SMALL BREAK LOCA MODEL RESOLUTION

- NUREG 0626 CONCERNS IDENTIFIED (1/80)
- GE/NRC MEETING TO PROPOSE ACTION PLAN (1/81)
- NRC/GE AGREEMENT REACHED (2/81)
  - REPORT TO BE SUBMITTED (1/82)
- GE PRESENTED NEW ECCS APPROACH FOR BWR'S (5/81)
  - ADEQUATE SAFETY MARGIN
  - BEST ESTIMATE PHILOSOPHY
- GE DEVELOPING SAFER
  - SAFE/REFLOOD REPLACEMENT
  - TECHNIQUE DESCRIPTION TO NRC (12/81)
- PURPOSE OF DISCUSSION
  - CLOSE OUT ISSUE
  - ELIMINATE NEED TO ISSUE 1/82 REPORT

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NRC CONCERNS AND RESOLUTION

CCFL MODELING IN SAFE

CORE BYPASS MODELING IN SAFE

RECIRCULATION LINE INVENTORY

TREATMENT OF PRESSURE VARIATION

INFLUENCE OF HOMOGENEOUS - EQUILIBRIUM

UNCERTAINTY ANALYSIS

OVERALL MODEL ASSESSMENT

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CCFL MODELING IN SAFE

- NRC CONCERN.

  CCFL INFLUENCE ON SMALL BREAKS DURING CORE UNCOVERY IS NOT ACCOUNTED FOR IN SAFE.

- RESPONSE:

  - SAFE/REFLOOD COMBINATION USED.

  - CCFL AT TOP OF CORE INCLUDED IN REFLOOD.

  - CCFL AT BOTTOM CONSERVATIVELY NEGLECTED.

    - ANALYTICAL STUDIES (REF.1).

    - TLTA COMPARISONS (REF.2).

- RESOLUTION

  CCFL IS CONSERVATIVELY ACCOUNTED FOR IN SMALL BREAK METHODS

TREATMENT IS ADEQUATE

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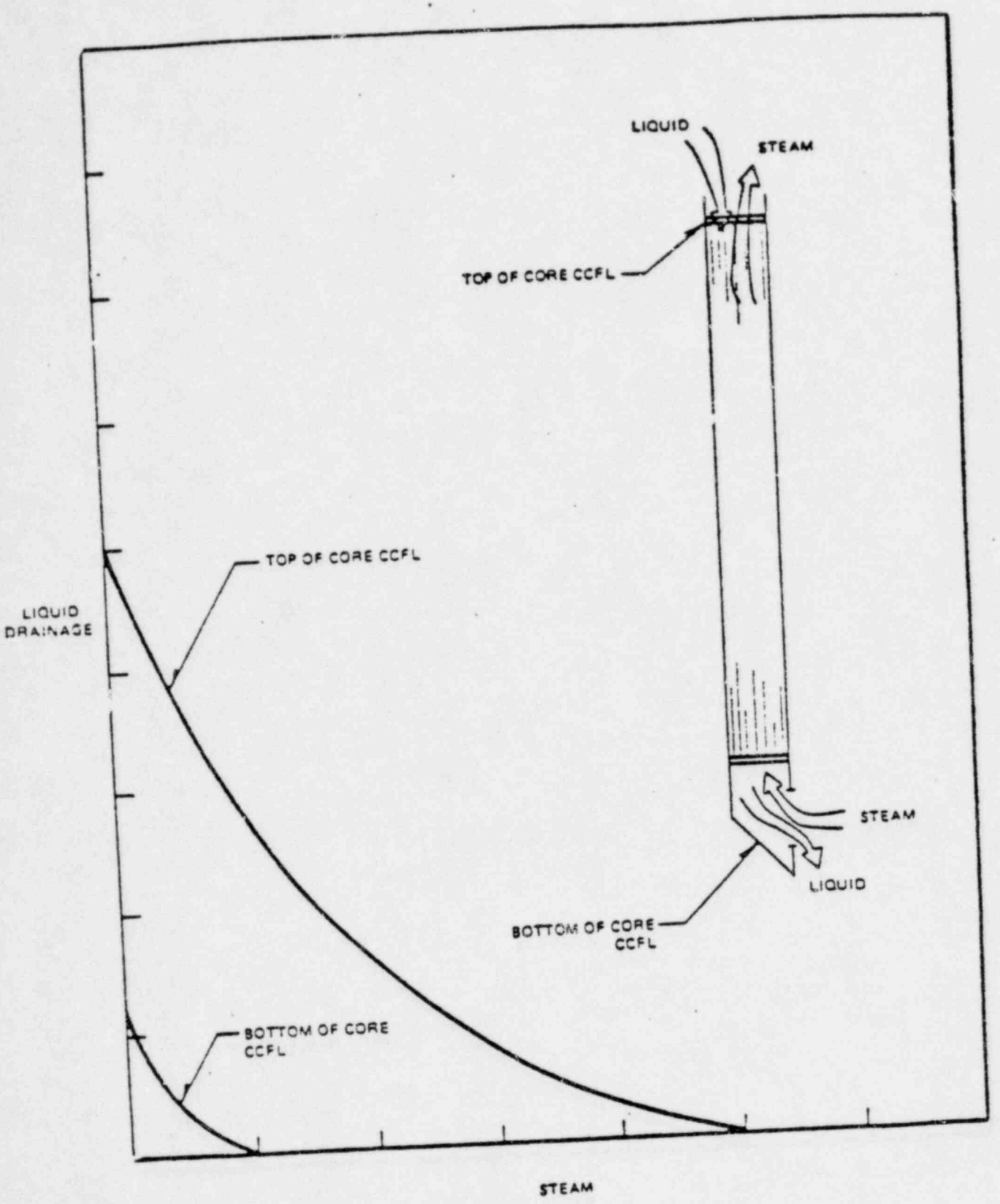

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CCFL ACROSS CORE

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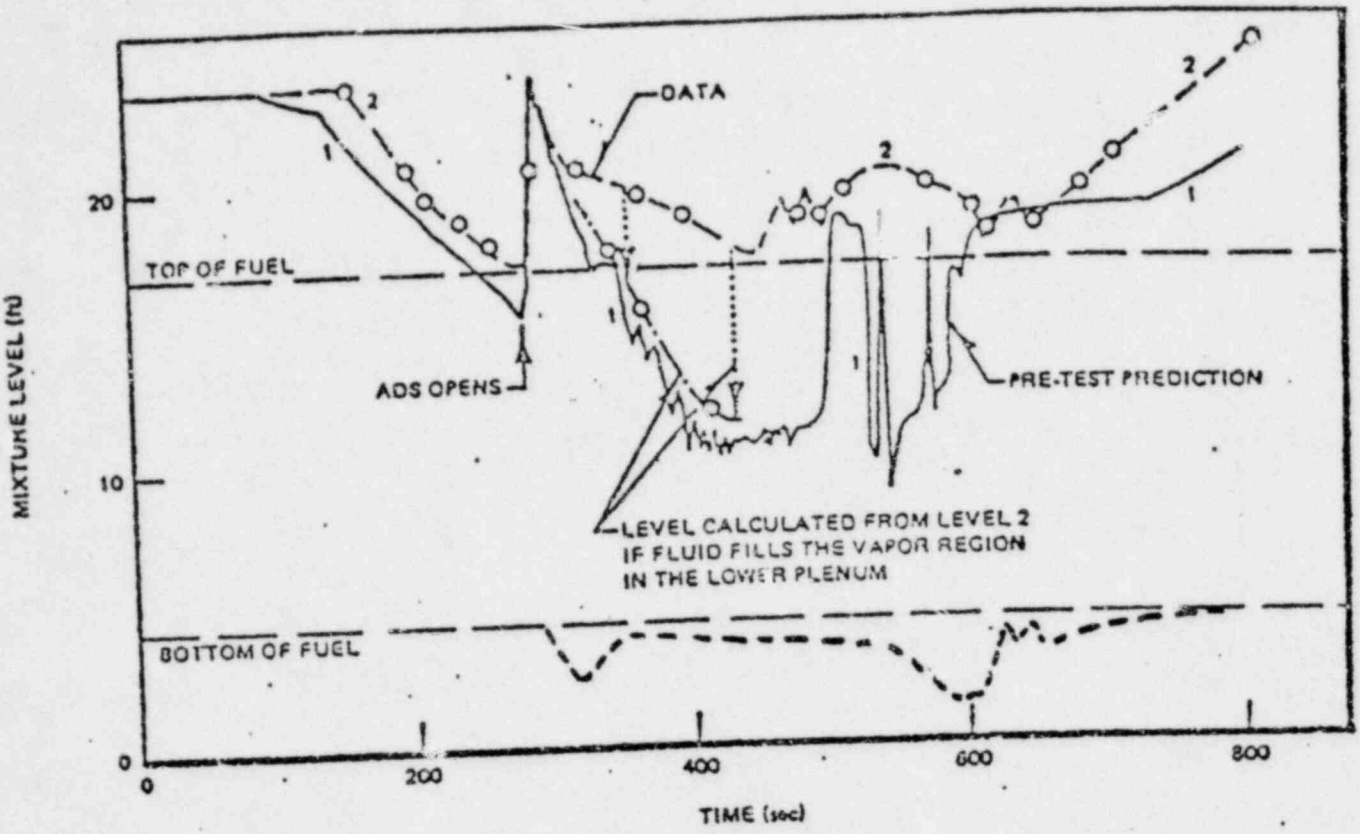
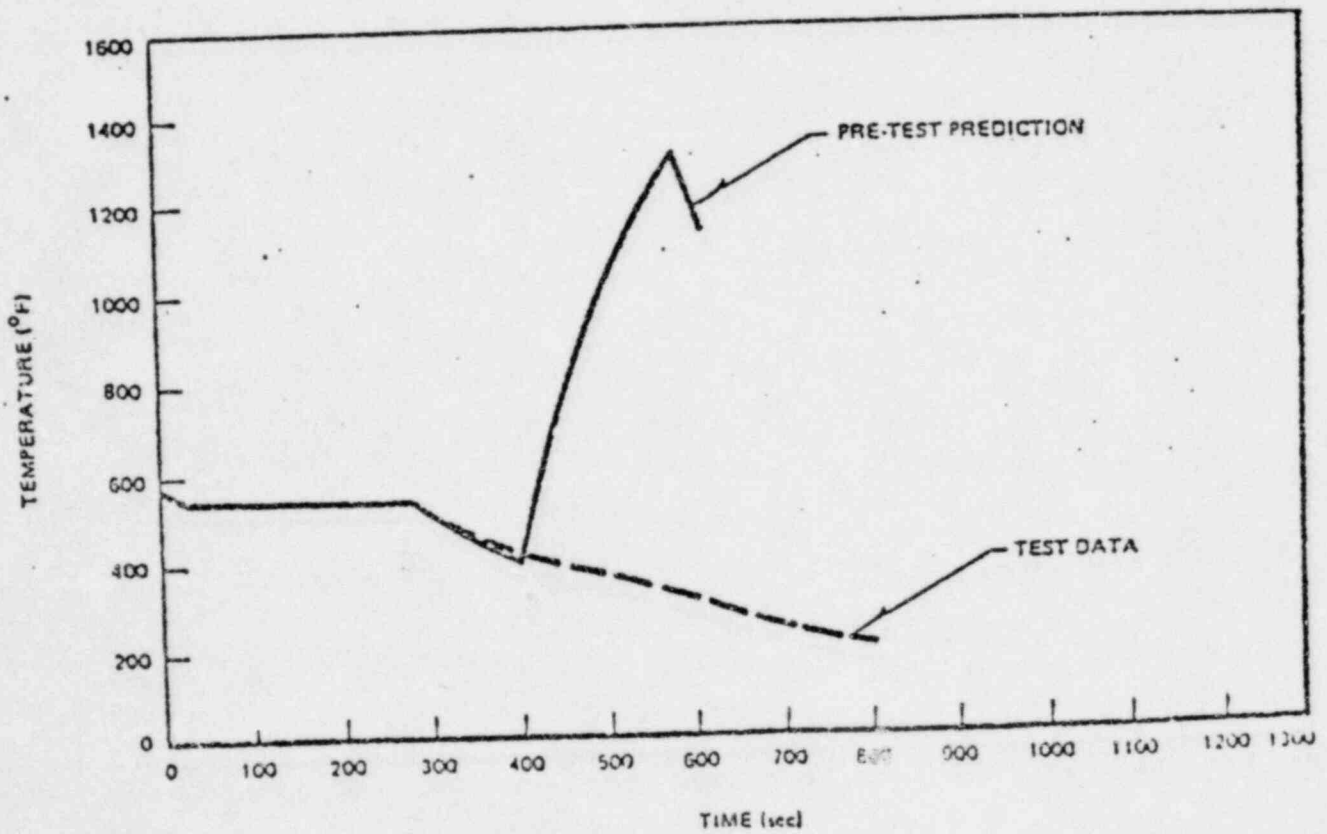


Effect of CCFL at SEO on the Mixture Level Inside the Shroud



Comparison of Peak Cladding Temperature, TLTA Small Break Test 11

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CORE BYPASS MODELING IN SAFE

- NRC CONCERN.

  SAFE DOES NOT DISTINGUISH THE BYPASS INVENTORY FROM THE CORE INVENTORY.

- RESPONSE:

  - SAFE/REFLOOD COMBINATION USED.

  - REFLOOD MODELS BYPASS SEPARATELY.

  - OVERALL COMPARISONS TO TLTA SHOW THAT THE MODELS ARE CONSERVATIVE. (REF. 2)

- RESOLUTION

  BYPASS IS SEPARATELY MODELED IN SMALL BREAK METHOD

TREATMENT IS ADEQUATE

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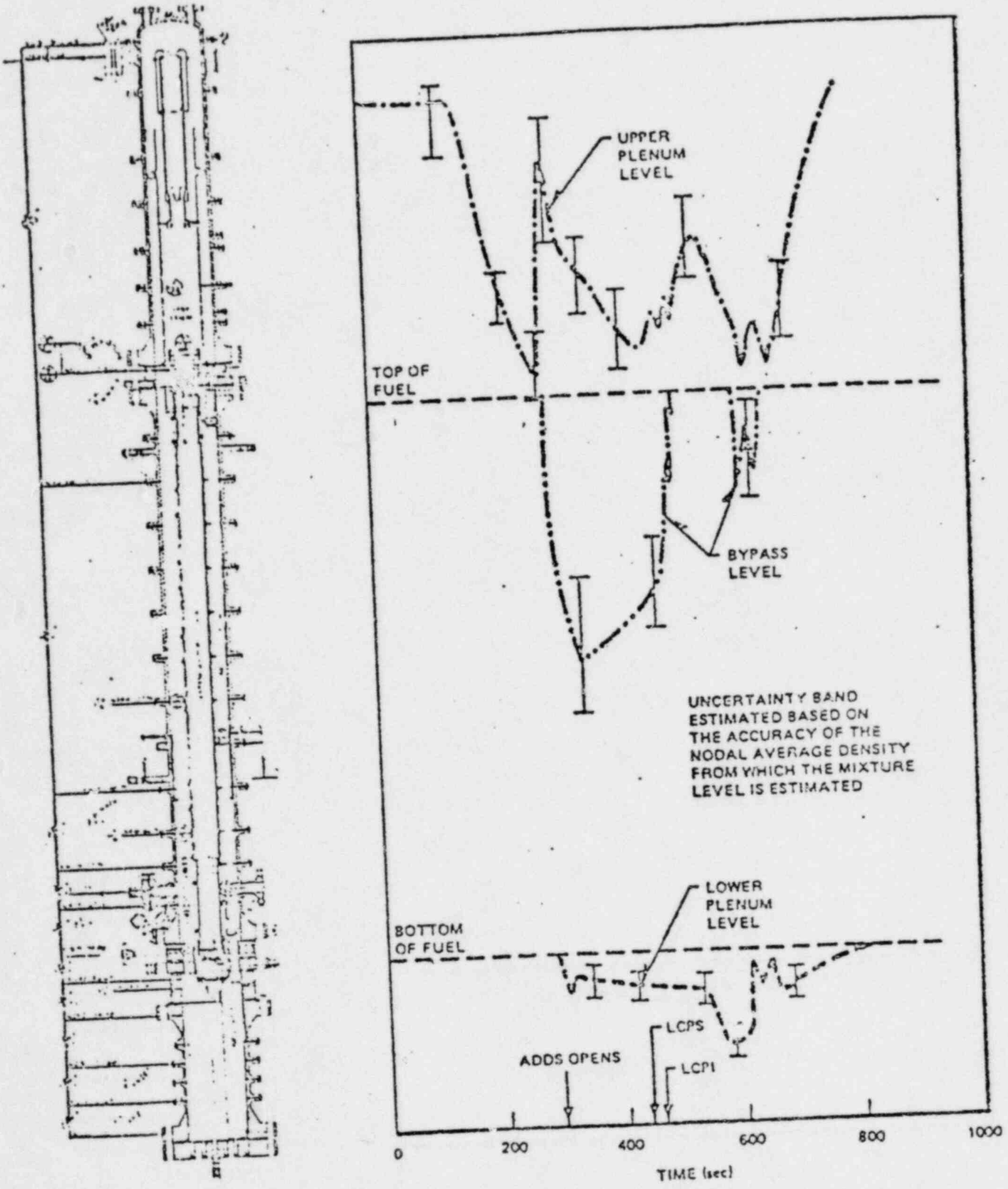

Two-Phase Mixture Level — Inside the Shroud

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RECIRCULATION LINE INVENTORY

NRC CONCERN:

THE GE MODEL INCORPORATES THE RECIRCULATION LINE INVENTORY INTO THE DOWNCOMER. GE SHOULD SHOW HOW THIS MODELING TECHNIQUE INFLUENCES SMALL BREAKS WHEN THE INVENTORY IN ONR OR BOTH OF THE RECIRCULATION LOOPS IS NOT DEPLETED.

RESPONSE:

- RECIRULCATION LINE INVENTORY IS INCLUDED IN SAFE DOWNCOMER
  - ONLY 2% OF TOTAL SYSTEM VOLUME

- IMPACT OF REJECTING THIS VOLUME
  - ΔPCT (+20 TO -40°F)

- IMPACT OF LUMPING THIS VOLUME AT BOTTOM OF DOWNCOMER
  - ΔPCT (+25 TO -40°F)

RESOLUTION:

TREATMENT IS ADEQUATE

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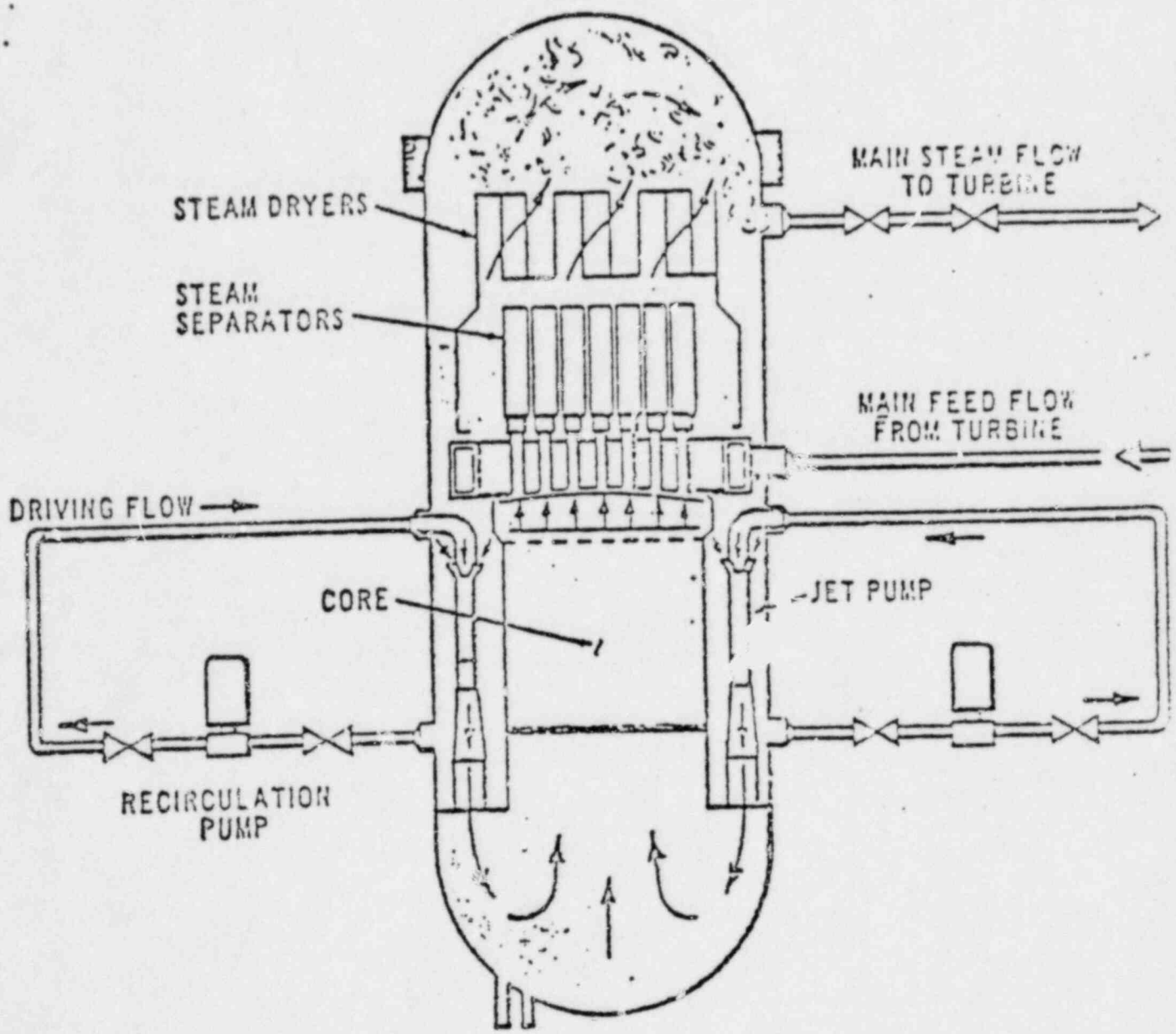

REACTOR SYSTEM

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TREATMENT OF PRESSURE VARIATION

NRC CONCERN:

WHAT IS EFFECT OF NEGLECTING PRESSURE VARIATIONS (THERMODYNAMIC) WITHIN REACTOR VESSEL (OTHER THAN STATIC HEADS).

RESPONSE:

- TRAC ANALYSES OF TLTA
  - SHOW ONLY STATIC HEAD SIGNIFICANT AFTER PUMP COASTDOWN
- TLTA RESULTS SHOW SAME EFFECT
  - BASED ON > 60 PRESSURE DROP MEASUREMENTS
- TLTA DATA FURTHER DEMONSTRATE ADEQUACY OF ASSUMPTION:
  - THROUGHOUT SYSTEM
  - NEAR BREAK
  - DURING SUBCOOLED ECCS INJECTION

RESOLUTION:

TREATMENT IS ADEQUATE

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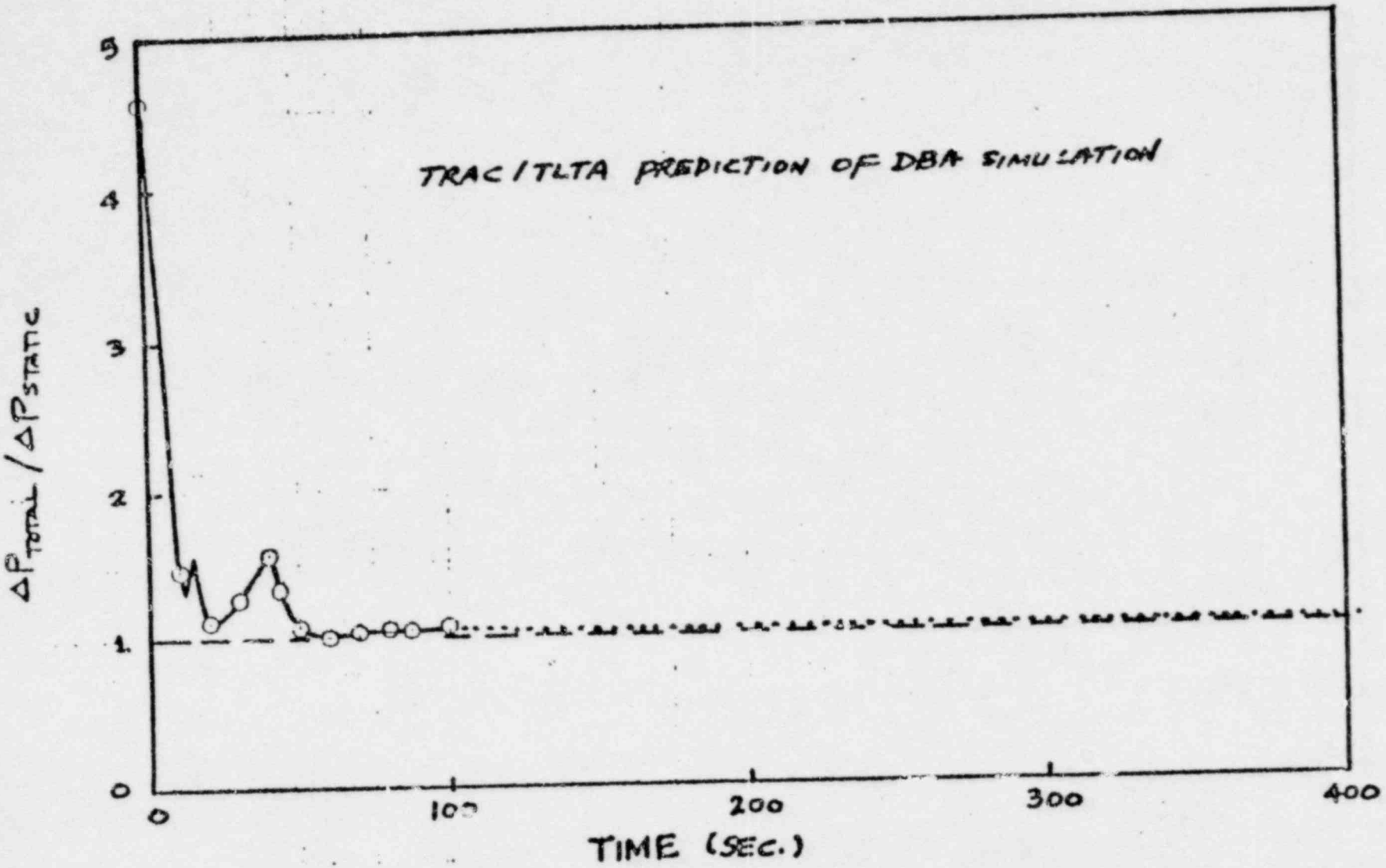
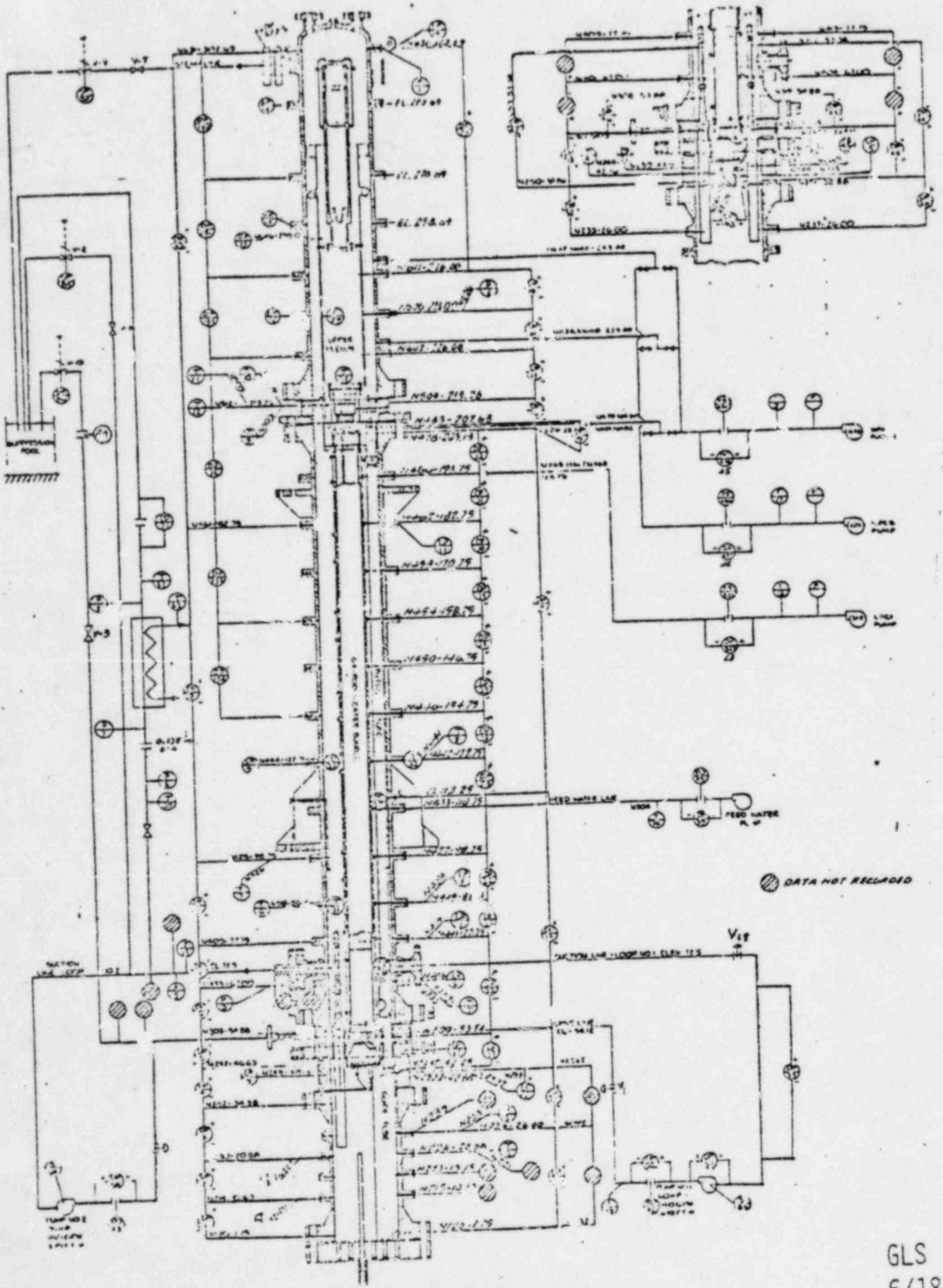
COMPARISON OF SYSTEM PRESSURE DROP





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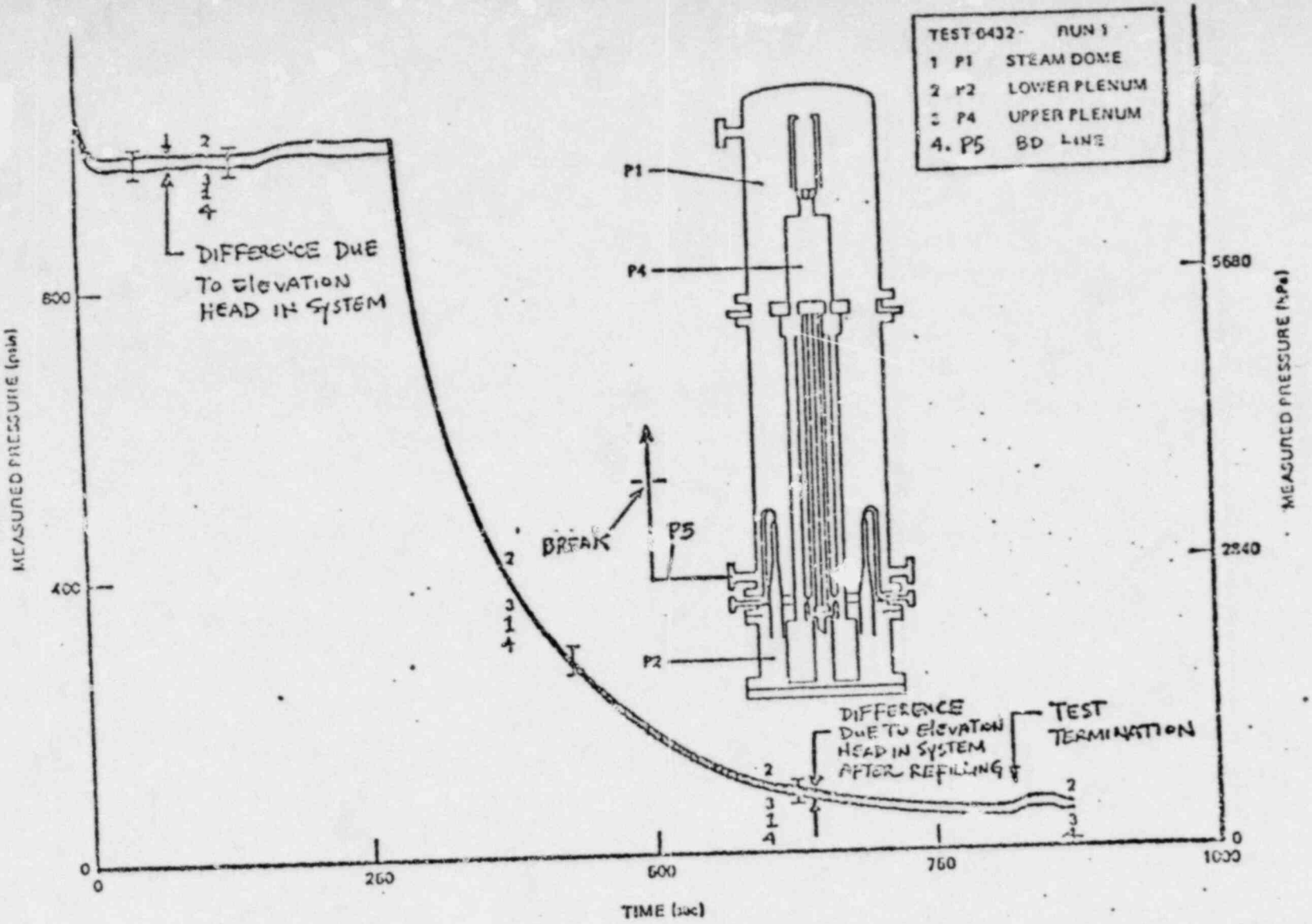

Pressure (TLTA SMALL BREAK TEST II)

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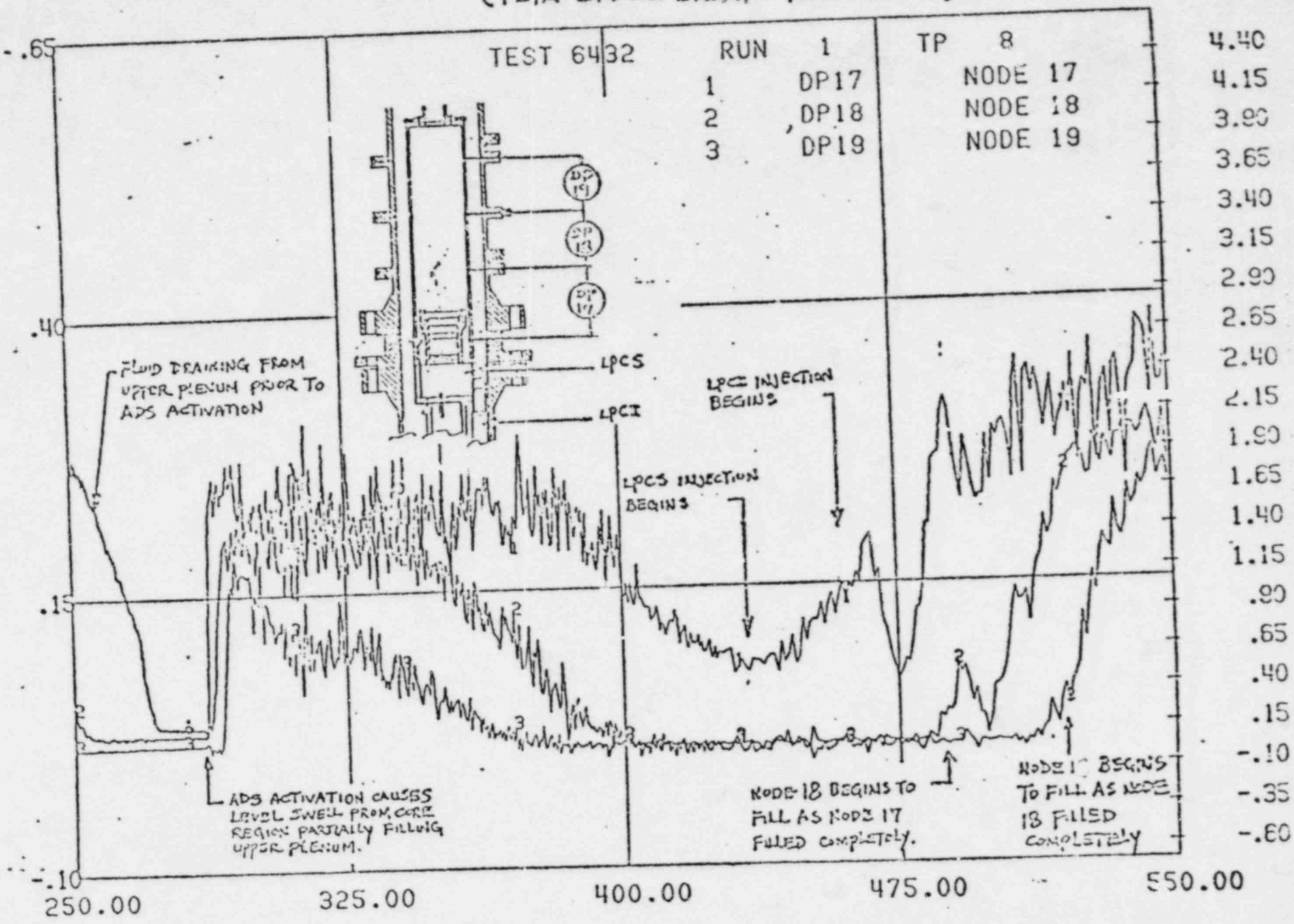
DIFFERENTIAL PRESSURES IN UPPER PLENUM
(TLTA SMALL BREAK TEST NO. 2)



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INFLUENCE OF HOMOGENEOUS EQUILIBRIUM

NRC CONCERN:

GE SHOULD INVESTIGATE THE INFLUENCE OF THE HOMOGENEOUS-EQUILIBRIUM ASSUMPTION USED IN THEIR LOCA CODES AND THEIR INFLUENCE ON SYSTEM DEPRESSURIZATION RATES.

RESPONSE:

- NON-HOMOGENEITY INCLUDED IN MODELS
  - BUBBLE RISE/VOID DISTRIBUTION
- MODEL ALLOWS FOR NON-EQUILLIBRIUM
  - SENSITIVITY STUDIES SHOW NO EFFECT
- BWR HAS SLOW BLOWDOWN TRANSIENT
  - RESPONSE GOVERNED BY THERMODYNAMIC EQUILIBRIUM
- TLTA SHOWS NO LOCAL DEPRESSURIZATION DUE TO SUBCOOLED INJECTION
- OTHER BLOWDOWN EXPERIMENTS WITH LOCAL SUBCOOLING ADEQUATELY PREDICTED

RESOLUTION:

PRESENT ASSUMPTIONS ADEQUATE

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SENSITIVITY OF THERMAL MIXING ON SMALL BREAKS

OUTSIDE SHROUD

BASIS:	95% (PRESENT MODEL)
SENSITIVITY RANGE:	10 TO 95%
IMPACT:	0 TO +40°F

INSIDE SHROUD

BASIS:	100% (PRESENT MODEL)
SENSITIVITY RANGE:	20 TO 100%
IMPACT:	0 TO +30°F

CONCLUSION

- NO IMPACT ON DBA
- NO IMPACT ON BOUNDING SMALL BREAK SPECTRUM

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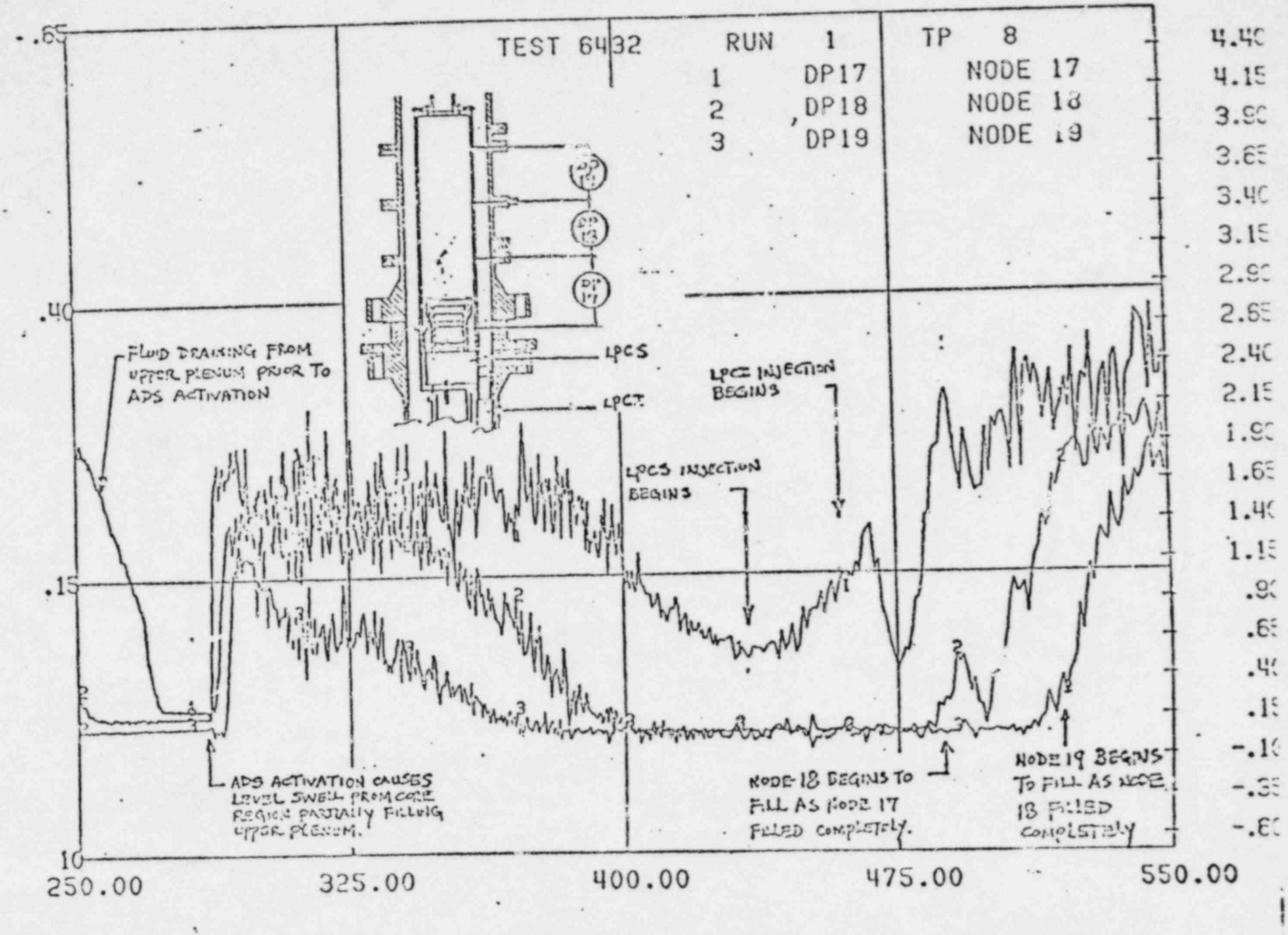
FIGURE 6 DIFFERENTIAL PRESSURES IN UPPER PLENUM
(TLTA SMALL BREAK TEST NO. 2)



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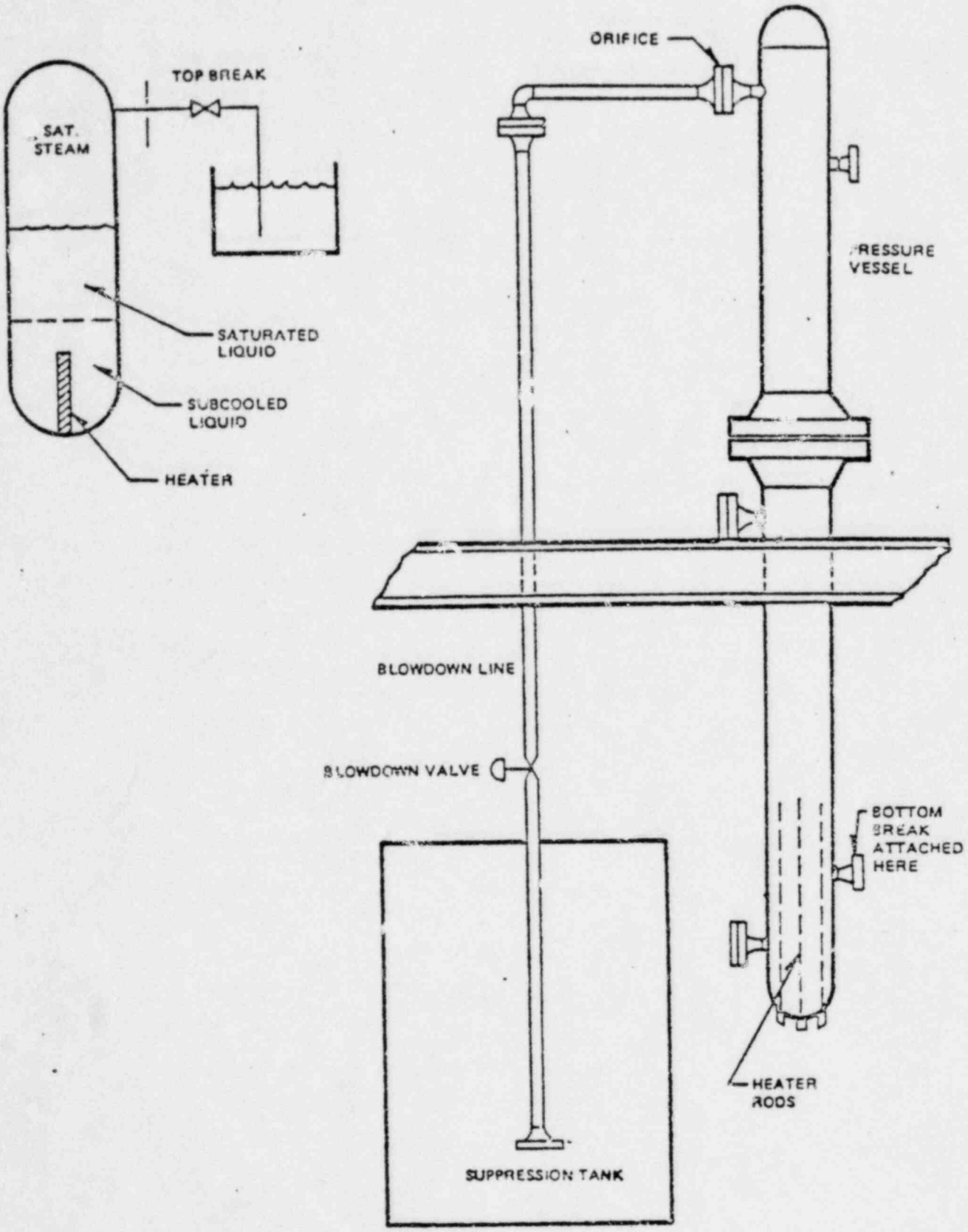

Figure 3.1.1.4-1. G.E. Blowdown Test Facility

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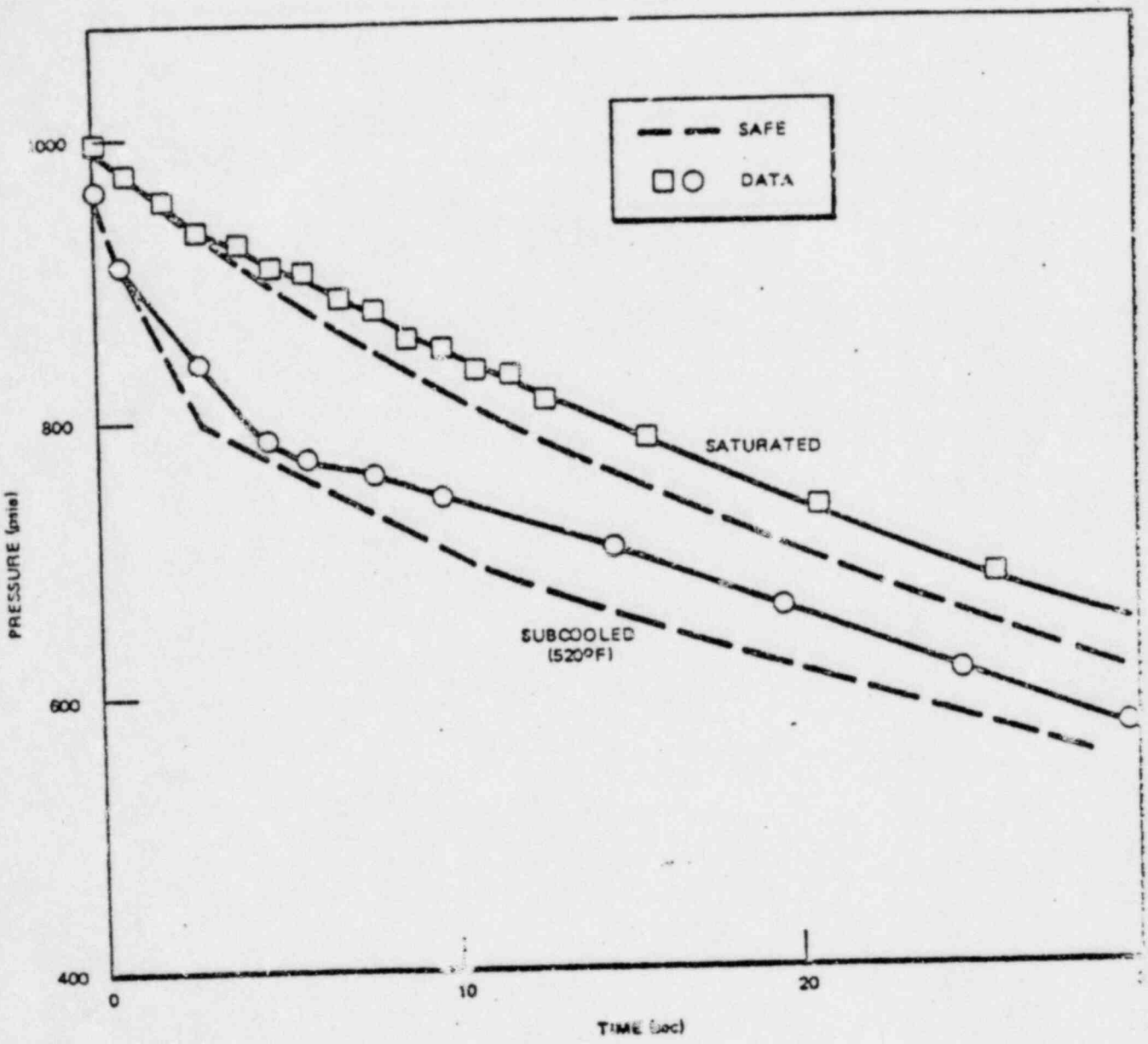

Figure 3.1.1.4-6A. Small Top Break Blowdown Test With And Without Initial Fluid Subcooling

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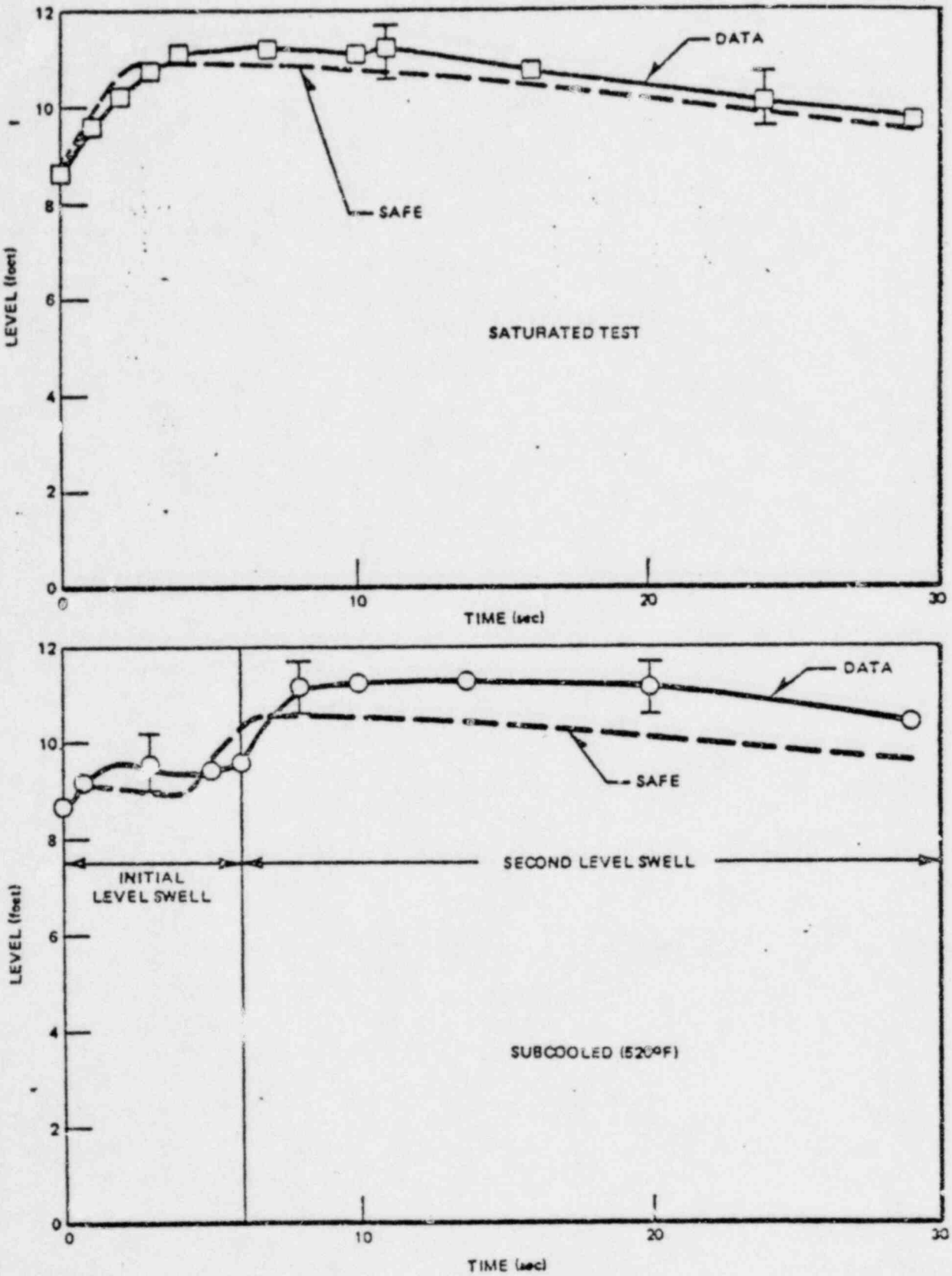

Figure 3.1.1.4-68. Small Top Break Blowdown Test With And Without Initial Fluid Subcooled

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UNCERTAINTY ANALYSIS

NRC CONCERN:

GE SHOULD PROVIDE AN EVALUATION OF THE UNCERTAINTIES IN THEIR ABILITY TO PREDICT SYSTEM PRESSURES, MIXTURE LEVELS, CLAD TEMPERATURES, AND REACTOR VESSEL INVENTORY DISTRIBUTION

RESPONSE:

- BREAK AREA SPECTRUM COVERS UNCERTAINTIES IN PRECISE MODELING OF BREAK FLOW AND RESULTING PRESSURE.
  - DEPRESSURIZATION RATES
- LEVEL CALCULATION CONSERVATIVE GIVEN A DEPRESSURIZATION RATE
  - DATA COMPARISONS (REF.4)
- SENSITIVITY STUDIES
  - GE REPORTS - ANALYTICAL BASIS (REFS. 1,4,5)
- DATA COMPARISONS WILL SHOW SMALL RANGE OF UNCERTAINTIES.

RESOLUTION:

PRESENT APPLICATION ADEQUATELY COVERS UNCERTAINTY

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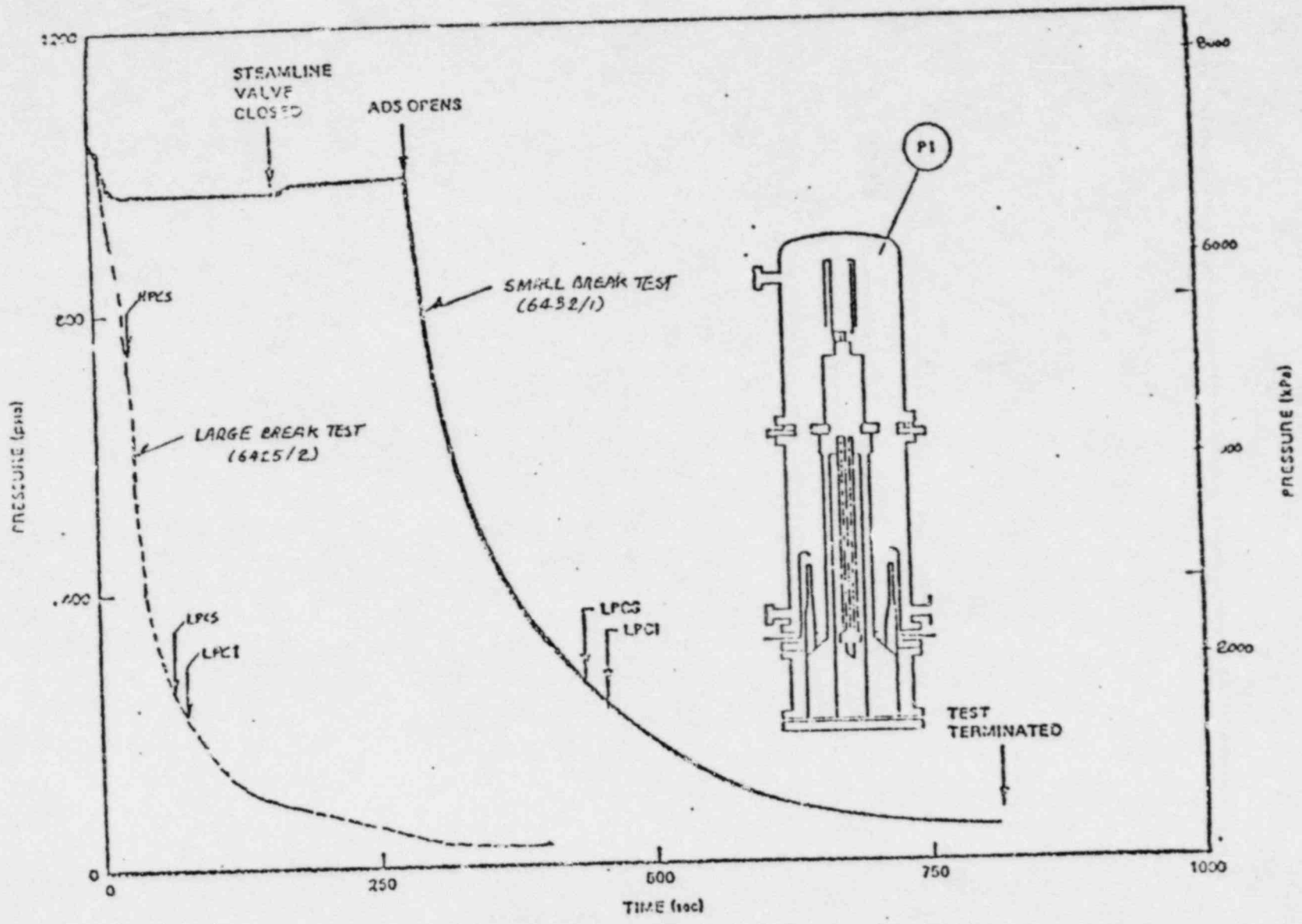

Comparison of system pressure responses for large and small break tests.

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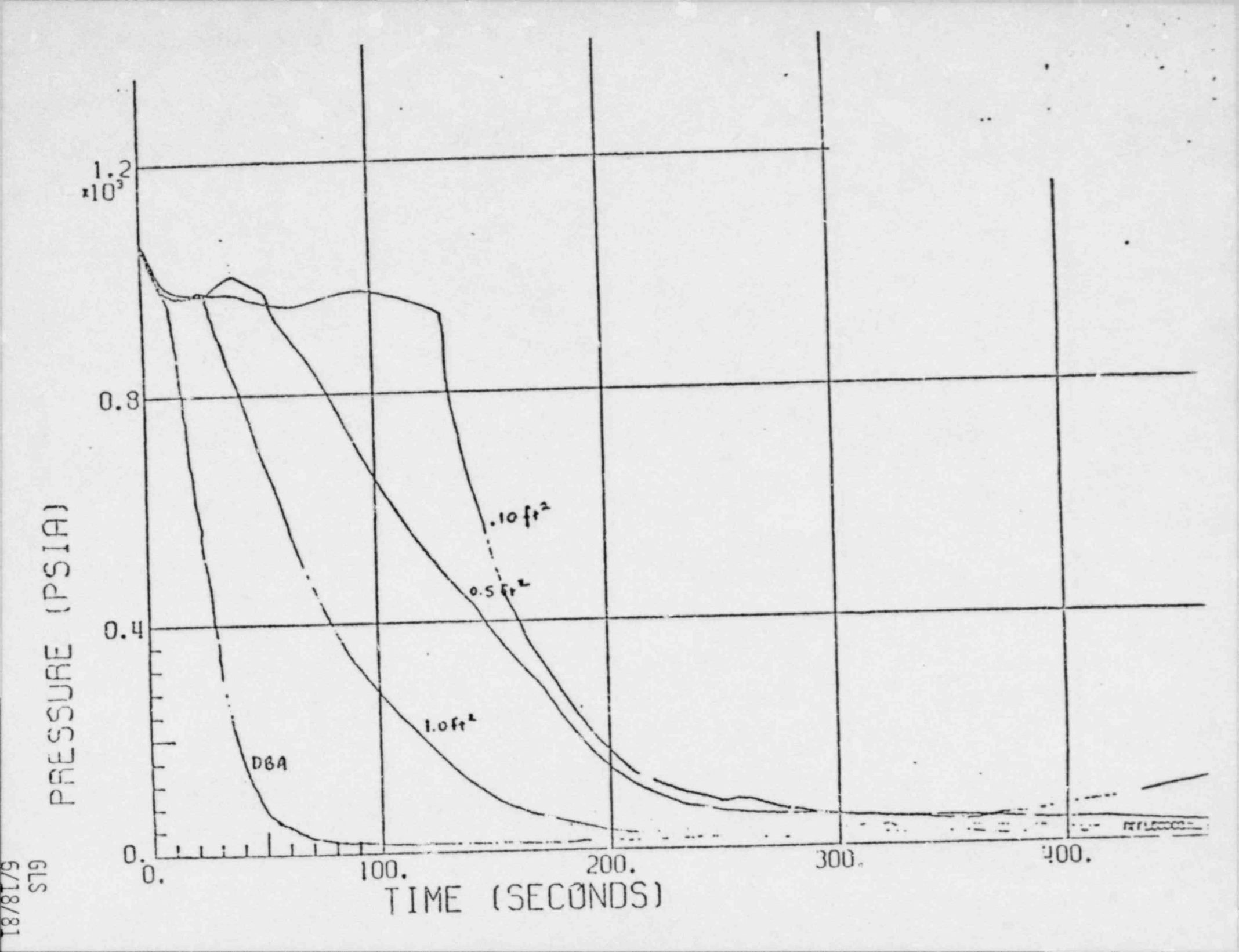
1.2
x10³
0.8
0.4
0.
0.
100.
200.
300.
400.
PRESSURE (PSIA)
TIME (SECONDS)
.10 ft²
0.5 ft²
1.0 ft²
DBA

S79
18/81/8

OVERALL MODEL ASSESSMENT

NRC CONCERN:

INTEGRAL EXPERIMENTAL VERIFICATION SHOULD BE CONDUCTED TO ASSESS THE OVERALL ADEQUACY OF THE COMPUTER CODES USED IN MODELING A SMALL BREAK LOCA.

RESPONSE:

- PRE TEST PREDICTIONS VS. INTEGRAL TLTA COMPARISONS
- POST TEST EVALUATIONS OF TLTA
- PREDICTIONS OF OTHER BLOWDOWN TESTS

RESPONSE:

OVERALL ADEQUACY CONFIRMED

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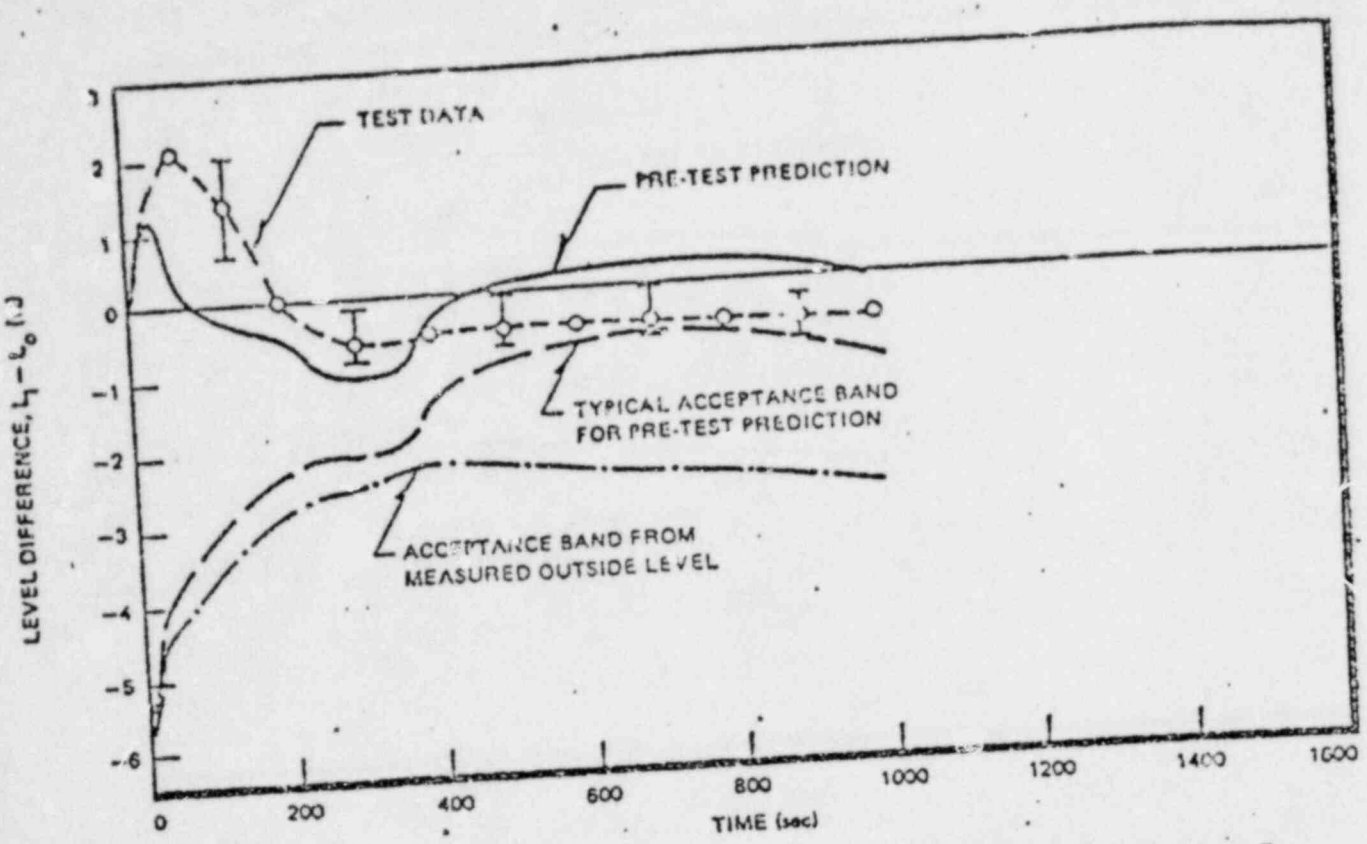
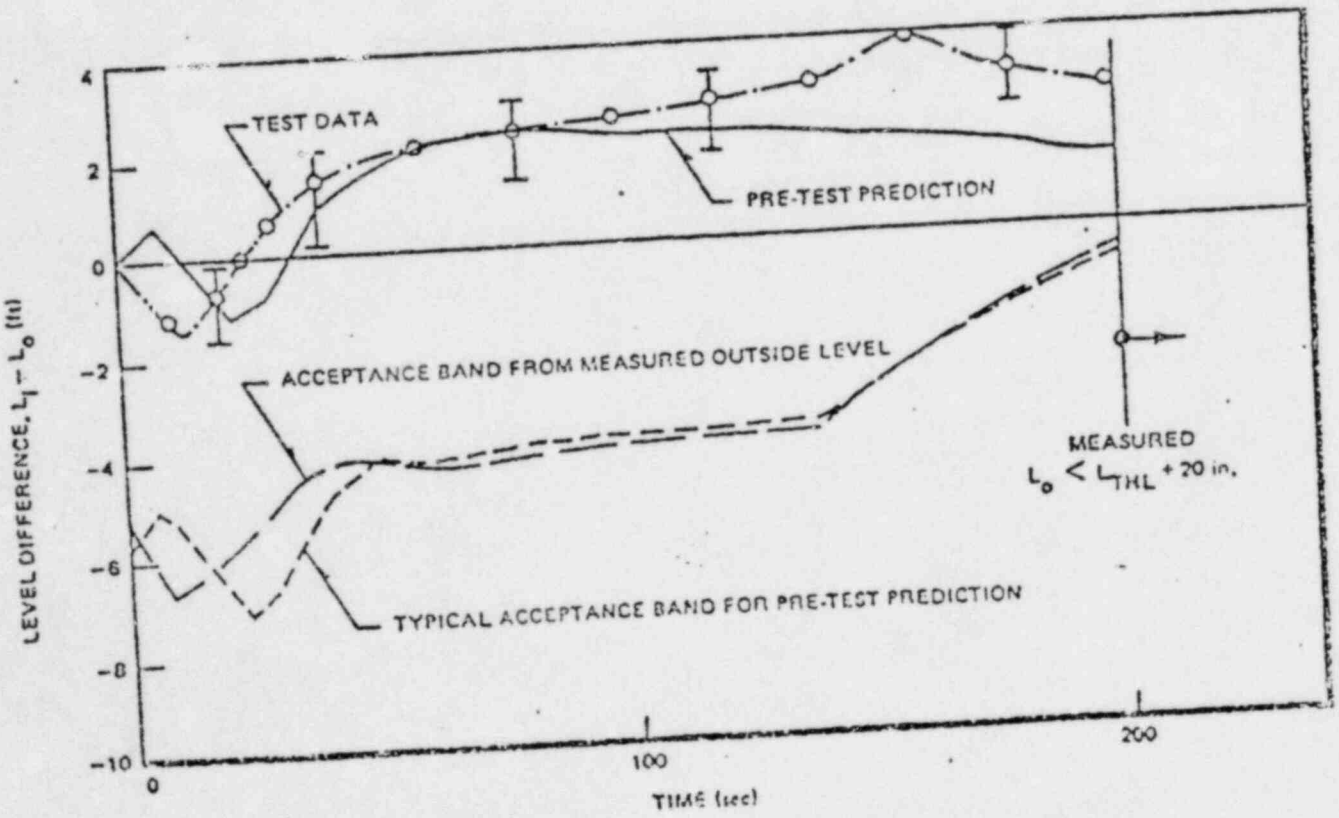


Figure 7. Comparison of Differential Levels, TLTA Small Break Test I



Comparison of Differential Levels, TLTA Small Break Test II

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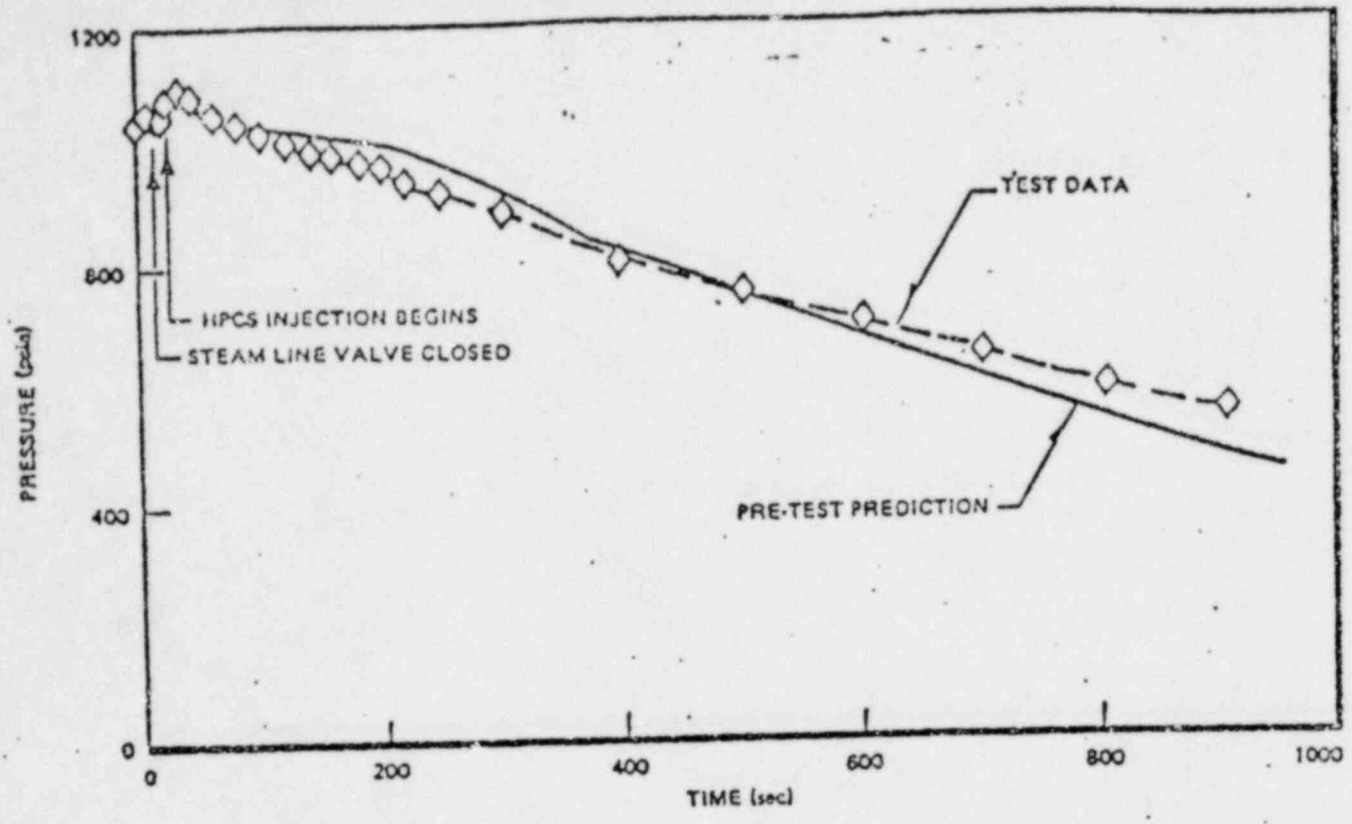
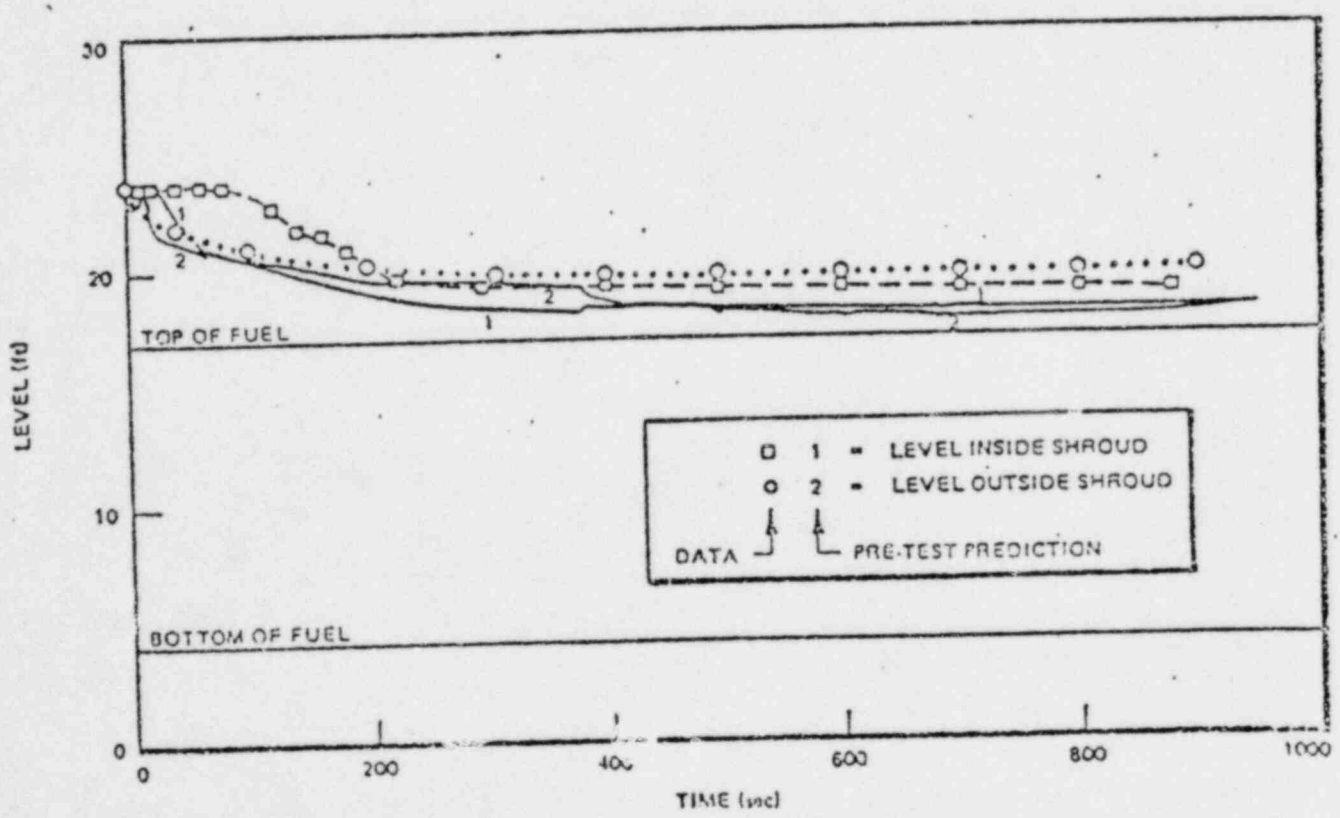


Comparison of System Pressure, TLTA Small Break Test I



Comparison of Mixture Level, TLTA Small Break Test I

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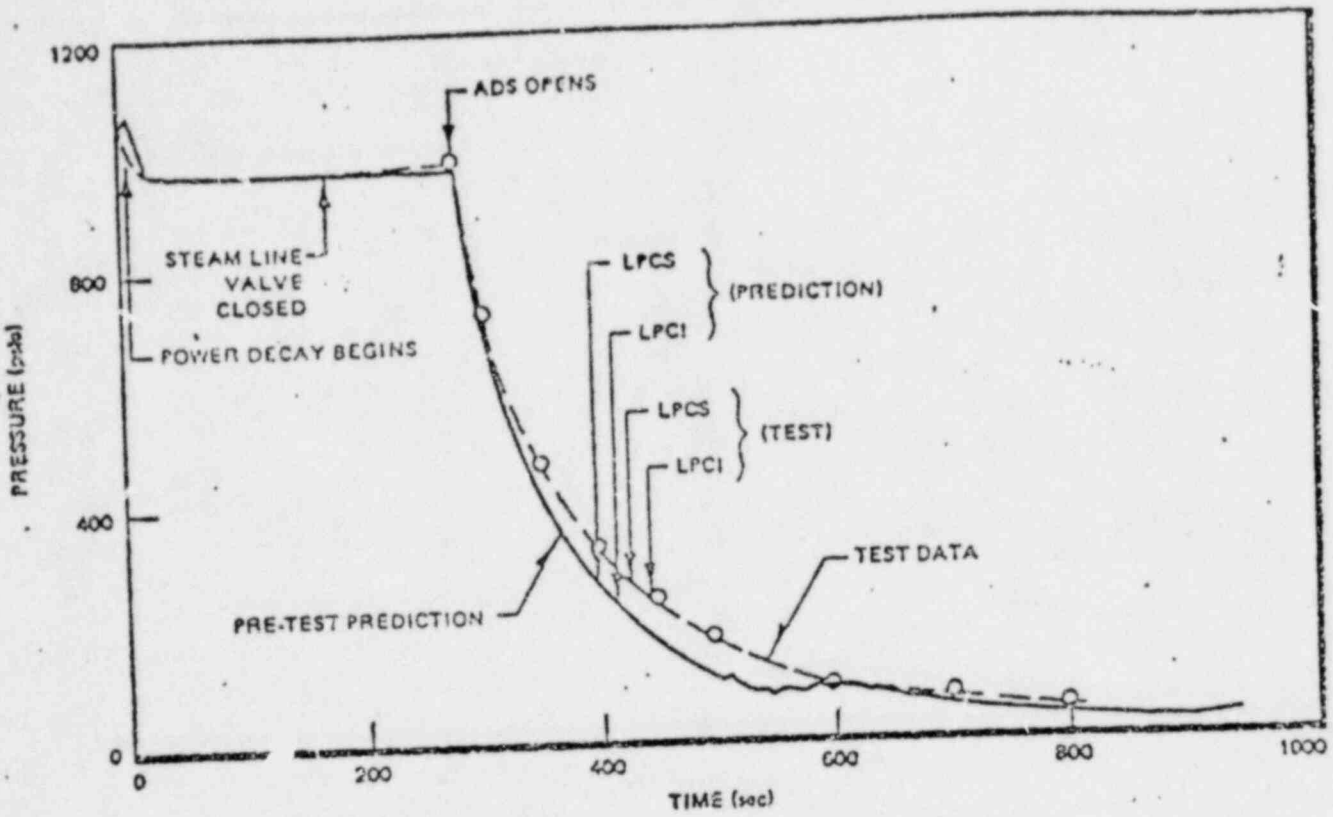
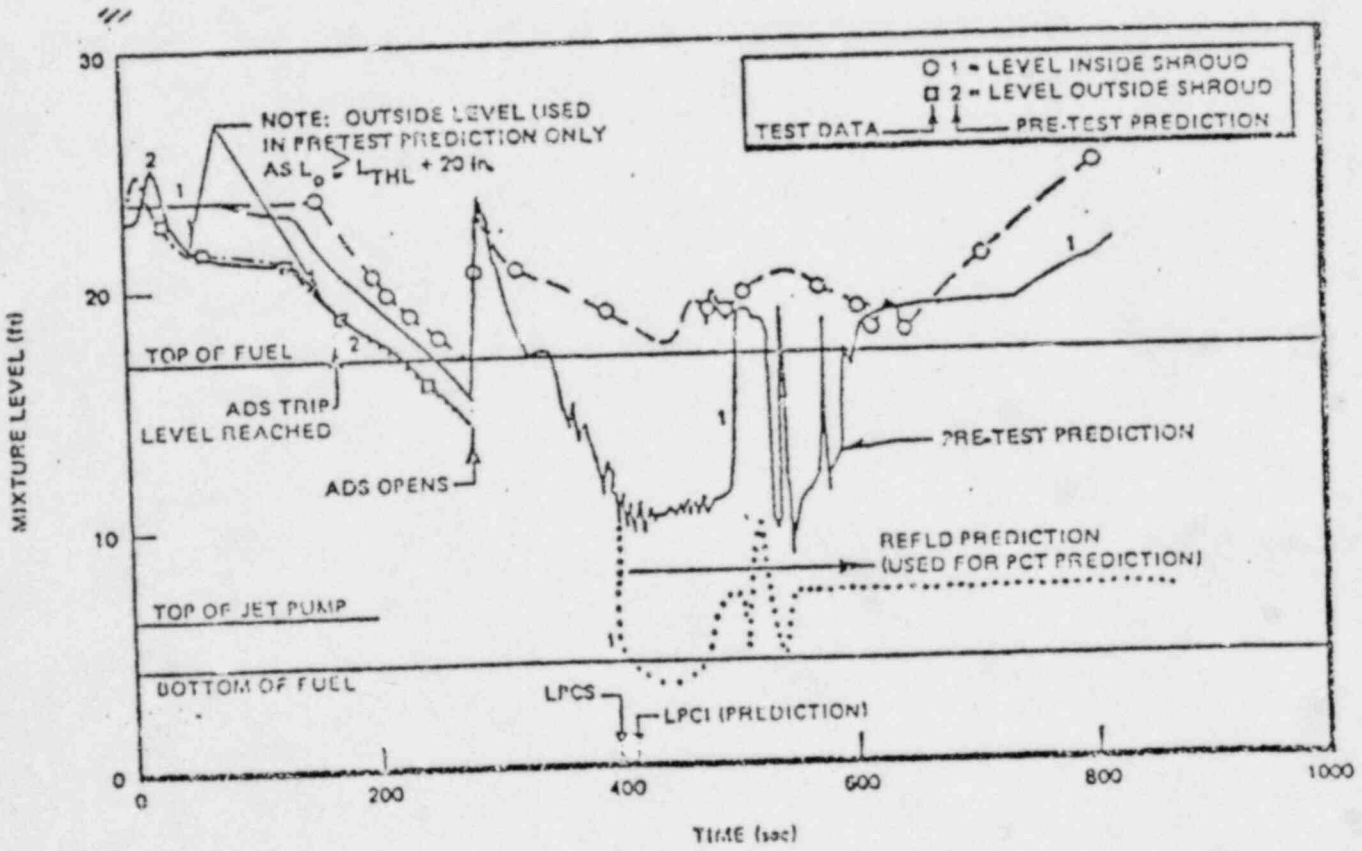


Comparison of System Pressure, TLTA Small Break Test II



Comparison of Mixture Level, TLTA Small Break Test II

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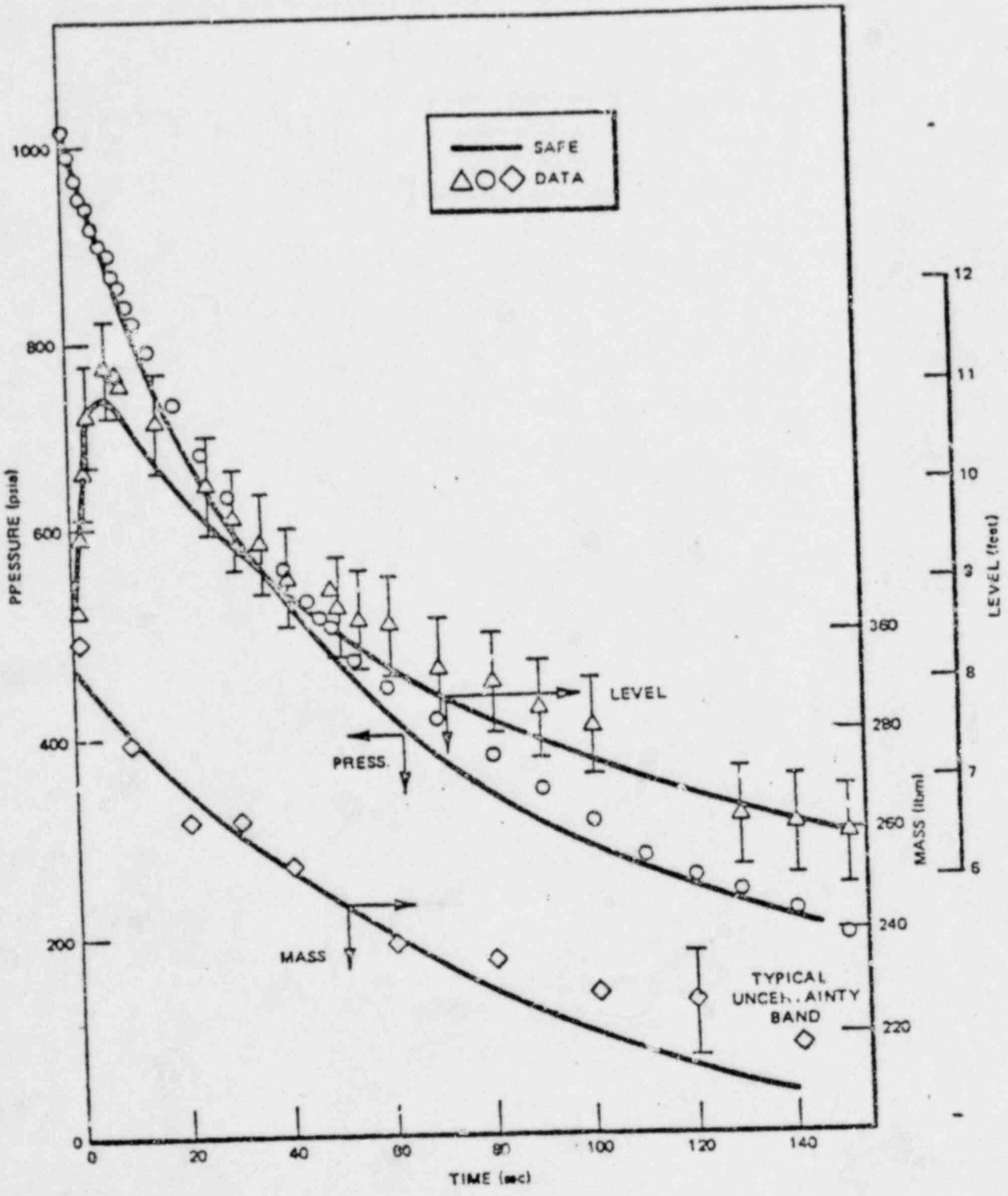

Figure 3.1.1.4-4. Top Break Blowdown Test

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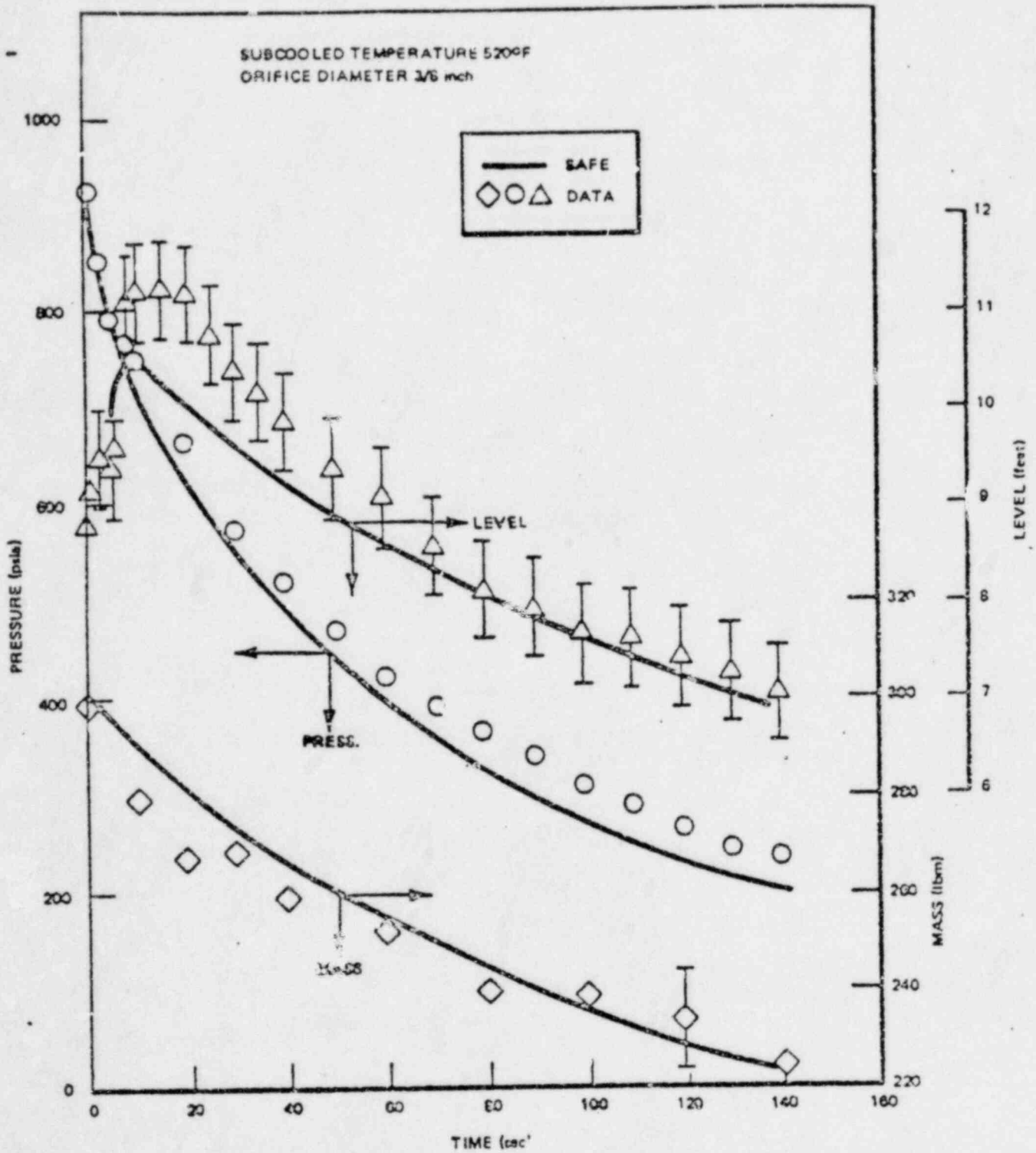

Figure 3.1.1.4-5. Top Break Blowdown Test With Initial Subcooling

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SUMMARY AND CONCLUSIONS

- NUREG 0626 CONCERNS RESOLVED BY:
  - CURRENTLY INCLUDED IN SAFETY ANALYSIS
  - DEMONSTRATED TO BE INSIGNIFICANT OR ADEQUATELY TREATED
    - ANALYTICALLY
    - EXPERIMENTALLY

CONCLUSION: CURRENT SMALL BREAK SAFETY ANALYSIS MODELS ARE CONSERVATIVE AND IN CONFORMANCE WITH 10FR 50.46 APPENDIX K AS ALL CONCERNS HAVE BEEN RESOLVED.

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