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

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NOV 18 1977

MEMORANDUM FOR: R. Mattson, Director, Division of Systems Safety, ONRR

FROM: R. Tedesco, Assistant Director for Plant Systems, DSS

SUBJECT: PROPOSED REVISIONS TO TASK ACTION PLAN A-39, "DETERMINATION OF SAFETY RELIEF VALVE (SRV) POOL DYNAMIC LOADS AND TEMPERATURE LIMITS FOR BWR CONTAINMENT"

The purpose of this memorandum is to confirm our plan for development of proposed revisions to the Task Action Plan A-39, "Determination of Safety Relief Valve (SRV) Pool Dynamic Loads and Temperature Limits for BWR Containment." First we are proposing to change the task action manager from John Kudrick, who is a section leader, to Tsung Ming Su.

In addition, we propose to change the task action plan to include efforts for resolution of the recent GE Part 21 notification related to multiple actuation of safety relief valves and concomitant load increases for BWR water pressure-suppression type containments. This concern resulted from the recent study performed by GE of the primary system pressure response following an isolation event which results in more than one safety relief valve to be actuated consecutively. Consistent with the current plan, we will include generic resolutions for the Mark I, II and III types of containments but different from the current plan, we will include review and evaluations of the load combinations which involve relief valve operations only.

This concern involves the Reactor Systems Branch, the Instrumentation and Control Systems Branch, Structural Engineering Branch, Mechanical Engineering Branch and the Analysis Branch within DSS and the Plant Systems Branch and Engineering Branch of DOR and will require appropriate scheduling and manpower requirements.

We will follow the same procedures used for the initial approval for the task action plans; i.e., draft the changes and submit them to all concerned branches. We expect to have draft changes by November 22, 1977;

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and allowing time for comments from other branches, we will provide you with a plan for your review by December 2, 1977.

Robert L. Tedesco, Assistant Director
for Plant Systems
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MARK I HYDRODYNAMIC/STRUCTURAL INTERACTION

FY 1977

LAWRENCE LIVERMORE LABORATORY
THERMO FLUID MECHANICS GROUP

R. W. MARTIN
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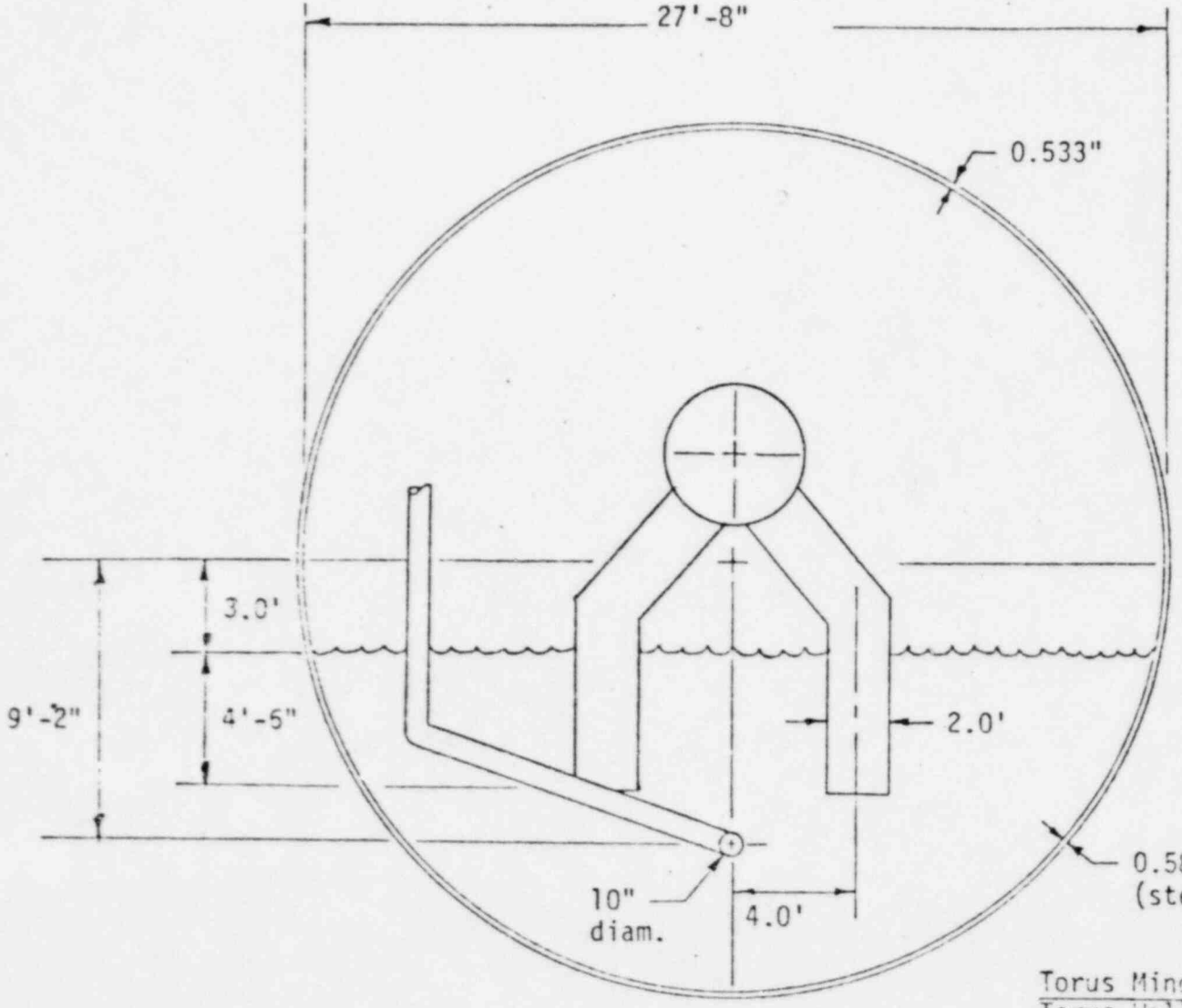
PRESENTED TO USNRC-DOR

NOVEMBER 15, 1977

- EXPERIMENTAL DATA EXISTS FOR SYSTEMS WITH DIFFERING FLEXIBILITIES.

- PURPOSE IS TO DETERMINE EFFECT OF TORUS WALL FLEXIBILITY ON HYDRODYNAMICALLY INDUCED LOADS PRODUCED DURING SRV, LOCA CHUGGING, AND LOCA VENT CLEARING



$$\frac{\text{Torus Minor Diameter}}{\text{Torus Wall Thickness}} , \frac{D}{t} = 568.49$$

FIGURE 1. Reference Dimensions for Monticello Plant Pressure Suppression System

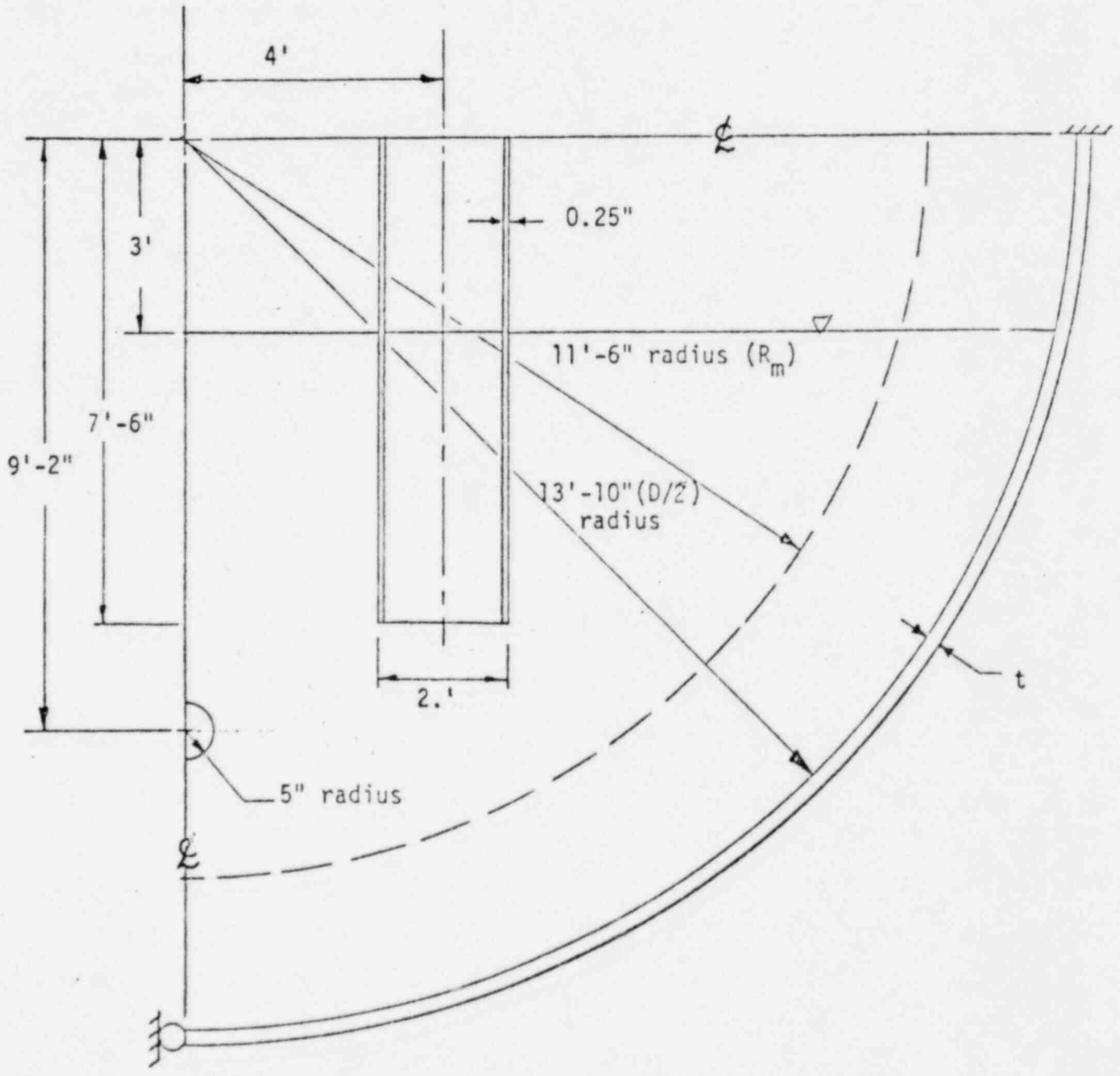


FIGURE 2. Idealized Problem Geometry

- STEAM RELIEF VALVE DISCHARGE (SRV) PROBLEM

SRV AND LOCA CHUG PROBLEMS

- TWO METHODS

  FINITE ELEMENT (DTVIS2)
  FINITE DIFFERENCE (CHAMP)

- FINITE ELEMENT

  FAST (2-5 MINUTES PER PROBLEM)
  RELATIVELY NO ZONING RESTRICTIONS
  SMALL DEFORMATIONS

- FINITE DIFFERENCE

  SLOW (3-10 HOURS PER PROBLEM)
  LAGRANGIAN ZONING LIMITATIONS
  VISCOUS DAMPING INSTABILITIES

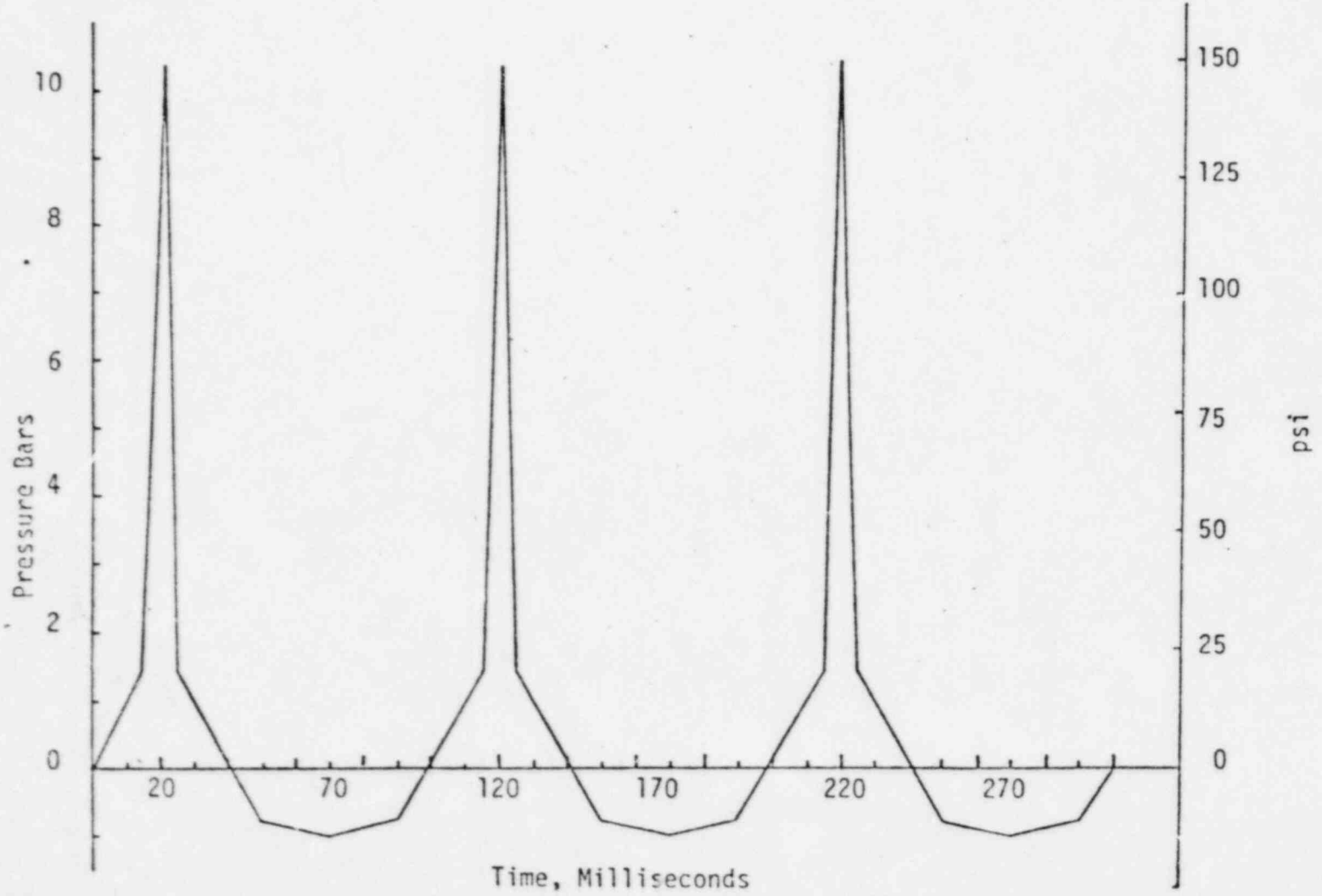


FIGURE 3. Input Pulse for SRV Discharge Problem

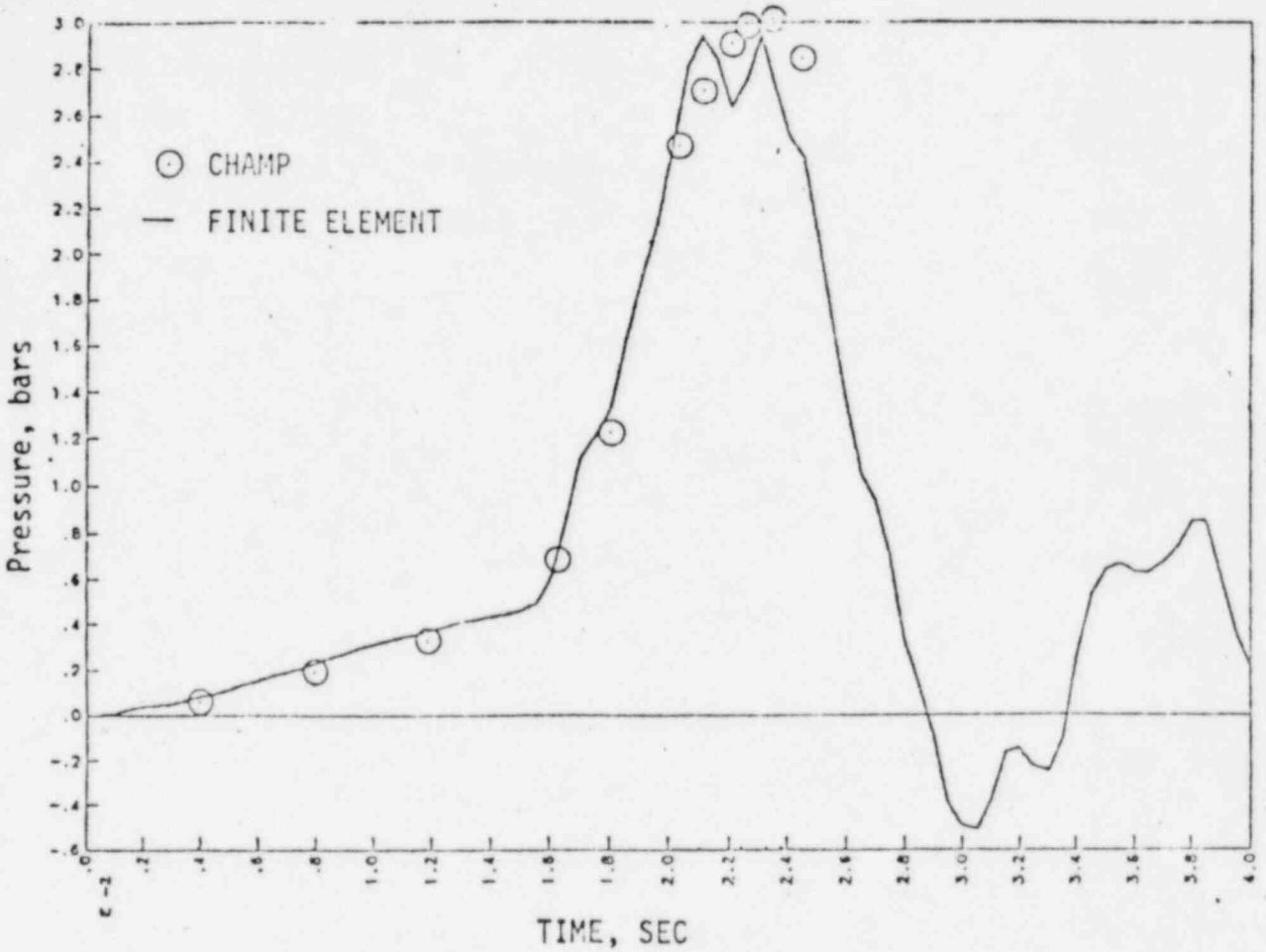


FIGURE 5. Pressure at Pool Bottom, D/t = 300 (SRV Problem)

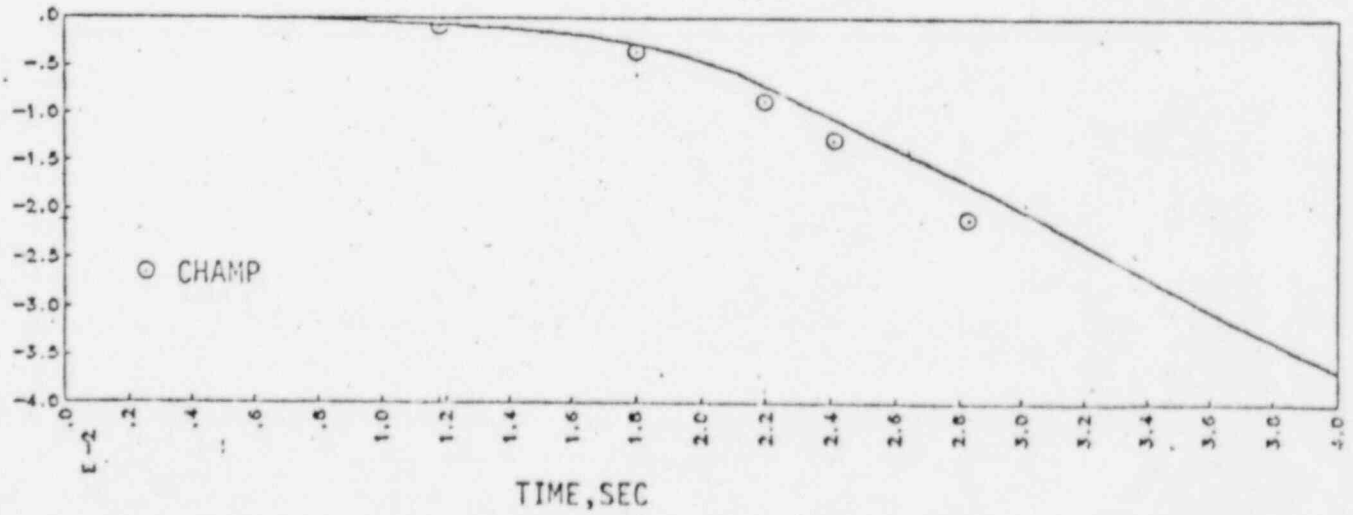


FIGURE 6. Wall Displacement at Pool Bottom, D/t = 300 (SRV Problem)

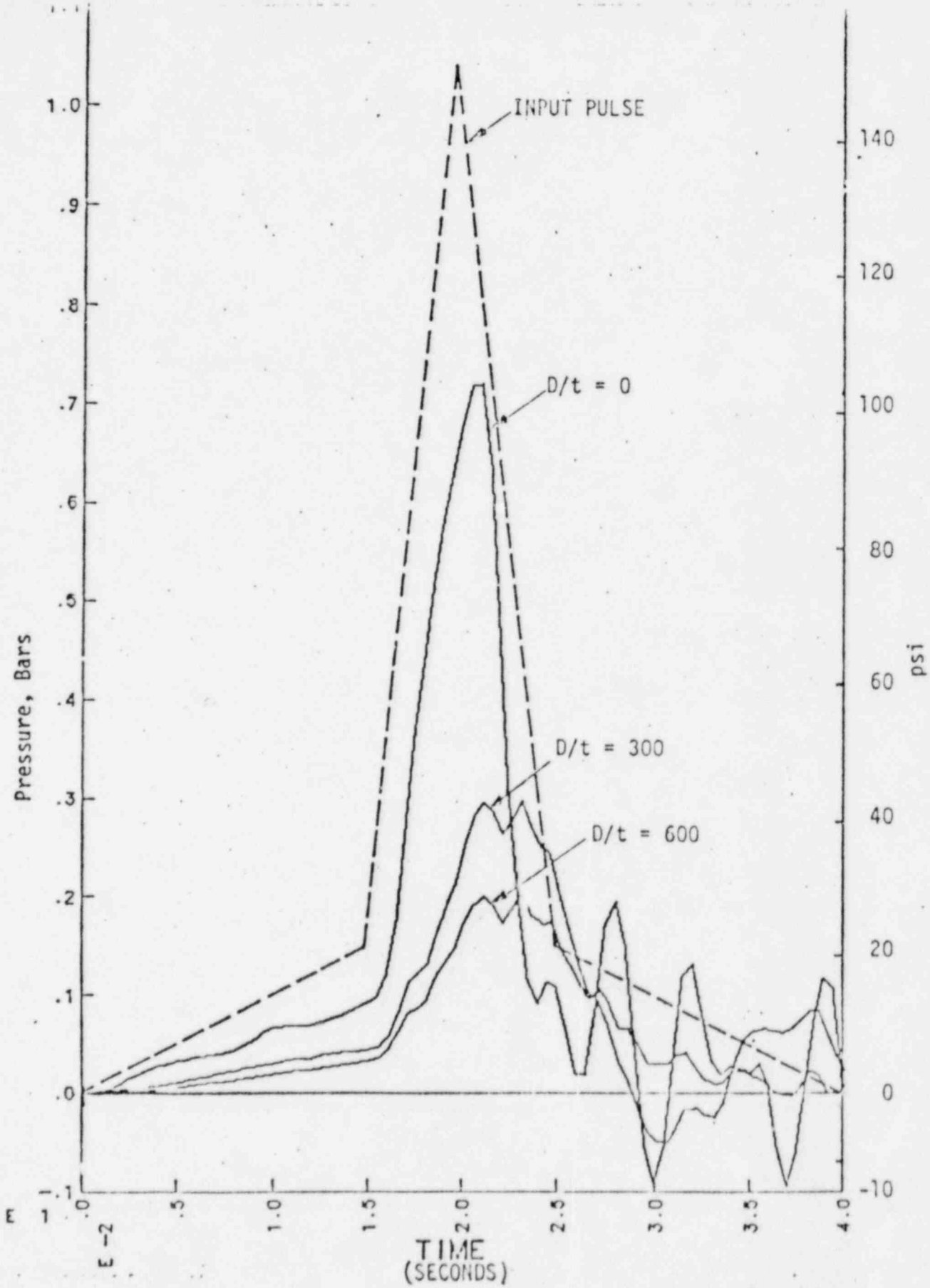


FIGURE 7. Effect of Torus Shell Thickness on the Pressure History at the Pool Bottom (SRV Discharge)

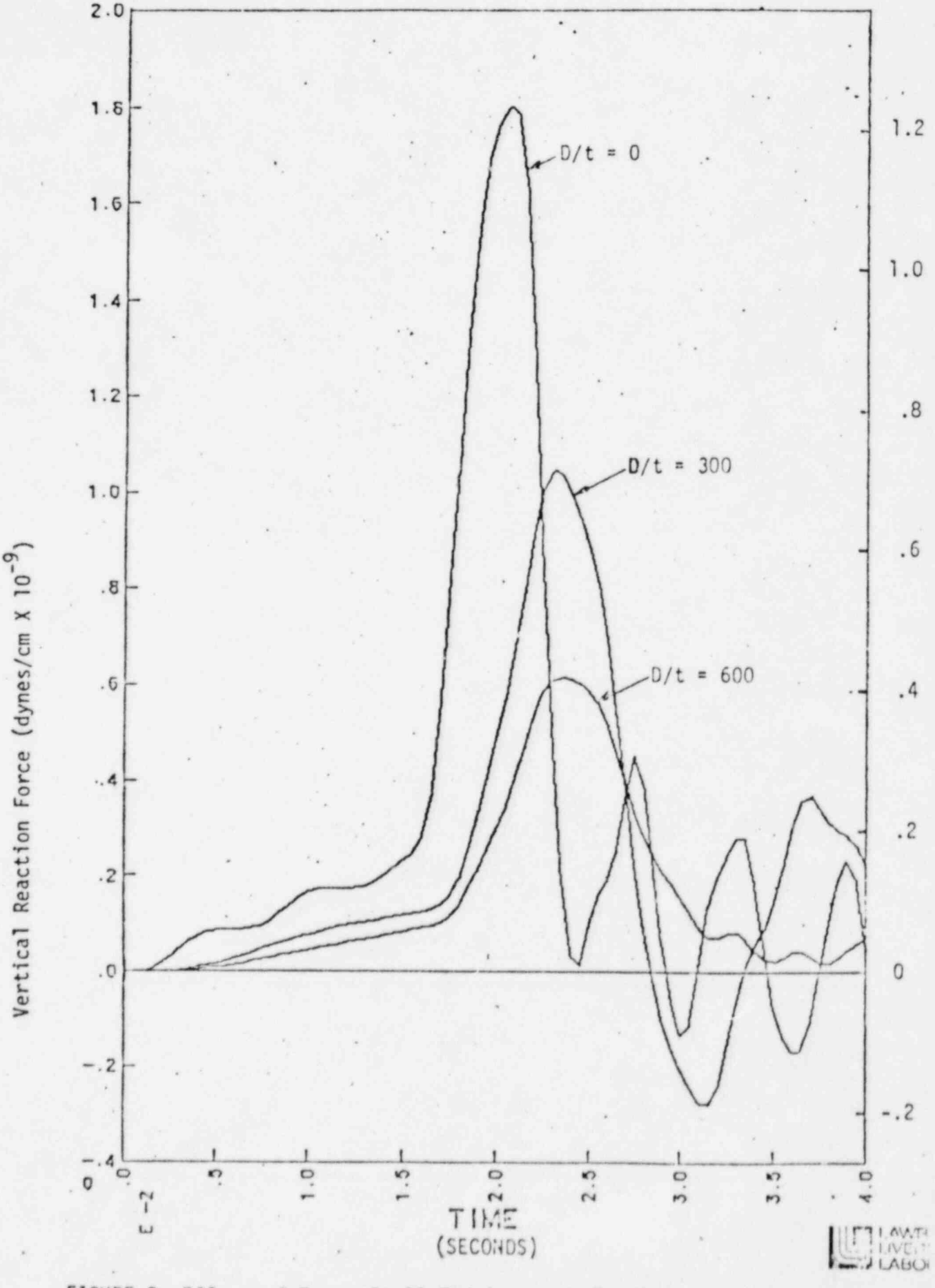


FIGURE 8. Effect of Torus Shell Thickness on Total Vertical Reaction Force History. (SRV Discharge)

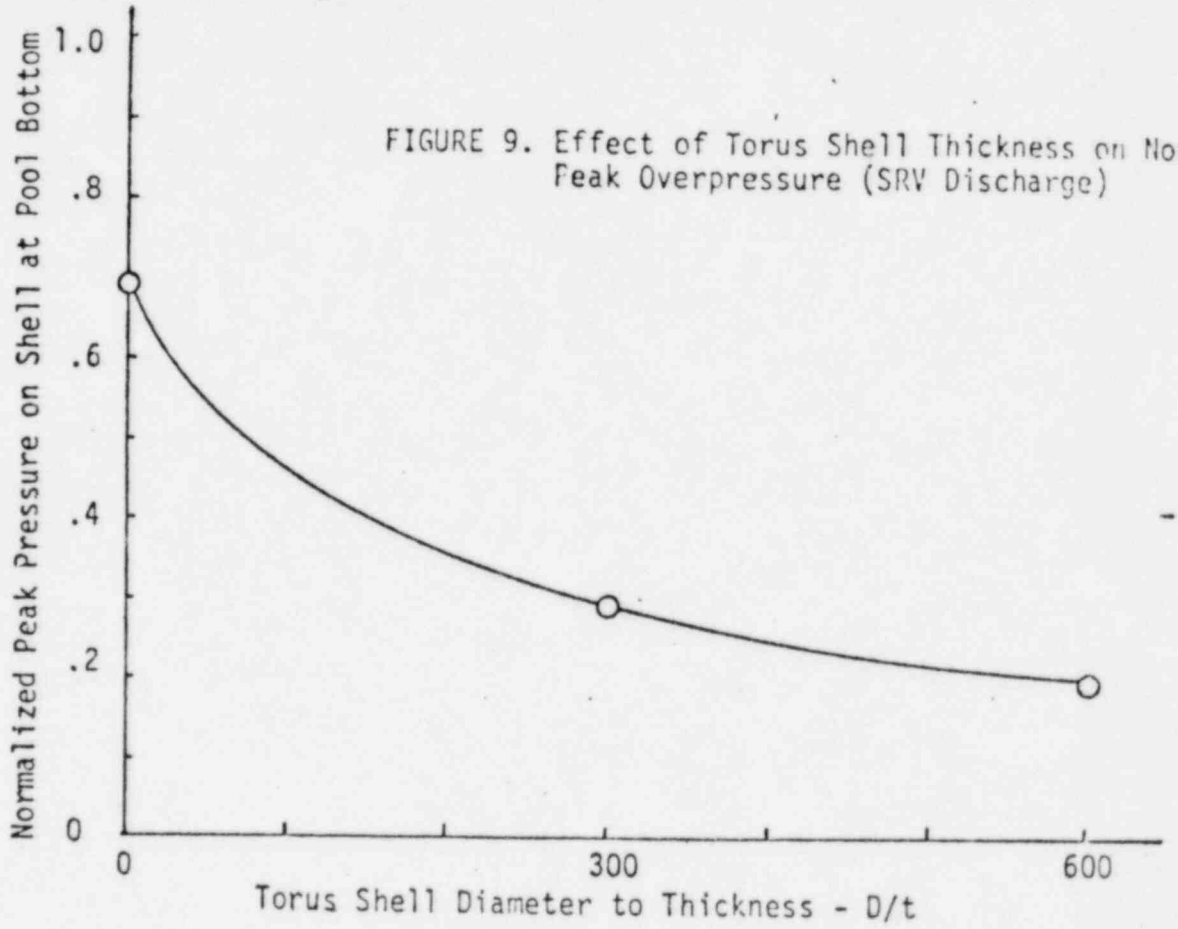


FIGURE 9. Effect of Torus Shell Thickness on Normalized Peak Overpressure (SRV Discharge)

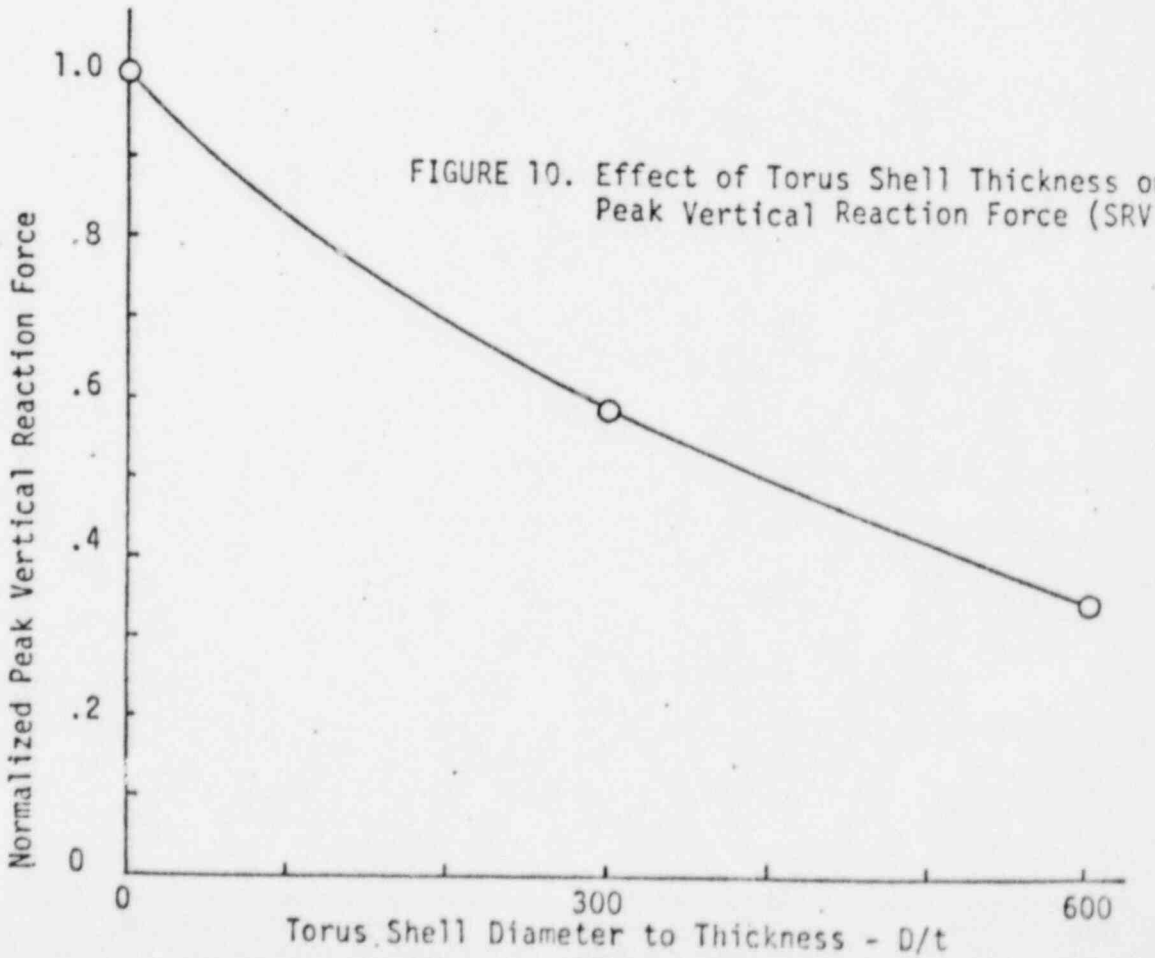


FIGURE 10. Effect of Torus Shell Thickness on Normalized Peak Vertical Reaction Force (SRV Discharge)

- LOCA CHUG PROBLEM

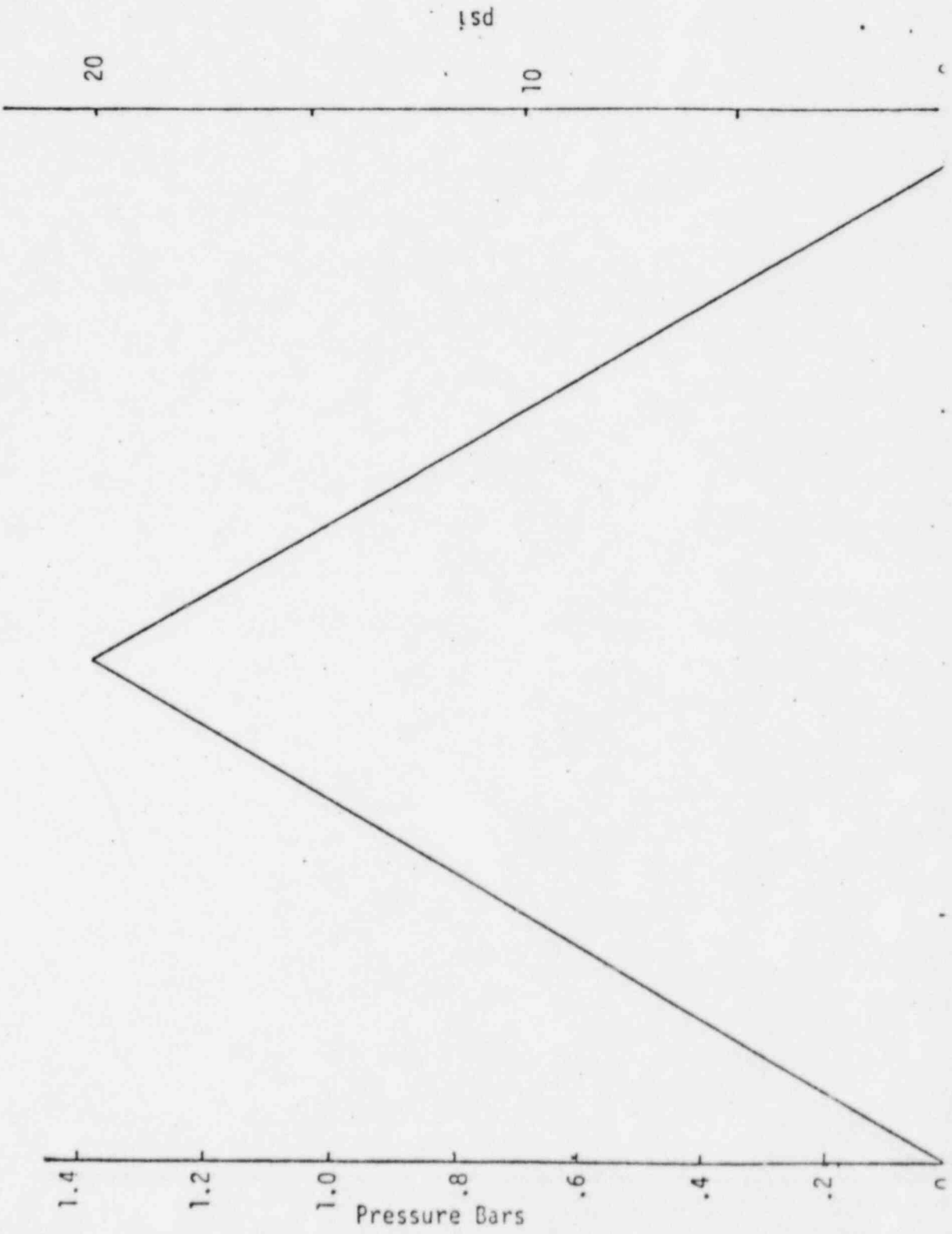


FIGURE 4. Input Pulse for LOCA Chugging Problem

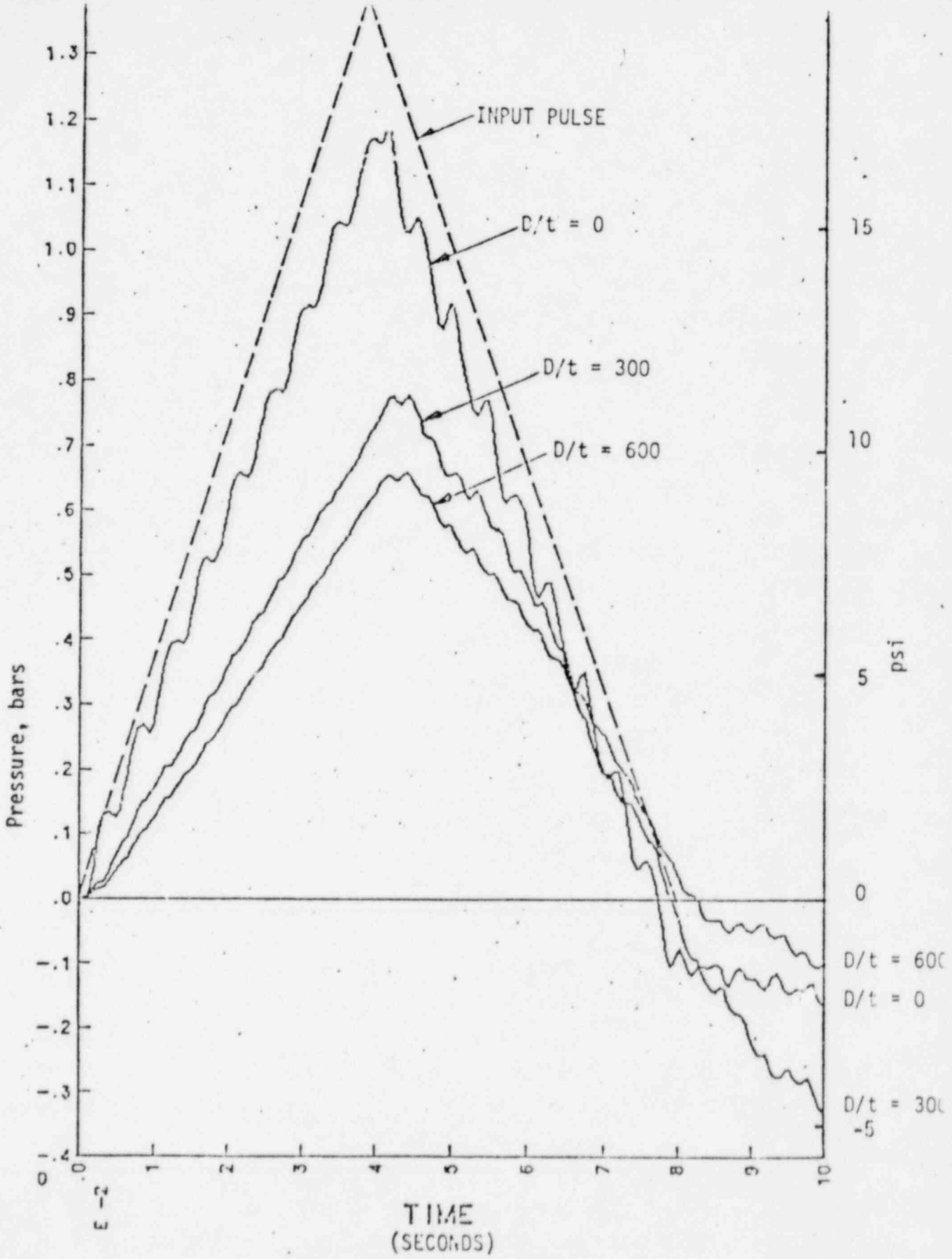


FIGURE 11. Effect of Torus Shell Thickness on Pool Bottom Pressure History (LOCA Chug)

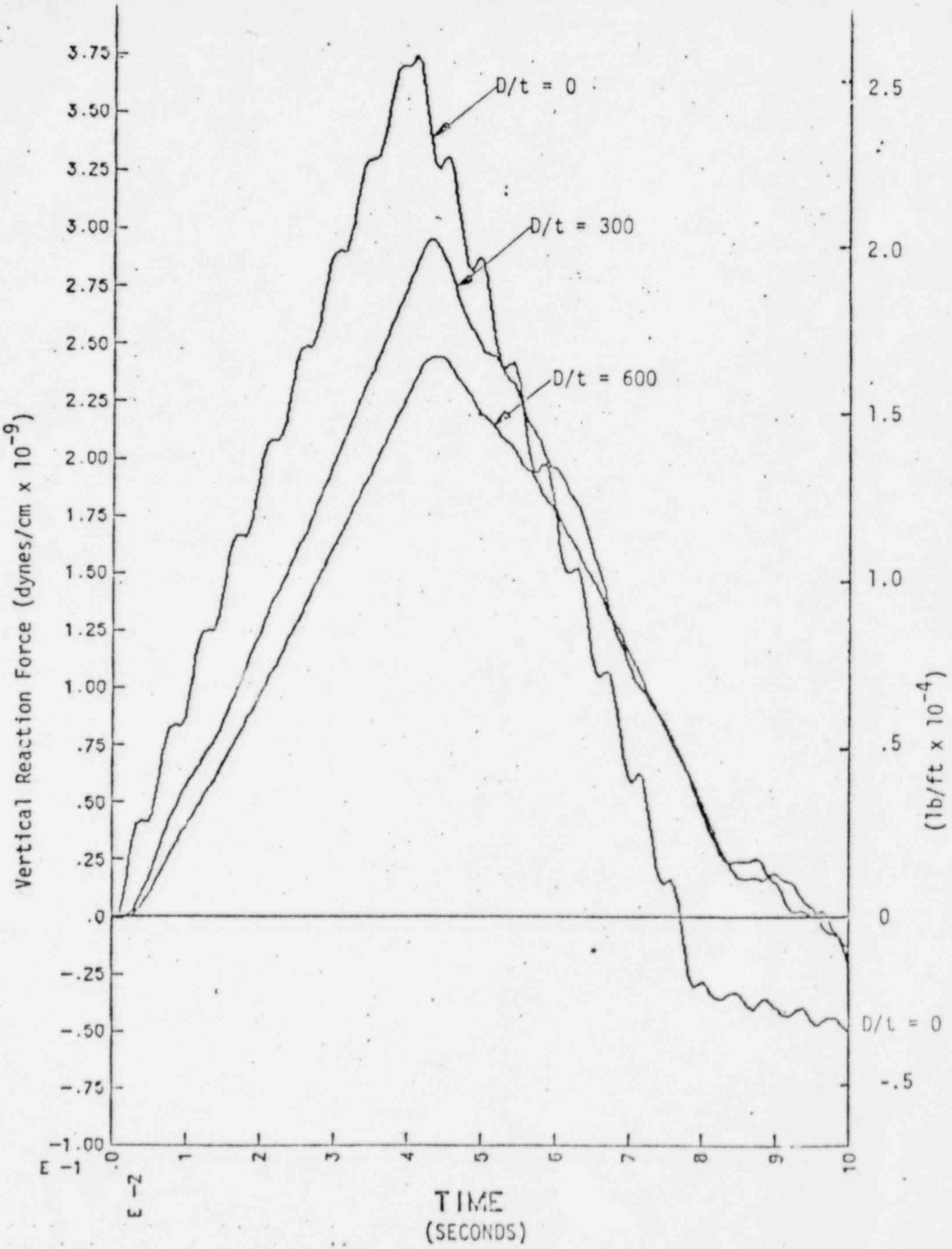


FIGURE 12. Effect of Torus Shell Thickness on Total Vertical Force (LOCA Chug)

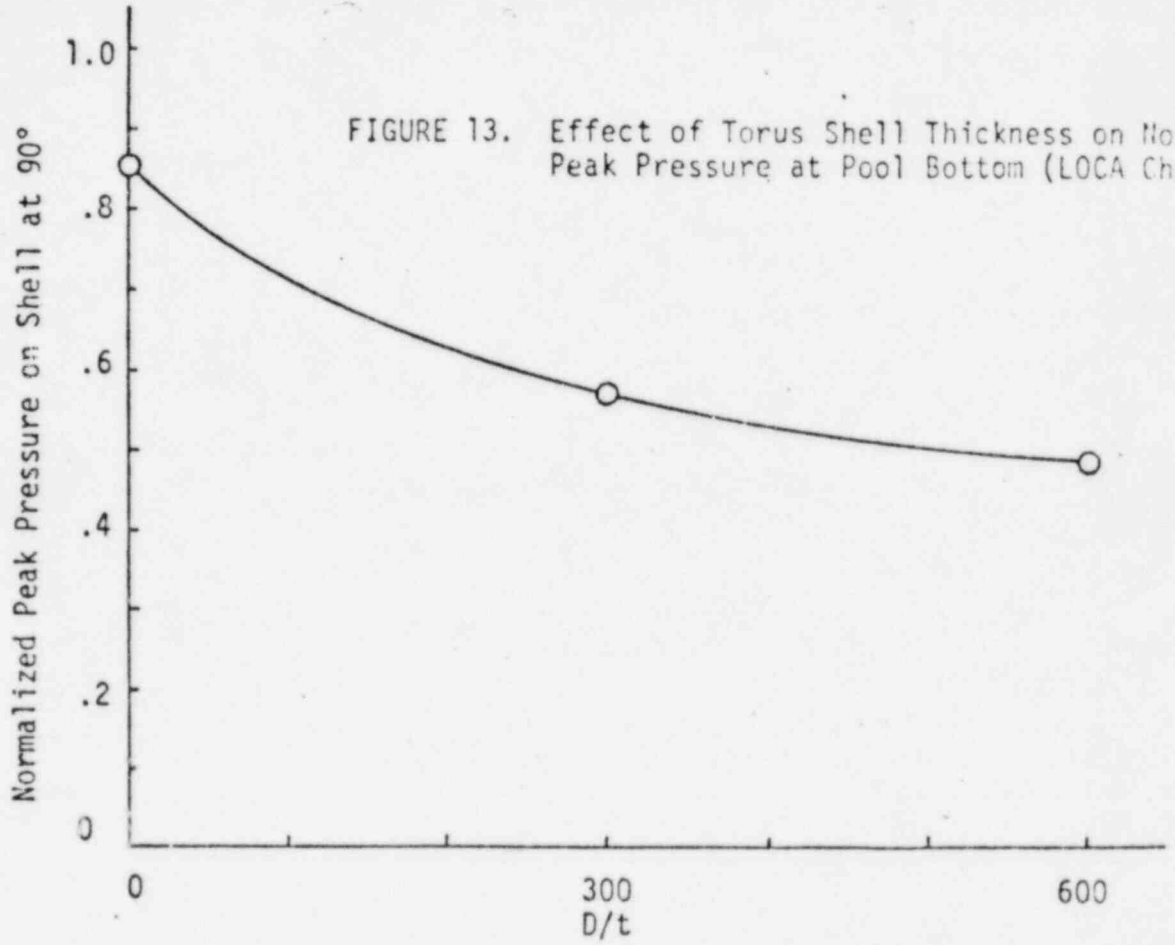


FIGURE 13. Effect of Torus Shell Thickness on Normalized Peak Pressure at Pool Bottom (LOCA Chug)

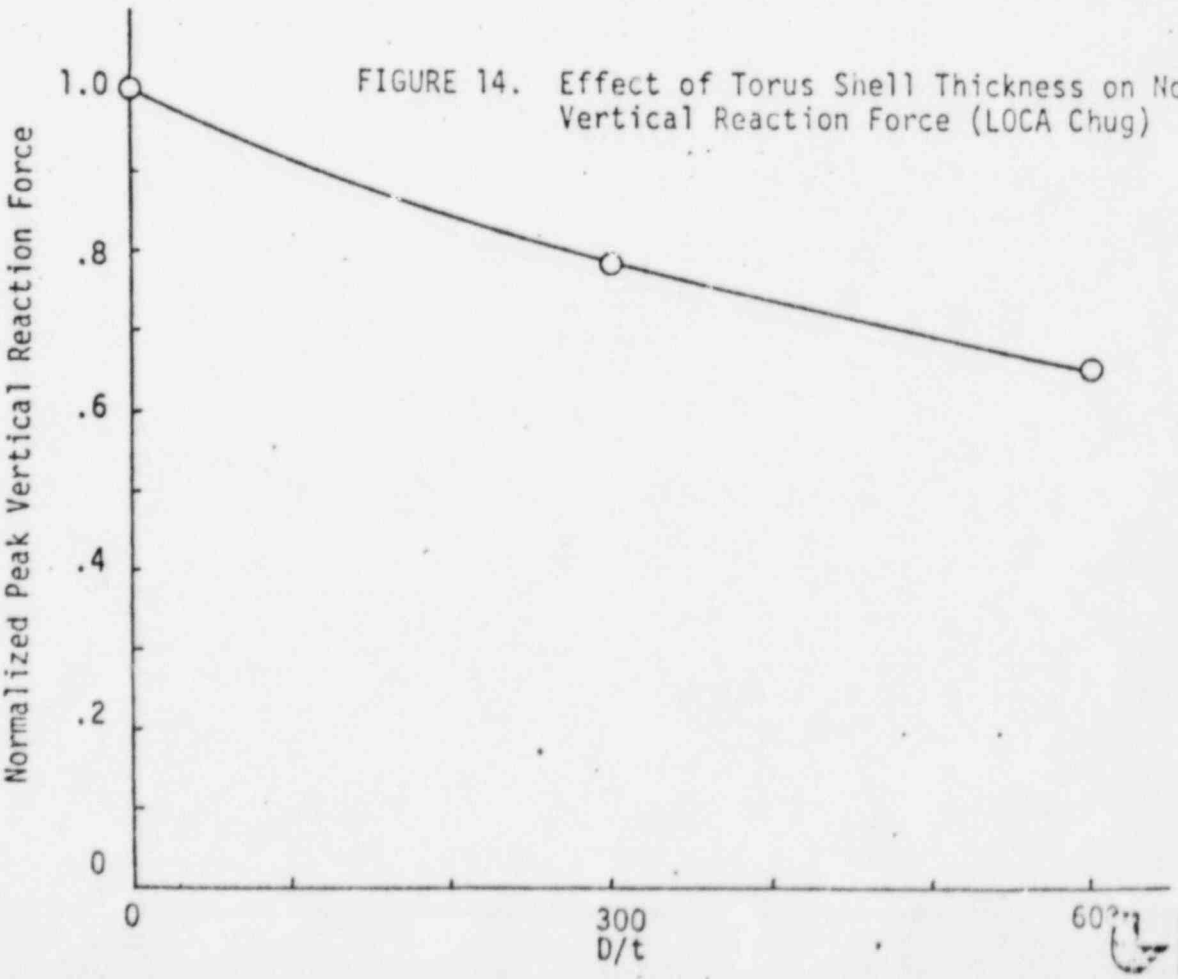


FIGURE 14. Effect of Torus Shell Thickness on Normalized Vertical Reaction Force (LOCA Chug)

LIMITATIONS OF CURRENT ANALYSIS

- STRUCTURAL

  PLANE SECTION MODELLING UNDERESTIMATES RIGIDITY OF ACTUAL DESIGN

- HYDRODYNAMIC

  LACK OF OUT-OF-PLANE LIMIT INTRODUCES TOO MUCH ENERGY IN THE SOURCE

- RESULT

  NET EFFECT IS TO OVERESTIMATE THE DEPENDENCE OF FORCES ON WALL THICKNESS

- LOCA VENT CLEARING PROBLEM

CHARACTERIZED BY LARGE FLUID MOTIONS (4.5 FT)

REQUIRES EULERIAN FORMULATION COUPLED TO LAGRANGIAN SHELL

EXISTING CODE UNDER DEVELOPMENT, CHAP, WAS EXPECTED TO PERFORM SATISFACTORILY (LARGE $ CONTRACT)

THIS WORK WILL BE DEFERRED UNTIL FY 78

CALCULATIONAL MATRIX

	D/T		
PROBLEM TYPE	0	300	600
SRV	X	X	X
LOCA CHUG	X	X	X
LOCA VENT CLEAR	-	-	-

LAWRENCE LIVERMORE LABORATORY

SUMMARY OF FY 77 RESULTS

FOR SRV AND LOCA CHUG PROBLEMS :

PRESSURE HISTORIES ON SHELL

PRESSURE HISTORIES IN FLUID FIELD

SHELL DISPLACEMENT HISTORIES

SOURCE BOUNDARY HISTORIES

VERTICAL FORCE HISTORIES

VERTICAL FORCE VS D/T RATIO

WORK FOR FY 78

- FOR THE SRV AND LOCA CHUG PROBLEMS

  IMPROVED MODELING OF THE STRUCTURE (3D)
  VARIATION OF PULSE WIDTHS AND AMPLITUDES
  IMPROVED MODELING OF THE SOURCE

  SEPARATE STRUCTURAL ANALYSIS TO IMPROVE
  APPROXIMATION FOR ACTUAL PSS (RETAIN 2D SIMPLICITY)

- FOR THE LOCA VENT CLEARING PROBLEM

  MODIFICATION OF VISCOUS DAMPING
  VALIDATION OF "SCALED" EULERIAN TO LAGRANGIAN
  BOUNDARY
  LIMIT D/T TO 300+ WITH EXISTING LAGRANGE
  MODIFY LAGRANGE TO TREAT 600:1
  MODIFY TO INCORPORATE SHELL BOUNDARY

FINITE ELEMENT CODE - DTVIS2

- TWO-DIMENSIONAL, IMPLICIT, LINEAR
- DYNAMIC THERMOVISCOELASTIC SOLIDS
- CONSTANT PRESSURE FLUID ELEMENTS
- ELASTIC THIN SHELL ELEMENTS
- SLIDE ELEMENTS

DTVIS2 REFERENCE DOCUMENTATION

- "Evaluation of Numerical Integration Methods in Elastodynamics"
  G. L. Goudreau
  R. L. Taylor
  Computer Methods in Applied Mechanics and Engineering
  V.2 (1973), No. 1
  North Holland Publishing Co.
  Amsterdam

- "Evaluation of Discrete Methods for the Linear Dynamic Response of Elastic and Viscoelastic Solids"
  G. L. Goudreau
  National Technical Information Service
  Operations Division
  Springfield, VA 22151, USA
  Accession No. PB194-286