BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

DATE: January 15, 1981

TO: R. A. Bari

FROM: W. T. Pratt WTP

SUBJECT: Some Very Preliminary Results of a Short-Term Analysis (3 week study) of Hydrogen Combustion during Degraded Core Accidents in the Sequoyah Nuclear Plant in the Presence of Glow Plugs.

INTRODUCTION AND SUMMARY

At the request of the NRR Containment Systems Branch (through the Reactor Systems Branch) an evaluation has been performed on the consequences of H_2 burning during a wide range of degraded core accidents in a PWR ice condenser plant. Use is made of the MARCH computer code[1] to predict the containment response. A major aim of our analysis was to assess the potential benefits (in terms of containment loadings) that might result from the installation of ignition sources (glow plugs) in an ice condenser plant to ensure H_2 burning at low concentration levels. In connection with our analysis, we were specifically requested[2] to assume that the installation of glow plugs would lead to the following combustion behavior:

A. Hydrogen combustion would occur at either of two concentrations, namely, from 10% to completion and from 8% to 4% (both with oxygen concentration > 6.5%).

In addition, we were also requested[2] to restrict our analysis to 75% Zr-steam reaction and assess the influence of the following input assumptions:

B. Burn duration.

C. Flame propagation between cells.

D. H_2 source term.

Comparison is made with a study[3] conducted at TVA related to the installation of glow plugs in the Sequoyah Nuclear Plant. Sequoyah is a four-loop PWR with an ice condenser containment. The following conclusions of the TVA study are pertinent to the present work:

1. TVA was not able to identify any accident scenario that became worse due to the operation of the igniters (p. 9-2, Volume 2).

2. Although the rate of H_2 release predicted for various accidents is very sequence-dependent, TVA considered that the ignition system should be effective for a wide range of accidents and associated release rates (p. 1-4, Volume 2).

Implicit in the first of the above conclusions is the assumption that the H_2 will eventually burn (due to the presence of random ignition sources) and that it is obviously better to ignite it at low concentrations rather than allowing H_2 to build-up to higher concentrations. In this context we were also unable to identify an accident scenario that became worse due to H_2 ignition at low concentrations as opposed to ignition at higher concentrations.

We are, however, unable to support the second of the above conclusions. The TVA analysis consisted of a series of scoping studies based on only one accident sequence, namely, an S_2D. The MARCH code was used to provide the steam and H_2 release rates from the primary system. The release rates were then used as input to the CLASIX[4] computer code (developed by Offshore Power Systems) to predict the containment response. TVA found from their CLASIX analysis that H_2 burning at low concentrations (those given in Table 1) could be accommodated by the Sequoyah containment assuming the S_2D steam and H_2 release rates. The basic question is: Are the S_2D release rates typical of a wide range of degraded core accidents, hence confirming the effectiveness of the ignition system for a wide range of potential accidents?

From our analysis of a wider range of accidents, we are unable to confirm the typicality of the S_2D release rates. In fact, the TVA S_2D release rates represent a very specific accident sequence in which no passive ECC (as well as active) water was injected into the primary system. This was inconsistent with the fact that the primary system pressure fell below the set point necessary for UHI injection. This is an input option to the MARCH code discussed more fully in the following section. The release rates used by TVA therefore represent the minimum amount of water that can be released from the primary system before core uncovery and the start of H_2 production.

The majority of accidents considered at BNL involved far greater steam release than that considered by TVA. Minimizing the steam release maximizes the quantity of ice available to mitigate the consequences of any H_2 burns in the lower compartment. The steam partial pressures in the lower compartment will also be minimized, which in turn makes it easier for the H_2 to attain low burning concentration. A key element of the TVA analysis requires burning of the H_2 as it is released in the lower compartment. To achieve this, low steam partial pressures are necessary together with a fresh supply of O_2 from the upper compartment. High steam partial pressures in the lower compartment can inert the atmosphere resulting in the H_2 burning downstream of the ice in the upper compartment. Also, any interruption of the return air supply from the upper to the lower compartment would prevent H_2 combustion in the lower compartment due to O_2 starvation. It is these basic differences between our analysis and the TVA study that lead us to the conclusion that the present TVA strategy for burning H_2 at low concentrations may not be effective for a wide range of degraded core accidents. In the following section we briefly describe the BNL analysis.

BNL MARCH Analysis

As a starting point to our analysis we obtained from BCL a MARCH input deck[5] for an S_2D sequence in Sequoyah. This input deck was run at BNL and the output is presented in Figures 1-10. In addition to the specific requests[2] noted in the previous section, we also selected a number of other input parameters (Table 1) that could significantly impact the accident progression and its consequences. It was requested[2] that we analyze a wider range of accident sequences and Table 2 summarizes the accidents considered. With seven accident sequences under consideration and six critical input assumptions, a full sensitivity study was clearly unrealistic in the time frame available. Representative values were therefore selected for the six input variables (Table 3) and used to generate a base case for each of the accident sequences. For selected accident sequences we then varied some (but not all) input parameters. Table 4 summarizes the cases run at BNL and gives some indication of the ice remaining at the start of significant H_2 production. Detailed output for the cases is presented in Figures 1-140. Results beyond 75% Zr-steam reaction are included for information purposes only and are not used in this study. Note that in Case 1, H_2 was assumed to burn from 4% down to 0%, and that for all other cases the H_2 burn characteristics of Table 1 were used.

The major differences between our assessment and the TVA study are related to the quantity of ice remaining during H_2 generation and the mole fraction of steam in the lower compartment. An inspection of Table 4 shows that there are several accident scenarios in which the ice is completely melted before H_2 generation. A comparison of the detailed output (Figures 1-140) for the various cases also shows significantly lower steam mole fractions in the lower compartment of the S_2D sequence when compared with the other accidents. This is illustrated most dramatically if one compares the steam mole fraction in the lower compartment (Volume 1) for the BCL S_2D case (Figure 3) with the results for a TLMBS case (Figures 123 or 133). The lower steam mole fraction in the S_2D case allows similar rates of H_2 generation to reach a flammable concentration much earlier (and therefore burn smaller quantities of H_2) than for those cases with higher steam mole fractions. For a case with higher steam mole fractions when the H_2 finally does reach a flammable concentration, the total quantity of H_2 present is much larger, which result in a significantly more energetic burn. High steam mole fractions can also completely suppress burning in the lower compartment leaving the H_2 to accumulate and burn in the upper compartment.

It is for the above reasons that we predict higher pressurization of the containment building for certain cases (as seen in the figures) when burning at low concentrations than was calculated by TVA. Consequently, we are unable to confirm that, by ensuring H_2 burning (by use of glow plugs) at low concentrations in an ice condenser plant, containment loadings will be acceptable for a wide range of potential degraded core accidents.

When communicating[6] the above results to NRC, the following two questions were raised regaring the BNL analysis:

1. UHI in MARCH is modeled as water addition to the bottom of the core when in fact the water is injected to the top of the core. How does this impact the predicted H_2 generation?

2. If ice remains in the chest, does MARCH neglect heat transfer to the spray droplets in the upper compartment?

With regard to the first question it should first be noted that the direction of UHI injection is only of importance to the S_2D sequence. For all other accidents*, the UHI occurs prior to core uncovery and all subsequent ECC (both passive or active) is injected to the bottom of the core as modeled in MARCH. However, if we consider the S_2D sequence, the BCL case (Case 1) avoids the problem by preventing UHI injection (although the primary system pressure falls below the set point necessary for injection) after the core reaches its melt temperature. At BNL we allow UHI depending on primary system pressure, not core temperature. Supplying water from below during core uncovery (MARCH model) maximizes H_2 generation rates. However, flooding from above (actual UHI) will produce steam in the upper region of the core and hence produce H_2 at a greater rate than if we assume no UHI. We consider that Case 1 (minimum H_2 generation rates) and Case 2 (maximum H_2 generation rates) bracket possible H_2 generation rates for the S_2D sequence. We again emphasize that the direction of UHI is only a problem for the S_2D sequence with an equivalent break area of 2 inches diameter. All other cases were modeled correctly. For example, an S_1D sequence with a 3 inch diameter break involves UHI prior to core uncovery and accumulator injection at core uncovery.

With regard to the second question, MARCH does indeed neglect heat transfer to the spray droplets in the upper compartment if (and only if) ice remains in the chest. H_2 burns in the upper compartment (if ice remains) may therefore be conservative because the heat sink associated with the water droplets is ignored. At a recent TA meeting[7] we presented the effect on H_2 burning of spray operation. We summarize our presentation below to give an indication of the effect of considering heat transfer to the water droplets:

1) Adiabatic H_2 burn, Δp = 64 psi,

2) Similar burn in presence of spray, Δp = 32 psi.

However, the MARCH results may not be conservative in other regards. MARCH instantaneously equilibrates the pressures between two cells so that the pressures presented (Figures 1-140) during H_2 burns do not represent an adiabatic burn in an individual compartment. The pressure pulse is shared evenly over both the upper and lower compartments. Again, we emphasize that this question applies only to those cases in which ice remains at the point of H_2 generation. An inspection of Table 4 will indicate those cases in which H_2 burning may occur in the presence of ice.

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*With the exception of the TMLB' sequence. In this case, UHI and Accumulator injection occurs after head failure.

We must emphasize that this is a very preliminary study carried out in only 3 weeks. We were not able to investigate the effect of burn duration or the H_2 source term. We consider that MARCH predicts a H_2-steam release mixture that is weak in terms of H_2 concentration. This is because as the H_2 is generated in the core, it is mixed with the entire quantity of steam in the primary system. For a four-loop plant with a single break in one loop, one would expect the H_2 to mix (apart from diffusion) with steam only in a direct route from the core exit to the break point. If we consider mixing only between the core and break (neglecting the steam content of the other 3 loops), it is possible that the H_2 concentration released to the containment (as predicted by MARCH) could be increased by a factor of 2.5. The role of sequence-dependent diffusion of hydrogen in the primary system requires further investigation. Finally, we were also unable to examine the effect of the air return system (except complete failure - TMLBS, TMLB', and AB). If combustion is to be sustained in the lower compartment, a fresh supply of O_2 from the upper compartment is essential. Any interruption in the air return will suppress burning in the lower compartment leaving the H_2 to accumulate and burn in the upper compartment.

REFERENCES

1. R. O. Wooton and H. I. Avci, "MARCH (Meltdown Accident Response Characteristics) Code Description and User's Manual," NUREG/CR-1711, BMI-2064, October 1980.

2. Private Communication, R. A. Bari (BNL) and C. Tinkler (NRC).

3. "Sequoyah Nuclear Plant - Core Degradation Program - Hydrogen Study Volumes 1 and 2," TVA, September 1980.

4. A brief description of the CLASIX code is provided in Reference 3.

5. In this short-term study, we were unable to critically review this input deck. It is our understanding that this deck also provided the basis for the TVA analysis and, perhaps, related studies at Sandia National Laboratory. The MARCH code itself is undergoing review at BNL as part of our TA program. Thus, our many reservations, which were communicated to NRC, apply here as well. In addition, in this short-term study, R. D. Gasser made a very preliminary independent assessment of the ice condenser heat transfer performance for a few accident sequences and found that the results were consistent with MARCH code predictions.

6. Telephone Conversation: W. T. Pratt (BNL) and C. Tinkler (NRC); W. Butler, J. Meyer and J. Long of NRC also participating, on December 31, 1980.

7. "TA Role in Resolution of Issues Important to the Z/IP Mitigation Feature Program," Meeting held at NRC on October 28, 1980.

TABLE 1

INPUT PARAMETERS

H_2 BURN CHARACTERISTICS

- BURN CONCENTRATIONS:

  10%⟶0%

  8%⟶4%

- BURN DURATION
- FLAME PROPAGATION BETWEEN CELLS

PRIMARY SYSTEM MODEL

- ECC OPERATION (PASSIVE AND ACTIVE) AFTER CORE REACHES MELT TEMPERATURE
- BREAK FLOW MODEL:
  - FLOW FROM STEAM SPACE
  - FLOW FROM WATER REGION

TABLE 2

ACCIDENT SEQUENCES CONSIDERED

SEQUENCE	COMMENTS
S_2D	SMALL BREAK LOCA (2 INCH DIA. EQUIV. BREAK) WITH FAILURE OF ECC SYSTEMS.
S_1D	SMALL BREAK LOCA (5 INCH DIA. EQUIV. BREAK) WITH FAILURE OF ECC SYSTEMS.
S_2H	SMALL BREAK LOCA (2 INCH DIA. EQUIV. BREAK) WITH FAILURE OF ECC IN RECIRCULATION.
S_1H	SMALL BREAK LOCA (5 INCH DIA. EQUIV. BREAK) WITH FAILURE OF ECC IN RECIRCULATION.
AB	LARGE BREAK LOCA WITH FAILURE OF ELECTRICAL POWER TO ESFs.
TMLB'	EXTENDED LOSS OF ALL AC POWER AND FAILURE OF THE AUXILIARY FEEDWATER.
TMLBS	EXTENDED LOSS OF ALL AC POWER AND FAILURE OF THE AUXILIARY FEEDWATER WITH INDUCED-LOCA THROUGH FAILURE OF THE REACTOR COOLANT PUMP SEALS.

TABLE 3

INPUT PARAMETERS FOR BASE CASES

H_2 BURN CHARACTERISTICS

- H_2 BURN FROM 8% to 4% CONCENTRATION
- 6 SECOND BURN DURATION
- NO BURN PROPAGATION BETWEEN VOLUMES
- NO ADDITIONAL H_2 SOURCE TERM

PRIMARY SYSTEM MODEL

- INJECTION OF ECC AFTER CORE REACHES MELT TEMP.
- STEAM BREAK LOCATION

TABLE 4

CASES CONSIDERED

CASE No.	COMMENTS	ICE LEFT* START H_2 GENERATION (LB)
1	S_2D BCL DECK	1.8×10^6
2	S_2D BASE CASE	0
3	S_2D BREAK FROM WATER SPACE. POWER RESTORED AT 89 MIN.	1.8×10^6
4	S_2D H_2 BURN FROM 10% to 0%. BREAK FROM WATER SPACE. POWER RESTORED AT 89 MIN.	1.8×10^6
5	S_1D BASE CASE	0
6	S_1D BREAK FROM WATER SPACE	1×10^6
7	S_2H BASE CASE	0
8	S_2H BREAK FROM WATER SPACE	0
9	S_1H BASE CASE	0
10	S_1H BREAK FROM WATER SPACE	8×10^5
11	AB BASE CASE	6×10^5
12	TMLB BASE CASE	1.4×10^6
13	TMLBS BASE CASE	0
14	TMLBS POWER RESTORED AT 450 MIN.	,

*INITIAL ICE INVENTORY 2.45×10^6 LB.

SEQUOYAH MARCH ANALYSIS

CASE 1 - FIGURES 1-10

CASE 2 - FIGURES 11-20

CASE 3 - FIGURES 21-30

CASE 4 - FIGURES 31-40

CASE 5 - FIGURES 41-50

CASE 6 - FIGURES 51-60

CASE 7 - FIGURES 61-70

CASE 8 - FIGURES 71-80

CASE 9 - FIGURES 81-90

CASE 10 - FIGURES 91-100

CASE 11 - FIGURES 101-110

CASE 12 - FIGURES 111-120

CASE 13 - FIGURES 121-130

CASE 14 - FIGURES 131-140

THE FOLLOWING UNITS ARE USED IN THE OUTPUT

PRESSURE - PSIA

TEMPERATURE - °F

VOLUME NO. 1 IS THE LOWER COMPARTMENT.

VOLUME NO. 2 IS THE UPPER COMPARTMENT.

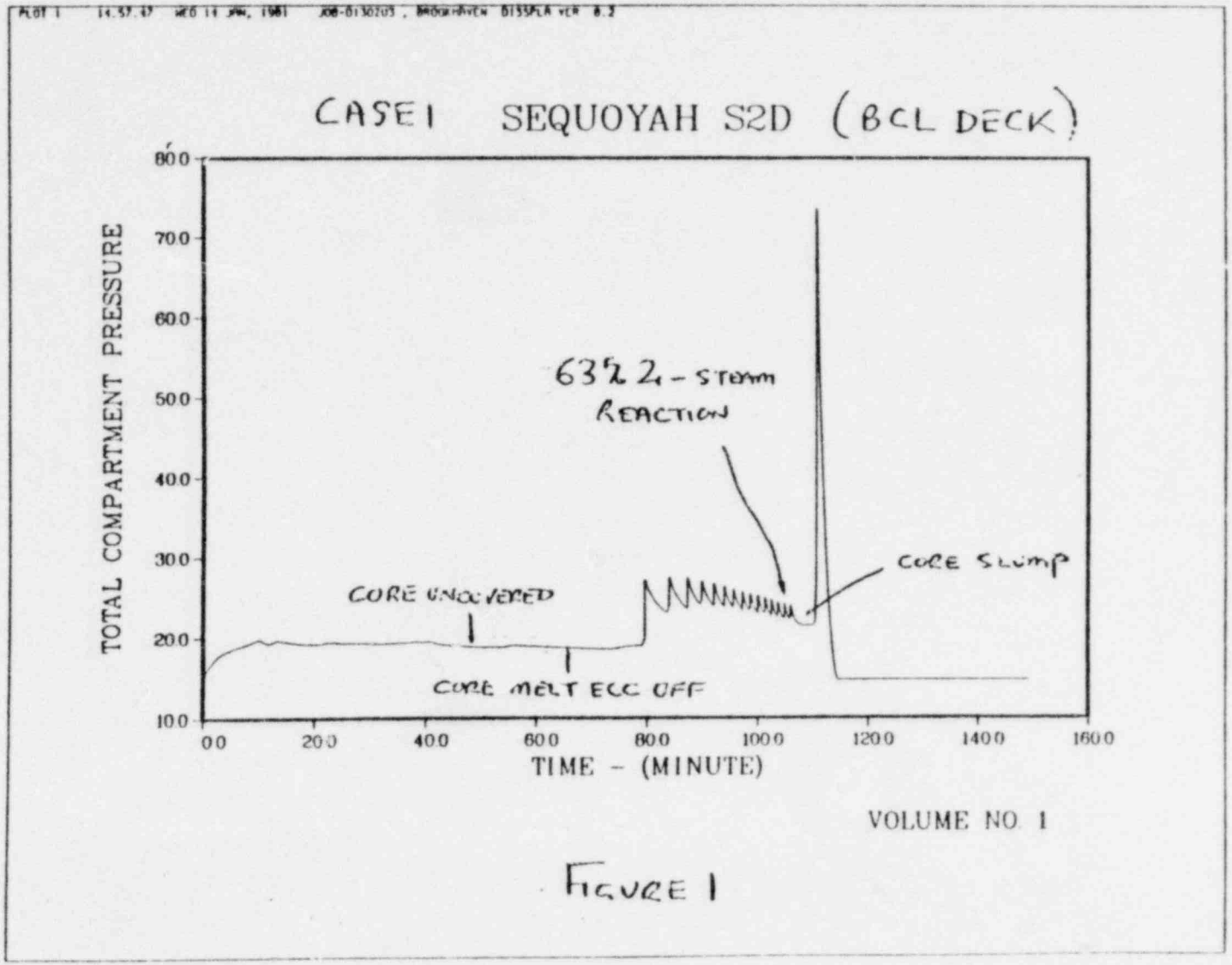

CASE1 SEQUOYAH S2D (BCL DECK)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
6322 - STEAM REACTION
CORE UNCOVERED
CORE MELT ECC OFF
CORE SLUMP
VOLUME NO 1

FIGURE 1

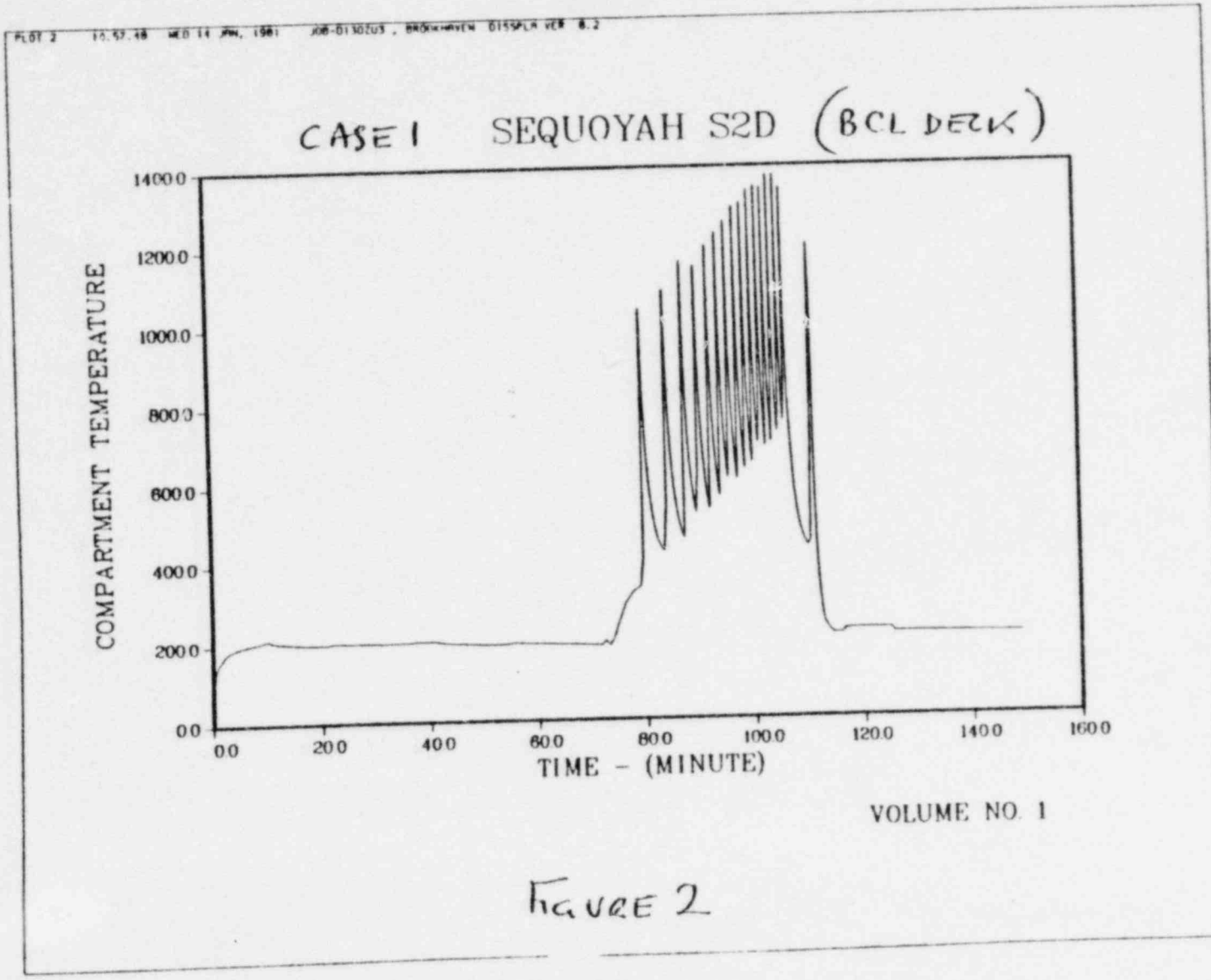

CASE 1 SEQUOYAH S2D (BCL DECK)
COMPARTMENT TEMPERATURE
14000
12000
10000
8000
6000
4000
2000
00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 2

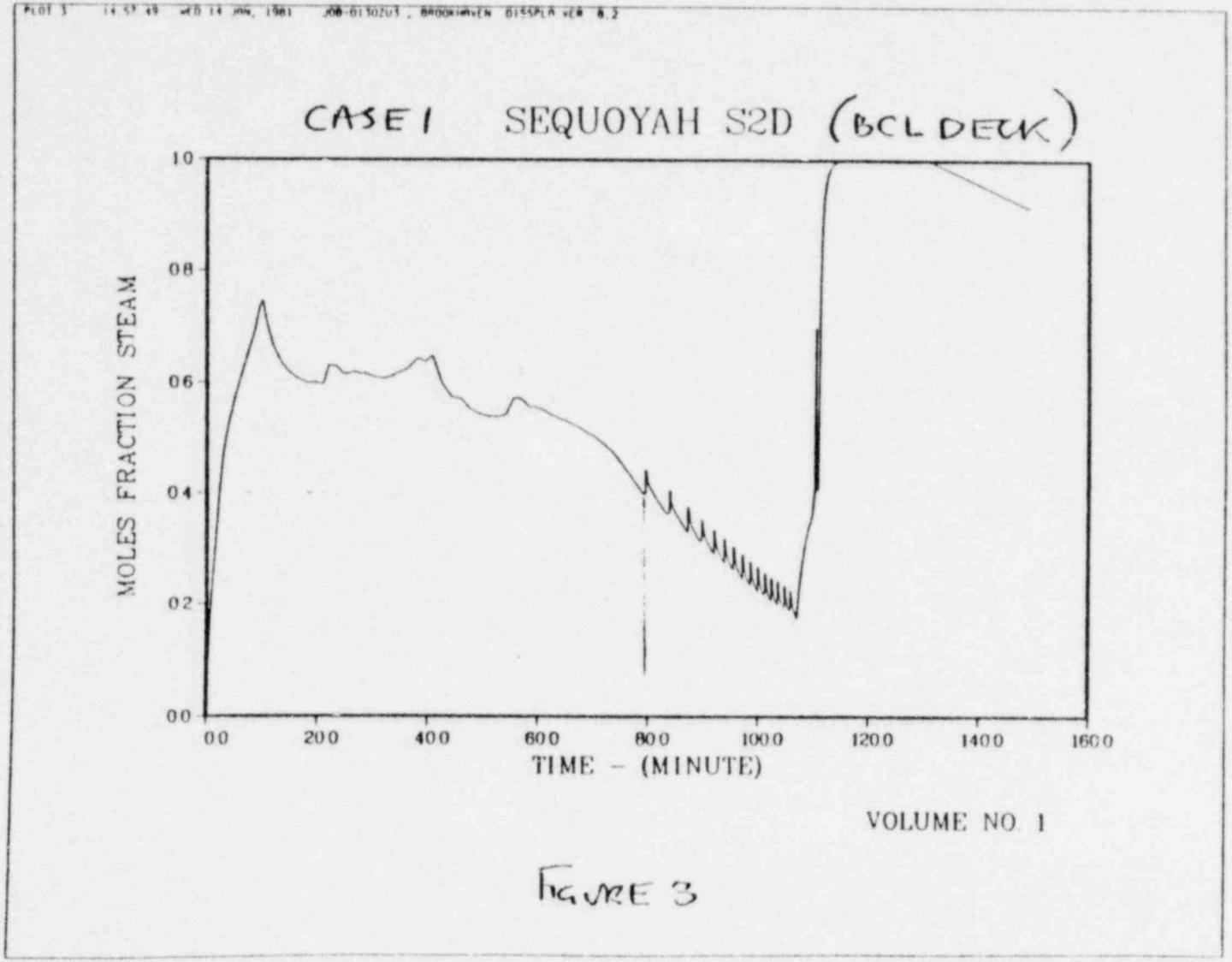

CASE 1 SEQUOYAH S2D (BCL DECK)
MOLES FRACTION STEAM
10
08
06
04
02
00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 3

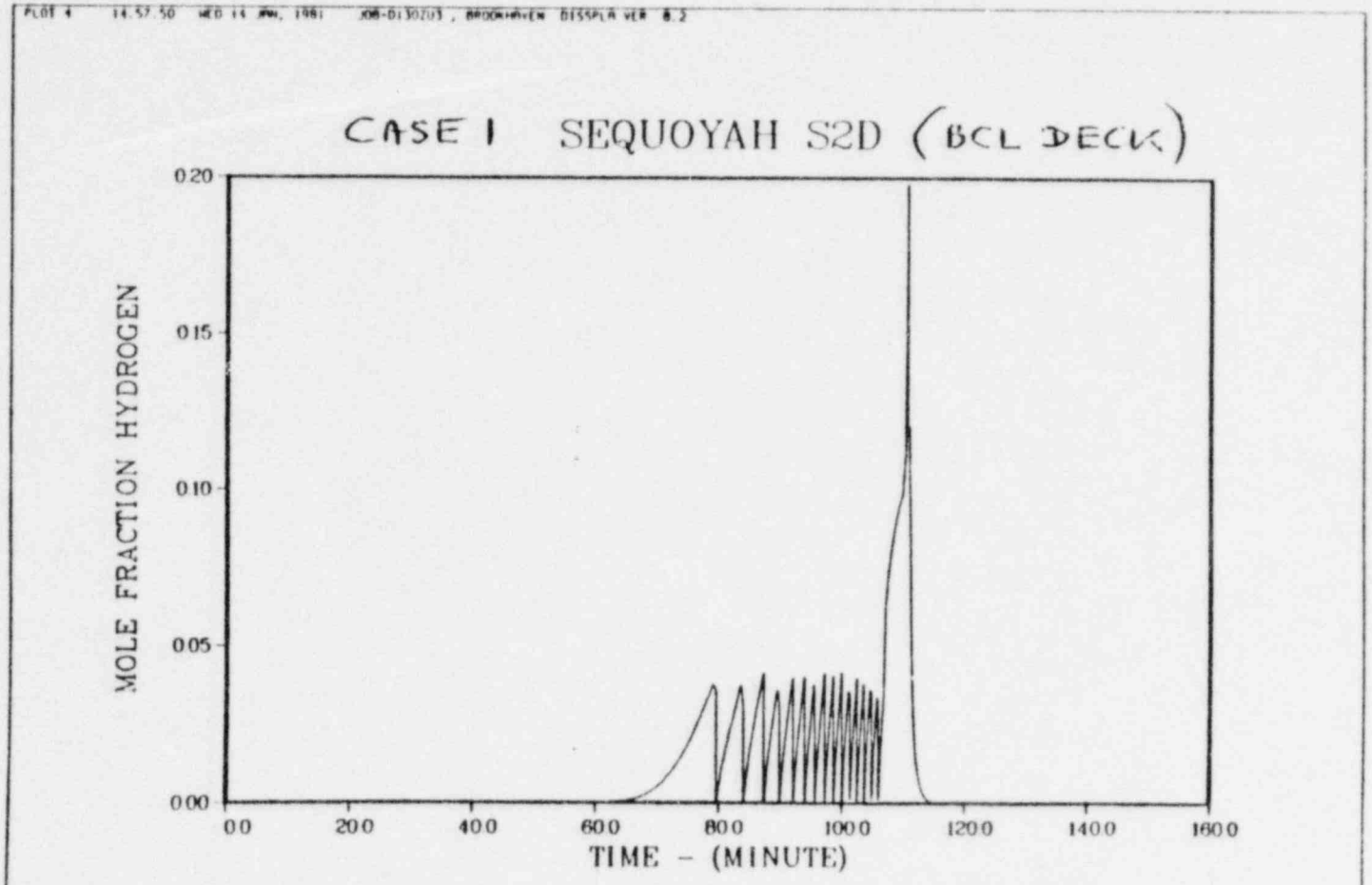

CASE 1 SEQUOYAH S2D (BCL DECK)
MOLE FRACTION HYDROGEN
0.20
0.15
0.10
0.05
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 4

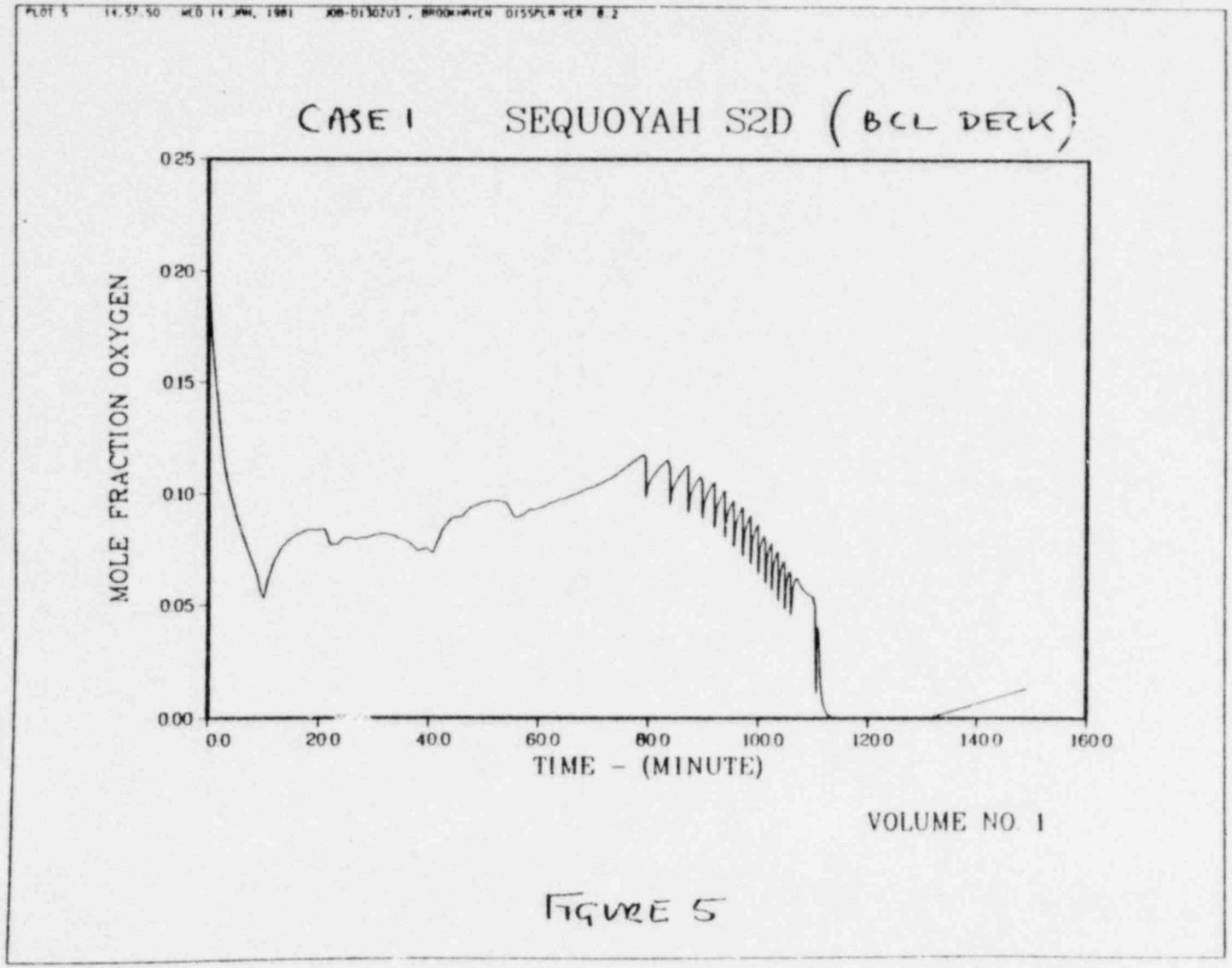

CASE 1 SEQUOYAH S2D (BCL DECK)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 5

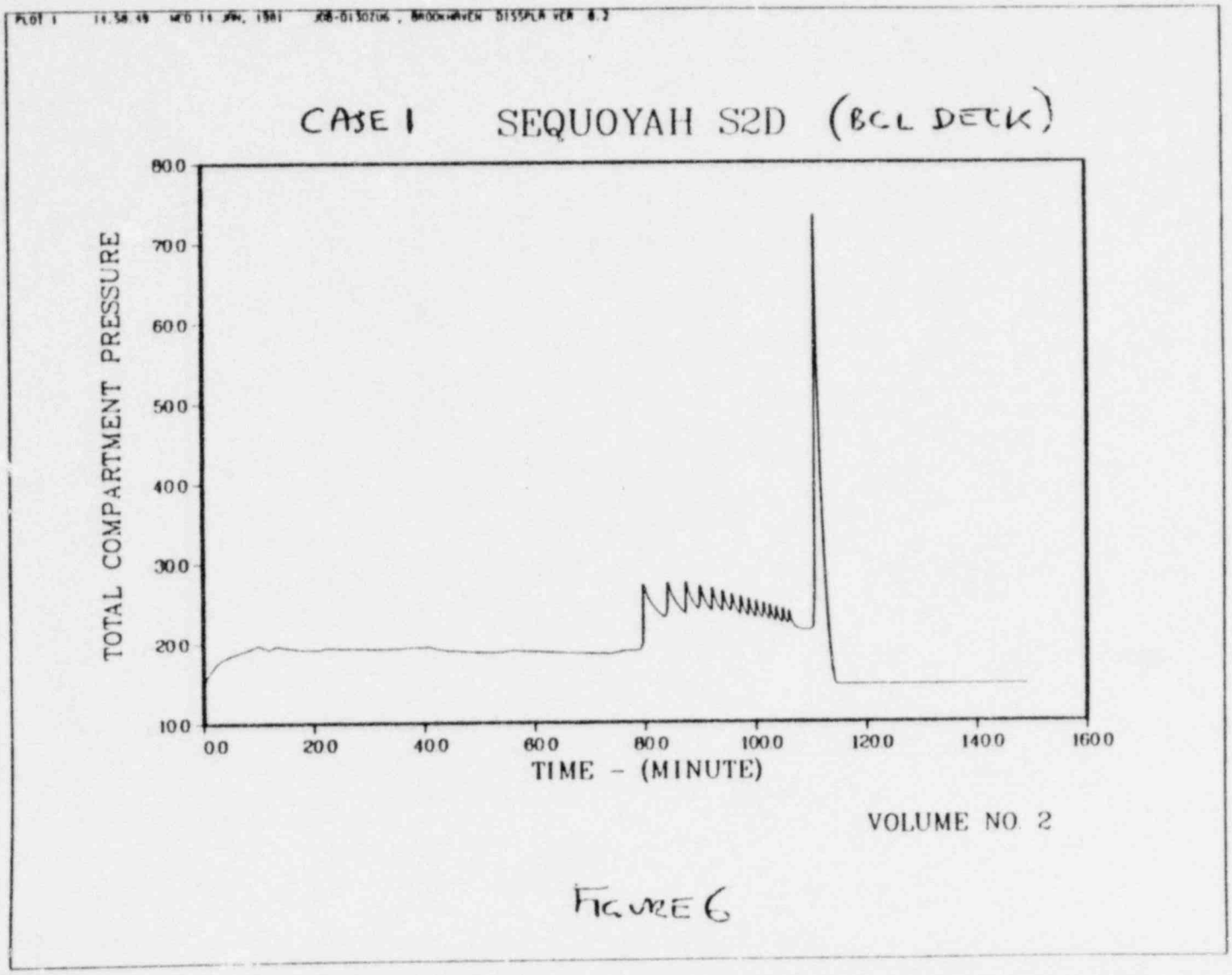

CASE 1 SEQUOYAH S2D (BCL DECK)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2

FIGURE 6

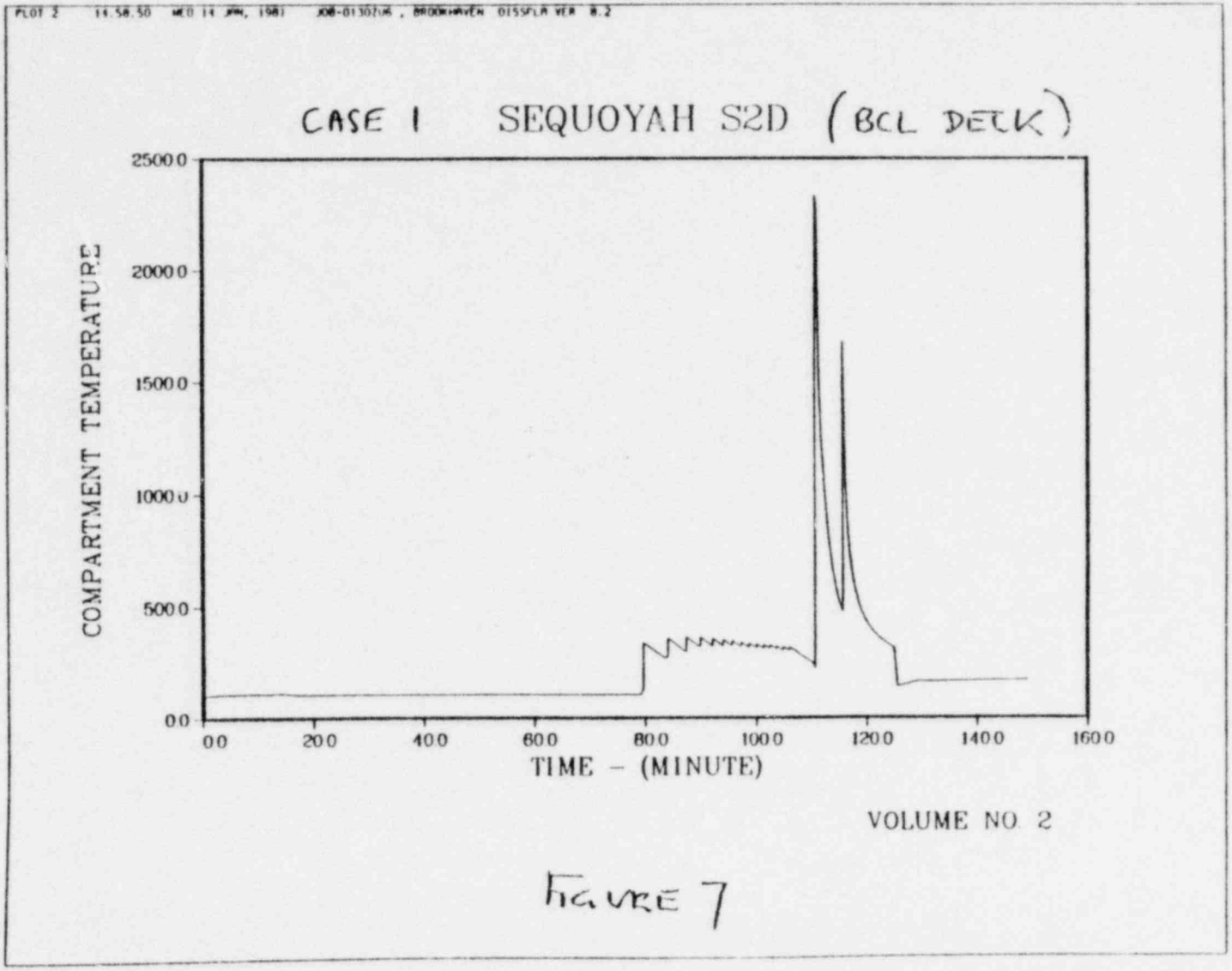

CASE 1 SEQUOYAH S2D (BCL DECK)
COMPARTMENT TEMPERATURE
25000
20000
15000
10000
5000
00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2

FIGURE 7

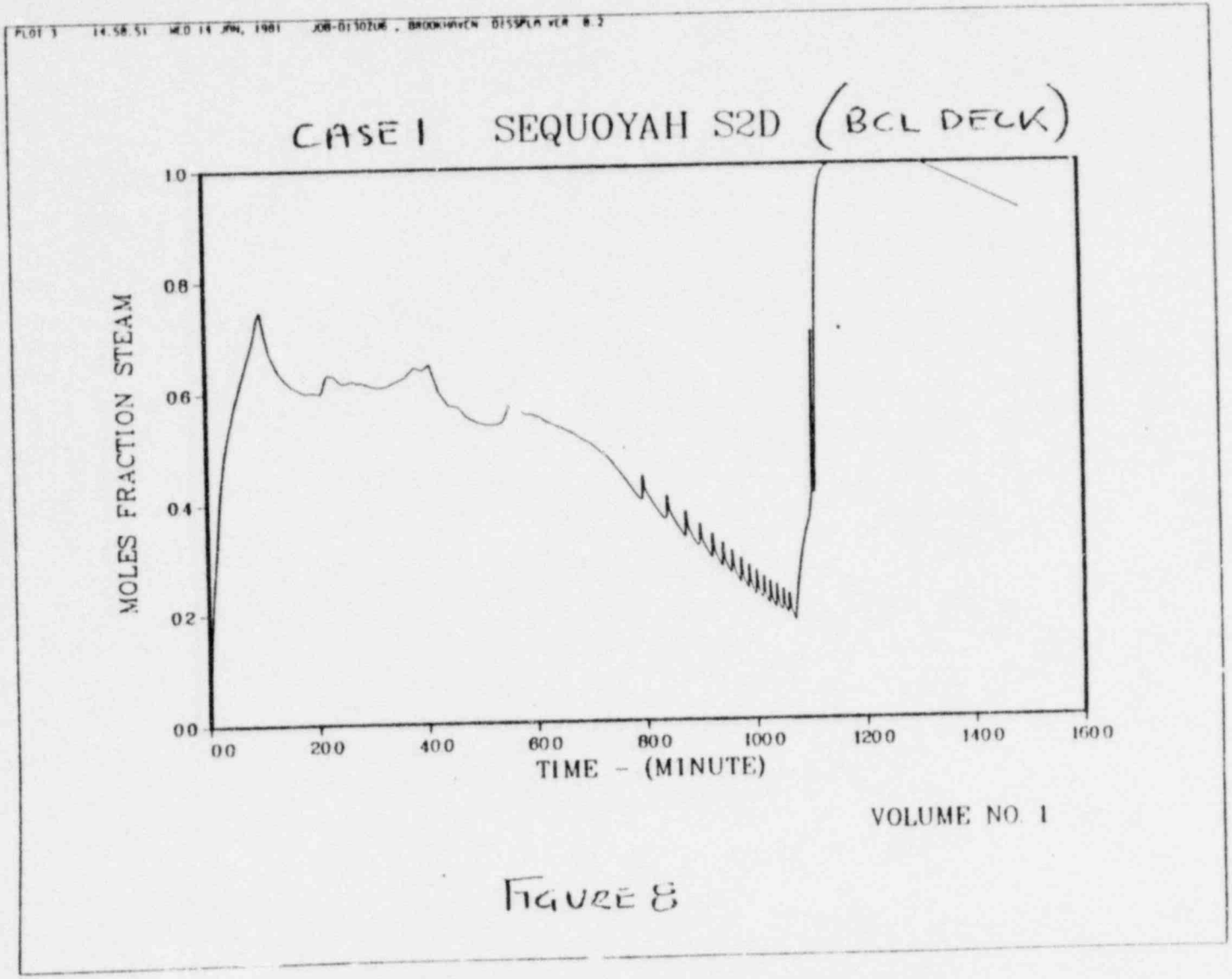

CASE 1 SEQUOYAH S2D (BCL DECK)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 8

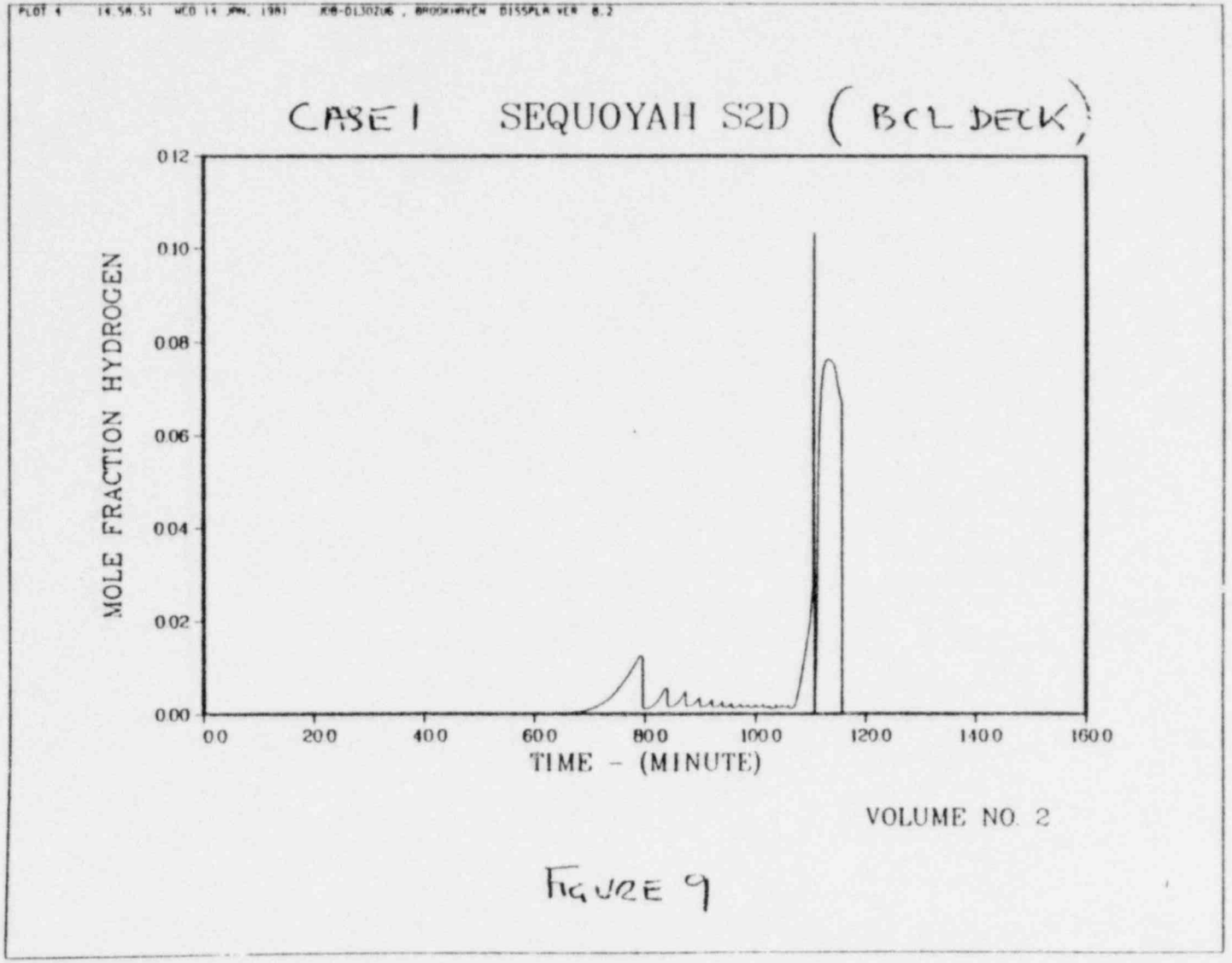

PLOT 4 14.58.51 WED 14 JAN, 1981 RB-DL30206 , BROOKHAVEN DISSPLA VER 8.2
CASE 1 SEQUOYAH S2D (BCL DECK)
MOLE FRACTION HYDROGEN
0.12
0.10
0.08
0.06
0.04
0.02
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 9

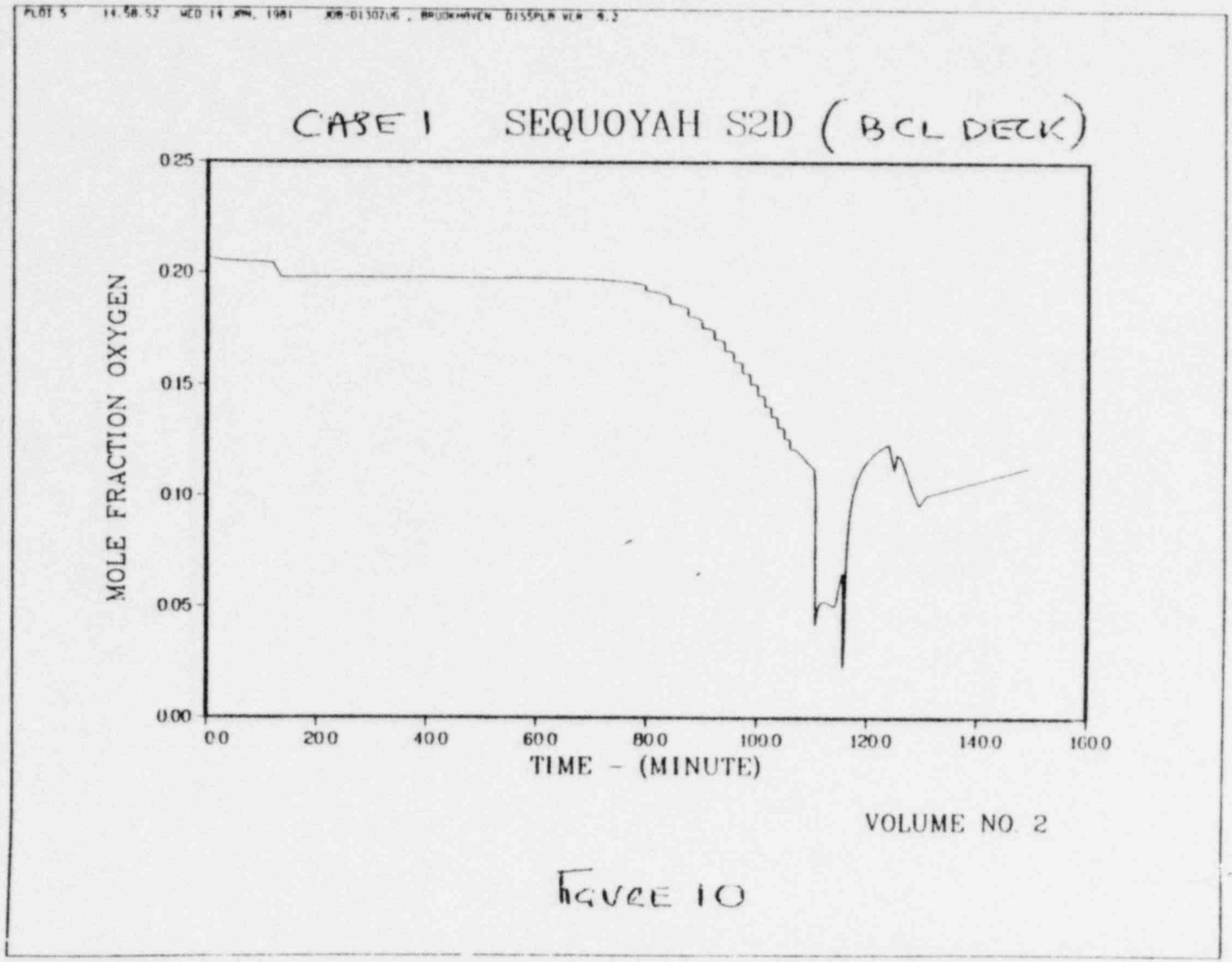

CASE 1 SEQUOYAH S2D (BCL DECK)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 10

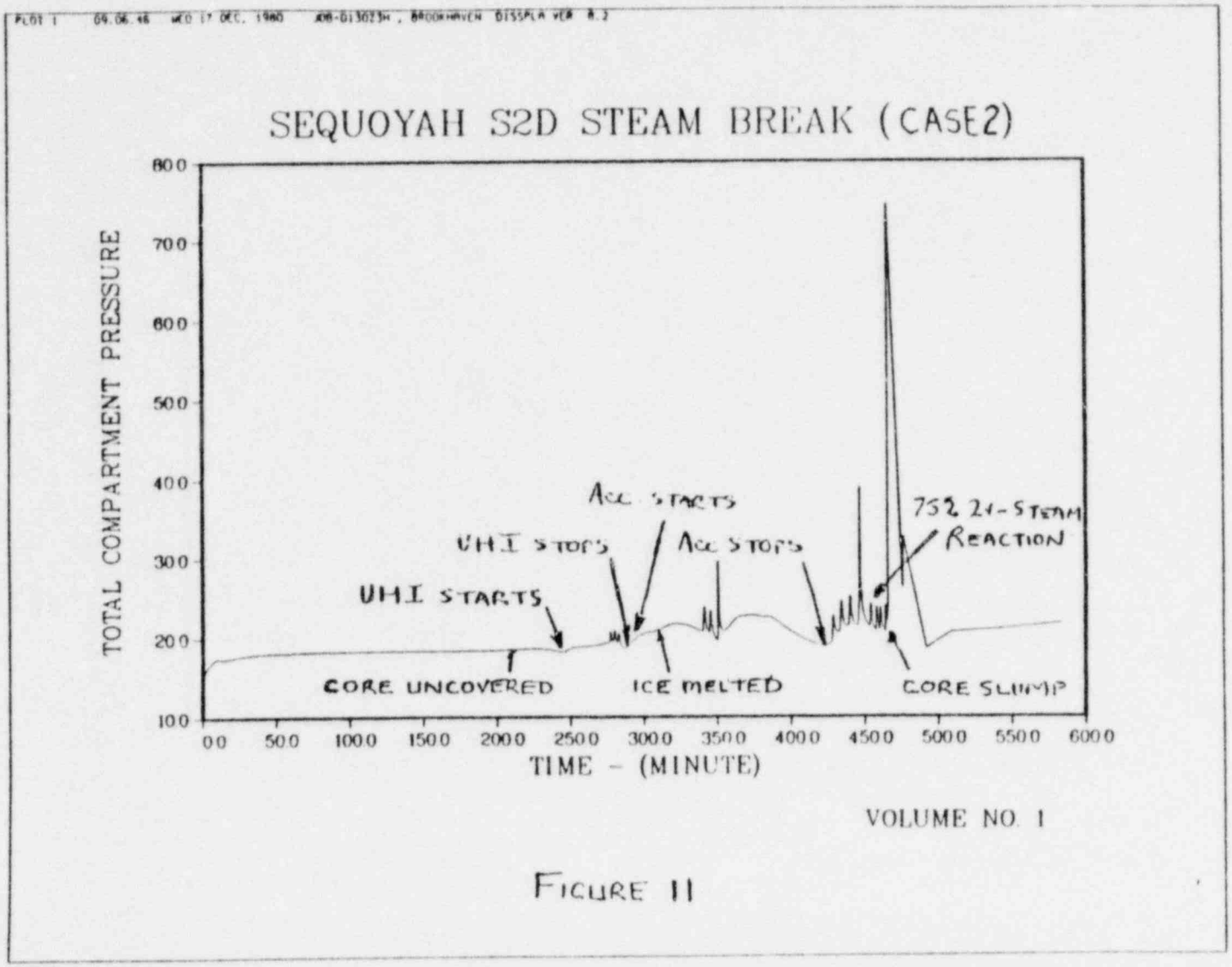

SEQUOYAH S2D STEAM BREAK (CASE2)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
UHI STARTS
UHI STOPS
ACC STARTS
ACC STOPS
752 Zr-STEAM REACTION
CORE UNCOVERED
ICE MELTED
CORE SLUMP
VOLUME NO. 1

FIGURE 11

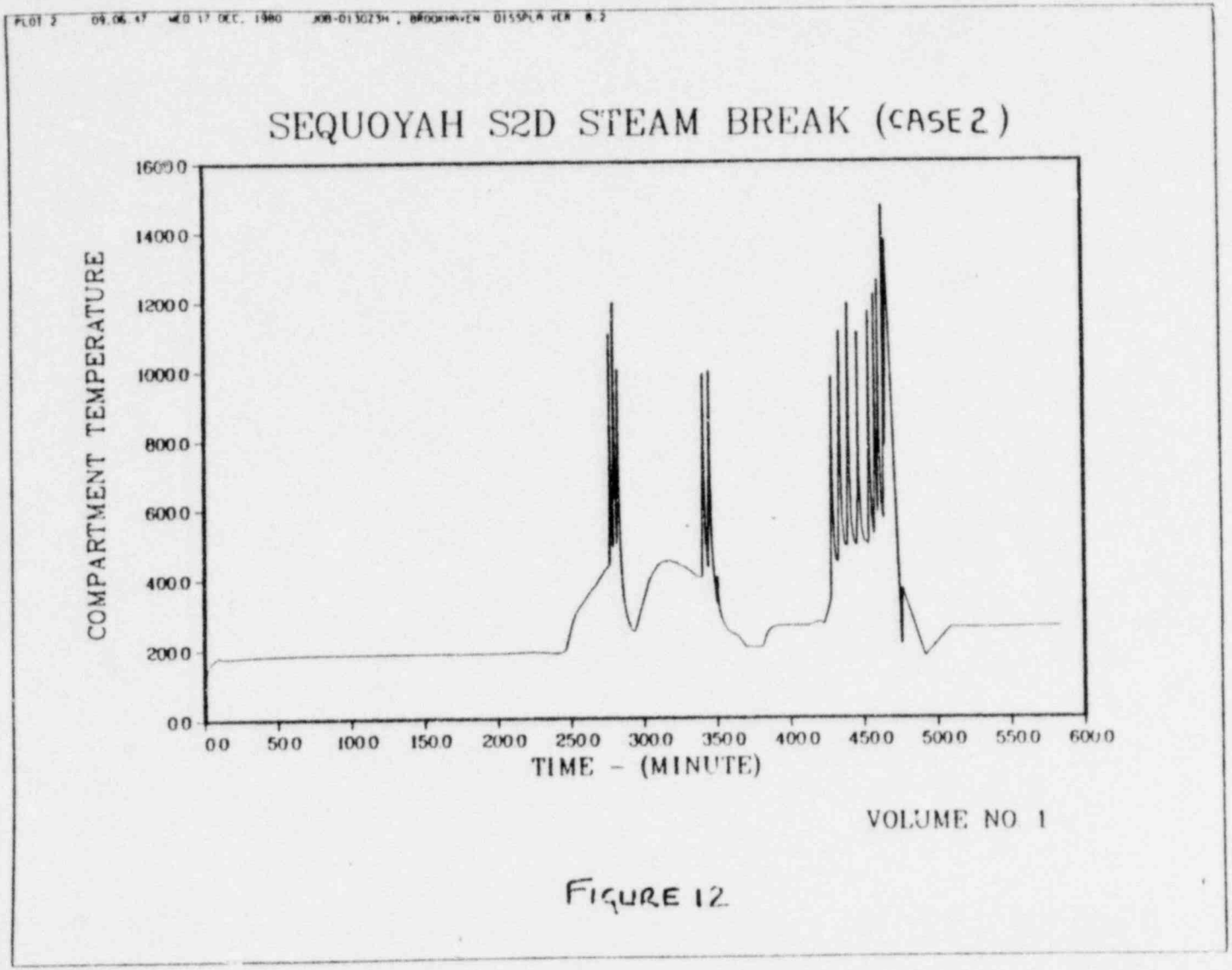

SEQUOYAH S2D STEAM BREAK (CASE 2)
COMPARTMENT TEMPERATURE
16000
14000
12000
10000
8000
6000
4000
2000
00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO 1

FIGURE 12

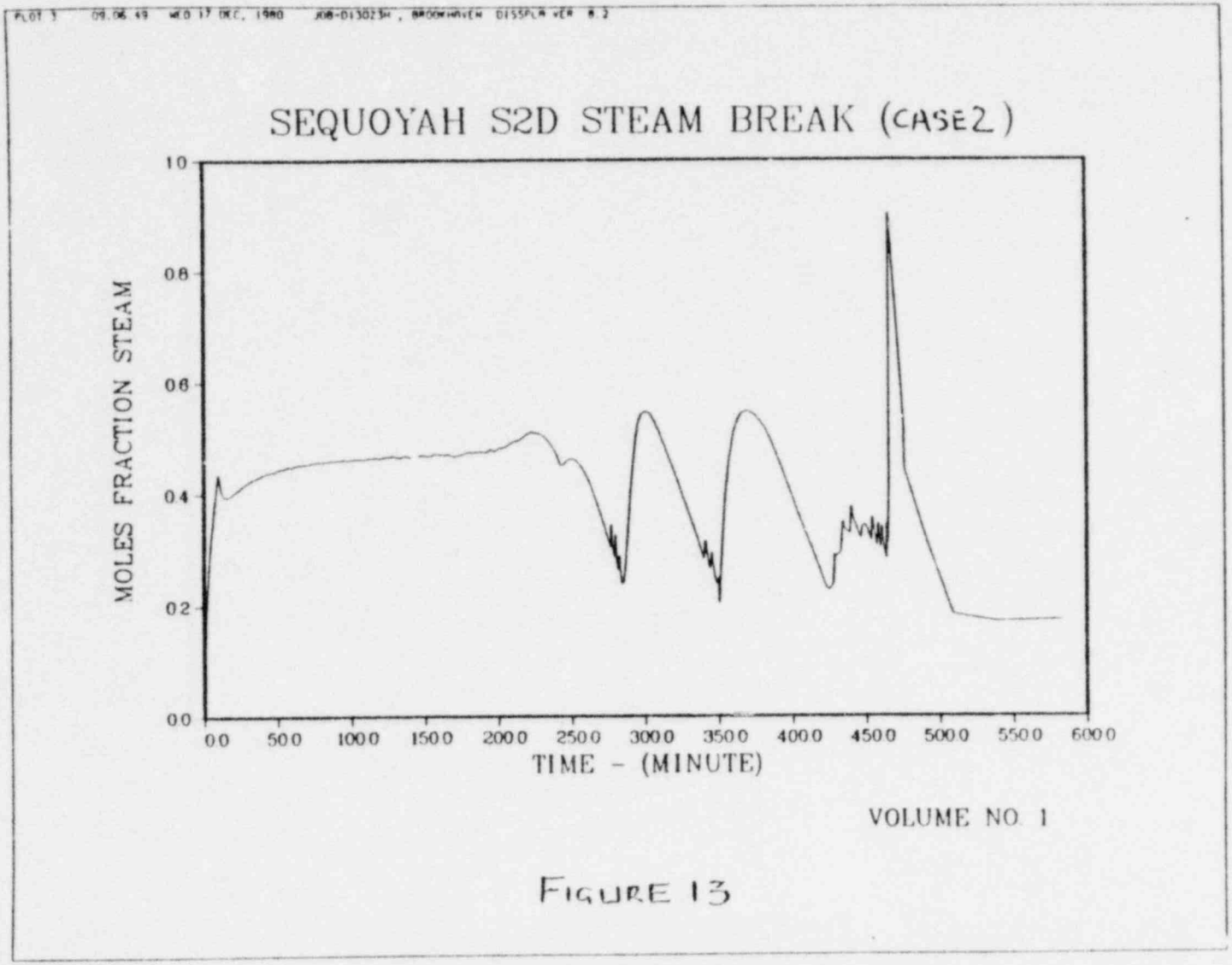

SEQUOYAH S2D STEAM BREAK (CASE2)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 13

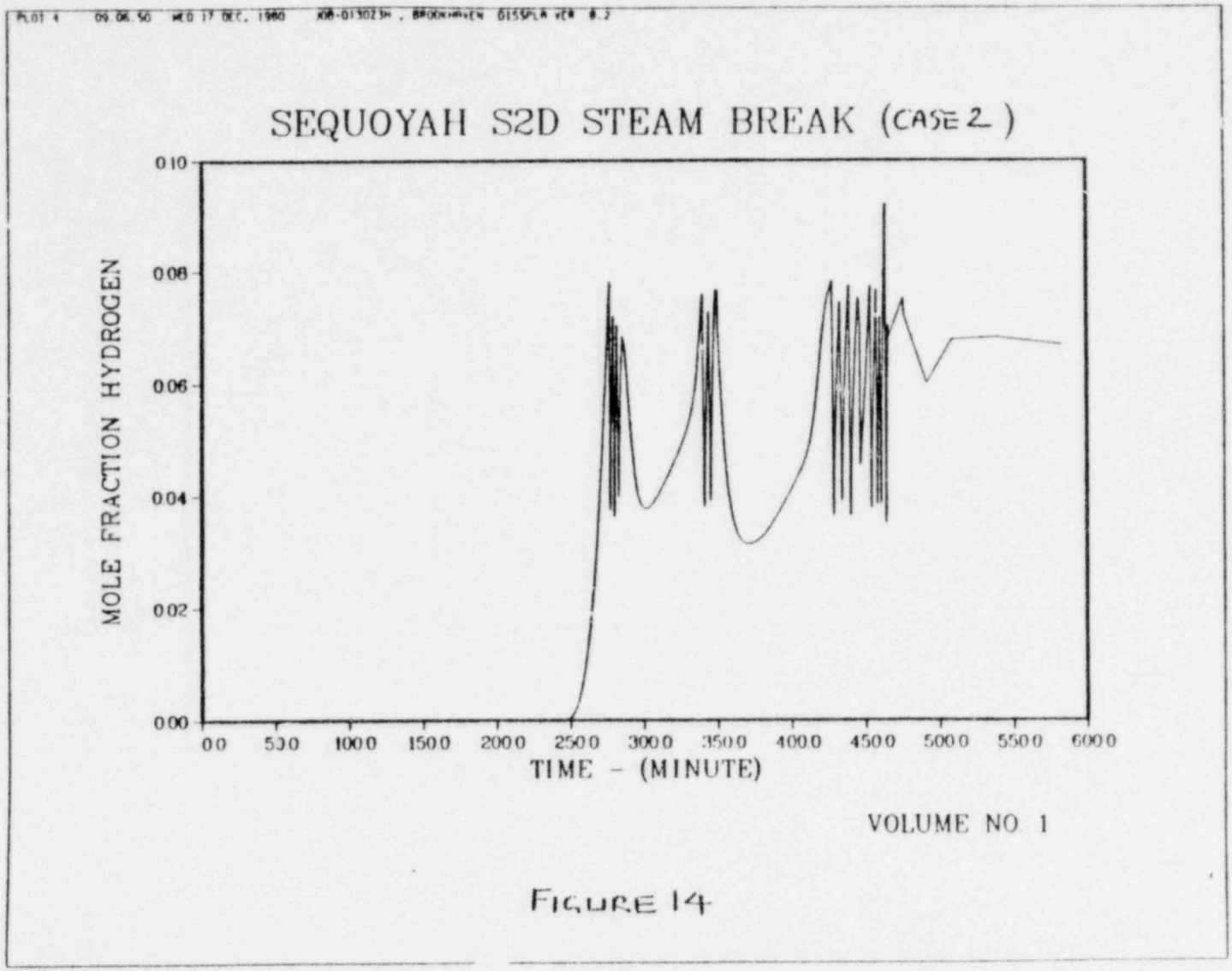

SEQUOYAH S2D STEAM BREAK (CASE 2)
MOLE FRACTION HYDROGEN
0.10
0.08
0.06
0.04
0.02
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO 1

FIGURE 14

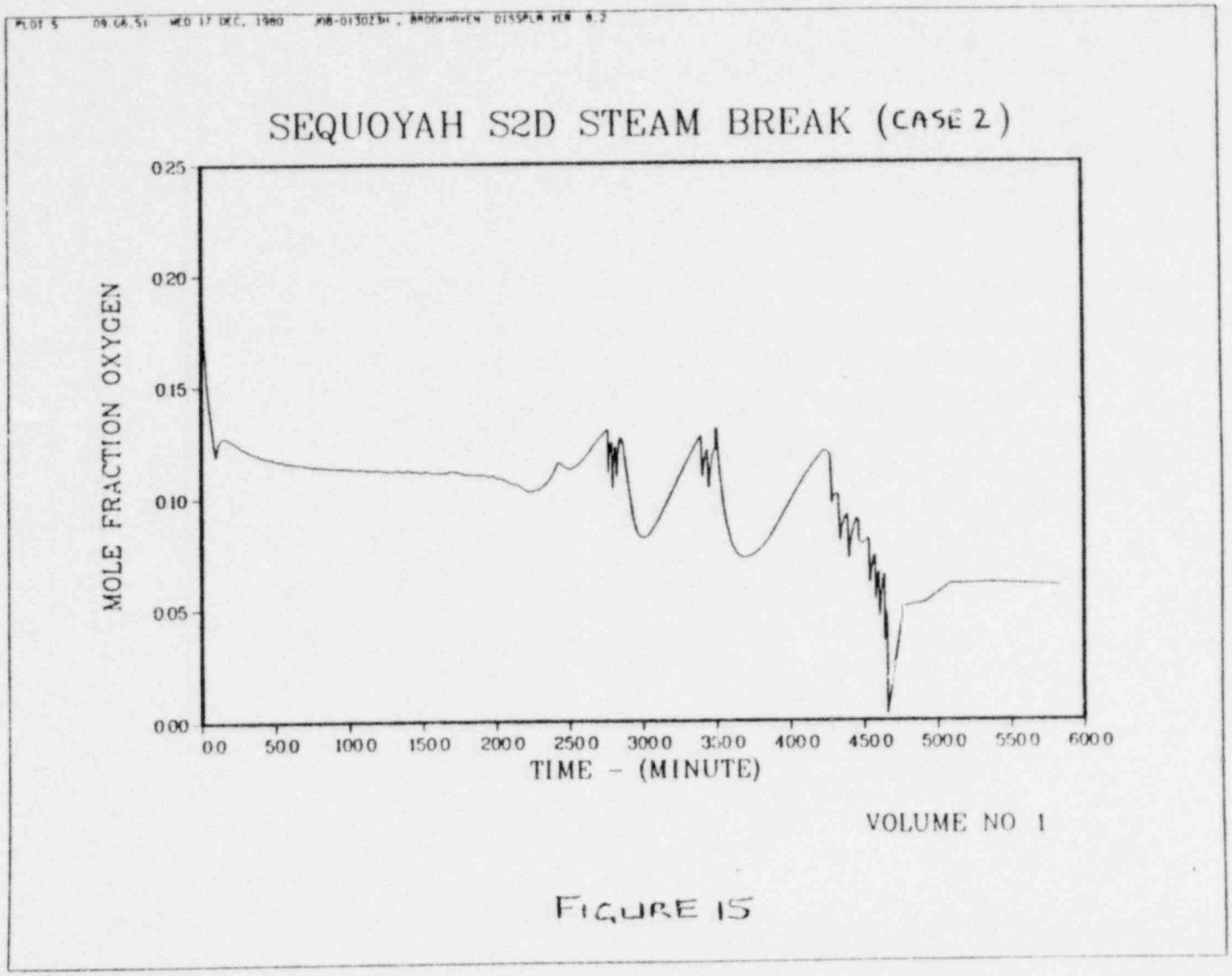

PLOT 5 09.CA.S1 WED 17 DEC. 1980 JOB-01302SH , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH S2D STEAM BREAK (CASE 2)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO 1

FIGURE 15

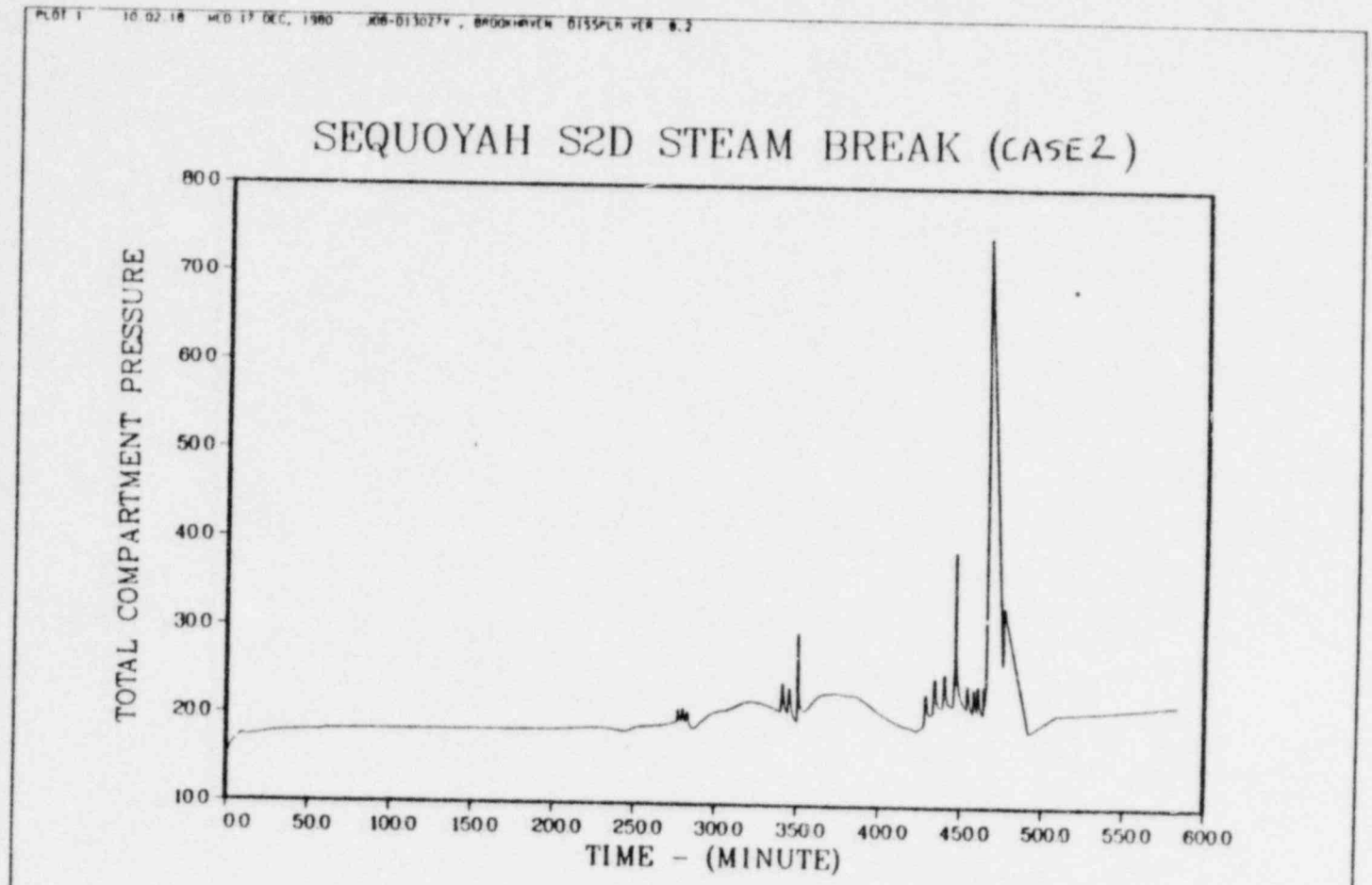

SEQUOYAH S2D STEAM BREAK (CASE2)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 16

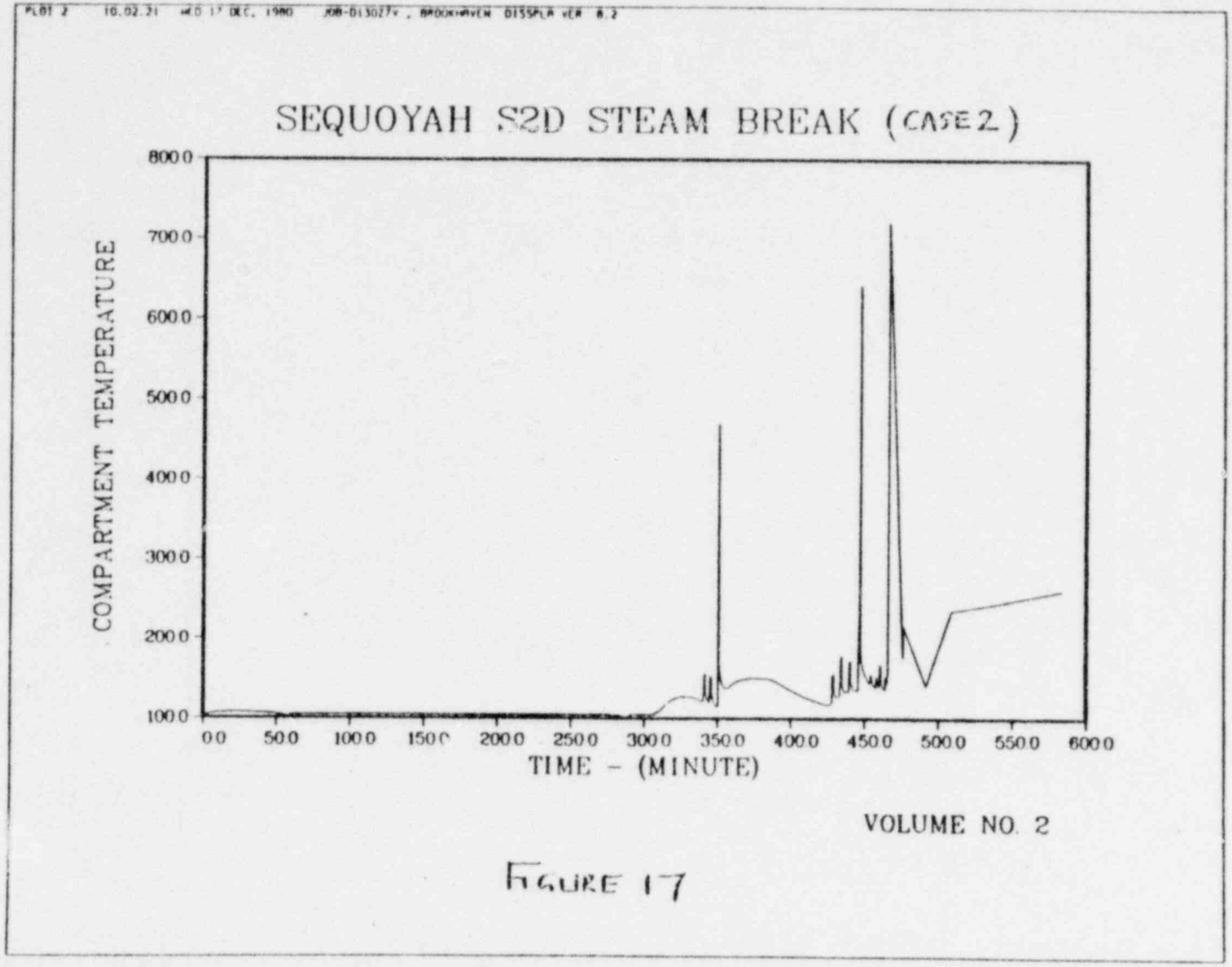

SEQUOYAH S2D STEAM BREAK (CASE 2)
COMPARTMENT TEMPERATURE
8000
7000
6000
5000
4000
3000
2000
1000
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 17

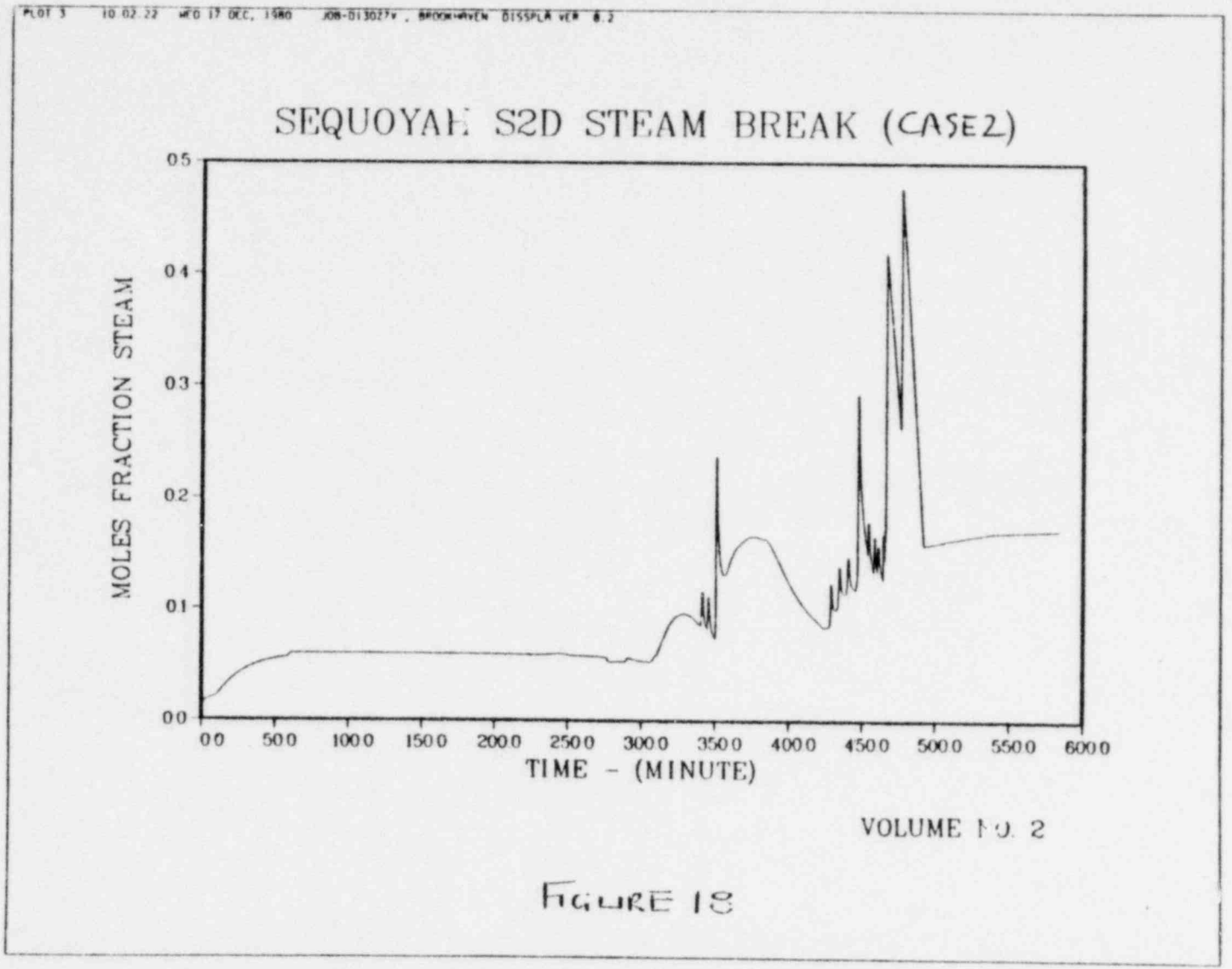

PLOT 3 10.02.22 WED 17 DEC, 1980 JOB-013027v , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH S2D STEAM BREAK (CASE2)
MOLES FRACTION STEAM
05
04
03
02
01
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 18

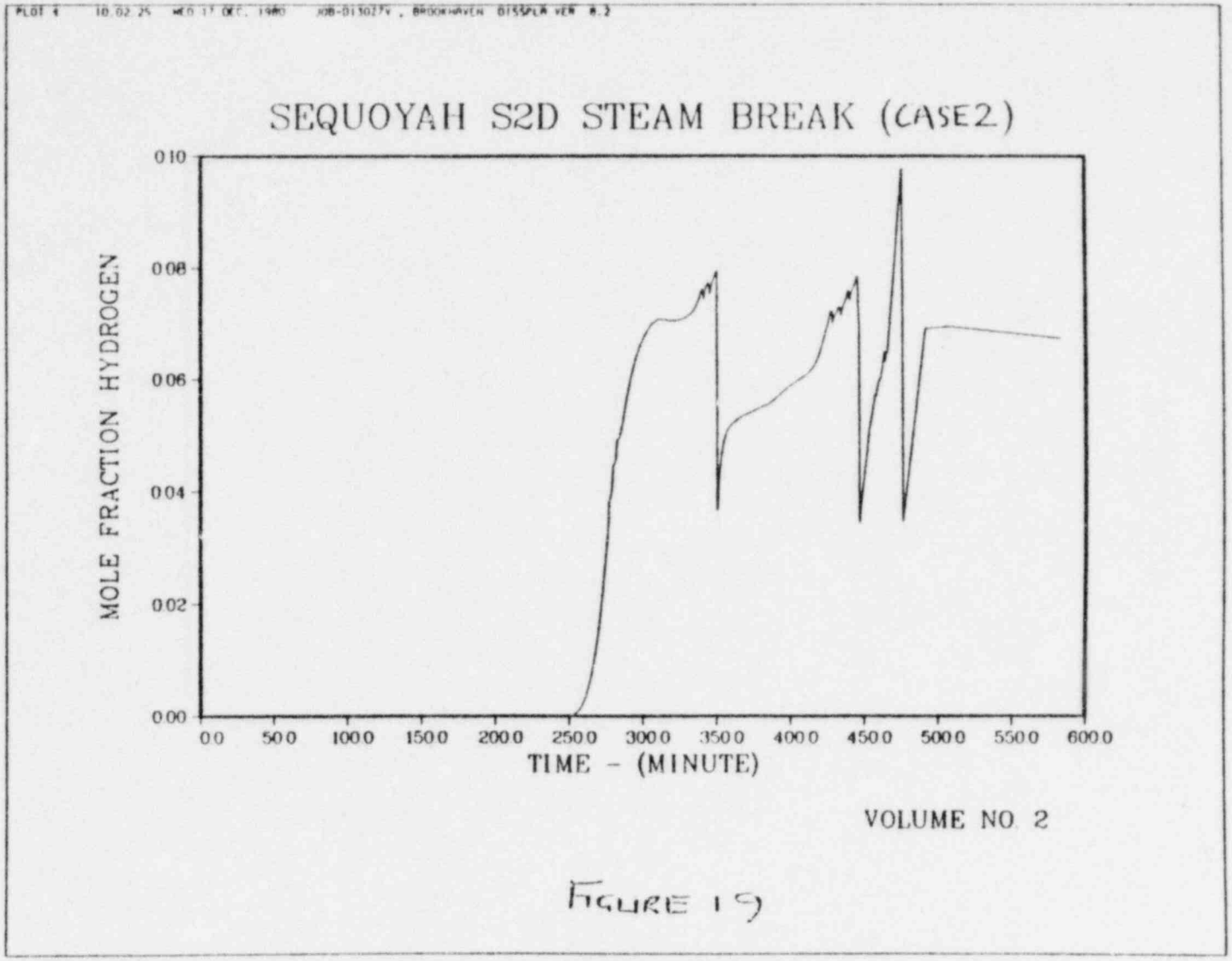

SEQUOYAH S2D STEAM BREAK (CASE2)
MOLE FRACTION HYDROGEN
0.10
0.08
0.06
0.04
0.02
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 19

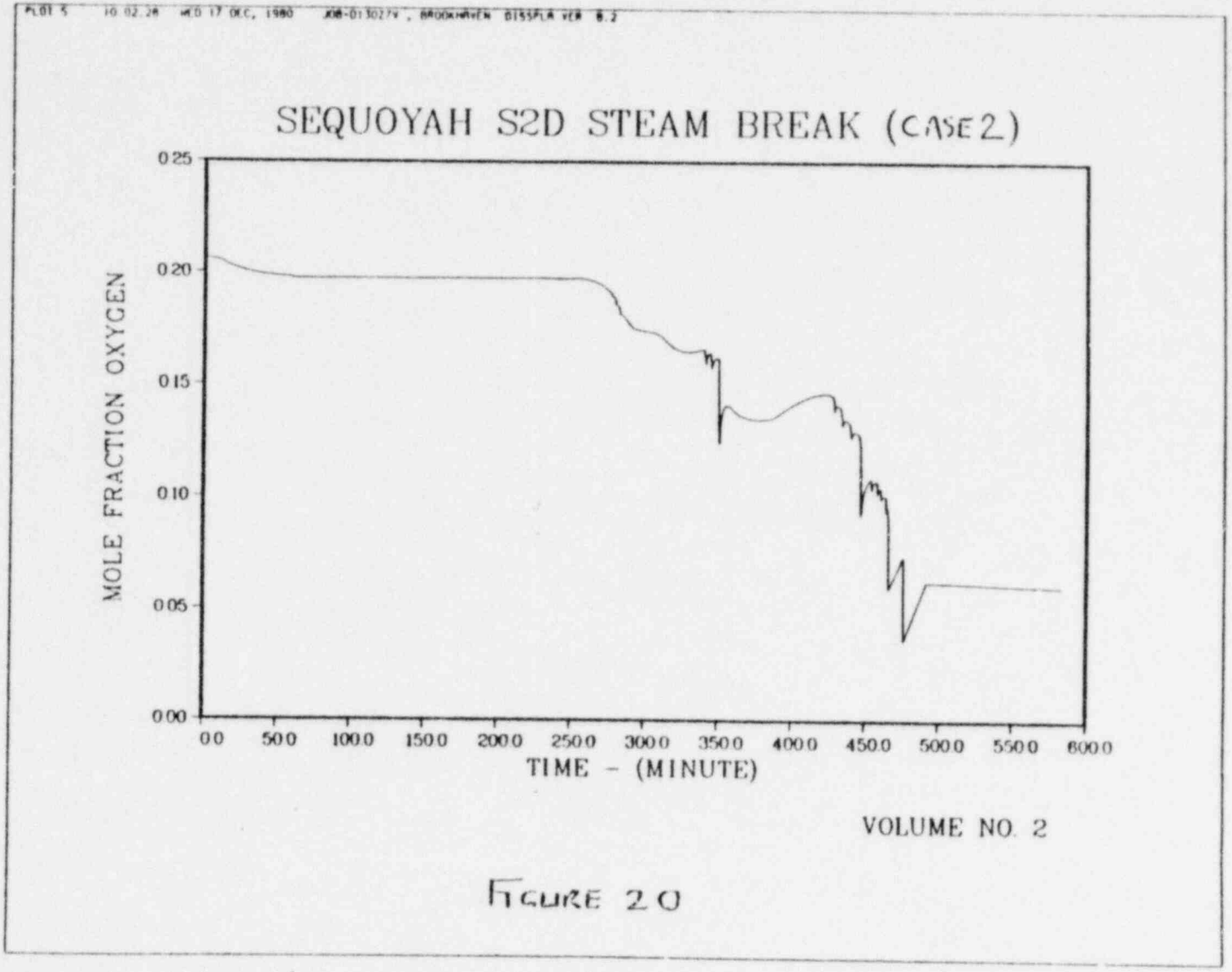

SEQUOYAH S2D STEAM BREAK (CASE 2)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 20

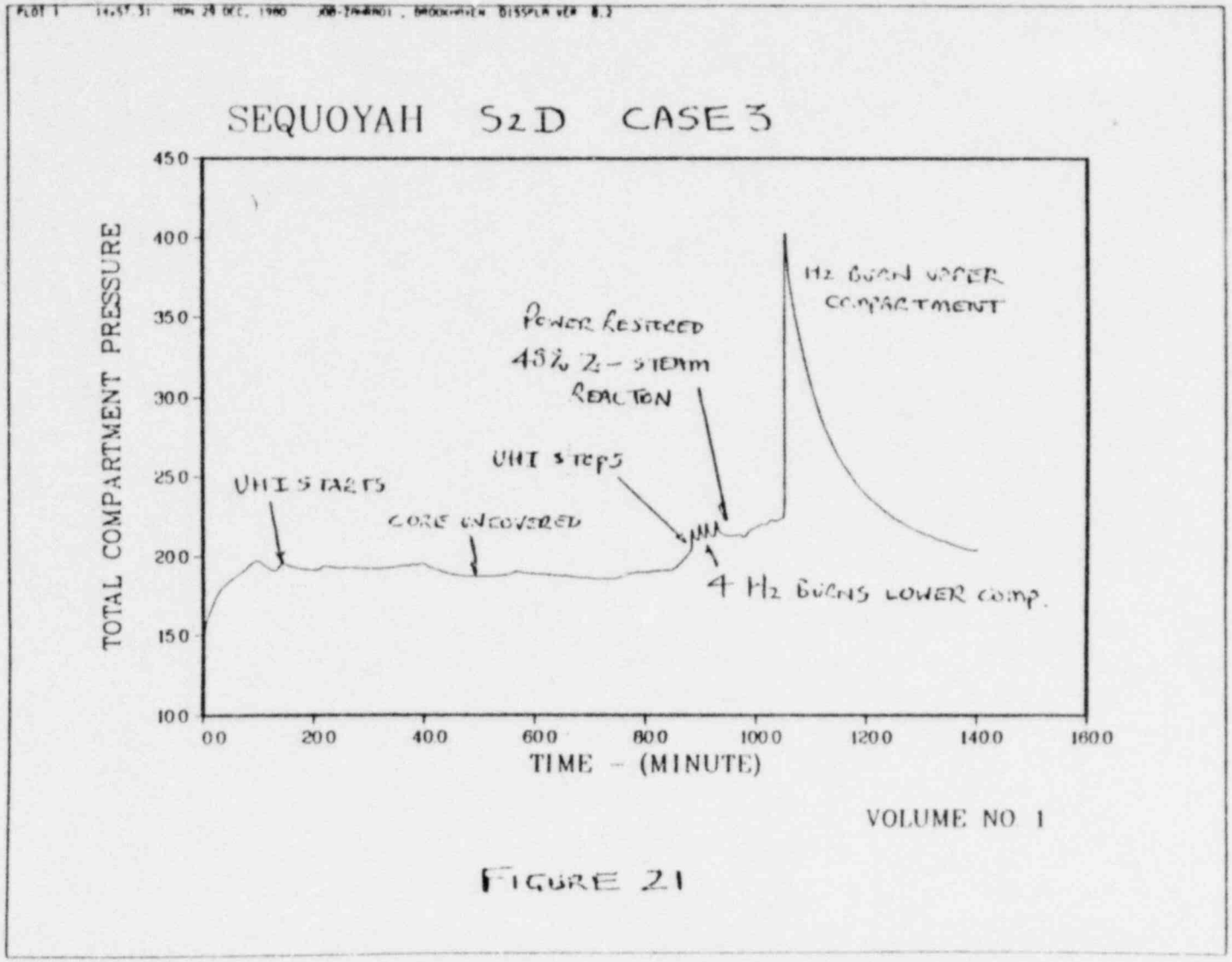

SEQUOYAH S2D CASE 3
TOTAL COMPARTMENT PRESSURE
450
400
350
300
250
200
150
100
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VHI STARTS
CORE UNCOVERED
VHI STOPS
POWER RESTORED
43% Zr - STEAM
REACTION
H2 BURN UPPER
COMPARTMENT
4 H2 BURNS LOWER COMP.
VOLUME NO 1

FIGURE 21

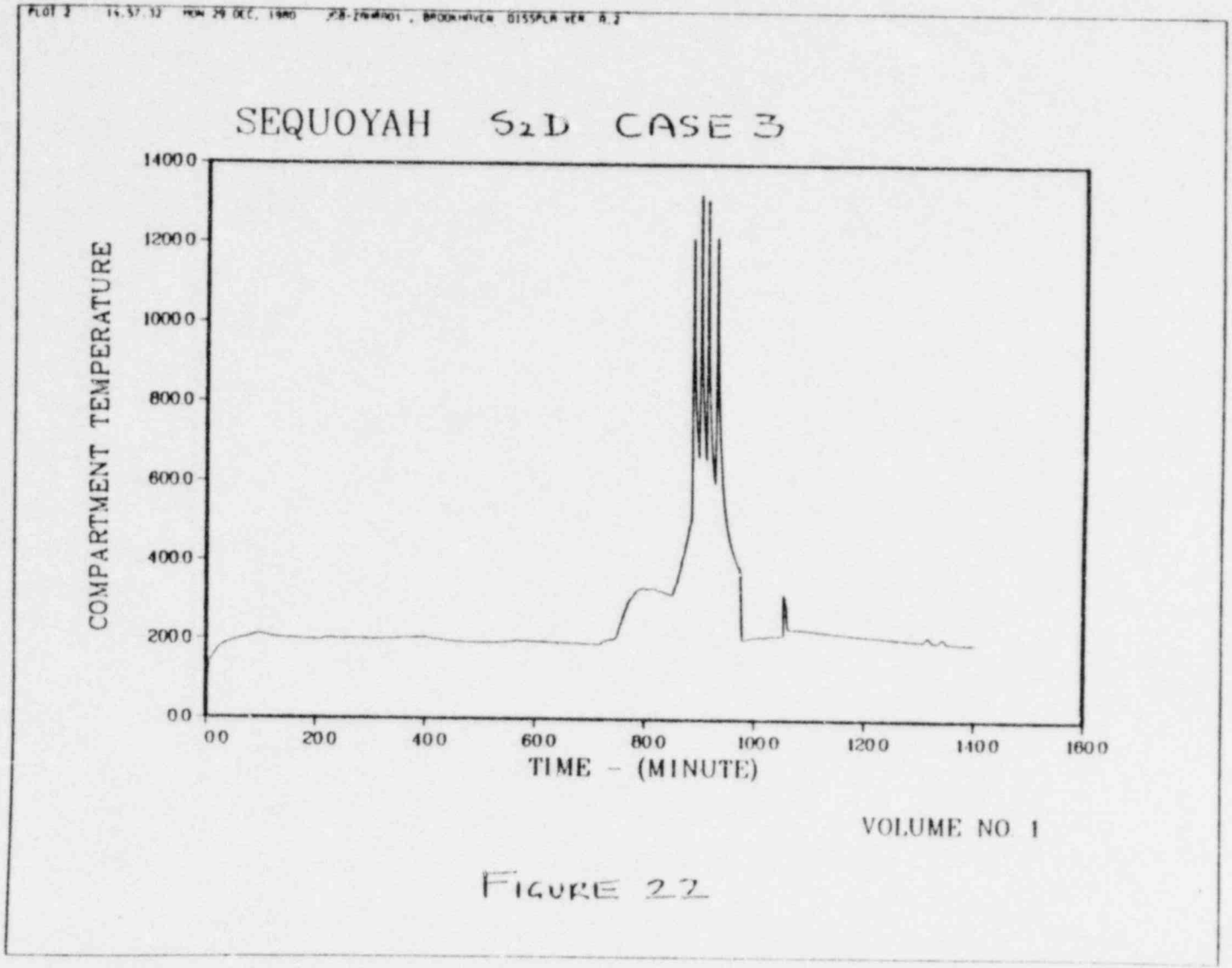

SEQUOYAH S2D CASE 3
COMPARTMENT TEMPERATURE
14000
12000
10000
8000
6000
4000
2000
00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 1

FIGURE 22

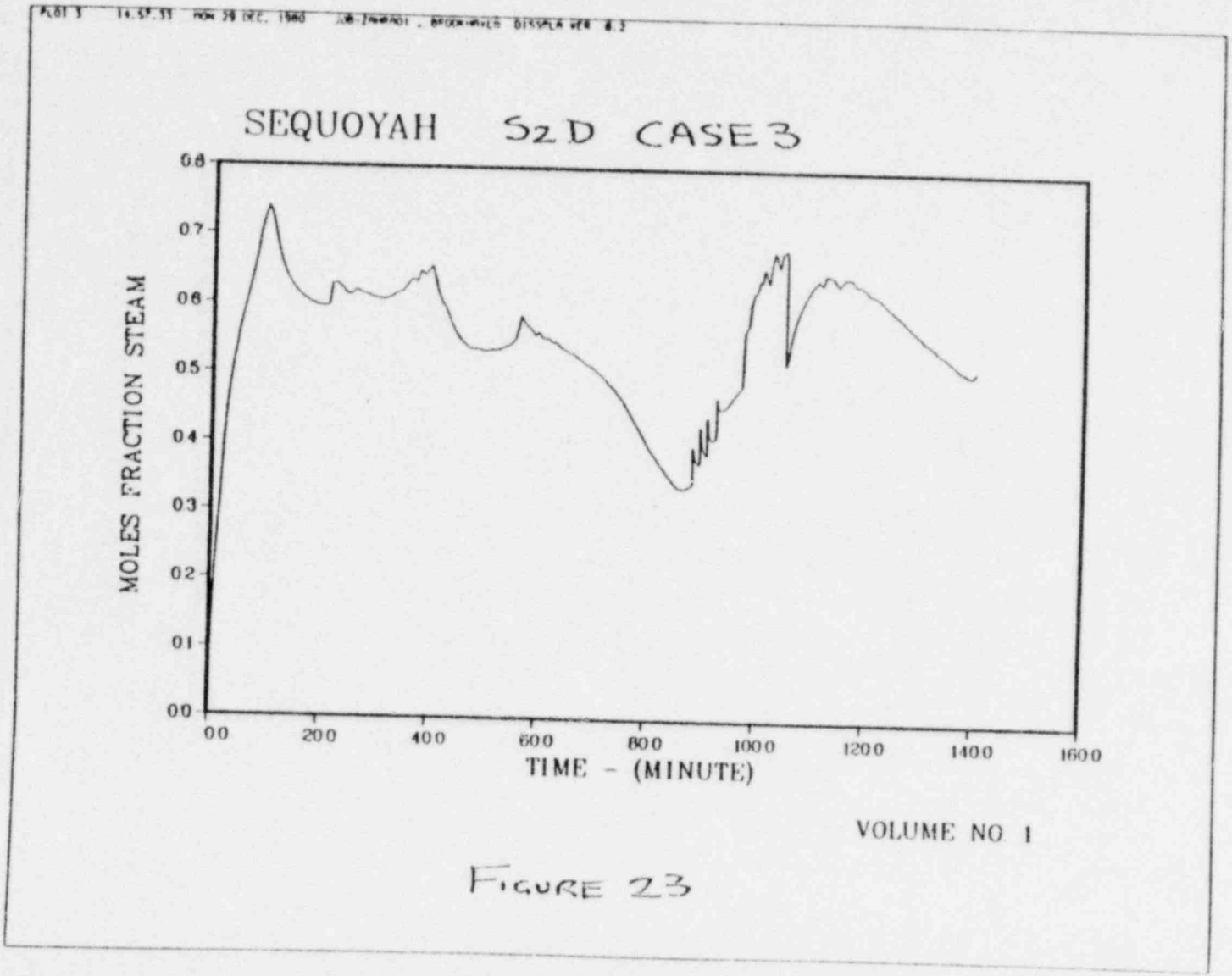

SEQUOYAH S2D CASE3
MOLES FRACTION STEAM
00
01
02
03
04
05
06
07
08
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 1

FIGURE 23

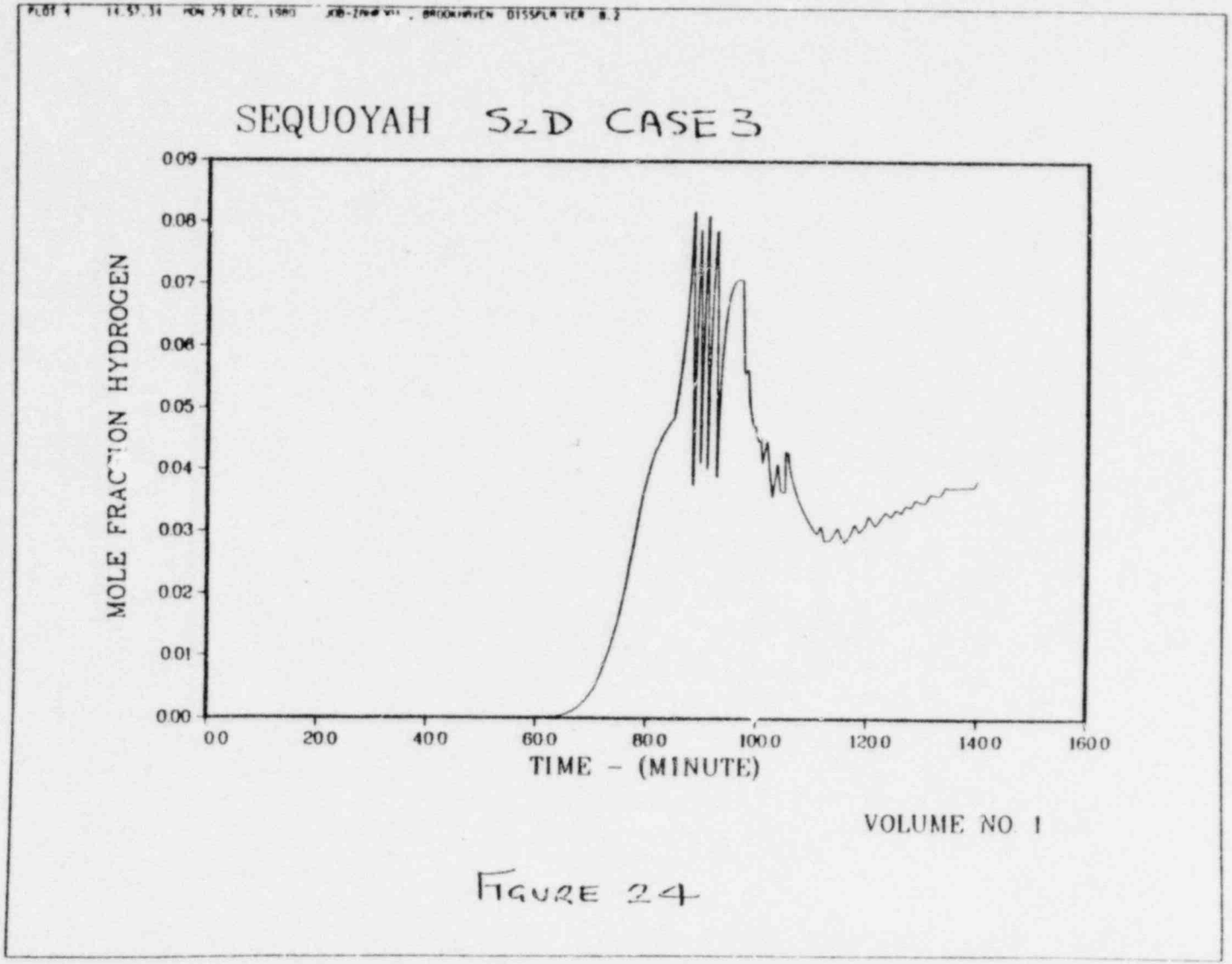

SEQUOYAH S2D CASE 3
MOLE FRACTION HYDROGEN
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 1

FIGURE 24

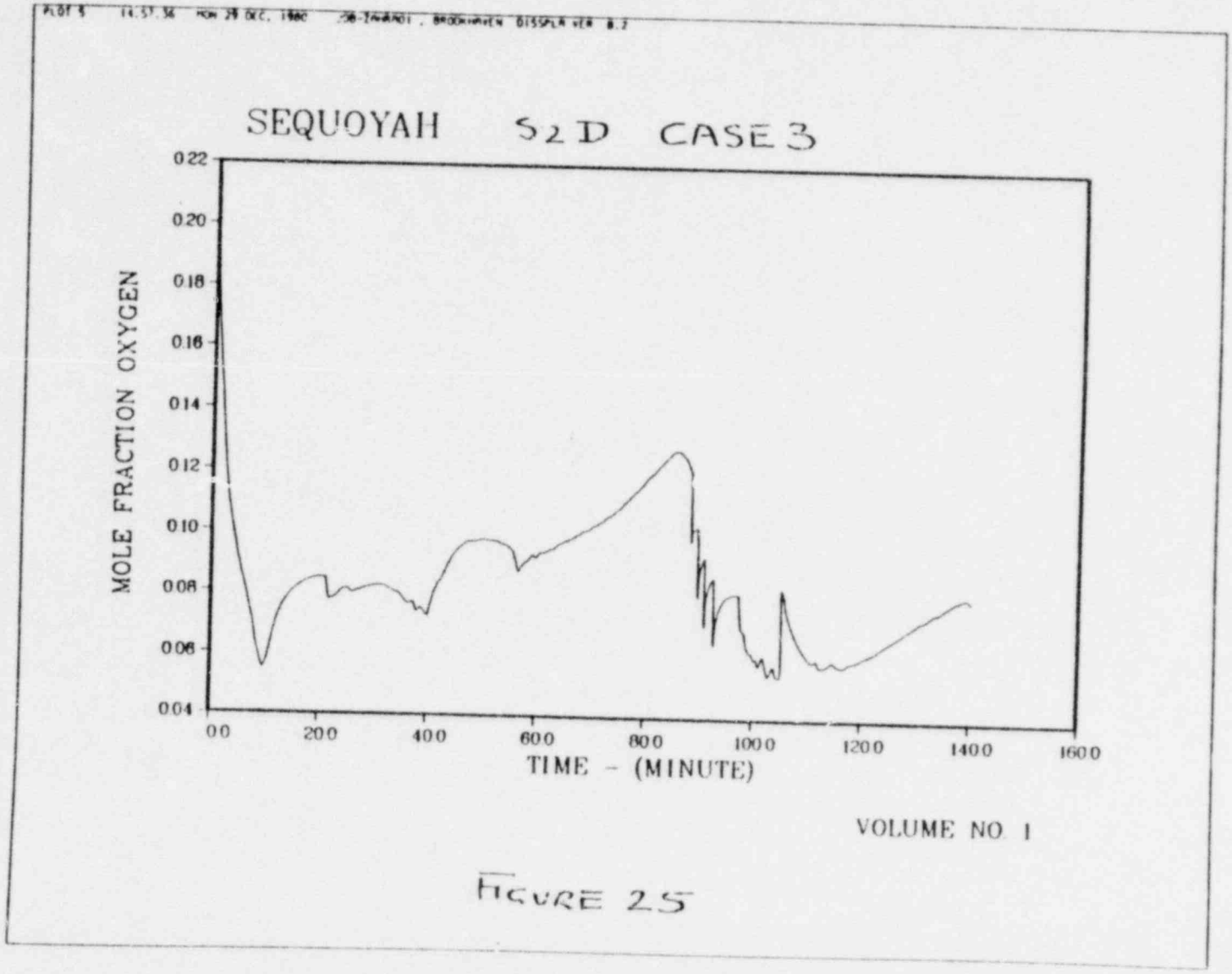

SEQUOYAH S2D CASE 3
MOLE FRACTION OXYGEN
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 25

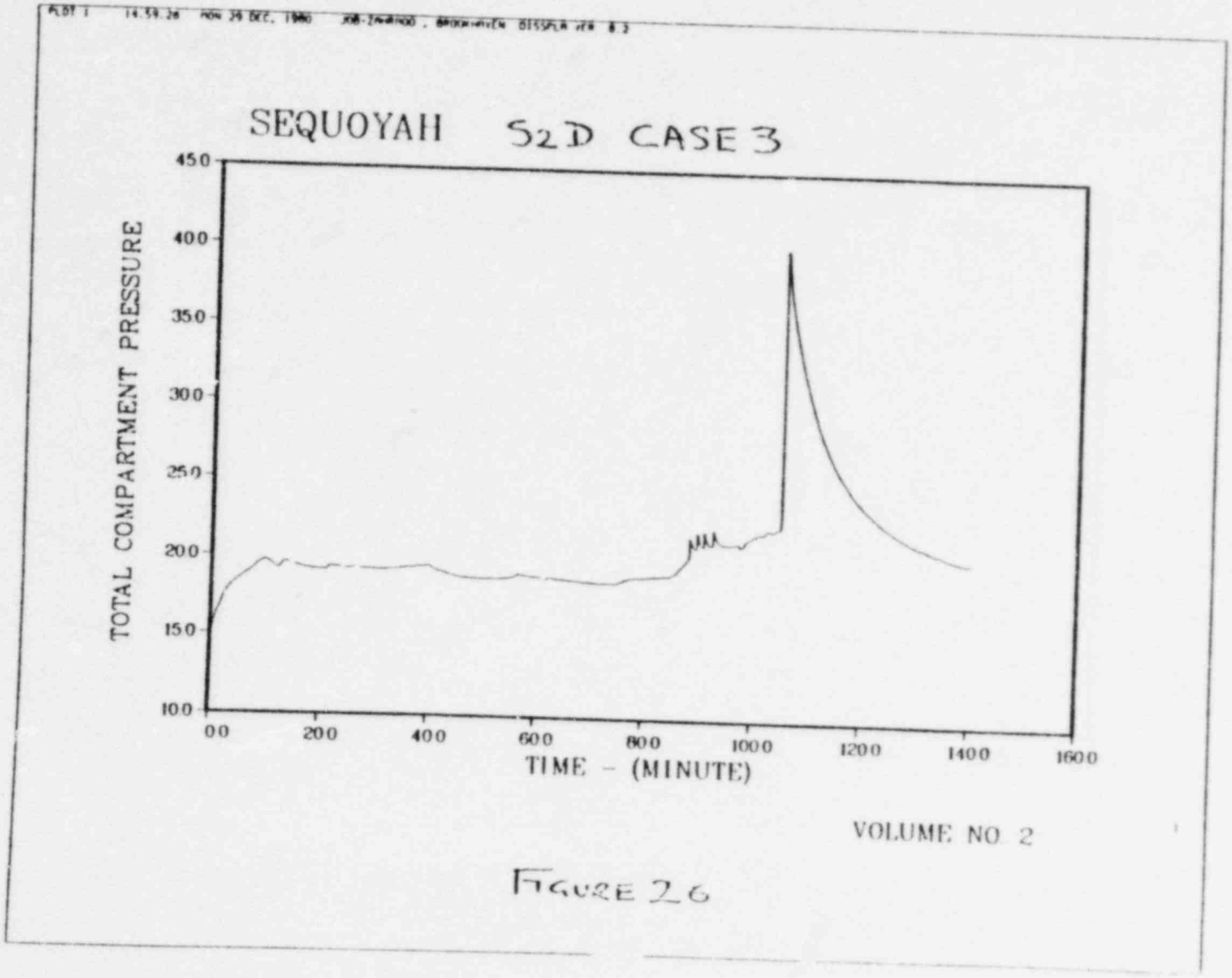

SEQUOYAH S2D CASE 3
TOTAL COMPARTMENT PRESSURE
450
400
350
300
250
200
150
100
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2

FIGURE 26

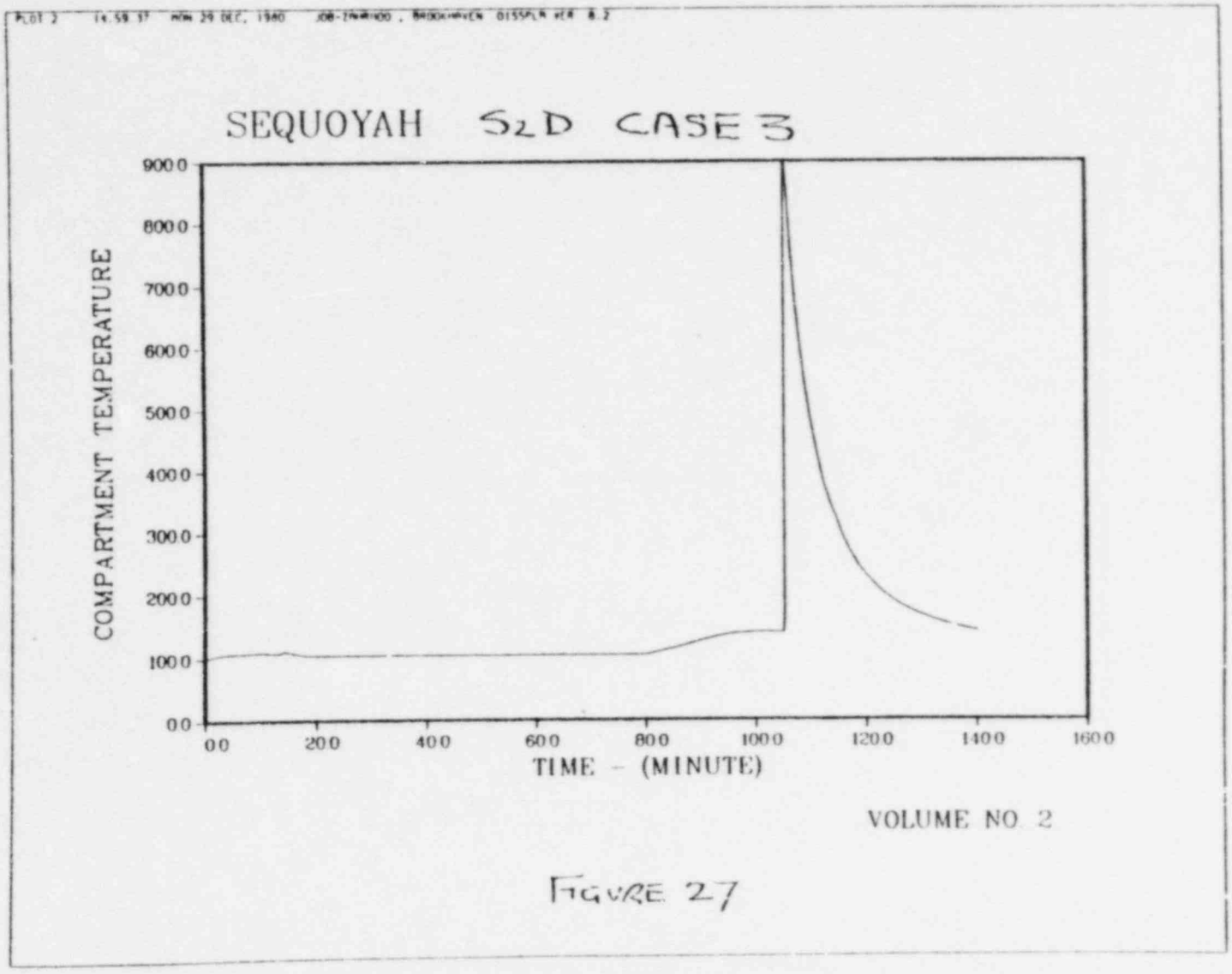

SEQUOYAH S2D CASE 3
COMPARTMENT TEMPERATURE
9000
8000
7000
6000
5000
4000
3000
2000
1000
00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 27

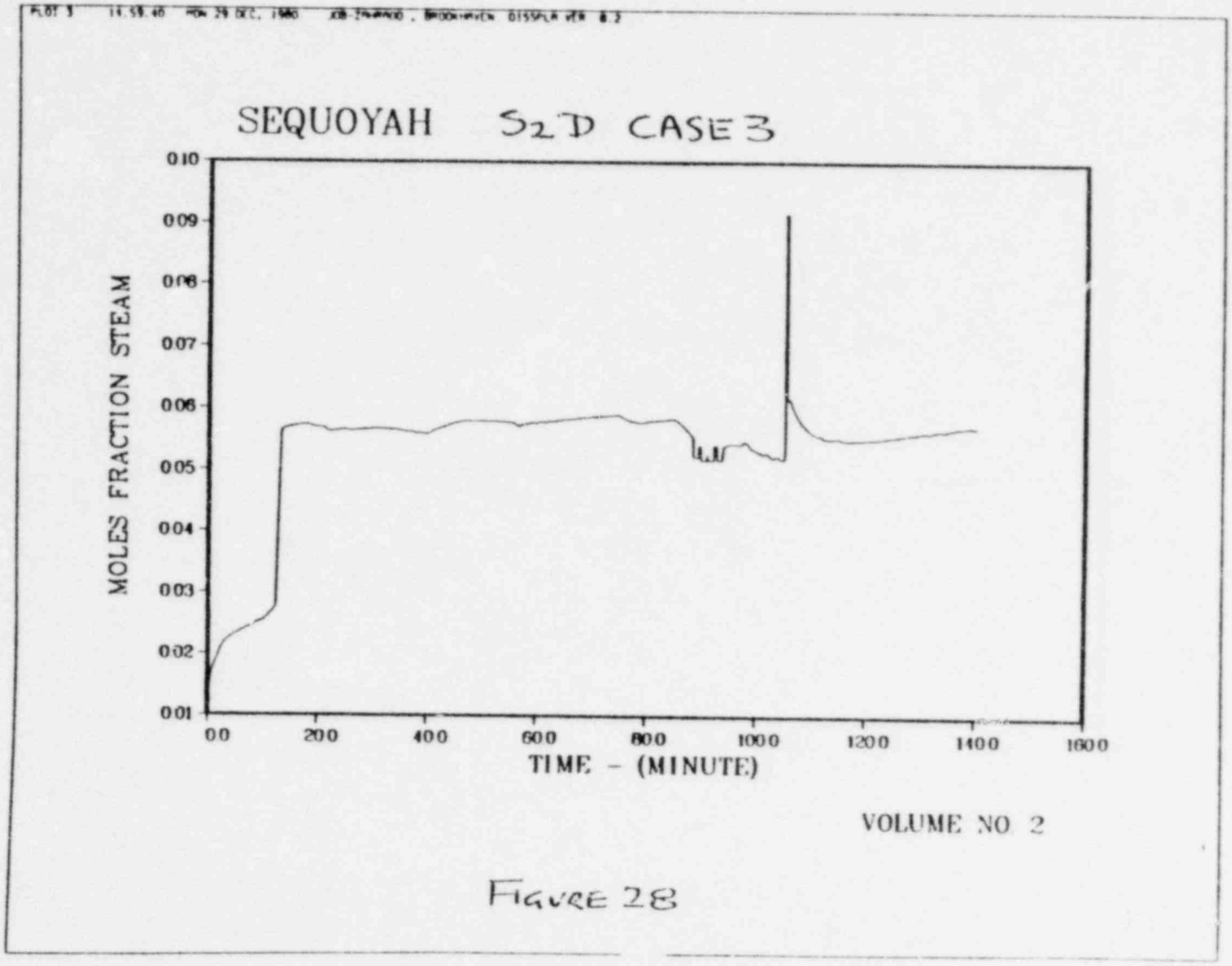

SEQUOYAH S2D CASE3
MOLES FRACTION STEAM
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2

FIGURE 28

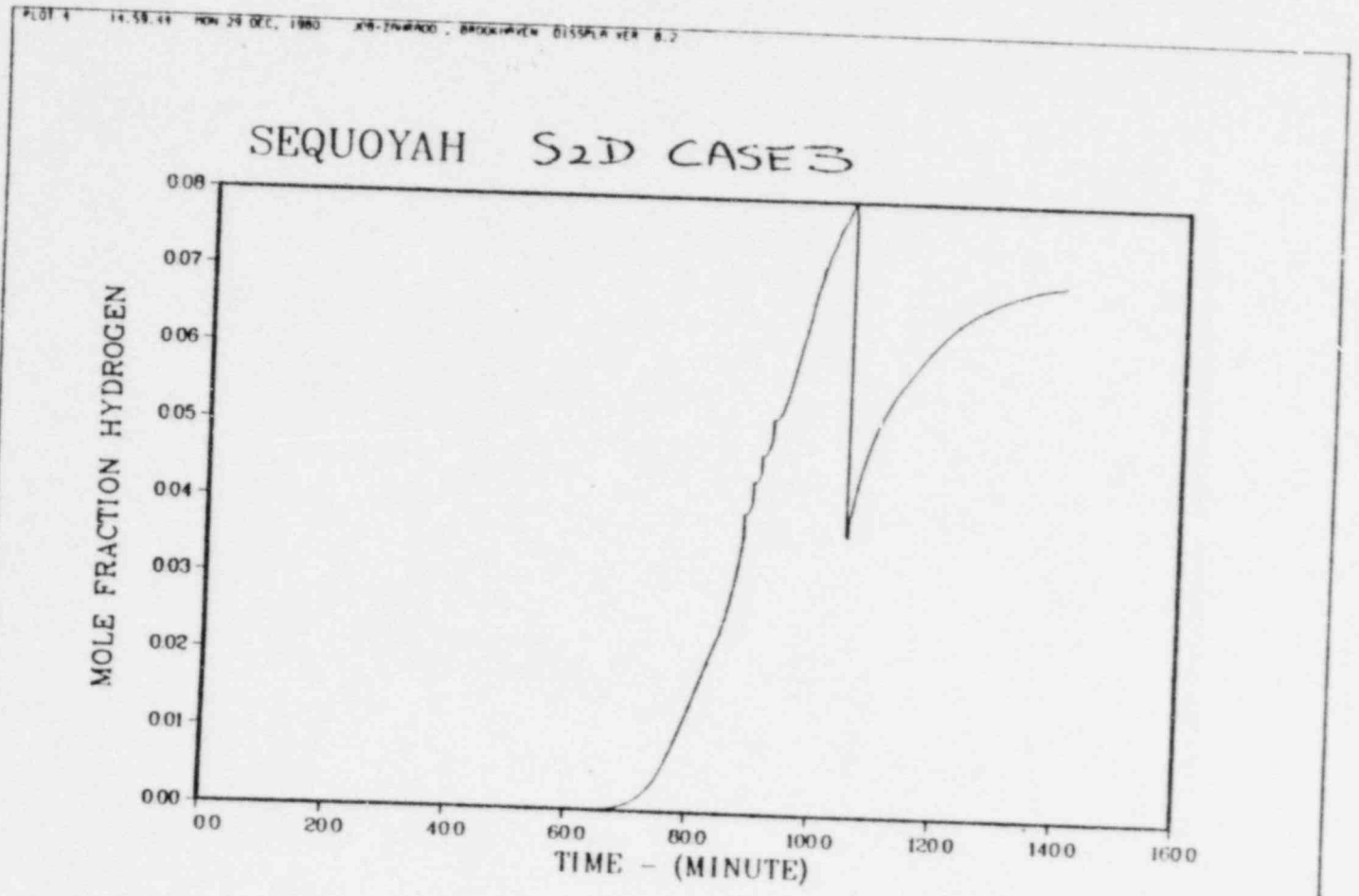

SEQUOYAH S2D CASE3
MOLE FRACTION HYDROGEN
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2

FIGURE 29

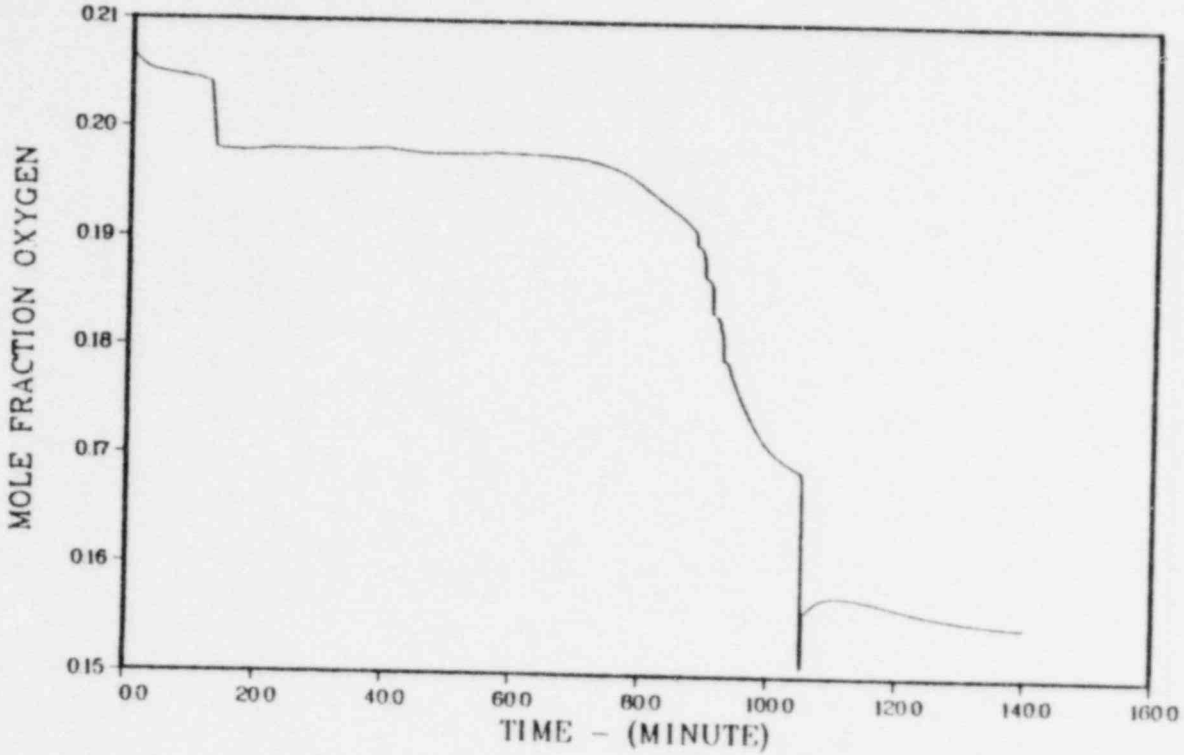

SEQUOYAH S2D CASE3
MOLE FRACTION OXYGEN
0.21
0.20
0.19
0.18
0.17
0.16
0.15
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2

FIGURE 30

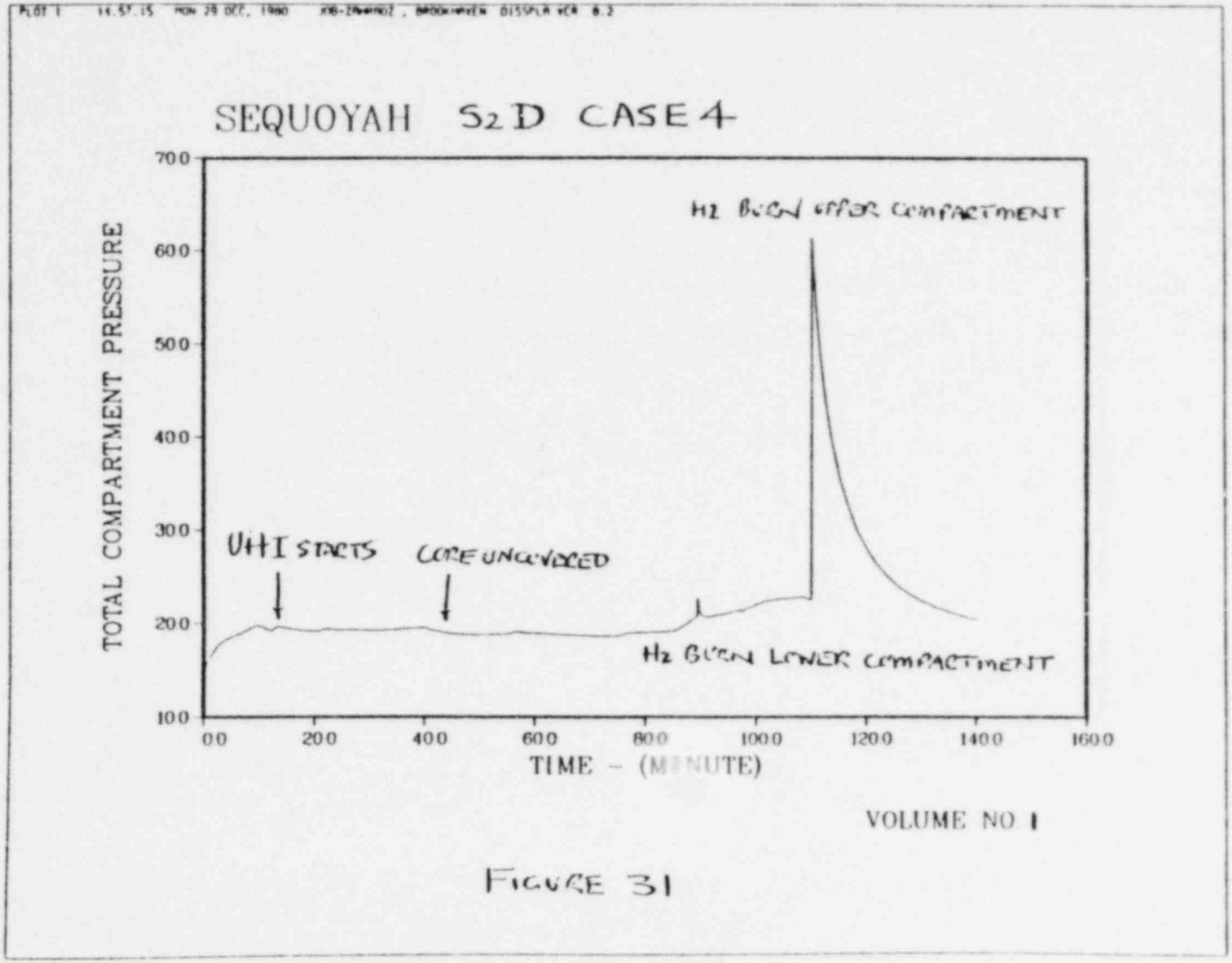

SEQUOYAH S2D CASE 4
TOTAL COMPARTMENT PRESSURE
700
600
500
400
300
200
100
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
H2 BURN UPPER COMPARTMENT
UHI STARTS
CORE UNCOVERED
H2 BURN LOWER COMPARTMENT
VOLUME NO 1

FIGURE 31

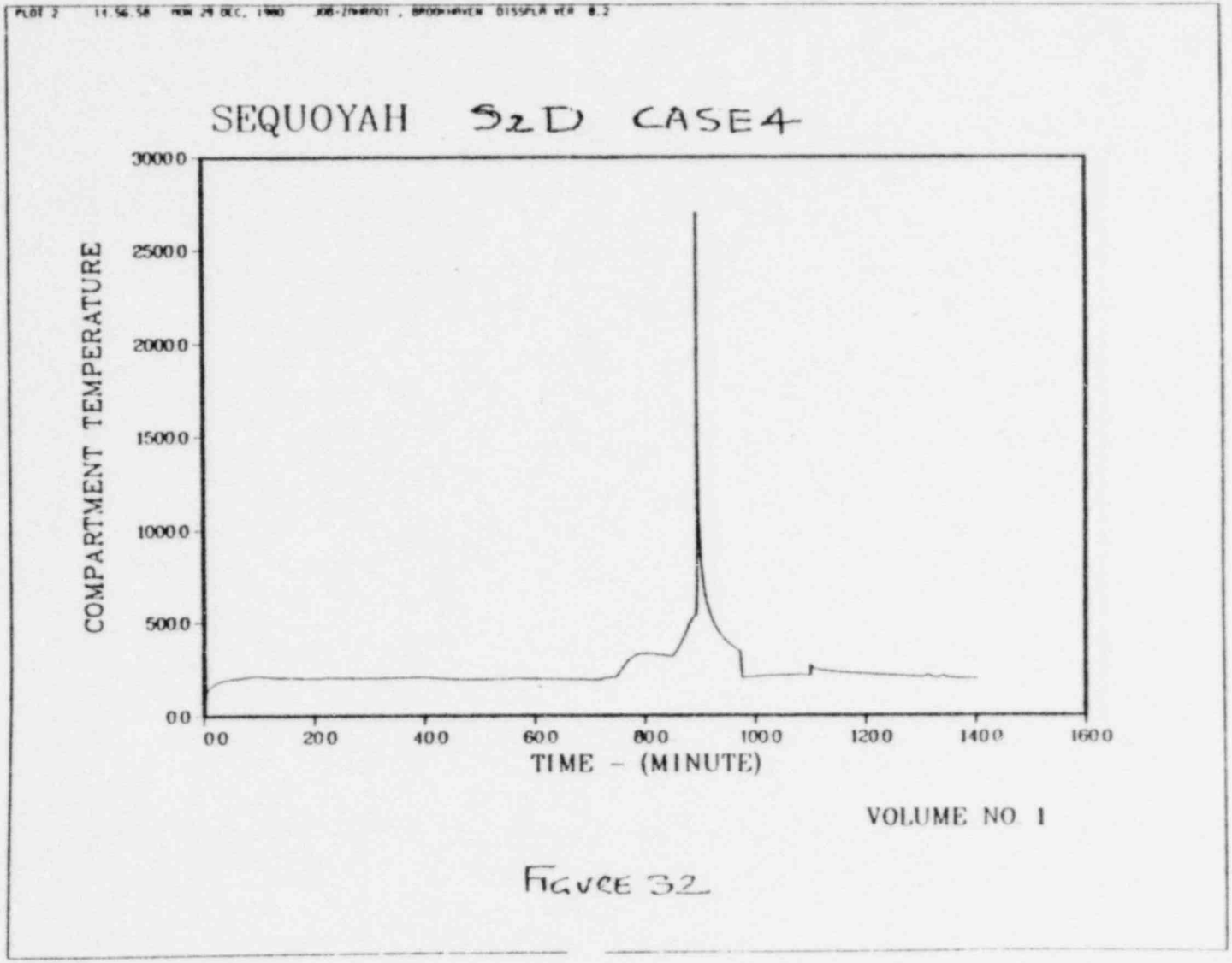

SEQUOYAH S2D CASE4
COMPARTMENT TEMPERATURE
30000
25000
20000
15000
10000
5000
00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 1

FIGURE 32

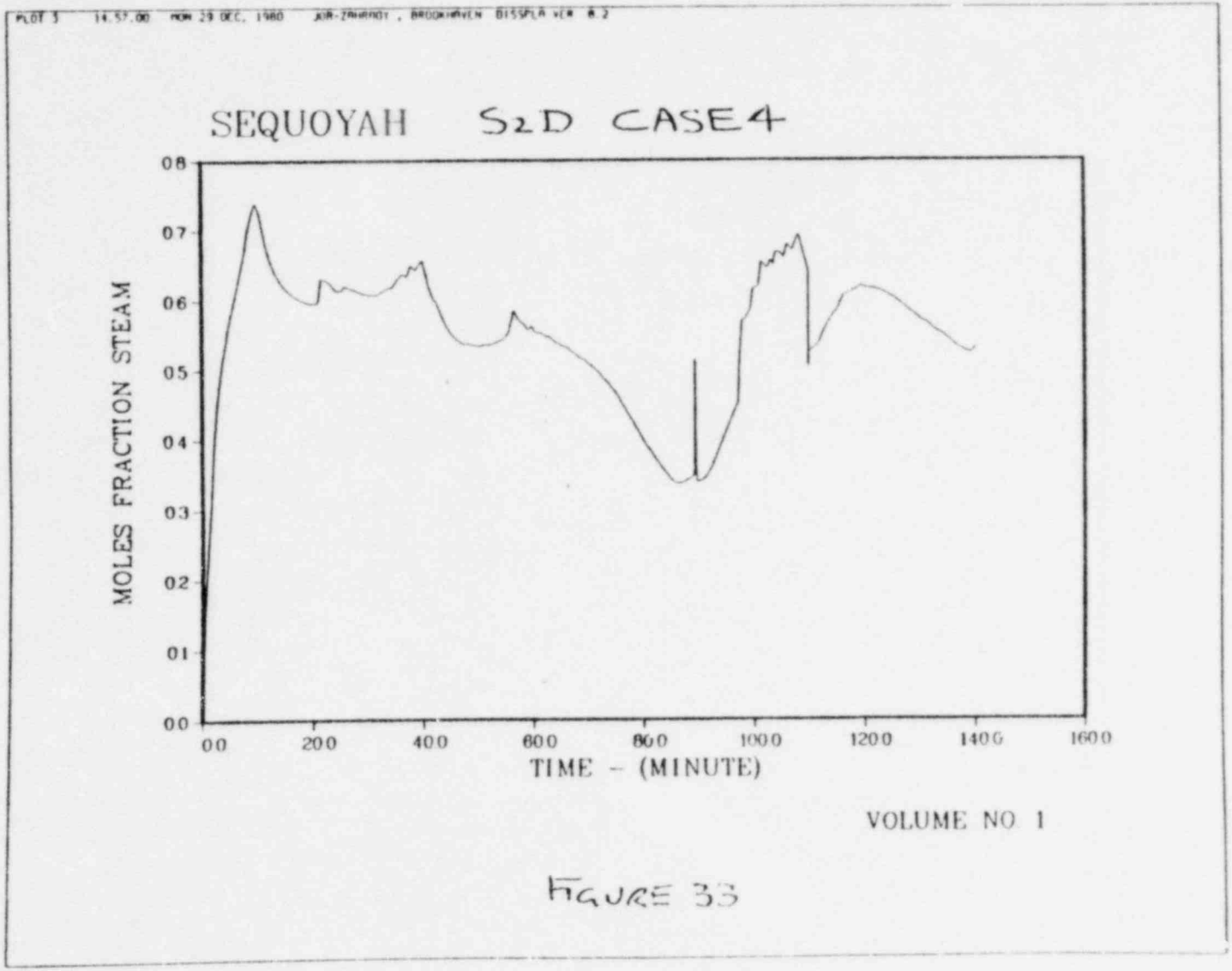

SEQUOYAH S2D CASE4
MOLES FRACTION STEAM
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 1

FIGURE 33

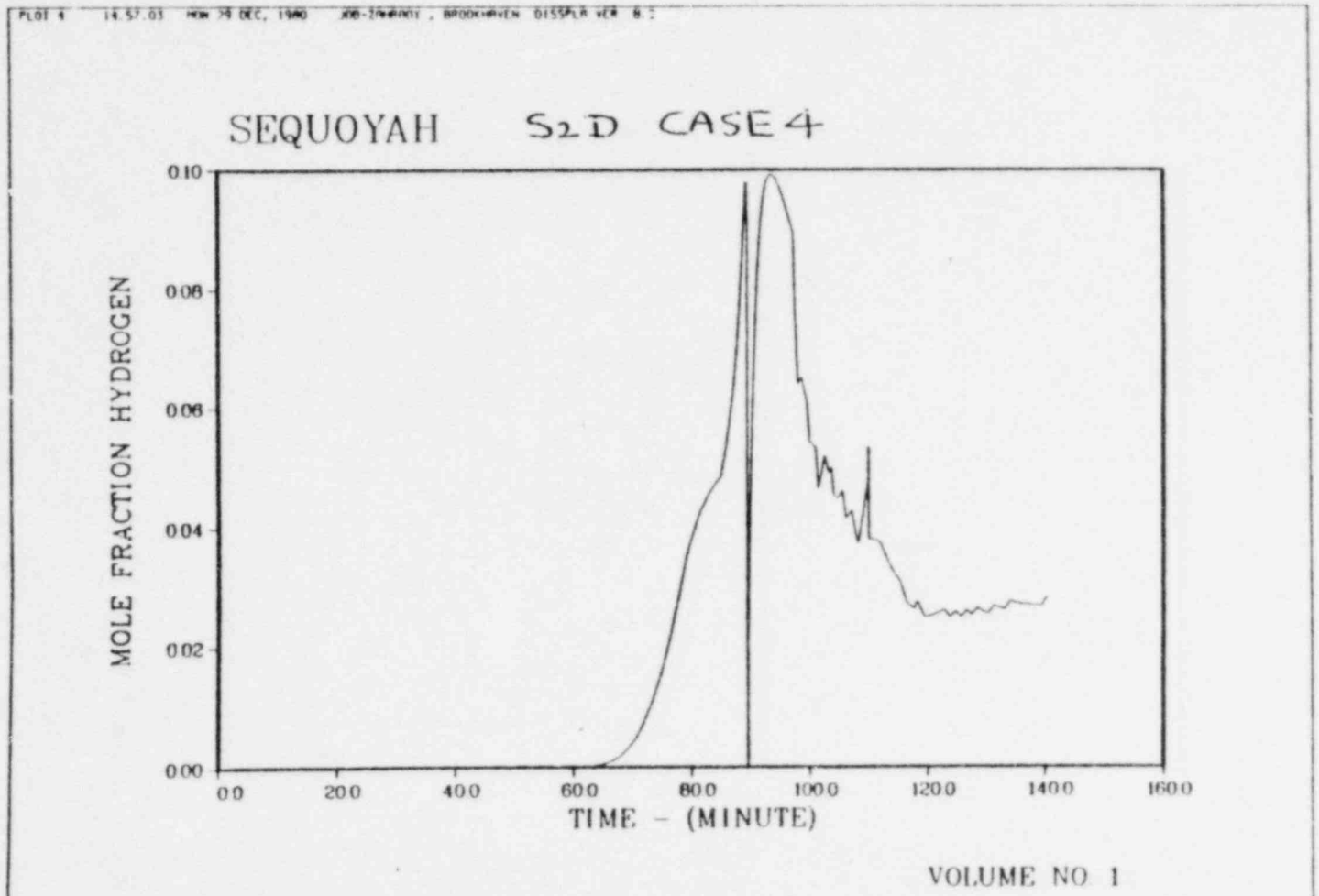

SEQUOYAH S2D CASE 4
MOLE FRACTION HYDROGEN
0.10
0.08
0.06
0.04
0.02
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 1

FIGURE 34

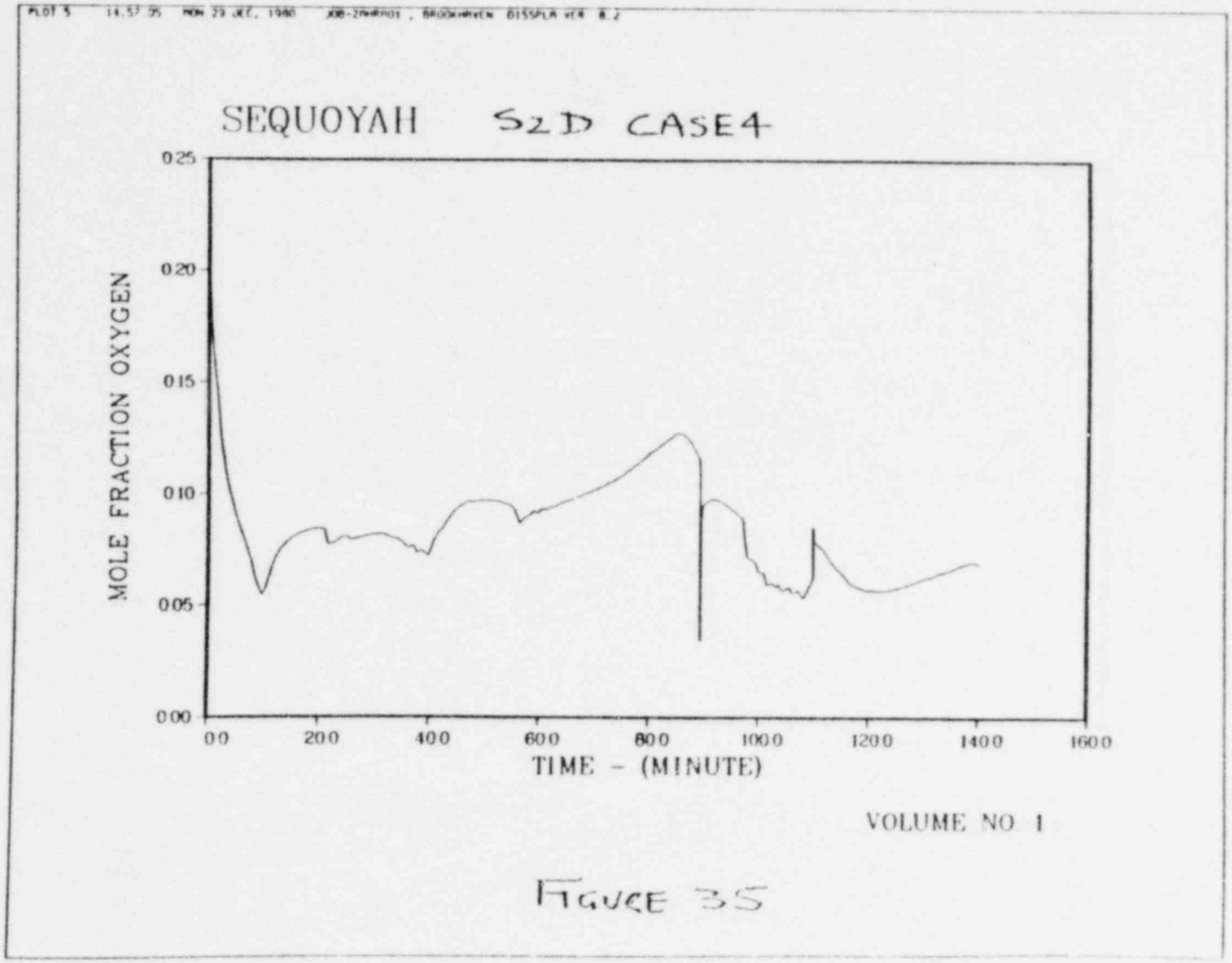

SEQUOYAH S2D CASE4
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 1

FIGURE 35

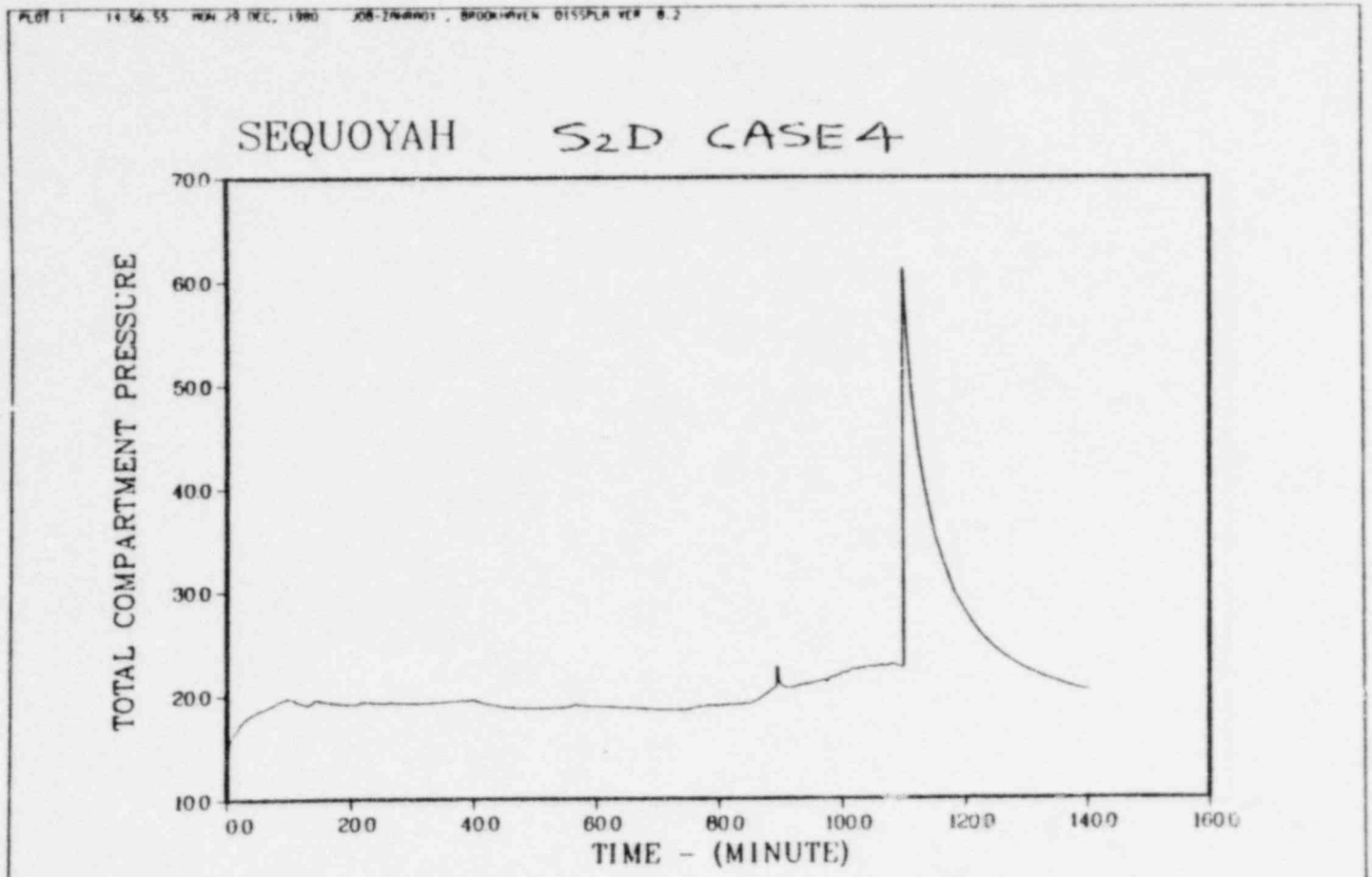

SEQUOYAH S2D CASE4
TOTAL COMPARTMENT PRESSURE
700
600
500
400
300
200
100
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2.

FIGURE 36

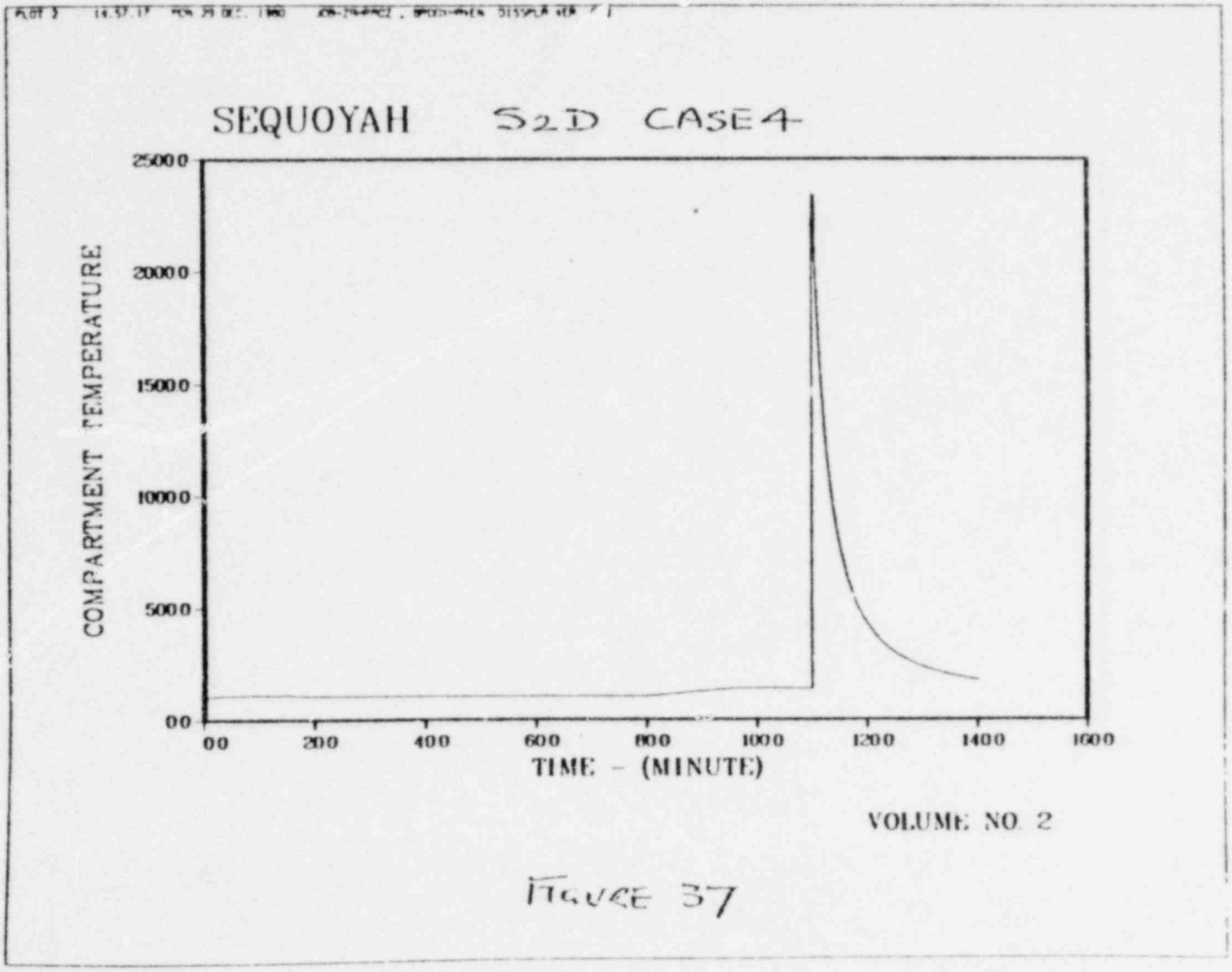

SEQUOYAH S2D CASE4
COMPARTMENT TEMPERATURE
25000
20000
15000
10000
5000
00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 37

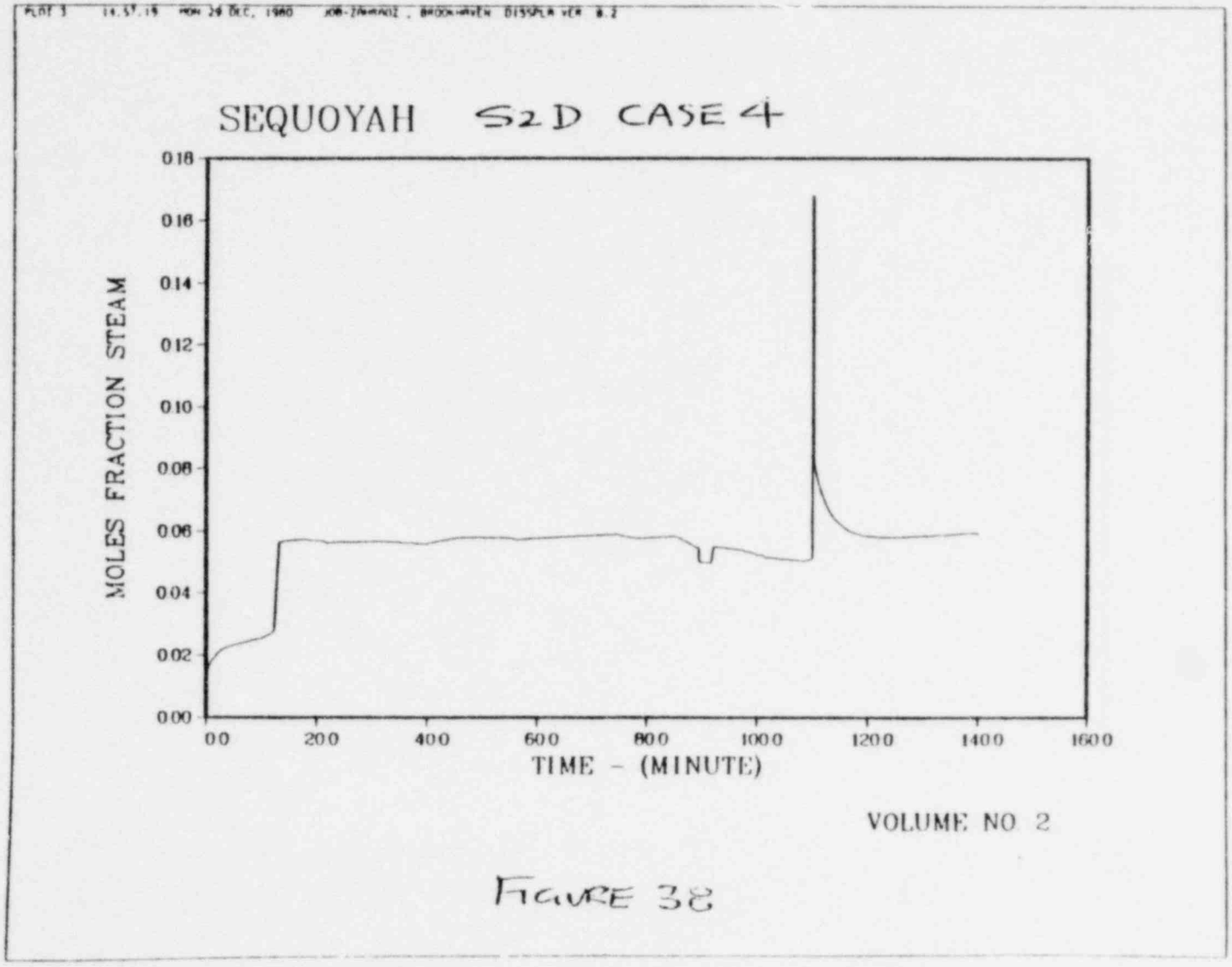

SEQUOYAH S2D CASE 4
MOLES FRACTION STEAM
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2

FIGURE 38

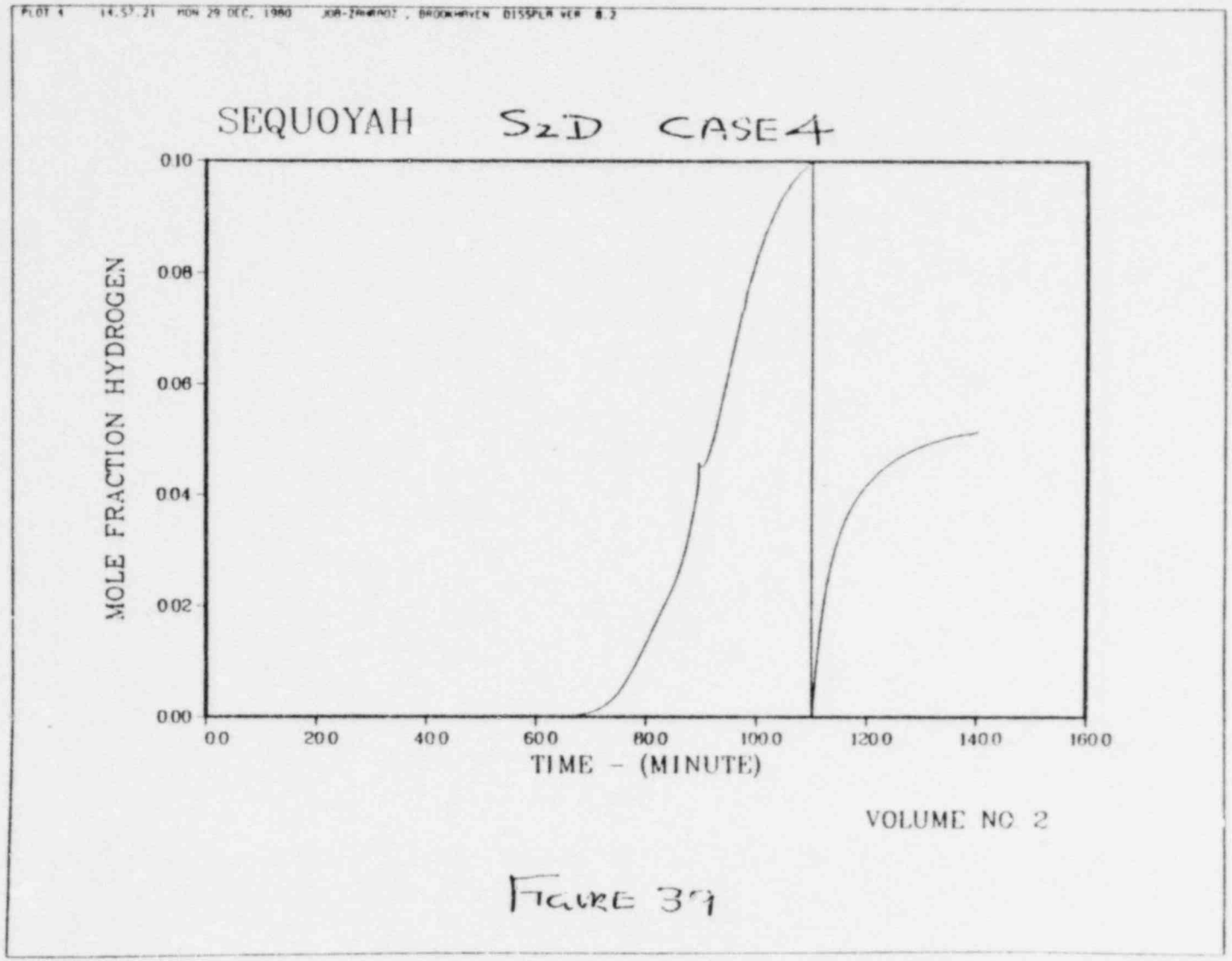

PLOT 4 14.57.21 MON 29 DEC, 1980 JOB-ZRHRNOZ , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH S2D CASE4
MOLE FRACTION HYDROGEN
0.10
0.08
0.06
0.04
0.02
0.00
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO 2

FIGURE 37

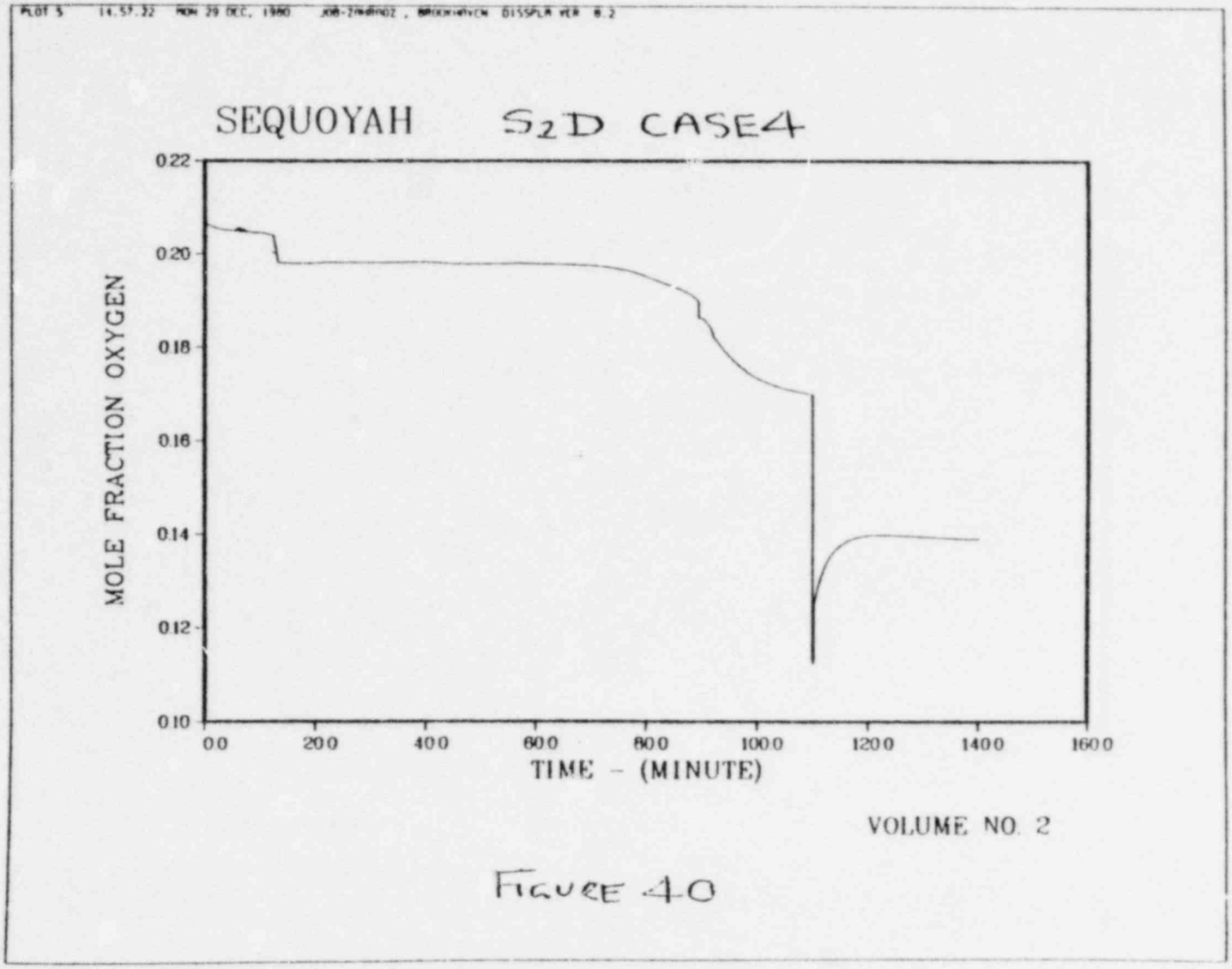

SEQUOYAH S2D CASE4
MOLE FRACTION OXYGEN
0.22
0.20
0.18
0.16
0.14
0.12
0.10
00
200
400
600
800
1000
1200
1400
1600
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 40

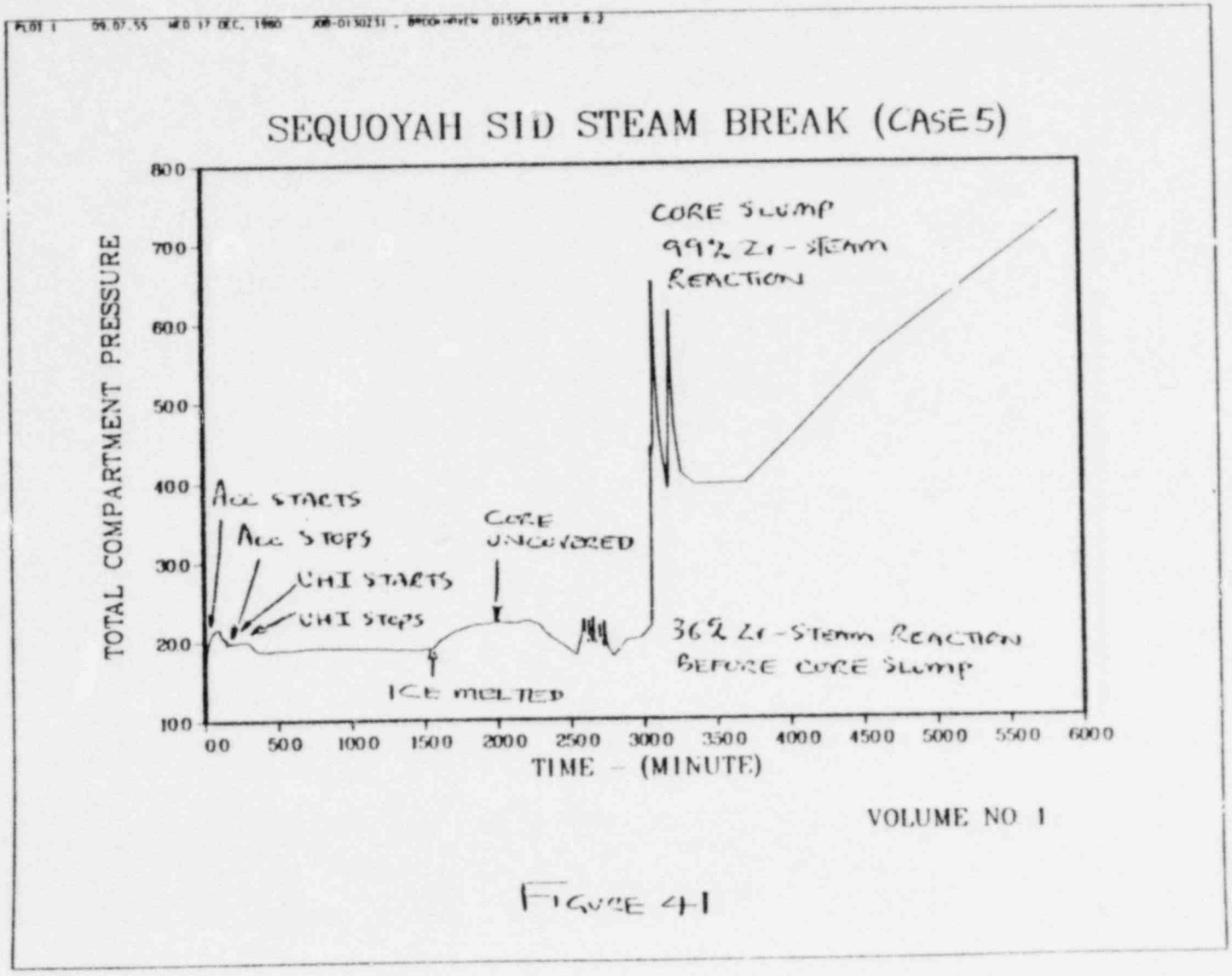

SEQUOYAH SID STEAM BREAK (CASE5)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
CORE SLUMP
99% Zr - STEAM
REACTION
ACC STARTS
ACC STOPS
CHI STARTS
CHI STOPS
CORE
UNCOVERED
ICE MELTED
36% Zr - STEAM REACTION
BEFORE CORE SLUMP
VOLUME NO 1

FIGURE 41

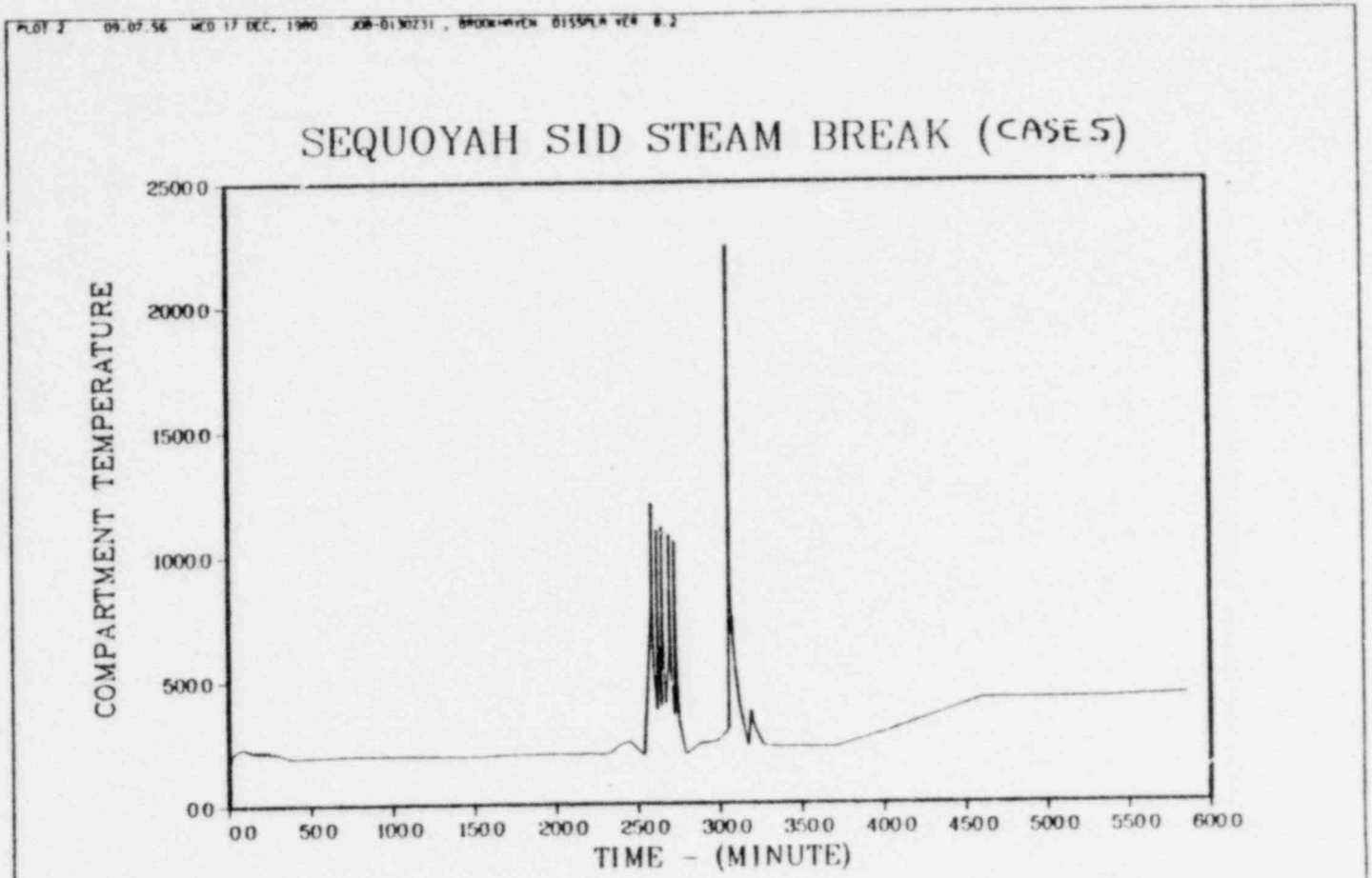

SEQUOYAH SID STEAM BREAK (CASES)
COMPARTMENT TEMPERATURE
25000
20000
15000
10000
5000
00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 4-2

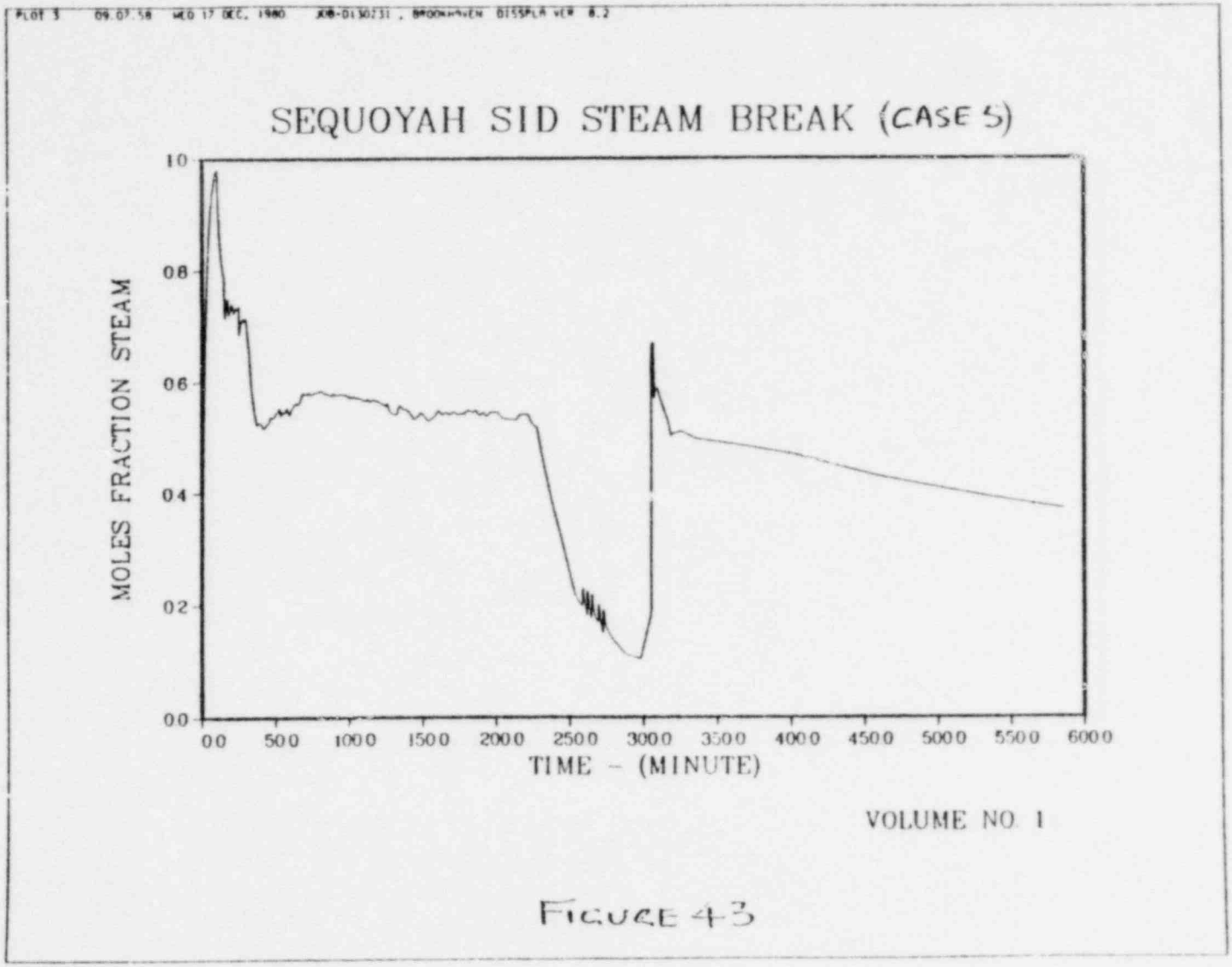

SEQUOYAH SID STEAM BREAK (CASE 5)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 43

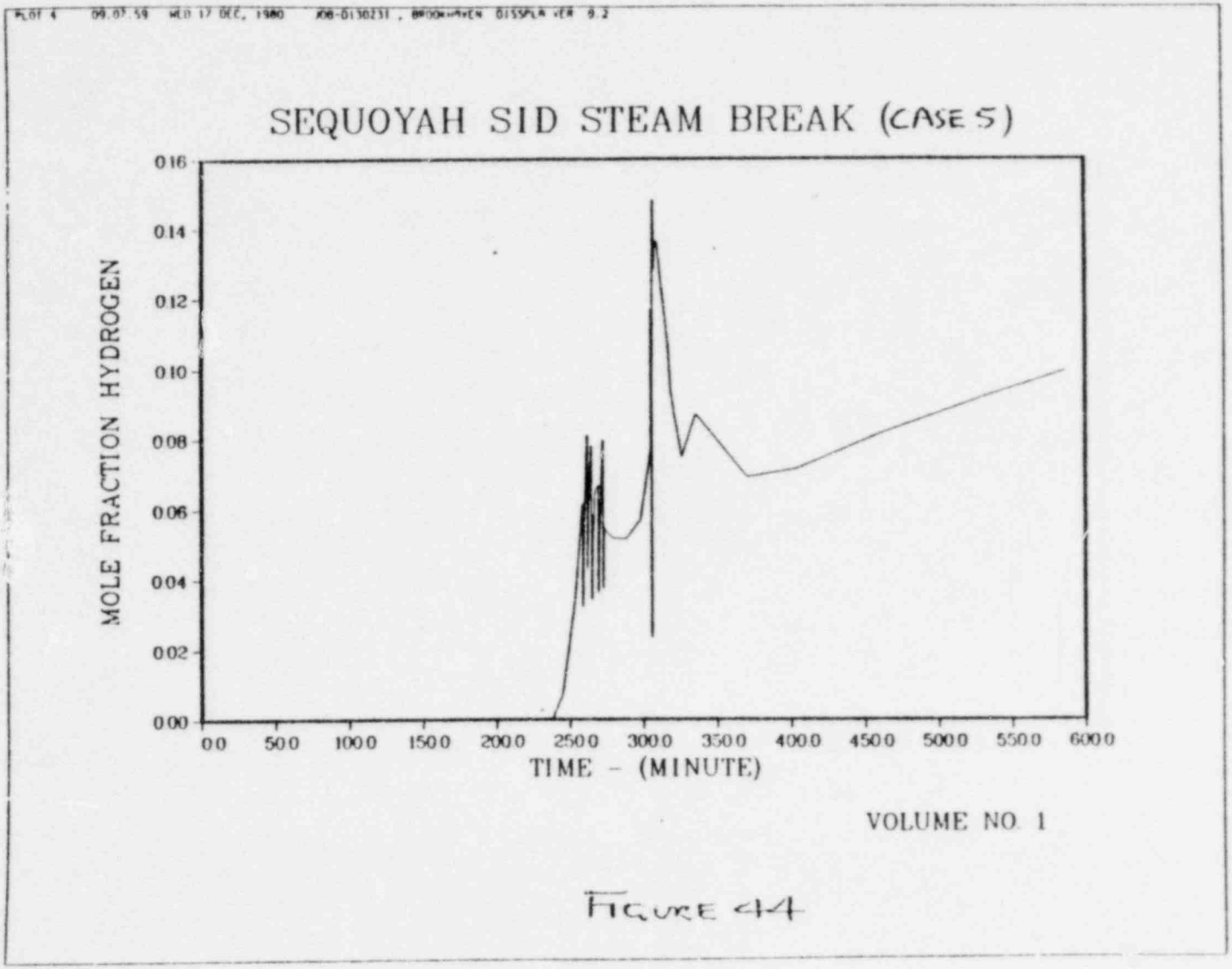

SEQUOYAH SID STEAM BREAK (CASE 5)
MOLE FRACTION HYDROGEN
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 44

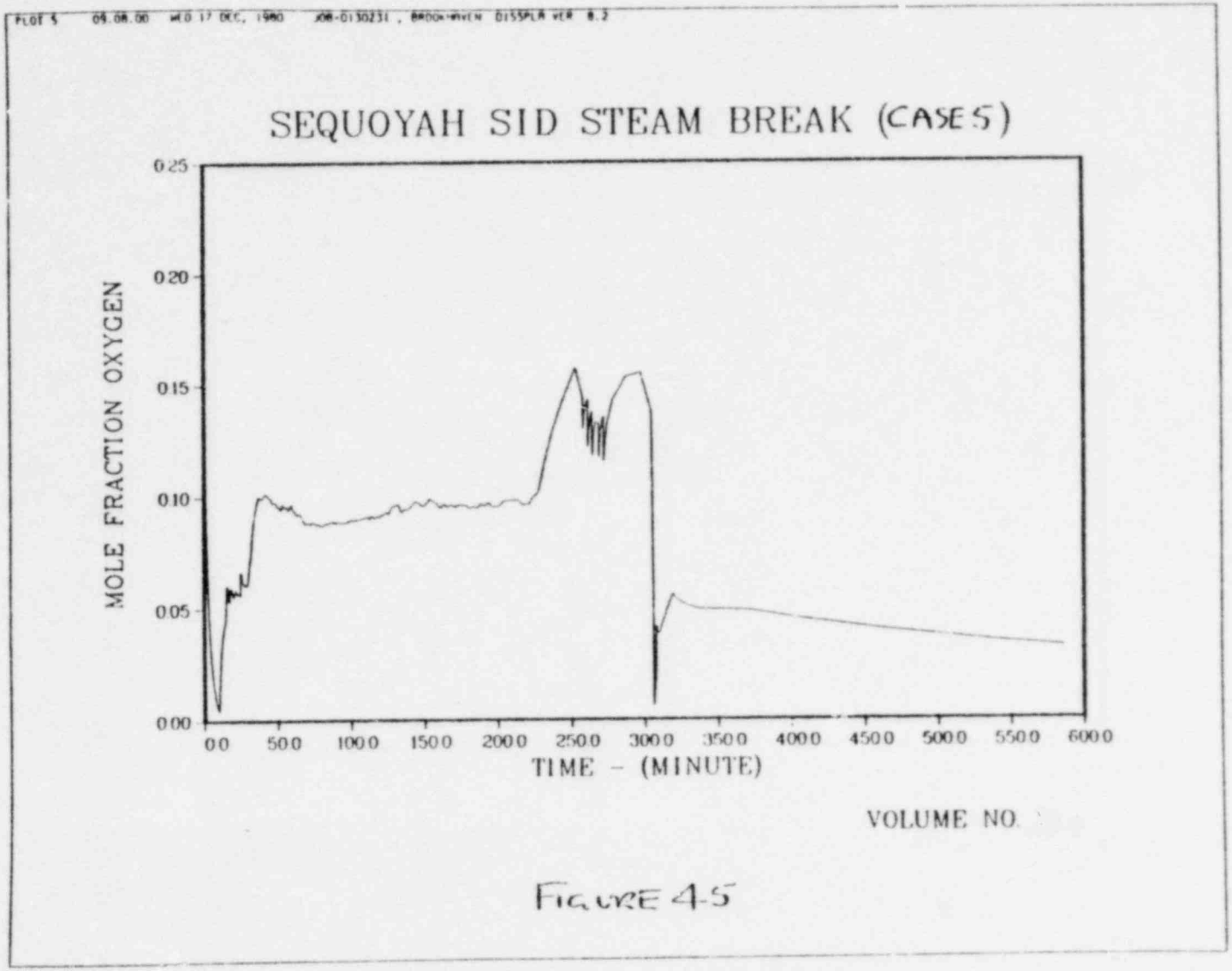

SEQUOYAH SID STEAM BREAK (CASE 5)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO.

FIGURE 4-5

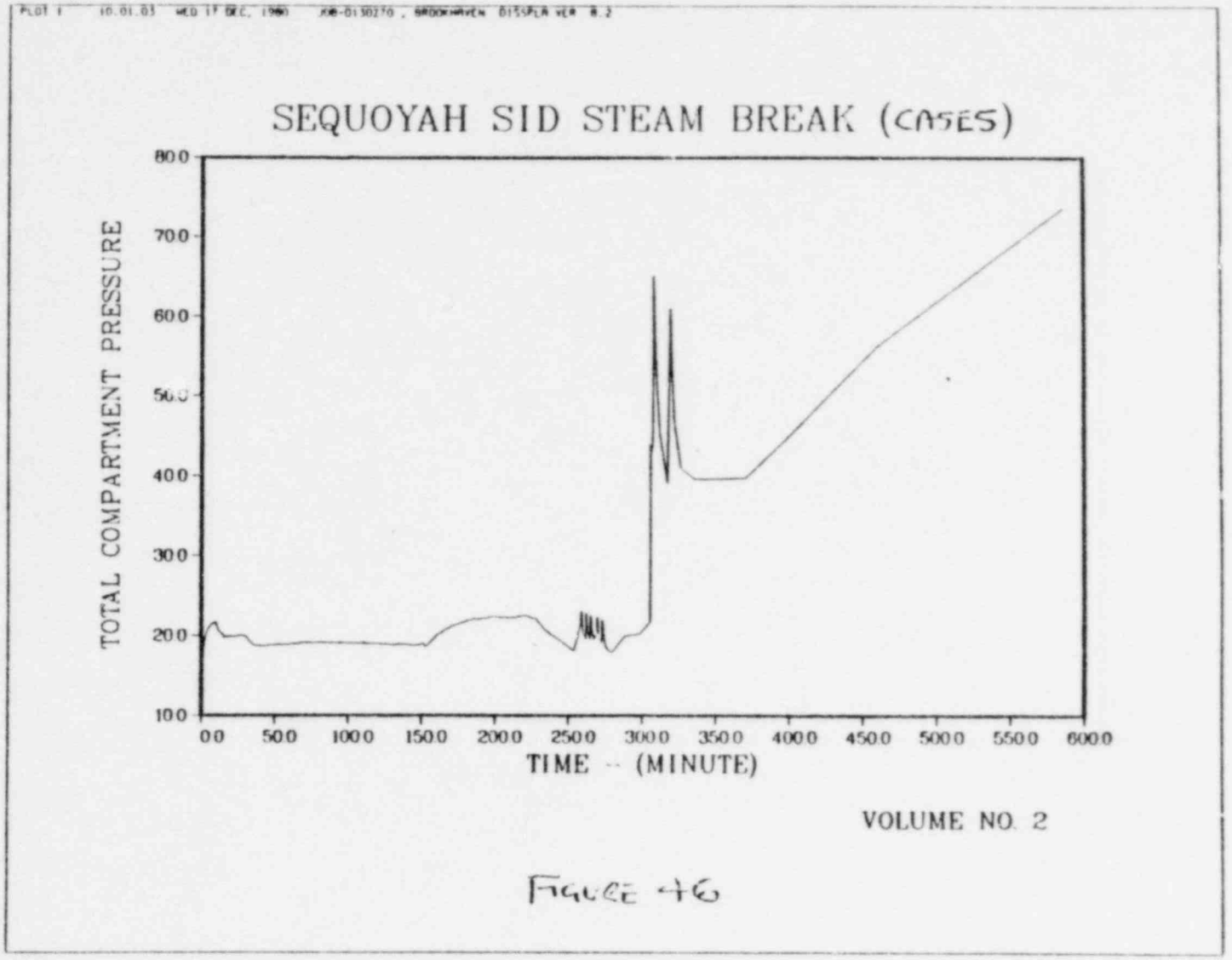

SEQUOYAH SID STEAM BREAK (CASES)
TOTAL COMPARTMENT PRESSURE
800
700
600
400
300
200
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME -- (MINUTE)
VOLUME NO. 2

FIGURE 46

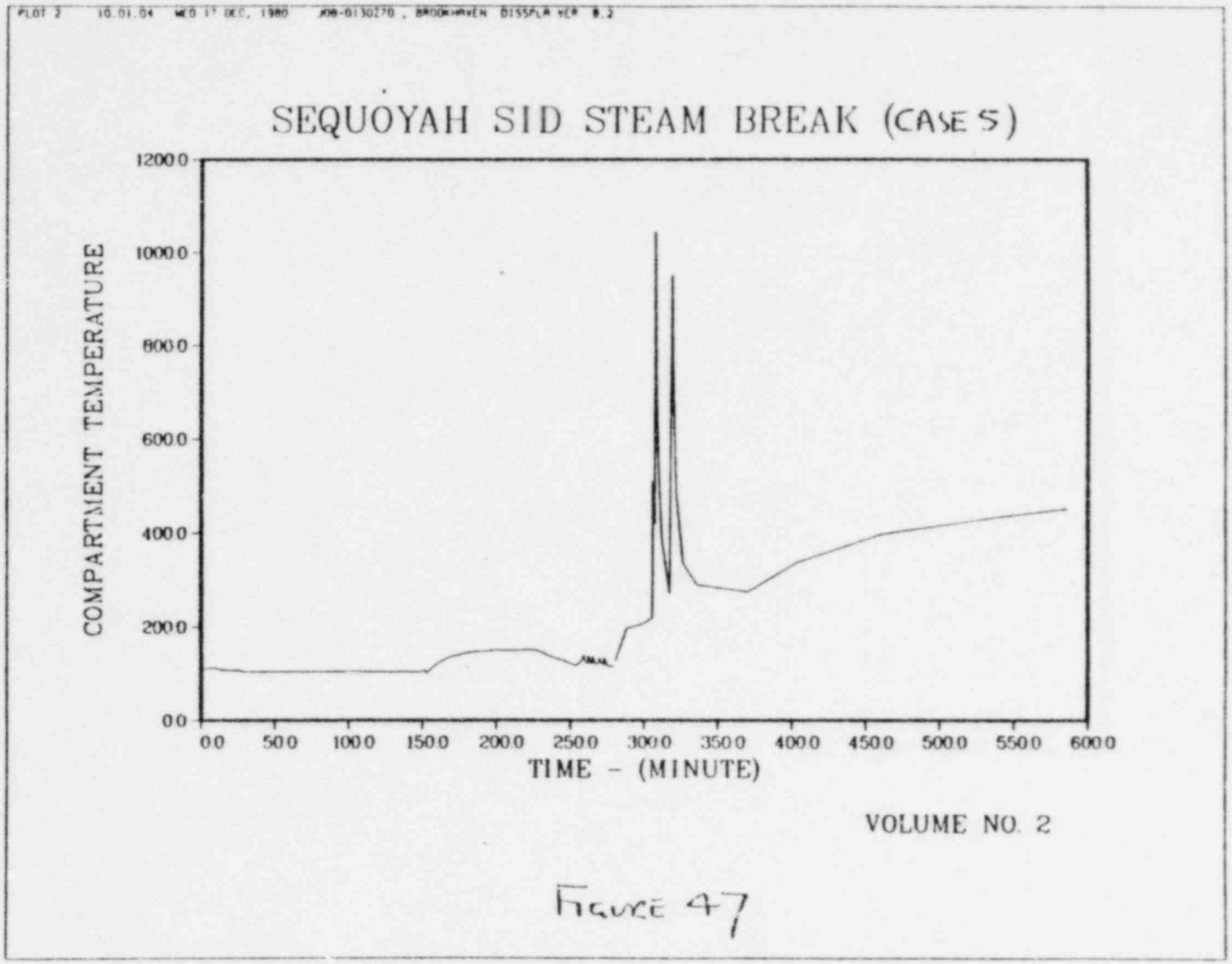

SEQUOYAH SID STEAM BREAK (CASE 5)
COMPARTMENT TEMPERATURE
12000
10000
8000
6000
4000
2000
00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 47

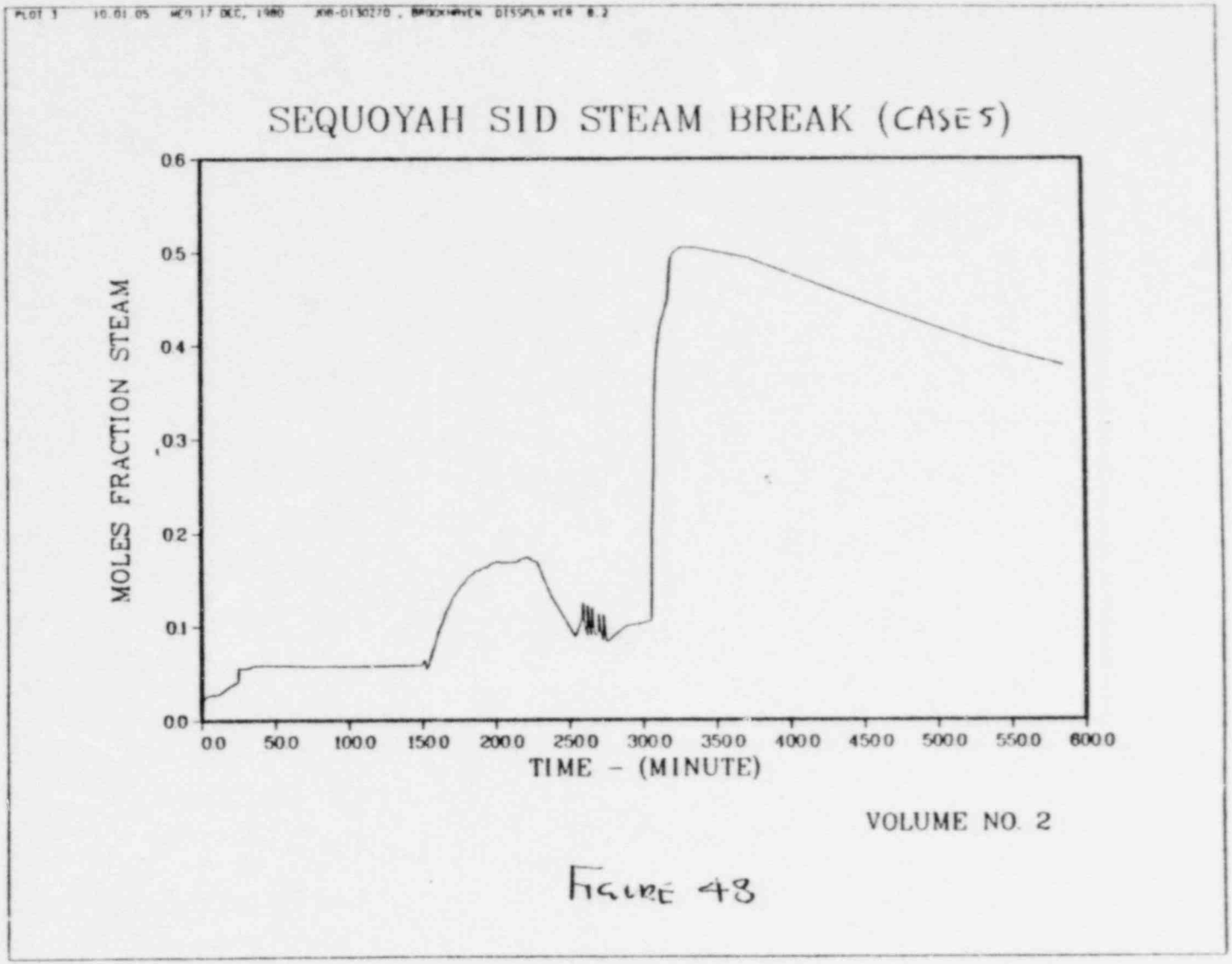

SEQUOYAH SID STEAM BREAK (CASE 5)
MOLES FRACTION STEAM
0.0
.01
.02
.03
.04
.05
.06
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

Figure 48

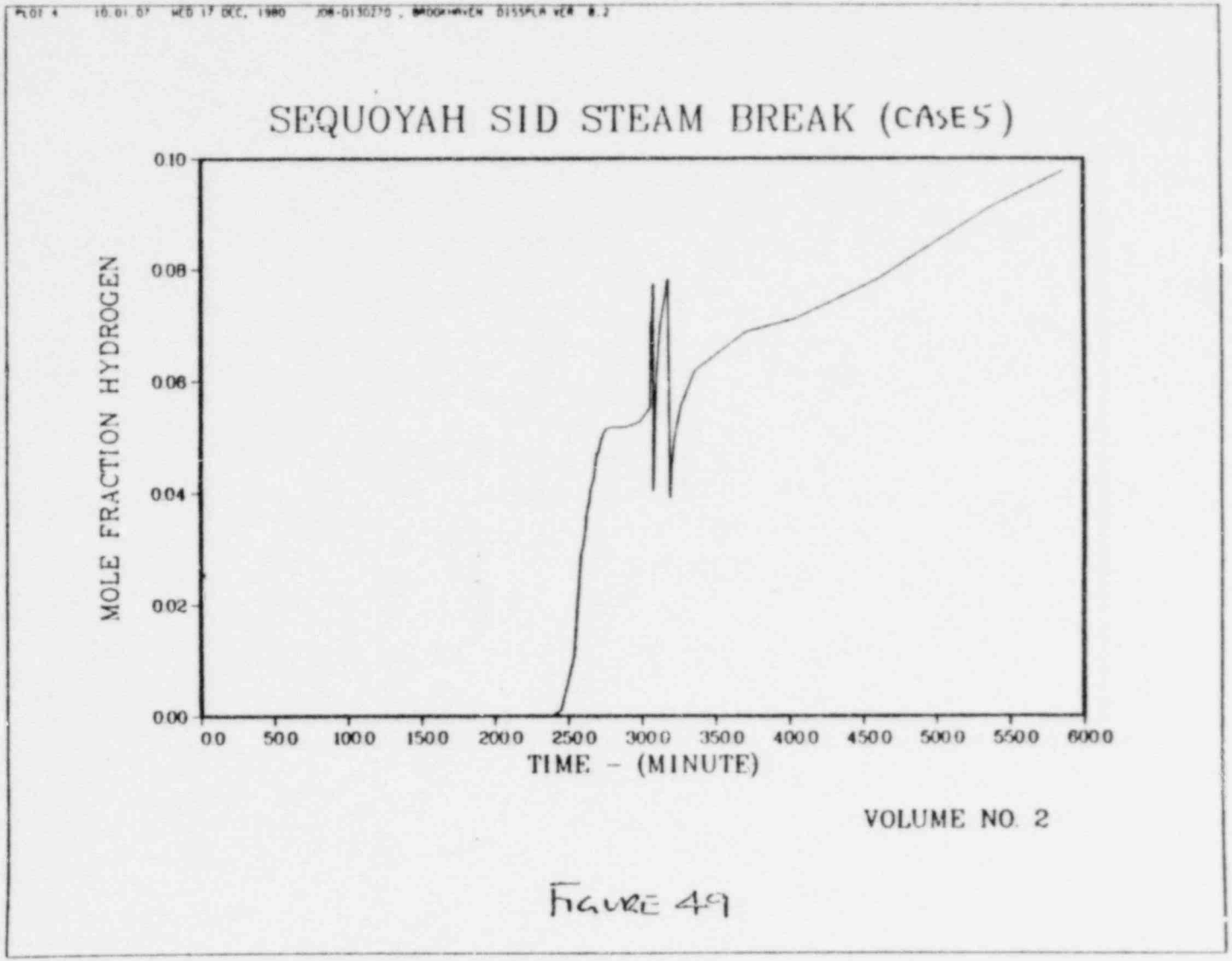

SEQUOYAH SID STEAM BREAK (CASE5)
MOLE FRACTION HYDROGEN
0.10
0.08
0.06
0.04
0.02
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 49

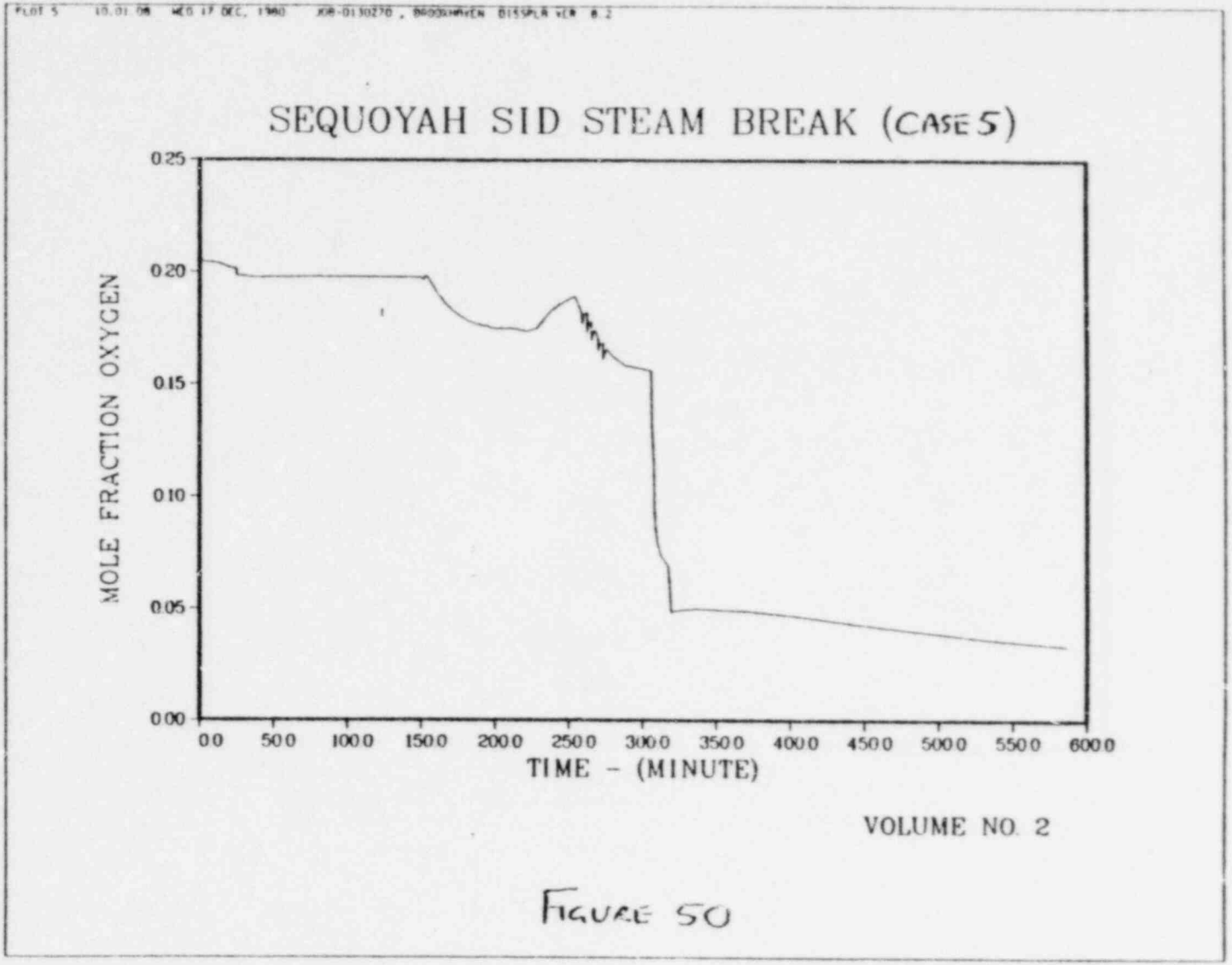

SEQUOYAH SID STEAM BREAK (CASE 5)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 50

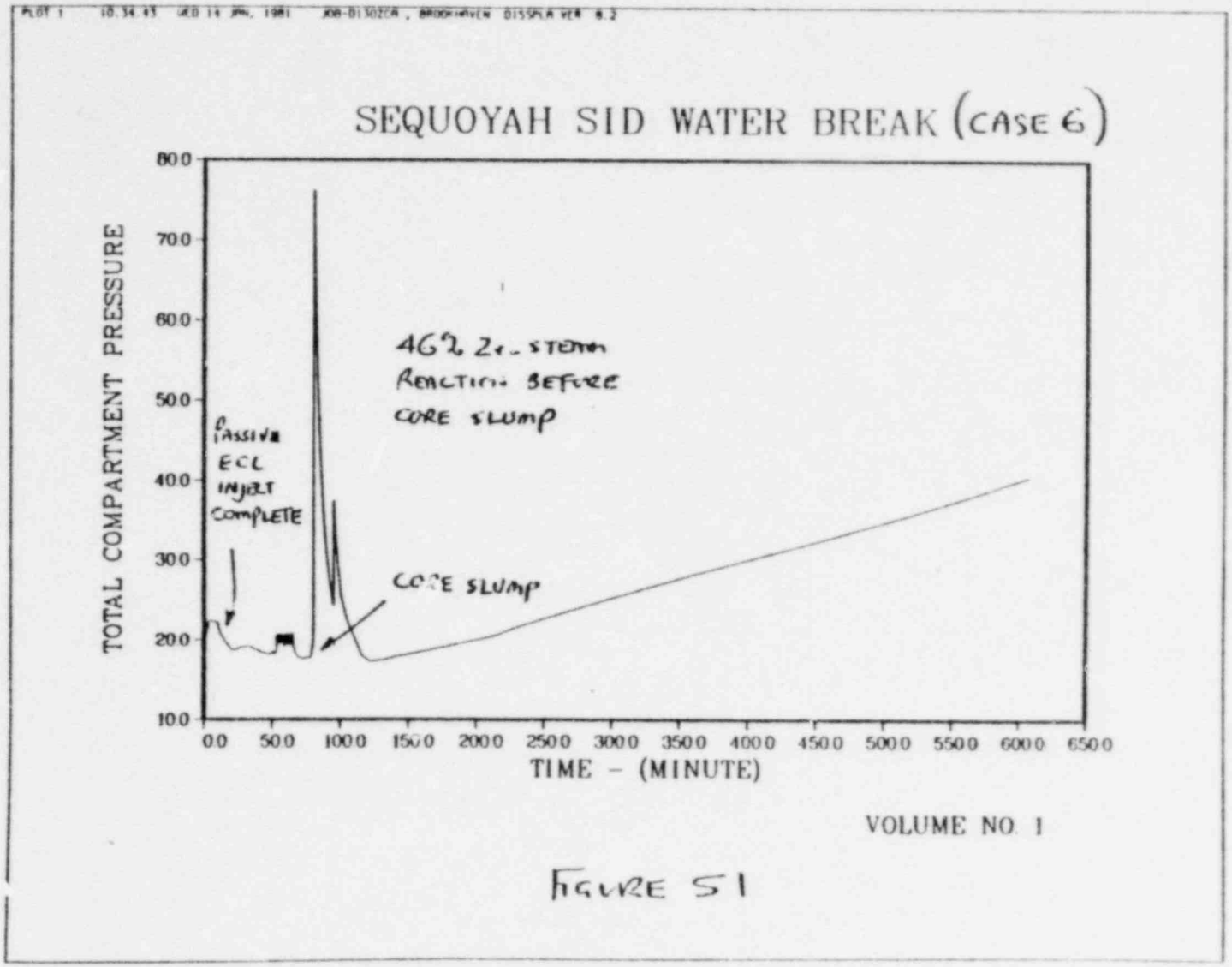

SEQUOYAH SID WATER BREAK (CASE 6)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
462 Zr-STEAM REACTION BEFORE CORE SLUMP
PASSIVE ECL INJECT COMPLETE
CORE SLUMP
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 51

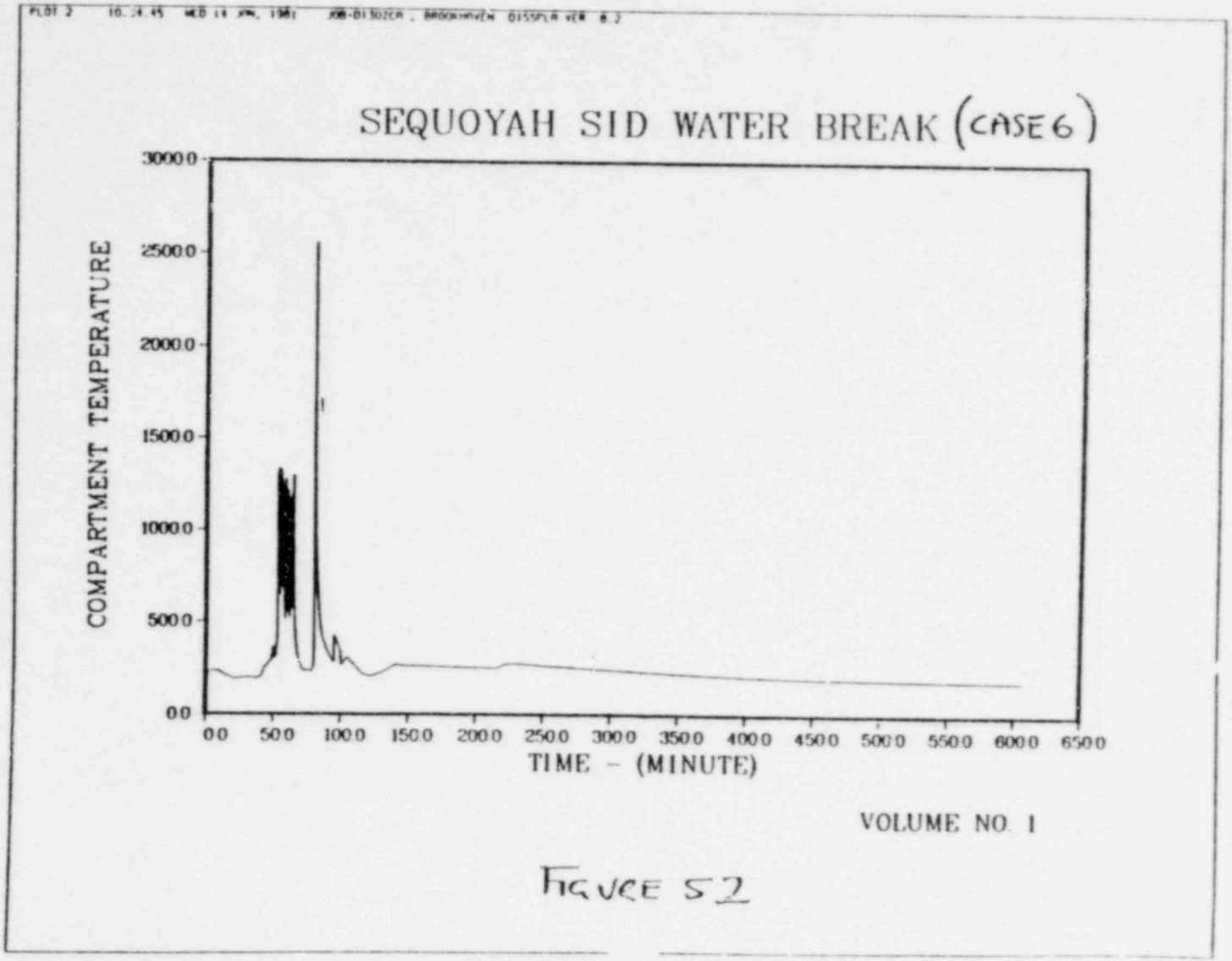

SEQUOYAH SID WATER BREAK (CASE 6)
COMPARTMENT TEMPERATURE
30000
25000
20000
15000
10000
5000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 52

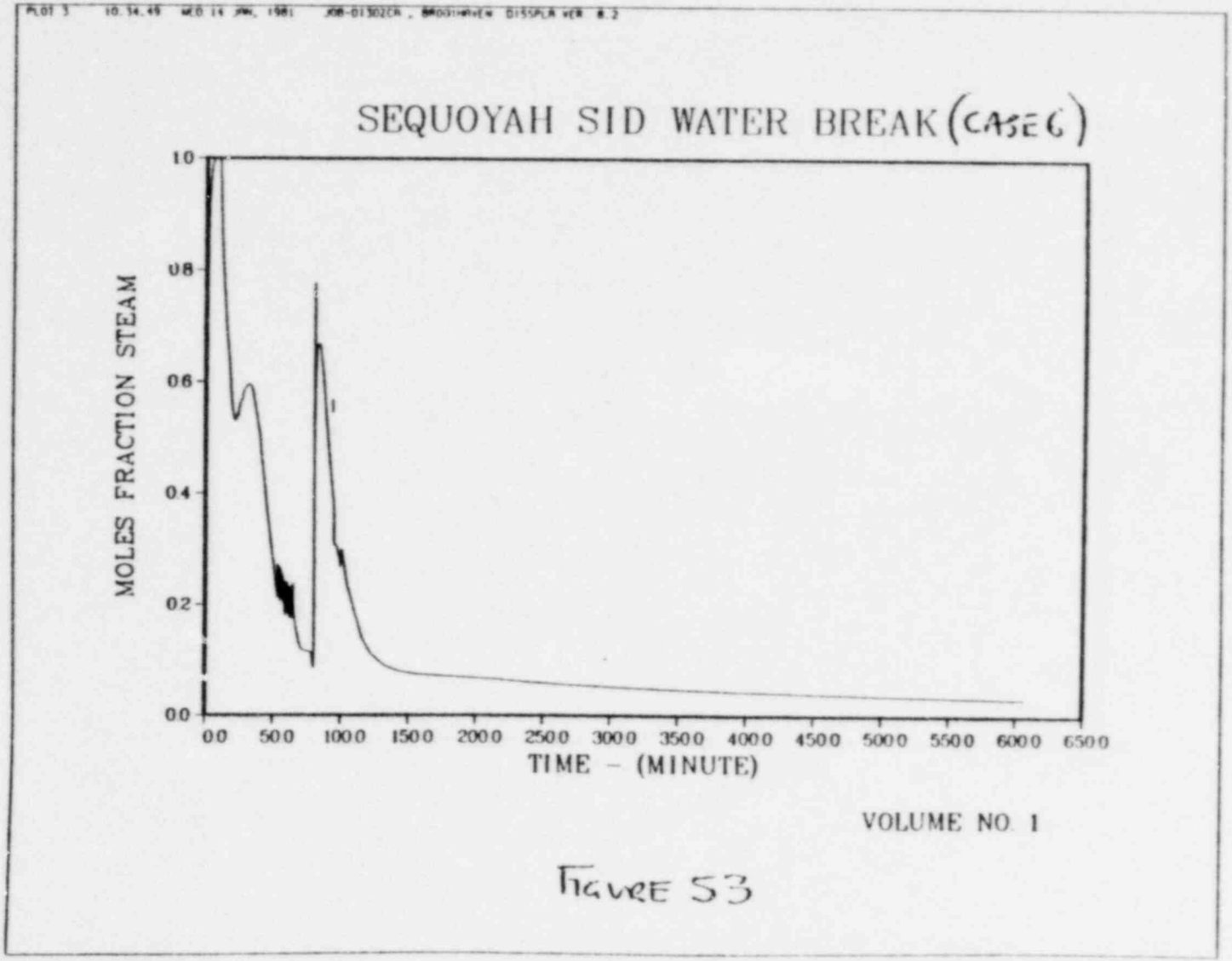

SEQUOYAH SID WATER BREAK (CASE 6)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

Figure 53

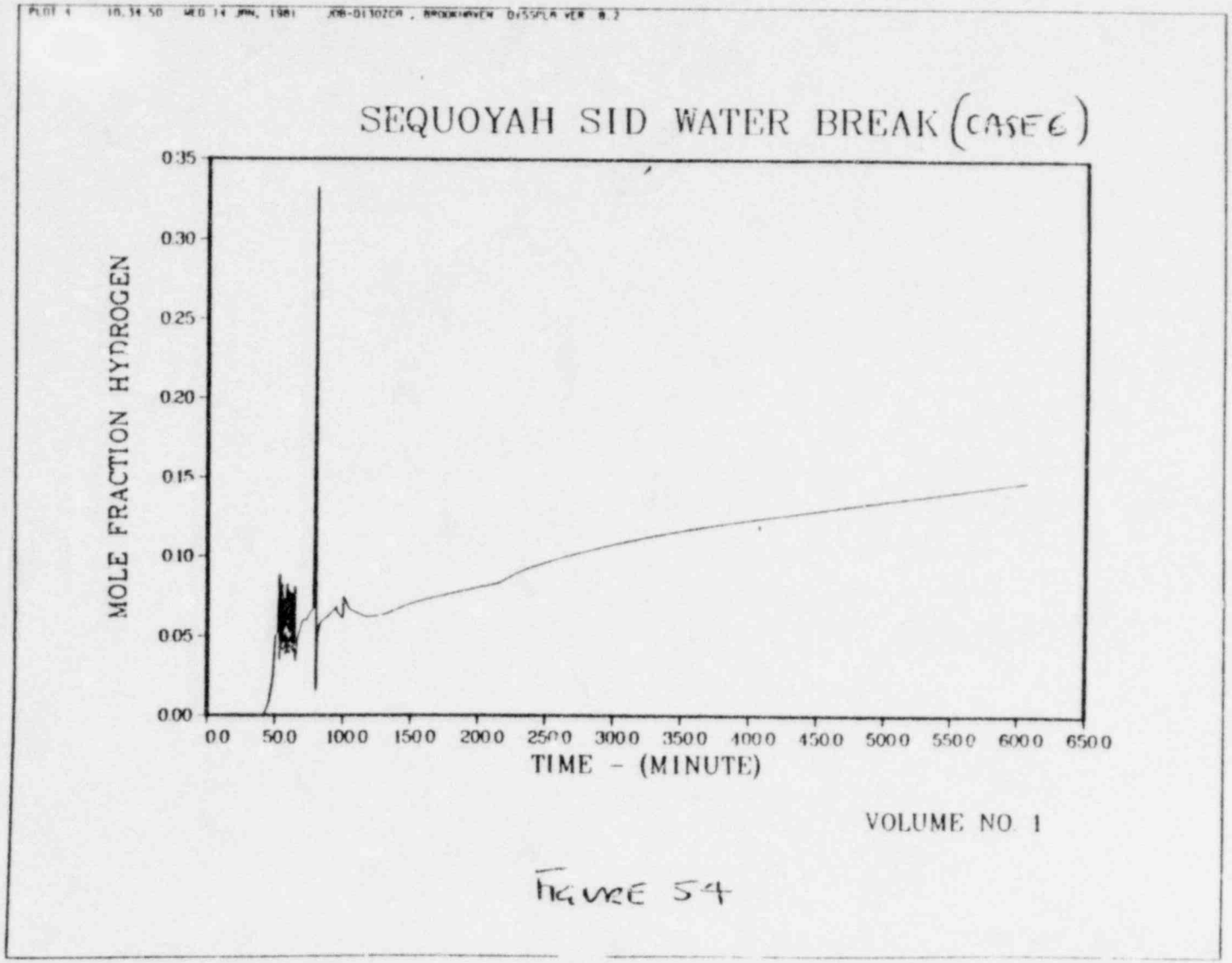

SEQUOYAH SID WATER BREAK (CASE 6)
MOLE FRACTION HYDROGEN
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 1

Figure 54

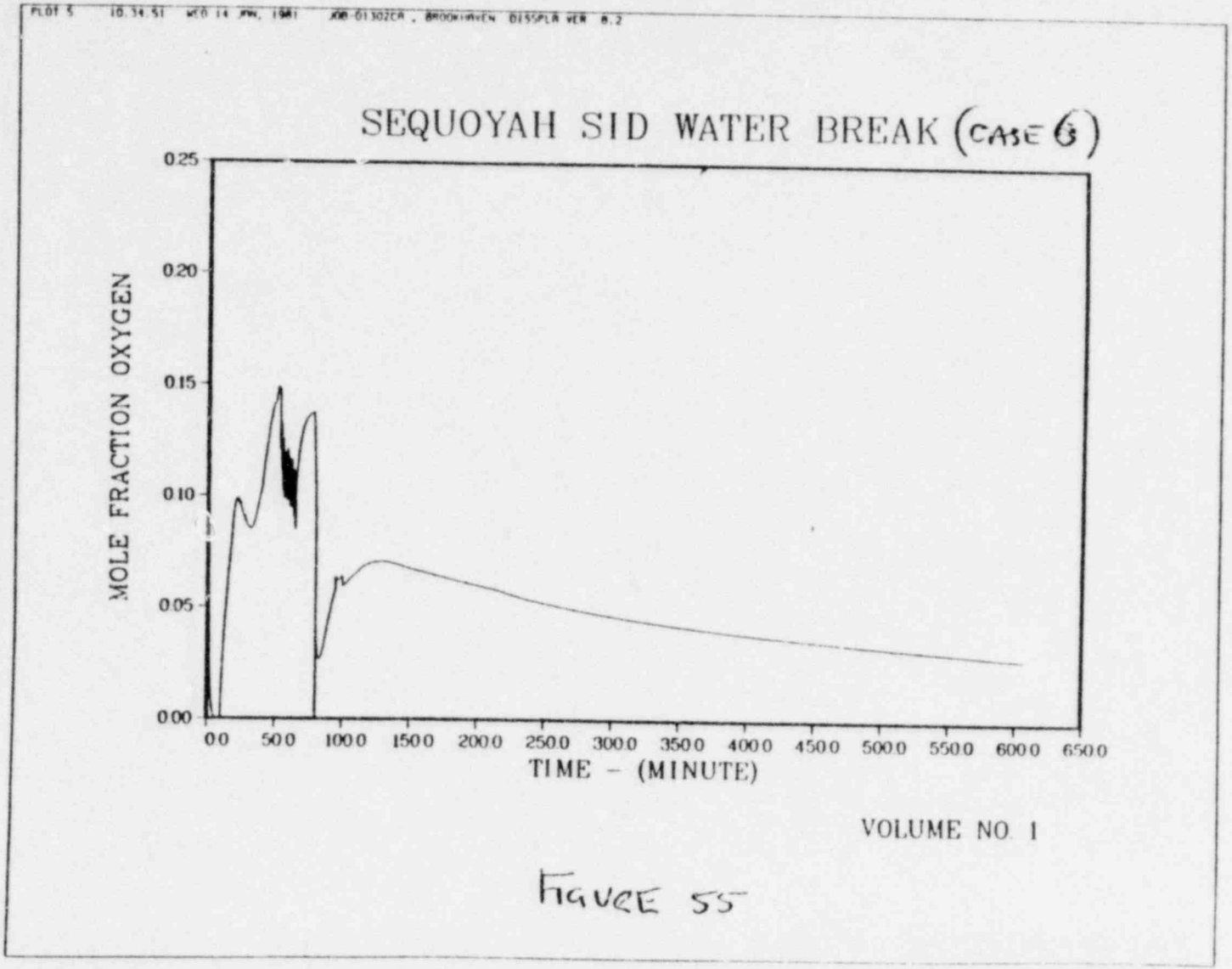

SEQUOYAH SID WATER BREAK (CASE 6)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 55

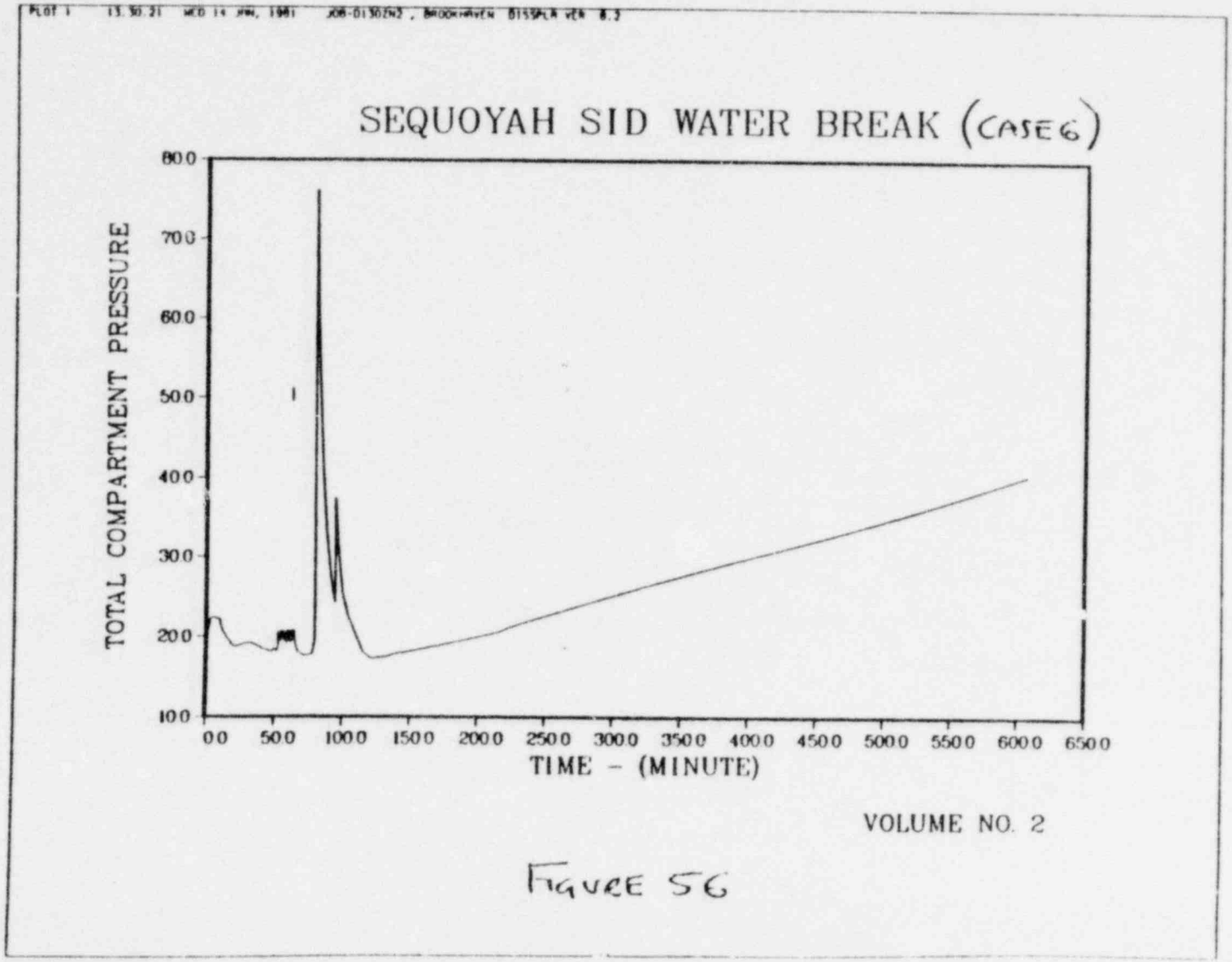

SEQUOYAH SID WATER BREAK (CASE6)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 56

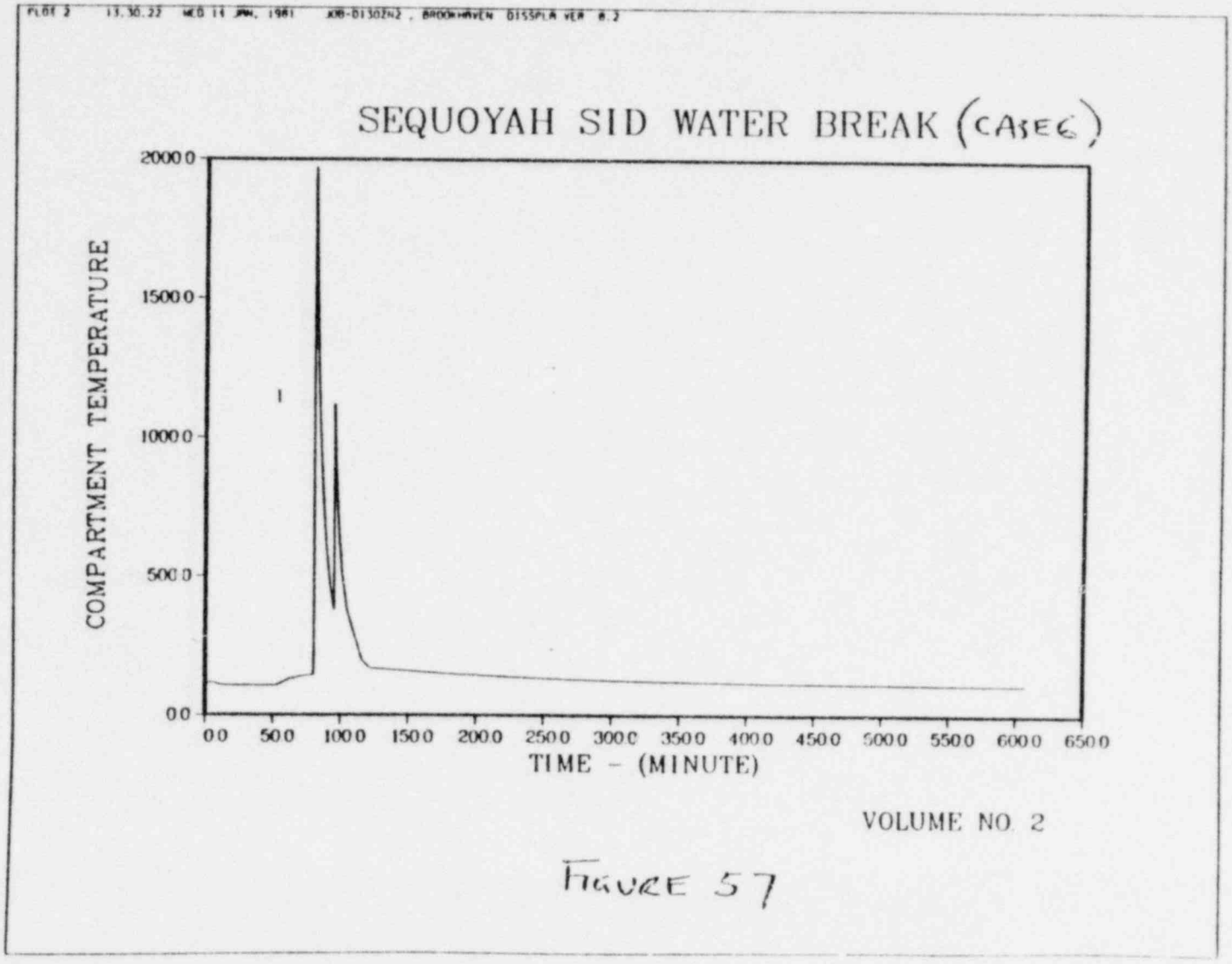

SEQUOYAH SID WATER BREAK (CASE6)
COMPARTMENT TEMPERATURE
20000
15000
10000
5000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO 2

FIGURE 57

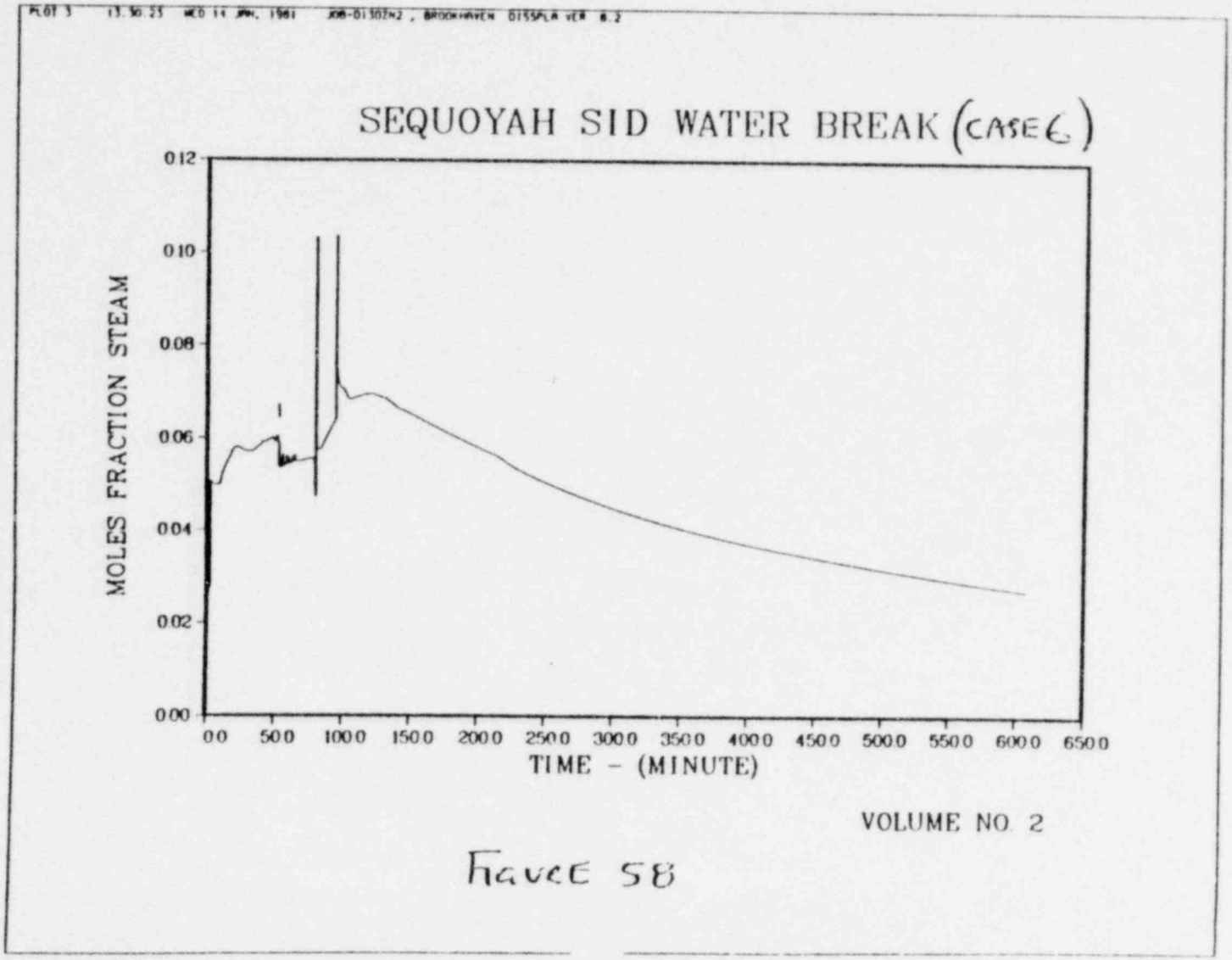

SEQUOYAH SID WATER BREAK (CASE 6)
MOLES FRACTION STEAM
0.12
0.10
0.08
0.06
0.04
0.02
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO 2

Figure 58

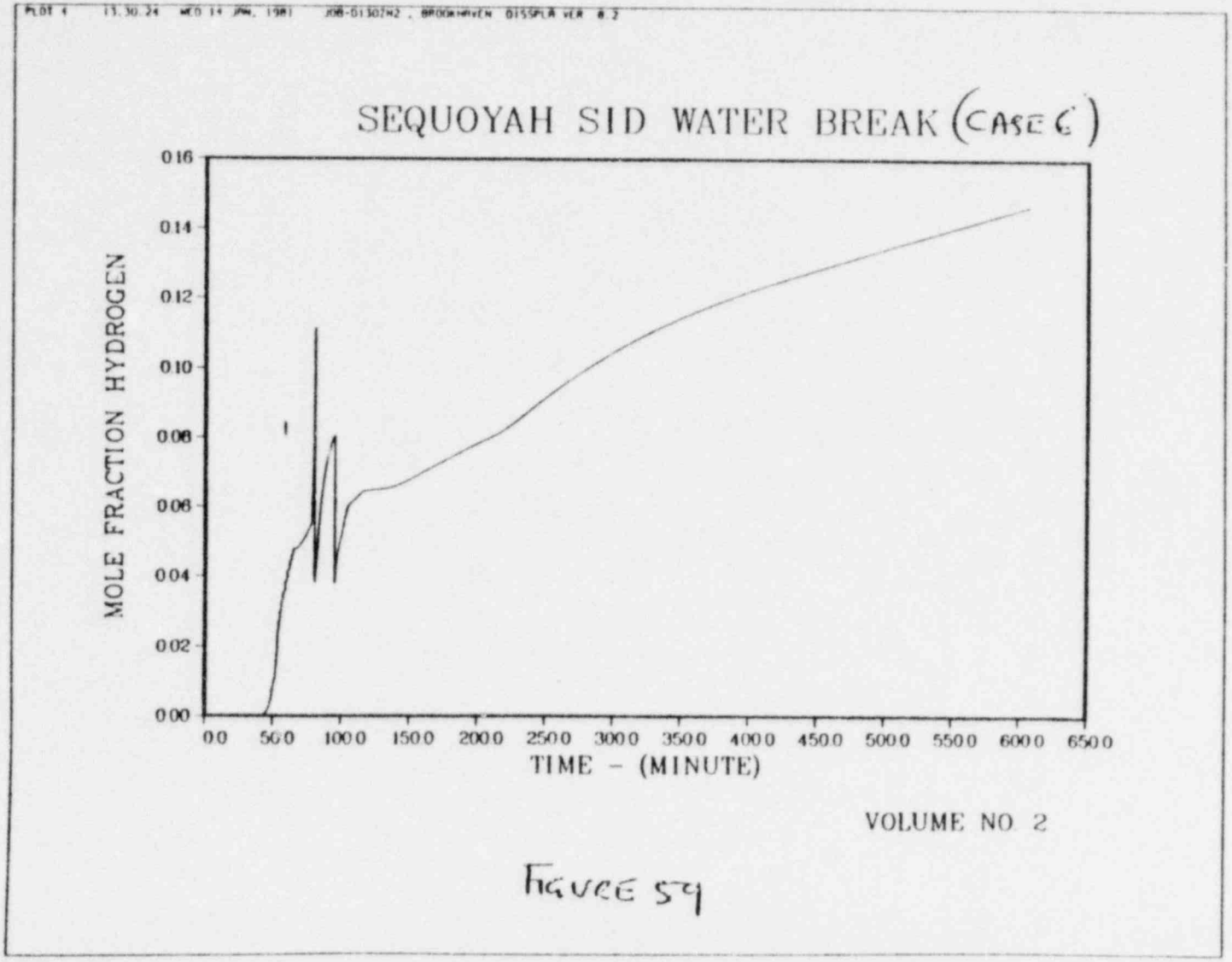

PLOT 4 13.30.24 WED 14 JAN, 1981 JOB-01307N2 . BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH SID WATER BREAK (CASE C)
MOLE FRACTION HYDROGEN
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO 2

FIGURE 59

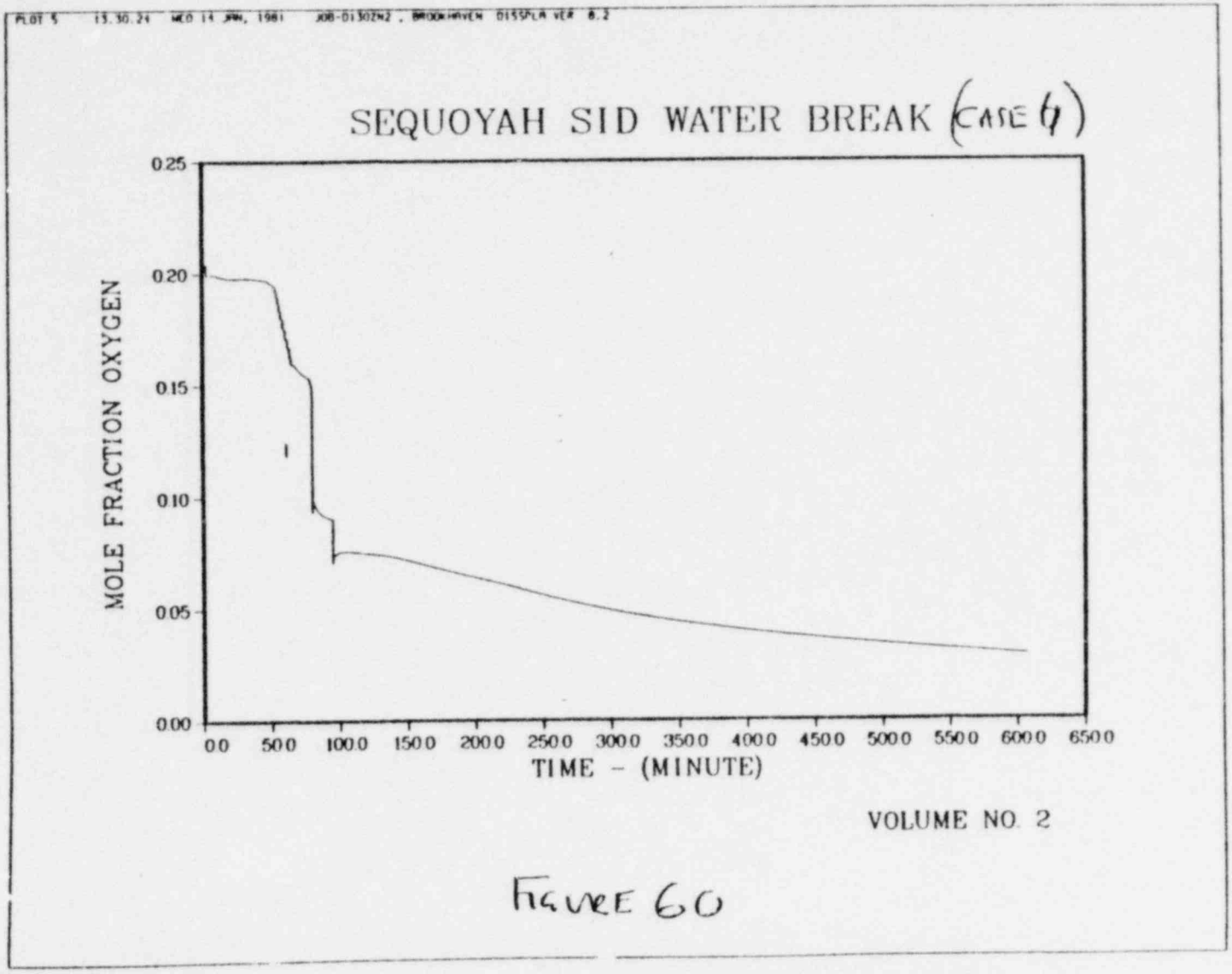

PLOT 5 15.30.24 WED 14 JAN, 1981 JOB-01502N2 . BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH SID WATER BREAK (CASE 4)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 60

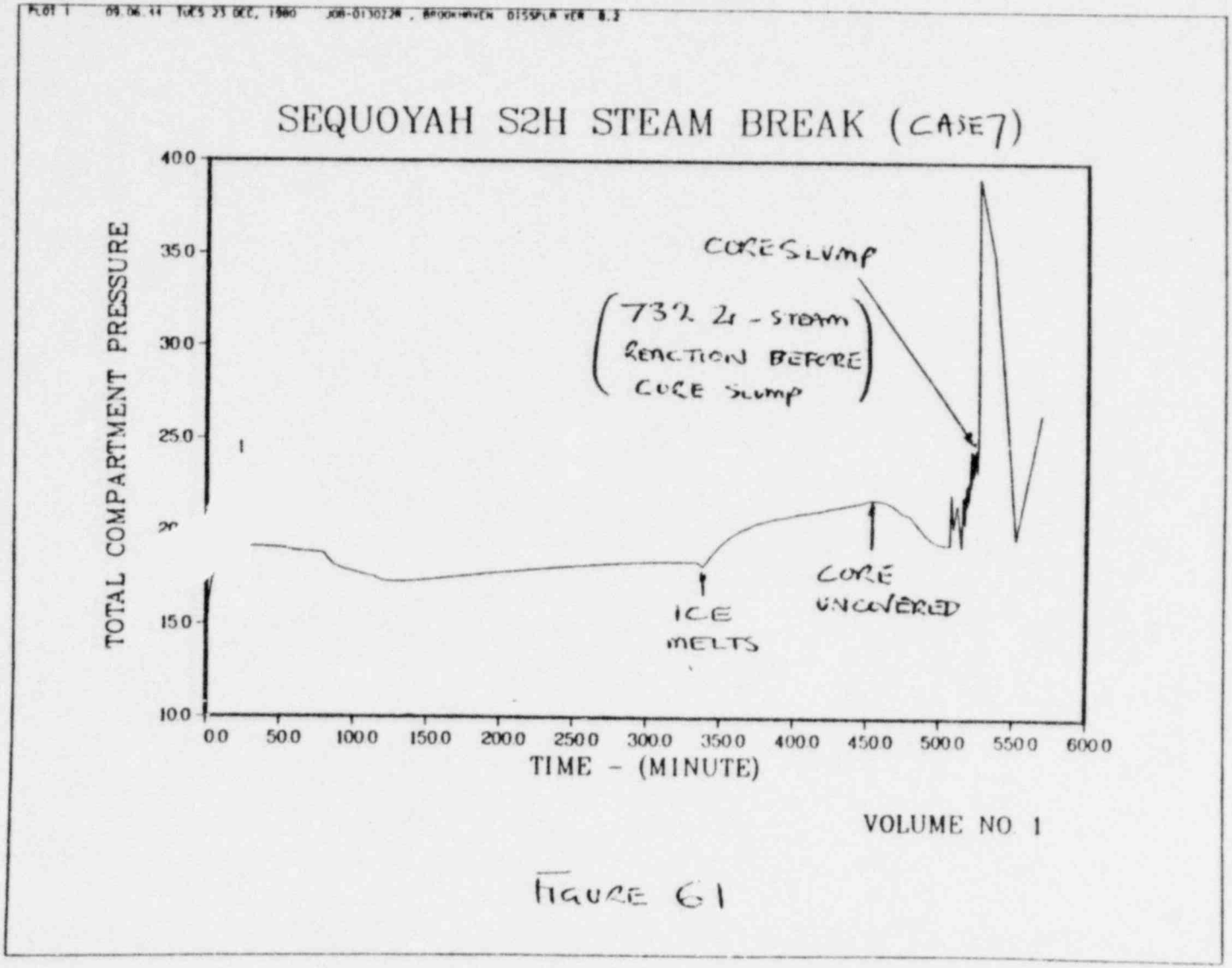

SEQUOYAH S2H STEAM BREAK (CASE7)
TOTAL COMPARTMENT PRESSURE
400
350
300
250
200
150
100
CORE SLUMP
(732.4 - STEAM REACTION BEFORE CORE SLUMP)
ICE MELTS
CORE UNCOVERED
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 61

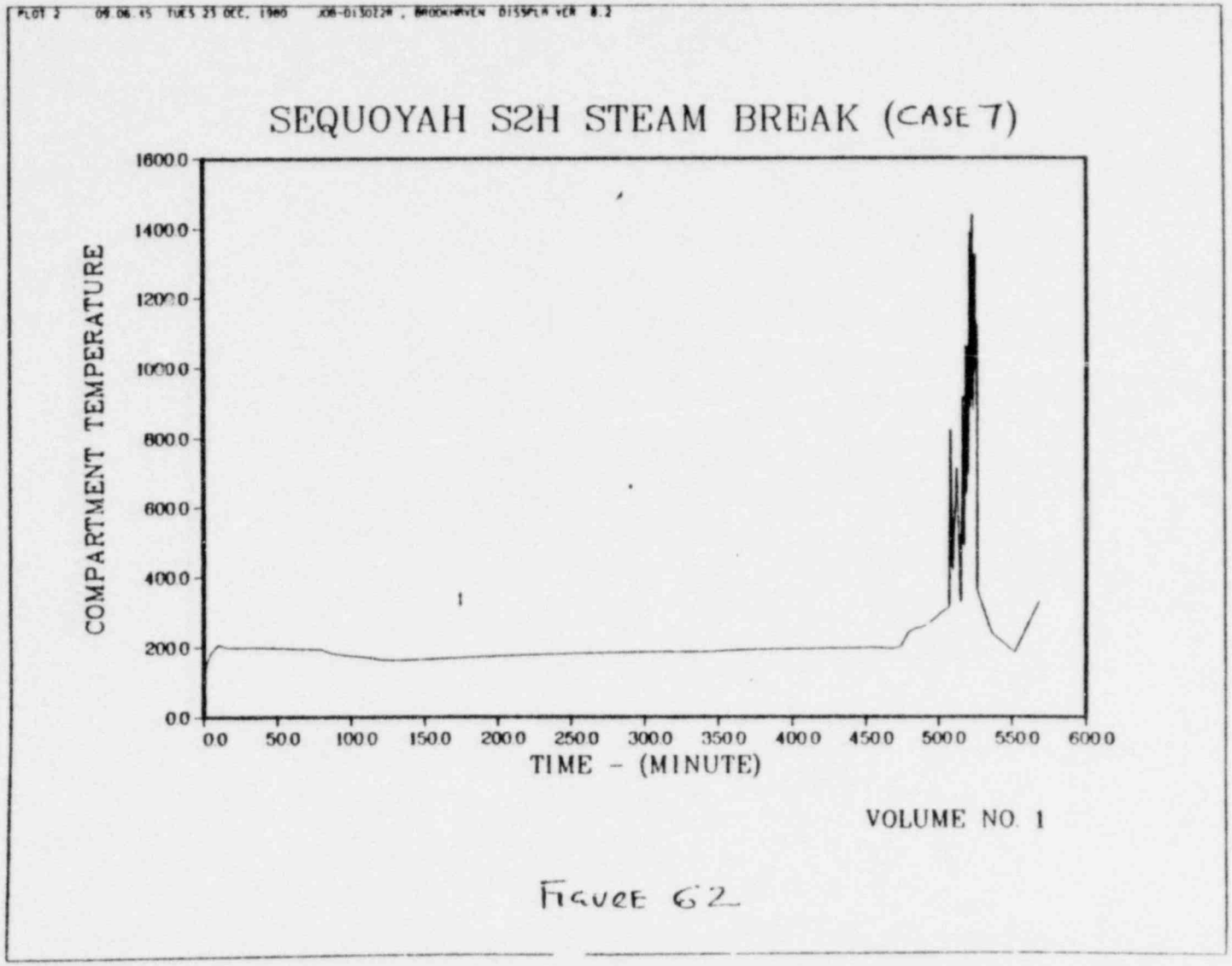

PLOT 2 09.06.45 TUES 25 DEC. 1986 J06-0150Z2M , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH S2H STEAM BREAK (CASE 7)
COMPARTMENT TEMPERATURE
16000
14000
12000
10000
8000
6000
4000
2000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 62

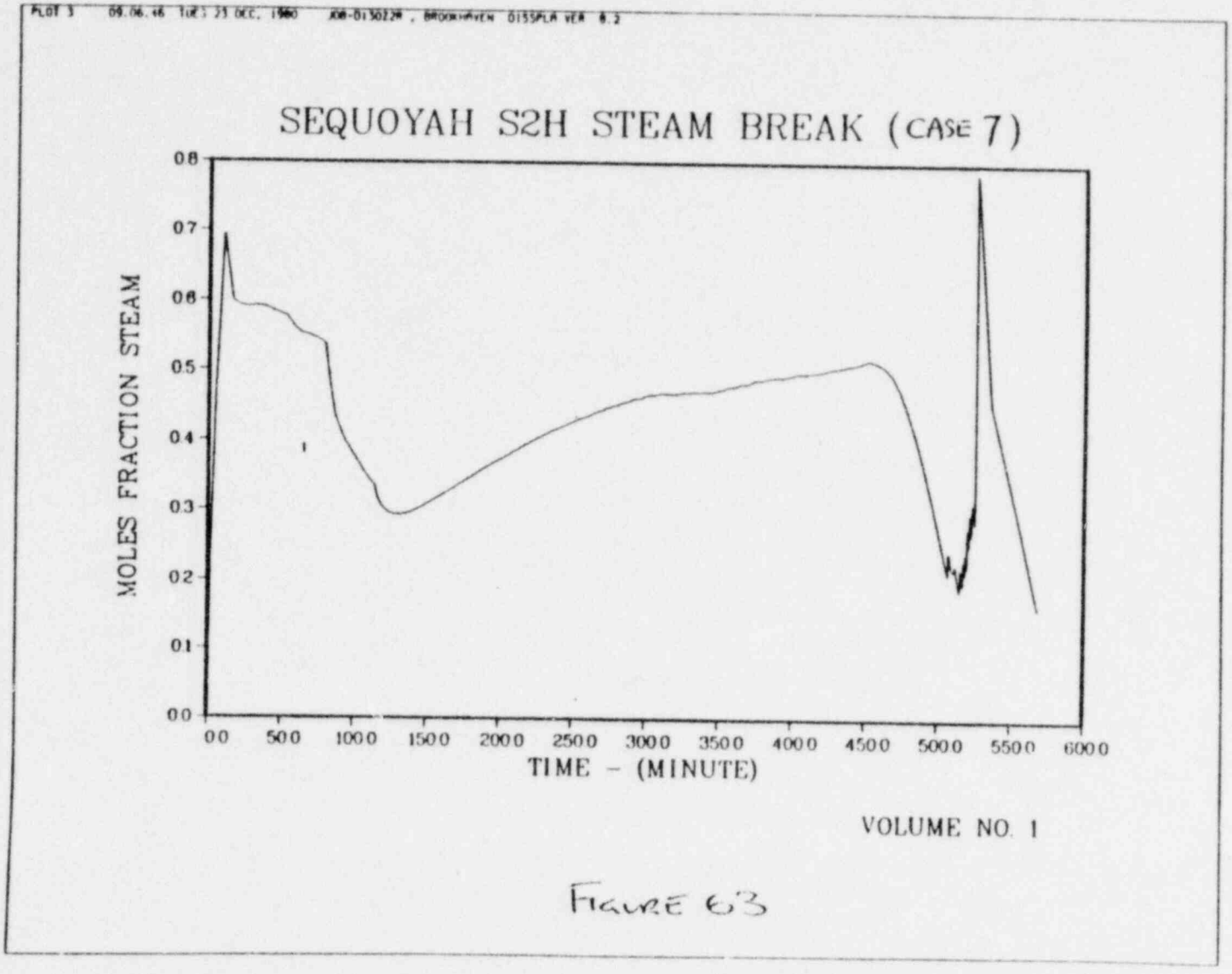

SEQUOYAH S2H STEAM BREAK (CASE 7)
MOLES FRACTION STEAM
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 63

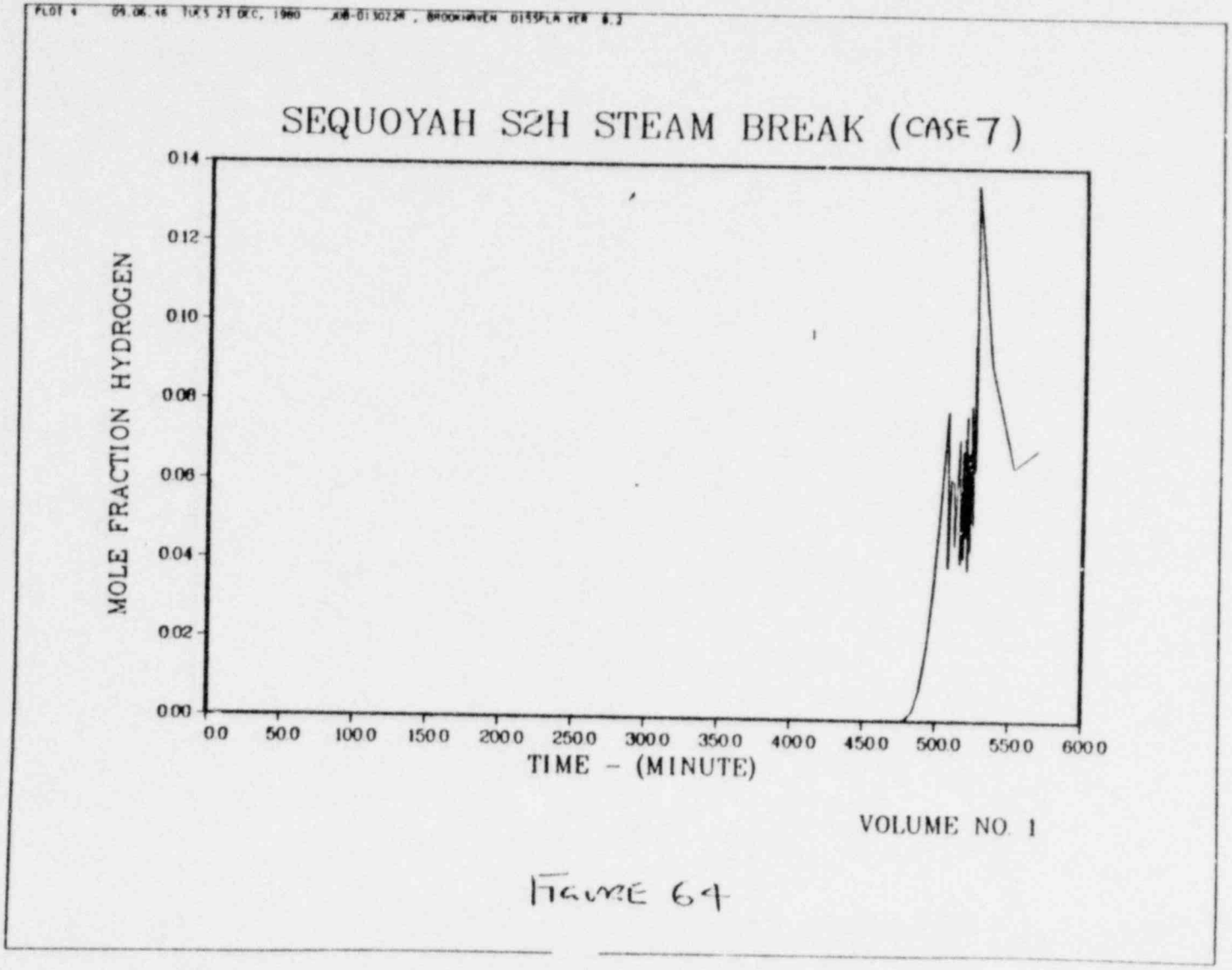

SEQUOYAH S2H STEAM BREAK (CASE 7)
MOLE FRACTION HYDROGEN
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 64

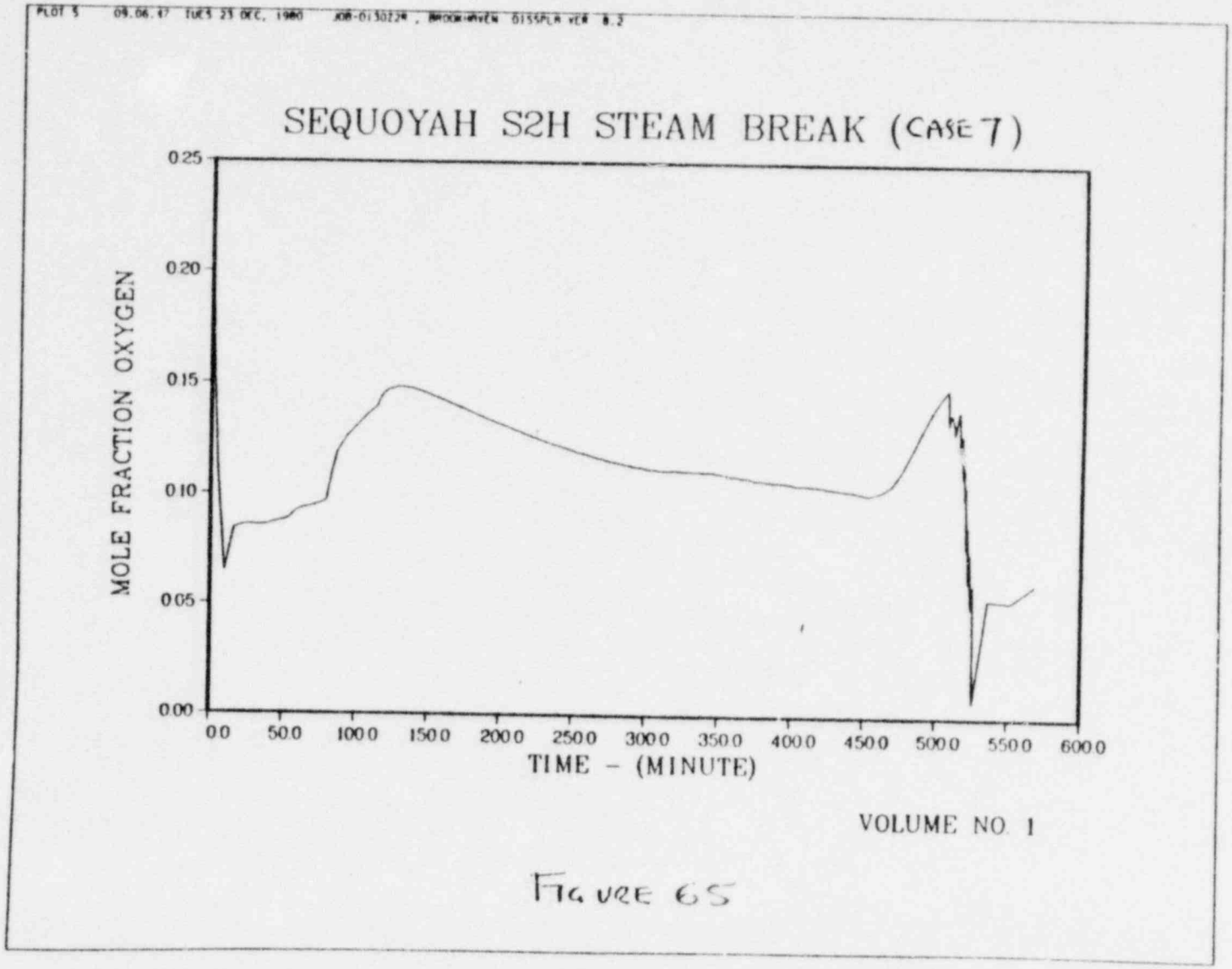

PLOT 5 09.06.47 TUES 25 DEC, 1990
SEQUOYAH S2H STEAM BREAK (CASE 7)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 65

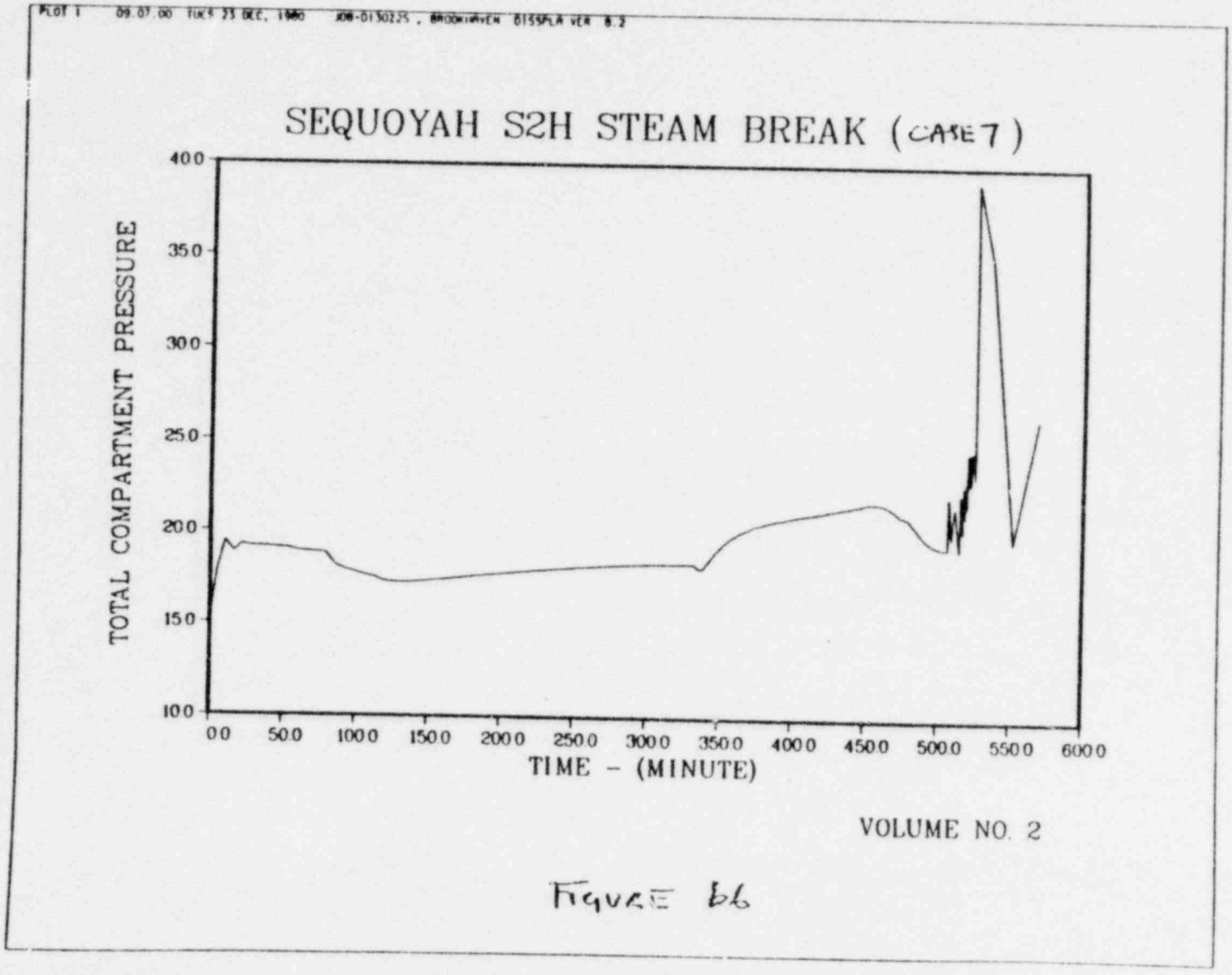

SEQUOYAH S2H STEAM BREAK (CASE 7)
TOTAL COMPARTMENT PRESSURE
400
350
300
250
200
150
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 66

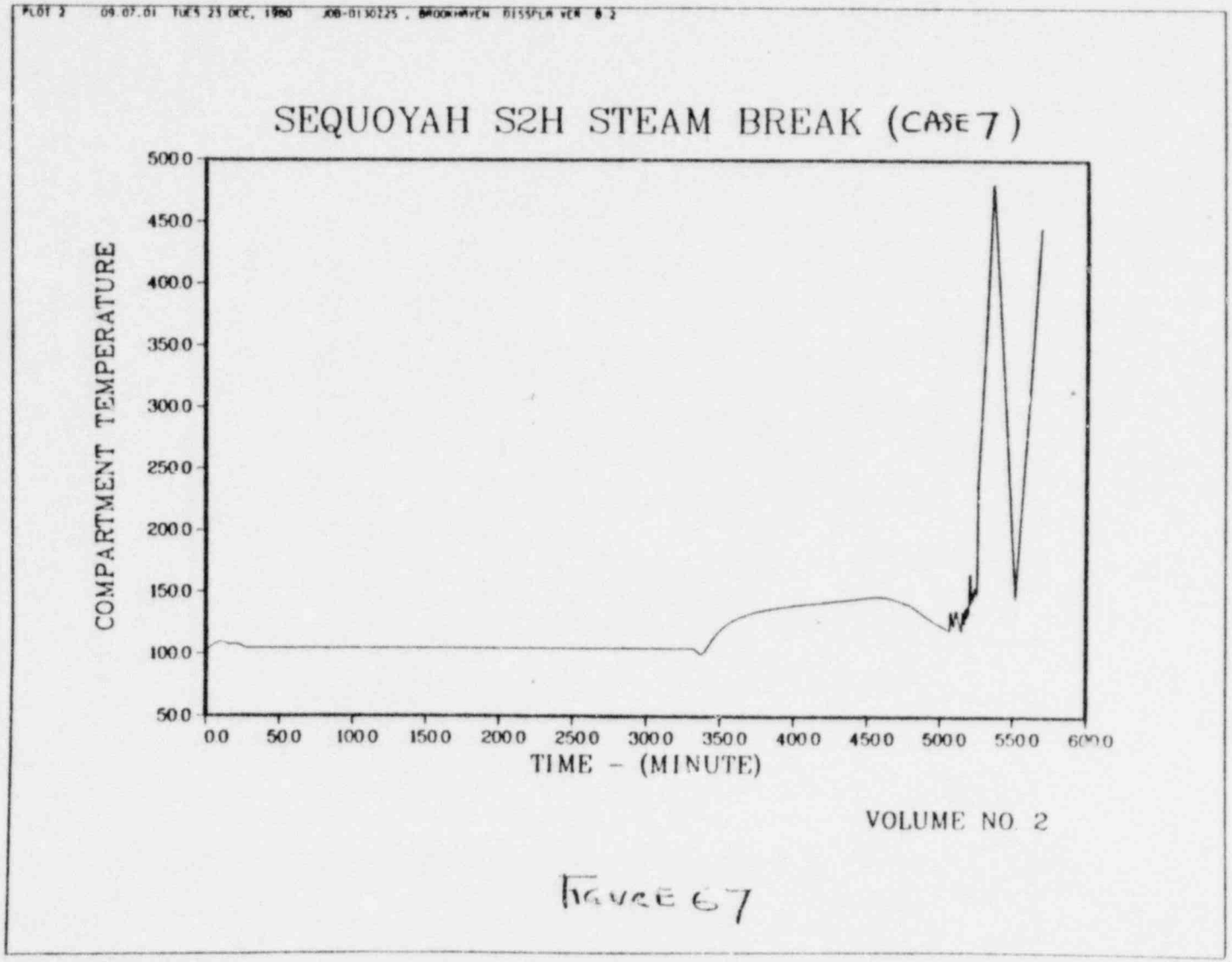

PLOT 2 09.07.01 TUES 23 DEC, 1980
SEQUOYAH S2H STEAM BREAK (CASE 7)
COMPARTMENT TEMPERATURE
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
TIME - (MINUTE)
VOLUME NO 2

Figure 67

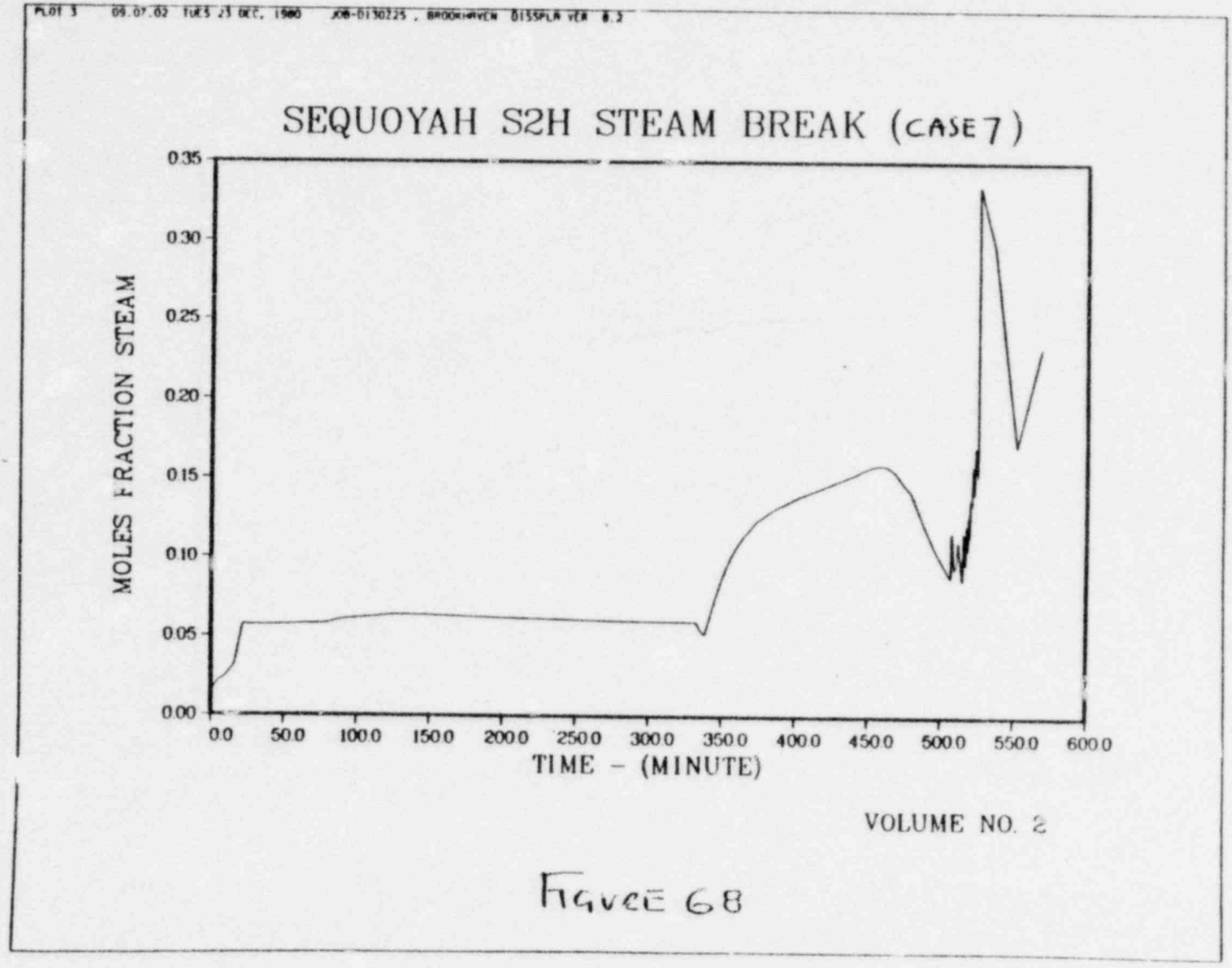

PLOT 3 09.07.02 TUES 23 DEC. 1980 JOB-0130225 , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH S2H STEAM BREAK (CASE 7)
MOLES FRACTION STEAM
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

Figure 68

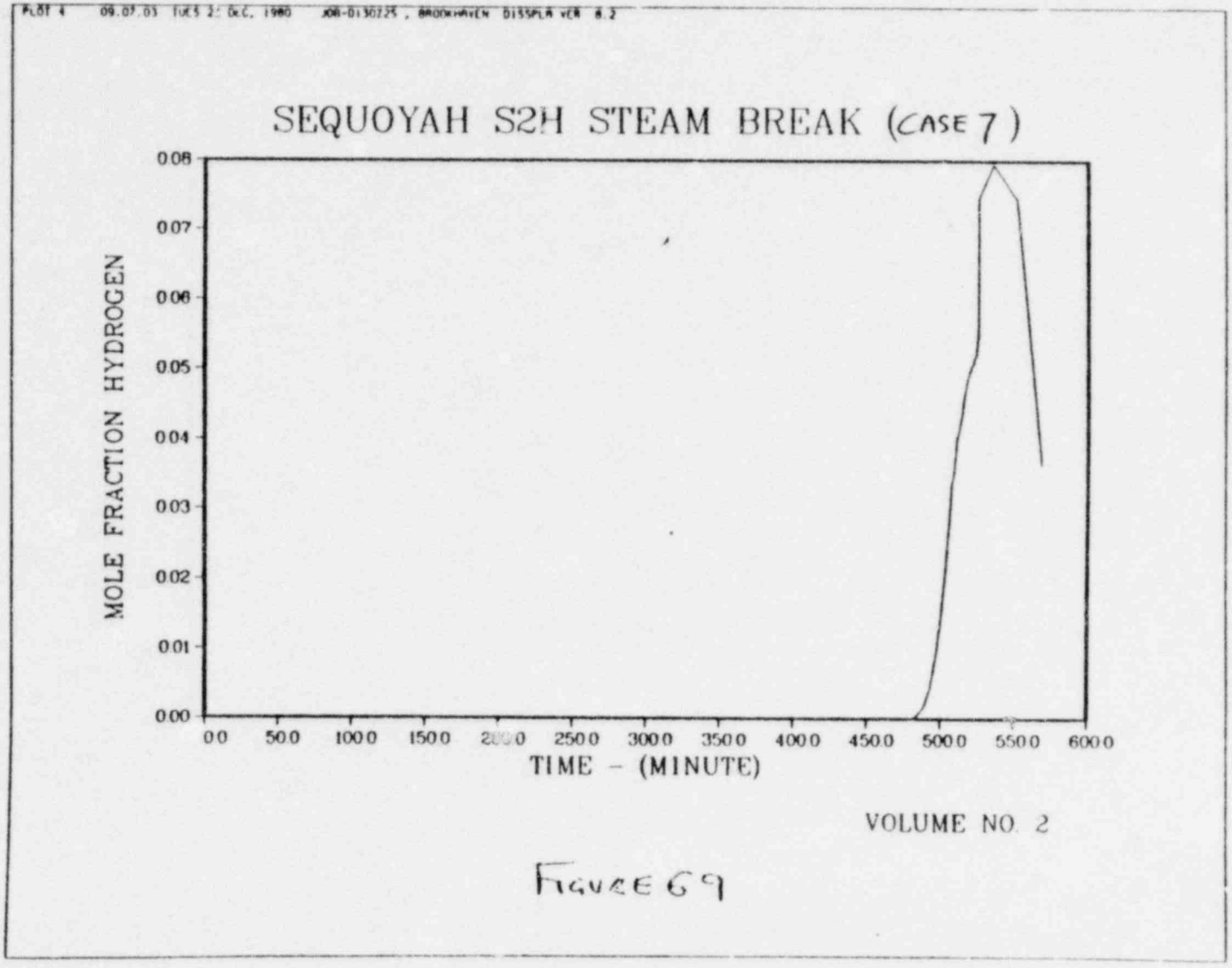

PLOT 4 09.07.03 TUES 2: DEC. 1980 JOB-0130225 , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH S2H STEAM BREAK (CASE 7)
MOLE FRACTION HYDROGEN
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 69

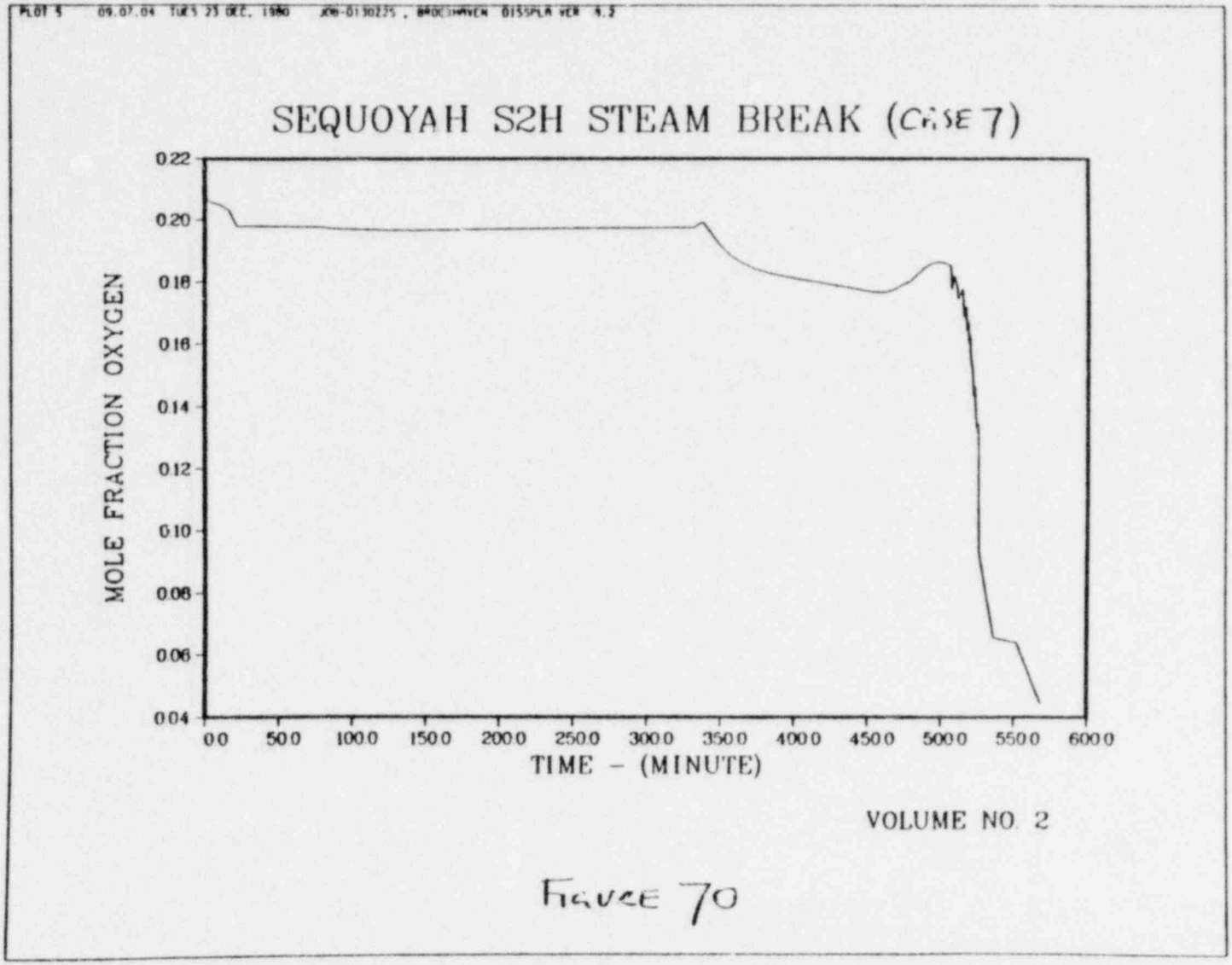

PLOT 5 09.07.04 TUES 23 DEC, 1980 JOB-0130235 , BROOKHAVEN DISSPLA VER 9.2
SEQUOYAH S2H STEAM BREAK (CASE 7)
MOLE FRACTION OXYGEN
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 70

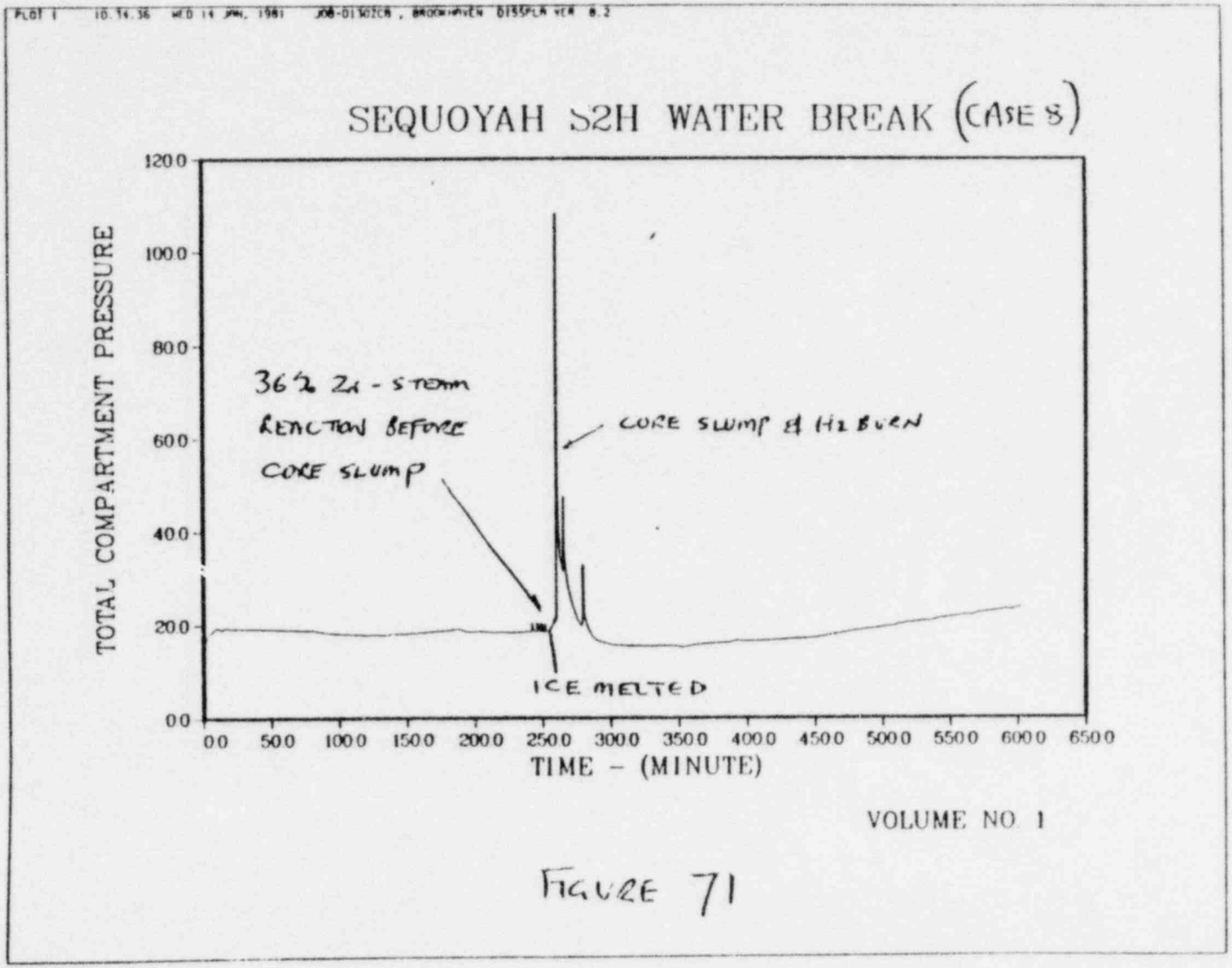

SEQUOYAH S2H WATER BREAK (CASE 8)
TOTAL COMPARTMENT PRESSURE
1200
1000
800
600
400
200
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
36% Zr - STEAM REACTION BEFORE CORE SLUMP
CORE SLUMP & H2 BURN
ICE MELTED
VOLUME NO 1

FIGURE 71

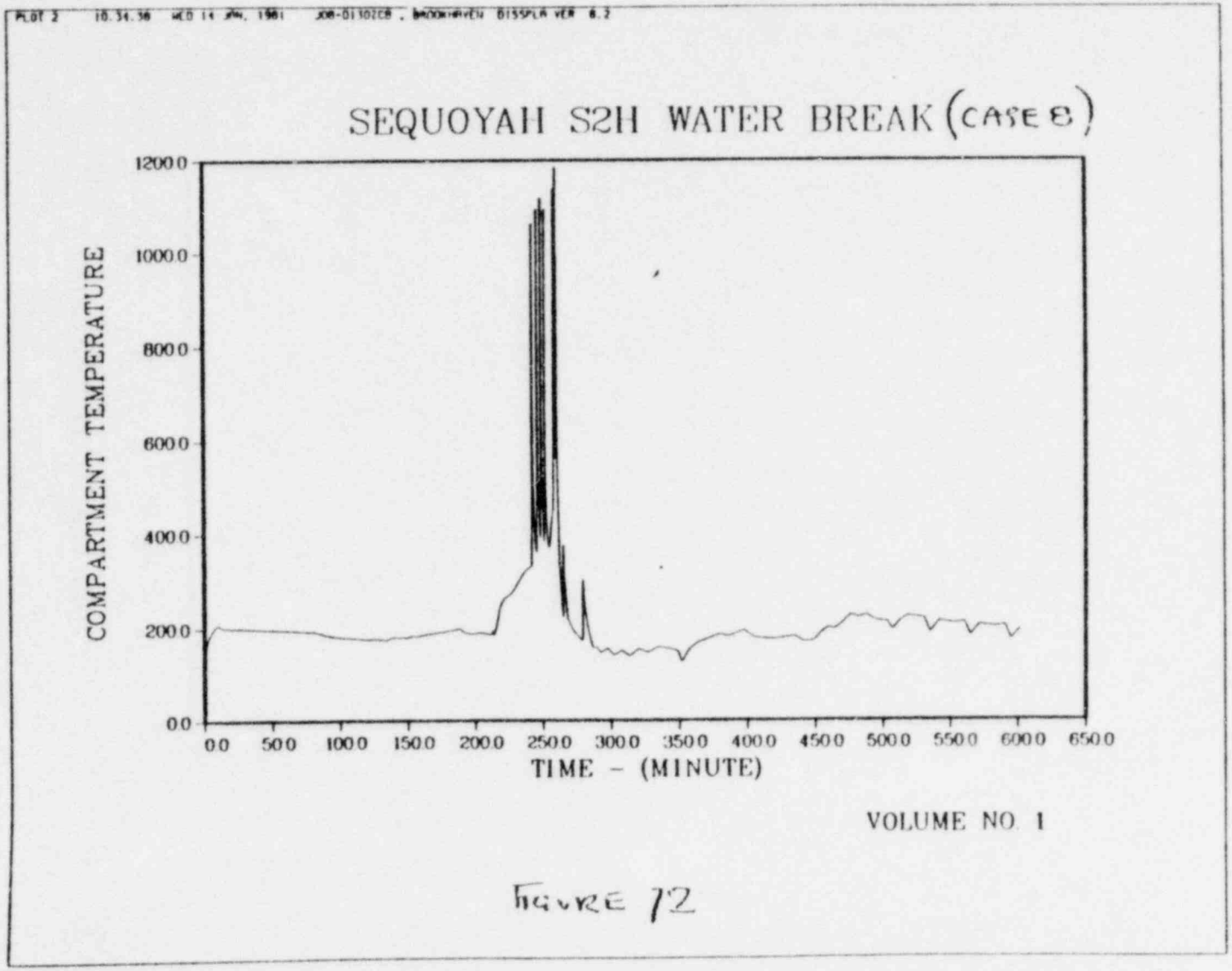

SEQUOYAH S2H WATER BREAK (CASE 8)
COMPARTMENT TEMPERATURE
12000
10000
8000
6000
4000
2000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 72

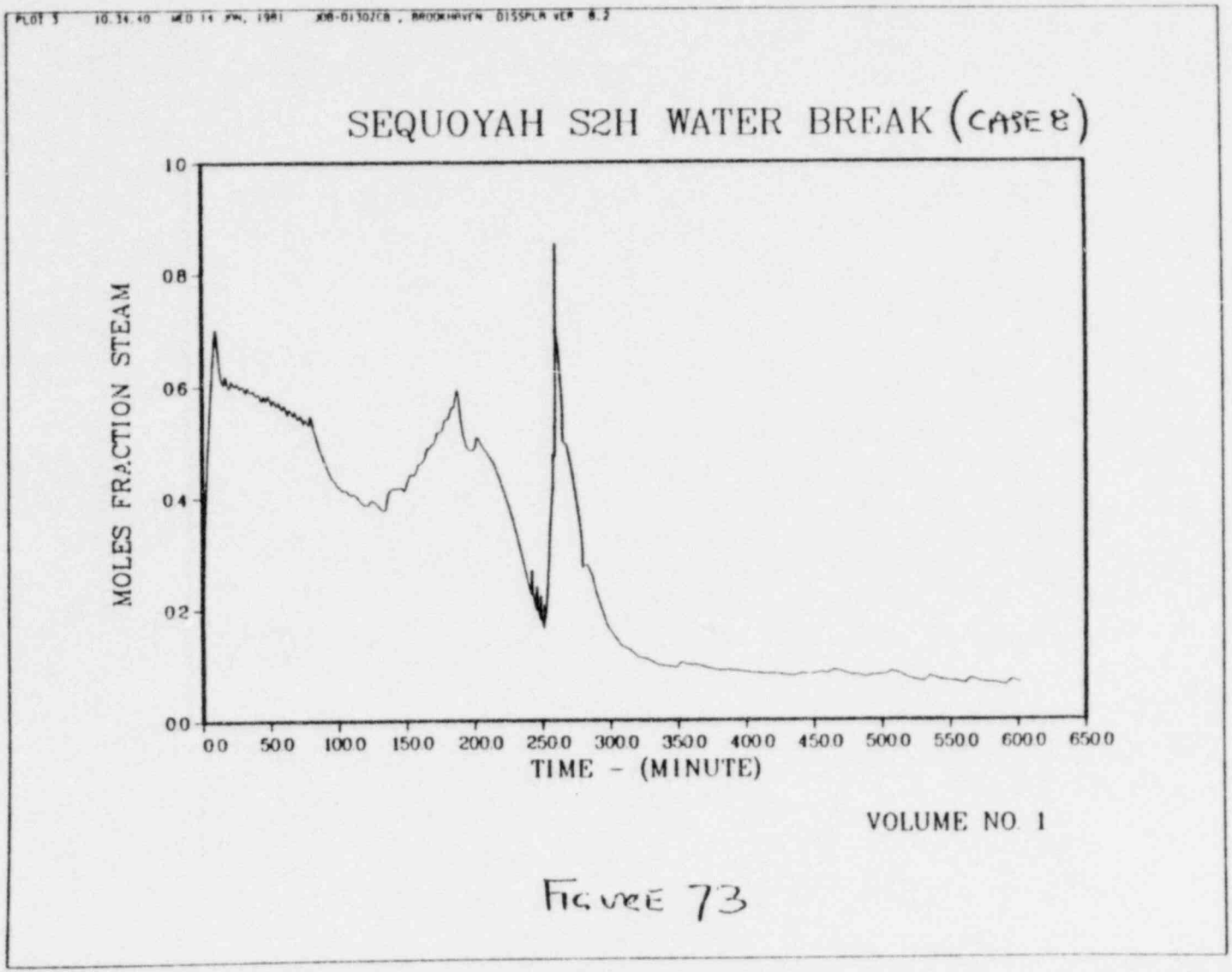

SEQUOYAH S2H WATER BREAK (CASE 8)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 73

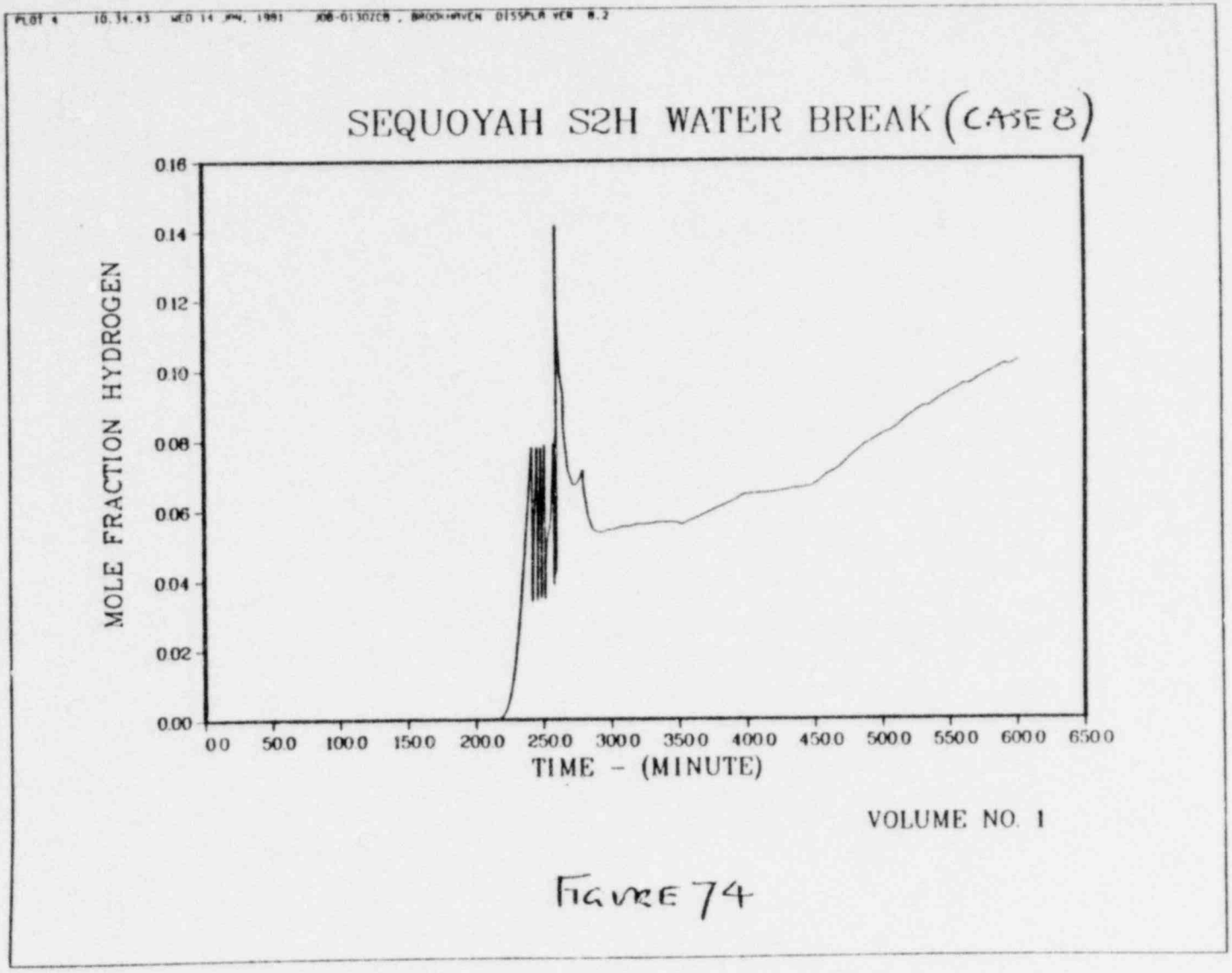

SEQUOYAH S2H WATER BREAK (CASE 8)
MOLE FRACTION HYDROGEN
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 74

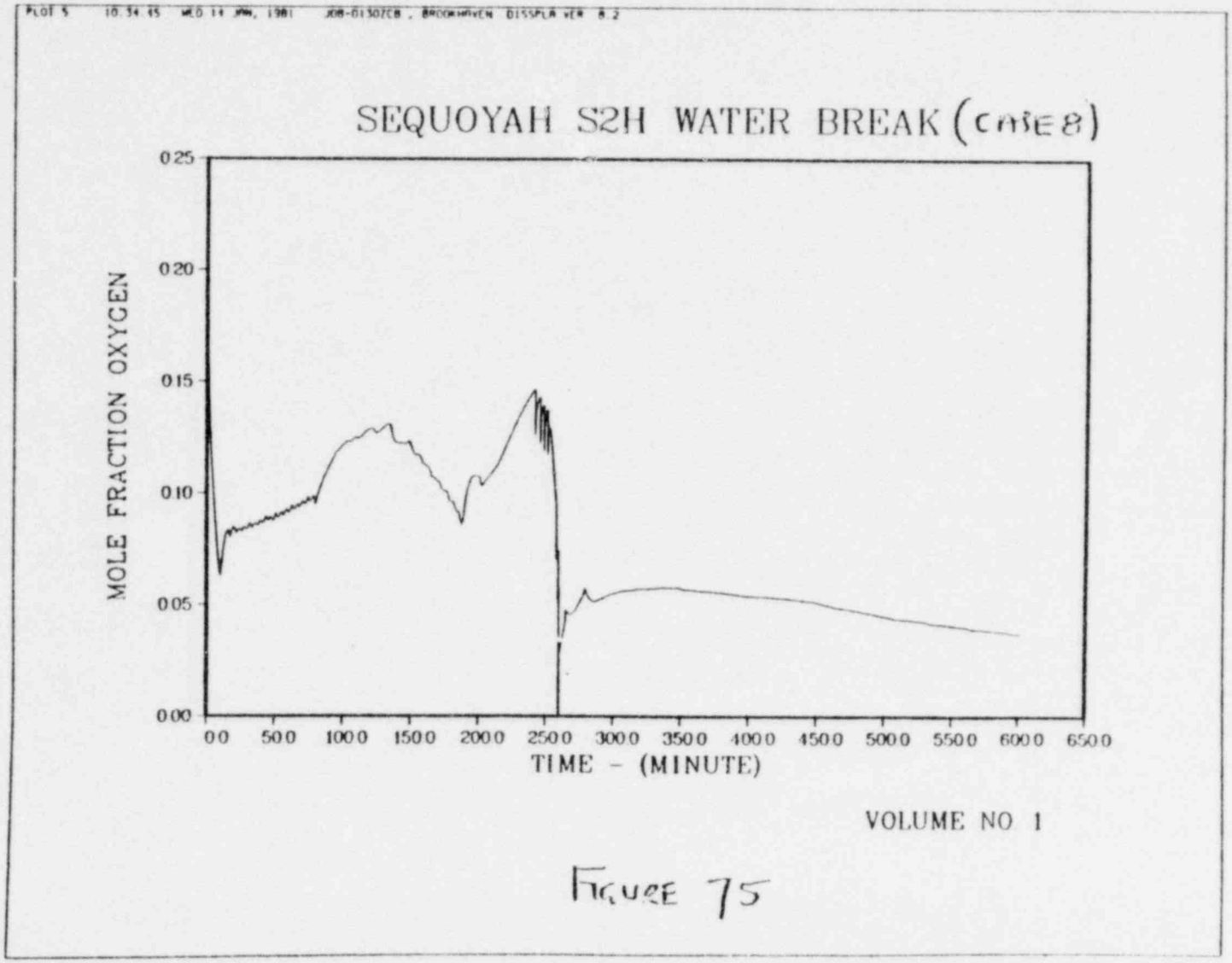

SEQUOYAH S2H WATER BREAK (case 8)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO 1

FIGURE 75

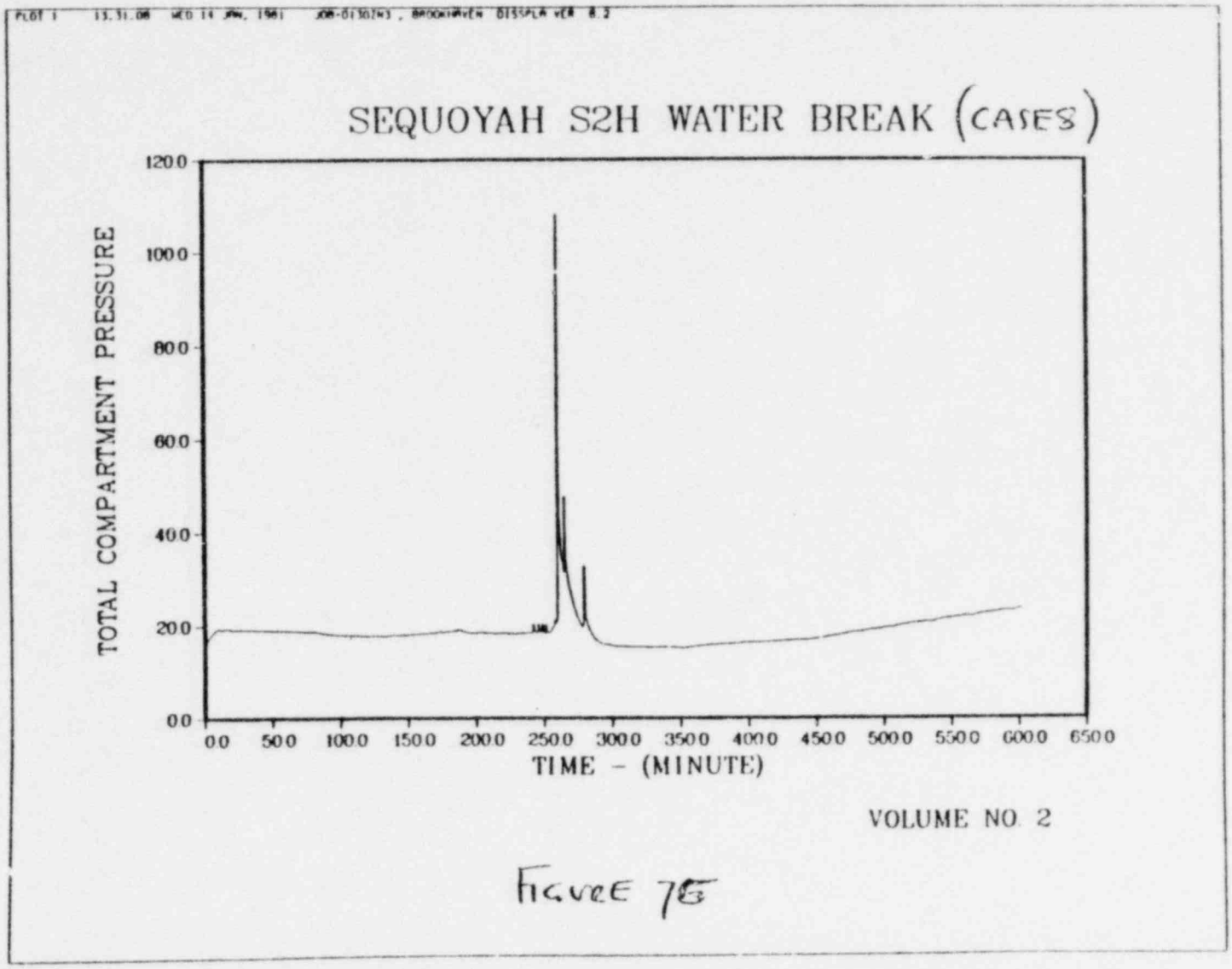

SEQUOYAH S2H WATER BREAK (CASES)
TOTAL COMPARTMENT PRESSURE
1200
1000
800
600
400
200
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 7B

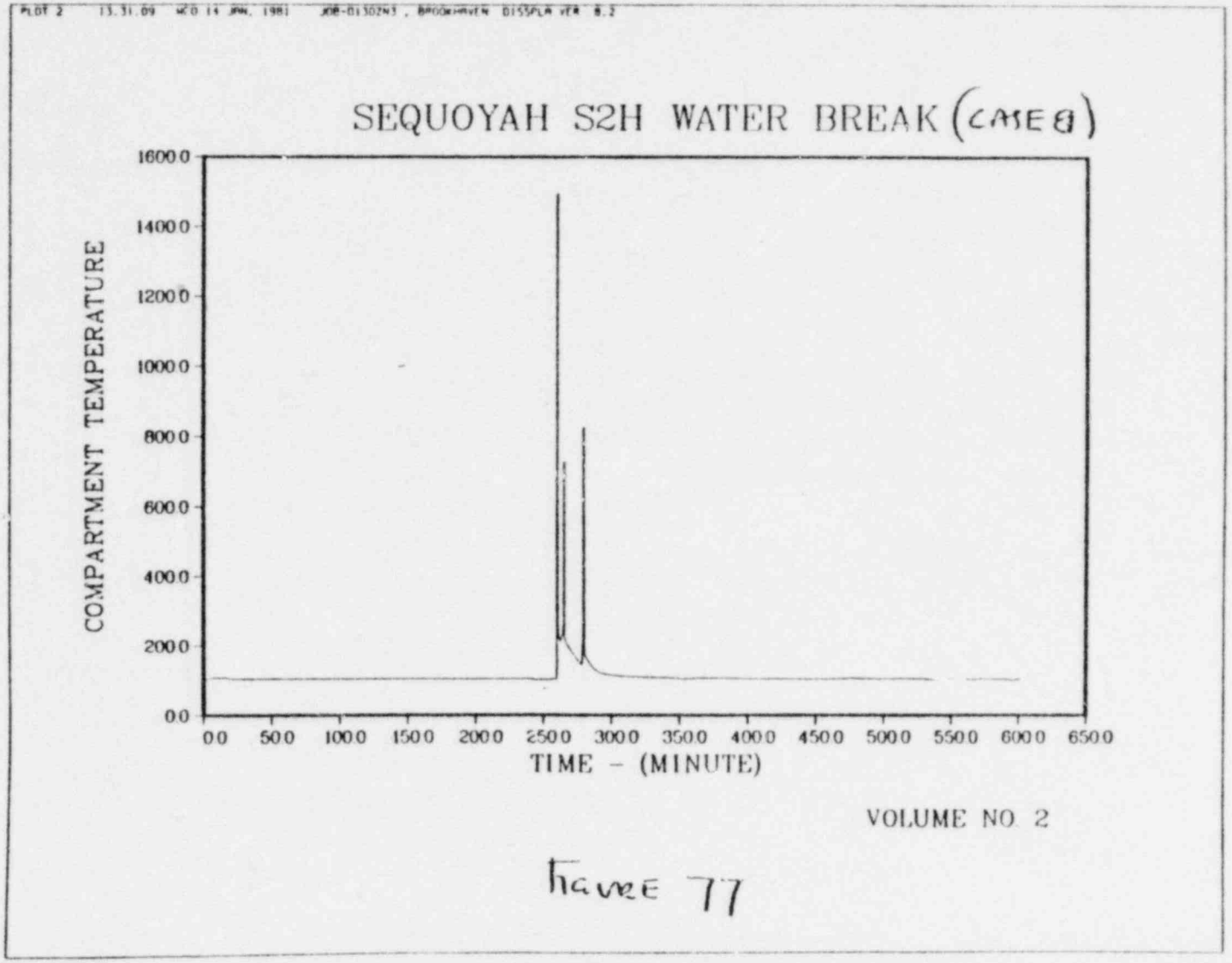

SEQUOYAH S2H WATER BREAK (CASE B)
COMPARTMENT TEMPERATURE
16000
14000
12000
10000
8000
6000
4000
2000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 2

Figure 77

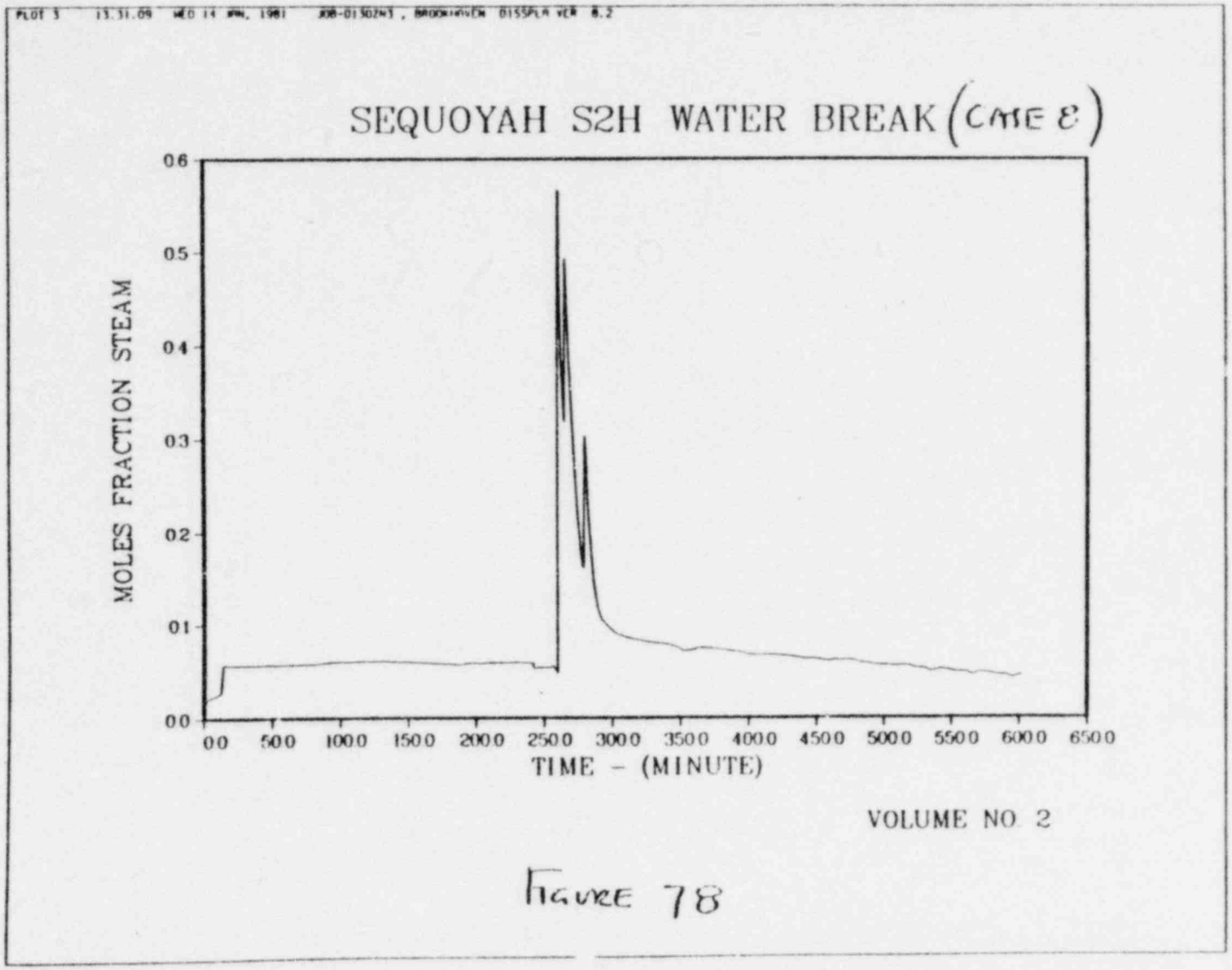

SEQUOYAH S2H WATER BREAK (CASE E)
MOLES FRACTION STEAM
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 78

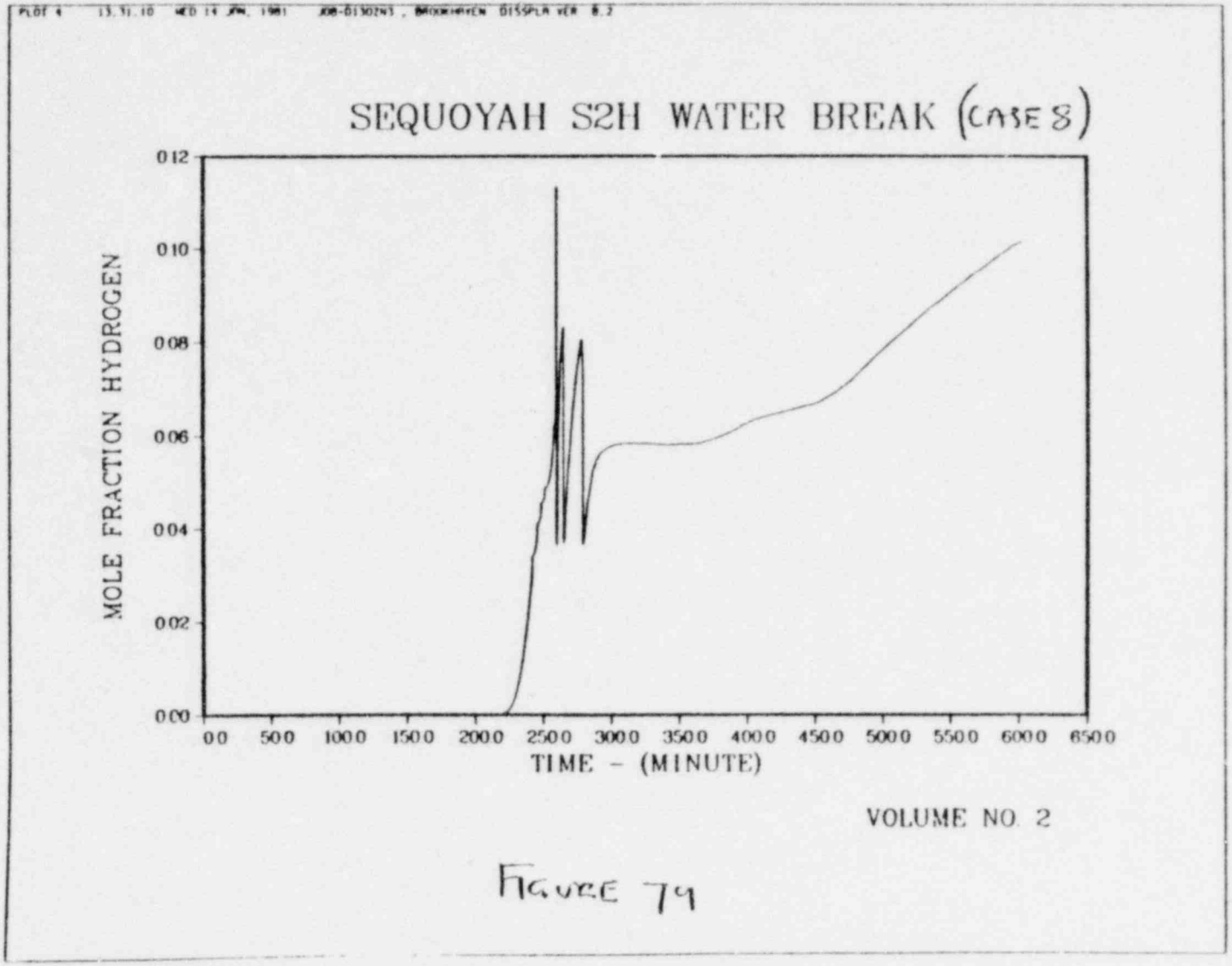

SEQUOYAH S2H WATER BREAK (CASE 8)
MOLE FRACTION HYDROGEN
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

Figure 79

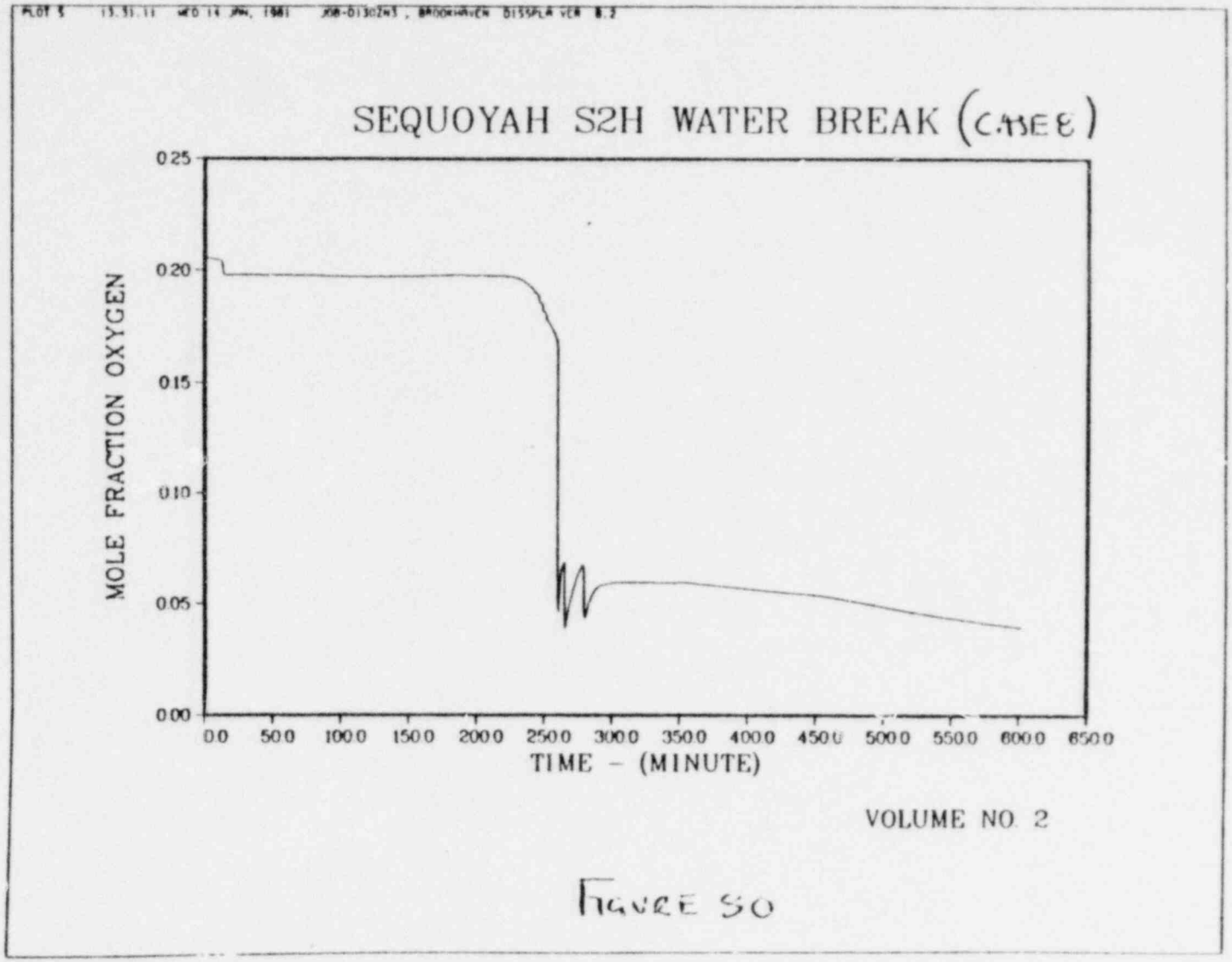

SEQUOYAH S2H WATER BREAK (CASE 8)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 50

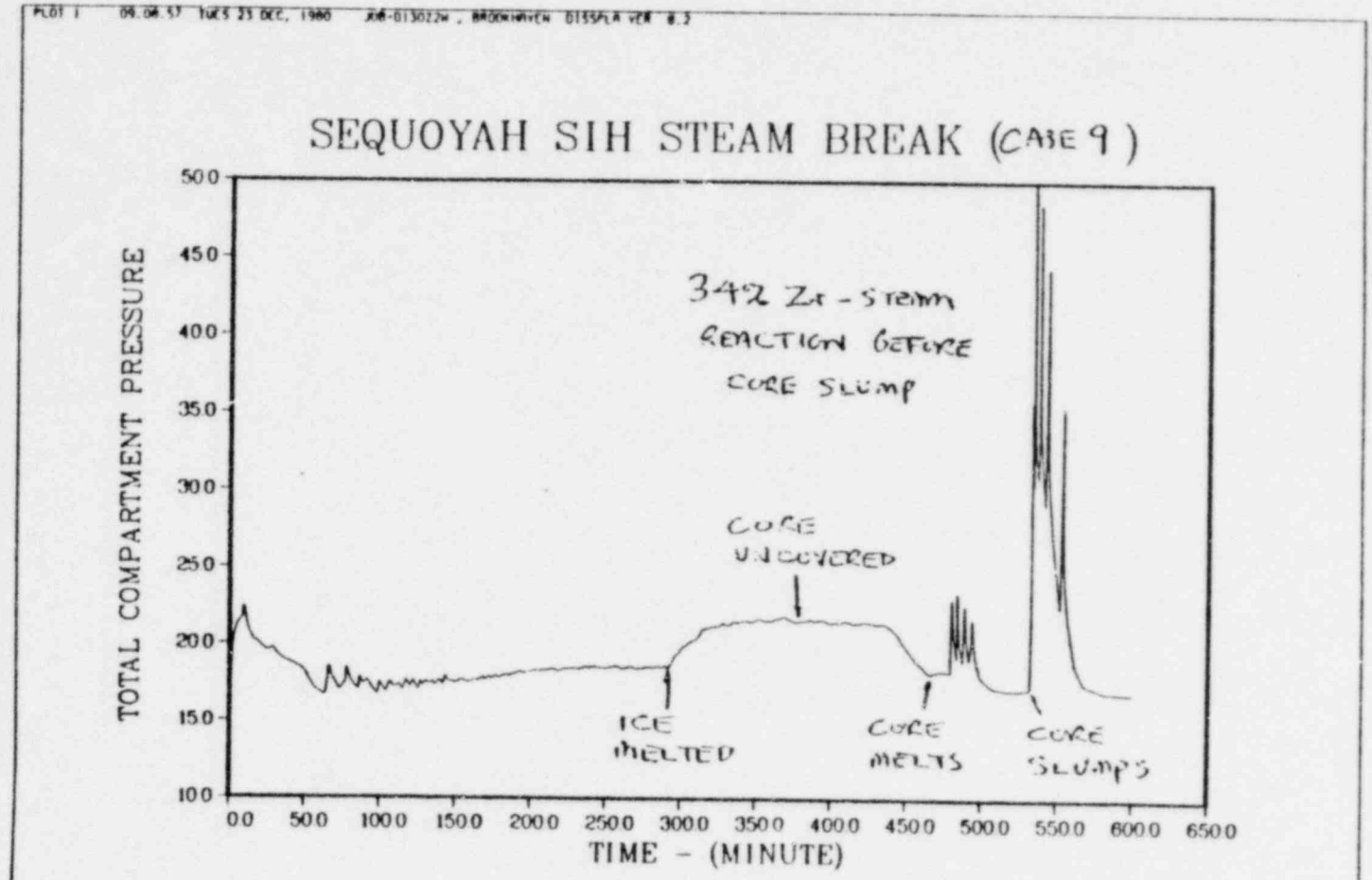

SEQUOYAH SIH STEAM BREAK (CASE 9)
TOTAL COMPARTMENT PRESSURE
500
450
400
350
300
250
200
150
100
342 Zr - STEAM REACTION BEFORE CORE SLUMP
CORE UNCOVERED
ICE MELTED
CORE MELTS
CORE SLUMPS
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 51

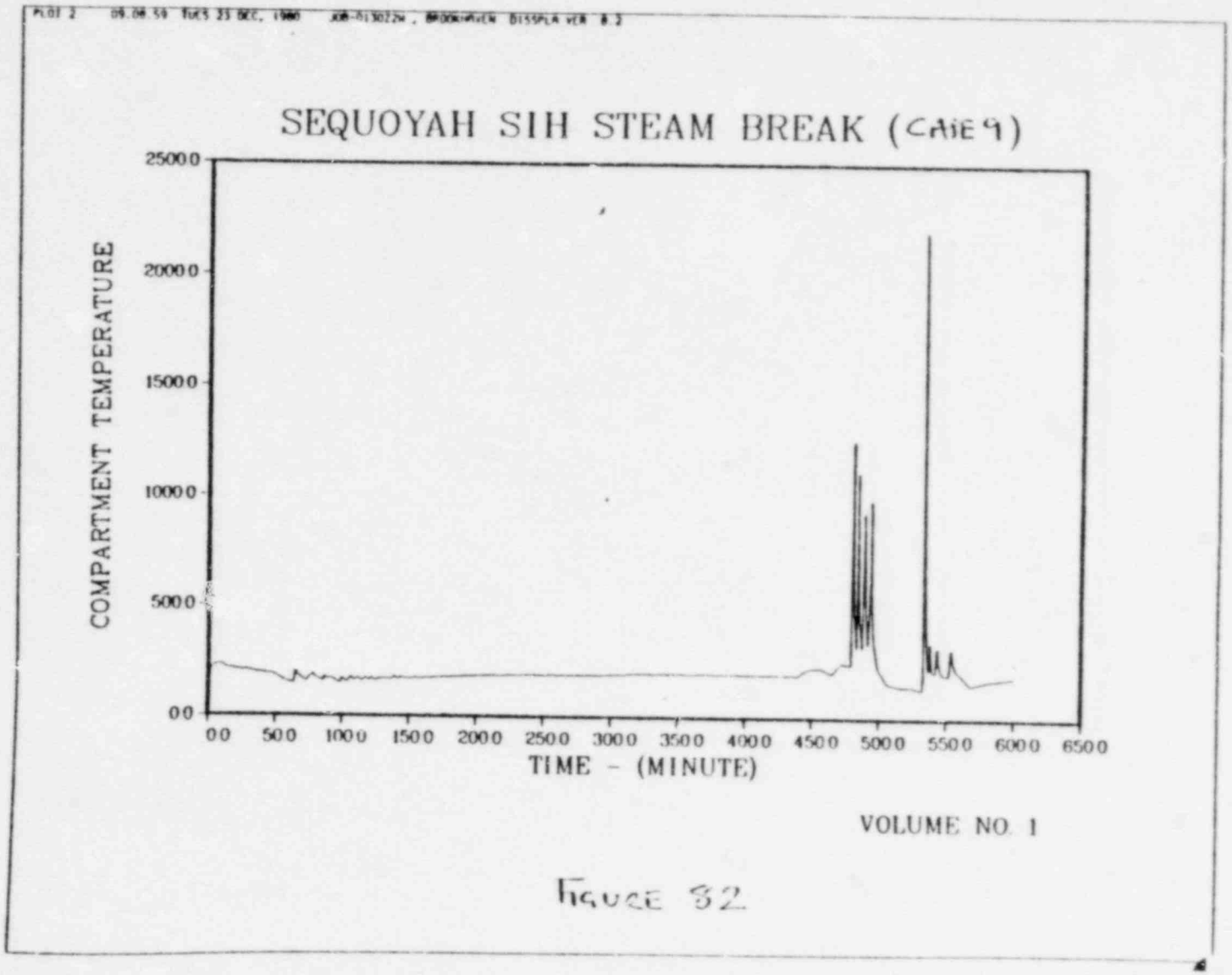

SEQUOYAH SIH STEAM BREAK (CASE 9)
COMPARTMENT TEMPERATURE
25000
20000
15000
10000
5000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 32

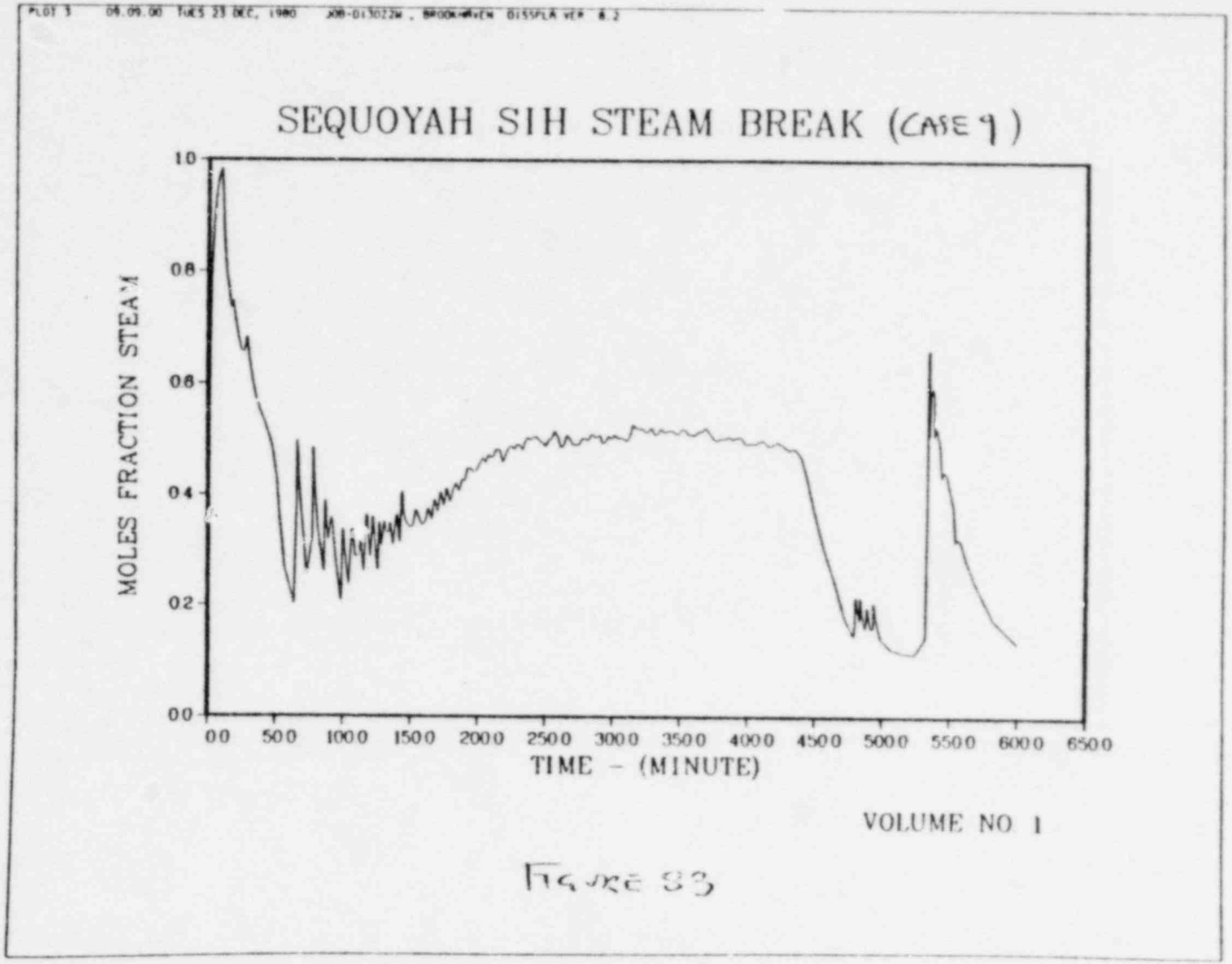

PLOT 3 08.09.00 TUES 23 DEC, 1980
SEQUOYAH SIH STEAM BREAK (CASE 9)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO 1

FIGURE 33

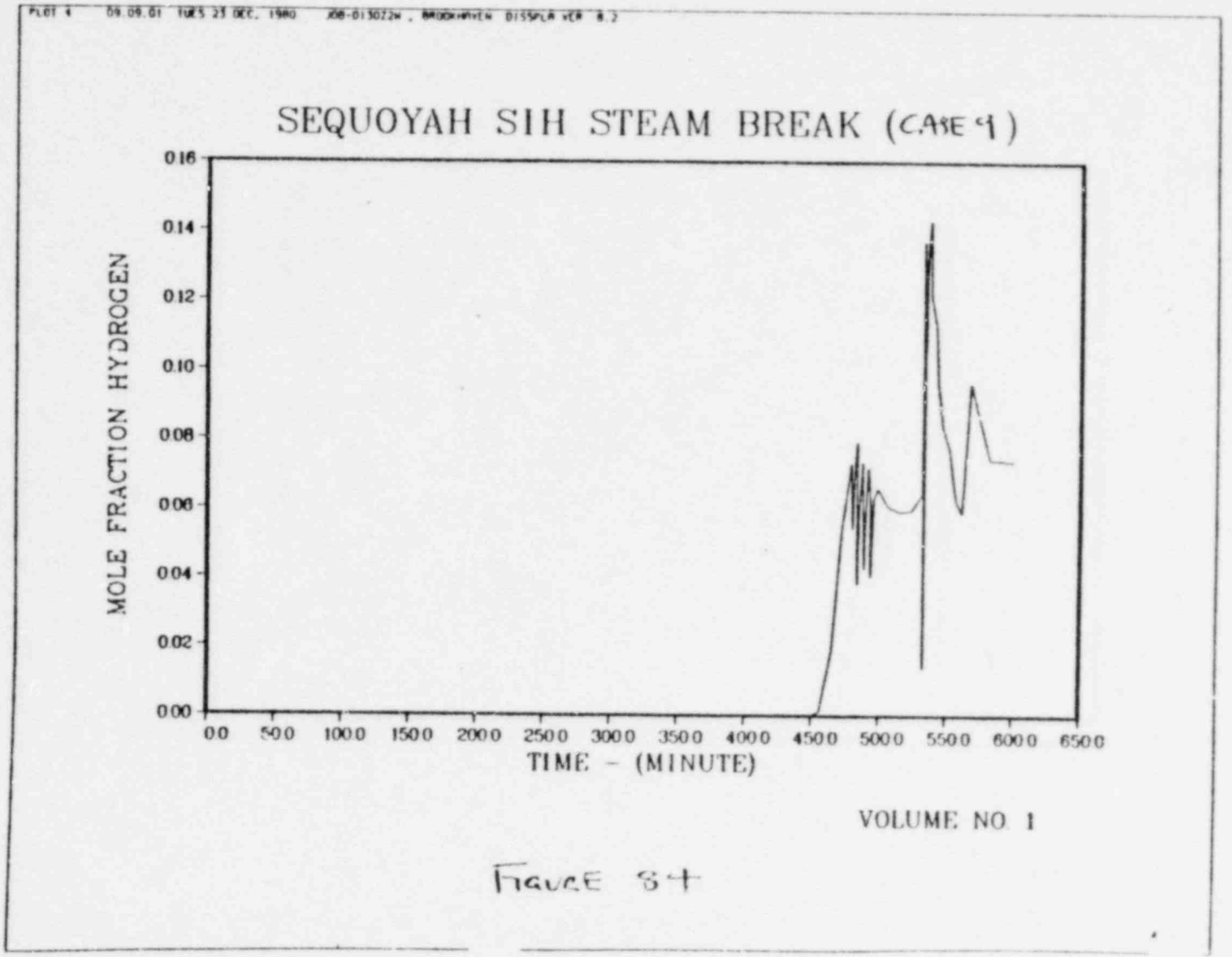

SEQUOYAH SIH STEAM BREAK (CASE 9)
MOLE FRACTION HYDROGEN
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO 1

FIGURE 34

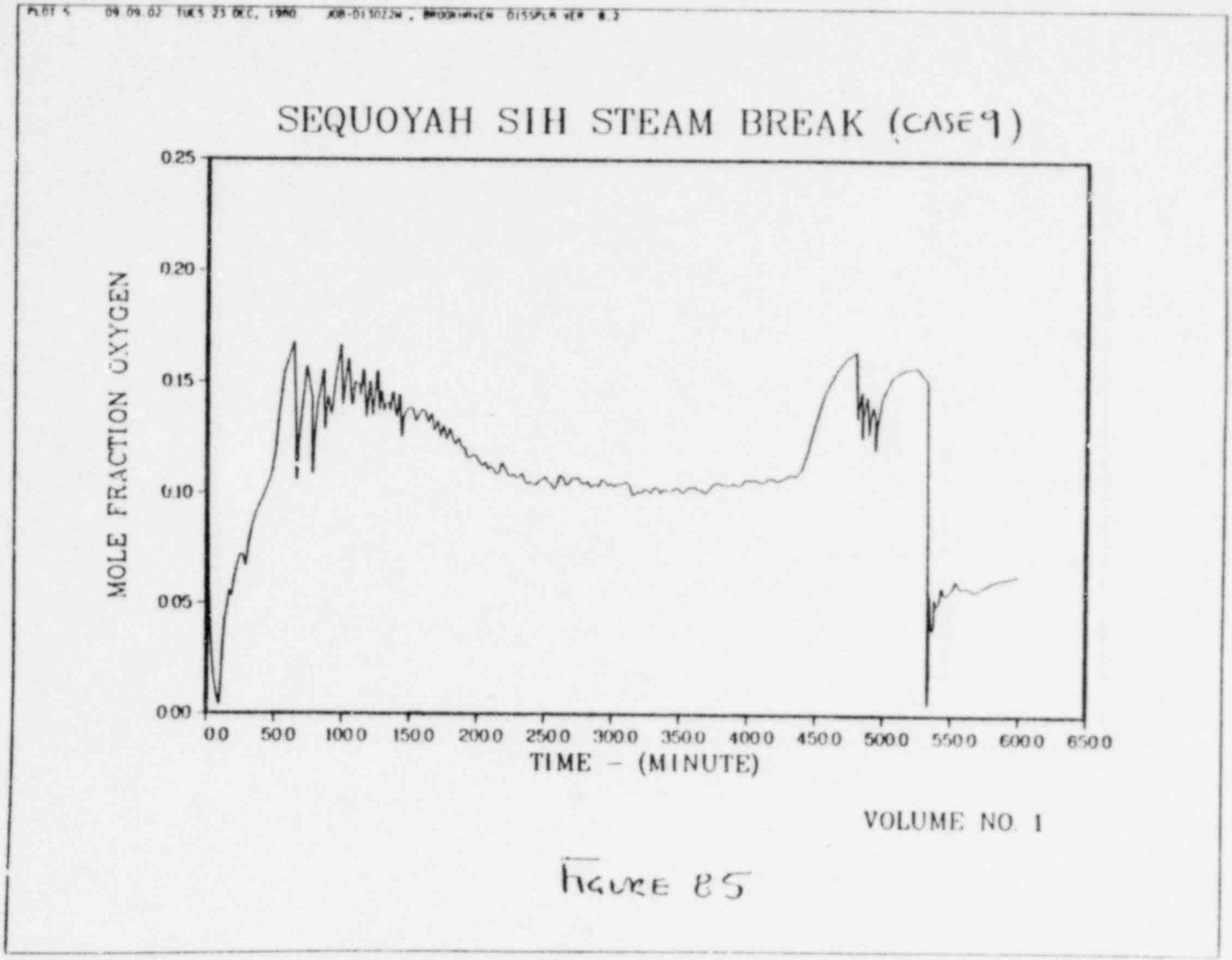

SEQUOYAH SIH STEAM BREAK (CASE 9)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 85

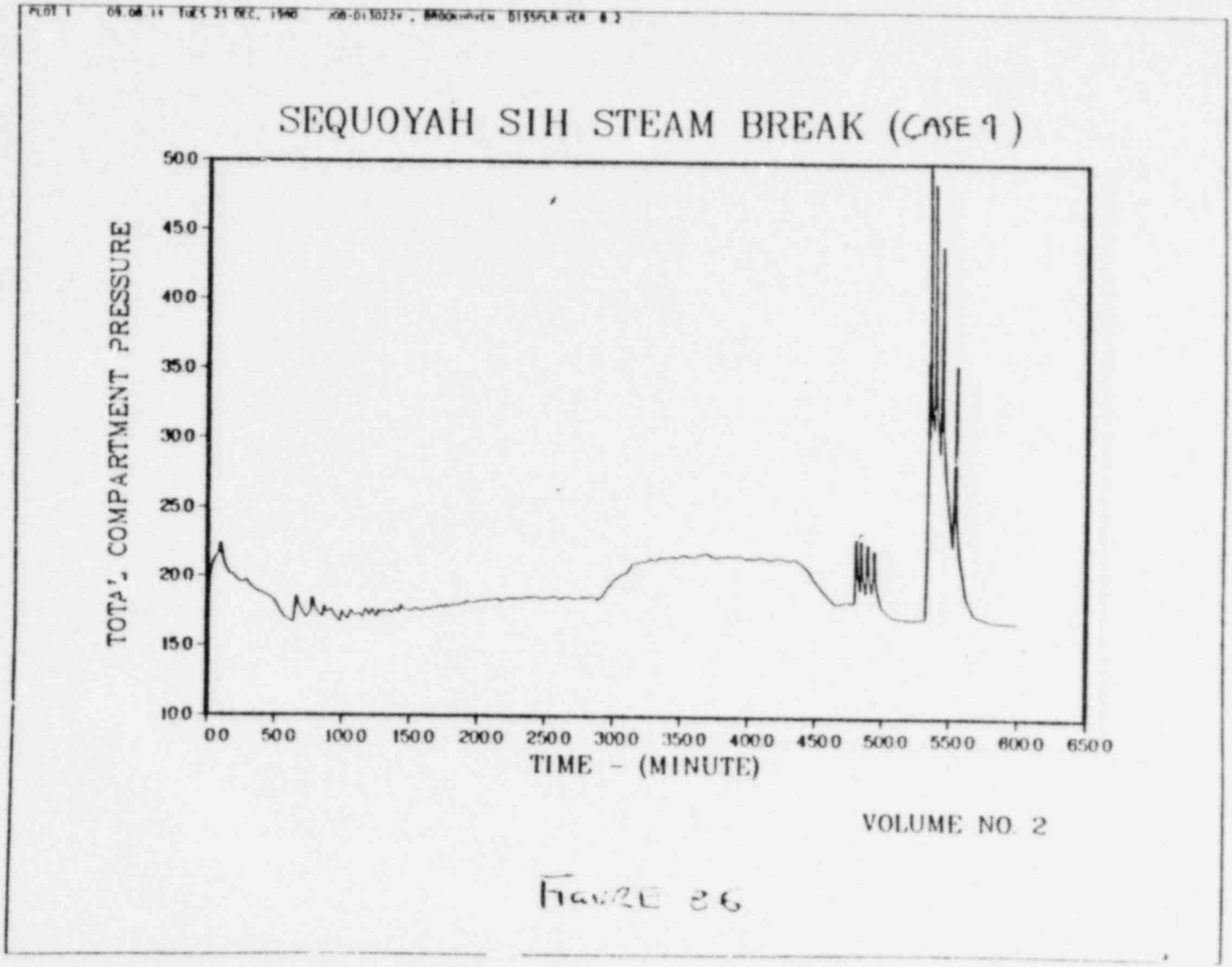

SEQUOYAH SIH STEAM BREAK (CASE 9)
TOTAL COMPARTMENT PRESSURE
500
450
400
350
300
250
200
150
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 26

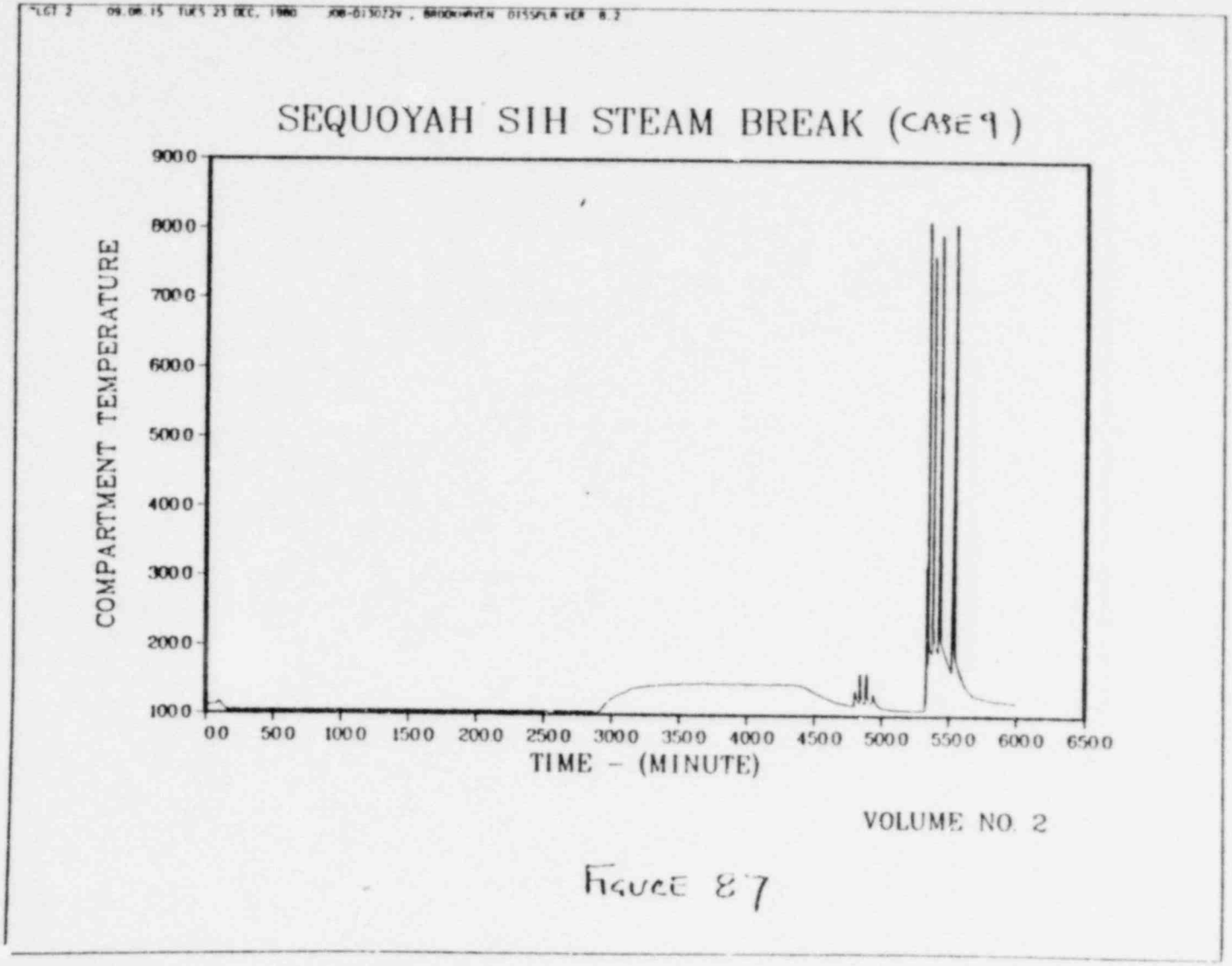

SEQUOYAH SIH STEAM BREAK (CASE 9)
COMPARTMENT TEMPERATURE
9000
8000
7000
6000
5000
4000
3000
2000
1000
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

Figure 87

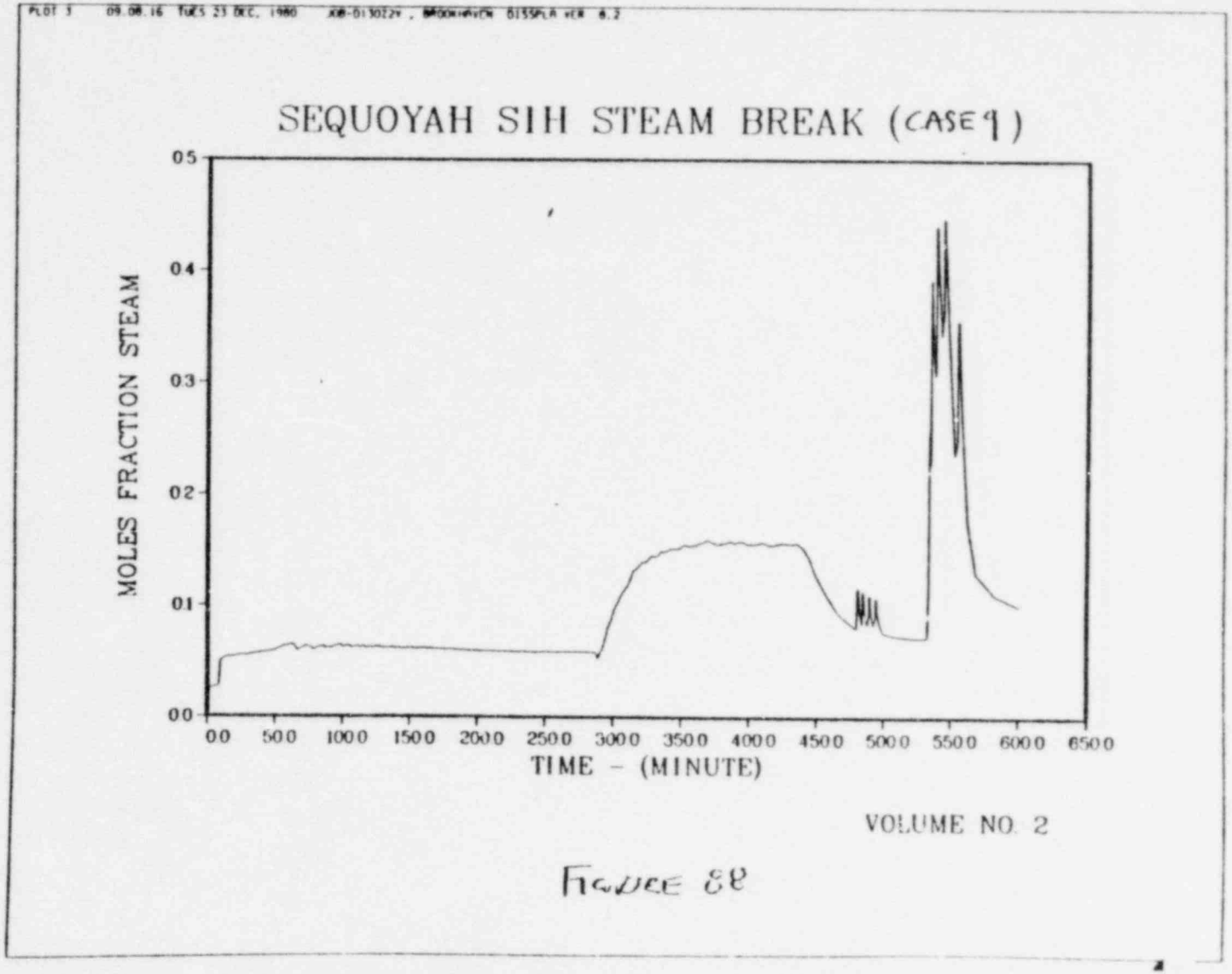

SEQUOYAH SIH STEAM BREAK (CASE 9)
MOLES FRACTION STEAM
05
04
03
02
01
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 88

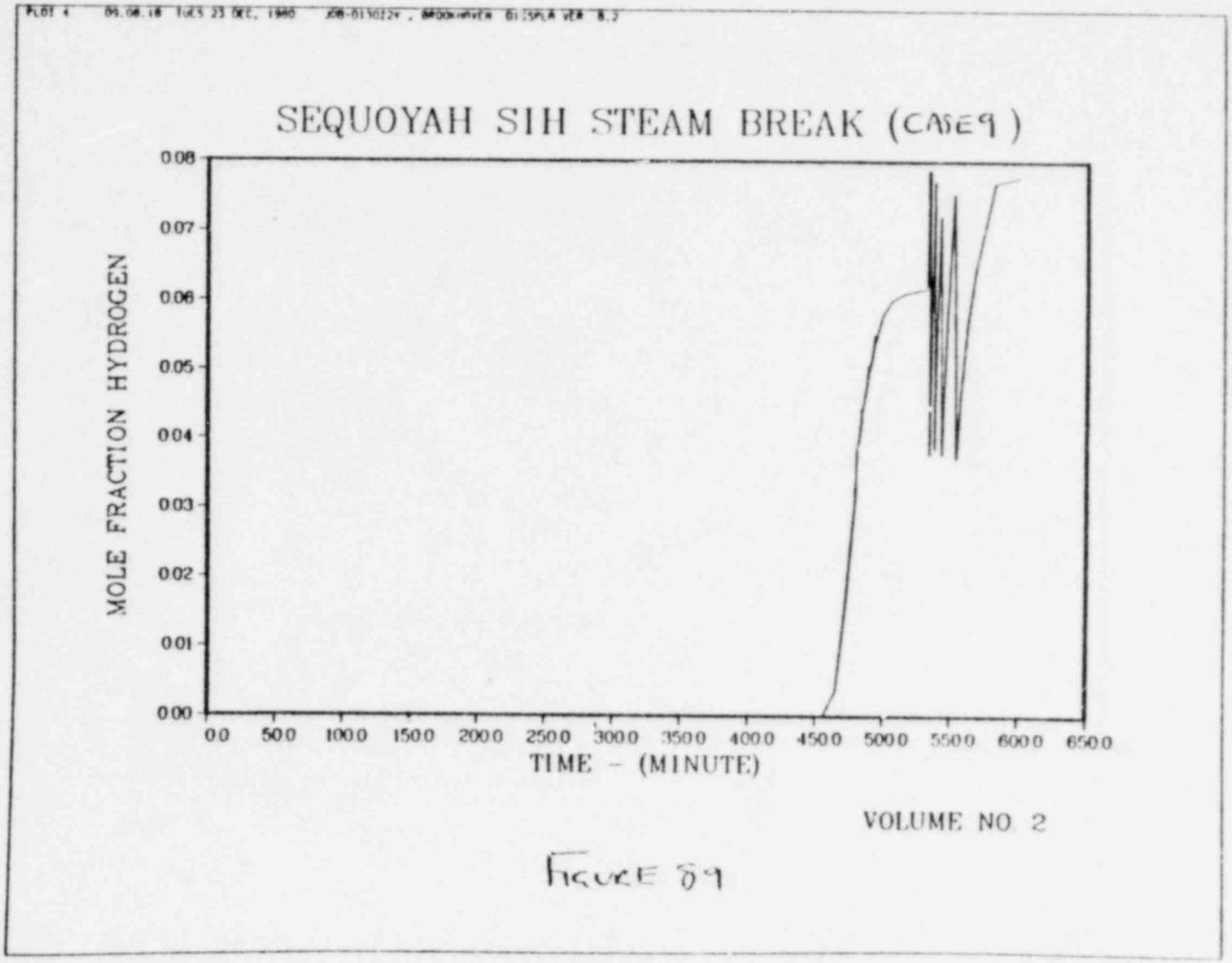

SEQUOYAH SIH STEAM BREAK (CASE9)
MOLE FRACTION HYDROGEN
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO 2

FIGURE 89

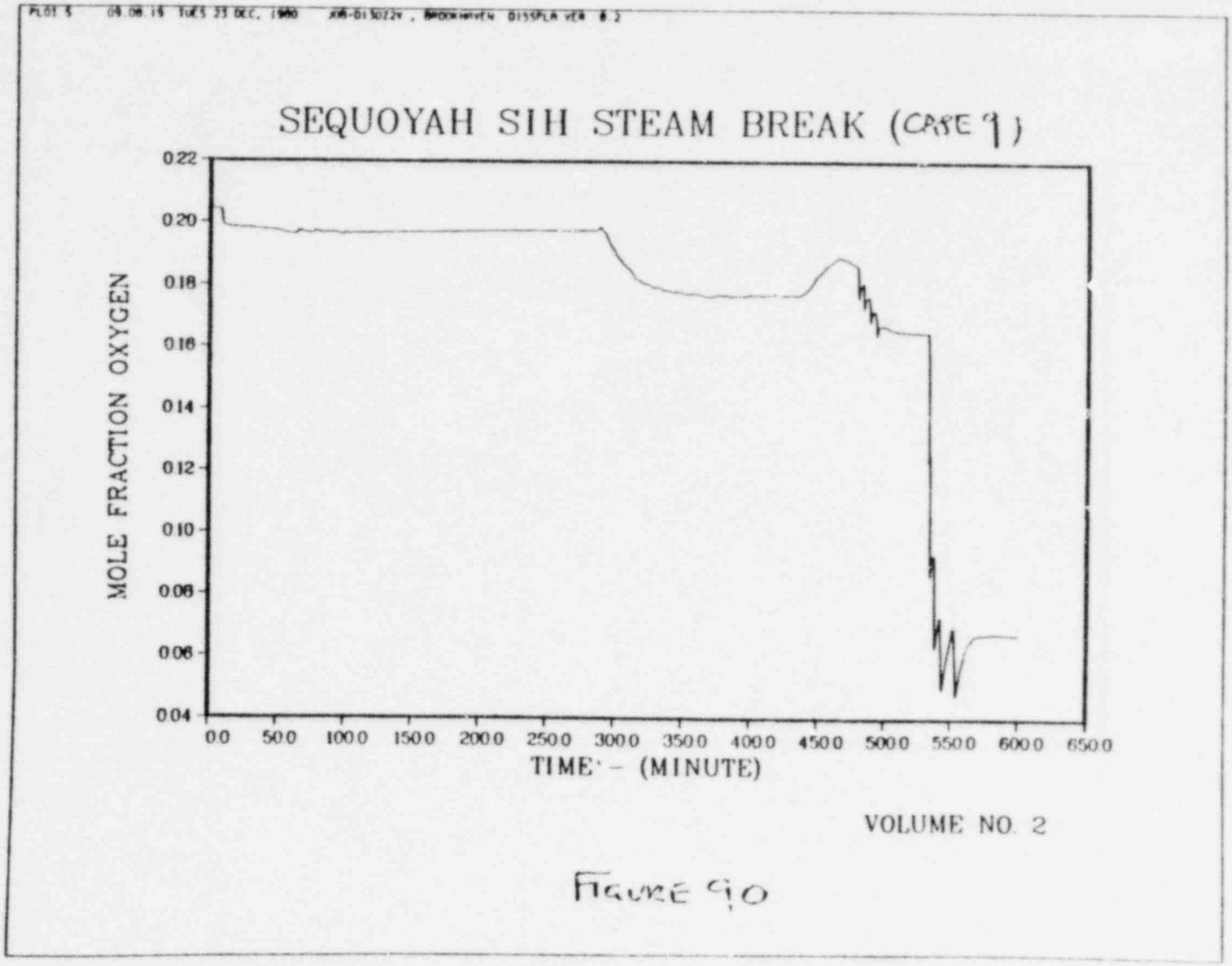

SEQUOYAH SIH STEAM BREAK (CASE 1)
MOLE FRACTION OXYGEN
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 9.0

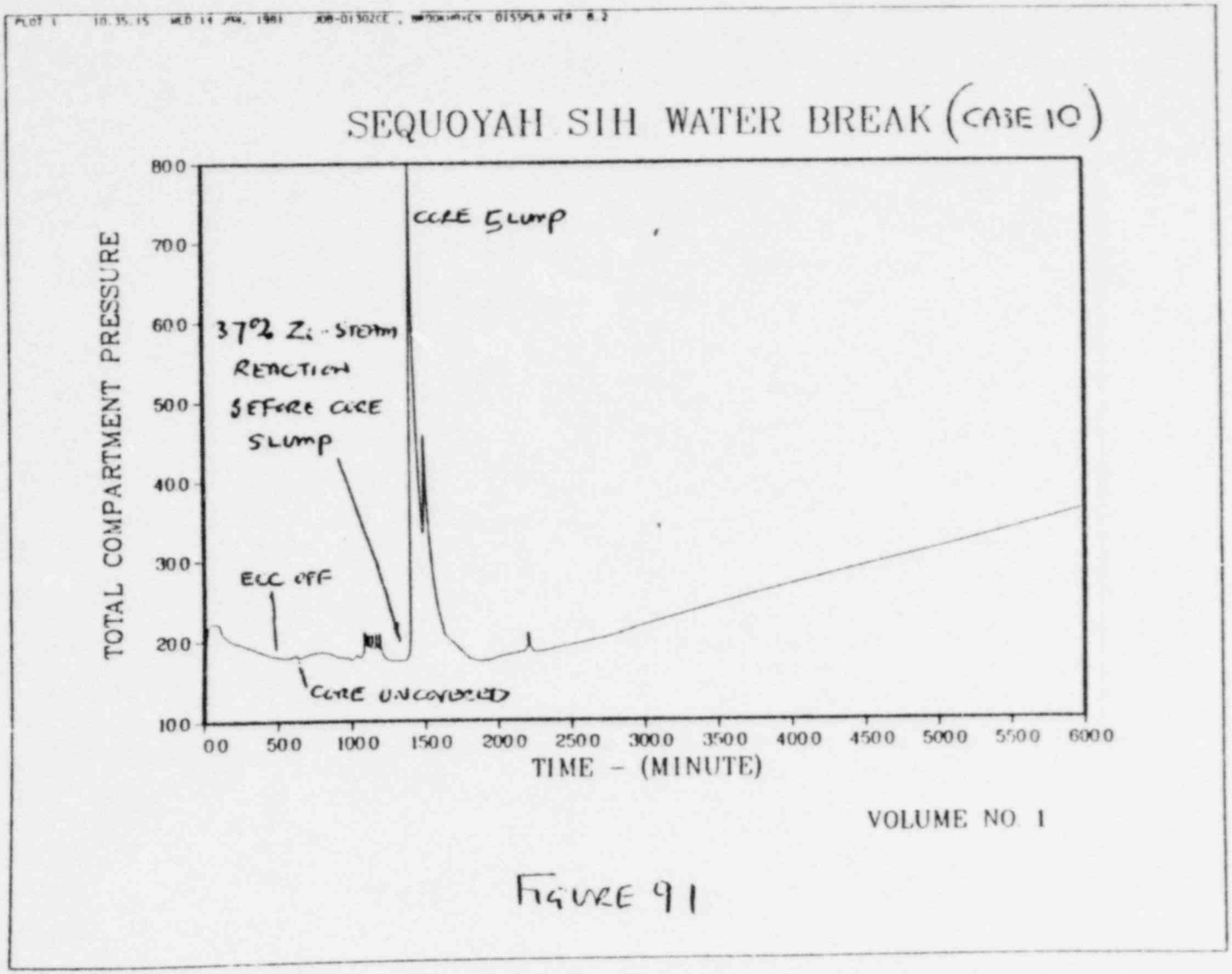

SEQUOYAH SIH WATER BREAK (CASE 10)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
37% Zr - STEAM REACTION BEFORE CORE SLUMP
CORE SLUMP
ECC OFF
CORE UNCOVERED
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO 1

FIGURE 91

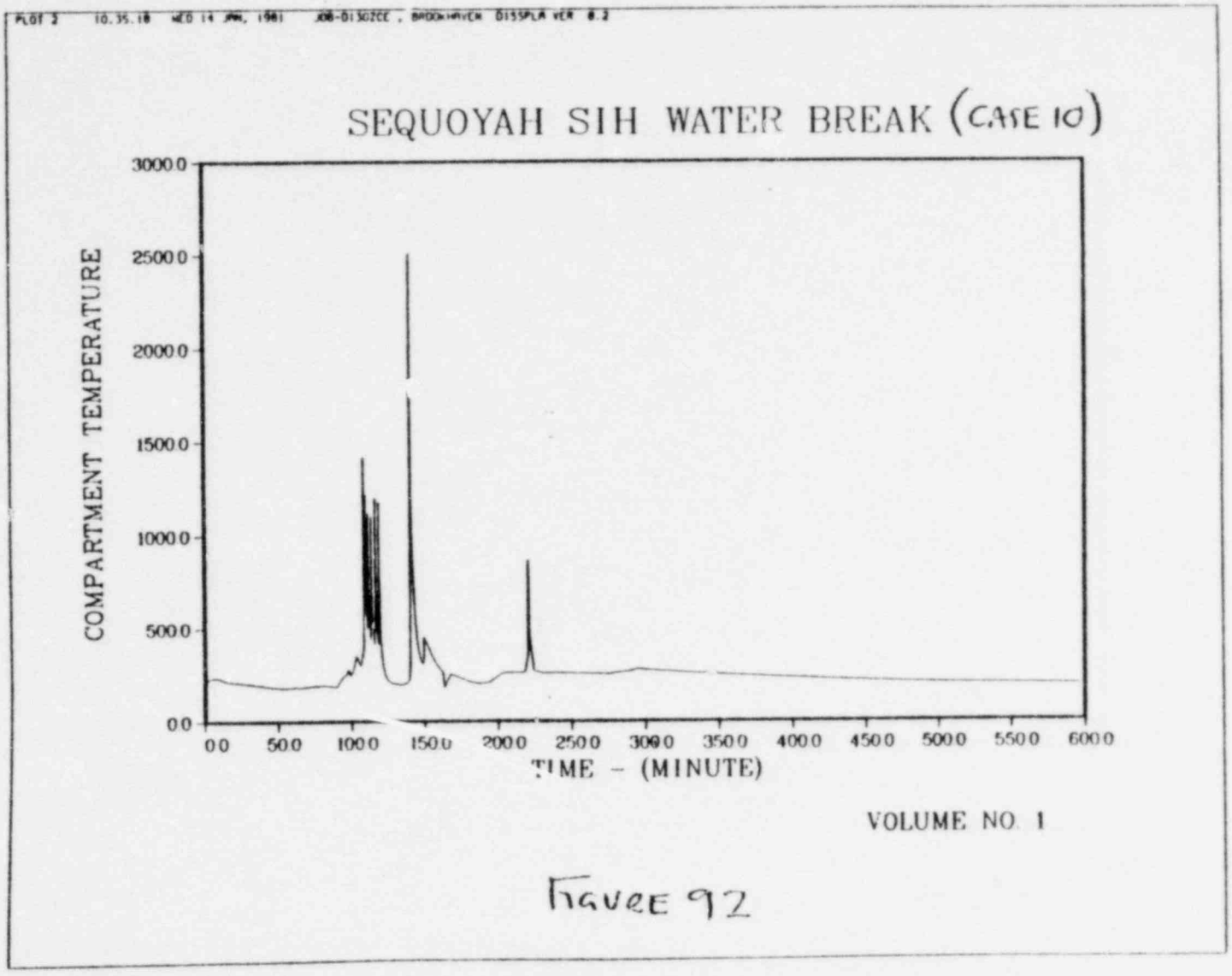

SEQUOYAH SIH WATER BREAK (CASE 10)
COMPARTMENT TEMPERATURE
30000
25000
20000
15000
10000
5000
00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 92

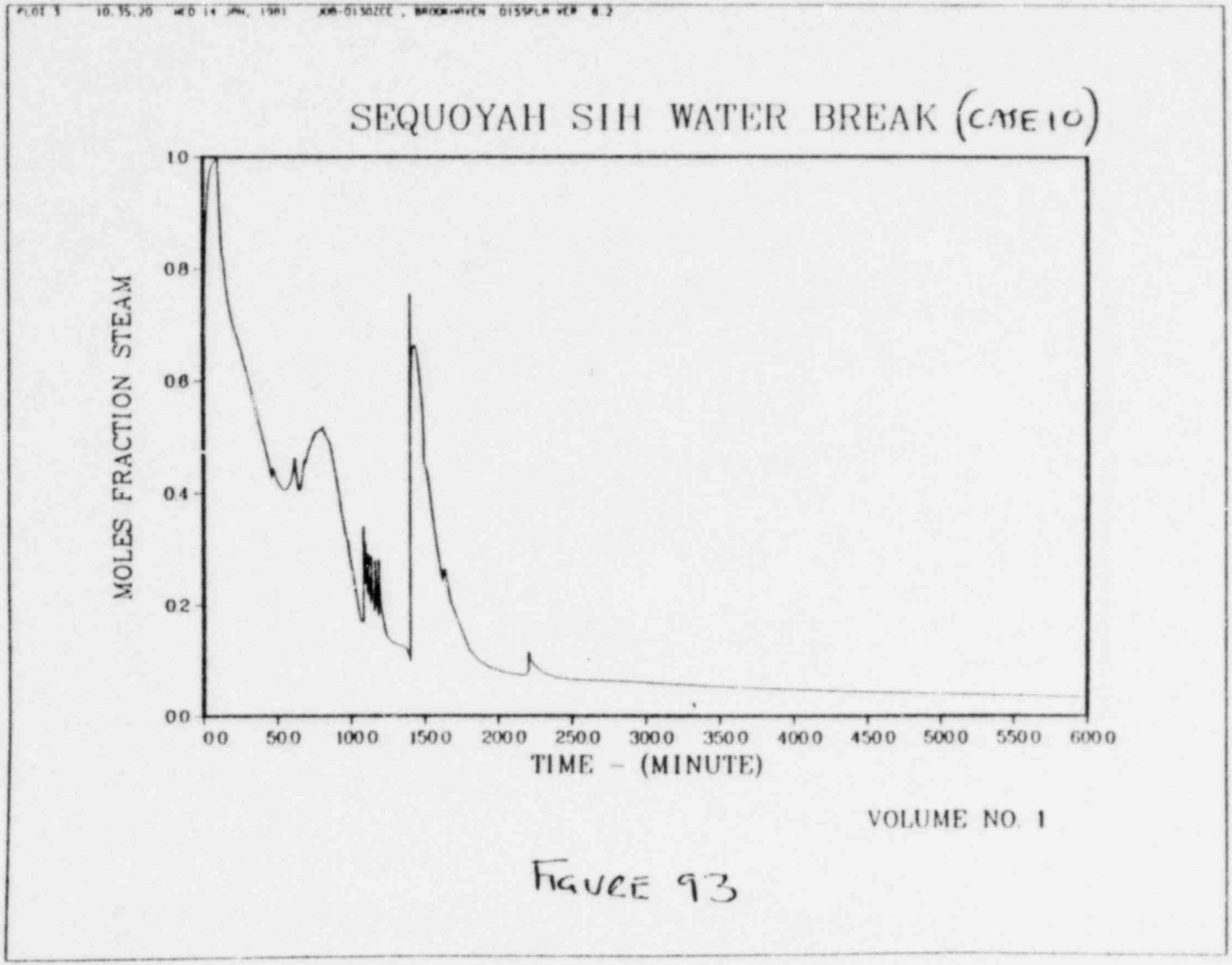

SEQUOYAH SIH WATER BREAK (CASE 10)
MOLES FRACTION STEAM
10
08
06
04
02
00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 93

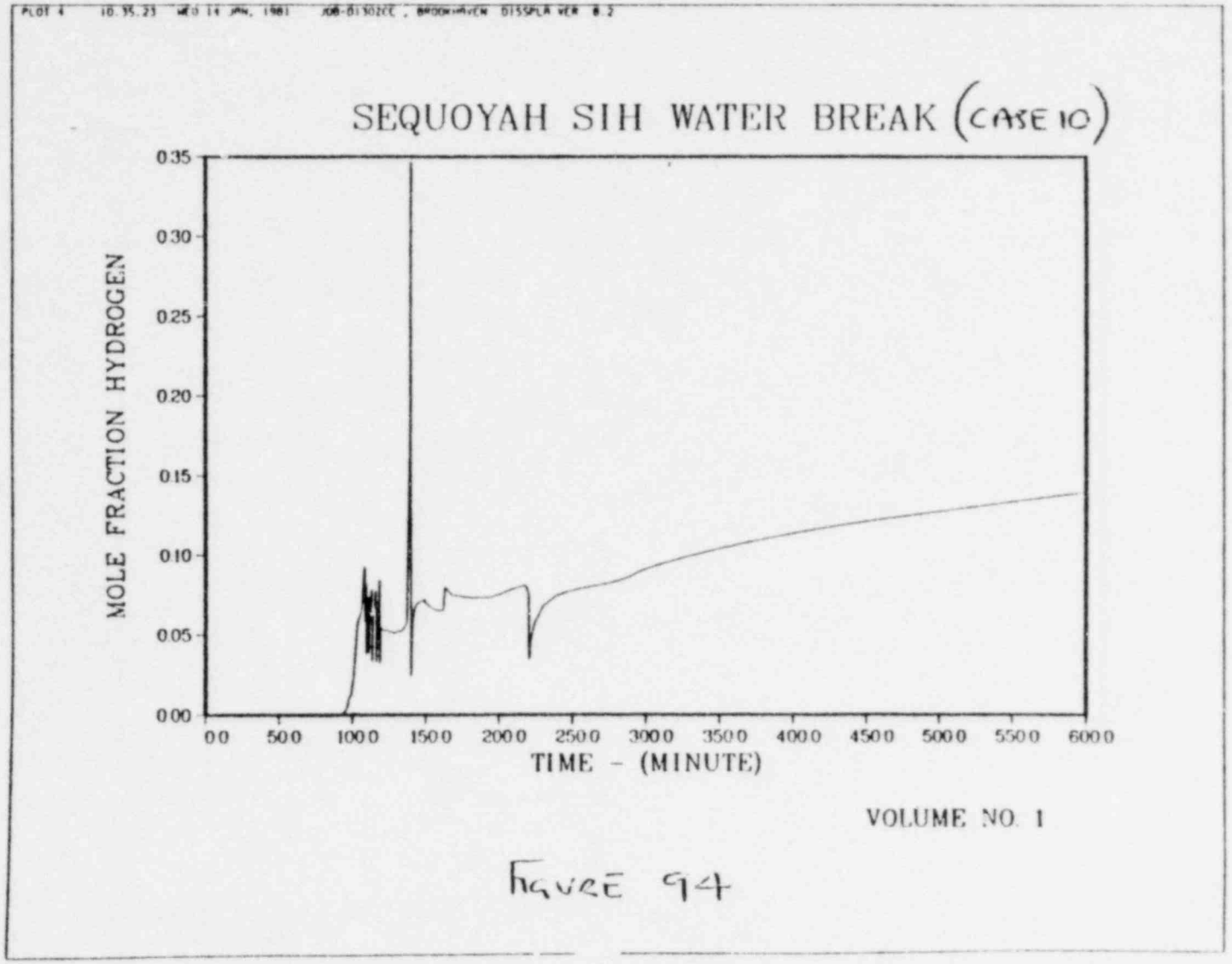

SEQUOYAH SIH WATER BREAK (CASE 10)
MOLE FRACTION HYDROGEN
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

Figure 94

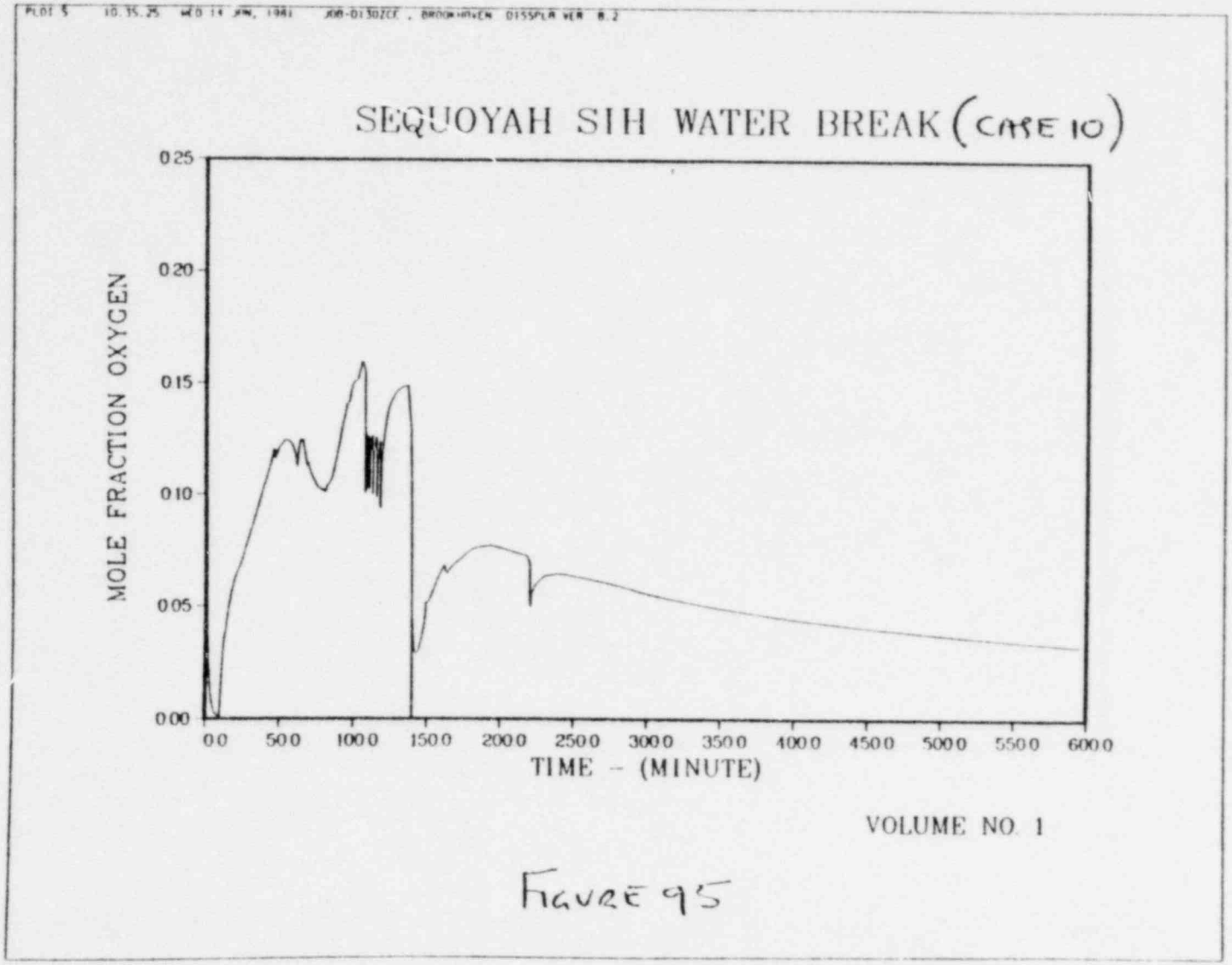

SEQUOYAH SIH WATER BREAK (CASE 10)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 95

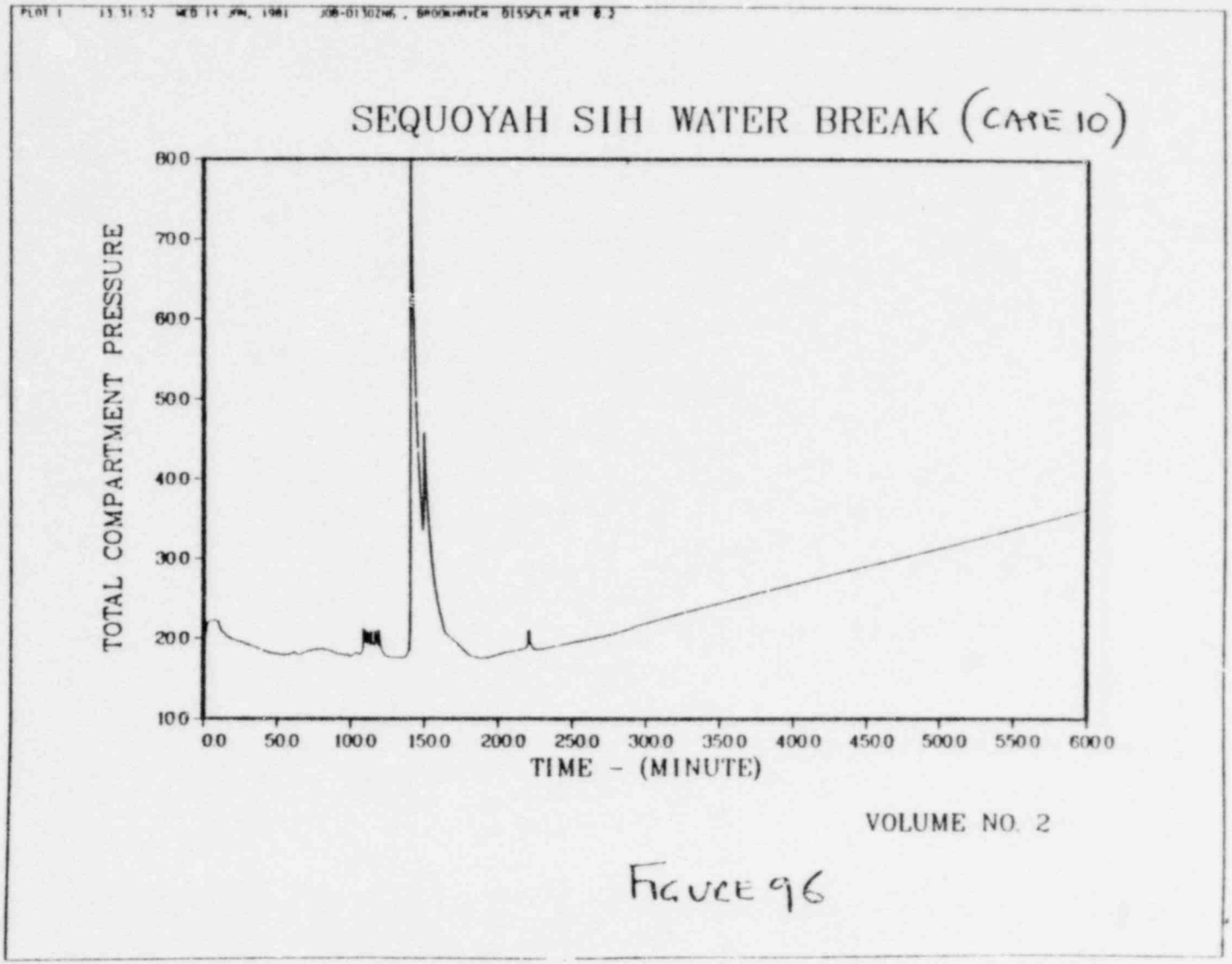
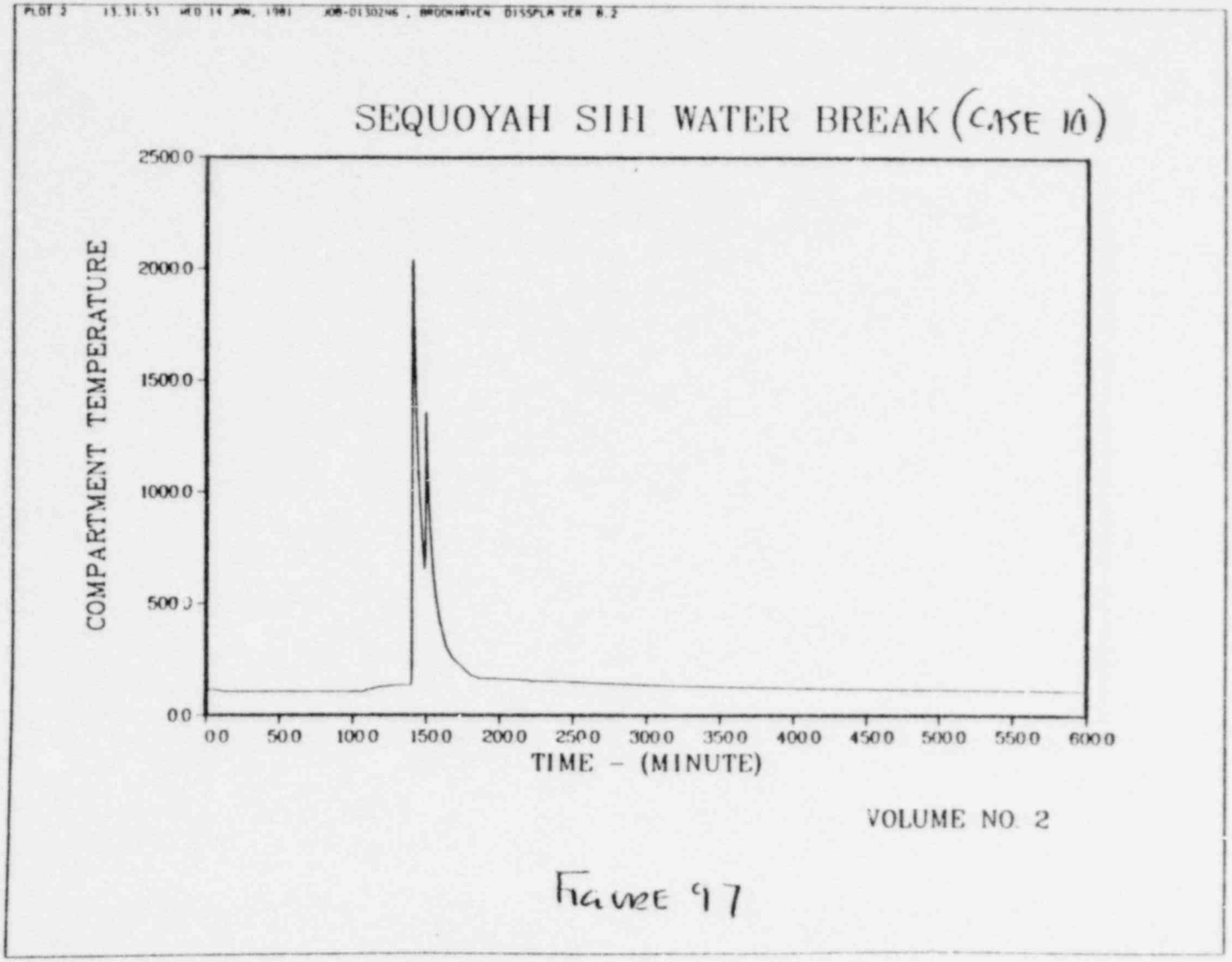

SEQUOYAH SIH WATER BREAK (CARE 10)
TOTAL COMPARTMENT PRESSURE
800
700
600
500
400
300
200
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 96


SEQUOYAH SIH WATER BREAK (CASE 10)
COMPARTMENT TEMPERATURE
25000
20000
15000
10000
5000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
TIME - (MINUTE)
VOLUME NO. 2

Frame 97

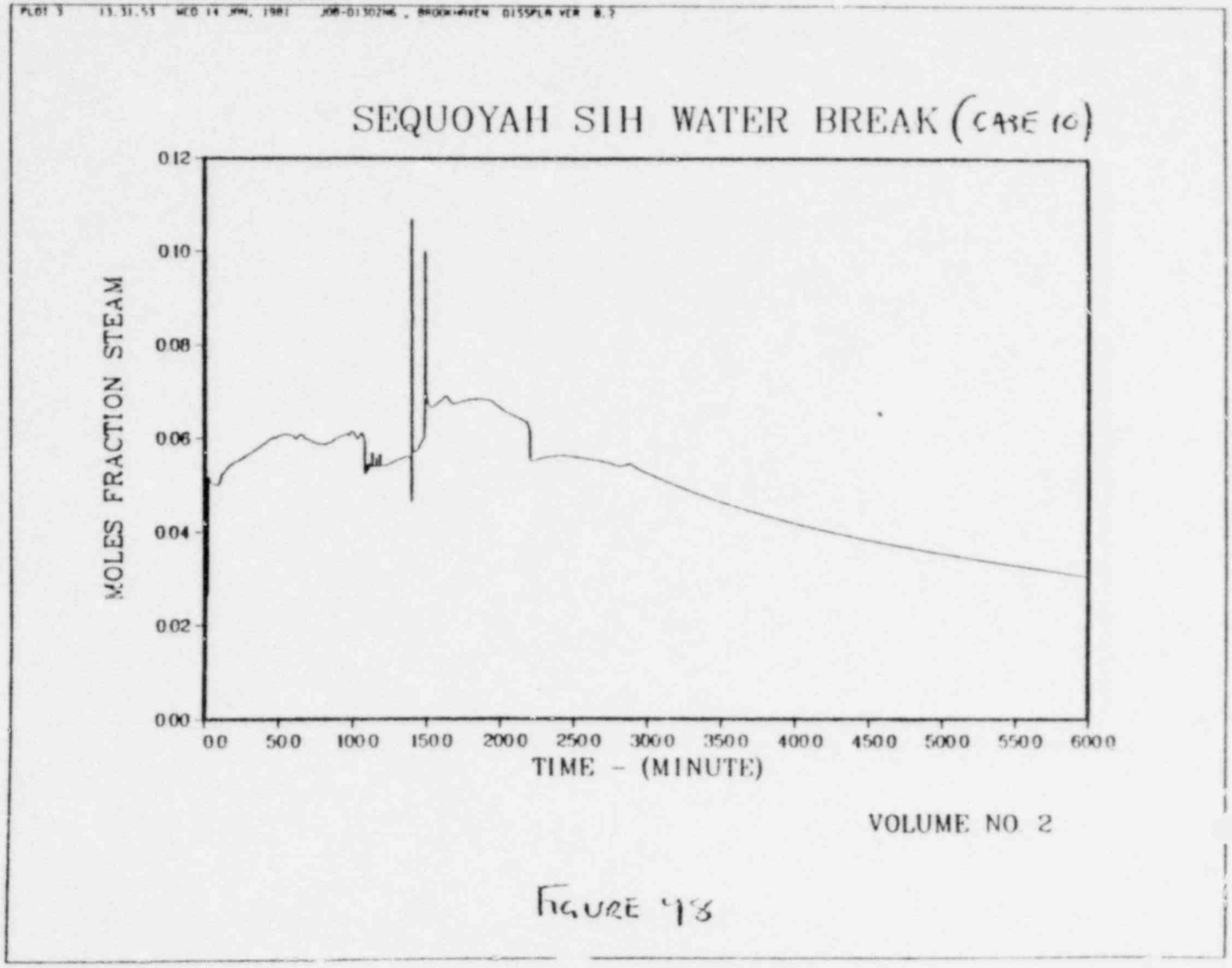

SEQUOYAH SIH WATER BREAK (CASE 10)
MOLES FRACTION STEAM
0.12
0.10
0.08
0.06
0.04
0.02
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO 2

FIGURE 43

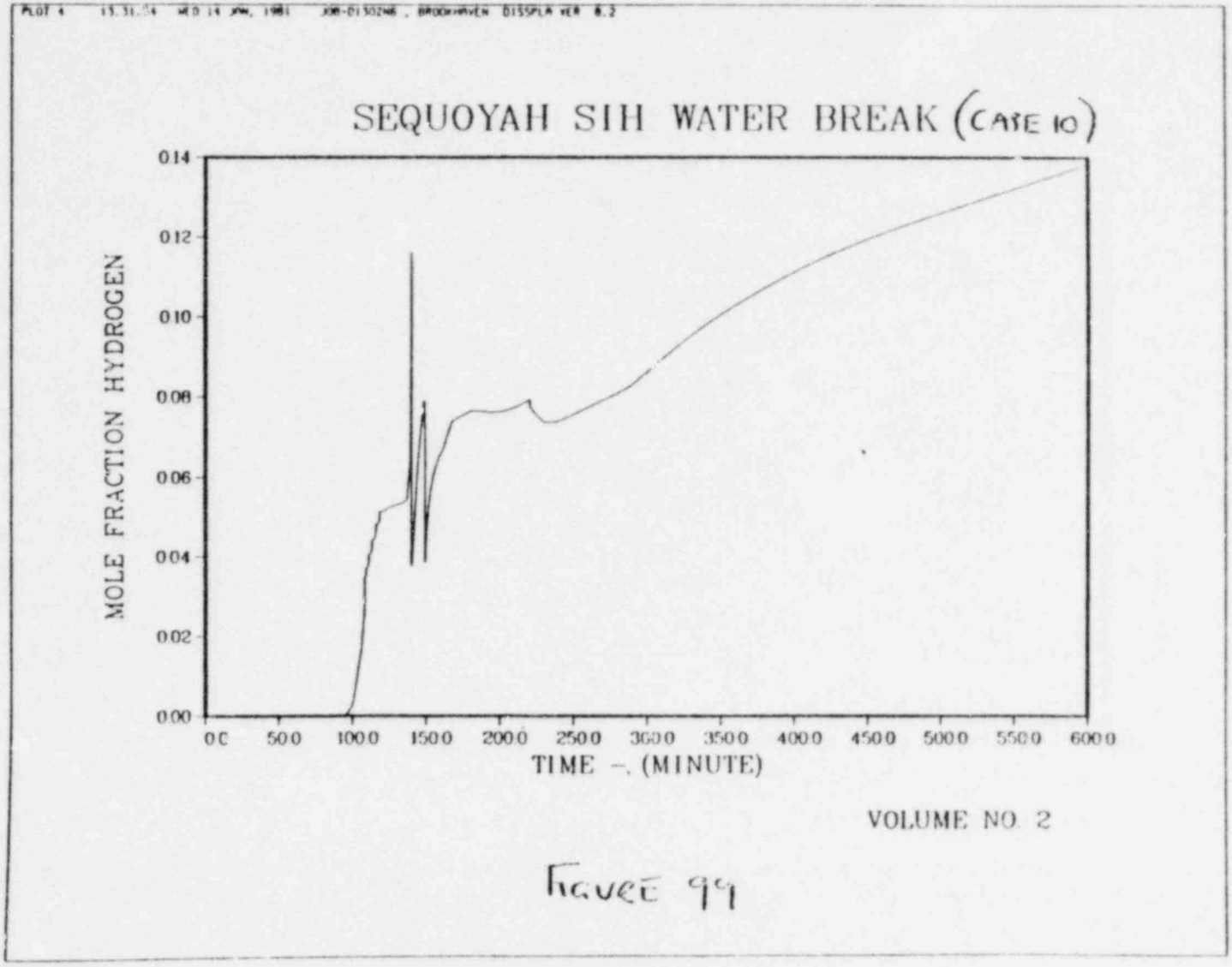

SEQUOYAH SIH WATER BREAK (CASE 10)
MOLE FRACTION HYDROGEN
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME -. (MINUTE)
VOLUME NO. 2

Figure 99

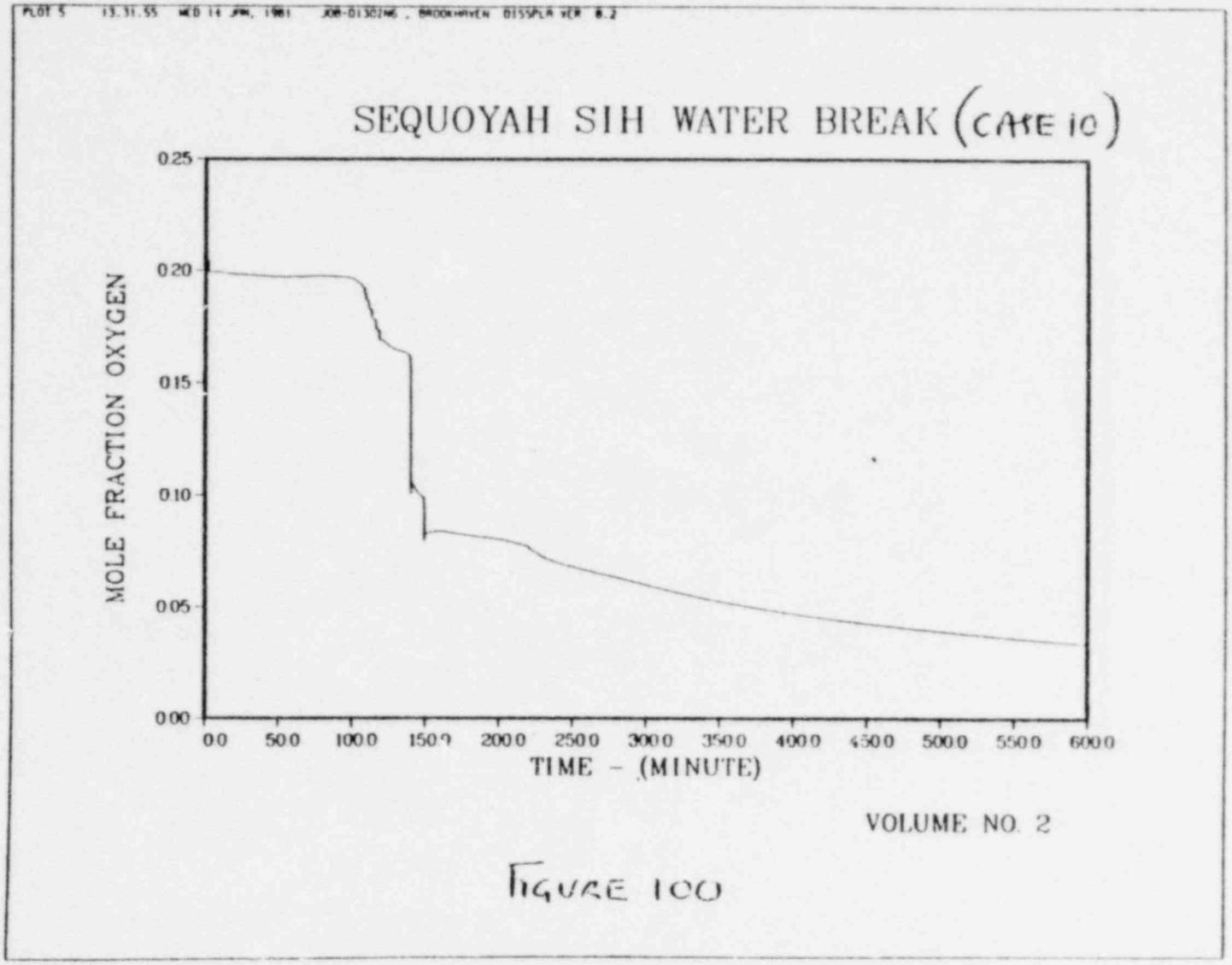

SEQUOYAH SIH WATER BREAK (CASE 10)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 100

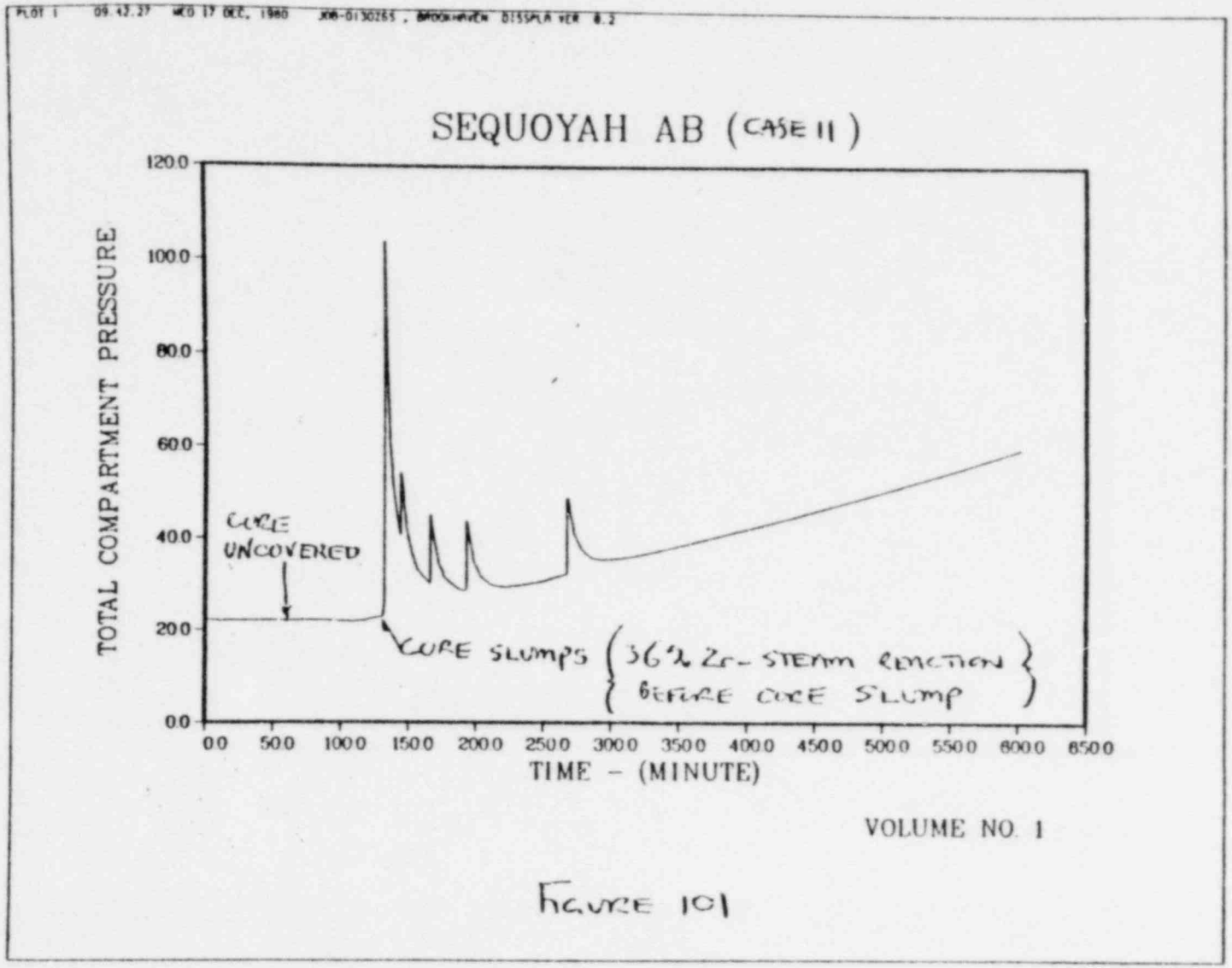

SEQUOYAH AB (CASE II)
TOTAL COMPARTMENT PRESSURE
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
CORE UNCOVERED
CORE SLUMPS
36% Zr-STEAM REACTION
BEFORE CORE SLUMP
VOLUME NO. 1

FIGURE 101

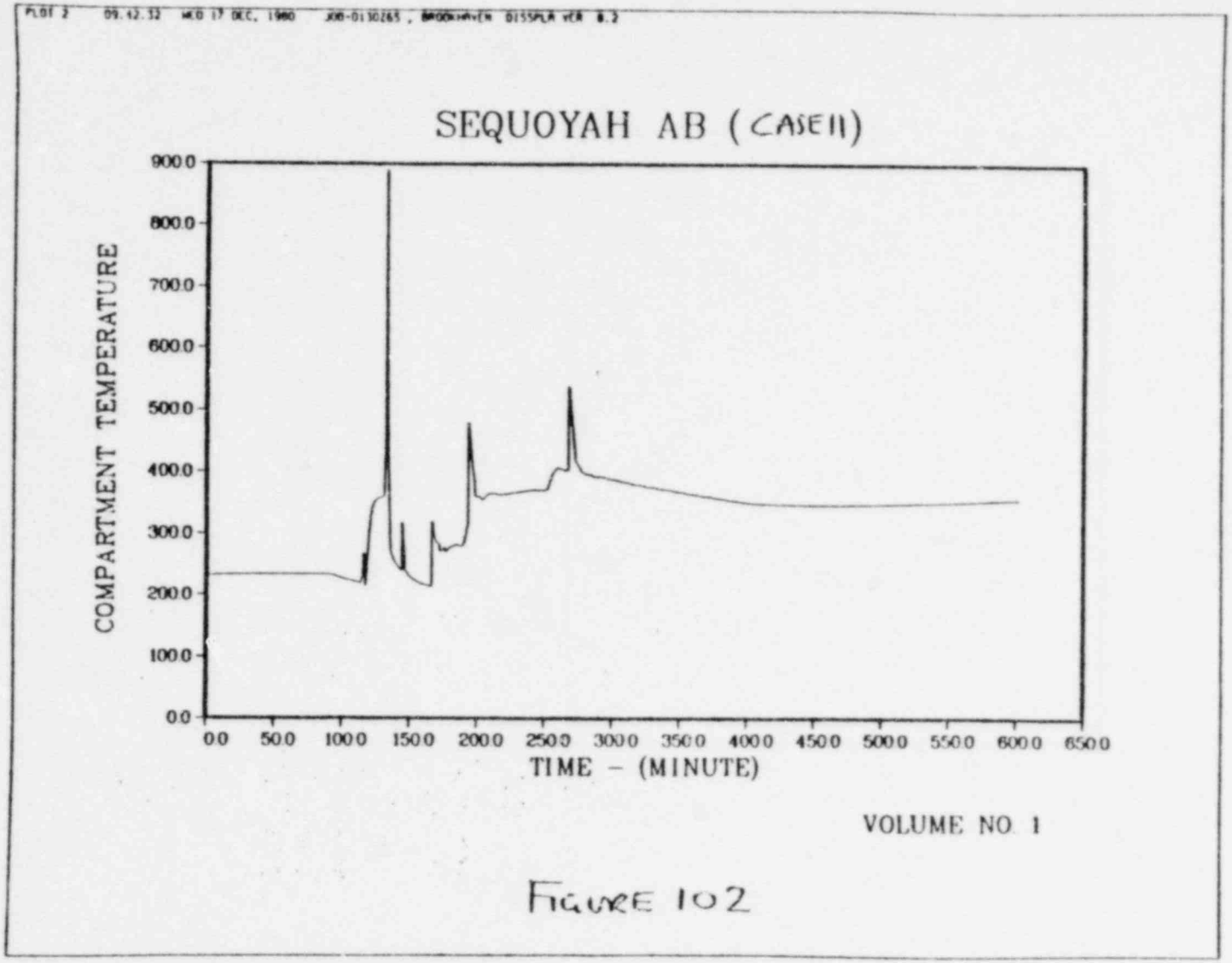

SEQUOYAH AB (CASE II)
COMPARTMENT TEMPERATURE
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 102

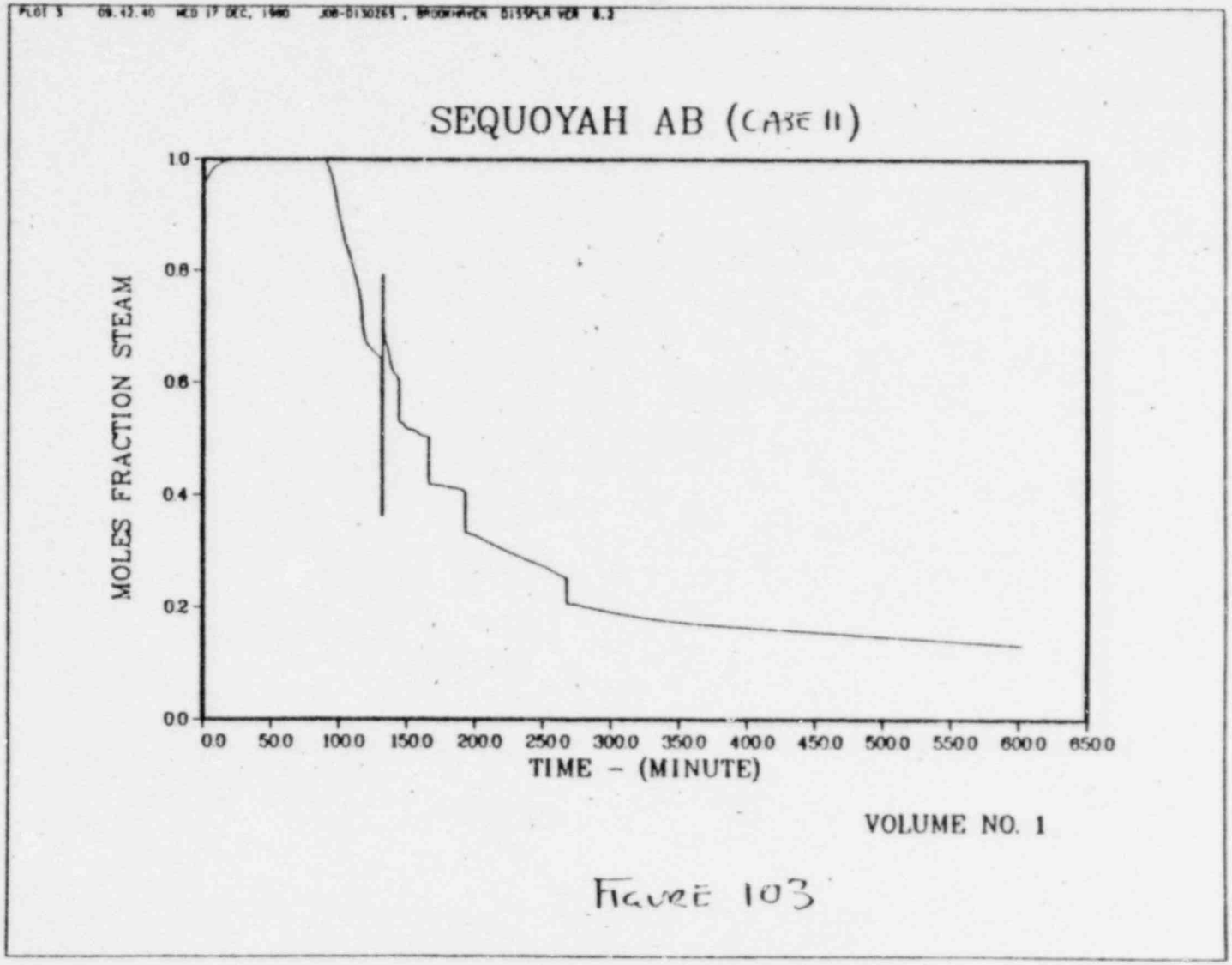

SEQUOYAH AB (CASE II)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

Figure 103

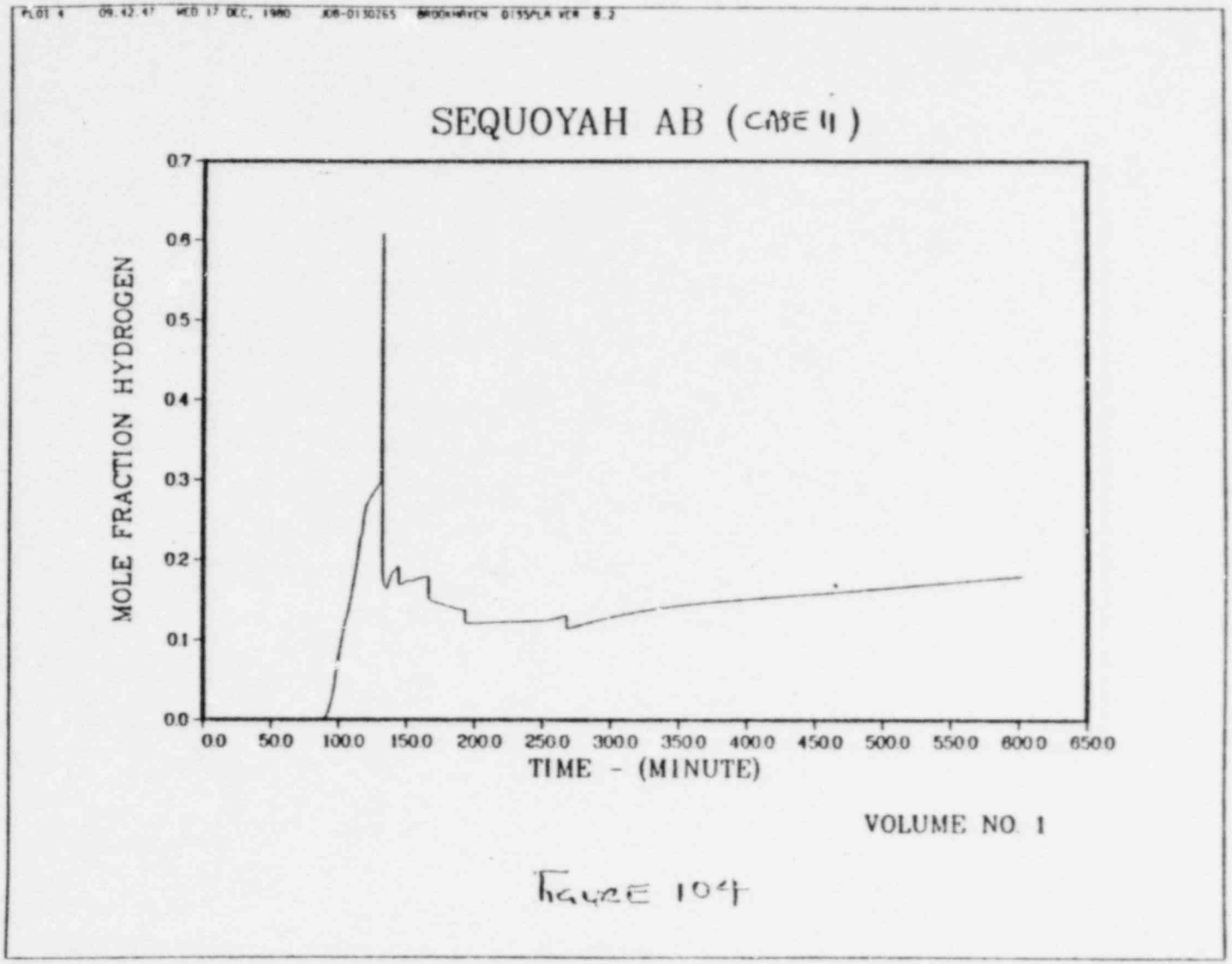

PLOT 4 09.42.47 WED 17 DEC, 1980 JOB-0130265 BROOKHAVEN OTSSPLA VER 8.2
SEQUOYAH AB (CASE 11)
MOLE FRACTION HYDROGEN
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 10-4

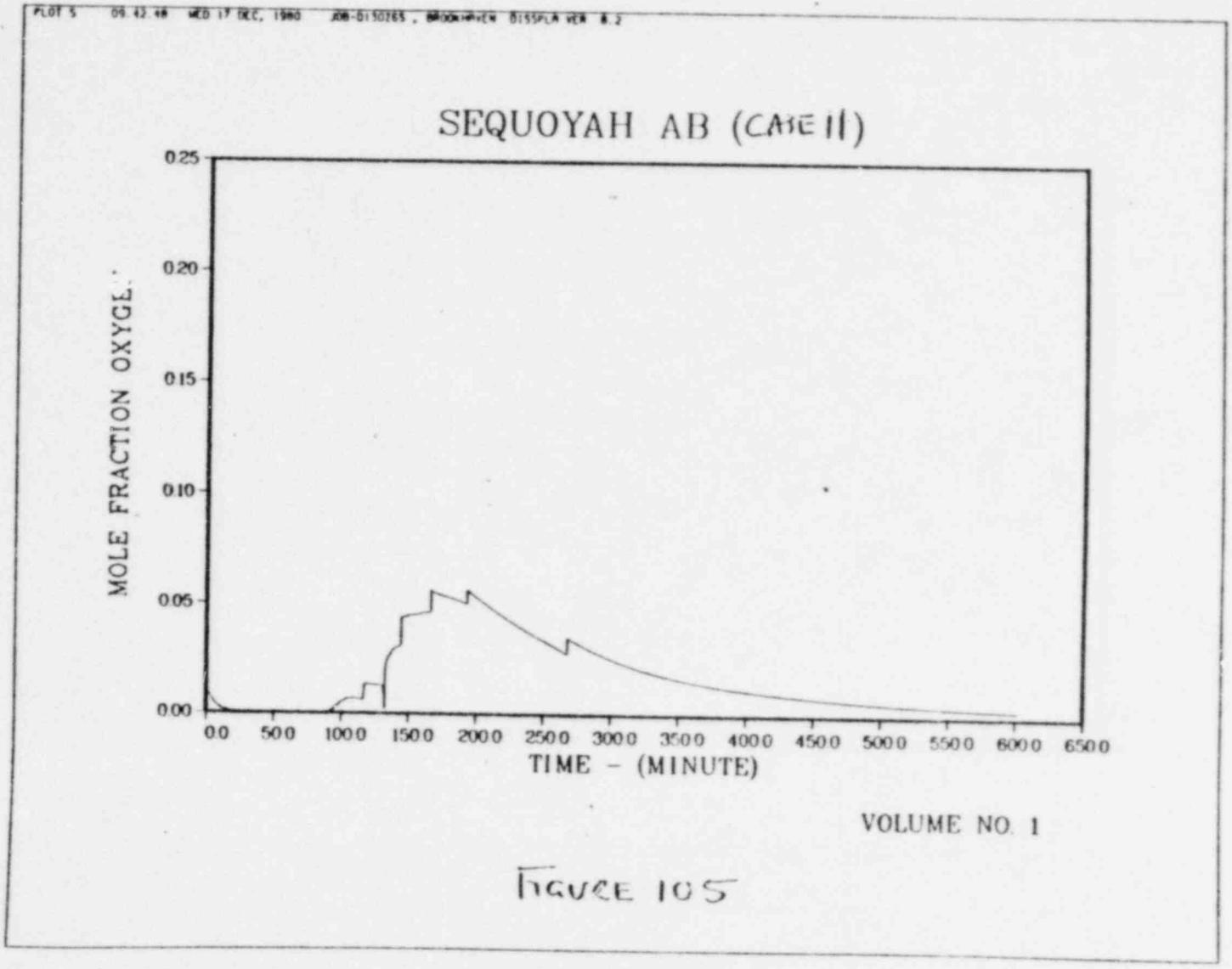

PLOT 5 09.42.48 WED 17 DEC, 1980 JOB-0150265 , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH AB (CASE II)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 10.5

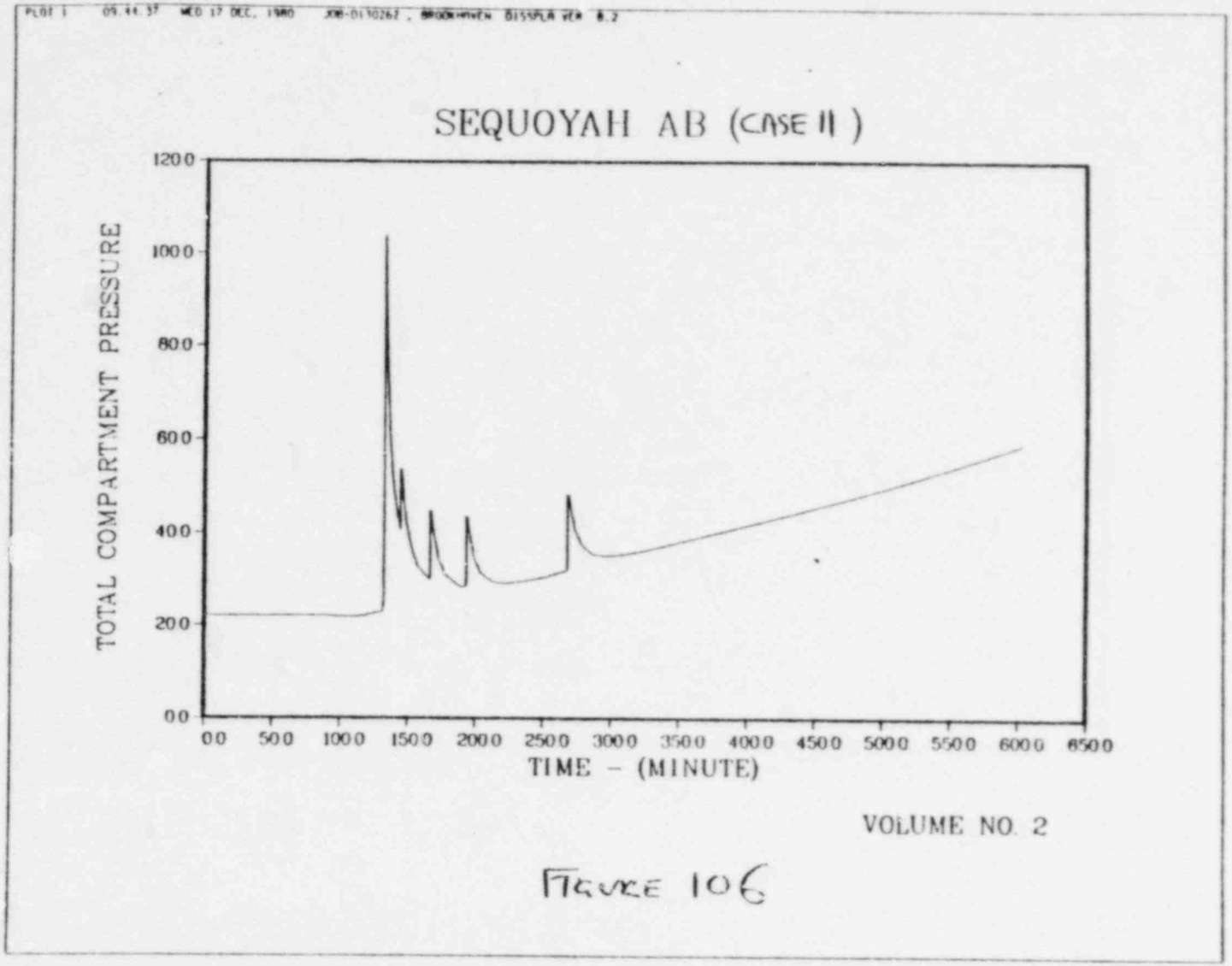

SEQUOYAH AB (CASE II)
TOTAL COMPARTMENT PRESSURE
1200
1000
800
600
400
200
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 106

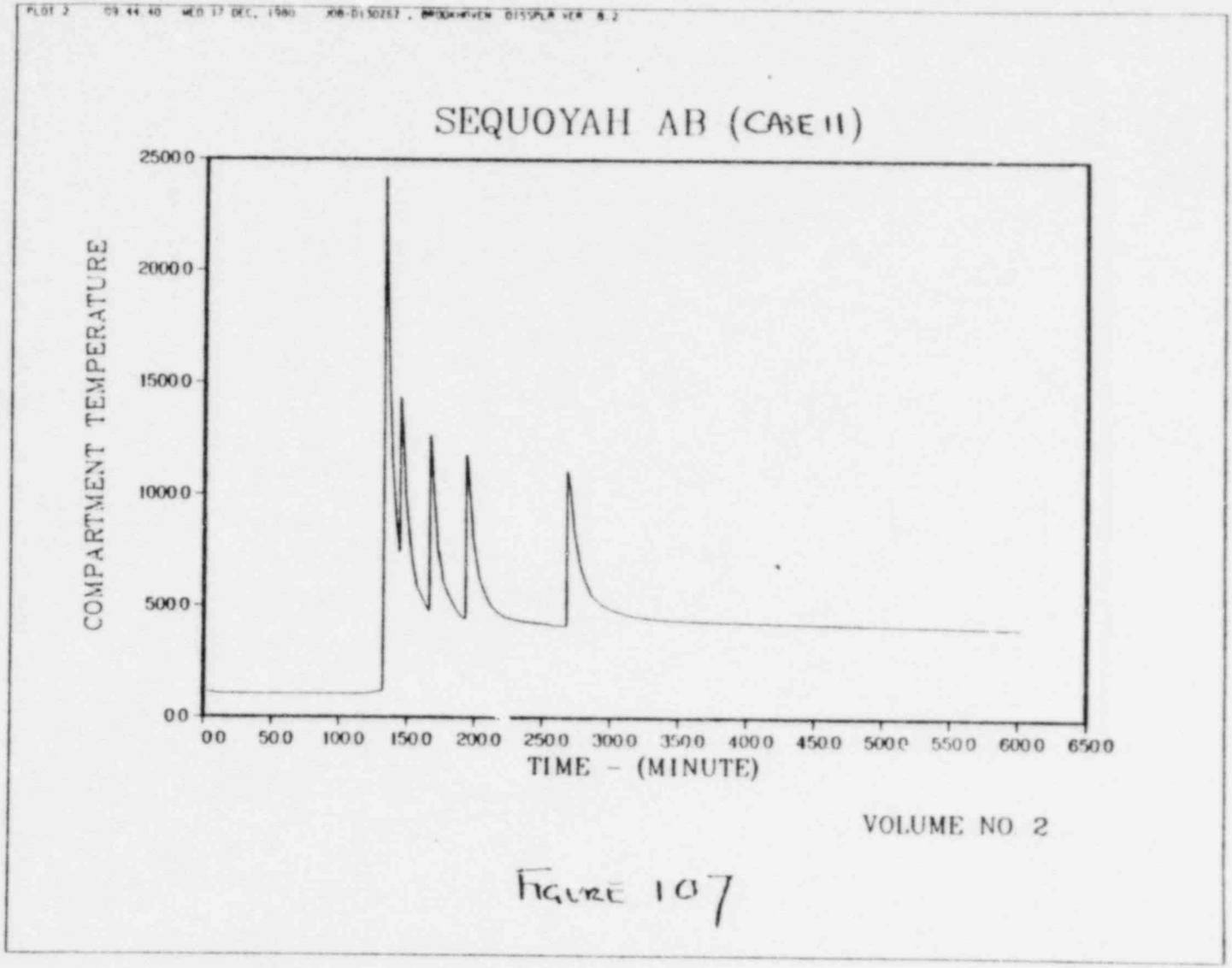

SEQUOYAH AB (CASE II)
COMPARTMENT TEMPERATURE
25000
20000
15000
10000
5000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500
TIME - (MINUTE)
VOLUME NO 2

FIGURE 107

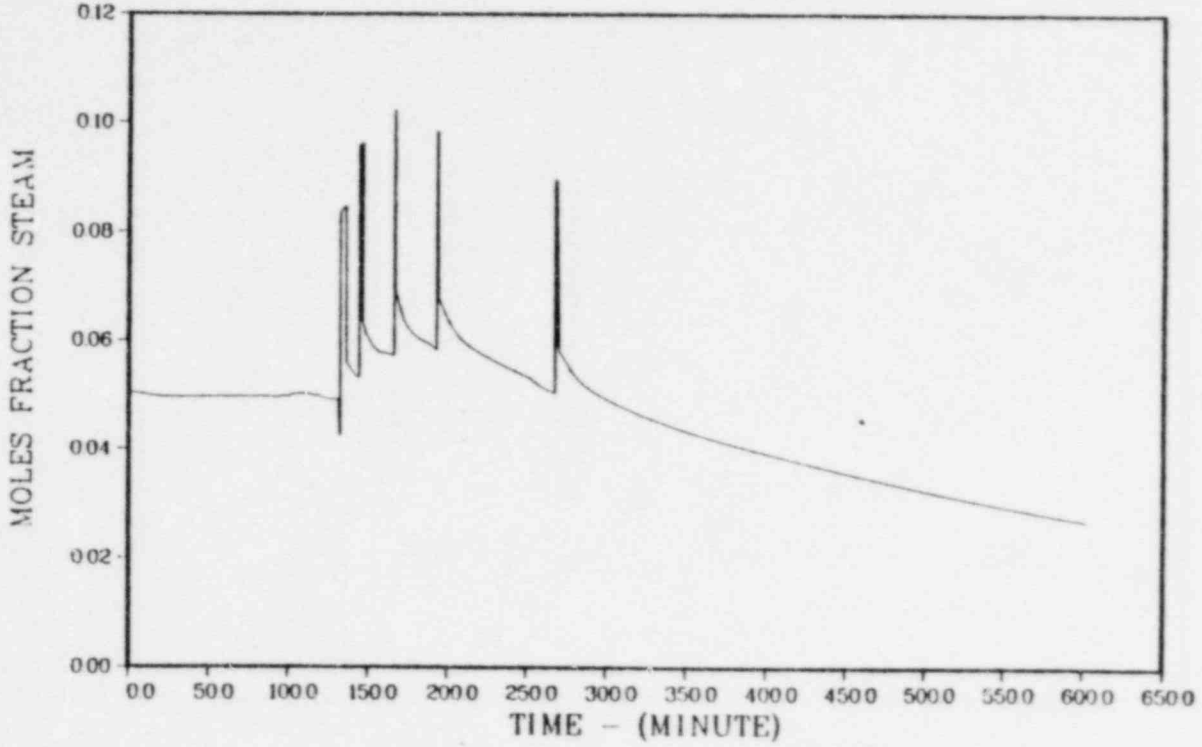

SEQUOYAH AB (CASE II)
MOLES FRACTION STEAM
0.12
0.10
0.08
0.06
0.04
0.02
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 108

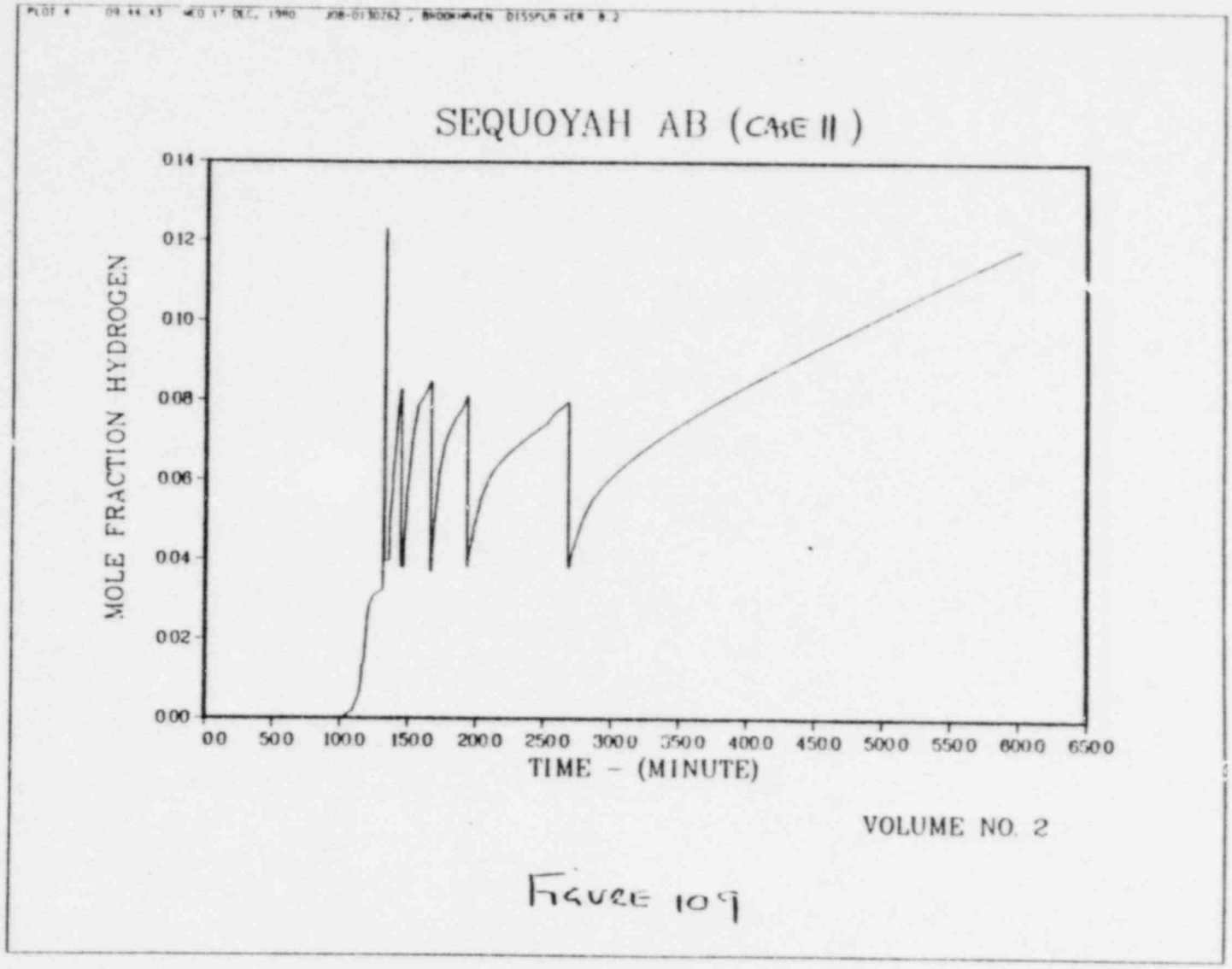

SEQUOYAH AB (CASE II)
MOLE FRACTION HYDROGEN
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

Figure 109

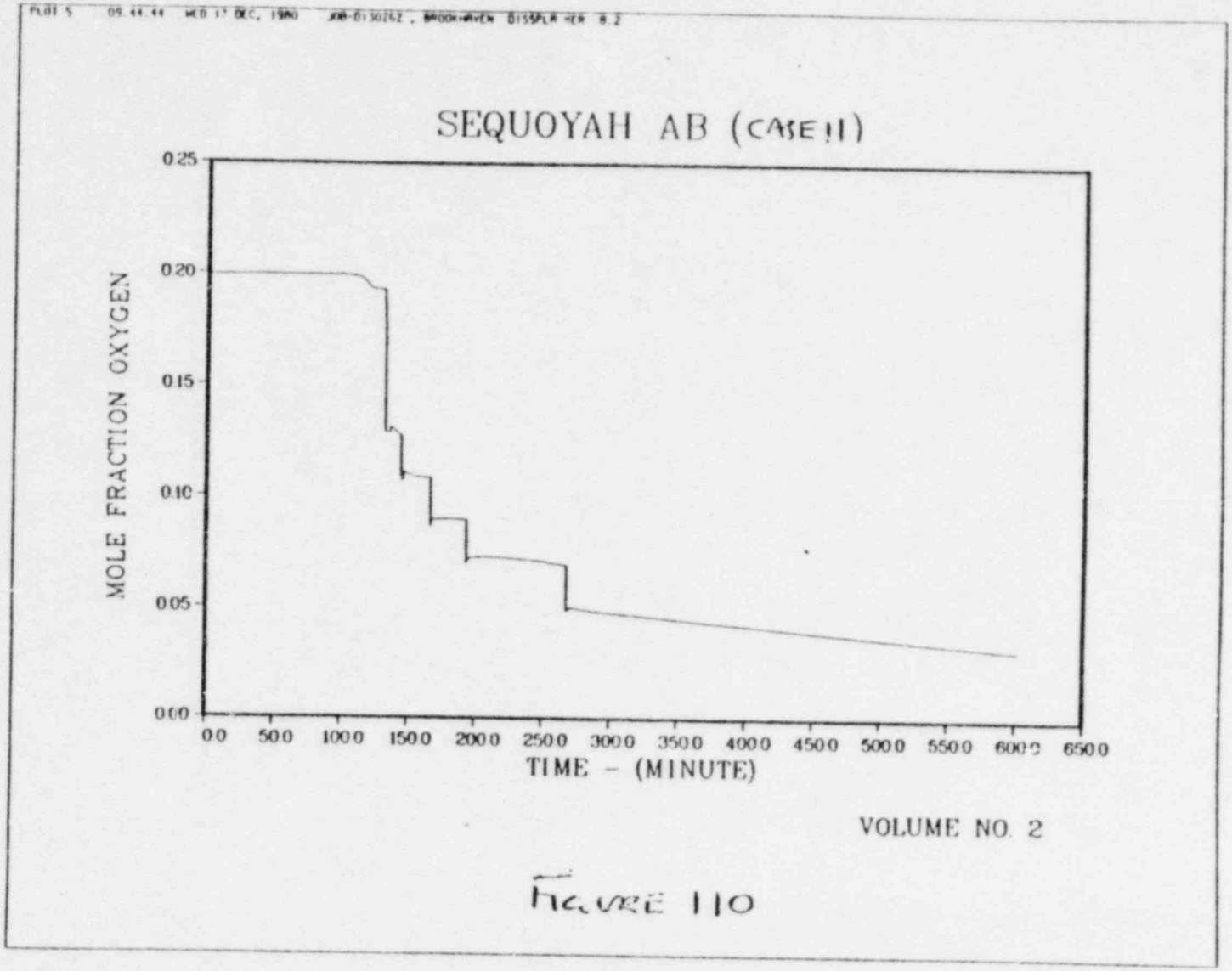

SEQUOYAH AB (CASE II)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 110

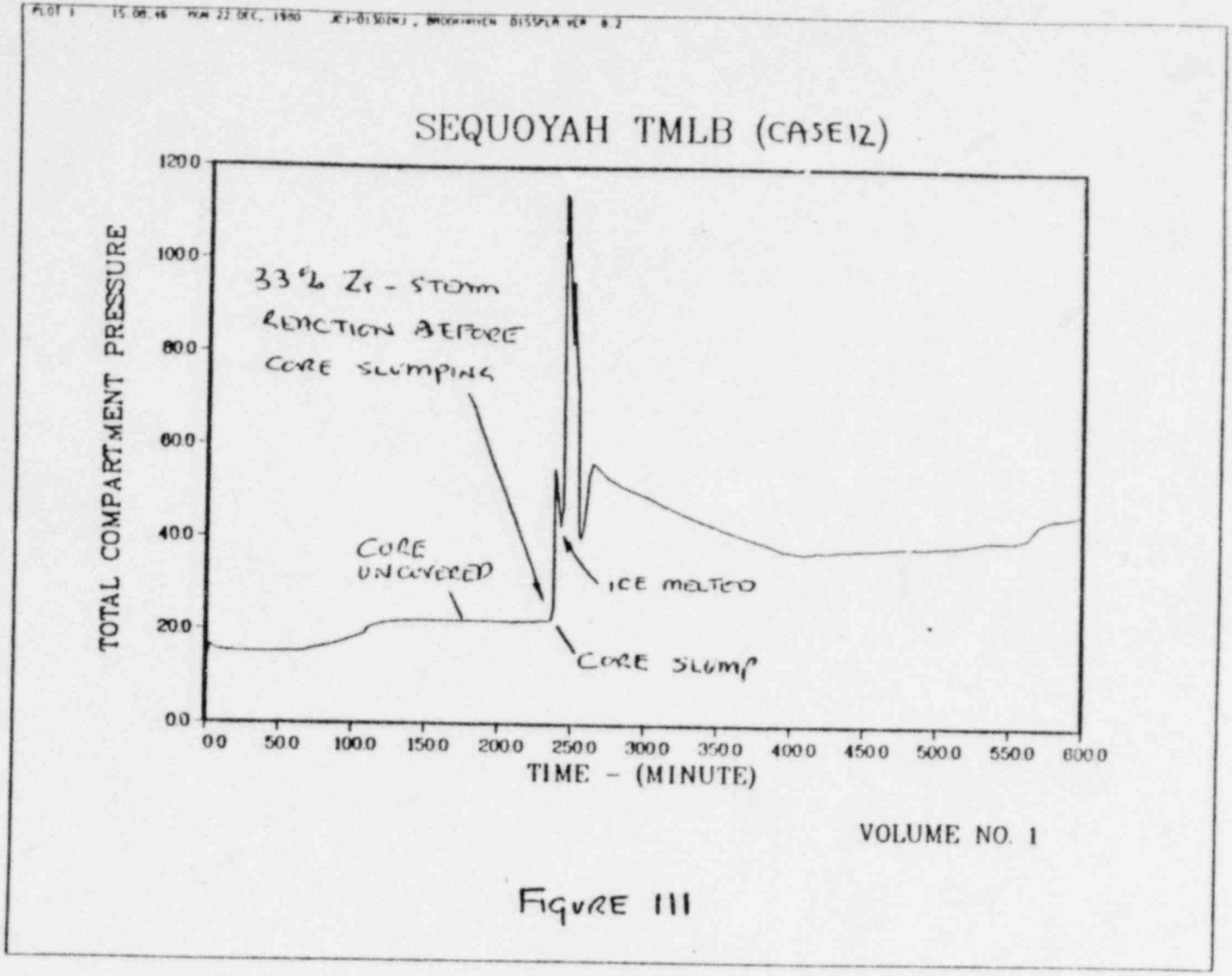

SEQUOYAH TMLB (CASE12)
TOTAL COMPARTMENT PRESSURE
1200
1000
800
600
400
200
00
33% Zr - STEAM REACTION BEFORE CORE SLUMPING
CORE UNCOVERED
ICE MELTED
CORE SLUMP
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE III

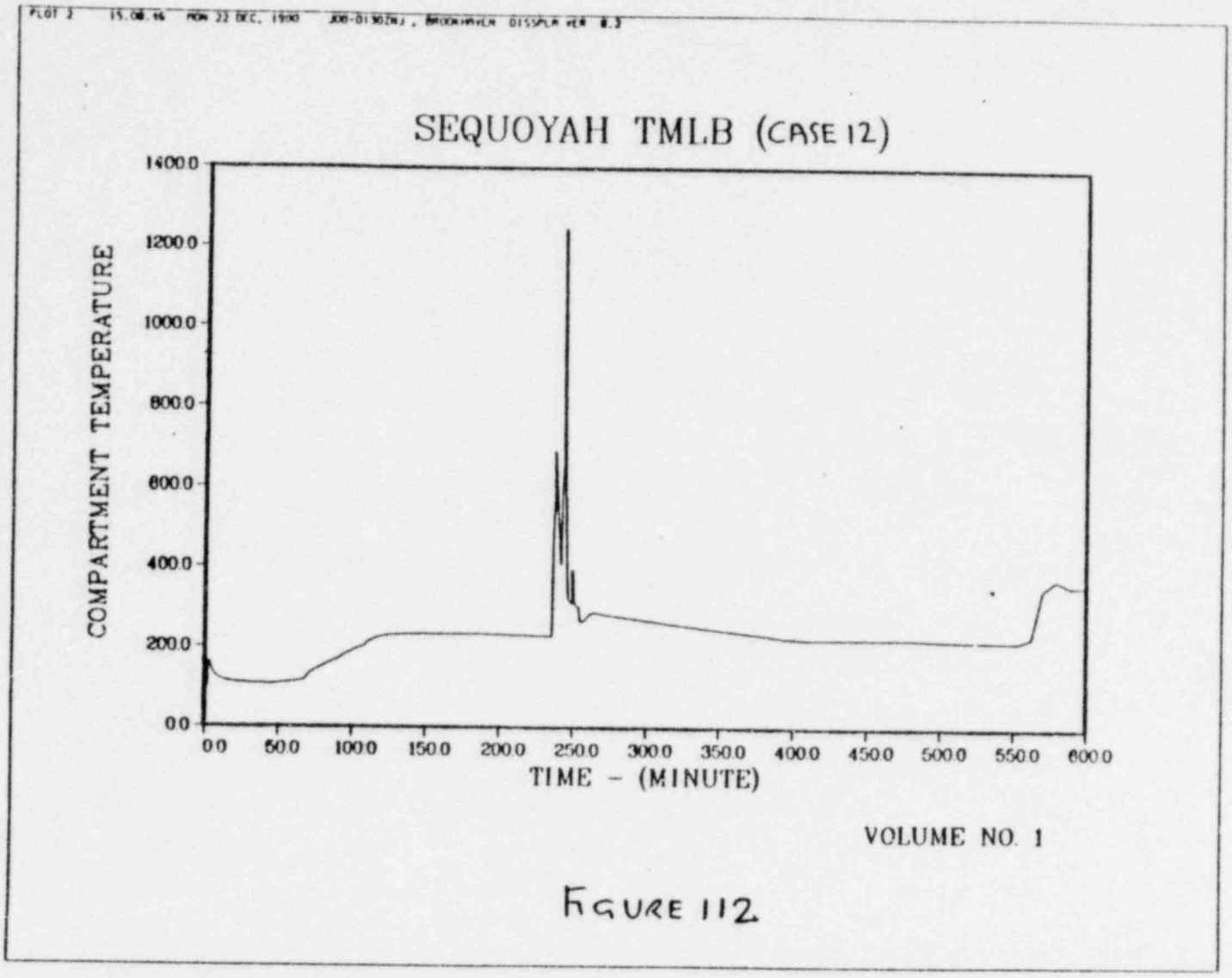

SEQUOYAH TMLB (CASE 12)
COMPARTMENT TEMPERATURE
14000
12000
10000
8000
6000
4000
2000
00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 112

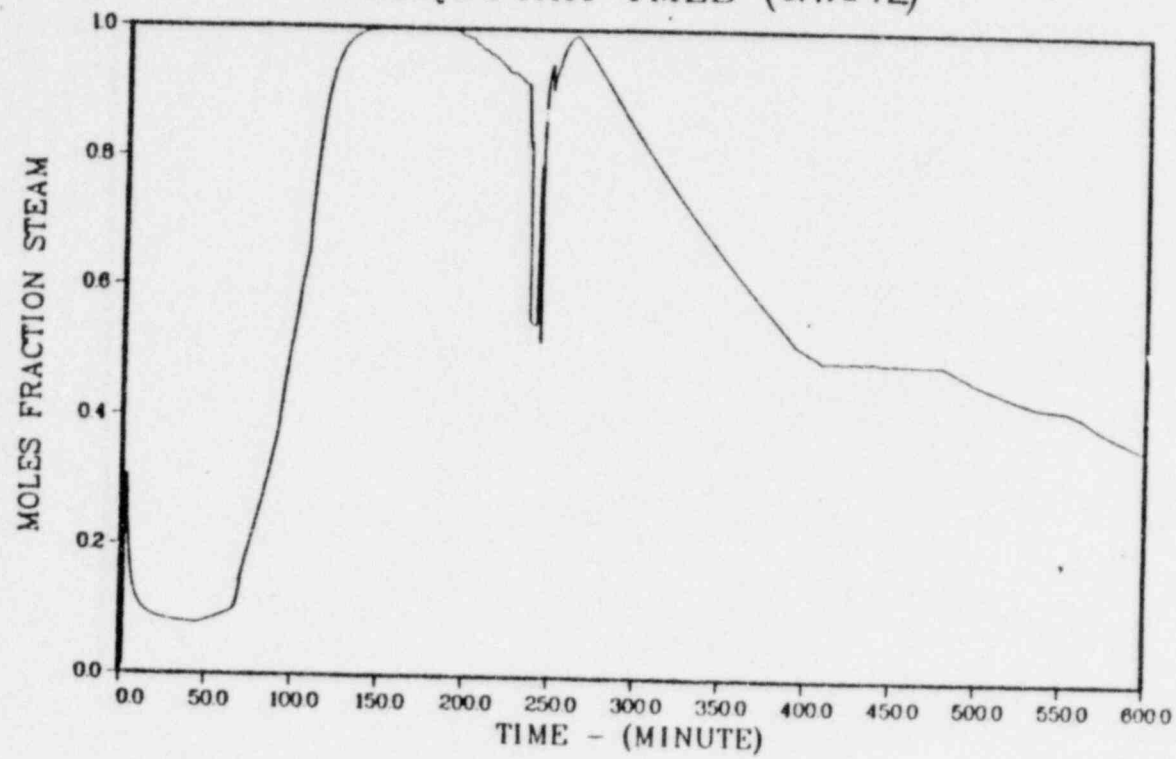

SEQUOYAH TMLB (CASE 12)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 113

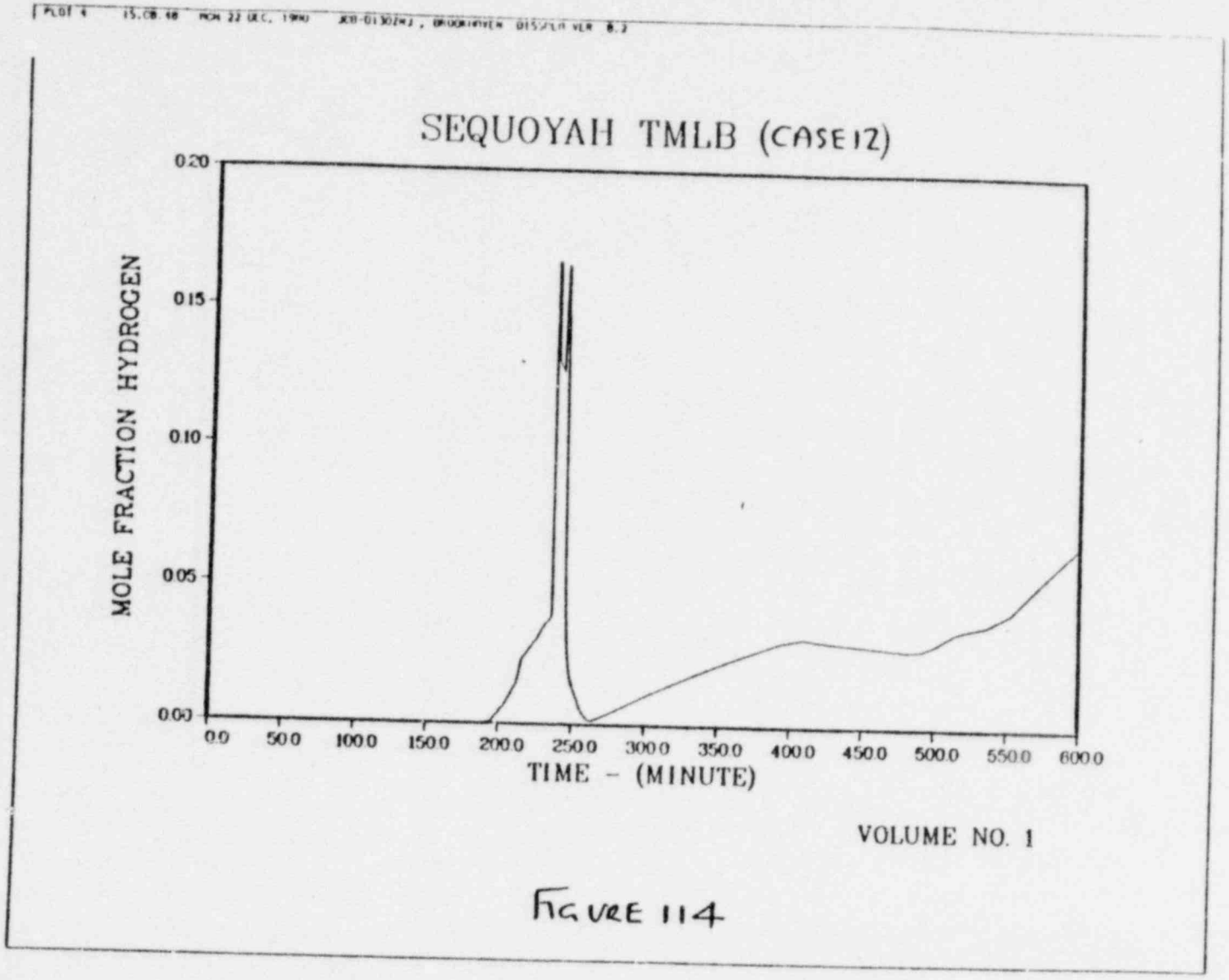

SEQUOYAH TMLB (CASE12)
MOLE FRACTION HYDROGEN
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 114

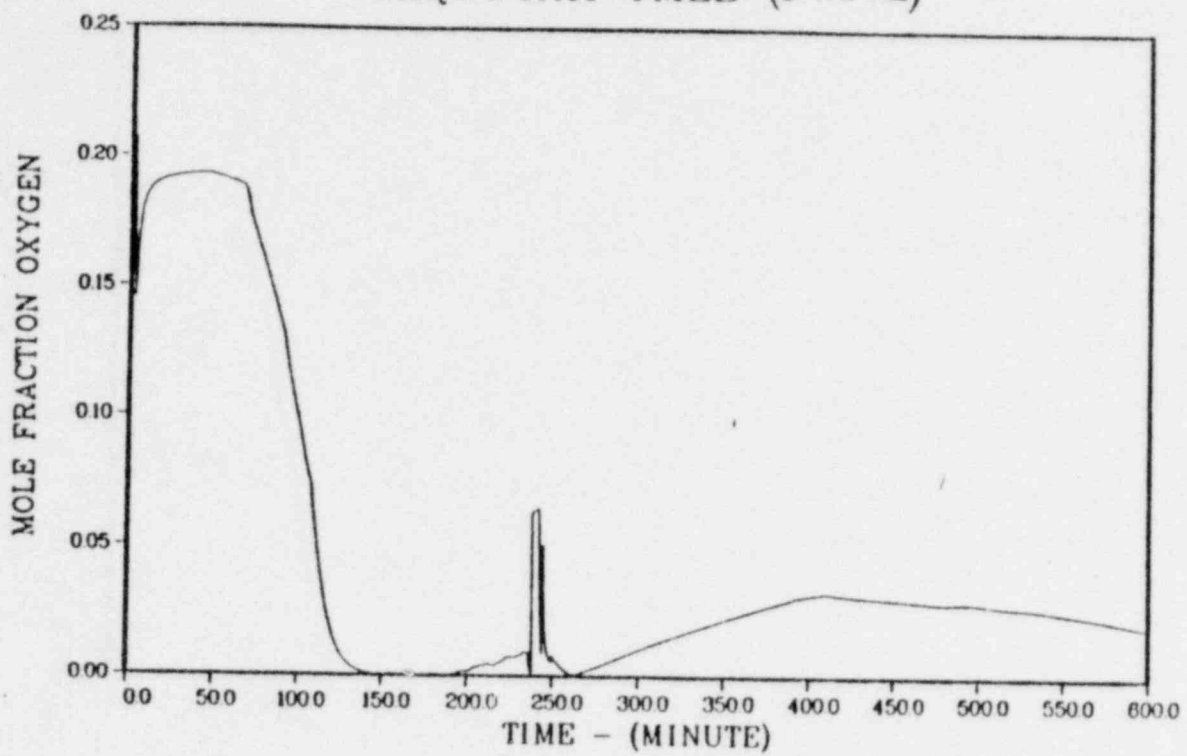

SEQUOYAH TMLB (CASE 12)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 115

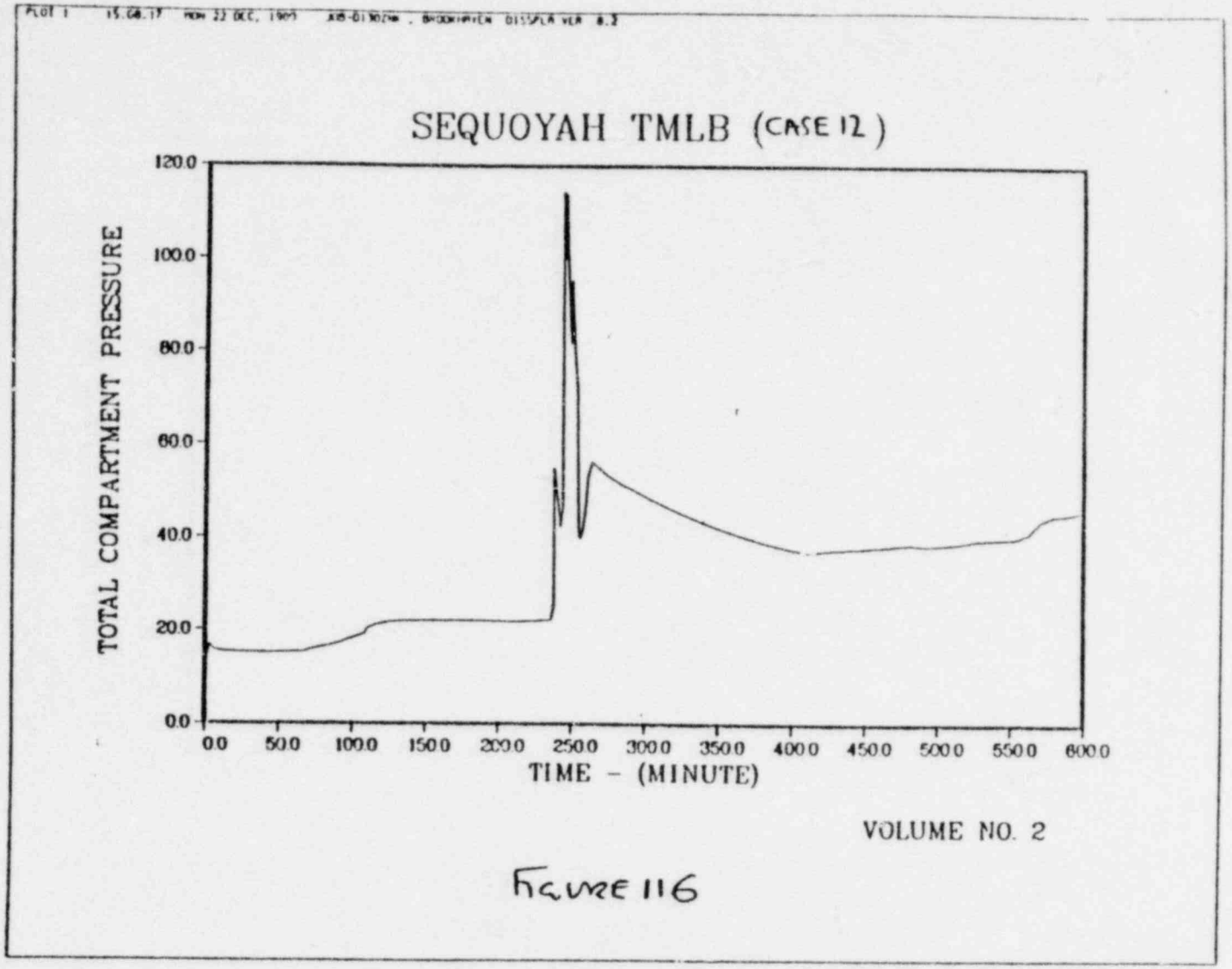

SEQUOYAH TMLB (CASE 12)
TOTAL COMPARTMENT PRESSURE
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

Figure 116

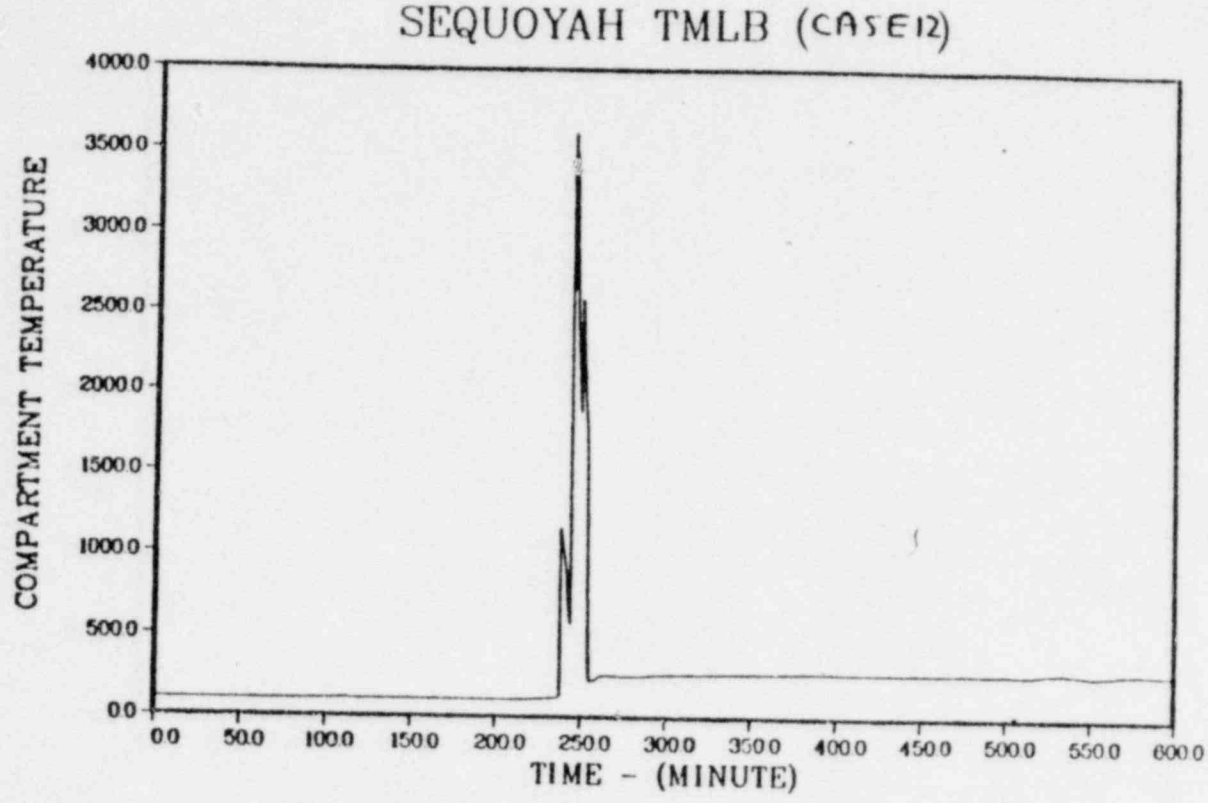

SEQUOYAH TMLB (CASE12)
COMPARTMENT TEMPERATURE
40000
35000
30000
25000
20000
15000
10000
5000
00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 117

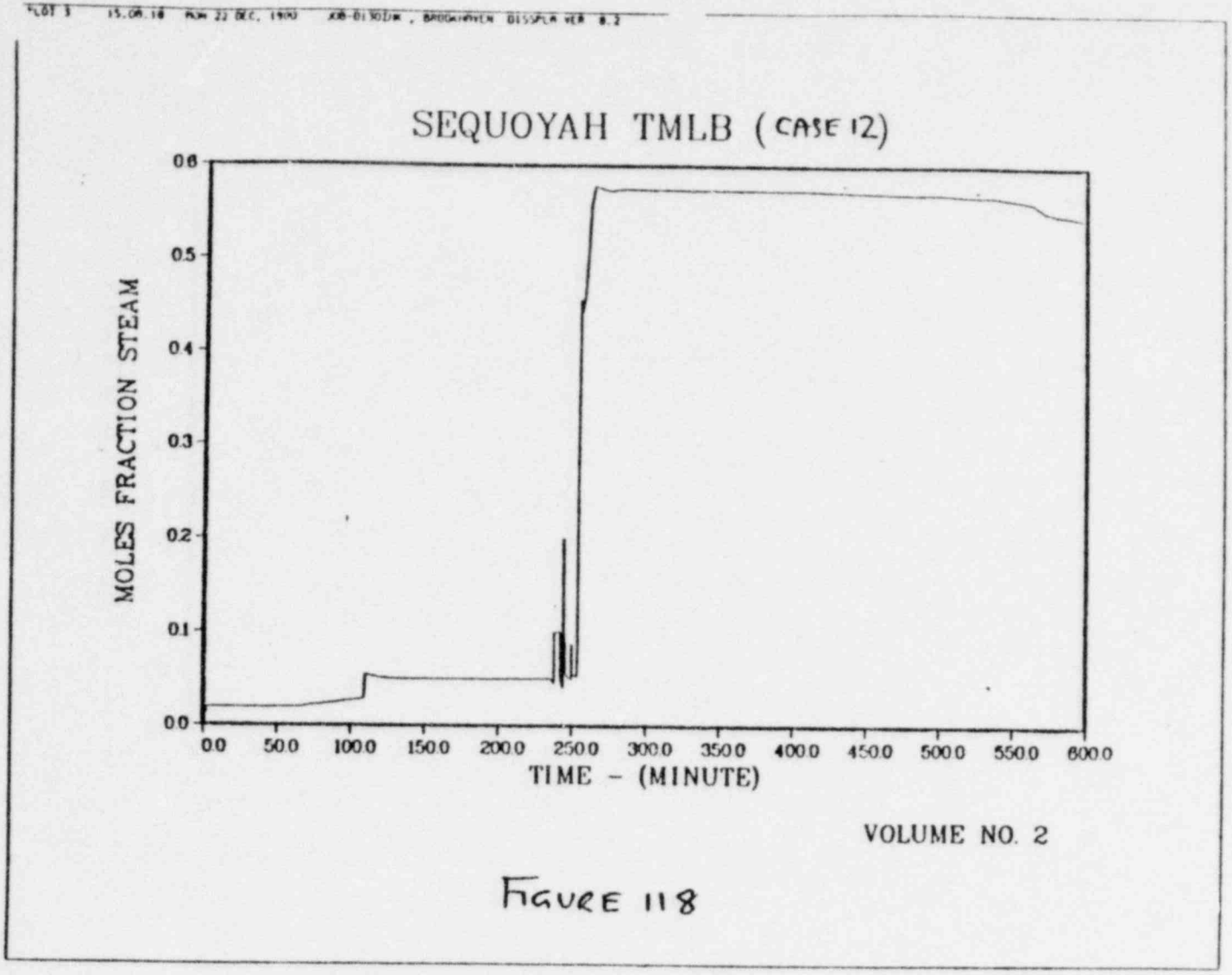

SEQUOYAH TMLB (CASE 12)
MOLES FRACTION STEAM
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 118

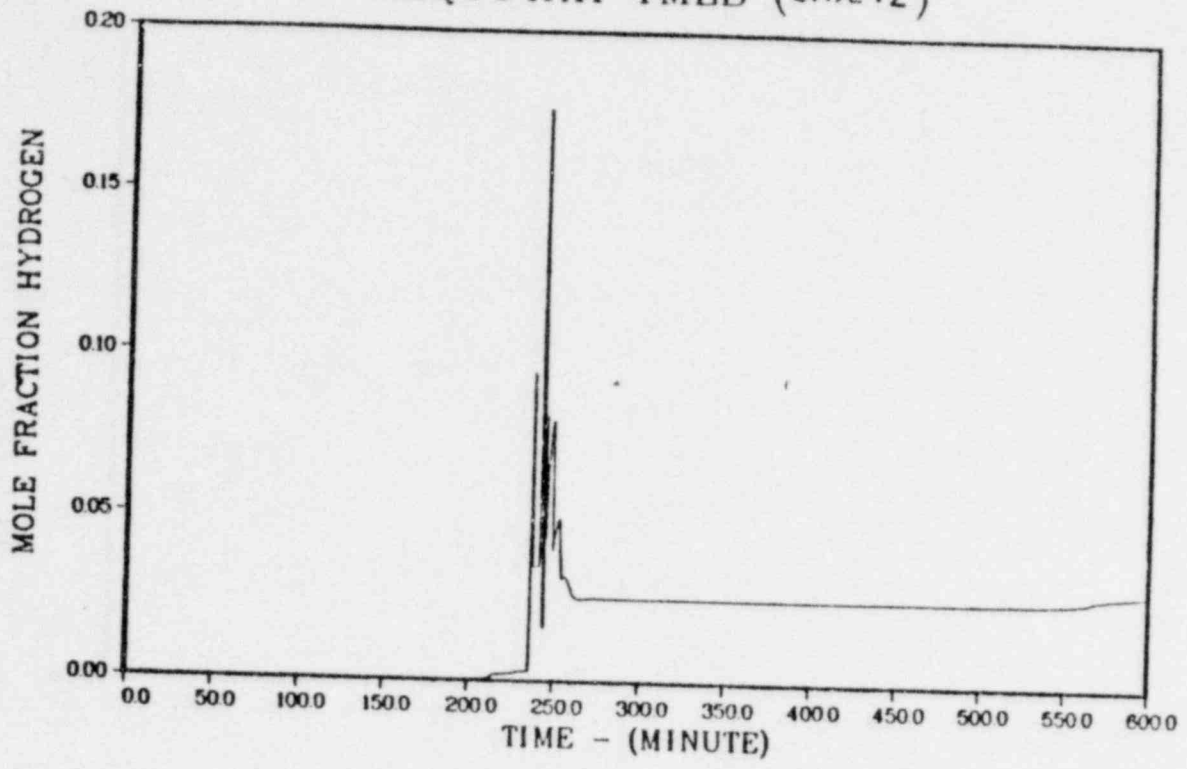

SEQUOYAH TMLB (CASE 12)
MOLE FRACTION HYDROGEN
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 119

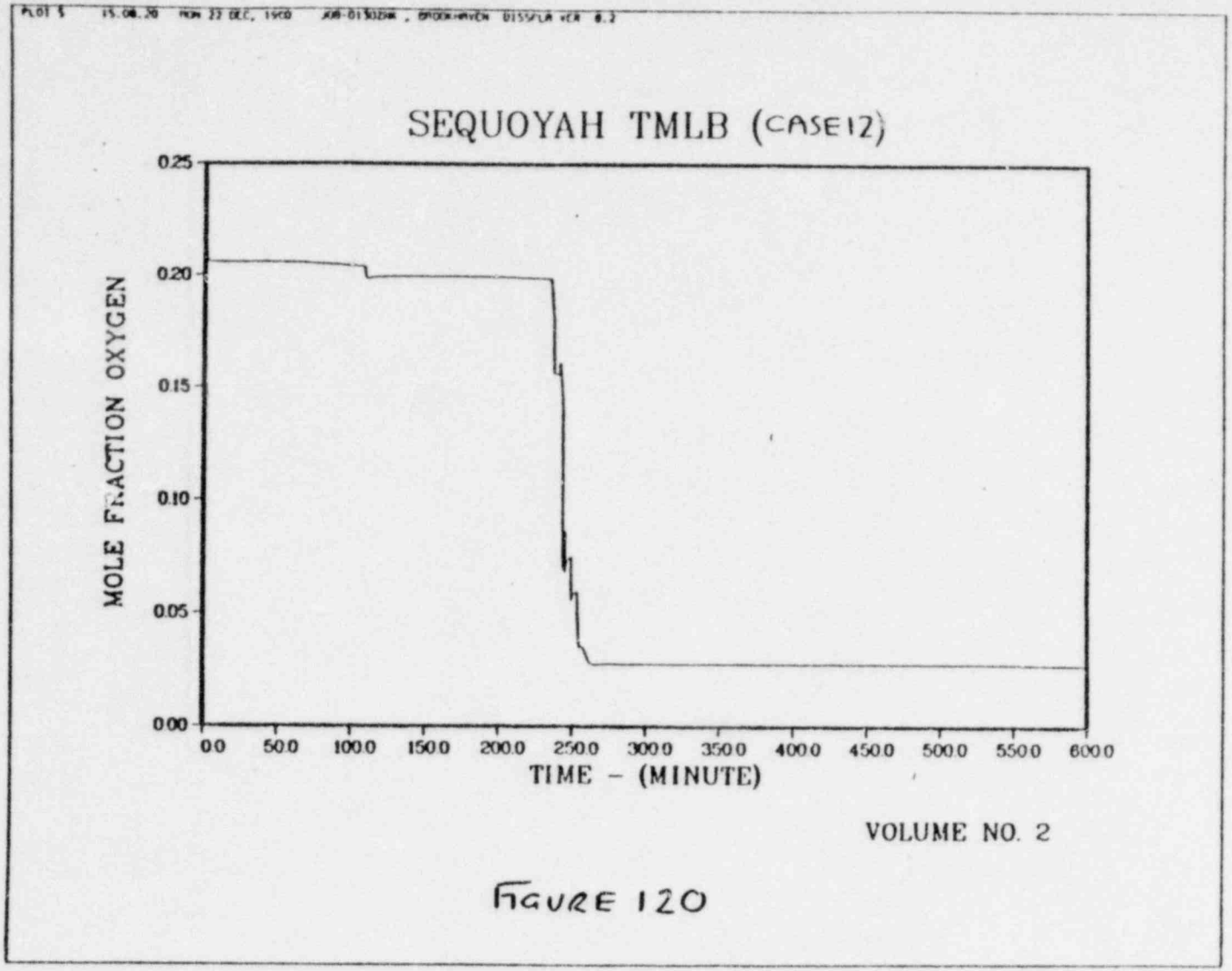

SEQUOYAH TMLB (CASE12)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500.0
1000.0
1500.0
2000.0
2500.0
3000.0
3500.0
4000.0
4500.0
5000.0
5500.0
6000.0
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 120

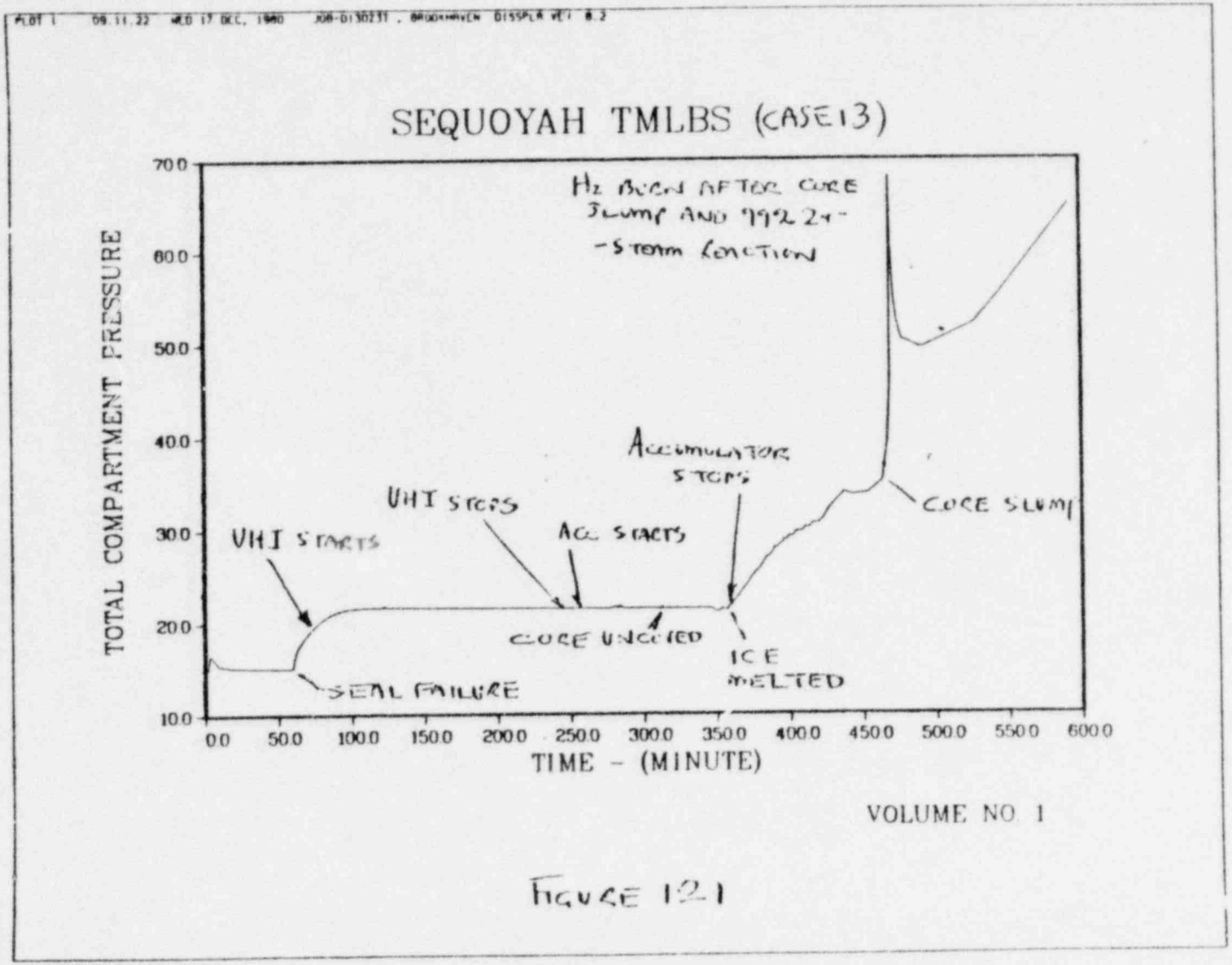

SEQUOYAH TMLBS (CASE13)
TOTAL COMPARTMENT PRESSURE
TIME - (MINUTE)
700
600
500
400
300
200
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
H2 BURN AFTER CORE SLUMP AND 9992 24-STEAM EJECTION
ACCUMULATOR STOPS
UHI STOPS
UHI STARTS
AC. STARTS
CORE SLUMP
CORE UNCOVED
ICE MELTED
SEAL FAILURE
VOLUME NO 1

FIGURE 12-1

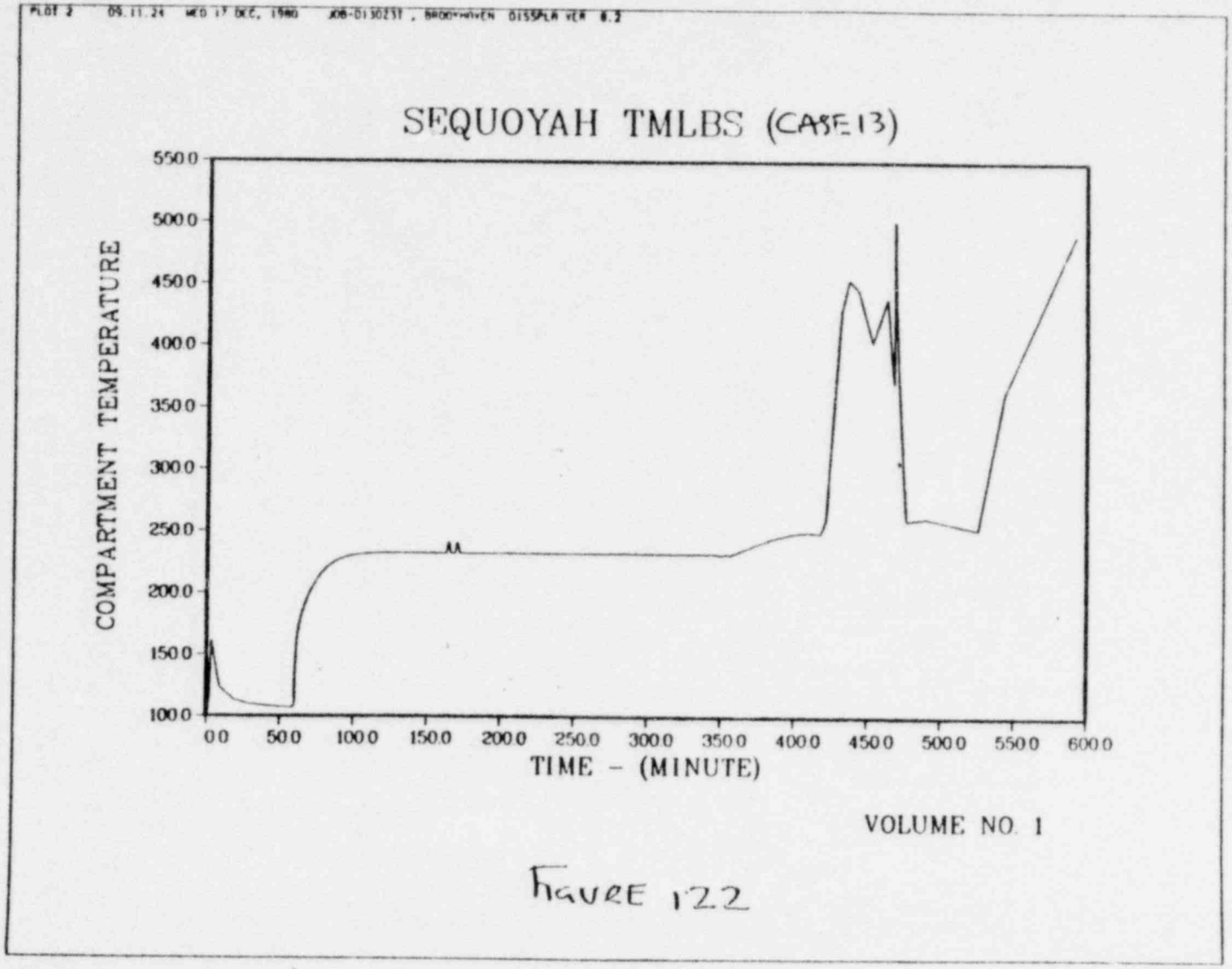

SEQUOYAH TMLBS (CASE 13)
COMPARTMENT TEMPERATURE
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

Figure 122

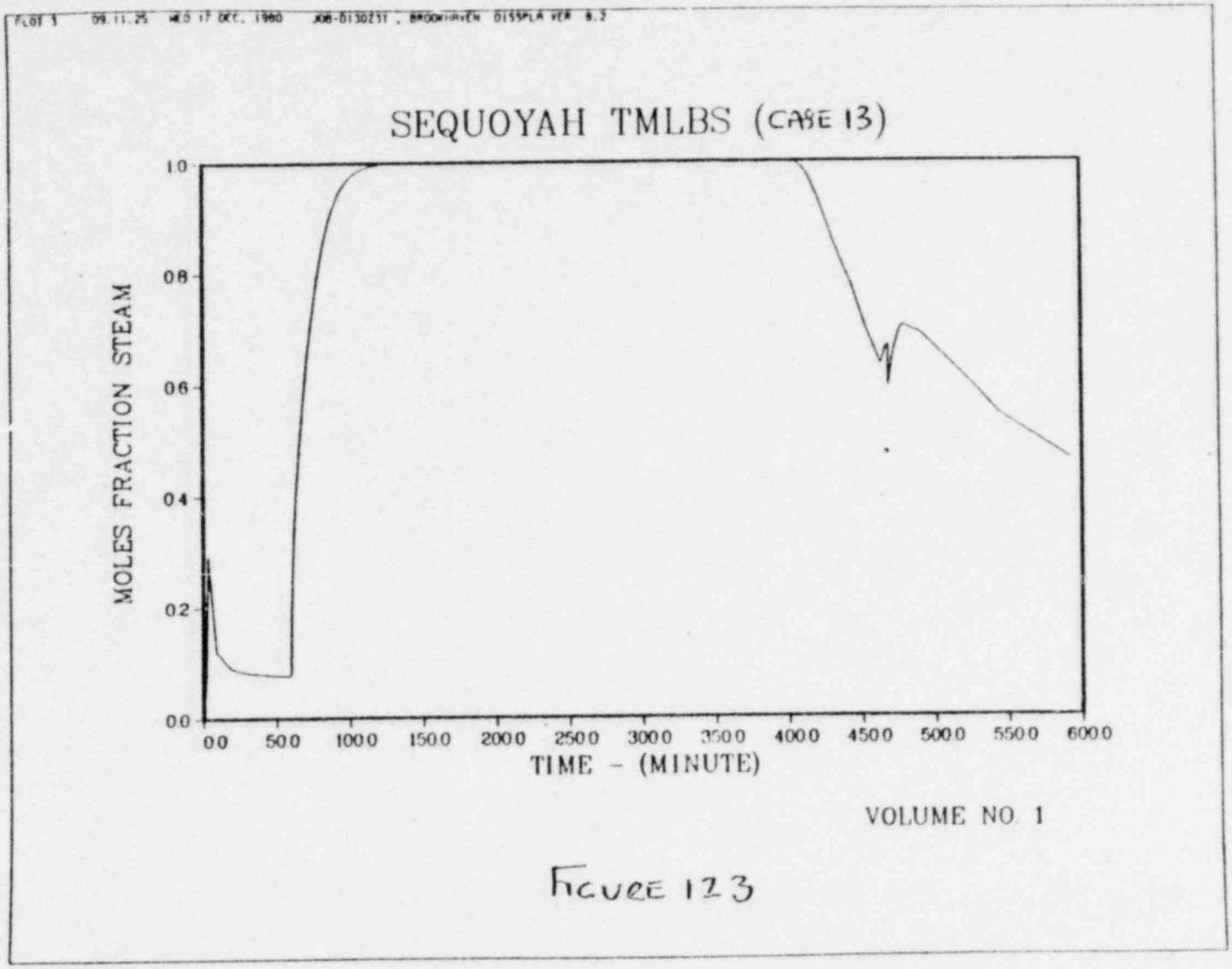

SEQUOYAH TMLBS (CASE 13)
MOLES FRACTION STEAM
1.0
0.8
0.6
0.4
0.2
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 123

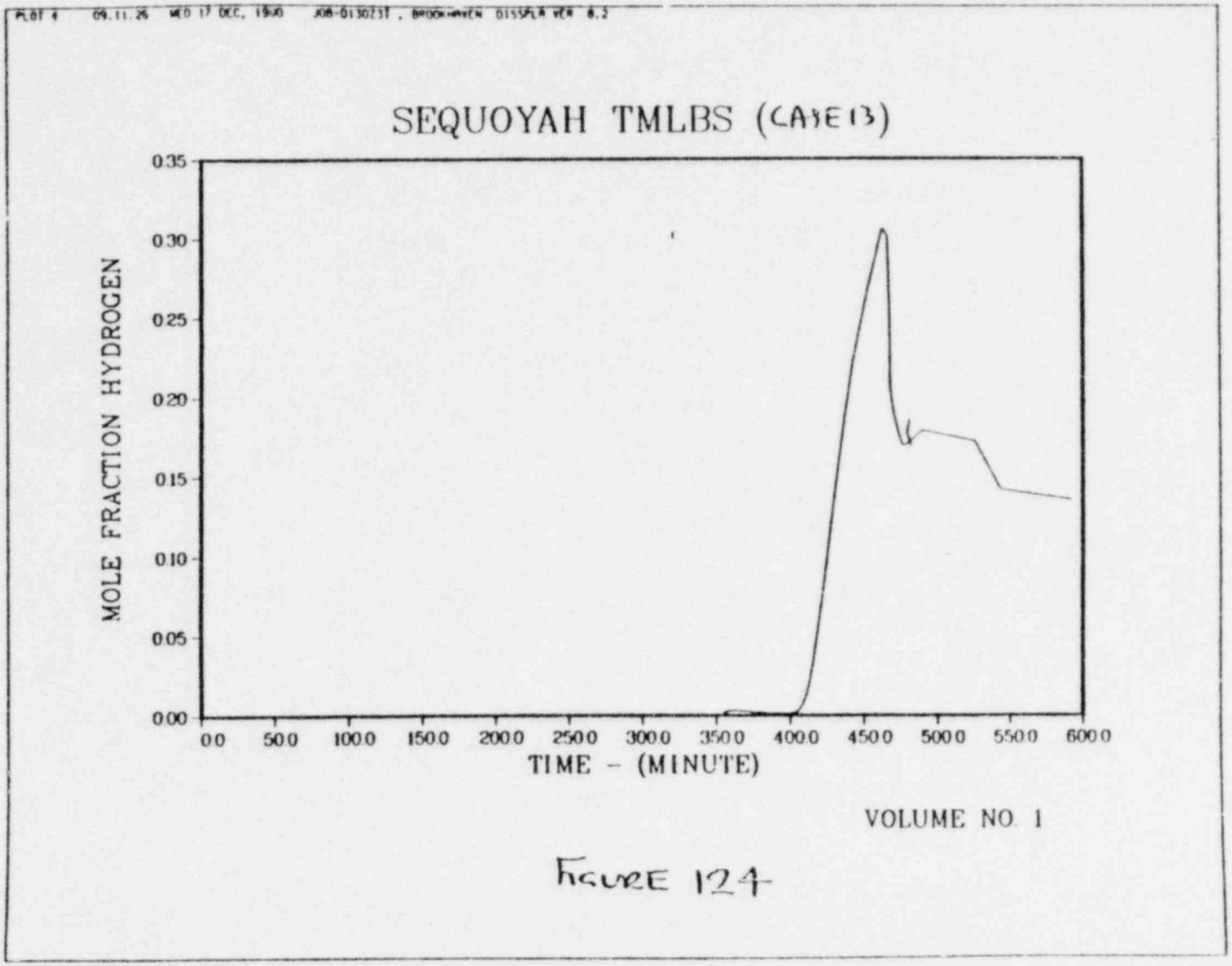

SEQUOYAH TMLBS (CASE13)
MOLE FRACTION HYDROGEN
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 124

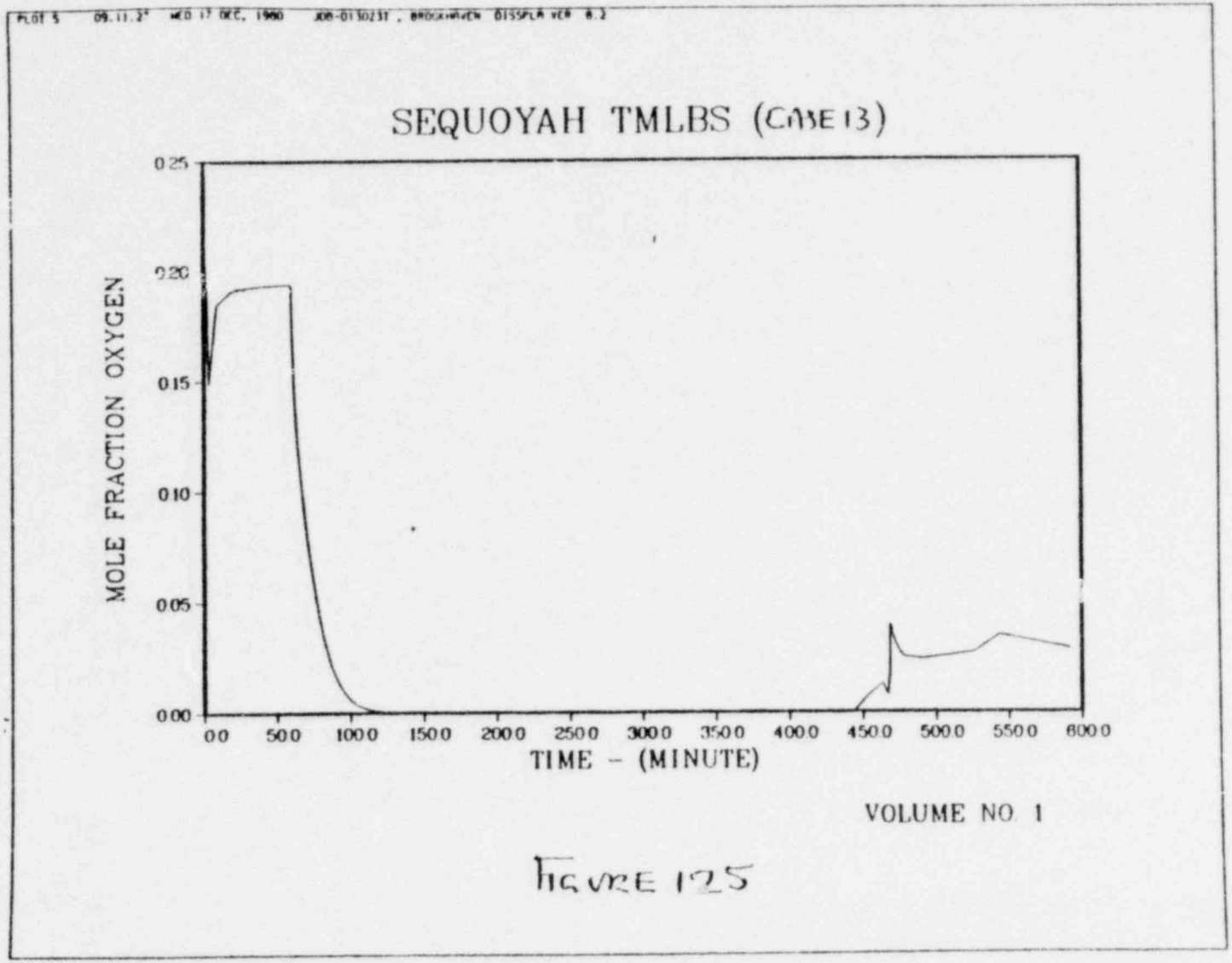

SEQUOYAH TMLBS (CASE 13)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 125

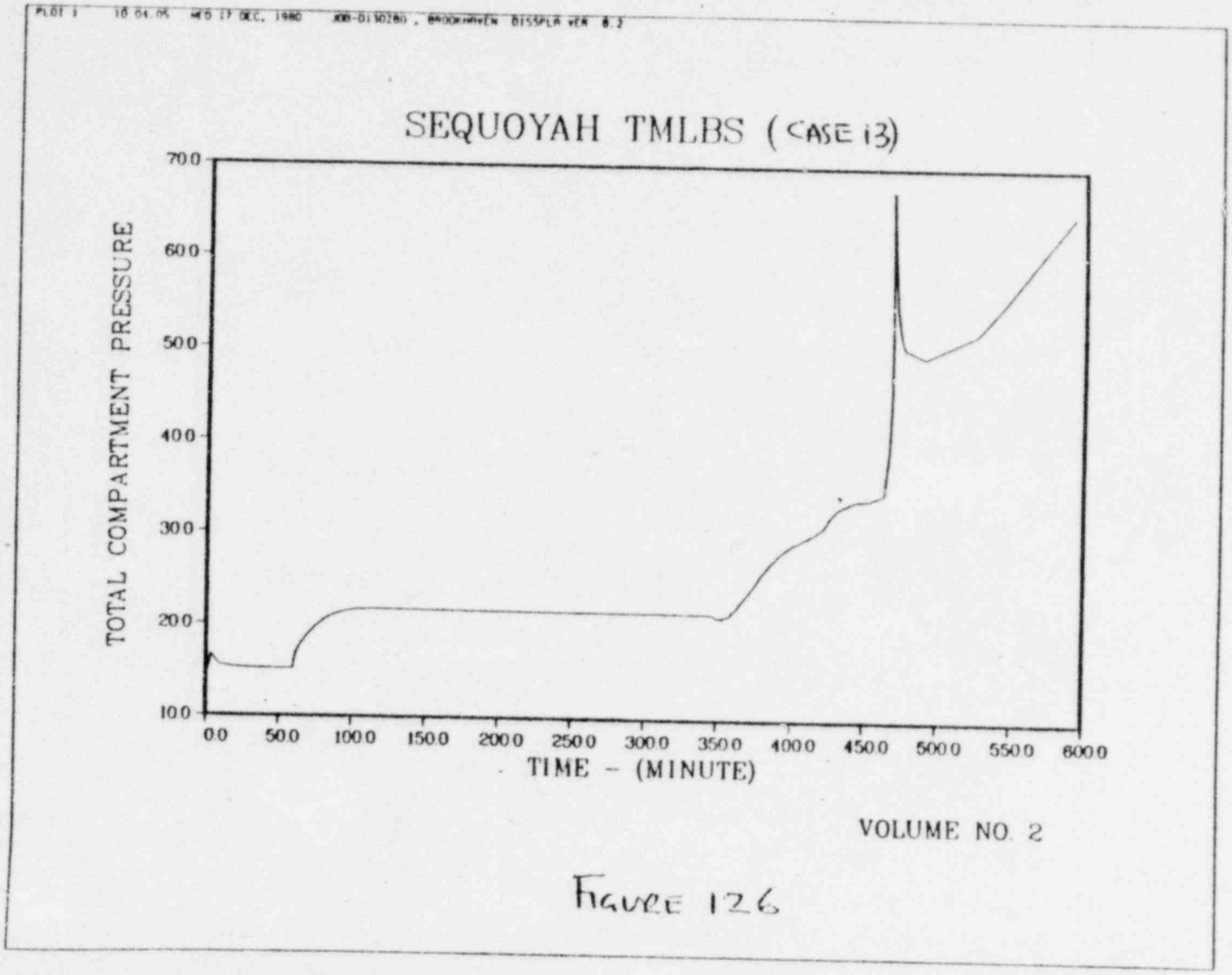

SEQUOYAH TMLBS (CASE 13)
TOTAL COMPARTMENT PRESSURE
700
600
500
400
300
200
100
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 126

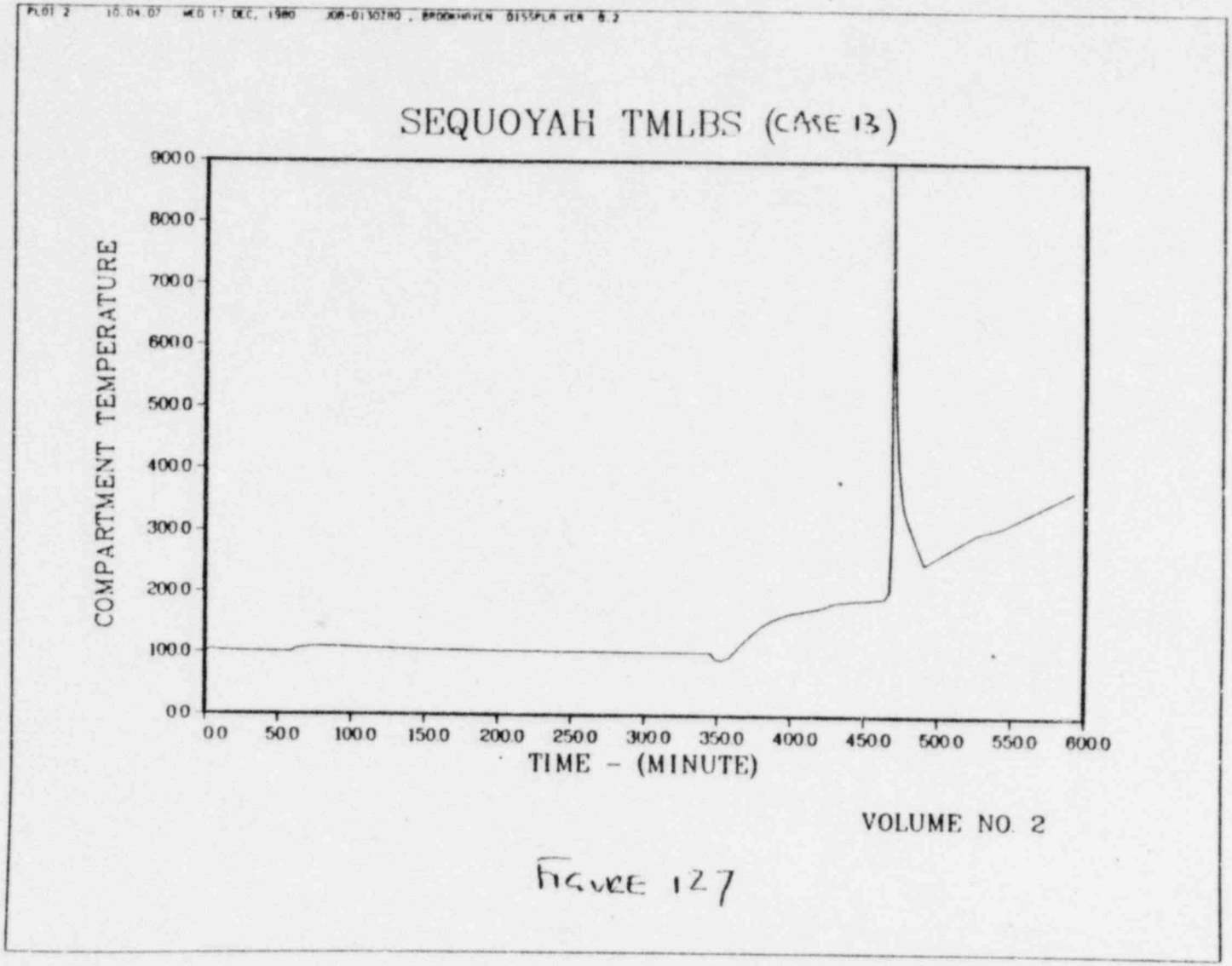

PLOT 2 10.04.07 WED 17 DEC, 1980 JOB-0130780 , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH TMLBS (CASE 13)
COMPARTMENT TEMPERATURE
9000
8000
7000
6000
5000
4000
3000
2000
1000
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
TIME - (MINUTE)
VOLUME NO. 2

Figure 127

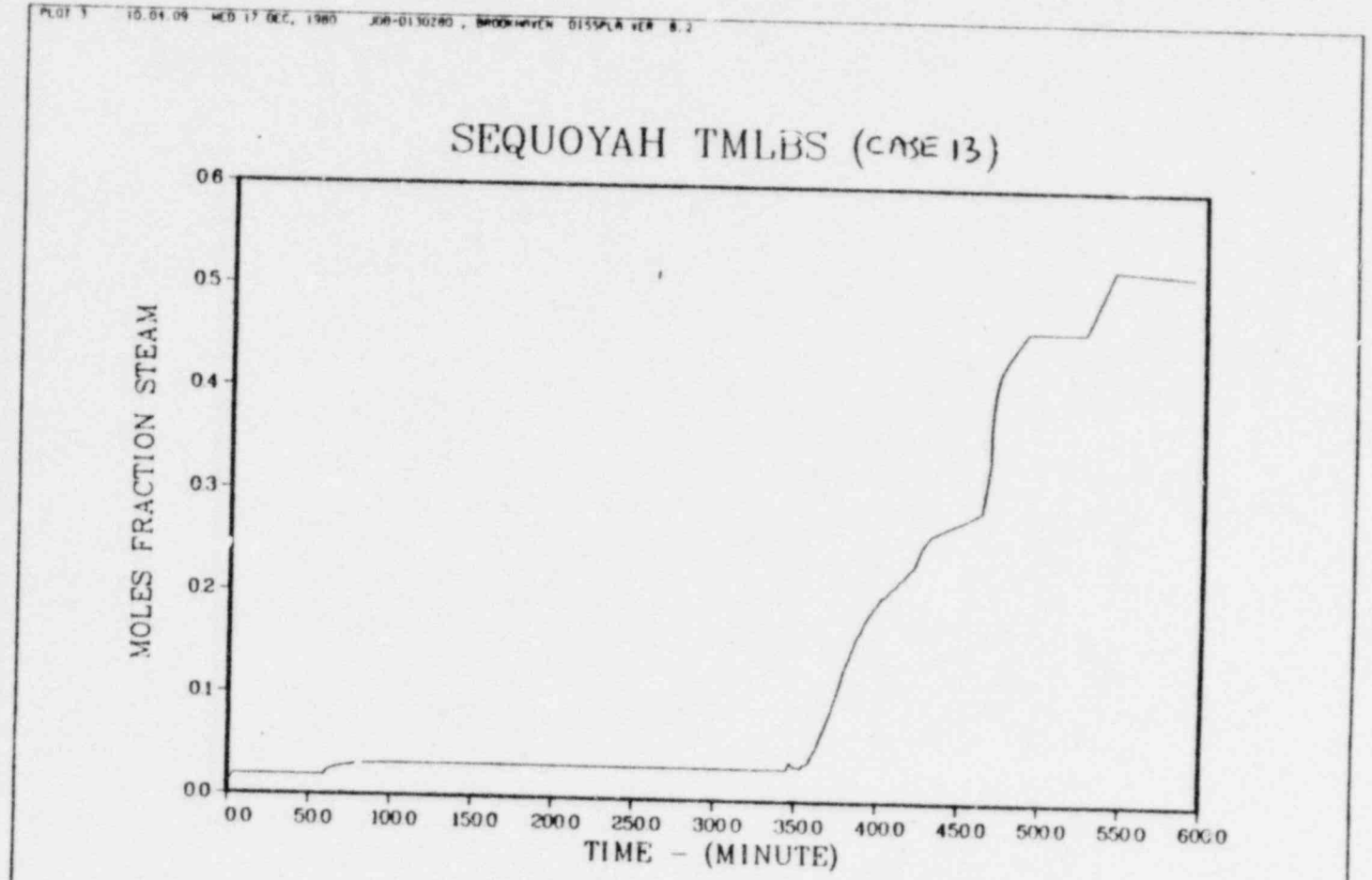

SEQUOYAH TMLBS (CASE 13)
MOLES FRACTION STEAM
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 129

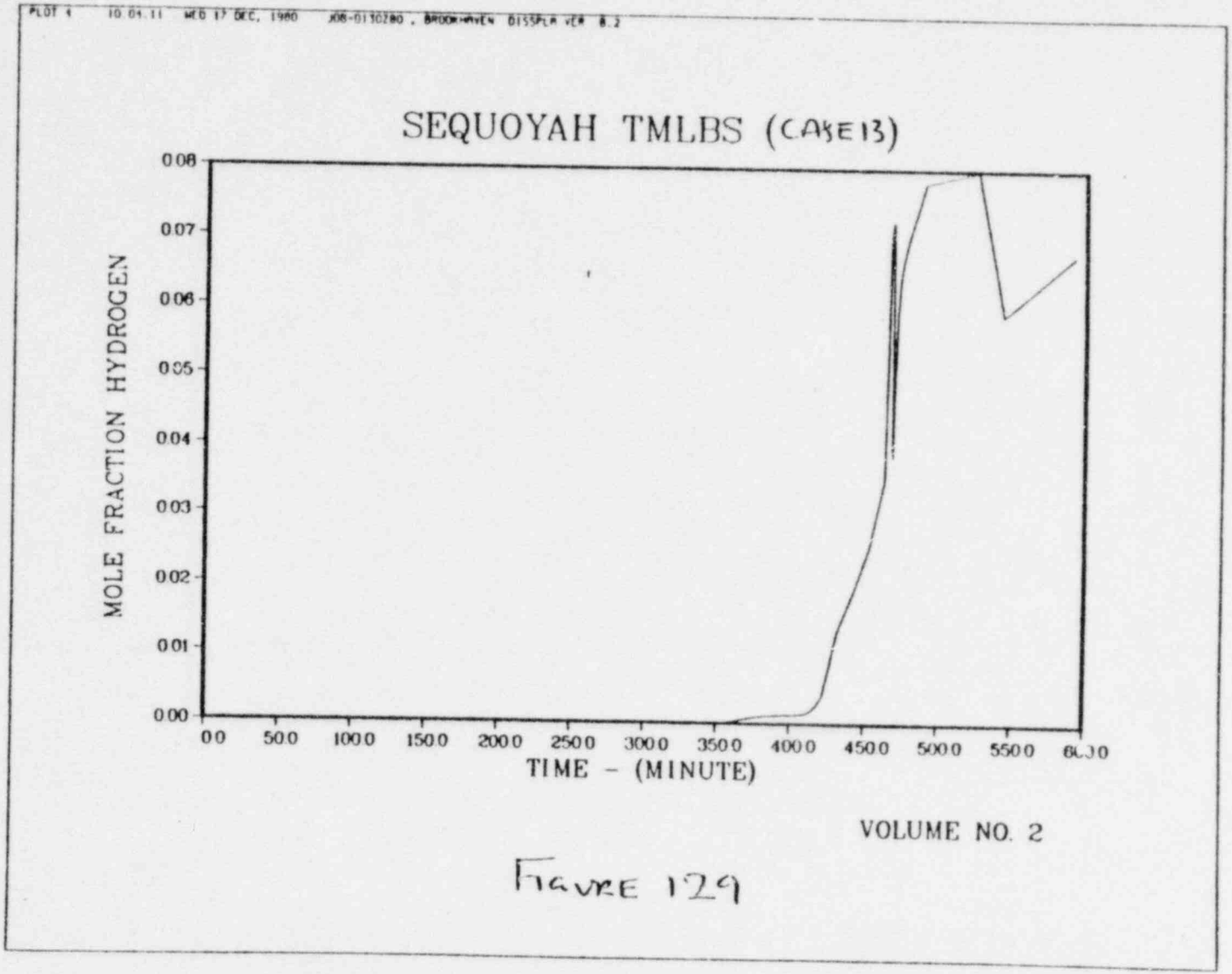

SEQUOYAH TMLBS (CASE13)
MOLE FRACTION HYDROGEN
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 129

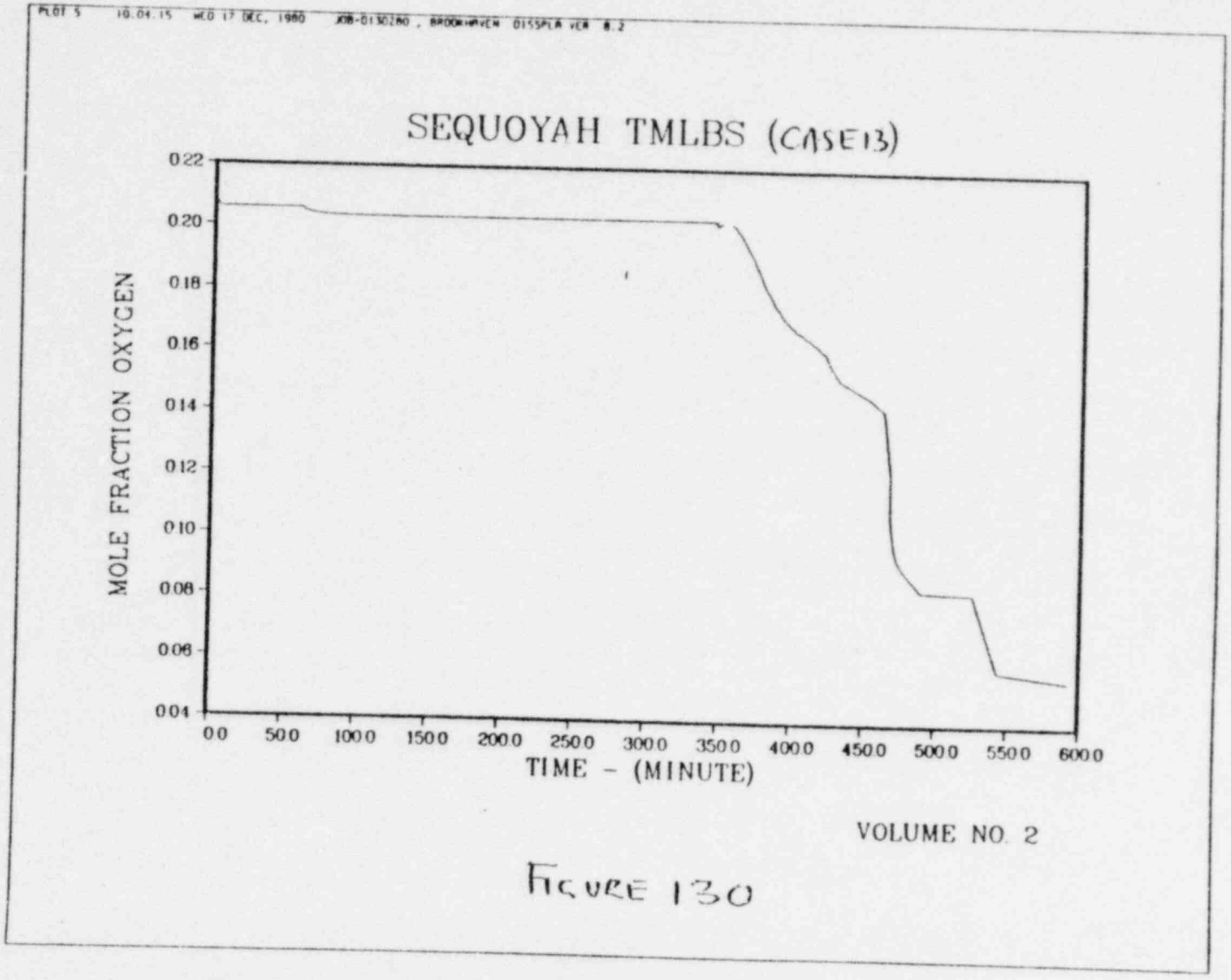

PLOT 5 10.04.15 WED 17 DEC, 1980 JOB-01302A0 , BROOKHAVEN DISSPLA VER 8.2
SEQUOYAH TMLBS (CASE13)
MOLE FRACTION OXYGEN
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.0
500.
1000.
1500.
2000.
2500.
3000.
3500.
4000.
4500.
5000.
5500.
6000.
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 130

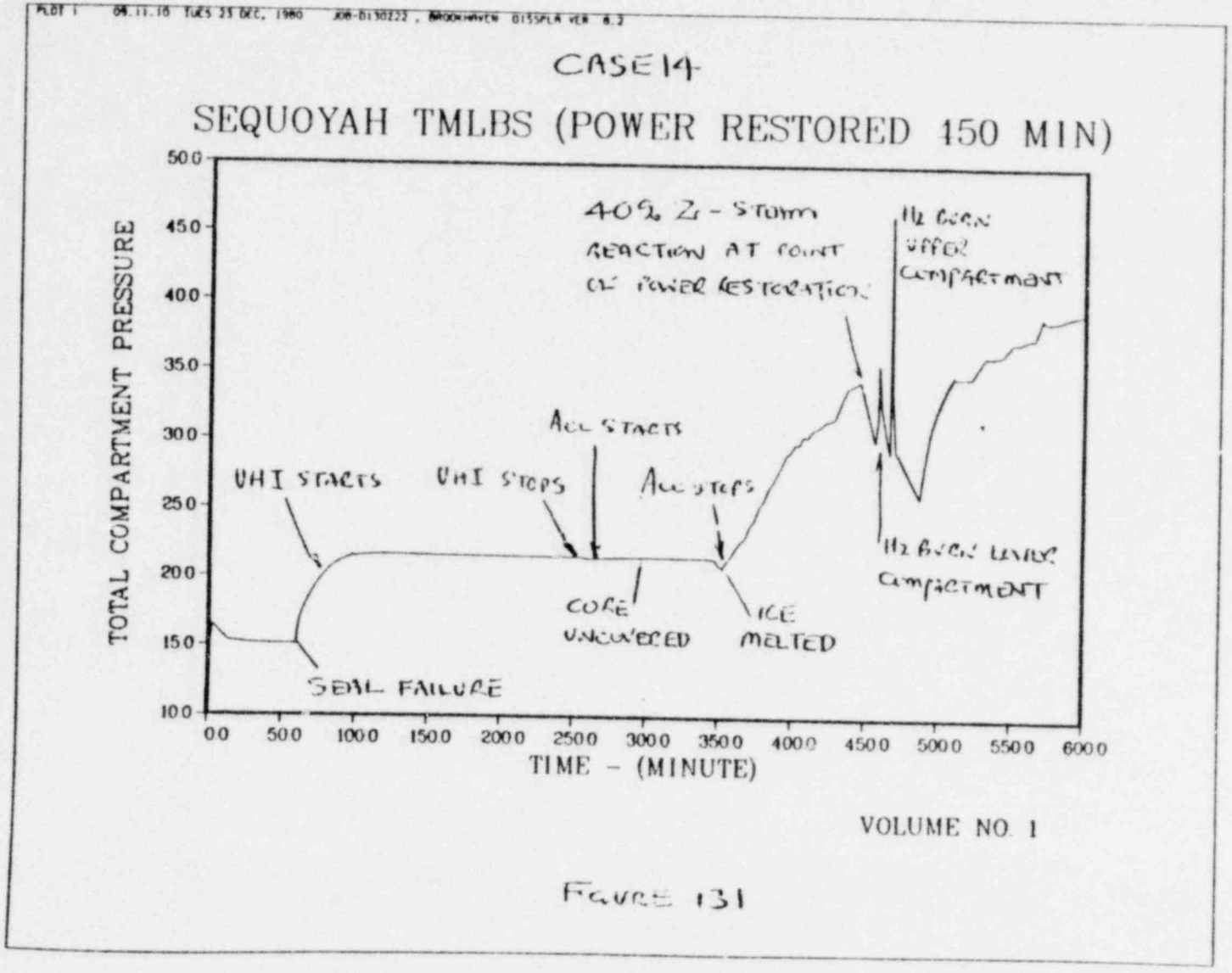

CASE 14
SEQUOYAH TMLBS (POWER RESTORED 150 MIN)
TOTAL COMPARTMENT PRESSURE
500
450
400
350
300
250
200
150
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
40% Zr - STEAM REACTION AT POINT OF POWER RESTORATION
H2 BURN UPPER COMPARTMENT
ACC STARTS
UHI STARTS
UHI STOPS
ACC STOPS
H2 BURN LOWER COMPARTMENT
CORE UNCOVERED
ICE MELTED
SEAL FAILURE
VOLUME NO. 1

FIGURE 131

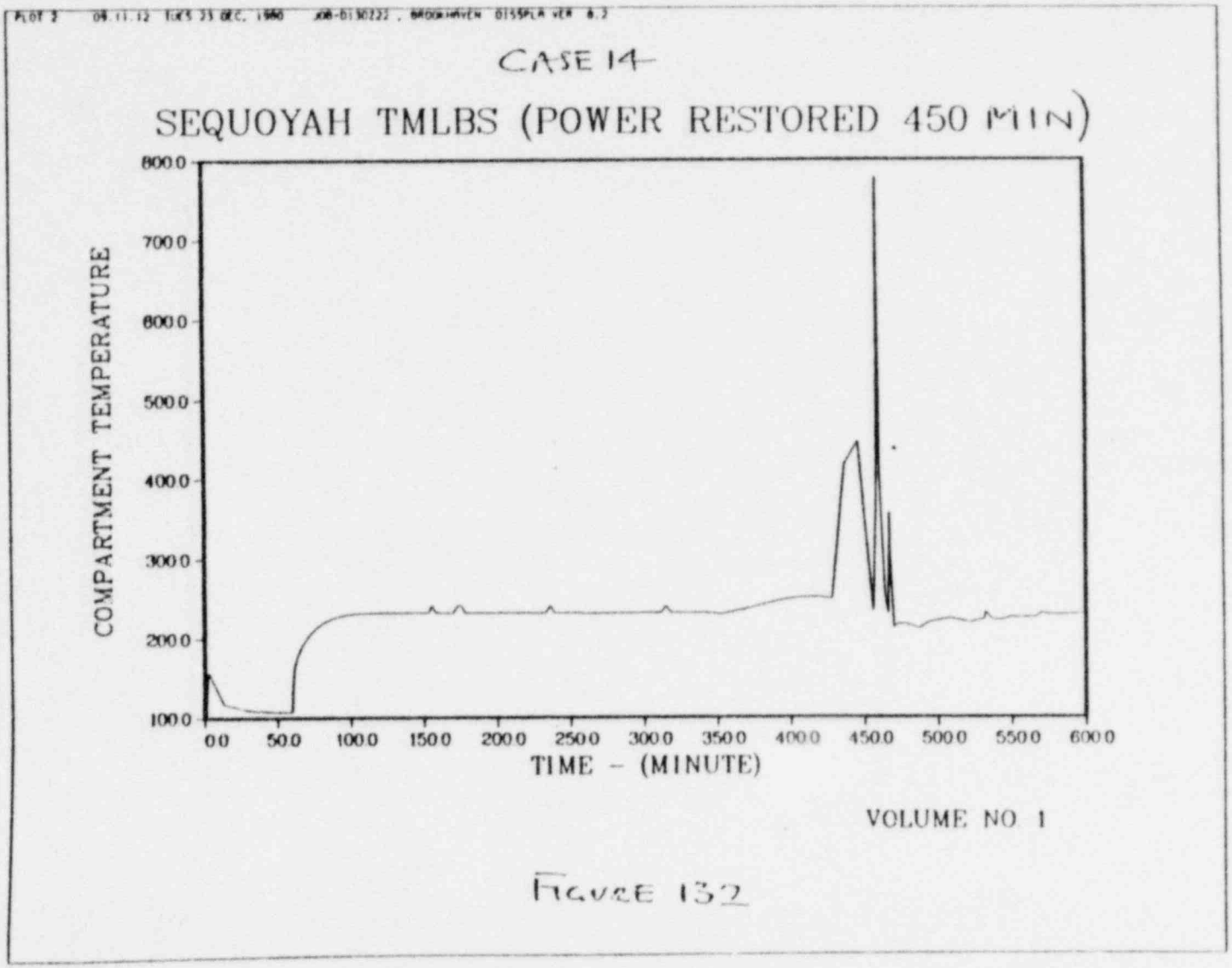

CASE 14
SEQUOYAH TMLBS (POWER RESTORED 450 MIN)
COMPARTMENT TEMPERATURE
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
500.0
1000.
1500.
2000.
2500.
3000.
3500.
4000.
4500.
5000.
5500.
6000.
TIME - (MINUTE)
VOLUME NO 1

FIGURE 132

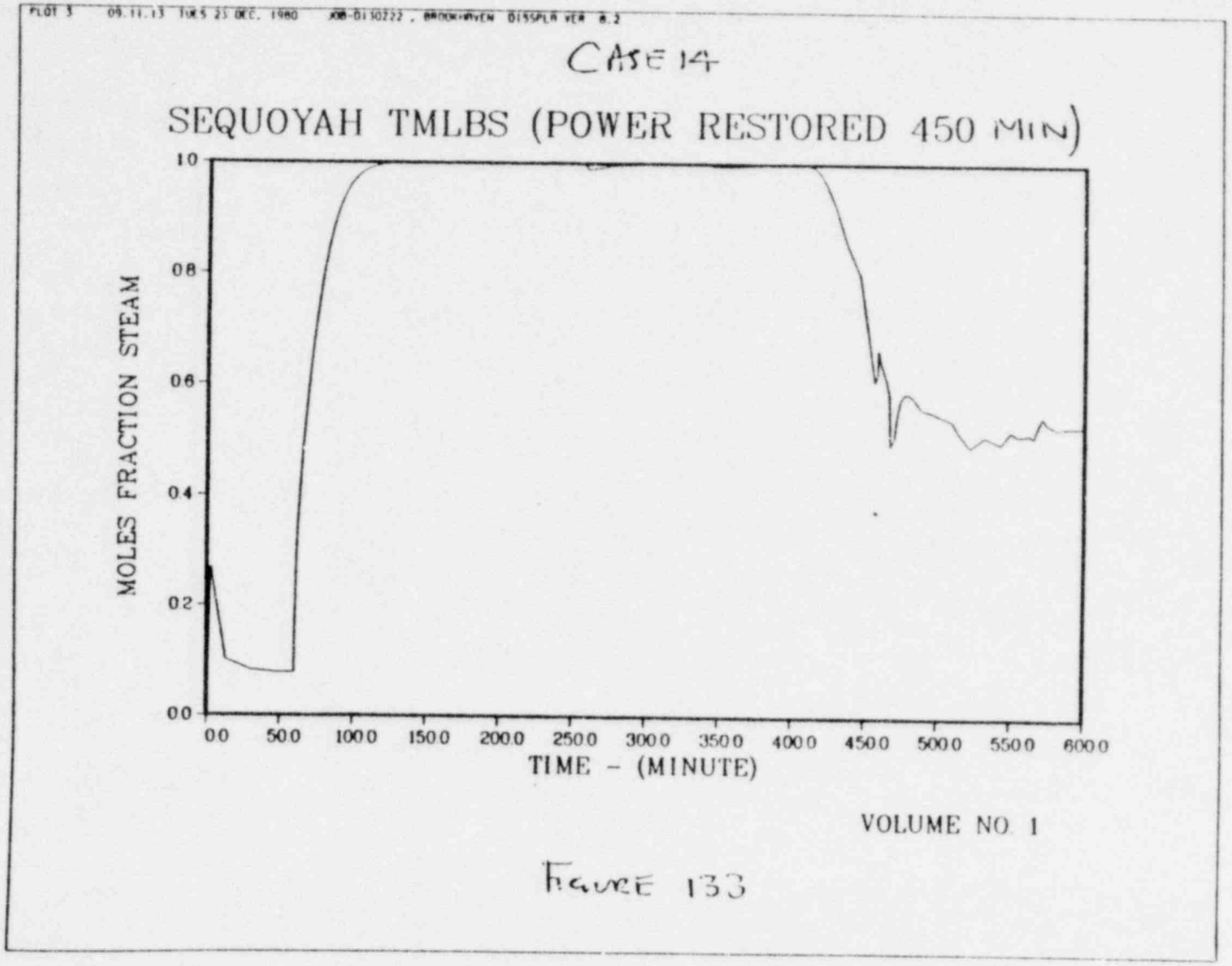

PLOT 3 09.11.13 TUES 23 DEC. 1980 JOB-DI30222 , BROOKHAVEN DISSPLA VER 8.2
CASE 14
SEQUOYAH TMLBS (POWER RESTORED 450 MIN)
MOLES FRACTION STEAM
10
08
06
04
02
00
00 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 133

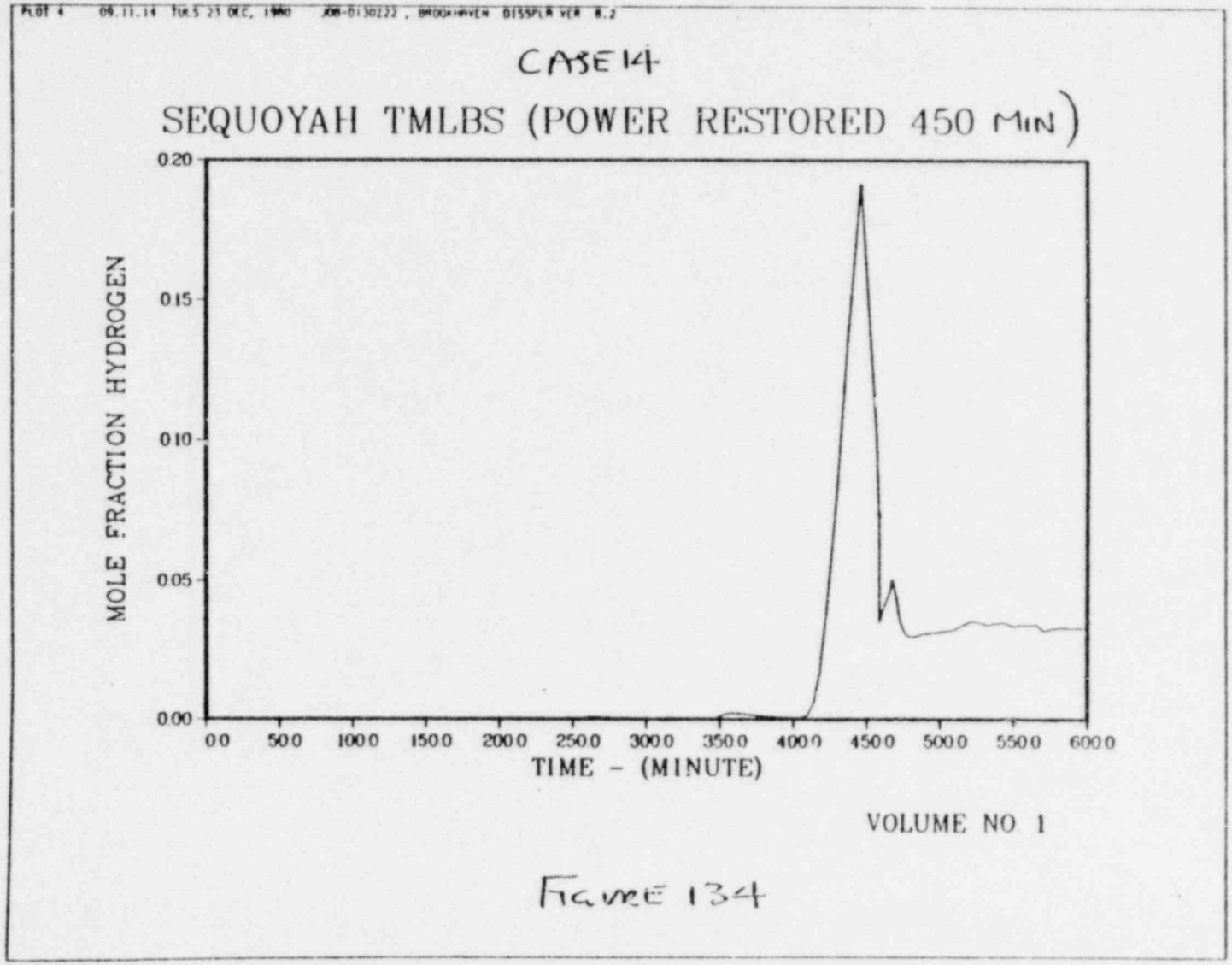

CASE 14
SEQUOYAH TMLBS (POWER RESTORED 450 MIN)
MOLE FRACTION HYDROGEN
0.20
0.15
0.10
0.05
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO 1

FIGURE 134

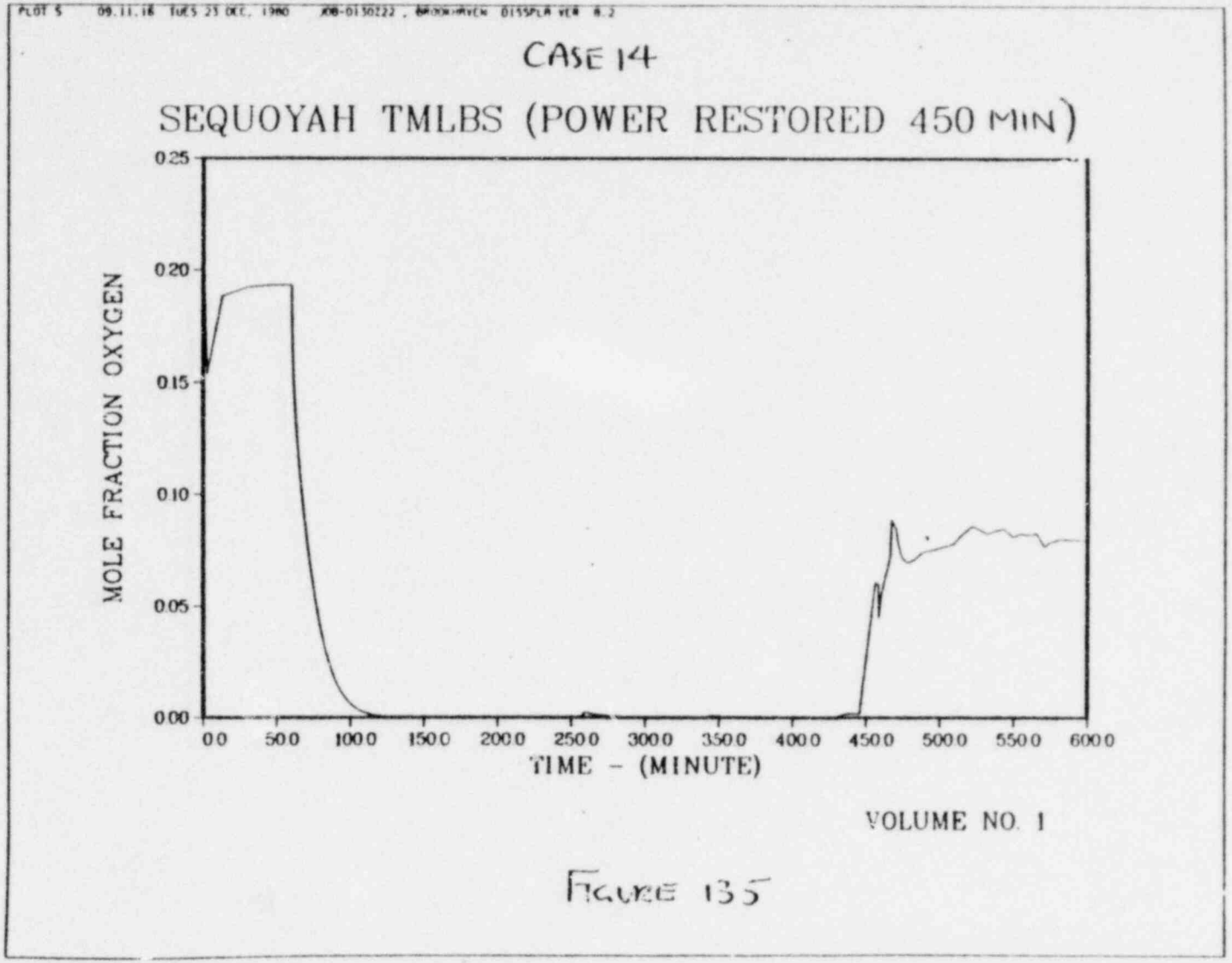
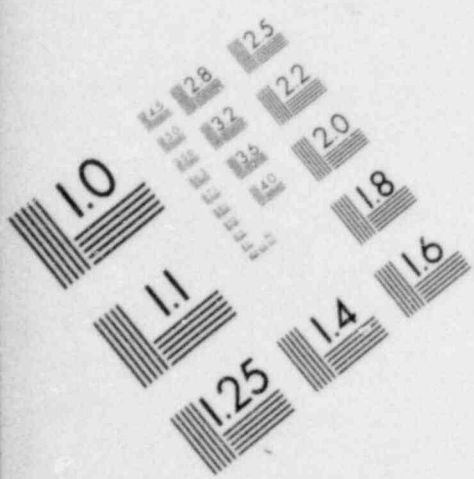

PLOT 5 09.11.18 TUES 23 DEC. 1980
CASE 14
SEQUOYAH TMLBS (POWER RESTORED 450 MIN)
MOLE FRACTION OXYGEN
0.25
0.20
0.15
0.10
0.05
0.00
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 1

FIGURE 135



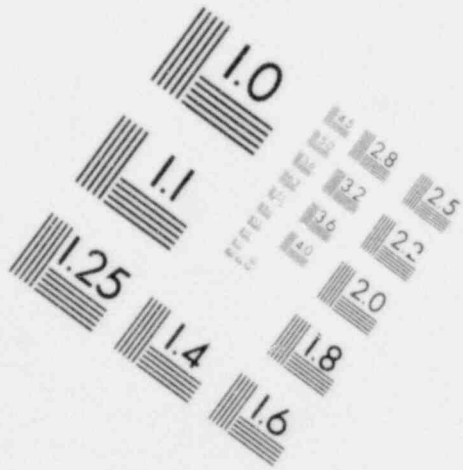
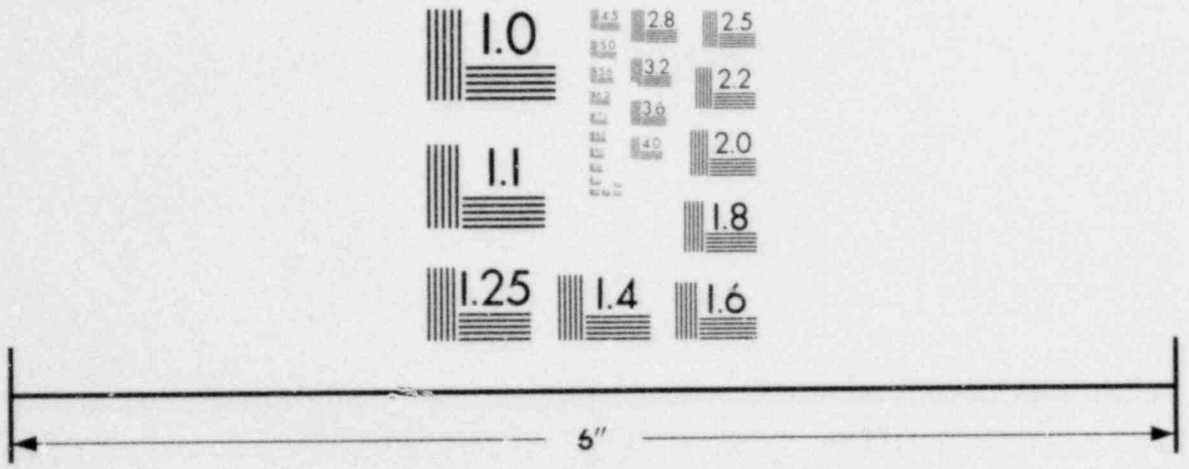
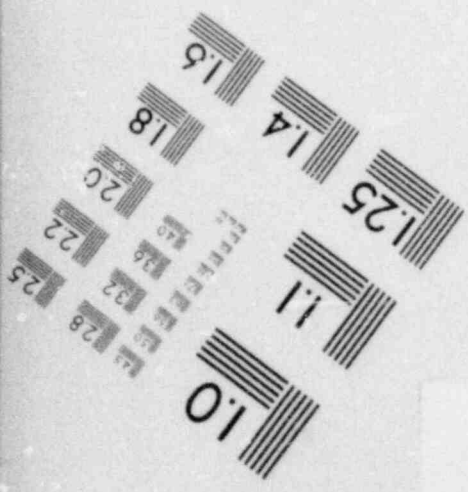
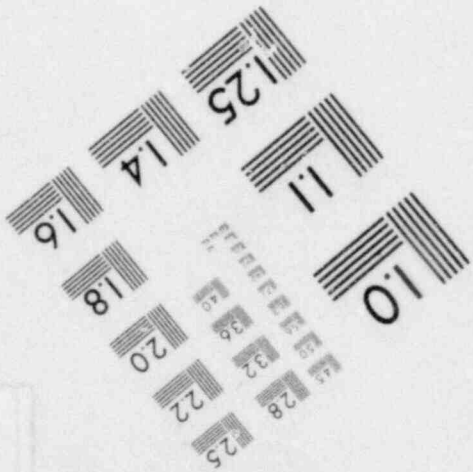
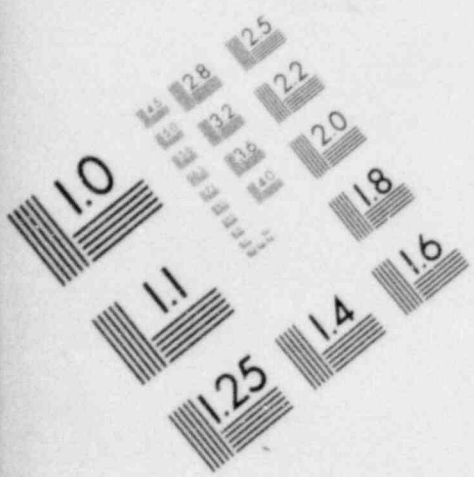


IMAGE EVALUATION TEST TARGET (MT-3)









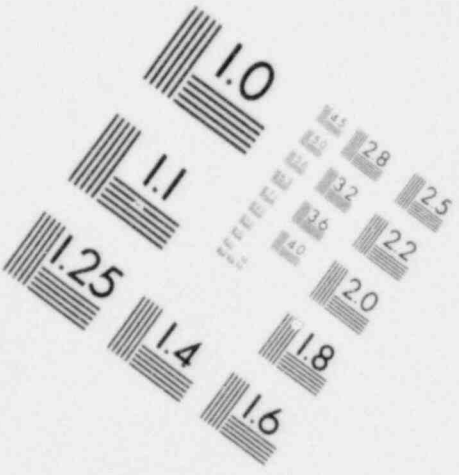
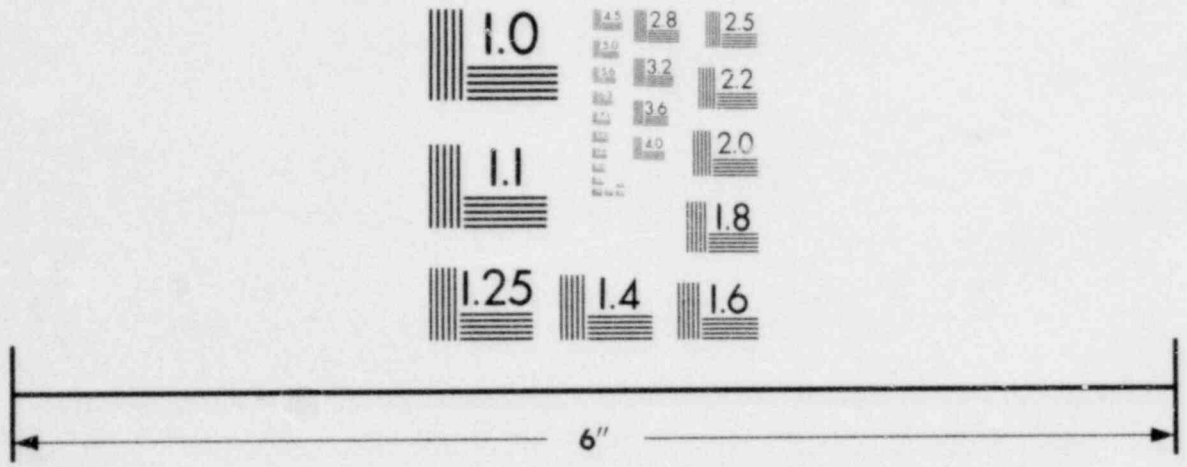
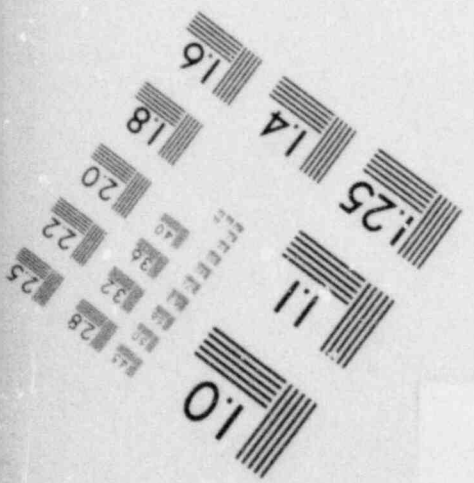
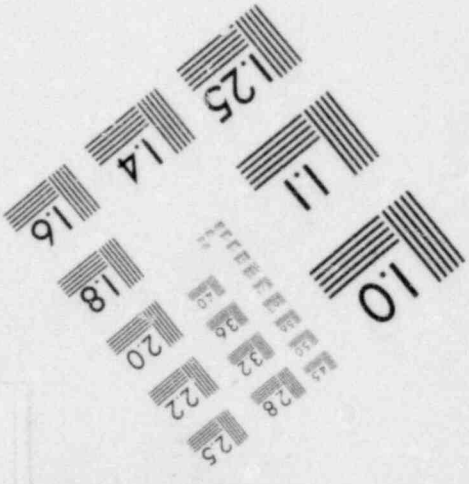


IMAGE EVALUATION TEST TARGET (MT-3)







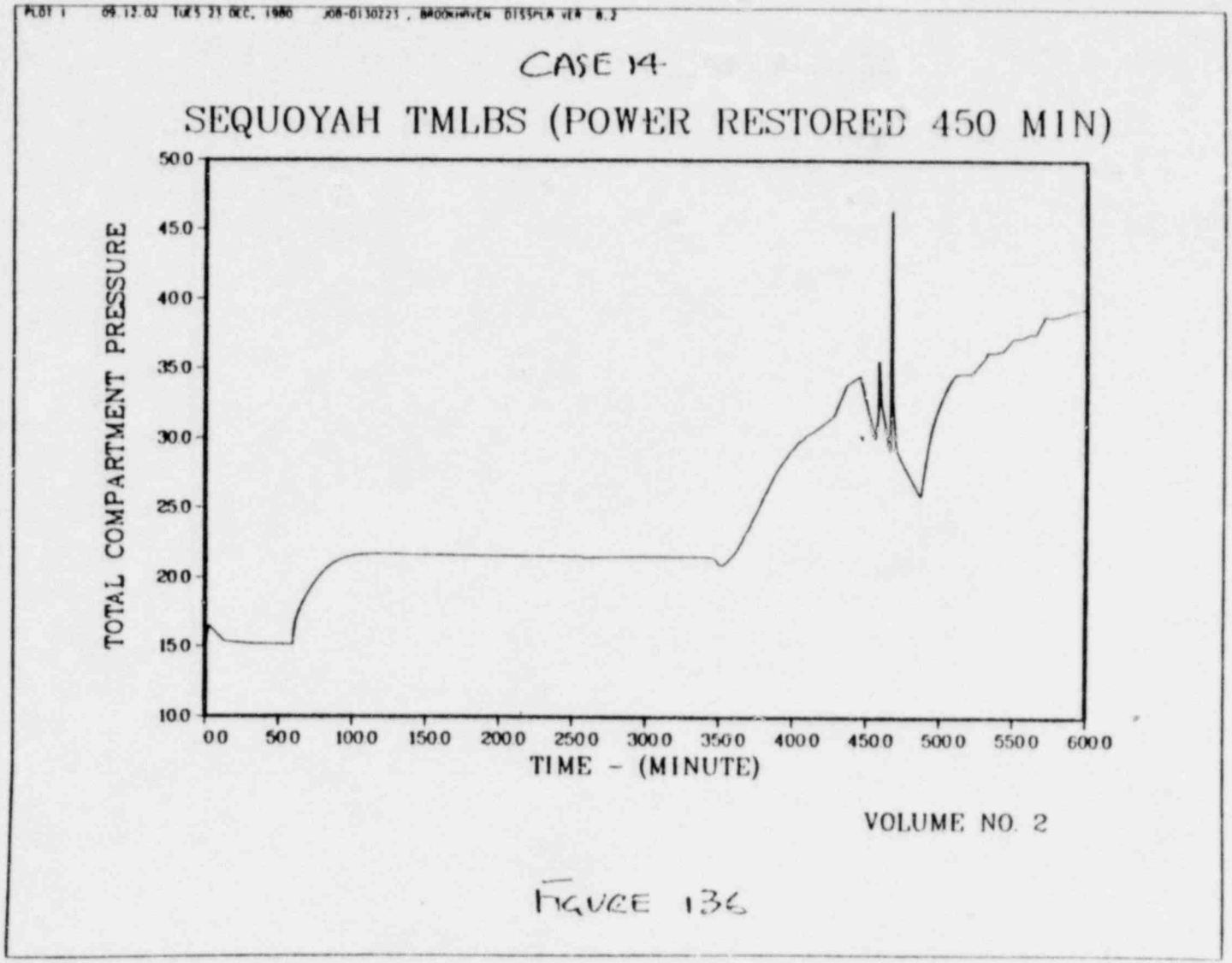

CASE 14
SEQUOYAH TMLBS (POWER RESTORED 450 MIN)
TOTAL COMPARTMENT PRESSURE
500
450
400
350
300
250
200
150
100
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 136

CASE 14

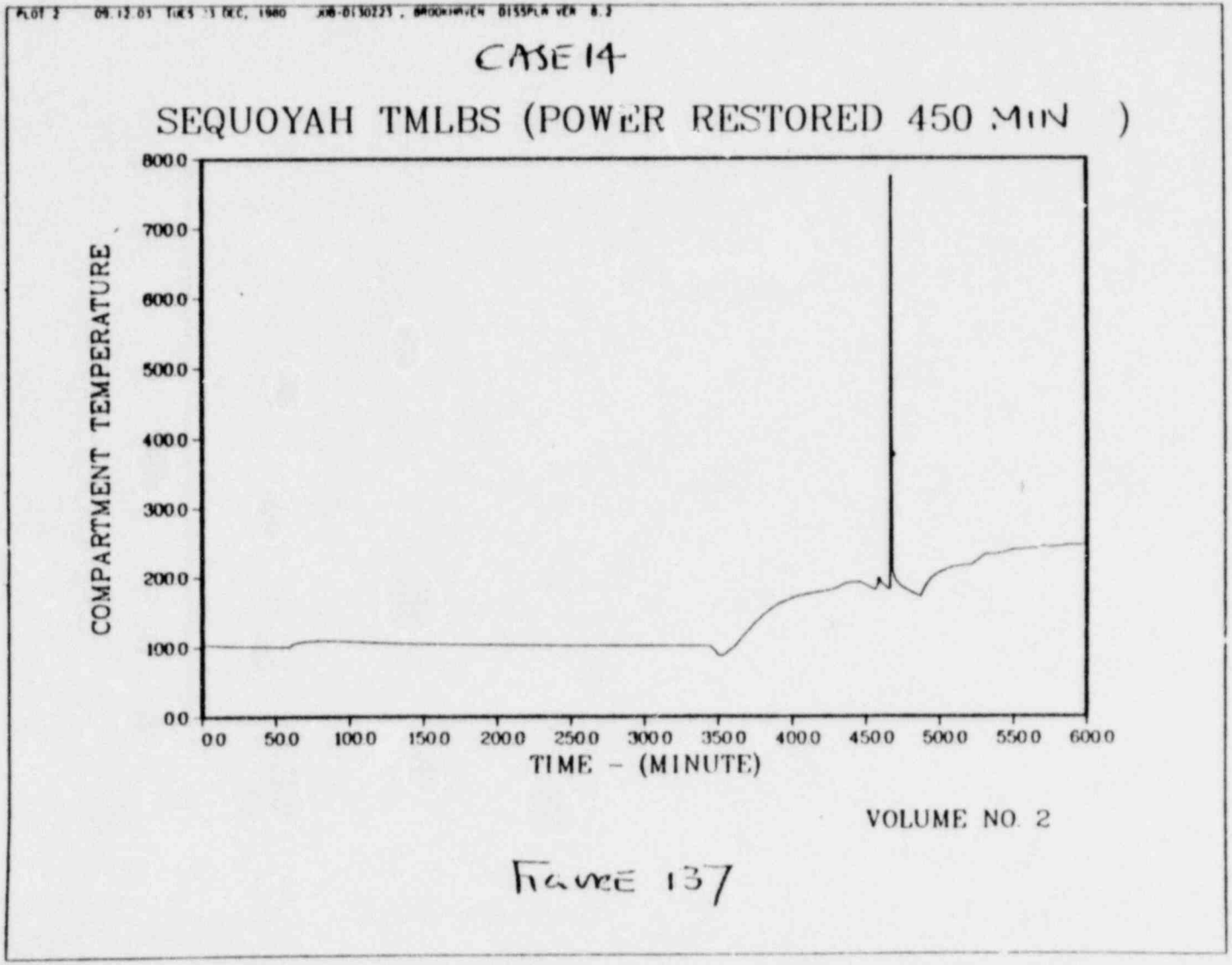


Figure 137

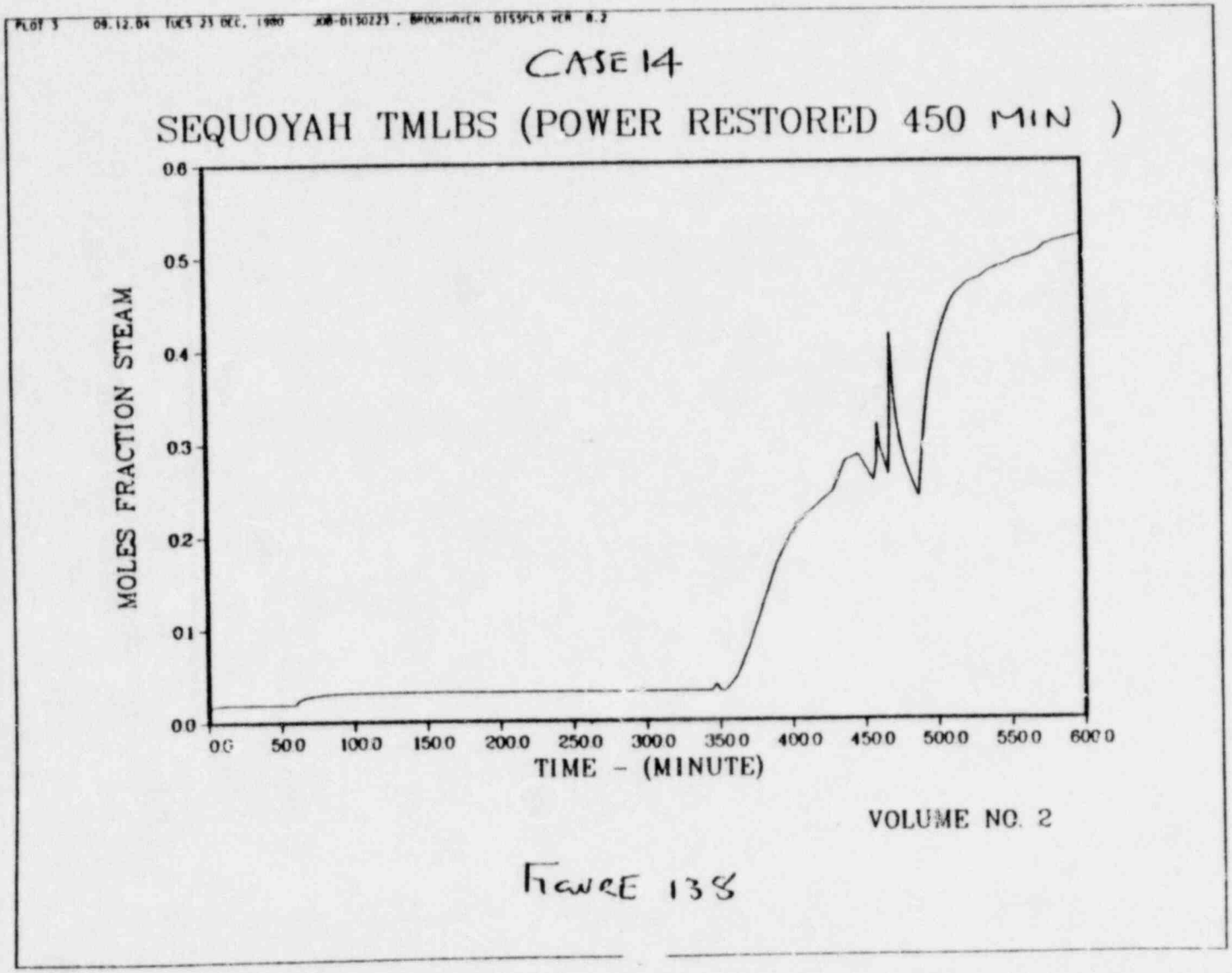

CASE 14
SEQUOYAH TMLBS (POWER RESTORED 450 MIN)
MOLES FRACTION STEAM
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 138

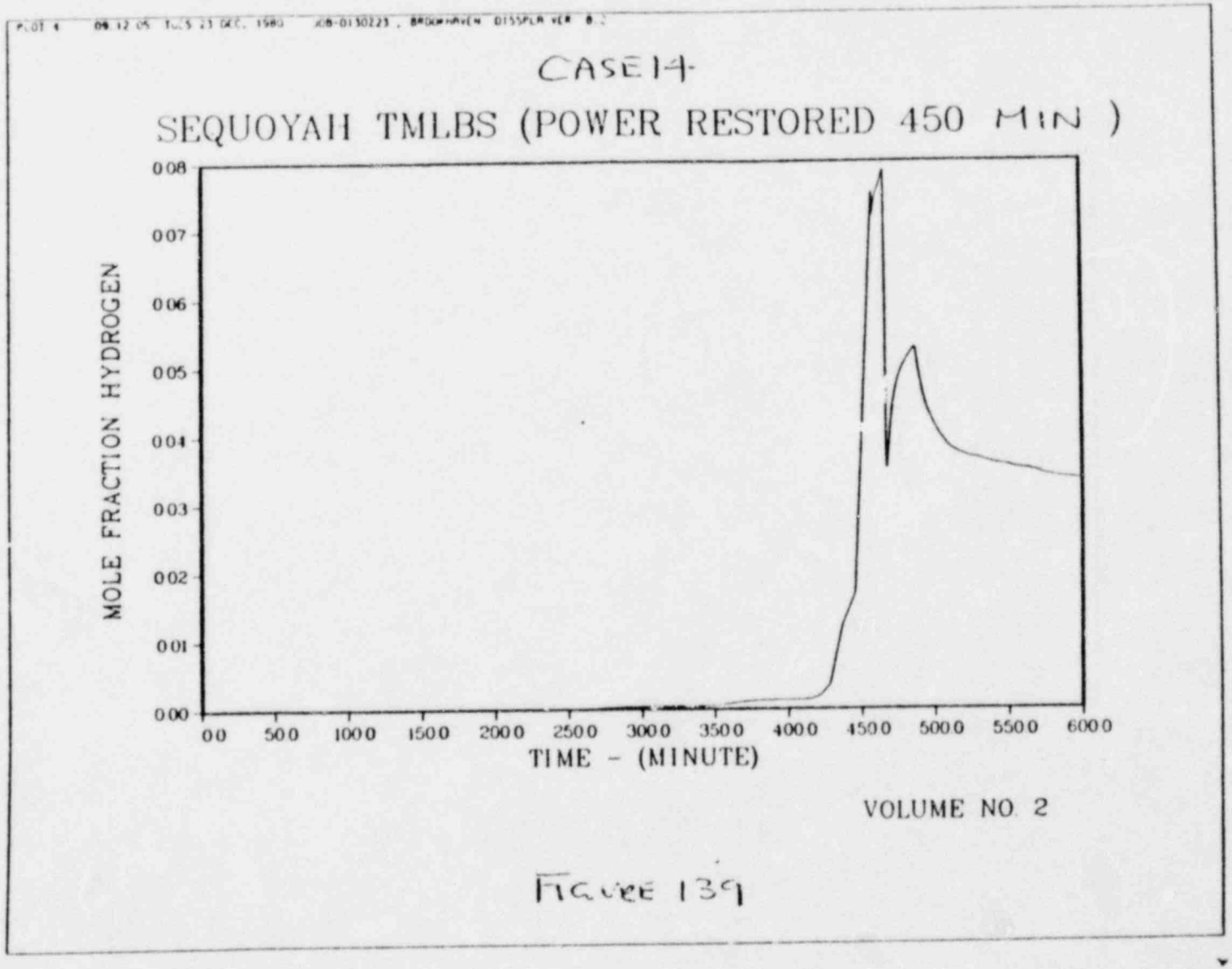

CASE14
SEQUOYAH TMLBS (POWER RESTORED 450 MIN)
MOLE FRACTION HYDROGEN
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
00
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO. 2

FIGURE 139

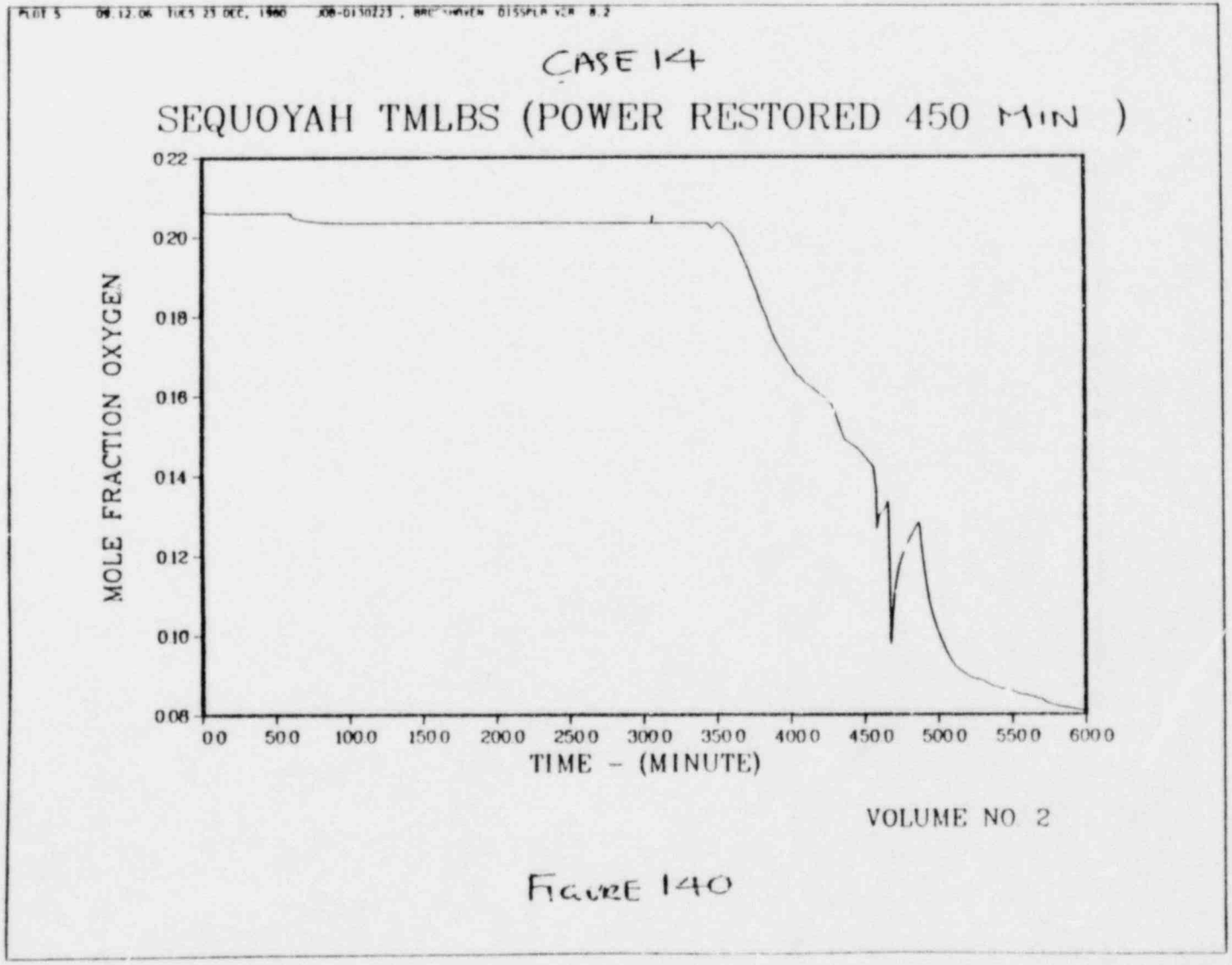

CASE 14
SEQUOYAH TMLBS (POWER RESTORED 450 MIN)
MOLE FRACTION OXYGEN
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
TIME - (MINUTE)
VOLUME NO 2

FIGURE 140

DISTRIBUTION FOR BOARD NOTIFICATION DATED MAR 4 1981 (BN-81-03)

[redacted]
LB#1 Rdg
DEisenhut/RPurple
BJYoungblood
RBirkel
MRushbrook
ASchwencer
JMiller
FMiraglia
RVollmer
TMurley
DRoss
FSchroeder
JKnight
VNoonan
RHartfield, MPA
OELD
OIE (3)
TERA
PDR
NSIC
TIC
ACRS (16)
HDenton/ECase
PPAS (Thompson)
NHughes
Board Notification File(LB#1)
bcc:
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BOARD NOTIFICATION
(McGuire 1-2)

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