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# DRESDEN NUCLEAR POWER STATION

## UNITS 2 AND 3

## LONG-TERM CONTAINMENT RESPONSE TO A DBA-LOCA WITH 65°F SERVICE WATER TEMPERATURE, 80°F INITIAL POOL TEMPERATURE AND INITIATION OF CONTAINMENT COOLING AT 1800 SECONDS

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## 1.0 STATEMENT OF ISSUE

The purpose of this report is to provide the results of an analysis to demonstrate the containment cooling capability of the Dresden Units 2 and 3 LPCI/Containment Cooling System during a LOCA with a service water temperature of 65°F and an initial suppression pool temperature of 80°F considering initiation of containment cooling at 1800 seconds into the event.

## 2.0 APPROACH TO RESOLUTION OF ISSUE

Two additional cases of the Dresden containment pressure/temperature response during the design basis loss-of-coolant accident (DBA-LOCA), which supplement the analysis described in Reference 1, were analyzed. These two additional cases use the same inputs and assumptions used for analysis of Reference 1 except for changes requested by the Commonwealth Edison Company (CECo) to demonstrate adequate containment cooling with a delay in the initiation of containment cooling.

The peak suppression pool temperatures from these analyses will be compared to the value of 180°F determined from Figure 5.2.3:3 of the Dresden SAR and shown for Mode C of the LPCI/Containment Cooling System Process Diagram.

## 3.0 ANALYSIS DESCRIPTION

The analysis of the two cases was performed with the assumptions that one LPCI/Containment Cooling System pump and one Containment Cooling Service Water (CCSW) pump are in operation with the flow rates used for Case 4 and Case 4A of Reference 1.

### 3.1 Analytical Model

A coupled reactor pressure vessel and containment model, based on the Reference 2 and Reference 3 models, was used to calculate the long-term transient response of the containment during the DBA-LOCA through the time of peak suppression pool temperature. This model performs fluid mass and energy balances on the primary system and the suppression pool, and calculates the reactor vessel water level, the reactor vessel pressure, the pressure and temperature in the drywell and suppression chamber airspace and bulk suppression pool temperature. The various modes of operation of all important auxiliary systems, such as SRVs and the MSIVs, and ECCS, the RHR system (LPCI/Containment Cooling System in the case of Dresden) and feedwater are modeled. The model can simulate actions based on system setpoints, automatic actions and operator-initiated actions.

### 3.2 Input Assumptions

The initial conditions and input parameters used in the analysis are the same as those described in Table 2 of Reference 1. Changes to the values given in Table 2 of Reference 1 are indicated in Table 1 of this report. The original values used for Cases 4 and 4A of Reference 1 are also shown in Table 1.

Key changes to the assumptions of the Reference 1 analysis include:

1) Initiation of containment cooling at 1800 sec.

2) The use of the May-Witt decay heat model (for Case 1).

3) The use of an initial suppression pool temperature of 80°F.

4) The use of a service water temperature of 65°F.

The latter two changes are included, as requested by CECo, to reflect more realistically the current winter ambient conditions.

It should be noted that the Case 1 analysis is conducted with May-Witt decay heat (Reference 4) and Case 2 is done with ANSI/ANS-5.1 decay heat (Reference 5). The metal-water reaction assumption is as specified by NRC Reg. Guide 1.7. According to this Reg. Guide, an amount of metal-water reaction of the fuel cladding corresponding to oxidation of the cladding to a depth of 0.23 mils is to be considered for Dresden.

### 3.3 Case Descriptions

The long-term containment pressure and temperature response was analyzed for the DBA-LOCA which was described in the SAR as an instantaneous double-ended guillotine break of a recirculation suction line. Case 4 and Case 4A of Reference 1 were re-analyzed for this report. Case 4 described in Reference 1 assumes the availability of one LPCI/Containment Cooling System pump and one CCSW pump. The pump flow rates for Case 4 are consistent with the values reported for Mode C in the Process Diagram. Case 4A of Reference 1 was performed with a lower heat exchanger heat removal rate to account for the uncertainty in the LPCI and CCSW flow measurements. Table 1 summarizes the LPCI/Containment Cooling System parameters assumed for the long-term heatup analyses of this report.

## 4.0 RESULTS

Table 2 summarizes the results of the long-term heatup calculations. Figures 1, 1A and 1B show long-term containment pressure and temperature response for Case 1, which has the assumption of nominal LPCI and CCSW flow rates and May-Witt decay heat. Figures 2, 2A and 2B show the containment pressure and temperature response for Case 2, obtained with the reduced heat exchanger K-values which account for flow measurement uncertainty and the ANSI/ANS-5.1 decay heat model. The results in Table 2 show that the peak pool temperature with the nominal LPCI and CCSW flow rates and May-Witt decay heat is 4°F higher than the value obtained with the ANSI/ANS-5.1 decay heat and reduced LPCI and CCSW flow rates. This shows that the reduction in temperature with the more realistic decay heat model is greater than the increase in the pool temperature response resulting from the uncertainty in the pump flow rates.

The results of Table 2 also demonstrate that the effect of the reduced service water temperature and initial suppression pool temperature given in Table 1 is more significant than the effect of delaying the initiation of containment cooling. Comparison of Case 2 to Case 4A of Reference 1 shows a net decrease of 20°F due to these effects. As a result, peak suppression pool temperatures are well below the value of 180°F determined from SAR Figure 5.2.3:3 and listed in Mode C of the LPCI/Containment Cooling System Process Diagram.

## 5.0 REFERENCES

1. GENE-770-26-1092, "Dresden Nuclear Power Station Units 2 and 3 LPCI/Containment Cooling System Evaluation," November 1992.

2. NEDM-10320, "The GE Pressure Suppression Containment System Analytical Model," March 1971.

3. NEDO-20533, "The General Electric Mark III Pressure Suppression Containment System Analytical Model," June 1974.

4. NEDO-10625, "Power Generation in a BWR Following Normal Shutdown or Loss-of-Coolant Accident Conditions," March 1973.

5. ANSI/ANS-5.1-1979, "Decay Heat Power in Light Water Reactors," 1979.

TABLE 1

KEY PARAMETERS OF DBA-LOCA CASES ANALYZED FOR DRESDEN

| | Ref. 1 Cases | | | |
|---|---|---|---|---|
| | Case 4 | Case 4A | Case 1 | Case 2 |
| $T_{SW}$ (°F) | 95 | 95 | 65 | 65 |
| Initial $T_{pool}$ (°F) | 95 | 95 | 80 | 80 |
| LPCI Flow Rate (gpm) | 5000 | 3881 | 5000 | 3881 |
| CCSW Flow Rate (gpm) | 3500 | 3071 | 3500 | 3071 |
| K-value (Btu/sec-°F) | 249.6 | 219.2 | 249.6 | 219.2 |
| Containment Cooling Initiation Time (sec) | 600 | 600 | 1800 | 1800 |
| Decay Heat Model | ANS 5.1 | ANS 5.1 | May-Witt | ANS 5.1 |

TABLE 2

DRESDEN CONTAINMENT PRESSURE AND TEMPERATURE RESPONSE DURING A DBA-LOCA

| | Ref. 1 Cases | | | |
|---|---|---|---|---|
| | Case 4 | Case 4A | Case 1 | Case 2 |
| Maximum $T_{pool}$ (°F) | 180 | 186 | 170 | 166 |
| Time of Max. $T_{pool}$ (sec) | 26400 | 32500 | 21600 | 22800 |
| $T_{pool}$ @ 1800 sec. (°F) | --- | --- | 144 | 142 |
| $P_{cont}$ (psia) (at time of max. $T_{pool}$) | 23.3 | 24.1 | 21.8 | 21.2 |

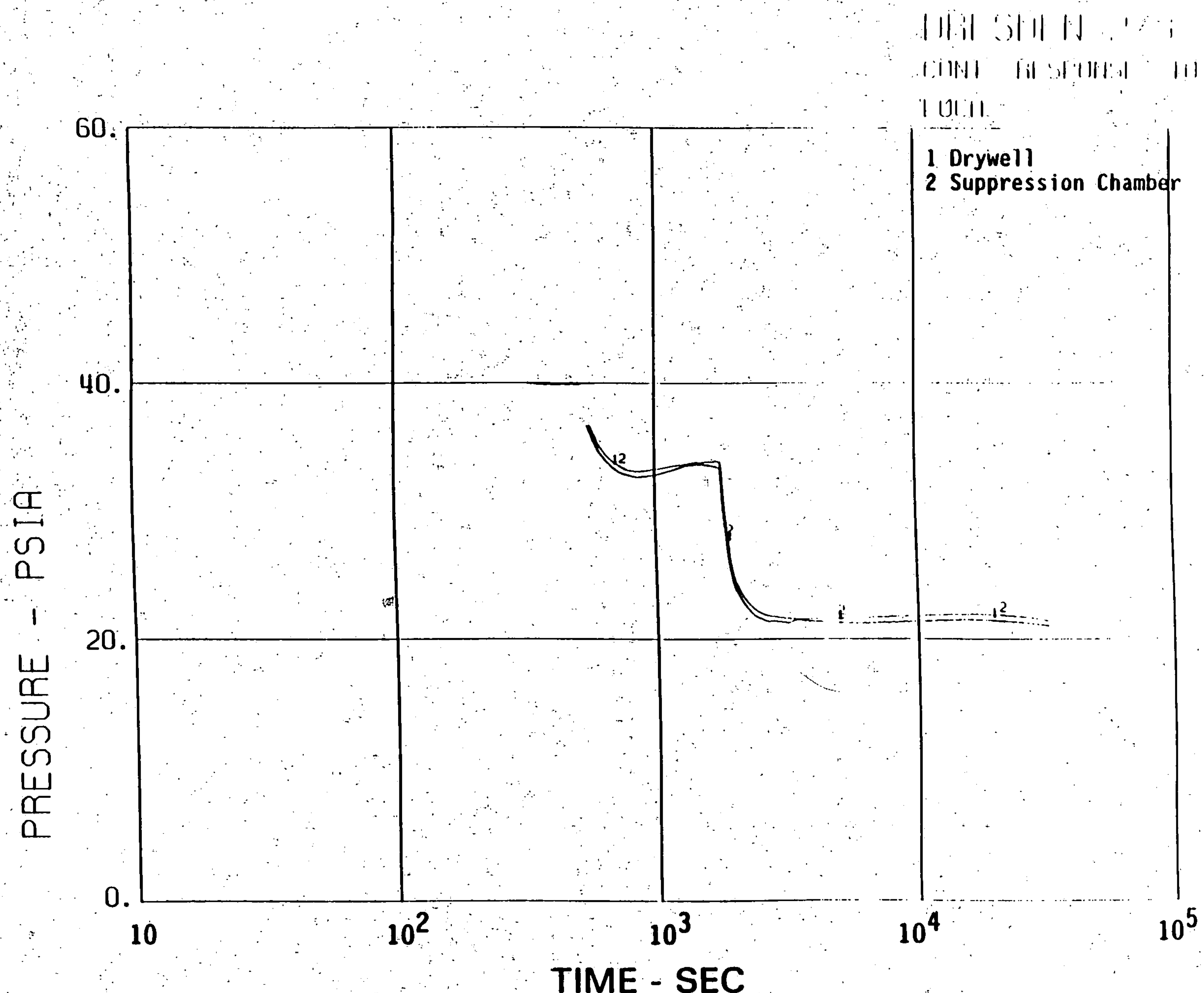


Figure 1 - Long-Term DBA-LOCA Drywell and Suppression Chamber Pressure Response for Case 1

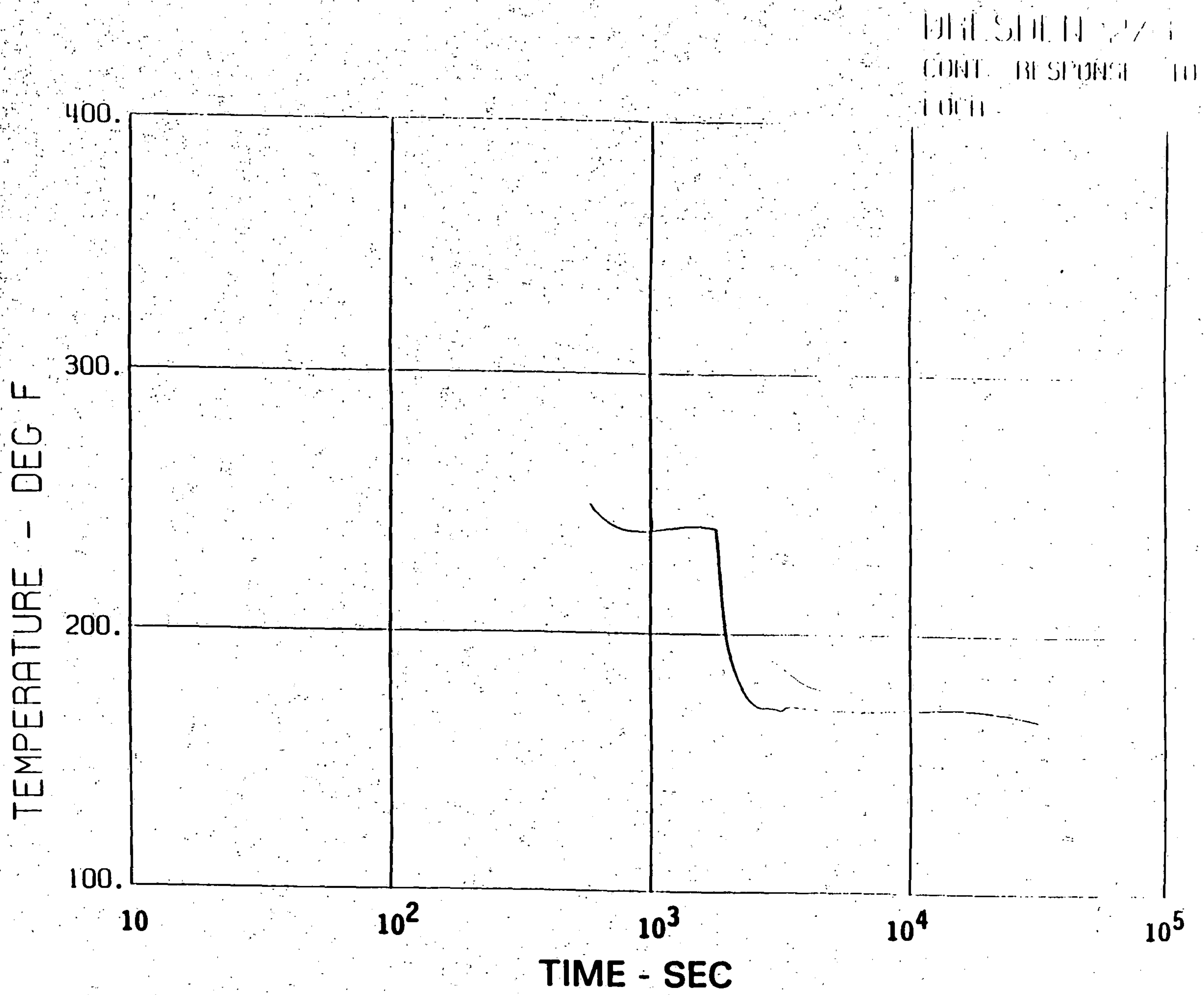


Figure 1A - Long-Term DBA LOCA Drywell Temperature Response for Case 1

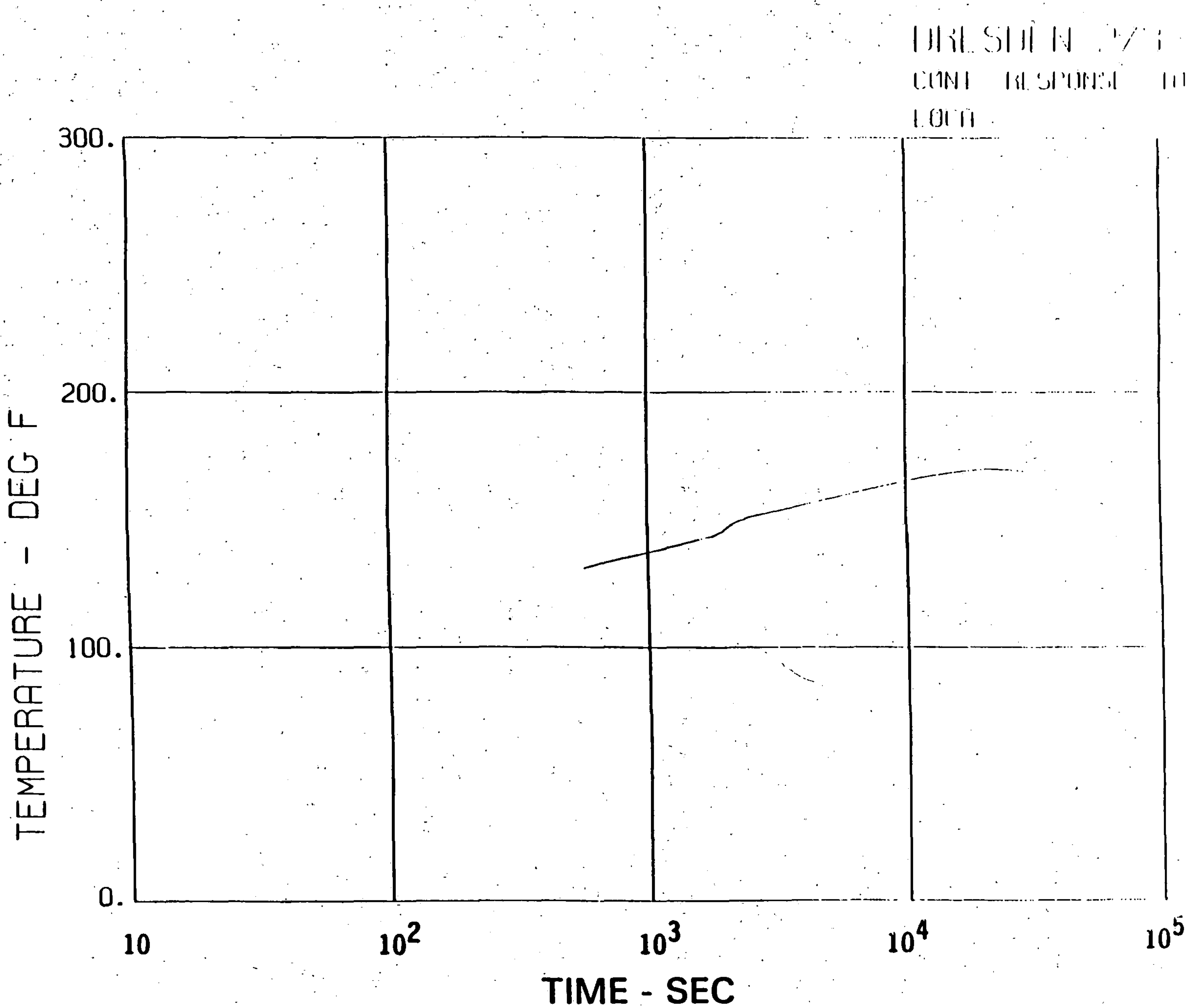


Figure 1B Long Term DBA LOCA Suppression Pool Temperature Response for Case 1

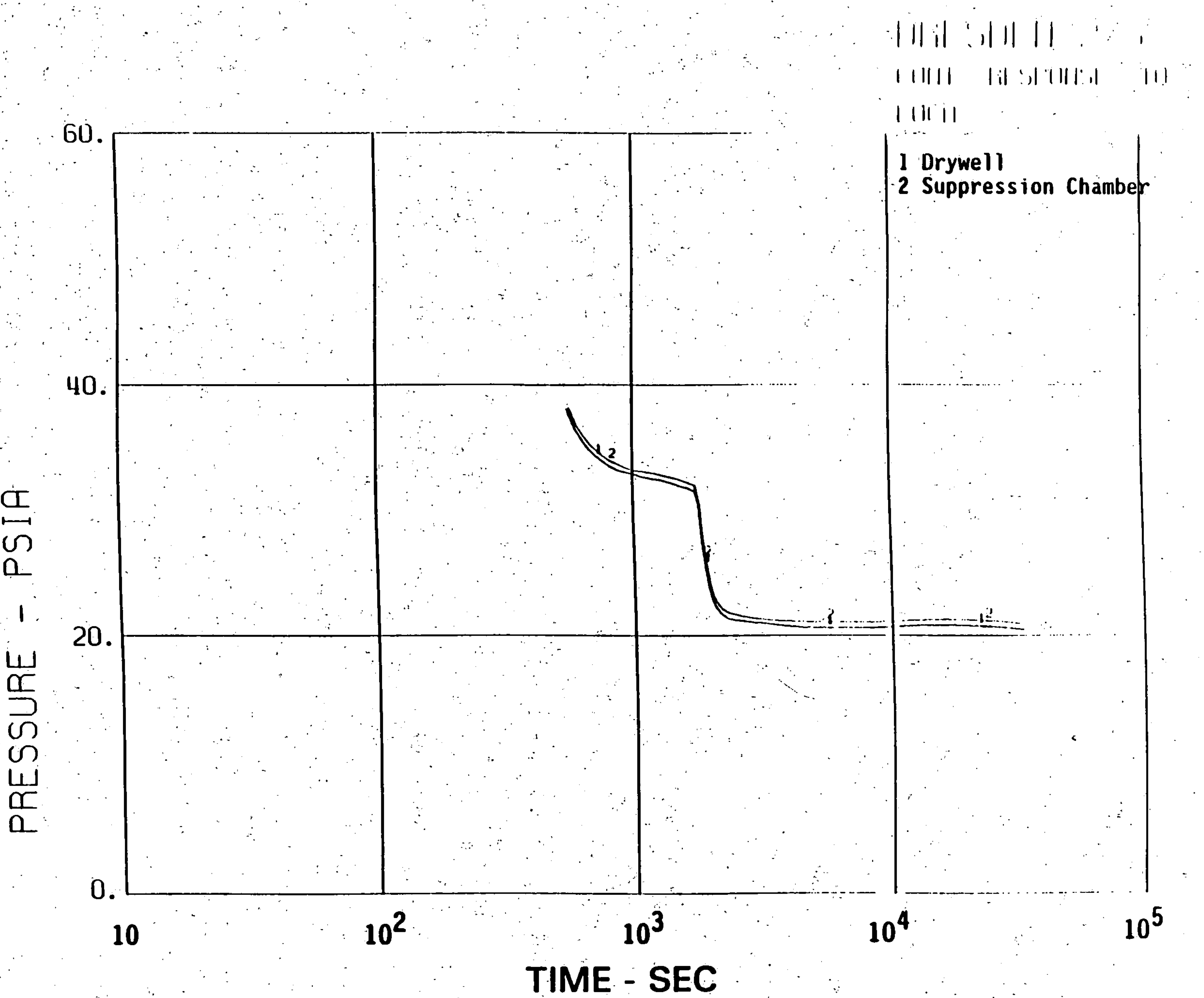


Figure 2 - Long-Term DBA-LOCA Drywell and Suppression Chamber Pressure Response for Case 2

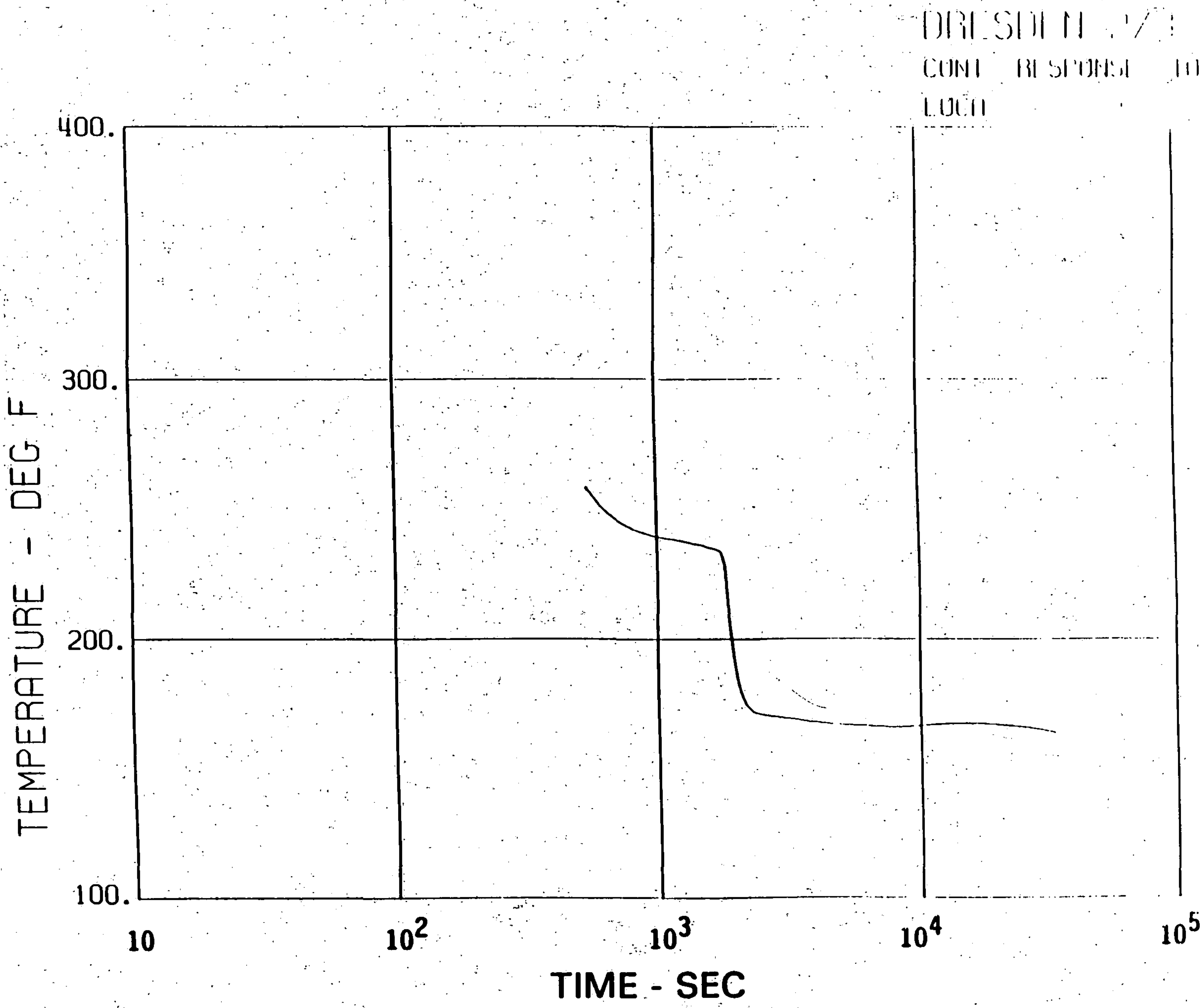


Figure 2A - Long-Term DBA-LOCA Drywell Temperature Response for Case 2

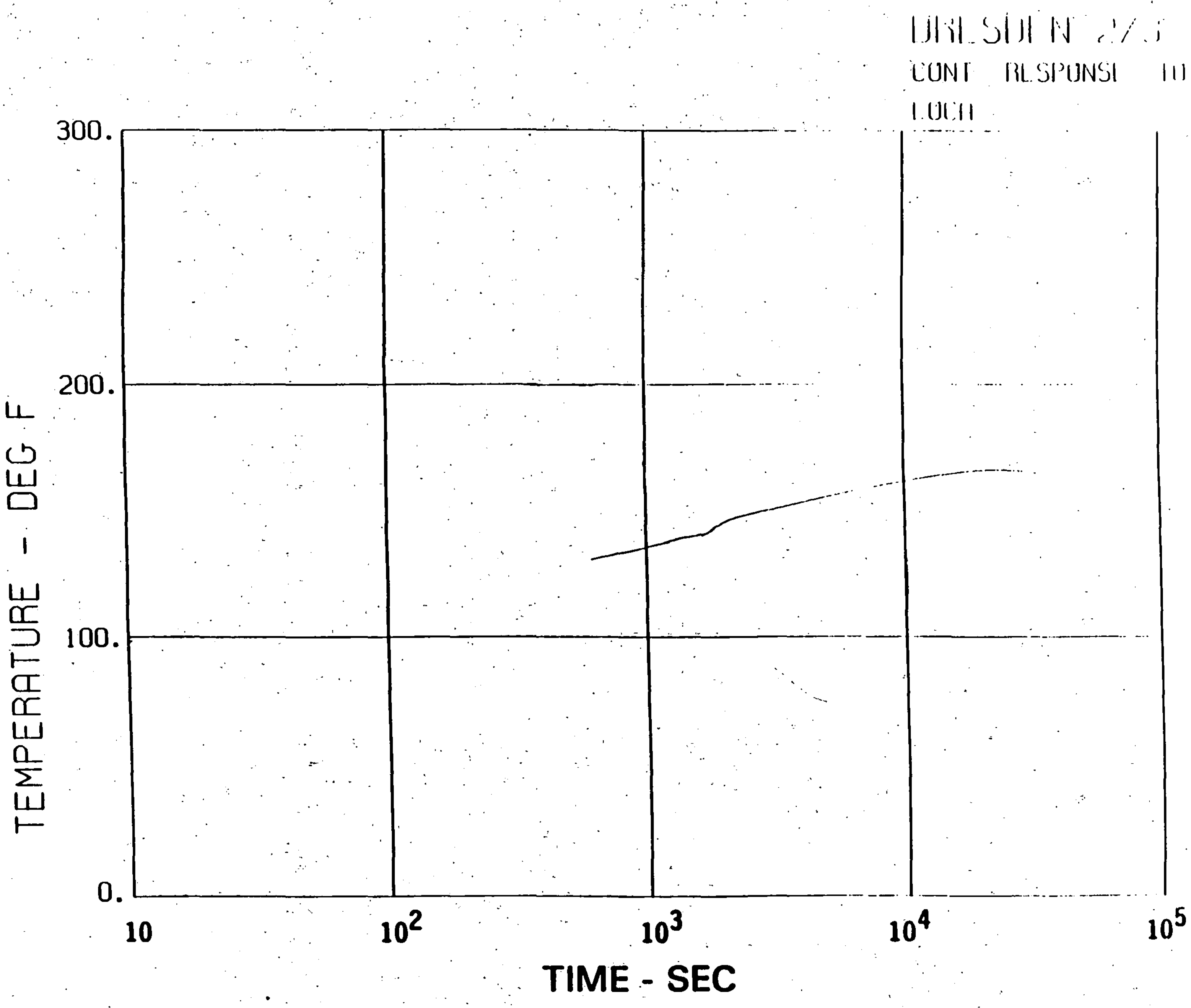


Figure 2B - Long-Term DBA-LOCA Suppression Pool Temperature Response for Case 2