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December 2, 2002
L-02-115

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: **Beaver Valley Power Station, Unit No. 1 and No. 2**
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
Response to a Request for Additional Information in Support of License Amendment Requests Nos. 300 and 172

This letter provides FirstEnergy Nuclear Operating Company (FENOC) responses to the Section 1.0 questions provided in the November 22, 2002 NRC Request for Additional Information (RAI) regarding License Amendment Requests (LAR) 300 and 172. The LARs were submitted by FENOC letter L-02-069 dated June 5, 2002. The changes proposed by the LARs will revise the Beaver Valley Power Station Units 1 and 2 Technical Specifications to permit each unit to be operated with an atmospheric containment.

The RAI requested FENOC to respond to the Section 1.0 questions by December 3, 2002, in order to support a planned December 11, 2002 meeting with the NRC staff. As discussed in the RAI, FENOC plans on providing the responses to Section 2.0 questions regarding the radiological assessment by January 24, 2003.

A list of regulatory commitments associated with the containment conversion project was submitted with FENOC letter L-02-069. Commitment number 6 states that FENOC will provide marked-up Updated Final Safety Analysis Report (UFSAR) pages reflecting the necessary changes associated with the conversion to an atmospheric containment. The UFSAR mark-up package was to be provided to the NRC by December 5, 2002. However, additional time is needed to complete the UFSAR mark-up package. FENOC will submit the UFSAR mark-up package to the NRC by January 31, 2003. Attachment B contains the commitments made in this letter.

As stated in Letter L-02-069, FENOC requests approval of the proposed amendments by July 15, 2003, to support implementation following the next scheduled refueling outage for Unit 2; i.e., 2R10.

A001

If there are any questions concerning this matter, please contact Mr. Larry R. Freeland, Manager, Regulatory Affairs/Performance Improvement at 724-682-5284.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 2, 2002.

Sincerely,

Mark B. Bezilla

Attachment:

A. Responses to RAI Section 1.0.

B. List of Commitments

c: Mr. D. S. Collins, NRR Project Manager
Mr. D. M. Kern, NRC Sr. Resident Inspector
Mr. H. J. Miller, NRC Region I Administrator
Mr. D. A. Allard, Director BRP/DEP
Mr. L. E. Ryan (BRP/DEP)

NRC Request for Additional Information

1.0 Enclosure 2

1.1 General Items:

Item 1.1.1. What is the involvement of BVPS-1 and 2 personnel in the design-basis analysis (DBA) containment integrity calculations (i.e., who ran and analyzed the MAAP5 containment calculations)?

Response to Item 1.1.1.
The MAAP5 analyses were run by Fauske and Associates, Inc. (FAI). However, Beaver Valley personnel were involved in all aspects of the DBA containment integrity calculations in support of the Containment Atmospheric Conversion project. Beaver Valley personnel have received MAAP user training from Fauske and Associates, Inc. Beaver Valley personnel participated in:

- creation of the MAAP5 plant model including data collection and model validation, conducted a detailed Owner's Acceptance Review of the Beaver Valley MAAP5 model for both units,

- creation of the run matrix and parameter matrix that addressed plant conditions and uncertainty ranges for key operating parameters, conducted a detailed Owner's Acceptance Review of the sensitivity study used to define the parameter matrix, and

- interpretation of the MAAP5 results including a detailed Owner's Acceptance Review of the design calculations prepared by FAI to document the MAAP5 calculations.

Item 1.1.2. Have MAAP5 and LOCTIC code comparison calculations been made where both codes use essentially an identical single node containment description with similar limiting assumptions (flashing and natural vs. forced convection) to show a degree of equivalency? What is the purpose of the MAAP5/LOCTIC comparison calculations?

Response to Item 1.1.2.
A direct comparison between MAAP5 and LOCTIC results where both codes used a single node model has not been performed.

The purpose of the MAAP5/LOCTIC comparison was to demonstrate that both codes predict similar results using the same inputs while employing different, but still conservative, effluent flash option (i.e., pressure flash) and modified condensation heat transfer coefficients.

Item 1.1.3. How does the flashing model in LOCTIC and the MAAP5 codes compare? Compare the uncertainties associated with the MAAP parameter (FELOCA) with the LOCTIC treatment for pressure flash.

Response to Item 1.1.3.

The pressure flash option in LOCTIC assumes that the break effluent liquid and steam phases come to equilibrium at the saturation temperature corresponding to the containment total pressure. The liquid drops to the floor at this temperature and the vapor effluent is added to the containment atmosphere. The pressure flash model is more realistic for calculating the first containment peak pressure because this peak occurs very shortly after the break. In contrast, under the temperature flash option the break effluent steam and liquid phases are assumed to come into temperature equilibrium with the containment atmosphere resulting in a higher steam fraction into containment. Temperature flash requires time for the liquid phase to cool by an evaporative (slow) process before reaching the floor. Since the time required for evaporation is generally longer, the liquid phase is expected to drop to the floor at an elevated temperature compared to the containment atmosphere temperature.

In the MAAP5 calculations the blowdown fluid is flashed based on the containment's total pressure and the steam is added to the containment gas space. A small fraction of the unflashed water mass is entrained into the gas space. The entrainment fraction is specified by a user-defined parameter (FELOCA) and is typically set at a value of 5%. The water that is not entrained is collected on the compartment's floor. Because water is calculated to be mechanistically entrained from the compartment floors and walls, the containment response is virtually insensitive to the FELOCA parameter in this range.

Item 1.1.4. What amounts of peak pressure and temperature margins are associated with the new MAAP5 models for a) forced condensation using the momentum-driven velocity, b) nodalization, and c) water entrainment? Discuss for main steam line break (MSLB) and loss-of-coolant accident (LOCA).

Response to Item 1.1.4.

The impact on the nodal pressure and temperature histories of water entrainment and momentum-driven flow are illustrated in the following family of plots (see Figures 1 through 5) for both the large break LOCA (case 8L-5_PP) and the MSLB (case 15M_N13_PP).

For the large break LOCA the peak pressure increases about one psi when water entrainment model is not activated and about 8 psi when neither the water entrainment model nor the momentum-driven flow model are activated. Higher gas temperatures are also illustrated for these two sensitivity cases.

For the MSLB the peak pressure is essentially unchanged when the water entrainment model is not activated but it increases about 3 psi when neither the water entrainment nor the momentum-driven flow models are not activated. A similar trend is demonstrated for the peak gas temperature such that the gas temperature is only significantly increased (about 45°F) when neither water entrainment nor momentum-driven flow are credited.

With MAAP5 one node model, the peak pressure decreases about 1.9 psi for the large break LOCA and about 4.1 psi for the MSLB compared to those of the 17 node model. Gas temperature in the one node model is also much lower than those of the 17 node model as shown in Figures 6 and 7. This is due to the difference in the effectiveness of the passive heat sinks for both the large break LOCA and MSLB. Additionally, the difference in the net energy removed by containment sprays also effects the MSLB results. The influence of nodalization is discussed in the MAAP5 Topical Report for the CVTR tests, i.e. Appendix E. As illustrated, with the MAAP5 modeling enhancement there is little dependence on the nodalization with respect to the calculated peak pressure. Increasing the nodes in the vertical direction enables the calculation to represent the measured vertical temperature profile.

Figure 1

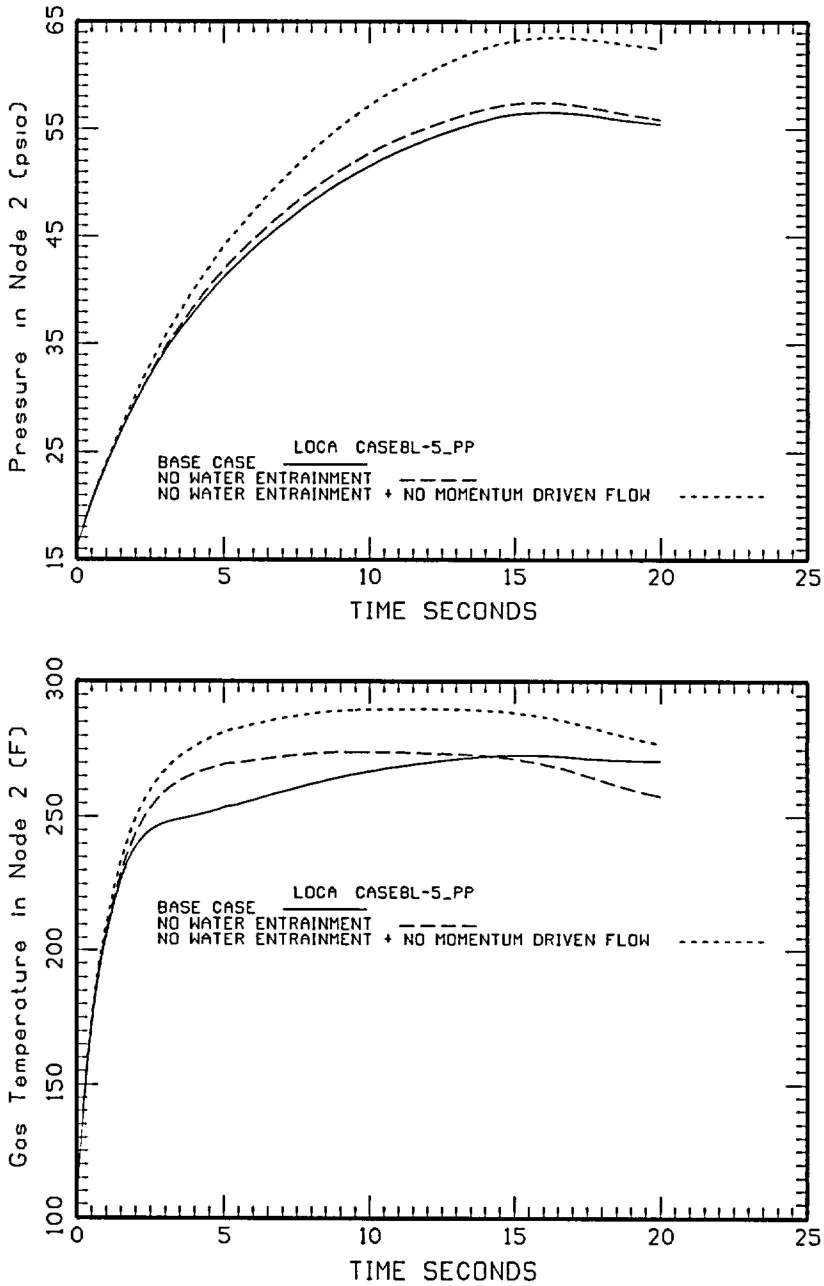
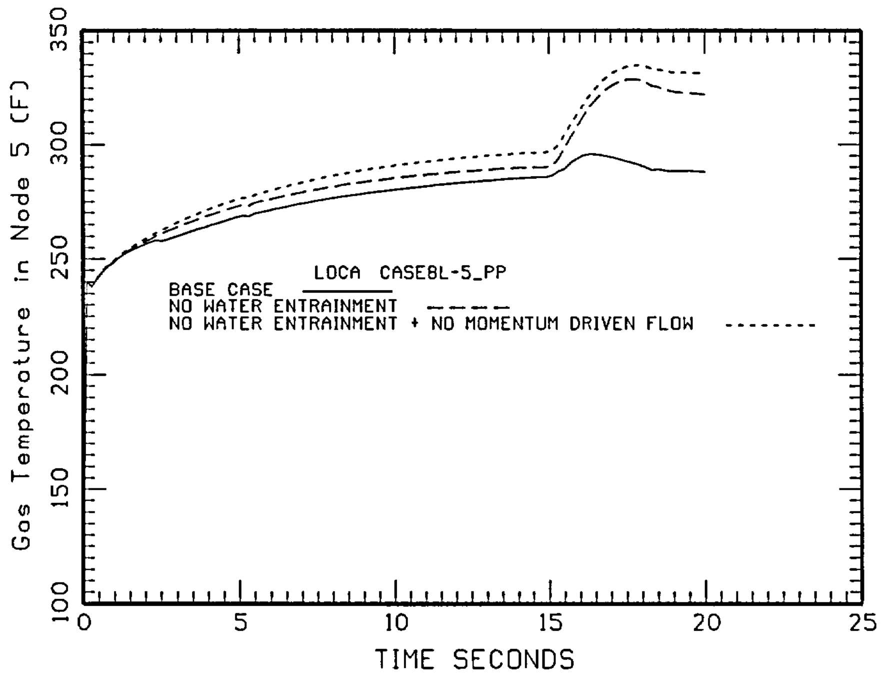

Pressure in Node 2 (psia)
65
55
45
35
25
15
0
5
10
15
20
25
TIME SECONDS
LOCA CASE8L-5_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW
Gas Temperature in Node 2 (F)
300
250
200
150
100
0
5
10
15
20
25
TIME SECONDS
LOCA CASE8L-5_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW

Figure 2


Gas Temperature in Node 5 (F)
350
300
250
200
150
100
0
5
10
15
20
25
TIME SECONDS
LOCA CASE8L-5_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW

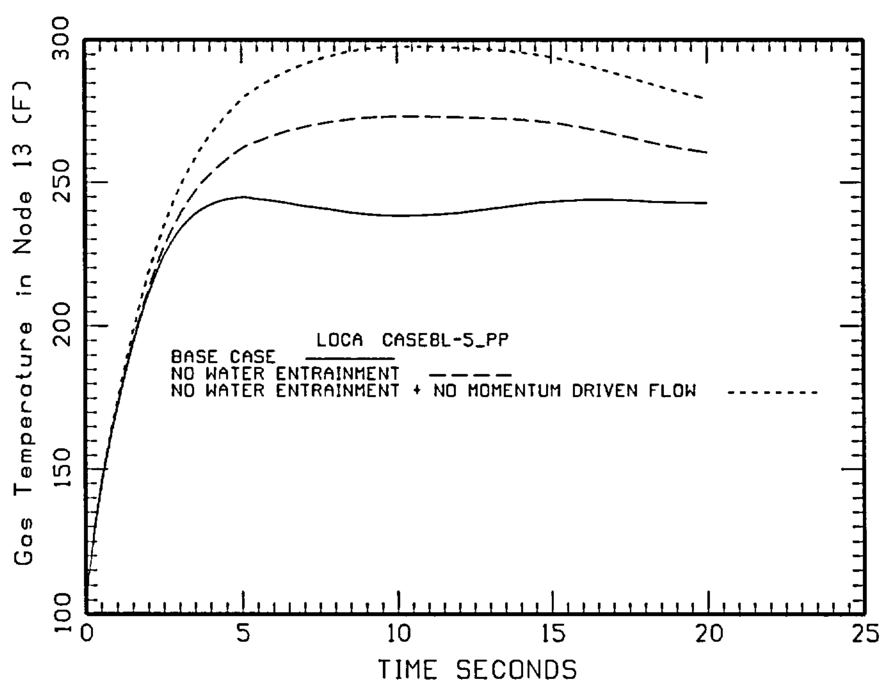

Gas Temperature in Node 13 (F)
300
250
200
150
100
0
5
10
15
20
25
TIME SECONDS
LOCA CASE8L-5_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW

Figure 3

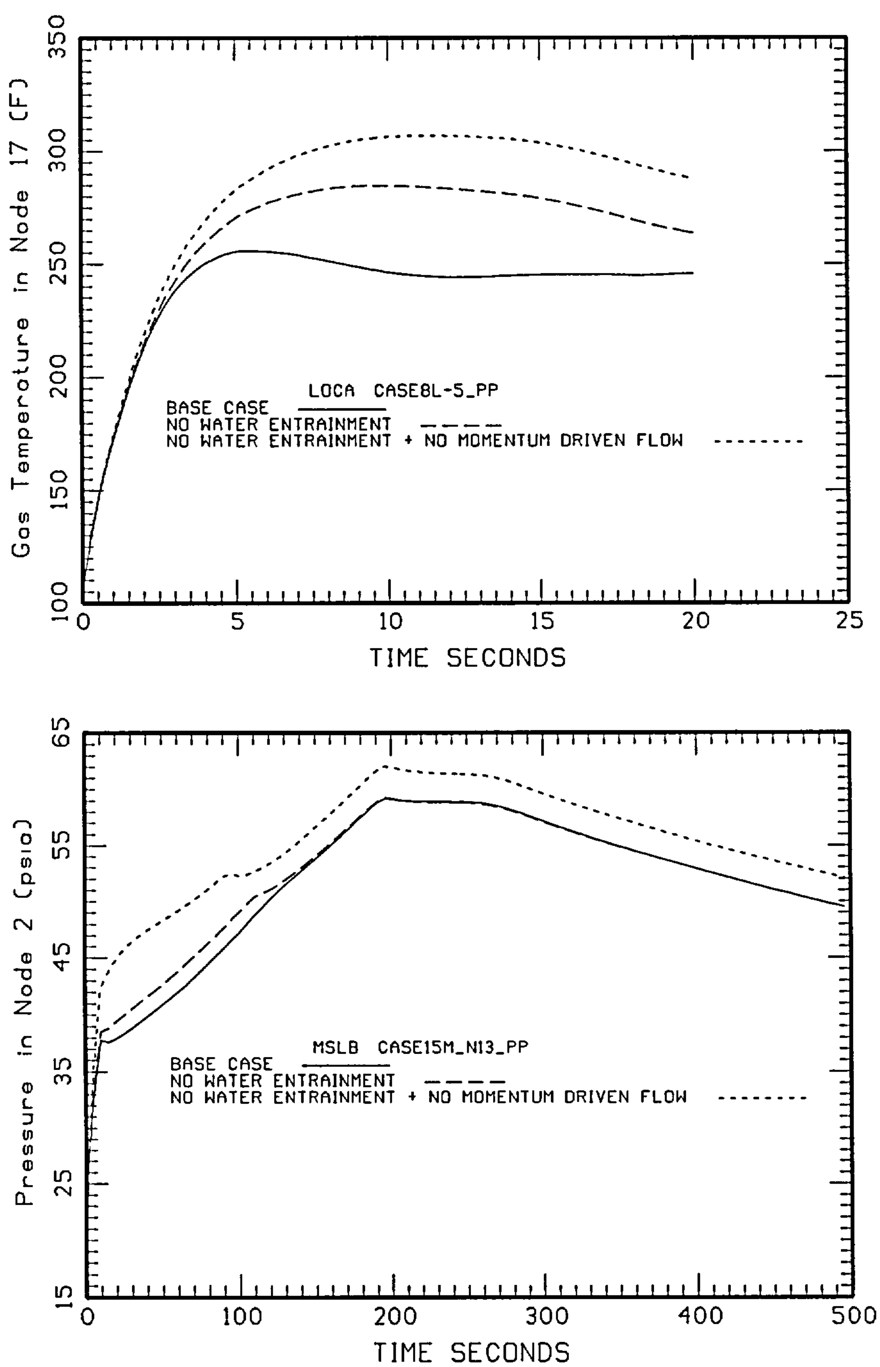

Gas Temperature in Node 17 (F)
350
300
250
200
150
100
0
5
10
15
20
25
TIME SECONDS
LOCA CASE8L-5_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW
Pressure in Node 2 (psia)
65
55
45
35
25
15
0
100
200
300
400
500
TIME SECONDS
MSLB CASE15M_N13_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW

Figure 4

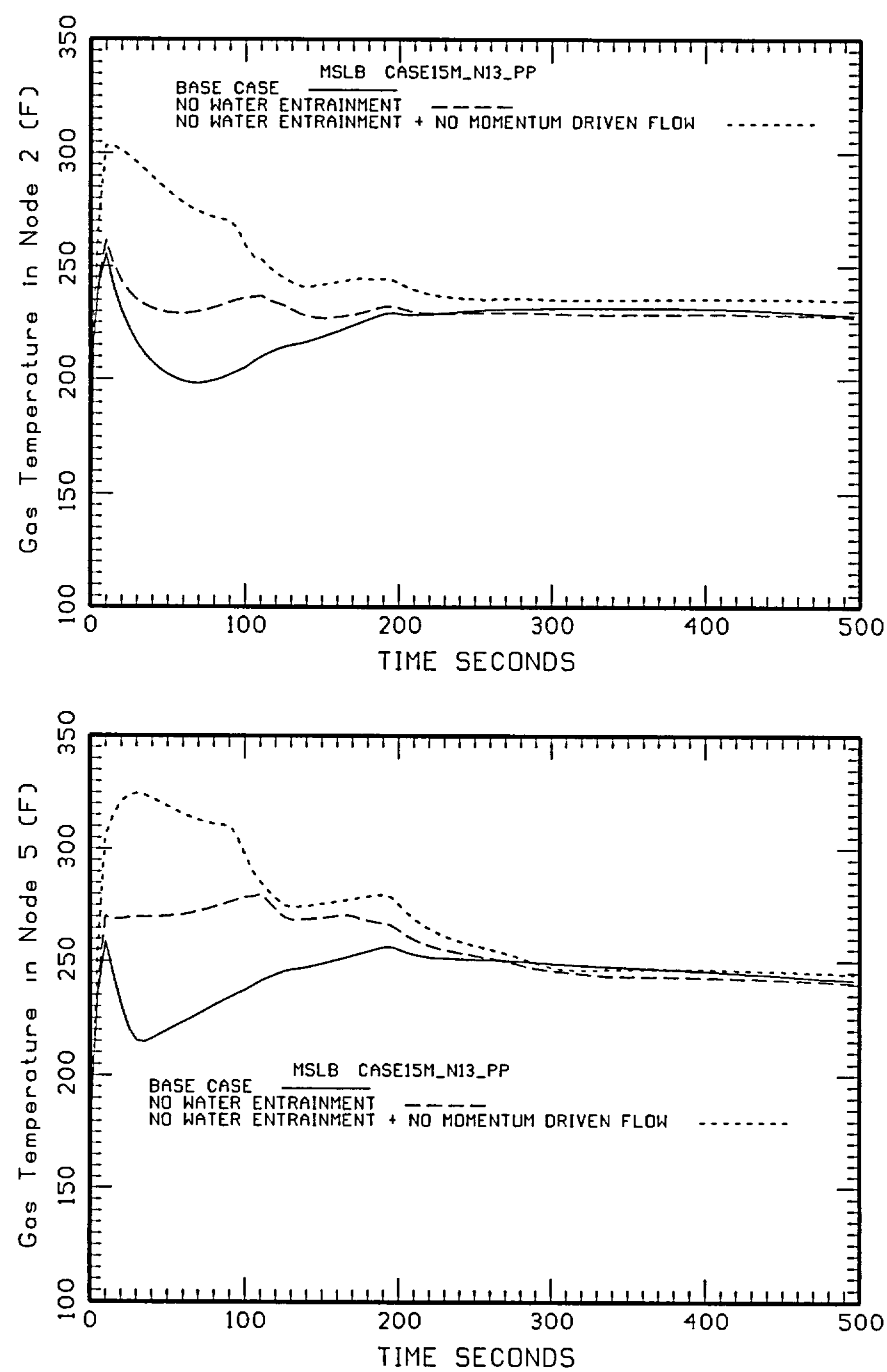

MSLB CASE15M_N13_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW
Gas Temperature in Node 2 (F)
TIME SECONDS
Gas Temperature in Node 5 (F)
TIME SECONDS
0
100
200
300
400
500
150
250
350

Figure 5

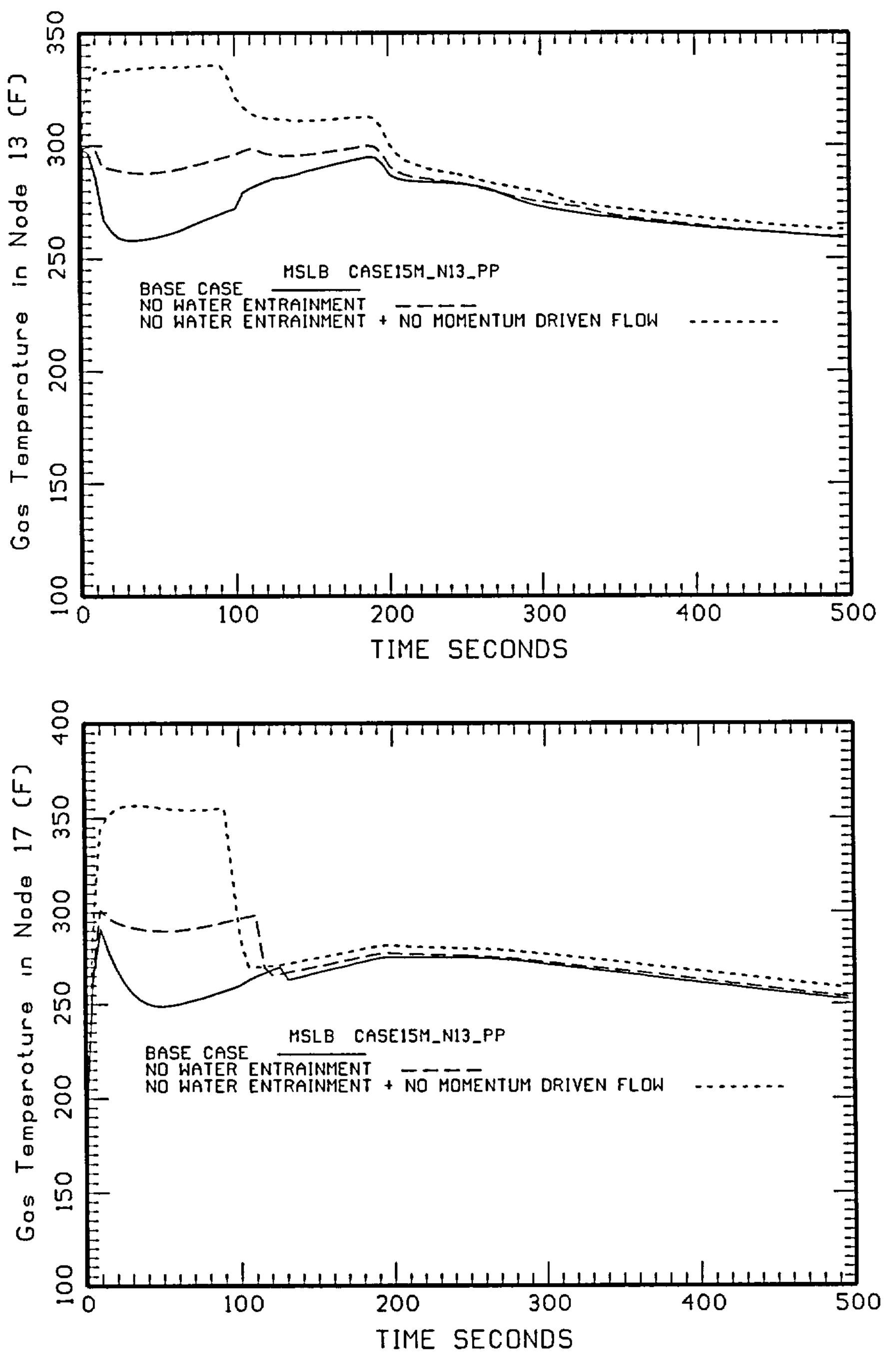

Gas Temperature in Node 13 (F)
100
150
200
250
300
350
0
100
200
300
400
500
TIME SECONDS
MSLB CASE15M_N13_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW
Gas Temperature in Node 17 (F)
100
150
200
250
300
350
400
0
100
200
300
400
500
TIME SECONDS
MSLB CASE15M_N13_PP
BASE CASE
NO WATER ENTRAINMENT
NO WATER ENTRAINMENT + NO MOMENTUM DRIVEN FLOW

Figure 6

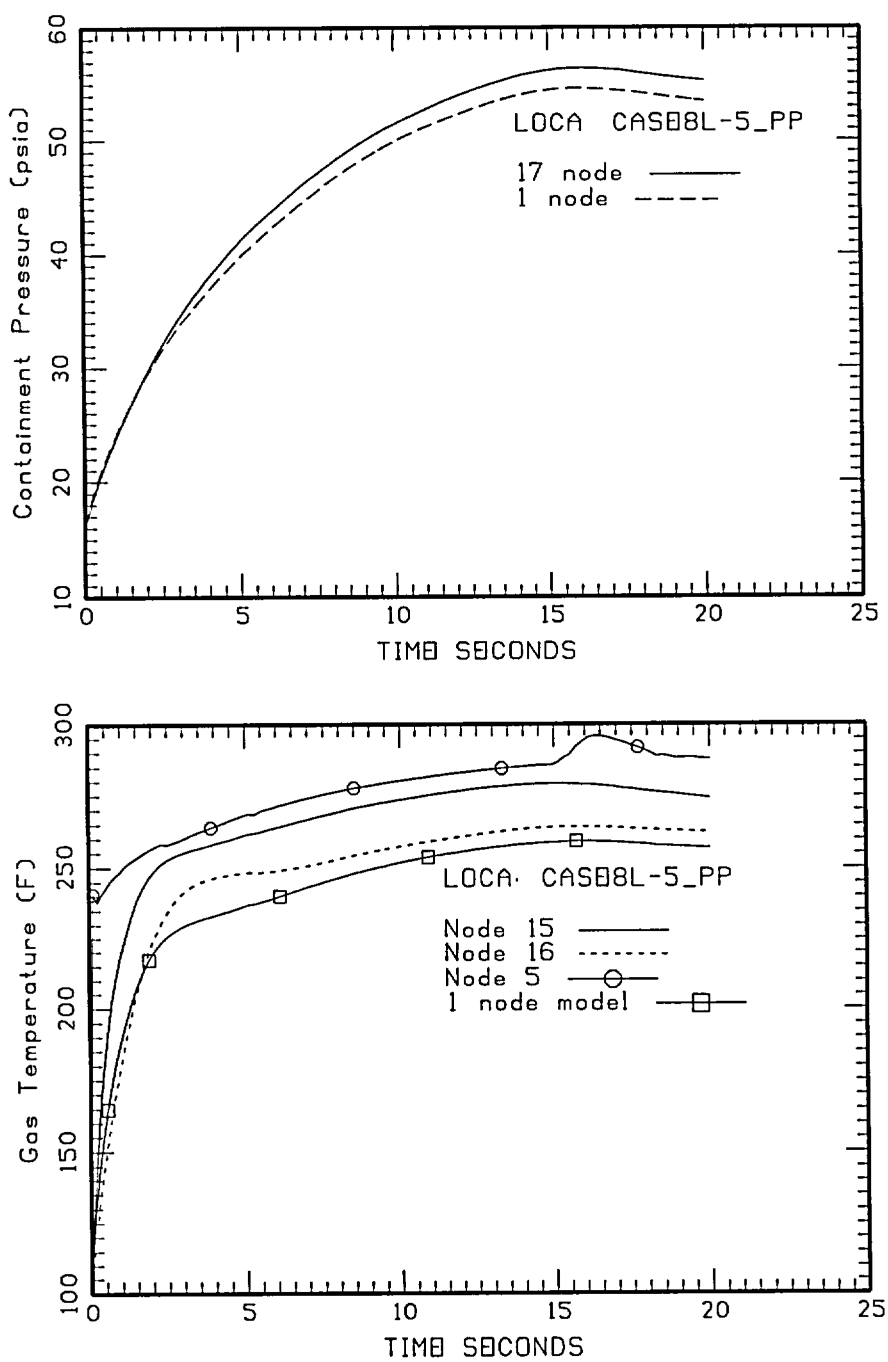
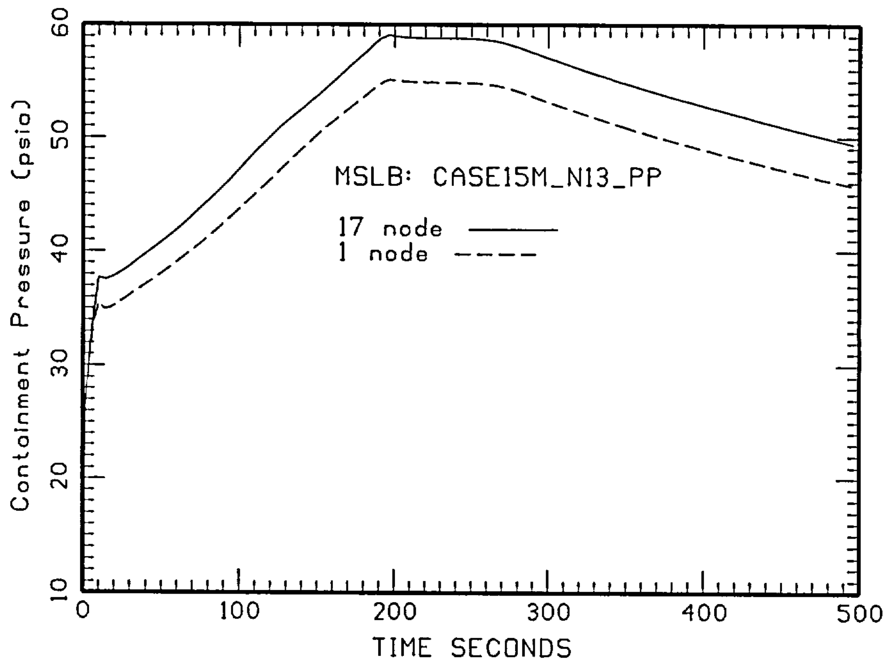
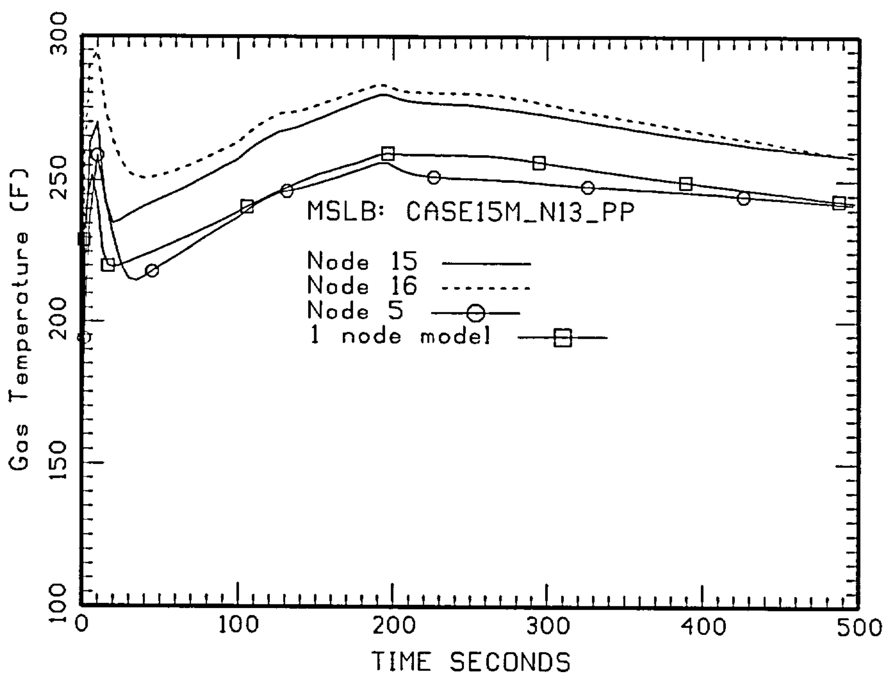

Containment Pressure (psia)
TIME SECONDS
LOCA CASE8L-5_PP
17 node
1 node
Gas Temperature (F)
TIME SECONDS
LOCA CASE8L-5_PP
Node 15
Node 16
Node 5
1 node model

Figure 7


Containment Pressure (psia)
MSLB: CASE15M_N13_PP
17 node
1 node
TIME SECONDS
0
100
200
300
400
500
10
20
30
40
50
60


Gas Temperature (F)
MSLB: CASE15M_N13_PP
Node 15
Node 16
Node 5
1 node model
TIME SECONDS
0
100
200
300
400
500
100
150
200
250
300

Item 1.1.5. What peak pressure and temperatures would have been calculated with the LOCTIC code for MSLB and LOCA cases (e.g., 15M as the MSLB, and Case 8L for LOCA) using the safety analysis methodology followed in the previous Updated Final Safety Analysis Report (UFSAR)?

Response to Item 1.1.5.
The LOCTIC calculated peak pressures and temperatures using the safety analyses methodology described in the UFSAR are provided below.

Unit	Accident	Case Number	Peak Pressure (psig)	Peak Temperature (°F)
1	LOCA	8L	47.64	271.4
1	MSLB	15M	47.23	365.4
1	MSLB	3M	43.91	369.1
2	LOCA	3L	49.10	273.2
2	MSLB	17M	47.03	346.1
2	MSLB	2M	41.78	359.8

1.2 Clarification Items:

Item 1.2.1. Show MAAP pressure and temperature time history profiles for MSLB (e.g., 15MN13-1.4) and LOCA representative calculations. Label temperature profiles by compartment number (include all compartments).

Response to Item 1.2.1.
The pressure and temperature time history profiles for the representative large LOCA double ended hot leg break (case 8L-5_PP) and the representative MSLB (case 15M_N13_PP) are provided for all seventeen containment nodes in Figures 8 through 11.

Figure 8

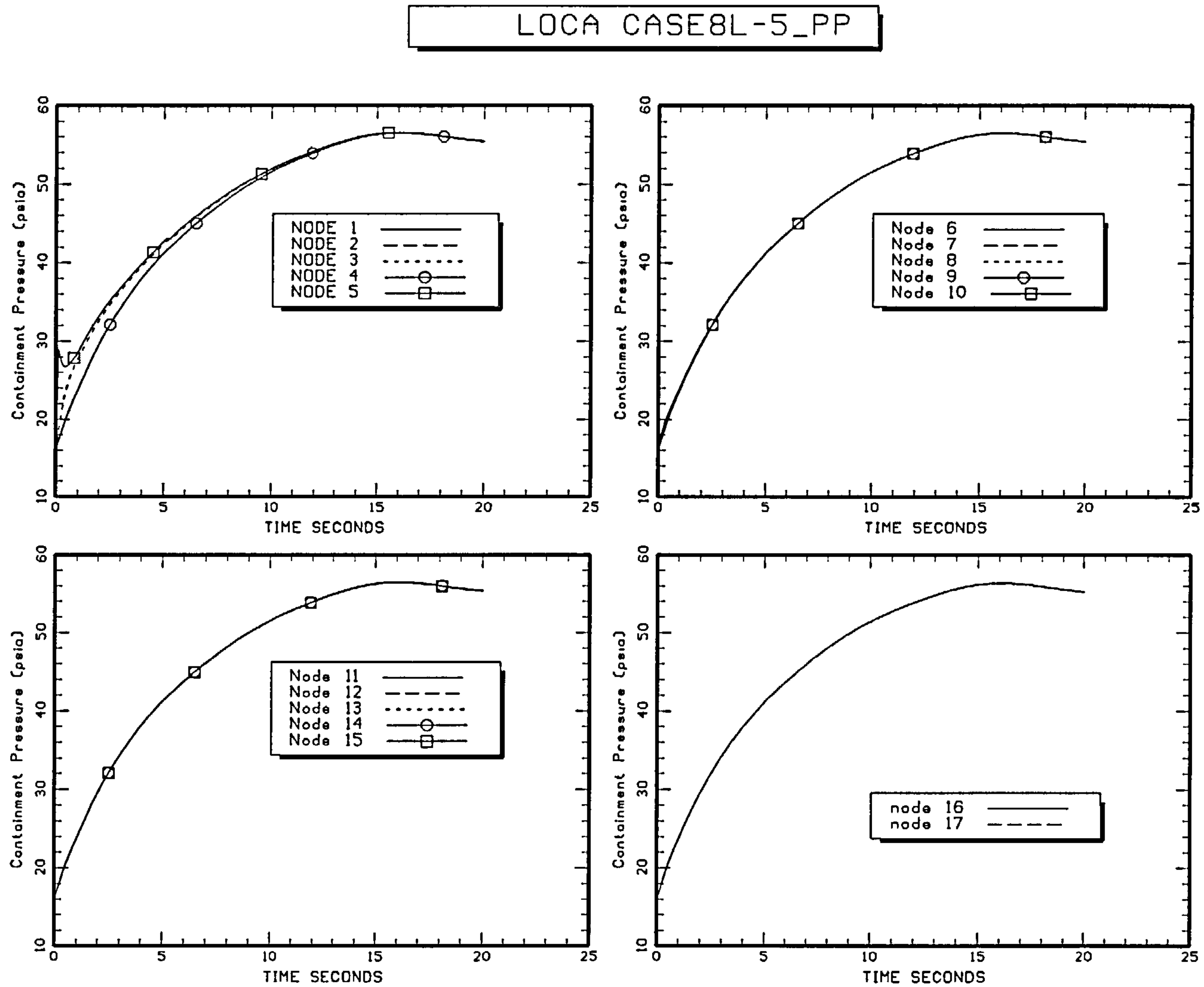

LOCA CASE8L-5_PP
Containment Pressure (psia)
TIME SECONDS
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17
10
20
30
40
50
60
0
5
10
15
20
25

Figure 9

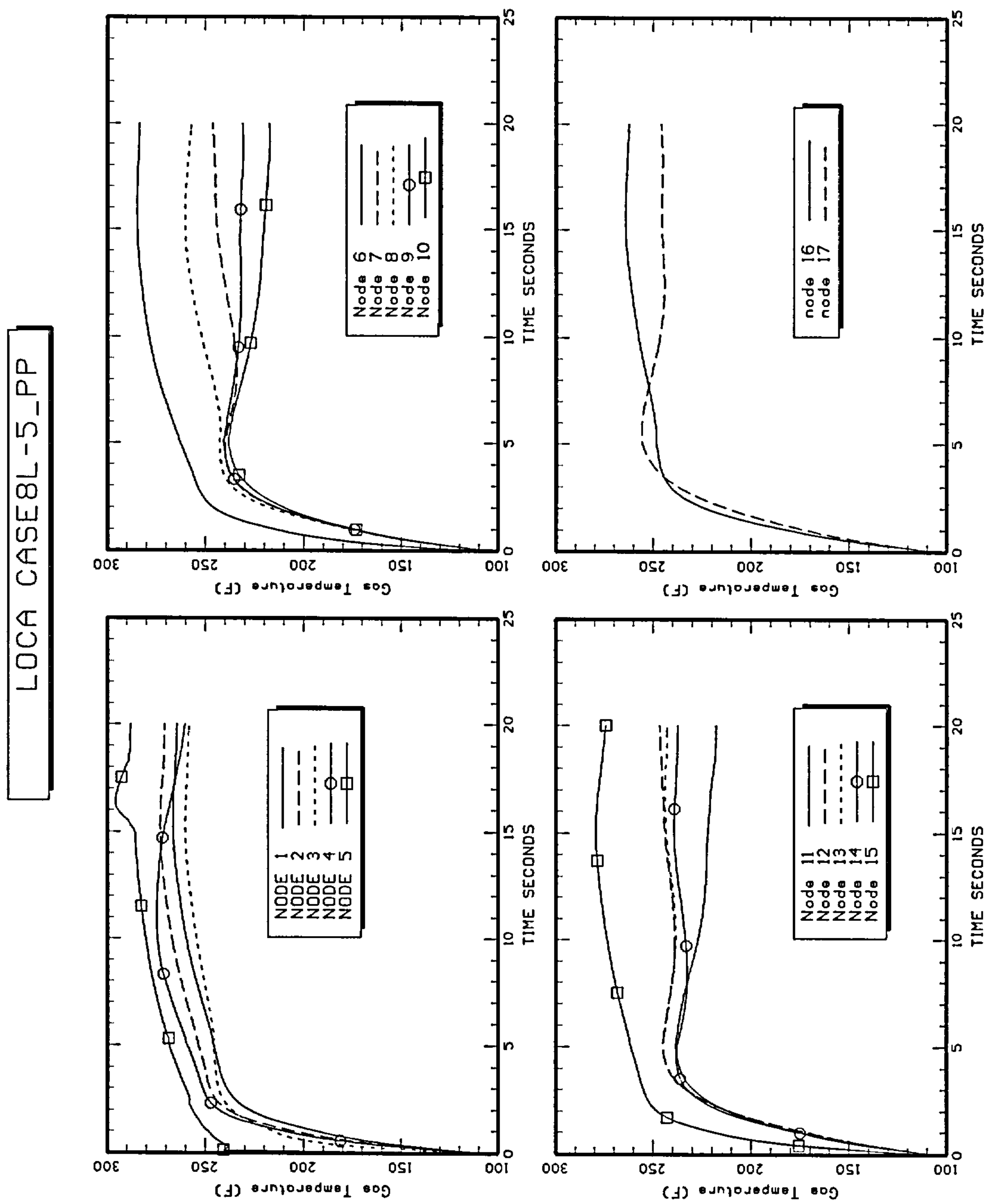
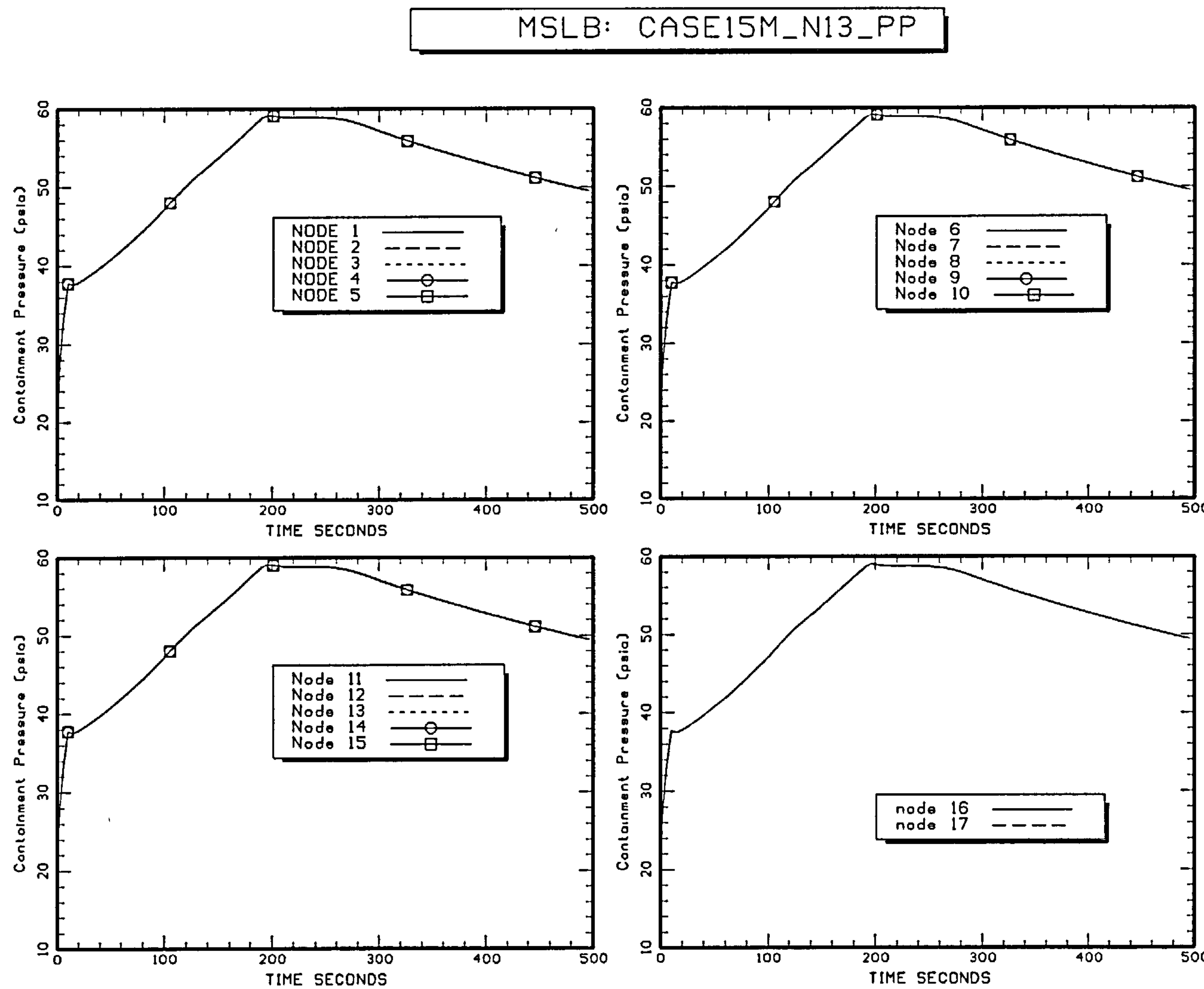

LOCA CASE8L-5_PP
Gas Temperature (F)
TIME SECONDS
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17

Figure 10


MSLB: CASE15M_N13_PP
Containment Pressure (psia)
TIME SECONDS
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17

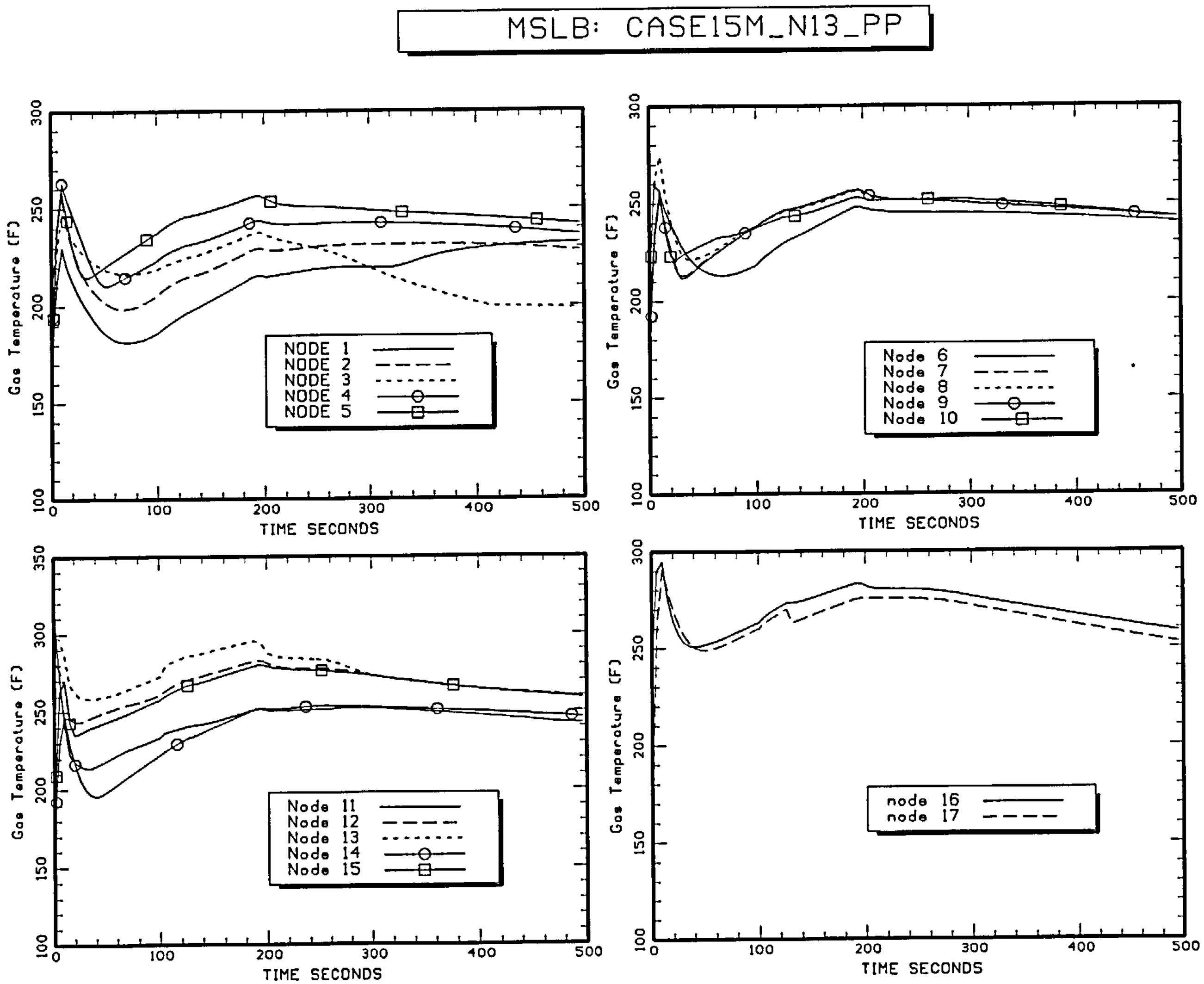

MSLB: CASE15M_N13_PP
Gas Temperature (F)
TIME SECONDS
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17

Figure 11

Item 1.2.2. Why is the upper containment initial pressure shown in Figure 4.1-4 below the maximum initial pressure specified in Table 4.1-3?

Response to Item 1.2.2.
The Figure 4.1-4 ordinate scale is incorrect. The values should be shifted up by 5 psi to properly represent the calculated response for this case. The initial pressure used for the reported results was the maximum initial pressure specified in Table 4.1-3. A corrected version of Figure 4.1-4 is provided.

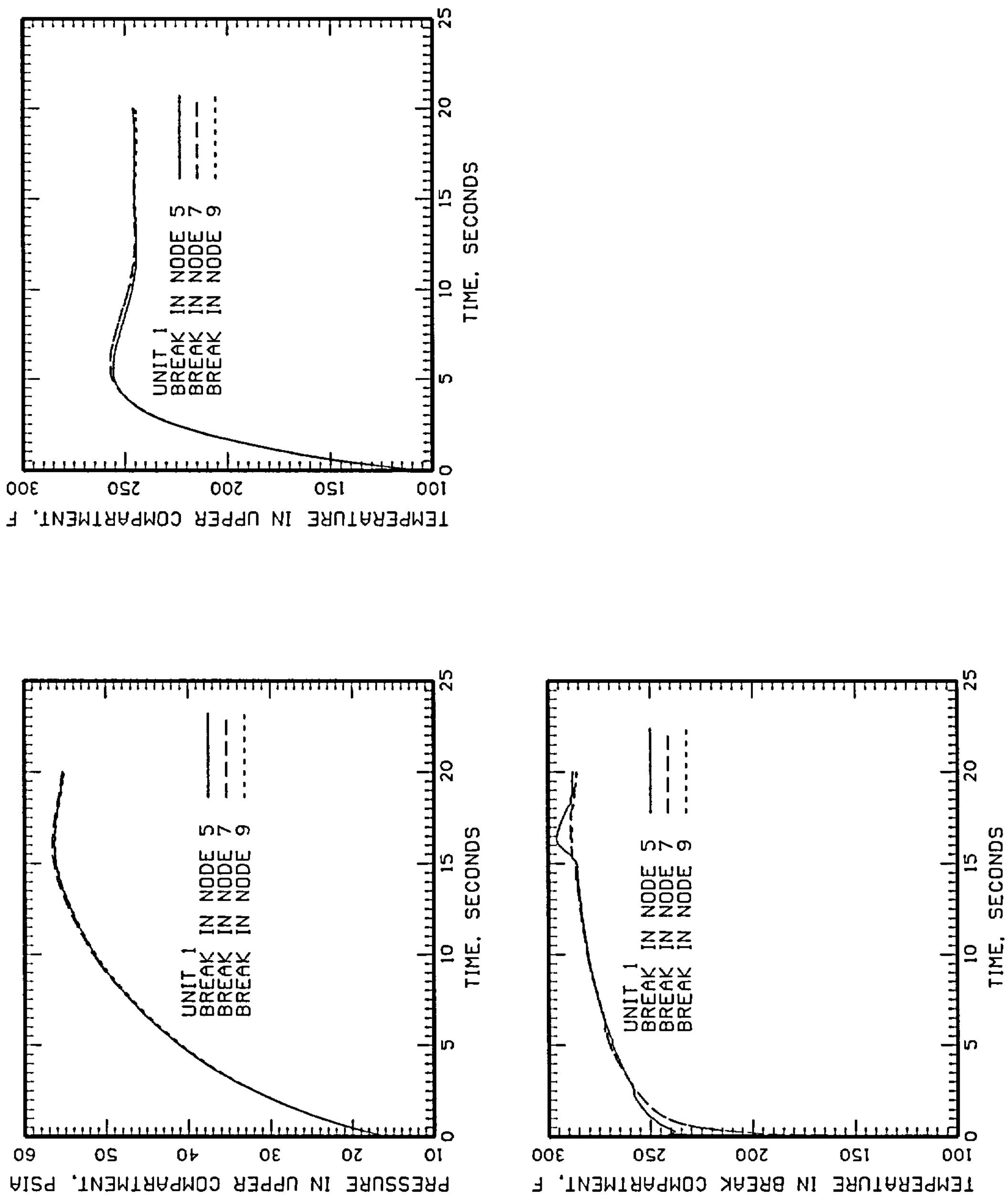


Figure 4.1-4
Composite Figure of the containment Pressurization and Gas Atmosphere Temperature Histories for the DEHL Analyses in the Three Different Loop Compartments for BVPS-1

Item 1.2.3. When does the quench spray flow inject into the containment for the MSLB calculation 15M-N13-1.4?

Response to Item 1.2.3.
The quench spray flow injection into containment for MSLB case 15M_N13 corresponds to the time that equals the sum of the containment high-high setpoint being reached plus the maximum quench spray delay time specified in Table 4.1-3. For this case the spray initiation time is the sum of 43 and 85 seconds, i.e., 128 seconds.

Item 1.2.4. Show water entrainment and pool temperature profiles in containment compartments for representative MSLB and LOCA calculations

Response to Item 1.2.4.
The water entrainment rate and sump water temperature profiles are provided for two representative sequences. The large LOCA sequence is the double ended hot leg break (case 8L-5_PP; Figures 12 and 13) and the MSLB case (case 15M_N13_PP) with the results shown in Figures 14 and 15. Water pool temperatures in Nodes 16 and 17 are the default values since there are no floors for these nodes, and therefore, no water mass.

Figure 12

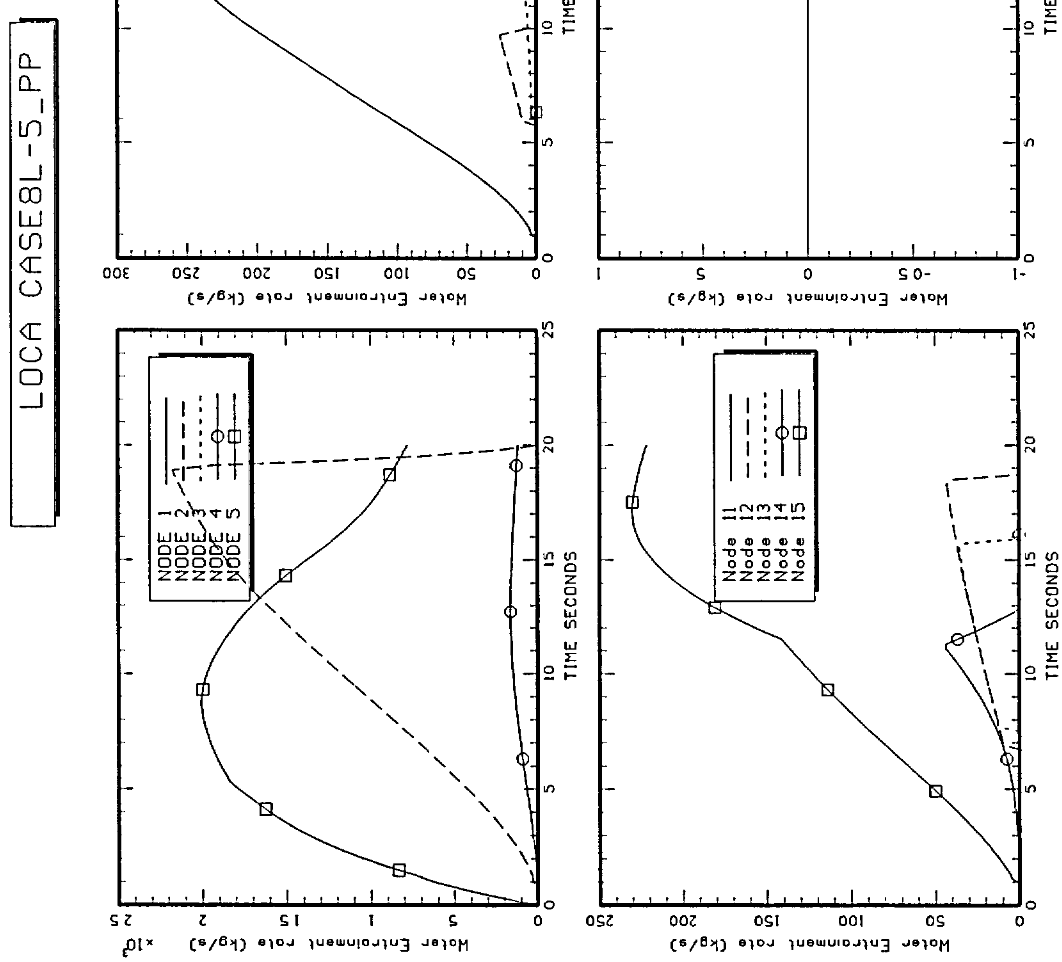

LOCA CASE8L-5_PP
Water Entrainment rate (kg/s)
x10^3
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17
TIME SECONDS

Figure 13

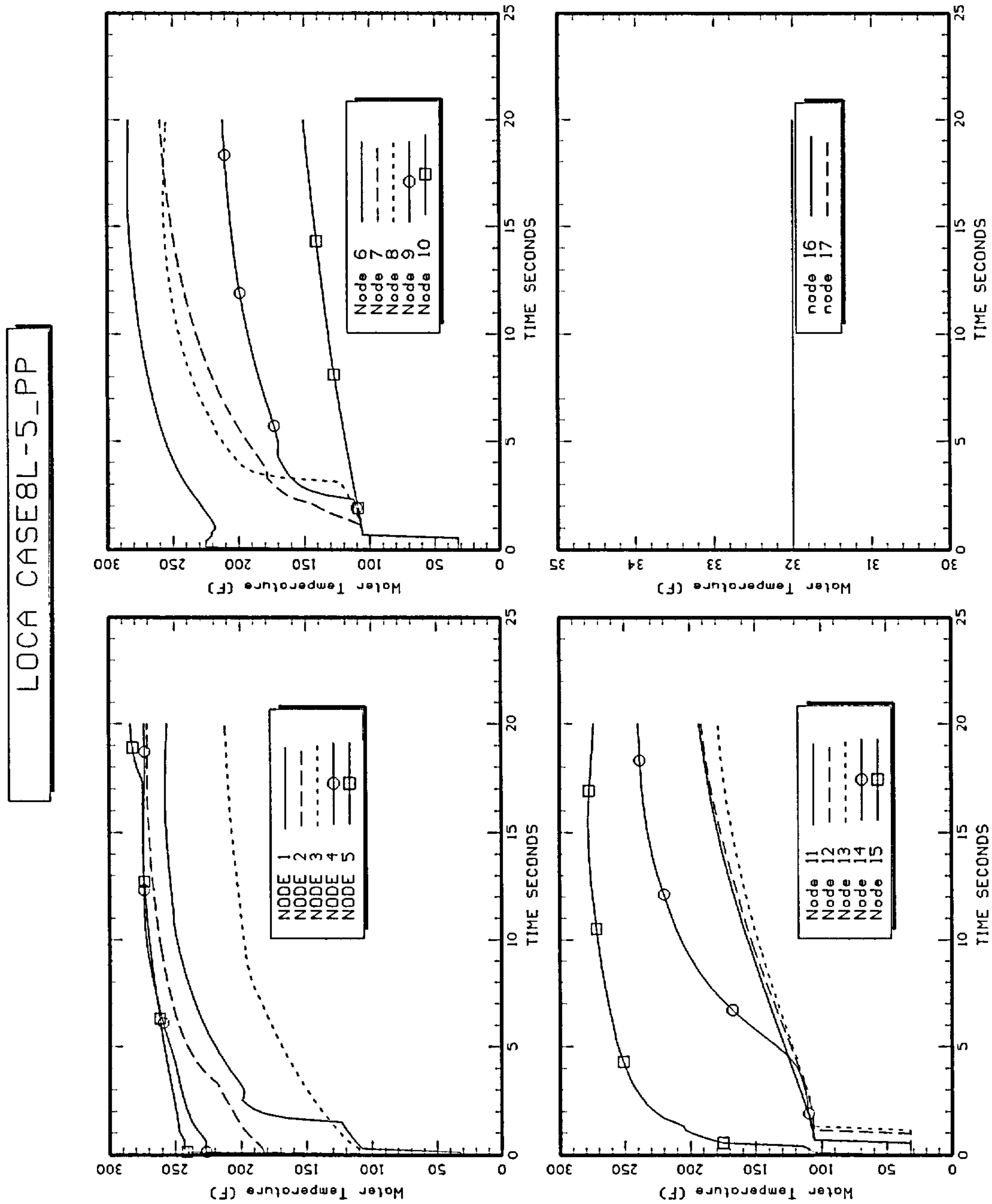
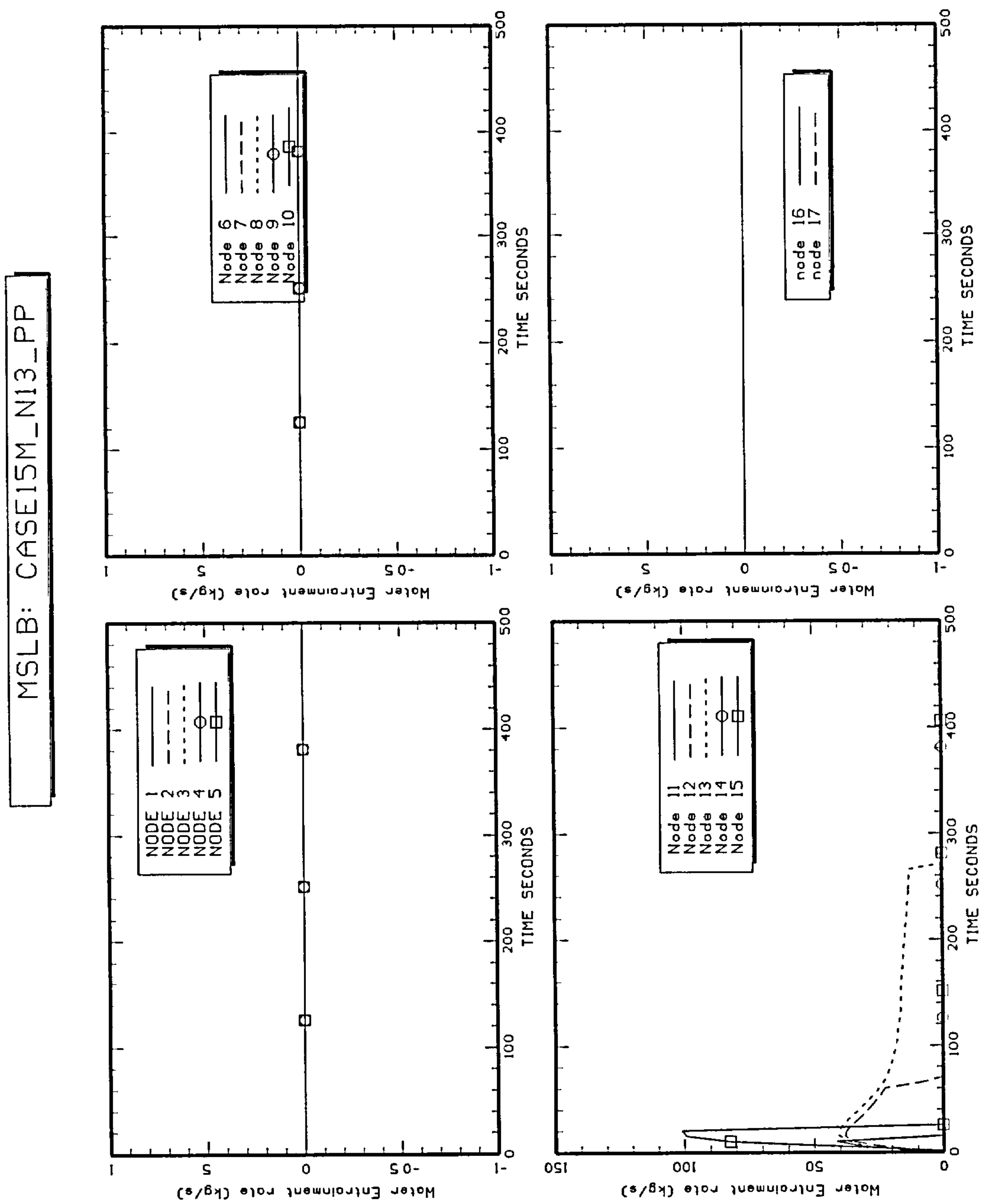

LOCA CASE8L-5_PP
Water Temperature (F)
TIME SECONDS
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17

Figure 14


MSLB: CASE15M_N13_PP
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17
Water Entrainment rate (kg/s)
TIME SECONDS

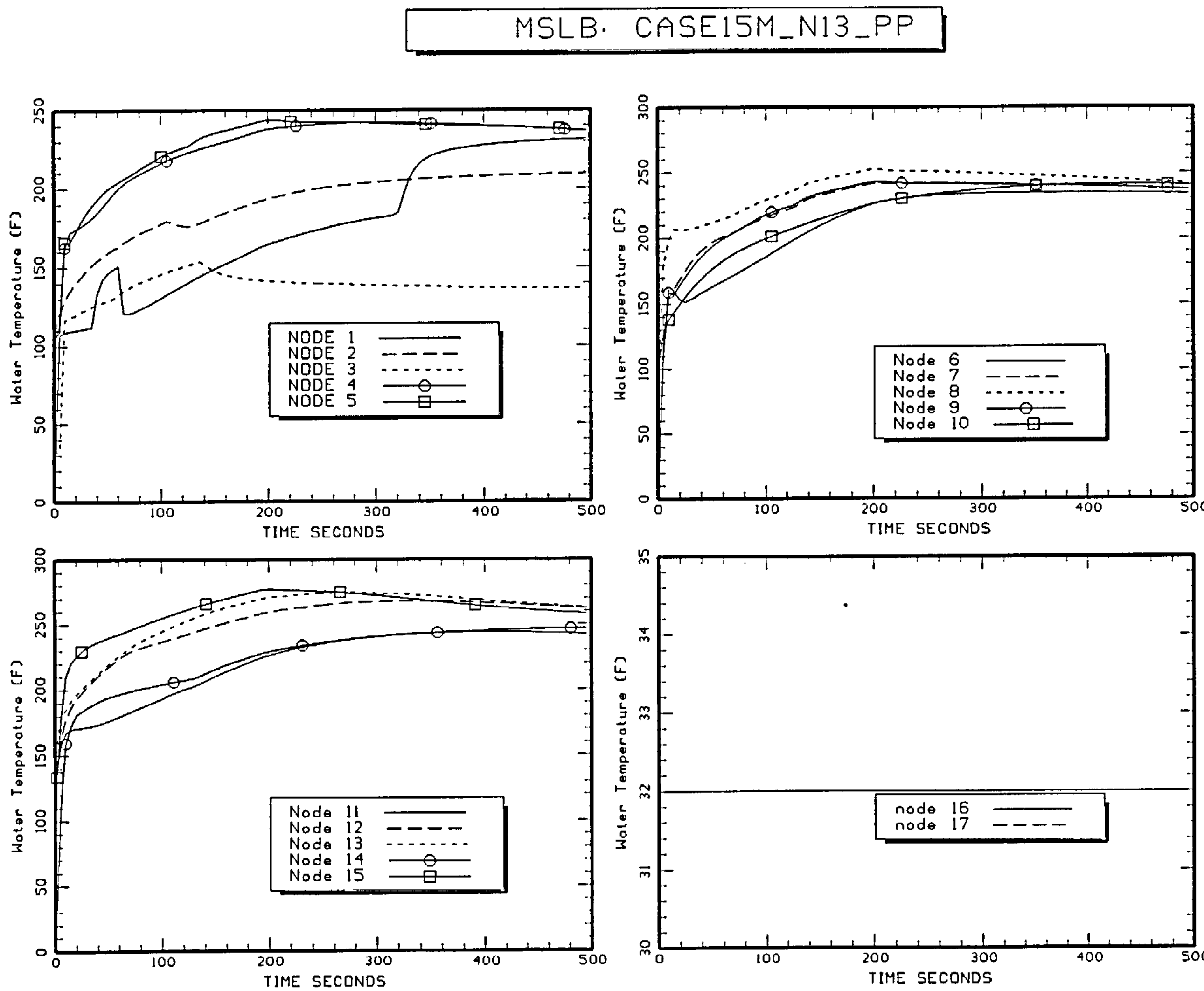

MSLB· CASE15M_N13_PP
Water Temperature (F)
TIME SECONDS
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17

Figure 15

Item 1.2.5. Provide MAAP5 momentum-driven velocity time history profiles for compartments using representative MSLB and LOCA cases (as above).

Response to Item 1.2.5.

The MAAP5 momentum-driven transient velocities for all containment nodes are provided in the attached Figures for the two representative sequences. The large LOCA sequence is the double ended hot leg break (case 8L-5_PP) and is shown in Figure 16 and the MSLB case (case 15M_N13_PP) is shown in Figure 17.

Figure 16

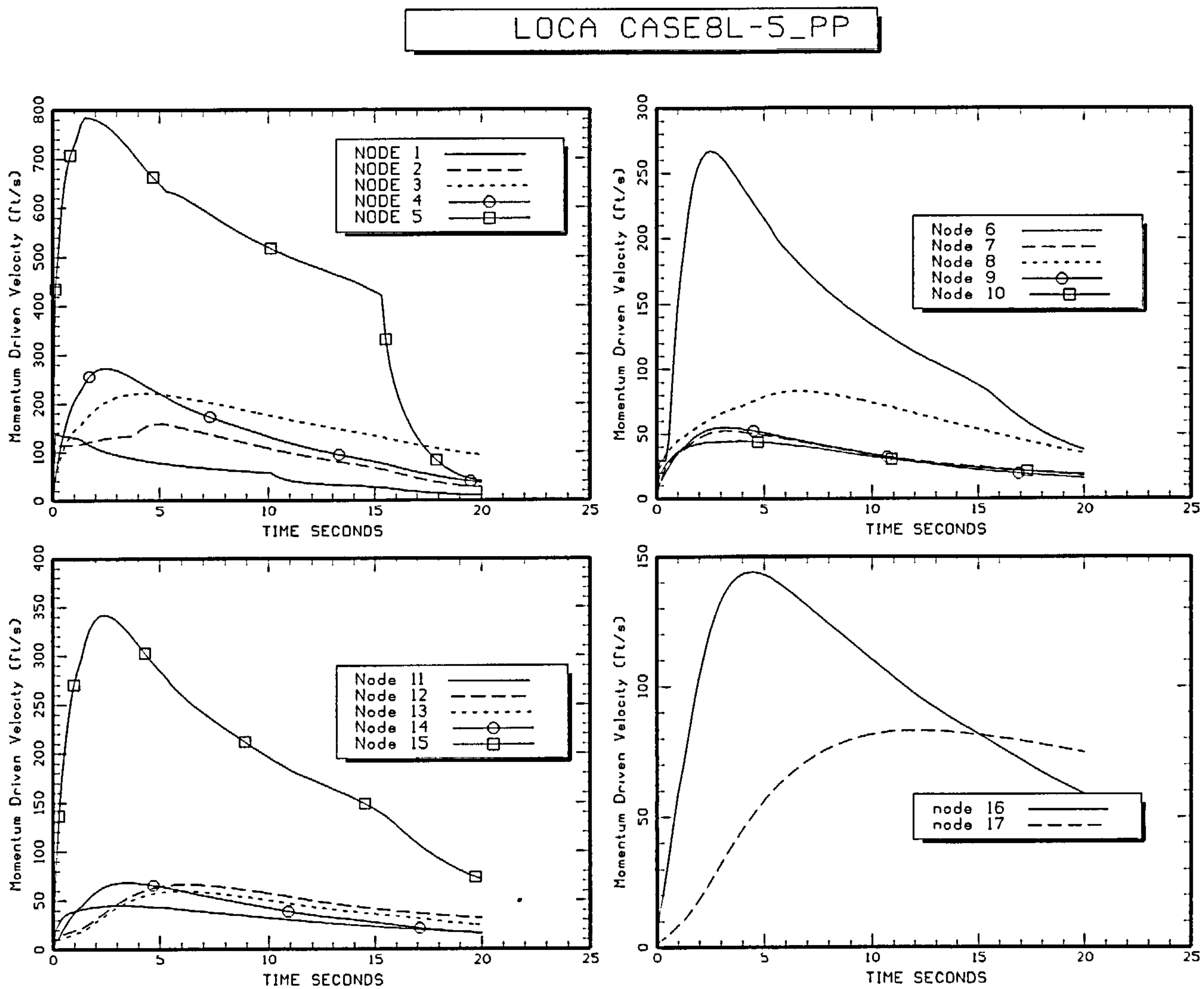
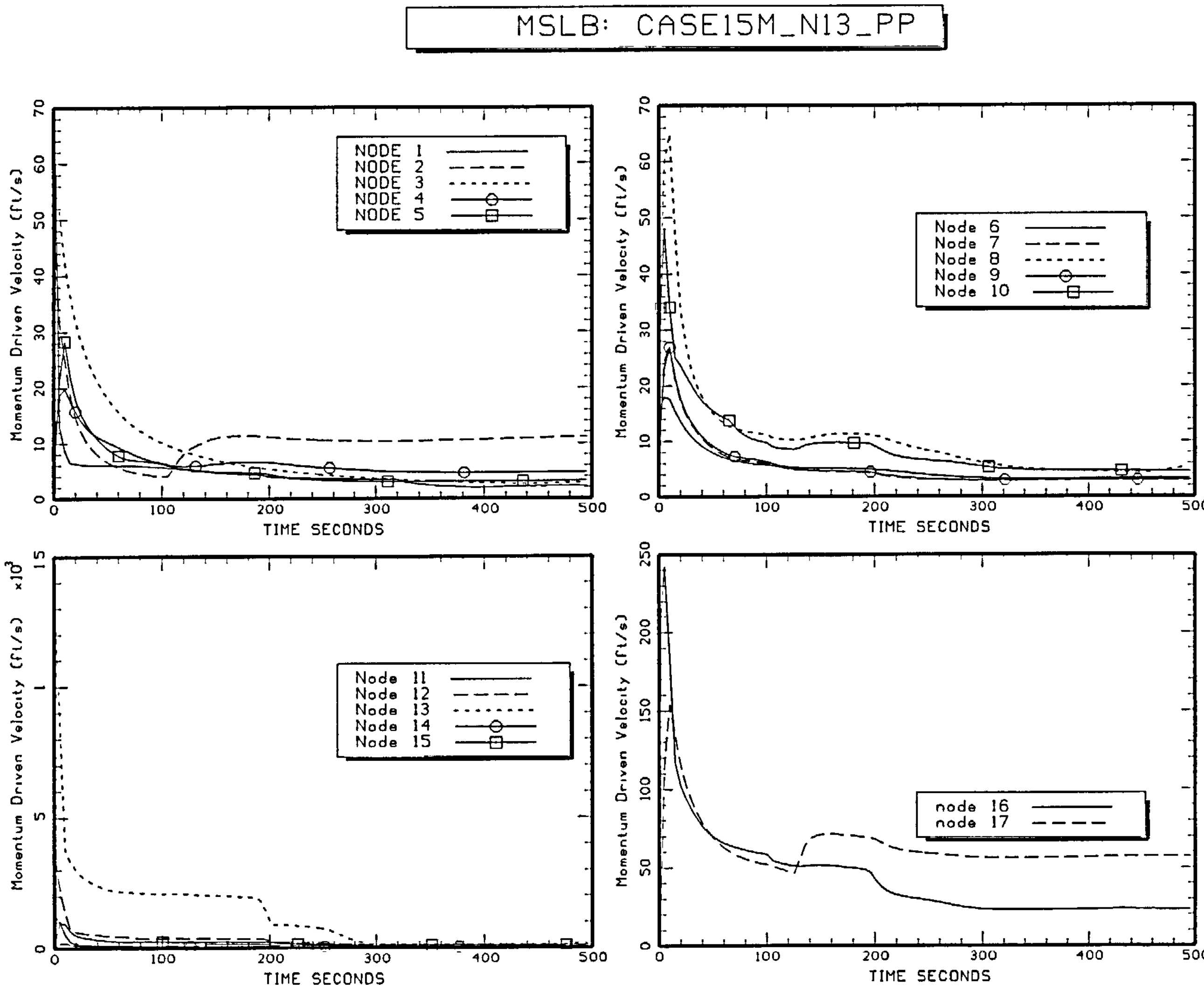

LOCA CASE8L-5_PP
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Momentum Driven Velocity (ft/s)
TIME SECONDS
Node 6
Node 7
Node 8
Node 9
Node 10
Momentum Driven Velocity (ft/s)
TIME SECONDS
Node 11
Node 12
Node 13
Node 14
Node 15
Momentum Driven Velocity (ft/s)
TIME SECONDS
node 16
node 17
Momentum Driven Velocity (ft/s)
TIME SECONDS

Figure 17


MSLB: CASE15M_N13_PP
Momentum Driven Velocity (ft/s)
TIME SECONDS
NODE 1
NODE 2
NODE 3
NODE 4
NODE 5
Node 6
Node 7
Node 8
Node 9
Node 10
Node 11
Node 12
Node 13
Node 14
Node 15
node 16
node 17
$x10^3$

Item 1.2.6. How are the MAAP5 water and steam discharges modeled? For instance, is the modeling represented as a pressure flash assumption with a percentage of water fallout going to the MAAP aerosol model? How is the water aerosol model initialized or seeded for added water from the discharge? How does the aerosol dropout compare to the LOCTIC model for liquid water removal from the atmosphere?

Response to Item 1.2.6.

For the analyses performed in support of the Beaver Valley application for containment conversion, as well as for the CVTR, HDR, Battelle-Frankfurt and CSTF experimental benchmarks, the discharge into containment is specified by either a separate design basis mass and energy release calculation or experimental measurements. As such, the water and steam discharge into the MAAP5 containment model is a time dependent boundary condition for the calculation. The discharged water is flashed based on the containment's total pressure. All evaluations assume a small fraction of the remaining water mass (typically 5% of the water flow rate), which is user specified, as becoming initially airborne. This water mass is added to the airborne mass evaluated by the MAAP aerosol model, which has been benchmarked with numerous experiments (including the ABCOVE tests). For the CVTR experiment, the incoming mass flow rate is 100% steam, and therefore, has no initial blowdown water mass added to the airborne aerosol mass.

The MAAP5 aerosol depletion (dropout) of the water mass is mechanistically calculated by the deposition models discussed in the MAAP User's Manual. The computer code LOCTIC does not have an aerosol dropout model. In LOCTIC, at the end of each time step, the containment atmosphere inventories of mass and energy are updated to reflect heat and mass transfers due to sprays, sinks, and blowdown during the time step. If these inventories are seen to correspond to a saturated state, all water mass in excess of what can be vaporized is deposited as liquid on the floor.

Item 1.2.7. Are liquid water (aerosol), gas and vapor masses summed to define a fluid density for the compartment flow equations and momentum-driven velocity equations?

Response to Item 1.2.7.

Yes, the liquid water (aerosol), noncondensible gas and vapor masses are summed to define the fluid density for the compartment flow equations and the momentum-driven velocity calculations.

Item 1.2.8. Are quantities set in the parameter files in British units converted to the International System of Units (SI) in the code? Comment on the form of the ideal gas equation used for determining the accumulator nitrogen gas mass when accumulator volumes and gas temperatures are set according to British units. (See files U1_MIN_ACCUM_N2 and CONTAINMENT_IAR _TABLE.)

Response to Item 1.2.8.
Yes, the quantities set in the parameter files in British units are converted to SI units in the MAAP5 code. All input values are converted to SI for code execution (pressure in Pa, temperature in K, etc.); this conversion occurs before accumulator nitrogen masses are computed. Hence, the ideal gas equation is correct as written, i.e. PV = nRT.

Attachment B to L-02-115

Commitment List

The following table identifies those actions committed to by FirstEnergy Nuclear Operating Company (FENOC) for Beaver Valley Power Station (BVPS) Unit Nos. 1 and 2 in this document. Any other actions discussed in the submittal represent intended or planned actions by FENOC. They are described only as information and are not regulatory commitments. Please notify Mr. Larry R. Freeland, Manager, Regulatory Affairs/Performance Improvement, at Beaver Valley on (724) 682-5284 of any questions regarding this document or associated regulatory commitments.

COMMITMENT	REFERENCE	DUE DATE
1. Submit UFSAR mark-up package to the NRC.	FENOC Letter L-02-115	January 31, 2003