

CALVERT CLIFFS-1 OVERCOOLING SEQUENCE
P, T, h ESTIMATION — CURRENT STATUS

DRAFT

PTS Study Group
Baltimore, Maryland
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Presented by:

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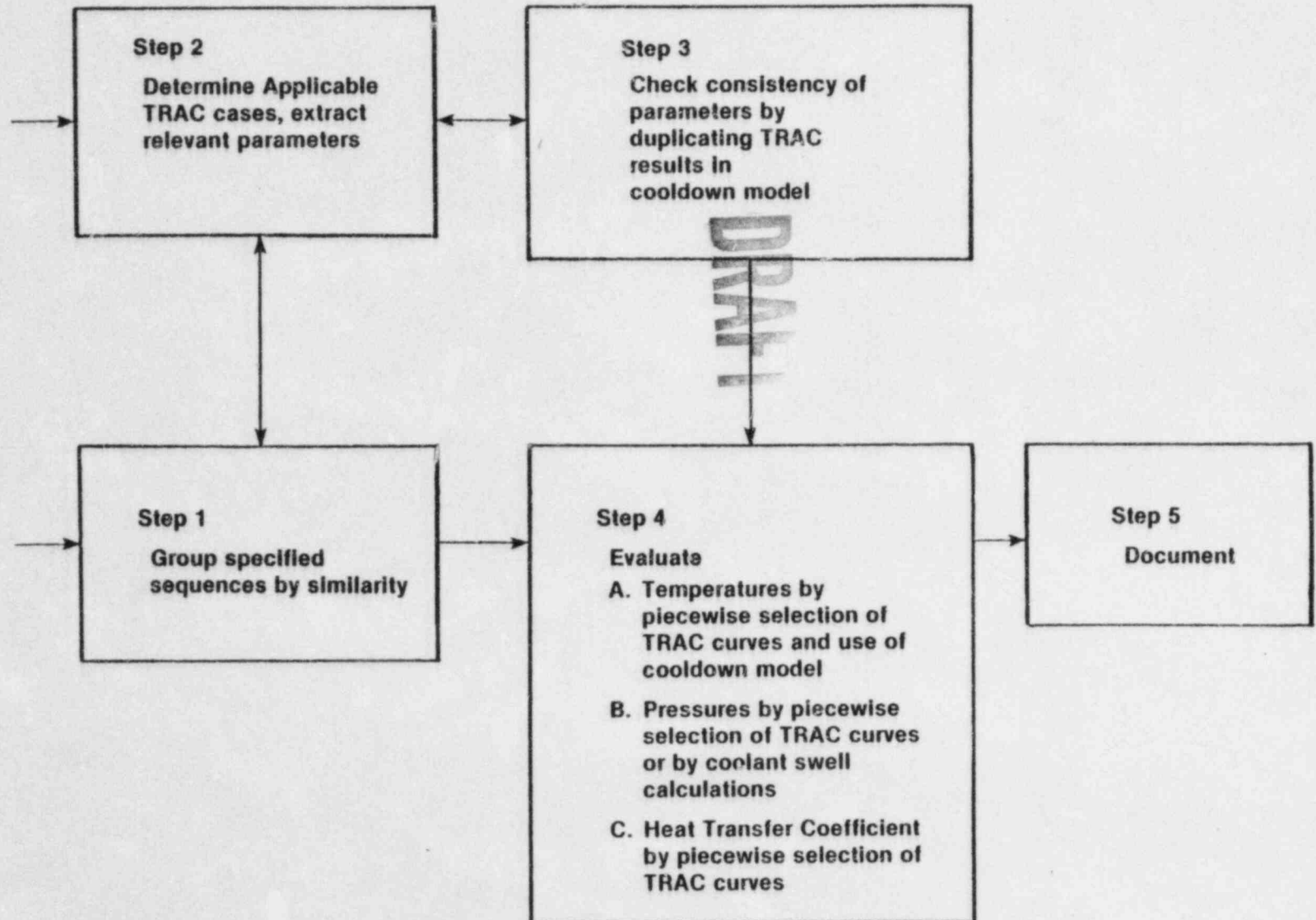
Figure 1. P, T, h Estimation Approach

Resource Data

15 calculations by
LANL (TRAC)
includes
steam line breaks
TBV failures
PORV and medium
break LOCAS

ORNL
Specified Sequences

Main steam line breaks
TBV failures
PORV sized LOCAs
Feedwater transients
100 cases



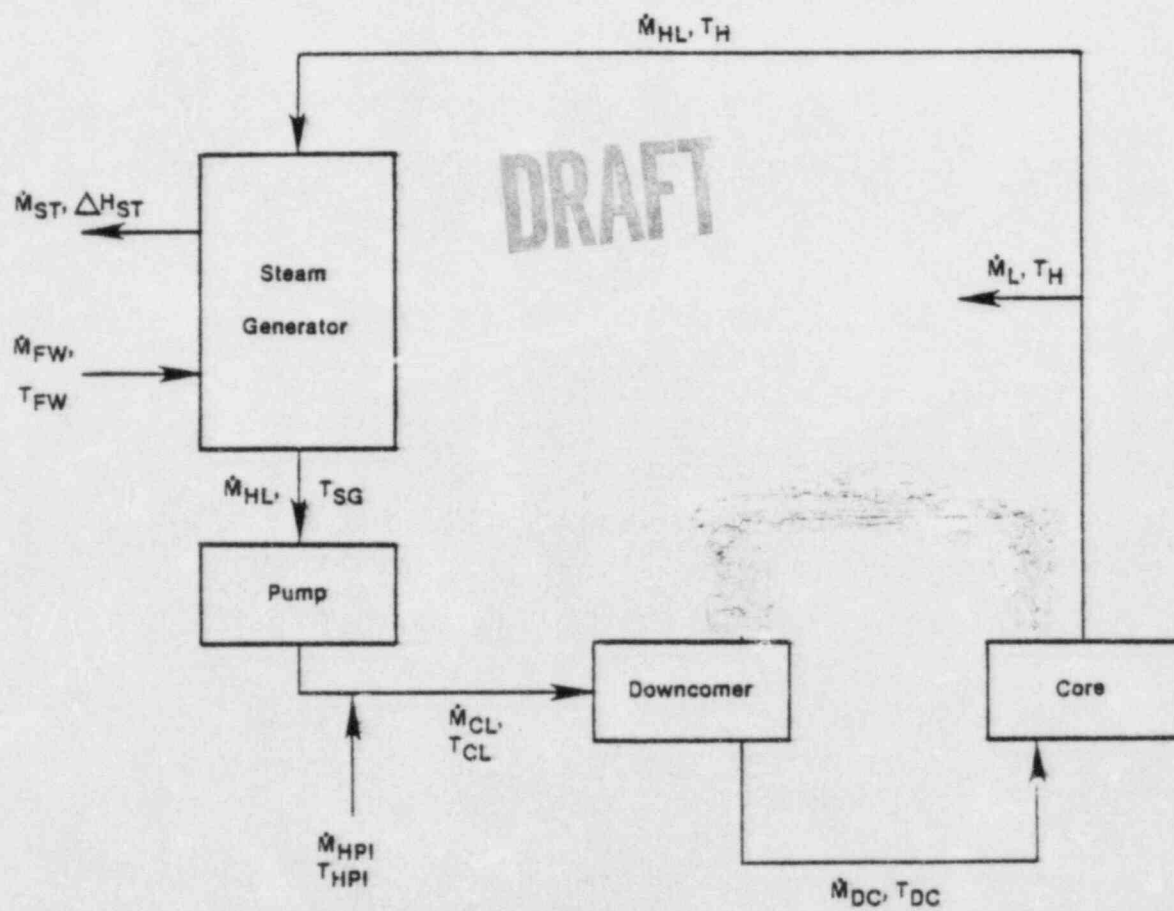


Figure 3. Simple Loop Model for Downcomer Temperature Evaluation

Heat Transfer Coefficient Estimation

Three main regimes are observed in the LANL calculations.

1. RCP's operating
2. RCP rundown following trip (100 sec)
3. Natural Circulation

Estimated h for each regime is given by:

1. h of 4000-5000 Btu/hr ft²°F calculated by TRAC with RCP's running.
2. Rundown from 5000 to 400 Btu/hr ft²°F following RCP trip.
3. Use floor of 400 Btu/hr ft²°F for natural circulation regime.

Table 1. MAIN STEAMLINE BREAK AT HOT 0% POWER
Initiator: Large Break Upstream of MSIV

Sequence number	MSIVs condition	MFIVs condition	AFW condition	AFW isolation to low press. S/G	AFW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttle AFW	Early est. frequency probability/yr
1.A	all close on demand ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand ~90.9 s	actuates on demand ~90.9 s	auto controlled	occurs on demand ~70 s	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	total of 1.A and 1.B is 1.2×10^{-4}
1.B	all close on demand ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand ~2.0 s	actuates on demand ~18.7 s	auto controlled	occurs on demand ~70 s	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	see 1.A
2.	all close on demand ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand ~90.9 s	actuates on demand ~90.9 s	auto controlled	occurs on demand ~70 s	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	3.0×10^{-6}
3.	all close on demand ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand ~90.9 s	actuates on demand ~90.9 s	auto controlled	occurs on demand ~70 s	failure	throttles AFW at + 22" in S/G	3.0×10^{-6}
= LAULTI 4.	all close on demand ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand ~90.9 s	actuates on demand ~90.9 s	auto controlled	occurs on demand ~70 s	failure	failure	1.0×10^{-6}
= LAULTI 5.	all close on demand ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand ~90.9 s	actuates on demand ~90.9 s	auto controlled	fails	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	2.0×10^{-7}

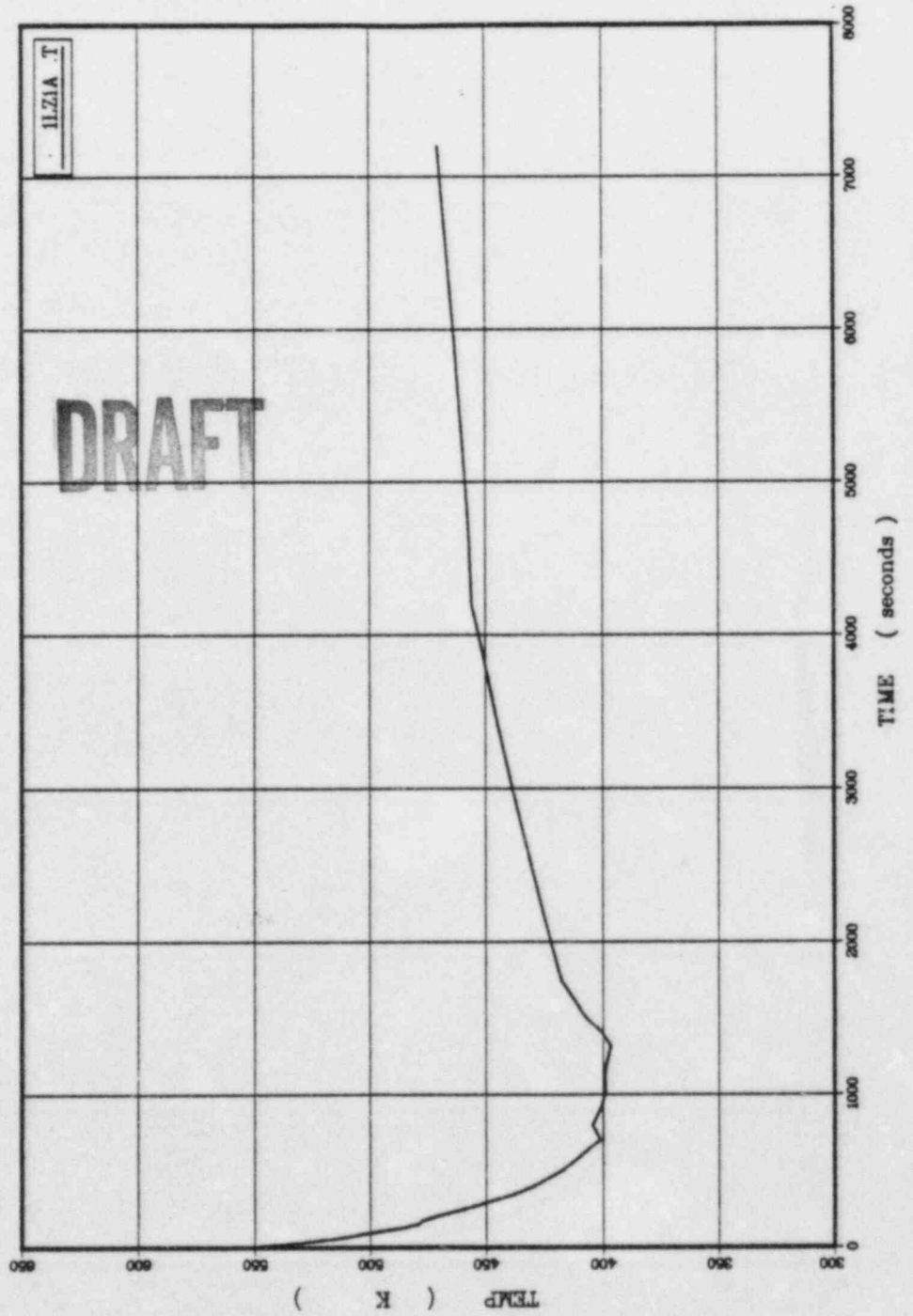
Table.1. Continued

Sequence number	MSIVs condition	MPIVs condition	AFW condition	AFW isolation to low press. S/G	AFW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttle AFW	Early est. frequency probability/yr
6.	all close on demand ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand ~90.9 s	fails to occur	auto controlled	occurs on demand ~70 s	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	3.0×10^{-8}
7.A	both fail to close ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand (time?)	does not occur	auto controlled	occurs on demand (time?)	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gal/min on any line	total of 7.A and 7.B is 1.0×10^{-7}
7.B	both fail to close ~18.4 s	all close on demand start closing ~18.4 s	actuates on demand (time?)	does not occur	initially in auto. operator kills flow to both S/Gs 300 s after MSIVs fail to close	occurs on demand (time?)	performed during recovery phase when pressure rises to shutoff head of HPI system	N/A	see 7.A

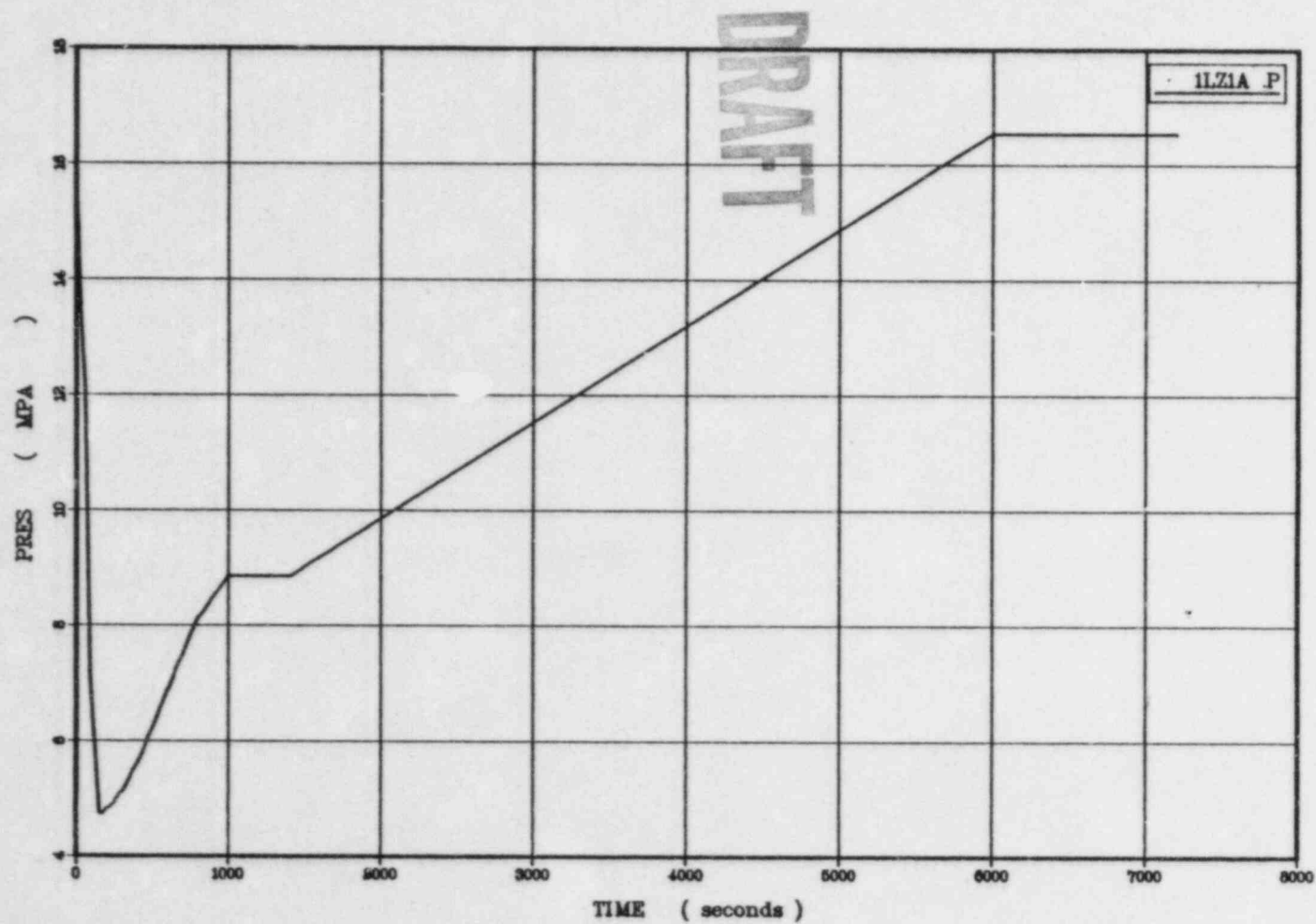
= LANL T2

= 1.7.A

DC TEMP FOR LARGE SLB AT HOT ZERO POWER CASE 1.1A

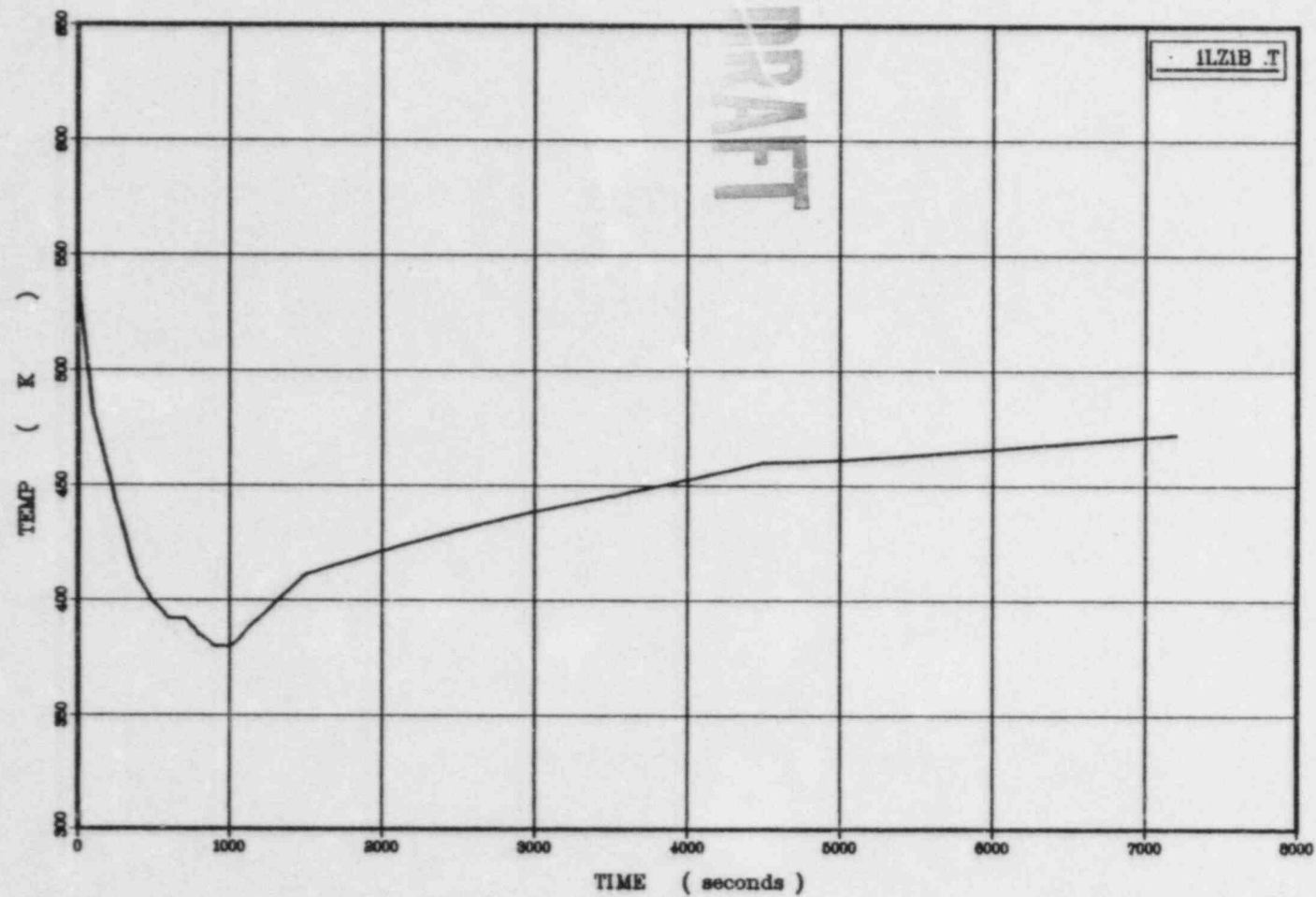


DC PRES FOR LARGE SLB AT HOT ZERO POWER CASE 1.1A

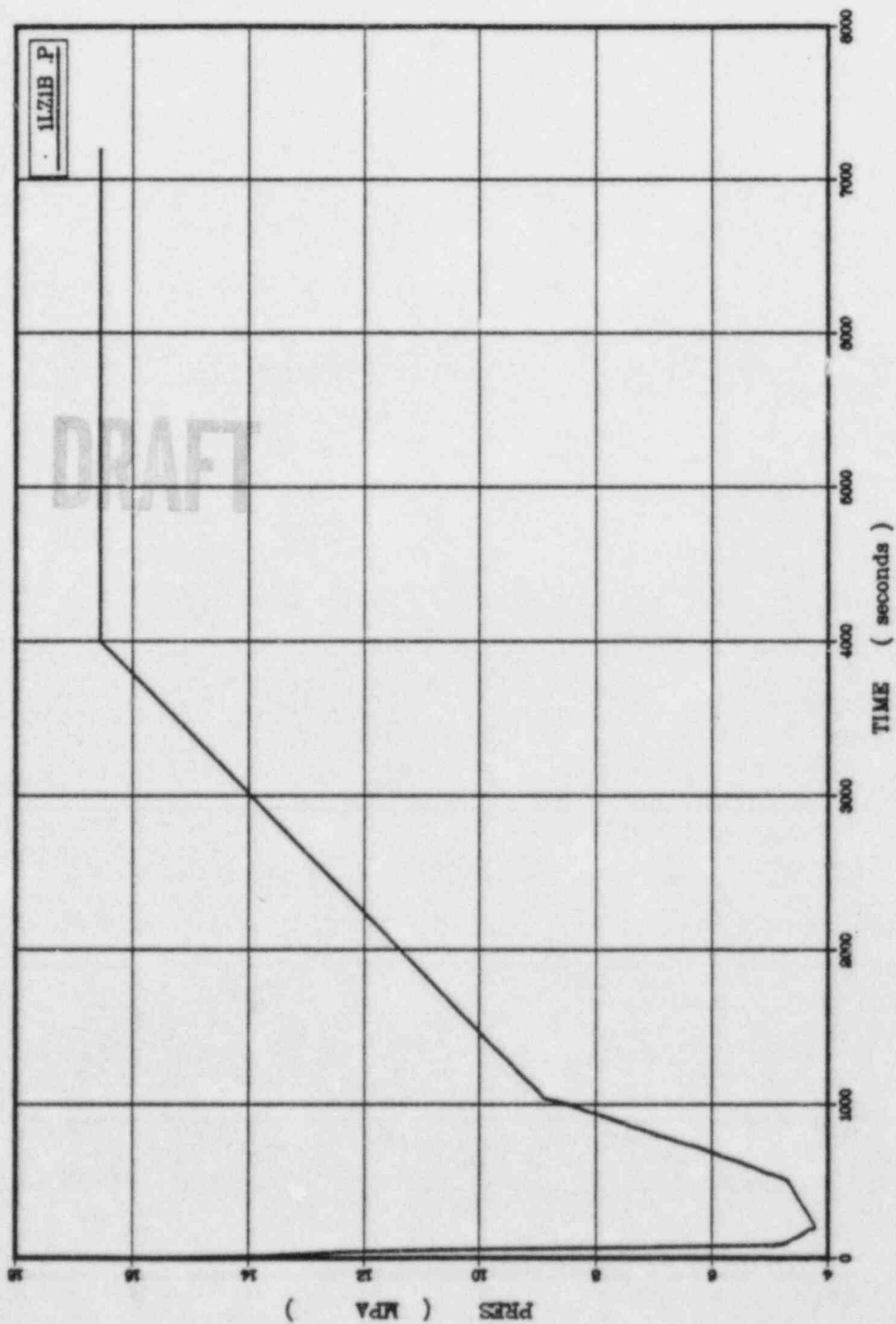


PLOT 1 07.57 THU 9 FEB, 1984 JOB-KTN1B7 ISSCO DISPLA VER 0.2

DC TEMP FOR LARGE SLE AT HOT ZERO POWER CASE 1.1B

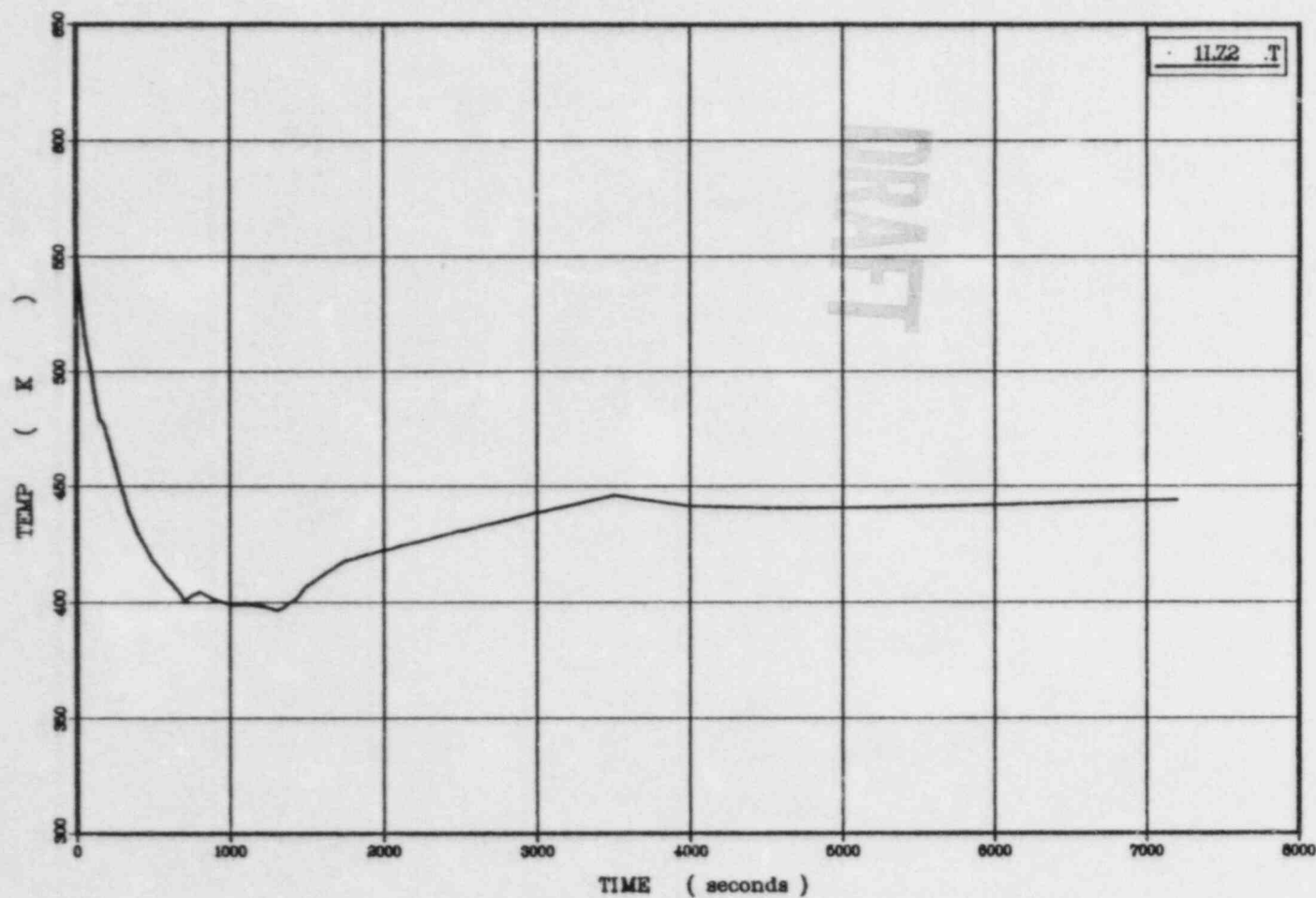


DC PRES FOR LARGE SLB AT HOT ZERO POWER CASE 1.1B



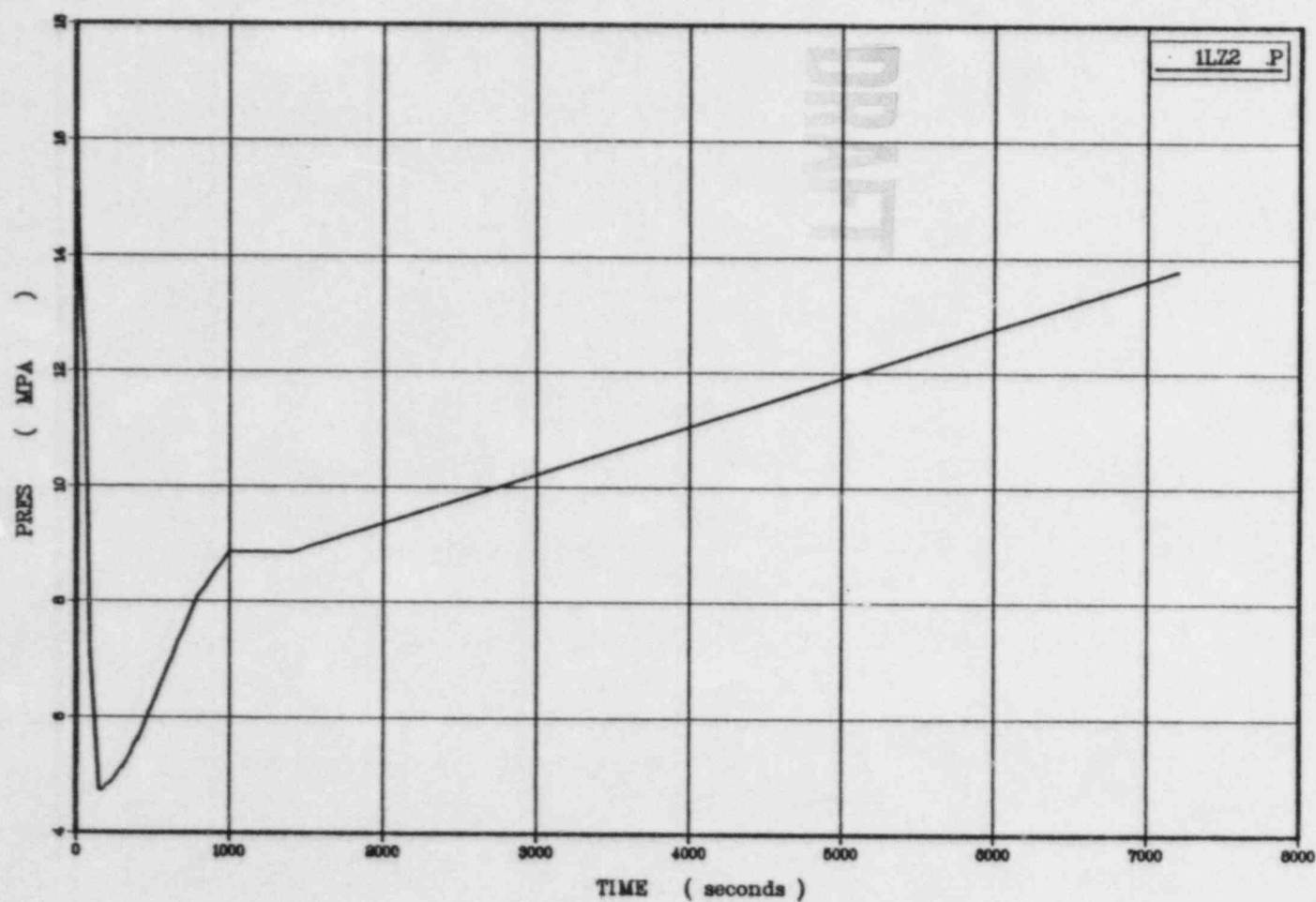
T 1 22.12.17 THUR 9 FEB, 1984 JOB-KTN2T , TESCO DISPLAY VER 8.2

DC TEMP FOR LARGE SLB AT HOT ZERO POWER CASE 1.2



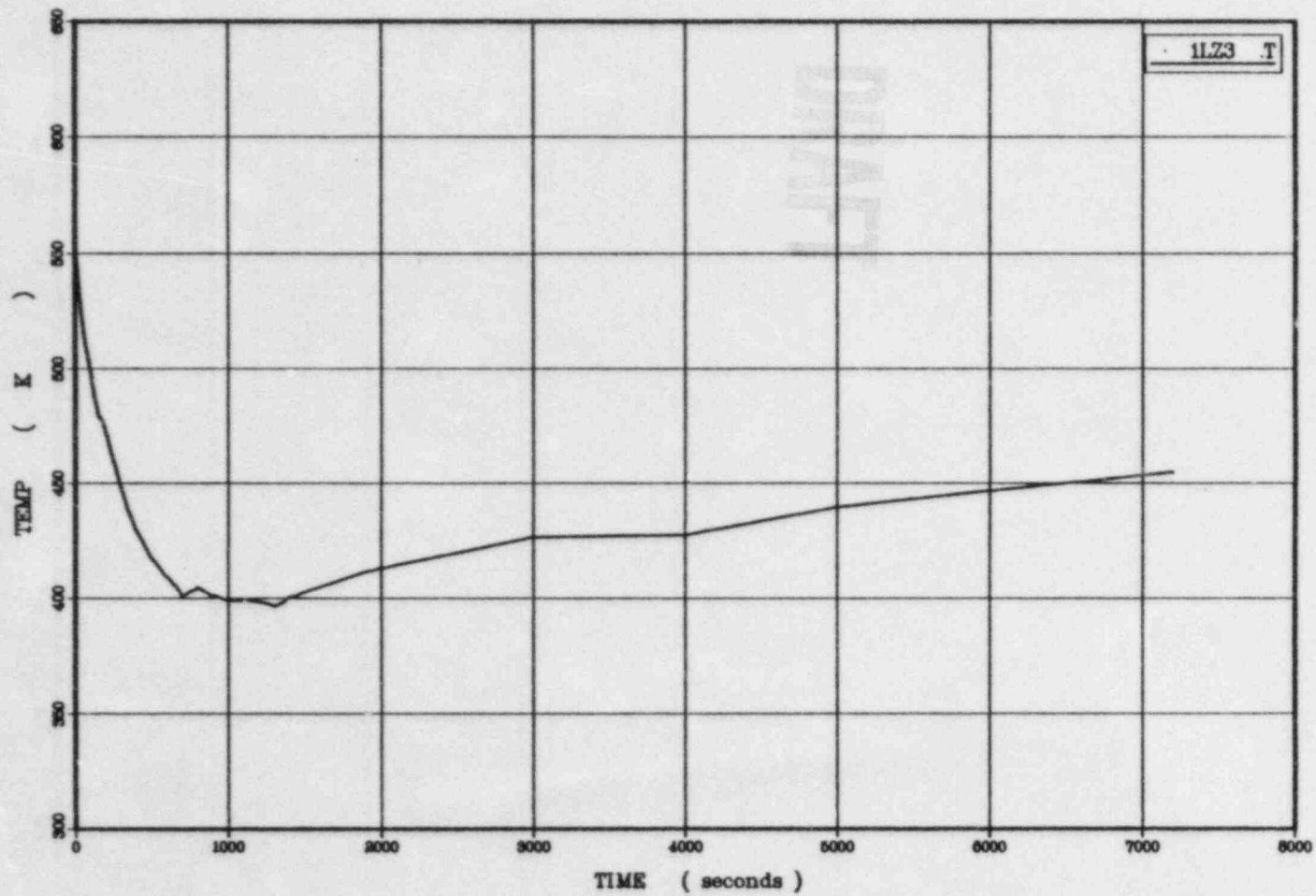
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DC PRES FOR LARGE SLB AT HOT ZERO POWER CASE 1.2



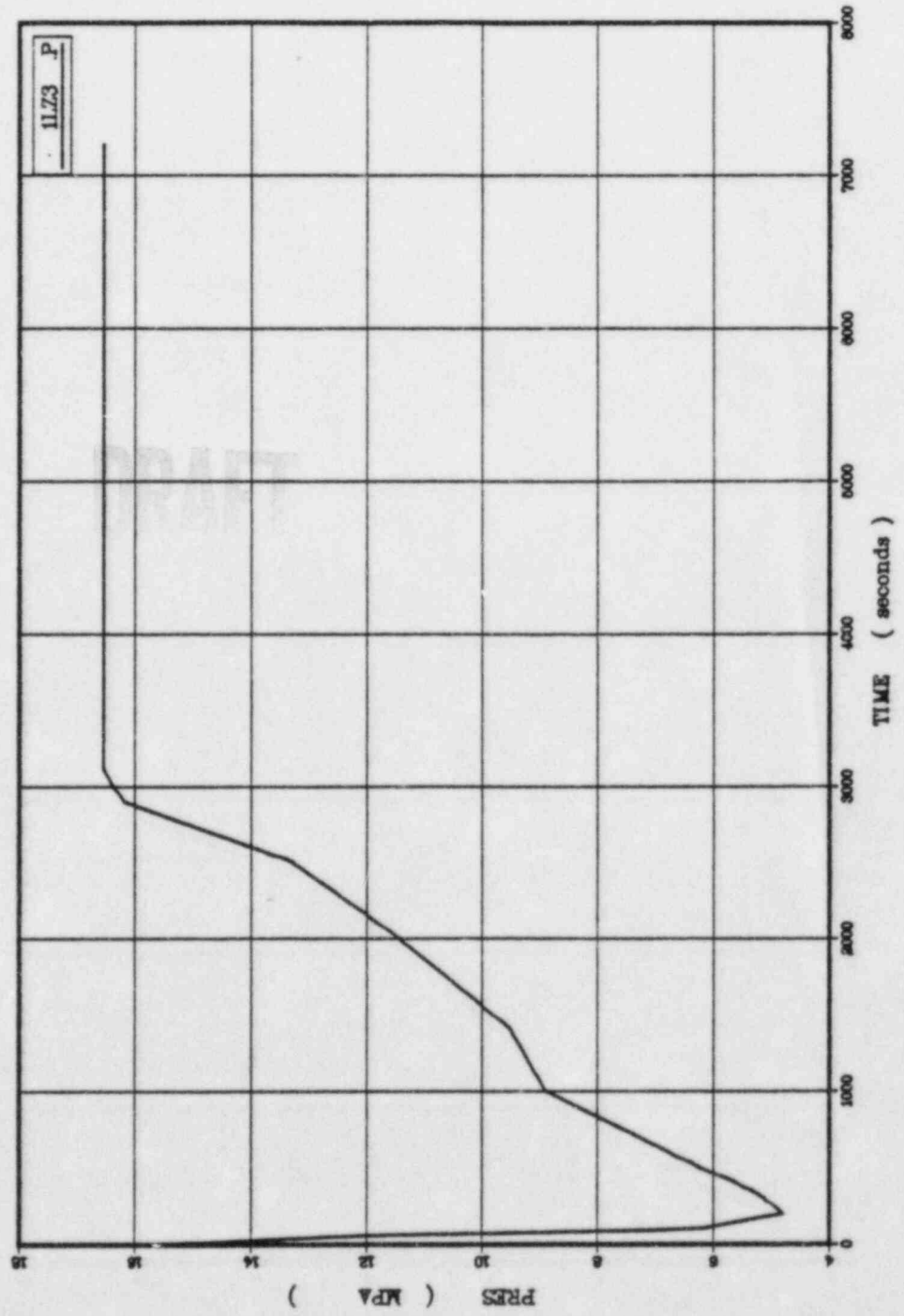
LOT 1 22.16.38 THUR 9 FEB, 1984 JOB-KTNJT , ISSCO DISPLA VER 8.2

DC TEMP FOR LARGE SLB AT HOT ZERO POWER CASE 1.3



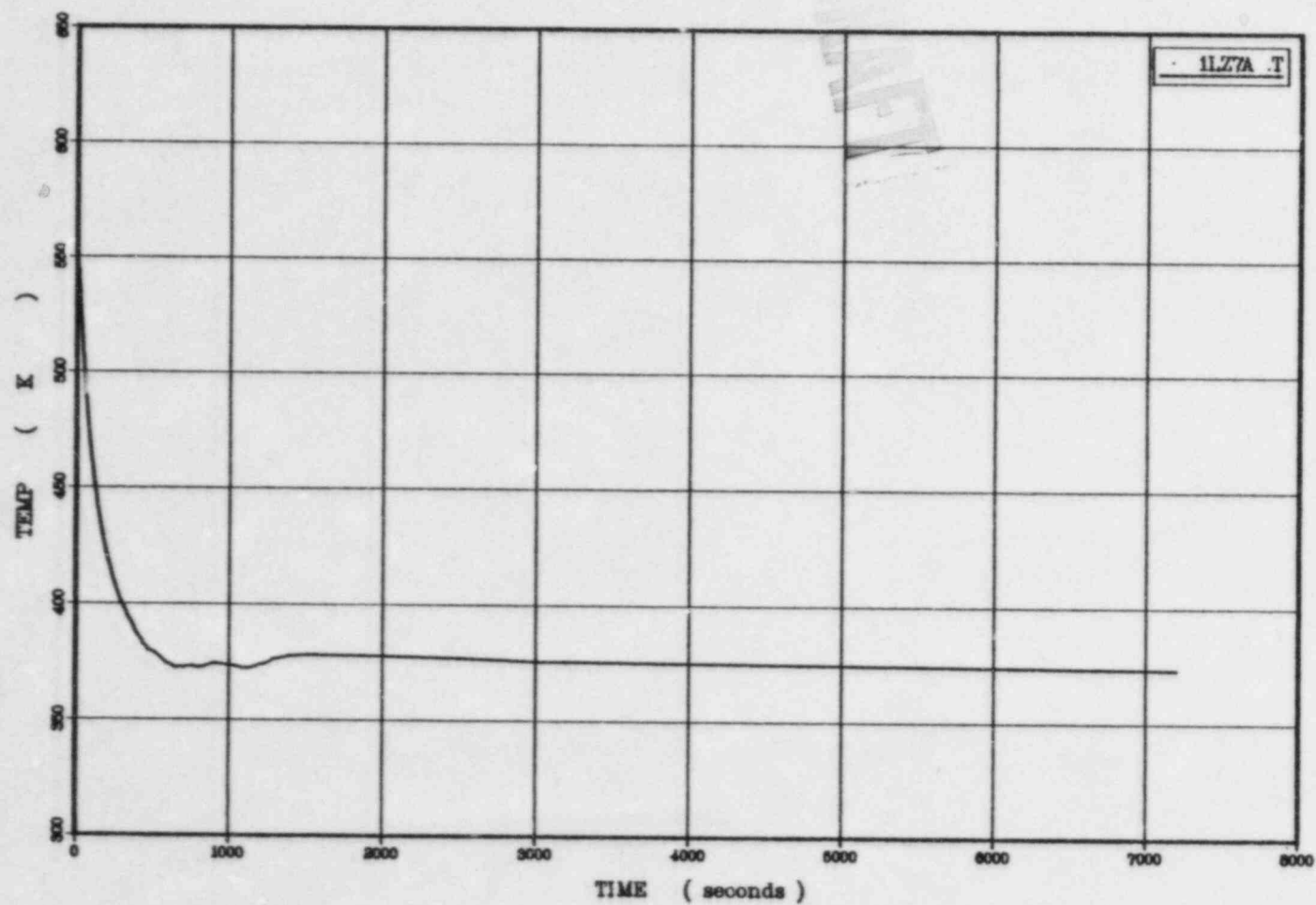
LOT 1 22.18.58 TIME 9 FEB, 1994 JOB-KTKSP, ISSCO DISPLAY VER 6.2

DC PRES FOR LARGE SLB AT HOT ZERO POWER CASE 13



PLOT 1 22.20.34 THUR 9 FEB, 1984 JOB-KIN7RT , ISSCO DISPLA VER 8.2

DC TEMP FOR LARGE SLB AT HOT ZERO POWER CASE 1.7A



DC PRES FOR LARGE SLB AT HOT ZERO POWER CASE 1.7A

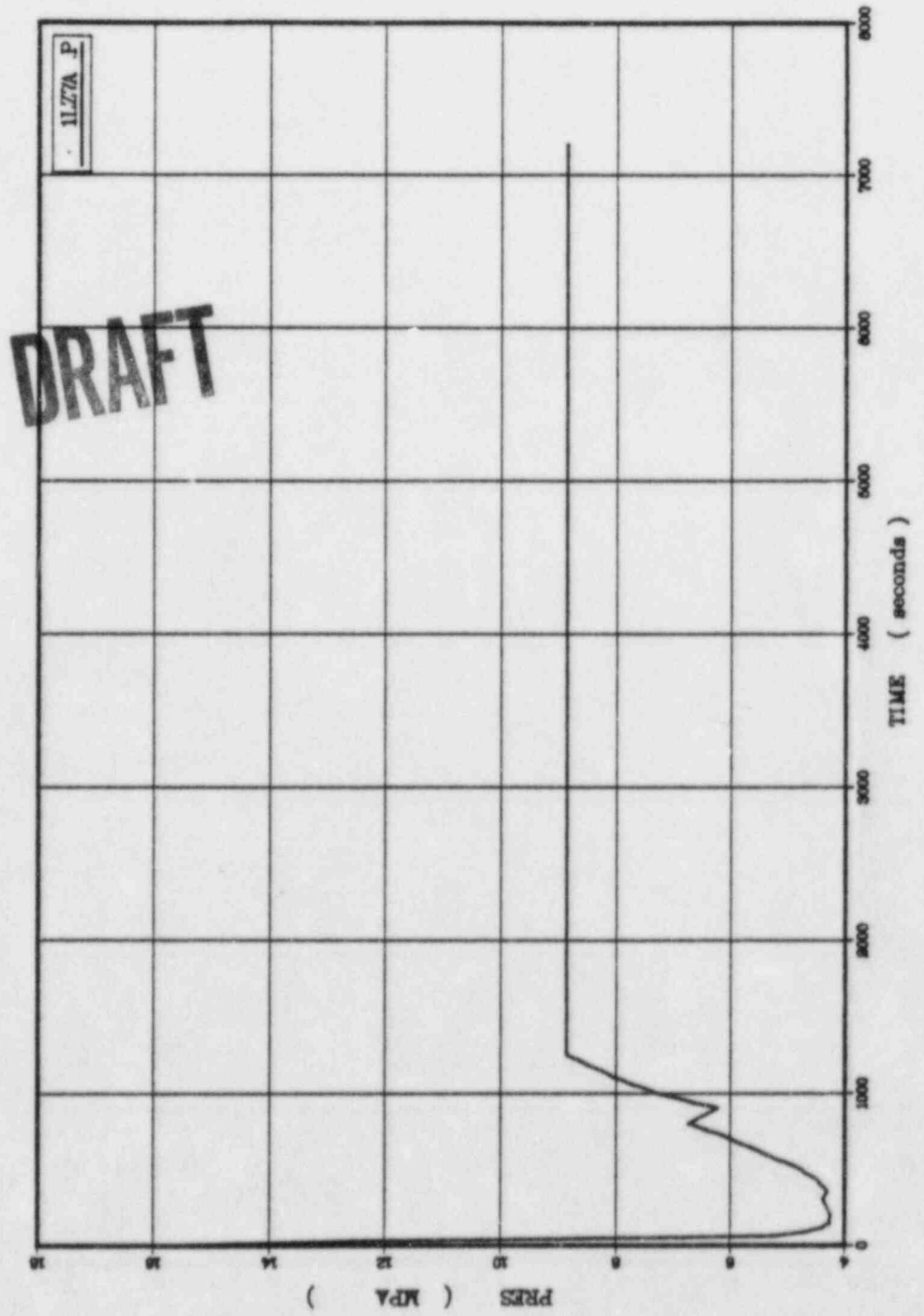


Table 3. Main Steamline Break at Full Power
Initiator: Large Break Upstream of NSIV

Sequence no.	Turbine condition	ADV condition	THV condition	Main feed runback	MSIV condition	MFIV condition	AFW condition	AFW isolation to low press S/G
1.	trips on demand ~2.8 s	all close on demand 28.7 s	all close on demand ~4.0 s	runback occurs	all close on demand ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.0 s	actuates on demand ~197.0 s
2.	trips on demand ~2.8 s	all close on demand 28.7 s	all close on demand ~4.0 s	runback occurs	all close on demand ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.9 s	actuates on demand ~197.9 s
3.	trips on demand ~2.8 s	all close on demand 28.7 s	all close on demand ~4.0 s	runback occurs	all close on demand ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.9 s	actuates on demand ~197.9 s
4.	trips on demand ~2.8 s	all close on demand 28.7 s	all close on demand ~4.0 s	runback occurs	all close on demand ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.9 s	actuates on demand 197.9 s
5.	trips on demand ~2.8 s	all close on demand 28.7 s	all close on demand ~4.0 s	runback occurs	all close on demand ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.9 s	actuates on demand ~197.9 s
6.	trips on demand ~2.8 s	all close on demand 28.7 s	all close on demand ~4.0 s	runback occurs	both fail to close ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.9 s	does not actuate since no ΔP signal generated
7.A	trips on on demand	ADV on line opposite broken line fails to close but is manually isolated at 30 minutes	all close on demand ~4.0 s	runback occurs	all close on demand ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.9 s	actuates on demand ~197.9 s
7.B	trips on on demand	ADV on line opposite broken line fails to close but is manually isolated at 15 minutes	all close on demand ~4.0 s	runback occurs	all close on demand ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.9 s	actuates on demand ~197.9 s
7.C	trips on on demand	ADV on line opposite broken line fails to close	all close on demand ~4.0 s	runback occurs	all close on demand ~41.2 s	all close on demand ~41.2 s	actuates on demand ~197.9 s	actuates on demand ~197.9 s
8.	trips on demand 2.8 s	all close on demand 28.7 s	all close on demand ~4.0 s	fails to occur on line with steam break	all close on demand (time?)	all close on demand (time?)	actuates on demand	actuates on demand
9	trips on demand 2.8 s	all close on demand 28.7 s	all close on demand ~4.0 s	fails to occur on both lines	all close on demand	all close on demand	actuates on demand	actuates on demand

= LANL T3

= LANL T3

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= 3.7.C

= 3.7.C

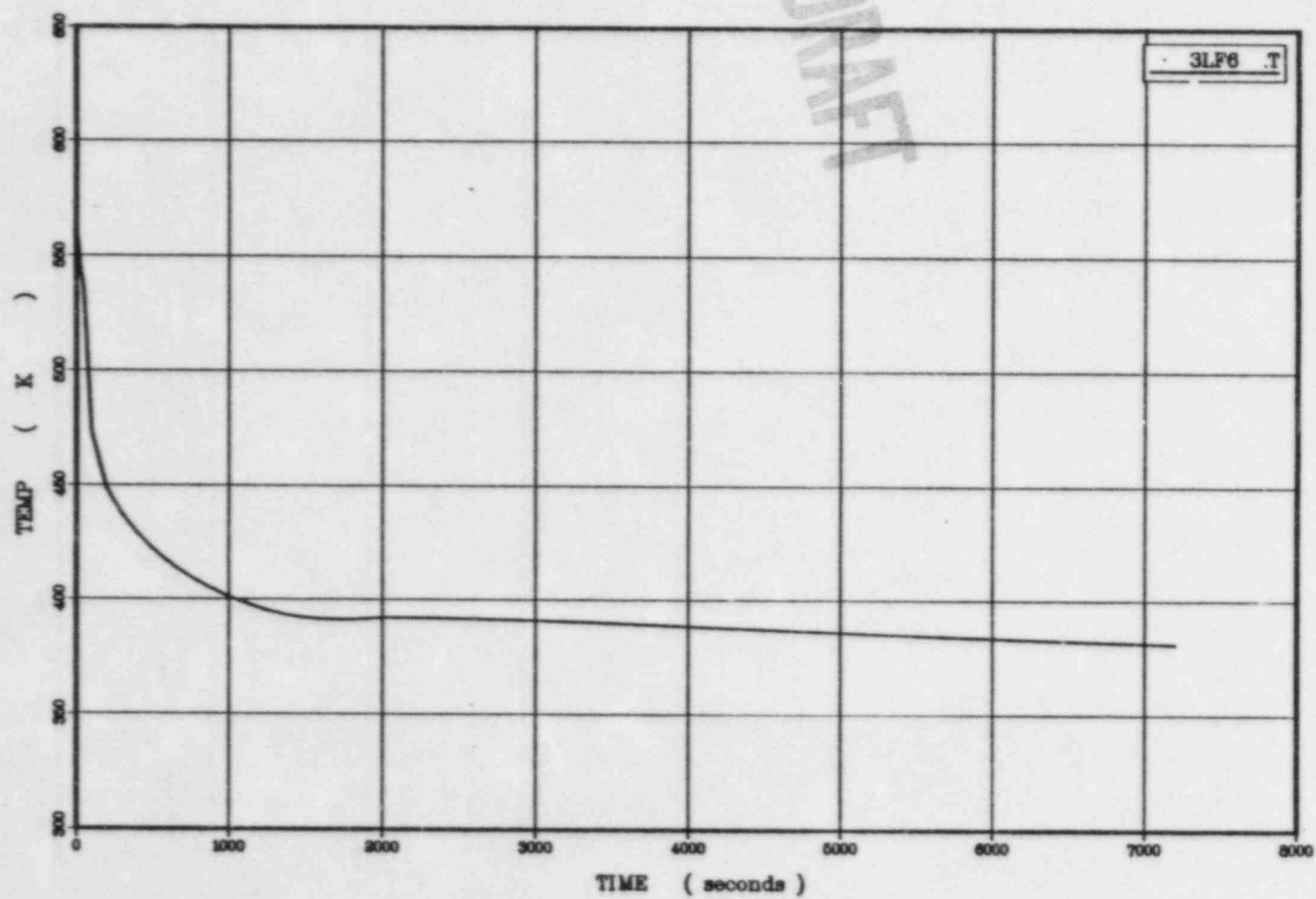
= 3.8

Table 3. Continued

AFW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttle AFW	Early est. frequency	Sequence no.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	1.0×10^{-3}	1.
auto controlled	occurs on demand	failure	throttles AFW at + 22" in S/G	3.0×10^{-5}	2.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	3.0×10^{-5}	3.
auto controlled	occurs on demand	failure	failure	6.0×10^{-6}	4.
auto controlled	fails to occur	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	1.6×10^{-6}	5.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gal/min on any line	1.0×10^{-7}	6.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	total of 7.A, 7.B, and 7.C is 2.0×10^{-5}	7.A.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	see 7.A	7.B.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	see 7.A	7.C.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	5.0×10^{-6}	8.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	5.0×10^{-7}	9.

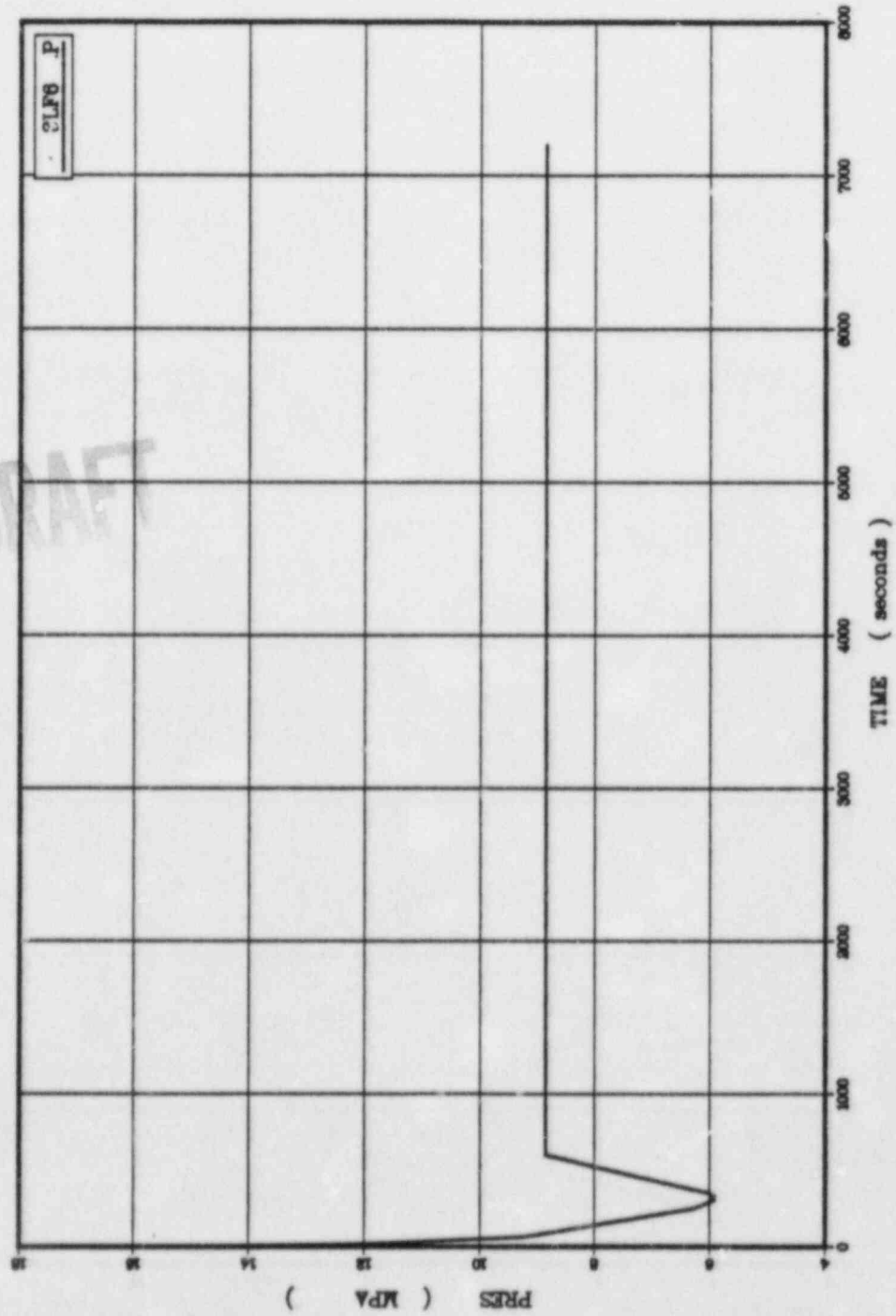
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DC TEMP FOR LARGE SLB AT FULL POWER CASE 3.6



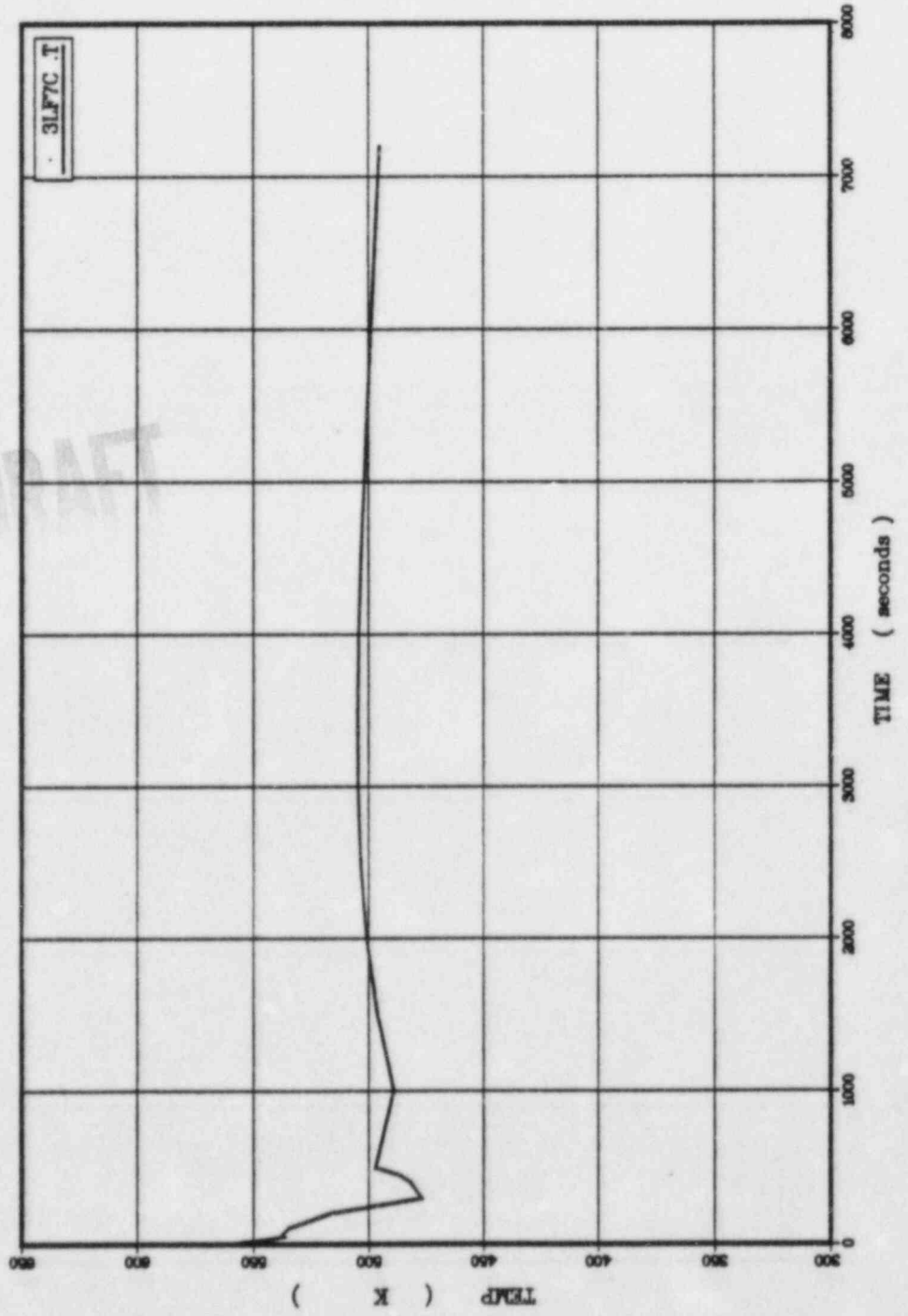
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DC PRES FOR LARGE SLB AT FULL POWER CASE 3.6



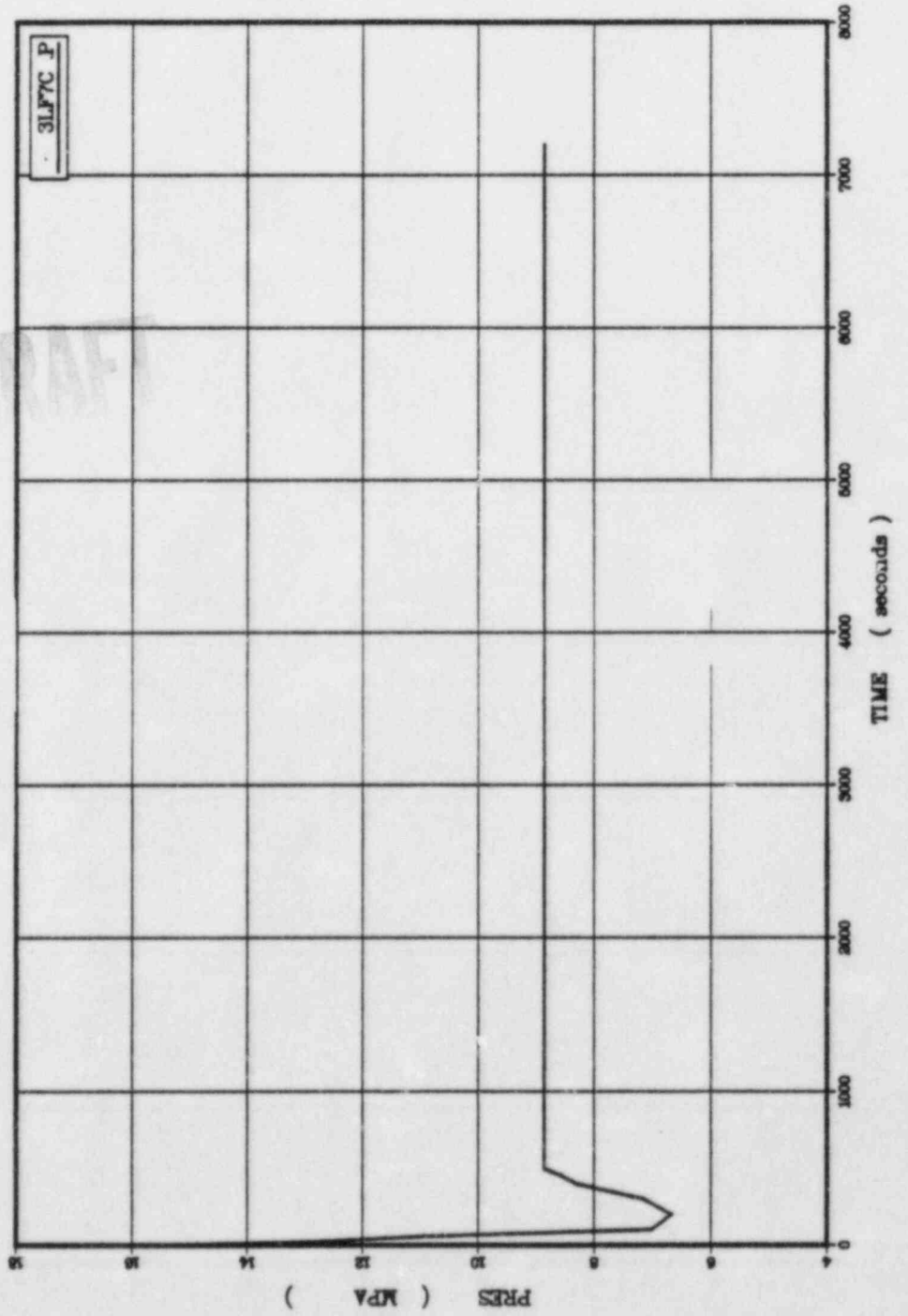
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DC TEMP FOR LARGE SLB AT FULL POWER CASE 3.7C



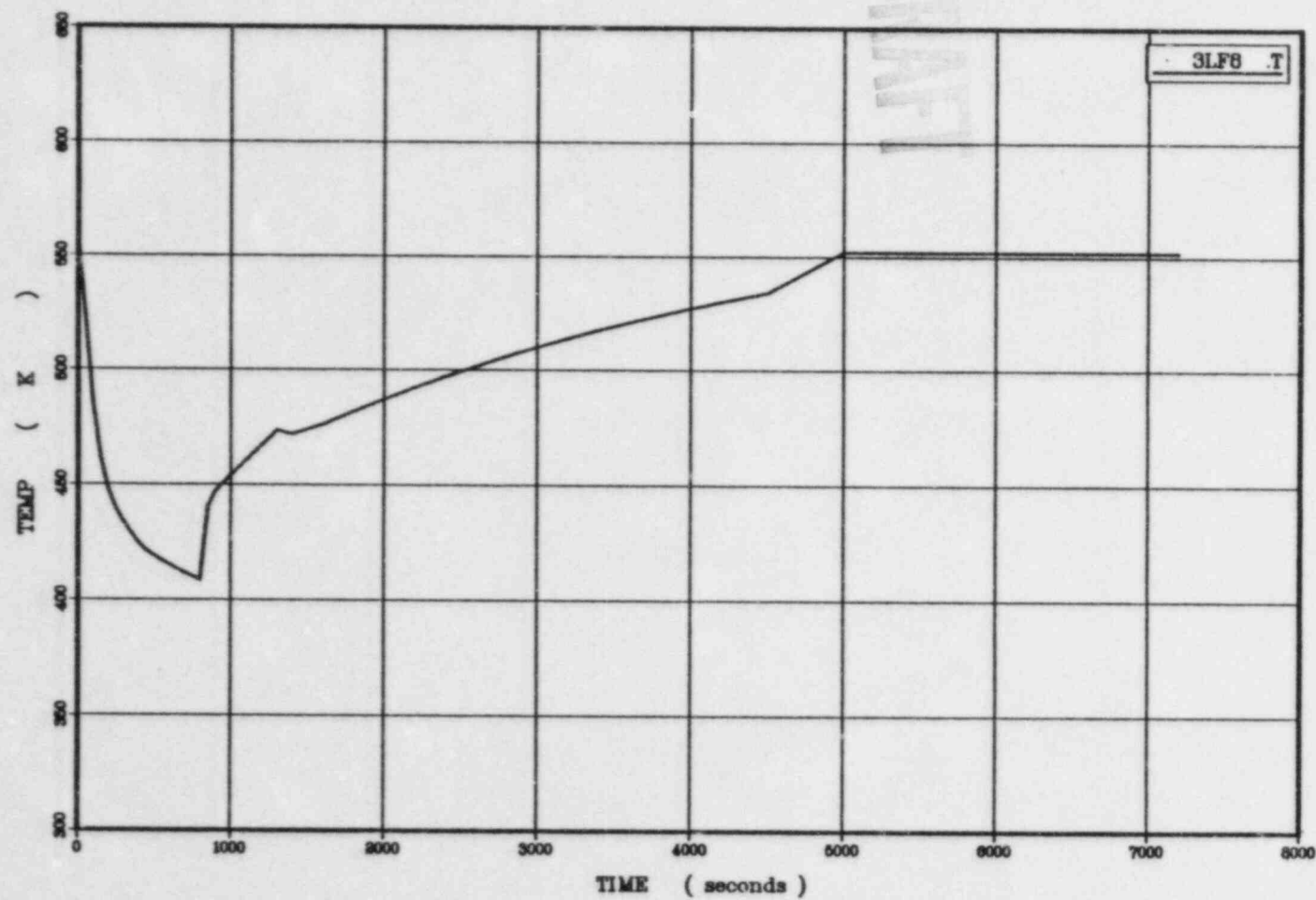
IT 1 23.24.01 TUES 14 FEB, 1994 JOB-KTK370P, 15000 0153PLR VER 0.2

DC PRES FOR LARGE SLB AT FULL POWER CASE 37C



PLOT 1 23.23.38 TUE3 14 FEB, 1984 JOB-KTN36T , 15500 DISPLA VER 8.2

DC TEMP FOR LARGE SLB AT FULL POWER CASE 3.8



PL01 1 23.29.30 TUE5 14 FEB, 1984 -- JOB-KTNDUP , ISS00 DISPLA VER 8.2

DC PRES FOR LARGE SLB AT FULL POWER CASE 3.8

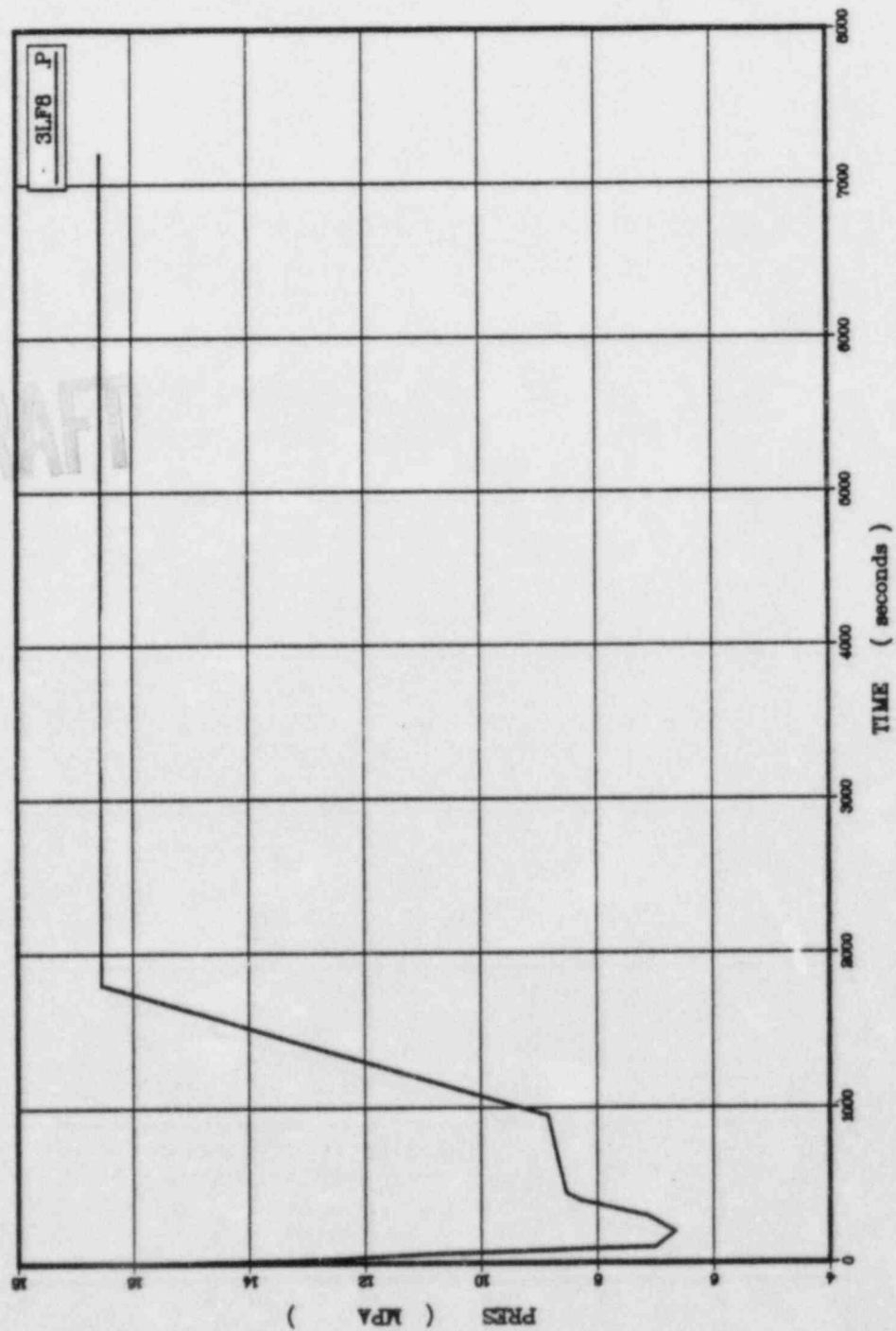


TABLE 5
REACTOR TRIP AT FULL POWER

Initiator: Unspecified

Sequence no.	Turbine condition	ADVs condition	TBVs condition	Mainfeed runback	MSIVs condition	MFLVs condition	AFW condition	AFW isolation to low pressure S/G
1.	trips on demand	quick open then close as required	quick open then close as required	runback occurs	remain open	remain open	not actuated	not actuated
2.	trips on demand	quick open then close as required	quick open then close as required	fails to occur on one line	remain open	remain open	actuates on demand	not actuated
3.	trips on demand	quick open then close as required	quick open then close as required	fails to occur on one line	remain open	remain open	actuates on demand	not actuated
4.	trips on demand	quick open then close as required	quick open then close as required	fails to occur on one line	remain open	remain open	actuates on demand	not actuated
5.	trips on demand	quick open then close as required	quick open then close as required	fails to occur on one line	remain open	remain open	actuates on demand	not actuated
6.	trips on demand	quick open then close as required	quick open then close as required	fails to occur on both lines	remain open	remain open	actuates on demand	not actuated
7.	trips on demand	quick open then close as required	quick open then close as required	fails to occur on both lines	remain open	remain open	actuates on demand	not actuated
8.	trips on demand	quick open then close as required	quick open then close as required	fails to occur on both lines	remain open	remain open	actuates on demand	not actuated
9A.	trips on demand	quick open then close as required	one TBV fails to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
9B.	trips on demand	quick open then close as required	two TBVs fail to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
9C.	trips on demand	quick open then close as required	three TBVs fail to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
10A.	trips on demand	quick open then close as required	one TBV fails to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
10B.	trips on demand	quick open then close as required	two TBVs fail to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated

= Loss of Load

= LANL T9

= LANL T9

= LANL T9

= LANL T9

= LANL T8

= LANL T8

= LANL T8

= LANL T4

= 5.12.B

= 5.12.C

= LANL T4

= 5.12.B

TABLE 5
(CONTINUED)

AFW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttle AFW	Early estimated frequency probability per year	Sequence no.
not actuated	not actuated	NA	NA	5.5×10^{-6}	1.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	5.0×10^{-3}	2.
auto controlled	occurs on demand	failure	throttles AFW at +22" in S/G	1.3×10^{-4}	3.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	1.3×10^{-4}	4.
auto controlled	occurs on demand	failure	failure	3.0×10^{-5}	5.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	2.5×10^{-4}	6.
auto controlled	occurs on demand	failure	throttles AFW at +22" in S/G	7.6×10^{-6}	7.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	7.0×10^{-6}	8.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	1.0×10^{-2}	9A.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	8.0×10^{-4}	9B.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	1.7×10^{-4}	9C.
auto controlled	occurs on demand	failure	throttles AFW at +22" in S/G	3.0×10^{-4}	10A.
auto controlled	occurs on demand	failure	throttles AFW at +22" in S/G	2.0×10^{-5}	10B.

TABLE 5
(CONTINUED)

Sequence no.	Turbine condition	ADVs condition	TBVs condition	Mainfeed runback	MSIVs condition	MFIVs condition	APW condition	APW isolation to low pressure S/G
10C.	trips on demand	quick open then close as required	three TBVs fail to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
11A.	trips on demand	quick open then close as required	one TBV fails to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
11B.	trips on demand	quick open then close as required	two TBVs fail to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
11C.	trips on demand	quick open then close as required	three TBVs fail to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
12A.	trips on demand	quick open then close as required	one TBV fails to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
12B.	trips on demand	quick open then close as required	two TBVs fail to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
12C.	trips on demand	quick open then close as required	three TBVs fail to close ~50 s	runback occurs	all close on demand ~510 s	all close on demand ~510 s	actuates on demand	not actuated
13A.	trips on demand	quick open then close as required	Initially one TBV fails to close at ~50 s. ~600 s after MSIV fails to close the TBV is isolated.	runback occurs	one MSIV fails to close	all close on demand ~510 s	actuates on demand	actuates on demand
13B.	trips on demand	quick open then close as required	Initially two TBVs fail to close at ~50 s. ~900 s after MSIV fails to close the TBVs are isolated.	runback occurs	one MSIV fails to close	all close on demand ~510 s	actuates on demand	actuates on demand
13C.	trips on demand	quick open then close as required	Initially three TBVs fail to close at ~50 s. ~1200 s after MSIVs fail to close all three TBVs are isolated.	runback occurs	one MSIV fails to close	all close on demand ~510 s	actuates on demand	actuates on demand
13D.	trips on demand	quick open then close as required	one TBV fails to close ~50 s	runback occurs	one MSIV fails to close	all close on demand ~510 s	actuates on demand	actuates on demand
14A.	trips on demand	quick open then close as required	Initially one TBV fails to close at ~50 s. ~600 s after MSIV fails to close the TBV is isolated.	runback occurs	both fail to close ~510 s	all close on demand ~510 s	actuates on demand	fails to actuate since no AP signal generated

TABLE 5
(CONTINUED)

AFW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttle AFW	Early estimated frequency probability per year	Sequence no.
auto controlled	occurs on demand	failure	throttles AFW at +22" in H/G	5.0×10^{-6}	10C.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	3.0×10^{-4}	11A.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	2.0×10^{-5}	11B.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	5.0×10^{-6}	11C.
auto controlled	occurs on demand	failure	failure	6.0×10^{-5}	12A.
auto controlled	occurs on demand	failure	failure	5.0×10^{-6}	12B.
auto controlled	occurs on demand	failure	failure	9.0×10^{-7}	12C.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	4.0×10^{-5}	13A.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	3.0×10^{-6}	13B.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	6.0×10^{-7}	13C.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	4.0×10^{-6}	13D.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gals/min on any line	1.0×10^{-5}	14A.

TABLE 5
(CONTINUED)

Sequence no.	Turbine condition	ADVs condition	TBVs condition	Mainfeed runback	MSIVs condition	NFIVs condition	AFW condition	AFW isolation to low pressure S/G
14B.	trips on demand	quick open then close as required	Initially two TBVs fail to close at ~50 s. ~900 s after MSIV fails to close the TBVs are isolated.	runback occurs	both fail to close ~510 s	all close on demand ~510 s	actuates on demand	fails to actuate since no AP signal generated
14C.	trips on demand	quick open then close as required	Initially three TBVs fail to close at ~50 s. ~1200 s after MSIVs fail to close all three TBVs are isolated.	runback occurs	both fail to close ~510 s	all close on demand ~510 s	actuates on demand	fails to actuate since no AP signal generated
14D.	trips on demand	quick open then close as required	one TBV fails to close ~50 s	runback occurs	both fail to close ~510 s	all close on demand ~510 s	actuates on demand	fails to actuate since no AP signal generated
15A.	trips on demand	quick open then close as required	one TBV fails to close ~50 s	fails to occur on one line	all close on demand ~510 s	all close on demand	actuates on demand	actuate ok, demand
15B.	trips on demand	quick open then close as required	two TBVs fail to close ~50 s	fails to occur on one line	all close on demand ~510 s	all close on demand	actuates on demand	actuate on demand
15C.	trips on demand	quick open then close as required	three TBVs fail to close ~50 s	fails to occur on one line	all close on demand ~510 s	all close on demand	actuates on demand	actuate on demand
16.	trips on demand	quick open then close as required	all TBVs fail to close	runback occurs	all close on demand	all close on demand ~510 s	actuates on demand	actuate on demand
17.	trips on demand	quick open then close as required	all TBVs fail to close	runback occurs	all close on demand	all close on demand ~510 s	actuates on demand	actuate on demand
18.	trips on demand	quick open then close as required	all TBVs fail to close	runback occurs	all close on demand	all close on demand ~510 s	actuates on demand	actuate on demand
19.	trips on demand	quick open then close as required	Initially all TBVs fail to close at ~50 s. ~1500 s after MSIV fails to close the TBVs are isolated	runback occurs	one MSIV fails to close	all close on demand ~510 s	actuates on demand	actuate on demand
20.	trips on demand	one fails to close and is not isolated	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand

= LANL T4

= 5.12.B

= 5.12.C

= 5.12.C

= 5.12.C

= 5.12.C

= LANL T3

= 5.23

TABLE 9
(CONTINUED)

AFW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttle AFW	Early estimated frequency probability per year	Sequence no.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gals/min on any line	8.0×10^{-7}	14B.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gals/min on any line	2.0×10^{-7}	14C.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gals/min on any line	1.0×10^{-6}	14D.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	1.0×10^{-5}	15A.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	8.0×10^{-7}	15B.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	2.0×10^{-7}	15C.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	4.5×10^{-5}	16.
auto controlled	occurs on demand	failure	throttles AFW at +22" in S/G	1.2×10^{-6}	17.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	1.2×10^{-6}	18.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	1.5×10^{-7}	19.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	1.8×10^{-2}	20.

= 5.23

= 5.23

= 5.23

TABLE 5
(CONTINUED)

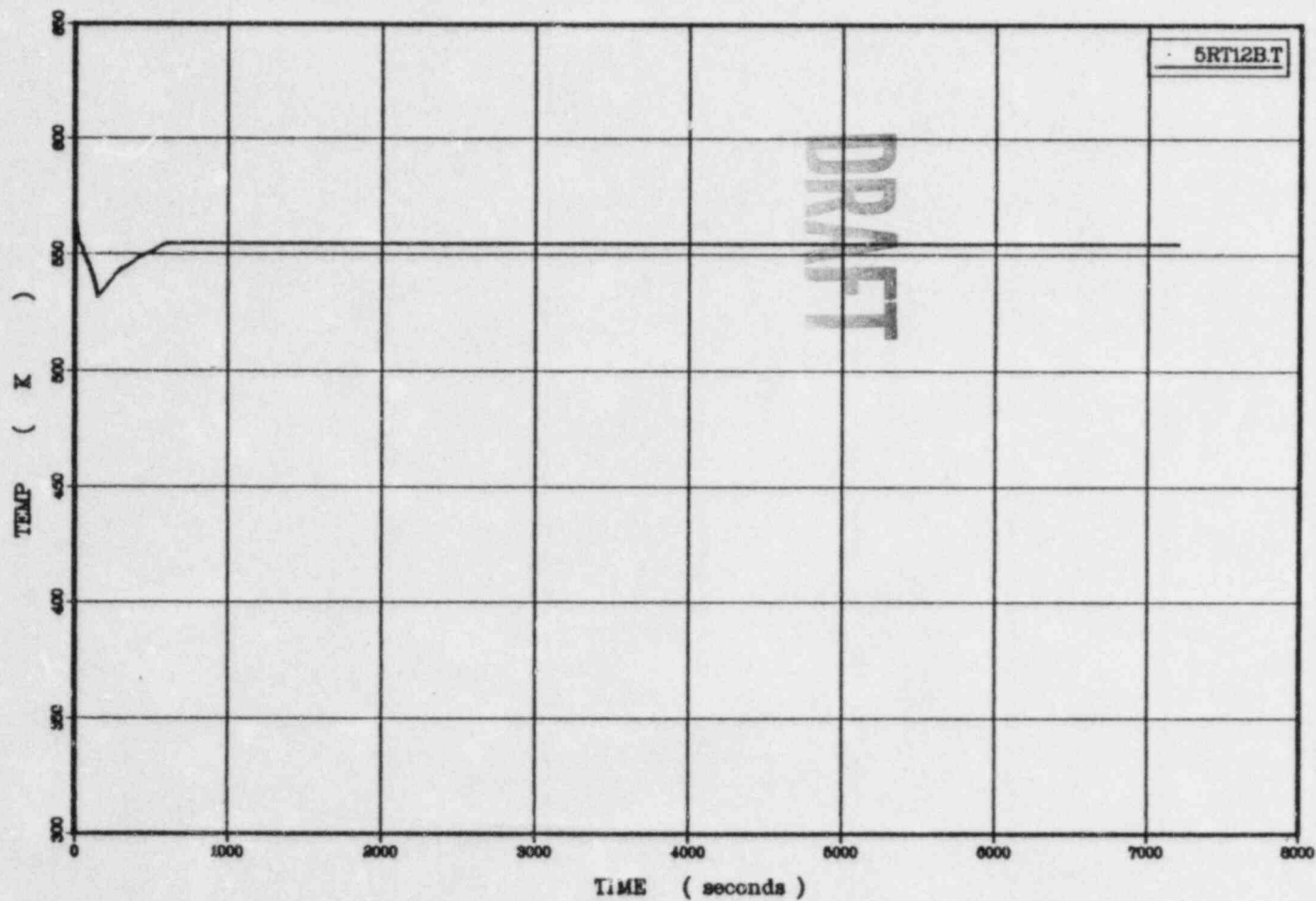
Sequence no.	Turbine condition	ADVs condition	THVs condition	Mainfeed runback	MSIVs condition	MPIVs condition	APW condition	APW isolation to low pressure S/G
21.	trips on demand	one fails to close and is not isolated	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
22.	trips on demand	one fails to close and is not isolated	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
23.	trips on demand	one fails to close and is not isolated	all close on demand	runback occurs	both fail to close	all close on demand	actuates on demand	fails to actuate since no ΔP
24.	trips on demand	one fails to close and is not isolated	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
25.	trips on demand	both fail to close and are not isolated	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	fails to actuate since no ΔP

TABLE 5
(CONTINUED)

APW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttle APW	Early estimated frequency probability per year	Sequence no.
auto controlled	occurs on demand	failure	throttles APW at +22" in S/G	5.0×10^{-4}	21.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	5.0×10^{-4}	22.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gals/min on any line	1.6×10^{-5}	23.
auto controlled	occurs on demand	failure	failure	1.0×10^{-7}	24.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles APW at +22" in S/G	9.0×10^{-4}	25.

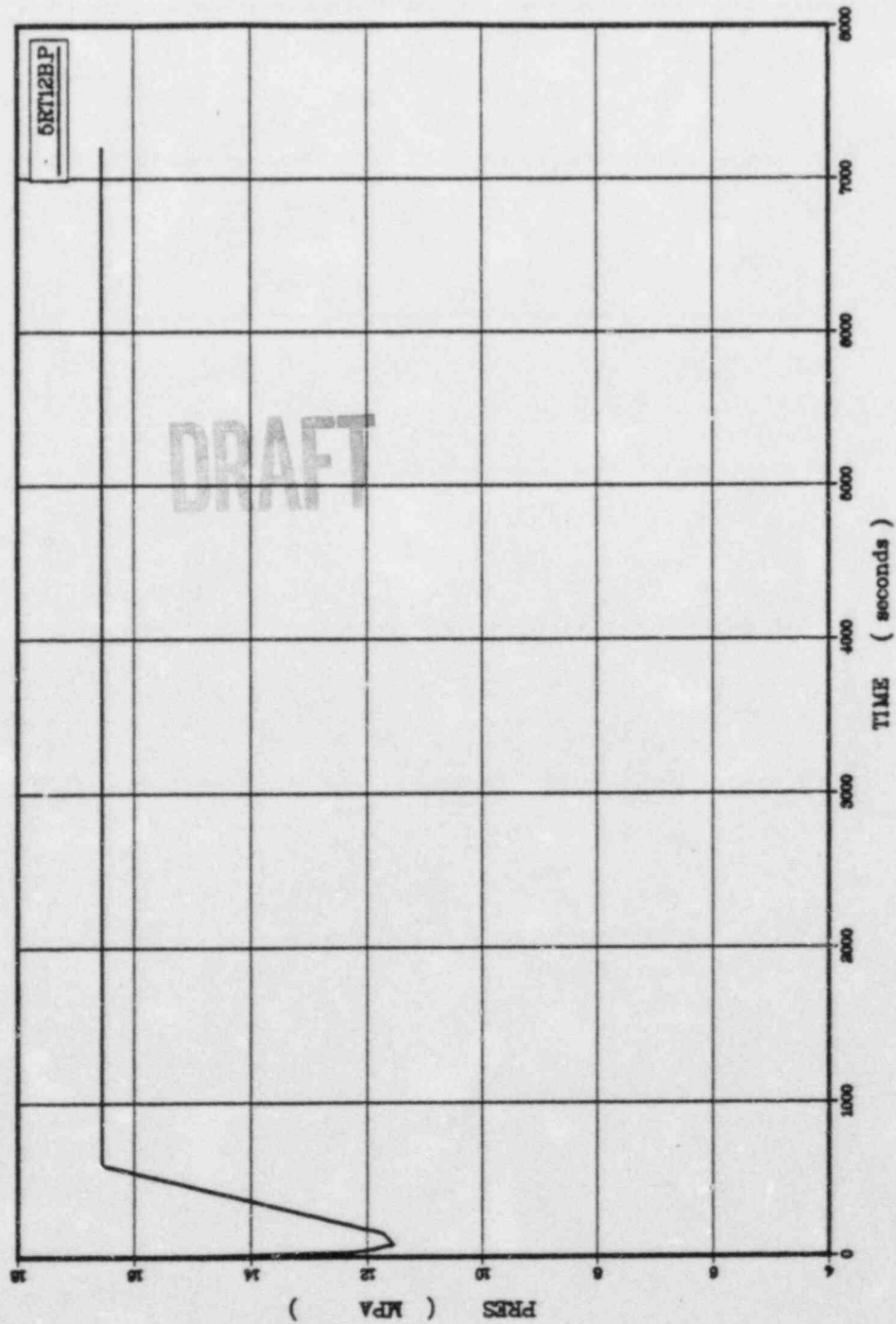
PLOT 1 22.27.53 THUR 9 FEB, 1984 JOB-KTNS12BT, 15500 DISPLA VER 8.2

DC TEMP FOR REACTOR TRIP FROM FULL POWER CASE 5.12B



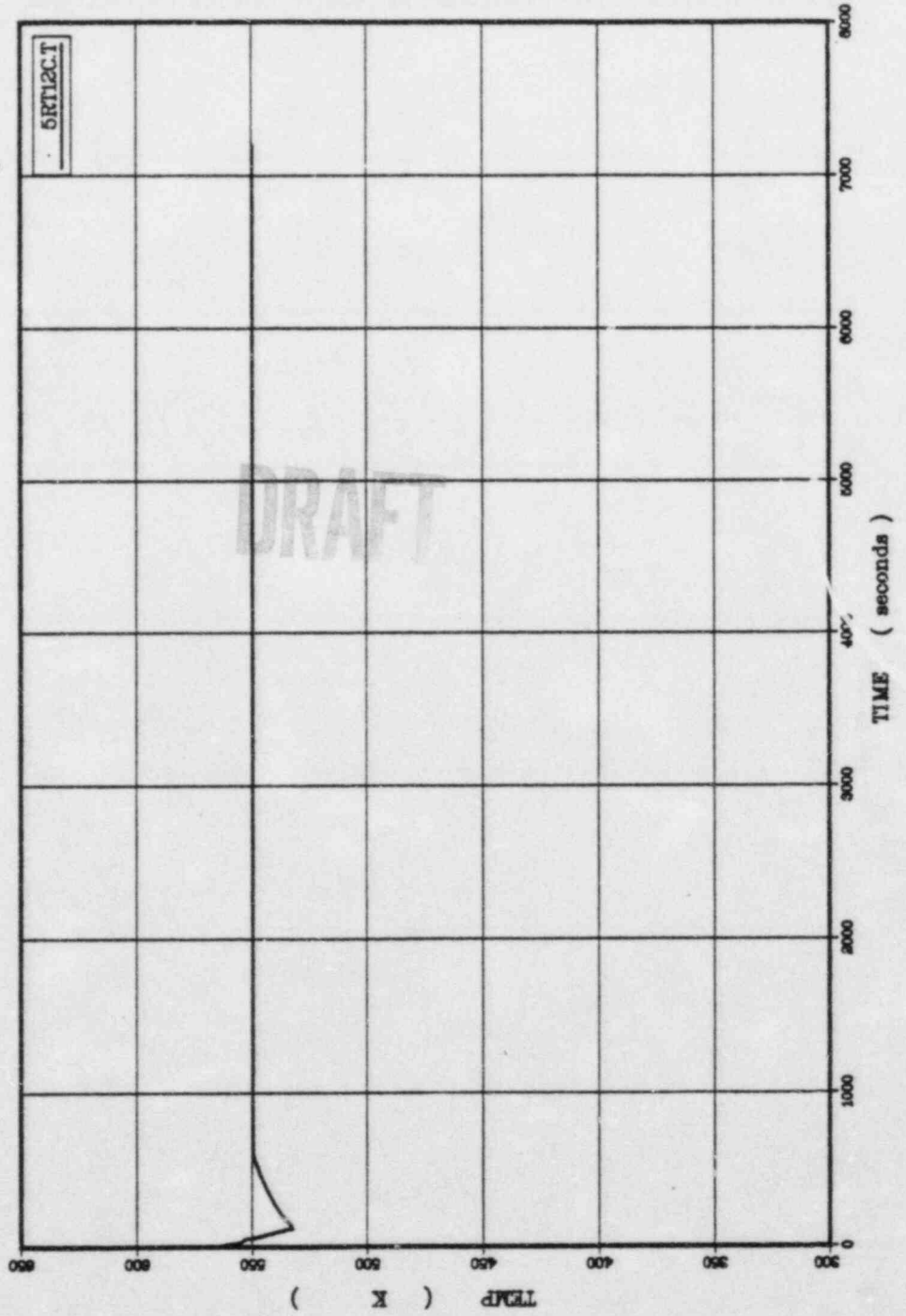
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DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 5.12B



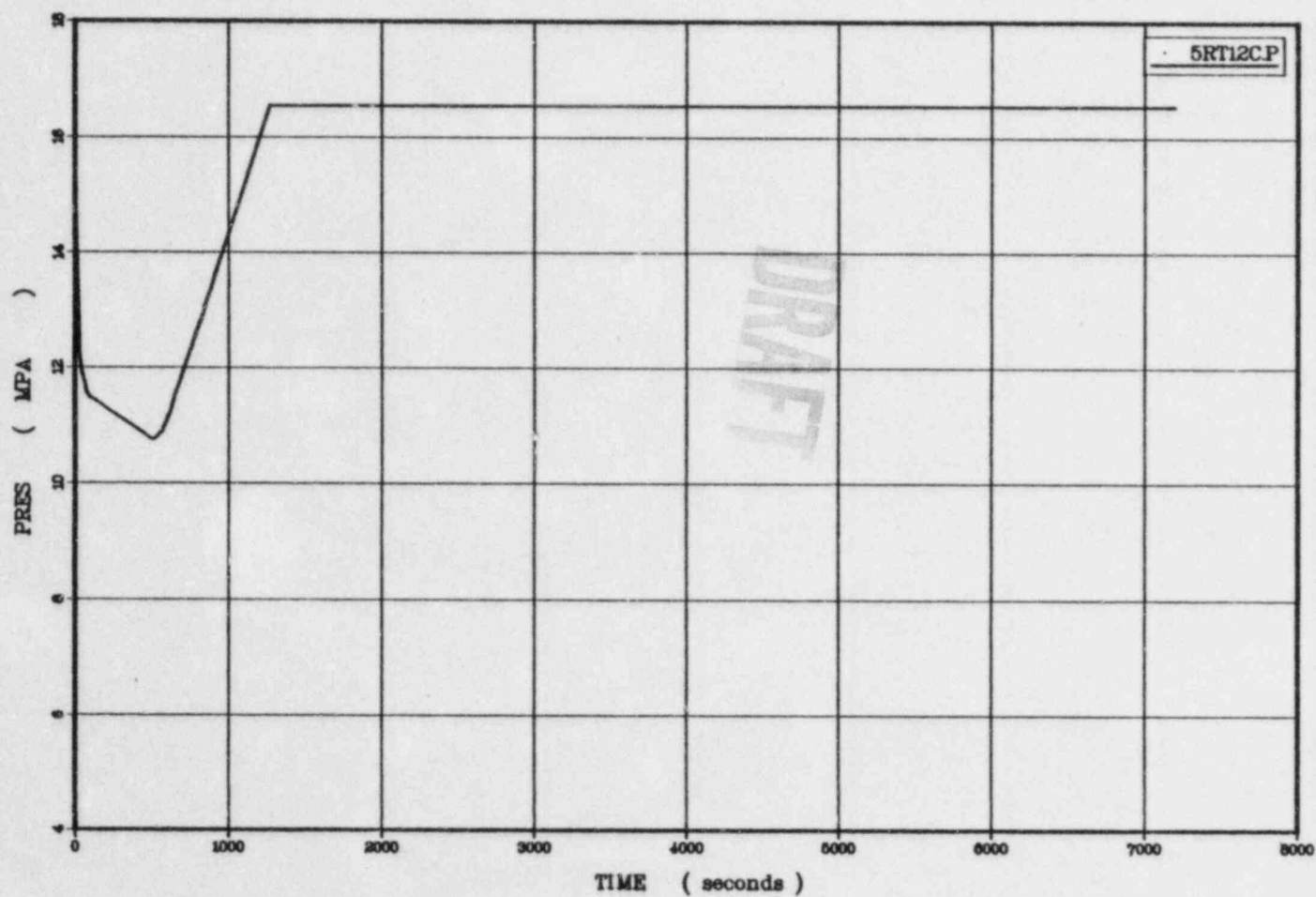
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DC TEMP FOR REACTOR TRIP FROM FULL POWER CASE 5.12C



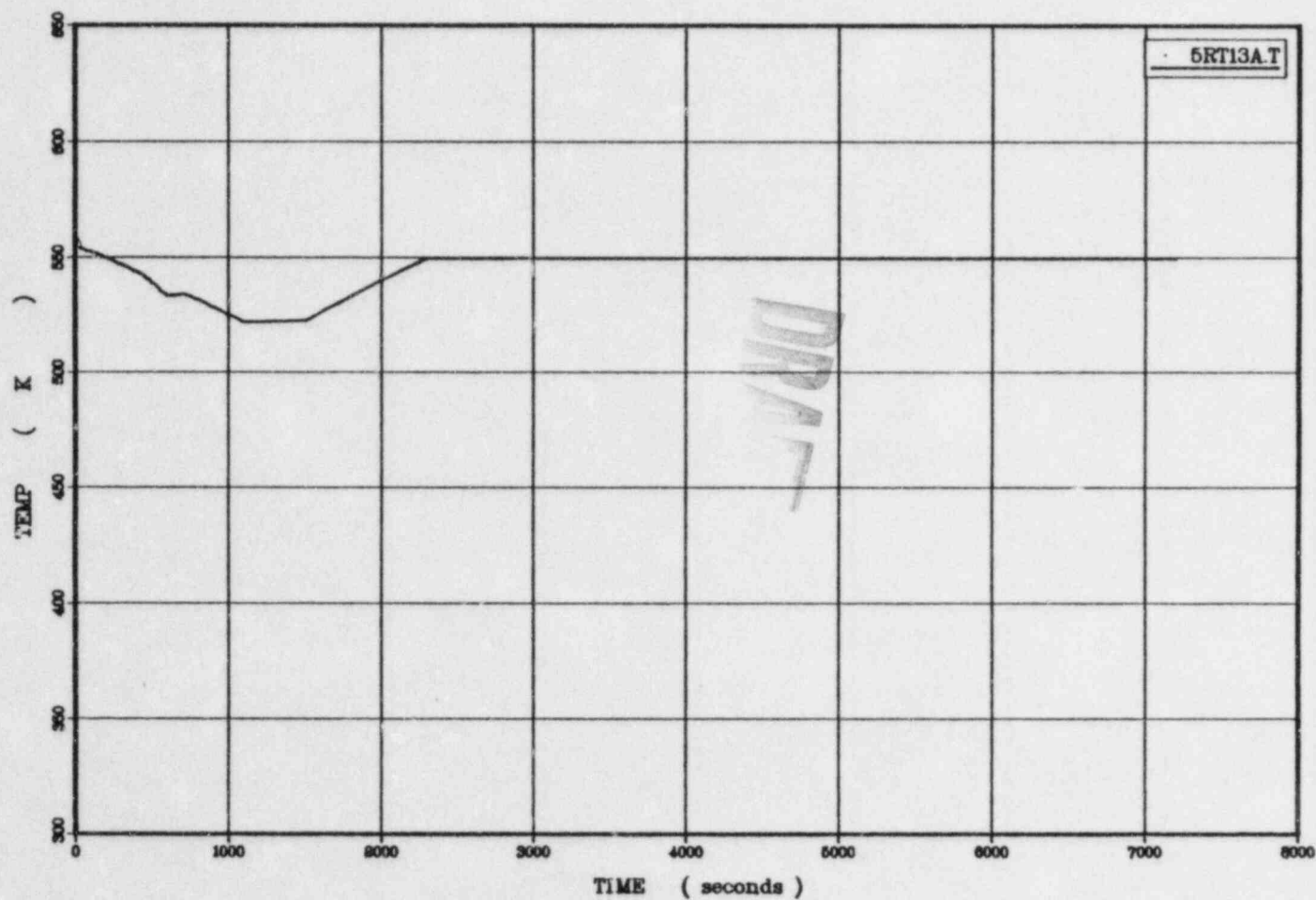
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DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 5.12C



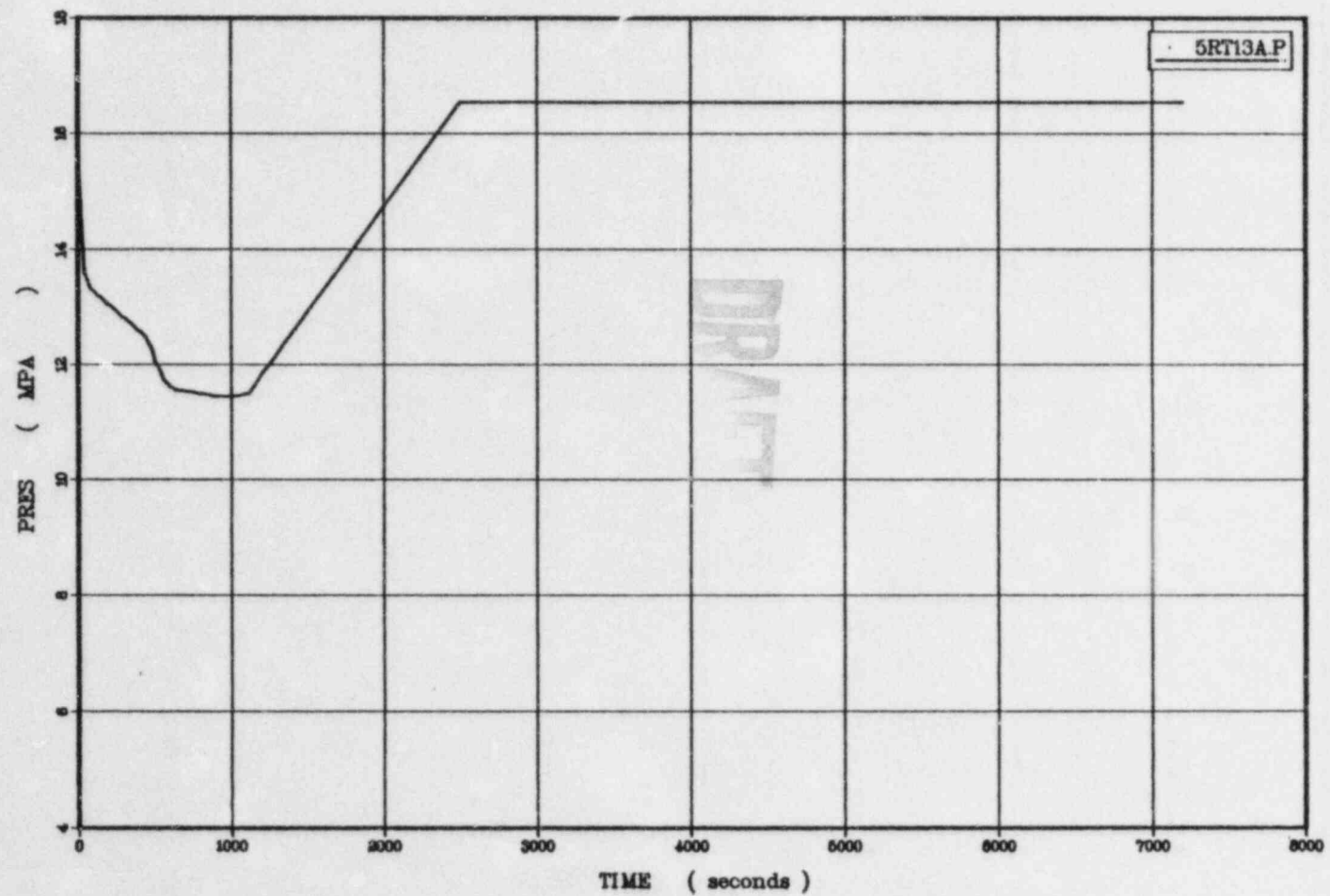
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DC TEMP FOR REACTOR TRIP FROM FULL POWER CASE 5.13A



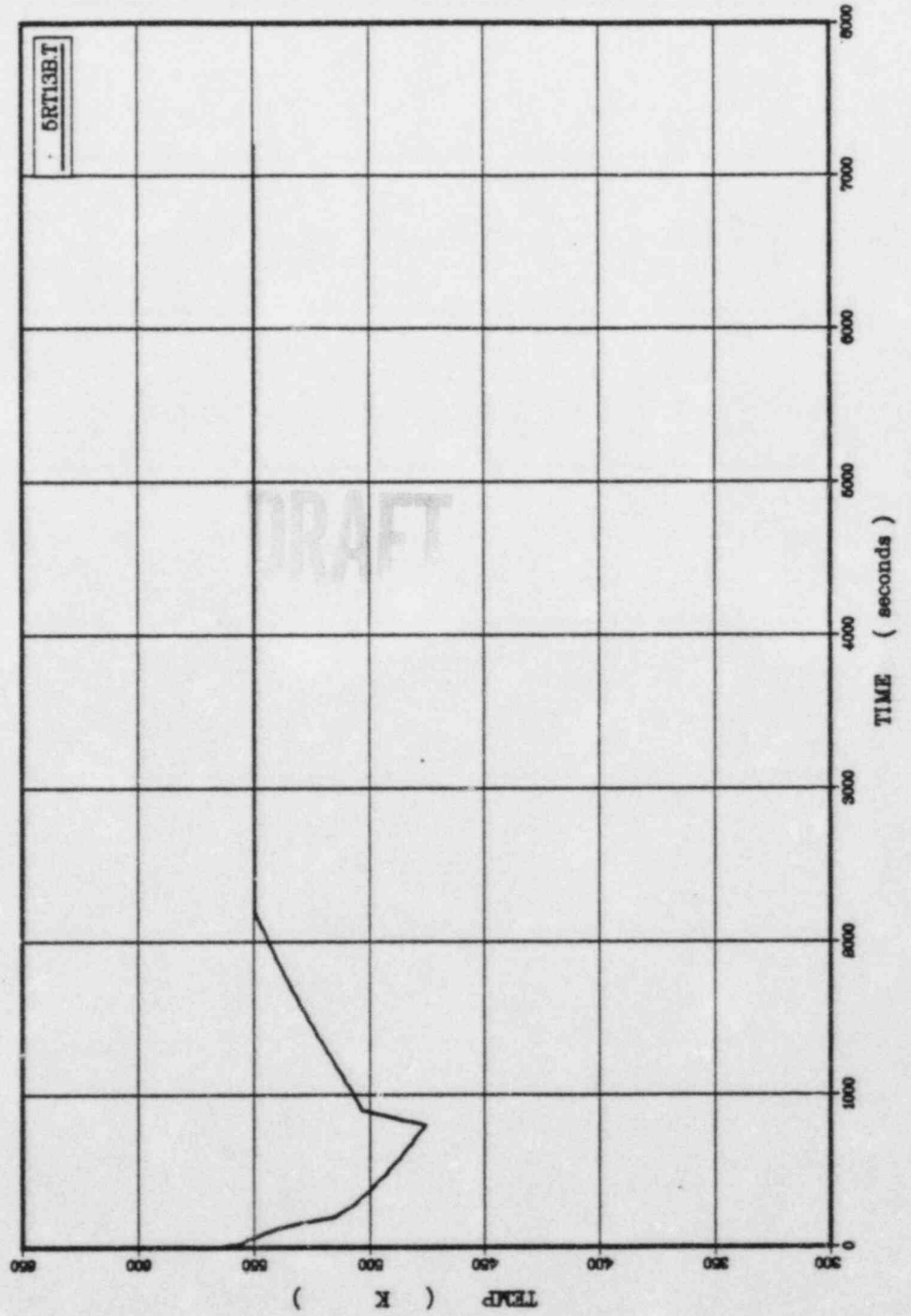
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DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 5.13A



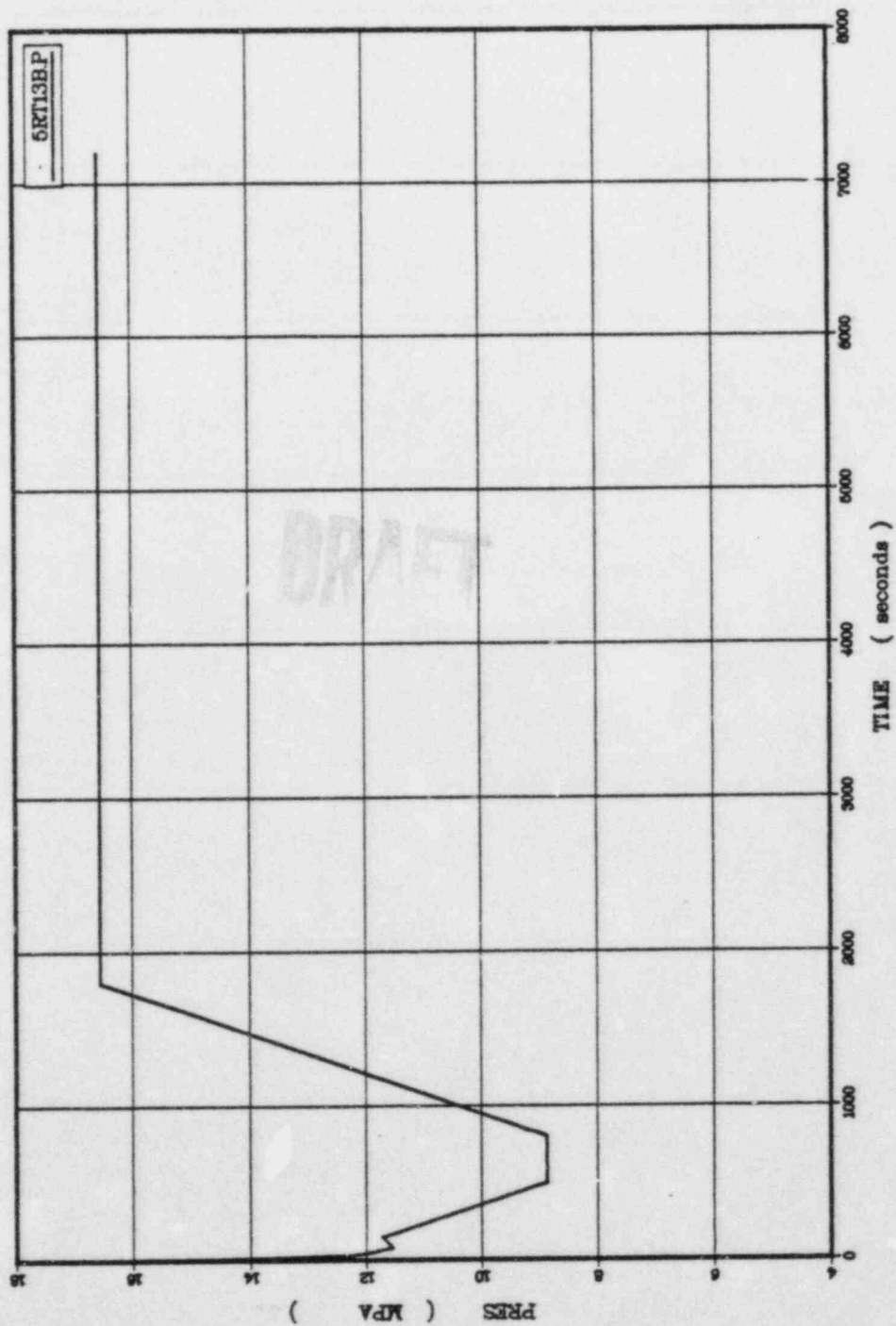
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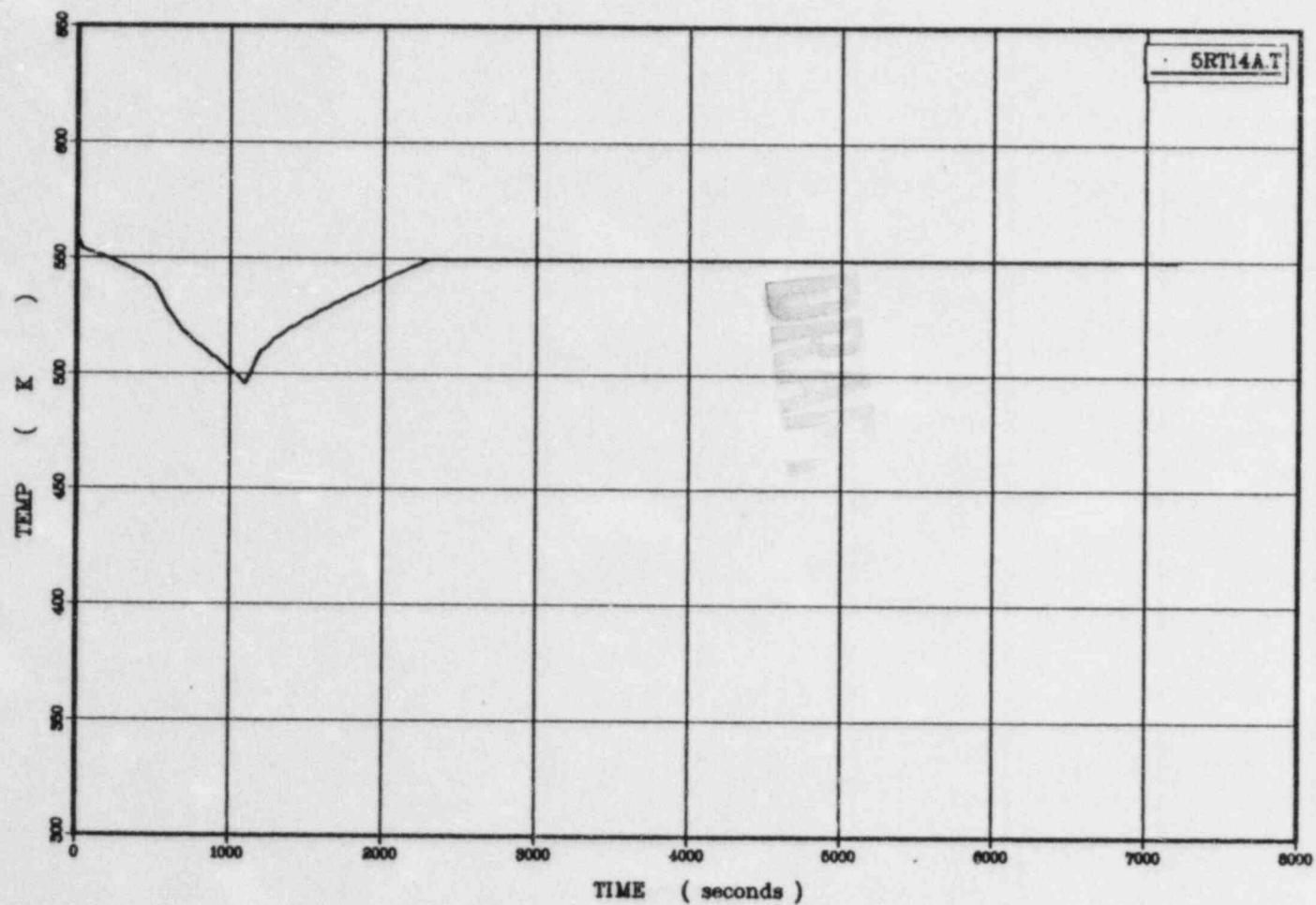


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DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 513B

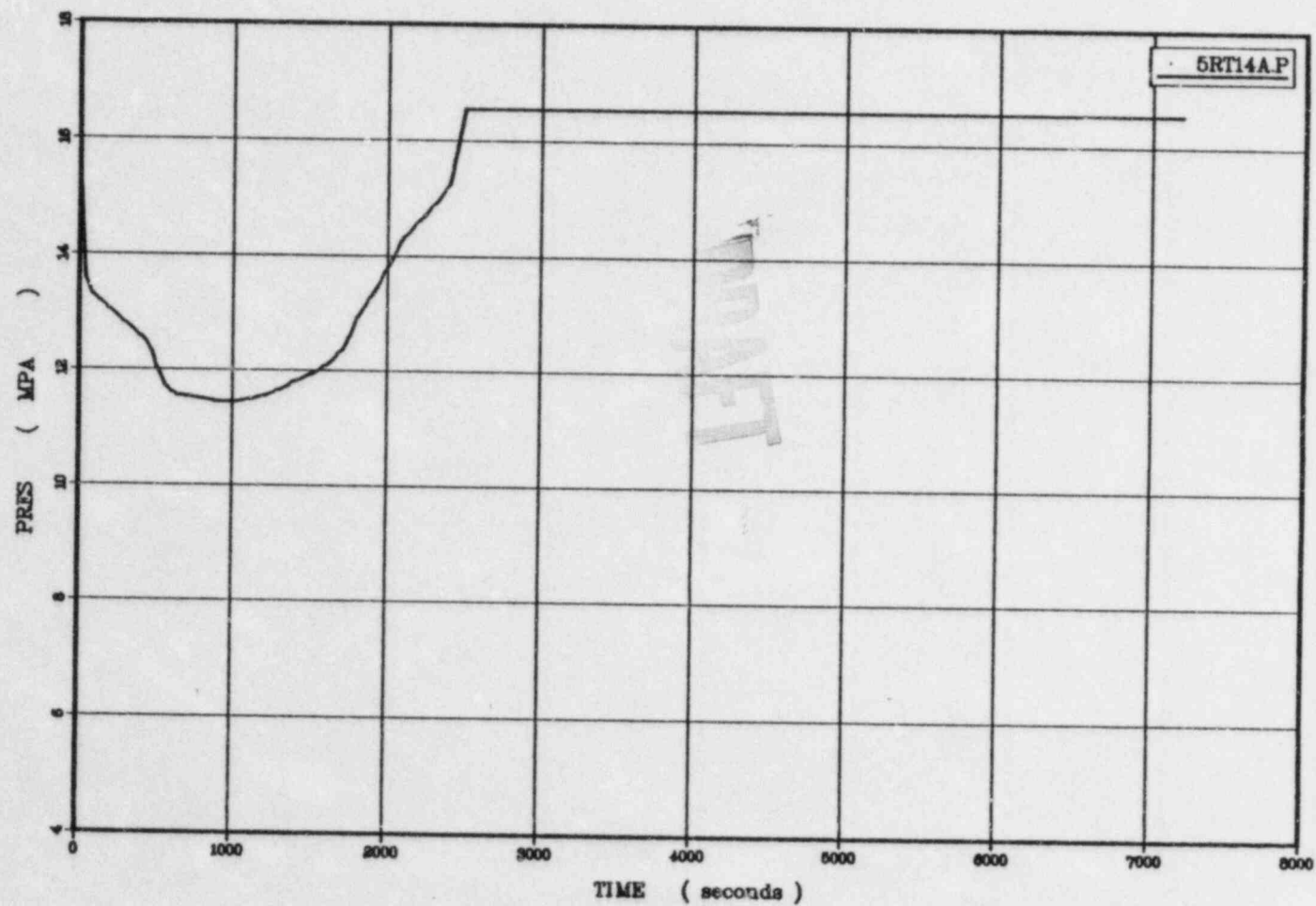


DC TEMP FOR REACTOR TRIP FROM FULL POWER CASE 5.14A



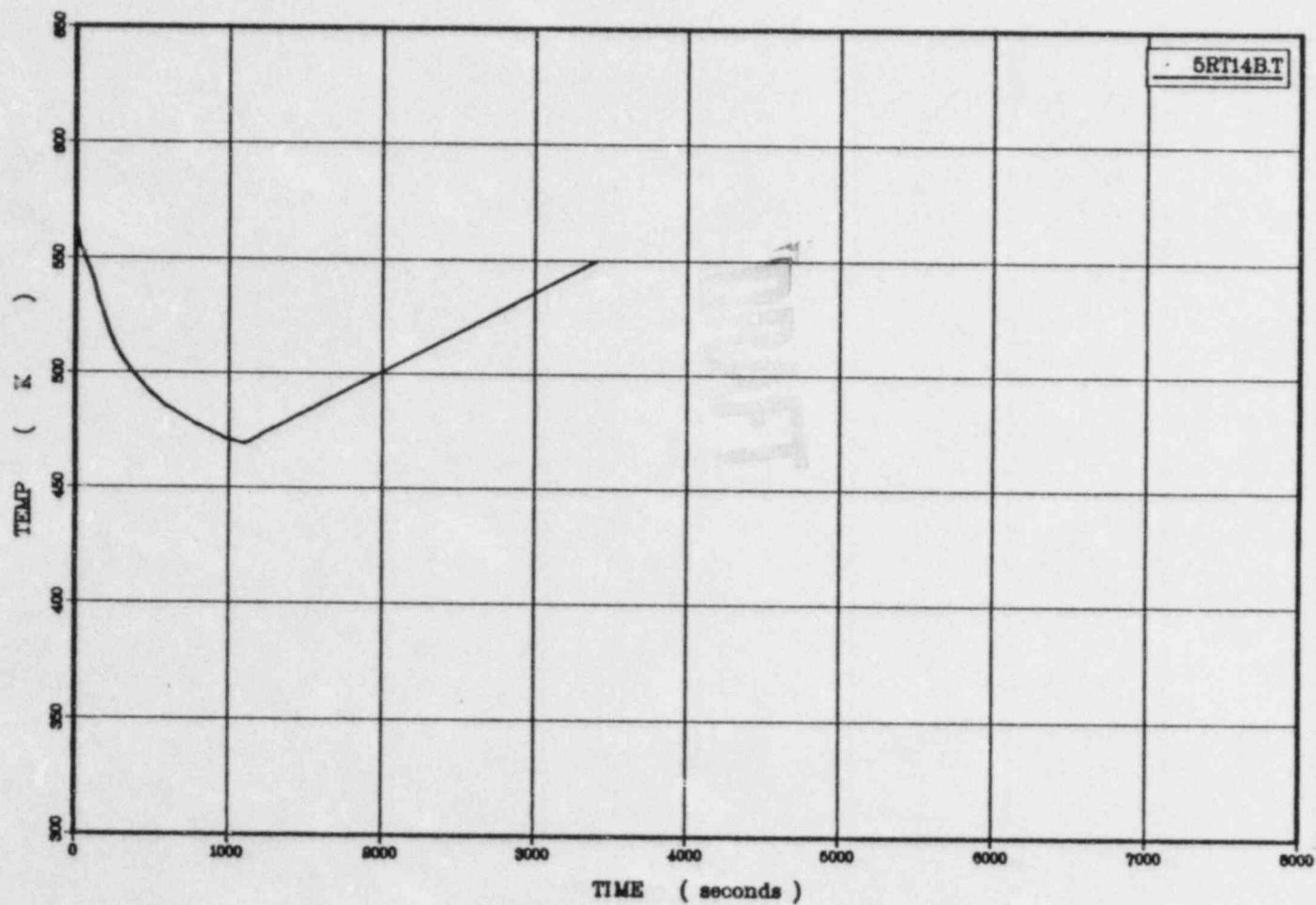
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DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 5.14A



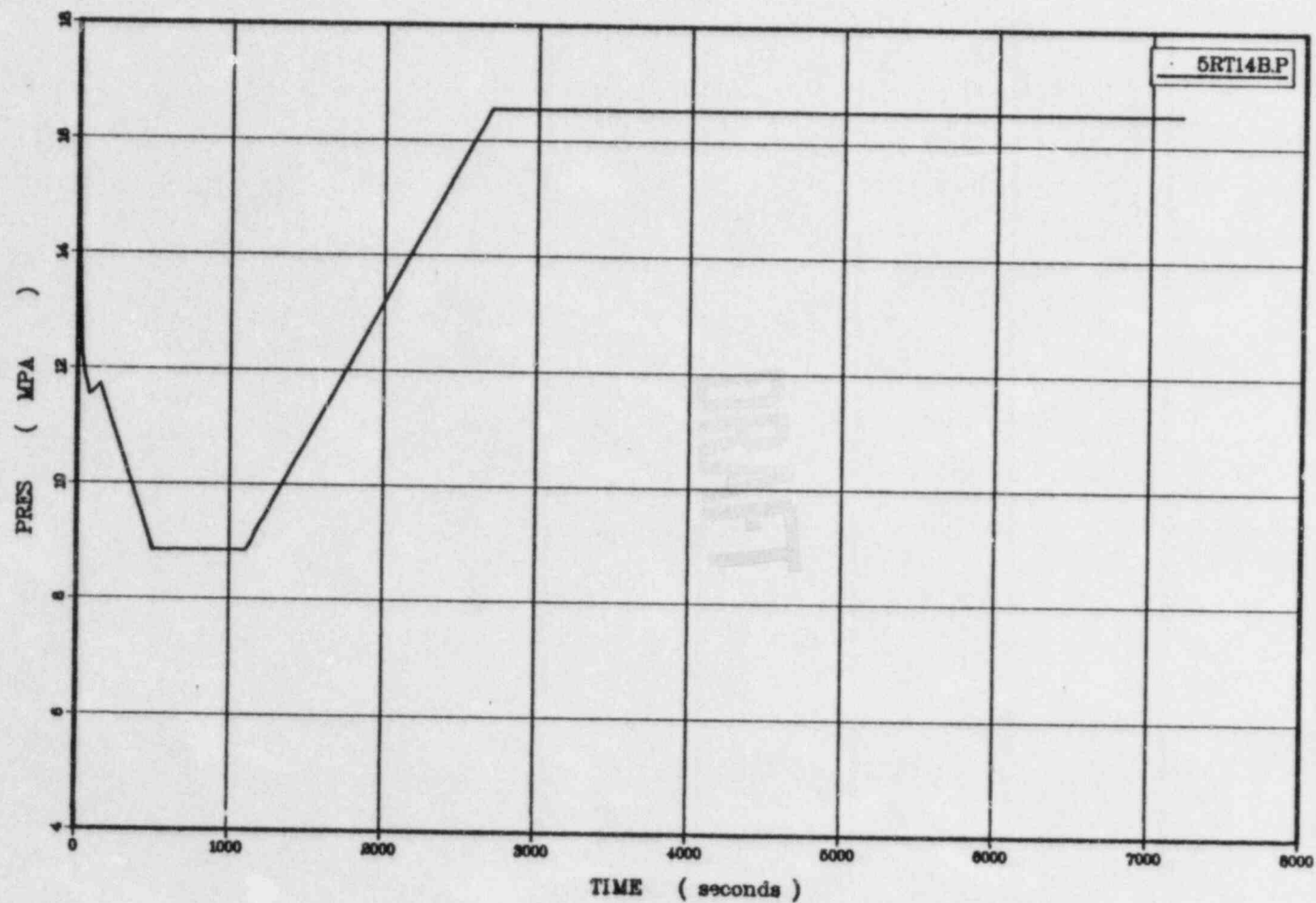
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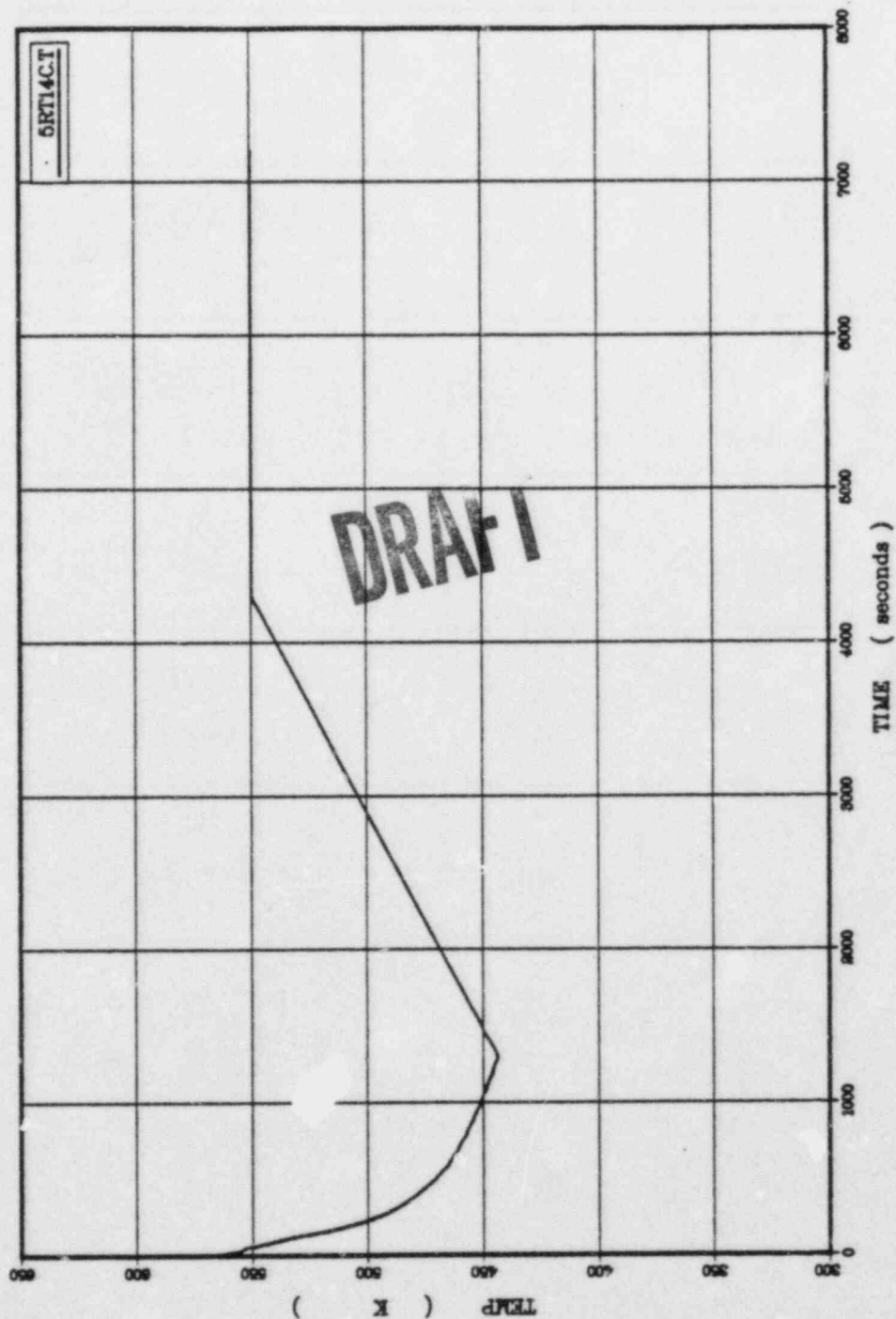


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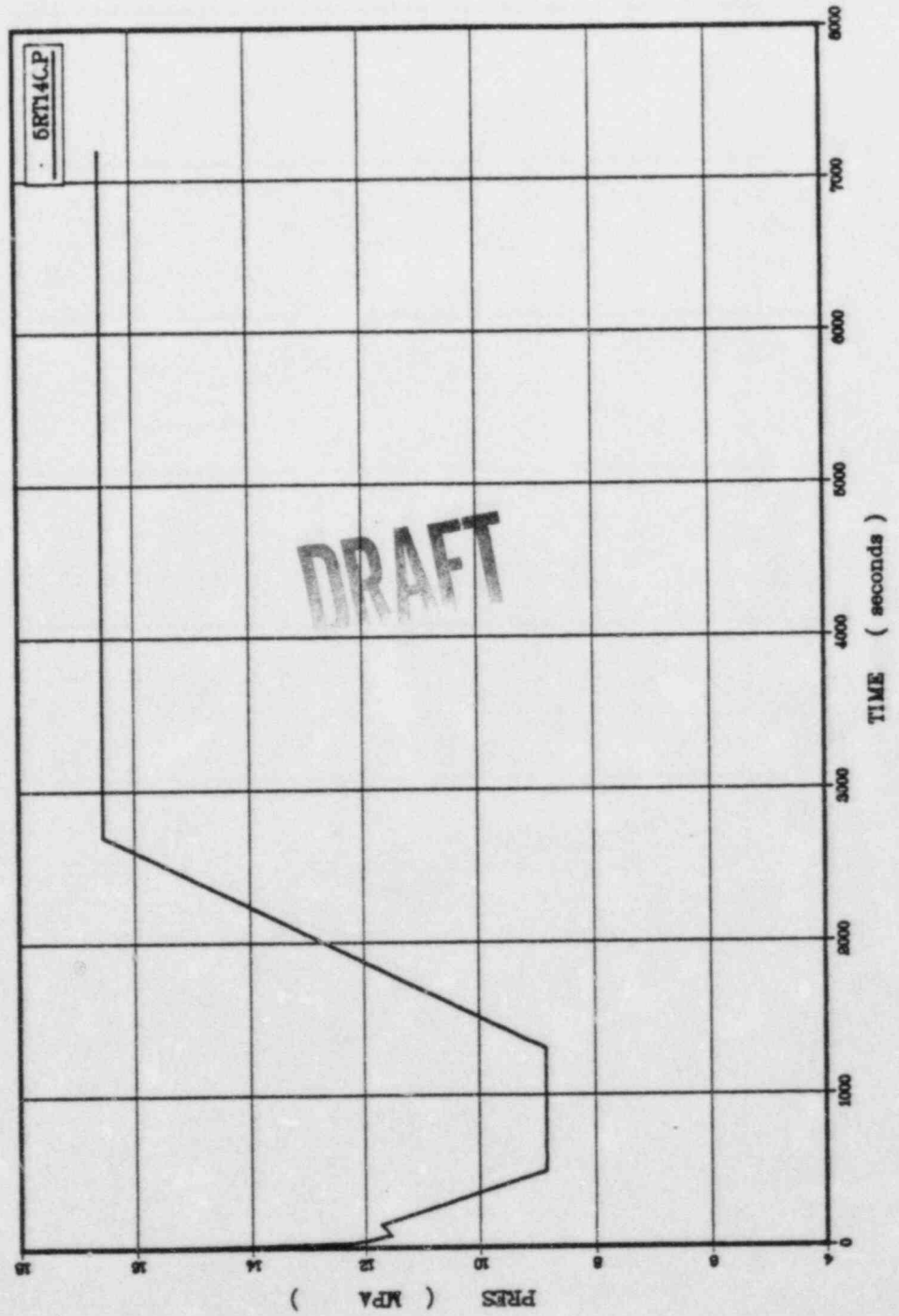
DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 5.14B



DC TEMP FOR REACTOR TRIP FROM FULL POWER CASE 514C

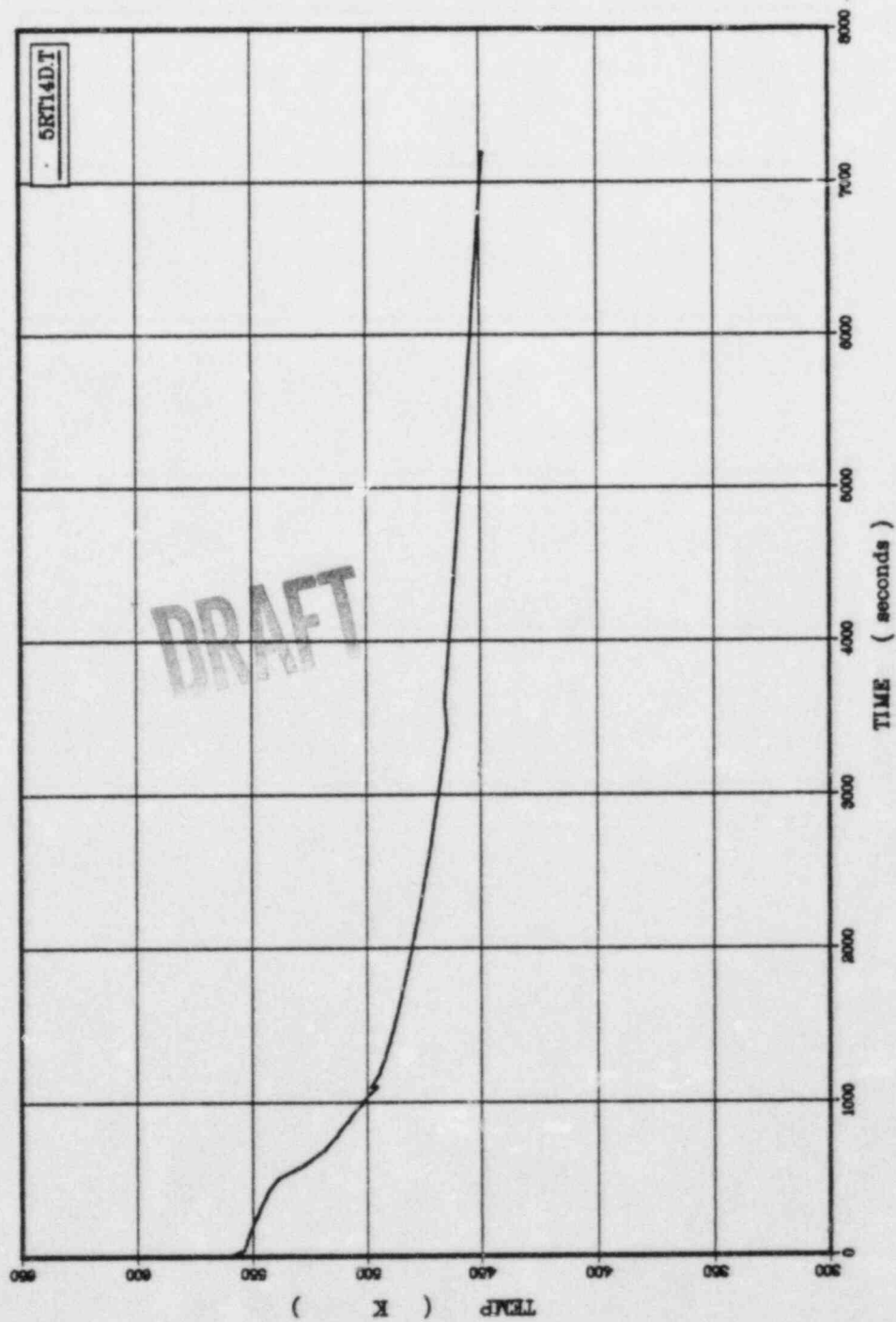


DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 514C

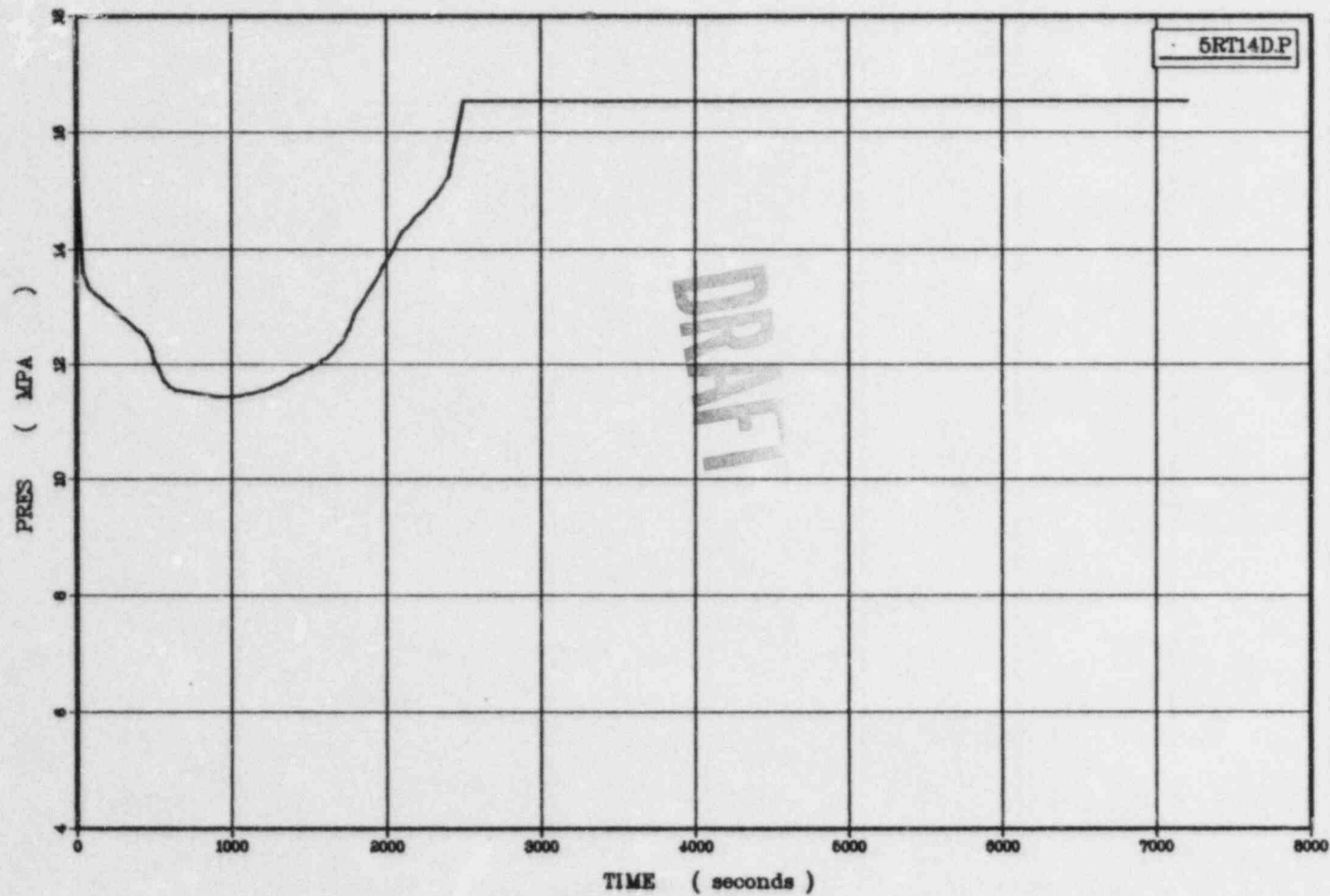


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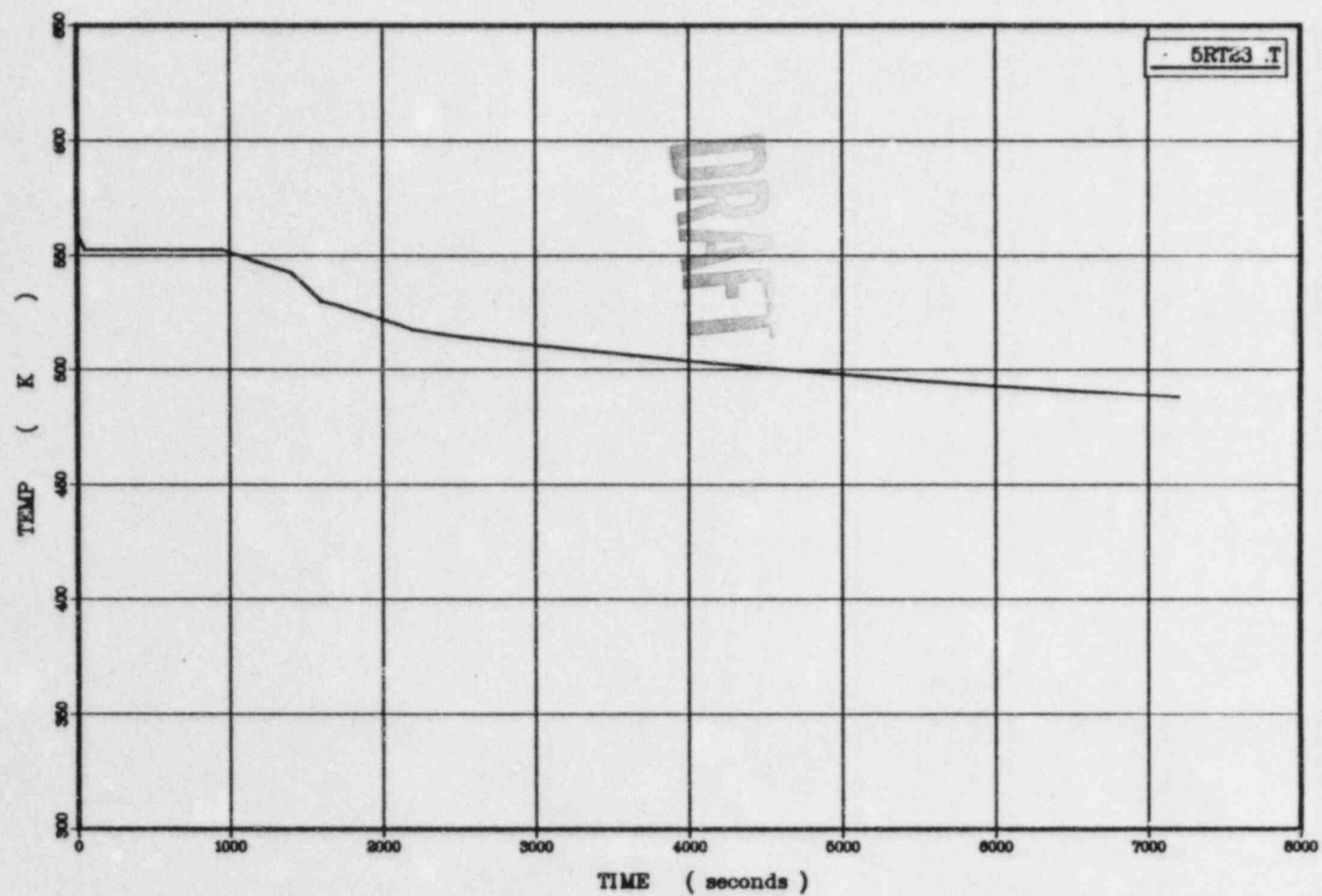
DC TEMP FOR REACTOR TRIP FROM FULL POWER CASE 5.14D



DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 5.14D

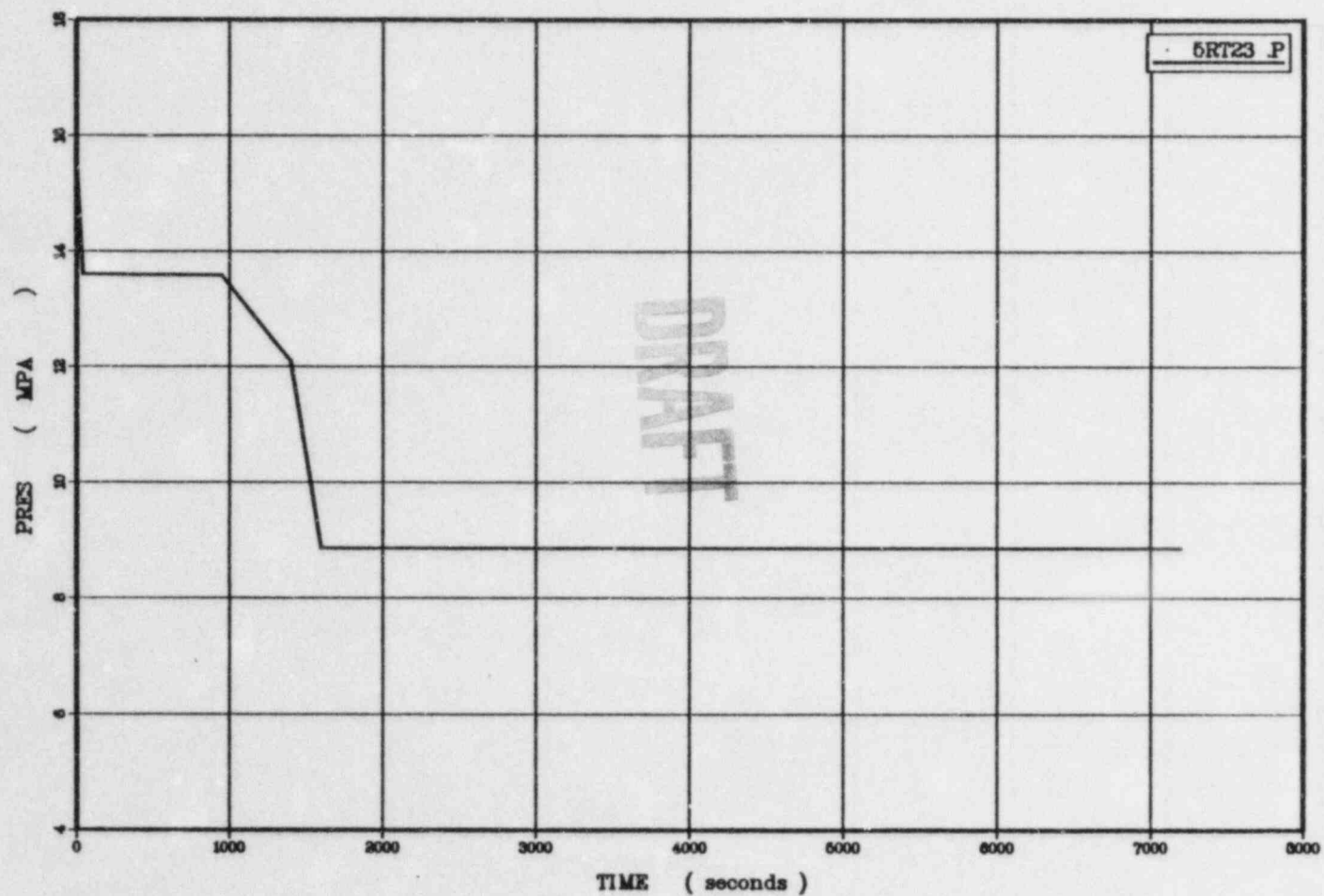


DC TEMP FOR REACTOR TRIP FROM FULL POWER CASE 5.23

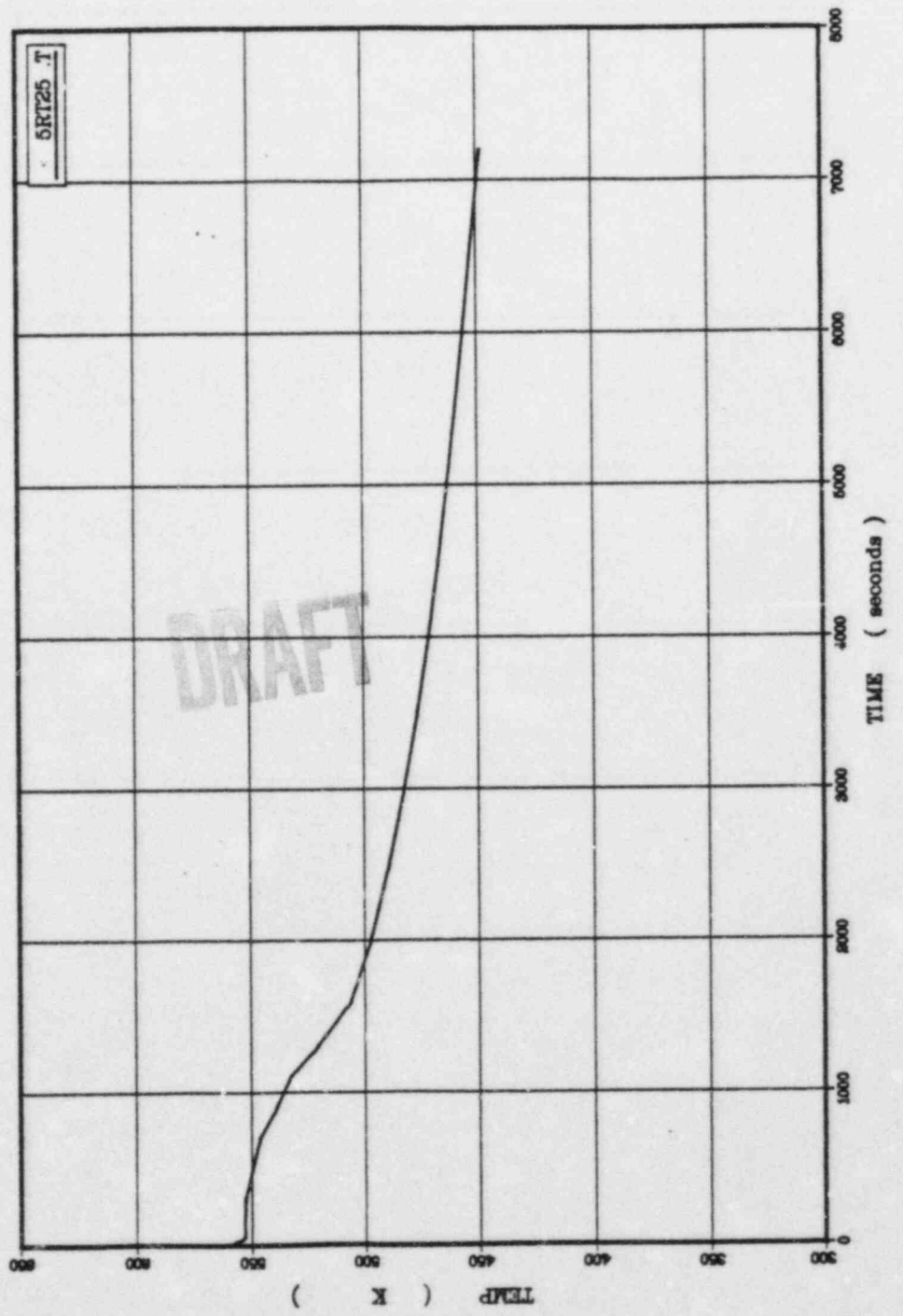


T 1 23.27.05 TUES 14 FEB, 1984 JOB-KTHS23P, 19300 DISPLA VER 6.2

DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 5.23



DC TEMP FOR REACTOR TRIP FROM FULL POWER CASE 5.25



PLOT 1 22.51.17 THUR 9 FEB, 1984 JOB-KTNS2SP, 13500 D135PLA VER 8.2

DC PRES FOR REACTOR TRIP FROM FULL POWER CASE 5.25

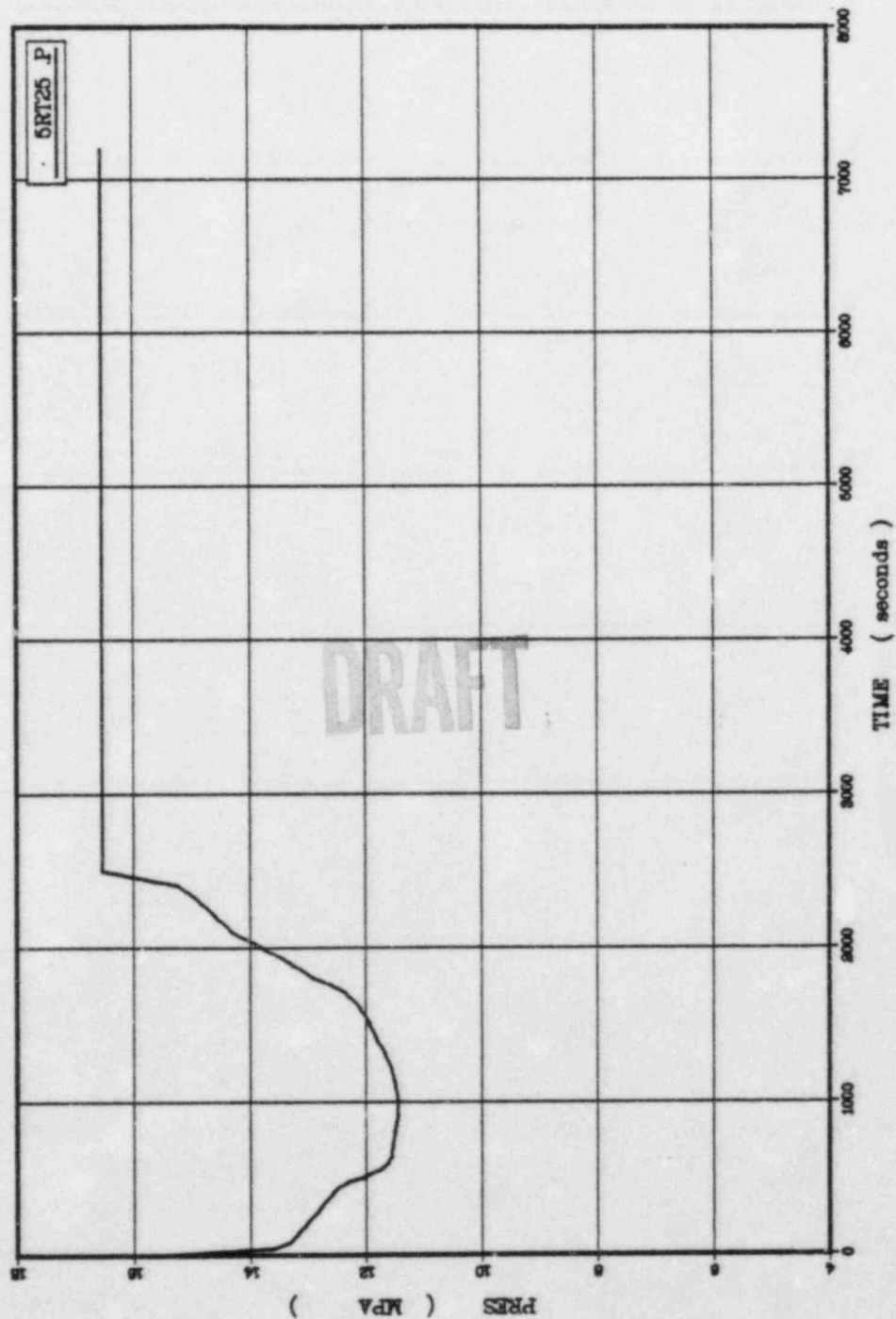


TABLE 6
SMALL BREAK LOCA

Initiator: Unspecified

Sequence no.	Reactor condition	Turbine condition	ADVs condition	TBVs condition	Mainfeed runback	MSIVs condition	MFIVs condition	AFW condition
1.	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	all close on demand	runback occurs	NA	NA	actuates on demand
2.	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	all close on demand	runback occurs	NA	NA	actuates on demand
③	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	all close on demand	runback occurs	NA	NA	actuates on demand
4.	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	all close on demand	runback occurs	NA	NA	actuates on demand
5.	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	one valve fails to close	runback occurs	all close on demand	all close on demand	actuates on demand
6.	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	one valve fails to close	runback occurs	all close on demand	all close on demand	actuates on demand
7.	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	two valves fail to close	runback occurs	all close on demand	all close on demand	actuates on demand
8.	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	two valves fail to close	runback occurs	all close on demand	all close on demand	actuates on demand
9.	trips at 14.6(s)	trips at 14.6(s)	one fails to close ~227(s)	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand
10.	trips at 14.6(s)	trips at 14.6(s)	one fails to close ~227(s)	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand
11.	trips at 14.6(s)	trips at 14.6(s)	all close on demand ~227(s)	all close on demand	runback occurs	NA	NA	actuates on demand

= LANL T4

= LANL T4

= LANL T5

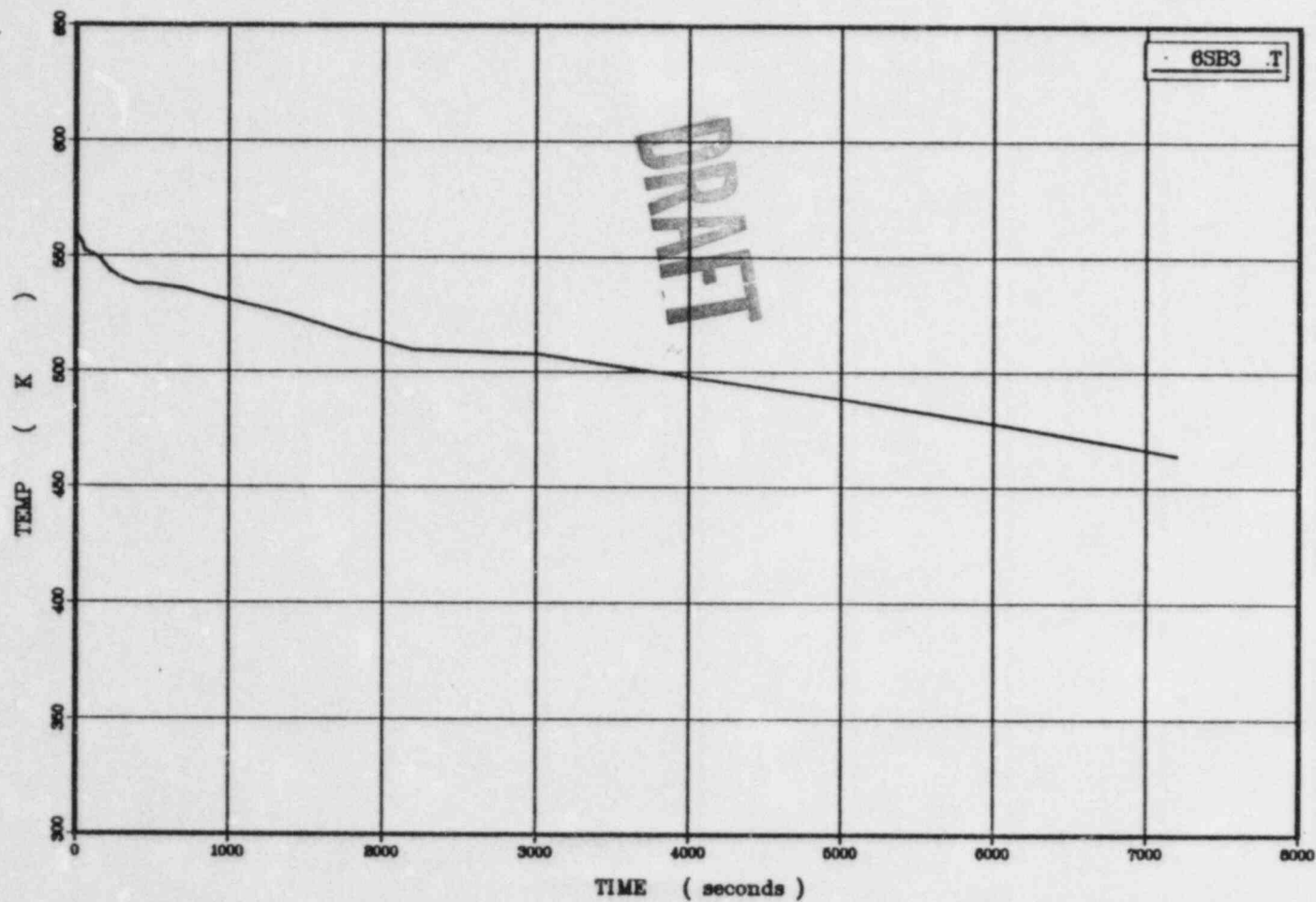
TABLE 6
(CONTINUED)

HPI condition	APW isolation to low pressure S/G	Operator isolates break	APW flow condition	Operator action: turn off charging pumps	Operator action: throttle AFW	Early estimated frequency probability per year	Sequence no.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	1.0×10^{-2}	1.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	failure	throttles AFW at +22" in S/G	2.7×10^{-4}	2.
actuates on demand	actuates on demand	break is not isolatable	auto flow controlled	NA	throttles AFW at +22" in S/G	1.0×10^{-3}	3.
fails to occur	actuates on demand	break is not isolatable	auto flow controlled	NA	throttles AFW at +22" in S/G	1.1×10^{-5}	4.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	2.0×10^{-5}	5.
actuates on demand	actuates on demand	break is not isolatable	auto flow controlled	NA	throttles AFW at +22" in S/G	1.4×10^{-5}	6.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	1.5×10^{-6}	7.
actuates on demand	actuates on demand	break is not isolatable	auto flow controlled	NA	throttles AFW at +22" in S/G	1.1×10^{-6}	8.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	3.0×10^{-5}	9.
actuates on demand	actuates on demand	break is not isolatable	auto flow controlled	NA	throttles AFW at +22" in S/G	2.3×10^{-5}	10.
actuates on demand	actuates on demand	isolates at 1.5 hours	auto flow controlled	throttles at ~300 s after break is isolated	throttles AFW at +22" in S/G	6.0×10^{-5}	11.

PLOT 1 23.27.25 TUE 14 FEB, 1984 JOB-KTN63T, 19960 DISPLA VER 8.2

DC TEMP FOR SMALL BREAK LOCA

CASE 6.3



PLOT 1 23/27-42 TUES 14 FEB, 1984 JOB-KTN63P , 13500 DISPLA VER 8.2

DC PRES FOR SMALL BREAK LOCA

CASE 6.3

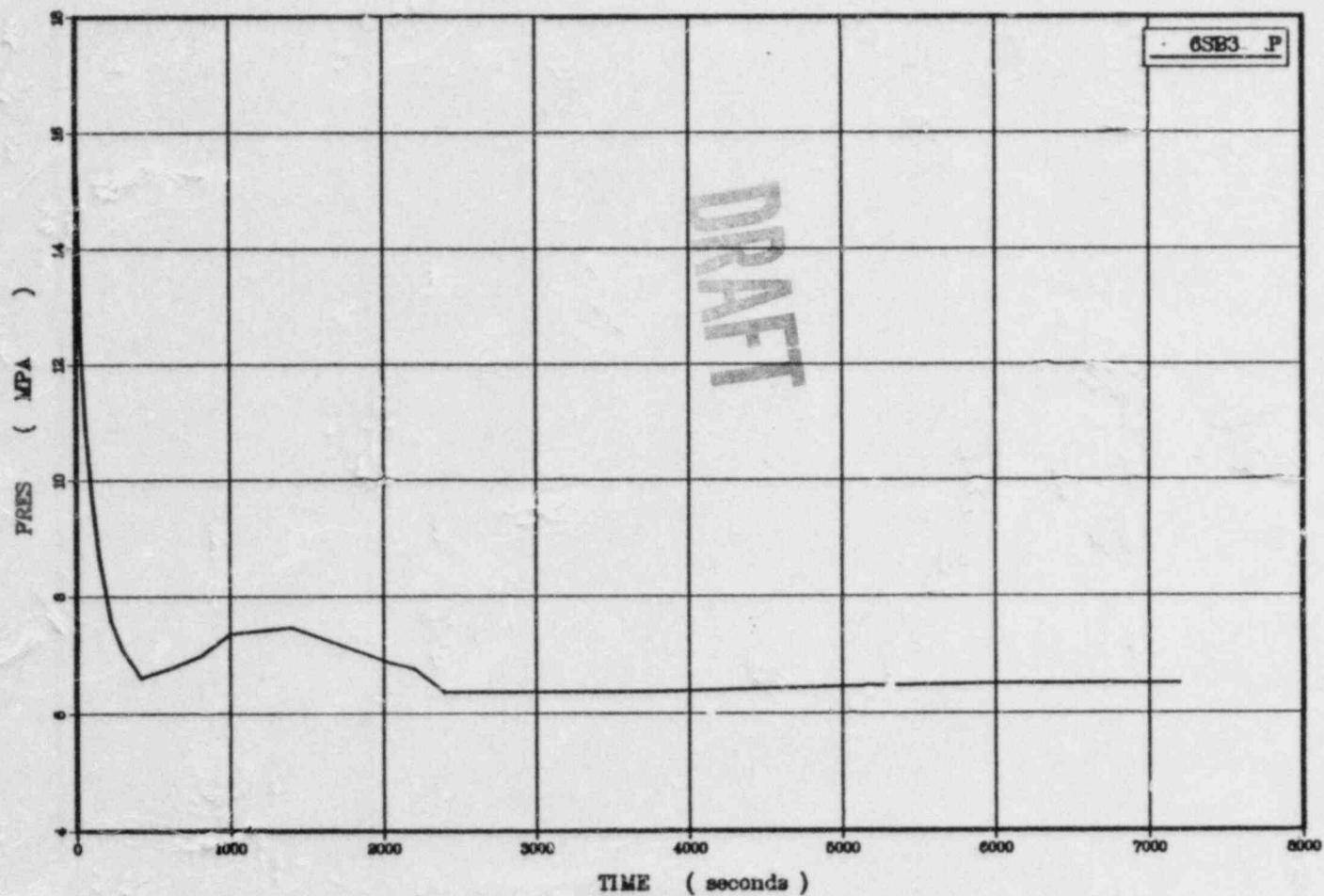


Table 2. Main Steamline Break at Hot 0% Power
Initiator: Small Break Upstream of MSIV

Sequence number	MSIVs condition	MFIVs condition	AFW condition	AFW isolation to low press. S/G	AFW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttles AFW	Early est. frequency probability/yr
1.	all close on demand (time?)	all close on demand start closing (time?)	actuates on demand (time?)	actuates on demand (time?)	auto controlled	occurs on demand (time?)	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	4.9×10^{-3}
2.	all close on demand	all close on demand	actuates on demand	actuates on demand	auto controlled	occurs on demand	failure	throttles AFW at + 22" in S/G	1.0×10^{-4}
3.	all close on demand	all close on demand	actuates on demand	actuates on demand	auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	1.0×10^{-3}
4.	all close on demand	all close on demand	actuates on demand	actuates on demand	auto controlled	occurs on demand	failure	failure	2.0×10^{-5}
5.	all close on demand	all close on demand	actuates on demand	actuates on demand	auto controlled	fails to occur	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	6.0×10^{-6}
6.	all close on demand	all close on demand	actuates on demand	actuates on demand	actuates on demand	fails to occur	failure	throttles AFW at + 22" in S/G	2.0×10^{-7}
7.	all close on demand	all close on demand	actuates on demand	actuates on demand	auto controlled	fails to occur	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	2.0×10^{-7}
8.	all close on demand	all close on demand	actuates on demand	fails to occur	auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at + 22" in S/G	1.0×10^{-6}

Table 2. Continued

Sequence number	MSIVs condition	MFIVs condition	AFW condition	AFW isolation to low press. S/G	AFW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttles AFW	Early est. frequency probability/yr
<u>9.A</u>	both fail to close	all close on demand	actuates on demand	does not occur	auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gals/min on any line	total of 9.A and 9.B is 3.5×10^{-6}
<u>9.B</u>	both fail to close	all close on demand	actuates on demand	does not occur	initially auto cont. At 300 s operator kills AFW to both S/Gs	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	AFW system not on	see 9.A
<u>10.</u>	both fail to close	all close on demand	actuates on demand	does not occur	auto controlled	occurs on demand	failure	flow does not exceed 160 gals/min on any line	1.0×10^{-7}
<u>11.</u>	both fail to close operator closes MFIVs at 300 s	both fail to close operator closes MFIVs at 300 s	on demand	on demand	controlled	on demand	recovery phase when pressure rises to shutoff head of HPI system	AFW \approx 22" in S/G	1.2×10^{-7}

TABLE 4
MAIN STREAMLINE BREAK AT FULL POWER
Initiator: Small Break Upstream of MSIV

Sequence no.	Turbine condition	ADV condition	TBV condition	Mainfeed runback	MSIV condition	MFIV condition	AFW condition	AFW isolation to low pressure S/G
1.	trips on demand	all close on demand	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
2.	trips on demand	all close on demand	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
3.	trips on demand	all close on demand	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
4.	trips on demand	all close on demand	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
5.	trips on demand	all close on demand	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
6.	trips on demand	all close on demand	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	fails to occur
7.	trips on demand	all close on demand	all close on demand	runback occurs	both fail to close	all close on demand	actuates on demand	fails to actuate since no AP signal generated
8.	trips on demand	all close on demand	all close on demand	fails to occur on line with steam break	all close on demand	all close on demand	actuates on demand	actuates on demand
9.	trips on demand	all close on demand	all close on demand	fails to occur on line with steam break	all close on demand	all close on demand	actuates on demand	actuates on demand
10.	trips on demand	all close on demand	all close on demand	fails to occur on line with steam break	all close on demand	all close on demand	actuates on demand	actuates on demand
11.	trips on demand	all close on demand	all close on demand	fails to occur on both steam lines	all close on demand	all close on demand	actuates on demand	actuates on demand
12A.	trips on demand	ADV on line opposite broken line initially fails to close but is isolated at 30 mins	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
12B.	trips on demand	ADV on line opposite broken line initially fails to close but is isolated at 15 mins	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
12C.	trips on demand	ADV on line opposite broken line fails to close	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuates on demand
13A.	trips on demand	ADV on line opposite broken line initially fails to close but is isolated at 30 mins	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuate on demand
13B.	trips on demand	ADV on line opposite broken line initially fails to close but is isolated at 15 mins	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuate on demand
13C.	trips on demand	ADV on line opposite broken line fails to close	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand	actuate on demand

TABLE 4
(CONTINUED)

APW flow condition	HPI condition	Operator action: turn off charging pumps	Operator action: throttle APW	Early estimated frequency probability per year	Sequence no.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles APW at +22" in S/G	1.2×10^{-2}	1.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	3.0×10^{-4}	2.
auto controlled	occurs on demand	failure	throttles APW at +22" in S/G	3.0×10^{-4}	3.
auto controlled	occurs on demand	failure	failure	6.0×10^{-5}	4.
auto controlled	fails to occur	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles APW at +22" in S/G	2.0×10^{-5}	5.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles APW at +22" in S/G	2.5×10^{-6}	6.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gals/min on any line	1.0×10^{-3}	7.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles APW at +22" in S/G	5.0×10^{-5}	8.
auto controlled	occurs on demand	failure	throttles APW at +22" in S/G	1.4×10^{-6}	9.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	failure	1.4×10^{-6}	10.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles APW at +22" in S/G	5.0×10^{-6}	11.
auto controlled	occurs on demand	performed during recovery phase when pressure rises to shutoff head of HPI system	insures that flow does not exceed 160 gals/min on any line	total of 12A, 12B, and 12C is 2.0×10^{-3}	12A. 12B. 12C.
auto controlled	occurs on demand	failure	insures that flow does not exceed 160 gals/min on any line	total of 13A, 13B, and 13C is 5.0×10^{-4}	13A. 13B. 13C.

TABLE 7
MEDIUM BREAK LOCA
Initiator: Unspecified

Sequence no.	Reactor condition	Turbine condition	ADV's condition	TBV's condition	Mainfeed runback	MSIV's condition	MFIV's condition	AFW
1.	trips on demand	trips on demand	all close on demand	all close on demand	runback occurs	NA	NA	actuates on demand
2.	trips on demand	trips on demand	all close on demand	all close on demand	runback occurs	NA	NA	actuates on demand
3.	trips on demand	trips on demand	all close on demand	all close on demand	runback occurs	NA	NA	actuates on demand
4.	trips on demand	trips on demand	all close on demand	all close on demand	runback occurs	NA	NA	actuates on demand
5.	trips on demand	trips on demand	all close on demand	one fails to close	runback occurs	all close on demand	all close on demand	actuates on demand
6.	trips on demand	trips on demand	all close on demand	one fails to close	runback occurs	all close on demand	all close on demand	actuates on demand
7.	trips on demand	trips on demand	one fails to close	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand
8.	trips on demand	trips on demand	one fails to close	all close on demand	runback occurs	all close on demand	all close on demand	actuates on demand

TABLE 7
(CONTINUED)

HPI condition	AFW isolation to low pressure S/G	Operator isolates break	AFW flow condition	Operator action: turn off charging pumps	Operator action: throttle AFW	Early estimated frequency probability per year	Sequence no.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	6.0×10^{-4}	1.
actuates on demand	actuates on demand	isolates at 1.5 hours	auto flow controlled	turns off at ~300 s after break is isolated	throttles AFW at +22" in S/G	1.0×10^{-6}	2.
actuates on demand	actuates on demand	break is not isolatable	auto flow controlled	NA	throttles AFW at +22" in S/G	2.0×10^{-3}	3.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	failure	throttles AFW at +22" in S/G	1.0×10^{-5}	4.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	1.0×10^{-6}	5.
actuates on demand	actuates on demand	break is not isolatable	auto flow controlled	NA	throttles AFW at +22" in S/G	3.0×10^{-6}	6.
actuates on demand	actuates on demand	isolates at 300 s	auto flow controlled	performed during recovery phase when pressure rises to shutoff head of HPI system	throttles AFW at +22" in S/G	2.0×10^{-6}	7.
actuates on demand	actuates on demand	break is not isolatable	auto flow controlled	NA	throttles AFW at +22" in S/G	3.0×10^{-6}	8.