Attachment 4
Turbine Driven Auxiliary Feedwater Pump Area Heatup Calculation

QA LIFETIME

900606-011

Devonrue Calculation Cover Sheet

Project No. 8-9025.00

Subject Ginna TDAFW Pump Area Ambient Temp. Rise

Description This calculation evaluates the ambient temperature rise in the area of the TDAFW pump during a 4 hour SBO-induced loss of ventilation.

Prepared by DL Borska Date 5/28/90

Reviewed by Date 6/4/90

Approved by Date 6/5/90

Number of pages 12 plus 5 pages of attachments

Appendices

Attachments I through III, total 5 pages

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Identification of Computer Calculations

No computer calculations have been utilized in this analysis.

Identification of Assumptions

1. The perimeter of the Intermediate Building is assumed to be as shown on Ginna Station Drawing 33013-2113, Rev. 0
2. The normal maximum ambient temperature in the Intermediate Building is assumed to be 104°F
3. The normal maximum ambient temperature of the Containment Structure just adjacent to the south wall of the Intermediate Building is assumed to be 120°F as stated in Ginna FSAR Table 3.11-1.
4. The south wall of the TDAFW pump Area is assumed to be poured concrete as shown on Ginna Station Drawing 33013-2113, Rev.0. The North, East, and West walls of the TDAFW pump area (the north portion of the Intermediate Building, el. 253) are solid concrete block as shown on Ginna Station Drawing 33013-2113, Rev.0. These walls are assumed to behave in a similar manner to poured concrete walls and will be treated similarly in this calculation.
5. The initial wall temperatures are assumed to be in equilibrium with the initial air temperature.
6. Thermal insulation on piping and equipment is assumed to be of the type and thickness defined in RG&E Technical Specification ME-269, Revision 0.
7. Heating Steam piping and equipment is conservatively assumed to have a normal operating temperature of 220°F.

Additional assumptions are stated throughout the body of this calculation.

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Identification of Design Inputs and Verified Sources

1. NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," including Appendix E, Appendix F, and the Appendix F Topical Report, November 1987.

2. RG&E Technical Specification, ME-269, "Pipe, Duct and Equipment Insulation, Ginna Station," draft issue Revision 0, dated January 30, 1989.

3. Ginna Station Plant Arrangement Drawing No. 33013-2113, Rev. 0, Cont. Struct. & Intermediate Bldg. Plan - Oper. Flr. El.253'-3".

5. Ginna Station P&ID Drawing No. 33013-1231, Rev. 13, Main Steam.

6. Ginna Station P&ID Drawing No. 33013-1915, Rev. 4, Heating Steam.

7. Marks Standard Handbook for Mechanical Engineers, Ninth Edition, 1987.

8. Ginna/UFSAR Table 3.11-1, "Environmental Service Conditions for Equipment Designed to Mitigate Design-Basis Events."

9. Vendor Drawing, LD-111347, Worthington, Corp., Outline drawing of Auxiliary Feedwater Pump Turbine

10. Gilbert Associates, Bill of Materials, for Steam Driven Auxiliary Feedwater pump and Steam Turbine Drive.

Methodology

The objective of this calculation is to determine the ambient temperature rise in the TDAFW pump area of the Intermediate Building during a 4 hour SBO-induced loss of ventilation. Because the Ginna Station Blackout coping duration is 4 hours, the simplified methodology provided in NUMARC 87-00, Section 7 will be applied. The Section 7 methodology is based on the fact poured concrete walls act as heat sinks and that their surface temperatures will remain essentially constant over the course of the 4 hour loss of ventilation. As stated in the previous section, the surface temperature of the solid concrete block walls will also be assumed to remain constant.

Section 7 of NUMARC 87-00 presents the following simplified equation for use in evaluating a four hour loss of ventilation:

$$T_{air} = T_w + [Q/A]^{3/4}$$

where:

Tair is the resultant ambient air temperature in the TDAFW pump area(the north portion of el. 253'-3" of the Intermediate Building) after 4 hours;

Tw is the wall temperature;

Q is the heat generation rate from hot piping, equipment, and electrical devices; and

A is the surface area of the walls and ceiling acting as heat sinks.

The effects of opening doors to allow removal of heat through natural circulation are evaluated as defined in Section 7, p. 7-15, of NUMARC 87-00:

$$T_{air} = T_w + \{Q^{3/4}/[A^{3/4} + 16.18\ F^{\ 0.8653}]\} \text{ where;}$$

F is the "door factor" and is equal to $H^{3/2}W$; where H and W are the height and width of the door, respectively.

The following steps shall be performed to accomplish the described method for determining the TDAFW pump area ambient temperature:

1. Sum the wall surface areas to obtain A in square meters. For conservatism, the surface area of the ceiling will be neglected as it is constructed of corrugated metal attached to the poured concrete floor slab of the elevation above.

2. Determine the initial wall temperature. The effects of the higher temperature of the south wall which is exposed on its outer surface to the Containment Structure ambient temperature will be considered.

3. Conservatively estimate the heat generation rate, Q, in the TDAFW pump area. This will be done by considering heat rejected by hot piping and equipment using the equations given on p. 7-19 of NUMARC 87-00. Heat rejected by operating electrical equipment will also be considered.

4. Apply the results of the above and calculate the resultant ambient temperature.

5. Evaluate the effects of opening doors.

Step 1: Sum wall surface areas to obtain A, in sq. meters

This step is accomplished using the referenced drawing, 33013-2113. As previously identified in the Assumptions Section, the solid concrete block walls bordering the North, East, and West sides of the Intermediate building will be considered in this evaluation. The South wall borders the Containment Structure and is constructed from poured concrete. The ceiling surface area has been neglected as a heat sink since it consists of corrugated metal.

The straight walls are simply scaled directly from the reference drawing (see Figure 2) while the curved wall length is determined using analytic geometry. Using Figure 1,

$$(\phi 1 + \phi 2)/360 * (\pi D) = \text{length of curved wall}$$

$$\phi 1 = \tan^{-1}(4\ 7/8\ /4) = 50.63°$$

$$\phi 2 = \tan^{-1}(5\ 13/16/3) = 62.70°$$

$$\phi 1 + \phi 2 = 113.33°$$

$$\text{therefore, length} = (113.33/360)\ \pi\ (33.68) = 33.33\ \text{m};$$

where 33.68 is the measured diameter of the containment from the referenced drawing

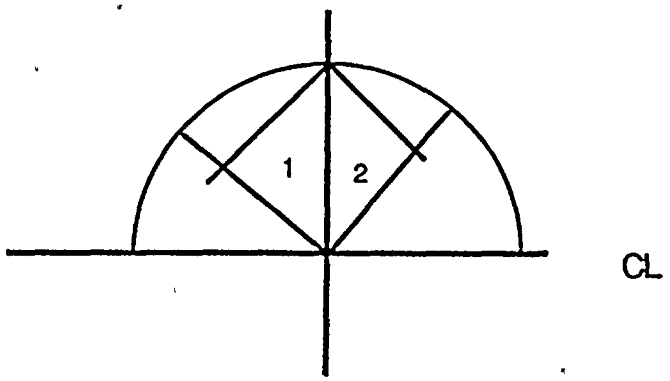

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Figure 1
Calculation of curved wall length

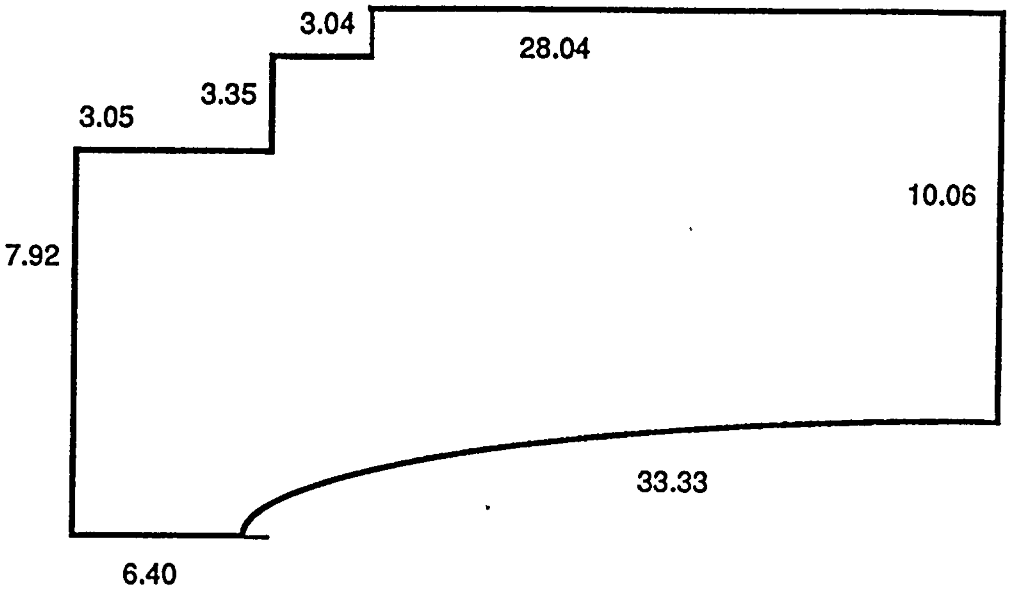

Figure 2
North Portion of Intermediate Building, El 278'-4"
(note: all dimensions are in meters)

Using the dimensions in Figure 2, the perimeter of the room is calculated by summing these lengths.

$$\Sigma L = 97.93 \text{ meters} = \text{Perimeter}$$

The Surface Area, A, is computed by multiplying the perimeter by the height of the walls. Review of the referenced drawing and the drawing for the elevation above (33013-2129), show that the height, h, is:

$$h = \text{el } 278'\text{-}4'' - 253'\text{-}6'' = 24'\text{-}10'' = 7.57 \text{ meters}$$

$$\text{therefore, } A = 97.93 * 7.57 = 741.33 \text{ sq. meters}$$

Step 2: Determine the initial wall temperature, T_i in °C

The initial wall temperature will be calculated by means of a weighted average of Surface area between the South wall, adjacent to the Containment Structure and all other walls. The initial temperature of all other walls is assumed to be **104°F**, which is the stated FSAR value for the normal maximum ambient temperature in the Intermediate Building. The South wall surface temperature is calculated as an average between the Containment maximum normal ambient of 120°F and the 104°F Intermediate Building ambient temperature. Therefore,

$$T\ (\text{South wall}) = (120°F + 104°F)/2 = 112°F$$

the initial temperature computed by weighted average on the basis of area is:

$$Ti = (33.33/97.93)*112 + (64.6/97.93) * 104 = 107°F = 41.7°C$$

Step 3: Estimate heat generation rate, Q, in watts

The major source of heat in the TDAFW pump area is hot piping and equipment. A physical inspection of the area revealed the following sources:

(1) 1/2" diam. Tb. Steam supply line (insulated), 15 ft. long
(1) 6" diam. Tb. Steam supply line (insulated) 110 ft. long
(1) 1/2" diam. Tb. exhaust line (uninsulated), 100 ft. long
(1) 3/4" Tb. exhaust line(uninsulated), 20 ft. long
(1) 4" diam. Tb. Exhaust line (insulated), 14 ft. long
(1) 4" diam. Tb. Exhaust line (uninsulated), 60 ft. long
(1) 8" diam Tb. exhaust line (insulated), 7 ft. long
(1) 8" diam. Tb Exhaust line (uninsulated), 20 ft. long
(1) 1-1/2 " diam. Heating Steam line (insulated), 89 ft. long
(1) 8" diam. Heating Steam line (insulated), 52.4 ft. long
(1) 2-1/2" diam. Heating Steam line (insulated), 69.4 ft. long
(1) 28" Diam. Stm. Turbine (insulated)

(1) 2" diam. T+T valve (uninsulated), 1.25 ft. long
(1) 12" diam Governor valve (uninsulated), 1.7 ft. long

In order to calculate the heat generated from the above listed sources, the surface temperature of insulated components must be determined. As stated in the Assumptions section, insulation type and thickness is assumed to be as specified in RG&E Thermal Insulation Spec ME-269, Table I, except in the case of AFW Turbine where the insulation thickness was scaled from the outline drawing. In accordance with paragraph 2.01 of ME-269, all insulation is assumed to be calcium silicate.

The surface temperature is calculated by considering the convective heat transfer between the insulated surface and the air;

$$q = h\ A\ dT = h\ (T_s - T_\infty)\ 2\pi\ r_s\ l$$

where h is the unit thermal surface conductance in Btu/hr. sq ft °F, r_s is the radius of the insulated surface in ft., l is the unit length , T_s is the insulated surface temperature, and T_∞ is the ambient air temperature

and

the conductive heat transfer from the pipe surface through the insulation;

$$q = (T_i - T_\infty) * 1/\{[\ln (r_s/r_i)/2\pi kl] + 1/\ 2\pi r_s\ l\ h\};$$

where T_i is the pipe surface temperature and r_i is the pipe radius

Combining the two equations yields;

$$Ts = \{1/hr_s *(T_i - T_\infty)\}/\{[\ln(r_s/r_i)/k\ ]+\ 1/r_s\ h\ \} + T_\infty$$

A similar development is applied to the AFW Turbine which is basically treated as an insulated sphere. The final equation is:

$$T_s = T_\infty + [(T_i - T_\infty)*(1/h\ r_s^2)]/\ \{[(r_s - r_i)/(k r_s r_i)] + (1/h * r_s^2)\}$$

In this evaluation, the following constant values are applied:

$T_\infty = 107$°F (see p. 7 of this calc.)
$h = 1.6$ Btu/hr sq ft °F (Table 4.4.11 of Marks Handbook)
$k = 0.045$ Btu/hr ft °F (Table 4.4.6 of Marks Handbook)

Note that the Tb. exhaust lines were considered to have a surface temperature of 240°F. This value is based upon the information in the AFW Steam Turbine Bill of Materials, previously referenced, which gives exit steam conditions.

The results obtained when applying the above equation are summarized in Table 1.

TABLE 1
CALCULATION OF INSULATED SURFACE TEMPERATURE (Ts)

Description	Ti (°F)	ri (ft)	Ins. thk. (ft)	rs (ft)	ln(rs/ri)	Ts(°F)
1/2" Tb. Stm sup.	550	0.02	0.125	0.145	1.981001	146.51
6"Tb. Stm sup.	550	0.276	0.2083	0.484	0.562304	148.47
4" Tb. Exh.	240	0.188	0.125	0.313	0.509761	126.93
8" Tb. Exh.	240	0.36	0.125	0.485	0.298045	128.66
1-1/2" Htg. Stm.	220	0.08	0.083	0.163	0.711724	129.05
8" Htg. Stm.	220	0.36	0.125	0.485	0.298045	125.41
2-1/2" Htg. stm.	220	0.12	0.083	0.203	0.525714	130.57
Stm Turbine	550	1.17	0.292	1.462	N/A	139

Using the results of Table 1, the heat generation, Q, can be calculated from the following equation found in Section 7 of NUMARC 87-00:

$$Q = \{0.1[0.4 + 15.7(T_S - T_a)^{1/6} D^{1/2} + 170.3(Ts - Ta)1/3D](Ts - Ta) + 1.4E\text{-}7D(T^4 s - T^4 w)\}L$$

and in the case of the spherical Turbine,

$$Q = \{0.1[2 + 37.0(T_S - T_a)^{1/4} D^{3/4}] * D(Ts - Ta) + 1.4E\text{-}7D^2(T^4 s - T^4 a)\}$$

Table 2 summarizes the inputs and results based on the above equations.

TABLE 2
CALCULATION OF HEAT GENERATED
by HOT PIPING & EQUIPMENT

Description	Ts(°F)	Ts(°K)	L(ft)	L(m)	Do(ft)	Do(m)	Ts-Ta	Ts4-Tw4	Q (watts)
1/2" Stm sup.	146.5	336.767	15	4.57	0.29	0.09	21.95	3.042E+09	677.39
6" Stm. sup.	148.5	337.856	110	33.5	0.968	0.3	23.04	3.209E+09	16629
1/2" Tb. exh	240	388.706	100	30.5	0.042	0.01	73.89	1.301E+10	3680.4
3/4" Tb. Exh.	240	388.706	20	6.1	0.063	0.02	73.89	1.301E+10	1042.6
4" Tb. Exh	126.9	325.889	14	4.27	0.626	0.19	11.07	1.459E+09	558.62
4" Tb. Exh.	240	388.706	60	18.3	0.333	0.1	73.89	1.301E+10	14620
8" Tb. Exh	128.7	326.85	7	2.13	0.97	0.3	12.03	1.593E+09	470.98
8" Tb. Exh.	240	388.706	20	6.1	0.667	0.2	73.89	1.301E+10	9471.8
1 1/2" Htg. Stm	129.1	327.067	89	27.1	0.326	0.1	12.25	1.623E+09	2171.2
8" Htg. Stm.	125.4	325.044	52.4	16	0.97	0.3	10.22	1.343E+09	2884.2
2-1/2" Htg Stm	130.6	327.911	69.4	21.2	0.406	0.12	13.09	1.742E+09	2259.6
28" Stm TB.	139	332.594	NA	NA	3.05	0.93	17.77	2.417E+09	400
T+T valve	550	560.928	1.25	0.38	0.167	0.05	246.1	8.918E+10	838.4
Governor Vlv	550	560.928	1.7	0.52	1	0.3	246.1	8.918E+10	6401.8

Total Q(watts)= 62105

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Review of Table 2 shows that the uninsulated Tb. exhaust lines were considered to have a surface temperature of 240°F. This value is based upon the information in the AFW Steam Turbine Bill of Materials, previously referenced, which gives exit steam conditions.

In addition to the 62,105 watts generated by hot piping and equipment, an additional 1,000 watts will be added to account for heat generated by emergency lighting, operating solenoids, etc.

Therefore, the total heat generated in the TDAFW pump area is:

$$Q = 62{,}105 + 1{,}000 = 63{,}105 \text{ watts}$$

Step 4: Calculate the ambient temperature

This step is accomplished by applying the NUMARC 87-00 correlation:

$$T_{air} = T_i + [Q/A]^{3/4}$$

$$T_{air} = 41.7 + [63{,}105/741.33]3/4$$

$$= 41.7 + 28 = 69.7°C = 157.5 °F$$

Step 5: Evaluate the effect of opening doors

This step is performed using the NUMARC 87-00 correlation for considering free convection through vertical openings. Arrangement drawing 33013-2121 shows double doors on the west side of the North wall which open to the Turbine Bldg. The Turbine bldg area adjacent to these doors is assumed to remain at 104°F during the 4 hour blackout duration due to its configuration and the lack of significant heat sources in the area.

The effects of opening doors to allow removal of heat through natural circulation are evaluated as defined in Section 7, p. 7-15, of NUMARC 87-00:

$$T_{air} = T_w + \{Q^{3/4}/[A^{3/4} + 16.18\ F^{\,0.8653}]\} \text{ where;}$$

F is the "door factor" and is equal to $H^{3/2}$ W; where H and W are the height and width of the door, respectively.

As measured from the layout drawing, W is 8 ft. (2.44m) and H is assumed to be 7ft., the standard industrial door height.

Applying these relationships to the double doors yields an F of:

$$F = (2.13)^{3/2} * (2.44) = 7.58$$

therefore, $T_{air} = 4 + 41.7 + \{(63{,}105)3/4 \,/\, [(741.33)3/4 + 16.18 * (7.58).8653]\}$

$$T_{air} = 4 + 41.7 + 16.91 = 62.61°\text{C} = 145°\text{F}$$

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Table 3.11-1

ENVIRONMENTAL SERVICE CONDITIONS FOR EQUIPMENT DESIGNED TO MITIGATE DESIGN-BASIS EVENTS

INSIDE CONTAINMENT

Normal Operation:

Temperature	60°F to 120°F
Pressure	0 psig
Humidity	50% (nominal)
Radiation	Less than 1 rad/hr general. Can be higher or lower near specific components.

Accident Conditions (LOCA):		Steam-Line Break
Temperature	Figure 6.1-2 (286°F maximum)	282°F
Pressure	Figure 6.1-1 (60 psig design)	60 psig
Humidity	100%	
Radiation	Tables 3.11-2 and 3.11-3; 1.43 x 10^7 rads gamma 2.07 x 10^8 rads beta 2	
Chemical spray	Solution of boric acid (2000 to 3000 ppm boron) plus NaOH in water. Solution pH between 8 and 10.	
Flooding	7-ft (approximately) maximum submergence elevation is 242 ft 8 in.	

AUXILIARY BUILDING

Normal Operation: 4

Temperature	50°F to 104°F
Pressure	0 psig
Humidity	60% (nominal)
Radiation	Less than 10 mrad/hr general, with areas near residual heat removal piping less than 100 mrad/hr during shutdown operation.

Accident Conditions (including sump recirculation) (LOCA) (one train of ESF cooling operating): 4

Temperature	50°F to 104°F
Pressure	0 psig
Humidity	60% (nominal)

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appears to be the best available. Zuber also performed an analysis for subcooled liquids and proposed a modification which is also in excellent agreement with experiment:

$$(q/A)_{max} = K_1\rho_v[\lambda + C_{pl}(t_{sat} - t_l)]\left[\frac{\sigma g_L g_c(\rho_l - \rho_v)}{\rho_v^2}\right]^{0.25}\left(\frac{\rho_l}{\rho_l + \rho_v}\right)^{1/2}$$

$$\left\{1 + \frac{5.33(\rho_l C_{pl} k_l)^{1/2}(t_{sat} - t_l)}{\rho_v[\lambda + C_{pl}(t_{sat} - t_l)]}\left[\frac{g_L(\rho_l - \rho_v)\rho_v^2}{\sigma^3 g_c^3}\right]^{1/8}\right\} \quad (4.4.14c)$$

Zuber's hydrodynamic analysis of the Leidenfrost point yields

$$(q/A)_{min} = K_2\lambda\rho_v\left[\frac{\sigma g_L g_c(\rho_l - \rho_v)}{\rho l^2}\right]^{1/4} \qquad 0.144 < K_2 < 0.177 \quad (4.4.14d)$$

Berenson finds better agreement with the data if $K_2 = 0.09$. For very small wires, the heat flux will exceed that predicted by this flat-plate formula. A reliable prediction of the critical temperature is not available.

For nucleate boiling accompanied by forced convection, the heat flux may be approximated by the sum of the heat flux for pool boiling alone and the heat flux for forced convection alone. This procedure will not be satisfactory at high qualities, and no satisfactory correlation exists for the maximum heat flux.

For a given liquid and boiling pressure, the nature of the surface may substantially influence the flux at a given (Δt), Table 4.4.10. These data may be used as rough approximations for a bank of submerged tubes. Film coefficients for scale deposits are given in Table 4.4.8.

For forced-circulation evaporators, vapor binding is also encountered. Thus with liquid benzene entering a 4-pass steam-jacketed pipe at 0.9 fps, up to the point where 60 percent by weight was vaporized, the maximum flux of 60,000 Btu/h/ft² was obtained at an overall temperature difference of 60°F; beyond this point, the coefficient and flux decreased rapidly, approaching the values obtained in superheating vapor, see Eq. (4.4.6).

For comparison, in a natural convection evaporator, a maximum flux of 73,000 Btu/h/ft² was obtained at $(\Delta t)_o$ of 100°F.

Combined Convection and Radiation Coefficients In some cases of heat loss, such as that from bare and insulated pipes, where loss is by convection to the air and radiation to the walls of the enclosing space it is convenient to use a combined convection and radiation coefficient $(h_c + h_r)$. The rate of heat loss thus becomes

$$q = (h_c + h_r)A(\Delta t)_r \quad (4.4.15)$$

where $(\Delta t)_r$ is the temperature difference, deg F, between the surface of the hot body and the walls of the space. In evaluating $(h_c + h_r)$, h_c should be calculated by the appropriate convection formula [see Eqs. (4.4.11c) to (4.4.11g)] and h_r from the equation

$$h_r = 0.00685\epsilon(T_{av}/100)^3$$

Table 4.4.10 Maximum Flux and Corresponding Overall Temperature Difference for Liquids Boiled at 1 atm with a Submerged Horizontal Steam-Heated Tube

Liquid	Aluminum		Copper		Chromium-plated copper		Steel	
	$\frac{q/A}{1000}$	$(\Delta t)_o$	$\frac{q/A}{1000}$	$(\Delta t)_o$	$\frac{q/A}{1000}$	$(\Delta t)_o$	$\frac{q/A}{1000}$	$(\Delta t)_o$
Ethyl acetate	41	70	61	55	77	55		
Benzene	51	80	58	70	73	100	82	100
Ethyl alcohol	55	80	85	65	124	65		
Methyl alcohol	..	..	100	95	110	110	155	110
Distilled water	..	..	230	85	350	75	410	150

Table 4.4.11 Values of $(h_c + h_r)$

For horizontal bare or insulated standard steel pipe of various sizes and for flat plates in a room at 80°F

Nominal pipe diam, in.	$(\Delta t)_r$, temperature difference, deg F, from surface to room														
	50	100	150	200	250	300	400	500	600	700	800	900	1000	1100	1200
½	2.12	2.48	2.76	3.10	3.41	3.75	4.47	5.30	6.21	7.25	8.40	9.73	11.20	12.81	14.65
1	2.03	2.38	2.65	2.98	3.29	3.62	4.33	5.16	6.07	7.11	8.25	9.57	11.04	12.65	14.48
2	1.93	2.27	2.52	2.85	3.14	3.47	4.18	4.99	5.89	6.92	8.07	9.38	10.85	12.46	14.28
4	1.84	2.16	2.41	2.72	3.01	3.33	4.02	4.83	5.72	6.75	7.89	9.21	10.66	12.27	14.09
8	1.76	2.06	2.29	2.60	2.89	3.20	3.88	4.68	5.57	6.60	7.73	9.05	10.50	12.10	13.93
12	1.71	2.01	2.24	2.54	2.82	3.13	3.83	4.61	5.50	6.52	7.65	8.96	10.42	12.03	13.84
24	1.64	1.93	2.15	2.45	2.72	3.03	3.70	4.48	5.37	6.39	7.52	8.83	10.28	11.90	13.70
FLAT PLATES															
Vertical	1.82	2.13	2.40	2.70	2.99	3.30	4.00	4.79	5.70	6.72	7.86	9.18	10.64	12.25	14.06
HFU	2.00	2.35	2.65	2.97	3.26	3.59	4.31	5.12	6.04	7.07	8.21	9.54	11.01	12.63	14.45
HFD	1.58	1.85	2.09	2.36	2.63	2.93	3.61	4.38	5.27	6.27	7.40	8.71	10.16	11.76	13.57

HFU, horizontal, facing upward; HFD, horizontal, facing downward.

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Table 4.4.6 Thermal Conductivities of Insulating Materials for High Temperatures

Material	Bulk density, lb per cu ft	Max temp, deg F	100 F	300 F	500 F	1000 F	1500 F	2000 F
Asbestos paper, laminated	22.	400	0.038	0.042				
Asbestos paper, corrugated	16.	300	0.031	0.042				
Diatomaceous earth, silica, powder	18.7	1500	0.037	0.045	0.053	0.074		
Diatomaceous earth, asbestos and bonding material	18.	1600	0.045	0.049	0.053	0.065		
Fiberglas block, PF612	2.5	500	0.023	0.039				
Fiberglas block, PF614	4.25	500	0.021	0.033				
Fiberglas block, PF617	9.	500	0.020	0.033				
Fiberglas, metal mesh blanket, #900	......	1000	0.020	0.030	0.040			
Cellular glass blocks, ave. value	8.5	900	0.033	0.045	0.062			
Hydrous calcium silicate, "Kaylo"	11.	1200	0.032	0.038	0.045			
85% magnesia	12.	600	0.029	0.035				
Micro-quartz fiber, blanket	3.	3000	0.021	0.028	0.042	0.075	0.106	0.142
Potassium titanate, fibers	71.5	....	.....	0.022	0.024	0.030		
Rock wool, loose	8-12	....	0.027	0.038	0.049	0.078		
Zirconia grain	113.	3000	.....	.....	0.108	0.129	0.163	0.217

Table 4.4.7 Thermal Conductance across Air Spaces
Btu/(h) (ft²)—Reflective insulation

Air space, in	Direction of heat flow	Temp diff, deg F	Mean temp, deg F	Aluminum surfaces, $\epsilon = 0.05$	Ordinary surfaces, non-metallic, $\epsilon = 0.90$
Horizontal, ¾-4 across	Upward	20.	80.	0.60	1.35
Vertical, ¾-4 across	Across	20.	80.	0.49	1.19
Horizontal, ¾ across	Downward	20.	75.	0.30	1.08
Horizontal, 4 across	Downward	20.	80.	0.19	0.93

Values of K for N Rows Deep

N	1	2	3	4	5	6	7	10
K	0.24	0.25	0.27	0.29	0.30	0.31	0.32	0.33

Gas Flow Normal to a Single Tube, D_oG/μ_f from 1000 to 50,000:

$$h_m = 0.30C_pG^{0.6}/(D'_o)^{0.4} \qquad (4.4.7a)$$

Fluid Flow Normal to a Bank of Staggered Tubes, D_oG_{max}/μ_f from 2000 to 40,000:

$$\frac{h_mD_o}{k_f} = K\left(\frac{C_p\mu}{k}\right)_f^{1/3}\left(\frac{D_oG_{max}}{\mu_f}\right)^{0.6} \qquad (4.4.8)$$

Water Flow Normal to a Bank of Staggered Tubes, D_oG_{max}/μ_f from 2000 to 40,000

$$h_m = 370(1 + 0.0067t_f)V_{sm}^{0.6}/(D'_o)^{0.4} \qquad (4.4.8a)$$

For baffled exchangers, to allow for leakage of fluids around the baffles, use 60 percent of the values of h_m from Eq. (4.4.8); for tubes in line, deduct 25 percent from the values of h_m given by Eq. (4.4.8).

Water Flow in Layer Form over Horizontal Tubes, $4\Gamma/\mu < 2100$

$$h_{hm} = 150(\Gamma/D'_o)^{1/3} \qquad (4.4.9)$$

for Γ ranging from 100 to 1,000 lb of water per h per ft (each side).

Water Flow in Layer down Vertical Tubes, $w/\pi D > 500$

$$h_m = 120\Gamma^{1/3} \qquad (4.4.9a)$$

Heat Transfer to Gases Flowing at Very High Velocities If a nonreactive gas stream is brought to rest adiabatically, as at the true stagnation point of a blunt body, the temperature rise will be

$$t_s - t_\infty = V^2/2g_cJC_p \qquad (4.4.9b)$$

where t_s is the stagnation temperature and t_∞ is the temperature of the free stream moving at velocity V. At every other point on the body, the gas is brought to rest partly by pressure changes and partly by viscous effects in the boundary layer. In general, this process is not adiabatic, even though the body transfers no heat. The thermal conductivity of the gas will transfer heat from one layer of gas to another. At an insulated surface, the gas temperature will therefore be neither the free-stream temperature nor the stagnation temperature. In general, the rise in gas temperature will be given by the equation

Project 8-9025.00
TDAFW Pump Area
Attach. III p. 1of2

BILL OF MATERIALS

tile

SHEET NO. 11

LOCATION: Pittsburgh, Pa.

CLIENT: Westinghouse Atomic Power Division
(Rochester Gas & Electric Corporation)

FOR: Feed Water System
Robert Emmett Ginna Nuclear Power Station - Unit No. 1

GAI W. O. 4155
CLIENT W. O. RH-33000

ITEM NO.	QUANTITY	DESCRIPTION OF MATERIAL	ISSUE	O
RC-6	1	STEAM DRIVEN Auxiliary Feedwater Pump, Worthington Corp. Model 3WTL-87-seven stage horizontally split, centrifugal pump. The pump shall be furnished with a minimum flow orifice. A curve to be furnished showing pump characteristics at various steam inlet pressures and steam consumption.	1	21

Design Data

Capacity	400 gpm
Total dynamic head	3,000 ft
Feedwater temperature	65-97°F
NPSH required	20.2 ft
Pump suction	Flooded
Steam pressure, operating	620-1085 psig
Steam temperature, operating	500-556°F
Steam conditions	1/4% moisture
Turbine exhaust pressure	10 psig
Speed	4575 rpm
Efficiency	67.5%
BHP	449
Minimum flow	95 gpm
Cooling water required	3 gpm

Construction

Casing	5% chrome steel
Shaft	13% chrome steel

(Continued Sheet 12)

GAI

ISSUE NO. 1
DATE 11-15-66
EDITOR SP
ENGINEER

ASSOCIATES, INC.

Project 8-9025.00

TDAFW Pump Area

Attach III P. 2 of 2

BILL OF MATERIALS

BM SYMBOL BROOKWOOD-RC

SHEET NO. 12

LOCATION: Pittsburgh, Pa.

CLIENT: Westinghouse Atomic Power Division
(Rochester Gas & Electric Corporation)
Feed Water System
Robert Emmett Ginna Nuclear Power Station - Unit No. 1

GAI W. O. 4155

CLIENT W. O. RH-33000

QUANTITY	DESCRIPTION OF MATERIAL		ISSUE	ORDER NO.
	Impellers	13% chrome steel	1	216026
	Wearing rings	13% chrome steel		
	Shaft sleeves	13% chrome steel		
	Diffusers	5% chrome steel		
	Bearings	Oil lubricated ball bearings		
	Discharge flange	3" - 1500# ASA		
	Suction flange	4" - 600# ASA		

Pump shall be furnished with the following:

1 Steam Turbine Drive, Worthington Type S, single stage, and shall require steam at 29.7 lbs/hp/hr at 680 psi, 10 psi exhaust and 500°F. Turbine shall be rated 450 hp at 4575 rpm. The turbine shall be suitable for quick starting.

Turbine shall be furnished with a Woodward oil relay direct acting constant speed governor, governor valve, integral steam strainer basket, insulation and jacket for the casing, tachometer, mounted half coupling, two (2) 4-1/2" steam pressure gauges, and trip and throttle valve limit switch.

Turbine Construction:

Casing	Carbon steel
Shaft	Alloy steel
Bucket wheels	Forged steel
Blades	Stainless steel

(Continued Sheet 13)

-66

Attachment 5
Containment Isolation Valves

Table 7-2 — Containment Isolation [Page 1 of 6]

Penetration Number	Description	Valve Number	Position At Normal Operation	Containment Isolation Maintained	Justification [Per 87-00]
2	Steam Generator Inspection / Maintenance	Blind Flanges	C	Yes	Locked cosed via blind flange.
29	Fuel Transfer Tube	Blind Flange	C	Yes	Locked closed via blind flange
100	Charging Line To B Loop	370B	O	Yes	Check valve.
101	Safety Injection Pump 1B Discharge	870B 889B	C C	Yes	Both components are check valves.
102	Alternate Charging To A Cold Leg	383B	C	Yes	Check valve.
103	Construction Fire Service Water	Blind Flange	C	Yes	Locked closed via blind flange.
105	Containment Spray Pump 1A	862A	C	Yes	Check valve.
106	Reactor Coolant Pump A Seal Water Inlet	304A	O	Yes	Check valve.
107	Sump A Discharge To Waste Holdup Tank	1723 1728	O O	Yes	Both components fail closed on loss of power.
108	Reactor Coolant Pump Seal Water Return Line and Excess Letdown To VCT	313	O	Yes	Valve less than 3" diameter. Valve closed by ECA-0.0, Step 8
109	Containment Spray Pump 1B	862B	C	Yes	Check valve.
110a (top)	Reactor Coolant Pump B Seal Water Inlet	304B	O	Yes	Check valve.
110b (bottom)	Safety Injection Test Line	879	LC	Yes	Locked closed.
111	Residual Heat Removal To B Cold Leg	720 959	C C	Yes	MOV-720 locked closed [breaker locked open]. 959 is not considered a CIV.
112	Letdown To Nonregenerative Heat Exchanger	200A 200B 202 371 427	O/C O/C C O O	Yes	All valves except 427 fail closed on loss of power. Valve 427 is not considered a CIV.
113	Safety Injection Pump 1A Discharge	870A 889A	C C	Yes	Both components are check valves.
119	Standby Auxiliary Feedwater Line To Steam Generator 1A	9704A 9705A	C C	NA	Containment boundary is SG secondary side and tubes. No containment isolation is required.
120a	Nitrogen To Accumulators	846 8623	C O/C	Yes	AOV-846 fails closed on loss of power. Valve 8623 is a check valve.
120b	Pressurizer Relief Tank To Gas Analyzer	539 546	C O	Yes	AOV-539 fails closed on loss of power. Manual valve 546 is not required to isolate.
121a	Nitrogen To Pressurizer Relief Tank	528 547	C LC	Yes	Valve 528 is a check valve. Manual valve 547 is locked closed.

Table 7-2 --- Containment Isolation [Page 2 of 6]

Penetration Number	Description	Valve Number	Position At Normal Operation	Containment Isolation Maintained	Justification [Per 87-00]
121b	Makeup Water To Pressurizer Relief Tank	508 529	C O/C	Yes	AOV-508 fails closed on loss of power. Valve 529 is a check valve.
121c	Containment Pressure Transmitter PT-945	PT-945 1819A	NA O	Yes	Valve is less than 3" diameter.
121d	Containment Pressure Transmitter PT-946	PT-946 1819B	NA O	Yes	Valve is less than 3" diameter.
123 (top)	Standby Auxiliary Feedwater Line To Steam Generator 1B	9704B 9705B	C C	NA	Containment boundary is SG secondary side and tubes. No containment isolation required.
123 (bottom)	Reactor Coolant Drain Tank To Gas Analyzer Line	1600A 1655 1789	O O O	Yes	AOV-1600A is not considered a CIV, but fails closed on loss of power. Manual valve 1655 is not required to isolate. Valve 1789 fails closed on loss of power.
124a	Excess Letdown Heat Exchanger Cooling Water Supply & Return	743 745	C C	Yes	Valve 743 is a check valve. AOV-745 fails closed on loss of power.
124b	Post Accident Air Sample To C Fan	1569 1571 1572 1574	LC LC LC LC	Yes	All four manual valves are locked closed.
125	Component Cooling Water From Reactor Coolant Pump 1B	759B	O	Yes	Non-radioactive, closed-loop system. Valve is closed by ECA-0.0, Step 8.
126	Component Cooling Water From Reactor Coolant Pump 1A	759A	O	Yes	Non-radioactive, closed-loop system. Valve is closed by ECA-0.0, Step 8.
127	Component Cooling Water To Reactor Coolant Pump 1A	749A 750A	O O	Yes	Non-radioactive, closed-loop system.
128	Component Cooling Water To Reactor Coolant Pump 1B	749B 750B	O O	Yes	Non-radioactive, closed-loop system.
129	Reactor Coolant Drain Tank And Pressurizer Relief Tank To Containment Vent Header	1713 1786 1787 1793	C O O LC	Yes	Valve 1713 is a check valve. AOVs 1786 and 1787 fail closed on loss of power. Manual valve 1793 is locked closed.
130	Component Cooling Water From Reactor Support Cooling	814	O	Yes	Non-radioactive, closed-loop system. Valve is closed by ECA-0.0, Step 8.
131	Component Cooling Water To Reactor Support Cooling	813	O	Yes	Non-radioactive, closed-loop system. Valve is closed by ECA-0.0, Step 8.

Table 7-2 --- Containment Isolation [Page 3 of 6]

Penetration Number	Description	Valve Number	Position At Normal Operation	Containment Isolation Maintained	Justification [Per 87-00]
132	Containment Mini-Purge Exhaust	7970 7971	O/C C	Yes	Both AOVs fail closed on loss of power.
140	Residual Heat Removal Pump Suction From A Hot Leg	701	C	Yes	MOV 701 locked closed via breaker being locked open.
141	Residual Heat Removal Pump 1A Suction From Sump B	850A 1813A	C C	Yes	MOV 850A is used for long-term cooling and is normally closed. Valve position is verified every shift via O-6.13, Step 5.9.71; therefore, valve is considered locked closed by administrative control. MOV-1813A is locked closed via the breaker being locked open.
142	Residual Heat Removal Pump 1B Suction From Sump B	850B 1813B	C C	Yes	MOV 850B is used for long-term cooling and is normally closed. Valve position is verified every shift via O-6.13, Step 5.9.72; therefore, valve is considered locked closed by administrative control. MOV-1813B is locked closed via the breaker being locked open.
143	Reactor Coolant Drain Tank Discharge Line	1003A 1003B 1721	O O O	Yes	All three AOVs fail closed on loss of power.
201 (top) 201 (bottom)	Reactor Compartment Cooling Units A And B	4757 4636	O O	Yes	Non-radioactive, closed-loop system.
202	B Hydrogen Recombiner (Pilot And Main)	1076B 1084B 10211S1 10213S1	LC LC C C	Yes	Manual Valves 1076B and 1084B are locked closed. Solenoid valves 10211S1 and 10213S1 fail closed on loss of power.
203a	Containment Pressure Transmitters PT-947 And PT-948	PT-947 PT-948 1819C 1819D	NA NA O O	Yes	All valves less than 3" diameter.
203b	Post-Accident Air Sample To B Fan	1563 1565 1566 1568	LC LC LC LC	Yes	All four manual valves are locked closed.
204	Purge Supply Duct	Blind Flange 5869	C C	Yes	Locked closed via blind flange. AOV-5869 fails closed on loss of power.
205	Hot Leg Loop Sample	955 956D 966C	C O C	Yes	AOV-965 is not considered a CIV. Manual valve 956D is not required to isolate. AOV-966C fails closed on loss of power.

Table 7-2 — Containment Isolation [Page 4 of 6]

Penetration Number	Description	Valve Number	Position At Normal Operation	Containment Isolation Maintained	Justification [Per 87-00]
206a (top)	Steam Generator Inspection / Maintenance	Blind Flanges	C	Yes	Locked Closed Via Blind Flange
206b (bottom)	Fuel Transfer Tube	Blind Flange	C	Yes	Locked Closed Via Blind Flange
207a (top)	Charging Line To B Loop	370B	O	Yes	Check Valve
207b (bottom)	Safety Injection Pump 1B Discharge	870B 889B	C C	Yes	Both Components Are Check Valves
209 (top) 209 (bototm)	Alternate Charging To A Cold Leg	383B	C	Yes	Check Valve
210	Oxygen Makeup To A & B Recombiners	1080A 10214S 10214S1 10215S 10215S1	LC C C C C	Yes	Manual valve 1080A locked closed. Solenoid valves 10214S, 10214S1, 10215S, and 10215S1 fail closed on loss of power.
300	Purge Exhaust Duct	Blind Flange 5879	C C	Yes	Locked closed via blind flange. AOV-5879 fails closed on loss of power.
301	Auxiliary Steam Supply To Containment	6151 6165	LC LC	Yes	Both manual valves are locked closed.
303	Auxiliary Steam Condensate Return	6152 6175	LC LC	Yes	Both manual valves are locked closed.
304	A Hydrogen Recombiner (Pilot & Main)	1076A 1084A 10205S1 10209S1	LC LC C C	Yes	Manual valves 1076A and 1084A are locked closed. Solenoid valves 10205S1 and 10209S1 fail closed on loss of power.
305a (bottom)	Containment Air Sample Out	1596 1597	O O	Yes	Manual valve 1597 is not required to isolate. AOV-1597 fails closed on loss of power.
305b (top)	Containment Air Sample Inlet	1598 1599	O O	Yes	Both AOVs fail closed on loss of power.
305c	Containment Air Sample Post-Accident	1554 1556 1557 1559 1560 1562	LC LC LC LC LC LC	Yes	All six manual valves are locked closed.
307	Fire Service Water	9227 9229	C C	Yes	AOV-9227 fails closed on loss of power. Valve 9229 is a check valve.
308	Service Water To A Fan Cooler	4629	LO	Yes	Non-radioactive, closed-loop system.
309	Mini-Purge Supply	7445 7478	O/C O/C	Yes	Both AOVs fail closed on loss of power.
310a (bottom)	Service Air To Containment	7141 7226	LC C	NA	Manual valve 7141 is locked closed. Valve 7226 is a check valve.

Table 7-2 — Containment Isolation [Page 5 of 6]

Penetration Number	Description	Valve Number	Position At Normal Operation	Containment Isolation Maintained	Justification [Per 87-00]
310b (top)	Instrument Air To Containment	5392 5393	O O	Yes	AOV 5392 fails closed on loss of power. Valve 5393 is a check valve.
311	Service Water From B Fan Cooler	4630	LO	Yes	Non-radioactive, closed-loop system.
312	Service Water To D Fan Cooler	4642	LO	Yes	Non-radioactive, closed-loop system.
313	Leakage Test Depressurization	Blind Flange 7444	C C	Yes	Locked closed via blind flange.
315	Service Water From C Fan Cooler	4643	LO	Yes	Non-radioactive, closed-loop system.
316	Service Water To B Fan Cooler	4628	LO	Yes	Non-radioactive, closed-loop system.
317	Leakage Test Supply	Blind Flange 7443	C C	Yes	Locked closed via blind flange.
318	Deadweight Tester	NA	NA	Yes	Locked closed. Penetration is welded shut.
319	Service Water From A Fan Cooler	4627	LO	Yes	Non-radioactive, closed-loop system.
320	Service Water To C Fan Cooler	4641	LO	Yes	Non-radioactive, closed-loop system.
321	A Steam Generator Blowdown	5701 5738	O O	Yes	Manual valve 5701 is not required to isolate. AOV-5738 fails closed on loss of power.
322	B Steam Generator Blowdown	5702 5737	O O	Yes	Manual valve 5702 not required to isolate. AOV-5737 fails closed on loss of power.
323	Service Water From D Fan Cooler	4644	LO	Yes	Non-radioactive, closed-loop system.
324	Demineralized Water To Containment	8418 8419	C C	Yes	AOV-8418 fails closed on loss of power. Valve 8419 isd a check valve.
332a	Containment Pressure Transmitters PT-944, PT-949, and PT-950	PT-944 PT-949 PT-950 1819E 1819F 1819G	NA NA NA O O O	Yes	All valves are less than 3" diameter.
332c	Hydrogen Monitor Instrumentation Lines	921 922 923 924	C C C C	Yes	All four solenoid valves fail closed on loss of power.

Table 7-2 — Containment Isolation [Page 6 of 6]

Penetration Number	Description	Valve Number	Position At Normal Operation	Containment Isolation Maintained	Justification [Per 87-00]
401	Main Steam From Steam Generator A	3505A 3507 3517 3519 3521	C O O O O	NA	Containment boundary is SG secondary side and tubes. No containment isolation is required.
402	Main Steam From Steam Generator B	3504A 3506 3516 3518 3520	C O O O O	NA	Containment boundary is SG secondary side and tubes. No containment isolation is required.
403	Feedwater Line To Steam Generator A	3993 3995 4000C 4003 4005 4011	O O C C O O	NA	Containment boundary is SG secondary side and tubes. No containment isolation is required.
404	Feedwater Line To Steam Generator B	3992 3994 4000D 4004 4006 4012	O O C C O O	NA	Containment boundary is SG secondary side and tubes. No containment isolation is required.
1000	Personnel Hatch	NA	C	Yes	Locked closed. Penetration is leak tested.
2000	Equipment Hatch	NA	C	Yes	Locked closed. Penetration is leak tested.

Attachment 6
TREAT Analysis of Station Blackout

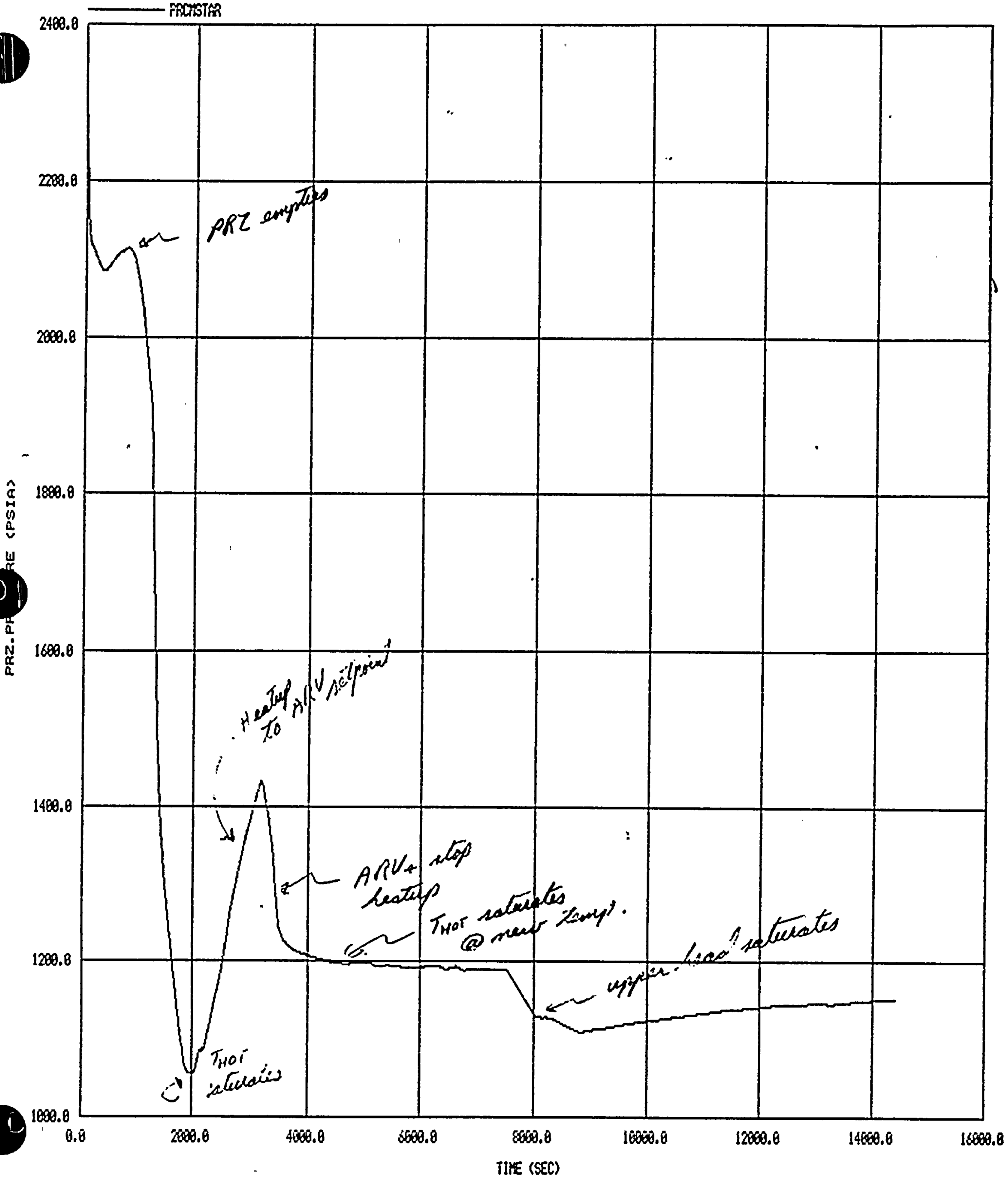
STATION BLACKOUT
TREAT SIMULATION

Summary of Significant Events and Operator Actions During the Analysis.

Time (sec)	Event/Action
0.0	Loss of all AC resulting in reactor trip, RCP coastdown, loss of main feedwater, and turbine trip.
500 (8.3 min.)	RCS loop flow reaches NC flow and remains there for duration of the analysis.
1000 (16.7 min.)	Pressurizer empties, RCS pressure decreases to P_{SAT} of hot leg. SG NR level returns on scale.
1300 (21.7 min.)	Aux. feedwater reduced from 400 gpm per SG to 25 lb/sec. (180 gpm) per SG.
2000 (33.3 min.)	RCS pressure reaches P_{SAT} for T_{HOT} Aux. feedwater reduced to 5lb/sec. (36 gpm) per SG. RCS begins heatup and re-pressurization to ARV setpoint.
2500 (41.7 min.)	Aux. feedwater reduced to 0.
3000 (50 min.)	ARVs open; terminates heatup. ARVs remain open for duration of the analysis removing decay heat.
3500 (58 min.)	RCS pressure reduced to P_{SAT} of T_{HOT}. Upper Plenum "collapsed" level decreases as voids appear.
5000 (1.4 hr.)	Aux. feed increased to 36 gpm per SG.
5500 (1.53 hr.)	Aux. feed increased to 72 gpm per SG.
7200 (2.0 hr.)	Aux. feed reduced to 57 gpm per SG.
8000 (2.2 hr.)	Aux. feed stopped. Upper Head reaches saturation and "collapsed" level decreases as voids appear.
14,400 (4.0 hr.)	Analysis terminated by starting of one SI pump.

Conclusion

- Break flow decreases from 6.6 lbs/sec. (63 gpm) to 3.45 lbs/sec. at 4 hr. following changes in RCS pressure.
- Voiding appears in the upper head and upper plenum. The voids are condensed in the SG. Natural circulation flow is never lost.
- Voiding in the upper head is approximately 50.5% by volume after 4 hr. Voiding in the upper plenum is approximately 46.5% by volume after 4 hr.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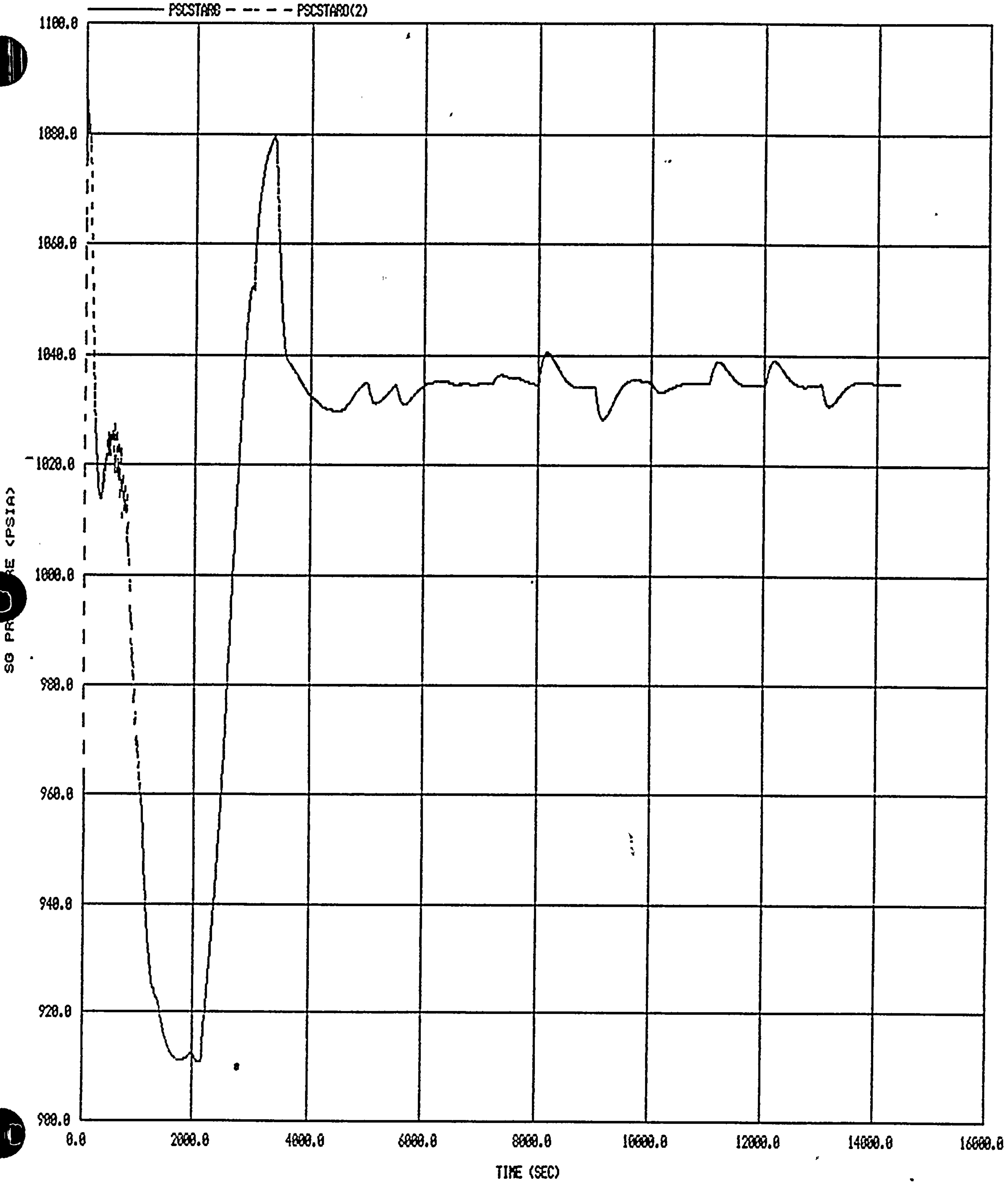
2200.0
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
0.0
2000.0
4000.0
6000.0
8000.0
10000.0
12000.0
14000.0
16000.0
TIME (SEC)
PRZ empties
Heatup to ARV setpoint
ARVs stop heatup
THOT saturates @ new temp.
upper head saturates
THOT saturates



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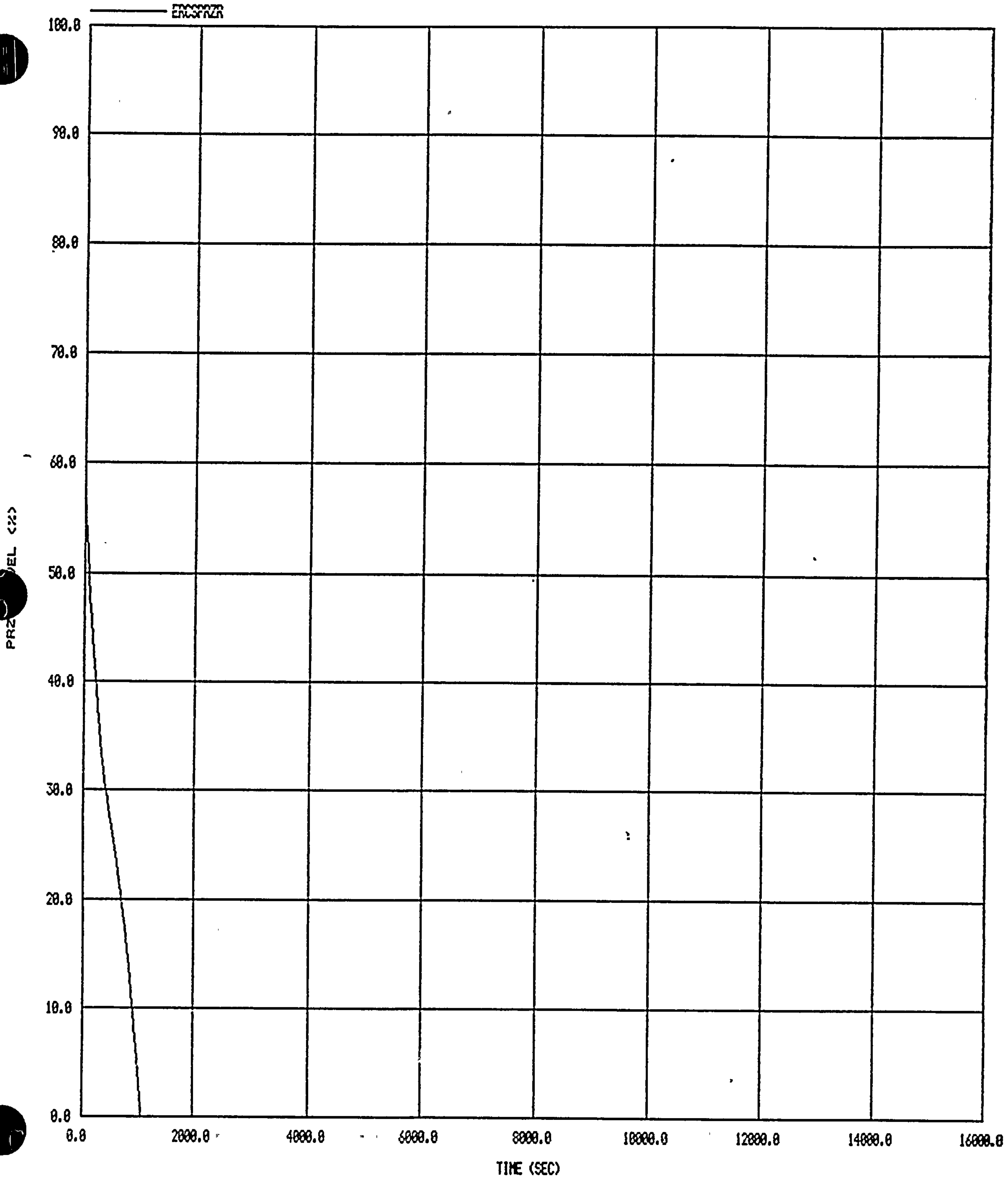

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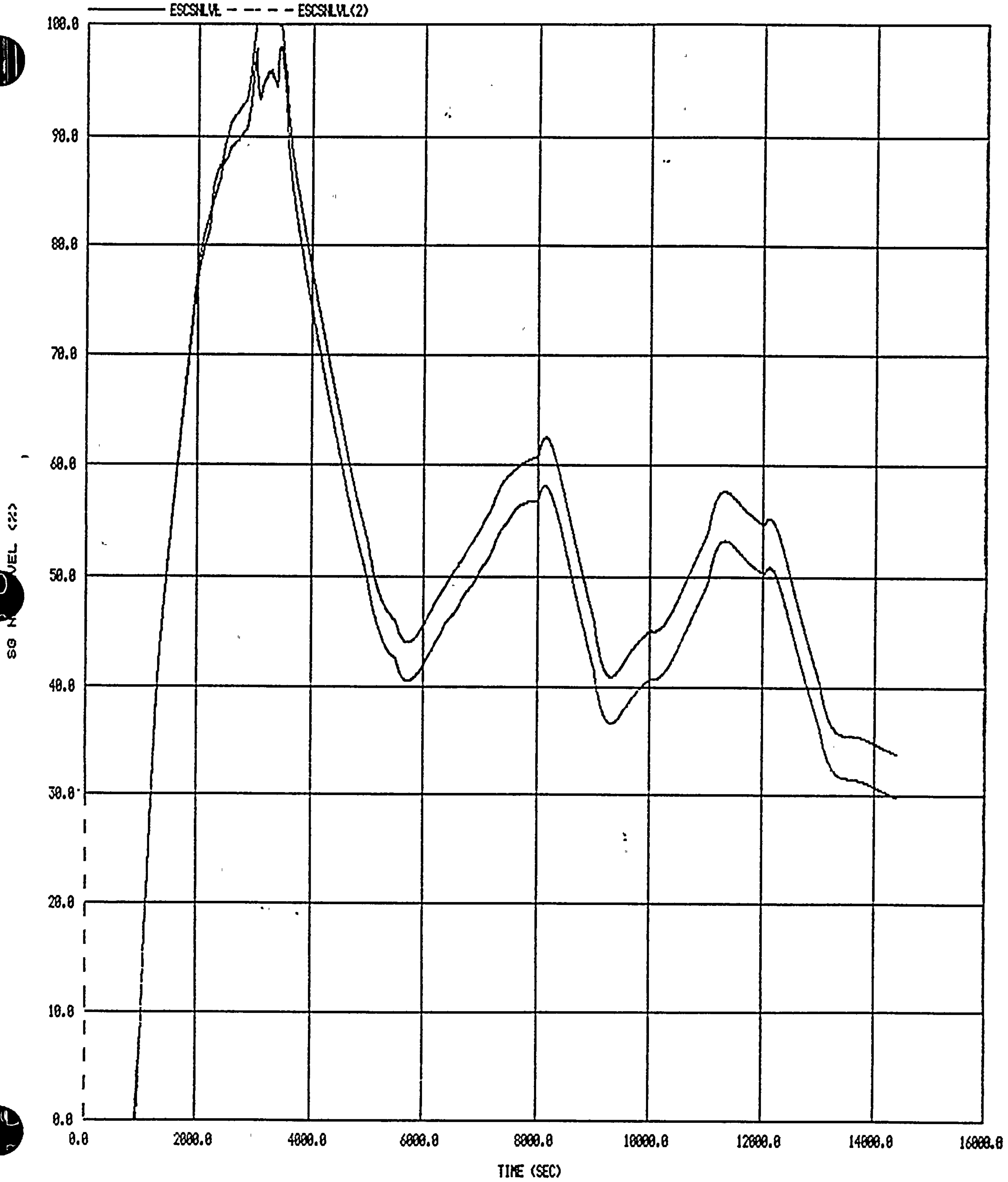

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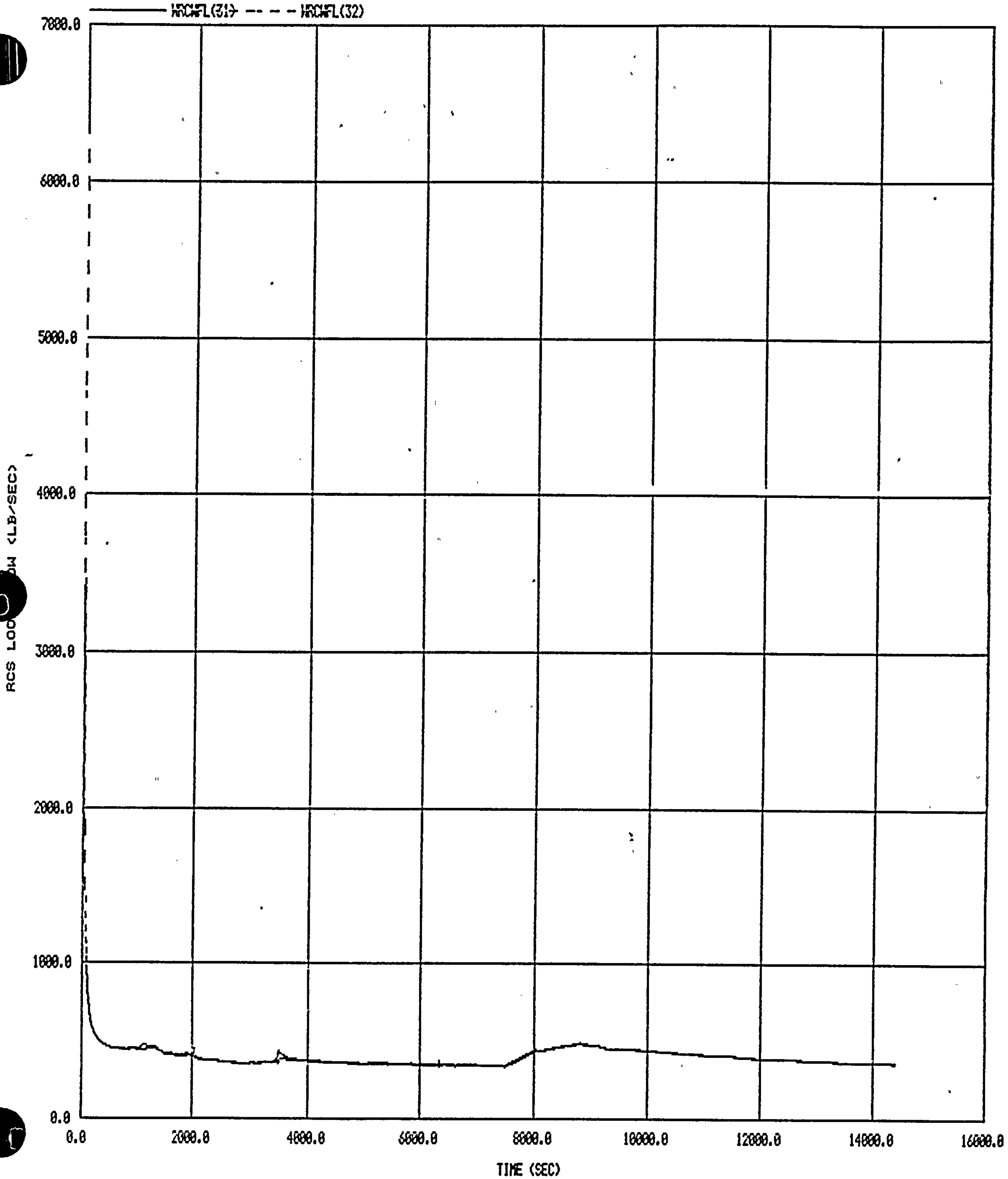

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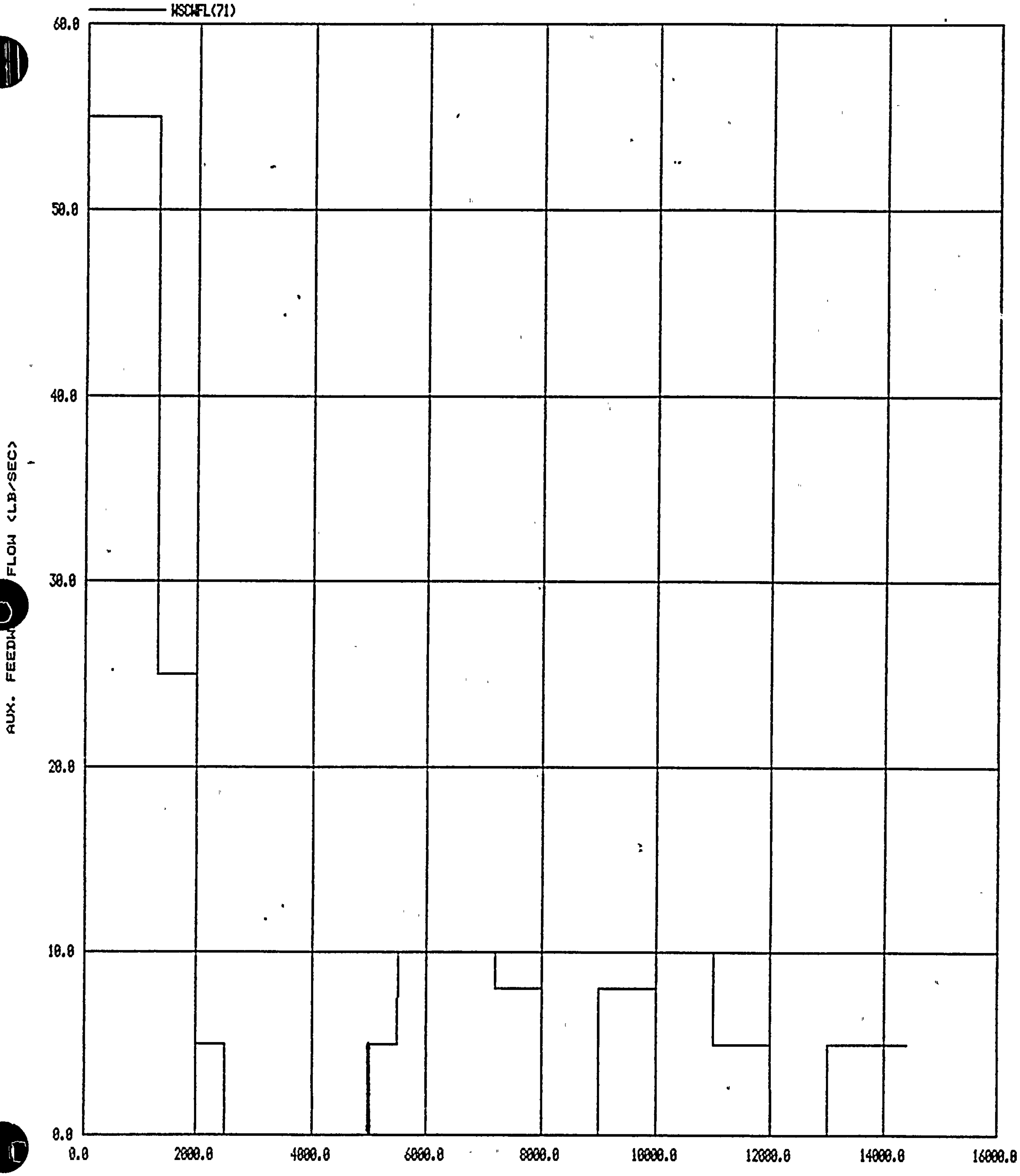

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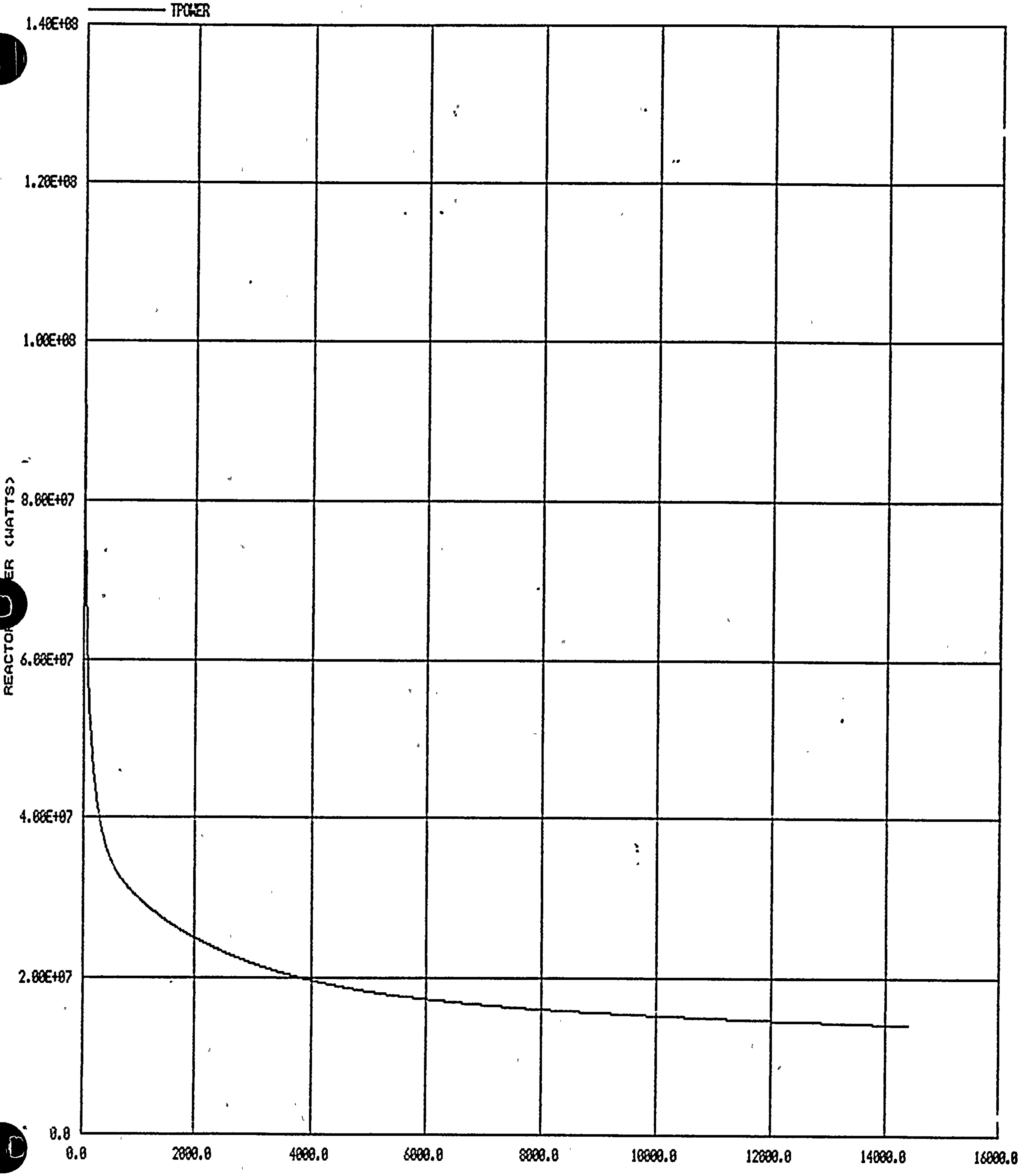

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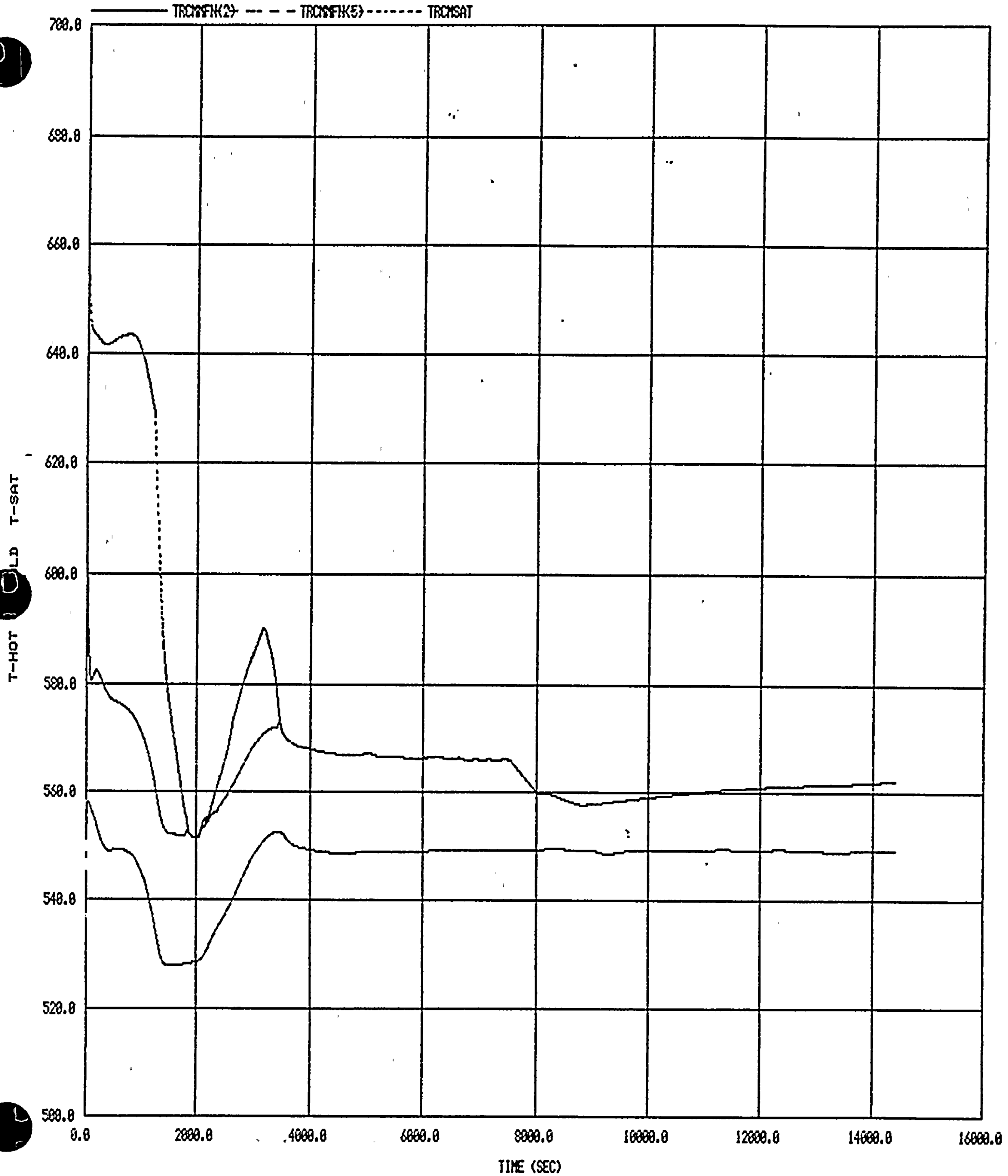

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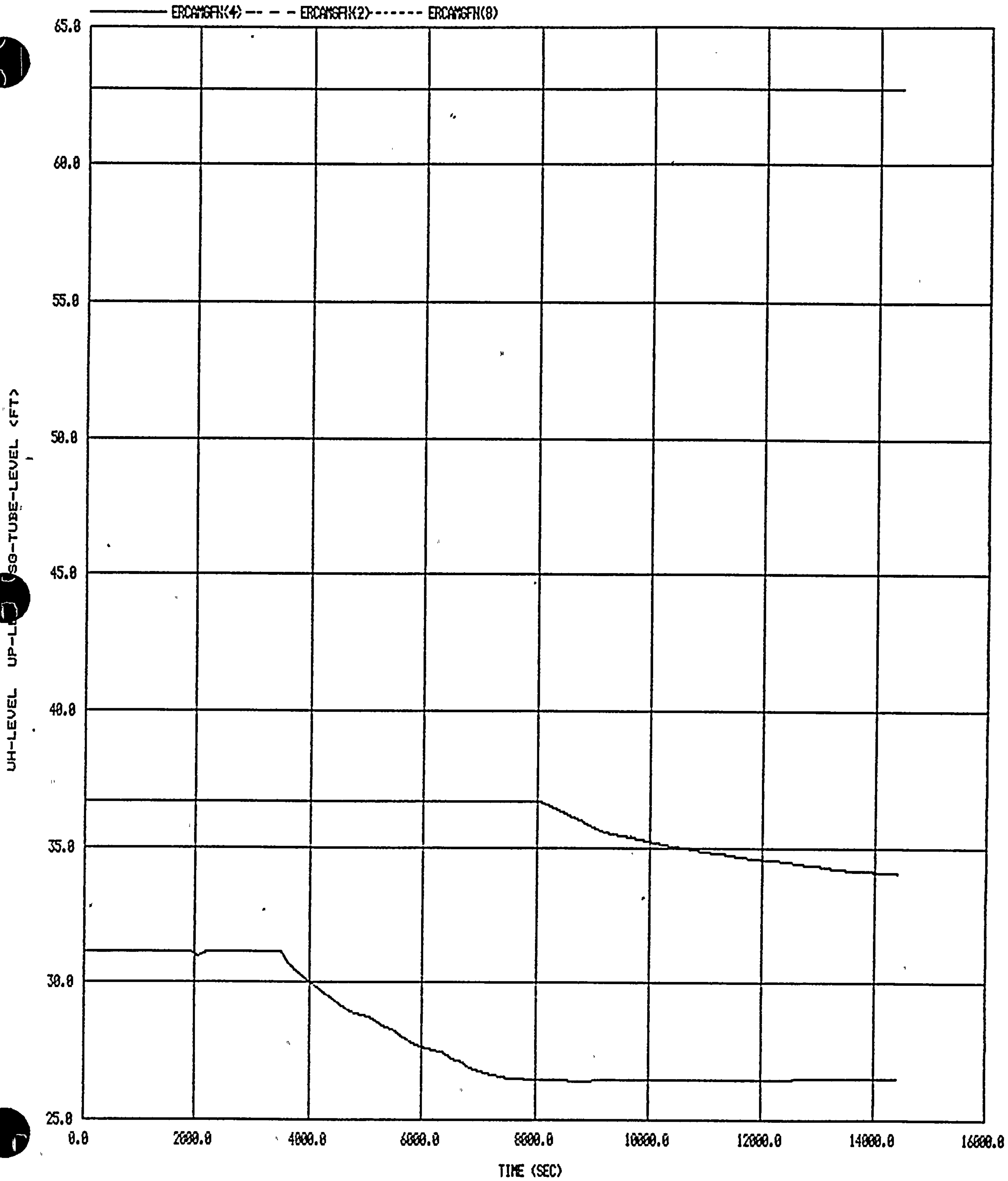

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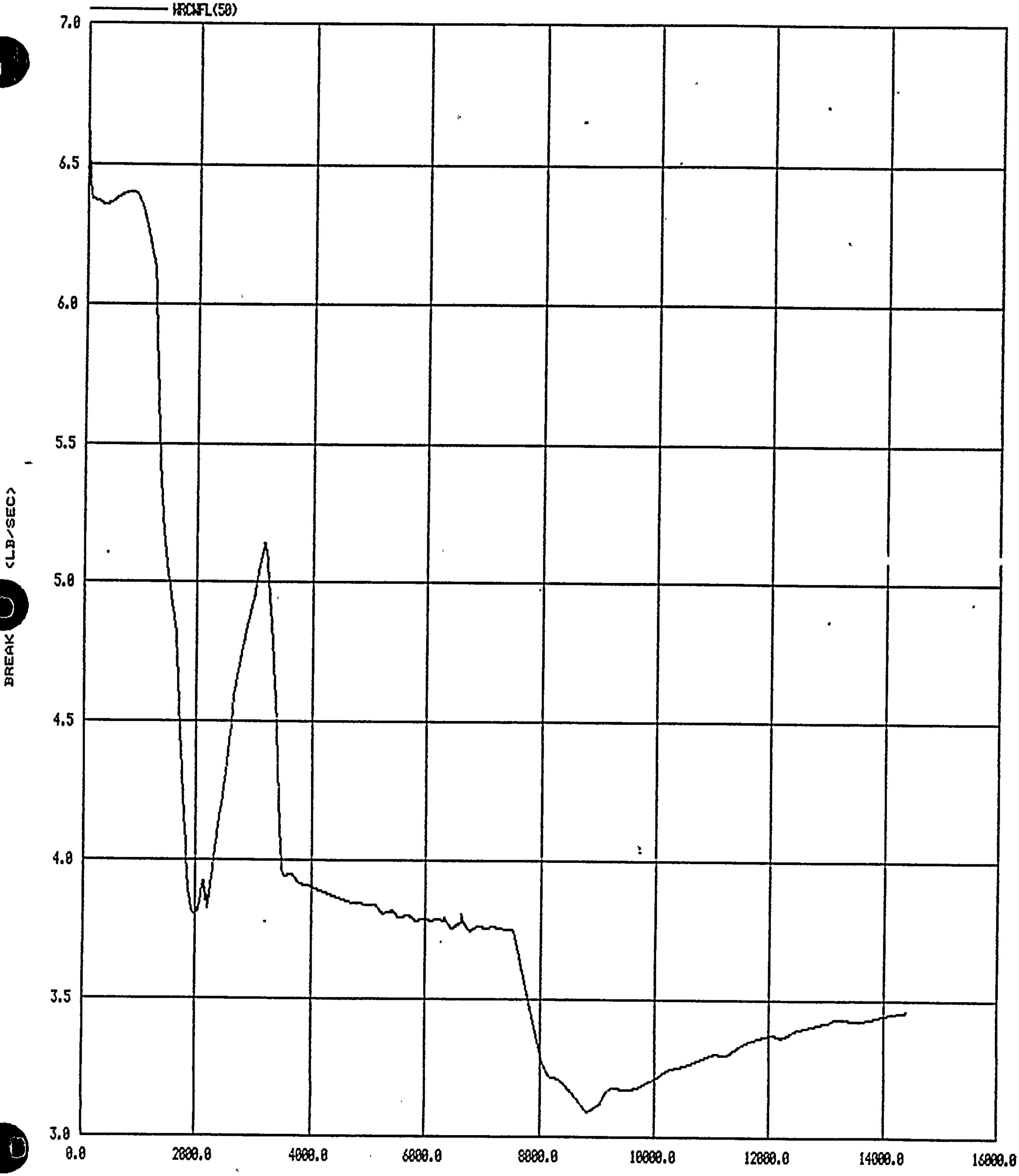

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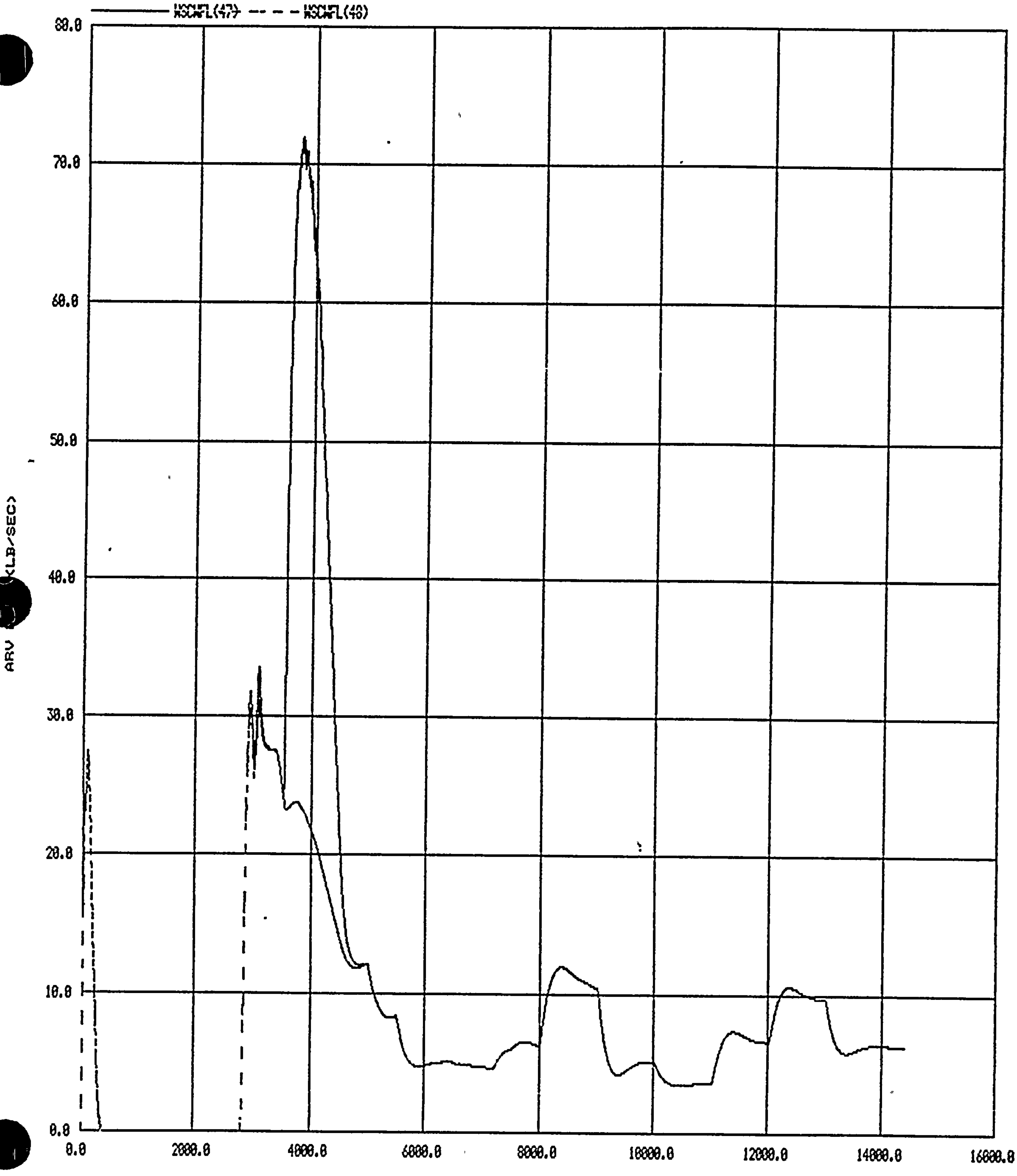

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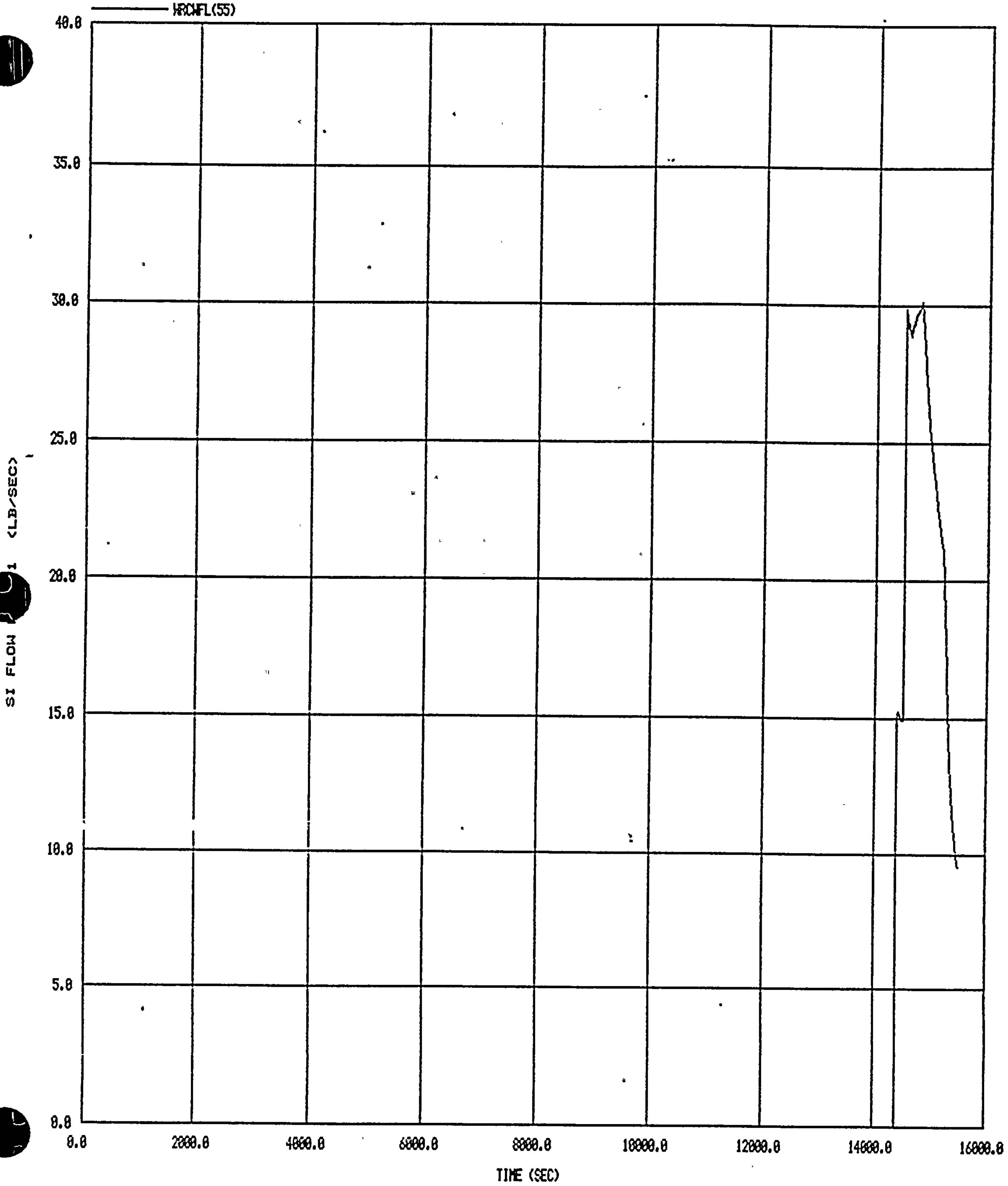

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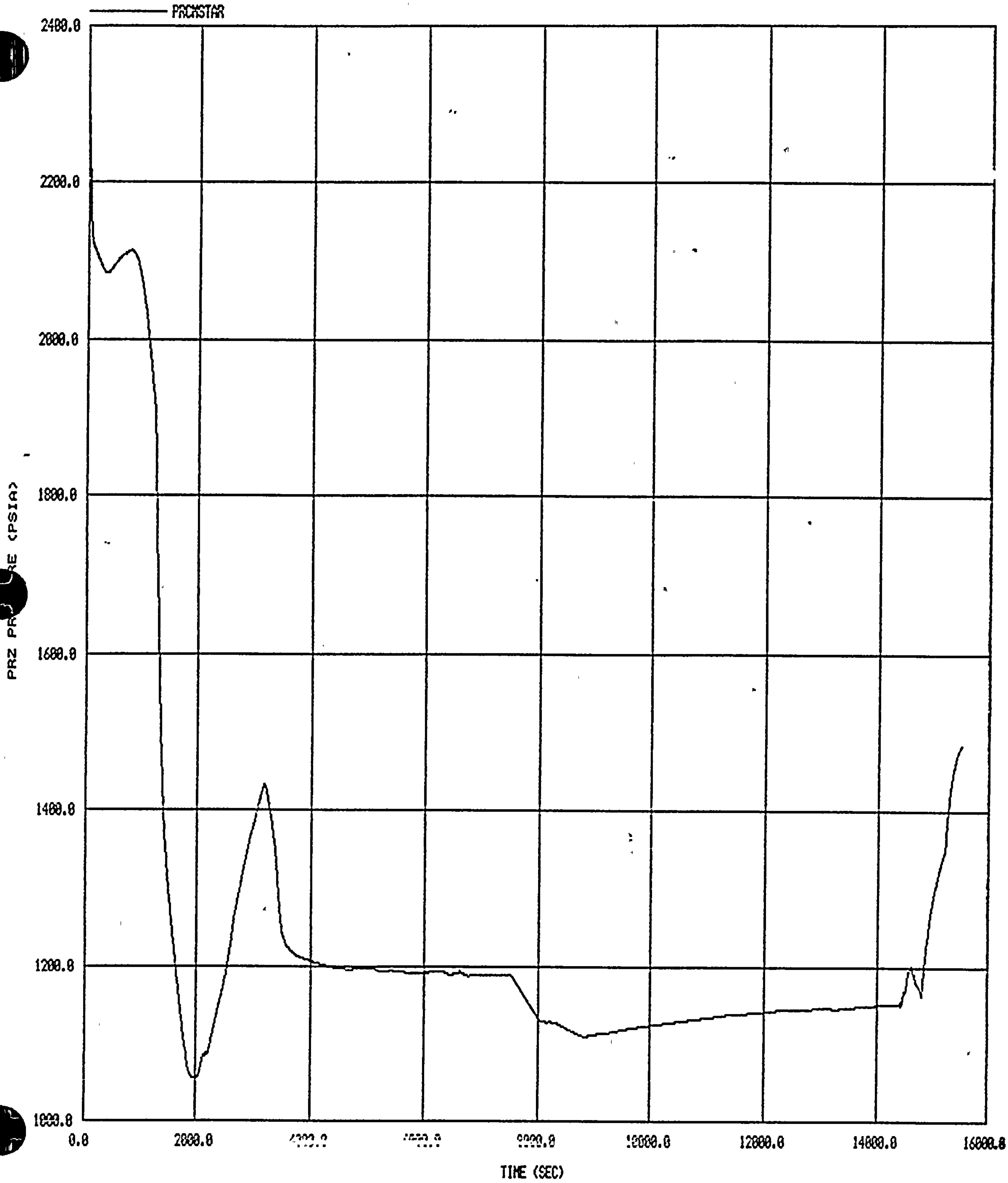

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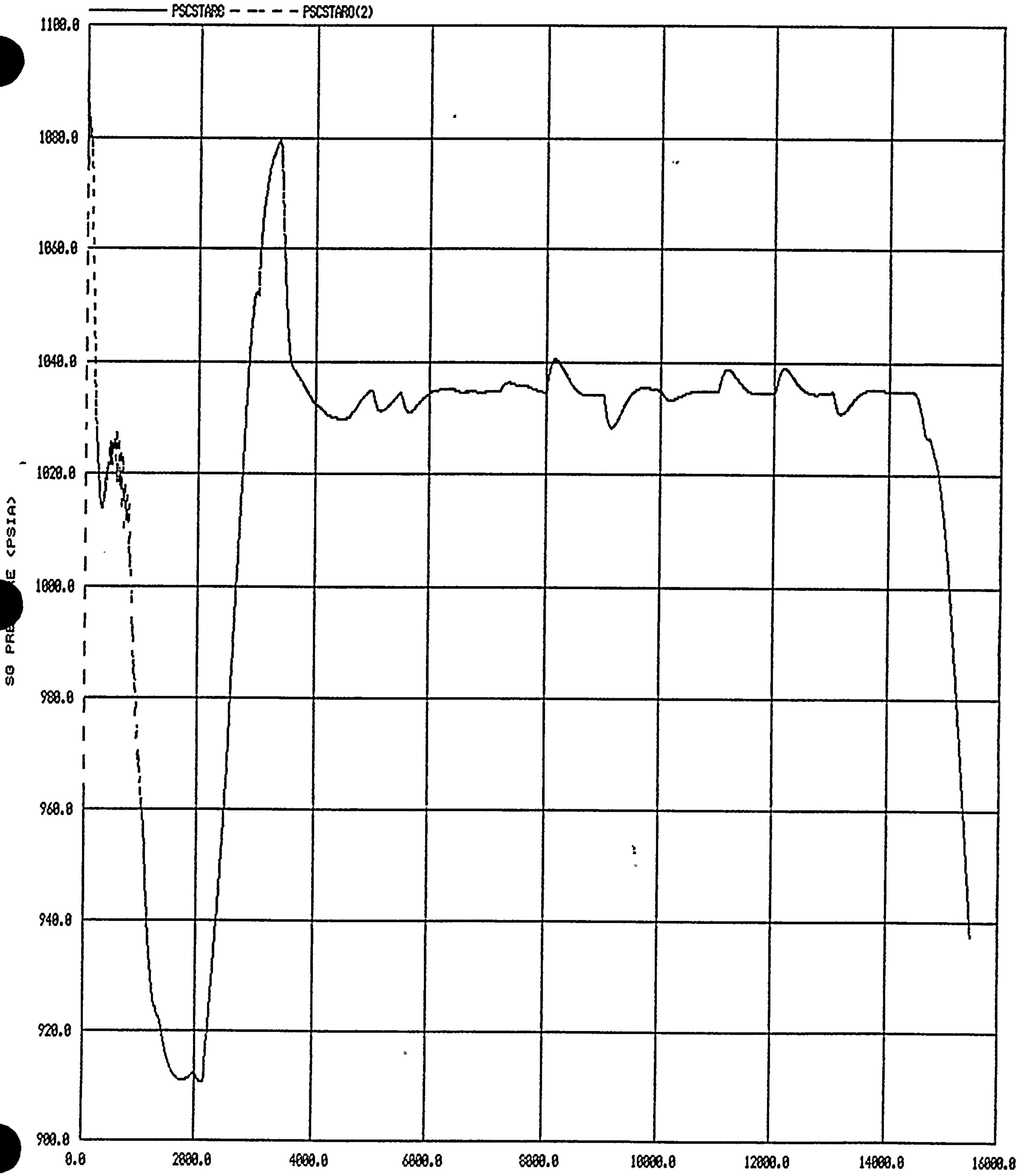

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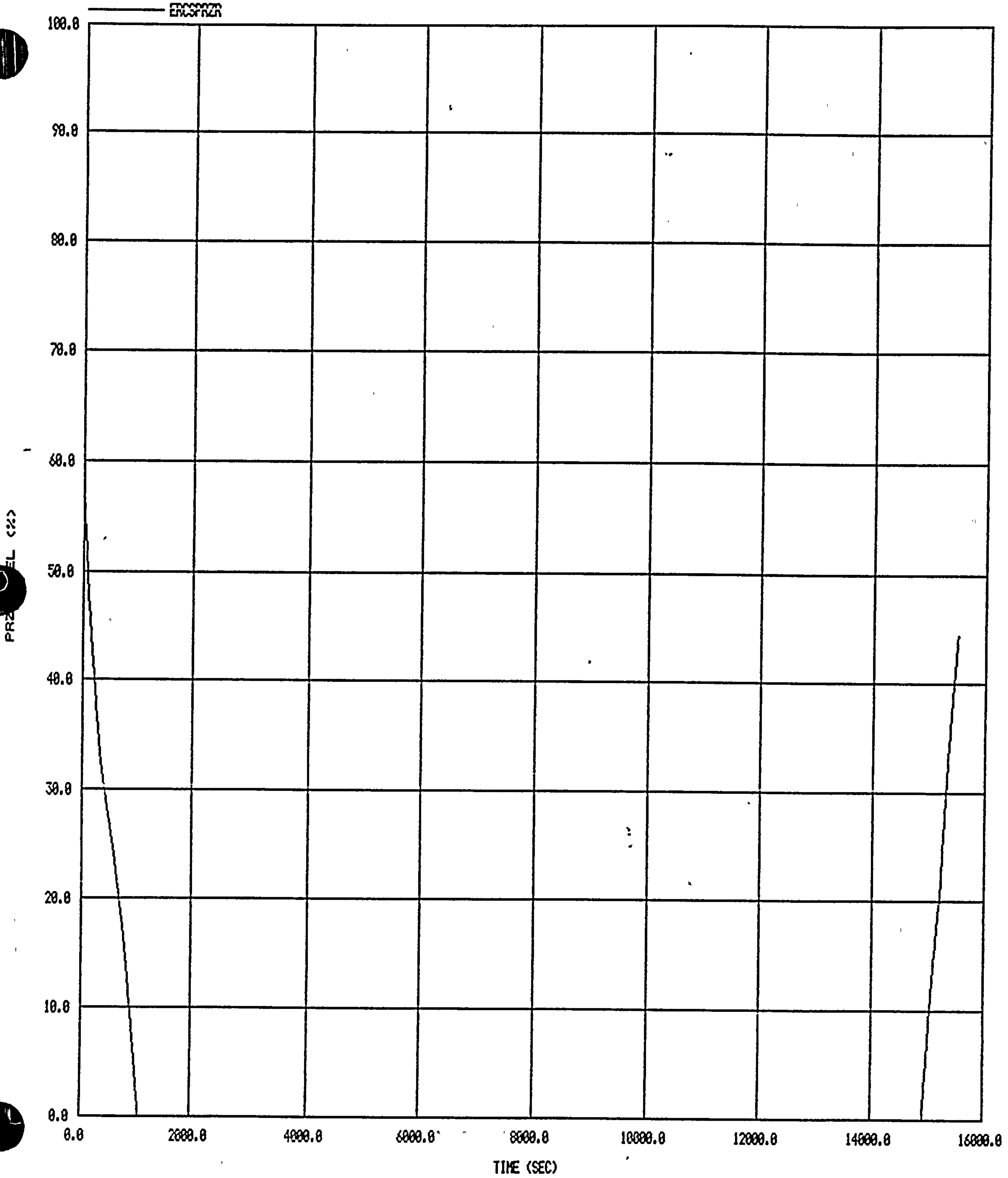

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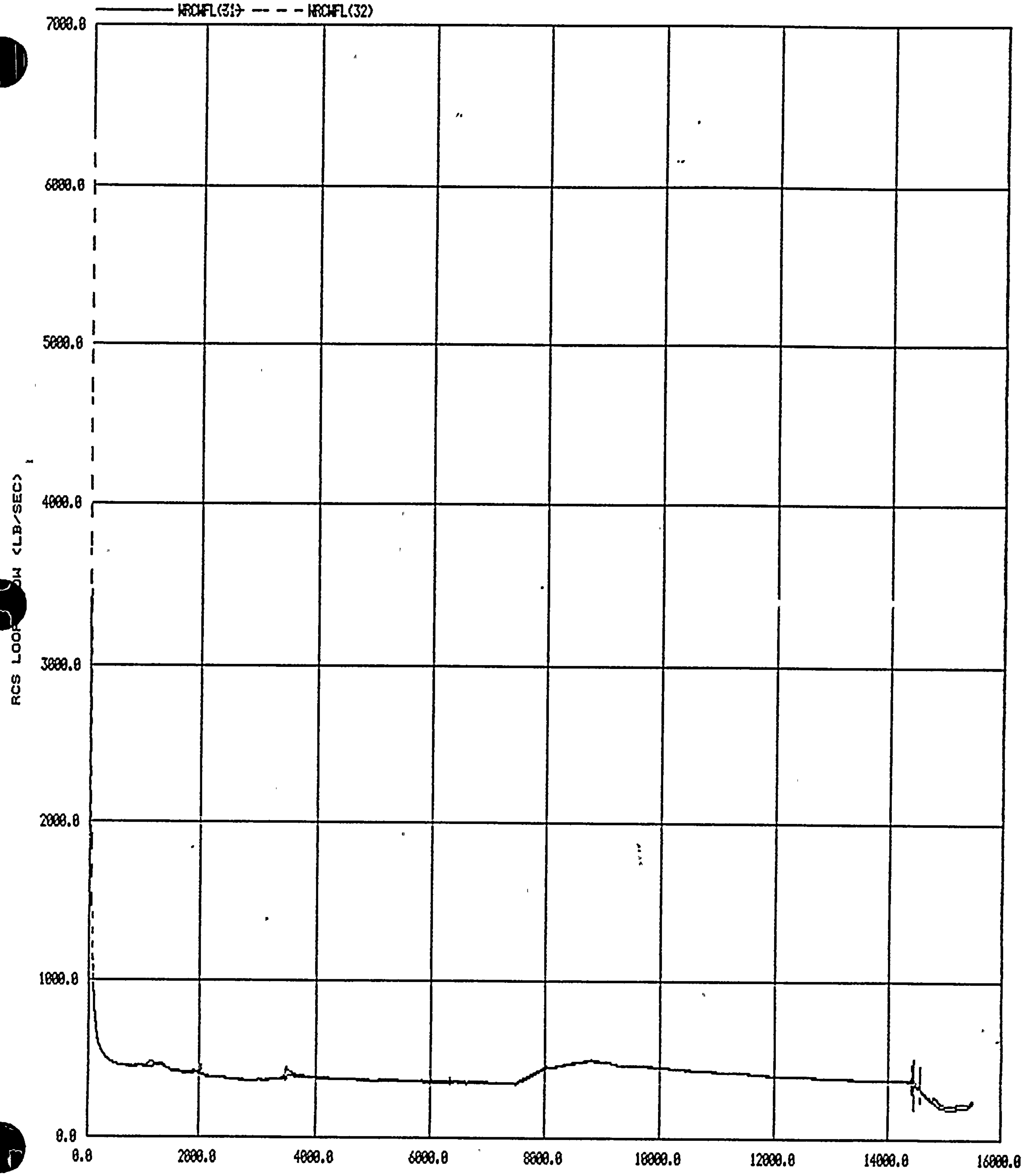

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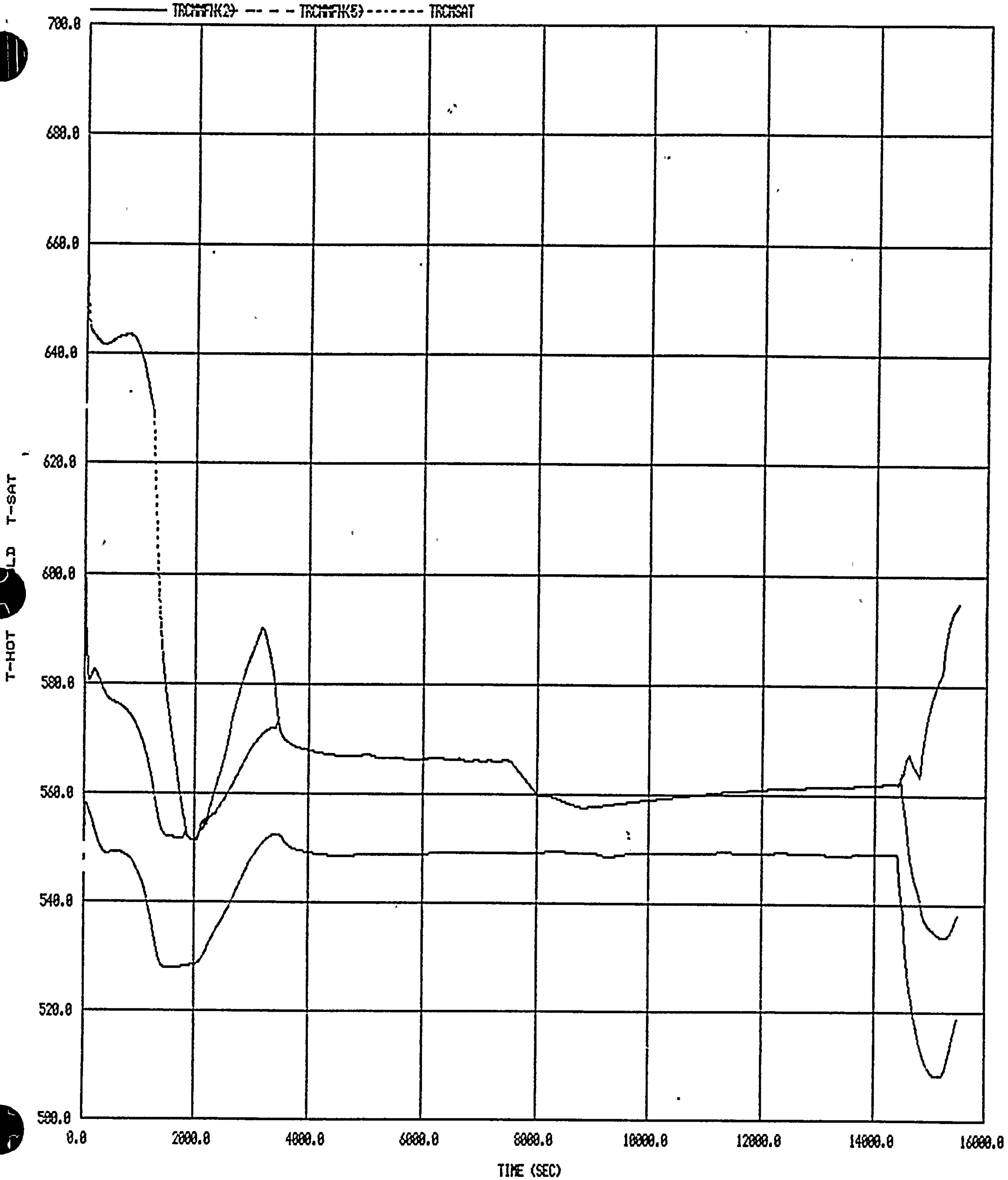
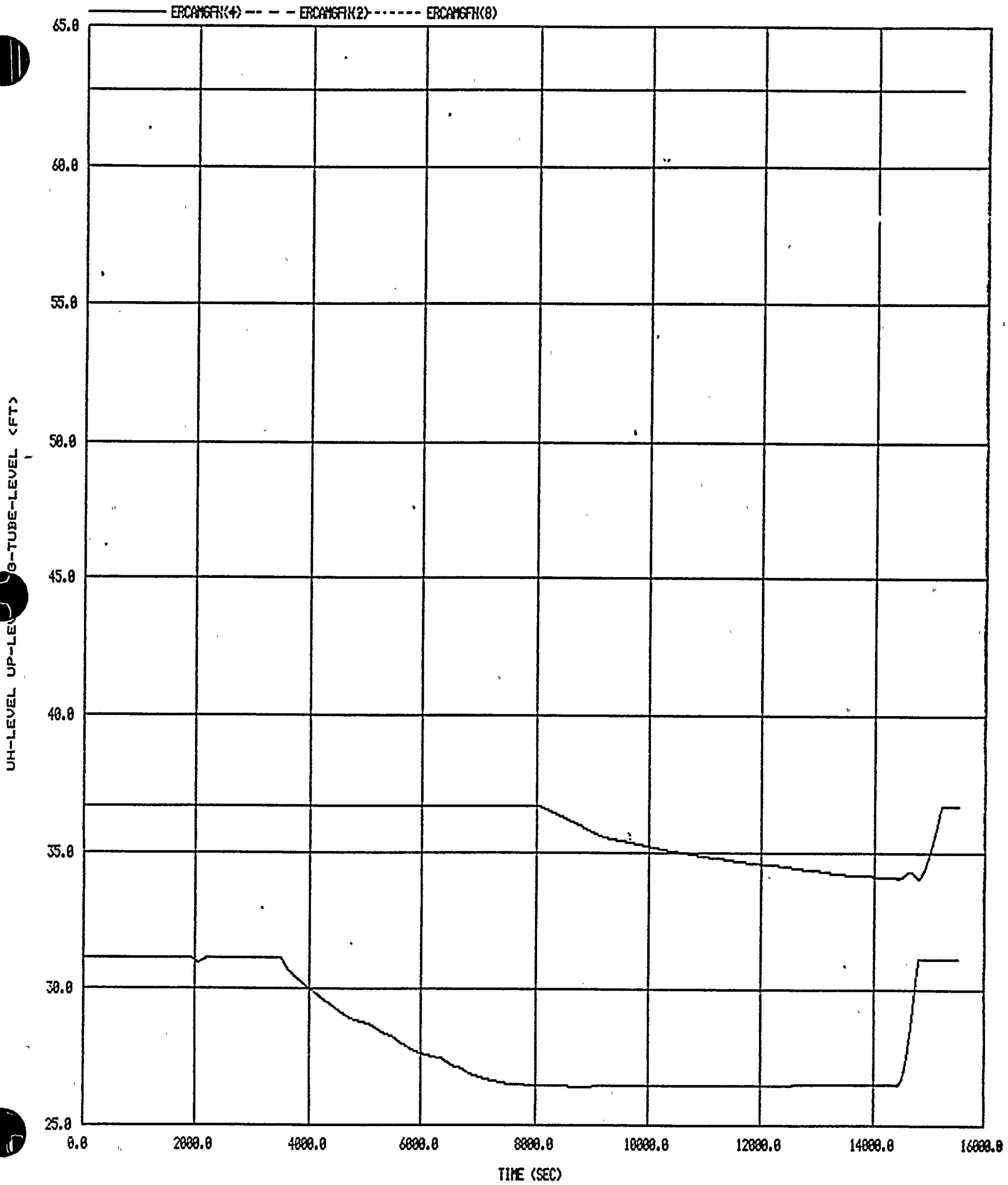
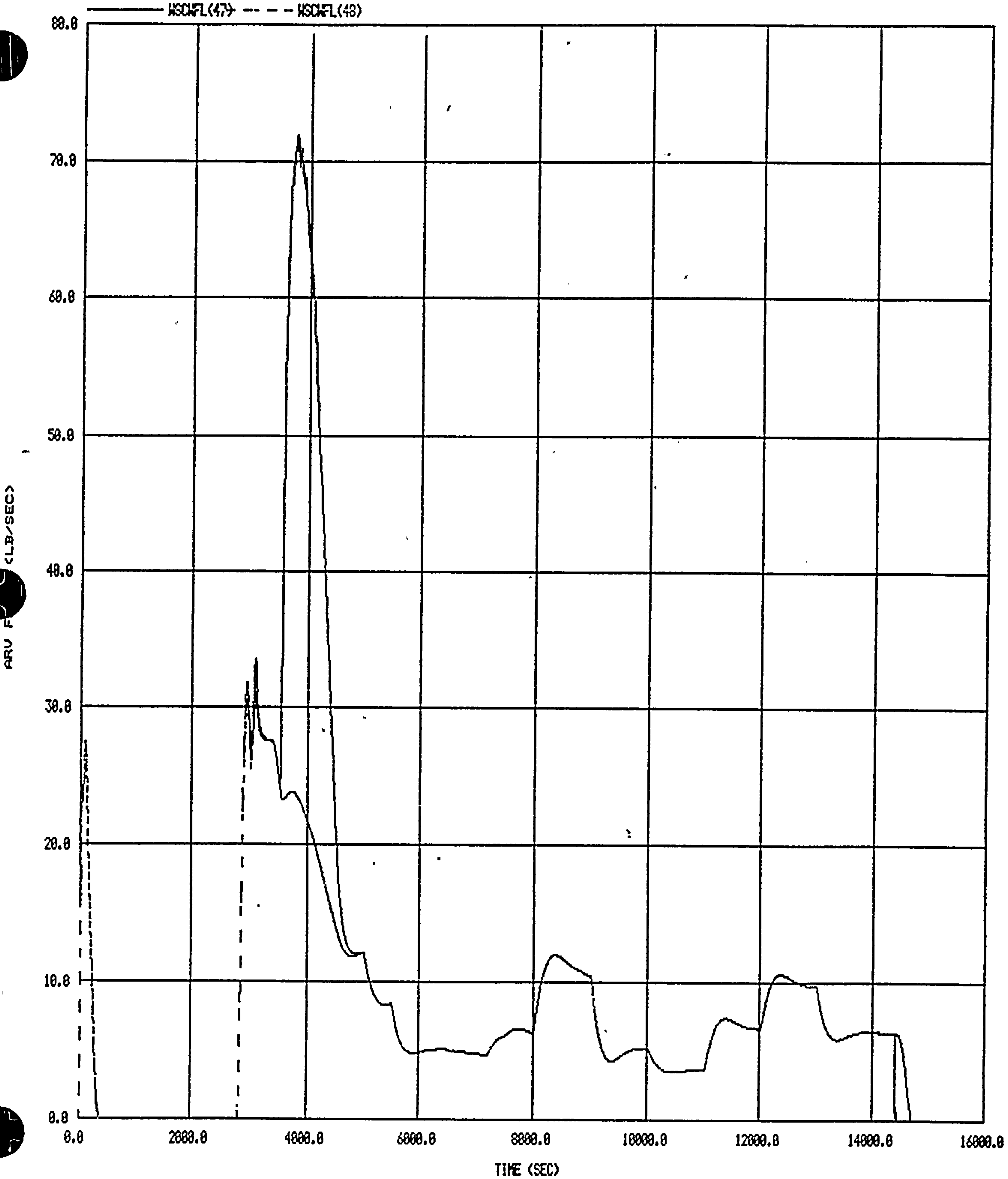


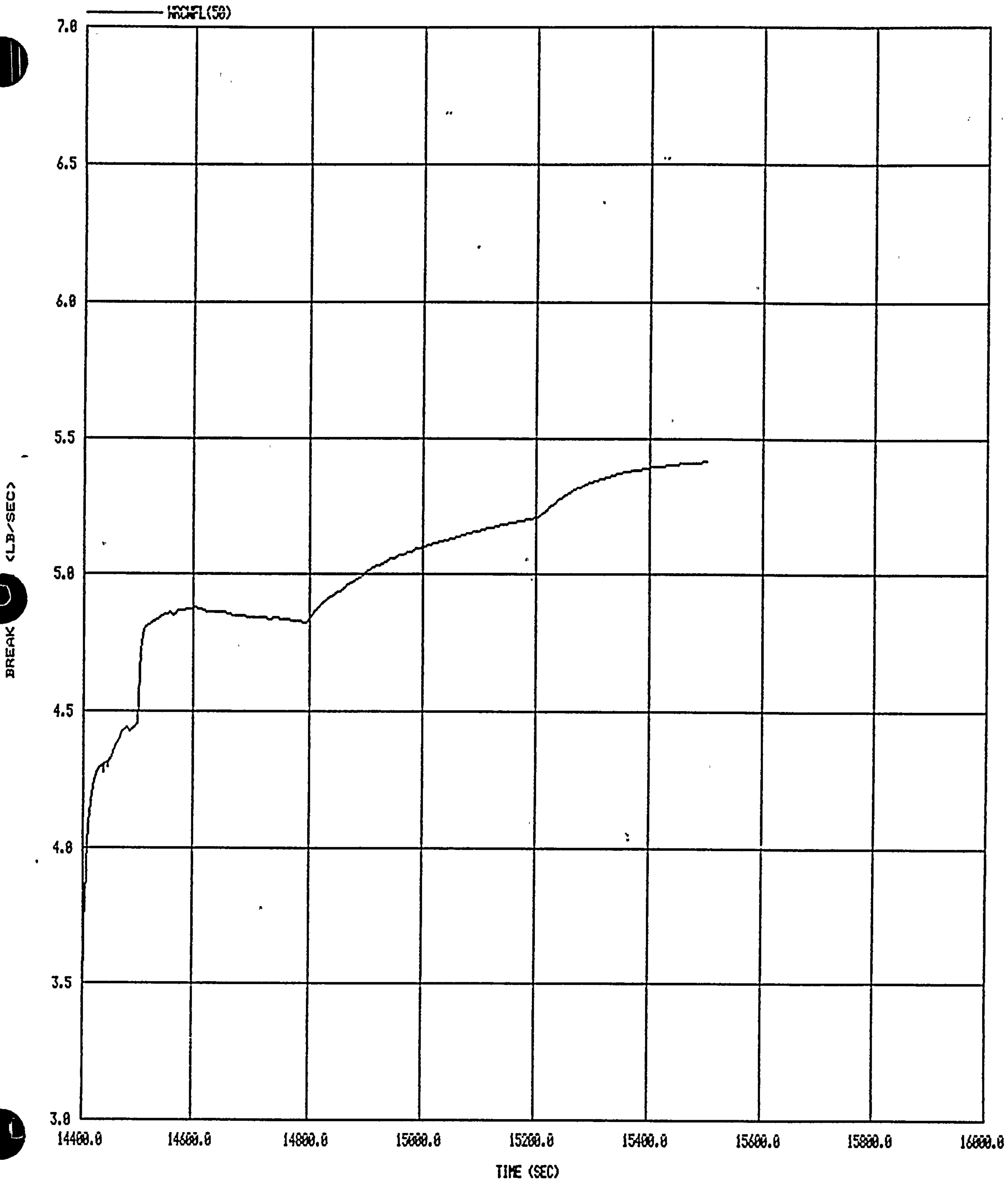
STATION BLACKOUT/RECOVERY



STATION BLACKOUT/RECOVERY



STATION BLACKOUT/RECOVERY



STATION BLACKOUT/RECOVERY

Attachment 7
Quality Assurance Classification Of Station Blackout Equipment

Station Blackout Coping Equipment QA Status [Page 1 of 2]

Equipment ID	Description	Shutdown Function	Quality Assurance Classification
TCD02A, TCD02B	Condensate Storage Tanks	AFW Supply To SGs	Safety Significant
PAFW03	Turbine Driven AFW Pump	AFW Supply To SGs	Safety Class 3
PLO11	TDAFWP DC Lube Oil Pump	AFW Supply To SGs	Safety Class 3
MOVs 3504A, 3505A	TDAWFP Steam Supply	AFW Supply To SGs	Safety Class 2
MOV-3996	TDAFWP Discharge Valve	AFW Flow To SGs	Safety Class 3
AOVs 4297, 4298	TDAFWP Flow Control Valves	AFW Flow To SGs	Safety Class 3
AOVs 3516, 3517	Main Steam Isolation Valves	Decay Heat Removal	Safety Class 2
SVs 3508-3515	SG Steam Relief Valves	Decay Heat Removal	Safety Class 2
PCVs 3410, 3411	SG Atmospheric Relief Valves	Decay Heat Removal	Safety Class 2
N_2 Backup To ARVs	Backup Gas Supply To SG ARVs	Decay Heat Removal	Safety Significant
3410S, 3411S	ARV Solenoids	Decay Heat Removal	Safety Significant
PCVs 9012, 9013	N_2 Supply Pressure Regulating Valves	Decay Heat Removal	Safety Significant
PCVs 3410A, 3411A	N_2 Supply Pressure Regulating Valves	Decay Heat Removal	Safety Significant
PCVs 15003, 15004	N_2 Supply Pressure Regulating Valves	Decay Heat Removal	Safety Significant
MOV-313	RC Pump Seal Return Isolation Valve	RC Pump Seal Protection	Safety Class 2
Batteries 1A, 1B	Station Batteries	Emergency Power Supply	Safety Class 3
DC Power Distribution Panels 1A, 1B	125 VDC Power Distribution	Emergency Power Supply	Safety Class 3
Inverters 1A, 1B	Inverters	Emergency Power Supply	Safety Class 3
Instrument Buses 1A, 1B	120 VAC Vital Buses	Emergency Power Supply	Safety Class 3
TEs 409A, B and 410A, B	RCS Hot & Cold Leg Temperature	Plant Status Monitoring	Safety Class 1
PT-420A	Pressurizer Pressure	Plant Status Monitoring	Safety Class 2
LTs 426, 433	Pressurizer Level	Plant Status Monitoring	Safety Class 2
LTs 460, 470	SG 1A, 1B Level	Plant Status Monitoring	Safety Class 2
PTs 469, 478	SG 1A, 1B Pressure	Plant Status Monitoring	Safety Class 2
NE-31, NE-32	Source Range Flux Detectors	Plant Status Monitoring	Safety Class 3
FT-2015	TDAFWP Flow	Plant Status Monitoring	Safety Class 3
LTs 2022A, 2022B	CST Level	Plant Status Monitoring	Safety Class 3

Station Blackout Coping Equipment QA Status [Page 2 of 2]

Equipment ID	Description	Shutdown Function	Quality Assurance Classification
PCH01B	Charging Pump 1B	Makeup To RCS	Safety Class 2
PCH01C	Charging Pump 1C	Makeup To RCS	Safety Class 2
Bus 16, Unit 15B	Charging Pump 1B Circuit Breaker	Power To PCH01B	Safety Class 3
Bus 16, Unit 15C	Charging Pump 1C Circuit Breaker	Power To PCH01C	Safety Class 3
Bus 16	480 V AC Bus	Power To Charging Pump	Safety Class 3
Bus 16, Unit 12B	Bus 15/Bus 16 Tie Circuit Breaker	Power To Charging Pump	Safety Class 3
Bus 15	480 V AC Bus	Power To Charging Pump	Not Nuclear Safety
Bus 15, Unit 3A	Bus 15/TSC Tie Circuit Breaker	Power To Charging Pump	Not Nuclear Safety
KED02	Technical Support Center Diesel	Power To Charging Pump	Safety Significant
KED03	Technical Support Center Generator	Power To Charging Pump	Safety Significant
TSC1	TSC Static Transfer Switch	Power To Charging Pump	Safety Significant
PFS01	Diesel Driven Fire Water Pump	Alternate Cooling Water To Turbine Driven AFW Pump	Safety Significant
TCD03	Outside Condensate Storage Tank	Alternate AFW Supply To SGs	Not Classified
9570A, 9573A, 9586A, 9584A, 9586G, 9584G, 9510A, 4048, 9509C, 9509D, 9509F, 9509E	Manual Valves	Alternate AFW Supply To SGs From TCD03	Not Classified
4078, 4079	Manual Valves	Alternate AFW Supply To SGs From Fire Water System	Appendix R
2291, 7310, 4318A, 2313	Manual Valves	Alternate AFW Supply To SGs From City Water System	Appendix R
2½" Hose(s)	Fire Hoses	Alternate AFW Supply To SGs From Fire Water System	Appendix R
Hydrants, Hose Stations	Fire Water Supply Points	Alternate AFW Supply To SGs From Fire Water System	Appendix R
1" Hose	Utility Hose	Alternate AFW Supply To SGs From City Water System	Appendix R