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February 14, 1992

C321-92-2040

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Dear Commission and Staff:

Subject: Oyster Creek Nuclear Generating Station
Docket No. 50-219
Technical Specification Change Request No. 198
Reactor Vessel Blowdown Multipliers

GPU Nuclear submitted the subject technical specification change request (TSCR) on July 22, 1991. The TSCR proposes a change to the design pressure of the Oyster Creek drywell primary containment vessel. As part of the analysis of containment response to the design basis loss of coolant accident, we utilized multipliers to conservatively establish the coolant inventory blowdown from the reactor vessel. The multipliers were derived by comparing the results of calculation models with test data. As requested by the NRC staff, the attachment to this letter provides a basis for our use of the reactor vessel blowdown multipliers.

Sincerely,

for J. J. Barton
Vice President and Director
Oyster Creek

JJB/PFC/amk

Attachment

cc: Administrator, Region I
NRC Resident Inspector
NRC Oyster Creek Project Manager

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ATTACHMENT

Oyster Creek Nuclear Generating Station
Reactor Vessel Blowdown Multipliers
For Use In
Containment Response Analysis

ATTACHMENT

GPUN submitted Technical Specification Change Request No. 198 to revise the Oyster Creek drywell design pressure. To establish a basis for the drywell design pressure, a RELAP5 reactor vessel blowdown model of Oyster Creek was developed. In response to the staff's request, additional information regarding RELAP5 critical flow model validation is provided. The validation work was performed with the same version of the RELAP5 MOD3 thermal hydraulic computer code that was used to evaluate the OC reactor vessel response.

To validate the use of RELAP5, a comparison of its critical flow calculation was made with experimental data from the full scale Marviken tests (tests 8, 15, 24). Additionally, the results were compared with homogeneous equilibrium model (HEM), Henry-Fauske, and Moody critical flow calculations of those same Marviken tests.

The RELAP5 calculations are expected to most closely match the Henry-Fauske Model during the subcooled critical flow period of the Marviken tests and then approach the HEM model calculation during two-phase critical flow. The RELAP5 calculation is expected to be lower than the Moody Model during two-phase flow.

The comparisons of the critical flow model results for Marviken Tests 8, 15 and 24 are shown in Figures 2, 3 and 4 respectively. From the comparisons with the experimental data, a set of discharge coefficients for the subcooled and saturated phases were developed for use with RELAP5. The coefficients are shown in Figure 1. The mass flow rate values for the HEM, Henry-Fauske and Moody models were hand calculated using the stagnation pressure and enthalpy from the RELAP5 volume upstream of the break in conjunction with the tables in the RELAP5 Users Guide. The comparisons were made at 1.0, 11.0, 21.0, 31.0 and 41.0 seconds for each test. The critical flow model comparison for Test 8 is shown in Figure 2 and exhibits the expected trends described above. The RELAP5 calculation matches both the experimental data and the Henry-Fauske Model during the subcooled portion of the blowdown and approaches the HEM solution during two-phase blowdown (T>22 seconds). During the transition period between 12 and 22 seconds, the RELAP5 calculation is between the Henry-Fauske and the HEM results but matches the data well. The Moody Model is very conservative during the two-phase blowdown. From these results, it may be concluded that the RELAP5 analysis is applicable over a wider range of conditions than the other critical flow models.

Figure 3 shows the comparisons for Test 15. The RELAP5 calculation matches the experimental data well during the early part of the tests, but the Henry-Fauske model is not accurate before 21 seconds. Flashing immediately upstream of the break may contribute to inaccuracies in the Henry-Fauske prediction during the first 11 seconds of the calculation. The RELAP5 critical flow calculation very closely matches the HEM Model during the two-phase flow period after 30 seconds. The Moody Model is again conservative during the two-phase blowdown.

The results for Test 24, shown in Figure 4, are similar to those for Test 8. However, the RELAP5 analysis is below both the data and the HEM prediction after 31 seconds. This under-prediction in the RELAP5 analyses may be a result of the short break nozzle in Test 24.

The results given in Figures 2, 3 and 4 show that the RELAP5 critical flow model may be applied with accuracy over a wider range of conditions than any of the other frequently used models. RELAP5 does tend to under-predict critical flow in short nozzles for some conditions.

The OC reactor vessel model was developed with these considerations in mind. Sensitivity studies were performed on the discharge nozzle nodalization and the flow coefficients were applied to the discharge pipes. To insure conservatism in the results, the discharge coefficients were also used as a multiplier on the break flow. What this means is that the break flow calculated by the RELAP5 model (with Cd=1.0) was multiplied by 1.3 when input into the containment computer code. As a result of this assumption, the break mass flow rate is conservatively estimated. This was shown by containment response calculations using the CONTEMPT computer code to be a conservative representation of the blowdown (refer to Figure 5).

Based upon this work, GPUN feels that the RELAP5 model of Oyster Creek provides a conservative representation of the reactor vessel response to a design basis accident.

FIGURE 1

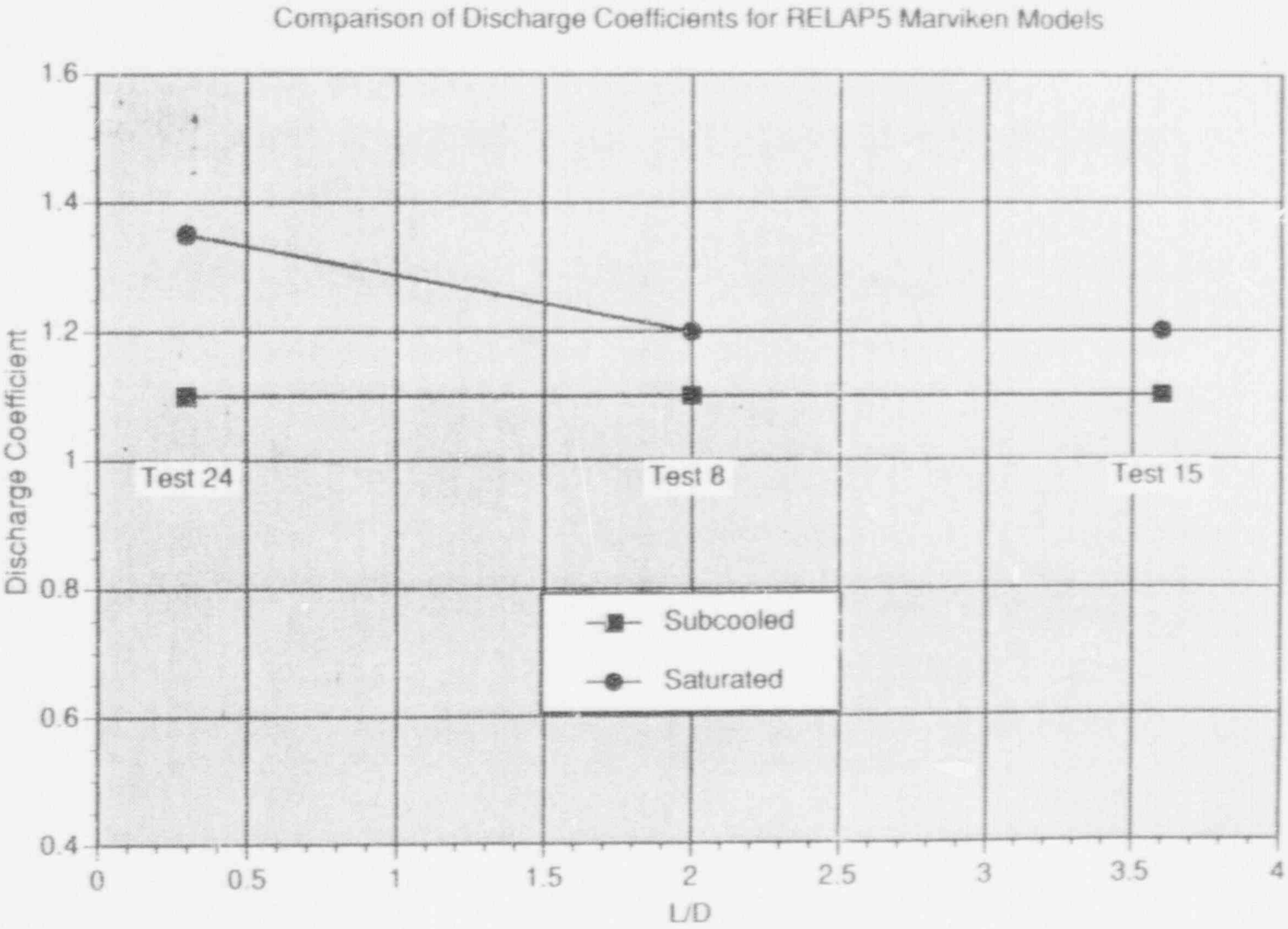
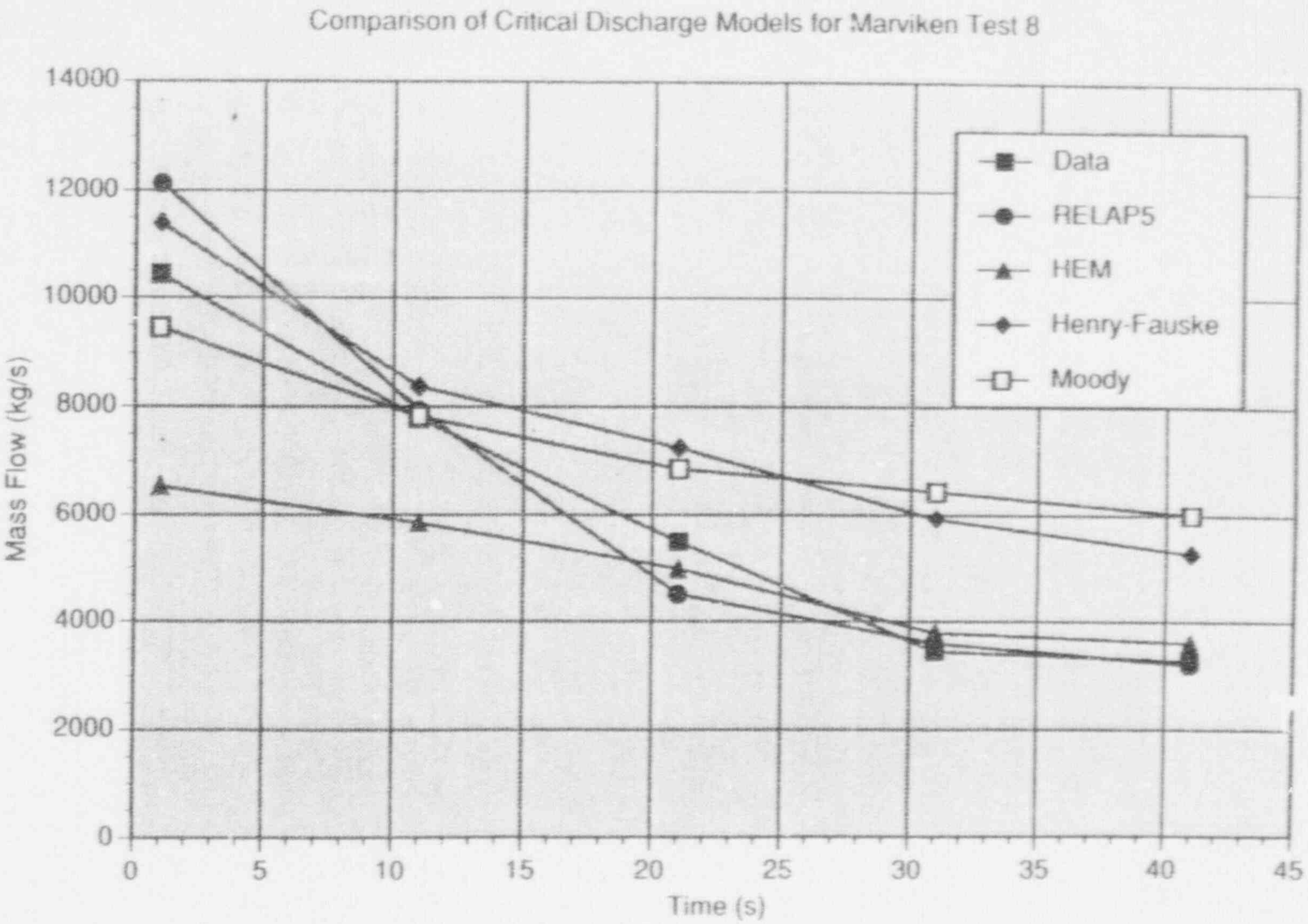

Comparison of Discharge Coefficients for RELAP5 Marviken Models
Discharge Coefficient
1.6
1.4
1.2
1
0.8
0.6
0.4
0
0.5
1
1.5
2
2.5
3
3.5
4
L/D
Test 24
Test 8
Test 15
Subcooled
Saturated

FIGURE 2


Comparison of Critical Discharge Models for Marviken Test 8
Mass Flow (kg/s)
14000
12000
10000
8000
6000
4000
2000
0
Time (s)
0
5
10
15
20
25
30
35
40
45
■ Data
● RELAP5
▲ HEM
◆ Henry-Fauske
□ Moody

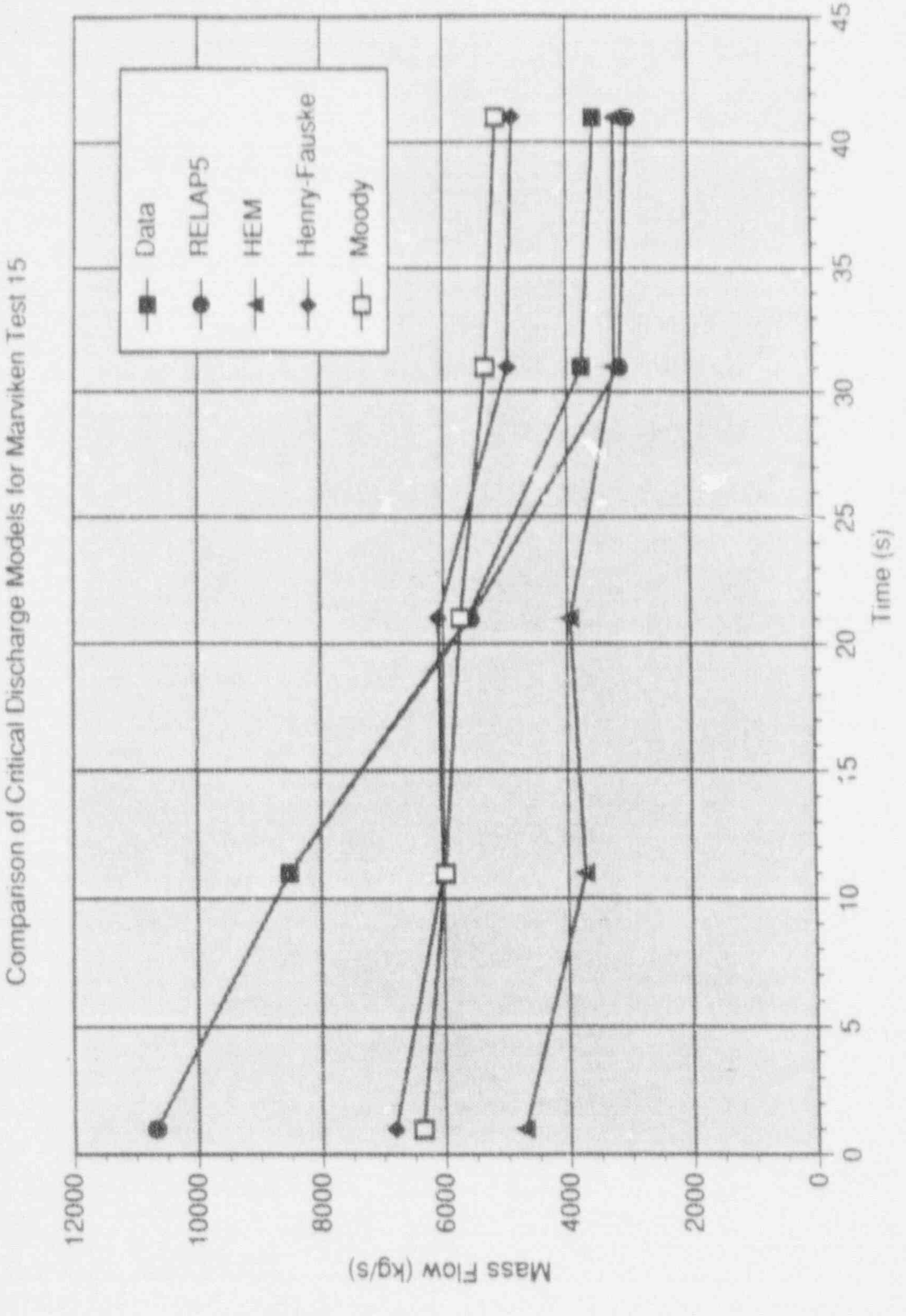

Comparison of Critical Discharge Models for Marviken Test 15
Data
RELAP5
HEM
Henry-Fauske
Moody
Mass Flow (kg/s)
0
2000
4000
6000
8000
10000
12000
Time (s)
0
5
10
15
20
25
30
35
40
45

FIGURE 3

FIGURE 4

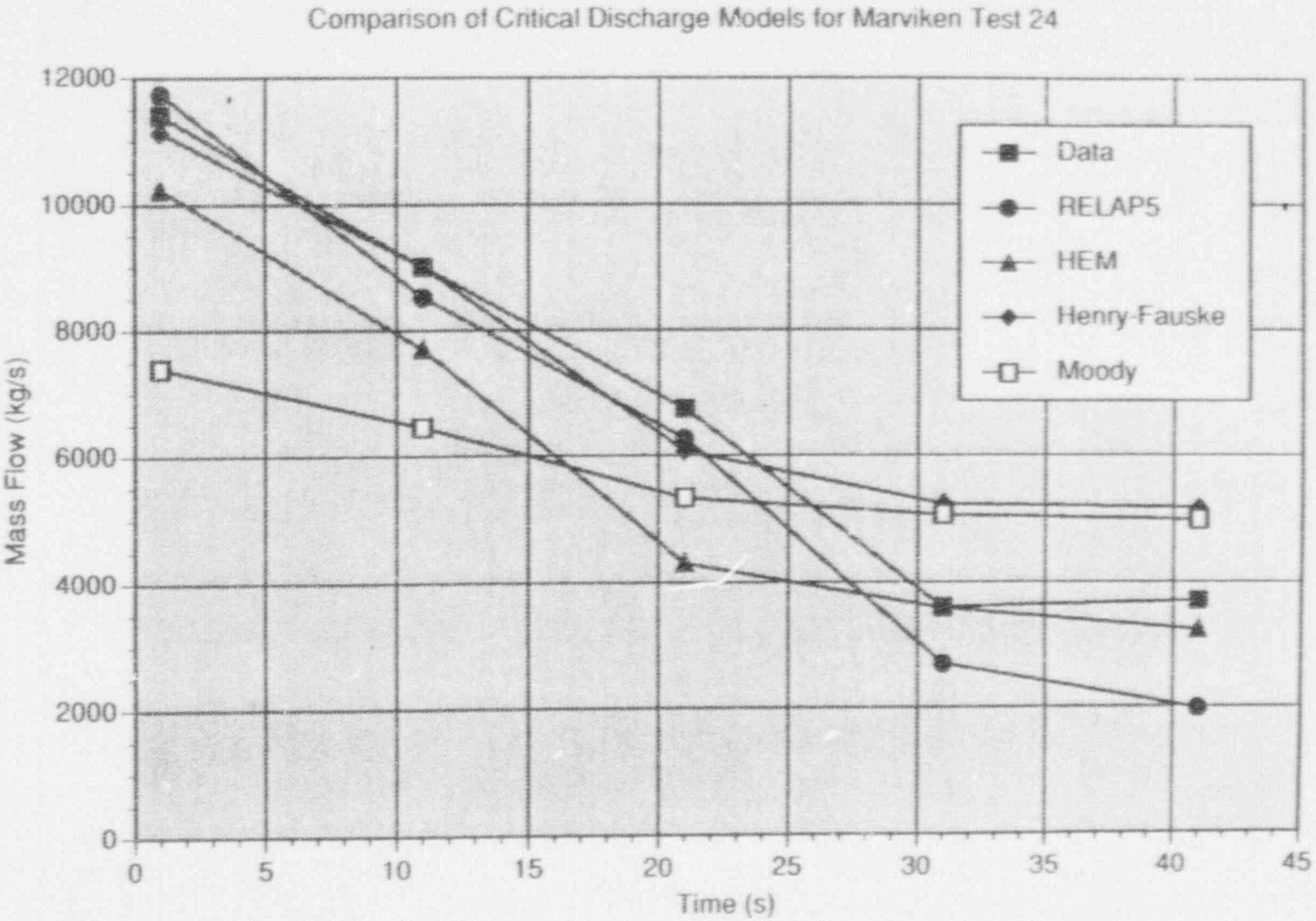
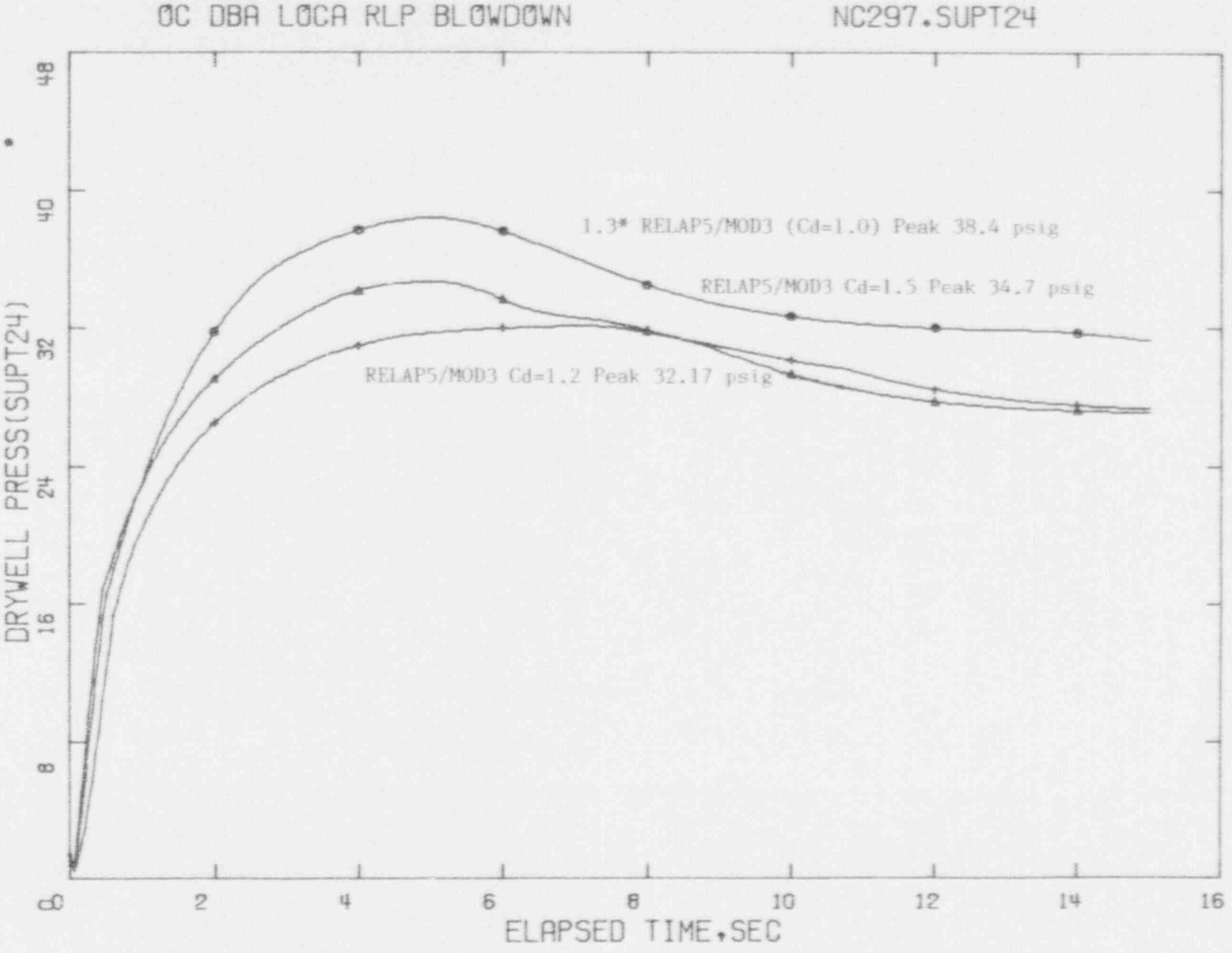

Comparison of Critical Discharge Models for Marviken Test 24
Mass Flow (kg/s)
0
2000
4000
6000
8000
10000
12000
Time (s)
0
5
10
15
20
25
30
35
40
45
Data
RELAP5
HEM
Henry-Fauske
Moody

FIGURE 5


OC DBA LOCA RLP BLOWDOWN
NC297.SUPT24
DRYWELL PRESS(SUPT24)
48
40
32
24
16
8
0
2
4
6
8
10
12
14
16
ELAPSED TIME,SEC
1.3* RELAP5/MOD3 (Cd=1.0) Peak 38.4 psig
RELAP5/MOD3 Cd=1.5 Peak 34.7 psig
RELAP5/MOD3 Cd=1.2 Peak 32.17 psig