UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

Generic Task No. A-7

FEB 21 1980

DOCKET NOS.: 50-219, 50-220, 50-237, 50-245, 50-249, 50-254, 50-259, 50-260, 50-263, 50-265, 50-271, 50-277, 50-278, 50-293, 50-296, 50-298, 50-321, 50-324, 50-325, 50-331, 50-333, 50-341, 50-354, 50-355, and 50-366.

LICENSEES: Boston Edison Company, Carolina Power & Light Company, Commonwealth Edison Company, Detroit Edison Company, Georgia Power Company, Iowa Electric Light & Power Company, Jersey Central Power & Light Company, Nebraska Public Power District, Niagara Mohawk Power Corporation, Northeast Nuclear Energy Company, Northern States Power Company, Philadelphia Electric Company, Power Authority of the State of New York, Public Service Electric and Gas, Tennessee Valley Authority, Vermont Yankee Nuclear Power Corporation.

FACILITIES: Oyster Creek Nuclear Generating Station, Nine Mile Point Unit No. 1, Pilgrim Unit No. 1, Dresden Unit Nos. 2 and 3, Millstone Unit No. 1, Quad Cities Unit Nos. 1 and 2, Monticello, Peach Bottom Unit Nos. 2 and 3, Browns Ferry Unit Nos. 1, 2 and 3, Vermont Yankee, Hatch Unit Nos. 1 and 2, Brunswick Unit Nos. 1 and 2, Duane Arnold Energy Center, Cooper, Fitzpatrick, Enrico Fermi Unit No. 2, and Hope Creek Unit Nos. 1 and 2.

SUBJECT: SUMMARY OF MEETING HELD ON FEBRUARY 7, 1980, WITH THE MARK I OWNERS GROUP

On February 7, 1980, the staff met with representatives of the Mark I Owners Group in Bethesda, Maryland, to discuss revisions to the NRC Acceptance Criteria and outstanding issues relative to the Mark I Containment Long Term Program. The attendees of the meeting are listed in Enclosure 1.

~~8008160167~~

The staff described its proposed revisions to the requirements for the plant-unique analyses, which were either clarifications or alternate assessment techniques. These revisions were developed primarily in response to comments raised by the Mark I Owners Group in meetings held on December 19 and 20, 1979, and in a letter from L.J. Sobon, GE, to D.G. Eisenhut, NRC, dated January 7, 1980. These revisions were intended to allow the structural analyst a limited degree of flexibility in the procedures for load definition, while maintaining an equivalent margin for uncertainty consistent with the quality of the test data from which the loads are derived.

The following specific revisions and clarifications were identified:

1. Alternate criteria were added to permit safety-relief valve (SRV) discharge loads to be derived from a series of at least four single valve, first actuation, in-plant discharge tests. The test data would serve to calibrate a coupled load-structure analytical model which could extrapolate to design-basis (e.g., subsequent actuations and multiple-valve discharge) conditions. The maximum amplification of the structural response would be determined from the measured pressure waveforms of both the Monticello and in-plant tests.

2. Alternate criteria were added to permit the froth source velocity and froth density to be defined from the plant-specific QSTF high-speed films. The basic technique is the same as that used to develop the generic load specification.

3. The criteria for the semi-empirically derived SRV discharge loads were amended to establish an upper limit for the peak pressure variation with discharge line volume (65 cubic feet) and to allow a separate uncertainty factor to be specified for global pressure loads on the torus from the Monticello test data. These changes were included to eliminate excessive conservatisms in the analysis technique.

4. With regard to suppression pool temperature limits, criteria were added to describe how in-plant tests should be conducted to determine the bulk to local pool temperature limits, to allow alternate monitoring for local pool temperature, and to specify that procedures or equipment be used to minimize operator actions to determine the limiting pool temperature.

5. The force histories for Type 2 and 3 vent header deflectors were revised to allow for geometric variations specified by the Mark I Owners Group.

6. The criteria were clarified, in that the maximum pool velocity is to be used to determine the drag load following impact. This specification is consistent with the derivation of the drag coefficients used to define the loads.

7. The drag coefficients for cylinders specified for impact on "other" structures and the cylindrical vent header deflectors were revised to be consistent.

8. All references to the staff review of plant-specific loading conditions have been removed from the criteria, because the staff does not intend to review plant-specific load assessments prior to implementation.

The Mark I Owners Group indicated that the alternate criteria for SRV discharge loads derived from in-plant tests were to specific and should only present the objectives of such testing, not the methods to be used. Detailed comments are shown in Enclosure 2. Further, the Mark I Owners Group indicated that an approach similar to that outlined in the alternate criteria had already been tried, unsuccessfully. Both the staff and the Mark I Owners Group agreed that some kind of analytical procedure is need to extrapolate to design-basis events. The staff, however, considers the alternate criteria general enough to allow a flexibility in the method and still specific enough to assure a reasonable load assessment. The staff is opposed to the use of general "knockdown" factors. However, the staff agreed to raise the cited objections to NRC management for a final decision, before the revised criteria are issued.

L.D. Steinert, GE, described two attenuation corrections that must be made to the SRV discharge analytical model; (1) longitudinal attenuation beyond about 50 degrees from the discharge point will be held constant and, (2) circumferential pressure for certain cases must be forced to the airspace pressure at the pool surface. These corrections are shown in Enclosure 3. The staff agreed with the general approach outlined. The methods will be determined later.

N.G. Gunther, GE, described the results of a statistical characterization of an eight valve SRV discharge as compared to a Monte Carlo analysis of the Monticello peak shell pressure measurements. The purpose of this study, as shown in Enclosure 4, was to provide justification for using the square-root-of-the-sum-of-the-squares (SRSS) method for combining SRV multiple valve discharge pressures. The results of this study indicate that at a 90% confidence level, SRSS will bound 88% of the peak positive pressures and 83% of the peak negative pressures. The staff indicated that a similar approach has been under review for the Mark III SRV discharge loads and, because of the complex nature of the phenomena and the mechanistic nature of the analysis, we do not expect this issue to be resolved in the near future.

The staff briefly described the analyses that should be performed for the confirmatory FSTF condensation oscillation tests (Enclosure 5). Additional discussions will be held as the test program progresses.

R.M. Polivka, EDS Nuclear, described the methods used and results of the "snap" tests performed on the FSTF downcomers (Enclosure 6). The Mark I Owners Group indicated that conservative values of the downcomer natural frequency and damping derived from these tests, corresponding to appropriate plant-specific conditions (i.e., tied or untied downcomers and flooded or unflooded downcomers), would be applied to the dynamic load factor scaling for the downcomer condensation loads. The staff considers this approach acceptable.

R. Broman, Bechtel, described the status of the development of downcomer condensation oscillation loads (Enclosure 7). The general procedure to develop a load specification consists of: (1) postulating a hypothetical oscillatory pressure load inside the downcomers, (2) applying the hypothetical load to a structural model of the vent system, and (3) adjusting the hypothetical load until the model predictions match the FSTF vent system response measurements. At this time, the model is insufficiently detailed, because it does not adequately predict the results of the static load test results. The model is being corrected. Once the model has been statically verified, load development will proceed. Results are expected in approximately a month.

C.I. Grimes

C. I. Grimes
A-7 Task Manager

Enclosures:
As stated

ENCLOSURE 1

ATTENDEES

MARK I OWNERS GROUP MEETING

FEBRUARY 7, 1980

NRC/DOR

C I. Grimes
K.R. Wichman
J.R. Fair
E.G. Adensam

NRC/DSS

S. Hou
T.M. Su
J.A. Kudrick

BNL

C. Economos
G. Maise
R. Kosson
G. Bienkowski
A.A. Sonin

GE

G.E. Wade
N.G. Gunther
L.D. Steinert
T.J. Mulford

NUTECH

N.W. Edwards
T.A. Ballard
L.J. Sobon

Bechtel

G.A. Kosi
R. Broman

PECo

R.H. Logue

Teledyne

R.H. Berks

EDS Nuclear

R.M. Polivka

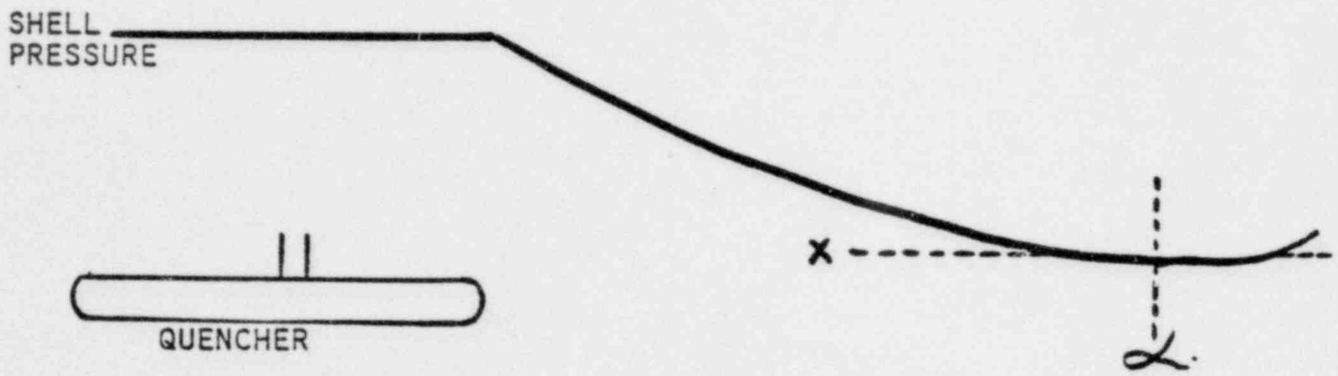
SRV EMPIRICAL APPROACH

- PROBLEMS WITH DRAFT NRC CRITERIA
  - FLUID-STRUCTURE MODELLING (CMM, FSI)
  - MEAUSREMENT OF NATURAL FREQUENCIES & DAMPING
  - MEASUREMENT/ANALYSIS OF COLUMN LOAD ATTENUATION
  - INSTRUMENTATION REQUIREMENTS (PIPING, COLUMNS)
  - GENERIC (MONTICELLO) CALIBRATION VS. PLANT UNIQUE CALIBRATION
  - USE OF WAVEFORM RESPONSE SPECTRA

- PROPOSED CRITERIA
  - STATE OBJECTIVES, NOT METHODS
  - EXTRAPOLATION FROM TEST CONDITIONS TO LDR DESIGN CASES
  - CONSIDER VARIATION IN LOAD AMPLITUDE, FREQUENCY

SRV TORUS SHELL PRESSURE ATTENUATION

SOME PRESSURE PREDICTIONS RESULT IN:



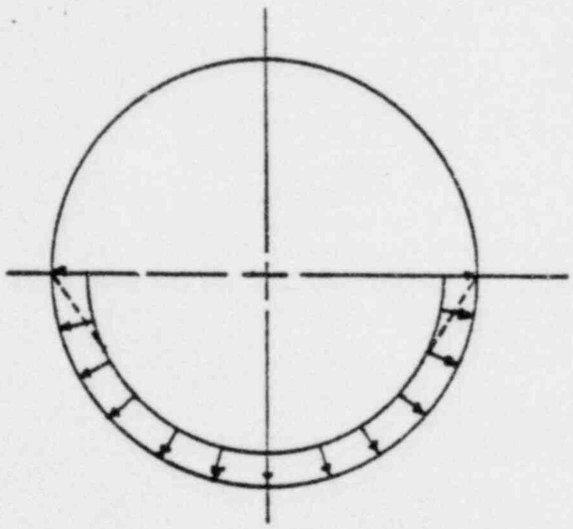
(SEE EQUATION 2-22 NEDE-21878-P)

RESOLUTION: LIMIT PRESSURE TO "X" AT AND BEYOND α

LDS
2/7/80

SRV TORUS SHELL PRESSURE ATTENUATION

PRESSURE PREDICTIONS AT LARGE DISTANCES FROM THE QUENCHER RESULT IN:



(SEE EQUATION 2-23 NEDE-21878-P)

RESOLUTION: ATTENUATE TO ZERO AT WATER SURFACE

LDS
2/7/80

ENCLOSURE 4

SRSS JUSTIFICATION

- COMPARISON OF ANALYSIS BASES
- CONSERVATISMS
- RESULTS - CDF's

N.G.G.
2-7-80

MONTE CARLO BASIS

- EIGHT ADJACENT VALVE "SIMULTANEOUS" ACTUATION
- MONTICELLO SINGLE VALVE TEST DATA

  $P^+ = 5.5 \pm .94$ PSID

  ASSUMED TO CORRESPOND TO 111% ASME RATED FLOW

  — RATIO BETWEEN PEAK POSITIVE AND NEGATIVE PRESSURES ASSUMED CONSTANT

- PHASING

  TARGET ROCK ACTUATION TIME TEST DATA

  $s = 25.34$ MS

  PRESSURE RISE RATE x SET POINT DEVIATION

- DISTRIBUTION

  ACCEPTED QBUBS ANALYTICAL MODEL FOR CIRCUMFERENTIAL ATTENUATION

- STATISTICS

  41 EIGHT VALVE ACTUATIONS: YIELD = 90/94.5

N.G.G.
2-7-80

SRSS BASIS

- MONTICELLO PEAK OBSERVED SHELL PRESSURES

$P^{+} = 6.7$ PSID

TEST 801 RUN 5

- DESIGN CONSERVATISMS

$$SRSS = \sqrt{\left[\frac{(6.7)\ (122.5)}{111.25}\right]^{2} + 2\left[AF \times \frac{(6.7)\ (122.5)}{111.25}\right]^{2}}$$

ATTENUATION FACTOR

N.G.G.
2-7-80

CONSERVATISMS

- EIGHT ADJACENT VALVES
- NO CREDIT FOR

  BUBBLE FREQUENCY

  DL VOLUME
- PHASED PRESSURES NEVER SUBTRACTIVE
- STATISTICS

RESULTS

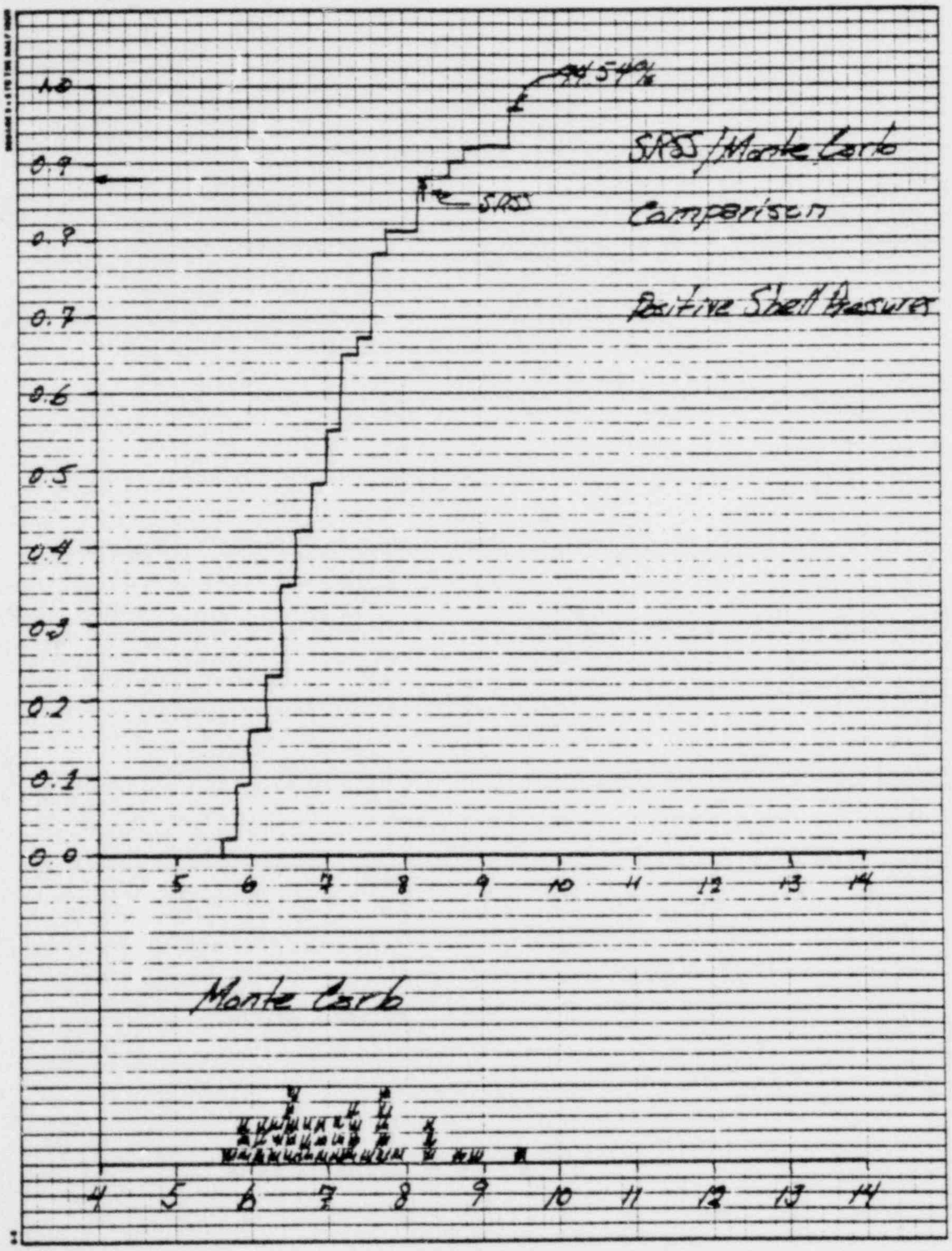
- POSITIVE SHELL PRESSURES

  SRSS Bounds 88% of Monte Carlo Population

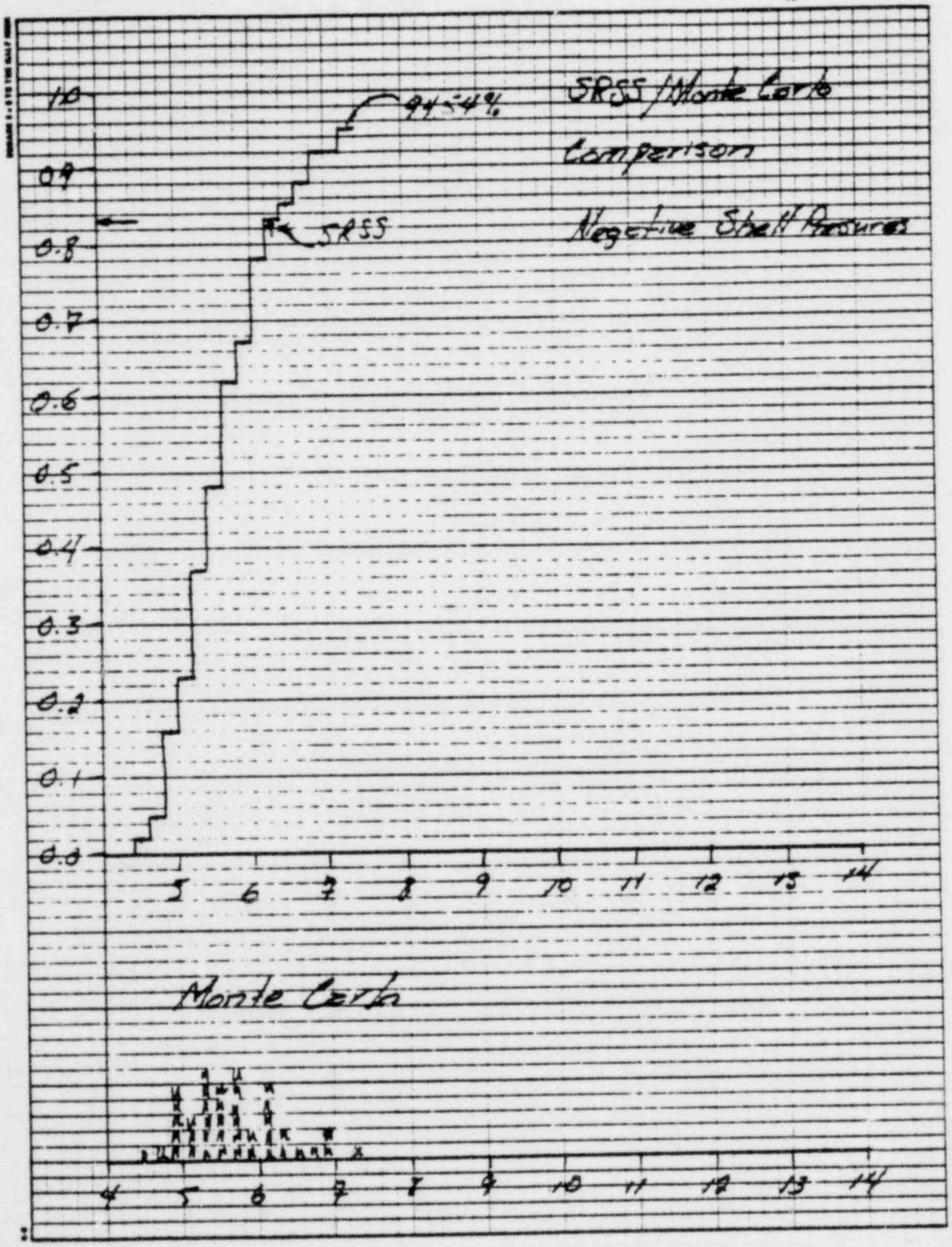
- NEGATIVE SHELL PRESSURES

  SRSS Bounds 83% of Monte Carlo Population

- 90% CONFIDENCE LEVEL



SRSS/Monte Carlo
Comparison
Positive Shell Pressures
SRSS
54%
Monte Carlo
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
4 5 6 7 8 9 10 11 12 13 14


SRSS/Monte Carlo
Comparison
Negative Shell Pressures
94.54%
SRSS
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
5
6
7
8
9
10
11
12
13
14
Monte Carlo
4
5
6
7
8
9
10
11
12
13
14

ENCLOSURE 5

CONFIRMATORY FSTF C/O TESTS

I. DATA ANALYSES

The following analyses should be performed in addition to those originally performed for test M8:

1. To resolve the issue of possible asymmetric loading during C/O, cross-correlations of downcomer pressures between a pair of downcomers and, particularly, between the two downcomers which are furthest from one another along the torus axis, are needed as a function of time phasing. The raw data (p vs. t) used for these correlations should also be provided for visual comparisons.

2. The amplitude and frequency of the net lateral loading on a tied downcomer pair should be presented, in addition to the vertical and horizontal loadings on the individual downcomers.

3. A more comprehensive presentation of the torus wall pressures, with the FSI removed, is needed. (To facilitate comparisons of the load specifications with the data in the FSTF test report.)

II. QUICK-LOOK DATA

The following data are needed to draw quick conclusions from the additional FSTF test series:

1. The test conditions, as presented in Tables 6.2.2-1 and 6.2.2-3 of NEDE-24539-P.

2. The wall pressure measurements at the bottom center of the torus.

3. Simultaneous pressure histories from two "distant" downcomers for visual comparison of the phase shift.

ENCLOSURE 6

SNAP TESTS ON THE FSTF
MARK I DOWNCOMERS

- Test Matrix
- Test Procedure
- Instrumentation
- "Quick-Look" Results
- Conclusions

RMP
2/7/80

FSTF SNAP TEST MATRIX

TEST NO.	D/C PAIR	TIED/UNTIED	DOWNCOMER WATER LEVEL	WETWELL WATER LEVEL
SD1	5 & 6	Untied	Dry	Dry
SD2	7 & 8	Untied	Dry	Dry
1	5 & 6	Untied	Dry ΔP	Flooded
2	7 & 8	Untied	Dry	Flooded
3	5 & 6	Tied	Dry	Flooded
4	7 & 8	Tied	Dry	Flooded
5	5 & 6	Tied	Flooded	Flooded
6	7 & 8	Tied	Flooded	Flooded
7	5 & 6	Tied	Dry	Dry
8	7 & 8	Tied	Dry	Dry

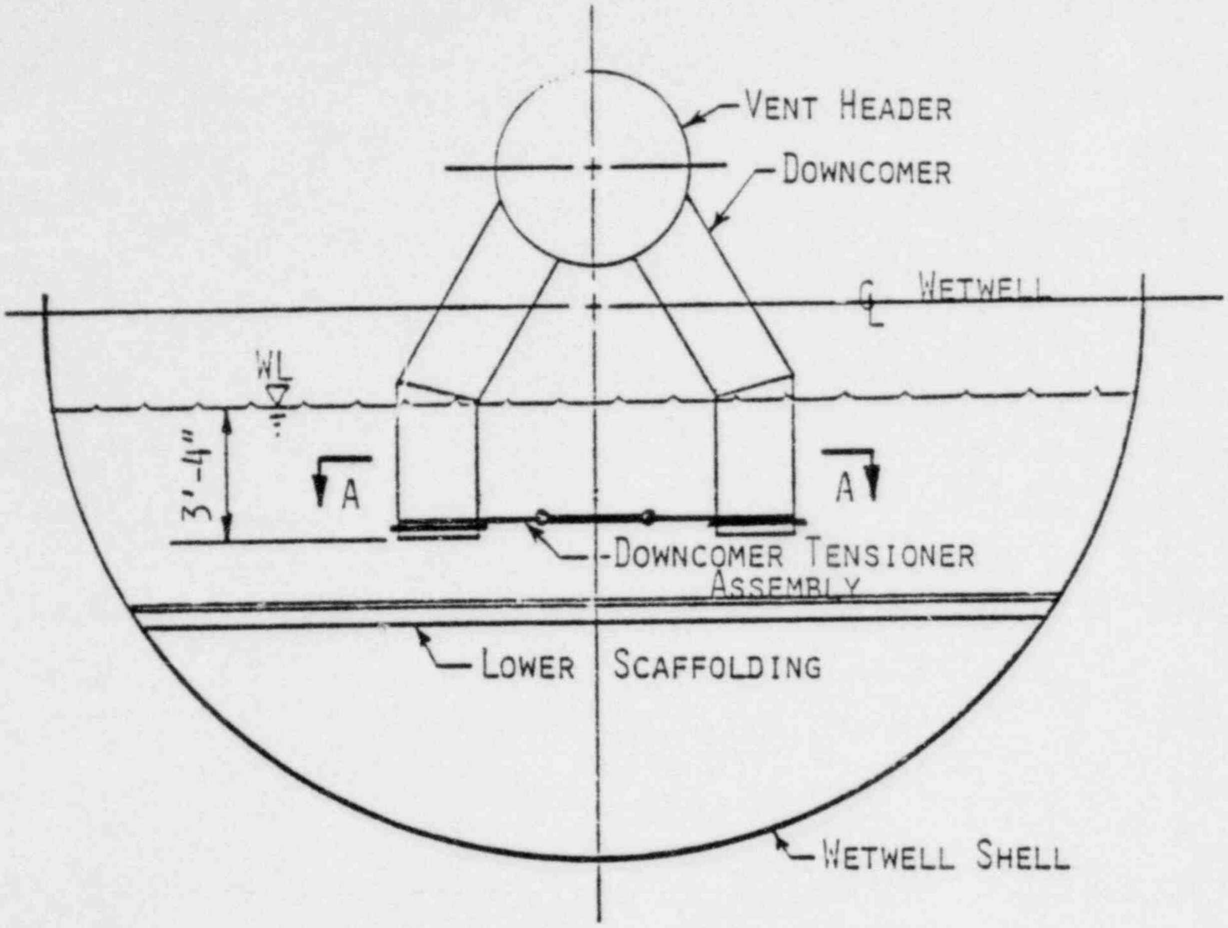
NOTES:

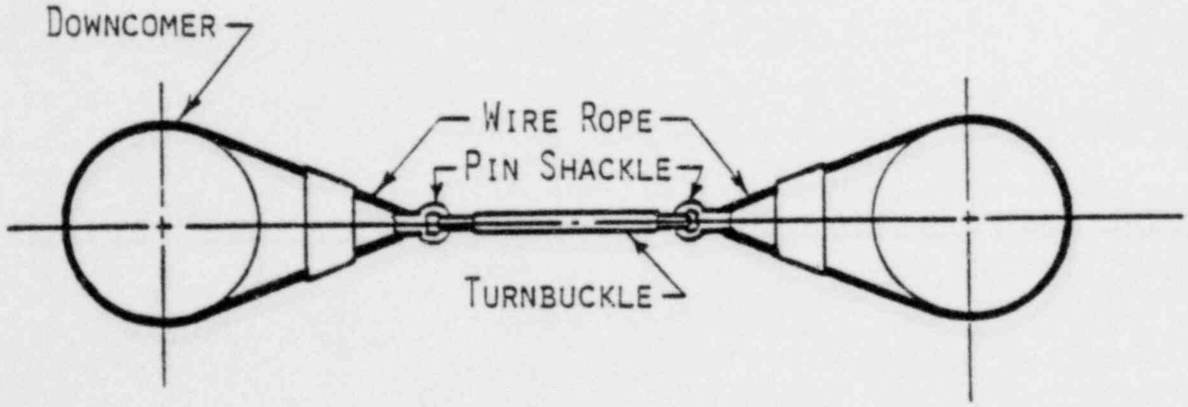
1. Tests 1 through 6 were performed with wetwell flooded to downcomer submergence of 3 ft. 4 in.

2. For tied configurations a tension/compression tiebar with D_o = 2.713 in. and t = 0.39 in. was used.

RMP
2/7/80

SNAP TEST PROCEDURE FOR UNTIED DOWNCOMERS

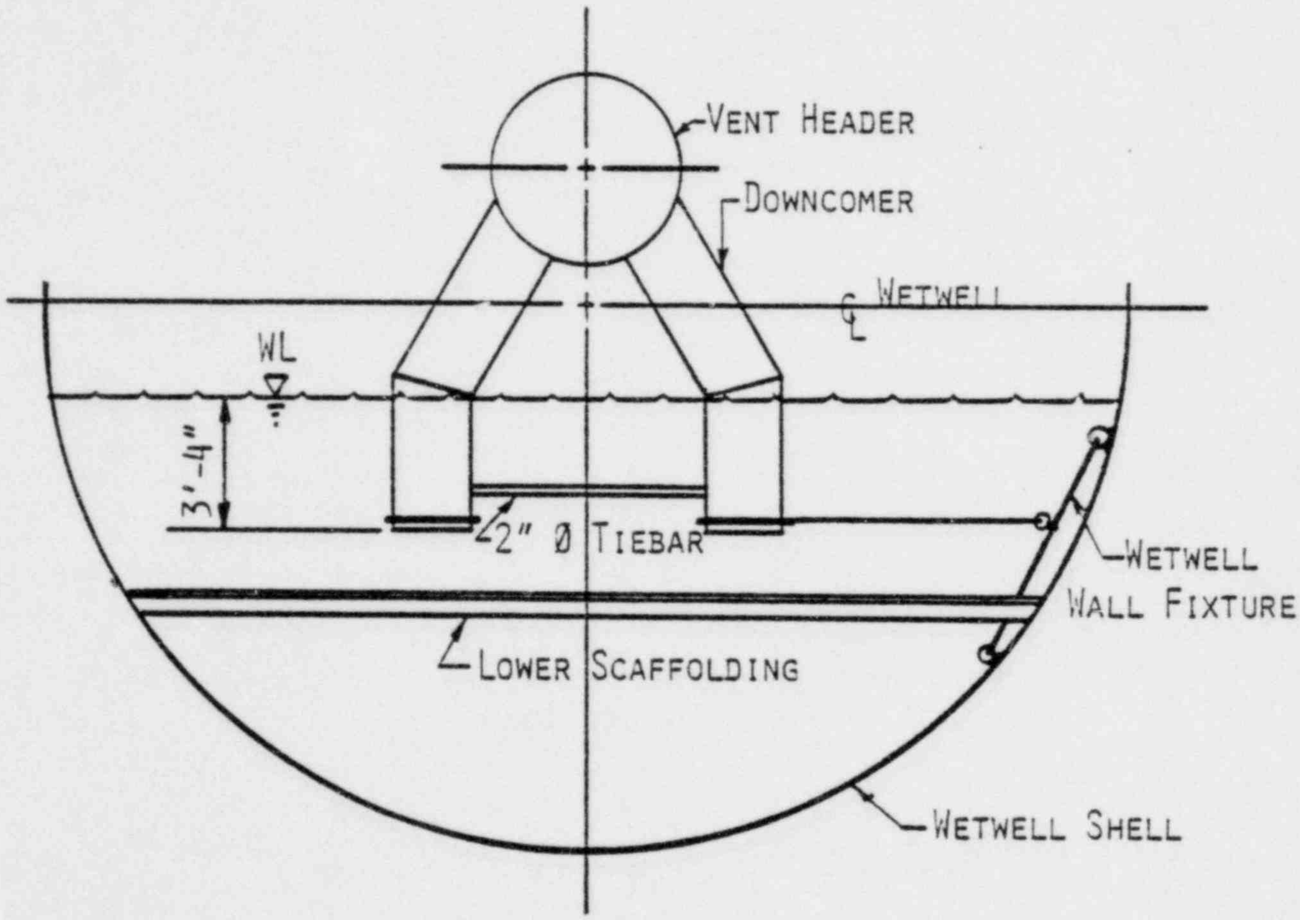




SECTION A-A

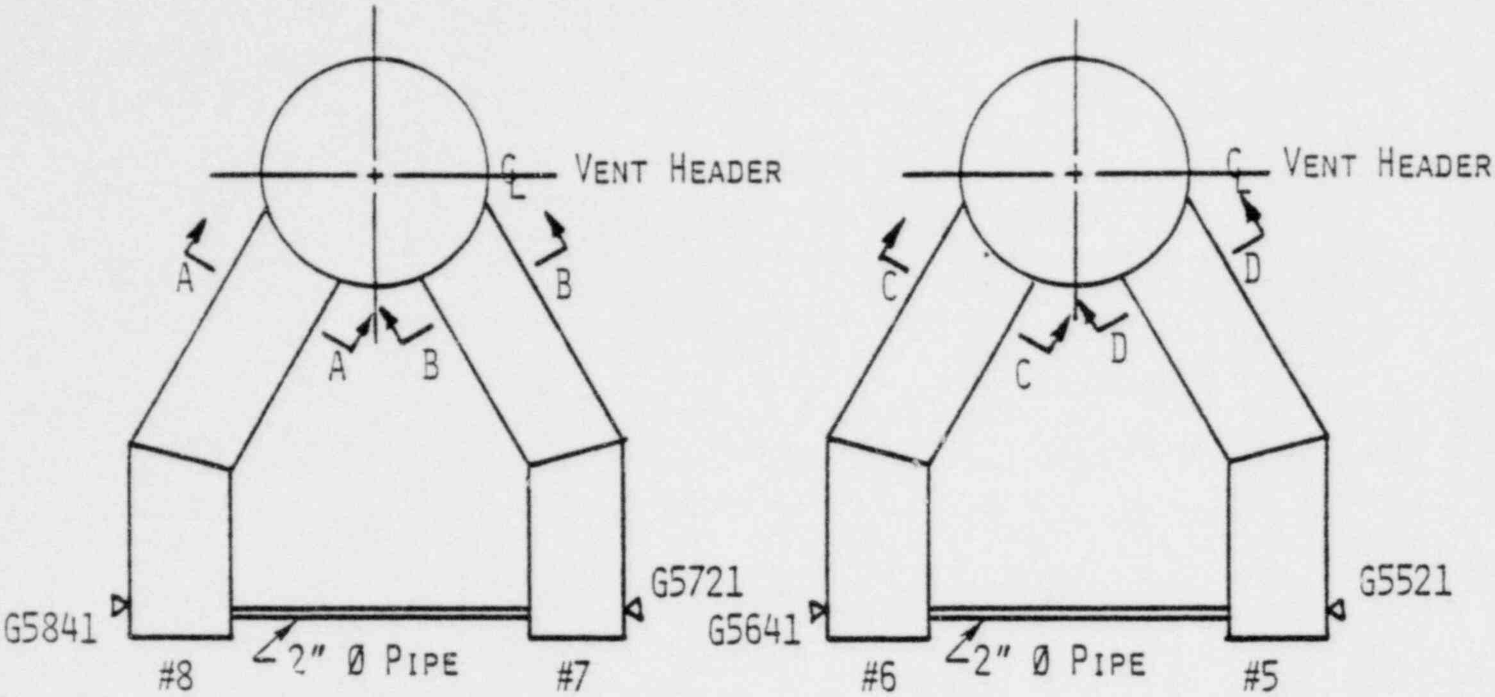
RMP
2/7/80

SNAP TEST PROCEDURE FOR TIED DOWNCOMERS

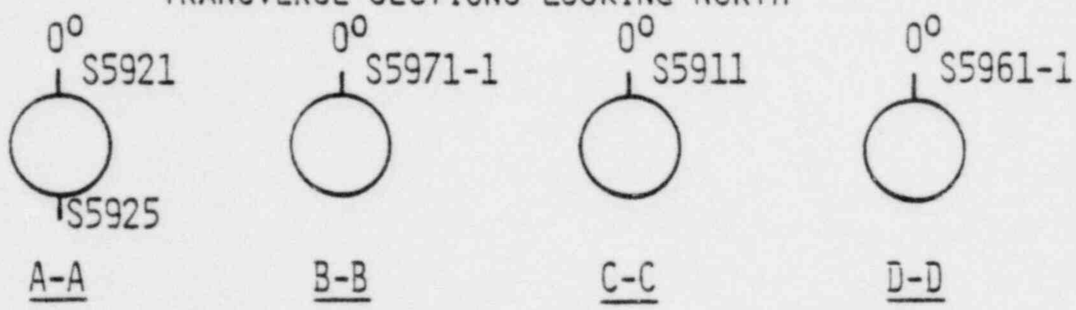


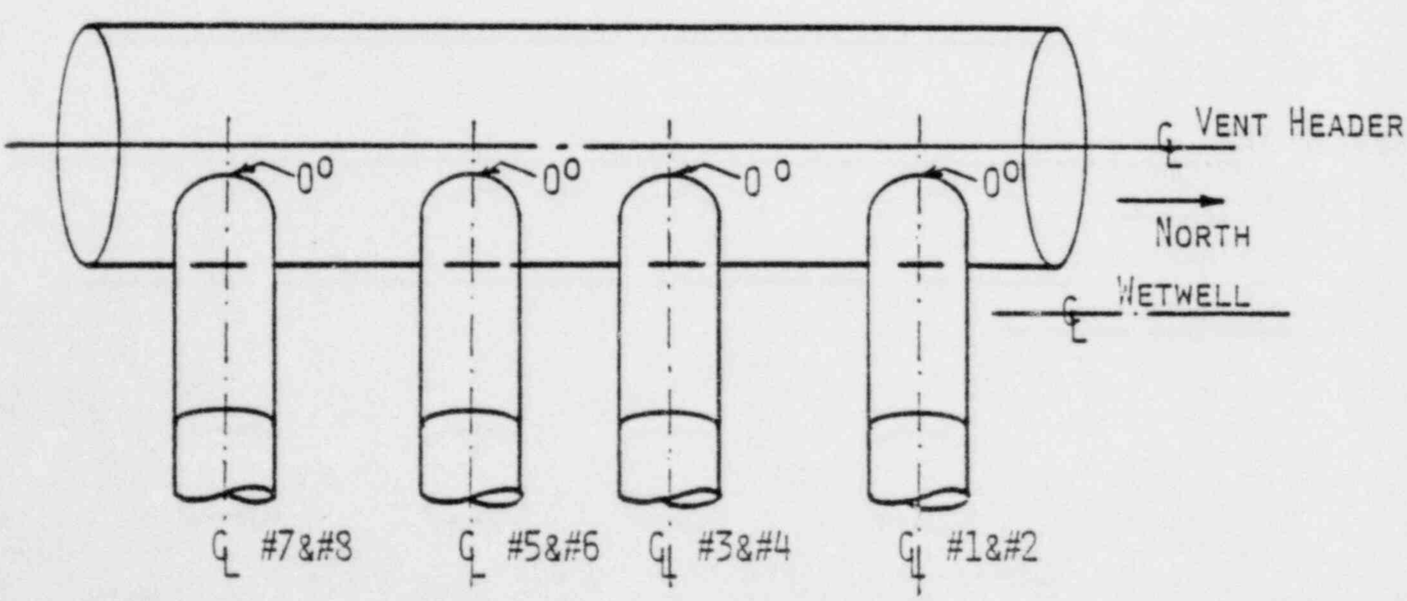
RMP
2/7/80

SNAP TEST INSTRUMENTATION



TRANSVERSE SECTIONS LOOKING NORTH





ELEVATION LOOKING WEST

RMP
2/7/80

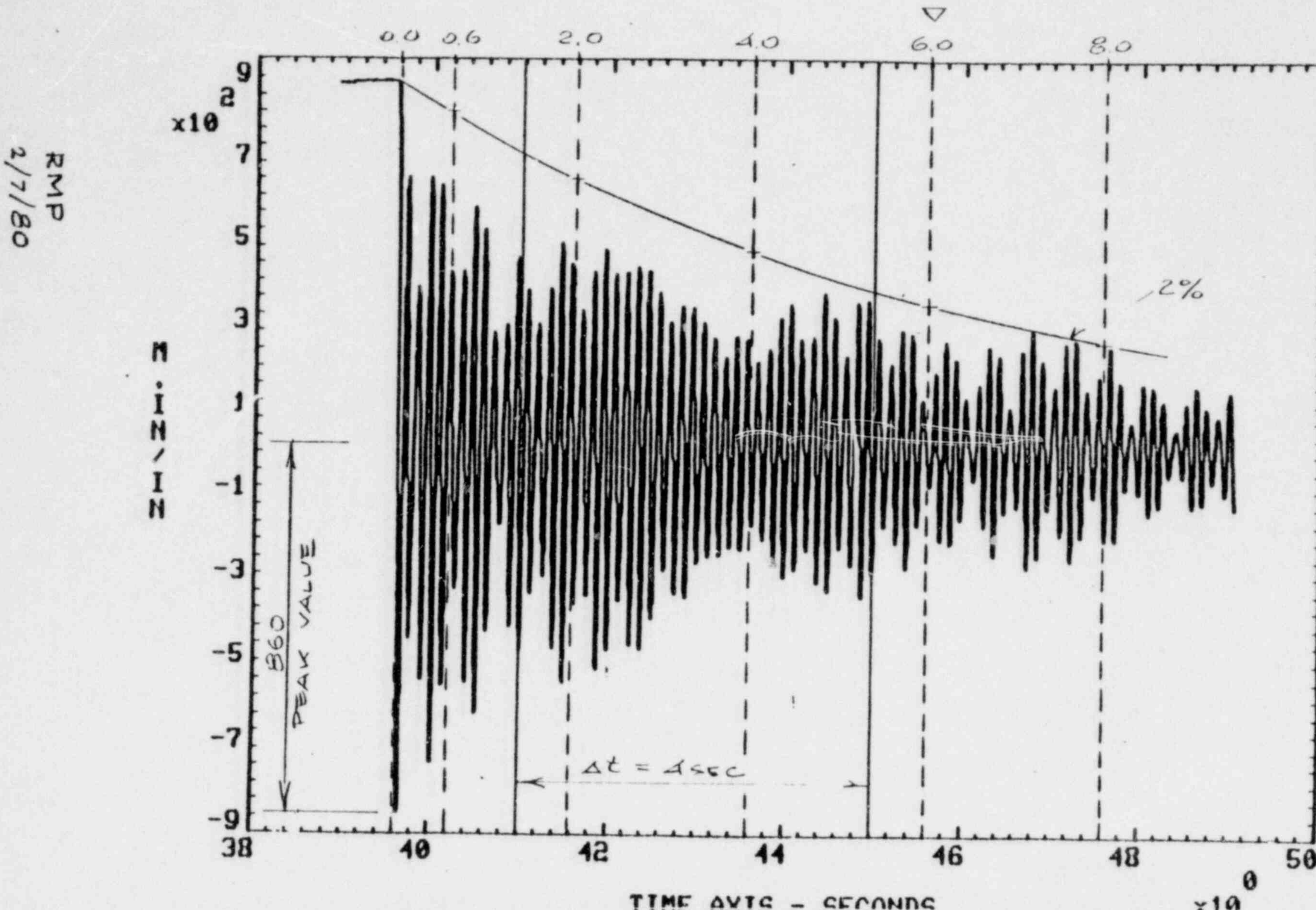
FSTF SNAP TEST

"QUICK-LOOK" RESULTS

NATURAL FREQUENCIES AND DAMPING

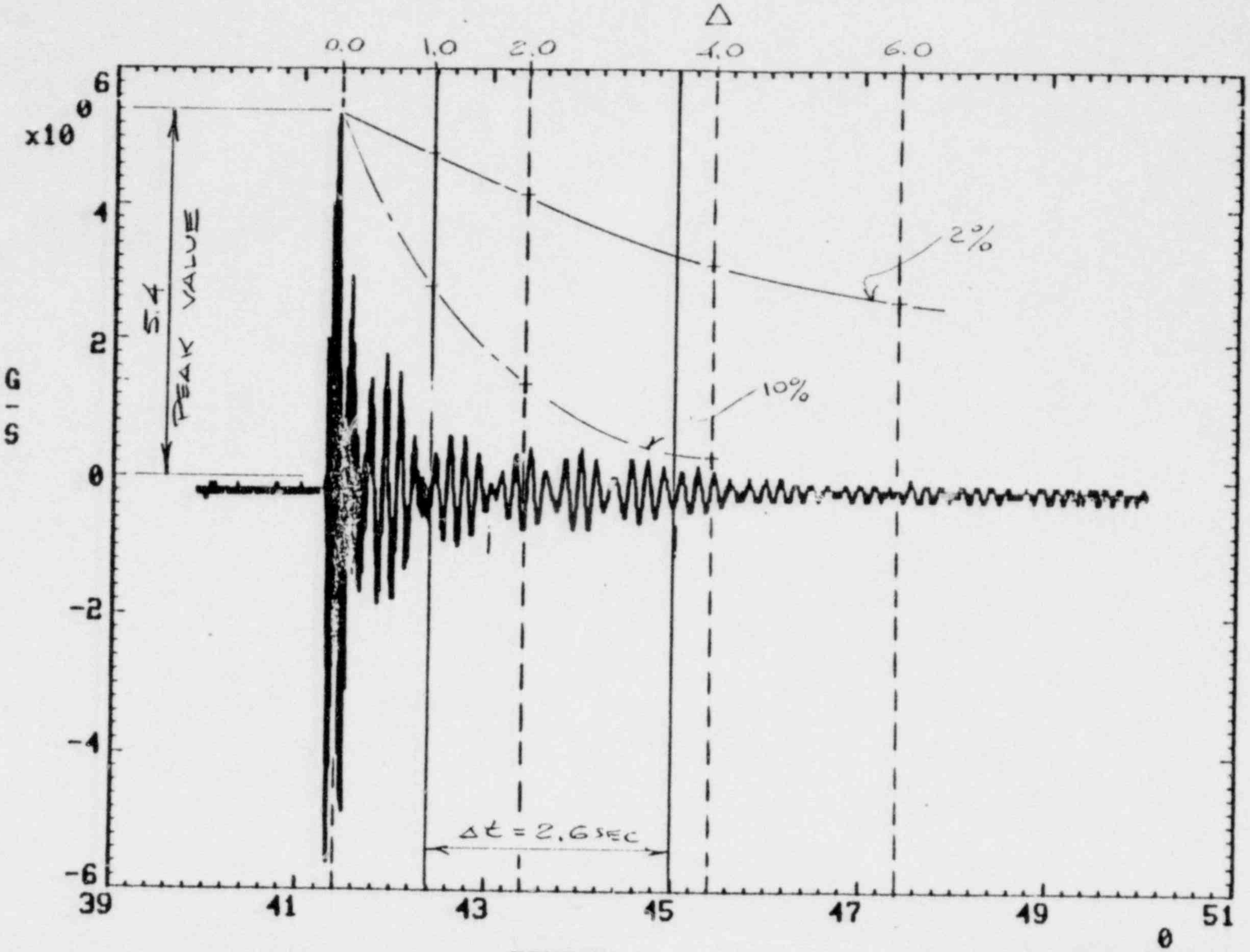
TEST NO.	D/C NO.	GAGE NO.		AVERAGE ω_D (Hz)	DAMPING RATIO ξ (%)
		ACCEL	STRAIN		
SD1	6	G5641	--	8.0	3 - 4
	6	--	S5911	8.0	2
SD2	8	G5841	--	10.0	4
	8	--	S5925	10.2	2
1	6	G5641	--	6.2	10
	6	--	S5911	5.6	10
2	8	G5841	--	7.1	8
	8	--	S5925	7.1	6
3	5	--	S5961-1	3.3	7
	6	--	S5911	3.4	7
4	8	--	S5925	5.8	5
5	5	--	S5961-1	3.1	8
	6	--	S5911	3.0	7
6	8	--	S5925	5.0	6
7	6	--	S5911	5.0	2
8	8	--	S5925	7.6	2

RMP
2/7/80



CHANNEL # - 12 MEASUREMENT I.D. - S5911

SD#1A SNAP TEST G.E. PROPRIETARY 12/17/79



CHANNEL # - 3

MEASUREMENT I.D. - G5641

SNAP TEST #1A

12/19/79

RMP
2/7/80

CONCLUSIONS

- Repeatability

- Reduction In Fundamental Frequency For Submerged Downcomers Vs. Downcomers In Air

  - Observed Frequency 7.1 Hz

  - Analytically Predicted Frequency 7.2 Hz

- Significant Increase In Damping Observed For Submerged Downcomers (5 To 10%) Vs. Downcomers In Air (2%)

RMP
2/7/80

ENCLOSURE 7

EVALUATION OF DOWNCOMER LOADS DURING CONDENSATION OSCILLATION

- REVIEW OF APPROACH

- DISCUSSION OF STRUCTURAL MODELLING

- CURRENT STATUS OF WORK

GENERAL APPROACH

- FINITE ELEMENT SHELL MODEL
  - NASTRAN Program
  - Model Header, Downcomers, Supr ts
  - Shell Representation (Quad 4 and TRIA3 Elements)
  - Test M-8 Configuration (Downcomer Ties, etc)

- STATIC VERIFICATION
  - Use of Downcomer "Jack Test" Data
  - Simulate Jacking Across a Downcomer Pair, and between Pairs
  - Correlate on Deflection

- POSTULATED CONDENSATION OSCILLATION LOADING

  1.5 psi Static Differential Pressure

  ± 2.5 psi @ 5.5 Hz In Header — FROM FSTF DATA — MS

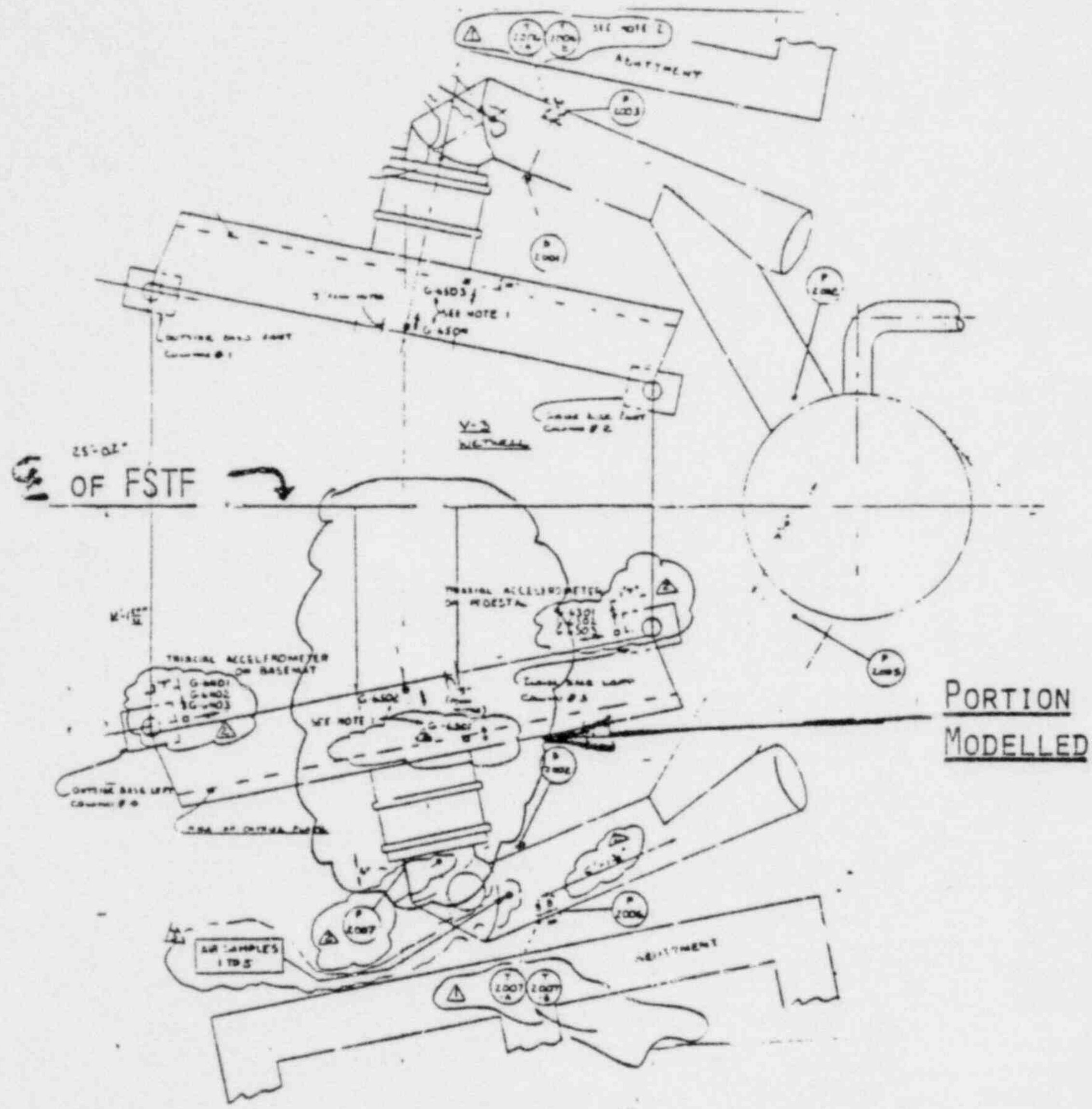
  ± 5.0 psi @ 5.5 Hz In Downcomer (Resultant Thrust)

- STATIC & DYNAMIC ANALYSIS FOR POSTULATED CONDENSATION OSCILLATION LOADING

- CORRELATION OF ANALYSIS & TEST RESULTS FOR STRUCTURAL RESPONSE

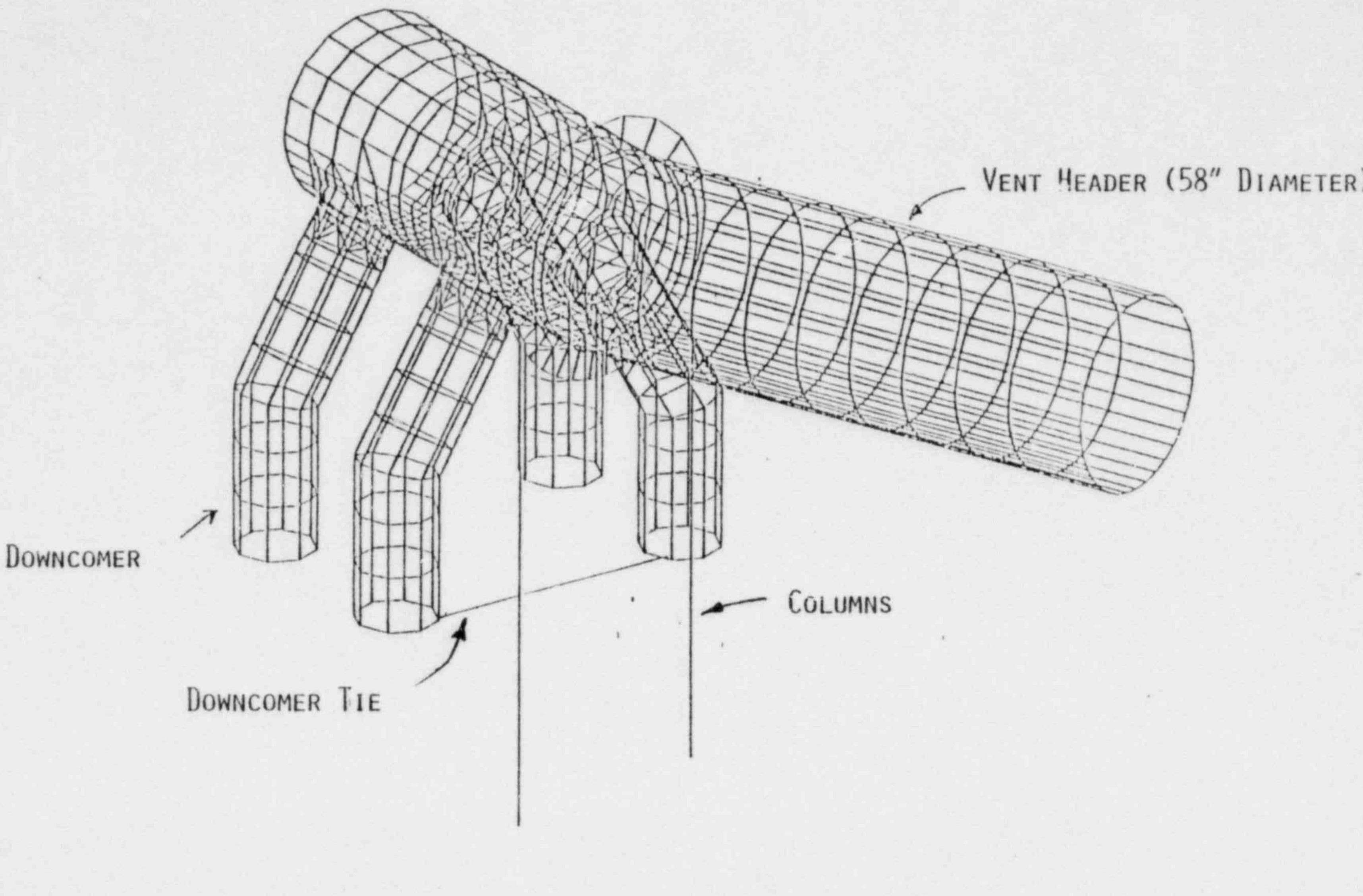
REVISIONS IN STRUCTURAL MODELING
(PEACH BOTTOM vs FSTF)

- SPAN LENGTH OF A BAY
- LENGTH OF DOWNCOMER
- HEADER EXTENSION BEYOND COLUMNS
- BOUNDARY CONDITIONS
- DESIGN DETAILS (DOWNCOMER ATTACHMENT, VACUUM BREAKER FLANGES, STIFFENING RING, ETC.)



℄ OF FSTF
PORTION MODELLED
AIR SAMPLES 1 TO 5

NASTRAN MODEL OF FSTF VENT SYSTEM



CURRENT STATUS OF WORK

- STATIC VERIFICATION

- ANALYSIS FOR CONDENSATION OSCILLATION

- UNEQUAL PRESSURE LOAD CASE