EVALUATION TO INCREASE NORMAL
DRYWELL TEMPERATURE OPERATING LIMIT

TOPICAL REPORT # 024

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1.0 ABSTRACT

This report provides a technical basis for increasing the Emergency Operating Procedures entry condition based on bulk drywell temperature from 135°F to 150°F. The normal limit for power operation can be raised to 150°F.

A series of CONTEMPT analyses were performed to determine the sensitivity of containment response for three events starting from different initial drywell temperatures. The analyses covered the containment response to the design basis LOCA; MSLB for defining the EQ temperature profile inside the drywell, and the loss of drywell cooling case which defines the limiting drywell temperature condition for the Remote Shutdown Panel study. The temperature profiles for each of these cases do not change significantly when the initial drywell temperature is raised to 150°F. In all cases, the peak temperatures and pressure are either unchanged or still within the acceptable ranges. Thus, it is concluded that it is acceptable to raise the EOP entry condition on bulk drywell temperature to 150°F and to permit normal plant operations up to this value of bulk drywell temperature.

2.0 INTRODUCTION

This report is being prepared to provide technical justification for increasing the entry condition to the Containment Control section of the Emergency Operating Procedures (EOPs) based on drywell bulk temperature. The intent of this report is to justify raising the entry condition from 135°F to 150°F.

Recently, the operator has begun computing drywell bulk temperature using the algorithm contained in Plant Administration Procedure 106 (Reference 1). The calculated bulk drywell temperature was usually near or a few degrees above the EOP entry condition value of 135°F. In order to prevent the operator from continuously being in the EOPs, it was proposed to raise the EOP entry condition to 150°F.

3.0 METHODOLOGY

The justification to raise the drywell temperature EOP entry condition to 150°F was based on the results from a series of analyses using the CONTEMPT code (Reference 2). The three cases that were analyzed are the following:

- Design basis LOCA
- 0.75 ft^2 MSLB, containment spray initiated at 10 minutes (EEQ Inside Containment Temperature Profile Analysis)
- Loss of drywell cooling, 50°F/hr cooldown begun at 10 minutes (Remote Shutdown Panel Performance Analysis)

The design basis LOCA was chosen since this break maximizes the energy input into the containment. The steam line break case defines the temperature profile for the environmental qualification of electrical equipment inside the drywell (Reference 3). The last case was used as the limiting case for drywell temperature as part of the remote shutdown panel study (Reference 4). The assumptions used for these cases are listed in Table 1.

TABLE 1

ANALYSIS ASSUMPTIONS

	DBA LOCA		EEQ MSLB		RSD PANEL CALC	
	CASE 1A	CASE 1B	CASE 2A	CASE 2B	CASE 3A	CASE 3B
Initial drywell pressure, psig	1.2	1.2	1.2	1.2	0.5	0.5
Initial torus pressure, psig	0.0	0.0	0.0	0.0	0.0	0.0
Initial drywell & torus humidity	0.01	0.01	0.01	0.01	0.01	0.01
Initial drywell temperature, F	135	150	135	150	135	150
Initial torus temperature, F	120	120	120	120	85	85

4.0 RESULTS

The results from the six CONTEMPT analyses are summarized in Figures 1 through 5 and the peak values for drywell pressure and temperature are given in Table 2. Figure 1 shows the drywell atmosphere response for the DBA LOCA over 1600 second period. The long term temperature profile is identical irrespective of the initial drywell temperature. The early portion of the transient shows a slight deviation between the two cases. This difference is shown in more detail on Figure 2. This figure shows that the post-peak atmospheric temperature profile for Case 1A (initial temperature = 135°F) is greater than that for Case 1B. This is caused by condensation in the drywell atmosphere so that energy is transferred to the drywell liquid region, resulting in a slightly higher liquid temperature profile for Case 1B for the first 10 minutes of the transient. It can be seen from Figure 2 that the peak drywell temperature for the DBA LOCA is not dependent upon the initial drywell temperature. This behavior is expected since the difference in drywell atmosphere energy between initial temperatures of 135°F and 150°F is small relative to the amount of energy deposited into the drywell by the blowdown.

The profile of drywell atmosphere temperature for the steam line break case is shown in Figures 3 and 4. Figure 4 shows that the long term temperature profile does not depend on the initial drywell temperature. Figure 3 depicts the short term temperature increase. The peak

temperature is roughly 5°F higher for the case starting from an initial temperature of 150°F when compared to the case starting from 135°F. This difference becomes smaller so that by the end of the first minute of the event, the temperature profiles are the same.

Figure 5 illustrates the temperature profiles for the loss of drywell coolers cases. Once the RPV cooldown has begun, the difference in the two profiles is nearly constant and its magnitude is the difference in the initial drywell temperatures for the two cases. The peak drywell temperature of 226°F is reached at roughly 6.3 hours. This value is acceptable since it is well below the design temperature for the drywell liner of 281°F. The increased temperature profile does not cause any detectable total drywell pressure difference because of the reduced initial mass of non-condensibles for the 150°F case. Thus, there is no increased chance of isolating the containment or initiating ADS based on a high drywell pressure signal.

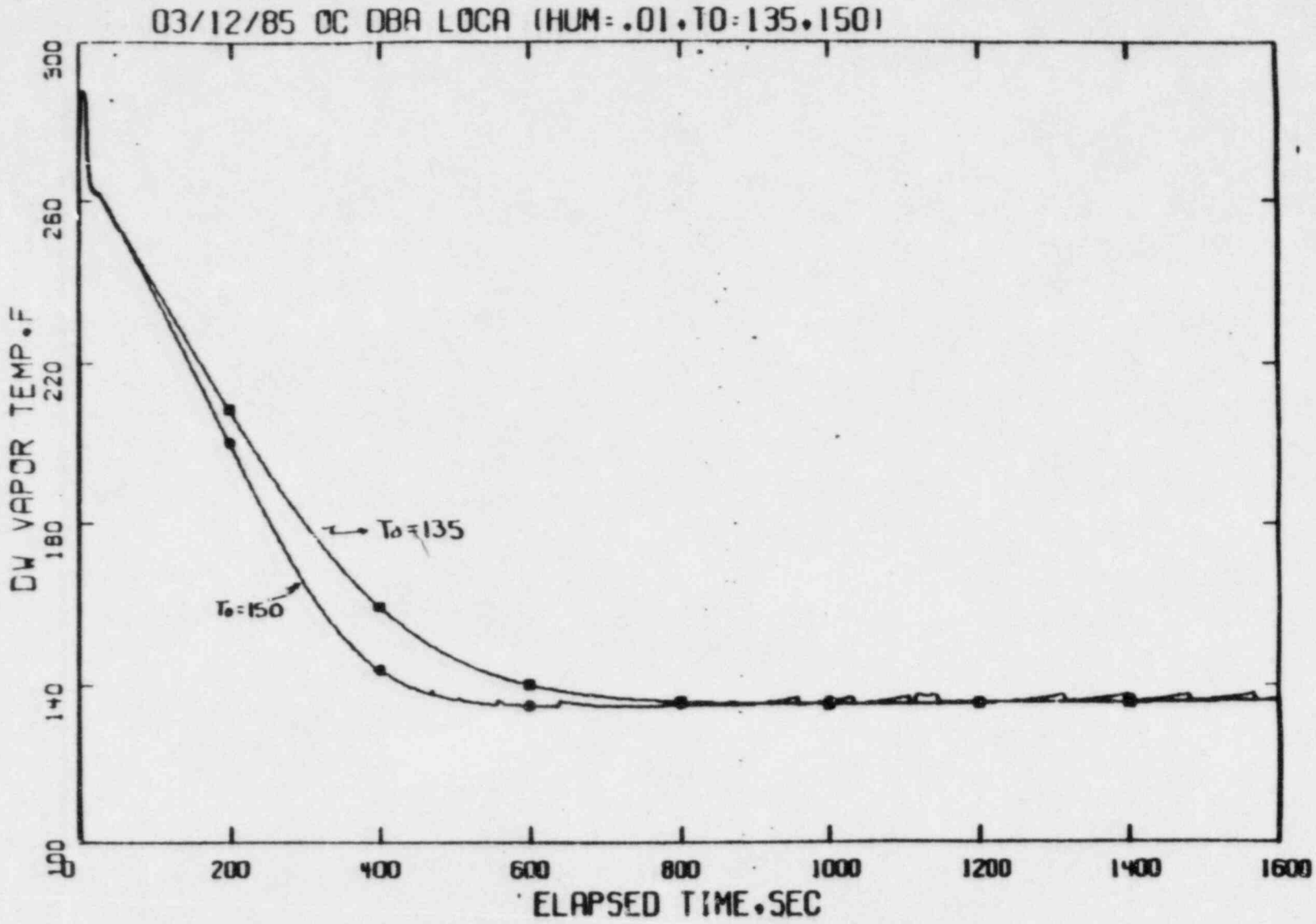
03/12/85 OC DBA LOCA (HUM=.01,TO=135,150)
DW VAPOR TEMP.F
ELAPSED TIME.SEC
To=135
To=150
100
140
180
220
260
300
200
400
600
800
1000
1200
1400
1600

FIGURE 1

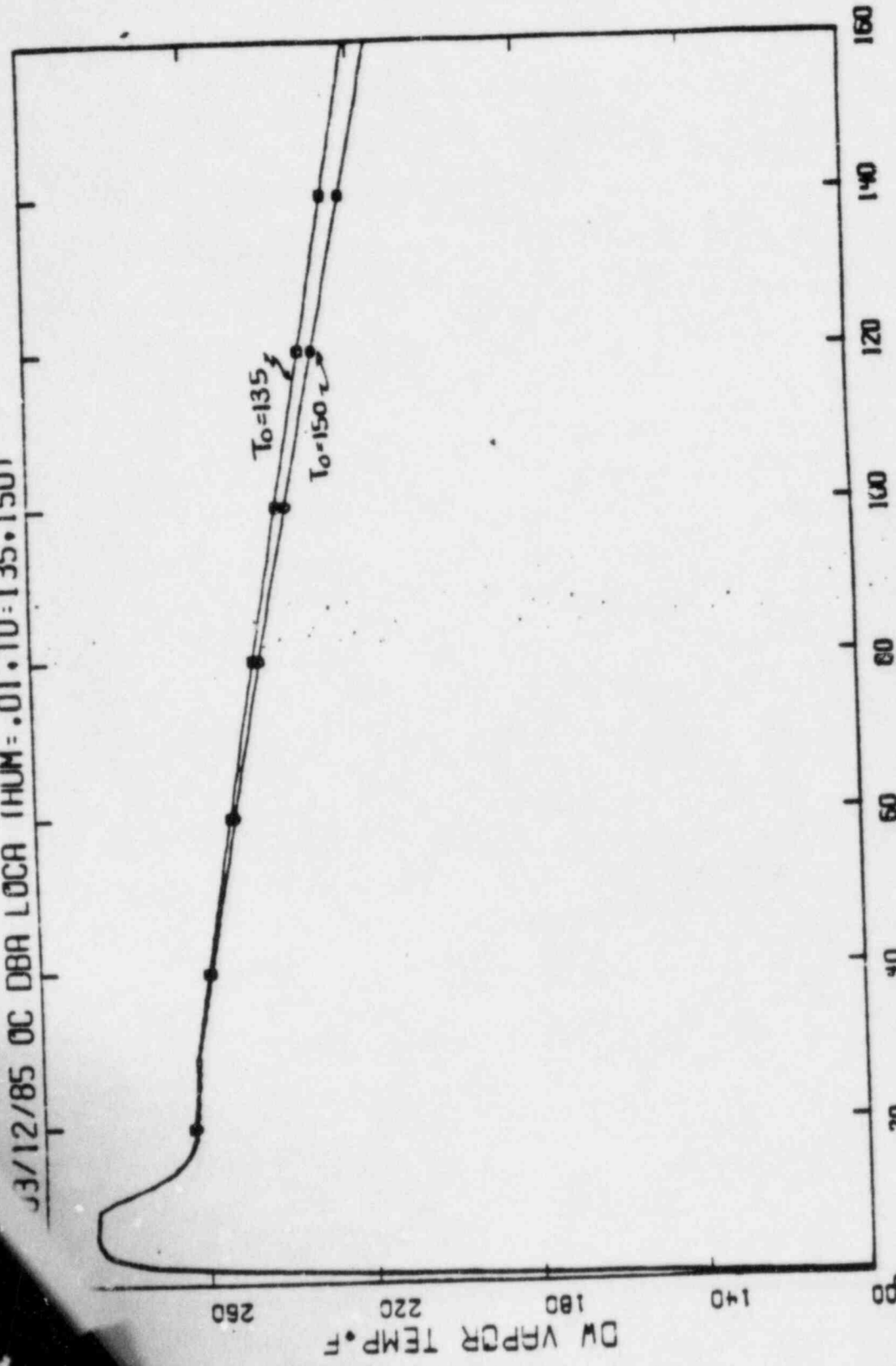
03/12/85 OC DBA LOCA (HUM=.01,TO=135,150)
To=135
To=150
DW VAPOR TEMP.F
ELAPSED TIME.SEC
140
180
220
260
0
20
40
60
80
100
120
140
160

FIGURE 2

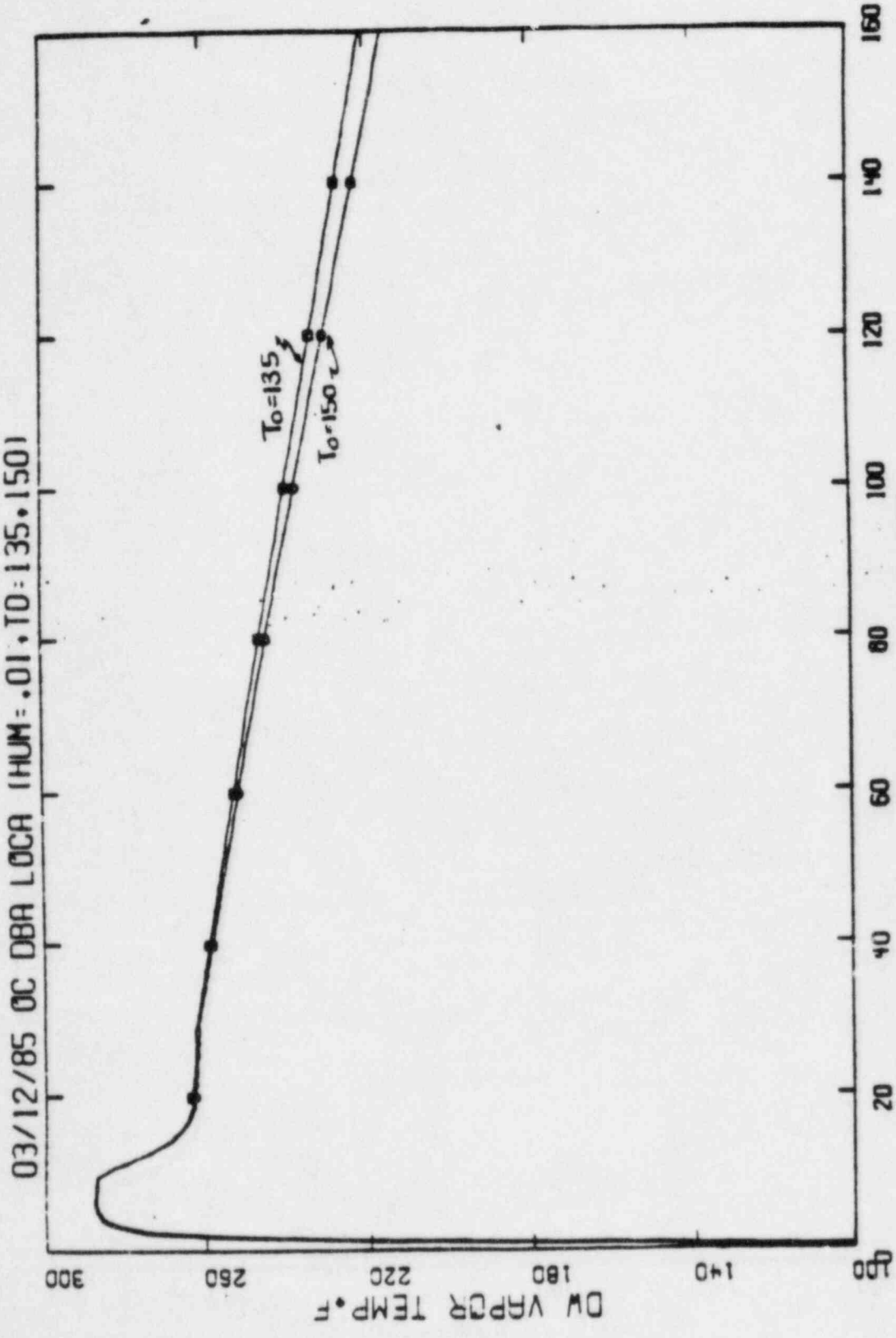
03/12/85 OC DBA LOCA (HUM=.01,TO=135,150)
To=135
To=150
DW VAPOR TEMP.°F
ELAPSED TIME,SEC
300
260
220
180
140
100
60
40
20
0
120
140
160
80

FIGURE 2

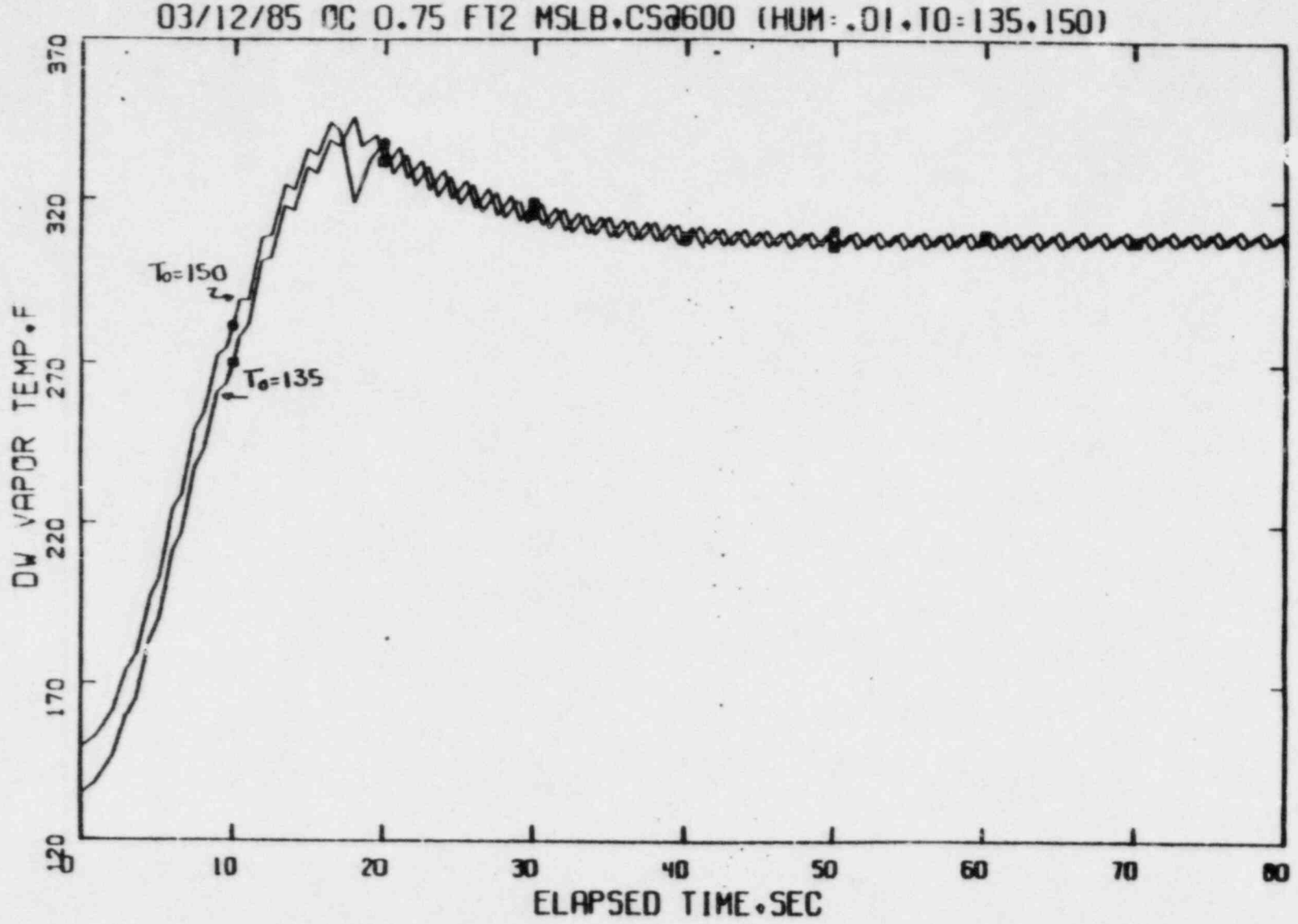
03/12/85 OC 0.75 FT2 MSLB.CS@600 (HUM=.01,TO=135,150)
DW VAPOR TEMP.F
ELAPSED TIME.SEC
To=150
To=135
120
170
220
270
320
370
0
10
20
30
40
50
60
70
80

FIGURE 3

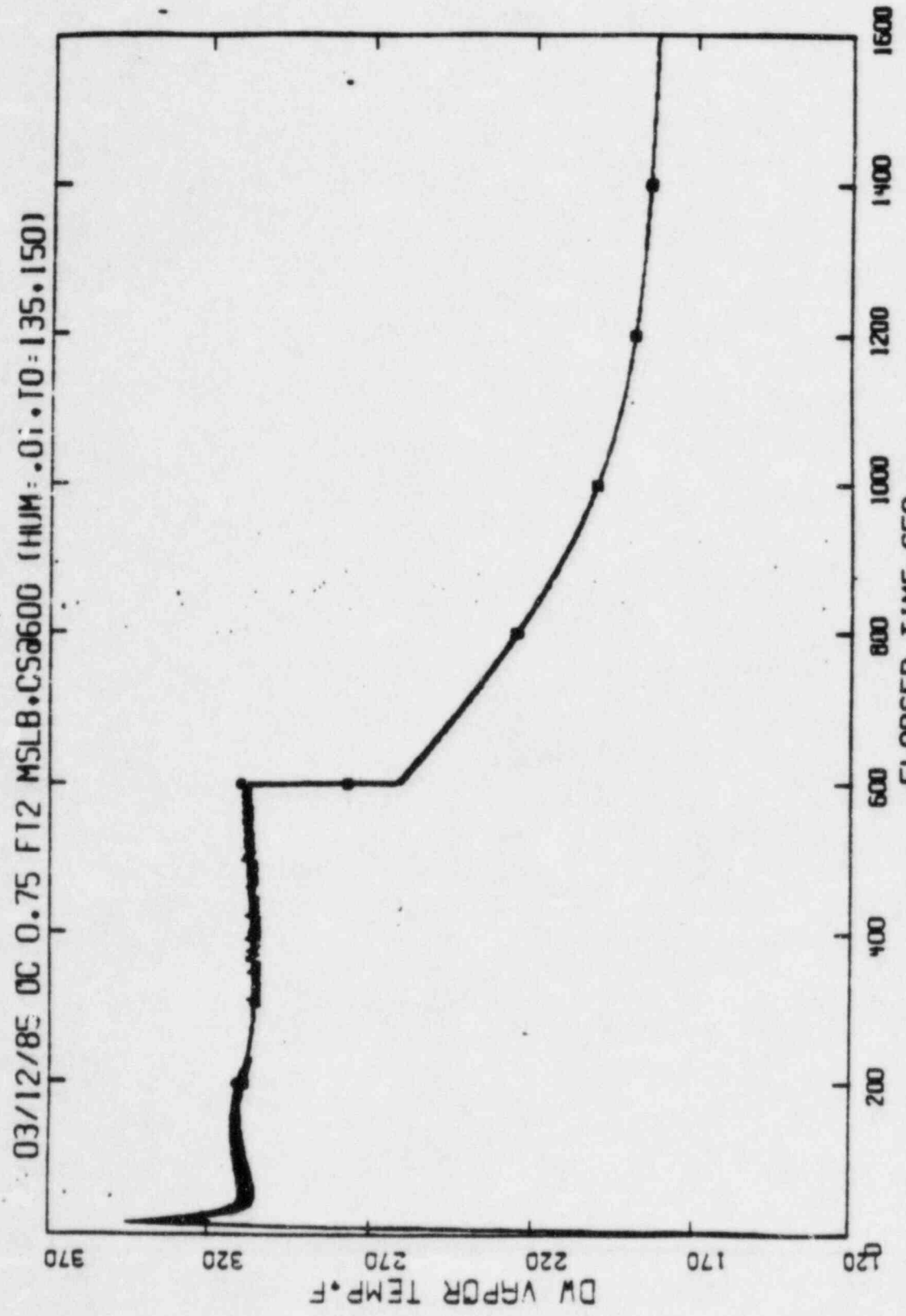
03/12/85 DC 0.75 F12 MSLB.CS@600 (HNJM=.01,TO=135,150)
DW VAPOR TEMP.F
120
170
220
270
320
370
ELAPSED TIME.SEC
200
400
600
800
1000
1200
1400
1600

FIGURE 4

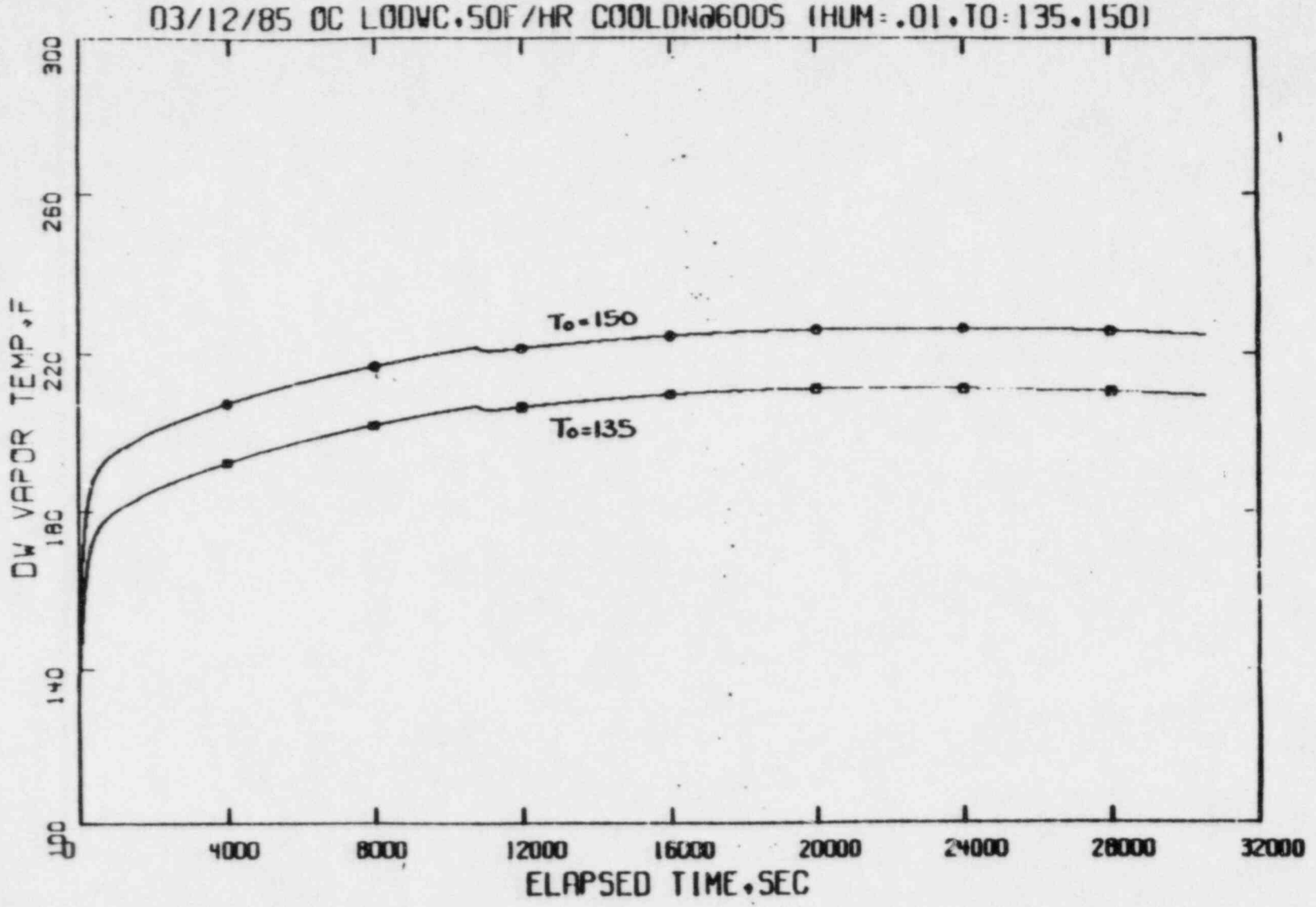
03/12/85 OC LODWC.50F/HR COOLDN@600S (HUM=.01,TO=135,150)
DW VAPOR TEMP,F
300
260
220
180
140
100
To=150
To=135
4000
8000
12000
16000
20000
24000
28000
32000
ELAPSED TIME,SEC

FIGURE 5

TABLE 2

PEAK VALUE SUMMARY

CASE	DRYWELL PRESSURE, PSIA	DRYWELL ATMOSPHERE TEMPERATURE, °F
1A	55.4 @ 6.6 seconds	287.6 @ 6.6 seconds
1B	55.2 @ 6.7 seconds	287.3 @ 6.7 seconds
2A	39.9 @ 18.5 seconds	345.4 @ 18.5 seconds
2B	39.1 @ 21 seconds	347.9 @ 18 seconds
3A	16.6 @ 22370 seconds	211.1 @ 22040 seconds
3B	16.5 @ 19370 seconds	226.2 @ 22620 seconds

5.0 CONCLUSION

The results for the LOCA and MSLB cases do not show a noticeable increase in the drywell atmospheric temperature profile when the initial drywell temperature is raised from 135°F to 150°F. In addition, the response of the other containment parameters are not dependent upon which of the two initial drywell temperatures are used.

The loss of coolers case indicates a temperature profile which is higher by roughly the difference in the initial drywell temperatures. However, this profile is acceptable with respect to remaining below the design temperature for the drywell liner and remaining below the containment isolation setpoint on high drywell pressure.

Also, since the temperature profiles do not change significantly, the findings of TDR 564 (Reference 5) on the YARWAY level instrument response will still be valid.

Thus, it is concluded that the upper limit for drywell temperature for normal operations may be raised to 150°F. Similarly, the entry condition into the Containment Control section of the EOPs may be raised to the same value.

6.0 REFERENCES

1. "Conduct of Operations", Oyster Creek Nuclear Generating Station Procedure 106, Rev. 32.

2. G. F. Niederauer et. al., "CONTEMPT-EI/28C - A Computer Program for Predicting Containment Pressure - Temperature Transients", Energy Incorporated, EI-81-03, February 1981.

3. N. G. Trikouros, P. S. Smith, "Oyster Creek Containment Temperature e for Environmental Qualification of Equipment", GPUN TDR #180, October 1980.

4. A. A. Irani, P. W. Lynches, "Oyster Creek Appendix R Drywell Temperature Analysis for Remote Shutdown System", GPUN TDR #660, February 1985.

5. P. W. Lynches, "Preliminary Transient Response Analysis for YARWAY RPV Level Measurement Instrumentation at Oyster Creek", GPUN TDR #564, July 1984.

6. P. S. Smith, "Increase of EOP Entry Condition on Bulk Drywell Temperature". GPUN TDR 670, March 1985.