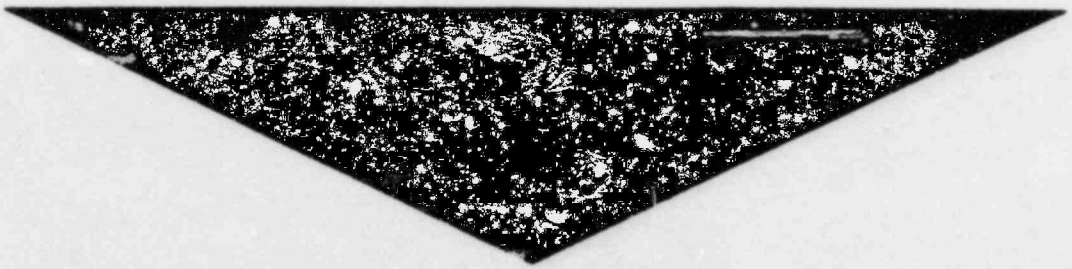
Clifford Wells
Communication Reviewer

Date: 2-4-85

Support Package Reviewer

Date: 25 Jan 85

SUPPORT PACKAGE COVER SHEET AND TABLE OF CONTENTS SP-84-6-47(g)



FAILURE ANALYSIS ASSOCIATES

SUPPORT PACKAGE COVER SHEET

Support Package Number: SP-84-6-47(g)

Communication Number: None

Communication Date: —

Communication Title or Subject: Calculations for Generator Shaft and Bearing for River Bend Nuclear station Diesel Generator

Project Number: D2-06-03-650C

Task Number (if applicable): _____

Task Engineer: Craig Kirby (Signature) Date: 12-2-84

Reviewer: _____ (Signature) Date: 1/3/85

SUPPORT PACKAGE CONTENTS
(Optional for Non Nuclear Work)

ITEM		SUPPORT OF
1.	Hand Calculation Cover Sheet: River Bend Generator Shaft and Bearing Analysis. (13 pages)	Provides outline of necessary calculations.
2.	TDI Torsional Analysis for River Bend's Diesel Generator by Rohwal Yang (4 pages)	Provides dimensions, weights, bearing reactions, and moments (used as check of calculations)

FAILURE ANALYSIS ASSOCIATES

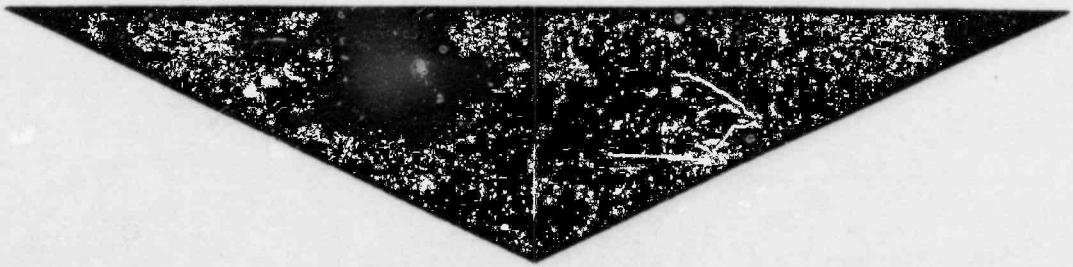
SUPPORT PACKAGE COVER SHEET (CONTINUED)

Support Package Number: SP-84-6-47(g)

SUPPORT PACKAGE CONTENTS

ITEM		SUPPORT OF
3.	Torque Excursions Between the Flywheel to Generator and Generator to Grid for River Bend by Lisa Shuto (2pages)	Provides torque inputs used in calculating stresses
4.	Telephone Memorandum: Craig Vogler, FaAA and Bob Klashen, Porter (1page)	Shaft Material, weight, magnetic pull
5.	Telephone Memorandum: Craig Vogler, FaAA and Walter Meacham, FaAA (1page)	8' Bearing clearances
6.	ASTM A-668 Class D material specification (10 pages)	Provides material properties of generator shaft

COMPONENT DESIGN REVIEW CHECKLIST - RIVER BEND STATION - UNIT 1.



COMPONENT DESIGN REVIEW CHECKLIST
RIVER BEND STATION - UNIT 1

Generator:
COMPONENT Shaft & Bearings

UTILITY Gulf States Utilities

GROUP PARTS LIST NO. 03-650C

TASK DESCRIPTION NO. DR-06-03-650C-0

SNPS GPL NO. 03-650C

CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- The static lateral and dynamic torsional loadings were computed and used to evaluate both the generator shaft factor of safety, for yielding and fatigue, and the bearing operating characteristics. The resulting bearing operating characteristics are within accepted industry allowables and the factors of safety are comparable to the lead engines at Shoreham and Comanche Peak.

- A review of the EDG Component Tracking System indicates that there have been no design related problems associated with this component. There is no site experience for River Bend listed in the Component Tracking System.

There are no maintenance or modification recommendations for this component other than those specified by the vendor.

Quality Revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

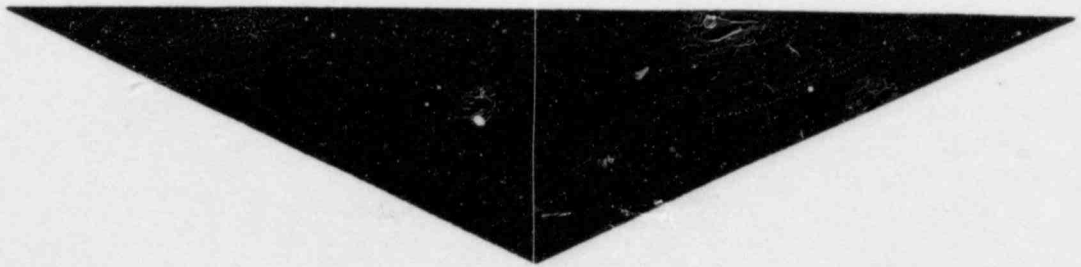
Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON _____ PROGRAM MANAGER _____

ITEM 1 HAND CALCULATION COVER SHEET: RIVER BEND GENERATOR SHAFT AND BEARING ANALYSIS.



HAND CALCULATION COVER SHEET

CALCULATION TITLE River Bend Generator Shaft and Bearing Analysis

PROJECT NO. 22-0603-650C

TASK NO. _____

DESCRIPTION OF CALCULATION

The primary purpose of this set of calculations is to determine if the generator shaft and bearing are acceptable for their intended use, in particular, that the factor of safety for static and fatigue failure is adequate and that the bearing oil film thickness is comparable to or surpasses, industry recommendation

REFERENCES:

The calculations follow the outline written by Walter Meacham of FaAA-Phoenix, in his calculations and support package for Shearon Harris. (SP-84-G-476) Other references are included in Support Package SP-84-G-476(S).

Subject Report: Deletion Justification for Component 03-650C Generator Shaft and Bearing

Report Number: DJ-03-01-650C Date: 12-3-84

Craig Vogler 12-3-84 12/11/84

Engineer Date Reviewer Date

Failure Analysis Associates

Wt of Flywheel:

For a solid disk $W_t = \rho \pi r^2 \ell$

$W_t = (.286)(\pi)\left(\frac{62\ 5/8}{2}\right)^2(4\ 5/8) = 4074$ lbs ✓ (TDC value 3589)

Est. Wt of generator shaft: (Act. weight not available at this time)

$$\left[\frac{\pi}{4}\left((24^2)(3) + (16\ 5/8)^2(14\ 3/4) + 44.44(19)^2\right) + \frac{1}{3}\pi\left(\frac{19.75}{2}\right)^2(9.31)\left[1 + \left(\frac{4}{9.375}\right) + \left(\frac{4}{9.38}\right)^2\right] + (4^2)(\pi)(20)\right](.286)$$

$$= \frac{\pi}{4}(.286)\left[\left(1728 + 3940 + 16043\right) + \left[\frac{1}{3}\pi(818)\left(1 + .427 + .122\right) + \pi(320)\right]\right].286$$

$$= .286\left[(17052) + (1378) + (1005)\right] = 5560 \text{ lbs est.}$$

(5760 per Gen Electric Co. of Fairfax)

Winding - rotor = 25,000 lbs

total shaft + rotor = approx. 30,560 lbs. ✓

From flange to rot. element = 36.0"

flange to bearing ℄ = 32."

C = 13 3/4 + 3 + 36 = 52.75" A = 7.85 ✓ W_c = 690 lbs

D = 13 3/4 + 3 + 82 = 98.75" B = 15.25

$\Sigma R = 0 \therefore \quad R_1 + R_2 = W_c + W_4 + W_6$

$R_1 + R_2 = 35297 \simeq 35300$ lbs

$\Sigma M = 0 \quad R_2 = \dfrac{(690)(7.85) + (4074)(15.25) + (52.75)(30,560) +}{98.75} = 17008$ lbs ✓ (17x1)

$R_1 = 18314$ lbs ✓

Pedestal Bearing Analysis

for 8" bearing:

vert 8.010 – 8.014 ave 8.012
horz 8.018 – 8.022 ave 8.020
Length: 16"

0.1 Visc. $\mu = 3.915 \times 10^{-6}$ reyn @ 155°F

$\frac{L}{D} = \frac{16}{8} = 2$

$R = \frac{1}{2}(8.012) = 4.006$

$C = \frac{1}{2}(8.020 - 8.000) = .010$
$8.000 - 7.991 = .009$"

$R+d = \frac{1}{2}(8.020) = 4.010$

$d = .004$

$S = \frac{d}{C} = \frac{.004}{.010} = .4$

$C_m = \frac{1}{2}(8.012 - 8.000) = .006$

$S = \frac{3.915 \times 10^{-6}\ (450/60)\left(\frac{4.006}{.010}\right)^2}{17008/16 \times 8} = .035$ ✓

$\epsilon_{12} = .805$ ✓

$h_{min} = (.010)(1 - .805) = .0019 = 1.95 \times 10^{-3}$ inches ✓

from table 4-1:

$\frac{L}{D} = \infty$, $S = .035 \therefore \frac{p_m}{P} = 1.56$ ✓

unit load: $\frac{17008}{16 \times 8} = 133$ psi ✓

$P_{max} = 133 \times 1.56 = 207$ psi

Min oil film thickness: 1.9×10^{-3} inches ✓
Peak oil film pressure 210 psi
Unit Load 133 psi

Summary of generator bearing

Minimum oil film thickness	1.9×10^{-3} inches ✓
Peak oil film pressure	210 psi
Unit load	133 psi

Industry recommendations for oil film thickness:

30 micro-inches per inch of shaft diameter

or $30 \times 10^{-6} \times 8.0" = 240 \times 10^{-6}$ inches $(.240 \times 10^{-3}")$

It can be concluded that the bearing is acceptable for its intended use.

Prof:

Determine stresses due to torques

$\tau = \frac{Tr}{J}$ use stress concentration factor of 2

@ Flywheel: $r = \frac{16.625}{2} = 8.31"$ $J = \frac{1}{2}\pi(8.31)^4 = 7490$

$T_{max} = 2.166 \times 10^5$ ft-lbs $= 2.60 \times 10^6$ in-lb
$T_{min} = -1.088 \times 10^5$ ft-lbs $= -1.31 \times 10^6$ in-lb

$\tau_{max} = \frac{2 \times 2.6 \times 10^6 (8.31)}{7490} = 5769$ psi

$\tau_{min} = \frac{2 \times (-1.31 \times 10^6)(8.31)}{7490} = -2907$ psi

$\tau_m = \frac{5769 + (-2907)}{2} = 1431$ psi

$\tau_a = 5769 - 1431 = 4338$ psi

@ Gen-Grid $r = 9.438$ $J = \frac{1}{2}\pi(9.438)^4 = 12463$

$T_{max} = 5.588 \times 10^4$ ft-lb $= 6.71 \times 10^5$ in-lb
$T_{min} = 5.345 \times 10^4$ ft-lb $= 6.41 \times 10^5$ in-lb

$\tau_{max} = \frac{2 \times 6.71 \times 10^5 (9.438)}{12463} = 1016$ psi

$\tau_{min} = \frac{2 \times 6.41 \times 10^5 (9.438)}{12463} = 971$ psi

$\tau_m = \frac{1016 + 971}{2} = 994$

$\tau_a = 1016 - 994 = 22$

Bending Moment

@ Flywheel

$M_1 = R_1 \cdot E - W_f(E-B) - W_c(E-A)$

$E = B + \frac{1}{2}(\text{Flywheel Thickness}) = \frac{1}{2}(4\ 5/8) + 15.25 = 17.56$

$M_1 = (18316)(17.56) - (4074)(2.31) - 690(17.56 - 7.85)$

$M_1 = 305,518$ lbf-in ✓

@ Gen-Grid

$M_2 = R_1 \cdot C - W_f(C-B) - W_c(C-A)$

$M_2 = 18316(52.75) - 4074(52.75 - 15.25) - 690(52.75 - 7.85)$

$M_2 = 782,413$ ✓

$\sigma_{max/min} = \pm \frac{Mc}{I}$ = @ Flywheel: $\pm \frac{305518(8.31)}{\frac{1}{4}\pi(8.31)^4} = 678$ psi ✓

use 2.5 stress riser: $\sigma_{max/min} = \pm 1700$ $\sigma_m = 0$ ✓

@ Grid-Gen: $\pm \frac{782,413(9.44)}{\frac{1}{4}\pi(9.44)^4} = 1184$ psi

with 2.5 stress riser: $\sigma_{max/min} = \pm 2960$ psi ✓ $\sigma_m = 0$ ✓

Combination Stresses:

@ Flywheel:

$\hat{\sigma}_{max} = (1700^2 + 3 \cdot 5769^2)^{1/2} = 10140$ psi ✓

$\hat{\sigma}_{min} = (1700^2 + 3(2907)^2)^{1/2} = 5314$ psi ✓

$\hat{\sigma}_a = (1700^2 + 3(4338)^2)^{1/2} = 7705$ psi ✓

$\hat{\sigma}_m = (0 + 3(1431)^2)^{1/2} = 2480$ psi ✓

RIVER BEND

@ Gen-Grid:

$\hat{\sigma}_{max} = (2960^2 + 3\cdot(1016)^2)^{1/2} = 3444$ ✓

$\sigma_{mid} = (2960^2 + 3\cdot(971)^2)^{1/2} = 3404$ ✓

$\hat{\sigma}_a = (2960^2 + 3\cdot(72)^2)^{1/2} = 2960$ ✓

$\sigma_m = (0 + 3\cdot(994)^2)^{1/2} = 1722$ ✓

Static Safety Factor:

Torsion:

@ Flywheel: $\eta_\tau = \frac{S_{sy}}{\hat{\tau}_{max}} = \frac{.577\,S_y}{\hat{\tau}_{max}}$

$\eta_\tau = \frac{21650}{5769} = 3.75$ ✓

for shaft mat'l of A 638 (AISI 4140) = assume 668 ✓

@ Gen-Grid: $\eta_\tau = \frac{21650}{1016} = 21.3$

Combined

@ Flywheel: $\eta_{\hat{\sigma}} = \frac{S_y}{\hat{\sigma}_{max}} = \frac{37500}{10140} = 3.7$ ✓

@ Gen-Grid: $\eta_{\hat{\sigma}} = \frac{37500}{3444} = 10.9$

Fatigue Safety Factor

$$n_f = \left(\frac{(S_a^{\wedge})^2 + (S_m^{\wedge})^2}{\sigma_a^2 + \sigma_m^2} \right)^{1/2} \quad \text{where: } S_m^{\wedge} = \frac{S_e}{\frac{\sigma_a}{\sigma_m} + \frac{S_e}{S_u}} \text{ and } S_a^{\wedge} = -\frac{S_e}{S_u} S_m^{\wedge} + S_e$$

@ Flywheel:

$$S_m^{\wedge} = \frac{26250}{\frac{7705}{2480} + \frac{26250}{75,000}} = 7594 \checkmark$$

$$S_a^{\wedge} = -\frac{26250}{75,000}(7594) + 26250 = 23,600 \checkmark$$

$$n_f = \left(\frac{23600^2 + 7594^2}{7705^2 + 2480^2} \right)^{1/2} = 3.06 \checkmark$$

@ Gen-Grid

$$S_m^{\wedge} = \frac{26250}{\frac{2960}{1722} + \frac{26250}{75000}} = 12,690$$

$$S_a^{\wedge} = -\frac{26250}{75,000}(12690) + 26250 = 21,810$$

$$n_f = \left(\frac{21,810^2 + 12,690^2}{2960^2 \quad 1722^2} \right)^{1/2} = 7.4$$

RIVER BEND

Distortion energy fatigue failure

@ Flywheel

$$U_d = \frac{1+\nu}{3E} = \frac{1+0.3}{3(\quad)} = 1.44 \times 10^{-8}$$

$U_{d\max} = 1.44 \times 10^{-8}(10140)^2 = 1.49$ $\quad \frac{3E}{1+\nu} = \frac{90\times10^6}{1.3} = 8320$

$U_{d\min} = 1.44 \times 10^{-8}(5314)^2 = 0.41$

$U_{dm} = 1.44 \times 10^{-8}(2480)^2 = .09$

I $\quad 8320\left[(1.49)^{1/2} - 2(.41)^{1/2}\right] \geq S_y$? $\quad -500 < 37500$

II $\quad 8320\left[(1.49)^{1/2} - (.09)^{1/2}\right] \geq S_e$? $\quad 7660 < 26250$

III $\quad 8320\left[(1.49)^{1/2} - (.09)^{1/2}\left(1 - \frac{26250}{75000}\right)\right] \geq S_e$? $\quad 8533 < 26250$

IV $\quad 8320(1.49)^{1/2} \geq S_y$? $\quad 10155 < 37500$

@ Gen- Grid

$$\varepsilon_{d_{max}} = \frac{1+0.3}{3(30\times10^6)}(3444)^2 = 0.17$$

$$\varepsilon_{d_{min}} = \frac{1.3}{90\times10^6}(3404)^2 = 0.17$$

$$\varepsilon_{d_m} = \frac{1.3}{90\times10^6}(1722)^2 = 0.043$$

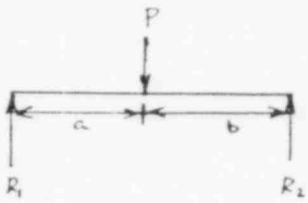
I $\left[\frac{3(30\times10^6)}{1+0.3}\right]^{\frac{1}{2}}\left[(.17)^{1/2}-2(.17)^{1/2}\right] \geq S_y$? $-3431 < 37500$ ok

II $\left[\frac{90\times10^6}{1.3}\right]^{1/2}\left[(.17)^{1/2}-(.043)^{1/2}\right] \geq S_e$? $1705 < 26250$ ok

III $\left[\frac{90\times10^6}{1.3}\right]^{\frac{1}{2}}\left[(.17)^{1/2}-(.043)^{1/2}\left(1-\frac{26250}{75000}\right)\right] \geq S_e$? $2310 < 26250$ ok

IV $\left[\frac{90\times10^6}{1.3}\right]^{\frac{1}{2}}(.17)^{1/2} \geq S_y$? $3431 < 37500$ ok

Dynamic lateral loads



At center of windings:

$P = 30560$ lbf

$a = 52.75"$

$b = (D-c) = 46.0"$

$\gamma = 52.75"$

$l = D = 98.75$

$\alpha = \frac{c}{l} = \frac{52.75}{98.75} \quad .53$

$\beta = \frac{b}{l} = \frac{46.0}{98.75} \quad .47$

$\xi = \frac{x}{l} = \frac{52.75}{98.75} \quad .53$

$I = \frac{1}{4}\pi (9.438)^4 = 6232$

$$EI\omega = \frac{Pl^3}{6}(\beta - \xi)(\alpha[1+\beta] - \xi^2)$$

$$= \frac{(30560)(98.75)}{6}(.47)(.53)[.53(1+.47) - .53^2]$$

$$= 6.1 \times 10^8$$

$$\omega = \frac{6.1 \times 10^8}{(30 \times 10^6)(6232)} = .0033"$$

@ Flywheel

$P = 4074$ lbf

$a = B = 15.25$

$b = (D - B) = 83.5$

$\gamma = C = 52.75$

$l = 97.75$

$\alpha = \frac{a}{l} = \frac{15.25}{97.75} = .155$

$\beta = \frac{b}{l} = \frac{83.5}{97.75} = .85$

$\gamma = \frac{x}{l} = \frac{52.75}{97.75} = .53$

$I = 6236$ (use of windings)

Total deflection

$$EIw = \frac{P l^3}{6}(\alpha)(1-\gamma)[\gamma(2-\gamma) - \alpha^2]$$

$$= \frac{4074(97.73)^3}{6}(.155)(1-.53)[.53(2-.53) - .155^2] =$$

$$= 3.60 \times 10^7$$

$$w = \frac{3.6 \times 10^7}{(30 \times 10^6)(6236)} = .0002$$

Total deflection at center of windings

$.0033 + .0002 = .0035"$

Dynamic load due to magnetic pull

$P = 14{,}000\ lb_f$ at $\frac{1}{32}"$ displacement $= 448000\ lb/in$

Force due to static offset

$F_s = 448{,}000\ (.0035) = 1568\ lb$

Dynamic load due to mass imbalance

$F_m = m(e+u)\omega^2$ where m = mass of windings
e = mass cg offset
u = static defl.
ω = rot. speed rad/sec

$m = \frac{25000}{386.4} = 64.7\ lb\text{-}sec^2/in$
$e = .010$ conservative assumption
$u = .0035$
$\omega = 47.12$ rad/sec

$F_m = 64.7(.010 + .0035)(47.12)^2$
$= 1939\ lb$

Total Dynamic load - approx:

Load $= F_m + F_s = 1568 + 1939 = 3507\ lb$

Gen weight $= 30560\ lb$

$\% \frac{\text{Dyn. load}}{\text{Gen weight}} = \frac{3507}{30560} = 12\%$

The generator shaft material was confirmed to be the same as that used at Shoreham and Comanche Peak (ASTM-CC8-class D). ref. phone conversation between Craig Vogler, FaAA and Bob Klasnem of Portec. Actual shaft weight = 5760

The calculated values for bearing reactions and moments at the flywheel and rotor centerline was checked against those computed by the TDI Torsional Analysis. The comparison is given below

		Calc. Value		TDI Value	
Generator bearing	R_2	17008	lbf	16807	lbf
Crankshaft bearing	R_1	18316	lbf	18314	lbf
Moment at Flywheel ℄	M_1	305518	lbf-in	273756	lbf-in
Moment at Rotor ℄	M_2	782413	lbf-in	730314	lbf-in

The conservative factors of safety calculated for the generator shaft for static and fatigue failure indicate the shaft is acceptable for its intended use.

ITEM 2 TDI TORSIONAL ANALYSIS FOR RIVER BEND DIESEL GENERATOR BY ROLAND YANG.

P.1/4

TORSIONAL AND LATERAL CRITICAL SPEED ANALYSIS

ENGINE NUMBERS 74039/42

DELAVAL-ENTERPRISE ENGINE MODEL DSR-48

3500 KW/4889 BHP AT 450 RPM

FOR

STONE & WEBSTER ENGINEERING CORP.

GULF STATES UTILITIES

DELAVAL ENGINE & COMPRESSOR DIVISION
550 - 85TH AVENUE
OAKLAND, CALIFORNIA 94621

REGISTERED PROFESSIONAL ENGINEER
2940
STATE OF CALIFORNIA

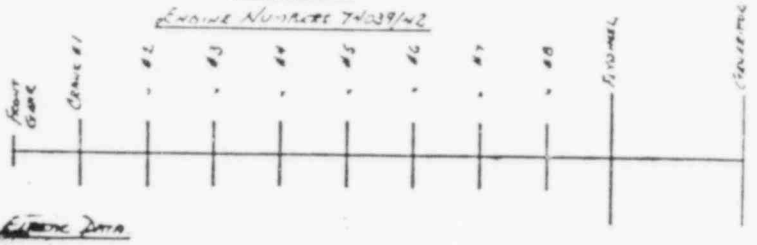
John J Barich Jr

By: Roland Yang
March 5, 1975

Revision - May 4, 1977

P.2/

GULF STATES UTILITIES COMPANY
DE LAVAL ENTERPRISE 12 N-8
3500 KW (4689 BHP) @ 450 RPM
225.6 RMEP
ENGINE NUMBERS 74039/42

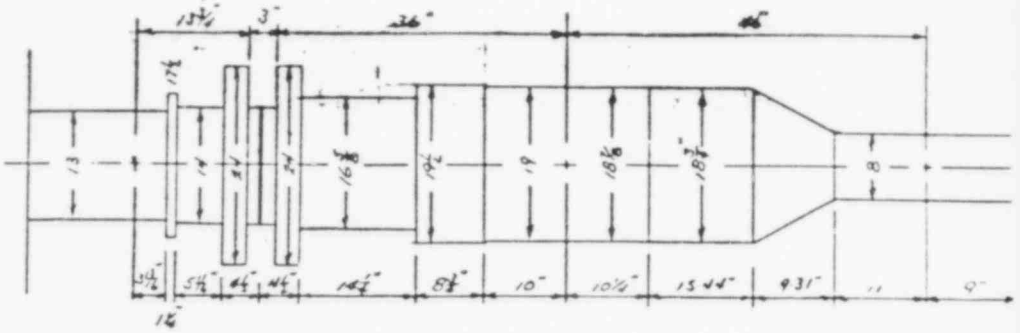


ROTATING DATA

CRANKSHAFT GEAR	26.52	
WATER PUMP GEAR	63.10	
CAM & IDLER	119.70	
SHAFT	96.-	
	218.95 LB. FT²	I = 6805 LB. FT. SEC²
CRANK No. 1		
CRANK	1541.85	
SHAFT	141.81	
	1383.66	I = 49.222 LB. FT. SEC²
CRANK No. 2 TO 7		
JOURNAL	43.130	
PIN	202.170	
2 WEBS	679.81	
ROTAT. WT.	309.99	
ROTAT. WT.	306.75	
	1541.86 LB. FT²	I = 47.922 LB. FT. SEC²
CRANK No. 8		
CRANK	1641.85	
SHAFT	71.63	
	[illegible] LB. FT²	I = 50.149 LB. FT. SEC²
CRANKSHAFT FLANGE	855.08	
FLYWHEEL [illegible]	13068	
GENERATOR SHAFT FLANGE	400	
	13723.48 LB. FT²	I = 426.527 LB. FT. SEC²
GENERATOR ROTOR	160100 LB. FT²	I = 4976.067 LB. FT. SEC²
TOTAL	187820 LB. FT²	

EQUIVALENT LENGTHS Dia 1

FRONT GEAR TO CRANK No 1	·001661	K = 58.121 ×10⁶ FT-LB/RAD
BETWEEN CRANKS	·001392	K = 69.32 ×10⁶ "
CRANK No 8 TO FLYWHEEL	·001224	K = 78.941 ×10⁶ "
FLYWHEEL TO GENERATOR		



$$L_2 = \frac{3 \cdot 047 \times 16.625}{20"} + \frac{\cdot 047 \times 16.625 + 14.25 \times \cdot 939 \times 16.625}{16.625"} + \frac{\cdot 939 \times 16.625 - \cdot 0065 \times 19 \times 8.75}{19.5"}$$

$$+ \frac{\cdot 0065 \times 19 \times 9}{19"}$$

$$= \cdot 0000138 + \cdot 00020525 + \cdot 0000518 + \cdot 00003760 = \cdot 00031170" \quad K = 309.72 \times 10^6 \text{ FT-LB/RAD}$$

SHAFT DIAMETERS

FRONT GEAR TO CYL. No 1	8"
CRANKPIN	12"
CYL. No 8 TO FLYWHEEL	12"
GENERATOR SHAFT	16⅞"

WEIGHTS

FLYWHEEL	3589 LB
GEAR & GENERATOR ROTOR	2500 LB

TORSIONAL NATURAL FREQUENCIES :-

N_1	2277 VPM
N_2	6421 "
N_3	8792 "

LATERAL NATURAL FREQUENCY OF GENERATOR SHAFT = 2880 VPM

ELECTRICAL NATURAL FREQUENCY = $\frac{35200}{\sqrt{16620 \times 68}}$ = ...

ELECTRICAL NATURAL FREQUENCY = $\frac{33200}{W}\sqrt{\frac{W}{166.2+48}}$

SIMPSON 05/04/77

2.875000E+01

left reaction = -18314.
right reaction = -16807.

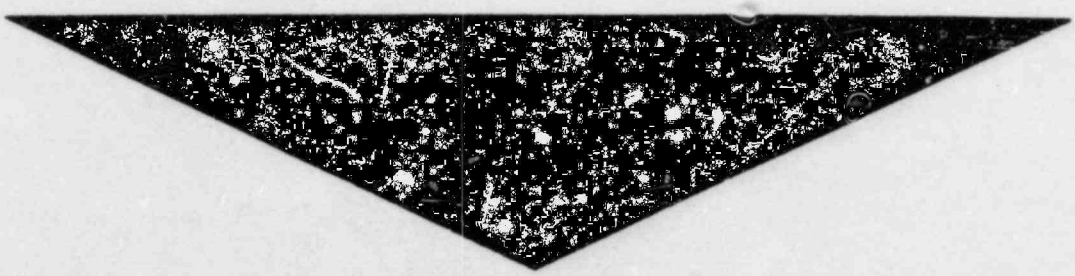
delta	dia	weight	inertia	shear	moment	slope	defl
0.	0.	0.	0.	18314.1	0.	0.000142	0.
3.812	13.000	143.2	1402.0	18170.9	69550.	0.000139	0.000538
1.250	13.000	47.0	1402.0	18124.0	92234.	0.000137	0.000713
5.687	14.000	247.8	1885.7	17876.2	194609.	0.000122	0.001451
4.500	24.000	576.1	16286.0	17300.1	273756.	0.000120	0.001997
0.	0.	3589.0	16286.0	13711.1	273756.	0.000120	0.001997
4.500	24.000	576.1	16286.0	13135.0	334160.	0.000117	0.002531
7.125	16.625	437.7	3749.9	12697.2	426187.	0.000093	0.003244
7.125	16.625	437.7	3749.9	12259.5	515095.	0.000063	0.003845
4.750	19.500	401.5	7097.5	11858.1	572375.	0.000051	0.004114
4.000	19.500	338.1	7097.5	11520.0	619131.	0.000040	0.004331
10.300	19.000	802.4	6397.1	10717.6	730319.	0.000005	0.004543
0.	0.	25000.0	6397.1	-14282.4	730319.	0.000005	0.004543
10.250	16.875	811.7	6230.4	-15094.0	579765.	-0.000031	0.004397
5.440	16.750	425.1	6067.0	-15519.1	496497.	-0.000047	0.004178
5.000	16.750	390.7	6067.0	-15909.8	417925.	-0.000063	0.003978
5.000	16.750	390.7	6067.0	-16300.5	337399.	-0.000078	0.003783
4.310	13.000	349.7	1402.0	-16650.2	184013.	-0.000128	0.003245
11.000	6.000	156.5	201.1	-16806.7	-0.	-0.000206	-0.000000

lateral frequency by raleigh's method = 2880.

PROGRAM STOP AT 1088

USED 11.83 UNITS

ITEM 3 TORQUE EXCURSIONS BETWEEN THE FLYWHEEL TO GENERATOR AND GENERATOR TO GRID FOR RIVER BEND.



MEMORANDUM

TO: Craig Vogler

FROM: Lisa Shusto

DATE: November 7, 1984

RE: TORQUE EXCURSIONS BETWEEN THE FLYWHEEL TO GENERATOR AND GENERATOR TO GRID ON REMAINING CRANKSHAFTS IN DR/QR PROGRAM

The available data on torque excursions between the Flywheel and generator and the generator and grid for the remaining plants in the DR/QR program are listed in Table I.

If you have any questions, feel free to call me.

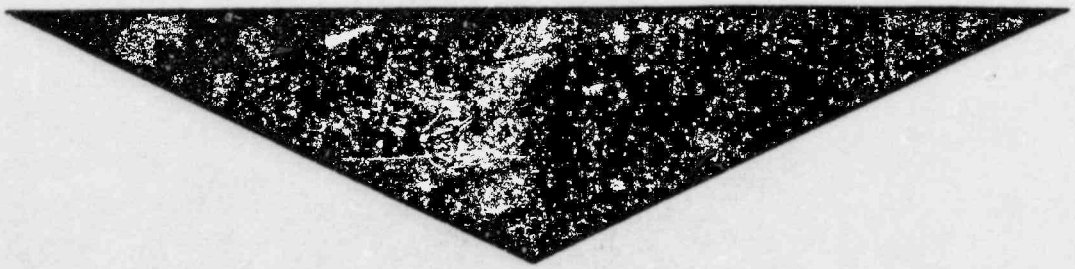
LMS/gg

TABLE I

Plant	Torque Values Between Flywheel & Generator (ft-lbs) maximum	minimum	Torque Values Between Generator & Grid (ft-lbs) maximum	minimum	QA
River Bend	2.166 E5	-1.088 E5	5.588 E4	5.345 E4	SP84-6-10(g)
Rancho Seco	1.840 E5	-7.434 E4	5.625 E4	5.290 E4	SP84-6-10(h)
Vogtle	2.558 E5	-3.530 E4	1.096 E5	1.096 E5	*
Perry	2.620 E5	-2.971 E4	1.105 E5	1.088 E5	*
WNP-1	ANALYSIS TO BE PERFORMED AT A LATER DATE				*
Bellafonte	ANALYSIS TO BE PERFORMED AT A LATER DATE				*

*QA not complete. To be supplied in appropriate DR Support Package

ITEM 4 TELEPHONE MEMORANDUM: CRAIG VOGLER, FaAA AND BOB KLASHEM, PORTEC.



P. 1/1

J.O. No. _____

TDI OWNER'S GROUP

TELEPHONE MEMORANDUM

CALL DATE 11-22-94 TIME 2:30 AM/PM INCOMING - OUTGOING

BETWEEN Craig Kogler OF UTILITY Failure Analysis Associates

AND Bob Klabon OF Portec

SUBJECT: Material specifications for TVA Bellefonte and GSU River Bend

DESCRIPTION:

for S.O. 1751055 - Bellefonte Material: ASTM A668 class D

weight - shaft: 7472 lbs

rotor windage 37347 lbs

for S.O. 1740842 - River Bend Material ASTM A668 class D

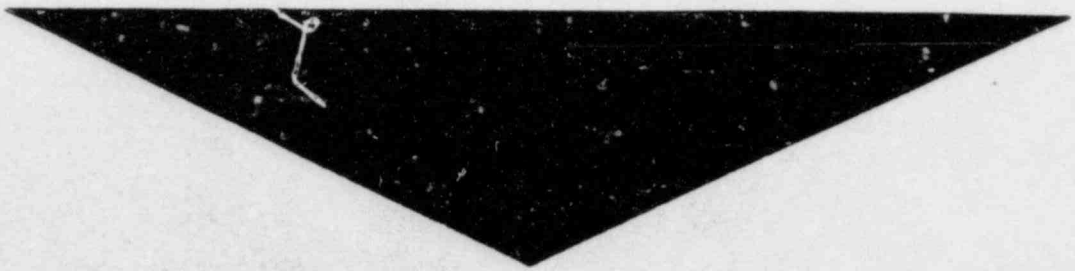
weight - shaft: 5760 lbs

rotor windage = 25000 lbs

ACTION: unbalanced magnetic pull @ 2/3" = 14,400 lbs

FOLLOW UP:

ITEM 5 TELEPHONE MEMORANDUM: CRAIG VOGLER, FaAA AND WALTER MEACHAM, FaAA.



J.O. No. _____

TDI OWNER'S GROUP

TELEPHONE MEMORANDUM

CALL DATE 11-19-94 TIME 11:30 AM/PM INCOMING _____ OUTGOING _____

BETWEEN Craig Vegler OF FaAA - Charlotte

AND Walter Measham OF FaAA, Phoenix office

SUBJECT: 8" diameter Sleevoil bearing

DESCRIPTION: The 8" Sleevoil Bearing has the following dimensions:

Vertical : 8.010 - 8.014

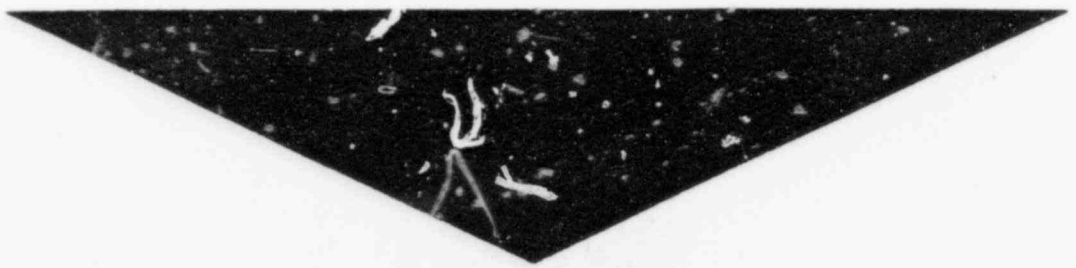
Horizontal : 8.018 - 8.022

Length 16 inch

ACTION: _____

FOLLOW UP: _____

ITEM 6 ASTM A-668 CLASS D MATERIAL SPECIFICATION.



Designation: A 668 – 72

American National Standard G55.2 : 274
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By American National Standards Institute

Standard Specification for STEEL FORGINGS, CARBON AND ALLOY, FOR GENERAL INDUSTRIAL USE[1]

This Standard is issued under the fixed designation A 668; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 This specification covers untreated and heat-treated carbon and alloy steel forgings for general industrial use. Other ASTM specifications for forgings are available for specific applications such as pressure vessels, railroad use, turbine generators, gearing, and others involving special temperature requirements.

1.2 Six classes of carbon steel and seven classes of alloy steel forgings are listed in Table 1, which indicates their required heat treatments, as well as mechanical properties.

1.3 Supplementary requirements of an optional nature are provided. These shall apply only when specified by the purchaser.

1.4 The appendix lists the grades corresponding to the various grades of the superseded ASTM Specifications A 235, A 237, and A 243.

NOTE—The values stated in U.S. customary units are to be regarded as the standard.

2. Applicable Documents

2.1 *ASTM Standards:*

A 275, Methods for Magnetic Particle Examination of Steel Forgings[2]

A 317, Methods for Macroetch Testing and Inspection of Steel Forgings[2]

A 370, Methods and Definitions for Mechanical Testing of Steel Products[3]

A 388, Recommended Practices for Ultrasonic Examination of Heavy Steel Forgings[2]

A 509, Definition of a Steel Forging[2]

E 30, Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron[4]

E 44, Definitions of Terms Relating to Heat Treatment of Metals[5]

3. Descriptions of Terms

3.1 *a ring-shaped or a disk-shaped forging*—forging whose length, as measured on its longitudinal axis, is less than its diameter or main transverse dimension is considered a ring or disk within the meaning of this specification.

3.2 *a ring-shaped forging*—forging whose length, as measured on its longitudinal axis, is more than its diameter shall be considered as a hollow cylinder within the scope of this specification if it has been lengthened by extrusion or forged in a manner similar to that of a ring, namely, expanded in diameter on a mandrel.

4. Basis of Purchase

4.1 When this specification is to be applied to an inquiry, contract, or order, the purchaser shall furnish the following information:

4.1.1 The class of forging desired as listed in Table 1,

4.1.2 The options which may be selected as found in 5.4.2, 6.1.2, 7.3, and 13.1, and

4.1.3 Applicable supplementary requirements.

5. Manufacture

5.1 *Melting Process*—The steel shall be made by the open-hearth, basic-oxygen, or

[1] This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel and Related Alloys, and is the direct responsibility of Subcommittee A01.06 on Steel Forgings and Billets.

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[2] Annual Book of ASTM Standards, Part 5.

[3] Annual Book of ASTM Standards, Parts 1, 2, 3, 4, 5, and 10.

[4] Annual Book of ASTM Standards, Part 32.

[5] Annual Book of ASTM Standards, Parts 2 and 10.

electric-furnace process.

5.2 *Discard*—Sufficient discard shall be made from each ingot to secure freedom from piping and undue segregation.

5.3 *Forging Process*—The forgings shall receive their hot mechanical work under a press, a hammer, or in a ring rolling mill, each of ample power to work the metal uniformly throughout its section. The forging shall be brought as close as practical to finished shape and size by hot mechanical work.

5.3.1 After forging and before reheating for heat treatment, the forgings shall be allowed to cool in a manner to prevent injury and to accomplish transformation.

5.4 *Heat Treatment*

5.4.1 All forgings, other than Class V, shall be heat treated as shown in Table 3.

5.4.2 Where options exist within a class, the choice of heat treatment shall be left to the discretion of the manufacturer, unless the purchaser specifies one of the available options.

6. Chemical Requirements

6.1 *Chemical Composition*

6.1.1 The steel shall conform to the requirements for chemical composition prescribed in Table 1.

6.1.2 The choice of chemical composition is left to the discretion of the manufacturer, unless otherwise specified by the purchaser.

6.2 *Heat Analysis*

6.2.1 An analysis of each heat shall be made by the manufacturer. When possible, the test sample shall be taken during the pouring of the heat. If the test sample is lost or declared inadequate for chemical determinations, the manufacturer may take alternative samples from locations near the surface of an ingot or bloom, as necessary to establish the analysis.

6.2.2 In the case of large ingots poured from two or more heats, the weighted average of the chemical determinations of the several heats shall conform to the requirements specified in Table 1 or by agreement (see 6.1.2).

6.3 *Product Analysis*—An analysis may be made by the purchaser from a forging representing each heat, or multiple heat if made in accordance with 6.2.2. Samples for analysis may be taken from the forging, or from a full-size prolongation at any point from the midradius to the outside diameter in the case of disk or solid forgings, or midway between the inner and outer surfaces of hollow forgings or rings, or from a test specimen. The chemical composition thus determined shall not vary from the requirements specified in Table 1 or agreed upon (see 6.1.2) by more than the amounts prescribed in Table 2.

7. Mechanical Requirements

7.1 *Tensile Requirements*

7.1.1 The material shall conform to the tensile properties prescribed in Table 3.

7.1.2 Tensile specimens shall be machined to the form and dimensions of Fig. 5 of Specification A 370 and shall be tested in accordance with the latest issue of Specification A 370.

7.1.3 *Size Classification* (see *Table 3*)

7.1.3.1 *Solid Forgings*—The nominal or specified rough machined diameter or thickness of solid forgings, disregarding large ends, collars, flanges, and journals shall determine the size classification. Where there are several sections of equal length but of different diameters, the largest diameter shall apply.

7.1.3.2 *Ring or Hollow Cylinder Forgings*—The size classification shall be determined by its nominal or specified rough machined thickness or width, whichever is the smaller dimension. The thickness shall be measured by the difference between the outside and inside radii. The width shall be measured parallel to the axis of the ring or hollow cylinder.

7.1.4 *Number of Tests*—Unless the purchaser specifies that forgings shall be furnished in accordance with the requirements of 7.3, the number of tension tests performed shall be as follows:

7.1.4.1 For all classes of heat-treated forgings with rough machined weights less than 5000 lb (2270 kg) each, one test shall be made from each size classification represented in each heat in each annealing or normalizing charge, or from each size classification in each heat in each normalizing or quenching charge represented in each tempering charge. For untreated forgings (Class V) weighing less than

5000 lb each, one test from each heat shall be made.

7.1.4.2 On all classes, for forgings with rough machined weights of 5000 lb or more, at least one test from each forging shall be made.

7.1.4.3 On all classes, for forgings with rough machined weights of 7000 lb (3180 kg) or more, two tests will be taken, on ring and disk forgings 180 deg apart; on shafts and long hollow cylinders, one from each end and offset 180 deg.

7.1.4.4 When forgings are made in multiple as a single forging, that is, forged as one piece and divided after heat treatment, the multiple forging shall be considered as one forging, and the number of tests required shall be as designated in 7.1.4.1, 7.1.4.2, and 7.1.4.3.

7.1.5 *Prolongations*:

7.1.5.1 A sufficient number of the forgings shall have prolongations for extracting specimens for testing. Locations of test specimens for various types of forgings shall be as shown in Fig. 1.

7.1.5.2 The nominal or principal outside rough machine diameter or thickness of the forgings, disregarding large ends, collars, flanges, and journals shall determine the size of the prolongations for test specimens, however, the prolongations on annealed, normalized, or normalized and tempered shafts may be extensions of the small diameter end of the shaft, as shown in Fig. 1.

7.1.5.3 For quenched forgings in Classes J, K, L, M, and N, the prolongations shall be sufficiently long so that the center of the gage length (for longitudinal specimens) or axis (for tangential specimens) of the tension test specimen shall be at the following locations.

7.1.5.4 On solid shafts, bars, rotors, or billets (see Fig. 1(*a*)), at midradius and from the end, 3½ in. (89 mm) or ¼ the diameter or thickness, whichever is less.

7.1.5.5 On hollow forgings (see Fig. 1(*b*)), at midwall and from the end, 3½ in. or ¼ the wall thickness, whichever is less.

7.1.5.6 On disk forgings (see Fig. 1(*c*)) (with prolongation on OD), at midthickness and from the OD 3½ in. or ¼ the thickness, whichever is less.

7.1.5.7 On disk forgings (see Fig. 1(*c*)) (with prolongation on the width or thickness) 3½ in. or ¼ the thickness, whichever is less, from any heat treated surface.

7.1.5.8 On ring forgings (see Fig. 1(*d*)) (with prolongation on width), at midwall and from the ring face 3½ in. or ¼ the wall thickness, whichever is less.

7.1.5.9 On ring forgings (see Fig. 1(*d*)) (with prolongation on the OD), at midwidth and from the OD 3½ in. or ¼ the width, whichever is less.

7.1.5.10 In place of prolongations, the manufacturer may elect to submit an extra forging(s) to represent each test lot; in this event, the representative forging must be made from the same heat of steel, have received the same reduction and type of hot working, be of the same nominal thickness, and have been heat treated in the same furnace charge as the forging(s) it represents.

7.1.6 Tests for acceptance shall be made after final heat treatment of the forgings.

7.1.7 Test specimens shall be parallel to the axis of the forging in the direction in which the metal is most drawn out except that rings, hollow forgings which are expanded, and disks shall be tested in the tangential direction.

7.1.8 Yield point shall be determined on carbon steel Grades A through F, and yield strength on alloy steel Grades G through N. For carbon steel grades not showing a yield point, the yield strength at 0.2 percent offset shall be reported.

7.2 *Hardness Tests*—Brinell hardness tests shall be taken on each forging (for exception, see 7.1.4.4), regardless of weight or class, after final heat treatment and rough machining.

7.2.1 The average value of the hardness readings on each forging shall fall within the hardness ranges specified in Table 3. The permissible variation in hardness in any forging shall not exceed 30 HB for Classes A through E, 40 HB for Classes F through J, 50 HB for Classes K through N.

7.2.2 At least two hardness tests shall be taken on each flat face of disks and rings approximately at midradius and 180 deg apart, for example, at the 3:00 and 9:00 positions on one face, and 6:00 and 12:00 positions on the opposite face. On solid forgings, at least four

tests shall be taken on the periphery of the forging, two at each end 180 deg apart.

7.3 If so specified by the purchaser, forgings may be supplied on the basis of hardness tests alone. If this option is exercised, the class shall be identified with the letter "H," that is, "AH," "BH," "CH," etc.

8. Retests

8.1 If the mechanical test results of any test lot do not conform to the requirements specified because of flaw development in the test specimen during testing, a retest shall be allowed if the defect is not caused by ruptures, cracks, or flakes in the steel.

9. Retreatment

9.1 When heat treated forgings are specified, and the mechanical test results of any test lot do not conform to the requirements specified, the manufacturer may retreat the lot not more than three additional times, and retests shall be made according to 7.2.

9.2 When untreated forgings (Class A) are specified, and the mechanical test results of any test lot do not conform to the requirements specified, the manufacturer may anneal, normalize, or normalize and temper, one or more times, but not more than three times, and retests shall be made in accordance with 7.2. The tensile properties shall conform to the requirements for the class of forgings ordered (Class A).

10. Dimensions and Tolerances

10.1 The forgings shall conform to the dimensions and tolerances specified on the purchaser's drawing or order.

11. Finish and Appearance

11.1 The forgings shall conform to the finish specified on the purchaser's drawing or shall otherwise have a good workmanlike appearance.

12. Marking

12.1 Each forging shall be legibly stamped by the manufacturer with the manufacturer's name or trademark, the manufacturer's serial number, the specification identification number, followed by the appropriate class number and, where applicable, an SAE Grade designation.

12.2 The type of stamps to be used shall be round, nosed or "interrupted dot," the stamps having a minimum radius of $\frac{1}{32}$ in. (0.79 mm).

13. Inspection

13.1 The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that the material is being furnished in accordance with the specification. Mill inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations. All tests and inspections, except product analyses, shall be made at the place of manufacture, unless otherwise agreed to.

14. Certification and Reports

14.1 The mill shall furnish to its reports to the purchaser with the following information:

14.1.1 Chemical analysis,

14.1.2 Heat treatment,

14.1.3 Results of tests for mechanical properties or hardness, or both, and

14.1.4 The results of any required supplementary tests.

15. Rejection

15.1 Any forging having injurious defects observed prior to or subsequent to acceptance at the manufacturer's plant shall be subject to rejection.

15.2 Samples tested by the purchaser in accordance with 6.3 that represent rejected material shall be preserved for 60 days from the date of the rejection report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for rehearing within that time.

SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, and order. Details of these supplementary requirements shall be agreed upon by the manufacturer and the purchaser.

S1. Chemical Composition

S1.1 The supplier shall obtain approval of the grade of steel he proposes to apply to the order and reach agreement with the purchaser on the ranges of each element specified in the composition.

S2. Special Forging Techniques

S2.1 Special Forging Techniques are required to produce metal flow during the hot working operation in the direction most favorable for resisting the stresses encountered in service. Verification of forging flow lines shall be by macro-etch testing of sample forgings in accordance with Method A 317.

S3. Rough Turning and Boring

S3.1 The position of any rough turning or boring in the sequence of manufacturing operations.

S4. Carbon Content for Welding

S4.1 For forgings intended for welding, the carbon content (product analysis) shall be limited to 0.35 max percent.

S5. Bend Tests

S5.1 The test specimen shall withstand being bent at room temperature through 180 deg without cracking on the outside of the bent portion of an inside diameter of 1" in (38 mm).

S6. Magnetic Particle Test

S6.1 Forgings shall be magnetic particle tested in accordance with the latest issue of Methods A 275.

S7. Ultrasonic Test

S7.1 Forgings shall be ultrasonically tested in accordance with the latest issue of Recommended Practice A 388.

S8. Vacuum Treatment

S8.1 Vacuum degassed steel shall be supplied.

S9. Tensile Requirements

S9.1 When sizes larger than permitted in Table 3 are required, ductility values may be reduced from the specified values.

S10. Heat Treatment

S10.1 A minimum tempering temperature shall be specified.

S11. Additional Tests

S11.1 Tests in addition to those prescribed in Section 7 may be specified.

S12. Additional Marking

S12.1 Additional identification marking or the locations of the stamping or both may be specified.

TABLE 1 Chemical Requirements

Elements	Composition, max percent	
	Classes A to E and XH to EH	Classes G to N and GH to NH
Manganese	1.10	
Phosphorus	0.030	0.040
Sulfur	0.030	0.040

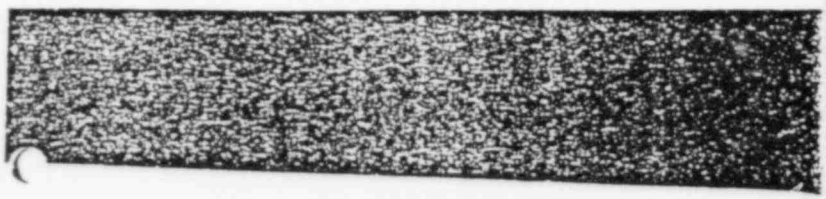

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TABLE 2 Permissible Variations in Product Analysis

Element	Permissible Variation Over the Maximum or Under the Minimum Limit Specified, Percent by Weight of Heat Analysis		
	5000 lb (2300 kg) and under	Over 5000 to 17 000 lb (2300 to 7800 kg), incl	Over 17 000 lb (7800 kg)
Carbon	0.02	0.03	0.04
Manganese	0.04	0.06	0.08
Phosphorus	0.010	0.010	0.015
Sulfur	0.010	0.010	0.015
Silicon	0.03	0.04	0.05
Nickel	0.07	0.07	0.07
Chromium	0.04	0.05	0.06
Molybdenum	0.03	0.04	0.05
Vanadium	0.01	0.01	0.02

TABLE 1 Tensile Requirements

Class	Size or Thickness		Tensile Strength, min		Yield Point, Yield Strength or Proof Stress, min		Elongation in 2 in. or 50 mm, min, %	Reduction of Area, min, per cent	Brinell Hardness
	Over	Not Over	psi	MPa	psi	MPa			
Carbon Steel									
A (Bolts) uncoated		3/4 (19)	47 000	325					
	3/4 (19)	1 1/2 (38)	45 000						137 max
B (Bolts) uncoated or mechanically or mechanically and temperately		3/4 (19)	60 000	415	30 000	205	24	36	137 183
C (Bolts) uncoated or mechanically or mechanically and temperately	1/2 (13)	1 1/2 (38)	60 000	415	33 000	230	23	36	137 183
		3/4 (19)	55 000	380	33 000	230	22	34	137 183
D (Bolts) Normalized, annealed or mechanically and temperately		1 1/2 (38)	55 000	380					
	1/2 (13)	1 (25)	75 000	515	37 500	260	24	40	149 207
	1 (25)	2 1/2 (64)	74 000	510	37 500	260	22	35	149 207
	2 1/2 (64)	3 (76)	70 000	485	37 500	260	20	30	149 207
		4 (102)	70 000	485	35 000	240	18	30	149 207
E (Bolts) Quenched and tempered		1 1/2 (38)	105 000	725	81 000	560	16	50	212 285
	1/2 (13)	2 1/2 (64)	105 000	725	85 000	585	14	45	174 235
	2 1/2 (64)	3 (76)	95 000	655	85 000	585	14	45	174 235
F (Bolts) Quenched and tempered, or mechanically quenched and temperately		4 (102)	95 000	655	85 000	585	14	45	174 235
	1/2 (13)	1 (25)	105 000	725	92 000	635	20	50	187 235
	1 (25)	1 1/2 (38)	95 000	655	85 000	585	20	50	174 235
	1 1/2 (38)	2 1/2 (64)	92 000	635	85 000	585	18	45	174 235
					85 000	585	18	45	174 235
Alloy Steel									
G (Bolts) Uncoated or mechanically or mechanically and temperately	1/2 (13)	1 1/2 (38)	90 000	620	78 000	540	20	50	183 255
		2 1/2 (64)	90 000	620	90 000	620	18	45	183 255
H (Bolts) Normalized and temperately	1 (25)	1 1/2 (38)	90 000	620	90 000	620	18	45	187 235
		2 1/2 (64)	90 000	620	75 000	515	20	50	187 235
J (Bolts) Normalized and tempered, or mechanically quenched and temperately	1 (25)	1 1/2 (38)	90 000	620	78 000	485	20	50	187 235
		2 1/2 (64)	90 000	620	65 000	450	20	50	187 235

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TABLE 3—*continued*

Class	Size of rivets		Tensile Strength		Total Proof Load Stress (Tensile Area)		Tensile Proof Load	Reduction of Area min. per cent	Hardness
	Over	Not Over	Psi	MPa	Psi	MPa	Pounds (Newtons)		
8.8 Hot-formed unalloyed steel rivets	7/16in	5/8in	120 000	830	90 000	620	7 070	35	241 to 321 HB
	5/8in	1in	110 000	760	80 000	550	15 700		
8.8 Hot-formed quenched and tempered steel rivets	4mm(?)	7mm(?)	120 000	830	100 000	690	2 200	35	241 to 321 HB
	7mm(?)	16mm(?)	110 000	760	90 000	620	6 280		
	16mm(?)	36mm(?)	100 000	690	80 000	550	15 700		
10.9 Hot-formed quenched and tempered steel rivets	4mm(?)	7mm(?)	140 000	970	120 000	830	2 640	35	296 to 352 HB
	7mm(?)	16mm(?)	130 000	900	110 000	760	7 540		
	16mm(?)	36mm(?)	120 000	830	100 000	690	18 800		
12.9 Hot-formed quenched and tempered steel rivets	4mm(?)	7mm(?)	170 000	1 170	140 000	970	3 080	35	363 to 429 HB
	7mm(?)	16mm(?)	160 000	1 100	130 000	900	8 790		
	16mm(?)	36mm(?)	140 000	970	120 000	830	21 900		

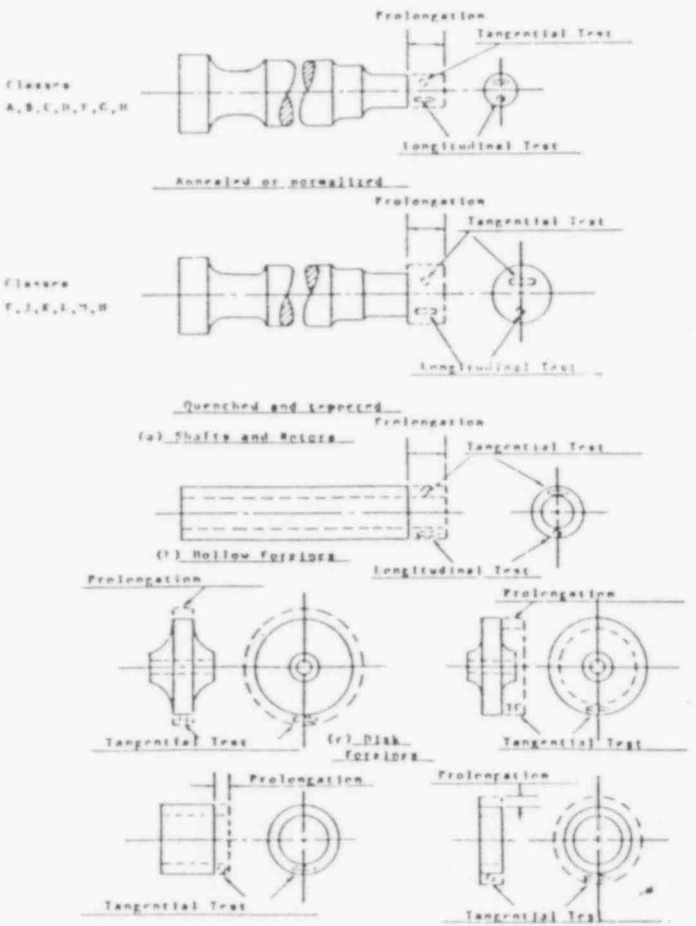

FIG. 1 Locations of Test Specimens for Various Types of Forgings