TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

February 15, 1985

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of the Application of ) Docket Nos. 50-390
Tennessee Valley Authority 50-391

Enclosed are the results of the Watts Bar reduced ice weight analysis performed by Westinghouse Electric Corporation (Enclosure 1). Also, enclosed are corresponding FSAR revisions to be included in Amendment 55 (Enclosure 2).

Please note that proposed revisions to the unit 1 draft Technical Specifications which reflect the results of the subject analysis were forwarded by TVA's letter dated January 30, 1985.

We request that this matter be reviewed expeditiously in order to ensure that the Technical Specifications will reflect the new values upon their issuance.

If you have any questions concerning this matter, please get in touch with D. B. Ellis at FTS 858-2681.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

J. W. Hufham

J. W. Hufham, Manager
Licensing and Regulations

Sworn to and subscribed before me
this 15th day of Feb. 1985.

Paulette H. White
Notary Public

My Commission Expires 8-24-88

Enclosures (2)
cc: U.S. Nuclear Regulatory Commission (Enclosures)
Region II
Attn: Mr. J. Nelson Grace, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323



B001
1/1

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT

RESULTS OF THE REDUCED ICE WEIGHT
ANALYSIS PERFORMED BY WESTINGHOUSE

The following are the major input assumptions used in the LOTIC analysis for the pump suction pipe rupture case with the steam generators considered as an active heat source for the Watts Bar Nuclear Station Containment:

1. Minimum safeguards are employed in all calculations, e.g., one of two spray pumps and one of two spray heat exchangers; one of two RHR pumps and one of two RHR heat exchangers providing flow to the core; one of two safety injection pumps and one of two centrifugal charging pumps; and one of two air return fans.

2. A sensitivity study was performed varying the ice mass to determine the approximate minimum ice mass necessary. The study consisted of generating a pressure transient for five various ice masses.

   A. $2.45 \times 10^6$ lbs.
   B. $2.125 \times 10^6$ lbs.
   C. $2.085 \times 10^6$ lbs.
   D. $2.075 \times 10^6$ lbs.
   E. $2.062 \times 10^6$ lbs.

3. The blowdown, reflood, and post reflood mass and energy releases described in Section 6.2.1.3.6 of Watts Bar's FSAR were used.

4. Blowdown and post-blowdown ice condenser drain temperatures of 190°F and 130°F are used.

5. Nitrogen from the accumulators in the amount of 2218 lbs. is included in the calculations.

6. Nuclear service water temperature of 85°F is used on the spray heat exchanger and the component cooling heat exchanger.

7. The air return fan is effective, 10 minutes after the transient is initiated.

8. No maldistribution of steam flow to the ice bed is assumed.

9. No ice condenser bypass is assumed. (This assumption depletes the ice in the shortest time and is thus conservative).

10. The initial conditions in the Containment are a temperature of 100°F in the lower and dead-ended volumes and a temperature of 85°F in the upper volume. All volumes are at a pressure of 0.3 psig and a 10% relative humidity.

11. A spray pump flow of 4000 gpm is used to the upper compartment.

12. A residual spray (2000 gpm) is used starting 1 hour after the transient is initiated. The residual heat removal pump and spray pump take suction from the sump during recirculation.

13. Containment structural heat sink data is found in Table 1.

14. The operation of one Containment spray heat exchanger (UA 2.446 x $10^6$ Btu/hr-°F) for containment cooling and the operation of one RHR heat exchanger (UA = 1.61 x $10^6$ Btu/hr-°F) for core cooling.

15. The air return fan returns air at a rate of 40,000 dfm from the upper to lower compartment.

16. An active sump volume of 51,000 $ft^3$ is used.

17. The pump flowrates vs. time given in Table 2 were used.

18. A power rating of 102% of Licensed Power (3425 Mwt) was used. With these assumptions, the heat removal capability of the Containment is sufficient to absorb the energy releases and still keep the maximum calculated pressure well below design.

Results:

A sensitivity to ice mass was performed based upon the above outlined assumptions, in conjunction with TVA's intent of determining the minimum ice mass with ice melt-out occurring after containment spray realignment.

A comprehensive plot Figure 21, illustrates the ice mass parameter study.

The following outline details the results of this study:

1. Ice mass - 2.45 x $10^6$ lbs. (tech spec wt. 2.722 x $10^6$ lbs.)
   Peak pressure - 9.51 psig occurring at 11850.6 seconds
   Ice mass meltout occurs approximately at 4650 seconds

   The following plots are provided:

   Figure 1 - containment pressure transient
   Figure 2 - upper and lower compartment temperature transients
   Figure 3 - active and inactive sump temperature transient
   Figure 4 - ice mass melt transient

2. Ice mass - 2.125 x $10^6$ lbs. (tech spec. wt. 2.361 x $10^6$ lbs)
   Peak pressure - 11.21 psig occurring at 3600.9 seconds
   Ice mass meltout occurs approximately 2990 seconds

   The following plots are provided:

   Figure 5 - containment pressure transient
   Figure 6 - upper and lower compartment temperature transients
   Figure 7 - active and inactive sump temperature transient
   Figure 8 - ice mass melt transient

3.* Ice mass - 2.0825 x $10^6$ lbs. (tech spec.wt. x $10^6$ lbs)
Peak pressure - 12.21 psig occurring at 2892.9 seconds
Ice mass meltout occurs approximately at 2815 seconds.

The following plots are provided:

Figure 9 - containment pressure transient
Figure 10 - upper and lower compartment temperature transients
Figure 11 - active and inactive sump temperature transient
Figure 12 - ice mass melt transient

4.* Ice mass - 2.075 x $10^6$ lbs. (tech spec. wt. 2.305 x $10^6$ lbs)
Peak pressure - 12.74 psig occurring at 2893 seconds
Ice mass meltout occurs approximately at 2765 seconds.

The following plots are provided:

Figure 13 - containment pressure transient
Figure 14 - upper and lower compartment temperature transient
Figure 15 - active and inactive sump temperature transient
Figure 16 - Ice mass melt transient

5.* Ice mass - 2.062 x $10^6$ lbs. (tech spec.wt. 2.291 x $10^6$ lbs)
Peak pressure - 13.45 psig occurring at 2893 seconds
Ice mass meltout occurs approximately at 2716 seconds

Figure 17, Containment pressure transients
Figure 18, Upper and lower compartment temperature transients
Figure 19, Active and inactive sump-temperature transient
Figure 20, Ice mass melt transient

*Case 3, 4 and 5 have double pressure peak.

TABLE 1

STRUCTURAL HEAT SINKS

A. Upper Compartment

| | Area ($ft^2$) | Thickness (ft) | |
|---|---|---|---|
| 1. Operating Deck | | | |
| Slab 1 | 4880 | 1.1 | Concrete |
| Slab 2 | 18280 | .0005 | Paint |
| | | 1.4 | Concrete |
| Slab 3 | 760 | .000125 | Paint |
| | | 1.5 | Concrete |
| Slab 4 | 3840 | .0208 | Stainless Steel |
| | | 1.5 | Concrete |
| 2. Shell & Misc. | | | |
| Slab 5 | 56331 | .000625 | Paint |
| | | .08 | Steel |

B. Lower Compartment

| | | | |
|---|---|---|---|
| 1. Operating Deck, Crane Wall, and Interior Concrete | | | |
| Slab 6 | 31963 | 1.43 | Concrete |

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TABLE 1 (Continued)

STRUCTURAL HEAT SINKS

A. Upper Compartment

2. Operating Deck

| | | | |
|---|---|---|---|
| Slab 7 | 2830 | .00125 | Paint |
| | | 1.0 | Concrete |
| Slab 8 | 760 | .0005 | Paint |
| | | 1.75 | Concrete |

3. Interior Concrete & Stainless Steel

| | | | |
|---|---|---|---|
| Slab 9 | 2270 | .021 | Stainless Steel |
| | | 2.0 | Concrete |

4. Floor*

| | | | |
|---|---|---|---|
| Slab 10 | 15921 | .0005 | Paint |
| | | 1.6 | Concrete |

5. Misc Steel

| | | | |
|---|---|---|---|
| Slab 11 | 28500 | .000625 | Paint |
| | | .066 | Steel |

C. Ice Condenser

1. Ice Baskets

| | | | |
|---|---|---|---|
| Slab 12 | 180,628 | 0.00663 | Steel |

TABLE 1 (Continued)

STRUCTURAL HEAT SINKS

A. Upper Compartment

2. Lattice Frames

| | | | |
|---|---|---|---|
| Slab 13 | 76,650 | 0.0217 | Steel |

3. Lower Support Structure

| | | | |
|---|---|---|---|
| Slab 14 | 28,670 | 0.0267 | Steel |

4. Ice Condenser Floor

| | | | |
|---|---|---|---|
| Slab 15 | 3336 | 0.000833 | Paint |
| | | 0.333 | Concrete |

5. Containment Wall Panels & Containment Shell

| | | | |
|---|---|---|---|
| Slab 16 | 19,100 | 1.0 | Steel & Insulation |
| | | 0.0625 | Steel Shell |

6. Crane Wall Panels and Crane Wall

| | | | |
|---|---|---|---|
| Slab 17 | 13,055 | 1.0 | Steel & Insulation |
| | | 1.0 | Concrete |

*In contact with sump

TABLE 1 (Continued)

MATERIAL PROPERTY DATA

| Material | Thermal Conductivity Btu/hr-ft-°F | Volumetric Heat Capacity $Btu/ft^3$-°F |
|---|---|---|
| Paint on Steel | 0.21 | 14.0 |
| Paint on Concrete | 0.083 | 28.4 |
| Concrete | .8 | 28.8 |
| Stainless Steel | 9.4 | 56.4 |
| Carbon Steel | 26.0 | 56.4 |

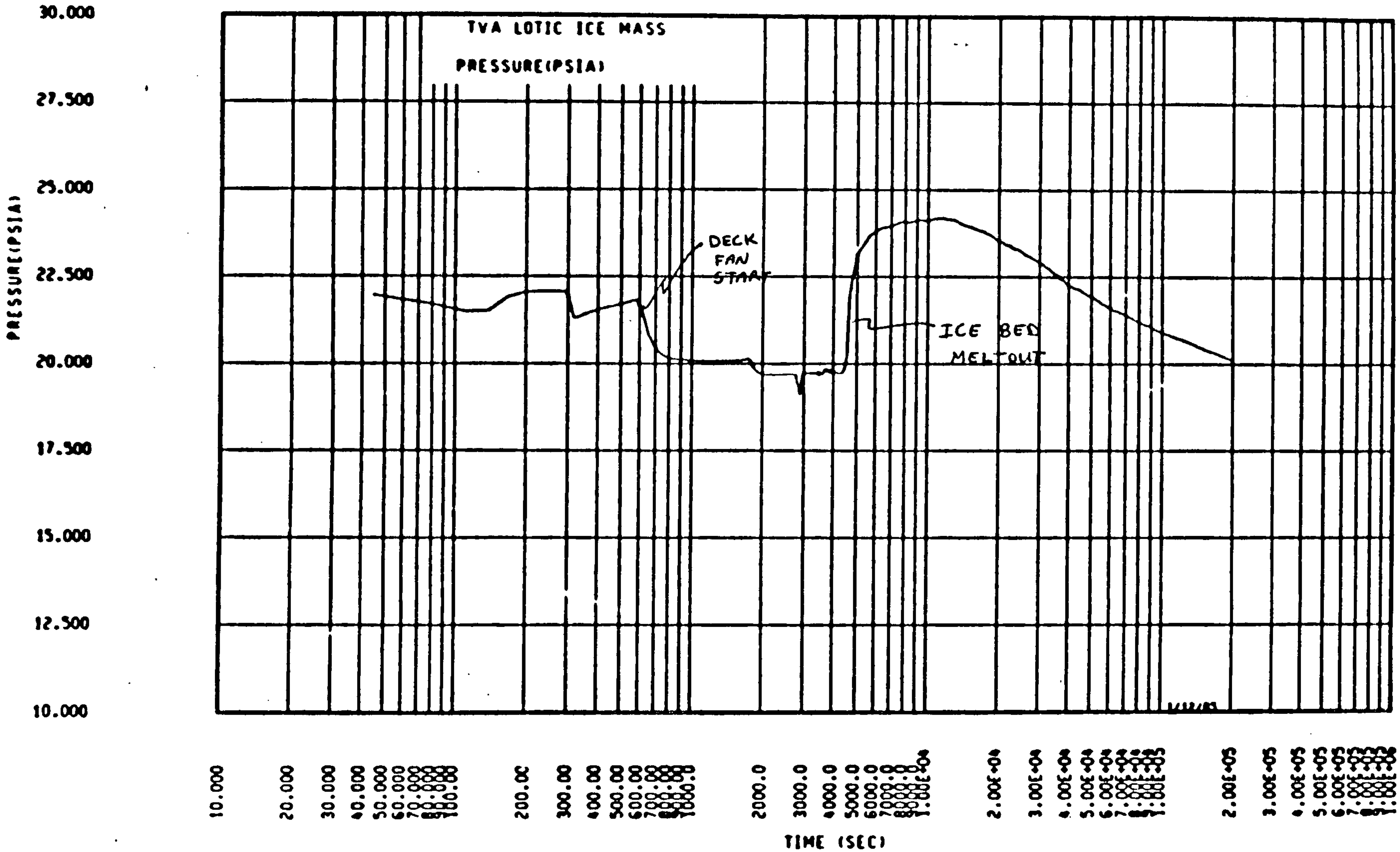
TABLE 2

PUMP FLOWRATES VS TIME

| Time After Safeguards Initiation (Sec.) | SIS Flow To Core (GPM) | Spray Flow (GPM) | RHR Spray Flow (GPM) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 15 | 460 | 0 | 0 |
| 20 | 1065 | 0 | 0 |
| 25 | 4853 | 0 | 0 |
| 135 | 4853 | 4000 | 0 |
| 1768 | 4853 | 4000 | 0 |
| 1788 | 4853* | 4000 | 0 |
| 1938 | 3788** | 4000 | 0 |
| 2754 | 3788 | 4000 | 0 |
| 2774 | 3788 | 0 | 0 |
| 2894 | 3788 | 4000 | 0 |
| 3600 | 1078 | 4000 | 2000 |
| END OF TRANSIENT | 1078 | 4000 | 2000 |

*3788 gpm from sump

**All flow from sump from this point until end of transient



TVA LOTIC ICE MASS
PRESSURE(PSIA)
30.000
27.500
25.000
22.500
20.000
17.500
15.000
12.500
10.000
PRESSURE(PSIA)
DECK FAN START
ICE BED MELTOUT
TIME (SEC)


FIGURE 1

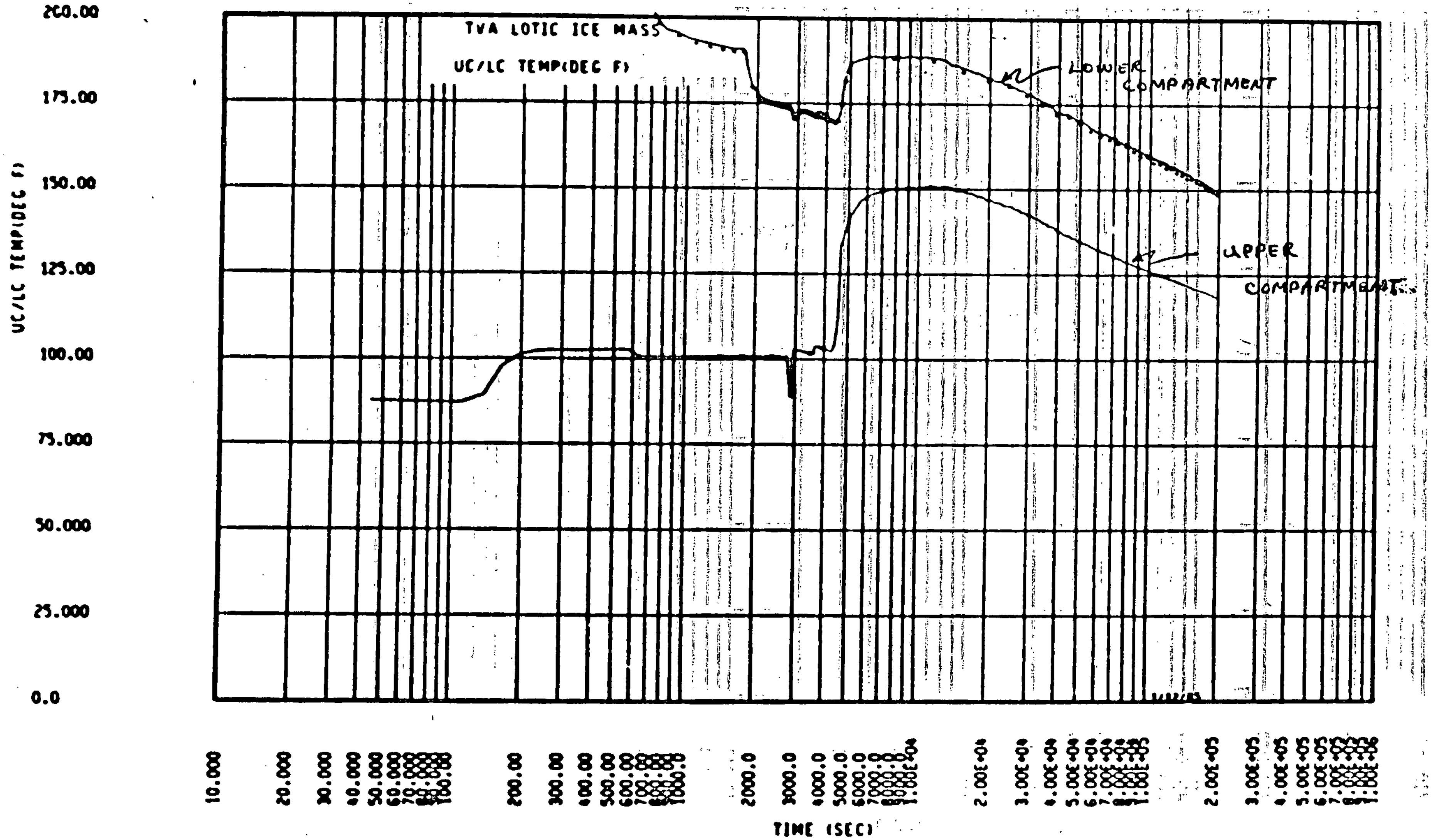
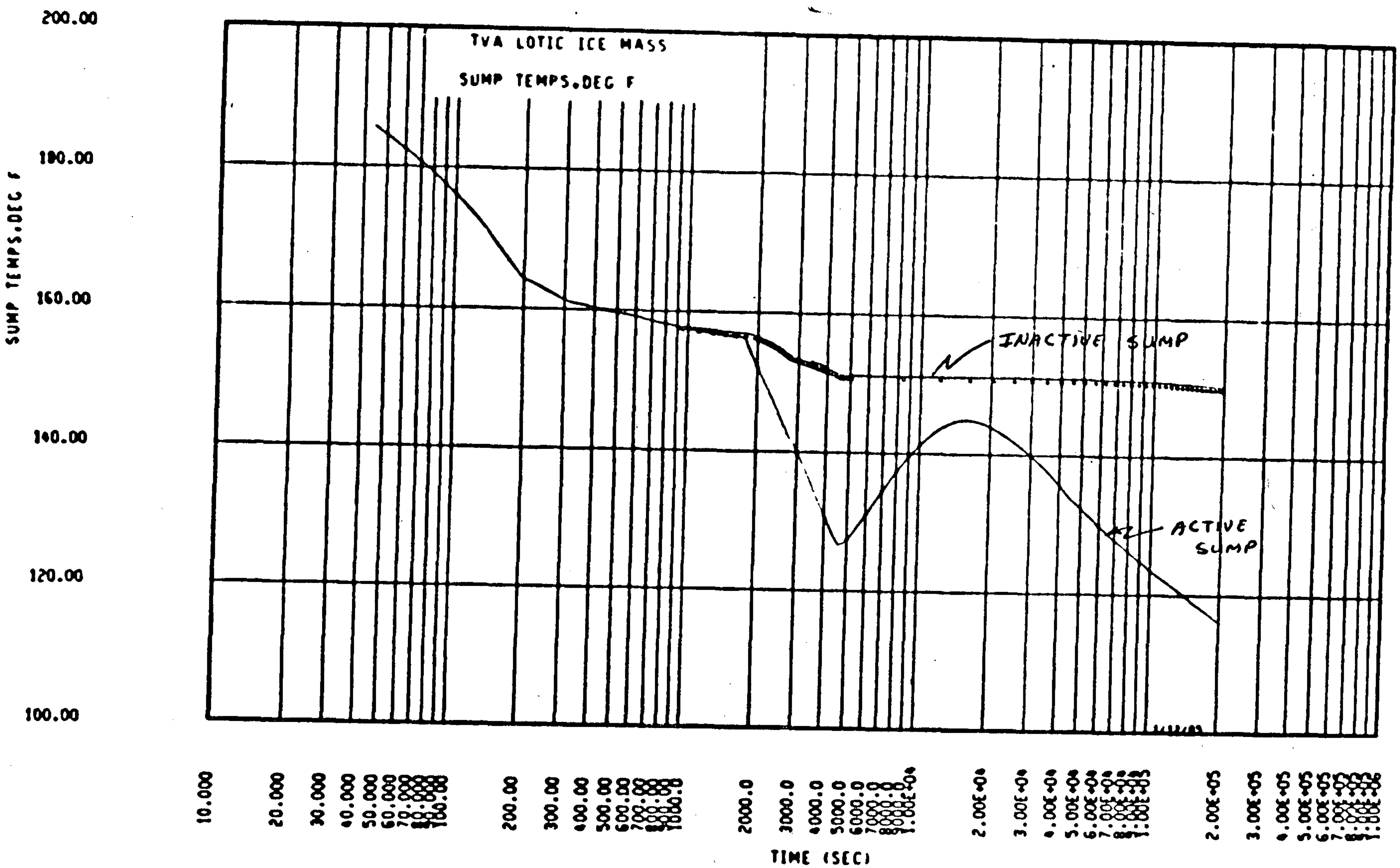

TVA LOTIC ICE MASS
UC/LC TEMP(DEG F)
LOWER COMPARTMENT
UPPER COMPARTMENT
UC/LC TEMP(DEG F)
200.00
175.00
150.00
125.00
100.00
75.000
50.000
25.000
0.0
10.000
20.000
30.000
40.000
50.000
200.00
300.00
400.00
500.00
2000.0
3000.0
4000.0
5000.0
6000.0
7000.0
2.00E+04
3.00E+04
4.00E+04
5.00E+04
6.00E+04
2.00E+05
3.00E+05
4.00E+05
5.00E+05
6.00E+05
TIME (SEC)

FIGURE 2



TVA LOTIC ICE MASS
SUMP TEMPS.DEG F
SUMP TEMPS.DEG F
200.00
180.00
160.00
140.00
120.00
100.00
INACTIVE SUMP
ACTIVE SUMP
10.000
20.000
30.000
40.000
50.000
200.00
300.00
400.00
500.00
2000.0
3000.0
4000.0
5000.0
6000.0
2.00E+04
3.00E+04
4.00E+04
5.00E+04
6.00E+04
2.00E+05
3.00E+05
4.00E+05
5.00E+05
6.00E+05
TIME (SEC)


FIGURE 3

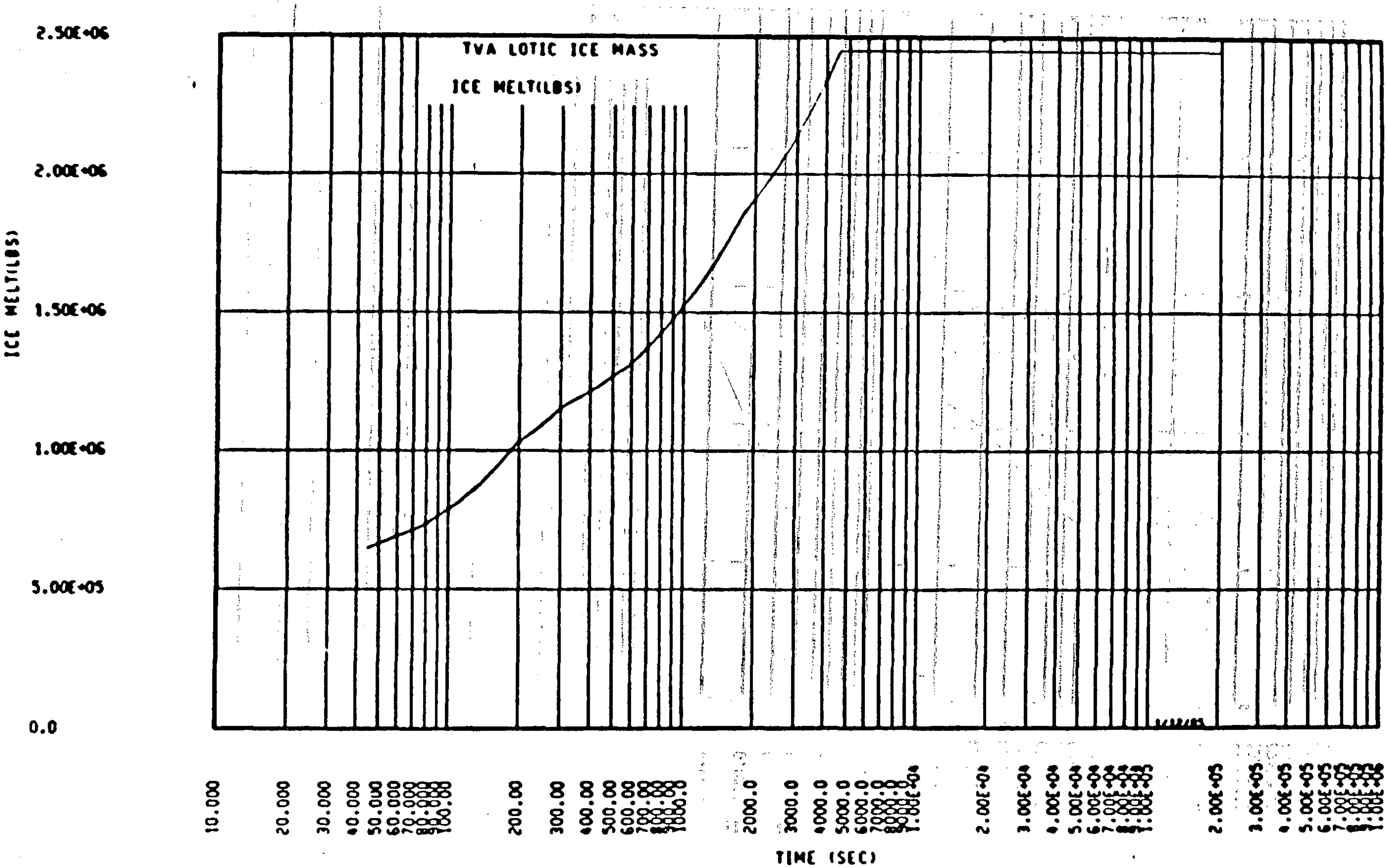

TVA LOTIC ICE MASS
ICE MELT(LBS)
ICE MELT(LBS)
2.50E+06
2.00E+06
1.50E+06
1.00E+06
5.00E+05
0.0
TIME (SEC)

FIGURE 4

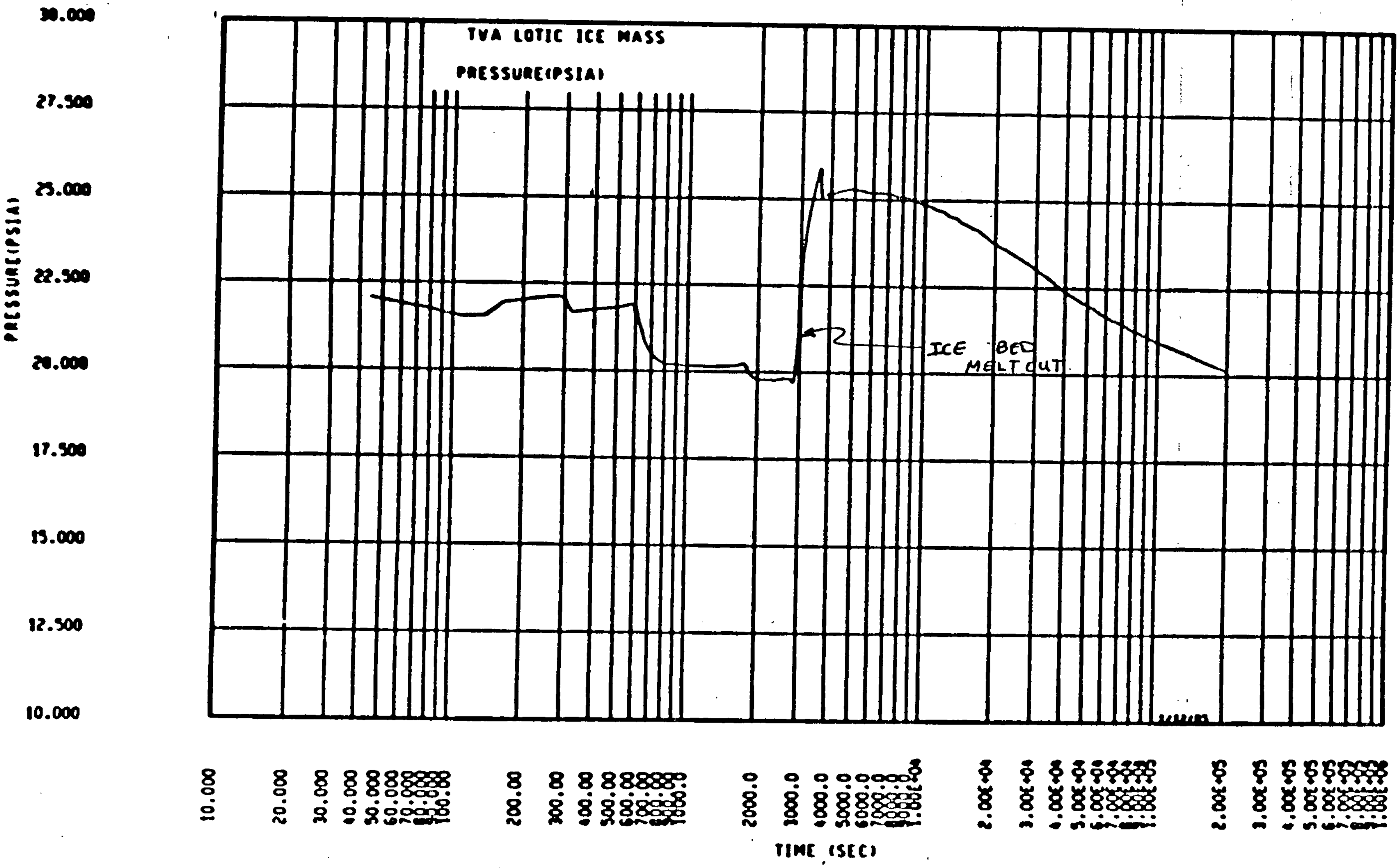

TVA LOTIC ICE MASS
PRESSURE(PSIA)
30.000
27.500
25.000
22.500
20.000
17.500
15.000
12.500
10.000
PRESSURE(PSIA)
ICE BED MELTOUT
10.000
20.000
30.000
40.000
50.000
200.00
300.00
400.00
2000.0
3000.0
4000.0
5000.0
2.00E+04
3.00E+04
4.00E+04
5.00E+04
2.00E+05
3.00E+05
4.00E+05
5.00E+05
TIME (SEC)

FIGURE 5

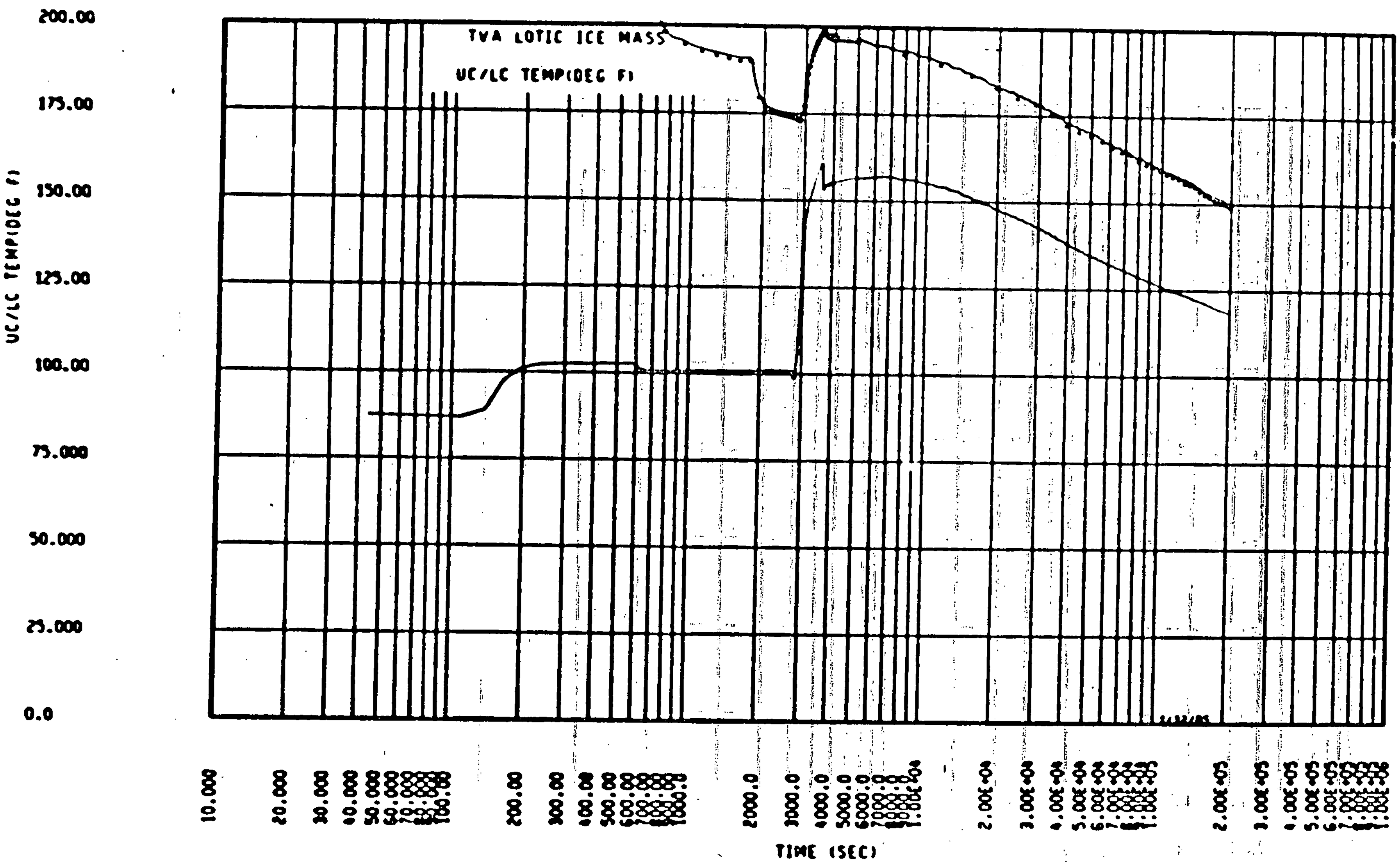
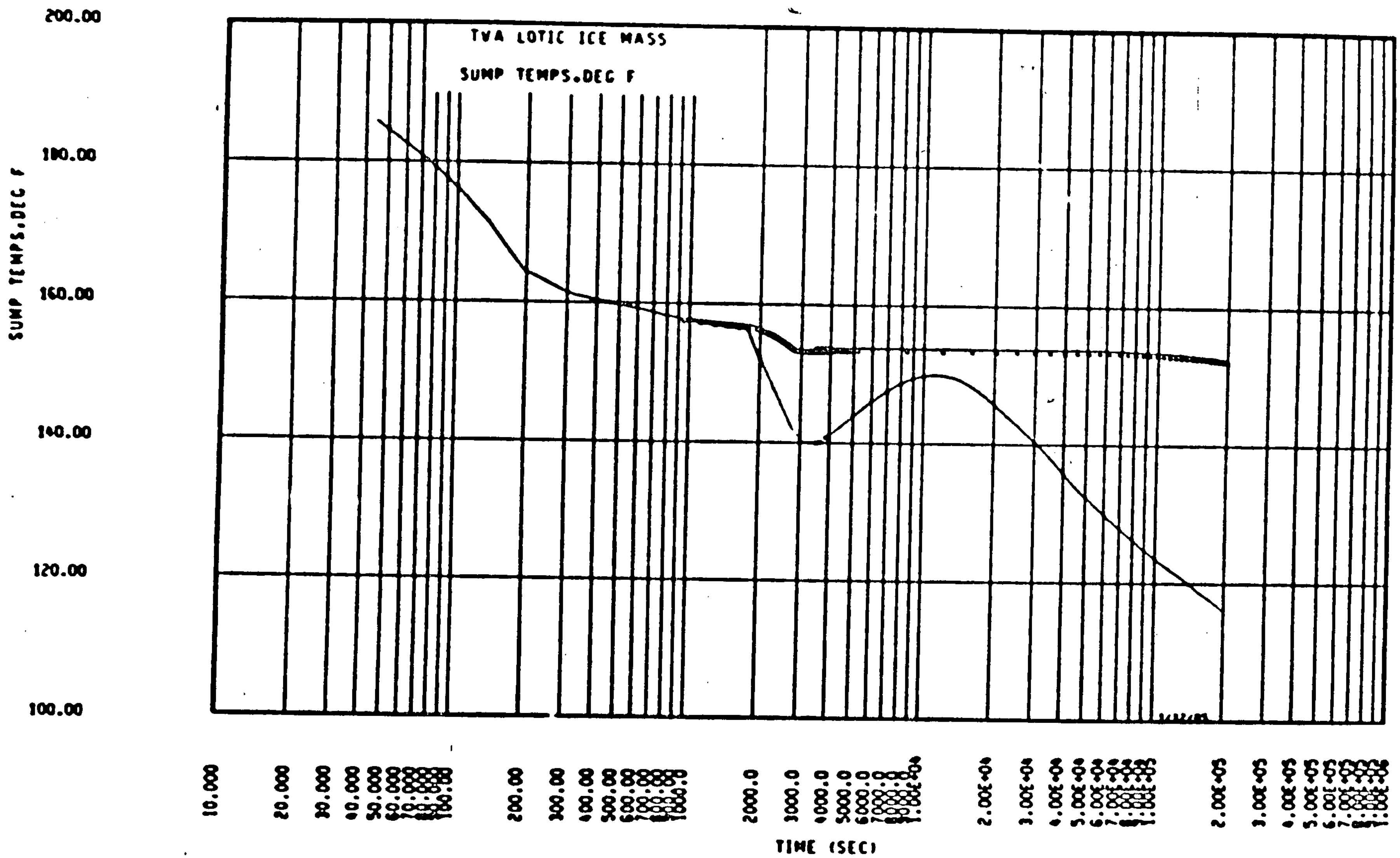

TVA LOTIC ICE MASS
UC/LC TEMP(DEG F)
UC/LC TEMP(DEG F)
200.00
175.00
150.00
125.00
100.00
75.000
50.000
25.000
0.0
TIME (SEC)

FIGURE 6



TVA LOTIC ICE MASS
SUMP TEMPS.DEG F
200.00
180.00
160.00
140.00
120.00
100.00
SUMP TEMPS.DEG F
TIME (SEC)


FIGURE 7

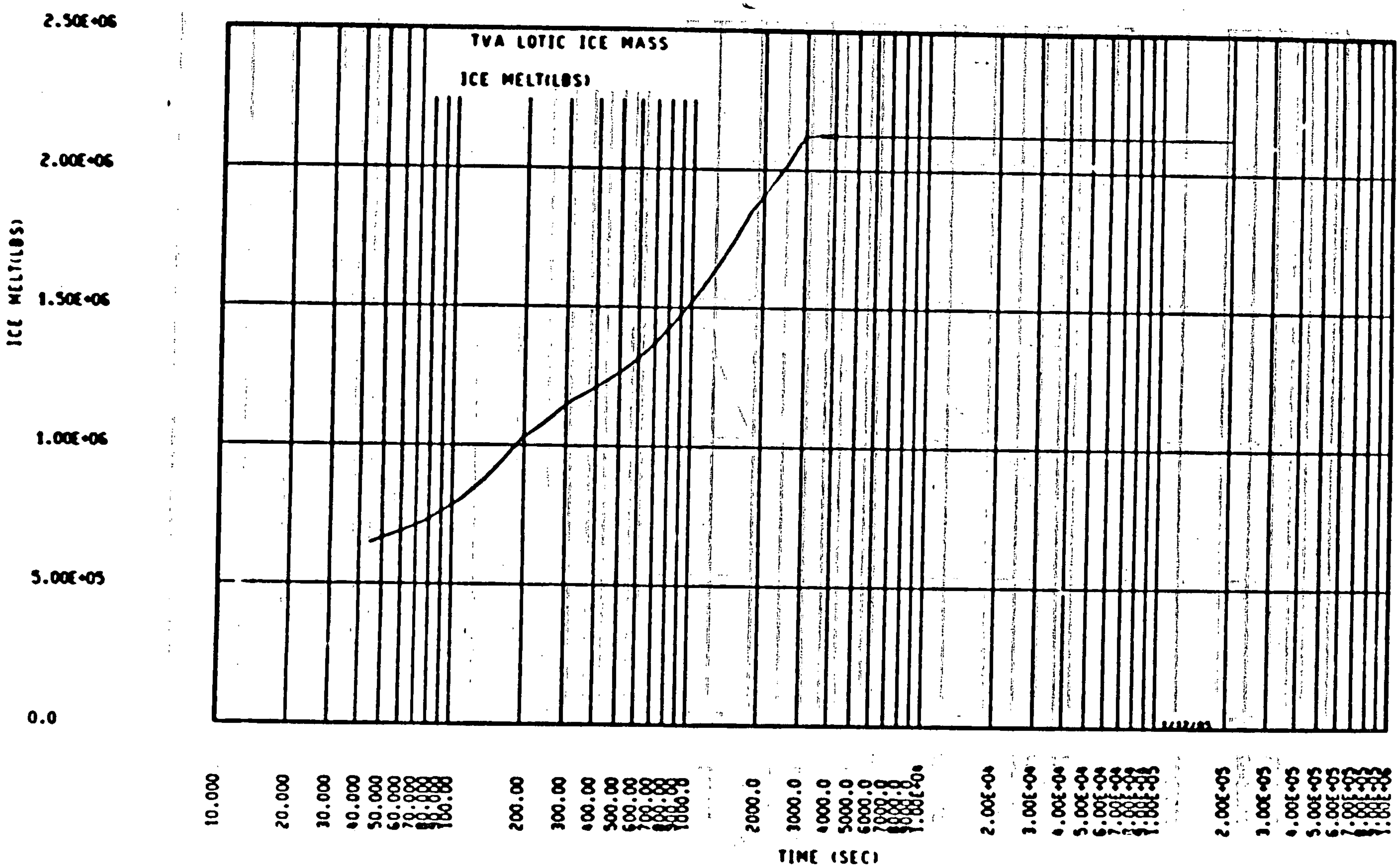

TVA LOTIC ICE MASS
ICE MELT(LBS)
ICE MELT(LBS)
2.50E+06
2.00E+06
1.50E+06
1.00E+06
5.00E+05
0.0
10.000
20.000
30.000
40.000
50.000
200.00
300.00
400.00
500.00
2000.0
3000.0
4000.0
5000.0
2.00E+04
3.00E+04
4.00E+04
5.00E+04
2.00E+05
3.00E+05
4.00E+05
5.00E+05
TIME (SEC)

FIGURE 8

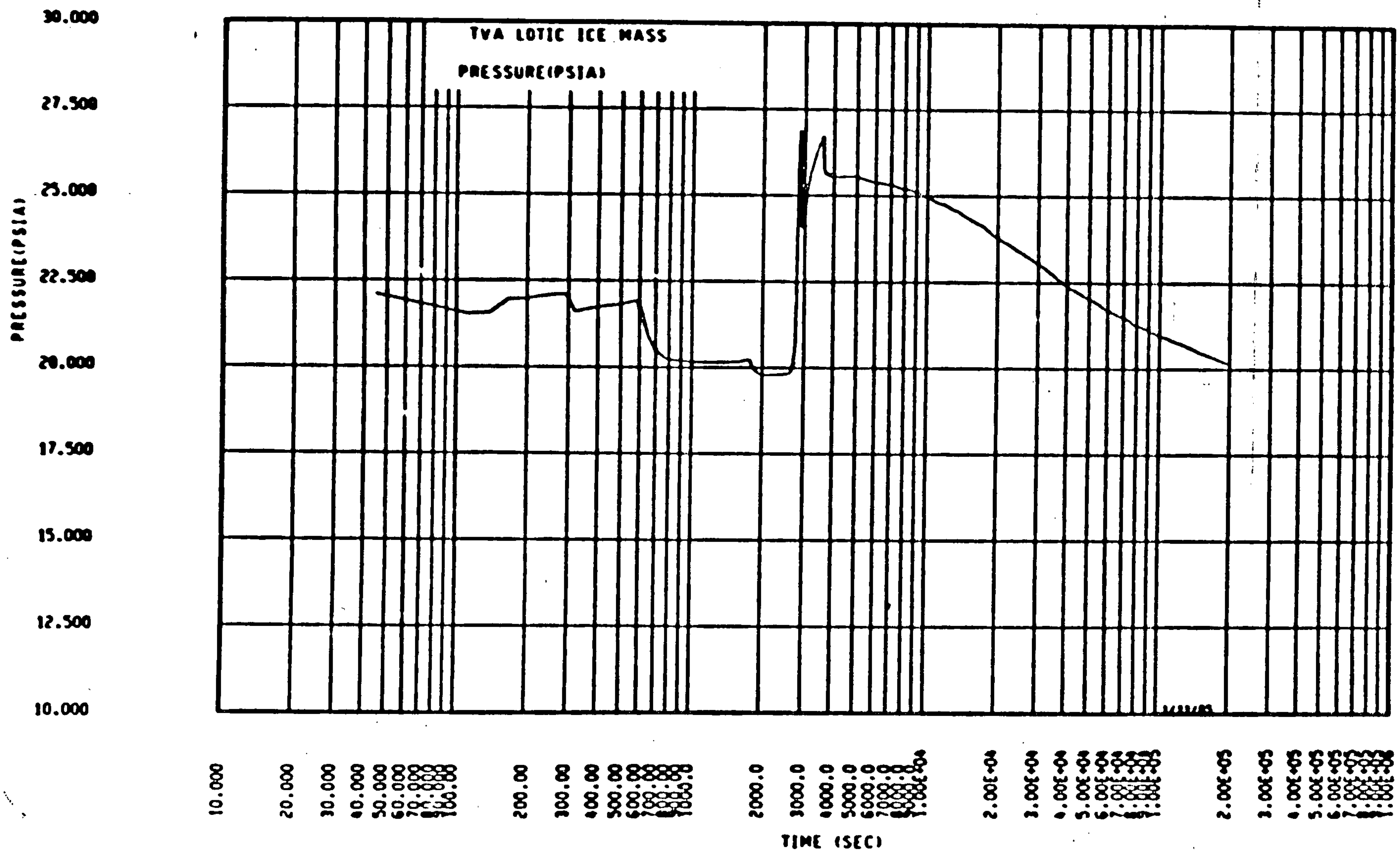
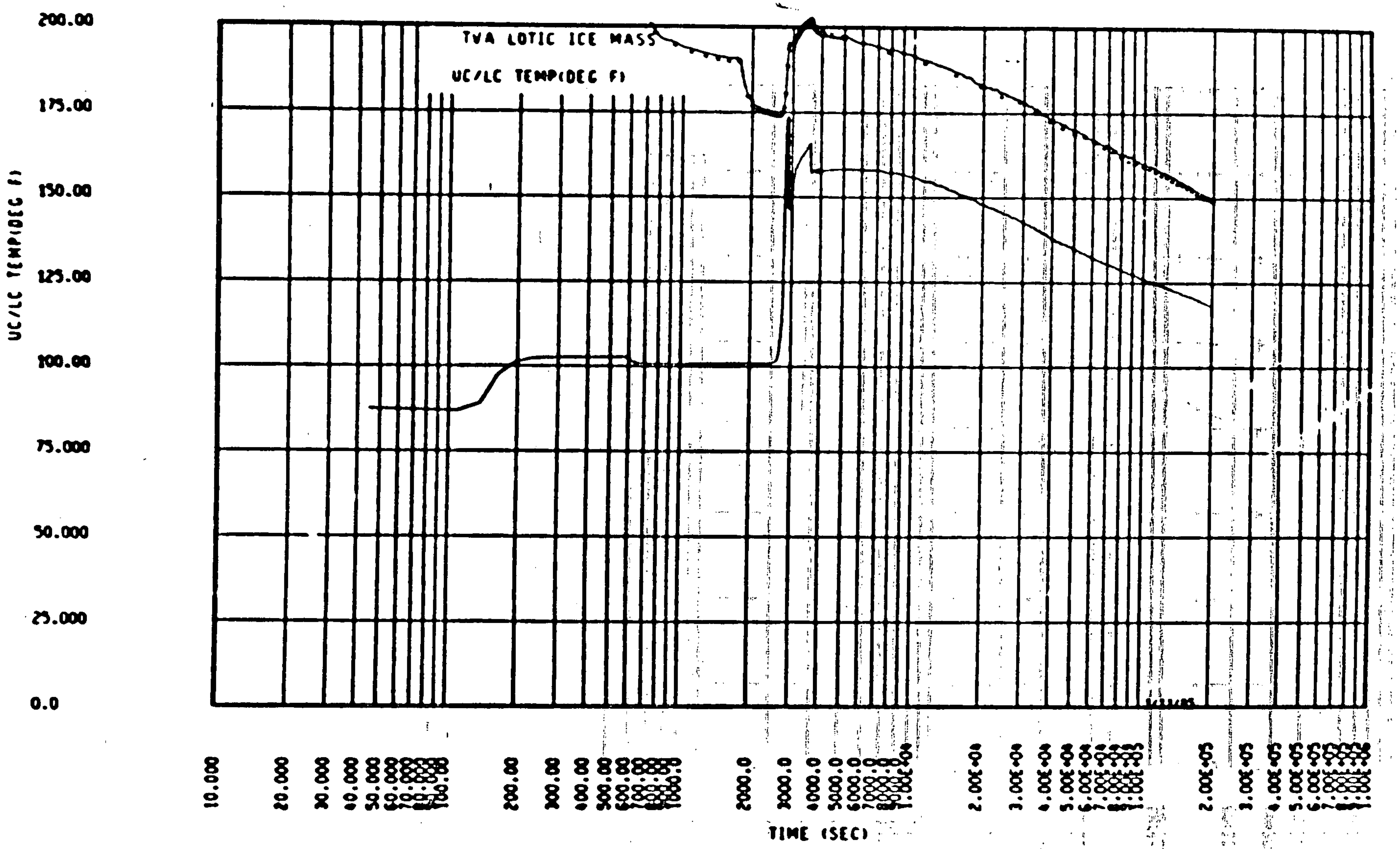

TVA LOTIC ICE MASS
PRESSURE(PSIA)
30.000
27.500
25.000
22.500
20.000
17.500
15.000
12.500
10.000
PRESSURE(PSIA)
10.000
20.000
30.000
40.000
50.000
200.00
300.00
400.00
500.00
2000.0
3000.0
4000.0
5000.0
2.00E+04
3.00E+04
4.00E+04
5.00E+04
2.00E+05
3.00E+05
4.00E+05
5.00E+05
TIME (SEC)

FIGURE 9



TVA LOTIC ICE MASS
UC/LC TEMP(DEG F)
200.00
175.00
150.00
125.00
100.00
75.000
50.000
25.000
0.0
UC/LC TEMP(DEG F)
TIME (SEC)


FIGURE 10

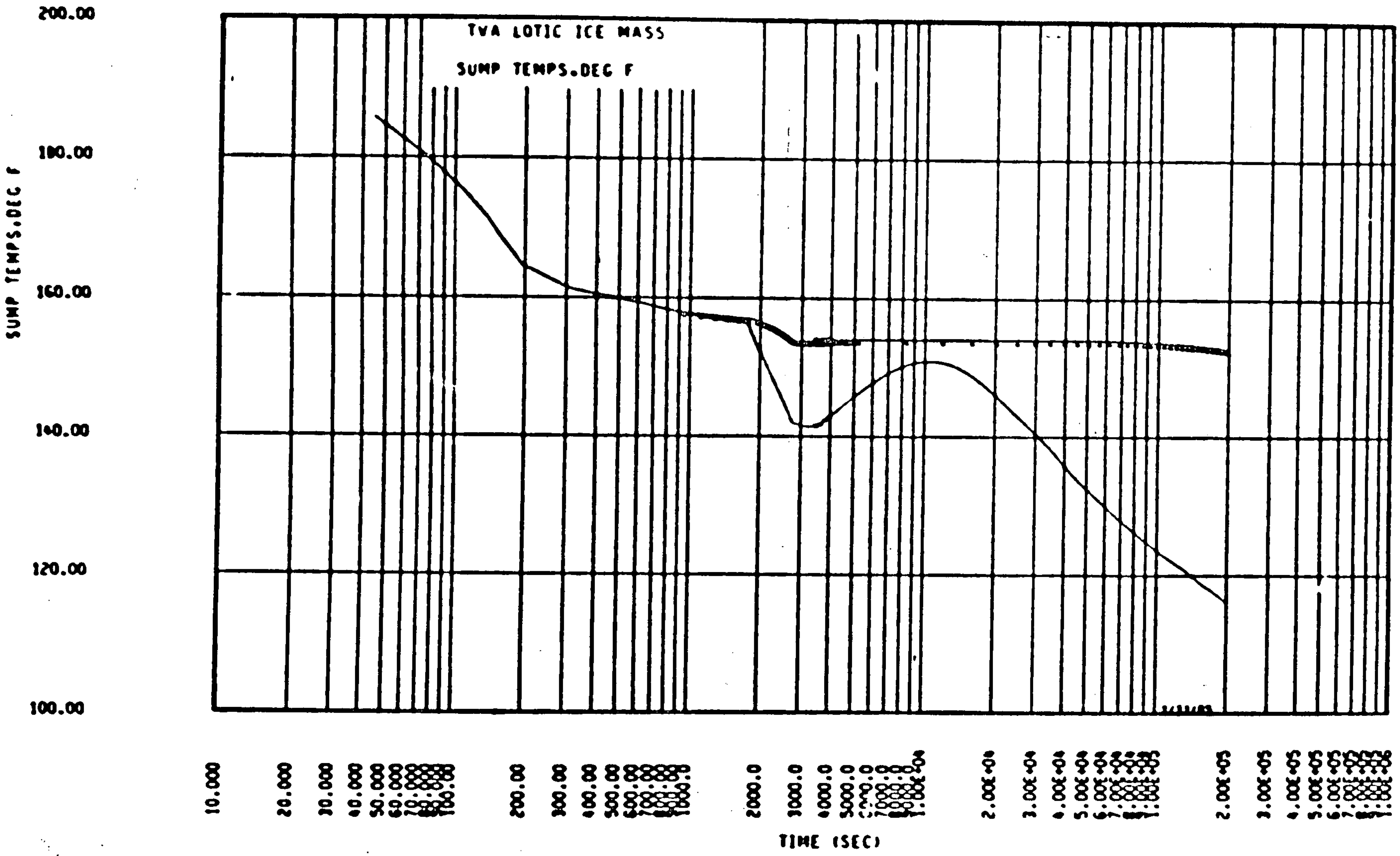

TVA LOTIC ICE MASS
SUMP TEMPS.DEG F
SUMP TEMPS.DEG F
200.00
180.00
160.00
140.00
120.00
100.00
TIME (SEC)

FIGURE 11

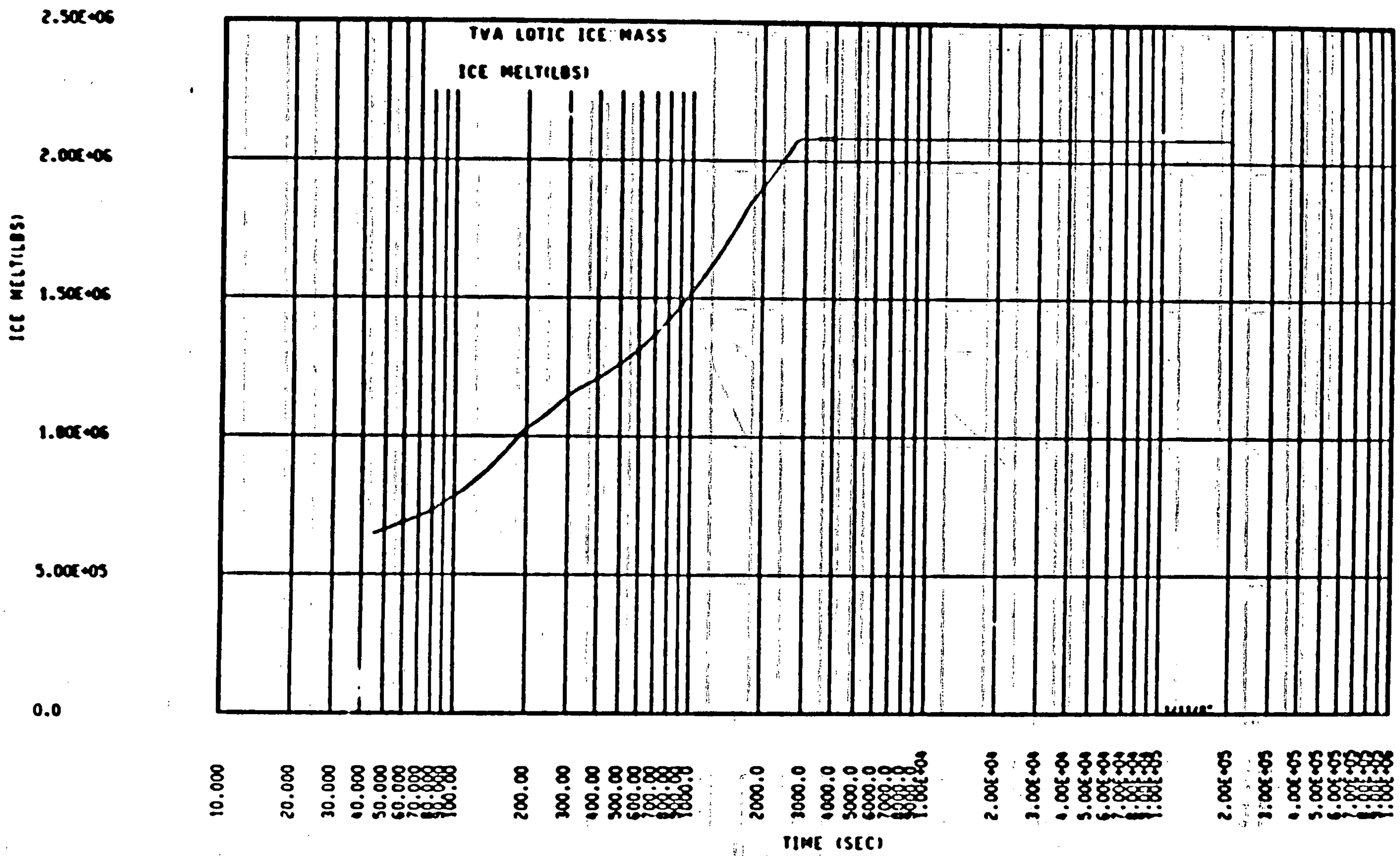
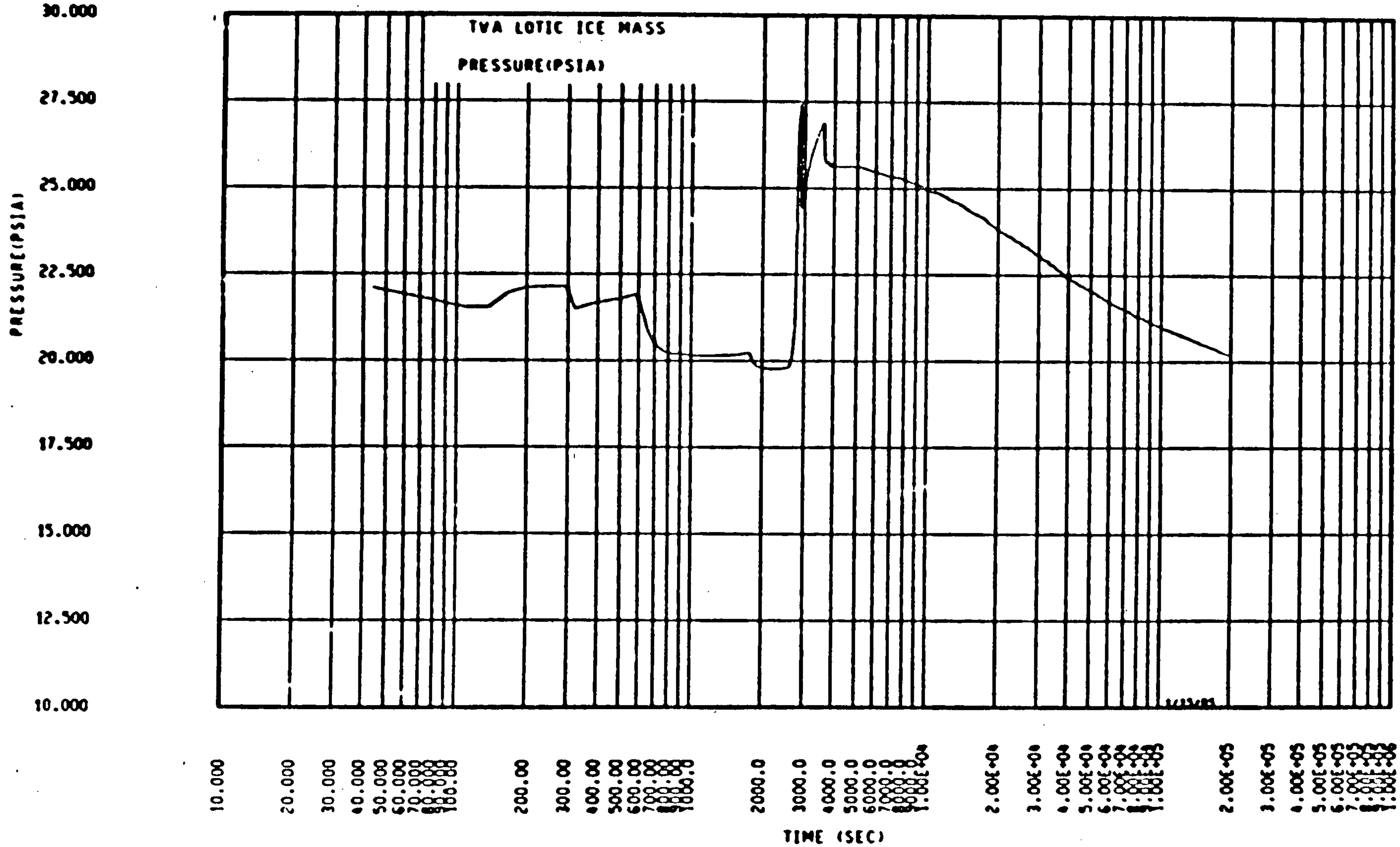

TVA LOTIC ICE MASS
ICE MELT(LBS)
ICE MELT(LBS)
2.50E+06
2.00E+06
1.50E+06
1.00E+06
5.00E+05
0.0
10.000
20.000
30.000
40.000
50.000
100.00
200.00
300.00
400.00
500.00
2000.0
3000.0
4000.0
5000.0
6000.0
2.00E+04
3.00E+04
4.00E+04
5.00E+04
2.00E+05
4.00E+05
5.00E+05
TIME (SEC)

FIGURE 12



TVA LOTIC ICE MASS
PRESSURE(PSIA)
30.000
27.500
25.000
22.500
20.000
17.500
15.000
12.500
10.000
PRESSURE(PSIA)
TIME (SEC)


FIGURE 13

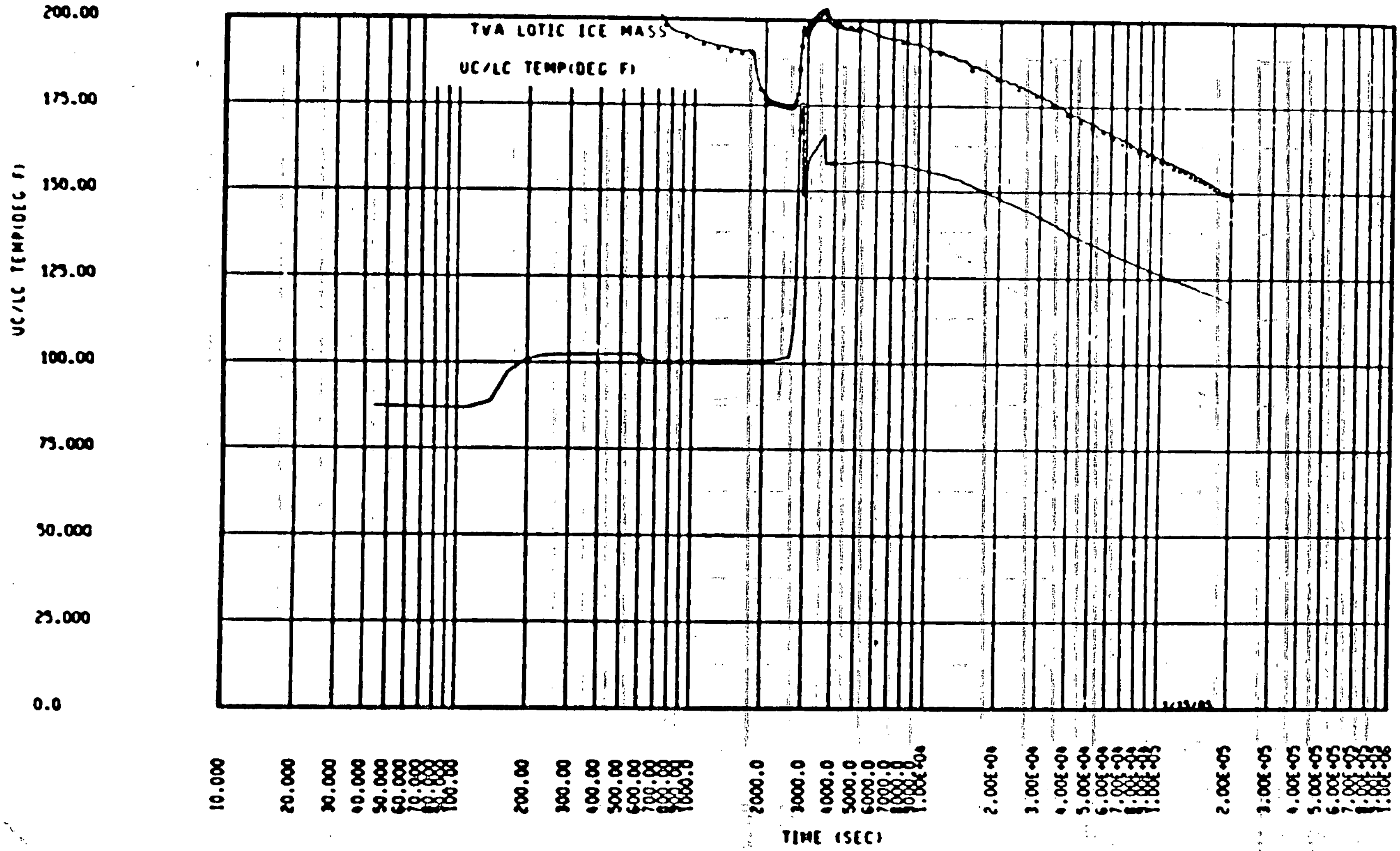
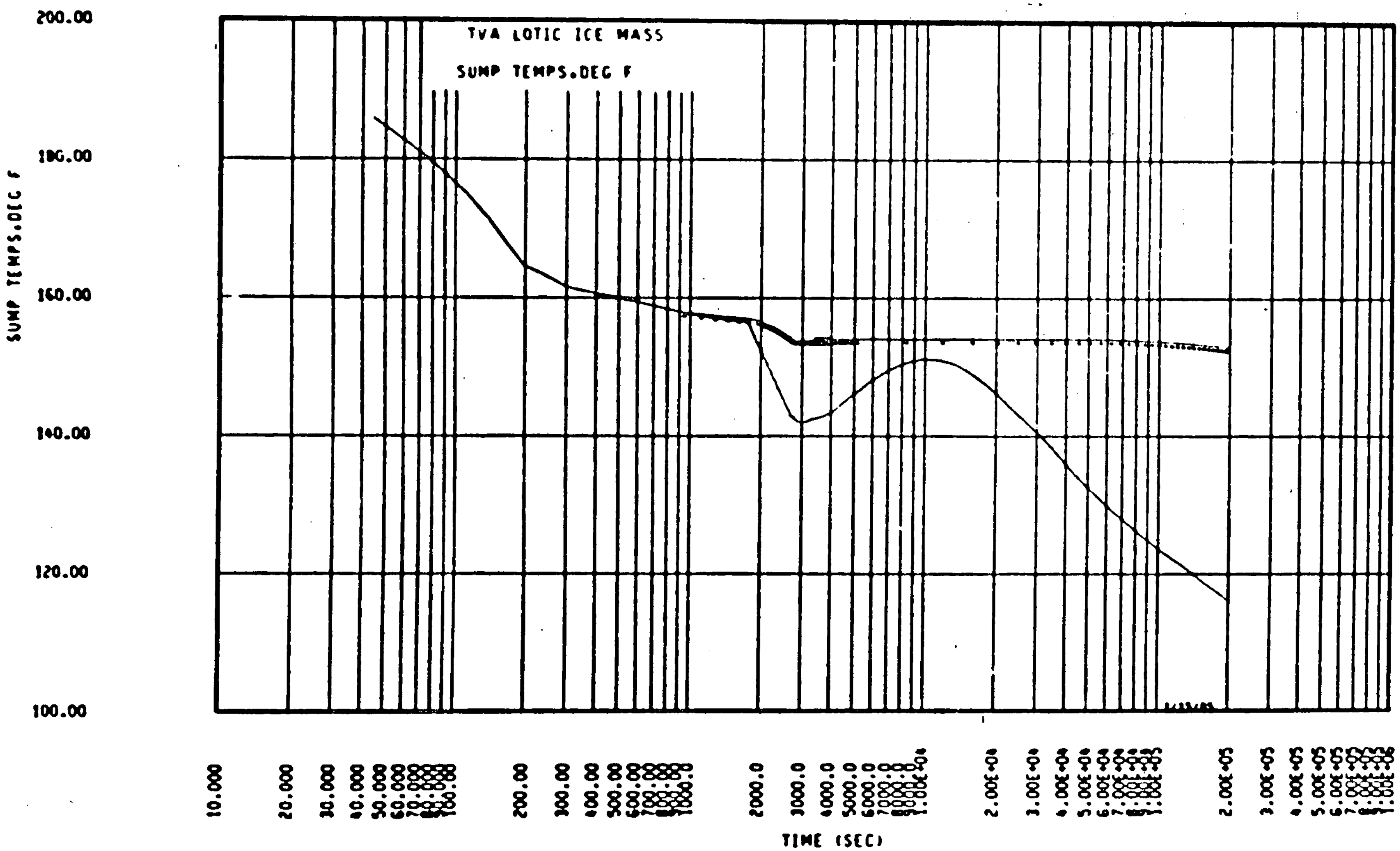

TVA LOTIC ICE MASS
UC/LC TEMP(DEG F)
UC/LC TEMP(DEG F)
200.00
175.00
150.00
125.00
100.00
75.000
50.000
25.000
0.0
TIME (SEC)

FIGURE 14



TVA LOTIC ICE MASS
SUMP TEMPS.DEG F
SUMP TEMPS.DEG F
200.00
180.00
160.00
140.00
120.00
100.00
TIME (SEC)


FIGURE 15

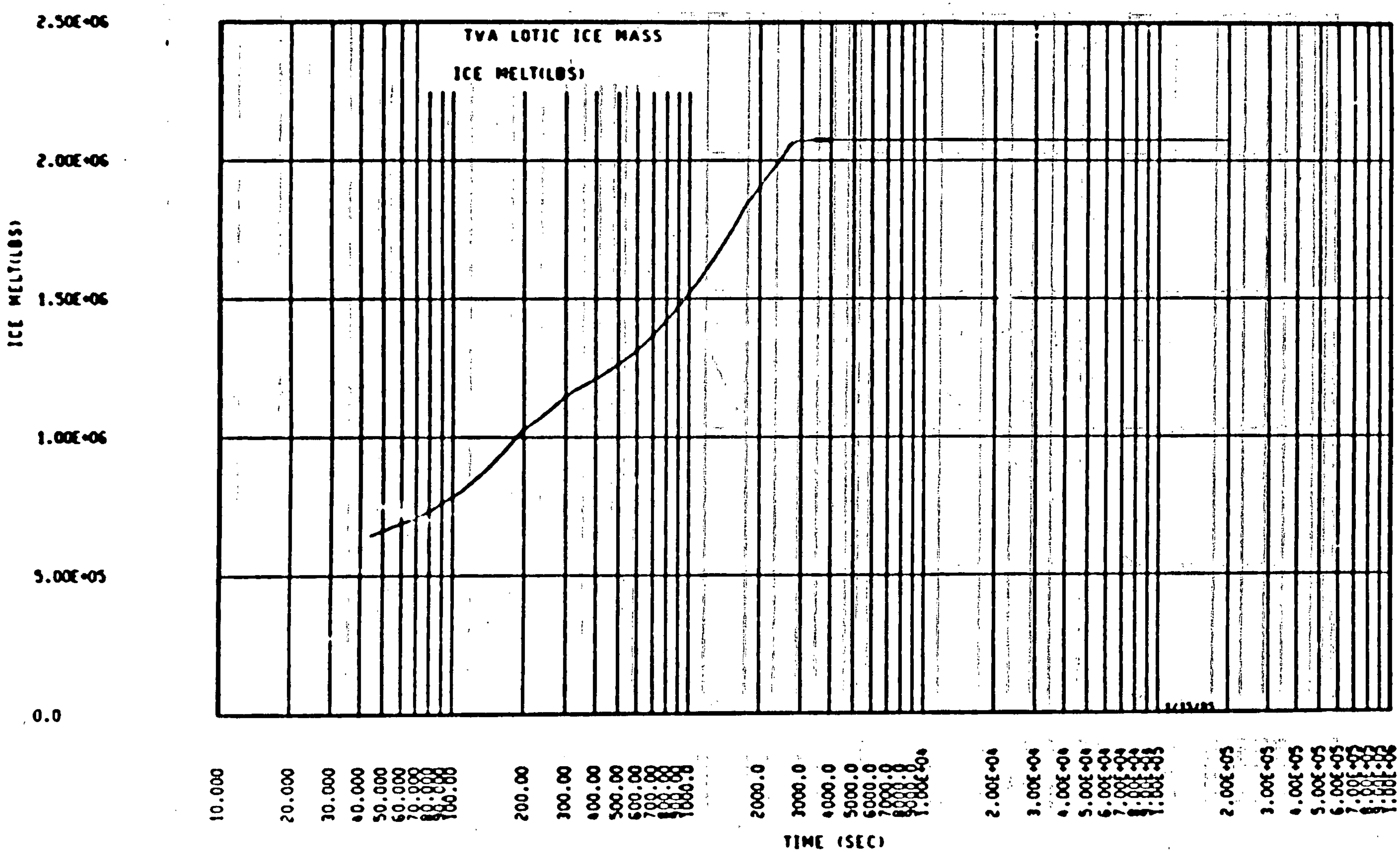
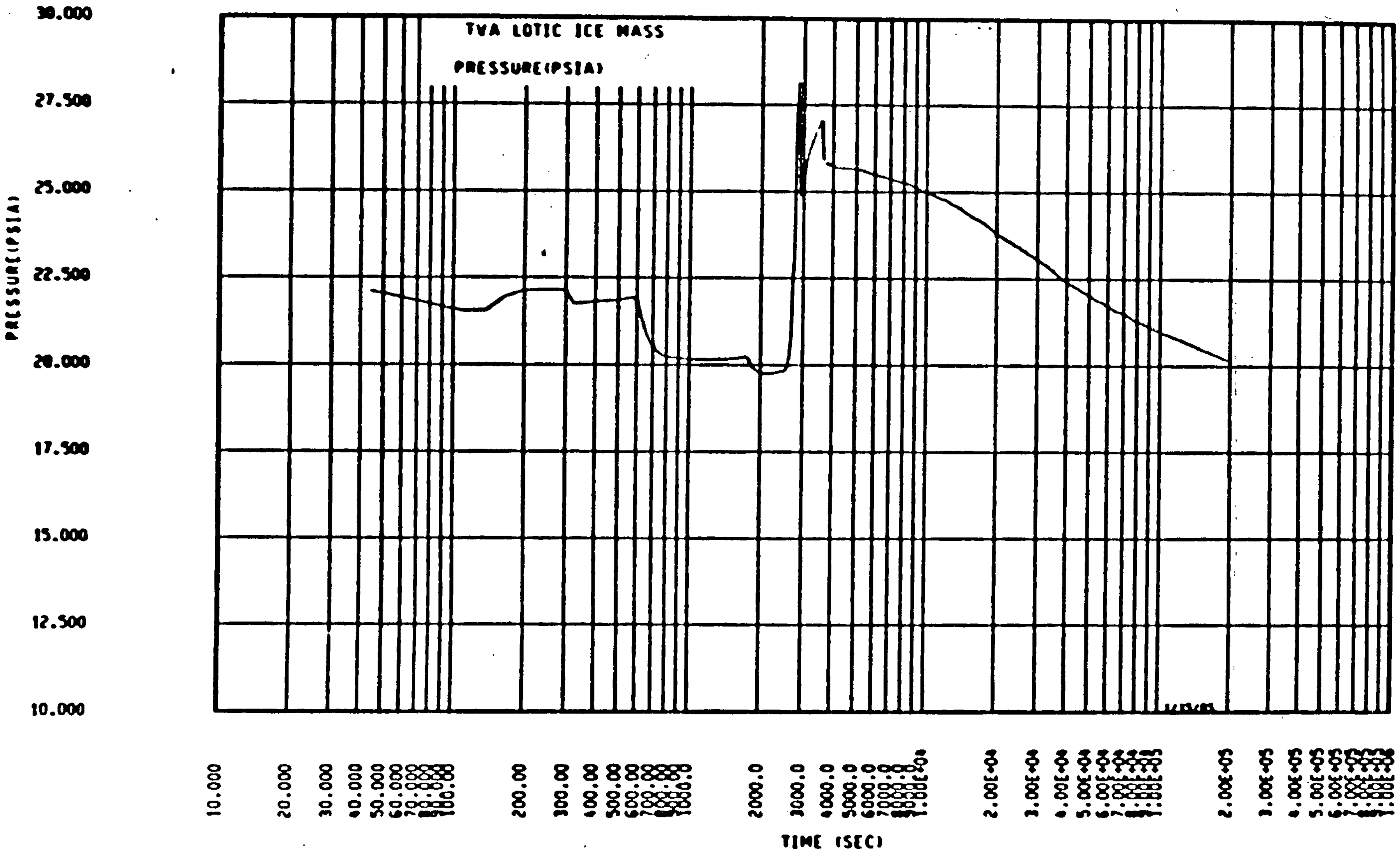



FIGURE 16



TVA LOTIC ICE MASS
PRESSURE(PSIA)
30.000
27.500
25.000
22.500
20.000
17.500
15.000
12.500
10.000
PRESSURE(PSIA)
TIME (SEC)


FIGURE 17

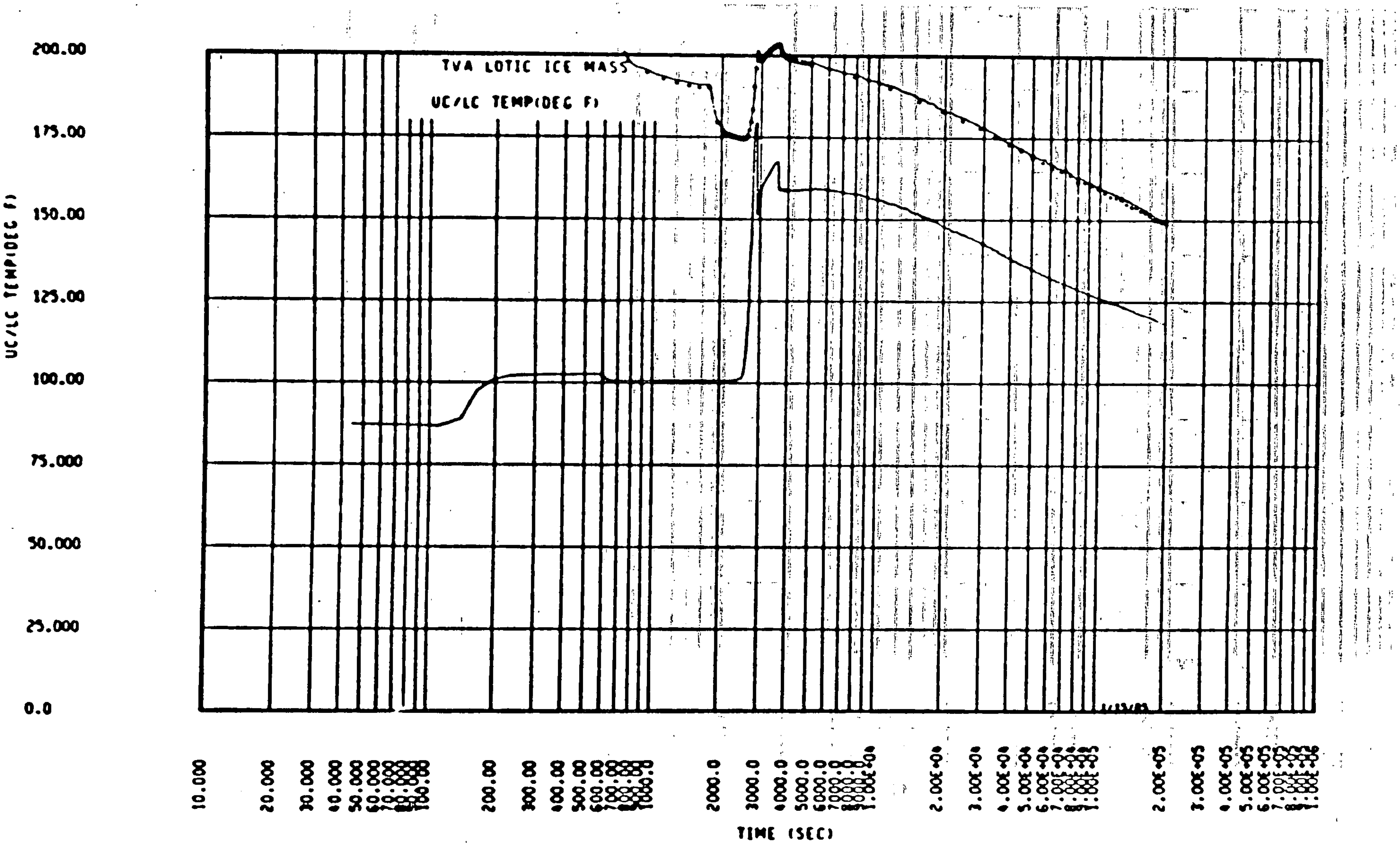

TVA LOTIC ICE MASS
UC/LC TEMP(DEG F)
200.00
175.00
150.00
125.00
100.00
75.000
50.000
25.000
0.0
UC/LC TEMP(DEG F)
TIME (SEC)

FIGURE 18

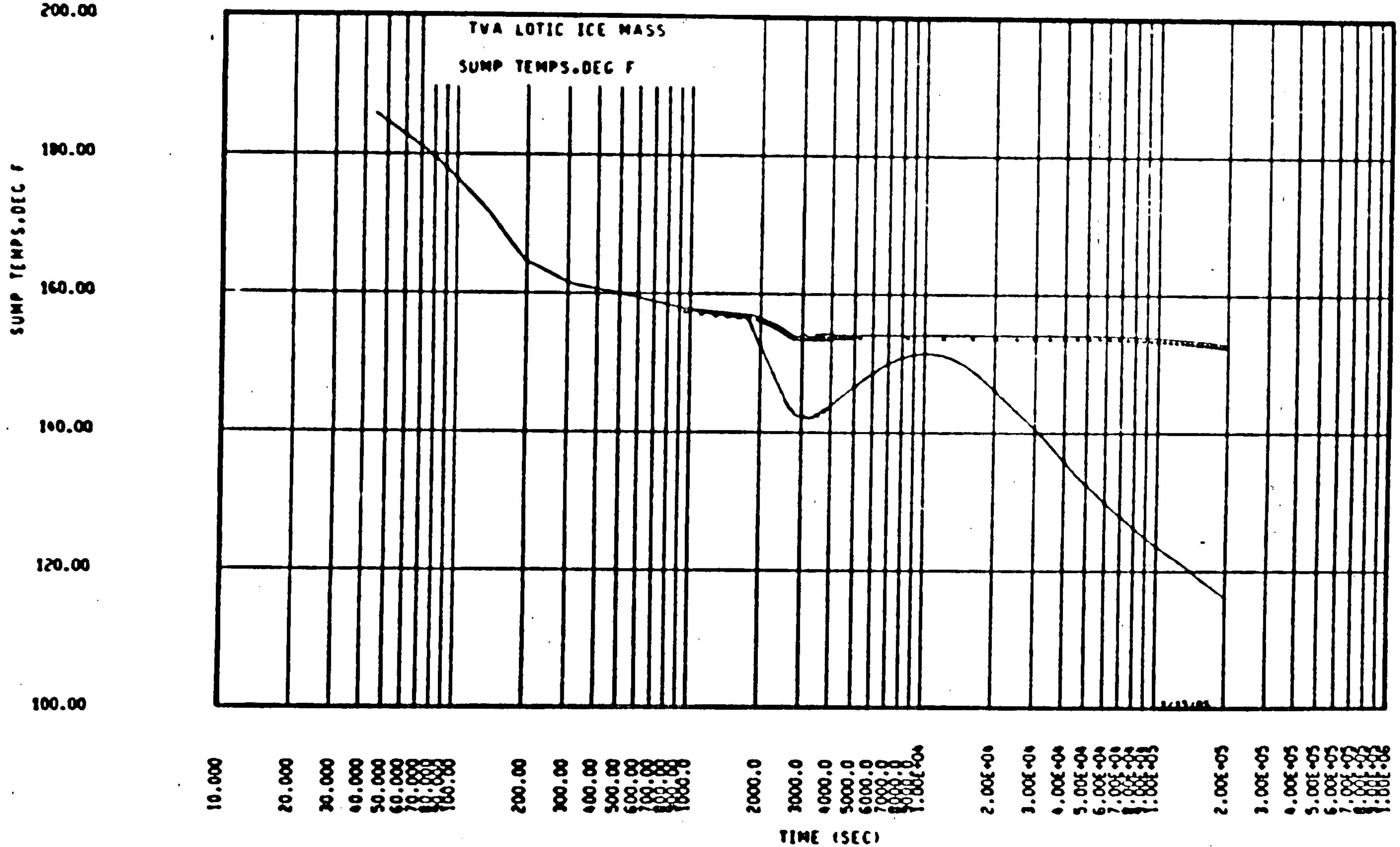

TVA LOTIC ICE MASS
SUMP TEMPS.DEG F
200.00
180.00
160.00
140.00
120.00
100.00
SUMP TEMPS.DEG F
TIME (SEC)

FIGURE 19

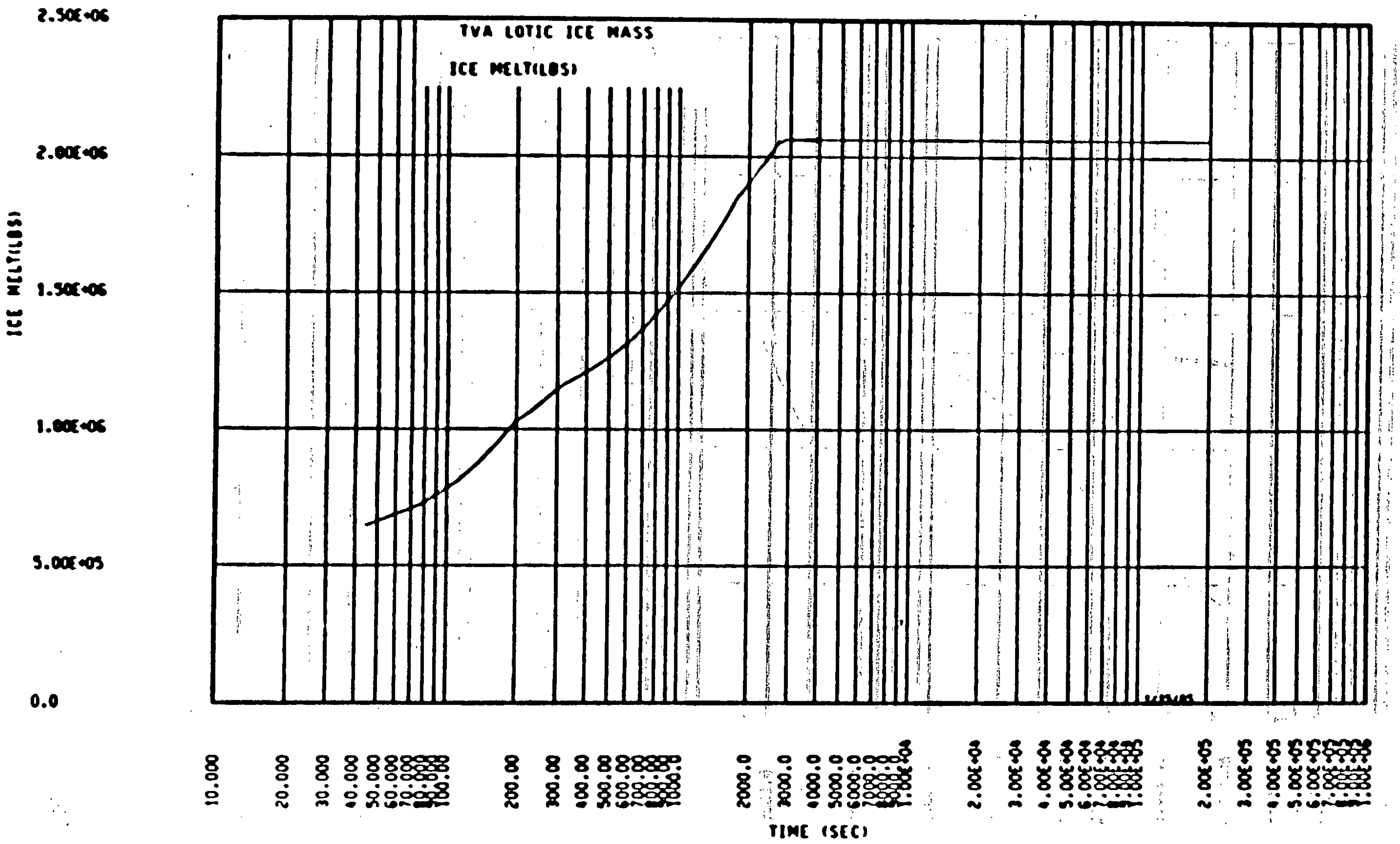

TVA LOTIC ICE MASS
ICE MELT(LBS)
ICE MELT(LBS)
2.50E+06
2.00E+06
1.50E+06
1.00E+06
5.00E+05
0.0
TIME (SEC)
10.000
20.000
30.000
40.000
200.00
300.00
400.00
2000.0
3000.0
4000.0
5000.0
2.00E+04
3.00E+04
4.00E+04
2.00E+05
3.00E+05

FIGURE 20

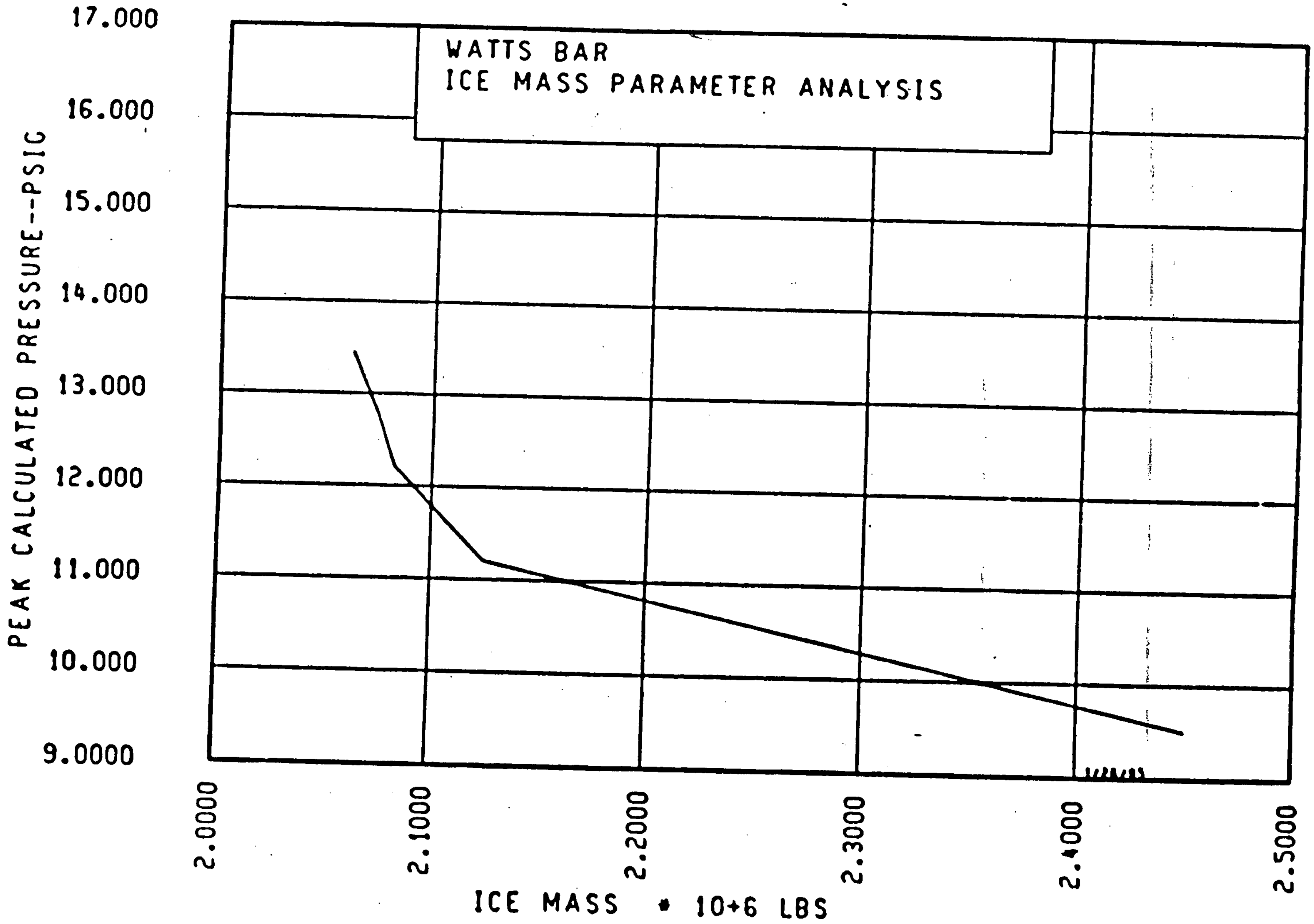

WATTS BAR
ICE MASS PARAMETER ANALYSIS
PEAK CALCULATED PRESSURE--PSIG
17.000
16.000
15.000
14.000
13.000
12.000
11.000
10.000
9.0000
2.0000
2.1000
2.2000
2.3000
2.4000
2.5000
ICE MASS * 10+6 LBS

FIGURE 21

ENCLOSURE 2

WATTS BAR NUCLEAR PLANT

FSAR REVISIONS TO REFLECT THE RESULTS OF THE REDUCED ICE WEIGHT ANALYSIS

1. Minimum safeguards are employed in all calculations, e.g., one of two spray pumps and one of two spray heat exchangers; one of two RHR pumps and one of two RHR heat exchangers providing flow to the core; one of two safety injection pumps and one of two centrifugal charging pumps; and one of two air return fans.

2. ~~2.45~~ 2.125 x $10^6$ lbs. of ice initially in the ice condenser which is at 15°F. (Technical Specification limit).

3. The blowdown, reflood, and post reflood mass and energy releases described in Section 6.2.1.3.6 were used.

4. Blowdown and post-blowdown ice condenser drain temperatures of 190°F and 130°F are used. (These numbers are based on Reference [21]).

5. Nitrogen from the accumulators in the amount of ~~5942~~ 2218 lbs. is included in the calculations.

6. Nuclear service water temperature of 85°F is used on the spray heat exchanger and the component cooling heat exchanger.

7. The air return fan is effective, 10 minutes after the transient is initiated.

8. No maldistribution of steam flow to the ice bed is assumed.

9. No ice condenser bypass is assumed. (This assumption depletes the ice in the shortest time and is thus conservative).

10. The initial conditions in the Containment are a temperature of 100°F in the lower and dead-ended volumes and a temperature of 85°F in the upper volume. All volumes are at a pressure of 0.3 psig and a 10% relative humidity.

11. A spray pump flow of 4000 gpm is used to the upper compartment. It should be noted that ~~since this analysis has been performed~~ the diesel loading sequence for the containment sprays ~~has changed~~. ~~While the actuating signals remain the same the loading sequence~~ has been modified such that the sprays will engage in ~~125~~ 135 seconds ~~instead of 45 seconds.~~ This modification was made to ensure that a frequency transient did not occur for a simultaneous LOCA and station blackout as desired by NRC Regulatory Guide 1.9, section C4. ~~The peak containment pressure will not change as a result of this modification since the containment sprays are not required for pressure suppression while ice remains in the ice condenser. Thus, the present analysis remains valid for the Watts Bar containment response to the design basis LOCA.~~

capability of the ECC system is given in Section 6.3.1 for this mode of operation.

13. Containment structural heat sink data is found in Table 6.2.1-1.

14. The operation of one Containment spray heat exchanger (UA = ~~3.1~~ 2.446 x $10^6$ Btu/hr-°F) for containment cooling and the operation of one RHR heat exchanger (UA = ~~1.64~~ 1.61 x $10^6$ Btu/hr-°F) for core cooling.

15. The air return fan returns air at a rate of 40,000 cfm from the upper to lower compartment.

16. An active sump volume of 51000 $ft^3$ is used.

17. The pump flowrates vs. time given in Table 6.2.1-2 were used.

18. A power rating of 102% of licensed power (3425 MWT) was used.

With these assumptions, the heat removal capability of the Containment is sufficient to absorb the energy releases and still keep the maximum calculated pressure well below design.

The following plots are provided:

Figure 6.2.1-1, Containment pressure transient

Figure 6.2.1-2, Upper and lower compartment temperature transients

Figure 6.2.1-3, Active and inactive sump temperature transient

Figure 6.2.1-4, ~~Inactive sump temperature transient~~ Ice melt transient

Tables 6.2.1-3 and 6.2.1-4 give energy accountings at various points in the transient.

As can be seen from Figure 6.2.1-1 the maximum calculated Containment pressure is ~~12.3~~ 11.21 psig, occurring at approximately ~~7000~~ 36009 seconds.

Also, a parameter study of the ice mass was performed. These results are presented in Figure 6.2.1-4A

Structural Heat Removal

Provision is made in the Containment pressure analysis for heat storage in interior and exterior walls. Each wall is divided into a number of nodes. For each node, a conservation of energy equation expressed in finite difference forms accounts for transient conduction into and out of the node and temperature rise of the node. Table 6.2.1-1 is a summary of the Containment

TABLE 6.2.1-1

STRUCTURAL HEAT SINKS

A. Upper Compartment

| | Area ($ft^2$) | Thickness (ft) | |
|---|---|---|---|
| 1. Operating Deck | | | |
| Slab 1 | 4880 | 1.1 | Concrete |
| Slab 2 | 18280 | .0005 | Paint |
| | | 1.4 | Concrete |
| Slab 3 | 760 | .00125 | Paint |
| | | 1.5 | Concrete |
| Slab 4 | 3840 | .0208 | Stainless Steel |
| | | 1.5 | Concrete |
| 2. Shell & Misc | | | |
| Slab 5 | 56331 | .000625 | Paint |
| | | .08 | Steel |

B. Lower Compartment

| | Area ($ft^2$) | Thickness (ft) | |
|---|---|---|---|
| 1. Operating Deck, Crane Wall, and Interior Concrete | | | |
| Slab 6 | 31963 | 1.43 | Concrete |
| 2. Operating Deck | | | |
| Slab 7 | 2830 | .00125 | Paint |
| | | 1.0 | Concrete |
| Slab 8 | 760 | .0005 | Paint |
| | | 1.75 | Concrete |
| 3. Interior Concrete & Stainless Steel | | | |
| Slab 9 | 2270 | .021 | Stainless Steel |
| | | 2.0 | Concrete |

TABLE 6.2.1-2

PUMP FLOWRATES VS TIME

| Time After Safeguards Initiation (Sec.) | SIS Flow To Core (GPM) | Spray Flow (GPM) | RHR Spray Flow (GPM) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| ~~10~~ 15 | 460 | 0 | 0 |
| ~~15~~ 20 | 1065 | 0 | 0 |
| ~~20~~ 25 | 4853 | 0 | 0 |
| ~~45~~ 135 | 4853 | 4000 | 0 |
| ~~1725~~ 1768 | 1065 | 4000 | 0 |
| ~~2025~~ 1788 | 4853* | 4000 | 0 |
| ~~2085~~ 1938 | 3788** | 4000 | 0 |
| ~~2980~~ 2754 | 3788 | 4000 | 0 |
| ~~3000~~ 2774 | 3788 | 0 | 0 |
| ~~3080~~ 2894 | 3788 | 4000** | 0 |
| 3600 | 1078 | 4000 | 2000 X [Delete] |
| END OF TRANSIENT | 1078 | 4000 | 2000 |

*3788 gpm from sump

**All flow from sump from this point until end of transient

TABLE 6.2.1-3

ENERGY BALANCES

| Sink | Approx. End of Blowdown (Btu) | Approx. End of Reflood (Btu)(t=216 sec) |
|---|---|---|
| *Ice Heat Removal | 186 ~~185~~ $(10^6)$ | 298 $(10^6)$ |
| *Structural Heat Sinks | 20 ~~34.6~~ $(10^6)$ | 58 ~~59.8~~ $(10^6)$ |
| *RHR Heat Exchanger Heat Removal | 0 | 0 |
| *Spray Heat Exchanger Heat Removal | 0 | 0 |
| Energy Content of Sump | 170 ~~169~~ $(10^6)$ | 246 ~~245~~ $(10^6)$ |
| Ice Melted | 0.6 $(10^6)$ | 1.05 $(10^6)$ |

*Integrated energies, BTU

TABLE 6.2.1-4

ENERGY BALANCES

| ~~Sink~~ | Approx. Time of Ice Bed Melt Out ~~(Btu) (t=4125)~~ 2990 | Approx. Time of Peak Pressure ~~(Btu) (t=6665.)~~ 3600.9 |
|---|---|---|
| *Ice Heat Removal | 557 ~~648~~ $(10^6)$ | 567 ~~648~~ $(10^6)$ |
| *Structural Heat Sinks | 71.4 ~~90.9~~ $(10^6)$ | 88.9 ~~146~~ $(10^6)$ |
| *RHR Heat Exchanger Heat Removal | 34.7 ~~65.0~~ $(10^6)$ | 48.5 ~~164~~ $(10^6)$ |
| *Spray Heat Exchanger Heat Removal | 20.9 ~~96.5~~ $(10^6)$ | 50.3 ~~278~~ $(10^6)$ |
| Energy Content of Sumps | 644 ~~621~~ $(10^6)$ | 611 ~~667~~ $(10^6)$ |
| Ice Melted | $2.125(10^6)$ | $2.125(10^6)$ |

*Integrated energies, BTU

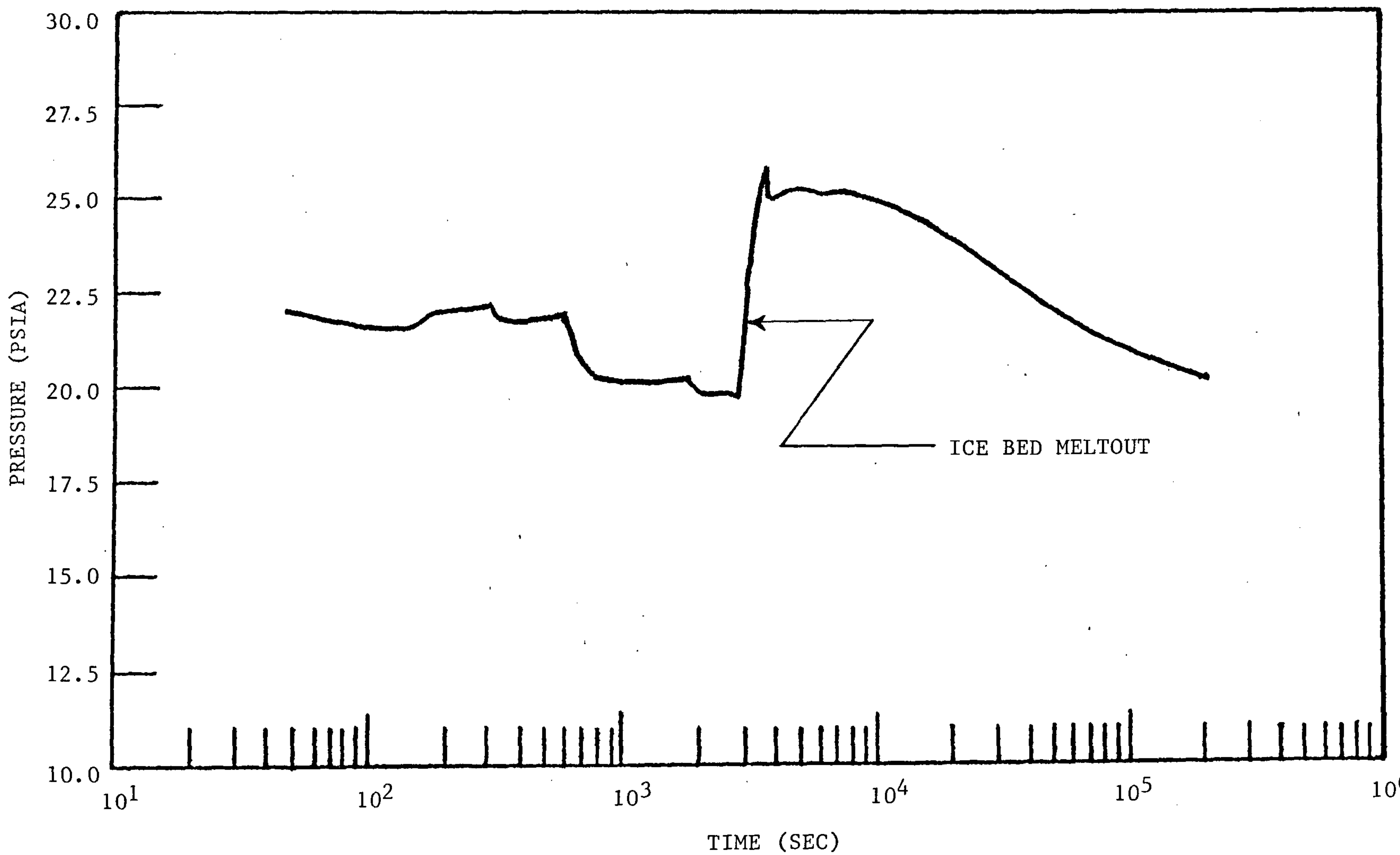



FIGURE 6.2.1-1. PRESSURE VS. TIME

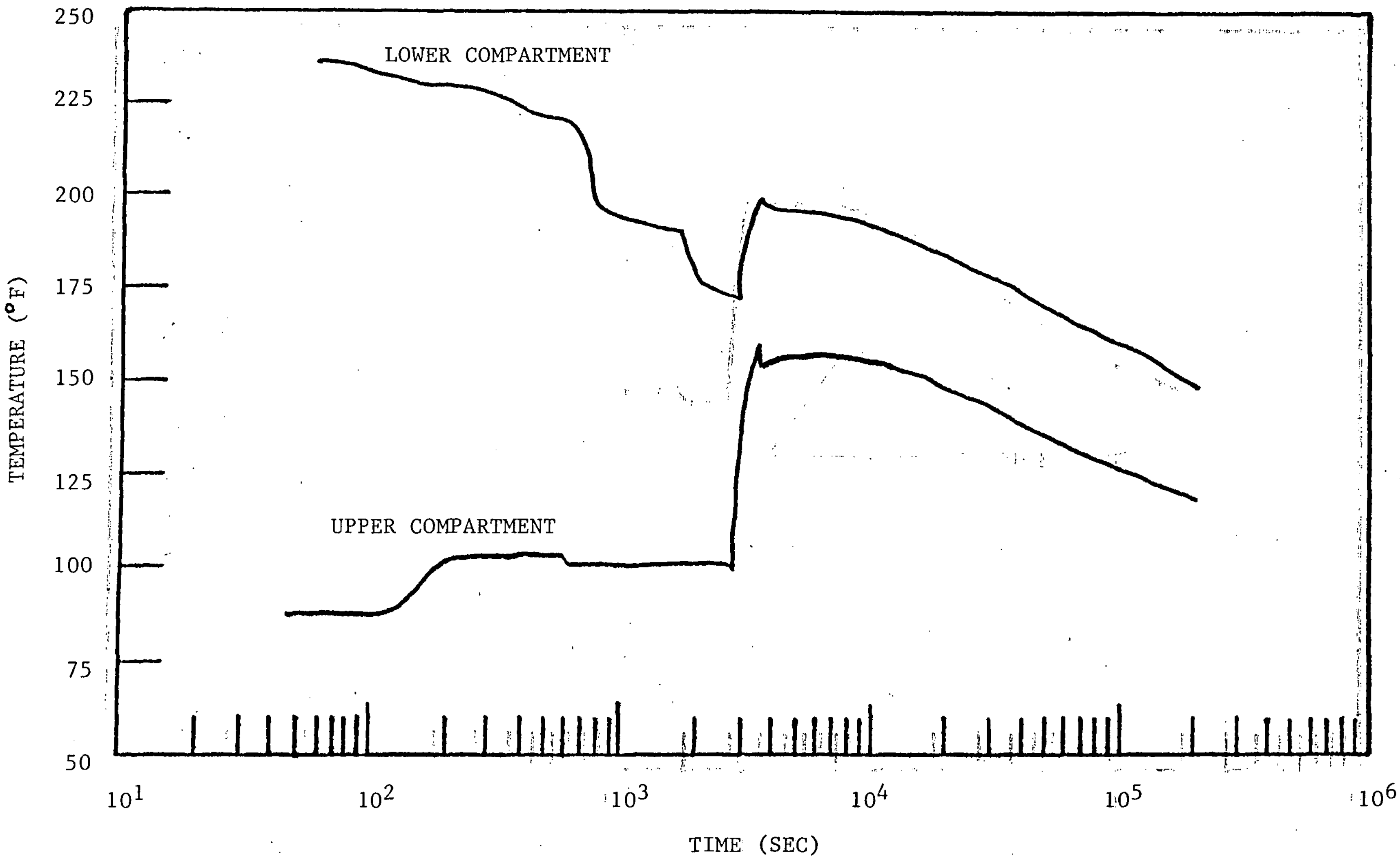



FIGURE 6.2.1-2. TEMPERATURE VS. TIME

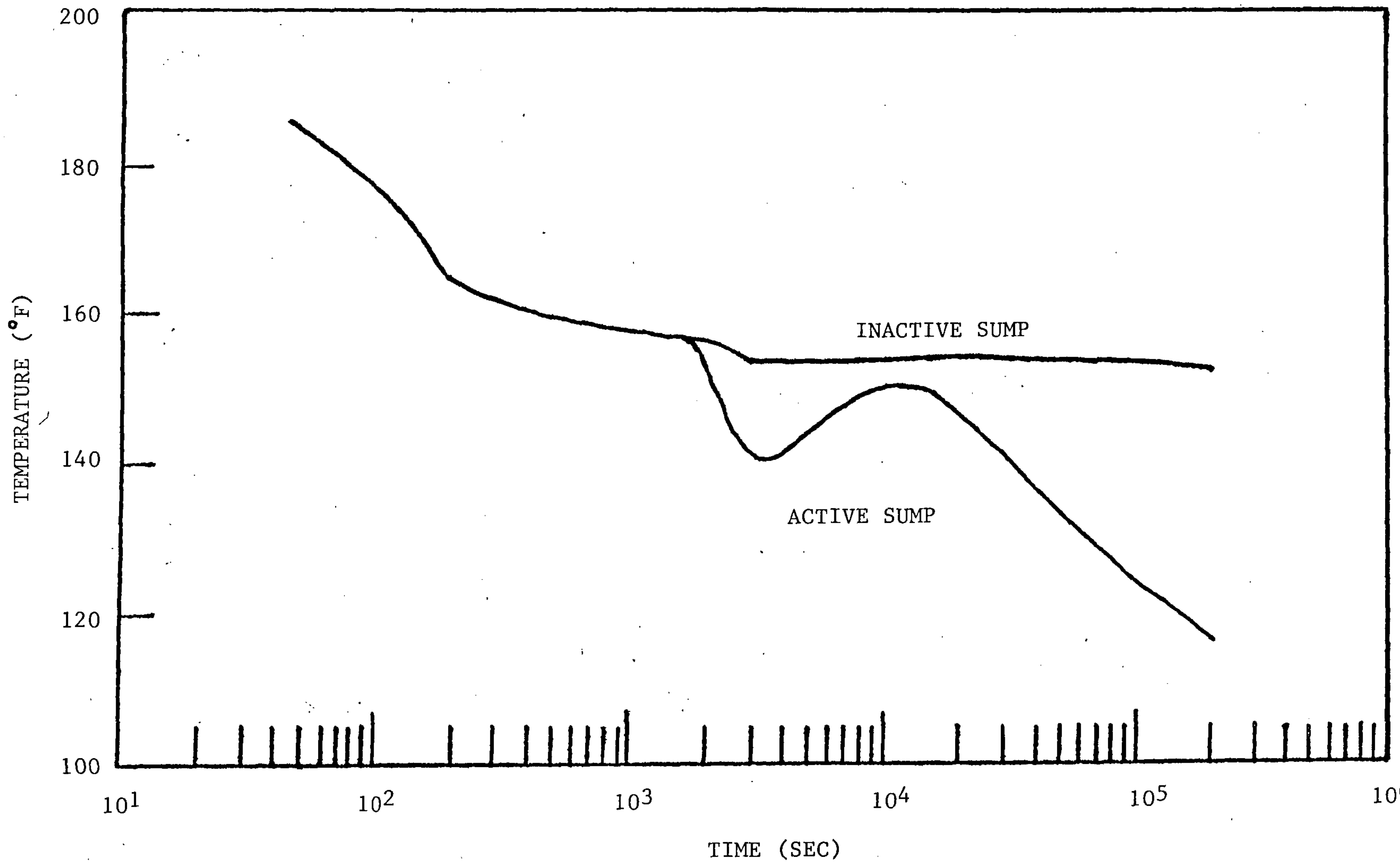



FIGURE 6.2.1-3. ACTIVE AND INACTIVE SUMP TEMPERATURE TRANSIENTS

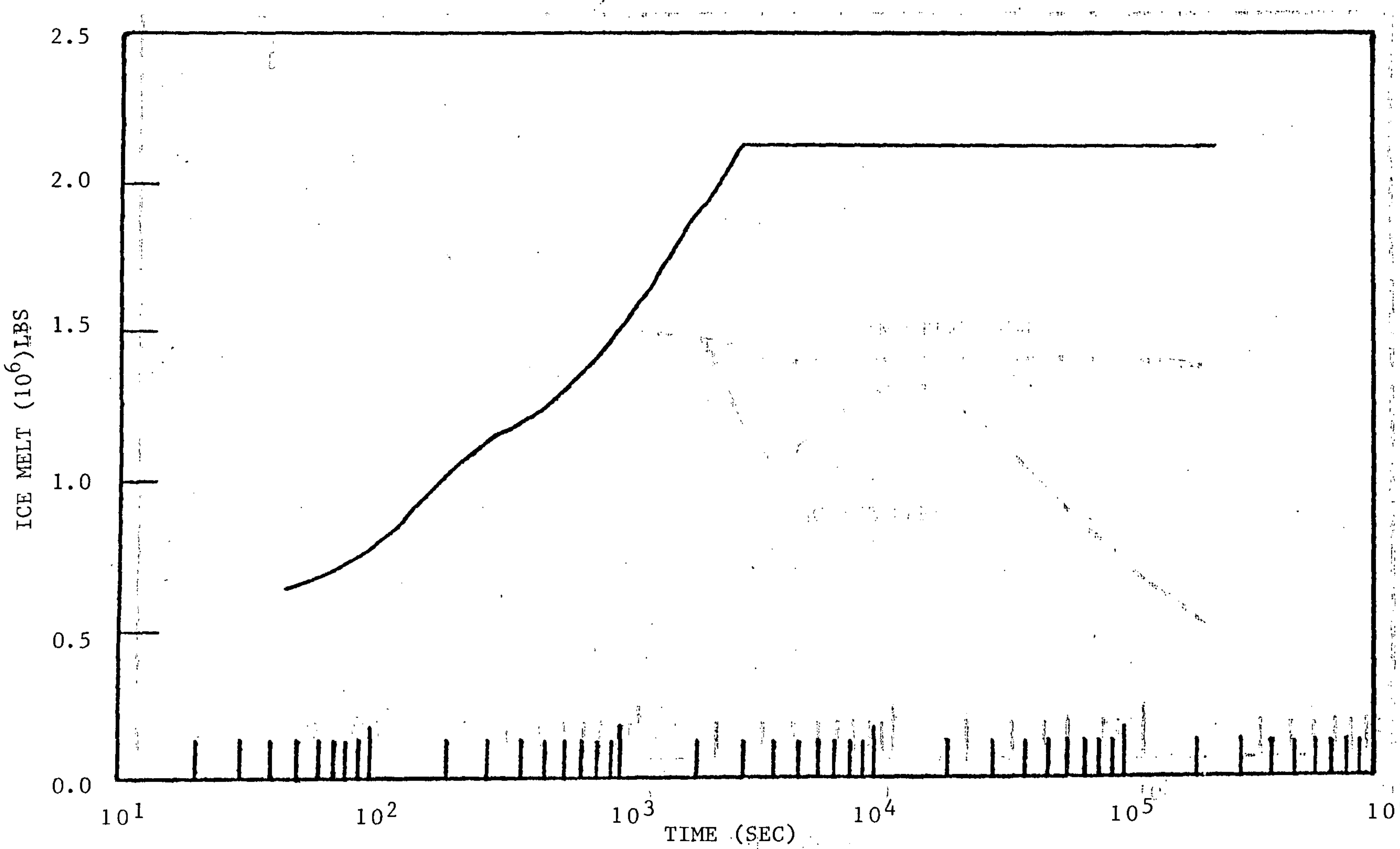



FIGURE 6.2.1-4. ICE MELT TRANSIENT

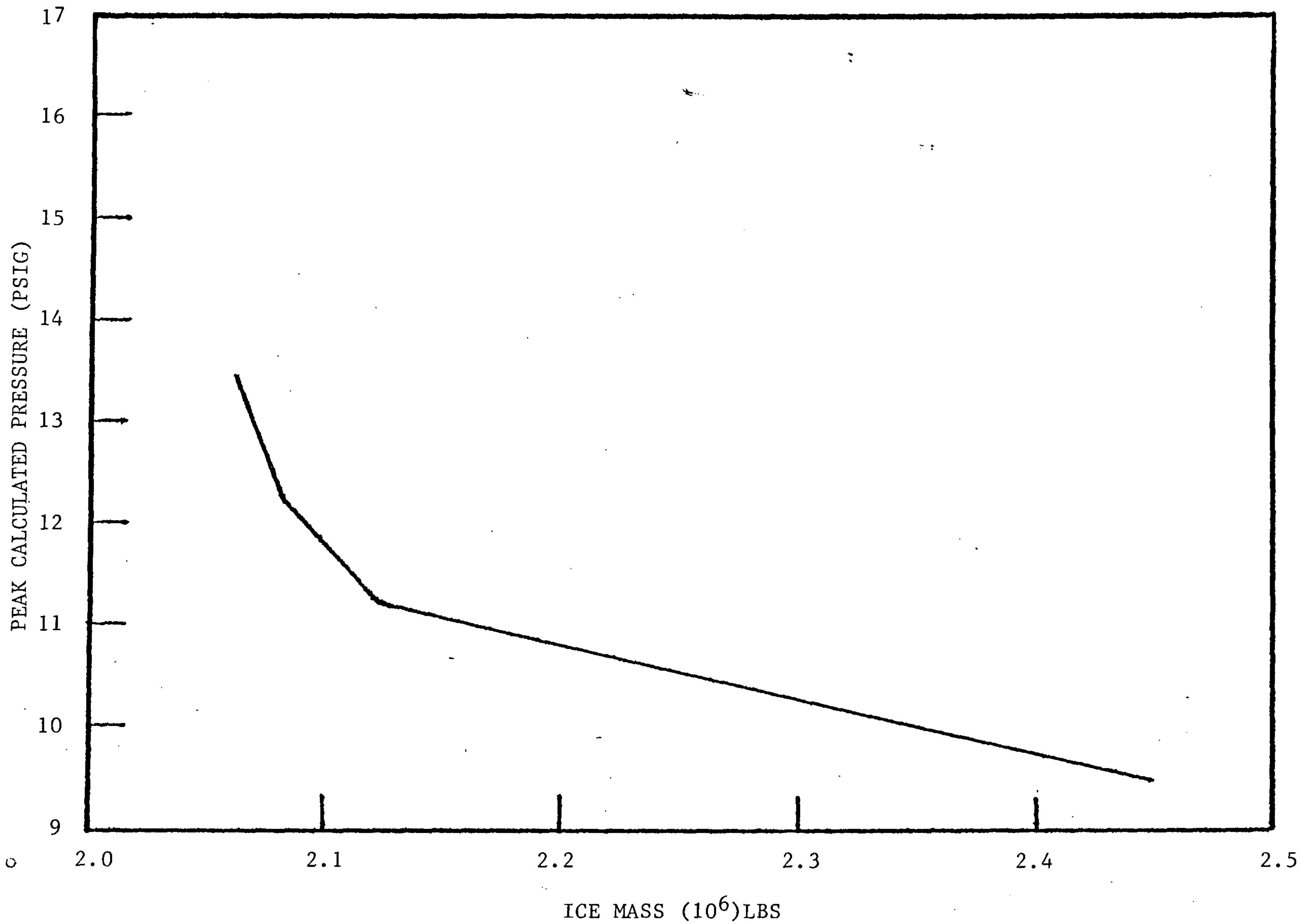



FIGURE 6.2.1-4A. ICE MASS VS. PRESSURE