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

JAN 17 1980

Generic Task No. A-7

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 50-336

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

SUBJECT: SUMMARY OF MEETINGS HELD ON DECEMBER 19 AND 20, 1979, WITH THE MARK I OWNERS GROUP

On December 19 and 20, 1979, the staff met with representatives of the Mark I Owners Group in Bethesda, Maryland, to discuss the NRC Acceptance Criteria for the Mark I Containment Long Term Program and issues relating to implementation of the program. The attendees for each meeting are listed in Enclosures 1 and 2. Slides from the December 19 meeting are presented in Enclosure 3.

December 19, 1979

A program has been initiated by the Mark I Owners Group to revise the suppression pool hydrodynamic load definition techniques and the corresponding descriptions in the Load Definition Report (NEDO-21888) to reflect changes required by the staff's Acceptance Criteria. The

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revised load specifications will be completed in stages dictated by the degree of complexity of the specific changes. The revised Load Definition Report (LDR) is expected to be completed in the Spring of 1980.

The NRC staff and consultants agreed to or specified the following clarifications of the Acceptance Criteria for the Mark I Long Term Program:

1. The margin specified for the net vertical download pressure (Criterion 2.3) can alternately be specific by the equation Download = Mean Download x [1 + 2×10^{-5} Mean Peak Download].

2. The longitudinal impact timing (Criterion 2.5) is to be developed using the same technique described in the LDR except that only the "main vent orifice" EPRI test data will be used.

3. With regard to the impact and drag loads on "other structures" (Criterion 2.7), the drag component for both cylindrical and flat-surfaced structures shall be based on the maximum pool velocity and when dynamic structural analyses are used they should include both the impact and drag load components covering at least two natural periods of the structure.

4. With regard to the froth impingement loads in Region I (Criterion 2.8), a source vector shall be defined by drawing a line from the 45-degree tangent on the vent header to the target structure and the vertical component decelerated to the elevation of the target structure. The resulting velocity, regardless of its vector, shall be applied in the most critical direction within the 90-degree sector defined by the Acceptance Criteria. As an alternate, the QSTF plant-specific movies may be used to define the source velocity for Region I, provided both the velocity and density are conservatively established. Guidance for an acceptable technique will be provided in the description of the source velocity definition in the staff's Safety Evaluation Report.

5. The drag load for pool fallback (Criterion 2.9) shall be assessed in a manner consistent with the LOCA bubble submerged drag loads (Criterion 2.14.2). The staff provided guidance on this matter, shown in Enclosure 4.

6. With regard to the vent header deflector loads (Criterion 2.10), the Mark I Owners Group presented a proposed method for adjusting QSTF measurements to various longitudinal positions on the deflector. This technique is described in detail in Enclosure 3. The staff and its consultants concluded that this approach appears reasonable, subject to our confirmation of the normalized displacement factor derived from the EPRI pool swell tests. The staff also noted that the dimensionless force time histories for the analytically derived deflector loads must use consistent units and Figures 2.10-3 and 2.10-4 should be corrected to reflect the possible geometric variations, as shown in Enclosure 3.

7. The staff noted that two separate specifications were provided in the Acceptance Criteria for the drag coefficient for a cylindrical body (Figures 2.7-2 and 2.10-2b). To provide a consistent basis for assessment, the staff replaced the two figures in the acceptance criteria with the single curve shown in Enclosure 5.

8. The staff's requirement relative to subsequent safety-relief valve (SRV) actuations (Criterion 2.13.3.1.2) applies only to the calculated pressure. The subsequent actuation analytical model shall be used to predict the frequency of the load and an uncertainty band of ±40% shall be applied to that frequency.

9. The load definition for "off-center" SRV discharge (Criterion 2.13.3.2) need not be provided in the LDR, since it was provided on the record in response to staff questions. Based on proposed Mark I plant modifications, it appears that this load definition technique may not be needed.

10. The limit specified for multiple SRV actuations (Criterion 2.13.3.3.2) of 1.65 times the local predicted peak bubble pressure shall be applied only at the bottom center of the torus; the circumferential pressure distribution shall be maintained.

11. The Mark I Owners Group indicated that they could not fully understand the derivation of the LOCA water jet loads (Criterion 2.14.1). The staff responded by noting that a derivation has been included in the Acceptance Criteria and additional information could be obtained from the reference cited in the Acceptance Criteria.

12. With regard to the LOCA bubble submerged drag loads (Criterion 2.14.2) after bubble contact is predicted, the QSTF plant-unique pool surface velocity above the structure will be used and the load will be assumed to act only vertically from that time on.

13. With regard to quencher bubble asymmetry (Criterion 2.14.4.1b), the maximum positive bubble pressure shall be assumed to act on one side of the quencher arm with ambient pressure acting on the opposite side. This assumption is conservative, based on data comparisons presented in NEDE-21864-P.

14. For chugging submerged structure drag load (Criterion 2.14.6), all structural analyses will be dynamic.

15. The staff stated that an acceptable method for performing plant-specific primary system analyses for the SRV discharge event cases (Criterion 2.13.7) would be an ODYN code analysis with corrections for sensible heat release and consideration of the uncertainties in the principal parameters that affect reactor pressure response. The staff further suggested that any alternate analysis techniques that are being considered by the Mark I Owners Group should be pursued generically.

During the course of the Acceptance Criteria review, the following issues were identified which have not yet been resolved:

1. The Mark I Owners Group presented vent system thrust loads for both with and without differential pressure control and indicated that calculated downcomer clearing times were conservative with respect to measured clearing times in QSTF for each Mark I plant configuration. Based on this information, the Mark I Owners Group concluded that the compensatory measures required by Criterion 2.2 were not necessary. The staff, however, concluded that the downcomer clearing time comparisons were not conclusive and that the comparison should be based on load predictions and loads inferred from measured vent system pressures. The staff agreed to review the QSTF data and reassess Criterion 2.2. In the interim, that criterion must be interpreted as requiring that the vent system pressures with differential pressure control are equal to those without differential pressure control up to the time of downcomer clearing.

2. The Mark I Owners Group has completed their assessment of compressibility effects on pool swell loads. They have concluded that compressibility will not cause higher pool swell pressure loads for the range of Mark I Plant conditions. A report will be issued in late January 1980.

3. The Mark I Owners Group presented a revised procedure for analytically-derived vent header deflector loads. This technique is based on a theoretical formulation of the deflector force components using the dimensionless force transients in the staff's Acceptance Criteria (Criterion 2.10.2). The staff concluded that a detailed review of the proposed procedure would be necessary and additional information may be necessary before the review could be completed.

4. The Mark I Owners Group presented the proposed schedules for the additional Full Scale Test Facility (FSTF) condensation tests that the Owners Group agreed to perform in response to the staff's requirements (Criterion 2.11). The staff concluded that a meeting should be held around the first week in February 1980 to discuss the results of the downcomer "snap" tests and to establish the instrumentation and analyses for the large liquid-break condensation tests.

5. The Mark I Owners Group indicated that they plan to propose additional justification for the "square root of the sum of the squares" (SRSS) technique for combining the discharge loads for multiple SRV actuations in January 1980. The staff expressed pessimism regarding the viability of this approach based on previous experience with the SRV phasing issue. The Mark I Owners Group indicated that such an approach is necessary because the current methodology (absolute sum) grossly over-predicts the test data.

6. The supporting test data for the T-quencher water jet load definition (Criterion 2.14.3) will be issued as an addendum to NEDE-25090-P in January 1980.

7. The development of the downcomer "condensation oscillation" loads (Criterion 2.11.2.2) is still in progress. A schedule for this load specification will be provided by January 4, 1980.

During the course of the meeting, the staff identified specific information that should be provided in the Long Term Program plant-unique analyses to assure a timely review. The staff also expressed concern regarding the delays that have arisen in the resolution of the few outstanding generic issues.

December 20, 1979

On December 20, 1979, representatives of the Mark I Owners Group met with the management of the Office of Nuclear Reactor Regulation to discuss plans for closure of the Mark I Containment Long Term Program. R. H. Logue, Chairman of the Mark I Owners Group, indicated that the plant-unique analyses are underway and plant modifications are proceeding based on the proposed suppression pool hydrodynamic load definition techniques and those staff positions that the Mark I Owners have adopted. However, the Mark I Owners consider some of the staff positions to be "ratchets" and they do not understand the need for the margins imposed by these positions. The specific staff positions in question were identified in a letter from L. J. Sobon, GE, to D. G. Eisenhut, NRC, dated November 30, 1979.

Preliminary plant-unique analyses performed by the Mark I Owners are resulting in calculated excessive stresses where test data have shown much smaller stresses relative to the ASME code limits. The Mark I Owners Group believes that the excessive calculated stresses are unrealistic and are caused by cumulative conservatisms and idealized loading conditions, resulting from not only the staff's positions but also from several of the load definition techniques proposed by the Mark I Owners. The Mark I Owners had previously been advised that the staff would be reducing manpower on the Mark I program in 1980. They requested that staff manpower continue to be made available to work with them to resolve these "paper" problems on a generic basis.

To exemplify the problem at hand, R. Smart of Northeast Utilities, citied comparisons of recent T-quencher discharge tests in the Millstone plant with SRV analytical model predictions for the tested conditions. The analytical structural response overpredicted the test measurements by factors of 10 to 20. Based on this comparison, the Mark I Owners Group has concluded that further refinements in the SRV discharge models are necessary. A similar problem has been encountered with the condensation oscillation load definition.

H. R. Denton, NRR, stated that, based on the experience gained through implementation of the TMI Lessons Learned activities, the staff plans to go to the ACRS in January or February to seek their endorsement of the staff's Mark I Acceptance Criteria and subsequently issue these criteria with deadlines for the installation of any plant modifications necessary to satisfy the requirements of the Long Term Program. One approach for implementing this effort that was discussed involved the use of orders, with exceptions to the staff's criteria resolved by adjudication.

The Mark I Owners Group requested that the staff further consider both the additional generic activities that they wish to pursue and the proposed modification schedules that have been submitted by each of the Mark I licensees. The Mark I Owners consider their proposed modification schedules to be the best practical in view of the availability of material and manpower. In addition, the Mark I Owners proposed to return to approximately a month with a specific plan to improve the hydrodynamic load assessment techniques.

The staff was not entirely satisfied with some of the proposed modification schedules. Further, the staff considers the Acceptance Criteria sufficient to proceed with implementation of the Long Term Program. However, the staff will consider alternate proposals submitted during the implementation period so long as they do not delay the modification schedules or significantly impact staff manpower.

C. I. Grimes

C. I. Grimes
A-7 Task Manager

Enclosures:
As stated

JAN 17 1980

cc:

Central Files	Docket Files
NRC PDR	Local PDR
NSIC	50-219
D. Eisenhut	50-259
S. Hanauer	50-260
M. Aycock	50-296
B. Grimes	50-324
L. Shao	50-325
G. Lainas	50-298
E. Adensam	50-237
V. Noonan	50-249
R. Tedesco	50-331
W. Butler	50-333
R. Denise	50-321
J. Kudrick	50-245
C. Anderson	50-366
T. M. Su	50-263
K. Wichman	50-220
J. Fair	50-293
D. Ziemann	50-277
T. Ippolito	50-278
C. Grimes	50-254
	50-265
H. Denton	50-271
T. Carter	50-341
C. Hofmayer	50-354
J. Shapaker	50-355
P. Check	
G. Knighton	
D. Crutchfield	
J. Stolz	
R. Baer	
R. Hartfield	
D. Thompson	
F. Schauer	
J. P. Knight	
S. Fabic	
L. Ruth	
R. Bosnak	
OELD	
OIE (3)	
ACRS (16)	
OSD (3)	

ATTENDEES

MARK I OWNERS GROUP MEETING

DECEMBER 19, 1979

Name	Organization
C. I. Grimes	NRC/DOR
R. I. Kosson	Grumman (BNL)
A. A. Sonin	MIT (BNL)
G. A. Kosi	Bechtel
W. S. Kennedy	Acurex
R. Kohrs	GE
R. A. Nelson	GE
S. A. Hucik	GE
L. Steinert	GE
A. F. Deardorff	NUTECH
R. Sharma	NUTECH
G. Edwards	NUTECH
T. Ballard	NUTECH
D. F. Lehnert	Detroit Edison
G. O'Conner	Yankee Atomic
S. A. White	Southern Company Services
G. Maise	BNL
E. G. Adensam	NRC/DOR
T. M. Su	NRC/DSS

ENCLOSURE 2

ATTENDEES

MARK I OWNERS GROUP MEETING

DECEMBER 20, 1979

Name	Organization
H. R. Denton	NRC/NRR
S. H. Hanauer	NRC/NRR
D. G. Eisenhut	NRC/DOR
G. C. Lainas	NRC/DOR
E. G. Adensam	NRC/DOR
K. R. Wickman	NRC/DOR
C. I. Grimes	NRC/DOR
R. H. Logue	Philadelphia Electric
V. S. Boyer	Philadelphia Electric
R. N. Smart	Northeast Utilities
C. Reed	Commonwealth Edison
K. B. Ramsden	Commonwealth Edison
D. F. Lehnert	Detroit Edison
R. B. Swenson	PASNY
G. O'Conner	Yankee Atomic
J. Weaver	Nebraska Public Power
R. D. Boyle	Nebraska Public Power
R. H. Buckholz	GE
P. W. Ianni	GE
R. Kohrs	GE
L. Steinert	GE
N. W. Edwards	NUTECH
A. Derdorff	NUTECH
T. T. Robin	Southern Company Services
S. A. White	Southern Company Services
G. A. Kosi	Bechtel

ENCLOSURE 3

MARK I CONTAINMENT PROGRAM
NRC/TRAC/GE MEETING
DECEMBER 19, 1979

0900	INTRODUCTION	STEINERT
0910	LDR REVISION TO INCORPORATE NRC ACCEPTANCE CRITERIA	NELSON
0930	NRC ACCEPTANCE CRITERIA REVIEW CLARIFICATIONS INTERPRETATIONS	ALL
1200	LUNCH	
1300	NRC ACCEPTANCE CRITERIA REVIEW (CONTINUED)	ALL
1400	STATUS OF FSTF RETEST	KOHRS
1430	SUMMARY	GRIMES
1500	ADJOURN	

LDS
12/19/79

ACTION PLAN

FOR

MARK I LOAD DEFINITION REPORT

REVISIONS TO

IMPLIMENT NRC

ACCEPTANCE CRITERIA FOR

COMPLETION OF LONG TERM PROGRAM

12/19/79
R.M.N.

NRC ACCEPTANCE CRITERIA

OCTOBER 31, 1979

- o CLARIFICATION OF REQUIREMENTS IN CRITERIA
- o DIRECT IMPLICATION OF NRC CRITERIA
  - FOLLOW ON CHANGES IN IMPLIMENTATION DUE TO CLARIFICATION DISCUSSIONS

12/19/79
R.M.N.

LOAD DEFINITION REPORT FOR
MARK I LONG TERM PROGRAM
COMPLETION

- LDR REVISION PROGRESSING BASED ON NRC ACCEPTANCE CRITERIA IMPLEMENTATION

- ISSUE REVISED LDR TO UTILITY/AE's FOR STRUCTURAL EVALUATIONS

SPRING 1980

12/19/79
R.M.N.

REVISION A - LDR CATEGORIES

CATEGORY I - LOADS WHICH CAN BE CHANGED IN THE LDR IMMEDIATELY

CATEGORY II - LOADS WHICH WILL REQUIRE A NOMINAL AMOUNT OF WORK TO REVISE LDR

CATEGORY III- LOADS WHICH WILL REQUIRE A MORE EXTENSIVE AMOUNT OF WORK TO REVISE LDR

12/19/79
R.M.N.

CATEGORY I LOADS

- o VENT SYSTEM THRUST LOADS

- o POOL SWELL LOADS
  - TORUS NET VERTICAL
  - TORUS SHELL PRESSURE HISTORY
  - VENT SYSTEM IMPACT & DRAG
  - DOWNCOMER IMPACT & DRAG
  - MAIN VENT IMPACT & DRAG
  - FROTH IMPINGEMENT

- o T-QUENCHER LOADS
  - TORUS SHELL PRESSURES

12/19/79
R.M.N.

CATEGORY II LOADS

- o POOL SWELL LOADS
  - LOCA JET
  - VENT HEADER DEFLECTOR LOADS

    QSTF METHOD
- o CONDENSATION OSCILLATION
  - LOCA DRAG LOADS
- o T-QUENCHER LOADS
  - WATER JET LOADS
  - BUBBLE DRAG LOADS

12/19/79
R.M.N.

CATEGORY III LOADS

- o POOL SWELL LOADS
  - IMPACT & DRAG ON OTHER STRUCTURES ABOVE THE POOL
  - LOCA BUBBLE DRAG
  - VENT HEADER DEFLECTOR LOADS

    ANALYTICAL METHOD

- o CONDENSATION OSCILLATION
  - LATERAL LOADS ON DOWNCOMERS

- o CHUGGING
  - LOCA DRAG LOADS
  - LATERAL LOADS ON DOWNCOMERS

12/19/79
R.M.N.

POOL SWELL DOWNLOAD

NRC CRITERIA:

$$DOWN = DOWN_{MEAN} + 2 \times 10^{-5} \quad (DOWN_{MEAN})^2$$

CLARIFICATION:

$$DOWN = DOWN_{MEAN} \ (1 + 0.00002 \ PEAKDOWN_{MEAN})$$

LDS
12/19/79

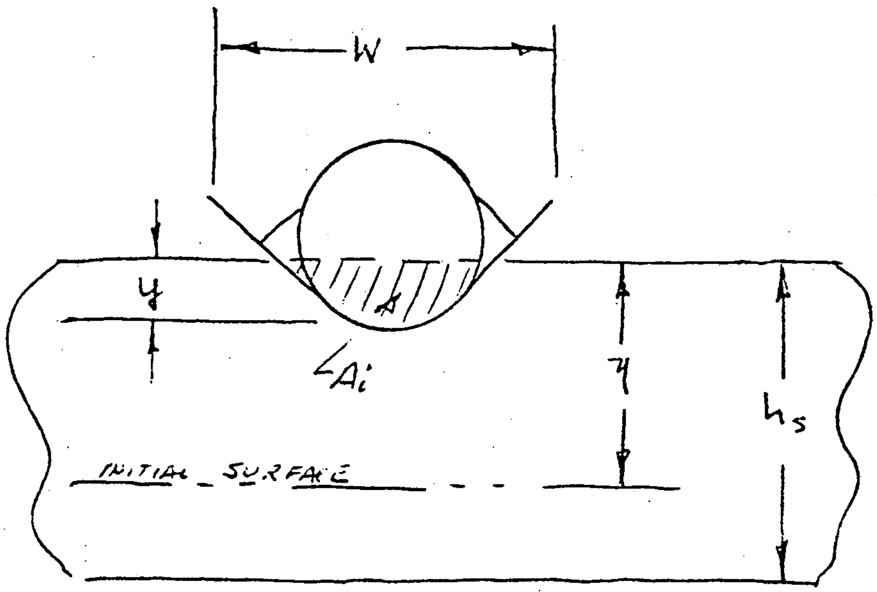
WSK 12/17/79

DEFLECTOR LOAD DEFINITION

GOVERNING EQUATIONS

o DEFLECTOR FORCE (REF 1)

$$F' = \underbrace{\rho g A_i}_{\text{BOUYANCY}} + \underbrace{(m'(y) + \rho A_i)\ddot{\eta}}_{\text{ACCELERATION DRAG}} + \underbrace{\frac{\partial m'}{\partial y}\dot{\eta}}_{\text{VELOCITY DRAG}} + \underbrace{(p_s - p_{fs})W'}_{\text{LOCAL STATIC PRESSURE}}$$



REF 1 KAPLAN, P. & SILBERT M.N. "IMPACT FORCES ON PLATFORM HORIZONTAL MEMBERS IN THE SPLASH ZONE", OFFSHORE TECHNOLOGY CONF. PAPER OTC 2498, MAY 1976.

DEFLECTOR LOAD DEFINITION

GOVERNING EQUATIONS (CONT)

o ADDED MASS FROM DRAG COEFFICIENT

$$\frac{\partial m'}{\partial y} = \frac{1}{2}\rho W C_D(y)$$

$$m' = \frac{1}{2}\rho W \int_0^y C_D(\xi)\, d\xi$$

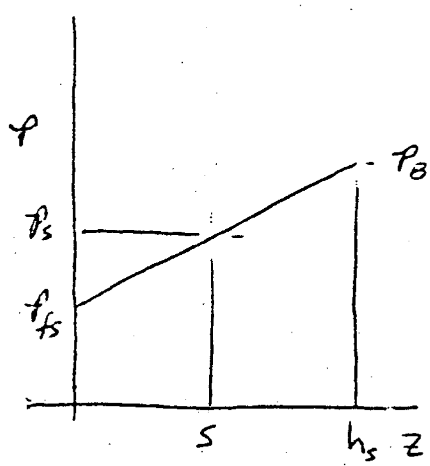
$C_D(y)$ PER ATTACHED GRAPHS EXCEPT THAT STEADY PORTION IS EXCLUDED ($C_0 = 0.7$)

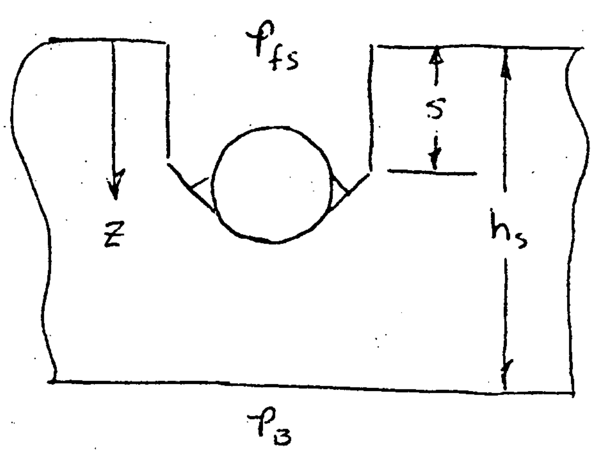
o LOCAL STATIC PRESSURE

$$(P_s - P_{fs})W = sW\rho\left(1 + \frac{F_d}{m_e}\right)$$

WHERE F_d = TORUS DOWNLOAD

m_e = EFFECTIVE MASS





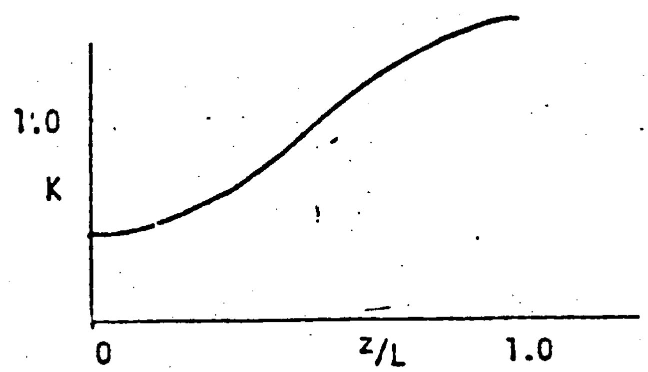
RANGE OF PARAMETERS
INFLUENCING DEFLECTOR LOADS
(FULL SCALE VALUES)

	DEFLECTOR LOADS MEASURED IN QSTF (6 PLANTS - 12 CONFIGURATIONS)	REMAINING PLANTS FOR WHICH DATA IS NOT AVAILABLE (7 PLANTS)
1) CLEARANCE (IN) (DISTANCE FROM BOTTOM OF DEFLECTOR TO WATER SURFACE)	0 - 21.05	0 - 14.29
2) DEFLECTOR WIDTH (IN)	25.3 - 30.0	20.0 - 26.0
3) $\dot{P}$ (PSI/SEC)	46.1 - 74.0	54.4 - 74.7
4) DOWNCOMER SUBMERGENCE (FT)	3.0 - 4.25	3.33- 4.4

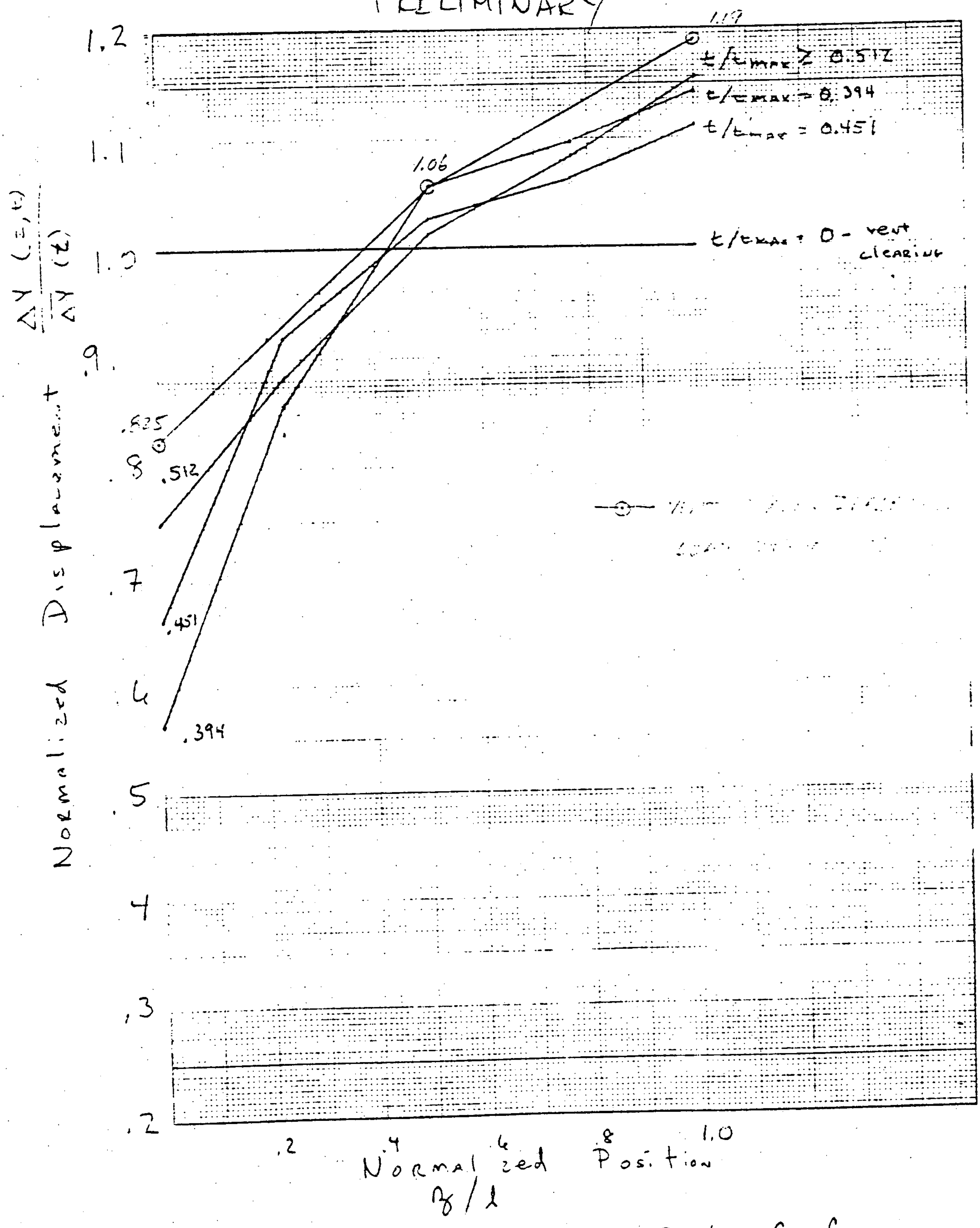
ACUREX Corporation

PROCEDURE FOR CREATING VENT HEADER DEFLECTOR
LOAD DEFINITION FROM QSTF DEFLECTOR LOAD MEASUREMENT

1) Plot K vs z/L using
EPRI Vent orifice data (SEE ATTACHED NUMERICAL FIGURE)



PRELIMINARY



Pool Surface

Displacement Longitudinal Distribution

Rev A

2) Surface acceleration given by

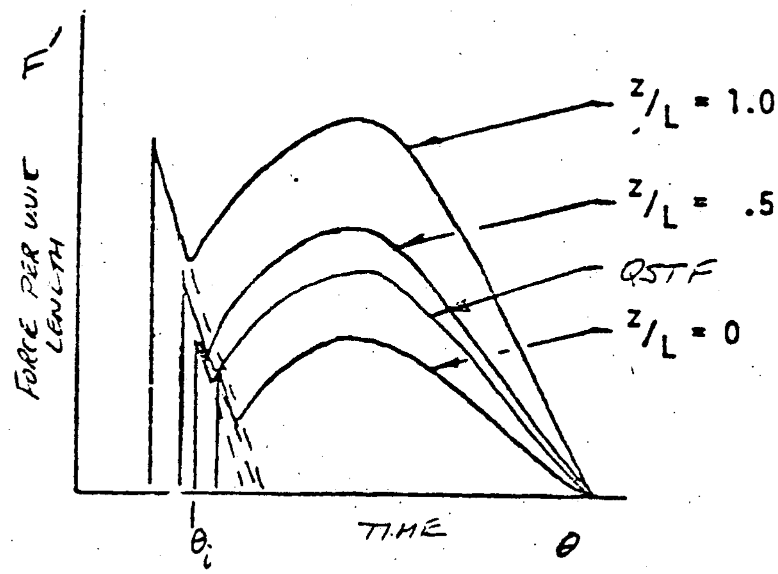
$$\ddot{X}_{z/L} = K\ \ddot{X}_{QSTF}$$

AND

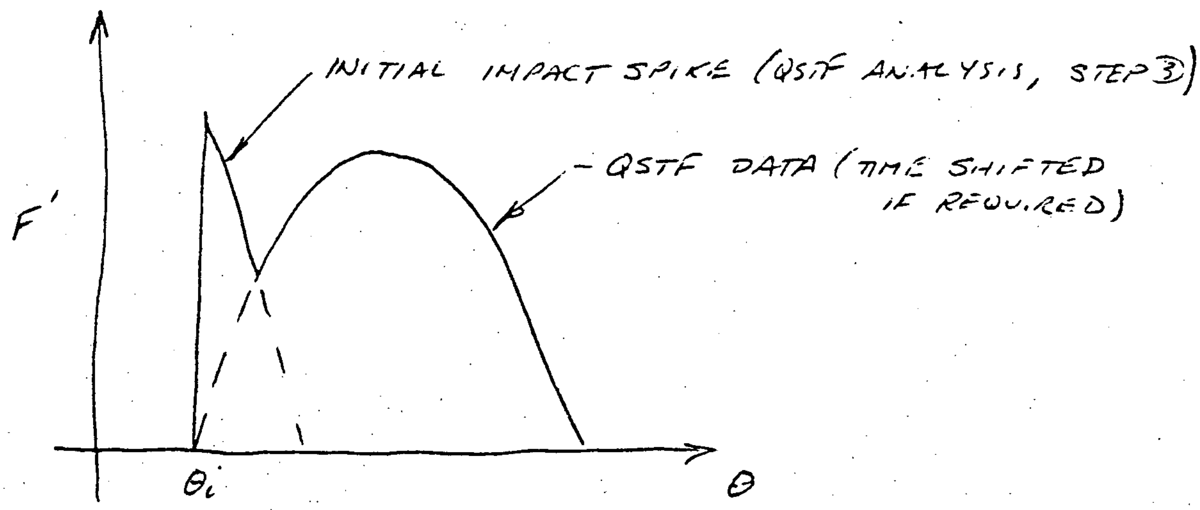
$$\dot{X}_{z/L} = \int \ddot{X}_{z/L}\ d\theta$$

$$X_{z/L} = \int \dot{X}_{z/L}\ d\theta$$

3) Run existing analysis (NEDO-24612) using NRC criteria drag coefficients and histories from 2) to produce 4 load histories (z/L = 0, .5, 1.0 & QSTF)



4) ADD IMPACT SPIKE FROM STEP ③ (QSTF ANALYSIS) TO QSTF MEASURED DATA AT TIME OF FIRST RESPONSE IN DATA AND ADJUST TIME SCALE TO CAUSE TIME OF IMPACT, θ_i, OF QSTF ANALYSIS AND DATA TO AGREE



5) COMPARE CALCULATED FORCES FROM STEP 3) AT IDENTICAL VALUES OF y, THE PENETRATION DEPTH

y	θ_{QSTF}	$\theta_{z/\ell}$	F'_{QSTF}	$F'_{z/\ell}$	$F'_{z/\ell}/F'_{QSTF}$
y_1	θ_1	θ_4	F_1'	F_4'	ϕ_1
y_2	θ_2	θ_5	F_2'	F_5'	ϕ_2
y_3	θ_3	θ_6	F_3'	F_6'	ϕ_3
⋮	⋮	⋮	⋮	⋮	⋮

6) MULTIPLY THE CURVE FROM STEP 4) by THE APPROPRIATE $F_{z/l}/F_{QSTF}$ RATIO AT θ_{QSTF} AND PLOT AT THE ASSOCIATED $\theta_{z/l}$ VALUE TO CREATE 3 FORCE HISTORIES ($z/l = 0, .5 \, \& \, 1.0$)

7) SCALE THE RESULTS OF STEP 6) TO FULL SCALE by:

force per unit length

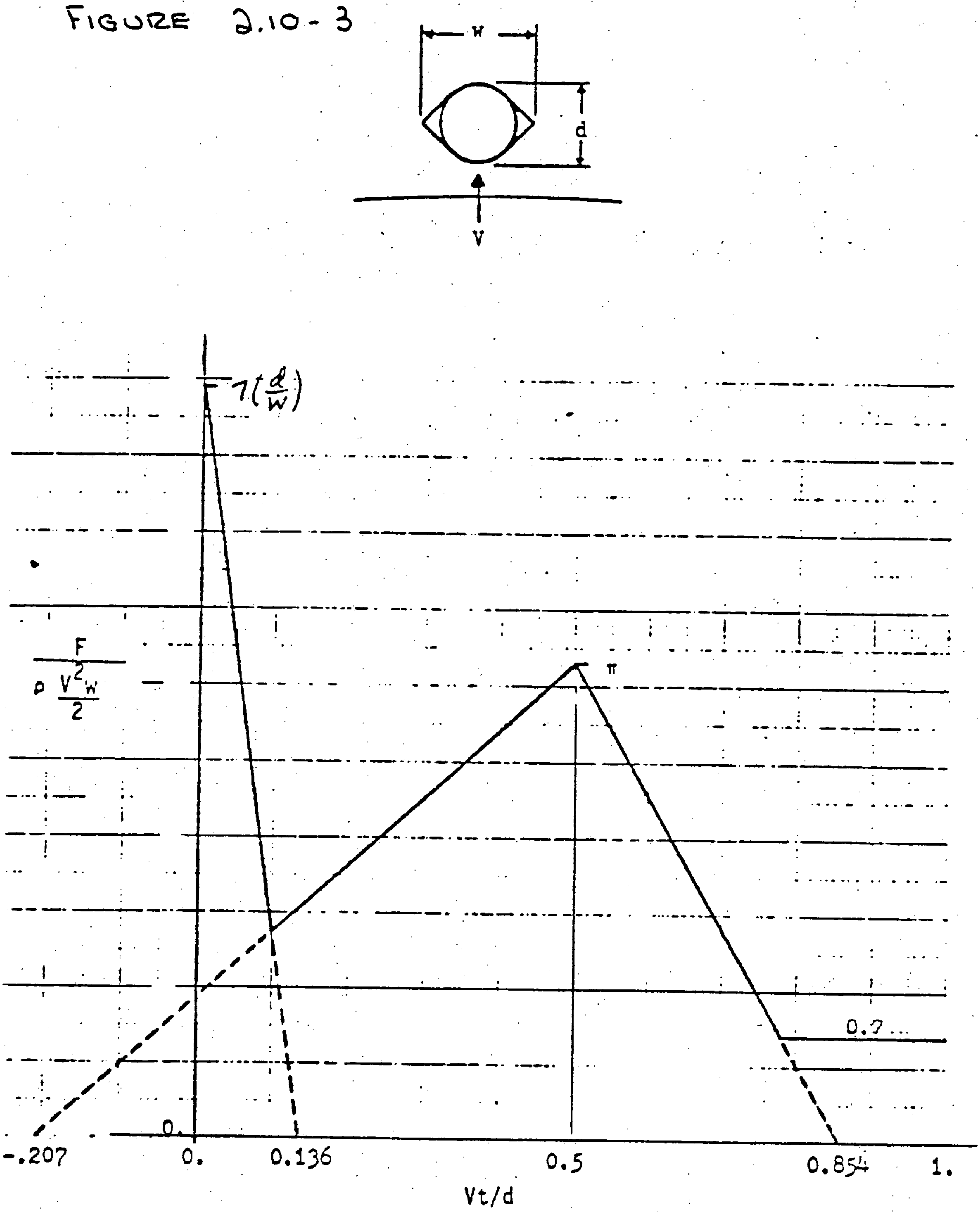
$$F'_{FS} = \frac{1}{\lambda^2} F'_{STEP\ 6)}$$

AT CORRESPONDING TIMES

$$\theta_{FS} = \frac{1}{\sqrt{\lambda}} \theta_{STEP\ 6)}$$

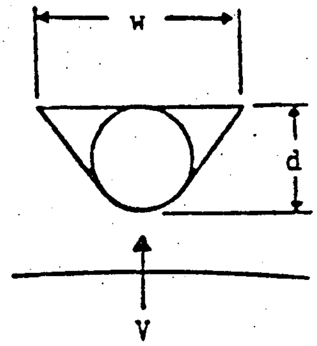
WHERE λ = QSTF SCALE FACTOR (LESS THAN ONE)

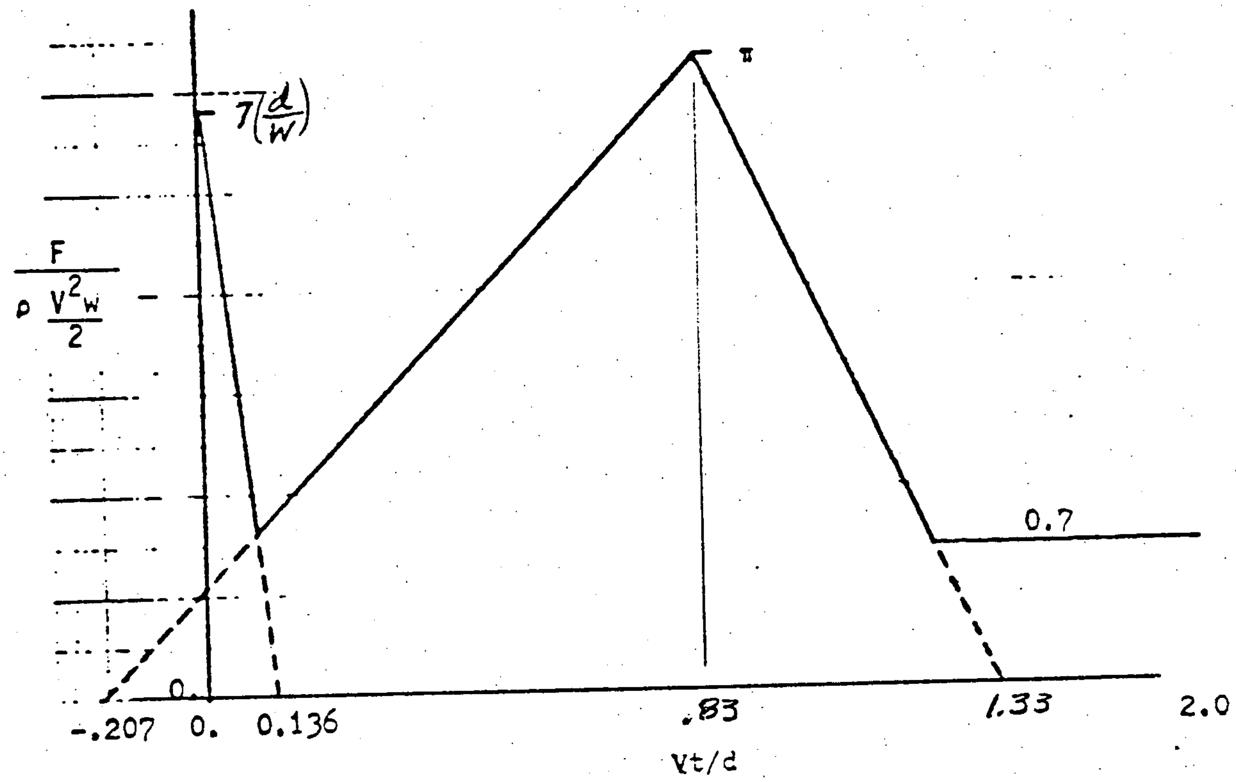
FIGURE 2.10-3



Impact and Steady Drag Force Correlation for Type 2 Deflector

FIGURE 2.10-4





Impact and Steady Drag Force Correlation for Type 3 Deflector

THRUST LOAD

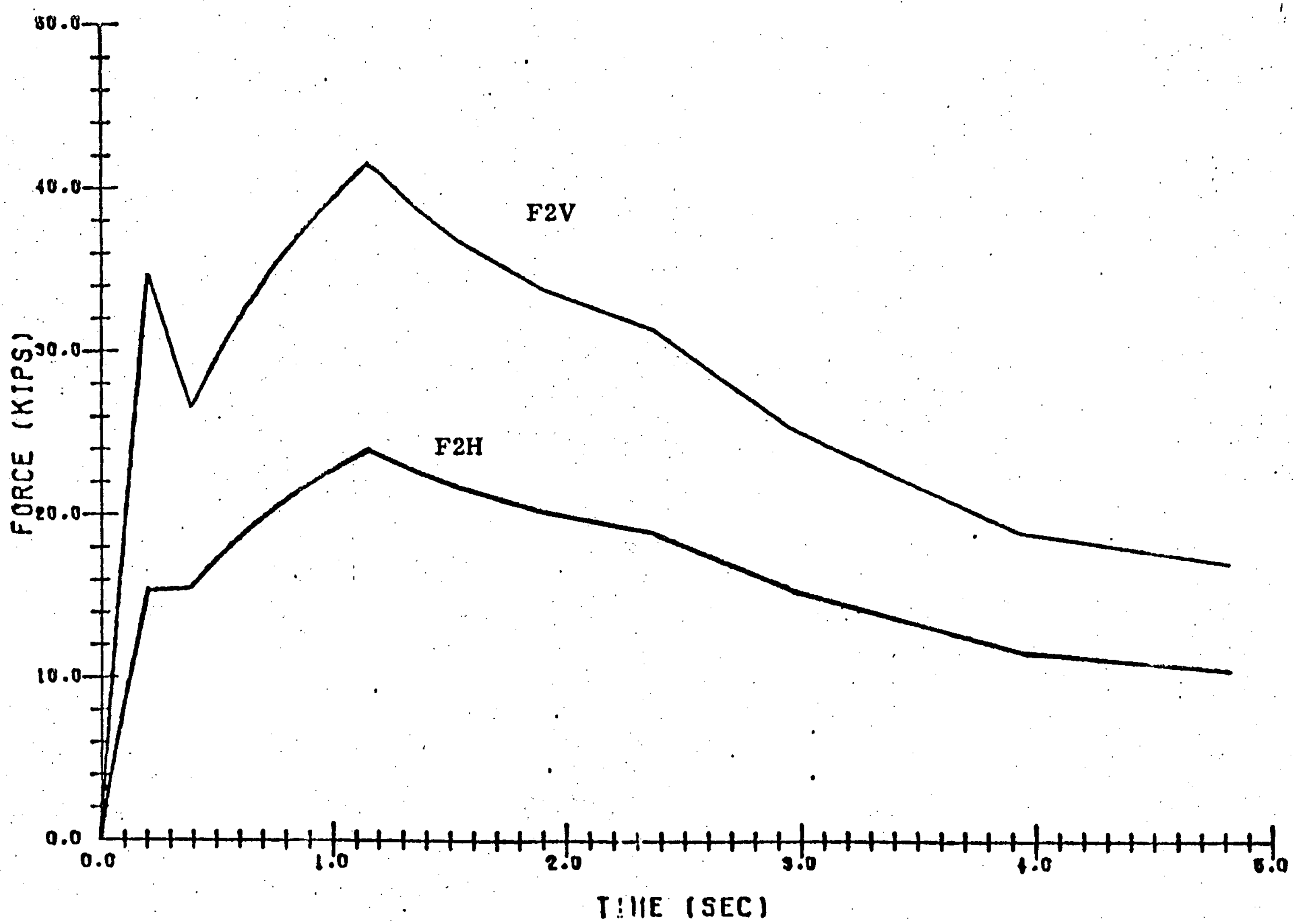
- ANALYTICAL MODEL FOR DOWNCOMER INTERNAL PRESSURE CONSERVATIVE FOR ΔP AND ZERO ΔP PREDICTIONS

  - VENT CLEARING PREDICTED LATER THAN QSTF

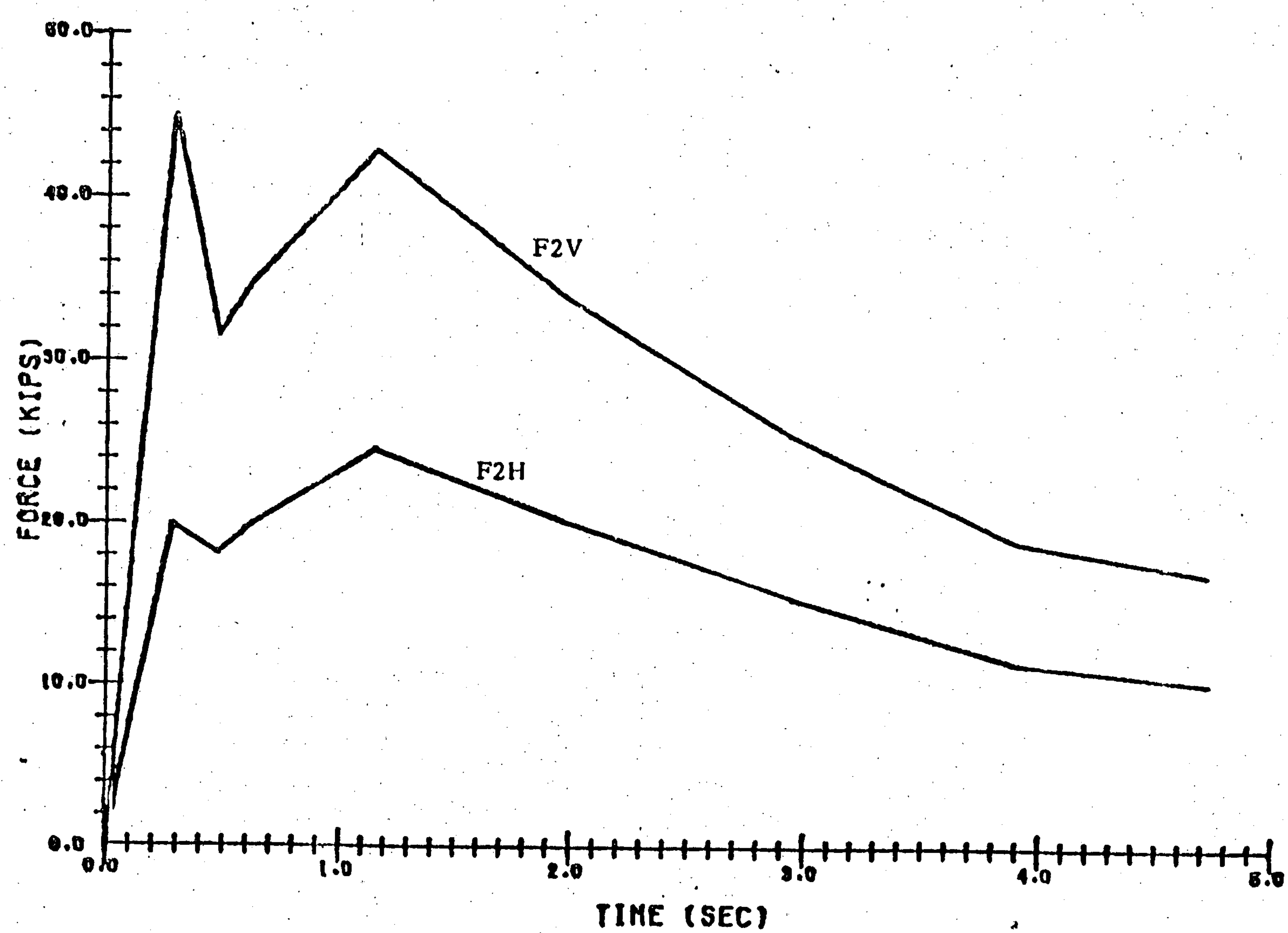
  - DOWNCOMER PRESSURE DURING TIME BETWEEN VENT CLEARING AND BUBBLE BREAKTHROUGH IS GREATER THAN QSTF

  - ZERO ΔP VENT CLEARING PREDICTED EVEN LATER

S. A. HUCIK
12/19/79



MONTICELLO . MIN. DELTAP VENT THRUST FORCES	VENT HEADER FORCES PER MITRE BEND



MONTICELLO • (O) DELTAP VENT THRUST FORCES	VENT HEADER FORCES FER MITRE BEND

SRV TORUS SHELL PRESSURES

FIRST ACTUATIONS:

- USE LDR FIRST ACTUATION PRESSURE PREDICTION
- USE LDR FIRST ACTUATION FREQUENCY PREDICTION ± 25%

SUBSEQUENT ACTUATIONS

- USE LDR FIRST ACTUATION PRESSURE PREDICTION
- USE LDR SUBSEQUENT ACTUATION FREQUENCY PREDICTION ± 40%

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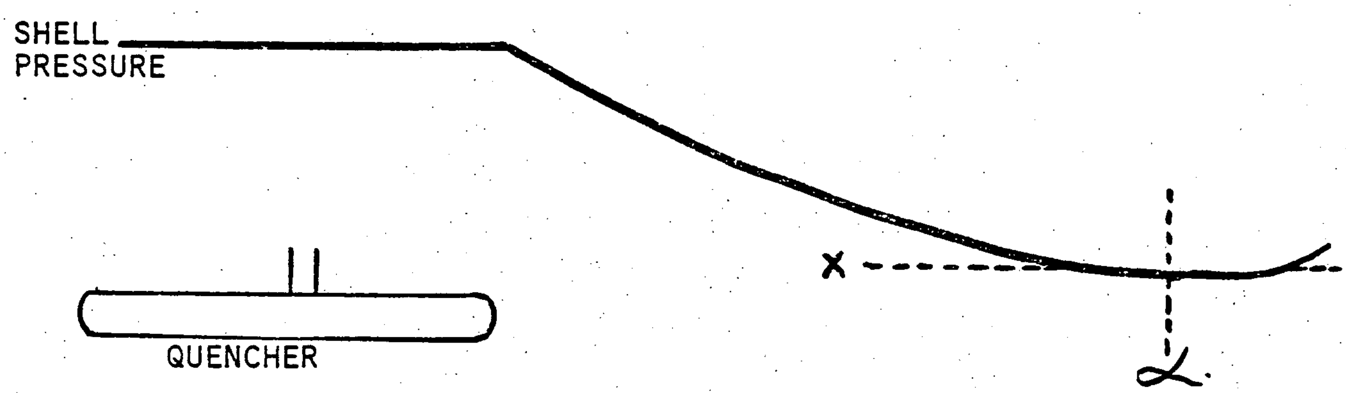
12/19/79

SRV TORUS SHELL PRESSURE ATTENUATION

SOME PRESSURE PREDICTIONS RESULT IN:



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

50° or more

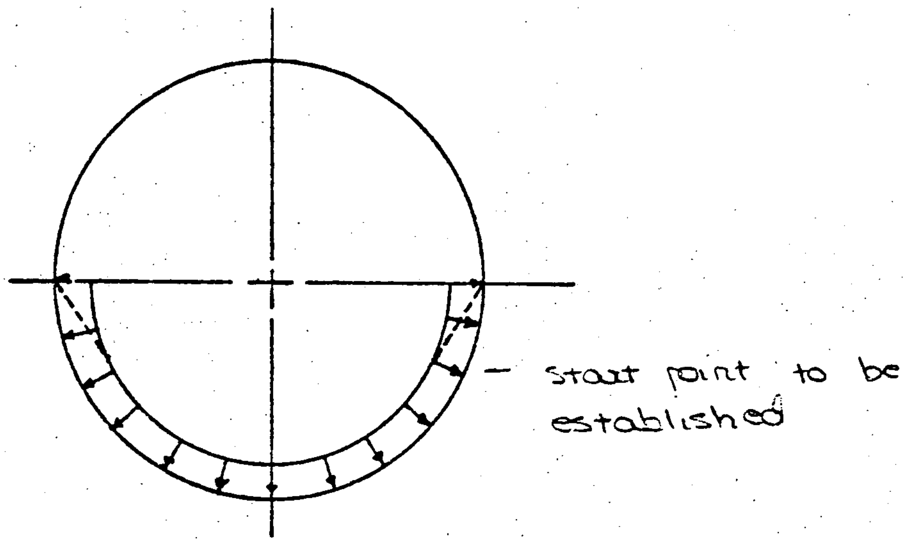
. SEE EQUATION 2-22 NEDE-21878-P

LDS
12/19/79

SRV TORUS SHELL PRESSURE ATTENUATION

PRESSURE PREDICTIONS AT LARGE DISTANCES FROM

THE QUENCHER RESULT IN:



RESOLUTION: ATTENUATE TO ZERO AT WATER SURFACE

SEE EQUATION 2-23 NEDE-21878-P

LDS
12/19/79

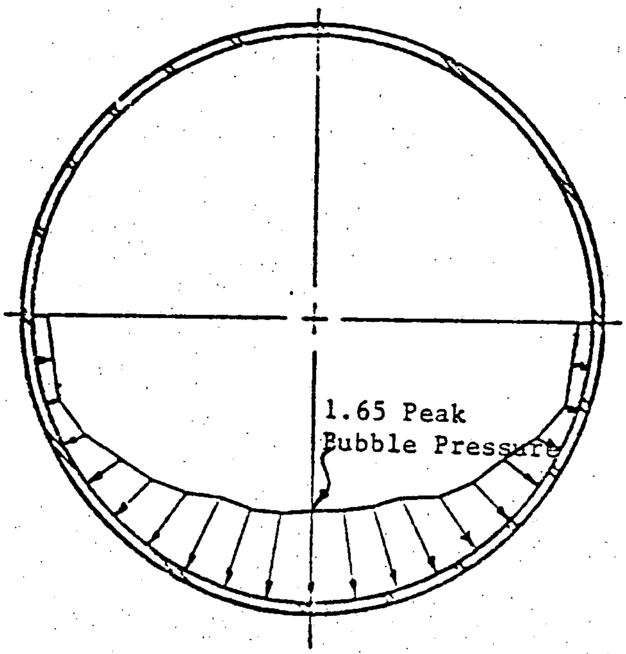
SRV TORUS SHELL PRESSURES FOR

MULTIPLE DISCHARGE LOADS

NRC CRITERIA:

COMBINED PEAK TORUS SHELL PRESSURE LIMITED TO MAXIMUM OF 1.65 TIMES PREDICTED PEAK BUBBLE PRESSURE

CLARIFICATION:



LDS
12/19/79

SUBMERGED STRUCTURES

LOCA BUBBLE DRAG LOAD - FLOW FIELD

NRC CRITERIA :

- AFTER CONTACT BETWEEN BUBBLES OF ADJACENT DOWNCOMERS, POOL SWELL FLOW FIELD ABOVE DOWNCOMER EXIT.

  — UNIFORM FLOW FIELD ABOVE DOWNCOMER EXIT.

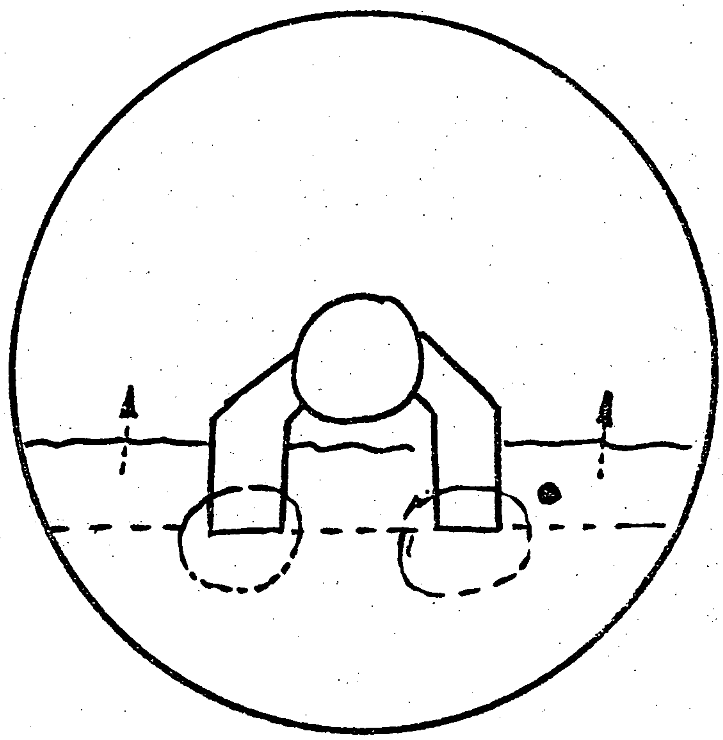
  — FLOW FIELD VELOCITY DETERMINED FROM QSTF PLANT UNIQUE TESTS.

  — DRAG LOAD CALCULATION ENDS WHEN BUBBLE ENGULFS STRUCTURE.

SAH-1
12/19/79

SUBMERGED STRUCTURES

LOCA BUBBLE DRAG LOAD - FLOW FIELD.



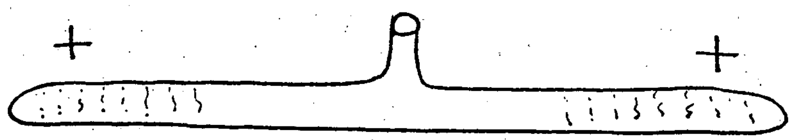
SAH-2
12/19/79

SUBMERGED STRUCTURES

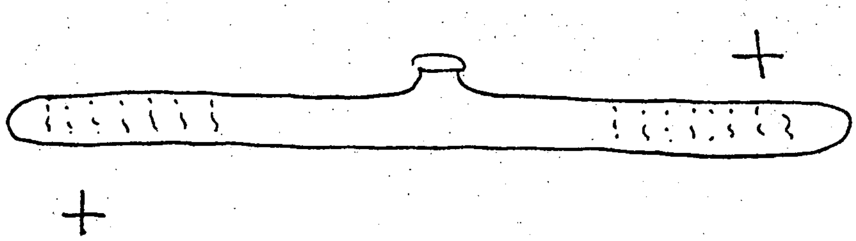
QUENCHER ARM LOADS

- QUENCHER ARM LOADS BASED ON ASSUMED BUBBLE ASYMMETRY.

- MAXIMUM SIDE FORCE CALCULATION
  - MAXIMUM BUBBLE PRESSURE ON ONE SIDE OF ARM.
  - ZERO ON OPPOSITE SIDE



- MAXIMUM MOMENTUM CALCULATION.
  - MAXIMUM POSITIVE BUBBLE PRESSURE ON DIAGONAL OF ARMS
  - ZERO ON REMAINING POSITIONS



SAH-1
12/19/79

SUBMERGED STRUCTURES

QUENCHER ARM LOADS

- MONTICELLO TQ TEST DATA SUPPORTS NO BUBBLE ASYMMETRY.

  — BUBBLE PRESSURES IN PHASE ON EACH SIDE OF TQ ARMS

  — DIFFERENTIAL PRESSURES SUPPORT IN-PHASE ASSUMPTION.

- LOAD DEFINITION METHODOLOGY CONSERVATIVE BASED ON MONTICELLO DATA.

SAH-2
12/19/79

FSTF TESTING STATUS

FSTF SNAP TEST-
TEST MATRIX AND STATUS

PURPOSE:

To Determine Damping and Natural Frequency of Mark I Downcomers

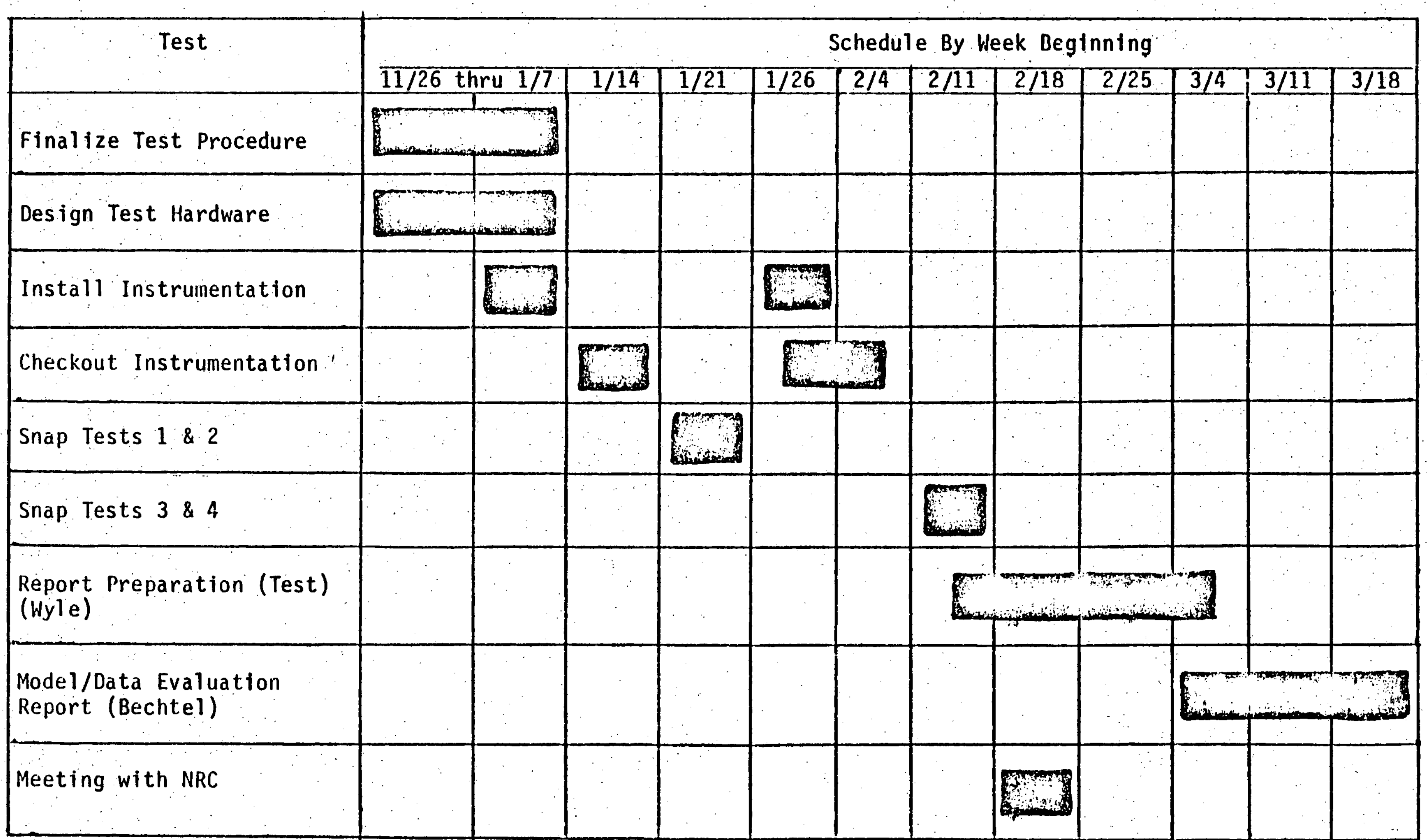
TEST MATRIX:

Test No.	D/C Pair	Condition	DC Water Level	Wetwell Water Level
1	5&6	Untied	Dry	Flooded
2	7&8	Untied	Dry	Flooded
3	5&6	Tied	Dry	Flooded
4	7&8	Tied	Dry	Flooded

SCHEDULE:

Complete Tests	February 1980
Complete Test Report	March 1980
Complete Evaluation Report	April 1980

SNAP TEST SCHEDULE



STF C/O RETEST -
TEST MATRIX AND STATUS

PURPOSE:

TO PROVIDE ADDITIONAL STATISTICAL BASIS FOR C/O TEST DATA DURING LARGE LIQUID BREAK TO ASSURE LDR C/O LOAD BOUNDS TEST DATA

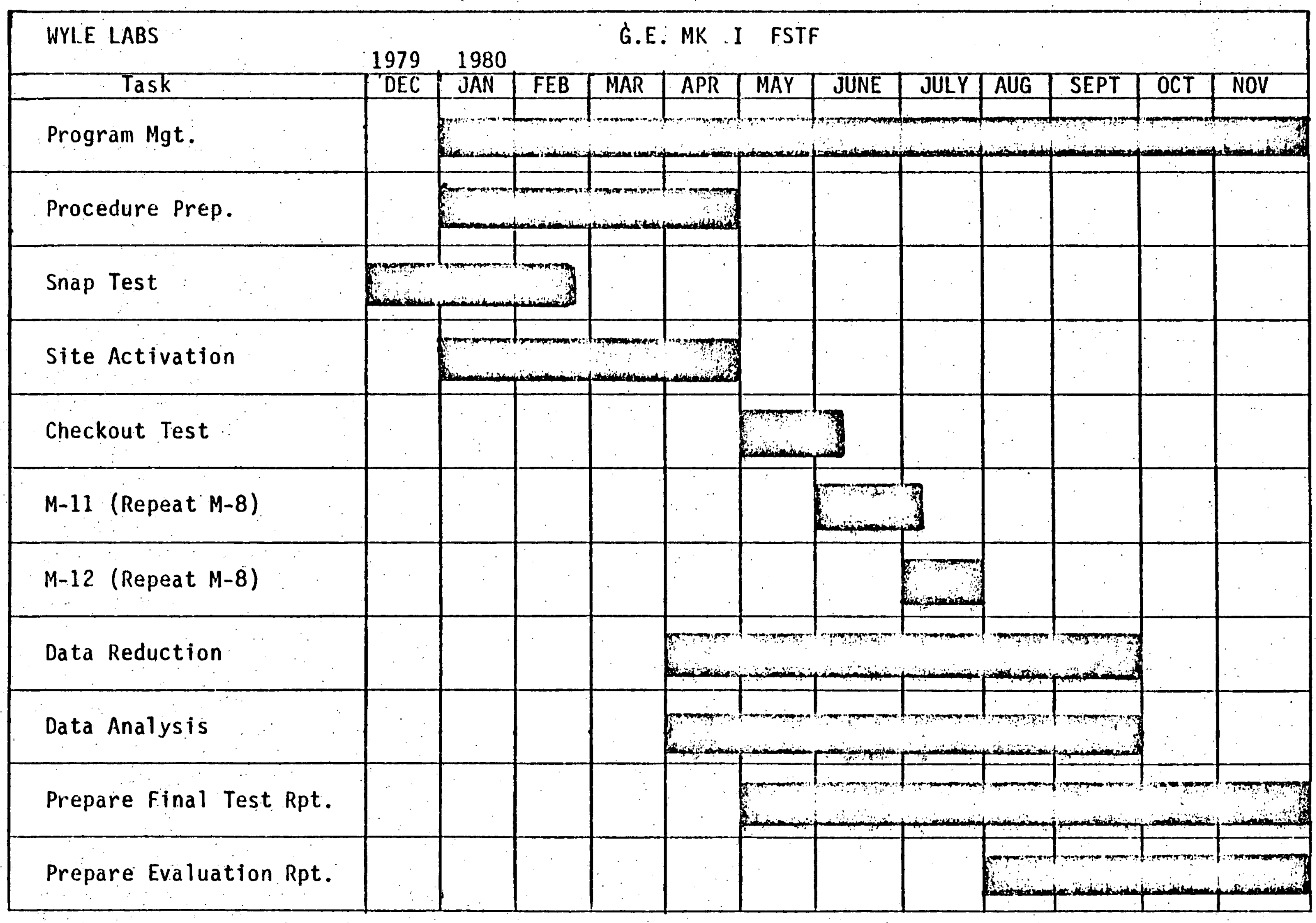
TEST MATRIX:

TEST NO.	SIMILAR TO:
M-11	M-8
M-12	M-8

SCHEDULE:

COMPLETE TESTS	JULY 1980
COMPLETE TEST REPORT	NOVEMBER 1980
COMPLETE EVALUATION REPORT	DECEMBER 1980

MILLSTONE


WYLE LABS
G.E. MK I FSTF
1979
1980
Task
DEC
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
Program Mgt.
Procedure Prep.
Snap Test
Site Activation
Checkout Test
M-11 (Repeat M-8)
M-12 (Repeat M-8)
Data Reduction
Data Analysis
Prepare Final Test Rpt.
Prepare Evaluation Rpt.

CLARIFICATION OF DRAG FOR POOL FALLBACK LOADS

The standard drag on a structure of length L is given by:

$$F_s = C_D D_{eq} L \frac{\rho U^2}{2g_c}$$

where D_{eq} is the equivalent diameter, as defined in Section 2.14. For cylinders, D_{eq} is simply the diameter, while for structures with sharp corners, $D_{eq} = 2^{1/2} L_{max}$, where L_{max} is the maximum transverse dimension.

The acceleration drag is given by:

$$F_A = \frac{\rho V_A}{g_c} \frac{dU}{dt}$$

where V_A is the acceleration volume, as given in Table I of NEDO 21471, and dU/dt for a free fallback is the gravitational acceleration, g.

The initial fallback load on structures within the air bubble, estimated using the froth fallback criteria of 25% water density and a maximum fallback velocity based on $(y_m - y_s)$ is:

$$F_i = SL \frac{\rho}{4} \frac{U^2}{g_c}$$

where S is the maximum horizontal cross-sectional dimension.

By inspection it may be noted that:

$$F_s = (2C_D) \frac{D_{eq}}{S} F_i$$

Since $D_{eq} \geq S$, it follows that for any value of $C_D > 0.5$, the standard drag load will bound the initial impact load. To provide sufficient conservatism for fallback densities greater than 25%, the minimum value of C_D should be taken as 1.2.

The ratio of standard drag to acceleration drag depends on the shape of the structure,

$$\frac{F_s}{F_A} = \frac{C_D D_{eq} L (y_m - y_s)}{V_A}$$

or

$$\frac{F_s}{F_A} = C_D \frac{(y_m - y_s)}{\pi R} \text{ for cylinders}$$

$$\frac{F_s}{F_A} = C_D \left(\frac{2}{4+\pi}\right) \frac{(y_m - y_s)}{S} \text{ for square rods (side, S)}$$

Since $(y_m - y_s)$ is on the order of 10 feet and the submerged structures have cross-sectional dimensions on the order of 0.1 to 1.0 foot, the standard drag is normally dominant. This is in contrast to the pool swell drag loads, where acceleration drag dominates due to rapid bubble growth.

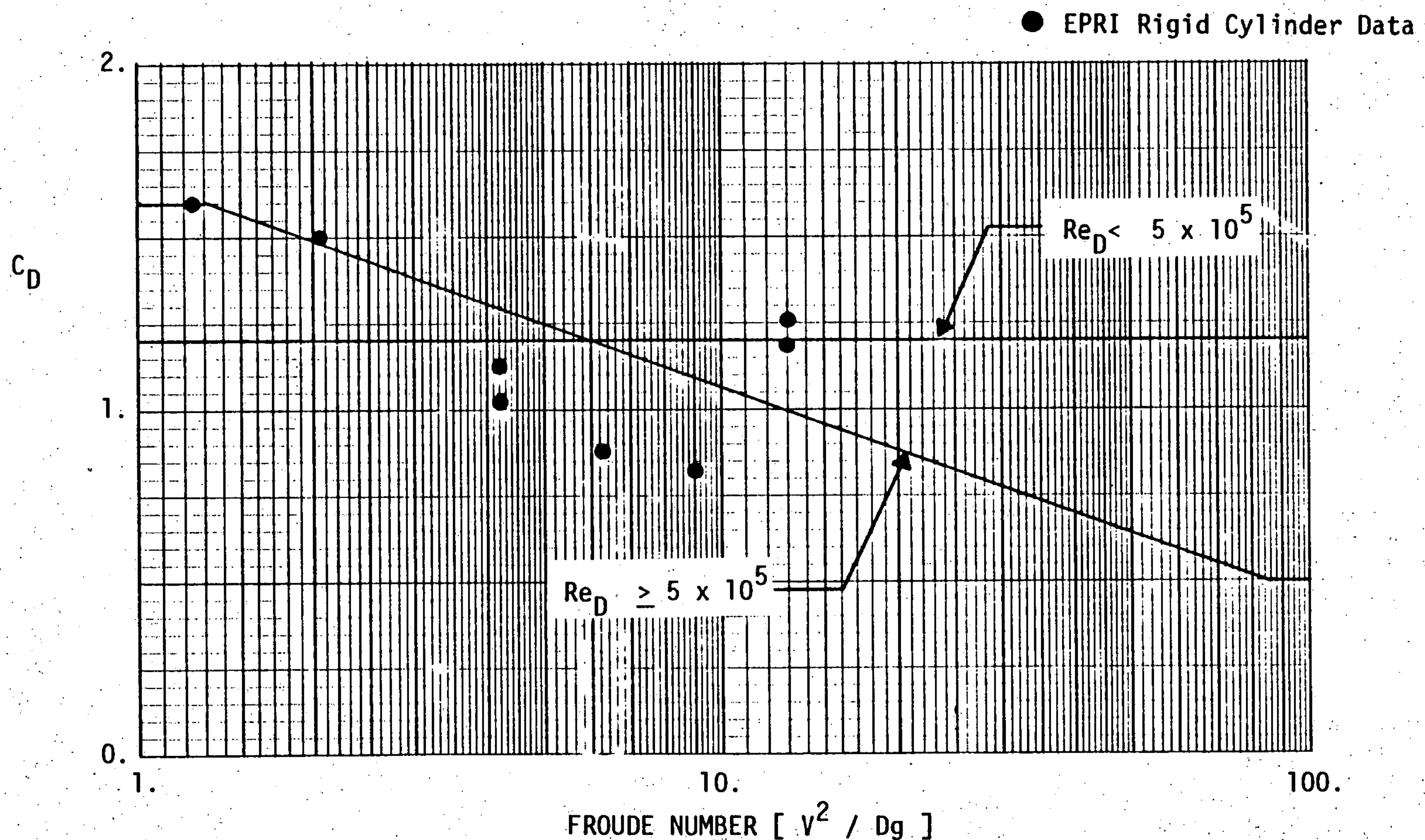


FIGURE 3.5-4 CYLINDRICAL TARGET DRAG COEFFICIENT FOLLOWING IMPACT

ENCLOSURE 5